

TABLE 6. APPROXIMATE LIMITS OF FLAMMABILITY OF SINGLE GASES AND VAPORS IN AIR AT ORDINARY TEMPERATURES AND PRESSURES^a

GAS OR VAPOR	LOWER LIMIT PER CENT BY VOLUME	UPPER LIMIT PER CENT BY VOLUME	Closed Cup FLASH POINT F DEG.
Acetaldehyde.....	4.0	57	-17
Acetone.....	2.1	13.0	0
Acetylene ^b	2.5	80	70
Allyl alcohol.....	2.4	27.0	91
Ammonia.....	16.0	27.0	12
Amyl alcohol.....	1.2	8.0	140
Amyl chloride.....	1.4	8.0	91
Amylene.....	1.6	8.0	91
Benzene (benzol).....	1.4	8.0	12
Benzyl chloride.....	1.1	8.0	140
Butane.....	1.6	8.5	-76
Butyl acetate.....	1.7	15.0	72
Butyl alcohol.....	1.7	15.0	84
Butylene.....	1.7	9.0	-22
Carbon disulfide.....	1.0	50	-22
Carbon monoxide.....	12.5	74	55
Crotonaldehyde.....	2.1	15.5	1
Cyclohexane.....	1.3	8.4	115
Cyclopropane.....	2.4	10.3	115
Decane.....	0.67	2.6	115
Dichloroethylene (1, 2).....	9.7	12.8	43
Diethyl selenide.....	2.5	12.8	43
Dioxan.....	2.0	22.2	65
Ethane.....	3.1	15.0	65
Ether (diethyl).....	1.7	48.0	-20
Ethyl acetate.....	2.2	11.5	24
Ethyl alcohol.....	3.3	19.0	55
Ethyl bromide.....	6.7	11.3	55
Ethyl cellosolve.....	2.6	15.7	104
Ethyl chloride.....	3.6	14.8	-58
Ethylene.....	3.0	34.0	56
Ethylene dichloride.....	6.2	15.9	-4
Ethyl formate.....	2.7	16.5	-31
Ethyl nitrite.....	3.0	16.5	-31
Ethylene oxide.....	3.0	80	-31
Furfural (125 C).....	2.1	6.5	140
Gasoline.....	1.3	6.5	-50
Heptane.....	1.0	6.0	25
Hexane.....	1.2	6.9	-7
Hydrogen cyanide.....	5.6	40.0	0
Hydrogen.....	4.1	74	82
Hydrogen sulfide.....	4.3	45.5	82
Illuminating gas.....	5.3	31.0	82
Iso-butyl alcohol.....	1.7	15.0	82
Iso-pentane.....	1.3	15.0	82
Iso-propyl acetate.....	1.8	7.8	43
Iso-propyl alcohol.....	2.5	15.0	53
Methane ^b	5.0	15.0	53

^aAdapted from: Limits of Inflammability of Gases and Vapors, by H. F. Coward and G. W. Jones (U. S. Bureau of Mines, Bulletin No. 279, 1939); Properties of Flammable Liquids, Gases and Solids (Associated Factory Mutual Fire Ins. Cos., January, 1940); and National Fire Codes for Flammable Liquids, Gases, Chemicals and Explosives—1945 (National Fire Protection Association).

^bTurbulent mixture.

^cClosed cup refers to the equipment used in flash point determinations.

TABLE 6. APPROXIMATE LIMITS OF FLAMMABILITY OF SINGLE GASES AND VAPORS IN AIR AT ORDINARY TEMPERATURES AND PRESSURES^a (Continued)

GAS OR VAPOR	LOWER LIMIT PER CENT BY VOLUME	UPPER LIMIT PER CENT BY VOLUME	Closed Cup FLASH POINT F DEG.
Methyl acetate.....	3.1	15.5	15
Methyl alcohol.....	6.0	36.5	54
Methyl bromide.....	13.5	14.5	54
Methyl butyl ketone.....	1.2	8.0	54
Methyl chloride.....	8.0	19.7	54
Methyl cyclohexane.....	1.1	10.1	25
Methyl ethyl ether.....	2.0	10.1	-35
Methyl ethyl ketone.....	1.8	11.5	30
Methyl formate.....	5.0	22.7	-2
Methyl propyl ketone.....	1.5	8.2	-2
Natural gas.....	4.8	13.5	20-45
Naphtha (benzine).....	1.1	6.0	174
Naphthalene.....	0.9	2.9	88
Nonane.....	0.74	3.2	56
Octane.....	0.84	3.2	56
Paraldehyde.....	1.3	8.0	59
Pentane.....	1.4	8.0	59
Propane.....	2.4	9.5	58
Propyl acetate.....	1.8	8.0	59
Propyl alcohol.....	2.5	8.0	59
Propylene.....	2.0	11.1	59
Propylene dichloride.....	3.4	14.5	59
Propylene oxide.....	2.1	21.5	68
Pyridine (70 C).....	1.8	12.4	40
Toluene (toluol).....	1.3	7.0	40
Turpentine.....	0.8	27.0	95
Vinyl ether.....	1.7	27.0	95
Vinyl chloride.....	4.0	22.0	95
Water gas (variable).....	6.0	70	63
Xylene (xylol).....	1.0	6.0	63

FLAMMABLE GASES AND VAPORS

Adequate ventilation is a primary requirement for eliminating or minimizing the hazard of fire or explosion due to gases and vapors. The need for good ventilation is not removed by the use of other precautions, such as the elimination of known ignition sources, segregation of hazardous operations, adoption of safe building construction, and installation of automatic alarms. Some safety engineers regard overventilation of an operation employing flammable liquids as a legitimate operating charge for the privilege or necessity of using a dangerous process. However, it is not possible to apply a reasonable safety factor to the ventilation estimate without consideration of the concentrations of gases or vapors that approach the danger point. Safety engineers prefer to limit the concentration to $\frac{1}{4}$ or $\frac{1}{2}$ of the lower explosive limit, and this fact should be given full weight in determining the capacity and design of ventilating equipment. Rarely should consideration be given to *operation above the upper explosive limit* in the open areas of buildings or rooms—even though unoccupied—because the danger of temporary drop of gas concentration to a point within the explosive range is too great.