

Appendix E: Ionization Potentials

Chemical Name	IP (eV)	Chemical Name	IP (eV)
Acetaldehyde	10.21	1-Butene	9.58
Acetamide	9.77	2-Butanone (MEK)	9.54
Acetic acid	10.69	cis-2-Butene	9.13
Acetic anhydride	10.00	trans-2-Butene	9.13
Acetone	9.69	3-Butene nitrile	10.39
Acetonitrile	12.20	n-Butyl acetate	10.01
Acetophenone	9.27	sec-Butyl acetate	9.91
Acetyl bromide	10.55	n-Butyl alcohol	10.04
Acetyl chloride	11.02	sec-Butyl alcohol	9.88
Acetylene	11.41	n-Butyl amine	8.71
Acrolein	10.10	s-Butyl amine	8.70
Acrylamide	9.50	t-Butyl amine	8.64
Acrylonitrile	10.91	n-Butyl benzene	8.69
Allyl alcohol	9.67	s-Butyl benzene	8.68
Allyl chloride	9.90	t-Butyl benzene	8.68
2-Amino pyridine	8.00	n-Butyl formate	10.50
Ammonia	10.20	Butyl mercaptan	9.15
Aniline	7.70	1-Butyne	10.18
Anisidine	7.44	n-Butyraldehyde	9.86
Anisole	8.22	n-Butyric acid	10.16
Arsine	9.89	n-Butyronitrile	11.67
Benzaldehyde	9.53	p-tert-Butyltoluene	8.28
Benzene	9.25	Camphor	8.76
Benzenethiol	8.33	Carbon dioxide	13.79
Benzonitrile	9.71	Carbon disulfide	10.07
Benzotrifluoride	9.68	Carbon monoxide	14.01
Biphenyl	8.27	Carbon tetrachloride	11.47
Boron oxide	13.50	Chlorine	11.48
Boron trifluoride	15.56	Chlorine dioxide	10.36
Bromine	10.54	Chlorine trifluoride	12.65
Bromobenzene	8.98	Chloroacetaldehyde	10.61
1-Bromobutane	10.13	α -Chloroacetophenone	9.44
2-Bromobutane	9.98	Chlorobenzene	9.07
1-Bromo-2-chloroethane	10.63	Chlorobromomethane	10.77
Bromochloromethane	10.77	1-Chlorobutane	10.67
1-Bromo-4-fluorobenzene	8.99	2-Chlorobutane	10.65
1-Bromo-2-methylpropane	10.09	1-Chloro-2-fluorobenzene	9.16
2-Bromo-2-methylpropane	9.89	1-Chloro-3-fluorobenzene	9.21
Bromoform	10.48	Chlorofluoromethane (Freon 22)	12.45
1-Bromopentane	10.10	Chloroform	11.37
1-Bromopropane	10.18	1-Chloro-2-methylpropane	10.66
2-Bromopropane	10.08	2-Chloro-2-methylpropane	10.61
1-Bromopropene	9.30	1-Chloropropane	10.82
3-Bromopropene	9.70	2-Chloropropane	10.78

Chemical Name	IP (eV)	Chemical Name	IP (eV)
---------------	---------	---------------	---------

Section 7: Appendices

2-Bromothiophene	8.63	3-Chloropropene	10.04
m-Bromotoluene	8.81	2-Chlorothiophene	8.68
o-Bromotoluene	8.79	m-Chlorotoluene	8.83
p-Bromotoluene	8.67	o-Chlorotoluene	8.83
1,3-Butadiene (butadiene)	9.07	p-Chlorotoluene	8.70
2,3-Butadione	9.23	Chlorotrifluoromethane (Freon 13)	12.91
Butane	10.63	Chrysene	7.59
1-Butanethiol	9.14	Cresol	8.14
Crotonaldehyde	9.73	Dimethoxymethane (methylal)	10.00
Cumene (isopropyl benzene)	8.75	Dimethylphthalate	9.64
Cyanogen	13.80	2,2-Dimethyl propane	10.35
Cyclohexane	9.80	Dimethyl sulfide	8.69
Cyclohexanol	9.75	Dinitrobenzene	10.71
Cyclohexanone	9.14	Dioxane	9.19
Cyclohexene	8.95	p-Dioxane	9.13
Cyclo-octatetraene	7.99	Diphenyl	7.95
Cyclopentadiene	8.56	Dipropyl amine	7.84
Cyclopentane	10.53	Dipropyl sulfide	8.30
Cyclopentanone	9.26	Durene	8.03
Cyclopentene	9.01	Epichlorohydrin	10.20
Cyclopropane	10.06	Ethane	11.65
Decaborane	9.88	Ethanethiol (ethyl mercaptan)	9.29
Diazomethane	9.00	Ethanolamine	8.96
Diborane	12.00	Ethene	10.52
Dibromochloromethane	10.59	Ethyl acetate	10.11
Dibromodifluoromethane	11.07	Ethyl alcohol	10.48
1,1-Dibromoethane	10.19	Ethyl amine	8.86
1,2-Dibromoethene	9.45	Ethyl benzene	8.76
Dibromomethane	10.49	Ethyl bromide	10.29
1,3-Dibromopropane	10.07	Ethyl chloride (chloroethane)	10.98
Dibutylamine	7.69	Ethyl disulfide	8.27
m-Dichlorobenzene	9.12	Ethylene chlorohydrin	10.52
o-Dichlorobenzene	9.06	Ethylene diamine	8.60
p-Dichlorobenzene	8.95	Ethylene dibromide	10.37
Dichlorodifluoromethane (Freon 12)	12.31	Ethylene dichloride	11.05
1,1-Dichloroethane	11.12	Ethylenimine	9.20
1,2-Dichloroethane	11.12	Ethylene oxide	10.57
cis-Dichloroethene	9.65	Ethyl ether	9.51
trans-Dichloroethene	9.66	Ethyl formate	10.61
Dichlorofluoromethane	12.39	Ethyl iodide	9.33
Dichloromethane	11.35	Ethyl isothiocyanate	9.14
1,2-Dichloropropane	10.87	Ethyl mercaptan	9.29
1,3-Dichloropropane	10.85	Ethyl methyl sulfide	8.55
2,3-Dichloropropene	9.82	Ethyl nitrate	11.22

Chemical Name	IP (eV)	Chemical Name	IP (eV)
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	12.20	Ethyl propionate	10.00
Diethoxymethane	9.70	Ethyl thiocyanate	9.89

N,N-Diethyl acetamide	8.60	Ethynylbenzene	8.82
Diethyl amine	8.01	Fluorine	15.70
Diethyl ether	9.53	Fluorobenzene	9.20
N,N-Diethyl formamide	8.89	o-Fluorophenol	8.66
Diethyl ketone	9.32	m-Fluorotoluene	8.92
Diethyl sulfide	8.43	o-Fluorotoluene	8.92
Diethyl sulfite	9.68	p-Fluorotoluene	8.79
Difluorodibromomethane	11.07	Formaldehyde	10.87
Dihydropyran	8.34	Formamide	10.25
Diiodomethane	9.34	Formic acid	11.05
Diisopropylamine	7.73	Freon 11 (trichlorofluoromethane)	11.77
N,N-Dimethyl acetamide	8.81	Freon 12 (dichlorodifluoromethane)	12.31
Dimethyl amine	8.24	Freon 13 (chlorotrifluoromethane)	12.91
Dimethylaniline	7.13	Freon 22 (chlorofluoromethane)	12.45
2,2-Dimethyl butane	10.06	Freon 112 (1,1,2,2-tetrachloro-1,2-difluoroethane)	11.30
2,3-Dimethyl butane	10.02	Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane)	11.78
3,3-Dimethyl butanone	9.17	Freon 114 (1,2-dichloro-1,1,2,2-tetrafluoroethane)	12.20
Dimethyl ether	10.00	2-Furaldehyde	9.21
Dimethylformamide	9.18	Furan	8.89
N,N-Dimethyl formamide	9.12	Furfural	9.21
1,1-Dimethylhydrazine	7.28	Heptane	10.08
1,1-Dimethoxyethane	9.65	2-Heptanone	9.33
Hexachloroethane	11.10	2-Methyl-1-butene	9.12
Hexane	10.18	3-Methyl-1-butene	9.51
2-Hexanone	9.35	3-Methyl-2-butene	8.67
1-Hexene	9.46	Methyl butyl ketone	9.34
Hydrazine	8.10	Methyl butyrate	10.07
Hydrogen	15.43	Methyl cellosolve	9.60
Hydrogen bromide	11.62	Methyl chloride	11.28
Hydrogen chloride	12.74	Methyl chloroform (1,1,1-trichloroethane)	11.00
Hydrogen cyanide	13.91	Methylcyclohexane	9.85
Hydrogen fluoride	15.77	4-Methylcyclohexene	8.91
Hydrogen iodide	10.38	Methyl disulfide	8.46
Hydrogen selenide	9.88	Methylene chloride	11.32
Hydrogen sulfide	10.46	Methyl ethyl ketone	9.53
Hydrogen telluride	9.14	Methyl formate	10.82
Hydroquinone	7.95	2-Methyl furan	8.39
Iodine	9.28	Methyl iodide	9.54
Iodobenzene	8.73	Methyl isobutyl ketone	9.30
Chemical Name	IP (eV)	Chemical Name	IP (eV)
1-Iodobutane	9.21	Methyl isobutyrate	9.98
2-Iodobutane	9.09	Methyl isocyanate	10.67
1-Iodo-2-methylpropane	9.18	Methyl isopropyl ketone	9.32
1-Iodopentane	9.19	Methyl isothiocyanate	9.25
1-Iodopropane	9.26	Methyl mercaptan	9.44
2-Iodopropane	9.17	Methyl methacrylate	9.70

Section 7: Appendices

m-Iodotoluene	8.61	1-Methyl naphthalene	7.96
o-Iodotoluene	8.62	2-Methyl naphthalene	7.96
p-Iodotoluene	8.50	2-Methylpentane	10.12
Isobutane	10.57	3-Methylpentane	10.08
Isobutyl acetate	9.97	2-Methyl propene	9.23
Isobutyl alcohol	10.12	Methyl propionate	10.15
Isobutyl amine	8.70	Methyl propyl ketone	9.39
Isobutyl formate	10.46	α -Methyl styrene	8.35
Isobutyraldehyde	9.74	Methyl thiocyanate	10.07
Isobutyric acid	10.02	Monomethyl aniline	7.32
Isopentane	10.32	Monomethyl hydrazine	7.67
Isophorone	9.07	Morpholine	8.20
Isoprene	8.85	Naphthalene	8.12
Isopropyl acetate	9.99	Nickel carbonyl	8.27
Isopropyl alcohol	10.16	Nitric oxide, (NO)	9.25
Isopropyl amine	8.72	Nitrobenzene	9.92
Isopropyl benzene	8.69	p-Nitrochloro benzene	9.96
Isopropyl ether	9.20	Nitroethane	10.88
Isovaleraldehyde	9.71	Nitrogen	15.58
Ketene	9.61	Nitrogen dioxide	9.78
2,3-Lutidine	8.85	Nitrogen trifluoride	12.97
2,4-Lutidine	8.85	Nitromethane	11.08
2,6-Lutidine	8.85	1-Nitropropane	10.88
Maleic anhydride	10.80	2-Nitropropane	10.71
Mesitylene	8.40	Nitrotoluene	9.45
Mesityl oxide	9.08	Octane	9.82
Methane	12.98	Oxygen	12.08
Methanethiol (methyl mercaptan)	9.44	Ozone	12.08
n-Methyl acetamide	8.90	Pentaborane	10.40
Methyl acetate	10.27	Pentane	10.35
Methyl acetylene	10.37	2,4-Pentanedione	8.87
Methyl acrylate	9.90	2-Pentanone	9.38
Methylal (dimethoxymethane)	10.00	1-Pentene	9.50
Methyl alcohol	10.85	Perchloroethylene	9.32
Methyl amine	8.97	Pheneloic	8.18
Methyl-n-amyl ketone	9.30	Phenol	8.50
Methyl bromide	10.54	Phenylene diamine	6.89
Phenyl ether (diphenyl oxide)	8.82	Sulfuryl fluoride	13.00
Phenyl hydrazine	7.64	o-Terphenyls	7.78

Chemical Name	IP (eV)	Chemical Name	IP (eV)
Phenyl isocyanate	8.77	1,1,2,2-Tetrachloro-1,2-difluoroethane (Freon 112)	11.30
Phenyl isothiocyanate	8.52	Tetrachloroethane	11.62
Phosgene	11.77	Tetrachloroethene	9.32
Phosphine	9.87	Tetrachloromethane	11.47
Phosphorus trichloride	9.91	Tetrahydrofuran	9.54
Phthalic anhydride	10.00	Tetrahydropyran	9.25
2-Picoline	9.02	Thiolacetic acid	10.00
3-Picoline	9.02	Thiophene	8.86
4-Picoline	9.04	Toluene	8.82
Propane	11.07	o-Toluidine	7.44
1-Propanethiol	9.20	Tribromoethene	9.27
Propargyl alcohol	10.51	Tribromofluoromethane	10.67
Propiolactone	9.70	Tribromomethane	10.51
Propionaldehyde	9.98	1,1,1-Trichloroethane	11.00
Propionic acid	10.24	Trichloroethene	9.45
Propionitrile	11.84	Trichloroethylene	9.47
Propyl acetate	10.04	Trichlorofluoromethane (Freon 11)	11.77
Propyl alcohol	10.20	Trichloromethane	11.42
Propyl amine	8.78	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	11.78
Propyl benzene	8.72	Triethylamine	7.50
Propylene	9.73	Trifluoromonobromo-methane	11.40
Propylene dichloride	10.87	Trimethyl amine	7.82
Propylene imine	9.00	2,2,4-Trimethyl pentane	9.86
Propylene oxide	10.22	Tripropyl amine	7.23
Propyl ether	9.27	Valeraldehyde	9.82
Propyl formate	10.54	Valeric acid	10.12
n-Propyl nitrate	11.07	Vinyl acetate	9.19
Propyne	10.36	Vinyl bromide	9.80
Pyridine	9.32	Vinyl chloride	10.00
Pyrrole	8.20	Vinyl methyl ether	8.93
Quinone	10.04	o-Vinyl toluene	8.20
Stibine	9.51	Water	12.59
Styrene	8.47	m-Xylene	8.56
Sulfur dioxide	12.30	o-Xylene	8.56
Sulfur hexafluoride	15.33	p-Xylene	8.45
Sulfur monochloride	9.66	2,4-Xylidine	7.65

Section 7: Appendices

ETHYGLYCOL	ETHYLENEGLYCOL	15.30
ETHYLACETATE	ETHYLACETATE	5.68
ETHYLENE	ETHYLENE	10.20
HEPTANE	HEPTANE	4.46
HEXANE	HEXANE	6.23
IAMYLACETATE	ISOAMYLACETATE	6.06
IPROPYLAMINE	ISOPROPYL AMINE	1.28
IPROPYLETHER	ISOPROPYL ETHER	0.84
ISOBUTANOL	ISOBUTANOL	4.99
ISOBUTYLENE	ISOBUTYLENE	1.00
ISOOCTANE	ISOOCTANE	1.86
ISOPHORONE	ISOPHORONE	0.74
M-XYLENE	META-XYLENE	0.45
MESITYLOXIDE	MESITYLOXIDE	0.54
MIBK	METHYL ISOBUTYL KETONE	1.21
MTBE	METHYL TERTIARY BUTYLETHER	0.89
O-XYLENE	ORTHO-XYLENE	0.54
OCTANE	OCTANE	2.71
P-XYLENE	PARA-XYLENE	0.47
PHOSPHINE	PHOSPHINE	3.02
PROPYLENE	PROPYLENE	1.41
PROPYOX	PROPYLENE OXIDE	16.02
PYRIDINE	PYRIDINE	0.78
QUINOLINE	QUINOLINE	0.97
T-BUTYLAMINE	TERTIARY BUTYLAMINE	1.01
T-CLC2H2CL	TRISDICHOROETHENE	0.45
THF	TETRAHYDROFURAN	2.06
THIOPHENE	THIOPHENE	0.41
TOLUENE	TOLUENE	0.54

† As it appears in the Sample Gas display page. Note that an "X" in the abbreviated name indicates the word "METHYL".

WARNING

Response factors apply in the 0-500 ppm range and are accurate to $\pm 25\%$. The values in this table were obtained using dry bottled gases. These response factors apply only to 10.6 eV lamps. They are not valid for instruments using PID lamps at any other energy. Using these response factors with a lamp at any other energy will critically compromise the instrument's ability to detect organic compounds.

Section 7. Appendices

Appendix A: Response Factor Table

ABBREVIATED NAME†	CHEMICAL NAME	RESPONSE FACTOR
1,4-DIOXANE	1,4-DIOXANE	1.48
1-BUTANOL	1-BUTANOL	6.02
1-PROPANOL	1-PROPANOL	11.69
123(CH ₃)C ₆ H ₅	1,2,3-TRIMETHYLBENZENE	0.49
124(CH ₃)C ₆ H ₅	1,2,4-TRIMETHYLBENZENE	0.43
12C ₂ H ₂ BR ₂	1,2-DIBROMOETHANE	11.66
12CL ₂ C ₆ H ₆	1,2-DICHLOROETHANE	0.62
135(CH ₃)C ₆ H ₅	1,3,5-TRIMETHYLBENZENE	0.34
1MTHO2PROPOL	1-METHOXY-2-PROPANOL	1.85
1XACETATE	METHYLACETATE	8.50
1XACRYLAC	METHYLACRYLATE	8.21
1XACTOACETAT	METHYLACETOACETATE	1.30
1XBENZOATE	METHYLBENZOATE	0.93
1XMTHACRYLAT	METHYLMETHACRYLATE	2.20
2-BUTANONE	2-BUTANONE	0.90
2-PENTANONE	2-PENTANONE	0.87
2-PROPANOL	2-PROPANOL	8.35
2MTHOXYETOH	2-METHOXYETHANOL	3.64
2XFORMAMIDE	N,N-DIMETHYLFORMAMIDE	1.13
2XMTACETAMID	N,N-DIMETHYLACETOAMIDE	0.66
4HYD4MTH2PNT	4-HYDROXY-4-METHYL-2-PENTANONE	0.73
ACETONE	ACETONE	1.24
ACETOPHENONE	ACETOPHENONE	0.59
AMYL ACETATE	AMYL ACETATE	5.31
BENZENE	BENZENE	0.55
BROMOMETHANE	BROMOMETHANE	2.72
BUTADIENE	BUTADIENE	0.69
BUTYLACETATE	BUTYLACETATE	8.03
C ₂ CL ₄	TETRACHLOROETHYLENE	0.60
C ₂ HCL ₃	TRICHLOROETHYLENE	0.69
C ₂ H ₄ CL ₂	DICHLOROETHANE	12.33
(C ₂ H ₅)C ₆ H ₅	ETHYLBENZENE	0.62
C ₆ H ₁₀ O ₃	ETHYLACETOACETATE	1.14
CHLOROBENZEN	CHLOROBENZENE	0.49
CUMENE	CUMENE	0.54
CYCLOHEXANE	CYCLOHEXANE	1.54
CYCLOHEXANON	CYCLOHEXANONE	0.82
DECANE	DECANE	3.66
ABBREVIATED NAME†	CHEMICAL NAME	RESPONSE FACTOR
DIETHYLAMINE	DIETHYLAMINE	0.89
DIMETHOXMETH	DIMETHOXYMETHANE	11.27

Table 7-4.
COMBUSTIBLE GAS - Cross Reference Factors
for Sirius General-Purpose Calibration Using Calibration Cylinder
(P/N 10045035) Set to 58% LEL Pentane Simulant

COMBUSTIBLE GAS	MULTIPLY %LEL READING BY
Acetone	1.1
Acetylene	0.7
Acrylonitrile ¹	0.8
Benzene	1.1
Butane	1.0
1,3 Butadiene	0.9
n-Butanol	1.8
Carbon Disulfide ¹	2.2
Cyclohexane	1.1
2,2 Dimethylbutane	1.2
2,3 Dimethylpentane	1.2
Ethane	0.7
Ethyl Acetate	1.2
Ethyl Alcohol	0.8
Ethylene	0.7
Formaldehyde ²	0.5
Gasoline	1.3
Heptane	1.4
Hydrogen	0.6
n-Hexane	1.3
Isobutane	0.9
Isobutyl Acetate	1.5
Isopropyl Alcohol	1.1
Methane	0.6
Methanol	0.6
Methyl Isobutyl ketone	1.1
Methylcyclohexane	1.1
Methyl Ethyl Ketone	1.1
Methyl Tertiary Butyl Ether	1.0
Mineral Spirits	1.1
iso-Octane	1.1
n-Pentane	1.0
Propane	0.8
Propylene	0.8
Styrene ²	1.9

Table 7-3. COMBUSTIBLE GAS - Typical Performance Specifications

RANGE	0 to 100% LEL
RESOLUTION	1% LEL
REPRODUCIBILITY	3% LEL to 50% LEL reading
	5% LEL to full scale or
RESPONSE TIME	90% of final reading in 30 seconds (normal temperature range)*
*See TABLE 7-2, NOTE 1.	

Table 7-4. COMBUSTIBLE GAS - Cross Reference Factors for Orion General-Purpose Calibration Using Calibration Cylinder (P/N 478191), (P/N 478192), (P/N 804769), or (P/N 804770) Set to 58% LEL

COMBUSTIBLE GAS	MULTIPLY %LEL READING BY	COMBUSTIBLE GAS	MULTIPLY %LEL READING BY
Acetone	1.1	Methyl Isobutyl ketone	1.1
Acetylene	0.7	Methylcyclohexane	1.1
Acrylonitrile ¹	0.8	Methyl Ethyl Ketone	1.1
Benzene	1.1	Methyl Tertiary Butyl Ether	1.0
Butane	1.0	Mineral Spirits	1.1
1,3 Butadiene	0.9	iso-Octane	1.1
n-Butanol	1.8	n-Pentane	1.0
Carbon Disulfide ¹	2.2	Propane	0.8
Cyclohexane	1.1	Propylene	0.8
2,2 Dimethylbutane	1.2	Styrene ²	1.9
2,3 Dimethylpentane	1.2	Tetrahydrofuran	0.9
Ethane	0.7	Toluene	1.1
Ethyl Acetate	1.2	Vinyl Acetate	0.9
Ethyl Alcohol	0.8	VM&P Naptha	1.6
Ethylene	0.7	O-Xylene	1.2
Formaldehyde ²	0.5	RESPONSE NOTES: 1. The compounds may reduce the sensitivity of the combustible gas sensor by poisoning or inhibiting the catalytic action. 2. These compounds may reduce the sensitivity of the combustible gas sensor by polymerizing on the catalytic surface. 3. For an instrument calibrated on Pentane, multiply the displayed %LEL value by the conversion factor above to get the true %LEL. 4. These conversion factors should be used only if the combustible gas is known. 5. These conversion factors are typical for a Orion Multigas Detector. Individual units may vary by + 25% from these values.	
Gasoline (unleaded)	1.3		
Heptane	1.1		
Hydrogen	0.6		
n-Hexane	1.3		
Isobutane	0.9		
Isobutyl Acetate	1.5		
Isopropyl Alcohol	1.1		
Methane	0.5		
Methanol	0.6		