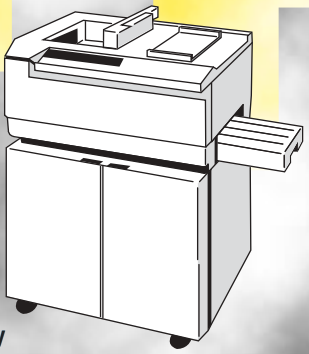
Indoor Air Quality

Health and Safety Guide

2nd Edition
(Revised)



Canadian Centre for
Occupational Health and Safety
CCOHS

Emergency Information

_____

Ambulance

_____

Fire

_____

Police

_____

Poison Control Centre

_____

Doctor

_____

Company Emergency Phone Number

Canadian Centre for Occupational Health and Safety
Hamilton Ontario Canada

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2nd Edition
(Revised)

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Indoor Air Quality Health & Safety Guide

Objectives

This guide will help you to:

- identify signs of indoor air quality (IAQ) problems
- identify possible causes
- plan remedial actions to eliminate or control IAQ problems
- understand your rights and responsibilities as given in the occupational health and safety legislation
- find sources of health and safety information

Target Audience

This guide is intended for non-industrial indoor workplaces which include offices, meeting facilities, schools, health care facilities and stores. It is an ideal work companion for managers, building management, maintenance staff, occupational health nurses, industrial hygienists, building designers, interior designers, engineers and health care professionals.

Scope

In this Guide, **Indoor Air Quality** refers to the *total indoor environment*, which encompasses air contaminants, lighting, noise, temperature, humidity and workstation design. A healthy indoor environment includes the following:

- adequate rate of fresh outdoor air supply
- acceptably low levels of dusts, gases, vapours, and biological contaminants
- adequate temperature and relative humidity
- workstation design that promotes the physical and mental well-being of workers

Summary

Indoor air quality (IAQ) is a recently recognized concern. In the 1970s energy conservation programs were encouraged in the USA and Canada. Ventilation rates were reduced and buildings were sealed to limit the entry of untempered outdoor air into buildings.

IAQ problems occur in buildings where chemical or biological contaminants build up to levels that can adversely affect some occupants. The following are some commonly reported health effects: headache, nausea, fatigue, drowsiness, dizziness, respiratory problems, chest tightness, dry throat, skin rashes, dry and itchy eyes, stuffy nose, runny nose, loss of concentration and general malaise. These symptoms are collectively known as Tight Building Syndrome (TBS). A well-known IAQ problem is building related illness (BRI). BRI is associated with a distinct set of symptoms and clinical abnormalities which are recognized as real occupational health conditions.

Workplace conditions such as noise, inadequate lighting, inadequate thermal environment, and ergonomic problems can cause discomfort that is sometimes falsely attributed to chemical or biological contaminants in the air.

In the past, symptoms reported by building occupants were often considered psychological because the symptoms seemed variable and subjective, and because an exact cause could not be identified.

Today, IAQ problems can be identified through workplace inspections and an analysis of worker health complaints. It is possible to control many health symptoms through effective building maintenance programs and by controlling specific air contaminants and their sources.

This Guide outlines how to identify potential IAQ problems and how to take steps towards controlling these problems. Actual recognition and control of IAQ problems may require specialists and a team approach involving complex measurement, analysis and implementation of controls.

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Section I

Indoor Air Quality (IAQ): An Occupational Health Concern?

1. Commonly Asked Questions
2. Why Do We Worry About Indoor Air Quality (IAQ)?

1. Commonly Asked Questions

Is indoor air quality (IAQ) a new occupational health and safety concern?

It is relatively new, but more than 20 years old! In 1976, industrial hygienists started investigating IAQ problems. Since then the concern persists and continues to increase. The origin of IAQ problems is primarily related to energy conservation activities. Causes of IAQ problems include:

- airtight buildings which reduce energy consumption by heating and cooling systems
- reduced intake of outside air
- construction materials, glues, fibreglass, particle boards, etc.
- increase in number of building occupants and time spent indoors
- increased awareness of potential IAQ problems
- media coverage of IAQ cases
- action by organized labour

Is indoor air quality a real occupational health concern or just a psychogenic illness propagated by some alarmists?

Indoor Air Quality (IAQ) is a real occupational health concern with a scientifically proven basis; however, it is rarely possible to prove that a specific health effect is caused by a particular workplace exposure. This is because people working indoors are simultaneously exposed to a wide range of conditions. Symptoms are often due to a combination of exposures.

Does health and safety legislation exist for IAQ?

Many Canadian jurisdictions do not have specific legislation for IAQ. In the United States, the Occupational Safety and Health Administration (OSHA) has published

Indoor Air Quality Standards. In absence of specific legislation, the *general duty clause* applies. This clause, common to all occupational health and safety (OH&S) legislation, stipulates that an employer must provide a safe and healthy workplace. Ensuring good IAQ is the employer's duty.

IAQ is implied in the Building Code as design and operation criteria. Building Codes generally refer to the ASHRAE 62-1989 standard *Ventilation for Acceptable Indoor Air Quality* published by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).

Many jurisdictions and voluntary organizations have recommended guidelines on indoor air quality.

When should I start suspecting an IAQ problem?

When there's a problem with IAQ, people experience adverse health conditions such as headaches, fatigue, shortness of breath, sinus congestion, coughing, sneezing, skin irritation, dizziness, nausea, and/or irritation of the eyes, nose and throat. People generally develop these symptoms within a few hours of starting the workday and feel better after leaving the building.

Why do only <u>some</u> people develop symptoms?

As with any other occupational illness, not all people are affected. The more sensitive or more exposed people experience symptoms sooner. As air quality deteriorates and/or duration of exposure increases, more people tend to be affected more seriously.

Can one become sensitive to IAQ problems as time passes?

It seems possible. Some people may not be sensitive to IAQ problems in their early years of work, but can become sensitized as exposure continues year after year. Such people may be more susceptible to developing health symptoms as IAQ worsens.

What causes IAQ problems?

IAQ problems may arise from one or more of the following causes:

- Indoor environment—inadequate temperature, humidity, lighting; excessive noise
- Indoor air contaminants—chemicals, dusts, moulds, fungi, gases, vapours, odours
- Insufficient outdoor air intake

Can we determine the cause from physical symptoms?

No. Different causes may produce similar physical symptoms. Symptoms only indicate that something may be wrong with the IAQ. All possible causes should be investigated.

What are indoor air contaminants? How do they affect our health?

Here's a list of common indoor air contaminants and their main sources:

- Carbon dioxide (CO_2), tobacco smoke, perfume—from building occupants
- Dust, fibreglass, asbestos, gas—from building materials
- Toxic vapours, volatile organic compounds (VOCs including formaldehyde)—from workplace cleansers, solvents, pesticides, disinfectants, glues
- Gases, vapours, odours—from furniture, carpets, and paints
- Fungus, bacteria, microbials, mites—from damp areas, stagnant water and condensate pans.
- Ozone—from photocopiers, electric motors, electrostatic air cleaners

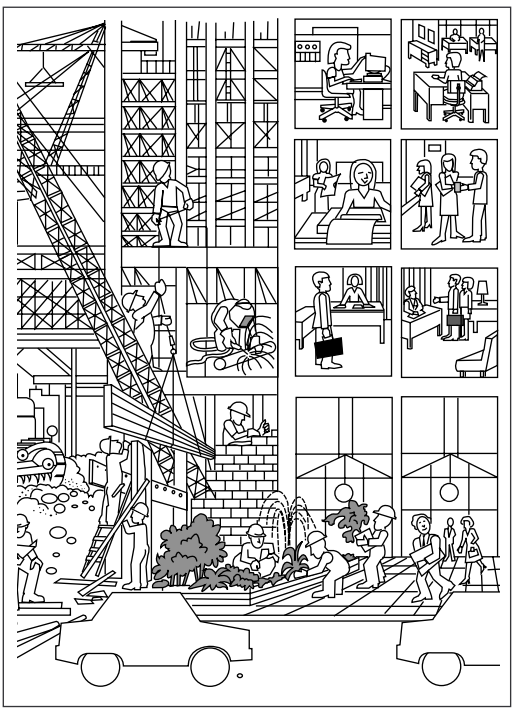
This guide describes common indoor air contaminants, and their health effects. It explains methods of controlling their concentration in the air, and lists the acceptable levels.

If I suspect an IAQ problem, how do I proceed to identify the cause and take remedial action?

No single method can be prescribed. A common sense approach seems to work best. Section IV of this Guide outlines ways of recognizing and controlling IAQ problems.

Who can help me to get started?

Section X of this Guide lists names of independent and governmental agencies that provide information and advice on workplace health and safety.



Today's office environment contains many IAQ concerns.

2. Why Do We Worry About Indoor Air Quality (IAQ)?

Occupants of buildings with poor IAQ report a wide range of health problems which are collectively known as Sick Building Syndrome (SBS). Illness related to specific indoor airborne contaminants is known as Building Related Illness (BRI).

Sick Building Syndrome (SBS) is also known as Tight Building Syndrome (TBS) because it is common among occupants of sealed office buildings. Health conditions associated with SBS include:

- dryness and irritation of the eyes, nose and throat
- difficulty concentrating on mental tasks
- headache, fatigue and drowsiness
- shortness of breath
- itchy and dry skin
- hypersensitivity and allergies

Building occupants generally experience symptoms after several hours at work and feel better after they've left the building.

Building Related Illness (BRI), frequently affects the respiratory system. People with BRI generally report flu-like symptoms such as fever, chills, shortness of breath, wheezing and fatigue. *Legionnaires Disease* is an example of BRI caused by a bacteria which may contaminate the building's air conditioning system. In contrast to SBS, BRI is an IAQ problem with a well know etiology.

In the indoor environment people are likely to be exposed to several hazards at the same time. There is no sufficient data to predict the effects of simultaneous exposure to

several harmful agents. Multiple chemical exposure can have a synergistic effect that's much more severe than reactions to individual agents.

The present state of knowledge about health effects from IAQ problems can be summarized as follows:

- Indoor air quality problems are a potential occupational hazard.
- Dose-response data exists on the health effects of repeated exposure to individual indoor air contaminants, but there is no data on exposure to a combination of contaminants.
- Exposure limits listed in health and safety regulations and the Threshold Limit Values (TLVs) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) are intended as a guide to prevent illness in industrial situations. These limits may not be appropriate in office settings.

Multiple Chemical Sensitivity

Simultaneous exposure to several chemicals may cause health problems even if the concentration of each chemical by itself is too low to be harmful. The effect of this type of combined exposure is known as Multiple Chemical Sensitivity (MCS). There is considerable ongoing debate on this subject.

Health conditions related to MCS include respiratory problems, eye irritation, lightheadedness, excessive fatigue and headache.

Multiple chemical exposure indoors may be due to airborne contaminants from renovations; new furniture; photocopiers; cleaning fluids, carpet glues, and photographic chemicals.

Chemically-induced Hypersensitivity

Chemical hypersensitivity is a much debated topic. Hypersensitivity may be suspected when only one or two people report health problems while others seem unaffected.

Hypersensitivity may result in two ways: from a single and perhaps massive exposure (e.g. during a chemical fire or chemical spill) or by long term repeated exposure to a chemical at low levels.

A small percentage of indoor workers who develop health problems may be extremely sensitive to one or more of the contaminants in the air. Some people, after working at a job or hobby for several years, become sensitized to the materials or chemicals they use. For people whose skin becomes sensitized to a particular chemical, even the slightest contact with the offending substance can trigger a massive skin reaction.

Some people develop respiratory sensitivity. For example, isocyanates in urethane foams or paints may induce asthma at concentrations above the recommended exposure limits. For some sensitized people, even a very small concentration in air can trigger an asthma attack.

Other chemicals can produce a sensitizing effect on the nervous system, cardiovascular system, digestive tract, or other parts of the body. In susceptible people even minimal exposure to certain chemicals can cause headache, dizziness, nausea, ringing in the ears, or stiff joints.

Section II

Sources of Indoor Air Quality (IAQ) Problems

1. **What Are the Possible Causes of IAQ Problems?**

2. **Types of Indoor Air Contaminants and their Sources**

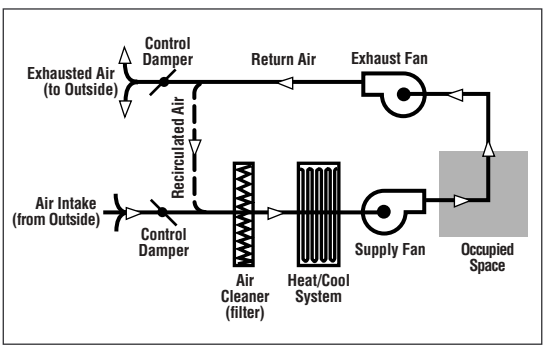
1. Possible Causes of IAQ Problems

IAQ problems may develop as a result of:

- lack of outdoor air for heating, ventilating and air conditioning (HVAC) system
- poorly designed, maintained or operated HVAC systems
- pollutants present in the *outdoor air* entering the building
- emissions from sources inside the building such as off- gassing from building materials, office furniture and equipment
- poor temperature and humidity control

Lack of Outdoor Air

An HVAC (heating, ventilating and air conditioning) system is designed to exhaust *used* indoor air to the outdoors and replace it with *fresh* outside air. The HVAC system filters out dust from the outside air, heats (or cools) the air to a preset indoor temperature, and then circulates the air through a duct system. Energy consumption (for heating or cooling) increases as the volume of outdoor air entering the ventilation system increases.



Schematic of Typical Ventilation System

Other factors contributing to IAQ problems include:

- sealed windows that do not open
- HVAC systems that do not draw sufficient outdoor air

Most IAQ problems result from VOCs (volatile organic compounds) and microbes.

Air Contaminants from Inside the Building

The following are examples of air contaminants originating in an office environment:

- CO_2 in exhaled air of occupants
- tobacco smoke
- emissions from office equipment such as photocopiers, laser printers, photo processors, and carbonless copying papers
- gases, vapours, dusts, and odours from parking garages, public transit stations, restaurants, laundries, health clubs and other facilities
- gases and vapours from cleaning fluids, detergents, volatile organic compound (VOC)
- emissions from carpets, carpet glues, furniture polishes and adhesives
- fungi and moulds from damp areas and slimy, stale water in the air conditioning system
- scents from perfumes, colognes and air fresheners
- body odours
- dusts and fibrous glass from building materials

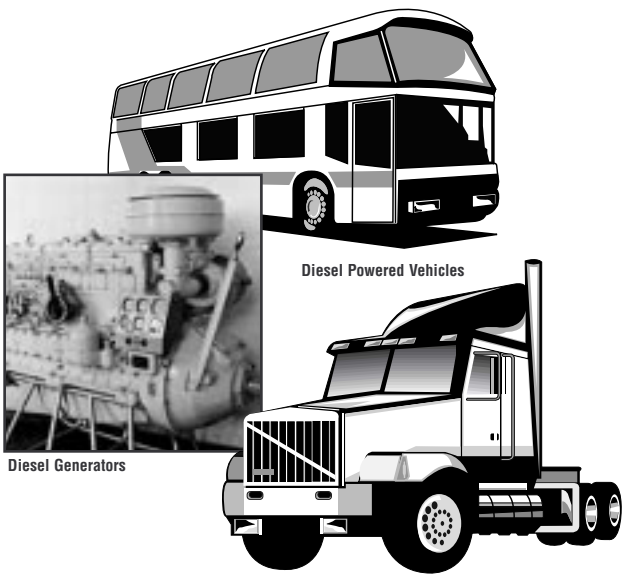
Outdoor Air Contaminants

Outdoor air contaminants enter the ventilation system with the outdoor air intake. Vehicle exhaust, smoke, and emissions from nearby facilities are just some of the air pollutants in a busy city. The contaminated outdoor air should be cleaned before it is brought into the building.

Diesel Engine Emissions

Diesel engine emissions are highly complex mixtures of chemicals in the form of gases and particulate matter. Diesel exhaust particles adsorb hundreds of chemicals onto their surfaces, including oxides of nitrogen and many other irritants and toxic chemicals.

The particles in diesel emissions are very small (90% are less than 1 micron (1 μmB = 0.001 mm), and can reach the lungs when inhaled. Epidemiological studies consistently suggest that long-term exposure to diesel exhaust in a variety of occupational circumstances may be associated with an increase in the risk of cancer, lung disease, cardiovascular disease, and other illnesses.



Sources of Diesel Emissions

2. Types of Indoor Air Contaminants and their Sources

In order to control indoor air contaminants we must identify their origin. It isn't always possible to pinpoint a single source. The following table gives some examples of indoor air contaminants and their potential sources.

Sample

SPECIFIC INDOOR AIR CONTAMINANTS AND THEIR SOURCES

Contaminant:	Asbestos
Source:	Certain old fireproofing and thermal insulation materials, ventilation shafts and ducts, boilers
Contaminant:	Ammonia
Source:	Blueprint machines, cleaning compounds, detergents
Contaminant:	Benzene, toluene, petroleum solvents
Source:	Rubber cement, copier toner, liquid eraser cleaning solvents, certain paints and coatings
Contaminant:	Diethylethanolamine
Source:	Boiler water additive
Contaminant:	Methyl alcohol
Source:	Spirit duplicating machines
Contaminant:	Trichloroethylene
Source:	Some correcting fluids, inks, adhesives, cleaning compounds

Sample

Contaminant:	Gasoline vapours
Source:	Vehicle exhausts
Contaminant:	Viruses, Bacteria, Fungi
Source:	Ventilation and humidification systems, cooling towers, ventilation ducts, condensate pans
	Water-damaged carpets and furniture, condensation on windows
	Infected co-workers
Contaminant:	Pesticides
Source:	Plant sprays, insect and rodent control
Contaminant:	Formaldehyde
Source:	Furniture emissions, particle board resins, laminated wood products
Contaminant:	Volatile Organic Compounds (VOCs)
Source:	Construction materials—plywood resins, adhesives, caulking compounds, new furniture, carpets, oil-based paints
Contaminant:	Sulphur dioxide
Source:	Outdoor sources such as coal burning, petroleum refining, natural gas burning processes
Contaminant:	Ozone
Source:	Electrostatic air cleaners, ozone generators photocopiers
Contaminant:	Radon (a radioactive gas)
Source:	Radioactive minerals in rocks, soil and building material could be a problem in basements with inadequate ventilation

Sample

Contaminant:	Carbon dioxide
Source:	Exhaled air from occupants Emissions from burners, furnaces, and vehicles
Contaminant:	Carbon monoxide
Source:	Vehicle exhausts, gas burners furnaces, cigarette smoke
Contaminant:	Mineral fibres, dusts
Source:	Insulation products, building materials, Gypsum board
Contaminant:	Tobacco smoke
Source:	Cigarette smoke
Contaminant:	Scents
Source:	Perfumes, colognes, air fresheners
Contaminant:	Body odours
Source:	Building occupants
Contaminant:	
Source:	
Contaminant:	
Source:	
Contaminant:	
Source:	

Note: *You may want to add to this list contaminants specific to your workplace.*

Sample

PRELIMINARY INSPECTION CHECKLIST

Inspector(s) _____

Location/Department _____ **Date** _____

✔ *Satisfactory* ✗ *Unsatisfactory, requires attention*

GENERAL OBSERVATIONS

Walls, Ceilings and Floors
- ❑ Walls, ceilings and windows free of mould
- ❑ Indoor plants free of mould/sour odour
- ❑ Flat surfaces dust free
- ❑ Thermostats in enclosed offices
- ❑ Cleaniness of shower facilities

Open-Concept Offices
- ❑ Areas enclosed by screens
- ❑ Screen heights (max. 5 ft.)
- ❑ Screens do not touch floor

Diffusers
- ❑ Diffusers unobstructed
- ❑ Diffuser condition (mould, dust, dirt)

Air Exhaust Louvres
- ❑ Louvers unobstructed
- ❑ Louvre condition (mold, dirt, dust)

Pollutant Sources (within 10 feet of Workstation)
- ❑ Photocopiers
- ❑ Chemical storage/handling area
- ❑ Smoking room
- ❑ Particle board/plywood shelves
- ❑ Paper storage area

CARBON MONOXIDE (CO) SOURCES

Air does not enter building from:
- ❑ parking garage
- ❑ loading dock
- ❑ other (describe) _____

Condition/location of indoor CO sources such as:
- ❑ gas stoves
- ❑ gas fired heating system
- ❑ free standing gas heaters
- ❑ other (describe)_____

VOLATILE ORGANIC COMPOUNDS (VOCs)

Cleanliness/condition/location of:
- ❑ chemical laboratories
- ❑ chemical storage faciilities
- ❑ plywood, particle board shelving (newly installed)

CIGARETTE SMOKE

- ❑ Smoking policy in place/enforced

VENTILATION SYSTEM (HVAC)

- ❑ Adequate outdoor air intake (min. 15 cubic feet/minute/person)
- ❑ Air intake clear of pollution sources
- ❑ Cleanliness of ducts and plenum
- ❑ Ventilation shut-down (nightly and/or weekends

HUMIDIFIERS

- ❑ Pans free of slime
- ❑ Ducts free of mould
- ❑ Fans free of hard water deposits
- ❑ Volatile chemicals used in boilers for steam spray humidifiers

AIR CONDITIONING SYSTEM

- ❑ Condensate trays free of slime
- ❑ Cooling coils free of slime
- ❑ Absence of mouldy odours

MAINTENANCE AND DESIGN

- ❑ Windows can be opened
- ❑ Alterations to ventilation system
- ❑ Number of occupants
- ❑ Usage/condition of carpeting
- ❑ Work areas repainted
- ❑ Presence of odours

Section III

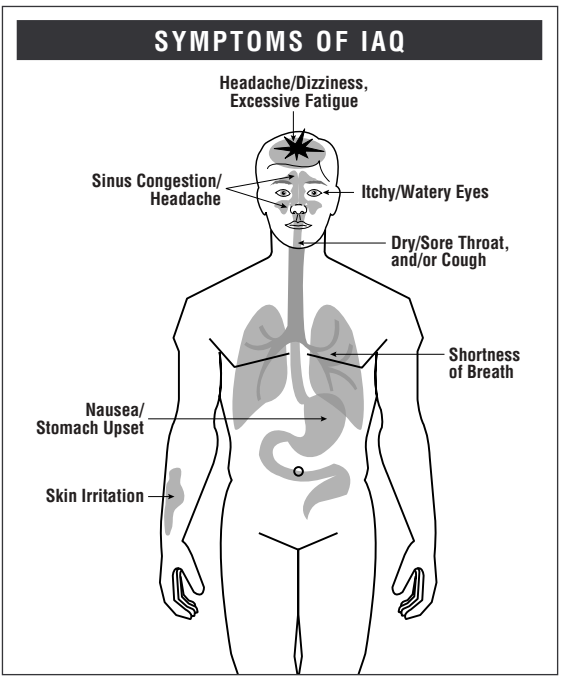
Recognition of Indoor Air Quality (IAQ) Problems

1. Reporting IAQ Problems
2. Gathering Data About IAQ Problems
3. Role of the Health and Safety Committee or Health and Safety Representative
4. How to Use Employee Feedback

1. Reporting IAQ Problems

Common symptoms of IAQ problems are eye irritation, dry throat, headache, excessive fatigue, sinus congestion, skin irritation, shortness of breath, cough, dizziness, nausea and other symptoms of not feeling well in general.

If you notice any of these symptoms it is your responsibility and your right to report them to your supervisor. Your supervisor if responsible to take action to resolve the situation. It is possible that your supervisor will be able to initiate remedial action immediately.



2. Gathering Data About IAQ Problems

Establish IAQ problem reporting procedures in consultation with the health and safety committee. A report should include the following information:

Sample

IAQ PROBLEM REPORTING FORM

Date _____

Work area (floor/department/location) _____

Symptoms experienced by individuals _____

_____

Time of day symptoms are experienced _____ ❑ am ❑ pm

Frequency and duration of symptoms _____

_____

History of symptoms (When were they first noticed?)

_____

Building conditions that may be related to indoor air quality problems (renovation, new equipment, etc.)

_____

Work activities and processes that may release air contaminants

_____

Suggested remedial actions

_____

_____

Encourage people to report any health complaints and unacceptable workplace conditions. Air quality is suspect if people frequently experience dry throat; eye and throat irritation, headache, drowsiness, and/or general malaise. Typically people experience these symptoms when they have been working in the building for several hours, and feel better after leaving the building.

3. Role of the Health and Safety Committee or Health and Safety Representative

If health complaints and workplace condition reports indicate IAQ problems, the joint health and safety committee can evaluate the situation.

☑ COLLECT health complaint data using a questionnaire customized for your workplace. You may need assistance from an expert. Here is a list of symptoms which may indicate the possibility of indoor air quality problems:

- ☛ headache
- ☛ dizziness
- ☛ nausea
- ☛ fatigue
- ☛ cold symptoms
- ☛ sinus congestion
- ☛ palpitations
- ☛ shortness of breath
- ☛ skin rashes and irritation
- ☛ drowsiness
- ☛ blurred vision
- ☛ wheezing
- ☛ allergies
- ☛ eye, nose, and throat irritation

REVIEW employee complaints and look for patterns in:

- ☛ type of health conditions reported
- ☛ duration and frequency of occurrence
- ☛ location of affected people

MEET affected people to clarify your findings.

CHECK heating, ventilating and air-conditioning (HVAC) system. You may be able to identify a problem by careful visual inspection of the ventilation system.

GET help from the building operator or engineer when checking the HVAC system.

Use the following sample IAQ Inspection Form to help you to prepare your own.

Sample

PRELIMINARY IAQ INSPECTION

Name(s) of Inspector(s): Sam Jones Peter Smith
Joan Mills

Date: July 20, 1998

Item Inspected: Outdoor Air Supply (%)
Assessment: ☑ **OK** ❑ **Not OK** ***(needs attention)***
Observation(s): Meets ASHRAE Standards

Item Inspected: Outdoor Air Intakes
Assessment: ☑ **OK** ❑ **Not OK** ***(needs attention)***
Observation(s): No pollution sources nearby?

Item Inspected: Particulate (dust) filters
Assessment: ❑ **OK** ☒ **Not OK** ***(needs attention)***
Observation(s): Several filters missing / dirty

Item Inspected: Spray Humidifiers
Assessment: ❑ **OK** ☒ **Not OK** ***(needs attention)***
Observation(s): Slime in the pans / mouldy odour
present? plugged drainage system?

Sample

Item Inspected: Steam Humidifiers
Assessment: ❑ **OK** ☒ **Not OK** ***(needs attention)***
Observation(s): Excessive condensation on windows in cold weather

Item Inspected: Air Chilling System
Assessment: ❑ **OK** ☒ **Not OK** ***(needs attention)***
Observation(s): Slime in condensate trays?
Dirt on cooling coils / Mouldy odour

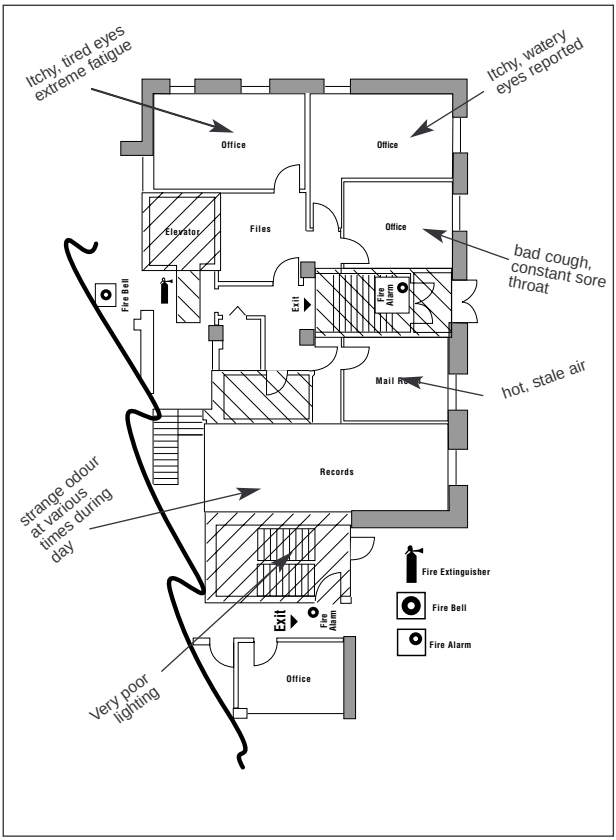
Item Inspected: Ducts
Assessment: ❑ **OK** ☒ **Not OK** ***(needs attention)***
Observation(s): Need cleaning / thick layer of dust present

Item Inspected: Odours in work areas
Assessment: ☑ **OK** ❑ **Not OK** ***(needs attention)***
Observation(s):

Notes

Collecting Health Conditions Data

Your supervisor or health and safety committee may use a questionnaire (similar to the one on the following page) to gather this information. Use a floor plan to illustrate the workstation(s) of people who experience health problems.



A fire escape floorplan is useful for recording information during inspections or while investigating complaints.

Sample

IAQ INFORMATION COLLECTION

Name(s) of Inspectors: Sam Jones Peter Smith
Joan Mills

Date: July 20, 1998

Location of Person on Floor Plan: Room 230

Reported Health Symptoms: Itchy, watery eyes

Time and Frequency of Symptoms: Late in day

Potential Causes: Poor Lighting / Glare from computer

Recommended Action: Orient computer screen to prevent glare

Location of Person on Floor Plan: Room 345

Reported Health Symptoms: Bad Cough / Sore Throat

Time and Frequency of Symptoms: At end of week

Potential Causes: Sitting directly in front of air vent

Recommended Action: relocate workstation or change air vent direction

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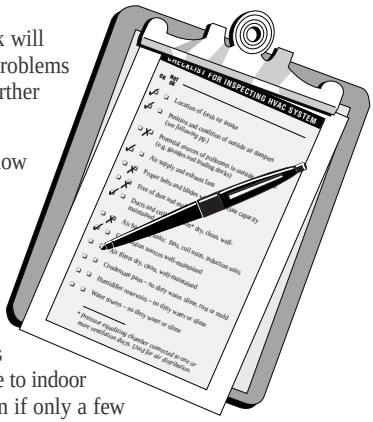
4. How to Use Employee Feedback

Employee feedback will indicate potential problems and the need for further investigation.



It's important to know the following facts when deciding whether or not an indoor air quality problem exists:

- Not everyone is equally sensitive to indoor air quality. Even if only a few people are affected, do not ignore the possibility of a problem. As time passes or air quality worsens, more and more people may become affected.
- Combined exposures may cause health problems even if the level of each of these exposures is below an acceptable limit.
- Health problems from exposure to a chemical may worsen in the presence of other chemicals (Multiple Chemical Sensitivity).
- In preliminary surveys, temperature, humidity and level of CO_2 are generally measured to ensure that the HVAC systems are in good working order. These surveys are only a starting point. Additional surveys may be needed to assess air contaminants originating inside the building or entering with outside air intake.

Section IV

Evaluation and Control of Indoor Air Quality (IAQ)

1. Units Used for Measuring Air Contaminants
2. Evaluation and Control of Air Contaminants
3. Sanitation
4. Housekeeping

1. Units Used for Measuring Air Contaminants

Vapours and Gases

We use ***ppm (parts per million)*** units to express concentration of gases and vapours per million parts of air. One ppm is a very small concentration equivalent to one millilitre of contaminant in one thousand litres.

Dust, Fibrous Glass Dust and Particulate Matter

The contaminant content of air is expressed in units of ***milligrams per cubic metre (mg/m³)***. One mg/m³ is equivalent to dispersing one milligram of dust uniformly in one thousand litres of air.

The mg/m³ unit can also be used for gases and vapours. To convert from mg/m³ to ppm and vice versa is simple.

Conversion

$$\text{Concentration in mg/m}^3 = \frac{\text{Concentration in ppm} \times \text{molecular weight}}{24.45}$$

$$\text{Concentration in ppm} = \frac{\text{Concentration in mg/m}^3 \times 24.45}{\text{Molecular Weight}}$$

This formula applies to gases when measurements are taken at room temperature 25 °C (77 °F) and normal atmospheric pressure (760 torr).

Asbestos and Synthetic Viterous Fibres

The asbestos glass fibre content in the air is expressed as number of ***fibres per cubic centimetre (f/cm³)***. This unit is used because the risk of lung cancer depends on the number of asbestos fibres reaching the lung.

Microbes (bacteria, moulds and fungi)

The air contamination by microbials is measured by the number of colony forming units (CFU) per cubic metre (CFU/m³) of air.

2. Evaluation and Control of Air Contaminants

Carbon Dioxide (CO_2)

Sources The occupants of a building are the main source of CO_2. Carbon dioxide is exhaled as a by-product of living processes. This CO_2 must be removed by the ventilation system. A faulty ventilation system could cause a build-up of CO_2 and a reduction in the normal oxygen concentration.

Health Hazards CO_2 is not a toxic gas. As the concentration of CO_2 increases, the oxygen content in air decreases. The reduction of oxygen in air makes people feel drowsy.

Recommended CO_2 Level In outdoor air, the concentration of CO_2 is 330–350 ppm. In the office environment, the concentration of CO_2 is higher as people exhale CO_2 at a rate of about 0.3 litres per minute (0.3 L/min) while performing light work. The ASHRAE standard 62-1989, *Ventilation for Acceptable Indoor Air Quality* recommends a minimum ventilation rate (outdoor air intake) of 15 cubic feet per minute (cf/m) or 7 litres per second (L/s). In offices the recommended ventilation rate is 20 cfm (10L/s) per person. The ASHRAE standard recommends that CO_2 be less than 1000 ppm.

Assessment The CO_2 removal rate by the ventilation system indicates the rate of fresh air supply. The carbon dioxide level is often used as a marker of how well the ventilation system is working. If you suspect a high CO_2 concentration, inspect the ventilation system for faulty conditions, inadequate operation and any changes in the workplace layout.

Sample

VENTILATION SYSTEM CHECKLIST

Name(s) of Inspectors: Sam Jones Joan Mills
Peter Smith

Date: July 25, 1998

Item Inspected: Number of Building Occupants
Assessment: ☒ **OK** ❑ **Not OK** ***(needs attention)***
Observation(s): Has increased 20% since last inspection

Item Inspected: Changes in workplace set-up
Assessment: ❑ **OK** ☒ **Not OK** ***(needs attention)***
Observation(s): newly constructed walls have created rooms with no air supplies or exhausts

---

Item Inspected: Air Supply Diffusers
Assessment: ❑ **OK** ☒ **Not OK** ***(needs attention)***
Observation(s): partially closed

Item Inspected: Return Air Grills
Assessment: ❑ **OK** ☒ **Not OK** ***(needs attention)***
Observation(s): Need to be cleaned

Sample

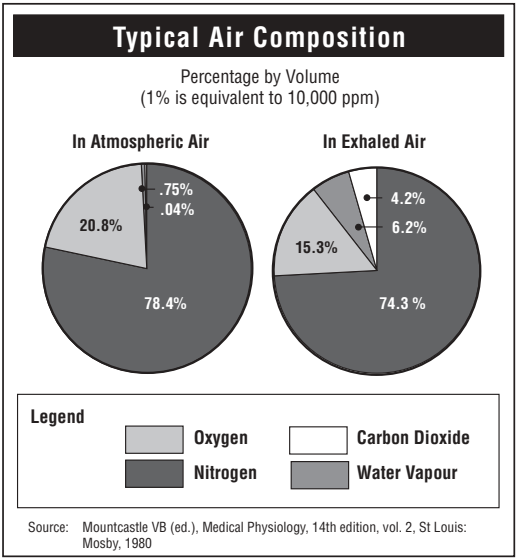
Item Inspected: Ceiling Air Mixing **Boxes**
Assessment: ☑ **OK** ❑ **Not OK** ***(needs attention)***
Observation(s):

Item Inspected: Location of exhaust and diffuser ducts
Assessment: ☑ **OK** ❑ **Not OK** ***(needs attention)***
Observation(s):

Item Inspected: Air Filters
Assessment: ☑ **OK** ❑ **Not OK** ***(needs attention)***
Observation(s):

Item Inspected: Duct Work
Assessment: ☑ **OK** ❑ **Not OK** ***(needs attention)***
Observation(s): recently cleaned

Item Inspected: Location of Air Intake (outdoor air)
Assessment: ❑ **OK** ☒ **Not OK** ***(needs attention)***
Observation(s): at ground level next to the loading dock



Source: Mountcastle VB (ed.), Medical Physiology, 14th edition, vol. 2, St Louis: Mosby, 1980

People may develop respiratory problems if the oxygen content changes only by about one percent. In the office environment, people exhale carbon dioxide at a rate of about 0.3 litres per minute (L/min). Oxygen consumption and CO_2 production increases with the activity level.

Control Measures

☑ ENSURE that the HVAC system is appropriate for the occupancy level, heat sources, amount and location of known contaminant releases.

ENSURE that air supply and intake openings are not obstructed.

EXAMINE the feasibility of local exhaust ventilation in areas of higher CO_2 generation.

INCREASE outdoor air intake to offset increased occupancy or contaminant generation from other sources.

CLEAN UP any dust accumulation, dampness, and microbial growth.

IDENTIFY pollution sources inside and outside the building. Such sources may include:

- ☛ photocopiers, gas furnaces and photography equipment and materials
- ☛ building materials
- ☛ building maintenance activities and materials
- ☛ carpets, carpet glues and new furniture
- ☛ sources outside the building such as parking garages, loading docks, warehouses, and industrial plants

PREVENT the entrance of contaminants from routine maintenance work, pest control, renovation, and construction work.

SELECT carpets, furniture, and equipment that have low emission ratings of VOCs.

PREVENT tobacco smoke from mixing with indoor air.

Carbon Monoxide (CO)

Sources Carbon monoxide is a colourless, odourless, toxic gas. It comes from combustion sources such as gas burners, tobacco smoke and motor vehicle exhaust.

Health Risk Carbon monoxide impairs the blood's capability to utilize oxygen in inhaled air. At low concentrations (above 9 ppm), CO may cause headache and fatigue. At high concentrations (greater than 1200 ppm), CO may cause poisoning and could even be fatal.

Assessment

- ☛ Are there any sources of CO inside the building?
- ☛ Can CO from outside sources enter the building?

ACGIH TLV is 25 ppm.

The table on the following page is a sample checklist.

Sample

POSSIBILITY OF CO ENTERING THE BUILDING			
	Possibility of Entrance		
	No	Marginal	Yes
Ventilation System			
Emissions from vehicles (left running in garages or near the building)			
Pollutants entering via doorways, stairwells, elevator shafts			
Combustion sources inside or nearby			
Heavy traffic near the building			
Exhaust systems of stoves and furnaces			

Exposure Control

☑ ENSURE that pathways of CO to offices from adjacent parking garages and loading docks are well sealed.

PREVENT CO from entering by maintaining positive air pressure (if possible) in occupied areas.

TURN OFF engines while waiting for service.

INCREASE ventilation.

INSTALL local exhaust in areas of CO emission.

MONITOR air quality in suspect locations by taking periodic CO measurements.

CO Measuring Device

Oxides of Nitrogen (NOx)

Sources Oxides of nitrogen may be present in diesel powered vehicle exhausts, and emissions from combustion appliances such as gas stoves and furnaces, diesel generators for emergency power.

Health Risks Exposure to oxides of nitrogen may cause shortness of breath and can injure the respiratory system.

Assessment Check the possibility that emissions from vehicles and combustion sources may be contaminating indoor air (see checklist for CO).

Exposure Control Same steps as exposure control for carbon monoxide.

Ozone (O_3)

Sources Indoor sources include photocopiers, ozone generators, faulty or poorly maintained electrical equipment and electrostatic air cleaners.

Health Risks One of the peculiar smells from running photocopiers is due to ozone. Ozone adversely affects the respiratory system. High levels of exposure (above 0.05 ppm) may cause lung injury. Ozone is classified in A4 category for carcinogenicity—insufficient data to classify into a category for carcinogenicity.

Assessment Ensure adequate ventilation where potential sources of ozone are present.

Exposure Control

☑ PLACE photocopiers and other sources of O_3 in well-ventilated areas.

LEARN to recognize O_3 odours.

REPORT excessive O_3 odours to employer and request remedial action.

Formaldehyde

Sources Many building materials, especially new materials, are potential emitters of formaldehyde gas. These include carpets, particle board furniture, glues and adhesives. Slow off-gassing from these building materials can cause a buildup of formaldehyde in indoor air, depending on the emission source, the rate of outdoor air intake by the ventilation system, the humidity and the temperature.

Health Hazards Formaldehyde gas is an irritant and respiratory sensitizer. Symptoms of exposure include dry and sore throat, nosebleeds, headaches, memory and concentration problems, nausea, dizziness, breathlessness, burning, stinging eyes, and pain. Some sensitive individuals may notice symptoms at concentrations as low as 0.01 ppm.

Formaldehyde is a suspected human carcinogen. ACGIH TLV for formaldehyde is 0.3 ppm with C notation which means the value should never be exceeded.

Assessment Although formaldehyde has a pungent odour, people may not realize they're being exposed to it because they can become accustomed to the smell. The odour of formaldehyde is not a reliable warning signal for exposure. Ensure adequate ventilation where potential sources of formaldehyde are present so that formaldehyde concentration in air is 0.1 ppm or less.

Exposure Control

☑ SELECT products with low formaldehyde emission levels if possible.

SEAL potential emission sources with a barrier such as polyurethane varnish.

OFF-GAS new building materials in a storage area prior to installation.

INCREASE airflow in areas of new furniture and carpets.

☒ DO NOT RECIRCULATE formaldehyde-contaminated air.

Dusts and Fibres

Sources *Indoor sources* include humidifier additives, poor housekeeping, inefficient vacuum cleaners, scale, rust, building materials, fungal spores, smoke, duct pipe insulation, asbestos, carpet fibres, and paper fibres.

Outdoor sources include airborne urban pollutants, construction activity, traffic activity, factory emissions, and releases from fires and accidents.

Particle size is important in determining whether or not inhaled dust can reach the lungs. Health hazard potential of specific dusts depends on their toxicity and on their particle size. Dust particle size is measured in microns (µm). One micron is one millionth of a metre (one thousandth of a millimetre). Dusts in the 0.1-10 µm size range find their way into the throat and lungs, and can affect human health. Larger dust particles (greater than 10 µm) get trapped in the nose. Extremely small (less than 0.1 µm) dust particles are exhaled after being inhaled.

Health Risks Excessive levels of dust particles can adversely affect the skin, eyes and respiratory system. Symptoms include irritation of the eyes, nose, throat and skin as well as coughing, sneezing, and respiratory problems.

Some dusts are toxic. Long-term exposure to asbestos fibres increases the risk of lung cancer. Other dusts such as lead and mercury compounds and silica dusts can cause a wide range of illnesses.

Assessment There is dust in indoor air where there are:

- exposed building material (eg. concrete, insulating material)
- renovation, retrofit activity
- dust in the air intake
- dust and debris in the air delivery and return dampers
- dusty filters
- dust deposits and/or odours around humidifiers
- use of personal ultrasonic humidifiers
- cigarette smoke
- handling of dusty materials
- paper shredding machines

Exposure Control

☑ MAINTAIN an adequate air filtering system.

CLEAN air circulation system regularly.

CLEAN frequently areas where dust settles.

USE local exhaust in areas where there is excessive dust from renovations or movement of materials.

PROVIDE negative air pressure and local exhaust in smoking rooms.

☒ DO NOT RECIRCULATE air that contains excessive levels of dust.

Tobacco Smoke

Sources cigarettes, pipes, cigars

Health Hazards Tobacco smoke contains a wide range of compounds including toxic dusts, carbon monoxide and volatile organic compounds (VOCs). It has been classified as carcinogenic (cancer causing). The effects of environmental tobacco smoke (ETS) on office building workers include:

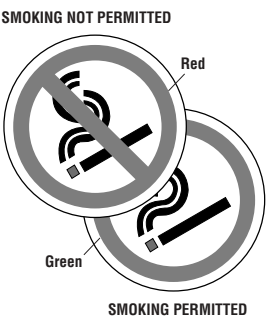
Short-term effects: annoyance, discomfort, coughing, sneezing, breathing problems, throat and eye irritation

Long-term effects: increased risk of lung cancer

Exposure Control

Designated Smoking Rooms

Depending on local laws, smoking may be prohibited in certain buildings. Where it is not, designated smoking rooms with separated exhaust to outdoors are required by law in some jurisdictions.



The purpose of having a designated smoking room is to prevent tobacco smoke from mixing with the building's air and reaching all occupants. Second-hand smoke is a health hazard.

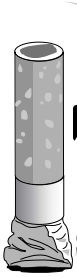
A designated smoking room should also:

- have a sign that meets the requirements of the applicable legislation
- be ventilated in accordance with ASHRAE Standard 62-1989, *Ventilation for Acceptable Indoor Air Quality*

☑ ENSURE that the designated smoking room meets design requirements set out in the legislation applicable to your workplace.

MARK smoking rooms with clear and legible signs.

ENSURE that the ventilation in the smoking room exhausts the air to the outside and does not recirculate the air within any work space.



ENSURE that the smoking room has ashtrays and non combustible, covered receptacles for waste disposal.

☒ DO NOT LEAVE the smoking room doors open.

DO NOT STAY in smoking rooms any longer than required.

Solvents: Volatile Organic Compounds (VOCs)

Sources Volatile organic compounds (VOCs) are given off by solvents in paints, coatings, paint removers, paint thinners, adhesives, caulking, carpets, photocopiers, acoustic ceiling tiles, air fresheners, cleaning agents, organic solvents, fabric softeners, and tobacco smoke.

Health Hazards At low exposure levels, symptoms include fatigue, headache, drowsiness, dizziness, weakness, joint pains, blurred vision, skin and eye irritation and general discomfort. As the exposure level increases, people may experience unpleasant odours, respiratory irritation, tightness in the chest, nausea and confusion.

Some highly sensitive individuals may have severe reactions at very low concentrations.

Assessment Check the following to assess the potential for VOC release:

- ☛ presence of new building materials
- ☛ presence of new furniture and new carpets
- ☛ use of cleaning products, solvents (check MSDS)
- ☛ presence of local exhaust in chemical storage area
- ☛ possibility of contamination from other areas in the building via the ventilation system
- ☛ possibility of VOCs entering the building from outside sources via the air intake.

Obtain information regarding emission levels of carpets, building materials, and furniture. Such data may be available from manufacturers and the Canada Mortgage and Housing Corporation (CMHC) in Canada and the Environmental Protection Agency (EPA) in the USA.

Exposure Control

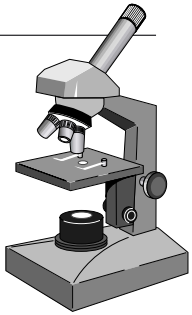
☑ INCREASE ventilation if air contaminants are widespread throughout the area.

STORE solvents, paints, cleaning liquids, paint thinners etc. in a separate storage room equipped with local exhaust.

ENSURE that there is adequate local exhaust in photographic and printing rooms.

KEEP containers closed when they're not in use.

Microbial Contaminants



Sources Important microbial sources are wetted areas due to leaks or floods—carpets, ceiling tiles, walls, insulation are prime suspects. Excessive humidity, stagnant water in humidifiers and condensate pans, condensation on windows, and dark and moist areas are possible sources of microbial growth such as fungal spores, moulds, and bacteria.

Viruses and contagious bacteria are emitted from people who are infected.

Legionella, a bacteria that causes Legionnaires disease, may grow in cooling towers, evaporative condensers, and hot water systems.

Health Hazards Microbial agents can cause allergic and asthma-like reactions. Some individuals are hypersensitive to microbial exposures, and show health symptoms at very low exposure levels.

Assessment Check for sites where microbial agents could grow, including:

- stagnant, dirty water in condensate pans, sumps, humidifiers and filter units
- wet carpets or furnishings resulting from leaks, spills and storm damage
- areas with mouldy odours
- flood water leaks
- portable humidifiers containing slime or algae
- mouldy or dirty ceilings, walls, tiles, window frames and carpets

Exposure Control

☑ PREVENT accumulation of stagnant water.

CLEAN or remove fungus contaminated sites.

MAINTAIN relative humidity in the 30-50% range.

DISCARD potential sources of mould such as old news papers and boxes.

WASH contaminated surfaces with diluted bleach (250 millilitres bleach in 4 litres of water).

DISCARD dirty and contaminated air filters.

AVOID using personal portable humidifiers.

Commonly Used Terms in Infection Control

Antiseptic: A chemical which has the ability to destroy potentially infective microorganisms and which can be used safely on living tissues.

Bleach Solution: The most commonly recommended disinfectant is bleach solution (i.e. a 0.5% sodium hypochlorite solution which can be prepared by mixing one part household chlorine bleach (5.25%) to nine parts water). This solution is corrosive and must be used with caution on metal surfaces.

Cleaning: Scrubbing and washing with hot water, soap or detergent to remove infectious agents and/or organic matter from surfaces.

Disinfection: The use of germicidal chemical agents to destroy infectious agents.

Sterilization: The use of a physical process or chemical agents to eliminate all viable microorganisms. The most common methods are steam and gas autoclaving and dry heat ovens.

Mould

Mould Removal

☑ REMOVE water-damaged wallpaper, carpeting, foam-rubber carpet pads, drapery, upholstery fabric and air fillers.

CLEAN baseboards, hardwood floors, ceiling tiles, cement, wood beams, framing and roofing material.

VACUUM the entire area and immediately discard the disposable bags.

STEAM clean all carpets and dry quickly.

MINIMIZE dispersal of any mould into the air.

WEAR correctly fitted mask with a HEPA (high efficiency particulate air) filter to avoid breathing any airborne mould spores while removing moulds

DISPOSE of the material in sealed plastic bags, and if you know that the mould is one of the toxic varieties, treat the bags like hazardous waste.

DECONTAMINATE the mouldy areas. A 10-percent solution of household bleach can be an effective disinfectant. However, it should be used only by those trained to use it safely using appropriate chemical-resistant gloves and chemical splash goggles.

SCHEDULE cleaning when the building is unoccupied to minimize the exposure of other people to airborne mould spores.

Mould Growth Prevention

ENSURE there are no leaks from roofs and broken water pipes.

BLOCK OFF areas where moisture can seep through cement foundations and can dampen the floor, carpeting and walls. This will minimize condensation and indoor dampness.

ENSURE that the heating, ventilation and air conditioning system provides adequate outside air, air filtration and exhaust of air contaminants. A minimum of 20 cubic feet per minute (cfm) of fresh air per occupant should be flowing through the room at all times.

ENSURE that filters are changed or washed, and that the water reservoirs are treated or changed regularly.

USE dehumidifiers to reduce humidity to 30-50 percent. If humidifiers are needed in winter months to overcome dry indoor air, make sure they do not use re-circulated water.

CLOSE windows tightly during winter months. Poor ventilation and poor air circulation can cause accumulation of humidity and growth of microorganisms, including mould.

Renovations

When the renovations are being done:

☑ REPLACE the affected material,

ENSURE adequate ventilation, and

INSTALL proper air-vapour barriers.

Asbestos

Asbestos is used for insulation and for making building materials fire resistant. Inhalation of asbestos fibres poses the risk of severe lung diseases such as lung cancer, asbestosis, and mesothelioma 10 -20 years or more after exposure. In the past, common uses of asbestos included:

- insulation, fire proofing, sound proofing, ceiling and floor tiles, acoustic spackles, and vinyl asbestos floor tiles;
- thermal insulation on pipes, boilers, and ceilings, fire protection on structural steel beams;
- the lining of heating and ventilation duct work, window glazing, and adhesives.

Now asbestos is not used in building materials but some of the older, installed products may still contain asbestos. Asbestos does not pose any health risk unless asbestos fibres are released in the air. Renovation work or damage to building materials can produce dry, crumbly (friable) material capable of releasing asbestos fibres into the air.

The following is a general outline of the actions recommended to control asbestos exposure:

☑ ARRANGE inspection by a qualified person to identify asbestos-containing building materials.

MAINTAIN an inventory of all asbestos-containing materials by location.

ESTABLISH an asbestos management plan or strategy.

POST warning signs in all routine maintenance areas to inform maintenance personnel that asbestos is present in the building.

IDENTIFY type and location of all asbestos-containing materials.

ASSIGN responsibility to someone to supervise the implementation of the asbestos management plan.

TRAIN the custodial staff in asbestos awareness and safe work practices.

ESTABLISH a procedure for reporting damaged or exposed asbestos containing material that may cause asbestos exposure.

ESTABLISH procedures for proper removal and disposal of asbestos-containing materials and ensure that all employees understand and follow these procedures.

NOTIFY utility workers and other personnel working in areas where asbestos-containing material is present

Dust Mites

Dust mites are of the spider family. Mites survive and grow in warm and humid areas (RH greater than 60%) with a sufficient supply of food such as human skin scales.

In the office environment, carpets provide a trap for dust and can serve as a breeding ground for dust mites. Similarly, fabric and foam chair cushions provide a warm, humid breeding ground and a supply of skin scales as food for the growth of dust mites.

Health Risks Dust mites produce allergens. The main allergen is concentrated in the fecal pellets. People who inhale mite allergens may become sensitized and experience asthma attacks, sneezing, runny and itchy nose, coughing, wheezing, or a combination of these symptoms.

Ordinary vacuum cleaners are not suitable for removing allergens. Instead of removing them, ordinary vacuum cleaners pick up the mites' fecal pellets, break them into fragments and pass dust back into the room with the exhaust air. These fine airborne particles can be inhaled. Only vacuum cleaners with high efficiency particulate air filters (HEPA filters) are suitable for removing allergens.

Exposure Control

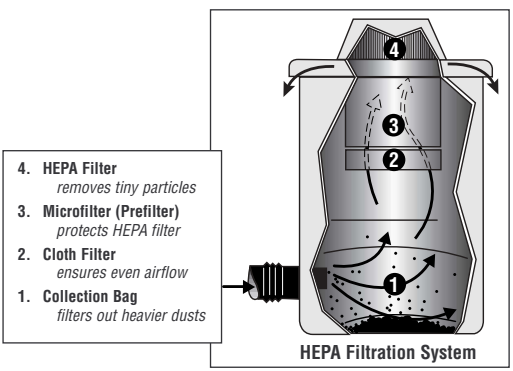
☑ KEEP kitchen and bathroom floors and other areas dry and clean to prevent mould build-up.

USE a dehumidifier in damp areas.

AVOID dust-catching draperies, blinds and carpets.

CHANGE or CLEAN filters in the heating/cooling system regularly according to manufacturer's specifications, usually stated as a pressure drop.

USE vacuum cleaners equipped with HEPA-type filtration systems.



HEPA Filtration System

3. Sanitation

It is important that all facilities are free from garbage, debris, dirt, and potentially infectious materials.

☑ FOLLOW sanitation procedures and safe work practises recommended by your employer.

CHECK product labels and MSDSs to know the potential hazards and safe work practises for all cleaning and disinfecting products you use.

WEAR personal protective equipment and clothing recommended by your supervisor.

ALWAYS clean counters and work areas before and after using them.

SELECT cleaning products appropriate for the task and facility. Use according to the supplier's recommendations to ensure proper cleaning.

USE germicides or diluted bleaches to disinfect areas as required.

REPORT all spills, accidents, incidents and other problems to your supervisor.

☒ DO NOT EAT, DRINK, or SMOKE while using a cleaning agent, bleach, disinfecting agent, or other chemical products.

DO NOT LEAVE open containers of bleaches, paints or solvents in the washrooms or other areas used by staff or visitors.

DO NOT MIX cleaning products.

4. Housekeeping

☑ MINIMIZE accumulation of loose and dust-producing materials and waste.

PLACE all trash and scrap in proper containers.

DISPOSE of oily rags in covered metal containers.

CLEAN UP spills promptly following prescribed procedures.

CLEAN UP moulds and dirt patches on walls and windows.

CLEAN soaked carpeting professionally within 24 hours to prevent mould and bacteria growth in the fibres, backing and under the carpeting.

✗ DO NOT BLOW OFF dust. Use a vacuum cleaner or brush.

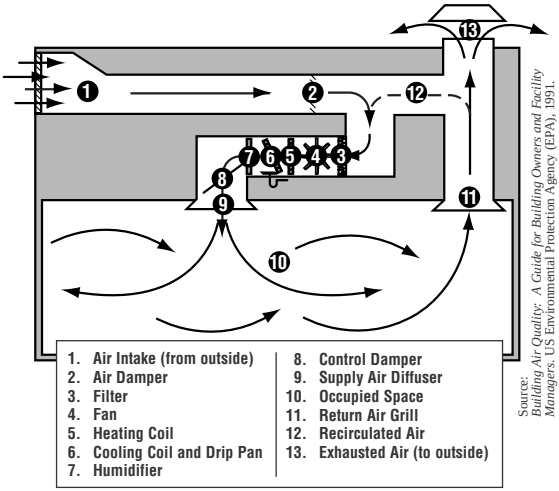
Section V

Ventilation

1. Heating, Ventilation and Air-Conditioning (HVAC) System
2. Checklist for Inspecting HVAC System

1. Heating, Ventilation and Air Conditioning (HVAC) System

The purpose of ventilation is to control temperature and humidity, to remove odours and airborne contaminants, and to introduce outdoor air.



Source: *Building Air Quality: A Guide for Building Owners and Facility Managers*. US Environmental Protection Agency (EPA), 1991.

Typical HVAC System Components

There are two kinds of ventilation that remove a fraction of the contaminated old air:

1. **Dilution ventilation**—A fraction of contaminated air is exhausted outside and replaced by outdoor air. The outdoor air mixes with the remaining contaminated air and thus dilutes the concentration of air pollutants.
2. **Local exhaust ventilation**—exhausts toxic gases, fumes, dusts and vapours at the source before they can mix into the room air. Fume hoods are the most commonly used type of local exhaust ventilation.

Dilution ventilation is used when:

- contaminants are relatively non-toxic
- there are a variety of contaminant sources
- emission sources are widely distributed in an area
- dilution air is not contaminated

Local exhaust ventilation is used when:

- contaminants are moderately or highly toxic or hazardous
- only one or a few fixed emission sources are present
- there is a risk of direct worker exposure

Ventilation Standards

Ventilation standards are defined in building codes. Most building codes reference the *ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) Standard 62-1989, Ventilation for Acceptable Indoor Air Quality*, and *Industrial Ventilation: A Manual for Recommended Practice, American Conference of Governmental Industrial Hygienists (ACGIH) 23rd edition, 1998.*

EXAMPLES OF RECOMMENDED VENTILATION RATES

	Estimated Maximum Occupants/1000 sq. ft.	Ventilation Rate: cubic ft./min./person
Office Space	7	20
Smoking Lounge	70	60
Conference Room	50	20
Laboratories	30	20
Theatre, Auditorium	150	20

Source: D. Jeff Burton, IAQ and HVAC Workbook, 3rd edition 1997.

Signs of Inadequate Ventilation

- air temperature that is too hot or too cold
- *stuffy* air (lack of outdoor air)
- accumulation of dirt
- excessive condensation on cold window or walls

Building occupants can check for these signs themselves. Generally, building managers, workplace inspection teams and health and safety committee members perform these initial inspections, which don't require any technical expertise.

Where one or more of these problems exists, corrections can often be made by adjusting the HVAC system without performing expensive technical measurements

Measures of Ventilation Adequacy

Co_2 is used as a surrogate measure for other contaminants including some particulates and odours that may build up due to the lack of adequate outdoor air supply. This build-up, together with physical factors such as air temperature and humidity, act to produce the reported health symptoms. Thus, a level of CO_2 greater than 1000 ppm is an *indicator* that ventilation should be improved.

ASSOCIATION OF TIGHT BUILDING SYNDROME (TBS) SYMPTOMS WITH CONCENTRATIONS OF CARBON DIOXIDE IN THE WORKPLACE

Concentration of CO_2	Symptoms Reported
Less than 600 ppm	None
600 – 1000 ppm	Occasional complaints of headache, drowsiness, stuffiness, etc.
Greater than 1000 ppm	Above complaints general

Source: Report of the International Committee on Indoor Air Quality, Ontario 1988.

CO_2 is not the sole cause of these complaints because adverse health effects associated with elevated levels of CO_2 have not been reported for levels less than 7000 ppm.

Sample

HVAC INSPECTION CHECKLIST

OK	NOT OK	
❑	❑	Location of outdoor air intake
❑	❑	Position and condition of outside air dampers
❑	❑	Potential sources of pollutants in outdoor air intake (e.g. garages and loading docks)
❑	❑	Air supply and exhaust fans
❑	❑	Proper fan belts and blades
❑	❑	Fan blades installed properly
❑	❑	Free of dust and mould
❑	❑	Ducts dry, clean, well-maintained
❑	❑	Air handling units: fans, coil units, induction units
❑	❑	Combustion sources well-maintained
❑	❑	Air filters dry, clean, well-maintained
❑	❑	Condensate pans – no dirty water, slime, rust or mould
❑	❑	Humidifier reservoirs – no dirty water or slime

Notes

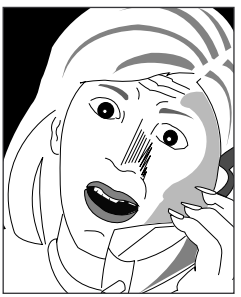
Section VI

Evaluation and Control of the Indoor Environment

1. Office Noise Levels
2. Thermal Comfort
3. Indoor Temperature Regulations and Guidelines
4. Lighting and Vision
5. Office Ergonomics

Feelings of discomfort and illness may be related to the total indoor environment. This section examines how the total indoor environment and workstation design can affect the health and comfort of indoor workers.

1. Office Noise Levels



The level of noise in an office varies according to: the nature of work performed; the operation and condition of equipment such as photocopiers, printers, typewriters and ventilation systems; the material used in floor and wall coverings; and the frequency and loudness of telephone calls.

Industrial noise regulations set exposure limits of 85-90 dB(A) for an 8-hour workday. These exposure limits are intended to prevent hearing loss. The noise in most office environments isn't loud enough to cause hearing loss, but can be disruptive, reduce productivity, and contribute to stress and discomfort.

There are no noise regulations specific to office noise levels. There are guidelines which recommend noise limits in offices, but these are not legal requirements.

The main objectives of office noise guidelines are:

- to prevent disruption of verbal communication
- to prevent discomfort and stress
- to minimize interference with concentration in the performance of mental work

Very few people are disturbed by noises below 45 dB(A). At levels around 55 dB(A) about half of people feel some amount of disturbance. Intermittent noise and varying levels of noise are more disturbing than continuous noise. Taking all these factors into account, it is generally recommended that noise levels in an office should not exceed 50 dB(A).

A constant background noise known as masking sound, white noise or sound conditioning is sometimes introduced in open plan offices. The purpose of masking sound is to conceal weak sounds from adjacent areas and provide privacy for verbal communication across an office desk. The level of masking sound should not exceed 48 dB(A).

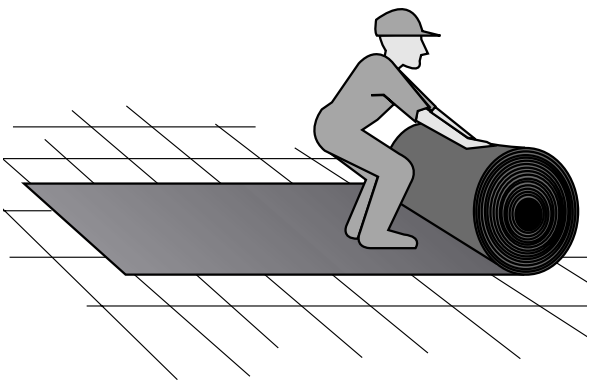
Guidelines for Noise Control

☑ SELECT quiet equipment.

ENSURE that equipment is well maintained.

ISOLATE noisy equipment from general work areas.

USE sound-absorbing materials such as carpeting, curtains, acoustic baffles and typewriter pads.



Carpeting is a good sound-absorbing material

2. Thermal Comfort

Thermal comfort depends on air temperature, humidity and air movement. Acceptable ranges for temperature and humidity are often referred to as the *comfort zone* in which a person wearing typical office clothing should feel neither too cold nor too warm.

Where air movement is virtually absent and when relative humidity can be kept at about 50%, the ambient temperature is the most important for maintaining thermal comfort. Unfortunately, temperature preferences vary greatly among individuals and there is no one temperature that can satisfy everyone.

Temperature and Humidity

Temperature is expressed in ***degrees Celsius (°C)*** or ***degrees Fahrenheit (°F)***. Optimum temperature for most people is 22° to 24 °C (72° to 75°F).

Humidity is expressed as percent relative humidity (% RH). Relative humidity of 50% means that the moisture content of air is 50% of the maximum possible moisture (100% RH) that air can hold at a given temperature. Optimum relative humidity is 30% to 60%. Hot air can hold more moisture than cold air. That is why water condenses on cold water glasses, water pipes and cold windows.

Humidex

Humidex is used by the weather forecast service of Environment Canada. This unit takes into account the combined effects of temperature and humidity and informs the public about how hot it is outdoors. Occasionally, humidex is used to warn indoor employees in non-air-conditioned workplaces.

HUMIDEX COMFORT RANGES	
Humidex Range	**Degree of Comfort**
20 – 29	Comfortable
30 – 39	Varying degree of comfort
40 – 45	Uncomfortable
46 and over	Many types of work must be restricted

Hazards

In an office that's too warm, occupants may feel lethargic or tire quickly; on the other hand, one that's too cold causes occupants to feel restless and easily distracted.

At about 50% relative humidity, most office workers have fewer respiratory problems (specifically in the winter) and feel comfortable in general. Higher humidity (greater than 70%) makes the office feel *stuffy* and can contribute to the development of bacterial and fungal growth (especially in sealed buildings). Airborne moulds and fungi cause allergic reactions in some sensitive individuals.

Humidity lower than 20% causes dry throat and dry skin, and can cause static electricity build-up on the body. In winter months, relative humidity is low because the colder the air gets, the less moisture it contains.

Air velocity should be delivered below 0.25 metres/second does not create any significant distraction, even for tasks requiring sustained attention.

ASHRAE Standard 55-1992 Thermal Environmental Conditions for Human Occupancy, recommends the following acceptable temperature at relative humidity (RH) of 50% and air speed less than 0.15 m/sec. 30 fpm).

ACCEPTABLE TEMPERATURES		
Season	**Clothing**	**Temperature**
Winter	Heavy slacks, long sleeve shirt and/or sweater	20–23.5°C (68–75°F)
Summer	Light slacks and short sleeve shirt	23–26°C (73–79°F)

Guidelines for Temperature and Humidity

☑ REPORT ventilation problems to the joint health and safety committee.

ENSURE that office ventilation is maintained by building maintenance engineers.

USE portable heaters only if the proper authority approves them. Heaters are potential fire hazards.

USE only heaters with thermostats. Place on surfaces or in areas away from combustible materials or curtains where they do not pose a fire or safety hazard.

PLACE heaters or fans so that they do not blow air directly on workers.

SEAL openings to prevent outside air from entering the building.

PLACE fans so that they do not vibrate and fall off surfaces.

UNPLUG heaters and fans and wait for blades to stop before moving them.

USE window curtains or blinds to increase or decrease heat from the sun.

CONSIDER impact on ventilation before rearranging office equipment, furniture, and partitions.

WEAR clothing appropriate for office conditions.

ENSURE that ventilation systems, dehumidifiers and humidifiers are properly cleaned and maintained.

INSULATE hot and cold surfaces.

DO NOT USE heaters that produce toxic fumes (e.g., kerosene heaters).

DO NOT INSTALL partitions and room dividers without evaluating the impact on local ventilation and ensuring proper provision of supply air and air circulation.

American Society of Heating, Refrigeration and Air Conditioning Engineers, (ASHRAE) Standard 55-1992 is generally used as a guideline for thermal environment.

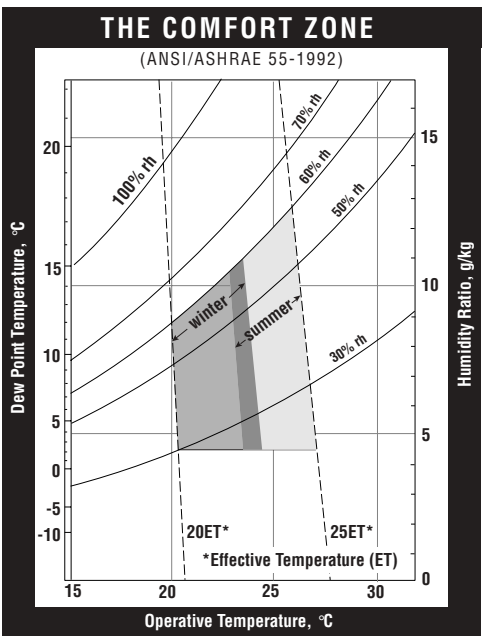
Office Space with Partition Dividers

3. Indoor Temperature Regulations and Guidelines

ASHRAE 55-1992 Standard for Thermal Conditions

The Standard aims to ensure a thermal environment that will satisfy 90% of the occupants.

Optimum temperature ranges call for a summertime range of 23 °C to 26 °C (73°F to 79°F) at 50% relative humidity (RH). The wintertime range is from 20 °C to 23.5 °C (68°F to 75°F) at 50% RH. The winter and summer zones overlap in the 23 °C to 24 °C (73°F to 75°F) range. In this overlap range, people in summer dress would be slightly cool while people in winter dress would be slightly warm.



4. Lighting and Vision

Although office work has not been proven to cause permanent vision or eye problems, many office workers report eyestrain, a burning sensation in the eyes, blurred vision, eye irritation or dryness, dry eyes and headache.

Contributing factors to eye problems:

- ☞ non-adjustable workstations where reading materials are too far away
- ☞ poor image quality on video display terminals (VDTs)
- ☞ glare, shadows and inadequate lighting
- ☞ low humidity which causes the eyes to become dry, itchy and irritated
- ☞ vision that is not corrected to suit the task
- ☞ poor job design which results in long periods of close work
- ☞ work habits that do not provide relief to eyes (e.g. extended period of work with computers)

Preventing Vision Problems

Prevent vision problems by ensuring good conditions for viewing work tasks:

☑ POSITION work so that it is easy to see. Use adjustable chairs, well-positioned VDTs, adjustable work surfaces, and task lights. (See pg. 67 VDT Workstation Setup.)

USE clear, legible source documents and VDTs with good image quality.

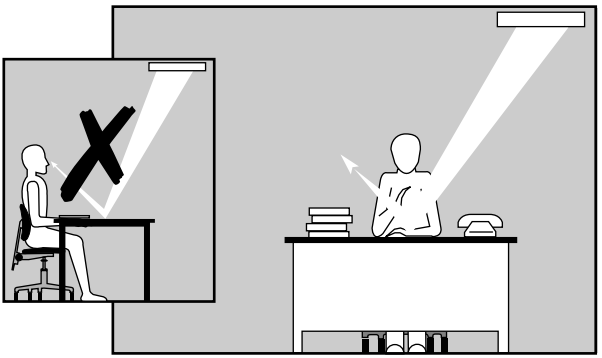
MAINTAIN adequate humidity levels to prevent dry eyes.

SCHEDULE regular eye examinations to avoid problems of uncorrected or improperly corrected vision. People who work with VDTs may require a special prescription to be able to read at an intermediate distance that bifocals cannot accommodate.

ENCOURAGE frequent changes in body position by varying tasks and using good work/rest schedules.

POSITION desk with window to the side of the worker.

POSITION desk to minimize glare. If you can see the image of the light fixture reflecting from your desktop, you have a glare problem.



ADJUST window blinds or drapes to control light and glare.

USE non-glare finishes and neutral (not too bright) colours on walls and furniture. The colour and finish of a surface determines how much light it reflects.

USE adjustable task lights to increase light levels when needed.

CHECK fluorescent lights for flicker. Replace fluorescent tubes regularly and maintain fixtures properly.

LOOK up and away from work frequently to rest the eyes.

ENSURE that storerooms, corridors and stairways are well lit.

Appropriate light levels depend on visual preferences and type of work. In the following chart, the higher ranges are for workers with poorer vision and for work requiring high speed or accuracy.

LIGHTING LEVELS

Location	Light Level (lux)*
Corridors	50-150
Stairs	100-200
Coat Rooms	100-200
Stock Rooms	200-400
Traditional Office Tasks	500-750
Conference Rooms	300-750
Drawing Offices	500-1000

* 10 lux = 1 dalx (decal lux) = approximately 1 foot candle

The occupational health and safety agency or department in your jurisdiction has regulations and guidelines regarding light levels.

DO NOT HANG glossy pictures or objects where light will reflect into eyes.

DO NOT PLACE a VDT facing a window.

5. Office Ergonomics

Office work poses the risk of musculoskeletal disorders known by many different names:

Repetitive Motion Injuries *(In this guide we will refer to RMI)*	**RMI**
Musculoskeletal Injuries	**MSI**
Repetitive Strain Injuries	**RSI**
Cumulative Trauma Disorders	**CTD**
Work-Related Musculoskeletal Disorders	**WRMSD**

In order to assess potential causes of health complaints, it is important to consider the ergonomic aspects of the job.

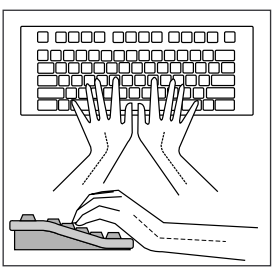
The three main causes of RMI are:

Repetition: work activities performed with a high rate of repetition

Force: work activities which require excessive muscle force for long periods

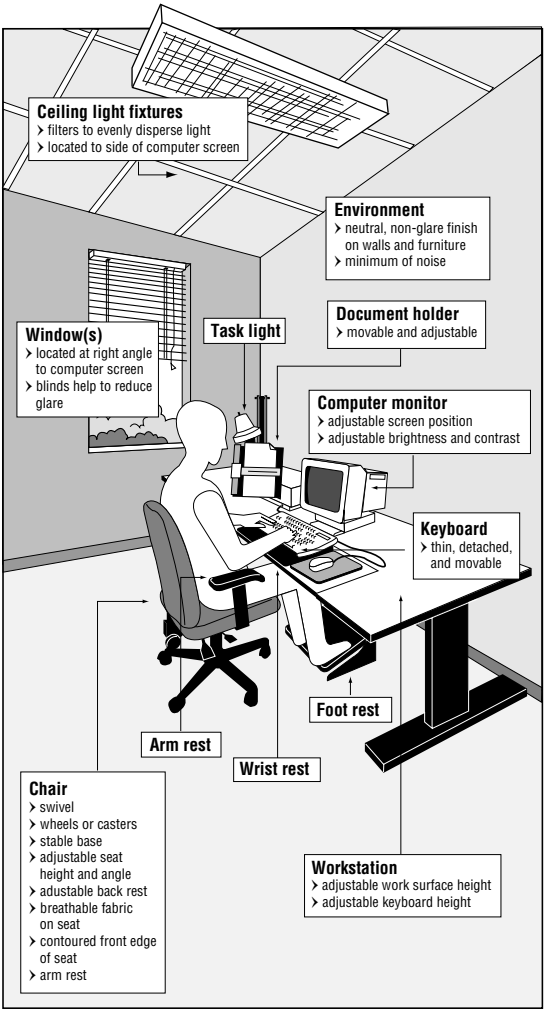
Posture: work activities which require maintaining awkward fixed postures for long periods

Keyboard work requires repetitive movement, and an inadequate workstation design may require a fixed awkward body position or an awkward wrist position. All of these factors contribute to the risk of RMI.

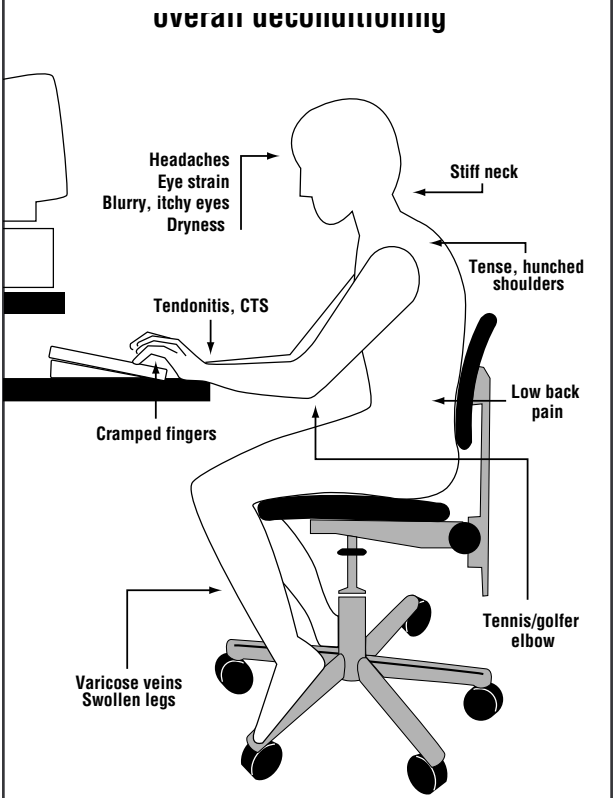


Duration of work is an important factor. Repetitive motion injuries develop slowly and are usually noticeable only after weeks, months, or years of work involving overuse of muscles, tendons, nerves and joints.

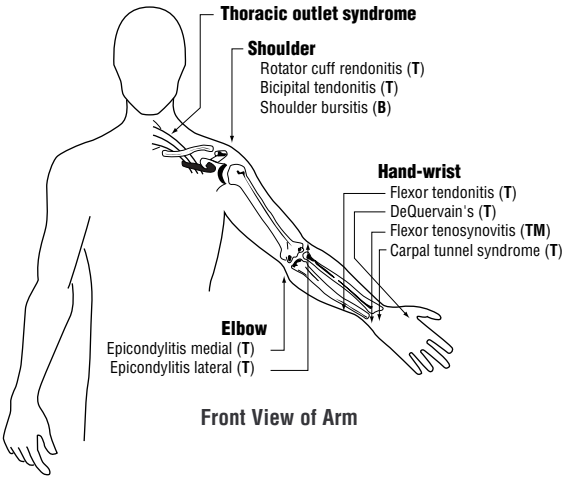
The VDT Workstation



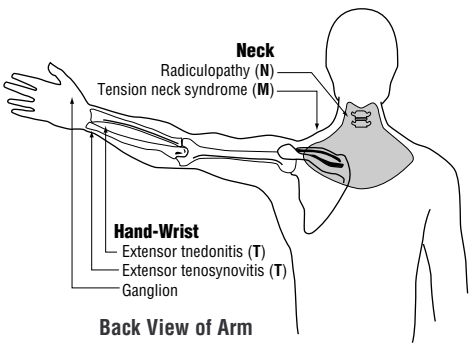
Symptoms of RMI



RMI Related to Computer Usage



Front View of Arm



Back View of Arm

T - Tendon/Ligament **M -Muscles**
N - Nerves **B - Bursa**

RMI—COMMON SYMPTOMS AND CAUSES

Symptom	Possible Cause(s)
Neck pain	Monitor too high
	Chair too low
	Monitor or document holder too far off the line of vision
	Poor sitting posture
	Slumping and slouching
	Typing with winged-up shoulders
Shoulder Pain	Tense shoulders while typing
Elbow Pain	Desk too high
	Mouse too far to the side
Carpal Tunnel Syndrome	Excessive up-and-down wrist and finger movement
	Typing with wrists bent upwards
	Tense or tight grip on mouse
Lower Back Pain	Sitting in one position for long periods
	Poor sitting position
	Slumping and slouching
	Chair too high
Eye strain	Reading materials too close or too far
	Too much or too little illumination
Blurry, itchy eyes	Glare
	Improper location of reading materials
	Uncorrected vision
Dryness	Low humidity

Workstation Exercises

VDT work often involves repetitive movements of the hands and few changes in body position. This can lead to muscle pain and strain.

☑ LOOK away from the screen occasionally and focus on a distant object to rest the eyes.

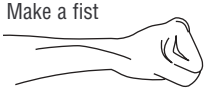
TAKE regular rest breaks to ease muscle aches, eye strain and stress. Use these rest breaks to stand up, stretch, move around and change mental activity.

RELAX muscles, stretch and change position while working at the VDT.

Hand and Forearm Exercises

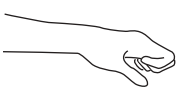
1 **Starting Position**

Step 1
Make a fist

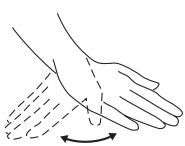


Step 2
Touch your fingertips to the base of your palm, keeping the thumb straight.

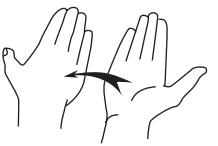
Step 3
Gently make a hook. Don't force your fingers with your other hand if something is painful.



2 Gently bend wrist from side to side as fast as possible. Hold 3–5 seconds. Repeat 3 times.



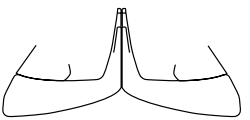
3 Start with arm in hand-shaking position and slowly rotate palm down until you feel a stretch. Hold 3–5 seconds. Then rotate palm up until you feel a stretch. Repeat 3 times.



4 Keeping elbow straight, grasp involved hand and slowly bend wrist down until you feel a stretch. Hold 3–5 seconds. Relax. Repeat 3 times.

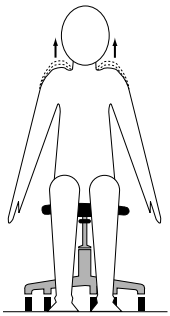
5 With involved hand in a handshake position, grasp and slowly turn it to a palm down position until you feel a stretch. Hold 3–5 seconds. Relax. Repeat 3 times.

6 Sitting with elbows on table and palms together, slowly lower wrists to table until you feel a stretch. Be sure to keep palms together throughout the stretch. Hold 5–7 seconds. Relax. Repeat 3 times.



Neck and Shoulder Exercises

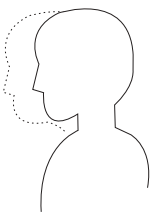
Shoulder Shrug



Purpose: To relieve early symptoms of tightness or tension in the shoulder and neck area.

Raise the top of your shoulders toward your ears until you feel slight tension in your neck and shoulders Hold this feeling of tension for 3-5 seconds, then relax your shoulders downward into their normal position.
Do this 2-3 times.

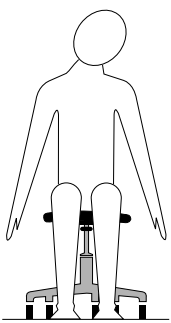
Head Glide



Purpose: To stretch chest, neck and shoulder muscles.

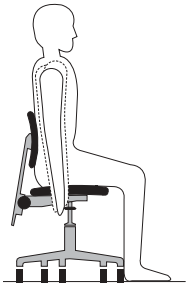
Sit or stand upright. Without lifting chin, glide head straight back. You know you're doing this exercise right if it gives you the feeling of a double chin. Hold for 20 counts and repeat 5-10 times.

Neck Relaxer



Purpose: To relax neck muscles.

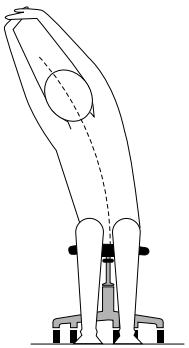
Drop your head slowly to the left, trying to touch your left ear to your shoulder. Repeat on the right side. Slowly drop your chin to your chest, turn your head all the way to the left, then turn all the way to the right.



Shoulder Roll

Purpose: To relax shoulder muscles.

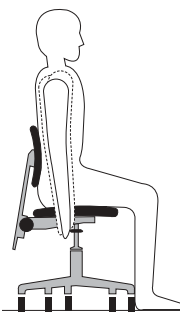
Slowly roll your shoulders backward five times in a circular motion. Then roll shoulders forward.



Back/Side Stretch

Purpose: To relax the back and side muscles

Interlace fingers and lift arms overhead, keeping elbows straight. Press arms as far back as you can. To stretch sides, slowly lean to the left, then to the right.



Middle/Upper Back Stretch

Purpose: To stretch upper and middle back muscles.

Hold your right arm with your left hand just above the elbow. Gently push your elbow toward your left shoulder. Hold stretch for 5 seconds. Repeat on left arm.

Back Curl

Purpose: To stretch lower back and legs.

Grasp shin. Lift leg off the floor. Bend forward (curling the back), reaching nose toward the knee. Repeat with the other leg.

Ankle Flex and Stretch

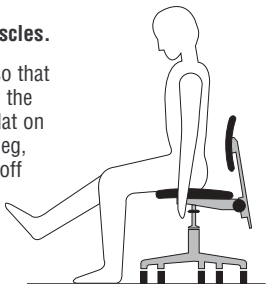
Purpose: To stretch ankle muscles.

Hold one foot off the floor, leg straight. Alternately flex ankle (Pointing toes up) and extend (pointing toes toward the floor). Repeat with the other leg.

Leg Lift

Purpose: Stretch leg muscles.

Sit forward on the chair so that your back is not touching the chair's back. Place feet flat on the floor. With a straight leg, lift one foot a few inches off the floor. Hold momentarily, return it to the floor. Repeat with the other leg.



Section VII

Instruments for Indoor Air Quality (IAQ) Assessment

This section describes instruments that are commonly used for taking air quality measurements.

The selection and use of instruments must be done in consultation with a qualified person.

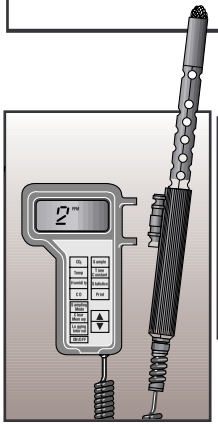
INDOOR AIR QUALITY ASSESSMENT INSTRUMENTS AND METHODS

INSTRUMENT	DATA OBTAINED	POLLUTANTS/ENVIRONMENT MEASURED	REMARKS
Direct reading calorimetric tube	Air drawn through a glass tube packed with specific compound. Length of stain in the tube indicates concentration of pollutant.	Substance-specific tubes available (NOx, CO_2, CO, Formaldehyde, Volatile organic compounds (VOCs)).	Easy to use. Instant results. Accuracy: + / – 25% Not appropriate for low levels
Direct-reading Portable Monitor	Provides an immediate measurement of the concentration in air.	CO_2, CO, VOCs	Costly. Must be calibrated before and after measurement.
Smoke Tube	Qualitative measurement of airflow and its direction.	Air motion	Quick. Inexpensive. Smoke stays still when air circulation is inadequate.
Thermal Anemometer	Direct readout of air speed (movement).	Air speed	Can be costly. Special care needed in positioning the sensor properly.

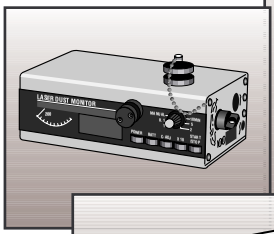
Passive Air Sampler	Collects air contaminants by diffusion. No pump used to draw air. Samples analyzed in a laboratory following standardized method.	Concentration of air contaminant. Formaldehyde, VOCs, Radon	Simple to install. Inexpensive Long sampling time (one day to one week)
Active Air Sampler	A pump draws air through a medium that catches air contaminants. Collected samples are analyzed in a laboratory following standardized methods.	Formaldehyde, VOCs	Shorter sampling time. High accuracy.
Direct-reading Dust Sampler	Monitor draws air through size-selective inlet. Detection mechanism inside monitor measures: number of particles (optical scattering) or collected dust mass piezoelectric monitors) depending on the type of monitor.	Dusts, fumes, smoke spores, and other suspended solid particles	Instant results. Suitable for workplace survey. Costly.

INSTRUMENT	DATA OBTAINED	POLLUTANTS/ENVIRONMENT MEASURED	REMARKS
Total Dust Sampling	Measured volume of air is drawn through a filter. Dust collected on this filter is measured in milligrams and the level of dust in the air is determined as milligrams per cubic meter (mg/m^3). Collected particles can be further examined under microscope to determine the types of particles and fibres and their possible sources.	All kinds of airborne solid particles (e.g. asbestos fibres).	Must wait for results. Good for detailed measurements in selected locations. Must follow standardized methodology for sampling and laboratory analysis.
Respirable Dust Sampling	Air is drawn through a cyclone which selects dust particles which can be inhaled, usually less than 10μm in diameter. Rest of sampling chain is similar to total dust samplers	Dusts and other solid particles suspended in the air.	Large volume of air must be sampled to get accurate results. Time-consuming method Strict quality control required. Standardized sampling and analysis protocol must be followed.

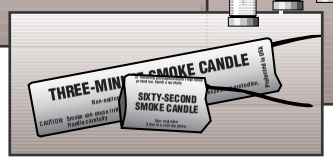
Microbial Organism Sampling	Air sampling to determine colony forming units per cubic meter. Spores are collected and allowed to grow on some type of agar medium	Fungal spores, microbial organisms. Rank order assessment. Colony forming units per cubic meter (CFU).	Requires specific expertise in microbial sampling for IAQ.



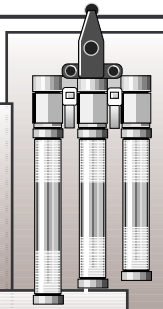
Multi-purpose Monitor



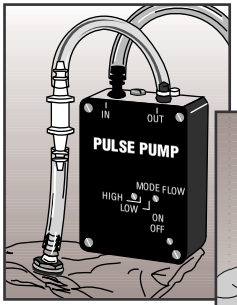
Dust Monitor



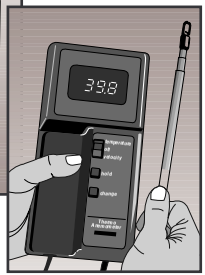
Smoke Candles/Tubes



Calorimetric Tubes



Air Sampling Pump



Thermoanemometer

Section VIII

Regulations, Standards and Guidelines

1. Regulations
2. Standards and Guidelines

1. Regulations

There are no regulations that set exposure limits specific to IAQ. Exposure limits such as ACGIH TLVs, which are adopted by some occupational health and safety jurisdictions, only apply to industrial environments. Industrial workers are often exposed to larger concentrations of a few contaminants at a time. Facilities are available to measure concentrations of such contaminants and control worker exposure by using protective measures and equipment.

In non-industrial settings such as offices, schools, hospitals and stores, workers may be exposed to low levels of many contaminants at the same time, without personal protective equipment. In these situations, stress and discomfort are normally the main concerns (not occupational disease).

General guidelines for IAQ are used instead of specific occupational exposure limits. The ASHRAE Standard 62-1989R, Ventilation for Acceptable Indoor Air Quality is widely used as a guide.

2. Standards and Guidelines

The following is a list of codes, standards and guidelines which provide guidance on how to achieve acceptable levels of IAQ.

ACR-2002-Assessment, Cleaning and Restoration. National Air Duct Cleaners Association. Washington, DC. 2002

Building Air Quality : A Guide for Building Owners and Facility Managers. (DHHS (NIOSH); 91-114) Cincinnati : National Institute for Occupational Safety and Health, 1991.

Ontario Building Code. Ontario Regulation 403/97 (1997) Ontario Gazette. Vol. 130, no. 48, 1997 11 03.

Burton, D.J. Indoor Air Quality Workbook, 1990. Salt Lake City, Utah : IVE, Inc., 1990.

Energy Code for Buildings Except Low-Rise Residential Buildings. ASHRAE/IESNA Standard; 90.1-2001. Atlanta : American Society of Heating, Refrigeration, and Air-Conditioning Engineers, 2002.

Federal-Provincial Advisory Committee on Environmental and Occupational Health. Exposure Guidelines for Residential Indoor Air Quality. Ottawa : Health Canada, 1994.

Guidelines for Reduction of Exposure to Volatile Organic Compounds (VOCs) in Newly Constructed or Remodeled Office Buildings. Sacramento : California Department of Health Services, 1992.

IAQ and Energy 98: Using ASHRAE Standards 62 and 90.1, ASHRAE 1999.

National Research Council Canada, Associate Committee on the National Building Code. National Building Code of Canada, 1995. Ottawa : National Research Council, 1995.

Occupational Safety and Health Administration, 29CFR parts 1910, 1915, 1926, and 1228. Indoor Air Quality : Proposed Rule. Federal Register. Vol. 59, no. 65 (April 5, 1994).

Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation; Air- Conditioning and Refrigeration Systems. (ANSI/ASHRAE Standard; 111-A88) Atlanta : American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1988.

S520 Standard and Reference Guide for Professional Mold Remediation. Institute of Inspection, Cleaning and Restoration Certification. Vancouver, WA. 2003

Thermal Environmental Conditions for Human Occupancy: An American National Standard. (ANSI/ASHRAE Standard; 55-1992) Atlanta : American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), 1995.

Use and Occupancy of Building Directive. Treasury Board Manual : Occupational Safety and Health; Chapter 2-17. Ottawa : Treasury Board, 1993.

National Air Duct Cleaners Association (NADCA) Standard ACR-2002 “Assessment Cleaning and Restoration” 2002.

Ventilation for Acceptable Indoor Air Quality. (ANSI/ ASHRAE Standard; 62-1989) Atlanta : American Society of Heating, Refrigeration, and Air-Conditioning Engineers, 1990.

INDOOR AIR QUALITY (IAQ) EXPOSURE STANDARDS/GUIDELINES

EXPOSURE	TYPICAL OFFICE LEVELS (PUBLIC WORKS CANADA)	ASHRAE 62-1989 *OR* ASHRAE 55-1992	OTHER STANDARDS
Outdoor Airflow Rate	15 L/s per person or greater	20 cfm per person 10 Litres per second per person	
Pressure Difference Between Zones		Neutral, except *clean rooms* and operating rooms	
Carbon Dioxide	600–800 ppm	1000 ppm	5000 ppm ACGIH
Total Volatile Organic Compounds (TVOCs)	less than 0.1 mg/m^3		Less than 0.16mg/m^3 Molhave, Indoor Air '91 0.5 mg/m^3, WA State 5.0 mg/m^3 excluding formaldehyde, NS recommendation for IAQ regulations

Carbon Monoxide	0.5–2 ppm	9 ppm	25 ppm ACGIH 9 ppm, EPA National Ambient Air Quality Standards
Formaldehyde	less than 0.1 ppm	0.1 ppm	0.05 ppm, WHO 0.3 ppm, ACGIH (ceiling)
Particulate Matter	0.01–0.04mg/m^3 in non-smoking area 0.2–0.6 mg/m^3 in smoking area	0.075 mg/m^3 (annual) 0.26 mg/m^3 (24 hour) Total particulates	0.05 mg/m^3 (annual) 0.15 mg/m^3 (24 hour), respirable EPA National Ambient Air Quality Standards
Temperature		20–23.5 °C, winter 22–26 °C, summer (ASHRAE 55-1992)	

EXPOSURE	TYPICAL OFFICE LEVELS (PUBLIC WORKS CANADA)	ASHRAE 62-1989 *OR* ASHRAE 55-1992	OTHER STANDARDS
Odours		Less than 20% of occupants dissatisfied (ASHRAE 55-1992)	
Humidity		50–70% Less than 10% of occupants dissatisfied (ASHRAE 55-1992)	30–70% summer 30–55% winter (EPA National Ambient Air Quality Standards)
Sulphur Dioxide		0.025 ppm (daily)	0.031 ppm (annual) 0.14 ppm (24 hour) EPA National Ambient Air Quality Standards 2 ppm ACGIH
Ozone	less than 0.05 ppm	0.05 ppm	Less than 0.12 ppm (1 hour) 0.05 ppm ACGIH
Nitrogen Oxides			0.15 mg/m^3 (24 hour)

			0.4 mg/m³ (1 hour) (WHO)
Nitrogen Dioxide			0.05 ppm, EPA, National Ambient Air Quality Standard 3 ppm ACGIH
Radon	Not detectable	0.02 WL (Working Level)	0.1 WL (Health Canada)
Asbestos			0.1 f/cc ACGIH 0.1 f/cc OSHA Action level

Legend of abbreviations used within chart

cfm = cubic foot per minute
1 cfm = 0.472 litres per second (L/s)
ppm = parts per million
f/cc = fibres per cubic centimetre
WL = Working Level, unit used for measuring radon daughter concentration in the air
CFU = Colony Forming Units

Health and Safety Legislation

1. Canadian OH&S Legislation
2. Workplace Hazardous Materials Information System (WHMIS)
3. Material Safety Data Sheets (MSDS)
4. Public Health Promotion Legislation
5. Fire Code
6. Building Code
7. Environmental Protection Legislation
8. US OH&S Legislation

2. Canadian OH&S Legislation

The purpose of Occupational Health and Safety (OH&S)

legislation is to protect you, the employee, against hazards on the job. It outlines the general rights and responsibilities of the employer, the supervisor and the employee.

The law makes both you and your employer jointly responsible for workplace health and safety legislation.

What Does the OH&S Legislation Say?

Each of the provinces and the federal government have their own OH&S legislation. The details of the OH&S legislation vary slightly from one jurisdiction to another but the basic elements are the same.

Most Canadian jurisdictions have a general duty provision in their OH&S legislation which requires employers to take all reasonable precautions to protect the health and safety of employees.

Government's Responsibilities

i) to enforce occupational health and safety legislation to conduct workplace inspections

ii) to disseminate information

iii) to promote training, education and research

Employee's Rights

i) to refuse unsafe work

ii) to participate in workplace health and safety activities through the Joint Health and Safety Committee (JHSC) or an employee health and safety representative

iii) to know actual and potential dangers in the workplace

Employee's Responsibilities

i) to work in compliance with the OH&S act and

regulations

ii) to use personal protective equipment and clothing as directed by the employer

iii) to report workplace hazards and dangers

Supervisor's Responsibilities

i) to ensure that employees use prescribed protective equipment

ii) to advise employees of potential and actual hazards

iii) to take every reasonable precaution in the circumstances for the protection of employees

Employer's Responsibilities

i) to establish and maintain a joint health and safety committee, or cause employees to select at least one health and safety representative

ii) to take every reasonable precaution to ensure the workplace is safe

iii) to inform employees about any potential hazards and provide training to work safely

iv) to provide personal protective equipment and ensure workers know how to use the equipment safely and properly

v) to immediately report all critical injuries to the government department responsible for OH&S

vi) to train all employees on how to safely use, handle, store and dispose of hazardous substances and handle emergencies

Joint Health and Safety Committee (JHSC)

i) must be composed of management and employee representatives

ii) at least half the members of the committee must be employee representatives

iii) must meet at least once every 3 months; 1 month in some jurisdictions

iv) must be co-chaired by one management chairperson and one employee chairperson

v) employee representatives are elected or selected by the employees or their union

Role of the Joint Health and Safety Committee

i) to act as an advisory body

ii) to identify hazards and obtain information

iii) to recommend corrective actions

iv) to assist in resolving work refusal cases

v) to participate in accident investigations and workplace inspections

Work Refusals

You can refuse work if you have reason to believe that the situation is unsafe to either yourself or your co-workers.

i) You must report to your supervisor that you are refusing to work and state why you believe the situation is unsafe.

ii) You, your supervisor, and a JHSC member or employee representative will investigate.

iii) You return to work if the problem is resolved.

iv) If the problem is not resolved, a government health and safety representative is called.

v) Your supervisor may assign you reasonable alternative work.

vi) The inspector will investigate the situation and give a decision.

Work Stoppage

Work stoppage legislation applies to Ontario only. Certified members of the Health and Safety Committee may direct the employer to stop work if all of the following three conditions exist:

i) Health and safety legislation is being violated.

ii) The violation poses a danger or a hazard to employees.

iii) Any delay in controlling the danger or hazard may seriously endanger an employee.

Ask your Health and Safety Committee for detailed procedures for work stoppage.

2. Workplace Hazardous Materials

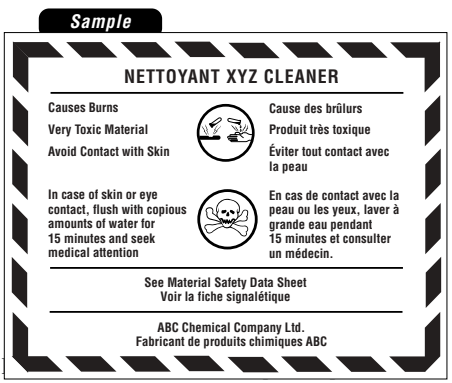
Information System (WHMIS)

(Pronounced whimiss)

WHMIS applies to all Canadian workplaces. It requires that all workers who work with or near a hazardous substance (controlled product) be informed about its potential hazards and recommended safe work practices.

WHMIS requires that information be provided in three ways:

1. All controlled products used in the workplace must have a WHMIS label on the container.
2. Material Safety Data Sheets (MSDS) and hazard information must be readily available in the workplace. A MSDS summarizes the health and safety information about the product.
3. Workers must receive training to be able to recognize and work safely with chemicals.



Sample WHMIS Label

The WHMIS label. It warns the user that a particular hazard exists. Actual hazards from toxic substances depend on the amount (level and duration) of exposure. A brief exposure at high levels may result in chemical poisoning within hours. Prolonged exposure at low levels may cause illness after several years.

WHMIS SYMBOLS AND CLASSES

	**CLASS A** **Compressed Gas**	Contents under high pressure. Cylinder may explode or burst when heated, dropped or damaged.
	**CLASS B** **Flammable and Combustible Material**	May catch fire when exposed to heat, spark or flame. May burst into flames.
	**CLASS C** **Oxidizing Material**	May cause fire or explosion when in contact with wood, fuels and other combustible material.
	**CLASS D, Division 1** **Poisonous and Infectious Material:** ***immediate and serious toxic effects***	Poisonous substance. A single exposure may be fatal or cause serious or permanent damage to health.
	**CLASS D, Division 2** **Poisonous and Infectious Material:** ***other toxic effects***	Poisonous substance. May cause irritation. Repeated exposure may cause cancer, birth defects, or other permanent damage.
	**CLASS D, Division 3** **Poisonous and Infectious Material:** ***biohazardous infectious material***	May cause disease or serious illness. Drastic exposures may result in death.
	**CLASS E** **Corrosive Material**	Can cause burns to eyes, skin or respiratory system.
	**CLASS F** **Dangerously Reactive Material**	May react violently causing explosion, fire or release of toxic gases, when exposed to light, heat, vibration or extreme temperatures.

3. Material Safety Data Sheets (MSDS)

Material Safety Data Sheets (MSDS) provide health, safety and handling information. Manufacturers are required to produce an MSDS for their products particularly for hazardous products. An MSDS provides the following information: (ANSI Z400.1-1993 Standard)

Section 1. Product and company identification

Section 2. Composition/information on ingredients

Section 3. Hazards identification

Section 4. First aid measures

Section 5. Fire fighting measures

Section 6. Accidental release measures

Section 7. Handling and storage

Section 8. Exposure controls/personal protection

Section 9. Physical and chemical properties

Section 10. Stability and reactivity

Section 11. Toxicological information

Section 12. Ecological information

Section 13. Disposal considerations

Section 14. Transport information

Section 15. Regulatory information

Section 16. Other information

4. Public Health Promotion Legislation

This legislation is to ensure the well being of all occupants of public buildings and to prevent the spread of disease. The act sets standards for sanitation and cleanliness. Washrooms, kitchens, eating areas, water quality and infectious diseases are high priority items.

Authority

Public Health Promotion and Promotion Act and Regulations are enforced by the Public Health Department/Public Health Unit in your town/city.

5. Fire Code

The Fire Code sets the requirements for fire prevention and protection. These include requirements for:

i) building design complementing the building code,
ii) fire protection and fire detection systems,
iii) storage of specific materials, and
iv) fire inspections.

Contact your local fire department for additional information and employee education in fire safety procedures.

Authority

The Fire Code is enforced by the local fire department in your town/city.

6. Building Code

The Building Code sets standards and guidelines for buildings, structures, facilities and systems. Heating, ventilation, storage facilities, renovations, and maintenance are all covered under the building code.

The objective of the Building Code is to make sure that:

i) buildings are structurally adequate for their intended use;

ii) structures and materials can withstand temperature extremes and ice and snow loads;

iii) building design meets fire safety code, electrical safety code and other regulatory requirements;

iv) building is suitable for the planned occupancy.

Authority

The building code is enforced by the provinces and the township.

7. Environmental Protection Legislation

The purpose of the environmental protection legislation is to prevent deterioration of the environment. The act specifies procedures for the storage, use and disposal of substances whose uncontrolled release can adversely affect the environment. Schools must be registered as waste generators and waste disposal must be done in compliance with the legislation.

Authority

The governmental environmental agencies in your jurisdiction enforce the Environmental Proctection Legislation.

8. US OH&S Legislation

In the United States (US) the Occupational Safety and Health Act is popularly known as OSHAct. The Occupational Health and Safety Administration (OSHA) is responsible for administering the OSHAct.

The OSHAct ***does not*** cover the following four categories of people:

- self-employed persons
- farms which employ only immediate family members of the farm employer
- employees covered by other legislation
- state and local government employees

OSHA regulations are published in Title 29 of the Code of Federal Regulations as:

- 29 CFR Part 1910— Occupational Safety and Health Standards
- 29 CFR Part 1926—Construction Standards

These standards define exposure limits, exposure monitoring methods, medical surveillance and protective measures.

Duties of Employers

The OSHAct sets out two main duties for employers:

- Employers must provide a workplace which is free from hazards that are known to cause or likely to cause death or serious physical harm to employees.
- Employers must comply with occupational safety and health standards under the Act.

Duties of Employees

Employees must comply with occupational safety and health standards, rules, regulations and orders which are applicable to their own conduct and actions.

Key Provisions

Some of the key provisions of the OSHAct are to:

- assure, insofar as possible, that every employee has safe and healthy working conditions
- require employers to maintain accurate records of exposures to potentially toxic materials or harmful physical agents and inform employees of the monitoring results
- provide for employee walk-around or interview of employees during the inspection process
- provide procedures for investigating alleged violations, at the request of any employee or employee representative issuing citations and assessing monetary penalties against the employer

Hazard Communication

The intent of the OSHA Hazard Communication Standard is to provide employees with information and training about the potential health hazards from exposure to workplace chemicals. The Standard requires that employee training include:

- explanations of the requirements of the standard;
- identification of workplace operations where hazardous chemicals are present;
- knowledge of the methods and observations used to detect the presence of hazardous workplace chemicals;
- assessment of the physical and health hazards of those chemicals
- warnings about hazards associated with chemicals in unlabelled pipes;
- descriptions of hazards associated with non-routine tasks;
- details about the measures employees can take to protect themselves against these hazards, including specific procedures;

- explanation of the labelling system;
- instructions on location and use of material safety data sheets (MSDSs);
- details on the availability and location of the hazardous materials inventory, MSDSs, and other written hazard communication material.

Hazard Warning and Symbols

Chemicals produced in the USA come under OSHA Hazard Communication Standard. The label on the container must warn about potential hazards of the product. OSHA does not require hazard symbols on the label, however, the skull and crossbones symbol is acceptable on containers of highly toxic substances and the flame symbol is acceptable on containers of flammable substances.

Section X

Information Sources

1. **Canadian Government Departments with Responsibility for Occupational Health and Safety**

2. **US Federal Safety and Health Agencies**

1. Canadian Government Departments Responsible for Occupational Health and Safety

Canadian Centre for Occupational Health and Safety (CCOHS)

Inquiries & Client Services
(free answers to your OH&S questions)
135 Hunter Street East
Hamilton, ON L8N 1M5
Phone: 905-570-8094
(8:30 AM to 5:00 PM EST Time)
Toll-free: 1-800-668-4284 (Canada and US only)
Fax: 905-572-4500
E-mail: clientservices@ccohs.ca
OSH Answers Web Site: www.ccohs.ca/oshanswers
Web Site: www.ccohs.ca

General Contact
Phone: 905-572-2981
Fax: 905-572-2206

Federal Jurisdiction

Workplace Health and Safety
Human Resources and Social Development Canada
1-800-641-4049
Ottawa ON K1A 0J2
Web Site: http://www.hrsdc.gc.ca/en/labour/workplace_health/index.shtml

Regional and District Offices:
Web Site: http://www1.servicecanada.gc.ca/en/gateways/where_you_live/menu.shtml

Provincial Jurisdictions

Alberta

Workplace Health and Safety
Alberta Employment, Immigration and Industry
10030-107 Street
Edmonton, AB T5J 3E4
(Edmonton and surrounding area)
Phone: (780) 415-8690
Toll-free in Alberta: 1-866-415-8690
Fax: (780) 422-3730
E-mail: whs@gov.ab.ca
Web Site: http://employment.alberta.ca/cps/rde/xchg/hre/hs.xsl/53.html

British Columbia

WorkSafeBC (Workers' Compensation Board of British Columbia)
6951 Westminster Highway (Richmond, BC)
PO Box 5350 Stn Terminal
Vancouver, BC V6B 5L5
Workplace Safety and Health Inquiries
Phone: (604) 276-3100
Toll-free in B.C.: 1-888-621-7233 (SAFE)
Fax: (604) 244-6490
Emergency and Accident Reporting
Toll-free in B.C.: 1-888-621-7233 (SAFE)
After hours: 1-866-922-4357 (WCB-HELP)
Web Site: www.worksafebc.com

Manitoba

Workplace Safety and Health Division
Manitoba Labour and Immigration
200-401 York Avenue
Winnipeg, MB R3C 0P8
General Inquiries: (204) 945-3446
Toll free in Manitoba: 1-800-282-8069
After hours: (204) 945-0581
Fax: (204) 945-4556
E-mail: wshcompl@gov.mb.ca
Web Site: www.gov.mb.ca/labour/safety/

New Brunswick

Workplace Health, Safety and Compensation Commission of New Brunswick

1 Portland Street
PO Box 160
Saint John, NB E2L 3X9
Phone: (506) 632-2200
Toll free: 1-800-222-9775
Fax: (506) 642-0718
E-mail: prevention@whscc.nb.ca
Web Site: www.whscc.nb.ca

Newfoundland and Labrador

Occupational Health and Safety Branch Department of Government Services

15 Dundee Avenue
Mount Pearl, NL A1N 4R6
General Inquiries: (709) 729-2706
Toll-free in NL: 1-800-563-5471
Fax: (709) 729-3445
Serious Workplace Accident Reports
Phone: (709) 729-4444 (24 Hours)
Web Site: www.gs.gov.nl.ca/ohs/

Northwest Territories and Nunavut

Workers' Safety and Compensation Commission of Northwest Territories and Nunavut

PO Box 8888
Yellowknife, NT X1A 2R3
General Inquiries: (867) 920-3888
Toll free: 1-800-661-0792
Fax: (867) 873-4596
Toll Free Fax: 1-866-277-3677
E-mail: yellowknife@wcb.nt.ca
Web Site: www.wcb.nt.ca

Iqaluit

PO Box 669
Iqaluit, NU X0A 0H0
Phone: (867) 979-8500
Fax: (867) 979-8501
Toll-free: 1-877-404-4407
Toll Free Fax: 1-866-979-8501
E-mail: iqaluit@wcb.nt.ca
Website: www.wcb.nt.ca

Nova Scotia

Occupational Health and Safety Division Nova Scotia Department of Environment and Labour and Workforce Development
5151 Terminal Rd., 6th Floor
PO Box 697
Halifax, NS B3J 2T8
General Inquiries: (902) 424-5400
Toll free in NS: 1-800-952-2687
Fax: (902) 424-5640
E-mail: webster@gov.ns.ca
Web Site: http://www.gov.ns.ca/enla/ohs/

Ontario

Ministry of Labour
Occupational Health and Safety Branch
505 University Avenue, 19th Floor
Toronto ON M7A 1T7
416-326-3835
Fax 416-326-7761
1-800-268-8013 (province-wide)
E-mail: webohs@mol.gov.on.ca
Web Site: www.labour.gov.on.ca/english/hs/index.html

Prince Edward Island

Workers' Compensation Board of PEI
Occupational Health and Safety
PO Box 757, 14 Weymouth Street
Charlottetown, PE C1A 7L7
General Inquiries: (902) 368-5680
Toll-free (in Atlantic Canada): 1-800-237-5049
Occupational Health & Safety
24 Hr Emergency Tel: (902) 628-7513
Customer Liaison Service: 1-866-460-3074
Fax: (902) 368-5705
Web Site: www.wcb.pe.ca

Québec

Commission de la santé et de la sécurité du travail du Québec (CSST) (Occupational Health & Safety Commission)
1199, rue de Bleury
C.P. 6056, Succursale «centre-ville»
Montréal QC H3C 4E1
Tel: 514-906-3780/514 906-3061, poste 2214
1-866-302-2778
Fax: 514-906-3781/514 906-3016
www.csst.qc.ca
(514) 906-2911 Urgence 24 h – Services de prévention-inspection
Web Site: http://www.csst.qc.ca/portail/fr/

Saskatchewan

Advanced Education, Employment and Labour
Occupational Health and Safety Division
400 - 1870 Albert Street
Regina, SK S4P 4W1
Phone: (306) 787-4496
Toll-free in SK: 1-800-567-7233
Fax: (306) 787-2208
Web Site: www.labour.gov.sk.ca/

Saskatoon Office:
122-3rd Avenue North
Saskatoon, SK S7K 2H6
Phone: (306) 933-5052
Toll-free: 1-800-667-5023
Fax: (306) 933-7339

Yukon Territory

Yukon Workers' Compensation, Health and Safety Board Occupational Health and Safety Branch
401 Strickland Street
Whitehorse, YT Y1A 5N8
General Inquiries: (867) 667-5645
24-hour Emergency Line for Reporting Serious Workplace Accidents and Injuries: (867) 667-5450
Toll free across Canada: 1-800-661-0443
Fax: (867) 393-6279
E-mail: worksafe@gov.yk.ca
Web Site: www.wcb.yk.ca

For an up-to-date listing of information sources visit
http://www.ccohs.ca/oshanswers/information/govt.html

2. US Federal Safety and Health Agencies

US Environmental Protection Agency (EPA)

Ariel Rios Building
1200 Pennsylvania Avenue NW,
Washington, DC 20460
Phone: (202) 272-0167
Web Site: www.epa.gov

National Institute for Occupational Safety and Health (NIOSH)

Education and Information Division (EID)
4676 Columbia Parkway
Cincinnati, OH 45226
1-800-CDC-INFO (1-800-232-4636)
Outside the US: (513) 533-8328
Fax: 1-513-533-8347
E-mail: eidtechinfo@cdc.gov
Web Site: www.cdc.gov/NIOSH/

Occupational Safety & Health Administration (OSHA)

200 Constitution Ave., NW
Washington, DC 20210
Phone: (202) 693-2000
Emergency reporting or if you have workplace safety and health related questions
Toll Free: 1-800-321-OSHA (6742)
Web Site: www.osha.gov

Glossary

ACGIH

American Conference of Governmental Industrial Hygienists. ACGIH is a society of professional hygienists and educators who work to promote occupational safety and health. The organization publishes recommendations on ventilation, air sampling and threshold limit values or TLVs designed to limit and control exposure of workers to airborne chemicals and physical hazards in the workplace.

Acceptable Indoor Air Quality (IAQ)

Air in which there are no known contaminants at harmful levels as determined by appropriate authorities, and air with which 80% or more of the people do not express dissatisfaction.

Air Changes Per Hour (ACH)

The number of times air is theoretically replaced in a space during one hour.

Air Conditioning (AC)

The process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, odour, cleanliness, and distribution.

Air Filter

An air-cleaning device that removes light particulate matter from normal atmospheric air.

Air Handling Unit

Refers to ventilation equipment in HVAC system *(see HVAC)*.

Air Intake

A part of the ventilation system that draws outdoor air into the air handling system.

Air Velocity
Rate of air flow

ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers)
The primary association involved in recommending IAQ guidelines and standards. The society is organized for the sole purpose of advancing the arts and sciences of heating, ventilation, air conditioning and refrigeration for the public's benefit through research, standards writing continuing education and publications.

ANSI
American National Standards Institute; an American organization that produces the ANSI standards.

Bake Out
The approach calls for the heating of a building interior to 90° F or more for one or more days. The increased temperature encourages the volatilization of VOCs (Volatile Organic Compounds).

Building Related Illness (BRI)
Refers to illness brought on by exposure to building air when symptoms of illness, and clinical signs of pathology are identified, an airborne agent and pathway for the agent are recognized.

CCOHS
Canadian Centre for Occupational Health and Safety, Canada's national organization for promotion of workplace health and safety. Provides information, advice, training and research.

Calorimetric
Chemical analysis techniques involving reactions in which a color is developed when a particular contaminant is present in the sample and reacts with the collection medium. The resultant color change determines the contaminant concentration.

Condensate
The water resulting from the process of condensation in HVAC systems.

CSA
Canadian National Standard Association, a national organization that produces CSA standards.

Duct
A conduit used for conveying air at low pressures.

EPA
U.S. Environmental Protection Agency.

Epidemiology
The study of the occurrence and causes of health effects in human populations. An epidemiological study compares occurrence of health effects in two groups of people who are alike except for one factor such as exposure to a chemical or the presence of a health effect.

Ergonomics
The science of matching a worker with his/her workstation and work environment.

Exhaust ventilation
The removal of air usually by mechanical means from any space near the source of air contaminants.

Filter, HEPA
High-efficiency particulate air filter that is at least 99.97 percent efficient in removing thermally generated monodisperse dioctylphthalate smoke particles with a diameter of 0.3u.

Fungus *(pl. fungi)*
Moulds, dusts, mildews, smuts, and mushrooms that grow in humid spots.

Heating, Ventilation and Air Conditioning (HVAC)
A common term for heating, ventilating, cooling, humidifying, dehumidifying, and conditioning air for comfort, safety and health.

IAPA
Industrial Accident Prevention Association (of Ontario).

IARC
International Agency for Research on Cancer. IARC, part of the World Health Organization, is an international organization that evaluates the human cancer risk from chemical exposure.

ISO
International Organization for Standardization, an international organization that produces the ISO standards.

Makeup Air
Outdoor air supplied to replace exhaust air and exfiltration.

Mould
A growth of fungi forming a furry patch.

National Institute of Occupational Safety and Health (NIOSH)
The research agency established by the US Congress in the Occupational Safety and Health Act of 1970.

Natural Ventilation
The movement of outdoor air into a space through intentionally provided openings, such as windows, and doors, or through nonpowered ventilators or by infiltration. (Just opening windows occasionally is not natural ventilation.)

Occupational exposure limit
Maximum exposure level permissible for 8 hours per day, five days per week.

Odours
Odours are often organic gases and vapours that stimulate the olfactory organs. Response varies with person, age, experience, time of exposure, and other factors.

Off-gassing

Gradual release of vapours and gases to the atmosphere, usually from new furnishings, carpets and building materials.

Outdoor Air (OA)

Air taken from the external atmosphere and, therefore, not previously circulated through the system.

Recirulated Air

Air removed from the conditioned space and intended for reuse as supplied air.

Relative Humidity (RH)

A measure of the amount of water vapour in air

Respirable Particles

Particles less than 10 micromeners aerodynamic diameter.

Return Air (RA)

Air which is returned to the fan from the occupied space for recirculation as supply air.

Sick Building Syndrome (SBS)

Usually refers to a class of complaints of symptoms seen in IAQ episodes (e.g. discomfort, headaches, irritation of upper respiratory tract).

Threshold Limit Value (TLVs)

Exposure guidelines established by American Conference of Government Industrial Hygiennists (ACGIH).

Tight Building Syndrome (TBS)

A list of symptoms associated with IAQ problems. TBS and SBS (Sick Building Syndrome) are interchangeably used for the same symptoms.

Ventilation

The process of supplying outdoor air and removing used air by natural or mechanical means to and from any space.

Volatile Organic Compounds (VOCs)

Organic compounds which evaporate readily. VOCs include aromatic hydrocarbons, halogenated hydrocarbons, alcohols, ketones, aldehydes, ethers and esters. Several hundred VOCs have been identified in indoor air, best known VOC is formaldehyde.

Appendices

A1. Sample Health Survey

In this section we give examples of questionnaires and checklists for identifying potential indoor air quality problems in the workplace.

USE these questionnaires and checklists in consultation with an expert.

SELECT a checklist that suits the objectives of your survey.

CUSTOMIZE these questionnaires and checklists to address conditions and work practises applicable to your workplace.

ANALYZE the responses to questionnaires and checklists in consultation with an expert.

Sample

HEALTH SURVEY

1. What is your present job?

.....

.....

2. How long have you been doing this job?

.....

3. In the last year, did you experience any of the following health conditions that lasted 2 days or more?

Headache	❑ YES	❑ NO
Nausea	❑ YES	❑ NO
Dizziness	❑ YES	❑ NO
Tiredness	❑ YES	❑ NO

Sample

Irritation of eyes, nose, throat	❑ YES	❑ NO
Breathing problems	❑ YES	❑ NO
Coughing	❑ YES	❑ NO
Sneezing	❑ YES	❑ NO
Wheezing	❑ YES	❑ NO
Blurred vision	❑ YES	❑ NO
Shortness of breath	❑ YES	❑ NO
Sinus congestion	❑ YES	❑ NO
Pain and discomfort of:		
back	❑ YES	❑ NO
neck	❑ YES	❑ NO
hands	❑ YES	❑ NO
shoulders	❑ YES	❑ NO
wrist	❑ YES	❑ NO

If you answered **NO** *to all of these questions, stop here.*

4. Have you noticed any unusual or unpleasant odours in the building? ❑ **YES** ❑ **NO**
5. At work is the pain or discomfort:

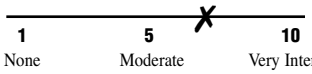
   ❑ **BETTER** ❑ **SAME** ❑ **WORSE**
6. After your shift, is the pain or discomfort:

   ❑ **BETTER** ❑ **SAME** ❑ **WORSE**
7. After a week away from work, is the pain or discomfort: ❑ **BETTER** ❑ **SAME** ❑ **WORSE**
8. Did the pain or discomfort cause you to take time off work? ❑ **YES** ❑ **NO**
9. Are you aware of any of the following pollutants entering your building or being produced nearby:
   - ❑ Ammonia
   - ❑ Asbestos
   - ❑ Carbon dioxide
   - ❑ Carbon monoxide

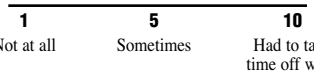
- ❑ Fiberglass
- ❑ Formaldehyde
- ❑ Methyl alcohol
- ❑ Microorganisms (such as viruses, bacteria and fungi)
- ❑ Mercury
- ❑ Motor vehicle exhaust (carbon monoxide, nitrogen oxides, lead particulates, sulfur oxides)
- ❑ Nitrogen oxides
- ❑ Ozone
- ❑ Paint vapours (organic solvents)
- ❑ Pesticides
- ❑ Polychlorinated biphenyls (PCBs)
- ❑ Radon and its decay products
- ❑ Sterilant gases (such as ethylene oxide)
- ❑ Sulfur oxides
- ❑ Perfumes, hair sprays
- ❑ Tobacco smoke (particulates, carbon monoxide, formaldehyde, coal tars, nicotine

10. How much does your *pain or discomfort* interfere with your work, your *life outside of work*, and your *sleep*? Please indicate on these scales with an "X".

For example



How much does it interfere with your work?



How much does it interfere with your life outside of work?

1	5	10
Not at all	Sometimes	Had to stop an activity

How much does it interfere with your sleep?

1	5	10
Not at all	Sometimes	Affects me nightly

11. What is your sex? ❑ **MALE** ❑ **FEMALE**

12. How old are you? _____ **YEARS**

13. Do you think any of the following might be causing IAQ problems at your workstation?

- ❑ air circulation
- ❑ humidifier
- ❑ air conditioning
- ❑ temperature
- ❑ noise
- ❑ illumination
- ❑ foul odours
- ❑ air circulation shut down on weekends and evenings
- ❑ irritants in the air
- ❑ outdoor contaminants
- ❑ machinery/equipment
- ❑ smoking
- ❑ overcrowding
- ❑ dividers
- ❑ renovations
- ❑ pesticide spraying
- ❑ new furnishing/carpeting
- ❑ others (specify) _____
- ❑ I don't know

Based on a report prepared by CCOHS staff for the Government of Newfoundland

14. Please make any comments or suggestions about how your job affects you and how to correct any problems in the workplace.

A2. Ventilation System Inspection

Observe safety rules when conducting inspections. Ventilation systems have potentially hazardous fans, electrical components and hot or cold surfaces.

Use the following checklist to conduct your inspection:

Sample

VENTILATION SYSTEM INSPECTION CHECKLIST

ITEM	INSPECT FOR	OK	NOT OK
Exhaust Hoods	Physical condition	❑	❑
	Dry	❑	❑
	No plugging or blockage	❑	❑
	Blast gate and damper settings	❑	❑
Outdoor Air	Location in relation to exhausts and other outdoor sources of harmful or unpleasant substances	❑	❑
	No plugging and blockage	❑	❑
	Dry, clean	❑	❑
	Operation of motorized louvers and dampers	❑	❑
Ductwork	Physical condition	❑	❑
	Dry	❑	❑
	No plugging or blockage	❑	❑
	Blast gate and damper settings	❑	❑
Reheat Coils/ Mixing Boxes	Dry, clean	❑	❑
	VAV (variable air volume) calibration set for at least the minimum required	❑	❑
	Outdoor air delivery at all times	❑	❑

Sample

ITEM	INSPECT FOR	OK	NOT OK
HVAC Equipment	Physical condition	❑	❑
	Dry, clean	❑	❑
	Filters in place, clean and dry	❑	❑
	No slime, mould, dirt, bird droppings or soot accumulation	❑	❑
	Cleanliness and operation of heating/cooling unit burners, combustion air fans, stacks, condensers, etc.	❑	❑
Supply Air Diffusers, Return Air Grilles	Open and unobstructed	❑	❑
	Clean	❑	❑
Fan	Direction of rotation and and rpm are appropriate	❑	❑
	Pulley/belt tightness and wear	❑	❑
	Guards in place	❑	❑
	Assembly intact and clean	❑	❑
	Vibration minimal	❑	❑
	Noise level acceptable	❑	❑
	No loose nuts and bolts	❑	❑
	Bearing lubrication (as indicated by temperature and vibration)	❑	❑
	Motor temperature	❑	❑
	Electrical connections and insulation intact	❑	❑
	Fan wheel correctly mounted and not worn or dirty	❑	❑
	Strainers, traps, drains and valves open and clear	❑	❑
	Couplings and alignment for direct drive fans	❑	❑

Sample

ITEM	INSPECT FOR	OK	NOT OK
Humidifiers, Cooling Coils Drain Pans	Clean	❑	❑
	No slime or mould build-up	❑	❑
	Drains clear and free-flowing	❑	❑
	No stagnant water accumulation	❑	❑
	No odour	❑	❑
Cooling Tower(s)	Drains clear	❑	❑
	No stagnant water	❑	❑
	No bird droppings, slime, mould or dirt build-up	❑	❑
Thermostats	Set appropriately	❑	❑
	Access controlled	❑	❑

Caution

Inspect internal fan components only when the fan is off and locked out.

Notes

A3. Selecting an IAQ Consultant

You may need the services of a consultant when the preliminary investigation reveals that a detailed investigation is necessary. There are no legal requirements for a person to be designated as an indoor air quality consultant. It is the Client's responsibility to find a competent consultant who is qualified by education, knowledge and experience.

Finding Addresses and Telephone Numbers of Consultants

The following organizations maintain a listing of persons and companies specializing in indoor air quality investigation:

1. Professional organizations such as, Canadian Registration Board of Occupational Hygienists (CRNOH), Occupational Hygiene Association of Ontario (OHAO), and Canadian Society of Safety Engineers.

2. Provincial Professional Engineers Associations
   Consult your local telephone directory
   For example in Ontario Call 1-800-339-3716

3. Canadian Institute of Public Health Inspectors (CIPHI)
   PO Box 75264
   15180 North Bluff
   White Rock, BC V4B 5L4
   Telephone: 1-888-245-8180
   E-mail: exec@ciphi.ca
   Web Site: www.ciphi.ca

4. American Conference of Governmental Industrial Hygienists (ACGIH)
   Cincinnati, Ohio, USA
   Telephone (513)742-2020
   E-mail: tech@acgih.org
   Fax: (513) 742-3355
   Website: www.aia.org

5. American Industrial Hygiene Association (AIHA)
   Fairfax, Virginia, USA
   Telephone: (703) 849-8888
   E-mail: infonet@aiha.org
   Fax: (703) 207-3561

6. US Environmental Protection Agency (EPA)
   Indoor Environment Division
   Washington D.C.
   Telephone: (202) 260-2080
   Web Site: www.epa.gov/iaq/index.html

Sample

CONSULTANT'S QUALIFICATION CHECKLIST

Consultant's Name _____

Employer _____

_____

1. Education
- ❑ Industrial Hygiene
- ❑ Engineering
- ❑ Related discipline

2. Certification and Registration
- ❑ Canadian Registration Board of Occupational Hygienists
- ❑ American Board of Industrial Hygiene
- ❑ Professional Engineers Associations
- ❑ Safety Engineers

3. Professional Education
- ❑ Recent publications
- ❑ Attendance at seminars
- ❑ Symposia
- ❑ Courses

4. Years of Experience (investigating IAQ complaints)
_____ Years

Sample

5. **Previous clients** (that can be contacted for reference)

6. **Sales agent**, supplier, or manufacturer of IAQ equipment ❑ Yes ❑ No

7. **Equipment used for investigation**

8. **Laboratories used for analyzing IAQ samples**
   - Is it a accredited laboratory? ❑ Yes ❑ No
   - Accredited by AIHA ❑ Yes ❑ No
   - Others

9. **Services that can be provided**

10. **Will the consultant testify in case of litigation** ❑ Yes ❑ No

11. **Examples of previous reports** ❑ Yes ❑ No

12. **Report understandable to non-technical persons** ❑ Yes ❑ No

13. **Deliverables** (contents and organization of the report)

14. **Cost of service** $

15. **Expected date of completion**

Notes

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- **Lockout**
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- **Pandemic Planning**
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- **Return to Work: The Basics**
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  - **TDG: An Overview**
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