Explosive Properties of Class I Gases and Vapors

EXPLANATION OF FOLLOWING FOUR TABLES ON CLASS I GASES AND VAPORS

Data on Class I gases and vapors presented on pages 10 through 15 contains the latest available from NFPA at the date of publication of this Appleton 2002 Code Review. The data is based primarily on NFPA 497-1997, Manual for Classification of Gases, Vapors and Dusts for Electrical Equipment in Hazardous (Classified) Locations with additional data secured from NFPA 325M-1994, Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids. These publications are the latest available on these subjects from NFPA at this time. The data on explosive properties of Class I gases and vapors is as follows:

TABLES 1 and 2. These are flammable chemicals with flash points below 100°F and are therefore the most hazardous. Normally, special electrical equipment is required where these flammable chemicals are present, as these substances form ignitable or explosive mixtures with air at ambient temperatures.

TABLES 3 and 4. These are combustible vapors with higher flash points than the flammable gases and vapors listed in Tables 1 and 2. The flash points of vapors in Table 3 range from 100°F or more, but less than 140°F and flash points of vapors in Table 4 range from 140°F or more, but less than 200°F.

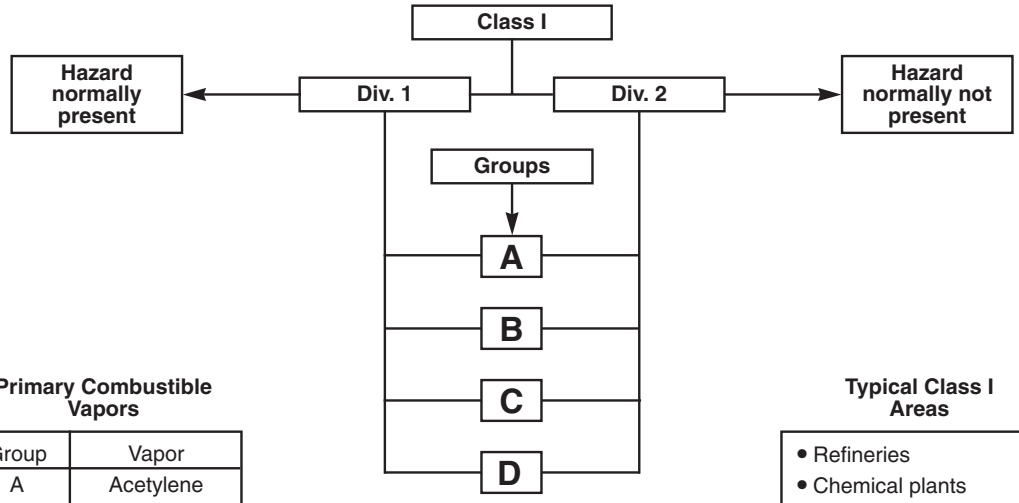
COMPARISON OF TABLE 1 WITH 1981 *NEC*® 500.2 TABLE

This comparison is made because from 1971 through 1981 a Table of Chemicals by Groups limited to Class I gases and vapors classified by Groups A through D, determined by actual tests was included in Article 500. In 1984 this Table was removed and a Fine Print Note (FPN) referencing NFPA Standard 325M 1977 as the resource for obtaining information on the properties of flammable liquids, gases, and volatile solids was placed in Section 500.2. This was the last time the *National Electrical Code*® enumerated, in table form, a list of gases. Table 1 represents an updated list of the 1981 500.2 Table. At this date, at the publication of the 2002 edition of the *National Electrical Code*®, Table 1 is the latest information available on such Class I gases and vapors. It's as current as NFPA 497-1997 AND NFPA 325M-1994.

NOTE: Tables 2, 3 and 4 on the following pages contain lists of Class I gases and vapors that were classified in Groups by chemical analysis rather than by actual tests. The Group classifications were based on analogy with other tested materials and on chemical structure. Consequently, Group classifications as shown in tables 2, 3 and 4 are not as reliable as those in Table 1.

TABLE	PAGE	TEST TYPE	FLASH POINT RANGE	DEGREE OF HAZARD
1	10 & 11	Actual Test	<100˚F	Most Ignitable
2	12 & 13	Chemical Analysis	<100˚F	Most Ignitable
3	14	Chemical Analysis	100˚F thru <140˚F	Next Most Ignitable
4	15	Chemical Analysis	140˚F thru <200˚F	Least Ignitable

Diagram of Class I Areas



Primary Combustible Vapors

Group	Vapor
A	Acetylene
B	Hydrogen
C	Ethelene
D	Gasoline

Typical Class I Areas

- Refineries
- Chemical plants
- Paint spray area
- Sewage treatment
- Pharmaceutical plants

TABLE 1: Class I Flammable Gases and Vapors Having Less Than 100°F Flash Point—Determined by Actual Tests❾

Normally, Special Electrical Equipment IS Required Where these Flammable Gases or Vapors are Present, as these Chemicals Form Ignitable or Explosive Mixtures with Air at Ambient Temperatures.

Substance	Class I Zone Group	Flash Point °F	Flash Point °C	Auto Ignition Temp. (AIT) °F	Auto Ignition Temp. (AIT) °C	Flammable (Explosive) Limits Percent by Volume Lower	Flammable (Explosive) Limits Percent by Volume Upper	Vapor Density (Air = 1)
Group A Atmospheres								
Acetylene	IIC	Gas	581	305	2.5	100	0.9	
Group B Atmospheres								
Acrolein (inhibited) ❾	IIB	–15	–26	428 *	220 *	2.8	31.0	.9
1,3-Butadiene ❿	IIB	Gas		788	420	2.0	12.0	1.9
Ethylene Oxide ❾	IIB	–4	–20	804	429	3.0	100	1.5
Hydrogen	IIC	Gas		932 **	500 **	4.0	75.0	0.1
Manufactured Gas (containing more than 30% H_2 by volume)	—	❷	❷	❷	❷	❷	❷	❷
Propylene Oxide ❾	—	–35	–37	840	449	2.3	36.0	2.0
Propyl Nitrate	—	68	20	347	175	2.0	100	NA ❸
Group C Atmospheres								
Acetaldehyde	IIA	–36	–38	347	175	4.0	60.0	1.5
Allyl Alcohol	—	72	22	713	378	2.5	18.0	2.0
n-Butyraldehyde	—	–10	–12	425	218	1.9	12.5	2.5
Carbon Monoxide	IIA	Gas		1292	700	12.5	74.0	.97
Crotonaldehyde	IIB	55	13	450	232	2.1	15.5	2.4
Diethyl Ether (Ethyl Ether)	IIB	–54	–12	320 ***	160 ***	1.9	36.0	2.6
Diethylamine	IIA	–18	–28	594	312	1.8	10.1	2.5
Epichlorohydrin	—	91	33	772	411	3.8	21.0	3.2
Ethylene	IIB	Gas		842	450	2.7	36.0	1.0
Ethylenimine	—	12	–11	608	320	3.3	54.8	1.5
Ethyl Mercaptan	—	0	–18	572	300	2.8	18.0	2.1
Hydrogen Cyanide (Hydrocyanic Acid)	IIB	0	–18	1000	538	5.6	40.0	0.9
Hydrogen Sulfide	—	Gas		500	260	4.0	44.0	1.2
Methylacetylene	—	Gas		NA ❸	NA ❸	1.7	NA ❸	1.4
Methyl Ether	—	Gas		662	350	3.4	27.0	1.6
Methyl Formal	—	34	1	460	238	NA ❸	NA ❸	3.1
2-Nitropropane	—	82	28	802	428	2.6	11.0	3.1
n-Propyl Ether	—	70	21	370 †	188 †	1.3	7	3.5
Tetrahydrofuran	IIB	7	–14	610	321	2.0	11.8	2.5
Triethylamine	IIA	+16	–9	480	249	1.2	8.0	3.5
Unsymmetrical Dimethyl Hydrazine (UDMH)	—	5	–15	480	249	2.0	95.0	1.9
Group D Atmospheres								
Acetone	IIA	–4	–20	869	465	2.5	12.8	2.0
Acrylonitrile	IIB	–15	–26	898	481	3.0	17.0	1.8
Ammonia	IIA	Gas		928	498	15.0	28.0	0.6
Benzene (Benzol)	IIA	12	–11	928	498	1.2	7.8	2.8
Butane	—	–76	–60	550	288	1.9	8.5	2.0
1-Butanol (Butyl Alcohol)	IIA	97	36	650	343	1.4	11.2	2.6
2-Butanol (Secondary Butyl Alcohol)	IIA	97	36	761	405	1.7 ❹	9.8 ❹	2.6
n-Butyl Acetate	IIA	72	22	790	421	1.7	7.6	4.0
iso-Butyl Acetate	—	64	18	790	421	2.4	10.5	4.0
Cyclopropane	IIB	Gas		938	503	2.4	10.4	1.5
Di-isobutylene	—	36	–2	736	391	0.8	4.8	3.8
Ethane	IIA	Gas		882	472	3.0	12.5	1.0
Ethanol (Ethyl Alcohol)	IIA	55	13	685	363	3.3	19.0	1.6
Ethyl Acetate	—	24	–4	800	427	2.0	11.5	3.0
Ethyl Acrylate (inhibited)	IIA	48	9	702	372	1.4	14.0	3.5
Ethylamine	—	0	–18	725	385	3.5	14.0	1.6

GROUP D ATMOSPHERES CONTINUED ON FOLLOWING PAGE

TABLE 1: Class I Flammable Gases and Vapors Having Less Than 100°F Flash Point—Determined by Actual Tests❶

Normally, Special Electrical Equipment IS Required Where these Flammable Gases or Vapors are Present, as these Chemicals Form Ignitable or Explosive Mixtures with Air at Ambient Temperatures.

Substance	Class I Zone Group	Flash Point °F	Flash Point °C	Auto Ignition Temp. (AIT) °F	Auto Ignition Temp. (AIT) °C	Flammable (Explosive) Limits Percent by Volume Lower	Flammable (Explosive) Limits Percent by Volume Upper	Vapor Density (Air = 1)
Group D Atmospheres (continued)								
Ethylenediamine (Anhydrous 76%)	—	91	33	725	385	2.5	12.0	2.1
Ethylene Dichloride	—	56	13	775	413	6.2	16.0	3.4
Gasoline	—	–50	–46	536 to 880	280 to 471	1.3	7.1	3-4 ❺
Heptane	IIA	25	–4	399	204	1.0	6.7	3.5
Hexane	IIA	–9	–23	437	225	1.1	7.5	3.0
Isoprene	—	–65	–54	428 ‡	220 ‡	1.5	8.9	2.4
Isopropyl Ether	—	–18	–28	830	443	1.4	7.9	3.5
Mesityl Oxide	—	87	31	652	344	1.4	7.2	3.4
Methane (Natural Gas)	IIA	Gas		1166	630	5.0	15.0	0.6
Methanol (Methyl Alcohol)	IIA	54	12	725 ‡‡	385 ‡‡	6.0	36.0	1.1
Methyl Ethyl Ketone	—	21	–6	759	404	1.4 ❻	11.4 ❻	2.5
Methyl Isobutyl Ketone	—	88	37	824	440	1.2 ❻	8.0 ❻	3.5
2-Methyl-1-Propanol (Isobutyl Alcohol)	—	–40	–40	433	223	1.7 ❼	10.6 ❽	2.5
2-Methyl-2-Propanol (Tertiary Butyl Alcohol)	—	52	11	892	478	2.4	8.0	2.6
Naphtha (Petroleum)	IIA	108	42	550	288	1.1	5.9	2.5
Octane	IIA	56	13	403	206	1.0	6.5	3.9
Pentane	—	–40	–40	470 ‡‡‡	243 ‡‡‡	1.5	7.8	2.5
1-Pentanol (Amyl Alcohol)	IIA	91	33	572	300	1.2	10.0 ❹	3.0
Propane	IIA	Gas		842	450	2.1	9.5	1.6
1-Propanol (Propyl Alcohol)	IIA	59	15	775	413	2.2	13.7	2.1
2-Propanol (Isopropyl Alcohol)	—	53	12	750	399	2.0	12.7 ❻	2.1
Propylene	—	Gas		851	455	2.0	11.1	1.5
Pyridine	IIA	68	20	900	482	1.8	12.4	2.7
Styrene	IIA	88	31	914	490	0.9	6.8	3.6
Toluene	IIA	40	4	896	480	1.1	7.1	3.1
Vinyl Acetate	IIA	21	–6	756	402	2.6	13.4	3.0
Vinyl Chloride	—	–108.4	–78	882	472	3.6	33.0	2.2
Xylenes	IIA	81 to 90	27 to 32	867 to 984	464 to 529	1.0 to 1.1	6.0 to 7.0	3.7

❶ All figures are based on experiments conducted at normal atmospheric pressures and at normal temperatures, where temperature is not a variable, unless otherwise indicated.

❷ Varies according to mixture. Some mixtures may be Group B. ❸ Not Available. ❹ At 212°F (100°C) ❺ Varies with different grades of gasoline. ❻ At 200°F (93°C)

❼ At 123°F (51°C) ❽ At 202°F (94°C)

❾ Electrical equipment for Group C permitted if external seals are installed per *NEC*® 501.5(A)

❿ Electrical equipment for Group D permitted if external seals are installed per *NEC*® 501.5(A)

* 455°F (235°C) in NFPA 497-1997 and 428°F (220°C) in NFPA 325M-1994.
** 968°F (520°C) in NFPA 497-1997 and 932°F (500°C) in NFPA 325M-1994.
*** 320°F (160°C) in NFPA 497-1997 and 356°F (180°C) in NFPA 325M-1994.
† 419°F (215°C) in NFPA 497-1997 and 370°F (188°C) in NFPA 325M-1994.
‡ 428°F (220°C) in NFPA 497-1997 and 743°F (395°C) in NFPA 325M-1994.
‡‡ 725°F (385°C) in NFPA 497-1997 and 867°F (464°C) in NFPA 325M-1994.
‡‡‡ 470°F (243°C) in NFPA 497-1997 and 500°F (260°C) in NFPA 325M-1994.

TABLE 2: Class I Flammable Gases and Vapors Having Less Than 100°F Flash Points—Determined by Chemical Analysis[9]

Normally, Special Electrical Equipment IS Required Where these Flammable Gases or Vapors are Present, as these Chemicals Form Ignitable or Explosive Mixtures with Air at Ambient Temperatures.

Substance	Class I Zone Group	Flash Point °F	Flash Point °C	Auto Ignition Temp. (AIT) °F	Auto Ignition Temp. (AIT) °C	Flammable (Explosive) Limits Percent by Volume Lower	Flammable (Explosive) Limits Percent by Volume Upper	Vapor Density (Air = 1)
Group B Atmospheres								
Formaldehyde	—	Gas		804	429	7.0	73.0	1.0
Group C Atmospheres								
Butyl Mercaptan (1-Butanethiol)	—	35	2	NA[2]	NA[2]	NA[2]	NA[2]	3.1
Dicyclopentadiene	—	90	32	937	503	NA[2]	NA[2]	4.6
Di-isopropylamine	—	21	–6	600	316	1.1	7.1	3.5
Dimethylamine	IIA	Gas		752	400	2.8	14.4	1.6
1,4-Dioxane	IIB	54	12	356	180	2.0	22.0	3.0
Di-n-propylamine	—	63	17	570	299	NA[2]	NA[2]	3.5
n-Ethyl Morpholine	—	90	32	NA[2]	NA[2]	NA[2]	NA[2]	4.0
Hydrogen Selenide	—	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]
Isobutyraldehyde	—	–40	–40	385	196	1.6	10.6	2.5
Isopropyl Glycidyl Ether	—	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]
Methylacetylene-Propadiene (stabilized)	—	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]
Methyl Mercaptan	—	0	–18	NA[2]	NA[2]	3.9	21.8	1.7
Monomethyl Hydrazine	—	73	23	382	194	2.5	92.0	1.6
Nitroethane	IIA	82	28	778	414	3.4	NA[2]	2.6
Nitromethane	IIA	95	35	785	418	7.3	NA[2]	2.1
1-Nitropropane	—	93	34	789	421	2.2	NA[2]	3.1
Propionaldehyde (Propanol)	—	16	–9	405	207	2.6	17.0	2.0
Valeraldehyde	—	536	280	432	222	NA[2]	NA[2]	3.0
Group D Atmospheres								
Acetonitrile	IIA	42	6	975	524	3.0	16.0	1.4
Allyl Chloride	—	–25	–32	905	485	2.9	11.1	2.6
n-Amyl Acetate	—	77	25	680	360	1.1	7.5	4.5
sec-Amyl Acetate	IIA	73	23	NA[2]	NA[2]	21	7.5	4.5
sec-Butyl Acetate	—	18	–8	NA[2]	NA[2]	1.7	9.8	4.0
Butylamine	—	10	–12	594	312	1.7	9.8	2.5
Butylene (1-Butene)	—	Gas		725	385	1.6	10.0	1.9
Chlorobenzene	—	84	29	1099	593	1.3	9.6	3.9
Chloroprene	—	–4	–20	NA[2]	NA[2]	4.0	20.0	3.0
Cyclohexane	IIA	1	–17	473	245	1.3	8.0	2.9
Cyclohexene	—	21	–6	471	244	1.2	NA[2]	2.8
Cumene	IIA	96	36	795	424	0.9	6.5	4.1
1,1-Dichloroethane	—	2	–17	820	438	6.2	16	3.4
1,2-Dichloroethylene	IIA	207	97	860	460	5.6	12.8	3.4
1,3-Dichloropropene	—	95	35	NA[2]	NA[2]	5.3	14.5	3.8
Ethyl Benzene	—	70	21	810	432	0.8	6.7	3.7
Ethyl Chloride	—	–58	–50	966	519	3.8	15.4	2.2
Ethyl Formate	IIA	–4	–20	851	455	2.8	16.0	2.6
Heptene (Heptylene)	—	30	–1	399	204	NA[2]	NA[2]	4.5
2-Hexanone (Methyl Butyl Ketone)	—	95	35	795	424	1.2	8.0	3.5
Hexenes (2-Hexene)	—	<20	<–7	473	245	NA[2]	NA[2]	3.0
Isoamyl Acetate	—	77	25	680	360	1.0[3]	7.5	4.5
Isobutyl Acrylate	—	82	28	800	427	NA[2]	NA[2]	4.4

GROUP D ATMOSPHERES CONTINUED ON FOLLOWING PAGE

TABLE 2: Class I Flammable Gases and Vapors Having Less Than 100°F Flash Points—Determined by Chemical Analysis❶

Normally, Special Electrical Equipment IS Required Where these Flammable Gases or Vapors are Present, as these Chemicals Form Ignitable or Explosive Mixtures with Air at Ambient Temperatures.

Substance	Class I Zone Group	Flash Point °F	Flash Point °C	Auto Ignition Temp. (AIT) °F	Auto Ignition Temp. (AIT) °C	Flammable (Explosive) Limits Percent by Volume Lower	Flammable (Explosive) Limits Percent by Volume Upper	Vapor Density (Air = 1)
Group D Atmospheres (continued)								
Isopropyl Acetate	—	35	2	860	460	1.8❹	8.0	3.5
Isopropylamine	—	–15	–26	756	402	23	10.4	2.0
Liquefied Petroleum Gas	—	NA	NA	761 to 842	405 to 450	1.5❺	8.6❺	2.0❺
Methyl Acetate	IIB	14	–10	850	454	3.1	16.0	2.6
Methyl Acrylate	—	27	–3	875	468	2.8	25.0	3.0
Methylamine	IIA	Gas		806	430	4.9	20.7	1.0
Methylcyclohexane	—	25	–4	482	250	1.2	6.7	3.4
Methyl Formate	—	–2	–19	840	449	4.5	23.0	2.1
Methyl Isocyanate	—	5	–15	994	534	5.3	26.0	2.0
Methyl Methacrylate	IIA	50	10	792	422	1.7	8.2	3.6
Nonane	IIA	88	31	401	205	0.8	2.9	4.4
Nonene	—	78	26	NA❷	NA❷	0.8	NA❷	4.4
Octene (1-Octene)	—	46	8	446	230	0.9	NA❷	3.9
2-Pentanone (Methyl Propyl Ketone)	—	45	7	846	452	1.5	8.2	3.0
1-Pentene	—	0	–18	527	275	1.5	8.7	2.4
n-Propyl Acetate	—	57	14	842	450	1.7❹	8.0	3.5
Propylene Dichloride	—	60	16	1035	557	3.4	14.5	3.9
Turpentine	—	95	35	488	253	0.8	NA❷	NA❷
Vinylidene Chloride	—	–19	–28	1058	570	6.5	15.5	3.4

❶ How above vapors were classified as Group B, C or D

These vapors were classified as Group B, C or D by chemical analysis rather than by actual tests by Underwriters Laboratories Inc. More specifically, the classifications were based on "analogy with tested materials and chemical structure." They are therefore only tentative classifications and may actually be incorrect in some instances. Therefore, it may be advisable to submit these untested chemicals to a qualified testing laboratory for verification of the group classifications.

❷ Not Available ❸ At 212°F (100°C) ❹ 100°F (38°C) ❺ Commercial Butane

TABLE 3: Class I Combustible Vapors Having Flash Points of 100°F or More, But Less Than 140°F—Determined by Chemical Analysis❶

Normally, Special Electrical Equipment IS NOT Required Where these Combustible Vapors are Present, as these Chemicals Do NOT Form Ignitible Mixtures with Air at Ambient Temperatures Unless Heated Beyond their Flash Points.

Substance	Class I Zone Group	Flash Point °F	Flash Point °C	Auto Ignition Temp. (AIT) °F	Auto Ignition Temp. (AIT) °C	Flammable (Explosive) Limits Percent by Volume Lower	Flammable (Explosive) Limits Percent by Volume Upper	Vapor Density (Air = 1)
Group B Atmospheres								
Allyl Glycidyl Ether ❿	—	NA ❷	NA ❷	135	57	NA ❷	NA ❷	3.9
n-Butyl Glycidyl Ether ❿	—	NA ❷	NA ❷	NA ❷	NA ❷	NA ❷	NA ❷	NA ❷
Group C Atmospheres								
Ethylene Glycol Monoethyl Ether	—	102	39	455	235	1.7	15.6	3.0
Ethylene Glycol Monoethyl Ether Acetate	—	120	49	644	340	1.5 ❸	12.3 ❸	4.1
2-Ethylhexaldehyde	—	126	52	375	191	0.8 ❸	7.2 ❻	4.4
Hydrazine	—	100	38	74 to 518	23 to 270	2.9	98.0	1.1
Iso-octyl Aldehyde	—	NA ❷	NA ❷	387	197	NA ❷	NA ❷	NA ❷
Morpholine ❾	—	95	35	590	310	1.4	11.2	3.0
Tetramethyl Lead	—	100	38	NA ❷	NA ❷	NA ❷	NA ❷	9.2
Group D Atmospheres								
Acetic Acid ❾	IIA	109	43	867	464	4.0	19.9 ❸	2.1
Acetic Anhydride	—	129	54	600	316	2.7	10.3	3.5
Acrylic Acid	—	129	54	820	438	2.4	8.0	2.5
t-Butyl Acetate	—	NA ❷	NA ❷	NA ❷	NA ❷	1.7	9.8	4.0
n-Butyl Acrylate (inhibited)	—	120	49	559	293	1.7	9.9	4.4
Cyclohexanone	IIA	111	44	473	245	1.1 ❹	9.4	3.4
p-Cymene	IIA	117	47	817	436	0.7 ❹	5.6	4.6
Decene (1-Decene)	—	<131	<55	455	235	NA ❷	NA ❷	4.8
Diethyl Benzene	—	133 to 135	56 to 57	743 to 842	395 to 450	NA ❷	NA ❷	4.6
Di-isobutyl Ketone	—	140	60	745	396	0.8 ❸	7.1 ❸	4.9
Dimethyl Formamide	—	136	58	833	445	2.2 ❹	15.2	2.5
Dipentene	—	113	45	458	237	0.7 ❺	6.1 ❺	4.7
Ethyl sec-Amyl Ketone	—	55	13	685	363	3.3	19.0	1.6
Ethyl Butanol	—	135	57	NA ❷	NA ❷	1.2	7.7	3.5
Ethyl Butyl Ketone	—	115	46	NA ❷	NA ❷	NA ❷	NA ❷	4.0
Ethylene Glycol Monomethyl Ether	—	102	39	545	285	1.8 ⓫	14 ⓫	2.6
Ethyl Silicate	—	125	52	NA ❷	NA ❷	NA ❷	NA ❷	7.2
Formic Acid (90%)	—	122	50	813	434	18.0	57.0	1.6
Fuel Oils	—	110 to 336	43 to 169	410 to 765	210 to 407	0.7	5.0	NA ❷
sec-Hexyl Acetate	—	113	45	NA ❷	NA ❷	NA ❷	NA ❷	5.0
Isoamyl Alcohol	—	109	43	662	350	1.2	9.0 ❹	3.0
Kerosene	IIA	110 to 162	43 to 72	410	210	0.7	5.0	4.5
Methyl Amyl Alcohol (Methyl Isobutyl Carbinol)	—	106	21	NA ❷	NA ❷	1.0	5.5	3.5
Methyl n-Amyl Ketone	—	120	49	740	393	1.1 ❼	7.9 ❽	3.9
o-Methylcyclohexanone	—	118	48	NA ❷	NA ❷	NA ❷	NA ❷	3.9
alpha-Methyl Styrene	—	127	53	1065	574	0.8	11.0	4.1
Naphtha (Coal Tar)	IIA	108	42	531	277	1.1	5.9	2.5
Propionic Acid	—	129	54	870	466	2.9	12.1	2.5
Tripropylamine	—	105	41	NA ❷	NA ❷	NA ❷	NA ❷	4.9

❶ All chemicals in the above Table 3 are Class II Combustible Liquids per NFPA Standard 321. Like the chemicals in Table 2, these vapors (except Acetic Acid and Morpholine) were classified as Group B, C or D by chemical analysis It may, therefore, be necessary to have a testing laboratory verify these Group classifications.

❷ Not Available ❸ At 200°F (93°C) ❹ At 212°F (100°C) ❺ At 302°F (150°C)

❻ At 275°F (135°C) ❼ 151°F (66°C) ❽ At 250°F (121°C)

❾ Acetic Acid and Morpholine were classified by actual tests.

❿ Electrical equipment for Group C permitted if external seals are installed per *NEC*® 501.5(A)

⓫ at STP.

TABLE 4: Class I Combustible Vapors Having Flash Points of 140°F or More But Less Than 200°F—Determined by Chemical Analysis❶

Normally, Special Electrical Equipment IS NOT Required Where these Combustible Vapors are Present, as these Chemicals Do NOT Form Ignitible Mixtures with Air at Ambient Temperatures Unless Heated Beyond their Flash Points.

Substance	Class I Zone Group	Flash Point °F	Flash Point °C	Auto Ignition Temp. (AIT) °F	Auto Ignition Temp. (AIT) °C	Flammable (Explosive) Limits Percent by Volume Lower	Flammable (Explosive) Limits Percent by Volume Upper	Vapor Density (Air = 1)
Group C Atmospheres								
n-Butyl Formal	—	NA❷	NA❷	NA❷	NA❷	NA❷	NA❷	NA❷
Chloroacetaldehyde	—	190	88	NA❷	NA❷	NA❷	NA❷	NA❷
1-Chloro-1-Nitropropane	—	144	62	NA❷	NA❷	NA❷	NA❷	4.3
n-Decaldehyde	—	NA❷	NA❷	NA❷	NA❷	NA❷	NA❷	NA❷
1,1-Dichloro-1-Nitroethane	—	168	76	NA❷	NA❷	NA❷	NA❷	5.0
Diethylaminoethanol (N-N-Diethylethanolamine)	IIA	140	60	608	320	NA❷	NA❷	4.0
Diethylene Glycol Monobutyl Ether	—	172	78	442	228	.9	24.6	5.6
Diethylene Glycol Monomethyl Ether	—	199	93	466	241	1.2❹	23.5❽	NA❷
N-N-Dimethyl Aniline	—	145	63	700	371	1.0	NA❷	4.2
Dipropylene Glycol Methyl Ether	—	185	85	NA❷	NA❷	1.1❸	3.0	5.1
Ethylene Glycol Monobutyl Ether	—	143	62	460	238	1.1❸	12.7❹	4.1
Ethylene Glycol Monobutyl Ether Acetate	—	160	71	645	340	0.88❸	8.54❹	NA❷
2-Ethyl-3-Propyl Acrolein	—	155	68	NA❷	NA❷	NA❷	NA❷	4.4
Furfural	—	140	60	600	316	2.1	19.3	3.3
Furfural Alcohol	—	167	75	915	490	1.8	16.3	3.4
Isodecaldehyde	—	185	85	NA❷	NA❷	NA❷	NA❷	5.4
Monomethyl Aniline (o-Toluidine)	—	185	85	900	482	NA❷	NA❷	3.7
Group D Atmospheres								
Acetone Cyanohydrin	—	165	74	1270	688	2.2	12.0	2.9
Adiponitrile	—	200	93	1022	550	NA❷	NA❷	1.0
Aniline	IIA	158	70	1139	615	1.3	11.0	3.2
Benzyl Chloride	—	153	67	1085	585	1.1	NA❷	4.4
t-Butyl Toluene	—	NA❷	NA❷	NA❷	NA❷	NA❷	NA❷	NA❷
n-Butyric Acid	—	161	72	830	443	2.0	10.0	3.0
Cresol	—	178 to 187	81 to 86	1038 to 1110	559 to 599	1.1 to 1.4	NA❷	3.7
Cyclohexanol	IIA	154	68	572	300	NA❷	NA❷	3.5
n-Decanol	—	180	82	550	288	NA❷	NA❷	5.3
Diacetone Alcohol	—	148	64	1118	603	1.8	6.9	4.0
o-Dichlorobenzene	IIA	151	66	1198	647	2.2	9.2	5.1
Dimethyl Sulfate	—	182	83	370	188	NA❷	NA❷	4.4
Dodecene (Dodecylene)	—	212	100	491	255	NA❷	NA❷	5.8
Ethylene Chlorohydrin (2-Chloroethanol)	—	138	59	797	425	4.9	15.9	2.8
2-Ethyl Hexanol	—	178	81	448	231	0.9	9.7	4.5
2-Ethyl Hexyl Acrylate	—	190	88	485	252	NA❷	NA❷	NA❷
Hexanol (Hexyl Alcohol)	IIA	145	63	NA❷	NA❷	NA❷	NA❷	3.5
iso-octyl Alcohol	—	180	82	NA❷	NA❷	NA❷	NA❷	NA❷
Isophorone	—	184	84	860	460	0.8	3.8	4.8
Methylcyclohexanol	—	154	68	565	296	NA❷	NA❷	3.9
2-Methyl-5-Ethyl Pyridine	—	165	74	NA❷	NA❷	1.1	6.6	4.2
Monoethanolamine	IIA	185	85	770	410	3.0❾	23.5❾	2.1
Monoisopropanolamine (1-Amino-2-Propanol)	—	171	77	705	374	NA❷	NA❷	2.6
Nitrobenzene	—	190	88	900	482	1.8❸	NA❷	4.3
Nonyl Alcohol (Diisobutyl Carbinol)	IIA	165	0	NA❷	NA❷	0.8❻	6.1❻	5.0
n-Octyl Alcohol	IIA	178	81	NA❷	NA❷	NA❷	NA❷	4.5
Phenylhydrazine	—	192	89	NA❷	NA❷	NA❷	NA❷	3.7
Propiolactone	—	165	74	NA❷	NA❷	2.9	NA❷	2.5
Propionic Anhydride	—	165	74	545	285	1.3	9.5	4.5
Tetrahydronaphthalene	—	160	71	725	385	0.8❻	5.0❼	4.6
Tridecene	—	NA❷	NA❷	NA❷	NA❷	0.6	NA❷	6.4
Triethylbenzene	—	181	83	NA❷	NA❷	56❿	NA❷	5.6
Undecene	—	NA❷	NA❷	NA❷	NA❷	0.7	NA❷	5.5
Vinyl Toluene	—	126	52	921	494	0.8	11.0	4.1

❶ These are Class IIIA Combustible Liquids per NFPA Standard 321. Groups C and D were determined by "analogy with tested materials and chemical structure." It may be necessary to have these chemicals tested by a qualified laboratory to verify above Group classifications. ❷ Not Available ❸ At 200°F (93°C) ❹ At 275°F (135°C) ❺ At 300°F (149°C) ❻ At 212°F (100°C) ❼ At 302°F (150°C) ❽ At 360°F (182°C) ❾ At 284°F (140°C) ❿ At 239°F (115°C)