

Metro Vancouver Spray Foam Incorporated.

20281 Grade Crecent, LANGLEY, BC V3A 4J5

Isocyanates

EXPOSURE CONTROL PLAN

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1.0 PURPOSE

The purpose of this Exposure Control Plan (ECP) is to provide safety guidelines and to protect workers from exposure to isocyanates, and has been designed and written to address, eliminate, and/or minimize, as much as practically feasible, potential hazards that may be associated with exposure to isocyanates in the course of Metro Vancouver Spray Foam Incorporated. work activities and operations.

The objective of this document is to establish a safe work environment for Metro Vancouver Spray Foam Incorporated. employees, contractors, and visitors who may be exposed to isocyanates in the workplace, and to provide guidance to Metro Vancouver Spray Foam Incorporated. operations personnel with respect to anticipating, recognizing, evaluating, controlling, and/or eliminating potential isocyanates exposure in their work environments. This document also outlines the responsibilities and duties of Management, Supervisors, Employees, and Contractors. This ECP must be reviewed annually as required by WorkSafeBC Legislation 5.54 (2). Important factors in developing this ECP was to ensure that Metro Vancouver Spray Foam Incorporated. employees, contract workers, and site visitors do not become inadvertently exposed to isocyanates.

2.0 POLICY

Metro Vancouver Spray Foam Incorporated., through the provision of this document, is committed to protecting the health and safety of all their employees, including other workers in the area (such as contractors) who may be exposed to isocyanates in the course of their job activities.

Metro Vancouver Spray Foam Incorporated. senior management is responsible for endorsing this document's contents and verifying that this ECP follows all applicable legislation, standards, and industry-accepted best practices, and that this document is reviewed and revised in relation to any legislative changes and whenever there are changes to the workplace and/or work procedures.

All employees, contractors, and visitors who may be exposed to isocyanates or supervise personnel who may be exposed to isocyanates, shall adhere to the protocols and procedures associated with this ECP.

3.0 SCOPE

This ECP has been designed to assist Metro Vancouver Spray Foam Incorporated. in complying with the applicable WorkSafeBC (WSBC) Occupational Health and Safety Regulations (OHSR)/Guidelines and applies to all workers who may be exposed to isocyanates during Metro Vancouver Spray Foam Incorporated. work activities and operations including spray foam application.

4.0 ROLES AND RESPONSIBILITIES

It is the responsibility of the supervisor to ensure that workers read and review the ECP and to discuss any concerns or any information that they may disagree with or not fully understand prior to the start of any work task where the potential for exposure exists. It is the responsibility of each worker to immediately address or make aware to the employer or supervisor of any unsafe conditions that may affect the health and safety of an individual before, during, and after work is performed.

4.1 Employer Responsibilities

- Ensuring that the ECP policies and site-specific assessments and procedures are completed and carried out by workers.

- Ensuring that site personnel properly coordinate and identify / assess on-site areas, work processes and worker activities that may contribute to risk.
- Ensuring that clear roles and responsibilities are assigned to each site personnel.
- Ensuring the necessary tools, resources, and support are readily available to site personnel to assist them in following this document and minimizing potential exposure to isocyanates.
- Ensuring that supervisors and workers are educated and trained to an acceptable level of competency.
- Assigning a Qualified Person to conduct occupational hygiene monitoring throughout the project, as required.
- Providing and maintaining a safe working environment.
- Maintaining records of training, fit test results, crew talks, and inspections (for example, for equipment, PPE, and work methods or practices).
- Developing procedures for dealing with emergencies that may arise while employees are at work.
- Investigating all near misses and exposure incidents.
- Ensuring that a review of this document and its contents is conducted annually (at minimum) or sooner if required due to changes in work process.
- Ensuring all staff have a fundamental understanding of:
 - **The Right to Know** about all reasonably foreseeable hazards in the workplace.
 - **The Right to Participate** in training, meetings, assessment, procedural reviews, etc.
 - **The Right to Refuse** what they consider to be unsafe work.

4.2 Supervisor Responsibilities

- Knowing the policies and procedures as outlined in this document.
- Ensuring that the isocyanates ECP policies and procedures are carried out by Metro Vancouver Spray Foam Incorporated. employees and other workers, as required.
- Providing instruction to workers at toolbox talks on the hazards associated with the use of products containing isocyanates at the workplace.
- Ensuring that each Metro Vancouver Spray Foam Incorporated. employee carry out their roles and responsibilities as per this ECP and the required policies and procedures.
- Ensuring that all on-site areas, work processes and worker activities that may contribute to potential isocyanates exposures are properly identified and assessed.
- Ensuring that appropriate and specific control measures are properly implemented to eliminate or minimize potential isocyanates exposures.
- Ensuring that the specified PPE is provided and assigned to Metro Vancouver Spray Foam Incorporated. employees, and that they are trained in the proper inspection, use, and maintenance of that equipment.
- Conducting investigations of any incidents and accidents, where required.
- Ensuring that workers using respirators have been fit tested and that the results are recorded.
- Directing the work in a manner that ensures the risk to workers and others is minimized and adequately controlled. This includes ensuring that workers use appropriate engineering controls and wear the necessary PPE.
- Ensuring a formal investigation of any incident where workers have been potentially exposed to a hazardous substance (e.g., isocyanates) is conducted. Where such exposures are confirmed, they must be reported to WSBC.

4.3 Worker Responsibilities

- Being familiar with and following the policies and procedures as outlined in this document.
- Participating in education and training provided by Metro Vancouver Spray Foam Incorporated. in the identified health and safety hazards associated with potential isocyanates exposure.
- Following site and task specific safe work procedures.
- Immediately reporting any unsafe practices, processes, or conditions to their supervisor.
- Verifying that identified control measures are in place and PPE is properly worn and functioning prior to the commencement of work activities involving isocyanates.
- Properly utilizing their PPE and the required identified controls during their work activities.
- Reporting all incidents and accidents immediately to their representative supervisor.
- Reporting any exposure incidents or any signs or symptoms of exposure or illness.
- Reporting any additional areas of potential exposures that were not previously identified in test results, drawings, and/or plans found during work activities to their representative supervisor.
- Informing their supervisors of any recommendations pertaining to the continuous improvement of this ECP and associated procedures.
- Working safely and practicing good hygiene as outlined in this document.

5.0 BACKGROUND INFORMATION: ISOCYANATES EXPOSURE

Isocyanates were developed in Germany during World War II as part of a process to replace natural rubber, which became very scarce during the war. Isocyanates are very reactive chemicals that contain the isocyanate group (-NCO). They react with alcohols to produce polyurethane polymers. Isocyanates are the essential raw materials for polyurethane plastics and are used in the production of paints and powder coatings to create weather-resistant surfaces.

They are also used to make building materials (for example, Styrofoam, flexible foams, adhesives, elastomers, and binders) and in the production of manufactured goods (for example, bedding, furniture, clothing, appliances, electronics, tires, and packaging). Products containing isocyanates have several brand or trade names. Isocyanates also have many different chemical names. The most used isocyanates are toluene diisocyanate (TDI) and methylene bisphenyl isocyanate (MDI). TDI is used in the production of soft synthetic rubbers. MDI is used in producing foams, hard synthetic rubbers (elastomers), and coatings. Other isocyanates include but are not limited to include;

- Naphthalene diisocyanate (NDI);
- Hexamethylene diisocyanate (HDI);
- Isophorone diisocyanate (IPDI).

NDI is used to produce elastomers. HDI and IPDI are both used in paints, coatings, leather finishing's, and foams.

Organic isocyanates are chemicals characterized by the general chemical formula $R(NCO)_x$. The two most commercially important isocyanates are toluene diisocyanate (TDI), which is also known by the synonyms tolylene diisocyanate or toluylene diisocyanate, and 4,41 diphenylmethane diisocyanate (MDI), which has the synonym methylene bis (4-phenylisocyanate). The abbreviations TDI and MDI are now universally used and understood in the industry.

Both TDI and MDI are denser than water and will sink to the bottom of water-filled containers. Although they react with water, the rate of reaction is very slow at temperatures below 50°C. At higher temperatures, the reaction of TDI and MDI with water liberates carbon dioxide gas and a solid, insoluble mass of polyureas is formed.

TDI and MDI will also react with basic materials such as sodium hydroxide ('caustic soda'), ammonia, primary and secondary amines, and with acids and alcohols. The reaction may be violent, generating heat, which can result in an increased evolution of isocyanate vapour and formation of carbon dioxide leading to a build-up of pressure within closed containers. The high reactivity of isocyanates is the basis for the poly-addition process for preparation of polyurethane plastics and foams. Neither TDI nor MDI is generally corrosive towards metals (except aluminum) at ambient temperatures.

All isocyanates are potentially hazardous materials and require care in handling. From the practical point of view, the principal hazard arises from the vapour (rather than the liquid) and hence the degree of hazard depends on the vapour pressure of the isocyanate concerned. Isocyanates with a high vapour pressure are in the TDI class. These include TDI and HDI.

Isocyanates with a low vapour pressure are in the MDI class. These include MDI itself, NDI, PAPI, IPDI, TMDI, and surface-coating materials (e.g., paints, lacquers) based on MDI. In the case of TDI the vapour pressure is such that at normal temperatures the concentration of vapour in air will exceed WorkSafe BC TLV-TWA. Hence full precautions are necessary whenever TDI or TDI-containing products are handled.

By contrast MDI has a lower vapour pressure at atmospheric temperature and with adequate ventilation a vapour concentration reaching the TLV-TWA for MDI is not reached. However, two exceptions are (a) spray applications where airborne droplets (aerosols) present a hazard at normal temperatures, and (b) the dust arising from the handling of pure MDI (solid at normal temperatures). Precautions such as supplied air and effective ventilation must be taken in both these circumstances.

5.1 Isocyanate Health Hazards & Symptoms

Classification:

✓	Specific Target Organ Toxicity - Repeated Exposure - Category 2
✓	Skin Irritation - Category 2
✓	Eye Irritation - Category 2A
✓	Respiratory Sensitizer (Solid/Liquid) - Category 1
✓	Skin Sensitizer - Category 1
✓	Germ Cell Mutagenicity - Category 1B
✓	Carcinogenicity - Category 1B
✓	Specific Target Organ Toxicity - Single Exposure - Category 3
✓	Acute aquatic toxicity - Category 2
✓	Flammable Liquids Category 3

Exposure to isocyanates may potentially cause severe adverse health effects, including inhalation, dermal, sensitization, and carcinogenicity concerns. Isocyanates are powerful skin and respiratory tract irritants and sensitizers, causing various types of lung illnesses with the most severe being occupational asthma (OA). OA can manifest several months or years of exposure. Symptoms may appear in the evening and as such the connection between a workplace exposure and the discomfort one is feeling may not be immediately apparent. Once a worker has OA, they can no longer be exposed to isocyanates

as this could trigger an asthmatic reaction even at concentrations much lower than applicable exposure limits.

Inhalation may cause irritation of the respiratory tract, difficulty in breathing, tightness of the chest including coughing, wheezing, and shortness of breath, headache, and discomfort, as well as other asthma-like symptoms. Dermal exposure may result in skin and eye irritation including blistering, swelling, and reddening; chronic exposure can lead to dermatitis. Direct contact to the eyes can damage tissue. Isocyanates are classified as a male reproductive toxin and as carcinogenicity category 2 – suspected of causing cancer. Isocyanates are known sensitizers, and once sensitized a person's subsequent exposure to airborne concentrations (even below applicable exposure limits) can cause asthmatic reactions, which can be life threatening if exposure continues.

6.0 RISK IDENTIFICATION, ASSESSMENT, & CONTROL

Metro Vancouver Spray Foam Incorporated. workers use isocyanate-containing products such as:

- Genyk Inc. – Isocyanate A-2732

Substance [CAS No.]	TWA	Ceiling	Notations
Diphenylmethane 4,4'-diisocyanate (MDI) [101-68-8]	0.005 ppm	C 0.01 ppm	2B; S(D); S(R); Skin
Polymethylene polyphenyl isocyanate [9016-87-9]	0.005 ppm	C 0.01 ppm	2B; S(D); S(R); Skin

Sensitization to isocyanates may develop as a result of a large single overexposure, for example from a spill or accident, or from repeated overexposure at lower levels. Once sensitized these people, when later exposed to even very low concentrations of isocyanates below the exposure standard, can react by developing asthma-like symptoms such as chest tightness, cough, wheezing, and shortness of breath. Such attacks may occur up to several hours after cessation of exposure (for example, during the night after exposure) but, if a person is particularly sensitive, the attack can occur earlier or immediately.

This sensitization is essentially irreversible and can prevent any further work for the individual in their job or position associated with the use of isocyanates – even at very low levels well below the regulated exposure limit at which it may not affect others. It has been estimated that 1 in 20 workers who work with isocyanates will become sensitized to them.

Workers have had to leave their respective industries in the past due to sensitization to isocyanates. An individual's response to isocyanate exposure can be immediate or may be delayed for several years. Asthmatic people are more prone to sensitization and other adverse reactions. Persons with a history of asthma, allergies, hay fever, recurrent acute bronchitis, or any occupational chest disease or impaired lung function is advised against risking exposure to isocyanates.

In rare cases, death has occurred from a severe asthma attack after significant isocyanate exposure.

Isocyanates are also skin irritants (causing inflammation and dermatitis) and there is some evidence that skin exposure can also cause respiratory sensitization.

Isocyanates are an irritant to the eyes. Splashes can cause severe chemical conjunctivitis.

Other health effects which have been reported include liver and kidney dysfunction. Some isocyanate materials are potential human carcinogens (IARC).

The odour threshold for isocyanates, i.e., the level at which an individual can smell an isocyanate, is typically higher than the allowed exposure limits. If a worker smells the sweet, fruity, pungent odour of an isocyanate, they are probably already overexposed.

In addition to the above health implications there are explosive issues possible with flammable airborne aerosols and vapours. Inadequately maintained ventilation systems can contribute to concentrations of airborne flammable aerosols and vapors in the workplace. High concentrations of aerosols and vapors in the air can be explosive.

A fire or explosion can occur when flammable aerosols and vapors are mixed with air in a concentration between the product's lower explosive limit (LEL) and its upper explosive limit (UEL) and encounter an ignition source.

Isocyanate-based products also contain inflammable solvents. In addition to the chemical risk inherent in these substances, the risk of deflagration and fire must therefore be considered.

Deflagration means combustion which propagates through a gas or across the surface of an explosive at subsonic speeds, driven by the transfer of heat.

- Eliminate sources of ignition, including static electricity;
- Keep concentrations of flammable vapours under 10% of the lower explosive limit (LEL);
- Ensure optimum operation of exhaust systems.



Combustible dusts present rapid combustion (deflagration) hazard when oxygen, heat, fuel, and dispersion of dust particles are present. If occurring in an enclosed space, the resulting pressure rise may cause an explosion. Oxygen, fuel, heat, dispersion, and confinement are the five elements that together are known as the “Dust Explosion Pentagon”; removal of one of which removes the possibility of explosion.

In order to reduce the possibility of explosion, dust, ignition, and damage control measures are implemented including:

- Use certified electrical equipment and wiring methods along with GFCI.
- Use control measures to reduce static electricity, including bonding equipment to the ground.
- Separate heated surfaces and heating systems from dust.
- Control smoking, open flames, sparks, etc.
- Control mechanical sparks and friction.
- Direct vents away from work areas.
- Have fire suppression equipment onsite.
- Maintain emergency exit routes.

Following review of the hazards associated with using isocyanate-based polyurethane systems, the site-specific control measures to be put in place, the use and application method of the product, and the work activity carried out by Metro Vancouver Spray Foam Incorporated. (application of spray foam for the purposes of thermal Spray Foam and/or fireproofing) presents a **moderate risk** hazard to workers. This risk rating is assigned provided that all specified engineering and administrative control methods are in place and carried out accordingly, and that workers don specified PPE from the site-specific procedures.

Below is a Hazard Identification and Risk Assessment Matrix outlining the probability and impact of exposure to isocyanates (probability of exposure very low, consequence of exposure major).

RISK RATING	A - LOW	B - MODERATE	C - High	D - VERY HIGH
	Additional controls normally not required – but may be implemented.	Must be verified that procedures / controls are in place and have been reviewed and found to be appropriate. If so, may proceed with work, i.e., manufacturer instructions.	Engineering or administrative controls or the use of PPE must be implemented, and a risk rating of A or B achieved prior to commencing work.	Immediate and extensive engineering or administrative controls must be implemented, and a risk rating of A or B achieved prior to commencing work. The controls must be monitored for integrity and effectiveness throughout the entire work duration.

Hazard Identification and Risk Assessment Matrix Summary					Consequence				
Probability of Exposure (P)		Consequence				1	2	3	4
1/ Very Low	Extremely unlikely	1-Minor	Potential minor injury or illness - no first aid.	Assessment Result	1	A	A	B	B
2/ Low	Unlikely that exposure will occur.	2-Moderate	Minor injury, illness, or disease requiring first aid. (no medical treatment)		2	A	B	C	C
3/ Medium	Exposure is likely to occur.	3-Major	Significant injury, illness or disease resulting in medical treatment.		3	B	C	D	D
4/ High	Exposure is very likely to occur.	4-Severe	Fatality or Immediately Dangerous to Life or Health (IDLH).		4	C	C	D	D

7.0 REGULATIONS & GUIDELINES

7.1 Exposure Limits

Occupational Health and Safety Regulation Section 5.48 provides established exposure limits for a worker's exposure to hazardous substances. Generally, these exposure limits are established according to the Threshold Limit Values (TLVs) adopted by the American Conference of Government Industrial Hygienists (ACGIH). WorkSafeBC has the authority to make exceptions and adopt occupational

exposures limits for specific chemical substances that are not consistent with the TLVs established by the ACGIH. Policy R5.48-1 sets out those exceptions.

An exposure limit is a maximum allowable airborne concentration and is not intended to represent a fine line between safe and harmful conditions. In determining an exposure limit, it is not possible to consider all factors that could influence the effect that exposure to the substance may have on an individual worker. Therefore, for all hazardous substances regardless of any assigned exposure limit, the guiding principle is elimination of exposure or reduction to the lowest level that is reasonably achievable below the exposure limit.

Due to a wide variation in individual susceptibility, some workers may experience discomfort from some substances at concentrations at or below the exposure limit. Others may be affected more seriously by aggravation of a pre-existing condition, or by development of an occupational disease.

Furthermore, other workplace contaminants may affect an individual's response. The effects of combined chemical exposures are often unknown or poorly defined. Occupational Exposure Limits (OELs) are the maximum permissible concentration of a hazardous substance that most healthy adults may be repeatedly exposed to without suffering adverse health effects. The limits assume the individual exposed to the substance is a healthy adult. There may be increased risk, for example for a smoker, or person with pre-existing health problems or individuals who suffer from allergies.

OELs are assigned three values. One value is based on normal working conditions of eight hours per day, over an average lifetime of exposure (generally forty years). ACGIH refers to this as the 8-hour TLV-TWA.

A second value provides a limit for a 15-minute exposure, a short-term exposure or STEL. This is a value to which a worker may be exposed to for fifteen minutes, a maximum of four times per shift, with at least one hour between exposures. This is referred to as the TLV-STEL.

A third value is the ceiling limit, TLV-C. This limit must never be exceeded at any time. OELs permit workers to be exposed to only very small quantities of substances. The amounts are measured in parts per million (ppm) or milligrams per cubic meter (mg/m³).

The American Conference of Governmental & Industrial Hygienists (ACGIH) provide exposure limits for Chemical and Biological Substances in the tabular form indicating the substance, TLV-TWA, TLV-STEL, notations, molecular weight, and the basis for establishing TLV's. Other regulatory bodies including provincial and federal governments commonly adopt Table 5.

Isocyanate based products are regulated in BC in accordance with Table 5 "Table of Exposure Limits for Chemical and Biological Substances", updated August 15th, 2023. Isocyanates (i.e., MDI) are assigned an **8-hour TLV-TWA of 0.005 ppm** and a **TLV-Ceiling of 0.01 ppm**, as well as an S(R) designation indicating sensitization via respiratory route.

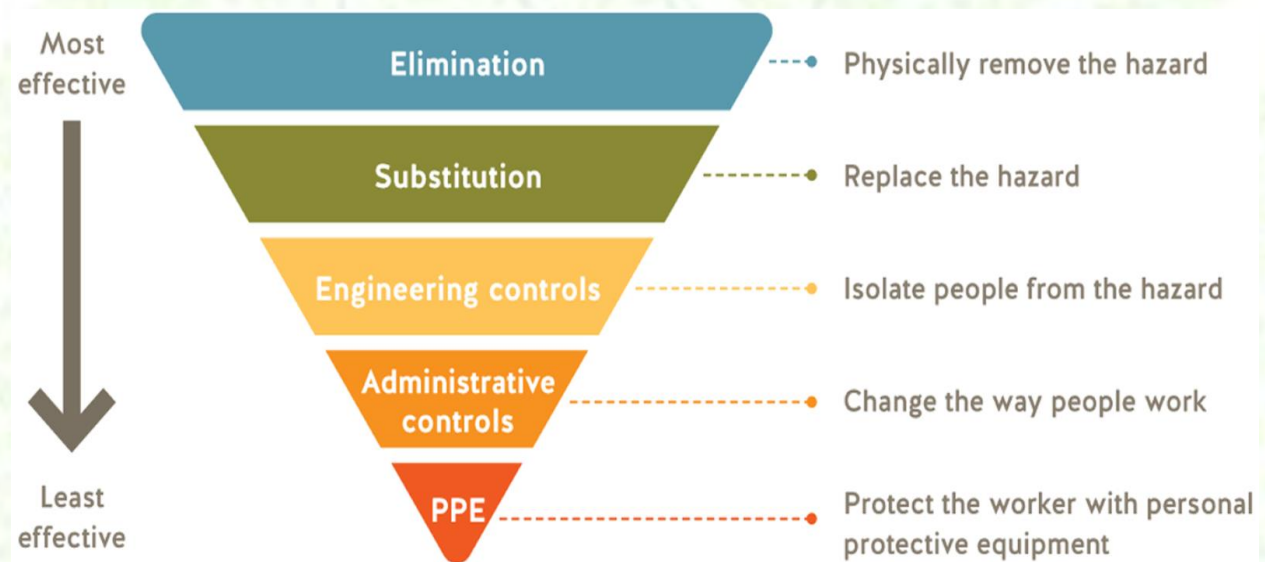


Employers must ensure workers are not exposed to isocyanate levels above the occupational exposure limits (OELs). The OELs for isocyanates in B.C. are very low – an 8-hour time-weighted average (TWA) of 0.005 parts per million (ppm) and a ceiling value (not to be exceeded) of 0.01 ppm. Isocyanates are ALARA substances, meaning exposure must be kept as low as reasonably achievable.

Where the work period exceeds 8 hours in a 24-hour day, the 8-hour TWA limit listed in the Table of Exposure Limits for Chemical and Biological Substances must be modified to ensure that workers on extended shifts are as equally protected as if they were working on conventional 8-hour shifts. Section 5.50(1) of the Regulation provides the factors by which the 8-hour TWA limit must be reduced. See [Appendix B](#) for modifying factors.

7.2 Hierarchy of Controls

In keeping with the ALARA (As Low as Reasonably Achievable) principle, control measures should be selected based on the following hierarchy.



Eliminate the Hazard	<ul style="list-style-type: none"> • Modify the process or choose a safer process. • Improve the work environment (e.g., ventilation). • Modify or change equipment or tools.
Contain the Hazard	<ul style="list-style-type: none"> • Install barriers, such as guardrails or machine guards. • Enclose the hazard so workers aren't exposed to it. • Install a booth for workers.
Revise the Work Procedure	<ul style="list-style-type: none"> • Modify the part of the procedure that is hazardous. • Change the sequence of steps. • Add additional steps (such as locking out energy sources).
Reduce the Exposure	<ul style="list-style-type: none"> • Reduce the number of times workers will encounter the hazard. • Reduce the number of workers exposed to the hazard. • Use personal protective equipment. • Rotate jobs to reduce the length of time each workers is exposed to the hazard.

Elimination/Substitution

The most effective way to reduce the potential of exposure to a hazardous material is to eliminate its use in the workplace or substitute it out for a less hazardous substance. While this is often not the most practicable or cost-effective method of hazard reduction, it should always be considered in the long-term planning strategy of an organization.

Metro Vancouver Spray Foam Incorporated. senior management will be tasked with staying up to date on any market developments regarding products of similar quality and effectiveness to Genyk Inc. Isocyanate A-2732. Should substitution of the currently used product with a different product that does not contain isocyanates become practicable economically and without a loss in quality/effectiveness, Metro Vancouver Spray Foam Incorporated. senior management will thoroughly investigate the opportunity and give due consideration to replacement of the product.

As of the time of writing and preparation of this document, the use of the above-mentioned isocyanate-containing product will continue following specific control measures and while using respiratory protection.

Engineering Controls

Engineering controls are the preferred method of eliminating or reducing occupational exposure to a hazard, including isocyanates. They effectively removed the hazard prior to coming into contact with the worker or isolate the worker from the hazard. Engineering controls must be properly used, routinely examined, regularly maintained, and replaced or repaired as necessary.

Engineering controls must be used to maintain isocyanate vapour concentrations below the prescribed WorkSafeBC TLV-TWA concentrations in air. Local exhaust ventilation and process enclosures will be used to reduce the potential of worker exposure. Area ventilation systems are to be used to dilute and displace contaminated air with fresh air supplied to the work area by mechanical exhaust fans. Air flow must be directed from clean areas into contaminated areas. Ventilation systems must be in place and running during work activities. Contaminated air must be exhausted (outside) from the work area without being recirculated or released into adjacent areas.

The above-mentioned engineering controls will be used at Metro Vancouver Spray Foam work sites. The specific type and quantity of engineering control measures will be detailed in site specific safe work procedures and associated documentation, as there may be some variety between sites and jobs.

Administrative Controls

Administrative controls include clear signage, delineation of the work area, scheduling and coordination of site activities, awareness tools, and training. Signage (warning of the hazards of exposure and restricting access to the area to those who are aware of the hazards of exposure and the necessary control/protective measures) must be installed at the perimeter of work areas where isocyanate-containing products are used, stored, and sprayed. Signage must be clear and visible on all containers containing isocyanates. Task specific safe work procedures must be followed by workers.

Frequent cleaning of the work area according to a set/regular schedule must be conducted. Educating employees as to the hazards of isocyanates exposure and control measures to eliminate/reduce exposure must also be conducted. Schedule work accordingly to minimize the number of workers in the

area. Compressed air shall not be used to clean debris from equipment, clothing, work surfaces, or any PPE.

Personal Protective Equipment

Personal protective equipment is specialized clothing or equipment that workers wear to protect them from coming into contact with hazards. Personal protective equipment is required if engineering and work practice controls are unavailable or impracticable, or do not completely eliminate occupational exposure to the hazards.

Workers must don necessary and specified PPE prior to conducting work tasks where the potential for isocyanates exposure exists. Necessary PPE includes protective clothing, chemical resistant, rubber or nitrile work gloves, steel toed boots, eye protection, chemically resistant disposable coveralls, and supplied air respirators when spray application is being carried out.

8.0 WORK PROCEDURES

All persons potentially exposed to isocyanates are expected to read and understand the following sections. Certain work practices put workers at risk. Workers must take care not to place themselves within areas of potential isocyanates exposure.

Areas where isocyanates exposures may occur must be restricted to workers who have been informed of the associated risks and who are wearing specified personal protective equipment. Empty containers must be decontaminated and then removed from the work premises, as specified in environmental legislation.

Keeping the work premises clean is crucial, as contaminated tools and equipment can lead to contamination of the skin (potentially causing dermatitis). Isocyanates, as mentioned, are skin irritants.

In addition to the following sections, workers will understand and follow any site-specific safe work procedures and/or task-specific instructions relating to spray foam application.

Note; site and task-specific safe work procedures are required.

8.1 Compliance Procedures

- a) Identify areas on site where isocyanates exposure could potentially occur.
- b) If required, develop a written plan that describes any corrective actions being taken to reduce exposure incidents, should any exposure incidents occur (i.e., document any exposure incident reported by a worker and write a plan detailing the actions that are taken to ensure a similar exposure incident does not occur in the future).
- c) Reassign employees who may be suffering from significant adverse effects and/or sensitization from isocyanates exposure to jobs with significantly less or no exposure.
- d) Metro Vancouver Spray Foam Incorporated. will post a copy of this ECP at the worksite and ensure workers are educated in its contents prior to conducting work activities involving isocyanates-containing products.
- e) Implement engineering and work practice controls to reduce and maintain worker exposure to isocyanates As Low as Reasonably Achievable (ALARA).
- f) Safety Data Sheets (SDSs) will be accessible to employees and will be reviewed periodically and updated when significant new data becomes available.

- g) Workers must wear PPE identified in procedures (i.e., protective gloves, clothing, eye / skin / face protection, and respiratory protection).
- h) Always use non-sparking tools and prevent static discharge:
 - i. Ground/bond container and receiving equipment;
 - ii. Take action to prevent static discharge;
 - iii. Use explosion proof equipment (i.e., electrical, lighting, ventilation).
- i) Never leave open pails and seal products immediately after use.
- j) Do not take contaminated clothing out of the workplace.

8.2 Exposure Monitoring

- a) Employees potentially exposed to isocyanates will be identified and classified into exposure groups and included in the sampling strategy, when required.
 - i. Workers are classified into similar exposure groups (SEGs) based on similar work task and expected exposure, when required.
 - ii. Exposure monitoring during individual work tasks of concern assess the potential for worker overexposure during specified work tasks.
- b) Employee exposure will be determined via breathing zone air samples that are collected using continuous monitoring instrumentation by a third-party qualified person.
- c) Additional monitoring shall be conducted when there is a significant change in production, equipment, process, or control measures which may result in a new or additional exposure to isocyanates.
- d) Workplace exposure monitoring and assessment will be carried out using occupational hygiene methods that are acceptable to WorkSafeBC.

Exposure monitoring is to be conducted for the purpose of procedural verification. Once exposure monitoring has been carried out and procedures have been verified, it may not be necessary to conduct additional monitoring. This ECP document will be updated following any occupational exposure monitoring intervention to include any changes to work practice and/or control measures (if required due to sampling results and/or recommended in sampling report).

Occupational exposure monitoring of isocyanates can be conducted using Supelco ASSET EZ4 Dry Samplers for Isocyanates, which collects the full range of isocyanate monomers and oligomers. MSA Altair 4x to monitor LELs.

8.3 Notification of Monitoring Results

The results of any workplace exposure monitoring and assessment, or a summary of the results, will be provided to employees at their request without delay.

8.4 Regulated Areas

Any area(s) where isocyanates are located or stored, as well as any area where workers may be exposed to isocyanates (i.e., areas where spray foam application occurs), shall be established as a 'Regulated Area', and observable signage will be posted at all entrances and accesses containing the words:

Danger/Regulated Area
or
Caution/Regulated Area

Access to any regulated area will be restricted to persons that are trained to recognize the hazards of isocyanate exposure and to work safely using the specified PPE.

Regulated areas will be isolated from non-regulated areas wherever practicable using airtight barriers (if possible), i.e., using 6 mil polyethylene sheeting to seal off the work area. Unprotected workers must not be allowed within 8 meters of an indoor work area or within 3 meters of an outdoor work area.

Prior to spray foam application, flooring will be covered with 6 mil poly sheeting, any non-fixed items will be removed from the regulated area, and any non-fixed items will be covered and sealed with 6 mil poly sheeting.

8.5 Respiratory Protection

A respirator will never be assigned to a person unless the person is given a quantitative or qualitative respirator fit test and the results of the fit test indicate that the face piece of the respirator fits properly. The purpose of the fit test procedure is to ensure that respirators used by the employees provide effective protection against airborne contaminants in the workplace. Training on PPE use, maintenance, and limitations is to be provided to all employees.

Respirator use shall be permitted under the following circumstances:

- In work environments where feasible engineering or work practice controls are not sufficient to reduce exposure to isocyanates to an acceptable amount.
- In work situations where engineering or work practice controls are not feasible.
- In emergencies where exposure could exceed the acceptable limits.

Supplied Air Respirators are required (mandatory) for any spray application. Grade D breathable air meeting the purity requirements of CSA Standard Z180.1 must be supplied to the respirator through an airline (i.e., Bullard Free-Air Pump) and must be analyzed at least every 6 months (except in the case of ambient air supply systems). Analysis results must be recorded and kept for a minimum of 5 years.

Whenever respirator use is required (i.e., under the above-mentioned circumstances), employees will be provided with a specified NIOSH (National Institute of Occupational Safety and Health) approved fit-tested respirator at no cost and workers shall use it properly. Metro Vancouver Spray Foam Incorporated. must maintain a written Respirator Program (RP) in accordance with WorkSafeBC and provide training and fit testing.

Respirators will be used, cleaned, and stored in accordance with the Respirator Program.

8.6 Personal Protective Equipment & Clothing

Supervisors will ensure that employees:

- Use specified PPE when with/around products containing isocyanates, including chemically resistant disposable coveralls and chemically resistant gloves, steel-toed boots, eye protection, and supplied air respirators.
- Have access to working eyewash stations and are trained to use them in case of emergency.
- Requiring respirators are fit tested to ensure they provide effective protection against airborne contaminants.
- Workers are to be clean shaven where the respirator seals with the face for an effective seal to be maintained (a requirement for a properly functioning respirator).

8.7 Hygiene & Decontamination

When isocyanate-based products are used, there is a risk of exposure through skin contact (in addition to inhalation route of exposure). As a result, strict personal hygiene measures are required to maintain worker exposure ALARA. Work areas will be inspected and cleaned according to a set schedule.

Contaminated work clothing and tools will not be allowed out of designated areas. Washing and change areas will be established to keep any isocyanate contamination out of break areas, clean areas, and any other non-designated work or non-work areas. Street clothes should be kept separate from work clothes.

Hands and face must be washed regularly throughout the workday, and prior to eating, drinking, and smoking, and contaminated work clothing or protective clothing will be left at the work site. Coffee and lunch breaks will be taken in a clean area separate from the work area. Decontamination of work surfaces will prevent skin exposure to isocyanates via direct contact with contaminated surfaces.

Rinse any skin contaminated by isocyanates with diluted rubbing (isopropyl) alcohol to neutralize the isocyanate, and then wash thoroughly with soap and water.

Dry sweeping and the use of compressed air are prohibited for removing and/or cleaning dust and debris containing isocyanates.

8.8 For Enclosed Environments

- Utilize polyurethane sheet double flap doorway to limit uncontrolled vapour escape.
- Apply two ducted 12" fans to the polyurethane barrier. One venting out toward the exit of the building, the other blowing fresh air in.
- For deep task locations, it may be necessary to use the stairwells to vent air in or out for greatest efficiency. Additional ducting may be required. Ensure coordination of all activities with those in control of the building and elevators.
- Effective signage and guards at all entrance points. Additionally, guards must be maintained at all openings where elevator doors are open – elevators must be locked out. Metro Vancouver Spray Foam Incorporated. workers will not handle the elevators – proper technicians will.

8.9 Air Discharge Points

- Ensure signage, guarding and all coordination activities in place prior to spray foam application.
- Ensure exhaust air is never closer than 20 meters to any intake area.

9.0 HEALTH MONITORING

Health monitoring of a person means monitoring the person to identify changes in their health status because of exposure to certain substances. It involves the collection of data in order to evaluate the effects of exposure and to determine whether the absorbed dose is within safe levels.

This allows for decisions to be made about implementing ways to eliminate or minimize the worker's risk of exposure, for example reassigning a worker to other duties that involve less exposure or improving control measures.

A baseline health assessment should include the isocyanate exposure history, as well as any chronic health issues and other activities such as drug use and smoking history. It is also recommended that a pulmonary function test be done on a regular basis, based on health care professional advice. Forced

vital capacity (FVC) and forced expiratory volume (FEV) should be measured and the measurements be repeated during, or at the end of the same work shift, between 4 and 10 hours after the employee resumes exposure to isocyanates. Attention should also be paid to each employee's ability to use respiratory protection.

Workers who repeatedly work with isocyanates should also undergo regular biological monitoring so that the level of specific isocyanate levels in their body can be monitored and controlled.

Implementation of a health monitoring program should be considered when:

- A reasonable likelihood of workplace exposure exists.
- An occupational disease or adverse health effect may result from the workplace exposure.
- There exists a means of detecting and/or measuring the disease or adverse health effect or its precursor.

Respiratory sensitizers, such as isocyanates, are substances for which WorkSafeBC considers health monitoring to be appropriate. Thus, Metro Vancouver Spray Foam Incorporated. should develop and implement an effective health monitoring program, in a manner acceptable to the Board, as the potential for exposure to isocyanates exists.

Workers potentially exposed to isocyanates should discuss their work with their doctor and then, if required, undergo medical examination based on that advice. A surveillance program consists of a questionnaire on the person's occupational history and symptoms, and depending on the result, medical consultations and lung function tests may be recommended – consult with your doctor.

The program has its benefits not only in the information gathered but also in worker awareness and occupational hygiene measures. Health surveillance should lead to detection of cases in their early stages, before the disease has fully developed. A medical examination should also precede the return to work of any worker who suffers from cardiac or respiratory disease. In addition, there should be a medical follow-up after any accidental exposure and whenever any respiratory symptoms are manifested.

Isocyanates are powerful skin and respiratory irritants and sensitizers, capable of causing occupational asthma. In the absence of strong exposure peaks, current literature suggests that an average exposure of less than 0.005 ppm and peaks of less than 0.020 ppm in total isocyanate functional groups (ppm of NCO groups) lead to an annual occupational asthma incidence of less than 1% in non-sensitized workers.

Health surveillance is important in diagnosing asthma as soon as possible to minimize the potential for permanent damage.

Metro Vancouver Spray Foam Incorporated. will:

- a) maintain records of risk assessments, worker exposures and worker training, and
- b) ensure that health monitoring records are maintained and readily available.

If a doctor deems required, lung function tests would be conducted (i.e., annually). If symptoms of overexposure occur, a pulmonary specialist will be able to determine whether the worker has become sensitized. Workers should report any suspect negative health effects to Metro Vancouver Spray Foam Incorporated. and a physician.

10.0 DOCUMENTATION

Metro Vancouver Spray Foam Incorporated. employees shall be familiar with the hazards, emergency procedures (hospital, fire, evacuation), and isocyanates handling procedures prior to starting work.

The supervisor will keep records of the incidences or concerns regarding the health and monitoring of workers. The supervisor will keep records of the incidences or concerns regarding any unsafe conditions or deficiencies.

10.1 Exposure Measurements

Metro Vancouver Spray Foam Incorporated. shall maintain isocyanates exposure monitoring records. Records shall include:

- Date of measurement.
- Area and location being monitored.
- Method of sampling and analysis.
- Number, duration, and results of samples collected.
- Type of protective equipment worn.

10.2 Respirator Fit Testing

Metro Vancouver Spray Foam Incorporated. shall maintain records of training and fit testing for all respirators. The records shall include:

- A copy of the Qualitative Fit Test report and the Respirator User Screening Form.
- The date of the most recent fit testing.
- The type and model number of respirators.
- The name and job of the employee.

10.3 Training Records

All training records shall be maintained by Metro Vancouver Spray Foam Incorporated.

10.4 Retention of Records

The records shall be retained for at least the following periods:

- Exposure and medical records shall be kept for as long as is practicable.
- Respirator fit testing records are updated/replaced annually.

11.0 EDUCATION & TRAINING

Employee training is one of the most important safety measures a company can take. Although great efforts can be put into protective equipment, operations, and processes with safety in mind, an improperly trained person can create an undue hazard; therefore, personnel must be given job training before being assigned to duties where isocyanates generation may occur or involving isocyanates exposure.

All workers who use isocyanate containing products must receive training with respect to the product use, clean up, personal hygiene, handling, hazards, first aid and storage. Particular attention should be paid to ensuring that workers understand the nature of the hazards associated with exposure to isocyanates and the safe ways of doing things. It is also necessary that workers understand the

importance of wearing protective clothing and respiratory protection equipment, as well as the need for good personal hygiene. They must also be aware of emergency strategies and be encouraged to update employer records if there is any change in their health.

The employer will perform the training or the employer's designate, and all records of attendance, dates of training, and material discussed will be documented and retained. The training should cover the following aspects:

- The correct handling and storage of isocyanates.
- Records of attendance, dates of training, and material discussed will be documented and retained.
- Operations, materials, and work activities that can contribute to isocyanates exposure.
- Potential routes of isocyanates exposure.
- The hazards, health effects, and symptoms of exposure to isocyanates.
- The hazards, health effects, and symptoms of diseases related to isocyanates exposure.
- The necessity of reporting early symptoms.
- The procedure to be adopted in the event of a spillage, suspected leakage, or suspected excess of isocyanates in the atmosphere.
- Engineering controls and safe work practices and procedures used to protect workers.
- The importance of proper equipment maintenance, control, and operation.
- Proper respirator use and the respirator program.
- Personal hygiene and decontamination procedures.
- Proper housekeeping procedures.
- First aid procedures to deal with exposure to isocyanates.
- The purpose and significance of an effective health monitoring program.
- The details of the exposure control plan.

Additional training or reference material on specific exposures will be made available to employees upon request.

12.0 FIRST AID TREATMENT

12.1 Inhalation

This may be either from the vapour or from an aerosol. Remove the affected person to fresh air. Keep at rest and in a position comfortable for breathing. Obtain immediate medical attention.

12.2 Eye Contact

If isocyanate has entered the eyes, flush them immediately with direct mains water or sterile water from an eye wash bottle for at least 20 minutes, holding the eyelids apart. Check for and remove any contact lenses. Obtain immediate medical attention.

12.3 Skin Contact

Remove and isolate contaminated clothing and shoes. Wash the skin immediately with copious amounts of water and soap. Wash contaminated clothing thoroughly with water before removal and continue to rinse for at least 20 minutes. Obtain medical attention if skin dermatitis appears. Clothing should be

decontaminated in an aqueous solution containing 2% - 5% ammonia (SG 0.880) and 0.2% - 0.5% liquid detergent for one hour and then laundered before re-use.

12.4 Ingestion

DO NOT induce vomiting. Wash out mouth with plenty of water. Remove victim to fresh air and keep at rest. If material has been swallowed and exposed person conscious, give small amounts of water to drink (stop if exposed person feels sick, vomiting may be dangerous). If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Obtain immediate medical attention. DO NOT give anything by mouth to an unconscious person.

13.0 HOUSEKEEPING PROCEDURES

Emergency procedures should be posted wherever there is a risk of exposure to isocyanates. Workers must be trained in emergency procedures including spills, chemical reactivity, and fires. General handling procedures including:

- Wash hands thoroughly following use.
- Do not get product in eyes, on skin, or on clothing.
- Do not inhale vapours or mists.
- Use proper personal hygiene practices.
- Eating, drinking, and smoking is prohibited in work areas.
- Remove contaminated clothing and protective equipment prior to entering eating and/or clean areas.

13.1 Spills

Workers must be trained in spill response prior to any spill incident occurring. Should a spill or accidental release occur, follow the detailed instructions in the spill response safe work procedure (separate document).

Isocyanate spills must be cleaned up immediately by workers wearing the proper PPE, and will include the following steps:

- Evacuate anyone in the area that is not involved in the clean-up and do not touch or walk through the spilled material.
- Always approach any spill from upwind.
- Stop leak if possible and risk level low.
- Move container(s) from spill area.
- Immediately cover the spill with a dry absorbent, i.e., vermiculite or sand (do not use sawdust or shredded paper due to the fire hazard).
- Shovel the waste into a metal container, cover, and place outside in a shaded, dry area prior to disposal (must be disposed via a licensed waste disposal contractor).
- Ensure that any containers are not sealed too tightly (any pressure build up must be allowed to escape).

13.2 Chemical reactivity

Isocyanates react vigorously with water, ammonia, or strong bases to produce heat and carbon dioxide (CO₂) gas. If this reaction occurs in a sealed container, the container may rupture or explode, releasing

isocyanate vapour and CO₂. Before disposing of empty isocyanate containers, they must be decontaminated by filling them with water and leaving them uncovered (for at least 48 hours) to allow CO₂ gas to escape. The containers must be pierced to prevent reuse.

13.3 Fires

Isocyanates, and most substances containing them, are flammable. They will burn and release toxic gases such as carbon monoxide, nitrogen oxides, and hydrogen cyanide. Isocyanates should be treated as a Class C fire hazard — do not use water or foam-containing fire extinguishers. Use a CO₂ or dry chemical extinguisher to put out flames. In the case of a major fire, firefighters in full turnout gear must wear self-contained breathing apparatus (in positive-pressure mode) to protect them from toxic fumes.

14.0 STORAGE & HANDLING

Handle and open containers with care. Empty containers may still contain hazardous residue. Use static lines when mixing and handling material. Do not puncture, drop, or slide containers. Store in a well-ventilated area. Store away from incompatible materials (e.g., oxidizing agents, strong alkalis, strong acids) and ignition sources.

Products containing isocyanates must be stored as follows:

- They must be placed in a cool and adequately ventilated area and locked in place.
- They must be kept away from incompatible substances (i.e., acids, alkalis, and amines).
- They must be placed in hermetically sealed containers that have been visually inspected for leaks or infiltration.
- Containers and packaging must be labeled and associated SDSs must be available.

Access to the storage area must be restricted to authorized personnel trained in procedures for the safe handling of isocyanate-containing products.

Drums and other containers holding isocyanates must not be heated. If the products they contain crystallize due to low warehouse temperatures, the containers must be moved to a warmer, ventilated area.

Established procedures for normal, emergency, and maintenance operations must be followed.

A clean and tidy work environment is essential, and equipment must be inspected to ensure it is not damaged. Storage must comply with manufacturer's specifications as indicated on the SDS.

The fire department must be informed of the presence of isocyanate-containing products and of the quantities stored.

15.0 PROGRAM REVIEW

Metro Vancouver Spray Foam Incorporated. employees shall be familiar with the hazards, emergency procedures (hospital, fire, evacuation), and work procedures prior to starting work. All workers shall be trained and understand the use, care, and maintenance of respirators.

All documentation relating to the acknowledgement of training with isocyanates exposure, site-safety, exposure control plan, and fit testing of respirators shall be signed by the workers and be made present on site for review.

The exposure control plan will be reviewed annually, at minimum (and updated as necessary) for the following:

- The effectiveness of control measures and work procedures used.
- First aid reports and any reported exposure related health issues.
- Documentation for training and education.



APPENDIX A: DEFINITIONS

- 1) **"ALARA"** is an acronym for an important principle governing worker exposure and stands for "As Low as Reasonably Achievable"; measures must be taken to keep a worker's exposure to a level as low as is reasonably achievable.
- 2) **"Carcinogen"**- a substance that has been shown to cause, or has the potential of causing cancer, in humans. Carcinogens are designated in section 5.57(1) of the OHS Regulation under section 5.57(1) of the WorkSafe Occupational Health and Safety.
- 3) **"Ceiling Limit"** means the concentration of a substance in air which may not be exceeded at any time during the work period.
- 4) **"Sensitizer"** - A sensitizer is a substance that has been shown to elicit an allergenic type of response in humans after an initial exposure, resulting in the development of symptoms upon subsequent exposure at much lower concentrations. Sensitizers are designated by WorkSafeBC substance with the letter "S" under section 5.57(1) of the WorkSafeBC Occupational Health and Safety Regulation.
- 5) **"Short-Term Exposure Limit" or "STEL"** means the time weighted average (TWA) concentration of a substance in air which may not be exceeded over any 15 minute period, limited to no more than 4 such periods in an 8 hour work shift with at least one hour between any 2 successive 15 minute excursion periods.
- 6) **"TLV / TWA / OEL"**
 - a. **Threshold Limit Value = TLV**
 - b. **Occupational Exposure Limit = OEL** and
 - c. **Time Weighted Average = TWA.**

The numbers assigned are based on normal working conditions of eight hours per day, over an average lifetime of exposure (generally forty years); the maximum permissible concentration of a hazardous substance that most healthy adults may be repeatedly exposed to without suffering adverse health effects. The limits assume the individual exposed to the substance is a healthy adult.

- 7) **"Designated Substance"** - Substances that are noted by one of the following on the Table of Exposure Limits for Chemical and Biological Substances:
 - ACGIH "A1" or "A2", or IARC "1", "2A" or "2B" carcinogen;
 - ACGIH reproductive toxin "R";
 - ACGIH sensitizer; "S" indicates a substance has the potential to produce sensitization, "S(D)" indicates a substance has the potential to produce sensitization via dermal route, "S(R)" indicates a substance has the potential to produce sensitization via respiratory route.
- 8) **"Qualified Person"** - A qualified person is an occupational health and safety professional with experience in the practice of occupational hygiene as it relates to isocyanates. WorkSafeBC considers a qualified person to include: Certified Industrial Hygienist (CIH); Registered Occupational Hygienist (ROH); Certified Safety Professional (CSP); Canadian Registered Safety Professional (CRSP); or others with acceptable education, training and experience recognizing, evaluating and controlling isocyanates hazards.

APPENDIX B: EXTENDED WORK SHIFTS

Table B-1: Modifying Factors for Work Periods Exceeding 8 Hours

Section 5.50(1) of the *OHS Regulation* ("Regulation") states:

If the work period is more than 8 hours in a 24 hour day, the 8-hour TWA limit must be reduced by multiplying the TWA limit by the following factors:

Factor	Length of work period (in hours)
0.7	More than 8, but not more than 10
0.5	More than 10, but not more than 12
0.25	More than 12, but not more than 16
0.1	More than 16