Guide to the Management

Hazardous Substances

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Notice to Reader

The purpose of Part II of the *Canada Labour Code* which covers occupational health and safety is to "prevent accidents and injury to health arising out of, linked with or occurring in the course of employment."

This document is intended primarily as a guide to help you investigate hazards associated with hazardous substances in accordance with sections 10.3 to 10.26 of Part X of the *Canada Occupational Health and Safety Regulations* (COHSR) when requested. It suggests a simple, practical approach for facilitating compliance with this part of the Regulations and Part II of the *Canada Labour Code*.

To help you better understand the regulatory requirements, we present, in the pages that follow, a decision tree as well as some examples from work places that are quite different from each other.

This guide can be applied to extended jurisdictions by replacing COHSR sections with the corresponding sections of their regulations:

COHSR sections	**COHSR *sections* (Aviation)**	**COHSR *sections* (Marine)**	**COHSR *sections* (Trains)**	**COHSR *sections* (Oil and Gas)**
10.3				
10.4	5.3	8.3	7.3	11.3
10.5	5.4	8.4	7.4	11.4
10.6	5.5	8.5	7.5	11.5
10.7-10.26	5.6-5.17	8.6-8.25	7.6-7.23	11.6-11.28

This document does not apply to the handling of complaints or refusal to work in dangerous circumstances. It also does not apply to the handling or transportation of dangerous goods, to which the *Transportation of Dangerous Goods Act, 1992* and regulations made thereunder apply.

1. Purpose of the Regulations

Part X of the *Canada Occupational Health and Safety Regulations* outlines occupational health and safety with regard to hazardous substances used, produced, handled, or stored for use in the work place in order to prevent accidents, injuries and occupational diseases related to them.

The goals of the COHSR in this regard are:

(a) to make it mandatory to keep and maintain records and files of all hazardous substances present in the work place,

(b) to ensure that the work place health and safety committee or the health and safety representative is notified of any investigation of a hazardous occurrence,

(c) to ensure that any investigation of a hazardous occurrence includes the development of a written procedure for controlling the hazardous substances,

(d) to guarantee the regular inspection, testing and maintenance of ventilation systems designed to reduce the concentration of airborne hazardous substances,

(e) to implement the requirements of the *National Fire Code of Canada* concerning the storage and handling of controlled products,

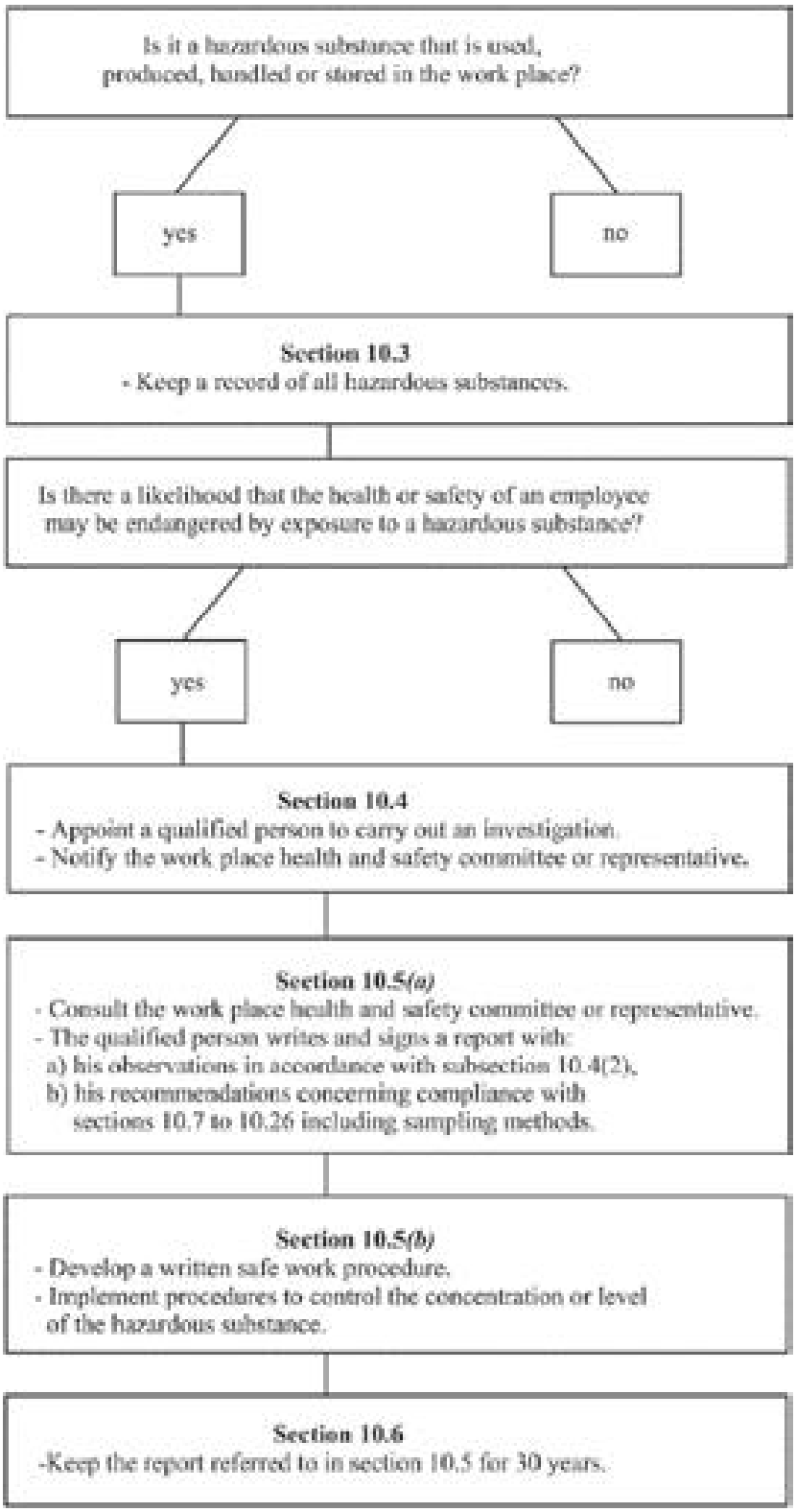
(f) to identify the information concerning hazardous substances to be disclosed on labels and display panels,

(g) to ensure that information is disclosed on the labels of samples of controlled products used in the laboratory, and

(h) to ensure that employees are not overexposed to ionizing or non-ionizing radiation.

In short, Part X is organized to provide you with a series of steps for developing an effective prevention program against adverse effects of hazardous substances. The following decision tree illustrates the steps described in sections 10.3 to 10.6 of the COHSR.

Decision Tree
(Sections 10.3 to 10.6 of the COHSR)



2. Definitions

Below are definitions from the *Code* and Regulations for the following:

- hazardous substances,
- risk and risk assessment, and
- qualified person.

2.1 Hazardous Substances

According to subsection 122.(1) of Part II of the *Canada Labour Code*, "hazardous substance includes a controlled product and a chemical, biological or physical agent that, by reason of a property that the agent possesses, is hazardous to the safety or health of a person exposed to it."

2.1.1. Chemical, Biological and Physical Agents

In industrial hygiene:

- a **chemical agent** is a mist, a vapour, a gas, fumes or dusts of a chemical compound or a mixture of chemical compounds that present a hazard to the health of any person exposed to it.
- a **biological agent** is an animal, an insect, a parasite or a micro-organism, such as moulds, fungi, viruses, rickettsiae or bacteria, that present a hazard to the health of any person who comes into contact with it.
- a **physical agent** is an ionizing or non-ionizing radiation, a vibration, a noise and an extreme temperature or pressure that presents a hazard to the health of any person exposed to it.

2.1.2. Controlled Products

Section 2 of the *Hazardous Products Act* (HPA) defines a **controlled product** as any product, material or substance included in any of the classes listed in Schedule II of the *Controlled Products Regulations*.

A. Compressed gas

B. Flammable and combustible material:

- B1. Flammable gases
- B2. Flammable liquids
- B3. Combustible liquids
- B4. Flammable solids
- B5. Flammable aerosols

B6. Reactive flammable materials

C. Oxidizing material

D. Poisonous and infectious material:

D1. Materials causing immediate and serious toxic effets

D2. Materials causing other toxic effects

D3. Biohazardous infectious materials

E. Corrosive material

F. Dangerously reactive material.

Controlled products include a large number of chemical substances, mixtures and products used in the work place, as well as various infectious materials.

2.2 Risk and Risk Assessment

The term risk is not defined in the *Canada Labour Code.*

The *Shorter Oxford English Dictionary* defines risk as “a hazard, danger; exposure to mischance or peril”. The french counterpart dictionnary, *Le Petit Robert*, defines a risk as “un danger éventuel plus ou moins prévisible”.

In standard CSA Q850-97 entitled *Risk Management: Guideline for Decision Makers*, the Canadian Standards Association defines risk as follows: “The chance of injury or loss as defined as a measure of the probability and severity of an adverse effect to health, property, the environment, or other things of value.”

In its publication *What Makes Chemicals Poisonous*?, the Canadian Centre for Occupational Health and Safety defines a chemical hazard as follows: “Hazard is the likelihood that a chemical will cause poisoning, given its poisoning strength and the amounts and the manner in which it is used, stored and handled.” This definition can be extended to biological and physical hazards.

In short, risk is a question of probability. While it is impossible to change the physical, chemical or biological properties of a hazardous substance, for the purposes of prevention it is possible to reduce the level of risk that it presents.

When doing a risk assessment, you must carefully examine the properties of physical, chemical and biological agents and assess their acceptability of the risks associated with them, taking into consideration the needs, interests and concerns of the interested parties.

How is Risk Assessed?

Risk assessment of a hazardous substance can be based on one or more of the following:

(a) judgment of a professional,

(b) personal observation, for example by collecting data in the work field,

(c) preliminary investigations using direct reading equipment,

(d) estimation of the probability that the concentration of an airborne chemical agent or the level of ionizing or non-ionizing radiation exceeds 50 percent of the standards prescribed by the *Canada Occupational Health and Safety Regulations*,

(e) review of the literature on the subject,

(f) use of a risk analysis method, like the method proposed by the Canadian Standards Association in CSA Q850-97, and/or

(g) study of the hazardous substance's properties, such as toxicity, flammability and chemical reactivity, and of the way in which the material is used, produced, handled or stored. How a substance is used can vary greatly from work place to work place and, therefore, so can the risk level.

If you used the method described in CSA Q850-97, the risk assessment will lead to one of the following three conclusions:

1. The risk associated with the hazardous substance is acceptable.
2. The risk associated with the hazardous substance will be acceptable provided the risk is decreased through elimination, substitution, reduction, monitoring, individual or collective protection, etc.
3. The risk associated with the hazardous substance is unacceptable when the level is higher than the standard, regardless of the level.

In light of the results of the investigation, managers of the work place will have to make decisions and put in place the necessary preventive and corrective measures.

2.3 Qualified Person

Subsection 10.4(1) of the *Canada Occupational Health and Safety Regulations* states that the investigation shall be conducted by a qualified person. Section 1.2 of the COHSR defines a qualified person as follows: "In respect of a specified duty, a person who, because of his knowledge, training and experience, is qualified to perform that duty safely and properly."

Because this risk assessment involves a combination of environmental, epidemiological and toxicological knowledge, it is important that the person who will do the investigation is well trained in these fields and possesses the required experience to complete it.

3. Sections of the Regulations

Section 10.3

Every employer shall keep and maintain a record of all hazardous substances that, in the work place, are used, produced, handled, or stored for use in the work place, and may either keep and maintain such a record in the work place or keep and maintain a centralized record in respect of several work places, in one work place.

Interpretation

The starting point of any preventive approach is to identify the potential sources of hazards. Therefore, you must **keep a record of all hazardous substances** found in the work place, that is, chemical, biological and physical agents with at least one property that presents a hazard to the health or safety of any person exposed to them, as well as all controlled products.

It may be that, in your work place, an employee or group of employees uses, produces, handles or stores a hazardous substance with a minimal risk of exposure. Whatever the actual risk level, that hazardous substance must be recorded in the log.

We present here a model of a log that can be easily done electronically in order to facilitate access and modifications. Depending on the size of your establishment, the log can be kept by employee, by workstation, by shop or for the entire work place.

Example of a Hazardous Substance Log (sec. 10.3)

Hazardous Substance Log
L.M. inc. – 13/04/xx

1	2	3	4	5	6	7
No. of the hazardous substance	**Name of substance/ Common use**	**Manufacturer/ Supplier**	**Work Station**	**Controlled Product**	**Use for the substance**	**Investigation needed**
# 2223	B.t.	Zorter	outside	no	to kill lepidoptera larvae	no
# 2224	transmission oil	10-OUTOU	station B	no	used for vehicle transmissions	no
# 2225	arc welding rods	Welder inc.	station C	yes, data sheet # 2225	to weld containers	yes reports # 20-02 and 20-05
# 2226	lead chromate/ orange paint DT 885	PPC inc.	station A	yes, data sheet # 2226 updated 13/05/xx	used to paint containers	yes report # 21-03

Note 1: The product number might correspond to the number on the material safety data sheet in the case of a controlled product or if the substance is not a controlled product but the MSDS is available. This makes everything easier to manage, especially if you enter this information in a database.

Note 2: Commercial name of the product, name of the substance, common name.

Note 3: Name of the manufacturer or supplier that appears on the container.

Note 4: Work area or work station where the substance or controlled product is used, produced, handled or stored.

Note 5: Is it a controlled product? If so, it would be wise to record the date on which the data sheet was last updated.

Note 6: Use for the substance: function, usefulness, service, use, application...

Note 7: Is a hazard investigation needed in accordance with section 10.4? This information could be very useful because it refers to a file number that will facilitate the research.

Section 10.4

Subsection 10.4(1)

If there is a likelihood that the health or safety of an employee in a work place is or may be endangered by exposure to a hazardous substance, the employer shall, without delay:

(a) appoint a qualified person to carry out an investigation in that regard; and

(b) for the purposes of providing for the participation of the work place committee or the health and safety representative in the investigation, notify either of the proposed investigation and of the name of the qualified person appointed to carry out that investigation.

Interpretation

A hazard investigation must be initiated when the health or safety of an employee or group of employees may be endangered by exposure to a hazardous substance.

Not all hazardous substances found in the work place will require a hazard investigation. An investigation may not be necessary if the health or safety of an employee exposed to a given hazardous substance may not be endangered.

In the following pages, we present four examples of hazardous substances. In the first two cases, spraying of the insecticide Bt and changing transmission oil, it is unlikely that the health or safety of the employee may be endangered. These two substances must appear in the log required under section 10.3, but the investigation referred to in section 10.4 is not necessary.

On the other hand, for UV exposure during arc welding and gun spraying of a paint containing lead chromate, the hazardous substances must appear in the log and the investigation referred under section 10.4 is mandatory.

EXAMPLE 1: A Biological Agent

An employee is spraying a liquid insecticide to kill Lepidoptera larvae in a small stand of spruce trees. The active ingredient of this insecticide is a combination of dried spores and protein toxin crystals coming from the bacteria *Bacillus thuringiensis subsp. kurstaki.* This insecticide is commonly known as Bt. When the buds develop, the employee applies an aqueous base of Bt that will be eaten by larvae. This operation lasts 15 minutes and is always done outside.

Bt is not a controlled product. However, it is a substance governed by the *Pest Control Products Act* and *Regulations,* administered by the Pest Management Regulatory Agency. The toxicity of the *subsp. kurstaki* strain is determined as follows: the oral lethal dose$_{50}$ (LD_{50}) in rats is 8,400 mg/kg and the lethal concentration$_{50}$ (LC_{50}) after four hours of inhalation in rats is 5,400 mg/m^3. See Appendix A for the definitions of LD_{50} and LC_{50}.

Even though Bt is fatal for Lepidoptera larvae, it is practically non-toxic for mammals. The U.S. Environmental Protection Agency classifies this pesticide in the "low toxicity" category, compared to a high toxicity substance, which has an LD_{50} lower than or equal to 50 mg/kg and an LC_{50} lower than or equal to 200 mg/m^3. If we look at the Hodge and Sterner scale (Appendix B), Bt is classified in the **very low toxicity** category for humans. In addition, this product is non-corrosive, not dangerously reactive, non-combustive, non-flammable, non-teratogenic, non-carcinogenic, non-mutagenic and non-pathogenic.

Since the probability that the health and safety of the employee may be endangered by the exposure to this Bt strain is very low, this hazardous substance **must be registered, but the investigation referred to in section 10.4 is not necessary.**

EXAMPLE 2: A Chemical Agent

A mechanic uses brand 10-OUTOU transmission oil. He does two or three oil changes per week. This product is not controlled.

This oil has an oral LD_{50} in rats of over 5,000 mg/kg and a LC_{50} by inhalation greater than 5,000 mg/m^3. The threshold limit value for a duration of eight hours (TLV-TWA) is set at 5 mg/m^3 for oil mists. Because the vapour pressure of this product is low, there is no risk of inhalation under normal oil change conditions.

In addition, this oil product is non-corrosive, not dangerously reactive, slightly flammable, slightly toxic, non-teratogenic, non-carcinogenic, non-mutagenic and non-pathogenic. During normal use, this oil presents very little hazard to health or safety.

It is unlikely that the health or safety of employees would be endangered by exposure to this transmission oil. Although **this product must be recorded in the log, the investigation mentioned in section 10.4 will not be necessary.**

EXAMPLE 3: A Physical Agent

Passers-by, onlookers and welders are exposed to ultraviolet rays emitted when welding work is performed in a shop. The duration of arc time varies from 30 minutes to two hours. No protective screen has been installed to protect the work area.

Exposing the eye to extremely intense arc light can cause acute ocular disorders. There are two clinical types of acute overexposure: keratoconjunctivitis and electrical dazzle. Radiation from welding arcs can exceed established thresholds in just a few seconds if the person is within a few meters of the arc. These painful effects can result in temporary disablement.

The primary symptoms of keratoconjunctivitis appear when the exposed person complains of severe eye pain, has the feeling of continuously having sand in the eyes, and tries to avoid light (photophobia). The major symptom of electrical dazzle is a blinding sensation, even when the eyes are closed.

There is also a chronic ocular disorder called “diffuse scleritis”, which is found mainly in torch welders. This type of scleritis is due to heat and light and is characterized by ocular tension, pain with pressure on the eyes, an excessive constriction of the pupils (miosis) and blurred vision.

Since the frequency of ocular disorders is well documented when proper personal protective equipment is not worn, **the type of welding rods used should be recorded in the log and the risk assessment should be conducted according to section 10.4.**

EXAMPLE 4: A Controlled Product

An employee is exposed to lead chromate while spray painting. Let us suppose that it takes 50 minutes to apply paint to one container and that the employee has to paint two containers per day. The painting is done in a warehouse that is not mechanically ventilated.

According to studies conducted on animals and epidemiological studies on humans, lead chromate is classified as cancer category A2 by the American Conference of Governmental Hygienists for lead and chromate. This means that this substance is a known carcinogen in animals and a suspected carcinogen to humans. This substance is also known to produce adverse effects on the cardiovascular and reproductive systems.

As a sign of high toxicity, the TLV-TWAs of lead chromate are quite low: 0.05 mg/m^3 in lead and 0,012 mg/m^3 in chromium. In this case, **you must record the name of the hazardous substance in a log and conduct a hazard investigation as well.**

Subsection 10.4(2)

> *In an investigation referred to in subsection (1), the following criteria shall be taken into consideration:*
>
> *(a) the chemical, biological and physical properties of the hazardous substance;*
>
> *(b) the routes of exposure to the hazardous substance;*
>
> *(c) the acute and chronic effects on health of exposure to the hazardous substance;*
>
> *(d) the quantity of the hazardous substance to be handled;*

(e) the manner in which the hazardous substance is stored, used, handled and disposed of;

(f) the control methods used to eliminate or reduce exposure of employees to the hazardous substance;

(g) the concentration or level of the hazardous substance to which an employee is likely to be exposed;

(h) whether the concentration of an airborne chemical agent or the level of ionizing or non-ionizing radiation is likely to exceed 50 percent of the values referred to in subsection 10.19(1) or the levels referred to in subsections 10.26(3) and (4); and

(i) whether the level referred to in paragraph (g) is likely to exceed or be less than that prescribed in Part VI.

For your investigation to be in compliance with the COHSR, **all the elements appearing in section 10.4(2) must be taken into consideration and appear in the report**. See the following table as an example.

IMPORTANT NOTE: Because of space restriction, the observations recorded in this table are not complete. They are only examples. Moreover, other aspects of arc welding have to be investigated under section 10.4 as well: fumes, noise, by-product gases, etc.

Example of Hazard Investigation (Sec. 10.4)

Hazard Investigation (Section 10.4) L.M. inc. – 13/04/xx	
Welding arcs from rods # 2225	
Factors taken into consideration	**Observations**
(a) Chemical, biological and physical properties	Visible, ultraviolet and infrared rays.
(b) Routes of exposure	Absorption by eyes and skin.
(c) Acute and chronic effects	**Acute**: 1) keratoconjunctivitis with possible lesions on the eyelids, conjunctiva and cornea 2) electrical dazzle with or without sequelae 3) burns to the skin. **Chronic**: diffuse scleritis.
(d) Amount handled	30 to 120 minutes per day (arc time).
(e) Way in which it is stored, used, handled and eliminated	- INOX 18/8 stainless steel arc welding. - Rods used: steel coated with rutile. - Amperage: 100 to 150 amps. - Voltage: 25 volts, direct current and electrode.
(f) Control methods used to eliminate or reduce exposure	- Welder's helmet equipped with an ultraviolet filter. - No screens to protect neighbouring areas. - Brand XX fireproof clothing and gloves.
(g) Concentration or level to which employee risks being exposed	- Exposure near the welding work: effective irradiance of 21.9 $\mu W/cm^2$ at 0.50 m from the source for actinic UV rays.
(h) Probability that the concentration or level exceeds 50% of the standard	- Exposure level very high: 50 times higher than the ACGIH standard for arc time UV rays. - Recommended protection filter value of 11. - Exposure limit: 0.6 sec (infrared).
(i) Probability that the level of lighting is higher or lower than the prescribed level	- Fill-in lighting available at 800 lux. - General lighting of 300 lux.

Section 10.5

On completion of an investigation referred to in subsection 10.4(1) and after consultation with the work place committee or the health and safety representative,

(a) the qualified person shall set out in a written report signed by the qualified person

(i) the qualified person's observations respecting the criteria considered in accordance with subsection 10.4(2), and

(ii) the qualified person's recommendations respecting the manner of compliance with sections 10.7 to 10.26, including recommendations respecting sampling and testing methods; and

(b) the employer shall develop and maintain a written procedure for the control of the concentration or level of the hazardous substance in the work place.

Interpretation

Following the hazard investigation and after having consulted the work place committee or the health and safety representative, the qualified person must prepare and sign a written report that includes all of his or her observations and recommendations concerning the various factors that were taken into consideration.

The hazard investigation consists of examining all hazardous substances to which employees are exposed in order to:

(a) eliminate, substitute, reduce or control them at the source,

(b) develop and implement an employee education program aimed at preventing and controlling the hazards,

(c) develop a preventive maintenance program for the ventilation systems,

(d) ensure that hazardous substances are stored, handled and used in a safe manner,

(e) prevent overexposure to ionizing and non-ionizing radiation,

(f) develop a safe work procedure for each hazardous substance, and

(g) recommend medical examinations for the employees likely to be exposed.

This approach reviews all of the important aspects included in an effective prevention program. It is important to mention that **all criteria referred to in subsection 10.4(2) must be addressed in the report**. The qualified person must mention whether they are pertinent or not.

Also, **sections 10.6 to 10.27 inclusive must be considered in the report**. These sections address the following topics:

s. 10.7:	Medical examinations
ss. 10.8 to 10.12:	Storage, handling and use

s. 10.13:	Warning of hazardous substances
ss. 10.14 & 10.15:	Employee education
s. 10.16:	Substitution of substances
ss. 10.17 & 10.18:	Ventilation
ss. 10.19 to 10.22:	Control of hazards
s. 10.23:	Warnings
s. 10.24:	Assembly of pipes
s. 10.25:	Explosives
s. 10.26:	Ionizing and non-ionizing radiation.

Consult the Regulations for the exact text of these sections. The qualified person must mention whether they are applicable to the actual occurrence or not. What follows is an example of recommendations an investigator could make for arc welding.

IMPORTANT NOTE: In this example, the stated recommendations concerning the procedure to follow for ensuring compliance with sections 10.7 to 10.26 are not detailed. They cover only the control of exposure to UV and do not address other hazardous aspects of arc welding, such as fumes, noise, burns and electrocution.

Example of recommendations

Recommendations Concerning Procedure to Follow (subparagraph 10.5(*a*) (ii)) **L.M. inc. – 13/04/xx**	
Welding arcs from rods # 2225	
Sections 10.7 to 10.26 of the Regulations	**Recommendations**
s. 10.7 Medical Examinations	- Eye exam every two years.
s. 10.8 Storage, Handling and Use	- Limit access to the welding area by diverting the forklift truck corridor. - Install a protective screen to protect others in the work area.
s. 10.9 Storage, Handling and Use in a Small Area	- Limit access to the welding area by diverting the forklift truck corridor.
s. 10.10 Container Designed and Built to Protect Employees	Not applicable.
s. 10.11 Quantity for Use or Processing	Not applicable.
s. 10.12 Flammable Material	- Keep flammable substances out of the area.
s. 10.13 Warnings of Hazardous Substances	- Post a notice: “Danger: Do not watch the arc” - Indicate that protective equipment is mandatory.
s. 10.14 Employee Education	- Consult the work place committee or representative in order to develop and implement an education program for welders, such as the AIHA’s “Welding Health and Safety”.
s. 10.15 Instruction and Training Record	- Keep a record of the instruction and training received by each welder. - Keep the record for two years.
s. 10.16 Substitution of Substances	Not applicable.
s. 10.17 Ventilation Systems Installed on or after January 1, 1997	Not applicable.
s. 10.18 Ventilation System Installed for the First Time	Not applicable.

Recommendations Concerning Procedure to Follow (cont'd) (subparagraph 10.5(*a*) (ii)) **L.M. inc. – 13 / 04 /xx**	
Welding arcs from rods # 2225	
s. 10.19 Control of Hazards	Not applicable. This section concerns chemical agents. However, - Increase the opacity of the protective glasses to 11. - Install a heavy-duty yellow non-combustible protective screen at 2 m. - Consider mobile screens. - Protect the overhead crane operator with an opaque screen.
s. 10.20 Lower Explosive Limit	Not applicable. This section concerns chemical agents.
s. 10.21 Compressed Air, Gas or Steam	Not applicable. This section concerns chemical agents.
s. 10.22 Compressed Air Used for Cleaning Clothing	Not applicable. This section concerns chemical agents.
s. 10.23 Detection Systems	Not applicable. This type of detection system does not exist on the market.
s. 10.24 Assembly of Pipes	Not applicable.
s. 10.25 Explosives	Not applicable.
s. 10.26 Ionizing and Non-ionizing Radiation	Not applicable. This device is not referred to in the schedule for section 10.26.

Model and Treatment of an Investigation Report Required by Section 10.5

Traditionally, the investigation reports include the following:

- Introductory page.
- Table of contents.
- Context (mandate and objectives) and date of the investigation.
- Methodology used.
- Applicable standards.

- Interpretation of results:

  (a) observations concerning the factors taken into consideration in accordance with subsection 10.4(2). See example on page 18.

  (b) recommendations concerning the procedure to follow for ensuring compliance with the provisions of sections 10.7 to 10.26, including recommendations concerning sampling and analysis methods. See the example on pages 21 and 22.

- Additional recommendations that might affect the following:

  (a) personal protective equipment, such as respiratory protective devices, hearing protectors, protective clothing;

  (b) how to make the work procedure safer.

- Conclusion.
- Signature of the qualified person.
- Appendix, such as the industrial hygiene report concerning the assessment of the level of exposure to radiation.

Upon receipt of the recommendations made by the qualified person, the employer must **develop and maintain a written procedure for controlling** the concentration or level of the hazardous substance present in the work place and **train the employees in this procedure**.

Section 10.6

A report referred to in section 10.5 shall be kept by the employer for a period of thirty years after the date on which the qualified person signed the report.

Interpretation

The requirement to keep the investigation report **for 30 years** takes into consideration the fact that occupational diseases such as asbestosis, silicosis, byssinosis, siderosis, leukemia and Raynaud's syndrome, can develop after several years of exposure to a hazardous substance, even sometimes after the person is no longer exposed.

For example, when exposed to welding arcs, an employee can develop diffuse scleritis if not properly protected. In addition, some cases of cataracts have been documented after ten years or more of exposure. Consequently, it is very important to keep a record of the investigation report for a sufficient period in order to document the work conditions that may have caused the disorder.

APPENDIX A

Definitions of Lethal Dose$_{50}$ and Lethal Concentration$_{50}$

Lethal Dose$_{50}$ or LD$_{50}$

The standard term for assessing oral or cutaneous toxicity is the lethal dose$_{50}$ (LD$_{50}$), which means the single dose of a substance that, when administered by a defined route in an animal assay, causes the death of 50% of the animal population. The LD$_{50}$ values in humans are only estimated. The LD$_{50}$ is usually expressed in terms of milligrams or grams of material per kilogram of body weight for the animal being tested (mg/kg or g/kg).

If we say that a chemical substance has an LD$_{50}$ oral on a rat of 300 mg/kg, this means that half of the rats died after stomach intubation of a single dose equivalent to 300 mg per kilogram of rat. Consequently, the lower the LD$_{50}$, the more toxic the chemical product.

The LD$_{50}$ is used to classify and compare products according to their acute oral toxicity and acute cutaneous toxicity (immediate serious toxic effects).

Lethal Concentration$_{50}$ or LC$_{50}$

The lethal concentration$_{50}$ (LC$_{50}$) is the concentration of a substance in air that, when administered by means of inhalation over a specified length of time in an animal assay, causes the death of 50% of the animal population. In the *Controlled Products Regulations*, the criteria are based on an exposure duration of four hours. The LC$_{50}$ is expressed in terms of volume (parts per million or ppm) in the case of gas and vapour, or weight (milligrams of substance per cubic metre of air or mg/m^3) in the case of dust, mist or fumes.

A chemical with an LC$_{50}$ by inhalation of 2,000 ppm over a four-hour period means that 50% of rats died after inhaling 2,000 ppm of this chemical in the air over four hours. The lower the LC$_{50}$, the more toxic the chemical product.

The LC$_{50}$ helps in determining the short-term toxic hazard that a substance presents.

APPENDIX B

Classes of Human Toxicity Based on the Results of Animal Assays According to the Hodge and Sterner Scale

The following table, developed by toxicologists Hodge and Sterner, makes it possible to estimate toxicity in an adult human male based on the oral LD_{50} in rats, the LC_{50} by inhalation over four hours in rats and the LD_{50} by dermal route in rabbits.

Route of Administration					
Toxicity Class	**Common description**	**LD_{50} oral (Single dose for rats) mg/kg**	**LC_{50} inhalation (Dose over a 4 hour period for rats) ppm**	**LD_{50} dermal (Single application to the skin of rabbits) mg/kg**	**Probable lethal dose for humans**
1	Extremely high toxicity	1 or less	10	5 or less	1 grain (1 drop, contact with mouth)
2	High toxicity	1-50	10-100	5-43	4 ml (1 teaspoon)
3	Moderate toxicity	50-500	100-1,000	44-340	30 ml (1 liquid oz)
4	Low toxicity	500-5,000	1,000-10,000	350-2,810	600 ml (1 pint)
5	Very low toxicity	5,000-15,000	10,000-100,000	2,820-22,590	1 litre (1 quart)
6	Relatively harmless	15,000 or more	100,000 or more	22,600 or more	more than 1 litre (more than 1 quart)

NOTE