Table of Fire Hazard Properties of Flammable Liquids

54-44

	FLASH POINT Deg. F.	IGNIT'N TEMP. Deg. F.	FLAMMABLE LIMITS Per Cent by Vol. Lower	Upper	Sp. Gr. (Water =1)	Vapor Density (Air=1)	Boiling Point Deg. F.	Water Soluble	EXTINGUISHING METHOD See Intro.	HAZARD IDENTIFICATION Health	Flammability	Reactivity
Methyl Ethyl Ether $CH_3OC_2H_5$ (Ethyl Methyl Ether)	−35	374	2.0	10.1	0.7	2.1	51	Yes	Water may be ineffective. "Alcohol" foam.	2	4	0
	Note: See Hazardous Chemicals Data.											
Methyl Ethyl Ketone $C_2H_5COCH_3$ (2—Butanone) (Ethyl Methyl Ketone)	21	960	1.8	10	0.8	2.5	176	Yes	Water may be ineffective. "Alcohol" foam.	1	3	0
	(Und. Lab. Class 85-90)											
Naphtha V.M. & P., Regular	28	450	0.9	6.0	<1		212-320	No	Water may be ineffective.	1	3	0
	Note: Flash point and ignition temperature will vary depending on the manufacturer.											
Nitroethane $C_2H_5NO_2$	82	778	3.4		1.1	2.6	237	Slight	Water may be ineffective except as a blanket. "Alcohol" foam. Explodes on heating.	1	3	3
	Note: See Hazardous Chemicals Data.											
Paraldehyde $(CH_3CHO)_3$	96 (oc)	460	1.3		1.0—	4.5	255	Slight	Water may be ineffective. "Alcohol" foam.	2	3	1
	Note: Melting point 54°F. See Hazardous Chemicals Data.											
Pentane $CH_3(CH_2)_3CH_3$	<−40	500	1.5	7.8	0.6	2.5	97	No	Water may be ineffective.	1	4	0
Petroleum Ether (Benzine) (Naphtha, Petroleum)	<0	550	1.1	5.9	0.6	2.5	95-140	No	Water may be ineffective.	1	4	0
	(Und. Lab. Class 95-100)											
Propanal CH_3CH_2CHO (Propionaldehyde)	15-19 (oc)	405	2.9	17.0	0.8	2.0	120	Slight	Water may be ineffective. "Alcohol" foam.	2	3	1
	Note: See Hazardous Chemicals Data.											
Propylene Oxide OCH_2CHCH_3	−35		2.8	37.0	0.9	2.0	95	Yes	Water may be ineffective. "Alcohol" foam.	2	4	2
	Note: See Hazardous Chemicals Data.											
Toluol $C_6H_5CH_3$ (Methyl Benzene) (Phenyl Methane) (Toluene)	40	896	1.2	7.1	0.9	3.1	231	No	Water may be ineffective.	2	3	0
	(Und. Lab. Class 75-80)											
	Note: See Hazardous Chemicals Data.											
Turpentine	95	488	0.8		<1		300	No	Water may be ineffective.	1	3	0
	(Und. Lab. Class 40-50)											
Vinyl Ethyl Ether $CH_2{:}CHOC_2H_5$ (Ethyl Vinyl Ether)	<−50	395	1.7	28	0.8	2.5	96	No	Water may be ineffective. "Alcohol" foam.	2	4	2
Xylene-o $C_6H_4(CH_3)_2$ (1, 2—Dimethyl Benzene) (Xylol-o)	90	869	1.0	6.0	0.9	3.7	292	No	Water may be ineffective.	2	3	0
	(Und. Lab. Class 40-45)											
	Note: See Hazardous Chemicals Data.											

the underside thereof, or on fire-resistive slabs or arches having no combustible material against the underside thereof. Such construction shall in all cases extend not less than 12 in. (0.3 m) beyond the appliance on all sides.

4-4.9.5 Floor-mounted appliances that are specifically listed for installation on a floor constructed of combustible material may be placed in accordance with the conditions of such listing.

4-4.9.6 Floor-mounted appliances may be placed on combustible floors although not listed for such installation, provided the floor under the appliance is protected in accordance with the requirements of accepted building code practice.

4-4.10 Unit Heaters, Suspended Type.

4-4.10.1 Suspended-type unit heaters shall be installed with clearances to combustible material not less than those indicated in Table 4-1.

4-4.10.2 Suspended-type unit heaters that are listed for installation with lesser clearances than specified in 4-4.10.1 may be installed in accordance with their listing.

4-4.10.3 Suspended-type unit heaters may be installed with lesser clearances to combustible material provided the combustible material is protected as described in Table 4-2 and Appendix B.

4-4.10.4 Suspended-type heaters shall be safely and adequately supported. Hangers or brackets supporting heaters shall be metal.

4-4.10.5 The location of any suspended unit heater or the duct work attached thereto shall be such that a negative pressure will not be created in the room in which the unit heater is located.

4-4.10.6 A suspended unit heater shall not be attached to a warm air duct system unless listed for such installation.

4-5 Installation of Outdoor Appliances.

4-5.1 Appliances listed for outdoor installation may be installed without additional environmental protection in accordance with the terms of their listing and shall be accessible for servicing.

4-5.2 Appliances not listed for outdoor installation may be installed outdoors if approved for such installation. Among the factors to be considered in judging the acceptability of appliances installed outdoors are: (a) protection from physical damage; (b) location of combustion air and other openings into the appliance; (c) surface temperatures; (d) weatherproofing; (e) adequate and safe venting; and (f) clearances to adjacent combustibles.

Chapter 5 Installation of Heating and Cooking Appliances

5-1 Kerosene and Oil Stoves and Portable Kerosene Heaters.

5-1.1 General Precautions.

5-1.1.1 The safety of installation and use of appliances of this kind depend largely upon the care of the installer and the care of the user in following the manufacturer's operating and installation instructions.

5-1.1.2 Appliances of this class shall be kept clean and in good repair. If parts become worn or damaged they shall be replaced promptly, preferably by the manufacturer or his representative. Where replacements or repairs must be made by the user, such attention shall be strictly confined to procedures that have been fully covered by the manufacturer's printed instructions.

5-1.1.3 Instructions furnished by the manufacturer shall be preserved.

5-1.1.4 Special care must be employed in the placing of kerosene stoves and portable kerosene heaters in order to avoid contact with combustible material including draperies, and to avoid accidental overturning. Placing fabrics on stoves for drying is dangerous.

5-1.1.5 Appliances shall be installed on noncombustible flooring unless listed for installation on combustible flooring.

5-1.1.6 A range shall be equipped with a drip pan beneath the burners and with integral base or legs to locate the cooking surface at a proper height for ordinary use.

5-1.1.7 Stoves shall be placed so that curtains or draperies may not be blown over or into contact with heater surfaces or open flame.

5-1.1.8 Appliances shall be carefully leveled in accordance with manufacturer's installation instructions.

5-1.1.9 When manufacturer's instructions specify that stoves are to be fastened to the floor these instructions shall be carefully followed, but in all cases stoves supplied with fuel from separate supply tanks shall be securely attached to the floor or otherwise secured in position to avoid strains on piping.

5-1.2 Controls.

5-1.2.1 Kerosene and oil stoves and portable kerosene heaters shall be equipped with a primary safety control, or shall be inherently constructed to prevent abnormal discharge of fuel at the burner in case of ignition failure or flame extinguishment.

5-1.3 Flue Connections. Appliances that are provided with a flue outlet shall be connected to a suitable flue having sufficient draft at all times to assure safe operation of the appliance. (*See Section 1-7.*)

5-1.4 Supply Tanks.

5-1.4.1 Stoves designed for barometric oil feed shall not be connected to separate supply tanks.

5-1.4.2 Stoves and portable kerosene heaters that are not designed for flue connection shall be equipped with integral tanks having capacity of not more than 2 gal (7.57 L).

5-1.4.3 An oil stove specifically designed and listed for use with separate supply tanks may be connected for gravity feed from a supply tank or an automatic pump.

5-1.4.4 Tanks supplying stoves by gravity feed shall be installed in such a way that the pressure at the inlet to the stove will not exceed 3 psi (21 kPa) or that the top of the tank will not be higher than 8 ft (2.5 m) above the stove connection. Shutoff valves shall be installed at the tank and the stove. Such tanks shall be installed in accordance with the applicable requirements in Chapter 2.

5-1.4.5 Automatic lift pumps shall be securely mounted. They shall be equipped with an overflow line returning to the supply tank. The oil piping shall comply with the applicable requirements in Chapter 3.

5-1.4.6 The filling of barometric tanks, kerosene stove tanks, and reservoirs of portable kerosene heaters shall be done outside of buildings or at a special location where precautions can be taken to minimize the spilling of oil.

5-1.4.7 A barometric tank shall not be placed in position in the stove sump until the oil has reached room temperature.

5-1.5 Clearances and Mounting.

5-1.5.1 Stoves shall be installed to provide clearances to combustible material not less than as shown in Table 5-1.

5-1.5.2 Stoves that are listed for installation with lesser clearances than specified in Table 5-1 may be installed in accordance with their listing.

Table 5-1

	Minimum Clearance, Inches		
Heating and Cooking Appliances	Sides	Rear	Chimney Connector
Ranges	24*	9	18
Room Heater, circulating type	12	12	18
Room Heater, radiant type	36	36	18

For SI Units: 1 in. = 25 mm; 1 ft = 0.3 m.

*For other than the oil burner side of a range the clearance at the side may be 18 in.

5-1.5.3 Stoves may be installed with lesser clearances to combustible material provided the combustible material is protected as described in Table 4-2 and Appendix B. In no case shall the horizontal distance be less than 6 in. (150 mm) from a range to that portion of adjacent unprotected combustible walls or cabinets extending above the cooking top of the range.

5-1.5.4 Stoves that have a fuel tank attached thereto shall in all cases be installed with sufficient clearance to provide direct and easy access to the fuel tank.

5-1.5.5 Stoves shall have a clearance vertically above the top of not less than 30 in. (.075 m) to combustible material or cabinets. When the underside of combustible material or cabinets is protected by asbestos millboard at least ¼ in. (6 mm) thick covered with sheet metal not lighter than 28 gage, the distance shall be not less than 24 in. (0.6 m). The protection shall extend 9 in. (225 mm) beyond the sides of the stove.

5-1.5.6 Listed stoves may be placed on combustible floors. Others shall be placed on the ground, on noncombustible floors, or on floors protected in accordance with accepted building code practice.

5-1.6 Additional Requirements for Portable Kerosene Heaters.

5-1.6.1 Portable kerosene heaters shall be listed.

5-1.6.2 Extreme caution shall be exercised in the placement and use of these devices, since surface temperatures may be sufficient to cause contact burns, and since the device may constitute a source of ignition in the presence of flammable vapors.

5-1.6.3 Portable kerosene heaters shall be equipped with a sheet metal tray underneath the burner as an integral part of the heater.

5-1.6.4 Labeling affixed to the heater by the manufacturer shall provide all of the following cautions and information as determined by the manufacturer:

(a) The provision of adequate ventilation when in operation.

(b) The use of only suitable fuel.

(c) The proper manner of refueling.

(d) The proper placement and handling when in operation.

(e) The proper procedures for the lighting, flame regulation, and extinguishment of the heater.

5-1.6.5 The heater shall be constructed with a center of gravity such that accidental tipping is minimized.

5-1.6.6 The heater shall be equipped with an automatic safety shutoff device or inherent design feature that minimizes fire hazards in the event of a tipover.

Chapter 6 Referenced Publications

6-1 The following documents or portions thereof are referenced within this document and shall be considered part of the requirements of this document. The edition indicated for each reference shall be the current edition

UNITED STATES MARINE CORPS
2d COMBAT ENGINEER BATTALION
2d MARINE DIVISION, FMF
CAMP LEJEUNE, NORTH CAROLINA 28542-5522

IN REPLY REFER TO:
8000
S-4
11 DEC 92

From: S-4
To: All Company Commanders

Subj: GUIDELINES FOR PLACEMENT AND CONTENTS OF SAFETY CABINETS

Ref: (a) Occupational Safety and Health Standards for General Industry (29CFR PART 1910)

Encl: (1) Definitions

1. Safety Cabinets have been purchased and distributed for use within the Battalion. To impliment proper use of the cabinets the following guidance is being issued.

2. Safety Cabinets can be stored inside buildings. However, cabinets must be positioned to minimize interference with exits, ladderwells, or areas normally used for the safe egress of Marines.

3. Cabinets may contain both flammable and combustible materials. These materials should be grouped by common types.

For Example;

Top Shelf	-	Enamel/CARC Paint
Middle Shelf	-	Aerosol spray cans
Bottom Shelf	-	Solvents

NOTE: Material identified as corrosives or oxidizers will not be stored with flammable and combustible material.

4. Not more than 60 gallons of CLASS I or CLASS II liquid nor more than 120 gallons of CLASS III liquids may be stored in a storage cabinet.

5. No more than 3 cabinets can be stored in one room.

6. No container may be placed in a cabinet without being clearly labeled and sealed.

7. Cabinets vents must be clear from obstruction.

8. Cabinets may not be stacked one upon the other.

9. When material is not being removed or returned from the cabinets the doors will be in the closed position.

10. Cabinets are not to be used as workbenches.

11. Leaking containers will not be stored in cabinets. Report leaking containers to the HMDO/AHMDO for proper disposal.

12. Point of contact is 2ndLt Kucharo at extensions 3704/3993.

J. M. JENNINGS

DEFINITIONS

Flammable liquid: CLASS I	A liquid having a flash point below 100'F and having a vapor pressure not exceeding 40 lb. per sq in. at 100'F and shall be known as a CLASS I liquid. (i.e. gasoline, acetone, benzene and rubber cement)
Combustible liquid: CLASS II	A liquid having a flash point at or above 100'F and below 140'F and shall be known as a CLASS II liquid. (i.e. diesel fuel, kerosene)
Combustible liquid: CLASS III	A liquid having a flash point at or above 140'F and below 200'F and shall be known as a CLASS III liquid. (i.e. mineral spirits, fuel oil #2)
Flash point:	The lowest temperature at which a liquid will give off sufficient vapor to ignite when exposed to a flame.
Oxidizer:	A material that yields oxygen readily to stimulate combustion.
Corrosive:	Any liquid or solid that causes visible destruction of human skin tissue, or a liquid that has a severe corrosion rate on steel. This includes acids and bases.

ENCLOSURE (1)

Table 5-2
Table of Properties of Commonly Used Flammable Liquids in Metric Units

The data in this table have been obtained from NFPA 325M 1984, *Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids*. Available figures from numerous sources will be found to vary over a wide range in many instances, depending on the purity or grade of samples and on the test conditions prescribed by different observers. The figures presented are for information and general guidance only and are not to be regarded as official standards.

The importance of obtaining precise data on the rate of evaporation by actual tests on particular paint formulations in use needs to be emphasized. Some of these multicomponent preparations may contain several solvents with widely different values of "lower explosive limit," "specific gravity," and "vapor density." Until such determinations are made, the operation should be on the side of safety. Therefore, the individual solvent whose data result in the largest required volume of air per gallon should be used as the basis for safe ventilation. Corrections and factors of safety for final ventilation values are to be applied as indicated in the footnotes.

	A Molecular Weight	B Flash Point Deg. C	C Ign. Temp. Deg. C	D Explo. Limits % by Volume Lower	D Upper	E Specif. Gravity (Water = 1)	F Vapor Density (Air = 1)	G Boiling Point Deg. C	H Kg. Per dm^3	I Cu. Meters of Vapor Per dm^3 Liquid	I Per kg. Liquid	J Approx. Cu. Meters of Air rendered barely explosive per dm^3 of Solvent
Acetone	58	–20	465	2.5	13	0.8	2.0	56	0.823	0.333	0.404	13.32
Amyl Acetate	130	16	360	1.1	7.5	0.9	4.5	149	0.875	0.166	0.190	14.92
sec-Amyl Acetate	130	32	–	–	–	0.9	4.5	121	0.863	0.166	0.193	–
Amyl Alcohol	88	33	300	1.2	10.0 @100	0.8	3.0	138	0.815	0.222	0.272	18.28
Benzine (Petroleum Ether)	Mix	<–18	288	1.1	5.9	0.6	2.5	35–60	0.647	0.200	0.309	17.98
Benzol (Benzene)	78	–11	498	1.3	7.9	0.9	2.8	80	0.875	0.267	0.306	20.27
n-Butyl Acetate	116	22	425	1.7	7.6	0.9	4.0	127	0.875	0.187	0.214	10.81
n-Butyl Alcohol	74	37	343	1.4	11.2	0.8	2.6	117	0.803	0.256	0.314	18.03
sec-Butyl Alcohol	74	24	405	1.7 @100	9.8 @100	0.8	2.6	94	0.803	0.256	0.319	14.80
Butyl Cellosolve (Glycol Monobutyl Ether)	118	64	244	–	–	0.9	4.1	171	0.844	0.183	0.203	–
Butyl Propionate	130	32	426	–	–	0.9	4.5	146	0.875	0.166	0.190	–
Camphor	152	66	466	0.6	3.5	1.0	5.2	204	0.982	0.160	0.163	26.51
Carbon Disulfide	76	–30	90	1.3	50.0	1.3	2.6	46	1.258	0.416	0.331	31.58
Cellosolve (Ethyl Cellosolve) (Ethylene Glycol Monoethyl)	90	41	238	2.6	15.7	0.9	3.1	135	0.934	0.241	0.259	9.51
Cellosolve Acetate (Ethylene Glycol Monoethyl Ether Acetate)	132	51	380	1.7	–	1.0–	4.7	157	0.970	0.172	0.177	9.95
Chlorobenzene-mono	113	28	593	1.3	9.6	1.1	3.9	132	1.102	0.235	0.213	17.86
Cottonseed Oil (Refined)	Mix	252	343	–	–	0.9	–	–	0.922	–	–	–
m- or p-Cresol	108	86	558	1.1 @150	–	1.0	–	201	1.030	0.223	0.223	20.04
Cyclohexane	84	–20	245	1.3	8.0	0.8	2.9	82	0.779	0.229	0.295	17.39
Cyclohexanone	98	44	420	1.1 @100	9.4	0.9	3.4	156	0.946	0.220	0.233	19.78
p-Cymene	134	47	436	0.7 @100	5.6	0.9	4.6	176	0.862	0.163	0.189	23.12
Denatured Alcohol	Mix	16	399	–	–	0.8	1.6	79	0.803	0.416	0.518	–
Dibutyl Phthalate	278	157	402	0.5 @235	–	1.0+	–	340	1.042	–	–	–
o-Dichlorobenzene	147	66	648	2.2	9.2	1.3	5.1	180	1.306	0.212	0.162	9.42
Diethyl Ketone	86	13	450	1.6	–	0.8	3.0	103	0.815	0.222	0.272	13.65
N-Dimethyl Formamide	73	58	445	2.2 @100	15.2	0.9	2.5	153	0.934	0.299	0.321	13.29
p-Dioxane (Diethylene Dioxide)	88	12	180	2.0	22.	1.0	3.0	101	1.075	0.277	0.258	13.57
Ethyl Acetate	88	–4	426	2.0	11.5	0.9	3.0	77	0.899	0.250	0.278	12.25
Ethyl Alcohol	46	13	363	3.3	19.	0.8	1.6	78	0.790	0.416	0.526	12.19
Ethyl Ether	74	–45	180	1.9	36.0	0.7	2.6	35	0.707	0.224	0.317	11.57
Ethyl Lactate	118	46	400	1.5 @100	–	1.0	4.1	154	1.018	0.203	0.199	13.33
Ethyl Methyl Ether	60	–37	190	2.0	10.1	0.7	2.1	11	0.730	0.277	0.380	13.57
Ethyl Propionate	102	12	440	1.9	11.	0.9	3.5	99	0.886	0.214	0.241	11.05
Ethylene Dichloride	99	13	413	6.2	16.	1.3	3.4	84	0.886	0.318	0.359	4.81
Gasoline	Mix	–43	257	1.4	7.6	0.8	3.4	38–204	0.839	0.190	0.227	13.38
Hexane n	86	–22	223	1.1	7.5	0.7	3.0	69	0.659	0.194	0.294	17.44
Kerosene	Mix	43-72	210	0.7	5.	>1	–	151–301	0.899	–	–	–
Linseed Oil – Raw	Mix	222	343	–	–	0.9	–	316	0.922	–	–	–
Methyl Acetate	74	–10	454	3.1	16.	0.9	2.8	60	0.922	0.267	0.290	8.35
Methyl Alcohol	32	11	464	6.0	36.	0.8	1.1	64	0.790	0.605	0.766	9.48
Methyl Carbitol (Diethylene Glycol Methyl Ether)	120	96	240	1.38	22.7	1.0+	4.14	192	1.018	0.205	0.201	14.86
Methyl Cellosolve	76	41	289	–	–	1.0–	2.6	124	0.970	0.310	0.320	–
Methyl Cellosolve Acetate (Ethylene Glycol Methyl Ether Acetate)	118	–38	–	1.7	8.2	1.0	4.07	144	0.994	0.204	0.206	–
Methyl Ether	46	Gas	350	3.4	27.0	–	1.6	–24	0.659	0.364	0.552	–
Methyl Ether Ketone (2-Butanone)	72	–9	404	1.4 @93	11.4 @93	0.8	2.5	80	0.803	0.266	0.331	19.00
Methyl Lactate	104	49	385	2.2 @100	–	1.1	3.6	145	1.090	0.245	0.233	11.29
Mineral Spirits No. 10	Mix	40	245	0.8 @100	–	0.8	3.9	149	0.803	0.171	0.212	21.20
Naphtha (V.M. & P. Regular)	Mix	–2	232	0.9	6.0	<1	–	100–160	0.743	0.180	0.242	19.82
Naphthalene	128	79	526	0.9	5.9	1.1	4.4	218	1.162	0.208	0.179	22.90
Nitrobenzene	123	88	482	1.8 @93	–	1.2	4.3	211	1.198	0.232	0.194	12.66
Nitroethane	75	28	414	3.4	–	1.1	2.6	114	1.042	0.352	0.337	10.00
Nitromethane (a)	61	35	418	7.3	–	1.1	2.1	101	1.126	0.436	0.387	39.20
1-Nitropropane	89	36	421	2.2	–	1.0	3.1	131	0.994	0.268	0.270	11.91
2-Nitropropane	89	24	428	2.6	11.0	1.0	3.1	120	0.982	0.268	0.273	10.04
Paraffin Oil	Mix	229	–	–	–	–	–	–	0.850 0.899	–	–	–
Perchloroethylene	106	None	None	None	None	1.63	5.8	121	1.629	0.234	0.143	–
Petroleum Ether	Mix	<–18	288	1.1	5.9	0.6	2.5	35–60	0.647	0.200	0.309	17.98
Propyl Acetate	102	13	450	1.7 @38	8.0	0.9	3.5	102	0.899	0.214	0.238	12.37
Propyl Alcohol	60	23	412	2.2	13.7	0.8	2.1	97	0.803	0.317	0.395	14.41
iso-Propyl Alcohol	60	12	399	2.0	12.0 @93	0.8	2.1	83	0.791	0.317	0.401	15.53
n-Propyl Ether	102	21	188	1.3	7.0	0.75	3.53	90	0.731	0.177	0.242	17.70
Pyridine	79	20	482	1.8	12.4	1.0	2.7	115	0.982	0.308	0.314	16.80
Rosin Oil	Mix	130	342	–	–	1.0	–	>360	0.982	–	–	–
Soy Bean Oil	Mix	282	445	–	–	0.9	–	–	0.922	–	–	–
Toluene	92	4	480	1.2	7.1	0.9	3.1	111	0.863	0.241	0.280	19.84
Turpentine	136	35	253	0.8	–	<1	–	149	0.863	0.173	0.200	21.45
Vinyl Acetate	86	–8	402	2.6	13.4	0.9	3.0	72	0.922	0.250	0.271	9.37
o-Xylene	106	32	463	1.0	7.0	0.9	3.7	144	0.875	0.202	0.231	20.00

NOTE: Column J gives the cubic meters of air rendered barely explosive by 1 liter of solvent. However, for most practical calculations, this value is close enough to the actual value of the vapor-air mixture.

*For final required safety ventilation values in each particular oven operation these figures are multiplied by the following factors as they apply:

(1) Temperature – Volume Conversion (see Table 5-1.11).

(2) Standard factor of safety of 4 for continuous process ovens (see 5-2.1).

(3) L.E.L. Correction factor for batch ovens between 121°C and 260°C, multiply by 1.4 (see 5-3.3).

(4) The maximum number of liters of solvent evaporated per unit of time on the basis of maximum possible loadings.

(a) Classified as a potentially explosive chemical.

Table 5-2
Table of Properties of Commonly Used Flammable Liquids in English Units

The data in this table have been obtained from NFPA 325M, 1984, *Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids*. Available figures from numerous sources will be found to vary over a wide range in many instances, depending on the purity or grade of samples and on the test conditions prescribed by different observers. The figures presented are for information and general guidance only and are not to be regarded as official standards.

The importance of obtaining precise data on the rate of evaporation by actual tests on particular paint formulations in use needs to be emphasized. Some of these multicomponent preparations may contain several solvents with widely different values of "lower explosive limit," "specific gravity," and "vapor density." Until such determinations are made, the operation should be on the side of safety. Therefore, the individual solvent whose data result in the largest required volume of air per gallon should be used as the basis for safe ventilation. Corrections and factors of safety for final ventilation values are to be applied as indicated in the footnotes.

	A	B	C	D		E	F	G	H	I		J
	Molecular Weight	Flash Point Deg. F	Ign. Temp. Deg. F	Explo. Limits % by Volume Lower	Upper	Specif. Gravity (Water = 1)	Vapor Density (Air = 1)	Boiling Point Deg. F	Lbs. Per Gal	Cu. Ft. of Vapor Per Gal. Liquid	Per Lb. Liquid	*Approximate Cu. Ft. of Air rendered barely explosive per gal. of Solvent
Acetone	58	–4	869	2.5	13	0.8	2.0	133	6.7	44.4	6.63	1780
n-Amyl Acetate	130	60	680	1.1	7.5	0.9	4.5	300	7.3	22.2	3.04	2000
sec-Amyl Acetate	130	89	–	–	–	0.9	4.5	249	7.2	22.2	3.09	–
Amyl Alcohol	88	91	572	1.2	10.0 @212	0.8	3.0	280	6.8	29.6	4.36	2440
Benzine (Petroleum Ether)	Mix	<0	550	1.1	5.9	0.6	2.5	95–140	5.4	26.7	4.94	2400
Benzene (Benzol)	78	12	928	1.3	7.9	0.9	2.8	176	7.3	35.7	4.89	2710
n-Butyl Acetate	116	72	797	1.7	7.6	0.9	4.0	260	7.3	25.0	3.42	1450
n-Butyl Alcohol	74	98	650	1.4	11.2	0.8	2.6	243	6.7	34.2	5.10	2410
sec-Butyl Alcohol	74	75	761	1.7 @212	9.8 @212	0.8	2.6	201	6.7	34.2	5.10	1980
Butyl Cellosolve (Glycol Monobutyl Ether)	118	148	472	–	–	0.9	4.1	340	7.5	24.4	3.25	–
Butyl Propionate	130	90	799	–	–	0.9	4.5	295	7.3	22.2	3.04	–
Camphor	152	150	871	0.6	3.5	1.0	5.2	399	8.2	21.2	2.58	–
Carbon Disulfide	76	–22	194	1.3	50.0	1.3	2.6	115	10.5	55.5	5.29	4210
Cellosolve (Ethylene Glycol Monoethyl)	90	106	460	2.6	15.7	0.9	3.1	275	7.8	32.2	4.13	1210
Cellosolve Acetate (Ethylene Glycol Monoethyl Ether Acetate)	132	124	715	1.7	–	1.0–	4.7	313	8.1	22.8	2.82	1320
Chlorobenzene-mono	113	82	1099	1.3	9.6	1.1	3.9	270	9.2	31.3	3.41	2380
Cottonseed Oil Refined	Mix	486	650	–	–	0.9	–	–	7.7	–	–	–
m- or p-Cresol	108	187	1038	1.1 @302	–	1.0	–	395	8.6	29.2	3.40	2620
Cyclohexane	84	–4	473	1.3	8	0.8	2.9	179	6.5	30.6	4.71	2320
Cyclohexanone	98	111	788	1.1 @212	9.4	0.9	3.4	313	7.9	29.4	3.72	2640
p-Cymene	134	117	817	0.7 @212	5.6	0.9	4.6	349	7.2	21.7	3.02	3080
Denatured Alcohol	Mix	60	750	–	–	0.8	1.6	175	6.7	55.5	8.29	–
Dibutyl Phthalate	278	315	757	0.5 @456	–	1.0+	–	644	8.7	–	–	–
o-Dichlorobenzene	147	151	1198	2.2	9.2	1.3	5.1	356	10.9	28.3	2.60	1260
Diethyl Ketone	86	55	842	1.6	–	0.8	3.0	217	6.8	29.6	4.36	1820
N-Dimethyl Formamide	73	136	833	2.2 @212	15.2	0.9	2.5	307	7.8	40.0	5.13	1780
p-Dioxane (Diethylene Dioxide)	88	54	356	2.0	22.	1.0+	3.0	214	8.97	37.0	4.13	1810
Ethyl Acetate	88	24	800	2.0	11.5	0.9	3.0	171	7.5	33.3	4.44	1630
Ethyl Alcohol	46	55	685	3.3	19.	0.8	1.6	173	6.6	55.5	8.41	1630
Ethyl Ether	74	–49	356	1.9	36.	0.7	2.6	95	5.9	29.9	5.07	1540
Ethyl Lactate	118	115	752	1.5 @212	–	1.0+	4.1	309	8.5	27.1	3.19	1780
Ethyl Methyl Ether	60	–35	374	2.0	10.1	0.7	2.1	51	6.1	37.0	6.06	1810
Ethyl Propionate	102	54	824	1.9	11.	0.9	3.5	210	7.4	28.6	3.86	1480
Ethyl Dichloride	99	56	775	6.2	16.	1.3	3.4	183	7.4	42.5	5.74	640
Gasoline	Mix	–45	495	1.4	7.6	0.8	3.4	100–400	7.0	25.4	3.63	1790
Hexane	86	–7	437	1.1	7.5	0.7	3.0	156	5.5	25.9	4.71	2330
Kerosene (Fuel Oil No. 1)	Mix	110-162	410	0.7	5.	<1	–	304–574	7.5	–	–	–
Linseed Oil – Raw	Mix	432	650	–	–	0.9	–	600+	7.7	–	–	–
Methyl Acetate	74	14	850	3.1	16.	0.9	2.8	140	7.7	35.7	4.64	1120
Methyl Alcohol	32	52	867	6.0	36.	0.8	1.1	147	6.6	80.8	12.2	1270
Methyl Carbitol (Diethylene Glycol Methyl Ether)	120	205	465	1.38	22.7	1.0+	4.14	379	8.5	27.4	3.22	1990
Methyl Cellosolve	76	105	551	–	–	1.0–	2.6	255	8.1	40.9	5.08	–
Methyl Cellosolve Acetate	118	–111	–	1.7	8.2	1.0	4.07	292	8.3	27.3	3.29	–
Methyl Ether	46	Gas	662	3.4	27.0	–	1.6	–11	5.5	48.6	8.84	–
Methyl Ethyl Ketone (2-Butanone)	72	16	759	1.4 @200	11.4 @200	0.8	2.5	176	6.7	35.5	5.30	2540
Methyl Lactate	104	121	725	2.2 @212	–	1.1	3.6	293	9.1	33.9	3.73	1510
Mineral Spirits No. 10	Mix	104	473	0.8 @212	–	0.8	3.9	300	6.7	22.8	1.72	2830
Naphtha (V.M. & P. Regular)	Mix	28	450	0.9	6.0	0.8	<1	212–320	6.2	24.0	3.87	–
Naphthalene	128	174	979	0.9	5.9	1.1	4.4	424	9.7	27.8	2.86	3060
Nitrobenzene	123	190	900	1.8 @200	–	1.2	4.3	412	10.0	31.0	3.10	1690
Nitroethane	75	82	778	3.4	–	1.1	2.6	237	8.7	47.0	5.40	1340
Nitromethane (a)	61	95	785	7.3	–	1.1	2.1	214	9.4	58.2	6.19	740
1-Nitropropane	89	96	789	2.2	–	1.0	3.1	268	8.3	35.8	4.32	1590
2-Nitropropane	89	75	802	2.6	11.0	1.0–	3.1	248	8.2	35.8	4.37	1340
Paraffin Oil	Mix	444	–	–	–	–	–	–	7.1–7.5	–	–	–
Perchloroethylene	106	None	None	None	–	1.6	5.8	250	13.6	–	–	–
Petroleum Ether	Mix	<0	550	1.1	5.9	0.6	2.5	95–140	5.4	26.7	4.94	2400
Propyl Acetate	102	55	842	1.7 @100	8.	0.9	3.5	215	7.5	28.6	3.81	1650
Propyl Alcohol	60	74	775	2.2	13.7	0.8	2.1	207	6.7	42.3	6.32	1920
iso-Propyl Alcohol	60	53	750	2.0	12.0 @200	0.8	2.1	181	6.6	42.3	6.41	2070
n-Propyl Ether	102	70	370	1.3	7.0	0.75	3.53	194	6.1	23.6	3.87	1820
Pyridine	79	68	900	1.8	12.4	1.0–	2.7	239	8.2	41.1	5.02	2240
Rosin Oil	Mix	266	648	–	–	1.0	–	>680	8.2	–	–	–
Soy Bean Oil	Mix	540	833	–	–	0.9	–	–	7.7	–	–	–
Toluene	92	40	896	1.2	7.1	0.9	3.1	231	7.2	32.2	4.48	2650
Turpentine	136	95	488	0.8	–	<1	–	300	7.2	–	–	–
Vinyl Acetate	86	18	756	2.6	13.4	0.9	3.0	161	7.7	33.3	4.33	1250
o-Xylene	106	90	867	1.0	7.0	0.9	3.7	292	7.3	27.0	3.70	2670

NOTE: Column J gives the cubic feet of air rendered barely explosive by 1 gallon of solvent. However, for most practical calculations, this value is close enough to the actual value of the vapor-air mixture.

*For final required safety ventilation values in each particular oven operation these figures are multiplied by the following factors as they apply:

(1) Temperature – Volume Conversion (see Table 5-1.11).

(2) Standard factor of safety of 4 for continuous process ovens (see 5-2.1).

(3) L.E.L. Correction factor for batch ovens between 250°F and 500°F multiply by 1.4 (see 5-3.3).

(4) The maximum number of gallons of solvent evaporated per unit of time on the basis of maximum possible loadings.

(a) Classified as a potentially explosive chemical.

Story. That portion of a building included between the upper surface of the floor and the upper surface of the floor or roof next above.

Street. A public thoroughfare (street, avenue, or boulevard) that has been dedicated for vehicular use by the public and can be used for access by fire department vehicles.

Structure. Any building, monument, or other object that is constructed with the ground as its foundation or normal resting place.

Supervised Automatic Fire Extinguishing System. Any automatic fire extinguishing system that is constantly monitored so as to determine its operating condition at all times.

System. Several items of equipment, assembled, grouped, or otherwise interconnected, for the accomplishment of a specific purpose or function.

Wildfire. An unplanned and unwanted fire requiring suppression action; an uncontrolled fire, usually spreading through vegetative fuels but often threatening structures.

Chapter 3 General Requirements

3-1* Means of Access for Fire Department Apparatus.

3-1.1 Means of access for fire department apparatus shall consist of fire lanes, private streets, streets, parking lot lanes, or a combination thereof.

3-1.2 Means of access for fire department apparatus shall be provided to all structures in planned building groups in accordance with Section 3-1 and the applicable provisions of Sections 3-2 through 3-9.

3-1.3* Means of access for fire department apparatus shall be constructed of a hard, all-weather surface adequately designed to support the heaviest piece of fire apparatus likely to be operated on the fire lane, private street, street, or parking lot lane.

3-1.4 Every dead-end roadway more than 300 ft (91 m) in length shall be provided at the closed end with a turnaround acceptable to the fire department.

3-1.5* Turns in roadways shall maintain the minimum road width.

3-1.5.1 Turns in publicly owned or privately owned major feed roadways shall be constructed with a minimum radius of 100 ft (30.5 m) to the centerline.

3-1.5.2 Turns in other privately owned means of access shall be constructed with a minimum radius of 25 ft (7.5 m) at the inside curb line and a radius of 50 ft (15 m) at the outside curb line.

3-1.6* Roadways shall be not less than 24 ft (7 m) wide provided no parking is allowed, not less than 30 ft (9 m) wide if parallel parking is allowed on one side, and not less than 36 ft (10.5 m) wide if parallel parking is allowed on both sides.

3-1.7 Parking in any means of access shall not be permitted within 20 ft (6 m) of a fire hydrant, sprinkler, or standpipe connection or in any other manner that will obstruct or interfere with the fire department's use of the hydrant or connection.

3-1.8 "No Parking" signs or other designation indicating that parking is prohibited shall be provided at all normal and emergency access points to structures and within 20 ft (6 m) of each fire hydrant, sprinkler, or standpipe connection.

3-1.9 Where no recognized water supply distribution system exists, appropriate access shall be provided for water supplies in accordance with the provisions of NFPA 1231, *Standard on Water Supplies for Suburban and Rural Fire Fighting*.

3-2 Fire Lanes.

3-2.1* Fire lanes shall be provided as required by the fire department having jurisdiction and in keeping with the following requirements.

3-2.2 Fire lanes shall be at least 20 ft (6 m) in width with the road edge closest to the structure at least 10 ft (3 m) from the structure.

3-2.3* "No Parking — Tow-Away Zone" signs shall be posted in accordance with the instructions of the fire department having jurisdiction, and a method of enforcing such provisions shall be provided.

3-2.4 Fire lanes connecting to public streets, roadways, or private streets shall be provided with curb cuts extending at least 2 ft (0.6 m) beyond each edge of the fire lane.

3-2.5 The designation and maintenance of fire lanes on private property shall be accomplished as specified by the fire department having jurisdiction.

3-3* Parking Lot Lanes. Parking lot lanes shall have a minimum of 25 ft (7.5 m) clear width between rows of parked vehicles for vehicular access and movement.

3-4 Grades.

3-4.1 Grades shall be no more than 10 percent.

Exception: The authority having jurisdiction may allow steeper grades where mitigation measures can be agreed upon jointly by the fire chief and the road engineer.

3-4.2 Any secondary road intersecting with another road shall be sloped one to three percent down and away from the intersection for a distance of 100 ft (30.5 m) from the intersection.

3-4.3 Grades shall be no less than 0.5 percent in order to prevent pooling of water in the traveled way.

3-5 Location of Structures.

3-5.1 Structures exceeding 1000 sq ft (93 sq m) gross floor area shall not be set back more than 50 ft (15 m) from an approved fire lane or street.

Installation of AIBs for Marine Corps armories and magazines will be approved by CMC (POS 40).

b. Facilities in which aircraft or vehicles are stored with ammunition aboard must be secured with a high security lock, or equivalent compensatory measures will be applied.

c. Doors not normally used for entry must be secured from the inside with locking bars, dead bolts, or padlocks. Panic hardware, when required, will be installed so as to prevent opening the door by drilling a hole and/or fishing from the outside. Panic hardware must meet safety, fire, and building codes and be approved by the Underwriters Laboratory or, when applicable, meet host country requirements.

d. Padlocks must be locked to the staple or hasp to preclude theft, loss, or substitution of the lock when an area or container is open.

e. Naval Weapons Support Center (NAVWPNSUPPCEN), Crane, IN will issue, repair, and replace cylinders, locks, and keys for high and medium security locks. Damaged or malfunctioning locks and requests for cylinder and key replacement will be sent by registered mail to Commanding Officer, Naval Weapons Support Center, Crane, Indiana 47522-5010 (Code 102).

f. Replacement or reserve locks, cores, and keys must be secured to preclude accessibility to unauthorized individuals.

g. The S&G model 6804 and LaGard Model 2233 changeable key-operated lock are authorized for use on response/security force lockers.

h. Approved cable seal locks are one-time use, serialized, throwaway locks which meet the federal specification listed below. Cable seal locks are authorized in lieu of padlocks for use on railcars, trucks, trailers, crates, and other shipping containers wherever "locked and sealed" security is specified. Cable seal locks provide both the "lock" and the "seal," therefore no additional locks are required. Several cable seal locks meet the federal specification; three are presented below. Further information may be obtained on the locks from: Brammall, Inc., P.O. Box 208, Angola, IN 46703 (telephone 800-348-4777); or E.J. Brooks Company, P.O. Box 7070, 164 North 13th Street, Newark, NJ 07101 (telephone 800-458-7325).

Meeting Federal Specification FF-S-2738, 12 May 90:

- E.J. Brooks Rod-Loc (NSN 5340-00-084-1570)
- Brammal Cone-Loc
  - Complete assembly, part no. 153-121
  - Flag wire only, part no. 153-117
  - Cone locking body only, part no. 153-116
- 12" Brammall Cable Loc Seal, part no. 137-101

Table of Fire Hazard Properties of Flammable Liquids

	FLASH POINT Deg. F.	IGNIT'N TEMP. Deg. F.	FLAMMABLE LIMITS Per Cent by Vol. Lower	Upper	Sp. Gr. (Water =1)	Vapor Density (Air=1)	Boiling Point Deg. F.	Water Soluble	EXTINGUISHING METHOD See Intro.	HAZARD IDENTIFICATION Health	Flammability	Reactivity
Denatured Alcohol	60 (Und. Lab. Class 70)	750			0.8	1.6	175	Yes	Water may be ineffective. "Alcohol" foam.	0	3	0
Government Formula												
CD-5	60-62											
CD-5A	60-61											
CD-10	49-59											
SD-1	57											
SD-2B	56											
SD-3A	59											
SD-13A	<19											
SD-17	60											
SD-23A	35											
SD-30	59											
SD-39B	60											
SD-39C	59											
SD-40M	59											
Dibutyl Ether $(C_4H_9)_2O$ (1—Butoxybutane) (Butyl Ether)	77	382	1.5	7.6	0.8	4.5	286	No	Water may be ineffective. "Alcohol" foam.	2	3	0
Dichloroethylene—1, 2 C1CH:CHC1	43		9.7	12.8	1.3	3.4	141	No	Water may be ineffective except as a blanket.	2	3	2
Diethylamine $(C_2H_5)_2NH$	<0	594	1.8	10.1	0.7	2.5	134	Yes	"Alcohol" foam. Water may be ineffective.	2	3	0
2, 2—Dimethyl Butane- $CH_3)_3CCH_2CH_3$ (Neohexane)	−54	797	1.2	7.0	0.6	3.0	122	No	Water may be ineffective.	1	3	0
3, 2—Dimethyl Pentane- $CH_3CH(CH_3)$ CH- (CH_3) CH_2CH_3	<20	635	1.1	6.7	0.7	3.5	194	No	Water may be ineffective.	0	3	0
P—Dioxane- $OCH_2CH_2OCH_2CH_2$ (Diethylene Dioxide)	54 *Note: See Hazardous Chemicals Data.*	356	2.0	22	1.0+	3.0	214	Yes	Water may be ineffective. "Alcohol" foam.	2	3	0
Divinyl Ether $(CH_2CH)_2O$ (Ethenyloxyethene) (Vinyl Ether)	<−22 *Note: See Hazardous Chemicals Data.*	680	1.7	27	0.8	2.4	102	No	Water may be ineffective.	2	3	2
Ethyl Acetate $CH_3COOC_2H_5$ (Acetic Ester) (Acetic Ether) (Ethyl Ethanoate)	24 (Und. Lab. Class 85-90)	800	2.2	110	0.9	3.0	171	Slight	Water may be ineffective. "Alcohol" foam.	1	3	0
Ethyl Alcohol C_2H_5OH (Grain Alcohol, Cologne Spirits, Ethanol)	55 (Und. Lab. Class 70)	689	3.3	19	0.8	1.6	173	Yes	Water may be ineffective. "Alcohol" foam.	0	3	0
Ethyl Alcohol and Water 96%	62											
95%	63											
80%	68											
70%	70											
60%	72											
50%	75											
40%	79											
30%	85											
20%	97											
10%	120											
5%	144											

	FLASH POINT Deg. F.	IGNIT'N TEMP. Deg. F.	FLAMMABLE LIMITS Per Cent by Vol. Lower	Upper	Sp. Gr. (Water =1)	Vapor Density (Air=1)	Boiling Point Deg. F.	Water Soluble	EXTINGUISHING METHOD See Intro.	HAZARD IDENTIFICATION Health	Flammability	Reactivity
Ethylamine $C_2H_5NH_2$ 70% aqueous solution (Amino Ethane)	<0	725	3.5	14.0	0.8	1.6	62	Yes	Water may be ineffective. "Alcohol" foam.	3	4	0
Ethyl Chloride C_2H_5C1 (Chloroethane) (Hydrochloric Ether) (Muriatic Ether)	−58	966	3.8	15.4	0.9	2.2	54	No	Water may be ineffective.	2	4	0
	Note: See Hazardous Chemicals Data.											
Ethylene Oxide CH_2OCH_2 (Dimethylene Oxide) (1, 2—Epoxyethane) (Oxirane)	<0	804	3.6	100	0.9	1.5	51	Yes	Vapors explosive. Water may be ineffective. "Alcohol" foam.	2	4	3
	(Und. Lab. Class 100)											
	Note: See Hazardous Chemicals Data.											
Ethyl Ether $C_2H_5OC_2H_5$ (Diethyl Ether) (Diethyl Oxide) (Ethyl Oxide)	−49	320	1.9	36	0.7	2.6	95	Slight	Water may be ineffective. "Alcohol" foam.	2	4	0
	(Und. Lab. Class 100)											
	Note: See Hazardous Chemicals Data.											
Fuel Oil No. 1 (Kerosene) (Range Oil) (Coal Oil)	100 Min or Legal	410	0.7	5	<1		304-574	No		0	2	0
	Note: The legal minimum flash point for kerosene varies in different states. The flash point is usually above 100°F.											
Gasoline C_5H_{12} to C_9H_{20}	−45		1.4	7.6	0.8	3-4	100-400	No	Water may be ineffective.	1	3	0
56-60 Octane	−45	536	1.4	7.6								
73 Octane			1.4	7.6								
92 Octane			1.5	7.6								
100 Octane	−36	853	1.4	7.4								
						(Und. Lab. Class 95-100) Note: Values may vary considerably for different grades of gasoline.						
Hexadiene—1, 4 $CH_3CH{:}CHCH_2CH{:}CH_2$ (Allylpropenyl)	−6		2.0	6.1	0.7	2.8	151	No	Water may be ineffective.	0	3	0
Hexane $CH_3(CH_2)_4CH_3$ (Hexyl Hydride)	−7	437	1.1	7.5	0.7	3.0	156	No	Water may be ineffective.	1	3	0
	(Und. Lab. Class 90-95)											
Isopropyl Alcohol $(CH_3)_2CHOH$ (Isopropanol) (Dimethyl Carbinol) (Propanol—2)	53	750	2.0	12	0.8	2.1	181	Yes	Water may be ineffective. "Alcohol" foam.	1	3	0
	(Und. Lab. Class 70)											
	Note: See Hazardous Chemicals Data.											
87.9% iso	57											
Jet Fuels JP-4	−10—+30	464	1.3	80						1	3	0
Kerosene	*See Fuel Oil No. 1*											
Methyl Alcohol CH_3OH (Methanol) (Wood Alcohol) (Columbian Spirits)	52	725	6.7	36	0.8	1.1	147	Yes	Water may be ineffective. "Alcohol" foam.	1	3	0
	(Und. Lab. Class 70)											
	Note: See Hazardous Chemicals Data.											
Methyl Cyclohexane $CH_2(CH_2)_4CHCH_3$ (Cyclohexyl Methane) (Hexahydroxytoluene)	25	482	1.2	6.7	0.8	3.4	214	No	Water may be ineffective.	2	3	0