

Respiratory Protection for Isocyanates

Summary:

Some jurisdictions specify the required respiratory protection for isocyanates. However, Manitoba has no such specifications for isocyanate exposures. The Employer must ensure worker exposure is less than the OEL. Thus, respirator selection would follow the normal process by the employer.

The following is a review of what other jurisdictions and respirator manufacturers recommend.

Alberta:

Supplied air provides high level of protection but air purifying respirators with organic vapour are acceptable provided a) they provide an adequate protection factor and b) are equipped with either an end of service life indicator or a written cartridge change-out schedule.

British Columbia

When spraying products containing isocyanates, workers in B.C. must use air-supplying respirators such as Self-contained breathing apparatus (SCBA) or Supplied-air (airline) respirator.

Workers who apply isocyanate products using a roller, brush, or caulking gun should wear a half-face elastomeric respirator with combination HEPA (particulate) and organic vapour/acid gas cartridges. Used cartridges must be replaced with new cartridges every shift.

3M (Respirator Manufacturer)



3M™ P100 Filter Cartridges, Pesticide/Organic Vapor

Pesticide vapor (except fumigants, unless allowed on label), paint spraying (including paints containing isocyanates when cartridge change out schedule is in place, according to NIOSH approval) and organic vapor; particulates. NIOSH Approval No. TC-23C/84A.



3M™ Organic Vapor Cartridges

Organic vapor: pesticide vapors (insecticides, herbicides, fungicides, but not fumigants unless allowed on label); paint spraying (including paints containing isocyanates when cartridge change out schedule is in place, according to NIOSH approval) and organic vapors; use particulate filter also if spraying material. NIOSH Approval No. TC-23C.

Source: <https://www.gemplers.com/tech/s3m6000.htm>

3M Respirator Selection Guide

In Summary, 3M recommends OV/N95 respirator for most common isocyanates but some specific isocyanates have short or unknown cartridge life/efficiency so supplied air should be used for these specific isocyanates.

Chemical Name CAS #	Synonym	IDLH (ppm)	OEL (ppm)	Respirator (Exposures < both APF x OEL and IDLH)	Comments
Ethyl isocyanate 109-90-0	Isocyanatoethene; Isocyanic acid, ethyl ester		TWA= 0.02 ppm STEL= 0.06 ppm -skin-	OV	Short service life
Hexamethylene diisocyanate 822-06-0	HDI		TWA=0.005	OV/N95	
	anhydride; HMPA; HMPAA				
Hexamethylene diisocyanate 822-06-0	HDI		TWA=0.005	OV/N95	
Methylene bisphenyl isocyanate 101-68-8	4,4-Diphenylmethane diisocyanate, MDI, Methylene-bis-(4-phenyl isocyanate)	100 mg/m ³	TWA=0.005 C=0.02 (OSHA)	OV/N95	
Methylene-bis(4-cyclohexylisocyanate) 5124-30-1			TWA=0.005	OV/N95	
Methyl isocyanate 624-83-9	Isocyanic acid, methyl ester	20	TWA=0.02 STEL=0.06 -skin-	SA	Unknown sorbent effectiveness
Phenyl isocyanate 103-71-9	Isocyanatobenzene, Carbamil Phenyl carbamide		TWA=0.005 STEL=0.015	OV	
Toluene-2,6-diisocyanate 91-08-7	2,6-TDI, 2,6-Toluene diisocyanate	10	TWA=0.001 (inhalable fraction and vapor) STEL=0.005 (inhalable fraction and vapor) -skin-	OV/N95	See comment E on page 8

Note: Comment E cautions that the product may be present as a vapour and an aerosol and recommends a particulate filter ahead of the chemical cartridge.

Source: 3m Respirator Selection Guide (2018)

OSHA

OSHA produced a letter of interpretation on the topic of respiratory protection for isocyanates. The content of the letter or introduction is provided below:

Paragraph 1910.134(d)(1)(i) of the revised Respiratory Protection Standard states **"the employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and the workplace and user factors that affect respirator performance and reliability."**

Paragraph(d)(3)(iii) further states that for protection against gases and vapors an air-purifying respirator may be used provided that:

(1) The respirator is equipped with an end-of-service life indicator (ESLI) certified by NIOSH for the contaminant; or

(2) If there is no ESLI appropriate for conditions in the workplace, the employer implements a change schedule for canisters and cartridges that is based on objective data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis for the change schedule and the basis for reliance on the data.

Currently, there are few respirators available on the market with end-of-service life indicators (ESLI), and none for MDI. An employer must select a cartridge or canister recommended for that chemical by the manufacturer. The employer must then implement a change schedule for the canister or cartridges that is based on objective information or data that will ensure that the canister and cartridges are changed before the end of their service life. The data relied upon and the information forming the basis of the determination must be included in the written respirator program. If more information becomes available, an employer would be expected to review and if necessary, revise the change out schedule.

Source: <https://www.osha.gov/laws-regs/standardinterpretations/2000-07-18>

Study by Yale University on Efficiency of Air Purifying Respirators

This study, part of the Survey of Painters and Repairers of Auto bodies by Yale (SPRAY), evaluated the effectiveness of respiratory protection against exposure to aliphatic polyisocyanates. Twenty-nine Workplace Protection Factor samples were collected. The outside facepiece GM concentration of total isocyanate group (NCO) was 378.4 $\mu\text{g NCO}/\text{m}^3$ with 96% concentrations exceeding the U.K. short-term exposure limit, 70 $\mu\text{g NCO}/\text{m}^3$, but no in-facepiece concentrations exceeded the limit. The GM WPF of total NCO was 319 (GSD 4) and the 5th percentile was 54. WPF of total NCO was positively correlated with the duration of painting task. The study concluded that negative pressure, air-purifying half-facepiece respirators equipped with organic vapor cartridges and paint prefilters provide effective protection against isocyanate exposure in spray and priming operations if workers are properly trained and fitted.

Source: **Respiratory Protection from Isocyanate Exposure in the Autobody Repair and Refinishing Industry** Youcheng Liu et al., Journal of Occupational and Environmental Hygiene, Volume 3, 2006.

NIOSH

The following recommendation is provided for Methylene bisphenyl isocyanate

Respirator Recommendations

NIOSH/OSHA

Up to 0.2 ppm:

(APF = 10) Any supplied-air respirator*

Up to 0.5 ppm:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode*

Up to 1 ppm:

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Up to 3 ppm:

(APF = 2000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

NIOSH has similar recommendations are provided for other isocyanates.

This is a change in the recommendations. Until November of 2018, NIOSH recommended or at least allowed air purifying respirators.