

Schedule: Compressed Gas - Flammable, Oxidizer

1) Description of Gas System

a) List of Gases

Table 1 Gas Cylinders (Complete for All gases including inert gases)				
Gas Identification (include all components)	Cylinder Size (scf)	Hazardous Components	Hazardous Component Concentration	Hazardous Component Volume (scf)
He, Helium CAS # 7440-59-7 NFPA – 0,0,0,NI Hazard Rating - Moderate	244	-	-	-
Ne, Neon CAS # 7440-01-9 NFPA – (?)2,0,0,NI Hazard Rating - Moderate	177	-	-	-
Ar, Argon CAS # 7940-37-3 NFPA – 0,0,0,NI Hazard Rating – Moderate	280	-	-	-
H ₂ , Hydrogen CAS # 7782-39-0 NFPA – 0,4,0,SA Hazard Rating – EXTREME				
D ₂ , Deuterium CAS # 7782-39-0 NFPA – 0,4,0,SA Hazard Rating – EXTREME				
N ₂ , Nitrogen CAS # 75-73-0 NFPA – 0,0,0,NI Hazard Rating - Moderate	255	-	-	-
O ₂ , Oxygen CAS # 7782-44-7 NFPA – 3,0,0,Ox Hazard Rating - HIGH	249	O ₂	100%	249

CO, Carbon Monoxide CAS # 630-08-0 NFPA – 2,4,0,NI Hazard Rating – EXTREME (Flammable and toxic)	27	CO	100%	27
C ₂ H ₂ , Acetylene CAS # 74-86-2 NFPA - 0,4,3,NI Hazard Rating – EXTREME (Flammable)	10	C ₂ H ₂ , Acetylene; acetone	>98%, <2%	10
C ₂ H ₄ , Ethylene CAS # 74-84-0 NFPA - 2,4,2,NI Hazard Rating – EXTREME (Flammable)	3.9	Ethylene	100%	3.9

National Fire Protective Association (NFPA) Rating Chart

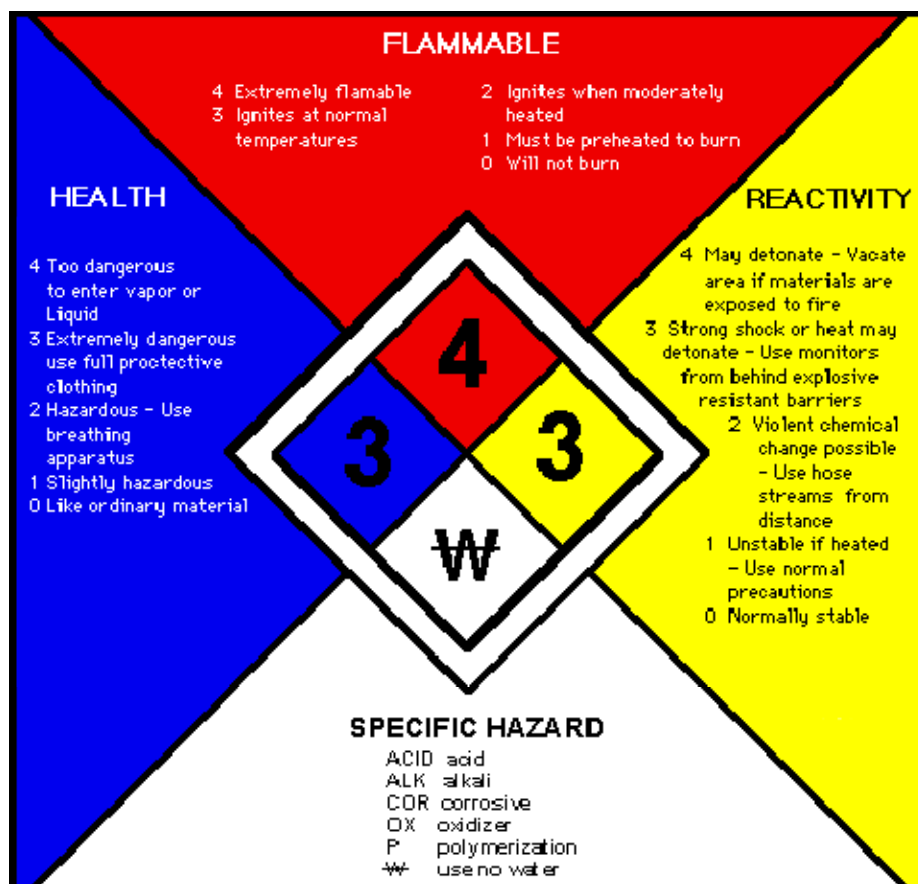


Table 2 Gas Hazards (Complete for Flammable or Pyrophoric gases only)				
Hazardous Component Name	Hazardous Component Volume (scf)	Hazard(s)	Lower Flammable Limit (% in air)	Upper Flammable Limit (% in air)
CO, Carbon Monoxide	27	Flammable, Toxic-inhalation	12.5 %	74 %
C ₂ H ₂ , Acetylene C ₂ H ₄ , Ethylene	10 3.9	Flammable Flammable	2.5% 2.7%	82% 36%

Table 3 Accidental Release Analysis (Complete for Flammable or Pyrophoric gases only)				
Hazardous Component Name	Hazardous Component Volume (scf)	Room Volume (scf)	Hazardous Component Concentration	Concentration % LFL
CO, Carbon Monoxide	27	636 sf x 12 = 7632 cf	27/7632 = 0.354%	0.354/12.5 = 2.8%
C ₂ H ₂ , Acetylene	10	7632 cf	10/7632 = 0.131%	0.131/2.5 = 5.2%
C ₂ H ₄ , Ethylene	3.9	7632 cf	3.9/7632 = 0.051%	0.051/2.7 = 1.9%

Table 4 Gas Hazards (Complete for Health Hazard gases only)						
Hazardous Component Name	Hazard(s)	8 Hour TLV (ppm)	STEL (ppm)	Ceiling (ppm)	IDLH (ppm)	Odor Threshold (ppm)
CO	toxic (asphyxiant)	25 ppm	400 PPM / 15 min	200 ppm	1500 PPM / 30 min	odorless

Table 5 Accidental Release Analysis (Complete for Health Hazard gases only)					
Hazardous Component Name	Release Rate	Exhaust System Description	Exhaust Rate	Discharge Concentration	Discharge % IDLH
CO	27 cf/5 min = 5.4 cfm	SW quadrant	26,340 cfm	5.4/26,340 = 205 ppm	205/1500 = 13.7% OK
		BL9 6610 cfm			
		BL10 6610 cfm			
		BL11 6610 cfm			
		BL12 6510 cfm			

b) Description of Hazard

The primary hazard in this setup is the accidental release of the supply gas for the experimental gas jet into the room. There are two possible release scenarios: Leaks from the gas supply line to the gas jet, leaks from the vacuum system pump exhaust.

Overpressure of the vacuum system with the jet gas is not considered a significant hazard, since the gas jet intrinsically contains a small (0.5mm) fixed aperture that limits the gas flow rate into the vacuum system even if the pulsed gas valve is artificially held open continuously. This gas volume can easily be pumped by the vacuum pumps on the system. Furthermore, the vacuum and cylinder gas pressure will be periodically monitored by the experimenters.

Specific information on carbon monoxide (CO):

Carbon monoxide is a colorless gas. To the human senses it is invisible. Carbon monoxide is a byproduct of combustion and will appear naturally in any situation where burning has taken place. Carbon monoxide is a toxic asphyxiant, meaning it reduces the oxygen transport properties of the blood. It reacts with the hemoglobin in the blood forming carboxyhemoglobin which prevents the hemoglobin from transferring oxygen. Low PPM doses of carbon monoxide can cause headaches and dizziness. If the victim is removed to fresh air no permanent damages will result. High doses can be fatal.

CO, Carbon Monoxide
carbon monoxide

TOXICITY AND IRRITATION

unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY	IRRITATION
Inhalation (man) TCLo: 150 ppm/24h	Nil Reported
Inhalation (man) LCLo: 4000 ppm/30m	

Inhalation (man) TCLO: 650 ppm/45m

Inhalation (rat) LC50: 1807 ppm/4h

Specific information on acetylene (C₂H₂):

Acetylene (C₂H₂):

Health Hazards:

Acetylene is an asphyxiant and may cause anesthetic effects at high concentrations. High concentrations may exclude an adequate supply of oxygen to the lungs. Effects of oxygen deficiency resulting from simple asphyxiants may include rapid breathing, diminished mental alertness, impaired muscular coordination, faulty judgement, depression of all sensations, emotional instability, and fatigue. As asphyxiation progresses, nausea, vomiting, prostration, and loss of consciousness may result, eventually leading to convulsions, coma, and death. Under normal operating conditions, acetone is not released from the cylinder. However, if the cylinder is overcharged with acetone or acetylene, acetone may occasionally "spit" out. Acetone is primarily a central nervous system toxin causing headache, nausea, dizziness, vomiting and fatigue. Moderate concentrations may cause respiratory irritation. Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

FIRE AND EXPLOSION HAZARDS:

*Pure acetylene can ignite by decomposition above 15 psig; therefore, the UEL is 100% if the ignition source is of sufficient intensity. The lower explosive limit of acetylene is 2.5%. GASEOUS ACETYLENE IS SPONTANEOUSLY COMBUSTIBLE IN AIR AT PRESSURE ABOVE 15 PSI (207 kPa.). It requires very low ignition energy so that fires which have been extinguished without stopping the flow of gas can easily reignite with possible explosive force. Acetylene has a density very similar to that of air so when leaking it does not readily dissipate. Gas may travel to a source of ignition and flash back. Fires involving acetylene occur occasionally at fusible metal pressure relief plugs at the tops and bottoms of cylinders, commonly due to hot metal or slag being dropped on the fusible plugs. When the fusible plug releases a large volume of acetylene will rush out, creating a "roaring" sound. The flame may extend a foot or two away from the cylinder until the pressure is reduced. In some cases, the other end of the cylinder may develop a coating of frost.

Acetylene can explode if the pressure of the gas exceeds about 100 kPa (≈14.5 psi) as a gas or when in liquid or solid form. It is shipped and stored dissolved in acetone or dimethylformamide (DMF), contained in a metal cylinder with porous filling. These containers must be stored upright. Do not open acetylene valves more than 1½ turns. Avoid impact against container.

All acetylene piped systems and associated equipment must be grounded. Never use copper piping for acetylene service, only steel or wrought iron pipe should be used. Under certain conditions, acetylene can react with copper, silver, and mercury to form acetylides, compounds which can act as ignition sources. Acetylene may react with unalloyed copper to form copper acetylide, which is a potentially shock sensitive, explosive crystal. Acetylene must never be used with unalloyed copper, for example copper tubing or tubing fittings. Brasses containing less than 65% copper in the alloy and certain nickel alloys are suitable for acetylene service under normal conditions. Acetylene can react explosively when combined with oxygen and other oxidizers including all halogens and halogen compounds.

Some elastomers such as Nitrile, Viton, and Silicon are not recommended since they can exhibit volume loss.

Definitions:

8 hour Threshold Limit Value (TLV): The airborne concentration averaged over an 8 hour period to which nearly all workers may be repeatedly exposed day after day without suffering an adverse health effect.

Ceiling: An airborne concentration that should not be exceeded at any time during a workday.

IDLH (Immediately Dangerous to Life or Health): An exposure level that is likely to cause death, permanent adverse health effects or would prevent escape from such an environment.

Odor Threshold: The geometric mean average airborne concentration of a substance that can be detected by olfactory perception. The 3M 2005 Respirator Selection Guide is the primary reference for the reported values

Release Rate: The volume flow rate assumed in a catastrophic failure. For compressed gases, assume that the contents of the cylinder release in 5 minutes. For a liquefied gas, assume that the contents of the cylinder release in 30 minutes.

STEL (Short Term Exposure Limit): An airborne concentration that workers can be exposed to for a short period of time (15 minutes) without suffering from irritation, chronic or reversible tissue damage, dose-rate dependent toxic effects or narcosis.

The gas cylinders with hazardous gases will only be opened after proper mounting, and connection to a leak checked gas delivery system. All gases will be handled using the standard laboratory safe gas handling procedures.

Used gas cylinders will be returned to the vendor if possible. If cylinders containing hazardous gases are non-returnable, contact EH&S for proper disposal procedures.