

Health and Physiology of Hazardous Chemicals Peter Thomas, P.E. | Resource Compliance



Common Chemicals in the San Joaquin Valley





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	Refrigerant Characteristics										
1	10 °F Evaporator Temperature, 95 °F Condensing Temperature										
Refrigerant Evaporator Condensing Theoretical Refrigerating Mass Flow Specific CF											
	Pressure	Pressure	Discharge	Effect	Rate	volume	ton				
	(psig)	(psig)	Temperature	(BTU/lb.)	(lb./min/ton)	Vapor (Cu.					
			(°F)			ft./Ib.)					
CFC-11	23.1*	6.9	118	65.98	3.03	10.7	32.8				
CFC-12	14.6	108.3	109	48.43	4.13	1.324	5.47				
HCFC-22	32.8	181.8	145	67.74	2.9	1.129	3.33				
CFC-500	19.7	130.6	110	58.54	3.42	1.362	4.60				
HCFC-502	41.1	199.7	100	43.51	4.60	.751	3.46				
R-717	23.8	181.1	221	465.50	.43	7.304	3.14				





Uses of Sulfur Dioxide





Uses of Chlorine











Ammonia Emissions



- Values in tons/day
- Data from 2006 California Air Resources Board (ARB) statistics



Ammonia Production





Ammonia Production

 First Manufactured in Oppau, Germany in 1913





Ammonia Production





Ammonia Grades

	COMM	AGRI	REFRIG	TECH	METAL	SEMICON
Ammonia wt. %, minimum	99.5	99.7	99.95	99.98	99.995	99.999



Chlorine Production





Hazardous Reactions

• NFPA Fire Protection Guide to Hazardous Materials (2001)



Acetaldehyde Acrolein Boron Boron Bromine Caloric Acid Chlorine Chlorites Chlorisilane Chromic Anhydride Chromyl Chloride Ethylene Dichloride **Ethylene Oxide** Fluorine Gold Hexachloromelamine Hydrazide Hydrogen Bromide Hypochlorous Acid lodine

Magnesium Perchlorate Mercury Nitric Acid Trioxide Nitrogen Tetroxide Nitrogen Trifluoride Nitryl Chloride Oxygen Difluoride Monoxide Phosphorous Pentoxide Trifluoride Phosphorous Trioxide **Picric Acid** Potassium Potassium Chlorate Potassium Ferricyanide Potassium Mercuricyanide Potassium Tricyanomercurate Silver Silver Chloride Sodium Stilbene Sulfur Tellurium Trichloromelamine









Hazardous Reactions

• NFPA Fire Protection Guide to Hazardous Materials (2001)

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Chemical / Physical Properties

- Boiling Point
- Vapor Pressure
- Vapor Density
- Solubility
- Color
- Smell





Boiling Point

- NH₃: -28.1°F
- **SO**₂: 14°F
- Cl₂: -29.27°F





Vapor Pressure

- NH₃: 93 psig @ 60°F
- **SO₂**: 47.03 psig @ 68°F
- **Cl₂**: 112.95 psia @ 77°F

Temp	Pres	sure	Temp	Pres	sure	Temp	Pres	sure	Temp	Pres	sure
°F	PSIA	PSIG	°F	PSIA	PSIG	°F	PSIA	PSIG	°F	PSIA	PSIG
-60	5.6	18.6	-14	21.4	6.7	31	61.0	46.3	76	143.0	128.3
-58	5.9	17.8	-13	22.0	7.3	32	62.3	47.6	77	145.4	130.7
-57	6.1	17.4	-12	22.6	7.9	33	63.6	48.9	78	147.9	133.2
-56	6.3	17.0	-11	23.2	8.4	34	64.9	50.2	79	150.5	135.8
-55	6.5	16.6	-10	23.7	9.0	35	66.3	51.6	80	153.0	138.3
-54	6.8	16.2	-9	24.4	9.6	36	67.6	52.9	81	155.6	140.9
-53	7.0	15.7	-8	25.0	10.3	37	69.0	54.3	82	158.3	143.6
-52	7.2	15.3	-7	25.6	10.9	38	70.4	55.7	83	161.0	146.3
-51	7.4	14.8	-6	26.3	11.6	39	71.9	57.2	84	163.7	149.0
-50	7.7	14.3	-5	26.9	12.2	40	73.3	58.6	85	166.4	151.7
-49	7.9	13.8	-4	27.6	12.9	41	74.8	60.1	86	169.2	154.5
-48	8.2	13.3	-3	28.3	13.6	42	76.3	61.6	87	172.0	157.3
-47	8.4	12.8	-2	29.0	14.3	43	77.8	63.1	88	174.8	160.1
-46	8.7	12.2	-1	29.7	15.0	44	79.4	64.7	89	177.7	163.0
-45	9.0	11.7	0	30.4	15.7	45	81.0	66.3	90	180.6	165.9
-44	9.2	11.1	1	31.2	16.5	46	82.6	67.8	91	183.6	168.9
-43	9.5	10.6	2	31.9	17.2	47	84.2	69.5	92	186.6	171.9
-42	9.8	10.0	3	32.7	18.0	48	85.8	71.1	93	189.6	174.9
-41	10.1	9.3	4	33.5	18.8	49	87.5	72.8	94	192.7	178.0
-40	10.4	8.7	5	34.3	19.6	50	89.2	74.5	95	195.8	181.1
-39	10.7	8.1	6	35.1	20.4	51	90.9	76.2	96	198.9	184.2
-38	11.0	7.4	7	35.9	21.2	52	92.7	78.0	97	202.1	187.4
-37	11.4	6.8	8	36.8	22.1	53	94.4	79.7	98	205.3	190.6
-36	11.7	6.1	9	37.6	22.9	54	96.2	81.5	99	208.6	193.9
-35	12.1	5.4	10	38.5	23.8	55	98.1	83.4	100	211.9	197.2
-34	12.4	4.7	11	39.4	24.7	56	99.9	85.2	101	215.2	200.5
-33	12.8	3.9	12	40.3	25.6	57	101.8	87.1	102	218.6	203.9
-32	13.1	3.2	13	41.2	26.5	58	103.7	89.0	103	222.0	207.3
-31	13.5	2.4	14	42.2	27.5	59	105.6	90.9	104	225.4	210.7
-30	13.9	1.6	15	43.1	28.4	60	107.6	92.9	105	228.9	214.2
-29	14.3	0.8	16	44.1	29.4	61	109.6	94.9	106	232.5	217.8
-28	14.7	0.0	17	45.1	30.4	62	111.6	96.9	107	236.0	221.3











Solubility





Solubility



Providing Solutions. Simplifying Regulation.



Color and Smell

Odor Threshold

- **NH**₃: 0.04 17 ppm
- **SO₂**: 0.1 1 ppm
- **Cl**₂: 0.002 3.5 ppm



Providing Solutions. Simplifying Regulation.



Flammable Ranges

Ammonia

- LFL: 15-16%
- UEL: 25-28%

• Sulfur Dioxide

o N/A

Chlorine

o N/A





Additional Resources







Chemical Data	isheet		Add	to MyChemicals Print
SULFUF	R DIOXIDE			INHALATION HAZARD 2
Chemical Identi	fiers Hazards Resp	onse Reco	mmendations Physical Properties F	Regulatory Information
Alternate Chem	ical Names			
Chemical T	dentifiers			
What is this info	ormation?			
CAS Number 7446-09-5	UN/NA N 1079	lumber	DOT Hazard Label Poison Gas	USCG CHRIS Cod
			Corrosive	<u> 510</u>
			Contosive	
NFPA 704			contrainte	
NFPA 704 Diamond	Hazard	Value	Description	
NFPA 704 Diamond	Hazard Health	Value 3	Description Can cause serious or permanent inj	ury.
NFPA 704 Diamond	Hazard Health	Value 3 0	Description Can cause serious or permanent inju Will not burn under typical fire cond	ury.
NFPA 704 Diamond	Hazard Health Flammability Instability	Value 3 0	Description Can cause serious or permanent inj Will not burn under typical fire cond Normally stable, even under fire con	ury. itions.



Exposure Limits

Exposure Limit	Ammonia	Chlorine	Sulfur Dioxide
PEL	25/50 ppm	0.5/1 ppm	2/5 ppm
STEL	35 ppm	1 ppm	5 ppm
Toxic Endpoint	0.14 mg/l 200 ppm	0.0087 mg/l 3 ppm	0.0078 mg/l 2.98 ppm
IDLH	300 ppm	10 ppm	100 ppm





Health Hazard Data

- Inhalation
- Absorption
 - o Skin Contact
 - o Eye Contact
- Injection
- Ingestion





Inhalation

- Remove from exposure; seek fresh air.
- Administer artificial respiration or oxygen if breathing has stopped.
- Seek medical aid.





Skin Contact

- Immediately flush with large quantities of water for at least 15 minutes. Do not remove clothing if frozen to skin.
- Seek medical aid.





Eye Contact

- Flush with large quantities of water for at least 15 minutes.
- Seek medical aid.





Ingestion

- Do not induce vomiting. Give 1–2 glasses of milk or water.
- Seek medical aid.





Acute Ammonia Exposure

• Burns to the respiratory tract





Acute Ammonia Exposure

• Dyspnea





Acute Ammonia Exposure

• Stridor





Acute Ammonia Exposure

• Chest pain



RESOURCE COMPLIANCE

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Acute Ammonia Exposure

• Pulmonary edema / pneumonia





Acute Ammonia Exposure

Conjunctivitis / lacrimation / corneal erosion





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Acute Ammonia Exposure

Severe burns First degree Epidermis burn Dermis Hypodermis Second degree burn Third degree burn *ADAM



Acute Chlorine Exposure

- Rapid heart rate
- Hypertension (high blood pressure)
- Hypotension (low blood pressure)
- Cardiovascular collapse



Thank You!