

APPENDIX

B

DATA TABLES

These tables are adapted from Reference [9]. See footnotes for explanations of symbols.

*Flammability Data for Gases and Vapors in Dry Air at 1 atm, 25°C
Except Where Indicated*

| Gas/Vapor | LMIE = G (mJ) | Stoi (vol%) | Opt = C ₀ (vol%) | LFL (vol%) | UFL (vol%) | Su (cm/s) | LOC in N ₂ (vol%) |
|-------------------------------|----------------------------------|----------------|--------------------------------|---------------|---------------|--------------|---------------------------------|
| acetaldehyde | 0.13(a) | 7.73 | | 4.0 | 57.0 | | |
| acetone | 0.19(a) | 4.97 | | 2.6 | 12.8 | 54 | 11.5 |
| acetone (in oxygen) | 0.0024 | | | 2.5 | 60 | | n/a |
| acetylene | 0.017 | 7.72 | 8.5 | 2.5 | 100 | 166 | 0 |
| acetylene (in oxygen) | 0.0002 | 28.6 | 40 | 2.5 | 100 | 1140 | n/a |
| acetylene (decomp @ 1 atm) | 10 ³ -10 ⁵ | 100 | 100 | n/a | 100 | | 0 |
| acetylene (decomp @ 2 atm) | 10 ² -10 ³ | 100 | 100 | n/a | 100 | | 0 |
| acrolein | 0.13 | 5.64 | | 2.8 | 31 | 66 | |
| acrylonitrile | 0.16 | 5.29 | 9.0 | 3.0 | 17.0 | 50 | |
| allyl chloride | 0.77(b) | | | 2.9 | 11.1 | | |
| ammonia | 680 | 21.8 | | 15 | 28 | | |
| benzene | 0.20 | 2.72 | 4.7 | 1.2 | 7.8 | 48 | 11.4 |
| 1,3 butadiene | 0.13 | 3.67 | 5.2 | 2.0 | 12 | 68 | 10.5 |
| n-butane | 0.25 | 3.12 | 4.7 | 1.6 | 8.4 | 45 | 12 |
| n-butane (in oxygen) | 0.009 | 13.3 | | 1.6 | 49 | | n/a |

| Gas/Vapor | LMIE = G (mJ) | Stoi (vol%) | Opt = C ₀ (vol%) | LFL (vol%) | UFL (vol%) | Su (cm/s) | LOC in N ₂ (vol%) |
|--------------------------------|------------------|----------------|--------------------------------|---------------|---------------|--------------|---------------------------------|
| <i>n</i> -butyl chloride | 1.24(b) | 3.37 | | 1.8 | 10.1 | | |
| carbon disulfide | 0.009 | 6.53 | 7.8 | 1.0 | 50.0 | 58 | 5 |
| cyclohexane | 0.22 | 2.27 | 3.8 | 1.3 | 8.0 | 46 | |
| cyclopentadiene | 0.17(a) | | | | | 46 | |
| cyclopentane | 0.24(a) | 2.71 | | 1.5 | | 44 | |
| cyclopropane | 0.17 | 4.44 | 6.3 | 2.4 | 10.4 | 56 | 11.5 |
| cyclopropane (in oxygen) | 0.001 | | 17 | 2.5 | 60 | | n/a |
| dichlorosilane | 0.015 | 17.4 | | 4.7 | 96 | | |
| diethyl ether | 0.19 | 3.37 | 5.1 | 1.9 | 36 | 47 | 10.5 |
| diethyl ether (in oxygen) | 0.0012 | | 14 | 2.0 | 82 | | n/a |
| dihydropyran | 0.36 | | | | | | |
| diisobutylene | 0.23(a) | | | 1.1 | 6.0 | | |
| diisopropyl ether | 0.23(a) | | | 1.4 | 7.9 | | |
| dimethoxymethane (methylal) | 0.12(a) | | | 2.2 | 13.8 | | |
| 2,2-dimethylbutane | 0.25 | 2.16 | 3.4 | 1.2 | 7.0 | 42 | |
| dimethyl ether | 0.15(a) | | | 3.4 | 27.0 | 54 | |
| 2,2-dimethyl propane | 1.57 | | | 1.4 | 7.5 | 39 | |
| dimethyl sulfide | 0.48(b) | | | 2.2 | 19.7 | | |
| di- <i>t</i> -butyl peroxide | 0.41 | | | | | | |
| ethane | 0.23 | 5.64 | 6.5 | 3.0 | 12.5 | 47 | 11 |
| ethane (in oxygen) | 0.0019 | 22.2 | 17 | 3.0 | 66 | | n/a |
| ethanol | 0.23(a) | 6.53 | | 3.3 | 19 | | 10.5 |
| ethyl acetate | 0.23(a) | 4.02 | 5.2 | 2.0 | 11.5 | 38 | |
| ethyl acrylate | 0.18(a) | | | 1.4 | 14 | | 8 |
| ethylamine | 0.19(a) | 5.28 | | 3.5 | 14 | | |
| ethylene | 0.084 | 6.53 | 7.5 | 2.7 | 36 | 80 | 10 |
| ethylene (in oxygen) | 0.00094 | 25.0 | 22.5 | 3.0 | 80 | | n/a |
| ethyleneimine | 0.11(a) | | | 3.6 | 46 | 46 | |
| ethylene oxide | 0.065 | 7.72 | 10.8 | 3.0 | 100 | 108 | 0 |
| ethylene oxide (decomp) | ~1500 | 100 | n/a | n/a | 100 | | 0 |

| Gas/Vapor | LMIE = G (mJ) | Stoi (vol%) | Opt = C ₀ (vol%) | LFL (vol%) | UFL (vol%) | Su (cm/s) | LOC in N ₂ (vol%) |
|-----------------------------------|------------------|----------------|--------------------------------|---------------|---------------|--------------|---------------------------------|
| furan | 0.14(a) | 4.44 | | 2.3 | 14.3 | | |
| <i>n</i> -heptane | 0.24 | 1.87 | 3.4 | 1.05 | 6.7 | 46 | 11.5 |
| <i>n</i> -hexane | 0.24 | 2.16 | 3.8 | 1.1 | 7.5 | 46 | 12 |
| <i>n</i> -hexane (in oxygen) | 0.006 | 9.52 | | 1.2 | 52* | | n/a |
| hydrogen | 0.016 | 29.5 | 28 | 5±1 | 75 | 312 | 5 |
| hydrogen (in oxygen) | 0.0012 | 66.7 | | 4.0 | 94 | 1400 | n/a |
| hydrogen (in nitric oxide) | 8.7 | 50.0 | | | | | n/a |
| hydrogen sulfide | 0.068 | | | 4.0 | 44 | | 7.5 |
| isooctane | 0.25(a) | 1.65 | | 0.95 | 6.0 | 41 | |
| isopropyl alcohol | 0.21(a) | 4.44 | | 2.0 | 12.7 | 41 | |
| isopropyl chloride | 1.08(b) | | | 2.8 | 10.7 | | |
| isopropylamine | 0.23(a) | | | | | 31 | |
| methane | 0.21 | 9.47 | 8.5 | 5.0 | 15.0 | 40 | 12 |
| methane (in oxygen) | 0.0027 | 33.3 | 23 | 5.1 | 61 | 450 | n/a |
| methane (in nitric oxide) | 8.7 | | | | | | n/a |
| methanol | 0.14 | 12.24 | 14.7 | 6.0 | 36.0 | 56 | 10 |
| methylacetylene | 0.11 | 4.98 | 6.5 | 1.7 | | | |
| methyl acrylate | 0.18(a) | | | 2.8 | 25 | | 8.7 |
| methylene chloride | >1000 | | | 14 | 22 | | 19 |
| methylene chloride (in oxygen) | 0.137 | | | 11.7 | 68 | | n/a |
| methyl ethyl ketone | 0.21(a) | 3.66 | 5.3 | 2.0 | 12.0 | | 11 |
| methyl butane (isopentane) | 0.21 | 2.55 | 3.8 | 1.4 | 7.6 | 43 | 12 |
| methyl cyclohexane | 0.27 | 1.96 | 3.5 | 1.2 | 6.7 | 44 | |
| methyl formate | 0.13(a) | | | 4.5 | 23 | | |
| <i>n</i> -pentane | 0.28 | 2.55 | 3.3 | 1.5 | 7.8 | 46 | 12 |
| 2-methyl pentene | 0.18 | 2.72 | 4.4 | | | 47 | |
| propadiene | 0.087(a) | | | | | | |
| propane | 0.25 | 4.02 | 5.2 | 2.1 | 9.5 | 46 | 11.5 |
| propane (in oxygen) | 0.0021 | 16.7 | 15 | | | | n/a |
| propionaldehyde | 0.18(a) | | | 2.6 | 17 | 58 | |

| Gas/Vapor | LMIE = G (mJ) | Stoi (vol%) | Opt = C ₀ (vol%) | LFL (vol%) | UFL (vol%) | Su (cm/s) | LOC in N ₂ (vol%) |
|--------------------------------|------------------|----------------|--------------------------------|---------------|---------------|--------------|---------------------------------|
| <i>n</i> -propyl chloride | 1.08(b) | | | 2.6 | 11.1 | | |
| propylene | 0.18(a) | 4.45 | | 2.0 | 11.0 | 52 | 11.5 |
| propylene oxide | 0.13 | 4.98 | 7.5 | 2.3 | 36.0 | 82 | 7.8 |
| isopropyl mercaptan | 0.53(b) | | | | | | |
| styrene | 0.18(a) | 2.05 | | 0.9 | 6.8 | | 9.0 |
| tetrahydrofuran | 0.19(a) | | | 2.0 | 11.8 | | |
| tetrahydropyran | 0.22 | | 4.7 | | | 48 | |
| thiophene | 0.39(b) | | | | | | |
| toluene | 0.24 | 2.27 | 4.1 | 1.1 | 7.1 | 41 | 9.5 |
| trichloroethane | | | | 7.5 | 12.5 | | 14 |
| trichloroethane (in oxygen) | 0.092 | | | 5.5* | 57* | | n/a |
| trichlorosilane | 0.017 | | | 7.0 | 83 | | |
| triethylamine | 0.22(a) | 2.10 | | 1.2 | 8.0 | | |
| vinyl acetate | 0.16(a) | 4.45 | | 2.6 | 13.4 | | |
| vinyl acetylene | 0.082 | | | 1.7 | 100 | | 0 |
| xylene(s) | 0.2 | 1.96 | | 1.0 | 7.0 | | |

LMIE = lowest minimum ignition energy measured at optimum concentration
[G in Eq. (6-1.3.1)]

Stoi = stoichiometric concentration

Opt = optimum concentration at which LMIE was measured [C₀ in Eq. (6-1.3.1)]

LFL = lower flammable limit

UFL = upper flammable limit

Su = fundamental burning velocity

LOC = limiting oxygen concentration of fuel–oxygen–nitrogen mixture

n/a = not applicable

(a) = LMIE calculated using heat of oxidation method [229]

(b) = LMIE is too high (measured at stoichiometric concentration)

but is not amenable to calculation using the heat of oxidation method [229]

Note 1: It is possible that the fuel concentration most easily ignited by capacitive spark discharge, as reported in this table (C₀), might differ from that most easily ignited by other types of static discharge (eg brush discharge). See 2-6.2.1.

Note 2: LFL and UFL values in air taken primarily from NFPA 325.

Note 3: LMIE, LFL and UFL values in oxygen taken primarily from NFPA 53 (* denotes elevated temperature).

Note 4: Su values taken from [223].

Note 5: LOC values taken primarily from NFPA 69. Some reported values might be too high (see reference [229]).