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# U. S. NAVAL AMMUNITION DEPOT

# CRANE, INDIANA

DEPARTMENT OF THE NAVY
BUREAU OF WEAPONS

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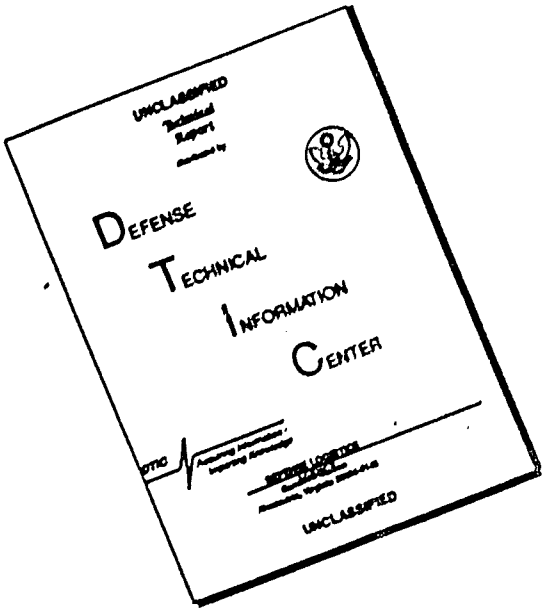


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U. S. NAVAL AMMUNITION DEPOT
Crane, Indiana

RDTR No. 71
24 February 1966

# AIR REACTIVE COMPOUNDS: Listing and Properties

Bernard E. Douda

Released

B. H. Calkins, Manager
Concept Division
Research and Development Department

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## ABSTRACT

Properties of air reactive compounds are listed.

## INTRODUCTION

The data in PART I regarding air reactive compounds were collected from Handbook of Organometallic Compounds, Herbert C. Kaufman, 1961. The information is reprinted herein through the courtesy of D. Van Nostrand Company, Inc. Abbreviations and notation are as defined in the following pages.

The data in PART II were collected by D. M. Johnson. They are included to provide leads to additional information.

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PART I

## ABBREVIATIONS

a - acid
ac.a. - acetic acid
acet. - acetone
alc. - alcohol
alk. - alkali
arom. - aromatic solvents
BM - Bohr Magnetons
C - Centigrade
c - cold
cp - centipoises
cs - centistokes
D - Debye units
d - decomposes
deg - degree
deliq. - deliquescent
eth - ethyl ether
exp - explodes
ext - extrapolated
F - Fahrenheit
h. - hot
hyg. hygroscopic
i. - insoluble
i- - iso
inf. - infusible
infl. - inflammable
Kcal - kilocalories
m- - meta
n - normal
o- - ortho
p- - para
pyr. - pyridine
s. - soluble
sec. - secondary
sl. - slightly
spon. - spontaneously
subl.-sublimes
sym. - symmetrical
tert. - tertiary
uns. - unsymmetrical
v. - very
∞ - miscible, infinite
> - greater than
< - less than

## PHYSICAL PROPERTIES

Characteristics - The color and state of aggregation are posted when available.

Solubility - The solubility of a given compound in a solvent is expressed gross terms such as soluble, slightly soluble, insoluble, or decomposes.

Refractive Index - Values posted are indicated by a specific temperature in °C and for a given spectral line.

Specific Gravity - Values are posted at a given temperature in °C, which may be referred to water at the same or another temperature.

Melting Point - Values are given in °C. A "d" before the figure indicates decomposition without melting, a "d" after the figure indicates decomposition upon melting.

Boiling Point - Values are shown in °C with an atmospheric pressure range of 740-770 mm of mercury indicated.

Vapor Pressure - The prime figure indicates the temperature in °C, the superscript, vapor pressure in mm of mercury. Occasionally, the vapor pressure equation is given where available.

Viscosity - Values are posted in terms of centistokes, centipoises, or millipoises, as specified.

Thermodynamic Values - Values are given for a specific temperature (25°C unless otherwise stated). The units are given in each instance.

Flash, Fire, and Autoignition Temperatures - These values are posted in °F.

Surface Tension - Values are expressed in dynes/cm unless otherwise stated.

Dipole Moments - These values are shown in Debye units.

# LITHIUM

## $LiCH_3$

| | |
|---|---|
| Name | Methyl lithium |
| Formula | $CH_3Li$ |
| Molecular Weight | 21.96 |
| Characteristics | solid |
| Melting Point | infus. |
| Addenda | spon. infl. |
| Reference | |

Annotated Bibliography on the Use of Organo-Lithium Compounds, Supplements 1-5 (1949-59), Metalloy Corp., Minneapolis

## $Li_2CH_2$

| | |
|---|---|
| Name | Methylene dilithium |
| Formula | $LiCH_2Li$ |
| Molecular Weight | 27.91 |
| Characteristics | solid - brown |
| Solubility | d. $H_2O$, air; i. all |
| Addenda | spon. infl. |

# SODIUM

## $NaCH_3$

| | |
|---|---|
| Name | Methyl sodium |
| Formula | $CH_3Na$ |
| Molecular Weight | 38.00 |
| Characteristics | solid |
| Solubility | 1. org.; d. air, $H_2O$ |
| Melting Point | d. 200 |
| Addenda | spon. infl. |

## $NaC_2H_5$

| | |
|---|---|
| Name | Ethyl sodium |
| Formula | $C_2H_5Na$ |
| Molecular Weight | 52.06 |
| Characteristics | crystalline - white |
| Solubility | d. $H_2O$, al., eth., air; i. org.; s. diethyl zinc |
| Melting Point | d. |
| Addenda | spont. infl. |

W. Schlenk, J. Holz - Ber. 50, 262 (1917)

# COPPER

$CuCH_3$

| | |
|---|---|
| Name | Methyl copper |
| Formula | $CH_3Cu$ |
| Molecular Weight | 78.58 |
| Characteristics | gas |
| Solubility | s. eth. |
| Addenda | spont. infl. |

## BERYLLIUM

### $BeC_2H_6$

| | |
|---|---|
| Name | Dimethyl beryllium |
| Formula | $(CH_3)_2Be$ |
| Molecular Weight | 39.08 |
| Characteristics | needles - white |
| Solubility | s.h. ether |
| Melting Point | 200 Subl. |
| Boiling Point | d. 190 |
| Vapor Pressure | $108^{1}$, $158.6^{30.5}$ |
| Addenda | spont. inflam. |
| Heat of Sublimation | 22 Kcal/mole |

G. E. Coates, F. Glockling - J. Chem. Soc., 1954, 2526-9

G. E. Coates, F. Glockling - J. Chem. Soc., 1954, 22-7

### $BeC_4H_{10}$

| | |
|---|---|
| Name | Diethyl beryllium |
| Formula | $(C_2H_5)_2Be$ |
| Molecular Weight | 67.13 |
| Characteristics | liquid - colorless |
| Solubility | s. org. |
| Melting Point | -13 to -11 |
| Boiling Point | $194^{ext}$ |
| Vapor Pressure | $93\text{-}95^{4}$ d. |
| Addenda | spont. inflam. |

G. E. Coates, F. Glockling - J. Chem. Soc., 1954, 22-7

# MAGNESIUM

## $MgCH_2$

| | |
|---|---|
| Name | Methylene magnesium |
| Formula | $MgCH_2$ |
| Molecular Weight | 38.35 |
| Characteristics | amorphous - rust |
| Solubility | d. $H_2O$, air; i. org. |
| Addenda | spon. infl. |

## $MgC_2H_6$

| | |
|---|---|
| Name | Dimethyl magnesium |
| Formula | $Mg(CH_3)_2$ |
| Molecular Weight | 54.50 |
| Characteristics | solid |
| Solubility | s. ether |
| Melting Point | d. 200 |
| Vapor Pressure | $190^{0.2}$ |
| Addenda | spont. inflam. |

## $MgC_8H_{18}$

| | |
|---|---|
| Name | Dibutyl magnesium |
| Formula | $(C_4H_9)_2Mg$ |
| Molecular Weight | 138.72 |
| Characteristics | crystalline |
| Solubility | s. ether |
| Melting Point | d. 200 |
| Addenda | spont. inflam. |

Kaufman, H.C., Handbook of Organometallic Compounds, D. Van Nostrand Company, Inc., New York, 1961, p. 30

# ZINC

## $ZnC_2H_6$

| | |
|---|---|
| Name | Dimethylzinc |
| Formula | $(CH_3)_2Zn$ |
| Molecular Weight | 95.45 |
| Characteristics | liquid - colorless |
| Solubility | d. $H_2O$, alc; s. org |
| Specific Gravity | (10) 1.386 |
| Melting Point | -42 |
| Boiling Point | 46 |
| Vapor Pressure | $0^{124}$ |
| Addenda | spont. inflam. |

R. C. Krug, P. J. C. Tang - JACS, 76, 2262-3 (1954)

Handbook of Chemistry and Physics, Chemical Rubber Publishing Co., Cleveland, Ohio (1958)

## $ZnC_4H_{10}$

| | |
|---|---|
| Name | Diethylzinc |
| Formula | $(C_2H_5)_2Zn$ |
| Molecular Weight | 123.50 |
| Characteristics | liquid - colorless |
| Solubility | d. $H_2O$, alc.; s. org. |
| Refractive Index | (8/Hα)1.4936 |
| Specific Gravity | (18) 1.182; |
| | (20/4) 1.2065; |
| | (8/4) 1.245 |
| Melting Point | -28 |
| Boiling Point | 118 |
| Vapor Pressure | $30^{27}$ |
| Addenda | spont. inflam. |

R. C. Krug, P. J. C. Tang - JACS, 76, 2262-3 (1954)

Handbook of Chemistry and Physics, Chemic ubber Publishing Co., Cleveland, Ohio (1958)

$ZnC_6H_{14}$

| | |
|---|---|
| Name | Di-n-propyl zinc |
| Formula | $(C_3H_7)_2Zn$ |
| Molecular Weight | 151.55 |
| Characteristics | liquid |
| Solubility | d. $H_2O$; s. org. |
| Refractive Index | (18.6/D) 1.4845; (18.6/Hα) 1.4803 |
| Specific Gravity | (20/4)1.1034 |
| Boiling Point | 160 |
| Vapor Pressure | $48^{10}$ |
| Addenda | spont. infl. |

R. C. Krug, P. J. C. Tang - JACS, 76, 2262-3 (1954)

Handbook of Chemistry and Physics, Chemical Rubber Publishing Co., Cleveland, Ohio (1958)

## CADMIUM

$CdC_2H_6$

| | |
|---|---|
| Name | Dimethyl cadmium |
| Formula | $(CH_3)_2Cd$ |
| Molecular Weight | 142.48 |
| Characteristics | liquid - colorless |
| Solubility | d. $H_2O$; s. org. |
| Refractive Index | (18/D)1.5849 |
| Specific Gravity | (17.9)1.9846 |
| Melting Point | -2.5 |
| Boiling Point | 105.5 |
| Addenda | musty odor; spont. infl. |
| Heat of Fusion | (18) 9153 cal/mole |
| Atomic Refraction | 12.61 |

E. Krause, A. von Grosse - Die Chemie der Metallorganischen Verbindungen, Brontraeger, Berlin (1937)

# CERIUM

## $CeH_3$

| | |
|---|---|
| Name | Trihydro cerine |
| Formula | $CeH_3$ |
| Molecular Weight | 143.15 |
| Characteristics | powder - black |
| Solubility | d. air, $H_2O$ |
| Specific Gravity | 5.5 g/cc |
| Melting Point | 1080 d. |
| Vapor Pressure | $450\text{-}500^{0.5}$ |
| Heat of Formation | 42.26 Kcal/mole |
| Addenda | spont. infl. |

D. Hurd - Chemistry of the Hydrides, Wiley, New York (1952)

# THORIUM

## $ThH_3$

| | |
|---|---|
| Name | Thorium hydride |
| Formula | $ThH_3$ |
| Molecular Weight | 235.07 |
| Characteristics | powder - black |
| Addenda | spont. infl. |

## BORON

### $BC_3H_9$

| | |
|---|---|
| Name | Trimethyl borine |
| Formula | $B(CH_3)_3$ |
| Molecular Weight | 55.92 |
| Characteristics | gas - colorless |
| Solubility | s. org.; d. air |
| Specific Gravity | (-100) 0.63; 1.9108 g/l |
| Melting Point | -153 (-161.5) |
| Boiling Point | -20 |
| Vapor Pressure | -50[80]; -80[31] |
| Heat of Vaporization | 5.7 Kcal/mole |
| Heat of Combustion | 23,000 Btu/lb |
| Addenda | spont. infl. |

Callery Chemical Co. PB - 124518 (1951)

G. Urry, J. Kerrigan, T.D. Parsons, H.I. Schlesinger - JACS, 76, 5299 (1954)

### $BC_6H_{14}Cl$

| | |
|---|---|
| Name | Dipropyl chloroborine |
| Formula | $(C_3H_7)_2BCl$ |
| Molecular Weight | 132.45 |
| Characteristics | liquid - colorless |
| Solubility | s. org., d. $O_2$ |
| Specific Gravity | (20) 0.848 |
| Melting Point | <125 |
| Boiling Point | 127 |
| Addenda | spont. infl. |

L. H. Long, D. Dollimore - J. Chem. Soc., 1953, 3902-10

## $BC_6H_{15}$

| | |
|---|---|
| Name | Triethyl borine |
| Formula | $(C_2H_5)_3B$ |
| Molecular Weight | 98.10 |
| Characteristics | liquid - colorless |
| Solubility | s. org., d. air |
| Refractive Index | (20/D) 1.4485 |
| Specific Gravity | (20) 0.696 |
| Melting Point | -93 |
| Boiling Point | 95 |
| Vapor Pressure | $0^{12.5}$ |
| Heat of Combustion | 21,900 Btu/lb |
| Addenda | spont. infl. |

## $BC_{10}H_{13}$

| | |
|---|---|
| Name | Phenyl cyclotetra-methyleneborine |
| Formula | $C_6H_5B(CH_2)_4$ |
| Molecular Weight | 144.02 |
| Characteristics | liquid - colorless |
| Solubility | s. org., d. air |
| Vapor Pressure | $85\text{-}7^{11}$ |
| Addenda | spont. infl. |

K. Torssell - Acta Chem. Scand., 8, 1779-86 (1954) I

## $BH_3Br_3P$

| | |
|---|---|
| Name | Tribromo borine-phosphine |
| Formula | $BBr_3 \cdot PH_3$ |
| Molecular Weight | 284.59 |
| Characteristics | amorphous - white |
| Addenda | spont. infl. |

Chem. Revs., 42, 581-615 (1942)

$BH_3Br_3As$

| | |
|---|---|
| Name | Tribromoborine - arsine |
| Formula | $BBr_3 \cdot AsH_3$ |
| Molecular Weight | 328.54 |
| Characteristics | liquid |
| Solubility | d. $H_2O$ |
| Melting Point | 7 |
| Boiling Point | 40 d. |
| Addenda | spont. infl. |

Chem. Revs., 42, 581-615 (1942)

$BH_6NCl_2Si_2$

| | |
|---|---|
| Name | Disilylamino dichloroborine |
| Formula | $(SiH_3)_2NBCl_2$ |
| Molecular Weight | 157.93 |
| Characteristics | solid |
| Melting Point | 62 d. |
| Vapor Pressure | $25^{22}$ |
| Addenda | spont. infl. |

$B_2CH_{11}NSi$

| | |
|---|---|
| Name | (Methyl sily)amino diborane |
| Formula | $B_2H_5N(CH_3)(SiH_3)$ |
| Molecular Weight | 86.81 |
| Characteristics | liquid - colorless |
| Solubility | s. org.; d. $H_2O$, air |
| Melting Point | -39.0 |
| Boiling Point | 51 |
| Vapor Pressure | $\log p = 8.58 - 1800/T;0^{82}$ |
| Heat of Vaporization | (60) 7716 cal/mole |
| Addenda | spont. infl. |

Callery Chemical Co. PB - 124518 (1951)
F.G.A. Stone - Quart, Revs. (London) 9 174-201 (1955)
JACS, 72, 3103-5 (1950)

$B_2C_6H_{18}$

| | |
|---|---|
| Name | Triethyl diborane |
| Formula | $(C_2H_5)_3B_2H_3$ |
| Molecular Weight | 111.82 |
| Characteristics | liquid - colorless |
| Solubility | s. org. |
| Vapor Pressure | $0^4$ |
| Addenda | spont. infl. |

J. Chem. Phys., 8, 188 (1940)

$B_2C_{18}H_{40}O_2$

| | |
|---|---|
| Name | Tetrabutyl diborinyl-oxyethane |
| Formula | $(C_4H_9)_2BOCH_2CH_2OB(C_4H_9)_2$ |
| Molecular Weight | 310.14 |
| Characteristics | liquid - colorless |
| Solubility | s. org. |
| Refractive Index | (27/D) 1.4343; (25/D) 1.4323 |
| Specific Gravity | (25) 0.8266 |
| Vapor Pressure | $144^2$; $168\text{-}9^{10}$; $133\text{-}4^1$ |
| Addenda | spont. infl. |

R. L. Letsinger, I. Skoog - JACS 76 4174-6 (1954)

$B_2H_5Cl$

| | |
|---|---|
| Name | Monochlordiborane |
| Formula | $H_3BBH_2Cl$ |
| Molecular Weight | 62.14 |
| Characteristics | gas - colorless |
| Solubility | s. org.; d. $H_2O$, air |
| Melting Point | -142 |
| Boiling Point | 0 |
| Vapor Pressure | $-78^{18}$ |
| Addenda | spont. infl. |

Callery Chemical Co. PB - 124518 (1951)

## $B_2H_{11}NSi_2$

| | |
|---|---|
| Name | Disilylaminodiborane |
| Formula | $B_2H_5N(SiH_3)_2$ |
| Molecular Weight | 102.92 |
| Characteristics | liquid - colorless |
| Solubility | s. org.; d. $H_2O$, air |
| Melting Point | -68.8 |
| Boiling Point | 54 (60) |
| Vapor Pressure | $7.974-1669/T;0^{162}$ |
| Heat of Vaporization | (54) 7640 cal/mole |
| Addenda | spont. infl. |

Callery Chemical Co., PB - 124518 (1951)
F.G.A. Stone - Quart, Revs. (London) 9 174-201 (1955)

## $B_2Cl_4$

| | |
|---|---|
| Name | Tetrachloro diborine |
| Formula | $B_2Cl_4$ |
| Molecular Weight | 163.47 |
| Characteristics | liquid - colorless |
| Solubility | d.$H_2O$ |
| Melting Point | -91 |
| Boiling Point | 65.5 |
| Addenda | spont. infl. |

Callery Chemical Co., PB - 124518 (1951)
G. Urry, T. Wartik, R. E. Moore, H. I. Schlesinger - JACS, 76, 5293-8 (1954)

## $B_3C_3H_9N_3Cl_3$

| | |
|---|---|
| Name | N,N',N"-Trimethyl trichlorocyclo triborazine |
| Formula | $[CH_3NBCl]_3$ |
| Molecular Weight | 225.96 |
| Characteristics | crystals |
| Solubility | s. org.; d. $H_2O$ |
| Melting Point | 156 |
| Vapor Pressure | $120-30^{0.05}$ subl. |
| Addenda | spont. infl. |

H.S. Turner - Chem. & Ind. 1958 526

## $B_3H_{12}Al$

| | |
|---|---|
| Name | Aluminum tris (tetrahydroborane) |
| Formula | $Al(BH_4)_3$ |
| Molecular Weight | 71.54 |
| Characteristics | liquid - colorless |
| Solubility | d. $H_2O$ (exp.); s. org. |
| Specific Gravity | (0) 0.561; (10) 0.533; (20) 0.544; (29.4) 0.537 |
| Melting Point | -64.5 |
| Boiling Point | 44.5 |
| Vapor Pressure | $\log p = 7.808 - 1565/T$; $0^{120}$; $17^{257}$ |
| Viscosity | $(23 \times 10^{-5})\ d^{1/3} e^{1291 d/T_p}$ |
| Heat of Vaporization | 7160 cal/mole |
| Heat of Combustion | 13760 cal/gm |
| Addenda | spont. infl. |
| Surface Tension | $(61.0 - 0.130T) d^{2/3}$ dynes/cm |

Callery Chemical Co., PB - 124518 (1951)

## $B_4H_{10}$

| | |
|---|---|
| Name | Tetraborane |
| Formula | $B_4H_{10}$ |
| Molecular Weight | 53.36 |
| Characteristics | gas - colorless |
| Solubility | d. $H_2O$ |
| Specific Gravity | (-35) 0.56 |
| Melting Point | -120.0 |
| Boiling Point | 16-18 |
| Heat of Vaporization | 6.47 Kcal/mole |
| Addenda | spont. infl. |

Callery Chemical Co., PB - 124518 (1951)

## $B_4Cl_4$

| | |
|---|---|
| Name | Boron chloride-tetramer |
| Formula | $(BCl)_4$ |
| Molecular Weight | 185.12 |
| Characteristics | crystals - yellow |
| Melting Point | 75 d. |
| Vapor Pressure | $23^{1.5}$; $68^{34}$ |
| Addenda | spont. infl. |

G. Urry, T. Wartik, R.E. Moore, H.I. Schlesinger - JACS, 76, 5293-8 (1954)

## $B_5H_{11}$

| | |
|---|---|
| Name | Dihydropentaborane |
| Formula | $B_5H_{11}$ |
| Molecular Weight | 65.19 |
| Characteristics | liquid - colorless |
| Solubility | d. alc., air |
| Melting Point | -123.1 |
| Boiling Point | 65 d. |
| Vapor Pressure | $0^{52.8}$; $-33.4^{7.2}$ |
| Heat of Vaporization | 7.61 Kcal/mole |
| Addenda | unstable; spont. infl. |

Callery Chemical Co., PB - 124518 (1951)

## $B_6H_{10}$

| | |
|---|---|
| Name | Hexaborane |
| Formula | $B_6H_{10}$ |
| Molecular Weight | 75.00 |
| Characteristics | liquid - colorless |
| Solubility | d. $H_2O$, alc. |
| Specific Gravity | 0.69 |
| Melting Point | -65 |
| Boiling Point | 110 |
| Vapor Pressure | $0^7$ |
| Addenda | spont. infl. |

Callery Chemical Co., PB - 124518 (1951)

$B_6H_{12}$

| | |
|---|---|
| Name | Dihydrohexaborane |
| Formula | $B_6H_{12}$ |
| Molecular Weight | 77.02 |
| Characteristics | liquid - colorless |
| Solubility | d. alc.; s. org. |
| Melting Point | -90 |
| Boiling Point | 20 d. |
| Addenda | unstable; spont. infl. |

Callery Chemical Co., PB - 124518 (1951)

## ALUMINUM

### $AlC_2H_5Cl_2$

| | |
|---|---|
| Name | Ethyl dichloroalumine |
| Formula | $C_2H_5AlCl_2$ |
| Molecular Weight | 126.96 |
| Characteristics | liquid - yellow |
| Solubility | d. $H_2O$, air |
| Specific Gravity | (25) 1.232 |
| Melting Point | 22 |
| Boiling Point | 194 (EXT) |
| Vapor Pressure | $80^{12}$; $100^{30}$; $120^{69}$; $160^{280}$; $180^{515}$ |
| Viscosity | (23.3) 3.18 cp |
| Addenda | spont. infl. |

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)

### $AlC_3H_9$

| | |
|---|---|
| Name | Trimethyl alumine |
| Formula | $(CH_3)_3Al$ |
| Molecular Weight | 72.09 |
| Characteristics | liquid - colorless |
| Solubility | s. org.; d. $H_2O$, air |
| Refractive Index | (12/D) 1.432 |
| Specific Gravity | (20) 0.752 |
| Melting Point | 15.4 |
| Boiling Point | 126 |
| Vapor Pressure | $20^{8.4}$; $60^{68.5}$; $100^{332}$ |
| Heat of Combustion | 10,500 cal/gm |
| Addenda | spont. infl. |
| Specific Heat | (33) 0.53 |

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)
K. Ziegler, H.G. Gellert, H. Martin, K. Nagel, J. Schneider - Ann., 589, 91-121 (1954)

## $AlC_4H_{10}Cl$

| | |
|---|---|
| Name | Diethyl chloroalumine |
| Formula | $(C_2H_5)_2AlCl$ |
| Molecular Weight | 120.56 |
| Characteristics | liquid-colorless |
| Solubility | d. $H_2O$, air |
| Specific Gravity | (25) 0.958 |
| Melting Point | -74 |
| Boiling Point | 208 ext. |
| Vapor Pressure | $41^{1}$; $90^{12}$; $130^{65}$; $170^{256}$; $190^{465}$ |
| Viscosity | (23.3) 1.453 cp |
| Addenda | spont. infl. |

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)
G. Pajaro - Ann.Chim. (Rome), 48, 193-7 (1958)

## $AlC_5H_{15}O$

| | |
|---|---|
| Name | Trimethyl alumine-dimethyl ether |
| Formula | $(CH_3)_3Al.(CH_3)_2O$ |
| Molecular Weight | 118.11 |
| Characteristics | liquid |
| Solubility | s.org., d.$H_2O$ |
| Melting Point | -30 |
| Boiling Point | 159 |
| Addenda | spont. infl. |

## $AlC_6H_{15}$

| | |
|---|---|
| Name | Triethyl alumine |
| Formula | $(C_2H_5)_3Al$ |
| Molecular Weight | 114.17 |
| Characteristics | liquid-colorless |
| Solubility | s.org., d. $H_2O$, air |
| Refractive Index | (6.5/D) 1.480 |
| Specific Gravity | (25) 0.8324 |
| Melting Point | -46 (-52.5) |
| Boiling Point | 194d.;207 ext. |
| Vapor Pressure | $48\text{-}50^{.004}$; $60^{0.8}$; $10^{13}$; $140^{110}$ |
| Viscosity | (25) 2.58 cp |
| Addenda | spont. infl. |
| Specific Heat | (33) 0.527 |

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)
G. Pajaro - Ann.Chim. (Rome), 48, 193-7 (1958)

## $AlC_7H_{19}O$

| | |
|---|---|
| Name | Trimethyl alumine-diethyl ether |
| Formula | $(CH_3)_3Al.O(C_2H_5)_2$ |
| Molecular Weight | 146.21 |
| Characteristics | liquid |
| Solubility | s.org., d.$H_2O$ |
| Vapor Pressure | $68^{15}$ |
| Addenda | spont. infl. |

K. Ziegler, H.G. Gellert, H. Martin, K. Nagel, J. Schneider - Ann., 589, 91-121 (1954)

## $AlC_{10}H_{23}O$

| | |
|---|---|
| Name | Diethyl 4-ethoxy butylalumine |
| Formula | $(C_2H_5)_2Al(CH_2)_4OC_2H_5$ |
| Molecular Weight | 186.27 |
| Characteristics | liquid - colorless |
| Solubility | d. air; s. org. |
| Vapor Pressure | $99.5^{5.5}$ |
| Addenda | spont. infl. |

G. Bahr, G. E. Muller - Chem.Ber., 88, 251-64 (1955)

$AlC_{10}H_{25}O$

| | |
|---|---|
| Name | Triethyl alumine-diethyl ether |
| Formula | $Al(C_2H_5)_3(C_2H_5)_2O$ |
| Molecular Weight | 188.29 |
| Characteristics | liquid - colorless |
| Refractive Index | (17.4/D) 1.4370; (17/Hα) 1.4343 |
| Specific Gravity | (17/4) 0.8200 |
| Boiling Point | 216-8 |
| Vapor Pressure | $112^{16}$ |
| Addenda | spont. infl. |

$AlC_{11}H_{26}N$

| | |
|---|---|
| Name | Diethyl diethyl-amino-3-propyl alumine |
| Formula | $(C_2H_5)_2Al(CH_2)_3N(C_2H_5)_2$ |
| Molecular Weight | 199.32 |
| Characteristics | liquid - straw |
| Solubility | d. air; s. org. |
| Melting Point | -2 |
| Vapor Pressure | $97^{2}$ |
| Addenda | spont. infl. |

G. Bahr, G. E. Muller - Chem.Ber., 88, 251-64 (1955)

$Al_2C_3H_9Br_3$

| | |
|---|---|
| Name | 1,1,1-Trimethyl tribromo dialumene |
| Formula | $(CH_3)_3AlAlBr_3$ |
| Molecular Weight | 338.81 |
| Characteristics | liquid - yellow |
| Solubility | s. org.; d. $H_2O$ |
| Specific Gravity | (25) 1.514 |
| Melting Point | 4 |
| Boiling Point | 166ext. |
| Vapor Pressure | $60^{15}$; $80^{39}$; $100^{89}$; $120^{185}$; $140^{359}$; $160^{650}$ |
| Viscosity | (23.3) 2.76 cp |
| Addenda | spont. infl. |

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)

$Al_2C_3H_{12}$

| | |
|---|---|
| Name | 1,1,2-Trimethyl dialumene |
| Formula | $(CH_3)_2HAlAlH_2(CH_3)$ |
| Molecular Weight | 102.09 |
| Solubility | d.air,$H_2O$ |
| Addenda | spont. infl. |

N. Sidgewick, "Chemical Elements and Their Compounds", vol.I and II - Oxford, London (1950)

$Al_2C_4H_{10}I_4$

| | |
|---|---|
| Name | 1,2-Diethyl tetraiodo-dialumene |
| Formula | $C_2H_5I_2AlAlI_2C_2H_5$ |
| Molecular Weight | 619.72 |
| Characteristics | liquid |
| Solubility | d.$H_2O$ |
| Vapor Pressure | $158\text{-}60^4$ |
| Addenda | spont. infl. |

K. Ziegler, H. G. Gellert, H. Martin, K. Nagel, J. Schneider - Ann., 589, 91-121 (1954)

$Al_2C_4H_{14}$

| | |
|---|---|
| Name | 1,1,2,2-Tetra-methyldialumene |
| Formula | $(CH_3)_2HAlAlH(CH_3)_2$ |
| Molecular Weight | 116.12 |
| Characteristics | liquid-colorless |
| Solubility | s.org.; d.$H_2O$ |
| Boiling Point | d. 160 |
| Addenda | spont. infl. |

N. Sidgewick, "Chemical Elements and Their Compounds", vol.I and II - Oxford, London (1950)

$Al_2C_5H_{16}$

| | |
|---|---|
| Name | Pentamethyl dialumene |
| Formula | $(CH_3)_3AlAlH(CH_3)$ |
| Molecular Weight | 130.14 |
| Characteristics | liquid |
| Solubility | d.air |
| Addenda | spont. infl. |

N. Sidgewick, "Chemical Elements and Their Compounds", vol. I and II - Oxford, London (1950)

$Al_2C_6H_{15}Cl_3$

| | |
|---|---|
| Name | 1,1,1-Triethyl trichlorodialumer |
| Formula | $(C_2H_5)_3AlAlCl_3$ |
| Molecular Weight | 247.52 |
| Characteristics | liquid-yellow |
| Solubility | s.org.; d.$H_2O$ |
| Specific Gravity | (25) 1.092 |
| Melting Point | -20 |
| Boiling Point | 204 ext. |
| Vapor Pressure | $90^{14}$; $110^{34}$; $130^{76}$ $170^{76}$; $190^{525}$ |
| Viscosity | (23.3) 1.91 cp |
| Addenda | spont. infl. |

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)

$Al_xH_{3x}$

| | |
|---|---|
| Name | Aluminum hydride |
| Formula | $(AlH_3)_x$ |
| Characteristics | solid - grey white |
| Solubility | d. $H_2O$, alc., air; s. eth. |
| Melting Point | 100 d. |
| Addenda | spont. infl. |

N. Sidgewick, "Chemical Elements and Their Compounds", vol.I and II - Oxford, London (1950)

## GALLIUM

### $GaC_3H_9$

| | |
|---|---|
| Name | Trimethyl galline |
| Formula | $GA(CH_3)_3$ |
| Molecular Weight | 114.82 |
| Characteristics | liquid - colorless |
| Solubility | d. $H_2O$; s. eth., $NH_3$ |
| Melting Point | -15.8 |
| Boiling Point | 55.7 |
| Vapor Pressure | $0^{64.5}$ |
| Addenda | spont.infl. |

G. E. Coates, R. G. Hayter - J.Chem.Soc., 1953, 2519
Handbook of Chemistry and Physics - Chemical Rubber Publishing Co., Cleveland (1958)

### $Ga_2C_4H_{12}$

| | |
|---|---|
| Name | Tetramethyl digalline |
| Formula | $(CH_3)_2GaGa(CH_3)_2$ |
| Molecular Weight | 199.58 |
| Characteristics | liquid - colorless |
| Solubility | d. $H_2O$, air |
| Boiling Point | 172 ext. |
| Vapor Pressure | $0^{0.5}$; $130^{500}$ d. |
| Addenda | spont. infl. |

### $Ga_2H_6$

| | |
|---|---|
| Name | Digallane |
| Formula | $H_3GaGaH_3$ |
| Molecular Weight | 145.49 |
| Characteristics | liquid - colorless |
| Solubility | d. $H_2O$, a., alk. |
| Melting Point | -21.4 |
| Boiling Point | 139 ext. |
| Vapor Pressure | $0^{2.5}$; $130^{700}$ d. |
| Addenda | spont. infl. |

D. Hurd, Chemistry of the Hydrides - Wiley, New York (1952)

# INDIUM

## $InC_3H_9$

| | |
|---|---|
| Name | Trimethyl indine |
| Formula | $In(CH_3)_3$ |
| Molecular Weight | 159.93 |
| Characteristics | crystalline |
| Solubility | s.pol.org.; d. $H_2O$, air |
| Specific Gravity | (10) 1.568 |
| Melting Point | 88.4 |
| Boiling Point | 135.8 |
| Vapor Pressure | $30^{7.2}$; $70^{72}$ |
| Addenda | spont.infl. |

E. Wiberg, M. Schmidt, A.G. Galinos - Angew. Chem., 66, 444 (1954)
F. Runge, et al - Z.Anorg.u.allgem.Chem., 267, 39 (1951)
L. M. Dennis, et al - JACS, 56, 1047 (1934)

## $InC_6H_{15}$

| | |
|---|---|
| Name | Triethyl indine |
| Formula | $(C_2H_5)_3In$ |
| Molecular Weight | 202.40 |
| Characteristics | liquid - colorless |
| Solubility | d. $H_2O$, air; s. org. |
| Specific Gravity | (20) 1.538 |
| Melting Point | -32 |
| Boiling Point | 144 |
| Addenda | spont.infl. |

F. Runge, et al - Z.Anorg.u.allgem.Chem., 267, 39 (1951)

## $InC_9H_{21}$

| | |
|---|---|
| Name | Tripropyl indine |
| Formula | $(C_3H_7)_3In$ |
| Molecular Weight | 244.10 |
| Characteristics | liquid - colorless |
| Solubility | s. org.; d. $H_2O$, air |
| Specific Gravity | (20) 1.501 |
| Melting Point | -51 |
| Boiling Point | 178 |
| Addenda | spont.infl. |

F. Runge, et al - Z.Anorg.u.allgem.Chem., 267, 39 (1951)

# THALLIUM

## $TlC_3H_9$

| | |
|---|---|
| Name | Trimethyl thallane |
| Formula | $(CH_3)_3Tl$ |
| Molecular Weight | 249.38 |
| Characteristics | needles - colorless |
| Solubility | d. light, $H_2O$; s. org. |
| Melting Point | 38.5 |
| Boiling Point | 147 ext. |
| Vapor Pressure | $20^5$; 90 exp. |
| Addenda | spont.infl. |

H. Gilman, R. G. Jones - JACS, 61, 1513 (1939)
H. Gilman - JACS, 72, 1760 (1950)
H. P. Groll - JACS, 52, 2998 (1930)

## ZIRCONIUM

### $ZrBr_2$

| | |
|---|---|
| Name | Dibromo zircine |
| Formula | $ZrBr_2$ |
| Molecular Weight | 251.05 |
| Characteristics | powder-black |
| Solubility | d.$H_2O$ |
| Melting Point | d. 350 |
| Addenda | spont.infl. |

# SILICON

## $SiC_4H_{12}$

| | |
|---|---|
| Name | Tetramethyl silane |
| Formula | $(CH_3)_4Si$ |
| Molecular Weight | 88.23 |
| Characteristics | liquid-colorless |
| Solubility | s.org.; i.$H_2O$ |
| Refractive Index | (20/D) 1.3582 |
| Specific Gravity | (26.2) 0.6361; (0/4) 0.6688; (17/4) 0.6497; (18.7) 0.6480; (20/4) 0.6480 |
| Melting Point | (α) - 101.7; (β) - 99.5 |
| Boiling Point | 26.2 |
| Heat of Vaporization | (26.2) 6.25 Kcal/mole |
| Heat of Formation | (l) -69 Kcal/mole; (g) -63 Kcal/mole |
| Heat of Combustion | -920 Kcal/mole |
| Addenda | spont.infl. |

W. Merten, W. Kleeburg - German Patent 936,138 (1955)
S. Tannenbaum, S. Kaye, G. F. Lewenz - JACS, 75, 3753-7 (1953)
Silicones and Other Organic Silicon Compounds - H. Post - Reinhold Publ. Corp., New York (1949)

## $SiH_4$

| | |
|---|---|
| Name | Silane |
| Formula | $SiH_4$ |
| Molecular Weight | 32.12 |
| Characteristics | gas - colorless |
| Solubility | d.air; alk.; s.org. |
| Specific Gravity | (-185) 0.68 |
| Melting Point | -185 |
| Boiling Point | -111.8 |
| Heat of Formation | 11.9 Kcal/mole |
| Addenda | spont.infl. |

Hydrides of Boron and Silicon - A. Stock - Cornell Univ. Press (1933)

## $Si_2H_6$

| | |
|---|---|
| Name | Disilane |
| Formula | $H_3SiSiH_3$ |
| Molecular Weight | 62.23 |
| Characteristics | gas - colorless |
| Solubility | s.org.;d. air; alk. |
| Specific Gravity | (-25) 0.686 |
| Melting Point | -132.5 |
| Boiling Point | -15 |
| Addenda | spont.infl. |

Handbook of Chemistry & Physics, 36th ed., 1954, Chemical Rubber Publ. Co., Cleveland, Ohio
Hydrides of Boron and Silicon - A.Stock - Cornell Univ. Press (1933)

## $Si_2H_{11}NB_2$

| | |
|---|---|
| Name | Disilylamino diborane |
| Formula | $B_2H_5N(SiH_3)_2$ |
| Molecular Weight | 102.92 |
| Characteristics | liquid - straw |
| Solubility | s.org.; d.$H_2O$ |
| Melting Point | -68.8 |
| Boiling Point | 54 |
| Addenda | spont.infl. |

## $Si_3C_8H_{24}O_3N_2$

| | |
|---|---|
| Name | Bis(ethylamino) siloxene |
| Formula | $[(C_2H_5)_2N]_2SiOSiH_2OSiH_2O$ |
| Molecular Weight | 280.57 |
| Characteristics | solid - orange |
| Solubility | d. $H_2O$, air |
| Addenda | spont.infl. |

H. Kautsky, H. P. Siebel - Z. anorg. u. allgem. chem., 273, 113-23 (1954)

## $Si_3H_8$

| | |
|---|---|
| Name | Trisilane |
| Formula | $H_3SiSiH_2SiH_3$ |
| Molecular Weight | 92.33 |
| Characteristics | liquid - colorless |
| Solubility | s.org.; d. $H_2O$; air; $CCl_4$ |
| Specific Gravity | (0) 0.743; (25) 0.725 |
| Melting Point | -117.4 |
| Boiling Point | 53 |
| Addenda | spont. infl. |

Handbook of Chemistry & Physics, 36th ed., 1954, Chemical Rubber Publ. Co., Cleveland, Ohio
Hydrides of Boron and Silicon - A. Stock - Cornell Univ. Press (1933)

## $Si_3H_9N$

| | |
|---|---|
| Name | Trisilylamine |
| Formula | $(SiH_3)_3N$ |
| Molecular Weight | 107.35 |
| Characteristics | liquid - colorless |
| Solubility | s. org. |
| Specific Gravity | (-106) 0.895 |
| Melting Point | -105.6 |
| Boiling Point | 52 |
| Addenda | spont.infl. |

Handbook of Chemistry & Physics, 36th ed., 1954, Chemical Rubber Publ. Co., Cleveland, Ohio
Hydrides of Boron and Silicon - A. Stock - Cornell Univ. Press (1933)

## $Si_3H_9P$

| | |
|---|---|
| Name | Trisilylphosphine |
| Formula | $(SiH_3)_3P$ |
| Molecular Weight | 124.32 |
| Characteristics | liquid - colorless |
| Solubility | s.org.; d. $H_2O$; air |
| Vapor Pressure | $0^{83}$ |
| Addenda | spont.infl. |

B. J. Aylett, H. J. Emeleus, B. G. Maddoch - J. Inorg. & Nucl. Chem., 1, 187-93 (1955)

$Si_4H_{10}$

| | |
|---|---|
| Name | Tetrasilane |
| Formula | $H_3SiSiH_2SiH_2SiH_3$ |
| Molecular Weight | 122.44 |
| Characteristics | liquid - colorless |
| Solubility | s. org.; d. $H_2O$; air |
| Specific Gravity | (0) 0.79 |
| Melting Point | -93.5 |
| Boiling Point | 109 |
| Addenda | spont.infl. |

Handbook of Chemistry & Physics, 36th ed., 1954, Chemical Rubber Publ. Co., Cleveland, Ohio
Hydrides of Boron and Silicon - A.Stock - Cornell Univ. Press (1933)

$Si_xH_{2x}$

| | |
|---|---|
| Name | Silicon hydride |
| Formula | $(SiH_2)_x$ |
| Characteristics | solid - brown |
| Solubility | d. a., alk. |
| Melting Point | d. $25^{0.01}$ |
| Addenda | spont.infl. |

## PHOSPHORUS

### $PCH_2F_3$

| | |
|---|---|
| Name | Trifluormethyl phosphine |
| Formula | $CF_3PH_2$ |
| Molecular Weight | 102.00 |
| Characteristics | gas - spon infl. |
| Boiling Point | -25.5 |

F. W. Bennett, H. J. Emeleus, R. N. Haszeldine - J. Chem. Soc., 1954 3896-3904

### $PC_2HF_6$

| | |
|---|---|
| Name | Bis(trifluormethyl) phosphine |
| Formula | $(CF_3)_2PH$ |
| Molecular Weight | 170.01 |
| Characteristics | gas - colorless - spon. infl. |
| Solubility | s. pol. org. |
| Boiling Point | 1 |

F. W. Bennett, H. J. Emeleus, R. N. Haszeldine - J. Chem. Soc., 1954 3896-3904

### $PC_2H_7$

| | |
|---|---|
| Name | Dimethyl phosphine |
| Formula | $(CH_3)_2PH$ |
| Molecular Weight | 62.05 |
| Characteristics | liquid - colorless - spont. infl. |
| Solubility | s. org., d. air |
| Boiling Point | 25 |
| Vapor Pressure | $-47^{30}$ |

## $PC_3F_9$

| | |
|---|---|
| Name | Tris(trifluormethyl) phosphine |
| Formula | $(CF_3)_3P$ |
| Molecular Weight | 238.01 |
| Characteristics | liquid - colorless - spont. infl. |
| Solubility | d. $H_2O$, s. pol. org. |
| Boiling Point | 17.3 |
| Heat of Vaporization | 5890 cal/mole |

F. W. Bennett, H. J. Emeleus, R. N. Haszeldine - J. Chem. Soc., 1953, 1565-71

## $PH_3$

| | |
|---|---|
| Name | Phosphine |
| Formula | $PH_3$ |
| Molecular Weight | 34.00 |
| Characteristics | gas - colorless - poisonous - spon. infl. |
| Solubility | sl. s. $H_2O$, s. al., et |
| Specific Gravity | 1.317 (1); (0) 1.529g |
| Melting Point | -133.5 |
| Boiling Point | -87.4 |
| Heat of Formation | 2.3 Kcal/mole |
| Entropy | (25) (g) 50.23 cal/deg mole |

E. L. Gefter - Z. Obschel Kh., 28, 1338-40 (1958)
A. P. Altshuller - JACS, 77, 4220-1 (1955)

## $PH_9Si_3$

| | |
|---|---|
| Name | Trisilyl phosphine |
| Formula | $P(SiH_3)_3$ |
| Molecular Weight | 124.32 |
| Characteristics | liquid - colorless - spon. infl. |
| Solubility | d. $H_2O$ |
| Vapor Pressure | $0^{83}$ |

B. J. Aylett, H. J. Emeleus, A. G. Maddock - J. Inorg. & Nucl. Chem., 1, 187-93 (1955)

## $PSF_3$

| | |
|---|---|
| Name | Trifluoro phosphane sulfide |
| Formula | $(S)PF_3$ |
| Molecular Weight | 120.04 |
| Characteristics | gas - spon. infl. |
| Solubility | d. $H_2O$, s. eth., i. org. |
| Melting Point | -148.8 |
| Boiling Point | d. -52.3 |

Booth, et al - JACS, 61, 2927, 2934, 2937, 3120 (1939)
Jackson and Davis - J. Chem. Soc., 1931, 2109-15

# ARSENIC

## $AsC_2H_6Cl$

| | |
|---|---|
| Name | Dimethyl chloro-arsine |
| Formula | $(CH_3)_2AsCl$ |
| Molecular Weight | 140.44 |
| Characteristics | liquid - colorless; spon. infl. |
| Solubility | i. $H_2O$; eth. s. alc. org. |
| Specific Gravity | (25) > 1 |
| Melting Point | < -45 |
| Boiling Point | 106.5 |

## $AsC_2H_7$

| | |
|---|---|
| Name | Dimethyl arsine |
| Formula | $(CH_3)_2AsH$ |
| Molecular Weight | 105.99 |
| Characteristics | liquid - colorless; spon. infl. |
| Solubility | s. org. |
| Specific Gravity | (20) 1.213; (25) 1.210 |
| Boiling Point | 35.6-7.0 |

D. Seyferth, E. G. Rochow - J. Org. Chem., 20, 250-6 (1955)

## $AsC_4H_{11}$

| | |
|---|---|
| Name | Diethyl arsine |
| Formula | $(C_2H_5)_2AsH$ |
| Molecular Weight | 134.04 |
| Characteristics | liquid - colorless; spont. inflam. |
| Solubility | s. org. |
| Refractive Index | (25/D) 1.4709 |
| Specific Gravity | (23/4) 1.338 |
| Boiling Point | 105 (96.5-97) |

"Handbook of Chemistry and Physics" - Chemical Rubber Publishing Co., Cleveland, Ohio (1958)

$AsH_9Si_3$

| | |
|---|---|
| Name | Trisilyl arsine |
| Formula | $As(SiH_3)_3$ |
| Molecular Weight | 168.25 |
| Characteristics | liquid; spont. infl. |
| Solubility | d. $H_2O$ |
| Boili . . °oint | d. 25 |
| Vapor . ssure | $0^{1.7}$ |

B. J. Aylett, et al - J. Inorg. & Nucl. Chem., 1, 187-93 (1955)

$As_2C_8H_{20}$

| | |
|---|---|
| Name | Tetraethyl diarsine |
| Formula | $(C_2H_5)_2AsAs(C_2H_5)_2$ |
| Molecular Weight | 266.07 |
| Characteristics | liquid; spont. inflam. |
| Solubility | i. $H_2O$; s. alc. eth. |
| Refractive Index | (25/D) 1.4709 |
| Specific Gravity | (23.7/4) 1.2 |
| Boiling Point | 185-90 |

"Handbook of Chemistry and Physics" - Chemical Rubber Publishing Co., Cleveland, Ohio (1958)

## TUNGSTEN

$WC_{48}H_{60}O_3Li$

| | |
|---|---|
| Name | Triphenyl tungsten-tris(phenyl lithium) tris (diethyl ether) |
| Formula | $(C_6H_5)_3W \cdot 3LiC_6H_5 \cdot 3(C_2H_5)_2O$ |
| Molecular Weight | 875.81 |
| Characteristics | violet |
| Solubility | s. org.; d. $H_2O$; alc. |
| Addenda | spon. infl. |

## MANGANESE

$MnC_{10}H_{10}$

| | |
|---|---|
| Name | Dicyclopentadienyl manganese |
| Formula | $(C_5H_5)_2Mn$ |
| Molecular Weight | 185.13 |
| Characteristics | crystalline - amber; paramagnetic; spon. infl. |
| Solubility | d. a. $H_2O$; air, s. $NH_3$; THF, pyr. i. aliph. |
| Melting Point | 172-3 |
| Boiling Point | 245 |
| Vapor Pressure | $100\text{-}30^{10^{-4}}$ $-10^{-5}$ |
| Heat of Vaporization | 12.0 Kcal/mole |
| Dipole Moment | 5.8 |
| Heat of Sublimation | 17.3 Kcal/mole |
| Specific Conductivity | (-33) $1.4 \times 10^{-5}$ ($NH_3$) |
| Heat of Fusion | 6.3 Kcal/mole |

G. Wilkenson, F. A. Cotton, J. M. Birmingham - J. Inorg. & Nucl. Chem., 2, 95-113 (1956)

# PART II

## ALUMINUM BOROHYDRIDE $Al(BH_4)_3$

Ref. 1 - P. 164

- is an unstable covalent liquid. The compound melts at -64.5° and has a vapor pressure of 119.5 mm Hg at 0°. Its boiling point is estimated to be 44.5°. It will ignite in air if trace of moisture is present. Its reaction with water is explosively violent.

It forms additional compounds with amines readily.

## BARIUM HYDRIDE $BaH_2$

Ref. 1 - P. 47-48

A white crystalline solid, density 4.21 $gm/cm^3$, $\Delta H_f$ = 40.96 Kcal/mole.

Orthorhombic with unit cell dimensions of a = 6.788 A.U.
b = 7.829 A.U.
c = 4.167 A.U.

Barium hydride is insoluble in common solvents, except those with which it reacts.

If the hydride is finely powdered, it may ignite spontaneously if it is exposed to moist air.

## BERYLLIUM BOROHYDRIDE $Be(BH_4)_2$

Ref. 1 - P. 163

- is a solid material with considerable covalent character. The vapor pressure of $Be(BH_4)_2$ at 0° is ca. 0.5 mm Hg; normal sublimation temperature is 91.3°. The compound is soluble in organic solvents including non-polar solvents like benzene. It is spontaneously inflammable in air and reacts very vigorously with water and other reducing agents. It begins to decompose at 123°.

## BERYLLIUM HYDRIDE $BeH_2$

Ref. 1

A non-volatile white solid, insoluble in ether, toluene and isopentane. Decomposes rapidly at 125°. Its reaction with water, even at -196°, is quite violent.

## CALCIUM HYDRIDE $CaH_2$

Ref. 1

A white, crystalline solid, melts above 1000°, density of 1.9 gm/cm$^3$, $\Delta H_f$ = 46.6 Kcal/mole. Insoluble in all the conventional inorganic and organic solvents. Not violently reactive with water.

## CALCIUM PHOSPHIDE $Ca_3P_2$

The action of water on $Ca_3P_2$ produces phosphine ($PH_3$) and diphosphine ($PH_2$). The diphosphine ignites spontaneously on contact with air.

$$\Delta H_f = \frac{-120.5 \text{ Kcal}}{\text{mole}}$$

## DECABORANE $B_{10}H_{14}$

Ref. 1

White crystalline solid, stable, melts at 99.50, boils at 213°, density 0.94 gm/cm$^3$ at 25°, vapor pressure 19.0 mm @ 100°. At room temperature and in contact with water, a sample of decaborane will be less than 10% hydrolyzed in 10 days; hydrolysis at 100° is even very slow.

## DIBORANE $B_2H_6$

Ref. 1

A colorless gas, relatively stable, melts at -165.5°, boils at -92.5°, density = 0.44 gm/cm$^3$ and $\Delta H_f$ = -6.7 Kcal/mole.

In presence of water vapor, will ignite spontaneously in air.

## DIETHYL ZINC

Ref. 3

Melts at -30 and boils at 117.6°. Ignites spontaneously on contact with air.

## DIPHOSPHINE $PH_2$ or $P_2H_4$

Ref. 1

The only Group V hydride known to be spontaneously inflammable. It is a liquid whose melting point is -99° and boiling point is 51.7°.

## LITHIUM HYDRIDE

Ref. 1

$M_1P_1$ ca. 680°

Density ca. 0.78

$\Delta H_f \approx 22$ Kcal/mole (21.61)

In the massive form $LiH_2$ reacts fairly briskly, but without ignition, upon being dropped into a large excess of water.

However, the addition of a small amount of water to a sizeable amount of finely divided $LiH_2$ results in the generation of sufficient heat to ignite the mass of hydride, and a violently exothermic reaction occurs.

## MAGNESIUM HYDRIDE

Ref. 2

In the air, magnesium hydride is oxidized to magnesium oxide and water with "self-inflammation".

Ref. 1

A white, non-volatile polymeric solid. It does not ignite spontaneously on exposure to air. Does not begin to decompose until a temperature of 280° is reached. It does react vigorously with water.

## MAGNESIUM PHOSPHIDE $Mg_3P_2$

The action of water on $Mg_3P_2$ produces phosphine ($PH_3$) and diphosphine ($PH_2$). The diphosphine is spontaneously ignited on contact with air.

## METHYLPHOSPHINE $CH_3PH_2$

Ref. 1

Boils at 25° and it is spontaneously inflammable.

## PHOSPHOROUS, WHITE

## SODIUM HYDRIDE NaH

A gray-white crystalline powder, density 1.396 $gm/cm^3$ (commercial about 0.95 $gm/cm^3$), $\Delta H_f$ = 13.8 Kcal/mole.

If this material is finely powdered, a spontaneous ignition may occur in moist air.

NaH and water is a very violent reaction, moreso than pure sodium and water.

## STRONTIUM HYDRIDE $SrH_2$

A white crystalline solid, density 3.72 $gm/cm^3$, $\Delta H_f$ = 42.2 Kcal/mole.

It is insoluble in normal solvents, but is vigorously reactive with water.

## TETRABORANE $B_4H_{10}$

Ref. 1

Colorless gas, unstable, melts at -120°, boils at 16°, density 0.56 $gm/cm^3$ at -35°.

## TETRASILANE $Si_4H_{10}$

A colorless, spontaneously inflammable volatile liquid with a melting point of -93.5° and boiling point of 109°.

## TRIETHYL ALUMINUM $Et_6Al_2$

Ref. 3

Melts at -52.5°, boils at 185.6°. Ignites spontaneously.

## TRIETHYL INDIUM $Et_3In$

Ref. 3

Melts at -32°, boils at 144° and does not appear to form an ether complex.

Spontaneously inflames in the air.

## TRIMETHYL ALUMINUM $Me_6Al_2$

Ref. 3

Melts at 15.0°, boils at 126° and is a clear mobile liquid at room temperature.

Explosively hydrolyzed by water and ignites spontaneously in air.

## TRIMETHYL ALUMINUM-DIMETHYL ETHER COMPLEX

Ref. 3

Melts at -29.9°, boils at 159°, and spontaneously inflammable.

## TRIMETHYL INDIUM $Me_3In$

Ref. 3

Melts at 88.4°, boils at 135.8°. Has a vapor pressure of 7.2 mm at 30°.

Spontaneously inflames in air.

## TRIMETHYL THALLIUM $Me_3Tl$

Melts at 38.5°, boils about 147°, and is spontaneously inflammable.

## TRI-N-PROPYL INDIUM $(n\text{-}C_3H_2)_3In$

Melts at -51°, boils at 178°, is monomeric in benzene. Spontaneously inflames in air.

## ZINC PHOSPHIDE $Zn_3P_2$

The action of water on $Zn_3P_2$ produces phosphine ($PH_3$) and diphosphine ($PH_2$). The diphosphine ignites spontaneously at contact with air.

## ALUMINUM PHOSPHIDE

# DIETHYL ALUMINUM CHLORIDE

## WATER REACTIVE CHEMICALS

Alkali Metals

Metallic Hydrides

Metallic Phosphides

Metallic Peroxide - Fuel Mixtures

## AIR REACTIVE CHEMICALS

Organo-metallic Compounds

Pyrophoric Metals and Alloys

White Phosphorous

## BIBLIOGRAPHY - REFERENCES

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|---|---|---|---|---|---|---|
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