

HIGHLY TOXIC AND PYROPHORIC COMPRESSED GASES

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

Highly toxic and pyrophoric gases are among the most hazardous materials that could be used on campus. Common examples are given below. Due to their extreme hazard they are highly regulated under the *California Fire Code* and/or the *Department of Homeland Security*. In some circumstances complex and expensive gas detection and alarm systems are required. These mitigations are required under when the volume of gas exceeds a particularly threshold for a building or floor.

Because of these complex issues, a generic Standard Operating Procedure template is **not** provided by EH&S for these materials. If a research group wants to use such materials, please contact the [EH&S Laboratory Safety Division](#) to discuss the appropriate mitigations.

Hazardous Gas Classification Table

(Because of their acute toxicity and high level of regulatory oversight, the gases listed here should not use a generic SOP, but rather a gas-specific version – contact EH&S for assistance)

Gas and Formula	CAS and UN or NA No.	UBC / CFC Class ¹	IDLH ²	LC50 ³	PEL ⁴
Ammonia – NH ₃	7664–41–7, UN1005	Corrosive ^{5,6} , flammable	300 ppm	4000 ppm	50 ppm
Arsine – AsH ₃	7784–42–1, UN2188	Highly toxic, flammable	3 ppm	20 ppm	0.05 ppm
Boron Tribromide – BBr ₃	10294–33–4, UN2692	Toxic	50 ppm	380 ppm	1 ppm ^{4(C)}
Boron Trichloride – BCl ₃	10294–34–5, UN1741	Corrosive ⁵	25 ppm ⁷	2541 ppm	5 ppm
Boron Trifluoride – BF ₃	7637–07–2, UN1008	Toxic	25 ppm	806 ppm	1 ppm ^{4(C)}

Gas and Formula	CAS and UN or NA No.	UBC / CFC Class ¹	IDLH ²	LC50 ³	PEL ⁴
Bromine – Br ₂	7726–95–6, UN1744	Highly toxic, corrosive, oxidizer	3 ppm	113 ppm	0.1 ppm
Carbon Monoxide – CO	630–08–0, UN1016	Flammable ⁵	1200 ppm	3760 ppm	50 ppm
Chlorine – Cl ₂	7782–50–5, UN1017	Toxic, corrosive, oxidizer	10 ppm	293 ppm	1 ppm ^{4(C)}
Chlorine Dioxide – ClO ₂	10049–04–4, NA9191	Toxic, oxidizer	5 ppm	250 ppm	0.1 ppm
Chlorine Trifluoride – ClF ₃	7790–91–2, UN1749	Toxic, oxidizer	20 ppm	299 ppm	0.1 ppm ^{4(C)}
Diborane – B ₂ H ₆	19278–45–7, UN1911	Highly toxic, flammable	15 ppm	80 ppm	0.1 ppm
Dichlorosilane – SiH ₂ Cl ₂ (HCl)	4109–96–0, UN2189	Toxic, corrosive, flammable	50 ppm	314 ppm	5 ppm ^{4(C)}
Ethylene Oxide – C ₂ H ₄ O	75–21–8, UN1040	Flammable ⁵	800 ppm	4350 ppm	1 ppm
Fluorine – F ₂	7782–41–4, UN1045	Highly toxic, oxidizer	25 ppm	185 ppm	0.1 ppm
Germane – GeH ₄	7782–65–2, UN2192	Toxic, flammable	6 ppm ⁷	622 ppm	0.2 ppm ⁸
Hydrogen Bromide – HBr	10035–10–6, UN1048	Corrosive ⁵	30 ppm	2860 ppm	3 ppm
Hydrogen Chloride – HCl	7647–01–0, UN1050	Corrosive ⁵	50 ppm	2810 ppm	5 ppm ^{4(C)}
Hydrogen Cyanide – HCN	74–90–8, UN1051	Highly toxic, flammable	50 ppm	40 ppm	10 ppm
Hydrogen Fluoride – HF	7664–39–3, UN1052	Toxic	30 ppm	1300 ppm	3 ppm
Hydrogen Selenide – H ₂ Se	7783–07–5, UN2202	Highly toxic, flammable	1 ppm	2 ppm	0.05 ppm

Gas and Formula	CAS and UN or NA No.	UBC / CFC Class ¹	IDLH ²	LC50 ³	PEL ⁴
Hydrogen Sulfide – H ₂ S	7783–06–4, UN1053	Toxic, flammable	100 ppm	712 ppm	20 ppm
Methyl Bromide – CH ₃ Br	74–83–9, UN1062	Toxic, flammable	250 ppm	1007 ppm	20 ppm ^{4(C)}
Methylisocyanate – CH ₃ NCO	624–83–9, UN2480	Highly toxic, flammable	3 ppm	22 ppm	0.02 ppm
Methyl Mercaptan – CH ₃ SH	74–93–1, UN1064	Toxic, flammable	150 ppm	1350 ppm	10 ppm ^{4(C)}
Nickel Carbonyl – Ni(CO) ₄	13463–39–3, UN1259	Highly toxic, flammable	2 ppm	18 ppm	0.001 ppm
Nitric Oxide – NO	10102–43–9, UN1660	Highly toxic, oxidizer	100 ppm	115 ppm	25 ppm
Nitrogen Dioxide – NO ₂	10102–44–0, UN1067	Highly toxic, oxidizer	20 ppm	115 ppm	5 ppm ^{4(C)}
Phosgene – COCl ₂	75–44–5, UN1076	Highly toxic	2 ppm	5 ppm	0.1 ppm
Phosphine – PH ₃	7803–51–2, UN2199	Highly toxic, pyrophoric	50 ppm	20 ppm	0.3 ppm
Phosphorus Oxychloride – POCl ₃	10025–87–3, UN1810	Highly toxic	0.96 ppm ^Z	96 ppm	0.1 ppm ⁸
Phosphorus Pentafluoride – PF ₅	7647–19–0, UN2198	Toxic, oxidizer	2.6 ppm ^Z	260 ppm	3 ppm
Phosphorus Trichloride – PCl ₃	7719–12–2, UN1809	Toxic, oxidizer	25 ppm	208 ppm	0.5 ppm
Selenium Hexafluoride – SeF ₆	7783–79–1, UN2194	Highly toxic	2 ppm	50 ppm	0.05 ppm (as Se)
Silicon Tetrachloride – SiCl ₄ (HCl)	10026–04–7, UN1818	Toxic, corrosive	50 ppm	750 ppm	5 ppm ^{4(C)}
Silicon Tetrafluoride – SiF ₄ (HF)	7783–61–1, UN1859	Toxic	30 ppm	450 ppm	0.1 ppm
Stibine – SbH ₃	7803–52–3, UN2676	Highly toxic, flammable	5 ppm	20 ppm	0.1 ppm

Gas and Formula	CAS and UN or NA No.	UBC / CFC Class ¹	IDLH ²	LC50 ³	PEL ⁴
Sulfur Dioxide – SO ₂	7446–09–5, UN1079	Corrosive ⁵	100 ppm	2520 ppm	5 ppm
Sulfuryl Fluoride – SO ₂ F ₂	2699–79–8, UN2191	Corrosive ⁵	200 ppm	3020 ppm	5 ppm
Tellurium Hexafluoride – TeF ₆	7783–80–4, UN2195	Highly toxic	1 ppm	25 ppm	0.02 ppm (as Te)
Titanium Tetrachloride – TiCl ₄	7550–45–0, UN1838	Highly toxic, corrosive	1.3 ppm	119 ppm	—
Tungsten Hexafluoride – WF ₆ (HF)	7783–82–6, UN2196	Toxic, corrosive	30 ppm	217 ppm	0.1 ppm

(Table adapted from Santa Clara County's Hazardous Gas Table.)

Footnotes:

1. UBC/ CFC Class. **Gases listed as either toxic or highly toxic should not use this SOP, but develop a gas-specific SOP**
 - a. UBC (Uniform Building Code)
 - b. CFC (California Fire Code)
 - c. Class as defined in CFC:
 - i. Health hazards per Article 2
 - ii. Highly toxic = < 200 LC50
 - iii. Toxic = 201–2000 LC50
 - d. Physical hazards per CFC Standard 7903.
2. **IDLH (Immediately Dangerous to Life and Health)** values published in 1994 by the National Institute for Occupational Safety and Health (NIOSH).
3. **LC50 data (Lethal concentration 50%)**: Lowest reported value, 1 hour adjusted, taken from Dept. of Transportation, Compressed Gas Association, Registry of Toxic Effects of Chemical Substances.
4. **PEL (Permissible Exposure Limit)** values published by Occupational Safety & Health Administration (OSHA). OSHA values used if available; otherwise, Threshold Limit Values (TLV) from ACGIH. (C) = TLV-ceiling limit, an exposure limit not to be exceeded under any circumstances.
5. Moderately toxic per cities of San Jose, Santa Clara, and Milpitas: LC50 = 2,000–5000.
6. When used as a refrigerant, Uniform Building Code Class does not apply.
7. IDLH determined by 0.01 of LC50.
8. Cal/OSHA PEL, Title 8, Section 5155, 9/1/95