MATERIAL COMPATIBILITY CHART

KEY

I = Insufficient data available to determine the compatibility with the intended gas.
S = Satisfactory for use with the intended gas (dry anhydrous) at normal operating temperature of 70°F
U = Unsatisfactory for use with the intended gas.
C = Compatibility depends on condition of use

NOTE: This chart is intended as a guide only. Actual applications may include variables which can effect the compatibility of certain materials with particular gases. Contact your gas supplier for additional compatibility information regarding the gases being used.
* The user should be thoroughly familiar with the specific properties of the gas material compatability depends on condition of use.

Gas	Primary Hazards					Metals					Plastics				Elastomers		
	Asphyxiant	Toxic	Flammable	Corrosive	Oxidizer	Aluminum	Brass	Copper	Monel	Stainless Steel	Kel-F/PCTFE	Teflon	Tefzel	Kynar	Viton	Buna-N	Neoprene
Acetylene	•		•			S	S	U	S	S	S	S	S	S	S	S	S
Air					•	S	S	S	S	S	S	S	S	S	S	S	S
Ammonia		•	•	•		S	U	U	S	S	S	S	S	S	S	S	S
Argon	•					S	S	S	S	S	S	S	S	S	S	S	S
*Arsine		•	•			I	S	S	S	S	S	S	S	S	S	S	S
Boron Trichloride		•		•		U	C	C	S	S	S	S	S	I	I	I	I
Boron Trifluoride		•		•		I	C	C	S	S	S	S	S	I	I	I	I
Boron-11 Trifluoride		•		•		I	C	C	S	S	S	S	S	I	I	I	I
*Bromine Trifluoride		•		•	•	C	C	C	S	S	C	C	S	U	U	U	U
1,3-Butadiene		•	•			S	S	S	S	S	S	S	S	S	S	S	S
n-Butane	•		•			S	S	S	S	S	S	S	S	S	S	S	S
1-Butene			•			S	S	S	S	S	S	S	S	S	S	S	S
cis-2-Butene			•			S	S	S	S	S	S	S	S	S	S	S	S
trans-2-Butene			•			S	S	S	S	S	S	S	S	S	S	S	S
Carbon Dioxide	•					S	S	S	S	S	S	S	S	S	S	C	C
Carbon Monoxide		•	•			S	S	S	S	S	S	S	S	S	S	S	S
Chlorine		•		•		U	U	U	S	S	S	S	S	S	S	U	U
*Chlorine Trifluoride		•		•	•	U	I	I	S	S	C	C	S	U	U	U	U
Deuterium	•		•			S	S	S	S	S	S	S	S	S	S	S	S
Dichlorosilane		•	•	•		U	I	I	S	S	S	S	S	S	I	I	I
Di-, Mono-, and Trimethylamines		•	•	•		U	U	U	S	S	S	S	S	S	U	U	I
Disilane			•			S	S	S	S	S	S	S	S	S	S	S	S
Ethane	•		•			S	S	S	S	S	S	S	S	S	S	S	S
Ethyl Chloride			•			S	S	S	S	S	S	S	S	S	S	S	S
Ethylene	•		•			S	S	S	S	S	S	S	S	S	S	S	S
*Fluorine		•		•	•	C	C	C	S	S	C	C	C	C	U	U	U
Halobarbon-14						S	S	S	S	S	S	S	S	S	S	S	S
Halocargon-23	•					S	S	S	S	S	S	S	S	S	S	S	S
Halocarbon-116	•					S	S	S	S	S	S	S	S	S	S	S	S
Helium	•					S	S	S	S	S	S	S	S	S	S	S	S
Hydrogen	•		•			S	S	S	S	S	S	S	S	S	S	S	S
Hydrogen Bromide		•		•		U	U	U	S	S	S	S	S	S	S	U	U
Hydrogen Chloride		•		•		U	U	U	S	S	S	S	S	S	S	U	U
*Hydrogen Fluoride		•		•		U	U	U	S	S	S	S	S	S	U	U	U
*Hydrogen Sulfide		•	•	•		S	S	I	S	S	S	S	S	S	U	S	S
Isobutane	•		•			S	S	S	S	S	S	S	S	S	S	S	S
Isobutylene	•		•			S	S	S	S	S	S	S	S	S	S	S	S
Krypton	•					S	S	S	S	S	S	S	S	S	S	S	S
Methane	•		•			S	S	S	S	S	S	S	S	S	S	S	S
Methyl Chloride		•	•			U	S	S	S	S	S	S	S	S	S	U	U
Methyl Fluoride		•	•			S	S	S	S	S	S	S	S	S	I	I	I
Neon	•					S	S	S	S	S	S	S	S	S	S	S	S
Nitric Oxide		•		•	•	S	U	U	U	S	S	S	S	S	S	I	I
Nitrogen	•					S	S	S	S	S	S	S	S	S	S	S	S
Nitrogen Dioxide		•		•	•	S	U	U	U	S	S	S	I	I	U	U	U
Nitrogren Trifluoride		•			•	I	S	S	S	S	S	S	S	S	S	I	I
Nitrous Oxide					•	S	S	S	S	S	S	S	S	S	S	S	S
Octafluorocyclobutane	•					S	S	S	S	S	S	S	S	S	S	S	S
Octafluoropropane	•					S	S	S	S	S	S	S	S	I	I	S	S
*Oxygen					•	U	S	S	S	C	S	S	S	S	C	U	U
*Phosphine		•	•			S	I	I	S	S	S	S	S	I	I	I	I
Propane	•		•			S	S	S	S	S	S	S	S	S	S	S	S
Propylene	•		•			S	S	S	S	S	S	S	S	S	S	S	U
*Silane			•			S	S	S	S	S	S	S	S	S	S	S	S
Silicone Tetrachloride		•		•		U	U	U	S	S	S	S	S	S	U	U	U
Silicone Tetrafluoride		•		•		U	U	U	S	S	S	S	S	S	U	U	U
Sulfur Dioxide		•		•		S	U	S	S	S	S	S	S	S	S	U	U
Sulfur Hexafluoride	•					S	S	S	S	S	S	S	S	S	S	S	S
Sulfur Tetrafluoride		•		•		U	U	U	S	S	S	S	S	S	U	U	U
Tungsten Hexafluoride		•		•		U	U	U	S	S	S	S	S	S	U	U	U
Xenon	•					S	S	S	S	S	S	S	S	S	S	S	S

REGULATOR
CGA CONNECTIONS

GAS	CGA Inlet Connection
Acetylene	510
Air (Industrial)	590
Air (Breathing Air)	346
Allene	510
Ammonia	705, 240
Argon	580
Arsine	350
Boron Trichloride	660
Boron Trifluoride	330
Bromine Trifluoride	670
Bromine Pentafluoride	670
Bromotrifluoroethylene	510
1-3 Butadine	510
Butane	510
Butenes	510
Carbon Dioxide	320
Carbon Monoxide	350
Carbonyl Fluoride	750
Carbonyl Sulfide	330
Chlorine	660
Chlorine Trifluoride	670
Chlorotrifluoroethylene	510
Cyanogen	750
Cyanogen Chloride	750
Cyclopropane	510
Deuterium	350
Diborane	350
1,2-Dibromodifluoromethane	668
Dimethylamine	705
Dimethyl Ether	510
2-2 Dimethyl Propane	510
Ethane	350
Ethyl Acetylene	510
Ethyl Chloride	510
Ethylene	350
Ethylene Oxide	510
Fluorine	679
“Freon 12” (Dichlorodifluoromethane)	660
“Freon 13” (Chlorotrifluoromethane)	660
“Freon 13B1” (Bromotrifluoromethane)	660
“Freon 14” (Tetrafluoromethane)	580
“Freon 22” (Chlorodifluoromethane)	660
“Freon 114” (1, 2 Dichlorotetrafluoroethane)	660
“Freon 116” (Hexafluoroethane)	660
“Freon RC318” (Octafluorocyclobutane)	660
“Genetron 21” (Dichlorofluoromethane)	660
“Genetron 23” (Fluoroform)	660
“Genetron 115” (Monochloropentafluoroethane)	660
“Genetron 152A” (1, 1-Difluoroethylene)	350
“Genetron 1132A” (1, 1-Difluoroethylene)	350
Germane	350
Helium	580
Hexafluoroacetone	330
Hexafluoropropylene	660
Hydrogen	350
Hydrogen Bromide	330
Hydrogen Chloride	330
Hydrogen Fluoride	670
Hydrogen Selenide	350
Hydrogen Sulfide	330
Iodine Pentafluoride	670
Isobutane	510
Isobutylene	510
Krypton	580
Methane	350
Methyl Acetylene	510
Methyl Bromide	330
3-Methyl Butene-1	510
Methyl Chloride	510
Methyl Mercaptan	330
Monoethylamine	705
Monomethylamine	705
Natural Gas	350
Neon	580
Nickel Carbonyl	660
Nitric Oxide	660
Nitrogen	580
Nitrogen Dioxide	660
Nitrogen Trioxide	660
Nitrosyl Chloride	330
Nitrous Oxide (Formerly1320)	326
Oxygen	540
Perfluoro-2-Butene	660
Perfluoropropane	660
Phosgene	660
Phosphine	350
Phosphorous Pentafluoride	330
Propane	510
Propylene	510
Silane	350
Silicon Tetrafluoride	330
Sulfur Dioxide	660
Sulfur Hexafluoride	590
Sulfur Tetrafluoride	330
Sulfuryl Fluoride	660
Tetrafluoroethylene	350
Trimethylamine	705
Vinyl Bomide	510
Vinyl Chloride	510
Vinyl Fluoride	350
Vinyl Methyl Ether	510
Xenon	580

NOTE: The above are standard CGA connections and are designated by the Compressed Gas Association

SAFETY & TECHNICAL

GAS PROPERTIES

			THERMOPHYSICAL PROPERTIES							HAZARDOUS PROPERTIES			
Product	Formula	State	Molecular Weight	Vapor Pressure at 70˚ F (psig)	Specific Gravity at 70˚ F (1atm)	Critical Temp. (˚F)	Critical Pressure (psia)	Specific Volume (cf/lb)	Heat Capacity (Btu/lb. Mole ˚F)	Ignition Temp., (˚F)	Flammable Limits in Air (Vol.%)	Threshold Limit Value (ppm)	Physiological Properties
Acetylene	C_2H_2	Dissolved Gas	26.04	635	0.905	97.3	905.3	14.7	10.6	581	2.5-81	SA	
Air		Compressed Gas	28.97	*	1.00	-221.1	546.8	13.3					Oxidant
Ammonia	NH_3	Liquefied Gas	17.03	114	0.60	270.4	1639	22.6	8.6	1204	15-28	25	Corrosive and Toxic
Argon	Ar	Compressed Gas	39.95	*	1.38	-188.1	710	9.7	4.97			SA	Inert
Arsine	AsH_3	Liquefied Gas	77.95	205	2.69	211.8	957	5.0			4-64	0.05	Poison
n-Butane	C_4H_{10}	Liquefied Gas	58.12	16	2.08	305.6	550.8	6.4		788	1.8-8.4	800	Narcotic
Carbon Dioxide	CO_2	Liquefied Gas	44.01	838	1.52	87.8	1071	8.74	8.97			5,000	Inert
Carbon Monoxide	CO	Compressed Gas	28.01	*	0.97	-220.4	507.4	13.8	6.96	1204	12.5-74	50	Toxic
Chlorine	Cl_2	Liquefied Gas	70.91	85.3	2.47	291.2	1118.7	5.4	8.2			1	Oxidant and Toxic
Deuterium	D_2	Compressed Gas	4.03	*	0.139	-390.7	241	96.0	6.97	1058	4.9-75	SA	
Diborane	B_2H_6	Compress Gas	27.67	*	0.95	62.1	581			100	0.8-98	0.05	Highly Toxic
Ethane	C_2H_6	Liquefied Gas	30.07	543	1.047	90.1	708	12.8	12.6	986	3-12.4	SA	
Ethyl Chloride	C_2H_5Cl	Liquefied Gas	64.52			368.96	764.4				3.8-15.4	1000	
Ethylene	C_2H_4	Compressed Gas	28.05	*	0.974	49.8	742	13.8	10.4	1009	3.1-32	SA	
Helium	He	Compressed Gas	4.003	*	0.138	-450.3	33.2	96.7	4.98			SA	Inert
Hydrogen	H_2	Compressed Gas	2.02	*	0.0696	-399.96	190.8	192	6.89	1085	4-75	SA	
Hydrogen Chloride	HCl	Liquefied Gas	36.46	613	1.27	124.6	1200	10.6	6.9			5	Corrosive and Toxic
Hydrogen Sulfide	H_2S	Liquefied Gas	34.08	252	1.189	212.7	1308	11.2	8.2	500	4.3-45	10	Irritant and Toxic
Isobutane	C_4H_{10}	Liquefied Gas	58.12	30.8	2.0	275	592.2	6.5		864	1.8-8.4	SA	Anaesthetic
Krypton	Kr	Compressed Gas	83.8	*	2.898	-82.8	798	4.6	5.0			SA	Inert
Methane	CH_4	Compressed Gas	16.04	*	0.555	-115.8	673	23.7		1000	5-15	SA	
Methyl Chloride	CH_3Cl	Liquefied Gas	50.49	58.7	1.74	289.6	968	7.6	9.97	1170	10.7-17.4	50	Toxic
Neon	Ne	Compressed Gas	20.18	*	0.696	-379.8	384.9	19.2	4.97			SA	Inert
Nitrogen	N_2	Compressed Gas	28.01	*	0.967	-232.4	492.9	13.8	6.97			SA	Inert
Nitrous Oxide	N_20	Liquefied Gas	44.01	745	1.53	97.6	1054	8.7	9.2			25	Oxidant
Oxygen	O_2	Compressed Gas	32.0	*	1.105	-181.1	736.9	12.1	7.03				Oxidant
Phosphine	PH_3	Liquefied Gas	34.0	592.7	1.184	124.3	948	11.4		122	Treat as Pyrophoric	0.3	Poison
Propane	C_3H_8	Liquefied Gas	44.1	109	1.55	206.2	617.4	8.5	17.4	874	2.1-9.5	SA	
Silane	SiH_4	Compressed Gas	32.12	*	1.11	24.8	702.7	12.0			Pyrophoric	0.5	
Sulfur Dioxide	SO_2	Liquefied Gas	64.06	34.4	2.26	315	1143	5.9	9.6			2	Irritant and Toxic
Sulfur Hexafluoride	SF_6	Liquefied Gas	146.05	310	5.11	114	545	2.5				1000	Inert
Xenon	Xe	Compressed Gas	131.3	*	4.56	61.9	852.6	2.9	5.02			SA	Inert

* Above critical temperature @ 21.1 ˚C. SA Simple asphyxiant

CONVERSION TABLES

Multiply unit in left column by select applicable factor at right

VOLUME

	cu in	cu ft	cu yd	cu cm	cu meter	liter	US gal
1 cu in	1	-	-	16.387	-	0.02	-
1 cu ft	1,728.0	1	0.0370	28,317	0.0283	28.32	7.481
1 cu yd	46,656	27	1	-	0.7646	764.5	202.0
1 cu cm	0.06	-	-	1	-	0.001	-
1 cu meter	61,024	35.31	1.308	1,000,000	1	1,000	264.2
1 liter	61.024	0.0353	-	1,000	0.001	1	0.2642
1 gallon (US)	231	0.1337	0.00495	3,785.4	0.00379	3.785	1

PRESSURE

	psi	bar	atm	mm Hg	inch Hg	inch water	kPa
1 psi	1	0.0689	0.0680	51.713	2.0359	27.68	6.895
1 bar	14.504	1	0.9869	750.06	29.530	401.48	100
1 atm	14.696	1.01325	1	760	29.921	406.8	101.325
1 mm Hg (torr)	0.0193	0.0013	0.00132	1	0.0394	0.5352	0.133
1 MPa	145.038	10.00	9.8692	7500.62	295.30	4014.63	1000
1 in Hg	0.4912	0.0339	0.0334	25.4	1	13.596	3
1 in water	.0361	0.3587	0.0025	269.02	10.591	1	35.808
1 kPa	0.145	0.01	0.0099	7.519	0	4.015	1

WEIGHT

	grain	oz	lb	ton	gram	kg	metric ton
1 grain	1	0.00229	-	-	0.0648	-	-
1 ounce	437.5	1	0.0625	-	28.35	0.02835	-
1 pound	7,000	16.00	1.00	0.0005	453.60	0.4536	-
1 ton	-	32,000	2,000	1	-	907.2	0.9072
1 gram	15.43	0.04	-	-	1	0.001	-
1 kilogram	-	35.274	2.205	-	1,000	1	0.001
1 metric ton	-	35.274	2,205	1.102	-	1,000	1

FLOW

	scc/min	LPM	SCFM	L/hr	Nm^3/hr	SCFH
1 scc/min	1	0.001	-	0.06	-	0.00212
1 LPM	1,000	1	0.0353	60	0.06	2.119
1 SCFM	28,317	28	1	1,699	1.699	60
1 L/hr	16.667	0.01667	-	1	0.001	0.0353
1 Nm^3/hr	16,667	16.667	0.589	1,000	1	35.314
1 SCFH	471.95	0.472	0.0167	28.317	0.0283	1

SCFM Standard Cubic Feet per Minute
SCFH Standard Cubic Feet per Hour

scc/min Standard Cubic Centimeters per Minute
LPM Liters per Minute
Nm^3/hr Normal Cubic Meters per Hour

DENSITY

	lb/cu in	lb/cu ft	lb/gal	g/cm^3	g/liter
1 lb/cu in	1	1,728	231.00	27.68	27,680
1 lb/cu ft	-	1	0.1337	0.0160	16.019
1 lb/gal	0.00433	7.481	1	0.1198	119.83
1 g/cm^3	0.03613	62.43	8.345	1	1,000
1 g/liter	-	0.06243	0.008345	0.001	1

CONVERSION
LIQUID TO GAS

ARGON

	WEIGHT		GAS		LIQUID	
	Pounds (lbs)	Kilograms (Kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1	0.4536	9.671	0.2543	0.086	0.3255
1 Kilogram	2.205	1	21.32	0.5605	0.18957	0.7176
1 SCF Gas	0.1034	0.0469	1	0.02832	0.008893	0.03366
1 Nm^3 Gas	3.933	1.784	38.04	1	0.3382	1.2802
1 Gal Liquid	11.63	5.276	112.5	2.957	1	3.785
1 L Liquid	3.072	1.3936	29.71	0.7812	0.2642	1

CARBON DIOXIDE

	WEIGHT		GAS		LIQUID	
	Pounds (lbs)	Kilograms (Kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1.0	0.4536	8.741	0.2294	0.11806	0.4469
1 Kilogram	2.205	1.0	19.253	0.5058	0.2603	0.9860
1 SCF Gas	0.1144	0.05189	1.0	0.02832	0.013506	0.05113
1 Nm^3 Gas	4.359	1.9772	38.04	1.0	0.5146	1.9480
1 Gal Liquid	8.470	3.842	74.04	1.9431	1.0	3.785
1 L Liquid	2.238	1.0151	19.562	0.5134	0.2642	1.0

NITROGEN

	WEIGHT		GAS		LIQUID	
	Pounds (lbs)	Kilograms (Kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1.0	0.4536	13.803	0.3627	0.1481	0.5606
1 Kilogram	2.205	1.0	30.42	0.7996	0.3262	1.2349
1 SCF Gas	0.07245	0.03286	1.0	0.02832	0.01074	0.04065
1 Nm^3 Gas	2.757	1.2506	38.04	1.0	0.408	1.5443
1 Gal Liquid	6.745	3.060	93.11	2.447	1.0	3.785
1 L Liquid	1.782	0.8083	24.60	0.6464	0.2642	1.0

OXYGEN

	WEIGHT		GAS		LIQUID	
	Pounds (lbs)	Kilograms (Kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1.0	0.4536	12.076	0.3174	0.1050	0.3977
1 Kilogram	2.205	1.0	26.62	0.6998	0.2316	0.8767
1 SCF Gas	0.08281	0.03756	1.0	0.02832	0.008691	0.0329
1 Nm^3 Gas	3.151	1.4291	38.04	1.0	0.3310	1.2528
1 Gal Liquid	9.527	4.322	115.1	3.025	1.0	3.785
1 L Liquid	2.517	1.1417	30.38	0.7983	0.2642	1.0

SCF (Standard Cubic Foot) gas measured at 1 atmosphere and 70°F. Nm3 (normal cubic meter) measured at 1 atmosphere and 0°C. Liquid Argon, Oxygen and Nitrogen measured at 1 ATM and Boiling Point of Liquid Carbon Dioxide measured at 21.42 ATM and 1.7°F.

WARRANTY

SMITH EQUIPMENT *SPECIALTY GAS REGULATOR MANUFACTURERS WARRANTY*

SMITH EQUIPMENT SPECIALTY GAS REGULATOR MANUFACTURERS WARRANTY

General Purpose, High Purity Analytical, and High Purity Regulators

Smith Equipment warrants the initial user of the products sold that such products are free from defects in material and workmanship under normal use and service for a period of (2) two years from the date of shipment from the factory.

Corrosive Service Regulators

Smith Equipment warrants the initial user of the products sold that such products are free from defects in material and workmanship under normal use and service (see note #1) for a period of three months from the date of installation of the equipment or three months from the date of shipment from the factory, whichever comes first.

Note #1 A Cross-Purge Assembly must be used in conjunction with these models in order to ensure effective purging of hazardous gas traces during cylinder change out.

Within said warranty period, Smith Equipment agrees to replace or repair free of charge at its factory, any product or part that is found to have defects in workmanship or materials.

Smith Equipment will not pay for or warrant repairs made by anyone other than personnel authorized by Smith Equipment to make such repairs. SMITH EQUIPMENT SHALL NOT BE LIABLE FOR CONSEQUENTIAL, SPECIAL, INCIDENTAL, OR INDIRECT DAMAGES, TO THE EXTENT PERMITTED BY LAW. EXCEPT AS OTHERWISE PROVIDED BY LAW, THIS EXPRESS WARRANTY SHALL BE THE EXCLUSIVE WARRANTY AND SHALL BE IN LIEU OF ALL IMPLIED WARRANTIES, INCLUDING IMPLIED WARRANTIES OF FITNESS FOR PARTICULAR PURPOSE AND MERCHANTABILITY. The warranty and remedies provided in this express warranty shall not apply to any product which has been damaged by accident, abuse or misuse, or modified or changed in any way except by personnel authorized by Smith Equipment. THE REMEDIES STATED HEREIN SHALL BE EXCLUSIVE REMEDIES OF THE INITIAL USER UNDER THE EXPRESS WARRANTY CONTAINED HEREIN AND UNDER ANY OTHER WARRANTIES EXPRESS OR IMPLIED REQUIRED BY LAW.