

**CRC Handbook of tables for  
Organic Compound Identification**



CRC HANDBOOK

of tables for

**ORGANIC  
COMPOUND  
IDENTIFICATION**

Third Edition

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**First Edition**  
**Tables for Identification of Organic Compounds**

Compiled by  
**Max Frankel, Ph.D.**  
**Saul Patai, Ph.D.**

Assisted by  
**Albert Zilkha, Ph.D.**  
**Robert Farkas—Kadmon**

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## PREFACE

The present volume is a revised and enlarged third edition of the book formerly titled TABLES FOR IDENTIFICATION OF ORGANIC COMPOUNDS. Four new classes of compounds, i.e., sulfonyl chlorides, sulfonamides, thiols and thioethers were added, bringing the number of classes included in the book to twenty-six. The tables of alkanes, alkenes, alkynes, aromatic hydrocarbons, phenols, nitriles and sulfonic acids were all thoroughly revised and considerably enlarged. In all, the addition of 2400 compounds to the third edition, raised the total number of parent compounds in the book to over 8150.

Three tables containing the dissociation constants of more than 1050 phenols, organic acids and organic bases were added. Correlation charts for I.R., Far I.R. and N.M.R. were also included.

Explanatory sections entitled "Explanations and References" precede the tables. In these sections the formulas of the derivatives and the full reaction equations for their preparation by the most important methods, together with some essential details and references to their preparations, are given.

An index covering both the names and synonyms of the compounds was added at the end of the book. An index listing the names of all tables and major subjects was also added.

The main objective of this book is to assist chemists in the identification of organic compounds. The organization of the compounds in classes according to increasing boiling points should also assist in the search for standard vapor phase chromatography work.

For further information of techniques of organic analysis one or more of the following books should be consulted:

- N. D. Cheronis, J. B. Entrikin and E. M. Hodnett, *Semimicro Qualitative Organic Analysis*, 3rd Ed., Interscience Publishers, New York, 1965.
- L. Meites, *Handbook of Analytical Chemistry*, McGraw Hill Book Co., 1963.
- F. Feigl, *Spot Tests in Organic Analysis*, 6th Ed., Elsevier Publishing Co., 1960.
- A. I. Vogel, *A Textbook of Practical Organic Chemistry*, 3rd Ed., Longmans Green and Co., London, 1957.
- R. L. Shriner, R. C. Fuson and D. Y. Curtin, *The Systematic Identification of Organic Compounds*, 4th Ed., John Wiley and Sons, New York, 1956.
- F. Wild, *Characterization of Organic Compounds*, 2nd Ed., Cambridge University Press, 1958.

The publication of the third edition would not have been possible without the work of those involved in the preparation of the earlier editions. The editor is thankful for the part in the earlier work contributed by Professors M. Frankel, S. Patai and A. Zilkha, and the late Mr. R. Farkas-Kadmon. Thanks are due also to Mrs. E. Shohamy and Mr. A. Glazer for assisting in collection of new data, to Mrs. Y. Elmaleh for typing the index, and especially to Prof. S. Patai, who as consulting editor, read all the new material and gave many helpful suggestions. The cooperation of Dr. Robert C. Weast and Mrs. F. Thomas in the publication of the book is gratefully acknowledged.

Z. R.

Jerusalem  
January 1967

## LIST OF ABBREVIATIONS USED

[ $\alpha$ ] <sub>D</sub> <sup>t</sup>	specific rotation	fum	fuming	pr	prisms
a	acid	glac	glacial	purp	purple
abs	absolute	glit	glittering	pyr	pyridine
abt	about	glyc	glycerol	rac	racemic (or racemate)
ac a	acetic acid	gran	granular	rect	rectangular
ac anh	acetic anhydride	grn	green	recr	recrystallization
acet	acetone	h	hot	redsh	reddish
add	addition	htng	heating	rhomb	rhombic
al	alcohol	hyd	hydrate or hydrolyses	r	rapid
alk	alkali	hyg , hygr	hygroscopic	r h	rapid heating
amor	amorphous	i	inactive	s	soluble
anh	anhydrous	i	insoluble	sec	secondary
arom	aromatic	ign	ignites	scar	scarcely
aqu	aqueous	insol	insoluble	s h	slow heating
asym , as	asymmetric	i , L	levorotatory (or L-configuration)	sh	short
bl	blue	leaf , lf	leaflets	sl	slightly
blk	black	lg	large	sld	solid
boil	boiling	lgr	ligroin	slend	slender
b p , B P	boiling point	liq	liquid	sm	small
br	brown	lng	long	soft	softens
bz	benzene	lt	light	sol , soln	solution(s)
brt	bright	lvs	leaves	solv	solvent(s)
brnsh	brownish	m-	meta	st	steel
c	cold	me , meth	methyl	stab	stable
ca	about	micr	microscopic	subl	sublimes
caust	caustic	mixt	mixture	sym	symmetrical
chl	chloroform	ml	milliliter	tab , tabl	tablet(s), tables
cl -bz	chlorobenzene	mod	modification	tert	tertiary
col	colorless	monohyd	monohydrate	tetr	tetragonal
comp	compound	monocl	monoclinic	tol	toluene
conc	concentrated	m p , M P	melting point	trans	transparent
cor	corrected	need , nd	needles	thk	thick
cr , cryst	crystals	o-	ortho	tricl	trichinic
d	decomposes	ol	olive	trim	trimeric
d , D	dextrorotatory (or D-configuration)	or	orange	uns	unsymmetrical
deriv	derivative	ord	ordinary	unst	unstable
deliq	deliquescent	org	organic	vac	vacuum, in vacuo
dil	dilute	orth	orthorhombic	v	very
dist	distillate	oxid	oxidation	var	variable
dk	dark	p-	para	vic-	vicinal
dl , d,l , D,L	racemic	pa	pale	visc	viscous
efflor	efflorescent	part	partly	volat	volatile or volatilizes
et	ethyl	pet	petroleum	vlt	violet
et ac	ethyl acetate	pet eth	petroleum ether	w	water
eth	ether	ph	phenyl	wh	white
exp	explodes	ph hydraz	phenyl hydrazine	yel	yellow
f	from	PhNO <sub>2</sub>	nitrobenzene	yelsh , ylsh	yellowish
fl	flakes	pl	plates	>	above, greater than
fluores	fluorescent	powd	powder	<	below, smaller than
f p	freezing point			∞	miscible
frz	freezes			xyl	xylene

## EXPLANATIONS AND REFERENCES TO THE TABLES

The following section gives explanations and references for the preparation of the derivatives appearing in the Tables. Formulas of the derivatives as well as the main methods for their preparation are given. Usually, only the reagents and the solvents required for the preparation of a derivative are mentioned without specific details for the reaction conditions and the exact procedure. The aim of these notes is mainly to enable the worker to choose the method preferable in the conditions and the reagents available to him in his laboratory for the derivatization of his specific compound. However, THIS IS ONLY A REFERENCE SECTION AND NOT AN INSTRUCTION MANUAL AND THE QUOTED REFERENCES SHOULD BE CONSULTED FOR THE ACTUAL PREPARATION OF DERIVATIVES, ESPECIALLY REGARDING SAFETY HAZARDS INVOLVED IN THE WORK.

References are usually given for the preparation of all the derivatives having separate columns in the Tables, as well as for important ones listed in the "miscellaneous" section of the Tables. References to five different popular analytical textbooks are given, assuming that at least one of them, or another equivalent publication, would be available to the worker. These are

- N D Cheronis, J B Entrikin and E M Hodnett, *Semimicro Qualitative Organic Analysis*, 3rd edition, Interscience, New York, 1965, quoted in the text as "Cheronis"
- R P Linstead and B C L Weedon, *A Guide to Qualitative Organic Chemical Analysis*, Butterworth Scientific Publication, London, 1956, quoted in the text as "Linstead"
- R L Shriner, R C Fuson and D Y Curtin, *The Systematic Identification of Organic Compounds*, 4th edition, John Wiley and Sons, New York, 1956, quoted in the text as "Shriner"
- A I Vogel, *A Textbook of Practical Organic Chemistry*, 3rd edition, Longmans, Green and Co., London, 1957, quoted in the text as "Vogel"
- F Wild, *Characterization of Organic Compounds*, 2nd edition, Cambridge University Press, Cambridge, 1958, quoted in the text as "Wild"

In addition, leading references from the original literature are also given. Although the literature coverage is not complete (especially for the common derivatives) it was attempted to describe different methods, and to give as many references as possible to less common derivatives having limited scope. More references can be found in the textbooks mentioned above.

Derivatives appear either in a separate column or in the "miscellaneous" section in the Tables, where separate columns are usually given for derivatives which should be tried first, and for which enough data are available. Derivatives which should be tried as a second choice, or preferred derivatives for which not enough data are available appear in the "miscellaneous" section. The explanations and the references for the different derivatives are arranged usually in the same order as in the Tables. Occasionally, this order is changed in the explanatory notes in order to describe the derivatives in a logical order (e.g., in Table 17 the phenylurethane appears in a separate column, while the phenylhydantoin appears in the "miscellaneous" section in the "explanations and references" section the phenylhydantoin appears directly after the phenylurethane).

Derivatives which are followed by an asterisk are those recommended for first trial. Other derivatives should be tried after these.

Although "Ar" usually stands for monovalent aromatic group, we used it a few times in the following sections as a polyvalent aromatic residue. This was done only for demonstration purposes.

## EXPLANATIONS AND REFERENCES TO TABLE I

As a result of their inertness no general suitable derivative exists for alkanes and cycloalkanes. Characterization is based only on the physical constants given in the Table—melting and boiling points, index of refraction and density. Any laboratory text-book will give adequate directions for the determination of these constants.

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE I. ALKANES AND CYCLOALKANES**  
**a) Gases and Liquids (Listed in order of increasing b.p.\*)\*\***

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_i^{20}$
1	<b>Methane</b>	-161 49	-182 48 <sup>T</sup>		
2	<b>Ethane</b>	-88 63	-183 27 <sup>T</sup>		
3	<b>Propane</b>	-42 07	-187 69 <sup>T</sup>		
4	<b>Cyclopropane</b>	-32 86	-127 42		0 5005 <sup>S</sup>
5	<b>2-Methylpropane (Isobutane)</b>	-11 73	-159 6		0 720 <sup>-79</sup>
6	<b>n-Butane</b>	-0 50	-138 35	1 3326 <sup>S</sup>	0 5572 <sup>S</sup>
7	<b>2,2-Dimethylpropane (Neopentane)</b>	9 503	-16 55	1 342 <sup>S</sup>	0 5910 <sup>S</sup>
8	<b>Cyclobutane</b>	13 08 <sup>741</sup> , 12 5	-80	1 37520 <sup>0</sup>	0 7038 <sup>0</sup>
9	<b>1,1-Dimethylcyclopropane</b>	20 63	-108 96	1 3668	0 6589
10	<b>2-Methylbutane</b>	27 852	-159 9	1 35373	0 61967
11	<b>trans-1,2-Dimethylcyclopropane</b>	29		1 3713	0 6769
12	<b>Ethylcyclopropane</b>	35 94	-149 41	1 3786	0 6839
13	<b>n-Pentane</b>	36 074	-129 721	1 35748	0 62624
14	<b>Methylcyclobutane</b>	36 3		1 3830	0 6933
15	<b>cis-1,2-Dimethylcyclopropane</b>	37	-140 9	1 3822	0 6928
16	<b>Spiropentane</b>	38 977	-107 06	1 41200	0 755
17	<b>Cyclopentane</b>	49 262	-93 879	1 40645	0 74538
18	<b>2,2-Dimethylbutane</b>	49 741	-99 87	1 36876	0 64916
19	<b>1,1,2-Trimethylcyclopropane</b>	56 7 <sup>750</sup>		1 3848 <sup>19 5</sup>	0 6822 <sup>19 5</sup>
20	<b>2,3-Dimethylbutane</b>	57 988	-128 538	1 37495	0 66164
21	<b>2-Methylpentane</b>	60 271	-153 67	1 37145	0 65315
22	<b>3-Methylpentane</b>	63 282		1 37652	0 66431
23	<b>1,2,3-Trimethylcyclopropane</b>	65 7 <sup>755</sup>		1 3945 <sup>18</sup>	0 6946 <sup>18</sup>
24	<b>n-Hexane</b>	68 74	-95 348	1 37486	0 65937
25	<b>Ethylcyclobutane</b>	70 64	-142 85	1 4020	0 7280
26	<b>Methylcyclopentane</b>	71 812	-142 455	1 4097	0 74864
27	<b>2,2-Dimethylpentane</b>	79 197	-123 811	1 38215	0 67385
28	<b>2,4-Dimethylpentane</b>	80 5	-119 242	1 38145	0 67270
29	<b>Cyclohexane</b>	80 738	6 554	1 42623	0 77855
30	<b>2,2,3-Trimethylbutane</b>	80 882	-24 912	1 38944	0 69011
31	<b>3,3-Dimethylpentane</b>	86 064	-134 46	1 39092	0 69327
32	<b>1,1-Dimethylcyclopentane</b>	87 846	-69 795	1 41356	0 75448
33	<b>2,3-Dimethylpentane</b>	89 784		1 39196	0 69508
34	<b>2-Methylhexane</b>	90 052	-118 276	1 38485	0 67859
35	<b>trans-1,3-Dimethylcyclopentane</b>	90 773	-133 702	1 40894	0 74479
36	<b>cis-1,3-Dimethylcyclopentane</b>	91 725	-133 975	1 41074	0 74880
37	<b>3-Methylhexane</b>	91 850		1 38864	0 68713
38	<b>trans-1,2-Dimethylcyclopentane</b>	91 869	-117 58	1 41200	0 75144
39	<b>3-Ethylpentane</b>	93 475	-118 604	1 39339	0 69816
40	<b>Quadracyclane (Quadracyclo [2.2.1.0<sup>2,6</sup>,0<sup>3,5</sup>] heptane)</b>	98		1 4804	
41	<b>n-Heptane</b>	98 427	-90 61	1 38764	0 68376
42	<b>2,2,4-Trimethylpentane</b>	99 238	-107 38	1 39145	0 69192
43	<b>cis-1,2-Dimethylcyclopentane</b>	99 532	-53 892	1 42217	0 77262
44	<b>Methylcyclohexane</b>	100 934	-126 593	1 42312	0 76939
45	<b>Ethylcyclopentane</b>	103 466	-138 446	1 41981	0 76647
46	<b>1,1,3-Trimethylcyclopentane</b>	104 893	-142 44	1 41119	0 74825
47	<b>2,2-Dimethylhexane</b>	106 84	-121 18	1 39349	0 69528
48	<b>2,5-Dimethylhexane</b>	109 103	-91 20	1 39246	0 69354
49	<b>1,trans-2,cis-4-Trimethylcyclopentane</b>	109 29	-130 78	1 41060	0 74727
50	<b>2,4-Dimethylhexane</b>	109 429		1 39534	0 70036
51	<b>2,2,3-Trimethylpentane</b>	109 841	-112 27	1 40295	0 71602
52	<b>1,trans-2,cis-3-Trimethylcyclopentane</b>	110 2	-112 705	1 4138	0 7535
53	<b>3,3-Dimethylhexane</b>	111 969	-126 1	1 40009	0 7100
54	<b>2,3,4-Trimethylpentane</b>	113 467	-109 21	1 40422	0 71906
55	<b>1,1,2-Trimethylcyclopentane</b>	113 729	-21 64	1 42298	0 77252
56	<b>2,3,3-Trimethylpentane</b>	114 76	-100 70	1 40750	0 72619
57	<b>2,3-Dimethylhexane</b>	115 607		1 40113	0 71214
58	<b>3-Ethyl-2-methylpentane</b>	115 65	-114 96	1 40401	0 71932

\*Derivative data given in order m p , crystal color, solvent from which crystallized

\*\*T = triple point, S = at saturation pressure

**TABLE I. ALKANES AND CYCLOALKANES**  
**a) Gases and Liquids (Listed in order of increasing b.p.\* ) (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>
59	1, <i>cis</i> -2, <i>trans</i> -4-Trimethylcyclopentane	116 731	-132 55	1 41855	0 76345
60	1, <i>cis</i> -2, <i>trans</i> -3-Trimethylcyclopentane	117 5	-112	1 4218	0 7704
61	2-Methylheptane	117 647	-109 04	1 39494	0 69792
62	4-Methylheptane	117 709	-120 955	1 39792	0 70463
63	3,4-Dimethylhexane	117 725		1 40406	0 71923
64	1, <i>cis</i> -2, <i>cis</i> -4-Trimethylcyclopentane	118		1 422	0 766
65	3-Ethyl-3-methylpentane	118 259	-90 87	1 40775	0 72742
66	3-Ethylhexane	118 534		1 40162	0 71358
67	3-Methylheptane	118 925	-120 5	1 39848	0 70582
68	Cycloheptane (Suberane)	118 20	-7 98	1 4449	0 8275°
69	<i>trans</i> -1,4-Dimethylcyclohexane	119 351	-36 962	1 42090	0 76255
70	1,1-Dimethylcyclohexane	119 543	-33 495	1 42900	0 78094
71	<i>cis</i> -1,3-Dimethylcyclohexane	120 088	-75 573	1 42294	0 76603
72	<i>trans</i> -1-Ethyl-3-methylcyclopentane	120 8	-108	1 4186	0 7619
73	<i>trans</i> -1-Ethyl-2-methylcyclopentane	121 2		1 4219	0 7690
74	<i>cis</i> -1-Ethyl-3-methylcyclopentane	121 4		1 4203	0 7724
75	1-Ethyl-1-methylcyclopentane	121 522	-143 80	1 42718	0 78093
76	2,2,4,4-Tetramethylpentane	122 284	-66 54	1 40694	0 71947
77	1, <i>cis</i> -2, <i>cis</i> -3-Trimethylcyclopentane	123 0	-116 43	1 4262	0 7792
78	<i>trans</i> -1,2-Dimethylcyclohexane	123 419	-88 194	1 42695	0 77601
79	2,2,5-Trimethylhexane	124 084	-105 78	1 39972	0 70721
80	<i>cis</i> -1,4-Dimethylcyclohexane	124 321	-87 436	1 42966	0 78285
81	<i>trans</i> -1,3-Dimethylcyclohexane	124 45	-90 108	1 43085	0 78472
82	<i>n</i> -Octane	125 665	-56 795	1 39743	0 70252
83	Isopropylcyclopentane	126 419	-111 375	1 42582	0 77653
84	2,2,4-Trimethylhexane	126 54	-120	1 4033	0 7156
85	<i>cis</i> -1-Ethyl-2-methylcyclopentane	128 050	-105 95	1 42933	0 78522
86	<i>cis</i> -1,2-Dimethylcyclohexane	129 728	-50 023	1 43596	0 79627
87	2,4,4-Trimethylhexane	130 38	-113 38	1 40745	0 72381
88	<i>n</i> -Propylcyclopentane	130 8	-118 7	1 4266	0 7761
89	2,3,5-Trimethylhexane	131 34	-127 8	1 4061	0 7219
90	Ethylcyclohexane	131 783	-111 323	1 43304	0 78792
91	2,2-Dimethylheptane	132 69	-113 0	1 4016	0 7105
92	2,2,3,4-Tetramethylpentane	133 016	-121 09	1 41472	0 73895
93	2,4-Dimethylheptane	133 5		1 4033	0 716
94	Methylcycloheptane	133 5		1 4410	0 8052
95	2,2,3-Trimethylhexane	133 6		1 4105	0 7292
96	4-Ethyl-2-methylhexane	133 8		1 4068	0 723
97	3-Ethyl-2,2-dimethylpentane	133 83	-99 2	1 4123	0 7348
98	4,4-Dimethylheptane	135 2		1 4076	0 725
99	2,6-Dimethylheptane	135 21	-102 9	1 4007	0 7089
100	2,5-Dimethylheptane	136 0		1 4038	0 715
101	3,5-Dimethylheptane	136 0		1 4067	0 723
102	Bicyclo[4.2.0]octane	136 0		1 4613	0 8573
103	<i>cis</i> -Bicyclo[3.3.0]octane	136-6 5		1 4595 <sup>25</sup>	0 8638 <sup>25</sup>
104	2,4-Dimethyl-3-ethylpentane	136 73	-122 2	1 4137	0 7379
105	1,1,3-Trimethylcyclohexane	137-8		1 4362	0 7868 <sup>25</sup>
106	3,3-Dimethylheptane	137 3		1 4085	0 725
107	2,2,5,5-Tetramethylhexane	137 5		1 40550	0 71875
108	2,3,3-Trimethylhexane	137 68	-116 80	1 4141	0 738
109	3-Ethyl-2-methylhexane	138		1 4120	0 731
110	<i>trans</i> -1,3,5-Trimethylcyclohexane	138 5-9 <sup>754</sup>		1 42740 <sub>H</sub>	0 7720
111	2,3,4-Trimethylhexane	139 0		1 4144	0 7392
112	<i>cis</i> -1,3,5-Trimethylcyclohexane	140-0 5 <sup>752</sup>		1 43010 <sub>H</sub>	0 7773
113	<i>trans</i> -1,2,4-Trimethylcyclohexane	140-1		1 43121 <sub>He</sub>	0 7813
114	2,2,3,3-Tetramethylpentane	140 274	-9 9	1 42360	0 75666
115	4-Ethyl-3-methylhexane	140 4		1 416	0 742
116	3,3,4-Trimethylhexane	140 46	-101 2	1 4178	0 7454
117	2,3-Dimethylheptane	140 5		1 4085	0 7260

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE I. ALKANES AND CYCLOALKANES**  
**a) Gases and Liquids (Listed in order of increasing b.p.\*)(Continued)**

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$
118	3,4-Dimethylheptane	140 6		1 4111	0 7314
119	3-Ethyl-3-methylhexane	140 6		1 4142	0 741
120	4-Ethylheptane	141 2		1 4096	0 730
121	2,3,4-Tetramethylpentane	141 551	- 102 123	1 42222	0 75473
122	2,3-Dimethyl-3-ethylpentane	142		1 419	0 754
123	<i>trans</i> -1,2,3-Trimethylcyclohexane	142 3 5 <sup>762</sup>		1 43582 <sub>He</sub>	0 7914
124	1-Isopropyl-3-methylcyclopentane (Pulegan)	142 4		1 4236	0 7730 <sup>22</sup>
125	4-Methyloctane	142 48	- 113 2	1 4061	0 7199
126	1-Isopropyl-2-methylcyclopentane	142 5 <sup>759</sup>		1 4279	0 7792
127	3-Ethylheptane	143 0		1 4093	0 727
128	2-Methyloctane	143 26	- 80 4	1 4031	0 7134
129	<i>cis</i> -1,2,3-Trimethylcyclohexane	144-6 <sup>753</sup>		1 43682 <sub>He</sub>	0 7930
130	3-Methyloctane	144 18	- 107 6	1 4062	0 7207
131	2,4,6-Trimethylheptane	144 8	-	1 4071	0 7225
132	<i>cis</i> -1,2,4-Trimethylcyclohexane	146		1 43209	0 786
133	3,3-Diethylpentane	146 168	- 33 11	1 42051	0 75359
134	2,2-Dimethyl-4-ethylhexane	147		1 4131	0 733
135	2,2,4-Trimethylheptane	147 7		1 4092	0 7275
136	2,2,4,5-Tetramethylhexane	147 8		1 41318	0 73546
137	2,2,5-Trimethylheptane	148		1 409	0 726
138	2,2,6-Trimethylheptane	148 2		1 4059	0 7195
139	2,2,3,5-Tetramethylhexane	148 4		1 4142	0 7378
140	Nopinane (7,7-Dimethylbicyclo[3.1.1]heptane)	149 <sup>747</sup>		1 4641	0 8611 <sup>22</sup>
141	<i>trans</i> -1-Ethyl-4-methylcyclohexane	149 05- 15	- 80 8	1 4304	0 7798
142	Cyclooctane	150 <sup>750</sup>	14 (4 3)	1 4586	0 8349
143	1-Ethyl-2-methylcyclohexane	150 2		1 432	0 784
144	<i>n</i> -Nonane	150 81	- 53 519	1 40542	0 71763
145	1,3,3-Trimethylbicyclo[2.2.1]heptane (Fenchane)	151 2		1 44714	0 8345
146	<i>trans</i> -1-Ethyl-4-methylcyclohexane	151 69		1 4382	0 7972
147	<i>cis</i> -1,1,3,5-Tetramethylcyclohexane	152 4- 5		1 4319	0 7813
148	<i>cis</i> -1-Ethyl-4-methylcyclohexane	152 55 60		1 4374	0 7969
149	2,5,5-Trimethylheptane	152 8		1 4136	0 7368
150	2,4,4-Trimethylheptane	153		1 412	0 733
151	2,3,3,5-Tetramethylhexane	153		1 4196	0 746
152	2,2,4,4-Tetramethylhexane	153 3		1 4208	0 7470
153	Isopropylcyclohexane	154 5	- 89 8	1 44095	0 80232
154	1,1,3,3-Tetramethylcyclohexane	154 8-5 0		1 4374	0 7936
155	2,2,3,4-Tetramethylhexane	154 9		1 4226	0 7548
156	2,2-Dimethyloctane	155		1 4082	0 7245
157	3-Ethyl-2,2,4-trimethylpentane	155 3		1 4223	0 7571
158	3,3,5-Trimethylheptane	155 6		1 4170	0 7428
159	2,3,6-Trimethylheptane	155 7		1 4125	0 7345
160	2,4-Dimethyloctane	155 8 6 0		1 4090	0 7259 <sup>20</sup>
161	<i>d,l-cis</i> -1-Ethyl-3-methylcyclohexane	155 97		1 4432	0 8094
162	<i>d,l</i> -2,5-Dimethyloctane	156-8		1 4160	0 7370
163	1,1,3,5-Tetramethylcyclohexane	156 4 5		1 4370	0 7929
164	<i>n</i> -Butylcyclopentane	156 56	- 107 985	1 4316	0 7846
165	<i>n</i> -Propylcyclohexane	156 724	- 94 90	1 43705	0 79360
166	2,3,5-Trimethylheptane	157		1 416	0 741
167	2,5-Dimethyl-3-ethylhexane	157		1 416	0 741
168	2,4,5-Trimethylheptane	157		1 4160	0 741
169	2,4-Dimethyl-3-isopropylpentane	157		1 42463	0 75830
170	2,2,3-Trimethylheptane	158		1 417	0 7420
171	2,4-Dimethyl-4-ethylhexane	158		1 419	0 747
172	2,2-Dimethyl-3-ethylhexane	159		1 420	0 749
173	2,2,3,4,4-Pentamethylpentane	159 3		1 43069	0 76703
174	1,1,3,4,4-Tetramethylcyclohexane	159 5-6 1		1 4380	0 7976
175	5-Ethyl-2-methylheptane	159 7		1 4134	0 736
176	2,7-Dimethyloctane	159 9		1 4086	0 7242

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE I. ALKANES AND CYCLOALKANES**  
**a) Gases and Liquids (Listed in order of increasing b.p.\*)(Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub>
177	3,6-Dimethyloctane	160		1 4145 <sup>18</sup>	0 7363
178	3,5-Dimethyloctane	160		1 413	0 736
179	4-Isopropylheptane	160		1 417	0 741
180	2,3,3-Trimethylheptane	160		1 4202	0 7488
181	4-Ethyl-2-methylheptane	160		1 413	0 736
182	2,6-Dimethyloctane	160-0 5		1 4113	0 7285
183	2,2,3,3-Tetramethylhexane	160 3		1 42818	0 76446
184	<i>trans</i> -1-Isopropyl-4-methylcyclohexane ( <i>p</i> -Menthan)	161		1 4393	0 792
185	4,4-Dimethyloctane	161		1 4144	0 7347
186	2,3,4,5-Tetramethylhexane	161		1 424	0 757
187	5-Ethyl-3-methylheptane	161		1 414	0 737
188	3,3-Dimethyloctane	161 2		1 4165	0 7390
189	4,5-Dimethyloctane	162		1 4173	0 7458
190	3,4-Diethylhexane	162		1 420	0 754
191	4-Propylheptane	162		1 4150	0 7364
192	1,1,4-Trimethylcycloheptane (Eucarvane)	162 3 <sup>720</sup>		1 4420	0 8011
193	<i>trans</i> -1,2,3,5-Tetramethylcyclohexane	162 4		1 44657 <sub>He</sub>	0 8140
194	2,3,4,4-Tetramethylhexane	162 2		1 4270	0 7639
195	2,3,4-Trimethylheptane	163		1 421	0 751
196	3-Isopropyl-2-methylhexane	163		1 421	0 751
197	2,2,7-Trimethylbicyclo[2.2.1]heptane ( $\alpha$ -Fenchane)	163 5 4 5 <sup>733</sup>		1 4590	0 8579
198	3-Ethyl-3-methylheptane	163 8		1 4208	0 7501
199	2,4-Dimethyl-3-ethylhexane	164		1 424	0 759
200	3,4,4-Trimethylheptane	164		1 424	0 757
201	3,3,4-Trimethylheptane	164		1 424	0 757
202	3,4,5-Trimethylheptane	164		1 424	0 759
203	2,3-Dimethyl-4-ethylhexane	164		1 424	0 759
204	1-Methyl-3-propylcyclohexane	164-5 (171 3)		1 4377	0 7895 <sup>21</sup>
205	2,3-Dimethyloctane	164 4 4 6 <sup>764</sup>		1 4152	0 7377
206	<i>d,l</i> -Pinane	164 5 5 0		1 4609	0 8551
207	2,3,3,4-Tetramethylhexane	164 6		1 4297	0 7694
208	3,3-Dimethyl-4-ethylhexane	165		1 427	0 764
209	5-Methylnonane	165 1	-87 7	1 4122	0 7326
210	4-Methylnonane	165 7	-98 7	1 4123	0 7323
211	3-Ethyl-2-methylheptane	166		1 418	0 746
212	2,4-Dimethyloctane	166		1 4182	0 746
213	<i>d</i> - $\alpha$ -Pinane	166 6 5 <sup>762</sup>		1 4630	0 8560
214	<i>d,l</i> -1-Isopropyl-3-methylcyclohexane ( <i>d,l-m</i> -Menthan)	166 7		1 44 <sup>24</sup>	0 7965 <sup>24</sup>
215	2,2,3,3,4-Pentamethylpentane	166 1		1 43606	0 78009
216	<i>trans</i> -1,2,4,5-Tetramethylcyclohexane	166 2-8 0		1 44446 <sub>He</sub>	0 8100
217	3,3-Diethylhexane	166 3		1 428	0 767
218	2-Methylnonane	166 8	-74 5	1 4099	0 7281
219	<i>d</i> -1-Isopropyl-3-methylcyclohexane ( <i>d-m</i> -Menthan)	167		1 446 <sup>23</sup>	0 8116 <sup>23</sup>
220	3-Ethyl-4-methylheptane	167		1 422	0 753
221	4-Ethyl-3-methylheptane	167		1 422	0 753
222	4-Ethyl-4-methylheptane	167		1 421	0 752
223	<i>l</i> - $\beta$ -Pinane	167 5-8 <sup>748</sup>		1 4605	0 8567
224	3-Methylnonane	167 8	-84 8	1 4125	0 7334
225	3-Ethyloctane	168		1 416	0 740
226	4-Ethyloctane	168		1 416	0 740
227	3-Ethyl-2,2,3-trimethylpentane	168		1 436	0 781
228	<i>l</i> -1-Isopropyl-3-methylcyclohexane ( <i>l-m</i> -Menthan)	168		1 4358	0 7938
229	<i>cis</i> -1-Isopropyl-4-methylcyclohexane ( <i>cis-p</i> -Menthane)	168 5		1 4515	0 816
230	<i>cis</i> -1,2,3,5-Tetramethylcyclohexane	168-70 <sup>762</sup>		1 44847 <sub>He</sub>	0 8166
231	2,3-Dimethyl-3-ethylhexane	169		1 427	0 765

\*Derivative data given in order m p , crystal color solvent from which crystallized

**TABLE I. ALKANES AND CYCLOALKANES**  
**a) Gases and Liquids (Listed in order of increasing b.p.\* ) (Continued)**

No	Name		Boiling point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>
232	<b>1-Isopropyl-4-methylcyclohexane</b> ( <i>p</i> -Menthan)	169 70		1 4375 <sup>21</sup>	0 7929
233	<b>3,4-Dimethyl-3-ethylhexane</b>	170		1 431	0 772
234	<b>3,3,4,4-Tetramethylhexane</b>	170		1 4368	0 7824
235	<b>Cyclononane</b>	170-2	9 7	1 4328 <sup>16</sup>	0 8534 <sup>15,2</sup>
236	<b>1-Isopropyl-2-methylcyclohexane</b> ( <i>o</i> -Menthane)	171		1 447 <sup>21</sup>	0 8135 <sup>21</sup>
237	<b>cis-1,2,4,5-Tetramethylcyclohexane</b>	171 <sup>75</sup>		1 44647 <sub>He</sub>	0 8122
238	<b>1-Methyl-1-propylcyclohexane</b>	172		1 4440	0 8101
239	<b>n-Decane</b>	174 123	-29 661	1 41189	0 73005
240	<b>1-Methyl-4-propylcyclohexane</b>	174 3-7 1		1 4393	0 798
241	<b>1-Methyl-2-propylcyclohexane</b>	175 5 6 0 <sup>7,6</sup>		1 4468 <sup>19</sup>	0 8130 <sup>19</sup>
242	<b>n-Pentylcyclopentane</b>	180 60 <sup>10</sup>	-83	1 4358	0 7912
243	<b>n-Butylcyclohexane</b>	180 947	-74 725	1 44075	0 79918
244	<b>trans-Decahydronaphthalene</b> ( <i>trans</i> -Decalin)	187 25	-30 40	1 4695	0 8699
245	<b>Isoamylcyclohexane</b>	193		1 4423	0 8023
246	<b>cis-Decahydronaphthalene</b> ( <i>cis</i> -Decalin)	195 69	-43 01	1 4810	0 8965
247	<b>n-Undecane</b> ( <i>n</i> Hendecane)	195 89	-25 594	1 41716	0 74017
248	<b>Cyclodecane</b>	201	9 6	1 4692	0 8577 <sup>20,4</sup>
249	<b>n-Pentylcyclohexane</b>	202 8	-57 5	1 4437	0 8037
250	<b>n-Hexylcyclopentane</b>	203		1 4392	0 7965
251	<b>9-Methyl-<i>trans</i>-decahydronaphthalene</b>	205, 77 <sup>10</sup>		1 4631	0 8620
252	<b>1,10-Dimethyl-<i>trans</i>-decahydronaphthalene</b>	213 83 <sup>10</sup>		1 4659	0 8633
253	<b>9-Methyl-<i>cis</i>-decahydronaphthalene</b>	215 85 <sup>10</sup>		1 4804	0 8910
254	<b>n-Dodecane</b>	216 278, 51 84 <sup>1</sup>	-9 587 (-12)	1 42160	0 74869
255	<b>1,10-Dimethyl-<i>cis</i>-decahydronaphthalene</b>	220, 88 99 <sup>10</sup>		1 4812	0 8896
256	<b>n-Hexylcyclohexane</b>	224 0, 92 0 <sup>10</sup>	-43	1 4462	0 8076
257	<b>n-Heptylcyclopentane</b>	224		1 4421	0 8010
258	<b>9-Ethyl-<i>trans</i>-decahydronaphthalene</b>	225 93 06 <sup>10</sup>		1 466	0 8610
259	<b>9-Ethyl-<i>cis</i>-decahydronaphthalene</b>	233 99 <sup>10</sup>		1 480	0 8860
260	<b>1-Methyl-<i>trans</i>-decahydronaphthalene</b>	235, 101 <sup>10</sup>		1 4270	
261	<b>n-Tridecane</b>	235 44 66 35 <sup>1</sup>	-5 392	1 4256	0 7564
262	<b>Bicyclohexyl</b>	236 5 7 5, 100 <sup>10</sup>	3 5-4 0	1 4795	0 8848
263	<b>n-Octylcyclopentane</b>	243		1 4446	0 8048
264	<b>n-Heptylcyclohexane</b>	244		1 4484	0 8109
265	<b>n-Tetradecane</b>	235 57, 80 13 <sup>1</sup>	5 863	1 4289	0 7628
266	<b>n-Nonylcyclopentane</b>	262		1 4467	0 8081
267	<b>n-Octylcyclohexane</b>	264		1 4503	0 8138
268	<b>n-Pentadecane</b>	270 63, 93 26 <sup>1</sup>	9 926	1 4319	0 7685
269	<b>n-Decylcyclopentane</b>	279 3		1 44862	0 81097
270	<b>n-Nonylcyclohexane</b>	282		1 4519	0 8163
271	<b>n-Undecylcyclopentane</b> ( <i>n</i> -Hendecylcyclopentane)	296		1 4503	0 8135
272	<b>n-Decylcyclohexane</b>	299		1 4538	0 81858
273	<b>2-Methylheptadecane</b>	311, 178 5 <sup>15</sup>		1 4394 <sup>14</sup>	0 7838 <sup>15</sup>
274	<b>n-Dodecylcyclopentane</b>	312		1 4518	0 8158
275	<b>n-Undecylcyclohexane</b> ( <i>n</i> -Hendecylcyclohexane)	316	5 8	1 4547	0 8206
276	<b>n-Tridecylcyclopentane</b>	327	5	1 4531	0 8178
277	<b>n-Dodecylcyclohexane</b>	331	12 5	1 4559	0 8223
278	<b>n-Tetradecylcyclopentane</b>	341	9	1 4543	0 8196

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE I. ALKANES AND CYCLOALKANES**  
**b) Solids (Listed in order of increasing m.p.)\*\***

No.	Name	Melting point, °C	Boiling point, °C	n <sub>D</sub>	D <sub>4</sub>
1	Pentadecyclopentane	17	355	1.4554 <sup>20</sup>	0.8213 <sup>20</sup>
2	<i>n</i> -Hexadecane (Cetane)	18.165	286.793; 105.20 <sup>1</sup>	1.43453 <sup>20</sup>	0.7734 <sup>20</sup>
3	Tridecylcyclohexane	18.5	346	1.4570 <sup>20</sup>	0.8239 <sup>20</sup>
4	Hexadecylcyclopentane	21	.....	1.4543 <sup>25</sup>	0.8194 <sup>25</sup>
5	<i>n</i> -Heptadecane	21.98	301.82; 117.26 <sup>1</sup>	1.4348 <sup>25</sup> ; 1.4369 <sup>20</sup>	0.7745 <sup>25</sup> ; 0.7780 <sup>20</sup>
6	Tetradecylcyclohexane	24	.....	1.4559 <sup>25</sup>	0.8221 <sup>25</sup>
7	Heptadecylcyclopentane	27	.....	1.4532 <sup>30</sup>	0.8173 <sup>30</sup>
8	<i>n</i> -Octadecane	28.18	316.12; 128.28 <sup>1</sup>	1.4191 <sup>70</sup> ; 1.4390 <sup>20</sup>	0.7751 <sup>30</sup> ; 0.7819 <sup>20</sup>
9	Pentadecylcyclohexane	29	.....	1.4545 <sup>30</sup>	0.8201 <sup>30</sup>
10	Octadecylcyclopentane	30	.....	1.4541 <sup>30</sup>	0.8186 <sup>30</sup>
11	<i>n</i> -Nonadecane	32.1	329.7; 138.8 <sup>1</sup>	1.4211 <sup>70</sup> ; 1.4409 <sup>20</sup>	0.7787 <sup>30</sup> ; 0.7855 <sup>20</sup>
12	Hexadecylcyclohexane	33.6	.....	1.4596 <sup>20</sup>	0.8279 <sup>20</sup>
13	Nonadecylcyclopentane	35	.....	1.4588 <sup>20</sup>	0.8266 <sup>20</sup>
14	<i>n</i> -Eicosane	36.8	342.7; 148.9 <sup>1</sup>	1.4230 <sup>70</sup> ; 1.4426 <sup>20</sup>	0.7550 <sup>70</sup> ; 0.7887 <sup>20</sup>
15	Heptadecylcyclohexane	37.8	.....	1.4603 <sup>20</sup>	0.8290 <sup>20</sup>
16	Eicosylcyclopentane	38	.....	1.4595 <sup>20</sup>	0.8276 <sup>20</sup>
17	<i>n</i> -Heneicosane	40.5	356.5; 152.94 <sup>1</sup>	1.4247 <sup>70</sup> ; 1.4441 <sup>20</sup>	0.7583 <sup>70</sup> ; 0.7917 <sup>20</sup>
18	Octadecylcyclohexane	41.6	.....	1.4610 <sup>20</sup>	0.8300 <sup>20</sup>
19	Heneicosylcyclopentane	42	.....	1.4602 <sup>20</sup>	0.8286 <sup>20</sup>
20	<i>n</i> -Docosane	44.4 (47)	368.6; 161.88 <sup>1</sup>	1.4260 <sup>70</sup> ; 1.4455 <sup>20</sup>	0.7631 <sup>70</sup>
21	Docosylcyclopentane	45	.....	1.4608 <sup>20</sup>	0.8295 <sup>20</sup>
22	Nonadecylcyclohexane	45.2	.....	1.4616 <sup>20</sup>	0.8310 <sup>20</sup>
23	<i>n</i> -Tricosane	47.6	380.2; 170.48 <sup>1</sup>	1.4276 <sup>20</sup> ; 1.4468 <sup>20</sup>	0.7641 <sup>70</sup> ; 0.7969 <sup>20</sup>
24	Eicosylcyclohexane	48.5	.....	1.4622 <sup>20</sup>	0.8318 <sup>20</sup>
25	Tricosylcyclopentane	49	.....	1.4614 <sup>20</sup>	0.8304 <sup>20</sup>
26	<i>n</i> -Tetracosane	50.9	391.3; 178.7 <sup>1</sup>	1.4286 <sup>70</sup> ; 1.4480 <sup>20</sup>	0.7657 <sup>70</sup> ; 0.7991 <sup>20</sup>
27	Tetracosylcyclopentane	51	.....	1.4619 <sup>20</sup>	0.8312 <sup>20</sup>
28	Heneicosylcyclohexane	51.5	.....	1.4627 <sup>20</sup>	0.8326 <sup>20</sup>
29	<i>n</i> -Pentacosane	53.7	401.9; 186.55 <sup>1</sup>	1.4302 <sup>70</sup> ; 1.4491 <sup>20</sup>	0.7693 <sup>70</sup> ; 0.8012 <sup>20</sup>
30	Pentacosylcyclopentane	54	.....	1.4624 <sup>20</sup>	0.8319 <sup>20</sup>
31	Docosylcyclohexane	54.4	.....	1.4632 <sup>20</sup>	0.8334 <sup>20</sup>
32	Hexacosylcyclopentane	56	.....	1.4628 <sup>20</sup>	0.8326 <sup>20</sup>
33	Nortricyclene (Tricyclo[2.2.1.0 <sup>2,6</sup> ]heptane)	56	106-7	.....	.....
34	<i>n</i> -Hexacosane	56.4	412.2; 194.18 <sup>1</sup>	1.4310 <sup>70</sup> ; 1.4501 <sup>20</sup>	0.7704 <sup>70</sup> ; 0.8032 <sup>20</sup>
35	Cyclohexadecane	57	93-8° <sup>8</sup>	.....	.....
36	Tricosylcyclohexane	57	.....	1.4637 <sup>20</sup>	0.8341 <sup>20</sup>
37	Heptacosylcyclopentane	59	.....	1.4633 <sup>20</sup>	0.8333 <sup>20</sup>
38	<i>n</i> -Heptacosane	59.0	422.1; 201.54 <sup>1</sup>	1.4321 <sup>70</sup> ; 1.4511 <sup>20</sup>	0.7732 <sup>70</sup> ; 0.8050 <sup>20</sup>
39	Tetracosylcyclohexane	59.5	.....	1.4641 <sup>20</sup>	0.8347 <sup>20</sup>
40	Cylopentadecane	60-1	.....	1.4592 <sup>61.5</sup>	0.8634 <sup>91.5</sup>
41	Octacosylcyclopentane	61	.....	1.4637 <sup>20</sup>	0.8339 <sup>20</sup>
42	<i>n</i> -Octacosane	61.4	431.6; 208.58 <sup>1</sup>	1.4330 <sup>70</sup> ; 1.4520 <sup>20</sup>	0.7750 <sup>70</sup> ; 0.8067 <sup>20</sup>
43	Pentacosylcyclohexane	61.9	.....	1.4645 <sup>20</sup>	0.8353 <sup>20</sup>
44	Nonacosylcyclopentane	63	.....	1.4640 <sup>20</sup>	0.8345 <sup>20</sup>
45	<i>n</i> -Nonacosane	63.7	440.8; 172.36 <sup>0.1</sup>	0.7797 <sup>65</sup> ; 1.4529 <sup>20</sup>	1.4361 <sup>65</sup> ; 0.8083 <sup>20</sup>

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

\*\*U = undercooled liquid.

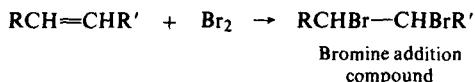
**TABLE I. ALKANES AND CYCLOALKANES**  
**b) Solids (Listed in order of increasing m.p.\* )\*\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	n <sub>D</sub>	D <sub>4</sub>
46	<b>Hexacosylcyclohexane</b>	64		1 4649 <sup>20</sup> <sub>U</sub>	0 8359 <sup>20</sup> <sub>U</sub>
47	<b>Triacontylcyclopentane</b>	65		1 4644 <sup>20</sup> <sub>U</sub>	0 8350 <sup>20</sup> <sub>U</sub>
48	<i>d,l</i> -Isobornane (2,2,3-Trimethylbicyclo[2.2.1]heptane)	65-7		1 4418 <sup>67</sup> <sub>U</sub>	0 8275 <sup>76</sup> <sub>U</sub>
49	<i>n</i> -Triacontane	65.8	449.7, 222.00 <sup>1</sup>	1 4348 <sup>70</sup> <sub>U</sub> 1 4536 <sup>20</sup> <sub>U</sub>	0 7797 <sup>70</sup> , 0 8097 <sup>20</sup> <sub>U</sub>
50	<b>Heptacosylcyclohexane</b>	66.1		1 4653 <sup>20</sup> <sub>U</sub>	0 8365 <sup>20</sup> <sub>U</sub>
51	<b>Hentriacosylcyclopentane</b>	67		1 4648 <sup>20</sup> <sub>U</sub>	0 8356 <sup>20</sup> <sub>U</sub>
52	<i>n</i> -Hentriaccontane	67.9	458, 184.17 <sup>0</sup> <sup>1</sup>	1 4543 <sup>20</sup> <sub>U</sub>	0 8111 <sup>20</sup> <sub>U</sub>
53	<b>Octacosylcyclohexane</b>	68		1 4656 <sup>20</sup> <sub>U</sub>	0 8370 <sup>20</sup> <sub>U</sub>
54	<b>Dotriacontylcyclopentane</b>	69		1 4651 <sup>20</sup> <sub>U</sub>	0 8360 <sup>20</sup> <sub>U</sub>
55	<i>n</i> -Dotriacontane (Bicyetyl)	69.7	467, 234.8 <sup>1</sup>	1 4550 <sup>20</sup> <sub>U</sub>	0 7791 <sup>75</sup> , 0 8124 <sup>20</sup> <sub>U</sub>
56	<b>Nonacosylcyclohexane</b>	69.9		1 4659 <sup>20</sup> <sub>U</sub>	0 8374 <sup>20</sup> <sub>U</sub>
57	<b>Tritriacontylcyclopentane</b>	70		1 4654 <sup>20</sup> <sub>U</sub>	0 8365 <sup>20</sup> <sub>U</sub>
58	<b>Tritriacontane</b>	71.4		1 4557 <sup>20</sup> <sub>U</sub>	0 8136 <sup>20</sup> <sub>U</sub>
59	<b>Triacosylcyclohexane</b>	71.6		1 4662 <sup>20</sup> <sub>U</sub>	0 8379 <sup>20</sup> <sub>U</sub>
60	<b>Tetraacosylcyclopentane</b>	72		1 4657 <sup>20</sup> <sub>U</sub>	0 8370 <sup>20</sup> <sub>U</sub>
61	<b>Tetraaccontane</b>	72.6, 73.1	285.4 <sup>3</sup>	1 4296 <sup>90</sup> <sub>U</sub> 1 4563 <sup>20</sup> <sub>U</sub>	0 7728 <sup>90</sup> , 0 8148 <sup>20</sup> <sub>U</sub>
62	<b>28-Methylnonacosane</b>	73.4	222.0 <sup>3</sup>		
63	<b>Hentriacosylcyclohexane</b>	73.3		1 4665 <sup>20</sup> <sub>U</sub>	0 8383 <sup>20</sup> <sub>U</sub>
64	<b>Pentatriacosylcyclopentane</b>	74		1 4660 <sup>20</sup> <sub>U</sub>	0 8374 <sup>20</sup> <sub>U</sub>
65	<b>Pentatriaccontane</b>	74.7		1 4568 <sup>20</sup> <sub>U</sub>	0 8157 <sup>20</sup> <sub>U</sub>
66	<b>Dotriacosylcyclohexane</b>	74.8		1 4668 <sup>20</sup> <sub>U</sub>	0 8388 <sup>20</sup> <sub>U</sub>
67	<b>Hexatriacosylcyclopentane</b>	75		1 4662 <sup>20</sup> <sub>U</sub>	0 8378 <sup>20</sup> <sub>U</sub>
68	<b>Hexatriaccontane</b>	76.2		1 4573 <sup>20</sup> <sub>U</sub>	0 8169 <sup>20</sup> <sub>U</sub>
69	<b>Tritriacosylcyclohexane</b>	76.3		1 4670 <sup>20</sup> <sub>U</sub>	0 8391 <sup>20</sup> <sub>U</sub>
70	<b>Heptatriaccontane</b>	77.7		1 4578 <sup>20</sup> <sub>U</sub>	0 8179 <sup>20</sup> <sub>U</sub>
71	<b>Tetratriacosylcyclohexane</b>	77.7		1 4673 <sup>20</sup> <sub>U</sub>	0 8395 <sup>20</sup> <sub>U</sub>
72	<b>Octatriaccontane</b>	79		1 4583 <sup>20</sup> <sub>U</sub>	0 8188 <sup>20</sup> <sub>U</sub>
73	<b>Pentatriacosylcyclohexane</b>	79.1		1 4675 <sup>20</sup> <sub>U</sub>	0 8399 <sup>20</sup> <sub>U</sub>
74	<b>Nonatriaccontane</b>	80.3		1 4588 <sup>20</sup> <sub>U</sub>	0 8197 <sup>20</sup> <sub>U</sub>
75	<b>Hexatriacosylcyclohexane</b>	80.4		1 4678 <sup>20</sup> <sub>U</sub>	0 8402 <sup>20</sup> <sub>U</sub>
76	<b>Tetraaccontane</b>	81.5		1 4593 <sup>20</sup> <sub>U</sub>	0 8205 <sup>20</sup> <sub>U</sub>
77	<b>Norbornane (Bicyclo[2.2.1]heptane)</b>	86-7, subl		1 4695 <sup>20</sup> <sub>U</sub>	0 8242 <sup>23</sup> <sub>solid</sub>
78	<b>2,2,3,3-Tetramethylbutane</b>	100.69			
79	<b>Bornane (Camphane)</b>	158.9, subl	106.47		
80	<b>Adamantane</b>	268(252.3)		1 568	1 07 <sub>solid</sub>

\*Derivative data given in order m p , crystal color, solvent from which crystallized

\*\*U = undercooled liquid

## EXPLANATIONS AND REFERENCES TO TABLE II

*Bromine addition compound.\**

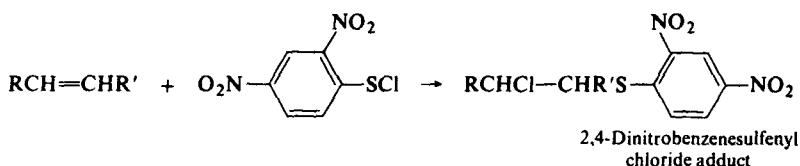
From the alkene and bromine in carbon tetrachloride.

For directions and examples see: Cheronis, p. 576; Shriner, p. 106.

From the alkene and bromine in water.

See: Vogel, p. 241.

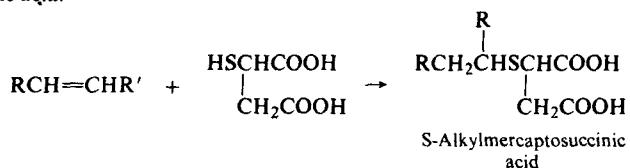
From the alkene and bromine in chloroform.

See: C. G. Schmitt and C. E. Boord, *J. Amer. Chem. Soc.*, **54**, 751 (1932).*2,4-Dinitrobenzenesulfenyl chloride addition compound.\**

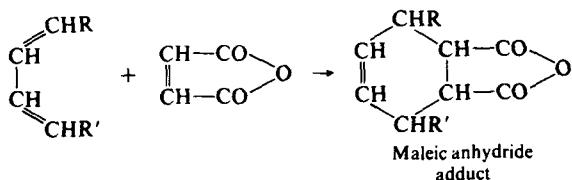
From the alkene and 2,4-dinitrobenzenesulfenyl chloride in glacial acetic acid.

For directions and examples see: Cheronis, p. 577; N. Kharasch and C. M. Buess, *J. Amer. Chem. Soc.*, **71**, 2724 (1949); D. J. Cram, *J. Amer. Chem. Soc.*, **71**, 3883 (1949); N. Kharasch, C. M. Buess and S. I. Strashun, *J. Amer. Chem. Soc.*, **74**, 3422 (1952).

From the alkene and 2,4-dinitrobenzenesulfenyl chloride in benzene or in carbon tetrachloride.

See: N. Kharasch and C. M. Buess, *J. Amer. Chem. Soc.*, **71**, 2724 (1949).*S-Alkylmercaptosuccinic acid.\**

From the alkene, mercaptosuccinic acid and benzoyl peroxide in methanol.

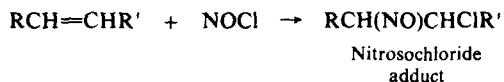
For directions and examples see: J. G. Hendrickson and L. F. Hatch, *J. Org. Chem.*, **25**, 1747 (1960).*Maleic anhydride adduct (from dienes).*

From the diene and maleic anhydride in benzene.

For directions and examples see: Linstead, p. 51; Vogel, p. 943.

From the diene and maleic anhydride in xylene.

See: Linstead, p. 51.

For general references see: M. C. Kloetzel in *Organic Reactions*, Vol. 4 (Ed. R. Adams), John Wiley and Sons, New York, 1948, p. 1; H. L. Holmes in *Organic Reactions*, Vol. 4, (Ed. R. Adams), John Wiley and Sons, New York, 1948, p. 60; O. Diels and K. Alder, *Chem. Ber.*, **62**, 2081 (1929).*Nitrosochloride addition compound.*

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE II (Continued)

From the alkene and nitrosyl chloride (prepared from sodium nitrite in concentrated hydrochloric acid) in ether-acetic acid mixture.

*For directions and examples see:* Linstead, p. 52; R. Perrot, *Compt. Rend.*, **203**, 329 (1936).

From the alkene and nitrosyl chloride (prepared from thionyl chloride and nitrogen trioxide) in ether.

*See:* M. Tuot, *Compt. Rend.*, **204**, 697 (1937).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,

DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.\*)\*\*

No	Name	Boiling point °C	Melting point °C	$n_{D}^{20}$	$D_{4}^{20}$	Bromine addition product					Miscellaneous
						$\alpha$ -Bromo-	B P., °C	M P., °C	$n_{D}^{20}$	$D_{4}^{20}$	
1	Ethene (Ethylene)	-103.71	-169.15 <sup>T</sup>		0.384 <sup>a</sup>	di-	131.36	9.85	1.53868	2.1792	
2	Propene (Propylene)	-47.70	-185.25 <sup>T</sup>	0.5139		di-	141.99	-55.5	1.52004	1.93268	
3	Cyclopropene	-36 <sup>711</sup>									
4	Allene	-34.5	-136			tetra-		10.7	1.6200	2.703	
5	2-Methylpropene	-6.90	-140.35	1.3467	0.5942 <sup>S</sup>	di-	149		1.5080	1.7595	2,4-Dinitrophenyl-sulfenyl chloride, 86.7
6	1-Butene	-6.26	-185.35	1.3465	0.5951	di-	166.3		1.5150	1.7951	2,4-Dinitrophenyl-sulfenyl chloride, 77.5.8.5
7	1,3-Butadiene	-4.41	-108.92	1.4292 <sup>2</sup> 0.650 <sup>1</sup>	0.6255 <sup>1</sup>	tetra-		118 lgr			
8	trans-2-Butene	0.88	-105.55		0.6042 <sup>S</sup>	di-	161.0		1.5110	1.7852	
9	Cyclobutene	2.4			0.733 <sup>0</sup>						
10	cis-2-Butene	3.72	-138.91		0.6306 <sup>1</sup>	di-	161.0		1.5110	1.7852	
11	1,2-Butadiene (Methylallene)	10.85	-136.19	1.4208 <sup>3</sup>	0.652 <sup>S</sup>	tetra-	97.5	-2	1.6070	2.5085	
12	3-Methyl-1-butene	20.06	-168.49	1.3643	0.6272	di-	61.2 <sup>12</sup>		1.50932	1.6776	
13	1,4-Pentadiene	25.97	-148.28	1.38876	0.66706	tetra		85.5 6.0, eth			
14	1-Pentene	29.97	-165.22	1.37148	0.64050	di-	68 <sup>12</sup>		1.5012 <sup>12</sup>	1.592 <sup>19</sup>	Mercaptosuccinic acid adduct, 107.3-6
15	2-Methyl-1-butene	31.16	-137.56	1.3778	0.6504	di-	47.4 48 <sup>9</sup>		1.5088	1.6711	Mercaptosuccinic acid adduct, 122.3-6
16	3-Methylcyclobutene	32		1.4005							
17	2-Methyl-1,3-butadiene (Isoprene)	34.07	-145.95	1.42194	0.68095	di-	90-6 <sup>12</sup>				Maleic anh adduct, 63-4, lgr
18	trans-2-Pentene	36.35	-140.24	1.3793	0.6482	di-	91.0 <sup>50</sup>		1.5096	1.6809	
19	cis-2-Pentene	36.94	-151.39	1.3830	0.6556	di-	92.4 <sup>50</sup>		1.5096	1.6817	
20	1-Methyl-1-cyclobutene	37.1		1.4088	0.7244						
21	2-Methyl-2-butene	38.57	-133.77	1.3874	0.6623						Nitrosochloride, 74, Mercaptosuccinic acid adduct, 153.7-4.0
22	3-Methyl-1,2-butadiene (1,1-Dimethylallene)	40		1.410	0.680	tetra-	150.2 <sup>1</sup>		1.594 <sup>17</sup>	2.305 <sup>17</sup>	
23	Cyclopentadiene	40.83 <sup>2</sup>	-85	1.4398 <sup>19.5</sup>	0.7983 <sup>19</sup>						Dimer 32, Maleic anh adduct, 164.5 Benzoquinone adduct, 75.6
24	1,3-Pentadiene (Piperylene)	41.1	-88.9	1.4309	0.6803	tetra-		114.5, al			Maleic anh adduct, 61, pet eth, Oxid by KMnO <sub>4</sub> → HCOOH + CH <sub>3</sub> COOH
25	3,3-Dimethyl-1-butene	41.24	-115.2	1.3760	0.6529	di-	95.3 5.6 <sup>10</sup>		1.5109	1.5615	
26	1, trans-3-Pentadiene	42.03	-87.47	1.43008	0.67603	tetra-	131 <sup>3</sup>	115, al			
27	1, cis-3-Pentadiene	44.07	-140.82	1.43634	0.69102	tetra-	131 <sup>3</sup>	115, al			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

\*\*T = triple point, S = at saturation pressure

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**

**a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous	
						x	Bromo-	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
28	Cyclopentene	44 24	-135 08	1 42246	0 77199	di-	71 5 <sup>12</sup>			1 5510 <sup>11</sup>	1 8713 <sup>11</sup>	Mercaptosuccinic acid adduct 142 8 3 1 Pseudo-nitroso 69 70 Perbenzoic acid oxid → epoxy-cyclopentane b p 102 3
29	1,2-Pentadiene (Ethylallene)	44 86	-137 26	1 42091	0 69257	tetra-	94 6 <sup>11</sup>				2 3469 <sup>12</sup>	
30	2,3-Pentadiene (1,3-Dimethylallene)	48 27	-125 26	1 42842	0 69502							
31	4-Methyl-1-pentene	53 88	-153 63	1 3828	0 6642	di	87 <sup>21</sup>			1 4980	1 5689	Mercaptosuccinic acid adduct 102 6 9
32	3-Methyl-1-pentene	54 14	-153 0	1 3842	0 6675	di	99 <sup>10</sup>			1 5060	1 6016	
33	3-Methyl-1,4-pentadiene	55		1 405	0 695							
34	2,3-Dimethyl-1-butene	55 67	-157 27	1 3904	0 6779	di-	80 <sup>1</sup>			1 5105	1 6033	
35	2-Methyl-1,4-pentadiene	56		1 405	0 694							
36	4-Methyl- <i>cis</i> -2-pentene	56 3	-134 43	1 3880	0 6690	di	72 3 <sup>18</sup>			1 5060	1 5983	
37	4-Methyl- <i>trans</i> -2-pentene	58 55	-140 81	1 3889	0 6686	di-	78 <sup>22</sup>			1 5070	1 5996	
38	1,5-Hexadiene (Biallyl)	59 46	-140 8	1 4042	0 6923	tetra-		52				Dil HNO <sub>3</sub> → succinic ac 185
39	2-Methyl-1-pentene	60 7	-135 72	1 3920	0 6817	di	87 8 <sup>20</sup>			1 5015	1 5581	
40	1-Hexene	63 49	-139 82	1 38788	0 67317	di-	89 90 <sup>18</sup>			1 5024	1 5774	2,4-Dinitrophenyl-sulfenyl chloride 61 2 Mercaptosuccinic acid adduct, 94 5 5 7
41	2-Ethyl-1-butene	64 6	-131 53	1 3969	0 6894	di-	87 <sup>21</sup>			1 5112	1 6045	
42	<i>trans</i> -1,3-Hexadiene	64 5 5 5		1 4060 <sup>19</sup>	0 6925 <sup>19</sup>	tetra-		19				
43	3-Methylcyclopentene	65 0		1 4207	0 7622							
44	<i>cis</i> -3-Hexene	66 44	-137 82	1 3947	0 6796	di	80 1 <sup>13</sup>			1 5045	1 6027	
45	3-Hexene ( <i>cis-trans</i> mixture)	66 6-67		1 3942	0 6816	di-	80 1 <sup>13</sup>			1 5045	1 6027	
46	<i>trans</i> -3-Hexene	67 08	-113 43	1 3943	0 6772	di-	80 1 <sup>13</sup>			1 5045	1 6027	
47	2-Methyl-2-pentene	67 29	-135 7	1 4004	0 6863	di-	71-2 <sup>18</sup>			1 5063	1 5849	Mercaptosuccinic acid adduct, 152 1 6
48	3-Methyl- <i>trans</i> -2-pentene	67 63	-134 84	1 4016	0 6942	di-	72 4 <sup>15</sup>			1 5085		
49	<i>trans</i> -2-Hexene	67 87	-132 97	1 3935	0 6784	di-	90 <sup>16</sup>			1 5025	1 5812	
50	2-Hexene ( <i>cis-trans</i> mixture)	67 9 8 1		1 3928	0 6813	di-	90 <sup>16</sup>			1 5025	1 5812	
51	2,3-Hexadiene	68		1 395	0 680							
52	2,3-Dimethyl-1,3-butadiene	68 78	-76 01	1 4394	0 7267	di-			47, lgr 138, bz			Maleic anh adduct, 78-9
53	<i>cis</i> -2-Hexene	68 84	-141 14	1 3977	0 6869	di-	90 <sup>16</sup>			1 5025	1 5812	
54	4-Methyl-1,2-pentadiene (1-Isopropyl-allene)	70		1 424	0 708							
55	3-Methyl- <i>cis</i> -2-pentene	70 45	-138 45	1 4045	0 6986	di-	72-4 <sup>15</sup>			1 5085		

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**  
**a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x-Bromo-	B P., °C	M P., °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
56	2-Methyl-2,3-pentadiene (Trimethyl allene)	72		1 425	0 711						
57	1,4-Hexadiene	72 3 2 5		1 4402 <sup>19</sup>	0 7057 <sup>19</sup>	tetra- 2 forms di		a) 63 4 b) f p <-50			
58	4,4-Dimethyl-1-pentene	72 49	-136 6	1 3918	0 6827		77-8°		1 4970	1 5129	Mercaptosuccinic acid adduct, 119 5
59	1, (cis and/or trans)-3-hexadiene	73		1 438	0 705						
60	2,3-Dimethyl-2-butene	73 21	-74 28	1 4122	0 7080	di		173 4 121			
61	2-Ethyl-1,3-butadiene	75		1 445	0 717						
62	4-Methylcyclopentene	75 2		1 4306	0 7796						
63	1-Methylcyclopentene	75 8	-127	1 4330	0 7802						
64	2-Methyl-1,(cis and/or trans)-3-pentadiene	76		1 446	0 719						
65	1,2-Hexadiene (n-Propylallene)	76		1 4282	0 7149	tetra-	130 <sup>3</sup>		1 5850	2 1873	
66	2-Methyl-1,(cis and/or trans)-3-pentadiene	76		1 446	0 719						
67	4-Methyl-1,3-pentadiene	76 3		1 451	0 719						
68	4,4-Dimethyl-trans-2-pentene	76 75	-115 24	1 3982	0 6889	di-	92 8- 93 <sup>14</sup>		1 5080	1 5538	
69	3,3-Dimethyl-1-pentene	77 54	-134 3	1 3984	0 6974	di-	95 3 6 <sup>10</sup>		1 5109	1 5615	
70	2,3,3-Trimethyl-1-butene	77 87	-109 85	1 4029	0 7050	di-	98-9 <sup>14</sup>	38-9			
71	3-Methyl-1,3-pentadiene	78 0 3		1 4494	0 7499						
72	trans-1,3,5-Hexatriene	78 5, 77 8 5		1 4884 <sup>13 5</sup>	0 74229 <sup>15</sup>	hexa-		78			
73	cis-1,3,5-Hexatriene	78 5		1 4577	0 7179						
74	3-Methyl-1,2-pentadiene	79 70		1 425	0 715						
75	2,4-Hexadiene	79 4 81 6 <sup>765</sup>	-79	1 4493	0 7152	2,5-di- tetra-	85 <sup>11</sup>	182	1 534 <sup>19</sup>	1 622 <sup>19</sup>	Maleic anh adduct, 95 6, lgr , SO <sub>2</sub> adduct, 43-3 5
76	3-Methyl-1,5-hexadiene	80-1		1 4116	0 7103						
77	4,4-Dimethyl-1,2-pentadiene (tert-Butylallene)	80-3			0 7184						
78	1,3-Cyclohexadiene	80 31 <sup>757</sup>	-104 8	1 4740	0 8413	di-		68, iso- merizes → m 108			Maleic anh adduct, 145-6, heptane, Benzoinone adduct, 196 7, lgr
79	4,4-Dimethyl-cis-2-pentene	80 42	-135 46	1 4024	0 6996	tetra- 2 forms di-	92 8 3 0 <sup>14</sup>		1 5080	1 5538	

\* Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**  
**a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x-Bromo-	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
80	3,4-Dimethyl-1-pentene	81		1.3995	0.701						
81	Cyclohexene	82.97	-103.51	1.44654	0.81096	di-	101.3 <sup>13</sup>		1.5445 <sup>19</sup>	1.7759 <sup>19</sup>	Mercaptosuccinic acid adduct, 150.5 1.5, KMnO <sub>4</sub> , oxid → adipic ac., 154, 2,4-Dinitrophenylsulfenyl chloride, 117.8 HBr → cyclohexyl bromide, b.p. 165
82	2,4-Dimethyl-2-pentene	83.4	-127.7	1.40165 <sup>22</sup>	0.6958 <sup>22</sup>	di-	88 <sup>17</sup>		1.50920 <sup>22.5</sup>	1.5431 <sup>22.5</sup>	
83	3-Methyl-1-hexene	84.0		1.397	0.695	di-	84.0-2 <sup>6</sup>		1.5028	1.5248	
84	2,3-Dimethyl-1-pentene	84.26	-134.8	1.4033	0.7051	di-	72.5-3.0 <sup>3</sup>		1.5028	1.5245	
85	3-Ethyl-1-pentene	85.13	-127.4	1.3980	0.6962	di-	93.5 <sup>15</sup>		1.5006	1.5251	
86	5-Methyl-1-hexene	85.31		1.3966	0.6920	di-	142.6-3.6 <sup>101</sup>		1.4970	1.5072	
87	5-Methyl-trans-2-hexene	86.0		1.400	0.700	di-	87.8 <sup>10</sup>		1.4960	1.5027	
88	2-Methyl-3-hexene	86.0		1.399	0.694	di-	96 <sup>19</sup>		1.5060	1.5310	
89	2,4-Dimethyl-2,3-pentadiene (Tetramethylallene)	86.5		1.40039	0.7006						
90	4-Methyl-1-hexene	86.73	-141.45	1.4000	0.6985	di-	94.7-5.7 <sup>11</sup>		1.4980	1.5027	
91	3,4-Dimethyl-2-pentene	87.0		1.407	0.713	di-	65.5-6.0		1.5104	1.5400	
92	4-Methyl-cis-2-hexene	87.37		1.4024	0.6996	di-	91.2 <sup>11</sup>		1.5045	1.5382	
93	4-Methyl-trans-2-hexene	87.6	-126.5	1.4023	0.6975	di-	91.2 <sup>11</sup>		1.5045	1.5382	
94	3,3-Dimethylcyclopentene	88		1.423	0.771						Nitrosochloride, 75.6
95	2-Ethyl-3-methyl-1-butene	89		1.410	0.715	di-	72.5-3.5 <sup>3</sup>		1.5062	1.5261	
96	5-Methyl-cis-2-hexene	91		1.400	0.700	di-	89.90 <sup>11</sup>		1.4990	1.5152	
97	5-Methyl-1,4-hexadiene	91.25		1.4390	0.7258	1,2-di-	101.4 <sup>18</sup>		1.5233 <sup>16</sup>	1.566 <sup>16</sup>	
98	2-Methyl-1-hexene	92.0	-102.84	1.4034	0.7030	di-	100.5-1.5 <sup>23</sup>		1.5000	1.5066	
99	1,3-Dimethylcyclopentene	92		1.428	0.766						
100	2-Methyl-1,5-hexadiene	92.5 <sup>769</sup>		1.423/6 <sup>17.3</sup>	0.7289 <sup>18.5</sup>						
101	2,4-Dimethyl-1,3-pentadiene	93	-114	1.4412	0.7368						
102	1,4-Dimethylcyclopentene	93.2		1.4283	0.779						
103	3-Methyl-trans-3-hexene	93.5		1.4107	0.7099						
104	1-Heptene	93.64	-119.03	1.39980	0.69698	di-	106.2 <sup>13</sup>		1.4990	1.5208	Mercaptosuccinic acid adduct 103.4-9

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous	
						x	Bromo	B P., °C	M P., °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
105	3-Methyl- <i>trans</i> -2-hexene	94.0		1.410	0.7120	di-	65.0 51 <sup>2</sup>			1.5040	1.5240	
106	2-Ethyl-1-pentene	94		1.405	0.708	di-	77.8 <sup>4</sup>			1.4990	1.4929	
107	3-Methyl- <i>cis</i> -3-hexene	95.35		1.4123	0.7132							
108	2-Methyl-2-hexene	95.41	-130.35	1.4106	0.7082	di-	73.0 1 <sup>8</sup>			1.4990	1.5116	
109	<i>trans</i> -3-Heptene	95.67	-136.63	1.4043	0.6981	di-	105.5 65 <sup>23</sup>			1.5010	1.5153	
110	<i>cis</i> -3-Heptene	95.75		1.4059	0.7030	di-	105.5- 65 <sup>23</sup>			1.5010	1.5153	
111	5-Methyl-1,2-hexadiene (Isobutylallene)	96		1.4282 <sup>19</sup>	0.7225 <sup>19</sup>							
112	3-Ethyl-2-pentene	96.01		1.4148	0.7204	di-	76.0-4 <sup>3</sup>			1.5090	1.5426	
113	2,3-Dimethyl-2-pentene	97.5	-118.3	1.4208	0.7277	di-	97.9 <sup>15</sup>			1.517 <sup>22</sup>	1.547 <sup>22</sup>	
114	<i>trans</i> -2-Heptene	97.95	-109.48	1.4045	0.7012	di-	96.2 <sup>12</sup>			1.5000	1.5129	
115	3-Ethylcyclopentene	98.1		1.4319	0.7830							
116	<i>cis</i> -2-Heptene	98.5		1.406	0.708	di-	96.2 <sup>12</sup>			1.5000	1.5129	
117	5-Methyl-1,3-cyclohexadiene	100.5 15 <sup>762</sup>		1.4662 <sup>22</sup> <sub>5</sub>	0.8252							
118	2,2-Dimethyl- <i>trans</i> -3-hexene	100.9		1.4063	0.7039	di-	96.5- 7.0 <sup>8</sup>			1.5032	1.4856	
119	1,4-Heptadiene	101		1.4202	0.7106	di-				1.5734	2.091	
120	2,4,4-Trimethyl-1-pentene	101.44	-93.48	1.4086	0.7150							
121	3,3-Dimethyl-1,5-hexadiene	101.6		1.4160	0.7249							
122	3,4-Dimethyl-1,5-hexadiene	101.8		1.4211	0.7304							
123	2,5-Dimethyl-3-hexene	102		1.406	0.710	di-	109 <sup>19</sup>			1.5058	1.5034	
124	5,5-Dimethyl-1-hexene	102.5		1.4049	0.709							
125	4-Methylcyclohexene	102.74	-115.5	1.4414	0.7947	di-	130 <sup>40</sup>				1.650 <sub>15</sub>	
126	3-Methylcyclohexene	104.0		1.4444	0.8010							
127	2-Isopropyl-3-methyl-1-butene	104		1.4085	0.722							
128	3,4,4-Trimethyl-1-pentene	104		1.412	0.719							
129	3,5-Dimethyl-1-hexene	104		1.404	0.708							
130	3,3-Dimethyl-1-hexene	104		1.4070	0.7140							
31	5,5-Dimethyl- <i>trans</i> -2-hexene	104.1		1.4055	0.7066							
32	2,4,4-Trimethyl-2-pentene	104.91	-106.33	1.4160	0.7218							
33	3,3,4-Trimethyl-1-pentene	105		1.4144	0.729							
34	2,2-Dimethyl- <i>cis</i> -3-hexene	105.4	-137.4	1.4099	0.7128							
35	1,2-Heptadiene ( <i>n</i> -Butylallene)	105.5 6.0		1.432 <sup>18</sup>	0.7306 <sup>18</sup>	2,3-di-	108- 10 <sup>12</sup> , 140 <sup>3</sup>			1.5200 <sup>18</sup>	1.5595 <sup>18</sup>	
36	1,2-Dimethylcyclopentene	105.8	-90.4	1.4448	0.7976	tetra-				1.5718	2.0675	
37	4-Ethylcyclopentene	106		1.440	0.798							
38	4,4-Dimethyl-2-hexene	106		1.413	0.722	di-	92.3 <sup>4</sup>			1.5113	1.5148	
39	1-Ethylcyclopentene	106.3	-118.4	1.4410	0.7982							
40	5,5-Dimethyl- <i>cis</i> -2-hexene	106.9		1.4113	0.7169							

Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**

**a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x-Bromo-	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
141	2-Methyl-2,4-hexadiene	107		1 4266 <sup>24</sup>	0 7439						
142	2-Methyl-1,3-cyclohexadiene	107 8		1 4662 <sup>18</sup>	0 8272 <sup>18</sup>						
143	3-Methyl-2,4-hexadiene	107 8		1 46146 <sup>15</sup>	0 7625 <sup>17</sup>						
144	4,4-Dimethyl-1-hexene	107 2		1 4102	0 7198	di-	224 5		1 5003	1 4689	
145	3-Ethyl-4-methyl-1-pentene	107 5		1 4097	0 7200						
146	2,4-Heptadiene	107 5 8 0		1 4578	0 7384						
147	2,4-Dimethyl- <i>trans</i> -3-hexene	107 6		1 4126	0 7145						
148	Quadracyclene (Quadracyclo [2,2,1,0 <sup>4,6</sup> ,0 <sup>5</sup> ]heptane)	108 <sup>740</sup> sl d		1 4804							
149	2,3,4-Trimethyl-1-pentene	108		1 415	0 729						
150	4-Methyl-1,3-hexadiene	108 10		1 4523	0 7558						
151	2,3,3-Trimethyl-1-pentene	108 3	-69	1 4174	0 7352						
152	4,5-Dimethyl-1-hexene	109		1 414	0 728						
153	1,5,5-Trimethylcyclopentene (Iso-laurolene)	109 <sup>754</sup>		1 4324	0 7824						Reduces Tollen's reagent on warming
154	2,4-Dimethyl- <i>cis</i> -3-hexene	109		1 4140	0 7178						
155	3,3-Dimethyl-2-ethyl-1-butene	110		1 4159	0 728						
156	3-Ethyl-2-methyl-1-pentene	110		1 415	0 730						
157	4,5-Dimethyl-2-hexene	110		1 413	0 725						
158	1-Methylcyclohexene	110 0	-121	1 4503	0 8102	di-	100 2 <sup>12</sup>				2,4-Dinitrophenyl-sulfenyl chloride, 139 40
159	2-Ethyl-4-methyl-1-pentene	110 3		1 4105	0 7195						
160	3-Ethyl-1-hexene	110 3		1 407	0 715						
161	2,3-Dimethyl-1-hexene	110 5		1 4113	0 7214						
162	2,4-Dimethyl-2-hexene	110 6		1 4118	0 7213						
163	3-Methyl-1-heptene	111		1 406	0 711						
164	2,4-Dimethyl-1-hexene	111 2		1 4110	0 720						
165	2,5-Dimethyl-1-hexene	111 6		1 4105	0 7172						
166	3-Ethyl-3-methyl-1-pentene	112		1 418	0 7305						
167	3,4-Dimethyl-1-hexene	112		1 413	0 724						
168	3,4,4-Trimethyl-2-pentene	112		1 4232	0 7395						
169	3,5-Dimethyl-2-hexene	112		1 416	0 725						
170	2-Methyl-3-heptene	112		1 402	0 706						
171	5-Methyl-3-heptene	112		1 410	0 713						
172	2,5-Dimethyl-2-hexene	112 2		1 4140	0 720	di-	88 <sup>13</sup>		1 4740	1 3980	
173	3-Methyl-1,5-heptadiene	112 5		1 4230 <sup>22,5</sup>							
174	2-Ethyl-3-methyl-1-pentene	112 5		1 4142	0 729						

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**  
**a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_{D}^{20}$	$D_{4}^{20}$	Bromine addition product					Miscellaneous
						<i>x</i> -Bromo-	B P, °C	M P °C	$n_{D}^{20}$	$D_{4}^{20}$	
175	<b>4-Methyl-1-heptene</b>	112 8		1 410	0 717						
176	<b>6-Methyl-3-heptene</b>	113 <sup>734</sup>		1 4114	0 7256	<i>di</i> -		97			
177	<b>4-Ethyl-1-hexene</b>	113		1 412	0 726						
178	<b>4-Ethyl-2-hexene</b>	113		1 412	0 725						
179	<b>2-Isopropyl-1-pentene</b>	113		1 414	0 725						
180	<b>5-Methyl-1-heptene</b>	113 3		1 4094	0 7164						
181	<b>4-Methyl-2-heptene</b>	113 5 4 1		1 4096	0 7154						
182	<b>2,3-Dimethyl-3-hexene</b>	114		1 416	0 728						
183	<b>4-Methyl-2-octene</b>	114		1 4100 <sup>25</sup>	0 7188 <sup>25</sup>						
184	<b>2,4-Dimethyl-2,4-hexadiene</b>	114-5		1 45457 <sup>16 5</sup>	0 7635 <sup>16 5</sup>						
185	<b>6-Methyl-2,4-heptadiene</b>	114 6		1 4397 <sup>25</sup>	0 7041 <sup>25</sup>						
186	<b>3-Ethyl-4-methyl-<i>trans</i>-2-pentene</b>	114 3		1 4210	0 7350						
187	<b>Cycloheptene (Suberene)</b>	114 38	-56	1 4580	0 8254	<i>di</i> -	unstable				Nitrosochloride, 118 Oxid → pimelic ac , 105
188	<b>1-Methyl-1,4-cyclohexadiene</b>	114 5-4 8	< -70	1 4703	0 848	<i>tetra</i> -		171			
189	<b>3-Ethyl-4-methyl-<i>cis</i>-2-pentene</b>	115		1 424	0 739						
191	<b>1,3,5-Cycloheptatriene (Tropilidene)</b>	115 5	-79 49	1 5243							Maleic anh adduct, 104 2-5 0, CCl <sub>4</sub>
192	<b>3,4-Dimethyl-2-hexene</b>	116		1 418	0 737						
193	<b>3-Ethyl-3-hexene</b>	116		1 418	0 729						
194	<b>6-Methyl-1,3-heptadiene</b>	116 8			0 741 <sup>22</sup>						
195	<b>2,5-Dimethyl-1,3-hexadiene</b>	116 8	> -80	1 45024	0 7412						
196	<b>2,3,4-Trimethyl-2-pentene</b>	116 3	-113 3	1 4275	0 7434						
197	<b>4,4-Dimethylcyclohexene</b>	116 98	-80 5	1 4420	0 7996						
198	<b>6-Methyl-2-heptene</b>	117		1 412	0 718						
199	<b>2-<i>n</i>-Propyl-1-pentene</b>	117 7		1 4136	0 7240						
200	<b>5-Methyl-2-heptene</b>	118		1 414	0 723						
201	<b>3,3-Dimethylcyclohexene</b>	119		1 445	0 804						
202	<b>2-Methyl-1-heptene</b>	119 22	-87 38	1 41195	0 72025						
203	<b>2,5-Dimethyl-1,5-hexadiene</b>	119 23	solid at -80, liq at -23	1 45054	0 7637						
204	<b>2-Ethyl-1-hexene</b>	120		1 4157	0 7270						Mercaptosuccinic acid adduct, 101 9-2 7
205	<b><i>d l</i>-1,2,3-Trimethylcyclopentene (Laurolene)</b>	120 1 <sup>752</sup>		1 4421	0 7950						
206	<b>4-Methyl-3-heptene</b>	120 4		1 41712 <sup>25</sup>	0 7411 <sup>25</sup>						
207	<b>3-Ethyl-2-hexene</b>	121		1 424	0 737						
208	<b>3-Methyl-3-heptene</b>	121		1 418	0 728						
209	<b>1-Octene</b>	121 28	-101 76	1 40870	0 71492	<i>di</i> -	240 2, 118 5 <sup>15</sup>		1 4970	1 4580	Mercaptosuccinic acid adduct, 96 1- 6

\*Derivative data given in order m p . crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**  
**a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product						Miscellaneous
						x Bromo	B P C	M P C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>		
210	<i>trans</i> -4-Octene	121 4 <sup>239</sup>	f p -94	1 41157	0 71467	di (meso)	103 <sup>s</sup>		1 4967 <sup>24</sup>	1 4525		
211	1,3-Cycloheptadiene (Hydrotropilidene)	121 52	-110 42		0 8929 <sup>0</sup>						H <sub>2</sub> → Cyclo heptane b p 118 20	
212	3-Methyl-2-heptene	121 6		1 4183	0 7296							
213	<i>cis</i> -4-Octene	121 7 <sup>239</sup>	f p -118	1 41361	0 72048	di (d l)	84 0 8 4 <sup>4 3</sup>		1 4981	1 4569		
214	2,3-Dimethyl-2-hexene	121 8	-115 1	1 4268	0 7408	di	85 7 <sup>s</sup>		1 5060	1 387		
215	3,4-Dimethyl- <i>trans</i> -3-hexene	122		1 430	0 747							
216	6-Methyl-1-heptene	122 4		1 4070	0 7125							
		113 5										
217	<i>cis</i> -3-Octene	122 3 <sup>241</sup>	f p -126	1 41246	0 71888							
218	<i>trans</i> -3-Octene	122 4 <sup>241</sup>	f p -110 4	1 41241	0 71630							
219	2-Methyl-2-heptene	123 5		1 4138	0 7241							
220	<i>trans</i> -2-Octene	125 0	-87 7	1 4132	0 7199							Mercaptosuccinic acid adduct 142 9 3 5
221	<i>cis</i> -2-Octene	125 64	-100 2	1 4150	0 7243							
222	2-Methyl-1,3-hepta-diene	127 8 <sup>4</sup>		1 4432	0 7432							
223	1,4-Dimethylcyclohexene	128		1 446	0 802							Nitrosochloride 83 4
224	1,5-Dimethylcyclohexene	128		1 448	0 8051							Nitrosochloride 118 9
225	2,6-Dimethyl 2-heptene	128 9		1 412	0 722							
226	4-Vinylcyclohexene	129 5		1 4623	0 8320	α β di			69 5 70			
		30 5 36 <sup>23</sup>							eth			
227	4-Methyl-2,4-hepta-diene	131 2		1 4621	0 7551							
228	3,4-Dimethyl-2,4-hexadiene	132 4		1 4410	0 7832							
		71 3										
229	3-Methyl-2,4-hepta-diene	132 5		1 4649	0 7667							HBr → Dihydro bromide b p 109 11 "
230	Bicyclo[4.2.0]oct-7-ene	132 5		1 4761		di	74 <sup>o</sup>					
231	4-Ethylcyclohexene	133		1 449	0 810							
232	1,6-Dimethylcyclohexene	133		1 454	0 815							
233	3,5-Dimethyl-2,4-heptadiene	133 44 <sup>4</sup>		1 4487	0 7728							
234	2,4-Octadiene	133 5 4 0		1 4542 <sup>2</sup>	0 7427 <sup>2</sup>							
235	2,5-Dimethyl-2,4-hexadiene	133 6 28 <sup>1</sup>	14 6 8	1 4796 <sup>19</sup>	0 7646 <sup>8</sup>	tetra		101				Oxid in air → polymeric peroxide 59
236	3-Ethylcyclohexene	134		1 451	0 814							
237	1,2,3,3-Tetramethyl-cyclopentene (Campholene)	134 5		1 44406	0 8035							
238	1-Ethylcyclohexene	136		1 4575	0 823							
239	1,2-Dimethylcyclohexene	137		1 4588	0 8250	di			142 3			Nitrosochloride 58 60
240	1,3-Dimethylcyclohexene	137		1 445	0 802				acet			
241	Bicyclo[4.2.0]oct-2-ene	137 9		1 4810 <sup>29</sup>	0 8948							

\*Derivative data given in order m p crystal color solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**  
**a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x Bromo	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
243	<b>1-Methylcycloheptene</b>	137 5 8 5		1 4581	0 8243 <sup>22</sup>						Nitrosochloride, 106, Nitrosate, 97 8
244	<b>2-Methyl-4-octene</b>	138 <sup>71</sup>		1 4181	0 7392						
245	<b>δ-Fenchene (1,5,5-Tri-methylbicyclo[2,2,1]hept-2-ene)</b>	139 40		1 44862	0 8433						Nitrosochloride, 131
246	<b>1,5,5-Trimethylcyclohexene (α-Cyclo-geraniolene)</b>	139-41 <sup>21</sup>		1 44612 <sup>21</sup>	0 7981 <sup>21</sup>						Nitrosochloride, 100 20, aq me , al Nitrosate, 102 4
247	<b>2,6-Dimethyl-2,4-heptadiene</b>	139 43 <sup>72</sup>		1 4587 <sup>44</sup>	0 74820						
248	<b>1,4,4-Trimethylcyclohexene (Pulenene)</b>	139 5-40 5		1 444 <sup>21</sup> <sup>22</sup>	0 8032 <sup>18</sup> <sup>22</sup>	di-	120 0 5 <sup>10</sup>		1 5247 <sup>11</sup>	1 5324 <sup>11</sup>	Nitrosochloride, 118 22, et ac
249	<b>1,5,6-Trimethylcyclohexene</b>	140		1 4572	0 831 <sub>2</sub> <sub>3</sub>						
250	<b>2,3-Dimethyl-2-norbornene (Santene 2,3-Dimethylbicyclo[2,2,1]-hept-2-ene)</b>	140-1, 35 <sup>1</sup>		1 46699	0 8640						Dichloride 88 9, Nitrosate, 216d , Nitrosochloride, 109 10 Nitrosite, 3 forms a) 122 4, b) 127-8, grn , c) 104, col
251	<b>2,6-Dimethyl-1,3-heptadiene (Iso-geraniolene)</b>	140-2, 31		1 4606 <sup>22</sup>	0 7923 <sup>22</sup>						
252	<b>Cyclooctatetraene</b>	140 56 142 3, 42 2 5 <sup>1</sup>	-4 68, -7	1 5290	0 9206						Maleic anh adduct, 167 8 Benzo-quinone adduct, 141, al Acrylic ac adduct 112 3, lgr AgNO <sub>3</sub> adduct, 173 4
253	<b>7-Methyl-3-octene</b>	141 <sup>74b</sup>		1 4168	0 7278						
254	<b>2,6-Dimethyl-1,5-heptadiene (Geraniolene)</b>	141-2, 165 70	-70	1 44361 <sup>22</sup>	0 7626 <sup>22</sup>						
255	<b>1,8-Nonadiene *</b>	141-4		1 4302	0 7511						
256	<b>1,3,5-Trimethylcyclohexene (Tetrahydro-mesitylene)</b>	142 5-3 5		1 449 <sup>13</sup> <sup>5</sup>	0 8025 <sup>14</sup> <sup>3</sup>						Nitrosochloride, 134
257	<b>3-Methyl-2-octene</b>	143-5 <sup>734</sup>		1 4247	0 7409 <sup>25</sup>						
258	<b>Cyclooctene</b>	143 8- 4 5 <sup>773</sup>		1 4693							Br <sub>2</sub> → Bromocyclooctene, b p 7-8 <sup>23</sup> , n <sub>D</sub> <sup>20</sup> 1 5182, Dichloride, b p 130 4-0 6 <sup>25</sup> , m p -5, n <sub>D</sub> <sup>20</sup> 1 5061, D <sub>4</sub> <sup>20</sup> 1 1620
259	<b>3,6-Dimethyl-2,4-heptadiene</b>	144-6		1 46335 <sup>14</sup>	0 7853 <sup>0</sup>						
260	<b>4-Nonene</b>	144-6, 44 6 <sup>12</sup>		1 4212 <sup>18</sup>	0 732 <sup>18</sup>	di-	119 20 <sup>12</sup>		1 4988 <sup>17</sup>	1 410 <sup>17</sup>	
261	<b>1,4,5-Trimethylcyclohexene</b>	144-6		1 4482	0 805						

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x-Bromo-	B P , °C	M P , °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	
262	<b>1-Vinylcyclohexene</b>	145, 63 5 <sup>53</sup>		1 4950 <sup>19</sup>							50% H <sub>2</sub> SO <sub>4</sub> → dimer, b p 118-9 <sup>5</sup>
263	<i>cis</i> -1,4-Cyclooctadiene	145 1 <sup>758</sup>	-53		0 8754						
264	<b>1,3,5-Cyclooctatriene</b>	145 6, 76 <sup>90</sup>		1 5035 <sup>25</sup>	0 8971 <sup>25</sup>	tetra-		139			Maleic anh adduct, 144-5, AgNO <sub>3</sub> adduct, 125-6, al
265	<b>4,4-Dimethyl-1,7-octadiene</b>	145 8		1 4330	0 7647						[α] <sub>D</sub> <sup>20</sup> -24 1
266	<i>ξ</i> -Fenchene (2,7,7-Tri-methylbicyclo[2,2,1]hept-2-enc)	146 2 6 8 <sup>752</sup>		1 4865	0 8626						
267	<b>1,6,6-Trimethylcyclohexene</b>	146 2- 7 2 <sup>767</sup> , 144 6		1 456 <sup>20</sup> 4	0 8217 <sup>20</sup> 3						Nitrosochloride, 133 4, et ac
268	<b>1-Nonene</b>	146 87	-81 37	1 41572		di-	141 5 <sup>20</sup>		1 4942	1 3980	
269	<b>3-Nonene</b>	147 4 <sup>750</sup>		1 4173	0 7294						
270	<b>1,5-Cyclooctadiene</b>	148 9		1 4905	0 8818 <sup>24</sup>						N-Bromosuccinimide → bromo-cyclooctadiene, b p 64 <sup>19</sup> , n <sub>D</sub> <sup>25</sup> 1 5410, D <sub>4</sub> <sup>25</sup> 1 3420
271	<b>4-Methyl-3,5-octadiene</b>	148 51		1 46285 <sup>25</sup>	0 7640 <sup>25</sup>						
272	<b>7-Methyl-2,4-octadiene</b>	149		1 4543 <sup>18</sup>	0 7521 <sup>18</sup>	tetra-	184 <sup>18</sup>				
273	<b>1-Ethyl-4-methylcyclohexene</b>	149, 153 4		1 453 <sup>16</sup>	0 8169 <sup>16</sup>						Nitrosochloride, 2 forms a) 103-4, pr , eth , b) 98 9, cr , eth
274	<b>1-Ethyl-3-methylcyclohexene</b>	149 51		1 454	0 8296						
275	<b>2-Nonene</b>	149 4 9 9		1 420 <sup>21</sup>	0 738 <sup>21</sup>						
276	<b>1,2,3-Trimethylcyclohexene</b>	149 6 150 <sup>749</sup>		1 463 <sup>12</sup>	0 8347 <sup>12</sup>						
277	<b>1-Ethyl-5-methylcyclohexene</b>	150		1 4527 <sup>25</sup>	0 812 <sup>25</sup>						
278	<i>β</i> -Fenchene (2,2 Dimethyl-5-methylene-bicyclo[2,2,1]heptane)	150 5 3 5		1 46511	0 8599	di-		81-2			[α] <sub>D</sub> <sup>25</sup> +62 5, Nitrosochloride, 120
279	<b>2,6-Dimethyl-2,5-heptadiene</b>	150 6 1 0		1 4490							
280	<b>2,7-Nonadiene</b>	150 6	-72 5	1 4358	0 7499						
281	Allylcyclohexane (3-Cyclohexylpropene)	151		1 4536 <sup>13</sup>	0 8196 <sup>13</sup>	di-	143 4 <sup>16</sup>			1 537 <sup>0</sup>	
282	<b>1-Ethylidene-4-methylcyclohexane</b>	152-3		1 4571 <sup>21</sup>	0 81 <sup>21</sup>						Nitrosochloride, 2 forms a) 117-8, least soluble, b) 113-4, more soluble
283	<b>4,5-Dimethyl-2,6-octadiene</b>	152 9-3 8		1 4375 <sup>25</sup>	0 7611 <sup>25</sup>						
284	<b>1-Ethylidene-3-methylcyclohexane</b>	153		1 458 <sup>4</sup>	0 8135 <sup>19</sup>						Nitrosochloride, 114, acet
285	<b>3,6-Dimethyl-2,6-octadiene</b>	153-5		1 44453	0 7767						
286	<b>2,6-Dimethyl-2,7-octadiene</b>	155 6 <sup>720</sup>		1 4385 <sup>18</sup>	0 7605 <sup>18</sup>						

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,

DIENES AND POLYENES

a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_{D}^{20}$	$D_{4}^{20}$	Bromine addition product					Miscellaneous	
						x	Bromo	B P, °C	M P, °C	$n_{D}^{20}$	$D_{4}^{20}$	
287	$\alpha$ -Pinene	156 0-6 3	-50	1 4560	0 8600	di-		169 70, al				Nitrosochloride, 109, Hydro- bromide, 89, Nitrosobromide, 91 2d , Acid $KMnO_4 \rightarrow$ pinonic ac , 103-5
288	1-Ethylidene-2-methylcyclohexane	158		1 47	0 823 <sup>0</sup>							
289	2,4-Dimethyl-2,4-octadiene	161 37 <sup>46</sup>		1 4558 <sup>9 8</sup>	0 7802 <sup>9 8</sup>							
290	1,4,4-Trimethylcycloheptene (Eucarvene)	161-5 <sup>720</sup>		1 4561	0 8185							
291	$\beta$ -Pinene (Nopinene, Pseudopinene)	163-4		1 4782	0 8694							[ $\alpha$ ] <sub>D</sub> - 22
292	2,7-Dimethyl-2,6-octadiene	163 5 4 5		1 44814	0 7849	tetra-		124-7				
293	3,7-Dimethyl-2,4-octadiene	164-7, 58 <sup>12</sup>		1 456	0 7933							
294	1-4-Carene (3,7,7-Tri-methylbicyclo[2,2,1]hept-2-ene)	165 5 7 0 <sup>707</sup>		1 474 <sup>30</sup>	0 8552 <sup>30</sup>							[ $\alpha$ ] <sub>D</sub> <sup>30</sup> + 62 2
295	Myrcene (2-Methyl-6-methylene-2,7-octadiene)	166		1 4722	0 7982							Maleic anh adduct, 33-4, 1,4-Naph-thoquinone adduct, 81 Methiodide, 130d
296	2,6-Dimethyl-2,6-octadiene	168, 56 <sup>14</sup>		1 45245 <sup>15</sup>	0 775 <sup>21</sup>							
297	1-3-Carene (3,7,7-Tri-methylbicyclo[2,2,1]-hept-3-ene)	168 97 <sup>05</sup> , 123 4 <sup>200</sup>		1 469 <sup>30</sup>	0 8586 <sup>30</sup>							[ $\alpha$ ] <sub>D</sub> <sup>30</sup> + 7 69, Nitrosochloride, 100-1
298	3,8- <i>o</i> -Menthadiene ( <i>cis</i> -3-Isopropenyl-4-methylcyclohexene)	169-70		1 4749	0 8507							
299	5-Decene	170 <sup>750</sup>	-112 to -111	1 4260	0 7474	di-	119 <sup>9</sup>		1 4912	1 3484		
300	<i>p</i> -8-Menthene (1-Iso propenyl-4-methylcyclohexane)	170		1 4523	0 8142							
301	<i>d-m</i> -8-Menthene (1-Isopropenyl-3-methylcyclohexane)	170		1 4546	0 8179							[ $\alpha$ ] <sub>D</sub> + 9 73
302	<i>l-m</i> -8-Menthene (1-Isopropenyl-3-methylcyclohexane)	170-1		1 4574	0 8189							[ $\alpha$ ] <sub>D</sub> - 8 06
303	6,8- <i>o</i> -Menthadiene (3-Isopropenyl-2-methylcyclohexene)	170 1		1 4758	0 8481							
304	5,8- <i>o</i> -Menthadiene (4-Isopropenyl-3-methylcyclohexene)	170-1		1 4778	0 8490 <sup>17</sup>							
305	1-Decene	170 57	-66 31	1 42146	0 74081	di-	145 160 <sup>18</sup>		1 4891 <sup>24</sup>	1 324 <sup>28</sup>		Mercaptosuccinic acid adduct, 93 5- 8
306	4-Decene	170 6		1 4243	0 7404							

\* Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**  
**a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Bromine addition product					Miscellaneous
						<i>x</i> -Bromo-	B P., °C	M P., °C	$n_D^{20}$	$D_4^{20}$	
307	<i>p</i> -Menthene (1-Iso-propylidene-4-methylcyclohexane)	172-4		1 4568	0 819 <sup>21</sup>						Nitrosochloride, 101-3
308	<i>1</i> -Isopropenyl-1,4-cyclohexadiene	172-6		1 5216	0 9068	<i>tetra</i> -		113			
309	<i>o</i> -Menthene (1-Iso-propylidene-2-methylcyclohexane)	173, 160-2		1 467	0 8345						
310	<i>m</i> -Menthene (1-Iso-propylidene-3-methylcyclohexane)	173-5		1 4670	0 8214						
311	$\alpha$ -Terpinene (1-Iso-propyl-4-methyl-1,3-cyclohexadiene)	173 5 4 8 <sup>755</sup>		1 477	0 8375						Dihydrochloride, 53-4, me al, Dihydrobromide, 58 9, me al, Dihydroiodide, 76, me al, Nitrosite, 155, Maleic anh adduct, 62, 66-7
312	2,4- <i>p</i> -Menthadiene(2-Isopropyl-5-methyl-1,3-cyclohexadiene)	174 6		1 4845 <sup>27</sup>	0 8441 <sup>27</sup>						
313	<i>l</i> -5-Isopropyl-2-methyl-1,3-cyclohexadiene	174-7		1 4732	0 8425						$[\alpha]_D^{20} -112$ 76, Nitrosite, $\alpha$ 120-1, $\beta$ 105 6
314	1,5- <i>p</i> -Menthadiene (5-Isopropyl-2-methyl-1,3-cyclohexadiene)	175 6		1 4777	0 8463 <sup>25</sup>						$[\alpha]_D +49$ 1, Nitrosite, $\alpha$ 113-4, $\beta$ 105 Maleic anh adduct, 126-7, pet eth
315	<i>d</i> -Silvestrene	175 8		1 4760	0 8479	<i>tetra</i> -		135			Dihydrochloride, 72, Nitrosochloride, 106-7
316	<i>d</i> -Limonene	176 6 4		1 4743	0 8411	<i>tetra</i> -		104			Nitrosochloride, 100-4, 2,4-Dinitrophenylsulfenyl chloride, 195-6
317	Isocarvestrene (5-Isopropenyl-1-methylcyclohexene)	176 7 <sup>65</sup>		1 4804	0 8496	<i>tetra</i> -		137-8, me al -chl			Dihydrochloride, 71 5, me al
318	<i>l</i> -3-Isopropenyl-1-methylcyclohexene	176-8	.....	1 4761 <sup>18</sup>	0 848 <sup>19</sup>						$[\alpha]_D^{18} -68$ 2, Dihydrochloride, 72
319	Dipentene ( <i>d l</i> -Limonene)	177 6-8 0		1 4727 <sup>20</sup>	0 8402 <sup>20</sup>	<i>tetra</i> -		125, eth			Dihydrochloride, 50-1, al
320	3,8- <i>m</i> -Menthadiene (1-Isopropenyl-5-methylcyclohexene)	179 <sup>30</sup>		1 4972							$[\alpha]_D +17$ 5
321	Menogerene (5-Isopropylidene-2-methyl-1,3-cyclohexadiene)	180 1 <sup>769</sup>		1 5005	0 8672	<i>di</i> -		115			
322	$\gamma$ -Terpinene (1-Iso-propyl-4-methyl-1,4-cyclohexadiene)	183		1 4765 <sup>14</sup> 5	0 849	<i>tetra</i> -		129-30, pet eth			$[\alpha]_D^{25} +36$ , Nitrosochloride, 111, Nitrosate, 116d, ac a -me al
323	<i>d l</i> -2,8- <i>m</i> -Menthadiene (1-Isopropenyl-3-methylcyclohexene)	184 7		1 503	0 864 <sup>20</sup>						

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**  
**a) Liquids 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>t</sub> <sup>20</sup>	Bromine addition product					Miscellaneous
						x-Bromo	B P °C	M P °C	n <sub>D</sub> <sup>20</sup>	D <sub>t</sub> <sup>20</sup>	
324	<b>Menogene</b> (3-Iso-propylidene-6-methylcyclohexene)	184 6 <sup>74</sup> 5		1 5026	0 8624						Nitrosite, 155, me al or chl, Maleic anh adduct, 205 8
325	<b>Terpinolene</b> (4-Iso-propylidene-1-methylcyclohexene)	186		1 4883	0 8633 <sup>15</sup>	di-tetra-2 forms		69 70 a) 119, ac a, b) 122			Maleic anh adduct, 182
326	<b>2-Undecene</b> (2-Hendecene)	192 3, 78 5 <sup>14</sup>		1 43325	0 7735 <sup>15</sup>	di-	145 6 <sup>9</sup>				
327	<b>5-Undecene</b> (5-Hendecene)	192 2		1 4289	0 7511						
328	<b>1-Undecene</b> (1-Undecene)	192 67	-49 19	1 42609	0 75032	di-	186 <sup>13</sup>		1 4916	1 3122	
329	<b>cis-Cyclodecene</b>	194 5 <sup>740</sup>		1 4854	0 8770	di-		121			O <sub>3</sub> → Sebacic acid, 134 5
330	<b>1-Dodecene</b>	213 36 88 7 <sup>10</sup>	-35 23	1 43002	0 75836	di-		-15			
331	<b>1-Tridecene</b>	232 78 104 5 <sup>10</sup>	-23 07	1 4336	0 7653						
332	<b>1-Tetradecene</b>	251 1, 119 0 <sup>10</sup>	-12 85	1 43631	0 7713	di-		0			Mercaptosuccinic acid adduct, 104 0 8
333	<b>Cedrene</b>	262-3, 124 6 <sup>12</sup>		1 5001 <sup>19</sup>	0 9359 <sup>15</sup>						
334	<b>1-Pentadecene</b>	268 17, 133 7 <sup>10</sup>	-3 73	1 4389	0 77641	di-	204-5 <sup>17</sup>		1 4897	1 2235	
335	<b>1-Hexadecene</b>	284 4 103 9 <sup>1</sup>	4 12	1 44120	0 78112	di-	225 7 <sup>15</sup>	13 5, al			1% Hot KMnO <sub>4</sub> → n pentadecyclic ac, 52 3, Mercaptosuccinic acid adduct, 105 0 8
336	<b>1-Heptadecene</b>	299 7, 116 <sup>1</sup>	11 2	1 4432	0 7852						
337	<b>2-Methyl-2-heptadecene</b>	314, 277 <sup>100</sup>	-2 5		0 7953	di-	267-8 <sup>28</sup>				
338	<b>1-Octadecene</b>	314 2, 128 <sup>1</sup>	17 6	1 4449	0 7888	di-		24, al			

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,  
DIENES AND POLYENES**  
**a) Liquids 2) (B.p. at reduced pressure only. Listed alphabetically)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>T</sub> <sup>20</sup>	Miscellaneous
1	Bicyclo[12.2.2]octadeca-14,16,18-triene	163.5-4.5 <sup>5,6</sup>		1.5204 <sup>25</sup>		Maleic anh adduct, 143-4
2	Bicyclo[4.2.0]oct-3-ene	81 <sup>140</sup>		1.4832		
3	Butylcyclooctatetraene	98 <sup>20</sup>		1.5083 <sup>25</sup>	0.8876 <sup>25</sup>	
4	<i>trans</i> -Cyclodecene	68-70 <sup>10</sup>		1.4822	0.8672	O <sub>3</sub> → Sebacic acid, 134.5
5	1,5,9,13-Cyclohexadecatetraene	93.8 <sup>9,8</sup>		1.5472		
6	<i>trans</i> -Cyclononene	73.4 <sup>30</sup>		1.4799	0.8615	Phenylazide adduct, 97.8-8.2
7	1,3-Cyclooctadecadiene	115 <sup>3</sup>		1.4899	0.8814	
8	1,3-Cyclooctadiene	48 <sup>25</sup>	-57 to -55	1.4940 <sup>25</sup>	0.8699 <sup>25</sup>	
9	1,3,6-Cyclooctatriene	68 <sup>80</sup>	-62 to -56		0.8940 <sup>25</sup>	
10	1,3-Cyclotetradecadiene	106-8 <sup>3</sup>		1.4982	0.8723 <sup>25</sup>	Nitrosochloride, 109-10, Nitrosate, 210d
11	1,2-Dimethylcyclooctatetraene	107 <sup>96</sup>		1.5219 <sup>25</sup>	0.8950 <sup>25</sup>	Maleic anh adduct, 184.5-5.5, bz-lgr, AgNO <sub>3</sub> adduct, 142.5-4.5, al
12	2,6-Dimethyl-2,5-octadiene	59.0-5 <sup>12</sup>		1.4500	0.733	
13	Ethylcyclooctatetraene	81 <sup>37</sup>		1.5187 <sup>25</sup>	0.8996 <sup>25</sup>	Maleic anh adduct, 97.8-5, bz-cyclohexane, AgNO <sub>3</sub> adduct, 124-5.5, al
14	5-Methylcycloheptene	69.70 <sup>38</sup>		1.42016 <sup>31</sup>	0.76061 <sup>31</sup>	
15	Methylcyclooctatetraene	84.5 <sup>67</sup>		1.5249 <sup>25</sup>	0.8978 <sup>25</sup>	
16	7-Pentadecene	114 <sup>3,2</sup>		1.4420	0.7765	
17	Propylcyclooctatetraene	73 <sup>9</sup>		1.5131 <sup>25</sup>	0.8870 <sup>25</sup>	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE II. ORGANIC DERIVATIVES OF ALKENES, CYCLOALKENES,

DIENES AND POLYENES

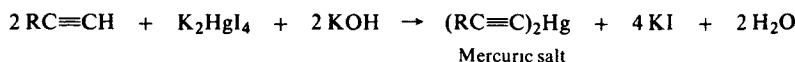
b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	Bromine addition product					Miscellaneous
						$\times$ Bromo	B p , °C	M p °C	$n_D^{20}$	$D_4^{20}$	
1	1-Nonadecene	23 4	328 0, 138 8 <sup>t</sup>	1 4445	0 7886						
2	Eicosene	28 6	341 2	1 4439 <sup>30</sup>	0 7882 <sup>30</sup>						
3	Bicyclo[4.7]pentadiene ( <i>endo</i> -4,7-Methylene-4,7,8,9-tetrahydroindene)	32	170	1 5070 <sup>25</sup>	0 9766 <sup>33</sup>						Phenylazide adduct, 128
4	1-Heneicosene	33 3	355	1 4494 <sup>s</sup>	0 7977 <sup>s</sup>						
5	1-Docosene	37 8		1 4505 <sup>s</sup>	0 8002 <sup>s</sup>						
6	1-Tricosene	41 6	379	1 4516 <sup>s</sup>	0 8023 <sup>s</sup>						
7	1-Tetracosene	45 3	390	1 4527 <sup>s</sup>	0 8045 <sup>s</sup>						
8	1-Pentacosene	48 7	401	1 4536 <sup>s</sup>	0 8063 <sup>s</sup>						
9	cis cis cis 1,4,7-Cyclononatriene	49 5-50									AgNO <sub>3</sub> adduct, 243d
10	d,l-Camphe (2,2-Dimethyl-3-methylenecyclo[2.2.1]heptene)	50	159 60			di-	91-2	153 5 <sup>15</sup>			
11	l-Camphe	51 3	159-60								2,4-Dinitrophenyl-sulfenyl chloride, 121 2, Hydrochloride, 125-7
12	1-Heptacosene	54 7	421	1 4552 <sup>s</sup>	0 8097 <sup>s</sup>						
13	1-Triacontene	62 4	448	1 4573 <sup>s</sup>	0 8141 <sup>s</sup>						
14	1-Hentriacontene	64 6	457	1 4580 <sup>s</sup>	0 8153 <sup>s</sup>						
15	1-Dotriacontene	66 7	465	1 4585 <sup>s</sup>	0 8165 <sup>s</sup>						
16	1-Tritriacontene	68 7	473	1 4591 <sup>s</sup>	0 8176 <sup>s</sup>						
17	1-Tetratriacontene	70 5	481	1 4596 <sup>s</sup>	0 8186 <sup>s</sup>						
18	1-Pentatriacontene	72 3	489	1 4601 <sup>s</sup>	0 8196 <sup>s</sup>						
19	1-Hexatriacontene	73 9	496	1 4605 <sup>s</sup>	0 8205 <sup>s</sup>						
20	1-Heptatriacontene	75 5	503	1 4610 <sup>s</sup>	0 8214 <sup>s</sup>						
21	1-Octatriacontene	77	510	1 4614 <sup>s</sup>	0 8223 <sup>s</sup>						
22	1-Nonatriacontene	78 4	517	1 4618 <sup>s</sup>	0 8231 <sup>s</sup>						
23	1-Tetracontene	79 8	523	1 4622 <sup>s</sup>	0 8238 <sup>s</sup>	2,3-trans-di-					
24	Bicyclo(2.2.2)-oct-2-ene	111 2	128 34					55 0 5 5			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

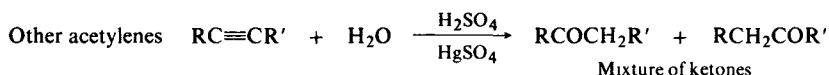
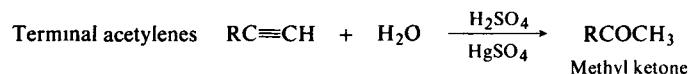
S = Supercooled liquid at 20°

## EXPLANATIONS AND REFERENCES TO TABLE III

*Hg salt (Mercuric acetylidyde) \**

From the terminal alkyne and  $\text{K}_2\text{HgI}_4$  (prepared from mercuric chloride, potassium iodide and potassium hydroxide)

*For directions and examples see Linstead, p 52, J R Johnson and W L McEwen, J Amer Chem Soc, 48, 469 (1926)*

*Hydration to form carbonyl compound*

From the alkyne in methanol and a catalyst composed of boron trifluoride etherate, red mercuric oxide and trichloroacetic acid

*For directions and examples see J G Sharefkin and E M Boghosian, Anal Chem, 33, 640 (1961)*

From the alkyne, mercuric sulfate and sulfuric acid in 70% methanol, in 70% acetone or in 60% acetic acid

*See Cheronis, p 576, H Erdmann and F Kother, Z Anorg Chem, 18, 48 (1898), R J Thomas, K N Campbell and G F Hennion, J Amer Chem Soc, 60, 718 (1938)*

From the alkyne, mercuric oxide and sulfuric acid in alcohol

*See J R Johnson, A M Schwartz and T L Jacobs, J Amer Chem Soc, 60, 1882 (1938)*

*NOTE* For directions and examples for the preparation of the semicarbazones and the 2,4-dinitrophenyl-hydrazone of the formed carbonyl compounds see explanations and references to Table IX and X, p 141, 142, 143

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)**  
a) Liquids (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Hydration product ( $RC\equiv CR' \rightarrow RCOCH_2R'$ ) and its derivatives				Hg salt	Miscellaneous
						Ketone	B p., °C	2,4-Dinitrophenylhydrazone of ketone	Semicarbazone of ketone		
1	<b>Ethyne (Acetylene)</b>	-84.0 (sat press)	-80.8, subl		0.6179 <sup>-x4</sup>	(Acetaldehyde)	(20.2)	(168)	(162-3)		
2	<b>Propyne (Methyl acetylene)</b>	-23.22	-102.7		0.6174 <sup>-23</sup>	Acetone	56	128	190	204	
3	<b>1-Butyne (Ethyl acetylene)</b>	8.09, 8.3	-125.72	1.3962	0.6682 <sup>x</sup>	2-Butanone	82	116-7	135.6	162.3, al	
4	<b>1,3-Butadiyne (Diacetylene)</b>	10.3	-35 to -36	1.4120	0.7249					161.5 2.0	KOBr → 1,4-Dibromo deriv, 49.50, bz
5	<b>3-Methyl-1-butyne (Isopropyl acetylene)</b>	26.35, 28	-89.7	1.3723	0.666						Tetrabromo deriv, b.p. 275
6	<b>2-Butyne (Dimethyl acetylene)</b>	27.2 6	-32.26	1.3921	0.6901	2-Butanone	82	116.7	135.6		Tetrabromo deriv, 243, eth, 2,4-Dinitrophenylsulfenyl chloride, 65.6
7	<b>3-Methyl-3-buten-1-yne (Isopropenyl acetylene)</b>	33		1.4158	0.6801 <sup>11</sup>						3,4-Dibromo deriv, b.p. 50.0-1.5 <sup>10</sup>
8	<b>3,3-Dimethyl-1-butyne (tert-Butyl acetylene)</b>	38.9	-81.20	1.37725 <sup>15</sup>	0.6737 <sup>15</sup>					92.5-3.0	Cu salt, 140, red
9	<b>1-Pentyne (Propyl acetylene)</b>	40.18	-105.7	1.3852	0.6901	2-Pentanone	102.3	145	112, 106	118.4	Tetrabromo deriv, b.p. 275
10	<b>1-Penten-4-yne (Allyl acetylene)</b>	42.3		1.4125 <sup>16</sup>	0.738 <sup>16</sup>	Allyl methyl ketone	111.2	160			1,2-Dibromo deriv, b.p. 79.5 80.5 <sup>10</sup> , 4,4,5,5-Tetrabromo deriv, b.p. 132.6 <sup>10</sup>
11	<b>cis-3-Penten-1-yne (cis-Propenyl acetylene)</b>	44.6		1.4330						48	
12	<b>trans-3-penten-1-yne (trans Propenyl acetylene)</b>	52.2		1.4377	0.7270					155.7	1,2-Dibromo deriv, b.p. 60-2 <sup>10</sup> , 3,4-Dibromo deriv, 66-76 <sup>10</sup>
13	<b>2-Pentyne (Ethyl methyl acetylene)</b>	56.07	-109.3	1.4039	0.7107	2-Pentanone + 3-Pentanone	102.3	145	112, 106		KMnO <sub>4</sub> → formic ac + propionic ac
14	<b>1-Penten-3-yne (Methyl vinyl acetylene)</b>	59.2 60.1		1.4496	0.7401						
15	<b>4-Methyl-1-pentyne (Isobutyl acetylene)</b>	61.1 2, 99	-105.1	1.3936 <sup>15</sup> <sub>α</sub>	0.7092 <sup>15</sup>						100.0-5
16	<b>3-Methyl-1-pentyne (sec-Butyl acetylene)</b>	65.70 <sup>70</sup> , 57.7		1.3916	0.7037						74.5
17	<b>1-Hexyne (Butyl acetylene)</b>	71.33	-131.9	1.3989	0.7155	2-Hexanone	128	106.7	125	96.2 4	
18	<b>4-Methyl-2-pentyne (Isopropyl methyl acetylene)</b>	72.0 5	-110.37	1.4078 <sup>19</sup>	0.716 <sup>19</sup>						
19	<b>4,4-Dimethyl-1-pentyne</b>	73.5		1.4028	0.7154						
20	<b>1,3-Pentadiyne</b>	75.0-5, 55.6	-45 to -35	1.4431 <sup>21</sup>	0.7375 <sup>21</sup>						
21	<b>1,4-Hexadiyne</b>	78-83		1.4112 <sup>25</sup>	0.825 <sup>9</sup>						
22	<b>3-Hexyne (Diethyl acetylene)</b>	81.5 <sup>74</sup>	-51	1.4112 <sup>25</sup>	0.7263 <sup>25</sup>	3-Hexanone	125	130	112		2,4-Dinitrophenylsulfenyl chloride, 65.6

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)**  
**a) Liquids (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>25</sup>	D <sub>4</sub> <sup>25</sup>	Hydration product (RC≡CR → RCOCH <sub>2</sub> R ) and its derivatives				Hg salt	Miscellaneous
						Ketone	B p °C	2,4-Dinitrophenyl hydrazone of ketone	Semicarbazone of ketone		
23	<b>4,4-Dimethyl-2-pentyne</b> ( <i>tert</i> Butyl methyl acetylene)	82 9 30		1 4071	0 7176						
24	<b>2-Hexyne</b> (Methyl propyl acetylene)	83 7 40	-92	1 4135	0 7317	2 Hexanone + 3 Hexanone	128	106 7	125		
25	<b>1-Hexen-3-yne</b> (Ethyl vinyl acetylene)	85 <sup>75x</sup>		1 4522	0 7492		125	130	112		1,2 Dibromo deriv b p 87 0 5 <sup>1</sup> 3,3,4,4 Tetra bromo deriv b p 140 50 <sup>10</sup>
26	<b>1,5-Hexadien-3-yne</b> (Divinyl acetylene)	85 0	-87 83	1 5045	0 7857						
27	<b>1-Hexen-4-yne</b>	87 <sup>53</sup>		1 446 <sup>14</sup>	0 767 <sup>14</sup>						1,2 Dibromo deriv b p 93 0 5 <sup>1</sup> 1,2,4,5 Tetra bromo deriv b p 154 5 50 <sup>10</sup>
28	<b>3-Ethyl-1-pentyne</b>	87 0 85		1 4102	0 7246						
29	<b>1,5-Hexadiyne</b> (Dipropargyl)	87 5 85 <sup>58</sup>	-4 266	1 4381 <sup>23</sup>	0 79943						
30	<b>2-Hexen-4-yne</b>	88 9		1 4918	0 7710	Allyl ethyl ketone	74 5 6 5 <sup>90</sup>	95 106			
31	<b>2-Methyl-3-hexyne</b>	95 2	-116 7	1 4114	0 7263						
32	<b>4-Methyl-2-hexyne</b>	95 94	f p	1 4170	0 73855						
			-107 63								
33	<b>3-Ethyl-3-penten-1-yne</b>	96 5		1 4338 <sup>23</sup>	0 7886 <sup>25</sup>						
34	<b>5-Methyl-3-heptyne</b>	98 100 <sup>13</sup>		1 4102	0 7360						
35	<b>1-Heptyne</b> ( <i>n</i> Pentyl acetylene)	99 74	-80 9	1 4087	0 7328	2 Heptanone	151 2	89	123 127	61 me al	
36	<b>5-Methyl-2-hexyne</b>	102 46	-92 91	1 41762	0 73776						
37	<b>8-Methyl-4-nonyne</b>	104 5		1 4311	0 7681						
38	<b>3-Heptyne</b> (Ethyl propyl acetylene)	105 6		1 415	0 7337	4 Heptanone	144	75	132		
39	<b>2-Heptyne</b> ( <i>n</i> Butyl methyl acetylene)	111 5 25		1 4230	0 748	2 Heptanone + 3 Heptanone	151 2 148	89	123 127		
40	<b>2,2,5,5-Tetramethyl-3-hexyne</b> ( <i>D</i> <i>tert</i> -butyl acetylene)	111 9 <sup>74b</sup>	19 4	1 4055	0 7120						
41	<b>1,6-Heptadiyne</b>	112 30 <sup>26</sup>	-85	1 451 <sup>1</sup>	0 8164 <sup>17</sup>						
42	<b>1-Octyne</b> ( <i>n</i> Hexyl acetylene)	126 2	-79 3	1 4159	0 7461	2 Octanone	173	64 5 58	124 5	80 4 7 me al	
43	<b>4-Octyne</b> (Dipropyl acetylene)	130 4 6 <sup>74x</sup>		1 4226	0 7484						
44	<b>3-Octyne</b> (Butyl ethyl acetylene)	131 0 -5		1 4261	0 748						
45	<b>2-Octyne</b> (Hexyl methyl acetylene)	138 0 4		1 4285	0 761	2-Octanone + 3-Octanone	173 169 70 <sup>73x</sup>	64 5 58 64 5	124 5 117 0 5		
46	<b>4-Nonyne</b> ( <i>n</i> Butyl propyl acetylene)	150 4 <sup>752</sup>		1 4296 <sup>25</sup>	0 757 <sup>25</sup>	4-Nonanone + 5-Nonanone	187 8 188 4	57 8 73 4 90			

\*Derivative data given in order m p , crystal color solvent from which crystallized

**TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)**

a) Liquids (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Hydration product ( $RC\equiv CR' \rightarrow RCOCH_2R'$ ) and its derivatives				Hg salt	Miscellaneous
						Ketone	B p., °C	2,4-Dinitrophenylhydrazone of ketone	Semicarbazone of ketone		
47	<b>1-Nonyne</b> (Heptyl acetylene)	150 8	-50	1 4217	0 7568	2-Nonanone	195 3	55-6	118 20	67 8-8 5, me al	
48	<b>3-Nonyne</b> (Methyl pentyl acetylene)	153 5 <sup>45</sup> , 92 <sup>97</sup>		1 4299	0 7616	3-Nonanone + 4-Nonanone	187 <sup>751</sup>	55 6	111-2		
49	<b>Cyclooctyne</b>	157 5-8 0 <sup>40</sup>		1 4850	0 868		187-8	57-8	73 4		
50	<b>2-Nonyne</b> (Methyl hexyl acetylene)	161		1 4331	0 769	3-Nonanone + 2-Nonanone	187 <sup>751</sup>	55-6	111 2		
51	<b>1,8-Nonadiyne</b>	162, 55 0-5 <sup>13</sup>	-27 28	1 4490	0 8158		195 3	55 6	118 20		
52	<b>1-Decyne</b> ( <i>n</i> -Octyl acetylene)	174 0	-44	1 4265	0 7655	2-Decanone	215 5	124	63, 81	80 0-7	
53	<b>3-Decyne</b> (Ethyl hexyl acetylene)	175-6		1 433 <sup>21</sup>	0 7765 <sup>21</sup>	3-Decanone + 4-Decanone	211		100 1		
54	<b>5-Decyne</b> (Dibutyl acetylene)	177, 100 <sup>80</sup>	-73	1 4332	0 7688	5-Decanone	206 7	60 1 5	51 2		
55	<b>Cyclononyne</b>	177 8 <sup>740</sup>	-36 4	1 4890	0 8972	Cyclo-nonanone	m p 34	146	57 5-8 0		NaNH <sub>2</sub> at 210° → 1-Decyne, b p 174
56	<b>2,7-Nonadiyne</b>	180	4 30	1 4674	0 8332						
57	<b>1-Undecyne</b> (1-Hendecyne, Nonyl acetylene)	195, 96 43 <sup>30</sup>	-25	1 4306	0 7728	2-Undecanone	228	63	122 0-5	79	
58	<b>Cyclododecyne</b>	203 4 <sup>740</sup> , 78 5 <sup>12</sup>		1 4950	0 8975	Cyclo-decanone	100 2 <sup>12</sup>		203-5		Ozonolysis → sebacic acid, 134 5
59	<b>6-Dodecyne</b> (Dipentyl acetylene)	209 <sup>745</sup> , 90 <sup>8</sup>		1 4380 <sup>25</sup>	0 7816 <sup>25</sup>						NaNH <sub>2</sub> → 1-Dodecyne, b p 215
60	<b>1-Dodecyne</b> (Decyl acetylene)	215 89 09 <sup>10</sup>	19	1 4340	0 7788					84 2 8	
61	<b>1-Tridecyne</b> ( <i>n</i> -Undecyl acetylene)	234, 102 95 <sup>10</sup>	-5	1 4371	0 7842						
62	<b>1-Tetradecyne</b> (Dodecyl acetylene)	252, 118 31 <sup>10</sup>	0	1 4396	0 7888						
63	<b>1-Pentadecyne</b> (Tridecyl acetylene)	268 129 79 <sup>10</sup>	10	1 4419	0 7928						
64	<b>1-Hexadecyne</b> (Tetradecyl acetylene)	284 103 3 <sup>1</sup>	15	1 4440	0 7965						

\*Derivative data given in order m p, crystal color, solvent from which crystallized

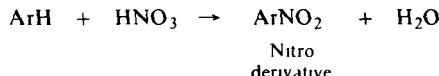
**TABLE III. ORGANIC DERIVATIVES OF ALKYNES (ACETYLENES)**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point °C	$n_{D}^{20}$	$D_{4}^{20}$	Miscellaneous
1	1-Heptadecyne	22	299	1 4437 <sup>25</sup>	0 7961 <sup>25</sup>	
2	2,6-Octadiyne	27	62 <sup>19</sup>	1 453 <sup>21</sup>	0 828 <sup>40</sup>	
3	1-Octadecyne	27	313	1 4474	0 8025	
			180			
4	2-Octadecyne	30	184 <sup>15</sup>		0 8016	
5	1-Nonadecyne	33	327	1 4488 <sup>s</sup>	0 8050 <sup>s</sup>	Hg salt, 96 7 <i>n</i> -BuOH
			144 <sup>15</sup>			
6	1-Eicosyne	35	340	1 4501 <sup>s</sup>	0 8073 <sup>s</sup>	
			153 <sup>1</sup>			
7	2-Heneicosyne	35 6	180 <sup>2</sup>	1 4499 <sup>40</sup>		
8	1-Heneicosyne	41		1 4513 <sup>s</sup>	0 8094 <sup>s</sup>	
9	1-Docosyne	45	363	1 4524 <sup>s</sup>	0 8114 <sup>s</sup>	
10	1-Tricosyne	49	374	1 4534 <sup>s</sup>	0 8131 <sup>s</sup>	
11	1-Tetracosyne	52	385	1 4544 <sup>s</sup>	0 8148 <sup>s</sup>	
12	1-Pentacosyne	55	395	1 4552 <sup>s</sup>	0 8163 <sup>s</sup>	
13	1-Hexacosyne	57	405	1 456 <sup>s</sup>	0 8177 <sup>s</sup>	
14	1-Heptacosyne	60	415	1 4568 <sup>s</sup>	0 8190 <sup>s</sup>	
15	1-Octacosyne	62	426	1 4575 <sup>s</sup>	0 8202 <sup>s</sup>	
16	1-Nonacosyne	65	432	1 4581 <sup>s</sup>	0 8213 <sup>s</sup>	
17	1-Triacentyne	67	441	1 4587 <sup>s</sup>	0 8224 <sup>s</sup>	
18	1-Henriacentyne	69	449	1 4593 <sup>s</sup>	0 8234 <sup>s</sup>	
19	1-Dotriacentyne	71	457	1 4598 <sup>s</sup>	0 8243 <sup>s</sup>	
20	1-Triacentyne	73	464	1 4603 <sup>s</sup>	0 825 <sup>s</sup>	
21	1-Tetraacentyne	74	472	1 4608 <sup>s</sup>	0 8260 <sup>s</sup>	
22	1-Pentraacentyne	76	479	1 4612 <sup>s</sup>	0 8268 <sup>s</sup>	
23	1-Hexatraacentyne	77	486	1 4617 <sup>s</sup>	0 8275 <sup>s</sup>	
24	1-Heptaacentyne	79	493	1 4621 <sup>s</sup>	0 8282 <sup>s</sup>	
25	1-Octatraacentyne	80	499	1 4625 <sup>s</sup>	0 8289 <sup>s</sup>	
26	1-Nonatraacentyne	82	505	1 4628 <sup>s</sup>	0 8295 <sup>s</sup>	
27	1-Tetraacentyne	83	512	1 4632 <sup>s</sup>	0 8301 <sup>s</sup>	

Derivative data given in order m p crystal color solvent from which crystallized

S = supercooled liquid at 20°

## EXPLANATIONS AND REFERENCES TO TABLE IV

*Nitro derivative \**

From the aromatic hydrocarbon with concentrated nitric and sulfuric acids

*For directions and examples see* Cheronis, p 578-80, Linstead, p 48, 49, Shriner, p 249, Vogel, p 520, Wild, p 24

From the aromatic hydrocarbon with fuming and concentrated nitric acids

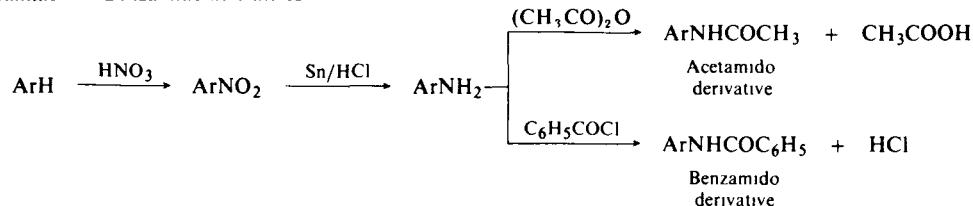
*See* Shriner, p 249, Wild, p 24

From the aromatic hydrocarbon with fuming nitric acid in acetic acid

*See* Vogel, p 520

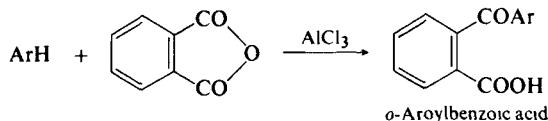
From the aromatic hydrocarbon with nitric and sulfuric acids in chloroform

*See* Vogel, p 580

*Acetamido and Benzamido derivatives \**

Nitration of the aromatic hydrocarbon is followed by reduction with tin and hydrochloric acid. The resulting amine is acetylated with acetic anhydride or benzoylated with benzoyl chloride.

*For directions and examples see* Cheronis, p 581, V L Ipatieff and L A Schmerling, *J Amer Chem Soc*, **59**, 1056 (1937), **60**, 1476 (1938), **65**, 2470 (1943)

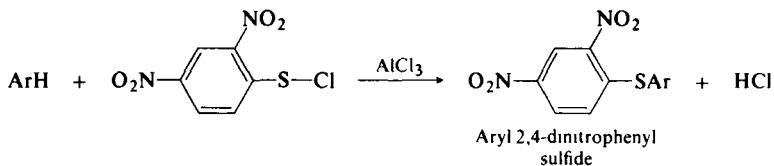
*o-Aroylbenzoic acid (product with phthalic anhydride)*

From the aromatic hydrocarbon, phthalic anhydride and aluminum chloride in carbon disulfide

*For directions and examples see* Cheronis, p 548, Shriner, p 250, Vogel, p 519, Wild, p 28, H W Underwood and W L Walsh, *J Amer Chem Soc*, **57**, 940 (1935)

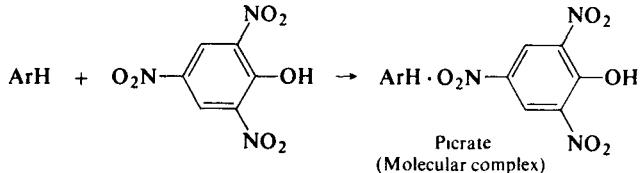
From the aromatic hydrocarbon, phthalic anhydride and aluminum chloride without solvent

*See* G F Lewenz and K T Serian, *J Amer Chem Soc*, **75**, 4087 (1953)

*2,4-Dinitrobenzenesulfenyl chloride derivative (Aryl 2,4-dinitrophenyl sulfide)*

From the aromatic hydrocarbon, 2,4-dinitrobenzenesulfenyl chloride and aluminum chloride in 1,2-dichloroethane

*For directions and explanations see* Cheronis, p 585, C M Buess and N Kharasch, *J Amer Chem Soc*, **72**, 3529 (1950)

*Picrate*

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives.

**EXPLANATIONS AND REFERENCES TO TABLE IV (Continued)**

### From the aromatic hydrocarbon and picric acid in alcohol

*For directions and examples see Linstead, p 50 Vogel, p 518, Wild, pp 29-30*

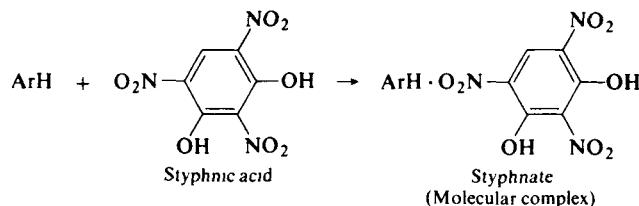
From excess of liquid aromatic hydrocarbon and picric acid without solvent

See Wild, pp 28-9 Baril and Hauber, *J Amer Chem Soc*, 53, 1087 (1931).

From the aromatic hydrocarbon in methanol or in dry benzene

See Cheronis, pp 582-3

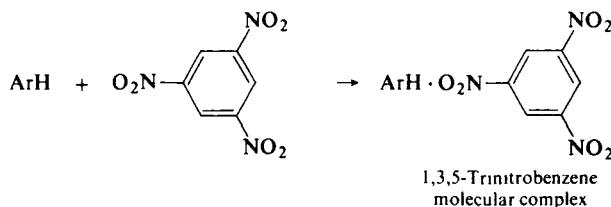
### *Styphnate*



From the aromatic hydrocarbon and styphnic acid (2,4,6-trinitroresorcinol) in acetic acid

*For directions and examples see Vogel, p 519, W J Hickinbottom, *Reactions of Organic Compounds*, 2nd ed., Longmans, Green and Co., London, 1948, p 76*

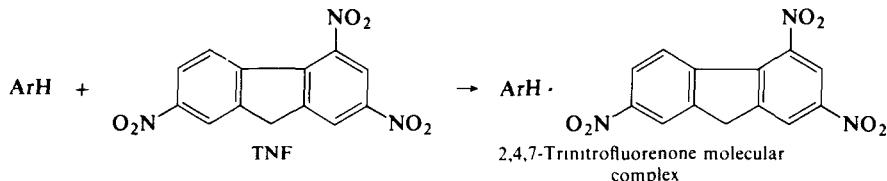
### 1,3,5-Trinitrobenzene derivative



From the aromatic hydrocarbon and 1,3,5-trinitrobenzene in alcohol, acetic acid, or benzene

*For directions and examples see Vogel, p 519*

### *2,4,7-Trinitrofluorenone (TNF) derivative \**



From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone in methanol-benzene and ethanol-benzene mixtures

For directions and examples see Cheronis, pp 582-3, M Orchin, *J Amer Chem Soc*, **68**, 1727 (1946), M Orchin, L Reggel and E O Woolfolk, *J Amer Chem Soc*, **69**, 1225 (1947).

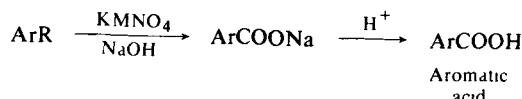
From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone in glacial acetic acid

See M C Kloetzel and H E Mertel, *J Amer Chem Soc*, **72**, 4786 (1950), M D Soffer and R A Stewart, *J Amer Chem Soc*, **74**, 567 (1952).

From the aromatic hydrocarbon and 2,4,7-trinitrofluorenone without solvent

See D E Laskowski and W C McCrone, *Anal Chem*, 30, 542 (1958)

Acids from side-chain oxidation



\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE IV (Continued)

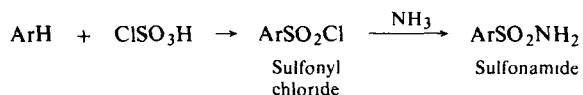
From the alkyl-substituted aromatic hydrocarbon with potassium permanganate in sodium hydroxide or sodium carbonate solution

For directions and examples see Cheronis, p 585, 627, Linstead, p 50, Shriner, p 250, Vogel, p 520, Wild, p 26

From the alkyl-substituted aromatic hydrocarbon with sodium bichromate and sulfuric acid

See Cheronis, p 627, Shriner, p 250, Wild, p 26

*Sulfonamide* \*



From the aromatic hydrocarbon and chlorosulfonic acid in chloroform, followed by aqueous ammonia

For directions and examples see Linstead, p 49, Wild, p 27, E H Huntress and F H Carten, *J Amer Chem Soc*, **62**, 511 (1940), E H Huntress and J S Autenrieth, *J Amer Chem Soc*, **63**, 3446 (1941)

From the aromatic hydrocarbon with chlorosulfonic acid without solvent, followed by ammonolysis with dry ammonium carbonate

See Wild, p 27

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
a) Liquids. (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	1,3,5 Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
1	Benzene	80.1	5.5	1.5011	0.87901	84		1,3-di 89, 1,3,5 tri 122		127	120	Sulfonamide, 156
2	Toluene	110.6	-95	1.49613	0.86694	88.2, pa yel	2,4-di 70 221	2,4-di 137 223	122, 128	102.3	Oxid → benzoic acid, 121, Sulfonamide, 137	
3	Ethylbenzene	136.2	-93.9	1.49594	0.86690	96.6, pa yel	2,4,6-tri 37	2,4,6-tri 132, 148	122, 128	97	Oxid → benzoic acid, 121, Sulfonamide, 109	
4	1,4-Xylene	138.3	13.26	1.49581	0.86105	90	2,3,5-tri 139			134.5	Oxid → terephthalic acid, >300, subl., Sulfonamide, 147	
5	1,3-Xylene	139.1	-47.89	1.49722	0.86417	91	2,4,6-tri 183		126, 142		Oxid → isophthalic acid, 348, h w, Sulfonamide, 137	
6	1,2-Xylene	144.4	-25.18	1.50545	0.88020	88	4,5-di 118			178	Oxid → phthalic acid, 206.8, Sulfonamide, 144	
7	Isopropylbenzene (Cumene)	152.4	-96.04	1.49146	0.86179		2,4,6-tri 109	4-mono 106, 2,4-di 216	133		Oxid → benzoic acid, 121 Sulfonamide, 106	
8	n-Propylbenzene	159.2	-99.59	1.49202	0.86204	103	2,4-di b p 150 <sup>1</sup>	4-mono 96, 2,4-di 208	125		Oxid → benzoic	
9	1-Ethyl-3-methylbenzene (m-Ethyltoluene)	161.3	-96.55	1.49661	0.86455						Oxid → isophthalic acid, 348, h w	
10	1-Ethyl-4-methylbenzene (p-Ethyltoluene)	162.1	-62.35	1.49500	0.86118						Oxid → terephthalic acid, >300, subl.	
11	1,3,5-Trimethylbenzene (Mesitylene)	164.7	-44.72	1.49937	0.86518	97	2,4-di 86, 2,4,6-tri 235			212	Oxid → trimellitic acid, 380, Sulfonamide, 141	
12	1-Ethyl-2-methylbenzene (o-Ethyltoluene)	165.2	-80.83	1.50456	0.88069						Oxid → phthalic acid, 206.8	
13	tert-Butylbenzene	169.1	-58.34	1.49266	0.86650		2,4-di 62, 2,4,6-tri 124	4-mono 170, 2,4-di 210		130.1	Oxid → benzoic acid, 121	
14	1,2,4-Trimethylbenzene (Pseudocumene)	169.4	-43.91	1.50484	0.87582	97	3,5,6-tri 185				Oxid → trimellitic acid, 225.35 d	
15	Isobutylbenzene	172.8	-51.53	1.48646	0.85321			4-mono 127.0 7.5		99.100	Oxid → benzoic acid, 121	
16	sec-Butylbenzene	173.3	-75.57	1.49020	0.86207		2,4-di b p 161.2 <sup>5</sup>	4-mono 126, 2,6-di 192		88-9	Oxid → benzoic	
17	3-Isopropyl-1-methylbenzene (3-Isopropyltoluene, m-Cymene)	175.1	-63.75	1.4930	0.8610							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS

a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_{D}^{20}$	$D_{4}^{20}$	Picrate	1,3,5 Trim-nitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
18	1,2,3-Trimethylbenzene (Hemimellitene)	176.08	-25.41	1.51393	0.89438	90.5						Oxid → hemimellitic acid, 190.7 d
19	trans-Propenylbenzene	176.57.5	-27.1 to -25.9	1.5463 <sup>25</sup>	0.902							
20	Indane	177	-51.4	1.5381	0.9645							
21	4-Isopropyl-1-methylbenzene (4-Isopropyltoluene, 4-Cymene)	177.1	-67.94	1.4909	0.8537		2,6-di 54, 2,3,6-tri 118			123.4		Sulfonamide, 115
22	2-Isopropyl-1-methylbenzene (2-Isopropyltoluene 2-Cymene)	178.35	-71.71	1.5006	0.8766							Br <sub>2</sub> → Tetrabromo, 59.5 60.5
23	1,3-Diethylbenzene	181.1		1.49552	0.86394		2,4,6-tri 62			114		
24	1-Methyl-3-propylbenzene (m-Propyltoluene)	181.8		1.4936	0.8610							
25	Indene	182.4	-2	1.5764	0.9915	98, yel						
26	n-Butylbenzene	183.27	-88.15	1.48979	0.86013				4-mono 105 2,4-di 214	97	72.3	Acid → polymer
27	1-Methyl-4-propylbenzene (p-Propyltoluene)	183.3		1.4919	0.8584							
28	1,2-Diethylbenzene	183.4		1.50346	0.87996							
29	1,4-Diethylbenzene	183.8		1.49483	0.86196							
30	1,3-Dimethyl-5-ethylbenzene	183.8	-84.4	1.4981	0.8648		2,4,6-tri 117.0 7.6					Br <sub>2</sub> → Tribromo, 89
31	1-Methyl-2-propylbenzene (o-Propyltoluene)	184.8	-60.2	1.4998	0.8744							
32	2,2-Dimethyl-1-phenylpropane (Neopentylbenzene)	186		1.4880	0.858							
33	1,4-Dimethyl-2-ethylbenzene	186.9		1.5043	0.8772		3,5,6-tri 127.8, al	4-mono 142, 2,4-di 181				Sulfonamide, 107-8
34	2-Methylindane	187.0		1.5070	0.9034							
35	3-Methyl-2-phenylbutane	188		1.486	0.8701				4-mono 147.8, 2,4-di 193			4-Benzamido deriv, 141.2
36	1-Methylindane	188.90		1.5274	0.939							Heat with Pt at 310-350 → Naphthalene, 80.3
37	1,3-Dimethyl-4-ethylbenzene	188.4	-63.0	1.5038	0.8763		2,5,6-tri 127.5 9.0					Br <sub>2</sub> → 2,5,6-Tribromo, 94.5, 81.2
38	3-tert-Butyl-1-methylbenzene (3-tert-Butyltoluene)	189.3	-41.39	1.4944	0.8657							
39	1,2-Dimethyl-4-ethylbenzene	189.55	-67.1	1.5031	0.8745							Oxid → trimellitic acid, 225.35 d
40	1,3-Dimethyl-2-ethylbenzene	190		1.5107	0.8904							Oxid → hemimellitic acid, 190-7 d

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
 a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	1 3 5 Trinitro benzene deriva tive	Nitro derivative	Acetamido derivative	Phthalic anhy dride deriva tive	2 4 Di nitro phenyl sulfenyl chloride deriva tive	Miscellaneous
41	<b>3-Phenylpentane</b>	191		1 4877	0 8649				4-mono 145 6 2 4-di 199 200			4 Benzamido deriv , 154
42	<b>1-Ethyl-3-isopropylbenzene</b>	192		1 4955	0 859							
43	<b>2-Methyl-2-phenylbutane</b>	192 38		1 4934	0 8737				4 mono 142 2 4 di 181			4-Benzamido deriv 112 3
44	<b>4-tert-Butyl-1-methylbenzene</b> (4-tert Butyltoluene)	192 8	- 52 49	1 4918	0 8612			2 6 di 96				
45	<b>1-Ethyl-2-isopropylbenzene</b>	193		1 5080	0 888							
46	<b>2-Phenylpentane</b>	193		1 4876	0 8576				4-mono 107 2 4-di 181 2			4-Benzamido 127 8
47	<b>1,2-Dimethyl-3-ethylbenzene</b>	193 9	- 49 5	1 5117	0 8921							Oxid → hemimellitic acid 190 7 d
48	<b>3-sec-Butyl-1-methylbenzene</b> (3-sec-Butyltoluene)	194		1 490	0 858							
49	<b>3-Isobutyl-1-methylbenzene</b> (3-Isobutyltoluene)	194		1 4888	0 8536							
50	<b>d-2-Methyl-1-phenylbutane</b>	194		1 4880	0 8617							
51	<b>1,3-Dimethyl-5-isopropylbenzene</b>	194 5		1 4955	0 8591							
52	<b>2-Phenyl-cis-2-butene</b>	194 5		1 5402 <sup>27</sup>	0 9191 <sup>2</sup>							
53	<b>4-Isobutyl-1-methylbenzene</b> ( <i>p</i> Isobutyltoluene)	196		1 4874	0 8517							
54	<b>2-sec-Butyl-1-methylbenzene</b> (2-sec Butyltoluene)	196		1 497	0 873							
55	<b>2-Isobutyl-1-methylbenzene</b> ( <i>o</i> -Isobutyltoluene)	196		1 4935	0 8649							
56	<b>1,4-Dimethyl-2-isopropylbenzene</b>	196 2		1 5010	0 8738							
57	<b>1-Ethyl-4-isopropylbenzene</b>	196 6		1 4923	0 8585							
58	<b>d,l-2-Methyl-1-phenylbutane</b>	197		1 486	0 859				4-mono 115 6 2 4 di 193 4			4-Benzamido 126
59	<b>1,2,3,5-Tetramethylbenzene</b> (Isodurene)	197 9		1 5125	0 8899			4 6-di 181 157		213		
60	<b>3-Methyl-1-phenylbutane</b> (Isopentylbenzene)	198 9		1 4847	0 8558							
61	<b>1,3-Dimethyl-2-isopropylbenzene</b>	199		1 509	0 890							
62	<b>1,3-Dimethyl-4-isopropylbenzene</b>	199 1		1 5018	0 869							
63	<b>3-Methylindene</b>	199 2 200 198 5		1 55907 <sup>27</sup>	0 9640	76 8, or - yel , al						
64	<b>4-sec-Butyl-1-methylbenzene</b> ( <i>p</i> -sec-Butyltoluene)	200		1 4932	0 8650							

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**a) Liquids. (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	1,3,5-Tri-nitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Di-nitro-phenyl sulfenyl chloride derivative	Miscellaneous
65	<b>2-<i>tert</i>-Butyl-1-methylbenzene</b> (2- <i>tert</i> -Butyltoluene)	200.5		1.5076	0.8897							
66	<b>3,5-Diethyl-1-methylbenzene</b> (3,5-Diethyltoluene)	200.7	-74.12	1.4969	0.8630			2,4,6- <i>tri</i> 106.65				
67	<b>2-Butyl-1-methylbenzene</b> (2-Butyltoluene)	201. 208		1.4958	0.8721							
68	<b>1-Ethyl-3-propylbenzene</b>	201		1.4930	0.8607							
69	<b>1,2-Dimethyl-4-isopropylbenzene</b>	201.8		1.4993	0.8699							
71	<b>1,2-Dimethyl-3-isopropylbenzene</b>	202.6		1.508	0.888							
72	<b>1-Ethyl-2-propylbenzene</b>	203		1.4992	0.8744							
73	<b>1,3-Di-isopropylbenzene</b>	203.2	-63.1	1.4883	0.85593			4,6- <i>di</i> 76.9 72. 2-ProH				
74	<b>1,2-Diethyl-4-methylbenzene</b>	203.6		1.5039	0.8762							
75	<b>1,2-Di-isopropylbenzene</b>	203.8		1.4960	0.8771							
76	<b>1,4-Dimethyl-2-propylbenzene</b>	204.3		1.4999	0.8717							
77	<b>1,2,3,4-Tetramethylbenzene</b> (Prehnitene)	205.0	-6.3	1.5201	0.9053	92-5		5,6- <i>di</i> 176				
78	<b>1-Ethyl-4-propylbenzene</b>	205		1.4921	0.8594							
79	<b>3-Butyl-1-methylbenzene</b> ( <i>m</i> -Butyltoluene)	205		1.491	0.859							
80	<b>2,4-Diethyl-1-methylbenzene</b> (2,4-Diethyltoluene)	205		1.5027	0.8748							
81	<b><i>n</i>-Pentylbenzene</b>	205.4	-75	1.4878	0.8585				4-mono 101-2, 2,4- <i>di</i> 202			4-Benzamido, 128.9
82	<b>3-Methyl-3-phenylpentane</b>	206		1.4958	0.8755							
83	<b>1,3-Dimethyl-5-<i>tert</i>-butylbenzene</b>	206-6.5	-21.5	1.4958	0.8645			2,4,6- <i>tri</i> 107 (one form), 114 (another form)				
84	<b>1,3-Dimethyl-4-propylbenzene</b>	206.6		1.4998	0.8723							
85	<b>1,2-Diethyl-3-methylbenzene</b>	206.6		1.5105	0.8910							
86	<b>4-Butyl-1-methylbenzene</b> (4-Butyltoluene)	207		1.490	0.857							
87	<b>2,5-Diethyl-1-methylbenzene</b> (2,5-Diethyltoluene)	207.1		1.5034	0.8758							
88	<b>1,2,3,4-Tetrahydronaphthalene</b> (Tetralin)	207.6	-35.79	1.54135	0.9702			5,7- <i>di</i> 95		153.5		Cl <sub>2</sub> → 5,6,7,8-Tetrachloro, 172
89	<b>1,3-Diethyl-2-propylbenzene</b>	207.6		1.5063	0.8856							
90	<b>2,6-Diethyl-1-methylbenzene</b> (2,6-Diethyltoluene)	208.8		1.5106	0.8907							
91	<b>1,2-Dimethyl-4-propylbenzene</b>	208.9		1.5000	0.8715							
92	<b>1,3-Dimethyl-5-propylbenzene</b>	209		1.4933	0.8610							
93	<b>2-Methyl-3-phenylpentane</b>	209		1.4912	0.8678							
94	<b>4-<i>tert</i>-Butyl-1,3-dimethylbenzene</b>	210-4		1.5030 <sup>37</sup>	0.9372 <sup>30</sup>			2,5,6- <i>tri</i> 112, al				
95	<b>1,4-Di-isopropylbenzene</b>	210.4	-17.1	1.48983	0.85676							
96	<b>1,2-Dimethyl-3-propylbenzene</b>	210.7		1.5075	0.8864							

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
 a) Liquids. (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	1,3,5 Trimnitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
97	<b>1-<i>tert</i>-Butyl-4-ethylbenzene</b>	211		1.4950	0.8635			2,6-di 94.5, al				
98	<b><i>d,l</i>-3-Phenylhexane</b>	211 208.3		1.4867	0.8596				2,4-di 207.8			
99	<b>2-Ethyl-1,3,5-trimethylbenzene</b>	212.4	-12.2	1.5074	0.883			4,6-di 111, al				
100	<b>3-Ethyl-4-isopropyl-1-methylbenzene</b>	213		1.5006	0.8722							
101	<b>5-Ethyl-1,2,4-trimethylbenzene</b>	213	-13.8	1.5075	0.833			3,6-di 87.8, al				
102	<b>6-Ethyl-1,2,4-trimethylbenzene</b>	213		1.5118	0.8897							
103	<b>2-Phenylhexane</b>	214		1.4882	0.8600				2,4-di 178			
104	<b>2-Methyl-1-phenylpentane</b>	215		1.4847	0.8624							
105	<b>4-Isopropyl-1-propylbenzene</b>	215		1.4972	0.8614							
106	<b>1,3-Dipropylbenzene</b>	215.8		1.5155 <sup>11</sup>	0.9137 <sup>1</sup>							
107	<b>5-Ethyl-1,2,3-trimethylbenzene</b>	215.8		1.5101	0.8863							
108	<b>3-Ethyl-1,2,4-trimethylbenzene</b>	216.6		1.5133	0.895			5,6-di 79.80, al				
109	<b>1,2,4-Triethylbenzene</b>	217.7		1.4982	0.8791							
110	<b>1,3,5-Triethylbenzene</b>	218 211.2		1.4965	0.8568 <sup>25</sup>			2,4,6-tri 112.4 2.6		129		2,4,6-Tribromo, 105
111	<b>2-Methyl-1,2,3,4-tetrahydro-naphthalene (2 Methyltetralin)</b>	218		1.5311	0.952							
112	<b>1-Methyl-1,2,3,4-tetrahydro-naphthalene (1-Methyltetralin)</b>	219		1.5357	0.9580							
113	<b>4-Ethyl-1,2,3-trimethylbenzene</b>	220.4		1.5180	0.9019							
114	<b>1,4-Dipropylbenzene</b>	221		1.4914	0.8564							
115	<b>3-Methyl-1-phenylpentane</b>	221		1.4876	0.8605							
116	<b>2-Propyl-1,3,5-trimethylbenzene</b>	221		1.5033	0.8782							
117	<b>1,1-Dimethyl-1,2,3,4-tetrahydronaphthalene (1,1-Dimethyltetralin)</b>	221		1.5292	0.950			Ar-x, x-di 64.5				
118	<b>3-<i>tert</i>-Butyl-1-isopropylbenzene</b>	222		1.4832	0.8512							
119	<b>1-Methyl-3-pentylbenzene (3-Pentyltoluene)</b>	223		1.4911	0.8593							
120	<b>4-<i>tert</i>-Butyl-1-isopropylbenzene</b>	224		1.4872	0.8665							
121	<b>2-Methyl-2-phenylhexane</b>	225		1.4943	0.8737							
122	<b>2,4-Di-isopropyl-1-methylbenzene (2,4-Di-isopropyltoluene)</b>	225		1.4990	0.8664							
123	<b>3-Methyl-3-phenylhexane</b>	226		1.4980	0.8776							
124	<b>n-Hexylbenzene</b>	226.1	-61.2	1.4864	0.8575				2,4-di 205.6			
125	<b>3-Phenylheptane</b>	227		1.4862	0.8607							
126	<b>2,6-Di-isopropyl-1-methylbenzene (2,6-Di-isopropyltoluene)</b>	228		1.5032	0.8768							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**a) Liquids. (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	1,3,5 Trinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
127	<b>5-Propyl-1,2,4-trimethylbenzene</b>	228		1.5095	0.887							
128	<b>6-Methyl-1,2,3,4-tetrahydronaphthalene (6-Methyltetralin)</b>	229		1.5357	0.9537							
129	<b>2,2-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,2-Dimethyltetralin)</b>	230		1.5200	0.935							
130	<b>2-Phenylheptane</b>	231		1.4863	0.8610							
131	<b>5-Methyl-1,2,3,4-tetrahydronaphthalene (5-Methyltetralin)</b>	234.4		1.54395	0.9720							
132	<b>2-Ethyl-1,2,3,4-tetrahydronaphthalene (2-Ethyltetralin)</b>	235		1.523	0.938							
133	<b>Cyclohexylbenzene</b>	235.6	7.8	1.5329	0.9502							
134	<b>1-Ethyl-1,2,3,4-tetrahydronaphthalene (1-Ethyltetralin)</b>	236		1.5321	0.9535							
135	<b>2,5-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,5-Dimethyltetralin)</b>	236		1.526	0.946							
136	<b>2,8-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,8-Dimethyltetralin)</b>	236		1.526	0.941							
137	<b>2,7-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,7-Dimethyltetralin)</b>	237.8		1.526	0.941							
138	<b>2,6-Dimethyl-1,2,3,4-tetrahydronaphthalene (2,6-Dimethyltetralin)</b>	238		1.526	0.941							Oxid → trimellitic acid 225-35 d
139	<b>1,4-Di-sec-butylbenzene</b>	239		1.4892	0.8590							
140	<b>1,5-Dimethyl-1,2,3,4-tetrahydronaphthalene (1,5-Dimethyltetralin)</b>	239		1.526	0.9410							
141	<b>3-Ethyl-3-phenylhexane</b>	239		1.4943	0.875							
142	<b>6-Ethyl-1,2,3,4-tetrahydronaphthalene (6-Ethyltetralin)</b>	241		1.5331	0.9568							
143	<b>2-Methyl-1-phenyl-1-butene</b>	241.2		1.528 <sup>18</sup>								Nitrosit, 129-30
144	<b>5-Ethyl-1,2,3,4-tetrahydronaphthalene (5-Ethyltetralin)</b>	242		1.540	0.973							
145	<b>n-Heptylbenzene</b>	244		1.4875	0.8595							
146	<b>1-Methylnaphthalene</b>	244.8	-30.57	1.6174	1.02025	142, or - red, al	153.5 4.5, al	4-mono 71, 4.5-di 143		68		Styphnate, 135, al
147	<b>5,6-Dimethyl-1,2,3,4-tetrahydronaphthalene (5,6-Dimethyltetralin)</b>	252		1.552	0.975							Oxid → melophanic acid, 238-42
148	<b>6,7-Dimethyl-1,2,3,4-tetrahydronaphthalene (6,7-Dimethyltetralin)</b>	252	10	1.5360	0.954			5.8 di 203				
149	<b>5,7-Dimethyl-1,2,3,4-tetrahydronaphthalene (5,7-Dimethyltetralin)</b>	253.1	-6	1.5405	0.9583							Heating with S at 320° → 1,3-Dimethylnaphthalene, b.p. 263

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**a) Liquids. (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	135 Trinitro benzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Di nitro phenyl sulfenyl chloride derivative	Miscellaneous
150	<b>5,8-Dimethyl-1,2,3,4-tetrahydronaphthalene (5,8-Dimethyltetralin)</b>	254		1.547	0.967							Heating with S at 230° → 1,4-Dimethylnaphthalene, b.p. 268
151	<b>2-Ethynaphthalene</b>	257.9	-7.5	1.59761	0.9922	77.0 7.5, al	88.9, 2- PrOH					Styphnate, 88-90
152	<b>1-Ethynaphthalene</b>	258.67	-13.88	1.6062	1.00816	98.5	111.5 12, al					Styphnate 111.3, al
153	<b>1,7-Dimethylnaphthalene</b>	263	-13	1.60831	1.0115	121	137					Styphnate, 143
154	<b>1,6-Dimethylnaphthalene</b>	263	-14	1.6072	1.003	114.5 or, al	139 yel					Styphnate, 122
155	<b>1,3-Dimethylnaphthalene</b>	263	-4.0	1.6078	1.0063	118	135, yel, al					Styphnate, 117.8, w-me al, 2,4,7-Trinitrofluorenone deriv., 142.5, or
156	<b>n-Octylbenzene (1-Phenyl-octane)</b>	264.5	-36	1.4845	0.8562							
157	<b>1-Allylnaphthalene</b>	265.7		1.6140	1.0228	69						
158	<b>1-Isopropynaphthalene</b>	267.9	-16	1.5950	0.99565	85.6						Dimer 198.5-9.5 Tetrabromo, 141.2
159	<b>1,4-Dimethylnaphthalene</b>	268, 262-4	7.66	1.6127	1.0166	144, or, me al	165.6 yel, me al					Styphnate, 126-7 or me al
160	<b>1,1-Diphenylethane</b>	268-70		1.5761	1.0033							Oxid → benzo-phenone, 49
161	<b>2-Isopropylnaphthalene</b>	a) 268.2 b) 262		1.5772 1.5861	0.9795 0.9770	93.5, 91.3						
162	<b>2-Propylnaphthalene</b>	273.5, 277.9		1.5872		93.4, or al	99					
163	<b>1-Propylnaphthalene</b>	277, 272.5	-10	1.5952	0.9918	91.2	86.7, al					
164	<b>1,3,7-Trimethylnaphthalene</b>	280	13.5	1.5759	1.007	144, or, al						Styphnate 151.5 or me al
165	<b>1-Isopropyl-7-methyl-naphthalene (Apocadulene)</b>	282		1.5884	0.9833	102, or, al						Styphnate, 166 (163-4), yel, al
166	<b>n-Nonylbenzene (1-Phenyl-nonane)</b>	282	-24	1.4838	0.8558							4-Sulfonamide, 94.5-5.0 Maleic anhydride → 3-(4-Nonylbenzoyl) acrylic acid, 82.3
167	<b>2-Butylnaphthalene</b>	283.5, 292	-8.1	1.57774	0.9673	71.3, or- yel, al						
168	<b>2-tert-Butylnaphthalene</b>	285-90	-4	1.5768	0.9687	102.3						
169	<b>1-tert-Butylnaphthalene</b>	287.9		1.5726	0.9629	96, yel						
170	<b>1-Butylnaphthalene</b>	289.34	-19.76	1.5819	0.97673	104.5, or- yel						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**a) Liquids. (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	1,3,5-Tinitrobenzene derivative	Nitro derivative	Acetamido derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
171	<b>4,5-Benzindane (1,2-Cyclopentanonaphthalene)</b>	294 5		1 6290	1 066	110	119 20					2,4,7-Trinitrofluorenone deriv., 133
172	<b>n-Decylbenzene (1-Phenyl-decane)</b>	300	-14 38	1 48319	0 85553							
173	<b>1-Pentylnaphthalene</b>	307	-22	1 5725	0 9656		75, yel					
174	<b>2-Pentylnaphthalene</b>	310	-21	1 5694	0 9561		74, yel					
175	<b>n-Undecylbenzene (n-Hendecylbenzene, 1-Phenylundecane)</b>	316	-5	1 4828	0 8553							4-Sulfonamide, 95 7 6 2
176	<b>1-Hexylnaphthalene</b>	322	-17 7	1 5647	0 9566		69 74					
177	<b>2-Hexylnaphthalene</b>	324	-5 6	1 620	0 9479		67-8, yel					
178	<b>n-Dodecylbenzene (1-Phenyl-dodecane)</b>	331	3	1 4824	0 8551							4-Sulfonamide, 97 5
179	<b>1-Heptylnaphthalene</b>	340		1 5582	0 9491							
180	<b>2-Heptylnaphthalene</b>	341	1	1 5556	0 9410							
181	<b>Tridecylbenzene (1-Phenyl-tridecane)</b>	346	10	1 4821	0 8550							
182	<b>1-Octylnaphthalene</b>	356	-2 0	1 5532	0 9427							
183	<b>2-Octylnaphthalene</b>	357	2 forms stable -0 5, meta-stable 13	1 5501	0 9356							
184	<b>1-Nonylnaphthalene</b>	372		1 5477	0 9371							
185	<b>2-Nonylnaphthalene</b>	372	12	1 5454	0 9298							
186	<b>1-Decylnaphthalene</b>	387		1 5435	0 9322							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**b) Solids. (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri-nitrobenzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
1	<b>1,2,6-Trimethylnaphthalene</b>	14	146 <sup>10</sup>	122-3, al	150-1, al						
2	<b>Diphenylmethane</b>	26 7	264 7, 261 2, 120 <sup>10</sup>					2,4,2',4'-tetra 172			$n_D^{20}$ 1 6010 $n_D^{20}$ 1 5770, D <sub>25</sub> 1 0056, CrO <sub>3</sub> → Benzophenone, 49 $n_D^{25}$ 1 5725
3	<b>1,2,3-Trimethylnaphthalene</b>	27 8, al	125-30 <sup>12</sup>	143, or , al	143 5, yel	154 6, al					
4	<b>1,6,7-Trimethylnaphthalene</b>	28, me al	285, 138 <sup>12</sup>	125 6, or , me al	148-9, or , me al	142-3, yel , me al					
5	<b>2-Isopropylazulene</b>	31, bl - vlt				dt 113 4					
6	<b>1,4-Dimethyl-7-isopropyl-azulene (<math>\delta</math>-Guiazulene)</b>	31 5, bl - vlt , al	167-8 <sup>12</sup>	122 2 5, bl , al	105-6, bl , me al	151-1 5					$D_t^{19}$ 0 9728 (super-cooled) 2,4,6-Tri-nitrotoluene deriv , 89
7	<b>2,6-Dimethylphenanthrene</b>	33-4, me al		135 6, yel , al	148 50, yel , me al						
8	<b>1,2,5-Trimethylnaphthalene</b>	33 5, 31-2, al	147 8 <sup>11</sup>	138 40, al	131, al	159-60, al					$n_D^{20}$ 1 6110, D <sub>20</sub> 1 0103, 2,4,6-Tri-nitrotoluene deriv , 90 0 5
9	<b>1-Propylphenanthrene</b>	34 5, me al		100-1, yel , me al							
10	<b>5-Isopropylazulene</b>	34 5				134, 122 3					
11	<b>2-Propylphenanthrene</b>	35-6, al	170 <sup>0.2</sup>	91 2, al							
12	<b>2-Methylnaphthalene</b>	37-8, 34 4	240-2, 110-2 <sup>16</sup>	116, al		123, yel	125 6, al	1-mono 81			CrO <sub>3</sub> → $\beta$ -Naphthoic acid, 182
13	<b>1-Ethyl-5-methylnaphthalene</b>	40, al	133 <sup>10</sup>	97, or , al							
14	<b>9-Isopropylphenanthrene</b>	41-2		109-10							
15	<b>6-Isopropylazulene</b>	43									
16	<b>2-Ethyl-6-methylnaphthalene</b>	44 5	145 50 <sup>11</sup>	109, or	119, yel	124 116-7, yel					2,4,6-Tri-nitrotoluene deriv , 62, yel
17	<b>2-Isopropylphenanthrene</b>	44-5, al		108, yel , me al							
18	<b>6-Isopropyl-1-methyl-phenanthrene</b>	45-6		143, or							
19	<b>2-Ethylazulene</b>	45 5, 44-5, bl		110 1		107					
20	<b>2,5-Dimethylphenanthrene</b>	46 7, al	204-5 <sup>15</sup>	127-9, yel , al	132-3, or , al						
21	<b>1,3,5-Trimethylnaphthalene</b>	47, me al	139 5 <sup>10</sup>	141-2, me al	138, yel						
22	<b>3-Ethyl-6-methylphenanthrene</b>	47-8		156-6 5, or 130-1, bl , al							
23	<b>2-Methylazulene</b>	47-8				140-1, dk red, al					
24	<b>1,3,8-Trimethylnaphthalene</b>	48, me al		127 5, or , al	140 5, al						
25	<b>4-Methylphenanthrene</b>	49 50, 95% al		140-1, al	135, or , al						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**b) Solids. (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Picrate	Styphnate	sym Tri-nitrobenzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
26	<b>1,4-Dimethylphenanthrene</b>	50 1 (cor ), me al		143 5, or -yel	135 5 6 5, or						
27	<b>Bibenzyl (1,2-Diphenylethane)</b>	53	284			102		4,4-di 180, 2,2',4,4-tetra 169		132 3	D <sup>30</sup> 0 9782, CrO <sub>3</sub> → Benzoic acid, 121
28	<b>Methylenefluorene (Bi-phenylencethylene)</b>	53		152 3							
29	<b>3,5-Dimethylphenanthrene</b>	53 4, me al		139, or , me al	124 5 or -yel		164 6, al				
30	<b>1,3-Dimethylazulene</b>	54		164 6							
31	<b>7-Methyl-3,4-benzphenanthrene</b>	54 0 4 5, al		134 0 4 5, red, al			178 5 8 8				
32	<b>Pentamethylbenzene</b>	54 3, 51	231 8	131		121		6-mono 154			
33	<b>1,2,4-Trimethylnaphthalene</b>	55-6 50, me al	146 <sup>12</sup>	148 8 5, or me al	123 5, yel , me al	165 6 5, me al					
34	<b>3,3'-Dimethylstilbene (sym-Di-m-tolylethylene)</b>	55 6		97							
35	<b>1,4,5,7-Tetramethylnaphthalene</b>	56	162 5 <sup>11</sup>	153				152 8 3 4			
36	<b>1,2,4,8-Tetramethylnaphthalene</b>	56 7	150 <sup>10</sup>	145 5		167, red, me al					2,4,6-Trinitrotoluene deriv , 88 yel
37	<b>2,9-Dimethylphenanthrene</b>	56 7, al		138, yel , al							
38	<b>1,5-Dimethylphenanthrene</b>	57 8, me al		134 5, or , me al							
39	<b>2-Benzylnaphthalene</b>	58	350	93 4, yel , al			124 3 5 4				D <sup>0</sup> 1 176
40	<b>1-Benzylnaphthalene</b>	58 9	350	103-4, yel							D <sup>1</sup> 1 166
41	<b>1,2-Dimethylazulene</b>	58 9, bl , al		129 30, blk , al		166 7 br-blk , al					
42	<b>9-Propylphenanthrene</b>	59	265 70 <sup>22</sup>	99, yel , al							
43	<b>1,7-Dimethyl-4-isopropyl-naphthalene</b>	60, al -w		92, or - red, al	120, yel						
44	<b>3-Methylphenanthrene</b>	62-3	140 50 <sup>6</sup>	137-8, yel , al							
45	<b>3,4-Dimethylphenanthrene</b>	62 3, me al		129-30, or -red, al	142 3, or -red, al						
46	<b>1-Ethylphenanthrene</b>	62 5, al		108-9, or , al	144, yel , al						
47	<b>sym-Diphenylacetylene (Tolane)</b>	62 5, al		111, yel			96, yel				
48	<b>9-Ethylphenanthrene</b>	62 5 3 0, 66, bz - pet eth	198 200	123-4, or -red, al							D <sup>78</sup> 1 0603 n <sup>28</sup> 1 6582

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**b) Solids. (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Picrate	Styphnate	sym-Tri-nitrobenzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenylsulfenyl chloride derivative	Miscellaneous
49	<b>1,4,5-Trimethylnaphthalene</b>	63	145 <sup>12</sup>	144 5, red, al	129 30						In H <sub>2</sub> SO <sub>4</sub> sol → grn
50	<b>4-Methylfluorene</b>	63, al									
51	<b>1,4,6,7-Tetramethylnaphthalene</b>	63 4, al		148 9			172 4 3 4				
52	<b>1,2,3-Trimethylphenanthrene</b>	63 8 4 8		187 8, or		200 7 1 5, yel, bz -al					
53	<b>1,8-Dimethylnaphthalene</b>	65 63	140 <sup>18</sup>	156 148	160						
54	<b>8-Methyl-3,4-benzphenanthrene</b>	65 6, al		107 8, red, al							
55	<b>2-Ethylphenanthrene</b>	67 8, me al 64 5		95 5 6 0, yel, al, 92 3			180 7 0 9				
56	<b>3,4-Benzphenanthrene</b>	68, al		120 8-8 5, red, al			170 8 1 1				
57	<b>1,3,7-Trimethylphenanthrene</b>	68 9 me al		163 4 al	160 1						
58	<b>4-Isopropyl-1-methylphenanthrene</b>	68 8 5 me al		113 6 4 or , al							
59	<b>4,8-Dimethylazulene</b>	69 70, bl , al		157-8, blk al		179 80 red-br , al					
60	<b>Biphenyl</b>	69 2 71	254 5 145 <sup>22</sup>					4 4'-di 237 229, 2,2',4,4'-tetra 150	225	142 3	n <sub>d</sub> <sup>20</sup> 1 475 D <sub>4</sub> <sup>20</sup> 0 866
61	<b>2-Methyl-3,4-benzphenanthrene</b>	70 4-1 0 al		141 8 3 2, red, bz -al		145 bz pet eth	158 8 5, or red, aq al				
62	<b>3-Methylpyrene</b>	71 2, al		211-2, br-red, bz							Conc H <sub>2</sub> SO <sub>4</sub> sol → yel with grn fluorescence on heating → olive grn with vlt fluorescence
63	<b>1,4,7-Trimethylphenanthrene</b>	72 3		141 2, me al	129 30						
64	<b>1,4-Dimethylanthracene</b>	74, al		140							
66	<b>4,9-Dimethyl-1,2-benzanthracene</b>	75 me al		116, br , me al		124-5, red, me al					
67	<b>Benzofluorene (<math>\omega</math>-Phenyl-dibenzfulvene)</b>	76, al		115 6							Dibromide, 116 d
68	<b>1,3-Dimethylphenanthrene</b>	76 7, ac a		153 5, or , al	165 6						
69	<b>1-Methyl-3,4-benzphenanthrene</b>	77 8	210 <sup>24</sup>	112-3, red, al			171 8 2 2				
70	<b>3-Isopropyl-1-methylphenanthrene</b>	79	180 <sup>15</sup>	150	155						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**b) Solids. (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym Tri-nitrobenzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfonyl chloride derivative	Miscellaneous
71	<b>1,2'-Binaphthyl</b>	79 80, 76		127 0-7 5 (cor.), or			145 0 6 9				
72	<b>2,3-Dimethylphenanthrene</b>	79 80		146 7, or -red, al	147 8, or , al						
73	<b>1,2,4,5-Tetramethylbenzene</b> (Durene)	79 2, 80	196 8						3,6-di 205	263	
74	<b>1-Ethyl-2-methylphenanthrene</b>	80, me al		134 5, me al		152 5-3 0					
75	<b>1,5-Dimethylnaphthalene</b>	80 0 0 5, 85% al		140							
76	<b>6-Methyl-3,4-benzphenanthrene</b>	80-1, al	206-8 <sup>2</sup>	118 0-8 5, red, me al			144 2- 4 5				
77	<b>Naphthalene</b>	80 3	218	149		153	153 4	1-mono 61, 57	172	173 4	
78	<b>1,3,6,8-Tetramethylnaphthalene</b>	81	115-6 <sup>2</sup>	151-2		175-6					
79	<b>1-Ethyl-7-methylphenanthrene</b> (Homopimanthrene)	81, al		115-6, yel , me al							Quinoxaline deriv., 154, ac a
80	<b>9-Methylanthracene</b>	81 5	196-7 <sup>12</sup>	137 d , red-br							D <sub>20</sub> <sup>w</sup> 1 065, n <sub>D</sub> <sup>20</sup> 1 6959, Irradiation in acetone → dimer, 228 0-8 5 Photo- oxide, ca 80, exp
81	<b>1-Isopropyl-7-methylphenanthrene</b>	82 3	170 <sup>1</sup>	119 20, or	148 9, yel	163 4, yel					
82	<b>6-Methylazulene</b>	83, bl - vlt		137, 125		141					
83	<b>1,3-Dimethylanthracene</b>	83		136							bl fluorescence
84	<b>2,2'-Dimethylstilbene</b> ( <i>cis</i> - <i>m</i> -Di- <i>o</i> -tolylethylene)	83	176 80 <sup>10</sup>	102							
85	<b>1-Methylanthracene</b>	85 6, me al	199 200	115 6 6 2, red, me al	176 4 7 0, red, me al		219 0- 9 8, red, bz				D <sub>20</sub> <sup>w</sup> 1 0471 n <sub>D</sub> <sup>20</sup> 1 6802, Irrad- iation → dimer, 246
86	<b>1,7-Dimethylphenanthrene</b>	86		132, me al	159, me al						
87	<b>1,6-Diphenylnaphthalene</b>	86 7		106-8							
88	<b>1,6-Dimethylphenanthrene</b>	87-8, me al		134, yel , al							
89	<b>1,9-Dimethylphenanthrene</b>	88, al		163 5, or -yel , me al	181						
90	<b>9-Methylphenanthrene</b>	90 1, aq al		152 3, al							
91	<b>1,2,10-Trimethylanthracene</b>	90 6 1 4, yel		138 5 9 5, al		169 6- 170 2, al					
92	<b>7-Ethyl-1-methylphenanthrene</b>	91 0 1 5, 84 5			141-2	135-6					
93	<b>Triphenylmethane</b>	92	358					4,4',4''- <i>tri</i> 206			Br <sub>2</sub> → bromo deriv., 152
95	<b>5-Isopropylnaphthalantracene</b>	92, ac, a		157							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**b) Solids. (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point °C	Picrate	Styphnate	sym Tri-nitro benzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitro phenyl sulfenyl chloride derivative	Miscellaneous
96	3,9-Dimethyl-1,2-benzanthracene	93		137-8, red, al		145, red, bz-lgr					
97	5,6-Benzindane (2,3-Cyclopentenonaphthalene)	94		120-1							
98	12-Isopropylnaphthalene	94.5 ac a		157.8							
99	Acenaphthene	96.2, yel al	278	162, or -red, al		168, yel, al	175.6	5-mono 101	198	187.9 d	$n_D^{20}$ 1.6066, D <sub>4</sub> <sup>20</sup> 1.0242 1,2-Dibromide, 121.3
100	2,7-Dimethylnaphthalene	96.7, al	262	136.0-6.5, yel, me al	158.0-9.5, yel, me al						
101	7-Isopropyl-1-methylfluorene	96.5-7.0, al						di ca 245			
102	Azulene	98.5-9.9	270 d, 115 35 <sup>10</sup>	120 d		167					Heat at 270° → Naphthalene, 80.3 2,4,6-Trinitrotoluene deriv, 95.5-100 D 1.035
103	Retene (7-Isopropyl-1-methylphenanthrene)	100.5-101, al	390, 158 6.5 <sup>2</sup>	124-5	141.2	139					
104	Phenanthrene	101, al, 96.3	340, 332	144 132.8		158-145	197			250.1	$n_D$ 1.5973 D 1.182
105	2,7-Dimethylphenanthrene	101.2, me al		152.3, or, al							
106	2,3,6-Trimethylnaphthalene	102, 92.3	286, 146-8 <sup>14</sup>	130, yel, me al	165, yel, me al						
107	2-Phenylnaphthalene	102-3					169.5 70.5				
108	1,2,3,4-Tetrahydroanthracene	103-5					182.4				
109	2,3-Dimethylnaphthalene (Guaiacene)	104.0-4.5	265-6	123.4							D <sub>4</sub> <sup>20</sup> 1.008
110	Ethylenefluorene	104, ac a		155.6							Dibromide, 93.5
111	1,7-Dimethylfluorene (Gibberene)	107.0-7.5		85-6, or -red		98, yel, al					In H <sub>2</sub> SO <sub>4</sub> sol → bl
112	1,1'-Dinaphthylmethane	110, al	>360, 270 <sup>14</sup>	142		141.5	216				
113	Fluoranthrene	110		185.6			216				
114	2,6-Dimethylnaphthalene	111	261-2	143			156				
115	2,4-Dimethylphenanthrene	111, al		138-9, 142, me al							
116	Fluorene	113.5, 116-7	293-5	87, 77		105	179	2-mono 156, 2,7-di 199	228		CrO <sub>3</sub> → Fluorenone, 84
117	4,10-Dimethyl-1,2-benzanthracene	114, pa yel, me al		162, blk							
118	4H-Cyclopenta(def)phenanthrene (Phenanthridene)	116, al	353	166							Benzylidene deriv, 108
119	1,3,8-Trimethylphenanthrene	116		174-5		188	199				
120	11-Methylnaphthalene	117-8		159-60, dk red		170, or	238.2 8.6				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**

b) Solids. (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri-nitrobenzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic-anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
121	<b>5-Methylchrysene</b>	117.2 7.8, bz -al		142.6 3.0, or -red, al		172.6 3.6, bz -al					
122	<b>1,2,5,6-Tetramethylnaphthalene</b>	118	150-60 <sup>10</sup>	156.7 red	166, bz	180.0 0.5, bz					
123	<b>Cyclohept(fg)acenaphthene</b> (Aceptiadene)	118.20 (subl), red, al		150.0							Maleic anh add comp, 248-50, bz
124	<b>1,2,7-Trimethylphenanthrene</b>	120.1, al		148.9	169.70						
125	<b>1',10-Dimethyl-1,2-dibenzanthracene</b>	122.3, al		147.8, red, al							In H <sub>2</sub> SO <sub>4</sub> sol → red
126	<b>9,10-Dimethyl-1,2-benzanthracene</b>	122.3		112.3, blk, al di 102.6, red, al							Highly carcinogenic
127	<b>Benz(bc)aceanthrylene</b>	122-3, al		141.5 2.0, dk red, al		162.5 3.0 or , al					
128	<b>1-Methylphenanthrene</b>	123, aq al		139, yel, al	152.3, yel						
129	<b>1,6,7-Trimethylphenanthrene</b>	123.4 al		165.6, or di 270, red	111.2						
130	<b>1,1'-Diacenaphthene</b>	(a) 124, al, (b) 169, pet eth									
131	<b>trans-Stilbene</b>	124, al	305 <sup>20</sup>	94.5		115.20					
132	<b>3,4-Benzfluorene</b>	124.5, al		130.1, red, al			191.8				
133	<b>9-Isopropylnaphthalenetracene</b>	125, al		152							
134	<b>6-Methylnaphthalenetracene</b>	126.2 7.2, al		149.50, red-br, al			221.4 1.8 163-4, al				
135	<b>5,8-Dimethyl-1,2-benzanthracene</b>	131, bz -al		175, red, al							
136	<b>8-Isopropylnaphthalenetracene</b>	132.3		118							
137	<b>1,4,5,8-Tetramethylnaphthalene</b>	132.3		154.6-5.4	143.4-4.2			158-9 234.5 5.0, 209.5 9.7, red, al			
138	<b>12-Methylnaphthalenetracene</b>	138, yel		115.6, red							
139	<b>2-Methyl-1',2'-benzpyrene</b>	138.9, pa yel, me al, after fusing, 140.0 0.2		184.5, br, bz -lgr		211.5- 2.0, red, bz -lgr					
140	<b>1,5-Dimethylnaphthalenetracene</b>	139.40, pa yel		166.7, scar, al							
141	<b>7-Methylnaphthalenetracene</b>	140		174, dk red			236.1- 6.5				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**b) Solids. (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri-nitrobenzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
142	<b>3,6-Dimethylphenanthrene</b>	141, al		172 3, or -yel, me al							
143	<b>5-Methyl-3,4-benzphenanthrene</b>	141 4-19					130 6 14, red				
144	<b>1,4-Dimethylchrysene</b>	142		141, red, al							
145	<b>1,2-Dimethylphenanthrene</b>	142 3, al		148, or , al	153, yel , al						
146	<b>8,10-Dimethyl-1,2-benzanthracene</b>	146, bz -al		166, red, al							
147	<b>1,2,8-Trimethylphenanthrene</b>	146 7, al	210 20 <sup>1</sup>	164 5, or , al		193 0					
148	<b>3-Methyl-1',2'-benzpyrene</b>	146 7 8 1, yel , al -eth		179 5 80 0, br -red, bz -lgr		3 5 al 210 5 11 0, bz -lgr					
149	<b>9-Methyl-1',2'-benzpyrene</b>	146 8 8 0, yel , hexane				218 5 9 5, red, bz -lgr					
150	<b>9-Phenylfluorene</b>	147 8, al						di ca 240 tetra ca 235 d			Bromide, di 181 2, tri 167 71
151	<b>2-Methylnaphthalene</b>	149 50, al		180			218 7 9 2				
152	<b>Pyrene</b>	149 50, pa yel	385	222, red, al 220, 227			242 3				
153	<b>9-Methylnaphthalene</b>	150 5 1 5, al		157 8			225 1 5 4				
154	<b>4-Methylchrysene</b>	151 0 1 5, bz-al		two forms 135 0 5 5, red, bz -lgr , 137 5 8 0, or , bz -lgr							
155	<b>trans-trans-1,4-Diphenyl-1,3-butadiene (trans-trans-Distyryl)</b>	152 5	350	152 3							Maleic anh add comp , 198-200
156	<b>Cinnamalfluorene</b>	155, pa yel , ac a		di 178 9							Tetrabromide, ca 160 d
157	<b>5-Methylnaphthalene</b>	155 9 6 9, bz -pet eth		153			235 4 5 6				
158	<b>1,2-Benzanthracene</b>	159-60		133			160				
159	<b>8-Methylnaphthalene</b>	160 0-0 6		166			243 2 3 6				
160	<b>1,1'-Binaphthyl</b>	160 5	240 4 <sup>12</sup>	145							
161	<b>Di-1-naphthastilbene (sym-Di-1-naphthylethylene)</b>	161, pa yel , al		tri 210							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**b) Solids. (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	<i>sym</i> Tri-nitrobenzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
162	<b>6-Methylchrysene</b>	161.0 14, et ac-al		170.0 06, or, bz-al		189.8 190.6, yel, bz-al					
163	<b>3-Methylnaphthalantracene</b>	163.0 39, al		146.0 68			239.0 9.6				
164	<b>2,6-Dimethyl-1,2-benzanthracene</b>	164. ac a		199. 200							
165	<b>Cyclopentadienophenanthrene</b>	164.5		146.7		172.3					
166	<b>10,11-Benz fluoranthene</b>	165, 166,		194.5		220.0 05					In H <sub>2</sub> SO <sub>4</sub> sol → bl
167	<b>Hexamethylbenzene</b>	165	264	170		174					
168	<b>3-Methylchrysene</b>	170.0 05, bz - pet-eth		164.0 45, grn al							
169	<b>Cholanthrene</b>	170-1. 173 (subl ), pa yel, bz-al		167.8, vlt-blk, bz			245.6				
170	<b>6-Methyl-1',2'-benzpyrene</b>	171.0 15, yel, bz-lgr		181.5 25 br bz-lgr	209.10, red bz lgr						
171	<b>6,7-Dimethyl-1,2-benzanthracene</b>	174, et ac		170							
172	<b>1,2-Benzpyrene</b>	176.5	310.2 <sup>10</sup>	197.8, 75, pa yel, bz - me al							
173	<b>5,10-Dimethyl-1,2-benzanthracene</b>	177, bz - al		174, red- blk, bz							
174	<b>4,5-Benzpyrene</b>	178-9, bz		229.30, red, bz							
175	<b>9,10-Dimethylanthracene</b>	180.1, al		176-7 d							
176	<b>10-Methylnaphthalantracene</b>	183.0- 36, yel, al		159.0 94							
177	<b>5,6-Dimethyl-1,2-benzanthracene</b>	187.8, al		191.3, red, al							
178	<b>2,2'-Binaphthyl</b>	188, 181	452	184			171				Lt bl fluorescence, KMnO <sub>4</sub> → Phthalic acid, 206.8
179	<b>1,2-Benzfluorene (Chrysophluorene)</b>	189-90, ac a, 183-4	413, 398 400	di 127.5, 124.6		144.5	213.5 55				
180	<b>1,8-Dimethylphenanthrene</b>	191-2, bz		151.2, yel			193.4				
181	<b>8-Methyl-1',2'-benzpyrene</b>	192-3, yel, bz		205, dk br, bz		233 d , red, bz					
182	<b>Bifluorenylidene (Dibiphenyleneethylene)</b>	194.5 (cor), red		177.8				two di- forms 171, dk red, 170, or red			Dibromide, 312, red, bz
183	<b>1,2,7,8-Dibenzanthracene</b>	196, bz		212, brt red							Bl-grn fluorescence in sol

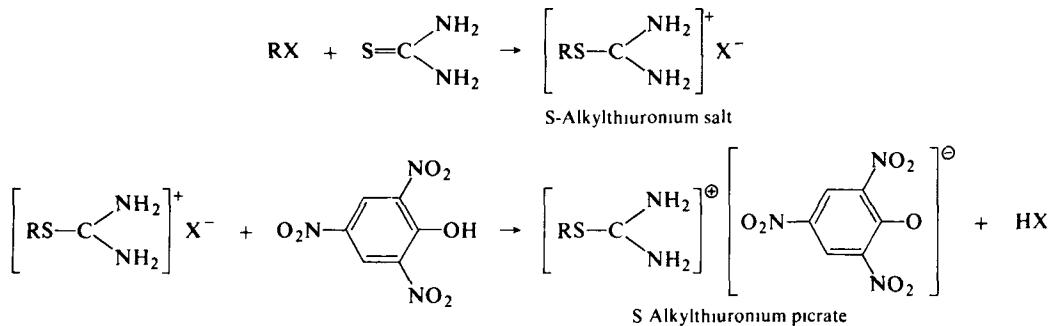
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IV. ORGANIC DERIVATIVES OF AROMATIC HYDROCARBONS**  
**b) Solids. (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Picrate	Styphnate	sym-Tri-nitrobenzene derivative	2,4,7-Tri-nitrofluorenone derivative	Nitro derivative	Phthalic anhydride derivative	2,4-Dinitrophenyl sulfenyl chloride derivative	Miscellaneous
184	<b>4-Methylnaphthalanthracene</b>	197 4-8 0, al		139 40, lt red			228 2-8 8				
185	<b>1,2,3,4-Dibenzanthracene</b>	200 2, pa yel , ac a	207, red								In conc H <sub>2</sub> SO <sub>4</sub> sol → pa vlt -red
186	<b>Di-2-fluorenylmethane</b>	201 2, al				-		di 256 7			Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> → Di-2-fluorenyl ketone, 297-8, yel , ac a
187	<b>2,3-Benzfluorene</b>	208 9					221 2-2 0				
188	<b>5-Methyl-1',2'-benzpyrene</b>	215 7-6 2, yel , eth -al		207 8, vlt -blk , bz -lgr		230 1, red, bz -lgr					
189	<b>Anthracene</b>	216 2	340 (cor ), 226 5 <sup>53</sup>	138		164	194				D <sub>27</sub> 1 25, Di-bromide, 122, CrO <sub>3</sub> → Anthraquinone, 273
190	<b>11,12-Benzfluoranthene</b>	217		170 1		182	236 7				
191	<b>4-Methyl-1',2'-benzpyrene</b>	217 5	480	203 4, vlt -br , bz							
192	<b>2,8-Dimethylchrysene</b>	218, bz		171 2, bz	204, or , bz	195, yel , bz					
193	<b>2-Methylchrysene</b>	224 5		143 6,							
194	<b>6,12-Dimethylchrysene</b>	237			207 d , bz	222					
195	<b>1,2-Benzphenanthrene (Chrysene)</b>	254, bz	448	273		186	248 9		214		Dibromide, 275
196	<b>Di-2-naphthastilbene (<i>3,3'-Di-2-naphthylethylene</i>)</b>	254 5, bz		215							
197	<b>1-Methylchrysene</b>	254 5 (cor ), (vacuum), bz				174-6, yel , bz					
198	<b>2,3,6,7-Dibenzphenanthrene</b>	257, grn -yel		184, or -red							Bl fluorescence in sol , intense yel -grn in u v
199	<b>2,3,5,6-Dibenzphenanthrene</b>	261, grn -yel , ac a		di 213, or -red							Bl fluorescence in bz sol , grn fluorescence in u v
200	<b>1,2,5,6-Dibenzanthracene</b>	262, met , ac a		di 214, or							
201	<b>Perylene</b>	273 4						270-1			
202	<b>Picene (1,2,7,8-Dibenzphenanthrene)</b>	365 6, xyl	518 20					257 8			Dibromide, 295, 2,7-Dianthraquinone add comp , 299-300
203	<b>1,2,3,4,5,6,7,8-Tetrabenzanthracene</b>	428 9						318-9, red			
204	<b>Coronene (Hexabenzobenzene)</b>	438-40 (cor ), yel , bz	525	>250 d , red, bz		>280 d , or , bz					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

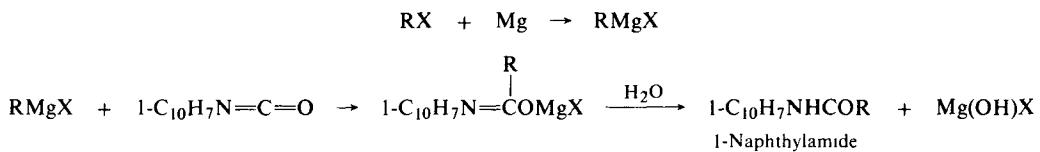
## EXPLANATIONS AND REFERENCES TO TABLE V

*S-Alkylthiuronium picrate (S-Alkylisothiourea picrate)\**

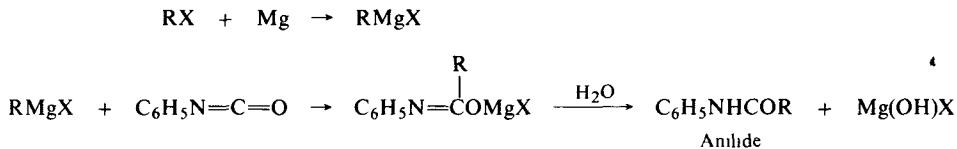
From the alkyl halide with thiourea in 95% ethanol, followed by addition of picric acid in ethanol

For directions and examples see Linstead, pp 82-3, Shriner, p 245, Vogel, pp 291-2, Wild, p 43, E L Brown and N Campbell, *J Chem Soc*, 1699 (1937), W J Levy and N Campbell, *J Chem Soc*, 1442 (1939)

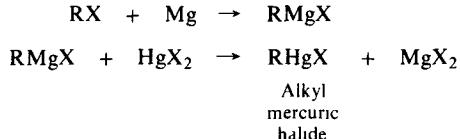
From the alkyl halide with thiourea in ethylene glycol, followed by addition of picric acid in ethanol

See Cheronis, p 550, H M Crosby and J B Entrikin, *J Chem Ed*, 41, 360 (1964)*1-Naphthylamide ( $\alpha$ -Naphthalide) \**

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with 1-naphthyl-isocyanate in ether

For directions and examples see Cheronis, pp 551, 553 Linstead, p 83 Shriner, p 244, Vogel, pp 290-1, Wild, pp 35-37 H Gilman and M Furry, *J Amer Chem Soc*, 50, 1214 (1928), H W Underwood and J C Gale, *J Amer Chem Soc*, 56, 2117 (1934)*Anilide \**

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with phenylisocyanate in ether

For directions and examples see Cheronis, pp 551, 554, Linstead, p 83, Shriner, p 244, Vogel, pp 290-1, Wild, pp 35-7, A M Schwartz and J R Johnson, *J Amer Chem Soc*, 53, 1063 (1931), H W Underwood and J C Gale, *J Amer Chem Soc*, 56, 2117 (1934)*Alkylmercuric halide \**

From the Grignard reagent (prepared from the alkyl halide and magnesium in dry ether) with the mercuric salt of the same halogen in ether

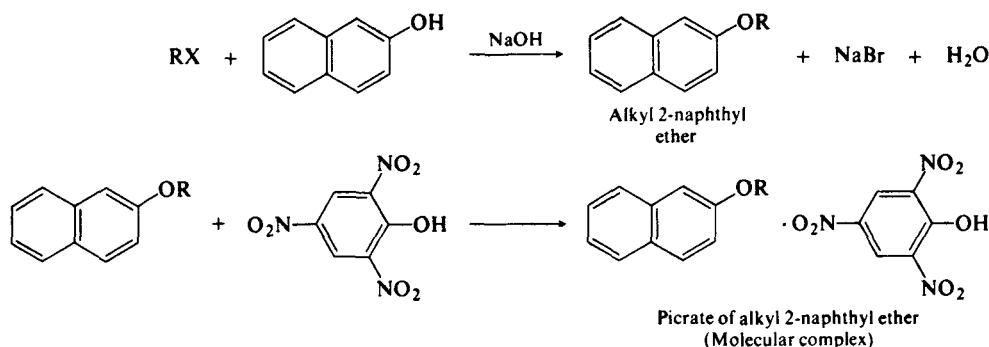
For directions and examples see Cheronis, pp 551, 554, Shriner, p 244, Vogel, p 291, Wild, p 38, C S Marvel, C Gauerke and E L Hill, *J Amer Chem Soc*, 47, 3009 (1925), E L Hill, *J Amer Chem Soc*, 50, 167 (1928), K H Slotta and K R Jacobi, *J prakt Chem*, 120, 249 (1929)

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE V (Continued)

*Picrate of alkyl 2-naphthyl ether (Molecular complex).\**



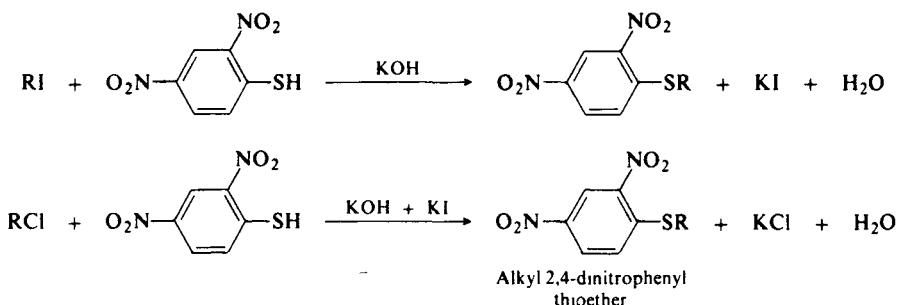
The alkyl 2-naphthyl ether is obtained from the alkyl halide with 2-naphthol in ethanolic sodium or potassium hydroxide.

For directions and examples see: Cheronis, p. 551; Linstead, p. 83; Shriner, p. 244; Vogel, p. 292; Wild, p. 44.

The picrate is obtained from the alkyl 2-naphthyl ether and picric acid in chloroform or ethanol.

See: Cheronis, p. 551; Linstead, p. 83; Vogel, p. 292; Wild, p. 44; O. L. Baril and G. A. Megrlichian, *J. Amer. Chem. Soc.*, **58**, 1415 (1936); V. H. Dermer and O. C. Dermer, *J. Org. Chem.*, **3**, 289 (1938).

*Alkyl 2,4-dinitrophenyl thioether (Alkyl 2,4-dinitrophenyl sulfide).*



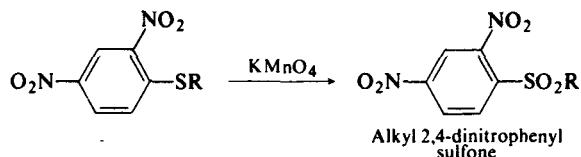
From the alkyl bromide or iodide with 2,4-dinitrophenol in butyl carbitol (2-(2-butoxyethoxy)ethanol) and aqueous potassium hydroxide.

For directions and examples see: Cheronis, p. 557; R. W. Bost, P. K. Starnes and E. L. Wood, *J. Amer. Chem. Soc.*, **73**, 1968 (1951).

From the alkyl chloride with 2,4-dinitrophenol in butyl carbitol (2-(2-butoxyethoxy)ethanol) with potassium iodide and aqueous potassium hydroxide.

See: Cheronis, p. 557; R. W. Bost, P. K. Starnes and E. L. Wood, *J. Amer. Chem. Soc.*, **73**, 1968 (1951).

*Alkyl 2,4-dinitrophenyl sulfone.*



From the alkyl 2,4-dinitrophenyl thioether (prepared from the alkyl halide as above) in glacial acetic acid, with aqueous potassium permanganate.

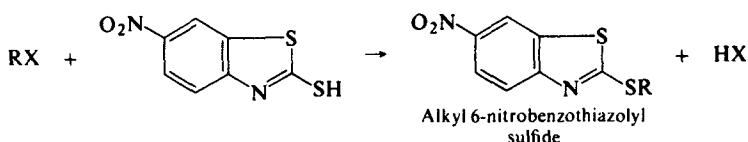
For directions and examples see: R. W. Bost, J. O. Turner and R. D. Norton, *J. Amer. Chem. Soc.*, **54**, 1985 (1932).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE V (Continued)

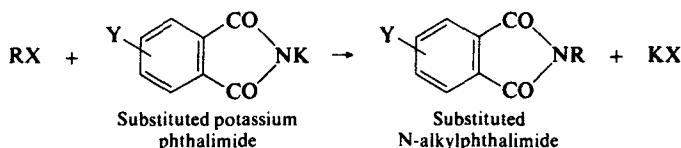
*6-Nitro-2-mercaptopbenzothiazole derivative.*



From the alkyl halide (especially a dihalide) and 6-nitro-2-mercaptopbenzothiazole in butyl carbitol (2-(2-butoxyethoxy)ethanol) and aqueous sodium hydroxide.

For directions and examples see: Cheronis, p. 557; H. B. Cutter and H. R. Golden, *J. Amer. Chem. Soc.*, **69**, 831 (1947); H. B. Cutter and A. Kreuchunas, *Anal. Chem.*, **25**, 198 (1953).

*Substituted N-alkylphthalimides.*



From the alkyl halide with the potassium salt of the substituted phthalimide.

For directions and examples see: Wild, p. 41.

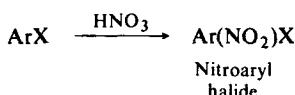
From the alkyl halide with the potassium salt of the substituted phthalimide or with the substituted phthalimide and potassium carbonate in dimethylformamide.

See: J. H. Billman and R. V. Cash, *J. Amer. Chem. Soc.*, **75**, 2499 (1953).

From the alkyl halide with the substituted phthalimide and potassium hydroxide in methanol-dioxane mixture.

See: C. H. Allen and R. V. V. Nicholls, *J. Amer. Chem. Soc.*, **56**, 1409 (1934).

*Nitro derivative.\**



From the aromatic halide with fuming and concentrated nitric acids.

For directions and examples see: Wild, p. 450.

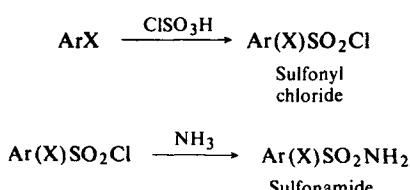
From the aromatic halide with 100% nitric acid.

See: Cheronis, pp. 559-561, 563.

From the aromatic halide with nitric and sulfuric acids.

See: Cheronis, pp. 560, 563; Vogel, p. 543.

*Sulfonamide.\**



The sulfonyl chloride is prepared from the aromatic halide and chlorosulfonic acid in chloroform or without solvent. The sulfonamide is obtained from the sulfonyl chloride with concentrated ammonia or dry ammonium carbonate.

For directions and examples see: Cheronis, pp. 564, 638, 639; E. H. Huntress and F. H. Carten, *J. Amer. Chem. Soc.*, **62**, 511 (1940).

NOTE: For additional information regarding directions and examples for the derivatization of aromatic halides (through the above reactions or additional ones, e.g., side-chain oxidation) see explanations and references to Table IV, pp. 32, 33, 34.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 1. Chlorides**

**a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	$n_{D}^{20}$	$D_4^{20}$	S-Alkyl thiuronium picrate	1 Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	<b>Methyl chloride</b>	-24			224	160	114	167		128	185, 189	Methyl-2-naphthyl ether, 70
2	<b>Vinyl chloride</b>	-14			104							Polymerizes to solid on irradiation
3	<b>Ethyl chloride</b>	13		0.917 <sup>b</sup>	188	126	104	192	104	115	156, 160	
4	<b>Isopropyl chloride</b>	36.5	1.378	0.859	196, 148		103		95			
5	<b>1-Chloropropene</b>	37					114					
6	<b>Allyl chloride</b>	44.5	1.416	0.940	155		114		99			3-Nitrophthalimide deriv., 100-1
7	<b>n-Propyl chloride</b>	46.5	1.388	0.889	181, 176	121	92	147	81	84	126	
8	<b>tert-Butyl chloride</b>	51	1.386	0.846	160-1	147	128	122-3				
9	<b>Chloroprene</b>	59	1.458	0.9583								Heating with maleic anh and boiling the adduct in water → 4-chloro-1,2,3,6-tetrahydrophthalic acid, 173-5
10	<b>sec-Butyl chloride</b>	68	1.397	0.874	190, 166	129	108	30.5	86	66	120	
11	<b>Isobutyl chloride</b>	69	1.398	0.881	174	125	109		85	76	105	
12	<b>Methylchloride (3-Chloro-2-methyl-1-propene)</b>	72	1.4340	0.9475								Phthalimide deriv., 89-90
13	<b>n-Butyl chloride</b>	78	1.402	0.886	180, 177	112	63	128	67	66	92	
14	<b>Neopentyl chloride</b>	85		0.879			130-1					
15	<b>tert-Amyl chloride</b>	86	1.405	0.865		138	92		117-8			
16	<b>3-Chloro-1-pentene</b>	93-4	1.4254	0.8978								Phthalimide deriv., 78-9
17	<b>DL-3-Chloro-2-methyl-1-butene</b>	94	1.4304	0.9088								$\text{Br}_2 \rightarrow$ dibromo deriv., 197-8
18	<b>Trimethylvinyl chloride (3-Chloro-2-methyl-2-butene)</b>	94	1.4320	0.925 (0.905)								$\text{Br}_2$ in ether → dibromo deriv., 197
19	<b>DL-2-Chloropentane</b>	97	1.4079	0.8695		102.3	94.6					
20	<b>3-Pentyl chloride (3-Chloropentane)</b>	97	1.4082	0.8723		117-8	127, 122					
21	<b>Isoamyl chloride</b>	100	1.409	0.872	179, 173	111	108	86	94	80	124	
22	<b>n-Amyl chloride (n-Pentyl chloride)</b>	106	1.412	0.882	154	112	96	110	67	80	83	
23	<b>1-Chloro-2-pentene</b>	109-10	1.435 <sup>21</sup>	0.908 <sup>21,5</sup>								Phthalimide deriv., 69-70
24	<b>2-Chloro-2-methylpentane</b>	110.3	1.4126	0.863		116-8	71-4					
25	<b>3-Chloro-2,2-dimethylbutane (Pinacolyl chloride)</b>	112	1.4181	0.8767				89-90				
26	<b>Cyclopentyl chloride</b>	114-5	1.4510	1.005					108			
27	<b>4-Chloro-2,2-dimethylbutane</b>	115	1.4160	0.8670			138-9	133				
28	<b>3-Chloro-3-methylpentane</b>	115-7	1.421	0.89			87-8					Carbonation of Grignard and conversion of acid to amide, 125-7, $\text{Br}_2 \rightarrow$ 2,3-dibromo deriv., 166-8 (173-4)
29	<b>2-Chloro-2,3-dimethylbutane</b>	117-9		0.8769 <sup>22</sup>								Grignard reagent + $\text{O}_2 \rightarrow \text{CrO}_3/\text{H}_2\text{SO}_4$
30	<b>3-Hexyl chloride (3-Chlorohexane)</b>	123	1.4163	0.870 <sup>20</sup>								3-hexanol → 3-hexanone, 2,4-Dinitrophenylhydrazone, 147.8 Semicarbazone, 110.11

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 1. Chlorides**

**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	$n_{D}^{20}$	$D_{4}^{20}$	S Alkyl thiuronium picrate	I Naph thyl amide	Anilide	Alkyl mer curic halide	Picrate of 2 naph thyl ether	2,4 Di nitro phenyl thio ether	2,4 Di nitro phenyl sulfone	Miscellaneous
31	2-Hexyl chloride (2-Chlorohexane)	123.4	1.4142 <sup>21</sup>	0.8694 <sup>21</sup>			91-2					
32	1-Chloro-2-ethylbutane	125-7	1.4230	0.8914			81.2 83-4					
33	3-Chloro-2,2,3-trimethylbutane	133										Carbonation of Grignard → acid, 80
34	<i>n</i> -Hexyl chloride	133	1.420	0.878	157	106	69	125		74	97	
35	Cyclohexyl chloride	143	1.462	0.989		188	146					6-Nitro-2-mercaptopbenzothiazole deriv 100-1 2 sulfone, 189
36	5-Chloro-2,3-dimethylpentane	152	1.4299	0.8825			80.1					
37	<i>n</i> -Heptyl chloride	159	1.426	0.877	142	95	57	120	82	101		
38	Benzyl chloride	179	1.539	1.100	188	166	117	104	123	130	178, 182	Quaternary salt with dimethyl aniline, 110
39	<i>n</i> -Octyl chloride	180, 184	1.431	0.875	134	91	57	115		78	98	
40	$\beta$ -Phenylethyl chloride	190					97					
41	4-Methylbenzyl chloride	192	1.5380	1.0512				84				Phthalimide, 120 117 Carbonation of Grignard → 4-tolylacetic acid, 92
42	$\alpha$ -Phenylethyl chloride	195										
43	3-Methylbenzyl chloride	195-6	1.5327 <sup>25</sup>	1.064 <sup>20</sup>			133					Phthalimide deriv , 117-8, Carbonation of Grignard → 3-tolylacetic acid, 61
44	2-Methylbenzyl chloride	197.9										Phthalimide deriv , 148-9, Heating with pyridine → alkyl pyridinium chl ride 183
45	$\beta$ -Chlorostyrene	197-9	1.571 <sup>25</sup>	1.109								$Br_2$ in chl → dibromo deriv , 32, Oxid → benzoic acid, 122
46	<i>n</i> -Nonyl chloride	202	1.434	0.870	131							
47	2-Chlorobenzyl chloride	213-4										5-Nitro deriv 66 Carbonation of Grignard → 2-chlorophenylacetic acid, 94-5
48	4-Chlorobenzyl chloride	214, 222					166					Oxid → 4-chlorobenzoic acid, 242
49	3-Chlorobenzyl chloride	216		1.2695 <sup>45</sup>								Oxid → 3-chlorobenzoic acid, 158, 155, Heating with 2,4-dichlorophenol in toluene → 2-(3-chlorobenzyl)-4,6-dichlorophenol, 59-60
50	<i>n</i> -Decyl chloride	223	1.437	0.868	137							
51	4-Isopropylbenzyl chloride	226-9										Carbonation of Grignard → acid, 52
52	<i>n</i> -Undecyl chloride ( <i>n</i> -Hendecyl chloride)	241	1.440	0.868	139							
53	<i>n</i> -Dodecyl chloride (Lauryl chloride)	243-4	1.4425	0.8673				114				Refluxed with pyridine → alkyl pyridinium chloride, 92
54	Cetyl chloride (Hexadecyl chloride)	286 d			155			102				3-Nitrophthalimide deriv , 101, Alkyl saccharin deriv , 98

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 1. Chlorides**

**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thiuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl-ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	<b>1,3-Bis(chloromethyl)benzene (<i>m</i>-Xylylene dichloride)</b>	32-4	250-5								Diphthalimide deriv , 237
2	<b>4-Bromobenzyl chloride</b>	36-8, 50	236	219							Oxid → 4-bromobenzoic acid, 251
3	<b>2,4,6-Trimethylbenzyl chloride</b>	37	130 <sup>22</sup>								Hydrolysis → 2,4,6-trimethylbenzyl alcohol, 88-9, Phthalimide deriv , 209-10
4	<b>2,6-Dichlorobenzyl chloride</b>	39-40									Carbonation of Grignard → 2,6-dichlorophenylacetic acid, 157 8
5	<b>1-Chloro-2,2,3,3-tetramethylbutane</b>	52-3									Grignard treated with O <sub>2</sub> at -5 → carbinol, 149-50
6	<b>1,2-Bis(chloromethyl)benzene (<i>o</i>-Xylylene dichloride)</b>	54-5	239-41								Oxid → phthalic acid, 200-6
7	<b>4-Nitrobenzyl chloride</b>	71									Oxid → 4-nitrobenzoic acid, 241
8	<b>1,4-Bis(chloromethyl)benzene (<i>p</i>-Xylylene dichloride)</b>	98-100	240-5								Heating with benzyl alcohol + KOH → dibenzyl ether, 67, Boiling with Pb(NO <sub>3</sub> ) <sub>2</sub> → terephthaldehyde, 115
9	<b>Triphenylmethyl chloride (Trityl chloride)</b>	113									Boiling with H <sub>2</sub> O → triphenyl carbinol, 162

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

A) Alkyl and cycloalkyl halides 2. Bromides  
a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	$n_D^{20}$	$D_t^{20}$	S-Alkyl thiuronium picrate	I Naph thyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitro phenyl thioether	2,4-Dinitro phenyl sulfone	Miscellaneous
1	<b>Methyl bromide</b>	3 5			224	160	114	172 160		128	185 189	
2	<b>Vinyl bromide</b>	16					104					
3	<b>Ethyl bromide</b>	38	1 425	1 460	188	126	104	193 198	104	115	156, 160	
4	<b>1-Bromopropene</b>	60	1 452	1 4133			114					
5	<b>Isopropyl bromide</b>	60	1 425	1 314	196, 148		103	93	92	95	140	
6	<b>Allyl bromide</b>	71	1 46545	1 398	155		114		99	71		
7	<b>n-Propyl bromide</b>	71	1 4341	1 353	181, 177	121	92	138	75	84	126	
8	<b>tert-Butyl bromide</b>	72 3		1 211		147	128					
9	<b>Isobutyl bromide</b>	91	1 435	1 253	174 167	125	109	55	84	76	105	
10	<b>sec-Butyl bromide</b>	91	1 437	1 256	190, 166	129	108	39	85	66	120	
11	<b>n-Butyl bromide</b>	101	1 440	1 274	180, 177	112	63	136, 129	67	66	92	
12	<b>tert-Amyl bromide</b>	108	1 442	1 198 <sup>18</sup>		138	92					
13	<b>Neopentyl bromide</b>	109		1 225			126					
14	<b>DL-2-Pentyl bromide</b>	117, 113	1 442	1 212		102 3	93					
15	<b>3-Pentyl bromide</b>	118	1 443	1 211			124					
16	<b>Isoamyl bromide</b>	120-1	1 442	1 213	179, 173	111	108	80	94	80	124	
17	<b>n-Amyl bromide (n-Pentyl bromide)</b>	129	1 445	1 219	154	112	96	127, 122	67	80	83	
18	<b>Cyclopentyl bromide</b>	137	1 489	1 387								
19	<b>2-Hexyl bromide (2-Bromo-hexane)</b>	146	1 483 <sup>25</sup>	1 1658			91-2					
20	<b>n-Hexyl bromide</b>	155 157	1 448	1 175	157	106	69	127 119		74	97	
21	<b>Cyclohexyl bromide</b>	165	1 495	1 336		188	146	153				
22	<b>n-Heptyl bromide</b>	180 174	1 451	1 140	142	95	57	118		82	101	
23	<b>Benzyl bromide</b>	198		1 438	188	166	117	119	123	130	178, 182	
24	<b>n-Octyl bromide</b>	201, 204	1 453	1 112	134	91	57	109		78	98	
25	<b><math>\alpha</math>-Phenylethyl bromide</b>	205					133					
26	<b><math>\beta</math>-Phenylethyl bromide</b>	218	1 556	1 359			97	169	84			
27	<b>n-Nonyl bromide</b>	220	1 454	1 090	131		217	115	109		86	92
28	<b><math>\beta</math>-Bromostyrene</b>	221						91				
29	<b>n-Dodecyl bromide (Lauryl bromide)</b>	130 <sup>6</sup>	1 458	1 038				108				
30	<b>n-Tetradecyl bromide</b>	179 <sup>20</sup>	1 460	1 017						94	104	m p 5

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 2. Bromides**

**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thiuronium picrate	1-Naph-thyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naph-thyl ether	2,4-Di-nitro-phenyl thioether	2,4-Di-nitro-phenyl sulfone	Miscellaneous
1	<b><i>n</i>-Hexadecyl bromide (Cetyl bromide)</b>	14	201 <sup>9</sup>	155, 137			101 2		95	105	$n_D^{20}$ 1.462, $D_4^{20}$ 1.001
2	<b>2-Bromobenzyl bromide</b>	31		222							$\text{CrO}_3 \rightarrow$ 2-bromobenzoic acid, 150
3	<b>3-Bromobenzyl bromide</b>	41		205							$\text{CrO}_3 \rightarrow$ 3-bromobenzoic acid, 155
4	<b>2-Nitrobenzyl bromide</b>	46-7									Oxid $\rightarrow$ 2-nitrobenzoic acid, 146-8
5	<b>4-Chlorobenzyl bromide</b>	51		194							$\text{CrO}_3 \rightarrow$ 4-chlorobenzoic acid, 242
6	<b>3-Nitrobenzyl bromide</b>	58-9									Oxid $\rightarrow$ 3-nitrobenzoic acid, 141
7	<b>4-Bromobenzyl bromide</b>	62		219							$\text{CrO}_3 \rightarrow$ 4-bromobenzoic acid, 251
8	<b>4-Nitrobenzyl bromide</b>	99									Oxid $\rightarrow$ 4-nitrobenzoic acid, 240

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**A) Alkyl and cycloalkyl halides 3. Iodides**

**a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	$n_D^{20}$	$D_4^{20}$	S-Alkyl thiuronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Miscellaneous
1	Methyl iodide	43	1.532	2.282	224	160	114	152, 145	117	128	185, 189	
2	Vinyl iodide	56				104						
3	Ethyl iodide	72	1.514	1.940	188	126	104	186, 182	104	115	156, 160	
4	Isopropyl iodide	90	1.499	1.703	196, 148	103			92	95	140	
5	<i>n</i> -Propyl iodide	102–3	1.505	1.743	181, 176	121	92	113	75	84	126	
6	Allyl iodide	103	1.578	1.777	155	121	114	112	99			
7	<i>tert</i> -Butyl iodide	103, 98			188	147	128					
8	<i>sec</i> -Butyl iodide	120	1.499	1.592	190, 166	129	108		85	66	120	
9	Isobutyl iodide	120	1.496	1.602	174, 167	125	109		72	84	76	105
10	<i>tert</i> -Amyl iodide	128		1.479		138	92					
11	<i>n</i> -Butyl iodide	130	1.499	1.616	180, 177	112, 110	63	117	67	66	92	
12	2-Pentyl iodide	142	1.496	1.510			93					
13	3-Pentyl iodide	142	1.497	1.511			124					
14	Isoamyl iodide	148	1.493	1.503	179, 173	111	108	122	94	80	124	
15	<i>n</i> -Amyl iodide ( <i>n</i> -Pentyl iodide)	155	1.496	1.512	154	112	96	110	67	80	83	
16	Cyclopentyl iodide	166–7	1.5447	1.7096								
17	Cyclohexyl iodide	179, sl d		1.626 <sup>15</sup>		188	146					
18	<i>n</i> -Hexyl iodide	179	1.493	1.437	157	106	69	110		74	97	
19	<i>n</i> -Heptyl iodide	204	1.490	1.373	142	95	57	103		82	101	
20	<i>n</i> -Nonyl iodide	220			131					86	92	
21	<i>n</i> -Octyl iodide	225–6	1.489	1.330	134					78	98	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES****A) Alkyl and cycloalkyl halides 3. Iodides****b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	S-Alkyl thioronium picrate	1-Naphthyl amide	Anilide	Alkyl mercuric halide	Picrate of 2-naphthyl ether	2,4-Dinitro phenyl thioether	2,4-Dinitro phenyl sulfone	Miscellaneous
1	<i>n</i> -Hexadecyl iodide (Cetyl iodide)	22		155, 137					95		105
2	Benzyl iodide	24		188	166	117	82	123	130	178, 182	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES****B) Dihalides and polyhalides (non-aromatic)****1. Fluorides (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	$n_D^{20}$	$D_4^{20}$	Miscellaneous
1	Perfluorocyclopentane	22		1 648 <sup>25</sup>	m p 10
2	1,3-Difluoropropane	41 2	1 3190 <sup>26</sup>	1 0057 <sup>25</sup>	m p 49
3	Perfluorocyclohexane	50			
4	Perfluoro- <i>n</i> -hexane	57	1 2515 <sup>22</sup>	1 6995 <sup>25</sup>	
5	Perfluoro-2-methylpentane	58	1 2564 <sup>22</sup>	1 7326	
6	Perfluoro- <i>n</i> -heptane	84	1 2770	1 801 <sup>25</sup>	
7	Perfluoro- <i>n</i> -nonane	127	1 2865 <sup>25</sup>	1 860 <sup>25</sup>	
8	Perfluoro- <i>n</i> -decane	150	1 2890 <sup>25</sup>	1 873 <sup>25</sup>	m p 36
9	Perfluoro- <i>n</i> -undecane (Perfluoro- <i>n</i> -hendecane)	161	1 2960 <sup>25</sup>	1 919 <sup>25</sup>	m p 57

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

**B) Dihalides and polyhalides (non-aromatic)**

**2. Chlorides a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	$n_{D}^{20}$	$D_{4}^{20}$	Miscellaneous
1	Dichloromethane (Methylene chloride)	41	1 4237	1 336	6-Nitro-2-mercaptopbenzothiazole deriv , 232-3, Di-(2-naphthyl) ether, 133 S-Alkyl bis-(thiuronium picrate), 267
2	<i>trans</i> -1,2-Dichloroethylene	48	1 452	1 2569	$\text{Br}_2 \rightarrow$ dibromo deriv , 190 5
3	1,1-Dichloroethane	57	1 4164	1 175	1,1-Di-(1-naphthyl)ether, 117
4	<i>cis</i> -1,2-Dichloroethylene	60	1 4428 <sup>25</sup>	1 282	$\text{Br}_2 \rightarrow$ dibromo deriv , 190-5
5	Chloroform	61	1 446	1 489	Gives carbalamine test with primary amines
6	2,2-Dichloropropane	70	1 4117	1 093	
7	1,1,1-Trichloroethane	74	1 4380	1 349	
8	Carbon tetrachloride	77	1 4630	1 595	
9	Ethylene dichloride (1,2-Dichloroethane)	84	1 4443	1 256	1,2-Di-(2-naphthyl)ether 217
10	1,1,2-Trichloroethylene	87	1 4773	1 464	$\text{HgO} + \text{NaOEt} + \text{KCN}$ in al shaken 1 hr at 40 60 → mercury bis-(trichloroethylene), $\text{Hg}(\text{—CCl=CCl}_2)_2$ , 83, eth
11	1,2-Dichloropropane	96	1 4388	1 155	1,2-Di-(2-naphthyl)ether, 152, 1,2-Diphenyl ether, 32
12	1-Bromo-2-chloroethane	106-7			6-Nitro-2-mercaptopbenzothiazole deriv , 202 3 Di-(2-naphthyl)ether, 217
13	1,1,2-Trichloroethane	114	1 4707	1 443	
14	1,1,2,2-Tetrachloroethylene (Perchloroethylene)	121	1 5055	1 623	With paraformaldehyde + conc $\text{H}_2\text{SO}_4 \rightarrow \alpha,\alpha$ -dichloro- $\beta$ -hydroxypropionic acid 88 9
15	1,2-Dichlorobutane	123-4	1 440		6-Nitro-2-mercaptopbenzothiazole deriv , 164-5
16	1,3-Dichloropropane	125	1 449	1 189 <sub>4</sub> <sup>18</sup>	1,3-Di-(1 naphthyl)ether, 103-4 1,3-Di-(2-naphthyl)ether 148 9 1,3-Diphenyl ether 60
17	1,3-Dichloro-2-methylpropane	135 6	1 4627 <sup>19</sup>	1 131 <sub>20</sub> <sup>20</sup>	
18	1-Bromo-3-chloropropane	143 4	1 4861	1 594	1,3-Di-(1-naphthyl) ether, 103-4 1,3-Di-(2-naphthyl)ether, 148-9 1,3-Diphenyl ether, 60
19	1,1,2,2-Tetrachloroethane	146	1 4942	1 600	
20	1,2,3-Trichloropropane	158	1 4585	1 417	
21	Pentachloroethane	161	1 504	1 681	
22	Benzalchloride	207, 214	1 5515	1 295 <sup>16</sup>	Oxid → benzonic acid, 122, Hydrolysis → benzaldehyde, 2,4-Dinitrophenylhydrazone 237, Semicarbazone, 222
23	Benzotrichloride	221		1 374 <sub>17</sub> <sup>17</sup>	Hydrolysis → benzoic acid, 122
24	2-Chlorobenzalchloride (2-Chlorobenzylidene chloride)	228-9	1 5670 <sup>16</sup>	1 399 <sub>18</sub> <sup>18</sup>	Oxid → 2-chlorobenzoic acid, 141 Hydrolysis → 2-chlorobenzaldehyde, 2,4-dinitrophenylhydrazone, 213 209
25	3-Chlorobenzalchloride (3-Chlorobenzylidene chloride)	237-40			Oxid → 3-chlorobenzoic acid, 158 Hydrolysis → 3-chlorobenzaldehyde, 2,4-dinitrophenylhydrazone, 256 248
26	4-Chlorobenzalchloride (4-Chlorobenzylidene chloride)	237			Oxid → 4-chlorobenzoic acid, 240, Hydrolysis → 4-chlorobenzaldehyde, 47 2,4-dinitrophenylhydrazone, 265

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES****B) Dihalides and polyhalides (non-aromatic) 2. Chlorides****b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point, °C	Miscellaneous
1	<b>3,4-Dichlorobenzotrifluoride</b>	26		Hydrolysis → 3,4-Dichlorobenzoic acid, 202
2	<b>DDT (2,2-Bis-(4-chlorophenyl)-1,1,1-trichloroethane)</b>	108	260	Heating with Cl <sub>2</sub> + trace PCl <sub>3</sub> in CCl <sub>4</sub> → 1,1,1,2-tetrachloro deriv, 91-2, Nitration → nitro deriv, 148, AlCl <sub>3</sub> + benzene → 1,1,2,2-tetraphenylethane, 211
3	<b>γ-Benzene hexachloride</b> (Gammexane, 666)	112		
4	<b>α-Benzene hexachloride</b>	157	288	Heat above m.p. → HCl + 1,2,4-trichlorobenzene, 17, b.p. 213, mononitro deriv, 56, dinitro, 103
5	<b>Hexachloroethane</b>	187 subl	185	
6	<b>β-Benzene hexachloride</b>	310		Unreactive to boiling pyridine, Unattacked by boiling HNO <sub>3</sub> or H <sub>2</sub> SO <sub>4</sub>

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE V. ORGANIC DERIVATIVES OF HALIDES

## B) Dihalides and polyhalides (non-aromatic)

## 3. Bromides a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Miscellaneous
1	<b>Dibromomethane (Methylene bromide)</b>	98-9	1.538	2.496	6-Nitro-2-mercaptopbenzothiazole deriv., 232 267
2	<b>1,1-Dibromoethane</b>	112	1.5128	2.055	6-Nitro-2-mercaptopbenzothiazole deriv., 145 1,1-Di-(1-naphthyl)ether, 117
3	<b>1,2-Dibromoethane</b>	132	1.5379	2.179	m p 10, 6-Nitro-2-mercaptopbenzothiazole deriv., 201 217
4	<b>DL-1,2-Dibromopropane</b>	141-2	1.5203	1.933	6-Nitro-2-mercaptopbenzothiazole, 194 1,2-Di-(2-naphthyl)ether, 152, 1,2-Diphenyl ether, 32
5	<b>1,2-Dibromo-2-methylpropane</b>	149	1.512	1.783	
6	<b>1,2-Dibromo-1-butene</b>	150		1.887	
7	<b>Bromoform</b>	150-1	1.598	2.890 <sup>o</sup>	m p 8
8	<b>1,3-Dibromopropene</b>	156	1.538 <sup>25</sup>	2.097 <sup>o</sup>	
9	<b>1,1-Dibromo-2-methylpropene</b>	156.7	1.530	1.866 <sup>26</sup>	
10	<b>2,3-Dibromobutane</b>	157	1.515	1.792	
11	<b>1,2-Dibromobutane</b>	166		1.820	6-Nitro-2-mercaptopbenzothiazole deriv., 164 5
12	<b>1,3-Dibromopropane</b>	167.8	1.523	1.982	1,3-Di-(1-naphthyl)ether, 103-4 1,3-Di-(2-naphthyl)ether, 148 1,3-Diphenyl ether, 60
13	<b>1,3-Dibromo-2-butene</b>	168-9	1.548	1.877	
14	<b>1,3-Dibromobutane</b>	174	1.507	1.820 <sup>o</sup>	
15	<b>1,1,2-Tribromoethane</b>	189	1.5933	2.6211	
16	<b>1,4-Dibromobutane</b>	197-8		1.847 <sup>o</sup>	p-toluidine (3 moles) $\xrightarrow{\text{heat}}$ N-4 tolylpyrrolidine, 42 dil al
17	<b>1,2,3-Tribromopropane</b>	220	1.582	2.402	
18	<b>1,5-Dibromopentane</b>	221	1.514 <sup>15</sup>	1.694 <sup>25</sup>	6-Nitro-2-mercaptopbenzothiazole deriv., 132 3 S-Alkyl bis-(thiuronium picrate), 247
19	<b>1,1,2,2-Tetrabromoethane</b>	243-4	1.638	2.967	
20	<b>1,8-Dibromooctane</b>	270-2	1.501 <sup>15</sup>	1.468 <sup>15</sup>	m p 15-6, S-Alkyl bis-(thiuronium picrate), 214
21	<b>1,9-Dibromononane</b>	285-8		1.415 <sup>15</sup>	m p -25, S-Alkyl bis-(thiuronium picrate), 193

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES****B) Dihalides and polyhalides (non-aromatic)****3. Bromides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point °C	Miscellaneous
1	<b>1,7-Dibromoheptane</b>	42	263	S-Alkyl bis-(thiuronium picrate), 208
2	<b>Carbon tetrabromide</b>	92	190	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES****B) Dihalides and polyhalides (non-aromatic)****4. Iodides a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	$n_{D}^{20}$	$D_{4}^{20}$	Miscellaneous
1	<b>Di-iodomethane (Methylene iodide)</b>	181	1.7425	3.325	6-Nitro-2-mercaptopbenzothiazole deriv., 232-3, Di-(2-naphthyl) ether, 133, S-Alkyl bis-(thiuronium picrate), 267
2	<b>1,3-Di-iodopropane</b>	224	1.6423	2.5755	1,3-Di-(1-naphthyl) ether, 103-4, 1,3-Di-(2-naphthyl) ether, 148-9, 1,3-Diphenyl ether, 60

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES****B) Dihalides and polyhalides (non-aromatic)****4. Iodides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point, °C	Miscellaneous
1	<b>1,2-Di-iodoethane</b>	81		6-Nitro-2-mercaptobenzothiazole deriv , 202 ether, 217
2	<b>Iodoform</b>	119		Comp with quinoline, 65

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 1. Fluorides (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	1,3-Difluorobenzene	82		1 4404 <sup>18</sup>	1 1473 <sup>25</sup>	74	1 3			
2	Fluorobenzene	87		1 466	1 024			125	4	Boiling with NaOH → 4-fluorophenol, 48, b p 186–8, n <sub>D</sub> <sup>20</sup> 1 5010, D <sup>56</sup> 1 1889
3	1,4-Difluorobenzene	88		1 4423 <sup>18</sup>	1 1632 <sup>25</sup>					
4	1,2-Difluorobenzene	92	-34	1 4451 <sup>18</sup>	1 1496 <sup>25</sup>			105	5	Oxid → 2-fluorobenzoic acid, 127
5	2-Fluorotoluene	114						174	6	Oxid → 3-fluorobenzoic acid, 124
6	3-Fluorotoluene	116						141	2	Oxid → 4-fluorobenzoic acid, 182
7	4-Fluorotoluene	117		1 496	0 998					Picrate, 113
8	1-Fluoronaphthalene	214		1 594	1 134					Picrate, 101
9	2-Fluoronaphthalene		60							

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**

• C) Aryl halides 2. Chlorides a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	Chlorobenzene	132		1.525	1.107	52	2,4	144	4	2,4-Dinitrobenzenesulfenyl chloride adduct, 123 4
2	2-Chlorotoluene	159		1.524	1.082	63	3,5	128	5	Oxid → 2-chlorobenzoic acid, 141
3	3-Chlorotoluene	162		1.521	1.072	91	4,6	185	6	Oxid → 3-chlorobenzoic acid, 158
4	4-Chlorotoluene	162	7	1.521	1.071	38	2	143	2	Oxid → 4-chlorobenzoic acid, 240
5	1,3-Dichlorobenzene	173		1.546	1.288	103	4,6	182	6	
6	1-Chloro-2-ethylbenzene	178, 180		1.5218	1.057					Oxid → 2-chlorobenzoic acid, 141
7	1,2-Dichlorobenzene	179		1.552	1.305	110	4,5	135, 140	4	
8	1-Chloro-3-ethylbenzene	184		1.5199	1.053					Oxid → 3-chlorobenzoic acid, 158
9	1-Chloro-4-ethylbenzene	184, 180-1		1.5175	1.045					Oxid → 4-chlorobenzoic acid, 240
10	2-Chloro-1,4-dimethylbenzene	184-5	2		1.059 <sub>20</sub> <sup>20</sup>	77, 101	5, 5,6	155	5	Sulfonyl chloride, 50
11	1-Chloro-2-vinylbenzene ( <i>o</i> -Chlorostyrene)	189		1.5649	1.100					Polymerizes on heating with benzoyl peroxide
12	1-Chloro-2,3-dimethylbenzene	190								Oxid → 3-chloro-2-methylbenzoic acid, 159
13	1-Chloro-2-isopropylbenzene	191		1.5168	1.0341					Oxid → 2-chlorobenzoic acid, 141
14	1-Chloro-2,4-dimethylbenzene	192, 187		1.5230 <sup>25</sup>	1.0598 <sub>20</sub> <sup>20</sup>	42	6	195	6	Oxid $\xrightarrow[\text{aq. KMnO}_4]{\text{CrO}_3/\text{H}_2\text{SO}_4}$ 4-chloro-3-methylbenzoic acid, 209 10. Oxid $\xrightarrow{\text{Fe}} 4\text{-chloroisophthalic acid, 294 5}$
15	1-Chloro-4-vinylbenzene ( <i>p</i> -Chlorostyrene)	192		1.5660	1.0868					Polymerizes on heating with peroxide
16	1-Chloro-3,4-dimethylbenzene	194-5	-6		1.069 <sub>15</sub> <sup>15</sup>	63	5	207	5	Cl <sub>2</sub> $\xrightarrow{\text{Fe}}$ 1,2-dichloro-4,5-dimethylbenzene, 76
17	1-Chloro-4-isopropylbenzene ( <i>p</i> -Chlorocumene)	198		1.5117	1.0208			91		Oxid → 4-chlorobenzoic acid, 240
18	2,6-Dichlorotoluene	199		1.5510	1.2686	50, 121	3, 3,5			Chlorosulfonic acid in chl → 3-sulfonyl chloride 54 6, 60. Oxid → 2,6-dichlorobenzoic acid 139
19	2,5-Dichlorotoluene	199	4-5		1.2535 <sub>20</sub> <sup>20</sup>	50 1, 100-1	4, 4,6			Oxid $\xrightarrow{\text{dil HNO}_3}$ 2,5-dichlorobenzoic acid, 154
20	2,4-Dichlorotoluene	200			1.549	1.249	104	3,5		Oxid → 2,4-dichlorobenzoic acid, 164
21	3,5-Dichlorotoluene	201				61 2, 99-100	2, 2,6	168 9	2	Oxid → 3,5-dichlorobenzoic acid, 188
22	2-Chloro-1,3,5-trimethylbenzene	204-6		1.5212 <sup>30</sup>	1.0337 <sup>30</sup>	178	4,6	165-6		Oxid $\xrightarrow{\text{aq. KMnO}_4}$ 2-chlorobenzene tricarboxylic acid, 285 (anh), 278 (hyd)
23	2,3-Dichlorotoluene	207		1.5511		51, 71-2	4, 4,6			Oxid $\xrightarrow{\text{alk. KMnO}_4}$ 2,3-dichlorobenzoic acid, 163
24	3,4-Dichlorotoluene	209		1.5471	1.2526	63, 91-2	6, 2,6			Oxid → 3,4-dichlorobenzoic acid, 206
25	1,2,4-Trichlorobenzene	213	17			56, 103	5, 3,5	>200		Sulfonyl chloride, 31-4
26	2-Chloro-4-isopropyl-1-methylbenzene (2-Chloro- <i>p</i> -cymene)	217		1.5178 <sup>17</sup>	1.0154 <sup>17</sup>	109-10	5,6			Boiling with dil HNO <sub>3</sub> → 3-chloro-4-methylbenzoic acid, 196
27	3-Chloro-4-isopropyl-1-methylbenzene (3-Chloro- <i>p</i> -cymene)	217		1.5179 <sup>18</sup>	1.0184 <sup>18</sup>	102-3, 106	2,6			
28	1-Chloronaphthalene	259		1.633	1.191	180	4,5			Picrate, 137
29	3-Chlorobiphenyl	284-5	16			202-3	4,4'			Oxid → 3-chlorobenzoic acid, 158, 155

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 2. Chlorides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
1	2-Chlorobenzotrichloride	29	283					Hydrolysis → 2-chlorobenzoic acid, 142
2	2,4,6-Trichlorotoluene	33 4, 38	54 50 178 80	3, 3 5				Oxid → 2,4,6-trichlorobenzoic acid, 160-1
3	2-Chlorobiphenyl	34	273					Oxid → 2-chlorobenzoic acid, 141
4	1,2-Dichloronaphthalene	35	296	169	di			n <sub>D</sub> <sup>20</sup> 1.6337, D <sub>4</sub> <sup>20</sup> 1.3147 Oxid $\text{CrO}_3/\text{ac } a$ → 5,6-dichloro-1,4-naphthoquinone, 181
5	2,3,4-Trichlorotoluene	41	231 <sup>761</sup>	60, 140-1	5 or 6, 5,6			Oxid → 2,3,4-trichlorobenzoic acid, 186-7
6	1,2,3,4-Tetrachlorobenzene	44-5	254	63 5, 151	5, 5,6			
7	3,4,5-Trichlorotoluene	44-5	245 <sup>788</sup>	81 2, 163-4	2, 2,6			Oxid → 3,4,5-trichlorobenzoic acid, 203, $\text{Cl}_2 \xrightarrow{\text{Al/Hg}}$ 2,3,4,5-tetrachlorotoluene, 97-8
8	2,3,5-Trichlorotoluene	45-6	232	58 9, 149-50	4 or 6, 4,6			Oxid → dil HNO <sub>3</sub> → 2,3,5-trichlorobenzoic acid, 162
9	1,6-Dichloronaphthalene	48		119	4	216	4	
10	1,2,3,5-Tetrachlorobenzene	50-1	246	40-1, 161-2	4, 4,6			
11	1,2,3-Trichlorobenzene	52 3	218-9	56, 92-3	4, 4,6	226-30	4	Sulfonyl chloride, 65
12	1,4-Dichlorobenzene	53	173	54	2	180 186	2	
13	4,4'-Dichlorodiphenylmethane	55	337	198-9	3,3'			Oxid → CrO <sub>3</sub> /ac a → 4,4'-dichlorobenzophenone, 145
14	2-Chloronaphthalene	56, 61	265	175	1,8	126	Picrate, 81	
15	2,2'-Dichlorobiphenyl	60		203-5	5,5'			
16	1,3-Dichloronaphthalene	61	291 <sup>775</sup>	150 and 158	di			Oxid → dil HNO <sub>3</sub> → phthalic acid, 200-6
17	1,3,5-Trichlorobenzene	63	208	68	2	210 2	Sulfonyl chloride, 35-40	
18	1,7-Dichloronaphthalene	63-4	286	138-9		226	Sulfonyl chloride, 118	
19	1-Bromo-4-chlorobenzene	67	197	72	2			
20	1,4-Dichloronaphthalene	68	286 <sup>740</sup>	92	8	244	6	Oxid → CrO <sub>3</sub> /ac a → 5,8-dichloro-1,4-naphthoquinone, 173 4 Boiling HNO <sub>3</sub> (D = 1.3) → 3,6-dichlorophthalic acid, 194 185
21	2,5-Dichloro-1,4-dimethylbenzene (2,5-Dichloro p-xylene)	68	224				Oxid → 2,5-dichloroterephthalic acid, 306	
22	4-Chlorobiphenyl	77	293				Oxid → 4-chlorobenzoic acid, 240	
23	2,4,5-Trichlorotoluene	82	230 <sup>715</sup>	89-90, 226 7	3, 3,6		Oxid → 2,4,5-trichlorobenzoic acid, 168	
24	Pentachlorobenzene	86, 84	276	143, 146	6			
25	1,8-Dichloronaphthalene	89				228	4	Sulfonyl chloride, 141
26	1,5-Dichloronaphthalene	107		142	8	204	3	Oxid → CrO <sub>3</sub> /ac a → 3-chlorophthalic acid, 185 7 Picrate, 87
27	2,7-Dichloronaphthalene	114 5		141 2	mono	218	3	Oxid → dil HNO <sub>3</sub> → 4-chlorophthalic acid, 157
28	2,6-Dichloronaphthalene	135-6	285			269	4	Sulfonyl chloride, 136, Cl <sub>2</sub> in chl → 1,2,6-trichloronaphthalene, 92 Oxid → CrO <sub>3</sub> /ac a → 1,4-naphthoquinone deriv 148 9
29	1,2,4,5-Tetrachlorobenzene	140	245	99, 232	3, 3,6		Chlorosulfonic acid → hexachlorobenzene, 229	
30	4,4'-Dichlorobiphenyl	149					Oxid → 4-chlorobenzoic acid, 240	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 2. Chlorides b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
31	5,6,7,8-Tetrachlorotetralin	174	180 <sup>26</sup>					$\text{Br}_2 \text{ in } \text{CS}_2 \rightarrow$ 1,2-dibromo-5,6,7,8-tetrachloronaphthalene, 142 $\text{CrO}_3/\text{ac a}$ $\rightarrow$ 2,4-dichloro-1-naphthol, 106-7 Boiling $\text{HNO}_3 \rightarrow$ phthalic acid, 200-6 fuming $\text{HNO}_3$
32	1,2,3,4-Tetrachlorotetralin	182, 187						Oxid $\rightarrow$ 2,4-dichloro-1-naphthol, 106-7 Boiling $\text{HNO}_3 \rightarrow$ phthalic acid, 200-6 fuming $\text{HNO}_3$
33	Octachloronaphthalene	198, 200	442					Oxid $\rightarrow$ hexachloro-1,4-naphthoquinone, 222 $\text{SbCl}_5$ in $\text{CCl}_4 \rightarrow$ cherry-red color
34	9,10-Dichloroanthracene ( <i>meso</i> -Dichloroanthracene)	209-10, yel				279	2	Sulfonyl chloride, 221-5, Oxid $\rightarrow$ 9,10-anthraquinone, 286, Maleic anh adduct, 258 9 Boiling with fuming $\text{HNO}_3 + \text{conc H}_2\text{SO}_4 \rightarrow$ tetrachloro-1,4-benzoquinone (chloroanil), 290
35	Hexachlorobenzene	229, subl, 226	309					

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 3. Bromides a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	Bromobenzene	156		1.560	1.494	70-2	2,4	166 161	4	1-Naphthylamide, 161, 2,4-Dinitrobenzenesulfenyl chloride adduct, 140-1
2	2-Bromotoluene	182			1.425	82	3,5	146	5	Oxid → 2-bromobenzoic acid, 150
3	3-Bromotoluene	184			1.410	103	4,6	168	6	Oxid → 3-bromobenzoic acid, 155
4	1-Bromo-2-ethylbenzene	199		1.5486	1.355					Oxid → 2-bromobenzoic acid, 150
5	1-Bromo-4-ethylbenzene	205		1.5448	1.342					Oxid → 4-bromobenzoic acid, 251
6	1-Bromo-2-vinylbenzene ( <i>o</i> -Bromostyrene)	210		1.5927	1.4160					Polymerizes on heating with benzoyl peroxide
7	1-Bromo-2-isopropylbenzene	210		1.5408	1.3020					Oxid → 2-bromobenzoic acid, 150
8	1-Bromo-4-vinylbenzene ( <i>p</i> -Bromostyrene)	212		1.5947	1.398					Polymerizes on heating with benzoyl peroxide, Oxid → 4-bromobenzoic acid, 251
9	1-Bromo-2,3-dimethylbenzene	217								Oxid → 3-bromophthalic acid, 188
10	1,3-Dibromobenzene	219		1.606	1.952	61	4	190	6	Oxid → 4-bromobenzoic acid, 251
11	1-Bromo-4-isopropylbenzene	219		1.5361	1.2854					Anilide, 143
12	1,2-Dibromobenzene	219		1.609	1.956	114	4,5	176	4	Oxid → 2,5-dibromobenzoic acid, 157
13	2-Bromocymene	234			1.267	97				Oxid → 3,4-dibromobenzoic acid, 235
14	2,5-Dibromotoluene	236			1.811					Picrate, 134, Carbonation of Grignard → 1-naphthoic acid, 162
15	3,4-Dibromotoluene	240			1.81					Oxid → 2-bromobenzoic acid, 150
16	1-Bromonaphthalene	281		1.658	1.484	85	4	191 193	4	
17	2-Bromobiphenyl	297								

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 3. Bromides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfonamide group	
1	4-Bromotoluene	28-9	184					Oxid → 4-bromobenzoic acid, 251
2	2-Bromonaphthalene	59	281			208	8	Picrate, 86, 79, 2,4,7-Trinitrofluorenone adduct, 138-40
3	1,2-Dibromonaphthalene	67						Oxid → 3,4-dibromophthalic acid, 196
4	1,4-Dibromonaphthalene	82						Oxid → 3,6-dibromophthalic acid, 135
5	1,4-Dibromobenzene	89	219	84	2,5	195	2	
6	4-Bromobiphenyl	89	310					Oxid → 4-bromobenzoic acid, 251
7	1,3,5-Tribromobenzene	120	271			222	2	
8	4,4'-Dibromobiphenyl	164						Oxid → 4-bromobenzoic acid, 251
9	1,2,4,5-Tetrabromobenzene	180		168	3			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 4. Iodides a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Nitro derivative		Sulfonamide		Miscellaneous
						M P	Position of nitro groups	M P	Position of sulfonamide group	
1	Iodobenzene	188-7		1.620	1.831	171	4			$\text{Br}_2 \rightarrow$ 1-Bromo-4 iodobenzene 91
2	3-Iidotoluene	204			1.698	108	4,6			Oxid $\rightarrow$ 3-iodobenzoic acid, 187
3	2-Iidotoluene	211			1.698	103	6			Oxid $\rightarrow$ 2-iodobenzoic acid, 162
4	1-Iodo-4-isopropylbenzene	236-8								$\text{Cl}_2$ in chl $\rightarrow$ dichloride ( $\text{ArICl}_2$ ) 110
5	1-Iodonaphthalene	305								Picrate, 128

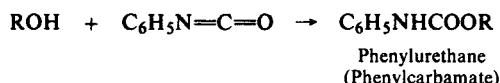
\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE V. ORGANIC DERIVATIVES OF HALIDES**  
**C) Aryl halides 4. Iodides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Nitro derivative		Sulfonamide		Miscellaneous
				M P	Position of nitro groups	M P	Position of sulfo- amide group	
1	4-Iodotoluene	35	211					HNO <sub>3</sub> at 200° → 4-iodobenzoic acid, 270
2	1-Iodo-2,4,5-trimethylbenzene	37	256–8					Cl <sub>2</sub> in chl → dichloride (ArICl <sub>2</sub> ), 66
3	1,3-Di-iodobenzene	40	285					
4	2-Iodonaphthalene	55	309					Picrate, 95
5	4-Iodobiphenyl	114	320 d	171	2,5			Cl <sub>2</sub> in chl → dichloride (ArICl <sub>2</sub> ), 102
6	1,4-Di-iodobenzene	129	289					

\*Derivative data given in order m p , crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE VI

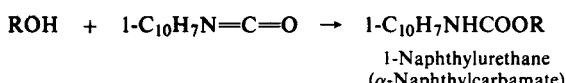
*Phenylurethane.*

From the dry alcohol with phenylisocyanate without solvent.

For directions and examples see: Linstead, pp. 34-35; Shriner, p. 211; Vogel, p. 264; B. T. Dewey and N. F. Witt, *Ind. Eng. Chem., Anal. Ed.*, **12**, 459 (1940); **14**, 648 (1942).

From the dry alcohol with phenylisocyanate in petrol ether.

See: Wild, pp. 55-57.

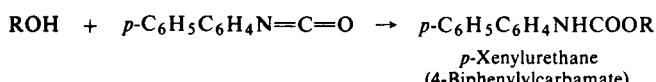
*1-Naphthylurethane ( $\alpha$ -Naphthylcarbamate).\**

From the dry alcohol with 1-naphthylisocyanate without solvent.

For directions and examples see: Cheronis, pp. 475-479; Linstead, pp. 34-35; Shriner, p. 211; Vogel, p. 264; V. T. Bickel and H. E. French, *J. Amer. Chem. Soc.*, **48**, 747 (1926); H. E. French and A. F. Wirtel, *J. Amer. Chem. Soc.*, **48**, 1736 (1926).

From the dry alcohol with 1-naphthylisocyanate in petrol ether.

See: Cheronis, pp. 476-477; Wild, pp. 55-57.

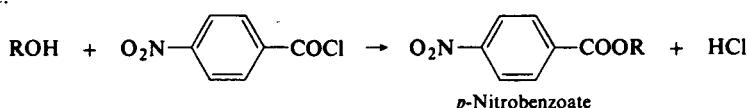
*p-Xenylurethane (4-Biphenylylurethane).*

From the alcohol with *p*-xenylisocyanate in toluene.

For directions and examples see: G. T. Morgan and A. E. J. Pette, *J. Chem. Soc.*, 1124 (1931); B. Witten and E. E. Reid, *J. Amer. Chem. Soc.*, **69**, 2470 (1947).

From the alcohol with *p*-xenylisocyanate in a benzene—petrol ether mixture.

See: M. J. van Gelderen, *Rec. Trav. chim.*, **52**, 969 (1933).

*p-Nitrobenzoate.\**

From the alcohol in excess and *p*-nitrobenzoyl chloride.

For directions and examples see: Cheronis, pp. 467-469, 471; Shriner, p. 212; Vogel, p. 263; Wild, p. 52; M. D. Armstrong and J. E. Copenhagen, *J. Amer. Chem. Soc.*, **65**, 2252 (1943).

From an aqueous solution of the alcohol with *p*-nitrobenzoyl chloride in a ligroin-benzene mixture.

See: Cheronis, pp. 468-469, 472.

From the alcohol with *p*-nitrobenzoyl chloride in pyridine.

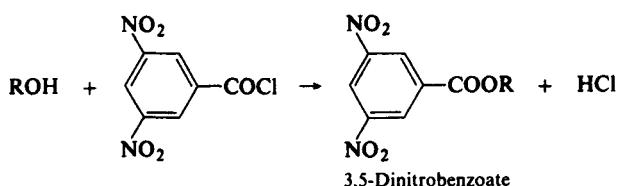
See: Shriner, p. 212; Wild, p. 52; L. F. King, *J. Amer. Chem. Soc.*, **61**, 2383 (1939).

From the alcohol with *p*-nitrobenzoyl chloride in aqueous sodium hydroxide.

See: Wild, p. 52.

From the alcohol with *p*-nitrobenzoyl chloride in an aqueous solution of sodium acetate and potassium hydroxide at low temperature.

See: Wild, p. 53; F. A. Menalda, *Rec. Trav. chim.*, **49**, 967 (1930); H. Henstock, *J. Chem. Soc.*, 216 (1933).

*3,5-Dinitrobenzoate.\**

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE VI (Continued)

From the alcohol in excess with 3,5-dinitrobenzoyl chloride.

*For directions and examples see:* Cheronis, pp. 467-470; Shriner, pp. 212-213; Vogel, p. 262; G. B. Malone and E. E. Reid, *J. Amer. Chem. Soc.*, **51**, 3424 (1929).

From an aqueous solution of the alcohol with 3,5-dinitrobenzoyl chloride in a ligroin-benzene mixture.

*See:* Cheronis, pp. 468-469, 472.

From the alcohol with 3,5-dinitrobenzoyl chloride and pyridine in benzene.

*See:* Linstead, p. 34; Wild, p. 53; T. Reichstein, *Helv. chim. Acta*, **9**, 799 (1926); W. M. D. Bryant, *J. Amer. Chem. Soc.*, **54**, 3758 (1932).

From the alcohol with 3,5-dinitrobenzoyl chloride and a catalytic amount of pyridine in isopropyl or *n*-butyl ether.

*See:* Cheronis, pp. 469, 471.

From the alcohol with 3,5-dinitrobenzoyl chloride in pyridine.

*See:* Cheronis, p. 469; Shriner, pp. 212-213; Vogel, pp. 262-263.

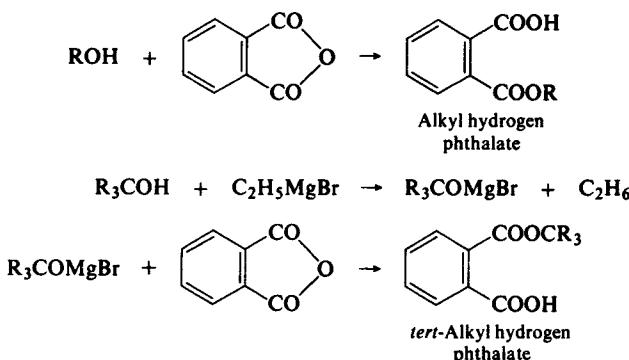
From the alcohol with 3,5-dinitrobenzoyl chloride in aqueous potassium hydroxide.

*See:* Linstead, p. 34.

From the alcohol in aqueous sodium hydroxide and potassium acetate with 3,5-dinitrobenzoyl chloride in a benzene-ligroin mixture.

*See:* Wild, pp. 53-54; W. N. Lipscomb and R. H. Baker, *J. Amer. Chem. Soc.*, **64**, 179 (1942).

*Hydrogen phthalate.\**



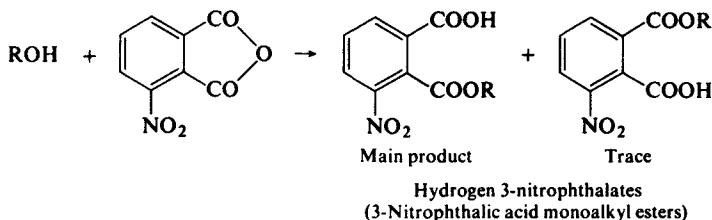
From the alcohol with phthalic anhydride.

*For directions and examples see:* E. E. Reid, *J. Amer. Chem. Soc.*, **39**, 1250 (1917); J. F. Goggans and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **61**, 2909 (1939).

From the alkoxy-magnesium halide derived from a tertiary alcohol (prepared from the alcohol with ethyl-magnesium bromide) with phthalic anhydride in ether or an ether-dioxan mixture.

*See:* W. A. Fessler and R. L. Shriner, *J. Amer. Chem. Soc.*, **58**, 1384 (1936).

*Hydrogen 3-nitrophthalate.\**



From the alcohol with 3-nitrophthalic anhydride.

*For directions and examples see:* Cheronis, pp. 473-474; Linstead, p. 35; Shriner, p. 213; Vogel, p. 265; Wild, p. 59; G. M. Dickinson, L. H. Crosson and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **59**, 1094 (1937); B. H. Nicolet and J. Sacks, *J. Amer. Chem. Soc.*, **47**, 2348 (1925); A. J. Veraguth and H. Diehl, *J. Amer. Chem. Soc.*, **62**, 233 (1940).

From a high boiling alcohol with 3-nitrophthalic anhydride in toluene.

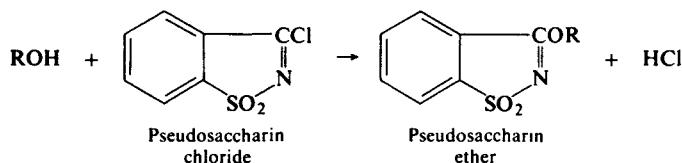
*See:* Linstead, p. 35; Shriner, p. 213; Vogel, p. 265; Wild, p. 59; G. M. Dickinson, L. H. Crosson and J. E. Copenhaver, *J. Amer. Chem. Soc.*, **59**, 1094 (1937).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE VI (Continued)

*Pseudosaccharin ether (Pseudosaccharin derivative).*



From the alcohol with pseudosaccharin chloride without solvent.

For directions and examples see: Vogel, p. 266; Wild, pp. 60-61; J. R. Meadoe and E. E. Reid, *J. Amer. Chem. Soc.*, **65**, 457 (1943).

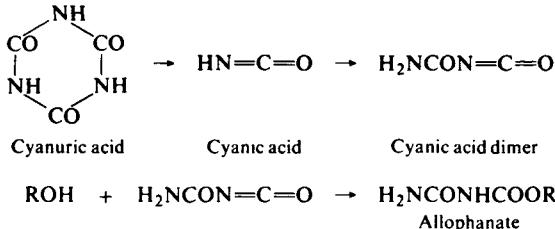
From the alcohol with pseudosaccharin chloride in chloroform.

See: H. Böhme and H. Opper, *Z. Anal. Chem.*, **139**, 255 (1953).

From the alcohol with pseudosaccharin chloride and a catalytic amount of pyridine in chloroform.

See: Cheronis, p. 482; H. Böhme and H. Opper, *Z. Anal. Chem.*, **139**, 255 (1953).

*Allophanate*



From the alcohol with cyanic acid (prepared from the depolymerization of cyanuric acid).

For directions and examples see: Linstead, p. 36; A. Behâl, *Compt. rend.*, **168**, 945 (1919); M. A. Spielman, J. D. Barnes and W. J. Close, *J. Amer. Chem. Soc.*, **72**, 2520 (1950); H. W. Blohm and E. I. Becker, *J. Amer. Chem. Soc.*, **72**, 5342 (1950); *Chem. Revs.*, **51**, 471 (1952).

From the alcohol with sodium cyanate and dry hydrochloric acid in dioxane.

See: E. S. Lane, *J. Chem. Soc.*, 2764 (1951).

*Benzoate.\**



*Especially for polyhydric alcohols.*

From the alcohol with benzoyl chloride.

For directions and examples see: Shriner, p. 212.

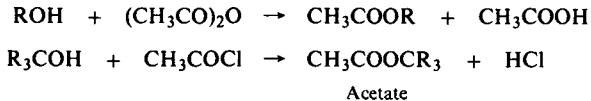
From the alcohol with benzoyl chloride in anhydrous pyridine.

See: Cheronis, pp. 481-482; Shriner, p. 212; Vogel, pp. 243, 447.

From the alcohol with benzoyl chloride in aqueous sodium hydroxide.

See: Vogel, p. 447.

*Acetate.*



*Especially for polyhydric alcohols.*

From the alcohol with acetic anhydride and sodium acetate.

For directions and examples see: Linstead, pp. 35, 39; Shriner, p. 212.

From the alcohol with acetic anhydride in pyridine.

See: Shriner, p. 212.

From the alcohol (especially a tertiary alcohol) with acetyl chloride in the presence of magnesium.

See: A. Spassow, *Chem. Ber.*, **70B**, 1926 (1937).

*NOTE:* For additional information regarding directions and examples for the preparation of derivatives of polyhydric alcohols see explanations and references to Table XIX, p. 326.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenylurethane	1 Naphthylurethane	4 Nitrobenzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
1	<b>Methanol</b> (Methyl alcohol)	64.65	f p -97	1.3306 <sup>15</sup>	0.7915	47, al	124, lgr	96, dil al	108 (cor), al	153 (cor)	82.5 (cor)	Pseudosaccharin ether, 182 (cor)
2	<b>Ethanol</b> (Ethyl alcohol)	78.32	f p -117.3	1.3610	0.7894	52	79, lgr	57, al	93, al	158 (cor), w	48	Pseudosaccharin ether, 219 (cor)
3	<b>2-Propanol</b> (Isopropyl alcohol)	82.4	-89.5	1.37927	0.78507	75-6, lt pet	106	110.5, lt pet 108	123, pet eth	154 (cor), w		Pseudosaccharin ether, 137 (cor)
4	<b>d,l-3-Buten-2-ol</b> (Methyl vinyl carbinol)	94.6								43-4		Allophanate, 152, Constant boil mixt with 21.76% w, b.p. 80
5	<b>2-Propen-1-ol</b> (Allyl alcohol)	97.1		1.41345	0.8540	70	108	28	49-50	124		
6	<b>1-Propanol</b> (n-Propyl alcohol)	97.1		1.38499	0.80359	57, pet	80, 76	35, pet	74, pet eth	145.5 (cor), w	54.1-4 (cor), pet eth - bz (9.1)	Pseudosaccharin ether, 124.5 (cor)
7	<b>2-Butanol</b> (d,l-sec-Butyl alcohol, Ethyl methyl carbinol)	99.5		1.39495 <sup>25</sup>	0.80692	64.5, pet	97	25-6, dil al	76	131 (cor)	59-60	Pseudosaccharin ether, 65.5 (cor)
8	<b>2-Methyl-2-butanol</b> (tert-Amyl alcohol)	102.3	-8.55	1.4052	0.80889	42, pet eth	72	85	116, 117-8			
9	<b>2-Fluoroethanol</b>	105		1.3633 <sup>25</sup>								
10	<b>2-Methyl-1-propanol</b> (Iso-butyl alcohol)	108.1		1.3939 <sup>25</sup>	0.80196	86, lgr	104	69	87	180.5 (cor)	65, pet eth	Pseudosaccharin ether, 100 (cor)
11	<b>3-Buten-1-ol</b>	122.5-3.5 <sup>25</sup>				23.4-4.5						
12	<b>d,l-3-Methyl-2-butanol</b> (sec-Isoamyl alcohol, d,l-Isopropyl methyl carbinol)	114, d 110-2		1.3973	0.8180	68	109			127	39, d 34, l 34	d [α] <sub>D</sub> <sup>20</sup> +5.34, in al
13	<b>3-Pentanol</b> (sym-sec-Amyl alcohol, Diethyl carbinol)	116.1		1.4103	0.82037	48-9	95, lgr	17	101, 99, 97	121		
14	<b>1-Butanol</b> (n-Butyl alcohol)	117.6, 116	-90.2	1.3974 <sup>25</sup>	0.80960	61	71	70, 64 35-6	64, 62.5	147 (cor)	73.1-5 (cor)	Pseudosaccharin ether, 96 (cor)
15	<b>d,l-2-Pentanol</b> (sec-Amyl alcohol)	119.85		1.4060	0.80919			74.5, 76, d 88-91	17	62	102-3	Pseudosaccharin ether, 38 (cor)
16	<b>3,3-Dimethyl-2-butanol</b> (d,l-Pinacolyl alcohol, tert-Butyl methyl carbinol)	120.4	5.3	1.4148	0.8185	77-8, pet eth			107, yel - wh , pet eth			
17	<b>2,3-Dimethyl-2-butanol</b> (Dimethyl isopropyl carbinol)	120.5	-14	1.4140	0.8208	65-6, pet eth	101		111, yel , bz - pet eth			
18	<b>3-Methyl-3-pentanol</b>	123	-22	1.4166 <sup>25</sup>	0.82334 <sup>25</sup>	43.5	83.5		96.5, yel , pet eth , 62.5			Allophanate, 152 (cor)

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenyl urethane	1-Naph thyl urethane	4 Nitro benzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydro- gen phthalate	Miscellaneous
19	<b>2-Methyl-2-pentanol</b> (Dimethyl <i>n</i> -propyl carbinol)	123, 121	-103, -108	1.4113	0.81341				72			Benzene, 182 al., Allophanate, 128
20	<b>2-Methoxyethanol</b> (Methyl cellosolve, Ethylene glycol mono-methyl ether)	124.5		1.40238	0.9647		112.5 3.0	50.5, dil al		129, dil al		Diphenyl urethane, 51
21	<b>2-Methyl-3-pentanol</b> (Ethyl isopropyl carbinol)	127.5		1.4168	0.82487	50			85, yel., pet eth	150.7	70.69 71, racemic	
22	<b>1-Chloro-2-propanol</b>	127							77			
23	<b>2-Methyl-1-butanol</b> (Active amyl alcohol, <i>d</i> -sec-Butyl carbinol)	128.9		1.4107	0.8193	31	82, lgr		70	157.8, w		[α] <sub>D</sub> <sup>20</sup> - 5.756
24	<b>2-Chloroethanol</b> (Ethylene chlorohydrin)	131				51	101			98		
25	<b>d,l-4-Methyl-2-pentanol</b> (Isobutyl methyl carbinol)	132		1.4011	0.80713	143, et ac	88	26	65, yel., pet eth			
26	<b>3-Methyl-1-butanol</b> ( <i>prum</i> -Isoamyl alcohol)	132	-117	1.40851 <sup>15</sup>	0.80918	56-7, lgr	68	21	61	166.3 (cor.), 30% al 165-6, w		Pseudosaccharin ether, 64 (cor.)
27	<b>d,l-2-Chloro-1-propanol</b>	133.4		1.436	1.103				76			Alkali + heat → propylene oxide b p 35
28	<b>3-Methyl-2-pentanol</b> ( <i>sec</i> -Butyl methyl carbinol)	134.2 <sup>749</sup>					72		43.5, yel., pet eth., 41			
29	<b>2-Ethoxyethanol</b> (Ethylene glycol monoethyl ether)	135		1.40797	0.9297		67.3-5		75, al	118.8.6 (anh), 94.2.4 (mono-hyd) w-al		Diphenyl urethane, 43
30	<b>3-Hexanol</b> (Ethyl <i>n</i> -propyl carbinol)	136		1.4159	0.81851				97, yel - wh., pet eth		76-7, pet eth	
31	<b>2,2-Dimethyl-1-butanol</b> ( <i>tert</i> -Amyl carbinol)	136.7		1.4208	0.82834	65-6	80-1, lgr		51, yel., pet eth			Pseudosaccharin ether, 68-9 It pet
32	<b>1-Pentanol</b> ( <i>n</i> -Amyl alcohol)	138 (cor.)	-78.5	1.40994	0.81479	46	68	11	46.4	136 (cor.)	75.5	Pseudosaccharin ether, 62 (cor.)
33	<b>d,l-2-Hexanol</b> ( <i>n</i> -Butyl methyl carbinol)	138.9 <sup>745</sup>		1.4126 <sup>25</sup>	0.80977 <sup>26</sup>		60.5	40	38.5		d 29	3,5-Dinitrophenyl urethane, 40 Camphor-like odor
34	<b>2,4-Dimethyl-3-pentanol</b>	140		1.42259	0.8288	95, eth - pet eth., 96-9	95, 99	155		150-1		
35	<b>Cyclopentanol</b>	140.85		1.4530	0.94688	132.5, al	118					
36	<b>2-Isopropoxyethanol</b> (Ethylene glycol mono-isopropyl ether)	141.5 <sup>736</sup>		1.40954	0.9030							Triphenylmethyl ether, 71.0-5, me al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS.**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenylurethane	1 Naph thylurethane	4 Nitro benzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitro phthalate	Hydro- gen phthalate	Miscellaneous
37	<b>3-Ethyl-3-pentanol</b> (Triethyl carbinol)	142		1.4305	0.83889							Camphor-like odor, Allo-phanate, 152 (cor )
38	<b>2,3-Dimethyl-1-butanol</b>	145		1.4195	0.8297 <sup>70.5</sup>	28.9			51.5, pa yel, pet eth			
39	<b>3-Hydroxy-2-butanone</b> (d,l-Acetoin, Acetyl methyl carbinol)	145	-72	1.4178	0.9861 <sup>30</sup>							Semicarbazone, 185, al, 202, 2,4-Dinitrophenylhydrazone, 318, or, PhNO <sub>2</sub> -tol Semicarbazone, 196, al, 2,4-Dinitrophenylhydrazone, 128.5 (cor ), or, al
40	<b>1-Hydroxy-2-propanone</b> (Acetol Acetyl carbinol)	146	-17	1.4295	1.0824 <sup>20</sup>							
41	<b>2-Methyl-1-pentanol</b> (2-Methyl-n-amyl alcohol)	148.0		1.4190	0.8208		75.6		50.5, yel, pet eth	145, 141, bz		
42	<b>2-Ethylbutanol</b>	148.9		1.4224	0.83345				51.5, pet eth			
43	<b>2-Bromoethanol</b> (Ethylene bromohydrin)	149d					86					
44	<b>2-n-Propoxyethanol</b> (Ethylene glycol mono-n-propyl ether)	150.0 <sup>736</sup>		1.41328	0.9112							
45	<b>Trichloroethanol</b>	151										
46	<b>3-Methyl-1-pentanol</b>	151-2 153.7 41	19	1.4188	0.8242	87	120 58 d,l 40-1, d 38- 40 l 37.8	71, al	142.3 38, yel pet eth			Urethane 64.5
47	<b>4-Methyl-1-pentanol</b> (Isoamyl carbinol Isohexyl alcohol)	152.3		1.4153	0.8131	48 (cor )			72, pet eth	138.5 40, bz - pet eth		
48	<b>d,l-4-Heptanol</b> (Di-n propyl carbinol)	156	-41.5	1.4205	0.8183		78.80	35	64		60	
49	<b>1-Hexanol</b> (n-Hexyl alcohol)	157.5	-51.6 -46.1	1.41778	0.81893	42	59.62	5	58.4 (cor ), 60.1	124 (cor ), 123	25	Pseudosaccharin ether 60 (cor )
50	<b>d,l-2-Heptanol</b> (n-Amyl methyl carbinol, sec-Heptyl alcohol)	158.7		1.4210	0.8167		54		49.4		57.5 d,l 76.5	
51	<b>2-Isobutoxyethanol</b> (Ethylene glycol mono-isobutyl ether)	159.3 <sup>746</sup>		1.41428	0.8900							
52	<b>2-sec-Butoxyethanol</b> (Ethylene glycol mono-sec-butyl ether)	159.3 <sup>746</sup>		1.41606	0.8966							
53	<b>2,4-Dimethyl-1-pentanol</b>	159.8		1.427	0.793					154.5, bz-pet eth		p-Xenylurethane, 74.5, pet

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenylurethane	1-Naphthylurethane	4-Nitrobenzoate	3,5-Dinitrobenzoate	Hydrogen 3-nitrophthalate	Hydrogen phthalate	Miscellaneous
54	<b>3-Chloro-1-propanol</b> (3-Chloropropyl alcohol)	161.2				38	76		77			
55	<b>2-Methyl-1-hexanol</b>	164.5		1.4250	0.8270					131.2, wh., pet		p-Xenylurethane, 88.0-5, pet
56	<b>2-Ethyl-1-pentanol</b> (2-Ethyl-n-amyl alcohol)	164.6								127.8, bz - pet		p-Xenylurethane, 77-77.5, pet
57	<b>d,l-4-Methyl-1-hexanol</b>	165.173		1.4219	0.8239		50			149		Odor of Amyl alcohol
58	<b>d,l-cis-2-Methylcyclohexanol</b> (cis-Hexahydro-o-cresol)	165.3	-9.3	1.4640	0.9340	90.1 93.4		51.2 55.6	98.9		103.4 104.5	
59	<b>4-Hydroxy-4-methyl-2-pentanone</b> (Diacetone alcohol)	166			0.9306 <sup>25</sup>			48	55			Oxime, 57.5-8.5 lgr -eth
60	<b>d,l-trans-2-Methylcyclohexanol</b> (trans-Hexahydro-o-cresol)	167.4	21	1.4611	0.9235	105 mixt cis + trans - 90.105		65 mixt cis + trans 35-6	114.5 114.5 85.90		124.5 mixt cis + trans 95.6	
61	<b>2-n-Butoxyethanol</b> (Ethylene glycol mono-n-butyl ether)	170.6 <sup>74</sup>		1.4177 <sup>26</sup>	0.9188	62				120.0 120.0 6		4-Nitrophenylurethane, 58.7 9.1, CCl <sub>4</sub>
62	<b>2-Aminoethyl alcohol</b> (Ethanolamine)	171										N-1-Naphthylurea, 186 (cor.) Picrate, 160
63	<b>2,6-Dimethyl-4-heptanol</b> (Di-isobutyl carbinol)	171.4 3.4		1.4242	0.8129 <sub>20</sub> <sup>20</sup>	61.2, lgr -al					118	p-Xenylurethane, 118 Allophanate, 156
64	<b>Furfuryl alcohol</b> (2-Furyl carbinol)	172.170		1.4863	1.1351 <sub>20</sub> <sup>20</sup>	45	129.30, lgr . 133	76	80.1		85	Urethane, 50. Pseudosaccharin ether 55
65	<b>d,l-cis-3-Methylcyclohexanol</b> (cis-Hexahydro-m-cresol)	173.4		1.4572	0.919	87.8	128.9	65	91.2		82-3	
66	<b>d,l-cis-4-Methylcyclohexanol</b> (cis-Hexahydro-p-cresol)	173.4 <sup>750</sup>		1.4549	0.914	118.9		94	134		72.3	
67	<b>d,l-trans-4-Methylcyclohexanol</b> (trans-Hexahydro-p-cresol)	173.45 <sup>74</sup>		1.4534	0.913	124.5, mixt cis + trans 112.5		67	139.40, mixt cis + trans 125.30		119-25, ac a	
68	<b>d,l-trans-3-Methylcyclohexanol</b> (trans-Hexahydro-m-cresol)	174.5		1.4550	0.9145	93.4 mixt cis + trans 75.85	122	58	97.8, mixt cis + trans 80.5		93.4	
69	<b>2,6-Dimethylcyclohexanol</b>	174.5 <sup>748</sup>		1.4619	0.9115, 0.9235	158						
70	<b>cis-2,5-Dimethylcyclohexanol</b>	175		1.4522 <sup>14</sup>	0.9096 <sup>14</sup>							Allophanate, 157.8
71	<b>trans-2,4-Dimethylcyclohexanol</b>	175		1.4560	0.900	96						Acetate, b p 198 <sup>74</sup>
72	<b>1,3-Dichloro-2-propanol</b>	176				73	115					

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenyl urethane	1 Naph thyl urethane	4 Nitro benzoate	3,5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydro- gen phthalate	Miscellaneous
73	<b>3-Bromo-1-propanol</b> (Triethylene bromo- hydrin)	176d					73					
74	<b>cis-2,4-Dimethylcyclohexanol</b>	176		1 4582	0 907							
75	<b>1-Heptanol (n-Heptyl alcohol)</b>	176.8	-34.6 -33.8	1 4245	0 82242	60 65	62	10	46 47	127 (cor)	16.5-17.5	Pseudosaccharin ether, 55 (cor) Allophanate, 125
76	<b>trans-2,5-Dimethylcyclohexanol</b>	177		1 4545 <sup>17</sup>	0 9079 <sup>17</sup>							
77	<b>2,2-Dimethylcyclohexanol</b>	177	8	1 4648	0 9225	85						
78	<b>Tetrahydrofurfuryl alcohol</b>	177-8 <sup>13</sup>		1 45167	1 0544	61, pet eth bis		46-8	83-4			Diphenylurethane, 81, me al
79	<b>2-Methyl-1,2-propanediol</b> (Isobutylene glycol)	178		1 4358 <sup>17</sup>	0 999 <sup>14</sup>	140 5						
80	<b>d,l-2-Octanol</b>	179		1 4265	0 8205	oil	63-4, 62.5	28	32		55, d,l 75	
81	<b>2,2-Dibromoethanol</b>	179-81										Urethane 90-1
82	<b>1,3,5-Trimethylcyclohexanol</b>	181		1 454 <sup>16</sup> 3	0 8876 <sup>16</sup> 8							
83	<b>2,3Butanediol (2,3-Butylene glycol)</b>	meso 181.7 <sup>42</sup> d,l 176.7 <sup>42</sup>	meso 34.4, d,l 7.6	1 43637	1 0433	meso bis 201						Dibenzoate d,l 53.4, meso 75.5-6.2
84	<b>Cyclohexyl carbinol</b> (Hexahydrobenzyl alcohol)	182		1 4649	0 9280							Acetate, b p 199-201 <sup>740</sup>
85	<b>2,3-Dichloropropanol</b>	182				73	93	37-8				2-Naphthylurethane, 99
86	<b>4-Methyl-1-heptanol</b>	182.7								133		Pseudosaccharin ether, 34 (cor)
87	<b>2-Ethyl-1-hexanol</b>	184.6		1 4328	0 8328	33-4	60 1			108		p-Xenylurethane, 80, pet, Pseudosaccharin ether, 53.5 (cor)
88	<b>3,3-Dimethylcyclohexanol</b>	185 <sup>754</sup>	11.2	1 4606 <sup>15</sup>	0 9128 <sup>14</sup>			83				Acetate, b p 194-5 <sup>750</sup> , o- Nitrobenzoate, 62
89	<b>cis-3,5-Dimethylcyclohexanol</b>	187		1 454 <sup>21</sup>	0 9109 <sup>21</sup>							Acetate, b p 201-2
90	<b>trans-3,5-Dimethylcyclohexanol</b>	d,l 187		1 4579	d 0 9146, l 0 9166							Acetate, d,l, b p, 196 d, [α] <sub>D</sub> <sup>26</sup> +4.55 l, [α] <sub>D</sub> <sup>17</sup> -7.74
91	<b>d,l-1,2-Propanediol (α-Propylene glycol)</b>	187.4		1 43162 <sup>25</sup>	1 0354 <sup>23</sup>	bis 153, 143-4						Monostearate, 59.5, Distearate, 72.3
92	<b>3,4-Dimethylcyclohexanol</b>	189		1 458 <sup>16</sup>	0 9073 <sup>16</sup>	119 cis						
93	<b>2,4,5-Trimethylcyclohexanol</b>	cis 191-3, trans 196				83.5, al, trans 95, al					81-3.5, eth - lgr	
94	<b>1,3,3-Trimethylcyclohexen-6-ol</b>	193 (cor)			0 9310 <sup>13</sup>							Acetate, b p 206.7
95	<b>2,3,6-Trimethylcyclohexanol</b>	193-5 <sup>747</sup>			0 9119 <sup>17</sup>							

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenyl-urethane	1 Naph thyl urethane	4 Nitro benzoate	3,5- Dinitro benzoate	Hydrogen 3-nitro phthalate	Hydro- gen phthalate	Miscellaneous
96	<b>2-(2-Methoxyethoxy)- ethanol</b> (Diethylene glycol monomethyl ether)	194		1.4244	1.035 <sup>20</sup> <sub>20</sub>			92		91 4 2 2 (anh ), 87 90 (mono- hyd ) w -al		4-Nitrophenyl- urethane, 73 5 76
97	<b>S-Nonanol</b>	194 <sup>743</sup>		1.4289 <sup>14</sup>								
98	<b>1-Octanol (n-Octyl alcohol)</b>	195	-16,	1.4274 <sup>25</sup>	0.8249	74 72	67	12	61 2	128 (cor )	22	Allophanate, 158 Pseudosaccharin ether 46 (cor )
99	<b>2-Methyl-2,4-pentanediol</b>	196 198	-16 7	1.42976 <sup>16</sup> <sub>7</sub>	0.9240 <sup>17</sup>							Odor of pinacol, Heating with 2% HBr → diene, b p 75 5-76 0
100	<b>2-(2-Ethoxyethoxy)- ethanol</b> (Diethylene glycol monoethyl ether)	196 <sup>763</sup>		1.4298	1.023 <sup>20</sup> <sub>20</sub>			oil	oil	oil		4 Nitrophenyl- urethane, 65 8 6 3
101	<b>Glycol (1,2-Ethanediol)</b>	197 85	-12 6	1.43192	1.11361	di 157	di 176	140, 141	di 169			bis-4-Nitro- phenylurethane, 135 5
102	<i>d,l</i> - <b>2-Nonanol</b>	198 2		1.4290 <sup>25</sup>	0.81910 <sup>25</sup> <sub>4</sub>		55 5, lt pet		42 8 (cor )		42 4, <i>d,l</i> 58-9	
103	<i>l</i> - <b>Linalool (<i>l</i>-Linalyl alcohol)</b>	199		1.46238	0.8622	65 6	53	70				[α] <sub>D</sub> -3 to -17
104	<b>Benzyl alcohol</b>	205 5	-15 3	1.53955	1.04540	77 75 5 76, pet eth	134	85	113	176	106, 104	Pseudosaccharin ether, 130 (cor )
105	<i>d,l</i> - <b>1,3-Butanediol (<i>d,l</i>-1,3-Butylene glycol)</b>	207 5, 204		1.44252 <sup>19</sup> <sub>5</sub>	1.0053	122-3 d 115-6	184					Diphenyl- urethane / 127 8
106	<i>d,l</i> - <b>2-Decanol</b> (Methyl <i>n</i> -octyl carbinol)	211		1.4344	1.08250		69, lt pet				48 9, <i>d</i> 38 9	
107	<b>1-Nonanol (<i>n</i>-Nonyl alcohol)</b>	213 5		1.43105	0.8271	60, 69, 62-4	65 5	60, 66	52 2	125 (cor )	42 5	Pseudosaccharin ether, 49 (cor )
108	<b>1,3-Propanediol (Tri-methylene glycol)</b>	214 7, 210-2	-30	1.43983	1.0538	di 137	di 164	di 119	di 178			Dibenzoate, 57, 59
109	<b>3-Methylbenzyl alcohol</b> (3-Tolyl carbinol)	217			0.9157 <sup>17</sup>		116					
110	$\alpha$ <b>4-Dimethylbenzyl alcohol</b> ( $\alpha$ -Methyl-4-tolyl carbinol)	219			0.9668 <sup>19</sup> <sub>5</sub>	96, pet eth						
111	<b>1-Phenyl-<i>n</i>-propyl alcohol</b> ( <i>d,l</i> -Phenylethyl carbinol)	219		1.5257	1.0056 <sup>20</sup> <sub>20</sub>		102	59-60, 56 5 7 8				
112	<b>2,3-Dibromo-1-propanol</b>	219d				84		59-60				3,5-Dinitro- phenylurethane, 71
113	<b>2-Phenethyl alcohol</b> (2-Phenylethanol)	219 8	-25 8	1.5240	1.0235 <sup>25</sup> <sub>4</sub>	78, 79- 80, al	119	61 5-2 (cor ), 62-3, al	108	123	188-9	
114	<i>d,l</i> - $\alpha$ - <b>Terpineol</b>	221	35, <i>d,l</i> 37-8	1.4834	0.9337	112 3, me al , <i>d,l</i> 110	152, 147	139, me al	78-9, lgr		117-8, ac a	Commercial liquid, lilac-like odor

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenyl urethane	1 Naph thyl urethane	4 Nitro benzoate	3,5 Dimitro benzoate	Hydro gen 3 nitro phthalate	Hydro gen phthalate	Miscellaneous
115	<b>Citronellol</b>	222 118 <sup>17</sup>										Oxid → Adipic acid, 89, Rose-like odor
116	<b>α-Isopropylbenzyl alcohol</b> ( <i>d,l</i> -Isopropyl phenyl carbinol)	222 4		1 51932 <sup>18</sup>	0 9790 <sup>20</sup> <sub>20</sub>		116 7					Oxid → Iso-propylphenyl ketone, b.p. 222
117	<i>d,l</i> -2-Undecanol ( <i>d,l</i> -2-Hendecanol Methyl <i>n</i> -nonyl carbinol)	228-9			0 8263 <sup>18</sup>						49 50	
118	<b>2-(2-<i>n</i>-Butoxyethoxy)-ethanol</b> (Diethylene glycol mono- <i>n</i> -butyl ether)	228-30		1 4341	0 957 <sup>20</sup> <sub>20</sub>							4-Nitrophenyl-urethane 54 5-5 3
119	<b>1,4-Butanediol</b> (Tetra-methylene glycol)	230, 235	19 0 5	1 4467	1 0171	<i>di</i> 183 3 5 chl 180	<i>di</i> 199, xyl	<i>di</i> 175 ac a				Dibenzoate, 81 2, eth
120	<b>Geraniol</b>	230		1 4766	0 8894		47 8	35	62 3	117	47, lgr	
121	<b>1-Decanol</b> ( <i>n</i> -Decyl alcohol)	231	5 99, 6 4	1 43682	0 8292	59 6, bz , then al	73	30 2, al	57 7	122 8 (cor )	38 (cor )	Pseudosaccharin ether, 47 5 (cor )
122	<b>2-Phenoxyethanol</b> (Ethylene glycol monophenyl ether)	237, 245		1 534	1 102 <sup>22</sup>					112 3		Benzoate 64 4-Toluene-sulfonate 80, al
123	<b>3-Phenylpropanol</b> (Hydrocinnamyl alcohol)	237 4, 235		1 53565	1 0079	45 47-8, al		45 6, 47	92	117		4 Nitrophenyl urethane 104 pet eth
124	<b>1,5-Pentanediol</b> (Penta-methylene glycol)	238-9		1 4499	0 9939 <sup>20</sup> <sub>20</sub>	<i>di</i> 174-5 (cor ) abs al	<i>di</i> 147	<i>di</i> 104-5, bz -al				
125	<b>1-Undecanol</b> (1-Hendecanol <i>n</i> -Undecyl alcohol)	243	15 85, 14 3			62, al , 52		99 5, al	55	123 3 (cor )	43 8 4 1	Allophanate 156 Pseudosaccharin ether 58 5 (cor )
126	<b>Diethylene glycol</b> (β,β'-Dihydroxydiethyl ether)	244 5	f p -10 45	1 4475	1 1212 <sup>15</sup> <sub>15</sub>		149	151 (cor ), 149, ac a				
127	<b>2-Methoxybenzyl alcohol</b> (Saligenin-2-methyl ether)	247		1 549 <sup>17</sup>	1 0495 <sup>15</sup> <sub>15</sub>		135-6					Allophanate, 180, Benzooate, 59, lgr
128	<b>2-Benzylxyethanol</b> (Ethylene glycol mono-benzyl ether)	265 0		1 5225	1 0700 <sup>20</sup> <sub>20</sub>							Triphenylmethyl ether, 76 7, eth
129	<i>n</i> -Hexyl phenyl carbinol	275		1 501	0 946	75						
130	<b>Triethylene glycol</b> (Ethylene glycol di-(β-hydroxyethyl)ether)	285, 165 <sup>14</sup>	-9 4	1 4578 <sup>15</sup>	1 1274 <sup>15</sup> <sub>15</sub>							bis-Triphenylmethyl ether, 142 2 5, acet
131	<b>Glycerol</b> (1,2,3-Trihydroxypropane)	290d	17 9	1 4729	1 26134	<i>tri</i> 180	<i>tri</i> 191-2, al	<i>tri</i> 188				4-Nitrophenyl urethane, 216 Tribenzoate, 71 2, 75 6 Acetate, b.p. 170 <sup>14</sup> , n <sub>D</sub> <sup>15</sup> 1 5245, Benzoate, 36 7
132	<b>3,4-Dimethoxybenzyl alcohol</b> (Veratryl alcohol)	296-7 <sup>32</sup>		1 555 <sup>17</sup>	1 179 <sup>17</sup> <sub>17</sub>	118						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenyl urethane	1 Naph thyl urethane	4 Nitro benzoate	3,5 Dinitro benzoate	Hydrogen 3 nitro phthalate	Hydro gen phthalate	Miscellaneous
133	<b>4-Methoxyphenyl methyl carbinol</b> (4 Anisyl methyl carbinol)	310d (cor.)		1.557	1.086 <sup>16</sup>	82 3						Odor of anise Oxid → 4 Methoxy acetophenone 38
134	<i>cis</i> -Octa-9-decen-1-ol (Oleyl alcohol <i>cis</i> -Octadecenyl alcohol)	333 5		1.4607	0.8489	oil	β 44 5 al					Allphanate 135 chl 129 chl 4 Nitrophenyl urethane 85 91

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	1 Naph thyl urethane	4 Nitro benzoate	3,5 Di nitro benzoate	Hydro gen 3 nitro phthal ate	Hydrogen phthalate	Pseudo sac charine ether	Miscellaneous
1	1-Phenylethyl alcohol ( <i>d,l</i> Methyl phenyl carbinol)	20, 20 1	202	92, 91-2, lgr	106	43 (cor ), al	95 93	108 ac a			$n_D^{20}$ 1 5275, $D_4^{20}$ 1 0129 Oxalate <i>d</i> 61
2	<i>trans</i> -2-Methylcyclohexanol	21	167 4	<i>d,l</i> 105	<i>d,l</i> 155						
3	1-Dodecanol ( <i>n</i> -Dodecyl alcohol, Lauryl alcohol)	24, 26	259	74	80	45, 42	60	124 (cor )	50 3 (cor )	54 (cor )	
4	1,1-Dimethyl-2-phenylethanol (Benzyl dimethyl carbinol)	24	216								$n_D^{20}$ 1 5174
5	4-Methoxybenzyl alcohol (4 Anisyl carbinol)	24-5	259	92 (cor )							Benzoate, 38, Me eth , b p 225-6, $n_D^{20}$ 1 5422, $D_4^{20}$ 1 1129
6	Cyclohexanol	25 1	161 1	82	129	50	112 3, al	160	99		$n_D^{20}$ 1 46477 $D_4^{20}$ 0 94155
7	<i>tert</i> -Butyl alcohol (Trimethyl carbinol)	25 5	82 5	136, eth	101	116, al	142, pet eth				$n_D^{20}$ 1 38779, $D_4^{20}$ 0 78670
8	3-Nitrobenzyl alcohol	27	175-80 <sup>3</sup>								Benzoate, 71 2 Ox → 3-nitro benzoic acid 140
9	2,3,3-Trimethylcyclohexanol	28	197								
10	Diethanolamine ( $\beta,\beta'$ -Dihydroxy-diethylamine)	28	270, 217-8 <sup>150</sup>								Picrate, 109-10
11	2,4-Hexadien-1-ol	30 5-1 5	76 <sup>12</sup>	78-9			85				
12	1-Tridecanol	$\alpha$ 30 6, $\beta$ 28 3	155 6 <sup>16</sup>			37 4 (cor )	124 (cor )	52 5	66 (cor )	$D_4^{20}$ 0 8223	
13	Cinnamyl alcohol	33	257	90 0-1 5	114	78, 76 5	121				
14	2-Methylbenzyl alcohol (2 Tolyl carbinol)	36, 35	219	79 (cor )							
15	<i>trans</i> -Octa-9-decen-1-ol (Elaidyl alcohol)	36 7, 35, 34	333, 216 <sup>18</sup>	56-7	71						
16	<i>d,l</i> -Fenchyl alcohol	38-9, $d\alpha$ 45, $l\alpha$ 47, $l\beta$ 3-4	201 5, $d\alpha$ 82, $l\alpha$ 82 201-2	104, <i>d</i> $\alpha$ 82, <i>l</i> $\alpha$ 82	149	109, $\alpha$ 108 9 $\beta$ 94-5, $l\alpha$ 109, $l\beta$ 83	104	95	169, <i>d</i> $\alpha$ 145, <i>l</i> $\alpha$ 146, <i>l</i> $\beta$ 153		
17	1-Tetradecanol (Myristyl alcohol)	39, 37 7	170-3 <sup>20</sup>	74, 71	82	51 2 (cor )	67	123 5 (cor )	60 (cor )	62 (cor )	$n_D^{18.4}$ 1 469, $D_4^{18.4}$ 0 9274
18	1,2,2-Trimethylcyclohexanol	41 (+ $\frac{1}{2}$ $H_2O$ )	81 4-8 <sup>20</sup>								
19	Pinacol (Tetramethylene glycol)	43, 45-6	172								Diacetate, 65, Hydrate, 46
20	<i>l</i> -Menthol	44, 42 5, 35, 33, 31, <i>d</i> 38-40 <i>d,l</i> 34	216	111-2, al, <i>d,l</i> 103-4	119, 126	61-2	153		112, 129- 31, ac a		Allophanate, 215
21	1-Pentadecanol	$\alpha$ 44, $\beta$ 38 9		72, bz	72	45 8 (cor )		122 5 (cor )	60 4	72 (cor )	
22	1,3,5-Trimethyl-1-cyclohexen-3-ol	46	87-90 <sup>17</sup>								$n_D^{19.3}$ 1 4735, $D_4^{20.2}$ 0 9132
23	<i>d,l</i> - $\alpha$ -Propylbenzyl alcohol	$d$ 49, $l$ 49	168-70 <sup>100</sup>		99	58			91, 53-4		
24	1,1,1-Trichloroisopropanol	50-1	161 8 <sup>773</sup>								
25	1-Hexadecanol (Cetyl alcohol)	50, 49 27	190 <sup>18</sup>	73	82	58 4 (cor ), 52	66	122 (cor )	66 8	69 5 (cor )	Camphor-like odor
26	2,2,6-Trimethylcyclohexanol	51, al	186-7 <sup>53</sup>								$n_D^{20}$ 1 4600, $D_4^{20}$ 0 9128

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	1 Naph thyl urethane	4 Nitro benzoate	3,5 Di nitro benzoate	Hydro gen 3 nitro phthal ate	Hydrogen-phthalate	Pseudo sac charine ether	Miscellaneous
27	3,3,5-Trimethylcyclohexanol	<i>trans</i> 52, 37	<i>cis</i> 201– 37 <sup>50</sup> , <i>trans</i> 196.5 <sup>70</sup>								Acetate, <i>cis</i> b p 209–10, <i>trans</i> b p 209–10
28	2,2-Dimethyl-1-propanol ( <i>tert</i> -Butyl carbinol, Neopentyl alcohol)	52–3	113	144, lgr	100				71		
29	4-Methylbenzhydrol (Phenyl 4-tolyl carbinol)	53, 58, 42								Ox → Phenyl 4-tolyl ketone, 60	
30	1-Heptadecanol	α 54	310		88.5	53.8 (cor.)	121.5 (cor.)	121.0–8 (cor.)	66.6–7 (cor.)	76 (cor.)	
31	Piperonyl alcohol	58		102.5							Benzoate, 66, Allophanate, 176.5
32	4-Methylbenzyl alcohol (4-Tolyl carbinol)	59–60	217	79			117.8				
33	1-Octadecanol (Stearyl alcohol)	59.5	210.5 <sup>15</sup>	79–80		64.3 (cor.)	66	119 (cor.)	72.5 (cor.)	74.5 (cor.)	
34	1-Nonadecanol	62				58.9		71		80.5	
35	Eicosanol	65	220 <sup>3</sup>			69.4			77		Acetate, 40
36	1-(1-Naphthyl) ethanol ( <i>d,l</i> -Methyl 1-naphthyl carbinol)	66							131–2, bz		
37	1,2-Diphenylethanol ( <i>d,l</i> -Benzyl phenyl carbinol)	67	167 <sup>10</sup>						131 (cor.), eth -lt pet		
38	4,4'-Dimethylbenzhydrol (Di-4-tolyl carbinol)	68, al									Carbinyl bromide 48.5–9 lgr
39	Benzhydrol (Diphenyl carbinol)	68, lgr	288, 180 <sup>20</sup>	139.40, bz	135.6, 139	131–2	141		164.5		Acetate 41.2 Benzoate 88–9, al Conc H <sub>2</sub> SO <sub>4</sub> → pa red Tetraacetate, 53
40	1-Glyceryl phenyl ether	69, eth									
41	Erythritol ( <i>d,l</i> -1,2,3,4 Tetrahydroxybutane)	72									
42	Dihydroxyacetone (1,3-Dihydroxy-2-propanone)	72									Diacetate, 48, Di-benzoate, 120.5, 2,4-Dinitrophenyl-hydrazone, 277–8
43	2-Nitrobenzyl alcohol	74	270–165 <sup>20</sup>								Benzoate, 101–2
44	1,10-Decanediol (Decamethylene glycol)	75.5, 72									1,10-Dibromide, 27.4 b p 162.5 5 <sup>10</sup>
45	2,2,2-Tribromoethanol	80	92–3 <sup>10</sup>								Urethane, 86–7
46	10-Nonadecanol (Myricyl alcohol)	85									
47	Phenacyl alcohol ( <i>α</i> -Hydroxy-acetophenone, Benzoyl carbinol)	86	118–20 <sup>11</sup>	96	54		128.6				Benzoate, 118.5, 3-Nitrobenzoate, 104.5
48	<i>n</i> -Triacontanol (1-Hydroxytriacontane)	86.5, bz									Acetate, 69, pet eth
49	2-Hydroxybenzyl alcohol (Saligenin)	86–7									2-Benzoate, 66
50	<i>d</i> -Sorbitol	89–93, 112 (anh.)									Hexaacetate, 99, Hexabenoate, 216–7, et ac
51	3-Nitrophenacyl alcohol (3-Nitrobenzoyl carbinol)	92.5–30, pa yel									Acetate, 53, eth –lgr, Semicarbazone, 214, al

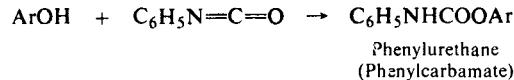
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VI. ORGANIC DERIVATIVES OF ALCOHOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl-urethane	1 Naph thyl urethane	4-Nitro benzoate	3,5-Di nitro benzoate	Hydro gen 3-nitro phthal ate	Hydrogen-phthalate	Pseudo sac charine ether	Miscellaneous
52	<b>4-Nitrobenzyl alcohol</b>	93	185 <sup>12</sup>								Acetate, 78, Benzoate, 94, 5
53	<b>4,4',4''-Trimethyltriphenyl carbinol</b> (Tris- <i>p</i> -tolyl carbinol)	96									Et eth 111 pet eth H <sub>2</sub> SO <sub>4</sub> , → gr - red
54	<b>meso-Erythritol</b>	121, 120 (cor.)	330								Tetraacetate 85, 89
55	<b>4-Nitrophenacyl alcohol</b> (4-Nitrobenzoyl carbinol)	121									Dibenzylidene, 201-2
56	<b>d l-Benzoin</b> (Benzoyl phenyl carbinol)	137, 133	344	165	140	123					Acetate, 124, et ac-lgr., Phenylhydrazone, 178, bz
57	<b>Cinchol</b> ( $\beta$ -Sitosterol)	137							202, 4		4 Nitrophenylurethane 183
58	<b>Furoin</b> (Furoyl furyl carbinol)	138, 9 (cor.), 135									Acetate, 83
59	<b>Cholesterol</b> (anh) ( <i>l</i> -Cholesterol)	148, 5	360d	168	176	185 190, 3				161	Acetate, 134, Benzoate, 145
60	<b>Triphenylmethanol</b> (Triphenyl carbinol)	161, 2, bz	380								Acetate, 76-7 Benzoate, 92-3
61	<b>Ergosterol</b>	165		185	202				202, chl		
62	<b>d-Mannitol</b>	166, <i>l</i> , 163-4, <i>d l</i> - $\alpha$ , 168		303							Acetate, 176, 180, eth, Benzoate, 168
63	<b>1,1,1-Tribromo-<i>tert</i>-butyl alcohol</b> (Brometone)	167-76, w-al									Hexaacetate, 126, eth, Benzoate, 149-50, 147-8, al
64	<b>Dulcitol</b> (1,2,3,4,5,6-Hexanehexol)	188, 5									
65	<b>4,4',4''-Triaminotriphenyl carbinol</b> (Pararosaniline base)	205									Acetate, 43, 4, al, Benzoate, 27, al
66	<b>d-Borneol</b> ("Borneo camphor")	208, 205, <i>d l</i> , 210, 5	212	138-9	132, iso 130, 127	153, <i>d l</i> , 134, 137	154, 5		161, 4, ac a, 165 (cor.)		Hexaacetate, 171, 168, 9, abs al, Hexabenoate, 189-91, eth-chl
67	<b>meso-Inositol</b> (1,2,3,4,5,6-Hexahydroxycyclohexane)	225 (cor.), 218						86, al			4,4',4'' Triacetyl, 192 acet-eth Me eth 105, eth, 135, bz
68	<b>d-Quercitol</b> (Pentahydrocyclohexane)	232, 234									Hexaacetate, 212, subl, tol, Hexabenoate, 258, al
69	<b>Pentaerythritol</b> (2,2-Bishydroxymethyl-1,3-propanediol)	262, 253									Pentabenoate, 155
											Tetraacetate, 84, wh, al, Tetra-benzoate, 99-101, al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE VII

*Phenylurethane*

From the phenol with phenylisocyanate without solvent

*For directions and examples see Linstead, pp 34-35, J B McKinley, J E Nickels and S S Sidue, Ind Eng Chem, Anal Ed, 16, 304 (1944)*

From the phenol with phenylisocyanate in kerosene

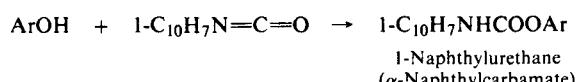
*See Cheronis, p 489*

From the phenol with phenylisocyanate and a catalytic amount of pyridine

*See Shriner, p 265*

From the phenol with phenylisocyanate in toluene

*See O L Brady and J Harris, J Chem Soc, 127, 2175 (1925)*

*1-Naphthylurethane ( $\alpha$ -Naphthylcarbamate) \**

From the phenol with 1-naphthylisocyanate without solvent

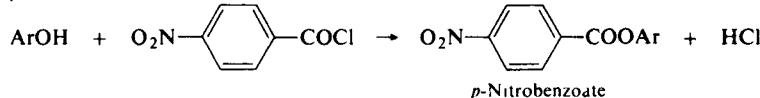
*For directions and examples see Cheronis, p 488, Linstead, pp 34-35, Vogel, p 683, Wild, p 68*

From the phenol with 1-naphthylisocyanate and a catalytic amount of pyridine, triethylamine or trimethylamine in ether

*See Shriner, p 211, Vogel, p 683, Wild, p 68, H E French and A F Wirtel, J Amer Chem Soc, 48, 1736 (1926)*

From the phenol with 1-naphthylisocyanate and a catalytic amount of a tertiary aliphatic amine in petroether

*See Cheronis, p 488, Vogel, p 684*

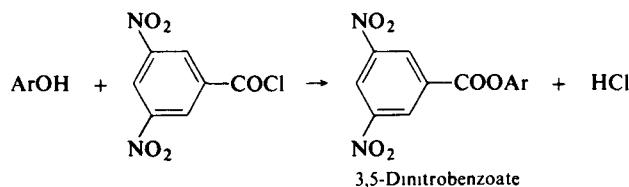
*p-Nitrobenzoate \**

From the phenol with *p*-nitrobenzoyl chloride in pyridine

*For directions and examples see Vogel, p 682, Wild, p 52*

From the phenol with *p*-nitrobenzoyl chloride without solvent

*See Wild, p 52*

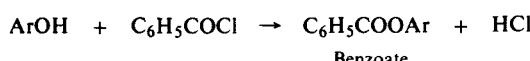
*3,5-Dinitrobenzoate \**

From the phenol with 3,5-dinitrobenzoyl chloride in pyridine

*For directions and examples see Cheronis, p 486, Vogel, p 682, Wild, p 65, R C Brown and R E Kremers, J Amer Pharm Ass, 11, 607 (1922), M Phillips and G L Keenan, J Amer Chem Soc, 53, 1924 (1931)*

From the phenol with 3,5-dinitrobenzoyl chloride without solvent

*See Shriner, pp 212-213*

*Benzooate*

From the phenol with benzoyl chloride in aqueous sodium hydroxide

*For directions and examples see Cheronis, pp 481-482, 487, Linstead, p 20, Wild, p 65*

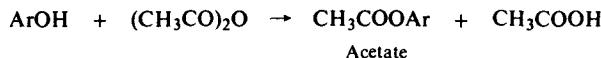
\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE VII (Continued)

From the phenol with benzoyl chloride in pyridine  
*See Linstead, p 19*

### *Acetate*

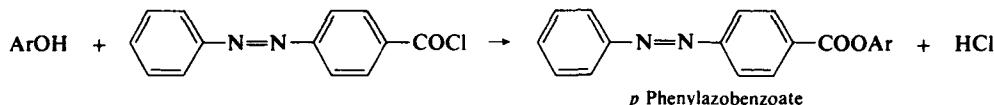


From the phenol with acetic anhydride in aqueous sodium hydroxide  
*For directions and examples see Linstead, p 21, Vogel, p 682, Wild, p 64, F D Chattaway, J Chem Soc, 2495 (1931)*

From the phenol with acetic anhydride and sodium acetate  
*See Linstead, p 21, Wild, p 64*

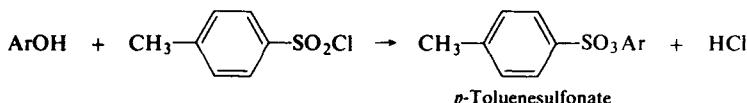
From the phenol with acetic anhydride and a catalytic amount of sulfuric acid  
*See Cheronis, p 487*

### *p-Phenylazobenzoate*



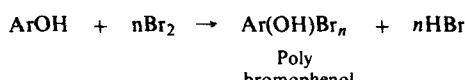
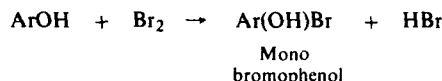
From the phenol with *p*-phenylazobenzoyl chloride in pyridine  
*For directions and examples see Cheronis, p 486, E O Woolfolk and J M Taylor, J Org Chem, 22, 827 (1957)*

### *p-Toluenesulfonate*



From the phenol with *p*-toluenesulfonyl chloride in pyridine  
*For directions and examples see Linstead, p 20, Vogel, p 684, Wild, p 66*  
 From the phenol with *p*-toluenesulfonyl chloride in aqueous sodium hydroxide  
*See Linstead, p 20*  
 From the phenol with *p*-toluenesulfonyl chloride and sodium hydroxide in aqueous acetone  
*See Wild, p 66*

### *Bromo derivative \**



From the phenol in aqueous methanol, in ethanol, in acetone or in dioxane with bromine in aqueous potassium bromide

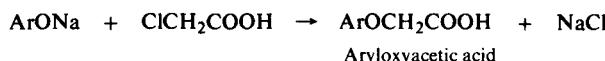
*For directions and examples see Cheronis, p 490. Shriner, p 264*  
 From the phenol in aqueous hydrochloric acid with bromine in water  
*See Linstead, p 19*  
 From the phenol in glacial acetic acid and bromine  
*See Wild, p 73*  
 From the phenol with bromine in carbon disulfide  
*See Vogel, p 679*  
 For a discussion on the effect of solvents in the bromination of phenols  
*See N D Cheronis, Micro and Semimicro Methods (Technique of Organic Chemistry), Vol 6, Interscience, New York, 1954, pp 286-287*

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE VII (Continued)

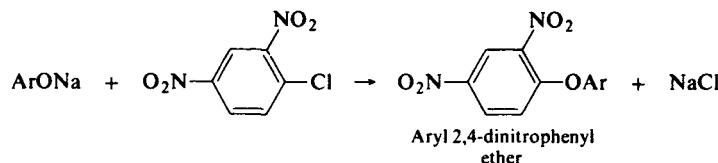
*Aryloxyacetic acid.\**



From the phenol in aqueous sodium hydroxide with aqueous chloroacetic acid.

For directions and examples see: Cheronis, pp. 489-490; Linstead, p. 20; Shriner, p. 264; Vogel, p. 683; Wild, p. 72; C. F. Koelsch, *J. Amer. Chem. Soc.*, **53**, 304 (1931); N. V. Hayes and G. E. K. Branch, *J. Amer. Chem. Soc.*, **65**, 1555 (1943).

*Aryl 2,4-dinitrophenyl ether.*



From the phenol in aqueous sodium hydroxide with 2,4-dinitrochlorobenzene in alcohol.

For directions and examples see: Cheronis, pp. 490-491; Vogel, p. 684; Wild, p. 71; R. W. Bost and F. Nicholson, *J. Amer. Chem. Soc.*, **57**, 2368 (1935).

From the phenol with 2,4-dinitrochlorobenzene and aqueous potassium hydroxide.

See: Linstead, pp. 20-21.

**NOTE:** For additional information regarding directions and examples for the preparation of derivatives of phenols which are similar to those of alcohols (e.g., 1-naphthylurethanes, 3,5-dinitrobenzoates, etc.) see explanations and references to Table VI, p. 77, 78, 79.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**

a) Liquids. (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point °C	Melting point, °C	$n_{D}^{20}$	$D_{4}^{20}$	Phenylurethane	$\alpha$ -Naphthylurethane	$\rho$ -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	$p$ -Toluene sulfonate	Miscellaneous
1	<b>2-Chlorophenol</b>	175.6	7	1.5473 <sup>40</sup>	1.2410 <sup>18</sup>	121	120	115	143	<i>mono</i> 48.9, <i>di</i> 76	74	Aryloxyacetic acid, 145, 2,4-Dinitrophenyl ether, 99, 4,6-Bis(dimethylamino-methyl) deriv., 62, 3, <i>p</i> -Phenylazobenzoate, 120-1 <i>p</i> -Phenylazobenzoate, 126-7
2	<b>2-Bromophenol</b>	195	5	1.5200 <sup>2</sup>	1.4924		129			95	78	Benzoate, 71, 2, Aryloxyacetic acid, 108, Acetate, b p 238
3	<b>2-Chloro-4-methylphenol</b> (2-Chloro- <i>p</i> -cresol)	195.6		1.5200 <sup>2</sup>	1.1785 <sup>27</sup>							Aryloxyacetic acid, 132, Acetate, 39
4	<b>2-Hydroxybenzaldehyde</b> (Salicylaldehyde)	197	1.6	1.574	1.1690 <sup>20</sup> <sub>20</sub>	133		128		63.4		Aryloxyacetic acid, 103, 2,4-Dinitrophenyl ether, 74, Benzoate, 55
5	<b>3-Methylphenol</b> ( <i>m</i> -Cresol)	203	12	1.540	1.03401	125, 121.2, al-lgr	127.8	90	165.4 (cor.), al	<i>tri</i> 84	51	Aryloxyacetic acid, 141, Benzoate, 38-9, al
6	<b>2-Ethylphenol</b>	207			1.0371 <sup>0</sup>	143.4, 141		56.7	108			Aryloxyacetic acid, 132, 3, Methyl urethane, 96, 7, 4,6-Dinitro deriv., 53
7	<b>2-Isopropylphenol</b>	212	16	1.5315	1.012							Aryloxyacetic acid, 148.5-50
8	<b>2-Bromo-4-ethylphenol</b>	213.4									121	
9	<b>3-Ethylphenol</b>	217	-4		1.0250 <sup>0</sup>	137, 138.8		68				Aryloxyacetic acid, 77, Benzoate, 52, 95% al
10	<b>2-Allylphenol</b>	220	-6	1.5181	1.0255 <sup>15</sup>	116, 106.0 6.5				6- <i>mono</i> 50		Aryloxyacetic acid, 148.5-50
11	<b>2-Chloro-4,6-dimethylphenol</b>	221.3					129.30	94.5				
12	<b>Methyl salicylate</b> (Methyl 2-hydroxybenzoate)	224	-8	1.5369	1.184	117, bz		128				Acetate, 52, Benzoate, 92, al
13	<b>2-Propylphenol</b>	224.6- 220.0- 0.5		1.5280	1.000 <sup>15</sup>	111, formic a			96			Aryloxyacetic acid, 99-100
14	<b>2-sec-Butylphenol</b>	227.8- 116 <sup>21</sup>	12-3	1.5288	0.9876	86, lgr						Aryloxyacetic acid, 109.5-110
15	<b>4-Allylphenol</b>	230-1 <sup>750</sup>	16	1.5441 <sup>18</sup>	1.033 <sup>18</sup>				103.0- 3.5			Urethane, 122, 3, Acetate, b p 238-9
16	<b>Ethyl salicylate</b> (Ethyl 2-hydroxybenzoate)	234	1.3	1.5226	1.131	98.100		107.8, yel, bz				Benzoate, 79-80, 87, al, 3,5-Dinitro deriv., 92-3
17	<b>2-n-Butylphenol</b>	234.7- 113 5 <sup>14</sup>		1.5180 <sup>25</sup> <sub>5</sub>	0.975				97			Aryloxyacetic acid, 104-5, Acetate, 105.5
18	<b>4-Isobutylphenol</b>	236, 235-9		1.5319 <sup>25</sup>	0.9796 <sup>20</sup> <sub>20</sub>							Aryloxyacetic acid, 124-5
19	<b>Carvacrol</b> (5-Isopropyl-2-methylphenol)	237.8	1	1.524	0.9760	134.5, 138	116, lgr	51	83, 76-7	46		Aryloxyacetic acid, 151, <i>p</i> -Xenylurethane, 116, al, 3,5-Dinitro deriv., 101.2, al
20	<b>Isopropyl salicylate</b> (Iso-propyl 2-hydroxybenzoate)	240-2		1.50650	1.0729							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**a) Liquids. (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Phenyl-urethane	α-Naph-thyl-urethane	p-Nitro-benzoate	3,5-Di-nitro-benzoate	Bromo derivative	p-Toluene sulfonate	Miscellaneous
21	3-Methoxyphenol (Resorcinol monomethyl ether)	243-244	-17.5				128.9			tri 104		Aryloxyacetic acid, 118, 111-3, w, 2,4-Dinitrophenyl ether, 87-8
22	2-Allyl-6-methoxyphenol	250-1 115°		1.5393				96.7				
23	4-Allyl-2-methoxyphenol (Eugenol)	254.8, 127 <sup>15</sup>	-9.1, 16.9	1.5410	1.0664	95.5	122, lgr	81	130.8 (cor.), al	tetra 118	85	Acetate, 29, al, Benzoate, 70, al, Aryloxyacetic acid, 81 100, 2,4-Dinitrophenyl ether, 115, N,N-Diphenylurethane, 108 3,5-Dinitro deriv., 72.3, al
24	Isobutyl salicylate (Iso-butyl 2-hydroxybenzoate)	260.2		1.50872	1.0639							Acetate, b.p. 169 <sup>34</sup> , Benzoate, b.p. 254.5 <sup>40</sup>
25	d,l-1,2,3,4-Tetrahydro-2-naphthol	264 <sup>716</sup>		1.5523 <sup>17</sup>	1.0715 <sup>17</sup>	99						Acetate, 79-80, bz-lgr, Benzoate, cis, 68, trans, 103.4, al
26	2-Methoxy-4-propenylphenol (Isoeugenol)	267.5		cis 1.5700, trans 1.5782	cis 1.0851, trans 1.0852	cis 118, trans 152	149.50, lgr	109	154.8 (cor.), n-BuOH			Aryloxyacetic acid, 116(94), 2,4-Dinitrophenyl ether, 128 3,5-Dinitro deriv., 60.1, al, p-Nitrobenzyl ether, 92 3,5-Dinitro deriv., 61-2, al
27	n-Butyl salicylate (n-Butyl 2-hydroxybenzoate)	270-2, 259-60	-5.9	1.51148	1.0728							Saponification → resorcinol, 110+ ac a, Diacetate, b.p. 130.1 <sup>7</sup>
28	Isoamyl salicylate (Isopentyl salicylate)	276.8		1.50799	1.0535							
29	3-Acetoxyphenol (Resorcinol monoacetate)	283		1.5328								

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point °C	Phenylurethane	α-Naphthylurethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous	
1	<b>2-Benzylphenol</b> (2-Hydroxydiphenylmethane) (Labile form)	21, stable 52, 54	312	117-8								Me eth , 30, Urethane, 110-1	
2	<b>4-n-Propylphenol</b>	22	232	129			123		b p 245 67 <sup>45</sup>	38	n <sub>D</sub> <sup>20</sup> 1 5220		
3	<b>4-n-Butylphenol</b>	22	248, 138-9 <sup>18</sup>	115, al		67-8, yel al	92		b p 138- 41 <sup>15</sup>	27	n <sub>D</sub> <sup>25</sup> 1 5165, D <sub>4</sub> <sup>20</sup> 0 978, Aryloxyacetic acid, 81		
4	<b>4-n-Amylphenol</b> (4-n-Pentylphenol)	23	248-53							51 0 85, al	n <sub>D</sub> <sup>20</sup> 1 5272, D <sub>4</sub> <sup>20</sup> 0 9621, Aryloxyacetic acid, 90		
5	<b>3-n-Propylphenol</b>	26	228				75 (117-8)				n <sub>D</sub> <sup>20</sup> 1 5223, D <sub>4</sub> <sup>20</sup> 0 9887, Aryloxyacetic acid, 96-7, lgr		
6	<b>2-Chloro-3,4-dimethylphenol</b>	27, pet eth								87, aq al			
7	<b>2,4-Dichloro-3-methylphenol</b> (2,4-Dichloro- <i>m</i> -cresol)	27	240 5- 2 5						92 0 2 5, al	90 5	Benzenesulfonate, 70, al		
8	<b>2,4-Dimethylphenol</b> ( <i>m</i> -4-Xylenol)	27 8	211 5 (cor )	103, 112, CCl <sub>4</sub>	135	102, 105	164 6 (cor ), 95% al			37 8, ac a	n <sub>D</sub> <sup>20</sup> 1 5420, D <sub>4</sub> <sup>14</sup> 1 0276, <i>p</i> -Xenylurethane, 184, Aryloxyacetic acid, 141, <i>p</i> -Phenylazobenzoate, 110-3 2,4-Dinitrophenyl ether, 102-3		
9	<b>2-Ethoxyphenol</b>	28	217							31	Allophanate, 212		
10	<b>2-Acetylphenol</b> (2-Hydroxyacetophenone)	28	215						89, al	87 8, al	n <sub>D</sub> <sup>20</sup> 1 5590, D <sub>4</sub> <sup>20</sup> 1 131, Semicarbazone, 210, Oxime, 118, Phenylhydrazone, 110		
11	<b>2-Methylphenol</b> ( <i>o</i> -Cresol)	31	191-2	141, 143	141 2, lgr	94	138 4 (cor ), al	di 56	54 5, pyr		Aryloxyacetic acid, 152, <i>p</i> -Phenylazobenzoate, 110-115, 2,4-Dinitrophenyl ether, 90, N,N-Diphenylurethane, 73		
12	<b>2-Methoxyphenol</b> (Guaiacol)	32, 28 2	205	136, al	118	93	141 2 (cor ), al	4,5,6- <i>tri</i> 116, al	85, lgr	57 8	n <sub>D</sub> <sup>20</sup> 1 5441, D <sub>4</sub> <sup>20</sup> <sub>vac</sub> , 1 1287, Aryloxyacetic acid, 116, 2,4-Dinitrophenyl ether, 97		
13	<b>5-Fluoro-2-nitrophenol</b>	32, lgr									Me eth , 52, lgr		
14	<b>3-Bromophenol</b>	33	236		108				52 4	b p 149 <sup>40</sup>	110 11 86	Aryloxyacetic acid, 108, <i>p</i> -Phenylazobenzoate, 125-6	
15	<b>3-Chlorophenol</b>	33	214		158	99	156			71	Aryloxyacetic acid, 110, 2,4-Dinitrophenyl ether, 75, <i>p</i> -Phenylazobenzoate, 127-8		
16	<b>2-Bromo-4-chlorophenol</b>	33-4	123 <sup>10</sup>								99-100	Aryloxyacetic acid, 139-40	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthylurethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulphonate	Acetate	Benzoate	Miscellaneous
17	<b>4-Methylphenol (<i>p</i>-Cresol)</b>	36	202	115	146	98	188.6 (cor.), al	<i>di</i> 49, <i>tetra</i> 198-9, al	69-70, al	70		<i>p</i> -Phenylazobenzzoate, 134 5-6 5, N,N-Diphenylurethane, 94, <i>p</i> -Xenylurethane, 198
18	<b>2,4-Dibromophenol</b>	36, 40	238-9			183.5		6- <i>mono</i> 95-6	120	36	97.5	Aryloxyacetic acid, 153, 2,4-Dinitrophenyl ether, 135, Me eth, 61 3, b p 272, Et eth, 53 5
19	<b>4-Methyl-2-nitrophenol (2-Nitro-<i>p</i>-cresol)</b>	36.5, yel, w-al	125 <sup>22</sup>				192				100-1	Me eth, 8 5, pa yel, b p 274, Et eth, b p 275 85 d
20	<b>4-Chlorophenol</b>	37, 43	217	148.5	166	171	186	2- <i>mono</i> 33.4, 2,6- <i>di</i> 90	71	7.8	88	Aryloxyacetic acid, 156, 2,4-Dinitrophenyl ether, 126, <i>p</i> -Phenylazobenzzoate, 153-4, N, N-Diphenylurethane, 97
21	<b>2,4-Diethylphenol</b>	37-8	219	170.1								Aryloxyacetic acid, 67-8
22	<b>3-Fluoro-2-nitrophenol</b>	39, lgr									114	Me eth, 43 5, lgr
23	<b>2,6-Dichloro-4-methylphenol (2,6-Dichloro-<i>p</i>-cresol)</b>	39, 42	120-5 <sup>14</sup>								9	NH <sub>4</sub> salt, 125, Me eth, b p 234
24	<b>3-Ethoxyphenol (Resorcinol monoethyl ether)</b>	40	246-7, pa yel, 254-8			183.5					97.5	2,4-Dinitrophenyl ether, 114-5, Picrate, 105-6, red, chl
25	<b>3-Iodophenol</b>	40		138		133	183		60-1	38, pet eth	72-3, pet eth	Aryloxyacetic acid, 115
26	<b>2-Benzoylphenol (2-Hydroxybenzophenone)</b>	41				124						<i>p</i> -Nitrobenzyl ether, 124 5, acet, Phenylhydrazone, 155, Semicarbazone, 250-1, Oxime, 141 3
27	<b>3-Methyl-2-nitrophenol (2-Nitro-<i>m</i>-cresol)</b>	41, yel, pet eth								59, al	79, al	Me eth, 54, yel, al
28	<b>Phenol</b>	41.8, 42	182, 183	126, bz	132.3, lgr	127, bz	145.8 (cor.), al	<i>tri</i> 95	95.6, al		69	Aryloxybenzoic acid, 99, <i>p</i> -Phenylazobenzoate, 148-50, <i>p</i> -Xenylurethane, 173, N,N-Diphenylurethane, 105
29	<b>3-Fluoro-4-nitrophenol</b>	42, w or lgr	173 <sup>12</sup>								118	Me eth, 56 5
30	<b>Phenyl salicylate (Salol, Phenyl 2-hydroxybenzoate)</b>	42, 38.8, 28.5 (three forms)		111-2, bz, 242		111				99.5	81	N,N-Diphenylurethane, 144

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthylurethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
31	<b>2-Iodophenol</b>	43	186-7 <sup>160</sup>	122					98 101	34, pct eth	D <sup>20</sup> 1 8757 Aryloxyacetic acid, 135 p-Phenylazobenzoate 126 8 2,4 Dinitrophenyl ether, 95	
32	<b>5-Bromo-2-nitrophenol</b>	44 yel	210			142-3	68	125	74 5		Me eth , 85 5 Et eth , 79 5 80 5, al	
33	<b>2,4-Dichlorophenol</b>	45	210			113	141	155	di 117	40 1, lgr	Aryloxyacetic acid, 141, 135, β-Naphthylurethane, 166, 2,4-Dinitrophenyl ether, 119	
34	<b>2-Nitrophenol</b>	45, yel , al	216			53 4	83			59	D <sup>20</sup> 1 2942, Aryloxyacetic acid, 158, 2,4-Dinitrophenyl ether, 142, N,N-Diphenylurethane, 114, p-Phenylazobenzoate, 136 5 7 0	
35	<b>5-Chloro-2-hydroxybiphenyl</b>	46								88		
36	<b>2-Chloro-5-methylphenol</b> (6-Chloro- <i>m</i> -cresol)	46	196					96	b p 122-3 <sup>11</sup>	31 40	Benzenesulfonate, 99	
37	<b>4-Bromo-5-isopropyl-2-methylphenol</b>	46, lgr									Me eth , b p 147 50 <sup>15</sup>	
38	<b>2-<i>tert</i>-Butyl-5-methylphenol</b> (6- <i>tert</i> -Butyl- <i>m</i> -cresol)	46-7	127 <sup>11</sup>						b p 139 <sup>17</sup>		Me eth , 22, b p 225 7	
39	<b>3-Chlorocatechol</b> (3-Chloro-1,2-dihydroxybenzene)	46-8, 48 50	110 11 <sup>11</sup>							110-11	2-Me eth , 31 5 3 0	
40	<b>4-Ethylphenol</b> (4-Hydroxyethylbenzene)	47	219	120	128	80 1	132-3			59 60, al	n <sub>D</sub> <sup>20</sup> 1 5239, D <sub>20</sub> <sup>20</sup> 1 0123 Aryloxyacetic acid, 97, p-Phenylazobenzoate, 117-8	
41	<b>3-Methyl-2,4,6-trichlorophenol</b> (2,4,6-Trichloro- <i>m</i> -cresol)	47, w	265					92 3	35, 32, eth	53		
42	<b>4-Chloro-2-methylphenol</b> (4-Chloro- <i>o</i> -cresol)	48	222-5							71	Aryloxyacetic acid, 115 7, Me eth , b p 213 5	
43	<b>2,6-Dibromo-4-methylphenol</b> (2,6-Dibromo- <i>p</i> -cresol)	49, 54				141 2			67	94 5		
44	<b>Thymol</b> (2-Isopropyl-5-methylphenol)	49 7, 51 5, acet	233 5	107, aq al	160, lgr	70	103 2, al	55	71	b p 242 3	33	Aryloxyacetic acid, 149, 2,4-Dinitrophenyl ether, 67, p-Xenylurethane, 194, p-Phenylazobenzoate, 85 6

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Bowing point, °C	Phenyl urethane	α-Naphthyl-urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulphonate	Acetate	Benzoate	Miscellaneous
45	<b>2-Hydroxy-4-methoxyacetophenone (Peonol)</b>	52-3, al							46.5			$n_D^{20}$ 1.54322, D <sup>20</sup> 1.310, <i>m</i> -Nitrobenzoate, 109, <i>p</i> -Nitrophenylhydrazone, 238-9, ac a
46	<b>2-Benzylphenol (2-Hydroxydiphenylmethane) (stable form)</b>	52-54, labile 21-2	312	117.5-80, lgr								Benzyl eth, 38, me al
47	<b>2-Chloro-3-methylphenol (2-Chloro-<i>m</i>-cresol)</b>	55.6-49.50	194					96		55.6		Benzenesulfonate, 58
48	<b>4-Methoxyphenol (Hydroquinone monomethyl ether)</b>	56-55	243-4						32	87, al		Aryloxyacetic acid, 110-2
49	<b>3-Methyl-6-nitrophenol (6-Nitro-<i>m</i>-cresol)</b>	56, yel, bz							48, al	77		Me eth, 62, Et eth, 55, pet eth, 50-1
50	<b>3-Bromo-4-methylphenol (3-Bromo-<i>p</i>-cresol)</b>	56	245							75		Me eth, b p 103-5 <sup>10</sup>
51	<b>2-Phenylphenol (2-Hydroxybiphenyl)</b>	56, 67.5 (cor.)	275						64.6, dil al	62.5-3	75-6	<i>p</i> -Phenylazobenzoate, 141-4, 2,4-Dinitrophenyl ether, 113-4
52	<b>2,6-Dibromophenol</b>	56-7	162 <sup>21</sup>					93.3		46	68	Me eth, 13, b p 143-5 <sup>34</sup> , Et eth, 40.6
53	<b>4-<i>n</i>-Caproylresorcinol</b>	56.7, tol - pet eth	343.5 d		89.91 pa yel, al							
54	<b>2-Bromo-4-methylphenol (2-Bromo-<i>p</i>-cresol)</b>	56.7	213-4, 102.4 <sup>20</sup>						121	b p 120 <sup>4</sup>		D <sub>20</sub> <sup>20</sup> 1.547
55	<b>5-Bromo-3-methylphenol (5-Bromo-<i>m</i>-cresol)</b>	56.7, 54								83		Me eth, b p 139 40 <sup>20</sup> , Picrate, 130
56	<b>2-Cyclohexylphenol</b>	56.7										4,6-Dinitro deriv., 106, al, 2,4-Dinitrophenyl ether 76.7
57	<b>2,3-Dichlorophenol</b>	56.7	206									Me eth, 31
58	<b>4,6-Dibromo-2-methylphenol (4,6-Dibromo-<i>o</i>-cresol)</b>	57			136.7			dt 90			62	.
59	<b>3-Hydroxy-6-nitrobiphenyl</b>	57.8, bz			135	171						2,4-Dinitrophenyl ether, 131 4-Nitro deriv., 176-8
60	<b>2,3,6-Trichlorophenol</b>	58, pet eth										
61	<b>2,6-Dichloro-3-methylphenol (2,6-Dichloro-<i>m</i>-cresol)</b>	58	234						100-1, al	90, al 78.0 8.5, al		
62	<b>2,5-Dichlorophenol</b>	58-9, pet eth	212								69	
63	<b>4-Propylcatechol (1,2-Dihydroxy-4-propylbenzene)</b>	60, bz	175-80 <sup>30</sup>									3-Me eth, b p 240-2, Di-me eth, b p 247
64	<b>1,2-Dihydroxynaphthalene (1,2-Naphthalenediol)</b>	60 (hyd.), 103-4 (anh.)										
65	<b>4-Isopropylphenol</b>	61	223-5								71-2	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenylurethane	α-Naphthylurethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
66	<b>5,6,7,8-Tetrahydro-2-naphthol</b>	61.5-2.5	275 <sup>705</sup>			113, 106.5			b p 158 <sup>14</sup>	96		N,N-Diphenylurethane, 114, Cinnamate, 77.5 Me eth, 84, al
67	<b>2,3,5-Trichlorophenol</b>	62 (hyg.)									103, lgr	
68	<b>2-Methyl-3,5,6-trichlorophenol (3,5,6-Trichloro-<i>o</i>-cresol)</b>	62, ac a									110, al	
69	<b>3,4-Dimethylphenol (<i>o</i>-4-Xylenol)</b>	62.5, w	225 <sup>757</sup>	120, dil al	141.2, lgr		181.6 (cor.), al	tri 171		22	58.5	Aryloxyacetic acid, 162.5 2,4-Dinitrophenyl ether 105-6 <i>p</i> -Xenylurethane, 183, al Picrate, 83.8, yel Me eth, 204.5, <i>p</i> -Phenylazobenzoate, 104-7 Picrate, 122, Me eth, 118
70	<b>2,6-Dinitrophenol</b>	63-4							135			
71	<b>4-Bromo-3-methylphenol (4-Bromo-<i>m</i>-cresol)</b>	63.5, pet eth	118-23 <sup>7</sup>						84.5		83.5	Benzenesulfonate, 79-80, Me eth, b p 108.5 <sup>12</sup> Et eth, b p 238-40
72	<b>4-Bromo-2-methylphenol (4-Bromo-<i>o</i>-cresol)</b>	64	235 (subl.)						b p 132 <sup>12</sup>	67.8		
73	<b>1-Acetyl-2-naphthol</b>	64, lgr								85.6, pyr		
74	<b>4-Bromophenol</b>	64, 66.4	238	140	169	180	191	tri 171		22	58.5	Aryloxyacetic acid, 157, 2,4-Dinitrophenyl ether, 141, N,N-Diphenylurethane, 99, <i>p</i> -Phenylazobenzoate, 167.5-8.5 Picrate, 133-4
75	<b>2-Methyl-1-naphthol</b>	64-5								81.2	94-5	
76	<b>4-Methylcatechol (3,4-Dihydroxytoluene)</b>	65, bz	252	di 166					di b p 260-4	di 58		Diaryloxyacetic acid, 58, Di- <i>p</i> -xenylurethane, 193 Me eth, 73
77	<b>3-Bromo-2-nitrophenol</b>	65-7, pet eth (anh.), 35 (hyd.), w							136.5-7.5, al		133	
78	<b>4-Chloro-3-methylphenol (4-Chloro-<i>m</i>-cresol)</b>	66, 55	235		153-4				98		86	2,4-Dinitrophenyl ether, 112, Benzenesulfonate, 66 Me eth, 91-2
79	<b>4-Hydroxy-3-nitrobiphenyl</b>	66							85-6, lgr		111	
80	<b>4-Methyl-2,3,5-trichlorophenol (2,3,5-Trichloro-<i>p</i>-cresol)</b>	66-7, ac a							37-8, w-ac a	89, w-al		
81	<b>2,6-Dichlorophenol</b>	67	219-20, 80-5 <sup>4</sup>							74.0-4.5		Me eth, b p 105-6 <sup>20</sup>
82	<b>3,5-Dimethylphenol (<i>m</i>-5-Xylenol)</b>	68	219.5 (subl.)	148, 151		109	195.4 (cor.), al	tri 166	83, ac a	b p 130 <sup>26</sup>	24	Aryloxyacetic acid, 111, 81, 2,4-Dinitrophenyl ether, 100, <i>p</i> -Phenylazobenzoate, 104.5-6.5, <i>p</i> -Xenylurethane, 150 Me eth, 67
83	<b>2-Bromo-6-nitrophenol</b>	68, yel								39.5-40		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	Toluene sulfonate	Acetate	Benzoate	Miscellaneous
84	3-Methylcatechol (2,3-Dihydroxytoluene)	68, bz										2-Me eth , 39, b p 204, Di-Me eth , b p 202-3
85	3,5-Dichlorophenol	68	233					tr 189	116	38 107, ac a	55	
86	2,6-Di-iodophenol	68										Me eth , 35, ac a , Et eth , 41-2, ac a
87	2,4,5-Trichlorophenol	68, pet eth									92 3, al	Aryloxyacetic acid, 157, Me eth , 77-5, al
88	5,6,7,8-Tetrahydro-1-naphthol	68 5-9 0, 74-5	264 5-5 0						73 5	46		Me eth , b p 124 <sup>10</sup> , Et eth , b p 259 <sup>205</sup>
89	2-Bromo-4,6-dichlorophenol	68 9	268 d					82-3				2,4-Dinitrophenyl ether, 140-1
90	2-Bromo-4-methyl-6-nitropheno (2-Bromo-6-nitro-p-cresol)	69, yel						128	110-11			
91	2,4,6-Trichlorophenol	69 5, ac a , 68	245			105 6				b p 261-2	75 5, al	Aryloxyacetic acid, 182 6, 2,4-Dinitrophenyl ether, 136, N,N-Diphenylurethane, 143, Me eth , 61-2, al , Et eth , 43-4
92	2,4,6-Trimethylphenol	70, 69	220	141-2 lgr				dt 158			62, pet eth	Aryloxyacetic acid, 142
93	2,3,4,6-Tetrachlorophenol	70	150 <sup>15</sup>						65 6	108		Me eth , 64-5, Et eth , 55, Benzene-sulfonate, 127
94	1-Chloro-2-naphthol	70, lgr , 72							42 3	99 100		Me eth , 70-1, Et eth , 58
95	Methyl 3-hydroxybenzoate	70	280	115-6, bz								
96	2-Methyl-6-nitropheno (6-Nitro-o-cresol)	70, w -al						66, al			42, al	Me eth , 30, pet eth , Et eth , b p 249 50, yel
97	3-Propylcatechol (1,2-Dihydroxy-3-propylbenzene)	70-2, pet eth										3-Me eth , b p 144-6 <sup>25</sup> , Di-Me eth , b p 134-7 <sup>22</sup>
98	2,4,5-Trimethylphenol (Pseudocumenol)	71	232	110				35		34 0-4 5, pet eth	63, al	Aryloxyacetic acid, 132, p-Xenylurethane, 196
99	4,6-Dichloro-3-methylphenol (4,6-Dichloro-m-cresol)	72	235-6, 110 <sup>18</sup>					104-5, al			57 5, al	n <sup>20</sup> 1 5722, Benzenesulfonate, 86, al
100	2,4-Di-iodophenol	72, w						165-7 (cor )	70-1, w -al	98		Me eth , 68, w -al , Et eth , 46, me al , 51
101	2-Chloro-4,5-dimethylphenol	72									43	
102	3,5-Dimethylcatechol (4,5-Dihydroxy-m-xylene)	73-4, w							dt 161, ac a			4-Me eth , b p 227-8

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthylurethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulphonate	Acetate	Benzoate	Miscellaneous
103	<b>5-Chloro-2-methylphenol</b> (5-Chloro-o-cresol)	73.4	225					tri 190	110		53.4	Me eth, b p 206-8, Et eth, b p 210-20
104	<b>2,5-Dibromophenol</b>	73.4							110			
105	<b>3-Iodo-2-nitrophenol</b>	73.5, w										Me eth, 83-4
106	<b>Ethyl 3-hydroxybenzoate</b>	73.8, bz	295-282									
107	<b>1,3-Dibromo-2-naphthol</b>	75										
108	<b>2,5-Dimethylphenol (p-2-Xylenol)</b>	75, al-eth	212	160.1, bz., 162, 166	172.3 lgr	87	137.2 (cor.)	tri 178			61	Aryloxyacetic acid, '18 p-Xenylurethane, 162, p- Phenylazobenzoate, 95.5-7.5, Picrate, 81-2, or, al
109	<b>2,3-Dimethylphenol (o-3-Xylenol)</b>	75, w-al		193.5								Aryloxyacetic acid, 187, p-Phenylazobenzoate, 134.6, Me eth, 29, b p 199, Et eth, 10, b p 212.5 Picrate, 203.4, Methiodide, 143 d (hyd.)
110	<b>8-Hydroxyquinoline</b> (Oxine)	75.6, dil al	266.6 <sup>752</sup>			174.5			115	b p 280	118.20, al	
111	<b>4-(Dimethylamino)phenol</b>	76							130	78		
112	<b>3-Chloro-4-hydroxybiphenyl</b>	76.7, 80									110.11, 95.7	2,4-Dinitrophenyl ether, 109-11
113	<b>3-Bromo-2,6-dichlorophenol</b>	76.5, lgr	264-70 <sup>751</sup>								102	Me eth, b p 260.5 <sup>50</sup>
114	<b>2-Methyl-4,5,6-trichlorophenol</b> (4,5,6-Trichloro-o-cresol)	77, pet eth							45, w-meal			Me eth, 51.5, al
115	<b>2-Bromo-4-methyl-3-nitrophenol</b> (2-Bromo-3-nitro-p-cresol)	77, yel, w							81			Me eth, 74
116	<b>3-(Diethylamino)phenol</b>	78	276.80							22.3		Methylurethane, 85.6, Methiodide, 140.3
117	<b>3-Phenylphenol</b> (3-Hydroxybiphenyl)	78, 75	>300						52.5		60.1, al.	Et eth, 34
118	<b>4-Bromo-2,6-dinitrophenol</b>	78 yel							136, al	110.5, bz	154, al	Me eth, 88, Et eth, 66
119	<b>4-Chloro-2-iodophenol</b>	78							57			
120	<b>2,4-Diaminophenol</b> (4 Hydroxy-m-phenylene-diamine)	78.80 unstable		128						88.84		Me eth, 68, Et eth, 67.8, 4,N-Acetyl, 249, N,N'-Diacetyl, 220-2, O,N,N'-Triacetyl, 180.2, N,N'-Dibenzoyl, 253-4, Picrate, 120 d, yel
121	<b>4-Methyl-3-nitrophenol</b> (3-Nitro-p-cresol)	79, yel, eth							91			Me eth, 17, b p 266.7
122	<b>2,3,4,6-Tetramethylphenol</b> (Isodurenonol)	79.81	230.50	178.9, wh, w-al						71-2, wh, w-al		
123	<b>2-Bromo-4,5-dimethylphenol</b>	80, pet eth								51		Me eth, b p 86 <sup>3</sup> , o-Nitrobenzoate, 151-2

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	$\alpha$ Naphthyl urethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
124	<b>5-Bromo-2-methylphenol</b> (5-Bromo- <i>o</i> -cresol)	80								41		
125	<b>4-Iodo-2-nitrophenol</b>	80 1								102 3	Me eth , 98, Et eth , 80	
126	<b>4-Hydroxy-3-methoxybenzaldehyde</b> (Vanillin)	81	285	116 7					115	102	78	Aryloxyacetic acid, 187 2,4-Dinitrophenyl ether, 131, 2,4-Dinitrophenylhydrazone, 271 d
127	<b>3,5-Dibromophenol</b>	81							53	77		Me eth , 140
128	<b>4-Chloro-2,6-dinitrophenol</b>	81							110 11			Me eth , 66 Et eth , 54 5
129	<b>4-Methyl-2-naphthol</b>	81 2							117 8			
130	<b>5-Chloro-2,3-dimethylphenol</b>	81 2								88, al		
131	<b>3-Methyl-2,4,6-tribromo-phenol</b> (2,4,6-Tribromo- <i>m</i> -cresol)	81 5-2 0, al							113 4, al	68, al	84 5 al	<i>p</i> -Phenylazobenzoate, 130-2
132	<b>2-Hydroxy-1-naphthaldehyde</b>	82	192 <sup>2</sup>							87, al <i>tr</i> 124, al		Me eth , 84 Et eth , 115, Oxime 157, Picrate, 120
133	<b>3,4-Di-iodophenol</b>	83								123		
134	<b>2-Hydroxyazobenzene</b> (2-Benzeneazophenol)	83							-20	93 pet eth		Me eth , 41, Et eth , 44 Cu deriv , 225 6, al
135	<b>5-Propylresorcinol</b> (1,3-Dihydroxy-5-propylbenzene, Divarinol)	83 4, bz , (anh ), 51, w								di 12-5		Di-Me eth , b p 147 <sup>29</sup>
136	<b>2,3,4-Trichlorophenol</b>	83 5, lgr									141, al	Me eth , 69 5, al
137	<b>4-Benzylphenol</b> (4-Hydroxydiphenylmethane)	84	321, 308							mono 87, pet	2,4-Dinitrophenyl ether, 75 6, Benzyl eth , 49 5, al	
138	<b>4-Chloro-2,3-dimethylphenol</b>	84								102		
139	<b>2,4-Dimethyl-1-naphthol</b>	84 5	169 70 <sup>10</sup>	174 5								Me eth , b p 150-1 <sup>12</sup> , Picrate 143 4, dk red
140	<b>4-Methyl-1-naphthol</b>	84 5									81	
141	<b>1-Bromo-2-naphthol</b>	85							56			Me eth , 85
142	<b>3-Bromo-2-naphthol</b>	85							94			Me eth , 77-8
143	<b>2-Nitroresorcinol</b> (1,3-Dihydroxy-2-nitrobenzene)	85, or -red, w -al							di 63			Di-Me eth , 131, yel , al Di-Et eth , 106 7
144	<b>3-(Dimethylamino)phenol</b> (3-Hydroxydimethyl aniline)	85	265-8, 138 <sup>10</sup>							36 5, b p 160 <sup>5</sup>	94	Picrate, 162, Methylurethane, 87, Ethylurethane, 150, 99 100, Me eth , b p 237, Et eth , b p 247
145	<b>3-Hydroxy-2-nitrobiphenyl</b>	85-6, bz , 81 2, yel , al								61 5 2 5	131 0 2 5	Benzenesulfonate, 130-1, 4-Nitro deriv , 126 7, 6-Nitro deriv , 214, 4,6-Dinitro deriv , 168 70
146	<b>2-Hydroxybenzyl alcohol</b> (Saligenin)	86 7, w									di 51, 70% al	Aryloxyacetic acid, 120, w

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthylurethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulphonate	Acetate	Benzoate	Miscellaneous
147	<b>4,6-Dinitro-2-methylphenol</b> (4,6-Dinitro- <i>o</i> -cresol)	86.5							95-6	135, 132		
148	<b>3-Nitrocatechol</b> (1,2-Dihydroxy-3-nitrobenzene)	86.5, yel., pet eth							<i>di b p</i> 103-4 <sup>1</sup>	2-mono 66	1-Me eth, 62, yel., 2-Me eth, 102-3, Di-Me eth, 64-5, al	
149	<b>4-Chloro-2-nitrophenol</b>	86-7							47.8			Me eth, 98 Et, 61-2
150	<b>2,4,5-Tribromophenol</b>	87, CH <sub>2</sub> Cl <sub>2</sub> , pet eth								99		Me eth, 105, <i>o</i> -Bromo- <i>p</i> -toluenesulfonate, 107.8, al
151	<b>4-Bromocatechol</b> (4-Bromo-1,2-dihydroxybenzene)	87								<i>di</i> 111		1-Me eth, 65
152	<b>4-(Methylamino)phenol</b>	87, bz							135, bz - lgr	43, pet eth	173-4, 50% al	Aryloxyacetic acid, 213.4, Me eth, 37
153	<b>2-Methyl-3,4,5-tribromo-phenol</b> (3,4,5-Tribromo- <i>o</i> -cresol)	89, pet										
154	<b>2-Amino-6-methylphenol</b> (6-Amino- <i>o</i> -cresol)	89, w							89, 90	78-9		N-Acetyl, 100.1
155	<b>N-Benzylidene-2-amino-phenol</b>	89								93-6		Et eth, b p, 215-6 <sup>20</sup>
156	<b>3-Nitro-2,4,6-tribromo-phenol</b>	89-90, lgr							146-7, al			Me eth, 82, al, Et eth, 79, eth
157	<b>2-Amino-6-chloro-4-methylphenol</b> (2-Amino-6-chloro- <i>p</i> -cresol)	89-90										N,O-Diacetyl, 162.3
158	<b>1,3-Dimethyl-2-naphthol</b>	89-90		197					85.6			Picrate, 132-3
159	<b>2-Propylhydroquinone</b> (1,4-Dihydroxy-2-propylbenzene)	90, bz										Di-Me eth, b p, 240-6
160	<b>4-Chlorocatechol</b> (4-Chloro-1,2-dihydroxybenzene)	90-1	136 <sup>a,s</sup>						<i>di b p</i> 145-7 <sup>7</sup>	<i>di</i> 96-7, eth		Di-Me eth, b p, 242.4
161	<b>3-Chloro-4,6-dimethyl-phenol</b>	90-1										
162	<b>2-Methyl-3,4,6-tribromo-phenol</b> (3,4,6-Tribromo- <i>o</i> -cresol)	91, pet							76-7, ac a	85, 133, bz		Me eth, 71, al
163	<b>5-Chloro-2,4-dinitrophenol</b>	92								69		
164	<b>4-Chloro-2,6-dibromo-phenol</b>	92							107-8			Me eth, 105, Et eth, 112, 6-Nitro deriv, 113.5
165	<b>4-Bromo-2-nitrophenol</b>	92, 89								75		2,4-Dinitrophenyl ether, 145-6 Me eth, 74
166	<b>4-tert-Amylphenol</b>	92-3										Me eth, 88 Et eth, 47, Benzene-sulfonate, 83-4
167	<b>4-Hydroxyphenylethyl alcohol</b> (Tyrosol)	93, chl	260-5 310, 156 <sup>15</sup>	108					55	<i>β-mono</i> 59, eth - lgr <i>di</i> <i>b p</i> 187 <sup>18</sup>	61 <i>di</i> 111, al	4-Et eth, 40

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\*** (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
168	<b>4-Iodophenol</b>	93 4, w		148, bz					99, me al	32	119	Aryloxyacetic acid, 156, N,N-Diphenylurethane, 127, 2,4-Dinitrophenyl ether, 156
169	<b>1-Naphthol (<math>\alpha</math>-Naphthol)</b>	94	278-80	177-8, al	152, lgr	143, 140	217 4 (cor), yel, al	2,4- <i>di</i> 105	89	48-9, al	56, al	Aryloxyacetic acid, 193, 5, <i>p</i> -Xenylurethane, 190, 2,4-Dinitrophenyl ether, 128, <i>p</i> -Phenylazo-benzoate, 118-9
170	<b>2-Iodo-4-nitrophenol</b>	94, 86-7								68		Me eth , 97, Et eth , 96
171	<b>2,4,6-Tribromophenol (Bromol)</b>	95, HCOOH 94, ac a (+1 ac a )			153	153	174	<i>tetra</i> 120	113, al	82, 87 ac a	81, al	Aryloxyacetic acid, 200, N,N-Diphenylurethane, 153, 2,4-Dinitrophenyl ether, 137 8 <i>p</i> -Phenylazo-benzoate, 116-9
172	<b>2,2'-Stillenediol (2,2'-Dihydroxystilbene)</b>	$\alpha$ 95, al , $\beta$ 197, al								$\alpha$ di 107-8		$\beta$ Di-Me eth 136
173	<b>6-Chloro-1-naphthol</b>	95								47		Picrate, 165
174	<b>3-Bromo-4-hydroxybiphenyl</b>	95								74 5	93 4	Benzenesulfonate 102 3
175	<b>1,3,6-Trihydroxynaphthalene (1,3,6-Naphthalenetriol)</b>	95								<i>tri</i> 112-3		Me eth , 103-4
176	<b>2,3,4-Tribromophenol</b>	95, w - HCOOH										Me eth , 106
177	<b>2,3,5-Trimethylphenol</b>	95 6	233	174, pet eth						241	50, pet eth	
178	<b>2-Naphthyl salicylate (Betol)</b>	95 5, stable, 93 5, labile		268, yel , ac a						136, al		
179	<b>3-Amino-2,4,6-trichlorophenol</b>	95 5-6 0, lgr										N-Acetyl, 185 0 6 5, tol
180	<b>3-Acetylphenol (3-Hydroxyacetophenone)</b>	96	296, 153°							44 0-4 5	52-3	D <sup>109</sup> 1 099, n <sub>d</sub> <sup>109</sup> 1 5348 Me eth b p 240, Semi-carbazone, 194-6
181	<b>5-Iodo-2-nitrophenol</b>	96, yel , pet eth								95	122	Me eth , 92, Et eth , 86-7
182	<b>2-Methoxy-5-propenylphenol</b>	96, 92	147 <sup>19</sup>							101		Et eth , 49 50
183	<b>2-Methyl-4-nitrophenol (4-Nitro-o-cresol)</b>	96, yel , bz , 30-40(+1 H <sub>2</sub> O), w	186 90							107, al		Me eth , 64, al , Et eth , 71, w -al
184	<b>2-(Methylamino)phenol</b>	96-7, 86 7, pet eth									128	N-Benzoyl, 160 1, Me eth , 33 0-3 5
185	<b>3-Nitrophenol</b>	97	194 <sup>20</sup>	129	167	174	159	<i>di</i> 91	112 3	55-6	95	D <sup>100</sup> 1 2797, Aryloxybenzoic acid, 156, 2,4-Dinitrophenyl ether 136, <i>p</i> -Phenylazo-benzoate, 160 5-2 5

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point °C	Phenyl urethane	α-Naphthylurethane	p-Nitrobenzoate	3,5 Dinitrobenzoate	Bromo derivative	/ Toluene sulfonate	Acetate	Benzoate	Miscellaneous
186	<b>2,3-Dibromo-5,6-dimethylphenol</b>	97, aq al							78, pet eth	153, al		
187	<b>5-Methyl-1-naphthol</b>	97-8								77 8		
188	<b>3-Acetylcatechol (2,3-Dihydroxyacetophenone)</b>	97-8, yel , w							di 109, bz		1-Me eth , 152 3 Di-Me eth , 48, Oxime 96 7 Semicarbazone, 166 7	
189	<b>2-Cyanophenol</b>	98								106, pet eth	D <sub>19</sub> <sup>b</sup> 11052 n <sub>D</sub> <sup>20</sup> <sup>b</sup> 153716	
190	<b>3-Chloro-4,5-dimethylphenol</b>	98							42, al			
191	<b>2,5-Di-iodophenol</b>	99, pet eth							70, ac a			
192	<b>4-tert-Butylphenol</b>	100	237	148 5	110			50 di 64 7	109 10	81-2	Aryloxyacetic acid, 86 5, 2,4-Dinitrophenyl ether 108 10 Benzene-sulfonate 70 1	
193	<b>3,4,5-Trichlorophenol</b>	101, lgr , 91	271 7 <sup>a</sup> 6							120, al	Me eth , 130, b p 256 61, m-Nitrobenzenesulfonate, 176	
194	<b>3,5-Dibromo-2-methylphenol (3,5-Dibromo-<i>o</i>-cresol)</b>	101 98 101								91-3		
195	<b>4,6-Dinitro-3-methylphenol (4,6-Dinitro-<i>m</i>-cresol)</b>	101 73 4							110 11	95	Me eth , 115 Et eth , 97	
196	<b>2-Acetyl-1-naphthol</b>	102, pa grn , al, 98, br - yel , bz	325, sl d						107 5, al	128, al		
197	<b>2-Methyl-3,4,5-trinitrophenol (3,4,5-Trinitro-<i>o</i>-cresol)</b>	102, or yel , acet									Me eth , 111 2, w -al	
198	<b>4-Methyl-2,3,6-tribromo-phenol (2,3,6 Tribromo-<i>p</i>-cresol)</b>	102, pet							77, lgr			
199	<b>1-Nitro-2-naphthol</b>	103, yel , al							61, pet eth		<i>m</i> -Nitrobenzenesulfonate, 176, ac a , Et eth , 104-5, yel , al	
200	<b>3,3'-Dihydroxydiphenylmethane</b>	103, yel , al							di 57 5 8 5, lgr 56 79, me al			
201	<b>4-Chloro-2-naphthol</b>	104								93	Me eth , 85, pet eth , Et eth , 30, me al	
202	<b>3,5-Di-iodophenol</b>	104, w									Me eth , 94, yel , eth	
203	<b>2-Bromo-4-methyl-5-nitrophenol (2-Bromo-5-nitro-<i>p</i>-cresol)</b>	104, yel							121			
204	<b>3-Hydroxybenzaldehyde (3-Formylphenol)</b>	104, 108 (cor )	240	158-60					b p 203	38, 48 5-9 0	Aryloxyacetic acid, 148, 2,4-Dinitrophenylhydrazone, 257d , Semicarbazone, 198 Picrate, 156 7	
205	<b>5-Methyl-2-naphthol</b>	104 5								107 8	Picrate, 156 7	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
206	<b>3-Hydroxy-4-nitrobiphenyl</b>	104 5, al				157	199					
207	<b>Catechol (Pyrocatechol, 1,2-Dihydroxybenzene)</b>	105	245 6	<i>di</i> 169	175	<i>mono</i> 159 <i>di</i> 169, al	<i>di</i> 152	<i>tetra</i> 192 3, wh - vlt	<i>mono</i> 57 8, <i>di</i> 65	<i>mono</i> 181, 131 <i>di</i> 84, al - eth	<i>mono</i> 181, 131 <i>di</i> 84, al - eth	Aryloxyacetic acid 136 8 Monobenzenesulfonate monoacetate, 86 me al Dibenzene-sulfonate, 155-6, acet
208	<b>2,4-Dibromo-1-naphthol</b>	105, 111							92-3			Me eth , 54-5, al <i>sym</i> -TNB add comp , 97, Picrate, 97, yel
209	<b>2,4-Dichloro-5-nitrophenol</b>	105 6								111 2		<i>m</i> -Nitrobenzoate, 154, <i>o</i> -Nitro- <i>p</i> -toluenesulfonate, 143
210	<b>Chlorohydroquinone</b>	106								<i>mono</i> 62, <i>di</i> 72, 99		
211	<b>4,6-Dinitro-2-iodophenol</b>	106 7, w							149	113		
212	<b>1,6-Dibromo-2-naphthol</b>	106-7 (+1 ac a , 84)								125		Me eth , 102, Et eth , 94
213	<b>2-Amino-5-chloro-4-methylphenol (2-Amino-5-chloro-<i>p</i>-cresol)</b>	106-7									N-Acetyl, 115, aq al, Me eth , 106, lgr	
214	<b>4-Chlororesorcinol (4-Chloro-1,3-dihydroxybenzene)</b>	106-7 89	259, 147 <sup>18</sup>					<i>di</i> 46 7	<i>di</i> 66			3-Me eth , 79-80 Di-Me eth , b p 135 7 <sup>17</sup>
215	<b>2-Hydroxypyridine (<math>\alpha</math>-Pyridone)</b>	106 7, bz	280 1			120		158-9, 53	b p 150- 60 <sup>0 09</sup>	42		Picrate, 176 7, Benzyl eth , 42
216	<b>2-Phenoxyphenol (2-Hydroxydiphenyl ether)</b>	106 7	151 5 <sup>11</sup>					b p 358-60	48 5			Me eth , 79, lgr
217	<b>5-Methylresorcinol (Orcinol, 3,5-Dihydroxytoluene)</b>	106 5 8, 56 8 (+1 H <sub>2</sub> O)	287-90	154	160, lgr	214	190	<i>tri</i> 104	<i>di</i> 25	<i>di</i> 88, al		Aryloxyacetic acid 217 <i>p</i> -Xenylurethane, 196 2,4-Dinitrophenyl ether, 153 4
218	<b>6-Amino-4-chloro-2-methylphenol (6-Amino-4-chloro-<i>o</i>-cresol)</b>	107						2,3- <i>di</i> 196				
219	<b>2,4-Dichloro-1-naphthol</b>	107-8							74-6			Me eth , 58
220	<b>1,2-Dihydroxynaphthalene (1,2-Naphthalenediol, <math>\beta</math>-Naphthohydroquinone)</b>	108, 105 5						<i>di</i> 104- 6, 109, ac a	<i>di</i> 106			Diaryloxyacetic acid, 104 6, 1-Me eth , 90 5, Di-Me eth , 31
221	<b>1,2,3,4-Tetrahydroanthranol</b>	108, lgr							109, al	142		Me eth , b p 197 <sup>14</sup>
222	<b>4-Methyl-5,6,7,8-tetrahydro-2-naphthol</b>	108					114 6			89		
223	<b>4-Acetylphenol (4-Hydroxyacetophenone)</b>	109							54			Semicarbazone, 199, 2,4-Dinitrophenylhydrazone, 261 5 (cor ), br , al
224	<b>3-Methyl-2,4,6-trinitrophenol (2,4,6-Trinitro-<i>m</i>-cresol)</b>	109 10, yel , al							135, pa yel , bz	140		Di-Me eth , 155, al , Di-Et eth , 36 7, w -al

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>P</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
225	<b>2-Iodo-6-nitrophenol</b>	109	10						96-7			Me eth , 96-7
226	<b>Resorcinol (1,3-Dihydroxybenzene)</b>	110 (stable), 108 8 5 (labile)	280 8 (cor ), 275 9	<i>di</i>	164, chl	<i>di</i> 182 175	<i>di</i> 201	<i>tr</i> 112	<i>di</i> 80-1, acet - <i>dil</i> <i>al</i>	57-8, <i>dil al</i>	<i>mono</i>	Aryloxyacetic acid, 175, 195, 2,4-Dinitrophenyl ether, 194, N,N-Diphenylurethane, 194, Me eth , 43-4, me al
227	<b>2,2'-Biphenol (2,2-Dihydroxybiphenyl)</b>	110 109, tol	326	<i>di</i>	145, <i>dil</i> <i>al</i>			<i>di</i> 188	190	<i>di</i> 95, xyl	<i>di</i> 101, <i>al</i>	Di-Me eth , 155, <i>al</i> , Di-Et eth , 36-7, w -al
228	<b>Bromohydroquinone</b>	110										
229	<b>4-Hydroxy-2'-nitrobiphenyl</b>	110 1, 116						<i>di</i> 186		<i>di</i> 72 122	156-7	Aryloxyacetic acid, 160-1, Benzene-sulfonate, 106, yel , al , Me eth , 60 0-0 5, Et eth , 51 5-nitro deriv , 151-2
230	<b>7-Methyl-1-naphthol</b>	110-11							39-41			Picrate, 164-5
231	<b>1-Methyl-2-naphthol</b>	111							66	116 7		Picrate, 163 4
232	<b>2-Chloro-4-nitrophenol</b>	111, w							63			Me eth , 98, Et eth , 82, 142
233	<b>2-Amino-6-nitrophenol</b>	111-2 aq <i>al</i>							2-mono 102-3 (hyd ), 122 (anh )			Me eth , 198
234	<b>2,4,6-Tribromoresorcinol (1,3-Dihydroxy-2,4,6-tribromobenzene)</b>	112, w							<i>mono</i> 114, CS <sub>2</sub> , <i>di</i> 108	<i>mono</i> 120, chl - pet - eth		Me eth , 104, Di-Me eth , 68-9, w -al
235	<b>4',5-Dimethyl-2-hydroxyazobenzene (2-p-Toluene-azo-p-cresol)</b>	112 3, tol							91, yel , ac a	95, yel , al		Et eth , 43, ac a , Propionate, 62, lgr
236	<b>4-Hydroxyphenanthrene (4-Phenanthrol)</b>	112-3 5, pet eth							58-9, al			Me eth , 68, me al
237	<b>2,2'-Dihydroxy-3,3'-dimethylbiphenyl</b>	113, pet eth										
238	<b>2,6-Dinitro-4-iodophenol</b>	113, w										
239	<b>2-Chloro-4,6-dinitrophenol</b>	113, 110										
240	<b>4,4'-Dihydroxy-2,2'-dimethylbiphenyl</b>	114										
241	<b>2-Bromo-4-nitrophenol</b>	114										
242	<b>4-Nitrophenol</b>	114		156	150-1	159	186, 188 (+1 ac a )	2,6- <i>di</i> 142	97	81-2, w -al	142 5	Aryloxyacetic acid, 187, 2,4-Dinitrophenyl ether, 120, N,N-Diphenylurethane, 112, p-Phenylazobenzzoate, 203-6 2,4-Dinitrophenyl ether, 248
243	<b>2,4-Dinitrophenol</b>	114								72	132	
244	<b>2,3,5-Tri-iodophenol</b>	114, bz - lgr								123		Et eth , 121

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
245	4-Hydroxy-3-methoxybenzyl alcohol	115							4-mono 51, di 48, bz -	4-mono 90, et ac-al , di 121		4-Et eth , 56 7
246	1-Hydroxyfluorenone	115, yel							130-1, aq al	128-9		Me eth , 141 5 25
247	Ethyl 4-hydroxybenzoate	115, 116										Oxime, 169-70,
248	4-Chloro-3,5-dimethylphenol	115-6	297-8							47 8		Phenylhydrazone, 173-4
249	3,5-Dimethyl-2,4-dinitrophenol	115-6, 106							171	148	156	
250	4-Bromo-1,5-dihydroxynaphthalene (4-Bromo-1,5-naphthalenediol)	116								di 138		Di-Me eth , 115
251	3-Benzoylphenol (3-Hy)	116 al										Oxime anti 76 bz syn 126 (on heating anti)
252	4-Hydroxybenzaldehyde	116-7									90	Aryloxyacetic acid 198, 2,4-Dinitrophenylhydrazone 270 1
253	3-Bromo-1,2-dihydroxynaphthalene (3-Bromo-1,2-naphthalenediol)	117								di 160		Naphthalene add comp , 100
255	Phloroglucinol (1,3,5-Trihydroxybenzene)	117 (+2H <sub>2</sub> O), 217-9 (anh )				283		tri 151		tri 104	tri 185	Picrate, 101-3
256	2,4'-Dihydroxydiphenylmethane	117-8, w -al								di 70, ac a	di 108	Di-Me eth , 26 Di-Et eth , 60, w -al
257	2,3,5,6-Tetramethylphenol (Durenonol)	118, wh , pet	249					4-mono 118, or , dil al				
258	4-Amino-2-methyl-6-nitrophenol (4-Amino-6-nitro-o-cresol)	118, al								4-mono 217, yel , al		
259	2,4-Dibromo-6-nitrophenol	118, ac a							140	89		Me eth , 76-7, yel , Et eth , 46
260	2-Methyl-5-nitrophenol (5-Nitro-o-cresol)	118, yel , lgr							123-4, al	74		Me eth , 74, al , Et eth , 61, al
261	2-Bromo-4,6-dinitrophenol	118-9, yel							157	104 5	94, aq al	Me eth , 48, yel
262	2-Bromo-5-nitrophenol	118 5-21, pet eth							131 5- 2 5, al			Me eth , 104, al
263	2-Amino-4-methyl-6-nitrophenol (2-Amino-6-nitro-p-cresol)	119, 110, br , al										N-Acetyl, 143, yel al
264	3-Amino-2,4,6-tribromo-phenol	119, pet eth							146-7, al			O,N,N-Triacetyl, 136

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl-urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
265	<b>2-Methylresorcinol (1,3-Dihydroxy-2-methylbenzene, 2,6-Dihydroxytoluene)</b>	119 20, bz	271 (cor.)							di 105-6, me al		Di-Me eth , 39
266	<b>4-Acetylcatechol (3,4-Dihydroxyacetophenone)</b>	119 2 7 116						di 144-5, et ac	4-mono 58, di 91, 88	di 118, al		Oxime, 184 d , et ac , 1-Me eth , 91, 2-Me eth , 115, Di- Me eth , 51
267	<b>2-Chloro-5-nitrophenol</b>	119 5, w							82	127-8		Me eth , 83, Et eth , 64 5, al
268	<b>5-Methyl-1,2,3-trihydroxybenzene (3,4,5-Trihydroxytoluene, 5-Methylpyrogallol)</b>	120 (subl.), bz							tri 99			3,5-Di-Me eth , 36, al
269	<b>9-Hydroxyanthracene (9-Anthrol, Anthranol)</b>	120, yel							126 31	286 8		
270	<b>6-Bromo-2-methyl-4-nitrophenol (6-Bromo-4-nitro-o-cresol)</b>	120 d , yel , lgr							137			
271	<b>2,2'-Dihydroxy-4,4'-dimethylbiphenyl</b>	120								dt 148, al - acet		
272	<b>4-Nitro-2-naphthol</b>	120, yel , pet eth						122, pa yel , al				m-Nitrobenzenesulfonate, 149, ac a , Me eth , 100-3, br , bz -al
273	<b>4-Chloro-1-naphthol</b>	120 1, 116 7, al or chl							44			Picrate, 171, Car- bonate, 228
274	<b>2-Chloro-3-nitrophenol</b>	120 5, w							51 5	94		Me eth , 94, Et eth , 51, me al
275	<b>4-Chloro-3,5-dibromophenol</b>	121								132		Me eth , 82 5
276	<b>3,4-Dimethyl-1-naphthol</b>	121 5 3 0, lgr	205 10 <sup>15</sup>			222 4			89 5 91			Turns red in air, Picrate, 168
277	<b>3-Aminophenol (3-Hydroxyaniline)</b>	122			143	179						N-Acetyl, 148, N-p-Toluenesulfonyl, 157, N-Phenyl-thiourea, 156
278	<b>2-Amino-3-chlorophenol</b>	122										N-Acetyl, 123, N- Benzoyl, 123, HNO <sub>2</sub> salt, 137
279	<b>4-Bromo-2-naphthol</b>	122						61				Me eth , 64
280	<b>4-Nitroresorcinol (1,3-Dihydroxy-4-nitrobenzene)</b>	122, yel , CCl <sub>4</sub>	178-9 <sup>11</sup>					di 90-1, al	1-mono 124, ac a , 3- mono 189, ac a , di 110			Di-Et eth , 85
281	<b>2,4,6-Trinitrophenol (Picric acid)</b>	122 (subl on slow htng , exp on rapid htng )							76			Naphthalene add comp , 149-51

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
282	<b>3-Hydroxyphenanthrene (3-Phenanthrol)</b>	122 3, al							114 5, aq al			Me eth , 63, me al , Et eth , 46, me al , Picrate, 124-5, red, al
283	<b>2,4-Dichloro-6-nitrophenol</b>	122 3							77			3-Nitrobenzoate, 149-50
284	<b>2-Naphthol (β-Naphthol)</b>	123	286	155-6, al	156 7, lgr	169	210 2 (cor.), al	84	125, al	71 2 70	106-7	Aryloxyacetic acid, 95, 2,4-Dinitrophenyl ether, 95, N,N-Diphenylurethane, 141, <i>p</i> -Phenylazobenzoate, 190 3
285	<b>2,3,4,5-Tetrabromophenol</b>	123, aq al						225 6		110 5, aq ac a	133, al	
286	<b>2,4-Dimethyl-2-methoxyphenol</b>	123							137 8	114		Et eth , 91
287	<b>2-Nitro-4,5,6-tribromophenol</b>	123, yel , bz										Me eth , 109, al , Et eth , 74
288	<b>1,4-Dichloro-2-naphthol</b>	123 4								90 1		
289	<b>4-Butyl-2-methylphenol (4-Butyl-<i>o</i>-cresol)</b>	124	127 9 <sup>15</sup>							268 70		
290	<b>3,3'-Biphenol (3,3'-Di-hydroxybiphenyl)</b>	124, w								di 82 5, dil al	di 92	Di-Me eth , 36, w - al , b p 328
291	<b>1,3-Dihydroxynaphthalene (1,3-Naphthalenediol)</b>	124, w								di 56, w -ac a		sym-Trinitrobenzene add comp , 174 5, red
292	<b>3-Iodo-4-nitrophenol</b>	124, yel , pet eth								73 7	119	Me eth , 69-70
293	<b>2-Methylhydroquinone (2,5-Dihydroxytoluene)</b>	124 5, bz						84	125	<i>mono</i> 92, pet eth , di 49, 45, w	di 119-20	Aryloxyacetic acid, 153, Di-Et eth , 24 5, b p 247-9
294	<b>4-Hydroxybenzyl alcohol (<i>α</i>,4-Dihydroxytoluene)</b>	124 5 5 5								<i>α</i> -mono 84, di 75	<i>α</i> -mono 88 9	
295	<b>4,6-Dimethylresorcinol (4,6-Dihydroxy-<i>m</i>-xylene)</b>	124 5-5 0, w (+l w )	276 9							di 45, al , b p 285-7		Di-Me eth , 76, Di-Et eth , 75, al
296	<b>4-Benzyl-1-naphthol</b>	125-6								87-8	103	
297	<b>Pentamethylphenol</b>	126	267	215						273	127	Me eth , 163 4
298	<b>3,5-Dinitrophenol</b>	126, 122								126 7		Me eth , 105-6, Et eth , 97
299	<b>7-Chloro-2-naphthol</b>	126 5								104 5		
300	<b>4-Chloro-3-nitrophenol</b>	126 5 w								83 5	96-7	Me eth , 98, al , Et eth , 47 5, al
301	<b>2-Nitro-3,4,6-tribromophenol</b>	127, pa yel , w - HCOOH								118		Me eth , 72, w - HCOOH
302	<b>2-Nitro-1-naphthol</b>	127-8, yel , al								118		Me eth , 80, Et eth , 84, yel , lgr
303	<b>1,3-Dibromo-2,4-dihydroxynaphthalene (1,3-Dibromo-2,4-naphthalenediol)</b>	128 9, ac a						186, CS <sub>2</sub>		4-mono 148, di 125, al		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α Naph thyl urethane	p Nitro ben zoate	3,5 Di nitro benzene	Bromo derivative	<i>p</i> Toluene sul fonate	Acetate	Benzoate	Miscellaneous
304	<b>4-Iodo-2-naphthol</b>	128.5							59			Me eth , 67
305	<b>4-Bromo-1-naphthol</b>	129							51			
306	<b>3-Methyl-4-nitrophenol</b> (4-Nitro- <i>m</i> -cresol)	129, w							34, al	74		Me eth , 55, lgr , Et eth , 45, al Hydrochloride, 105-7, Picrate, 200-1
307	<b>3-Hydroxypyridine (β-Pyridone)</b>	129							b p 210, 92°	50.0- 0.5		Me eth , 107
308	<b>4-Hydroxy-3-nitroazobenzene</b>	129, lgr							120.5, ac a	132, bz		Turns br in air
309	<b>3-Amino-2-methylphenol</b> (3-Amino- <i>o</i> -cresol)	129, w							108			Me eth , 108
310	<b>6-Bromo-2-naphthol</b>	129.30							103			<i>m</i> -Nitrobenzenesulfonate, 166, ac a
311	<b>8-Nitro-1-naphthol</b>	130										Me eth , 243, Et eth , 170, N-Acetyl, 157-8, yel
312	<b>4-Amino-2-nitrophenol</b>	131, dk red										
313	<b>Methyl 4-hydroxybenzoate</b>	131			134-5, bz				85	135		
314	<b>5-Methyl-1,2,4-trihydroxybenzene (2,4,5-Trihydroxytoluene)</b>	131.2, bz							tri 114.5, al			4-Me eth , 124, w , 4-Et eth , 131 (subl ), bz, Tri-me eth , 55, w -me al Picrate, 160
315	<b>5-Chloro-1-naphthol</b>	131.2, w or CS <sub>2</sub>							53			
316	<b>4-Cyclohexylphenol</b>	132		145.5		137, al	168 (cor )		35	118.5, me al		
317	<b>Pyrogallol (1,2,3-Trihydroxybenzene)</b>	133	309	tri 173		tri 230	tri 205	di 158	di 110- 11, tri 165, 173	mono 140, di 108, tri 90, al		Tri-N,N-Diphenylurethane, 212
318	<b>2-Amino-4,6-dimethylphenol</b>	134-5, al										N-Acetyl, 96, aq al , O,N-Dibenzoyl, 153.5 Me eth , b p 239-40
319	<b>4-Amino-5-isopropyl-2-methyl-6-nitrophenol</b> (4-Amino-5-isopropyl-6-nitro- <i>o</i> -cresol)	134.5 yel , al								1-mono 280-3, di 222.5, bz		
320	<b>4,6-Dibromo-2-naphthol</b>	134-5							128	128.9		Me eth , 103, Et eth , 98
321	<b>2,3-Dichloro-1,4-dihydroxynaphthalene</b>	135, 155-6, aq al							di 239-40	di 252		Di-Me eth , 107-8, Dipropionate, 166-7, Dibutyrate, 128
322	<b>4-Benzoylphenol (4-Hydroxybenzophenone)</b>	135							81, me al	115, 94-5		2,4-Dinitrophenylhydrazone, 242.4 (cor ), Semicarbazone, 194

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulphonate	Acetate	Benzoate	Miscellaneous
323	2-Amino-4-methylphenol (2-Amino <i>p</i> -cresol)	135, w										N-Benzoyl, 191, al, O,N-Dibenzoyl, 190-1, al, O,N-Diacetyl, 128-9, Me eth, 93-4, pet eth
324	3-Amino-4,6-dichlorophenol	135-6 w							113-4			N-Acetyl, 233-6, Me eth, 51
325	2,6-Dinitrohydroquinone	135 6 (anh.)								4-mono 95-6, <i>di</i> 135-6	4-mono 150 1	4-Me eth, 102, Di-Me eth, 95-6 112
326	1,4-Dimethyl-2-naphthol	135 6										
327	Trichlorohydroquinone	136, w										Di-Et eth, 68 5, al
328	5-Iodo-3-nitrophenol	136, w										Me eth, 84
329	Trichlorophloroglucinol	136, al										Di-Me eth, 93-5
330	1,6-Dihydroxynaphthalene (1,6-Naphthalenediol)	137-8, bz										Tri-Me eth, 130-1, al
331	2,4-Dinitro-1-naphthol	138										Di-Me eth, 60-1
332	4-Amino-2,6-dimethylphenol	138 d, bz										pet eth, Di-Et eth, 83, lgr, 2-
333	2-Amino-3-bromophenol	138										Naphthylamine add comp, 110 5
334	2-Amino-4-chlorophenol	138 (unstable)										Me eth, 97, Et eth, 92
335	1,4,6-Trihydroxynaphthalene (1,4,6-Naphthalenetriol)	138-40										N-Acetyl, 136-7, aq al, O,N-Diacetyl, 160, Me eth, 66, w
336	2,6-Dibromo-3,4,5-trihydroxybenzoic acid (Dibromogalic acid)	139 d (+1H <sub>2</sub> O)										N-Acetyl, 185, O,N-Dibenzoyl, 157-8, Me eth, 82-3
337	2-Hydroxy-2'-nitrobiphenyl	139-40										
338	4-Phenyl-1-naphthol	140										
339	1,3-Dihydroxy-2-methylnaphthalene (2-Methyl-1,3-naphthalenediol)	140										
340	1,2,4-Trihydroxybenzene	140-5, eth										
341	2-Amino-5-iodophenol	141										

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	p Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
342	<b>4-Hydroxy-2-nitrobiphenyl</b>	141-3							169	105 6	Me eth , 72	
343	<b>1,8-Dihydroxynaphthalene (1,8-Naphthalenediol)</b>	142, ac a , 140, w							<i>dt</i> 155 ac anh	<i>dt</i> 174 5	Di-Me eth , 50, pet eth Picrate, 135 7 2-Naphthylamine add comp , 124	
344	<b>2-Amino-4-nitrophenol</b>	142 3 (anh ), 80-90 (hyd )			122				122, yel , al		N-Acetyl, 279, N-Benzoyl, ca 200 d , Me eth , 124 5 Et eth , 97 8	
345	<b>3,4-Dihydroxy-phenanthrene (Morphol)</b>	143, pet eth							<i>dt</i> 159, eth		Me eth , 62 3, Di-Me eth , 45, me al	
346	<b>3-Chloro-1-naphthol</b>	143, 134 5, lgr							69, lgr	118 9	Me eth , b p 162-4 <sup>18</sup>	
347	<b>2-Isopropyl-5-methyl-hydroquinone (Thymoquinol)</b>	143, 139 5	290	232 3, al	147 8, al				<i>dt</i> 73 5	141 2, al		
348	<b>2,6-Dibromo-4-nitrophenol</b>	144							128 9	181		
349	<b>3,4,5-Tribromocatechol</b>	144 (+1H <sub>2</sub> O)							<i>dt</i> 120		Di-Me eth , 86-7	
350	<b>3-Amino-4-methylphenol (3-Amino-p-cresol)</b>	144									N-Acetyl, 178 O,N-Diacetyl, 128 9 N-Benzenesulfonyl, 183, Me eth , 47, w	
351	<b>8-Nitro-2-naphthol</b>	144-5, yel							101-2, w -al		<i>m</i> -Nitrobenzenesulfonate, 144-6, ac a , Me eth , 69, Et eth , 72-3, yel , pet eth	
352	<b>4-Benzoylresorcinol (2,4-Dihydroxybenzophenone)</b>	144 6							<i>dt</i> 78			
353	<b>1-Hydroxyacenaphthene (1-Acenaphthol)</b>	144 5-5 5 (cor ), 148		137					b p 166-8 <sup>5</sup>			
354	<b>4-Amino-2,3,6-trinitrophenol</b>	145 d , ac a									N-Acetyl, 178-9, N-Benzoyl, 205, ac a , Me eth , 138-9, al	
355	<b>4-Benzoylcatechol (3,4-Dihydroxybenzophenone)</b>	145, 134								<i>dt</i> 95	Me eth , 131-2, Di-Me eth , 103 4	
356	<b>3-Bromo-5-nitrophenol</b>	145							99		Me eth , 88	
357	<b>3,4-Dihydroxybiphenyl (4-Phenylcatechol)</b>	145							<i>dt</i> 77 5			
358	<b>2,4,6-Tri-iodoresorcinol</b>	145, CS <sub>2</sub>							8 0			
359	<b>2,4'-Dihydroxychalcone</b>	145							<i>dt</i> 170			
360	<b>2,6-Diamino-4-methylphenol (4-Hydroxy-3,5-toluenediamine)</b>	146							<i>dt</i> 94 5	<i>dt</i> 120	4'-Me eth , 148 d , al N,N'-Diacetyl, 225-7, dil al , 1,2,6-Triacetyl, 228, al	
361	<b>5-Aminoresorcinol (3,5-Dihydroxyaniline)</b>	146-52									N-Benzoyl, 139, Di-Me eth , 46, Picrate, 167-70 d , yel , aq al	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α-Naph thyl- urethane	p-Nitro- benzoate	3,5-Di- nitro- benzoate	Bromo derivative	<i>p</i> - Toluene sul- fonate	Acetate	Benzoate	Miscellaneous
362	<b>4-Acetylresorcinol</b> (Resacetophenone, 2,4-Dihydroxyacetophenone)	147							3-mono 119 20, 4- mono 74, di 38 84	3-mono 67, 4- mono 106 7 78		Semicarbazone, 216, 2,4-Dinitro- phenylhydrazone, 218, Oxime, 199, Phenylhydrazone, 159
363	<b>3-Chloro-5-nitrophenol</b>	147										Me eth , 101, Et eth , 47, al
364	<b>5-Nitro-2-naphthol</b>	147, yel , w										<i>m</i> -Nitrobenzene- sulfonate, 106, ac a , Et eth , 115, yel , al
365	<b>2-Methyl-3-nitrophenol</b> (3-Nitro- <i>o</i> -cresol)	147, yel , w							94, al			Me eth , 52 3, w - me al
366	<b>2-Chloro-4-hydroxybenzaldehyde</b>	147 8								52	97	Semicarbazone, 214, Oxime, 194, <i>p</i> -Nitrophenyl- hydrazone, 288 d
367	<b>1,5-Dibromo-4,8-di- hydroxynaphthalene</b>	147 5								di 131		
368	<b>5-Acetylresorcinol</b> (3,5- Dihydroxyacetophenone)	148								di 91 2		Semicarbazone, 205 6 <i>p</i> -Nitro- phenylhydrazone, 236 7
369	<b>2,4-Dinitroresorcinol</b>	148							mono 126-7	di 119 20	di 182 4	Aryloxyacetic acid, 155, Me eth , 108, Di-Et eth , 57
370	<b>4-Propionylphenol</b> (4- Hydroxypropiophenone)	148								62, lgr	107 5	2,4-Dinitrophenyl- hydrazone, 229
371	<b>9,10-Dihydroxyphenanthrene</b> (9,10-Phenanthrenediol)	148							mono 168 70, di 202	di 216 7		
372	<b>3,4,5-Trihydroxyphenanthrene</b> (3,4,5-Phenanthrenetriol)	148, w							tri 138, bz - pet eth			Tri-me eth , 90, me al
373	<b>4-Hydroxypyridine</b> ( $\gamma$ - Pyridone)	148 5 (anh ), 65 (+1 H <sub>2</sub> O)	>350						140 50	81		Picrate, 240, Methiodide, 108 9
374	<b>3-Nitrosalicylic acid</b>	148 5-9 0										Amide, 155, 145
375	<b>3-Acetamidophenol</b> (3- Hydroxyacetanilide)	148 9, w							99 5 100 5			
376	<b>2-Amino-3,6-dimethyl- phenol</b>	149 50, bz										N-Benzoyl, 210-11, O,N-Dibenzoyl, 178-9
377	<b>2,6-Dimethylhydroquinone</b>	149-51, xyl										4-Me eth , 77, pet eth
378	<b>2,4'-Dihydroxybenzo- phenone</b>	150								84 5		
379	<b>5-Amino-2-bromophenol</b>	150 d										
380	<b>2-Amino-5-bromophenol</b>	150										O,N-Dibenzoyl, 133 4. H <sub>2</sub> SO <sub>4</sub> salt, 239 40
381	<b>1-Hydroxyanthracene</b> (1- Anthrol)	150-3, br , al								128-30		Me eth , 70, Et eth , 69
382	<b>2-Amino-4-chloro-6-nitro- phenol</b>	152										N-Acetyl, 150 60, yel

\* Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Phenyl urethane	α Naphthylurethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p Toluene sulphonate	Acetate	Benzolate	Miscellaneous
383	<b>4-Hydroxyazobenzene (4-Benzeneazophenol)</b>	152, al							89, 84 5, yel , al	136-8, yel , al		Hydrochloride, 169 $\text{HNO}_3 \rightarrow$ 2,4-Dinitrophenol, 113 Propionate, 75, red
384	<b>Tribromophloroglucinol</b>	152 3 (anh ), w							mono 169, bz - pet eth , <i>tri</i> 181 3, al			Me eth , 123, bz Tri-Me eth 145, al Di-Et eth , 63 5, w -ac a , Tri-Et eth , 102 4, ac a
385	<b>4-Amino-2-chlorophenol</b>	153							116-7, aq al			N-Acetyl, 144 O,N-Diacetyl, 124 Me eth , 62
386	<b>2,2'-Dihydroxy-5,5'-dimethylbiphenyl</b>	153-4, w								<i>di</i> 88		Diformate, 61, 70% al
387	<b>2-Amino-5-chlorophenol</b>	154, aq al										O,N-Dibenzoyl, 140, al Me eth , 46, Hydrochloride 226 d
388	<b>1,2,4-Trihydroxynaphthalene (1,2,4-Naphthalenetriol)</b>	154							<i>tri</i> 134 5			
389	<b>6-Hydroxybiphenyl-2-carboxylic acid</b>	154 (anh )							177, ac a	88-9, al	121, 150	Benzenesulfonate, 104-5 Butyrate, 59-60
390	<b>4-Amino-3-nitrophenol</b>	154, dk red							134, al	185		N-Acetyl, 218, yel , w O,N-Diacetyl, 146, O-m-nitrobenzenesulfonate, 184
391	<b>2-Azoxyphe nol (2,2'-Dihydroxyazoxybenzene)</b>	154 5								<i>di</i> 150, bz	<i>di</i> 108 al	Di-Me eth 81 Di-Et eth , 102
392	<b>3,5-Stilbenediol (3,5-Dihydroxystilbene, Pinosylvyn)</b>	155 5-6 0, ac a							<i>di</i>	100-i me al	150 1 ac a me al	Me eth , 122-3, ac a Di-Me eth , 56 7 me al
393	<b>1-Hydroxyphenanthrene (1-Phenanthrol)</b>	156, eth							135-6, al			Me eth , 105, me al , Picrate 182, or-red, me al
394	<b>4-Iodo-3-nitrophenol</b>	156, yel , al								107 5		Me eth , 62, Et eth , 63 5
395	<b>1,4,5-Trichloro-2-naphthol</b>	157-8, ac a								129		Me eth , 95-6, me al , Picrate, 185, red, Propionate, 95, ac a
396	<b>9-Hydroxyphenanthrene (9-Phenanthrol)</b>	158, bz, 153								77-8, al	99-100	
397	<b>5-Nitroresorcinol</b>	158, w								<i>di</i> 105		Me eth , 141-2, yel , Di-Me eth , 89, eth -et ac , Et eth , 80, w
398	<b>4,4'-Dihydroxydiphenylmethane</b>	158, w								<i>di</i> 69- 70, al	<i>di</i> 156, al	Di-Me eth , 52, Di-Et eth , 38-9
399	<b>2,4,6-Tri-iodophenol</b>	158-9, w - al						181		156, bz	137	Me eth , 98-9, bz Et eth , 83, eth

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluenesulfonate	Acetate	Benzoate	Miscellaneous
400	<b>Salicylic acid (2-Hydroxybenzoic acid)</b>	158.3	211 <sup>20</sup>			205, me al			135, wh	132		Aryloxyacetic acid, 191, Amide, 142, Anilide, 136, p-Toluamide, 156 N-2,4-Dinitrophenyl, 211, orange-red
401	<b>4-Amino-2,3,6-trichlorophenol</b>	159, al							153, yel			
402	<b>4-Amino-3-chlorophenol</b>	160										N-Acetyl, 121
403	<b>6-Amino-2,4-dinitro-3-methylphenol (6-Amino-2,4-dinitro-<i>m</i>-cresol)</b>	160	160, al									N-Acetyl, 225, yel
404	<b>2,2'-Dihydroxychalcone</b>	160-1								dt 85.5 6.0	dt 114	2-Me eth, 112, al 2-Et eth, 61, al
405	<b>4-Amino-6-nitroresorcinol</b>	160-1 d, eth-lgr										N-Acetyl, 261, yel, ac a, Di-Me eth 136.7, red aq al
406	<b>4,4'-Dihydroxy-3,3'-dimethylbiphenyl</b>	160-1								dt 131, al, 135.5	185, ac a	
407	<b>2,3-Dihydroxynaphthalene (2,3-Naphthalenediol)</b>	160.1, w									dt 235	Me eth, 108, Di-Me eth, 116.5, lgr, Et eth, 109-10, Di-Et eth, 96-7, 2-Naphthylamine add comp 168
408	<b>1,2-Dihydroxyanthracene (1,2-Anthracenediol)</b>	160-2								dt 157.0-7.5, al-ac a		
409	<b>6-Retenol (6-Hydroxyretene)</b>	161, xyl								110.5 11	134-5	Picrate, 152-2.5, red, al
410	<b>5-Amino-2-methylphenol (5-Amino-<i>o</i>-cresol)</b>	161, w								111-2, aq al		N-Acetyl, 225, N,N-Diacetyl, 132-3, O,N-Dibenzoyl, 162, Me eth, 58
411	<b>4,4'-Dihydroxytriphenylmethane</b>	161, w-al								dt 109.10		Di-Me eth, 100.1, chl-me al
412	<b>3-Hydroxyphthalic acid</b>	161 d								114-6		
413	<b>1,2,3,4-Tetrahydroxybenzene (Apionol, Phenetrol)</b>	161, pink, et ac								tetra 142	148 tetra 191.2	1,4-Di-Me eth, 106, Tetra-Me eth, 89
414	<b>5-Amino-2-nitrophenol</b>	162, or - yel, w										N-Acetyl, 221, yel, ac a, O,N-Diacetyl, 149, w
415	<b>1,3,4-Trichloro-2-naphthol</b>	162								133.5-4.0, ac a		
416	<b>2-Amino-5-methylphenol (6-Amino-<i>m</i>-cresol)</b>	162 d										N-Benzoyl, 169, acet-pet eth, O,N-Dibenzoyl, 162.3, me al, Me eth, 171, 50% al
417	<b>1-Amino-2,4-dihydroxynaphthalene</b>	162 (at 130 → vlt)										O,O,N-Triacetyl, 155-6, bz

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
418	<b>2,4'-Biphenol (2,4'-Dihydroxybiphenyl)</b>	162.3	342						<i>dt</i> 94, al			Di-Me eth , 70
419	<b>2,5-Dimethylresorcinol (2,6-Dihydroxy-p-xylene)</b>	163, bz	277.80						<i>dt</i> 69, al			Me eth , 118-21, bz
420	<b>2-Amino-3,5-dimethylphenol</b>	163, bz							186.7			O,N-Diacetyl, 87-8, N-Benzoyl, 211.2, al O,N-Dibenzoyl, 148-9, me al , Hydrochloride, 270.80, <i>dt</i> HCl
421	<b>4-Nitro-1-naphthol</b>	164, w										<i>m</i> -Nitrobenzenesulfonate, 135, Me eth , 81, yel , bz 85-6, Et eth , 120, al , 116.7
422	<b>3,5-Dinitrocatechol (1,2-Dihydroxy-3,5-dinitrobenzene)</b>	164							120, <i>dt</i> 112.4, 124, al			1-Me eth , 123.2- Me eth , 80 Di-Me eth , 102, al , 1-Et eth , 155, al , Di-Et eth . 78 94.5
423	<b>2,2'-Dihydroxy-6,6'-dimethylbiphenyl</b>	164							<i>dt</i> 87, al	<i>dt</i> 136, al		
424	<b>2-Amino-3,4-dihydroxynaphthalene</b>	164							<i>dt</i>	>200		N-Acetyl, 170 d , 3-O,N-Diacetyl, 195 d , acet
425	<b>2,6-Dibromohydroquinone</b>	164							<i>dt</i> 117	<i>tr</i> 125-6		2,4-Di-Me eth , 83, 2,6-Di-Me eth , 178-9
426	<b>2-Benzoylphloroglucinol (2,4,6-Trihydroxybenzophenone)</b>	165										2,4-Di-Me eth , 105.6
427	<b>5-Amino-3-nitrophenol</b>	165, yel										N-Acetyl, 260-70, et ac
428	<b>2-Methoxy-4-nitrophenol</b>	165 d , yel , chl							156-8	188, yel , al		Me eth , 105.6
429	<b>3-Amino-4,5-dimethylphenol</b>	165, eth , br , (173- 5, subl )										N-Acetyl, 191 (sinters, 184), O,N-Diacetyl, 157, al , O,N,N-Triacetyl, 100-1, al , N-Benzoyl, 195-6 1,3-Di-Me eth , 159.83, 1,2,3-Tri-Et eth , 105
430	<b>1,2,3,5-Tetrahydroxybenzene</b>	165							<i>tr</i> 74			<i>p</i> -Phenylazobenzoate, 213.5- 4.0, 2,4-Dinitrophenyl ether, 118
431	<b>4-Phenylphenol (4-Hydroxybiphenyl)</b>	165	305.8	167.5				177, ac a , 179,	88-9, 87-8, al	150-1, al		N-Benzoyl, 145, O,N-Dibenzoyl, 192 3-Me eth , 70-1, red, lgr , Di-Me eth , 53-4, red, lgr , 44-5 N-Acetyl, 184-5, Et eth , 74, or
432	<b>4-Amino-2-bromophenol</b>	165, 155										
433	<b>Benzeneazocatechol (3,4-Dihydroxyazobenzene)</b>	165 d , dk red, al										
434	<b>4-Amino-2-chloro-3-nitrophenol</b>	165.5 d , bz										

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
435	<b>4-Amino-2,5-dinitrophenol</b>	166-7, al										N-Acetyl, 144-5, Me eth , 153, bz -lgr , red, Et eth , 139
436	<b>4-Amino-2,6-dinitro-3-methylphenol (4-Amino-2,6-dinitro-m-cresol)</b>	167, red, 50% al										N-Acetyl, 231 d , ac a , Et eth , 96 7, Hydrochloride, 200 d , dil, HCl
437	<b>2-Benzamidophenol (2-Hydroxybenzalide)</b>	167 d							109-10, al	134 40, al		Me eth , 60
439	<b>2,3,4-Trichloro-1-naphthol</b>	168, lgr								123-4		
440	<b>2-Hydroxyphenanthrene (2-Phenanthrol)</b>	168, al							142-3	139-40, al	Et eth , 112, al , Picrate, 156, red	
441	<b>1,5-Di-(2-hydroxyphenyl)-1,4-pentadiene-3-one</b>	168							dt 128, al	135, al	Di-Me eth , 125, al , Di-Et eth , 89, al	
442	<b>3,5-Diaminophenol</b>	168-70								150-1		3,5-Diacetyl, 195
443	<b>4-Acetamidophenol (4-Hydroxyacetanilide)</b>	169										
444	<b>2-Amino-4,6-dinitrophenol (Picramic acid)</b>	169, dk red, al										N-Acetyl, 201, N-Benzoyl, 230, 220, N-p-Toluene-sulfonyl, 191
445	<b>4-Amino-2-chloro-5-nitrophenol</b>	169 5 d										N-Acetyl, 166, yel , Et eth , 128 5, or
446	<b>3,3'-Dihydroxybenzophenone</b>	170								89-90	101-2	
447	<b>1,4-Dihydroxy-2-methyl-naphthalene (2-Methyl-1,4-naphthohydroquinone)</b>	α 170, β 60, ac a							dt 113, al	181		
448	<b>4-Amino-2,6-dinitrophenol (Isopicramic acid)</b>	170, br , w										N-Acetyl, 182, N-Benzoyl, 263, 250, Me eth , 212, Et eth , 172
449	<b>Benzeneazoresorcinol (2,4-Dihydroxyazo-benzene)</b>	170, dk red								dt 104, or - red, al		Di-Me eth , 92, red, al , Di-Et eth , 70 yel -red, al
450	<b>3,4-Diaminophenol</b>	170 2, 167 8, unstable										N,N'-Diacetyl, 205-7, 3,4-Dibenzoyl, 203 5, 1,3,4-Tribenzoyl, 225, Et eth , 71 2 b p 294-6
451	<b>5-Nitro-1-naphthol</b>	171, dk yel -red, w							114, w - al	109, me al		Me eth , 96-7, yel pet eth
452	<b>Hydroquinone (1,4-Dihydroxybenzene)</b>	171, 172	286	dt 224, 205 7		dt 258, al	dt 317	dt 186	mono 98-9, bz , di 159, 25% al	dt 123, w	dt 199, 204 (cor ), tol	Aryloxyacetic acid, 250, 2,4-Dinitrophenyl ether, 243-6, N,N-Diphenylurethane, 250

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α Naphthyl urethane	p-Nitrobenzoate	3,5-Di nitrobenzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
453	<b>2-Azophenol (2,2'-Dihydroxyazobenzene)</b>	172, yel , bz							<i>di</i> 150, or -red			Di-Me eth , 153, or , Di-Et eth , 131, red
454	<b>2,3,4-Trihydroxyacetophenone (Gallaceto-phenone)</b>	173 192 0-2 5							2,4- <i>di</i> 107-8, 3,4- <i>di</i> 78-81, <i>tri</i> 85			Semicarbazone, 225 d , Oxime, 162-3 , Picrate, 133
455	<b>3,5-Dinitrosalicylic acid</b>	173-4 (anh )								163		Amide, 181, Anilide, 180 (subl ), 194
456	<b>2-Aminophenol (2-Hydroxyaniline)</b>	174								175		N-Acetyl, 209, 201, N-Benzenesulfonyl, 141, N-p-Toluenesulfonyl, 146
457	<b>3-Benzamidophenol (3-Hydroxybenzamidine)</b>	174, tol								153		Et eth , 103
458	<b>4-Amino-2-methylphenol (4-Amino <i>o</i>-cresol)</b>	175, bz						109-10, bz -lgr				N-Acetyl, 179, O,N-Dibenzoyl, 194, ac a , Me eth , 59 0-9 5, 92-3, aq al
459	<b>1,6,7-Trihydroxynaphthalene (1,6,7-Naphthalenetriol)</b>	175							<i>tri</i> 143 4			
460	<b>4-Nitocatechol</b>	176, yel , w							<i>di</i> 98	<i>di</i> 156, al		Di-Me eth , 96, w -al , Di-Et eth , 73 5, pa yel
461	<b>1,4-Dihydroxynaphthalene (1,4-Naphthalenediol, 1,4-Naphthohydroquinone)</b>	176, 192							<i>di</i> 128 30, al	<i>di</i> 169, ac a		Me eth , 131, Di-Me eth , 85, CS <sub>2</sub>
462	<b>1,7-Dihydroxynaphthalene (1,7-Naphthalenediol)</b>	178, bz	203 4		182-3				<i>di</i> 108, bz	<i>di</i> 101 5, 113-5		Di-Et eth , 67
463	<b>1,2-Dihydroxyphenanthrene (1,2-Phenanthrediol)</b>	178, w -al							<i>di</i> 147, me al			Di-Me eth , 100 2, lgr
464	<b>4-Amino-6-isopropyl-3-methylphenol (4-Amino-6-isopropyl-<i>m</i>-cresol)</b>	178-9, bz										N-Benzoyl, 178-9, O,N-Dibenzoyl, 166-7, aq al , Hydrochloride, 255
465	<b>1,8,9-Trihydroxyanthracene (1,8,9-Anthracenetriol, Anthralin)</b>	178 80, 176 7							<i>tri</i> 209 10			
466	<b>4-Amino-3-methylphenol (4-Amino-<i>m</i>-cresol)</b>	179, 50% al								92, pet eth		N-Acetyl, 138, Hydrochloride, 215, Me eth , 29-30
467	<b>2,5-Dihydroxyphenanthrene (2,5-Phenanthrediol)</b>	180, xyl							<i>di</i> 144, w -ac a			Di-Me eth , 117, ac a
468	<b>9,10-Dihydroxyanthracene (9,10-Anthradiol)</b>	180, yel							<i>di</i> 260, ac a	<i>di</i> 292, yel xyl -chl		Di-Me eth , 202, bz , Di-Et eth , 148, bl fluor , al

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl-urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
469	<b>1,2,5,8-Tetrahydroxynaphthalene (1,2,5,8-Naphthalenetetrol)</b>	180 d							<i>tetra</i> 202			
470	<b>4-Hydroxy-3-iodo-5-methoxybenzaldehyde (5-Iodovanillin)</b>	180							105-6	135 5-6 5		Oxime, 178 9 Semicarbazone, 187 8 d
471	<b>6-Nitro-1-naphthol</b>	181 2							121			
472	<b>4-Amino-3,5-dimethylphenol</b>	181 2, chl										N-Acetyl, 178 80 N-Benzyl, 104 5, Me eth , 43, pet eth N-Acetyl, 213, yel
473	<b>2-Amino-4-nitroresorcinol</b>	182, br , aq al										
474	<b>3-Azoxyphe nol (3,3'-Dihydroxyazoxybenzene)</b>	183							<i>dt</i> 102, 50% al	<i>dt</i> 75, ac a		Di-Me eth , 49 50, 47 6
475	<b>N-Benzylidene-4-amino-phenol</b>	183							92	144		Me eth , 62, Et eth , 76(71), Hydrochloride, 167-77
476	<b>4-Aminophenol (4-Hydroxyaniline)</b>	184 (subl )				178 5 (cor )			168			O,N-Diacetyl, 150, 2,4-Dinitrobenzoyl, 204 5 (cor ), N-p-Toluenesulfonyl, 253
477	<b>1,9-Dihydroxyphenanthrene (1,9-Phenanthrenediol)</b>	184 5, bz							<i>dt</i> 154-5, w -al			9-Me eth , 131 2, bz -pet eth Di-Me eth , 113 4, me al
478	<b>4,6-Diacetylresorcinol (Resodiacetophenone)</b>	185, al							<i>dt</i> 120	<i>mono</i> 214-5, <i>dt</i> 118		Di-Me eth , 171 5, Dioxime, 242, Phenylhydrazone, 233
479	<b>4-Amino-2-naphthol</b>	185							137			O,N-Dibenzoyl, 309
480	<b>7-Hydroxy-4-methylcoumarin (4-Methyl-umbelliferone)</b>	185 6, al	155-6		143				150, al	159-60, al		Me eth , 159, m-Nitrobenzoate, 210-11, Picrate, 108
481	<b>3-Amino-4-nitrophenol</b>	185-6, or , w										N-Benzoyl, 166, Me eth , 131, Et eth , 105-6
482	<b>1,2,6-Trihydroxynaphthalene (1,2,6-Naphthalenetriol)</b>	188							<i>tri</i> 262			
483	<b>α,2,4-Trihydroxyacetophenone (ω-Hydroxyresacetophenone)</b>	189							<i>tri</i> 129	<i>α-mono</i> 200		α-Me eth , 136, p-Nitrophenylhydrazone, 205 d , Oxime, 105-7
484	<b>2,7-Dihydroxynaphthalene (2,7-Naphthalenediol)</b>	190, 185-6, w							150, chl	<i>mono</i> 171-2, me al , <i>dt</i> 136, w	<i>mono</i> 199, me al , <i>dt</i> 139, al	Aryloxyacetic acid, 149, N,N-Diphenylurethane, 176, Me eth , 117 Di-Me eth , 139, Di-Et eth , 104, al
485	<b>1,4,5,8-Tetrahydroxynaphthalene (1,4,5,8-Naphthalenetetrol)</b>	190							<i>tetra</i> 277 9			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	$\alpha$ Naph thyl urethane	p-Nitro benzoate	3,5 Di nitro benzoate	Bromo derivative	$p$ Toluene sul fonate	Acetate	Benzoate	Miscellaneous
486	1,5-Diacetyl-2,3,4-tri-hydroxybenzene (4,6-Diacetylpyrogallol Gallodiacetophenone)	190 1, w							mono 207 9	tri 189		Tri-Me eth , 73-4
487	3,9-Dihydroxyacridine	190 2 lt br → dk in air al										9-Me -3-Et eth , 144, yel , w In al → grn fluor
488	Pentachlorophenol	190 2						145	149-50	164-5, 159		Aryloxyacetic acid , 196
489	5-Amino-2-naphthol	191										O,N-Diacetyl , 187, O,N-Dibenzoyl , 223
490	1,4-Dihydroxynaphthalene (1,4-Naphthalenediol)	192							di 128-30	di 169		
491	5-Amino-1-naphthol	192								di		O,N-Dibenzoyl , 276
492	Tetrabromocatechol	192-3							215-6	197-8, bz - lgr	Me eth , 162-3, Di- Me eth , 151-2, 118-20	
493	6-Hydroxyquinoline	193, al						98	36 8	230-1, ac a		Methiodide , 236 d , Picrate , 235 6
494	3-Methyl-2,4,5,6-tetra-bromophenol (2,4,5,6-Tetrabromo-m-cresol)	194, ac a							165 6	153-4	Me eth , 145 6, al , Et eth , 108, eth	
495	1,5-Dichloro-4,8-dihydroxynaphthalene	194, ac a							4-mono 148- 60, ac a di 154, 143, acet	4-mono 157-8, ac a , di 179, acet		
496	1,6-Dinitro-2-naphthol	195 d						181				Me eth , 204, 198, Et eth , 144, yel , Alc NH <sub>3</sub> at 160° → 1,6-di-nitro-2-naphthyl- amine , 248, Oxid → 4-nitro-phthalic acid , 165
497	5,6-Dihydroxyace-naphthene (5,6-Acenaphthenediol)	196-9, bz							di 194-5			
498	1,2,7-Trihydroxynaphthalene (1,2,7-Naphthalene-triol)	197							181-2			
499	4-Methyl-2,3,5,6-tetra-bromophenol (2,3,5,6-Tetrabromo-p-cresol)	199							156			
500	2-Hydroxyquinoline	199										2-Ph eth , 69
501	2-Amino-4-methyl-5-nitro-phenol (2-Amino-5-nitro-p-cresol)	199-200 d										N-Acetyl , 242, ac a , Me eth , 132, yel
502	6-Amino-1-naphthol	199 5										O,N-Diacetyl , 130, N-Benzoyl , 203, O,N-Dibenzoyl , 230
503	Hexahydroxybenzene	200 d							hexa 203	hexa 313		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthylurethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
504	<b>Methylenedi-2-naphthol</b> (2,2'-Dihydroxy-1,1'-dinaphthylmethane)	200, ac a							<i>di</i> 214, al			Di-Me eth , 144-7, al , Picrate, 178 9, red-br
505	<b>3-Hydroxybenzoic acid</b>	200							131			Aryloxyacetic acid, 206, Amide, 170, <i>p</i> -Bromophenacyl ester, 176
506	<b>Methyl gallate</b> (Methyl 3,4,5-trihydroxybenzoate)	200-1							<i>tri</i> 120, 120 2, al	<i>tri</i> 139, al		
507	<b>3-Hydroxyquinoline</b>	200-1, bz							90			Picrate, 240 5
508	<b>7-Amino-2-naphthol</b>	201, 208								177		N-Acetyl, 232, O,N-Diacetyl, 156, N-Benzoyl, 243-6, O,N-Dibenzoyl, 181
509	<b>4-Amino-3-methyl-2-nitrophenol</b> (4-Amino-2-nitro- <i>m</i> -cresol)	201, al										O,N-Diacetyl, 127 8
511	<b>2-Acetamidophenol</b> (2-Hydroxyacetanilide)	201 3, 209, aq al							122	140		O,N-Diacetyl, 77
512	<b>2-Acetylhydroquinone</b> (2,5-Dihydroxyacetophenone)	202							<i>di</i> 68	<i>di</i> 113		<i>p</i> -Nitrophenylhydrazone, 215-6, Oxime, 149-50
513	<b>2,8-Dihydroxyphenanthrene</b> (2,8-Phenanthrenediol)	202, w -al							<i>di</i> 125, al			
514	<b>4-Hydroxy-4'-nitrobiphenyl</b>	203, 200-1							159, bz	138 9, lgr	208-10, ac a	Me eth , 111, yel., al , 3,5-Dinitro deriv , 197-8
515	<b>3,5-Dimethoxy-4-hydroxybenzoic acid</b>	205							191	229-32		
516	<b>4-Hydroxycoumarin</b> (Benzotetronic acid)	206, 232 3							103			Me eth , 124, w
517	<b>2,3,5-Trihydroxyacetophenone</b>	206-7, yel., ac a							<i>tri</i> 106-7, lgr	<i>tri</i> 106-7		<i>p</i> -Nitrophenylhydrazone, 241-2 d, w -al
518	<b>2,4,5-Trihydroxyacetophenone</b>	206-7, red							2,4- <i>di</i> 165-6, bz			
519	<b>6-Chloro-3-hydroxy-4-methylbenzoic acid</b>	206-8							146			Amide, 239-40, Anilide, 222
520	<b>8-Amino-2-naphthol</b>	207 d										O,N-Diacetyl, 178, O,N-Dibenzoyl, 208
521	<b>3-Azophenol</b> (3,3'-Dihydroxyazobenzene)	207, yel							<i>di</i> 144, yel., al	<i>di</i> 188, w -al		Di-Me eth , 73-4, Di-Et eth , 91, yel
522	<b>2-Amino-5-nitrophenol</b>	207-8, or , 201-2, w							188, yel., al			N-Acetyl, 271-2, O,N-Diacetyl, 187, Me eth , 139
523	<b>2-Methyl-3,4,5,6-tetrabromophenol</b> (3,4,5,6-Tetrabromo- <i>o</i> -cresol)	208							154			
524	<b>2,6-Dichloro-3,4,5-tribromophenol</b>	209								202		Me eth , 143-4

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naphthyl urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	p-Toluene sulphonate	Acetate	Benzoate	Miscellaneous
525	4-Hydroxy-3-methoxybenzoic acid (Vanillic acid)	210 (subl.)				140 1 d				110, w	178, aq al	Hydrazide, 207, Phenylhydrazide, 150-25
526	4,4'-Dihydroxybenzophenone	210								156, 152	Me eth, 151-2, Di-Me eth, 146, 2,4-Dinitrophenylhydrazone, 190-2	
527	cis-1,2-Dihydroxyacenaphthylene glycol (cis-Acenaphthylene glycol)	212-3, w							mono 122-3, al, di 130, me al			
528	4-Hydroxy-4'-nitroazobenzene	212-3 219 0-95								147, or	195, or	Me eth, 157 5 80
529	6-Amino-2-naphthol	213 d										O,N-Diacetyl, 220
530	2,4-Dihydroxybenzoic acid	213, 216 d										Amide, 222, Anilide, 126-7, p-Nitrophenyl ester, 189
531	Methylphloroglucinol (2,4,6-Trihydroxytoluene)	214-6, et ac							tri 76, lgr			2-Me eth, 91 (+1H <sub>2</sub> O), 117 9 (anh), 4-Me eth, 124, Tri-Me eth, 10 13, b p 140-2 <sup>18</sup>
532	4-Hydroxybenzoic acid	215, 210							187	221-3		Aryloxyacetic acid, 278, Amide, 198, p-Toluidide, 204
533	4,6-Dinitroresorcinol	215, yel				di 178			mono 135	di 139	di 343-4	Me eth, 113, Di-Me eth, 157, Et eth, 77, Di-Et eth, 133
534	4-Chloro-2,3,5,6-tetrabromophenol	215								203		Me eth, 161
535	2,6-Dihydroxynaphthalene (2,6-Naphthalenediol)	215, 218							di 175	di 215		Di-Me eth, 50, bz, Di-Et eth, 162, al
536	1,2,4,5-Tetrahydroxybenzene	215-20							tetra 226-7			2-Me eth, triacetyl, 142, Tetra-Me eth, 103.
537	4-Azophenol (4,4'-Dihydroxyazobenzene)	α 216, grn (anh), β 216, dk red (anh)							di 198-9, yel, ac a	di 210 5 15, 249-51, red-yel, bz		Di-Me eth, 160 5 25, me al, Di-Et eth, 157-9, yel, al, 160
538	2-Amino-3-nitrophenol	216 7, red							136			N-Acetyl, 172, Me eth, 75-6
539	4-Benzamidophenol (4-Hydroxybenzanilide)	216 7, 227							171	235		Me eth, 153-4, al, Et eth, 173, aq al, Benzyl eth, 226-7
540	2,5-Dimethylhydroquinone (Hydrophlorone)	217							mono 117, di 135	mono 162-3, pet eth, di 159, me al		Me eth, 90, lgr

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl urethane	p-Nitro benzoate	3,5-Dinitro benzoate	Bromo derivative	p-Toluene sulfonate	Acetate	Benzoate	Miscellaneous
541	<b>Phloroglucinol (1,3,5 Trihydroxybenzene)</b>	217 9, rapid htng , 200 9, slow htng		<i>tri</i> 190 1		283	<i>tri</i> 162	<i>tri</i> 151		<i>tri</i> 104 6, al	<i>tri</i> 173 4, al	Monobenzenesulfonate, 163 4 (anh ) Monobenzenesulfonate, diacetate, 95 6, bz Dibenzenesulfonate, 120-1, bz , Dibenzenesulfonate monoacetate, 81 me al
542	<b>2-Amino-3,5-dinitrophenol</b>	218, yel , al							186			O,N-Di p-Toluene sulfonyl, 188 N Acetyl, 171 Me eth , 181
543	<b>2,2'-Dihydroxy-1,1'-binaphthyl</b>	218								<i>di</i> 109, al	<i>mono</i> 204, <i>di</i> 160	Dipicrate, 175 6, Di-Me eth , 190, Di-Et eth , 90
544	<b>7-Hydroxybenzo [a]pyrene</b>	218 9, yel								194 5, yel	191 2, yel	Me eth , 183 4, pyr p-Nitrobenzyl eth , 252-3
545	<b>Acetylphloroglucinol (2,4,6-Trihydroxyaceto phenone, Phloracetophenone)</b>	219, w , 222								<i>tri</i> 103	<i>2-mono</i> 168, 4 <i>mono</i> 210- 11, <i>tri</i> 117 8	2-Me eth 205 7 4-Me eth , 139 40, Tri-Me eth , 103 Tri-Et eth , 75, aq al
546	<b>1,1'-Dihydroxy-2,2'-binaphthyl</b>	220								<i>di</i> 169		Di-Me eth , 122, lgr
547	<b>3,5-Dihydroxypyrene</b>	220 d , ac a								<i>di</i> 155		Di-Me eth , 177-8
548	<b>3,6-Dihydroxyphenanthrene (3,6-Phenanthrenediol)</b>	221, w -al								<i>di</i> 124 5, al		3-Me eth , 135 6 w -me al Di-Me eth , 104-5, w -me al
549	<b>2,3-Dimethylhydroquinone (3,6-Dihydroxy-<i>o</i>-xylene)</b>	221, sl d , w								<i>mono</i> 174 5, acet - pet eth , <i>di</i> 182, acet - pet eth		Di-Et eth , 68 9
550	<b>3-Hydroxy-2-naphthoic acid</b>	222								184-6		Amide, 218, Anilide, 244 p-Toluide, 222
551	<b>4-Amino-6-chloro-3-methylphenol (4-Amino-6-chloro-<i>m</i>-cresol)</b>	223-5 d									<i>mono</i> 200, al , 212, bz , <i>di</i> 187-90	O,N-Diacetyl, 162 O,N-Dibenzoyl, 220
552	<b>4-Azoxypheol (4,4'-Dihydroxyazoxybenzene)</b>	224 d								<i>di</i> 163, or , al		Di-Me eth , 118-9 yel , Di-Et eth , 137-8

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	α-Naphthyl-urethane	p-Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
553	5-Hydroxyquinoline	224						85				Hydrochloride, 240, Methiodide, 224, Picrate, 187 N-Acetyl 193 Me eth , 132
554	2-Amino-4-chloro-5-nitrophenol	225 d , yel										
555	1,2,3,4-Tetrahydroxynaphthalene (1,2,3,4-Naphthalenetetrol)	225							tetra 220			
556	1,8-Dihydroxyanthracene (1,8-Anthracediol, Chrysazol)	225, yel , al -w								di 184, et ac		Di-Me eth , 198, al , Di-Et eth , 139, al
557	4-Amino-6-nitrocatechol	228, yel										O,O,N-Triacetyl, 207, ac a
558	5-Hydroxycoumarin	229								88 9, 84		Me eth , 85 7
559	2-Hydroxy-5-nitro-benzoic acid	229 30										Amide, 225, Anilide, 224
560	Pentabromophenol	229 5, 225 6								197, 171		Me eth , 173 4, Et eth , 136
561	2,6-Dihydroxyphenanthrene (2,6-Phenanthrediol)	234, w -al								di 122-3, al	di 252 3	Di-Me eth , 87, me al
562	3-Amino-2-naphthol	235										O,N-Diacetyl, 188, O,N-Dibenzoyl, 184
563	5-Hydroxy-1-naphthoic acid	235							202	241		
564	2,3-Dihydroxyacridine (2,3-Acridinediol)	235 d										Di-Me eth , 107, yel -wh , al
565	Tetrachlorohydroquinone	236 7										
566	7-Hydroxyquinoline	238-40, al , (br at 200)							116	di 245	di 233 88-9, al	Methiodide, 251 d , al , Picrate, 244-5
567	1,7-Dihydroxyanthrone (Euxanthone)	240								7-mono 160, al , di 185, bz	di 221 2, 214	7-Me eth , 130-5
568	1,6-Dihydroxypyrene (1,6-Pyrenediol)	240 d , sinters at 175										Sol red with grn fluor In alkali red soln with bl fluor , Zn dust → pyrene, 149-50
569	4-Amino-2,5-dimethyl-phenol	242 d , al										N-Acetyl, 177 9, al , Et eth , 69 5
570	3,8-Dihydroxyphenanthrene (3,8-Phenanthrediol)	247, lt red, w -al								di 184, al		Di-Me eth , 117, me al
571	3-Hydroxy-1-naphthoic acid	248								169 70	222-3	Amide, 209-11, Anilide, 112-3
572	2,5-Dihydroxypyridine (2,5-Pyridinediol)	248								5-mono 156		Hydrochloride, 106 (hyd ), 154 (anh )
573	1,4-Dihydroxyisoquinoline (1,4-Isoquinolinediol)	>250, ac a turns red at 200								4-mono 207-8		4-Me eth , 171, acet -pet eth
574	2,3-Dihydroxyquinoline (3-Hydroxycarbostyril, 2,3-Quinolinediol)	257 8, >300								3-mono 211	3-mono 286 7, di 45 6, pet eth	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE VII. ORGANIC DERIVATIVES OF PHENOLS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Phenyl urethane	$\alpha$ -Naphthyl urethane	<i>p</i> -Nitrobenzoate	3,5-Dinitrobenzoate	Bromo derivative	<i>p</i> -Toluene sulfonate	Acetate	Benzoate	Miscellaneous
575	1,5-Dihydroxynaphthalene (1,5-Naphthalenediol)	265, 258							<i>dt</i> 159- 61, <i>dil</i> <i>al</i>	<i>dt</i> 235, 242, pyr		Di-Me eth, 183-4, Di-Et eth, 130, w-al, 2 Naphthylamine add comp, 229-5 Di-Me eth, 169-70, me al
576	2,7-Dihydroxyphenanthrene (2,7-Phenanthrenediol)	265, w-al							<i>dt</i> 181-5, <i>al</i>			
577	Phenolphthalein	265 (cor), 261		<i>dt</i> 135, <i>bz</i>				<i>dt</i> 143, <i>al</i>	<i>dt</i> 169, <i>bz</i> - <i>lgr</i>			
578	1,5-Dihydroxyanthracene (Rufol, 1,5-Anthracenediol)	265 d, yel							<i>dt</i> 198, et ac			Di-Me eth, 224, me al, Di-Et eth, 179, al
579	4,4'-Biphenol (4,4'-Dihydroxybiphenyl)	274-5, al							<i>dt</i> 189 90, <i>bz</i>	<i>dt</i> 161, <i>dil</i> <i>al</i> , 164 (cor)	<i>dt</i> 241, ac a	Aryloxyacetic acid, 274, Di-Me eth, 173 (subl), Di-Et eth, 176
580	1-Amino-2-naphthol	276 d										O,N-Diacetyl, 206, O,N-Dibenzoyl, 235
581	2,7-Dihydroxyanthracene (2,7-Anthracenediol)	280-5 d, <i>bz</i> , turns dk at 250								282		Di-Me eth, 216-7, ac a, Di-Et eth, 192-3
582	2,3-Dihydroxyanthracene (2,3-Anthracenediol)	282 d, yel								<i>dt</i> 175		Di-Me eth, 204, al
583	4,4'-Dihydroxystilbene (4,4'-Stilbenediol)	284, ac a								<i>dt</i> 213		Di-Me eth, 214-5, Di-Et eth, 208
584	3,5'-Dimethoxy-5,7,4'-trihydroxyflavonol (Syringetin)	288-9, pa yel, ac a								<i>tetra</i> 224-6		4'-Benzyl eth, 240-1
585	2,7-Dihydroxy-4-methyl-quinoline	290-300, w-al (+1H <sub>2</sub> O), turns br at 280								7-mono 250-4, <i>al</i>	7-mono 288, al	
586	2,6-Dihydroxyanthracene (Flavol, 2,6-Anthracenediol)	295-300 d, <i>al</i> , turns dk at 270								<i>dt</i> 260-1, ac a		Di-Me eth, 255-6, ac a, Di-Et eth, 230-1
587	Bi- $\alpha$ -naphthol (4,4'-Dihydroxy-1,1'-binaphthyl)	300, 250								<i>dt</i> 217		Di-Me eth, 252, Di-Et eth, 211
588	2,8-Dihydroxyacridine (2,8-Acridinediol)	>300, turns red at 275										Di-Me eth, 138-9, Di-Et eth, 142-3
589	2,6-Dibromo-1,5-dihydroxynaphthalene	>300, 224 d turns dk at 200								1-mono 273, <i>dt</i> 228	<i>dt</i> 262, pyr	1-Acetyl, 5-benzoate, 164, Di-Me eth, 161, Di-Et eth, 148
590	3,7-Dihydroxyacridine (3,7-Acridinediol)	324, pa yel, w-al								<i>dt</i> 224, ac a		In al sol → grn fluor
591	3,8-Dihydroxypyrene (3,8-Pyrenediol)	330, Tri-cl-bz-ph hydraz, turns dk at 280										Di-Me eth, 244, cl-bz

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

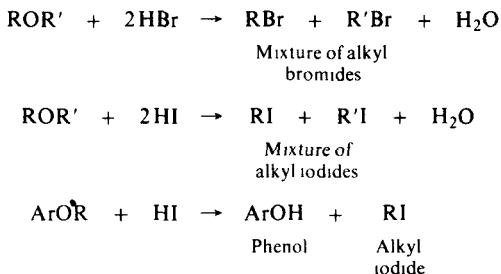
**TABLE VII. ORGANIC DERIVATIVES OF PHENOLS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Phenyl urethane	α-Naph thyl urethane	p Nitro benzoate	3,5-Di nitro benzoate	Bromo derivative	p-Toluene sul fonate	Acetate	Benzoate	Miscellaneous
592	1,3-Dihydroxyacridone	370								mono 200, yel	mono 295 7	Me eth (i) 203, dk br , (ii) 252, yel . Di-Me eth , 286-7 d , Anil , 269 70, Zn dust → acridine, 111

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE VIII

#### *Cleavage to alkyl bromide or alkyl iodide*

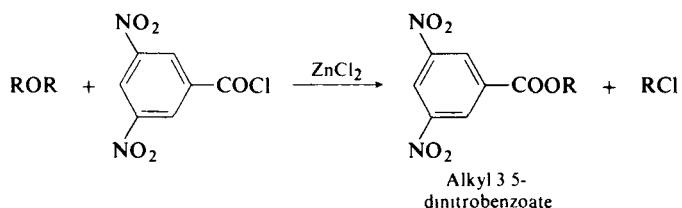


#### From the ether with concentrated hydrochloric acid

For directions and examples see Cheronis, p. 543, Linstead, pp. 46-7, Shriner, p. 116, Vogel, p. 316.

**NOTE** For directions and examples for preparation of derivatives of alkyl iodides and alkyl bromides formed on cleavage of ethers see explanations and references to Table V, pp. 52, 53, 54.

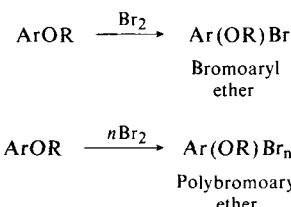
### Alkyl 3,5-dinitrobenzoate \*



From a symmetrical aliphatic ether with freshly fused zinc chloride and 3,5-dinitrobenzoyl chloride

For directions and examples see Cheronis, pp 542, 543, Linstead, p 46, Shriner, p 239, Vogel, p 316, Wild, p 96 H W Underwood, O L Baril and G C Toone, *J Amer Chem Soc*, **52**, 4087 (1930)

### Bromo derivative



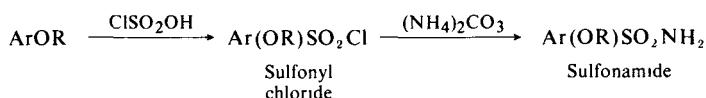
From alkyl aryl or diaryl ether with bromine in glacial acetic acid or chloroform

For directions and examples see Cheronis, p 545, Shriner, p 240

From the aromatic ether with bromine in alcohol, acetic acid, ether, chloroform or petrol ether

See Wild, pp 98-9, 101, H W Underwood, O L Baril and G C Toone, *J Amer Chem Soc*, **52**, 4087 (1930).

### Sulfonamide \*



The sulfonyl chloride is prepared from the aromatic ether with chlorosulfonic acid in chloroform or without solvent. The sulfonamide is obtained from the sulfonyl chloride with ammonium carbonate and/or aqueous ammonia.

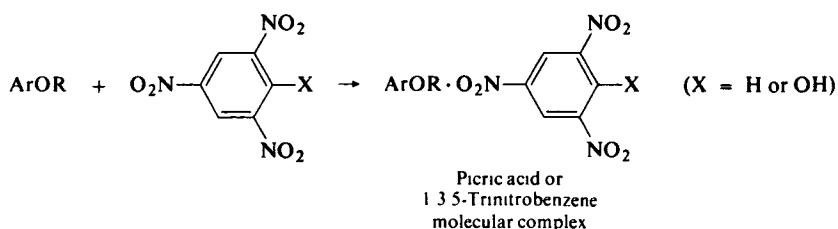
For directions and examples see Cheronis, pp 545, 546, Linstead, pp 47, 50, Shriner, p 241, Vogel, p 672, Wild, pp 27, 101, E H Huntress and F H Carten, *J Amer Chem Soc*, **62**, 511, 603 (1940).

\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE VIII (Continued)

*Picric acid and 1,3,5-trinitrobenzene addition complexes*



From the aromatic ether with the aromatic polynitro compound in chloroform

*For directions and examples see Cheronis, pp 545, 547, Linstead, pp 47, 50, Shriner, p 241, Vogel, p 672, Wild, p 100, O L Baril and G A Megrdichian, J Amer Chem Soc, 58, 1415 (1936), E K Andersen, Acta Chem Scand, 8, 157 (1954)*

From the aromatic ether with picric acid in ethanol

*See V H Dermer and O C Dermer, J Org Chem, 3, 289 (1938)*

*NOTE* For additional information regarding directions and examples for the derivatization of aromatic ethers (nitration, side-chain oxidation, etc) see explanations and references to Table IV, pp 32, 33, 34

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5 Tri-nitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
1	Ethylene oxide (Epoxyethane)	10.7	-111.7	1.3614 <sup>4</sup>	0.89713 <sup>9</sup>							HBr → Ethylene bromohydrin, b.p. 149
2	Ethyl methyl ether	10.8, 10										
3	Furan	31.27	-85.6	1.42157	0.9366							Maleic anhydride → 3,6-Endoxo-Δ <sup>4</sup> -tetrahydrophthalic anhydride, 125d, 118d, abs eth Iodide, b.p. 72
4	Diethyl ether (Ethyl ether)	34.60	-116.3, stab., -123.3, unst	1.3526	0.71352						93	
5	Propylene oxide (1,2-Epoxypropane)	35		1.466	0.830							Heating with dil H <sub>2</sub> SO <sub>4</sub> → d l-propylene glycol, b.p. 187.4
6	Ethyl vinyl ether	35.75	-115.8	1.3768	0.7589							Dil acid → al + acetaldehyde
7	Methyl n-propyl ether	39										
8	Allyl methyl ether	46										
9	Ethyl isopropyl ether	53.4			0.7211 (0.745 <sup>9</sup> )							Heating with 1% H <sub>2</sub> SO <sub>4</sub> (sealed tube) → al + isopropyl alcohol
10	tert-Butyl methyl ether	55.2		1.3689	0.7405							Constant boil mixt with w, b.p. 52.6, with 4% w
11	2,3-Epoxybutane	cis 58 97 <sup>45</sup> trans 53-4 <sup>741</sup>			cis 0.8226 <sup>25</sup> , trans 0.8010 <sup>25</sup>							Normal crude mixt is 65% trans + 35% cis
12	Chloromethyl methyl ether	59		1.3974	1.015	163						
13	α-Butylene oxide (1,2-Epoxybutane)	61-2		1.385 <sup>17</sup>	0.837 <sup>17</sup>							
14	Ethyl n-propyl ether	63.6	<-79	1.36948	0.7386							Constant boil mixt with al, b.p. 61.2, with 25% al
15	2-Methylfuran (Sylvan)	64		1.434	0.913							
16	Tetrahydrofuran	65		1.407	0.889							
17	Allyl ethyl ether	66-7 <sup>42</sup>		1.3881	0.7651							
18	Di-isopropyl ether (Isopropyl ether)	67.5	-60	1.3688	0.726							Heating with 2% H <sub>2</sub> SO <sub>4</sub> → al + allyl alcohol
												123, 120-1, CCl <sub>4</sub>

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfonamide	Nitro derivative	Bromo derivative	1,3,5-Tri-nitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
19	<i>n</i> -Butyl methyl ether	70	-115.5	1.3728, 1.3736	0.7455, 0.774							Oxid by alkaline KMnO <sub>4</sub> at 35 40° → ac a + methoxyacetic acid
20	<i>tert</i> -Butyl ethyl ether	73.1 (cor.)		1.3760	0.7404							Constant boil mixt with w, b p 65.2, with 6% w
21	Tetrahydrosylvan	79		1.407	0.855							
22	Chloromethyl ethyl ether	80, 83d		1.40398	1.014							
23	Ethyl isobutyl ether	81.1 (cor.)		1.3739 <sup>25</sup>	0.7323 <sup>25</sup>							
24	<i>sec</i> -Butyl ethyl ether	81.2 (cor.)		1.3802	0.7503							
25	Isopropyl <i>n</i> -propyl ether	83		1.376	0.7370							
26	Ethylene glycol dimethyl ether	84.7		1.37965	0.8665							
27	Dihydropyran	86		1.440	0.923							
28	<i>tert</i> -Amyl methyl ether	86.3		1.3885	0.7703							
29	Tetrahydropyran	88		1.421	0.881							
30	Di- <i>n</i> -propyl ether ( <i>n</i> -Propyl ether)	90.1	-122	1.38829	0.74698						74	Constant boil mixt with w, b p 73.8, with 9% w, Constant boil mixt with me al, b p 62.3, with 50% me al
31	<i>n</i> -Butyl ethyl ether	92.3 (cor.)	-124	1.3820	0.7505							
32	2,5-Dimethylfuran	94		1.4363 <sup>21,6</sup>	0.888 <sup>20,1</sup>		penta 180, chl					Maleic anhydride → 3,6-Endoxo-3,6-dimethyl-Δ <sup>4</sup> -tetrahydrophthalic anhydride, 78, eth
33	α-Chloroethyl ethyl ether	98		1.404	0.966							
34	<i>n</i> -Amyl methyl ether	99-100		1.3873	0.761							
35	<i>tert</i> -Amyl ethyl ether	101		1.3912	0.7657							
36	1,4-Dioxane	101.4	11.8	1.4232	1.03361				65-6			Iodine derivative, 84.5, Constant boil mixt with 48 mole % dioxane, b p 82.8

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5 Tri nitro benzene addition compound	3,5 Dinitro benzoate	Miscellaneous	
37	Ethylene glycol mono-ethyl monomethyl ether (1-Ethoxy-2-methoxyethane)	102		1.38677	0.8529								
38	Cyclopentyl methyl ether	105		1.4206	0.862								
39	β-Chloroethyl ethyl ether	107		1.411	0.989								
40	n-Butyl isopropyl ether	108 <sup>738</sup>		1.3889 <sup>734</sup> <sub>546</sub>	0.7594 <sup>15</sup>							Boil HI → n-butyl iodide + isopropyl iodide	
41	α-Epichlorohydrin	115.7		1.438	1.181								
42	α,α'-Dichloroethyl ether	116, 114		1.4183 <sup>24</sup>	1.138 <sup>42</sup>								
43	n-Amyl ethyl ether	118		1.3927	0.762								
44	Di-sec-butyl ether	121		1.3928 <sup>25</sup>	0.760					b p 90 l n <sub>D</sub> <sup>25</sup> 1.250	75.5		
45	Cyclopentyl ethyl ether	122		1.423	0.853								
46	Di-isobutyl ether (Isobutyl ether)	123			0.7616 <sup>15</sup>							87, 84.5 55	
47	Ethylene glycol mono-methyl mono-n-propyl ether (1-Methoxy 2-n-propoxyethane)	124.5		1.39467	0.8472								
48	n-Hexyl methyl ether	126		1.3972	0.772								
49	2-Methoxy-1-propanol	130 <sup>758</sup>										97	
50	Cyclohexyl methyl ether	134		1.435	0.875								
51	Ethylene glycol mono-ethyl ether ("Cello-solve", 2-Ethoxyethanol)	134.8, 135.1		1.40797	0.9297 0.9311							75	
52	3-Ethoxy-2-methyl-2-butanol	141											
53	n-Hexyl ethyl ether	142		1.4008	0.772								
54	Di-n-butyl ether (Butyl ether)	142.4, 144	-98	1.3989	0.76829							62.3, 64	
55	Cyclohexyl ethyl ether	149		1.435	0.864								
56	Anisole (Methoxybenzene, Methyl phenyl ether)	153.8, (43 <sup>10</sup> )	-37.5	1.52211	0.99393	79.81, unst in air	113, 110.1, al	2,4-di 86.9, al., 95.5	2,4-di 61, al			87	
57	3-Methoxy-2-methyl-1-propanol	155		1.4140 <sup>27</sup>								64	
58	Diethylene glycol dimethyl ether	162.0	-75	1.4099	0.9440 <sup>29</sup>								

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5 Tri-nitro benzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
59	Furfuryl alcohol (2-Furancarbinol)	170		1.4868	1.1351						80-1, pyr oil	p-Nitrobenzoate, 76, N-Phenylurethane, 45
60	Ethylene glycol mono- <i>n</i> -butyl ether ( <i>n</i> -Butyl "cellosolve")	171 <sup>743</sup>		1.4177	0.9188				172			3-Nitrophthalate, 120
61	Benzyl methyl ether	170-1 (cor.)		1.5008	0.9649	115 6						
62	2-Methoxytoluene (2-Methyl anisole, Methyl 2-tolyl ether, 2-Cresyl methyl ether)	171		1.505	0.9853	116, 113 4, pa yel	137, al	3,5-di 69, pa yel, me al	5-mono 63-4, al			Oxid → <i>o</i> -Methoxybenzoic acid, 101
63	Phenyl ethyl ether (Phenetole)	172	-33	1.5080, 1.5074	0.9666	92	150	<i>p</i> -mono 58				
64	Di-isoamyl ether (Isoamyl ether)	172.5		1.409	0.778						60 1	Constant boil mixt with w, b p 97.2
65	4-Methoxytoluene (4-Methylanisole, Methyl 4-tolyl ether, 4-Cresyl methyl ether)	173, 176		1.512	0.970	88-9, yel -or	182, al					Oxid → <i>p</i> -Anisic acid, 184-6, 184, w
66	3-Methoxytoluene (3-Methylanisole, Methyl 3-tolyl ether, 3-Cresyl methyl ether)	173, 177 (cor.)		1.513	0.972	113 4, yel -or	129 30, al	2-mono 54-5, pet eth, 2,4,6-tri 92, al				Oxid → <i>m</i> -Methoxybenzoic acid, 110
67	Tetrahydrofurfuryl alcohol	117		1.45167	1.0544						83-4	<i>p</i> -Nitrobenzoate, 46-8, N-Phenylurethane, 61, pet eth
68	Phenyl isopropyl ether	178		1.4992	0.975							conc H <sub>2</sub> SO <sub>4</sub> + ac a → <i>o</i> -Isopropylphenol, b p 213-4, m p 130
69	β,β'-Dichloroethyl ether	178		1.4568	1.220							
70	2-Ethoxytoluene (2-Cresyl ethyl ether, Ethyl 2-tolyl ether)	184		1.505	0.953	117 5 8 5, pa yel	148-9, al	di 51				Oxid → <i>o</i> -Ethoxybenzoic acid, 25, 190-5, well dried
71	Benzyl ethyl ether (Homophenetole)	184-6 (cor.)		1.4958	0.9478							Refluxed in bz + P <sub>2</sub> O <sub>5</sub> → Ethylene + Diphenylmethane, 25 I
72	Di- <i>n</i> -amyl ether ( <i>n</i> -Amyl ether)	187.5	-69.3	1.416	0.78298						42 3	
73	Diethylene glycol diethyl ether	188		1.411	0.906							
74	Phenyl <i>n</i> -propyl ether ( <i>n</i> -Propoxybenzene)	188, 189.3 (cor.)		1.5014, 1.5011	0.9494 <sub>20</sub>		116 7, al					

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5-Tri-nitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
75	<b>4-Ethoxytoluene (4-Cresyl ethyl ether Ethyl 4-tolyl ether)</b>	190.5		1.505	0.949	110.1, or -yel	138.0 5, al					Oxid → <i>p</i> -Ethoxybenzoic acid, 198, 195–5, al
76	<b>3-Ethoxytoluene (3-Cresyl ethyl ether Ethyl 3-tolyl ether)</b>	190.5		1.506	0.949	114.5 or -yel	110.1 al					Oxid → <i>m</i> -Ethoxybenzoic acid, 137
77	<b>Diethylene glycol monomethyl ether</b>	194		1.4244	1.035 <sub>20</sub> <sup>20</sup>							<i>p</i> -Nitrophenylurethane, 73.5
78	<b>3-Chloroanisole</b>	194						131				
79	<b>2-Chloroanisole</b>	195		1.5433 <sup>25</sup>	1.1865 <sub>4</sub> <sup>45</sup>			95				
80	<b>Diethylene glycol monoethyl ether</b>	196		1.4298	1.023 <sub>20</sub> <sup>20</sup>						oil	<i>p</i> -Nitrophenylurethane, 66
81	<b>4-Chloroanisole</b>	200			1.1851 <sub>4</sub> <sup>12.8</sup>		151	2-mono 95				
82	<b><i>n</i>-Butyl phenyl ether (<i>n</i>-Butoxybenzene)</b>	206		1.5049		110–2, pa yel chl	103.4, al					
83	<b>2-Chlorophenetole</b>	208	17				133	82				
84	<b>2-Bromoanisole</b>	210					140	106				
85	<b>Benzyl isobutyl ether</b>	210.2 (cor.)		1.4826	0.9233							
86	<b><i>p</i>-Bromoanisole</b>	215, 216			1.494 <sub>6</sub> <sup>6</sup>		148	88				
87	<b>Methyl thymyl ether</b>	216			0.954 <sub>6</sub> <sup>6</sup>			tri 92				
88	<b>Triethylene glycol dimethyl ether</b>	216	-47	1.4233	0.9871 <sub>20</sub> <sup>20</sup>							
89	<b>1,3-Dimethoxybenzene (Resorcinol dimethyl ether)</b>	217 (cor.)	-58, -52	1.4233	1.0552 <sub>25</sub> <sup>25</sup>	56.8, or -yel, unst in air	166–7, al	2,4-di 72, pa yel, al, 4,6-di 157 al, 2,4,6- tri 123–4, pa red, al	4,6-di 140, al			
90	<b>2-Bromophenetole</b>	218					135	98				
91	<b>Benzyl <i>n</i>-butyl ether</b>	219–21 (cor.)		1.4833	0.9227							
92	<b>Creosol (4-Methylcatechol 2-methyl ether)</b>	221	5.5	1.5353 <sup>25</sup>	1.0919 <sub>4</sub> <sup>25</sup>	112, yel						
93	<b><i>n</i>-Butyl 2-tolyl ether (2-Butoxytoluene)</b>	223			0.9437 <sub>6</sub> <sup>6</sup>		95–6, al					
94	<b>2-Methoxyaniline (2-Anisidine)</b>	225	5		1.0978 <sub>15</sub> <sup>15</sup>							
95	<b>Di-<i>n</i>-hexyl ether (<i>n</i>-Hexyl ether)</b>	228–9 <sup>761</sup>			0.7936							
96	<b>Safrole (4-Allyl-1,2-methylenedioxybenzene)</b>	233	11	1.5383	1.100	104.0 5.5, or -red			tri 108, penta 169– 70, bz	51		
97	<b>4-Bromophenetole</b>	233, 229	12				145	47				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5 Tri nitro benzene addition compound	3,5 Dinitro benzoate	Miscellaneous
98	<b>Resorcinol diethyl ether</b>	235	12.4			109	184		tri 69			
99	<b>Eugenol methyl ether</b> (4-Allyl-1,2-dimethoxybenzene)	244		1.5360	1.0336	114.5, red-br, chl	7		tri 78, abs al			
100	<b>2-Iodophenetole</b>	246							tri 110			
101	<b>trans-(β)-Isosafrole</b> (1,2-Methylene-dioxy-4-propylbenzene)	248	6.8	1.5782	1.122	84 74.5, dk red, chl			di 52-3, eth, tri 109 10, pet eth	85.6, brt scar		
102	<b>3-Methoxyaniline (3-Anisidine)</b>	251				169d, yel						N-Formyl, 57, N-Acetyl, 81, N-p-Toluenesulfonyl, 68
103	<b>Di-n-heptyl ether</b> (n-Heptyl ether)	263, 260		1.427	0.8056 <sub>20</sub> <sup>20</sup>						47	
104	<b>Isoeugenol methyl ether</b>	264	16-7	1.5692	1.0528	42.5, dk red, chl			di 101.0 5, abs eth	69-70, brt scar		Oxid → Veratric acid, 181
105	<b>Tetraethylene glycol dimethyl ether</b>	266, 275		1.432	1.009							
106	<b>Methyl 1-naphthyl ether</b> (1-Methoxy-naphthalene)	271 (cor.)	< -10	1.6940 <sup>25</sup>	1.09159	129.5 30.5 yel - or , chl	156.7, al	2-mono 80, 4 mono 85, yel , al	4-mono b p 181-2, 5- mono 67.5 80, x- mono 46, al , 2,4-di 54.5, al	139.40, 137.8, yel		
107	<b>2-Nitroanisole</b>	277	10	1.562	1.254							Reduct → o-anisidine, b p 225
108	<b>Ethyl 1-naphthyl ether</b> (1-Ethoxynaphthalene)	280.5 (cor.)	5.5	1.5973 <sup>25</sup>	1.074	118.5 9.0 (cor.)	164-5, al	2-mono 84, 4- mono 116-7, al	4-mono 48, al	125.5, yel		
109	<b>Dibenzyl ether</b> (Benzyl ether)	290 300d	3.6		1.0428	77.8, or - yel , chl			di 107-8, al		112	
110	<b>Isoamyl 1-naphthyl ether</b>	317.5 (cor.)	< -10	1.57049 <sup>14.2</sup>	1.00689 <sup>14.2</sup>	96.0-7.0						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5-Tri nitrobenzene addition compound	3,5-Dinitro benzoate	Miscellaneous
1	<b>4-Chlorophenetole (1-Chloro-4-ethoxybenzene)</b>	21	212	1.5227 <sup>19</sup>	1.1231 <sup>20</sup>		134		2,6-di 54			
2	<b>Veratrole (1,2-Dimethoxybenzene)</b>	22.5	207, 205	1.5287 <sup>21</sup>	1.080	56 7, red	135 6, al	95	4,5-di 92-3 di 67, eth. 65, 62 4, tri 108, pet eth			
3	<b>Anethole (1-Methoxy-4-propenylbenzene)</b>	22.5, al	235	1.558	0.989 <sup>22</sup>	69 70d, or -red, al						
4	<b>4-Methoxybenzyl alcohol (Anisyl alcohol)</b>	24	151 <sup>23</sup> , 138 <sup>14</sup>				66 5 7 0, or , h al	159	di 135	di 58		Phenylurethane, 93 p-Nitrobenzoate, 94
5	<b>n-Amyl 2-naphthyl ether</b>	24.5	327.5 (cor.)	1.5587 <sup>20</sup>								
6	<b>4-Iodophenetole (1-Ethoxy-4-iodobenzene)</b>	27	252					96				
7	<b>Diphenyl ether (Phenyl ether)</b>	28	259	1.5826 <sup>24</sup>	1.073	110	di 159, al	4,4'-di 144 4, al, 2,4,2',4'-tetra 195 7, pa yel, ac a	4,4'-di 54 5, al			
8	<b>Isoamyl 2-naphthyl ether</b>	28.0 5	321 0 (cor.)				93 5-4 0, al					
9	<b>2-Methoxyphenol (Guaiacol, Catechol monomethyl ether)</b>	28.2	205	1.5441	1.1287 <sup>20</sup> vac	86 7			4,5,6-tri 116, al		141 2 (cor.), al	
10	<b>2-Methoxybiphenyl (2-Biphenyl methyl ether)</b>	29, pet eth	274					5-mono 95 6, pa yel, me al				
11	<b>β-Bromoethyl phenyl ether</b>	32							56			
12	<b>Isobutyl 2-naphthyl ether</b>	33	304									
13	<b>Didodecyl ether (Dilauryl ether)</b>	33, 28-30	190-5 <sup>1</sup>									
14	<b>2-Ethoxybiphenyl (2-Biphenyl ethyl ether)</b>	34	132 <sup>6</sup>									
15	<b>sec-Butyl 2-naphthyl ether</b>	34	298 5 (cor.)				86					
16	<b>3-Ethoxybiphenyl (3-Biphenyl ethyl ether)</b>	35	158 <sup>8</sup>									
17	<b>3-Nitrophenetole</b>	35	284									
18	<b>n-Butyl 2-naphthyl ether</b>	35.5	309 (cor.)				67					
19	<b>Ethyl 2-naphthyl ether (Neonerolin)</b>	36, 37	282 (cor.)	1.5932 <sup>47</sup>	1.064	101	161-3, al		1-mono 66, pet eth, 1,6-di 94, pet eth			
20	<b>3-Aminodiphenyl ether</b>	37, lgr	315									N-Hydrochloride, 141, 139, N-Acetyl, 83, lgr

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfonamide	Nitro-derivative	Bromo derivative	1,3,5-Tri-nitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
21	<b>3-Nitroanisole</b>	39	258		1.373 <sup>18</sup>							Reduct → <i>m</i> -Anisidine, (Picrate, 169d)
22	<b>Isopropyl 2-naphthyl ether</b>	40	285			95						
23	<b>2-Naphthyl <i>n</i>-propyl ether</b>	40	297			81						
24	<b>Catechol diethyl ether (1,2-Diethoxybenzene)</b>	43, dil al	217			69-71, red-br, unst in air	3,4-di 162 3, al	<i>tri</i> 122				
25	<b>bz-Tetrahydro-6-methoxy-quinoline</b>	43	130	1.5718 <sup>50</sup>								
26	<b>2,4,6-Trichlorophenetole</b>	44	246									
27	<b>8-Methoxyquinoline</b>	45	175 <sup>29</sup>									
28	<b>2-Aminodiphenyl ether</b>	47	173 <sup>14</sup>									
29	<b>Pyrogallol trimethyl ether (1,2,3-Trimethoxybenzene)</b>	47, dil al	241			78.5-80.0, yel	2,3,4- <i>tri</i> 123 4	5-mono 106, ac a	mono oil, <i>di</i> oil, 4,5,6- <i>tri</i> 73 4	81, pa yel		Acetate, 81
30	<b>4-Iodoanisole</b>	52	139									
31	<b>Phloroglucinol trimethyl ether (1,3,5-Trimethoxybenzene)</b>	52 3, al	255 5 (cor.)									
32	<b>Hydroquinone monomethyl ether</b>	52.5	244 <sup>754 2</sup>									
33	<b>4-Nitroanisole</b>	54	274	1.5707 <sup>60</sup>	1.233 <sup>20</sup>							Reduct → <i>p</i> -Anisidine, 57
34	<b>Hydroquinone dimethyl ether (1,4-Dimethoxybenzene)</b>	56, 75% al	213 (cor.)			47-8, or - red, unst in air	148, al	2-mono 72, yel, 2,3- <i>di</i> 177, 2,5- <i>di</i> 202	<i>di</i> 142, ac a	<i>di</i> 86 5, red		
35	<b>4-Methoxyaniline (4-Anisidine)</b>	57	246		1.071 <sup>55</sup>							N-Formyl, 81, N-Acetyl, 130-2, w, N-Benzoyl, 216 7
36	<b>4-Cyclohexylphenyl methyl ether</b>	59	116 <sup>4</sup>									
37	<b>2,4,6-Trichloroanisole</b>	60										
38	<b>1,3-Diphenoxypy propane (Trimethylene glycol diphenyl ether)</b>	61, al	338-40 (cor.)									
39	<b>Catechol dibenzyl ether (1,2-Dibenzoyloxybenzene)</b>	63 4, wh, me al										
40	<b>1-Phenyl-2-phenoxy-methanol</b>	64										
41	<b>α-Glyceryl phenyl ether</b>	70	187 <sup>15</sup>									
42	<b>2,4,6-Tribromophenetole</b>	72						79				<i>p</i> -Nitrobenzoate, 84

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5-Tri-nitrobenzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
43	Hydroquinone diethyl ether (1,4-Diethoxybenzene)	72						mono 49, yel, 2,3-di 130, yel, al, 2,5-di 176, yel, al		86.5		
44	Methyl 2-naphthyl ether (Nerolin)	73 (cor), eth	273			116.5-70, dk yel, 113.0-3.5	150.1, al	1-mono 128, 1,6,8-tri 215d	x-mono 62.3, pet eth, 1-mono 83-4, 3-mono 77.8, 6-mono 108	93.5, yel		
45	2,4,5-Tribromophenol	73						79				
46	4-Ethoxybiphenyl (4-Biphenyl ethyl ether)	76, 74	188 <sup>13</sup>									
47	Benzyl 1-naphthyl ether	77 (cor)	200 <sup>12</sup>			85-100 (cor)						
48	2-Phenyl-2-phenoxy-ethanol	81										p-Nitrobenzoate, 87
49	4-Aminodiphenyl ether	83.5, 84, w	189 <sup>14</sup>									N-Acetyl, 127, N-HCl, 122
50	Biphenylene oxide (Dibenzofuran)	86, wh, al	288 (cor)			94		3-mono 181-2, di 245, ac a		96, yel		
51	4-Methoxybiphenyl (4-Biphenyl methyl ether, 4-Phenylanisole)	90, 89					3-mono 91.2, al, 3,5-di 137-8, yel, al, 3,4'-di 171	3-mono 79, 4'-mono 144, pet, 3,4'-di 134, 3,5-di 87, pet				
52	1,2-Diphenoxymethane (Ethylene glycol diphenyl ether)	98, al					4,4'-di 228-9, al	2',4'-di 215.2 (cor), pa yel, acet	di-p 134-5, al			
53	Benzyl 2-naphthyl ether (2-Benzoyloxynaphthalene)	101.5 (cor), al	d			123.0 (cor)						
54	Anisoin (4,4 -Dimethoxybenzoin)	113										Methyl ether, 52-3, yel, CCl <sub>4</sub> , Ethyl ether, 103-4, al-w
55	Hydroquinone dibenzyl ether (1,4-Dibenzoyloxybenzene)	128-9, al						83				

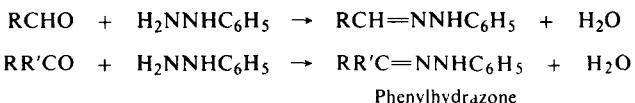
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE VIII. ORGANIC DERIVATIVES OF ETHERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Picrate	Sulfon amide	Nitro derivative	Bromo derivative	1,3,5-Tri nitro benzene addition compound	3,5-Dinitrobenzoate	Miscellaneous
56	Anilsil (4,4'-Dimethoxybenzil)	133, yel										Monoxime, 133, <i>syn</i> -Dioxime, 217, <i>anti</i> -Dioxime, 195, bz, Disemicarbazone, 254-5, dil ac a, Dihydrazone, 118 Acetyl, 74, al, Methyl ether, 47, b p 271 Dibenzoyl, 128-9, N-Benzoyl, 167 8
57	Antiarol (5-Hydroxy-1,2,3-trimethoxybenzene)	148, w										
58	Anhalamine (6,7-Dimethoxy-8-hydroxy-1,2,3,4-tetrahydroisoquinoline)	187-8, al				234-6						
59	7-Methoxyquinoline	210	287 <sup>758</sup>			229						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLES IX AND X

*Phenylhydrazone \**

From the carbonyl compound with phenylhydrazine in methanol or ethanol

*For directions and examples see* Cheronis pp 497-8 Shriner, p 131

From the carbonyl compound with phenylhydrazine in aqueous acetic acid

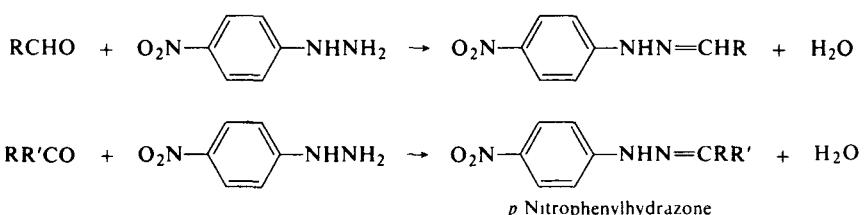
*See* Wild, p 111

From the carbonyl compound with phenylhydrazine in methanol in the presence of acetic acid

*See* Cheronis, p 511

From the carbonyl compound in alcohol with phenylhydrazine hydrochloride and sodium acetate in water

*See* Vogel, p 721

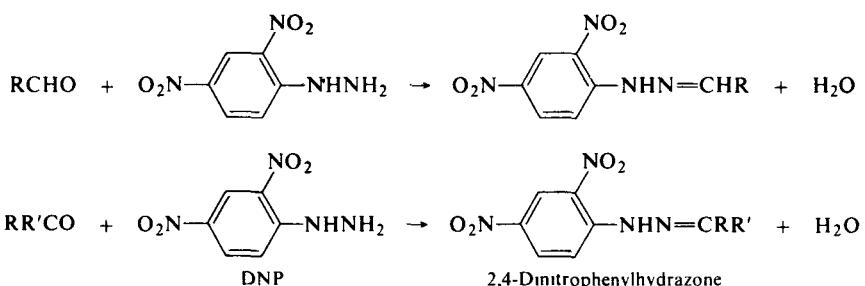
*p-Nitrophenylhydrazone \**

From the carbonyl compound with *p*-nitrophenylhydrazine and a catalytic amount of acetic acid in alcohol

*For directions and examples see* Shriner, pp 131, 219, Vogel, p 722, Wild, p 112

From the carbonyl compound in alcohol or water with *p*-nitrophenylhydrazine in aqueous acetic-hydrochloric acids

*See* G Petit, *Bull Soc Chim France*, 141 (1948)

*2,4-Dinitrophenylhydrazone (DNP-derivative) \**

From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in methanol or ethanol

*For directions and examples see* Linstead, p 26, Shriner, p 219, Vogel, p 344, Wild, pp 114-5, O L Brady and G V Elsmie, *Analyst*, 51, 77 (1926), O L Brady, *J Chem Soc*, 756 (1931), H H Strain, *J Amer Chem Soc*, 57, 758 (1935), O L Brady and S G Jarret, *J Chem Soc*, 1021 (1950)

From the carbonyl compound with 2,4-dinitrophenylhydrazine and 1% hydrochloric acid in methanol or ethanol

*See* Cheronis, pp 499-501, 511, Vogel, p 722, Wild, pp 112-4, C F H Allen, *J Amer Chem Soc*, 52, 2955 (1930), C F H Allen and J H Richmond, *J Org Chem*, 2, 222 (1937)

From the carbonyl compound with 2,4-dinitrophenylhydrazine and acetic acid in diglyme (diethylene glycol dimethyl ether)

*See* H J Shine, *J Org Chem*, 24, 1790 (1959)

From the carbonyl compound in 95% ethanol with 2,4-dinitrophenylhydrazine and concentrated hydrochloric acid in diglyme (diethylene glycol dimethyl ether)

*See* Cheronis, p 501, H J Shine, *J Org Chem*, 24, 252 (1959), *J Chem Ed*, 36, 575 (1959)

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

From the carbonyl compound in ethanol with 2,4-dinitrophenylhydrazine in 85% phosphoric acid  
*See* Vogel, p 344, G D Johnson, *J Amer Chem Soc*, **73**, 5888 (1951), **75**, 2720 (1953)

From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in isopropyl alcohol  
*See* N R Campbell, *Analyst*, **61**, 391 (1936)

From the carbonyl compound with 2,4-dinitrophenylhydrazine in pyridine  
*See* E A Braude and C J Timmons, *J Chem Soc*, 3131 (1953)

### *Semicarbazone \**



From the carbonyl compound with aqueous semicarbazide hydrochloride and sodium acetate

*For directions and examples see* Cheronis, pp 503-504, 512, Shriner, p 218, Vogel, p 344, Wild, p 121, A Michael, *J Amer Chem Soc*, **41**, 417 (1919)

From the carbonyl compound in ethanol with aqueous semicarbazide hydrochloride and sodium acetate

*See* Linstead, p 27, Shriner, p 218, Wild, p 122, R L Shriner and T A Turner, *J Amer Chem Soc*, **52**, 1267 (1930)

From the carbonyl compound and acetone semicarbazone in acetic acid

*See* B Angla, *Ann Chim Anal Chim Appl*, **22**, 10 (1940)

### *Thiosemicarbazone \**

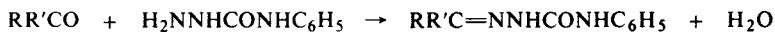
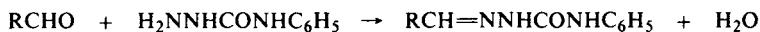


Thiosemicarbazone

From the carbonyl compound with thiosemicarbazide and sodium acetate in water, alcohol or acetic acid

*For directions and examples see* Cheronis, pp 503, 512, Wild, p 128, F J Wilson and R Burns, *J Chem Soc*, **121**, 873 (1922), W Baird, R Burns and F J Wilson, *J Chem Soc*, 2527 (1927), M Busch, *J prakt Chem*, **124**, 301 (1930), P P T Sah and T C Daniels, *Rec Trav Chim*, **69**, 1545 (1950)

### *Phenylsemicarbazone \**

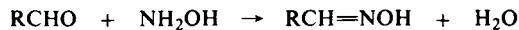


Phenylsemicarbazone

From the carbonyl compound with phenylsemicarbazide in alcohol or acetic acid

*For directions and examples see* P P T Sah and T -S Ma, *J Chinese Chem Soc*, **2**, 32 (1934), *CA*, **28**, 3713 (1934)

### *Oxime \**



Oxime

From the carbonyl compound with hydroxylamine hydrochloride and pyridine in ethanol or without solvent

*For directions and examples see* Cheronis, p 513, Shriner, p 254, Vogel, p 345, J B Buck and W S Ide, *J Amer Chem Soc*, **53**, 1536 (1931), W E Bachmann and C H Boatner, *J Amer Chem Soc*, **58**, 2097 (1936), W E Bachmann and M X Barton, *J Org Chem*, **3**, 300 (1938)

For a modification of the above method in aqueous alcohol

*See* W M D Bryant and D M Smith, *J Amer Chem Soc*, **57**, 57 (1935)

From the carbonyl compound with hydroxylamine hydrochloride and sodium hydroxide in methanol or aqueous ethanol

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

*See:* Cheronis, p. 513; Shriner, p. 255; Vogel, p. 721; Wild, p. 121.

From the carbonyl compound with hydroxylamine hydrochloride and potassium hydroxide in 95% ethanol.

*See:* Shriner, p. 255.

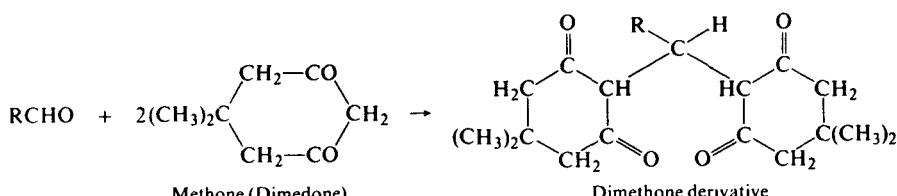
From the carbonyl compound with hydroxylamine hydrochloride and sodium or potassium acetate in water or aqueous ethanol.

*See:* Linstead, p. 27; Vogel, pp. 343, 345; J. S. Buck and W. S. Ide, *J. Amer. Chem. Soc.*, **53**, 1536 (1931).

From the carbonyl compound with hydroxylamine hydrochloride and sodium carbonate or bicarbonate in water or aqueous ethanol.

*See:* Wild, p. 120.

*Dimethone derivative (Methone derivative).\**



*This derivative is specific for aldehydes only.*

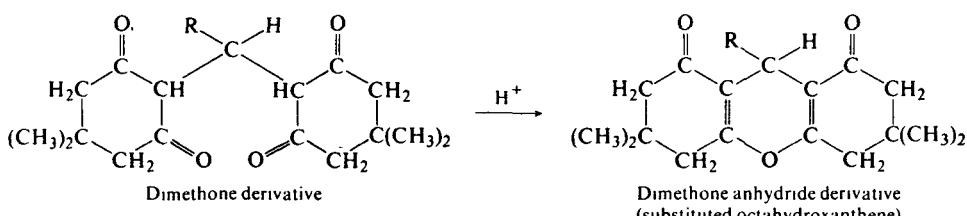
From the aldehyde and methone (dimedone; 5,5-dimethyl-1,3-cyclohexanedione; dimethyl dihydroresorcinol) in aqueous ethanol or methanol.

*For directions and examples see:* Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, pp. 136-7; D. Vorlander, *Z. Anal. Chem.*, **77**, 241 (1929); *Z. Angew. Chem.*, **42**, 46 (1929); W. Weinberger, *Ind. Eng. Chem., Anal. Ed.*, **3**, 365 (1931).

From the aldehyde with methone and a catalytic amount of piperidine in aqueous ethanol.

*See:* E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*Anhydride of dimethone derivative (substituted octahydroxanthene).\**



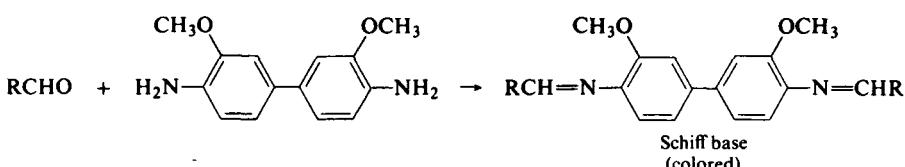
From the dimethone derivative with acetic anhydride.

*For directions and examples see:* Cheronis, p. 505; Vogel, p. 333.

From the dimethone derivative and a catalytic amount of hydrochloric acid in water or in ethanol.

*See:* Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, p. 137; E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*o-Dianisidine spot test.*



*This test is usually applicable to aldehydes only.*

From the aldehyde and a saturated solution of *o*-dianisidine (4,4'-diamino-3,3'-dimethoxybiphenyl) in glacial acetic acid.

*For directions and examples see:* F. Feigl, *Spot Tests in Organic Analysis*, 6th Ed., Elsevier Publishing Co., New York, 1960, p. 225; R. Wasicky and O. Frehden, *Mikrochim. Acta*, **1**, 55 (1927).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
 a) Liquids 1) Listed in order of increasing atmospheric b.p.\*

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semi-carbo-zone	2,4-Di-nitro-phenyl hydra-zone	p-Nitro phenyl-hydra-zone	Phenyl-hydra-zone	Oxime	Dimeth-one deriv (Dime-done deriv)	Dimeth-one anhydride	Miscel-laneous	o-Dianisidine spot test		
													Cold	Hot	Limit γ
1	<b>Formaldehyde</b> (Methanal)	-21	-91		169	167, yel al	181 2, yel , bz	145	oil	189, al , 191 4			pa yel	or br	50
2	<b>Trifluoroacetaldehyde</b>	-20				151									
3	<b>Acetaldehyde</b> (Ethanal)	20 2	-123 5	1 3392 <sup>18</sup> , 1 3316	162 3	stable 168, al un- stable 157, mix ture 148	128 5	57, 99	47	139, al	175-6, al	Thio- semicar- bazone, 146	or	dk br	30
4	<b>Propionaldehyde</b> (Propanal)	48 9	-81	1 364	89, bz - lgr , 154, w	148, or , 150, red, 155	125, yel , 50% al	oil	40	154 6, al	143	Picrate, 156-7	dk ol gn	red	20
5	<b>Glyoxal</b>	50	15		270	328	311	180	178	mono 186, di 228	mono 224	Phenyl- osazole, 169-70			
6	<b>Acrolein</b> (Acraldehyde)	52 4	-87 7	1 4025	171, w	165	150-1	50 1, hot lgr , pyra- zoline		192, 50% al	163, al		red br	vlt br	0 1
7	<b>Propynal</b> (Propargyl aldehyde)	55										Cu deriv , 160			
8	<b>2,2,2-Trifluoropropionaldehyde</b>	56 <sup>745</sup>				151									
9	<b>Isobutyraldehyde</b>	64	-65 9	1 3730	125 6	187, or - yel , al , 182	130 1, or - yel , al	oil	oil	154	144				
10	<b>2-Methyl-2-propenal</b> (Methacrolein)	73 5		1 4191	198	206		74, py- razo- line							
11	<b>n-Butyraldehyde</b> (Butanal)	74 7	-97 1	1 38433	95 5, lgr , 106	123, al	87, yel , al , 93 5, red	93 5	b p 152 <sup>715</sup>	134, 142	141				
12	<b>Trimethylacetaldehyde</b> (Pivaldehyde)	75	3, 6	1 3791	190	210, yel			41	oil					
13	<b>Chloroacetaldehyde</b>	85-6				134-5d, 148, al									
14	<b>2-Chloropropion-aldehyde</b>	86										Hydrate, b p 80 5-81			
15	<b>Dichloroacetaldehyde</b>	89 5- 90 5				155-6, using only 1 equiv- alent of re- agent				b p 67-9 <sup>17</sup> , using only 1 equiv- alent of re- agent					

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
 a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	Semi-carba-zone	2,4-Di-nitro-phenyl-hydra-zone	p-Nitro-phenyl-hydra-zone	Phenyl-hydra-zone	Oxime	Dimeth-one deriv (Dime-done deriv.)	Dimeth-one anhydride	Miscel-laneous	o-Dianisidine spot test		
													Cold	Hot	Limit, γ
16	<b>Methoxyacetaldehyde</b>	92		1.3950		124.5	115								
17	<b>3-Methylbutanal</b> (Isovaleraldehyde)	92.5	-51	1.39225	107	123, yel - or , al	110.1, al	oil	48.5	154.5, al	173 (cor )	Thio-semicarbazone, 52.3			
18	<b>2-Methyl-1-butanal</b> (α-Methylbutyraldehyde)	92-3	20, tri-	1.3942	103.5, bz - pet eth	120									
19	<b>Trichloroethanal</b> (Chloral, Trichloroacetaldehyde)	98	-57.5	1.45572	90d	131	131, yel		56			Hydrate, 51.7			
20	<b>Pentanal</b> (Valeraldehyde)	103.4	-91.5	1.3947		98, yel , al , 107			52, pet eth	104.5	113	Thio-semicarbazone, 65			
21	<b>tert-Butylacetaldehyde</b>	103		1.4150		147									
22	<b>2-Butenal</b> (Crotonaldehyde)	104	-69	1.4362 <sup>20,5</sup>	199	190, crim , bz - lt pet	184.5	56	119	183	163, sint , 167	Phenyl-semicarbazone, 126-7	dk red	dk br - red	2
23	<b>Dimethylethylacet-aldehyde</b>	104													
24	<b>Ethoxyacetaldehyde</b>	106		1.3956		116.7	113.4,								
25	<b>2-Isopropylacrolein</b>	107.9		1.4223		165									
26	<b>2-Butynal</b>	105		1.446 <sup>19</sup>		136									
27	<b>Methylisopropyl-acetaldehyde</b>	114		1.3998 <sup>25</sup>		124									
28	<b>2-Bromosobutyraldehyde</b>	115		1.4518 <sup>25</sup>											
29	<b>Diethylacetaldehyde</b> (2-Ethylbutyraldehyde)	116	117	1.4025	99, bz - lt pet	95, pa - or , lt pet , 129.30, al				102, me al					
30	<b>Methyl-n-propyl-acetaldehyde</b>	116 <sup>737</sup>				102	103								
31	<b>2-Methyl-2-butenal</b>	116.9				216									
32	<b>n-Propoxyacetaldehyde</b>	119 <sup>748</sup>					86								
33	<b>Isobutylacetaldehyde</b> (Isocaproaldehyde)	121 <sup>743</sup>				127	99		b p 103 <sup>35</sup>						
34	<b>Paraldehyde</b> (Acetaldehyde trimer)	124.4 <sup>752</sup>	12.6	1.4049								Dilute acid → Acetaldehyde, b p 20.2	dk ol grn	dk red br	4
35	<b>2-Pentenal</b>	125													
36	<b>3-Methoxyisobutyraldehyde</b>	129		1.4030 <sup>27</sup>	180	102	123								

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	Semi carba zone	2,4-Di-nitro phenyl hydra zone	<i>p</i> Nitro phenyl hydra zone	Phenyl hydra zone	Oxime	Dimeth one deriv (Dime done deriv.)	Dimeth one anhy dride	Miscel laneous	<i>o</i> -Dianisidine spot test		
													Cold	Hot	Limit γ
37	3-Chloropropion-aldehyde	130-1		1 475 <sup>15</sup>								Trimer 35.5, dil HCl-abs al b p 170.5 <sup>12-5</sup>			
38	Hexanal (Capro-aldehyde)	131		1 4068	106, bz - pet eth	104, or - yel			51, pet eth me al	108.5, dil al		Phenyl-semicarbazone, 135-6			
39	Ethylisopropylacet-aldehyde	133.5		1 4086 <sup>25</sup>		121									
40	3,3-Dimethyl-pentanal	134		1 4292		102									
41	3-Methyl-2-butenal (3-Methylcroton-aldehyde)	135		1 4526	223	182									
42	Cyclopentanecarboxaldehyde	136			124										
43	2-Methylpenten-2-al-1 (3-Ethyl-2-methylacrolein)	136.8		1 4488	207	159, red al		58-60	48-48.8						
44	Tetrahydrofurfural	142-3 <sup>779</sup>		1 4473 1 43658	166	134						Conc HCl → brt red col α Benzyl-α phenyl hydra zone 67 me al			
45	5-Methylhexanal	144 <sup>750</sup>		1 4114	117	117 <sup>~</sup>									
46	3-Furaldehyde	144 <sup>732</sup>		1 4945	211										
47	1-Cyclopentenyl-formaldehyde	146		1 4828 <sup>21</sup>	208			188		149.5					
49	2-Chloro-2-butenal (2-Chlorocroton-aldehyde)	147-50		1 478 <sup>23</sup>								Cyano-hydrin b p 137.8 <sup>26</sup> , $n_D^{20}$ 1 4762			
50	2-Hexenal	150		1 4470 <sup>13</sup>	176			139							
51	3-Hexenal	150			147										
52	Heptanal (Enanth-aldehyde)	155	-45	1 4125	109, al	108, yel , al	73		57	135	112		red-br	red	9
53	Ethylisobutylacet-aldehyde	155			98										
54	Di- <i>n</i> -propylacetal-dehyde	161		1 4142 <sup>16</sup>	101				b p 126 <sup>47</sup>						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
 a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semi-carbo zone	2,4-Dinitrophenylhydra zone	p Nitrophenylhydra zone	Phenylhydra zone	Oxime	Dimethone deriv (Dimedone deriv.)	Dimethone anhydride	Miscellaneous	o-Dianisidine spot test		
													Cold	Hot	Limit, γ
55	2-Furancarboxaldehyde (Furfural)	161.7	-36.5	1.52608	202	212.4, yel, 230 (cor), red, mixture 185	54	97	α 75-6, pet eth, β 91.2, al	160d	162.5	Phenylsemicarbazone, 180.1	dk red-vlt	dk bl-vlt	0.02
56	Hexahydrobenzaldehyde	162		1.4495 <sup>19</sup>	173, 176, w	172			90-1, pet eth			Oxime-HCl, 107-8d			
57	2-Ethylhexanal-1 (n-Butylethylacetaldehyde)	163		1.4150	254d	114.5, dil al, 120.1, yel, al			65						
58	2,2,3-Trichloro-n-butylaldehyde (n-Butylchloral, Crotonchloral)	164.5 5.5		1.47554								NH <sub>1</sub> → Butylchloral ammonia, 62			
59	Butanediol (Succinaldehyde)	169-70d		1.4254		280			di 172			Polymer, 65			
60	Octanal (n-Octaldehyde Caprylaldehyde)	171		1.42167	98, dil me al 101	106, yel, al, 96	80, brt yel		60, me al	90, dil al	101	Thiosemicarbazone, 94-94.5			
61	2-Ethyl-3-n-propylacrolein	173		1.4518 <sup>22</sup>	150.1, 153	124.5 122									
62	3-Fluorobenzaldehyde	173						202	114	63					
63	2,2,2-Tribromoethanal (Bromal)	174, yel								115		Mono-hydrate, 53.5	no reac	dk grn	40
64	4-Fluorobenzaldehyde	174.5 <sup>52</sup>						212	147	syn 116.7, anti 86					
65	2-Fluorobenzaldehyde	175	-44.5					205	90	63					
66	Benzaldehyde	179	-26, f p -55.6	1.5446	222, 233-5, r htng	237, or, al	190, red, al 234.6, 262	158, 154.5	α 35 (stable) β 130, eth 64, pet eth	193	200	Phenylsemicarbazone, 180.1	or	red-or	3
67	Nonanal (Pelargonialdehyde)	185		1.4273	100.84, me al	100 (cor), yel, al			86			Phenylsemicarbazone, 131.2			
68	5-Methylfurfural	187		1.5147 <sup>25</sup>	211*	212 (cor)	130, red	147-8	syn 112, anti 51-2						
69	Glutaraldehyde	187-9d		1.4330 <sup>26</sup>			169		di 175, 178, w						
70	Phenylethanal (Phenylacetaldehyde)	194	33	1.53191	153, dil al, 156	121, grn-yel, al, 110	58, lgr, 62-3	97-8, eth, 100	165	126		dk br-red	dk br	polym	

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_{D}^{20}$	Semi carba zone	2,4-Di nitro phenyl hydra-zone	<i>p</i> Nitro phenyl hydra zone	Phenyl hydra zone	Oxime	Dimeth-one deriv (Dime done deriv.)	Dimeth one anhy dride	Miscel-laneous	<i>o</i> -Dianisidine spot test		
													Cold	Hot	Limit, γ
71	<b>2-Hydroxybenz-aldehyde</b> (Salicyl-aldehyde)	197 (cor)	-7, f p 16	1.574	231	248, red, abs al 252d, lt red, ac a	227, red-br, al	142	57, 63		208, 70% al	<i>p</i> -Nitrobenzoate, 128	or	or	5
72	<b>2-Thiophenecarbox-aldehyde</b>	198		1.5950 <sup>1b</sup>		242		119 139							
73	<b>3-Methylbenz-aldehyde</b> (3-Tolu-aldehyde)	199		1.5413 <sup>21</sup>	204 223 4	212, 194	157	91, lgr, 84	60, lgr	172	206		dk or - red	ch red	5
74	<b>2-Methylbenz-aldehyde</b> (2-Tolu-aldehyde)	200		1.5481	209 al, 212, 218	193 4, red, ac a	222, red, al	101, 105 6, 111	49	167	215		dk or - red	ch red	5
75	<b>4-Methylbenz-aldehyde</b> (4-Tolu-aldehyde)	204 5		1.5454	234, al, 215	232 5 4 5 (cor), or - yel al	200 5 (cor), dk red, ac a	112-3, 121	79-80, 110				dk or - red	ch red	5
76	<b>d-Citronellal</b> ( <i>d</i> -Rhodinal)	207		1.4485	83-4, chl, ppt by lgr 91 2	78, yel, al			oil	77 9, dil al	173		dk grn	brt red	10
77	<b>Decanal</b> (Capralde-hyde)	207-9		1.4287	102	104, yel				69, dil me al	91 7, dil al	Thio-semicarbazone, 99-100	pa ol	dk br	200
78	<b>2-Chlorobenz-aldehyde</b>	213-4	11	1.56708	146, yel, 225, pyr, 229-30, me al	213 6 (cor), 209, or red, xyl	237 8, red, al, 241, br-red, 249, or	86	α 75-6, al, β 101 3	205d, al	224 6 (cor), al				
79	<b>Phenoxyethanal</b> (Phenoxyacetaldehyde, Glycolaldehyde phenyl ether)	215d		1.5380 <sup>21</sup>	145				86, pa yel, al	95, pet eth					
80	<b>3,5-Dimethylbenz-aldehyde</b>	220-2	9	1.5385	201 2							Oxid → acid, 170, al			
81	<b>3-Phenylpropion-aldehyde</b> (Hydro-cinnamaldehyde)	224			127, al	149, yel, al	122 3, yel, dil al		93-4 5, dil al 97 (cor)	143 5					
82	<b>Citral a.</b> (Geranal)	228d		1.48752	164, me al	108-10, red-or al, 116							dk red	red blk	0 1
83	<b>Citral b.</b> (Neral)	228d		1.4900	HCl 171, mix-ture 132, NaOAc	96, red-or, al							dk red	red blk	0 1

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**a) Liquids 1) Listed in order of increasing atmospheric b.p.\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	Semi carba zone	2,4 Di nitro phenyl hydra zone	p Nitro phenyl hydra zone	Phenyl hydra zone	Oxime	Dimeth-one deriv (Dime-done deriv.)	Dimeth-one anhydride	Miscel-laneous	o-Dianisidine spot test			
													Cold	Hot	Limit γ	
84	<b>2,6-Dimethylbenz-aldehyde</b>	228 <sup>742</sup>	11		158											
85	<b>3-Methoxybenz-aldehyde (3-Anis-aldehyde)</b>	230	3-4	1.5538	233d		171	76	39-40 pet eth., 112			Phenyl-thio-semicarbazone, 153	dk or	red br	0.4	
86	<b>3-Bromobenz-aldehyde</b>	234-6			205		220	141	72							
87	<b>4-Isopropylbenz-aldehyde (Cumal-aldehyde)</b>	236		1.5301	211, me al	241, red bz, 243, red, ac a, 244 5, al -chl	190, al	129, al	α 52, al β 111	170-1, al	172 3		dk red	ol yel	3	
88	<b>3-Ethoxybenz-aldehyde</b>	245 5		1.5408												
89	<b>4-Methoxybenz-aldehyde (4-Anisaldehyde)</b>	248	2 5	1.5731	210, 203	253 4d, red, ac a, 250, red, xyl	160, red-vlt	120 1, wh, dil al	α* 64-5, bz α 4 5 (from α' on fu-sion) β 133, bz	144 5 (cor.), al	243 (cor.), al		dk or	red br	0.4	
90	<b>3-Phenylpropenal (Cinnamaldehyde)</b>	252d	-7 5	1.61949	215 6 w	255d, red, ac a	195, red, al	168, yel, dil al	α 64-5, lgr, β 138 5, bz	213 (cor.), al	175, al		dk ch red	ch red	0.05	
91	<b>4-Ethoxybenz-aldehyde</b>	255, 249	13-4			202d, al, 208			syn 157 anti 118							
92	<b>3,4-Diethoxybenz-aldehyde (Proto-catechualdehyde diethyl ether)</b>	277-80							98			Oxid → acid, 165				
93	<b>Diphenylacetaldehyde</b>	315-6d				162				α 120, β 106			Oxid → Benzo-phenone 48			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 2) Reduced pressure b.p. only (listed in order of increasing semicarbazone m.p.)\*

No	Name	Boiling point °C	Melting point °C	$n_{D}^{20}$	Semi carba zone	2,4 Di nitro phenyl hydra zone	<i>p</i> Nitro phenyl hydrazone	Phenyl hydra zone	Oxime	Di meth one deriv (Dimedone deriv)	Di meth one anhydride	Miscellaneous	o Dianisidine spot test		
													Cold	Hot	Limit γ
1	7-Methyloctanal	94 <sup>120</sup>			80	100									
2	3-(2-Furyl)propionaldehyde	70 <sup>14</sup>		1.4470	80										
3	2-Methyloctanal	83 <sup>20</sup>			80										
4	2,3-Dichloro- <i>n</i> -butyraldehyde	58 60 <sup>20</sup>		1.4618 <sup>21</sup>	96 7				oil						
5	Octanal ( <i>n</i> Octaldehyde)	81 <sup>32</sup>		1.4217	98 101	106 yel	80		59 60	89 8					
6	Undecanal (Heptadecanal)	120 <sup>20</sup>	-4	1.4324 <sup>23</sup>	103 meal	104 yel			72 wh me al				Trimer 47 8		
7	Tridecanal ( <i>n</i> Tridecyl aldehyde)	136 <sup>8</sup>	15		106 al	108			80 5 dil al				Trimer 61 5 eth		
8	2-Hydroxypropionaldehyde	114 <sup>9</sup>			114 w		127								
9	2- <i>n</i> -Amylcinnamaldehyde (2 <i>n</i> Pentyl cinnamaldehyde Jasminaldehyde)	161 3 <sup>19</sup>		1.5381	118	164 red al			74 al w						
10	2-Methyl-3-phenylpropionaldehyde	90 <sup>6</sup>			123										
11	2-Hydroxy-2-methylhexanal ( <i>n</i> Butyl methylglycolaldehyde)	87 8 <sup>3</sup>			143										
12	Phenoxyacetaldehyde	83		1.5360	146	138				95					
13	2-Ethyl-2-hexenal	73 <sup>20</sup>			152	125									
14	2-Ethyl-3-hexenal	84 <sup>52</sup>			156										
15	Cyclohexylacetaldehyde	58 <sup>10</sup>		1.4509 <sup>25</sup>	159	125									
16	2-Nonenal	126 <sup>21</sup>		1.4426	165	126	113								
17	2-Heptenal	85 <sup>14</sup>		1.4314	169		116								
18	2,3,6-Trimethylbenzaldehyde	114 <sup>10</sup>			169					126					
19	3,5-Dimethylhexahydrobenzaldehyde	71 <sup>11</sup>			171										
20	2-Hydroxy-2-phenylpropionaldehyde (Methylphenylglycolaldehyde)	101 <sup>4</sup>			182 3										
21	2,4,6-Trimethylbenzaldehyde	98 <sup>6</sup> 128 <sup>15</sup>		1.5524	188										
22	2-Hydroxy-2-phenylbutyraldehyde (Ethyl phenylglycolaldehyde)	110 11			188										
23	2-Hydroxybutyraldehyde (Aldol)	83 <sup>2</sup>			194		109 11 red yel dil al		<i>syn</i> 112 <i>anti</i> 51 2	146 8 30° me al	126	4 Bromophenylhydrazone			
24	1,2,3,4-Tetrahydro-2-naphthaldehyde	92 <sup>1</sup>			197										
25	2-(1-Naphthyl)propionaldehyde	132 <sup>2</sup>			204										

\* Derivative data given in order m p crystal color solvent from which crystallized

TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES

a) Liquids 2) Reduced pressure b.p. only (listed in order of increasing semicarbazone m.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	Semi carba zone	2,4 Di nitro phenyl hydra zone	<i>p</i> Nitro phenyl hydrazone	Phenyl hydra zone	Oxime	Di meth one deriv (Dime done deriv.)	Di meth one anhy dride	Miscellaneous	o Dianisidine spot test		
													Cold	Hot	Limit γ
26	1,6-Hexanedial (Adipic dialdehyde)	94 <sup>12</sup> , 70 <sup>4</sup>		1.4350	di 206				di w	185 6					
27	2-Methylcinnamaldehyde	124 <sup>14</sup>		1.6057 <sup>17</sup>	208, al - w mono										
28	Phenylglyoxal	108 <sup>15</sup>			208 9d yel al bis 229d		309					91 (mono hyd ) w 2 Thio semicarba zone, 170 yel al			
30	Cyclohexenecarbox-aldehyde	70 <sup>13</sup>		1.4921 <sup>1</sup>	213				99						
31	2-Phenoxybenzaldehyde	153 <sup>1</sup>			215										

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**a) Liquids 3) Miscellaneous; reduced pressure b.p. only (listed alphabetically)\***

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	Semi carba zone	2,4 Di nitro phenyl hydrazone	p-Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Di meth one deriv (Dime done deriv )	Di meth one anhydride	Miscellaneous	o Dianisidine spot test		
													Cold	Hot	Limit γ
1	<b>2-Chloroacrolein</b>	29 31 <sup>17</sup>		1 463								Diethylacetal, b p 158 60			
2	<b>4-Chloro-n-butylaldehyde</b>	50 1 <sup>11</sup>		1 44662 <sup>8 5</sup>		134 5	110		74 5						
3	<b>d,l-2,3-Dichloropropion-aldehyde</b>	48 <sup>14</sup>		1 4762								Dimethylacetal, b p 78-82 <sup>14</sup> , n <sub>D</sub> <sup>15</sup> 1 144			
4	<b>2-Heptynal</b>	54 <sup>13</sup>		1 4521 <sup>17</sup>		74									
5	<b>2,4-Hexadienal (Sorbaldehyde)</b>	65 <sup>11</sup>		1 5372 <sup>22</sup>				102	160						
6	<b>4-Hydroxy-n-butyl-aldehyde</b>	68 <sup>8</sup>		1 4403		118									
7	<b>3-Hydroxy-2-isopropyl-propionaldehyde</b>	84 <sup>10</sup>				126									
8	<b>3-Hydroxy-3-methyl-n-butylaldehyde</b>	67 <sup>13</sup>					142								
9	<b>4-Methoxy-2-methyl-n-butylaldehyde</b>	66 <sup>55</sup>		1 4280 <sup>25</sup>		88									
10	<b>5-Methyl-2-thiophene-carboxaldehyde</b>	114 <sup>25</sup>		1 5782 <sup>29</sup>				126							
11	<b>3-Methyl-2-thiophene-carboxyaldehyde</b>	114 <sup>25</sup>		1 5833 <sup>25</sup>				149							
12	<b>4-Octenal</b>	84 <sup>13</sup>		1 4463 <sup>25</sup>		108				108,					
13	<b>Phenylpropargyl aldehyde</b>	116 7 <sup>17</sup>		1 6032 <sup>25</sup>						lgr					
14	<b>2-Phenylpropionaldehyde</b>	76 <sup>4</sup>													
15	<b>3-Pyridinecarboxaldehyde (Nicotinaldehyde)</b>	99 <sup>26</sup>													
16	<b>2,2,4-Trichloro-n-butyl-aldehyde</b>		f p -78												
17	<b>2,4,6-Trihydroxybenzaldehyde (Phloroglucinaldehyde)</b>		d												
18	<b>4-Vinylbenzaldehyde (4-Formylstyrene)</b>	93 <sup>14</sup>		1 5960 <sup>25</sup>					195d , (hyd ), w			HNO <sub>3</sub> → acid, 73 5 2,4,6 Triacetate 156 7, al 2-Benzoate 198 200, chl			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point °C	Semi carba zone	2,4-Dinitro phenyl hydra zone	p Nitro phenyl hydrazone	Phenyl hydra zone	Oxime	Dimeth one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	o Dianisidine spot test		
												Cold	Hot	Limit γ
1	3-Chlorobenzaldehyde	17.8	213.4	228, pyr 230, me al	248, dk red, xyl, 256, or - yel	216, dil al	134.5, abs al	α, anti 70.1, al β, syn 118			n <sub>D</sub> <sup>20</sup> 1.55908			
2	2,3,5,6-Tetramethylbenzaldehyde	20	135 <sup>11</sup>	270d				125						
3	2-Ethoxybenzaldehyde (Salicylaldehyde ethyl ether)	20.2-6.7	247.9	219, al				57.9, pet eth			Diacetate 88.9, ac anh			
4	Tetradecanal (Myristaldehyde)	23.3.5	166 <sup>24</sup>	106.5, dil al	108	95 brt yel		82.5 3.5, dil al			Trimer, 65			
5	Pentadecanal	24.5	160 <sup>14</sup>	106.5, al	106.7, yel, pyr-al	94.5, yel, al		86, dil al			Trimer, 69.70			
6	Hexadecanal (Palmitaldehyde)	34		107, dil al, 108-9	108	96.5, yel, eth		88, yel			Trimer, 73 Thiosemi-carbazine, 106.9			
7	1-Naphthaldehyde	34	292 162 <sup>18</sup>	221		224	80	98.90						
8	Phenylacetaldehyde	34	195	156, 163	121	151	mono 63, 58, di 101-2	99, 103	165					
9	4-Methoxy-1-naphthaldehyde	34, wh	200 <sup>11</sup>				113				Azine 185, yel, al			
10	(5-Hydroxymethyl)furfural	35.6	115 20 <sup>0.5</sup>	195d al, recr tol - lgr	184 red	185 dk red, al	140.1, tol	77.8, 108						
11	Heptadecanal (Margaric aldehyde)	35-6, 63						89.5, et ac			Trimer, 77-8, lt pet			
12	3,4-Methylenedioxybenzaldehyde (Piperonal)	37	263	230, 234, 237	265d, xyl, 266d, red, ac a	199-200, red	102.3, yel, al, 99, 106	syn 146, me al, anti 112, w	177.8, 193, yel, al	220 (cor)		brt red	dk red	4
13	2-Iodobenzaldehyde	37	129 <sup>14</sup>	206			79	108						
14	Octadecanal (Stearaldehyde)	38		108-9	101, 110	101, yel, me al		89			Thiosemicarbazone, 111			
15	2-Methoxybenzaldehyde (o-Anisaldehyde, Salicylaldehyde methyl ether)	38-9	243-6 (cor)	215d, al	253.5 (cor), red, xyl	204-5, br red		92, dil al			n <sub>D</sub> <sup>20</sup> 1.5598			
16	2-Aminobenzaldehyde	40												
17	4-Diethylaminobenzaldehyde	41	172 <sup>7</sup>	241d, al		220	221 103, yel - br	135 93						
18	Dodecanal (Lauraldehyde)	2 forms a) 42-3 b) 11	238	103, 106	106, yel	90		76-7, eth, 77-8, me al			Thiosemicarbazone, 100			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Semi-carba-zone	2,4-Dinitrophenyl hydrazone	<i>p</i> -Nitrophenyl hydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dime-dene deriv)	Dimeth-one anhydride	Miscellaneous	o Dianisidine spot test		
												Cold	Hot	Limit, γ
19	3,4-Dichlorobenzaldehyde	43.4	247.8			276.7, or		<i>syn</i> 120 al., on fusing → <i>anti</i> 114.5 118-9						
20	3-Phenylcinnamaldehyde	44	210 <sup>11</sup>	214.5	196		173, yel							
21	2,4,5-Trimethylbenzaldehyde	44	120 <sup>10</sup>	243			127							
22	2-Nitrobenzaldehyde	44		256	265	263	156	<i>anti</i> 102 <i>syn</i> 154, bz				grn br	red br	5
23	3,4-Dimethoxybenzaldehyde (Veratraldehyde)	44, 58	285	177	261.3 (cor.), or, PhNO <sub>2</sub> 264.5		121, al.	94.5, lgr	173					
24	4-Chlorobenzaldehyde	48	214.5 6.5	230, pyr 233, me al	254 (cor.), or	237, dk br, al	127 7.5, lt yel, dl al	α 110, β 146						
25	2-Pyrrolecarboxaldehyde	50	217.9	183.5, w		182.3, red, xyl	139, lgr	164, bz				n <sub>D</sub> <sup>25</sup> 1.5939		
26	Benzylglycolaldehyde	52	121 <sup>1</sup>	137								Benzoate, 70		
27	Furfural diacetate	52, eth	220											
28	4-Chloro-2-hydroxybenzaldehyde	52.5		212 pa yel, ac a		257, or, ac a		155, col, al						
29	Quinoline-4-carboxaldehyde	51.3, tol (anh), 84.4.5 (mono-hyd.)	123 <sup>1</sup>			261.2 yel al		181.2 me al				Picrate, 179		
30	2-Ethyl-4-hydroxybenzaldehyde	53	145 <sup>1</sup>											
31	2-(2-Furyl)-acrolein	54, lgr	95 <sup>9</sup>	219.5			132, pet eth	110.1						
32	2,3-Dimethoxybenzaldehyde ( <i>o</i> -Veratraldehyde)	54	137 <sup>12</sup>	231d			138	99, al-w						
33	9-Hydroxynonanal	54	120 <sup>0.1</sup>											
34	2,3-Diphenylpropionaldehyde	54	170 <sup>11</sup>	125										
35	3-Benzoyloxybenzaldehyde	54	218 <sup>20</sup>											

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point °C	Semi-carba-zone	2,4-Dinitrophenylhydrazone	<i>p</i> -Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dime-dione deriv)	Dimethone anhydride	Miscellaneous	o-Dianisidine spot test		
												Cold	Hot	Limit, γ
36	3-Chloro-2-hydroxybenzaldehyde (3-Chlorosalicylaldehyde)	54.5	55		240-3, 50% ac a			167-8, dil al			5 Nitro deriv, 129, yel, dil al			
37	Octatrienal	55												
38	Isoquinoline-1-carbox-aldehyde	55.5		197				171.2						
39	Phthalaldehyde	56						di 191						
40	2,3,5-Trichlorobenz-aldehyde	56	col, dil al								Oxid $\xrightarrow{\text{KMnO}_4}$			
41	2-Hydroxy-5-methylbenzaldehyde (5-Methylsalicylaldehyde)	56	dil al	217.8				149 yel , al	105, w		acid, 162.3 Diacetate, 94, al			
42	3-Iodobenzaldehyde	57		226				155	62					
43	4-Bromobenzaldehyde	57		228, 229	128, 257	212 207.8	113	syn 157, anti 111						
44	3-Nitrobenzaldehyde	58		246	293d	247		120, 124	120 122					
45	2,5-Dichlorobenz-aldehyde	58	231-3					104-5, al	127.5-8, dil al					
46	2,4,6-Trichlorobenz-aldehyde	58-9												
47	2-Phenanthraldehyde	59, 59.5		282					175					
48	Paraisobutyraldehyde (2,4,6-Tri-isopropyl-1,3,5-trioxan)	59.60	195 (cor), sl de-polym								See Isobutyr-aldehyde b p 64			
49	1-Hydroxy-2-naphthal-dehyde	59.60, gm - yel , al - w							145, bz					
50	2-Naphthaldehyde	60, w	150 <sup>15</sup>	245, al	270	230	205.6 d , al , 217.8	189d	156, dil al					
51	4-Phenylbenzaldehyde	60		243d , al	239d , scar , xyl				149-50					
52	3-Methoxy-1-naphthal-dehyde	60, pet eth		200, al - w			197, red, ac a		102, al - w					
53	4-Ethoxy-3-methoxybenzaldehyde	64												
54	3,5-Dichlorobenz-aldehyde	65	235 40 <sup>748</sup>					106.5, yel , pet eth	112					
55	2,3-Dichlorobenz-aldehyde	65.7												
56	5-Methoxy-1-naphthal-dehyde	66, yel , pet eth		246, ac a-w			246, red, ac a -w		104, w					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Semi-carbo-zone	2,4-Dinitrophenylhydrazone	p-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimethone deriv (Dime-dione deriv)	Dimethone anhydride	Miscellaneous	o-Dianisidine spot test		
												Cold	Hot	Limit, γ
57	Dibenzofuran-2-carboxaldehyde	68					162							
58	2,6-Dichlorobenzaldehyde	70-1												
59	2,4-Dimethoxybenzaldehyde (β-Resorcyraldehyde dimethyl ether)	71, dil al, 69	165 <sup>10</sup>					106, w			o-Nitrophenylhydrazone, 154, p-Bromo-phenylhydrazone, 142			
60	Quinoline-2-carboxaldehyde	71, pet eth (anh), 51 (mono-hyd), w				250, yel, 225, subl	204, yel, al	188			5-Nitro deriv 188 9, metal			
61	4-Ethoxy-1-naphthaldehyde	72									Hydrazone, 160 182, dk red, Azine, 209, yel, PhNO <sub>2</sub>			
62	4-Aminobenzaldehyde	72		153			156	124			Oxime HCl, 133 5	or br	red br	0 4
63	2,4-Dichlorobenzaldehyde	72, 74 5						136 7						
64	4-Dimethylamino-benzaldehyde	74		222	325	182	148	185						
65	4-Methylthiazole-5-carboxaldehyde	75, 72 5	118 <sup>21</sup>				159, 161							
66	Quinoline-6-carboxaldehyde	75 6 (anh), 55 (hyd)		239, yel, al			185, red, al	191, yel, al			Methiodide, 218, yel, al			
67	3,4,5-Trimethoxybenzaldehyde (Gallaldehyde trimethyl ether)	78, 75	163-5 <sup>10</sup>	219-20		201-2		83 4						
68	4-Iodobenzaldehyde	78		224	257	201	121							
69	3-Phenanthraldehyde	80		275			145							
70	4-Hydroxy-3-methoxybenzaldehyde (Vanillin)	80 1, w	285d	230, 240d.	271d (cor), red, ac ac, 268	227, ac a, 223	105, bz	117, w, 122	196-8 (cor), al	228	2,4-Dinitrophenyl ether, 131	brt or red	ch red	3
71	2-Hydroxy-1-naphthaldehyde	82, al	192 <sup>27</sup>	240, yel, me al				157			Picrate, 120	or	brk red	10
72	Stilbene-2-carboxaldehyde	83												
73	2-Methoxy-1-naphthaldehyde	84, al	200-1 <sup>11</sup>								Azine, 255-6, yel, PhNO <sub>2</sub>			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point °C	Semi-carba-zone	2,4-Dinitrophenylhydrazone	p-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Dimeth-one deriv (Dime-done deriv)	Di meth-one anhydride	Miscellaneous	o-Dianisidine spot test		
												Cold	Hot	Limit, γ
74	2,3,6-Trichlorobenz-aldehyde	86 7									Ac anh + ac a + NaOAc → 2,3,6-trichlorocinnamic acid, 189, ac a			
75	Isophthalaldehyde	89												
76	3,4,5-Trichlorobenz-aldehyde	90 1, al		252-4, al		342d, or, PhNO <sub>2</sub>	242 147	180			2-Nitro deriv, 118 5 9 0 Oxid alk KMnO <sub>4</sub> → 3,4,5-trichlorobenzoic acid, 210			
77	Phenylglyoxal hydrate	91			α 217d		309	dt 152	α 129, dt 168					
78	2,3,4-Trichlorobenz-aldehyde	91									Ac anh + ac a + NaOAc → 2,3,4-trichlorocinnamic acid, 185			
79	Quinoline-8-carbox-aldehyde	94 5, dil al		238 9, bz			176, yel, al	115, dil al						
80	2-Phenylcinnamaldehyde	94, al, 95	195 200 <sup>1</sup>	188-9, al, 195			125 6, yel, ac a	165-6, al						
81	3,5-Dichloro-2-hydroxybenzaldehyde (3,5-Dichlorosalicylaldehyde)	95 6		227d, ac a			141 153, pa yel, al	195-6, al-w (4 1)			Ac anh + ac a + NaOAc → dichlorocoumarin, 160, bz			
82	Hydroxyacetaldehyde (Glycolaldehyde)	96 7					162				Phenylosa-zone, 178 9, yel, eth, p-Nitrophenylosazone, 311			
83	3-Chloro-n-butyr-aldehyde (Trimer)	96 7	28-33 <sup>13</sup>											
84	2,2-Dimethyl-3-hydroxypropionaldehyde	97	85 <sup>15</sup>											
85	2,3,4,6-Tetrachlorobenzaldehyde	97 8												
86	Benzaldehyde-2-carboxylic acid (2-Formylbenzoic acid, Phthalaldehydic acid)	98 9 (hyd.), 240-50 (anh.)		202					120, w					
87	3-Hydroxy-2-naphthaldehyde	99-100		>270, me al			246-8	207d						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Semi carba zone	2,4-Di nitro phenyl hydrazone	<i>p</i> -Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Dimeth one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	o Dianisidine spot test		
												Cold	Hot	Limit, γ
88	5-Chloro-2-hydroxybenzaldehyde	99-100	105 <sup>12</sup>	286-7, ac a			150 2	128 w 123 4						
89	9-Phenanthraldehyde	101	240	223		265		157						
90	3-Hydroxybenzaldehyde	104-108 (cor), w		198, 199	259, scar, xyl 260d, red, al	221 2, dil ac a	130 1 5, tol, 147, recr bz	90, 88				dk br red	dk ch red	4
91	9-Anthraldehyde	105		219, yel, al			207, or, al	187						
92	4-Nitrobenzaldehyde	106		221, 211	320	249	159, 153	<i>anti</i> 133, 129, <i>syn</i> 182 4				or br	red br	1
93	2,3,4,5-Tetrachlorobenzaldehyde	106 6 5												
94	2,3-Dihydroxybenzaldehyde	108		226d			167							
95	2-Chloro-5-hydroxybenzaldehyde	110 5-1 5, ac a		236, pa yel			250 1, red, dil al		146 7, abs al					
96	1-Phenanthraldehyde	111 5						189						
98	2,4,5-Trichlorobenzaldehyde	112-3, al									Ac anh + ac a + NaOAc → 2,4,5-trichlorocinnamic acid, 200 1			
99	3-Hydroxy-2,4,6-trichlorobenzaldehyde	113-6 5, 50% ac a				272-3d, yel or	,	170-2, dil al						
100	2-Ethoxy-1-naphthaldehyde	115, al		214-5, yel, al			91				Azine, 184, yel, PhNO <sub>2</sub> , al			
101	Metaldehyde	115, 246, (polymers)								Dil a → acetaldehyde, b p 20 2				
102	4-Hydroxybenzaldehyde	116-7, w		224, 280d	280d, purp, ac a, 260 (mono-hyd), red, w	266	177 8, al, 184, slow htng	72, 112 (anh)	188-90 (cor), 184	246		dk or red	ch red	5
103	Terephthalaldehyde	116, 118	245			di 281	di 278d, 154	di 200						
104	2,4,6-Trimethoxybenzaldehyde	118						201-3, me al						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Semi carba zone	2,4-Dinitro phenyl hydra zone	p Nitro phenyl hydrazone	Phenyl hydra zone	Oxime	Dimeth one deriv (Dime done deriv)	Di meth one anhy dride	Miscellaneous	o Dianisidine spot test		
												Cold	Hot	Limit γ
105	1-Bromo-2-naphthaldehyde	118									Oxid → acid 186			
106	4-Chloro-3-hydroxybenzaldehyde	121		238 9, pa yel		226 7 vlt red dil al		126 (anh ) 106 10d (mono-hyd )						
107	Pyrene-3-carboxaldehyde	126												
108	1,2,3,4-Tetrahydrophenanthrene-9-carboxaldehyde	129												
109	4,6-Dichloro-3-hydroxybenzaldehyde	129 30												
110	2,4-Dihydroxybenzaldehyde (β-Resorcyaldehyde)	135-6, yel , w		260d	286d brt red AmOH		156 60d	191, w			2 Nitro deriv 157			
111	3-Chloro-4-hydroxybenzaldehyde	139 (cor )		210d , yel , v dil ac a				144 5, w						
112	2-Chloro-3-hydroxybenzaldehyde	139 9 5		236 7, pa yel		244 5 or red, al		149 dil al						
113	2,6-Dichloro-3-hydroxybenzaldehyde	140 2						174 5 dil al						
114	2,4-Dichloro-3-hydroxybenzaldehyde	141, ac a				277 8, or red		188, al						
115	d,l-Glyceraldehyde (dimer)	142, 40° me al		160d	166 7 (cor ), 50° me al			117 8	197 (cor ) 50° al 203	172 50° al				
116	2-Chloro-4-hydroxybenzaldehyde	147 8 w		214, yel al		284d dk red al		194 al						
117	3,4-Dihydroxybenzaldehyde (Protocatechualdehyde)	153 4, w		230d	275d , dk red, me al		175 6d , w 121 8	157, xyl	145d , al		Dibenzoate 96 7, al			
118	3,5-Dihydroxybenzaldehyde (α-Resorcylic aldehyde)	156 7		223 4										
119	3,5-Dichloro-4-hydroxybenzaldehyde	158 9 (cor ), 156, dil al		236 7d (cor ), grn - yel , ac a				185, dil al						
120	Hydroxypyruvic aldehyde	160							135					
121	Diphenylglycolaldehyde	163		242					124					
122	Benzaldehyde-3-carboxylic acid (3-Formylbenzoic acid)	175, w		265				164	188d					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

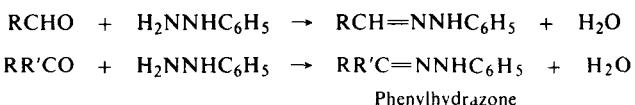
**TABLE IX. ORGANIC DERIVATIVES OF ALDEHYDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Semi- carba- zone	2,4 Di- nitro- phenyl- hydra- zone	<i>p</i> Nitro- phenyl- hydra- zone	Phenyl- hydra- zone	Oxime	Dimeth- one deriv (Dime- done deriv )	Di- meth- one anhy- dride	Miscellaneous	<i>o</i> -Dianisidine spot test		
												Cold	Hot	Limit γ
123	2-Hydroxybenzaldehyde-3-carboxylic acid (3-Formyl-salicylic acid)	179					188, al	193, yel , w						
124	4-Hydroxy-1-naphthaldehyde	181, yel , w		224								Hydrazone, 220-36, dk red Azine, 236, yel , PhNO <sub>2</sub>		
125	Indole-3-carboxaldehyde	195, 198					198							
126	Pentachlorobenzaldehyde	202.5					152.5 (cor ), yel , al	201 (cor ), bz						
127	3,4-Benzopyrene-5-carboxaldehyde	203												
128	3,4,5-Trihydroxybenzaldehyde (Gallaldehyde)	212d , (mono- hyd )				226, 234- 6d		195- 200d						
129	4-Hydroxybenzaldehyde-3-carboxylic acid (5-Formyl-salicylic acid)	248-9					219, al	179						
130	Benzaldehyde-4-carboxylic acid (4-Formylbenzoic acid)	256, w , subl					226	208-10						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## **EXPLANATIONS AND REFERENCES TO TABLES IX AND X**

### *Phenylhydrazone* \*



From the carbonyl compound with phenylhydrazine in methanol or ethanol

For directions and examples see Cheronis pp 497-8 Shriner, p 131

From the carbonyl compound with phenylhydrazine in aqueous acetic acid

See Wild, p 111

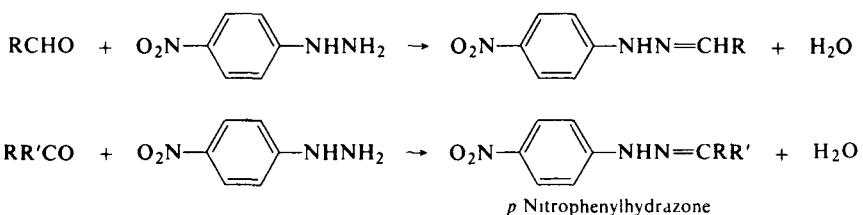
From the carbonyl compound with phenylhydrazine in methanol in the presence of acetic acid

See Cheronis, p. 511.

From the carbonyl compound in alcohol with phenylhydrazine hydrochloride and sodium acetate in water

*See Vogel, p 721*

*p*-Nitrophenylhydrazone \*



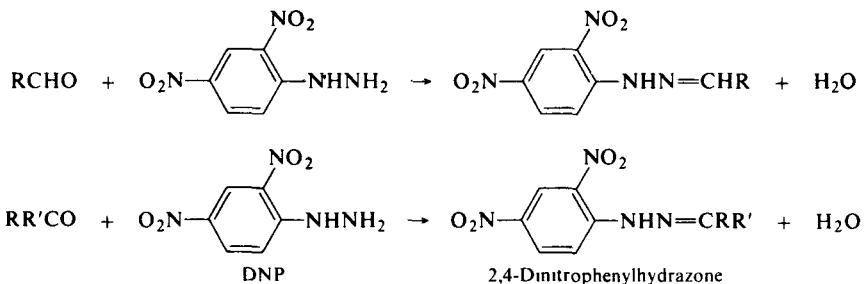
From the carbonyl compound with *p*-nitrophenylhydrazine and a catalytic amount of acetic acid in alcohol

*For directions and examples see Shriner, pp 131, 219, Vogel, p 722, Wild, p 112*

From the carbonyl compound in alcohol or water with *p*-nitrophenylhydrazine in aqueous acetic-hydrochloric acids

See G. Petit, *Bull. Soc. Chim. France*, 141 (1948).

### *2,4-Dinitrophenylhydrazone (DNP-derivative) \**



From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in methanol or ethanol

For directions and examples see Linstead, p 26, Shriner, p 219, Vogel, p 344, Wild, pp 114-5, O L Brady and G V Elsmie, *Analyst*, **51**, 77 (1926), O L Brady, *J Chem Soc*, **756** (1931), H H Strain, *J Amer Chem Soc*, **57**, 758 (1935), O L Brady and S G Jarret, *J Chem Soc*, **1021** (1950).

From the carbonyl compound with 2,4-dinitrophenylhydrazine and 1% hydrochloric acid in methanol or ethanol

See Cheronis, pp 499-501, 511, Vogel, p 722, Wild, pp 112-4, C F H Allen, *J Amer Chem Soc*, **52**, 2955 (1930), C F H Allen and J H Richmond, *J Org Chem*, **2**, 222 (1937).

From the carbonyl compound with 2,4-dinitrophenylhydrazine and acetic acid in diglyme (diethylene glycol dimethyl ether)

*See* H J Shine, *J Org Chem*, **24**, 1790 (1959)  
 From the carbonyl compound in 95% ethanol with 2,4-dinitrophenylhydrazine and concentrated hydro-

From the carbonyl compound in 95% ethanol with 2,4-dinitrophenylhydrazine and concentrated sulfuric acid in diglyme (diethylene glycol dimethyl ether)

\*Derivatives recommended for first trial

## EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

From the carbonyl compound in ethanol with 2,4-dinitrophenylhydrazine in 85% phosphoric acid  
*See* Vogel, p 344, G D Johnson, *J Amer Chem Soc*, **73**, 5888 (1951), **75**, 2720 (1953)

From the carbonyl compound with 2,4-dinitrophenylhydrazine and sulfuric acid in isopropyl alcohol  
*See* N R Campbell, *Analyst*, **61**, 391 (1936)

From the carbonyl compound with 2,4-dinitrophenylhydrazine in pyridine  
*See* E A Braude and C J Timmons, *J Chem Soc*, 3131 (1953)

### *Semicarbazone \**



From the carbonyl compound with aqueous semicarbazide hydrochloride and sodium acetate

*For directions and examples see* Cheronis, pp 503-504, 512, Shriner, p 218, Vogel, p 344, Wild, p 121, A Michael, *J Amer Chem Soc*, **41**, 417 (1919)

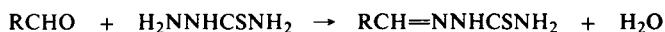
From the carbonyl compound in ethanol with aqueous semicarbazide hydrochloride and sodium acetate

*See* Linstead, p 27, Shriner, p 218, Wild, p 122, R L Shriner and T A Turner, *J Amer Chem Soc*, **52**, 1267 (1930)

From the carbonyl compound and acetone semicarbazone in acetic acid

*See* B Angla, *Ann Chim Anal Chim Appl*, **22**, 10 (1940)

### *Thiosemicarbazone \**

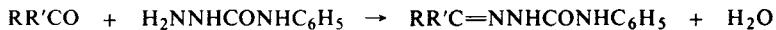
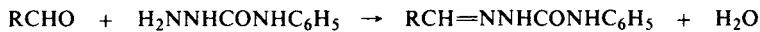


Thiosemicarbazone

From the carbonyl compound with thiosemicarbazide and sodium acetate in water, alcohol or acetic acid

*For directions and examples see* Cheronis, pp 503, 512, Wild, p 128, F J Wilson and R Burns, *J Chem Soc*, **121**, 873 (1922), W Baird, R Burns and F J Wilson, *J Chem Soc*, 2527 (1927), M Busch, *J prakt Chem*, **124**, 301 (1930), P P T Sah and T C Daniels, *Rec Trav Chim*, **69**, 1545 (1950)

### *Phenylsemicarbazone \**

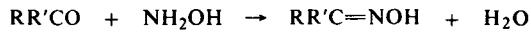
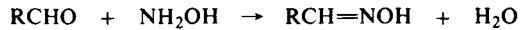


Phenylsemicarbazone

From the carbonyl compound with phenylsemicarbazide in alcohol or acetic acid

*For directions and examples see* P P T Sah and T -S Ma, *J Chinese Chem Soc*, **2**, 32 (1934), *CA*, **28**, 3713 (1934)

### *Oxime \**



Oxime

From the carbonyl compound with hydroxylamine hydrochloride and pyridine in ethanol or without solvent

*For directions and examples see* Cheronis, p 513, Shriner, p 254, Vogel, p 345, J B Buck and W S Ide, *J Amer Chem Soc*, **53**, 1536 (1931), W E Bachmann and C H Boatner, *J Amer Chem Soc*, **58**, 2097 (1936), W E Bachmann and M X Barton, *J Org Chem*, **3**, 300 (1938)

For a modification of the above method in aqueous alcohol

*See* W M D Bryant and D M Smith, *J Amer Chem Soc*, **57**, 57 (1935)

From the carbonyl compound with hydroxylamine hydrochloride and sodium hydroxide in methanol or aqueous ethanol

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLES IX AND X (Continued)

*See:* Cheronis, p. 513; Shriner, p. 255; Vogel, p. 721; Wild, p. 121.

From the carbonyl compound with hydroxylamine hydrochloride and potassium hydroxide in 95% ethanol.

*See:* Shriner, p. 255.

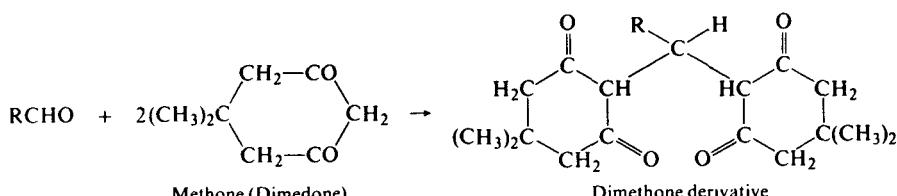
From the carbonyl compound with hydroxylamine hydrochloride and sodium or potassium acetate in water or aqueous ethanol.

*See:* Linstead, p. 27; Vogel, pp. 343, 345; J. S. Buck and W. S. Ide, *J. Amer. Chem. Soc.*, **53**, 1536 (1931).

From the carbonyl compound with hydroxylamine hydrochloride and sodium carbonate or bicarbonate in water or aqueous ethanol.

*See:* Wild, p. 120.

*Dimethone derivative (Methone derivative).\**



*This derivative is specific for aldehydes only.*

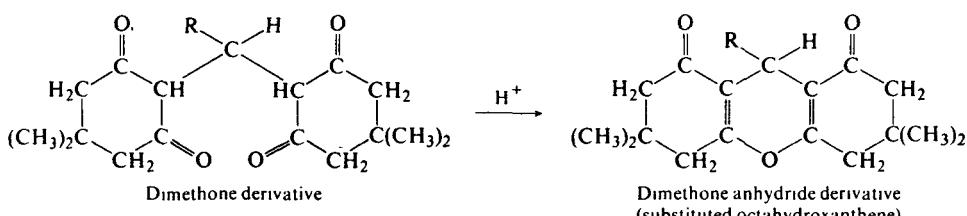
From the aldehyde and methone (dimedone; 5,5-dimethyl-1,3-cyclohexanedione; dimethyl dihydroresorcinol) in aqueous ethanol or methanol.

*For directions and examples see:* Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, pp. 136-7; D. Vorlander, *Z. Anal. Chem.*, **77**, 241 (1929); *Z. Angew. Chem.*, **42**, 46 (1929); W. Weinberger, *Ind. Eng. Chem., Anal. Ed.*, **3**, 365 (1931).

From the aldehyde with methone and a catalytic amount of piperidine in aqueous ethanol.

*See:* E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*Anhydride of dimethone derivative (substituted octahydroxanthene).\**



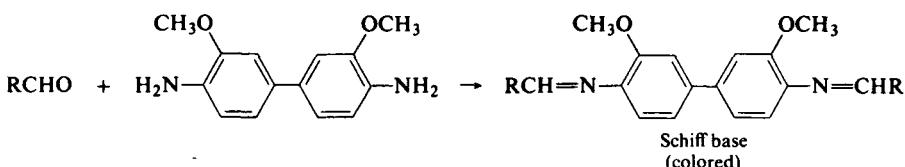
From the dimethone derivative with acetic anhydride.

*For directions and examples see:* Cheronis, p. 505; Vogel, p. 333.

From the dimethone derivative and a catalytic amount of hydrochloric acid in water or in ethanol.

*See:* Cheronis, p. 505; Linstead, p. 27; Shriner, p. 220; Vogel, p. 333; Wild, p. 137; E. C. Horning and M. G. Horning, *J. Org. Chem.*, **11**, 95 (1946).

*o-Dianisidine spot test.*



*This test is usually applicable to aldehydes only.*

From the aldehyde and a saturated solution of *o*-dianisidine (4,4'-diamino-3,3'-dimethoxybiphenyl) in glacial acetic acid.

*For directions and examples see:* F. Feigl, *Spot Tests in Organic Analysis*, 6th Ed., Elsevier Publishing Co., New York, 1960, p. 225; R. Wasicky and O. Frehden, *Mikrochim. Acta*, **1**, 55 (1927).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE X. ORGANIC DERIVATIVES OF KETONES  
a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point °C	Melting point °C	$n_D^2$	D <sub>4</sub>	Semi carbazole	2,4-Dinitrophenyl hydrazone	p-Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	Acetone (2-Propanone)	56	-95	1.3592		190 w	126-128 vcl al	148-9 yel al	42	59	Thiosemicarbazone 179
2	3-Buten-2-one (Methyl vinyl ketone)	81		1.4095 <sup>2</sup>		141-140					
3	2-Butanone (Ethyl methyl ketone)	80-82	86.4	1.3791	0.804	146	116-7 115 vcl al	128-9 vcl w al	oil	b.p. 152	Phenylsemicarbazone 168
4	3-Butyn-2-one (Ethynyl methyl ketone)	86					181	143			
5	2,3-Butanedione (Bicyclo)	88 gr vcl	f.p. 24	1.3927		mono 238 (cor.) w di 278 9 ca	di 314 (cor.) red or PhNO	mono 230 or yel	mono 134 yel dil il di 243d yel bz	mono 76 di 245 6 (cor.) 234 S subl	
6	2-Methyl 3-butanone (Isopropyl methyl ketone)	94.3		1.3879	0.8046	113-4 112.3 d	120-117 or vcl al chl	108-9 or yel al	oil	dil al oil	
7	2-Methyl 1-buten-3-one (Isopropenyl methyl ketone)	97 <sup>1</sup>		1.4232 1.4235		173	181				
8	Cyclobutanone	100		1.4189			146				
9	3-Pantanone (Diethyl ketone)	102	39.8	1.3922		138-9	156 pet or al	144 or yel 50 il	oil	b.p. 165	
10	2-Pantanone (Methyl n-propyl ketone)	102.3		1.3902 1.39012	0.80639	112-106	143-4 vcl or al	117	oil	b.p. 167	
11	1-Penten-3-one (Ethyl vinyl ketone)	102 <sup>1</sup>		1.4192			129				
12	3,3-Dimethyl-2-butanone ( <i>tert</i> -Butyl methyl ketone. Pinacolone)	106	49.8	1.3960 1.3956	0.8114	157-8	125 or vcl al fusion 131		oil	75-79	
13	1-Methoxy-2-propanone (Methoxymethyl methyl ketone)	115		1.3981			163-159	111-109			
14	1-Methoxy-3-butanone (1-Methoxyethyl methyl ketone)	116		1.3936		141					
15	4-Methyl-2-pantanone (Isobutyl methyl ketone)	116.8		1.3956	0.8008	132-138	95 or red al			b.p. 176	
16	3-Methyl 2-pantanone ( <i>sec</i> -Butyl methyl ketone)	118		1.3990		94.5 pet eth	71.2			oil b.p. 89 <sup>a</sup>	
17	1-Chloro-2-propanone (Chloro acetone)	119				150-164d	125			b.p. 171 <sup>71</sup>	
18	2-Methyl 1-penten-3-one (Ethyl isopropenyl ketone)	119		1.4270 <sup>4</sup>		161					
19	1,1-Dichloro-2-propanone (1,1-Dichloroacetone)	120			1.305 <sup>5</sup>	163					
20	2,4-Dimethyl-3-pantanone (Diisopropyl ketone)	124		1.4001	0.8108	160 (cor.) 149	88-85-6 or 94-8				
21	Methyl neopentyl ketone	125 122		1.4018 <sup>25</sup>			100				
22	3-Hexanone (Ethyl n-propyl ketone)	125		1.4007	0.81491 <sup>2</sup>	113	130			b.p. 86 <sup>17</sup>	
23	2,2-Dimethyl-3-pantanone ( <i>tert</i> -Butyl ethyl ketone)	125 <sup>23</sup>		1.4052			144				
24	2-Hexanone (n-Butyl methyl ketone)	128		1.40069	0.81127	125 (cor.) 121 rapid htng	106 red or al 110	88	oil	49	Thiosemicarbazone 110

\*Derivative data given in order m.p. crystal color solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Semi carbazole	2,4-Dinitrophenyl hydrazone	p-Nitrophenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
25	<b>4-Methyl-3-penten-2-one</b> (Isopropylideneacetone Mesityl oxide)	130		1.44397	0.86532	α 164 β 133 4, bz	200, red, al, 203, red, ac a 112	132 4, or -yel, al	142	β 48-9, me al	
26	<b>3,3-Dimethyl-2-pentanone</b> ( <i>tert</i> -Amyl methyl ketone)	130 <sup>733</sup>		1.4100							
27	<b>Cyclopentanone</b>	130 7	-51 3	1.4366 1.4370	0.94869	210 203, 216-7, rapid htng	146, or ac a, 142, or -yel, al	154	55, lt pet	56 5, pet eth	
28	<b>5-Hexen-2-one</b> (Allylacetone)	132		1.4174 <sup>25</sup>		102	108				
29	<b>1-Methoxy-2-butanone</b> (Ethyl methoxymethyl ketone)	133 <sup>757</sup>		1.4063			198				
30	<b>2,2,4-Trimethyl-3-pentanone</b> ( <i>tert</i> -Butyl isopropyl ketone)	135		1.4065		132				144	
31	<b>5-Methyl-3-hexanone</b> (Ethyl isobutyl ketone)	135 <sup>735</sup>		1.407		152					
32	<b>2-Methyl-1-penten-4-one</b>	135 45d				192					
33	<b>1-Bromo-2-propanone</b> (Bromoacetone)	136				135d				36	
34	<b>2-Methyl-3-hexanone</b> (Isopropyl <i>n</i> -propyl ketone)	136		1.4075		119					
35	<b>4-Methyl-3-hexanone</b> ( <i>sec</i> -Butyl ethyl ketone)	136		1.402		137	78				
36	<b>2-Methoxy-3-pantanone</b> (Ethyl 1-methoxyethyl ketone)	136 <sup>730</sup>		1.4019		120					
37	<b>Cyclobutyl methyl ketone</b>	136		1.4283 <sup>28</sup>		149					
38	<b>3-Methyl-2-hexanone</b>	137				70					
39	<b>3-Methyl-1-hexen-5-one</b>	138		1.4197 <sup>25</sup>		112					
40	<b>1-Chloro-2-butanone</b> (Chloromethyl ethyl ketone)	138		1.4372							
41	<b>3-Methyl-1-penten-4-one</b>	138				201				75 6	
42	<b>3,4-Dimethyl-2-pentanone</b>	138		1.4094		113					
43	<b>4-Hexen-3-one</b>	139		1.4388		157					
44	<b>2,4-Pentanedione</b> (Acetylacetone)	139	-30	1.4465 <sup>25</sup> <sup>6</sup>	0.976	mono 122, di 209	209, yel, al			di 149, al	
45	<b>2-Methylcyclopentanone</b>	139		1.4364		184, 182				b p 103 <sup>22</sup>	
46	<b>3-Ethyl-2-pantanone</b>	139 <sup>746</sup>		1.4073		99					
47	<b>3-Hydroxy-3-methyl-2-butanone</b> (Acetyl diethyl carbinol)	140				165				87	
48	<b>4-Methyl-2-hexanone</b>	142, 139		1.4057 <sup>25</sup>		120, 128					
49	<b>1-Propoxy-2-propanone</b> (Isopropoxymethyl methyl ketone)	142		1.4004			142 144				
50	<b>d-3-Methylcyclopentanone</b>	143		1.4340 <sup>19</sup>		184 5				α 91-2, β 67-9	[α] <sub>D</sub> <sup>2</sup> + 132 9
51	<b>3,4-Dimethyl-4-penten-2-one</b>	144				114					
52	<b>4-Heptanone</b> (Di- <i>n</i> -propyl ketone)	144	-34 0	1.4069	0.8175	132, pet eth	75, yel - or , al 71			b p 193	
53	<b>2,4-Dimethyl-3-hexanone</b> ( <i>sec</i> -Butyl isopropyl ketone)	145		1.4059, 1.4080							
54	<b>3-Hydroxy-2-butanone</b> ( <i>d l</i> -Acetoin)	145, 148	-72, 15	1.4178	0.9861 <sup>30</sup>	185, al, 202	di 318, or, PhNO <sub>2</sub> tol				Phenylsazone, 243d, yel, bz
55	<b>d l-3-Methylcyclopentanone</b>	145 <sup>755</sup>		1.4329		185					
56	<b>1-Methoxy-3-methyl-2-butanone</b> (Isopropyl methoxymethyl ketone)	145 <sup>748</sup>		1.4078			163				

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Semi-carbazone	2,4-Dinitrophenyl hydrazone	p-Nitro phenyl hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
57	<b>2,2-Dimethyl-3-hexanone (<i>tert</i>-Butyl <i>n</i>-propyl ketone)</b>	145 <sup>738</sup>		1.4107			124, 116				
58	<b>1-Hydroxy-2-propanone (Acetol)</b>	146	-17	1.4295		196, al	128.5 (cor.), or, al 116	173			
59	<b>4-Chloro-3-methyl-2-butanone (<math>\alpha</math>-Chloroisopropyl methyl ketone)</b>	146		1.4390							
60	<b>1-Hepten-4-one</b>	146.7				110, w-al					b p 92.3 <sup>13</sup>
61	<b>3,4-Dimethyl-3-penten-2-one</b>	147		1.4506 <sup>14</sup>		200					
62	<b>1-Ethoxy-2-butanone (Ethoxy-methyl ethyl ketone)</b>	147 <sup>752</sup>		1.4068							
63	<b>2,5-Dimethyl-3,4-hexanedione (Di-isobutylryl)</b>	148		1.42057							mono 125, di 172
64	<b>3-Heptanone (<i>n</i>-Butyl ethyl ketone)</b>	148		1.4092		101, 103, 152					
65	<b>5-Methyl-4-hexen-3-one</b>	148		1.4496 <sup>15</sup>		163					
66	<b>5-Methyl-5-hexen-2-one (Methylallylacetone)</b>	149		1.4285 <sup>25</sup>		137					
67	<b>2-Methyl-4-heptanone (Isobutyl <i>n</i> propyl ketone)</b>	150 <sup>750</sup>				124					
68	<b>4,4-Dimethyl-3-hexanone (<i>tert</i>-Amyl ethyl ketone)</b>	150.2				98					
69	<b>2-Heptanone (<i>n</i>-Amyl methyl ketone)</b>	151.2	-35.5	1.40069		123, al., 127	89, yel or, al 74		207		
70	<b>3-Ethyl-5-hexen-2-one</b>	152		1.4260 <sup>25</sup>			53				
71	<b>5-Hepten-2-one (Crotylacetone)</b>	153		1.4280 <sup>25</sup>	0.8446	105.97					
72	<b>1-Methoxy-2-pantanone (Methoxymethyl <i>n</i>-propyl ketone)</b>	153 <sup>745</sup>		1.4119							
73	<b>3,3-Dimethylcyclopentanone</b>	153 <sup>748</sup>				178					
74	<b>2,2,4,4-Tetramethyl-3-pantanone (Di-<i>tert</i>-butyl ketone)</b>	154		1.4392, 1.4194							
75	<b>1-Bromo-2-butanone (Bromo-methyl ethyl ketone)</b>	155, 50 <sup>12</sup>		1.4670							
76	<b>Cyclopentyl methyl ketone</b>	155				143					
77	<b>2,2,5,5-Tetramethylcyclopentanone</b>	155		1.4280							
78	<b>1-Methoxy-3-hexanone (1-Methoxyethyl <i>n</i>-propyl ketone)</b>	155 <sup>746</sup>		1.4091		169, 170					
79	<b>Cyclohexanone</b>	156	-16.4	1.4507		166-7	160, 162, yel al 80	146.7, 90% al	81.2, 50% al	91, lgr	
80	<b>4-Methyl-6-hepten-3-one</b>	156				147, w-me al					
81	<b>2-Hepten-4-one</b>	156.7									
82	<b>2,3-Hexanedione</b>	158									
83	<b>3,4-Dimethyl-2-hexanone</b>	158, 155				120, 118, 126					di 175
84	<b>3,4-Dimethyl-3-hexen-2-one</b>	158		1.4476 <sup>15</sup>		142					
85	<b>2,2,4-Trimethyl-3-hexanone (<i>tert</i>-Butyl isobutyl ketone)</b>	158				145					
86	<b>2-Ethyl-1-hexen-3-one</b>	158 <sup>742</sup>		1.4408 <sup>18</sup>		119					
87	<b>3,3-Dimethyl-1-methoxy-2-butanol (tert Butyl methoxy-methyl ketone)</b>	159 <sup>743</sup>		1.4193							
88	<b>1-Isopropoxy-3-methyl-2-butanone</b>	160		1.4771		220	88				
89	<b>2-Methyl-3-cyclopentenone</b>	161									127

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Semi carbazole	2,4-Dinitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
90	<b>1-Ethylcyclopentanone</b>	161 <sup>755</sup>				189					
91	<b>3-Methyl-2-heptanone</b>	162		1.415		82					
92	<b>4,5-Dimethyl-5-hexen-3-one</b>	162 <sup>750</sup>				110					
93	<b>3,5-Dimethyl-4-heptanone (Di-sec-butyl ketone)</b>	162, 170-3				83-4					
94	<b>6-Methyl-3-heptanone (Ethyl isoamyl ketone)</b>	163, 160				132					
95	<b>2-Methoxy-3-methyl-2-pentanone (sec-Butyl methoxymethyl ketone)</b>	164 <sup>757</sup>		1.4162							
96	<b>1-Methoxy-4-methyl-2-pentanone (Isobutyl methoxymethyl ketone)</b>	164 <sup>751</sup>		1.4140							
97	<b>2-Methylcyclohexanone</b>	165 1, 166	-14 0	1.4885	0.92500	191 197d, al, rapid htng	135 5 7 0, al 137 (cor) 202 3	132	b p 220 <sup>15-41</sup>	43, eth	
98	<b>4-Hydroxy-4-methyl-2-pentanone (Diacetone alcohol)</b>	166, 164								58	3,5-Dinitrobenzoate, 55
99	<b>4,5-Dimethyl-4-hexen-3-one</b>	166 <sup>750</sup>				209					
100	<b>2,2-Dimethyl-3-heptanone (n-Butyl tert-butyl ketone)</b>	166 <sup>745</sup>		1.4167		145					
101	<b>2,6-Dimethyl-4-heptanone (Di-isobutyl ketone, Isovalerone)</b>	168 0		1.4173 <sup>25</sup>		122, 126	66, or - red 92				
102	<b>2-Methyl-4-octanone (n-Butyl isobutyl ketone)</b>	168				132					
103	<b>2,5-Dimethyl-4-heptanone (sec-Butyl isobutyl ketone)</b>	169, 167				133					
104	<b>d-3-Methylcyclohexanone</b>	169		1.4456 <sup>21</sup>		180, me al				43	[α] <sub>D</sub> <sup>25</sup> +13.38
105	<b>d,l-3-Methylcyclohexanone</b>	168, 169 6	-73 5	1.4430 1.4463	0.91535	179, me al 191 4d, rapid htng	155 yel	119	94, w-al		
106	<b>1-Methoxy-2-hexanone (n-Butyl methoxymethyl ketone)</b>	169 <sup>744</sup>		1.4173							
107	<b>4-Octanone (n-Butyl n-propyl ketone)</b>	170				96					
108	<b>Methyl acetoacetate</b>	170	-40 6	1.41964	1.0765	152					
109	<b>2,2-Dimethylcyclohexanone</b>	170 171		1.4482		201 193	140-2				
110	<b>6-Methyl-2-heptanone (Isohexyl methyl ketone)</b>	171		1.4146		154	77				
111	<b>trans-2,4-Dimethylcyclohexanone</b>	171		1.4429 <sup>16</sup>		136					
112	<b>4-Methylcyclohexanone</b>	171 25	-40 6	1.4445	0.91562	199, me al, 203 5d, rapid htng	128 5, yel, al	109 10, al	37 9		
113	<b>d,l-2,5-Dimethylcyclohexanone</b>	171-3		1.4446		α 122, β 173				111, al	
114	<b>2-Octanone (Hexyl methyl ketone)</b>	173	-21 5	1.41518, 1.4154	0.81853	122 3 (cor), pet eth - al	58, or , al 92 3, yel , al				
115	<b>5-Ethyl-3-heptanone</b>	173				134					
116	<b>d-2,5-Dimethylcyclohexanone</b>	173-4				176 7					
117	<b>3-Ethyl-2-methylcyclopentanone</b>	174				170, al				97 8	[α] <sub>D</sub> <sup>20</sup> +11.6

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Semi-carbazone	2,4-Dinitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
118	<b>2,6-Dimethylcyclohexanone</b>	174		1 4500, 1 4470							
119	<b>2-Isopropylcyclopentanone</b>	174		1 4395 <sup>29</sup>							
120	<b>Acetoxyacetone</b>	174-5, 74 <sup>18</sup>		1 4150	1 0749	202 145 me al		144, yel , bz	60d , eth	b p 144 <sup>20</sup>	
121	<b>2,4-Heptanedione (n-Butyryl-acetone)</b>	174 5									Cu salt, 165 161, pa bl
122	<b>3-Methyl-3-hepten-2-one</b>	175				164					
123	<b>cis-2,4-Dimethylcyclohexanone</b>	176		1 4430 <sup>25</sup>		200, 190				98 9	
124	<b>4-Ethyl-4-hydroxy-3-hexanone</b>	178 <sup>742</sup>				177					
125	<b>2,3-Dimethylcyclohexanone</b>	178-9		1 4505		203-4					
126	<b>2,2,6-Trimethylcyclohexanone</b>	179 <sup>767</sup>		1 4480		209	141				
127	<b>3,3-Dimethylcyclohexanone</b>	179 <sup>748</sup>		1 4482 <sup>17</sup>		219					
128	<b>5-Ethyl-4-hepten-3-one</b>	179 <sup>740</sup>				105					
129	<b>3-Ethyl-4-methylcyclopentanone</b>	180				208-9 w-al				oil, b p 117 <sup>11</sup>	
130	<b>Cyclohexyl methyl ketone</b>	180		1 4514		177		154		60	
131	<b>trans-3,5-Dimethylcyclohexanone</b>	d l 180 1		1 4475 <sup>21</sup>	d l	193-4, 0 897	d l 193-4, 1 189			d l oil, b p 116-8 <sup>14</sup>	d [α] <sub>D</sub> <sup>20</sup> + 4 65 l [α] <sub>D</sub> <sup>20</sup> - 7 91
132	<b>5-Hydroxy-4-octanone (Butyriol)</b>	180-90					99				
133	<b>Ethyl acetoacetate</b>	181				133, 129d	93				
134	<b>Cycloheptanone</b>	181, 182				163	148	137		23	
136	<b>cis-3,5-Dimethylcyclohexanone</b>	182-3		1 4407	0 890	202 3				74	
137	<b>2-Propylcyclopentanone</b>	183		1 4429		214d , al				oil, b p 109-11 <sup>9</sup>	
138	<b>2,2,6-Tetramethylcyclohexanone</b>	184 <sup>772</sup>	15	1 4473							
139	<b>3-Methyl-2,4-hexanedione</b>	184 183									Cu salt, 177
140	<b>5-Nonanone (Di-n-butyl ketone)</b>	186-7	f p -5 9	1 421 <sup>15</sup>	0 8222	90, al					
141	<b>3,4-Dimethylcyclohexanone</b>	187		1 4520 1 4507	0 906	189					
142	<b>3-Nonanone (Ethyl n-hexyl ketone)</b>	187 <sup>751</sup>				112					
143	<b>2,5-Dimethylcyclohexen-3-one</b>	189 90		1 4753 <sup>22</sup>		165, me al				92 3, me al 169, al 121	
144	<b>Methyl 2-pyridyl ketone (2-Acetyl-pyridine)</b>	190									
145	<b>3-Propylcyclopentanone</b>	190-1		1 4456 <sup>12</sup>			178 9, me al			oil, b p 121 2 <sup>12</sup>	
146	<b>3-Ethylcyclohexanone</b>	192		1 4537, 1 4511		182, 175					
147	<b>1,5-Dimethylcyclohexen-4-one</b>	192-3, 194	-9	1 428, 1 449	0 97370	mono 185d , di 224	di 257 pyr	di 210 2 red al	di 120, dil al	102	
148	<b>2,5-Hexanedione (Acetonyl-acetone)</b>	194								mono b p 130 <sup>11</sup> , di 137	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Semi-carbazone	2,4-Dinitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
149	<i>d</i> -Fenchone	195-6		1.46355 <sup>18</sup>	0.947 <sup>19</sup>	184, 172	140		b p 202-3 <sup>18</sup>	<i>d or l</i> α+ 165 β+ 123, <i>d l</i> α+ 159 β+ 129	Hydrazone 56 7
150	2-Nonanone ( <i>n</i> -Heptyl methyl ketone)	195.3	-8	1.42072	0.82133 0.82217	118.9 al					
151	1-Acetyl-4-methylcyclohexanone	195-7		1.4509 <sup>18</sup>		α 159, me al β 175				57 9	
152	Methyl levulinate	196.0		1.42333	1.04945	143	142, al		96 105, al		
153	4-Fluoroacetophenone	196		1.5081 <sup>25</sup>		219					
154	<i>d,l</i> -2-Ethyl-5-methylcyclohexanone	197		1.4485		178-81				80, w -al	
155	1-Acetyl-2-methylcyclohexanone	197 200				172.3					
156	2- <i>n</i> -Propylcyclohexanone	198- 97 <sup>48</sup>		1.4558 <sup>13</sup>		133d, w - al				67 8	
157	1-Acetylcyclohexene	200		1.4892		220				59	
158	3-(Trifluoromethyl)acetophenone	202				174	114				
159	β-Thujone	202, 76 <sup>10</sup>									
160	Acetophenone (Methyl phenyl ketone)	205, 202	20	1.541 1.5339	1.02810	198-9 (cor), 50% al, 203	238-40, al, 249- 50, or - red, ac d	184-5, or -red	105, wh, al, → dk	60	
161	2-Ethyl-4-methylcyclohexanone	205 <sup>747</sup>		1.4452							
162	Ethyl levulinate	206		1.42288	1.01114	148	102			104	
163	4-Decanone	206.7				51.2					
164	1,5-Dimethylcyclohexen-3-one	208-9		1.4819 <sup>22</sup>		179-80, yel, al, 168.71				76.8	Thiosemicarbazone, 195d
165	<i>t</i> -Menthone	209, 207	-6.6	1.4505		189, 187, 184	146, or , al		53	59, eth	
166	2-Decanone (Methyl <i>n</i> -octyl ketone)	211, 215.5	14, f p 3.1	1.42523	0.82370	124, 126, pet eth					
167	Methyl 4-pyridyl ketone	212								142	
168	4- <i>n</i> -Propylcyclohexanone	212 <sup>740</sup>		1.4514 <sup>25</sup>		180					
169	2-Acetylthiophene (Methyl 2-thienyl ketone)	213	10.5	1.5666		190, bz					
170	2-Methylacetophenone (Methyl 2-tolyl ketone)	214, 216		1.5320		205, al, 210	159, yel , al 161			61	
171	6-Bromo-2-hexanone	214 <sup>720</sup>		1.4713			81				
172	1,5,5-Trimethylcyclohexen-3-one (Isophorone)	215		1.4789 <sup>21.5</sup>	0.9255 <sup>20.5</sup>	199.5d , al , 191			68, dil al	79.5, pet eth , 76	
173	<i>n</i> -Propyl 2-pyridyl ketone	217-8							82	48	
174	Propiophenone (Ethyl phenyl ketone)	218, 220	20, 18.6	1.5270	1.0105	173.4 (cor), al , 182, rapid htng	190.1, red, bz , 189			54, 53, pet eth	Picrate, 75
175	Methyl 3-pyridyl ketone	220, 218	~						137	113	
176	3-Methylacetophenone (Methyl 3-tolyl ketone)	220		1.5306	1.007	198, 203	207			55, 57, al	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Semi-carbazone	2,4 Di-nitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
177	<b>Isobutyrophenone (Isopropyl phenyl ketone)</b>	222 217		1.5190	0.9863 <sup>1b</sup> "	181, al	163, or - red, dil ac a		73	94, lt pet	
178	<b>Acetyl benzoyl ketone</b>	222, yel		1.537 <sup>1a</sup>		di 229 32		di 256	α 143	α, mono 166, β, mono 114 di 240	
179	<b>5-Ethyl-1-methylcyclohexene-3-one</b>	223 7				162 8d , al					Thiosemicarbazone, 150 1
180	<b>4[8]-p-Menthene-3-one (Pulegone)</b>	224, 221 2		1.48705 <sup>1x</sup>		174 175 6	142			119	
181	<b>Pivalophenone (tert Butyl phenyl ketone)</b>	224 <sup>7a</sup>		1.5082		150	194 5			167	
182	<b>1-Phenyl-2-butanone (Benzyl ethyl ketone)</b>	226		1.5102		135 146					
183	<b>6-Undecanone (6-Hendecanone Di-n-amyl ketone)</b>	228 15		1.42875	0.82471	oil				oil	
184	<b>3-Chloroacetophenone</b>	228				232		176		88	
185	<b>Ethyl 1-thienyl ketone</b>	228				167				55-6	
186	<b>2-Undecanone (2-Hendecanone Methyl n-nonyl ketone)</b>	228 12 1	12 7	1.42899	0.82564	122 0 5	63, al	90 1, yel , al		44 5	
187	<b>2,4-Dimethylacetophenone</b>	228 234 5		1.5381 1.5340		185 7				63 4, pet eth	
188	<b>2-Chloroacetophenone</b>	229		1.685 <sup>2z</sup>		160				113	
189	<b>1-Phenoxy-2-propanone (Phenoxy-acetone)</b>	229 30 120 <sup>1a</sup>		1.5228	1.0903	173, 176 (cor ), 50% al					
190	<b>n-Propyl 4-pyridyl ketone</b>	229 31				187 8, al , 191	190, or - red, dil ac a				Picrate, 96
191	<b>n-Butyrophenone (Phenyl n-propyl ketone)</b>	230, 218 21	11 5 13 0	1.5196 1.5203						50, abs eth	
192	<b>d-Carvone</b>	230		1.49952	0.9608	162-3, 142 3, d / 154 6	191, red, ac a	174 5, red-br		d α 72- 3, al d, β 56-7, l, α, (-) 72, l, β, (+) 57-8, d, l 93-4	[α] <sub>D</sub> <sup>20</sup> +62 9
193	<b>2,5-Dimethylacetophenone</b>	230		1.5291 1.5306		168 9					
194	<b>4-Chloroacetophenone</b>	232 236	12			204 160, 146 142	231	239	114	95	
196	<b>4-Phenyl-2-butanone (Methyl-β-phenylethyl ketone)</b>	235				210				87	
197	<b>Isovalerophenone (Isobutyl phenyl ketone)</b>	236								76, 64 5	
198	<b>3,5-Dimethylacetophenone</b>	236 7		1.5276 <sup>2z</sup>				179 80, yel , ac a		114, me al	
199	<b>2-Methoxyacetophenone (2-Acetyl anisole)</b>	239, 245		1.5395	1.089	183			114, al	83, 96 0 5, pet	
200	<b>3-Methoxyacetophenone (3-Acetyl anisole)</b>	240, 252		1.5583 <sup>1a</sup>	1.0993 <sup>1a</sup>	196					
201	<b>5-Phenyl-3-pentanone</b>	244		1.5125		80					
202	<b>5-Isopropyl-2-methylacetophenone (2-Acetyl-p-cymene)</b>	245		1.51849	0.9654 <sub>20</sub>	147	140 2, clearing at 160			91-2 5	

\* Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Semi carbazole	2,4-Di nitrophenyl hydrazone	<i>p</i> -Nitro phenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
203	<i>α</i> -Bromopropiophenone	245 50		1.5686 <sup>25</sup>						85	
204	3,4-Dimethylacetophenone	246 7, 251		1.5400		233 4					
205	2,4,5-Trimethylacetophenone	246 7				204				85 6	
206	<i>n</i> -Propyl 3-pyridyl ketone	246 52		1.5128		169 70					Picrate, 104
207	<i>n</i> -Valerophenone ( <i>n</i> -Butyl phenyl ketone)	248 5 242		1.5150	0.988 <sub>20</sub> <sup>20</sup>	160, w -al 166, brt red, ac a	161 5 2 5, or -red, al	182 162	52 0- 5, pet eth		
208	2-Aminoacetophenone	250 2d	20			290d , al			108, al	109, subl , w 130	
209	2,5-Dichloroacetophenone	251	14								
210	4-Isopropylacetophenone	252 4									
211	1,1,1-Tribromoacetone	255d									
212	Ethyl benzoylacetate	265									
213	<i>n</i> -Enanthophenone ( <i>n</i> -Hexyl phenyl ketone)	283 3	16 4	1.50760 <sub>He</sub>	0.95155	125 119, dil al 167, al		127 8		55	
214	3-Phenylcyclohexanone	287 8 <sup>7,16</sup>								128 9, al	
215	1-Acetyl naphthalene (Methyl 1-naphthyl ketone)	302		1.629		288 5-9 5, 232-3			146	140, 137 5	
216	Ethyl 1-naphthyl ketone	305 7		1.6109						58	Picrate, 77-8, al , 79
217	2-Benzoylpypyridine (Phenyl 2-pvridyl ketone)	317		1.6056			199		136, yel , al	150 165	Picrate, 130, al
218	2,4,5-Trimethylbenzophenone	328			1.0332 <sub>4</sub> <sup>18</sup>						
219	2,4,4'-Trimethylbenzophenone	340								132, al	
220	<i>α</i> -Methylstyryl phenyl ketone (Dypnone)	340 5 sl d			1.108 <sub>0</sub> <sup>20</sup>	151, bz				syn 134, al , anti 78	
221	1,5-Diphenyl-3-pentanone (Di-benzylacetone)	352, 348	13 4							95 6	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)\***

No	Name	Semi-carbazone	Boiling point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Miscellaneous
1	1-Chloro-2-methyl-3-pentanone	70	64 <sup>9</sup>			
2	4-Methyl-2-octanone	70	94 <sup>10</sup>			
3	1-Hepten-5-one	82 3, w al	46 7 <sup>12</sup>	1 4254 <sup>18</sup> <sup>13</sup>	0 8487 <sup>18</sup> <sup>13</sup>	
4	3-Dodecanone	89 w - al	134 <sup>18</sup>			m p 19
5	1,3-Diethoxy-2-propanone ( <i>sym</i> -Diethoxyacetone)	91	105 <sup>13</sup>	1 4202		
6	1-Ethoxy-2-propanone (Ethoxyacetone)	96	36 <sup>28</sup>	1 4000		
7	3-Cyclopentyl-2-butanone ( $\alpha$ -Cyclopentyl- $\alpha$ -methylacetone)	98	79 <sup>17</sup>	1 4470		
8	7-Methyl-1-octen-5-one	101 2	62 3 <sup>14</sup>	1 4288 <sup>12</sup> <sup>5</sup>		
9	Cyclohexyl methoxymethyl ketone	102	111 <sup>21</sup>	1 4552 <sup>25</sup>		
10	1-Phenoxy-2-butanone (Ethyl phenoxyethyl ketone)	102	100 <sup>5</sup>	1 5201		
11	1-Naphthoxyacetone	103	205 8 <sup>14</sup>			
12	1-Hepten-6-one	108 w - al	41 3 <sup>10</sup>	1 4350 <sup>18</sup>	0 8673 <sup>18</sup>	
13	1-Phenoxy-2-pentanone (Phenoxyethyl <i>n</i> -propyl ketone)	108	112 <sup>4</sup>	1 5148		
14	3-Octyn-2-one	109	76 <sup>15</sup>	1 4446 <sup>25</sup>		2,4-Dinitrophenylhydrazone 88
15	3-Hepten-6-one	109 10 wh	61 2 <sup>20</sup>	1 4290 <sup>21</sup>	0 8618 <sup>21</sup>	
16	3-Methyl-4-phenyl-2-butanone	112 114	130 <sup>17</sup>	1 5090 <sup>19</sup>		
17	3-Methyl-3-hepten-5-one	114	82 6 <sup>12</sup>	1 4488 <sup>25</sup>		
18	1-Chloro-2-ethyl-3-hexanone	115	92 <sup>12</sup>			
19	1,3-Dimethoxy-2-propanone ( <i>sym</i> -Dimethoxyacetone)	120	78 <sup>18</sup>	1 4174		
21	<i>trans</i> -3-Hepten-2-one	125 128	60 <sup>16</sup>	1 4421	0 8445	
22	5-Hydroxy-5-methyl-3-heptanone	125	86 <sup>14</sup>	1 4386 <sup>14</sup>		
23	$\alpha$ -Ethoxacetophenone	128	122 <sup>15</sup>	1 5250		
24	3-Propylpropiophenone (Ethyl 3-propylphenyl ketone)	128	145 <sup>20</sup>			
25	$\alpha$ -Methoxyacetophenone	129	126 <sup>19</sup>			
26	1-Phenyl-4-hexen-1-one	130	97 <sup>1</sup>	1 5270 <sup>25</sup>		
27	5-Phenyl-2-pentanone	130	122 <sup>6</sup>			
28	2-Methyl-3-octen-6-one	131 2	73 7 <sup>11</sup>	1 44533		
29	1-Phenyl-1-hexen-5-one	132 et ac	153 5 <sup>10</sup>	1 5458 <sup>25</sup>		
30	3-Phenyl-1-hexen-5-one	132	153 5 <sup>10</sup>	1 5193 <sup>25</sup>		2,4-Dinitrophenylhydrazone, 103
31	4-Phenyl-2-pentanone	137	115 <sup>13</sup>	1 5124		
32	3-Propyl-3-hexen-2-one	142	72 <sup>9</sup>			
33	3-Acetyl furan	150	84 <sup>21</sup>			
34	3-Hydroxy-3-methyl-2-pentanone	150	73 <sup>50</sup>	1 4200		
35	1-Cyclopentyl-2-propanone (1-Cyclopentylacetone)	150	67 <sup>12</sup>			
37	<i>cis</i> -3-Hepten-2-one	152	70 <sup>15</sup>	1 4505 <sup>22</sup>	0 8555 <sup>22</sup>	
38	3-Hydroxy-3-methyl-2-heptanone	152	84 <sup>19</sup>			
39	d-2-Ethyl-5-methylcyclohexanone	152 4	83 4 <sup>18</sup>		0 9016 <sup>15</sup>	[ $\alpha$ ] <sub>D</sub> + 8 5
40	5-Hydroxy-2-pentanone	155	86 <sup>10</sup>	1 4350 <sup>25</sup>		
41	3-Phenyl-2-butanone	158	107 <sup>22</sup>	1 5092		
42	3-Phenyl-3-hexen-5-one	158	138 <sup>14</sup>			
43	Dicyclopentyl ketone	162	112 <sup>12</sup>			
44	2-Ethylcyclohexanone	162 163	76 <sup>20</sup>	1 4522		2,4-Dinitrophenylhydrazone 162
45	2,3-Dimethyl-2-hepten-6-one	163	76 <sup>13</sup>			
46	3-n-Propylcyclohexanone	169	42 <sup>9</sup> <sup>7</sup>	1 4530		
48	2-Cyclohexenone	172, 168	68 <sup>22</sup>	1 4879		2,4-Dinitrophenylhydrazone, 163 117
49	2-Chloropropiophenone (2-Chlorophenyl ethyl ketone)	173	106 <sup>12</sup>			
50	d,L-1-Acetyl-3-methylcyclohexanone	174-5	99 100 <sup>38</sup>			
51	3-n-Propyl-2-cyclohexenone	175	60 <sup>9</sup> <sup>4</sup>	1 4876 <sup>25</sup>		2,4-Dinitrophenylhydrazone, 156
52	2-Bromoacetophenone	177	112 <sup>10</sup>			2,4-Dinitrophenylhydrazone, 189

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)\* (Continued)

No	Name	Semi-carbazone	Boiling point °C	$n_{D}^{20}$	$D_4^{20}$	Miscellaneous
53	2-Methyl-3-butetyl phenyl ketone	177	100 <sup>2,1</sup>	1.5223 <sup>25</sup>		
54	4-Methoxycyclohexanone	178	85 <sup>14</sup>	1.4560		2,4-Dinitrophenylhydrazone, 150
55	5,5-Dimethyl-3-hexen-2-one	178	79 <sup>10</sup>	1.4430		
56	Ethyl 2-methylstyryl ketone	178	152 <sup>14</sup>			
57	2-Bromopropiophenone (2-Bromophenyl ethyl ketone)	179	118 <sup>11</sup>			
58	3-Isopropyl-2-cyclohexenone	179	60 <sup>0,3</sup>	1.4842		2,4 Dinitrophenylhydrazone, 155
59	2-Ethylacetophenone	180	118 <sup>29</sup>	1.5249		
60	3-Pyridylacetone	185	123 <sup>1</sup>			
61	1-6-Isopropyl-3-cyclohexenone	185	98-100 <sup>10</sup>	1.484		$[\alpha]_D^{25} -64.5$ 2,4-Dinitrophenylhydrazone, 137-8 <i>p</i> -Nitrophenylhydrazone, 168-9
62	4- <i>n</i> -Butylacetophenone	185	141 <sup>14</sup>			
63	3-Phenyl-2-hexen-5-one	185	138 <sup>14</sup>			
64	3-Ethyl-2-cyclohexenone	186	57 <sup>0,9</sup>	1.4913		
65	3-Methyl-3-phenyl-2-butanone	186	77 <sup>15</sup>	1.5083		
66	2-Methyl-3-octen-5-one	187-8	68-78 <sup>24</sup>	1.4748		
67	4-Isopropylcyclohexanone	188, 188-9	91 <sup>13</sup>	1.4560		<i>p</i> -Nitrophenylhydrazone, 123-4
68	4,4,6-Trimethyl-2-cyclohexen-1-one	188, 185-7	73-5 <sup>13</sup>			
69	2-Acetyl-5-methylfuran	191	73 <sup>8</sup>			
71	3-Phenyl-2-pentanone		110 <sup>18</sup>	1.5051		
72	4-Phenylhexahydroacetophenone (Methyl 4-phenylcyclohexyl ketone)	191	121 <sup>1,2</sup>			
73	2,6,6-Trimethylcycloheptanone	191-2	85.5 <sup>12</sup>	1.4568 <sup>18</sup>	0.9095 <sup>18</sup>	2,4-Dinitrophenylhydrazone, 170
74	Acetyl phenyl carbinol	194	137			126 Oxime 113
75	2-Tetralone	194	131 <sup>11</sup>	1.5555 <sup>25</sup>		<i>m p</i> 18, Oxime, 88
76	3-Isopropylcyclohexanone	195	51 <sup>1</sup>	1.4540		
77	1-Propionylcyclohexene	195, 189	102 <sup>14</sup>			Oxime, 78
78	$\alpha$ -Thienylacetone (1-( $\alpha$ -Thienyl)-2-propanone)	195	106 <sup>12</sup>	1.5366 <sup>14</sup>		
79	5,5-Dimethyl cyclohexen-3-one	195	88.5 <sup>32</sup>			$H_2SO_4 \rightarrow$ red $\rightarrow$ vlt $\rightarrow$ col
80	2-Acetyl biphenyl	197	105 <sup>1</sup>			
81	3-Methyl-2-cyclohexen-1-one	199, 201	78 <sup>14</sup>	1.4945		2,4-Dinitrophenylhydrazone, 176 178
82	1-Acetyl-2,2-dimethylcyclohexene	201	118 <sup>49</sup>	1.4810 <sup>25</sup>		
83	1,1-Dimethyl-2-tetralone	204	96 <sup>0,5</sup>	1.538		
84	2-Methyl-1-tetralone	205, 195	138 <sup>16</sup>	1.5447		
85	6-Propionyltetralin	209	163 <sup>11</sup>	1.5508 <sup>29</sup>		
86	3-Methyl-2- <i>n</i> -propylcyclopentanone	210	58 <sup>2</sup>	1.4778		
87	4-Methyl-1-tetralone	211	111 <sup>1</sup>			
88	1-Acetyl cyclopentene	211	74 <sup>12</sup>			
89	2-Acetyl-5-methylthiophene	217	83 <sup>2</sup>	1.5622		
90	1-Tetralone	217, yel , al	170 <sup>49</sup>			Oxime, 102, prisms, 88-9, needles, me al
91	Neopentyl phenyl ketone	218	116 <sup>11</sup>	1.5078		Oxime, 114
92	3-Methyl-2,5-hexanedione	220	71 <sup>10</sup>	1.4260		
93	cis-1-Decalone	220d	116 <sup>18</sup>	1.4939		
94	3-Acetyl biphenyl	223	138 <sup>1</sup>	1.6140 <sup>25</sup>		
95	1,2-Dimethyl cyclohexen-3-one	225d	118-9 <sup>12</sup>			
96	3-Chloroacetophenone	232	113 <sup>11</sup>	1.5494		
97	3-Bromoacetophenone	233	132 <sup>17</sup>	1.5755		
99	6-Acetyl tetralin	234	156 <sup>10</sup>	1.5591 <sup>25</sup>		
100	2,3-Dimethyl-2-cyclopentenone	250	92 <sup>25</sup>	1.4830		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing semicarbazone m.p.)\* (Continued)

No	Name	Semi carbazone	Boiling point °C	$n_{D}^{20}$	$D_{4}^{20}$	Miscellaneous
101	1-Ethyl-2-methyl-3-cyclohexenone	250	105 <sup>19</sup>			
102	3-Acetylthianaphthene	250	137 <sup>3</sup>			
103	2-Oxopropionaldehyde (Methylglyoxal, Pyruvic aldehyde)	dt 254	52 <sup>12</sup>			<i>bis</i> -2,4-Dinitrophenylhydrazone 299 300, red, PhNO <sub>2</sub> , Dioxime 157, al

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point °C	Semi-carbazone	2,4 Di-nitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	<b>2-Aminoacetophenone</b>	20	250-2d	290d, al			108, al	109, subl., w	
2	<b>2-Dodecanone (n-Decyl methyl ketone)</b>	20.5	246.7	122.3 dil al					$n_D^{20}$ 1.42855, D <sub>4</sub> <sup>20</sup> 0.81982
3	<b>n-Amyl phenyl ketone (n-Pentyl phenyl ketone)</b>	24.7	265.2	131.5, 50% al 133 (cor)	168 (cor), ac a				$n_D^{25}$ 1.50272
4	<b>3,5-Dichloroacetophenone</b>	26	134.6 <sup>17</sup>						
5	<b>Benzyl methyl ketone (Phenyl-acetone)</b>	27	216.5 (cor)	199.9 5, al, 188	156	145	86.7 lgr 83	68.70	$n_D^{20}$ 1.5168
6	<b>4-Methylacetophenone</b>	28	226	204.5, al, 197	260.4 (cor), scar, ac a	198	97, al	87.8, pet eth	$n_D^{20}$ 1.5348, D <sub>4</sub> <sup>20</sup> 1.003
7	<b>2-Hydroxyacetophenone</b>	28	215	210	210.12 212.3		110	118	
8	<b>Phorone (Di-isopropylidene-acetone)</b>	28, yel -gr	198	221, w 186	118			48	Tetrabromide, 88.9, al
9	<b>2-Tridecanone (Methyl n-undecyl ketone n-Hendecyl methyl ketone)</b>	28	263	123, al, 126, 117	69, or -yel	101-2		56.7, al - pet eth	$n_D^{20}$ 1.43175
10	<b>Furfuralacetophenone</b>	29, yel - red	317d		169, scar				
11	<b>Ethyl 2-furyl ketone</b>	30.28	183	189					
12	<b>4-Cyclohexylcyclohexanone</b>	30.31 29.2	100 <sup>9</sup> i	216	137			101.2, 104.5	
13	<b>2-(1'-Hydroxycyclopentyl)-cyclopentanone</b>	31	99 <sup>3</sup>					78	
14	<b>7-Tridecanone (Di-n-hexyl ketone)</b>	31.2	255, 264			96			
15	<b>2-Acetyl furan (2-Furyl methyl ketone)</b>	32, 33	169-73	150, me al, 148	220	185.6, red, w - al	86, yel, w -al	104, eth - pet eth, 92	$n_D^{20}$ 1.5017, D <sup>20</sup> 1.098
16	<b>Levulinic acid (3-Acetyl propionic acid)</b>	33	245.6		206 (cor), or -yel, ac a	174.5	108, bz	45-6	
17	<b>2-Tetradecanone (n-Dodecyl methyl ketone)</b>	33-4, dil al		115.6, al					
18	<b>Methyl 1-naphthyl ketone (1 Acetyl naphthalene)</b>	34	302	222.5 4			146	136	$n_D^{20}$ 1.6257, Picrate, 116, yel
19	<b>1,3-Diphenyl-2-propanone (1,3 Diphenylacetone Dibenzyl ketone)</b>	34, 35, 30	330	145.6, abs al, 125.6, dil al	100		121, al, 128.9	125, 123	
20	<b>2,2,6,6-Tetramethyl-4-piperidone</b>	34.9, red, dry eth, 58 (mono- hyd), eth	205-6	219.20, al				153 al	
21	<b>4-Chloropropiophenone</b>	36.35	118 <sup>2</sup>	177, 175.6					
22	<b>2-Phenylcyclopentanone</b>	37	126-7 <sup>10</sup>	218d					
23	<b>Furfuralacetone</b>	38, 39	116 <sup>10</sup>		241 (cor)		131-2, al		
24	<b>4-Methoxyacetophenone</b>	38, 37	258	197.8, dil al	220 (cor), red, 231.8 (cor)	195.5 5, or, al	142, yel, al	86.7, wh, pet eth	
25	<b>1-Phenyl-1-hepten-3-one (n-Butyl styryl ketone)</b>	38.9, 40	159-67 <sup>11</sup>				98, yel		Dimer, 175-6

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Di-nitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
26	<b>4,4-Dimethylcyclohexanone</b>	38-41	73 <sup>14</sup>	204		106 7			$n_D^{20}$ 1.4537 $D_4^{20}$ 0.932
27	<b>3,4-Methylenedioxypropiophenone (Propiopiperone)</b>	39		187 8		97	104		
28	<b>2-Hydroxybenzophenone</b>	39, w-al 153	250 <sup>160</sup>			155, al			
29	<b>2-Methoxybenzophenone (2-Anisyl phenyl ketone)</b>	39							
30	<b>3-Bromopropiophenone</b>	40		183					
31	<b>Benzalacetone</b>	41	212	187		157	115		
32	<b>1-Indanone (<math>\alpha</math>-Hydrindone)</b>	42, 38	241 2 <sup>739</sup>	233 239	227, 223 258	166 234 5, ac a	130 1 134 5 me al 124 8	146 144 bz pet eth	Thiosemicarbazone, 148
33	<b>2,4-Dichloroacetophenone</b>	42	235 40	208				152	
34	<b>3-Aminopropiophenone</b>	42, yel	168 9 <sup>15</sup>	196 7				112 112 3	$N-p$ Toluenesulfonyl deriv 97 al
35	<b>2-Bromobenzophenone</b>	42	345					133	
36	<b>8-Pentadecanone (Di-n-heptyl ketone)</b>	42	178					120	
37	<b>4-Phenyl-3-butene-2-one (Methyl styryl ketone)</b>	42	262	186, al, 198, 142	227, red, ac a 223, or - red, al	165 7, red, al	156 7 yel, al, 159	115 6, 60°, al 87	$H_2SO_4 \rightarrow$ or -red
38	<b>3-Chlorobenzyl phenyl ketone</b>	43						102	
39	<b>8-Acetylguanine</b>	43 5	116 <sup>0</sup>		253				
40	<b>2-Benzoylfuran (2-Furyl phenyl ketone)</b>	44	150 <sup>3</sup>					122	
41	<b>1,3-Dichloro-2-propanone (1,3-Dichloroacetone)</b>	45	175, 173						$n_D^{20}$ 1.47144, $D_4^{20}$ 1.3826
42	<b>2-Acetylquinoline</b>	46				54			
43	<b>3-Chloropropiophenone</b>	46		179-80				90 1	
44	<b>4-Bromopropiophenone</b>	46	140 <sup>2</sup>	171				63 63 5	
45	<b>Phenyl n-undecyl ketone (n-Hendecyl phenyl ketone Laurophenone)</b>	47, 44		94 5 95					
46	<b>2-Aminopropiophenone</b>	47, pet eth		190d, al				88 9, w	Hydrochloride, 184 5 N-Acetyl 70 1 $D_{50}^{50}$ 1.0976
47	<b>Benzophenone</b>	48, 49	306 (cor.)	164-5, al, 167	238 9, or - yel, ac a, 229	154 5, yel, al, 144, red, al	137 8, al	142 3, me al, 144 140	
48	<b>2,4,6-Heptanetrione (Diacetylacetone)</b>	49	121 <sup>10</sup>	mono 203			dt 142	2,6-dt 68 5	$n_D^{20}$ 1.4930, $D_4^{20}$ 1.0681
49	<b>5-Phenoxy-2-pentanone (Methyl 3-phenoxypropyl ketone)</b>	50	121 <sup>2</sup>	108 10	110				
50	<b>9-Heptadecanone (Di-n-octyl ketone)</b>	50-50 5	250-3			54		111 2	
51	<b>Phenacyl bromide (<math>\omega</math>-Bromoacetophenone)</b>	50, 51		146	212-3, yel, or			89 5, 97	
52	<b>4-Bromoacetophenone</b>	51, 50 5	225	208	230, 237 (cor.)		126	128, 129	
53	<b>3-Bromophenacyl bromide</b>	51, lgr	174 <sup>14</sup>	163-4d, al					
54	<b>Ethyne phenyl ketone</b>	51			214				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Dinitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
55	<b>3,4-Dimethoxyacetophenone</b> (Acetoveratrone)	51, w-al	286-8	218, w-al	206-7	227	131	140, w-al	
56	<b>Diphenylacetone</b>	52		169					4-Nitrobenzoate 84
57	<b>Methyl 2-naphthyl ketone</b> (2-Acetyl naphthalene)	53 4, al , 56	301	234 5 237	262d, red, ac a	176-7, 171	149, 145 6		Picrate, 82
58	<b>Chloromethyl 2-phenylethyl ketone</b>	54	244 5	156	147, 146			89	
59	<b>2-Furyl-2-thenoylmethane</b>	55 5	195 <sup>6</sup>						Cu salt, 274
60	<b>Phenyl 2-thienyl ketone</b> (2-Benzoylthiophene)	56	300	195-7				93	
61	<b>2-Nonadecanone</b> ( <i>n</i> -Heptadecyl methyl ketone)	56		124-5	125 5 6			77	
62	<b>4-n-Caproylresorcinol</b> (2,4-Dihydroxy- <i>n</i> -caproylbenzene)	56 7	243 5d					190-1d , 50% al	
63	<b>2,2-Dichlorobenzoin</b>	57							
64	<b>3-Propionylphenanthrene</b>	57						53 6 4 7	Picrate, 113
65	<b>9-Propionylphenanthrene</b>	57							Picrate, 107
66	<b>Benzalacetophenone</b> (Phenyl styryl ketone Chalcone)	58, pa 57 8	345	α 168, β 170, yel, γ 179-80d	244d, or -red, ac a , 245 (cor )	120	140 68		Picrate, 93 7, Dimers, 124, 178, 195, 225 6
67	<b>2-Indanone</b>	58 58 9		218, 212-15 (dec )		232 (dec )		155	
68	<b>Phenacyl chloride</b> ( $\omega$ -Chloro-acetophenone)	59	244	156, 149	213 4d 214 5d			89	
69	<b>3-Phenyl-2,4-pentanedione</b>	60	134 <sup>20</sup>						Cu salt, 224
70	<b>Mesitylacetone</b>	60	130 <sup>10</sup>	205, 197					
71	<b>Ethyl 2-naphthyl ketone</b>	60	312 4	202				133, w-al	
72	<b>Difurfuralacetone</b>	60, yel							
73	<b>Desoxybenzoin</b> (Benzyl phenyl ketone)	60, al	321 (cor )	148, dil al	204 (cor ), or 202 4 (cor ), 199-200, or	163, red-br , 160	121-2 116, yel , al 109, wh , ac a	98, al	
74	<b>4-Methylbenzophenone</b> (Phenyl 4-tolyl ketone)	60, 55	326 (cor )	121-2, al				154, less soluble in w-ac a , 115, more soluble in w-ac a	
75	<b>1-Phenyl-1,3-butanedione</b> (Benzoylacetone Methyl phenacyl ketone)	61	261-2		151, pa yel , al	100-1, me al	150-3		
76	<b>1,1-Diphenylacetone</b>	61, al					131, bz	165	
77	<b>2,4'-Dibromobenzophenone</b>	62, pet eth	381-4 sl d	170				141-2	
78	<b>5-Isopropyl-1,3-cyclohexanedione</b>	62							
79	<b>Benzyl 3-chlorophenyl ketone</b>	62							
80	<b>4-Methoxybenzophenone</b> (4-Anisyl phenyl ketone)	62 4 al	354		180, dk or	198-9, al	132, 90	120 α 140 1, 137-8, β 115 6	
81	<b>2-Phenylcyclohexanone</b>	63, al , 60	160 <sup>15</sup>	190	139			169	
82	<b>4-Methoxybenzil</b>	63						124	
83	<b>1-Acetyl-2-hydroxynaphthalene</b>	64						27 5	
84	<b>11-Heneicosanone</b> (Di- <i>n</i> -decyl ketone)	64, w-al							Benzoate, 85 6, pyr
85	<b>Benzoylformic acid</b> (Phenylglyoxylic acid)	66	147 51 <sup>12</sup>		196 7d (cor ), yel			α 127, eth , β 145d , w	Thiosemicarbazone, 188 9 (cor ), yel
86	<b>2,2-Dimethylbenzophenone</b> (Di-2-tolyl ketone)	67			190			105	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE X. ORGANIC DERIVATIVES OF KETONES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Dinitrophenyl-hydrazone	p-Nitrophenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
87	<b>1,5-Diphenyl-1,5-pentanedione</b> (1,3-Dibenzoylpropane)	67.5, 62-3						di 165 6d	
88	<b>3,5-Dibromoacetophenone</b>	68, al, 65	198 <sup>15</sup>	268d, w - ac a 186, yel, al	222 3, vlt -red, ac a, 218-20, br -red, chl -me al	109-10, yel, al 180, yel, al	153, al, 152		
89	<b>Cinnamalacetone</b>	68, eth							
90	<b>Benzoyl-2-furoylmethane</b>	68	169 <sup>2</sup>						
91	<b>12-Tricosanone</b> (Di-n-undecyl ketone Di n-hendecyl ketone, Laurone)	69.5		179				39 40, al	Cu salt, 248
92	<b>Diphenyl triketone</b>	70, 69, yel, lgr							Heating with excess phenylhydrazine → 4 Benzene-azo-1,3,5 tri- phenylpyrazole, 156 7 yel -red, al
93	<b>2-Chlorobenzyl phenyl ketone</b>	71						86	
94	<b>Dihydroxyacetone</b>	72			277 8	160		84	Diacetate, 48 Dibenzoate, 120 5, Dimer 78 81
95	<b>3-Acetylphenanthrene</b>	72		230				193 4	
96	<b>4-Methoxybenzalacetone</b> (Anisal-acetone)	73, me al			229 (cor), red, ac a			119 20	Picrate, 125 6
97	<b>Benzylacetophenone</b>	73		144				87	
98	<b>Phenoxyethyl phenyl ketone</b> ( $\alpha$ Phenoxyacetophenone)	74	187 <sup>8</sup>	187					
99	<b>9-Acetylphenanthrene</b>	74	170 <sup>1</sup>	201				154-5	
100	<b>1-Naphthyl phenyl ketone</b>	75 5-6 0	225 <sup>15</sup>	385	$\alpha$ 246 7, red, $\beta$ 243 4, or, mixt 220			161	Picrate, 107 8
101	<b>9-Acetylfluorene</b>	75.5				139			
102	<b>2-Benzofuryl methyl ketone</b>	76, 72	136 <sup>11</sup>	207		154		118	
103	<b>Benzyl 4-methoxyphenyl ketone</b>	77							Picrate, 87, or
104	<b>4-Methoxybenzalacetophenone</b> (Anisalacetophenone 4-Methoxychalcone)	77, yel, al		$\alpha$ 168, al, $\beta$ 190, al					
105	<b>2-Naphthoxyacetone</b>	78, 77		203		154	123		
106	<b>4-Phenylcyclohexanone</b>	78		212, 229d, al			110		
107	<b>Benzoyl-2-thenoymethane</b>	78	201 <sup>4</sup>						
108	<b>4-Chlorobenzophenone</b>	78							
109	<b>1,4-Cyclohexanedione</b>	79	132 <sup>20</sup>	mono 221 2, di 231	185 240	106	$\beta$ 105-6 188		Cu salt, 278
110	<b>Di-n-tridecyl ketone</b> (Myristone)	79							
111	<b>Phenacyl phenyl ketone</b> (Di-benzoylmethane, $\omega$ -Benzoyl-acetophenone)	keto 81, enol 78, al		205		mono 105	57 mono 165	Dibromo deriv , 94-5, eth	
112	<b>3-Nitroacetophenone</b>	81		257	228	128, 135	132		
113	<b>4-Bromobenzophenone</b>	82		350	230	126	$\alpha$ 116-7, $\beta$ 110-1		
114	<b>1-Benzoylpropionic acid</b>	82-3d				100-4, br, bz			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Semi carbazole	2,4-Dinitrophenyl-hydrazone	p-Nitro phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
115	<b>Fluorenone</b>	83, yel , bz	341 5		283 4	269	151 2, yel , al	195 6 (cor )	
116	<b>4-Iodoacetophenone</b>	85, eth	153 <sup>18</sup>						
117	<b>Di-n-Heptadecyl ketone</b>	88 5, lgr , 89						67, 62 3	
118	<b>4,4'-Dimethylbenzophenone</b> (Di 4-tolyl ketone)	95, al	335	143 4	218 9		100, yel , al	163, al	Hydrazone, 108 10
119	<b>Benzil (Dibenzoyl)</b>	95, yel	347	mono 174-5 d , di 243 4d , al	di 189, yel , al , 185	mono <sup>*</sup> 192 3, dk or , ac a , di 290, yel . pyr -eth	mono 134, yel , al , di 235, chl rapid htng	α mono 137 8, 140, bz , di 237	
120	<b>β,β-Diphenylpropiophenone</b>	96 92						133	
121	<b>3-Hydroxyacetophenone</b>	96, 95	296	189 91	261				
122	<b>4-Chlorophenacyl bromide</b>	96-8							
123	<b>2,3-Dihydroxyacetophenone</b> (3-Acetylcatechol)	97 8, dk yel , bz - lgr		166 7				96 7	Acetate, 72 Diacetate 109, bz Di-Me eth , b p 143 4 <sup>14</sup> 143 4 <sup>14</sup>
124	<b>2-Naphthylglyoxal</b>	98, (hyd ), w 109	183 <sup>20</sup>						Diacetate, 150, bz -pet eth osazone 184
125	<b>3-Aminoacetophenone</b>	98-9, pa yel , al		196d , w			192 4, w - al	Hydrazone, 98, al	
126	<b>2-Benzoylacrylic acid</b>	99 (anh ) 64 (mono hyd )		190			197	168d	Hydrazone, 185 6, al
127	<b>Di-2-thienoylmethane</b>	100							Cu salt, 263
128	<b>Di-1-naphthyl ketone</b>	100						200	Picrate 121 5 20
129	<b>1,3-Dibenzoylbenzene</b>	101 2, al							
130	<b>2-Acetyl-1-hydroxynaphthalene</b>	102, gr - yel , al , 98, yel , bz	325 sl d	245 50, pa yel		136 7, wh , dil al	168 9		Acetate, 107 5, Benzoate, 128, al
131	<b>Cinnamacetophenone</b>	102, yel , al			222, red , ac a , 218 9d	α 135, al			
132	<b>1,3-Cyclohexanedione</b>	104						156	
133	<b>4-Tolyl (4,4'-Dimethylbenzyl)</b>	104 5						225	
134	<b>2-Propionylphenanthrene</b>	105, 104							Picrate, 107
135	<b>2-Aminobenzophenone</b>	105-6, pa yel , al							
136	<b>Benzoylnitromethane</b>	106					105 5 5, yel , al	96, w	
137	<b>4-Aminoacetophenone</b>	106, w	294	250, yel al	266 7, 263			147 8, al	4 Toluenesulfonamide, 203
138	<b>Benzalacenaphthenone</b>	107, yel , w -al						48	
139	<b>Benzyl 4-chlorophenyl ketone</b>	108						123	
140	<b>4-Bromophenacyl bromide</b>	108 9						115	
141	<b>4-Hydroxyacetophenone</b> (4-Acetylphenol)	109		199	210, br , al		151, wh → yel	145, 143 4, bz	Acetate, 72 Acetate, 54, Benzoate, 134 5, al
142	<b>trans-1,2-Dibenzoylethylene</b>	110						211	
143	<b>Piperonalacetone</b>	110-1, pa yel		α 217, al , β 168, bz			163	186, al	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Dinitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
144	<b>2-Acetylbenzothiophene</b>	112		235					
145	<b>1,5-Diphenyl-3-pentadienone</b> (Dibenzalacetone)	112, 111		187-90, al ac a	180, red, ac a	173, yel , bz	152 3, 147 8, yel , al	142 4	Picrate, 114
146	<b>4,4'-Dimethoxybenzoin</b> (Anisoin)	113, dil al		185 (cor ), w-al					Acetate, 94-5, al -pet eth
147	<b>1,4-Diacetylbenzene</b>	114	130 <sup>3</sup>					240	
148	<b>3,4-Dihydroxyacetophenone</b> (4-Acetylcatechol)	116, w	127 33 <sup>11</sup>					184d , et ac	3 4-Diacetate, 91
149	<b>3-Hydroxybenzophenone</b>	116, al						syn 76, anti 126, bz	
150	<b>α-Hydroxyacetophenone</b> (Phenacyl alcohol, Benzoyl carbinol)	117 8	118 <sup>11</sup>	146 6 5, al			112, lgr - eth	70	Acetate, 49, eth , Benzoate, 118, dil al
151	<b>7-Acenaphthenone</b>	121 (cor ), al					90, dk , al	175, al , 183 4, bz , di 222d	Picrate, 113
152	<b>4-Phenylacetophenone</b> (4-Acetyl-biphenyl, Methyl 4-xenyl ketone)	121, al	325-7		241 5-2, red-or			186-7, al	
153	<b>Piperonalacetophenone</b> (3,4-Methylenedioxychalcone)	122, yel , al		α 203-5, abs al					Dibromide, 152, bz -lgr (1 1), Picrate, 126-8
154	<b>9-Hydroxyxanthene</b> (Xanthylol)	122-4d							Heat → Dixanthyl ether, 219, Dixanthyl, 204, lgr
155	<b>4-Aminobenzophenone</b>	124, w -al						168, al , 127, w - al	Hydrazone, 139-40, yel , al
156	<b>4-Phenylphenacyl bromide</b>	124 5						172	
157	<b>2-Naphthoin</b>	126 ,							Acetate, 111
158	<b>4-Phenylphenacyl chloride</b>	126-7							Acetate, 111
159	<b>Vanillalacetone</b> (4-Hydroxy-3-methoxystyryl methyl ketone)	129, yel , al			230 (cor ), red	127-8, yel			
160	<b>Dianisalacetone</b>	129, yel , bz -pet eth			82-3			147 8	
161	<b>4,4'-Dimethoxybenzil</b> (Anisil)	133, yel		di 254 5, dil ac a				mono 133 syn di 217, anti, di 195, bz	Dihydrazone, 118
162	<b>d,l-Benzoin</b>	133, al , 129	344	α 205-6, w	245, yel , al , 234		α 158-9, bz -lgr , β 106	α 151 2, bz , β 99	Acetate, 83, al , Benzoate, 124 5, 75% al
163	<b>cis-1,2-Dibenzoylethylene</b>	134						di 210 1d	
164	<b>3,4,5-Tribromoacetophenone</b>	134 5, al		265d , ac a			129-34d , yel , pet eth		
165	<b>4-Hydroxybenzophenone</b> (4-Benzoylphenol)	134 5, w		194, bz	242 4 (cor ), or 216 7, or - red, al		144, pet eth 79-81, lgr -bz	81, Heat → 152 α 161, al , β 102, pa yel , eth	Acetate, 81, al Benzoate, 94 5, 115
166	<b>1-Furoin</b>	135, 138-9 (cor )							Acetate, 76-7, Benzoate, 92 3
167	<b>Mesityl phenyl ketone</b>	137			232				
168	<b>4-Chlorobenzyl phenyl ketone</b>	138	.					96	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Semi carbazole	2,4-Di nitrophenyl hydrazone	p-Nitrophenyl hydrazone	Phenylhydrazone	Oxime	Miscellaneous
169	<i>α</i> -Anisal- <i>α'</i> -cinnamalacetone	139, red, al					Pyrazoline, 155 6, yel, al		Dibromide, 139-40, CS <sub>2</sub> . Tetrabromide, 155 6, CS <sub>2</sub>
170	<b>4-Aminopropiophenone</b>	140, w						153, al	
171	<b>3,3'-Dibromobenzophenone</b>	141						181 2d	N-Acetyl deriv 161, w
172	<b>2-Acetylphenanthrene</b>	143		260			187 8		
173	<b>Dicinnamalacetone</b>	144, yel, abs al			195 7 (cor), dk red <i>di</i> 265	166, yel, al			Light → d
174	<b>1,2-Dibenzoylethane</b>	147					mono 116, <i>di</i> 179	204	
175	<b>2,4-Dihydroxyacetophenone</b> (Resacetophenone)	147, 144		218, 214 20d	206 8		156 8	202 3	2,4-Diacetate, 38 2,4 Dibenzoate, 81
176	<b>3,5-Dihydroxyacetophenone</b>	147 8, w		205 6, al		236 7, red, w - ac a			3,5-Diacetate, 91-2, lgr
177	<b>4,4'-Dichlorobenzophenone</b>	147-8			238-40			135	
178	<b>1,2-Dibenzoylbenzene</b>	148					mono 150		
179	<b>9-Benzoylanthracene</b> (9-Anthra-phenone)	148, yel, bz							H <sub>2</sub> SO <sub>4</sub> → brief blue color
180	<b>4-Hydroxypropiophenone</b>	148			229				
181	<b>5,5-Dimethyl-1,3-cyclohexanedi one</b> (Methone Dimedone)	148 9					mono 115 <i>di</i> 176		
182	<b>2,3,4,2'-Tetrahydroxybenzophenone</b>	149 (anh.), 100 (hyd), yel, w							2,3,4,2'-Tetraacetate, 118, al
183	<b>Anthrone</b>	154, ac a							
184	<b>1,4-Dibenzoylbenzene</b>	161, al					mono		Al sol → bl fluorescence
185	<b>Furil (2,2'-Bifuryl)</b>	165, yel, bz				mono 82 3, yel, <i>di</i> 184,	106, β, mono 97-8, α, <i>di</i> 100, 166, β, <i>di</i> 188 90		
186	<b>Benzanthrone</b>	170, yel, al							H <sub>2</sub> SO <sub>4</sub> → or-red sol, gr fluorescence
187	<b>Quinhydrone</b>	171, dk gr, subl					152	161	
188	<b>2,3,4-Trihydroxyacetophenone</b> (Gallacetophenone)	172, w		225, rapid htng				162 3	2,3,4-Triacetate, 85 Picrate, 133
189	<b>Xanthone</b> (Diphenylene ketone oxide)	174	350				152	161	
190	<b>4,4'-Bis(dimethylamino)benzophenone</b>	174					174 5	233	Hydrazone, 150, Picrate, 156
191	<b>4,4'-Dibromobenzophenone</b>	177	395					150-2	Hydrazone, 92-4
192	<i>d,l</i> -Camphor	<i>d,l</i> 178, <i>d</i> 179	209, 205	247-8d (cor), 236-7, al	<i>d,l</i> 164, <i>d</i> 177, or, al	217	233	<i>d</i> 118 9	<i>d</i> [α] <sub>D</sub> <sup>20</sup> + 44, Hydrazone, 55
193	<b>3-Acetylindazole</b>	182, yel, ac a			>320, red, PhNO <sub>2</sub>			222, bz - al	N-Acetyl deriv, 123, ac a
194	<b>3,4,5-Trihydroxyacetophenone</b>	187-8, w		216-7, al		260d, red, w-ac a			3,4,5-Triacetate, 111-2, lgr

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE X. ORGANIC DERIVATIVES OF KETONES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Semi carbazole	2,4-Di nitrophenyl hydrazone	p Nitro phenyl hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
195	<b>3-Acetylindole</b>	190 1, bz						144 7, w	N-Acetyl deriv, 151, subl, pet eth -bz, Picrate, 183, yel, pet eth Diacetyl deriv, 165 6, bz
196	<b>2,5,2',6'-Tetrahydroxybenzo-phenone</b>	200 2d w							2,5,2',6'-Tetraacetate, 118 9, al
197	<b>2,5-Dihydroxyacetophenone</b> (Quinacetophenone)	202, yel gr, w			215 6			149 50, tol	2,5-Diacetate, 68, ac a
198	<b>2,4,5-Trihydroxyacetophenone</b>	206 7 red							2,4,5-Triacetate 165 6, bz
199	<b>2,3,5-Trihydroxyacetophenone</b>	206-7, yel, ac a			241 2d, w-al				2,3,5-Triacetate, 106 7, lgr
200	<b>2,4,6-Trihydroxyacetophenone</b> (Phloracetophenone)	219, anh, w							2,4,6-Triacetate, 103, 2,4,6-Tribenzoate, 117 8
201	<b>2,3-(3',4',5'-Triphenylcyclo-pentadieno)-indone</b>	222				246-7			
202	<b>3,4,3'4'-Tetrahydroxybenzo-phenone</b>	227 8, w						145, al	
203	<b>Ninhydrin</b> (Triketohydridene hydrate)	243, 241d				di 207 8, or-red, al		201	Warm aqueous sol of α-amino acids → intense bl, vlt, etc At 125-30, loses w, turns red
204	<b>Phenacridone</b>	304 5, yel, ac a							N-Benzyl deriv, 188 9, yel, al

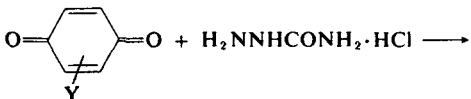
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XI

The derivatives of quinones are usually similar to those of ketones. Therefore, for directions and examples for their preparation see explanations and references to Tables 9 and 10, pages 141, 142, 143.

The derivatives listed as *phenylhydrazone*, *p-nitrophenylhydrazone* and *2,4-dinitrophenylhydrazone* of quinones in most cases are not real substituted phenylhydrazones, but either addition compounds or hydroxy derivatives of variously substituted aromatic azo compounds.

*Semicarbazone \**



Monosemicarbazone

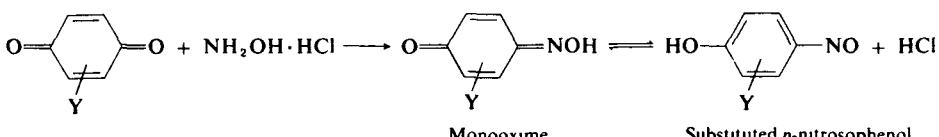


Disemicarbazone

From the quinone with semicarbazide hydrochloride in water

For directions and examples see Linstead, p 30, Vogel, p 749

*Oxime \**



From the quinone with hydroxylamine hydrochloride in water

For directions and examples see Linstead, p 30

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XI. ORGANIC DERIVATIVES OF QUINONES**  
 (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	Semi carbazole	2,4 Di nitrophenyl hydrazone	p-Nitrophenyl hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
1	2,3,5-Trimethyl-1,4-benzoquinone	32, yel , eth		252 3 d , yel				1-mono 181 2, yel , al	
2	2-Isopropyl-5-methyl-1,4-benzoquinone (Thymoquinone)	45 5, or - yel	232	mono 201 2d , yel , al , di 237, yel	mono 179 80, dk red, al	93		4-mono 134, yel 1-mono 160 2, pa yel chl	
3	2,3-Dimethyl-1,4-benzoquinone ( <i>o</i> -Xylo- <i>p</i> quinone)	55 (subl ), yel						mono 166, yel	
4	2-Bromo-1,4-benzoquinone	56						1-mono 184, or 4-mono 196	
5	2-Chloro-1,4-benzoquinone	57, yel - red		4-mono 185d				1-mono 184, pa grn -yel , 4-mono 148d	
6	2-Methyl-1,4-benzoquinone ( <i>p</i> -Toluquinone)	67 6 68 4		4-mono 178 9, yel , al di 240d , or -red	di 269, PhNO <sub>2</sub>	130		mono 134 5d w , di 220d , yel -wh	
7	2,6-Dimethyl-1,4-benzoquinone ( <i>m</i> -Xylo- <i>p</i> -quinone)	68 71, yel						1-mono 175, yel , al -w 4 mono 170 1, yel bz di 128, br	
8	4-Chloro-1,2-benzoquinone	78 pa yel -red, hexane							
9	2,5-Dimethyl-1,4-naphthoquinone	94 yel me al 98 9, or - red, w		mono 232 3, w -me al	266 8, or		mono 226, red, ac a		[ $\alpha$ ] <sub>D</sub> <sup>18</sup> +31° in chl
10	Dunnione								
11	2-Methyl-1,4-naphthoquinone	106, yel , me al			4-mono 299d			mono 160, di 166-8	Benzoyl chloride + Zn dust → 1 4-dibenzoyloxy- 2-methylnaphthalene, 180 0-0 5, col , al
12	Quinone (1,4-Benzoquinone)	116, yel 113		mono 166, yel , 165- 6d , red, 178, di 243d , red	mono 185 6, br , al , di 231	152	240		Picrate, 79, Quinhydrone, 171
13	2-Chloro-1,4-naphthoquinone	117, yel , w						4-mono 200 d 198, pa yel , bz	
14	1,4-Naphthoquinone ( $\alpha$ -Naphthoquinone)	117 8, yel , al		mono 247, grn -yel , ac a	mono 278, yel , pyr	mono 277 9, or -red, PhNO <sub>2</sub>	mono 205-6d , dk vlt , bz		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XI. ORGANIC DERIVATIVES OF QUINONES**  
**(Listed in order of increasing m.p.)\*** (Continued)

No	Name	Melting point °C	Boiling point, °C	Semi-carbazone	2,4 Dinitrophenyl-hydrazone	p-Nitrophenyl-hydrazone	Phenyl hydrazone	Oxime	Miscellaneous
15	<b>2,5-Dimethyl-1,4-benzoquinone (<i>p</i>-Xylo-<i>p</i>-quinone)</b>	125, yel , al					122 4, yel , 154 5, or	<i>mono</i> 168, yel , w , <i>dt</i> 272, yel , al , 254	Monobenzoylphenyl-hydrazone, 122 4, yel , lgr
16	<b>2,6-Dibromo-1,4-benzoquinone</b>	131, yel , al		4- <i>mono</i> 225d , yel , al				4- <i>mono</i> 170d , br	
17	<b>2,6-Diphenyl-1,4-benzoquinone</b>	137 8, red							
18	<b>2,5-Dihydroxy-3-<i>n</i>-dodecyl-1,4-benzoquinone (Embelin)</b>	143, or - red, eth - bz		<i>dt</i> 236			<i>dt</i> 189 90	<i>tetra</i> 175	Diacetate, 54 Dibenzoate, 97-8
19	<b>1,2-Naphthoquinone (<math>\beta</math>-Naphthoquinone)</b>	145 7d , red, eth , 120		1- <i>mono</i> 184d , yel , al		1- <i>mono</i> 250 1, 2- <i>mono</i> 236, dk red, ac a	2- <i>mono</i> 138, dk red, al	1- <i>mono</i> 109 5, 2- <i>mono</i> 162-4d , <i>dt</i> 169, yel , al	
20	<b>3,7-Dimethyl-1,2-naphthoquinone</b>	151 2, red, al						2- <i>mono</i> 222d , or	
21	<b>5-Hydroxy-1,4-naphthoquinone (Juglone)</b>	153 4, or , bz						<i>mono</i> 167 0 7 5, red, ac a , <i>dt</i> 225 (exp ), dk br , ac a	Acetate, 154-5
22	<b>3-Chloro-1,2-naphthoquinone</b>	172, red, chl						1- <i>mono</i> 167 8, or	
23	<b>1,8-Dihydroxy-2-methyl-9,10-anthraquinone (2-Methylchrysazin)</b>	175							Diacetate, 205
24	<b>2-Methyl-9,10-anthraquinone</b>	177 9, 177, pa yel							Diacetate, 217, pa yel , ac a
25	<b>3,5-Dihydroxy-2-methyl-1,4-naphthoquinone (Droserone)</b>	181, pa yel , al							
26	<b>2,3,4-Trihydroxy-9,10-phenanthraquinone</b>	185d , br - red		<i>mono</i> 270d , br -red, al				<i>dt</i> 151	Diacetate, 119, me al
27	<b>6-Bromo-1,4-dihydroxy-9,10-anthraquinone (6-Bromoquinizarin)</b>	185 5, red- br , bz							Phenazine, 255d , br , al
28	<b>1,2-Anthraquinone</b>	185 90d , or -br							
29	<b>4-Chloro-1,2-naphthoquinone</b>	188, red br , bz							
30	<b>7-Isopropyl-1-methyl-9,10-phenanthraquinone (Retene-quinone)</b>	197, or , al		<i>mono</i> 200, yel , pyr		<i>mono</i> 222 3, red, ac a	<i>mono</i> 160, or , bz -al	<i>mono</i> 128 5, 130 1 (cor ), yel , al	Di Me eth , 176 5, or - yel , al , Diacetate, 220 5, yel , al

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XI. ORGANIC DERIVATIVES OF QUINONES**  
**(Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Dinitrophenylhydrazone	p-Nitrophenylhydrazone	Phenylhydrazone	Oxime	Miscellaneous
31	<b>Camphorquinone</b>	199, yel, dil al		3 mono ( $\alpha$ ) 236d, al	mono 36, di 190	239	183 90, pa yel, al, 170	mono $\alpha$ 153 $\beta$ 114 5, di (four forms) $\alpha$ 201d, $\beta$ 248d, $\gamma$ 136 $\delta$ 194d	3-p-Bromophenylhydrazone, 215 6, ac a, Hydrazone, 182
32	<b>1-Hydroxy-9,10-anthraquinone</b>	200, or - red, al, 193	subl						Acetate, 176 9, yel, al
33	<b>1,4-Dihydroxy-9,10-anthraquinone (Quinizarin)</b>	200 2 (cor), red, ac a, 195							Diacetate, 207 8, yel, pyr, 200-1, yel, ac anh
34	<b>9,10-Phenanthaquinone</b>	206 7 5, or -yel, 208, or	>360, subl $\rightarrow$ or -red	mono 220d	mono 312-3d, dk red	mono 245, red, xyl	mono 165, dk red, al	mono 158, grn - yel, al, di 202d	Conc H <sub>2</sub> SO <sub>4</sub> $\rightarrow$ dull grn
35	<b>1,4-Anthraquinone</b>	218d, yel, turns dark at 200 10						233 br, turns dark at 205	
36	<b>4-Chloro-1,2,3-trihydroxy-9,10-anthraquinone</b>	233, yel							Triacetate, 187, yel, Conc H <sub>2</sub> SO <sub>4</sub> $\rightarrow$ red
37	<b>2-Bromo-9,10-phenanthraquinone</b>	233 4, red-yel, ac a						mono 163 4, or	
38	<b>1-Bromo-9,10-phenanthraquinone</b>	233-4, yel						mono 213d	
39	<b>Chrysoquinone (Chrysene-quinone)</b>	239 5, red						mono 161, or	Conc H <sub>2</sub> SO <sub>4</sub> $\rightarrow$ bl
40	<b>1,2,8-Trihydroxy-9,10-anthraquinone (2-Hydroxychrysazin)</b>	239 40, red, ac a							Triacetate, 224, yel 2-Me eth, 220 or, chl -me al, 2,8-Di-Me eth, 193, br -yel, chl -me al, 1,2,8-Tri-Me eth, 157, yel, me al
41	<b>1-Amino-9,10-anthraquinone</b>	251, or - red							N-Acetyl, 218, or -red, N-Benzoyl, 255, grn, N-p-Toluenesulfonyl, 228 9
42	<b>3-Amino-9,10-phenanthraquinone</b>	254, dk red-br, al						mono 247d, red-br	
43	<b>1,2,4-Trihydroxy-9,10-anthraquinone</b>	259, dk red, abs al							2-Me eth 232 3, red, bz, 2,4-Di-Me eth 186-9, or, 2-Acetate, 179 80, or, al Triacetate, 198-200 (melters 193), pa yel
44	<b>Acenaphthenequinone</b>	261 (cor), yel, ac a		mono 192-3, ac a, di 271, al	mono 247, or - red, ac a	mono 179, or - red, al, di 219, dk yel, al	mono 230, dil al, 220d		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XI. ORGANIC DERIVATIVES OF QUINONES**  
**(Listed in order of increasing m.p.)\* (Continued)**

No.	Name	Melting point, °C	Boiling point, °C	Semi-carbazone	2,4-Dinitrophenyl hydrazone	p-Nitrophenyl hydrazone	Phenylhydrazone	Oxime	Miscellaneous
45	1,3-Dihydroxy-4-methyl-9,10-anthraquinone (4-Methylpurpuroxanthin)	265 6, or , bz							Di-Me eth , 162, yel , chl , Diacetate, 181-2, yel , ac a
46	2-Bromo-1,4-dihydroxy-9,10-anthraquinone (2-Bromoquinizarin)	265 8, br - red							Diacetate, 226-9, yel
47	3-Bromo-9,10-phenanthraquinone	268 dk - yel , ac a		mono 242d			mono 177, red	mono 198, di 212d , grn	
48	Aceanthrenequinone (3,4-Benzacenaphthenequinone)	270, red, bz					mono 203, or , bz	mono 251d , yel , ac a	subl
49	1,2,5-Trihydroxy-9,10-anthraquinone (Hydroxyanthrarufin)	273 4, red, ac d							2-Me eth , 229, yel , al , 1,2-Di-Me eth , 231, or , al , 1,2,5-Tri-Me eth , 203 4, yel , al , Triacetate, 228 9, yel , al
50	1,5-Dihydroxy-9,10-anthraquinone (Anthrarufin)	280 (subl ), pa yel	379-81						Diacetate, 245d , pa yel , ac a
51	Chloranilic acid (2,5-Dichloro-3,6-dihydroxy-1,4-benzoquinone)	283 4, red, w (+2H <sub>2</sub> O)							Di-Me eth , 141 2, red , Di-Et eth , 107, red, Diacetate, 182 5, yel
52	9,10-Anthraquinone	286	382, 376 8 (cor )					mono 224, pa yel , (rapid htng )	Diacetate, 260, col , ac a
53	Chloranil (2,3,5,6-Tetrachloro-1,4-benzoquinone)	290, yel , ac a , (slow htng , sealed tube)	subl						SO <sub>2</sub> —Tetrachlorohydroquinone, In w -alkali sol → alkali salts of chloranilic acid
54	Alizarin (1,2-Dihydroxy-9,10-anthraquinone)	290, or , al	430						2-Benzoate, 214 6, al , 2-p-Bromobenzoate, 195, yel , Diacetate, 184, yel , al , Di-Me eth , 215
55	2-Amino-9,10-phenanthraquinone	>300, dk vlt , w , sinters at 205-10							N-Acetyl, 324, dk red-vlt , PhNO <sub>2</sub> , N-Benzoyl , 297-8, br -red, PhNO <sub>2</sub>
56	3-Aminoalizarin (3-Amino-1,2-dihydroxy-9,10-anthraquinone)	>300, dk red, ac a							N-Acetyl, 238-40, yel -br , Monobenzoyl, 275, dk yel , Dibenzoyl, 252, yel
57	1,4-Diamino-5,8-dihydroxy-9,10-anthraquinone (5,8-Diaminoquinizarin)	>300, br -vlt , PhNO <sub>2</sub>							N,N'-Dibenzoyl, 284-5, br -vlt , xyl , N,N'-Di-phenyl, 258-60, dk bl , bz -lgr , 1,4-Di-Me eth , 250d , vlt -blk , ac a
58	Dianthraquinone (9,9'-Di-anthranyl-10,10'-quinone)	>300, yel							Conc H <sub>2</sub> SO <sub>4</sub> → vlt -red , CrO <sub>3</sub> → Anthraquinone , Zn dust + ac a → di-anthranol, 230 (enol), 250 (keto)

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XI. ORGANIC DERIVATIVES OF QUINONES**  
**(Listed in order of increasing m.p.)\* (Continued)**

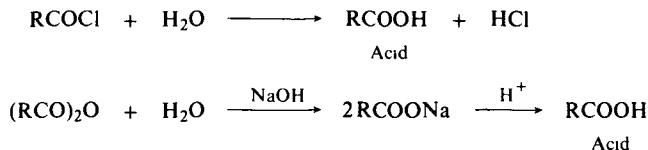
No	Name	Melting point, °C	Boiling point, °C	Semi carbazole	2,4-Dinitro-phenyl-hydrazone	p-Nitro-phenyl-hydrazone	Phenyl-hydrazone	Oxime	Miscellaneous
59	<b>2-Amino-9,10-anthraquinone</b>	306, 303 6, red, al							N-Acetyl, 262, yel , N,N-Diacetyl, 258, yel , ac a N-Benzoyl, 227 8, yel , ac a
60	<b>2-Hydroxy-9,10-anthraquinone</b>	305, yel , al	306						Acetate, 159 60, al , Benzooate, 202 4, ac a
61	<b>1,2,3-Trihydroxy-9,10-antha-quinone (Anthragallol)</b>	313 4d , br -or (290, subl )							Triacetate, 181 2, yel , al 188 9, pyr 2,3-Di-p-toluenesulfonate 196 8, yel , pyr , Tri-Me eth , 167 9, grn -yel , bz -pet , Triacetate, 181-2, yel , ac a , Tribenzoate, 213 5, pa yel , al bz
62	<b>1,2,6-Trihydroxy-9,10-antha-quinone (Flavopurpurin)</b>	>330, (>160, subl )							2,6-Di-Me eth , 239, yel , 1,2,6-Tri-Me eth , 225-6, yel Diacetate 238 Tri-acetate 202 3
63	<b>1,2,7-Trihydroxy-9,10-antha-quinone (Antrapurpurin)</b>	369, or , al							2-Acetate, 296-8 yel , al , 2,7-Diacetate, 192 3, yel , al -ac a Triacetate, 223, pa yel , ac a Tri-Me eth , 201, yel , al

\*Derivative data given in order m p , crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or *via* the acyl halide. All of them appear therefore under the same title.

*Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid*



From the acyl halide in water

*For directions and examples see* Wild, p 180

From the acyl halide with aqueous sodium hydroxide

*See* Vogel, p 369, Wild, p 180

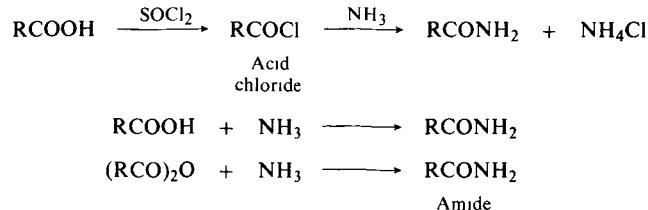
From the acid anhydride with water

*See* Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, *J Chem Soc*, 97, 1677 (1910)

From the acid anhydride with aqueous sodium hydroxide

*See* Linstead, pp 16-7 Wild, p 184

*Amide \**



Acid chloride is prepared from the acid and thionyl chloride. Amide is formed on addition of aqueous ammonia.

*For directions and examples see* Cheronis, p 440, Shriner, p 200, Vogel, p 361, Wild, p 181

From the acid chloride in benzene with aqueous ammonia

*See* D Swern, J M Stutzman and E T Roe, *J Amer Chem Soc*, 71, 3017 (1942)

By passing gaseous ammonia through a benzene or ether solution of the acyl chloride

*See* Linstead, p 14, Wild, p 182

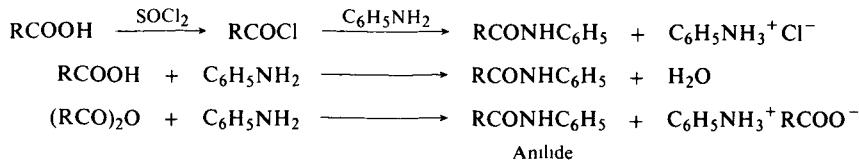
From the neat acid with gaseous ammonia

*See* J A Mitchell and E E Reid, *J Amer Chem Soc*, 53, 1879 (1931)

From the acid anhydride with aqueous ammonia

*See* Wild, p 184, 185

*Anilide \**



From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether.

*For directions and examples see* Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200-1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

From the acid chloride with aniline in aqueous sodium hydroxide

*See* Wild, pp 181, 219

From the acid and aniline at high temperatures

*See* Vogel, p 362

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the sodium salt of the acid with aniline and concentrated hydrochloric acid

*See* Shriner, p 201, Wild, p 154

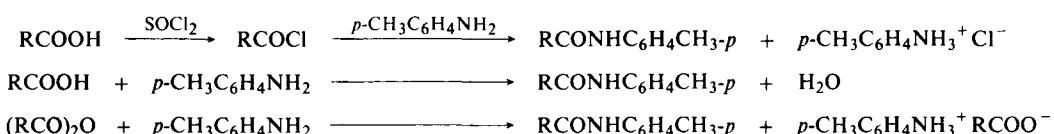
From the acid anhydride with aniline without solvent

*See* Linstead, p 17, Vogel, p 377, Wild, p 185

From the acid anhydride with aniline in benzene

*See* Linstead, p 15, Wild, p 185

### *p-Toluidide* \*



From the acid chloride with *p*-toluidine in ether or benzene

*For directions and examples see* Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361

From the acid and *p*-toluidine at high temperatures

*See* Cheronis, pp 441, 442-3, Vogel, p 362

From the sodium salt of the acid, *p*-toluidine and concentrated hydrochloric acid

*See* Shriner, p 201, Wild, p 154

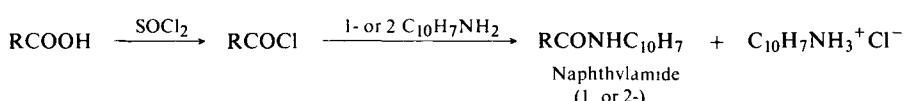
From the acid anhydride with *p*-toluidine without solvent

*See* Cheronis, p 459, Linstead, p 17

From the acid anhydride with *p*-toluidine in benzene

*See* Wild, p 185

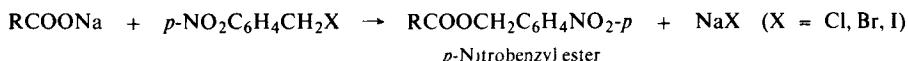
### *1- and 2-Naphthylamide* \*



From the acid chloride with the naphthylamine

*For directions and examples see* Cheronis, p 446, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

### *p-Nitrobenzyl ester* \*



From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol

*For directions and examples see* Cheronis, pp 447, 448, Shriner, p 200, Vogel, p 362, Wild, p 144, 5

From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone

*See* F F Blicke and F D Smith, *J Amer Chem Soc*, 51, 1947 (1929)

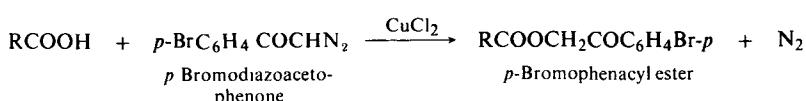
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl bromide in 1 2 water-ethanol

*See* E E Reid, *J Amer Chem Soc*, 39, 124 (1917)

From the sodium or the potassium salt of the acid and *p*-nitrobenzyl chloride or iodide in 1 2 water-ethanol

*See* J A Lyman and E E Reid, *J Amer Chem Soc*, 39, 701 (1917)

### *p-Bromophenacyl ester* \*



From the sodium salt of the acid and *p*-bromophenacyl bromide in aqueous ethanol

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

*For directions and examples see* Cheronis, pp 447, 448, Linstead, p 14, Shriner, p 200, Vogel, p 362, Wild, p 146

From the sodium salt of the acid (neutralization with sodium carbonate) with *p*-bromophenacyl halide in 1:2 water-ethanol

*See* W L Jedefind and E E Reid, *J Amer Chem Soc*, **41**, 1043 (1920)

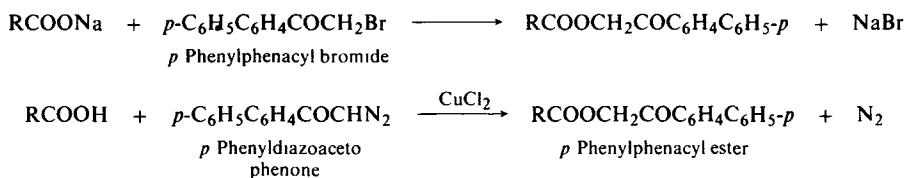
From the sodium salt of the acid (neutralization with sodium hydroxide) with *p*-bromophenacyl bromide in 95% ethanol

*See* R M Hann, E E Reid and G S Jamieson, *J Amer Chem Soc*, **52**, 818 (1930), C G Moses and E E Reid, *J Amer Chem Soc*, **54**, 2101 (1930)

From the acid and *p*-bromodiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

*See* J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

### *p*-Phenylphenacyl ester \*



From the sodium salt of the acid (neutralization with sodium carbonate) and *p*-phenylphenacyl bromide in aqueous alcohol

*For directions and examples see* Linstead, p 14, Vogel, p 363, N L Drake and J Bronitsky, *J Amer Chem Soc*, **52**, 3715 (1930)

From the sodium salt of the acid (neutralization with sodium hydroxide) and *p*-phenylphenacyl bromide in aqueous alcohol

*See* Shriner, p 200, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

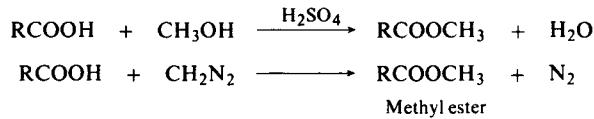
For dibasic acids from the acid, ethylamine and *p*-phenylphenacyl bromide in aqueous ethanol

*See* Wild, p 147, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

From the acid and *p*-phenyldiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

*See* J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

### *Methyl ester*



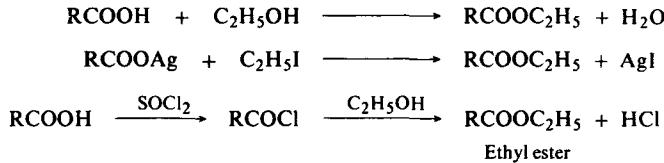
From the acid with methanol and a catalytic amount of sulfuric acid

*For directions and examples see* Linstead, p 16, Vogel, p 383

From the acid and diazomethane in ether

*See* B Eistert, in *Newer Methods of Preparative Organic Chemistry*, Interscience, New York, 1948, p 513

### *Ethyl ester*



From the acid and ethanol in the presence of a catalytic amount of sulfuric acid

*For directions and examples see* Vogel, pp 383, 385, 386, 387

From the silver salt of the acid with ethyl iodide

*See* Vogel, p 388

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the acid chloride and ethanol.

*See:* Vogel, p. 389.

*NOTE:* The same methods can be used for the formation of other esters.

### *S-Benzylthiuronium salt.\**



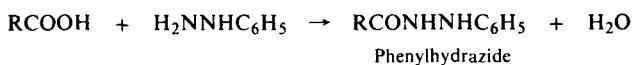
From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

*For directions and examples see:* Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, *Bull. Soc. Chim. [S]*, **5**, 1153 (1938), S. Veibel and K. Ottung, *Bull. Soc. Chim.* **6**, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

*See:* Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, *J. Amer. Chem. Soc.*, **58**, 1004 (1936).

### *Phenylhydrazide.*



From the acid with phenylhydrazine without solvent.

*For directions and examples see:* Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, *J. Amer. Chem. Soc.*, **64**, 470 (1942).

From the acid with phenylhydrazine in benzene.

*See:* Shriner, p. 201; Wild, p. 152.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
a) Liquids 1)(Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	$n_{D}^{20}$	$D_4^{20}$	p-Toluide	Anilide	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
1	<b>Thioacetic acid</b>	93			1 074 <sup>10</sup>	130	76		108			
2	<b>Formic acid</b>	100 7	8 4	1 37137	1 22026	53	50	140 135				<i>p</i> -Nitrobenzyl ester, 31
3	<b>Acetic acid (Ethanoic acid)</b>	118 2	16 6	1 36976 1 3721	1 04926	153 147	114	86 0	82			<i>p</i> -Nitrobenzyl ester, 78
4	<b>Difluoroacetic acid</b>	134 5							52			
5	<b>Acrylic acid</b>	141, 140	13	1 4224	1 0621 <sup>16</sup>	141	104 5, w		84-5, pet eth			
6	<b>Propionic acid (Propanoic acid)</b>	141	-20 8	1 3868	0 99336	126, 123	106	63 4	81			<i>p</i> -Nitrobenzyl ester 31
7	<b>Propiolic acid</b>	144d	18		1 139 <sup>15</sup>		87		61 2			
8	<b>Isobutyric acid (Isobutanoic acid)</b>	154 7	-46 1	1 3920	0 94791	108 5 9 5	105	76 8	128 129			
9	<b>Methacrylic acid</b>	161	16	1 429	1 015				102 6			<i>p</i> -Bromoanilide, 116
10	<b><i>n</i>-Butyric acid (<i>n</i>-Butanoic acid)</b>	162 5 164	-5 5 -8	1 3983 1 3979	0 95790	75	96 97	63	115 6			<i>p</i> -Nitrobenzyl ester, 35
11	<b>Pyruvic acid (<math>\alpha</math>-Oxopropionic acid)</b>	165d 80 <sup>23</sup>	13 6	1 4138	1 2668 <sup>15</sup>	109 130	104, subl		124 5, 145			2,4-Dinitrophenylhydrazone 218, yel , al
12	<b>Vinylacetic acid (3-Butenoic acid)</b>	169 163	-35	1 4221	1 0094		58		73			
13	<b>Isocrotonic acid (<i>cis</i>-(<math>\beta</math>)-Crotonic acid <i>cis</i>-2-Butenoic acid)</b>	169	15	1 4456	1 0265	132	101 2	81	101 2			
14	<b><i>d,l</i>-2-Methylbutanoic acid (Ethylmethylacetic acid)</b>	176 7 174		1 4052	0 938 <sup>20</sup> <sub>20</sub>	92 5 3 0	110	55	112			
15	<b>Isovaleric acid (3-Methylbutanoic acid)</b>	176 5	-30 0	1 4043	0 92623	106 7	109 5 (cor )	68 0	135 137			
16	<b><i>n</i>-Amylpropionic acid (1-Heptyne-1-carboxylic acid)</b>	180 220d	f p 2 5			68, bz			91			Nitrile, b p 194 6 <i>o</i> -Toliduide, 60, pet eth
17	<b>3,3-Dimethylbutanoic acid (<i>tert</i>-Butylacetic acid)</b>	184, 96 <sup>26</sup>	6 7	1 4096	0 9124	134	132, et ac - pet eth		132	b p 126		
18	<b><i>d,l</i>-<math>\alpha</math>-Chloropropionic acid</b>	186				124	92		80			
19	<b>Cyclopropanecarboxylic acid</b>	186, 182 4	17, 18-9	1 43901	1 0885				125			b p 134, $n_{D}^{20}$ 1 41902, $D_4^{15}$ 0 96078
20	<b><i>n</i>-Pentanoic acid (<i>n</i>-Valeric acid)</b>	186 4	-34 5	1 4086	0 93922	74	63	75	106			
21	<b>2,2-Dimethylbutanoic acid (Dimethylethylacetic acid)</b>	187, 190	-15 0	1 4141, 1 4145	0 9276	83 0 5	92, 90-1		103			<i>p</i> -Phenylphenacyl ester, 86
22	<b>Allylactic acid (4-Pentenoic acid)</b>	188 9		1 4341 1 4283	0 9843 <sup>18</sup>				94, b p 230			
23	<b>Cyclopropylacetic acid</b>	190 <sup>750</sup>		1 4320 <sup>25</sup>								<i>p</i> -Phenylphenacyl ester, 83
24	<b><i>d,l</i>-2,3-Dimethylbutanoic acid (Isopropylmethylacetic acid)</b>	191 7	-1 5	1 4146	0 9275	112 6	78 4		132			<i>p</i> -Phenylphenacyl ester, 74
25	<b>Dichloroacetic acid</b>	194	5-6	1 4659	1 5634	153	118	99	98, subl			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	P-Toluene	Anilide	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
26	<b>Cyclobutanecarboxylic acid</b>	195	14403 <sup>25</sup>	1.0599					152 3	b p 136 0 - 5	b p 159 62	
27	<b>2-Ethylbutanoic acid</b> (Diethylacetic acid)	195	-31 8	1.4132	0.9239	116 2	127 5		112 107			
28	<b>d,l-2-Methylpentanoic acid</b> (Methyl-n-propylacetic acid)	195 6		1.4136	0.9230	81	95		79 6			
29	<b>d,l-3-Methylpentanoic acid</b>	197 5	-41 6	1.4159	0.9262	74 8	87, 88 112 0, 110 5 111 5	77 3	124 9			
30	<b>4-Methylpentanoic acid</b> (Iso caproic acid, Isobutylacetic acid)	199 1 <sup>52</sup>	-33	1.4144	0.9225	63 0			120 1			
31	<b>Methoxyacetic acid</b> (Glycolic acid methyl ether)	204, 203		1.41677	1.1768			58, pet eth	96 5 7 0, 92-4			
32	<b>2-Ethyl-2-methylbutanoic acid</b> (Diethylmethylacetic acid)	204		1.4256					78			
33	<b>Hexanoic acid</b> (n-Caproic acid)	205 35	-3 9, f p -1 5- -2	1.41635	0.93568	74 5	94 5	72 0	100, 101		b p 166-7	
34	<b>Ethoxyacetic acid</b> (Glycolic acid ethyl ether)	206 7		1.41937	1.1021	32, eth	95 92	104 8	80-2			
35	<b>5-Methylhexanoic acid</b>	207 <sup>52</sup>		1.4220				75	103			
36	<b>2-Ethylpentanoic acid</b> (Ethyl-n-propylacetic acid)	209				129	94		104 5			
37	<b>2-Methylhexanoic acid</b> (n-Butylmethylacetic acid)	209 6		1.4189 <sup>25</sup>		85	98		73 70- 25			
38	<b>α-Chloroisovaleric acid</b>	20-2								b p 178 9	Nitrile b p 154 5 Chloride, b p 149	
39	<b>α-Bromobutanoic acid</b>	217d				92	98		112, 108			
40	<b>4-Methylhexanoic acid</b>	217 8 <sup>54</sup>		1.4211	0.9194			76 5	98			
41	<b>2,2-Dimethylhexanoic acid</b>	218							89			
42	<b>4-Ethyl-4-methylbutanoic acid</b> (active-Amylacetic acid)	221			0.9149					b p 158 64	b p 173 9	[α] <sub>D</sub> <sup>b</sup> + 7 6 in me al
43	<b>2-Chloro-n-valeric acid</b> (2-Chloropentanoic acid)	222								b p 160	b p 185-6	Nitrile, b p 160
44	<b>n-Heptanoic acid</b> (n-Heptoic acid)	223 0	-7 46	1.4234	0.91808	81	70, 65	72 0	96, 96 5			
45	<b>2-Ethylhexanoic acid</b> (α-Ethylcaproic acid)	228							102			p-Phenylphenacyl ester, 53 4, 49 5 50
46	<b>Cyclohexylacetic acid</b>	237							172			
47	<b>n-Caprylic acid</b> (n-Octanoic acid)	237, 239 3	16 3	1.4268	0.90884	70	57	67 4	110, 106	b p 207 8 <sup>54</sup>		
48	<b>Pelargonic acid</b> (n-Nonanoic acid)	254 4	12 3	1.43446 <sup>54</sup> , yel	0.90552	84	57	68 5	99			
49	<b>d-Citronellic acid</b> (2,6-Dimethyl-1-octene-8-carboxylic acid)	257			0.9308				84 5		b p 113 5 <sup>12</sup> , [α] <sub>D</sub> <sup>b</sup> + 0 3	[α] <sub>D</sub> + 21, Nitrile, b p 230, D <sup>20</sup> 0 8645
50	<b>2-Phenylpropionic acid</b>	265							92			
51	<b>4-Acetylbutanoic acid</b> (γ-Acetobutyric acid)	275d , 195- 200 <sup>65</sup>	13-4				123, w		114, chl			Semicarba- zone 175d (+ 1 H <sub>2</sub> O), w , Oxime, 104 5 bz

\* Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing amide m.p.)\***

No	Name	Amide	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	P-Toluide	Anilide	p-Bromophenacyl ester	Methyl ester	Ethyl ester	Miscellaneous
1	3-Ethoxypropionic acid	51	120 <sup>17</sup>		1 4216							
2	3-Heptynoic acid	67	102 <sup>2</sup>		1 4635 <sup>25</sup>							
3	2-Heptynoic acid	68 9, al	135 <sup>20</sup>	14	1 4619	0 978				b p 91-3 <sup>19</sup> , n <sub>D</sub> <sup>20</sup> 1 4455, D <sub>4</sub> <sup>20</sup> 0 937		
4	<i>trans</i> -Oleic acid	75-6	216 <sup>6</sup> , 250 (super-heated steam)	α 13 36, β 16 25	1 4597		42 5	41	40, 46			
5	2-Fluoropropionic acid	76	60 <sup>8</sup>									
6	2-Azidoisovaleric acid (2-Triazoisovaleric acid)	78 9, bz	82 <sup>0 1</sup>			1 0638 <sup>33</sup>				b p 82 <sup>16</sup> , D <sub>20</sub> <sup>20</sup> 1 0295		
7	<i>d,l</i> -Lactic acid	78 5 9 0	122 <sup>15</sup> (cor), bz-al (3 1)	18			107	58 5-9 0, w	112 8	144 8	154	
8	<i>d,l</i> -2-Azidopropionic acid ( <i>d,l</i> -2-Triazopropionic acid)	80, bz	121 5 <sup>20</sup>							b p 70 <sup>16</sup> , n <sub>D</sub> <sup>25</sup> 1 428 57, D <sub>23</sub> <sup>23</sup> 1 065	Explodes on heating	
9	2-Ethyl-3-Hexenoic acid	80	132 <sup>19</sup>									
10	4-Phenoxybutanoic acid	80	197 <sup>18</sup>									
11	2-Methoxypropionic acid	81	89 <sup>10</sup>									
12	<i>l</i> -Citronellic acid (2,6-Dimethyl- <i>l</i> -octen-8-carboxylic acid)	84-5	117 9 <sup>0 6</sup>		1 4563 <sup>24</sup>	0 9274 <sup>25</sup>	93-4	76		b p 86 <sup>11</sup>	[α] <sub>D</sub> <sup>24</sup> -6 6	
13	2-Ethyl-4-methylpentanoic acid (Ethylisobutylacetic acid)	89	115 <sup>20</sup>									
14	2-Octynoic acid	90	133 <sup>10</sup>		1 4595			60				
15	6-Methyloctanoic acid	91	149 <sup>23</sup>		1 4337							
17	3-Methylhexanoic acid	98	112 <sup>16</sup>		1 4222							
18	2,3-Dimethylpentanoic acid	102	92 <sup>15</sup>									
19	2-Cyanopropionic acid	105, 81	142-5 <sup>11</sup>									
20	7-Methyloctanoic acid	106	105 <sup>2</sup>									
21	1-Chlorocyclohexane carboxylic acid	110, me	138-40 <sup>13</sup> al-w									
22	2-Cyanobutanoic acid	113	153-5 <sup>15</sup>									
23	Methylneopentylacetate	123	108 <sup>14</sup>									
24	2-Isopropylbutanoic acid (2-Ethyl-3-methylbutanoic acid)	135	105 <sup>15</sup>									
25	5-Cyclopentylpentanoic acid	136	123 <sup>4 5</sup>									
26	2-Methylcyclopentane-carboxylic acid	148	107 <sup>9</sup>		1 4504 <sup>22</sup>							
27	3,4,4-Trimethylpentanoic acid	167	98 <sup>4</sup>		1 4320 <sup>21</sup>							
28	cis-4-Methylcyclohexane-carboxylic acid	175	130 <sup>13</sup>									
29	Cyclopantanecarboxylic acid	179	123 <sup>27</sup>									

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
1	<i>β</i> -Bromobutyric acid ( <i>β</i> -Bromo- butanoic acid)	20	122 <sup>16</sup>					92.3		b p 183.4	
2	<i>trans</i> - <i>β</i> -Ethyl- <i>α</i> -methylacrylic acid	24	112 <sup>12</sup> <i>cis</i> 94 <sup>10</sup>			91, <i>cis</i> 46		80			<i>n</i> <sub>D</sub> <sup>20</sup> 1.4578 <i>cis</i> <i>n</i> <sub>D</sub> <sup>25</sup> 1.4485
3	<i>d,l</i> - <i>α</i> -Azidobutyric acid ( <i>d,l</i> - <i>α</i> - Triazobutyric acid)	24	81 <sup>9,2</sup>					38.9, bz - pet eth		b p 64 <sup>7</sup> , D <sub>20</sub> <sup>20</sup> 1.038	
4	Undecylenic acid (10-Undecen- 1-oic acid 10-Hendecen-1-oic acid)	24.5	275					87			Cu salt, 232-4, Pb salt, 80
5	2-Ethoxybenzoic acid (Salicylic acid ethyl ether)	24.5 5.5	300d					132			
6	<i>d,l</i> - <i>α</i> -Bromopropionic acid	25.7	203.5	125	99, 100			123	b p 145- 50	b p 159- 60d	
7	<i>n</i> -Undecylic acid ( <i>n</i> -Undecanoic acid, <i>n</i> -Hendecanoic acid)	28.5, <i>α</i> 13.4, <i>β</i> 16.3	280, 284	80	71	68.2		103			
8	<i>α</i> -Chloroisobutyric acid ( <i>α</i> - Chloroisobutanoic acid)	31	118 <sup>50</sup>		69.70, al				b p 133.5	b p 148.9	
9	<i>α</i> -Azidoisobutyric acid ( <i>α</i> - Azidoisobutanoic acid <i>α</i> - Triazoisobutyric acid)	31	75 <sup>9,2</sup>					93-4		b p 71 <sup>16</sup> , D <sub>20</sub> <sup>20</sup> 1.0344	D <sub>33</sub> <sup>33</sup> 1.1433
10	Cyclohexanecarboxylic acid (Hexahydrobenzoic acid)	31, 30.1	233		146 (cor.)			185.6			
11	<i>α</i> -Ketobutyric acid (2 Oxo- butanoic acid)	31	78 <sup>25</sup>					117			<i>n</i> <sub>D</sub> <sup>20</sup> 1.3975, <i>p</i> - Nitrophenyl- hydrazone, 194
12	Fluoroacetic acid	31-2	167-9					108			
13	Caproic acid ( <i>n</i> -Decanoic acid)	31.5	268.70	78	70	67, al., 66		108, 100.1, 98, 99	b p 224	b p 243-5	<i>n</i> <sub>D</sub> <sup>20</sup> 1.42855
14	Bromoacetoacetic acid	31.5	215 sl d					126, 117		b p 174d	Phenyl ester, 46.5, b p 266
15	2-Hexenoic acid	32	-		110			58			
16	<i>n</i> -Butylmethylglycolic acid	33						84			D 0.860 <sup>55</sup>
17	<i>cis</i> -13-Docosenoic acid (Erucic acid)	33-4	264 <sup>15</sup>	75-8	55	62.5, 61.0					
18	Levulinic acid ( $\gamma$ -Ketovaleric acid, $\beta$ -Acetylpropionic acid)	33-5 deliq	245-6	108.9, w	102, w	61	84	107-8d			Oxime, 96
19	Pivalic acid (Trimethylacetic acid)	35.5	163-4	119-20	132-3, 128 (cor.)	75.6	155.7, 153-4, et ac-pet eth				
20	<i>d,l</i> - <i>α</i> -Methylhydrocinnamic acid ( <i>α</i> -Benzylpropionic acid)	36.5	272	130, d 115-6			107.8, d 113-4				
21	1-Cyclohexenylcarboxylic acid	38	107 <sup>3</sup>					128			
22	<i>n</i> -Hexylmethylglycolic acid	40						59			
23	5-Acetyl- <i>n</i> -valeric acid ( $\delta$ - Acetylpentanoic acid)	40.2, 31.2	250.3 <sup>280</sup>								Semicarbazone, 144-6, ac a
24	<i>d,l</i> - <i>α</i> -Campholytic acid (1,5,5-Trimethylcyclopenten- 4-carboxylic acid)	40.5	162-5 <sup>45</sup> , 1.240- 3					103, w	b p 200		Nitrile, b p 200-5
25	$\beta$ -Chloropropionic acid	41, w, 39, lgr	204						b p 155- 7, D <sup>0</sup> 1.198	b p 162, D <sub>20</sub> <sup>20</sup> 1.1086, <i>n</i> <sub>D</sub> <sup>20</sup> 1.42537	Nitrile, b p 175- 6, D <sup>18.5</sup> 1.1443
26	<i>d,l</i> - <i>α</i> -Ethylphenylacetic acid ( <i>d,l</i> - <i>α</i> -Phenylbutanoic acid)	42	270					85-7, 83			

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No.	Name	Melting point, °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
27	$\alpha$ -Ethylpimelic acid	43	223 <sup>17</sup>		145						
28	Tridecyclic acid ( <i>n</i> -Tridecanoic acid)	43, 41 6	312, 177 <sup>10</sup>	88	80		75 0	100			
29	Lauric acid ( <i>n</i> -Dodecanoic acid)	44, 42	299	87	78		76	100, 99 133, bz 93-4, 89 90			
30	d,l- $\alpha$ -Bromoisovaleric acid	44	230d	124	116						
31	Elaidic acid ( <i>trans</i> -Oleic acid)	44 5, 51	234 <sup>18</sup>				65		b p 174	b p 186	<i>p</i> -Phenylphenacyl ester, 73 5, <i>p</i> -Chlorophenacyl ester, 56
32	4-Cyanobutanoic acid ( $\gamma$ -Cyanobutyric acid)	45						69 70, sealed tube		b p 245	
33	Dimethylneopentylacetic acid	45	230 <sup>732</sup>				71				
34	<i>trans</i> -2-Methyl-2-butenoic acid (Angelic acid)	45 6	185 (cor.)		126, bz			127-8			Isobutyl ester, b p 177 2-Naphthylamide, 135, bz, Heating 2 hours in sealed tube → tiglic acid, 64-5
35	Dibromoacetic acid	48	232-5					156			
36	$\alpha$ -Bromoisobutyric acid ( $\alpha$ -Bromoisobutyric acid)	48 9	198 200	92 5, al	83, al - w			148			<i>o</i> -Toluidide, 63
37	<i>tert</i> -Butylpropionic acid	48-9	110 <sup>10</sup>						b p 66 <sup>13</sup> , D <sup>0</sup> 0 9209	b p 75 <sup>15</sup> , D <sup>0</sup> 0 9209	
38	Hydrocinnamic acid ( $\beta$ -Phenylpropionic acid)	48 7, 40	279-80 (cor.)	135	98, 96	36 3	104	105, 82			<i>p</i> -Phenylphenacyl ester, 95 ..
39	$\beta$ -Cyanopropionic acid	48-50						97, sealed tube	b p 215, n <sub>D</sub> <sup>20</sup> 1 42427, D <sup>20</sup> 1 0353	b p 220 <sup>734</sup> D <sup>20</sup> 1 0353	
40	Benzylpyruvic acid	49 50 (+ $\frac{1}{2}$ $H_2O$ ), w						180			Semicarbazone, 175d, Oxime, 65, Phenylhydrazone, 144-5
41	Bromoacetic acid	50	208		131	88		91	b p 144d	b p 168-9	
42	2-Pentyoic acid (Ethylpropionic acid)	50	100 <sup>10</sup>					146			
43	$\gamma$ -Phenylbutyric acid	52	290					84			
44	<i>n</i> -Pentadecylic acid ( <i>n</i> -Pentadecanoic acid)	52 3	212 <sup>16</sup>		78	39 5-40 (cor.)	77 2	102 5			
45	$\beta$ -Campholenic acid	53 5	245					86		222 5	Nitrile, 225, D <sup>20</sup> 0 9093
46	Myristic acid (Tetradecanoic acid)	53 9	202 <sup>16</sup>	93	84		81	103			
47	Trichloroacetic acid	57 8	197 5	113	97, 94	80		141	b p 153 8	b p 168	Phenylhydrazide, 123
48	$\alpha$ -Acetoxypropionic acid (O-Acetylactic acid)	57 60, 39-40	167-70 <sup>78</sup>								Nitrile, b p 172-3
49	$\beta$ -Acetylglutaric acid	58							mono 141-2, al -eth	89	
50	<i>sec</i> - <i>n</i> -Amylmalonic acid (2-Ethylbutane-1,1-dicarboxylic acid, <i>sec</i> - <i>n</i> -Pentylmalonic acid)	58, bz			di 219-20					di b p 243 5	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
51	<i>trans</i> -Brassidic acid	59.7	256 <sup>10</sup>		78		94.2	94			
52	5-Phenylpentanoic acid	60			90			109			
53	β-Cyclohexylacrylic acid	60	154 <sup>11</sup>					159			
54	β-Chloroisocrotonic acid	61	195 (subl.)		108			110	b p 142	b p 161	
55	Margaric acid ( <i>n</i> -Heptadecanoic acid)	61.2	231 <sup>16</sup>			48.5 9.0 (cor.)	82.6	108, 106			
56	Chloroacetic acid	α 61.3, β 56.2 γ 52.5	189	162	136.7		104	121	b p 130	b p 145.6	
57	β-Bromopropionic acid	62.5						111	b p 80 <sup>27</sup> , D <sup>17</sup> I 4897	b p 70 <sup>12</sup> , D <sup>15</sup> I 2609	2-Naphthylamide, 174
58	Palmitic acid (Hexadecanoic acid)	62.7	222 <sup>16</sup>	98	90.6, al	42.5	86, 82	106.7, 105.3, al			
59	cis-2-Methyl-2-butenoic acid (Tiglic acid)	64.5 50	198.5 (cor.)	70.0 1.5	77, pet eth	64	68	75.6, bz			
60	Cyanoacetic acid	66			198-9			119-20	b p 200	b p 207	Nitrile, 29-30, b p 218.9
61	Benzoylformic acid	66						91			Nitrile, 32-3, b p 206-8, 2,4-Dinitrophenylhydrazone, 196-7d (cor.), Phenylhydrazone, 64
62	Acetoxyacetic acid	66-8, bz	145 <sup>12</sup>		89-90, w					b p 179, D <sup>17</sup> I 0993	
63	2,3-Dibromopropionic acid	67, stab., 51, unst	160 <sup>20</sup>					130			
64	3,3-Dimethylacrylic acid	67	106 <sup>20</sup>					108			
65	2-Furylacetic acid	67			85			138			
66	3,3,4,4-Tetramethylpentanoic acid	67									
67	4-Ketocyclohexanecarboxylic acid (4-Oxocyclohexane-carboxylic acid)	67-8, bz - pet eth							b p 140 <sup>20</sup>	b p 158 <sup>40</sup>	Semicarbazone, 200d, Oxime, 147, eth
68	d,l-2-Phenyllactic acid	68 (+½ H <sub>2</sub> O), w 94 (anh.), d 116-7, w, l 115.6, bz						101.2, di-chloroethylene, I 62.5 3.5, bz	22		d,l-Et eth, 60-2, Igr, d-Quinine salt, 216d, al, l-1-Menthylester, 55.5-6.0
69	d-Chaulmoogric acid (d-ω-Cyclopentyltridecanoic acid)	68.5	247-8 <sup>20</sup>	100	89			106, al	22	b p 230 <sup>20</sup> , D <sup>15</sup> I 09064	[α] <sub>D</sub> +62 in chl
70	Stearic acid (Octadecanoic acid)	70-1, 69.6		102	95.5, al		92	109, 108.4, al			.
71	trans-Crotonic acid ( <i>trans</i> -2-Butenoic acid)	72, w	189 (cor.)	132, bz	118, w, 115	67.4	95.6	159-60, bz	b p 121	b p 138, D <sup>20</sup> I 9175, n <sub>D</sub> <sup>20</sup> I 42524	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
72	<b>γ-Bromocrotonic acid</b>	74, lgr						101	b p 87 <sup>15</sup> , D <sub>4</sub> <sup>19</sup> 1 490 n <sub>D</sub> <sup>20</sup> 1 498	b p 97-8 <sup>15</sup> , D <sub>4</sub> <sup>16</sup> 1 402, n <sub>D</sub> <sup>20</sup> 1 490	
73	<b>Caproylacetic acid</b>	74d						100	b p 118 <sup>19</sup> , D <sub>4</sub> <sup>0</sup> 0 9916	b p 127 <sup>19</sup> , D <sup>0</sup> 0 9721	Nitrile, b p 127-8 <sup>14</sup> , D <sup>15</sup> 0 9914
74	<b>3-Ketocyclohexanecarboxylic acid (3-Oxocyclohexane-carboxylic acid)</b>	75 6, bz	195-7 <sup>20</sup>								Semicarbazone, 183-4, al, Oxime, 170d, w, Phenylhydrazone, 125, yel
75	<b>2-Thienylacetic acid</b>	76						148			
76	<b>sec-Butylmalonic acid (Isopentane-1,1-dicarboxylic acid)</b>	76						di 242	di b p 217 8 <sup>748</sup>	di b p 245-50 <sup>762</sup>	
77	<b>Phenylacetic acid</b>	76 5, subl	256 5 (cor.)	135-6	117-8	65	89	156			
78	<b>Eicosanoic acid (Arachidic acid)</b>	77, 75	204 <sup>1</sup>	96	92		89	108 9			
79	<b>Glycolic acid (Hydroxyacetic acid)</b>	78 9, 80		143, w	97, w	106 8	138	120, al - et ac			On prolonged heating at 100° → anh., 128 30
80	<b>α-Hydroxyisobutyric acid (2-Hydroxyisobutanoic acid Dimethylglycolic acid)</b>	79	212	132-3, w	136, w	80 5	98, acet				
81	<b>α-Methylcinnamic acid</b>	81, 74						128			
82	<b>2-Ketocyclohexanecarboxylic acid (2-Oxocyclohexane-carboxylic acid)</b>	81-2, eth							b p 107-8 <sup>12</sup> , 159-60 <sup>100</sup>	Alcoholic sol + FeCl <sub>3</sub> → blue color	
83	<b>n-Docosanoic acid (Behenic acid)</b>	81-2			101 2			111	54	50	
84	<b>β-Iodo propionic acid</b>	82, 85						101 142			
85	<b>α-Benzoylpropionic acid</b>	82-3, bz - pet eth			137-8, al			145-6			Phenylhydrazone, 100 4, br, bz
86	<b>Iodoacetic acid</b>	83						95			
87	<b>γ-Chlorocrotonic acid</b>	83	117 8 <sup>13</sup>					130-2, w	b p 191-3 <sup>750</sup>	Nitrile, b p 73 <sup>15</sup> , D <sup>0</sup> 1 1495	
88	<b>Lignoceric acid (Tetracosanoic acid)</b>	84					91				p-Chlorophenacyl ester, 100
89	<b>β-Methyladipic acid</b>	85, 91	223 <sup>18</sup>		200						
90	<b>α-Benzoylbutyric acid (α-Benzoylbutanoic acid)</b>	85-7						148-9	b p 168-71 <sup>19</sup>	Nitrile, b p 134-5 <sup>3</sup>	
91	<b>d,l-α-Bromophenylacetic acid</b>	86, 84						148, 144			Nitrile, 29, b p 242d
92	<b>(4-Methoxyphenyl)acetic acid</b>	87, 84						189			
93	<b>Dineopentylacetic acid</b>	88						140			
94	<b>Dibenzylacetic acid</b>	89		175, abs al	155, abs al			128-9, bz			
95	<b>(2-Tolyl)acetic acid</b>	90, 88						161			
96	<b>α-Thienylglyoxylic acid</b>	91						88			
97	<b>Δ<sup>5</sup>-Campholytic acid (4,5,5-Trimethylcyclopentene-1-carboxylic acid)</b>	91						90, lgr			
98	<b>Citraconic acid (Methylmaleic acid)</b>	92d , 92-3, 91d , eth -lgr		mono 170-1, yel , eth	mono 153, di 175 5, al	di 70 6		di 185-7d	di b p 210-1	di b p 231	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
99	2-Bromobenzoylformic acid	93-101						136-7, w			Nitrile, 62-4, yel , Oxime, 162-4d
100	β-Chlorocrotonic acid	94	206-11 sl d		123-4			100 1	b p 64 7 <sup>14</sup> , D <sub>4</sub> <sup>22</sup> 1 555, n <sub>D</sub> <sup>20</sup> 1 463	b p 180, 184, D <sub>4</sub> <sup>20</sup> 1 1062, n <sub>D</sub> <sup>20</sup> 1 459	1-Naphthyl- amide, 169-70
101	Phenyl-n-propylglycolic acid	94						132			
102	(2-Chlorophenyl)acetic acid	95, w		170	138 5			175, w			Nitrile, 25, b p 251, o-Tolu- dide, 174
103	(4-Tolyl)acetic acid	95, 91						185			
104	o-Chlorohydrocinnamic acid	96 5, w	159 <sup>15</sup>					119, bz	b p 255		Nitrile, b p 267-8
105	2-Hydroxy-3-phenylpropionic acid	97, 96						112			
106	1,2,3,4-Tetrahydro-2-naphthoic acid	97						139			
107	Glutaric acid (1,3-Propane-dicarboxylic acid)	98	302 4	di 218	di 223 4	di 69	di 136 8	di 175-6			
108	3-Phenoxypropionic acid	98						119			
109	α-Crotonic acid	99	212					112			
110	Phenoxyacetic acid	98-9, 99 100	285d		99, al		148 5	101 5			
111	2-Benzofurylacetic acid	99						164			
112	1-Naphthylglycolic acid	99 124-5						135			
113	Citric acid	100 (+1 H <sub>2</sub> O), 153 (anh )		tri 189, al	tri 192	tri 102	tri 148	tri 210-5d, w			
114	2-Methoxybenzoic acid (o-Anisic acid Salicylic acid methyl ether)	100 1	200				113	129			
115	I-Malic acid (Hydroxysuccinic acid)	100-1		di 206-7	di 197	mono 87 2, di 124 5	di 179	di 156-7, d,l 162 3			
116	Oxalic acid	101 (+2 H <sub>2</sub> O) (rapid htng ), 189 5 (anh ) subl at 150-60		mono 169, di 268	mono 148 9, di 254, 246, bz	di 204	mono 219, di 419d				
117	Acetylpyruvic acid (2,4-Diketo-n-valeric acid, 2,4-Dioxopentanoic acid)	101, bz						131-2d , al	63-4		
118	n-Butylmalonic acid (Pentane-1,1-dicarboxylic acid)	101			di 193			di 200		di b p 235-40	Mononitrile, 122 5-6 5, w , subl
119	α-Cyanohydrocinnamic acid (Benzylcyanoacetic acid)	101-2						130		b p 176-85 <sup>21</sup>	
120	2-Chloro-6-methylbenzoic acid	102, w						167			Nitrile, 82-3, pet eth
121	Aleuritic acid (9,10,16-Trihydroxypalmitic acid)	102, w							63-4		Hydrazide, 139-40, Azide, 50d , al

\* Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
122	(2-Bromophenyl)acetic acid	103 4, 109						186 7			Nitrile, b p 145 7 <sup>14</sup>
123	Benzylacetic acid	103 4d			107 8			113			Nitrile, 80 1, 1-Menthyl ester, 41
124	Pimelic acid	104-5, subl	223 <sup>15</sup>	di 206, al	mono 108 9 di 155 6, me al -w		di 136 6	di 175			
125	2-Toluic acid (2-Methylbenzoic acid)	104 5, 107 8	259 <sup>751</sup>	144	125	90 7	57	142 8 (cor.)			
126	Allylmalonic acid	105, eth				46, al			di b p 222-3	Mononitrile, b p 223, Dinitrile, b p 217 8	
127	(4-Chlorophenyl)acetic acid	105-6, 104		190	164 5, al			175, al	32, b p 260	o-Toluidide, 190, bz Nitrile, 30, b p 265-7	
128	Δ <sup>2</sup> -Cyclogeranic acid (1,5,5-Tri-methylcyclohexene-6-carboxylic acid)	106, lgr	138 <sup>11</sup>					120 1, bz -pet eth	b p 101 2 <sup>10</sup>		
129	d-Campholic acid (d-1,2,2,3-Tetramethylcyclopentane-1-carboxylic acid)	106, d l 109	255		91			80, d l 90	b p 208	b p 220	Nitrile, 73, Anhydride, 56, d l 66
130	Atropic acid (1-Phenylacrylic acid)	106-7, w			134			121 2, w		b p 124 <sup>16</sup> , n <sub>D</sub> <sup>20</sup> 1 52605	
131	l-Campholic acid	106-7	250	di 201	mono 107-8, dil al , di 186 7	di 43 8	di 130 6	78-9 mono 93-5, di 175	b p 211	b p 228	Anhydride, 57 8
132	Azelaic acid (Heptane-1,7-dicarboxylic acid)	106 5	>360 sl d , 237 <sup>15</sup>	2							
133	Methylnonopentylglycolic acid	109						116			
134	trans-4-Methylcyclohexane-carboxylic acid	111						226			
135	cis-α-Chloroallocinnamic acid	111			138 9, al-w			134, bz	b p 157 8 <sup>10</sup> , D <sub>4</sub> <sup>25</sup> 1 1569 n <sub>D</sub> <sup>25</sup> 1 5525		
136	Ethylmalonic acid	111						di 214			
137	3-Toluic acid (3-Methylbenzoic acid)	111 3, 110-1	263, subl	118	126	86 6	108	94, 97			
138	O-Benzoyllactic acid (Lactic acid benzoate)	112						124		b p 288	Nitrile, b p 269-70, 1-Naphthylamide, 155, 2-Naphthylamide, 177
139	2,4,6-Triethylbenzoic acid	113						156			
140	2-Phenylbenzoic acid	113						177			
141	(1-Naphthyl)glyoxalic acid	113						151			
142	Bromomalonic acid	113d		di 217, ac a				di 181, al	di b p 215-25	di b p 233-5d	Dinitrile, 65-6
143	(4-Bromophenyl)acetic acid	114, subl						192 4			Nitrile, 46 7
144	2-Acetylbenzoic acid (Acetophenone- <i>o</i> -carboxylic acid)	114-5						116 5, w	30		Oxime, 159, 2,4-Dinitrophenylhydrazone, 186

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
145	<b>Pyrotartaric acid (Methylsuccinic acid)</b>	115		164	<i>mono</i> 159, et ac 123, chl <i>di</i> 200			<i>di</i> 225			
146	<b>2-Phenoxypropionic acid</b>	115-6, 112-3		115	117 118 9 150, 145			132 3, 130			
147	<b>3-Benzoylpropionic acid</b>	116						145-6, w		18 9	Semicarbazone, 181d Dinitrile, 91, 79
148	<b>Benzylmalonic acid</b>	117d , 121			<i>di</i> 217	<i>di</i> 119 5		<i>di</i> 225			
149	<i>d l</i> - <b>Tropic acid (3 Hydroxy-2 phenylpropionic acid)</b>	117 8 <i>d</i> 130						169			
150	<b>Cuminic acid (4 Isopropyl benzoic acid)</b>	117-8, al						133		<i>b p</i> 263 4	Nitrile, <i>b p</i> 243-4 <sup>734</sup>
151	<i>d l</i> - <b>Mandelic acid (α-Hydroxy-phenylacetic acid)</b>	118, <i>d</i> 133 <i>l</i> 134		172, al	151 2, al	123 4		133 4 (cor)			
152	<i>l</i> - <b>Arabonic acid</b>	118 9, al		200	204			136, me al			<i>o</i> -Toluidide, 172
153	<b>α-Chlorodiphenylacetic acid</b>	118-9d , bz -lgr			88			115		43 4	Anhydride, 219
154	<i>d l</i> - <b>Citramalic acid (<i>d l</i>-2-Hydroxy-2-methylsuccinic acid)</b>	119					<i>mono</i> 140 1	<i>di b p</i> 112 <sup>15</sup>			Me eth , 90 2 Et eth , 81 3
155	<b>Anilinomalonic acid</b>	119d, al -lgr			<i>mono</i> 157d , w <i>di</i> 162, 246 7, ac a			<i>di</i> 156	<i>di</i> 68	<i>di</i> 45, al	
156	<b>4-Chloromandelic acid</b>	119 22, 112 3						122 3			Nitrile, 43 Me eth 85-8, bz pet eth
157	<b>(3-Nitrophenyl)acetic acid</b>	120						110			
158	<b>cis-2-Bromoallocinnamic acid</b>	120						129	<i>b p</i> 111 <sup>6</sup> , D <sup>20</sup> 1 4726	<i>b p</i> 173 4 <sup>30</sup> , D <sup>25</sup> 1 3713	
159	<b>3-Furoic acid (3 Furancarboxylic acid)</b>	121						169			
160	<b>1-Cyclopentenylcarboxylic acid</b>	121		122	126						
161	<b>Cetylmalonic acid (Heptadecane-1,1-dicarboxylic acid)</b>	121 5 20, ac a					<i>mono</i> 130 50d , lgr -al	<i>di</i> 44, eth	<i>di</i> 22		
162	<b>cis-1,3-Cyclopentanedicarboxylic acid</b>	122 <i>trans</i> 161					226				
163	<i>d l</i> - <b>trans-Camphenic acid</b> ( <i>d l</i> - <i>trans</i> -Camphene-camphoric acid)	122 3, ac a			<i>di</i> 165, ac a		<i>di</i> 231 2, ac a				
164	<b>Benzoic acid</b>	122.4, at 100, subl	249	158	160, boil 50% al	89	119 0	130	<i>b p</i> 199 6	<i>b p</i> 212 6	
165	<b>3,3,3-Trichlorolactic acid</b>	124			164			96			
166	<b>3-Nitrosalicylic acid</b>	125 (hyd )						145			
167	<b>Diethylmalonic acid</b>	125				<i>di</i> 91		<i>mono</i> 146, <i>di</i> 224			
168	<b>1,14-Tetradecanedicarboxylic acid</b>	126			163						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
169	2,4-Dimethylbenzoic acid	127 (anh) 90 (hyd)			141			179-81			
170	cis-2-Chloroallicinamic acid	127						112			
171	2-Benzoylbenzoic acid (Benzophenone-2-carboxylic acid)	128, 91 (+1 H <sub>2</sub> O), w			195	100 4		165 (cor)	52		
172	1,10-Decanedicarboxylic acid	128						185			
173	2-Thenoic acid (2-Thiophene-carboxylic acid)	129						180			
174	4-Bromopyromucic acid (4-Bromofuran-2-carboxylic acid)	129						155-6		29 b p 235 6	
175	Maleic acid (cis-Butenedioic acid)	130 (+30% Fumaric acid), 137 (pure)		dt 142, eth	mono 198, 187, yel, al, dt 187, al	dt 91 (cor)	168 70, 190	mono 172 3, w 153 sl d, dt 260, 181, me al			Heated at 160 → anh, 60, b p 202
176	Tribromoacetic acid	131, 135	245d					122			
177	(1-Naphthyl)acetic acid (1-Naphthaleneacetic acid)	131, 135			155, al, 159 6			180 1, al			
178	trans-α-Bromocinnamic acid	131-2						119	23	b p 294-6	
179	2,5-Dimethylbenzoic acid	132			140			186			
180	cis-β-Chloroallicinamic acid	132		142	134 5			76	34	b p 265 sl d	
181	trans-Cinnamic acid	133	300	168	153, 109	116 8	145 6	147 8			Nitrile, 20-1, b p 255 6
182	Chloromalonic acid	133			dt 118, w		dt 170	dt b p 206-8 <sup>72</sup>	dt b p 222		Di-p-bromo-anilide 239
183	Sebacic acid (Decanedioic acid, Octane-1,8-dicarboxylic acid)	33, subl	243 <sup>15</sup>	dt 201	mono 122 3, dt 73 5, 72 6	dt 147	mono 170, dt 210, 208				Phenylhydrazide, 194
184	2-Furoic acid (2-Furancarboxylic acid, Pyromucic acid)	133-4, 132	230-2	170 5, al	123 5, al	133 5	138 5	142 3		34, b p 195	
185	Malonic acid (Propanedioic acid)	134 8-9		mono 156d, dt 252-3, al	mono 132, dt 230, 227-8, al	dt 85 5		mono 106 10, dt 170, w -al	dt b p 199		Phenylhydrazide, 194
186	O-Acetylsalicylic acid (Aspirin)	135, rapid htng	140d		136	90 5		138			Phenacyl ester, 105
187	β-Campholytic acid (1,5,5-Tri-methylcyclopentene-2-carboxylic acid)	135	247-9, 255-6	114	104, al - w			130	b p 203 4	b p 214	
188	2-Anilinoisovaleric acid	135, w						102 3		b p 275-80	
189	Acetone-1,3-dicarboxylic acid	135d, et ac			dt 155, al						Oxime, 53 4 w Acids or alkalies → acetone b p 56 + CO <sub>2</sub>
190	d l-cis-Camphenic acid (d l cis-Camphenecamphoric acid)	135-7			dt 212			dt 225			
191	Phenylpropionic acid	136-7, subl		142	128, 126, 125	83		99-100, 109			Melts under w at 80

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
192	<i>trans</i> -Glutaconic acid	136-8			<i>mono</i> 167, <i>di</i> 228						Acetic anhydride → anh 88
193	3-Ethoxybenzoic acid	137						139 0-5			
194	Methylmalonic acid	137, 138d		<i>mono</i> 145d , <i>di</i> 228, 214				217, 206			
195	<i>trans</i> - $\alpha$ -Chlorocinnamic acid	137-8		116, al	118, al			121 2	33	b p 209 <sup>75</sup> , D <sub>4</sub> <sup>25</sup> 11719, n <sub>D</sub> <sup>25</sup> 15705	
196	3-Thenoic acid (3-Thiophene-carboxylic acid)	138				130		180			
197	<i>cis</i> -Cyclobutane-1,2-dicarboxylic acid	138					<i>di</i> 228, w	<i>di</i> b p 225	<i>di</i> b p 238-42 <sup>720</sup>	Anhydride, 75 71-3	
198	2-Pyridinecarboxylic acid (Picolinic acid)	138						107			
199	(3-Chloromethyl)benzoic acid	138, w						124		b p 168 9 <sup>25</sup>	Nitrile 67 al b p 258 60
200	5-Chloro-2-nitrobenzoic acid	139, w			164, eth			154, eth	48 S, me al		Methylamide, 134, al-w , Di- methylamide, 104 5
201	Anhydrocamphoronic acid	139			202 3				$\alpha$ 138, $\beta$ 45		
202	Butane-1,1,4-tricarboxylic acid	139 40, bz - et ac		<i>mono</i> 177						<i>tri</i> b p 175 6 <sup>18</sup> , D <sup>15</sup> 10726	
203	<i>meso</i> -Tartaric acid	140			<i>mono</i> 193-4, pa yel , w	93		<i>di</i> 187, 189 90, dil me al			Diphenylhydra- zide 245
204	3-Nitrobenzoic acid	140			162	154	141	132	143 137, subl	78 5, 70 47, 40-1	
205	3-Bromo-4-toluic acid (2-Bromo-4-methylbenzoic acid)	140									Nitrile, 47
206	2-Chloro-4-nitrobenzoic acid	140-2				168			172, al	73-5	
207	(2-Nitrophenyl)acetic acid	141, 138							161		
208	Furanacrylic acid ( $\beta$ -(2-Furyl)-acrylic acid)	141	286						168 9		
209	2-Anilinobutyric acid	141			92, al				123, w		Nitrile, 39
210	(2-Naphthyl)acetic acid (2-Naphthaleneacetic acid)	141-2, 143							200, 205		
211	4-Chloro-2-nitrobenzoic acid	142, w							172, al		
212	<i>trans</i> - $\beta$ -Chlorocinnamic acid	142		122-5	128				118	41 3 29	
213	2-Chlorobenzoic acid	142, 140		131	114, 118, pet eth	106	106		142, 202	b p 234	b p 293 b p 243
214	(2-Bromophenoxy)acetic acid	142 5, al							151, al		b p 160 70 <sup>16</sup>

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
215	<b>Suberic acid</b> (Octanedioic acid, Hexane-1,6-dicarboxylic acid)	144, 139 41		di 218, 219	mono 128 9, di 186-7 154 5	di 85	di 144 2	mono 125 7, di 216-7		di b p 282 6	
216	<b>Asaronic acid</b> (2,4,5-Tri-methoxybenzoic acid)	144, bz - pet eth	ca 300					184 5	97 5, yel	72, yel	Nitrile, 112-4, al
217	<b>(2-Chlorophenoxy)acetic acid</b>	145 6, w			121			149 5	b p 186 8	32	
218	<b>2-Nitrobenzoic acid</b>	146			155	112	107	176	b p 275, 269, D <sub>4</sub> <sup>20</sup> 1 286	30, b p 148 50 <sup>10</sup>	
219	<b>Phthalonic acid</b>	146			mono 176 di 208			α 179d β 155d			Phenylhydrazone, 171 2
220	<b>(2-Hydroxyphenyl)acetic acid</b>	147 149, 141						118			
221	<b>2-Anilinovaleric acid</b> (2-Anilinopentanoic acid)	147-8, al -w						99, eth - pet eth			Nitrile, 51, pet eth
222	<b>Diphenylacetic acid</b>	148		172 3	180			167 5 8 0			
223	<b>Diglycolic acid</b>	148, 142		mono 148, w	mono 118, di 152, eth al (2 1)			mono 135			
224	<b>Oxanilic acid</b>	148 9			di 154			228			
225	<b>(4-Hydroxyphenyl)acetic acid</b>	148 50, 148, w						175			Benzoate of amide, 167 9
226	<b>2-Bromobenzoic acid</b>	150		141	110	102	155	b p 243 4	b p 254-5		
227	<b>Benzilic acid</b> (α-Hydroxy-diphenylacetic acid)	150	189-90	174 5	99 5	152	153, chl , 154 5	74-5	34		Acetate, 98, ac a
228	<b>Citric acid</b> (2-Hydroxypropane-1,2,3-tricarboxylic acid)	153 (slow htng )		tri 189 al	tri 192, al -w	tri 102	tri 148	tri 210 5d			Triphenyl ester, 124
229	<b>(4-Nitrophenyl)acetic acid</b>	153			198		207	198			
230	<b>2,5-Dichlorobenzoic acid</b>	153						155			
231	<b>Phenylmalonic acid</b>	153						233			
232	<b>Adipic acid</b> (Butane 1,4-dicarboxylic acid)	153 4 (cor )	216 <sup>15</sup>	241	mono 151 3 w di 240 1 al	106	154 5, 152 6	mono 125 30, w , di 220	3, b p 162 <sup>10</sup>	di 8, b p 112 <sup>10</sup> , f p 0	Diphenyl ester, 105-6, al -w
233	<b>(4-Bromophenoxy)acetic acid</b>	153-4 al								54, al	Phenyl ester, 73, al Oxime, 159
234	<b>Phenylpyruvic acid</b>	154									
235	<b>3-Bromobenzoic acid</b>	155			136	105	120	155	31 2	b p 254-5	
236	<b>2,4,6-Trimethylbenzoic acid</b>	155, 153						188			
237	<b>2-Chloro-4-methylbenzoic acid</b>	155-6						182			Nitrile, 61-2, subl
238	<b>(4-Chlorophenoxy)acetic acid</b>	155 6, w . 158			125		136	133	b p 177 80	49	
239	<b>3-(1-Naphthyl)propionic acid</b>	156						104			
240	<b>Tartronic acid</b> (Hydroxy-malonic acid)	156 8d						di 198, dil al , 195-6d			
241	<b>Benzylopyruvic acid</b>	156 8d (+ 1 H <sub>2</sub> O), al -w						138d	59, 62	46	1-Oxime, 98- 100d (+ 1 H <sub>2</sub> O)

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	<i>p</i> -Toluide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous	
242	Cyclobutane-1,1-dicarboxylic acid	157, w 158			<i>dt</i> 214 5			<i>dt</i> 275 7		b p 218 12 <i>dt</i> b p 222 6 b p 245	Dihydrazide 109 10 al -w	
243	3-Chlorobenzoic acid	158 155			122 5 al	107	116	134	21 b p 231	b p 245		
244	Salicylic acid (2 Hydroxybenzoic acid)	158 3, subl at 76	156	136	97 8	140	142 139	-8 6 b p 223 3	13 b p 234 231 5			
245	1-Naphthoic acid	161 2 (cor )			162 3 164		135 5	202 205				
246	2-Iodobenzoic acid	162			141	111	143	110	184			
247	2-Anilinopropionic acid	162, w			127, al			144		b p 272	Nitrile, 92, al N-Acetyl, 143, w	
248	4-Dibenzothienylacetic acid	162						206				
249	Alloxanic acid	162 3d , eth						191, w	171, et ac	115, acet - chl 91, al	Phenylamide 99, eth	
250	5-Chloro-3-nitrosalicylic acid (5-Chloro-2-hydroxy-3-nitrobenzoic acid)	163						199				
251	2-Benzofurylacetic acid	163						210				
252	Cholanic acid	164, ac a						175		93-4, 80% al	[α] <sub>D</sub> <sup>25</sup> +21 74 in chl , Propyl ester 56-7, Butyl ester, 53	
253	4-Nitrophthalic acid	165		mono 172	192			200d				
254	Itaconic acid (Methylene-succinic acid)	165			mono 151 5, eth	<i>dt</i> 90 6	<i>dt</i> 117 4	<i>dt</i> 191 2 8, al				
255	5-Bromosalicylic acid (5-Bromo-2-hydroxybenzoic acid)	165			222			232	61, b p 264 6	50		
256	6-Chloro-3-nitrobenzoic acid	165, w						178, w	73, me al	28 9		
257	3,4-Dimethylbenzoic acid	166, 164				104, 108		130				
258	Tricarballylic acid (Propane-1,2,3-tricarboxylic acid)	166				<i>tri</i> 252, PhNO <sub>2</sub>	<i>tri</i> 138 2	<i>tri</i> 205 7d				
259	Mesitylenic acid (3,5-Dimethylbenzoic acid)	166						133				
260	<i>d,l</i> -Phenylsuccinic acid	167-8, 84 (anh ), <i>dl</i> 173 4		mono (α) 175, mono (β) 168-9	mono (α) 175, mono (β) 171, <i>dt</i> 222			<i>mono</i> (α) 158 9 <i>mono</i> (β) 145, <i>dt</i> 211				
261	Mesitylacetic acid	168						210				
262	3-Chloro-4-hydroxybenzoic acid	169 70, w, 164-5						180 2	106 7	77 8	Nitrile, 155	
263	<i>d</i> -Tartaric acid	169 71				mono 180d , 194 (cor ), ac a , <i>dt</i> 263 4d , al	<i>dt</i> 163	<i>dt</i> 204	mono 171-2, <i>dt</i> 196d , al			Phenylhydrazide, 240

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
264	Azobenzene-3-carboxylic acid	170 1, or , al						198-9, or , al	58, me al		
265	2,2-Diphenylpropionic acid	171 175						149			
266	8-Chloro-1-naphthoic acid	171 2, al -w						207 5, red, al	50		
267	4-Bromo-2,5-dimethylbenzoic acid	171 5 2 5, lgr						209-10			Nitrile, 103-4
268	5-Chlorosalicylic acid (5-Chloro-2-hydroxybenzoic acid)	172 w						226-7	50, b p 249d	25	Nitrile, 165-7, Phenyl ester, 81-3, Me eth , 81-2, Et ester, 118
269	4-Chloro-2-methylbenzoic acid	172						183			Nitrile, 67
270	2,4-Dibromobenzoic acid	174						198			
271	3-Aldehydebenzoic acid (3-Formylbenzoic acid)	175						190d	53	b p 278	Nitrile, 79-81, eth , Semicarbazone, 265, Phenylhydrazone, 164
272	3-Thianaphthenecarboxylic acid	175			173			198			
273	Apiolic acid (2,5-Dimethoxy 3,4-methylenedioxybenzoic acid)	175, w						71-2, w			Nitrile, 135 5, al -w
274	Allomucic acid (2,3 4,5-Tetrahydroxyadipic acid)	176d , w						175 6, w , di 209d , w	di 139-41 al		Polyphenylhydrazide, 218d , al
275	8-Bromo-1-naphthoic acid	178, bz			151, al			179-80	33, pet eth	52, pet eth	
276	3-Phenanthyiacetic acid	178						176			
277	Acetylenedicarboxylic acid	179						di 294d			
278	4-Tolueic acid (4-Methylbenzoic acid)	179 80, subl 182	275 (cor )	160, 165	144 5, 148, 140	104 5	153	160, 158			
279	6-Bromo-3-nitrobenzoic acid	180						197-8	82	66	Nitrile, 117, subl
280	5-Bromo-2,4-dimethylbenzoic acid	180 1						197 5-8 5			Nitrile, 88-9
281	Veratric acid (3 4 Di methoxybenzoic acid)	181 (anh )			154			164			
282	N-Benzoylanthranilic acid (2 Benzamidobenzoic acid)	181			279			218-9	100	98	Nitrile, 156
283	4-Chloro-3-nitrobenzoic acid	181-2			131			156, al	83, me al	59, yel	Nitrile, 100-1
284	3,5-Dinitrosalicylic acid (3,5-Dinitro-2-hydroxybenzoic acid)	174 (+1H <sub>2</sub> O)						181			
285	4-Fluorobenzoic acid	182 182 6						154, 154 5			Nitrile, 35
286	4-Chloropicolinic acid (4-Chloropyridine-2-carboxylic acid)	182d						158, 152-4	57-8		Phenyl ester, 68, pet eth
287	2,4-Dinitrobenzoic acid	183						203			
288	2-Naphthoic acid	184, 185 5		192, al	171, bz , 173	142	158	192-3, al , 195			
289	3-Bromosalicylic acid (3-Bromo-2-hydroxybenzoic acid)	184						165			Nitrile, 49-50
290	2-Anilinoisobutyric acid (2-Anilinoisobutanoic acid)	184 5, w			155, al			136			
291	4-Anisic acid (4-Methoxybenzoic acid)	184 6, 184 2 (cor )	275-80	186	169-71	132	152	167, 162-3, w			Nitrile, 93-4, al

\* Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
292	(2-Carboxyphenyl)acetic acid (Homophthalic acid)	185, 180						228			
293	Acetylanthranilic acid	185, ac a			167 8, al			177, al			Nitrile, 133, w , N-Methylamide, 172 al
294	Succinic acid (Butanedioic acid, Ethane-1,2-dicarboxylic acid)	185, 182 8	235d	mono 179 80, di 254 5-5 5, 260	mono 148 5, di 230, al	di 88	di 211 0	mono 157 di 260d , w			
295	5-Bromopyromuic acid (5-Bromofuran-2-carboxylic acid)	186, w						144 5		b p 234	Hydrazide 135 5 6 0, Azide, 66 7
296	Hippuric acid	187			208	136	151	183			
297	3-Iodobenzoic acid	187				121	128	186			
298	5-Bromo-2-toluic acid (4-Bromo-2-methylbenzoic acid)	187, subl						180			Nitrile, 70
299	2-Cyanobenzoic acid (Phthalic acid mononitrile)	187, 192						173	151	70	
300	3-Nitroanisic acid (4-Methoxy-3-nitrobenzoic acid)	187			163						
301	Fluorene-2-acetic acid	187					266				
302	Coumarin-3-carboxylic acid	187d , w				250	236	116-7	94		
303	d-Camphoric acid (1,2,2-Trimethylcyclopentane-1,3-dicarboxylic acid)	187 5-8 0, l 187, d,l 202, 208	( $\alpha$ ) 212-4, ( $\beta$ ) 190-6	mono	65 5	( $\alpha$ ) mono ( $\alpha$ -amide- $\beta$ -acid)	( $\beta$ ) 86	( $\alpha$ ) 77	( $\alpha$ ) 47 8		Nitrile, 182
						( $\beta$ ) 10, mono	dt b p	( $\beta$ ) 57	( $\beta$ ) 57		
						( $\beta$ ) 196, di 226, di, l 226	263 4	dt b p	285 6		
304	3-Bromophthalic acid	188							mono		Anhydride, 132-4
305	4-Bromo-3,5-dinitrobenzoic acid	188, al					188, pale yellow , al -w	125 me al -w	127 8		
							di 181d , dil H <sub>2</sub> SO <sub>4</sub> tetra 310d , w	118, al -w	118, al -w		
306	Butane-1,2,3,4-tetracarboxylic acid (low melting form)	189, w			187 (rapid htng ), al -w		tetra 75-6, w		168 w		Heating → monoanoh of high melting form
307	Anthroxic acid	190, 196d									
308	$\alpha$ -Chrysenic acid ( <i>o</i> -2-Naphthylbenzoic acid)	190									
309	<i>l</i> -Ascorbic acid	190d , d,l 168-9									[ $\alpha$ ] <sub>D</sub> <sup>25</sup> +48 in me al , Diphenylhydrazone, 178d , red, Di-p-nitrophenyl hydrazone 262d al Di 2 4 dinitro phenylhydrazone, 282d , br -red

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
310	<b>Chlorofumaric acid</b>	191 2, ac a			186, al	di 138 5			di b p 224	di b p 250 sl d	Ethyl ester amide, 102
311	<i>N</i> -Methylacetylanthranilic acid	192 3					155				<i>N</i> -Methylamide, 171 2 <i>N</i> -Ethyl- amide, 140
312	<b>Coumarilic acid (Coumarone-2-carboxylic acid)</b>	192 3, w	310 5	sl d	159			159		27	Nitrile, 36, Phenyl ester, 101
313	<b>Dimethylmalonic acid</b>	193, subl				83 6					
314	<i>trans</i> -Aconitic acid	194 5d (cor.), <i>cis</i> 125 → <i>trans</i> on heat- ing			di 189, <i>cis</i> , <i>mono</i> 170d , al	tri 186	di 269 tri 250 → br , 260 → sinters				Heat → Itaconic acid, 165
315	<b>Benzylidene malonic acid</b>	195 6d						di 189 90	di 44	85, di 32	Mononitrile, 183 Dinitrile, 87
316	<b>4-Ethoxybenzoic acid</b>	198 195 6			169, 170 172			202			
317	<i>trans</i> -3-Nitrocinnamic acid	199 <i>cis</i> 138				174	178, 173	196			
318	<b>Chrysodiphenic acid (2-Phenyl-naphthalene-1,2'-dicarboxylic acid)</b>	199						1-mono 275, 2'-mono 220	1-mono 171 5, me al , 2'-mono 124, di 90		
319	<b>3,4-Dihydroxybenzoic acid (Protocatechuic acid)</b>	199-200d			166	188		212		134 5 w	
320	<b>3-Hydroxybenzoic acid</b>	200, subl		163 dil al	156 7, w	106 8	176, 176 1- 4	170 167			
321	<b>Phthalic acid (Benzene-1,2-dicarboxylic acid)</b>	200 6, 191 (sealed tube), 230 (rapid htng )		mono	mono 150 (slow htng ), 160 5 (rapid htng ), di 201	di 170 di 253-5	di 155 5 152 8	mono 149, di 220			
322	<b>3,4-Dichlorobenzoic acid</b>	201 2, 208 9						133			
323	<i>4</i> -Chloromethyl benzoic acid	203						173			Nitrile, 79 80, al , b p 263
324	<b>5-Bromo-2-nitro-4-toluic acid (2-Bromo-4-methyl-5-nitrobenzoic acid)</b>	203, 200						191		61	Nitrile, 132
325	<b>4-Bromo-3-nitrobenzoic acid</b>	203 4			156, or - yel , al			156	104	74	Nitrile, 120
326	<i>d,l</i> -Tartaric acid	203-4 (+1 H <sub>2</sub> O) 205 6 (anh )			di 235-6	di 147 6		di 226, w-me al			
327	<i>cis</i> -Apocamphoric acid	204, w , <i>trans</i> 190-1, w			mono 212						Anhydride, 178, al
328	<b>3,5-Dinitrobenzoic acid</b>	204-5			234	157	159	183			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
329	<b>Mesaconic acid</b> (Methylfumaric acid)	204.5 (cor.), subl		<i>mono</i> (α) 196, <i>di</i> 212, al	<i>mono</i> (α) 202, <i>mono</i> (β) 163, <i>di</i> 185.7	<i>di</i> 134 (cor.)		<i>mono</i> (α) 222, <i>mono</i> (β) 174, <i>di</i> 176.5			
330	<b>5-Bromo-3-nitro-4-toluic acid</b> (6-Bromo-4-methyl-2-nitrobenzoic acid)	206						171			Nitrile, 130, subl
331	<b>Anthracene-9-carboxylic acid</b> ( <i>meso</i> -Anthroic acid)	207, pa yel, al							111, yel		Nitrile, 170-2, lgr
332	<b>Vanillic acid</b>	207, 210				140d				44, b p 293	
333	<b>trans-2-Coumaric acid</b> ( <i>trans</i> -2-Hydroxycinnamic acid)	207.8d, subl, w				152.5		209d			Acetate, 154.5, 146, bz
334	<b>Oxamic acid</b>	210			148-9			419d			
335	<b>Pentamethylbenzoic acid</b>	210						206			
336	<b>4-Coumaric acid</b> (4-Hydroxy-cinnamic acid)	210.3, 206 (anh)						194	137 126		Acetate, 200.5
337	<b>trans-2-Chlorocinnamic acid</b>	212, yel, al			176			168	105, b p 278-9	b p 162 <sup>12</sup>	Nitrile, 40
338	<b>2,4-Dihydroxybenzoic acid</b> (β-Resorcylic acid)	213d (rapid htng), 216d, 217			126-7	188.9		222			Loses H <sub>2</sub> O of crystallization at 100. Easy loss of CO, gives m.p. varying from 194 to 236
339	<b>2-Bromo-3,5-dinitrobenzoic acid</b>	213						216, pa yel, al-w	109, me al-w	74, al	
340	<b>4-Dibenzofurylacetic acid</b>	214									
341	<b>Mucic acid</b>	214d (varies with htng rate)				310	225	212 <i>mono</i> 192d, <i>di</i> 220			
342	<b>3-Chloroanisic acid</b> (3-Chloro-4-methoxybenzoic acid)	223.255 214.5						193	94.5		
343	<b>4-Hydroxybenzoic acid</b>	215, 213- 4 210		203-4, al	196.7, yel, w	180.2	191.5 (cor.), 184	162 (+1 H <sub>2</sub> O), w			
344	<b>Piperic acid</b>	216				145					
345	<b>3-Chloro-2-naphthoic acid</b>	216.7, me al-w						237	58, me al	50	
346	<b>3-Nitrophthalic acid</b>	218									
347	<b>Acenaphthene-5-carboxylic acid</b>	219, bz		<i>di</i> 226	<i>di</i> 234	189		<i>di</i> 201d 198 223			
348	<b>4-Cyanobenzoic acid</b> (Terephthalic acid mono-nitrile)	219, 214			179	189			62	54	
349	<b>4-Phenylbenzoic acid</b>	221						223			
350	<b>3-Hydroxy-2-naphthoic acid</b>	222.3 (cor.)		221-3	243-4, ac a, 249 (cor.)			217.8 (cor.), yel, al			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	<i>p</i> -Toluidide	Anilide	<i>p</i> -Nitrobenzyl ester	<i>p</i> -Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
351	4-Hydroxy-2-naphthoic acid	225.6		206				217.8			
352	5-Bromo-3-nitro-2-toluic acid (4-Bromo-2-methyl 6 nitrobenzoic acid)	226						235			Nitrile, 106-7, subl
353	9-Fluorenecarboxylic acid	227.230, 225						251			
354	Biphenyl-2,2'-dicarboxylic acid (2,2' Diphenic acid)	227.233 229			mono 176, <i>di</i> 229- 30, al	<i>di</i> 187, 182.6		mono 193, 190.1, <i>di</i> 212, w			
355	Methyliminodiacetic acid	227d						mono 169, <i>di</i> 169			
356	2,4,6-Trinitrobenzoic acid	228						264d			
357	Piperonylic acid	229, 228						169, al			
358	5-Nitrosalicylic acid	229.30						225			
359	4-Chloro-3-hydroxy-2-naphthoic acid	231, yel						225	116, yel		
360	1-Phenanthroic acid	232						284			
361	3-Pyridylacrylic acid	233						148			
362	4-Bromo-3-hydroxy-2-naphthoic acid	233-5d, yel, al-ac a			161-2						Acetate, 183
363	4-Chloro-1-hydroxy-2-naphthoic acid	234, al		143-4	180-1				120-1	92-3	<i>o</i> -Toluidide, 148-9, <i>m</i> -Toluidide, 188-9
364	3-Chloro-2-nitrobenzoic acid	235 w			186						
365	Benzophenone-2,4-dicarboxylic acid	235, w						<i>di</i> >288	<i>di</i> 107		
366	5-Bromo-2-hydroxy-3-toluic acid (5 Bromo-2-hydroxy 3-methylbenzoic acid)	236			125, al-w			75-8	109	75	
367	2-Thianaphthenecarboxylic acid	236						177			
368	Butane-1,2,3,4-tetracarboxylic acid (high melting form)	236-7 (slow htng )			<i>di</i> 168, acet (slow htng )			<i>di</i> 169d	tetra 63-4, lgr		Di-imide, 320d, w
369	7-Bromo-1-naphthoic acid	237 (cor ), 60% al			202, al-w			247, 50% al	55 (cor ), 60% me al	46	
370	3-Pyridinecarboxylic acid	237.8 235, 232		150	85, 132, bz-lgr, 265, w			128, 122			
371	trans-2-Nitrocinnamic acid	240, <i>cis</i> 146-7			132	141	185				
372	2-Chloroquinoline-3-carboxylic acid	240						200-1			
373	4-Nitrobenzoic acid	241									
374	Azobenzene-4-carboxylic acid	241, red, al		204, 192	211, 204	168	137	201, 198 224-5, red	96 123-4, or, me al	57 86-7, or-red, al	<i>Nitrile</i> , 120-1, br, bz, Propyl ester, 64, red, lgr
375	4-Chlorobenzoic acid	243, 240			194, al	129.5, al	126	179, 170	44	b p 238	
376	7-Chloro-1-naphthoic acid	243, 60% al			185, al-w			237, 50% al	54, 60% al		
377	3-Chlorocinchoninic acid (2-Chloroquinoline-4-carboxylic acid)	244, al			202, al			334-5, al-w, 276-8 (after fusion)	89-90, acet	64.5	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromophenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
378	5-Chloro-1-naphthoic acid	245, 241-2 subl						239		42	Nitrile, 145
379	Azobenzene-2,2'-dicarboxylic acid	245, dk yel, al						mono 215d, red-br, et ac, di 294d, red-br, ac a 260, al	di 101, red, me al	di 85, pa red, al	
380	Anthracene-1-carboxylic acid ( $\alpha$ -Anthroic acid)	245, yel, al, 252						108, ac a			Nitrile, 126, yel, Phenyl ester, 207-9, yel
381	2-Amino-9,10-anthraquinone-1-carboxylic acid	250 2, or - red						300, or, PhNO <sub>2</sub> , 189-90, w			
382	4-Bromobenzoic acid	251-3			197	180					p-Phenylphenacyl ester, 193
383	9-Phenanthroic acid	251, 253						233			
384	4-Bromocinnamic acid	251 3						181	80		
385	Cinchoninic acid (Quinoline-4-carboxylic acid)	253 4 (+1 or 2H <sub>2</sub> O)			183			24	13, b p 173 <sup>15</sup>		Nitrile, 102
386	Gallic acid (3,4,5-Trihydroxybenzoic acid)	253-4d, 222-40d			207	141	134	189			
387	1-Acenaphthoic acid	256						228			
388	2-Phenanthroic acid	260						243			
389	Cinchomeronic acid (Pyridine-3,4-dicarboxylic acid)	260d, w			di 199-206			3-mono 200d, 4-mono 170d, w, di 163-5d	3-mono 182 4-mono 154-72, b p di 141	4-mono 131-3, bz, di b p 172 <sup>21</sup>	Imide, 229-30, subl
390	5-Bromo-1-naphthoic acid	261, 256						241			
391	Chelidonic acid ( $\gamma$ -Pyrone-2,6-dicarboxylic acid)	262						245	di 122 5	48-9 227, di 63	Nitrile, 147, subl p-Phenylphenacyl ester, 195-8d
392	4-Iodobenzoic acid	270, 265			210	141	146	217 186-7			
393	5-Chloro-2-naphthoic acid	270, al			202 5			234			
394	3-Phenanthroic acid	270						198			
395	Quinoline-3-carboxylic acid	272						317, yel	161 5, yel, acet, 155	45	Nitrile, 144
396	1-Chloroanthraquinone-2-carboxylic acid	272, pa yel, al			248 9, pa yel, bz-ac a			142, yel, al			Benzyl ester, 135-6, yel, al
397	Anthracene-2-carboxylic acid ( $\beta$ -Anthroic acid)	281, yel, al						293-5, yel, al		134-5	
398	trans-4-Nitrocinnamic acid	285						204, 217			
399	Fumaric acid (trans-Butanedioic acid)	286-7, (sealed tube), >200, subl, 293-5			mono 233 0-4 5, di 313 4, ac a	186 150 8	191	270, 300 2 subl, di 266d	di 102, b p 192	mono 66, di b p 218	At 230 → maleic anh 56
400	Muconic acid	289d (slow htng ), 306 (rapid htng )						di 240d			trans-trans 296-8, cis-cis 195

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XII. ORGANIC DERIVATIVES OF CARBOXYLIC ACIDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

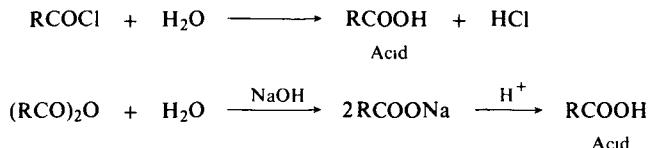
No	Name	Melting point °C	Boiling point °C	p-Toluidide	Anilide	p-Nitrobenzyl ester	p-Bromo phenacyl ester	Amide	Methyl ester	Ethyl ester	Miscellaneous
401	<b>9,10-Anthaquinone-2-carboxylic acid</b>	290-2, yel , ac a			258 60			280, ac a -bz	170	147	
402	<b>9,10-Anthaquinone-1-carboxylic acid</b>	293 4, pa yel , ac a			288 9, pa yel , PhNO <sub>2</sub>			280 pa yel , al	189, pa yel , me al	169, yel , al	Nitrile, 247, yel , ac a
403	<b>Bromoterephthalic acid</b> (2-Bromobenzene-1,4-dicarboxylic acid)	299						dt 270	1-mono 145, 4-mono 164 di 54		
404	<b>Terephthalic acid</b> (Benzene-1,4-dicarboxylic acid)	300, subl without melting			dt 334 7, PhNO <sub>2</sub>	dt 263 5	dt 225	dt >225			
405	<b>Chloroterephthalic acid</b> (2-Chlorobenzene-1,4-dicarboxylic acid)	>300, w						dt >300	dt 60		
406	<b>4-Pyridinecarboxylic acid</b> (Isonicotinic acid)	324						156			
407	<b>9,10-Anthaquinone-2,3-dicarboxylic acid</b>	240-2, yel , ac a						mono >340, br , ac a			Anhydride, 290
408	<b>Isophthalic acid</b> (Benzene-1,3-dicarboxylic acid)	348, subl				202 5	179 1	mono 280, di 280			Ba salt (+6 H <sub>2</sub> O) very soluble— differentiates from Terephthalic acid
409	<b>Benzophenone-4,4'-dicarboxylic acid</b>	subl <360						dt >300	dt 224 231		Dinitrile, 204-5
410	<b>Trimesic acid</b> (Benzene-1,3,5-tricarboxylic acid)	380 (cor )			tri 118-20d , ac a		tri 197 (sealed tube)	365d (cor )	tri 143-4, me al	tri 132 3, al 133 after sin-tering at 127	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or *via* the acyl halide. All of them appear therefore under the same title.

*Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid*



From the acyl halide in water

*For directions and examples see* Wild, p 180

From the acyl halide with aqueous sodium hydroxide

*See* Vogel, p 369, Wild, p 180

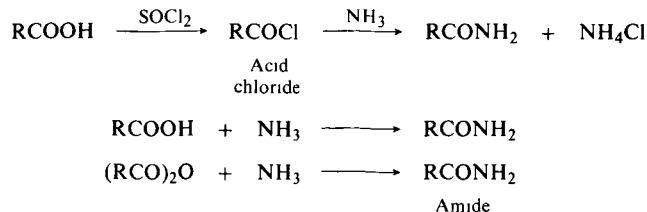
From the acid anhydride with water

*See* Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, *J Chem Soc*, 97, 1677 (1910)

From the acid anhydride with aqueous sodium hydroxide

*See* Linstead, pp 16-7 Wild, p 184

*Amide \**



Acid chloride is prepared from the acid and thionyl chloride. Amide is formed on addition of aqueous ammonia.

*For directions and examples see* Cheronis, p 440, Shriner, p 200, Vogel, p 361, Wild, p 181

From the acid chloride in benzene with aqueous ammonia

*See* D Swern, J M Stutzman and E T Roe, *J Amer Chem Soc*, 71, 3017 (1942)

By passing gaseous ammonia through a benzene or ether solution of the acyl chloride

*See* Linstead, p 14, Wild, p 182

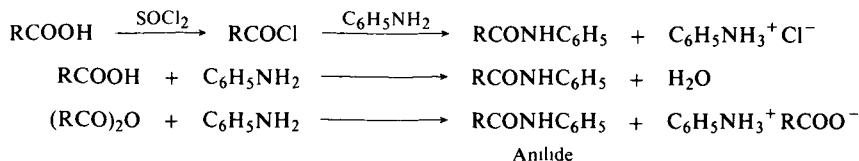
From the neat acid with gaseous ammonia

*See* J A Mitchell and E E Reid, *J Amer Chem Soc*, 53, 1879 (1931)

From the acid anhydride with aqueous ammonia

*See* Wild, p 184, 185

*Anilide \**



From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether.

*For directions and examples see* Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200-1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

From the acid chloride with aniline in aqueous sodium hydroxide

*See* Wild, pp 181, 219

From the acid and aniline at high temperatures

*See* Vogel, p 362

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the sodium salt of the acid with aniline and concentrated hydrochloric acid

*See* Shriner, p 201, Wild, p 154

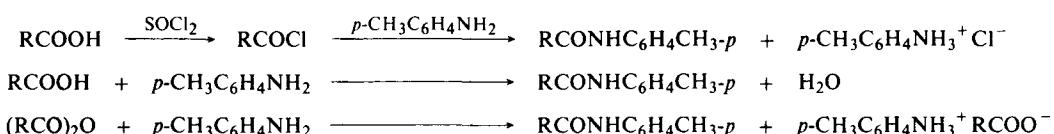
From the acid anhydride with aniline without solvent

*See* Linstead, p 17, Vogel, p 377, Wild, p 185

From the acid anhydride with aniline in benzene

*See* Linstead, p 15, Wild, p 185

### *p-Toluidide* \*



From the acid chloride with *p*-toluidine in ether or benzene

*For directions and examples see* Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361

From the acid and *p*-toluidine at high temperatures

*See* Cheronis, pp 441, 442-3, Vogel, p 362

From the sodium salt of the acid, *p*-toluidine and concentrated hydrochloric acid

*See* Shriner, p 201, Wild, p 154

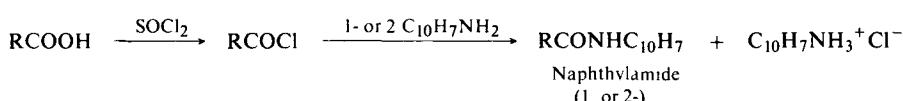
From the acid anhydride with *p*-toluidine without solvent

*See* Cheronis, p 459, Linstead, p 17

From the acid anhydride with *p*-toluidine in benzene

*See* Wild, p 185

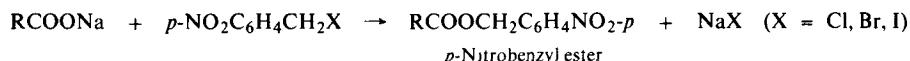
### *1- and 2-Naphthylamide* \*



From the acid chloride with the naphthylamine

*For directions and examples see* Cheronis, p 446, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

### *p-Nitrobenzyl ester* \*



From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol

*For directions and examples see* Cheronis, pp 447, 448, Shriner, p 200, Vogel, p 362, Wild, p 144, 5

From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone

*See* F F Blicke and F D Smith, *J Amer Chem Soc*, 51, 1947 (1929)

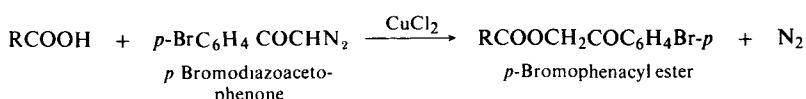
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl bromide in 1 2 water-ethanol

*See* E E Reid, *J Amer Chem Soc*, 39, 124 (1917)

From the sodium or the potassium salt of the acid and *p*-nitrobenzyl chloride or iodide in 1 2 water-ethanol

*See* J A Lyman and E E Reid, *J Amer Chem Soc*, 39, 701 (1917)

### *p-Bromophenacyl ester* \*



From the sodium salt of the acid and *p*-bromophenacyl bromide in aqueous ethanol

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

*For directions and examples see* Cheronis, pp 447, 448, Linstead, p 14, Shriner, p 200, Vogel, p 362, Wild, p 146

From the sodium salt of the acid (neutralization with sodium carbonate) with *p*-bromophenacyl halide in 1:2 water-ethanol

*See* W L Jedefind and E E Reid, *J Amer Chem Soc*, **41**, 1043 (1920)

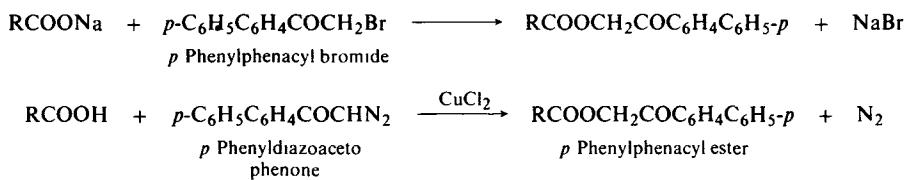
From the sodium salt of the acid (neutralization with sodium hydroxide) with *p*-bromophenacyl bromide in 95% ethanol

*See* R M Hann, E E Reid and G S Jamieson, *J Amer Chem Soc*, **52**, 818 (1930), C G Moses and E E Reid, *J Amer Chem Soc*, **54**, 2101 (1930)

From the acid and *p*-bromodiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

*See* J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

### *p*-Phenylphenacyl ester \*



From the sodium salt of the acid (neutralization with sodium carbonate) and *p*-phenylphenacyl bromide in aqueous alcohol

*For directions and examples see* Linstead, p 14, Vogel, p 363, N L Drake and J Bronitsky, *J Amer Chem Soc*, **52**, 3715 (1930)

From the sodium salt of the acid (neutralization with sodium hydroxide) and *p*-phenylphenacyl bromide in aqueous alcohol

*See* Shriner, p 200, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

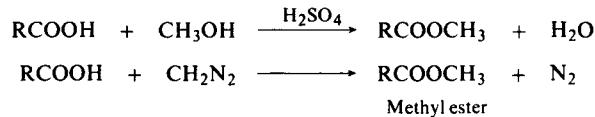
For dibasic acids from the acid, ethylamine and *p*-phenylphenacyl bromide in aqueous ethanol

*See* Wild, p 147, N L Drake and J P Sweeney, *J Amer Chem Soc*, **54**, 2059 (1932)

From the acid and *p*-phenyldiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

*See* J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951)

### *Methyl ester*



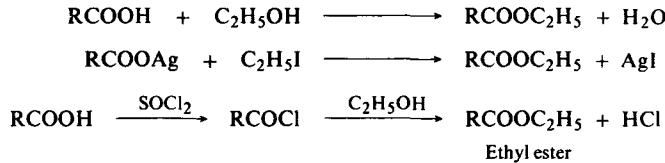
From the acid with methanol and a catalytic amount of sulfuric acid

*For directions and examples see* Linstead, p 16, Vogel, p 383

From the acid and diazomethane in ether

*See* B Eistert, in *Newer Methods of Preparative Organic Chemistry*, Interscience, New York, 1948, p 513

### *Ethyl ester*



From the acid and ethanol in the presence of a catalytic amount of sulfuric acid

*For directions and examples see* Vogel, pp 383, 385, 386, 387

From the silver salt of the acid with ethyl iodide

*See* Vogel, p 388

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the acid chloride and ethanol.

*See:* Vogel, p. 389.

*NOTE:* The same methods can be used for the formation of other esters.

### *S-Benzylthiuronium salt.\**



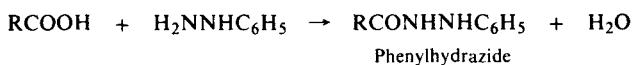
From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

*For directions and examples see:* Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, *Bull. Soc. Chim. [S]*, **5**, 1153 (1938), S. Veibel and K. Ottung, *Bull. Soc. Chim.* **6**, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

*See:* Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, *J. Amer. Chem. Soc.*, **58**, 1004 (1936).

### *Phenylhydrazide.*



From the acid with phenylhydrazine without solvent.

*For directions and examples see:* Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, *J. Amer. Chem. Soc.*, **64**, 470 (1942).

From the acid with phenylhydrazine in benzene.

*See:* Shriner, p. 201; Wild, p. 152.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**I. Acyl Fluorides (Listed in order of increasing b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
1	Acetyl fluoride	20-1			1.002 <sup>15</sup>	118		82	114	147	134	
2	Propionyl fluoride	44.6				141		81	106	126		
3	Fluoroacetyl fluoride	50.5-51				167.9	31-2	108				
4	Trichloroacetyl fluoride	66.8				197	57.8	141	97	113		
5	n-Butyryl fluoride	67				162.5		115	96	75	125	
6	Chloroacetyl fluoride	73.5					63	120	137	162	117.8	
7	Phthaloyl difluoride	224.6	42-3				206	220( <i>di</i> )	253( <i>di</i> )	201( <i>di</i> )		
8	Phenylacetyl fluoride	88-9 <sup>17</sup>	.				76	156	118	136	159	

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**II. Acyl Chlorides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	P-Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
1	<b>Acetyl chloride</b>	51–2		1.3897 <sup>20</sup>	1.1053 <sup>20</sup>	118		82	114	147	134	
2	<b>Oxalyl chloride</b>	64	-12	1.4341 <sup>13</sup>	1.4884 <sup>13,4</sup>		101 (dihyd.)	419d	246	268		
3	<b>Fluoroacetyl chloride</b>	72–3				167 9	31–2	108				
4	<b>Acryl chloride</b>	76		1.4343 <sup>20</sup>	1.1144 <sup>20</sup>	140		85	105	141		
5	<b>Propionyl chloride</b>	80		1.4051 <sup>20</sup>	1.0654 <sup>20</sup>	141		81	106	126		
6	<b>Isobutyryl chloride</b>	92		1.4079 <sup>20</sup>	1.0177 <sup>20</sup>	154 5		128	105	107		
7	<b>Methacryl chloride</b>	95–6		1.4435		160 5	15–6	102–6				
8	<b>Vinylacetyl chloride</b>	98				163		72–3	58			
9	<b>n-Butyryl chloride</b>	101–2		1.4121 <sup>20</sup>	1.0284 <sup>20</sup>	162 5		115	96	75		
10	<b>Pivalyl chloride</b>	105–6					35	154	129	120		
11	<b>Dichloroacetyl chloride</b>	108				194		98	118	153		
12	<b>Chloroacetyl chloride</b>	108–10		1.454 <sup>20</sup>	1.3997 <sup>18</sup>	189	63	120	137	162		
13	<b>DL-<math>\alpha</math>-Chloropropionyl chloride</b>	110–11		1.440 <sup>20</sup>	1.285 <sup>20</sup>	185–6		80	92	124		
14	<b>Methoxyacetyl chloride</b>	113				204		97	58			
15	<b>DL-Ethylmethylacetyl chloride</b>	115–6				176		112	110	93		
16	<b>Isovaleryl chloride</b>	115		1.4136 <sup>24,3</sup>	0.9854 <sup>24,4</sup>	176		135	109 10	107	138 5	
17	<b>Acetylglucyl chloride</b>	115–8					206	137				Hydrazide 115 Me ester 58 9
18	<b>Trichloroacetyl chloride</b>	118		1.470 <sup>20</sup>	1.6202 <sup>20</sup>	197	57 8	141	97	113		
19	<b>Cyclopropane carbonyl chloride</b>	120			1.152 <sup>20</sup>	186	18	125				
20	<b>Ethoxyacetyl chloride</b>	123–4				207		80 2				
21	<b>trans-Crotonyl chloride</b>	126		1.46 <sup>18</sup>	1.08 <sup>20</sup>	186	72	161	118	132		
22	<b>n-Pentanoyl chloride (n-Valeryl chloride)</b>	126		1.420 <sup>20</sup>	1.0004 <sup>20</sup>	186		106	63	74	112	
23	<b>Allylacetyl chloride</b>	128			1.074 <sup>16</sup>	188 9		94				
24	<b>Bromoacetyl chloride</b>	133–5			1.908 <sup>0</sup>	208	50	91	131		134	
25	<b>Cyclobutane carbonyl chloride</b>	137				195		153				
26	<b><math>\beta</math>-Methoxypropionyl chloride</b>	142 3		1.424		107 <sup>10</sup>		50 5				
27	<b>Diethylacetyl chloride</b>	140		1.4234		190		107				
28	<b><math>\beta</math>-Chloropropionyl chloride</b>	144		1.455	1.331 <sup>13</sup>	199	42		119	121		
29	<b>Isocaproyl chloride (4-Methylpentanoyl chloride)</b>	147			0.9725 <sup>20</sup>			121	112	63		
30	<b><math>\alpha</math>-Acetoxypropionyl chloride (O-Acetyl lactoyl chloride)</b>	150	part d	1.4241 <sup>17</sup>	1.192		57 60, 40					
31	<b>DL-<math>\alpha</math>-Bromobutyryl chloride</b>	150–2				217d	-4	112	98	92		
32	<b>n-Hexanoyl chloride (n-Caproyl chloride)</b>	153		1.426 <sup>20</sup>	0.9754 <sup>20</sup>	205		100	95	75	107	
34	<b>Furoyl chloride</b>	173 4										
35	<b>n-Heptanoyl chloride (Enanthoyl chloride)</b>	175		1.4345 <sup>15</sup>	0.9634 <sup>20</sup>	223	133–4	142–3 96	124 70 (65)	107 81	101	
36	<b>Hexahydrobenzoyl chloride (Cyclohexane carboxylic acid chloride)</b>	183 4		1.4766 <sup>15</sup> , 1.4711 <sup>20</sup>	1.0964 <sup>6</sup>		29 30	185	143 4			
37	<b>3-Fluorobenzoyl chloride</b>	189, 204					124	130				
38	<b>Succinyl dichloride</b>	190d	20	1.473 <sup>15</sup>	1.3954 <sup>5</sup>		186	260 (di)	230 (di)	255 (di)		
39	<b>4-Fluorobenzoyl chloride</b>	193	9				183	154 5				

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**II. Acyl Chlorides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	P-Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
40	<i>n</i> -Octanoyl chloride ( <i>n</i> -Capryloyl chloride)	196			0.949 <sup>20</sup>	239	16	110, 106	57	70	103	
41	Benzoyl chloride	197	-1	1.558 <sup>15</sup>	1.212 <sup>20</sup>		122	130	163	158		
42	Diethyl malonyl dichloride	197		1.5537 <sup>20</sup>	1.2187 <sup>15</sup>		125	224 ( <i>di</i> )				
43	2-Fluorobenzoyl chloride	206	4				126.5	116				
44	Phenylacetyl chloride	210		1.533 <sup>20</sup>	1.1685 <sup>20</sup>		76	156	118	136	159	
45	<i>n</i> -Nonanoyl chloride (Pelargonyl chloride)	215			0.946 <sup>15</sup>	255	12	99	57	84	103	
46	Glutaryl dichloride	218		1.473 <sup>20</sup>	1.324 <sup>20</sup>	302	97.8	175.6 ( <i>di</i> )	224			
47	4-Chlorobenzoyl chloride	222	16	1.579 <sup>20</sup>	1.362 <sup>20</sup>		240	179, 170	194			
48	Hydrocinnamoyl chloride ( $\beta$ -Phenylpropionyl chloride)	225 d			1.135 <sup>21</sup>		48	105	98, pet eth	135		
49	3-Chlorobenzoyl chloride	225					158	134	122			
50	Phenoxyacetyl chloride	225-6					98-9	101.5	101			
51	4-Methylbenzoyl chloride (4-Toluyl chloride)	225.6	-3.9	1.545 <sup>20</sup>	1.1686 <sup>20</sup>		179-80	160	145	160 165		
52	<i>n</i> -Decanoyl chloride	232				268	70	31	108, 98	70	78	104
53	2-Chlorobenzoyl chloride	233						142	142	118	131	
54	3-Methoxybenzoyl chloride	242.4						110, 105				Benzylamine salt of acid, 112
55	3-Bromobenzoyl chloride	243, 239						155	155	136		Hydrazide, 151
56	2-Bromobenzoyl chloride	245	11					150	155.6	141		Hydrazide, 153
57	2-Methoxybenzoyl chloride	254							129	131		Phenyl ester, 59
58	4-Methoxybenzoyl chloride (Anisoyl chloride)	262.3	22	1.58 <sup>20</sup>	1.261 <sup>20</sup>		184	162.3	169, 163	186		Anisidine, 202
59	Phthaloyl dichloride	276	15.6	1.569 <sup>20</sup>	1.406 <sup>20</sup>		200.6	220 ( <i>di</i> )	253.5 ( <i>di</i> )	201 ( <i>di</i> )		
60	3-Nitrobenzoyl chloride	278	35				140	143	154	162		
61	1-Naphthoyl chloride	297.5	20				161	202				Piperidine, 85.7

\*Derivative data given in order m p., crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

## II. Acyl Chlorides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	<i>p</i> -Toluidide	2-Naphthyl amide	Miscellaneous
						B p °C	M p , °C					
1	$\beta$ -Ethoxypropionyl chloride	78 <sup>22</sup>				120 <sup>17</sup>		51				
2	Azidoacetyl chloride	50 <sup>20</sup>					16	58				
3	Oleyl chloride	163 <sup>2</sup>					16	75 6	41	42 5		
4	$\gamma$ -Phenoxybutyryl chloride	155 <sup>20</sup>					64-5	80				
							60					
5	$\gamma$ -Phenylbutyryl chloride	140-2 <sup>12</sup>				290	52	84 5				
6	$\omega$ -Undecenoyl chloride ( $\omega$ -Undecylenoyl chloride, $\omega$ -Hendecenoyl chloride)	128 <sup>14</sup>				275	24 5	87				
7	Benzoylformyl chloride	125 <sup>9</sup>					64-6	91				
8	Iodoacetyl chloride	49-52 <sup>15</sup>				2 25 <sup>25</sup>	83	95	143-4			
9	$\beta$ -Iodopropionyl chloride	81 <sup>15</sup>					82, 85	101, 142				
10	Palmitoyl chloride	194 <sup>17</sup>	11-2				63	106-7	90	98	109	
11	Myristoyl chloride	174 <sup>16</sup>	1-3				54, 58	107	84	93	108	
12	Phenylpropionyl chloride	115-6 <sup>17</sup>					136-7	108-9, 99 100	126	142		
13	Dodecanoyl chloride (Lauroyl chloride)	145 <sup>18</sup>	-17	1 446 <sup>20</sup>		299	44	110 102	78	87	106	
14	$\alpha$ -Phenoxybutyryl chloride	128- 31 <sup>38</sup>				258	82 3 99	111 123	93-4			Phenyl ester, 48-9
15	Cyanoacetyl chloride	57 <sup>5</sup>					66	119 20	198-9			
16	Nicotinyl chloride	90 <sup>15</sup>					235	122	85			
17	Dibenzylacetyl chloride	202 <sup>18</sup>					89	129	155			
18	$\alpha$ -Phenoxypropionyl chloride	115 <sup>20</sup>					115 6 112 3	132	117	115	117	
19	DL- $\alpha$ -Bromoisovaleryl chloride	59 <sup>15</sup>					44	133	116	124	145	
20	3-Ethoxybenzoyl chloride	135- 40 <sup>16</sup>	27 8				137	139				
21	$\alpha$ -Bromoisobutyryl chloride	52 <sup>30</sup>		1 475 <sup>23</sup>			48 9	148	83	92 5	135	
22	4-Isopropylbenzoyl chloride	121 <sup>10</sup>					256-8	153				
23	Benzilic acid chloride ( $\alpha$ -Hydroxydiphenylacetyl chloride)	193 5 <sup>27</sup>					150	154 5	175	190		Me ester 74-5
24	1-Naphthoxyacetyl chloride	194 <sup>10</sup>					190	155	144			
25	Hexahydrophenylacetyl chloride (Cyclohexylacetyl chloride)	98 100 <sup>23</sup>				244-6	33	171-2				4-Phenetidine, 145 6
26	Azelayl dichloride	166 <sup>1*</sup> 140 <sup>0</sup> †					106 5	175 (di)	186-7 (di)	191 (di)		
27	2-Nitrobenzoyl chloride	148 <sup>9</sup>	20				146	176	155			
28	Mesaconyl dichloride (Methylfumaryl dichloride)	64-5 <sup>14</sup>					240 5	177 (di)	186 (di)	212		
29	1-Naphthylacetyl chloride	188 <sup>23</sup>					131	180 1 154				
30	2,4,6-Trimethylbenzoyl chloride	155-6 <sup>18</sup>		1 5263 <sup>25</sup>	1 0967 <sup>25</sup>		152	188				
31	3-Formylbenzoyl chloride	130 <sup>20</sup>					175	190				
/				1 4684	1 1212 <sup>20</sup>		198 134 5	202 210 (di)	170 198 (di)			
32	4-Ethoxybenzoyl chloride	160 <sup>20</sup>										
33	Sebacoyl dichloride	182 <sup>16</sup>										

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

## II. Acyl Chlorides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acid		Amide	Anilide	<i>p</i> -Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
34	Adipyl dichloride	130-2 <sup>18</sup>					153	220 ( <i>di</i> )	240-1	241		Di-N-methyl-amide, 152-3
35	Benzylmalonyl dichloride	141 <sup>15</sup>					117d	225 ( <i>di</i> )	217 ( <i>di</i> )			
36	Phenylmalonyl dichloride	122 <sup>15</sup>					152-3	233				
37	<i>trans</i> -Aconityl trichloride (1,2,3-Propylenetricarboxylic acid trichloride)	155-7 <sup>20</sup>					194-5	260 ( <i>tri</i> ) (sin-ters)				Di-Me ester, 51
38	Fumaryl dichloride	63 <sup>13</sup>		1 5004 <sup>18</sup>	1 408 <sup>20</sup>		300-2	266 ( <i>di</i> )	314 ( <i>di</i> )			

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**II. Acyl Chlorides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p. °C					
1	Salicyloyl chloride	92 <sup>15</sup>	19-20			158	142	136		156	189	
2	Stearoyl chloride	202-3 <sup>6</sup>	23			70 1	109	95		102	112	
3	2-Iodobenzoyl chloride		35-40, 30-1			162	184					
4	trans-Cinnamoyl chloride	258	35 6	1.6202 <sup>37</sup>	1.1632 <sup>37</sup>	133	147 8	151		168		Hydrazide, 164
5	4-Bromobenzoyl chloride	245-7	42			251 3	189-90	197				Di-Me ester, 68
6	Isophthaloyl dichloride	276	43-4	1.570 <sup>47</sup>	1.388 <sup>47</sup>	345-7	280 (di)					Dihydrazide, 220
7	2-Naphthoyl chloride	304-6	43			184-5	192					Piperide, 88-90
8	2,4-Dinitrobenzoyl chloride		46			183	203					Me ester, 70
9	4-Formylbenzoyl chloride	258	48			256						Me ester, 63, Phenylhydra- zone of acid, 226
10	4-Nitrophenylacetyl chloride		48			153	198	198				
11	2-Naphthoxyacetyl chloride		54			156	147	145				4-Phenetidine, 164-5, Et ester, 48-9
12	Diphenylacetyl chloride		56-7			148	168	180				
13	trans-2-Nitrocinnamoyl chloride		64 5			240	185			173	191 2	Me ester, 73
14	3,5-Dinitrobenzoyl chloride		68 9, 74			204 5	183	234				Me ester, 108, Et ester, 93
15	4-Nitrobenzoyl chloride	150-2 <sup>15</sup>	75			241	201	211		204		
16	3-Nitrophthaloyl dichloride		77			218	201 (di)	234 (di)		226 (di)		
17	Benzylidene malonyl dichloride		77			195-6	189 (di)					Di Me ester 45
18	Fluorene-9-carboxylic acid chloride		77			230-2	251					Me ester, 63
19	Terephthaloyl dichloride		83-4				>250 (di)	334-7 (di)				Di-1-naphthyl- amide, 334
20	4-Iodobenzoyl chloride		83 77-8			270 265	218		210			
21	Diphenylcarbamyl chloride (Diphenylaminoformyl chloride)		86				189					Me ester, 86, Et ester, 72, lgr
22	2,2'-Diphenic acid dichloride		94			228 9	212					
23	α,α-Diphenylpropionyl chloride		95-6			173-4	149					Benzyl ester, 71 2
24	Phenanthrene-2-carboxylic acid chloride		101			259 60	242 3	217-8				
25	Phenanthrene-9-carboxylic acid chloride		102			252	232 226	218				
26	Diphenyl-4-carbonyl chloride (4-Phenylbenzoyl chloride)		114-5			228	223					Me ester, 117-8, Et ester, 46
27	Phenanthrene-3-carboxylic acid chloride		116-7			269	233 227	216-7				
28	trans-4-Nitrocinnamoyl chloride		124			286	217					Me ester, 161
29	Fluorenone-4-carboxylic acid chloride		128, yel			227, yel	230, 225					Oxime of acid, 263, Me ester, 132, Et ester, 103
30	Fluorenone-1-carboxylic acid chloride		140, yel				229-30					Oxime of acid 230 Me ester, 86 9, Et ester, 84 6

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**II. Acyl Chlorides b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
31	Azobenzene-4,4'-dicarboxylic acid dichloride		144-5, red				330d					Di-Me ester, 242, Di-Et ester, 146 Me ester, 170
32	9,10-Anthraquinone-2-carboxylic acid chloride		147				290, yel	280	258-60			
33	Di-(1-naphthyl) acetyl chloride		167-9				228.5					
34	9,10-Anthraquinone-2,6-di-carboxylic acid dichloride		197-8				>400	>370				
35	9,10-Anthraquinone-1,4-di-carboxylic acid dichloride		203-5				>300					
36	9,10-Anthraquinone-1,5-di-carboxylic acid dichloride		260-3				>390					Di-Me ester, 236, Di-Et ester, 155, yel

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**III. Acyl Bromides a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p Toluidide	2-Naphthyl amide	Miscellaneous
						B p , °C	M p °C					
1	Oxalyl dibromide	64				101 (hyd)	419d (di)	254 (di)	268 (di)			
2	Acetyl bromide	81		1.4538 <sup>10</sup>	1.6625 <sup>16</sup>	118	82	114	147	132		
3	Propionyl bromide	103				141	81	106	126			
4	Chloroacetyl bromide	127				63	120	137	162	117-8		
5	n-Butyryl bromide	128				162.5	115	96	75	125		
6	Isovaleryl bromide	138-40				176	135		107	138.5		
7	Trichloroacetyl bromide	143			1.90 <sup>15</sup>	197	57-8	162.5	95-7	113		4-Nitroanilide, 146-7
8	Bromoacetyl bromide	150			2.425	208	50	91	131		134	
9	DL- $\alpha$ -Bromopropionyl bromide	154-5			2.061 <sup>16</sup>	204	25.7	123	99, 110			
10	$\alpha$ -Bromoisobutyryl bromide	162-4				198- 200	48.9	148	83	92.5	135	
11	DL- $\alpha$ -Bromobutyryl bromide	172.4				127 <sup>25</sup>	-4	112, 108				
12	n-Hexanoyl bromide (n-Caproyl bromide)	175-6				205		100	95	75	107	
13	DL- $\alpha$ -Bromoisovaleryl bromide	184-94					44	133	116	124	145	
14	Benzoyl bromide	218-9			1.570 <sup>15</sup>		122	130	163	158		

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES

## III. Acyl Bromides a) Liquids

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\*

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acid		Amide	Anhydride	$P$ -Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
1	3-Methylbenzoyl bromide	137 <sup>52</sup>				111	94 97	126	118			
2	<i>n</i> -Pentanoyl bromide ( <i>n</i> -Valeryl bromide)	64 <sup>66</sup>			186.5		106	63	74			
3	3-Chlorobenzoyl bromide	145 <sup>40</sup>				158, 155	134	122				
4	2-Chlorobenzoyl bromide	144 <sup>37</sup>				140	142	114, 118	131			
5	2-Methylbenzoyl bromide	135 <sup>37</sup>				104.5	143	125	144			
6	2-Bromobenzoyl bromide	167 <sup>18</sup>				150	155	141				
7	Phenylacetyl bromide	150-5 <sup>50</sup>				76	156	117-8	135-6	159		
8	4-Methylbenzoyl bromide	147 <sup>42</sup>				179-80	160	145 148	160, 165			
9	4-Methoxybenzoyl bromide	185 <sup>27</sup>				184-6	167, 163	169-71	186			
10	4-Chlorobenzoyl bromide	142 <sup>27</sup>				240	179, 170	194				
11	4-Bromobenzoyl bromide	136 <sup>18</sup>				251	189	197				
12	Succinyl dibromide	105-6 <sup>13</sup>				186	260 (di)	230 (di)	255 (di)			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**III. Acyl Bromides b) Solids (Listed in order of increasing m.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
1	<b>3-Nitrobenzoyl bromide</b>		43				140	143	154	162		
2	<b>trans-Cinnamoyl bromide</b>		48				133	148	151, 153	168		
3	<b>4-Iodobenzoyl bromide</b>		55				270, 265	217	210			
4	<b>3,5-Dinitrobenzoyl bromide</b>		60				204-5	183	234			
5	<b>4-Nitrobenzoyl bromide</b>		64				241	201, 198	211	203		
6	<b>Phthaloyl dibromide</b>		80				206	220 (di)	253 (di)	201 (di)		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**  
**IV. Acyl Iodides. Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	P-Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
1	<b>Acetyl iodide</b>	108			1.98 <sup>17</sup>	118		82	114	147	134	
2	<b>Propionyl iodide</b>	127				141		81	106 103	126		
3	<b>n-Butyryl iodide</b>	146-8				162.5		115	96	75	125	,

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE XIII. ORGANIC DERIVATIVES OF ACYL HALIDES**

**IV. Acyl Iodides. Liquids**

2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amides)\*

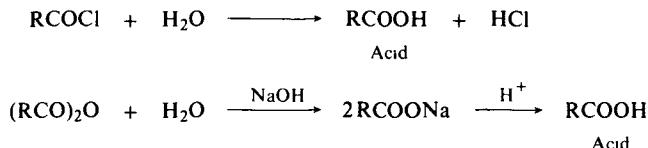
No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anilide	p-Toluidide	2-Naphthyl amide	Miscellaneous
						B p., °C	M p., °C					
1	Dichloroacetyl iodide	55 <sup>15</sup>		1.5754		194		98	118	153		
2	Chloroacetyl iodide	37 <sup>4</sup>		1.5903			63	120	137, 134	162		
3	Benzoyl iodide	109 <sup>10</sup>					122	130	163	158		
4	Trichloroacetyl iodide	74 <sup>30</sup>		1.5711		197	57-8	141	97-94	113	117-8	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV

The derivatives of three classes of compounds (carboxylic acids, acyl halides and acid anhydrides) are essentially the same as those of carboxylic acids, and are prepared either directly from the acid or *via* the acyl halide. All of them appear therefore under the same title.

*Hydrolysis of acid halide or acid anhydride to the corresponding carboxylic acid*



From the acyl halide in water

*For directions and examples see* Wild, p 180

From the acyl halide with aqueous sodium hydroxide

*See* Vogel, p 369, Wild, p 180

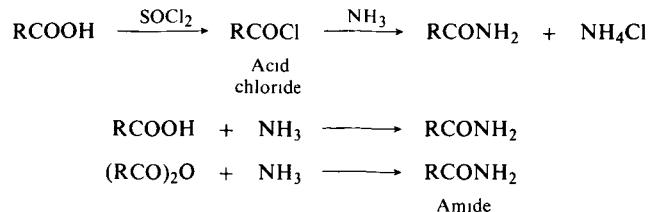
From the acid anhydride with water

*See* Vogel, p 376, Wild, p 184, A C D Rivett and N V Sidgwick, *J Chem Soc*, 97, 1677 (1910)

From the acid anhydride with aqueous sodium hydroxide

*See* Linstead, pp 16-7 Wild, p 184

*Amide \**



Acid chloride is prepared from the acid and thionyl chloride. Amide is formed on addition of aqueous ammonia.

*For directions and examples see* Cheronis, p 440, Shriner, p 200, Vogel, p 361, Wild, p 181

From the acid chloride in benzene with aqueous ammonia

*See* D Swern, J M Stutzman and E T Roe, *J Amer Chem Soc*, 71, 3017 (1942)

By passing gaseous ammonia through a benzene or ether solution of the acyl chloride

*See* Linstead, p 14, Wild, p 182

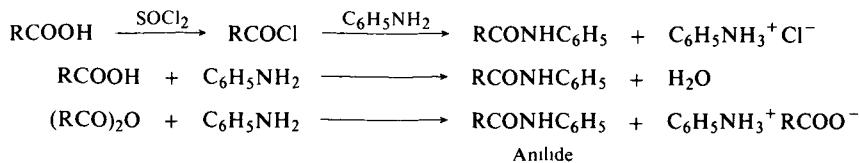
From the neat acid with gaseous ammonia

*See* J A Mitchell and E E Reid, *J Amer Chem Soc*, 53, 1879 (1931)

From the acid anhydride with aqueous ammonia

*See* Wild, p 184, 185

*Anilide \**



From the acid chloride (prepared from the acid and thionyl chloride) and aniline in benzene or in ether.

*For directions and examples see* Cheronis, p 445, Linstead, p 14, Shriner, pp 98, 200-1, Vogel, pp 361, 369, 458, Wild, p 182, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

From the acid chloride with aniline in aqueous sodium hydroxide

*See* Wild, pp 181, 219

From the acid and aniline at high temperatures

*See* Vogel, p 362

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the sodium salt of the acid with aniline and concentrated hydrochloric acid

*See* Shriner, p 201, Wild, p 154

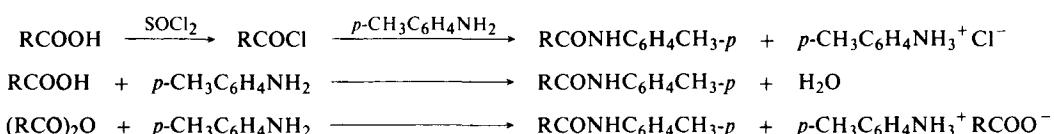
From the acid anhydride with aniline without solvent

*See* Linstead, p 17, Vogel, p 377, Wild, p 185

From the acid anhydride with aniline in benzene

*See* Linstead, p 15, Wild, p 185

### *p-Toluidide* \*



From the acid chloride with *p*-toluidine in ether or benzene

*For directions and examples see* Cheronis, pp 441, 444, 458, Linstead, p 14, Shriner, pp 200-1, Vogel, p 361

From the acid and *p*-toluidine at high temperatures

*See* Cheronis, pp 441, 442-3, Vogel, p 362

From the sodium salt of the acid, *p*-toluidine and concentrated hydrochloric acid

*See* Shriner, p 201, Wild, p 154

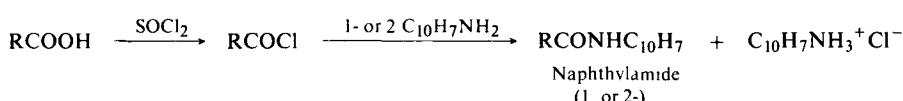
From the acid anhydride with *p*-toluidine without solvent

*See* Cheronis, p 459, Linstead, p 17

From the acid anhydride with *p*-toluidine in benzene

*See* Wild, p 185

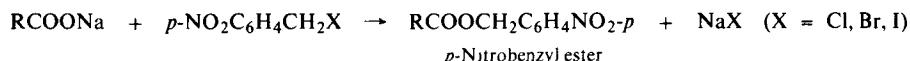
### *1- and 2-Naphthylamide* \*



From the acid chloride with the naphthylamine

*For directions and examples see* Cheronis, p 446, P W Robertson, *J Chem Soc*, 115, 1210 (1919)

### *p-Nitrobenzyl ester* \*



From an aqueous solution of the sodium salt of the acid, with the *p*-nitrobenzyl halide in ethanol

*For directions and examples see* Cheronis, pp 447, 448, Shriner, p 200, Vogel, p 362, Wild, p 144, 5

From an aqueous solution of the sodium salt of the acid with *p*-nitrobenzyl bromide in acetone

*See* F F Blicke and F D Smith, *J Amer Chem Soc*, 51, 1947 (1929)

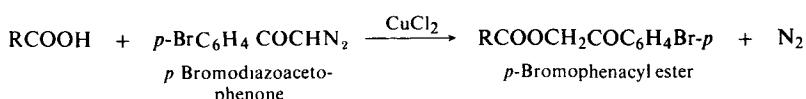
From the sodium or the potassium salt of the acid and *p*-nitrobenzyl bromide in 1 2 water-ethanol

*See* E E Reid, *J Amer Chem Soc*, 39, 124 (1917)

From the sodium or the potassium salt of the acid and *p*-nitrobenzyl chloride or iodide in 1 2 water-ethanol

*See* J A Lyman and E E Reid, *J Amer Chem Soc*, 39, 701 (1917)

### *p-Bromophenacyl ester* \*



From the sodium salt of the acid and *p*-bromophenacyl bromide in aqueous ethanol

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)**

*For directions and examples see Cheronis, pp 447, 448, Linstead, p 14, Shriner, p 200, Vogel, p 362, Wild, p 146*

From the sodium salt of the acid (neutralization with sodium carbonate) with *p*-bromophenacyl halide in 1,2 water-ethanol

See W L Judefind and E E Reid, *J Amer Chem Soc*, **41**, 1043 (1920).

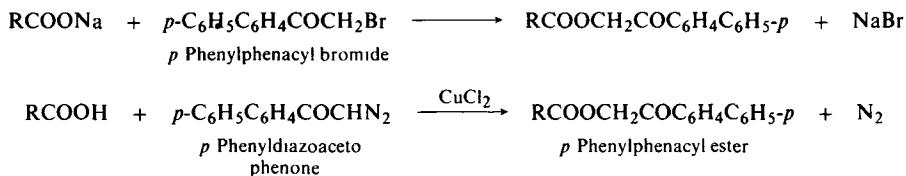
From the sodium salt of the acid (neutralization with sodium hydroxide) with *p*-bromophenacyl bromide in 95% ethanol

See R M Hann, E E Reid and G S Jamieson, *J Amer Chem Soc*, **52**, 818 (1930), C G Moses and E E Reid, *J Amer Chem Soc*, **54**, 2101 (1930).

From the acid and *p*-bromodiazooacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, 73, 5301 (1951).

*p*-Phenylphenacyl ester \*



From the sodium salt of the acid (neutralization with sodium carbonate) and *p*-phenylphenacyl bromide in aqueous alcohol

*For directions and examples see Linstead, p 14, Vogel, p 363, N L Drake and J Bronitsky, J Amer Chem Soc, 52, 3715 (1930)*

From the sodium salt of the acid (neutralization with sodium hydroxide) and *p*-phenylphenacyl bromide in aqueous alcohol

See Shriner, p 200, N L Drake and J P Sweeney, *J Amer Chem Soc*, 54, 2059 (1932).

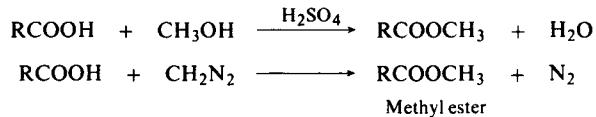
For dibasic acids from the acid, ethylamine and *p*-phenylphenacyl bromide in aqueous ethanol

See Wild, p 147, N L Drake and J P Sweeney, *J Amer Chem Soc*, 54, 2059 (1932)

From the acid and *p*-phenyldiazoacetophenone in dioxane in the presence of catalytic amounts of cupric chloride

See J L E Erickson, J M Dechary and M R Kesling, *J Amer Chem Soc*, **73**, 5301 (1951).

### *Methyl ester*



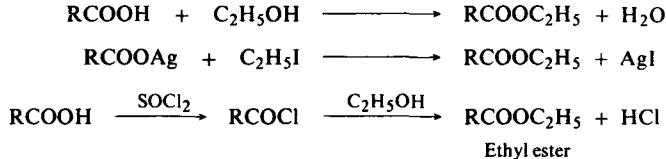
From the acid with methanol and a catalytic amount of sulfuric acid

*For directions and examples see Linstead, p 16, Vogel, p 383*

### From the acid and diazomethane in ether

See B Eistert, in *Newer Methods of Preparative Organic Chemistry*, Interscience, New York, 1948, p 513

### *Ethyl ester*



From the acid and ethanol in the presence of a catalytic amount of sulfuric acid

*For directions and examples see* Vogel, pp 383, 385, 386, 387

#### From the silver salt of the acid with ethyl iodide

*See Vogel, p 388*

\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLES XII, XIII AND XIV (Continued)

From the acid chloride and ethanol.

*See:* Vogel, p. 389.

*NOTE:* The same methods can be used for the formation of other esters.

### *S-Benzylthiuronium salt.\**



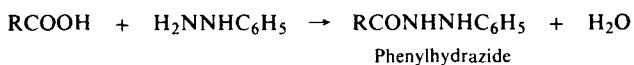
From the sodium or the potassium salt of the acid and S-benzylthiuronium chloride in water.

*For directions and examples see:* Linstead, p. 15; Vogel, p. 36; Wild, p. 149; S. Veibel and H. Lillelund, *Bull. Soc. Chim. [S]*, **5**, 1153 (1938), S. Veibel and K. Ottung, *Bull. Soc. Chim.* **6**, 1434 (1939).

From the sodium or the potassium salt of the acid in water or in aqueous ethanol with an ethanolic solution of S-benzylthiuronium chloride.

*See:* Cheronis, p. 449; Shriner, p. 202; J. J. Donleavy, *J. Amer. Chem. Soc.*, **58**, 1004 (1936).

### *Phenylhydrazide.*



From the acid with phenylhydrazine without solvent.

*For directions and examples see:* Shriner, p. 201; Wild, p. 152; G. H. Stempel and G. S. Schaffel, *J. Amer. Chem. Soc.*, **64**, 470 (1942).

From the acid with phenylhydrazine in benzene.

*See:* Shriner, p. 201; Wild, p. 152.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES**  
 a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Acid anhydride	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acid		Amide	Anhde	p-Toluidide	2-Naphthyl-amide	Miscellaneous
						B P	M P					
1	Trifluoroacetic	39		1 269 <sup>25</sup>	1 490 <sup>25</sup>	72		75	88			
2	Perfluoropropionic	72		1 273 <sup>25</sup>	1 571 <sup>25</sup>	96		95				
3	Perfluoro-n-butrylic	108		1 285 <sup>20</sup>	1 665 <sup>20</sup>	120		105	93			
4	Acetic	140	-73	1 3904 <sup>20</sup>	1 0811 <sup>20</sup>	118	16	82	114	153		
5	n-Propionic	167	-45	1 404 <sup>20</sup>	1 017 <sup>15</sup>	141		81	106	126 (124)		
6	Perfluoro-n-caproic (Perfluoro-n-hexanoic)	176		1 295 <sup>20</sup>	1 769 <sup>25</sup>	157		117				
7	Isobutyric	182			0 957 <sup>17</sup>	154		128	105	107		
8	Pivalic (Trimethylacetic)	190				164	35	154	129	120		
9	n-Butyric	198			0 978 <sup>15</sup>	162		115	96	75 (73)	125	
10	Citraconic (Methylmaleic)	214	7-8	1 471 <sup>21</sup> 5	1 238 <sup>25</sup>	92d		185-7 (di)	175 (di)			
11	Isovaleric	215				176		135 (137)		107	138	
12	Dichloroacetic	216d				194		98	118	153		
13	Valeric (Pentanoic)	218			0 922 <sup>17</sup>	186		106	63	74	112	
14	Crotonic	248		1 4745 <sup>20</sup>	1 0397 <sup>20</sup>	189	72	161 (158)	118 (115)	132		
15	Caproic (n-Hexanoic) (245)	254-7		1 4297 <sup>20</sup>	0 92 <sup>20</sup>	205		100	95 (92)	75 (73)	107	
16	n-Heptanoic	258		1 4335 <sup>15</sup>	0 9175 <sup>20</sup>	223		96	70 (65) 175 6 (di)	81	101	
17	α-Methylglutaric	272-5					79		mono (2 forms) 114 or 100	174 5 (di) mono (2 forms) 126 or 98-9	227-8 (di), 115-9 (mono)	
18	Caprylic (n-Octanoic)	280-5	-1	1 436 <sup>17</sup>	0 9065 <sup>17</sup>	239	16	110 (106) 57 (55)	70		103	
19	cis-Hexahydroisophthalic	304				187	9	298-9 (di)				

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

a) Liquids 2) (Reduced pressure b.p. only) (Listed in order of increasing m.p. of the corresponding amide derivative)\*

No.	Acid anhydride	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acid		Amide	Anilide	<i>p</i> -Toluidide	2-Naphthylamide	Miscellaneous
						B.P.	M.P.					
1	<b>DL-<math>\alpha</math>-Bromobutyric</b> .....	148-52 <sup>10</sup>	.....	.....	.....	127 <sup>25</sup>	-4	112	.....	.....	.....	4-Nitrophenyl ester, 48-9; 2-Naphthyl ester, 54
2	<b>DL-<math>\alpha</math>-Bromopropionic</b> .....	120 <sup>5</sup> (123-4 <sup>10</sup> )	.....	.....	.....	204	26	123	.....	.....	.....	.....

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

b) Solids (Listed in order of increasing m.p.)\*

No	Acid anhydride	Melting point, °C	Boiling point, °C	Acid		Amide	Anilide	<i>p</i> -Toluidide	2-Naphthylamide	Miscellaneous
				B P	M P					
1	Oleic	22			16	76	41	43	169	
2	Capric ( <i>n</i> -Decanoic)	24		268, 70	31	108, 98	70	78	104	D <sub>D</sub> <sup>20</sup> 0 8596, n <sub>D</sub> <sup>20</sup> 1 4234
3	β-Ethyl-β-methylglutaric	25	185 <sup>20</sup>	232	87	105 ( <i>mono</i> )				1-Naphthylamide, 126
4	Hexahydrobenzoic	25	280-3		29-30	185-6				
5	α,α-Dimethylsuccinic ( <i>unsym</i> -Dimethylsuccinic)	29	220		141					α-Me ester, 41 β Me ester, 52, Anil, 87
6	cis-Hexahydrophthalic	32	145 <sup>18</sup>		192					Conc HCl at 180 — <i>trans</i> form, 221
7	DL-Methylsuccinic	37	244-8		115 (112)	225 ( <i>di</i> )	123, chl ( <i>mono</i> ), 159 et, ac, ( <i>mono</i> )	164 ( <i>mono</i> )	155 ( <i>mono</i> )	Anil, 109-10
8	<i>n</i> -Undecanoic ( <i>n</i> -Hendecanoic)	37		284	30	103, 99	71	80		
9	2-Methylbenzoic ( <i>o</i> -Toluic)	39			104, 5	143	125	144		
10	β-Methylglutaric	41	276-8		87		200 ( <i>di</i> )	mono 135	143 ( <i>mono</i> )	
							121 (117) ( <i>mono</i> )			
11	Bromoacetic	41-2		208	50	91	131			
12	Lauric ( <i>n</i> -Dodecanoic)	42		299	44 (42)	110, 100	78	87	134	
13	Benzoic	42	360		122	130	163	158	106	
14	trans-α,β-Dimethylsuccinic	43			198 (208)	238 ( <i>di</i> )	165, 7 ( <i>mono</i> )			Imide, 78
15	Iodoacetic	46			83	95	143, 4			
16	Chloroacetic	46		189	63	121	134	162	117-8	
17	<i>n</i> -Tridecanoic	50		312	44	100	80	88		
18	DL-Phenylsuccinic	54	204-6 <sup>22</sup>		168	209, 10 ( <i>di</i> )	222 ( <i>di</i> )	175 ( <i>α</i> -)		Imide, 90
						158-9 ( <i>α</i> )	175 ( <i>α</i> -)	168, 9		
						144, 5 ( <i>β</i> -)	170-1 ( <i>β</i> -)	( <i>β</i> -)		
19	Myristic ( <i>n</i> -Tetradecanoic)	54		202 <sup>16</sup>	54	107, 103	84	93	108	D <sub>D</sub> <sup>20</sup> 0 8502, n <sub>D</sub> <sup>20</sup> 1 4335
20	Glutaric	56		200 <sup>20</sup>	97	<i>di</i> 175, 6	224	218		
21	Maleic	56,	198		130	181 (172)	173-5 ( <i>mono</i> )	187 ( <i>di</i> )	<i>di</i> 142	
		52-4				266 ( <i>di</i> )	186 ( <i>di</i> )			
22	Suberic ( <i>dimer</i> ) (Octanedioic)	56-7			144 (141)	127 ( <i>mono</i> )	128 ( <i>mono</i> )	<i>di</i> 218		
						217 ( <i>di</i> )				
23	α-Bromoisobutyric	63-5		198-	48-9	148	83	92	135	1-Naphthylamide, 116
				200						
24	Palmitic ( <i>n</i> -Hexadecanoic)	64		222 <sup>16</sup>	63	106, 7	90	98	109	D <sub>D</sub> <sup>20</sup> 0 847, n <sub>D</sub> <sup>20</sup> 1 4357
25	Margaric ( <i>n</i> -Heptadecanoic)	67		231 <sup>16</sup>	61	108				
26	Itaconic (Methylenesuccinic)	67-8			165	<i>di</i> 192	190, 185			
27	Sebacic ( <i>dimer</i> ) (Decanedioic)	68		243 <sup>15</sup>	133	210 ( <i>di</i> )	201 ( <i>di</i> ), 201 ( <i>mono</i> )	201		
						170 ( <i>mono</i> )	122 ( <i>mono</i> )			
28	Stearic ( <i>n</i> -Octadecanoic)	70			70	109	95	102	112	
29	3-Methylbenzoic ( <i>m</i> -Toluic)	71			111, 3	94	126	118		Hydrazide, 97
30	Phenylacetic	72			76-7	156	118	136	159	
31	2-Bromobenzoic	75-6			150	155, 6				Hydrazide, 153
32	Arachidic ( <i>n</i> -Eicosanoic)	77-8			77	108-9	92	96	112	
33	2-Chlorobenzoic	79			142, 140	142	114, 118	131		
34	cis-α-Methylglutamic	85			118		148 ( <i>mono</i> )			
35	cis-β-Methylglutamic	86			147-9		143 ( <i>mono</i> )			
36	cis-α,β-Dimethylsuccinic	87			129, 122	148, 9 ( <i>mono</i> )	222 ( <i>di</i> )			Mono-Et ester, 73
						244 ( <i>di</i> )				Imide, 111, 101, Anil, 146
37	3,5-Dichlorophthalic	89			164					Imide, 208, N-Phenyl-imide, 150
38	4-Methylphthalic	92	295		152	188 ( <i>di</i> )				Imide, 196
39	3-Chlorobenzoic	95			158, 155	134	122			
40	4-Methylbenzoic ( <i>p</i> -Toluic)	95			179, 80	160	145	160		
41	Diphenylacetic	98			148	167-8	180			Me ester, 60

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Acid anhydride	Melting point, °C	Boiling point, °C	Acid		Amide	Anilide	<i>p</i> -Toluidide	2-Naphthylamide	Miscellaneous
				B P	M P					
42	<b>4-Chlorophthalic</b>	99			157					Imide, 210-11, Di-Me ester, 37, Anil, 174
43	<b>Anisic (4-Methoxybenzoic)</b>	99			184-6	167, 163	169 71	186		
44	<b>DL-Benzylsuccinic</b>	102			161					Imide, 97 8, Dihydrazide, 146
45	<b>β-Phenylglutaric</b>	105			140		171 (168) (mono)	154 (mono)		Imide, 174, Di-Me ester, 86-7
46	<b>4-Ethoxybenzoic</b>	108			198	202	170			Hydrazide, 124
47	<b>α-Benzylcinnamic</b>	108-9			158					Me ester, b p 278, Et ester, 38-9
48	<b>3,5-Dinitrobenzoic</b>	109			204-5	183	234			
49	<b>4-Bromophthalic</b>	113			173-5,					
		109			166					
50	<b>3-Methylphthalic</b>	114-5, 110			157					Imide, 189-90
51	<b>4-Nitrophthalic</b>	119			165	200d	192	mono 172		
52	<b>Succinic</b>	120	261		186	157 (mono), 260 (di)	148 (mono) 230 (di)	180 (mono) 255 (di)		Di-Me ester, 40
53	<b>Nicotinic (3-Pyridine-carboxylic)</b>	123			237 8	128	85	150		
54	<b>3-Chlorophthalic</b>	124 5			186					Imide, 118 20 (sealed tube)
55	<b>4-Iodophthalic</b>	125-6			182, 185					Imide, 224-4
56	<b>3,4-Dimethylphthalic</b>	126			201					Imide, 240-1, Methyl-imide, 98 9
57	<b>3-Bromophthalic</b>	132-4			188, 178					Mono-Et ester, 127 8
58	<b>Phthalic</b>	132			206, 200	149 (mono) 220 (di)	170 (mono) 253-5 (di)	mono 160		
59	<b>3-Iodobenzoic</b>	134			187	187				Me ester, 54-5
60	<b>2-Naphthoic (β-Naphthoic)</b>	135			184	192-3	171-2	192		
61	<b>2-Nitrobenzoic</b>	135			146	176	155			
62	<b>Cinnamic</b>	136			133	148	151, 153	168		
63	<b>trans-DL-Hexahydrophthalic acid</b>	140			221	mono 196				
64	<b>Homophthalic (2-Carboxy-phenylacetic)</b>	141			180-1	230 (2-), 185 (α-)	231			
65	<b>1-Naphthoic (α-Naphthoic)</b>	146			162	202	163			
66	<b>3-Bromobenzoic</b>	148-9			155	155				
67	<b>3-Iodophthalic</b>	159 61			206					Di-Me ester, 89, Di-Et ester, 70, Imide, 238
68	<b>2,4-Dinitrobenzoic</b>	160			183	203				
69	<b>3-Nitrobenzoic</b>	160, 163			140	143	154	162		
70	<b>3-Nitrophthalic</b>	162			218	201 (di)	234 (di)	226 (di)		
71	<b>3,5-Dinitrophthalic</b>	163-4, 161			226					Et ester, 187, Di-Et ester, 73
72	<b>4,5-Dichlorophthalic</b>	188	313		200, 188					Mono-Et ester, 133 4
73	<b>4-Nitrobenzoic</b>	189			241	201, 198	211, 204	204, 192		
74	<b>4-Chlorobenzoic</b>	194			240	179, 170	194			
75	<b>3,6-Dichlorophthalic</b>	194-5	339		194-5					
76	<b>3,4-Di-iodophthalic</b>	198			212-3					
77	<b>β-Phenylglutaconic</b>	206			154-5	138 (mono)	174 (mono)	184 (mono)		Mono-Et ester, 78, Imide, 256-7
78	<b>4,5-Dimethylphthalic</b>	208			123, 196					Methylimide, 150, Ethylimide, 89

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XIV. ORGANIC DERIVATIVES OF ACID ANHYDRIDES

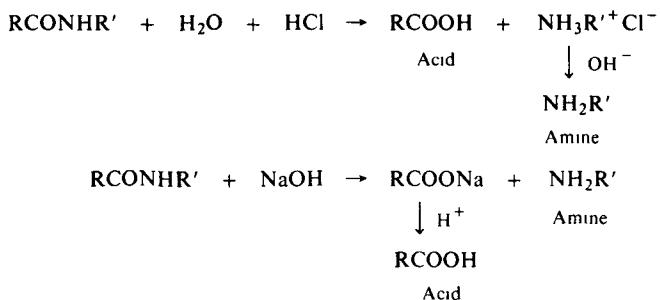
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Acid anhydride	Melting point, °C	Boiling point, °C	Acid		Amide	Anilide	<i>p</i> -Toluidide	2-Naphthyl-amide	Miscellaneous
				B P	M P					
79	<b>2,2'-Diphenic</b>	217		229		191 ( <i>mono</i> ) 212 ( <i>di</i> )	176 ( <i>mono</i> ) 230 ( <i>di</i> )			H <sub>2</sub> SO <sub>4</sub> at 100-120 → Fluorenone-4-carboxylic acid, 227
80	<b>4-Bromobenzoic</b>	218		251		189	197			
81	<b>D-Camphoric</b>	221		188		177 ( <i>mono</i> ) 193 ( <i>di</i> )	209 (204) ( <i>mono</i> ), 226 ( <i>di</i> )	α 212-4, β 190-6		
82	<b>4-Iodobenzoic</b>	228		270, 267		217 8				Me ester, 114
83	<b>Tetrachlorophthalic</b>	256, 249		250 d						Mono-Me ester, 142, Mono-Et ester, 94 5, Imide, 338-9, 2-Naphthylimide, 287, Anil, 268-9
84	<b>1,8-Naphthalenedicarboxylic</b>	274		274			250 82 ( <i>di</i> )			Heat with aq NH <sub>3</sub> → 1,8-Naphthalimide, 300 N-Phenylimide, 202
85	<b>Tetrabromophthalic</b>	280		266						Di-Me ester, 102 3 Mono-Me ester, 267, Imide, > 380, yel., Anil, 279-80, <i>p</i> -Tolil, 280, 2-Naphthylimide, 306-8
86	<b>Tetraiodophthalic</b>	318, 325, yel		324 7						Mono-Me ester, 298

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XV

*Hydrolysis of amide or imide to the corresponding carboxylic acid and amine \**



From the amide with aqueous hydrochloric acid

*For directions and examples see Cheronis, pp 607, 608, Vogel, pp 404, 808*

From the amide with 85% or 100% phosphoric acid

*See Cheronis, p 609, G Berger and S C J Olivier, Rec Trav chim, 46, 600 (1927), W M Dehn and K E Jackson, J Amer Chem Soc, 55, 4284 (1933)*

From the amide with 70% sulfuric acid

*See Wild, p 193*

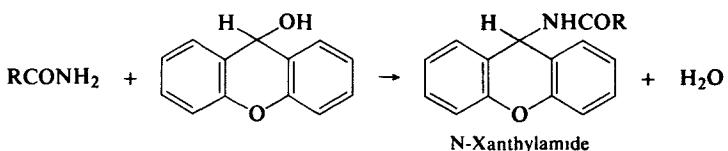
From the amide with aqueous sodium hydroxide

*See Cheronis, p 609, Vogel, pp 404, 799, Wild, p 193*

*NOTE For directions and examples for preparation of derivatives of carboxylic acids formed on hydrolysis of amides and imides see explanations and references to Tables XII, XIII and XIV, p 186, 187, 188, 189*

*For directions and examples for preparation of derivatives of amines formed on hydrolysis of amides and imides see explanations and references to Table XVIII, p 291, 292, 293, 294*

*N-Xanthylamides \**



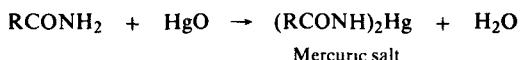
From the amide with xanthydrol in glacial acetic acid

*For directions and examples see Cheronis, p 610, Linstead, p 66, Shriner, p 222, Vogel, p 405, Wild, p 195, R F Phillips and B M Pitt, J Amer Chem Soc, 65, 1355 (1943), W Andriani, Rec Trav chim, 35, 180 (1916)*

From the amide with xanthydrol in ethanol-water-acetic acid mixture

*See Shriner, p 222, Wild, p 195, R F Phillips and B M Pitt, J Amer Chem Soc, 65, 1355 (1943)*

*Hg salt (Hg derivative) \**



From the amide with mercuric oxide in methanol or ethanol

*For directions and examples see Cheronis, pp 610, 611, Wild, p 197, J W Williams, W T Rainey and R S Leopold, J Amer Chem Soc, 64, 1738 (1942)*

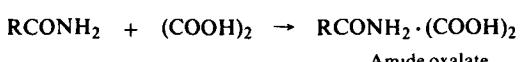
From the amide with mercuric oxide in water

*See Vogel, p 405*

From the amide with yellow mercuric oxide without solvent

*See Cheronis, p 611, Wild, p 196, J W Williams, W T Rainey and R S Leopold, J Amer Chem Soc, 64, 1738 (1942)*

*Oxalate*



From the amide with anhydrous oxalic acid in the presence of ethyl acetate

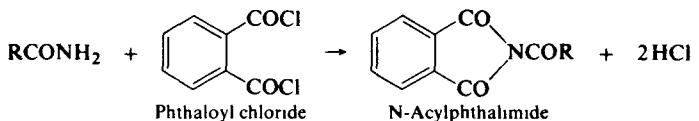
\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## **EXPLANATIONS AND REFERENCES TO TABLE XV (Continued)**

*For directions and examples see: Cheronis, p. 611; Wild, p. 196; C. A. MacKenzie and W. T. Rawles, *Ind. Eng. Chem., Anal. Ed.*, **12**, 737 (1940).*

### *N-Acylphthalimide (Phthalimide derivative).*



From the amide with phthaloyl chloride in toluene or without solvent.

For directions and examples see: Cheronis, p. 611; T. W. Evans and W. M. Dehn, *J. Amer. Chem. Soc.*, **51**, 3651 (1929).

\*Derivatives recommended for first trial.

**WARNING:** This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

a) Liquids (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Derived acid				Derived amine				Miscellaneous
						M P., °C	B P., °C	<i>P</i> -Nitrobenzyl ester	<i>P</i> -Bromo-phenacyl ester	M P., °C	B P., °C	Acetamide	Benzamide	
1	N,N-Dimethylformamide	153, 76 <sup>39</sup>	-61	1 42938 <sup>224</sup>	0 9484 <sup>224</sup>	8 4	100 7	31	140, 135	7		41		
2	N,N-Diethylformamide	176-8, 68 <sup>15</sup>			0 908 <sup>16</sup>	8 4	100 7	31	140, 135	56		42		
3	N-Methylformamide	180-5, 131 <sup>90</sup>	-3 8, -5 4	1 4310 <sup>45</sup>	1 011 <sup>19</sup>	8 4	100 7	31	140, 135	-6	28	80		
4	Formamide	193, 195d	2 55			8 4	100 7	31	140, 135	NH <sub>3</sub>				Xanthyl deriv, 184, Oxalate, 107 4 7 7
5	N-Ethylformamide	197 9			0 952 <sup>21</sup>	8 4	100 7	31	140, 135	16 5, 19		71		
6	N-Formylpiperidine (Form-N-piperidine)	222				8 4	100 7	31	140, 135	106		48		
7	N-Acetyl piperidine (Aceto-N-piperidine)	226				166	118 2	78	86 0	106		48		
8	N-Methylformanilide	243-4, 249- 51, 128- 9 <sup>15</sup>	12 5		1 0928 <sup>23</sup>	8 4	100 7	31	140, 135	196	102	63		
9	N-Ethylformanilide	258 <sup>728</sup> , 123 <sup>11</sup>			1 0549	8 4	100 7	31	140, 135	205	54	60		
10	N-Propylformanilide	267 <sup>731</sup> (cor.)			1 044 <sup>16</sup>	8 4	100 7	31	140, 135	222	47			
11	N-Isobutylformanilide	274 <sup>731</sup> (cor.)				8 4	100 7	31	140, 135	227				
12	N-Isoamylformanilide	285- 6 <sup>728</sup>			1 004 <sup>16</sup>	8 4	100 7	31	140, 135	254 5 (cor.)				

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Xan thyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	p Nitro benzyl ester	p Bromo phenacyl ester	M P , °C	B P °C	Acet amide	Benz amide	
1	<i>n</i> -Butyranilide	35		~ 5 5 - 8	162 5 164		63		184	114	160	
2	Oleanilide	41		α 13 36	250	(super heated steam)	40 46		184	114	160	
3	N-Benzopiperide ( <i>N</i> -Benzoyl piperidine)	48		122 4	249	89	119 0		106		48	
4	Ethyl urethane (Ethyl carbamate)	49 48	169						NH <sub>3</sub>			
5	Formanilide	50 47		8 4	100 7	31	140 135		184	114	160	B p 271 Benzyl chloride → benzyl form anilide 48
6	Malonic acid monoamide (Malonamic acid)	50		134 8 9		di 85 5			NH <sub>3</sub>			
7	N-Propylacetanilide	50		16 6	118 2	78	86 0				47	
8	Difluoroacetamide	52			134 5				NH <sub>3</sub>			
9	N-Benzyl- <i>n</i> -caproamide	53		- 3 9	203 35		72		184 5	60	105	
10	Phenyl urethane (Phenyl carbamate)	53							184	114	160	
11	Methyl urethane (Methyl carbamate)	54 52	193						NH <sub>3</sub>			
12	N-Ethylacetanilide	54		16 6	118 2	78	86 0		205	54	60	B p 249
13	<i>n</i> Butyl urethane ( <i>n</i> Butyl carbamate)	54							NH <sub>3</sub>			
14	N-Benzylisovaleramide	54		- 30	176 5	68 0	135 137		184 5	60	105	
15	Acetoacetamide	54							NH <sub>3</sub>			
16	Isobutyl urethane (Isobutyl carbamate)	55	148						NH <sub>3</sub>			
17	N-Methyl-2-acetotoluuidine	56		16 6	118 2	78	86 0		208	56	66	
18	Carpylanilide	57 55		16 3	237		67 4		184	114	160	
					239 3							
19	Pelargonanilide	57		12 3	254 4		68 5		184	114	160	
20	N-Benzylacetanilide	58		16 6	118 2	78	86 0	37	298	58	107	
21	Methoxyacetanilide	58			204 203				184	114	160	
22	d- <i>L</i> -Lactanilide	59		18	122 <sup>15</sup>		112 8		184	114	160	
23	N-Ethylbenzanilide	60		122 4	249	89	119 0		205	54	60	
24	<i>n</i> -Propyl urethane ( <i>n</i> Propyl carbamate)	60							NH <sub>3</sub>			
25	N-Benzylformamide	60		8 4	100 7	31	140 135		184 5	60	105	
26	N-Benzylacetamide	61		16 6	118 2	78	86 0		184 5	60	105	
27	Proprolamide	61-2		18	144d				NH <sub>3</sub>			
28	<i>n</i> -Valeranilide ( <i>n</i> -Pentananilide)	63		- 34 5	186 4		75		184	114	160	
29	Isoamyl urethane (Isoamyl carbamate)	64	145						NH <sub>3</sub>			
30	Erucanilide	65, 55		33 4	264 <sup>15</sup>		62 5		184	114	160	
31	3-Acetotoluuidine ( <i>N</i> Acetyl- <i>m</i> - toluidine)	66 65		16 6	118 2	78	86 0		203	65	125	
32	N-Methyl-3-acetotoluuidine	66		16 6	118 2	78	86 0		206 7	66	125	
33	Ethyl oxanilate .....	66 7								184	114	160
34	Benzindole	68		122 4	249	89	119	52	253	157 8	68	
35	Heptanamide	70, 65		- 7 46	223		72		184	114	160	
36	Capranilide ( <i>n</i> -Decananilide)	70		31 3	268 7		60		184	114	160	
37	<i>n</i> -Undecanamide ( <i>n</i> Hendecananilide)	71		28 5	280, 284		68 2		184	114	160	
				α 13 4								
				β 16 3								

\*Derivative data given in order m p , crystal color solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No.	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M.P., °C	B.P., °C	p-Nitrobenzyl ester	p-Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide	
38	2-Methylhexanamide	72	.....	209.6	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
39	N,N-Diphenylformamide	73	.....	8.4	100.7	31	140; 135	53-4	.....	101	180	.....
40	Vinylacetanilide	73	.....	-35	169; 163	.....	.....	184	.....	114	160	.....
41	Oleamide	76	.....	α: 13.36 β: 16.25	250 (super-heated steam); 216 <sup>a</sup>	.....	40-6	.....	NH <sub>3</sub>	.....	.....	.....
42	Thioacetanilide	76	.....	93	.....	.....	.....	184	.....	114	150	.....
43	Tiglamide	76	.....	64.5-5.0	198.5 (cor.)	64	68	.....	NH <sub>3</sub>	.....	.....	.....
44	Tiglanilide	77	.....	64.5-5.0	198.5 (cor.)	64	68	.....	184	114	160	.....
45	4-Methylhexanilide	77	.....	217-8 <sup>254</sup>	.....	.....	.....	184	.....	114	160	.....
46	Lauranilide (Dodecanilide)	78	.....	44; 42	299	.....	76	.....	184	114	160	.....
47	d,l-2,3-Dimethylbutananilide	78	.....	-1.5	191.7	.....	.....	184	.....	114	160	.....
48	Pentadecanilide	78	.....	52.3	212 <sup>16</sup>	39.5-40 (cor.)	77.2	.....	184	114	160	.....
49	d,l-Lactamide	78.5-9.0; 76	.....	18	122 <sup>15</sup>	.....	112.8	.....	NH <sub>3</sub>	.....	.....	.....
50	Transbrassidanilide	79	.....	59.7	256 <sup>10</sup>	.....	94.2	.....	184	114	160	.....
51	2-Acetophenetide (N-Acetyl-o-phenetidine)	79	.....	16.6	118.2	78	86.0	.....	229	79	104	.....
52	d,l-2-Methylpentanamide	79.6; 80	.....	195-6	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
53	Tridecanilide	80	.....	43; 41.6	312; 177 <sup>10</sup>	.....	75.0	.....	184	114	160	.....
54	d,l-α-Chloropropionamide	80	.....	.....	186	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
55	Propionamide	81; 77	214; 211	-20.8	141	31	63.4	.....	NH <sub>3</sub>	.....	.....	Mercury deriv., 201; Oxalate, 80.8-1.0
56	Acetamide	82	245; 238-40	16.6	118.2	78	86.0	.....	NH <sub>3</sub>	.....	.....	Mercury deriv., 196-7; Oxalate, 127.3; Phthalimide, 135-6
57	Ethoxyacetamide	82	.....	206-7	.....	104.8	.....	NH <sub>3</sub>	.....	.....	.....	.....
58	N-Methyl-4-acetotoluuidine	83	.....	16.6	118.2	78	86.0	.....	210	83	.....	.....
59	α-Bromoisobutyranilide	83	.....	48-9	198-200	.....	.....	.....	184	114	160	.....
60	γ-Phenylbutyramide	84	.....	52	290	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
61	Myristanilide	84	.....	53.9	212 <sup>16</sup>	.....	81	.....	184	114	160	.....
62	Acrylamide	85	.....	13	141; 140	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
63	Allylurea	85	.....	.....	.....	.....	.....	58	.....	.....	.....	.....
64	Acetoacetanilide	85	.....	.....	.....	.....	.....	184	.....	114	160	.....
65	d,l-α-Ethylphenylacetamide (α-Phenylbutyramide)	86; 83	.....	42	270	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
66	4-n-Propylacetanilide	87	.....	16.6	118.2	78	86.0	.....	225	87	115	.....
67	α-Undecylenamide (α-Hendecyleneamide)	87	.....	24.5	275	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
68	Propiolanilide	87	.....	18	144d.	.....	.....	184	.....	114	160	.....
69	3-Bromoacetanilide	87	.....	16.6	118.2	78	86.0	18	251	87	120; 136	.....
70	d,l-3-Methylpentanilide	87	.....	-41.6	197.5	.....	.....	.....	184	114	160	.....
71	n-Butyl oxamate	88	.....	189.5 (anh.); 101(+ 1H <sub>2</sub> O)	.....	di: 204	.....	.....	NH <sub>3</sub>	.....	.....	.....
72	2-Chloroacetanilide	88	.....	16.6	118.2	78	86.0	.....	209; 207	87	99	.....
73	D-Chaulmoogranilide	89	.....	68.5	247-8 <sup>20</sup>	.....	.....	.....	184	114	160	.....
74	Palmitanilide	90	.....	62.7	222 <sup>16</sup>	42.5	86; 82	.....	184	114	160	.....
75	N-Phenylmaleimide	91	.....	130	.....	di: 91 (cor.)	168-70; 190	.....	184	114	160	.....

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Xan thyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	p-Nitrobenzyl ester	p-Bromo phenacyl ester	M P °C	B P °C	Acet amide	Benz amide	
76	Bromoacetamide	91		50	208	88		NH <sub>3</sub>				
77	α-Phenylpropionamide	92	158		265			NH <sub>3</sub>				
78	Isopropyl urethane (Isopropyl carbamate)	92		77 75	204 <sup>1</sup>		89	33				
79	Arachidamide	92			186			184	114	160		
80	d l α Chloropropionamide	92		-15 0	187 190			184	114	160		
81	2,2-Dimethylbutanamide	92						184	114	160		
82	2-Nitroacetamide	92 94		16 6	118 2	78	86 0	71	92 94	98 110		
83	Maleimide	93		130		dt 91 (cor )	168 70 190	NH <sub>3</sub>				
84	Elaeaidamide	93 4		44 5 51	234 <sup>15</sup>		65	NH <sub>3</sub>				
85	Transbrassidamide	94		59 7	256 <sup>10</sup>		94 2	NH <sub>3</sub>				
86	2-Ethylpentanamide	94			209			184	114	160		
87	N-Methyl-N-(1-naphthyl) acetamide	94		16 6	118 2	78	86 0	294	94 5	121		
88	n-Caproamide (n Hexanamide)	95 92		-3 9	205 35		72	184	114	160		
89	N-Butyramide	95		-5 5 -8	162 5	35	63	184	114	160		
90	N-Benzylpalmitamide	95		62 7	222 <sup>16</sup>	42 5	86 82	184 5	60	105		
91	Azelaic acid monoamide	95		106 5	>360 sl	dt 43 8	dt 130 6	NH <sub>3</sub>				
92	d l-2-Methylpentanamide	95			195 6			184	114	160		
93	Iodoacetamide	95		83				NH <sub>3</sub>				
94	Stearanamide	95		70 1 69 6			92	184	114	160		
95	Heptanamide	96	154 5	-7 46	223 0		72	NH <sub>3</sub>				
96	Trichlorolactamide	96		124				NH <sub>3</sub>				
97	Semicarbazide	96						14	113 5	mono	mono	Gives semicarbazones with aldehydes and ketones
									67 dt (sym)	172 5 di (sym)	241 (cor )	
98	3-Toluamide	97, 94		111 3, 110 1	236, subl	86 6	108					Mercury deriv , 200
99	Trichloroacetamide	97, 94		57 8	197 5	80		184	114	160		
100	3-Acetothenemide	97		16 6	118 2	78	86 0	248	37	103		
101	N-Benzylstearamide	97		70 1 69 6			92	184 5	60	105		
102	Glycollanamide	97		78 9 80		106 8	138	184	114	160		
103	Methoxyacetamide	97			204 203			NH <sub>3</sub>				
104	Hydrocinnamanamide (β Phenylpropionanilide)	98, 96		48 7, 40	279 80	36 3	104	184	114	160		
105	α-Hydroxyisobutyramide	98		79	212	80 5	98	NH <sub>3</sub>				
106	Dichloroacetamide	98, subl		5-6	194		99	NH <sub>3</sub>				
107	2-Methylhexanamide	98			209 6			184	114	160		
108	4-Methylhexanamide	98			217 8 <sup>45</sup>			NH <sub>3</sub>				
109	4-Methyl-2-nitroacetamide	99, 94		16 6	118 2	78	86 0	117	99	148		
110	Capramide (n-Decanamide)	99	148	31 3	268 7		67 0	NH <sub>3</sub>				
111	2-Bromoacetanilide	99		16 6	118	78	86 0	32	250	99	116	
112	Phenoxyacetanilide	99		98 9, 99	285d		148 5	184	114	160		
				100				NH <sub>3</sub>				
113	Pelargonamide	99	147 5 8 5	12 3	254 4		68 5	NH <sub>3</sub>				
114	α-Bromopropionanilide	99, 110		25 7	203 5			184	114	160		
115	n-Caproamide (n-Hexaneamide)	100, 101	160	-3 9	203 35		72	NH <sub>3</sub>				Oxalate, 71 1- 3
116	Tridecanamide	100		43, 41 6	312, 177 <sup>10</sup>		75	NH <sub>3</sub>				
117	Phenylpropionamide	100, 109		136-7, subl		83		NH <sub>3</sub>				

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No.	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M.P., °C	B.P., °C	p-Nitrobenzyl ester	p-Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide	
118	N,N-Diphenylacetamide	101	.....	16.6	118.2	78	86.0	53-4	.....	101	180	.....
119	β-Iodopropionamide	101	.....	82; 85	.....	.....	.....	.....	.....	.....	.....	.....
120	N,N'-Diacetyltrimethylene-diamine	101	.....	16.6	118.2	78	86.0	.....	136	mono:	mono:	.....
121	Methylurea	101	230	.....	.....	.....	.....	.....	-6	28	80	Picrate, 127d.
122	Phenoxyacetamide	101	.....	98-9; 99-100	285d.	.....	148.5	.....	NH <sub>3</sub>	.....	.....	.....
123	N-Methylacetanilide	102	.....	16.6	118.2	78	86.0	.....	196	102	63	B.p. 237; Conc. HNO <sub>3</sub> + H <sub>2</sub> SO <sub>4</sub> → p-Nitro deriv., 153
124	Levulinanilide	102	.....	33-5, deliq.	245-6	61	84	.....	184	114	160	.....
125	Pentadecanamide	102	.....	52.3	212 <sup>16</sup>	39.5-40 (cor.)	77.2	.....	NH <sub>3</sub>	.....	.....	.....
126	Isocrotonamide	102	.....	15	169	.....	81	.....	NH <sub>3</sub>	.....	.....	.....
127	Isocrotonanilide	102	.....	15	169	.....	81	.....	184	114	160	.....
128	n-Undecanamide (n-Hendecanamide)	103; 99	.....	28.5; α: 13.4; β: 16.3	280-4	.....	68.2	.....	NH <sub>3</sub>	.....	.....	.....
129	3-Benzophenetidine (N-Benzoyl-m-phenetidine)	103	.....	122.4	249	89	119	.....	248	97	103	.....
130	N,N-Dicyclohexylacetamide	103	.....	16.6	118.2	78	86.0	20	225 sl. d.	103	153	.....
131	3,4-Dimethylbenzanilide	104	.....	166; 164	.....	.....	.....	.....	184	114	160	.....
132	2-Benzophenetidine (N-Benzoyl-o-phenetidine)	104	.....	122.4	249	89	119	.....	229	79	104	.....
133	Pyruvanilide	104, subl.	.....	13.6	165d; 80 <sup>25</sup>	.....	.....	.....	184	114	160	.....
134	N-Cyclohexylacetamide	104	.....	16.6	118.2	78	86.0	.....	134	104	149	.....
135	2-n-Propylacetanilide	104-5	.....	16.6	118.2	78	86.0	.....	222-4	104-5	119	.....
136	2-Ethylpentanamide	105; 103	.....	209	.....	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....
137	Isobutyranilide	105	.....	-46.1	154.7	.....	76.8	.....	184	114	160	.....
138	4-n-Butylacetanilide	105	.....	16.6	118.2	78	86.0	.....	261	105	126	.....
139	Acrylanilide	105	.....	13	141; 140	.....	.....	.....	184	114	160	.....
140	β-Phenylpropionamide (Hydrocinnamamide)	105	189	48.7; 40	279-80	36.3	104	.....	NH <sub>3</sub>	.....	.....	.....
141	Propionanilide	106; 103	.....	-20.8	141	31	63.4	.....	184	114	160	Conc. HNO <sub>3</sub> + H <sub>2</sub> SO <sub>4</sub> → p-Nitro deriv., 182
142	Palmitamide	106	142	62.7	222 <sup>16</sup>	42.5	86; 82	.....	NH <sub>3</sub>	.....	.....	.....
143	N-Benzylbenzamide	106	.....	122.4	249	89	119	.....	184-5	60	105	.....
144	D-Chaulmoogramide	106	.....	68.5	247-8 <sup>20</sup>	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....
145	sym-Dimethylurea	106	.....	.....	.....	.....	.....	.....	-6	28	80	.....
146	n-Valeramide (n-Pentanamide)	106	167	-34.5	186.4	.....	75	.....	NH <sub>3</sub>	.....	.....	Oxalate, 61.1-4
147	Myristamide	107; 103	.....	53.9	212 <sup>16</sup>	.....	81	.....	NH <sub>3</sub>	.....	.....	.....
148	N-Benzylbenzanilide	107	.....	122.4	249	89	119	37	298	58	107	.....
149	Margaramide (Heptadecanamide)	108	.....	61.2	231 <sup>16</sup>	48.5-9.0	82.6	.....	NH <sub>3</sub>	.....	.....	.....
150	Thioacetamide	108	.....	93	.....	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....
151	Fluoroacetamide	108	.....	31-2	167-9	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....
152	Levulinanilide	108d.	.....	33-5, deliq.	245-6	61	84	.....	NH <sub>3</sub>	.....	.....	.....
153	Azelaic acid monoanilide	108	.....	106.5	> 360 sl. d.; 237 <sup>15</sup>	di: 143.8	di: 130.6	.....	184	114	160	.....
154	Arachidamide	108-9	.....	77; 75	204 <sup>1</sup>	.....	89	.....	NH <sub>3</sub>	.....	.....	.....

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M.P., °C	B.P., °C	p-Nitrobenzyl ester	p-Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide	
155	<b>Anthranilamide</b>	109		147d				NH <sub>3</sub>				
156	<b>2-Iodoacetanilide</b>	109		16 6	118 2	78	86	61, 58		109	139	
157	<b>Pimelic acid monoanilide</b>	109		104-5, subl	223 <sup>15</sup>		di 136 6		184	114	160	
158	<b>Stearamide</b>	109	139 41	70 1, 69 6			92	NH <sub>3</sub>				
159	<b>α-Methylhydrocinnamamide</b>	109		44, 42	299			NH <sub>3</sub>				
160	<b>Lauramide (Dodecanamide)</b>	170, 102		16 3	237,		76	NH <sub>3</sub>				
161	<b>n-Caprylamide (n-Octanamide)</b>	110, 108	148		239 3		67 4	NH <sub>3</sub>				
162	<b>Isovaleramide</b>	110		-30 0	176 5		68 0		184	114	160	
163	<b>d,l-2-Methylbutanilide</b>	110			176-7, 174		55		184	114	160	
164	<b>3-Nitrophenylacetamide</b>	110		120				NH <sub>3</sub>				
165	<b>2-Ethylacetanilide</b>	111		16 6	118 2	78	86 0		210-1	111	147	
166	<b>β-Bromopropionamide</b>	111		62 5				NH <sub>3</sub>				
167	<b>3-Aminobenzamide</b>	111		174d				NH <sub>3</sub>				
168	<b>2-Ethylbutanamide</b>	112, 107		-31 8	195			NH <sub>3</sub>				
169	<b>4-Methylpentanilide (Isocaproanilide)</b>	112, 110		-33	199 1 <sup>752</sup>		77 3		184	174	160	
170	<b>d,l-2-Methylbutanamide</b>	112			176-7, 174		55	NH <sub>3</sub>				
171	<b>2-Acetotoluidide</b>	112		16 6	118 2	78	86 0	200		110 1 <sup>1</sup>	146	KMnO <sub>4</sub> → Acetylanthranilic acid, 185
172	<b>d-Hydnocarpamide (α-Cyclopentylundecylamide)</b>	112-3		60 5				NH <sub>3</sub>				
173	<b>4-Aminobenzamide</b>	114		118d				NH <sub>3</sub>				
174	<b>Acetanilide</b>	114 (cor.)		16 6	118 2	78	86 0		184	114	160	B p 304, Conc HNO <sub>3</sub> + H <sub>2</sub> SO <sub>4</sub> → p-nitro deriv., 210
175	<b>N-Benzylcrotonamide</b>	114		72	189 (cor)	67 4	95-6		184-5	60	105	
176	<b>Ethyl oxamate</b>	114		189 5 (anh), 101(+ 2H <sub>2</sub> O) (rapid htng)	dt 204				16 5, 19		71	
177	<b>2-Chlorobenzanilide</b>	114, 118		142, 140		106	106		184	114	160	
178	<b>Dihydroacetic acid monoanilide</b>	115		109	270				184	114	160	
179	<b>n-Butyramide</b>	115	185-7	-5 5, -8	162 5, 164		63	NH <sub>3</sub>				Mercury deriv., 222-4, Oxalate, 65 9 6 2
180	<b>Methacrylamide</b>	116		16	161			NH <sub>3</sub>				
181	<b>α-Bromoisovaleranilide</b>	116		44	230d				184	114	160	
182	<b>trans-α-Crotonanilide</b>	118, 115		72, w	189 (cor)	67 4	95-6		184	114	160	
183	<b>Phenylacetanilide</b>	118		76 5, subl	256 5 (cor)	65	89		184	114	160	Conc HNO <sub>3</sub> → 2,4-dinitro- phenylacetic acid, 189
184	<b>Dichloroacetanilide</b>	118		5-6	194		99		184	114	160	
185	<b>N-Ethyl-4-nitroacetanilide</b>	118		16 6	118 2	78	86 0	96		119	98	
186	<b>Trimesic acid trianilide</b>	118- 20d		380 (cor)			tri 197 (sealed tube)		184	114	160	
187	<b>3-Iodoacetanilide</b>	119		16 6	118 2	78	86 0	33, 27	NH <sub>3</sub>	119	157	
188	<b>Cyanoacetamide</b>	120	222-3	66								

\*Derivative data given in order m.p. crystal color, solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m. p.)\* (Continued)**

No	Name	Melting point °C	Xan thyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	p-Nitro benzyl ester	p-Bromo phenacyl ester	M P , °C	B P °C	Acet amide	Benz amide	
189	Glycolamide	120		78 9, 80								
190	Isocaproamide (Isohexanamide)	120 1	159-60	-33	199 1 <sup>752</sup>		106 8	138 77 3	NH <sub>3</sub> NH <sub>3</sub>			
191	Chloroacetamide	121	208 9	α 61 3 β 56 2, γ 52 5	189			104				
192	2-Chlorophenoxyacetanilide	121		145 6, w					184	114	160	
193	Tribromoacetamide	122		131, 135	245d				NH <sub>3</sub>			
194	Sebacic acid monoanilide	122		33, subl	243 <sup>19</sup>		dt 73 5, 72 6	dt 147	184	114	160	
195	3-Chlorobenzanilide	122 5		158 155			107	116	184	114	160	
196	α-Bromopropionamide	123		25 7	203 5				NH <sub>3</sub>			
197	Furanilide	123 5		133 4	230-2	133 5	138 5		184	114	160	
198	Pyruvamide	124		13 6	165d 80 <sup>25</sup>				NH <sub>3</sub>			
199	3-Methylpentanamide	125		-41 6	197 5				NH <sub>3</sub>			
200	4-Chlorophenoxyacetanilide	125		155 6 w 158			136		184	114	160	
201	3-Benzotoluamide (N Benzoyl m toluidine)	125		122 4	249	89	119 0		203	65	125	
202	2-Toluanilide	125		104-5, 107 8	259 <sup>751</sup>	90 7	57		184	114	160	
203	Acetyl-β-phenylhydrazine	125 6		16 6	118 2	78	86 0	19, 23 243	128, dt 107	168, dt 177		
204	Adipic acid monoamide	125-30		153 4 (cor )	216 <sup>15</sup>	106	154 5, 152 6	NH <sub>3</sub>				
205	Succinimide	126	245-7	185, 182 8	235d	dt 88	dt 211	NH <sub>3</sub>				
206	3-Toluanilide	126		111-3, 110 1	263, subl	86 6	108		184	114	160	
207	Angelanilide	126		45-6	185 (cor )				184	114	160	
208	β-Resorcylanilide (2,4-Dhydroxybenzanilide)	126 7		213d (rapid htng ) 216, 217		188-9			184	114	160	
209	2-Ethylbutanamilde	127, 127 5		-31 8	195				184	114	160	
210	Suberic acid monoamide	127		144 139 41		dt 85	dt 144 2	NH <sub>3</sub>				
211	4-Methoxyacetanilide	127		16 6	118 2	78	86 0	58	240	130 127	154, 157	
212	Angelamide	127 8		45 6	185 (cor )				NH <sub>3</sub>			
213	Phenylpropiolanilide	128, 126		136 7, subl		83			184	114	160	
214	Nicotinamide	128 129, 129 31		237-8 subl					NH <sub>3</sub>			B p 150 60 <sup>5-10-4</sup> Chloroaurate, 205, N-Ethyl, 188-9, N isopropyl, 184 6
215	Pivalanilide	128 (cor ), 132-3		35 5	163 4		75-6		184	114	160	
216	Suberic acid monoanilide	128-9		144, 139-41		dt 85	dt 144 2		184	114	160	
217	Isobutyramide	129, 127	210-1	-46 1	154 7		76 8		NH <sub>3</sub>			Mercury deriv , 241
218	2-Methoxybenzamide	129		100-1	200		113		NH <sub>3</sub>			
219	2-Bromo-4-nitroacetanilide	129		16 6	118 2	78	86 0	105		129	160	Mercury deriv , 222, Phthali- mide, 168
220	Benzamide	130, 129	222 5- 3 5, 224	122 4	249	89	119		NH <sub>3</sub>			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	p-Nitrobenzyl ester	p-Bromo-phenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
221	3,4-Dimethylbenzamide	130		166, 164				NH <sub>3</sub>				
222	α,β-Dibromopropionamide	130, 133		67 (stab), 50 (unstab)	160 <sup>20</sup>			NH <sub>3</sub>				
223	Anthranilanilide	131		147				184				
224	Bromoacetanilide	131		50	208	88		184				
225	2-Methoxybenzanilide	131		100-1	200		113	184				
226	Nicotinanilide	132, bz, 85 (+ 2H <sub>2</sub> O), w, 265 (anh)		237 8, subl				184				
227	2,2-Dimethylbutanamide	132, 103		-15 0	187, 190			184				
228	d,l-2,3-Dimethylbutanamide	132		-15	191 7			NH <sub>3</sub>				
229	3,3-Dimethylbutananilide	132		6 7	184, 96 <sup>26</sup>			184				
230	3,3-Dimethylbutanamide	132		6 7	184, 96 <sup>26</sup>			NH <sub>3</sub>				
231	2,5-Dichloroacetanilide	132		16 6	118 2	78	86 0	50		132	120	
232	Malonic acid monoanilide	132		134 8 9		dt 85 5			184		114	160
233	Urea (Carbamide)	132 8	265, 274					NH <sub>3</sub>				
234	2,4-Dimethylacetanilide	133, 130		16 6	118 2	78	86 0		217	133, 130	192	
235	Mesityleneamide (3,5-Dimethylbenzamide)	133		16 6				NH <sub>3</sub>				
236	4-Isopropylbenzamide	133		177, al				NH <sub>3</sub>				
237	α-Bromoisovaleramide	133		44	230d			NH <sub>3</sub>				
238	4-Chlorophenoxyacetamide	133		155-6, w, 158			136		NH <sub>3</sub>			
239	d l-Mandelamide	133 4 (cor)		118		123-4			NH <sub>3</sub>			
240	N-(2-Naphthyl)acetamide	134		16 6	118 2	78	86 0	112		132	162	
241	3-Chlorobenzamide	134		158, 155		107	116		NH <sub>3</sub>			
242	Phenacetin (4-Aceto-phenetidide)	134		16 6	118 2	78	86 0	2 3	248 254	137	173	Br <sub>2</sub> → 1-Bromo deriv, 140 Mercury deriv, 245 10%HNO <sub>3</sub> → 3-Nitro deriv, 103
243	Chloroacetanilide	134, 136-7		α 61 3, β 56 2, γ 52 5	189		104		184	114	160	
244	2,3-Dimethylacetanilide	135		16 6	118 2	78	86 0		221-2	135	189	
245	Isovaleramide	135, 136	182-3	-30 0	176 5		68 0		NH <sub>3</sub>			
246	Acetyl salicylanilide	136		135	140d	90 5			184	114	160	
247	3-Bromobenzanilide	136		155		105	120		184	114	160	
248	Salicylanilide	136		158 3 (subl at 76)	97-8	140			184	114	160	
249	α-Hydroxyisobutyranilide	136		79	212	80 5	98		184	114	160	
250	N,N-Diacetyltetramethyl-enediamine	137		16 6	118 2	78	86 0	27	159	dt 137	dt 177	
251	Benzo-2-iodonanilide (N-Benzoyl-α-iodoaniline)	139		122 4 (subl at 100)	249	89	119	61, 58		109	139	
252	3-Ethoxybenzamide	139		137					NH <sub>3</sub>			
253	2,5-Dimethylacetanilide	139		16 6	118 2	78	86 0	15 5	213-5 184	139	140	
254	3-Aminobenzanilide	140		174d					114	114	160	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous	
				M P, °C	B P, °C	p-Nitrobenzyl ester	p-Bromophenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide		
255	2-Toluamide	140, 143	199 200 5	104-5, 107 8	259 <sup>751</sup>	90 7	57		NH <sub>3</sub>				Mercury deriv , 196
256	Trichloroacetamide	141		57-8	197 5	80			NH <sub>3</sub>				
257	2-Iodobenzanilide	141		162		111	143		184	114	160		
258	2-Bromobenzanilide	141		150		110	102		184	114	160		
259	3-Tolylurea	142							203	65	125		
260	2-Chlorobenzanilide	142		142, 140		106	106		NH <sub>3</sub>				
261	Salicylamide	142		158 3 (subl at 76)		97-8	140		NH <sub>3</sub>				Mercury deriv , 190
262	Furamide	142-3	210	133 4, 132	230-2	133 5	138 5		NH <sub>3</sub>				
263	3-Nitrobenzamide	143, 142		140		141	132		NH <sub>3</sub>				
264	Iodoacetanilide	143-4		83					184	114	160		
265	3,5-Dimethylacetanilide	144, 140		16 6	118 2	78	86		220	144, 140	136		
266	2-Benzotoluidide (N-Benzoyl-o-toluidine)	144		122 4	249	89	119		200	110-11	146	KMnO <sub>4</sub> → Benzoylanthranilic acid, 177	
267	3-Nitrosalicylamide	145 (hyd )		125					NH <sub>3</sub>				
268	2,4-Dichloroacetanilide	145		16 6	118 2	78	86 0	63		145	177		
269	α-d l-Phenylsuccinamide (β form)	145		167-8, 84 (anh )					NH <sub>3</sub>				
270	4-Toluamide	145, 148		179 80, 182 subl	275 (cor )	104 5	153		184	114	160		
271	Diethylmalonic acid monoamide	146		125		di 91			NH <sub>3</sub>				
272	Cyclohexanecarboxanilide (Hexahydrobenzanilide)	146, 131		30-1	233				184	114	160		
273	Phenylurea	147	225						184	114	160		
274	N,N'-Dibenzoyltrimethylene-diamine	147		122 4	249	89	119		136	mono 126, di 101	mono 140, di 147		
275	Benzo-2-ethylanilide (N-Benzoyl-o-ethylaniline)	147		122 4	249	89	119		210-11	111	147		
276	2,4,6-Trichloroacetanilide	148		16 6	118 2	78	86 0	78		148	172		
277	α-Bromoisoctyramide	148		48-9	198-200				NH <sub>3</sub>				
278	Cinnamamide	148, 142		133	300	116 8	145 6						
279	Succinic acid monoanilide	148 5		185, 182 8	235 d	di 88	dt 211		184	114	160		
280	N-Cyclohexybenzamide	149		122 4	249	89	119		134	104	149		
281	Benzylurea	149							184-5	60	105		
282	Phthalic acid monoamide (Phthalamic acid)	149		200-6, 197 (sealed tube), 230 (rapid htng )		di 155 5	dt 152 8		NH <sub>3</sub>				
283	β-Benzoylpropionanilide	150, 145		116					184	114	160		
284	Ethylmalonic acid monoanilide	150		111		75			184	114	160		
285	2-Chlorophenoxyacetamide	150		145-6, w					NH <sub>3</sub>				
286	Adipic acid monoanilide	151 3		153-4 (cor )	216 <sup>18</sup>	106	154 5, 152 6		184	114	160		
287	Cinnamanilide	151, 153		133	300	116 8	145 6		184	114	160	Acid KMnO <sub>4</sub> → Benzoic acid, 122 4	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	p Nitro benzyl ester	p-Bromo phenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
288	4-Fluoroacetanilide	152		16 6	118 2	78	86 0	- 1	186	152	185	
289	d L-Mandelanilide	152		118		123 4			184	114	160	
290	4-Acetotoluuidine (N-Acetyl-p-toluidine)	153, 147		16 6	118 2	78	86 0	45	200	147	158	KMnO <sub>4</sub> → 4-Acetamido-benzoic acid, 256, Br <sub>2</sub> → 3-Bromo deriv, 117
291	N-Methyl-4-nitroacetanilide	153		16 6	118 2	78	86 0	152	184	153	112	
292	Veratranilide	154		181					114	160		
293	4-Fluorobenzamide	154		182,	182 6			NH <sub>3</sub>				
294	3-Nitrobenzaniide	154		140		141	132		184	114	160	
295	Benzilamide	154-5, 155		150		99 5	152	NH <sub>3</sub>				
296	3-Nitrosalicylamide	155, 145		125 (+ H <sub>2</sub> O)				NH <sub>3</sub>				
297	2,5-Dichlorobenzamide	155		153				NH <sub>3</sub>				
298	2-Bromobenzamide	155		150		110	102	NH <sub>3</sub>				Mercury deriv, 242
299	Dibenzylacetanilide	155		89					184	114	160	
300	2-Nitrobenzaniide	155		146		112	107		184	114	160	
301	3-Bromobenzamide	155		155		105	120	NH <sub>3</sub>				Mercury deriv, 235
302	N-(1-Naphthyl) acetanilide	155, 159 6		131, 135					184	114	160	
303	Phthalonamide ( $\beta$ form)	155d		146				NH <sub>3</sub>				
304	3-Nitroacetanilide	155		16 6	118 2	78	86 0	114		mono 155, di 76	mono 155, di 150	
305	Pimelic acid dianilide	155-6		104-5, subl	223 <sup>15</sup>		di 136 6		184	114	160	
306	Pivalamide	155-7, 153-4		35 5	163-4		75-6	NH <sub>3</sub>				
307	N-Phenylsuccinimide	156		185, 182 8	235d	di 88	di 211		184	114	160	
308	Dibromoacetamide	156		48	232-5			NH <sub>3</sub>				
309	L-Malamide	156 5- 8 0		100-1			mono 87 2, di 124 5	di 179	NH <sub>3</sub>			
310	Phenylacetamide	156, 157	196	76 5, subl	256 5 (cor )	65	89		NH <sub>3</sub>			
311	3-Hydroxybenzaniide	157, 155		200, subl		106-8	176, 176 1 4		184	114	160	
312	Succinic acid monoamide (Succinamic acid)	157		185, 182 8	235d	di 88	di 211	NH <sub>3</sub>				
313	N-Acetylindole	157-8		16 6	118 2	78	86	52	253	157-8	68	
314	d L-Phenylsuccinamide ( $\alpha$ form)	158		167-8				NH <sub>3</sub>				
315	4-Benzotoluuidine (N-Benzoyl-p-toluidine)	158		122 4	249	89	119	45	200	147	158	CrO <sub>3</sub> → 4-Benzamido benzoic acid, 278
316	N-(1-Naphthyl) acetamide	159		16 6	118 2	78	86 0	50		159	160	Br <sub>2</sub> → 4-Bromo deriv, 193, Fuming HNO <sub>3</sub> → dinitro deriv, 250

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Xan thyl amide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	p-Nitro benzyl ester	p Bromo phenacyl ester	M P, °C	B P, °C	Acet amide	Benz-amide	
317	<b>4-Toluamide</b>	159, 160	224-5	179-80, 182, subl	275 (cor )	104 5	153		NH <sub>3</sub>			Mercury deriv , 260
318	<b>Crotonamide</b>	161, 158		72, w	189 (cor )	67 4	95 6		NH <sub>3</sub>			
319	<b>N-(1-Naphthyl) benzamide</b>	161		122 4	249	89	119	50		159	160	
320	<b>N-(2-Naphthyl) benzamide</b>	162		122 4	249	89	119	112		132	162	
321	<b>4-Aminoacetanilide</b>	162		16 6	118 2		86 0	140, 147	267	mono	mono	Azo-β-naphthol deriv , 261
322	<b>4-Hydroxybenzamide</b>	162 (hyd )		215, 213 4, 210		180-2	191 5 (cor ) 184		NH <sub>3</sub>			
323	<b>Benzanilide</b>	163 160		122 4	249	89	119		184	114	160	Br <sub>2</sub> →4-Bromo deriv , 204
324	<b>1-Naphthamide</b>	163, 164		161 2 (cor )			135 5		184	114	160	
325	<b>Trichloroacetanilide</b>	164		124					184	114	160	
326	<b>Veratramide</b>	164		181					NH <sub>3</sub>			
327	<b>2-Benzoylbenzamide</b>	165		128, 91 (hyd )		100 4			NH <sub>3</sub>			
328	<b>L-Glutamamide</b>	165		211 (rapid hting ), 197 (slow hting )					NH <sub>3</sub>			
329	<b>Protocatechuamide</b>	166		199- 200d			188		184	114	160	
330	<b>4-Anisamide</b>	167, 163		184 6 184 2 (cor )	275-80	132	152		NH <sub>3</sub>			Mercury deriv , 222
331	<b>4-Bromoacetanilide</b>	167, 168		16 6	118 2	78	86 0	66	245	168	204	
332	<b>Acetylanthranilamide</b>	167		185 ac a					184	114	160	
333	<b>Diphenylacetamide</b>	168		148					NH <sub>3</sub>			
334	<b>α-Benzoyl-β-phenylhydrazine</b>	168		122 4	249	89	119	19 23	243	128	168	
335	<b>2-Furanacrylamide (β-(2-Furyl)-acrylic acid)</b>	168-9		141	286				NH <sub>3</sub>			
336	<b>Piperonyl amide</b>	169		229, 228					NH <sub>3</sub>			
337	<b>d l-Tropamide</b>	169		117-8					NH <sub>3</sub>			
338	<b>Methylimino diacetic acid monoamide</b>	169		227d					NH <sub>3</sub>			
339	<b>Methylimino diacetic acid diamide</b>	169		227d					NH <sub>3</sub>			
340	<b>4-Hydroxyacetanilide</b>	169		16 6	118 2	78	86 0	184, 186		mono	N-mono 216-7, N,O-d 234	
341	<b>4-Anisamide</b>	169-71		184 6 184 2 (cor )	275-80	132	152		184	114	160	
342	<b>3-Hydroxybenzamide</b>	170 167		200 subl		106 8	176 176 7- 4		NH <sub>3</sub>			
343	<b>Sebacic acid monoamide</b>	170		33, subl	243 <sup>15</sup>	dt 73 5 72 6	dt 147		NH <sub>3</sub>			
344	<b>cis-Aconitanilide</b>	170d		125			tri 186		184	114	160	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No.	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M.P., °C	B.P., °C	p-Nitrobenzyl ester	p-Bromophenacyl ester	M.P., °C	B.P., °C	Acetamide	Benzamide	
345	Malonic acid diamide (Malondiamide).....	170	270	134.8-9	.....	di: 85.5	.....	.....	NH <sub>3</sub>	.....	.....	.....
346	D,L-Phenylsuccinic acid monoanilide ( $\beta$ form).....	170	.....	167-8; 84 (anh.)	.....	.....	.....	.....	184	114	160	.....
347	4-Ethoxybenzylamide .....	170; 172	.....	198; 195-6	.....	.....	.....	.....	184	114	160	.....
348	2-Naphthylanilide.....	171; 173	.....	184; 185.5	.....	.....	.....	.....	184	114	160	.....
349	N,N'-Diacetylethylenediamine .....	172	.....	16.6	118.2	78	86.0	8.5	116	di: 172	di: 244	.....
350	Benz-2,4,6-trichloroanilide (N-Benzoyl-2,4,6-trichloroaniline).....	172	.....	122.4	249	89	119	78	.....	148	172	.....
351	Azelaic acid diamide .....	172	.....	106.5	>360 sl. d.; 237 <sup>15</sup>	di: 43.8	di: 130.6	NH <sub>3</sub>	.....	.....	.....	.....
352	Maleic acid monoamide (Maleamic acid).....	172-3; 153 sl.d.	.....	137-8; 130 (+ 3% fumaric acid)	.....	di: 91 (cor.)	168-70; 190	NH <sub>3</sub>	.....	.....	.....	.....
353	4-Phenetylurea (Dulcin) .....	173	.....	.....	.....	.....	.....	2-3	248; 254	137	173	.....
354	4-Benzophenetide .....	173	.....	122.4	249	89	119	2-3	248; 254	137	173	.....
355	Benzylanilide .....	174-5	.....	150	.....	99.5	152	.....	184	114	160	.....
356	Pimelic acid diamide .....	175	.....	104-5, subl.	223 <sup>15</sup>	.....	di: 136.6	NH <sub>3</sub>	.....	.....	.....	.....
357	d,l-Phenylsuccinic acid monoanilide ( $\alpha$ form).....	175	.....	167-8; 84 (anh.)	.....	.....	.....	.....	184	114	160	.....
358	4-Hydroxyphenylacetamide.....	175	.....	148-50; 148, w.	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
359	Citraconic acid dianilide .....	175.5	.....	92-3; 22d.	.....	70.6	.....	.....	184	114	160	.....
360	Glutaric acid diamide.....	175-6	.....	98	302-4	di: 69	di: 139.8	NH <sub>3</sub>	.....	.....	.....	.....
361	2-(4-Tolyl)benzamide .....	175-6	.....	139-140	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
362	2-Nitrobenzamide.....	176; 175	.....	146	.....	112	107	NH <sub>3</sub>	.....	.....	.....	.....
363	Phthalonic acid monoanilide .....	176	.....	146	.....	.....	.....	184	114	160	.....	.....
364	N,N-Dibenzoyltetramethylene diamine.....	177	.....	122.4	249	89	119	27	159	di: 137	di: 177	.....
365	Acetylthranilamide.....	177	.....	185, ac. a.	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....
366	2,6-Dimethylacetanilide.....	177	.....	16.6	118.2	78	86.0	.....	215; 218	177	168	.....
367	D-Camphoric acid monoamide .....	177	.....	187.5- 8.0	.....	65.5	.....	NH <sub>3</sub>	.....	.....	.....	.....
368	Mesaconic acid diamide.....	177	.....	204.5 (cor.), subl.	.....	di: 134 (cor.)	.....	NH <sub>3</sub>	.....	.....	.....	.....
370	4-Cyanobenzylamide .....	179	.....	219; 214	.....	189	.....	.....	184	114	160	.....
371	N-Benzylphthalamide .....	179	.....	200-6; 191 (sealed tube); 230 rapid htng.)	.....	di: 155.5	di: 152.8	.....	184-5	60	105	.....
372	4-Chloroacetanilide .....	179	.....	16.6	118.2	78	86.0	72	.....	179	192	.....
373	$\alpha$ -Phthalonamide .....	179d.	.....	146	.....	.....	.....	NH <sub>3</sub>	.....	.....	.....	.....

\*Derivative data given in order: m.p., crystal color, solvent from which crystallized.

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Xanthylamide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	p Nitrobenzyl ester	p Bromophenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
374	2,4-Dimethylbenzamide	179.81		127, 90 (+H <sub>2</sub> O)				NH <sub>3</sub>		,		
375	D-Tartaric acid monoanilide	180d		169.71		di 163	di 204	184		114	160	
376	α-Acetyl-β-methylurea	180		16.6	118.2	78	86.0	-6		28	80	
377	Diphenylacetanilide	180		148				184		114	160	
378	3,5-Dinitrosalicylamide	181		182				NH <sub>3</sub>				
379	1-Naphthylacetamide	181		131, 135				NH <sub>3</sub>				
380	Maleic acid diamide	181, 180		137		di 91 (cor.)	168.70, 190	NH <sub>3</sub>				
381	unsym-Dimethyl urea	182	225					7			41	
382	Thiourea	182						NH <sub>3</sub>				
383	Hippuramide	183		187		136	151	NH <sub>3</sub>				
384	4-Tolylurea	183					45	200		147	158	
385	3,5-Dinitrobenzamide	183		204-5		157	159	NH <sub>3</sub>				
386	2-Iodobenzamide	184		162		111	143	NH <sub>3</sub>				
387	4-Iodoacetanilide	184		16.6	118.2	78	86.0	67-8		184	222	
388	Benzo-4-fluoroanilide (N-Benzoyl-p-fluoroaniline)	185		122.4	249	89	119	-1	186	152	185	
389	N,N'-Diacetyl- <i>o</i> -phenylene-diamine	185		16.6	118.2	78	86.0	102		di 185	di 301	
390	2-Nitrocinnamamide	185		240		132	141	NH <sub>3</sub>				
391	Mesaconic acid dianilide	185.7		204.5 (cor.)		di 134 (cor.)		184		114	160	
392	Citraconic acid diamide	185.7		92-3, 92d		di 70.6		NH <sub>3</sub>				
393	Chlorofumaranilide	186		191-2		di 138.5		184		114	160	
394	3-Iodobenzamide	186		187		121	128	NH <sub>3</sub>				
395	Suberic acid dianilide	186.7		144, 139- 41		di 85	di 144.2	184		114	160	
396	Maleic acid dianilide	187		137		di 91 (cor.)	168-70, 190	184		114	160	
397	Maleic acid monoanilide	187		137		di 91 (cor.)	168-70, 190	184		114	160	
398	Hippuric acid	187.5		122.4	249	89	119	Glycine 228 30, 262d 53.4		206	187.5	Acetamide, 136, Benzamide, 151
399	unsym-Diphenylurea	189	180	194-5d (cor.)			tri 186		101	180		
400	Aconitic acid dianilide	189						184	114	160		
401	meso-Tartaric acid diamide	189-90, 187		140		93		NH <sub>3</sub>				
402	4-Bromobenzamide	189-90		251-3		180		NH <sub>3</sub>				Mercury deriv., 266
403	Itaconic acid dianilide	190, 185		165		di 90.6	di 117.4	184		114	160	
404	Picramide	190		122.5				NH <sub>3</sub>				Acetamide, 230, Benzamide, 196
405	N,N'-Diacetyl- <i>m</i> -phenylene-diamine	191		16.6	118.2	78	86.0	63		mono 87-9, di 191	mono 125 di 240	
406	Itaconic acid diamide	191.2- 8		165		di 90.6	di 117.4	NH <sub>3</sub>				
407	Mucic acid monoamide	192d		214d, varies with htng rate, 223- 255		310	225	NH <sub>3</sub>				

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Xan thyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	p-Nitro benzyl ester	p-Bromo phenacyl ester	M P °C	B P °C	Acet amide	Benz- amide	
408	4-Nitrophthalimide	192		165				184		114	160	
409	2-Tolylurea	192	228	122 4	249	89	119	72		200	110-11	146
410	Benzo-4-chloroaniline (N Benzoyl p-chloroaniline)	192								179, 172	192	.
411	Buret	192d		184				NH <sub>3</sub>				
412	2-Naphthamide	192 195		185 5				NH <sub>3</sub>				
413	D-Camphoric acid diamide	193		187 5 8 0		65 5		NH <sub>3</sub>				
414	4-Chlorobenzanilide	194		243, 240		129 5	126	184		114	160	
415	4-Coumaramide	194		210 3				NH <sub>3</sub>				
				206								
				(anh )								
416	2-Benzoylbenzanilide	195		128 91		100 4		184		114	160	
				(+1 H <sub>2</sub> O)								
417	3-Nitrocinnamamide	196		199		174	178, 173	NH <sub>3</sub>				
418	D-Tartaric acid diamide	196d		169 71		di 163	di 204	NH <sub>3</sub>				
419	2-Methyl-4-nitroacetanilide	196 202		16 6	118 2	78	86 0	130	184	202		
420	L-Malanilide (Hydroxysuccin anilide)	197		100 1		mono	di 179		114	114	160	
						87 2						
						di						
						124 5						
421	4-Hydroxybenzanilide	198		215		180 2	191 5	184		114	160	
		196 7		213 4			(cor )					
422	4-Nitrophenylacetamide	198		153			207	NH <sub>3</sub>				
423	4-Nitrophenylacetanilide	198		153			207	147 8	215	di 193 ,	203	
424	Cyanoacetanilide	198-9		66				184		114	160	
425	Citric acid trianilide	199 192		100 153		tri 102	tri 148	184		114	160	
				(anh )								
426	4-Nitrophthalimide	200d		165				NH <sub>3</sub>				
427	cis-Aconitic acid dianilide	200		125			tri 186	184	114	160		
428	Methylsuccinic acid dianilide	200		115				184	114	160		
429	4-Nitrobenzamide	200	232	241		168	137	NH <sub>3</sub>				
430	2-Naphthylacetamide	200 205		141 2				NH <sub>3</sub>				
				143								
431	Isatin	200 1										Acetamide, 147
432	3-Nitrophthalic acid diamide	201d		218		189		NH <sub>3</sub>				
433	Sebacic acid dianilide	201		33, subl	243 <sup>15</sup>	di 73 5	di 147	184	114	160		
						72 6						
434	1-Naphthoamide	202		161 2		135 5		NH <sub>3</sub>				
				(cor )								
435	4-Ethoxybenzamide	202		198				NH <sub>3</sub>				
				195-6								
436	2,4-Dinitrobenzamide	203		183		142	158	NH <sub>3</sub>				
437	D-Camphoric acid monoanilide	204		187 5		65 5		184	114	160		
				8 0								
438	Benzo-4-bromoanilide (N Benzoyl-p bromoaniline)	204		122 4	249	89	119	66	245	168	204	
439	4-Nitrocinnamamide	204, 217		285		186	191	NH <sub>3</sub>				
440	N-Phenylphthalimide	205		200 6		dt 155 5	dt 152 8	184	114	160		
				191								
				(sealed tube),								
				230								
				(rapid htng )								

\*Derivative data given in order m.p., crystal color solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Xan thyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	p-Nitro benzyl ester	p-Bromo phenacyl ester	M P °C	B P °C	Acet amide	Benz amide	
441	Carballylic acid triamide	207d 205 7d		166			tri 138 2		NH <sub>3</sub>			
442	Gallalide	207		253 4d 222 40d		141	134		184	114	160	
443	Phthalonic acid diamide	208		146					184	114	160	
444	Hippuramide	208		187		136	151		184	114	160	
445	2-Coumaramide	209d		207 8, subl		152 5			NH <sub>3</sub>			
446	Sebacic acid diamide	210 208		133, subl	243 <sup>15</sup>	di 73 5 72 6	di 147		NH <sub>3</sub>			
447	4-Iodobenzalide	210		270, 265		141	146		184	114	160	
448	Citric acid triamide	210-5		153 (slow htng )		tri 102	tri 148		NH <sub>3</sub>			
449	4-Nitrobenzalide	211 204		241		168	137		184	114	160	
450	d-l-Phenylsuccinic acid diamide	211		167 8 84 (anh )					NH <sub>3</sub>			
451	Protocatechuamide	212		199 200d		188			NH <sub>3</sub>			
452	2,2'-Diphenic acid diamide	212		227 233		di 187 182 6			NH <sub>3</sub>			
453	4-Nitroacetamide	213 4		16 6	118 2	78	86 0	147 8		215	di 199 208	
454	Ethylmalonic acid diamide	214		111		75			NH <sub>3</sub>			
455	3-Nitrophthalimide	216		218		189			NH <sub>3</sub>			
456	Suberic acid diamide	216 7		144 139 41		di 85	di 144 2		NH <sub>3</sub>			
457	Methylmalonic acid diamide	217 206		137 138d					NH <sub>3</sub>			
458	4-Iodobenzamide	217		270 265		141	146		NH <sub>3</sub>			
459	Benzylmalonic acid diamide	217		117d 121		di 119 5			184	114	160	
460	4-Hydroxy-2-naphthamide	217 8		225 6					NH <sub>3</sub>			
461	Acetylurea	218		16 6	118 2	78	86 0		NH <sub>3</sub>			
462	3-Hydroxy-2-naphthamide	218		222 3 (cor )					NH <sub>3</sub>			
463	sym -Di-3-tolylurea	218		200-6, 191 (sealed tube)					203	65	125	
464	Phthalic acid diamide	220		230 (rapid htng )		di 155 5	di 152 8		NH <sub>3</sub>			
465	Mucic acid diamide	220		214d , varies with htng rate, 223-255		310	225		NH <sub>3</sub>			
466	Saccharin	220	198 9	206					NH <sub>3</sub>			
467	Adipic acid diamide	220, 229		153-4 (cor )	216 <sup>15</sup>	106	152 6 154 5		NH <sub>3</sub>			
468	d-l-Phenylsuccinic acid diamide	222		167-8, 84 (anh )					184	114	160	

\*Derivative data given in order m p , crystal color solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Xan thyl amide	Derived acid				Derived amine				Miscellaneous
				M P °C	B P °C	p Nitro benzyl ester	p Bromo phenacyl ester	M P °C	B P °C	Acet amide	Benz amide	
469	<i>β</i> -Resorcylamide	222		213d (rapid htng ) 216d 217		188 9		NH <sub>3</sub>				
470	4-Cyanobenzamide	223	219 214			189		NH <sub>3</sub>				
471	Diethylmalonic acid diamide	224	125	302 4	di 91		NH <sub>3</sub>					
472	Glutaric acid dianilide	224	98	di 69		di 139 8	184	114	160			
473	5-Nitrosalicylanilide	224	229 30				184	114	160			
474	5-Nitrosalicylamide	225	229 30				NH <sub>3</sub>					
475	Benzylmalonic acid diamide	225	117d 121		di 119 5		NH <sub>3</sub>					
476	Methylsuccinic acid diamide	225	115				NH <sub>3</sub>					
477	Malonic acid dianilide	225 227, 230	134 8-9		di 85 5		184	114	160			
478	<i>d l</i> -Tartaric acid monoamide	226	203 4 (+1 H <sub>2</sub> O) 205 6 (anh )		di 147 6		NH <sub>3</sub>					
479	D-Camphoric acid dianilide	226	187 5 8 0		65 5		184	114	160			
480	Succinic acid dianilide	230, 226	185 182 8	235d	di 88	di 211	184	114	160	Heat above m p → succinanil, 155 6 + aniline, b p 184		
481	2,2 -Diphenanilide	230	227 229 233		di 187 182 6		184	114	160			
482	Phthalimide	233 5 (cor ) 238	176 7	200 6 191 (sealed tube) 230 (rapid htng )	249	89	119	122 119	232	198, 204		
483	3,5-Dinitrobenzaniide	234	204 5		157	159	184	114	160			
484	3-Nitrophthalic acid dianilide	234	218		189		184	114	160			
485	Terephthalic acid monoanilide	234 7	300, subl with out melting		di 263 5	di 225	184	114	160			
486	<i>d l</i> -Tartaric acid monoanilide	236	203 4 (+1 H <sub>2</sub> O) 205 6 (anh )				184	114	160			
487	N-Benzylacrylamide	237	13	141, 140			184 5	60	105			
488	Carbanilide ( <i>sym</i> -Diphenyl urea)	238, 240					184	114	160			
489	Muconic acid diamide	240d	289d (slow htng ) 306 (rapid htng )				NH <sub>3</sub>					
490	Adipic acid dianilide	241	153-4 (cor )	216 <sup>15</sup>	106	152 6, 154 5	184	114	160			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	p-Nitrobenzyl ester	p-Bromo-phenacyl ester	M P, °C	B P, °C	Acet-amide	Benz-amide	
491	N,N'-Dibenzoylene-diamine	244		122 4	249	89	119	8 5	116	di 172	di 244	
492	Gallamide	245		253-4d, 222 40d		141	134		NH <sub>3</sub>			
493	3-Hydroxy-2-naphthalimide	249 (cor), 244		222-3 (cor)					184	114	160	
494	sym-Di-2-tolylurea	250							200	110 1	146	
495	Carballylic acid trianilide	252		166			tri 138 2		184	114	160	
496	Phthalic acid dianilide	253 5		200 6, 191 (sealed tube), 230 (rapid htng)		dt 155 5	dt 152 8		184	114	160	
497	Oxalic acid dianilide	254		189 5 (anh), 101 (+2 H <sub>2</sub> O) (rapid htng)		dt 204			184	114	160	
498	Succinic acid diamide	255, 260d	275	185, 182 8	235d	dt 88	dt 211		NH <sub>3</sub>			
499	2,4,6-Trinitrobenzamide	264d		228					NH <sub>3</sub>			
500	D-Tartaric acid dianilide	264d		169-71		dt 163	dt 204		NH <sub>3</sub>	114	160	
501	Fumaric acid diamide	266d		293 5 286-7 (sealed tube), 200, subl		150 8			NH <sub>3</sub>			
502	sym-Di-4-tolylurea	268						45	200	147	158	
503	Isophthalic acid monoamide	280		348, subl		202 5	179 1		NH <sub>3</sub>			
504	Isophthalic acid diamide	280		348, subl		202 5	179 1		NH <sub>3</sub>			
505	Acetylenedicarboxylic acid diamide	294d		179					NH <sub>3</sub>			
506	Mucic acid monoanilide	310		214, varies with htng rate, 223-255		310	225		184	114	160	
507	N,N'-Diacetyl p-phenylenediamine	310		16 6	118 2	78	86 0	140, 147	267	mono 162-3, di 304	mono 128, di 300	
508	Fumaric acid dianilide	314		286 7 (sealed tube), 293-5, 200, subl		150 8			184	114	160	
509	N,N'-Diacetylbenzidine	317		16 6	118 2	78	86 0	127		mono 199, di 317	mono 203-5, di 352	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

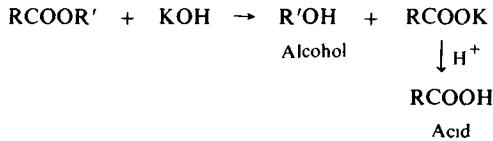
**TABLE XV. ORGANIC DERIVATIVES OF AMIDES AND IMIDES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Xanthyl amide	Derived acid				Derived amine				Miscellaneous
				M P, °C	B P, °C	p Nitrobenzyl ester	p-Bromo-phenacyl ester	M P, °C	B P, °C	Acetamide	Benzamide	
510	Terephthalic acid dianilide	334 7		300, subl without melting		di 263 5	di 225					
511	N,N'-Dibenzoylbenzidine	352		122 4	249	89	119	127		mono 199 di 317	mono 203 5 di 352	
512	Trimesic acid triamide	365d		380 (cor )			tri 197 (sealed tube)	NH <sub>3</sub>				
513	Oxalic acid diamide	419d (sealed tube)		189 5 (anh ), 101 (+2 H <sub>2</sub> O), (rapid htng )		di 204		NH <sub>3</sub>				

\*Derivative data given in order m p , crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XVI

*Hydrolysis to the corresponding acid and alcohol \**



From the ester with aqueous sodium or potassium hydroxide

*For directions and examples see Cheronis, p 539, Linstead, p 42, Vogel, pp 390, 391, 786, Wild, p 187*

From the ester and potassium hydroxide in anhydrous or aqueous diethylene glycol

*See Cheronis, p 538, C E Redemann and H J Lucas, Ind Eng Chem, Anal Ed, 9, 514 (1937)*

From the ester with sodium methoxide in methanol or with sodium ethoxide in ethanol

*See Linstead, p 40, Vogel, p 391*

From an  $\alpha$ -hydroxy ester in water without catalyst

*See A Findlay and E M H Hickmans, J Chem Soc, 95, 1004 (1909)*

*Saponification equivalent*

The saponification equivalent (S E) measures the number of equivalents of base required for complete hydrolysis of an ester. It is defined as

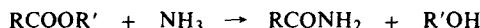
$$S E = \frac{\text{Milligrams ester taken for hydrolysis}}{\text{Milliequivalents of KOH required for complete hydrolysis}}$$

*For directions and examples see Cheronis, pp 975-6, Shriner, p 235, Vogel, p 392*

*NOTE For directions and examples for preparation of derivatives of the carboxylic acids formed on hydrolysis of esters see explanations and references to Tables XII, XIII and XIV, pp 186, 187, 188, 189*

*For directions and examples for preparation of derivatives of alcohols formed on hydrolysis of esters see explanations and references to Table VI, pp 77, 78, 79*

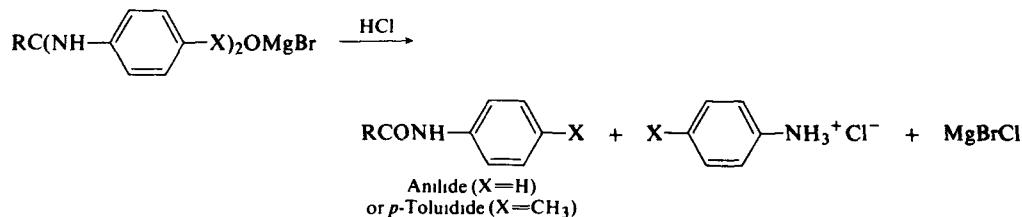
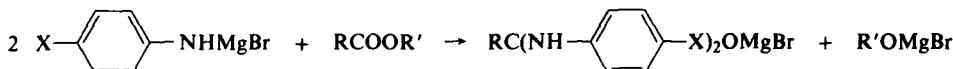
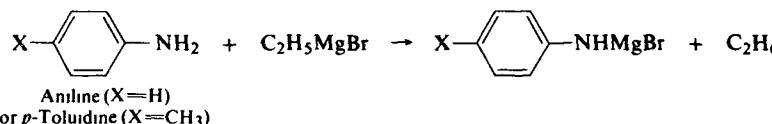
*Amide*



From the ester with aqueous or alcoholic ammonia

*For directions and examples see Linstead, p 42, Wild, p 188*

*Anilide and p-Toluidide*



From the ester and the N-magnesium bromide derivative of aniline or p-toluidine (prepared from the amine and ethylmagnesium bromide) in anhydrous ether

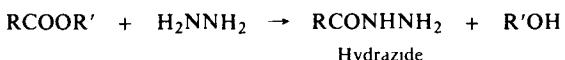
*For directions and examples see Cheronis, p 537, Linstead, pp 42-3, Vogel, p 394, Wild, p 190, C F Koelsch and D Tenenbaum, J Amer Chem Soc, 55, 3049 (1933), D V N Hardy, J Chem Soc, 398 (1936)*

\*Derivatives recommended for first trial

WARNING This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE XVI (Continued)

### *Hydrazide*



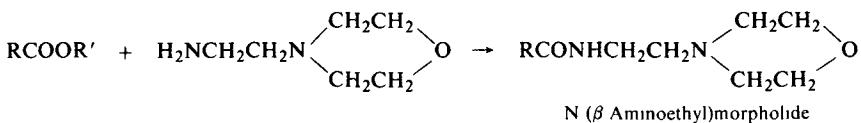
From the ester and 90% hydrazine hydrate

*For directions and examples see Linstead, p 42, Wild, p 191*

From the ester and 85% hydrazine hydrate in alcohol

*See Cheronis, p 535, Shriner, p 237, Vogel, p 395, P P T Sah, Rec Trav chim, 59, 1036 (1940)*

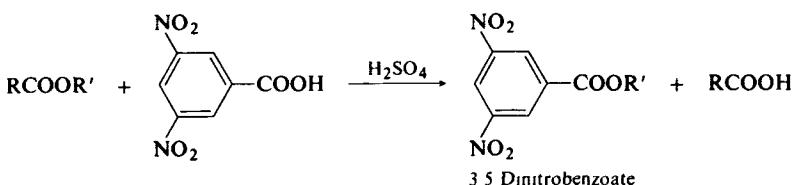
### *N-(β-Aminoethyl)morpholid\**



From the ester and *N*-(β-aminoethyl)morpholine in ethylene glycol or without solvent

*For directions and examples see Cheronis, p 536, R W Bost and L V Mullen, J Amer Chem Soc, 73, 1967 (1951)*

### *3,5-Dinitrobenzoate \**



From the ester with 3,5-dinitrobenzoic acid with a catalytic amount of sulfuric acid

*For directions and examples see Linstead, p 43, Shriner, p 238, Vogel, p 393, W B Renfrow and A Chaney, J Amer Chem Soc, 68, 150 (1946)*

From the ester with 3,5-dinitrobenzoyl chloride and pyridine

*See Cheronis, p 538*

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.).\*

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Saponification				Amide	$p$ -Toluidide	3,5-Dinitrobenzoate	Miscellaneous			
						Equivalent	Acid		Alcohol							
							M.P., °C	B.P., °C	M.P., °C	B.P., °C						
1	Ethyl nitrite	17				75			-117.3	78.32						
2	Methyl formate	31.50	-99	1.34648 <sup>1</sup> He (yel)	0.97421	60	8.4	100.7	-97	64.65	2.55	53	93, al 108 (cor), al			
3	Ethyl formate	54.15	-79.4	1.35975	0.92247	74	8.4	100.7	-117.3	78.32	2.55	53	93, al			
4	Methyl acetate	57.1	-98.7	1.36170 1.3639	0.9274 0.93347	74	16.6	118.2	-97	64.65	82	153 147	108 (cor), al			
5	Ethyl trifluoroacetate	60.5		1.3093 <sup>15</sup>		142	-15.25	72.4	-117.3	78.32			93, al			
6	Methyl nitrate	65			1.217 <sup>15</sup>	77			-97	64.65			108 (cor), al			
7	Isopropyl formate	71.68			0.8728	88	8.4	100.7	-89.5	82.4	2.55	53	123, pet eth			
8	Butyl nitrite	75			0.911	103			-90.2	117.6 116			64, 62.5			
9	Methyl chloroformate	75		1.38675	1.2231	94.5			-97	64.65			108 (cor), al			
10	Ethyl acetate	77.15	-83.6	1.372	0.90055	88	16.6	118.2	-117.3	78.32	82	153 147	93, al			
11	Methyl propionate	79.65	-87.5	1.3779	0.9151	88	-20.8	141	-97	64.65	81.81.3. 79	126 123	108 (cor), al			
12	Methyl acrylate	80.3		1.3984	0.961 <sup>19.2</sup>	86	13	140, 141	-97	64.65	84.5, pet eth	141	108 (cor), al			
13	n-Propyl formate	80.85, 81	-92.9	1.37789	0.9071, 0.918	88	8.4	100.7		97.1	2.55	53	74, pet eth			
14	tert-Butyl formate	83				102	8.4	100.7	25.5	82.5	2.55	53	142, pet eth			
15	Allyl formate	83.6			0.946	86	8.4	100.7		97.1	2.55	53	49-50			
16	Ethyl nitrate	87	-112		1.106	91			-117.3	78.32			93, al			
17	Isopropyl acetate	88.9, 91	-73.4	1.3740 <sup>25</sup>	0.872	102	16.6	118.2	-89.5	82.4	82	153, 147	123, pet eth			
18	Dimethyl carbonate (Methyl carbonate)	90.5		1.3687	1.0702 1.0694	90			-97	64.65			108 (cor), al			
19	Methyl isobutyrate	92.6, 92.26	-87.7, -84.7	1.3840	0.8906	102	-46.1	154.7	-97	64.65	128, 129	108.5- 9.5	108 (cor), al			
20	Ethyl chloroformate	93		1.3974	1.13519	108.5			-117.3	78.32			93, al			
21	sec-Butyl formate	97		1.384	0.884	102	8.4	100.7		99.5	2.55	53	76			
22	tert-Butyl acetate	97.8		1.386	0.867	116	16.6	118.2	25.5	82.5	82	153, 147	142, pet eth			
23	Isobutyl formate	98.4	-95.8	1.38568	0.88535, 0.8755	102	8.4	100.7		108.1	2.55	53	87			
24	Isoamyl nitrite	99		1.38708 <sup>21</sup>	0.880 <sup>15</sup>	117			-117	132			61			
25	Ethyl difluoroacetate	99		1.3463		124			134.5	-117.3	78.32	52	93, al			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>40</sub> <sup>20</sup>	Saponification				Amide	P Tolu dide	3,5-Di- nitro benzoate	Miscellaneous			
						Equiv- ivalent	Acid		Alcohol							
							M P, °C	B P, °C	M P °C	B P, °C						
26	Methyl meth-acrylate	99, 100 1	-50	1.413	0.936	100	16	161	-97	64 65	102 6		108 (cor ), al	Polymerizes on standing or heating.		
27	Ethyl propionate	99 1	-73 85	1.3853	0.8889	102	-20 8	141	-117 3	78 32	81, 81 3, 79	126, 123	93, al	N-(β-Aminoethyl)morpholine, 85		
28	Ethyl acrylate	101		1.4059 <sup>19,4</sup>	0.9136 <sup>15</sup>	100	13	141	-117 3	78 32	84-5, pet eth	141	93, al	Polymerizes on standing or heating		
29	Methyl pivalate (Methyl trimethylacetate)	101		1.4228	0.8910	116	35 5	163-4	-97	64 65	155 7, 153 4, et ac - pet eth	119 20	108 (cor ), al			
30	n-Propyl acetate	101 55	-95	1.38468	0.8834	102	16 6	118 2		97 1	82	153 147	74, pet eth			
31	Methyl n-butyrate	102 3	-84 8	1.3879	0.8982	102	-5 5 -8	162 5, 164	-97	64 65	115 6	75	108 (cor ), al			
32	Allyl acetate	104		1.40488	0.9276	100	16 6	118 2		97 1	82	153 147	49 50			
33	Trimethyl ortho-formate (Methyl orthoformate)	105, 102		1.3793	0.9676	106	8 4	100 7	-97	64 65	2.55	53	108 (cor ), al			
34	Methyl iso-crotonate	106 2 108 2 (cor )				100	15	169	-97	64 65	101 2	132	108 (cor ), al			
35	n-Butyl formate	106 6	-91 9	1.38940	0.8885	102	8 4	100 7	-90 2	117 6, 116	2.55	53	64, 62 5			
36	Ethyl isobutyrate	109 8, 111	-88 2	1.3903	0.86930	116	-46 1	154 7	-117 3	78 32	128, 129	108.5- 9.5	93, al	Hydrazide, 104, eth -al		
37	n-Propyl nitrate	110		1.3979	1.063	105				97 1			74, pet eth			
38	Chloromethyl acetate	111			1.094 <sup>15</sup>	108 5	16 6	118 2		82	153 147					
39	Isopropyl propionate	111 3			0.8931 <sup>9</sup>	116	-20 8	141	-89 5	82 4	81, 81 3, 79	126, 123	123, pet eth			
40	sec-Butyl acetate	112 0		1.3865 <sup>25</sup>	0.872, 0.8648 <sup>25</sup>	116	16 6	118 2		99 5	82	153, 147	76			
41	n-Propyl chloro-formate	113 115		1.40350	1.0901	122 5				97 1			74, pet eth			
42	Methyl isovalerate	116 7		1.3900 <sup>25</sup>	0.8808	116	-30 0	176 5	-97	64 65	135, 137	106 7	108 (cor ), al			
43	Isobutyl acetate	117 2 118		1.39008	0.8747	116	16 6	118 2		108 1	82	153, 147	87			
44	Ethyl pivalate (Ethyl trimethyl-acetate)	118 15		1.39061	0.85467	130	35 5	163-4	-117 3	78 32	155 7, 153-4, et ac - pet eth	119 20	93, al			
45	Ethyl meth-acrylate	118 5 <sup>11</sup>		1.41472	0.91063	114	16	161	-117 3	78 32	102 6		93, al	Polymerizes on heating. 4-Bromo-anilide, 116		

\*Derivative data given in order m p crystal color solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Saponification					Amide	$p$ -Toluidide	3,5-Dinitrobenzoate	Miscellaneous				
						Equivalent	Acid		Alcohol									
							M P., °C	B P., °C	M P., °C	B P., °C								
46	Methyl crotonate	118.8-119.3			0.9806 <sup>4</sup>	100	72	189 (cor.)	-97	64.65	118, w., 115	132, bz	108 (cor.), al					
47	Isopropyl iso-butyrate	120.76			0.84708 <sup>21,3</sup>	130	-46.1	154.7		82.4	128, 129	108.5-9.5	123, pet eth	Hydrazide, 104, eth-al				
48	Ethyl <i>n</i> -butyrate	121.6	-100.8	1.40002	0.87917	116	-5.5, -8	162.5, 164	-117.3	78.32	115-6	75	93, al					
49	<i>n</i> -Propyl pro-pionate	122.2, 123.4	-75.9	1.39325	0.8809	116	-20.8	141		97.1	81, 81.3, 79	126, 123	74, pet eth					
50	<i>tert</i> -Amyl acetate (Dimethylethylcarbinyl acetate)	124		1.392	0.8738 <sup>19</sup>	130	16.6	118.2	-8.55	102.3	82	153, 147	116, 117-8					
51	Allyl propionate	124				114	-20.8	141		97.1	81, 81.3, 79	126, 123	49.50					
52	Isoamyl formate	124.2	-93.5	1.39756	0.8820	116	8.4	100.7	-117	132	2.55	53	61					
53	Ethyl isocrotonate	125.5-126 <sup>74</sup>		1.42423	0.91820	114	15	169	-117.3	78.32	101.2	132	93, al					
54	<i>n</i> -Butyl acetate	126.1	-73.5	1.39614	0.881	116	16.6	118.2	-90.2	117.6, 116	82	153, 147	64, 62.5					
55	Diethyl carbonate (Ethyl carbon-ate)	126.5	-43.0	1.3852	0.9752	118			-117.3	78.32			93, al					
56	<i>tert</i> -Butyl iso-butyrate	126.7		1.3921		144	-46.1	154.7	25.5	82.5	128, 129	108.5-9.5	142, pet eth	Hydrazide, 104, eth-al				
57	Methyl <i>n</i> -valerate (Methyl <i>n</i> -pentanoate)	127.7	-91.0	1.397	0.885	116	-34.5	186.35	-97	64.65	106	74	108 (cor.), al					
58	Isopropyl <i>n</i> -butyrate	128			0.8652 <sup>13</sup>	130	-5.5, -8	162.5, 164	-89.5	82.4	115-6	75	123, pet eth					
59	Isobutyl chloro-formate	130, 128.8		1.40711 <sup>17,9</sup>		136.5				108.1			87					
60	Methyl methoxy-acetate	130		1.39636	1.0511	104		203	-97	64.65	96.5-7.0, 92.4		108 (cor.), al					
61	Methyl chloro-acetate	130, 132		1.4221	1.238	108.5	$\alpha$ 61.3, $\beta$ 56.2, $\gamma$ 52.5	189	-97	64.65	121	162	108 (cor.), al					
62	Ethyl methoxy-acetate	132			1.0118 <sup>15</sup>	118		203	-117.3	78.32	96.5-7.0, 92.4		93, al					
63	<i>n</i> -Amyl formate	132.1, 130	-73.5	1.39916	0.8853	116	8.4	100.7	-78.5	138 (cor.)	2.55	53	46.4					
64	<i>sec</i> -Amyl(3) acetate (Diethylcarbinyl acetate)	133			1.4005	130	16.6	118.2		116.1	82	153, 147	101, 99, 97					
65	<i>sec</i> -Amyl(2) acetate (Methyl <i>n</i> -propylcarbinyl acetate)	133.5		1.3960	0.8692 <sup>18</sup>	130	16.6	118.2		119.85	82	153, 147	62					
66	Allyl isobutyrate	134				128	-46.1	154.7		97.1	128, 129	108.5-9.5	49-50	Hydrazide, 104, eth-al				
67	Ethyl isovalerate	134.7	-99.3	1.4009	0.86565	130	-30.0	176.5	-117.3	78.32	135, 137	106-7	93, al					
68	<i>n</i> -Propyl iso-butyrate	135		1.3959	0.8843 <sup>9</sup>	130	-46.1	154.7		97.1	128, 129	108.5-9.5	74, pet eth	Hydrazide, 104, eth-al				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification					Amide	p-Toluene-diol	3,5-Dinitrobenzoate	Miscellaneous				
						Equiv alent	Acid		Alcohol									
							M P, °C	B P °C	M P °C	B P °C								
69	<i>n</i> -Butyl nitrate	136			1.048 <sup>0</sup>	119			-90.2	117.6 116			64, 62.5					
70	Methyl pyruvate	136.8 138, 134-7			1.154 <sup>0</sup>	102	13.6	165d	-97	64.65	124.5 145	109 130	108 (cor), al	2,4-Dinitrophenylhydrazone, 186.5-7.5 (cor), yel, diox-meal				
71	Methyl α-hydroxyisobutyrate	137				118	79	212	-97	64.65			132.3, w	108 (cor), al				
72	Isobutyl propionate	138, 137	-71.4	1.3975	0.8876 <sup>0</sup>	130	-20.8	141		108.1	81, 81.3, 79	123-6	87					
73	Ethyl crotonate	138, 136.7 <sup>49</sup>		1.42524	0.91752	114	72, w	189 (cor)	-117.3	78.32	159.60, bz	132, bz	93, al					
74	Allyl <i>n</i> -butyrate	142				128	-5.5 -8	162.5, 164		97.1	115-6	75	49.50					
75	Isoamyl acetate (3-Methylbutyl acetate)	142		1.40034	0.8674	130	16.6	118.2	-117	132	82	153, 147	61					
76	Isopropyl iso-valerate	142		1.3938 <sup>25</sup>	0.8538 <sup>17</sup>	144	-30	176.5	-89.5	82.4	135.137	106.7	123, pet eth					
77	<i>n</i> -Propyl <i>n</i> -butyrate	143.8	-95.2	1.4005	0.872	130	-5.5 -8	162.5 164		97.1	115.6	75	74, pet eth					
78	β-Methoxyethyl acetate (Ethylene glycol mono-methyl ether acetate, Methyl cellosolve acetate)	144			1.088	118	16.6	118.2		124.5	82	153 147						
79	Methyl bromo-acetate	144d			1.657	153	50	208	-97	64.65	91		108 (cor), al					
80	<i>n</i> -Butyl chloroformate	145, 139		1.417 <sup>x,4</sup>	1.079	136.5			-90.2	117.6, 116			64, 62.5					
81	β-Chloroethyl acetate	145		1.4234	1.178	122.5	16.6	118.2		131	82	153, 147						
82	Methyl <i>d,l</i> -lactate	145 144.8		1.4144	1.0931	104	16.8, 18	122 <sup>15</sup>	-97	64.65	78.5-9.0 (cor), bz-al (31)	107	108 (cor), al					
83	Ethyl chloro-acetate	145	-26	1.42274	1.158	122.5	α 61.3, β 56.2, γ 52.5	189	-117.3	78.32	121	162	93, al					
84	<i>tert</i> -Butyl <i>n</i> -butyrate	145-6.6		1.4001 <sup>17,5</sup>		144	-5.5, -8	162.5, 164	25.5	82.5	115-6	75	142, pet eth					
85	Triethyl orthoformate (Ethyl-orthoformate)	145.5		1.3922	0.8909	148	8.4	100.7	-117.3	78.32	2.55	53	93, al					
86	Ethyl <i>n</i> -valerate (Ethyl <i>n</i> -pentanoate)	145.5	-91.2	1.40094	0.8739	130	-34.5	186.35	-117.3	78.32	106	74	93, al					
87	Ethyl α-chloro-propionate	146			1.087	136.5		186	-117.3	78.32	80	124	93, al	Phenylhydra-zide, 95				

\* Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_D^n$	$D_4^{20}$	Saponification				Amide	$p$ -Toluidide	3,5-Dinitrobenzoate	Miscellaneous			
						Equiv.- alent	Acid		Alcohol							
							M.P. °C	B.P. °C	M.P. °C	B.P. °C						
88	<i>n</i> -Butyl propionate	146.8	-89.6	1.4038 <sup>15</sup>	1.401	130	-20.8	141	-90.2	117.6, 116	81.81.3, 79	126, 123	64 62.5			
89	Benzyl chloro-acetate	147		1.5246 <sup>18</sup>	1.2223 <sup>1</sup>	170.5	$\alpha$ 61.3. $\beta$ 56.2 $\gamma$ 52.5	189	-15.3	205.5	121	162	113			
90	Di-isopropyl carbamate (Isopropyl carbonate)	147.2 (cor.)		1.3932	0.9162	146			-89.5	82.4			123, pet eth			
91	Methyl isobutyl-carbinyl acetate	148			0.8805 <sup>16</sup>	130	16.6	118.2	-97	64.65	82	153 147	108 (cor.), al			
92	Methyl ethoxy-acetate	148			1.0112 <sup>1</sup>	118		206.7	-97	64.65	80.2	32, eth	108 (cor.), al			
93	Isobutyl iso-butyrat e	148.6	-80.65	1.3999	0.87496 <sup>19</sup>	144	-46.1	154.7		108.1	128, 129	108.5 9.5	Hydrazide, 104, eth-al			
94	<i>n</i> -Amyl acetate ( <i>n</i> -Pentyl acetate)	149.25	-70.8	1.4031	0.8756	130	16.6	118.2	-78.5	138 (cor.)	82	153 147	46.4			
95	Ethyl $\alpha$ -hydroxy-isobutyrate	150				132	79	212	-117.3	78.32		132.3, w	93, al			
96	Methyl glycolate	151.2			1.1677 <sup>18</sup>	90	78.9 80		-97	64.65	120. al - et ac	143, w	108 (cor.), al			
97	Methyl <i>n</i> -caproate (Methyl <i>n</i> -hexanoate)	151.25	-71.0	1.405	0.88464	130	-3.9	205.35	-97	64.65	100.1	74.5	123, pet eth			
98	Isopropyl <i>n</i> -valerate (Isopropyl <i>n</i> -pentanoate)	153.5		1.4009	0.8579	144	-34.5	186.35	-89.5	82.4	106	74	61			
99	Isoamyl chloro-formate	154		1.41916 <sup>1</sup> <sub>He</sub>	1.032 <sup>15</sup>	150.5			-117	132			93, al			
100	Ethyl <i>d,l</i> -lactate	154.5		1.410	1.030	118	16.8, 18	122 <sup>15</sup>	-117.3	78.32	78.5 9.0 (cor.), bz-al., (3.1)	107	93, al			
101	Ethyl pyruvate	155		0.0596 <sup>15.6</sup>	1.408 <sup>15.6</sup>	116	13.6	165d	-117.3	78.32	124.5, 145	109, 130	93, al			
102	<i>n</i> -Propyl iso-valerate	155.5		1.40413 <sup>17.8</sup>	0.8643 <sup>17.8</sup>	144	-30	176.5		97.1	135, 137	106-7	Phenylhydrazone, 118, dil al 4-Nitrophenylhydrazone, 185-7, 2,4-Dinitrophenylhydrazone, 154.5 155 (cor.), diox-al			
103	<i>n</i> -Hexyl formate	155.51	-62.65	1.40898 <sup>15</sup> <sub>He (yel)</sub>	0.88133	130	8.4	100.7	-51.6 -46.1	157.5	2.55	53	74, pet eth 58.4 (cor.)			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Saponification				Amide	$p$ -Toluidine	3,5-Dinitrobenzoate	Miscellaneous			
						Equiv- alent	Acid		Alcohol							
							M P °C	B P °C	M P °C	B P °C						
104	$\beta$ -Ethoxyethyl acetate (Ethylene glycol monoethyl ether acetate, Ethyl cellosolve acetate)	156.2, 158		1.40292	0.9701	132	16.6	118.2		135	82	153, 147	75, al			
105	Isobutyl <i>n</i> -butyrate	157		1.40295 <sup>18,4</sup>	0.8620	144	-5.5 -8	162.5 164		108.1	115.6	75	87			
106	Ethyl dichloroacetate	158		1.43860	1.2821	157	5.6	194	-117.3	78.32	98 (subl.)	153	93, al			
107	Ethyl bromoacetate	159		1.451	1.506	167	50	208	-117.3	78.32	91		93, al			
108	Ethyl glycolate	160			1.0869 <sup>15</sup>	104	78.9 80		-117.3	78.32	120, al- et ac	143, w	93, al			
109	Isoamyl propionate	160.2		1.4065	0.870	144	-20.8	141	-117	132	81.81.3 79	126 123	61			
110	Ethyl $\alpha$ -bromo- propionate	162			1.524	181	25.7	203.5	-117.3	78.32	123	125	93, al			
111	Cyclohexyl formate	162.5 <sup>750</sup>		1.443	1.010	128	8.4	100.7	25.1	161.1	2.55	53	112-3, al			
112	$\beta$ -Bromoethyl acetate	163			1.524	167	16.6	118.2		149d	82	153, 147				
113	Tetraethyl silicate (Ethyl orthosilicate)	165.5, 168.5		1.38619	0.93975	52			-117.3	78.32			93, al			
114	<i>n</i> -Propyl <i>n</i> - valerate ( <i>n</i> - Propyl <i>n</i> - pentanoate)	166.2, 167	-70.7	1.4065	0.8699	144	-34.5	186.35		97.1	106	74	74, pet eth			
115	<i>n</i> -Butyl <i>n</i> -butyrate	166.6	-91.5	1.406	0.869	144	-5.5 -8	162.5, 164	-90.2	117.6 116	115.6	75	64, 62.5			
116	Ethyl <i>n</i> -caproate (Ethyl <i>n</i> - hexanoate)	167.7	-67.5	1.40727	0.8710	144	-3.9	205.35	-117.3	78.32	100.1	74.5	93, al			
117	Ethyl trichloro- acetate	168		1.450	1.380	191.5	57.8	197.5	-117.3	78.32	141	113	93, al			
118	Isopropyl <i>d,l</i> - lactate	168, 166.8		1.4082 <sup>25</sup>	0.998	132	16.8, 18	122 <sup>15</sup>	-89.5	82.4	78.5 (cor.), bz-al (3.1)	107	123, pet eth			
119	Di- <i>n</i> -propyl car- bonate ( <i>n</i> -Propyl carbonate)	168.5 (cor.)		1.4014	0.9411	146				97.1			74, pet eth			
120	<i>n</i> -Amyl propionate ( <i>n</i> -Pentyl propionate)	168.7	-73.1	1.4096 <sup>15</sup>	0.8761 <sup>15</sup>	144	-20.8	141	-78.5	138 (cor.)	81.81.3, 79	126, 123	46.4			
121	Ethyldiene di- acetate	169			1.061 <sup>12</sup>	73	16.6	118.2	-12.6	197.85	82	153, 147	169			
122	Isoamyl iso- butyrate	169			0.8760 <sup>0</sup>	158	-46.1	154.7	-117	132	128, 129	108.5- 9.5	61			
123	Methyl aceto- acetate	170		1.41964	1.0765 <sup>0</sup>	116			-97	64.65			108 (cor.), al			
124	Isobutyl iso- valerate	171		1.40569	0.8534	158	-30	176.5	.	108.1	135, 137	106.7	87			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Saponification				Amide	$\rho$ -Toluidine	3,5-Dinitrobenzoate	Miscellaneous			
						Equivalent-	Acid		Alcohol							
							M.P., °C	B.P., °C	M.P., °C	B.P., °C						
125	Methyl enanthate (Methyl <i>n</i> -heptanoate)	173.8	-55.8	1.412	0.88011	144	-74.7	223	-97	64.65	96, 96.5	81	108 (cor.), al 46.4			
126	Ethylene glycol diformate	174			1.193 <sup>0</sup>	59	8.4	100.7	-78.5	138 (cor.)	2.55	53				
127	<i>sec</i> -Butyl <i>n</i> -valerate ( <i>sec</i> -Butyl <i>n</i> -pentanoate)	174.5		1.4081	0.8605 <sup>20</sup>	158	-34.5	108.35		99.5	106	74	76			
128	Cyclohexyl acetate	175		1.442	0.970	142	16.6	118.2	25.1	161.1	82	153, 147	112.3, al 64, 62.5			
129	<i>n</i> -Butyl chloroacetate	175			1.081	150.5	$\alpha$ 61.3, $\beta$ 56.2, $\gamma$ 52.5	189	-90.2	117.6, 116	121	162				
130	Furfuryl acetate	175.7		1.4627	1.118	140	16.6	118.2		172, 170	82	153, 147	80.1			
131	Methyl methyl-acetoacetate	177.4		1.418	1.030	130			-97	64.65			108 (cor.), al			
132	<i>n</i> -Heptyl formate	178.12		1.41505 <sup>15</sup>	0.87841	144	8.4	100.7	-34.6, -33.8	176.8	2.55	53	46.47			
133	<i>n</i> -Hexyl acetate	178.1	-80.9, -60.9	1.41122 <sup>15</sup>	0.87336	144	16.6	118.2	-51.6, -46.1	157.5	82	153, 147	58.4 (cor.)			
134	Isoamyl <i>n</i> -butyrate	178.6		1.411	0.864	158	-5.5, -8	162.5, 164	-117	132	115.6	75	61			
135	Ethyl $\beta$ -bromo-propionate	179			1.425	181	62.5		-117.3	78.32	111		93, al			
136	Ethyl acetyl-glycolate	179			1.0993 <sup>17</sup>	73			-117.3	78.32			93, al			
137	Isobutyl <i>n</i> -valerate (Isobutyl <i>n</i> -pentanoate)	179		1.4099	0.8625	158	-34.5	186.35		108.1	106	74	87			
138	$\beta$ -Hydroxyethyl formate (Ethylene glycol mono-formate)	180			1.1989 <sup>15</sup>	90	8.4	100.7	-78.5	138 (cor.)	2.55	53	46.4			
139	Ethyl methylacetooacetate	180.8 (cor.), 187		1.419	1.0191	144			-117.3	78.32	73, eth		93, al			
140	Ethyl acetoacetate	181		1.41976	1.025	130			-117.3	78.32			93, al			
141	Methyl pyromucate (Methyl 2-furoate)	181.3		1.4860	1.180	126	133.4, 132	230-2	-97	64.65	142-3	170.5, al	108 (cor.), al			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>t</sub> <sup>20</sup>	Saponification				Amide	p-Toluidide	3,5-Dinitrobenzoate	Miscellaneous			
						Equiv. equivalent	Acid		Alcohol							
							M.P. °C	B.P. °C	M.P. °C	B.P. °C						
142	Dimethyl malonate (Methyl malonate)	181.5	-62	1.41398	1.1539	66	134.8	9	-97	64.65	mono 106 110 di 170 w-al	mono 156d di 252 3, al	108 (cor.) al	Phenylhydrazide, 194		
143	Ethyl β-methoxyethyl carbonate	182.6		1.4036 <sup>25</sup>	1.0424 <sup>25</sup>	148			-117.3	78.32			93 al			
144	Methyl cyclohexanecarboxylate (Methyl hexahydrobenzoate)	183		1.45372 <sup>15</sup>	0.9954 <sup>15</sup>	142	30.1	233	-97	64.65	185.6		108 (cor.), al			
145	Diethyl oxalate (Ethyl oxalate)	185.19	-41.5, -40.6	1.41043	1.0785	73	189.5 (anh.) 101 (+ 2H <sub>2</sub> O)		-117.3	78.32	mono 219 di 419d	mono 169 di 268	93, al	N-(β-Aminoethyl)-morpholine 170		
146	n-Amyl n-butylate (n-Pentyl n-butylate)	186.4	-72.3	1.412	0.866	158	-5.5, -8	162.5 164	-78.5	138 (cor.)	115-6	75	46.4			
147	n-Butyl n-valerate (n-Butyl n-pentanoate)	186.9	-92.8	1.4123	0.8678	158	-34.5	186.35	-90.2	117.6 116	106	74	64 62.5			
148	β-Hydroxyethyl acetate (Ethylene glycol monoacetate)	187-9				104	16.6	118.2	-78.5	138 (cor.)	82	153 147	46.4			
149	n-Propyl n-caproate (n-Propyl n-hexanoate)	187.15 186	-74.0	1.417	0.86719	158	-3.9	205.35		97.1	100.1	74.5	74, pet eth			
150	Dimethyl sulfate (Methyl sulfate)	188	-27	1.3874	1.3348 <sup>15</sup>	63			-97	64.65			108 (cor.), al			
151	n-Butyl lactate	188	-43	1.4216	0.984 <sup>20</sup>	146	16.8, 18	122 <sup>15</sup>	-90.2	117.6 116	78.5-9.0 (cor.), bz-al (3.1) 96, 96.5	107	64 62.5			
152	Ethyl enanthate (Ethyl n-heptanoate)	188.6	-66.3	1.413	0.86856	158	-7.47	223	-117.3	78.32		81	93, al			
153	Methyl ethylacetacetate	189.7 (cor.)			0.989	144			-97	64.65	95.6, bz		108 (cor.), al			
154	Di-isobutyl carbonate (Isobutyl carbonate)	189.8 (cor.)		1.4072	0.9138	174				108.1			87			
155	n-Hexyl propionate	190	-57.5	1.41621 <sup>15</sup> He (yel)	0.86980	158	-20.8	141	-51.6 -46.1	157.5	81, 81.3, 79	126 123	58.4 (cor.)			
156	Ethylene glycol diacetate	190.2	-31	1.4150	1.1040	73	16.6	118.2	-78.5	138 (cor.)	82	153, 147	46.4			
157	Isoamyl iso-valerate	190.4		1.41300 <sup>18.7</sup>	0.870	172	-30	176.5	-117	132	135, 137	106.7	61			
158	n-Heptyl acetate	192.45		1.41653 <sup>15</sup> He (yel)	0.87070 <sup>15</sup>	158	16.6	118.2	-34.6, -33.8	176.8	82	153, 147	46, 47			
159	Cyclohexyl propionate	193 <sup>750</sup>			0.9718 <sup>0</sup>	156	-20.8	141	25.1	161.1	81, 81.3, 79	126, 123	112.3, al			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Saponification				Amide	$p$ -Tolu-dide	3,5 Di-nitrobenzoate	Miscellaneous			
						Equivalent	Acid		Alcohol							
							M P., °C	B P., °C	M P., °C	B P., °C						
160	Di-isopropyl oxalate (Iso-propyl oxalate)	193.4		1.4100	1.0097	87	189.5 (anh.), 101 (+ $2\text{H}_2\text{O}$ )		-89.5	82.4	mono 219, <i>di</i> 419d	mono 169, <i>di</i> 268	123, pet eth			
161	Ethyl $\beta$ -ethoxy-ethyl carbonate	194.5		1.5064 <sup>25</sup>	1.0115 <sup>25</sup>	162			-117.3	78.32			93, al			
162	<i>sec</i> -Octyl acetate	194.5		1.4141	0.8606 <sup>19</sup>	172	16.6	118.2		179	82	153, 147	32			
163	Methyl <i>n</i> -caprylate (Methyl <i>n</i> -octanoate)	194.6	-41	1.417	0.878	158	16.3	237 239.3	-97	64.65	57	70	108 (cor), al			
164	$\alpha$ -Tetrahydro-furfuryl acetate	195, 194		1.4350	1.0624 <sup>25</sup>	144	16.6	118.2		177- 8 <sup>743</sup>	82	153, 147	83-4			
165	Methyl levulinic acid	196, 191		1.42333	1.04945	130	33.5	245-6	-97	64.65	107-8, al	108.9, w	108 (cor), al	Semicarba- zone, 142- 3, Phenyl- hydrazone, 94-6, 2,4- Dinitro- phenylhyd- razone, 141.5-2.5 (cor), diox-al, Oxime, 96		
166	Ethyl cyclohexanecarboxylate (Ethyl hexahydrobenzoate)	196		1.45012 <sup>15</sup>	0.9672 <sup>15</sup>	156	30.1	233	-117.3	78.32	185.6		93, al			
167	Diethyl methyl-malonate	196			1.019 <sup>15</sup>	87	137, 138d		-117.3	78.32	217, 206	mono 145d, <i>di</i> 228, 214	93, al			
168	Phenyl acetate	196.7		1.503	1.078	136	16.6	118.2	41.8, 42	182	82	153, 147	145.8 (cor), al			
169	Ethyl ethylacetacetate	198		1.422	0.9856	158			-117.3	78.32	95.6, bz		93, al	Ketone cleavage → 2-penta- none, b p 102		
170	<i>n</i> -Octyl formate	198.8	-39.1	1.42082 <sup>15</sup> He (yel)	0.87435	158	8.4	100.7	-16, -16.7	195	2.55	53	61-2			
171	2-Ethyl-1-hexyl acetate	199			0.8733 <sup>20</sup>	172	16.6	118.2		184.6	82	153, 147				
172	Methyl benzoate	199.2	-12.4	1.5164	1.0888	136	122.4	249	-97	64.65	130	158	108 (cor), al			
173	Diethyl malonate (Ethyl malonate) ...	199.3	-51.5	1.41618	1.05513	80	134.8-9		-117.3	78.32	mono 106 10, <i>di</i> 170, w-al	mono 156d, <i>di</i> 252-3, al	93, al	Phenylhy- drazide, 194		
174	Methyl cyanoacetate	200	-22.5		1.0962 <sup>25</sup>	99	66		-97	64.65	119.20		108 (cor), al			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification				Amide	p-Toluene-dide	3,5-Dinitrobenzoate	Miscellaneous			
						Equiv. equivalent	Acid		Alcohol							
							M P., °C	B P., °C	M P., °C	B P., °C						
175	Dimethyl mesaconate	203		1.45119	1.0914	79	204.5 (cor.)		-97	64.65	mono (α) 222 (β) 174, di 176.5	mono (α) 196, di 212, al	108 (cor.), al	Dihydrazide, 215d, dil al		
176	Benzyl formate	203		1.516	1.080	136	8.4	100.7	-15.3	205.5	2.55	53	113			
177	Vinyl benzoate	203		~	1.065	148	122.4	249			130	158				
178	Cyclohexyl isobutyrate	204 <sup>750</sup>		0.9489 <sup>0</sup>	170	-46.1	154.7	25.1	161.1	128.129	108.5	112-3, 9.5		Hydrazide, 104, al-eth		
179	Dimethyl maleate	204.4	7.6	1.44156	1.14513 <sup>15</sup>	72	137		-97	64.65	mono (α) 172.3, w, 153, sl d, di 181, me al	di, 142, eth	108 (cor.), al			
180	α-Tetrahydro-furfuryl propionate	204-7			1.044	158	-20.8	141		177.8 <sup>743</sup>	81, 81.3	126	83.4			
181	Ethyl levulinate	205.8		1.42288	1.01114	144	33.5	245.6	-117.3	78.32	107-8d	108-9, w	93, al	Semicarbazone, 147.8, Phenylhydrazone, 103-4, 2,4-Dinitrophenylhydrazone, 101.2, diox-al, Oxime, 96		
182	Ethyl allylaceto-acetate	206 sl d, 211-2 sl d		1.43 <sup>17.6</sup>	0.9898	170			-117.3	78.32			93, al	Semicarbazone, 125, w		
183	n-Amyl n-valerate (n-Pentyl n-pentanoate)	207.4		1.4181 <sup>15</sup>	0.8825 <sup>0</sup>	172	-34.5	186.35	-78.5	138 (cor.)	106	74	46.4			
184	Di-n-butyl carbonate (n-Butyl carbonate)	207.5 (cor.)		1.4117	0.9238	174			-90.2	117.6, 116			64, 62.5			
185	n-Butyl n-caproate (n-Butyl n-hexanoate)	207.74	-63.1, -64.3	1.41877 <sup>15</sup> He (yel)	0.86530	172	-3.9	205.35	-90.2	117.6, 116	100-1	74.5	64, 62.5			
186	n-Hexyl n-butylate	207.88	-78	1.41875 <sup>15</sup> He (yel)	0.86519	172	-5.5, -8	162.5, 164	-51.6, -46.1	157.5	115-6	75	58.4 (cor.)			
187	2-Tolyl acetate (“o-Cresyl acetate”)	208			1.048	150	16.6	118.2	31	191.2	82	153, 147	134.8 (cor.), al			
188	Diethyl sulfate (Ethyl sulfate)	208		1.4010 <sup>18</sup>	1.172 <sup>25</sup>	77			-117.3	78.32			93, al.			
189	n-Propyl n-enanthate (n-Propyl n-heptanoate)	208	-64.8	1.41835 <sup>15</sup>	0.86556	172	-7.47	223		97.1	96, 96.5	81	74, pet eth			
190	Ethyl n-caprylate (Ethyl n-octanoate)	208.35	α -43.1, β -59.2	1.41775	0.8667	172	16.3	237, 239.3	-117.3	78.32	110, 106	70	93, al	N-(β-Aminoethyl) morpholide, 59		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Saponification					Amide	p-Toluidide	3,5-Dinitrobenzoate	Miscellaneous				
						Equiv.- alent	Acid		Alcohol									
							M P., °C	B P., °C	M P., °C	B P., °C								
191	<b>Isobutyl enanthate</b> (Isobutyl <i>n</i> -heptanoate)	209			0.8593	186	-7 47	223		108 1	96, 96.5	81	87					
192	<b>Isopropyl levulinate</b>	209.3		1.42088	0.98724	158	33.5	245.6		82.4	107.8d	108-9, w	123, pet eth	Semicarba- zone, 141-2, Phenylhydra- zone, 108 9, 2,4-Dinitro- phenylhydra- zone, 88-9 (cor.), 90 9				
193	<b>Trimethylene glycol diacetate</b> (1,3-Diacetoxyp- ropane)	210			1.069	80	16.6	118.2	-30	214.7 210.2	82	153 147	178					
194	<b><i>n</i>-Octyl acetate</b>	210			0.8847°	172	16.6	118.2	-16 -16.7	195	82	153 147	61.2					
195	<b><i>n</i>-Heptyl pro- pionate</b>	210	-50.9	1.42605 <sup>13</sup> He (yel)	0.86786	172	-20.8	141	-34.6 -33.8	176.8 79	81.81.3	126 123	46.47					
196	<b>Dimethyl citra- conate</b>	210.5		1.44856	1.11531	79	92.91d eth lgr	206 11, sl d	-97	64.65	100.1		108 (cor.), al	Dihydrazide, 177, w, 1- Naphthyl- amide, 169- 70				
197	<b><i>n</i>-Propyl pyro- mucate (<i>n</i>-Propyl 2-furoate)</b>	211		1.4737 <sup>25</sup> .9	1.0745 <sup>25</sup> .9	154	133-4, 132	230.2		97.1	142.3	170.5, al	74, pet eth					
198	<b>Ethylene glycol dipropionate</b>	211			1.0544 <sup>15</sup>	87	-20.8	141	-78.5	138 (cor.)	81.81.3, 79	126 123	46.4					
199	<b>Cyclohexyl <i>n</i>- butyrate</b>	212 <sup>750</sup>			0.9572°	170	-5.5, -8	162.5, 164	25.1	161.1	115.6	75	112-3, al					
200	<b>3-Tolyl acetate</b> ("m-Cresyl acetate")	212	12	1.4978	1.049	150	16.6	118.2	11.95	202.7	82	153, 147	164.5 (cor.), al					
201	<b>Ethyl aceto- pyruvate</b>	213.5		1.4757 <sup>17</sup>	1.1251	158	101, bz		-117.3	78.32	131.2d, al		93, al					
202	<b>Ethyl benzoate</b>	212.4 213.2	-34.7	1.50570	1.04684	150	122.4	249	-117.3	78.32	130	158	93, al	N-(β-Amino- ethyl) mor- pholide, 123.4				
203	<b>4-Tolyl acetate</b> ("p-Cresyl acetate")	212.5		1.500	1.051	150	16.6	118.2	36	202	82	153 147	188.6 (cor.), al					
204	<b>Di-<i>n</i>-propyl oxalate (<i>n</i>- Propyl oxalate)</b>	213.9	-51.7	1.4168	1.0169	87	189.5 (anh.), 101 (+2 H <sub>2</sub> O)			97.1	mono 219, <i>di</i> 419d	mono 169, <i>di</i> 268	74, pet eth	NH <sub>4</sub> OH → Di- <i>n</i> -propyl oxamate, 90-2, me al				
205	<b>Methyl pel- argonate</b>	214, 213-4			0.892	172	12.3	254.4	-97	64.65	99	84	108 (cor.), al					
206	<b>Dimethyl glu- tarate</b>	214 <sup>761</sup>	-34.7	1.42415	1.0874	80	98	302.4	-97	64.65	<i>di</i> 175	<i>di</i> 218	108 (cor.), al					

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Saponification					Amide	$\rho$ -Toluene	3,5-Dinitrobenzoate	Miscellaneous				
						Equivalent	Acid		Alcohol									
							M.P., °C	B.P., °C	M.P., °C	B.P., °C								
207	2,6-Dimethylphenyl acetate ( <i>vic-m</i> -Xylenyl acetate)	214-6				164	16 6	118 2	49	203	82	153, 147	158 8 (cor ), al					
208	Methyl 2-toluate (Methyl 2-methylbenzoate)	215		1.068	1.055	150	104-5, 107 8	259 <sup>751</sup>	-97	64 65	142 8 (cor )	144	108 (cor ), al					
209	Benzyl acetate	217		1.5200	1.055	150	16 6	118 2	-15 3	205 5	82	153, 147	113	N-( $\beta$ -Aminoethyl)morpholide, 95 2				
210	Diethyl succinate	217 25	-20 8	1.41975	1.0398	87	185 182 8	235d	-117 3	78 32	mono 157, di 260d , w	mono 179 80, di: 254 5- 5 5, 260	93, al	N-( $\beta$ -Aminoethyl)morpholide, 174				
211	Diethylene glycol monoethyl ether acetate	218		1.013		176	16 6	118 2		198	82	153, 147	oil					
212	Diethyl fumarate	218 4, 213-4	0 55	1.44103	1.052	86	286 7 (sealed tube), 233-5, 200, subl		-117 3	78 32	mono 270, 300-2, subl , di 266d	mono 233 0- 4 5, di 313 4, ac a	93, al					
213	Isopropyl benzoate	218 5		1.4890 <sup>25</sup>	1.013	164	122 4	249	-89 5	82 4	130	158	123, pet eth					
214	Methyl phenylacetate	220		1.507	1.068	150	76 5, subl	256 5 (cor )	-97	64 65	156	135-6	108 (cor ), al					
215	<i>L</i> -Linalyl acetate	220		1.4460	0.8951	196	16 6	118 2		199	82	153, 147		$[\alpha]_D$ -3 to -17, 4-Nitrobenzoate, 70				
216	Methyl 3-toluate (Methyl 3-methylbenzoate)	221, 215		1.061	1.050	111 3, 110-1	263, subl	-97	64 65	94, 97	118	108 (cor ), al						
217	<i>n</i> -Propyl levulinate	221 2		1.42576	0.98955	158	33-5	245 6		97 1	107-8d	108-9, w	74, pet eth	Semicarbazone, 129- 30, Hydrzone, 88-90, Phenylhydrazone, 67-8 (cor ), al , Oxime, 96				
218	Diethyl <i>d,l</i> -tartronate	222-5d		1.152 <sup>15</sup>	88	156-8d		-117 3	78 32	di 198, dil al , 195- 6d			93, al					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_{D}^{20}$	$D_{4}^{20}$	Saponification				Amide	$p$ Toluidide	3,5-Dinitrobenzoate	Miscellaneous			
						Equiv. equivalent	Acid		Alcohol							
							M.P. °C	B.P. °C	M.P. °C	B.P. °C						
219	Diethyl maleate	222.7	-17	1.44156	1.066	86	137		-117.3	78.32	mono 172.3, w 152.3 sl d di 181, me al	di 142, eth	93, al			
220	Methyl salicylate	224		1.5369	1.184	152	158.3		-97	64.65	142, 139	156	108 (cor), al 93, al			
221	Ethyl <i>n</i> -butoxy-ethyl carbonate	224		1.4143 <sup>2</sup>	0.9756 <sup>25</sup>	190			-117.3	78.32						
222	<i>sec</i> -Butyl levulinic acid	225.8		1.42495	0.96698	172	33.5	245.6		99.5	107.8d	108.9, w 75	76	Oxime, 96		
223	<i>n</i> -Heptyl <i>n</i> -butyrate	225.87	-57.5	1.42279 <sup>15</sup> He (yel)	0.86371	186	-5.5 -8	162.5, 164 -33.8	34.6	176.8	115.6		46.47			
224	2,4-Dimethyl-phenyl acetate (unsym-m-Xylenyl acetate)	226 (cor.)		1.4990 <sup>15</sup>	1.0298 <sup>15.5</sup>	164	16.6	118.2	27	211.5 (cor.)	82	153, 147	164.6 (cor.), 95% al			
225	Methyl <i>n</i> -caprate (Methyl <i>n</i> -decanoate)	226		1.426	0.873	186	31.5	268.70	-97	64.65	108 100.1	78	108 (cor.), al			
226	<i>n</i> -Amyl <i>n</i> -caproate ( <i>n</i> -Pentyl <i>n</i> -hexanoate)	226.16	-50, -47	1.42280 <sup>15</sup> He (yel)	0.86349	186	-3.9	205.35	-78.5	138 (cor.)	100.1	74.5	46.4			
227	<i>n</i> -Butyl <i>n</i> -enanthate ( <i>n</i> -Butyl <i>n</i> -heptanoate)	226.2		1.42280 <sup>15</sup>	0.86382	186	-7.47	223	-90.2	117.6, 116	96.965	81	64 62.5			
228	<i>n</i> -Hexyl <i>n</i> -valerate ( <i>n</i> -Hexyl <i>n</i> -pentanoate)	226.3	-63.1	1.42286 <sup>15</sup>	0.86345	186	-34.5	186.35	-51.6 -46.1	157.5	106	74	58.4 (cor.)			
229	<i>n</i> -Propyl <i>n</i> -caprylate ( <i>n</i> -Propyl <i>n</i> -octanoate)	226.43	-46.2	1.42351 <sup>15</sup> He (yel)	0.86591	186	16.3	237 239.3		97.1	110.106	57	74, pet eth			
230	Ethyl 2-toluate (Ethyl 2-methyl benzoate)	227		1.507 <sup>21.6</sup>	1.0325 <sup>4.5</sup>	164	104.5, 107.8	259 <sup>751</sup>	-117.3	78.32	142.8 (cor.)	144	93, al			
231	Ethyl pelargonate	227	$\alpha$ -55.0, $\beta$ -36.7	1.42200	0.8657	186	12.3	254.4	-117.3	78.32	99	84	93, al	N-( $\beta$ -Aminoethyl) morpholide, 61.3		
232	<i>t</i> -Menthyl acetate	227			0.9185	198	16.6	118.2	43	216	82	153, 147	153			
233	Ethyl phenyl-acetate	227.5		1.49921 <sup>18.5</sup>	1.0333	164	76.5, subl	256.5 (cor.)	-117.3	78.32	156	135.6	93, al	N-( $\beta$ -Aminoethyl) morpholide, 88.9		
234	<i>n</i> -Octyl propionate	227.9	-41.6	1.42185 <sup>15</sup> He (yel)	0.86633	186	-20.8	141	-16, -16.7 -117.3	195	81.813, 79 di 191.2- 8, al	126, 123	61-2			
235	Diethyl itaconate	228		1.4377	1.0467	93	165			78.32			93, al			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
 Including esters of inorganic acids  
 a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Saponification				Amide	<i>p</i> -Toluene-dioxide	3,5-Dinitrobenzoate	Miscellaneous			
						Equiv. equivalent	Acid		Alcohol							
							M P., °C	B P., °C	M P., °C	B P., °C						
236	Diethyl meso-conate	229		1.4488	1.0453	93	204.5 (cor.), subl		-117.3	78.32	mono (α) 222 (β) 174 <i>dt</i> 176.5	mono (α) 196 <i>di</i> 212, al	93, al			
237	Di-isobutyl oxalate (Isobutyl oxalate)	229		1.4180	0.97373	101	189.5 (anh.), 101 (+2 H <sub>2</sub> O)			108.1	mono 219 <i>di</i> 419d	mono 169 <i>di</i> 268	87			
238	Allyl benzoate	230		1.067 <sup>4</sup>	1.0578 <sup>15</sup>	162	122.4	249	97.1	130	158	49.50				
239	Isobutyl levulinate	230.9		1.42677	0.96770	172	33.5	245.6	108.1	107.8d	108.9, w	87	Semicarbazone, 112.3, Phenylhydrazone, 84.6, 2,4-Dinitrophenylhydrazone, 55.6, Oxime, 96			
240	<i>n</i> -Propyl benzoate	231		1.500	1.023	164	122.4	249	97.1	130	158	74, pet eth				
241	Diethyl citraconate	231		1.4442	1.0491	93	92d, eth lgr	206.11 sl d	-117.3	78.32	100.1	93, al	1-Naphthylamide, 169-70			
242	Methyl 3-chlorobenzoate	231				170.5	158, 155		-97	64.65	134	108 (cor.), al				
243	β-Phenylethyl acetate	232-224		1.5108	1.057 <sup>22,5</sup>	164	16.6	118.2	-25.8	219.8	82	153.147	108			
244	Ethyl β-(2-furyl) acrylate	232	14	1.5286	1.0891 <sup>15</sup>	166	141	286	-117.3	78.32	168.9, w	93, al				
245	Di-(β-methoxyethyl) carbonate	232		1.4193 <sup>25</sup>	1.0936 <sup>25</sup>	178				124.5						
246	Di-isoamyl carbonate	233 (cor.)		1.4174	0.9067	202			-117	132		61				
247	Diethyl glutarate	233.66	-23.8	1.02229	1.42395	94	98	302-4	-117.3	78.32	<i>di</i> 218 175-6	93, al	N-(β-Aminoethyl)morpholide, 152.7			
248	Ethyl 3-toluate	234		1.505 <sup>21,4</sup>	1.0265 <sup>21,4</sup>	164	111.3, 110.1	263, subl	-117.3	78.32	94.97	118	93, al			
249	Ethyl salicylate	234		1.52542	1.1396	166	158.3, subl at 76		-117.3	78.32	142, 139	156	93, al			
250	Methyl 2-chlorobenzoate	234				170.5	142, 144		-97	64.65	142, 202	131	108, (cor.), al			
251	Ethyl 4-toluate	234.5		1.5089 <sup>18,2</sup>	1.0269 <sup>18,2</sup>	164	179.80, subl	275 (cor.)	-117.3	78.32	160, 158	160, 165	93, al			
252	Diethyl bromomalonate	235			1.426 <sup>13</sup>	239	113d		-117.3	78.32	<i>di</i> 181, al	<i>di</i> 217, ac a	93, al			

\*Derivative data given in order m p crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	Saponification					Amide	$P_{Tolu}$ dide	3,5-Di nitro benzoate	Miscellaneous				
						Equiv- alent	Acid		Alcohol									
							M.P., °C	B.P., °C	M.P., °C	B.P., °C								
253	Ethylene glycol di-n-butylate	235-77 <sup>49</sup>		1.42619 <sub>He</sub>	1.0005	101	-55,-8	162.5, 164	-78.5	138 (cor.)	115.6	75	46.4					
254	Diethyl butyl-malonate	235-40			1.425	101			-117.3	78.32	di 200		93, al					
255	2,4,6-Trimethyl-phenyl acetate (Mesityl acetate)	236				178	16.6	118.2	70.69	220	82		153, 147					
256	2,5-Dimethyl-phenyl acetate ( <i>p</i> -Xylenyl acetate)	237 <sup>768</sup>			1.0264 <sup>15</sup>	164	16.6	118.2	74.5	212	82		153, 147	137.2 (cor.), al				
257	<i>n</i> -Butyl levulinate	237.8		1.42905	0.97353	172	33.5	245.6	-90.2	117.6, 116	107.8d	108-9, w	64, 62.5	Semicarba- zone, 102- 3, Phenyl- hydrazone, 79-81, 2,4-Dinitro- phenylhyd- razone, 65-8, Oxime, 96				
258	Benzyl <i>n</i> -butyrate	238-40			1.033 <sup>16</sup>	178	-55,-8	162.5, 164	-15.3	205.5	115-6	75	113					
259	Methyl hydro-cinnamate (Methyl $\beta$ -phenylpro-pionate)	239			1.0455 <sup>0</sup>	164	48.7, 40	279-80 (cor.)	-97	64.65	105, 82	135	108 (cor.), al					
260	<i>n</i> -Propyl salicylate	239, 249-51		1.51610	1.0979	180	158.3			97.1	142, 139	156	74, pet eth					
261	Guaiacol acetate (2-Methoxy-phenyl acetate)	240		1.5101 <sup>25</sup>	1.1285 <sup>25</sup>	166	16.6	118.2	32, 28.2	205	82	153, 147	141.2 (cor.), al					
262	Isopropyl salicylate	240-2, 237		1.50650	1.0729	180	158.3, subl at 76		-89.5	82.4	142, 139	156	123, pet eth					
263	Dimethyl <i>l</i> -malate	242		1.4425	1.2334	81	100-1		-97	64.65	di 156-7	di 206-7	108 (cor.), al	[ $\alpha$ ] <sub>D</sub> <sup>20</sup> -6.85				
264	Geranyl acetate	242		1.4660	0.9174 <sup>15</sup>	196	16.6	118.2		230	82	153, 147	62-3					
265	Isobutyl benzoate	242.2 (cor.)			0.999	178	122.4	249		108.1	130	158	87					
266	Di- <i>n</i> -butyl oxalate ( <i>n</i> -Butyl oxalate)	243, 245.5	-29.6	1.4240	0.98732	101	189.5 (anh.), 101 (+ $2H_2O$ )		-90.2	117.6, 116	mono 219, di 419d	mono 169, di 268	64, 62.5					
267	Methyl 2-bromo-benzoate	244				215	150		-97	64.65	155		108 (cor.), al					
268	<i>n</i> -Octyl <i>n</i> -butyrate	244.1	-55.6	1.42674 <sup>15</sup> He (yel)	0.86288	200	-55,-8	162.5, 164	-16,-16.7	195	115.6	75	61.2					
269	Ethyl <i>n</i> -caprate (Ethyl <i>n</i> -decanoate)	244.9	$\beta$ -20, $\gamma$ -30.6	1.42575	0.8650	200	31.5	268.70	-117.3	78.32	108, 100.1	78	93, al	N-( $\beta$ -Amino- ethyl) mor- pholide, 60.1				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_{D}^{20}$	$D_{4}^{20}$	Saponification				Amide	$P_{Tolu}$ dide	3,5 Di nitro benzoate	Miscellaneous			
						Equiv alent	Acid		Alcohol							
							M P , °C	B P °C	M P °C	B P °C						
270	Diethyl adipate	245, 133.8 <sup>15</sup>	-21	1.42765	1.0090	101	153-4 (cor.)	216 <sup>15</sup>	-117.3	78.32	mono 125 30, w., di 220	241	93, al	N-(β-Amino- ethyl) mor- pholide 165		
271	Methyl phenoxy- acetate	245			1.150 <sup>15</sup>	166	98.9	285d	-97	64.65	101.5		108 (cor.) al			
272	Thymyl acetate	245			1.009 <sup>0</sup>	192	16.6	118.2	51.5	233.5	82	153 147	103.2 (cor.), al			
273	Carvacryl acetate	245 (cor.)		1.49128 <sup>28</sup>	0.98959 <sup>25</sup>	192	16.6	118.2	1	237.5	82	153, 147	83			
274	Diethylene glycol diacetate ( $\beta,\beta'$ - Diacetoxy di- ethyl ether)	245.51, 148 <sup>26</sup>		1.4348	1.1078 <sup>15</sup>	95	16.6	118.2	-10.45	244.5	82	153 147	149 ac a			
275	<i>n</i> -Butyl <i>n</i> - caprylate ( <i>n</i> - <i>Butyl n-octa-</i> <i>noate</i> )	245.02	-41.9, -43	1.42647 <sup>15</sup> He (yel)	0.86278	200	16.3	237	-90.2	117.6 116	110.106	70	64 62.5			
276	<i>n</i> -Heptyl <i>n</i> - valerate ( <i>n</i> - <i>Heptyl n-pentanoate</i> )	245.2	-46.4	1.42536 <sup>15</sup> He (yel)	0.86225	200	-34.5	186.35	-34.6 -33.8	176.8	106	74	46.47			
277	<i>n</i> -Amyl <i>n</i> -enam- thate ( <i>n</i> -Pentyl <i>n</i> -heptanoate)	245.4	-49.5	1.42627 <sup>15</sup> He (yel)	0.86232	200	-7.47	223	-78.5	138 (cor.)	96.96.5	81	46.4			
278	<i>n</i> -Hexyl <i>n</i> -Caproate ( <i>n</i> - <i>Hexyl n-decanoate</i> )	245.4	-55.25	1.42637 <sup>15</sup> He (yel)	0.86216	200	-3.9	205.35	-51.6 -46.1	157.5	100.1	74.5	58.4 (cor.)			
279	Di-( $\beta$ -ethoxy- ethyl) carbonate	245.5		1.4239 <sup>25</sup>	1.0635 <sup>25</sup>	206				135			75, al			
280	Diethylene glycol monobutyl ether acetate	246			0.983	204	16.6	118.2		228-30	82	153 147				
281	Isobutyl phenyl- acetate	247			0.999 <sup>18</sup>	192	76.5 (cor.)	256.5 (cor.)		108.1	156	135-6	87			
282	Ethyl hydrocinnam- ate (Ethyl $\beta$ - phenylpro- pionate)	247.2			1.0147	178	40.48.7	279-80 (cor.)	-117.3	78.32	105.82	135	93, al			
283	Di- <i>n</i> -propyl succinate	248, 246	-10.4	1.4252	1.011	101	185, 182.8	235d		97.1	mono 157, di 260d , w	mono 179 80, di 254.5- 55, 260	74, pet eth			
284	Methyl 2-meth- oxybenzoate	248		1.534 <sup>19.5</sup>	1.1571 <sup>19</sup>	166	100.1	200	-97	64.65	129		108 (cor.), al			
285	Methyl undecylen- ate (Methyl hendecylenate)	248	-27.5	1.43928	0.889 <sup>15</sup>	198	24.5	275	-97	64.65	87		108 (cor.), al			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_{D}^{20}$	$D_4^{20}$	Saponification				Amide	$p$ -Toluene-	3,5-Dinitrobenzoate	Miscellaneous			
						Equival-	Acid		Alcohol							
							M P, °C	B P °C	M P °C	B P °C						
286	Isoamyl levulinate	248.8		1.43102	0.96136	186	33.5	245.6	-117	132	107.8d	108.9w	61	Semicarba-zone, 91-2, Phenylhydrazone, 70.2, 2,4-Dinitrophenylhydrazone, 50.5 Oxime, 96		
287	Diethyl acetone-dicarboxylate	250d			1.113	101	135		-117.3	78.32			93, al	Dianilide, 155, bz, Semicarba-zone, 94.5, Cu(OAc) <sub>2</sub> → Cu enolate, 142.3, grn bz		
288	n-Butyl benzoate	250.3	-22.4		1.000	178	122.4	249	-90.2	117.6, 116	130	158	64.62.5			
289	Ethyl phenoxyacetate	251			1.104 <sup>17.5</sup>	180	98-9	285d	-117.3	78.32	101.5		93, al			
290	Methyl 3-methoxybenzoate	252		1.52236	1.131	166	109-10		-97	64.65			108 (cor), al	α-Phenylethylamide, 128.6 9.0, Benzylamide, 111.8 2.8		
291	Diethyl l-malate	253		1.4362	1.1290	95	100-1		-117.3	78.32	di 156.7	di 206.7	93, al	$[\alpha]_D^{20} = -10.18$		
292	n-Amyl levulinate (n-Pentyl levulinate)	253.4		1.43192	0.96136	186	33.5	245.6	-78.5	138 (cor)	107.8d	108.9w	46.4	2,4-Dinitrophenylhydrazone, 84.2, Oxime, 96		
293	n-Butyl phenylacetate	254		1.489	0.994	192	76.5, subl	256.5 (cor)	-90.2	117.6, 116	156	135.6	64.62.5			
294	β-Methoxyethyl benzoate (Methyl "cellosolve" benzoate)	255		1.5040 <sup>25</sup>	1.0891 <sup>25</sup>	180	122.4	249		124.5	130	158		4-Nitrobenzoate, 50.5, dil al		
296	Diethyl pimelate	255	-23.8	1.42985	0.9929	108	105	223 <sup>15</sup>	-117.3	78.32	di 175	di 206. al	93, al	N-(β-Aminoethyl)morpholide, 137.9		
297	Ethyl benzoylformate	256-7		1.5190 <sup>25</sup>	1.222 <sup>25</sup>	178	66		-117.3	78.32	91		93, al	Phenylhydrazone, 64, 2,4-Dinitrophenylhydrazone, 196.7d (cor)		

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**Including esters of inorganic acids**  
**a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Equivalent	Saponification				Amide	p Tolu dide	3,5 Di nitrobenzoate	Miscellaneous				
							Acid		Alcohol									
							M P °C	B P °C	M P °C	B P °C								
298	Glyceryl triacetate	258		1.161 <sup>15</sup>	72.7	16.6	118.2		17.9	290d	82	153 147		Tris-4-nitrobenzoate, 188				
299	Ethyl 3-methoxybenzoate	260		1.5161	1.0993	180	109.10		-117.3	78.32			93, al	Benzyl- amide, 111.8 2,8,α- Phenyl- ethylamide, 128.6 9.0				
300	β-Ethoxyethyl benzoate ("Cello-solve" benzoate)	260-1 <sup>738.5</sup>		1.4969 <sup>25</sup>	1.0585 <sup>25</sup>	194	122.4	249		135	130	158	75, al					
301	Isobutyl salicylate	260.2		1.50872	1.0639	194	158.3, subl at 76			108.1	142, 139	156	87					
302	n-Amyl n-caprylate (n-Pentyl n-octanoate)	260.21	-34.8	1.43019 <sup>17</sup> He (yel)	0.86132	214	16.3	237 239.3	-78.5	138 (cor.)	110, 106	70	46.4					
303	n-Hexyl n-enanthate (n-Hexyl n-heptanoate)	260.9	-47.9	1.42939 <sup>1</sup> He (yel)	0.86114	214	-7.47	223	-51.6, -46.1	157.5	96, 96.5	81	58.4 (cor.)					
304	n-Heptyl n-caproate (n-Heptyl n-hexanoate)	260.97	-34.4	1.42934 <sup>15</sup> He (yel)	0.86115	214	-3.9	205.35	-34.6, -33.8	176.8	100.1	74.5	46.47					
305	Ethyl 2-methoxybenzoate	261		1.5224	1.1124	261	100.1	200	-117.3	78.32	129		93, al					
306	n-Octyl n-valerate (n-Octyl n-pentanoate)	261.1	-42.5	1.42743 <sup>15</sup> He (yel)	0.86148	214	-34.5	186.35	-16 -16.7	195	106	74	61.2					
307	Isoamyl benzoate	262.3		1.4950	1.004	192	122.4	249	-117	132	130	158	61					
308	Dimethyl d-camphorate	263		1.46334 <sup>16.9</sup>	1.0747	114	187.5 8.0		-97	64.65	mono (α- amide β- acid), 176. (β- amide- α- acid), 182.3, di 192-3	212.4, β 190-6	108 (cor.), al					
309	Ethyl undecylenate (Ethyl hendecylenate)	264		1.4449 <sup>23</sup>	0.88271 <sup>15</sup>	212	24.5	275	-117.3	78.32	87		93, al					
310	Isobutyl succinate	265		1.427	0.974	115	185, 182.8	235d		108.1	mono 157, di 260d, w	mono 179 80, di 254.5 5.5, 260	87					

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	Saponification				Amide	<i>p</i> -Toluene-dicarboxylic acid	3,5-Dinitrobenzoate	Miscellaneous			
						Equivalent	Acid		Alcohol							
							M.P., °C	B.P., °C	M.P., °C	B.P., °C						
311	Ethyl benzoylacetate	265 sl d, 270 d		1.5498	1.116	192			-117.3	78.32			93, al	Ketone cleavage → aceto-phenone, m.p. 19.65, b.p. 202		
312	Di-isoamyl oxalate (Isoamyl oxalate)	267.8, 262		1.427	0.961	115	189.5 (anh) 101 (+ $2\text{H}_2\text{O}$ )		-117	132	mono 219, <i>di</i> , 419d	mono 169, <i>di</i> , 268	61			
313	Dimethyl suberate	268	-5	1.43326	1.0198	101	144, 139-41		-97	64.65	mono 125.7, <i>di</i> , 216.7	<i>di</i> , 218, 219	108 (cor), al			
314	Methyl laurate	268		1.432	0.870	214	44.42	299	-97	64.65	100, 99	87	108 (cor), al	$\beta$ -Naphthol → $\beta$ -naphthyl methyl ether, 72		
315	Ethyl 4-methoxybenzoate (Ethyl anisate)	269	7	1.5254	1.1038	180	184.6, 184.2 (cor.)	275.80	-117.3	78.32	167, 162.3, <i>w</i>	186	93, al	N-( $\beta$ -Aminoethyl) morpholidate, 130.6		
316	Ethyl laurate	269														
317	Trimethyl aconitate	270	-17	1.4321	0.8671 <sup>18</sup>	228	44.42 194-5 (cor.) <i>d</i>	299	-117.3 -97	78.32 64.65	100, 99 <i>tri</i> turns br at 250, sinters at 260	87	93, al 108 (cor), al			
318	<i>n</i> -Butyl salicylate	270-2, 268		1.51148	1.0728	194	158.3, subl. at 76		-90.2	117.6, 116	142, 139	156	64, 62.5			
319	Ethyl cinnamate	271	6.70	1.55982	1.0490	176	133	300	-117.3	78.32	147-8	168	93, al	N-( $\beta$ -Aminoethyl) morpholidate, 121.9		
320	Di- <i>n</i> -butyl succinate	274.5	-29.3	1.4298	0.9760	115	185, 182.8	235d	-90.2	117.6, 116	mono 157, <i>di</i> , 260d, <i>w</i>	mono 179, 80, <i>di</i> , 254.5 -5.5, 260	64, 62.5			
321	Ethyl 2-nitrobenzoate	275	30			195	146		-117.3	78.32	176			93, al		
322	Triethyl aconitate	275d		1.45562	1.1064	86	194-5 (cor.)		-117.3	78.32	<i>tri</i> turns br at 250, sinters at 260		93, al			
323	Di-isopropyl d-tartarate	275			1.1274	117	169.71		-89.5	82.4	mono 171-2, <i>di</i> , 196d, al	123, pet eth		$[\alpha]_D^{20}$ +14.886, Phenylhydrazide, 240		
324	Ethyl 4-ethoxybenzoate	275			1.076 <sup>21</sup>	194	198, 195-6		-117.3	78.32	202		93, al	Hydrazide, 126-7, al		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_{D}^{20}$	$D_4^{20}$	Equiv alent	Saponification				Amide	$p$ Tolu dide	3,5 Di nitro benzoate	Miscellaneous				
							Acid		Alcohol									
							M P °C	B P °C	M P °C	B P °C								
325	<i>n</i> -Octyl <i>n</i> -caproate ( <i>n</i> Octyl <i>n</i> hexanoate)	275.2	-28.4	1.43256 <sup>15</sup> He (yel)	0.86032	228	-3.9	205.35	-16 -16.7	195	100.1	74.5	61.2					
326	Isoamyl salicylate	276.8		1.50799	1.0535	208	158.3 subl at 76 -7.47		-117	132	142.139	156	61					
327	<i>n</i> -Heptyl <i>n</i> -enanthate ( <i>n</i> Heptyl <i>n</i> heptanoate)	277.2	-33.3	1.43183 He (yel)	0.86039	228	-7.47	223.0	-34.6 -33.8	176.8	96.965	81	46.47					
328	<i>n</i> -Hexyl <i>n</i> -caprylate ( <i>n</i> Hexyl <i>n</i> octanoate)	277.44	-30.6	1.43230 <sup>1</sup> He (yel)	0.86033	228	16.3	237 239.3	-51.6 -46.1	157.5	110.106	70	58.4 (cor.)					
329	Resorcinol diacetate	278 sl d			1.179	97	16.6	118.2	110 (stab) 108 8.5 (labile) -117.3	280.8 (cor.)	82	153 147	di 201					
330	Diethyl suberate	282	5.9	1.43236	1.9807	115	144 139.41			78.32	mono 125.7 di 216-7	di 218-9	93 al	N-( $\beta$ -Aminoethyl) morpholide, 157.2				
331	Resorcinol monoacetate	283				152	16.6	118.2	110 (stab) 108- 8.5 (labile) -97	280.8 (cor.)	82	153 147	di 201					
332	Dimethyl phthalate (Methyl phthalate)	283.8		1.5138	1.191	97	200.6 191 (sealed tube)			64.65	mono 149 di 220	mono 150 (slow htng) 160.5 (rapid htng)	108 (cor.) al					
333	Diethyl iso-phthalate	286 <sup>733</sup>	11.5			111	348 (subl.)		-117.3	78.32	mono 280 di 280		93 al					
334	Diethyl <i>d</i> -camphorate	286		1.45354 <sup>26.2</sup>	1.0298	128	187.5- 8.0		-117.3	78.32	mono ( $\alpha$ amide) 176 ( $\beta$ amide- $\alpha$ - acid) 182.3, di 192.3	$\alpha$ 212- 4 $\beta$ 190-6	93, al					
335	Glyceryl tri-propionate	289				1.083 <sup>19</sup>	86.7	-20.8	141	17.9	290d	81.813, 79	126 123	Tris-4-nitrobenzoate, 188				

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>40</sub> <sup>20</sup>	Saponification				Amide	p-Tolu-dide	3,5-Dinitrobenzoate	Miscellaneous			
						Equiv alent	Acid		Alcohol							
							M P °C	B P °C	M P °C	B P, °C						
336	Diethyl phthalate (Ethyl phthalate)	289.5, 298		1.5019	1.1175	111	200.6, 191 (sealed tube)		-117.3	78.32	mono 149, di 220	mono 150 (slow htng), 160.5 (rapid htng)	93, al			
337	n-Heptyl n-caprylate (n-Heptyl n-octanoate)	290.6	-10.2	1.43492 <sup>1</sup> He (yel)	0.85958	242	16.3	237 239.3	-34.6, -33.8	176.8	110, 106	70	46, 47			
338	n-Octyl n-enanthate (n Octyl n-heptanoate)	290.8	-21.5	1.43488 <sup>1</sup> He (vel)	0.85961	242	-7.47	223.0	-16, -16.7	195	96, 96.5	81	61.2			
339	Diethyl azelate	291	-18.5	1.43509	0.97294	122	106.5	>360 sl d 237 <sup>13</sup>	-117.3	78.32	mono 93.5 di 175	di 201-2	93, al	N-(β-Aminoethyl) morpholide, 141.3		
340	Triethyl citrate	294		1.44554	1.1369	92	153 (anh) 100 (+1 H <sub>2</sub> O) 53.9		-117.3	78.32	tri 210 5d, w	tri 189, al	93, al			
341	Ethyl myristate	295	α 11.9 β 12.3	1.4362	0.8573 <sup>23</sup>	256		202 <sup>16</sup>	-117.3	78.32	103	93	93, al	N-(β-Aminoethyl) morpholide, 76		
342	Di-n-propyl d-tartarate	297			1.1390	117	169.71			97.1	mono 171-2, di 196d, al	74, pet eth	[α] <sub>D</sub> <sup>20</sup> +12.00, Phenylhydrazide, 240			
343	Isoamyl succinate	297		1.434	0.958	129	185 182.8	235d	-117	132	mono 157 di 260d, w	mono 179- 80, di 254.5 5.5, 260	61			
344	Di-(β-n-butoxyethyl)carbonate	297.8		1.4279 <sup>24</sup>	0.9766 <sup>65</sup>	262					170.6 <sup>743</sup>					
345	Diethyl benzyl-malonate	300			1.077 <sup>17</sup>	125	117d		-117.3	78.32	225		93, al			
346	α-Tetrahydro-furfuryl benzoate	300.2 <sup>50</sup>			1.137 <sup>20</sup>	206	122.4	249		177 8 <sup>743</sup>	130	158	83-4			
347	Di-isopropyl phthalate (Iso-propyl phthalate)	302			1.065 <sup>19</sup>	115	200.6, 191 (sealed tube)		-89.5	82.4	mono 149 di 220	mono 150 (slow htng), 160-5 (rapid htng)	123, pet eth			
348	n-Octyl n-caprylate (n-Octyl n-octanoate)	306.8	-15.1	1.43698 <sup>15</sup> He (yel)	0.85919	256	16.3	237. 239.3			110, 106	70	61.2			

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Including esters of inorganic acids

a) Liquids. 1) (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_{D}^{20}$	$D_{4}^{20}$	Equiv.- alent	Saponification				Amide	<i>p</i> -Tolu- dide	3,5-Di- nitro- benzoate	Miscellaneous				
							Acid		Alcohol									
							M.P., °C	B.P., °C	M.P., °C	B.P., °C								
349	Diethyl sebacate	307	13	1.43657	0.9631	129	33, subl	243 <sup>15</sup>	-117.3	78.32	mono 170 <i>di</i> 210, 208	<i>di</i> 201	93, al					
350	2-Tolyl benzoate ("o-Cresyl" benzoate)	307			1.114 <sup>19</sup>	212	122.4	249	31	191.2	130	158	138.4 (cor.), al					
351	Ethyl 1-naphthoate	309		1.1274 <sup>15</sup>	200	161.2 (cor.)			-117.3	78.32	202.205		93, al					
352	Glyceryl tri- butyrate	318		1.033 <sup>1</sup>	100.7	-5.5 -8	162.5, 164	17.9	290d	115.6	75		Tris-4-nitro- benzoate, 188					
353	Di- <i>n</i> -butyl <i>d,l</i> - tartarate (Di- <i>n</i> - butyl racemate)	320			1.0879 <sup>18</sup>	131	205.6 (anh), 203-4 (+1 $H_2O$ )		-90.2	117.6, 116	<i>di</i> 226, w-me al	64, 62.5	Dianilide, 235-6					
354	Benzyl salicylate	320				228	158.3, subl at 76		-15.3	205.5	142, 139	156	113					
355	Di- <i>n</i> -butyl phthalate ( <i>n</i> Butyl phthalate)	340.7		1.4900	1.047 <sup>20</sup>	139	200.6, 191 (sealed tube)		-90.2	117.6, 116	mono 149, <i>di</i> 220	mono 150 (slow htng), 160.5 (rapid htng)	64, 62.5	N-( $\beta$ -Amino- ethyl) mor- pholide, 124				
356	Di- <i>n</i> -butyl sebacate	345			0.9329 <sup>15</sup>	157	133, subl	243 <sup>15</sup>	-90.2	117.6, 119	mono 126.5, <i>di</i> 210, 208	<i>di</i> 201	64, 62.5	Phenylhyd- razide, 194				
357	Di-isoamyl phthal- ate (Isoamyl phthalate)	349			1.024 <sup>17</sup>	153	200-6, 191 (sealed tube)		-117	132	mono 149, <i>di</i> 220	mono 150 (slow htng), 160.5 (rapid htng)	61					
358	Tricresyl phos- phate	400d, 275 80 <sup>20</sup>	-30	1.5568	1.197 <sup>25</sup>	122.7			36	202.32			188.6 (cor.), al					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

Reduced pressure b.p. only

a) Liquids. 2) (Listed in order of increasing m.p. of the corresponding amide)\*

No	Name	Boiling point °C	Melting point, °C	$n_{D}^{20}$	$D_{4}^{20}$	Saponification					Amide	<i>p</i> -Toluide	3,5-Dinitrobenzoate	Miscellaneous				
						Equiv- alent	Acid		Alcohol									
							M.P., °C	B.P., °C	M.P., °C	B.P., °C								
1	3,5-Dimethylphenyl acetate ( <i>Sym-m-Xylenyl acetate</i> )	130 <sup>26</sup> , 120 <sup>11</sup>				164	16 6	118 2	63 2 68	220 2	82	153, 147	195 4, al					
2	Dimethyl azelate	156 <sup>20</sup> , 146 2 <sup>10</sup>		1 43607	1 0069	108	106	>360 sl d	-97	64 65	mono 93 5, di 172	di 201 2, 198	108 (cor ), al					
3	Dimethyl adipate	107 6 <sup>11</sup>	8 5	1 4277	1 0625	87	153 4 (cor )	216 <sup>15</sup>	-97	64 65	mono 125 30, w, di 220	241	108 (cor ), al					
4	$\beta$ -n-Butoxyethyl benzoate (Butyl "cellosolve" benzoate)	156 5 7 0 <sup>14</sup> , 131 6 2 6 <sup>3</sup>		1 4925 <sup>25</sup>	1 0277 <sup>25</sup>	222	122 4	249		170 6 <sup>11</sup>	130	158		4-Nitro- phenylurethane, 58 7 9 1, CCl <sub>4</sub>				
5	Ethyl furoylacetate	170 <sup>20</sup> 143 <sup>10</sup>		1 5055 <sup>16</sup>	1 165 <sup>17</sup>				-117 3	78 32	159, al		93, al	Oxime, 131 2, di, al				
6	Methyl furoylacetate	144 5 <sup>20</sup> , 96-8 <sup>1</sup>							-97	64 65	159, al		108 (cor ), al	Semicarbazone, 141- 2, bz -al (3 1), Oxime, 124 5, bz				
7	Di-n-propyl adipate	155 <sup>16</sup>	-20	1 4314	0 9790	115	153 4			97 1	mono 161 di 220	di 241	74, pet eth					
8	Dimethyl pimelate	119 3 9 6 <sup>10</sup>	-20 6	1 42888	1 0383	94	105		-97	64 65	di 175	di 206, al	108 (cor ), al					
9	Di-n-propyl maleate	114-7 <sup>6</sup>		1 444 <sup>18</sup> , <sup>3</sup>	1 026	100	137			97 1	di 181, me al	mono 195d, chl, di 142, eth	74, pet eth					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	p-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
				Equiv alent	Acid		Alcohol					
					M P, °C	B P, °C	M P °C	B P °C				
1	<b>Dimethyl succinate</b>	18.2	196	73	185, 182.8	235d	-97	64.65	mono 157, d 260d	mono 179.80, d 254.5 55.260	108 (cor.), al	$n_D^{20}$ 1.41965 $D_4^{20}$ 1.1192
2	<b>Methyl myristate</b>	18.5	323	242	53.9	202 <sup>16</sup>	-97	64.65	103	93	108 (cor.), al	$n_D^1$ 1.428
3	<b>Ethyl piperonylate</b>	18.5	286	194		228, 229	-117.3	78.32	169, al		93, al	
4	<b>Diethyl d-tartarate</b>	18.6	280	103	169.71		-117.3	78.32	mono 171-2, d 196d , al		93, al	$n_D^{20}$ 1.44677, $D_4^{20}$ 1.2028 $[\alpha]_{D}^{20}$ (grn) + 7.87, Phenylhydrazide, 204
5	<b>Phenyl propionate</b>	20	211	150	-20.8	141	41.8.42	182 183	81	123.126	145.8 (cor.), al	$D_{25}^{20}$ 1.0467, Tri-bromo, 95
6	<b>Ethyl margarate</b>	20.6 ( $\beta$ )		298	61.2	231 <sup>16</sup>	-117.3	78.32	108, 106			
7	<b>Methyl 3-chlorobenzoate</b>	21	231	170.5	158, 155		-97	64.65	134		93, al 108 (cor.), al	
8	<b>Benzyl benzoate</b>	21	323-4 (cor.)	212	122.4		-15.3	205.5	130	158	113	$n_D^{21}$ 1.5681, $D^{19}$ 1.1224
9	<b>Di-n-butyl d-tartarate</b>	22		131	169.71		-90.2	117.6, 116	mono 171-2 d 196d , al		64, 62.5	$D_4^{18}$ 1.0886, $[\alpha]_D^{15}$ + 10.09, Phenylhydrazide, 240
10	<b>3,4-Dimethylphenyl acetate</b>	22	235	164	16.6	118.2	62.5	225	82	153, 147	181.6, rods, al	
11	<b>Isobutyl stearate</b>	(a) 22.5, (b) 28.9, (two forms)		340	70.1			108.1	109, 108.4, al	102	87	
12	<b>Isoamyl stearate</b>	23		354	70-1		-117	132	109, 108.4, al	102	61	
13	<b>Cetyl acetate (n-Hexadecyl acetate)</b>	$\alpha$ 18.5, $\beta$ 24.2, 22		284	16.6	118.2	49.27	190 <sup>18</sup>	82	153, 147	66	
14	<b>Ethyl palmitate</b>	$\alpha$ 19.4, $\beta$ 24.2	185	284	62.7	222 <sup>16</sup>	-117.3	78.32	106-7, 105.3, al	98	93, al	
15	<b>Methyl anthranilate</b> (Methyl 2-aminobenzoate)	24.4	299.8	151	146		-117.3	78.32	109	151	93, al	N-( $\beta$ -Aminoethyl) morpholide, 126, Picrate, 106
16	<b>Di-n-propyl d,l-tartarate</b>	25	286 <sup>76</sup>	117	203-4 (+1 $H_2O$ ), 205-6 (anh)			97.1	226, w - me al		74, pet eth	$D_4^{20}$ 1.1256
17	<b>Dimethyl sebacate</b>	26.6, 27-8		115	133, subl	243 <sup>15</sup>	-97	64.65	mono 170, d 210, 208	d 201	108 (cor.), al	$n_D^{28}$ 1.43549, $D_4^{28}$ 0.98818, Phenylhydrazide, 194

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	P-Toluidide	3,5-Dinitrobenzoate	Miscellaneous				
				Equiv- alent	Acid		Alcohol									
					M P °C	B P, °C	M P, °C	B P, °C								
18	Methyl β-(2-furyl) acrylate	27	227	152	141	286	-97	64 65	168 9		108 (cor), al					
19	n-Butyl stearate	27 5, 28		340	70 1		-90 2	117 6, 116	109, 108 4, al	102	64 62 5					
21	d-Bornyl acetate	29	226, 221	196	16 6	118 2	204 5 5 5	212	82	153, 147	154	$n_D^{25}$ 1 4633, D <sub>15</sub> 0 991 (undercooled)				
22	Methyl margarate	29		284	61 2	231 <sup>16</sup>	-97	64 65	108, 106		108 (cor), al					
23	Eugenyl acetate	30	282	206	16 6	118 2	-9 1	253	82	153, 147	130 8 (cor), 95% al	$n_D^{20}$ 1 52069 D <sub>15</sub> 1 087				
24	Methyl palmitate	30	184 <sup>12</sup>	270	62 7	222 <sup>16</sup>	-97	64 65	106 7, 105 3, al	98	108 (cor), al	$n_D^{45}$ 1 4317				
25	n-Amyl stearate (n-Pentyl stearate)	30		354	70 1		-78 5	138 (cor)	109, 108 4, al	102	136 (cor)					
26	Ethyl 2-nitrobenzoate	30	275	195	146		-177 3	78 32	176		93, al					
27	n-Octadecyl acetate	29 97, $\alpha$ 31 95	312	16 6	118 2		$\alpha$ 57 95, 59 5	210 5 <sup>15</sup>	82	153, 147	66	$\beta$ -Form exist below 0°, $\alpha$ -Form seeding with crys or cooling soln of the compound				
28	Ethyl 2-naphthoate	32	304	200	184, 185 5		-117 3	78 32	192-3, 195, al	192, al	93, al	$n_D^{20}$ 1 596, D <sub>40</sub> 1 117				
29	Methyl-3-bromo-benzoate	32		229	155		-97	64 65	155		108 (cor), al					
30	Methyl 4-toluate	33	222 5, 217	150	179-80, subl	275 (cor)	-97	64 65	160, 158	160, 165	108 (cor), al					
31	Thymyl benzoate	33		255	122 4		51 5	233 5	130 mono	158 mono	103 2, al					
32	Di-( $\beta$ -ethoxyethyl) phthalate			155	200 6, 191 (sealed tube)			134 8	149, di 220	150 (slow htng), 160-5 (rapid htng) di 201	75, al					
33	Ethyl stearate	$\alpha$ 30 9, $\beta$ 33 5	199 <sup>10</sup>	312	70-1		-117 3	78 32	109, 108 4, al	102	93, al	$\alpha \rightarrow \beta$ Slowly on rubbing, N-( $\beta$ -Aminoethyl) morpholid, 58				
34	Di-isopropyl d,l-tartarate	34	275 <sup>75</sup>	117	203 4 (+ 1H <sub>2</sub> O), 205-6 (anh)		-89 5	82 4	226, w-me, al		123, pet eth	D <sub>40</sub> 1 1166				
35	Ethyl pyromucate (Ethyl furoate)	34	197	140	133 4, 132	230-2	-117 3	78 32	142-3	170 5, al	93, al	$n_D$ 1 4797, D <sub>40</sub> 1 1174 (undercooled)				
36	Diethyl 4-nitrophthalate	34		133 5	165		-117 3	78 32	200 d	mono 172	93, al	.				
37	Ethyl benzilate	34		256	150		-117 3	78 32	153, chl	189-90	93, al					

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Equiv alent	Saponification				Amide	P-Toluidide	3,5-Di-nitrobenzoate	Miscellaneous				
					Acid		Alcohol									
					M P °C	B P, °C	M P - °C	B P °C								
38	2,4,5-Trimethylphenyl acetate (Pseudocumenyl acetate)	34-45	245.6	178	16.6	118.2	71	232	82	153, 147						
39	Methyl cinnamate	36	261	162	133	300	-97	64.65	147.8	168	108 (cor), al					
40	Ethyl <i>d,l</i> -mandelate	37	254	180	118		-117.3	78.32	133.4	172, al	93, al					
41	Dimethyl itaconate	38	208	79	165		-97	64.65	di 191.2		108 (cor), al	n <sub>D</sub> <sup>20</sup> 1.44413 D <sub>4</sub> <sup>25</sup> 1.12410				
42	Methyl sebacate	38	288d	216	133, subl	243 <sup>15</sup>	-97	64.65	mono 170, di 210, 208	di 201	108 (cor), al	Phenylhydrazide, 194				
43	Methyl stearate	38.8	214-5 <sup>15</sup>	298	70-1		-97	64.65	109, 108.4, al	102	108 (cor), al					
44	Benzyl cinnamate	39		238	133	300	-15.3	205.5	147	168	113					
45	Methyl dibenzylacetate	41		254	89		-97	64.65	128.9, bz	175, abs	108 (cor), al					
46	Phenyl salicylate (Salol)	42		214	158.3, subl at 76		41.8, 42	182, 183	142.139	156	145.8 (cor), al	Tribromo deriv of phenol, 95				
47	Benzyl succinate	42		208	185	235d	-15.3	205.5	mono 157, di 260d	mono 179.80, di 254.5	113					
48	Dibenzyl phthalate	43 -		173	200.6, 191 (sealed tube)				mono 149, di 220	mono 150 (slow htng), 160.5 (rapid htng), di 201	113					
49	Diethyl terephthalate	44	302	111	300, subl without melting		-117.3	78.32	>225		93, al	Dianilide, 334-7, PhNO <sub>2</sub>				
50	Cinnamyl cinnamate	44		264	133	300	33	257	147-8	168	121					
51	Ethyl 2-nitrocinnamate	44		221	240		-117.3	78.32	185		93, al					
52	Methyl 2-chloro-cinnamate	44		196.5	212, yel, al		-97	64.65	168		108 (cor), al					
53	Diethyl 3-nitrophthalate	46		133.5	218		-117.3	78.32	di 201d	di 226	93, al	N-( $\beta$ -Aminoethyl) morpholide, 131.9				
54	Ethyl 3-nitrobenzoate	47	296	195	140		-117.3	78.32	di 187, 189.90, dil me al		93, al					
55	Dicyclohexyl oxalate	47, 42		127	189.5 (anh), 101 (+ 2H <sub>2</sub> O)		25.15	161.1	mono 219, di 419d	mono 168, di 268	112-3, al					
56	2-Phenylethyl cinnamate	47.8		252	133	300	-25.8	219.8	147.8	168	108					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	P-Toluidide	3,5-Dinitrobenzoate	Miscellaneous
				Equivalent	Acid		Alcohol					
					M.P. °C	B.P., °C	M.P., °C	B.P. °C				
58	1-Naphthyl acetate	48-49		186	166	118-2	94	278-80	82	153, 147	217-4, yel al	
59	Methyl 4-methoxybenzoate (Methyl anisate)	49, 45	255	166	184-6	275-80	-97	64-65	167, 162-5, w	186	108 (cor.), al	
60	Phenacyl acetate (Benzoylcarbinyl acetate, $\omega$ -Acetoxyacetophenone)	49		178	166	118-2	86	118 20 <sup>11</sup>	82	153, 147		
61	Di-3-tolyl carbonate (Di-“m-cresyl” carbonate)	49		242				12	203		165-4 (cor.), al	
62	Triphenyl phosphate	49	260 <sup>20</sup>	108-7			41-8, 42	182, 183			145-8 (cor.), al	D <sub>40</sub> 1185, Tri-bromo deriv of phenol, 95
63	Dibenzyl d-tartarate	50		165	169-71		-15-3	205-5	mono 171-2, di 196d, al		113	Phenylhydrazide, 240
64	Dibenzyl succinate	51-2		149	185, 182-8	235d	-15-3	205-5	mono 157 di 260d	mono 179-80, di 254-5 55, 260	113	
65	Methyl piperonylate	51-2	270-1 <sup>77</sup>	180	229, 228		-97	64-65	169, al		108 (cor.), al	
66	Cetyl palmitate ( <i>n</i> -Hexadecyl palmitate)	51-6		480	62-7	222 <sup>16</sup>	49-27	190 <sup>18</sup>	106-7 105-3, al	98	66	
68	Furfuryl diacetate	52	220	99	166	118-2			82	153, 147		Hydrolysis → furfural, b.p., 161-7, Semicarbazone, 202
69	Ethylene glycol dilaurate	52		213	44, 42	299	-12-6	197-85	100, 99	87	169	
70	Phenyl stearate	52		360	70-1		41-8, 42	182, 183	109, 108-4, al	102	145-8 (cor.), al	Tribromo deriv of phenol, 95
71	Methyl <i>d,l</i> -mandelate	53-3	250 sl d	166	118		-97	64-65	133-4	172, al	108 (cor.), al	
72	Dimethyl tartronate	53-4		74	156-8d		-97	64-65	di 198, dl al		108 (cor.), al	
73	Dimethyl oxalate	54	163.5 <sup>202</sup>	59	189.5 (anh.), 101 (+ 2H <sub>2</sub> O)		-97	64-65	mono 219, di 419d	mono 168, di 268	108 (cor.), al	
74	Tetraethyl pyromellitate	54		91.5	275		-117.3	78.32	di 187, 189-90, dl me al		93, al	
75	Diethyl <i>meso</i> -tartrate	55		103	140		-117.3	78.32			93, al	Bis-phenylhydrazide, 245

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	p-Toluidide	3,5-Di-nitrobenzoate	Miscellaneous				
				Equiv alent	Acid		Alcohol									
					M P, °C	B P., °C	M P. °C	B P. °C								
76	3-Tolyl benzoate ("m-Cresyl" benzoate)	55	314	212	122.4	249	12	203	130	158	165.4 (cor.), al					
77	Ethyl 4-nitrobenzoate	56	186.3	195	241		-117.3	78.32	201, 198	204, 192	93, al	N-(β-Aminoethyl) morpholide, 186.3				
78	1-Naphthyl benzoate	56		248	122.4	249	94	278-80	130	158	217.4, yel, al					
79	Cetyl stearate ( <i>n</i> -Hexadecyl stearate)	56.6		508	70-1		49.27	190 <sup>18</sup>	109, 108.4, al	102	66					
80	Di-isobutyl <i>d,l</i> -tartarate	58	311	131	203.4 (+ 1H <sub>2</sub> O), 205.6 (anh.)			108.1	<i>du</i> 226, w-me al		87					
81	Ethyl diphenylacetate	58		240	148		-117.3	78.32	167.5 8.0	172.3	93, al					
82	Ethyl 2-benzoylbenzoate	58		254	128 (anh.) 91 (+ 1H <sub>2</sub> O), w		-117.3	78.32	165 (cor.), 162		93, al	N-(β-Aminoethyl) morpholide, 150.2				
83	Diethyl naphthalate	58.60		136	274		-117.3	78.32			93, al					
84	Methyl diphenylacetate	60		226	148		-97	64.65	167.5 8.0	172.3	108 (cor.), al					
85	Di-2-tolyl carbonate (Di- "o-cresyl" carbonate)	60		242			30.75	190.8			138.4 (cor.), al					
86	Methyl 2-(4-tolyl)- benzoate	61		254	139-46		-97	64.65	175.6, al		108 (cor.), al					
87	Dimethyl <i>d</i> -tartarate	61.5		89	169.71		-97	64.65	<i>mono</i> 171.2, <i>di</i> 196d, al		108 (cor.), al	Two other forms, m p 48 and 50, Phenylhydrazide, 240				
88	Ethylene glycol dimyristate	63.0		241	53.9	202 <sup>18</sup>	-12.6	197.85	103	93	169					
89	Dimethyl 4-nitro- phthalate	66		119.5	165		-97	64.65	200d	<i>mono</i> 172	108 (cor.), al					
90	Dicyclohexyl phthalate	66		165	200-6 191 (sealed tube)		25.15	161.1	<i>mono</i> 149, <i>di</i> 220	<i>mono</i> 150 (slow htng.), 160-5 (rapid htng.), <i>di</i> 201	112-3, al	n <sub>D</sub> <sup>20</sup> 1.451, D <sub>4</sub> <sup>20</sup> 1.383				
92	Ethyl oxanilate	66-7		193	148.9		-117.3	78.32	228		93, al					
93	Dimethyl isophthalate	67.8		97	348, subl		-97	64.65	<i>mono</i> 280, <i>di</i> 280		108 (cor.), al					
94	Ethyl 2-(4-tolyl)ben- zoate	68, 69	314, 299	268	139-40		-117.3	78.32	175.6, w		93, al					
95	Phenyl benzoate	69, 71	314	198	122.4	249	41.8, 42	182, 183	130	158	145.8 (cor.), al	AlCl <sub>3</sub> → 4-Hydroxy benzophenone, Tri- bromo deriv of phenol, 95				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Saponification					Amide	<i>p</i> - Toluidide	3,5-Di- nitro- benzoate	Miscellaneous				
				Equiv- alent	Acid		Alcohol									
					M P °C	B P °C	M P °C	B P °C								
96	Dimethyl 3-nitro-phthalate	69		133.5	218		-97	64.65	<i>di</i> 201d	<i>dt</i> 226	108 (cor), al					
97	Methyl 3-hydroxy-benzoate	70		152	200, subl		-97	64.65	170 167	163, dil al	108 (cor), al					
98	Ethylene glycol di-palmitate	70.5 69		269	62.7	222 <sup>16</sup>	-12.6	197.85	106.7 105.3, al	98	169					
99	2-Naphthyl acetate	71		186	16.6	118.2	123	285.6	82	153 147	210.2 al					
100	Glyceryl tristearate	71		297	70.1		17.9	290d	109 108.4 al	102		n <sup>20</sup> 1.4399 D <sup>20</sup> 0.862				
101	4-Tolyl benzoate (" <i>p</i> -Cresyl" benzoate)	71	316	212	122.4	249	36	202	130	158	188.6 (cor), al					
102	Glyceryl tribenzoate	72, lgr., 76, al		135	122.4	249	17.9	290d	130	158						
103	Phenyl cinnamate	72		238	133	300	41.8 42	182 183	147.8	168	145.8 (cor), al	Tribromo deriv. of phenol, 95				
104	Ethylene glycol dibenzoate	73		135	122.4	249	-12.6	197.85	130	158	<i>di</i> 169					
105	Methyl 2-nitro-cinnamate	73		207	240		-97	64.65	185		108 (cor), al					
106	Di-isobutyl <i>d</i> -tartarate	73-4, 70		131	169.71			108.1	mono 171.2, <i>di</i> 169d, al		87	Phenylhydrazide, 240				
107	Ethyl 3-hydroxy-benzoate	73.8	282	166	200, subl		-117.3	78.32	170, 167	163, dil al	93 al					
108	Diphenyl phthalate (Phenyl phthalate)	74-5, 70		159	200.6, 191 (sealed tube)		41.8, 42	182, 183	mono 149 <i>di</i> 220	mono 150 (slow htng), 160.5 (rapid htng), <i>di</i> 201	145.8 (cor), al	Tribromo deriv. of phenol, 95				
109	Methyl 3-hydroxy-2-naphthoate	75		202	222-3 (cor)		-97	64.65	217.8 (cor), yel, al	221-3	108 (cor), al					
110	Methyl benzilate	75		242	150		-97	64.65	154.5, chl	189.90	108 (cor), al					
111	Ethylene glycol di- <i>n</i> -stearate	76, 73		297	70, 69.6		-12.6	197.85	109, 108.4, al	102	169					
112	Trimethyl citrate	76, 78.9	283.7d	78	100, 153 (anh.)		-97	64.65	<i>tri</i> 210- 5d, w	<i>tri</i> 189, al	108 (cor), al					
113	Methyl 2-naphthoate	77	290	186	184, 185.5		-97	64.65	192-3, al	192, al	108 (cor), al					
114	Methyl <i>α</i> -phenyl- <i>n</i> -butyrate	77-8		178	42	270	-97	64.65	85-7		108 (cor), al					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Saponification				Amide	<i>p</i> - Toluide	3,5-Di- nitro- benzoate	Miscellaneous	
				Equiv- ivalent	Acid		Alcohol					
					M P., °C	B P., °C	M P., °C	B P., °C				
115	Diphenyl carbonate	78	306	214			41 8, 42	182 183			145 8 (cor ), al	Phenylhydrazine → N,N'-diphenylcar- bazide, Tribromo deriv of phenol, 95
116	Methyl 3-nitrobenzoate	78	279	181	140		-97	64 65	143	162	108 (cor ), al	
117	Ethyl 3-nitrocinnamate	79									93, al	
118	Isoeugenyl acetate	79	283	206	16 6	118 2	-117 3	78 32	196	153, 147	158 4 (cor ), BuOH	Dibromide, 132-3
119	Methyl 2-benzoyl- benzoate	79-80, 52	352	240	128 (anh ), 91 (+1 H <sub>2</sub> O), w		-97	64 65	165 (cor ), 162		108 (cor ), al	
120	Benzyl oxalate	80		135	189 5 (anh ) 101 (+2 H <sub>2</sub> O)		-15 3	205 5	mono 219, <i>di</i> 419d	mono 169 <i>di</i> 268	113	
121	Methyl 4-bromobenzoate	81		215	251 3		-97	64 65	189 90, w		108 (cor ), al	
122	Benzoin acetate	83		254	16 6	118 2	133	344	82	153, 147		
123	Pentaerythritol tetra- acetate	84		76	16 6	118 2	262 253		82	153, 147		
124	Pyrocatechol dibenzoate (Catechol dibenzoate)	84		159	122 4	249	105	245 6	130	158	<i>di</i> 152	
125	Ethyl 3-hydroxy-2- naphthoate	85	291	216	222 3 (cor )		-117 3	78 32	217 8 (cor ), yel , al	221-3	93, al	
126	Diguaiacon carbonate (Di-(2-methoxyphenyl) carbonate, "Guaiacol carbonate")	87		274			32	205			141 2 (cor ), al	Monobromo deriv , 178
127	Dimethyl <i>d-l</i> -tartarate	90 (stab ), 84 (meta- stab )	282	89	203 4 (+1 H <sub>2</sub> O), 205 6 (anh )		-97	64 65	226, w - me al		108 (cor ), al	
128	Di-2-tolyl oxalate (Di- "o-cresyl" oxalate)	91		135	189 5 (anh ), 101 (+2 H <sub>2</sub> O)		30 75	190 8	mono 219, <i>di</i> 419d	mono 169, <i>di</i> 268	138 4 (cor ), al	
129	Ethyl 3,5-dinitroben- zoate	94, 93		240	204-5		-117 3	78 32	183		93, al	N-( $\beta$ -Aminoethyl) morpholide, 189 5
130	2-Naphthyl salicylate	95 5, 93 5		264	158 3 subl at 76		123	285-6	142, 139	156	210 2, al	
131	Methyl 4-nitrobenzoate	96		181	241		-97	64 65	201, 198	204, 192	108 (cor ), al	
132	<i>n</i> -Propyl 4-hydroxy- benzoate	96		180	215, 210			97 1	162 (+1 H <sub>2</sub> O), w	203-4, al	123, pet eth	
133	1,2,4-Triacetoxylbenzene ("Hydroquinone tri- acetate")	96-7		76	16 6	118 2	140 5		82	153, 147		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVI. ORGANIC DERIVATIVES OF ESTERS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point °C	Saponification					Amide	<i>p</i> -Toluidide	3,5-Dinitrobenzoate	Miscellaneous				
				Equiv- alent	Acid		Alcohol									
					M P °C	B P, °C	M P, °C	B P °C								
134	Ethyl 3,5-dinitro-salicylate	99		256	182, 173 (+1 H <sub>2</sub> O)		-117 3	78 32	181		93, al					
135	Dimethyl fumarate	101 7	193 25	72	286 7 (sealed tube), subl 200		-97	64 65	mono 270, 300 2 subl <i>di</i> 266d		108 (cor ), al	n <sub>D</sub> <sup>10 5</sup> 1 40625, D <sup>110 5</sup> 1 0397				
136	Ethyl 5-nitrosalicylate	102		211	229 30		-117 3	78 32	225		93, al					
137	Dimethyl naphthalate	104		122	274		-97	64 65			108 (cor ), al					
138	Di-3-tolyl oxalate (Di- "m-cresyl" oxalate)	105		135	189 5 (anh), 101 (+2 H <sub>2</sub> O)		12	203	mono 219, <i>di</i> 419d	mono 169 <i>di</i> 268	164 5 (cor ), al					
139	Phloroglucinol tri-acetate (1,3,5-Tri-acetoxybenzene)	105-6		76	16 6	118 2	200 9 (slow htng ), 217 9 (rapid htng )	82		153, 147	<i>tri</i> 162					
140	Diphenyl adipate	106		149	153-4 (cor )	216 <sup>15</sup>			mono 125-30, w, <i>di</i> 220	241	145 8 (cor ), al	Tribromo deriv. of phenol, 95				
141	Acetyl salicylaldehyde diacetate ("Salicyl aldehyde triacetate")	107, 103		89	16 6	118 2			82	153, 147		Hydrolysis → salicylaldehyde, b p 197 (cor )				
142	2-Naphthyl benzoate	107		248	122 4	249	123	285-6	130	158	210 2, al					
143	Methyl 3,5-dinitrobenzoate	108		226	204 5		-97	64 65	183		108 (cor ), al					
144	Dimethyl mesotartrate	111		89	140		-97	64 65	<i>di</i> 187, 189 90, dil me al		108 (cor ), al	Bis-phenylhydrazide, 245				
145	Di-4-tolyl carbonate (Di- <i>"p</i> -cresyl carbonate)	114		242			36	202			188 6 (cor ), al					
146	Ethyl oxamate	114 5		117	210		-117 3	78 32	419d		93, al					
147	Cholesteryl acetate	114		416	16 6	118 2	148 5	82		153, 147						
148	Ethyl 4-hydroxybenzoate	116		166	215, 210		-117 3	78 32	162 (+1 H <sub>2</sub> O), w	203-4, al	93, al	N-( $\beta$ -Aminoethyl) morpholide, 184				
149	Resorcinol dibenzoate	117		159	122 4	249	110 (stab), 108 8 5 (labile)	280 8 (cor )		158	<i>bis</i> 201					
150	Ethyl 3-nitrosalicylate	118		211	125 (+1 H <sub>2</sub> O)		-117 3	78 32	145		93, al					
151	Methyl 5-nitrosalicylate	119		197	229 30		-97	64 65	225		108 (cor ), al					

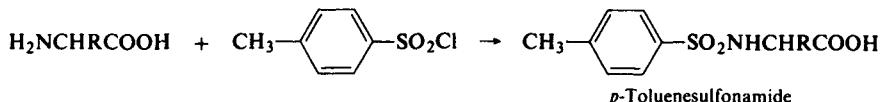
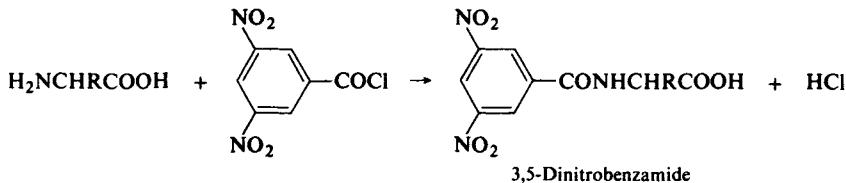
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVI. ORGANIC DERIVATIVES OF ESTERS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

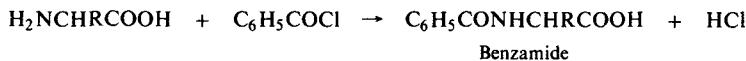
No	Name	Melting point, °C	Boiling point, °C	Equiv- alent	Saponification				Amide	<i>p</i> - Toluidide	3,5-Di- nitro benzoate	Miscellaneous				
					Acid		Alcohol									
					M P °C	B P °C	M P. °C	B P. °C								
152	Diphenyl succinate	121		135	185 182.8	235d	41.8, 42	182, 183	mono 157, <i>di</i> 260d	mono 179.80, <i>di</i> 254.5 55, 260	148.5 (cor ), al	Tribromo deriv of phenol, 95				
153	Di-4-tolyl succinate (Di- "p-cresyl" succinate)	121		149	185 182.8	235d	36	202	mono 157, <i>di</i> 260d	mono 179.80, <i>di</i> 254.5- 55, 260	188.6 (cor ), al					
154	Hydroquinone diacetate	124		97	16.6	118.2	171	286	82	153, 147	bis 317					
155	Methyl 3-nitro- cinnamate	124		207	199		-97	64.65	196		108					
156	Methyl 3,5-dinitro- salicylate	127		242	182		-97	64.65	181, 173 (+1 H <sub>2</sub> O)		108					
157	Methyl 4-hydroxy- benzoate	131		152	215, 210		-97	64.65	162 (+1 H <sub>2</sub> O), w	203-4, al	108					
158	Methyl 3-nitro- salicylate	132		197	125 (+1 H <sub>2</sub> O)		-97	64.65	145		108					
159	Triethyl trimesate	133		98	380 (cor )		-117.3	78.32	tri 365d (cor )		93, al					
160	Ethyl 4-nitro- cinnamate	137, 142		221	285		-117.3	78.32	204, 217		93, al					
161	Dimethyl terephthalate	141		97	300 (subl without melting)		-97	64.65	<i>di</i> >225		108					
162	Tetramethyl pyromellitate	142		77.5	275		-97	64.65			108					
163	Trimethyl trimesate	144		84	380 (cor )		-97	64.65	tri 365d (cor )		108					
164	Di-4-tolyl oxalate (Di- "p-cresyl" oxalate)	148-9		135	189.5 (anh ), 101 (+2 H <sub>2</sub> O)		36	202	mono 219, <i>di</i> 419d	mono 169, <i>di</i> 268	188.6 (cor ), al					
165	Methyl 4-nitro- cinnamate	161		207	285		-97	64.65	204, 217		108					
166	Diethyl mucate	163-4		133	214d, 223-55		-117.3	78.32	mono 192d, <i>di</i> 220		93, al					
167	Pyrogallol triacetate	165, 172		84	16.6	118.2	133	309	82	153, 147	tri 205					
168	Dimethyl mucate	165.7d		119	214d, 223-55		-97	64.65	mono 192d, <i>di</i> 220		108					
169	Methyl gallate	200-1		184	253-4d, 222 40d		-97	64.65	189		108					
170	Hydroquinone di- benzoate	204 (cor ), 199		159	122.4	249	171, 172	286	130	158	bis 317					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XVII

*p-Toluenesulfonamide (p-Toluenesulfonyl derivative).\**From the amino acid in aqueous sodium hydroxide with *p*-toluenesulfonyl chloride in ether.For directions and examples see: Cheronis, pp. 453-454; Linstead, pp. 77-78; Shriner, p. 231; Vogel, p. 437; Wild, pp. 169-170; E. Fischer and P. Bergell, *Chem. Ber.*, **35**, 3779, 3784 (1902); E. W. McChesney and W. K. Swann, *J. Amer. Chem. Soc.*, **59**, 1116 (1937).From the amino acid in aqueous sodium hydroxide with *p*-toluenesulfonyl chloride.See: J. I. Harris and T. S. Work, *Biochem. J.*, **46**, 582 (1950).From the amino acid with *p*-toluenesulfonyl chloride and triethylamine in aqueous tetrahydrofuran.See: D. Theodoropoulos and L. C. Craig, *J. Org. Chem.*, **21**, 1376 (1956).For an extensive list of references for the preparation of the *p*-toluenesulfonyl derivatives of amino acids see: J. P. Greenstein and M. Winitz, *Chemistry of the Amino Acids*, Vol. 2, John Wiley and Sons, New York, 1961, pp. 886-889.*3,5-Dinitrobenzamide (3,5-Dinitrobenzoyl derivative).\**

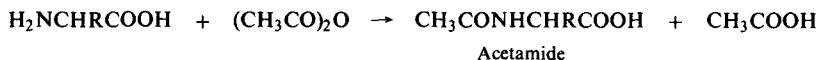
From the amino acid in aqueous sodium hydroxide with 3,5-dinitrobenzoyl chloride.

For directions and examples see: Cheronis, p. 453; Vogel, p. 436; Wild, p. 168; B. C. Saunders, *Biochem. J.*, **28**, 580 (1934); *J. Chem. Soc.*, 1397 (1938); B. C. Saunders, G. J. Stacey and I. G. E. Wilding, *Biochem. J.*, **36**, 368 (1942); B. W. Town, *Biochem. J.*, **35**, 578 (1941).*Benzamide (Benzoyl derivative).*

From the amino acid in aqueous sodium carbonate or bicarbonate and benzoyl chloride.

For directions and examples see: Linstead, p. 77; Vogel, p. 436; Wild, p. 167.

From the amino acid in aqueous sodium hydroxide with benzoyl chloride.

See: Cheronis, p. 453; E. Fischer and P. Bergell, *Chem. Ber.*, **35**, 3779, 3784 (1902); **39**, 597 (1906).*Acetamide (Acetyl derivative).*

From the amino acid with acetic anhydride in water.

For directions and examples see: Linstead, p. 77; Shriner, p. 226; Wild, p. 167; R. M. Herbst and D. Shemin in *Organic Syntheses*, Coll. Vol. 2, (Ed. A. H. Blatt), John Wiley and Sons, New York, 1943, p. 11.

From the amino acid in aqueous sodium hydroxide with acetic anhydride.

See: Cheronis, p. 454; M. Bergmann and L. Zervas, *Biochem. Z.*, **203**, 288 (1928).*Carbobenzoxamide (Carbobenzoxy derivative; Benzyloxycarbonyl derivative).*

From the amino acid in aqueous sodium hydroxide with carbobenzoxy chloride (benzyl chloroformate).

For directions and examples see: M. Bergmann and L. Zervas, *Chem. Ber.*, **65**, 1192 (1932); M. Winitz, L. Bloch-Frankenthal, N. Izumiya, S. M. Birnbaum, C. G. Baker and J. P. Greenstein, *J. Amer. Chem. Soc.*, **78**, 2423 (1956).

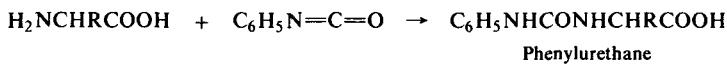
\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE XVII (Continued)

For an extensive list of references for the preparation of the carbobenzoxy derivatives of amino acids see: J. P. Greenstein and M. Winitz, *Chemistry of the Amino Acids*, Vol. 2, John Wiley and Sons, New York, 1961, pp. 887-895.

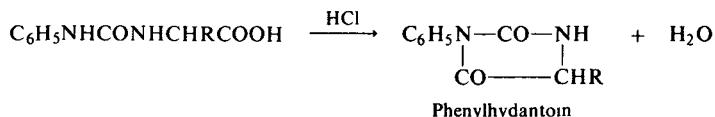
*Phenylurethane (Phenylurea derivative).\**



From the amino acid with aqueous potassium hydroxide and phenylisocyanate.

For directions and examples see: Linstead, p. 78; Shriner, p. 211; Wild, p. 171.

*Phenylhydantoin.\**



From the phenylurethane (obtained as described above) in aqueous hydrochloric acid.

For directions and examples see: Cheronis, p. 456.

*Rf Values.*

For the determination of the Rf values of amino acids in aqueous phenol, in collidine-lutidine and in butanol-acetic acid mixtures see: R. J. Block, R. LeStrange and G. Zweig, *Paper Chromatography*, Academic Press, New York, 1952, pp. 51-66; E. Lederer and M. Lederer, *Chromatography*, Elsevier Publishing Co., New York, 1957, pp. 306-311.

*NOTE:* For additional information regarding directions and examples for the preparation of derivatives of amino acids which are similar to those of amines (e.g., phenylurethane, acetamide, etc.) see explanations and references to Table XVIII, p. 291, 292, 293, 294.

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
 (Listed in order of increasing decomposition temperatures)\* \*\*

No	Name	Decomp temp °C	Specific rotation			Rf values***			<i>p</i> Toluene- sulfonyl	Phenyl urea	Benzoyl	3,5 Dinitro benzoyl	Picrate	Miscellaneous
			[ $\alpha$ ] <sub>D</sub>	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol- Ac acid						
1	3-Aminohydro- cinnamic acid	84-5												Acetyl, 162, Hydrochloride, 191
2	N-Methyl- $\beta$ - alanine	99-100												Hydrochloride, 105, aq al
3	Aminomalonic acid	109									61, pet eth			Formyl, 48, Heat $\rightarrow$ glycine decom temp 228 30 262
4	2-Aminophenyl- acetic acid	119										179, al		Acetyl, 158, Formyl, 110
5	2-Amino-1- Naphthoic acid	126												N-Acetyl, 195-6, al
6	N-Phenyl- glycine	127								195	63			Acetyl 124
7	4-Aminohydro- cinnamic acid	132									194-5			Acetyl 143 (anh ) 124 (hyd )
8	L-Ornithine	140	11.5	25	c = 6.5	0.79	0.11	0.15	190	240 (mono), 189 (di)		208		$\alpha,\delta$ -Dicarbo- benzyloxy, 112 4
9	Anthranilic acid (2 Amino benzoic acid)	147				0.85			217	181	182	278	104	
10	3-Aminophenyl- acetic acid	151												Amide, 164 6, al Chloro- acetyl 187-8, al
11	5-Amino- pentanoic acid ( $\omega$ -Amino- <i>n</i> - valeric acid)	157									105 94			
12	2-Aminocin- namic acid	158, yel									191 3, al			Monoacetyl, 250 1, al. Diacetyl 158, lgr
13	DL- $\beta$ -Amino- <i>n</i> - valeric acid DL-3-Amino pentanoic acid)	160 5									145 6			N- $\beta$ Naphthal- enesulfonyl 134
14	2-Amino-4- toluic acid	165												Acetyl, 279-81
15	3-Aminoben- zoic acid	174				0.86				270 264	248	270		
16	trans-4-Amino- cinnamic acid	175-6									274			Acetyl, 259 60
17	$\omega$ -Aminotri- decyclic acid	177									111 105			Benzenesul- fonyl, 120, al
18	3-Amino-4- toluic acid (Homoanthra- nilic acid)	177												Amide, 146, Acetyl, 184, Formyl, 186, al

\*Derivative data given in order m p , crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\*Aqueous phenol 80°, w/w for basic amino acids 3 vol —°, of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained Collidine-lutidine mixture 2,6-lutidine (100 ml ), 2,4,6-collidine (100 ml ), water (100 ml ), diethylamine (3 ml ), Butanol-acetic acid-water 40 ml 10 ml 10 ml

**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
 (Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp °C	Specific rotation			Rf values***			<i>p</i> -Toluene-sulfonyl	Phenyl urea	Benzoyl	3,5-Dinitrobenzoyl	Picrate	Miscellaneous
			[ $\alpha$ ] <sub>D</sub>	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
19	4-Amino-1-naphthoic acid	177												Acetyl, 189, Amide, 175
20	trans-3-Aminocinnamic acid	181, yel									229			Acetyl, 237, al
21	3-Amino-1-naphthoic acid	181												Acetyl, 254 5
22	N-Ethylglycine	182												Hydrochloride, <i>ca</i> 180
23	L-Canavanine	184	7.9	20		0.51								Carbo-benzyloxy, 137
24	L-Glutamine	185				0.6								4-Nitrobenzyl ester 136 4-Bromo phenacyl ester, 151
25	Hippuric acid	187												
26	4-Aminobenzoic acid	188				0.81				300	278	290		
27	DL-Canaline	190-5									158 60 (di)			$\gamma$ -Carbobenzoxo, 208-10 Formyl, 183
28	Betaine (Trimethyl-glycine)	193												
29	DL- $\beta$ -Aminobutyric acid	194				0.78					154			
30	DL-Glutamic acid	199				0.31	0.20	0.3	117		153 155			Acetyl, 187
31	4-Aminophenylacetic acid	199 200									205-6, al			Acetyl, 168 70, Chloroacetyl, 158-60 Carbobenzoxo, 106
32	$\beta$ -Alanine	200				0.66	0.22	0.37		168	120	202		
33	L-Isoserine	200				0.39					107-9			
34	$\omega$ -Amino- <i>n</i> -caproic acid (6-Amino-hexanoic acid)	202									45-7			
35	$\gamma$ -Aminobutyric acid	203				0.75								Hydrochloride, 135 Heat $\rightarrow$ pyrrolidone, 24, pet eth
36	DL-Proline	203 (mono-hyd) 191				0.88	0.28	0.43		170		217	135-7	
37	$\gamma$ -Amino- <i>n</i> -caproic acid (4-Amino-hexanoic acid)	205-7									150 2			Hydrochloride, 120 1
38	6-Amino-1-naphthoic acid	205-6												Acetyl, 170 2, 252-3
39	1-Amino-2-naphthoic acid	205 r h												Heating with conc HCl $\rightarrow$ 1-naphthylamine, 50

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\* Aqueous phenol 80% w/w, for basic amino acids 3 vol --% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml). Butanol-acetic acid-water 40 ml 10 ml 10 ml

**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
 (Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp °C	Specific rotation			Rf values***			<i>p</i> -Toluene sulfonyl	Phenyl urea	Benzoyl	3,5 Dinitro benzoyl	Picrate	Miscellaneous
			[α] <sub>D</sub>	T °C	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol- Ac acid						
40	L-Arginine	207	11.8	20	c = 0.87 in 0.5 N-NaOH	0.89	0.17	0.2			298 (mono), 235 (di)	150	217 (mono), 190 (di)	Monocarbo- benzyloxy, 175
			12.5	20	c = 3.48 in water									
41	L-Glutamic acid	211 r h , 197 s h	31.2	22.4	c = 1.0 in 6N-HCl	0.31	0.2	0.3	131					Acetyl, 199, Carboben- zyloxy, 120
42	S-Amino-1- naphthoic acid	212			c = 1.47 in water									Acetyl, 296, al
43	Sarcosine	212												Acetyl, 135
44	L-3,5-Di-iodo- tyrosine	213	2.9	20	c = 5.08 in 1.1 N-HCl	0.61	0.55							
45	L- $\alpha$ -Asparagine	213-5				0.47								Carboben- zyloxy, 164
46	DL- $\gamma$ -Amino-n- valeric acid (DL-4-Amino- pentanoic acid)	214 (cor.)									132			
47	L-Canaline	214				0.77						99 (di)		
48	$\beta$ -Aminoiso- valeric acid	217											192.3	Hydrochloride, 120
49	$\beta$ -Hydroxy- valine	218										182	153 (mono)	2-Naphthalene- sulfonyl, 261
50	L-Proline	220.2	-93.0	20	c = 2.42 in 0.6 N-KOH	0.88	0.28	0.43	130-3					154 Phenylhy- dantoin, 144
			-52.6	20	c = 0.57 in 0.5 N-HCl									
51	L-Citrulline	222	3.7	20	c = 2 in water	0.63	0.23	0.25						206
52	7-Amino-1- naphthoic acid	223-4												Acetyl, 229
53	L-Lysine	224	14.6	20	c = 6.5 in water	0.81	0.11	0.14			184	235 (mono), 149 (di)		266 Monohydro- chloride 235 Dihydrochlo- ride, 193 $\alpha,\epsilon$ - Dicarboben- zyloxy, 150
			25.9	22.9	c = 2.0 in 6 N-HCl									
54	$\beta$ -L-Asparagine	227				0.40	0.21	0.19	175		164	189	196	180 Carboben- zyloxy, 165
55	3,5-Diamino- benzoic acid	228												3,5-Diacetyl, 184, Et ester, 84
56	L-Serine	228	14.45	25	c = 9.34 in 1 N-HCl	0.36	0.28	0.27						Carboben- zyloxy, 121
			-6.83	20	c = 10.4 in water									
57	Glycine	228.30, 262				0.41	0.24	0.26	147		197	187.5	179	202 Carboben- zyloxy, 120
58	DL-Thyroxine	230 s h , 250 r h				0.86	0.76					210.5		N-Chloro- acetyl, 201, Me ester 156
59	DL- $\beta$ -Hydroxy- norvaline	230									156	170		Phenylhy- dantoin, 154.5

\*Derivative data given in order m p, crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\*Aqueous phenol 80% w/w, for basic amino acids 3 vol — % of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained, Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
 (Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp., °C	Specific rotation			Rf values***			<i>p</i> -Toluene sulfonyl	Phenyl urea	Benzoyl	3,5- Dinitro- benzoyl	Picrate	Miscellaneous
			[ $\alpha$ ] <sub>D</sub>	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol- Ac acid						
60	<b>DL-β-Amino-</b> <b>hydrocinnamic</b> <b>acid</b>	231									194.6			Hydrochloride, 218, Formyl, 128-9, Acetyl, 161, al Amide, 266
61	<b>DL-Homo-</b> <b>aspartic acid</b> ( $\alpha$ -Amino- $\alpha$ - methyl suc- cimic acid)	232												
62	<b>D-β-Amino-</b> <b>hydrocinnamic</b> <b>acid</b>	234.5	7.0	20	water									N-Formyl, 142-3
63	<b>L-β-Amino-</b> <b>hydrocinnamic</b> <b>acid</b>	234.5	-7.5	25	water									N-Formyl, 142.3
64	<b>3-Amino-</b> <b>salicylic acid</b>	235									189			Acetyl, 215, N- Benzenesul- fonyl, 194
65	<b>DL-Allo-</b> <b>threonine</b>	237				0.50	0.34				176 (mono), 174 (di)			
66	<b>DL-Arginine</b>	238				0.89	0.17	0.2			230 (di, anh.), 176 (di, hyd)	200 (mono), 196 (di)		
67	<b>4-Dimethyl-</b> <b>aminobenzoic</b> <b>acid</b>	242												Amide, 206, Anilide, 182.3
68	$\beta$ -Amino- $\beta$ - phenyliso- butyric acid	243												
69	<b>DL-Isoserine</b>	246				0.39						205		
70	<b>DL-Serine</b>	246				0.36	0.28	0.27	213	169	149-50			
71	<b>4-Hydroxy-</b> <b>phenylglycine</b>	248									117			
72	<b>Isoaspartic acid</b> ( $\alpha$ -Amino- $\alpha$ - methylmalonic acid)	250												Diamide, 200.1 Heat $\rightarrow$ ala- nine, 295 d
73	<b>DL-Threonine</b>	251					0.50	0.34	0.35			177.8	145	
74	<b>DL-<math>\alpha</math>-Amino-</b> <b>phenylacetic</b> <b>acid</b>	256 (subl.)										175, al		Phenylhydan- ton, 164
75	<b>L-Cystine</b>	260	-214.4	24.4	c = 1.0 in 1.02 N-HCl				0.1	204.5	160	181 (di)	180	Acetyl, 198.5, Formyl, 180
76	<b>DL-<math>\alpha</math>-Amino-</b> <b>hydratropic</b> <b>acid (DL-<math>\alpha</math>-</b> <b>Phenyl-</b> <b>alanine)</b>	260 (subl.)			c = 0.4 in 0.2 N-NaOH									Dicarboben- zyloxy, 123
														N-Carbo- ethoxy, 191, al

\* Derivative data given in order m p , crystal color, solvent from which crystallized

\*\* Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\* Aqueous phenol 80% w/w for basic amino acids 3 vol —% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
 (Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp., °C	Specific rotation			Rf values***			<i>p</i> -Toluene-sulfonyl	Phenyl urea	Benzoyl	3,5-Dinitro benzoyl	Picrate	Miscellaneous
			[ $\alpha$ ] <sub>D</sub>	T °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol Ac acid						
77	Glycylglycine	260				0.39		0.22	178	176	208	210		Carbobenzoxy, 178
78	DL- $\beta$ -Phenylalanine	264				0.85	0.48	0.68	134.5	182	188		173	Carbobenzoxy, 103
79	DL-Aspartic acid	270 (>300)				0.19	0.21	0.24			119 (hyd.), 176 (anh.) 128			Carbobenzoxy, 116
80	DL- $\alpha$ -Amino-octanoic acid	270				0.89	0.55							
81	L-Aspartic acid	270	24.6	24	c = 2.0 in 6 N HCl	0.19	0.21	0.24	140	162	185			Carbobenzoxy, 116
82	DL- $\alpha$ -Amino-nonanoic acid	273									128			
83	L-Hydroxy-proline	274	-47.3	20	c = 1.31 in 1 N-HCl	0.63	0.28		153	175	100 (mono), 92 (di)			
84	DL-Tryptophane	275			c = 1.0 in water	0.75	0.50	0.50	176			240		N-Benzenesulfonyl 185
85	$\alpha$ -Aminoisobutyric acid	280				0.74	0.32				198			Carbobenzoxy, 169-70
86	DL- $\alpha$ -Amino-heptanoic acid	281									135			1-Naphthylurea, 198
87	DL-Methionine	281				0.81	0.42	0.55	105		145			Acetyl, 114, Formyl, 100, Carbobenzoxy, 112
88	5-Aminosalicylic acid	283									252			Monoacetyl, 218 Diacetyl, 184
89	DL-Lanthionine	283				0.26	0.11				195.8 (di)			
90	L-Methionine	283	-8.11	25	c = 0.8 in water	0.81	0.42	0.55			94.5 (hyd.), 150 (anh.)			Acetyl, 98.9 1-Naphthylurea, 188
91	L-(+)-Iso-leucine		40.6	20	c = 5.1 in 6 l N-HCl	0.84	0.45	0.72	130-2	121	117			Formyl, 156
			11.29	20	c = 3.1 in water									
92	L-Phenylalanine	283	-35.1	20	c = 1.94 in water	0.85	0.48	0.68	164	181	146	93		Carbobenzoxy, 126.8
93	L-Hexahydro-tyrosine	285												N-4-Nitrobenzoyl, 225
94	D-(+)-Iso-leucine	285	-40.86	20	c = 4.53 in 6 l N-HCl	0.84	0.45	0.72	130.2	121	117			Formyl, 156
95	L-Histidine	288. 253	13.0 -39.0	22.7 25	c = 1.5 in 6 N-HCl c = 1.13 in water	0.69	0.27	0.2	202.4		230 (mono)	189	86	Carbobenzoxy, 209
96	L-Cysteic acid	289 260	8.66	20	c = 1.85 g in 25 ml water									Diphenylacyl ester, 203

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\*Aqueous phenol 80%, w/w for basic amino acids 3 vol —% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml) Butanol-acetic acid-water 40 ml 10 ml 10 ml

**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
**(Listed in order of increasing decomposition temperatures)\* \*\* (Continued)**

No	Name	Decomp temp. °C	Specific rotation			Rf values***			<i>p</i> -Toluene-sulfonyl	Phenylurea	Benzoyl	3,5-Dinitrobenzoyl	Pierce	Miscellaneous
			[α] <sub>D</sub>	T, °C	Conc (C) and solvent	Aqueous phenol	Collidine-Lutidine	Butanol-Ac acid						
97	L-Tryptophane	290 252	-31.5	22.7	c = 1.0 in water c = 2.42 in 0.5 N-NaOH	0.75	0.50	0.5	176	166	183	233		Carbobenzoyloxy 126
98	DL-N-Methyl- $\alpha$ -alanine	292	6.17	20										Methylamide, 43, Hydrochloride, 110
99	DL-Isoleucine	292, 275 s h				0.84	0.45	0.72	141	120	118			Formyl, 121
100	L-(+)- $\alpha$ -Aminobutyric acid	292, 303 s h	18.65	19	c = 4.8 in 6 N-HCl	0.71	0.31	0.45				121		Formyl, 126, 1-Naphthylurea, 195
101	DL-Leucine	293, s h 332				0.84	0.45	0.73		165	137.41	187		
102	DL- $\alpha$ -Amino- $\alpha$ -methylvaleric acid (DL- $\alpha$ -Amino- $\alpha$ -methylpentanoic acid)	295, s h												1-Naphthylurea 196
103	DL-Alanine	295				0.60	0.28	0.38	139		166	177		Carbobenzoyloxy, 114.5 Formyl 194.5
104	D- $\alpha$ -Amino-hydratropic acid	295 (subl.)	70.0	18	water									
105	L-Alanine	297 2.7	14.7 22	15	c = 5.8 in 0.97 N-HCl c = 10.3 in water	0.60	0.28	0.38	133		151			Carbobenzoyloxy, 84 1-Naphthylurea, 220.2 Formyl, 114
106	DL-Norleucine	297 327				0.84	0.45	0.74	124					
107	DL-Valine	298, s h, 282				0.78	0.36	0.6	110	164	132	158		
108	L-Djenkolic acid	300-50 -47.5	-60.5 25	20.5	1% in 1N-HCl 2% in 1N-HCl water	0.40	0.13				166 (mono), 88 (di)			
109	D-N-Methyl- $\alpha$ -alanine	300	5.6	20										Hydrochloride, 165.6
110	Taurine	300-5				0.42								N-Me, 241, N-Et, 147
111	L-(+)-Norleucine	301 6.26	21.3 20		c = 4.25 in 6 N-HCl c = 0.7 in water	0.84	0.45	0.74			53			Formyl, 115-6, 2-Naphthalenesulfonyl, 149
112	DL-Norvaline	303, s h				0.80	0.39	0.65		117				Formyl, 132, Phenylhydantoin, 103
113	Creatine ( $\alpha$ -Methylguanidoacetic acid)	303		-								218.20		Diacetyl, 165
114	4-Aminocyclohexanecarboxylic acid	303-4												Heat → lactam, 191-2

\*Derivative data given in order m p, crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\*Aqueous phenol 80% w/w for basic amino acids 3 vol -% of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber, otherwise low values are obtained. Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml). Butanol-acetic acid-water 40 ml 10 ml 10 ml

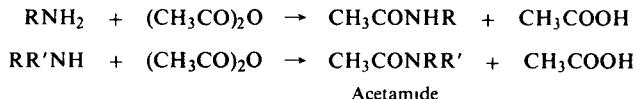
**TABLE XVII. ORGANIC DERIVATIVES OF AMINO ACIDS**  
 (Listed in order of increasing decomposition temperatures)\* \*\* (Continued)

No	Name	Decomp temp °C	Specific rotation			Rf values***			<i>p</i> Toluene sulfonyl	Phenyl urea	Benzoyl	3,5 Dinitro benzoyl	Picrate	Miscellaneous
			[α] <sub>D</sub>	T °C	Conc (C) and solvent	Aqueous phenol	Collidine- Lutidine	Butanol Ac acid						
115	DL- $\alpha$ -Amino- butyric acid	304				0.71	0.31	0.45		170	147			1-Naphthyl- urea, 194, Phthalyl, 96
116	meso-Lan- thionine	304				0.26	0.11			198	200			Dicarbo- benzyloxy, 139-40
117	Creatinine	305, 260										220		
118	L- $\alpha$ -Amino- phenylacetic acid	305 10	-111.0, -157	20, 20	water dil HCl									Acetyl 191, Formyl 190
119	meso-2,3-Di- aminosuccinic acid	306										(di) 212 hyd		Diacetyl, 235
120	L-(+)-Norva- line	307	23.0	20	c = 10 in 10% HCl	0.80	0.39			64				Acetyl, 137
121	L-Tyrosine	314-8 r h 290.5 s h	-8.64 -13.2	20 18	c = 4.4 in 6.3 N HCl c = 0.91 in 3 N NaOH	0.51	0.51	0.45	N- 188	104	N- 166 7,211 2 (di)			N-Acetyl, 148, Diacetyl, 172, N-Carboben- zyloxy, 101
122	L-(+)-Valine	315	28.8	20	c = 3.4 in 6 N-HCl	0.78	0.36	0.60	147		127	157.8		Carboben- zyloxy, 64-5
123	L-Leucine	337	15.1	25.9	c = 2.0 in 6 N-HCl c = 2.0 in water	0.84	0.45	0.73	124	115	118	187		
124	DL-Tyrosine	340 r h , 295 s h				0.51	0.51	0.45	224.6		N- 197	252.4 (di)		
125	1-Aminocyclo- hexanecar- boxylic acid	350, 320 s h											209-10	Hydrochloride, 310
126	DL-2,3-Di- aminosuccinic acid										164 (di) hyd			Diacetyl, 235
127	DL-Ornithine					0.79	0.11	0.15	188 (mono)	192	4 N 285-8, 188 (di)		208 (di)	
128	L-(+)-Alloiso- leucine		38.1	20	c = 3.97 in 6 N-HCl					151				Formyl, 126, L- Naphthylurea, 166. Benzene- sulfonyl, 147
129	DL-Lysine					0.81	0.11	0.14		196	249 (mono); 146 (di)		225 (mono)	Monohydro- chloride, 260.3, Dihy- drochloride, 187-9
130	L-Cysteine					0.57								S-Benzyl, 216, Oxid → L- cystine, 260 d Hydrochlo- ride, 175-8, [α] <sub>D</sub> <sup>25</sup> 9.5 (c = 2 in water)

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

\*\*Decomposition points of amino acids are only a first doubtful identification as they depend on velocity of heating and other conditions

\*\*\*Aqueous phenol 80%, w/w for basic amino acids 3 vol — " of a conc aq NH<sub>3</sub> has to be present (in a separate vessel) in the chamber otherwise low values are obtained Collidine-lutidine mixture 2,6-lutidine (100 ml), 2,4,6-collidine (100 ml), water (100 ml), diethylamine (3 ml), Butanol-acetic acid-water 40 ml 10 ml 10 ml

**EXPLANATIONS AND REFERENCES TO TABLE XVIII***Acetamide (Acetyl derivative) \***For primary and secondary amines only*

From the amine with acetic anhydride without solvent

*For directions and examples see* Cheronis, pp 591-593, Linstead, p 60, Vogel, p 652, Wild, p 218, J J Sudborough, *J Chem Soc*, 79, 533 (1901), L C Raiford, R Taft and H P Lankelma, *J Amer Chem Soc*, 46, 2051 (1924)

From the amine with acetic anhydride in aqueous sodium hydroxide

*See* F D Chattaway, *J Chem Soc*, 2495 (1931)

From the amine with acetic anhydride in pyridine

*See* Cheronis, pp 590, 592-593

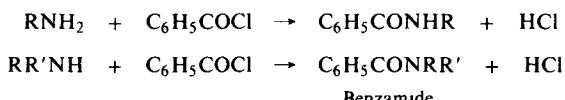
From the amine hydrochloride with acetic anhydride in aqueous sodium acetate

*See* Linstead, p 60, Vogel, p 652

From the amine with acetic anhydride in water

*See* Shriner, p 226

From the amine with acetic anhydride in acetic acid

*See* Wild, p 218*Benzamide (Benzoyl derivative) \***For primary and secondary amines only*

From the amine with benzoyl chloride in aqueous sodium hydroxide

*For directions and examples see* Cheronis, pp 591, 593-594, Linstead, p 60, Vogel, p 652, Wild, p 219

From the amine with benzoyl chloride in a pyridine-benzene mixture

*See* Shriner, p 226

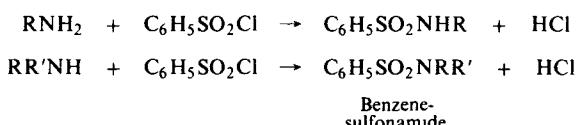
From the amine with benzoyl chloride in benzene

*See* Shriner, p 227

From the amine with benzoyl chloride in an aqueous sodium hydroxide-chloroform mixture

*See* Shriner, p 226

From the amine with benzoyl chloride

*See* Vogel, p 653*Benzenesulfonamide (Benzenesulfonyl chloride derivative) \***For primary and secondary amines only*

From the amine with benzenesulfonyl chloride in aqueous sodium hydroxide

*For directions and examples see* Cheronis, pp 595-596, Shriner, pp 103-104, Vogel, p 653, O Hinsberg, *Chem Ber*, 23, 2962 (1890), 38, 906 (1905)

From the amine in aqueous sodium hydroxide with benzenesulfonyl chloride in methanol

*See* Cheronis, p 596

From the amine with benzenesulfonyl chloride in benzene

*See* Wild, p 221

From the amine in aqueous sodium hydroxide with benzenesulfonyl chloride in acetone

*See* Wild, p 221

From the amine with benzenesulfonyl chloride in aqueous pyridine

*See* Wild, p 221

From the amine with benzenesulfonyl chloride in pyridine

*See* Vogel, p 653

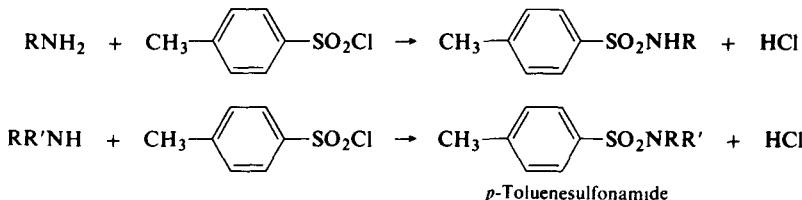
\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)

From the amine with benzenesulfonyl chloride in aqueous sodium hydroxide  
*See* Wild, p 221

*p-Toluenesulfonamide (p-Toluenesulfonyl chloride derivative) \**



*For primary and secondary amines only*

From the amine with *p*-toluenesulfonyl chloride in aqueous sodium hydroxide

*For directions and examples see* Cheronis, p 595, Linstead, p 60, Shriner, pp 103 104, Vogel, p 653

From the amine with *p*-toluenesulfonyl chloride in benzene

*See* Wild, p 221

From the amine with *p*-toluenesulfonyl chloride in acetone

*See* Wild, p 221

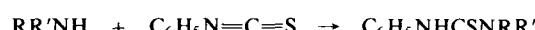
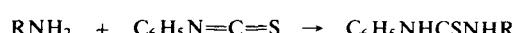
From the amine with *p*-toluenesulfonyl chloride in pyridine

*See* F Bell, *J Chem Soc*, 2787 (1929)

From the amine with *p*-toluenesulfonyl chloride in aqueous pyridine

*See* Wild, p 221

*Phenylthiourea \**



*Phenylthiourea*

*For primary and secondary amines only*

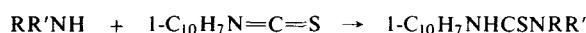
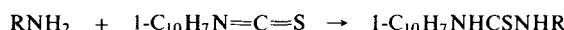
From the amine with phenylisothiocyanate in alcohol

*For directions and examples see* Cheronis, pp 599-600, Shriner, p 227, Vogel, p 422, Wild, p 227, T Otterbacher and F C Whitmore, *J Amer Chem Soc*, 51, 1909 (1929)

From the amine with phenylisothiocyanate without solvent

*See* Vogel, p 422, Wild, p 227, N A Lange, H L Ebert and L K Youse, *J Amer Chem Soc*, 51, 1911 (1929)

*1-Naphthylthiourea \**



*1-Naphthylthiourea*

*For primary and secondary amines only*

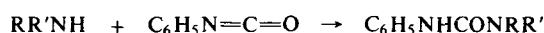
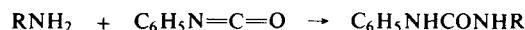
From the amine with 1-naphthylisothiocyanate in ethanol

*For directions and examples see* Cheronis, pp 600-601, Vogel, p 422, Wild, p 227, C M Suter and E W Moffet, *J Amer Chem Soc*, 55, 2497 (1933)

From the amine with 1-naphthylisothiocyanate without solvent

*See* Vogel, p 422, Wild, p 227, C M Suter and E W Moffet, *J Amer Chem Soc*, 55, 2497 (1933)

*Phenylurea*



*Phenylurea*

*For primary and secondary amines only*

From the amine with phenylisocyanate in petrol ether

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

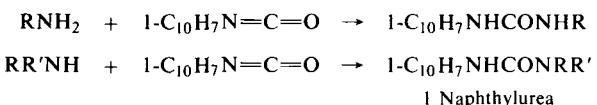
**EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)**

*For directions and examples see Linstead, p 61, Wild, pp 223-224*

From the amine with phenylisocyanate without solvent

See N A Lange, H L Ebert and L K Youse, *J Amer Chem Soc*, 51, 1911 (1929).

### *I-Naphthylurea* \*



*For primary and secondary amines only*

From the amine with 1-naphthylisocyanate without solvent

For directions and examples see Cheronis, p 599, H E French and A F Wirtel, *J Amer Chem Soc*, 48, 1736 (1926).

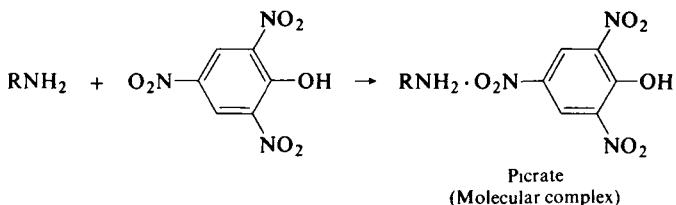
From the amine with 1-naphthylisocyanate in petrol ether

See Linstead, p 61, Wild, pp 223-224

From the amine with 1-naphthylisocyanate with water

See Wild n 224

*Picrate* \*



### *For primary, secondary and tertiary amines*

From the amine with picric acid in methanol or in ethanol

*For directions and examples see Cheronis, pp 603-604, Linstead, p 50, 61, Shriner, p 229, Vogel, pp 422-423, Wild, p 212*

From the amine with picric acid in water

See Vogel, p 422

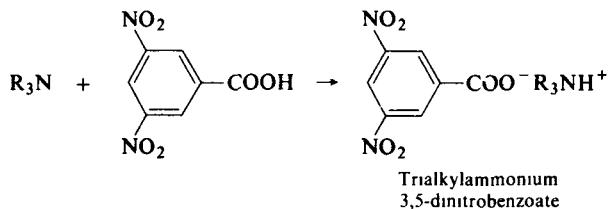
From the amine with picric acid in acetone or benzene

*See Wild, p 212*

### From the amine with picric acid

*See Shriner, p 229*

### *3,5-Dinitrobenzoic acid salt \**

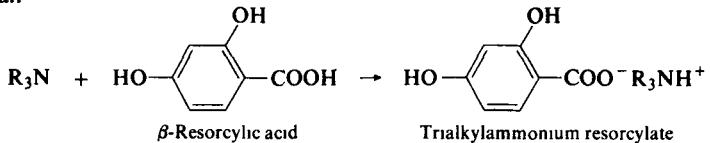


### *Especially for tertiary amines*

From the amine with 3,5-dinitrobenzoic acid in methanol or ethanol

*For directions and examples see Cheronis, pp 602-603, Wild, p 215, C A Buehler, E J Currier and R Lawrence, *Ind Eng Chem, Anal Ed*, 5, 277 (1933), C A Buehler and J D Calfree, *Ind Eng Chem, Anal Ed*, 6, 351 (1934)*

### *$\beta$ -Resorcylic acid salt*



\*Derivatives recommended for first trial

**WARNING** This is not an instruction manual References should be consulted for the preparation of derivatives

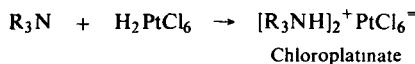
## EXPLANATIONS AND REFERENCES TO TABLE XVIII (Continued)

*Especially for tertiary amines.*

From the amine with  $\beta$ -resorcylic acid in ether.

*For directions and examples see:* Cheronis, p. 603; K. W. Wilson, F. E. Anderson and R. W. Donohoe, *Anal. Chem.*, **23**, 1032 (1951).

*Chloroplatinic acid salt.\**

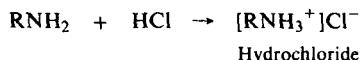


*Especially for tertiary amines.*

From the amine in aqueous hydrochloric acid with aqueous chloroplatinic acid.

*For directions and examples see:* Shriner, p. 230; Wild, p. 213.

*Hydrochloride.*



*For primary, secondary and tertiary amines.*

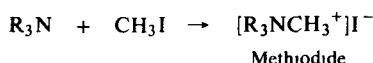
From the amine with gaseous hydrogen chloride in ether, benzene or chloroform.

*For directions and examples see:* Cheronis, p. 601; Shriner, p. 224; Wild, p. 211.

From the amine with dilute aqueous hydrochloric acid.

*See:* Wild, p. 211.

*Methiodide.\**



*Especially for tertiary amines.*

From the amine with methyl iodide without solvent.

*For directions and examples see:* Linstead, p. 61; Shriner, p. 228; Vogel, p. 660; Wild, p. 232.

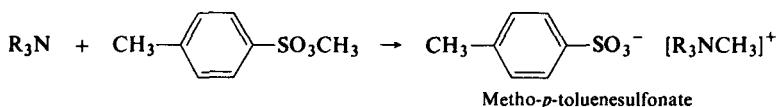
From the amine with methyl iodide in isopropyl ether.

*See:* Cheronis, p. 604.

From the amine with methyl iodide in ether or benzene.

*See:* Vogel, p. 660.

*Metho-p-toluenesulfonate (Methyl p-toluenesulfonate).\**



*Especially for tertiary amines.*

From the amine with methyl *p*-toluenesulfonate in isopropyl ether.

*For directions and examples see:* Cheronis, p. 604.

From the amine with methyl *p*-toluenesulfonate in benzene.

*See:* Linstead, p. 62; Shriner, p. 229; Vogel, p. 660; Wild, p. 233; C. S. Marvell, E. W. Scott and K. L. Amstutz, *J. Amer. Chem. Soc.*, **51**, 3638 (1929).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	P-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous	
1	<b>Methylamine</b>	-6			0.699 <sup>11</sup>	28	80	30	75	113	207, 215		
2	<b>Dimethylamine</b>	7			0.6804 <sup>6</sup>		41	47	79	135	158		
3	<b>Ethylamine</b>	16.5			0.7057 <sup>4</sup>		71	58	63	106	165		
4	<b>Isopropylamine</b>	19	33	1.377 <sup>15</sup>	0.6914 <sup>8</sup>			26		135		1-Naphthylurea, 200, 1-Naphthylthiourea, 143	
5	<b>Ethyl methyl amine</b>	36									196	Chloroplatinate, 207, Hydrochloride, 126-30	
6	<b>tert-Butylamine</b>	46		1.3794 <sup>18</sup>	0.7004 <sup>15</sup>	101.2	134			120	198	Hydrochloride, 270-80	
7	<b>n-Propylamine</b>	49		1.3901 <sup>17</sup>	0.714 <sup>25</sup>		84	36	52	63	135	1-Naphthylurea, 196	
8	<b>Isopropyl methyl amine</b>	50			0.7026 <sup>4</sup>					120	135	Phenylurea, 131	
9	<b>Cyclopropylamine</b>	50		1.421 <sup>20</sup>	0.824 <sup>20</sup>		99	120 (di)			149	Hydrochloride, 100	
10	<b>Ethyleneimine</b>	56			0.832 <sup>24</sup>				52		142	Oxalate, 115	
11	<b>Diethylamine</b>	56		1.3873 <sup>18</sup>	0.7108 <sup>4</sup>		42	42	60	34	155	1-Naphthylthiourea, 108	
12	<b>Allylamine</b>	58		1.4194 <sup>22</sup>	0.7436 <sup>20</sup>				39	64	140		
13	<b>DL-sec-n-Butylamine</b> (2-Aminobutane)	63		1.395 <sup>17</sup>	0.718 <sup>20</sup>		76	70	55	98	139	40	
14	<b>unsym-Dimethylhydrazine</b>	63		1.4075 <sup>22</sup>	0.7914 <sup>22</sup>							Hydrochloride, 81-2, Oxalate, 142, Sulfate, 105	
15	<b>Trimethyleneimine</b> (Azetidine)	63		1.4287 <sup>24</sup>	0.8436 <sup>20</sup>						166-7	Chloroplatinate, 203, Chloroaurate, 192	
16	<b>Isobutylamine</b>	69		1.3988 <sup>17</sup>	0.724 <sup>25</sup>								
17	<b>n-Butylamine</b>	77		1.401	0.7401 <sup>20</sup>		57	53	78	82	150	1-Naphthylurea, 149, 1-Naphthylthiourea, 108-9, Hydrochloride, 195	
18	<b>2-Amino-2-methylbutane</b>	78			0.756 <sup>9</sup>						183		
19	<b>DL-sec-Butyl methyl amine</b>	78.9			0.740 <sup>15</sup>						78	Chloroplatinate, 151	
20	<b>Ethyl propyl amine</b>	80.1		1.3966	0.773 <sup>24</sup>							Hydrochloride, 225, Chloroplatinate, 198, Chloroaurate, 86	
21	<b>Sym-Dimethylhydrazine</b>	81		1.4209 <sup>20</sup>	0.8274 <sup>20</sup>						147	50	Oxalate, 119, Hydrochloride, 168
22	<b>Cyclobutylamine</b>	82		1.4363 <sup>19</sup>	0.8328 <sup>24</sup>							Chloroplatinate, 210.5	
23	<b>Di-isopropylamine</b>	84			0.722 <sup>22</sup>						140	N-Nitroso, 48, Chloroplatinate, 186.9, Hydrochloride, 216-7	
24	<b>Pyrrolidine</b>	89		1.4270 <sup>15</sup>	0.852 <sup>22</sup>				123		112, yel., 163-4, red		
25	<b>n-Butyl methyl amine</b>	90-1		1.4018 <sup>18</sup>	0.7367 <sup>15</sup>						111	Hydrochloride, 170, Chloroplatinate, 205	
26	<b>5-Amino-1-pentene</b>	91-4										Chloroplatinate, 166, Chloroaurate, 195	
27	<b>DL-2-Amino-n-pentane</b> (sec-n-Amylamine)	92			0.7384 <sup>20</sup>							Hydrochloride, 168, Oxalate, 226, 131	
28	<b>Isoamylamine</b>	96		1.4096 <sup>18</sup>	0.751 <sup>18</sup>					102	138	Chloroaurate, 82-3 1-Naphthylurea, 132	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized.

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	$p$ -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
29	<b>D-2-Methyl-n-butylamine (active-Amyl amine)</b>	96			0.7505 <sup>25</sup>							[ $\alpha$ ] <sub>D</sub> <sup>25</sup> -5 86, Hydrochloride, 176, Chloroplatinate, 240
30	<b>2-Methylpyrrolidine</b>	97.8			0.84 <sup>20</sup>					88.5	9.5	Oxalate, 178.9, Chloroplatinate, 172.3 (anh.), 206.7, rapid htng. Picrate of N-methyl deriv., 235
31	<b>3-Methylpyrrolidine</b>	103.5		1.4480 <sup>20</sup>	0.8654 <sup>9</sup>					106		Chloroplatinate, 194
32	<b>n-Amylamine</b>	104			0.7614 <sup>20</sup>					139		2-Naphthylthiourea, 114
33	<b>2-(Methylamino)-n-pentane</b>	105			0.947 <sup>20</sup>					77.8		Chloroplatinate, 138
34	<b>Piperidine</b>	106		1.4530 <sup>20</sup>	0.8606 <sup>20</sup>		48	93.4	96	101	152	
35	<b>2-Aminodiethylether</b>	108.9		1.4101 <sup>20</sup>	0.8512 <sup>20</sup>						122	Picrolonate, 204
36	<b>Di-n-propylamine</b>	109.10		1.4046 <sup>20</sup>	0.7384 <sup>20</sup>			51		69	75	1-Naphthylurea, 93
37	<b>2,5-Dimethylpyrrolidine</b>	110.3		1.4357 <sup>15</sup>	0.8185 <sup>12</sup>						117.8	Hydrochloride, 188, 90, Chloroplatinate, 225
38	<b>2,4-Dimethylpyrrolidine</b>	115.7		1.4325 <sup>20</sup>	0.8297 <sup>20</sup>						116.7	Chloroplatinate, 210
39	<b>1,2-Ethylenediamine</b>	116	8.5	1.454 <sup>26</sup>	0.898 <sup>25</sup>	172 (di)	244 (di)	168 (di)	360	102	233 (di)	
40	<b>L-2-Methylpiperidine</b>	117	50.1								116.7	Hydrochloride, 190, Chloroplatinate, 194
41	<b>DL-2-Methylpiperidine</b>	118-9		1.4464 <sup>24</sup>	0.8436 <sup>24</sup>		45		55		164	Hydrochloride, 207, Oxalate, 125
42	<b>DL-1,2-Diaminopropane</b>	119-20			0.878 <sup>15</sup>	139 (di)	192 (di)				135 (di)	
43	<b>Isohexylamine</b>	125			0.758 <sup>25</sup>						123.5	Hydrochloride, 220, Oxalate, 166, Chloroplatinate, 200
44	<b>DL-3-Methylpiperidine</b>	126		1.446 <sup>24</sup>	0.845 <sup>24</sup>						138 (di)	Hydrochloride, 172, N-2,4-Dinitrophenyl deriv., 67
45	<b>2,6-Dimethylpiperidine</b>	127-8		1.4366 <sup>25</sup>	0.816 <sup>25</sup>			111	50		162.4	Chloroplatinate, 212
46	<b>n-Hexylamine</b>	130			0.763 <sup>25</sup>			40	96		126	
47	<b>3-Amino-n-hexane</b>	130										Hydrochloride, 227, Chloroplatinate, 190-200
48	<b>Morpholine</b>	130						75	118	147	136	146
49	<b>Cyclohexylamine</b>	134		1.4372 <sup>20</sup>	0.8191 <sup>20</sup>	101	149	89		148		
50	<b>Trimethylenediamine (1,3-Diaminopropane, 1,3-Propylenediamine)</b>	136			0.884 <sup>25</sup>	1,3-di	1,3-di	96	148		250	Chloroplatinate, 240
51	<b>2,2,6-Trimethyl-piperidine</b>	138.9				126, 107	140, 147					195.6
52	<b>Di-isobutylamine</b>	139	-77	1.4093 <sup>20</sup>	0.745 <sup>20</sup>	86					121	Hydrochloride, 236, Chloroaurate, 128
53	<b>4-Amino-n-heptane</b>	139.40			0.767 <sup>20</sup>							Hydrochloride, 246-7, Chloroplatinate, 235
54	<b>1,3-Diaminobutane</b>	141.2										Hydrochloride, 171.2
55	<b>2-Amino-n-heptane</b>	142		1.4199 <sup>19</sup>	0.7665 <sup>19</sup>							Hydrochloride, 133, Oxalate, 204-5, Chloroaurate, 63.4
56	<b>unsym-Diethylethylene-diamine</b>	145			0.827 <sup>19</sup>					115 (mono), 211 (di)		Chloroplatinate, 211
57	<b>Furfurylamine (<math>\alpha</math>-Furylmethylamine)</b>	145.6									150	Oxalate, 145, With $\text{CO}_2$ from air $\rightarrow$ comp., 75, Hydrochloride, 110

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boling point, °C	Melting point, °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	$p$ -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
58	Cyclohexyl methyl amine	145 7			0 8651 <sup>0</sup>		85-6				170	Hydrochloride, 193
59	2-Ethylpiperidine ( $\alpha$ -Ethylpiperidine)	146 7			0 832 <sup>15</sup>		64-5				133	Hydrochloride, 181, Chloroplatinate, 202
60	2,2,4-Trimethyl-piperidine	148										Chloroplatinate, 215, Methiodide, 266
61	Sym-Diethylethylene-diamine	149 50		1 4503 <sup>25</sup>	0 876 <sup>0</sup>			74-5				Hydrochloride, 260, Chloroplatinate, 223, Chloroaurate, 220
62	4-Ethylpiperidine ( $\gamma$ -Ethylpiperidine)	151		1 41954 <sup>26</sup> <sub><math>\alpha</math></sub>	0 871 <sup>16</sup>							Chloroplatinate, 173, Chloroaurate, 105
63	3-Ethylpiperidine ( $\beta$ -Ethylpiperidine)	153									63	Hydrochloride, 141, Chloroplatinate, 183
64	<i>n</i> -Heptylamine	155	-23	1 41954 <sup>26</sup> <sub><math>\alpha</math></sub>	0 777 <sup>20</sup>					75	121	1-Naphthylthiourea, 68 9
65	Di- <i>n</i> -butylamine	159								86	59	1 Naphthylthiourea, 123
66	Tetramethylenediamine (1,4-Diaminobutane, Putrescine)	159	27		0 877 <sup>25</sup> <sub>4</sub>	137 (di)	177 (di)		224 (di)		249-50 (di)	
67	DL-2-Hydroxy- <i>n</i> -propylamine (Isopropanolamine)	163			0 973 <sup>18</sup>						142	Chloroplatinate, 195, Hydrochloride, 73
68	Hexahydrobenzylamine	163 5		1 4646 <sup>18</sup>	0 87 <sup>20</sup> <sub>4</sub>			98, 107				Hydrochloride, 254
69	Cyclohexyl ethyl amine	164			0 868 <sub>0</sub>							133
70	2-Ethylcyclohexylamine	170 1		1 4682 <sup>20</sup>	0 8744 <sup>20</sup> <sub>4</sub>							Chloroplatinate, 239
71	2-Aminoethyl alcohol (Ethanolamine)	171		1 4539 <sup>20</sup>	1 022 <sup>20</sup> <sub>4</sub>							1-Naphthylurea, 186
72	3-Amino-2-hydroxy-pentane	172			0 906 <sup>18</sup>							N-Chloroacetyl deriv , 52 60, Monooxalate, 166, Dioxalate, 204
73	2-Aminopropyl alcohol	173-6										Hydrochloride, 86, Chloroplatinate, 198 9
74	2-Amino-3-hydroxy-pentane	174		1 4458	0 9289 <sup>24</sup>							Chloroplatinate, 154, Picrolonate, 215
75	2-Fluoroaniline	176	-35 -29			80	113					Picrate of N,N-dimethyl deriv , 131
76	Pentamethylenediamine (1,5-Diaminopentane, Cadaverine)	178 80			0 9174 <sup>0</sup> <sub>4</sub>		135 (di)	119		148	237	
77	<i>n</i> -Octylamine	180			0 777 <sup>20</sup>							112
78	5-Methyl-2-pyrazoline	180						156				1 Naphthylthiourea, 72
79	Benzyl methyl amine	181			0 945 <sup>18</sup> <sub>5</sub>							Phenylurea, 127
80	Aniline	184		1 5863 <sup>20</sup>	1 022 <sup>20</sup> <sub>4</sub>	114	160	112	95	54	117-8	Chloroplatinate, 197
81	Benzylamine	184-5		1 5401	0 9826 <sup>19</sup> <sub>4</sub>	65	105	88	103	180		180
82	4-Fluoroaniline	186	-1	1 5195 <sup>20</sup>	1 1725 <sup>20</sup> <sub>4</sub>	152	185		116, 185	156	194	
83	DL- $\alpha$ -Phenylethylamine ( $\alpha$ -Aminoethyl-benzene)	187, 185	.		0 9395 <sup>15</sup>	57	120					N-4-Nitrobenzoyl deriv , 181
84	1,2-Diaminocyclohexane	187				260 (di)						Hydrochloride, 158
85	3-Fluoroaniline	187-8, yel			1 160 <sup>16</sup>	84						Hydrochloride, 280
86	Di-isoamylamine	187-8	-44	1 4229 <sup>21</sup>	0 7672 <sup>21</sup> <sub>4</sub>					72	94 5	1-Naphthylurea, 95, Methiodide, 221
87	3-Aminopropyl alcohol	188		1 457 <sup>26</sup>	0 982 <sup>26</sup> <sub>4</sub>						222	Chloroplatinate, 199

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1)(Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
88	<b>1,2,3-Triaminopropane</b>	190				200–2 ( <i>tri</i> )	217–8 ( <i>tri</i> )				>269	
89	<b>4-Amino-2,6-dimethyl-piperidine</b>	195									220	Chloroplatinate, >250
90	<b>N-Methylaniline</b>	196		1 573 <sup>16</sup>	0 989 <sub>4</sub> <sup>20</sup>	102	63	79	94	87	145	
✓91	<b>1-Phenylisopropylamine</b>	196–7		1 5181 <sup>25</sup>	0 9424 <sub>6</sub> <sup>20</sup>		159					Oxalate, 131, Hydrochloride, 236
92	<b>β-Phenylethylamine</b> (β-Aminoethylbenzene)	198			0 958 <sub>4</sub> <sup>24</sup>	51	116	69		135	174, 167	
93	<b>Benzyl ethyl amine</b>	199			0 935 <sub>11</sub> <sup>21</sup>				50		118	
94	<b>2-Methylaniline (<i>o</i>-Toluidine)</b>	200		1 5688 <sup>20</sup>	1 0053 <sub>20</sub> <sup>20</sup>	110–1	146	124	185 6	136	213	Hydrochloride, 184
95	<b><i>n</i>-Nonylamine</b>	201				34–5	49				111	
96	<b>3-Methylaniline (<i>m</i>-Toluidine)</b>	203		1 5686 <sup>20</sup>	0 990 <sub>22</sub> <sup>21</sup>	65	125	95	171–2		200	
97	<b>Di-<i>n</i>-amylamine</b>	205								72		2-Naphthylthiourea 126, Hydrochloride, 275
98	<b>DL-2-Phenylisopropylamine</b>	205				64 ini- tially, 93 on stand- ing					143	Hydrochloride 145–7
99	<b>N-Ethylaniline</b>	205		1 5559 <sup>20</sup>	0 9625 <sub>4</sub> <sup>20</sup>	54	60		87	89	132 138	
100	<b>4-Methylpyrazole</b>	207		1 4920 <sub>46</sub> <sup>16</sup>	1 015 <sup>20</sup>						142	1- <i>o</i> -Nitrobenzoyl deriv , 107
101	<b>3-Methylbenzylamine</b> ( <i>m</i> -Xylylamine)	207			0 9654 <sup>20</sup>	235–40	150				198, 156	Hydrochloride, 208
102	<b>2-Chloroaniline</b>	209 207		1 5895 <sup>20</sup>	1 2125 <sup>21</sup>	87	99	129	193, 105	156	134	Chloroplatinate, 214
103	<b>N,2-Dimethyl-aniline</b> (N-Methyl- <i>o</i> -toluidine)	208			0 973 <sup>16</sup>	56	66				90	
104	<b>2-Methylbenzylamine</b> ( <i>o</i> -Xylylamine)	208	–20	1 5436 <sup>19</sup>	0 977 <sub>6</sub> <sup>19</sup>	69	88				215	Chloroplatinate, 220–3
105	<b>4-Methylbenzylamine</b> ( <i>p</i> -Xylylamine)	208	13	1 5364 <sup>20</sup>	0 952 <sub>6</sub> <sup>20</sup>	107–8	137				204	
106	<b>3-Methylpyrazole</b>	208		1 497 <sub>16</sub> <sup>16</sup>	1 020 <sub>4</sub> <sup>16</sup>	29 30					144	N- <i>o</i> -Nitrobenzoyl deriv , 120
107	<b>1-Phenylpropylamine</b>	208			1 5173 <sup>25</sup>	0 9347 <sub>6</sub> <sup>25</sup>		115–6	81			Hydrochloride, 190
108	<b>2-Phenylpropylamine</b>	210					85				182	Hydrochloride, 123 4
109	<b>N,4-Dimethyl-aniline</b> (N-Methyl <i>p</i> -toluidine)	210				83		67			131	N-Nitroso deriv , 52, Hydrochloride, 119 5
110	<b>2-Ethylaniline</b>	210–11	46 6	1 5584 <sup>22</sup>	0 9810 <sup>20</sup>	111	147				194–5	
111	<b>L-Menthylamine</b>	212, 207				145	156			135	215	[α] <sub>D</sub> <sup>10</sup> – 34 2
112	<b>2,5-Dimethylaniline</b> ( <i>p</i> -2-Xylylamine)	213 5, pa yel	14 2	1 5591 <sup>21</sup>	0 9735 <sup>20</sup>	139	140	138	232–3, 119	148	171	
113	<b>1-Phenylisobutylamine</b>	214		1 5123 <sup>20</sup>	0 920 <sub>6</sub> <sup>20</sup>						166–8	Oxalate, 120–2, Hydrochloride, 275 7
114	<b>3-Methylpyridazine</b>	215			1 0486 <sub>26</sub> <sup>26</sup>						143–4	
115	<b>2,6-Dimethylaniline</b> ( <i>m</i> -2-Xylylamine)	215, 218	11 2	1 5610 <sup>20</sup>	0 9842 <sup>20</sup>	177	168		212	204	180	
116	<b>4-Ethylaniline</b>	216, 214	–6	1 5550 <sup>20</sup>	0 9690 <sup>20</sup>	94	151		104			
117	<b>2,4-Dimethylaniline</b> ( <i>m</i> -4-Xylylamine)	217		1 561 <sup>20</sup>	0 9783 <sub>4</sub> <sup>20</sup>	133, 130	192	130	181	152	209	
118	<b>2-Chloro-N-methyl-aniline</b>	218			1 1735 <sup>11</sup>	.					133	
119	<b>2,4-Dimethylbenzyl-amine</b>	218–9									223	Hydrochloride, 212, Chloroplatinate, 226

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfon amide	$\rho$ -Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
120	2-Amino-N,N-dimethyl-aniline	219				72	51			138-40		
121	3,5-Dimethylaniline ( <i>m</i> -Xylidine)	220	9.8	1.5581 <sup>20</sup>	0.9706 <sup>20</sup>	144, 140	144-5			153	200	N-Formyl deriv., 76
122	N-Ethyl-3-methylaniline (N-Ethyl- <i>m</i> -toluidine)	221, 215		1.5305 <sup>20</sup>	0.950 <sup>20</sup>		72					Hydrochloride, 159, Chloroplatinate, 182
123	3,5-Dimethylbenzyl-amine	221		1.5684 <sup>20</sup>	0.9931 <sup>20</sup>	135	189				225	Hydrochloride, 245, Chloroplatinate, 204
124	2,3-Dimethylaniline ( <i>o</i> -3-Xylidine)	221-2	3.5	1.5684 <sup>20</sup>	0.9931 <sup>20</sup>	135	189				221	Hydrochloride, 254, N-Formyl deriv., 102
125	1-Aminoindane (1-Hydrindamine)	222					142-3				207	
126	3-Phenylpropylamine	222			0.976 <sup>25</sup>		57.8			152.3		Hydrochloride, 218
127	2-Methyl-4,5,6,7-tetrahydroindole	222			0.987 <sup>10</sup>			86-91		141		Methiodide 195, Chloroplatinate, 187
128	N- <i>n</i> -Propylaniline	222			0.949 <sup>18</sup>	47		54		104		
129	2- <i>n</i> -Propylaniline	222-4				104-5	119				151	Hydrochloride, 173
130	2-Chloro-4-methylaniline	223				113	137					
131	$\alpha$ -Amino- <i>n</i> -butylbenzene	223			0.9367 <sup>20</sup>		128					Chloroplatinate, 184, Hydrochloride, 288
132	<i>trans</i> -9-Aminodecalin	223	-25	1.492 <sup>20</sup> <sub>Re</sub>	0.939 <sup>20</sup>	183	148.9					N-Formyl deriv., 172
133	$\gamma$ -Amino- <i>n</i> -butylbenzene	223		1.5152 <sup>20</sup>	0.9289 <sup>15</sup>		108, lgr					Hydrochloride, 144, Chloroplatinate, 220
134	2-Methoxyaniline ( <i>o</i> -Anisidine)	225	5-6			85, 88	60, 84	89	127	136	200	N-Formyl deriv., 84
135	4-Isopropylaniline ( <i>p</i> -Cumidine)	225			0.953 <sup>20</sup>	102	162					
136	4- <i>n</i> -Propylaniline	225				93-4	115					Hydrochloride, 203.4
137	N-Isobutylaniline	227			0.940 <sup>18</sup>	92	153	132	122.3			
138	$\alpha$ -Methyl- $\alpha$ -phenylhydrazine	227		1.5824 <sup>20</sup>								
139	4- <i>tert</i> -Butylaniline	228	17	.		173	140		179-80			N-Formyl deriv., 59
140	<i>cis</i> -9-Aminodecalin	228	-13.5	1.498 <sup>21</sup> <sub>Re</sub>	0.951 <sup>21</sup>	127	147					Hydrochloride, 270-4
141	2-Ethoxyaniline ( <i>o</i> -Phenetidine)	229				79	104	102	164	137		N-Formyl deriv., 165-6
142	2,4,6-Trimethylaniline (Mesidine)	229, 232				216	204	137	167	193	189-91	
143	2-Aminoindane (2-Hydrindamine)	230				127	155					Hydrochloride, 241
144	3-Chloroaniline	230	236	1.5931 <sup>20</sup>	1.2225 <sup>18</sup>	72, 78	119-20	121	138, 210	124, 116	177	
145	2,2'-Diaminodiethyl-sulfide	231.3									212	Dihydrochloride, 131
146	1,2,3,4-Tetrahydroisoquinoline	233		1.5798 <sup>23</sup>	1.064 <sup>23</sup>	46	129	154			200, 195	
147	2- <i>tert</i> -Butylaniline	233-5		1.5453 <sup>20</sup>	0.977 <sup>15</sup>	159-61					151	Hydrochloride, 192.3
148	3-Amino-4-(dimethylamino)toluene	234										
149	4-Isobutylaniline	235, pale				127			136-7			
150	4-Aminoindane (4-Hydrindamine)	236	-3			126	136				111	Hydrochloride, 84
151	2-Aminoundecane (2-Aminohendecane, <i>sec-n</i> -Undecylamine)	237				58						
152	<i>unsub</i> - <i>m</i> -Ethylphenylhydrazine	237			1.018 <sup>15</sup>							Hydrochloride, 137, Reduces warm Fehling

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1)(Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_D$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	$p$ -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
153	<i>sym</i> -Ethylphenyl-hydrazine	238 9		1.55 <sup>15</sup>	1.004 <sup>15</sup>		100					Hydrochloride, 164, Oxalate, 167
154	2-Bromo-4-methylaniline (3-Bromo- <i>p</i> -toluidine)	240	26		1.51 <sup>20</sup>	118	149					Hydrochloride, 221
155	1-Aminoundecane (1-Aminohendecane, <i>n</i> -Undecylamine, <i>n</i> -Hendecylamine)	240	15-6			48	60					Hydrochloride, 190
156	4-Chloro-N-methyl-aniline	240			1.169 <sup>11,5</sup>	92-4					153	Nitrosamine, 51
157	4-Chloro-2-methylaniline (5-Chloro- <i>o</i> -toluidine)	241	29			140						
158	2-Amino- <i>p</i> -cymene ( <i>p</i> -Cymidine)	241		1.543 <sup>19</sup>	0.994 <sup>20</sup>	71	102					Hydrochloride, 207
159	N-Butylaniline	241		1.5381 <sup>20</sup>	0.9358 <sup>20</sup>		56					
160	Phenylhydrazine	243	19 23	1.6081 <sup>20</sup>	1.0978 <sup>20</sup>	128 107 ( <i>dt</i> )	168 177 ( <i>dt</i> )	148	56 151	172		
✓ 161	$\alpha,\alpha'$ -Diamino- <i>m</i> -xylene ( <i>m</i> -Xylylenediamine)	245 8				<i>dt</i> 134 5, bz	N,N'- <i>di</i> 172 135				185-90	Dihydrobromide, 266
162	2-Chloro-6-methoxy-aniline (3-Chloro- <i>o</i> -anisidine)	246 sl d				123						
163	3-Ethoxyaniline ( <i>m</i> -Phenetidine)	248				97	103					
164	4-Ethoxyaniline ( <i>p</i> -Phenetidine)	248, 254	2 3		1.065 <sup>16</sup>	137	173	143	106	136	69	
165	1,2,3,4-Tetrahydro-quinoline	250	20	1.593 <sup>24</sup>	1.054 <sup>24</sup>		75	67				
166	2-Aminoacetophenone	250	2d	20		76 7	98		148			Semicarbazone, 290, Oxime, 109, Hydrochloride, 168 d
167	3-Bromoaniline	251	18	1.626 <sup>20</sup>	1.579 <sup>20</sup>	87	120 136					
168	3-Methoxyaniline ( <i>m</i> -Anisidine)	251				81			68	143	180	Hydrochloride, 167 8
169	3-Bromo-2-methylaniline (6-Bromo- <i>o</i> -toluidine)	254				163	176-7					
✓ 170	4-Amino-1,2,3,5-tetra-methylbenzene (Iso-duridine)	255	23 4			215-7					200	
✓ 171	Dicyclohexylamine	255 sl d	abt 20	1.488 <sup>18</sup>	0.925 <sup>18</sup>	103	153				173	
172	6-Methyl-1,2,3,4-tetra-hydroisoquinoline	256			1.0235 <sup>8</sup>						205	Hydrochloride, 195-7, Methiodide, 144 5, N-Nitroso deriv , 98
✓ 173	4-Amino-N,N-diethyl-aniline	261				104	172					
✓ 174	4- <i>n</i> -Butylaniline	261			0.945 <sup>20</sup>	105	126					Chloroplatinate, 200-2
175	1-Amino-5,6,7,8-tetra-hydronaphthalene	261 3		1.5896 <sup>23</sup>	1.0625 <sup>16</sup>	158						Hydrochloride, 259 61
176	7-Methyl-1,2,3,4-tetra-hydroquinoline	264					70-2				153-4	Hydrochloride, 175
177	4-Methylindole	267	5		1.062 <sup>20</sup>						194 5	
178	2-Amino-4-chloro-N,N-dimethylaniline	267 8				90					191	
179	DL-3-Aminopropylene-glycol (2,3-Dihydroxy-propylamine)	268 part d		1.49 <sup>10</sup>	1.175 <sup>20</sup>		O,N- <i>di</i> 109 O,O,N- <i>tri</i> 113					Chloroplatinate, 185, Picrolonate, 220, O,N- <i>di</i> -4-Nitrobenzoyl deriv , 139

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point °C	$n_D^{20}$	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
180	Diethanolamine (Di-(2-hydroxyethyl)-amine)	270	28	1.4776 <sup>20</sup>	1.0966 <sup>20</sup>						110	Nitrate, 69, Chloroplatinate, 160
181	3-(Dimethylamino) aniline	272			0.995 <sup>25</sup>	87.69 (di)	163.4				187	N-Chloroacetyl deriv, 102
182	1-(N,N-Diethylamino) naphthalene	290		1.5961 <sup>20</sup>	1.015 <sup>20</sup>						152.4	1,3,5-Trinitrobenzene add comp, 95, scar
183	1-(Methylamino) naphthalene	294				94.5	121		164			
184	Dibenzylamine	300		1.5743 <sup>22</sup>	1.0256 <sup>22</sup>		112					Hydrochloride, 256
185	$\alpha$ -Aminodiphenyl-methane (Benzhydryl-amine)	303-4		1.5963 <sup>21,5</sup>	1.0635 <sup>21,5</sup>	146.7	172.167	68	159		205.6	N-Formyl deriv, 132
186	1,2-Diphenylethylamine	313			1.031 <sup>15</sup>						212.3	Oxalate, 158, Chloroplatinate, 188
187	2,3-Diphenylpropyl-amine	315.7				85 (di)						Hydrochloride, 188
188	2-(Methylamino) naphthalene	317, 309				51	84	107	78		145	90, Chloroaurate, 144.5
189	2-(N,N-Diethylamino) naphthalene	320.2										Hydrochloride, 182.3
												1,3,5-Trinitrobenzene add comp, 116, blk.
												Hydrochloride, 177, Chloroplatinate, 95

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines a) Liquids 2) (b.p. at reduced pressure only)**  
**(Listed in order of increasing m.p. of the corresponding acetyl derivative)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Acetamide	Benzamide	Benzene sulfonamide	P-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
1	3-Aminostyrene	112.5 <sup>12</sup>			1.0216 <sup>20</sup>	74.5	90, bz - lgr , 126, al-w					Polymerizes readily
2	2-Bromo-4-ethoxyaniline (3-Bromo-p-phenetidine)	160 <sup>23</sup>				97						Hydrochloride, 232
3	3-Aminothiophenol	180-90 <sup>16</sup>				N,S-di 97 di)						Hydrochloride, 137
4	2-n-Butylamine	122.5 <sup>12</sup>			0.953 <sup>20</sup>	100	116.7					Hydrochloride, 126
5	2-(2-Aminophenyl)ethyl alcohol	147.8 <sup>3,5</sup>		1.5849 <sup>19</sup>		103.5						Hydrochloride, 216-26
6	6-Amino-3,4'-dimethylbiphenyl	165.7 <sup>4</sup>				104						Hydrochloride, 261
7	2,2-Diphenylpropylamine	179-82 <sup>22</sup>			1.027 <sup>18</sup>	106.7	82-3					Hydrochloride, 228
8	2-Chloro-4-methoxyaniline (3-Chloro-p-anisidine)	156 <sup>31</sup>				114						
9	2-Aminostyrene	97.8 <sup>8</sup>			1.0130 <sup>21</sup>	129						Polymerizes readily
10	2-Aminothiophene	77.9 <sup>11</sup>				161.2	172-3					Oxidizes rapidly, N-2-toluenesulfonyl deriv , 183.4
11	4,4'-Diamino-2,3'-dimethylbiphenyl	244 <sup>12</sup>				N,N'-di 253, tetra 191	N,N'-di 245					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
1	<b>Di-n-heptylamine</b>	1	271						117-20	
2	<b>4-Aminostyrene</b>	23.5	98 <sup>a</sup>	142	160-1					D <sub>21</sub> <sup>b</sup> 1012 n <sub>D</sub> <sup>20</sup> 1.625
3	<b>3-Bromo-4-methylaniline</b> (2-Bromo-p-toluidine)	25-6	254-7	117-8	132					
4	<b>2-Amino-3-methylpyridine</b> (2-Amino- $\beta$ -picoline)	26	224	64	220				229	
5	<b>2-Aminothiophenol</b>	26	234	135 (N,S-di)	154 (N,S-di)					
6	<b>n-Dodecylamine</b>	27-8	247-9				73			Hydrochloride, 98, Chloroplatinate, 215 Hydrochloride, 180 3
7	<b>DL-2,6-Dimethyl-1,2,3,4-tetrahydroquinoline</b>	31-2	267		103-5					
8	<b>5-Bromo-2-methylaniline</b> (4-Bromo-o-toluidine)	32	253 part d	165						
9	<b>1-Amino-2-methylnaphthalene</b> (2-Methyl-1-naphthylamine)	32		188	180					
10	<b>2-Bromoaniline</b>	32	250	99	116				146 161	129
11	<b>4,4'-Dimethyldibenzylamine</b> (p-Dixylylamine)	32.5	220 <sup>30</sup>							153
12	<b>2-Aminobenzyl</b>	33	173-83 <sup>11</sup>	117	166				167-8	Hydrochloride, 272
13	<b>3-Iodoaniline</b>	33.27	145 6 <sup>15</sup>	119	157		128			Hydrochloride, 198
14	<b>unsym -Diphenylhydrazine</b>	34	220 <sup>40-50</sup>	184	192					
15	<b><math>\alpha, \alpha</math> -Diamino-1,4-dimethylbenzene</b> (p-Xylylenediamine)	35		194 (tetra)	193 (N,N'-di)				232	
16	<b>3-Bromo-5-methylaniline</b> (5-Bromo-m-toluidine)	36	255 60	171 2						
17	<b>4-Amino-N-methylaniline</b>	36	258	63	165				206	
18	<b>Pentadecylamine</b>	36, 33	300	72						Hydrochloride, 199
19	<b>N-Benzylaniline</b>	37	298	58	107	119	148-9	103	48	
20	<b>3-Iodo-4-methylaniline</b> (2-Iodo-p-toluidine)	37-8		130						Oxalate, 103
21	<b>5-Aminodane</b> (5-Hydridamidine)	37-8	247-9 <sup>745</sup>	106	137					
22	<b>2-Amino-5,6,7,8-tetrahydronaphthalene</b> (5,6,7,8-Tetrahydro-2-naphthylamine)	38	275-7 <sup>713</sup>	107	167				204	
23	<b>2-Amino-5-bromonaphthalene</b> (5-Bromo-2-naphthylamine)	38	207 10 <sup>16</sup>	165	109				216	N-Benzal, 63
24	<b>2,2-Diphenylethylamine</b>	38	180 <sup>34</sup>	88	144 5				212 3	Phenylurethane 191 2, Hydrochloride, 256-7
25	<b>2,3-Dimethyl-1,2,3,4-tetrahydroquinoline</b>	38-9			92				178	
26	<b>2-Iodo-4-methylaniline</b> (3-Iodo-p-toluidine)	40		133	161					Oxalate, 120, Hydrochloride, 188
27	<b>2-Chloro-4,6-dimethylaniline</b> (5-Chloro-m-4-xylidine)	40		205-6	148					2-Naphthylthiourea 154
28	<b>2-Amino-6-methylpyridine</b> (6-Amino- $\alpha$ -picoline)	41	208-9	90	90				202	Hydrochloride, 155, Chloroplatinate, 218
29	<b>4-Amino-N,N-dimethylaniline</b>	41, 53	262	132-3	228				188	
30	<b>1,6-Diaminohexane</b> (Hexamethylenediamine)	42	204-5	125-7 (di)	155 (di)	154 (di)			220	
31	<b>1,3-Diaminoisopropyl alcohol</b>	42	235						230	Hydrochloride, 185, Chloroplatinate, 240
32	<b>4-Amino-3-methylbiphenyl</b>	43	190 <sup>15</sup>	165, 158	189					N-Benzal, 108
33	<b>2,4'-Diaminobiphenyl</b>	45	363	202 (di)	278 (di)					
34	<b>4-Methylaniline</b> (p-Toluidine)	45	200	147	158	120	118	141	182	
35	<b>4-Aminothiophenol</b>	46	140-5 <sup>16</sup>	154 (N-), 144 (132) (N,S-di)	180 (N-)					Oxidized readily → 4,4-diaminodiphenyl sulfide, 104 5

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**

**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
36	<b>4-Aminobenzyl cyanide</b>	46		97 ( <i>mono</i> ) 152-3 ( <i>di</i> )	176-7				185	N-Formyl, 135
37	<b>2-Aminopropiophenone</b>	47	93 <sup>a</sup>	71	130					Oxime, 88-9, Semicarbazone, 190, N-Propionyl, 51
38	<b>3-Bromo-4-ethoxyaniline (2-Bromo-<i>p</i>-phenetidine)</b>	47	189 <sup>20</sup>	114					178 9	
39	<b>4-Amino-2-thiocresol</b>	47		95 (N-), 125 (N,S- <i>di</i> )						S-Me, 47
40	<b>2-Iodo-5-methylaniline (4-Iodo-<i>m</i>-toluidine)</b>	48, 38			151, 146					N-Formyl, 129
41	<b>1-Amino-4-fluoronaphthalene (4 Fluoro-1 naphthylamine)</b>	48	162 <sup>1b</sup>		197					Hydrochloride, 280
42	<b>4-Aminodibenzyl</b>	48			170 1					Hydrochloride, 210, Chloroplatinate, 286-9
43	<b>3,4-Dimethylaniline (<i>o</i>-4-Xylylidine, 4-Amino-<i>o</i>-xylene)</b>	49	224	99		118				N-Formyl, 52, Hydrochloride, 256
44	<b>2-Ethoxy-6-nitroaniline</b>	49, yel		64						N-Me, 59
45	<b>Heptadecylamine</b>	49	335-40	62	91					
46	<b>2-Aminobiphenyl</b>	49	299	121	102					N-Formyl, 75, N-Propionyl, 65
47	<b>4-Amino-2-methyldiphenylamine</b>	49 50	196 <sup>4</sup>	139 40						Hydrochloride, 185 7
48	<b>2-Bromo-4,6-dimethylaniline (5-Bromo-<i>m</i>-4-xylylidine)</b>	49 50		196 7	186				122	
49	<b>2,5-Dichloroaniline</b>	50	251	132	120				86	Hydrochloride, 191 2
50	<b>1-Aminooxindole</b>	50		186-7	189					
51	<b>1-Aminonaphthalene (<i>α</i>-naphthylamine)</b>	50		159	160	167	157, 147	165	163 181	
52	<b>1-Amino-1,2,3-triazole</b>	51			151				130	Hydrochloride, 114
53	<b>2-Amino-1-methylnaphthalene (1-Methyl-2-naphthylamine)</b>	51	,	188 9	222					
54	<b>1-Amino-3-methylnaphthalene (3 Methyl-1 naphthylamine)</b>	51-2		175 6	188 9					
55	<b>1-Amino-4-methylnaphthalene (4 Methyl-1-naphthylamine)</b>	51-2	176 <sup>12</sup>	166 7	238-9					Hydrochloride, 233-4
56	<b>4-Chloro-2-methoxyaniline (5-Chloro-<i>o</i>-anisidine)</b>	52, 46	260	150					200	N-Formyl, 177 8, Hydrochloride, 238
57	<b>Indole</b>	52	253	157 8	68	254				N-Nitroso, 171
58	<b>2-Aminodiphenylmethane</b>	52	190 <sup>22</sup>	135	116					Hydrochloride, 137
59	<b>2,2'-Ditolylamine (Di-<i>o</i>-tolylamine)</b>	52 3	318		114-5					
60	<b>4-Aminobiphenyl</b>	53	302	171, 120 ( <i>di</i> )	230		255 160			N-Formyl, 172
61	<b>1,4-Bis-(methylamino)benzene (<i>11m</i>-Dimethyl-<i>p</i>-phenylene-diamine)</b>	53	150 <sup>17</sup>						186	N,N'-Dinitroso, 148
62	<b>Diphenylamine</b>	53-4		101	180	124	141	152	182	
63	<b>DL-<i>α</i>-Aminobenzyl cyanide</b>	55			159 60				160-1	
64	<b>4-Methoxy-3-nitroaniline (2-Nitro-<i>p</i>-anisidine)</b>	57, or		153						N-Chloroacetyl, 150, N,N-Di-Me, 46, red
65	<b>5-Bromo-2-ethoxyaniline (4-Bromo-<i>p</i>-phenetidine)</b>	57 53		133					135 7	
66	<b>2-Amino-5-bromobiphenyl</b>	57		130	162					
67	<b>4-Methoxyaniline (<i>p</i>-Anisidine)</b>	58	240	130, 127	154, 157	95	114	157, 171		
68	<b>1-Amino-7-methylnaphthalene (7-Methyl-1-naphthylamine)</b>	58-9	162 <sup>10</sup>	182-3	204					
69	<b>4-Bromo-2-methylaniline (5-Bromo-<i>o</i>-toluidine)</b>	59	240	156-7	115					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Acetamide	Benzamide	Benzene sulfon amide	<i>p</i> -Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
70	<b>2-Amino-1 chloronaphthalene</b> (1 Chloro 2 naphthylamine)	59		147	98	131				N Formyl 136
71	<b>2 Aminoazobenzene</b>	59		126	122					
72	<b>1-Amino-2-chloronaphthalene</b> (2 Chloro 1 naphthylamine)	59 60		191 ( <i>mono</i> ) 88 ( <i>di</i> )	122					
73	<b>5-Methylindole</b>	60	267						151	
74	<b>2-Aminopyridine</b>	60 58	204	71	165 ( <i>di</i> )				216 7	
75	<b>3-(3 Indolyl)-propylamine</b>	60 4							146 9 156	Hydrochloride 170
76	<b>2-Methylindole</b>	61	271 2						139	1 3 5 Trinitrobenzene add comp 152 N Formyl 75
77	<b>2-Iodoaniline</b>	61 58		109	139				112	Hydrochloride 153 4
78	<b>1 Naphthyl phenyl amine</b> (N Phenyl 1 naphthylamine)	62	226 <sup>2</sup>	115	152					
79	<b>3-Chloro-4 methoxyaniline</b> (2 Chloro <i>p</i> anisidine)	62		94					186	
80	<b>1-Amino-3 chloronaphthalene</b> (3 Chloro 1 naphthylamine)	62		197	162					Hydrochloride 219
81	<b>2-Amino-4,4 -dimethylbiphenyl</b>	62 3		118 9	95 6					
82	<b>8-Amino-6-methylquinoline</b>	62 4		91 2						1 3 5 Trinitrobenzene add comp 139
83	<b>2-Amino-1 bromonaphthalene</b> (1 Bromo 2 naphthylamine)	63		<i>mono</i> 140 <i>di</i> 105						N Propionyl 139 N Benzal 93 4 1 3 5 Trinitrobenzene add comp 192
84	<b>1,3-Diaminobenzene</b> ( <i>m</i> Phenylene diamine)	63	282 4	191 ( <i>di</i> ) 87 9 ( <i>mono</i> )	240 ( <i>di</i> ) 125 ( <i>mono</i> )	194	172		184	
85	<b>2,4-Dichloroaniline</b>	63	245	145	117	128	126		106	
86	<b>2-Amino-5 methylnaphthalene</b> (5 Methyl 2 naphthylamine)	63 4		123 4	155 6					Hydrochloride 255
87	<b>3-Bromo-4-methoxyaniline</b> (2 Bromo <i>p</i> anisidine)	64		111						
88	<b>2,5-Diaminotoluene</b>	64	273 4	220 ( <i>di</i> )	307	2 <i>mono</i> 147	2 <i>mono</i> 150			
89	<b>3-Aminopyridine</b>	64	250 2	<i>mono</i> 133 <i>di</i> 88	119					
90	<b>9-Aminofluorene</b>	64		262	260 1					Hydrochloride 255
91	<b>4-Methylphenylhydrazine</b> ( <i>p</i> Tolylhydrazine)	65	240 4d	121	1 N <i>mono</i> 68 70 2 N <i>mono</i> 146					
92	<b>4-Aminobenzyl alcohol</b>	65		188 (O N <i>di</i> )	4 <i>mono</i> 150 90					Hydrochloride 217
93	<b>2-Bromo-6-methoxyaniline</b> (3 Bromo <i>o</i> anisidine)	65								Hydrochloride 225
94	<b>1,3-Diamino-2,6-dimethylbenzene</b> (2 4 Diamino <i>m</i> xylene)	65 6		>260 ( <i>di</i> )	232 (227) ( <i>di</i> )					N N Diformyl 220
95	<b>Aminoacetamide</b> (Glycineamide)	65 7								Hydrochloride 186 9 Chloroaurate 197 8 Hot H <sub>2</sub> O → glycine + NH <sub>3</sub> Hydrochloride 175 N Phenyl 150
96	<b>2-Aminocyclohexanol</b>	66	219							
97	<b>2-Amino-5-methylbenzophenone</b>	66 yel		159	118				145	
98	<b>4-Bromoaniline</b>	66	245	168	204				180	
99	<b>1,8-Diaminonaphthalene</b>	66		311 2 ( <i>di</i> )	134		207 ( <i>di</i> )	148		

\*Derivative data given in order m p crystal color solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
100	<b>3-Amino-5-bromopyridine</b>	66-7	150 <sup>12</sup>	76-8 (hyd) 127 (anh)					212-3	Chloroaurate, 185 7
101	<b>1-Amino-8-methylnaphthalene</b> (8-Methyl-1-naphthylamine)	67 8		183-4	195-6					
102	<b>4-Iodoaniline</b>	67-8		184	222			153		N 4-Nitrobenzoyl, 269 N-Benzal, 86
103	<b>1-Amino-2,4,5-trimethylbenzene</b> (Pseudocumidin)	68		162	167	136				
104	<b>2,2'-Diaminodibenzyl</b>	68		249 (di)	255 (di)				225 30	
105	<b>2-Amino-4-methylnaphthalene</b> (4-Methyl-2-naphthylamine)	68		172 3	194-5					
106	<b>3-Nitro-N-methylaniline</b>	68		95	105	83				
107	<b>1-Amino-3-bromonaphthalene</b> (3-Bromo-1-naphthylamine)	70		174	166					Hydrochloride, 247
108	<b>1-Amino-5-methyl-1,2,3-triazole</b>	70			158, 138 (di)					N-Benzal, 67 8, Hydro- chloride, 138
109	<b>8-Aminoquinoline</b>	70, 65, yel		103	98		154-6			Hydrochloride, 208 9
110	<b>2-Nitroaniline</b>	71, golden- yel		92, 94	98, 110	104	142		73	
111	<b>3,4-Diaminotriphenylmethane</b>	71 2		226 (di)	243 (di)					
112	<b>4-Chloroaniline</b>	72		179, 172	192	122	95, 119	152		Hydrochloride 208
113	<b>8-Amino-6-Chloroquinoline</b>	73								Chloroplatinate, 212, Methiodide, 178
114	<b>4-Aminophenylurethane</b> (N-carbethoxy-1,4-diaminobenzene)	73-4		202, 181	230					Hydrochloride, 242
115	<b>4-Aminodiphenylamine</b>	75 (anh)		158	203					
116	<b>3,5-Dimethylindole</b>	75	278						180	
117	<b>Duridine</b> (3-Amino-1,2,4,5-tetramethylbenzene)	75	261	207						Hydrochloride, 260
118	<b>1-Amino-3,4,5-trimethylbenzene</b>	75	240	163 4						N-Formyl, 98
119	<b>2-Amino-1,4-dimethylnaphthalene</b> (1,4-Dimethyl-2-naphthylamine)	75	333	219-20						
120	<b>4-Nitromesidine</b> (2-Amino-4-nitromesitylene)	75		191	169	163				
121	<b>2-Methoxy-6-nitroaniline</b> (3-Nitro- <i>o</i> -anisidine)	76, yel		158-9						N-Me, 58, red
122	<b>2-Bromo-1,4-diaminobenzene</b> (2-Bromo- <i>p</i> -phenylenediamine)	76		200(di)	235(di)					
123	<b>4,6-Dimethyl-2-nitroaniline</b> (5-Nitro- <i>m</i> -4-xylyline)	76, 70		176, 173	185					
124	<b>1-Amino-5-methylnaphthalene</b> (5-Methyl-1-naphthylamine)	77-8		194-5	173-4				210 d	
125	<b>2,4,6-Trichloroaniline</b>	78	263	204, 206	174	152-4			83	
126	<b>4-Methyl-3-nitroaniline</b> (2-Nitro- <i>p</i> -toluidine)	78		148	172	160	164	171		
127	<b>2,4-Dibromoaniline</b>	79		146	134		134		124	
128	<b>1-Naphthyl 4-tolyl amine</b>	79		124	140					
129	<b>2-Aminodiphenylamine</b>	79-80		121 (2-N-)	136 (2-N-)					
130	<b>2,4-Diaminophenol</b> (4-Hydroxy- <i>m</i> -phenylenediamine)	79-80		220-2 (2,4-N-) 180-2 (tri)	253 (di)				120	
131	<b>4-Aminopyrazole</b>	80-2			173 (di)				193-4	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**

**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	<i>p</i> -Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
132	<b>4-Bromo-3-methylaniline</b> (6-Bromo- <i>m</i> -toluidine)	81	240	103-4						N,N-Di-Me , 55
133	<b>2,2'-Diaminodibenzyl sulfide</b>	81		209 ( <i>di</i> )					203 4	N,N'-Diformyl, 163
134	<b>2,2'-Diaminobiphenyl</b>	81	162 <sup>4</sup>	<i>mono</i> 89, <i>di</i> 161	159 (2-N-) 190 ( <i>di</i> )					N,N'-Diformyl, 137
135	<b>3-Aminoacenaphthene</b>	81		192 3, al	209, al				221	N-Formyl, 151, Alc, FeCl <sub>3</sub> → bl -vlt col
136	<b>2-Aminobenzyl alcohol</b>	82	270 80 part d	N- <i>mono</i> 114	O- 198-9				110	Hydrochloride, 108
137	<b>1-Amino-1,3,4-triazole</b>	82 3							194-5	Hydrochloride, 153, N-Formyl, 117, Chloro- platinate, 230 2-Naphthylthiourea, 158
138	<b>4-Chloro-3-methylaniline</b> (6 Chloro- <i>m</i> -toluidine)	83		91	119					
139	<b>2,6-Dibromoaniline</b>	83-4	262-4	210					123-4	
140	<b>5-Chloro-2-methoxyaniline</b> (4-Chloro- <i>o</i> -anisidine)	84		104	77 8				194	
141	<b>4-Aminotriphenylmethane</b>	84, bz	248 <sup>12</sup>	168	198					N,N-Di-Me , 132
142	<b>1-Amino-3-iodonaphthalene</b> (3-Iodo-1-naphthylamine)	84		207	174					
143	<b>4-Aminobutyrophenone</b>	84		142						Hydrochloride, 178
144	<b>4,4'-Diaminodiphenyl disulfide</b>	85, yel , 106		205 ( <i>di</i> )						N,N'-Dicarboxy, 136-7
145	<b>7-Methylindole</b>	85	266		84				176	
146	<b>2-Amino-4-bromobenzaldehyde</b>	85								Oxime, 194, Phenylhydra- zone, 215
147	<b>2,2'-Diaminodiphenyl sulfide</b>	85 6		160 ( <i>di</i> )	162 3 ( <i>di</i> )					
148	<b>4-Aminoveratrol</b> (3,4-Dimethoxy- aniline)	85 6	174 6	133	177					Chloroplatinate, 227
149	<b>2-Aminophenanthrene</b>	85, pa yel		225	216					
150	<b>4-Aminobenzonitrile</b>	86		205	170				150	N-Formyl, 188-9, N-Propionyl, 169
151	<b>4-Iodo-2-methylaniline</b> (5-Iodo- <i>o</i> - toluidine)	87 92		170, 162	184				189	N-Benzal, 55, Phenyl- urethane, 232
152	<b>4-Aminoacenaphthene</b>	87		175 6	196				190- 200	
153	<b>3-Aminoacetanilide</b>	87 9		191			241			
154	<b>3-Aminophenanthrene</b>	87 5		200-1	213					
155	<b>4-Amino-3-methyl-1-phenylpyrazole</b>	88	312	94 5 (hyd ), 120(anh )	181				138	N-Formyl, 112 (anh ), 81 (hyd ), Chloroplatinate, 226
156	<b>2-Hydroxy-3-methylaniline</b> (3-Amino- <i>o</i> -cresol)	89		N- <i>mono</i> 78-9						N-Acetyl of Me eth , 100
157	<b>3,4-Diaminotoluene</b>	89 90	265	210 ( <i>di</i> ), 95 (3-N), 131 (4-N)	263-4 ( <i>di</i> )	178-9 ( <i>di</i> )	4- <i>mono</i> 140			
158	<b>2-Nitrophenylhydrazine</b>	90, red		140 1, <i>di</i> 57 8	166					N-Formyl, 177
159	<b>2,2'-Diaminodibenzyl disulfide</b>	90-1		202-5 ( <i>di</i> )						N,N'-Dipropionyl, 190-1
160	<b>4-Chloro-1,3-diaminobenzene</b>	91		242 ( <i>di</i> )	178 ( <i>di</i> )		215			
161	<b>1-Amino-2,6-dimethylnaphthalene</b> (2,6-Dimethyl-1-naphthylamine)	91		211	219-20					
162	<b>1-Amino-4-mercaptopnaphthalene</b> (4-Amino-1-thiophenol)	91 3		N- <i>mono</i> 173						S-Me , 54
163	<b>2-Methyl-3-nitroaniline</b> (6-Nitro- <i>o</i> -toluidine)	92 97		158	168					
164	<b>2-Methyl-6-nitroaniline</b> (3-Nitro- <i>o</i> -toluidine)	92	305d	158	167					1-Naphthylthiourea, 171

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	<i>p</i> -Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
165 <sup>a</sup>	<b>3-Bromo-2-hydroxy-5-methylaniline</b> (3-Amino-5-bromo- <i>p</i> -cresol)	93		N-mono 129 <i>dt</i> 169	N-mono 185 <i>dt</i> 166	N-mono 157 <i>dt</i> 230				
166	<b>4-Chloro-2,6-dibromoaniline</b>	93		226	194					
167	<b>2,2'-Diaminodiphenyl disulfide</b>	93		156 ( <i>dt</i> )					141 ( <i>dt</i> )	
168	<b>1,18-Diaminooctadecane</b>	93			150 ( <i>dt</i> )					Hydrochloride >225
169	<b>4,4'-Diaminodiphenylmethane</b>	93	232 <sup>a</sup>	236 ( <i>dt</i> ) (228)	151 153 ( <i>dt</i> )					N,N'-Dibenzal, 130
170	<b>3-Nitrophenylhydrazine</b>	93, yel		145 150 ( <i>dt</i> )	151 153 ( <i>dt</i> )					
171	<b>7-Aminoquinoline</b>	93 4 (anh.), 73 (hyd.)		167	189					Chloroplatinate, 225
172	<b>2-Aminodibenzofuran</b>	94		178 83 ( <i>dt</i> )	201					
173	<b>3-Aminoquinoline</b>	94 84		172 167					210	
174	<b>7-Amino-2,4-dimethylquinoline</b>	94 100	>300	212					215 7	
175	<b>Skatole (3 Methylindole)</b>	95	267	68					170 1	Hydrochloride, 167 8, N-Propionyl, 45
176	<b>2-Chloro-4,6-dibromoaniline</b>	95		227	192					Hydrochloride, 195,
177	<b>4-Hydroxybenzylamine</b>	95								N-Acetyl of Me ether, 96
178	<b>1-Amino-4,5-dimethyl-1,2,3-triazole</b>	95							124 5	Hydrochloride 131, Chloroplatinate, 215
179	<b>1-Amino-8-hydroxynaphthalene</b> (8 Hydroxy-1-naphthylamine 8 Amino-1-naphthol)	95-7		N-mono 181 N,O-di 118	N-mono 193, N,O-di 206	N mono 189			163 4	N-Formyl, 140 50
180	<b>5-Amino-2-methylpyridine</b> (5 Amino- $\alpha$ -picoline)	96		126	111				201	Dihydrochloride, 215 8
181	<b>4,4'-Diamino-3,3'-dimethyl-diphenyl sulfide</b>	96		<i>dt</i> 220	<i>dt</i> 233				186 ( <i>dt</i> )	Dihydrochloride, 248-9
182	<b>6,6'-Diamino-3,3'-dimethyl-diphenylmethane</b>	96		226 ( <i>dt</i> ) 152 ( <i>tetra</i> )					199	Dihydrochloride, 248 9
183	<b>N-Ethyl-4-nitroaniline</b>	96		119	98		107			
184	<b>2,4-Di-iodoaniline</b>	96		141 171	181					
185	<b>1-Amino-8-nitronaphthalene</b> (8-Nitro-1-naphthylamine)	97, red		191		194				
186	<b>3-Aminobenzyl alcohol</b>	97		N mono 106-7	N-mono 115 N,O-di 113 4					
187	<b>5-Bromo-2-methoxyaniline</b> (4-Bromo- $\alpha$ -anisidine)	97-8		160	108					
188	<b>2-Amino-4-methylpyridine</b> (2-Amino- $\gamma$ -picoline)	98		102-3	114, 182 3 ( <i>dt</i> )				227	
189	<b>2-Aminophenacyl alcohol</b>	98		N-mono 141	N,O-di 167					Phenylhydrazone, 198
190	<b>1-Amino-4-chloronaphthalene</b> (4-Chloro-1-naphthylamine)	98		186						
191	<b>1,2-Diaminonaphthalene</b>	98		234 ( <i>dt</i> )	291 ( <i>dt</i> )	1-mono 215				
192	<b>4-Amino-4'-methylbiphenyl</b>	99	190 <sup>a</sup>	221						Hydrochloride, 280 3
193	<b>3-Aminoacetophenone</b>	99		128-9						Semicarbazone, 196
194	<b>2,4-Diaminotoluene</b>	99		N,N'-di 224	224 ( <i>dt</i> )	2-mon 138, 2,4-di 192	4-mon 160, 2,4-di 192-3			

\*Derivative data given in order, m.p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	<i>p</i> -Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
195	4-Amino-3,2'-dimethylazobenzene	100, yel		185 ( <i>mono</i> ), 65 (75) ( <i>di</i> ), lgr						N-Chloroacetyl, 171-2
196	1,2-Diaminobenzene ( <i>o</i> -Phenylenediamine)	102	256-8	185 ( <i>di</i> )	301 ( <i>di</i> )	185	260 ( <i>di</i> )		208	
197	1-Amino-4-bromonaphthalene (4-Bromo-1-naphthylamine)	102, 95		193						N-Formyl, 172, 1,3,5-Tri-nitrobenzene add comp., 196
198	2-Naphthyl 4-tolyl amine	103		85	139					
199	3,4-Diaminobiphenyl	103		3- <i>mono</i> 211 4- <i>mono</i> 155, 3,4- <i>di</i> 163 248	3- <i>mono</i> 186, 4- <i>mono</i> 221, 3,4- <i>di</i>					
200	6,6'-Diamino-3,3'-dimethyl-diphenyl sulfide	103-4		165 ( <i>di</i> )	185 ( <i>di</i> )				179 ( <i>di</i> )	
201	2-Amino-8-nitronaphthalene (8-Nitro-2-naphthylamine)	104, red		196	162					
202	Piperazine	104	140	mono 52, <i>di</i> 144	mono 75, <i>di</i> 196	282 ( <i>di</i> )	173		280	
203	4,4'-Diaminodibenzyl sulfide	104-5		188 ( <i>di</i> )	224 ( <i>di</i> )					
204	3-Amino-4,4'-dimethylbiphenyl	104-5		156-7	160 1					Hydrochloride, abt 230
205	1,3-Diamino-4,6-dimethylbenzene (4,6-Diamino- <i>m</i> -xylene)	105		1- <i>mono</i> 165, <i>di</i> 295	258 9 ( <i>di</i> )		221 ( <i>di</i> )			N,N -Diformyl 182 3
206	2-Bromo-4-nitroaniline	105, yel		129	160					N-Me , 118
207	Triphenylmethylamine	105		207-8	160-2					N-Benzyl, 110
208	4-Aminophenanthrene	105		190	224				216	Oxime (alkali-stable), 156,
209	2-Aminobenzophenone	105-6, pa yel		72, 89	80					(acid stable), 127; N Propionyl, 78
210	3-Amino-6-phenylpyridine	105-6		148-9	201					
211	3-Amino-4-methylpyridine (3-Amino- $\gamma$ -picoline)	106	260	84	81			179 80		Chloroplatinate, 227, Hydrochloride, 180
212	4-Bromophenylhydrazine	106								Acetophenone deriv , 112
213	4-Aminoacetophenone	106	294	167	205	128	203			Semicarbazone, 250, Oxime, 148
214	2,4-Diaminopyridine	107			191-2 ( <i>di</i> )					Chloroplatinate, 224
215	9-Phenanthrylmethylamine	107		182-5	167					N-Benzyl, 104
216	2-Methyl-5-nitroaniline (4-Nitro- <i>o</i> -toluidine)	107		151		172				N-Formyl, 178 9, N-4-Nitrobenzoyl, 214
217	2,5-Diaminopyridine	107-10		290 ( <i>di</i> )	230 ( <i>di</i> )					
218	2-Naphthyl phenyl amine	108		93	148, 136					
219	2-(4-Aminophenyl) ethyl alcohol	108		105	O- <i>mono</i> 59-60, N,O- <i>di</i> 136	93				Hydrochloride, 171
220	5-Aminoacenaphthene	108		238 ( <i>mono</i> ), 122 ( <i>di</i> )	210, 199				190 200	N-Formyl, 172, FeCl <sub>3</sub> → bl col
221	4,4'-Diamino-2,2'-dimethylbiphenyl ( <i>m</i> -Tolidine)	108 9		281 (275) ( <i>di</i> )					225	N,N'-Dibenzal, 172-3
222	4-Aminoantipyrine (4-Amino-2,3-dimethyl-1-phenylpyrazolone-5)	109, yel		199					144	
223	3-Amino-4-methylbenzophenone	109		108						Hydrobromide, 130, dil HBr
224	2-Aminobenzamide	109-11		177	214-5					
225	1,4-Diamino-2-iodobenzene (2-Iodo- <i>p</i> -phenylenediamine)	110 5		211	254					

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**

**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	<i>p</i> -Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
226	<b>5-Aminoquinoline</b>	110	310	178			203 4			
227	<b>4-Amino-2-nitrostilbene</b>	110 1, dk red	192 3							Hydrochloride, 223
228	<b>3-Aminocamphor</b>	110 5	121	141					191	Oxime, 145, N-Formyl, 87
229	<b>4-Bromo-2-nitroaniline</b>	111, or	104	137-8						N-Me, 102, N-Et, 91
230	<b>3'-Amino-4-methylbenzophenone</b>	111	139							Oxime, 146, Hydrochloride, 198
231	<b>4-Amino-3-methylbenzophenone</b>	112, pa yel	175	158						N-Propionyl, 128
232	<b>2-Aminonaphthalene (<math>\beta</math>-Naphthylamine)</b>	112	132	162	102	133	129	195		
233	<b><math>\beta</math>-Aminopropiophenone (1-Aminoethyl phenyl ketone)</b>	112 4 (unst.)	90-1	104-5					164 5	Hydrochloride, 187, Chlo-roplatinate, 205
234	<b>2-Hydroxybenzylaniline</b>	113	93							Hydrochloride, 131, Chlo-roplatinate, 184
235	<b>4-Ethoxy-2-nitroaniline (3-Nitro <i>p</i>-phenetidine)</b>	113, 108, red	104		72	94				
236	<b>5-Bromo-2-hydroxy-3-methyl-aniline</b>	113		N-mono 119, <i>di</i> 200	N-mono 195					
237	<b>3-Nitroaniline</b>	114		mono 155, <i>di</i> 76	155, 150 ( <i>di</i> )	136	138	160	143	
238	<b>6-Aminoquinoline</b>	114 (anh.)	162		mono 138 <i>di</i> 75	169		193		Methiodide, 199
239	<b>cis-2,5-Dimethylpiperazine</b>	114	162		152 ( <i>di</i> )			146-7 ( <i>di</i> )		N,N'-Dinitroso, 95
240	<b>3-Amino-2-phenylquinoline</b>	115 6	223 <sup>3</sup>	mono 124 <i>di</i> 173	179 80				194 5	Methiodide, 238, Ethio-dide, 202
241	<b>5-Amino-3-methyl-1-phenylpyrazole</b>	116	333	110					160 2	Hydrochloride, 199 200
242	<b>4-Aminotriphenylcarbinol</b>	116		176						N,N-Dimethyl, 92-3
243	<b>5-Bromo-2-hydroxy-4-methyl-aniline</b>	116		N-mono 199, <i>di</i> 188	N-mono 223					
244	<b>4-Chloro-2-nitroaniline</b>	116-7, yel	104				110			
245	<b>4-Methyl-2-nitroaniline (3-Nitro-<i>p</i>-toluidine)</b>	117	99	148	102	146				Hydrochloride, 170 1
246	<b>5-Amino-2-methylquinoline (5-Aminoquinaldine)</b>	117 8 (anh.), grnsh	205							N-Cinnamoyl, 257
247	<b>trans-2,5-Dimethylpiperazine</b>	118	162		228 9 ( <i>di</i> )		225 ( <i>di</i> )			N,N'-Dinitroso, 174
248	<b>2,3,4,6-Tetrabromoaniline</b>	118		228-9						1,3,5-Trinitrobenzene add comp, 108
249	<b>2-Methoxy-5-nitroaniline (4-Nitro-<i>o</i>-anisidine)</b>	118, or - red	175 6	160-1			128			N-Me, 87
250	<b>4-Hydroxypyrazole</b>	118			109 ( <i>di</i> )				129	
251	<b>2-Amino-5,4'-dimethylazobenzene</b>	118-9, or -red	157		135					N-Carbethoxy, 94
252	<b>1-Amino-5-nitronaphthalene (5-Nitro-1-naphthylamine)</b>	119, red	220			183				N-Formyl, 199
253	<b>5-Hydroxy-2,4,6-tribromoaniline</b>	119		O,N,N- <i>tri</i> 136			146 7			
254	<b>1,4-Diaminonaphthalene</b>	120		303 ( <i>di</i> )	mono 186, <i>di</i> 280		mono 187 8			
255	<b>1,9-Diaminofluorene</b>	120		293 ( <i>di</i> )	abt 310 ( <i>di</i> )				205	
256	<b>2-(<math>\omega</math>-Aminoethyl)-indole (2-(2-Indolyl)-ethylamine)</b>	120			173 4					N-Benzal, 122
257	<b>2,2'-Diamino-4,4'-dimethylbi-phenyl</b>	120		189 ( <i>di</i> )	170 ( <i>di</i> )					N,N'-Diformyl, 185

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

## 1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>P</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
258	<b>2,6-Diaminopyridine</b>	121		203 ( <i>di</i> )	176 ( <i>di</i> )				240	
259	<b>cis-4,4'-Diaminostilbene</b>	121, pa yel		172 ( <i>di</i> )	253 ( <i>di</i> )					
260	<b>4-Aminobenzhydrol</b>	121			145					Hydrochloride, 270 3
261	<b>3-Amino-6-hydroxyacetophenone</b>	121 110 yel		N-mono 165 <i>di</i> 174						Oxime, 201 Et eth , 60
262	<b>2-Aminotriphenylcarbinol</b>	121		192						
263	<b>3-Hydroxyaniline (3-Amino-phenol)</b>	122		mono 148 <i>di</i> 101	N-mono 174	157	156	122 3		
264	<b>2,4,6-Tribromoaniline</b>	122 119		232						N-Formyl 222
265	<b>4-Amino-2-hydroxyacetophenone</b>	122 3		N-mono 91						N,N-Di Me 120
266	<b>1-Aminoisoquinoline</b>	122 3							290 1	Hydrochloride, 233
267	<b>3,4,5-Tribromoaniline</b>	123		255 6	210					Chloroplatinate, >300
268	<b>4,4'-Diamino-2,2'-dimethyl-diphenylmethane</b>	123		228 ( <i>di</i> )					216	
269	<b>cis-2,2'-Diaminostilbene</b>	123, 107, red		214-5 ( <i>di</i> )					155-6	Hydrochloride 230
270	<b>2,4-Dimethyl-5-nitroaniline</b>	123		159	200	149	192			
271	<b>2-Amino-4-nitrobenzaldehyde</b>	124								Oxime, 193 Semicarba-zone, 390 Anil, 147, red
272	<b>4-Aminobenzophenone</b>	124		153	152					N-Propionyl 139
273	<b>7-Amino-8-hydroxyquinoline</b>	124, br		N-mono 177					205	
274	<b>2-Amino-5-nitrobiphenyl</b>	125, yel		133						
275	<b>3-Hydroxy-4-methoxyaniline (4-Aminoguaiaacol)</b>	125 7		N-mono 116 9	N,O-di 162 4		169			
276	<b>2-Amino-1-nitronaphthalene (1-Nitro-2-naphthylamine)</b>	126, or - yel		123	168	156	160			
277	<b>4-Aminoazobenzene</b>	126		146	211					N-propionyl, 170
278	<b>Hydrazobenzene</b>	126 7		mono 159, <i>di</i> 105	mono 126, bz <i>di</i> 162					
279	<b>5-Chloro-2-nitroaniline</b>	126 5 gold-yel		121						N-Me , 107 N,N-Di-Me , 49
280	<b>Benzidine</b>	127		317 ( <i>di</i> ) 199 (mono)	352 ( <i>di</i> ) 203 5 (mono)	232 ( <i>di</i> )	243 ( <i>di</i> )			
281	<b>2-Aminopyrimidine</b>	127 8							237-8	Chloroplatinate, 216 Hydrochloride, 196
282	<b>2-Amino-6-bromonaphthalene (6-Bromo-2-naphthylamine)</b>	128		192	218					
283	<b>5-Bromo-2-hydroxyaniline (2-Amino-4-bromophenol)</b>	128, 88		177 9						Me eth , 97 8
284	<b>5-Aminoisoquinoline</b>	128							>200	Methiodide, 228 Ethiodide, 216
285	<b>2-Aminovanillin (2-Amino-4-hydroxy-3-methoxybenzaldehyde)</b>	128 9		97						Oxime, 151 2, Phenyl-hydrazone, 165
286	<b>2-Amino-3,7-dimethylnaphthalene (3,7-Dimethyl-2-naphthylamine)</b>	129, 134		231						Hydrochloride, 275
287	<b>4-Methoxy-2-nitroaniline (3-Nitro-p-anisidine)</b>	129, 123, dk red		117, yel	140					N-4-Nitrobenzoyl, 204
288	<b>2-Aminotriphenylmethane</b>	129		154 5						N-Me , 130-2

\*Derivative data given in order m.p. crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	<i>p</i> -Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
289	<b>2-Aminoquinoline</b>	129							255-6	Methiodide, 247, Ethiodide, 232, 1,3,5-Trinitrobenzene add comp., 186, red
290	<b>4,4'-Diamino-3,3'-dimethyl-biphenyl (<i>o</i>-Tolidine)</b>	129		<i>mono</i> 103 (hyd.), <i>di</i> 315 <i>tetra</i> 211	198 ( <i>mono</i> ), 265 ( <i>di</i> )					N,N'-Diformyl, 254 1-Naphthylthiourea, 167, 3-Nitrophthalimide, 185
291	<b>2,4-Diaminodiphenylamine</b>	130		188 ( <i>di</i> )	2- <i>mono</i> 213					
292	<b>3-Aminocoumarin</b>	130, yel		201 2	173					
293	<b>2-Methyl-4-nitroaniline (5-Nitro-<i>o</i>-toluidine)</b>	130		202		158	174			1-Naphthylthiourea 165
294	<b>2-Amino-4-chloropyridine</b>	130 1		115-6	<i>mono</i> 120; <i>di</i> 165				243	
295	<b>4-Hydroxy-3-nitroaniline</b>	131, 127, red		N- <i>mono</i> 157 8						N-Me, 113 Et eth, 40
296	<b>4-Bromo-3-nitroaniline</b>	131 2		146						N,N -Di-Me, 72
297	<b>2-Aminobenzothiazole</b>	132, 129		186	186					
298	<b>2-Amino-4-methylquinoline</b>	133	320							256 abt 250 164
299	<b>2,2'-Diaminobenzophenone</b>	133, pa yel		168 (154) ( <i>di</i> )						N-Phenyl, 129, Chloroplatinate, 230
300	<b>2,2'-Diaminoazobenzene</b>	134, red		271 ( <i>di</i> )						
301	<b>3,5-Dimethyl-2-hydroxyaniline</b>	134-5		N- <i>mono</i> 96	154 (O,N- <i>di</i> )					N-Formyl, 68
302	<b>2-Hydroxy-5-methylaniline (4-Hydroxy-<i>m</i>-toluidine)</b>	135		N- <i>mono</i> 160, N,O- <i>di</i> 145	191, N,O- <i>di</i> 190					N-Propionyl, 95 6, N,O-Dipropionyl, 91 2
303	<b>3-Methyl-4-nitroaniline (6-Nitro-<i>m</i>-toluidine)</b>	135		102						2-Naphthylthiourea, 159
304	<b>2-Amino-3-methylnaphthalene (3-Methyl-2-naphthylamine)</b>	135		181-2	190					
305	<b>2-Aminoacenaphthene</b>	135							260, yel, eth	Hydrochloride, 270
306	<b>DL-2,2'-Diamino-6,6'-dimethyl-biphenyl</b>	136		205 ( <i>di</i> )	182 ( <i>di</i> )		162 3 ( <i>di</i> )			
307	<b>1,4-Diamino-2-nitrobenzene (2-Nitro-<i>p</i>-phenylenediamine)</b>	137, blk		1- <i>mono</i> 162, 4- <i>mono</i> 189, <i>di</i> 186	4- <i>mono</i> 236					1,4-Di-4-nitrobenzoyl, >305
308	<b>9-Aminophenanthrene</b>	137 8, 104		207 8	199				190	
309	<b>4,4'-Diamino-3,3'-dimethoxy-biphenyl (Dianisidine)</b>	137-8		242 ( <i>di</i> )	236 ( <i>di</i> )				225 ( <i>di</i> )	
310	<b>3,5-Dimethyl-4-hydroxyaniline (5-Amino-2-hydroxy-<i>m</i>-xylene)</b>	137-8		160 ( <i>di</i> )						Me eth, 66
311	<b>2,6-Dinitroaniline</b>	138		197						
312	<b>2-(4-Aminophenyl)-quinoline</b>	138		<i>mono</i> 189, <i>di</i> 154	234					
313	<b>2-Amino-3,6-dimethylnaphthalene (3,6-Dimethyl-2-naphthylamine)</b>	139		207						
314	<b>2-Methoxy-4-nitroaniline (5-Nitro-<i>a</i>-anisidine)</b>	139-40, pa yel		153-4	150	181	175, 170			
315	<b>4-Aminopropiophenone</b>	140		161	190					Oxime, 153
316	<b>4-Amino-3-nitrobenzophenone</b>	140, 135, yel			154 5					N,N-Di-Me, 116, N-Et, 100

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	p-Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
317	<b>2-Amino-4-methyldiphenylamine</b>	140			161					Hydrochloride, 200
318	<b>1,4-Diaminobenzene (<i>p</i>-Phenylenediamine)</b>	140, 147	267	<i>mono</i> 162 3 <i>di</i> 304	<i>mono</i> 128 <i>di</i> 300	247 ( <i>dt</i> )	266 ( <i>dt</i> )			3,5 Dinitrobenzoate, 178
319	<b>2-Hydroxy-5-nitroaniline</b>	142 3 (anh) 80-90 (hyd), or		220	>200		122 (O-)			Me eth 118 Et eth , 99
320	<b>2-Amino-4-nitrostilbene</b>	142 3, red		N- <i>mono</i> 220 yel , al						Hydrochloride, 219
321	<b>5-Amino-8-hydroxyquinaline</b>	143		N- <i>mono</i> 221 2, al , N,O- <i>di</i> 206 7, al	205 (O, N- <i>dt</i> )					Me eth , 156, yel
322	<b>1-Amino-2-nitronaphthalene</b> (2-Nitro-1-naphthylamine)	144, red- yel		199	175					N-Et , 77, red
323	<b>2-Amino-5-nitronaphthalene</b> (5-Nitro-2-naphthylamine)	144, red		186	182					
324	<b>5-Hydroxy-2-methylaniline</b> (4-Hydroxy- <i>o</i> -toluidine)	144		N- <i>mono</i> 178 N,O- <i>di</i> 128		183 (N-)				
325	<b>2,5-Dimethyl-4-nitroaniline</b> (5-Nitro- <i>p</i> -2-xylidine)	144-5		168-9		162	185			
326	<b>4-Amino-4'-bromobiphenyl</b>	145		247			174			
327	<b>1-Aminophenanthrene</b>	146		220					204	
328	<b>3,5-Dihydroxyaniline</b> (5-Amino-resorcinol)	146-52		119 21 (tri)						Di Me eth , 46 Picrate of Di-Me eth , 167-70 N,N'-Di-Me , 82, N-Et , 101
329	<b>4-Amino-2-chlorobenzaldehyde</b>	147, yel		152						1-Naphthylthiourea, 187
330	<b>4-Nitroaniline</b>	147 8, yel		215	199, 203 ( <i>dt</i> )	139	191	100		
331	<b>5-Amino-3-methyl-1,2,4-triazole</b>	148		>270	285 90			225		
332	<b>2,2'-Dihydroxyhydrazobenzene</b>	148			186 ( <i>dt</i> )				Di-Me eth , 102	
333	<b>7-Amino-2-methylquinoline</b>	148 (anh)			172 3			213-4		
334	<b>4,4'-Diamino-2,2'-dimethyl azoxybenzene</b>	148, gold- yel		281 ( <i>dt</i> )	290					
335	<b>4-Bromo-3-hydroxyaniline</b>	150		210-2			135-6 (O-)			
336	<b>3-Amino-1-phenyl-1,2,4-triazole</b>	150		3- <i>mono</i> 168, 3,3- <i>di</i> 118				220	Hydrochloride, 187	
337	<b>4-Aminochalcone</b> (4-Aminobenzalacetophenone)	151, golden		179						Oxime, 139
338	<b>4-Aminopyrimidine</b>	151-2		202				226		N-Me , 74-5, N-Phenyl, 142-3
339	<b>Pentamethylaniline</b>	151-2	277-8	213						N-Formyl, 217, N-Me , 60, N,N-Di-Me , 53-4
340	<b>N-Methyl-4-nitroaniline</b>	152		153	112	121				N-Me , 115, N-Et , 90
341	<b>5-Bromo-2-nitroaniline</b>	152, red- yel		139						
342	<b>3-Chloro-4-hydroxyaniline</b>	153		N- <i>mono</i> 144, <i>di</i> 124			116-7 (O-)			Me eth , 62

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**

**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfon amide	<i>p</i> -Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
343	<b>4-Chloro-2-hydroxyaniline</b>	154		140 ( <i>dt</i> )						Hydrochloride, 226 7, Benzyl eth , 46 7 Me eth , 52
344	<b>4-Aminoquinoline (<math>\gamma</math>-Amino-quinoline)</b>	154 (anh )		178					274	Methiodide, 224, Ethiodide, 232
345	<b>3-Aminobenzopyrazole</b>	154		177 8 ( <i>di</i> )	182 ( <i>di</i> )					
346	<b>2,5-Dihydroxy-4-nitroaniline</b> (2-Amino-5-nitrohydroquinone)	154, red		mono 226 <i>di</i> 183 4						Di Me eth , 158
347	<b>4-Hydroxy-2-nitroaniline</b>	154, red		N-mono 218 N O- <i>di</i> 146						Me eth , 129 123
348	<b>3-Aminotriphenylcarbinol</b>	155		164						O,N,N-Trimethyl, 81
349	<b>L-2,2'-Diamino-6,6-dimethyl-biphenyl</b>	156		205 ( <i>dt</i> )	172 ( <i>di</i> )					
350	<b>3,3'-Diaminoazobenzene</b>	156 140, or -yel		272 ( <i>di</i> )	286 ( <i>di</i> )					
351	<b>5-Amino-1-phenyl-1,2,4-triazole</b>	157							175	Chloroplatinate, 197
352	<b>4-Nitrophenylhydrazine</b>	157, or -red		205	193				119 20	
353	<b>4-Aminopyridine (<math>\gamma</math>-Amino pyridine)</b>	158		150 (anh )	202				215 6	
354	<b>4,4'-Diamino-3,3'-dimethyl-diphenylmethane</b>	158 9		224 ( <i>di</i> ) 119 ( <i>tetra</i> )	215 ( <i>di</i> )				192-3	
355	<b>2-Amino-8-nitroquinoline</b>	159		211	166				257	
356	<b>3-Amino-1,2,4-triazole</b>	159							231	Hydrochloride, 153
357	<b>2-Amino-4'-nitrobiphenyl</b>	159, or -red		199			163			
358	<b>3-Amino-2-methylquinoline</b>	159 60	270	165	161				235	N-Formyl, 163
359	<b>1-Amino-4-hydroxy-3-nitro-naphthalene</b> (4-Hydroxy-3-nitro-1-naphthylamine)	160, ma- roon		250, 238	330					
360	<b>2,4-Dihydroxy-5-nitroaniline</b>	160-1, red		N-mono 261 <i>tri</i> 176						Di-Me eth , 136 7
361	<b>1,3-Diamino-4-nitrobenzene</b> (4-Nitro- <i>m</i> -phenylenediamine)	161 157, yel red		1-mono 200 1,3- <i>di</i> 246	222 ( <i>di</i> )		169 ( <i>di</i> )			N,N,N',N'-Tetramethyl, 81
362	<b>3-Hydroxy-4-methylaniline</b> (2-Hydroxy- <i>p</i> -toluidine)	161		N-mono 225 <i>di</i> 132 3			111-2 (O-)			N-Chloroacetyl, 154 5
363	<b>2-Hydroxy-4-methylaniline</b> (3-Hydroxy- <i>p</i> -toluidine)	162		N-mono 171	N-mono 169, N,O- <i>di</i> 162					
364	<b>4-Aminoacetanilide</b>	162		304						
365	<b>3-Hydroxy-4-nitroaniline</b>	162, 158, or -yel		N-mono 221, N,O- <i>di</i> 149						Me eth , 169, 161
366	<b>2,4-Dimethyl-6-hydroxyaniline</b>	163		mono 186 7, <i>di</i> 87 8	N-mono 211, N,O- <i>di</i> 148 9					Me eth , 150
367	<b>2-Aminofluorenone</b>	163, vlt - red		227						Hydrazone, 209, N-Carbethoxy, 167 8
368	<b>1-(2-Aminoethyl)-4-hydroxybenzene</b> (4-(2-Aminoethyl)phenol, Tyramine)	164		N-mono 162, <i>di</i> 172					206	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boling point, °C	Acetamide	Benzamide	Benzene sulfonamide	p-Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
369	<b>4-Aminophenacyl alcohol</b>	165, yel		N-mono 176 7, O-mono 130 N,O-di 162	188 (O-)					Phenylhydrazone, 199
370	<b>3-Bromo-4-hydroxyaniline</b>	165 155, pa br		N-mono 157	N-mono 184 5, di 192				210 (di)	
371	<b>2,7-Diaminonaphthalene</b>	166		261 (di)	267 (di)					
372	<b>4-Amino-4'-iodobiphenyl</b>	166-7, 159 yel								N-Benzal, 209, N-Piperonylidine, 150 1, Hydrochloride, 295 N-Me , 112
373	<b>4-Amino-3-nitrobiphenyl</b>	167, red		132	143					
374	<b>1,2-Diamino-4-hydroxybenzene (3,4-Diaminophenol)</b>	167-8		1,2-di 205 7	1,2-di 203 tri 225					
375	<b>4,4'-Diaminotriphenylcarbinol</b>	168 s h , 175 r h		4,4'-di 267						Me eth , 162
376	<b>4-Amino-2-phenylquinoline</b>	168		108, 117 (di)	182					Methiodide, 274, Ethiodide, 244, N-Formyl, 275
377	<b>2,6-Dinitro-4-methylaniline</b>	168, 172		195	186					
378	<b>4-Amino-2-methylquinoline</b>	168	333						197 9	N-Phenyl, 150, Chloroplatinate, 223 N-Formyl, 175-6
379	<b>6-Aminocoumarin</b>	168-70, yel		216-7	173	159				
380	<b>Picramic acid (3,5-Dinitro-2-hydroxyaniline)</b>	169, red		N-mono 201, O- 193	N-mono 300 O- 218		191			
381	<b>3,3 -Diaminobenzophenone</b>	173, yel		226-7 (di)						Oxime, 177-8
382	<b>4,5-Dimethyl-2-hydroxyaniline</b>	173 5		N-mono 191, N,O-di 157	N-mono 195 6, N,O-di 152 3					
383	<b>2-Hydroxyaniline</b>	174		mono 209 201, di 124	N-mono 141	146				
384	<b>4-Hydroxy-3-methylaniline</b>	175		N-mono 179	N,O-di 194		109-10 (O-)			
385	<b>6-Amino-5,7-dimethylquinoline</b>	175	>300	212					182	
386	<b>4,4'-Diaminodiphenyl sulfone</b>	175-6		286 (di)						N,N'-Di-Me , 179-80, N,N-Tetramethyl, 260
387	<b>trans-2,2'-Diaminostilbene</b>	176, 168, gold-yel		304 (di)					209	Hydrochloride, 267
388	<b>6-Amino-5-nitroquinoline</b>	178, 174, yel					168		270	
389	<b>6-Aminothymol</b>	178 9		N-mono 74, tri 91	N-mono 178-9, N,O-di 166 7					Oxid → thymoquinone, 45 5
390	<b>4-Hydroxy-2-methylaniline (5-Hydroxy-o-toluidine)</b>	179		N-mono 130	92 (O-)					Hydrochloride, 215
391	<b>2,4-Dinitroaniline</b>	180, 188		120	202, 220		219			
392	<b>1-Amino-4-chloroanthraquinone</b>	180, red		203-4						N,N-Di-Me , 172
393	<b>2,6-Dimethyl-4-hydroxyaniline</b>	181		178-80						N-Benzal, 104-5, N-Me , 43, N-Et , 161-2
394	<b>4-Amino-2,6-dimethylpyrimidine</b>	183							214	N-Phenyl, 104
395	<b>4-Aminobenzamide</b>	183, yel		275						N-Chloroacetyl, 241 3

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**

1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
396	<b>4-Hydroxyaniline (4-Amino-phenol)</b>	184, 186		150 ( <i>di</i> ), 168 ( <i>mono</i> )	N- <i>mono</i> 216-7, N,O- <i>di</i> 234	125	N- <i>mono</i> 252-4, O- 142	150		3,5-Dinitrobenzoate, 178
397	<b>1-Amino-3-hydroxynaphthalene (3-Hydroxy-1-naphthylamine)</b>	185		N- <i>mono</i> 179	309 (O,N- <i>di</i> )		137 (O-)			
398	<b>5-Hydroxy-2-nitroaniline</b>	185 6, or 186		N- <i>mono</i> 266						Me eth , 131, br , Et eth , 105, yel
399	<b>6,6'-Diamino-3,3'-dimethyl triphenylmethane</b>	185-6	430, part d	217 ( <i>di</i> )	196 ( <i>di</i> )					
400	<b>4-Amino-2,6-dimethylpyridine</b>	186	246	113					194 5	Chloroplatinate, 250
401	<b>4-Amino-4'-hydroxyazobenzene</b>	186		N- <i>mono</i> 203 <i>dt</i> 236 7						N,N-Di-Me , 203
402	<b>4-Amino-4'-methylbenzophenone</b>	186 7		155						Phenylhydrazone, 163
403	<b>6-Amino-2-methylquinoline</b>	187-8		168 9						N-Cinnamoyl, 257
404	<b>4-Amino-2,6-diethyl-5-methyl-pyrimidine (Cyanethine)</b>	189	280 d	59						
405	<b>2,4,6-Trinitroaniline (Picramide)</b>	190		230	196	211				
406	<b>1-Amino-6-hydroxynaphthalene (6-Hydroxy-1-naphthylamine)</b>	190 185		N- <i>mono</i> 218, N,O- <i>di</i> 187	N- <i>mono</i> 152 N,O- <i>di</i> 223				170	
407	<b>4,4'-Diaminoazoxybenzene</b>	190, yel		275						Sn + HCl → 1,4-Diaminobenzene, 147
408	<b>4-Amino-3-nitrobenzaldehyde</b>	191, yel		155						Phenylhydrazone, 202, Oxime, 207 4-Nitrophenylhydrazone, 270-2
409	<b>2-Amino-1,5-dinitronaphthalene (1,5-Dinitro-2-naphthylamine)</b>	191		201			182			
410	<b>DL-2,2'-Diamino-1,1'-dinaphthyl</b>	193		235 6 ( <i>di</i> )	235 ( <i>di</i> )				185	
411	<b>8-Amino-6-nitroquinoline</b>	194, red		224						Chloroplatinate, 180, Methiodide, 176
412	<b>1-Amino-4-nitronaphthalene (4-Nitro-1-naphthylamine)</b>	195		190	224	173, 158	185			
413	<b>2-Amino-4,6-dimethylpyrimidine</b>	197							230	Hydrochloride, 181, Chloroplatinate, 225, N-Me , 98
414	<b>4,6-Diamino-2-methylquinoline</b>	197		6- <i>mono</i> 250						6-N-Cinnamoyl, 253-4, 4-N-Et , 195, 6-N-Et , 232
415	<b>1,2-Diamino-4-nitrobenzene (4-Nitro-o-phenylenediamine)</b>	198, red		1 mono 205 2 mono 195	235 ( <i>di</i> )					N,N'-Di-Me , 172
416	<b>2,4-Dinitrophenylhydrazine</b>	199 200		197 8	206-7					
417	<b>2-Hydroxy-5-methyl-4-nitroaniline</b>	200, yel		N- <i>mono</i> 242						Me eth , 132, N-Acetyl of Me eth , 156
418	<b>4-Amino-3-nitropyridine</b>	200, yel							197 8	Hydrochloride, 258-9, Chloroplatinate, 256
419	<b>4-Amino-4'-nitrobiphenyl</b>	200, red		264, 240, yel		174, yel				
420	<b>2-Amino-5-nitrobenzaldehyde</b>	200, yel		160-1			181-2			Oxime, 203 N,N-Di-Me 105, yel
421	<b>2-Amino-7-hydroxynaphthalene (7-Hydroxy-2-naphthylamine)</b>	201		N- <i>mono</i> 232, N,O- <i>di</i> 156	N- <i>mono</i> 243 6, N,O- <i>di</i> 181 <i>di</i> 243 4, pa yel , al					
422	<b>2-Amino-1-bromo-3-methylantraquinone</b>	202, 204								

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Acetamide	Benzamide	Benzene sulfon amide	P-Toluene sulfon amide	Phenyl thiourea	Picrate	Miscellaneous
423	<b>4,4'-Diamino-1,1'-dinaphthyl</b>	202		363 ( <i>di</i> )	320 ( <i>di</i> )				147	
424	<b>4,4',4''-Triaminotriphenylmethane</b>	203		201 ( <i>tri</i> )						1,3,5-Trinitrobenzene add comp , 140, blk Oxime, 201 2
425	<b>Isatin</b>	204		141						
426	<b>3-Amino-5-phenylacridine</b>	204		256	246					
427	<b>2-Amino-1,4-naphthoquinone</b>	204 5, or -red		202						N-Phenyl, 191
428	<b>1-Amino-2-methylnaphthaquinone</b>	205, red		<i>mono</i> 176 7, <i>di</i> 203-6			218			
429	<b>4,4',4''-Triaminotriphenylcarbinol</b> (Pararosaniline)	205		192 ( <i>tri</i> )						Me eth , 135
430	<b>1-Amino-7-hydroxynaphthalene</b> (7-Hydroxy-1-naphthylamine)	205 7		N- <i>mono</i> 165	N- <i>mono</i> 208-9, N,O- <i>di</i> 208					
431	<b>4,6-Diaminoisophthalaldehyde</b>	208		270 ( <i>mono</i> ), 280 ( <i>di</i> )						Dioxime, 220, Diphenylhydrazone, 337
432	<b>N-4-Hydroxybenzylaniline</b>	208								Me eth , 65, Et eth , 65
433	<b>6-Aminobenzopyrazole</b>	210		248 (6-N-), 184-5 ( <i>di</i> )						Dihydrochloride, 230
434	<b>4,4'-Diamino-2,5,2',5' -tetra-methyltriphenylmethane</b>	210		217 ( <i>di</i> )	250 ( <i>di</i> )					
435	<b>3-Indolylpyruvic acid</b>	211, grey								4-Nitrophenylhydrazone, 153-4, Oxime, abt 175
436	<b>2-Amino-6-hydroxynaphthalene</b> (6-Hydroxy-2-naphthylamine)	212 3			N,O- <i>di</i> 228 30					Me eth , 78 Et eth , 91
437	<b>5-Amino-1,4-dihydroxyanthra-quinone</b> (5-Aminoquinizarin)	212 3, br red								N-Phenyl, 223, Di-Me eth , 242-3
438	<b>2-Amino-4,5-dimethylpyrimidine</b>	214 5							250	Chloroplatinate, 227
439	<b>5-Bromo-4-hydroxy-2-methyl-aniline</b>	215, 205		171 2 ( <i>di</i> )	229 ( <i>di</i> )					
440	<b>4-Amino-4'-nitroazobenzene</b>	216 205		245						N-Me , 206 7, bl
441	<b>2-Hydroxy-6-nitroaniline</b>	216, red		N- <i>mono</i> 172			136 (O-)			Me eth , 76
442	<b>3,4-Diaminopyridine</b>	218 9			222 3 ( <i>di</i> )				235-7	Chloroplatinate, 231
443	<b>1-Amino-5-chloroanthraquinone</b>	219, red		219	218					
444	<b>3,6-Dimethylcarbazole</b>	219			129				192	N-Nitroso, 106
445	<b>3-Aminothioxanthone</b>	221-2, yel -br		236 7						Hydrochloride, 230
446	<b>2-Amino-10-hydroxyphenanthrene</b>	221		182 (O, N- <i>di</i> )	225 (O, N- <i>di</i> )					
447	<b>5-Amino-4-nitroacenaphthene</b>	222, red		252	233					N-Formyl, 227
448	<b>5-Chloro-4-hydroxy-2-methyl-aniline</b>	223 5, 204 5		162 ( <i>di</i> )	220 ( <i>di</i> )					
449	<b>2,6-Dimethylcarbazole</b>	224							162	N-Nitroso, 113
450	<b>2-Amino-1,8-dinitronaphthalene</b> (1,8-Dinitro-2-naphthylamine)	226		238			221			
451	<b>trans-4,4'-Diaminostilbene</b>	231, yel		353 ( <i>di</i> )	352 ( <i>di</i> )					
452	<b>2-Amino-3-hydroxynaphthalene</b> (3-Hydroxy-2-naphthylamine)	234		188 (O,N- <i>di</i> )	N- <i>mono</i> 233-5					
453	<b>1-Amino-2,4-dinitronaphthalene</b> (2,4-Dinitro-1-naphthylamine)	242		259	252		166			
454	<b>2,5-Dimethyl-4-hydroxyaniline</b>	242		177-9						Et eth , 69 70
455	<b>1-Amino-3-bromoanthraquinone</b>	243, red		214			227			
456	<b>4,4'-Diaminobenzophenone</b>	244		237 ( <i>di</i> )					185	Phenylhydrazone, 240
457	<b>Carbazole</b>	246		69	98					
458	<b>1-Amino-2-hydroxyanthraquinone</b>	250, br		N- <i>mono</i> 170						Et eth , 182, red

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

## 1. Primary and secondary amines c) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Acetamide	Benzamide	Benzene sulfonamide	<i>p</i> -Toluene sulfonamide	Phenyl thiourea	Picrate	Miscellaneous
459	1-Aminoanthraquinone	252, 243		218	255		228	9		
460	3-Aminocarbazole	254		3-mono 217, <i>di</i> 200, <i>tri</i> 175	3-mono 250					
461	2,7-Diaminocarbazole	260		320 ( <i>di</i> )						N,N'-Dibenzal, 290
462	1,8-Diaminoanthraquinone	262, red		284 ( <i>di</i> )	324 ( <i>di</i> )					
463	1,4-Diaminoanthraquinone	268, vlt		271 ( <i>di</i> )	284 ( <i>di</i> ), 280 ( <i>mono</i> )					
464	2-Amino-3-nitrofluorenone	269, vlt		245 6						N-Carbethoxy, 204
465	1,1'-Diamino-2,2'-dinaphthyl	281		230 ( <i>di</i> )	278 ( <i>di</i> )					
466	1,7-Diaminoanthraquinone	290, red		283 ( <i>di</i> )	325 ( <i>di</i> )					
467	2,7-Diaminofluorenone	290, vlt		222 ( <i>di</i> )					230 ( <i>di</i> )	Oxime, 255, Phenylhydrazone, 230, 4-Nitrophenylhydrazone, 280
468	1,6-Diaminoanthraquinone	292, red		295 ( <i>di</i> )	275 ( <i>di</i> )					
469	1-Amino-5-nitroanthraquinone	293, red		275	237					N-Me, 250 2, vlt-blk, N-Et, 238 N-Me, 250
470	1-Amino-4-nitroanthraquinone	296, yel - red		256 8						
471	5,8-Diaminoquinizarin (1,4-Diamino-5,8-dihydroxyanthraquinone)	>300, br -vlt		5,8- <i>di</i> 284		5,8- <i>di</i> 275				
472	2-Aminoanthraquinone	305 8, 302		mono 262, <i>di</i> 258	228	271	304			
473	2-Amino-3-bromoanthraquinone	307, or -yel		259 217	279					N-Benzal, 174
474	2-Aminoquinizarin (2-Amino-1,4-dihydroxyanthraquinone)	313 4, grn -yel								N-Phenyl, 255 6, N-4-Tolyl, 220
475	1,5-Diaminoanthraquinone	319, red		317 ( <i>di</i> )	>350 ( <i>di</i> )					
476	2,7-Diaminoanthraquinone	>330, or		>350	300 ( <i>di</i> )					
477	2,5-Dianilino-1,4-benzoquinone	345, red-br								Anil, 203, Dianil, 240, red
478	2,8-Diaminoacridone	>350		>350 ( <i>di</i> )	>250 ( <i>di</i> )					N,N'-Dibenzal, 370

\*Derivative data given in order m.p. crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Methyl p-toluenesulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
1	<b>Trimethylamine</b>	3			0.6709 <sup>0</sup>		230	216, 225		p-Toluenesulfonate salt, 162
2	<b>Dimethyl ethyl amine</b>	37.5					193			Hydrochloride, 221
3	<b>N-Methylpyrrolidine</b>	78-80					221		233	
4	<b>Triethylamine</b>	89		1.400 <sup>20</sup>	0.7255 <sup>45</sup>		173			2,4-Dinitrobenzoate salt, 81 3,β-Resorcylic acid salt, 120
5	<b>1,2-Dimethylpyrrolidine</b>	96		1.4252 <sup>20</sup>	0.7994 <sup>40</sup>		235	223		
6	<b>1,3-Dimethylpyrrolidine</b>	96-7			0.792 <sup>15</sup>		dumorphous, 181 or 110-5	58.9	HgCl <sub>2</sub> add comp , 200	
7	<b>Pyridine</b>	116		1.5092 <sup>21</sup>	0.978 <sup>25</sup>	139	117	167	241, 262.4	p-Toluenesulfonate salt, 160, Ethiodide, 91
8	<b>1,2,5-Trimethylpyrrolidine</b>	116		1.4335 <sup>24</sup>	0.815 <sup>4</sup>		310	163		.
9	<b>2-Dimethylaminodiethyl ether</b>	121		1.406 <sup>20</sup>	0.806 <sup>20</sup>		160.5	119-21		
10	<b>Dimethylaminoacetone</b>	123								Oxime, 99
11	<b>1-Methylpyrazole</b>	127		1.4787 <sup>He</sup>	0.993 <sup>14</sup>		190	148	196.8	
12	<b>N-Ethylpiperidine</b>	128		1.4416 <sup>20</sup>	0.8237 <sup>4</sup>			167.5	202	
13	<b>2-Methylpyridine (α-Picoline)</b>	129		1.503 <sup>17</sup>	0.9497 <sup>15</sup>	150	230	169	216, 195	p-Toluenesulfonate salt, 161, Ethiodide, 123
14	<b>β-Dimethylaminoethyl alcohol</b> (2-Dimethylaminoethyl alcohol)	135		1.43 <sup>20</sup>	0.8866 <sup>40</sup>			96.7		
15	<b>1,3-Dimethylpyrazole</b>	136		1.467 <sup>15</sup>	0.9628 <sup>15</sup>		256	138		
16	<b>2-Methylpyrazine</b>	136-7			1.029 <sup>4</sup>		129.30	133		
17	<b>4-Methylpyrimidine</b>	141.2			1.031 <sup>18</sup>			131.4		HgCl <sub>2</sub> double salt, 198
18	<b>2,6-Dimethylpyridine (2,6-Lutidine)</b>	142.3					233	168	208	
19	<b>3-Methylpyridine (β-Picoline)</b>	143		1.504 <sup>24</sup>	0.9515 <sup>45</sup>			150	202	Styphnate, 154, Oxid → nicotinic acid, 228
20	<b>4-Methylpyridine (γ-Picoline)</b>	143		1.506 <sup>19</sup>	0.957 <sup>15</sup>			167	231	β-Resorcylic acid salt, 125
21	<b>4-Chloropyridine</b>	147.8							202	
22	<b>2-Ethylpyridine</b>	149			0.9371 <sup>17</sup>			187.9	165.7	
23	<b>3-Chloropyridine</b>	149						135	168	
24	<b>Tri-n-propylamine</b>	156.5		1.4176 <sup>20</sup>	0.753 <sup>20</sup>		207.8	116		Ethiodide, 238
25	<b>2,4-Dimethylpyridine (2,4-Lutidine)</b>	157, 159		1.503 <sup>14</sup>	0.9273 <sup>25</sup>			183	216	β-Resorcylic acid salt, 143
26	<b>2,5-Dimethylpyridine (2,5-Lutidine)</b>	160						169	192.4	
27	<b>1,3,4-Trimethylpyrazole</b>	160		1.4866 <sup>18</sup>	0.9561 <sup>48</sup>			164		
28	<b>3-Ethylpyridine</b>	162-4			0.954 <sup>0</sup>			128-30	208-9, 196	
29	<b>β-Diethylaminoethyl alcohol</b> (2-Diethylaminoethyl alcohol)	163		1.440 <sup>25</sup>	0.8601 <sup>25</sup>					4-Nitrophenylurethane, 60
30	<b>Tropidine (2-Tropene)</b>	163		1.4884 <sup>19</sup>	0.953 <sup>20</sup>		abt 300	285	217	
31	<b>2,3-Dimethylpyridine (2,3-Lutidine)</b>	164						188	195	
32	<b>3,4-Dimethylpyridine (3,4-Lutidine)</b>	164						163	205	
33	<b>4-Ethylpyridine</b>	164-5			0.9417 <sup>20</sup>			168	213	
34	<b>2,4,5-Triethylpyridine (2,4,5-Collidine)</b>	165-8						128-31	205	
35	<b>1,4-Bis-dimethylaminobutane</b>	167						199		
36	<b>Tropane</b>	167			0.931 <sup>20</sup>		>300	281	230	
37	<b>1-Diethylaminoisopropyl alcohol</b>	167.72			0.8511 <sup>20</sup>			89		
38	<b>2-Chloropyridine</b>	170, 166			1.205 <sup>15</sup>	120				
39	<b>3-Bromopyridine</b>	170		1.5694 <sup>20</sup>	1.645 <sup>4</sup>	156	165		175	
40	<b>3,5-Dimethylpyridine (3,5-Lutidine)</b>	170-1						245	255	

\*Derivative data given in order. m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**2. Tertiary amines a) Liquids 1)(Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Methyl p toluenesulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous	
41	<b>2,4,6-Trimethylpyridine</b> (2,4,6-Collidine)	172			0.917 <sup>20</sup>			156	223		
42	<b>1,4,5-Triethylpyrazole</b>	176-7		1.4848 <sup>18</sup> <sub>Hg</sub>	0.9685 <sup>18</sup>			175.6			
43	<b>2,3,6-Trimethylpyridine</b> (2,3,6-Collidine)	176.8						146	250.2		
44	<b>Benzyl dimethyl amine</b>	181						93	192	Picrolonate, 151	
45	<b>2,3,5-Trimethylpyridine</b> (2,3,5-Collidine)	184						183, 179	227.8		
46	<b>N,N,2-Trimethylaniline</b> (N,N-Dimethyl o-toluidine)	185		1.515 <sup>20</sup>	0.9286 <sup>20</sup>			122, 116		1,3,5-Trinitrobenzene add comp., 113	
47	<b>2,6-Dimethyl-4-ethylpyridine</b>	186			0.916 <sup>11</sup>			119-20	210		
48	<b>2,4-Diethylpyridine</b>	187-8			0.9338 <sup>0</sup>			98 100	170-1		
49	<b>3-Diethylaminopropyl alcohol</b>	190					175				
50	<b>Methyl 2-pyridyl ketone</b>	192					161	131	220	Oxime, 121 Phenylhydrazone, 155, Ethiodide, 205	
51	<b>2,3,4-Trimethylpyridine</b> (2,3,4-Collidine)	192-3			0.912 <sup>15</sup>			163.4	259		
52	<b>N,N-Dimethylaniline</b>	193	225	1.5582 <sup>20</sup>	0.9557 <sup>20</sup>	161	228, 220	163	173	p-Toluenesulfonate salt, 133, 3,5-Dinitrobenzoate salt, 115	
53	<b>2-Bromopyridine</b>	194			1.657 <sup>15</sup>	127					
54	<b>3-Ethyl-4-methylpyridine</b>	195.6			0.9656 <sup>0</sup>			148.50	234, 205		
55	<b>3,5-Dimethyl-2-ethylpyridine</b>	198						152	189		
56	<b>N,N,2,6-Tetramethylaniline</b> (N,N-Dimethyl-m-2-xylidine 2-Dimethylamino-m-xylene)	199-200		1.513 <sup>20</sup>	0.912 <sup>20</sup>					1,3,5-Trinitrobenzene add comp., 108	
57	<b>N-Ethyl-N-methylaniline</b>	201			0.919 <sup>55</sup>		125	134.5		Hydrochloride, 114	
58	<b>N,N,2,5-Tetramethyl-</b> <b>aniline</b> (N,N-Dimethyl-p-2- xylidine, 2-Dimethylamino- p-xylene)	204						158	196		
59	<b>N,N,2,4-Tetramethyl-</b> <b>aniline</b> (N,N Dimethyl-m-4- xylidine, 4-Dimethylamino- m-xylene)	205		1.5201 <sup>20</sup>	0.9164 <sup>20</sup>			123.4	219	1,3,5-Trinitrobenzene add comp., 114	
60	<b>N,N-Diethyl-2-methylaniline</b> (N,N-Diethyl-o-toluidine)	206, 210					224	180			
61	<b>2-Chloro-N,N-dimethylaniline</b>	207									
62	<b>N,N,4-Trimethylaniline</b> (N,N-Dimethyl-p-toluidine)	210		1.536 <sup>20</sup>	0.929 <sup>20</sup>	85	152	132		1,3,5-Trinitrobenzene add comp., 124, vlt	
63	<b>3,4-Diethylpyridine</b>	211					219	129			
64	<b>Tri-n-butylamine</b>	211, 216			0.778 <sup>20</sup>			180	106	β-Resorcylic acid salt, 121	
65	<b>N,N,3-Trimethylaniline</b> (N,N-Dimethyl-m-toluidine)	212		1.5492 <sup>20</sup>	0.941 <sup>20</sup>			177			
66	<b>Methyl 4-pyridyl ketone</b>	212-4							130	205	Oxime, 142, Phenylhydrazone, 150, HgCl <sub>2</sub> double salt, 183-4
67	<b>N,N-Diethylaniline</b>	218, 216									
68	<b>Methyl 3-pyridyl ketone</b>	220			0.9351 <sup>20</sup>		102	142		Oxime, 133, Phenylhydrazone, 137, HgCl <sub>2</sub> double salt, 158	
69	<b>N,N-Diethyl-4-methylaniline</b> (N,N-Diethyl-p-toluidine)	229			0.924 <sup>16</sup>			184			
70	<b>2,3,4,5-Tetramethylpyridine</b>	232.4									
71	<b>Quinoline</b>	239	-15.6	1.6268 <sup>20</sup>	1.0929 <sup>20</sup>	126	133	170.2	210	p-Toluenesulfonate salt, 155, Ethiodide, 159, Styphnate, 207.8	
72	<b>Isoquinoline</b>	243	26, 24	1.615 <sup>20</sup> , 1.622 <sup>25</sup>	1.0986 <sup>20</sup>	163	159	203	227, 218	Ethiodide, 148	
								222	263		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**2. Tertiary amines a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting Point, °C	n <sub>D</sub>	Density g/ml	Methyl p-toluenesulfonate	Methiodide	Picrate	Chloro platinate	Miscellaneous
73	<b>DL-Nicotine (DL-1-Methyl-2-(3-pyridyl)-pyrrolidine)</b>	243			1 008 <sup>20</sup>		219	218	abt 280	
74	<b>2-Dimethylaminobenzaldehyde</b>	244, yel				164			205 6	Oxime, 87, p-Nitrophenylhydrazone, 191
75	<b>Tri-isoamylamine</b>	245, 237			0 786 <sup>20</sup>			125		
76	<b>N,N-Dipropylaniline</b>	245			0 9104 <sup>20</sup>		156	261		
77	<b>2-Ethylquinoline (<math>\alpha</math>-Ethyl-quinoline)</b>	245-6		1 598 <sup>23</sup>	1 050 <sup>17</sup>		180	148	188	
78	<b>2-Methylquinoxaline</b>	245-7						215	>250	
79	<b>1-Methylindole</b>	247, 239			1 0707 <sup>0</sup>			150		
80	<b>2-Methylquinoline (Quinaldine)</b>	247		1 6126 <sup>20</sup>	1 0585 <sup>24</sup>	161, 134	195	191, 195	228	$\beta$ -Resorcylic acid salt, 145 Ethiodide, 233
81	<b>8-Methylquinoline</b>	248		1 616 <sup>20</sup>	1 072 <sup>21</sup>			200		
82	<b>L-Nicotine (L-1-Methyl-2-(3-pyridyl)-pyrrolidine)</b>	248		1 528 <sup>20</sup>	1 0097 <sup>20</sup>			218	275	$[\alpha]_D^{20} - 167-8$
83	<b>1-Ethylisoquinoline</b>	250						207 10	200	
84	<b>2,4-Dimethyl-5,6,7,8-tetrahydro-quinoline</b>	250	20	1 5415 <sup>20</sup>	1 0043 <sup>20</sup>		157	144		Hydrochloride, 195
86	<b>N-Methyl-2-pyridone</b>	255						145	141	
87	<b>4,6-Dimethylquinoline</b>	255 6, 280						236-7	238	
88	<b>3-Ethylisoquinoline</b>	257				80		171 2	180	
89	<b>Tri-n-amylamine (Tri-n-pentyl-amine)</b>	257, 245								
90	<b>3-Methylquinoline (<math>\beta</math>-Methyl-quinoline)</b>	257 9	16 7	1 6171 <sup>20</sup>	1 0673 <sup>24</sup>		221	187	249	Ethiodide 220
91	<b>6-Methylquinoline</b>	258			1 6157 <sup>20</sup>	1 0654 <sup>20</sup>	154	219, 216 276 subl	229 182	
92	<b>3-Chloroquinoline (<math>\beta</math>-Chloro-quinoline)</b>	258 60							>300	
93	<b>3-Bromo-N,N-dimethylaniline</b>	259	11					135		
94	<b>5-Methylquinoline</b>	260					105	210 3		
95	<b>4-Methylquinoline (<math>\gamma</math>-Methyl-quinoline)</b>	261-3			1 0862 <sup>20</sup>		173 4	210-1	226 30	Ethiodide, 141 3
96	<b>2,4-Dimethylquinoline</b>	264-5			1 061 <sup>15</sup>		263 5	193-4	229	
97	<b>2-Phenylpyridine</b>	268-9						175	204	
98	<b>6,8-Dimethylquinoline</b>	269			1 066 <sup>4</sup>			288-9	235	
99	<b>N,N-Di-n-butylaniline</b>	271				180		125		
100	<b>4-Ethylquinoline (<math>\gamma</math>-Ethyl-quinoline)</b>	272-4					149	178-80	204	
101	<b>N,N-Dimethyl-1-aminonaphthalene (N,N-Dimethyl-<math>\alpha</math>-naphthyl-amine)</b>	273		1 624 <sup>15</sup>	1 0446 <sup>15</sup>			145		1,3,5-Trinitrobenzene add comp , 105 7
102	<b>5,8-Dimethylquinoline</b>	273 5	4 5		1 07 <sup>21</sup>			198	234	
103	<b>3-Bromoquinoline (<math>\beta</math>-Bromo-quinoline)</b>	274 6	12					190		Oxalate, 107
104	<b>3,5-Dimethyl-1-phenylpyrazole</b>	275					190	103	186	
105	<b>6-Bromoquinoline</b>	278	19, 24				278	217		
106	<b>2,4,7-Trimethylquinoline</b>	280-1		1 5973 <sup>24</sup>	1 0337 <sup>20</sup>		322	232	272	
107	<b>4,7-Dimethylquinoline</b>	283						224	227	
108	<b>3,4-Dimethyl-1-phenylpyrazole</b>	285		1 5724 <sup>20</sup>	1 0574 <sup>24</sup>			122 5	180	
109	<b>8-Chloroquinoline</b>	288					165		235	
110	<b>2,3'-Bipyridyl</b>	289, 298						150, <i>dt</i> 165-8		
111	<b>8-Bromoquinoline</b>	302-4				281			230	
112	<b>6-Methoxyquinoline</b>	305d	20, 28	1 601 <sup>30</sup>	1 0422 <sup>26</sup>		236	305		
113	<b>N-Benzyl-N-methylaniline</b>	306				164		127		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XVIII. ORGANIC DERIVATIVES OF AMINES

2. Tertiary amines a) Liquids (b.p. at reduced pressure only)

2) (Listed in order of increasing m.p. of the corresponding picrate derivative)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Methyl p-toluene sulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
1	N,N-Dimethyl-2-nitroaniline	151 3 <sup>10-11</sup> , or -yel		1.6102				102 3		Hydrochloride, 174, 1,3,5-Trinitrobenzene add comp., 112
2	2,6-Diethylpyridine	71 3 <sup>17</sup>					142	115	211 2	
3	2-Iodopyridine ( $\alpha$ -Iodopyridine)	93 <sup>13</sup>		1.6366 <sup>20</sup>	1.9735 <sup>20</sup>		207	120	210	
4	1,3-Dimethyl-1,2,3,4-tetrahydroquinoline	130 2 <sup>17</sup>					204	131		Reduces Fehling's and Tollen's reagent Zn + AcOH $\rightarrow$ aniline, b.p. 184 + diethylamine b.p. 56
5	$\beta,\beta$ -Diethylphenylhydrazine	110 2 <sup>14</sup>					131			
6	3-Dimethylaminobenzaldehyde	138°, yel					185 6	147	168 r h	Oxime, 75-6, Semicarbazone, 229 <i>p</i> -Nitrophenylhydrazone, 188 Hydrochloride, 203
7	4-Methyl-5,6,7,8-tetrahydroquinoline	122 <sup>11</sup>					183	170		
8	3-Methyl-5,6,7,8-tetrahydroquinoline	126 7 <sup>17</sup>					162	171	219	
9	3-Ethylquinoline ( $\beta$ -Ethylquinoline)	135 8 <sup>12</sup>		1.603 <sup>18</sup>	1.0508 <sup>21</sup>		191	197		Hydrochloride, 173
10	4-Bromopyridine ( $\gamma$ -Bromopyridine)	27.5 30° <sup>3-0.5</sup>	0-1	1.5679 <sup>20</sup>				223		Decomposes to yel-br solid on standing

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**2. Tertiary amines b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Methyl p-toluenesulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
1	<b>Pyrimidine</b>	21	123-4			156		Chloroaurate, 226
2	<b>4,6-Dimethylpyrimidine</b>	25	160			12-34	103-4	$n_D^{25}$ 1.6022, Ethiodide, 229
3	<b>2,8-Dimethylquinoline</b>	27	252		221	180		
4	<b>4-Bromoquinoline (<math>\gamma</math>-Bromoquinoline)</b>	29-30, 25	270d		265-70			
5	<b>Quinoxaline (Benzopyrazine)</b>	30	230		176			$D_4^{25}$ 1.1334, $n_D^{25}$ 1.6231, Oxalate, 169, Ethiodide, 146
6	<b>5-Methylpyrimidine</b>	30.5	154			141		HgCl <sub>2</sub> , double salt, 246, Chloroaurate, 209
7	<b>4-Chloroquinoline (<math>\gamma</math>-Chloroquinoline)</b>	31	263			212	278	
8	<b>7-Chloroquinoline</b>	31-2	267-8		250		253	
9	<b>8-Iodoquinoline</b>	36			200		251	
10	<b>1,3,5-Trimethylpyrazole</b>	37	170			147	187-91	$n_{He}^{25}$ 1.4589
11	<b>2-Chloroquinoline (<math>\alpha</math>-Chloroquinoline)</b>	38	267			122		
12	<b>2,3-Dimethyl-5,6,7,8-tetrahydroquinoline</b>	38	125 <sup>14</sup>		117	169		
13	<b>7-Methylquinoline</b>	39	252			237	223-4	
14	<b>4-Bromoisoquinoline</b>	40	280-5		233			Ethiodide, 168-9
15	<b>6-Chloroquinoline</b>	41	262	143	248			Oxime, 93, Semicarbazone, 214
16	<b>4-(Diethylamino)benzaldehyde</b>	41, yel						Phenylhydrazone, 103, Anil, 108-9
17	<b>3-Nitropyridine</b>	41	216				254	Hydrochloride, 154
18	<b>2,4,8-Trimethylquinoline</b>	42	270		229	193		
19	<b>4-Chloro-2-methylquinoline (4-Chloroquinoladine)</b>	42.3			212	178		
20	<b>5-Chloroquinoline</b>	45	256		231, 172		255	
21	<b>2,6,8-Trimethylquinoline</b>	46	264-5			187-9	206-7	Hydrochloride, 207
22	<b>2-(Dimethylamino)naphthalene (N,N-Dimethyl-<math>\beta</math>-naphthylamine)</b>	47	305			206		
23	<b>2,4,5,8-Tetramethylquinoline</b>	48, pa yel	168-72 <sup>12</sup>			161		Hydrochloride, 254
24	<b>5-Bromoquinoline</b>	48, 52	280		205			Hydrochloride, 225
25	<b>2-Bromoquinoline (<math>\alpha</math>-Bromoquinoline)</b>	49			210			
26	<b>8-Methoxyquinoline</b>	50	283		160	143		Hydrochloride, 213
27	<b>7-Bromoquinoline</b>	52, 34	290		240, yel			Ethiodide, 220
28	<b>2-Iodoquinoline (<math>\alpha</math>-Iodoquinoline)</b>	52-3			211-2			Clinice cold CHCl <sub>3</sub> → chloride, 128-30, yel
29	<b>3-Iodopyridine (<math>\beta</math>-Iodopyridine)</b>	53, 50					211	
30	<b>4,8-Dimethylquinoline</b>	54.5	258-9			216-7	226	
31	<b>2,3,8-Trimethylquinoline</b>	55-6	281			242-5		Hydrochloride, 260
32	<b>2,6-Dimethylquinoline</b>	60	266	175	236-7	186, 178		Styphnate, 200
33	<b>N,N-Dimethyl-3-nitroaniline</b>	60, red			205	119		
34	<b>3,4'-Bipyridyl</b>	62	297			215		
35	<b>2,4,6-Trimethylquinoline</b>	65.5 (anh), 39.5 (hyd)	281.2		245-7, 225	200-1		Hydrochloride, 268-72
36	<b>3,3'-Bipyridyl (<math>\beta</math>,<math>\beta</math>-Bipyridyl)</b>	68	291-2			232		
37	<b>2,3-Dimethylquinoline</b>	68.9	263		218	230-1	230	
38	<b>2,2'-Bipyridyl (<math>\alpha</math>,<math>\alpha'</math>-Bipyridyl)</b>	69				158		
39	<b>5-Nitroquinoline</b>	72 (anh)			215			Hydrochloride, 214
40	<b>N,N-Dibenzylaniline</b>	72, 70			135	131		
41	<b>2,2'-Bis-(dimethylamino)-biphenyl</b>	72-3			190-2			Hydroiodide, 256-7
42	<b>3,4-Dimethylquinoline</b>	73-4, 65	293		191	215, 205		Hydrochloride, 290
43	<b>8-Hydroxy-2-methylquinoline (8-Hydroxyquinoladine)</b>	74	266					Me eth, 125, b p 282
44	<b>4-Dimethylaminobenzaldehyde</b>	74						Semicarbazone, 222, <i>p</i> -Nitrophenylhydrazone, 182, 2,4-Dinitrophenylhydrazone, 325, Anil, 100, grn-yel
45	<b>8-Hydroxyquinoline</b>	75			143	204		Benzoate, 120, 1,3,5-Trinitrobenzene add comp, 124
46	<b>N,N-Dimethyl-4-aminophenol (N,N-Dimethyl-4-hydroxyaniline)</b>	76						Acetate, 78, Me eth, 49, <i>p</i> -Toluenesulfonyl, 130
47	<b>8-Bromoisoquinoline</b>	80.5			274			Nitrate, 193

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**2. Tertiary amines b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Methyl p-toluenesulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
48	3,4'-Biquinolyl	83-4			244			
49	2,2'-Dipyridylamine	84, 95 after resolidification	307-8		227-8	160		Diethiodide, 198
50	N,N-Dimethyl-4-nitroaniline (4-Nitroso-N,N-dimethylaniline)	85			140			Hydrochloride, 177
51	N,N-Dimethyl-3-aminophenol (N,N-Dimethyl-3-hydroxyaniline)	85						Benzoate, 95, Me urethane, 87
52	2,3,6-Trimethylquinoline	86-7	285		212			
53	6,6'-Dimethyl-2,2'-bipyridyl	89-90			170 I			HgCl <sub>2</sub> add comp , 238
54	4,4'-Bis-(dimethylamino)-diphenylmethane	91	390		214 (di)	185 (mono), 178 (di)		1,3,5-Trinitrobenzene add comp , 114, vlt
55	6-Iodoquinoline	91			>300		265	Hydrochloride, 210
56	Tribenzylamine	91			184	190		Ethiodide, 190, $\beta$ -Resorcylic acid salt, 141
57	2,3,4-Trimethylquinoline	92	285		260	216	215	Hydrochloride, 274
58	4-Dimethylaminobenzophenone	92			188-90			Anil, 151, Phenylhydrazone, 105
59	N-Methyl-4-pyridone	92-4 hyg					176 (anh )	HgCl <sub>2</sub> double salt, 177-80
60	1,5-Dimethylbenzimidazole	95	300			255		Hydrochloride, 215
61	1-Phenylisoquinoline	95-6	300			165	242	Hydrochloride, 235
62	6-Bromo-2-methylquinoline (6-Bromoquinaldine)	96 7			237			Ethiodide, 218
63	4-Iodoquinoline ( $\gamma$ -Iodoquinoline)	97			251		185	
64	4,4'-Bis-(dimethylamino)-benzhydrol	98, 102, grn			195 (di)			Me eth , 71 2, 1,3,5-Trinitrobenzene add comp , 76
65	5-Iodoquinoline	100			245		263	
66	4,4'-Bis-(dimethylamino)-triphenylmethane (Leuco-malachite green)	102, bz , 93, al			231 (220) (di)			1,3,5-Trinitrobenzene add comp , 89
67	2,2'-Biquinolylmethane	103			205	239, 210 (di)		
68	2-Hydroxypyridine ( $\alpha$ -Hydroxypyridine, $\alpha$ -Pyridone)	106-7	280-1					Benzoate, 42, HgCl <sub>2</sub> comp with Me eth , 200, HgCl <sub>2</sub> comp with Et eth , 141-2
69	Acridine	111			224	208		
70	3,5-Dibromopyridine	112	222	219	274			
71	1,2-Dimethylbenzimidazole	112 (anh ), 65(hyd )	290		254	238		
72	Antipyrine (2,3-Dimethyl-1-phenyl-5-pyrazolone)	113	319			188		Salicylate, 92
73	4,4'-Bipyridyl	114 (anh ), 73 (hyd )				257		Nitrate, 256
74	4-Dimethylaminoazobenzene	117, yel			174, al			
75	Triphenylamine	127	365					Methochloride, 194
76	3-Hydroxypyridine ( $\beta$ -Hydroxypyridine)	129						Hydrochloride, 214, Fuming HNO <sub>3</sub> in ac a → trinitro deriv , 280
77	Methyleneaminoacetonitrile	129	210			127		Oxalate, 177, Chloroplatinate of Et eth , 192
78	7-Nitroquinoline	132 3			231-2			Acid hydrolysis → glycine
79	6,8'-Biquinolyl	148			126 (mono)	268		Ethiodide, 220
80	4-Hydroxypyridine ( $\gamma$ -Hydroxypyridine)	149 (anh )						
81	6-Nitroquinoline	154, 149			245			Acetate, 140 50, Benzoate, 81, Zn → pyridine, b p 116
82	Quinuclidine	158 (sealed tube)				275-6	238-40	Styphnate, 190, Hydrobromide, 245
83	2,7'-Biquinolyl	160			263	240		Ethiodide, 270-1

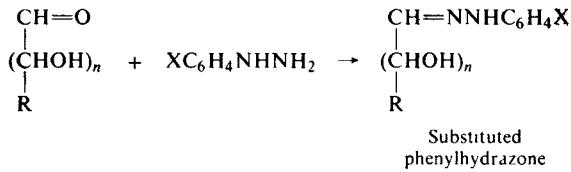
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XVIII. ORGANIC DERIVATIVES OF AMINES**  
**2. Tertiary amines b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Methyl p-toluenesulfonate	Methiodide	Picrate	Chloroplatinate	Miscellaneous
84	2,2'-Biquinolyl ketone	164				179		Oxime, 201, Phenylhydrazone, 199
85	6-Hydroxypyrimidine	164-5				190		Acetyl, 180, 215-20 after resolidification
86	7,7'-Biquinolyl	171-2			310 (mono)	300		
87	4,4'-Bis-(dimethylamino) benzophenone (Michler's ketone)	174			105	156		Oxime, 233
88	5,5'-Biquinolyl	175			272	>300		Hydrochloride, 292
89	2,3'-Biquinolyl	176			286		278	Diethiodide, 270
90	6,6'-Biquinolyl	181			>290 (di)			1,3,5-Trinitrobenzene add comp, 193-5
91	6-Hydroxyquinoline	193				236		
92	2,2'-Biquinolyl ( $\alpha, \alpha'$ -Biquinolyl)	196				210, 215		
93	3-Hydroxyquinoline ( $\beta$ -Hydroxyquinoline)	198				240-5		
94	1,2-Di(2-pyrrolyl)ethanedi one (2,2'-Bipyrrolyl)	200, pale						<i>o</i> -Phenylenediamine → dipyrrolylquinoxaline, 158, Monoxime, 147, Diphenylhydrazone, 146
95	4-Hydroxyquinoline ( $\gamma$ -Hydroxyquinoline)	201 (anh.)						Hydrochloride, 187 (anh.), KMnO <sub>4</sub> → kynuric acid, 200 (anh.)
96	6-Hydroxy-2-methylquinoline (6-Hydroxyquinaldine)	213						Et eth., 71, Picrate of Et eth., 192, Ethiodide of Et eth., 182
97	5-Hydroxyquinoline	224			224		230	Hydrochloride, 240
98	4-Hydroxy-2-methylquinoline (4-Hydroxyquinaldine)	232 (anh.)			201 (anh.)	200	215	Me eth., 82
99	7-Hydroxyquinoline	235			251	244-5		Benzoate, 88-9
100	5-Hydroxy-2-methylquinoline (5-Hydroxyquinaldine)	246, 232-4						Picrate of Me eth., 217, Picrate of Et eth., 213, 206
101	4,4'-Dipyridylamine	273-5				235, 174		Hydrochloride, > 300
102	Hexamethylene tetramine	280		205	190	179	>280	Dil. acid → formaldehyde, semicarbazone, 169

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XIX

*Substituted phenylhydrazones \**

From the carbohydrate and one equivalent of phenylhydrazine in aqueous acetic acid

*For directions and examples see Cheronis, p 520, Wild, p 77*

From the carbohydrate, phenylhydrazine hydrochloride and sodium acetate in water

*See Wild, p 77*

From the carbohydrate with *p*-nitrophenylhydrazine hydrochloride and sodium acetate in methanol

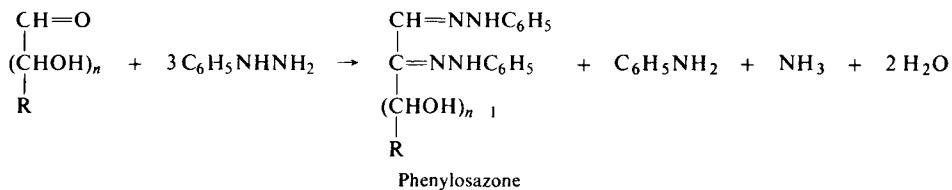
*See Cheronis, p 523*

From the carbohydrate and *p*-nitrophenylhydrazine in alcohol

*See Vogel, p 456*

From the carbohydrate and benzylphenylhydrazine in aqueous alcohol

*See Shriner, p 77*

*Phenylsazone \**

From the carbohydrate and excess of phenylhydrazine in glacial acetic acid

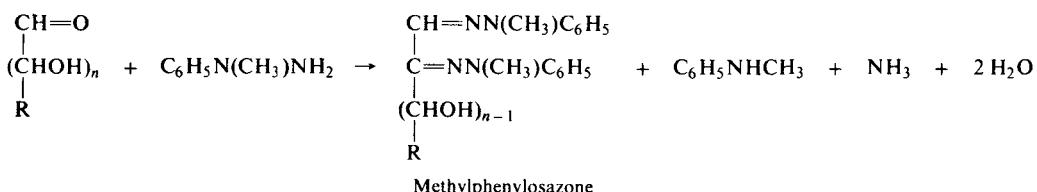
*For directions and examples see Cheronis, pp 523, 524*

From the carbohydrate, excess of phenylhydrazine hydrochloride and sodium acetate in aqueous acetic acid

*See Cheronis, pp 524, 525 Linstead p 38 Shriner, p 132 Vogel, p 455*

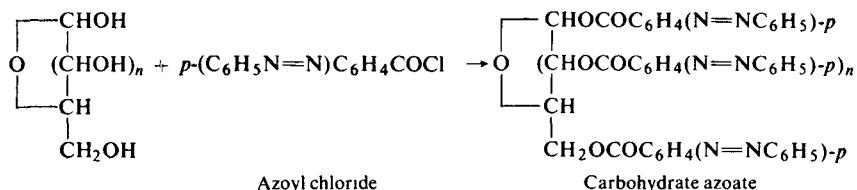
From the carbohydrate and excess of phenylhydrazine in methyl cellosolve-glacial acetic acid mixture

*See W T Haskins, R M Hann and C S Hudson, J Amer Chem Soc, 68, 1766 (1946)*

*Methylphenylsazone*

From the carbohydrate and *as*-methylphenylhydrazine in aqueous alcohol

*For directions and examples see Vogel, p 456*

*p-Phenylazobenzoate (azoate) \**

From the carbohydrate and azoyl chloride (*p*-phenylazobenzoyl chloride) in anhydrous pyridine

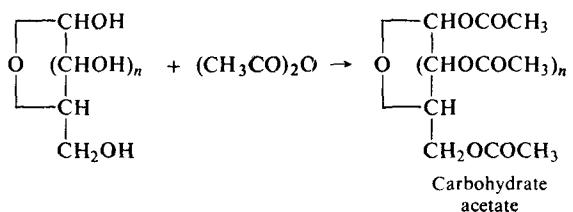
*For directions and examples see Cheronis, p 526, G H Coleman, A G Farnham and A Miller, J Amer Chem Soc, 64, 1501 (1942), G H Coleman and C M McClosky, J Amer Chem Soc, 65, 1588 (1943)*

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE XIX (Continued)

### *Acetate*



From the carbohydrate, acetic anhydride and sodium acetate

For directions and examples see Linstead, p 39, Shriner, p 212, Vogel, p 451, Wild, p 78

### *Specific rotation*

Specific rotation can be used as means for identification

For directions and examples see Cheronis, p 578, Wild, p 78

### *General references*

C A Browne and F W Zerban, *Physical and Chemical Methods of Sugar Analysis*, 3rd edition, John Wiley and Sons, New York, 1941, J Stanek, M Carny, J Kocourek and J Pacak, *The Monosaccharides*, Academic Press, New York, 1963, pp 865-955, G R Pigman in *The Carbohydrates*, (Ed W Pigman), Academic Press, New York, 1957, pp 602-640

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES**

a) Liquids (Listed in order of increasing m.p. of the corresponding phenylosazone derivatives)\*

No	Name	Melting point, °C	Specific rotation			Rf-Values in <i>n</i> -butanol- acetic acid-water (4:1:5)	Phenylosazone		Azoate ( <i>p</i> -Phenyl- azobenzoate)		<i>p</i> -Nitro- phenyl- hydrazone	<i>p</i> -Bromo- phenyl- hydrazone	Miscellaneous
			[α] <sub>D</sub>	T, °C	Conc., Solvent		M P	[α] <sub>D</sub> <sup>T</sup> Solvent	M P	[α] <sub>D</sub> <sup>25°, chl</sup>			
1	DL-Methyl-tetrose						140-2						Phenylbenzylhydra- zone, 99-100
2	Apiose	+3.8, +5.6	20 15	c = 3.4, water			156						<i>p</i> -Bromophenyl- osazone, 210-2
3	DL-Gulose						157.9						Phenylhydrazone, 143, <i>p</i> -Bromophenyl- osazone, 183
4	L-Erythrose	+11.5 → +15.2 → +30.5	24	c = 3, water			164						Benzylphenylhydra- zone, 105, [α] <sub>D</sub> <sup>10°</sup> +32.8, c = 5, 95% al, Triacetyl, 134
5	D-Erythrose	-14.5	20	c = 11, water			164, 166	0.5, pyr - al					Benzylphenylhydra- zone, 105.6 [α] <sub>D</sub> <sup>10°</sup> +32.8, c = 5, 95% al, <i>p</i> -Bromophenylosa- zone, 195 Phenyl- hydrazone, 116
6	DL-Erythrose						164, 166.8						Benzylphenylhydra- zone, 83
7	DL-Erythrulose						164						Methylphenylosa- zone, 158.9
8	L-Erythrulose	+1.2	20	water			164						<i>p</i> -Bromophenyl osazone, 195
9	L-Idose	+52.7	20	c = 6.2, water			168, 160						
10	D-Gulose	-20.4 → +61.6	20	water			168, 160	+6, c = 0.4, me al					Phenylhydrazone, 143 <i>p</i> -Bromophenyl osazone, 186
11	β-Methylglycer- aldehyde						171						Benzylphenylhydra- zone, 116
12	L-Methyltetrose	-30.5 → -16.5	20	c = 9.47. 96% al			172-3						Benzylphenylhydra- zone, 96.7 Diethyl mercaptal, 109
13	D-Rhamnose (6-Desoxy-D- mannose)	-8.25	16.5	c = 10, water			185, 191	-95.2, pyr					<i>p</i> -Bromophenylosa- zone, 225, 222-3
14	3-Amino-3-desoxy- D-glucose	-61 → -78	18	water			207						N-Benzoyl, 128-30
15	DL-Xylulose (DL-Xylo- ketose)						210.5						Methylphenylosa- zone, 173

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Specific rotation			Rf-Values in <i>n</i> -butanol- acetic acid-water (4:1:5)	Phenylsazone		Azote ( <i>p</i> -Phenyl- azobenzene)		<i>p</i> -Nitro- phenyl- hydrazone	<i>p</i> -Bromo- phenyl- hydrazone	Miscellaneous
			[ $\alpha$ ] <sub>D</sub>	T, °C	Conc., Solvent		M P	[ $\alpha$ ] <sub>D</sub> <sup>T</sup> Solvent	M P	[ $\alpha$ ] <sub>D</sub> <sup>25,438</sup> , chl			
1	1,3-Dihydroxyacetone	65-71 (mono- mer), 80 (dimer)					132				156, 160		Phenylhydrazone, 115, Me phenylsazone, 127 130 Diacetate, 46 7 Dibenzoate, 120, Di- <i>p</i> -nitrobenzoate, 198, Oxime, 84
2	$\beta$ -Melibiose dihydrate (6-[ $\alpha$ -D-Galactosido]-D-glucose)	82-5	+111.7 → +129.5	20	c = 4, water		176-8	+43.2, pyr	280	+172			<i>p</i> -Bromophenyl- osazone, 181 2, Phenylhydrazone, 145 160 Oxime, 186, Octaacetate, 177.5, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +102.5
3	D-Ribose	87, 95	-21.5, -23.7	20	c = 4, water	0.31	164	160					170, ([ $\alpha$ ] <sub>D</sub> <sup>20</sup> -5.7, al )
4	L-Ribose	87	+20.3 → +20.7	20	c = 4, water		166						164.5 Phenylhydrazone, 154.5
5	2-Desoxy-D-ribose	90	+2.88 → +2.13	23	water								Benzylphenylhydra- zone, 127.9
6	Glycolic aldehyde (Glyco- aldehyde)	95.7					179						<i>p</i> -Nitrophenyl- osazone, 311, Diphenyl- osazone, 207, Benzyl- phenylsazone, 198, Monoacetate, 157.8, Phenylhydrazone, 162
7	D-Fructose	102.4	-132.2 → -92.4	20	c = 4, water	0.23	210		125	-440	176, ([ $\alpha$ ] <sub>D</sub> +16, pyr -al )		$\alpha$ -Nitrophenylhydra- zone, 156.7 $\alpha$ -Me phenylsazone, 161.2, Pentaacetate $\alpha$ - form, 70, [ $\alpha$ ] <sub>D</sub> <sup>10</sup> +34.7, chl $\beta$ -form, 108-9, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> -120.5, chl
8	Lactic aldehyde (Lactaldehyde)	105					154, 145				128.9		Phenylhydrazone, 93
9	$\alpha$ -L-Rhamnose (6-Desoxy-L-mannose)	105, 93-4 (hyd.)	-8.6 → +8.2	20	c = 4, water	0.37	222, 182	+94, pyr			186.191		<i>p</i> -Nitrophenylosa- zone, 208, 2-Naph- thylhydrazone, 170, [ $\alpha$ ] <sub>D</sub> +8.4, me al , Semicarbazone, 183, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +75 → +57, w
10	L-Altrose	105, 107-9	-32.3	20	water		165 178						Benzylphenylhydra- zone, 148
11	D-Altrose	105	+32.6	20	c = 7.6, water		178						Benzylphenylhydra- zone, 148-50
12	2-Amino-2- desoxy-D-glucose (Glucosamine)	105-10	+48, +44		water		210						Phenylurea, 210, N- Acetyl, 190, Oxime, 127, Semicarbazone, 165
13	$\alpha$ -D-Lyxose	106.7, 101	+5.5 → -14.0		c = 8, water		164				172	162, 156.7	<i>Benzylphenylhydra- zone, 116, 128.</i> [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +26.4, c = 4.9, abs al

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Specific rotation			Rf Values in <i>n</i> -butanol- acetic acid-water (4:1:5)	Phenylsazone		Azoate ( <i>p</i> -Phenyl azobenzoate)		<i>p</i> Nitro phenyl- hydrazone	<i>p</i> -Bromo phenyl- hydrazone	Miscellaneous
			[ $\alpha$ ] <sub>D</sub>	T °C	Conc Solvent		M P	[ $\alpha$ ] <sub>D</sub> <sup>T</sup> Solvent	M P	[ $\alpha$ ] <sub>D</sub> <sup>25</sup> chl			
14	Raffinose (2-[6-( $\alpha$ -D-Galactosido)- $\alpha$ -D-glucoside] $\beta$ -D-fructose)	118.9, (anh) 80 (hyd)	+123, +105.2	20	c = 4, water	0.05			145	+146			Tritriyl, 130, $\alpha$ -Methylphenylhydrazone, 190, Emulsin $\rightarrow$ sucrose + galactose
15	$\beta$ -L-Rhamnose	122.6	+9.1	20	water		222 185	+94 pyr			190.1, ([ $\alpha$ ] <sub>D</sub> <sup>20</sup> +21.4)		$\alpha$ -Methylphenylhydrazone, 124, <i>p</i> -Bromophenylhydroszone, 222
16	D-Tagatose	124	+1.0	22	c = 1, water		196.7 201						Diacetone deriv, 65.6, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +71.8, w
17	D-Threose	126.32	+29 → +19.6	22	water		164						Benzylphenylhydrazone, 194, bz, Acetone deriv, 84, Triacetate, 113.4, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +35.5, chl
18	D-1-Amino-fructose	127.8					210						
19	$\beta$ -D-Allose	128	+0.58 → +14.41	20	c = 5, water		178, 174				145, ([ $\alpha$ ] <sub>D</sub> <sup>20</sup> -6.7, al)		
20	$\beta$ -L-Allose	128.9	-1.9	20	water		165				141.5, ([ $\alpha$ ] <sub>D</sub> <sup>20</sup> +6.4, al)		
21	D-Talose	128.30	+30 → +20.6	21	water		201 197				205		Phenylhydrazone, 178, Benzylphenylhydroszone, 199
22	DL-Xylose	129.31											
23	$\alpha$ -D-Mannose	133	+29.3 → +14.2	20	c = 4 water	0.20	210.5 210				194.5, ([ $\alpha$ ] <sub>D</sub> <sup>20</sup> +56, pyr-al (1.1))	208.10	Phenylhydrazone, 199 200, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +26.3 → +33.8, pyr, $\alpha$ -Methylphenylhydrazone, 178, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +8.6, c = 0.5, me, al, Benzylphenylhydroszone, 165
24	$\beta$ -D-Mannose	132	-17.0 → +14.2	20	c = 4, water		210				194.5	208.10	Phenylhydrazone, 199 200, $\alpha$ -Methylphenylhydrazone, 178, $\text{CaCl}_2$ add comp, 101.2
25	L-Mannose	132	+14.0 → -14.0		water		208						Phenylhydrazone, 195, [ $\alpha$ ] <sub>D</sub> +1.2, HCl
26	DL-Mannose	132.3											Phenylhydrazone, 195
27	$\alpha$ -D-Manno-heptose	134.5	+85.05 → +68.64	20	c = 11 water		217.9 200						Phenylhydrazone, 197, Hexaacetate, 106, 50% al, 139.40, eth
28	DL-Glyceraldehyde (dimer)	139, 142					132						<i>p</i> -Bromophenylhydroszone, 168, Dibenzoate, 231, Di- <i>p</i> -nitrobenzoate, 247, Semicarbazone, 160, 2,4-Dinitrophenylhydrazone, 166-7
29	D-Isorhamnose (6-Desoxy-D-glucose)	139-40	+72.3 → 29.7	20	c = 10, water		185, 187.9						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Specific rotation			Rf-Values in <i>n</i> -butanol- acetic acid water (4:1:5)	Phenylosazone		Azote ( <i>p</i> -Phenyl- azobenzoate)		<i>p</i> -Nitro phenyl hydrazone	<i>p</i> Bromo- phenyl- hydrazone	Miscellaneous	
			[ $\alpha$ ] <sub>D</sub>	T, °C	Conc., Solvent		M P	[ $\alpha$ ] <sub>D</sub> <sup>T</sup> Solvent	M P	[ $\alpha$ ] <sub>D</sub> <sup>25</sup> chl				
30	$\alpha$ -L-Glucose	141.3	-95.5 → -51.4	20	c = 4, water		208						Diphenylhydrazone, 162	
31	L-Xylose	144, 141.3	-79.3 → -18.6	20	c = 9.94, water	0.28	159.61						Tetraacetate, 126 ( $\beta$ -form)	
32	$\alpha$ -D-Xylose	145, 143	+93.6 → +18.8	20	c = 4, water		164.155	-40.9, al	157	+244	155	128	Me phenylhydrazone, 108. Benzylphenyl- hydrazone, 95. [ $\alpha$ ] <sub>D</sub> -33, c = 0.57, al 2-Naphthylhydra- zone, 124. [ $\alpha$ ] <sub>D</sub> +18.6, me al Methylphenylosazone, 181. Oxime, 188.9, [ $\alpha$ ] <sub>D</sub> +13.2, w	
33	D-Fucose (6- Desoxy-D- galactose, D-Rhodose)	145	+89.3 → +75.7	22	water		177							
34	L-Fucose (6-Desoxy-L- galactose, L-Rhodose)	145	-152.6 → -75.9	20	c = 4 water	0.27	178				210.1	181.4	Phenylhydrazone, 170. $\alpha$ -Methylphenylhy- drazone, 174. [ $\alpha$ ] <sub>D</sub> -17.0, pyr Oxime, 188.9. $\alpha$ -Me gluco- side, 158. [ $\alpha$ ] <sub>D</sub> -197.5, w. $\beta$ -Me glucoside, 119. [ $\alpha$ ] <sub>D</sub> +16.04, w	
35	$\alpha$ -D-Glucose	146 (anh.), 83 (hyd.)	+112.2 → +52.7	20	c = 4, water	0.18	210	-1.5, c = 2, pyr -al (1:1)	266	+223	88.196 ([ $\alpha$ ] <sub>D</sub> +21.5, me al.)	164.6, ([ $\alpha$ ] <sub>D</sub> -43.6 +18.9 c = 4, pyr)		2-Naphthylhydrazone, 178. <i>p</i> -Nitrophenyl- osazone, 257. 2,4- Dinitrophenylosa- zone, 256.7. $\alpha$ -Penta- acetate, 112
36	2-Desoxy- D-glucose	148	+46.6	18	water								Benzylphenylhydra- zone, 158.9	
37	$\beta$ -D-Glucose	148.50	+18.7 → +52.7	20	c = 4, water		210						<i>p</i> -Nitrophenylosa- zone, 257. 2,4-Di- nitrophenylosazone, 256.7. $\beta$ -Penta- acetate, 132	
38	Melezitose (2-[3-( $\alpha$ -D- Glucosido)-D- fructosido]- $\alpha$ - D-glucose)	153.4 (+2 H <sub>2</sub> O)	+88.2	20	c = 4, water				130 (sin- teres)	+188				
39	Turanose (3-[ $\alpha$ - D-Glucosido]- D-fructose)	157 (anh.), 60.5 (hyd.)	+27.3 → +75.8	20	c = 4, water		215.20						Heptaacetate, 140.1, eth. [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +37, chl	
40	$\beta$ -D-Arabinose	158.9	-175 → -105		c = 9.45, water	0.21	162.3, 160						Oxime, 136. Benzyl- phenylhydrazone, 173	
41	$\beta$ -L-Arabinose	160	+190.6 → +104.5	20	water		166		262	+755	186	155	Benzylphenylhydra- zone, 174. Me phenylhydrazone, 165. Oxime, 139. Tetraacetate, $\alpha$ -form 94.6, eth. $\beta$ -form 86. w. Tetraben- zoate, 160.1, 173, Semicarbazone, 190, 163	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES**

b) Solids (Listed in order of increasing m.p.)\* (Continued)

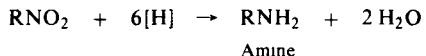
No	Name	Melting point, °C	Specific rotation			Rf Values in n-butanol-acetic acid-water (4:1:5)	Phenoxyazone		Azoate (p-Phenylazobenzoate)		p-Nitrophenylhydrazone	p-Bromo-phenylhydrazone	Miscellaneous
			[α] <sub>D</sub>	T, °C	Conc., Solvent		M P	[α] <sub>D</sub> <sup>T</sup> Solvent	M P	[α] <sub>D,25,chl</sub>			
42	$\beta$ -D-Galacturonic acid	160	(+55.3)	20	water	0.11					151 ([α] <sub>D</sub> +11.5, me al)	Phenylhydrazone, 140, Brucine salt, 180	
43	$\beta$ -Maltose (4-[ $\alpha$ -D-Glucosido]- $\beta$ -D glucose)	160.5, 102.3 (+1 H <sub>2</sub> O)	+111.7 → +130.4	20	c = 4, water	0.11	205-6		275	+2		Phenylhydrazone, 130, p-Nitrophenyl- osazone, 261, p-Bromophenoxyazone, 198, 2-Naphthyl- hydrazone, 176, Octaacetate, 160.1, [α] <sub>D</sub> <sup>20</sup> +62.59, chl	
44	DL-Fucose (6-Desoxy-DL-galactose, DL-Rhodose)	161						187				Diacetone deriv., 41	
45	DL-Sorbose	162.3											
46	L-Galactose	162-3	-120 → -73.6 →		c = 10, water	0.20	169 70 192 5					Phenylhydrazone, 158.60, [α] <sub>D</sub> +21.6, w	
47	DL-Galactose	163, 144						206				Phenylhydrazone, 158.60, $\alpha$ -Methyl- phenylhydrazone, 183	
48	$\beta$ -D-Glucuronic acid	163	+36.3	20	water					225		Semicarbazone, 188, Cinchonine salt, 204, [α] <sub>D</sub> <sup>20</sup> +139.9, w	
49	DL-Arabinose	164						169				Diphenylhydrazone, 204, p-Bromophenoxy- osazone, 200-2	
50	L-Sorbose	165, 159.61	-43.7 → -43.4	20	c = 12, water	0.20	156, 168	-6, me al				p-Bromophenoxy- osazone, 181, o-Nitro- phenylozone, 211.2, $\beta$ -Me glucoside, 120-2, [α] <sub>D</sub> <sup>20</sup> -88.5, w, Pentaacetate, 97, [α] <sub>D</sub> +2.9, chl	
51	D-Sorbose	165	+42.9	20	c = 1, water		168, 160 242					$\beta$ -Me glucoside, 119, [α] <sub>D</sub> +88.5, w	
52	3-( $\beta$ -D-Galactosido)-D-arabinose	166-8	-50.3 → +63.1	19	water							Benzylphenylhydra- zone, 223-5	
53	$\alpha$ -D-Galactose	167	+150.7 → +80.2	20	c = 5, water	0.16	196, 201		276	+436	154, 197	168	$\alpha$ -Methylphenylhydra- zone, 190-1, Benzyl- phenylhydrazone, 157, Diphenylhydra- zone, 157, $\alpha$ -Penta- acetate, 95
54	Stachyose ( $\alpha$ -Galactosyl $\frac{1 \rightarrow 6}{\beta}$ $\alpha$ -galactosyl $\frac{1 \rightarrow 4}{\beta}$ $\alpha$ -glucosyl $\frac{1 \rightarrow 2}{\beta}$ $\beta$ -fructoside)	167-70	+148	20	water							Tetradecaacetate, 95-6, [α] <sub>D</sub> <sup>20</sup> +120, al, Tetradeca-p-nitro- benzoate, 166	
55	Sucrose (2-[ $\alpha$ -D-Glucosido]- $\beta$ -D-fructose)	169.70, me al, 185, w-al	+66.53	20	c = 26, water	0.14			125	+35		Nonreducing, Octaacetate, 72, 69, [α] <sub>D</sub> <sup>20</sup> +59.6, chl, Tritriyl, 128	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XIX. ORGANIC DERIVATIVES OF CARBOHYDRATES**  
b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Specific rotation			Rf Values in <i>n</i> -butanol- acetic acid-water (4:1:5)	Phenylosazone		Azoate ( <i>p</i> -Phenyl- azobenzoate)		<i>p</i> -Nitro- phenyl- hydrazone	<i>p</i> -Bromo- phenyl- hydrazone	Miscellaneous
			[ $\alpha$ ] <sub>D</sub>	T, °C	Conc., Solvent		M P	[ $\alpha$ ] <sub>D</sub> <sup>T</sup> Solvent	M P	[ $\alpha$ ] <sub>D</sub> <sup>25.35</sup> , chl			
56	D-Glucoheptulose	171	+67.4	20	water		209-10						Hexaacetate, 112, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +87.0, $\alpha$ -Me glucoside, 138.40, [ $\alpha$ ] <sub>D</sub> <sup>2</sup> +108.5 w
57	4-[ $\beta$ -D-Glucosido]- $\beta$ -D-mannose	176 (anh.), 139.40 (hyd.)	+15.1 → +10.7	16	water		198						
58	$\alpha$ -L-Rhamnohexose	180.1	-80 → -61.4	20	c = 9.67, water	0.38	200						Benzylphenylhydrazone, 183.4
59	L-Ascorbic acid	190, 187	+49	18	me al						262 (di)	170 (di)	Diphenylhydrazone, 187. Di-2,4-dinitrophenylhydrazone, 282
60	Gentiobiose (6-[ $\beta$ -D-Glucosido] D-glucose)	190-5 (anh.), 86 (hyd.)	+21.4 → +8.7	20	c = 5, water		163.4, 170, 179	-42.9 <sup>20</sup> , 95° al					Octaacetate ( $\alpha$ ) 188.9, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +52.3, chl, ( $\beta$ ) 192.3, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> -5.3, chl
61	$\alpha$ -D-Glucoheptose	193	-20	20	water		194-5						$\beta$ -Me glucoheptoside, 169, [ $\alpha$ ] <sub>D</sub> -75, w, Hexaacetate, 164 ( $\alpha$ form), 135 ( $\beta$ -form)
62	$\alpha$ , $\alpha$ -Trehalose (1-[ $\alpha$ -D-Glucosido]- $\alpha$ -D-glucose)	210.203 (anh.) 97 (+2 H <sub>2</sub> O)	+178.3	20	c = 7, water				134.5	+210			Nonreducing Octanitrile, 124. Octaacetate, 100.2, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +162, chl. Hexaacetate, 93-6, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +158.3, chl
63	Primeverose (6-[ $\beta$ -D-Xylosido]-D-glucose)	210, 208	+24.1 → -3.3		c = 2.5, water		220						$\beta$ -Heptaacetate, 216, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> -23.5, chl
64	Lactose (4-[ $\beta$ -D-Galactosido]-D glucose)	$\alpha$ -form, 223 (anh.). 201 (hyd.). $\beta$ -form, 252 (anh.)	+90 → +55.3 (+52.3) +35 → +55.3 (+52.3)	20	c = 4, water	0.09	200, 210-2						<i>p</i> -Nitrophenylhydrazone, 258. Octaacetate, 100. Benzylphenylhydrazone, 128. 2-Naphthylhydrazone, 203
65	$\beta$ -Celllobiose (4-[ $\alpha$ -D-Glucosido]- $\beta$ -D-glucose)	225	+14.2 → +34.6	20	c = 8, water		208 10, 198	-6.5 <sup>20</sup> , pyr-al (1.1)	273	+105			Phenylhydrazone, 90. Octaacetate, ( $\alpha$ ) 229.30, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> +42, chl. Semicarbazone, 183.5. Octaacetate ( $\beta$ ), 192.202, [ $\alpha$ ] <sub>D</sub> <sup>20</sup> -14.5, chl. Oxime, 123.5
66	6-[ $\beta$ -Cellulosido]- $\alpha$ -D-glucose	247-52 (anh.), 200 (hyd.)	+15.0 → +8.4		water		224						
67	6-[ $\beta$ -Lactosido]- $\alpha$ -D-glucose	257	+34.7 → +22.6	24	water		233						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**EXPLANATIONS AND REFERENCES TO TABLE XX***Formation of amine by reduction \**

From the nitro compound and tin in hydrochloric acid

*For directions and examples see* Cheronis, p 625, Linstead, p 69, Shriner, p 262, Vogel, p 529, Wild, p 247

From catalytic hydrogenation (Raney nickel, platinum oxide and palladium on charcoal) of the nitro compound in ethanol, methanol or dioxane

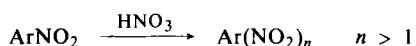
*See* Cheronis, p 626, Linstead, p 70, N D Cheronis and M Koeck, *J Chem Ed*, **20**, 488 (1943), K Johnson and E F Degering, *J Amer Chem Soc*, **61**, 3194 (1939), S V Voris and P E Spoerri, *J Amer Chem Soc*, **60**, 935 (1938), E R Blout and D C Silverman, *J Amer Chem Soc*, **66**, 1442 (1944)

From the nitro compound and lithium aluminum hydride in ethers

*See* N G Gaylord, *Reduction with Complex Metal Hydrides*, Interscience, New York, 1956, pp 762-773

For partial reduction of polynitro compounds with sodium or ammonium polysulfide *see* Linstead, p 71, Vogel, p 551

*NOTE* For directions and examples for the preparation of the derivatives of the amine formed on reduction of the nitro compounds see explanations and references to Table XVIII, p 291, 292, 293, 294

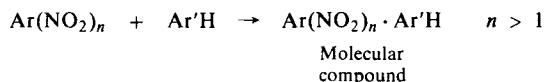
*Polynitro derivative \**

From the aromatic nitro compound with concentrated or fuming nitric acid and sulfuric acid

*For directions and examples see* Cheronis, pp 580, 627, Shriner, p 249, Vogel, pp 526, 527

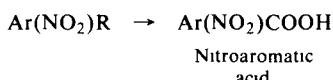
From fuming nitric acid in acetic acid or acetic anhydride

*See* Wild, pp 24, 247, 248, J Reilly and W J Hickinbottom, *J Chem Soc*, **117**, 135 (1920), O L Brady and W H Gibson, *J Chem Soc*, **119**, 102 (1921)

*Molecular compounds of aromatic polynitro compounds with aromatic hydrocarbons*

Molecular addition compounds are formed from the aromatic polynitro compound and aromatic hydrocarbons

*For directions and examples see* Table IV, p 32, 33, 34 Wild, p 248, T Asahina and C Shinomiya, *J Chem Soc Japan*, **59**, 341 (1938), O C Dermer and R B Smith, *J Amer Chem Soc*, **61**, 748 (1939)

*Nitroaromatic acids from side-chain oxidation*

From the alkylaromatic nitro compound and basic aqueous potassium permanganate

*For directions and examples see* Cheronis, p 627, Vogel, p 629

From the alkylaromatic nitro compound and sodium bichromate and sulfuric acid in water

*See* Cheronis, p 628, Vogel, p 629

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS**  
a) Liquids (Listed in order of increasing atmospheric b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Data for the corresponding amine obtained on reduction of all nitro groups					Nitration product		Miscellaneous	
						Amine		Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point, °C	Position of nitro groups	
						Boiling point, °C	Melting point, °C							
1	Nitroethylene	98.9			1.073 <sup>14</sup>	16.5		71	58	165			Polymerizes readily on contact with base	
2	Nitromethane	101	-17	1.3797 <sup>25</sup>	1.1297 <sup>24</sup>	-6		28	80	30	207 215			
3	Nitroethane	114		1.392 <sup>20</sup>	1.0497 <sup>24</sup>	16.5			71	58	165			
4	2-Nitropropane	120		1.394	1.024 <sup>0</sup>	33			26				Phenylthiourea deriv of amine, 101, 1-Naphthylurea deriv of amine, 200	
5	3-Nitropropylene (3-Nitropropene)	125.30			1.051 <sup>21</sup>	58				39	140			
6	1-Nitropropane	132		1.4002 <sup>24</sup>	1.008 <sup>24</sup>	49			84	36	135			
7	DL-2-Nitrobutane	140		1.4013	0.987 <sup>20</sup>	63			76	70	139-40			
8	2-Methyl-1-nitropropane	140.1			0.987 <sup>20</sup>	69			57	53	150		p-Toluenesulfonamide deriv of amine, 78	
9	2-Methyl-2-nitrobutane	150				78					183			
10	DL-2-Nitropentane	152.4				92							Hydrochloride of amine, 168, Oxalate, 226 131	
11	1-Nitrobutane	153		1.4103 <sup>20</sup>	0.9710 <sup>20</sup>	77					151		Chloroaurate, 82.3 Phenylthiourea deriv of amine, 65, 1-Naphthylurea deriv of amine, 149	
12	1-Nitroisobutylene (1-Nitroisobutene)	154-8			1.052 <sup>0</sup>	69				57	53	150		
13	3-Methyl-1-nitrobutane	164				96						138		
14	1-Nitropentane	173		1.4175	0.9525 <sup>24</sup>	104						139	Phenylthiourea deriv of amine, 69, 2-Naphthylthiourea deriv of amine, 114	
15	2-Nitrohexane	176			0.9357 <sup>20</sup>	116-8								
16	1-Nitrohexane	193		1.4234	0.9396 <sup>20</sup>	130							Phenylthiourea deriv of amine, 75	
17	1-Nitroheptane	193.5			0.9476 <sup>17</sup>	155							Hydrochloride of amine, 133 Oxalate, 204.5, Chloroaurate, 63-4	
18	2-Nitroheptane	194.8			0.9466 <sup>0</sup>	142							SnCl <sub>2</sub> + HCl → Cyclohexanone oxime 89.90	
19	Nitrocyclohexane	205.6	-34	1.4612 <sup>19</sup>	1.068 <sup>19</sup>	134		104	147				1 Naphthylthiourea deriv of amine, 72	
20	1-Nitrooctane	206.10	part d		0.9346 <sup>20</sup>	180					112			
21	Nitrobenzene	210.1		1.553 <sup>20</sup>	1.2031 <sup>40</sup>	184		114	160	112	90	1.3		
22	2-Nitrotoluene	222		1.5474 <sup>20</sup>	1.1622 <sup>19</sup>	200		110.11	146, 143	124	213	70.1	2.4	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

a) Liquids (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Data for the corresponding amine obtained on reduction of all nitro groups					Nitration product		Miscellaneous	
						Amine		Acet-amide	Benz-amide	Benzene sulfon-amide	Picrate	Melting point, °C	Position of nitro groups	
						Boiling point, °C	Melting point, °C							
23	1-Ethyl-2-nitrobenzene	224		1.5407 <sup>19</sup>	1.126 <sup>24</sup>	210 11 214		111-2	147		194 5			
24	1,3-Dimethyl-2-nitrobenzene (2-Nitro- <i>m</i> -xylene)	226	13		1.112 <sup>15</sup>	215 218		177	168		180	182	1,3,5	<i>p</i> -Toluenesulfonamide deriv of amine, 212
25	Phenylnitromethane	226d		1.5323 <sup>20</sup>	1.1598 <sup>20</sup>	184-5		60	105	88	194			
26	3-Nitrotoluene	233	16	1.5470 <sup>21</sup>	1.1571 <sup>20</sup>	203		65	125	95	200			Oxid → 3-nitrobenzoic acid, 140
27	1,4-Dimethyl-2-nitrobenzene (2-Nitro- <i>p</i> -xylene)	241 2			1.132 <sup>15</sup>	213-5		139	140	138	171	139	1,2,4	
28	1-Ethyl-4-nitrobenzene	241		1.5458 <sup>19</sup>	1.124 <sup>25</sup>	216 214		94	151			37	2,4,6	<i>p</i> -Toluenesulfonamide deriv of amine, 104
29	1,3-Dimethyl-4-nitrobenzene (4-Nitro- <i>m</i> -xylene)	246	2		1.126 <sup>17,5</sup>	217		133 130	192	129-30	209	182	1,3,5	
30	1,2-Dimethyl-3-nitrobenzene (3-Nitro- <i>o</i> -xylene)	250	15			221-2		135	189		221	82	1,2	
31	2-Nitro- <i>p</i> -cymene	264		1.5309 <sup>20</sup>	1.0744 <sup>20</sup>	241		71	102			54	2,6	
32	2-Nitroanisole	265	10	1.5620 <sup>20</sup>	1.2540 <sup>20</sup>	225 230	5-6 17	85 88 169-70	60 84 134-6	89	200	68	2,4,6	
33	1- <i>tert</i> -Butyl-4-nitrobenzene	267												Dil HNO <sub>3</sub> → 4-nitrobenzoic acid, 240
34	2-Nitrophenetole	268	5-6	1.5425 <sup>20</sup>	1.1903 <sup>18</sup>	229		79	104	102		86	2,4	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS**  
b) Solids (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of all nitro groups					Nitration product		Miscellaneous	
				Amine		Acet-amide	Benz-amide	Benzene sulfonamide	Picrate	Melting point, °C	Position of nitro groups	
				Boiling point, °C	Melting point, °C							
1	2-Methyl-2-nitropropane ( <i>tert</i> -Nitrobutane)	25	6	127	46		134		198			Phenylthiourea deriv of amine, 120
2	4-Fluoro-1-nitrobenzene	25	7		184	6	152	185				N- <i>p</i> -Nitrobenzamide deriv of amine, 181
3	1-Nitro-2,3,6-trimethylbenzene	30			235		186					
4	3,4-Dimethyl-1-nitrobenzene (4-Nitro- <i>o</i> -xylene)	30		226	51, 47	8	99			82	1,2	N-Formyl deriv of amine, 52 N-Chloroacetyl, 109
5	2-Chloro-1-nitrobenzene	32		209			87	99	129	134		
6	2,4-Dichloro-1-nitrobenzene	33	258		63		143-6	115	128	106	50	52, 2,4
7	4-Bromo-3-nitrotoluene	33			136 <sup>16</sup>		121, 114					
8	3-Nitrophenetole (3-Ethoxy-1-nitrobenzene)	34		248			97	103		158		<i>p</i> -Toluenesulfonamide deriv of amine, 157
9	2-Nitrobiphenyl	37, 33				49-50	121	102				
10	6-Chloro-2-nitrotoluene	37	238			245	157-9	173				Oxid → 6-chloro-2-nitrobenzoic acid, 161
11	3-Iodo-1-nitrobenzene	38, 35				33, 27	119	157				<i>p</i> -Toluenesulfonamide deriv of amine, 128
12	3-Nitroanisole (3-Methoxy-1-nitrobenzene)	38	258	251			81			169	106	<i>p</i> -Toluenesulfonamide deriv of amine, 68
13	4-Chloro-2-nitrotoluene	38	240		21-2	139	40, 131					Oxid → 4-chloro-2-nitrobenzoic acid, 142
14	5-Nitroindane	40, yel	152 <sup>14</sup>	250	37-8	106	137					
15	2-Bromo-1-nitrobenzene	43		250	32	99	116					
16	4-Nitroindane	44	139 <sup>10</sup>	236	-3	126	136					
17	Nitromesitylene	44		232	3	216-7	204		189	91	86	<i>di</i> <i>p</i> -Toluenesulfonamide deriv of amine, 167
18	3-Chloro-1-nitrobenzene	45		230		72, 78	119	20	121	177		
19	2-Nitroazoxybenzene	49, yel				98	156					
20	2-Iodo-1-nitrobenzene	49				61, 58	109	139				
21	4-Nitrotoluene	52	234	200	45	147	158	120	182	70	183	2,4, 2,4,6
22	4-Chloro-1,3-dinitrobenzene (1-Chloro-2,4-dinitrobenzene)	52			91	142 ( <i>di</i> )	178 ( <i>di</i> )					NaOH → 2,4-Dinitrophenol, 114, Hydrazine → 2,4-dinitrophenylhydrazine, 199
23	4-Nitroanisole (4-Methoxy-1-nitrobenzene)	53		240	58	130, 127	154	95		89	2,4	
24	2,5-Dichloro-1-nitrobenzene	54			50, lgr	132	120			104	1,3	
25	4-Iodo-3-nitrotoluene	55				48, 38	151, 136					N-Formyl deriv of amine, 129, NaOH → 3-Nitro- <i>p</i> -cresol, 36-7
26	3-Bromo-1-nitrobenzene	56		251	18	87	120, 136	160	180	59	1,2	
27	1-Nitronaphthalene	57, 60			50	159	167	163, 181				
28	β-Nitrostyrene	58, yel	250-60d									Irradiation → dimer, 180-7
29	1-Methyl-2-nitro-naphthalene	58-9, yel			51	188-9	222					

\*Derivative data given in order m.p., crystal color, solvent from which crystallized.

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product		Miscellaneous	
				Amine		Acet-amide	Benz amide	Benzene sulfon-amide	Picrate	Melting point, °C	Position of nitro groups		
				Boiling point, °C	Melting point, °C								
30	<b>4-Nitrophenetole</b> (1-Ethoxy-4-nitrobenzene)	60 58		248 254	3 4	137	173	143	69	86	2,4		
31	<b>3,4-Dinitrotoluene</b>	61		265	89 90	4 mono 131 2, di 210	3-mono 193 4 di 263 4	178 9 (di)				Oxid → 3,4-dinitrobenzoic acid, 165, 161	
32	<b>3-Nitrobiphenyl</b>	61, 59			30	148							
33	<b>2,3-Dinitrotoluene</b>	63		255	63 4							(NH <sub>4</sub> ) <sub>2</sub> S → 2-Nitro- <i>m</i> -toluidine, 108, red HNO <sub>3</sub> → 2,3-Dinitrobenzoic acid, 201	
34	<b>1-Methyl-8-nitronaphthalene</b>	63 4			67 8	183-4	195 6						
35	<b>2,6-Dinitrotoluene</b>	66			105	202 3				80, 82	2,4,6	Oxid → 2,6 Dinitrobenzoic acid, 202 3	
36	<b>2,4,6-Trinitroanisole</b> (1-Methoxy-2,4,6-trinitrobenzene)	68										Naphthalene adduct, 69-70, NH <sub>3</sub> in al → picramide, 188	
37	<b>2,4-Dinitrotoluene</b>	70, 72		292	99	224 (di)	224 (di)	2 mono 138 di 191		80 82	2,4,6	Naphthalene adduct, 60, Oxid → 2,4-dinitrobenzoic acid 182-3 SnCl <sub>2</sub> + HCl → 4-Nitro- <i>o</i> -toluidine, 107 vel	
38	<b>2-Nitroazobenzene</b>	71, or - red			59	126	122						
39	<b>1-Methyl-4-nitronaphthalene</b>	71-2, pa yel			51 2	166 7	238 9					Dil HNO <sub>3</sub> → 4-nitro-1-naphthoic acid, 220-1	
40	<b>4-Bromo-1,3-dinitrobenzene</b> (1-Bromo-2,4-dinitrobenzene)	75, 72										NaOH → 2,4-Dinitrophenol, 114 Al NH <sub>3</sub> → 2,4-dinitroaniline, 180 188, yel Sn + HCl → 1,3-Diaminobenzene 63, Hydrazine → 2,4-dinitrophenylhydrazine, 199	
41	<b>3,5-Dimethyl-1-nitrobenzene</b>	75	273	220-1		144, 140						N-Formyl deriv of amine, 76 7	
42	<b>4,5-Dimethyl-1,3-dinitrobenzene</b>	76										(NH <sub>4</sub> ) <sub>2</sub> S → 1-Amino-3,4-dimethyl-5-nitrobenzene, 75 Acetyl deriv of this, 209-10, Benzoyl deriv of this, 223-4	
43	<b>5-Methyl-2-nitronaphthalene</b>	76 7			63 4	123-4	155-6						
44	<b>2-Nitronaphthalene</b>	78			112	132	162	102	195				
45	<b>2,4,6-Trinitrophenetole</b> (1-Ethoxy-2,4,6-trinitrobenzene)	78										Naphthalene adduct, 39, NH <sub>3</sub> in al → picramide, 188	
46	<b>2,4,6-Trinitrotoluene</b> (T N T)	80, 82										Naphthalene adduct, 97; CrO <sub>3</sub> /conc H <sub>2</sub> SO <sub>4</sub> → 2,4,6-trinitrobenzoic acid, 220	
47	<b>2-Methyl-1-nitronaphthalene</b>	81, yel			32, pet eth	188	180						
48	<b>4-Nitrophenanthrene</b>	81			105	190	224						
49	<b>3,4-Dimethyl-1,2-dinitrobenzene</b>	82										Reduct → 1-amino-3,4-dimethyl-2-nitrobenzene, 66, red, Acetyl deriv of this, 115 6, Benzoyl deriv of this, 199-200	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of all nitro groups					Nitration product		Miscellaneous	
				Amine		Acet-amide	Benz-amide	Benzene-sulfonamide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point, °C	Melting point, °C							
50	5-Methyl-1-nitronaphthalene	82 3		77 8	194 5	173 4						
51	Picryl chloride	83			208 (tri)		211					NaOH → Picric acid, 122 NH <sub>3</sub> → 2,4,6-Trinitroaniline, 188 192 5 NaOH → 4 Nitrophenol, 114
52	4-Chloro-1-nitrobenzene	84		72	179 172	192	122					
53	2,5-Dibromo-1,4-dinitrobenzene	127										2,5-Dibromo-p-nitroaniline, 175, yel
54	2,4-Dimethyl-1,3-dinitrobenzene	84 82		65 6, lgr	>260 (di)	232 (227) (di)						Reduct → 1 amino-2,4-dimethyl 3-nitrobenzene 84 N N Diformyl, 219 20
55	2,4-Dinitromesitylene	85								232	2,4,6	Reduct → 2-amino-4-nitro mesitylene, 75 Acetyl deriv of this, 191 Benzoyl deriv of this, 169 Benzenesulfonyl deriv of this, 163
56	2,5-Dibromo-1-nitrobenzene	85		51 2	171 2							
57	4-Bromo-1-nitronaphthalene	85		102	193							N-Formyl deriv of amine, 172
58	2,4-Dinitrophenetole 1,3-Dinitro-4-ethoxybenzene	86		67 8	193 (di)					78	2,4,6	Reduct → 2-nitro p-phenetidine, 40
59	4-Chloro-1-nitronaphthalene	87 85		98	186							
60	1,3-Dinitrobenzene	90		63	191 (di), 87 9 (mono)	240 (di), 125 (mono)	194	184				(NH <sub>3</sub> ) <sub>2</sub> S → 3 Nitroaniline, 114 Naphthalene adduct, 52
61	2,3-Dimethyl-1,4-dinitrobenzene	90		116	275 6 (di)							1-amino-2,3-dimethyl-4-nitrobenzene, 114
62	3,5-Dinitrotoluene	92	283 5		235 6 (di)							Oxid → 3,5-dinitro-benzoic acid 204 5 (NH <sub>3</sub> ) <sub>2</sub> S → 5-Nitro-m toluidine 98
63	3,6-Dimethyl-1,2-dinitrobenzene	93		75								Oxid → 2,3-dinitro-p-toluic acid, 249
64	4,6-Dimethyl-1,3-dinitrobenzene	93		105	1-mono 165 di 295	258 9 (di)				125	4,5,6	N,N'-Diformyl deriv of amine, 182 3
65	2,4'-Dinitrobiphenyl	93	363	45	202 (di)	276 8 (di)						
66	8-Chloro-1-nitronaphthalene	94		88 9 96	137							
67	2,4-Dinitroanisole 1,3-Dinitro-4-methoxybenzene	95										2,4 Dinitrophenol, 114, Naphthalene adduct, 50, Reduct → 2 amino-4-nitroanisole, 118, or -red, Acetyl deriv of this, 175 6
68	3-Nitroazobenzene	96, or		56 7	130-1							
69	4-Chloro-2-nitroanisole (5-Chloro-2-methoxy-1-nitrobenzene)	98		84	104	77 8						
70	2-Nitrophenanthrene	99, pa yel		85, pa yel	225	216						
71	8-Bromo-1-nitronaphthalene	99-100		90	138 9							CrO <sub>3</sub> → 2-Nitrophenanthraquinone, 260, golden yel

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Data for the corresponding amine obtained on reduction of all nitro groups					Nitration product		Miscellaneous	
				Amine		Acet-amide	Benz-amide	Benzene sulfon-amide	Picrate	Melting point, °C		
				Boiling point, °C	Melting point, °C							
72	3,5-Dimethyl-1,4-dinitrobenzene	101			104						Reduct → 1-amino-2,6-dimethyl-4-nitrobenzene, 158	
73	1,2-Dinitronaphthalene	102-3, br			98	234 (di)	291 (di)	1-mono 215				
74	5-Nitroacenaphthene	106, 101, yel			108	238	210, 199		190 200			
75	2,β-Dinitrostyrene	106-7, yel									Alk KMnO <sub>4</sub> → 2-nitrobenzoic acid, 146-8	
76	5-Chloro-1-nitronaphthalene	111			85	128						
77	3-Nitrodurene (3-Nitro-1,2,4,5-tetramethylbenzene)	112-3	261-2	75	207							
78	4-Nitrobiphenyl	114	302	53	171	230					N-Formyl deriv of amine, 172	
79	9-Nitrophenanthrene	116-7		137-8, 104	207-8	199			190		Picrate, 78-9	
80	1,2-Dinitrobenzene	118		102	185 (di)	301 (di)	185				(NH <sub>4</sub> )S → 2-Nitroaniline, 71, Hot aq NaOH → 2-nitrophenol, 45	
81	2,4'-Dinitrodiphenylmethane	118, yel		88-9	224-5 (210) (di)						Oxid → 2,4'-dinitrobenzophenone, 197	
82	4,5-Dimethyl-1,2-dinitrobenzene	118, 115		126	227-8 (di)						Reduct → 1-amino-4,5-dimethyl-2-nitrobenzene, 140	
84	3-Methyl-2-nitro-1,4-naphthoquinone	121-2, 125, yel									Dil KMnO <sub>4</sub> → phthalic acid, 200-6, Na <sub>2</sub> SO <sub>3</sub> Reduct or Fe + ac a → 2-amino-3-methyl-1,4-naphthoquinone, 167, red	
85	1,3,5-Trinitrobenzene	122									Anthracene adduct, 164, Naphthalene adduct, 156, Fluorene adduct, 105	
86	5-Bromo-1-nitronaphthalene	122		69, 63-4	215							
87	Picric acid	122										
88	2,5-Dimethyl-1,3-dinitrobenzene	123-4		102-3							Naphthalene adduct, 149, Fluorene adduct, 84, Anthracene adduct, 138, n-Butylammonium picrate, 151	
89	1-Nitro-2,4,6-tribromo-benzene	125		122	232	198					Reduct → 1-amino-2,5-dimethyl-3-nitrobenzene, 98	
90	4-Bromo-1-nitrobenzene	126		66	168	204					Formyl deriv of amine, 222	
91	2,2'-Dinitrobiphenyl	124, 128		81	mono 89-90, di 161	mono 158-60, di 190-1	134		180		NaOH → 4-Nitrophenol, 114	
92	1,4-Dinitronaphthalene	131-2, yel		120, yel	303-4 (di)	280 (di)					N,N'-Diformyl deriv of amine, 137	
93	3,5-Dimethyl-1,2-dinitrobenzene	132		78								
94	4-Nitroazobenzene	135, or	>360	126	144-6	211, 205					Reduct → 1-amino-2,4-dimethyl-6-nitrobenzene, 76	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product	Miscellaneous	
				Amine		Acet amide	Benz- amide	Benzene sulfon amide	Picrate	Melting point, °C	Position of nitro groups	
				Boiling point °C	Melting point °C							
95	<b>4-Chloro-1,5-dinitronaphthalene</b>	138										NaOH → 4,8-Dinitro-1-naphthol, 235 Sn + HCl → 1,5-Diaminonaphthalene, 190, PCl <sub>5</sub> → 1,4,5-Trichloronaphthalene, 131
96	<b>2-Nitroindene</b>	141										Zn + Ac a → 2-indanone oxime, 155
97	<b>4-Bromo-1,5-dinitronaphthalene</b>	143										NaOH → 4,8 Dinitro-1-naphthol, 235, HNO <sub>3</sub> , At 180 → 3-nitrophthalic acid, 218
98	<b>2,4-Dinitrostilbene</b>	143.5, yel		119.20, pa yel								
99	<b>1,3-Dinitronaphthalene</b>	144.5, yel		196	263.5 (di)							
100	<b>9-Nitroanthracene</b>	146, yel		145.50	273.4							
101	<b>4-Chloro-1,3-dinitronaphthalene</b>	146.7										CrO <sub>3</sub> Oxid. of amine → anthraquinone 273.286, yel
102	<b>2,5-Dimethyl-1,4-dinitrobenzene</b>	147, 142		150								Warm dil NaOH → 2,4 dinitro-1-naphthol, 140 Reduct → 1 amino 2,5 dimethyl-4-nitrobenzene, 144.5
103	<b>3-Nitroacenaphthene</b>	151-2, yel		81.2	192.3	209.10			221			
104	<b>4-Nitroazoxybenzene</b>	153, pa yel		138	151 172							
105	<b>3,8-Dinitroacenaphthene</b>	155-6, br-yel		167.8, yel								
106	<b>2-Nitrofluorene</b>	156, 154		129	191							
107	<b>3-Nitro-1,2-naphthoquinone</b>	156, red										SnCl <sub>2</sub> + HCl → 3-Amino 1,2-naphthohydroquinone, 164
108	<b>2,2'-Dinitrodiphenylmethane</b>	159		160								Dil HNO <sub>3</sub> → phthalic acid, 200.6 Oxid → 2,2'-dinitrobenzophenone, 188.9
109	<b>1,6-Dinitronaphthalene</b>	161.2, 166, pa yel		85.6, 77	257 (263) (di)	265 (di)						
110	<b>1,8-Dinitronaphthalene</b>	170, 173		66		311.2 (di)				218	1,3,8	
111	<b>4-Bromo-1,8-dinitronaphthalene</b>	170, yel										NaOH → 4,5-Dinitro-1-naphthol, 235, HNO <sub>3</sub> , At 180 → 3-nitrophthalic acid, 218, Al NH <sub>3</sub> → 4-amino-1,8-dinitronaphthalene, 246, red, Acetyl deriv of this, 245
112	<b>3-Nitrophenanthrene</b>	170-1		87.8	200.1	213 222						
113	<b>4-Iodo-1-nitrobenzene</b>	173		67.8	184							Aq NaOH → 4-nitrophenol, 114
114	<b>1,4-Dinitrobenzene</b>	173, 171		140, 147	304 (di), 162.3 (mono)	300 (di), 128 (mono)						
115	<b>3,3'-Dinitrodiphenylmethane</b>	175		53-4	193 (di)							Oxid → 3,3'-dinitrobenzophenone, 155

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Data for the corresponding amine obtained on reduction of all nitro groups					Nitration product		Miscellaneous	
				Amine		Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point °C	Position of nitro groups	
				Boiling point °C	Melting point °C							
116	4-Nitrophenanthrene-quinone	179 80, pa yel										CrO <sub>3</sub> → 6-Nitrodiphenic acid, 248 50, o-Phenylene diamine → quinoxaline deriv , 217-8, Monoxime, 169-70, Dioxime, 210, Monosemicarbazone, 210-11
117	4-Chloro-1,8-dinitronaphthalene	180, pa yel										NaOH → 4,5-Dinitro-1-naphthol, 235, PCl <sub>5</sub> → 1,4,5-Trichloronaphthalene, 131
118	9-Nitrofluorene	181 2		64 47		262						Oxid → 4,4'-dinitrobenzophenone, 189
119	4,4'-Dinitrodiphenyl-methane	183		93	236 7 (di)		260-1					Aniline → 2-anilino-3-nitro-1,4-naphthoquinone-4-anil, 250
120	4-Chloro-3-nitro-1,2-naphthoquinone	184, red										
121	2-Nitroanthraquinone	185		303-6		262	227-8					
122	2,2'-Dinitrostilbene	196, yel		176, golden yel		304 (di)			209			
123	4,6-Dinitrostyrene	199, yel										Acid K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> → 4-nitrobenzoic acid, 240
124	3,3'-Dinitrobiphenyl	200, yel		94		257 8 (di)						
125	2,5-Dinitrofluorene	207, yel		175		289 (di)						
126	2,2'-Dinitroazobenzene	209-10, 194-5 yel		134, red		271 (di), or						
127	1,5-Dinitronaphthalene	214 217		190		360 (di)				154	1,4,5	
128	4,4'-Dinitroazobenzene	222 3 216, or -red		250-1		212 (mono)						
129	2,5-Dinitrophenanthrenequinone	228, yel - red										Monoxime, 190 1, o-Phenylenediamine → quinoxaline deriv , 262-4
130	1-Nitroanthraquinone	230		252, 243		218	255					
131	2,7-Dinitronaphthalene	234, yel		166 159		261 (di)	267 (di)			210 (di)		
132	4,4'-Dinitrobiphenyl	237 240		128		317 (di), 199 (mono)	352 (di), 203-5 (mono) >300					
133	1,3-Dinitroanthraquinone	240, yel		290								
134	1,6-Dinitroanthraquinone	255-7, yel		262, red		295 (di)	275 (di)					
135	2-Nitrophenanthrene-quinone	258-60, yel			205-10, dk vlt							CrO <sub>3</sub> → 4-Nitrodiphenic acid, 217, Monoxime, 213, Mono-thiosemicarbazone, 234 5
136	3-Nitrophenanthrene-quinone	279-80, or										CrO <sub>3</sub> → 5-Nitrodiphenic acid, 268, Monoxime, 240, Dioxime, 200, Monosemicarbazone, 254, red
137	2,7-Dinitroanthraquinone (Fritzsche's reagent)	280, 262, pa yel		>330		>350 (di)	300 (di)					

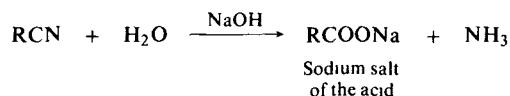
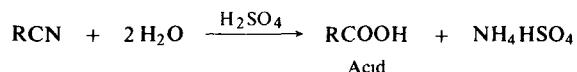
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XX. ORGANIC DERIVATIVES OF NITRO COMPOUNDS

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Boiling point °C	Data for the corresponding amine obtained on reduction of all nitro groups						Nitration product		Miscellaneous	
				Amine		Acet amide	Benz amide	Benzene sulfon amide	Picrate	Melting point °C	Position of nitro groups		
				Boiling point °C	Melting point °C								
138	<i>trans</i> -4,4'-Dinitrostilbene	288, yel		231, yel	353 ( <i>di</i> )	352 ( <i>di</i> )							
139	9,10-Dinitroanthracene	294 263 yel										Oxid → anthraquinone, 273 286 yel	
140	1,7-Dinitroanthra-quinone	295		290, red	283 ( <i>di</i> )	325 ( <i>di</i> )							
141	2,7-Dinitrophenantrene-quinone	301 3, pa yel		>360, dk vlt								CrO <sub>3</sub> → 4,4' Dinitrodiphenic acid, 257 8, Monoxime, 246-8, <i>o</i> -Phenylenediamine → quinoxaline deriv., 356, Fluorene adduct, 270, red -yel	
142	1,8-Dinitroanthra-quinone	311 2		262, red	284 ( <i>di</i> )	324 ( <i>di</i> )							
143	1,5-Dinitroanthra-quinone	384-5, pa yel		319, red	317 ( <i>di</i> )	>350 ( <i>di</i> )						Monoxime, 253	

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**EXPLANATIONS AND REFERENCES TO TABLE XXI***Hydrolysis to the corresponding acid \**

From the nitrile and 75% sulfuric acid, or 4 1 phosphoric acid-sulfuric acid

*For directions and examples see Cheronis, pp 618, 619, Linstead, p 65, Shriner, p 258, Vogel, p 410, Wild, p 250*

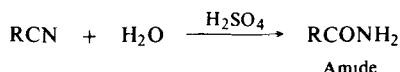
From the nitrile and potassium hydroxide in aqueous methanol, ethanol or benzyl alcohol

*See Linstead, p 65, Vogel, pp 410, 805, Wild, p 250, L Palfrey, S Sabetai and S Rovira, Compt Rend, 209, 483 (1939)*

From the nitrile and potassium hydroxide in ethylene glycol or glycerol

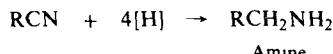
*See Cheronis, pp 618, 620, S Rovira and L Palfrey, Compt Rend, 211, 396 (1940)*

*NOTE* For the directions and examples for the preparation of the derivatives of the carboxylic acid formed on hydrolysis see the explanations and references to Tables XII, XIII and XIV, pp 186, 187, 188, 189

*Partial Hydrolysis to the corresponding amide \**

From the nitrile with sulfuric acid

*For directions and examples see Cheronis, pp 619, 620 Vogel, p 411*

*Reduction to the corresponding amine \**

From the nitrile and sodium in absolute ethanol

*For directions and examples see Cheronis, p 621, Shriner, p 259, Vogel, p 411, Wild, p 254, H B Cutter and M Taras, Ind Eng Chem, Anal Ed, 13, 830 (1941)*

From the nitrile and lithium aluminum hydride in ether

*See W G Brown in Organic Reactions, Vol 6 (Ed R Adams), John Wiley and Sons, New York, 1951, p 469, N G Gaylord, Reduction with Complex Metal Hydrides, Interscience, New York, 1956, pp 731-750*

*For summary of reduction methods see V Migrdichian, Organic Cyanogen Compounds, Reinhold Publishing Corp, New York, 1947, pp 151-172*

*NOTE* For directions and examples for the preparation of the derivatives of the amine formed on reduction of the nitrile see explanations and references to Table XVIII, pp 291, 292, 293, 294

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point, °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Anilide	S-Benzyl thiourea ronium chloride	Amine	Benz-amide	Ben-zene sulfon amide	Phenyl thiourea		
						B P, °C	M P °C				B P °C	Benz-amide	Ben-zene sulfon amide	Phenyl thiourea	Picrate	
1	Cyanoacetylene	42.5	5	1.38699 <sup>1</sup>	0.8159 <sup>1</sup>	144d, 83 4 "	18	61.2	87							HgNO <sub>3</sub> → Wh precipitate, Dimer, 64.5-5.0
2	Cyanoacetaldehyde	71.2			0.881 <sup>1</sup>						45 6 <sup>1</sup>					HNO <sub>3</sub> → Cyano-acetic acid, 66, 2,4-Di-nitro phenyl-hydrazone, 170.1, aq al., p-Nitro-phenyl-hydrazone, 153-4
3	Acrylonitrile	77.8		1.393 <sup>20</sup>	0.797 <sup>20</sup>	140	13	85	105							Gives solid polymer on addition of conc NaOMe sol
4	Fluoroacetonitrile	80				165	33	77								
5	Acetonitrile (Cyanomethane)	81-2		1.3442 <sup>20</sup>	0.7828 <sup>20</sup>	118		82	114	135	16.5	71	58	106, 135	165	
6	Trichloroacetonitrile	86, 83.4			1.439 <sup>12</sup>	196.7	58	141	95-7							
7	Methacrylonitrile ( $\alpha$ -Methylacrylonitrile)	90.1		1.399 <sup>25</sup>	0.7991 <sup>18</sup>	160	15.6	102.6								Gives solid polymer on heating with benzoyl peroxide
8	Propionitrile (Cyanoethane)	97, 103.5		1.3659 <sup>25</sup>	0.777 <sup>2</sup>	141		79	106	151	49	84	36	63	135	
9	Isobutyronitrile	104, 107.8			0.773	154.3	-47	129	109 10	143	69	57	53	82	150	
10	Trimethylacetone (tert-Butylcyanide)	106	15-6	1.3792		35	153.4	127-9								
11	2-Ethylacrylonitrile	111		1.4132		180		84, bz								
12	Dichloroacetonitrile	113			1.374 <sup>11.5</sup>	194	5.6	98								
13	$\alpha$ -Chloroisobutyronitrile	116		1.4045 <sup>25</sup> , 1.435 <sup>14</sup>	1.064 <sup>14</sup>	31		69.70								Me ester of acid, 143-4
14	n-Butyronitrile (1-Cyano-propane)	117		1.3812 <sup>24</sup>	0.796 <sup>1</sup>	162		116	96	146	77		65	151		

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous		
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Phenylthiourea		
						B P., °C	M P., °C									
15	<i>trans</i> -Crotomo-nitrile	119		1.4217		189	72	158	115		83.4			109.5-10.5	131.5-2.5	n <sub>D</sub> <sup>b</sup> of amine 1.4263, 1-Naphthylthiourea of amine, 129.30
16	Allylcyanide	119		1.4060 <sup>20</sup>	0.835 <sup>15</sup>	169, 163		73	58	75.7				123.7, 56.7	136.8 7.4	n <sub>D</sub> <sup>b</sup> of amine 1.4191, Al KOH → crotonic ac., 72 1-Naphthylthiourea of amine, 109.10
17	Methoxyaceto-nitrile	120		1.380 <sup>28</sup>	0.9373 <sup>28</sup>	203-4		96	58							
18	2-Hydroxyiso-butyronitrile (Acetone cyanohydrin)	120d	-19	1.3996 <sup>20</sup>	0.93 <sup>20</sup>		79	98	136							
19	3-Hydroxy-4-methoxybenzo-nitrile	124 131.5- 2.0					255.7									Acetate, 116, Acetate of acid, 206-7, Me ester of acid, 83.4, 66-7
20	2-Methylbutyro-nitrile	125.6		1.380 <sup>25</sup>	0.8061 <sup>9</sup>	177		112	110		95.5- 6.0					HCl salt of amine, 176, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 240
21	Chloroaceto-nitrile	127				1.193 <sup>20</sup>	189	63	120	137					142-3	Addition comp with AlCl <sub>3</sub> , 38, HCl salt of amine, 144
22	Isovaleronitrile	130				0.7884 <sup>20</sup>	176		136	113, 109 10	153	96		102	138	3-Nitrohydrogen phthalate of amine, 108
23	2,4-Pentadieno-nitrile	135-8		1.4880	0.8444		72	124								Me ester of acid, 50.2 <sup>20</sup>

\*Derivative data given in order m p, crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 1)(Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D$	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscel- laneous	
						Acid		Amide	Anilide	S-Benzyl thiou- ronium chloride	Amine	Benz- amide	Ben- zene sulfon amide	Phenyl thiourea	Picrate	
						B P., °C	M P., °C				B P., °C					
24	2-Chlorocrotononitrile	136				212, 85 95 <sup>10</sup>	99	212			128 31				191	Me ester of acid, 161, HCl salt of amine, 220
25	Ethoxyacetonitrile	136 7 <sup>53</sup>				156 7 <sup>16</sup>		80 2			108 <sup>750</sup>				121 3	$n_D^{\prime\prime}$ of amine 1 4108, Et ester of acid, b p 152
26	2-Methylcrotononitrile	138		1 4319	0 8313	198 5	64	75 6	77							<i>p</i> -Toluidide of acid, 70 5-1 5
27	2-Bromoiso- butyronitrile	139-40		1 445 <sup>25</sup>			48-9	148	83							
28	4-Pentenonitrile	140		1 4213 <sup>14</sup>	0 848 <sup>14</sup>	188-9		94		91 4, 98						$H_2PtCl_6$ salt of amine, 166, Thiourea deriv of amine, 43 5-4 0
29	Thiophene-2,3- dicarbonitrile (2,3-Dicyano- thiophene)	140					272-4	di 228								Di-Me ester of acid, 32 3
30	3,3-Dimethyl- acrylonitrile	140 2			0 8292 <sup>14</sup>	199	70	107-8, 65 6	126 7		105 8			105 0 5 5	139- 40d	HCl salt of amine, 193-4
31	Valeronitrile (1- Cyanobutane)	141		1 3991 <sup>15</sup>	0 8035 <sup>15</sup>	186		106	63		104			69	139	
32	2-Chlorobutyro- nitrile	143				189 <sup>627</sup>		75 5 6 0	74 5							142, 124
33	Diethylacetone- nitrile	145				190		107			71 5					168-9
34	2-Furanecarbo- nitrile ( $\alpha$ -Furo- nitrile, 2- Cyanofuran)	147		1 4798 <sup>20</sup>	1 0822 <sup>20</sup>		133 4	142	124	211	145 6					150
35	2-Methylacetone- acetonitrile	147, 145 6		1 4239 <sup>20</sup>	0 9794 <sup>20</sup>	224 <sup>34</sup>	73	138-40								Semicar- bazone, 153, <i>p</i> - Nitro- phenyl- hydra- zone, 147
36	Cyclobutane- carbonitrile (Cyanocyclo- butane)	150				195		152-3, 155	112 5- 3 0		110 <sup>753</sup>					HCl salt of amine, 235 5

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous		
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz amide	Ben zene sulfon amide	Phenyl thiourea			
						B P, °C	M P, °C										
37	2-Chloro-3-methylbutyronitrile	154-5			0.9922 <sup>12</sup>	210-2, 126 <sup>32</sup>	37 9							-	137-8, 160	Et ester of acid, b p 178-9, HCl salt of amine, 190d, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 193.5	
38	Isocapronitrile (4-Methyl-pentano nitrile)	155		1.4085 <sup>14</sup>	0.807 <sup>14</sup>	199 4	-33	119, 121	111-2		125				123.5		
39	2,2-Dimethyl-acetoacetonitrile	163.4			1.008 <sup>13</sup>	103 <sup>1</sup>		121								Oxime, 99-100	
40	2-Methyl-hexanonitrile	165		1.4070	0.7985	210		72	98		45- 54 <sup>15</sup>						
41	3-Methoxy-propionitrile	165		1.4032	0.9367 <sup>45</sup>	107 <sup>10</sup>		50			120						
42	n-Capronitrile (n-Hexano nitrile)	165	-80 31	1.4115 <sup>20</sup>	0.8093 <sup>20</sup>	205		100	95		130	40	96	77	126	HCl salt of amine 219	
43	(Ethylamino) acetonitrile (N-Ethylglycinonitrile)	166.7 81.3 <sup>29</sup>					180-2				126-9	di	117- 8		di 194.5	HCl salt, 141.2	
44	d,l-3-Methyl-hexanonitrile	171-2 <sup>74</sup>		1.4143	0.8109	212 3 <sup>55</sup>		99 100			148 9 <sup>756</sup>					p-Toluidide of acid, 73.4, n <sub>D</sub> <sup>20</sup> of amine, 0.7787	
45	Chlorofumaro-nitrile	172 64 <sup>10</sup>		1.49571 <sup>20</sup>	1.2499 <sup>20</sup>		191 2		di	186						Di-Me ester of acid, b p 113.4 <sup>1</sup>	
46	2-Acetoxy-propionitrile (O-Acetyl lactonitrile)	172.3				167 70 <sup>78</sup>	57 60									H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 207.9	
47	3-Ethoxypropionitrile	173		1.4068	0.9189 <sup>45</sup>	119 <sup>19</sup>		50			138					n <sub>D</sub> <sup>20</sup> of amine, 1.4242, D <sub>4</sub> <sup>20</sup> of amine, 0.8697	
48	3-Chlorobutyronitrile	176			1.0772 <sup>9</sup>	101 <sup>11</sup>	43 4.5		89 90						147	H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 212	
49	3-Chloropropionitrile	178			1.1443 <sup>18</sup>	204	41		119, w							p-Toluidide of acid, 121 HCl salt of amine, 146-8	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous		
						Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	Benz amide	Ben zene sulfon amide	Phenyl thiourea		
						B P °C	M P °C				B P °C	Benz amide	Ben zene sulfon amide	Phenyl thiourea		
50	<b>Indole-3-carbonitrile (3 Cyanindole)</b>	178 rose				208 10										
51	<b>S-Methyl-hexanonitrile</b>	178 80				216		104	75	149 5						
52	<b>Thiophene-3-carbonitrile (3 Cyanothiophene)</b>	179 203 5	1.5565 <sup>21</sup>	1.1956 <sup>20</sup>		138	180									
53	<i>d l</i> -4-Methyl-hexanonitrile	180	1.4144	0.8141	217 8		98				152 3 <sup>20</sup>				n <sub>D</sub> <sup>20</sup> of amine, 1.4238, D <sub>4</sub> <sup>20</sup> of amine, 0.7802	
54	<i>d l</i> -Lactonitrile (Acetaldehyde cyanohydrin)	182 4	1.4058 <sup>18</sup>	0.9877 <sup>20</sup>	122 <sup>1</sup>	18	79 75 6	59	153	161 2				142		
55	<b>Glycolonitrile (Formaldehyde cyanohydrin)</b>	183 sl d				80	120	97	141 146 7	171				160	Benzoyl deriv 195 6	
56	<b>Heptanonitrile</b>	183 187			0.8107 <sup>20</sup>	223		95	71	155			75	121		
57	<b>4-Cyanoheptane</b>	183-4				221 2		123 4		167					Et ester of acid b p 183 H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 211 d	
58	<b>Benzonitrile</b>	190			1.5289 <sup>20</sup>	1.0102 <sup>13</sup>		122	129	162	167	184 5				
59	<b>Thiophene-2-carbonitrile (2-Cyanothiophene)</b>	192	-13	1.5641 <sup>13</sup>	1.1800 <sup>15</sup>		129 30 192	180	140		167	58 <sup>5</sup>	105	88	156	HCl salt of amine, 193 4
60	<b>2-Octynonitrile</b>	194 6				148 91 <sup>9</sup>	f p 2 5	91	44							
61	<b>4-Chlorobutyronitrile</b>	196 7			1.162 <sup>10</sup>	196 <sup>22</sup>	16	88 9	60 70, bz - pet eth							

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscel- laneous	
						Acid		Amide	Anilide	S-Benzyl thiourea chloride	Amine	Benz- amide	Ben- zene sulfon- amide	Phenyl thiourea	Picrate	
						B P., °C	M P., °C				B P., °C					
62	Methyl cyano-acetate	200, 115 <sup>36</sup>	-22.5	1.4170 <sup>25</sup>	1.0962 <sup>25</sup>						58 <sup>15</sup>					Hydrolysis → malonic acid, 135, HCl salt of amine, 102.5, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 192, NH <sub>3</sub> , → Cyanoaceta-mide, 118
63	Dibenzyl acetonitrile	200 15					89	128.9	155							
64	2-Tolunitrile (2-Methylbenzonitrile)	205	-13	1.5272 <sup>25</sup>	0.9912 <sup>25</sup>	104	140	125	146	208	88					215 Acetyl deriv of amine, 69
65	2,3,3-Trimethyl-1-cyclopentene-1-carbonitrile (β-Campholytonitrile)	205, 225			0.9127 <sup>15</sup>	255-6	135	130, al	104, aq al	205.5 6.5						178 Et ester of acid, 222.5, HCl salt of amine, 175-6
66	Caprylonitrile (Octanonitrile)	206, 199		1.4224 <sup>15</sup>	0.8172 <sup>17</sup>	239	16	110	57	180						112
67	1,1-Dicyano-propane (Ethyl malononitrile)	206 <sup>75b</sup> , 90-1 <sup>20</sup>			0.9515 <sup>11</sup>		111.5	di 216								Dihydra-zide of acid, 168, al NH <sub>3</sub> → Cyano-acet-amide, 118
68	Ethyl cyano-acetate	207		1.4179 <sup>20</sup>	1.0564 <sup>27</sup>					198.9						
69	1,1-Dicyano-butane (Propyl malononitrile)	210 <sup>7-10</sup>			0.9224 <sup>18</sup>		96	di 184	di 198							
70	3-Tolunitrile (3-Methylbenzonitrile)	212	-23		1.0316 <sup>20</sup>		113, 110	95	126	140	207					198, 156 Acetyl deriv of amine, 150
71	Cyclohexyl-acetonitrile	215		1.457 <sup>18</sup>	0.913 <sup>18</sup>	244.6	33	171-2				188-9	79-81			155.6 HCl salt of amine, 252-3, n <sub>D</sub> <sup>20</sup> of amine, 1.4625
72	4,4-Dicyano-1-butene (Allyl malononitrile)	217-8	f p -12					105, eth								Di-Et ester of acid, b p 222.3, p-Nitro- benzyl ester of acid, 46, al

\*Derivative data given in order: m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1)(Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine B P, °C	Benzamide	Benzene sulfonamide	Phenyl thiourea	
						B P, °C	M P, °C								
73	3-Isopropylidene-1-methylcyclopentane-1-carbonitrile ( $\beta$ -Fencholenitrile)	217 9			0 9203 <sup>1</sup>	259	72 3	86 5 7 5						Me ester of acid, 97 9	
74	3-Hydroxypropionitrile	220			1 059 <sup>u</sup>	d	syrup				188		222	Sodium salt of acid, 143, $P_2O_5 \rightarrow$ acrylonitrile, b p 77	
75	1,1-Dicyano-3-methylbutane (Isobutyl malononitrile)	222						108, bz	di 195 6, al						
76	Nonanomitrile	224	-34 2	1 42522	0 8221 <sup>1</sup>	255	15	99	57		201	49	111	Acetyl deriv of amine, 34 5	
77	2-Phenylcrotononitrile	224 6		1 5555	1 013		136	98 9							
78	Ethylenecyanohydrin	229 7 220			1 059 <sup>u</sup>						107 8 <sup>ab</sup>		130, 222	Me ester of acid, b p 177 84 $H_2PtCl_6$ salt of amine, 199	
79	2-Phenylpropionitrile	232				265 8		97 5		210				182	Me ester of acid, 221, M p of amine, 85 $HCl$ salt of amine, 123 4, $H_2PtCl_6$ salt of amine, 229d
80	Phenylacetonitrile (Benzyl cyanide)	234		1 5211 <sup>2</sup>	1 0214 <sup>1</sup>		76 7	157	118	163	198	116	135	174, 167	
81	Phenoxyacetonitrile	239 40			1 09 <sup>1</sup>	285	98 9	101 5			228 9 <sup>c</sup>		167 8	$HCl$ salt of amine, 215, $HBr$ salt of amine, 192-3	

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Anilide	S-Benzyl thiourea benzyl chloride	Amine	B P., °C	Benz amide	Benzene sulfonamide	Phenyl thiourea	Picrate	
						B P. °C	M P., °C				B P., °C						
82	<b>4-Hydroxybutyronitrile</b>	240			1.029 <sup>a</sup>	204					205 6						Acid forms readily butyrolactone, b p 204, CrO <sub>3</sub> + butyrolactone → succinic acid, 186
83	(3-Tolyl)acetonitrile ( <i>m</i> -Xylylcyanide)	240 4			1.0022 <sup>22</sup>	120-3 <sup>b</sup>	61	141			214 5 <sup>44</sup>					176	Et ester of acid, b p 237 8, HCl salt of amine, 159
84	(4-Tolyl)acetonitrile ( <i>p</i> -Xylylcyanide)	242 3	18	1.5153 <sup>2</sup>	0.9922 <sup>22</sup>	265-7	94	185			214 5	95 6				155	Et ester of acid, b p 240, HCl salt of amine, 216-7
85	<b>4-Isopropylbenzonitrile</b>	243-4 <sup>44</sup>						117 8, al	153, 133			227 <sup>24</sup>					Et ester of acid, b p 263 4 HCl salt of amine, 239-40
86	(2-Tolyl)acetonitrile ( <i>o</i> -Xylylcyanide)	244			1.0156 <sup>22</sup>		88 9	161			215 5 7 0					177	HCl salt of amine, 227-8
87	<b>Decanonitrile</b>	245		1.4320 <sub>He</sub>	0.8294 <sub>1</sub>	269	31	100, 108	70								HCl salt of amine, 128
88	<b>3-Methyl-2-phenylbutyronitrile</b>	245 9 <sup>4</sup>		1.5038 <sup>2</sup>	0.967 <sup>1</sup>	159 60 <sup>14</sup>	61 2	111 2	132 3		155-6 <sup>24</sup>						HCl salt of diamine, 144 5
89	<b>1,2-Dicyanopropane</b> (Methyl succinonitrile)	252 4	12					115	dt 225	dt 200		172 3	154				Hydrazide of acid, 101-2, Phenylhydrazide of acid, 110
90	<b>1-Undecanonitrile</b> (1-Hendecanonitrile)	253 4				164 <sup>1</sup>	28 2 6	98 0 7	71								
91	<b>2-Phenylvaleronitrile</b>	254-5 <sup>20</sup>		1.5000	0.960 <sup>15</sup>	280	58	83 5			90 <sup>3</sup>						
92	<b>10-Undeceno-nitrile</b> (10-Hendeceno-nitrile)	257, 129-30 <sup>14</sup>		1.4442 <sup>20</sup>	0.8443 <sup>20</sup>	274	24 5	87									

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
 a) Liquids 1) (Listed in order of increasing atmospheric b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscellaneous	
						Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz amide	Benzene sulfon- amide	Phenyl thiourea	Picrate		
						B P °C	M P °C				B P °C						
93	3-Phenylpropionitrile	261			1.0014 <sup>18</sup>	280 <sup>754</sup>	48.5	105	98		221.5 <sup>74</sup>	57.8				152-3	HCl salt of amine, 218, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 233
94	2-Cyanobenzal chloride ( $\alpha,\alpha$ -Dichloro-o-tolunitrile)	261						155, bz	117								
95	N-Methylanilinonitrile (N-Cyano-N-methylaniline)	266	13					95 100	163								Picrate, 195
96	3-(2-Chlorophenyl)propionitrile	267.8		1.5390	1.1390 <sup>20</sup>			96.5, w	119 bz								Me ester of acid, 255 HCl salt of amine, 167
97	1,3-Dicyano-2-methylpropane (2-Methylglutaronitrile)	269.71				205 8 <sup>12</sup>	79	di	175.6			78 <sup>11</sup>					Di-p-toluidide of acid, 174.5, n <sub>D</sub> <sup>20</sup> of amine, 1.4585
98	O-Benzoyl lactonitrile (Lactonitrile benzoate)	269-70						112	124								Di-p-nitrobenzyl ester of acid, 119.5
99	3-Cyanobenzal chloride ( $\alpha,\alpha$ -Dichloro-m-tolunitrile)	272.5						132									
100	4-Cyanobenzal chloride ( $\alpha,\alpha$ -Dichloro-p-tolunitrile)	273.6 <sup>20</sup>						151.8									
101	Dodecanonitrile (Lauroonitrile)	276.7	4	1.43595	0.8273 <sup>15</sup>	225	44	110 102, aq. al.	78	141	247.9						M p of amine, 28.3 Acetyl deriv of amine, 68.5-9.5, bz. p-Toluene-sulfonyl deriv of amine, 73
102	1,3-Dicyanopropane (Glutaronitrile)	286		1.4365 <sup>23</sup>	0.9951 <sup>16</sup>			97	175	224		178.80 di 135	119	148	237		

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**a) Liquids 1)(Listed in order of increasing atmospheric b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub>	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>					Miscel laneous	
						Acid		Amide	Anilide	S-Benzyl thiouronium chloride	Amine B P °C	Benz amide B P °C	Benzene sulfon amide	Phenyl thiourea	Picrate	
						B P °C	M P °C									
103	4-Methoxyhydrocinnamono-nitrile (3-(4-Methoxy-phenyl)-propionitrile)	290-300					104-5	125			118 20 <sup>2</sup>					Me ester of acid, 38, M p of amine, 65 7-6 3, HCl salt of amine, 220 5 M p of amine, 42
104	1,4-Dicyanobutane (Adiponitrile)	295	0-1	1 4597 <sup>20</sup>	0 951 <sup>19</sup>		153, 150	220	239		204 5	di 155	di 154		220	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acid)\*

No	Name	Boiling point, °C	Melt-ing point, °C	$n_D$	Density g/ml	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscel-laneous	
						Acid		Amide	Anilide	S-Benzyl thiou-ronium chloride	Amine	Benz-amide	Benzene sulfonyl amide	Phenyl-thiourea	
						B P, °C	M P, °C				B P °C				
1	1,2,2,3-Tetramethyl-3-cyclopentene-1-acetonitrile (5-Methyl- $\alpha$ -campholenonitrile)	115 9 <sup>18</sup>		1.4722 <sup>18</sup>	0.9217 <sup>48</sup>	150-15 <sup>12</sup>	35 6 7 0	99 100, lgr							
2	1-Cyanocyclohexene	81 <sup>12</sup>		1.4818 <sup>25</sup>	0.954 <sup>25</sup>	238 40 <sup>638</sup>	38	127 8			55 7 <sup>12</sup>				181
3	2-Hydroxybutyronitrile (Propanal cyanohydrin)	102-3 <sup>23</sup>		1.4150	0.9621	225 60d	43 4		89 90		172 <sup>756</sup>	112 1 3 1			N,O-Di-p-nitrobenzoyl deriv of amine, 119 2, Acetate, 43, CS <sub>2</sub>
4	Hydnocarponitrile	155 6 <sup>2-3</sup>		1.4559 <sup>25</sup>	0.8580 <sup>25</sup>		59 60	108 5d							
5	$\alpha$ -Chloro- $\alpha$ -phenylacetonitrile	131-5 <sup>13</sup>					60 1	116							
6	Butyl cyanoacetate	115 <sup>15</sup>		1.4243 <sup>25</sup>	0.998 <sup>25</sup>		66	119-20	198-9						
7	3-Bromopropionitrile	69 <sup>7</sup>		1.4789 <sup>25</sup>			62								154, yel
8	2,4-Diphenylbutyronitrile	152 6 <sup>1</sup>				190 <sup>1</sup>	72 3, 76	96							Nitrile + alkali → acrylic acid, p-toluidine of which, 141
9	Thiophene-2-acetonitrile	115 20 <sup>22</sup>		1.5399 <sup>25</sup>	1.153 <sup>25</sup>		76, 63-4	146 7			72-4 <sup>3</sup>	61, bz - lgr		109 5 10	HCl salt of amine, 202 4, N-Acetyl deriv of amine, 45 5 6 5
10	<i>trans</i> -4-Chlorocrotononitrile	61-14 <sup>11</sup>		1.4705	1.1207	117 8 <sup>13</sup>	83	130-2							
11	2-Cyanopentanoic acid	125-30 <sup>2</sup>					96	di 184	di 198						Amide of nitrile, 124 5, Amide of nitrile, 88-9 M p of amine, 37
12	Azelaonitrile (1,7-Dicyanoheptane)	183 <sup>11</sup> , 160 <sup>3</sup>		1.4426 <sup>25</sup>			106	di 175	di 186-7		258-9				
13	3-Chloro-2-hydroxy-2-methylpropionitrile (Chloroacetone cyanohydrin)	110 <sup>22</sup>		1.4520	1.2027 <sup>15</sup>	230-5	110								
14	1,11-Dicyanoundecane (1,11-Dicyanohendecane)	189 90 <sup>7</sup>					111-2	di 175 6	mono 112 5-3 0, di 160 1						M p of amine, 58 HCl salt of amine, 254 5, al

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

a) Liquids 2) (b.p. at reduced pressure only) (Listed in order of increasing m.p. of the corresponding acid)\* (Continued)

No	Name	Boil ing point °C	Melt ing point °C	$n_D$	Density g/ml	Derivatives of the corresponding acid $RCN \rightarrow RCOOH$				Derivatives of the corresponding amine $RCN \rightarrow RCH_2NH_2$				Miscel- laneous		
						Acid		Amide	Anilide	S-Benzyl thiou- ronium chloride	Amine	Benz amide	Ben- zene sulfon amide	Phenyl thiourea	Picrate	
						B P °C	M P °C									
15	2-Cyanobutyric acid	153 <sup>15</sup>				111 5	212 4									Hydrazide of acid, 95 6, Amide, 113 Acid + conc $H_2SO_4$ → fluore- none, 83
16	2-Cyanobiphenyl	172 <sup>15</sup>				114	177									Di-p-tolu- uide of acid 165 M p of amine, 61 5 HCl salt of diamine, 309 10
17	1,12-Dicyanodode- cane ( $\alpha,\omega$ -Dode- cane dicyanide)	225 8 <sup>17</sup>				129, w	di 189	di 191, 170 1							Di-p-tolu- uide of acid 165 M p of amine, 61 5 HCl salt of diamine, 309 10	
18	1-Cyano-4-isoprop- enylcyclohexene	116 8 <sup>11</sup>		1 4978	0 9439	164- 5 <sup>10</sup>	132 3	164 5								M p of amine 60
19	Sebaconitrile (1,8- Dicyanoctane)	201 3 <sup>16</sup>				134	di 210	di 198							M p of amine 60	
20	Suberonitrile (1,6- Dicyanohexane)	180 <sup>12</sup>				141	di 216 7	di 186 7			240 1 225 6	di 121 2		di 180	M p of amine, 52	
21	3-Cyanoindene (Indene-3-car- bonitrile)	140 2 <sup>13</sup>				161, 156-7	180	158							Hydrazide of acid, 186	
22	Aminoacetonitrile (Glycinonitrile)	58 <sup>15</sup> , part d				262 d	65-6	62 (+2 $H_2O$ )			116 5	di 244	di 168	di 233 5	HCl salt, 165 5 6 5, M p of amine, 8 5	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point C	Boiling point C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	Benz amide	Ben zene sulfon amide	Picrate		
				B P C	M P °C				B P C					
1	2 Cyanodiphenyl-methane	19	313 4		117	163								
2	N Piperidinoacetonitrile	19	210		215 7				182 3				dt 225 220 1	Methiodide 192 3 HCl salt of acid 215 6 Phenylthiourea deriv of amine 92 3
3	3-Chloro-2-tolunitrile	19	107 <sup>28</sup>		159 154				58					
4	Tetradecanonitrile	19 20			54	103	82							M p of amine 37
5	Cinnamonnitrile	20	255 6		133	153	147	175						HCl salt of amine 235
6	Trichloroacrylonitrile	20			76	97 8 87	98							n <sub>D</sub> <sup>20</sup> 1 5100
7	DL-Mandelonitrile (Benzaldehyde cyano hydrin)	22			118 9	133 4	151 2 146		116 7	148 9			153 4 al	M p of amine 56 5 8 0 O Benzoyl deriv 63 4 3 Nitrobenzoyl deriv 83 4 p Toluidide of acid 174 HCl salt of amine 208 19 acet
8	Pentadecanonitrile	23	322		52	102	78		299					M p of amine 34 0 6 5 HCl salt of amine 199
9	2-Methoxybenzonitrile	24 5	255 6		00 1	129	131		226 8					N Acetyl deriv of amine 72 H PtCl <sub>6</sub> salt of amine 187
10	(2-Chlorophenyl) aceto-nitrile (2 Chlorobenzyl cyanide)	25	251		95	175 w	138 9		105 8				187 bz	
11	1,1-Dicyanoethane (Methylmalononitrile)	26			135 138 d	dt 217	dt 182						dt 252 d	Di p toluidide of acid 227 8 Di HCl salt of amine 201
12	2-Cyanopyridine (2 Pyridinecarbonitrile Picolonitrile)	26	212 5		136 7	106 7	76		95 8 <sup>2</sup>				159 60 d	HAuCl <sub>4</sub> salt 190 N Acetyl deriv of amine 59 60 bz pet eth Oxalate salt of amine 166 7 d
13	4-Tolunitrile (4 Methyl benzonitrile)	27 29	217		179 80	155 165	147 8		108	137			205 15d	D <sup>1</sup> 0 9805 M p of amine 13 N Acetyl deriv of amine 107 8
14	D-Mandelonitrile	28 9	170d		133	123								[α] <sub>D</sub> <sup>25</sup> +46 9 in bz
15	d l-(2-Bromophenyl) acetonitrile (2 Bromo benzyl cyanide)	29	242d		84	143 4								Et ester of acid b p 150 2 <sup>3</sup> M p of amine 163 4 HBr salt of amine 163 4
16	(4-Chlorophenyl) aceto-nitrile (4 Chlorobenzyl cyanide)	30	265 7		105	175	164 5		114 6 <sup>1</sup>				212	HCl salt of amine 218 0 8 5 p Toluene sulfonate deriv of amine 235
17	Malononitrile (Methylene cyanide)	30	218 9		135	170			136	140	96	250	n <sub>D</sub> <sup>20</sup> 1 4146 N Acetyl deriv of amine 126 D <sup>1</sup> 0 8224	
18	Hexadecanonitrile	31			63	106 7	90							
19	Maleonitrile (cis 1 2 Dicyanoethylene)	31			130	181	187	163 173	163 70	dt 178 5 9 5	dt 155 al	dt 250d		
20	2,2-Dicyanopropane (Dimethylmalononitrile)	31 2	169 5 subl		192 3 subl part d >130	dt 269	203 4	159 60	153	dt 152				Di Me ester of acid b p 177 <sup>54</sup> HCl salt of amine 256 7

\*Derivative data given in order m p crystal color solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Picrate		
				B P, °C	M P, °C									
21	<i>tert</i> -Butylacetonitrile (Neopentyl cyanide)	32-3	138	186 8		132	131							HCl salt of amine, 158 60, subl
22	1-Naphthylacetonitrile	33			131	154, 180								
23	4,4-Dicyanoheptane (Dipropylmalononitrile)	33 4 (anhyd) 49 50 (hydr)	223-4, 135- 40° <sup>2</sup>	161	di 214	di 168 0 5, me al			132 <sup>25</sup>	di 154				
24	Heptadecanonitrile	34			61	106			335-40	91				M p of amine, 49, N-Acetyl deriv of amine, 62
25	1-Naphthonitrile (1-Cyanonaphthalene)	34, 37	299		162	202			155 <sup>12</sup>		148	223		N-Acetyl deriv of amine, 134, Igr Methiodide deriv of amine, 213, al
26	2-Cyanopropionic acid	35	142 5 <sup>11</sup>		135, 120	di 206	di 182, 214							Amide, 105 81 Mono- <i>p</i> -toluidide of acid, 145 d Di- <i>p</i> -toluidide of acid, 227 8 245
27	4-Fluorobenzonitrile	35	189-90		183	154-5			183				203	
28	Coumarilonitrile (Coumarin-2-carbonitrile)	36		310-5, sl d	192-3, w	159	159							Et ester of acid, 27 Ph ester of acid, 101
29	Indole-3-acetonitrile	36 0 5	157 <sup>0 2</sup>		164-5 199	150 1	149 5 50			137 8		247d		Me ester of acid, 135 M p of amine, 116 7, 146 HCl salt of amine, 248 9 N-Acetyl deriv of amine, 77, pet eth
30	3-Bromobenzonitrile	38	225		155	155			244-5	135 6			205	
31	2-(N-Anilino)-butyronitrile	39			141	123, w	92, al							Et ester of acid, 26 b p 278
32	trans- <i>o</i> -Chlorocinnamono-nitrile	40			212, yel, al	168	176							Me ester of acid, b p 278 9
33	Octadecanonitrile	41 43			70	109	95 88							
34	3-Chlorobenzonitrile	41			158, 155	134	122-5		110-2 <sup>17</sup>	214			203	
35	2-Chlorobenzonitrile	43	232		141	142	118		103-4 <sup>11</sup>	116 7			217	N-Acetyl deriv of amine, 79-80
36	4-Chloromandelonitrile	43			119-22, 112-3	122-3								O-Benzoyl deriv, 57-8 Me ester of acid, 85 8, bz-pet eth
37	Nonadecanonitrile	43			69	109 5 8	95 5-6 5							Me ester of acid, 39 5 40
38	2-Bromo-4-tolunitrile	44			204									
39	3,3-Dicyanopentane (Diethylmalononitrile)	44-5	195, 92 <sup>24</sup>		125, w	mono 146, di 224								
40	4-Cyanobutyric acid	45			97 8	182-3	di 221 2			105				Amide, 69 70 Et ester of acid, b p 245 M p of amine, 157 8, HCl salt of amine, 92-4 HAuCl <sub>4</sub> salt of amine, 86 7, 106
41	5-Chloro-2-tolunitrile (4-Aminophenyl)acetonitrile (4-Aminobenzyl cyanide)	45-6			169									Me ester of acid, 30-1
42		46	312		199	161 2								N-Benzoyl deriv, 176-7, Picrate, 185
43	meso-2,3-Dimethyl-succinonitrile	46			209, 198 d	di 310-3	di 235							Di-Me ester of acid, b p 198 9

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thiomium chloride	Amine	Benzamide	Benzene sulfonamide		
				B.P., °C	M.P., °C								
44	3-Bromo-4-tolunitrile	47			140	137							
45	(4-Bromophenyl)acetonitrile (4-Bromobenzyl cyanide)	47			114, subl	192 4						Et ester of acid, 30, HCl salt of amine, 240-3	
46	N-Anilinoacetonitrile	48 lgr			127 8	136	113						
47	3-Cyanopropionic acid	48 50			235	185	mono 157, <i>di</i> 269 d	mono 148 5, <i>di</i> 230		79 80		Amide, 97, Me ester of acid, b p 215, Di- <i>p</i> -toluidide of acid, 256, M.p. of amine, 193 203 d, HCl salt of amine, 135-6, 95-6 Me ester of acid, 28	
48	3-Chloro-4-tolunitrile	48 50			200 2								
49	3,3-Diphenylacrylonitrile ( $\beta$ -Phenyl cinnamonnitrile)	49			162, 167		130 1						
50	3-Bromo-2-hydroxy benzonitrile	49-50			184	165							
51	4,4-Dicyanoheptane (Dipropylmalononitrile)	49-50 ( <i>hyd.</i> ), 33 4 ( <i>anh.</i> )			161	<i>di</i> 214	<i>di</i> 168 0-5, me al		132 <sup>25</sup>	<i>di</i> 154			
52	<i>trans</i> -2,3-Diphenyl-acrylonitrile	49-51	213 4 <sup>23</sup>		172	127, acet	141, al						
53	Eicosanonitrile	49 5			77, 75 2	108 9	92		196 2 <sup>40</sup>			M.p. of amine, 57 8, n <sub>D</sub> <sup>20</sup> of amine, 1 4341 HAuCl <sub>4</sub> salt of amine, 196-8, Di-HCl salt of amine, 224	
54	3-Cyanopyridine (Nicotinonitrile)	50	240-5		232	122	85, w, 132, bz - lgr		88-90 <sup>2</sup>	132	<i>tri</i> 206 8		
55	(4-Iodophenyl)acetonitrile (4-Iodobenzyl cyanide)	50-1			135							HCl salt of amine, 294 6 d	
56	4-Cyanodiphenyl-methane	51			157 8							Acid $\xrightarrow{\text{CrO}_3}$ 4-Benzoylbenzoic acid, 197-200, al	
57	2-(N-Anilino)-valeronitrile	51, pet eth			147-8, al	99, eth - pet eth							
58	2-Aminobenzonitrile (Anthranilonitrile)	51, yel., CS <sub>2</sub>	267 8 <sup>77</sup>		147	109-11	130-1			167		Et ester of acid, b p, 266-8, <i>p</i> -Toluidide of acid, 151 HCl salt of amine, 241, 208	
59	2-Bromobenzonitrile	53	253		150	155-6			118 <sup>9</sup>				
60	5-Cyanothiazole	53			218	186						Me ester of acid, 68-9, N-Acetyl deriv of amine, 159-60 N-Acetyl deriv, 248.	
61	3-Aminobenzonitrile	53-4, aq. al	288-90		174	78 9	114					Me ester of acid, 36-8, Et ester of acid, b p 294, Fe/AcOH $\rightarrow$ Benzonitrile, b p 190 + NH <sub>3</sub>	
62	2-Quinolinoacetonitrile	53 4	140 <sup>1</sup>		274-5				138-40 <sup>7</sup>		<i>di</i> 202	Picrate, 176-7 d, Me ester of acid, 72, lgr	
63	2-Iodobenzonitrile	55			162	184				154		HCl salt of amine, 248-50, N-Acetyl deriv of amine, 134-5	

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide	Picrate		
				B P °C	M P °C									
64	<b>2,4,6-Trimethylbenzonitrile</b>	55, bz	225 30		155, lgr	187 8			98 5 100 <sup>a</sup> 135 <sup>19</sup>	153 4				Me ester of acid, b p 241 2 <sup>18</sup>
65	<b>α-Aminobenzyl cyanide</b>	55			256	130 2, al				di 223 5				N-Acetyl deriv, 130-8, et ac pet eth N Benzoyl deriv, 151 Picrate, 160-1, yell NH <sub>4</sub> salt, 183
66	<b>Cyanoform (Tricyano methane)</b>	55 6 pet eth												
67	<b>Succinonitrile</b>	56 6	265 7		186 8	260	230	149	159	177		250 5		M p of amine, 27 N-Acetyl deriv of amine 137
68	<b>2-Iodo-4-tolunitrile (2-Iodo-4-methylbenzonitrile)</b>	57-8			205 6	167								
69	<b>2,6-Dinitrobenzonitrile</b>	58 (145)			202 3									Me ester of acid, 147 M p of amine, 88, HCl salt of amine, 185, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 193
70	<b>d,L-2,3-Dimethylsuccinonitrile</b>	58 9	.....		135	mono 148 9, di 244	di 222							Di-Me ester of acid, b p 200
71	<b>2-Chloro-4-tolunitrile</b>	61 2			155 6	182								
72	<b>4-Methoxybenzonitrile</b>	61 2	256 7		184 6	162 3	169	177 184 5	236 7					N-Acetyl deriv of amine, 96, H <sub>2</sub> PtCl <sub>6</sub> salt of amine, 210
73	<b>2,4-Dichlorobenzonitrile</b>	61-2			164 160	194			140 <sup>122</sup>					Me ester of acid, b p 132 <sup>15</sup> , n <sub>D</sub> <sup>25</sup> of amine 1 5738, HCl salt of amine, 281 2 4 3
74	<b>4-Methoxycinnamonnitrile</b>	64			170	186								Me ester of acid, 90 Et ester of acid, 49 50
75	<b>3,5-Dichlorobenzonitrile</b>	65, subl			188				254 <sup>6</sup>					Me ester of acid, 58, n <sub>D</sub> <sup>25</sup> of amine 1 5690, HCl salt of amine, 300
76	<b>cis-1,4-Dicyanocyclohexane</b>	65			168 9									Acid + conc HCl at 180 → trans isomer, 300 Di-p-toluidide of acid, 217
77	<b>Bromomalononitrile</b>	65 6			113d	181								M p of amine, 60 N Acetyl deriv of amine, 126, Methiodide deriv of amine, 168, al Amide, 119 20, Anilide, 198 9, Warming with benzaldehyde → α-cyanocinnamic ac, 180, M p of amine, 200, HCl salt of amine, 123
78	<b>2-Naphthonitrile (2-Cyanonaphthalene)</b>	66 62	305		184	192, 195								NH <sub>3</sub> → Diethylcyanoacetamide, 121
79	<b>Cyanoacetic acid</b>	66			135 6	170	226 7			120 w				
80	<b>2-Cyano-2-ethylbutyric acid (Diethylcyanoacetic acid)</b>	66 57	240 5, 164 <sup>a</sup>		125, w	mono 146, di 224								

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz-amide	Benzene sulfonamide	Picrate		
				B.P., °C	M.P., °C									
81	2,4-Diphenylglutaronitrile	66, 70 I	220-7 <sup>5</sup>		2 forms (a) 164-5, w, (b) 185-6, chl - pet eth								Di-HCl salt of amine, 319 20, iso-PrOH	
82	$\alpha$ -Chloro-3-tolunitrile	67, al	258 60		132, w	124						173	HCl salt of amine, 169, $H_2PtCl_6$ salt of amine, 219	
83	4-Chloro-2-tolunitrile	67			172	183								
84	1-Cyanoacenaphthene (Acenaphthene 1-carbonitrile)	68			161									
85	Phenylmalononitrile ( $\alpha$ -Cyanobenzyl cyanide)	69			152 3	233								
86	6-Nitro-2-tolunitrile	69 70			184	163								
87	(4-Hydroxyphenyl) acetonitrile (4-Hydroxybenzyl cyanide)	69 70, w	330		148-50	175						200	Me ester of acid, 66 Acetate, 49 50 M p of amine, 160 1	
88	5-Bromo-2-tolunitrile	70			187	180								
89	$\alpha$ -Bromo-2-tolunitrile (2-Cyanobenzyl bromide)	71 2	124 <sup>4</sup>		147								Me ester of acid, 32 0-5	
90	2,2-Diphenylglutaronitrile	71 2 5			195-7, 183	1-mono 142-4							Anhydride of acid, 134, Imide of acid, 158 9	
91	(2-Aminophenyl)acetonitrile (2-Aminobenzyl cyanide)	72			119	93							N-Acetyl deriv, 120, Benzamide, 175-9, N-Acetyl deriv of acid, 158	
92	3,4-Dichlorobenzonitrile	72			208 9	133						228	Me ester of acid, 46 5 7 5, HCl salt of amine 240 2	
93	1,2,2,3-Tetramethyl-cyclopentene-1-carbonitrile (Campholic nitrile)	73	217 9	255	106	80	91, al		210	98				
94	Dicyanodimethyl amine (Bis(cyanomethyl) amine)	75, 77			247 5, 225d	di 143	di 140 5		208	tri 166, chl		212d	N-Nitroso deriv, 43, N-Benzoyl deriv, 131 2, Tri-HCl salt of amine, 233	
95	Diphenylacetonitrile ( $\alpha$ -Phenylbenzyl cyanide)	75			148	168	180	145	134 <sup>2</sup>	144-5		211 2 d	M p of amine, 42 3 5, $HBr$ salt of amine, 205 7	
96	4-Cyano-N,N-dimethyl-aniline	75 6	318		242 5- 3 5	206	182-3						Me ester of acid, 102, HCl salt of amine, 212	
97	1-Cyanoisoquinoline	78, 93			161									
98	4-Cyanopyridine	78, 83			315	155-6								
99	$\alpha$ -Chloro-4-tolunitrile (4-Cyanobenzyl chloride)	78-80, al	263		203	173								
100	2,5-Diphenylvaleronitrile	79			80-1, lgr									
101	3-Cyanobenzaldehyde (3-Formylbenzonitrile)	79-81			175, w	190d							Oxime, 99-101, w, Semi-carbazone of acid, 265, Phenylhydrazone of acid, 164	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide		
				B P, °C	M P, °C								
102	6-Nitro-3-tolunitrile	80		219	151								
103	Benzoylacetonitrile	81		103-4d	113	108						155d	
104	6-Chloro-2-tolunitrile	82 3		102	167								
105	8-Cyanoquinoline	84, 50% al		187	171-3, w								
106	2-Nitro-3-tolunitrile	84		223	192								
107	2,3,4,5-Tetrachlorobenzonitrile	84		194 5	207 8, acet - al	197, al							
108	4-Cyanobiphenyl	85 6		228	223				195-200 <sup>15</sup>				
109	2-Naphthylacetonitrile	86, 81		142	200								
110	cis-2,3-Diphenylacrylonitrile	86	228 30 <sup>23</sup>	137-8	167-8, chl - lgr	179, chl - pet eth							
111	4-Aminobenzonitrile (4-Cyanoaniline)	86		188	182 9				268 70				
112	1-Cyano-2-phenylacrylonitrile (Benzalmalononitrile)	87		195-6d	di 189-90								
113	5-Bromo-2,4-dimethylbenzonitrile	88 90		180-1	197 5-8 5								
114	2-Cyanotriphenylmethane	89	270-85 <sup>20-30</sup>	162									
115	5-Cyanoquinoline	89 (anh), 70 (+1.5 H <sub>2</sub> O)		342									
116	2,6-Dimethylbenzonitrile	90 1		116	138 5-9 0, 120-5				96-8				
117	Phenylcyanoacetic acid	92											
118	2-(N-Anilino)-propionitrile	92, al		162, w	144	127, al							
119	2,4-Dibromobenzonitrile	92											
120	β-(2-Nitrophenyl)-acrylonitrile	92, w	194-6 <sup>7-8</sup>	174 cis 146-7, yel , trans 240 180-1	198 185								
121	5-Chloro-2-nitro-4-tolunitrile	93											
122	α-Bromo-3-tolunitrile (3-Cyanobenzyl bromide)	93, al		155-6									
123	4-Nitro-3-tolunitrile	93-4		134	176-7								
124	2-(N-Anilino)-isobutyronitrile	93-4, al		184-5, w	136	155, al							
125	2-Cyanoquinoline	94		157	133, 123								

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH					Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz-amide, B.P., °C	Benzene sulfonamide	Picrate		
				B.P., °C	M.P., °C									
126	<b>4-Cyanovaleric acid (2-Methylglutaromono-nitrile)</b>	95.6, w		205-8 <sup>12</sup>	79	di 175.6							Di-p-toluidide of acid, 74.5, H <sub>2</sub> PtCl <sub>6</sub> salt of amine 202.3	
127	<b>Fumaronitrile</b>	96			295, 300	266	313-4	178, 182						
128	<b>4-Chlorobenzonitrile</b>	96.94.6	223, 95 <sup>5</sup>	240	179, 170	194			217	140		210		
129	<b>9-Phenanthrylacetonitrile</b>	96.5-7.0		224.5	250-2									
130	<b>3,5-Dibromobenzonitrile</b>	97, subl		219.20	187								Me ester of acid, 63	
131	<b>2-Chloro-3-nitrobenzonitrile</b>	97-101, pa yel		185									Me ester of acid, 70 Et ester of acid, b.p. 314d	
132	<b>2-Hydroxybenzonitrile (2-Cyanophenol)</b>	98		211 <sup>20</sup>	159	133	135						D <sub>4</sub> <sup>99.6</sup> 1 1052, n <sub>D</sub> <sup>99.6</sup> 1.53716 O-Benzoyl deriv., 106, pet eth., M.p. of amine, 125, 129, H <sub>2</sub> PtCl <sub>6</sub> salt of amine 197d HI salt of amine, 184	
133	<b>4-Chloro-2-nitrobenzonitrile</b>	98			142	172							Me ester of acid, 42-3	
134	<b>4-Cyanotriphenylmethane</b>	100, me al			165, ac a		196, ac a							
135	<b>4-Chloro-3-nitrobenzonitrile</b>	100.1			181-2	156	131					210d	Me ester of acid, 83 HCl salt of amine, 227.8	
136	<b>3-Nitro-4-tolunitrile</b>	101			164.5	153								
137	<b>2-Cyano-3-phenylpropionic acid</b>	101.2, 75			120-1	225							Amide, 130, Di-Me ester of acid, 35.6	
138	<b>3-Cyanophenanthrene</b>	102			269	233.4, 227-8	216.7							
139	<b>2,3,3-Triphenylpropionitrile</b>	102, me al			222-3, al	213							Me ester of acid, 162, HCl salt of amine, 269.72	
140	<b>4-Cyanoquinoline</b>	102			253.4	181							Methiodide, 216, HAuCl <sub>4</sub> salt, 232 Di-HCl salt of amine, 255d Me ester of acid, 42	
141	<b>4-Bromo-1-naphthonitrile (1-Bromo-4-cyanonaphthalene)</b>	102-3			212, 220									
142	<b>4-Bromo-2,5-dimethylbenzonitrile</b>	103-4			171.5- 2.5	209-10								
143	<b>5-Nitro-3-tolunitrile</b>	104.5			174	164-5							Me ester of acid, 84.5	
144	<b>2,4-Dinitrobenzonitrile</b>	104.5, al			182-3	203-4							Me ester of acid, 70, Hydrazide of acid, 231.3	
145	<b>4-Nitro-2-tolunitrile</b>	105			179	173.4							Me ester of acid, 69	
146	<b>6-Chloro-3-nitrobenzonitrile</b>	105.6			165	178							Me ester of acid, 73.	
147	<b>5-Bromo-3-nitro-2-tolunitrile</b>	106-7			226	235								
148	<b>2-Nitro-4-tolunitrile</b>	107, pa yel			190	166								
149	<b>9-Cyanophenanthrene</b>	107, 111.0- 3			256.5- 7.0	232-3, 226	218			167		241	M.p. of amine, 108.5 HCl salt of amine, 294, N-Acetyl deriv. of amine, 182.3 Picrate of acid, 217-8	
150	<b>3-Cyanoquinoline</b>	108			275	198-9, 195								

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	B P., °C	Benzamide	Benzene sulfonamide	
				B P., °C	M P., °C								
151	2-Cyanophenanthrene	109			259 60	242 3	217 8						
152	3-Nitro-2-tolunitrile	109 10			151 2 pa yel	158							Me ester of acid, 50
153	2-Nitrobenzonitrile	110			146	174 6	155						HCl salt of amine, 248 50
154	4-Chloro-1-naphtho-nitrile (1-Chloro-4-cyanonaphthalene)	110			223-4, 210	235 6							
155	5-Cyanoacenaphthene (Acenaphthene-5-carbonitrile)	110 1			219, bz	198							
156	4-Bromobenzonitrile	112	235 7		251	189 90				250	143	221	M p. of amine, 20 N-Acetyl deriv. of amine 113
157	2,4,5-Trimethoxybenzonitrile	112 4. al		ca 300	144, bz - pet eth	184 5	154 5						Me ester of acid, 97 5 Et ester of acid, 72
158	4-Hydroxybenzonitrile (4-Cyanophenol)	113			213-4	162(+1 H <sub>2</sub> O)	196 7						M p. of amine, 109 (anh.), 95 (+1H <sub>2</sub> O) HCl salt of amine 195 HI salt of amine 198 200
159	2,3-Diphenylvaleronitrile (2 forms)	(a) 115 al	(a) 235 40 <sup>20</sup>	(b) 210 2 <sup>20</sup>	(a) 152-3 (b) 178 lgr								
160	α-Bromo-4-tolunitrile (4-Cyanobenzyl bromide)	115 6 al			229 30								Me ester of acid, 54 Et ester of acid, 35 6
161	(4-Nitrophenyl)acetonitrile (4-Nitrobenzyl cyanide)	116			153	197 8 191	198						
162	6-Bromo-3-nitrobenzonitrile	117			180	197 8	166						
163	(2-Hydroxyphenyl) acetonitrile (2-Hydroxybenzyl cyanide)	117 9	240 3		147 9	116 8, al		163					O-Benzoyl deriv. 50, lgr HCl salt of amine, 155
164	3-Nitrobenzonitrile	118			140	141-3							HCl salt of amine 224
165	4-Bromo-3-nitrobenzonitrile	120			203 4	156							
166	4-Cyanoazobenzene	120 1, br, bz			241, red, al	224-5, red							Me ester of acid, 123 4, or, me al, Et ester of acid, 86-7, red, al
167	Dipicolinonitrile (2,6-Dicyanopyridine)	123 113			252d 228	di 302							Di-Me ester of acid, 124 5 Di-Et ester of acid, 41 2
168	2-Cyanohexanoic acid	123-6 5			101	di 200	di 193						
169	Dibromomalononitrile (Bromodicyanomethane)	124			147d 136-7d	di 200, 206d							Di-Me ester, 67
170	1-Cyanoanthracene	126			245, yel, al	260							Me ester of acid, 108, yel, ac a
171	2,2,3-Triphenylpropionitrile	126			162 132	111, al							Me ester of acid, 127
172	1-Cyanophenanthrene	128			232-3	284	245						

\*Derivative data given in order m p., crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point, °C	Boiling point, °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thionium chloride	Amine	B.P., °C	Benzamide	Benzene sulfonamide	
				B.P., °C	M.P., °C								
173	2,3-Diphenylbutyronitrile (2 forms)	(a) 129-30 (b) 188 92 <sup>13</sup>	210 2 <sup>16</sup>	133-4 186	173 4 193								Et ester of acid, 91 2
174	5-Bromo-3-nitro-4-tolunitrile	130		206	171								
175	2,5-Dichlorobenzonitrile	130	301	154	155					135 <sup>9</sup>		230	HCl salt of amine, 151 2, n <sub>D</sub> <sup>20</sup> of amine 1 5885
176	2,5-Dibromobenzonitrile	132		157									Me ester of acid 40 1, p-Nitrophenyl ester of acid, 183 4
177	5-Bromo-2-nitro-4-tolunitrile	132		203 200	191								Et ester of acid, 61
178	2-Hydroxy-3-nitrobenzonitrile (2 Cyano-6-nitrophenoxy)	132 3		148	155 145 6								Me ester of acid, 132 (94) al
179	4-Nitro-1-naphthonitrile (1-Cyano-4-nitronaphthalene)	133		220 1	218								Me ester of acid 107 8
180	4-Acetamidobenzonitrile	133, w		185, ac a	177, al	167 8, al							N-Methylamide of acid, 172, al
181	6-Cyanoquinoline	135, bz - lgr		291 2	174, bz - al					158-9 <sup>2</sup>			Me ester of acid, 90 HCl salt of amine, 239, n <sub>D</sub> <sup>20</sup> of amine 1 6390
182	Apiolonitrile (2,5-Dimethoxy-3,4-methylenedioxybenzonitrile)	135 5, al		175, w									Me ester of acid, 71 2, al
183	1-Nitro-2-naphthonitrile (2-Cyano-1-nitronaphthalene)	138		239									Hot aq Ba(OH) <sub>2</sub> → 1-hydroxy-2-naphthoic acid, 191 2 al
184	3,5-Dichloro-2-hydroxybenzonitrile	139		219 5 223	209								Me ester of acid 147
185	trans-1,4-Dicyanocyclohexane	140		300									Di-Me ester of acid, 71
186	3,3,3-Triphenylpropionitrile	140, al	ca 365	177	198								Me ester of acid, 120-1 5
187	4-Cyano-2-phenylquinoline (2-Phenyl-4-quinolinonitrile)	140, al		218	196	198							M.p. of amine >287 HCl salt of amine 232 5
188	Phthalonitrile (o-Dicyanobenzene)	141		200 6	dt 219	dt 253	dt 151, 157		dt 184		170		N,N-Diacetyl deriv. of diamine, 146 Et ester of acid, 121 lgr
189	8-Nitro-2-naphthonitrile (2-Cyano-8-nitronaphthalene)	143		295, 288	218								Me ester of acid 81 Et ester of acid 45
190	5-Chloro-2-naphthonitrile (5-Chloro-2-cyanonaphthalene)	144		270	186-7	202							Et ester of acid, 42
191	5-Chloro-1-naphthonitrile (5-Chloro-1-cyanonaphthalene)	145		245, 241 2	239								Acetate, 93 Me ester of acid, 122
192	3,5-Dichloro-4-hydroxybenzonitrile	146		269, 265									HCl salt of amine, 235-40
193	4-Nitrobenzonitrile	147, 149		241	200	211, 204						184 5	Et ester of acid, 48 9
194	5-Bromo-1-naphthonitrile (1-Bromo-5-cyanonaphthalene)	147		261, 256	241								

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benzamide	Benzene sulfonamide		
				B P. °C	M P. °C								
195	<b>5-Iodo-2-naphthonitrile</b> (2-Cyano 5 iodo-naphthalene)	148.5		264, al	196	203							M p of amine, 120 HCl salt of amine, 251 3 N-Acetyl deriv amine 135-6
196	<b>3-Cyano-3-phenylpropionic acid</b>	150	215.8 <sup>10</sup>		166-7								Di-Me ester of acid, 55, al, Imide of acid, 88-90. M p of amine, 209 HCl salt of amine, 203, N-Acetyl deriv of amine, 65
197	<b>2-Cyano-2-propylvaleramide</b> (Dipropyl-cyanoacetamide)	153		161	di 214	di 168 8.5, me al							
198	<b>2,6-Dibromobenzonitrile</b>	155, subl	308.9	157	208.5								Me ester of acid, 83 Hydrazide of acid, 204
199	<b>3-Chloro-4-hydroxybenzonitrile</b>	155		169-70, w, 164.5	180-2								Me ester of acid, 106.7, Et ester of acid, 77-8
200	<b>5-Chloro-2,4-dinitrobenzonitrile</b>	156		182.3	212	226							
201	<b>4-Benzamidobenzonitrile</b> (N-Benzoylantranilonitrile)	156		181	218.9	279							Me ester of acid, 100 Et ester of acid 98
202	<b>5-Bromo-2-hydroxybenzonitrile</b>	158-9		165	232	222							O-Acetyl deriv of acid, 60
203	<i>d l</i> -2,3-Diphenylsuccinonitrile	160		183 (+1 H <sub>2</sub> O)		mono 173.5, al							
204	<b>Isophthalonitrile</b> ( <i>m</i> -Dicyanobenzene)	161.5 2.0		345.7	di 280								
205	<b>2-Hydroxy-4-nitrobenzonitrile</b> (2-Cyano-5-nitrophenol)	160.1, yel		235, 226, w	192.4								Benzoate, 122, yel, al, Et ester of acid, 84-5
206	<i>d l</i> -4-Cyano-3,4-diphenylbutyric acid ( <i>d l</i> -2,3-Diphenylglutaromonomonitrile)	162.3, bz		208-10 (cor.), aq ac a	mono 200-5 d, al	mono 201-2, 50% al							Et ester, 99-100, al, Imide of acid, 225-9, aq al
207	<i>d</i> -3-Carboxy-2,2,3-trimethylcyclopentyl-acetonitrile	164			233, PhNO <sub>2</sub>								[α] <sub>D</sub> +64.41, Me ester, 77, Et ester, 58
208	<b>5-Chloro-2-hydroxybenzonitrile</b> (4-Chloro-2-cyanophenol)	165.7		172, 167.5	226								Me ester of acid, 84
209	<b>2,3-Diphenylcinnamonnitrile</b> (Cyanotriphenylethylene)	166.7, 162.3		213	223								
210	<b>1,7-Dicyanonaphthalene</b>	167, al		294-6									
211	<b>4,4'-Dicyanodiphenylmethane</b>	169		334, 290									Di-Me ester of acid, 81.2
212	<b>2,2'-Diphenic acid mononitrile</b> (2-Carboxy-2'-cyanobiphenyl)	170.2, bz		233.5	mono 193, di 212	mono 181-3							Di-Me ester of acid, 74, Me ester, 110, Et ester, 91-2
213	<b>5-Nitro-2-naphthonitrile</b> (2-Cyano-5-nitronaphthalene)	172.3		295, yel	261-3, br -yel								Me ester of acid, 112, yel

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXI. ORGANIC DERIVATIVES OF NITRILES**  
**b) Solids (Listed in order of increasing m.p.)\*** (Continued)

No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN + RCOOH				Derivatives of the corresponding amine RCN + RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S-Benzyl thiuronium chloride	Amine	Benz amide	Benzene sulfonamide		
				B P °C	M P °C								
214	9-Cyanoanthracene (9-Anthracencarbonitrile)	175, 170-2			207, pale yel							Me ester of acid, 111, M p of amine, 90	
215	2,3-Dicyanopyridine	175 6			228 9	2-mono 168 5d, di 165							
216	1,3-Dicyanonaphthalene	179, ac a			267 8								
217	3-Cyanocoumarin	182			187 d	236	250						
218	2-Cyanocinnamic acid	183, al			195 6d	di 189-90							
219	2-Cyanobenzoic acid	187, 192			200 6	di 219	di 253	di 151, 157	di 184		170		
220	1,2-Dicyanonaphthalene	190, bz			175	di 265							
221	2-Hydroxy-5-nitrobenzonitrile (2-Cyano-4-nitrophenol)	194-6, yel , w			229-30, 227	225, al						p-Nitrobenzoyl ester of acid, 115	
222	Tetracyanoethylene	198 200, subl	223									n <sub>D</sub> <sup>25</sup> 1.560 D <sup>2</sup> 1.348 N,N Dimethylaniline → N,N-dimethyl 4-tricyanovinylaniline 173 5, ac a Anthra cene → adduct, 268 70, acet	
223	5-Nitro-1-naphthonitrile (1-Cyano-5-nitronaphthalene)	205			241 2, 239	235 6						Me ester of acid, 109-10, Et ester of acid, 93	
224	1,4-Dicyanonaphthalene	208, ac a			309, 288							Di-Me ester of acid, 67 Di-Et ester of acid, 64	
225	1,6-Dicyanonaphthalene	208-10			310							Di-Me ester of acid, 99	
226	1,5-Dicyanonaphthalene	211, 266-7			310, ac a							Di-Me ester of acid, 114 5 Di-Et ester of acid, 123-4	
227	3-Cyanobenzoic acid	217			345	280						NH <sub>3</sub> → 3-Cyanobenzamide, >300 Me ester, 65, Et ester, 56	
228	4-Cyanobenzoic acid	219			ca 300, subl	di >250	di 334-7				232 d	NH <sub>3</sub> → 4-Cyanobenzamide, 223, Me ester, 62, Et ester, 54	
229	Terephthalonitrile ( <i>p</i> -Dicyanobenzene)	222			ca 300, subl	di >250	di 334-7				232 d	N,N'-Diacetyl deriv of diamine, 225	
230	1,8-Dicyanonaphthalene	232			260	di 250-82d						Di-Me ester of acid, 102 3, Di-Et ester of acid, 58 60	
231	4,4'-Dicyanobiphenyl	233 4										Di-Me ester of acid, 214 224, Di-Et ester of acid, 112, Heating acid with lime → biphenyl, 71	
232	<i>t</i> -2,3-Diphenylsuccinonitrile	239 40			176-7, 190, w							Imide of acid, 196 8, ac a	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXI. ORGANIC DERIVATIVES OF NITRILES

b) Solids (Listed in order of increasing m.p.)\* (Continued)

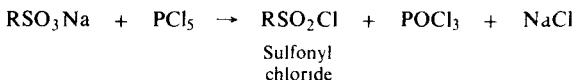
No	Name	Melting point °C	Boiling point °C	Derivatives of the corresponding acid RCN → RCOOH				Derivatives of the corresponding amine RCN → RCH <sub>2</sub> NH <sub>2</sub>				Miscellaneous	
				Acid		Amide	Anilide	S Benzyl thiuronium chloride	Amine	Benz amide	Ben zene sulfon amide	Picrate	
				B P °C	M P °C				B P °C				
233	1-Cyano-9,10-anthra-quinone	247, yel, ac a		293-4, pa yel, ac a	280, pa yel, al	288-9, pa yel, PhNO <sub>2</sub>							Me ester of acid, 189, yel, Et ester of acid, 169, yel
234	2,3-Dicyanonaphthalene	251, al		239-41									Imide of diacid, 275
235	2,7-Dicyanonaphthalene	267-8, ac a		>320	di	297-8							Di-Me ester of acid 135-6
236	2,6-Dicyanonaphthalene	293, al		>300 d	di	>320							Di-Me ester of acid, 191

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLES XXII AND XXIII

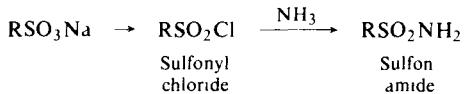
The main derivatives of the sulfonic acids are obtained by converting them to the corresponding sulfonyl chlorides. Hence sulfonic acids and sulfonyl chlorides are often identified through the same derivatives.

### *Sulfonyl chloride*



From the sulfonic acid or its sodium or potassium salt with phosphorus pentachloride without solvent  
*For directions and examples see* Cheronis, p 638, Linstead, p 89, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

### *Sulfonamide \**

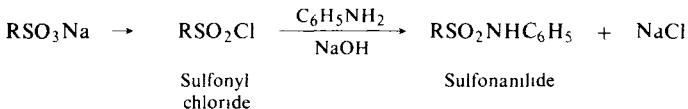


From the sulfonyl chloride (prepared from the acid or its salt) and concentrated aqueous ammonia solution  
*For directions and examples see* Linstead, p 49, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

From the sulfonyl chloride, aqueous ammonia and ammonium carbonate

*See* Cheronis, p 639

### *Sulfonanilide \**



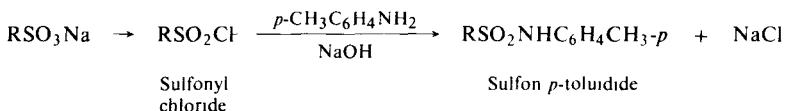
From the sulfonyl chloride (prepared from the acid), aniline, and sodium hydroxide

*For directions and examples see* Linstead, p 89, Wild, p 161

From the sulfonyl chloride and aniline

*See* Vogel, p 553

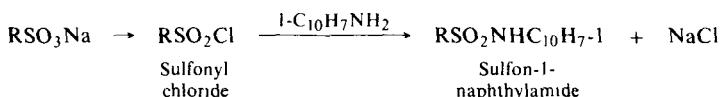
### *Sulfon-p-toluidide \**



From the sulfonyl chloride, *p*-toluidine and aqueous sodium hydroxide

*For directions and examples see* Vogel, p 553

### *Sulfon-1-naphthylamide \**



From the sulfonyl chloride (prepared from the acid) and 1-naphthylamine in benzene

*For directions and examples see* Cheronis, p 639

### *S-Benzylthiuronium salt \**



From the sodium, potassium or ammonium salt of the sulfonic acid and S-benzylthiuronium chloride in water

*For directions and examples see* Cheronis, pp 635, 636, Linstead, pp 15, 89, Shriner, p 269, Wild, pp 149, 159, E Chambers and G. W Watt, *J Org Chem*, **6**, 376 (1941), E Campagne and C M Suter, *J Amer Chem Soc*, **64**, 3040 (1942), S Veibel, *J Amer Chem Soc*, **67**, 1867 (1945)

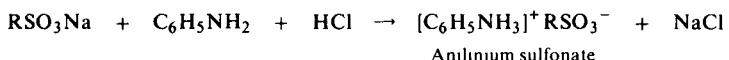
\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE XXII AND XXIII (Continued)

From sodium or potassium sulfonate and S-benzylthiuronium chloride in alcohol  
*See J J Donleavy, J Amer Chem Soc, 58, 1004 (1936)*

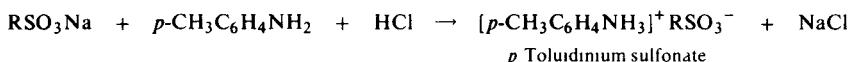
### *Anilinium salt \**



From the sodium or potassium salt of the acid, aniline and hydrochloric acid in water

*For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942)*

### *p-Toluidinium salt \**



From the sulfonic acid and *p*-toluidine

*For directions and examples see Shriner, p 269*

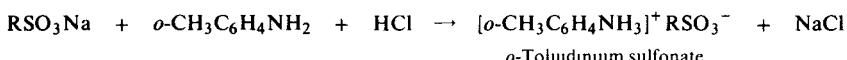
From the sodium, potassium or ammonium salt with *p*-toluidine or *p*-toluidine hydrochloride in water

*See Shriner, p 269, Vogel, p 555, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942), A D Barton and L Young, J Amer Chem Soc, 65, 294 (1943)*

From the sodium, potassium, ferric or barium salt (after boiling with sulfuric acid) with *p*-toluidine and hydrochloric acid

*See Cheronis, p 637, Fieser, J Amer Chem Soc, 51, 2460 (1929)*

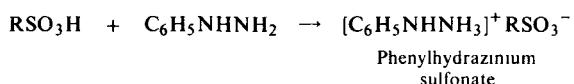
### *o-Toluidinium salt \**



From the sodium or the potassium salt of the sulfonic acid with *o*-toluidine and hydrochloric acid in water

*For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942)*

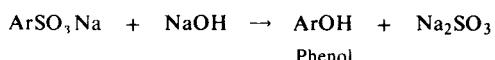
### *Phenylhydrazinium salt \**



From the sulfonic acid with phenylhydrazine in water-alcohol

*For directions and examples see Wild, p 159, P H Latimer and R W Bost, J Amer Chem Soc, 59, 2500 (1937)*

### *Phenols by KOH fusion*



By fusion of the sodium arylsulfonate and sodium hydroxide in a nickel crucible

*For directions and examples see Vogel, p 552*

By fusion of the sodium arylsulfonate, potassium hydroxide and zinc dust

*See Linstead, p 89*

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
a) Listed in order of increasing m.p. of the corresponding sulfonamide\*

No	Name	Melting point °C	S-Benzyl thiorium salt	p-Toluidinium salt	Anilinium salt	o Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous	
1	Propane-1-sulfonic acid		67-8			b p 180	52, eth		84	Phenylhydrazine salt, 204	5	
2	Ethane sulfonic acid	115				b p 171	60, eth		66	Phenylhydrazine salt, 182	8	
3	Propane-2-sulfonic acid	-37				b p 79 <sup>18</sup>	60, eth - pet eth		134	B p 159 <sup>14</sup> , D <sub>4</sub> <sup>25</sup> = 11877, n <sub>D</sub> <sup>20</sup> = 1.4332, m-T uide, 109		
4	Heptane-1-sulfonic acid					16	75			Phenylhydrazine salt, 100	0.5	
5	2,4,5-Trimethoxybenzene sulfonic acid					130	76	170				
6	Methane sulfonic acid	20				b p 60 <sup>21</sup>	90	100	125-6	Phenylhydrazine salt, 193	5-4d	
7	Hexadecane-1-sulfonic acid (Cetyl sulfonic acid)	54				54	97					
8	10-Bromocamphor-3-sulfonic acid					97	100 2					
9	Benzyl sulfonic acid			113, al	102	83	92 3, eth , bz	105, w , al	102, al	166 (146), yel , al	Diethylamide, 29, Ethylamide, 65-6, Hydrazide, 131-2, Methylamide, 109-10, Phenylhydrazine salt, 173	
10	3-Toluene sulfonic acid (3-Methylbenzene sulfonic acid)	oil	106		108	12	108, al	96, al				
11	3-Hydroxynaphthalene-2-sulfonic acid				241 2		112	110				
12	Pyridine-3-sulfonic acid	357					Hydrochloride, 141-4 d	110 1	145	Diethylamide, 49-50, Hydrazide, 94, me al		
13	2,6-Dimethylbenzene sulfonic acid	98				39		113 (96)				
14	2-(N-Methylamino)benzene sulfonic acid	182 d						114 5 5 5		N-4-Toluene sulfonyl, 193		
15	Indane-4-sulfonic acid					53 3 5	118-9, w					
16	2-Phenylethane-1-sulfonic acid	91				33	122		77			
17	4-Formylbenzene sulfonic acid (Benzaldehyde-4-sulfonic acid)						122-4			Amide oxime, 185, Dimethylamide, 134-7, Di-O-acetate, 86-7 5, Chloride diacetate, 111-3		
18	2-Methylnaphthalene-1-sulfonic acid					83-5	124					
19	4-Fluorobenzene sulfonic acid					36 (30)	125 (123), w					
20	4-Chloro-3-methylbenzene sulfonic acid					65	128	92		Sulfonyl bromide, 67 5		
21	3-Chloro-4-methoxybenzene sulfonic acid					82	131					
22	3-Ethoxybenzene sulfonic acid					38	131					
23	D-Camphor-10-sulfonic acid	193				67	132		121			
24	2-Fluoronaphthalene-6-sulfonic acid	105				97, chl	133		129			
25	DL-Camphor-8-sulfonic acid	56 8				106	133-5, w					
26	3-Methyl-4-nitrobenzene sulfonic acid					50	133 5				.	
27	3-Chloro-4-methylbenzene sulfonic acid					38	134	96			.	
28	3,5-Dimethylbenzene sulfonic acid		121-2, al			94 (90), bz	135, al	119, al			.	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
**a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)**

No	Name	Melting point °C	S-Benzyl thiuronium salt	p-Tolu-dinium salt	Anilinium salt	o-Tolu-dinium salt	Sulfonyl chloride	Sulfonamide	Sulfonamide	Sulfoni-naphthalimide	Miscellaneous
29	<b>Indane-5-sulfonic acid</b>	92				46-7, eth	135 5 6, al	129, al			
30	<b>D-Camphor-8-sulfonic acid</b>					138, ([α] <sub>D</sub> <sup>b</sup> + 128 7 in chl )	137, ([α] <sub>D</sub> <sup>b</sup> + 93 6 in al )				
31	<b>4-Toluene sulfonic acid (4-Methylbenzene sulfonic acid)</b>	104 5 (92)	181-2	198	238	190	71, eth	138 5 9, dihyd 105	103, eth -al	157, al	Phenylhydrazide, 155, al, o-Tolu-dide, 110, aq ac a, Triethylammonium salt, 65
32	<b>2,4-Dimethylbenzene sulfonic acid</b>	62 (hyd )	146				34	139 (137)	110		
33	<b>4-Vinylbenzene sulfonic acid (4-Styrene sulfonic acid)</b>			182 3				139 40			Dimethylamide, 62 3
34	<b>3,4-Dichlorobenzene sulfonic acid</b>						22 4 (19)	140 (135)			
35	<b>2-Bromonaphthalene-1-sulfonic acid</b>						97	140			
36	<b>2,4,6-Trimethylbenzene sulfonic acid</b>	77					56	142	109		
37	<b>3-Aminobenzene sulfonic acid (Metanilic acid)</b>		148					142			
38	<b>D-Camphor-2-sulfonic acid</b>			196 7			88	143	124		
39	<b>4-Methylnaphthalene-2-sulfonic acid</b>						124-5, eth	143 4, al			
40	<b>3,4-Dimethylbenzene sulfonic acid</b>	64	208				52	144			
41	<b>4-Chlorobenzene sulfonic acid</b>	93	175	208 10	222 3	163 4	53	144	104	190	
42	<b>4-Methyl-3-nitrobenzene sulfonic acid</b>		hyg	130	109	128	36	144 5		153	
43	<b>3-Bromocamphor-8-sulfonic acid</b>	195 6 (anh )					136 7	145			
44	<b>5-Chloro-2-methylbenzene sulfonic acid</b>						24 (21)	145, aq al			
45	<b>4-Bromo-3-methylbenzene sulfonic acid</b>						50	146			
46	<b>4-Methoxy-3-nitrobenzene sulfonic acid</b>						66	146 3			
47	<b>3-Chlorobenzene sulfonic acid</b>							148			
48	<b>2,5-Dimethylbenzene sulfonic acid</b>	184		199 200	206 7		24 6	148			
49	<b>Naphthalene-1-sulfonic acid</b>	90	137	181	183	237	68 (66)	150	112 (152)		
50	<b>4-Ethoxybenzene sulfonic acid</b>						39	150			
51	<b>4,6-Dichloro-2,5-dimethylbenzene sulfonic acid</b>						81	150	175		
52	<b>3-Bromo-4-methylbenzene sulfonic acid</b>						60	151			
53	<b>Benzene sulfonic acid</b>	66	148	205	240	176	14 5	153 (156)	112 (110)	170 1	N-Xanthylsulfonamide, 200
54	<b>2-Aminobenzene sulfonic acid (Orthanilic acid)</b>		132					153			N-Benzoyl deriv. of amide, 198, Hydrochloride, 201
55	<b>2-Iodonaphthalene-1-sulfonic acid</b>						110	154			
56	<b>2,6-Dichloro-4-methylbenzene sulfonic acid</b>						56	154-5			
57	<b>2-Chloro-5-methylbenzene sulfonic acid</b>						56	156	229 30 5		
58	<b>2-Toluene sulfonic acid (2-Methylbenzene sulfonic acid)</b>	57	170	203 4	218		10	156 3	136, aq al		Sulfonyl bromide, b p 138 <sup>10</sup> , N-Xanthylsulfonamide, 182 3 5

\*Derivative data given in order m.p. crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
 a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)

No	Name	Melting point, °C	S-Benzyl thiuronium salt	p-Toluidinium salt	Anilinium salt	<i>o</i> -Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonamide	Sulfon I naphthylamide	Miscellaneous
59	3-Bromocamphor-10-sulfonic acid	47.5					65	156.5			
60	2,4-Dinitrobenzene sulfonic acid	106.8 ( <i>hyd</i> )					102	157 (154)			Hydrazide, 110
61	2-Methyl-4-nitrobenzene sulfonic acid	130 ( <i>anh</i> )				177	106	157			
62	Benzophenone-3,3'-disulfonic acid						<i>dt</i> 137.8	<i>dt</i> 157	<i>dt</i>	177.8	Methylamide, 106.7, Dimethylamide, 118.9
63	3-Nitrobenzyl sulfonic acid	74					100, bz	159, w			
64	4,6-Dimethyl-2-hydroxy-1,3-benzene disulfonic acid						<i>dt</i> 89.91	<i>dt</i> 160.1			
65	2-Nitrodiphenylamine-4-sulfonic acid	220 d					157	162			
66	2-Ethoxybenzene sulfonic acid						65.6	163	158		Phenylhydrazide, 132.3
67	3-Methyl-2-nitrobenzene sulfonic acid						58.5	163.5			
68	3-Amino-6-methylbenzene sulfonic acid							164	146.7		Chloride of N-acetyl deriv, 124 Chloride of N-chloroacetyl deriv, 87, Amide of N-acetyl deriv, 242
69	4-Chloro-2-nitrobenzene sulfonic acid						75	164	138		Anhydride, 114.5, Phenylhydrazide, 151, Ph ester, 82
70	4-Aminobenzene sulfonic acid (Sulfanilic acid)	185	109		132			165	200	196	N-Acetyl, 214, Me ester, 92
71	3,6-Dichloro-2,5-dimethylbenzene sulfonic acid						71	165	171		
72	6-Aminonaphthalene-1-sulfonic acid	172.4						165			Benzoylguanidine salt, 210.11
73	4-Bromobenzene sulfonic acid	102.3 (88.9)	170	215.6	237.8	182.3	76, eth	166 (161)	119	183.4	
74	5-Bromo-2-methylbenzene sulfonic acid						33.5	167			
75	2,3-Dimethylbenzene sulfonic acid						47	167			
76	5-Chloro-2-methyl-3-nitrobenzene sulfonic acid						60	167			
77	3-Nitrobenzene sulfonic acid	48	146	222	222	193	64	167	126	166.7	
79	4,6-Dichloro-2-methylbenzene sulfonic acid						43	168			
80	4-Chloronaphthalene-2-sulfonic acid						106	168			Et ester, 76.9
81	4-Bromo-2-methylbenzene sulfonic acid						50	168			
82	Propane-1,3-disulfonic acid	92, d without melting					<i>dt</i> 45	<i>dt</i> 169. w	<i>dt</i> 129		B p 157 <sup>1,4</sup> , Di- <i>m</i> -toluidide, 222, Di-hydrazide, 105
83	Propane-1,1-disulfonic acid							<i>dt</i> 169.70	151.2, al		Di-(N-ethyl)anilide, 128.9, al
84	3-Carboxybenzene sulfonic acid (3-Sulfobenzoic acid)	98 ( <i>hyd</i> )	163		224.6		<i>dt</i> 20	<i>dt</i> 170			
85	4-Methyl-2-nitrobenzene sulfonic acid	141 ( <i>anh</i> )					98.9	170			<i>o</i> -Anisidine, 135
86	2,4-Dimethyl-3-nitrobenzene sulfonic acid	144 ( <i>anh</i> )					96	172			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
 a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)

No	Name	Melting point, °C	S-Benzyl thioether salt	p-Tolu dinium salt	Anilinium salt	o-Tolu dinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
87	2,5-Dimethyl-3-nitrobenzene sulfonic acid	128		135-6		126.5-7.5	60.1	172.3	143.4		
88	4-Nitrodiphenylamine-2-sulfonic acid					102-4	173	164			
90	3,4-Dibromobenzene sulfonic acid	66.5-7.5 (anh.)				34	175				
91	4-Chloro-3-nitrobenzene sulfonic acid					40.1	175-6, yel., al				
92	3-Amino-4-methylbenzene sulfonic acid						176				N-Acetyl of chloride, 144, N-Benzoyl of Chloride, 196, N-Benzoyl, 203
93	7-Chloronaphthalene-2-sulfonic acid	118 (anh.), 68 (tetrahyd.)				86.5	176				Me ester, 89, Et ester, 65
94	4-Bromo-3-nitrobenzene sulfonic acid					55.7	176.7				
95	4-Hydroxybenzene sulfonic acid						176-7				
96	5-Methylnaphthalene-1-sulfonic acid	115	169	202	170	192					176-8
97	4-Methylnaphthalene-1-sulfonic acid					81	177	158			
98	4-Nitrobenzene sulfonic acid	95 (109 11), hyg		179.80			80, lgr	180, 50% al	136 (171), al		
99	3-Chloro-2-methylbenzene sulfonic acid	60.72, 72 (anh.)				72, pet eth	180, w				
100	2,5-Dichlorobenzene sulfonic acid	93.7 (>100)	170	247-8	262.3	250-1	38	181 (186)	160	160	
101	2,4,5-Trimethylbenzene sulfonic acid	112				61.2	181				
102	8-Aminonaphthalene-2-sulfonic acid						181	146.7			
103	5-Chloro-4-methyl-2-nitrobenzene sulfonic acid	128				99	181				
104	2,4-Dichlorobenzene sulfonic acid	86		204-6		170-2	55	182			
105	4-Iodobenzene sulfonic acid						85	183			
106	Quinoline-8-sulfonic acid	312					124	183.4	143		
107	6-Chloronaphthalene-2-sulfonic acid						110.5	183-4			
108	5-Nitronaphthalene-2-sulfonic acid	118-9, yel			260		125	184, yel			
109	4-Chloro-2-methylbenzene sulfonic acid						54	185			
110	4-Chloro-2,5-dimethylbenzene sulfonic acid	100					50	185	155		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
**a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)**

No	Name	Melting point, °C	S-Benzyl thionium salt	p Toluidinium salt	Anilinium salt	o Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
111	<b>2-Carboxy-5-methylbenzene sulfonic acid</b>	190 (158), (anh)					dt 59	185			Nitrile of the sulfonyl chloride, 67, lgf, NH <sub>4</sub> salt of 2-amide, 186 (mono-hyd) Et ester, 92
112	<b>8-Chloronaphthalene-2-sulfonic acid</b>						94	185-6			
113	<b>2-Chloro-5-nitrobenzene sulfonic acid</b>	168-9 d (hyd)					89-90, w	185 6, w			
114	<b>2-Bromobenzene sulfonic acid</b>						51, eth	186, w			
115	<b>2,3-Dichloro-6-methylbenzene sulfonic acid</b>						49	186			
116	<b>2-Methyl-5-nitrobenzene sulfonic acid</b>	133 5 (di-hyd)		256 7		256-8	46 7	186	148		
117	<b>2-Chloro-4-methylbenzene sulfonic acid</b>						46 (52)	186			
118	<b>3,5-Dichloro-2-methylbenzene sulfonic acid</b>						54	186			
119	<b>6-Chloro-3-nitrobenzene sulfonic acid</b>	168 9					90, eth	186, w			
120	<b>2,4-Dimethyl-5-nitrobenzene sulfonic acid</b>	132 (122), dtl HNO <sub>3</sub>					98	187 (179)			Sulfonyl fluoride, 109-10
121	<b>2-Methyl-5-nitrobenzene sulfonic acid</b>	131					46 7 (44), eth -pet eth	187	148		
122	<b>4-Chloronaphthalene-1-sulfonic acid</b>	130 3 d			145-6	151	95	187	145-6	162	Me ester, 83, Et ester, 104
123	<b>8-Iodonaphthalene-1-sulfonic acid</b>						115	187	140		
124	<b>2,4-Diaminobenzene-1,5-disulfonic acid</b>						275	187	236		
125	<b>2,6-Dichloro-3-methylbenzene sulfonic acid</b>						19 5	188			
126	<b>4-Nitronaphthalene-1-sulfonic acid</b>						99	188			
127	<b>2-Chlorobenzene sulfonic acid</b>						28 5, eth	188			
128	<b>5-Methylnaphthalene-2-sulfonic acid</b>						120-2	188 9	248-50		
129	<b>Phenanthrene-3-sulfonic acid</b>	175 6 (anh), 120-1 (mono-hyd), 88-9 (di-hyd)		222			110-1 (108)	190			Me ester, 119-20, al, Et ester, 107 8
130	<b>2,4-Dibromobenzene sulfonic acid</b>	110 (anh)					79, eth	190			
131	<b>8-Nitronaphthalene-1-sulfonic acid</b>	115 (tri-hyd)					165 d	190 5-1 5	178-8 5		
132	<b>4-Methylbenzene-2,4-disulfonic acid</b>	oil		277 d	dt 189	170-1	54 (56), eth 69	dt 190 5-1	189		
133	<b>3,5-Dichloro-4-methylbenzene sulfonic acid</b>							191			
134	<b>2,5-Dimethyl-6-nitrobenzene sulfonic acid</b>	145 (anh)		158 5-9, al		143-5, 50% al	110, eth - pet -eth	192, 50% al	182, bl , al		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
**a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)**

No	Name	Melting point, °C	S-Benzyl thionium salt	p-Toluidinium salt	Anilinium salt	o-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
135	<b>Quinoline-6-sulfonic acid</b>	> 260					91	192			
136	<b>3,4-Dicarboxybenzene sulfonic acid (4-sulfophthalic acid)</b>	138-40 <i>(mono-hyd.)</i>					167-70 d, eth	192-	200 d, w		
137	<b>2-Nitrobenzene sulfonic acid</b>	70 (85)					69	193			
138	<b>Phenanthrene-9-sulfonic acid</b>	174 <i>(anh.)</i>	235				127	193 4, al	115		
139	<b>2-Carboxybenzene sulfonic acid (2-Sulfobenzoic acid)</b>	68 9 <i>(hyd.)</i> , 134 <i>(anh.)</i>	206	197 (200)	165	127-8	79, pet eth, 40, eth	C 193-4 <i>(anh.)</i> , S 153 4, sl htng	194 5		
140	<b>4-Bromonaphthalene-1-sulfonic acid</b>						87	195			
141	<b>2,5-Dibromobenzene sulfonic acid</b>	128 <i>(anh.)</i>					71, pet eth -eth	195, al			
142	<b>7-Methylnaphthalene-1-sulfonic acid</b>						96	195-6	162 4		
143	<b>5-Fluoronaphthalene-1-sulfonic acid</b>	105 6					122-3	196-7			Me ester, 118, eth
144	<b>Acenaphthene-3-sulfonic acid</b>			284 6			113-4	196-9			Me ester, 122-3, Et ester, 137-9, lgr
145	<b>2,5-Dimethyl-4-nitrobenzene sulfonic acid</b>	140	143 5 4 5		143 5 4 5		75	197-8	131		
146	<b>8-Chloronaphthalene-1-sulfonic acid</b>						101 (96 8)	197 6			Me ester, 70, Et ester, 67-8
147	<b>4-Chloro-3-methyl-5-nitrobenzene sulfonic acid</b>						52	201			
148	<b>5-Amino-2-hydroxybenzene sulfonic acid (4-Aminophenol-2-sulfonic acid)</b>	100 <i>(anh.)</i>						202	159		Pyridine salt of O,N-diacetyl deriv, 143-4
149	<b>4-Nitrobenzyl sulfonic acid</b>	71					90	204	220		
150	<b>Anthracene-1-sulfonic acid</b>						90	205			
151	<b>6-Methylnaphthalene-2-sulfonic acid</b>						97 8	205 6			
152	<b>4-Iodonaphthalene-1-sulfonic acid</b>						124 (121)	206 (204)	136		
153	<b>4-Fluoronaphthalene-1-sulfonic acid</b>	100					86, chl	206	144		Et ester, 93
154	<b>4-Aminonaphthalene-1-sulfonic acid (Naphthionic acid)</b>		195					206			N-Acetyl deriv of amide, 241 N-Acetyl deriv of anilide, 231
155	<b>4-Amino-2-nitrobenzene sulfonic acid</b>						59-60	206 7			
156	<b>Retene-6-sulfonic acid</b>	121-3					146-7 5	206 7 5			Me ester, 117 9, Et ester, 114 5
157	<b>2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonic acid</b>						119	208	207		
158	<b>4-(N-methylamino)benzene sulfonic acid</b>	244 5 d						210-1			N-4-Toluenesulfonyl, benzidine salt, 255
159	<b>6-Chloronaphthalene-1-sulfonic acid</b>						70	214			Et ester, 114-5
160	<b>1-Nitronaphthalene-2-sulfonic acid</b>	105, grn			(202)		120-1, pink, bz-pet eth	214, 50% al	202		
161	<b>2,5-Dichlorobenzene-1,3-disulfonic acid</b>						114	215-7			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
**a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)**

No	Name	Melting point, °C	S-Benzyl thiouronium salt	p-Toluidinium salt	Anilinium salt	<i>o</i> -Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
162	5-Methylbenzene-1,3-disulfonic acid					94, eth	216, w	216, w	153, al		
163	Naphthalene-2-sulfonic acid	91, hyg	190 1	221	269	213	76 (79)	217 (213)	132		
164	4-Acetamidobenzene-1-sulfonic acid						218	218		215	
165	5-Aminonaphthalene-2-sulfonic acid		191				218 9 d	127-8			N-Acetyl, 238-9
166	8-Nitronaphthalene-2-sulfonic acid	135-6 (hyd)					169	223, 228	172-3		
167	5-Chlorobenzene-1,3-disulfonic acid						106	224			
168	2-Methylbenzene-1,4-disulfonic acid						98, bz - pet eth	di 224	di 178		
169	4-Carboxy-3-nitrobenzene sulfonic acid	111 (+2½-H <sub>2</sub> O)					di 160	di 226, mono-S			
170	5-Chloronaphthalene-1-sulfonic acid						95	226	138		Me ester, 89, Et ester, 46 Sulfonyl bromide, 110 Me ester, 93, al, Et ester, 82 5, al
171	3,4-Di-iodobenzene sulfonic acid	122 5, after drying at 100					82, bz - pet eth	227, aq al			
172	2,4,6-Tribromobenzene sulfonic acid	64					64	228	220-2		
173	4'-Nitrobiphenyl-4-sulfonic acid						178	228			
174	3,4-Dichloro-2-methylbenzene sulfonic acid						52	228			
175	Benzene-1,3-disulfonic acid		214				63	229	148 50	245	Alkali fusion → resorcinol, 110
176	Biphenyl-4-sulfonic acid						115	230	125		
177	2,4-Di-iodobenzene sulfonic acid	162 (anh)					77 8	230			Me ester, 78, al, Et ester, 57, al
178	1-Ethoxybenzene-2,5-disulfonic acid						di 106-8	di 233			
179	Methane disulfonic acid (Methionic acid)						8, b p 133 <sup>10</sup>	di 233	di 192-3		B p 220-70 <sup>10-15</sup> d
180	3,5-Dinitrobenzene sulfonic acid						99, chl - lgr	235, w , al			
181	4-Aminobenzene-1,3-disulfonic acid (Aniline-2,4-disulfonic acid)	120 d						di 235			
182	5-Iodonaphthalene-1-sulfonic acid						114	236 (239)			
183	5-Nitronaphthalene-1-sulfonic acid						113	236	123		Me ester, 117 8, chl
184	4-Carboxybenzene sulfonic acid (4-Sulfobenzoic acid)	94 (hyd), 260 (anh)	213					di 57	di 236	di 252	
185	2,3-Dichloro-4-methylbenzene sulfonic acid						41	237			
186	6-Hydroxynaphthalene-2-sulfonic acid	167 (anh), 129 (hyd)	217 (207)	248	264	208		237	161		
188	4-Methylbenzene-1,2-disulfonic acid						109-11, bz - pet eth	237 9	190, al		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
**a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)**

No	Name	Melting point °C	S-Benzyl thiuronium salt	<i>o</i> -Toluidinium salt	Anilinium salt	<i>p</i> -Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
189	4,5-Dimethylbenzene-1,3-disulfonic acid					79, yel , al	239	200, al			
190	4-Hydroxybenzene-1,3-disulfonic acid (Phenol-2,4-disulfonic acid)	> 100 d				<i>dt</i> 89	<i>dt</i> 239	<i>dt</i> 205			
191	4-Methoxybenzene-1,3-disulfonic acid					86	240	209			
192	4-Acetamidonaphthalene-1-sulfonic acid (Acetyl naphthionic acid)		232 3	231 2			241	231			
193	Naphthalene-2,7-disulfonic acid	212	299	251-2	238	158 (162), bz <i>dt</i> 97 8 <i>dt</i> 125	242 <i>dt</i> 242 <i>dt</i> 244				
194	5-Nitrobenzene-1,3-disulfonic acid										
195	2,4,6-Trimethylbenzene-1,3-disulfonic acid (Mesitylene disulfonic acid)									150-1	
196	2,3,4,6-Tetrabromobenzene sulfonic acid					96 5	<i>ca</i> 245 d				
197	4,6-Dimethylbenzene-1,3-disulfonic acid					130, pet eth 84-5	249, w 250	196, 50° al 171 2			
198	1-Chloronaphthalene-2-sulfonic acid	130 3 d (anh )									Et ester, 104
199	Azobenzene-4,4'-disulfonic acid	169 d (anh )				<i>dt</i> 222 (170)	<i>dt</i> 250 d				
200	Phenanthrene-2-sulfonic acid	150	291			156, ac a	253-4, al	157 8			Me ester, 101-2 (96-8), Et ester, 89, yel br , al
201	Benzene-1,2-disulfonic acid		206			143	254	241			
202	2-Amino-5-methylbenzene-1,4-disulfonic acid	d at 290				<i>dt</i> 156, chl	<i>dt</i> 257, w				Imide, 186
203	5-Aminonaphthalene-1-sulfonic acid (Laurent's acid)		179				259-60	171			
204	2-Methylbenzene-1,3-disulfonic acid					88, bz	>260	162, al			
205	Anthracene-2-sulfonic acid					122, yel , tol	261	201			
206	Anthraquinone-2-sulfonic acid	211	308	309		197, pa yel , bz 169 70	261, yel , ac a 261 2	193, yel -br			
207	7-Nitronaphthalene-1-sulfonic acid										
208	Azoxobenzene-3,3'-disulfonic acid	126				138	273				
209	Naphthalene-1,4-disulfonic acid					160 (166)	273, w , al	179			
210	4,6-Dichlorobenzene-1,3-disulfonic acid					123	276				
211	Benzidine-2,2'-disulfonic acid					Hydrochloride, 205	278				
212	9,10-Dichloroanthracene-2-sulfonic acid					221	279	248			
213	4-Nitronaphthalene-2,7-disulfonic acid					<i>dt</i> 140 1	<i>dt</i> 286-7				
214	Benzene-1,4-disulfonic acid					131 (139)	288	249			
215	Azobenzene-3,4'-disulfonic acid					<i>dt</i> 123 5	<i>dt</i> 288				
216	Naphthalene-1,3-disulfonic acid					<i>dt</i> 137 5	<i>dt</i> 292 3				
217	2,5-Dimethylbenzene-1,3-disulfonic acid					81, lgr	295, al	174, al			
218	Naphthalene-1,6-disulfonic acid	125 (anh )	81	314-5	298-9	323 4	129, bz	297-8			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS**  
 a) Listed in order of increasing m.p. of the corresponding sulfonamide\* (Continued)

No	Name	Melting point °C	S-Benzyl thiuronium salt	p Tolu dinium salt	Anilinium salt	o Tolu dinium salt	Sulfonyl chloride	Sulfonamide	Sulfonamide	Sulfonaphthalimide	Miscellaneous
219	Naphthalene-1,7-disulfonic acid						di 123	di 298 300			
220	Biphenyl-4,4'-disulfonic acid	72	171	330			203	300			
221	Naphthalene-2,6-disulfonic acid		256				225, bz	305			
222	Azobenzene-3,3'-disulfonic acid						166	305			
223	Naphthalene-1,5-disulfonic acid	240-5 (anh)	257 (251)				di 183	di 310 (>340)	di 249		Di-Me ester, 205, chl
224	Benzene-1,3,5-trisulfonic acid	>100					tri 187	tri 310 5	tri 237		Tri-Et ester, 147, bz
225	Anthracene-1,5-disulfonic acid						di 249, pa yel	di >330, yel	di 293		
226	Anthracene-1,8-disulfonic acid						225 yel, bz	333	224		
227	Anthraquinone-1,8-disulfonic acid	293-4					222 3, yel PhNO <sub>2</sub>	>340	237 8, yel, PhNO <sub>2</sub>		
228	Anthraquinone-1,5-disulfonic acid	310-1 (hyd), yel					265-70, yel, PhNO <sub>2</sub>	>350	269 70, red- yel, PhNO <sub>2</sub>		

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXII. ORGANIC DERIVATIVES OF SULFONIC ACIDS

b) M.p. of the amide deriv. not available; listed in order of increasing m.p. of the corresponding anilide deriv.\*

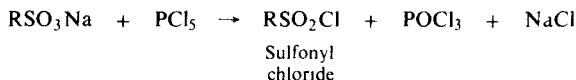
No	Name	Melting point, °C	S-Benzyl thuronium salt	p-Toluidinium salt	Anilinium salt	o-Toluidinium salt	Sulfonyl chloride	Sulfonamide	Sulfonanilide	Sulfon-1-naphthylamide	Miscellaneous
1	Ethane-1,2-disulfonic acid	104	201 2	270 d	270, w		di 95		69		
2	Vinylsulfonic acid (Ethylene-sulfonic acid)		145 6, w				b p 118 20 <sup>250</sup>	71, b p 174 <sup>1</sup>		B p 135 <sup>2</sup> , n <sub>D</sub> <sup>25</sup> 1 4505	
3	Phenol-O-sulfonic acid	145 (hyd.)		124-5	165				126 5-7 5		
4	8-Aminonaphthalene-1-sulfonic acid (Peri acid)		300						139 40	Anilinium salt of N-acetyl deriv., 273	
5	3,5-Dimethyl-2-hydroxybenzene sulfonic acid	121 5 d							142 3	Chloride of O-acetyl deriv., 62, pet eth., Methylanilide, 111 2	
6	Benzophenone-2-sulfonic acid						96-7		143 5		
7	7-Hydroxynaphthalene-1,3,6-trisulfonic acid						196		152-5		
8	1-Hydroxynaphthalene-2-sulfonic acid	>250	169					O-acetyl deriv., 157-8		O-acetyl deriv. of p-toluidide, 135-6	
9	2-Hydroxynaphthalene-1,6-disulfonic acid						di 111	di 191			
10	Anthraquinone-2,7-disulfonic acid						di 186, chl	di 192			
12	7-Hydroxynaphthalene-1,3-disulfonic acid (G-Acid)		228	294		271	eth 161-2		195		
13	7-Hydroxynaphthalene-1-sulfonic acid (Bayer Acid)		218	232	240	242			195		
14	4-Hydroxynaphthalene-1-sulfonic acid (NW-Acid)	170, r h	103	196	186 7	203-4			199-200	2-Naphthylamide, 204	
15	5-Hydroxynaphthalene-1-sulfonic acid	110-2 d							201	Chloride of O-acetyl deriv., 129	
16	2-Hydroxynaphthalene-3,6-disulfonic acid (R-Acid)		233	250	254	257			202		
17	Anthraquinone-1-sulfonic acid	218	191		284		216 8, yel., PhNO <sub>2</sub>	214, gold-yel		NH <sub>3</sub> → 1-Aminoanthraquinone, 252 (243)	
18	Anthraquinone-1,6-disulfonic acid	215 7, gold, ac a					197 8, yel., PhNO <sub>2</sub> di 177	227 8, yel., cl -bz di 231			
19	2-Hydroxynaphthalene-1,5-disulfonic acid								233		
20	2-Hydroxynaphthalene-1,7-disulfonic acid			219			169		237 8, yel., cl -bz di 321		
21	Anthraquinone-1,7-disulfonic acid	120 (hyd.)					231-2, br - yel., PhNO <sub>2</sub> di 250, yel., cl -bz				
22	Anthraquinone-2,6-disulfonic acid										

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLES XXII AND XXIII

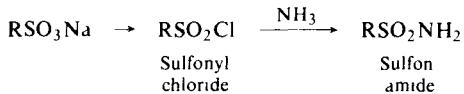
The main derivatives of the sulfonic acids are obtained by converting them to the corresponding sulfonyl chlorides. Hence sulfonic acids and sulfonyl chlorides are often identified through the same derivatives.

### *Sulfonyl chloride*



From the sulfonic acid or its sodium or potassium salt with phosphorus pentachloride without solvent  
*For directions and examples see* Cheronis, p 638, Linstead, p 89, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

### *Sulfonamide \**

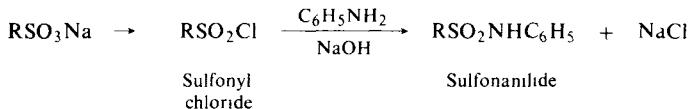


From the sulfonyl chloride (prepared from the acid or its salt) and concentrated aqueous ammonia solution  
*For directions and examples see* Linstead, p 49, Shriner, pp 268, 270, Vogel, p 553, Wild, p 161

From the sulfonyl chloride, aqueous ammonia and ammonium carbonate

*See* Cheronis, p 639

### *Sulfonanilide \**



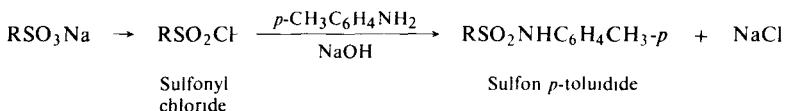
From the sulfonyl chloride (prepared from the acid), aniline, and sodium hydroxide

*For directions and examples see* Linstead, p 89, Wild, p 161

From the sulfonyl chloride and aniline

*See* Vogel, p 553

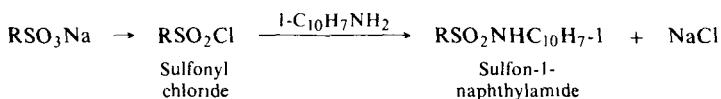
### *Sulfon-p-toluidide \**



From the sulfonyl chloride, *p*-toluidine and aqueous sodium hydroxide

*For directions and examples see* Vogel, p 553

### *Sulfon-1-naphthylamide \**



From the sulfonyl chloride (prepared from the acid) and 1-naphthylamine in benzene

*For directions and examples see* Cheronis, p 639

### *S-Benzylthiuronium salt \**



From the sodium, potassium or ammonium salt of the sulfonic acid and S-benzylthiuronium chloride in water

*For directions and examples see* Cheronis, pp 635, 636, Linstead, pp 15, 89, Shriner, p 269, Wild, pp 149, 159, E Chambers and G. W Watt, *J Org Chem*, **6**, 376 (1941), E Campagne and C M Suter, *J Amer Chem Soc*, **64**, 3040 (1942), S Veibel, *J Amer Chem Soc*, **67**, 1867 (1945)

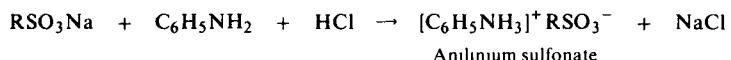
\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE XXII AND XXIII (Continued)

From sodium or potassium sulfonate and S-benzylthiuronium chloride in alcohol  
*See J J Donleavy, J Amer Chem Soc, 58, 1004 (1936)*

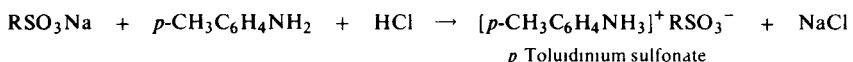
### *Anilinium salt \**



From the sodium or potassium salt of the acid, aniline and hydrochloric acid in water

*For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942)*

### *p-Toluidinium salt \**



From the sulfonic acid and *p*-toluidine

*For directions and examples see Shriner, p 269*

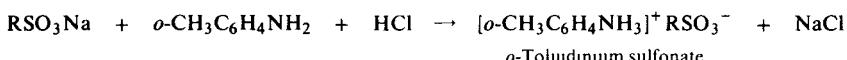
From the sodium, potassium or ammonium salt with *p*-toluidine or *p*-toluidine hydrochloride in water

*See Shriner, p 269, Vogel, p 555, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942), A D Barton and L Young, J Amer Chem Soc, 65, 294 (1943)*

From the sodium, potassium, ferric or barium salt (after boiling with sulfuric acid) with *p*-toluidine and hydrochloric acid

*See Cheronis, p 637, Fieser, J Amer Chem Soc, 51, 2460 (1929)*

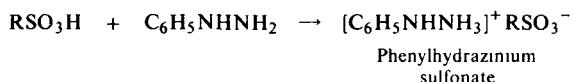
### *o-Toluidinium salt \**



From the sodium or the potassium salt of the sulfonic acid with *o*-toluidine and hydrochloric acid in water

*For directions and examples see Cheronis, p 637, O C Dermer and V H Dermer, J Org Chem, 7, 581 (1942)*

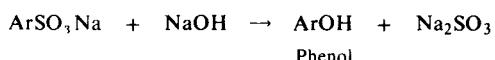
### *Phenylhydrazinium salt \**



From the sulfonic acid with phenylhydrazine in water-alcohol

*For directions and examples see Wild, p 159, P H Latimer and R W Bost, J Amer Chem Soc, 59, 2500 (1937)*

### *Phenols by KOH fusion*



By fusion of the sodium arylsulfonate and sodium hydroxide in a nickel crucible

*For directions and examples see Vogel, p 552*

By fusion of the sodium arylsulfonate, potassium hydroxide and zinc dust

*See Linstead, p 89*

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
 (Listed in order of increasing m.p.)\*

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1 Naph thyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzyl thium	p-Tolu dine	Aniline	o Tolu dine	
1	Methanesulfonyl chloride	8	b p 220 70 <sup>15</sup> -20 <sup>d</sup>	233	192-3						B p 133 <sup>10</sup>
2	2-Ethylbenzenesulfonyl chloride	11.7		100							
3	3-Methylbenzenesulfonyl chloride (Toluene-3-sulfonyl chloride)	12		108, al	96						
4	4-Ethylbenzenesulfonyl chloride	12		110							
5	Benzenesulfonyl chloride	14.5	43-4 (mono- hyd ) 66 (anh )	156, 153		170-1	148	205	240	176	N-Xanthylsulfo amide 196 N-Xanthylsulfo amide, 200
6	Heptane-1-sulfonyl chloride	16		75							
7	2,6-Dichloro-3-methylbenzene- sulfonyl chloride	19.5		188							
8	3-Carboxybenzenesulfonyl chloride	20	98 (hyd), 148 (anh )	di 170			163	224-6			The m.p. is that of the 1,3-dichloride
9	3,4-Dichlorobenzenesulfonyl chloride	22.4-19		140-135							
10	5-Chloro-2-methylbenzenesulfonyl chloride	24		145, aq al							
11	2,5-Dimethylbenzenesulfonyl chloride	24.6	48 (anh ) 86 (hyd )	148			184				N-Xanthylsulfo amide, 176
12	2-Chlorobenzenesulfonyl chloride	28.5		188							
13	2-Phenylethane-1-sulfonyl chloride	33	91	122	77						
14	5-Bromo-2-methylbenzenesulfonyl chloride	33.5		166-7							
15	2,4-Dimethylbenzenesulfonyl chloride	34	62 (hyd )	110							
16	3,4-Dibromobenzenesulfonyl chloride	34	66.5-7.5 (anh )	175							
17	2,4,6-Trichlorobenzenesulfonyl chloride	35-40		210-2d							
18	4-Methyl-3-nitrobenzenesulfonyl chloride	36	92, hyg	144.5	109	153		130-1		28	
19	4-Fluorobenzenesulfonyl chloride	36, 30		125							
20	3-Ethoxybenzenesulfonyl chloride	38		131							
21	3-Chloro-4-methylbenzenesulfonyl chloride	38		134	96						
22	2,5-Dichlorobenzenesulfonyl chloride	38	93-7	181	160	160	170	247-8	262.3	250.1	
23	2,6-Dimethylbenzenesulfonyl chloride	39	98	113-96							
24	4-Ethoxybenzenesulfonyl chloride	39		150							
25	4-Chloro-3-nitrobenzenesulfonyl chloride	40.1 60-2		175.6 yel al							
26	2,3-Dichloro-4-methylbenzene- sulfonyl chloride	41		237							
27	4,6-Dichloro-2-methylbenzene- sulfonyl chloride	43		168							
28	3,3-Dimethylbutane-1-sulfonyl chloride	43.4		96.7							
29	Propane-1,3-disulfonyl chloride	45	92d	169, w	di 125						
30	2-Chloro-4-methylbenzenesulfonyl chloride	46, 52		186							Di-m-toluidide 222
31	Indane-5-sulfonyl chloride	46.7, eth	92	135.5-6, al	129, al						
32	2-Methyl-5-nitrobenzenesulfonyl chloride	46.7	133.5 (+2H <sub>2</sub> O)	186	148			256-7		256-8	B p 183.5 <sup>10</sup>
33	2,3-Dimethylbenzenesulfonyl chloride	47		167							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzyl thionium	p-Toluidine	Aniline	o-Toluidine	
34	<b>4-Bromo-3-methylbenzenesulfonyl chloride</b>	50		146							
35	<b>3-Methyl-4-nitrobenzenesulfonyl chloride</b>	50		133.5							
36	<b>4-Bromo-2-methylbenzenesulfonyl chloride</b>	50		168							
37	<b>4-Chloro-2,5-dimethylbenzenesulfonyl chloride</b>	50	100	185	155						
38	<b>2-Bromobenzenesulfonyl chloride</b>	51, eth		186 w							
39	<b>3,4-Dichloro-2-methylbenzenesulfonyl chloride</b>	51.2		228							
40	<b>3,4-Dimethylbenzenesulfonyl chloride</b>	52	64.55	144			208				
41	<b>4-Chloro-3-methyl-5-nitrobenzenesulfonyl chloride</b>	52		201							
42	<b>4-Chlorobenzenesulfonyl chloride</b>	53	69.93	144	104	190	175	208-10	222.3	163.4	B p 140 i
43	<b>Indane-4-sulfonyl chloride</b>	53.35		118.9, w							
44	<b>4-Methylbenzene-1,3-disulfonyl chloride</b> (Toluene-2,4-disulfonyl chloride)	54.46		di 186?	189						
45	<b>4-Chloro-2-methylbenzenesulfonyl chloride</b>	54		185							
46	<b>3,5-Dichloro-2-methylbenzenesulfonyl chloride</b>	54		186							
47	<b>Hexadecane-1-sulfonyl chloride</b>	54	54	97							
48	<b>2,4-Dichlorobenzenesulfonyl chloride</b>	55	86	182				204.6		170-2	
49	<b>4-Bromo-3-nitrobenzenesulfonyl chloride</b>	55.7		176.7							
50	<b>2,4,6-Trimethylbenzenesulfonyl chloride</b>	56	78	142	109						
51	<b>2-Chloro-5-methylbenzenesulfonyl chloride</b>	56		156	229.30.5						
52	<b>2,6-Dichloro-4-methylbenzenesulfonyl chloride</b>	56		154.5							
53	<b>4-Carboxybenzenesulfonyl chloride</b>	57	94 (hyd.), 260 (anh.)	di 236	di 252						The m.p. is that of the 1,4-dichloride
54	<b>Tetralin-6-sulfonyl chloride</b>	58		135	155.6						
55	<b>3-Methyl-2-nitrobenzenesulfonyl chloride</b>	58.5		163.5							
56	<b>5-Carboxy-2-methylbenzenesulfonyl chloride</b> (4-Toluic acid-2-sulfonyl chloride)	59	190, 158 (anh.)	185							The m.p. is that of the 1,5-dichloride
57	<b>4-Amino-3-nitrobenzenesulfonyl chloride</b> (2-Nitroaniline-4-sulfonyl chloride)	59-60		206-7							
58	<b>5-Chloro-2-methyl-3-nitrobenzenesulfonyl chloride</b>	60		167							
59	<b>3-Bromo-4-methylbenzenesulfonyl chloride</b>	60		151							
60	<b>2,5-Dimethyl-3-nitrobenzenesulfonyl chloride</b>	61	128, 200	173	143.4			136			
61	<b>2,4,5-Trimethylbenzenesulfonyl chloride</b>	61	112	181							
62	<b>Benzene-1,3-disulfonyl chloride</b>	63		229	148.50	245	214				N-Xanthylsulfonamide, 170 Alk fusion → resorcinol, 110
63	<b>4-Chloro-3-methylbenzenesulfonyl chloride</b>	63		128	92						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzyl thionium	p-Toluidine	Aniline	o Toluidine	
64	7-Methylnaphthalene-2-sulfonyl chloride	63.4		163-4							
65	2,4,6-Tribromobenzenesulfonyl chloride	64	64	228	220-2d						
66	3-Nitrobenzenesulfonyl chloride	64	48	167	126	166.5	146	222	126.5-7.5	193	
67	2,3,4-Trichlorobenzenesulfonyl chloride	64.5		227-30							
68	3-Bromocamphor-10-sulfonyl chloride	65	47.5	156							
70	2-Ethoxybenzenesulfonyl chloride	65.6		163	158						
71	4-Methoxy-3-nitrobenzenesulfonyl chloride	66		146.3							
72	D-Camphor-10-sulfonyl chloride	67	193	132	121.88						
73	2-Methylbenzenesulfonyl chloride (Toluene-2-sulfonyl chloride)	68	57	156.3	136		170	203-4	218		N-Xanthylsulfonamide, 182.35
74	Naphthalene-1-sulfonyl chloride	68, 66	90	150	112.152						
75	4-Methylbenzenesulfonyl chloride (Toluene-4-sulfonyl chloride)	69	104.5	138.5.9 (anh.), 105 (+2H <sub>2</sub> O)	103	157	137 181-2	181 198	183 238	237 190	
76	2-Nitrobenzenesulfonyl chloride	69	70.85	193	115						
77	3,5-Dichloro-4-methylbenzenesulfonyl chloride	69		191							
78	2,4-Dimethoxybenzenesulfonyl chloride	70		167							
79	6-Chloronaphthalene-1-sulfonyl chloride	70		214							
80	3,4-Dimethyl-5-nitrobenzenesulfonyl chloride	70		180							
81	2,5-Dibromobenzenesulfonyl chloride	71	128 (anh.)	195							
82	3,6-Dichloro-2,5-dimethylbenzenesulfonyl chloride	71		165	171						
83	3-Chloro-2-methylbenzenesulfonyl chloride	72, pet eth	60-72	180, w							
84	4-Methoxynaphthalene-2-sulfonyl chloride	75		157	145						
85	2-Chloronaphthalene-1-sulfonyl chloride	75		153							
86	4-Chloro-2-nitrobenzenesulfonyl chloride	75	82	164, 237	138						Phenylhydrazide 151, Ph ester, 82
87	2,5-Dimethyl-4-nitrobenzenesulfonyl chloride	75	140	197-8	131						
88	4-Bromobenzenesulfonyl chloride	76, eth	88.90 91, hgy., 122	166, 161 217, 213	119 132	183.5	170 190.1	215.6 221	237-8 269	182-3 213	
89	Naphthalene-2-sulfonyl chloride	76, 79									
90	6-Bromonaphthalene-1-sulfonyl chloride	77		217							
91	2,4-Di-iodobenzenesulfonyl chloride	77-8	167 (anh.)	230							Me ester, 78, al, Et ester, 57, al
92	2-Carboxybenzenesulfonyl chloride	79, pet eth	68.9 (hyd.), 134 (anh.)		194-5		206	196 200	165	127-8	The m.p. is that of the 1,2-dichloride
93	2,4-Dibromobenzenesulfonyl chloride	79, eth	110 (anh.)	190							
94	4,5-Dimethylbenzene-1,3-disulfonyl chloride	79, yel		239	200, al						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
**(Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naph thyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzyl thiuronium	p-Tolu dine	Aniline	o-Tolu dine	
95	4-Nitrobenzenesulfonyl chloride	80 lgr	109 11 95 hyg	180, 50°. al	171 136 d			179 80			
96	6-Methoxynaphthalene-1-sulfonyl chloride	80.5		149.5	177.5						
97	2,5-Dimethylbenzene-1,3-disulfonyl chloride	81, lgr		295 al	174 al						
98	4,6-Dichloro-2,5-dimethylbenzene-sulfonyl chloride	81		150	175						
99	4-Methylnaphthalene-1-sulfonyl chloride	81, eth		174 177 al	158						
100	3,4-Di-iodobenzenesulfonyl chloride	82, bz pet eth	122.5	227, aq al							
101	3-Chloro-4-methoxybenzenesulfonyl chloride	82		131							
102	7-Methoxynaphthalene-2-sulfonyl chloride	83		220	121						
103	2-Methylnaphthalene-1-sulfonyl chloride	83.5		124							
104	1-Chloronaphthalene-2-sulfonyl chloride	84.5	130 3d (anh.)	250	171 2						
105	4-Iodobenzenesulfonyl chloride	85		183	143						
106	4-Ethoxynaphthalene-2-sulfonyl chloride	85		183	143.5						
107	4,5-Dichloro-3-methylbenzene-sulfonyl chloride	85.8		183.5							
108	4-Methoxybenzene-1,3-disulfonyl chloride	86		240	209						
109	4-Fluoronaphthalene-1-sulfonyl chloride	86	100 (hyd.)	206	144						Et ester, 93
110	7-Chloronaphthalene-2-sulfonyl chloride	87	68 (tetra-hyd.) 118 (anh.)	76							Me ester, 89, Et ester, 65
111	4-Bromonaphthalene-1-sulfonyl chloride	87		195							
112	D-Camphor-3-sulfonyl chloride	88	77	143	124			196 7			Me ester, 77
113	2-Methylbenzene-1,3-disulfonyl chloride	88		260	162						
114	8-Methylnaphthalene-2-sulfonyl chloride	88		116							
115	4-Hydroxybenzene-1,3-disulfonyl chloride (Phenol-2,4 disulfonyl chloride)	89	>100d	239							
116	3,5-Dimethyl-2-hydroxybenzene-1,3-disulfonyl chloride	89.91		160 1							
117	Anthracene-1-sulfonyl chloride	90		205							
118	2-Chloro-5-nitrobenzenesulfonyl chloride	90, w	168 9d (hyd.)	185.6							
119	Quinoline-6-sulfonyl chloride	91	>260	192							
120	Benzylsulfonyl chloride	92.3, eth., lgr		105, w, al	102	166 146		113, al	102	83	Hydrazide, 131.2, Phenylhydrazide, 173
121	6-Iodonaphthalene-1-sulfonyl chloride	92.5		213							
122	6-Methoxynaphthalene-2-sulfonyl chloride	93		189	120						
123	5-Chloro-2-nitrobenzenesulfonyl chloride	93		159							
124	1-Bromonaphthalene-2-sulfonyl chloride	93		271							

\*Derivative data given in order m.p., crystal color solvent from which crystallized

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzyl thiuronium	p-Toluidine	Aniline	o Toluidine	
125	5-Methylbenzene-1,3-disulfonyl chloride	94, eth		216, w	153, al						
126	3,5-Dimethylbenzenesulfonyl chloride	94, 90, bz		135, al	129, al			121 2, al			
127	8-Chloronaphthalene-2-sulfonyl chloride	94		185							
128	1-Iodonaphthalene-2-sulfonyl chloride	94		247							
129	4-Chloronaphthalene-1-sulfonyl chloride	94 5	130 3d	187		162				151	<i>o</i> Toluidide 145 6 Me ester 83 Et ester, 104 Di-Et ester 77 eth <i>m</i> -Toluidide 230
130	Ethane-1,2-disulfonyl chloride	95		69			201 2	270d	270, w		
131	5-Bromonaphthalene-1-sulfonyl chloride	95		232 3							
132	5-Chloronaphthalene-1-sulfonyl chloride	95		226	138						Sulfonyl bromide, 110, Me ester, 89, Et ester, 46
133	7-Methylnaphthalene-1-sulfonyl chloride	96		195 6	162 4						
134	2,4-Dimethyl-3-nitrobenzenesulfonyl chloride	96	144 (anh.)	172							
135	5-Bromonaphthalene-2-sulfonyl chloride	96		220							
136	2-Benzoylbenzenesulfonyl chloride (Benzophenone 2-sulfonyl chloride)	96 7			143 5						
137	2,3,4,6-Tetrabromobenzenesulfonyl chloride	96 5		245d							
138	10-Bromocamphor-3-sulfonyl chloride	97		100 2							
139	6-Fluoronaphthalene-2-sulfonyl chloride	97 chl	105 (hyd.)	133	129		190 1	221	269	213	
140	2-Bromonaphthalene-1-sulfonyl chloride	97		140							
141	6-Methylnaphthalene-2-sulfonyl chloride	97 8		205 6							
142	5-Nitrobenzene-1,3-disulfonyl chloride	97 8		242							
143	2,4-Dimethyl-5-nitrobenzenesulfonyl chloride	98	132 122 dil HNO <sub>3</sub>	187 179							Sulfonyl fluoride, 109 10
144	2-Methylbenzene-1,4-disulfonyl chloride	98		224	di 178						
145	4-Methyl-3-nitrobenzenesulfonyl chloride	98 9		170							<i>o</i> Anisidine, 135
146	4-Methoxynaphthalene-1-sulfonyl chloride	98 5		226	147 5						
147	5-Chloro-4-methyl-2-nitrobenzenesulfonyl chloride	99	128	181							
148	3,5-Dinitrobenzenesulfonyl chloride	99, chl, lgr		235							
149	4-Nitronaphthalene-1-sulfonyl chloride	99		188							
150	7-Iodonaphthalene-2-sulfonyl chloride	100		210							
151	7-Bromonaphthalene-2-sulfonyl chloride	100		218							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzyl thionium	p Toluidine	Aniline	o-Toluidine	
152	<b>3-Nitrobenzylsulfonyl chloride</b>	100, bz	74 (hyd.)	159 d, w							Me amide 106 7 Dimethylamide 118 9
153	<b>8-Chloronaphthalene-1-sulfonyl chloride</b>	101		197							
154	<b>2,4-Dinitrobenzenesulfonyl chloride</b>	102	106 8 (hyd.) 130 (anh.)	157 154							Hydrazide, 110
155	<b>4-Nitrodiphenylamine-2-sulfonyl chloride</b>	102 4		173	164						
156	<b>4-Ethoxynaphthalene-1-sulfonyl chloride</b>	103		170	180						
157	<b>7-Ethoxynaphthalene-2-sulfonyl chloride</b>	103		142	153						
158	<b>3,7-Diethylnaphthalene-1-sulfonyl chloride</b>	105 7		207							
159	<b>5,6-Dichloronaphthalene-1-sulfonyl chloride</b>	106		223							
160	<b>4-Chloronaphthalene-2-sulfonyl chloride</b>	106		168							Et ester 76 9
161	<b>2-Methyl-4-nitrobenzenesulfonyl chloride</b>	106		157							
162	<b>DL-Camphor-8-sulfonyl chloride</b>	106	56 8	133 5, w							
163	<b>5-Chlorobenzene-1,3-disulfonyl chloride</b>	106		224							
164	<b>3-Ethoxybenzene-1,4-disulfonyl chloride</b>	106 8		dt 233							
165	<b>6-Ethoxynaphthalene-2-sulfonyl chloride</b>	107 5		183	153						
166	<b>4-Methylbenzene-1,2-disulfonyl chloride</b>	109 11		237 9	190						
167	<b>2,5-Dimethyl-6-nitrobenzenesulfonyl chloride</b>	110	145 (anh.)	192	182			158 5 9		143 5 50% al	
168	<b>2-Iodonaphthalene-1-sulfonyl chloride</b>	110		154							
169	<b>Phenanthrene-3-sulfonyl chloride</b>	110-1	175 6 (anh.) 120 1 (+1 H <sub>2</sub> O) 88d (+ 2H <sub>2</sub> O)	190			222				Me ester 119 20, al Et ester 107 8
170	<b>6-Chloronaphthalene-2-sulfonyl chloride</b>	110 5		184							
171	<b>2-Hydroxynaphthalene-1,6-disulfonyl chloride</b>	111			dt 191						
172	<b>Acenaphthene-5-sulfonyl chloride</b>	111		223	178						
173	<b>3-Hydroxynaphthalene-2-sulfonyl chloride</b>	112		110					241 2		
174	<b>5-Nitronaphthalene-1-sulfonyl chloride</b>	113		236	123						
175	<b>Acenaphthene-3-sulfonyl chloride</b>	113 4	87 9	199	284 6						Me ester, 122 3, Et ester, 137 9, lgr
176	<b>2,5-Dichlorobenzene-1,3-disulfonyl chloride</b>	114		215 7							
177	<b>5-Chloronaphthalene-2-sulfonyl chloride</b>	115		216							
178	<b>Biphenyl-4-sulfonyl chloride (4-Phenylbenzenesulfonyl chloride)</b>	115		230	125						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzyl thionium	p-Toluidine	Aniline	o-Toluidine	
179	2-Ethoxynaphthalene-1-sulfonyl chloride	116		158	187						
180	4,5-Dichloronaphthalene-1-sulfonyl chloride	117		229							
181	2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonyl chloride	117.8		206-8	205.7						
182	6-Ethoxynaphthalene-1-sulfonyl chloride	118		154	194.5						
183	4,6-Dichloronaphthalene-1-sulfonyl chloride	119		226							
184	5-Methoxynaphthalene-1-sulfonyl chloride	119.5		194.5	157						
185	5-Methylnaphthalene-2-sulfonyl chloride	120.2		188.9	248-50, 133-4						
186	8-Bromonaphthalene-2-sulfonyl chloride	121		187							
187	5-Ethoxynaphthalene-1-sulfonyl chloride	121		182.5	130						
188	2-Methoxynaphthalene-1-sulfonyl chloride	121		159	196.5						
189	1-Nitronaphthalene-2-sulfonyl chloride	121, pink, bz-pet eth	105, lgr	214	202						
190	6,8-Dichloronaphthalene-2-sulfonyl chloride	121		228							
191	2-Chloro-5-methyl-6-nitrobenzene sulfonyl chloride	122		177							
192	Anthracene-2-sulfonyl chloride	122		261	201						
193	5-Fluoronaphthalene-1-sulfonyl chloride	122-3	105 (hyd.)	196.7							
194	4,6-Dichlorobenzene-1,3-disulfonyl chloride	123		276							
195	Azobenzene-3,4'-disulfonyl chloride	123.5		di 288							
196	7,8-Dichloronaphthalene-2-sulfonyl chloride	124		227							
197	4-Iodonaphthalene-1-sulfonyl chloride	124, 121		206, 204	136						
198	6-Bromonaphthalene-2-sulfonyl chloride	124		127							
199	Quinoline-8-sulfonyl chloride	124	312	183-4							
200	4-Methylnaphthalene-2-sulfonyl chloride	124.5		143-4							
201	1,5-Dichloronaphthalene-1-sulfonyl chloride	125		282							
202	2,4,6-Trimethylbenzene-1,3-disulfonyl chloride	125		di 244	di 150.1						
203	5-Nitronaphthalene-2-sulfonyl chloride	125	118-9, yel	184							
204	6-Nitronaphthalene-1-sulfonyl chloride	127		223-4							
205	Phenanthrene-9-sulfonyl chloride	127	174 (anh.)	193-4				235			
206	Naphthalene-1,6-disulfonyl chloride	129	125 (anh.)	298			81, 235	314-5	298-9	323-4	Me ester, 106, me al., Et ester, 108 al
207	7-Chloronaphthalene-1-sulfonyl chloride	129		235							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Amide	Anilide	1 Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzyl thionium	p-Toluidine	Aniline	o-Toluidine	
208	4,6-Dichloronaphthalene-2-sulfonyl chloride	130		218							
209	2,4,5-Trimethoxybenzenesulfonyl chloride	130		76	170						
210	4,6-Dimethylbenzene-1,3-disulfonyl chloride	130, pet eth		249, w	196, 50% al						
211	5,6,7-Trichloronaphthalene-1-sulfonyl chloride	131		249							
212	Benzene-1,4-disulfonyl chloride	131-139		288	249						
213	5,8-Dichloronaphthalene-2-sulfonyl chloride	134		244							
214	3,7-Dichloronaphthalene-1-sulfonyl chloride	136		269							
215	3-Bromocamphor-8-sulfonyl chloride	136-7									
216	8-Chloro-7-methoxynaphthalene-1-sulfonyl chloride	137		153	196						
217	Benzophenone-3,3-disulfonyl chloride	137-8		dt 157	dt 177-8						N-Xanthylsulfonamide, 197
218	Naphthalene-1,3-disulfonyl chloride	137.5		dt 292-3							
219	7,8-Dichloronaphthalene-1-sulfonyl chloride	138		221							
220	Azoxybenzene-3,3'-disulfonyl chloride	138	126	dt 273							
221	D-Camphor-8-sulfonyl chloride	138		137							
222	3-Methoxynaphthalene-2-sulfonyl chloride	138		113	174						
223	8-Cyanonaphthalene-1-sulfonyl chloride	139		333-4							
224	4-Nitronaphthalene-2-sulfonyl chloride	139.5		225							
225	6-Iodonaphthalene-2-sulfonyl chloride	140		222							
226	8-Iodonaphthalene-1-sulfonyl chloride	140	115	187							
227	4-Nitronaphthalene-2,7-disulfonyl chloride	140-1		286-7							
228	4-Hydroxybenzenesulfonyl chloride	141		176-7			169	202	170	192	
229	4,8-Dichloronaphthalene-2-sulfonyl chloride	141		205							
230	5-Iodonaphthalene-1-sulfonyl chloride	141		239							
231	Pyridine-3-sulfonyl chloride	Hydro chloride, 141-4	357	110-1	145						Hydrazide, 94
232	6,7-Dichloronaphthalene-1-sulfonyl chloride	142		268							
233	Benzene-1,2-disulfonyl chloride	143		254	241						
234	6-Ethoxy-1-nitronaphthalene-2-sulfonyl chloride	146		218							
235	Retene-6-sulfonyl chloride	146-7.5, yel-br	121-3	206-7.5							
236	7-Bromonaphthalene-1-sulfonyl chloride	147		209							
237	4-Acetamidobenzenesulfonyl chloride	149		219	214	215					
238	5,7-Dichloronaphthalene-1-sulfonyl chloride	149		272							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1-Naphthyl amide	Salts of the corresponding acid				Miscellaneous
							S-Benzyl thiu ronium	p-Tolu-dine	Aniline	o-Tolu-dine	
239	4,5-Dibenzyl naphthalene-1-sulfonyl chloride	151		168							
240	4,7-Dichloronaphthalene-1-sulfonyl chloride	151		217							
241	7-Ethoxy-8-nitronaphthalene-1-sulfonyl chloride	155		173-4							
242	2-Amino-5-methylbenzene-1,3-disulfonyl chloride	156, chl		di 257, w	di 196-7, aq al						
243	Phenanthrene-2-sulfonyl chloride	156	150	253-4	157-8			291			
244	4,7-Dichloronaphthalene-2-sulfonyl chloride	156		196							Me ester, 101 Et ester, 89, yel -br
245	6,7,8-Trichloronaphthalene-2-sulfonyl chloride	157		245							
246	4,5-Dichloronaphthalene-2-sulfonyl chloride	158		197							
247	5,6,8-Trichloronaphthalene-2-sulfonyl chloride	158		235							
248	Naphthalene-2,7-disulfonyl chloride	158, 162		242			212	299	251-2	238	
249	Naphthalene-1,4-disulfonyl chloride	160-166		273, w, or al	179						
250	4-Carboxy-3-nitrobenzene-sulfonyl chloride	di 160	111 (+2½ H <sub>2</sub> O)	192							The m.p. is that of the 1,4-dichloride, Diamide, 226
251	7-Hydroxynaphthalene-1,3-disulfonyl chloride	161-2			195		228	294		271	
252	Fluorene-2-sulfonyl chloride	164	155 (hyd.)	213d							
253	2,5-Dimethylbenzene-1,4-disulfonyl chloride	164		310	223						
254	8-Nitronaphthalene-1-sulfonyl chloride	165 d	115 d (+3 H <sub>2</sub> O)	191	178-85						
255	7-Iodonaphthalene-1-sulfonyl chloride	165		240							
256	Azobenzene-3,3'-disulfonyl chloride	166		di 305							
257	3,6-Dichloronaphthalene-2-sulfonyl chloride	166		218							
258	5,6-Dichloronaphthalene-2-sulfonyl chloride	167		192							
259	Phthalic acid-4-sulfonyl chloride (3,4-Dicarboxybenzenesulfonyl chloride)	167-70, d eth	138-40 (+1 H <sub>2</sub> O)	192-200 d, w							
260	8-Nitronaphthalene-2-sulfonyl chloride	169	135-6 (+1½ H <sub>2</sub> O)	223	172-3						
261	4-Amino-2-hydroxybenzene-sulfonyl chloride	169		155							
262	2-Hydroxynaphthalene-1,7-disulfonyl chloride	169		233							
263	7-Nitronaphthalene-1-sulfonyl chloride	169-70		261-2							
264	4,6,7,8-Tetrachloronaphthalene-2-sulfonyl chloride	176		235							
265	4'-Nitrobiphenyl-4-sulfonyl chloride	178		228							
266	Naphthalene-1,5-disulfonyl chloride	183	245 (anh.)	310, 340	249		257, 251 d	332			Di-Me ester, 205, chl
267	Anthraquinone-2,7-disulfonyl chloride	186, chl			di 192						

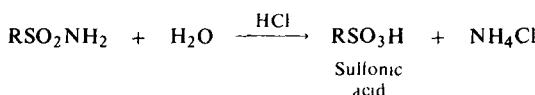
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIII. ORGANIC DERIVATIVES OF SULFONYL CHLORIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Amide	Anilide	1 Naph thyl amide	Salts of the corresponding acid				Miscellaneous
							S Benzyl thiuronium	p-Tolu dine	Aniline	o-Tolu dine	
268	Benzene-1,3,5-trisulfonyl chloride	187		tri 310 5	tri 237						Tri-Et ester, 147, bz
269	7-Hydroxynaphthalene-1,3,6-trisulfonyl chloride	196			152 5						
270	Anthraquinone-2-sulfonyl chloride	197		261	193		211	308	309		Me ester, 123, Et ester, 125
271	Anthraquinone-1,6-disulfonyl chloride	197 8, yel, PhNO <sub>2</sub>	215 7, gold		227 8, yel		171	330 d			
272	Biphenyl-4,4'-disulfonyl chloride	203		300							
273	Benzidine-2,2'-disulfonyl chloride	Hydro-chloride, 205		di 278							
274	Anthraquinone-1-sulfonyl chloride	216 8, yel, PhNO <sub>2</sub>	218		214		191		284		NH <sub>3</sub> → 1-Amino-anthraquinone, 252, 243
275	9,10-Dichloroanthracene-2-sulfonyl chloride	221		279	248						
276	Azobenzene-4,4'-disulfonyl chloride	222	169d (anh)	250 d							Et ester, 104
277	Anthraquinone-1,8-disulfonyl chloride	222 3, yel, PhNO <sub>2</sub>	293-4	>340	237-8, yel, PhNO <sub>2</sub>						
278	Anthracene-1,8-disulfonyl chloride	225		333	224						
279	Naphthalene-2,6-disulfonyl chloride	225		305			256		360		
280	2-Hydroxynaphthalene-1,5-disulfonyl chloride	231			231						
281	Anthracene-1,5-disulfonyl chloride	240		di 330	di 293						
282	Anthraquinone-2,6-disulfonyl chloride	250, yel cl bz			di 321						
283	Anthraquinone-1,3-disulfonyl chloride	265 70, yel	310 1 (hyd)	>350	269 70, yel -red						
284	2,4-Diaminobenzene-1,5-disulfonyl chloride	275		187	236						
285	Anthraquinone-1,7-disulfonyl chloride	301 2, br - yel, PhNO <sub>2</sub>	120 (hyd)		237-8, yel cl bz						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XXIV

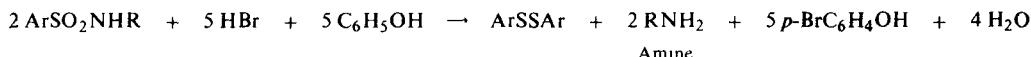
*Formation of sulfonic acid by hydrolysis \**

From hydrolysis of the sulfonamide by 25% hydrochloric acid.

For directions and examples see Cheronis, p. 631; Shriner, pp. 104, 267, R. S. Schreiber and R. L. Shriner, *J Amer Chem Soc*, **56**, 1618 (1934).

From hydrolysis of the sulfonamide in a mixture of concentrated sulfuric acid and 85% phosphoric acid.

See Cheronis, p. 633.

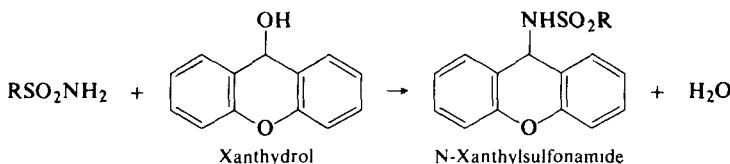
*Formation of the amine by hydrolysis*

From hydrolysis of the sulfonamide in 48% hydrobromic acid and phenol.

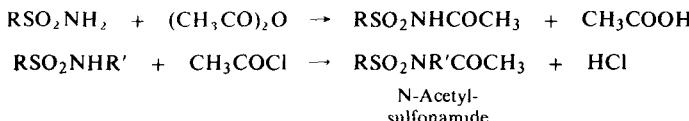
For directions and examples see Shriner, pp. 105, 267, H. R. Snyder and R. E. Heckert, *J Amer Chem Soc*, **74**, 2066 (1952); H. R. Snyder and H. C. Geller, *J Amer Chem Soc*, **74**, 4864 (1952).

NOTE For directions and explanations for the preparation of derivatives of the sulfonic acid formed by the hydrolysis of the sulfonamide see explanations and references to Table XXII, pp. 369, 370.

For directions and explanations for the preparation of the amine formed by the hydrolysis of the sulfonamide see explanations and references to Table XVIII, pp. 291, 292, 293

*N-Xanthylsulfonamide \**

From the sulfonamide and xanthylol in glacial acetic acid.

For directions and examples see Cheronis, p. 634; Linstead, p. 95; Shriner, p. 267; R. F. Phillips and V. S. Frank, *J Org Chem*, **9**, 9 (1944).*N-Acetylsulfonamide.*

From the sulfonamide and acetic anhydride.

For directions and examples see Cheronis, p. 634.

From the sulfonamide and acetyl chloride in acetic acid.

See Linstead, p. 95; Vogel, p. 555.

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\*

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
1	2-Methylpropane-1-sulfonamide	14-6		b p 80 <sup>13</sup>		38	107					
2	N,N-Diethylbenzylsulfonamide	29		92	105, w, al	102	166 (146)		113, al	102	83	
3	2-Methylpropane-1-sulfonanilide	38		b p 80 <sup>13</sup>	14-6		107					
4	3-Methylbutane-1-sulfonanilide	42		b p 98 <sup>13</sup>	3		90 1					
5	Butane-1-sulfonamide	45	-15	b p 75 <sup>10</sup>		10 5	60 5					
6	Propane-1-sulfonamide	52, eth	7 5	b p 78 <sup>15</sup>		10	84		67-8			
7	Ethane sulfonamide	58, eth	-17	b p 178		58	66	115				
8	Ethane sulfonanilide	58	-17	b p 178	58		66	115				
9	N,N-Diethyltoluene-4-sulfonamide	60	104-5	69	105 (dihyd.), 138 5-9 (anh)	103	157	181-2	198	238	190	Phenylhydrazinium salt, 114 5 Phenylhydrazinium salt, 204 5d Phenylhydrazinium salt, 182 8 Phenylhydrazinium salt, 182 8 <i>m</i> -Toluidide, 109
10	Propane-2-sulfonamide	60, eth - pet eth	-37	b p 61 <sup>9</sup>		84	134					
11	N-Ethyltoluene-4-sulfonamide	64	104-5	69	105 (dihyd.), 138 5-9 (anh)	103	157	181 2	198	238	190	
12	N-Ethylbenzyl sulfonamide	65-6, eth, lgr		92	105, w, al	102	166 (146)		113, al	102	83	
13	N-(1-Naphthyl)ethane sulfonamide	66	-17	b p 178	58	58		115				
14	Ethane-1,2-disulfonanilide	69		di 95, eth				201 2	d at 270	270, w		Di Et ester, 77, eth, <i>m</i> -Toluidide, 230
15	N-Methyltoluene-2-sulfonamide	74-5	57	68		136		170	203 4	218		
16	Heptane-1-sulfonamide	75		16								
17	2,4,5-Trimethoxybenzene sulfonamide	76		130		170						
18	2-Phenylethane-1-sulfonanilide	77	91	33	122							
19	N-Methyltoluene-4-sulfonamide	78 9	104-5	69	105 (dihyd.), 138 5-9 (anh)	103	157	181 2	198	238	190	
20	Propane-2-sulfonanilide	84		b p 61 <sup>9</sup>	60		134					
21	N-(1-Naphthyl)propane-1-sulfonamide	84	7 5	b p 78 <sup>15</sup>	52	10		67 8				
22	N,N-Dimethyltoluene-4-sulfonamide	86-7	104-5	69	105 (dihyd.), 138 5-9 (anh)	103	157	181 2	198	238	190	
23	Methane sulfonamide	90	20	b p 60 <sup>21</sup>		100 5	125 5					Phenylhydrazinium salt, 193 5-4d
24	N-(1-Naphthyl)-3-methylbutane-1-sulfonamide	90-1		b p 98 <sup>13</sup>	3	42						
25	4-Chloro-3-methylbenzene sulfonanilide	92		63	128							
26	Toluene-3-sulfonanilide	96		12	108			106				

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzyl thionium	p-Toluidinium	Anilinium	o-Toluidinium	
27	3-Chloro-4-methylbenzene sulfonanilide	96		38	134							
28	3,3-Dimethylbutane sulfonamide	96-7		43-4								
29	Hexadecane-1-sulfonamide	97	54	54								
30	2-Ethylbenzene sulfonamide	100		117								
31	10-Bromocamphor-3-sulfonamide	100-2		97								
32	Methane sulfonanilide	100.5	20	b p 60 <sup>21</sup>	90		125.5					
33	N,N-Dimethylbenzyl sulfonamide	101		92-3, eth, lgr	105, w, al	102, al	166 (146)	113, al	102	83		Phenylhydrazinium salt, 193.5-4d
34	Benzyl sulfonanilide (Toluene- $\alpha$ -sulfonanilide)	102, al		92	105, w, al		166 (146)	113, al	102	83		Hydrazide, 131.2, Phenylhydrazide, 173
35	Toluene-4-sulfonanilide	103	92 (104.5)	69	137			181.2	198	238	190	N-Xanthylsulfonamide, 197
36	4-Chlorobenzene sulfonanilide	104	69 (93)	53	144		190	175	208.10	222.3	163.4	
37	Benzyl sulfonamide (Toluene- $\alpha$ -sulfonamide)	105, w, al		92-3, eth, lgr		102, al	166 (146)	113, al	102	83		Hydrazide, 131.2, Phenylhydrazide, 173
38	N-(1-Naphthyl)-2-methylpropane sulfonamide	107		b p 80 <sup>13</sup>	14-6	38						
39	Toluene-3-sulfonamide	108, al		12		96			106		108	
40	2,4-Dimethyl-6-nitrobenzene sulfonamide	108	97									
41	2,4,6-Trimethylbenzene sulfonanilide	109	78	56	142							
42	N-Methylbenzyl sulfonamide	109-10		92-3, eth, bz	105, w, al	102, al	166 (146)	113, al	102	83		N-Xanthylsulfonamide, 203 N-Xanthylsulfonamide, 188, Hydrazide, 131.2, Phenylhydrazide, 173
43	2,4-Dimethylbenzene sulfonanilide	110	62 (hyd.)	34								
44	4-Ethylbenzene sulfonamide	110		12								N-Xanthylsulfonamide, 196
45	3-Hydroxynaphthalene-2-sulfonamide	110		112						241.2		
46	Pyridine-3-sulfonamide	110-1	357	Hydrochloride, 141-4 d		145						Hydrazide, 94
47	Naphthalene-1-sulfonanilide	112 (152)	90	68, 66	150			137	181	183	237	
48	Benzene sulfonanilide	112	66 (anh.)	14.5	156		170.1	148	205	240	176	N-Xanthylsulfonamide, 200
49	3-Methoxynaphthalene-2-sulfonamide	113		138		174						
50	2,6-Dimethylbenzene sulfonamide	113 (96)	98	39								
51	2-(N-Methylamino)benzene sulfonamide	114.5-5.5	182 d									2-N-p-Toluene-sulfonyl deriv of sulfonamide, 193

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	I-Naph-thyl amide	S-Benzyl thuronium	p-Tolu-dinium	Ani-linium	o-Tolu-dinium	
52	2-Nitrobenzene sulfon-anilide	115	70 (85)	69	193							
53	N-Benzyltoluene-4-sulfonamide	115.6	92	69	137			181-2	198	238	190	N-Xanthylsulfon-amide, 197
54	8-Methylnaphthalene-2-sulfonamide	116		88								
55	Indane-4-sulfonamide	118.9, w		53-35, b p 140-1 <sup>4</sup>								
56	4-Bromobenzene sulfon-anilide	119	88-90	76, eth	166, 161		183.5	170	215.6	237.8	182.3	
57	3,5-Dimethylbenzene sulfonanilide	119		94.90	135				121.2			
58	6-Methoxynaphthalene-2-sulfonanilide	120		93	189				d			
59	D-Camphor-10-sulfon-anilide	121	193	67	132							
60	7-Methoxynaphthalene-2-sulfonanilide	121		83	220							
61	2-Phenylethane-1-sulfonamide	122	91	33		77						
62	4-Formylbenzene sulfon-anilide	122.4										Oxime, 158, O,O-Diacetate of sulfonamide, 86-75
63	5-Nitronaphthalene-1-sulfonanilide	123		113	236							Me ester, 117.8, chl
64	2-Methylnaphthalene-1-sulfonamide	124		83.5								Me ester, 77, [α] <sub>D</sub> +98.6 in chl
65	D-Camphor-3-sulfon-anilide	124	77	88	143				196.7			
66	Biphenyl-4-sulfonanilide	125		115	230							5-N-Acetyl deriv of sulfonamide, 247 Sulfonyl bromide, 67.5
67	4-Fluorobenzene sulfon-amide	125		36.30								
68	N-(1-Naphthyl)methane sulfonamide	125.5	20	b p 60 <sup>21</sup>	90	100.5						
69	3-Nitrobenzene sulfon-anilide	126	48	64	167		166.5	146	222	222	193	
70	Phenol-O-sulfonanilide	126.5-7.5	145 (mono-hyd)						124.5	126.5	7.5	
71	5-Aminonaphthalene-2-sulfonanilide	127.8			219			191				
73	4-Chloro-3-methylbenzene sulfonamide	128		63		92						
74	6-Fluoronaphthalene-2-sulfonanilide	129	105 (hyd.)	97	133							
75	5-Ethoxynaphthalene-1-sulfonanilide	130		121	182.5							
76	3-Chloro-4-methoxybenzene sulfonamide	131		82								
77	4-Aminonaphthalene-2-sulfonamide	131 (hyd.)										
78	2,5-Dimethyl-4-nitro-benzene sulfonanilide	131	140	75	197-8				143.5	143.5	4.5	4-N-Acetyl deriv of sulfonamide, 220

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiourea	p-Toluidinium	Anilinium	o-Toluidinium	
79	3-Ethoxybenzene sulfonamide	131		38								
80	D-Camphor-10-sulfonamide	132	193	67		121 (88)						
81	Naphthalene-2-sulfonanilide	132	91 (hyg.)	76 79	217 213							
82	6-Fluoronaphthalene-2-sulfonamide	133	105 (hyd.)	97, chl		129		190 1	221	269	213	
83	DL-Camphor-8-sulfonamide	133 5 w	56 8	106								
84	3-Methyl-4-nitrobenzene sulfonamide	133 5		50								
85	3-Chloro-4-methylbenzene sulfonamide	134		38		96						
86	N-(1-Naphthyl)propane-2-sulfonamide	134	-37	b p 61 <sup>a</sup>	60	84						m-Toluidide, 109
87	3,5-Dimethylbenzene sulfonamide	135, al		94, 90, bz		129, al			121 2			
88	Tetraline-6-sulfonamide	135		58		155 6						
89	Indane-5-sulfonamide	135 5 6, al	92	46-7, eth b p 148 9 <sup>a</sup>		129, al						
90	Toluene-2-sulfonanilide	136	57	68	156			170	203 4	218		N-Xanthylsulfonamide, 183
91	4-Iodonaphthalene-1-sulfonanilide	136		124 121	206 204							
92	D-Camphor-8-sulfonamide	137		138								[α] <sub>D</sub> <sup>b</sup> +93 6, in al
93	4-Chloro-2-nitrobenzene sulfonanilide	138	82	75	237							
94	2,4-Dimethylbenzene sulfonamide	138	62 (hyd.)	34		110		146				N-Xanthylsulfonamide, 188
95	Toluene-4-sulfonamide	138 5 9 0 (anh.) 105 (dihvd.)	104 5	69		103	157	181 2	198	238	190	N-Xanthylsulfonamide, 197
96	8-Aminonaphthalene-1-sulfonanilide	139 40						300				
97	4-Vinylbenzene sulfonamide	139 40							182 3			Dimethylamide, 62 3
98	2-Bromonaphthalene-1-sulfonamide	140		97								
99	3,4-Dichlorobenzene sulfonamide	140, 135		22 4, 19								
100	2,4,6-Trimethylbenzene sulfonamide	142	78	56		109						N-Xanthylsulfonamide, 203
101	7-Ethoxynaphthalene-2-sulfonamide	142		103		153						
102	3-Aminobenzene sulfonamide	142						148				
103	3,5-Dimethyl-2-hydroxybenzene sulfonanilide	142 3	121 5									2-O-Acetyl deriv of sulfonyl chloride, 62, pet eth
104	D-Camphor-3-sulfonamide	143	77	88		124			196 7			N-Methylanilide, 111 2, Me ester, 77, [α] <sub>D</sub> +98 6 in chl
105	5-Chloro-2-methylbenzene sulfonamide	143	21, 24									

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthylamide	S-Benzylthiouronium	p-Toluidinium	Anilinium	o-Toluidinium	
106	4-Iodobenzene sulfonanilide	143		85	183							
107	2,5-Dimethyl-3-nitrobenzene sulfonanilide	143.4	128 (200)	61	173				135-6			126.5-7.5
108	4-Methylnaphthalene-2-sulfonamide	143.4		124.5								
109	Benzophenone-2-sulfonanilide	143.5		96.7								
110	4-Ethoxynaphthalene-2-sulfonanilide	143.5		85	183							
111	3,4-Dimethylbenzene sulfonamide	144	64 (55)	52				208				
112	4-Fluoronaphthalene-1-sulfonanilide	144	100 (hyd.)	86	206							Et ester, 93
113	4-Chlorobenzene sulfonamide	144	69 (93)	53		104	190	175	208-10	222.3	163.4	
114	4-Methyl-3-nitrobenzene sulfonamide	144.5	92 (hyg.)	36		109	153		130.1		28	
115	3-Chloro-6-methylbenzene sulfonamide	145, aq. al.		24								
116	Pyridine-3-sulfonanilide	145			110.1							
117	3-Bromocamphor-8-sulfonamide	145	195.6 (anh.)	136.7								
118	4-Chloronaphthalene-1-sulfonanilide	145.6	130.3	94.5	187		162			145.6	151	Me ester, 83 Et ester, 104
119	4-Bromo-3-methylbenzene sulfonamide	146		50								
120	4-Methoxy-3-nitrobenzene sulfonamide	146.3		66								
121	1-Aminonaphthalene-7-sulfonanilide	147			181 (hyd.)							
122	4-Methoxynaphthalene-2-sulfonanilide	147.5		98.5	226							Benzoylguanidine salt, 214.6
123	3-Chlorobenzene sulfonamide	148							199-200	206.7		
124	2-Methyl-5-nitrobenzene sulfonanilide	148	133.5	46-7	186				256.7		256.8	
125	2,5-Dimethylbenzene sulfonamide	148	48 (anh.) 86 (hyd.)	24.6				184				N-Xanthylsulfonamide, 176
126	Benzene-1,3-disulfonanilide	148.50		63	229		245	214				N-Xanthylsulfonamide, 170
127	6-Methoxynaphthalene-1-sulfonamide	149.5		80.5		177.5						
128	Naphthalene-1-sulfonamide	150	90	68, 66		112 (152)		137	181	183	237	
129	4-Ethoxybenzene sulfonamide	150		39								
130	4,6-Dichloro-2,5-dimethylbenzene sulfonamide	150		81		175						
131	3-Bromo-4-methylbenzene sulfonamide	151		60								
132	2-Hydroxynaphthalene-3,6,8-trisulfonanilide	152.5		tri 196								
133	7-Ethoxynaphthalene-2-sulfonanilide	153		103	142							
134	2-Chloronaphthalene-1-sulfonamide	153		75								

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzyl thionium	p-Toluidinium	Anilinium	o-Toluidinium	
135	8-Chloro-7-methoxynaphthalene-1-sulfonamide	153		137		196						
136	2-Aminobenzene sulfonamide	153						132				
137	5-Methylbenzene-1,3-disulfonanilide	153, al		94, eth	216, w							2-N Benzoyl deriv of sulfonamide 198, Hydro chloride, 201
138	6-Ethoxynaphthalene-2-sulfonanilide	153		107.5	183							
139	2-Iodonaphthalene-1-sulfonamide	154		110								
140	6-Ethoxynaphthalene-1-sulfonamide	154		118		194.5						
141	2,6-Dichloro-4-methylbenzene sulfonamide	154-5		56								
142	4-Chloro-2,5-dimethylbenzene sulfonanilide	155	100	50	185							
143	4-Amino-2-hydroxybenzene sulfonamide	155		169								
144	Tetraline-6-sulfonanilide	155.6		58	135							
145	Benzene sulfonamide	156 (153)	43.4 (mono-hyd), 66 (anh)	14.5				170.1	148	205	240	176
146	2-Chloro-5-methylbenzene sulfonamide	156		56		229-30.5						
147	D-3-Bromocamphor-10-sulfonamide	156	47.5	65								
148	Toluene-2-sulfonamide	156.3	57	68		136		170	203.4	218		
149	4-Methoxynaphthalene-2-sulfonamide	157		75.5	145							
150	5-Methoxynaphthalene-1-sulfonanilide	157		119.5	194.5							
151	N-(1-Naphthyl)toluene-4-sulfonamide	157	104-5	69	105 (dihyd.), 138.5.9 (anh)	103		181.2	198	238	190	
152	Benzophenone-3,3'-disulfonamide	157		di 137-8			di 177.8					
153	2,4-Dinitrobenzene sulfonamide	157, 154	106.8 (hyd), 130 (anh)	102								N-Xanthylsulfonamide, 197 Hydrazide 110
154	2-Methyl-4-nitrobenzene sulfonamide	157		106								
155	2-Nitrodiphenylamine-4-sulfonanilide	157	220d		162							
156	Phenanthrene-2-sulfonanilide	157.8	150	156	253-4				291			
157	4-Methylnaphthalene-1-sulfonanilide	158		81	174, 177							
158	2-Ethoxynaphthalene-1-sulfonamide	158		116		187						
159	4-Methoxynaphthalene-1-sulfonanilide	158		81	177							

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthyl amide	S Benzyl thiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
160	2-Ethoxybenzene sulfonamide	158		65 6	163							Phenylhydrazide, 132 3
161	2-Methoxynaphthalene-1-sulfonamide	159		121		196 5						
162	3-Nitrobenzylsulfonamide (3-Nitrotoluene- $\alpha$ -sulfonamide)	159d, w	74 (hyd.)	100 bz								Me amide, 106 7 Dimethylamide, 118 9
163	5-Amino-2-hydroxybenzene sulfonanilide	159 (98)	100 (anh.)		202 d							
164	5-Chloro-2-nitrobenzene sulfonamide	159		93								
165	2,5-Dichlorobenzene sulfonanilide	160	93 7	38	181			170				
166	3,5-Dimethyl-2-hydroxybenzene-1,4-disulfonamide	160 1		di 89 91								
167	6-Hydroxynaphthalene-2-sulfonanilide	161	129 (hyd.) 167 (anhyd.)		238			217 (207)	247	264	208	
168	2-Methylbenzene-1,3-disulfonanilide	162		88	260							
169	N-(1-Naphthyl)-4-chloronaphthalene-1-sulfonamide	162	130 3	94 5	187	145 6			145 6	151		Me ester, 83 Et ester, 104
170	2-Nitrodiphenylamine-4-sulfonamide	162	220 d			157						
171	7-Methylnaphthalene-1-sulfonanilide	162 4		96	197							
172	2-Ethoxybenzene sulfonamide	163		65 6		158						
173	7-Methylnaphthalene-2-sulfonamide	163 4		63 4								Phenylhydrazide, 132 3
174	3-Methyl-2-nitrobenzene sulfonamide	163 5		58 5								
175	5-Amino-2-methylbenzene sulfonamide	164				146 7						5-N-Acetyl deriv of sulfonamide, 242
176	4-Chloro-2-nitrobenzene sulfonamide	164		75		138						Phenylhydrazide, 151, Ph ester, 82
177	4-Nitrodiphenylamine-2-sulfonanilide	164		102 4	174							
178	4-Aminobenzene sulfonamide	165				200	196	185				
179	3,6-Dichloro-2,5-dimethylbenzene sulfonamide	165		71		171			172 4			
180	6-Aminonaphthalene-1-sulfonamide	165										Benzoylguanidine salt, 210 1
181	N-(1-Naphthyl)benzyl sulfonamide	166 (146)		92 3, eth, bz	105, w, al	102, al			113, al	102	83	Hydrazide, 131 2, Phenylhydrazide, 173
182	4-Bromobenzene sulfonamide	166, 161	88-90	76, eth		119	183 5	170	215-6	237-8	182-3	
183	5-Bromo-2-methylbenzene sulfonamide	166 7		33-5								
184	N-(1-Naphthyl)-3-nitrobenzene sulfonamide	166 5	48	64	167	126		146	222	126 5-7 5	193	
185	3-Nitrobenzene sulfonamide	167	48	64		126	166 5	146	222	126 5-7 5	193	

\*Derivative data given in order m.p. crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthylamide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
186	2,4-Dimethoxybenzene sulfonamide	167		70								
187	5-Chloro-2-methyl-3-nitrobenzene sulfonamide	167		60								
188	4-Hydroxynaphthalene-1-sulfonamide	167					199-200					
189	2,3-Dimethylbenzene sulfonamide	167		47								
190	4,6-Dichloro-2-methylbenzene sulfonamide	168		43								
191	4-Chloronaphthalene-2-sulfonamide	168		106								Ester, 76-9
192	4,5-Dibenzylnaphthalene-1-sulfonamide	168		151								
193	4-Bromo-2-methylbenzene sulfonamide	168		50								
194	Propane-1,3-disulfonamide	169, w	92 d	di 45			di 125					Di- <i>m</i> -toluidide, 222, Di-hydrazone, 105
195	Propane-1,1-disulfonamide	169-70					151-2, al					
196	2,4,5-Trimethoxybenzene sulfonanilide	170		130	76							
197	4-Acetamidonaphthalene-1-sulfonanilide	170			241							
198	4-Ethoxynaphthalene-1-sulfonamide	170		103			180					
199	3-Carboxybenzene sulfonamide	di 170	98 (hyd.), 148 (anh.)	di 20				163	224-6			
200	4-Methyl-2-nitrobenzene sulfonamide	170		98-9								<i>o</i> -Anisidine, 135
201	N-(1-Naphthyl)benzene sulfonamide	170-1	43-4 (mono-hyd), 66 (anh.)	145	156	112		148	205	240	176	Me ester, b p 150 <sup>15</sup> , N-Xanthylsulfonamide, 200
202	3,6-Dichloro-2,5-di-methylbenzene sulfonanilide	171		71	165							
203	5-Aminonaphthalene-1-sulfonanilide	171			260			179				
204	4-Nitrobenzene sulfonanilide	171 (136)	109-11 (95)	80, lgr	180				179-80			
205	2,4-Dimethyl-3-nitrobenzene sulfonamide	172	144 (anh.)	96								
206	8-Nitronaphthalene-2-sulfonanilide	172-3	135-6 (hyd.)	169	223							
207	2,5-Dimethyl-3-nitrobenzene sulfonamide	173	128 (200)	61		143-4			136			
208	4-Nitrodiphenylamine-2-sulfonamide	173		102-4			164					
209	7-Ethoxy-8-nitro-naphthalene-1-sulfonamide	173-4		155								
210	2,5-Dimethylbenzene-1,3-disulfonanilide	174, al		81, lgr	295, al							
211	3-Methoxynaphthalene-2-sulfonanilide	174		138	113							
212	3,4-Dibromobenzene sulfonamide	175	66.5-7.5 (anhyd.)	34								

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naph-thyl-amide	S-Benzyl-thiuronium	p-Tolu-dinium	Ani-linium	o-Tolu-dinium	
213	<b>4,6-Dichloro-2,5-di-methylbenzene sulfonanilide</b>	175		81	150							
214	<b>4-Chloro-3-nitrobenzene sulfonamide</b>	175 6, yel. al		40 1 (60 2)								
215	<b>7-Chloronaphthalene-2-sulfonamide</b>	176	68 (tetra-hyd ) 118 (anhyd )	87								Me ester, 89, Et ester, 65
216	<b>3-Amino-4-methylbenzene sulfonamide</b>	176										3-N-Benzoyl deriv of sulfonamide, 203, 3-N-Acetyl deriv of sulfonyl chloride, 144, 3-N-Benzoyl deriv of sulfonyl chloride, 196
217	<b>4-Bromo-3-nitrobenzene sulfonamide</b>	176-7		55 7								
218	<b>4-Hydroxybenzene sulfonamide</b>	176 7		141					169	202	170	192
219	<b>5-Methylnaphthalene-1-sulfonamide</b>	176 8	115									
220	<b>4-Methylnaphthalene-1-sulfonamide</b>	177 d 174		81, lgr		158						
221	<b>2-Chloro-5-methyl-6-nitrobenzene sulfonamide</b>	177		122								
222	<b>Benzophenone-3,3-disulfonanilide</b>	177 8		dt 137 8	dt 157							
223	<b>6-Methoxynaphthalene-1-sulfonanilide</b>	177 5		80 5	149 5							
224	<b>Acenaphthene-5-sulfonanilide</b>	178		111	223							
225	<b>2-Methylbenzene-1,4-disulfonanilide</b>	dt 178		98	224							
226	<b>8-Nitronaphthalene-1-sulfonanilide</b>	178 8 5	115 (trihyd )	165 d	190 5 15							
227	<b>Naphthalene-1,4-disulfonanilide</b>	179		160 (166)	273, w, al							
228	<b>4-Nitrobenzene sulfonamide</b>	180, 50°, al	109 11 (95) (hyg.)	80, lgr		171 (136) d			179 80			
229	<b>4-Ethoxynaphthalene-1-sulfonanilide</b>	180		103	170							
230	<b>3,4-Dimethyl-5-nitrobenzene sulfonamide</b>	180		70								
231	<b>3-Chloro-2-methylbenzene sulfonamide</b>	180 w	60-72	72, pet eth								
232	<b>2-Aminonaphthalene-8-sulfonamide</b>	181 (hyd )				147						
233	<b>2,5-Dichlorobenzene sulfonamide</b>	181	93 7 (>100)	38		160	160	170	247-8	262-3	250-1	1-N-Acetyl deriv of sulfonamide, 213, Benzoyl-guanidine salt, 214-6
234	<b>2,4,5-Trimethylbenzene sulfonamide</b>	181	112	61								.

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naph thyl-amide	S-Benzyl thium	p-Tolu dium	Anilinium	o Tolu dium	
235	5-Chloro-4-methyl-2-nitrobenzene sulfonamide	181	128	99								
236	2,4-Dichlorobenzene sulfonamide	182	86	55					204 6		170 2	
237	2,5-Dimethyl-6-nitrobenzene sulfonanilide	182	145 (anh.)	110	192				158 5 9, al		143 5, 50°, al	
238	5-Ethoxynaphthalene-1-sulfonamide	182.5		121		130						
239	6-Ethoxynaphthalene-2-sulfonamide	183		107.5		153						
240	4-Iodobenzene sulfonamide	183		85		143						
241	4-Ethoxynaphthalene-2-sulfonamide	183		85		143.5						
242	Quinoline-8-sulfonamide	183-4	312	124								
243	4,5-Dichloro-3-methylbenzene sulfonamide	183.5		85.8								
244	N-(1-Naphthyl)-4-bromobenzene sulfonamide	183.5	88-90	76, eth	166 161	119		170	215 6	237-8	182 3	
245	6-Chloronaphthalene-2-sulfonamide	184		110.5								
246	5-Nitronaphthalene-2-sulfonamide	184	118.9, yel	125						260 d		
247	8-Chloronaphthalene-2-sulfonamide	185		94								
248	4-Chloro-2-methylbenzene sulfonamide	185		54								
249	4-Chloro-2,5-dimethylbenzene sulfonamide	185	100	50		155						
250	2-Carboxy-5-methylbenzene sulfonamide (4-Toluic acid-2-sulfonamide)	185	190 (158) (anh.)	di 59								
251	2-Chloro-5-nitrobenzene sulfonamide	185-6	168-9 d (hyd.)	90, w								
252	2-Bromobenzene sulfonamide	186, w		51, eth								
253	3,5-Dichloro-2-methylbenzene sulfonamide	186		54								
254	2-Methyl-5-nitrobenzene sulfonamide	186	133.5 (dihyd.)	46-7, b p 183-5 <sup>10</sup>		148			256-7		256-8	
255	2-Chloro-4-methylbenzene sulfonamide	186		46, 52								
256	4-Methylbenzene-1,3-disulfonamide (Toluene-2,4-disulfonamide)	186-7 (191)		54, 46		189			277 d	di 189	di 170-1	Di-m-toluidide, 138
257	2-Ethoxynaphthalene-1-sulfonanilide	187		116	158							
258	4-Chloronaphthalene-1-sulfonamide	187	130.3 d	94-5		145-6	162			145-6	151	Me ester, 83, Et ester, 104
259	8-Iodonaphthalene-1-sulfonamide	187	115	140								

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naph-thyl amide	S-Benzyl thium	p-Toluinium	Anilinium	o-Toluinium	
260	2,4-Dimethyl-5-nitrobenzene sulfonamide	187 (179)	132 (122) dil HNO <sub>3</sub>	98								Sulfonyl chloride, 109-10
261	2,4-Diaminobenzene-1,5-disulfonamide	187		275		236						
262	8-Bromonaphthalene-2-sulfonamide	187		121								
263	2-Chlorobenzene sulfonamide	188		28.5								
264	4-Nitronaphthalene-1-sulfonamide	188		99								
265	2,6-Dichloro-3-methylbenzene sulfonamide	188		19.5								
266	5-Methylnaphthalene-2-sulfonamide	188.9		120.2		248.50 (133.4)						
267	4-Methylbenzene-1,3-disulfonanilide	189		54, 46	186-7							
268	6-Methoxynaphthalene-2-sulfonamide	189		93		120						
269	Sulfanilylguanidine (Sulfaguanidine)	189.90 (anh.), 143 (hyd.)										4-N-Acetyl deriv of sulfonamide, 262.6 (248.51) Hydrochloride, 205.6
270	N-(1-Naphthyl)-4-chlorobenzene sulfonamide	190	69 (93)	53	144	104		175	208-10	222.3	163.4	
271	2,4-Dibromobenzene sulfonamide	190	110 (anh.)	79, eth								
272	4-Methylbenzene-1,2-disulfonanilide (Toluene-3,4-disulfonanilide)	190		109.11	237.9							
273	Phenanthrene-3-sulfonamide	190	175-6 (anh.), 120-1 (mono-hyd.), 88 d (dihyd.)	110.1				222				Me ester, 119.20, al Et ester, 107-8
274	4-Aminonaphthalene-1-sulfonanilide	190										4-N-Acetyl deriv of sulfonamide, 247
275	8-Nitronaphthalene-1-sulfonamide	191	115 d (trihyd.)	165 d		178-85						
276	2-Hydroxynaphthalene-1,6-disulfonanilide	191		di 111								
277	3,5-Dichloro-4-methylbenzene sulfonamide	191		69								
278	Sulfapyridine	191-2										4-N-Acetyl deriv of sulfonamide, 226.7, acet
279	Anthraquinone-2,7-disulfonanilide	192		di 186 chl								
280	4-Carboxy-3-nitrobenzene sulfonamide (2-Nitrobenzoic acid-4-sulfonamide)	192	111 (+2½ H <sub>2</sub> O)	di 160								Diamide, 226
281	Quinoline-6-sulfonamide	192	>260	91								
282	5,6-Dichloronaphthalene-2-sulfonamide	192		167								

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzyl thiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
283	<b>Anthraquinone-2,7-disulfonamide</b>	192		186								
284	<b>2,5-Dimethyl-6-nitrobenzene sulfonamide</b>	192	145 (anh.)	110		182			158 5			143 5, 50° <sub>o</sub> al
285	<b>2-Amino-5-methylbenzene-1,3-disulfonanilide</b>	192		156	257							
286	<b>Methane disulfonanilide</b>	192 3	220 7 <sup>15</sup> d	8 b p 133 <sup>10</sup>	dt 233							
287	<b>3,4-Dicarboxybenzene sulfonamide (Phthalic acid-4 sulfonamide)</b>	192 200 d w	138 40 (mono-hyd.)	167 70 d eth								
288	<b>2-Nitrobenzene sulfonamide</b>	193	70 (85)	69		115						
289	<b>Anthraquinone-2-sulfonanilide</b>	193		197	261				211	308	309	
290	<b>Phenanthrene-9-sulfonamide</b>	193 4	174 (anh.)	127						235		Me ester, 123 Et ester, 125 Me ester, 106, me al Et ester, 108. al
291	<b>2-Carboxybenzene sulfonanilide</b>	194 5	68 9 (hyd.) 134 (anh.)	79, pet eth				206	196 (200)	165	127 8	
292	<b>5-Methoxynaphthalene-1-sulfonamide</b>	194 5		119 5		157						
293	<b>6-Ethoxynaphthalene-1-sulfonanilide</b>	194 5		118	154							
294	<b>7-Hydroxynaphthalene-1,3-disulfonanilide</b>	195		161 2				228	294		271	
295	<b>4-Bromonaphthalene-1-sulfonamide</b>	195		87								
296	<b>7-Hydroxynaphthalene-1-sulfonanilide</b>	195						218	232	240	242	
297	<b>2,5-Dibromobenzene sulfonamide</b>	195	128 (anh.)	71								
298	<b>7-Methylnaphthalene-1-sulfonamide</b>	195 6		96		162 4						
299	<b>4,6-Dimethylbenzene-1,3-disulfonanilide</b>	196, 50° <sub>o</sub> al		130, pet eth	249, w							
300	<b>4,7-Dichloronaphthalene-2-sulfonamide</b>	196		156								
301	<b>N-(1-Naphthyl)-4-amino-benzene sulfonamide</b>	196			165	200		185				
302	<b>8-Chloro-7-methoxy-naphthalene-1-sulfonanilide</b>	196		137	153							
303	<b>5-Fluoronaphthalene-1-sulfonamide</b>	196 7	105 (hyd.)	122 3								Me ester, 118, eth
304	<b>2-Methoxynaphthalene-1-sulfonanilide</b>	196 5		121	159							
305	<b>8-Chloronaphthalene-1-sulfonamide</b>	197		101								
306	<b>4,5-Dichloronaphthalene-2-sulfonamide</b>	197		158								
307	<b>2,5-Dimethyl-4-nitrobenzene sulfonamide</b>	197 8	140	75		131			143 5 4 5		143 5 4 5	

\*Derivative data given in order m.p. crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
308	<b>Sulfamethazine (Sulfadimethylpyrimidine)</b>	198.9 (+½ H <sub>2</sub> O), pa yel	87.9	113.4		284.6						4-N-Acetyl deriv of sulfonamide, 249.50
309	<b>Acenaphthene-3-sulfonamide</b>	199										Me ester, 122.3, Et ester, 137.9, lgr
310	<b>4-Hydroxynaphthalene-1-sulfonanilide</b>	199-200	170		167			103	196	186.7	203.4	2-Naphthyl sulfonamide, 204
311	<b>4-Aminobenzene sulfonanilide</b>	200			165		196	185	109		132	4-N-Acetyl deriv of sulfonanilide, 214, Me ester, 92
312	<b>4,5-Dimethylbenzene-1,3-disulfonanilide</b>	200, al		79, yel	239							
313	<b>4-Chloro-3-methyl-5-nitrobenzene sulfonamide</b>	201		52								
314	<b>Anthracene-2-sulfonanilide</b>	201		122	261							Phenylhydrazide, 210, Me ester, 157, Et ester, 160
315	<b>5-Hydroxynaphthalene-1-sulfonanilide</b>	201	110.2 d									O-Acetyl deriv of sulfonyl chloride, 129
316	<b>2-Hydroxynaphthalene-3,6-disulfonanilide</b>	202						233	250	254	257	
317	<b>5-Amino-2-hydroxybenzene sulfonamide</b>	202 d	100 (anh.)			159 (98)						
318	<b>1-Nitronaphthalene-2-sulfonanilide</b>	202	105, grn	121, bz - pet eth	214							
319	<b>Sulfathiazole</b>	202.5										4-N-Acetyl deriv of sulfonamide, 256.7
320	<b>4-Nitrobenzyl sulfonamide (4-Nitrotoluene-<math>\alpha</math>-sulfonamide)</b>	204	71	90	220 d							
321	<b>Anthracene-1-sulfonamide</b>	205		90								
322	<b>4,8-Dichloronaphthalene-2-sulfonamide</b>	205		141								
323	<b>3-Amino-4-hydroxybenzene sulfonamide</b>	205 (170)	155-6 d									
324	<b>4-Hydroxybenzene-1,3-disulfonanilide (Phenol-2,4-disulfonanilide)</b>	205	>100 d	89	239							
325	<b>6-Methylnaphthalene-2-sulfonamide</b>	205-6		97.8								
326	<b>2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonanilide</b>	205-7		117-8	206-8							
327	<b>4-Iodonaphthalene-1-sulfonamide</b>	206, 204		124, 121		136						
328	<b>4-Fluoronaphthalene-1-sulfonamide</b>	206	100 (hyd.)	86		144						Et ester, 93
330	<b>4-Amino-3-nitrobenzene sulfonamide</b>	206.7		59-60								

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	I-Naphthylamide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
331	Retene-6-sulfonamide	206.75	121.3	146.75, yel-br 117-8								Me ester, 117.9, Et ester, 114-5
332	2,6-Dimethyl-4-hydroxybenzene-1,3-disulfonamide	206.8				205.7						
333	3,7-Diethylnaphthalene-1-sulfonamide	207		105.7								
334	6-Bromonaphthalene-2-sulfonamide	207		124								
335	7-Bromonaphthalene-1-sulfonamide	209		147								
336	4-Methoxybenzene-1,3-disulfonanilide	209		86	240							
337	7-Iodonaphthalene-2-sulfonamide	210		100								
338	4-(N-Methylamino)benzene sulfonamide	210.11	244.5d									p-Toluenesulfonate, benzdine salt, 255
339	2,4,6-Trichlorobenzene sulfonamide	210-2d		35.40								
340	4-Aminonaphthalene-1-sulfonamide	212				190						
341	6-Iodonaphthalene-1-sulfonamide	213		92.5								
342	Fluorene-2-sulfonamide	213d	155 (hyd.)	164								
343	Anthraquinone-1-sulfonanilide	214	218	216-8, yel., PhNO <sub>2</sub>				191		284		NH <sub>3</sub> → 1-Aminoanthraquinone, 252 (243)
344	1-Nitronaphthalene-2-sulfonamide	214	105, grn	121, pink, bz-pet eth		202						
345	4-Acetamidobenzene sulfonanilide	214		149	219		215					
346	6-Chloronaphthalene-1-sulfonamide	214		70								Et ester, 114-5
347	N-(1-Naphthyl)-4-acetamidobenzene sulfonamide	215		149	219	214						
348	2,5-Dichlorobenzene-1,3-disulfonamide	215.7		114								
349	5-Methylbenzene-1,3-disulfonamide	216, w		94, eth		153, al						
350	5-Chloronaphthalene-2-sulfonamide	216		115								
351	Naphthalene-2-sulfonamide	217, 213	91 (hyg.), (122)	76, 79		132		190.1	221	269	213	
352	4,7-Dichloronaphthalene-1-sulfonamide	217		151								
353	6-Bromonaphthalene-1-sulfonamide	217		77								
354	4,6-Dichloronaphthalene-2-sulfonamide	218		136								
355	7-Bromonaphthalene-2-sulfonamide	218		100								
356	3,6-Dichloronaphthalene-2-sulfonamide	218		166								

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzyl thiuronium	p-Toludinium	Antolinium	o-Toludinium	
357	6-Ethoxy-1-nitro-naphthalene-2-sulfonamide	218		146								
358	5-Aminonaphthalene-2-sulfonamide	218 9 d				127 8						
359	4-Acetamidobenzene sulfonamide	219		149			214	215				
360	5-Bromonaphthalene-2-sulfonamide	220		96								
361	4-Nitrobenzyl sulfonanilide (4-Nitrotoluene- $\alpha$ -sulfonanilide)	220 d	71	90	204							
362	7-Methoxynaphthalene-2-sulfonamide	220		83		121						
363	2,4,6-Tribromobenzene sulfonanilide	220 2 d	64	64	228							
364	7,8-Dichloronaphthalene-1-sulfonamide	221		138								
365	8-Hydroxynaphthalene-1-sulfonamide	222 d	107 (hyg.)									
366	6-Iodonaphthalene-2-sulfonamide	222		140								
367	2,5-Dimethylbenzene-1,4-disulfonanilide	223		164	310							
368	5,6-Dichloronaphthalene-1-sulfonamide	223		106								
369	Acenaphthene-5-sulfonamide	223		111		178						
370	6-Nitronaphthalene-1-sulfonamide	223-4		127								
371	2-Methylbenzene-1,4-disulfonamide	224		98		dt 178						
372	5-Chlorobenzene-1,3-disulfonamide	224		106								
373	Anthracene-1,8-disulfonanilide	224		225	333							
374	4-Nitronaphthalene-2-sulfonamide	225		139 5								
375	4,6-Dichloronaphthalene-1-sulfonamide	226		119								
376	4-Carboxamido-3-nitrobenzene sulfonamide (2-Nitrobenzamide-4-sulfonamide)	226	111 (+25 H <sub>2</sub> O)	dt 160	192							
377	5-Chloronaphthalene-1-sulfonamide	226		95		138						
378	4-Methoxynaphthalene-1-sulfonamide	226		98 5		147 5						
379	3,4-Di-iodobenzene sulfonamide	227, aq. al	122 5	82, bz - pet eth								
380	7,8-Dichloronaphthalene-2-sulfonamide	227		124								
381	Anthraquinone-1,6-disulfonanilide	227 8, yel	215 7, gold	197-8, yel., PhNO <sub>2</sub>								
382	2,3,4-Trichlorobenzene sulfonamide	227-30		64 5								

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	I Naphthyl amide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
383	3,4-Dichloro-2-methylbenzene sulfonamide	228		51-2								
384	4'-Nitrobiphenyl-4-sulfonamide	228		178								
385	2,4,6-Tribromobenzene sulfonamide	228	64	64		220-2 d						
386	8-Nitronaphthalene-2-sulfonamide	228-223	135.6 (+1.5 H <sub>2</sub> O)	169		172-3						
387	6,8-Dichloronaphthalene-2-sulfonamide	228		121								
388	Benzene-1,3-disulfonamide	229		63		148-50	245	214				N-Xanthylsulfonamide, 170, Alk fusion → resorcinol, 110
389	4,5-Dichloronaphthalene-1-sulfonamide	229		117								
390	Biphenyl-4-sulfonamide	230		115								
391	2,4-Di-iodobenzene sulfonanilide	230	167 (anh.)	77-8		125						Me ester, 78, al. Et ester, 52, al
392	2-Hydroxynaphthalene-1,5-disulfonanilide	231		di 231								
393	5-Bromonaphthalene-1-sulfonamide	232-3		95								
394	2-Hydroxynaphthalene-1,7-disulfonanilide	233		169								
395	Methane disulfonamide	233	b p 220 70 <sup>15-20</sup> d	di 8, b p 133 <sup>10</sup>		di 192-3						
396	2-Ethoxybenzene-1,4-disulfonamide	233		di 106-8								
397	3,5-Dinitrobenzene sulfonamide	235		99, chl., lgtr								
398	4-Aminobenzene-1,3-disulfonamide (Aniline-2,4-disulfonamide)	235, w	120 d									
399	7-Chloronaphthalene-1-sulfonamide	235		129								
400	5,6,8-Trichloronaphthalene-2-sulfonamide	235		158								
401	4,6,7,8-Tetrachloronaphthalene-2-sulfonamide	235		176								
402	5-Nitronaphthalene-1-sulfonamide	236		113		123						
403	4-Carboxamidobenzene sulfonamide	236	94 (hyd.) 260 (anh.)	di 57		di 252						
404	2,4-Diaminobenzene-1,5-disulfonanilide	236		275	187							
405	2,3-Dichloro-4-methylbenzene sulfonamide	237		41								
406	Benzene-1,3,5-trisulfonanilide	tri 237	>100	tri 187	tri 310-5							Tri-Et ester, 147, bz
408	Anthraquinone-1,7-disulfonanilide	237-8, yel., cl bz	120 (hyd.)	321-2, br-yel., PhNO <sub>2</sub>								
409	Anthraquinone-1,8-disulfonanilide	237-8, yel., PhNO <sub>2</sub>	293-4	222-3	>340							
410	4-Methylbenzene-1,2-disulfonamide	237-9		109-11		190						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1 Naphthyl amide	S-Benzyl thiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
411	6-Hydroxynaphthalene-2-sulfonamide	238	129 (hyd) 167 (anh)			161		217 (207)	248	264	208	
412	4-Hydroxybenzene-1,3-disulfonamide (Phenol-2,4-disulfonamide)	239	>100 d	89		205						
413	5-Iodonaphthalene-1-sulfonamide	239		141								
414	4,5-Dimethylbenzene-1,3-disulfonamide	239		79, yel		200, al						
415	7-Iodonaphthalene-1-sulfonamide	240		165								
416	4-Methoxybenzene-1,3-disulfonamide	240		86		209						
417	4-Aacetamidonaphthalene-1-sulfonamide	241				170						
418	Benzene-1,2-disulfonanilide	241		143	254			206				
419	5-Nitrobenzene-1,3-disulfonamide	242		di 97 8								
420	Naphthalene-2,7-disulfonamide	242		158 162				212	299	251-2	238	
421	2,4,6-Trimethylbenzene-1,3-disulfonamide	244		di 125		di 150 1						
422	5,8-Dichloronaphthalene-2-sulfonamide	244		134								
423	2,3,4,6-Tetrabromobenzene sulfonamide	245 d		96 5								
424	6,7,8-Trichloronaphthalene-2-sulfonamide	245		157								
425	N,N'-Di(1-naphthyl)benzene-1,3-disulfonamide	245		63	229	148 50		214				
426	Anthraquinone-1,5-disulfonamide	246 (350)	310 d	265-70		270 d						Alk fusion → resorcinol, 110, N-Xanthylsulfonamide, 170
427	1-Iodonaphthalene-2-sulfonamide	247		94								
428	9,10-Dichloroanthracene-2-sulfonanilide	248		221	279							
430	5-Methylnaphthalene-2-sulfonanilide	248-50		120-2	188 9							
431	4,6-Dimethylbenzene-1,3-disulfonamide	249, w		130, pet eth		196, 50% al						
432	Benzene-1,4-disulfonanilide	249		131 (139)	288							
433	5,6,7-Trichloronaphthalene-1-sulfonamide	249		131								
434	Naphthalene-1,5-disulfonanilide	249	245 (anh)	di 183	310 (340)			257 251d	332			Di-Me ester, 205, chl
435	1-Chloronaphthalene-2-sulfonamide	250	130 3d (anh)	84 5		171 2						
436	Azobenzene-4,4'-disulfonamide	250 d	169d (anh)	di 222								Et ester, 104
437	4-Carboxanilidobenzene sulfonanilide	252	94 (hyd), 260 (anh)	di 57	di 236							

\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthyl amide	S-Benzyl thionium	p-Toluidinium	Anilinium	o-Toluidinium	
438	<b>Phenanthrene-2-sulfonamide</b>	253.4	150	156		157.8			291			Me ester, 101-2, Et ester, 89, yel -br
439	<b>Benzene-1,2-disulfonamide</b>	254		143		241		206				
440	<b>2-Amino-5-methylbenzene-1,3-disulfonamide</b>	257		156		192						
441	<b>2-Amino-5-methylbenzene-1,4-disulfonamide</b>	257, w	290	di 156, chl		di 196-7, aq af	171		179			5-N-Acetyl deriv of sulfonamide, 231-2
442	<b>5-Aminonaphthalene-1-sulfonamide</b>	260			88		162					
443	<b>2-Methylbenzene-1,3-disulfonamide</b>	260			122		201					Me ester, 157, Et ester, 160
444	<b>Anthracene-2-sulfonamide</b>	261				197	193	211	308	309		Me ester, 123, Et ester, 125
445	<b>Anthraquinone-2-sulfonamide</b>	261				169.70						
446	<b>7-Nitronaphthalene-1-sulfonamide</b>	261-2										
447	<b>6,7-Dichloronaphthalene-1-sulfonamide</b>	268				142						
448	<b>3,7-Dichloronaphthalene-1-sulfonamide</b>	269				136						
449	<b>Anthraquinone-2,6-disulfonanilide</b>	269-70	310.11 (hyd)	265.70, yel	>350							
450	<b>Anthraquinone-1,5-disulfonanilide</b>	270 d	310 d	265-70	246 (350)							
451	<b>1-Bromonaphthalene-2-sulfonamide</b>	271			93							
452	<b>5,7-Dichloronaphthalene-1-sulfonamide</b>	272			149							
453	<b>Naphthalene-1,4-disulfonamide</b>	273, w, al			160 (166)		179					
454	<b>Azoxybenzene-3,3'-disulfonamide</b>	273	126	di 138								
455	<b>4,6-Dichlorobenzene-1,3-disulfonamide</b>	276			123							
456	<b>Benzidine-2,2'-disulfonamide</b>	278			Hydro-chloride, 205							
457	<b>9,10-Dichloroanthracene-2-sulfonamide</b>	279			221		248					
458	<b>1,5-Dichloronaphthalene-2-sulfonamide</b>	282			125							
459	<b>4-Nitronaphthalene-2,7-disulfonamide</b>	286-7			140.1							
460	<b>Azobenzene-3,4'-disulfonamide</b>	288			123.5							
461	<b>Benzene-1,4-disulfonamide</b>	288			131 (139)		249					
462	<b>Naphthalene-1,3-disulfonamide</b>	292.3			di 137.5							
463	<b>Anthracene-1,5-disulfonanilide</b>	293			di 240	di >330						
464	<b>2,5-Dimethylbenzene-1,3-disulfonamide</b>	295, al			81, lgr		174, al					

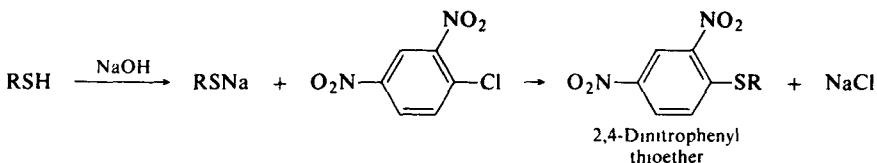
\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXIV. ORGANIC DERIVATIVES OF SULFONAMIDES AND SULFONANILIDES**  
 (Listed in order of increasing m.p.)\* (Continued)

No	Name	Melting point, °C	Sulfonic acid	Derivatives of the corresponding acid				Salts of the corresponding acid				Miscellaneous derivatives of the acid
				Chloride	Amide	Anilide	1-Naphthylamide	S-Benzylthiuronium	p-Toluidinium	Anilinium	o-Toluidinium	
465	Naphthalene-1,6-disulfonamide	298	125 (anh.)	129				81 (235)	314-5	298-9	323-4	
466	Naphthalene-1,7-disulfonamide	298-300	123									
467	Biphenyl-4,4'-disulfonamide	300	72	203				171	330 d			
468	Naphthalene-2,6-disulfonamide	305		225				256		360		
469	Azobenzene-3,3'-disulfonamide	305		di 166								
470	2,5-Dimethylbenzene-1,4-disulfonamide	310		164		223						
471	Naphthalene-1,5-disulfonamide	310 (340)	245 (anh.)	183		249		257, 251 d	332			Di-Me ester, 205, chl
472	Benzene-1,3,5-trisulfonamide	310-5	>100	tri 187		tri 237						Tri-Et ester, 147, bz
473	Anthraquinone-2,6-disulfonanilide	321		di 250, yel, cl bz	di 240		di 293					
474	Anthracene-1,5-disulfonamide	330										
475	Anthracene-1,8-disulfonamide	333		225		224						
476	8-Cyanonaphthalene-1-sulfonamide	333-4		139								
477	Anthraquinone-1,8-disulfonamide	>340	293-4	222-3, yel, PhNO <sub>2</sub>		237-8, yel, PhNO <sub>2</sub>						
478	Anthraquinone-1,3-disulfonamide	>350	310-11 (hyd.)	265-70, yel		269-70, red-yel						

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XXV

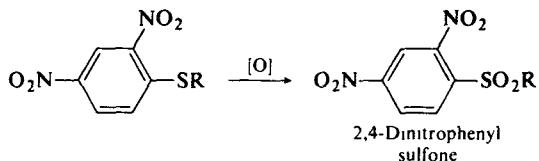
*2,4-Dinitrophenyl thioether (2,4-Dinitrophenyl sulfide).\**

From the sodium thiolate (prepared from the thiol and sodium hydroxide) and 2,4-dinitrochlorobenzene in methanol.

*For directions and examples see:* Cheronis, p. 642.

From the sodium thiolate and 2,4-dinitrochlorobenzene in aqueous or absolute alcohol.

*See:* Linstead, p. 86; Shriner, p. 255; Vogel, p. 500; Wild, p. 91; R. W. Bost, J. O. Turner and R. D. Norton, *J. Amer. Chem. Soc.*, **54**, 1985 (1932); R. W. Bost, J. O. Turner and M. W. Conn, *J. Amer. Chem. Soc.*, **55**, 4956 (1933).

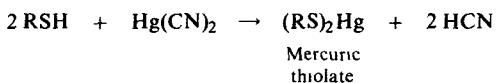
*2,4-Dinitrophenyl sulfone.\**

From the thioether (prepared from the thiol and 2,4-dinitrochlorobenzene) and potassium permanganate in aqueous or glacial acetic acid.

*For directions and examples see:* Cheronis, p. 641; Linstead, p. 87; Vogel, p. 501; Wild, pp. 91-2.

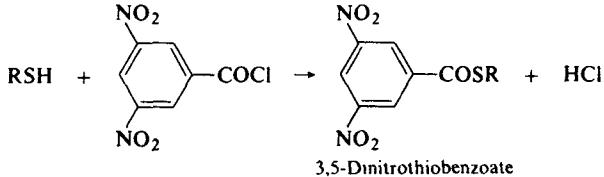
From the thioether with hydrogen peroxide, ammonium molybdate and perchloric acid in water.

*See:* Cheronis, p. 642.

*Hg salt.*

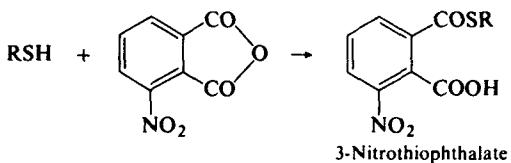
From the thiol and aqueous mercuric cyanide in ethanol.

*For directions and examples see:* Linstead, p. 86; Wild, pp. 90-91; E. Wertheim, *J. Amer. Chem. Soc.*, **51**, 3661 (1929).

*3,5-Dinitrothiobenzoate.\**

From the thiol, 3,5-dinitrobenzoyl chloride and pyridine.

*For directions and examples see:* Cheronis, p. 643; Shriner, p. 255; Vogel, p. 501; Wild, p. 92; E. Wertheim, *J. Amer. Chem. Soc.*, **51**, 3661 (1929).

*3-Nitrothiophthalate.\**

From 3-Nitrophthalic anhydride and the thiol.

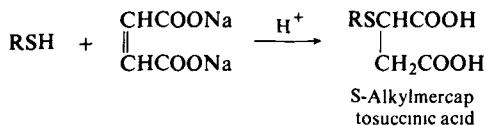
*For directions and examples see:* Wild, p. 93; E. Wertheim, *J. Amer. Chem. Soc.*, **51**, 3661 (1929).

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

## EXPLANATIONS AND REFERENCES TO TABLE XXV (Continued)

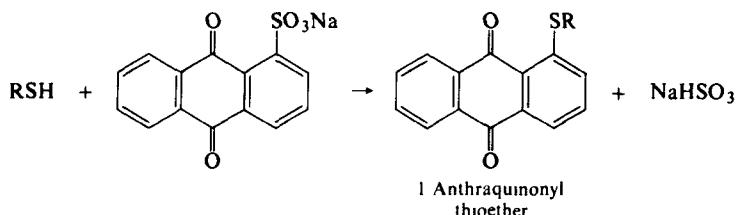
*S-Alkylmercaptopsuccinic acid (Alkylthiosuccinic acid) \**



From the thiol and disodium maleate in ethanol

For directions and examples see J G Hendrickson and L F Hatch, *J Org Chem*, **25**, 1747 (1960)

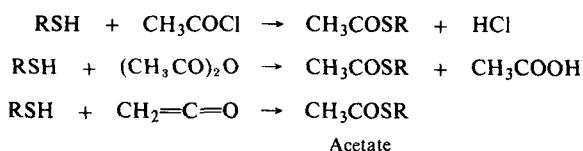
*1-Anthraquinonyl thioether*



From the thioether with sodium anthraquinone-1-sulfonate and sodium hydroxide in water

For directions and examples see E E Reid, C M MacKall and G E Miller, *J Amer Chem Soc*, **43**, 2104 (1921) W S Hoffman and E E Reid, *J Amer Chem Soc*, **45**, 1831 (1923) L M Ellis and E E Reid, *J Amer Chem Soc*, **54**, 1674 (1932)

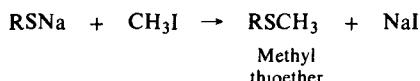
*Acetate*



From the thiol with acetyl chloride, or from the thiol with acetic anhydride and aqueous sodium hydroxide, or from the thiol with ketene

For directions and examples see A Schoberl and A Wagner in *Methoden der Organischen Chemie (Houben-Weyl)*, Vol 9 (Ed E Muller), Georg Thieme Verlag, Stuttgart, 1955, pp 753-756

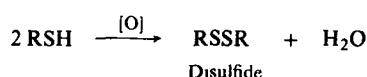
*Methyl thioether*



From the sodium thiolate with alkyl halide

For directions and examples see E E Reid, *The Chemistry of Bivalent Sulfur*, Vol 2, Chemical Publishing Co, New York, 1960, p 25

*Disulfide*



From the thiol (or thiophenol) with ferric chloride in aqueous acetic acid

For directions and examples see Linstead, p 87, Wild, p 95, T Zincke and W Frohneberg, *Chem Ber*, **43**, 840 (1910)

From the thiol with chlorine, bromine or iodine in hydrocarbon solvent

See E E Reid, *The Chemistry of Bivalent Sulfur*, Vol 1, Chemical Publishing Co, New York, 1958, p 124

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)**  
**a) Liquids (Listed in order of increasing atmospheric b.p.)\***

No	Name	Boiling point °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	2,4-Di-nitrophenyl thioether	2,4-Di-nitrophenyl sulfone	3,5-Di-nitrothiobenzoate	3-Nitrothiophthalate	1-Anthraquinonylthioether	Mercury salt	S-Alkylmercapto succinic acid	Disulfide	Miscellaneous
1	<b>Methanethiol (Methyl mercaptan)</b>	5 96	-123		0 8599 <sup>25</sup>	127 8	189 5			221	176	133	-84 72, b p 116 8	
2	<b>Ethanethiol (Ethyl mercaptan)</b>	36	-144 4	1 4318	0 83147 <sup>25</sup>	114-5	160	62	149	184	85	119 5	-101 4, b p 153 5	Acetyl, b p 114
3	<b>2-Propanethiol (sec-Propyl mercaptan)</b>	56	-130 7	1 4256	0 8142	93 5 50	140 5	84	145	134	63		-69 b p 176	
4	<b>2-Methyl-2-propane-thiol (tert-Butyl mercaptan)</b>	64 2	1 26	1 4230	0 7999	109 11						164	b p 200 1	Benzoyl, b p 110 <sup>28</sup>
5	<b>1-Propanethiol (n-Propyl mercaptan)</b>	67 5	-113 8	1 4348	0 8047	85-6 5	127 5	52	137	151	72	118 9	-85 59 b p 195-6	
6	<b>2-Butanethiol (sec-Butyl mercaptan)</b>	84 5	-165 0	1 4367	0 8294	65 6 60	120				189	135	b p 95 7 <sup>14</sup>	Benzoyl, b p 150 <sup>20</sup>
7	<b>2-Methyl-1-propane-thiol (Isobutyl mercaptan)</b>	88 72		1 4386	0 8357	74 5 50	105 5	63 4	136	144	95	120 9 1 4	b p 220	
8	<b>2-Propene-1-thiol (Allyl mercaptan)</b>	90 67 9		1 4680	0 93044	72	105	52					b p 174d	
9	<b>1-Butanethiol (n-Butyl mercaptan)</b>	98 100	-119 to -115	1 44402	0 8337	66	92	49	144	112 5	86	103 7-4 144 5	b p 226	Benzoyl, b p 160 <sup>23</sup>
10	<b>2-Pantanethiol (sec-Amyl mercaptan)</b>	112 9	-169	1 4386 <sup>25</sup>	0 82815 <sup>25</sup>								b p 122 3 <sup>10</sup>	
11	<b>2-Methoxyethanethiol</b>	113		1 4488 <sup>23</sup>		90								Acetyl, b p 110 <sup>110</sup>
12	<b>D,L-3-Methylbutane-thiol (Isoamyl mercaptan)</b>	117 118 20		1 44118	0 83475							115 6-6 0	b p 250	
13	<b>1-Phenylethane-1-thiol</b>	119 20		1 557	1 022		161					58		Acetyl, b p 123-5 <sup>13</sup>
14	<b>D-2-Methyl-1-butane-thiol</b>	119 21			0 8403 <sup>25</sup>	78 9					60	122 3-6	b p 122 3	[α] <sub>D</sub> <sup>23</sup> +3 21
15	<b>2-Chloropropanethiol</b>	125		1 4844	1 1062	76 7						b p 113-20 <sup>20</sup>		Acetyl, b p 70-1 <sup>9</sup>
16	<b>2-Chloroethanethiol</b>	125-6		1 5289	1 203	95 7						b p 170 80		Acetyl, b p 51 <sup>4</sup>
17	<b>2-Ethoxyethanethiol</b>	125 6		1 5795	0 9462	66						b p 150-2 <sup>15</sup>		
18	<b>1-Pantanethiol (n-Amyl mercaptan)</b>	126 64	-75 83	1 44366	0 8390	79 5 80 5	83	40	132	114	75	107 8	b p 140-5 <sup>17</sup>	PdCl <sub>2</sub> deriv , 41
19	<b>2-Hexanethiol (sec-Hexyl mercaptan)</b>	142 138 9	-147 0	1 4426 <sup>25</sup>	0 83050 <sup>25</sup>									
20	<b>1,2-Ethanedithiol (Ethylene dithioglycol)</b>	147, 46 7 <sup>16</sup>	-41 0	1 5550	1 1185 <sup>25</sup>	248								Di-Me eth , b p 183
21	<b>1-Hexanethiol (n-Hexyl mercaptan)</b>	151 2	-81 03	1 4490	0 8526	73 5 50	97			129	58	96 0-5		
22	<b>2-Hydroxyethanethiol</b>	158, 54 <sup>12</sup>		1 4443	1 1143	100 2					123		28	Diacetyl, b p 98-9, Dibenzoyl, 39, S-Phenylurethane, 59-60, bz

\*Derivative data given in order m p , crystal color, solvent from which crystallized

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)

a) Liquids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Boiling point, °C	Melting point, °C	$n_D^{20}$	$D_4^{20}$	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	3,5-Dinitrothiobenzoate	3-Nitrothiophthalate	1-Anthraquinonyl thioether	Mercury salt	S-Alkyl mercapto succinic acid	Disulfide	Miscellaneous
23	<b>Cyclohexanethiol</b> (Cyclohexyl mercaptan)	158–60		1.4933	0.9782	148	172				78	150.5–15	b p 288	
24	<b>cis-3-Methyl-1-cyclohexanethiol</b>	165		1.4647 <sup>25</sup>	0.916 <sup>25</sup>									$[\alpha]_{D}^{25}$ –2.24
25	<b>Thiophenol</b> (Mercaptobenzene)	169.5, 172.5	–14.9	1.5888	1.0780	121	161	149	131				66.5 61	4-Nitro-thiobenzoyl, 115.7–8, Phenyl-urethane, 128
26	<b>trans-3-Methyl-1-cyclohexanethiol</b>	171		1.4663 <sup>25</sup>	0.914 <sup>25</sup>									$[\alpha]_{D}^{25}$ +5.50
27	<b>2-Thiophenethiol</b>	171.1, 166		1.6021	1.168 <sup>19.5</sup>	119	143						56	Acetyl, b p 230.2
28	<b>1,3-Propanedithiol</b>	172.9	–79.0	1.5371 <sup>25</sup>	1.0775 <sup>25</sup>	194							b p 198 <sup>20</sup>	Diben-zoyl, 56.3
29	<b>1-Heptanethiol (n-Heptyl mercaptan)</b>	176.7	–43.4	1.4498 <sup>25</sup>	0.83891 <sup>25</sup>	81–2	101	53	96	132	77	105.8–6.2	b p 164 <sup>6</sup>	
30	<b>2-Octanethiol (sec-Octyl mercaptan)</b>	186.4	–79.0	1.4481 <sup>25</sup>	0.83293 <sup>25</sup>							b p 161–71 <sup>6</sup>		
31	<b>2-Thiocresol</b> (2-Tolu(en)thiol)	194.3	15			101, 98 95	155				170.3			S-4-Nitrobenzoyl, 90–1
32	<b>Phenylmethanethiol</b> (Benzyl mercaptan)	194.5			1.058	130, 128.5– 9.5	182.5	120	137			189– 90, 192	74, 70	Ph eth., 42
33	<b>3-Thiocresol</b> (3-Tolu(en)thiol)	195.4				100–15, 91	145							S-4-Nitrobenzoyl, 95–6, Ag deriv., 126–7
34	<b>1,4-Butanedithiol</b>	195.6	–53.9	1.5265 <sup>25</sup>	1.0395 <sup>25</sup>									Diben-zoyl, 49.5
35	<b>2-Phenylethanethiol</b>	199		1.5643 <sup>19</sup>	1.0318 <sup>18</sup>	93–45	133						b p 168– 80 <sup>15</sup>	Acetyl, b p 134.5 <sup>14</sup>
36	<b>1-Octanethiol (n-Octyl mercaptan)</b>	199.1	–49.2	1.4519 <sup>25</sup>	0.83956 <sup>25</sup>	78, 76– 75	98			95	71	96.1–6	b p 178– 83 <sup>5</sup> 90	
37	<b>2-Chlorothiophenol</b>	205												
38	<b>2,5-Dimethylthiophenol</b> ( <i>p</i> -Xylene-2-thiol)	211–2				1.2752 <sup>19.5</sup>	138							S-Ph eth., b p 172.5 <sup>11</sup> , S-4-Tolyl, eth., b p 188 <sup>11</sup>
39	<b>2,4-Dimethylthiophenol</b> ( <i>m</i> -Xylene-4-thiol)	214												S-Ph eth., b p 171 <sup>11</sup> , S-Benzyl eth., 35

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)

a) Liquids (Listed in order of increasing m.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	$n_D^{20}$	$D_4^{20}$	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	3,5-Dinitrothiobenzzoate	3-Nitrothiophthalate	1-Anthraquinonyl thioether	Mercury salt	S-Alkyl mercapto-succinic acid	Disulfide	Miscellaneous
40	2-Hydroxythiophenol (Thiocatechol)	216 7 <sup>51</sup> , 88 90 <sup>8</sup>	5-6		1 2373 <sup>0</sup>									O-Me eth , b p 218-9, Di-Me eth , b p 237
41	Bis(2-mercaptoethyl) ether	217	-80	1 5339	1 1648 <sup>25</sup>									4-Nitro- benzoyl, 106 5 Dibenzoyl, 45
42	1,5-Pentanedithiol	217 3, 110 <sup>16</sup>	-72 5											
43	1-Nonanethiol ( <i>n</i> - Nonyl mercaptan)	220 2	-20 1	1 45197	0 83714	86, 84 5	92			117 5		105-6 78, al	b p 211-2 <sup>8</sup>	
44	2-Isopropyl-5-methyl- benzenethiol (Thiethylmethyl)	230-1												S-Me eth , b p 244
45	5-Isopropyl-2-methyl- benzenethiol (Thiocarvacrol)	235-6			0 9975 <sup>17</sup> 0									
46	1,6-Hexanedithiol	237 1	-21 0	1 5077 <sup>25</sup>	0 9886 <sup>25</sup>									Dibenzoyl, 57
47	1-Naphthalenethiol ( $\alpha$ -Mercapto naphthalene)	285, 114 8 <sup>10</sup>		1 6802	1 1607									Benzyl eth , 78-80, 4-Nitro- benzoyl, 121-30, Acetyl, b p , 200-3 <sup>25</sup>

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point, °C	Boiling point °C	2,4-Dinitrophenyl thioether	2,4-Dinitrophenyl sulfone	Acetate	Benzoate	S-Alkyl mercapto-succinic acid	Disulfide	Methyl thio-ether	Miscellaneous
1	<b>3-Hydroxythiophenol (Thioresorcinol)</b>	17	168 <sup>15</sup>			<i>di</i> 78		95	15 b p 224 sl d	Di-Me eth , b p 224-5	
2	<b>Hexadecanethiol (Cetyl mercaptan)</b>	19	123-80 <sup>5</sup>	91, 96	105			105 65	55 5		D <sub>4</sub> <sup>a</sup> 0 9432 n <sub>D</sub> <sup>20</sup> 1 4940
3	<b>1,10-Decanedithiol</b>	20 17 8	297 1				<i>di</i> 57 55				D <sub>4</sub> <sup>a</sup> 1 1753, Oxime, 70, Phenyl- hydrazone, 90 1
4	<b>Benzoylmethanethiol (2-Mercapto-acetophenone)</b>	23 4	116 22 <sup>4</sup>					81			
5	<b>2-Aminothiophenol</b>	26	234, 125-7 <sup>b</sup>	152		<i>di</i> 135		93	b p 234 sl d		
6	<b>3-Phenylenedithiol (Dithioresorcinol)</b>	27 1	245 123 <sup>11</sup>								Trinitrobenzene add comp , 76 7
7	<b>4-Dimethylaminothiophenol</b>	28 5	259 60	176					118		
8	<b>2-Phenylenedithiol (Dithiocatechol)</b>	29	238 9			<i>di</i> 88 5	<i>di</i> 74 5 94-5				
9	<b>4-Hydroxybenzenethiol (Thiohydroquinone)</b>	30	144 6 <sup>20</sup>				S- 85 6, bz -lgr , <i>di</i> 66 tetra 73, me al	75, <i>di</i> 161		84 5	S-Et eth , 39-41
10	<b><i>threo</i>-Dithiothreitol (<i>threo</i>-2,3-Dihydroxy-1,4-dithiobutane)</b>	42 3	123-5 <sup>2</sup>								Oxid → <i>trans</i> -4,5-dihydroxy- <i>o</i> -dithiane, 132, Diisopropylidene deriv 78, me al
11	<b>4-Thiocresol (4-Toluenethiol)</b>	43-4	195	102 5 4	189 5	<i>di</i> 66	<i>di</i> 161				S-4-Tolyl deriv , 57 S-4-Nitrobenzoyl 114 5 S-Chloroacetyl, 40
12	<b>4-Chloro-1-naphthalenethiol</b>	43 4, al							122		
13	<b>4-Aminothiophenol</b>	46	140 5 <sup>16</sup>			N-mono 154 163, yel		82	b p 272 3		
14	<b>1,4-(Dimethylthio)-benzene (<i>p</i>-Xylylene dimercaptan)</b>	46-7	156 <sup>12</sup>				<i>di</i> 135				
15	<b>5-Amino-2-methylthiophenol</b>	47, bz - pet eth				<i>di</i> 125, yel , bz - pet eth			147 lgr	Tri-Me eth , b p 159	
16	<b>4-Chlorothiophenol</b>	54	123					163 4	73		
17	<b>2-Hydroxy-1-naphthalenethiol</b>	55, pet eth				O- 120, CCl <sub>4</sub> , <i>di</i> 57					
18	<b>1,3,5-Benzenetrithiol</b>	57 60				<i>tri</i> 73-4, al			<i>tri</i> 66 8, al		
19	<b>2-Nitrothiophenol</b>	58 61		131 3				199	64 5		
20	<b>1-Amino-2-propanethiol</b>	63 5						Dihydrochloride, 214		Hydrochloride, 87- 8, al Picrate, 143-4 d	
21	<b>4-Bromothiophenol</b>	75	231	142	190	51 2, me al		94 5	38, al	Benzenesulfonate, 75	
22	<b>3-Nitrothiophenol</b>	77			160			84			
23	<b>4-Nitrothiophenol</b>	77					123 7, 50% ac a	184	72		
24	<b>4-Nitro-1-naphthalenethiol</b>	77 9		193				189			
25	<b>2-Naphthalenethiol (2-Mercaptonaphthalene)</b>	81	286	145	228	53 5		139		4-Nitrobenzoyl, 183-4, 2-Tolyl eth , b p 229 5 <sup>11</sup>	

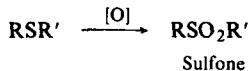
\* Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXV. ORGANIC DERIVATIVES OF THIOLS (MERCAPTANS)**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point °C	2,4-Dinitrophenyl ether	2,4-Dinitrophenyl sulfone	Acetate	Benzoate	S-Alkyl mercapto succinic acid	Disulfide	Methyl thioether	Miscellaneous
26	<b>DL-<i>erythro</i>-Dithiothreitol (<i>erythro</i>-2,3-Dihydroxy-1,4-dithiobutane)</b>	82 3, lt pet eth			tetra 126, bz						Oxid → <i>cis</i> -4,5-dihydroxy- <i>o</i> -dithiane, 132 Di-isopropylidene deriv., 145, pet eth $\text{CrO}_3/\text{AcOH} \rightarrow$ sulfone, 83
27	<b>4-Iodothiophenol</b>	85 6, al		140 5					124	45 38	
28	<b>4-Amino-1-naphthalenethiol</b>	91 3			N-mono 173			168			
29	<b>2-(3-Aminopropionamido)ethanethiol (Aletheine)</b>	93 6, subl 140 <sup>10</sup> s			di 139 40, et ac				.		Hydrochloride, 214 7, 95° al. Oxalate, 121 2, al
30	<b>Bis(4-mercaptophenyl)ether</b>	98			di 68						
31	<b>4-Phenylenedithiol (1,4-Dimercaptobenzene)</b>	98, aq al			di 126, pet eth				di 85, me al		Di-Et eth, 81 5, al
32	<b>2-Aminoethanethiol</b>	98 100	130	94 5	di 30				Dihydrochloride, 216		Hydrochloride, 70 2, al. Picrate, 126 S-Acetyl hydrochloride, 137
33	<b>Triphenylmethanethiol</b>	107		190		139-41	185		ca 155		
34	<b>4-Bromo-2-nitrothiophenol</b>	110		142					150	107 8, al	
35	<b>4-Biphenylthiol</b>	111 2, al		146	170						
36	<b>3-Amino-1-propanethiol</b>	112 3							Dihydrochloride, 219		Hydrochloride, 69, dil al
37	<b>1,8-Naphthalenedithiol</b>	113 4, al								di 84	
38	<b>4-Hydroxy-1-naphthalenethiol</b>	114			di 77						
39	<b>Bis(4-thiophenyl)sulfide</b>	114			di 65			190			
40	<b>2,4,6-Trinitrothiophenol</b>	114		217						di 250	
41	<b>1,5-Naphthalenedithiol</b>	118 21, yel			di 187-9	di 232					
42	<b>4-Chloro-2-nitrothiophenol</b>	120 2		141							
43	<b>2,4-Dinitrothiophenol</b>	131 2		193 7	240 1	107	113		280		
44	<b>6-Hydroxy-2-naphthalenethiol</b>	137, al				di 110, 107, al			221		
45	<b>2-Benzothiazolthiol</b>	177 9, aq me al								52, aq al	Et eth, 26 al
46	<b>2,7-Naphthalenedithiol</b>	181, 174, al				di 110	di 152-3				
47	<b>1-Anthraquinonethiol</b>	187, yel, ac a						>350.	218, yel, al		Benzyl eth, 241, yel, ac a
48	<b>2-Anthraquinonethiol</b>	206, yel, ac a							162, yel, ac a		Et eth, 138, yel, al, Benzyl eth, 138, yel, al
49	<b>2-Benzimidazolthiol</b>	298, 296 7, dil al									Benzyl eth, 186 7, 1-N-Me eth, 190-2

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLE XXVI

*Sulfone \**

From the thioether in glacial acetic acid with dilute aqueous potassium permanganate

*For directions and examples see* Cheronis, p 641, Linstead, p 87, G W Fenton and C K Ingold, *J Chem Soc*, 2338 (1929), H Rheinboldt and E Giesbrecht, *J Amer Chem Soc*, 68, 973 (1946)

From the thioether with aqueous hydrogen peroxide in acetone or in acetic acid

*See* O Hinsberg, *J prakt Chem*, 90, 350 (1914), H Rheinboldt and E Giesbrecht, *J Amer Chem Soc*, 68, 973 (1946), C G Overberger, S P Lightelm and E A Swire, *J Amer Chem Soc*, 72, 2856 (1950)

From the thioether with hydrogen peroxide and ammonium molybdate in aqueous perchloric acid

*See* Cheronis, p 641

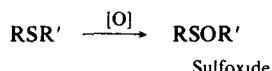
From the thioether with potassium bichromate and sulfuric acid in water

*See* G Raiziss, L W Clemence, M Severac and J C Moetsch, *J Amer Chem Soc*, 61, 2763 (1939)

From the thioether with chromic anhydride in glacial acetic acid

*See* C G Overberger, S P Lightelm and E A Swire, *J Amer Chem Soc*, 72, 2856 (1950)

For extensive lists of references for the oxidation of thioethers to the corresponding sulfones *see* A Schoberl and A Wagner in *Methoden der Organischen Chemie (Houben-Weyl)*, Vol 9, (Ed E Miller), Georg Thieme Verlag, Stuttgart, 1955, pp 227-231, E E Reid, *Organic Chemistry of Bivalent Sulfur*, Vol 2, Chemical Publishing Co, New York, 1960, pp 64-65

*Sulfoxide*

From the thioether with hydrogen peroxide in acetic acid, in acetone or in alcohol-acetic acid mixture

*For directions and examples see* O Hinsberg, *Chem Ber*, 43, 289 (1910), R L Shriner, H C Struck and W V Jorison, *J Amer Chem Soc*, 52, 2060 (1930), P Karrer, N J Antia and R Schwyzer, *Helv chim Acta*, 34, 1392 (1951)

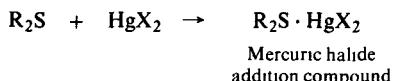
From the thioether with perphthalic acid in ether

*See* H Bohme, *Chem Ber*, 70, 378 (1937)

From the thioether with chromic anhydride in aqueous acetic acid

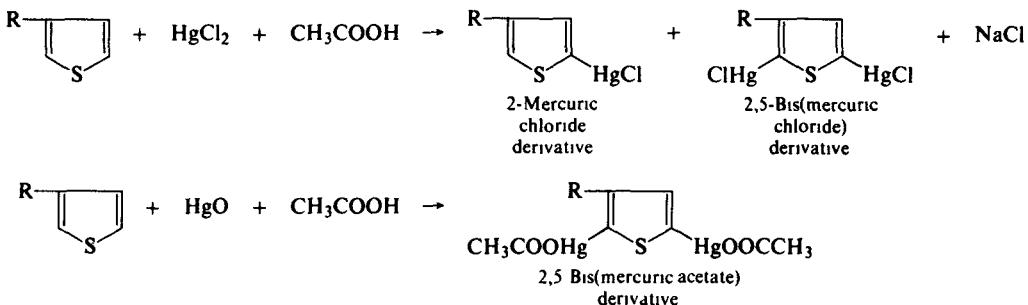
*See* R Knoll, *J prakt Chem*, 113, 40 (1926)

For additional references for the oxidation of thioethers to the corresponding sulfoxides *see* A Schoberl and A Wagner in *Modern Methoden der Organischen Chemie (Houben-Weyl)*, Georg Thieme Verlag, Stuttgart, 1955, pp 211-215

*Mercuric halide addition compound*

From the thioether with mercuric chloride, bromide or iodide in ethanol, acetone or aqueous solution

*For directions and examples see* W F Faragher, J C Morrell and S Comay, *J Amer Chem Soc*, 51, 2774 (1929), E E Reid, *Organic Chemistry of Bivalent Sulfur*, Vol 2, Chemical Publishing Co, New York, 1960.

*Mercuric halide or mercuric acetate derivative*

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

## EXPLANATIONS AND REFERENCES TO TABLE XXVI (Continued)

*These derivatives are for substituted thiophenes only.*

From the substituted thiophene with the mercuric salt (with or without sodium acetate) in ethanol or in acetic acid.

*For directions and examples see: H. D. Hartough, *Thiophene and its Derivatives*, (*The Chemistry of Heterocyclic Compounds*, Vol. 3), Interscience, London, 1952, pp. 444-453.*

*For various additional compounds of thioethers with metal salts see: E. E. Reid, *Organic Chemistry of Bivalent Sulfur*, Vol. 2, Chemical Publishing Co., New York, 1960, pp. 52-60.*

\*Derivatives recommended for first trial.

WARNING: This is not an instruction manual. References should be consulted for the preparation of derivatives.

TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)

a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)\*

No	Name	Boiling point, °C	Melting point, °C	$\eta_{D}^{20}$	D <sub>4</sub> <sup>20</sup>	Sulfone	Sulfoxide	Disulfide	Miscellaneous
1	Dimethyl sulfide (Methyl sulfide)	37.3	-98.27	1.4356	0.8458 <sup>21</sup>	109 b p 238	18.45 b p 189	109.7	Tri-HgCl <sub>2</sub> , add comp., 158 150 1, rapid htng HgI <sub>2</sub> , add comp., 75, SnBr <sub>4</sub> , add comp., 85-7, PtCl <sub>2</sub> , add comp. 159 PtBr <sub>2</sub> , add comp. 159 PdCl <sub>2</sub> , add comp., 130 PdBr <sub>2</sub> , add comp., 125 AgNO <sub>3</sub> , add comp., 126
2	Ethyl methyl sulfide	66.9	-104.8	1.4353	0.8483	36. eth		130	HgCl <sub>2</sub> , add comp., 128 HgI <sub>2</sub> , add comp. 59 PdCl <sub>2</sub> , add comp. 67
3	Methyl vinyl sulfide	67.3		1.4845	0.9026				
4	Divinyl sulfide (Vinyl sulfide)	84			0.9174				
5	Allyl methyl sulfide	91.3		1.4712	0.8767				
6	Diethyl sulfide (Ethyl sulfide)	92	-102.05	1.44233	0.8368	73.4 b p 248	4.6.15 b p 88 9 <sup>15</sup>	152.6 154	Disulfoxide 123 4 <sup>11</sup> Mono-HgCl <sub>2</sub> , add comp., 90 Di-HgCl <sub>2</sub> , add comp., 119.5 HgI <sub>2</sub> , add comp. 110 AgNO <sub>3</sub> , add comp., 122 SnCl <sub>4</sub> , add comp., 102 SnBr <sub>4</sub> , add comp. 84, PtCl <sub>2</sub> , add comp., 106 PtBr <sub>2</sub> , add comp., 118 PtI <sub>2</sub> , add comp. 136, PdCl <sub>2</sub> , add comp., 83 PdBr <sub>2</sub> , add comp., 100
7	Ethyl vinyl sulfide	92		1.4756	0.8756				
8	Isopropyl methyl sulfide	93.5, 85	-101.48	1.4392	0.8291				
9	Methyl <i>n</i> -propyl sulfide	95.5	-112.98	1.4442	0.8438				
10	<i>tert</i> -Butyl methyl sulfide	99		1.4402	0.8257				
11	Chloromethyl methyl sulfide	107.1		1.4967					
12	Ethyl isopropyl sulfide	107.3	-122.19	1.4407	0.8246				
13	Isobutyl methyl sulfide	112.5		1.4433	0.8335				
14	Methyl 2-methylallyl sulfide	113.0	2	1.4712					
15	Allyl ethyl sulfide	115.6			0.8676				
16	Ethyl <i>n</i> -propyl sulfide	118.5, 110.2	-117.04	1.4461	0.84448	25. b p 142 <sup>23</sup>		173.7	
17	Di-isopropyl sulfide (Isopropyl sulfide)	120.7	-78.08	1.4381	0.8135	36	68.5	176	PtCl <sub>2</sub> , add comp., 163 PtBr <sub>2</sub> , add comp., 174, PtI <sub>2</sub> , add comp., 176, PtI <sub>4</sub> , add comp., 139
18	<i>n</i> -Butyl methyl sulfide	122.5		1.4477	0.8427				HgCl <sub>2</sub> , add comp., 116.5
19	Chloromethyl ethyl sulfide	128				33			
20	Isopropyl propyl sulfide	132		1.4440	0.8269				
21	<i>sec</i> -Butyl ethyl sulfide	133.6		1.4477	0.8353				
22	Ethyl isobutyl sulfide	134.2		1.4452	0.8306				
23	Diallyl sulfide (Allyl sulfide)	139 <sup>758</sup> , 35 <sup>5-7</sup>	-83	1.4877 <sup>27</sup>	0.88765 <sup>27</sup>	b p 109 <sup>3</sup>	b p 107- 9 <sup>7-8</sup>	b p 78 80 <sup>16</sup>	HgCl <sub>2</sub> , add comp., 108
24	Methyl 2-methylbutyl sulfide	139-40			0.8410 <sup>19</sup>				
25	2-Chloroethyl methyl sulfide	140, 44 <sup>20</sup>		1.4908	1.1155				
26	Di- <i>n</i> -propyl sulfide ( <i>n</i> -Propyl sulfide)	141.2	-101.9	1.4481	0.8358	30	14.5.50, b p 82 <sup>15</sup>	194	Mono-HgCl <sub>2</sub> , add comp., 88.9 Di- HgCl <sub>2</sub> , add comp., 122.127.5 Chloroamine-T → sulthlimide, 110.15
27	<i>n</i> -Butyl ethyl sulfide	144.2	-95.13	1.4491	0.8376	50			
28	Methyl pentyl sulfide (Amyl methyl sulfide)	144.5-5.5		1.448	0.843			193	HgCl <sub>2</sub> , add comp., 127
29	Di- <i>tert</i> -butyl sulfide ( <i>tert</i> -Butyl sulfide)	150		1.4505				201, b p 88 <sup>21</sup>	
30	Diacetyl sulfide (Thioacetic anhydride)	155.8 d, 63 <sup>20</sup>		1.4810 <sup>21</sup>	1.124				Reduction → acetaldehyde, b p 20.2, 2,4-dinitrophenylhydrazone, 168
31	Dichloromethyl sulfide (Chloromethyl sulfide)	156.5	-54, -37	1.5313	1.4065	70.5-2.0			
32	2-Chloroethyl ethyl sulfide	157, 63-5 <sup>47</sup>		1.06644	1.4878				

\*Derivative data given in order m p, crystal color, solvent from which crystallized

**TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)**  
**a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Sulfone	Sulfoxide	Disulfide	Miscellaneous
33	<b>2-Aminoisopropyl methyl sulfide</b>	158				b p 140 <sup>4</sup>			
34	<b>Ethyl 3-methylbutyl sulfide</b>	160		1 4495	0 8349	13 5			HgCl <sub>2</sub> add comp , 87
35	<b>4-Chlorophenyl methyl sulfide</b>	170		1 6023 <sup>25</sup>	1 1224 <sup>25</sup>	57 8			Hydrochloride, 136, Picrate, 127,
36	<b>3-Aminopropyl methyl sulfide</b>	170				44, b p 165 8 <sup>6</sup>	197		Oxalate, 207d
37	<b>Di-isobutyl sulfide (Isobutyl sulfide)</b>	172 3		1 4463	0 8262	17, b p 265	68 5	215	Mono-HgCl <sub>2</sub> add comp , 116, Di-HgCl <sub>2</sub> add comp , 131, PtCl <sub>2</sub> add comp , (i) 83 (ii) 139, PtBr <sub>2</sub> add comp , 143 4 PtI <sub>2</sub> add comp , 187 PtCl <sub>4</sub> add comp , 162, AuCl <sub>3</sub> add comp , 87 PdCl <sub>2</sub> add comp , 95, PdBr <sub>2</sub> add comp , 140, PdI <sub>2</sub> add comp , 145
38	<b>Di-2-methylallyl sulfide (2-Methylallyl sulfide)</b>	173							
39	<b>Chloromethyl dichloromethyl sulfide</b>	177 2 <sup>753</sup>		1 5395	1 5258				
40	<b>Dicrotyl sulfide (Crotyl sulfide)</b>	186 5, 88 9 <sup>20</sup>		1 495 <sup>25</sup>	0 9032 <sup>0</sup>				
41	<b>Di-n-butyl sulfide (n-Butyl sulfide)</b>	188 0 182, 109 15 <sup>15</sup>	-79 7	1 45405	0 8386	44, resolidifies at 32 5	33	231	Di-HgCl <sub>2</sub> add comp 113 110 5 PtBr <sub>2</sub> add comp 65 PtI <sub>2</sub> add comp 67 PdCl <sub>2</sub> add comp , 32 Pd(NO <sub>2</sub> ) <sub>2</sub> add comp , 166, AgNO <sub>3</sub> add comp 98 Hydrochloride, 153 4, acet Picrate, 116 8
42	<b>4-Aminobutyl methyl sulfide</b>	188 90				42 b p 165 <sup>1</sup>			
43	<b>Di-dichloromethyl sulfide (Di-chloromethyl sulfide)</b>	189 62 4 <sup>10</sup>		1 5464	1 6273				
44	<b>Methyl phenyl sulfide</b>	194-6 78-9 <sup>13</sup>		1 5870	1 0533 <sup>25</sup>	88, w			
45	<b>2-Chloroethyl chloromethyl sulfide</b>	194 5 77 <sup>10</sup>		1 5311	1 338				
46	<b>Benzyl methyl sulfide</b>	195 8		1 5550 <sup>25</sup>		127, w			
47	<b>Ethyl phenyl sulfide</b>	205, 200-2		1 5701 <sup>15</sup>	1 024 <sup>15</sup>	42, b p 160 <sup>12</sup>			PdCl <sub>2</sub> add comp , 140
48	<b>Isopropyl phenyl sulfide</b>	208		1 5468	0 9855				PdCl <sub>2</sub> add comp , 162
49	<b>Methyl 4-tolyl sulfide</b>	211 2, 104-5 <sup>20</sup>		1 57537 <sup>16</sup>	1 0302 <sup>16</sup>	89, bz - pet eth	50-4		
50	<b>Di-(3-methylbutyl)sulfide (Isoamyl sulfide)</b>	215 3		1 4471	0 8285	31, b p 295		250	PdCl <sub>2</sub> add comp , 95 PdBr <sub>2</sub> add comp , 133 PdI <sub>2</sub> add comp , 143, SnCl <sub>4</sub> add comp , 64, SnBr <sub>4</sub> add comp , 45 6
51	<b>Allyl phenyl sulfide</b>	215-8, 104-6 <sup>25</sup>		1 5760	1 0275				
52	<b>Di-2-chloroethyl sulfide (2-Chloroethyl sulfide, Mustard gas, Yperite)</b>	217	14 4	1 53125	1 2741	56, b p 183 <sup>20</sup>	109-11		
53	<b>Phenyl propyl sulfide</b>	219-20		1 5571	0 9995	44			PdCl <sub>2</sub> add comp , 91
54	<b>Ethyl 4-tolyl sulfide</b>	220 1		1 5568	1 0016 <sup>17 5</sup>	55 6			Mono-HgCl <sub>2</sub> add comp , 84, Di-HgCl <sub>2</sub> add comp , 142
55	<b>Benzyl ethyl sulfide</b>	222 3, 98-9 <sup>13</sup>				84			PdCl <sub>2</sub> add comp , 97
56	<b>3-Methylbutyl phenyl sulfide</b>	240-2		1 5380	0 9681	36			
57	<b>2-Chloroethyl phenyl sulfide</b>	245, 121 <sup>15</sup>		1 5838	1 1799	45			
58	<b>2-Chloroethyl 4-tolyl sulfide</b>	255-7, 150-2 <sup>20</sup>				78			
59	<b>2-Hydroxyethyl 4-tolyl sulfide</b>	282-3, 119 20 <sup>1</sup>				55			
60	<b>Di-(3-tolyl)sulfide (m-Tolyl sulfide)</b>	290, 174 <sup>12</sup>				94	b p 215 <sup>15</sup>	b p 150 d	

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)**

a) Liquids 1) Noncyclic (Listed in order of increasing b.p.)\* (Continued)

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Sulfone	Sulfoxide	Disulfide	Miscellaneous
61	<b>Diphenyl sulfide (Phenyl sulfide)</b>	296, 157-8 <sup>18,5</sup>	-21.5	1.6312	1.1160	128-9, b.p. 379 80	70.5	61	Disulfone of the disulfide, 193-4
62	<b>Di-n-heptyl sulfide (n-Heptyl sulfide)</b>	298				34, 90			
63	<b>4-Chlorophenyl phenyl sulfide</b>	305-15d, 167-8 <sup>10</sup>							
64	<b>Phenyl 3-tolyl sulfide</b>	309.5, 164.5 <sup>11</sup>	-6.5		1.0937 <sup>16</sup>				
65	<b>Phenyl 2-tolyl sulfide</b>	309.9 300.5, 160.5 <sup>11</sup>			1.1012 <sup>15</sup>	81, al			
66	<b>Phenyl 4-tolyl sulfide</b>	311.5, 167.5 <sup>11</sup>	15.7		1.0900 <sup>15,7</sup>	127-8 al			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)**  
**a) Liquids 2) Cyclic (Listed in order of increasing b.p.)\***

No	Name	Boiling point, °C	Melting point, °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Sulfone	HgCl <sub>2</sub> addition compound	Miscellaneous
1	<b>Ethylene sulfide (Thiurane Thiacyclopropane)</b>	55-6		1 4914	1 0046			Polymerizes rapidly
2	<b>2-Methylethylene sulfide (2-Methylthiurane)</b>	76		1 473 <sup>19</sup>	0 946 <sup>18</sup>			
3	<b>Thiophene</b>	84 12	-38 30	1 5287	1 0644			2-HgCl deriv , 182-3; 2-HgBr deriv , 169-70, 2-HgI deriv , 116-7
4	<b>2,2-Dimethylethylene sulfide (2,2-Dimethyl-thiurane)</b>	87, 84 6		1 4641				
5	<b>Trimethylene sulfide (Thietane Thiacyclobutane)</b>	95	-73 25	1 506 <sup>23</sup>	1 0200	76, w	93 5 d	Methiodide, 98 5-9 0
6	<b>2-Ethylethylene sulfide (2-Ethylthiurane)</b>	104		1 475 <sup>19</sup>	0 930 <sup>18</sup>			
7	<b>2-Methyltrimethylene sulfide (2-Methyl-thietane)</b>	106		1 4831	0 9571	b p 251 5-3 5		
8	<b>2-Methylthiophene</b>	112 4		1 52042	1 02183			5-HgCl deriv , 204, 5-HgBr deriv , 179-80, 5-HgI deriv , 111-2
9	<b>2,4-Dimethyltrimethylene sulfide (2,4-Dimethylthietane)</b>	113 4		1 4502 <sup>18</sup>	0 8710 <sup>18</sup>	b p 255 0 5 5		
10	<b>3-Methylthiophene</b>	115 4		1 52042	1 02183			2-HgCl deriv , 128-9, 2,5-Di-HgOOCCH <sub>3</sub> deriv , >240d
11	<b>2,2-Dimethyltrimethylene sulfide (2,2-Dimethylthietane)</b>	120		1 4739 <sup>18</sup>		55	118	
12	<b>Tetramethylene sulfide (Thiolane Thiophane Thiacyclopentane)</b>	121 2, 120 2 5	-96 17	1 5047	0 99869	28 36	128	Sulfoxide, 105-7 <sup>12</sup>
13	<b>2-Methyltetramethylene sulfide (2-Methylthiolane)</b>	132 5 <sup>20</sup>	-100 71	1 4922	0 9555	b p 279-80 <sup>25k</sup>	di 162	
14	<b>2-Ethylthiophene</b>	132 5-4 0		1 5127	0 990 <sup>24</sup>			5-HgCl deriv , 147-8, 5-HgI deriv , 96-7
15	<b>3-Ethylthiophene</b>	135 6		1 5146	0 9980			2-HgCl deriv , 67-8, 2,5-Di-HgCl deriv , 295-7d
16	<b>2,5-Dimethylthiophene</b>	135 5 6 0	-62 57	1 5126	0 98587			3-HgCl deriv , 156-7, 3-HgI deriv , 175
17	<b>2,4-Dimethylthiophene</b>	137 8, 140		1 5130	0 9956			5-HgCl deriv , 138-9, 5-HgI deriv , 137-9
18	<b>3-Methyltetramethylene sulfide (3-Methylthiolane)</b>	138 2	-81 10	1 4924	0 9634	1, 0 5	83	
19	<b>2,3-Dimethylthiophene</b>	140 2-1 2	-49 1 to -48 9	1 5188	1 0021			5-HgCl deriv , 218 5-9 5, 5-HgI deriv , 184 0-4 5, 4,5-Di-HgOOCCH <sub>3</sub> , 237-40
20	<b>trans-2,5-Dimethyltetramethylene sulfide (trans-2,5-Dimethylthiolane)</b>	142	-76 35	1 4766	0 9188	3, b p 278	111	
21	<b>cis-2,5-Dimethyltetramethylene sulfide (cis-2,5-Dimethylthiolane)</b>	142 3		1 4799	0 9222	4, b p 278	di 180	
22	<b>3,4-Dimethylthiophene</b>	144 6		1 5212	1 008 <sup>21</sup>			2-HgCl deriv , 139-40 5, 2-HgBr deriv , 152, 2-HgI deriv , 142
23	<b>1,4-Thioxane</b>	148 9	-17	1 5070	1 1177	130, 105 5	171	Sulfoxide, 25, 45
24	<b>2-Methylpentamethylene sulfide (2-Methylthiane)</b>	151	-58 14	1 4905	0 9428	68 5	102	
25	<b>2-Isopropylthiophene</b>	152		1 5037	0 9673			
26	<b>3-Isopropylthiophene</b>	155 7, 157		1 5052	0 9733			5-HgCl deriv , 137
27	<b>3-Methylpentamethylene sulfide (3-Methylthiane)</b>	157-8	-60 17	1 4922	0 9473	83	136	
28	<b>2-Ethyltetramethylene sulfide (2-Ethylthiolane)</b>	157 8		1 4896	0 9451			mono 100, di 146-8
29	<b>2-Propylthiophene</b>	157 5 9 5		1 5048	0 9683			5-HgCl deriv , 155, 5-HgSCN deriv , 169 0-9 5
30	<b>4-Methylpentamethylene sulfide (4-Methylthiane)</b>	158 6	-28 11	1 5049	0 9687	121 5	136	
31	<b>2-Ethyl-5-methylthiophene</b>	159 8 60 4	-68 6	1 5073	0 9663			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)**  
**a) Liquids 2) Cyclic (Listed in order of increasing b.p.)\* (Continued)**

No	Name	Boiling point °C	Melting point °C	n <sub>D</sub> <sup>20</sup>	D <sub>4</sub> <sup>20</sup>	Sulfone	HgCl <sub>2</sub> addition compound	Miscellaneous
32	2-Ethyl-3-methylthiophene	160 0 1 5		1 5092 <sup>22</sup>	0 9792 <sup>22</sup>			5 HgCl deriv , 172-3, 5-HgI deriv , 156-7
33	2,6-Dimethyl-1,4-thioxane	160 1		1 4733		105 5		
34	3-Propylthiophene	160 2		1 5057	0 9716			
35	2-Allylthiophene	161, 158 5 9 0		1 5281 <sup>20</sup>	1 0175 <sup>20</sup>			
36	3,5-Dimethyl-1,4-thioxane	162				102		
37	3-Ethyl-5-methylthiophene	162 4	-60 to -59	1 5098	0 9742			
38	2,3,5-Trimethylthiophene	163 5, 164 5 <sup>46</sup>		1 5131	0 9753			x-HgCl deriv , 160-1
39	2- <i>tert</i> -Butylthiophene	163 9	-59 2	1 49788	0 9514			
40	3- <i>tert</i> -Butylthiophene	168 9	-54 8	1 50149	0 9574			
41	Hexamethylene sulfide (Thiepane Thiacyclo heptane)	170 173 4		1 5125	0 9883	71	149	Methiodide, 141 5-2 0
42	2,3,4-Trimethylthiophene	172 7 160 3		1 5208	0 995			
43	1,3-Dithiolane(1,3-Dithiacyclopentane)	175		1 5975 <sup>15</sup>	1 259 <sup>1</sup>	di 205	117, 126	Methiodide, 96, Disulf-oxide, 134
44	2-Methyl-5-propylthiophene	179 5 80 5		1 5026				
45	Cyclohexene sulfide (7-Thiabicycloheptane)	180 71 5- 3 5 <sup>21</sup>		1 5309	0 9274			
46	2- <i>n</i> -Butylthiophene	181-2 <sup>40</sup>		1 50896	0 9537			
47	2,5-Diethylthiophene	181-2, 63- 6 <sup>14</sup>		1 5036	0 962 <sup>14</sup>			
48	3- <i>n</i> -Butylthiophene	181 3		1 51005	0 9570			
49	2,3,4,5-Tetramethylthiophene	182 4 187 9		1 5196	0 9442 <sup>21</sup>			
50	3,4-Diethylthiophene	185-7		1 5157 <sup>17</sup>				2-HgCl deriv , 118
51	2-Ethyl-1,3-dithiolane	191 2						
52	2,4-Dimethyltetramethylene sulfide (2,4-Dimethylthiolane)	197 8 <sup>42</sup>		1 4818	0 9265	124 b p 123 3 <sup>5</sup>	89	
53	3-Ethyl-2,4,5-trimethylthiophene	204 6 <sup>48</sup>		1 5132	0 9609			
54	2- <i>n</i> -Octylthiophene	257 9, 106 8 <sup>1</sup>		1 4824	0 920			

\*Derivative data given in order m p , crystal color, solvent from which crystallized

**TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)**  
**b) Solids (Listed in order of increasing m.p.)\***

No	Name	Melting point °C	Boiling point °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
1	Ethyl 2-naphthyl sulfide	16	170.5 <sup>15</sup>	43.5			
2	Ethyl hexadecyl sulfide	19		88			
3	Thiane (Pentamethylene sulfide Thiacyclohexane)	19.07, 13	142	98.5 9.0			D <sub>4</sub> <sup>0</sup> 0.9849, n <sub>D</sub> <sup>20</sup> 1.5067, HgCl <sub>2</sub> add comp., 137.5, al., Meth iodide, 192 subl
4	2-Methyl-1,4-dithiane	20		di 304			
5	Didecyl sulfide (Decyl sulfide)	27	217.8*	206.7			
6	3-Tolyl 4-tolyl sulfide	27.8 al	179 <sup>11</sup>	116 ac a	72		
7	Diundecyl sulfide (Undecyl sulfide n-Hendecyl sulfide)	34.8					
8	Di-(2-bromoethyl) sulfide (Bromoethyl sulfide)	35		111.2			
9	4-Iodophenyl phenyl sulfide (4 Iododiphenyl sulfide)	35		141			
10	2-Aminophenyl phenyl sulfide (2-Amino-diphenyl sulfide)	35.6, al	212 <sup>22</sup>	122, dil al			N-Benzenesulfonyl, 225.6
11	4-Bromophenyl methyl sulfide	37.5		56.7			
12	Didodecyl sulfide (n-Dodecyl sulfide)	40.5				34.5	
13	Benzyl phenyl sulfide	41.44.5, al	197 <sup>2</sup>	146.6.5 148, al	123		
14	Di-(4-chlorobenzyl) sulfide (4-Chlorobenzyl sulfide)	41				59	
15	1-Naphthyl phenyl sulfide	41.8, aq al	220.5 <sup>11</sup>	99.5 100.5 al			
16	3-Nitrophenyl phenyl sulfide (3-Nitrodiphenyl sulfide)	42.5		80.5 81			
17	Ethyl 4-nitrophenyl sulfide	44		138.5			
18	Isopropyl 4-nitrophenyl sulfide	44.5		115.3			
19	Di-(4-methoxyphenyl)sulfide (4-Methoxyphenyl sulfide)	46		130	96	45	Disulfone, 221, r h 210.2, s h
20	Dibenzoyl sulfide (Thiobenzoic anhydride, Benzoyl sulfide)	48, al				133, 128	
21	Dibenzyl sulfide (Benzyl sulfide)	50, chl		151.7, al bz	134.8	73	D <sub>4</sub> <sup>0</sup> 1.0712 HgCl <sub>2</sub> add comp., 131, HgI <sub>2</sub> add comp., 37.8, FeCl <sub>3</sub> add comp., 94 PtCl <sub>4</sub> add comp., 159 PtCl <sub>4</sub> add comp., 172d, PtBr <sub>2</sub> add comp., 139 PtI <sub>2</sub> add comp., 129
22	2,5-Dichlorophenyl methyl sulfide	51		88			
23	Methyl 2-naphthyl sulfide	51.8.64	226 <sup>11</sup>	115.6, al di 120-1	67.5		Disulfone, 166
24	Bis(phenylthio)methane	52					
25	Ditetradecyl sulfide (n-Tetradecyl sulfide)	53.8				46	
26	Di-(2-diphenoxymethyl)sulfide	54 al		108, pink, al		97	
27	1,3-Dithiane	54		di 330 308			
28	Bis(benzylthio)methane	55		di 216			
29	4-Nitrophenyl phenyl sulfide (4-Nitrodiphenyl sulfide)	55, yel lgr	240 <sup>23</sup>	142, aq al			
30	Di-n-octyl sulfide (n-Octyl sulfide)	57		76		b p 178-83 <sup>5</sup>	
31	Di-(4-tolyl)sulfide (4-Tolyl sulfide)	57.3	179 <sup>11</sup>	158, bz	95, pet eth	48, al	
32	2-Aminophenyl 4-aminophenyl sulfide (2,4'-Diaminodiphenyl sulfide)	61.62.5, aq al		124-6			Diacetyl, 208
33	Dihexadecyl sulfide (n-Hexadecyl sulfide)	61.3		103.4	99.8		
34	2-Chloroethyl 4-nitrophenyl sulfide	62		128			
35	Di-(2-tolyl)sulfide (2-Tolyl sulfide)	64, al	285, 174 <sup>15</sup>	134.5, al	121, pet eth	38-9, al	
36	Methyl 2-nitrophenyl sulfide	64.5, yel , al		106			D <sub>4</sub> <sup>0</sup> 1.2626, n <sub>D</sub> <sup>20</sup> 1.62458, AgNO <sub>3</sub> add comp., 122, yel , al
37	Benzyl 4-bromophenyl sulfide	65		159			

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

**TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
38	1,2-Bis(phenylthio)ethane	69 70		di 180			
39	Diocetadecyl sulfide (Octadecyl sulfide)	71, 64 5				62 5	
40	2-Phenyl-1,3-dithiane	71-2		di 265			
41	Methyl 4-nitrophenyl sulfide	72		141			
42	Di-(3-phenylpropyl)sulfide (3-Phenylpropyl sulfide)	73		117		b p 165-6° <sup>03</sup>	D <sub>4</sub> <sup>80 1</sup> 1 2391, n <sub>D</sub> <sup>80 1</sup> 1 64008
43	Di-(2-methoxyphenyl)sulfide (2-Anisyl sulfide)	73, al	252-3 <sup>10</sup>	157-8, bz		120	
44	Di-(4-methylbenzyl)sulfide (4-Methylbenzyl sulfide)	76		197			
45	Cinnamyl phenyl sulfide	78		111 2	90 1		
46	4-(Methylthio)benzaldehyde	78, yel , lgr	273, 153 <sup>17</sup>				Phenylhydrazone, 138, Thiosemicarbazone, 177-9, yel
47	4-Nitrobenzyl phenyl sulfide	79		209 5			
48	1,2-Bis(tolylthio)ethane	80 1		di 200 1			
49	2-Nitrophenyl phenyl sulfide (2-Nitrodiphenyl sulfide)	80 2, 77, yel	210 <sup>15</sup>	147 5, al			
50	Di-(2-aminobenzyl) sulfide	81				90 1 lgr et ac	N,N'-Diformyl, 163 N,N'-Diacetyl, 209 Picrate, 203 4d
51	4-Nitrophenyl 4-tolyl sulfide	81 5, yel		170 1, yel			
52	Di-(2-aminophenyl) sulfide	87		146 7		93, al	N,N'-Diacetyl, 164 5 N,N'-Dibenzoyl, 162 3
53	Di-(2-phenylethyl) sulfide (2-Phenylethyl sulfide)	92 5 90		100 6	69	b p 172 5° <sup>8</sup>	
54	4-Aminophenyl phenyl sulfide (4 Amino-diphenyl sulfide)	96, lgr	243 <sup>29</sup>	176, al	152, w		Hydrochloride, 197 8d N-4-Toluenesulfonyl, 73 Dihydrochloride, 248-9 dil HCl
55	Di-(4-amino-3-methylphenyl) sulfide	96 25°, al					N,N'-Diacetyl, 22, al , N,N'-Dibenzoyl, 233, me al , Dipicrate, 186, w
56	Di-(4-chlorophenyl)sulfide (4-Chlorophenyl sulfide)	98 88 90	212 <sup>18</sup>	148 9, subl	143	73	
57	3-Aminophenyl 4-nitrophenyl sulfide (3-Amino-4'-nitrodiphenyl sulfide)	99 100					N-Acetyl, 115-6, N,N-Dimethyl, 83 4
58	Di-(2-amino-5-methylphenyl) sulfide	103 4, al				98	Dihydrochloride, 100d , al , N,N'-Diacetyl, 165, al N,N'-Dibenzoyl, 185 6, al , Diurethane, 113, bz -pet eth Dipicrate, 179, bz
59	Di-(4-aminobenzyl) sulfide	104 5				96 8, al	N,N'-Diacetyl, 188, N,N'-Dibenzoyl, 224
60	Di-(4-aminophenyl) sulfide	108 9, w		178, me al	175d , al	85 106, al	N,N'-Diacetyl, 220 1 N,N'-Dibenzoyl, 234
61	Di-(1-naphthyl)sulfide	110, al	290 <sup>15</sup>	187, al	166, al	91	
62	1,4-Dithiane	111 2	199-200	mono 200, di >330			Methiodide, 73 4, Sulfoxidesulfone, 279
63	Di-(4-bromophenyl)sulfide (4-Bromophenyl sulfide)	112, al	243 <sup>20</sup>	172	153, al	94 5	
64	2,4-Dinitrophenyl phenyl sulfide (2,4-Dinitro-diphenyl sulfide)	121, 117, bz		161			
65	Di-(2-nitrophenyl)sulfide (2-Nitrophenyl sulfide)	122 3, yel , al -ac a		164		198-9, ac a or bz	
66	Benzyl 4-nitrophenyl sulfide	123		172			
67	Di-(3-hydroxyphenyl)sulfide (3-Hydroxyphenyl sulfide)	130		190 1, 186-7	94 5, pet eth	95	Acetyl, 87
68	1,3-Bis(2-nitrophenylthio)propane	140		di 156-7			
69	Di-(2-hydroxyphenyl)sulfide (2-Hydroxyphenyl sulfide)	142, bz		179, 164-5, bz		b p >200d	Diacetyl, 95-6, al Di-Me eth , 73
70	1-Naphthyl 2-naphthyl sulfide (1,2'-Dinaphthyl sulfide)	151	291 2 <sup>15</sup>	123			
71	Di-(2-naphthyl)sulfide (2-Naphthyl sulfide)	151	296 <sup>15</sup>	177, al	137 5 8 5	139	

\*Derivative data given in order m.p., crystal color, solvent from which crystallized

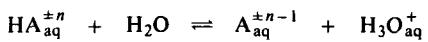
**TABLE XXVI. ORGANIC DERIVATIVES OF THIOETHERS (SULFIDES)**  
**b) Solids (Listed in order of increasing m.p.)\* (Continued)**

No	Name	Melting point °C	Boiling point, °C	Sulfone	Sulfoxide	Disulfide	Miscellaneous
72	<b>Di-(4-hydroxyphenyl)sulfide</b> (4-Hydroxyphenyl sulfide)	151, al		240 1, w	195, acet	150 1	Diacetyl, 94 55, Di-Me eth , 46, Di-Et eth 55
73	<b>Di-(4-nitrobenzyl)sulfide</b> (4-Nitrobenzyl sulfide)	158-9		260 5	212	126 5	
74	<b>Di-(4-nitrophenyl)sulfide</b> (4-Nitrophenyl sulfide)	174-5, 156 7, or , or pa yel		282, 245 225		182, ac a	
75	<b>Di-(3-nitrophenyl)sulfide</b> (3-Nitrophenyl sulfide)	193		201		84, al	
76	<b>Di-(2,4-dinitrophenyl)sulfide</b> (2,4-Dinitro phenyl sulfide)	193 7 193 4, yel , ac a		240 1		280	
77	<b>Di-(2,4,6-trinitrophenyl)sulfide</b> (Dipicryl sulfide)	230 1 226, yel		307			

\* Derivative data given in order m p , crystal color, solvent from which crystallized

## EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation



and the corresponding equilibrium constant  $K_e$  is given by

$$K_e = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})(a_{\text{H}_2\text{O}})}$$

where the  $a$ 's are the activities of the species. At low electrolyte concentrations  $a_{\text{H}_2\text{O}}$  is virtually constant, and a second constant,  $K_a$ , the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{\text{H}_2\text{O}}) = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})} = \frac{(c_{\text{A}_{\text{aq}}^{\pm n-1}})(c_{\text{H}_3\text{O}^+})}{(c_{\text{HA}_{\text{aq}}^{\pm n}})} \cdot \frac{f_{\pm}^2}{f_{\text{HA}_{\text{aq}}^{\pm n}}}$$

where the  $c$ 's are the concentrations and the  $f$ 's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient  $pK_a$  notation, where

$$pK_a = -\log K_a$$

For Table XXVII,  $\text{HA}^{\pm n} = \text{RCOOH}$ , and  $\text{A}^{\pm n-1} = \text{RCOO}^-$

For Table XXVIII,  $\text{HA}^{\pm n} = \text{ArOH}$ , and  $\text{A}^{\pm n-1} = \text{ArO}^-$

For Table XXIX,  $\text{HA}^{\pm n} = \text{RR}'\text{R}''\text{NH}^+$  and  $\text{A}^{\pm n-1} = \text{RR}'\text{R}''\text{N}(\text{R}, \text{R}' \text{ and } \text{R}'')$  may be alkyl or aryl groups or a hydrogen atom

For monobasic acids  $pK_a = pK_1$

For dicarboxylic acids both  $pK_1$  and  $pK_2$  are given,  $pK_1$  is defined above, and  $pK_2$  is the analogous dissociation constant of the monoanion,  $\text{A}^{\pm n-1}$ , obtained on the first dissociation. For other dibasic acids such as the conjugate acids of amino acids, or diamines,  $pK_1$  is as defined above, and  $pK_2$  is the dissociation constant for the species obtained after the first protonation

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for  $pK$  determinations, see G Kortum, W Vogel and K Andrusow, in *Pure and Applied Chemistry*, Vol 1, Butterworths, London, 1961, pp 190-536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution see D D Perrin, *Dissociation Constants of Organic Bases in Aqueous Solution*, Butterworths, London, 1965

For general references including methods of determination of  $pK$ , and data for both acids and bases see J F King, in *Elucidation of Structures by Physical and Chemical Methods*, Vol 1 (Ed K W Bently) (*Technique of Organic Chemistry*, Vol 9), Interscience, New York, 1963, Chapter 6, pp 318-401, H C Brown, D H McDaniel and O Hafliger in *Determination of Organic Structures by Physical Methods*, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XXVII. ACID DISSOCIATION CONSTANTS OF  
ORGANIC ACIDS IN AQUEOUS SOLUTION**  
(Listed in order of increasing pKa)

No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
1	Heptafluoro- <i>n</i> -butyric acid	25	0 17		51	1,3,5-Benzenetricarboxylic acid	25	2 12	3 89
2	Trifluoroacetic acid	25	0 23						pK <sub>3</sub> = 4 70
3	Trichloroacetic acid	25	0 63		52	D,L-3,5-Di-iodotyrosine	25	2 12	6 48
4	2,4,6-Trinitrobenzoic acid	25	0 65		53	3-(2-Fluorophenyl)alanine	24	2 12	9 01
5	Tribromoacetic acid	25	0 66		54	3-(4-Fluorophenyl)alanine	24	2 13	9 05
6	3-Chlorophenylglycine	25	1 05	3 93	55	D,L-β-Phenylalanine	25	2 16	9 15
7	2,6-Dinitrobenzoic acid	25	1 14		56	<i>L</i> -Lysine	25	2 16	9 18
8	Trichloroacrylic acid	25	1 15		57	<i>d</i> -Lysine	25	2 16	9 16
9	Diffluoroacetic acid	25	1 24						pK <sub>3</sub> = 10 79
10	Oxalic acid	25	1 27	4 28					pK <sub>3</sub> = 10 81
11	Dichloroacetic acid	25	1 29		58	Glutamic acid	20	2 16	4 324
12	2-Chloro-6-nitrobenzoic acid	25	1 34		59	6,6,6-Trifluoronorleucine	25	2 164	9 463
13	2-Bromo-6-nitrobenzoic acid	25	1 37		60	3-(3-Chlorophenyl)alanine	25	2 17	8 91
14	Benzenehexacarboxylic acid	25	1 40	2 19	61	2-Chloro-5-nitrobenzoic acid	25	2 17	
				pK <sub>3</sub> = 3 31	62	D,L-Serine	25	2 21	4 15
				pK <sub>4</sub> = 4 78	63	Diethylmalonic acid	25	2 21	7 29
				pK <sub>5</sub> = 5 89	64	N-Propylalanine	25	2 21	10 19
				pK <sub>6</sub> = 6 96	65	N-Ethylalanine	25	2 22	10 22
15	<i>d,l</i> -2,3-Dibromosuccinic acid	20	1 42	3 24	66	D,L-N-Methylalanine	25	2 22	10 19
16	2,4-Dinitrobenzoic acid	25	1 42		67	2-Nitrobenzoic acid	25	2 22	
17	<i>erythro</i> -2-Bromo-3-chlorosuccinic acid	19	1 43	2 60	68	3-(2-Chlorophenyl)alanine	25	2 23	8 94
18	<i>d,l</i> -2,3-Dichlorosuccinic acid	20	1 46	2 86	69	6-Bromo-2-methylbenzoic acid	20	2 25	
19	<i>threo</i> -2-Bromo-3-chlorosuccinic acid	20	1 46	2 77	70	6-Chloro-2-methylbenzoic acid	20	2 26	
20	<i>meso</i> -2,3-Dibromosuccinic acid	20	1 51	2 71	71	<i>d,l</i> -Valine	25	2 286	9 744
21	<i>meso</i> -2,3-Dichlorosuccinic acid	20	1 52	2 94	72	<i>d,l</i> -2-Aminobutyric acid	25	2 29	9 83
22	4,4,4-Trifluorovaline	25	1 537	8 098	73	2-Benzyl-2-cyanopropionic acid	25	2 29	
23	4,4,4-Trifluorotheanine	25	1 554	7 822	74	2-Amino- <i>n</i> -pentanoic acid	25	2 318	9 808
24	2-Amino-4,4,4-trifluoro- <i>n</i> -butyric acid	25	1 600	8 169	75	(3,4-Dihydroxyphenyl)alanine	25	2 32	8 68
25	2,5-Dinitrobenzoic acid	25	1 62						pK <sub>3</sub> = 9 88
26	Nitroacetic acid	25	1 68		76	2-Chloro-3-hydroxysuccinic acid	25	2 32	
27	Trifluoroacrylic acid	25	1 79		77	3-Hydroxyglutaric acid	25	2 32	4 24
28	Benzenepentacarboxylic acid	25	1 80	2 73					pK <sub>3</sub> = 9 56
				pK <sub>3</sub> = 3 97	78	<i>d,l</i> -Leucine	25	2 32	9 74
				pK <sub>4</sub> = 5 25	79	<i>d,l</i> -Norleucine	25	2 335	9 83
				pK <sub>5</sub> = 6 46	80	<i>d,l</i> -Alanine	25	2 34	9 87
29	Cyclopropane-1,1-dicarboxylic acid	25	1 82	5 43	81	cis-Caronic acid ( <i>cis</i> -1,1-Dimethyl-2,3-cyclopropanedicarboxylic acid)	25	2 34	8 31
30	Hydroxyproline	25	1 82	9 66	82	N-Ethylglycine	25	2 34	10 23
31	DL-Histidine	25	1 82	6 04	83	Glycine	25	2 35	9 78
				pK <sub>3</sub> = 9 12	84	N-Methylglycine	25	2 35	10 18
32	2,3-Dinitrobenzoic acid	25	1 85		85	N-Propylglycine	25	2 35	10 19
33	2-Methyl-4-nitrobenzoic acid	25	1 86		86	N- <i>n</i> -Butylglycine	25	2 35	10 25
34	1,2,4,5-Benzenetetracarboxylic acid	25	1 92	2 87	87	N-Isobutylglycine	25	2 35	10 12
				pK <sub>3</sub> = 4 49	88	2-Aminoisobutyric acid	25	2 36	10 25
				pK <sub>4</sub> = 5 63	89	(Methylsulfonyl)acetic acid	25	2 36	
35	trans-Ethylene oxide-1,2-dicarboxylic acid	19	1 93	3 25	90	2-Cyano-2-cyclohexylacetic acid	25	2 37	
36	cis-Ethylene oxide-1,2-dicarboxylic acid	18	1 94	3 92	91	2-Cyanopropionic acid	25	2 37	
37	Maleic acid	25	1 94	6 23	92	D,L-Tryptophane	25	2 38	9 39
38	Ornithine	25	1 94	8 65	93	1,2,3,5-Benzenetetracarboxylic acid	25	2 38	3 51
39	2-Chloro-4-nitrobenzoic acid	25	1 96						pK <sub>2</sub> = 4 44
40	4-Aminosalicylic acid (4-Amino-2-hydroxybenzoic acid)	25	1 99	3 92					pK <sub>3</sub> = 5 81
41	2-Chloro-3-nitrobenzoic acid	25	2 02		94	4-Aminobenzoic acid	25	2 38	
42	Asparagine	25	2 05	3 87	95	2-Cyanoisobutyric acid	25	2 42	
43	Anthranilic acid	25	2 05	4 95	96	Cyanoacetic acid	25	2 46	
44	5,5,5-Trifluoroleucine	25	2 05	8 92	97	Pyruvic acid	25	2 49	
45	S-Ethylcysteine	25	2 05	8 60	98	O-Acetylcitric acid	25	2 49	.
46	1,2,3,4-Benzenetetracarboxylic acid	25	2 06	3 25	99	3-Pentenoic acid	25	2 51	
				pK <sub>3</sub> = 4 73	100	1,2,4-Benzenetricarboxylic acid	25	2 52	3 84
				pK <sub>4</sub> = 6 21					pK <sub>3</sub> = 5 20
47	Di- <i>n</i> -propylmalonic acid	25	2 07	7 51	101	(2-Chlorovinyl)acetic acid	25	2 54	
48	3-(4-Chlorophenyl)alanine	25	2 08	8 96	102	Oxaloacetic acid	25	2 55	4 37
49	3-(3-Fluorophenyl)alanine	24	2 10	8 98	103	Fluoroacetic acid	25	2 58	
50	Arginine	25	2 10	9 07					

**TABLE XXVII. ACID DISSOCIATION CONSTANTS OF  
ORGANIC ACIDS IN AQUEOUS SOLUTION**  
(Listed in order of increasing pKa) (Continued)

No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
104	Phenylmalonic acid	25	2.58		162	(2,4-Dichloro-6-methylphenoxy)acetic acid	20	3.13	
105	2-Chloro-3-hydroxybutyric acid	25	2.58		163	2-Cyanobenzoic acid	25	3.14	
106	2-Fluoroacrylic acid	25	2.58		164	(3-Methoxyphenoxy)acetic acid	25	3.14	
107	2,4-Dioxo-n-pentanoic acid	25	2.58		165	Ethyl-n-propylmalonic acid	25	3.15	7.43
108	2-Chloro-3-hydroxy-3-phenyl propionic acid	25	2.61		166	4,4,4-Trifluorocrotonic acid	25	3.15	
109	2-Chloro-6-hydroxybenzoic acid	25	2.63		167	(4-Iodophenoxy)acetic acid	25	3.16	
110	2-Butynoic acid (Tetrolic acid)	25	2.65		168	(2-Iodophenoxy)acetic acid	25	3.17	
111	1-Aminocyclohexanecarboxylic acid	25	2.66		169	3,3-Difluoroacrylic acid	25	3.17	
112	Bromosuccinic acid	50	2.69	4.69	170	Dimethylmalonic acid	25	3.17	6.06
113	3-Hydroxy-2-naphthoic acid	25	2.71		171	Phenoxyacetic acid	25	3.17	
114	5-Aminosalicylic acid (5-Amino-2-hydroxybenzoic acid)	25	2.74	5.84	172	Iodoacetic acid	25	3.18	
115	Triethylsuccinic acid	25	2.74		173	3-Iodo-2-methylbenzoic acid	20	3.18	
116	Salicylic acid (2-Hydroxybenzoic acid)	30	2.75, (3.00)	12.38	174	2-Hydroxy-3-chloroisobutyric acid	25	3.20	
117	2,4-Dichlorobenzoic acid	25	2.76		175	(4-Methoxyphenoxy)acetic acid	25	3.21	
118	1,2,3-Benzenetricarboxylic acid	25	2.80	4.20	176	(4-Methylphenoxy)acetic acid	25	3.22	
				119	meso-Tartaric acid	25	3.22	4.82	
				177	2-Chlorocrotonic acid	25	3.22		
				178	2,4-Dihydroxybenzoic acid	30	3.22		
				179	(2-Methoxyphenoxy)acetic acid	25	3.23		
				180	(2-Methylphenoxy)acetic acid	25	3.23		
				181	Cyclopentane-1,1-dicarboxylic acid	25	3.23	4.08	
				182	3-Bromomandelic acid	25	3.23		
				183	3-Chloromandelic acid	25	3.24		
				184	2,6-Dimethylbenzoic acid	25	3.25		
				185	3-Iodomandelic acid	25	3.26		
				186	2-Fluorobenzoic acid	25	3.27		
				187	3-Chloro-2-methylbenzoic acid	25	3.27		
				188	(4-Chloro-2-methylphenoxy)acetic acid	25	3.28		
				189	3-Bromo-2-methylbenzoic acid	20	3.28		
				190	cis-3-Chloroacrylic acid	18	3.32		
				191	cis-3-Cyclopropane-1,2-dicarboxylic acid	24	3.33	6.47	
				192	(2,6-Dimethylphenoxy)acetic acid	25	3.36		
				193	1-Anthaquinone-1-carboxylic acid	20	3.37		
				194	3-Hydroxy-3-phenylpropionic acid	18	3.40		
				195	d,l-Mandelic acid	25	3.41		
				196	Anthraquinone-2-carboxylic acid	20	3.42		
				197	N-Formylglycine	19	3.43		
				198	2,4,6-Trimethylbenzoic acid	25	3.44		
				199	3-Nitrobenzoic acid	25	3.44		
				200	Cyclohexane-1,1-diacetic acid	25	3.45	7.08	
				201	2-Phenylbenzoic acid (Biphenyl-2-carboxylic acid)	25	3.46		
				202	meso-2,3-Diphenylsuccinic acid	25	3.48		
				203	(2,4-Dimethylphenyl)acetic acid	25	3.50	7.28	
				204	Tetramethylsuccinic acid	25	3.50		
				205	d,l-2,3-Diethylsuccinic acid	25	3.51	6.60	
				206	2-Phenoxybenzoic acid	20	3.53		
				207	2-Hydroxy-2-phenylpropionic acid	18	3.53		
				208	Terephthalic acid	25	3.54	4.46	
				209	2-tert-Butylbenzoic acid	25	3.54		
				210	3-Aminopropionic acid	25	3.55		
				211	4-Cyanobenzoic acid	25	3.55		
				212	3-(Methylamino)benzoic acid	25	3.55		
				213	3-Methoxy-2-methylbenzoic acid	20	3.58		
				214	d,l-2,3-Diphenylsuccinic acid	25	3.58		
				215	2-Ethoxy-2-methylbenzoic acid	20	3.62		
				216	Isophthalic acid	25	3.62	4.60	
				217	3-Ethyl-3-methylglutaric acid	25	3.62	6.70	
				218					
				219					
				220					
				221					

**TABLE XXVII. ACID DISSOCIATION CONSTANTS OF  
ORGANIC ACIDS IN AQUEOUS SOLUTION**  
(Listed in order of increasing pKa) (Continued)

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
222	3,3-Diethylglutaric acid	25	3 62	7 12	279	<i>cis</i> -Tetrahydronaphthalene-2,3-dicarboxylic acid	20	3 98	6 47
223	<i>meso</i> -2,3-Diethylsuccinic acid	25	3 63	6 46	280	4-Chlorobenzoic acid	25	3 98	
224	(2,4-Dichlorophenoxy)acetic acid	20	3 64		281	2,5-Dimethylbenzoic acid	25	3 98	
225	Malonamic acid (Malonic acid mono-amide)	25	3 64		282	3-Bromopropionic acid	18	3 99	
226	2-Isopropylbenzoic acid	25	3 64		283	2-Hydroxy-2-methylbutyric acid	18	3 99	
227	Decahydronaphthoxyacetic acid	25	3 64		284	3-Cyanopropionic acid	25	3 99	
228	2-Cyclohexyloxypropionic acid	25	3 64		285	3-Chloropropionic acid	25	3 996	
229	<i>trans</i> -3-Chloroacrylic acid	18	3 65		286	<i>trans</i> -Tetrahydronaphthalene-2,3-dicarboxylic acid	20	4 00	5 70
230	9-Anthracenecarboxylic acid	20	3 65		287	(2-Nitrophenyl)acetic acid	25	4 004	
231	Ethoxycetic acid	18	3 65		288	3-Aminopentanoic acid	25	4 02	
232	<i>trans</i> -Cyclopropane-1,2-dicarboxylic acid	24	3 65	5 13	289	4-Aminobutyric acid	25	4 03	
233	N-Acetyl glycine	25	3 67		290	<i>cis</i> -Cyclobutane-1,3-dicarboxylic acid	25	4 03	
234	1-Anthracenecarboxylic acid	20	3 68		291	2-Hydroxyisobutyric acid	18	4 04	
235	2-Benzyl-2-phenylsuccinic acid	20	3 69	6 49	292	(2-Iodophenyl)acetic acid	25	4 04	
236	3,3-Di- <i>n</i> -propylglutaric acid	25	3 69	7 31	293	<i>trans</i> -4-Nitrocinnamic acid	25	4 05	
237	Cyclopentyloxyacetic acid	25	3 70		294	(2-Bromophenyl)acetic acid	25	4 05	
238	3,3-Dimethylglutaric acid	25	3 70	6 29	295	(2-Chlorophenyl)acetic acid	25	4 07	
239	<i>cis</i> -3-Aminocyclohexanecarboxylic acid	15	3 70		296	2-Methoxybenzoic acid	20	4 08	
240	<i>d,l</i> -N-Acetylalanine	25	3 72		297	3-Methoxybenzoic acid	25	4 09	
241	N-Propionylglycine	25	3 72		298	3-Iodopropionic acid	18	4 09	
242	2,3-Dimethylbenzoic acid	25	3 74		299	<i>cis</i> -Cyclohexane-1,3-dicarboxylic acid	16	4 10	
243	Formic acid	25	3 74		300	Ethylsuccinic acid	25	4 00	
244	Phthalamic acid (Phthalic acid mono-amide)	25	3 75		301	Iminodipropionic acid	30	4 11	9 61
245	Glutaconic acid	25	3 77	5 08	302	Benzylsuccinic acid	20	4 11	5 65
246	<i>meso</i> -2,3-Dimethylsuccinic acid	25	3 77	5 94	303	<i>trans</i> -3-Nitrocinnamic acid	25	4 12	
247	2-Ethylbenzoic acid	25	3 79		304	4-Fluorobenzoic acid	25	4 14	
248	3-Methylcyclopentyl-1,1-diacetic acid	25	3 79	6 74	305	(3-Chlorophenyl)acetic acid	25	4 14	
249	<i>trans</i> -Cyclobutane-1,2-dicarboxylic acid	20	3 79	5 61	306	4,4,4-Trifluorobutyric acid	25	4 15	
250	Cyclohexyloxyacetic acid	25	3 80		307	<i>trans</i> -2-Nitrocinnamic acid	25	4 15	
251	2-Hydroxybutyric acid	18	3 80		308	3-Isopropoxybenzoic acid	20	4 15	
252	Cyclopentyl-1,1-diacetic acid	25	3 80	6 77	309	2-Naphthoic acid	25	4 16	
253	3-Bromobenzoic acid	25	3 81		310	Succinic acid	25	4 16	
254	3-Chlorobenzoic acid	25	3 82		311	(3-Iodophenyl)acetic acid	25	4 16	
255	<i>trans</i> -Caronic acid ( <i>trans</i> -1,1-Dimethyl-2,3-cyclopropanedicarboxylic acid)	25	3 82	5 32	312	3-Ethoxybenzoic acid	20	4 17	
256	2,2-Diethylsuccinic acid	25	3 84		313	2,2-Diphenyladipic acid	20	4 17	5 80
257	<i>trans</i> -3-Aminocyclohexanecarboxylic acid	15	3 85		314	(4-Iodophenyl)acetic acid	25	4 18	
258	3-Iodobenzoic acid	25	3 85		315	2-Anthracenecarboxylic acid	20	4 18	
259	(4-Nitrophenyl)acetic acid	25	3 85		316	<i>trans</i> -Cyclohexane-1,4-dicarboxylic acid	16	4 18	
260	<i>cis</i> -3-Methylcyclohexyloxyacetic acid	25	3 85		317	4,4,5,5,6,6-Heptafluorohexanoic acid	25	4 18	
261	Lactic acid	25	3 86		318	2,4-Dimethylbenzoic acid	25	4 18	
262	<i>cis</i> -Cinnamic acid	25	3 88		319	<i>trans</i> -Cyclohexane-1,2-dicarboxylic acid	19	4 18	
263	Hydroxycrylic acid	25	3 89		320	(4-Bromophenyl)acetic acid	25	4 19	
264	1,2,3-Cyclohexanetricarboxylic acid	23	3 89	4 85	321	(4-Chlorophenyl)acetic acid	25	4 19	
			pK <sub>3</sub> = 8 83		322	Mesaconic acid	18	4 20	
265	<i>cis</i> -Cyclobutane-1,2-dicarboxylic acid	19	3 90	5 89	323	Benzoic acid	25	4 20	
266	2-Methylcyclohexyloxyacetic acid	25	3 90		324	3-Propoxybenzoic acid	20	4 20	
267	3-Fluorobenzoic acid	25	3 90		325	2-Ethoxybenzoic acid	20	4 21	
268	3-Hydroxybenzoic acid	30	3 90	9 78	326	3,4-Diphenyladipic acid	25	4 22	
269	2-Methylbenzoic acid	25	3 91		327	<i>trans</i> -2-Chlorocinnamic acid	25	4 23	
270	2,2-Diphenylglutaric acid	20	3 91	5 38	328	3-Fluoromandelic acid	25	4 24	
271	3-Phenoxybenzoic acid	20	3 91		329	(1-Naphthyl)acetic acid	25	4 24	
272	2-(Bromomethyl)butyric acid	18	3 92		330	(2-Isopropoxy)benzoic acid	20	4 24	
273	Diphenylacetic acid	25	3 94		331	2-Propoxybenzoic acid	20	4 24	
274	2,2-Dibenzylsuccinic acid	20	3 96	6 66	332	3-Butoxybenzoic acid	20	4 25	
275	Triphenylacetic acid	25	3 96		333	(4-Fluorophenyl)acetic acid	25	4 25	
276	<i>trans</i> -Cyclopentane-1,2-dicarboxylic acid	25	3 96	5 85	334	Acrylic acid	25	4 25	
277	4-Bromobenzoic acid	25	3 97		335	3-Methylglutaric acid	25	4 25	
278	(3-Nitrophenyl)acetic acid	25	3 97		336	(2-Naphthyl)acetic acid	25	4 26	5 51
			pK <sub>3</sub> = 8 83		337	<i>cis</i> -Cyclopentane-1,3-dicarboxylic acid	25	4 26	
			pK <sub>3</sub> = 8 83		338	5-Aminopentanoic acid	25	4 27	

**TABLE XVII. ACID DISSOCIATION CONSTANTS OF  
ORGANIC ACIDS IN AQUEOUS SOLUTION**  
(Listed in order of increasing pKa) (Continued)

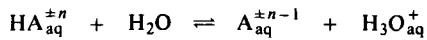
No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
339	3-Methylbenzoic acid	25	4.27		401	3-(2-Chlorophenyl)propionic acid	25	4.58	
340	2,2-Diphenylsuccinic acid	25	4.28	5.39	402	3-(3-Chlorophenyl)propionic acid	25	4.58	
341	3-Ethylglutaric acid	25	4.29	5.33	403	4-Methyl-3-pentenoic acid	25	4.60	
342	Angelic acid	18	4.29		404	cis-3-Hydroxycyclohexanecarboxylic acid	25	4.60	
343	trans-3-Chlorocinnamic acid	25	4.29		405	2-Hydroxycinnamic acid	25	4.61	
344	3,5-Dimethylbenzoic acid	25	4.30		406	4-Hydroxybenzoic acid	27.8	4.61	9.31
345	3-Isopropylglutaric acid	25	4.30	5.51	407	Levulinic acid	18	4.64	
346	3-n-Propylglutaric acid	25	4.31	5.31	408	2-Methyl-3-hydroxybutyric acid	18	4.65	
347	Phenylacetic acid	25	4.31		409	3-(3-Methoxyphenyl)propionic acid	25	4.65	
348	trans-Cyclohexane-1,3-dicarboxylic acid	19	4.31	5.73	410	4-Acetylbutyric acid	18	4.66	
349	2,2-Diphenylsубeric acid	20	4.31	5.39	411	2-Methylacrylic acid	18	4.66	
350	trans-Cyclopentane-1,3-dicarboxylic acid	25	4.32	5.42	412	3-Phenylpropionic acid	25	4.66	
351	2,2-Diphenylazelaic acid	20	4.33	5.38	413	3-(2-Methylphenyl)propionic acid	25	4.66	
352	(3,4-Dimethoxyphenyl)acetic acid	25	4.33		414	4-Pentenoic acid	25	4.67	
353	3,4,5-Trihydroxybenzoic acid	30	4.33		415	4-Ureidobutyric acid	25	4.68	
354	cis-Cyclohexane-1,2-dicarboxylic acid	20	4.34	6.77	416	3-(3-Methylphenyl)propionic acid	25	4.68	
355	4-Isopropylbenzoic acid	25	4.35		417	3-(4-Methylphenyl)propionic acid	25	4.68	
356	Vinylacetic acid	25	4.35		418	(4-Isopropoxy)benzoic acid	20	4.68	
357	Glutaric acid	25	4.35	5.42	419	trans-2-Hydroxycyclohexanecarboxylic acid	25	4.68	
358	4-Ethylbenzoic acid	25	4.35		420	trans-4-Hydroxycyclohexanecarboxylic acid	25	4.68	
359	(4-Methoxyphenyl)acetic acid	25	4.36		421	3-(4-Methoxyphenyl)propionic acid	25	4.69	
360	4-Methylbenzoic acid	25	4.37		422	2-Pentenoic acid	25	4.69	
361	(4-Methylphenyl)acetic acid	25	4.37		423	trans-Crotonic acid	25	4.69	
362	(4-Ethylphenyl)acetic acid	25	4.37		424	4-Hydroxypentanoic acid	18	4.69	
363	4-Methoxycinnamic acid	25	4.38		425	2-Hexenoic acid	25	4.70	
364	trans-Cyclohexane-1,2-diacetic acid	20	4.38	5.42	426	4-Hexenoic acid	25	4.72	
365	(4-Isopropylphenyl)acetic acid	25	4.39		427	5-Hexenoic acid	25	4.72	
366	trans-4-Aminocyclohexanecarboxylic acid	25	4.39	10.55	428	2-Ethylpentanoic acid	18	4.72	
367	3-Hydroxycinnamic acid	25	4.40		429	2-Ethylbutyric acid	25	4.75	
368	4-tert-Butylbenzoic acid	25	4.40		430	4-Phenylbutyric acid	25	4.76	
369	cis-Crotonic acid	18	4.41		431	Acetic acid	25	4.76	
370	3,4-Dimethylbenzoic acid	25	4.41		432	Isovaleric acid	25	4.78	
371	trans-2-Bromocinnamic acid	25	4.41		433	4-Propoxybenzoic acid	20	4.78	
372	cis-Cyclohexane-1,2-diacetic acid	20	4.42	5.45	434	4,4-Dimethylpentanoic acid	18	4.79	
373	cis-Cyclopentane-1,2-diacetic acid	20	4.42	5.42	435	Cyclobutanecarboxylic acid	25	4.79	
374	(4-tert-Butylphenyl)acetic acid	25	4.42		436	d,l-2-Methylpentanoic acid	18	4.79	
375	trans-Cyclopentane-1,2-diacetic acid	20	4.43	5.43	437	5-Methyl-4-hexenoic acid	25	4.80	
376	trans-4-Chlorocinnamic acid	25	4.43		438	4-Methyl-2-pentenoic acid	25	4.80	
377	Adipic acid	25	4.43	5.42	439	3-(2-Methoxyphenyl)propionic acid	25	4.80	
378	4-Cyanobutyric acid	25	4.44		440	2-Methylbutyric acid	18	4.81	
379	trans-Cinnamic acid	25	4.44		441	n-Butyric acid (n-Butanoic acid)	25	4.82	
380	trans-3-Methylcinnamic acid	25	4.44		442	trans-3-Hydroxycyclohexanecarboxylic acid	25	4.82	
381	3-(Acetylamino)propionic acid	25	4.45		443	Nicotinic acid	25	4.82	11.98
382	2-Ureidoobutyric acid	25	4.46		444	Cyclopropanecarboxylic acid	25	4.83	
383	4-Methoxybenzoic acid	25	4.47		445	cis-4-Aminocyclohexanecarboxylic acid	25	4.83	10.62
384	3-(4-Nitrophenyl)propionic acid	25	4.47		446	d,l-3-Methylpentanoic acid	18	4.84	
385	Pimelic acid	25	4.48		447	Isonicotinic acid	20	4.84	12.23
386	3-(1-Naphthoyl)propionic acid	20	4.48		448	cis-4-Hydroxycyclohexanecarboxylic acid	25	4.84	
387	3-Methylcyclohexyl-1,1-diacetic acid	25	4.49	6.08	449	Isocaproic acid	18	4.84	
388	4-Methylcyclohexyl-1,1-diacetic acid	25	4.49	6.10	450	n-Pentanoic acid (n-Valeric acid)	25	4.84	
389	5,5,5-Trifluoropentanoic acid	25	4.49		451	Isobutyric acid	25	4.86	
390	3-Ureidopropionic acid	25	4.49		452	Propionic acid (Propanoic acid)	25	4.87	
391	3-(2-Nitrophenyl)propionic acid	25	4.50		453	4-Hydroxyisocaproic acid	18	4.87	
392	trans-2-Methylcinnamic acid	25	4.50		454	n-Hexanoic acid (n-Caproic acid)	25	4.88	
393	2-Methoxycinnamic acid	25	4.50		455	n-Heptanoic acid	25	4.89	
394	3-Hexenoic acid	25	4.52		456	n-Octanoic acid (n-Caprylic acid)	25	4.89	
395	Suberic acid	25	4.52	5.40	457	Cyclohexylpropionic acid	25	4.91	
396	Azelaic acid	25	4.53	5.40	458	d,l-2,3-Dimethylsuccinic acid	25	4.94	6.20
398	Succinamic acid (Succinic acid mono-amide)	25	4.54		459	n-Nonanoic acid (Pelargonic acid)	25	4.94	
399	trans-4-Methylcinnamic acid	20	4.56		460	Cyclohexylbutyric acid	25	4.95	
400	O-Acetylsalicylic acid (Aspirin)	17	4.57						

**TABLE XXVII. ACID DISSOCIATION CONSTANTS OF  
ORGANIC ACIDS IN AQUEOUS SOLUTION**  
(Listed in order of increasing pKa) (Continued)

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
461	Tiglic acid	18	4 96		468	<i>cis</i> -3-Methyl-2-pentenoic acid	25	5 15	
462	3-(2-Naphthoyl)propionic acid	20	4 96		469	Itaconic acid	18	5 54	
463	Cyclopentanecarboxylic acid	25	4 99		470	Citraconic acid	18	6 17	
464	2,2-Dimethylbutyric acid	18	5 03		471	Ethylenediamine-N,N,N ,N'-tetra- acetic acid	25	6 27	10 95
465	Trimethylacetic acid	25	5 05		472	Ethylenediamine-N,N -diacetic acid	30	6 42	9 46
466	3,3-Dimethylacrylic acid (3-Methyl- crotonic acid)	25	5 12		473	Ethylenediamine-N,N'-dipropionic acid	30	6 87	9 60
467	<i>trans</i> -3-Methyl-2-pentenoic acid	25	5 13						

## EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation



and the corresponding equilibrium constant  $K_e$  is given by

$$K_e = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})(a_{\text{H}_2\text{O}})}$$

where the  $a$ 's are the activities of the species. At low electrolyte concentrations  $a_{\text{H}_2\text{O}}$  is virtually constant, and a second constant,  $K_a$ , the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{\text{H}_2\text{O}}) = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})} = \frac{(c_{\text{A}_{\text{aq}}^{\pm n-1}})(c_{\text{H}_3\text{O}^+})}{(c_{\text{HA}_{\text{aq}}^{\pm n}})} \cdot \frac{f_{\pm}^2}{f_{\text{HA}_{\text{aq}}^{\pm n}}}$$

where the  $c$ 's are the concentrations and the  $f$ 's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient  $pK_a$  notation, where

$$pK_a = -\log K_a$$

For Table XXVII,  $\text{HA}^{\pm n} = \text{RCOOH}$ , and  $\text{A}^{\pm n-1} = \text{RCOO}^-$

For Table XXVIII,  $\text{HA}^{\pm n} = \text{ArOH}$ , and  $\text{A}^{\pm n-1} = \text{ArO}^-$

For Table XXIX,  $\text{HA}^{\pm n} = \text{RR}'\text{R}''\text{NH}^+$  and  $\text{A}^{\pm n-1} = \text{RR}'\text{R}''\text{N}(\text{R}, \text{R}' \text{ and } \text{R}'')$  may be alkyl or aryl groups or a hydrogen atom

For monobasic acids  $pK_a = pK_1$

For dicarboxylic acids both  $pK_1$  and  $pK_2$  are given,  $pK_1$  is defined above, and  $pK_2$  is the analogous dissociation constant of the monoanion,  $\text{A}^{\pm n-1}$ , obtained on the first dissociation. For other dibasic acids such as the conjugate acids of amino acids, or diamines,  $pK_1$  is as defined above, and  $pK_2$  is the dissociation constant for the species obtained after the first protonation

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for  $pK$  determinations, see G Kortum, W Vogel and K Andrusow, in *Pure and Applied Chemistry*, Vol 1, Butterworths, London, 1961, pp 190-536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution see D D Perrin, *Dissociation Constants of Organic Bases in Aqueous Solution*, Butterworths, London, 1965

For general references including methods of determination of  $pK$ , and data for both acids and bases see J F King, in *Elucidation of Structures by Physical and Chemical Methods*, Vol 1 (Ed K W Bently) (*Technique of Organic Chemistry*, Vol 9), Interscience, New York, 1963, Chapter 6, pp 318-401, H C Brown, D H McDaniel and O Hafliger in *Determination of Organic Structures by Physical Methods*, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XXVIII. ACID DISSOCIATION CONSTANTS OF PHENOLS  
IN AQUEOUS SOLUTION  
(Listed in order of increasing pKa)**

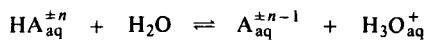
No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
1	Picric acid (2,4,6-Trinitrophenol)	25	0 29 (0 71)		51	2-Hydroxy-3-methoxybenzylamine	25	8 70	10 52
2	4-Hydroxypyrimidine	20	1 85	8 59	52	3-Hydroxypyridine	20	8 72	
3	2-Hydroxypyrimidine	20	2 24	9 17	53	2-Fluorophenol	25	8 82	
4	4-Chloro-2,6-dinitrophenol	25	2 97		54	Isovianillin (5-Formyl-2-methoxyphenol 3-Hydroxy-4-methoxybenzaldehyde)	25	8 889	
5	2,6-Dinitrophenol	25	3 71		55	3-Hydroxy-2-methoxybenzylamine	25	8 89	10 52
6	2,4-Dinitrophenol	25	4 09		56	4-Hydroxy-3-methoxybenzylamine	25	8 94	10 42
7	2,6-Dinitrohydroquinone	21	4 42	9 14	57	3-Nitro-2,4,6-trimethylphenol	25	8 98	
8	8-Hydroxyquinoline	20	5 017	9 813	58	Sodium 4-hydroxybenzenesulfonate	25	9 01	
9	2,5-Dinitrophenol	25	5 04		59	Pyrogallol (1 2 3-Trihydroxybenzene)	25	9 01	11 64
10	3,4-Dinitrophenol	25	5 42		60	2-Methylhydroquinone (Toluhydroquinone)	25	9 05	11 62
11	8-Hydroxyquinaldine	25	5 55	10 31	61	3-Chlorophenol	25	9 08	
12	4-Methyl-8-hydroxyquinoline	25	5 58	10 00					(9 02)
13	3,4-Dimethyl-8-hydroxyquinoline	25	5 80	10 05	62	3-Bromophenol	25	9 11	
14	5-Formyl-2-nitrophenol (3-Hydroxy-4-nitrobenzaldehyde)	25	6 00		63	3-Iodophenol	25	9 17	
15	5-Chloro-2-nitrophenol	25	6 05		64	3-Acetylphenol	25	9 19	
16	5-Carboethoxy-2-nitrophenol (Ethyl 3-hydroxy-4-nitrobenzoate)	25	6 11		65	4-Iodophenol	25	9 20	
17	5-Carbomethoxy-2-nitrophenol (Methyl 3-hydroxy-4-nitrobenzoate)	25	6 15		66	Sodium 3-hydroxybenzenesulfonate	25	9 29	
18	2,4-Dimethyl-8-hydroxyquinoline	25	6 20	10 60	67	1-Naphthol	20 5	9 30	
19	3-Nitrocatechol	25	6 68		68	3-(Methylsulfonyl)phenol	25	9 33	
20	2-Nitro-5-phenylphenol (3-Hydroxy-4-nitrobiphenyl)	25	6 74		69	4-Bromophenol	25	9 34	
21	2-Formylphenol (Salicylaldehyde)	25	6 79		70	3-Fluorophenol	25	9 36	
22	5-Methoxy-2-nitrophenol	25	7 09		71	1,4-Naphthohydroquinone (1 4 Dihydroxy naphthalene)	26 5	9 37	10 93
23	4-Nitrophenol	25	7 16		72	4-Chlorophenol	25	9 38	
24	2-Nitrophenol	25	7 21		73	Sodium 4-hydroxybenzoate	20	9 39	
25	2,6-Dimethyl-4-nitrophenol	25	7 22		74	Resorcinol (1 3-Dihydroxybenzene)	30	9 44	11 32
26	5-Methyl-2-nitrophenol	25	7 25		75	Catechol (1 2-Dihydroxybenzene)	30	9 48	12 08
27	2,6-Dichlorohydroquinone	25	7 30	9 99	76	4-Phenylphenol (4 Hydroxybiphenyl)	22 5	9 51	
28	Vanillin (4-Formyl-2-methoxyphenol 4-Hydroxy-3-methoxybenzaldehyde)	25	7 396		77	3-(Methylthio)phenol	25	9 53	
29	2-Nitrohydroquinone	21	7 63	10 06	78	4-(Methylthio)phenol	25	9 53	
30	4-Formylphenol (4-Hydroxybenzaldehyde)	25	7 66		79	2,4,6-Trimethylolphenol	25	9 56	
31	4-(Methylsulfonyl)phenol	25	7 83		80	2-Naphthol	19 5	9 57,	(9 93)
33	o-Vanillin (2-Formyl-6-methoxyphenol, 2-Hydroxy-3-methoxybenzaldehyde)	25	7 91		81	3-Phenylphenol (3-Hydroxybiphenyl)	22 5	9 64	
34	4-Cyanophenol (4-Hydroxybenzonitrile)	25	7 95		82	3-Methoxyphenol	25	9 65	
35	3-Formylphenol (3-Hydroxybenzaldehyde)	25	8 00		83	2,6-Dimethylolphenol	25	9 66	
36	4-Acetylphenol	25	8 05		84	2-Aminophenol (2-Hydroxyaniline)	28	9 71	
37	3,5-Dimethyl-4-(methylsulfonyl)phenol	25	8 13		85	2,4-Dimethylolphenol	25	9 77	
38	4-Cyano-3,5-dimethylphenol (2,6-Dimethyl-4-hydroxybenzonitrile)	25	8 21		86	4-Methylophenol	25	9 82	
39	3,5-Dimethyl-4-nitrophenol	25	8 25		87	3-Methylophenol	25	9 83	
40	4-Cyano-2,6-dimethylphenol (3,5-Dimethyl-4-hydroxybenzonitrile)	25	8 27		88	3-Aminophenol (3-Hydroxyaniline)	21 5	9 87	9 92
41	2-Carboxamidophenol (Salicylamide)	20	8 37		89	Sodium 4-hydroxybenzenephosphonate	25	9 90	
42	3-Nitrophenol	25	8 38		90	3-Ethylphenol	28	9 90	
43	4-Carbobenzyloxyphenol (Benzyl 4-hydroxybenzoate)	25	8 41		91	2,6-Dimethyl-4-methylphenol	25	9 92	
44	2-Bromophenol	25	8 42		92	2-Methylophenol	25	9 92	
45	Phloroglucinol (1,3,5-Trihydroxybenzene)	25	8 45	(7 0)	93	4-Fluorophenol	25	9 92	
46	2-Iodophenol	25	8 46		94	Sodium 3-hydroxybenzoate	20	9 94	
47	4-Carbobutoxyphenol (n-Butyl 4-hydroxybenzoate)	25	8 47		95	2-Methoxyphenol	25	9 98	
48	4-Carbomethoxyphenol (Methyl 4-hydroxybenzoate)	25	8 47		96	Phenol	25	9 99,	(9 95)
49	2-Chlorophenol	25	8 48		97	Eugenol (4-Allyl-2-methoxyphenol)	25	10 00	
50	4-Carboethoxyphenol (Ethyl 4-hydroxybenzoate)	25	8 50		98	2-Phenylphenol (2-Hydroxybiphenyl)	22 5	10 01	
				8 88	99	4-Ethylphenol	28	10 01	
					100	3-Methylphenol (m-Cresol)	25	10 09	
					101	3-Ethyl-5-methylphenol	28	10 10	
					102	3,5-Dimethylphenol	25	10 15	
					103	4-Methyl-2-methylophenol	25	10 15	
					104	4-Methoxyphenol	25	10 20	
					105	Sodium 3-hydroxybenzenephosphonate	25	10 2	

**TABLE XXVIII. ACID DISSOCIATION CONSTANTS OF PHENOLS  
IN AQUEOUS SOLUTION  
(Listed in order of increasing pKa)**

No.	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No.	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
106	<b>2-Ethylphenol</b>	28	10 2		115	<b>2,6-Dimethylphenol</b>	25	10 59	
107	<b>2,5-Dimethylphenol</b>	24	10 22		116	<b>2,4,6-Trimethylphenol</b>	25	10 88,	
108	<b>4-Methylphenol (<i>p</i>-Cresol)</b>	25	10 26					(10 99)	
109	<b>2-Methylphenol (<i>o</i>-Cresol)</b>	25	10 28		117	<b>Hydroquinone (1,4-Dihydroxybenzene)</b>	25	10 85,	11 39
110	<b>4-Indanol</b>	25	10 32		118	<b>4-Hydroxypyridine</b>	20	11 09	
111	<b>3,4-Dimethylphenol</b>	25	10 32		119	<b>Tetramethylhydroquinone (Durohydro-</b>	25	11 51	
112	<b>2,4,5-Trimethylphenol</b>	25	10 45		120	<b>2-Hydroxypyridine</b>	20	11 62	
113	<b>2,4-Dimethylphenol</b>	25	10 45						
114	<b>2,3-Dimethylphenol</b>	25	10 50						

## EXPLANATIONS AND REFERENCES TO TABLES XXVII, XXVIII AND XXIX

The dissociation of an organic carboxylic acid, phenol or the conjugate acid of an amine in aqueous solution is expressed by the equation



and the corresponding equilibrium constant  $K_e$  is given by

$$K_e = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})(a_{\text{H}_2\text{O}})}$$

where the  $a$ 's are the activities of the species. At low electrolyte concentrations  $a_{\text{H}_2\text{O}}$  is virtually constant, and a second constant,  $K_a$ , the thermodynamic dissociation constant, is defined as

$$K_a = K_e(a_{\text{H}_2\text{O}}) = \frac{(a_{\text{A}_{\text{aq}}^{\pm n-1}})(a_{\text{H}_3\text{O}^+})}{(a_{\text{HA}_{\text{aq}}^{\pm n}})} = \frac{(c_{\text{A}_{\text{aq}}^{\pm n-1}})(c_{\text{H}_3\text{O}^+})}{(c_{\text{HA}_{\text{aq}}^{\pm n}})} \cdot \frac{f_{\pm}^2}{f_{\text{HA}_{\text{aq}}^{\pm n}}}$$

where the  $c$ 's are the concentrations and the  $f$ 's are the activity coefficients of the species

The dissociation constants in the Tables are given in the more convenient  $pK_a$  notation, where

$$pK_a = -\log K_a$$

For Table XXVII,  $\text{HA}^{\pm n} = \text{RCOOH}$ , and  $\text{A}^{\pm n-1} = \text{RCOO}^-$

For Table XXVIII,  $\text{HA}^{\pm n} = \text{ArOH}$ , and  $\text{A}^{\pm n-1} = \text{ArO}^-$

For Table XXIX,  $\text{HA}^{\pm n} = \text{RR}'\text{R}''\text{NH}^+$  and  $\text{A}^{\pm n-1} = \text{RR}'\text{R}''\text{N}(\text{R}, \text{R}' \text{ and } \text{R}'' \text{ may be alkyl or aryl groups or a hydrogen atom})$

For monobasic acids  $pK_a = pK_1$

For dicarboxylic acids both  $pK_1$  and  $pK_2$  are given,  $pK_1$  is defined above, and  $pK_2$  is the analogous dissociation constant of the monoanion,  $\text{A}^{\pm n-1}$ , obtained on the first dissociation. For other dibasic acids such as the conjugate acids of amino acids, or diamines,  $pK_1$  is as defined above, and  $pK_2$  is the dissociation constant for the species obtained after the first protonation

For a comprehensive compilation of the dissociation constants of organic acids (including phenols) in aqueous solution, as well as summary of the methods for  $pK$  determinations, see G Kortum, W Vogel and K Andrusow, in *Pure and Applied Chemistry*, Vol 1, Butterworths, London, 1961, pp 190-536

For a comprehensive compilation of the dissociation constants of organic bases (especially amines) in aqueous solution see D D Perrin, *Dissociation Constants of Organic Bases in Aqueous Solution*, Butterworths, London, 1965

For general references including methods of determination of  $pK$ , and data for both acids and bases see J F King, in *Elucidation of Structures by Physical and Chemical Methods*, Vol 1 (Ed K W Bently) (*Technique of Organic Chemistry*, Vol 9), Interscience, New York, 1963, Chapter 6, pp 318-401, H C Brown, D H McDaniel and O Hafliger in *Determination of Organic Structures by Physical Methods*, Vol 1 (Ed E A Braude and F C Nachod), Academic Press, New York, 1955, Chapter 14, p 567

\*Derivatives recommended for first trial

WARNING This is not an instruction manual References should be consulted for the preparation of derivatives

**TABLE XXIX. DISSOCIATION CONSTANTS OF  
ORGANIC BASES IN AQUEOUS SOLUTION**

(Listed in order of increasing pKa)

(The data relates to the acid dissociation constant (Ka) of the conjugate acid ( $BH^+$ ) of the listed base (B))

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
1	2,4,6-Trinitroaniline	25	-9.41		59	2-Amino-6-nitronaphthalene	25	2.62	
2	2,4-Dinitroaniline	25	-4.53		60	N,N-Dimethyl-3-nitroaniline	25	2.63	
3	2,6-Dinitro-4-methylaniline	25	-3.96		61	2-Chloroaniline	25	2.65	
4	2,4-Dichloro-6-nitroaniline	25	-3.61		62	2-Amino-4-cyanonaphthalene	25	2.66	
5	2,6-Dichloro-4-nitroaniline	20	-2.55		63	1-Amino-3-bromonaphthalene	25	2.67	
6	N-Cyanodiethylamine	25	-2.0		64	3-Bromoquinoline	25	2.69	
7	1-Amino-2-nitronaphthalene	25	-1.74		65	1-Amino-3-chloronaphthalene	25	2.69	
8	4-Chloro-2-nitroaniline	25	-1.02		66	5-Nitroquinoline	20	2.69	
9	Dicyanomethyl ethyl amine	25	-0.6		67	6-Nitroquinoline	20	2.72	
10	2-Fluoropyridine	25	-0.44		68	1-Amino-5-nitronaphthalene	25	2.73	
11	Pyrrole	25	-0.27		69	2-Amino-8-nitronaphthalene	25	2.73	
			(-3.8)		70	3-Cyanoaniline	25	2.748	
12	2-Nitroaniline	25	-0.26		71	1-Amino-8-nitronaphthalene	23	2.79	
13	Bis (cyanomethyl) amine	25	0.2		72	1-Amino-3-iodonaphthalene	25	2.82	
14	2-Chloropyridine	25	0.49,		73	3-Bromopyridine	25	2.84	
			(0.72)		74	3-Chloropyridine	25	2.84	
15	1-Amino-4-nitronaphthalene	20	0.54		75	1-Amino-6-nitronaphthalene	25	2.89	
16	Quinoxaline	20	0.56		76	4-Methyl-3-nitroaniline	25	2.96	
17	N,N-Dimethyl-4-nitroaniline	25	0.607		77	3-Cyano-N,N-dimethylaniline	25	2.969	
18	Pyrazine	27	0.65		78	3-Fluoropyridine	25	2.97	
19	Diphenylamine	25	0.79		79	2-Amino-5-nitronaphthalene	25	3.01	
20	3-Nitropyridine	25	0.81		80	2-Methoxypyridine	25	3.06	
21	2-Bromopyridine	25	0.90		81	2-Amino-7-nitronaphthalene	25	3.10	
22	2-Cyanoaniline	25	0.95		82	1,3-Dimethylpyrazole	25	3.11	
23	2,6-Dimethyl-4-nitroaniline	22	0.98		83	2-Methoxyquinoline	20	3.16	
24	4-Nitroaniline	25	1.00		84	3-Acetylpyridine	25	3.18	
25	N-Chlorodiethylamine	25	1.02		85	4-Hydroxypyridine	20	3.20	
26	2-Methyl-4-nitroaniline	24.5	1.04		86	2-Fluoroaniline	25	3.20	
27	2-Bromoquinoline	25	1.05		87	1-Amino-4-bromonaphthalene	25	3.21	
28	Tris (2-cyanoethyl) amine	25	1.1		88	3-Iodopyridine	25	3.25	
29	Pyrimidine	20	1.23		89	1-Amino-3-methoxynaphthalene	25	3.26	
			(1.31)		90	1-Amino-3-hydroxynaphthalene	25	3.30	
30	2-Amino-3-nitronaphthalene	25	1.48		91	1-Amino-5-chloronaphthalene	25	3.34	
31	3-Methyl-4-nitroaniline	25	1.50		92	2-Amino-4-chloronaphthalene	25	3.38	
32	2,5-Dichloroaniline	22	1.57		93	4-Aminofluorene	25	3.39	
33	4-Cyanoaniline	25	1.74		94	2-Amino-4-bromonaphthalene	25	3.40	
34	4-Cyano-N,N-dimethyl aniline	25	1.78		95	2-Amino-4-iodonaphthalene	25	3.41	
35	2-Iodopyridine	25	1.82		96	1-Amino-7-chloronaphthalene	25	3.48	
36	2,3-Dimethyl-4-nitroaniline	25	1.96		97	1-Amino-6-chloronaphthalene	25	3.48	
37	2,4-Dichloroaniline	25	2.00		98	Quinazoline	20	3.49	
38	1-Amino-3-nitronaphthalene	25	2.07		99	3-Chloroaniline	25	3.52	
39	3-Methoxy-5-nitroaniline	25	2.11		100	4-Bromo-2,6-dimethylaniline	25	3.54	
40	4-Aminobenzophenone (4-Benzoylaniline)	25	2.17		101	3-Methylpyrazole	25	3.56	
41	4-Aminoacetophenone (4-Acetyl aniline)	25	2.19		102	3-Aminoacetophenone (3-Acetyl aniline)	25	3.56	
			(2.75)		103	3-Fluoroaniline	25	3.57	
42	2-Aminoacetophenone (2-Acetyl aniline)	25	2.22		104	4-Bromo-2-methylaniline	25	3.58	
43	Pyridazine	20	2.24		105	3-Bromoaniline	25	3.58	
44	1-Amino-3-cyanonaphthalene	25	2.26		106	2-(Methylthio)pyridine	20	3.59	
45	Cinnoline	20	2.27		107	3-Iodoaniline	25	3.61	
46	1,2,4-Triazole	25	2.30		108	5-Bromoquinoline	25	3.62	
47	2,4-Dibromoaniline	15	2.3		109	1-(Methylamino)naphthalene	27	3.67	
48	2,6-Dibromoaniline	25	2.34		110	2-Amino-7-chloronaphthalene	23	3.71	
49	7-Nitroquinolinol	20	2.40		111	4-Bromopyridine	20	3.78	
50	2-Amino-4-nitronaphthalene	25	2.43		112	4-Iodoaniline	25	3.78	
51	Thiazole	20	2.44		113	2-Aminobiphenyl	22	3.82	
52	3-Nitroaniline	25	2.466		114	3,5-Dimethoxyaniline	25	3.82	
53	Pyrazole	25	2.48		115	4-Chloropyridine	20	3.84	
54	2-Bromoaniline	25	2.53		116	4-Bromoaniline	25	3.86	
55	1-Amino-7-nitronaphthalene	25	2.55		117	1-Aminofluorene	25	3.87	
56	8-Nitroquinolinol	20	2.55		118	1-Amino-6-methoxynaphthalene	25	3.90	
57	3,5-Dimethyl-4-nitroaniline	25	2.59		119	1-Aminonaphthalene	25	3.92	
58	2-Iodoaniline	25	2.60		120	2,6-Dimethylaniline	25	3.95	

**TABLE XXIX. DISSOCIATION CONSTANTS OF  
ORGANIC BASES IN AQUEOUS SOLUTION**

(Listed in order of increasing pKa) (Continued)

(The data relates to the acid dissociation constant (Ka) of the conjugate acid (BH<sup>+</sup>) of the listed base (B))

No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T, °C	pK <sub>1</sub>	pK <sub>2</sub>
121	8-Aminoquinoline	20	3.95		183	8-Methylquinoline	25	4.91	
122	1-Amino-5-hydroxynaphthalene	25	3.96		184	3,5-Dimethylaniline	25	4.91	
123	1-Amino-3-methylnaphthalene	25	3.96		185	3-Aminoquinoline	20	4.91	
124	1-Amino-6-hydroxynaphthalene	25	3.97		186	3-Methoxypyridine	25	4.91	
125	4-Chloroaniline	25	4.00		187	4-tert-Butylaniline	25	4.95	
126	3-(Methylthio)aniline	25	4.00		188	3,5-Di-tert-butylaniline	25	4.97	
127	4-Iodopyridine	20	4.02		189	2-Vinylpyridine	25	4.98	
128	2-Amino-4-methoxynaphthalene	25	4.05		190	1,3-Diaminobenzene ( <i>m</i> -Phenylenediamine)	25	4.98	2.41
129	2-Amino-5-hydroxynaphthalene	25	4.07		191	N,3-Dimethylaniline	21	5.00	
130	1-Amino-7-methoxynaphthalene	25	4.07		192	2-tert-Butylaniline	25	5.03	
131	3-Bromo-4-methoxyaniline	23	4.08		193	6-Methoxyquinoline	20	5.03	
132	1-Aminoanthracene	25	4.1		194	N,N-Dimethylaniline	25	5.068	
133	2-Aminonaphthalene	25	4.16		195	4-Methylaniline	25	5.08	
134	N-Allylaniline	25	4.17		196	3-Hydroxypyridine	25	5.10	8.60
135	3-Ethoxyaniline	25	4.17		197	N-Ethylaniline	24	5.12	
136	1-(Ethylamino)naphthalene	25	4.18		198	N-n-Butylaniline	25	5.12	
137	2-Amino-7-methoxynaphthalene	25	4.19		199	3,5,6-Trimethylaniline	20.5	5.12	
138	1-Amino-7-hydroxynaphthalene	25	4.20		200	2-Benzylpyridine	25	5.13	
139	3-Methoxyaniline	25	4.20		201	6-Methylquinoline	25	5.15	
140	4-Aminobiphenyl	29	4.22		202	2-Amino-5,6,7,8-tetrahydronaphthalene	17	5.17	
141	4-Bromo-N,N-dimethylaniline	25	4.232		203	3,4-Dimethylaniline	25	5.17	
142	3-Aminobiphenyl	17	4.25		204	4-Ethoxyaniline	28	5.20	
143	2-Amino-7-hydroxynaphthalene	25	4.25		205	4-Methylquinoline	25	5.20.	
144	2,3,5,6-Tetramethylaniline	25	4.30		206	Pyridine	25	5.25	
145	2-Bromo-N,N-dimethylaniline	25	4.31		207	Bis(2-cyanoethyl)amine	25	5.26	
146	4-(Methylthio)aniline	25	4.35		208	7-Methylquinoline	25	5.29	
147	2-n-Propylaniline	25	4.36		209	N-Cyclopentylaniline	25	5.30	
148	Tris(2-chloroethyl)amine	25	4.37		210	5-Aminoindane	16	5.31	
149	2-Ethylaniline	25	4.37		211	4-Methoxyaniline	25	5.31	
150	2,4,6-Trimethylaniline	25	4.37		212	Aminoacetonitrile	25	5.34	
151	3,5-Dimethylpyrazole	25	4.38		213	N,N,3-Trimethylaniline	25	5.344	
152	3-(Methylthio)pyridine	20	4.42		214	N,4-Dimethylaniline	23	5.36	
153	2-Isopropylaniline	25	4.42		215	Isoquinoline	20	5.42	
154	N-Isobutylaniline	25	4.43		216	N-n-Hexylaniline	19	5.42	
155	2-Ethoxyaniline	28	4.43		217	5-Aminoquinoline	20	5.42	
156	2-Methylaniline	25	4.44		218	2,2,2-Trichloroethylamine	20	5.47	
157	1-Amino-5,6,7,8-tetrahydronaphthalene	16	4.47		219	Benzimidazole	25	5.53	
158	Phenanthridine	20	4.48		220	1-Methylbenzimidazole	25	5.54	
159	2-Methoxyaniline	25	4.52		221	3-Ethylpyridine	25	5.56	
160	2,5-Dimethylaniline	25	4.53		222	1-Ethylbenzimidazole	25	5.59	
161	1-(Cyanomethyl)pyridine	25	4.55		223	6-Aminquinoline	20	5.59	
162	(Cyanomethyl) diethyl amine	25	4.55		224	N-Cyclohexylaniline	25	5.60	
163	Bis(2-Cyanoethyl) ethyl amine	25	4.55		225	4-Vinylpyridine	25	5.62	
164	2-(Dimethylamino)naphthalene	25	4.566		226	N,N,4-Trimethylaniline	25	5.627	
165	Aniline	25	4.603		227	3-Methylpyridine	25	5.63	
166	5-Methylquinoline	25	4.62		228	4-Methylbenzimidazole	25	5.65	
167	N,2-Dimethylaniline	23	4.62		229	N,N-Di-n-propylaniline	23	5.68	
168	2-Aminofluorene	25	4.64		230	2-Methylquinoline	25	5.69	
169	2-Amino-6-methoxynaphthalene	25	4.64		231	1-Isopropylbenzimidazole	25	5.71	
170	4-Fluoroaniline	25	4.65		232	3-Isopropylpyridine	25	5.72	
171	3-tert-Butylaniline	25	4.66		233	2-tert-Butylpyridine	25	5.76	
172	3-Isopropylaniline	25	4.67		234	N-Isopropylaniline	25	5.77	
173	2,3-Dimethylaniline	25	4.70		235	5-Methylbenzimidazole	25	5.78	
174	3-Methylaniline	25	4.70		236	3-tert-Butylpyridine	25	5.82	
175	3-Ethylaniline	25	4.70		237	2-Isopropylpyridine	25	5.83	
176	1,2-Diaminobenzene ( <i>o</i> -Phenylenediamine)	25	4.74		238	4-Ethylpyridine	25	5.87	
177	N-n-Propylaniline	25	4.79		239	2-Ethylpyridine	25	5.89	
178	Quinoline	25	4.81		240	2-Methylpyridine	25	5.94	
179	3-Aminofluorene	25	4.82		241	4-(Methylthio)pyridine	20	5.94	
180	1-(Dimethylamino)naphthalene	28	4.83		242	2-Hexylpyridine	25	5.95	
181	N-Methylaniline	25	4.848						
182	2,4-Dimethylaniline	25	4.89						
				0.6					

**TABLE XXIX. DISSOCIATION CONSTANTS OF  
ORGANIC BASES IN AQUEOUS SOLUTION**  
(Listed in order of increasing pKa) (Continued)

(The data relates to the acid dissociation constant (Ka) of the conjugate acid ( $\text{BH}^+$ ) of the listed base (B))

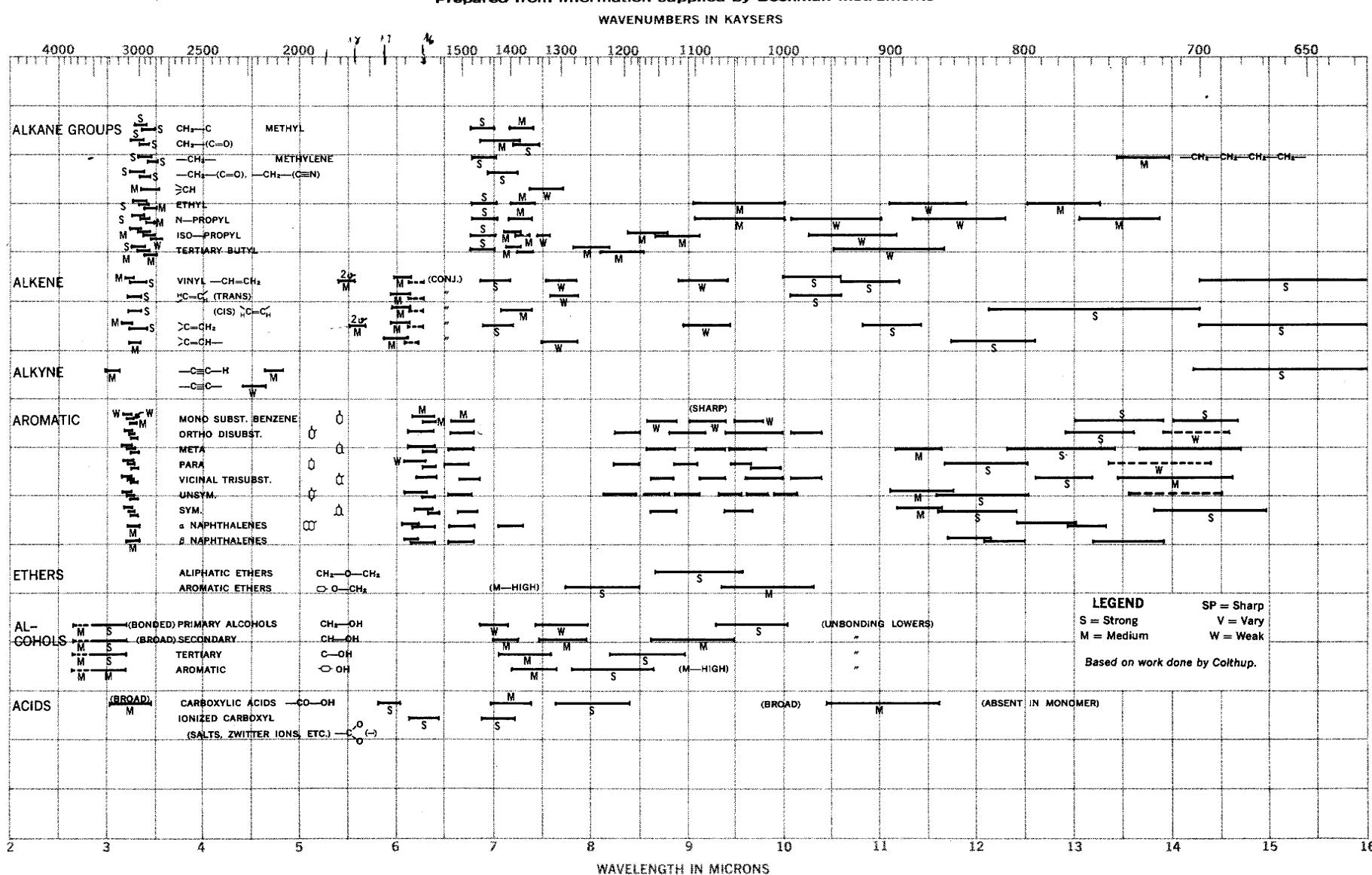
No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
243	2-n-Propylpyridine	25	5.97		305	Bis(2-hydroxyethyl)amine	25	8.88	
244	4-tert-Butylpyridine	25	5.99		306	N,N-Dimethylbenzylamine	25	8.91	
245	2-Pentylpyridine	25	6.00		307	3-Bromopropylamine	21	8.93	
246	4-Isopropylpyridine	25	6.02		308	1,2-Bis(dimethylamino)ethane	30	8.97	5.85
247	4-Methylpyridine	25	6.03		309	1-(Aminoethyl)benzene	25	9.08	
248	3-Aminopyridine	25	6.03		310	2-Acetoxyethylamine	25	9.1	
249	N,N,2-Trimethylaniline	25	6.11		311	4-Aminopyridine	25	9.114	
250	N,2,6-Trimethylaniline	25	6.12		312	4-Aminoquinoline	20	9.13	
					313	(3-Cyanopropyl) diethyl amine	25	9.13	
252	2-Methylbenzimidazole	25	6.19		314	3-Methoxybenzylamine	25	9.15	
253	1,4-Diaminobenzene ( <i>p</i> -Phenylenediamine)	25	6.2	2.67	315	2-Methylbenzylamine	25	9.19	
254	2-Isopropylbenzimidazole	25	6.21		316	1-Aminoindane	22.5	9.21	
255	2-Ethylbenzimidazole	25	6.27		317	<i>trans</i> -1-Amino-2-hydroxycyclopentane	25	9.28	
256	N,N-Di- <i>n</i> -butylaniline	19	6.30		318	Diallylamine	25	9.29	
257	2,5-Dimethylpyridine	25	6.40		319	Dimethyl (2-hydroxyethyl) amine	20	9.31	
258	2-Phenylimidazole	25	6.40		320	3-Methylbenzylamine	25	9.33	
259	Bis(2-chloroethyl)methyl amine	25	6.43		321	Benzylamine	25	9.35,	
260	4-Methoxyquinoline	30	6.45		322	4-Methylbenzylamine	25	9.36	
261	3,4-Dimethylpyridine	25	6.46		323	3,4-Dimethoxybenzylamine	25	9.39	
262	4-Methoxypyridine	25	6.47		324	2,3-Dimethoxybenzylamine	25	9.41	
263	Bis(2-chloroethyl) ethyl amine	25	6.55		325	2-Phenethylaminoethylamine	25	9.44	6.59
264	1,2-Dimethylbenzimidazole	25	6.55		326	N,N-Diethylbenzylamine	25	9.44	
265	2,3-Dimethylpyridine	25	6.57		327	4-Methoxybenzylamine	25	9.47	
266	2,6-Dimethylpyridine	25	6.60		328	2-(Methylthio)ethylamine	20	9.49	
267	7-Aminoquinoline	20	6.61		329	2-Hydroxyethylamine	25	9.498	
268	N,N-Diethylaniline	22	6.61		330	2-(Dimethylamino)ethylamine	25	9.53	6.63
269	4-Ethoxypyridine	20	6.67		331	N-Methylbenzylamine	25	9.54	
270	2-Aminopyridine	25	6.71		332	1,2-Bis(diethylamino)ethane	25	9.55	6.18
271	2,4-Dimethylpyridine	25	6.77		333	2-Aminoindane	21.5	9.57	
272	Imidazole	25	6.95		334	N-Propylbenzylamine	25	9.58	
273	N-tert-Butylaniline	25	7.00		335	1,2,3-Triaminopropane	20	9.59	7.95,
274	(2-Cyanoethyl) dimethyl amine	29	7.0						pK <sub>3</sub> = 3.72
275	2-Benzyl-2-pyrroline	25	7.06		336	2-Methoxyethylamine	20	9.61	
276	2-Aminoquinoline	20	7.30		337	5-Bromo- <i>n</i> -pentylamine	21	9.62	
277	N,N-Di-isopropylaniline	25	7.37		338	<i>trans</i> -1-Amino-2-hydroxycyclohexane	25	9.63	
278	N-Methylmorpholine	25	7.38		339	1-Amino-1,2,3,4-tetrahydronaphthalene	20	9.63	
279	2,4,6-Trimethylpyridine	25	7.43		340	N-Ethylbenzylamine	25	9.64	
280	4-Methylimidazole	25	7.518		341	3,3,3-Trichloro- <i>n</i> -propylamine	20	9.65	
281	1,3-Triazine	25	7.6		342	1-Allylpiperidine	25	9.65	
282	N-Ethylmorpholine	25	7.67		343	2-Methoxybenzylamine	25	9.70	
283	2-Cyanoethylamine	29	7.7		344	<i>cis</i> -1-Amino-2-hydroxycyclopentane	25	9.70	
284	Tris(2-hydroxyethyl)amine	25	7.762		345	2-(Furylaminooethyl)amine	20	9.72	6.20
285	2-Methylimidazole	25	7.85		346	<i>cis</i> -1-Amino-2-hydroxycyclohexane	25	9.72	
286	N-Methylaziridine	25	7.86		347	Piperazine	25	9.81	5.55
287	N- <i>n</i> -Butylaziridine	25	7.86		348	Trimethylamine	25	9.81	
288	2-Ethyl-2-pyrroline	25	7.87		349	Phenethylamine ((2-Aminoethyl)benzene)	25	9.84	
289	2,3,5,6-Tetramethylpyridine	20	7.90		350	Diethyl 2-hydroxyethyl amine	20	9.87	
290	2-Cyclohexyl-2-pyrroline	25	7.91		351	1-Methyl-3-pyrroline	25	9.88	
291	N-Ethylaziridine	24	7.93		352	1,2-Diaminoethane (1,2-Ethylenediamine)	25	9.928	6.848
292	Aziridine	25	8.01		353	<i>cis</i> -1,2-Diaminocyclohexane	20	9.93	6.13
293	N,2-Diethylaziridine	25	8.18		354	2-Amino-1,2,3,4-tetrahydronaphthalene	17	9.93	
294	2-Ethylaziridine	25	8.29		355	Tri- <i>n</i> -butylamine	25	9.93	
295	Triallylamine	25	8.31		356	4,4,4-Trichloro- <i>n</i> -butylamine	20	9.93	
296	Morpholine	25	8.33		357	<i>trans</i> -1,2-Diaminocyclohexane	20	9.94	6.47
297	2,4-Dimethylimidazole	25	8.36		358	3-Hydroxypropylamine	25	9.96	
298	2-Bromoethylamine	24	8.49		359	<i>meso</i> -2,3-Diaminobutane	25	9.97	6.92
299	Bis(2-hydroxyethyl) methyl amine	25	8.52		360	<i>d,l</i> -2,3-Diaminobutane	25	10.00	6.91
300	1,2-Bis(furylaminooethyl)ethane	20	8.61	5.74	361	1,2-Diaminopropane (1,2-Propylenediamine)	25	10.00	7.13
301	2,2-Dimethylaziridine	25	8.64		362	<i>cis</i> -Neobornylamine	25	10.01	
302	<i>trans</i> -2,3-Dimethylaziridine	24	8.69						
303	<i>cis</i> -2,3-Dimethylaziridine	23	8.72						
304	(2-Chloroethyl) diethyl amine	25	8.80						

**TABLE XXIX. DISSOCIATION CONSTANTS OF  
ORGANIC BASES IN AQUEOUS SOLUTION**

(Listed in order of increasing pKa) (Continued)

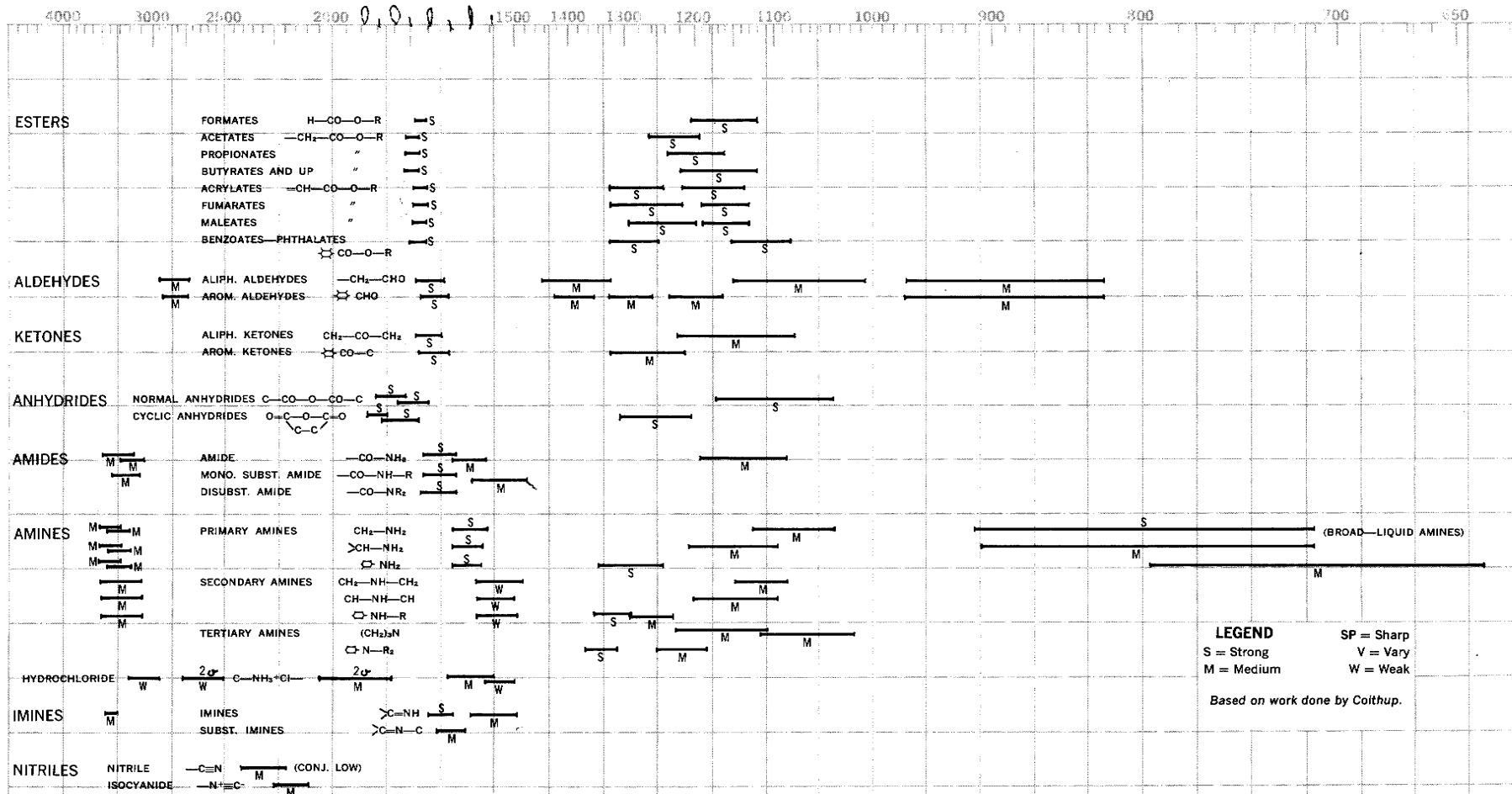
(The data relates to the acid dissociation constant (Ka) of the conjugate acid ( $BH^+$ ) of the listed base (B))

No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>	No	Name	T °C	pK <sub>1</sub>	pK <sub>2</sub>
363	2-(Diethylamino)ethylamine	25	10.02	7.07	417	n-Pentylamine	25	10.63	
364	1-Methylpiperidine	25	10.08		418	n-Undecylamine (n-Hendecylamine)	25	10.63	
365	Dimethyl isobutyl amine	20	10.08		419	n-Nonylamine	25	10.64	
366	5,5,5-Trichloro-n-pentylamine	20	10.12		420	Acridine	25	10.65	
367	2-(Methylamino)ethylamine	20	10.15	6.86	421	n-Octylamine	25	10.65	
368	cis-1,2,6-Trimethylpiperidine	30	10.15		422	Methylamine	25	10.657	
369	2,2-Dimethyl-n-propylamine	25	10.15		423	1-Ethyl-2-methylpiperidine	25	10.66	
370	1,2-Bis(methylamino)ethane	25	10.16	7.40	424	n-Heptylamine	25	10.66	
371	Dimethyl propyl amine	20	10.16		425	2-Aminoheptane	25	10.67	
372	Dimethyl ethyl amine	20	10.16		426	Cyclohexylamine	25	10.68	
373	trans-Bornylamine	25	10.17		427	tert-Butylamine	25	10.68	
374	1,2,2,4-Tetramethylpiperidine	30	10.18		428	tert-Butyl dimethyl amine	20	10.69	
375	n-Butyl dimethyl amine	25	10.19		429	n-Propylamine	25	10.69	
376	1,2-Dimethylpyrrolidine	26	10.20		430	1,2,2,6-Tetramethylpiperidine	30	10.70	
377	1,2-Dimethylpiperidine	25	10.22		431	Ethylamine	25	10.70	
378	1,5-Diaminopentane	25	10.25	9.13	432	Isobutylamine	25	10.72	
379	Tri-n-propylamine	25	10.26		433	3-(Trimethylsilyl)-n-propylamine	25	10.73	
380	1,2-Bis(propylamino)ethane	25	10.27	7.53	434	Dimethylamine	25	10.73	
381	2-(Butylamino)ethylamine	25	10.30	7.53	435	Triethylamine	25	10.75	
382	1,3-Diaminopropane (1,3-Propylenediamine)	25	10.30	8.29	436	2-Cyclohexylpyrrolidine	25	10.76	
383	2-Benzylpyrrolidine	25	10.31		437	1,4-Diaminobutane	20	10.80	9.35
384	Tri-isobutylamine	25	10.32		438	Di-isobutylamine	21	10.91	
385	N-Methylpyrrolidine	25	10.32		439	1,6-Diaminohexane	25	10.93	9.83
386	2-(propylamino)ethylamine	25	10.34	7.54	440	Di-isoamylamine	27.8	10.94	
387	4-Hydroxy-n-butylamine	20	10.35		441	Quinuclidine	25	10.95	
388	1,2-Bis(isopropylamino)ethane	25	10.40	7.59	442	2-Methylpiperidine	25	10.95	
389	1-n-Propylpiperidine	26.5	10.41		443	2-(Trimethylsilyl)ethylamine	25	10.97	
390	3-Aminopentane	25	10.42		444	Di-n-tridecylamine	25	11.00	
391	3-Aminocyclohexene	25	10.42		445	Di-n-octadecylamine	25	11.00	
392	1-n-Butylpiperidine	26	10.43		446	1,8-Diaminooctane	20	11.00	10.1
393	1-Ethylpiperidine	23	10.45		447	Di-n-propylamine	25	11.00	
394	1,2-Bis(ethylamino)ethane	25	10.46	7.70	448	Di-n-dodecylamine	25	11.00	
395	Diethyl methyl amine	20	10.46		449	Di-n-pentadecylamine	25	11.00	
396	5-Hydroxy-1-pentylamine	23	10.46		450	Di-n-hexylamine	25	11.01	
397	Dimethyl isopropyl amine	20	10.47		451	Di-n-octylamine	25	11.01	
398	trans-1-Amino-4-methylcyclohexane	25	10.48		452	2,2,4-Trimethylpiperidine	30	11.04	
399	(Aminomethyl)cyclohexane	25	10.49		453	Cyclohexyl methyl amine	25	11.04	
400	cis-1-Amino-2-methylcyclohexane	25	10.49		454	Diethylamine	25	11.04	
401	2-Aminooctane	25	10.49		455	2,2,6,6-Tetramethylpiperidine	25	11.07	
402	trans-1-Amino-2-methylcyclohexane	25	10.51		456	Azepine	25	11.07	
403	cis-1-Amino-3-methylcyclohexane	25	10.56		457	cis-2,6-Dimethylpiperidine	25	11.07	
404	2-(Ethylamino)ethylamine	25	10.56	7.63	458	3-Methylpiperidine	25	11.07	
405	Dimethyl sec-butyl amine	20	10.57		459	Piperidine	25	11.123	
406	6-Hydroxy-n-hexylamine	21	10.60		460	Di-isopropylamine	21	11.13	
407	6-Bromo-n-hexylamine	21	10.60		461	Di-n-pentylamine	26	11.16	
408	1-Aminohexadecane	25	10.60		462	2,2,6-Trimethylpiperidine	30	11.21	
409	1-Aminodocosane	25	10.60		463	(tert-Butylamino)cyclohexane	25	11.23	
410	1-Aminoctadecane	25	10.60		464	Di-n-butylamine	25	11.25	
411	1-Aminopentadecane	25	10.61		465	1,2,2,4,4-Pentamethylpiperidine	25	11.25	
412	n-Butylamine	25	10.61		466	Pyrrolidine	25	11.27	
413	1-Aminohexadecane	25	10.61		467	Azetidine	25	11.29	
414	trans-1-Amino-3-methylcyclohexane	25	10.61		468	Isopropylamine	25	11.54, (10.63)	
415	1-Aminotetradecane	25	10.62		469	1,2-Dimethyl-2-pyrroline	25	11.90	
416	2-(Isopropylamino)ethylamine	25	10.62	7.70	470	Acetamidine (Methylamidine)	25	12.40	

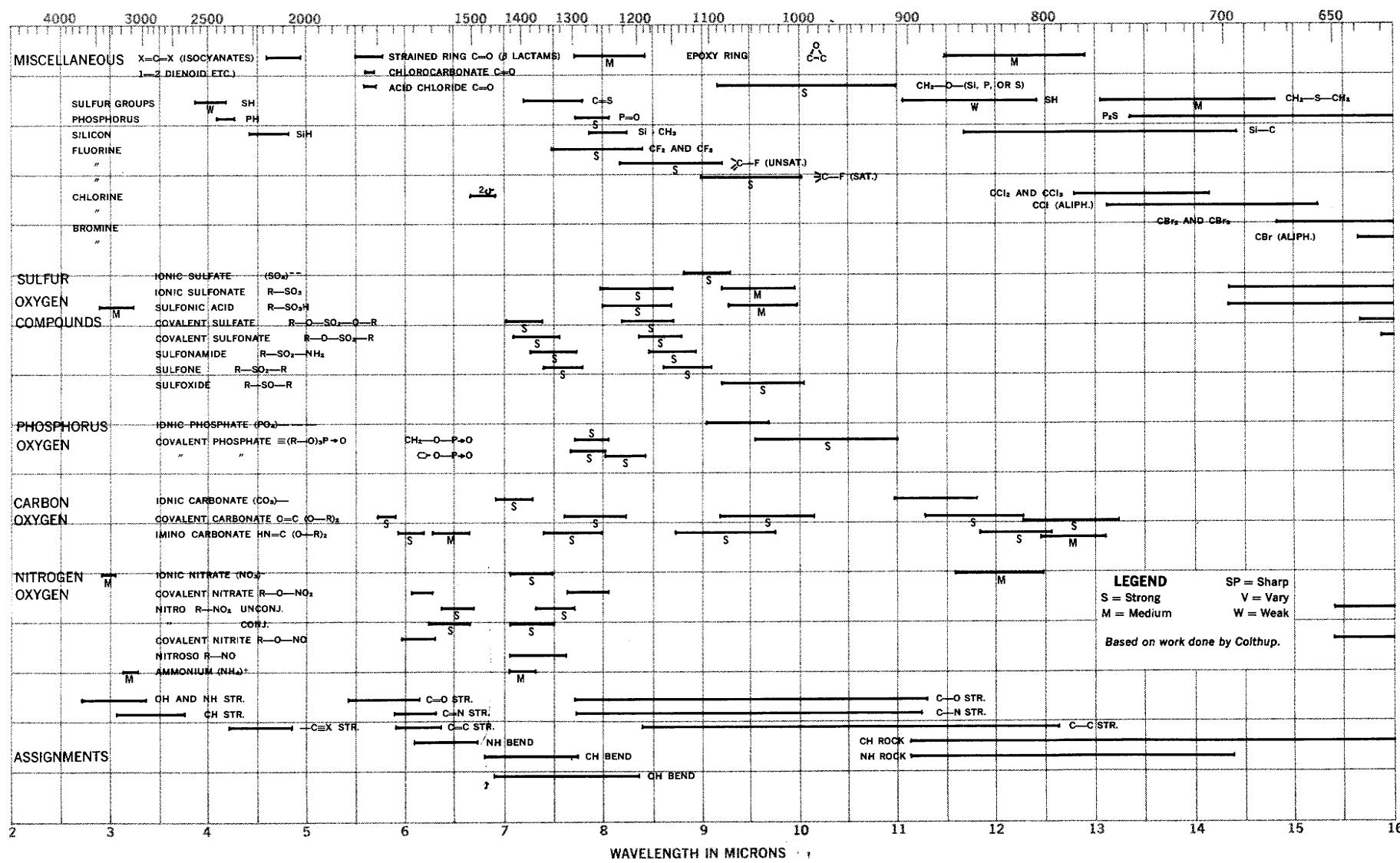


# INFRARED CORRELATION CHART No. 1 (Con't.)

WAVE NUMBERS IN KAYSERS



## WAVENUMBERS IN KAYSERS



# INFRARED CORRELATION CHART No. 2

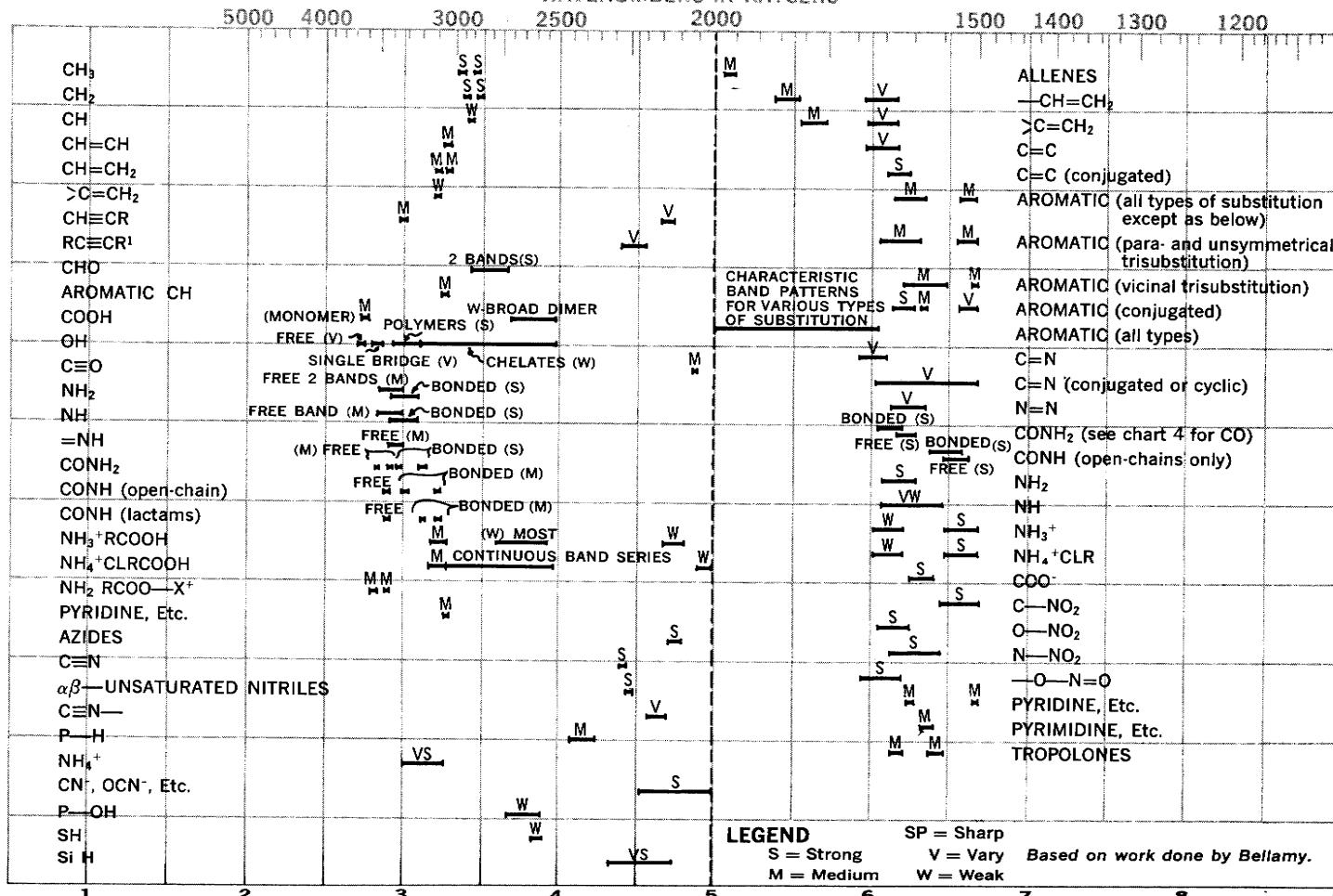
Prepared from information supplied by Beckman Instruments

This chart presents some information regarding structure, double-bond vibrations, hydrogen stretching and triple-bond vibrations.

HYDROGEN STRETCHING AND TRIPLE-BOND VIBRATIONS, 3750-2000 CM.<sup>-1</sup>

DOUBLE-BOND VIBRATIONS, ETC. 2000-1500 CM.<sup>-1</sup>

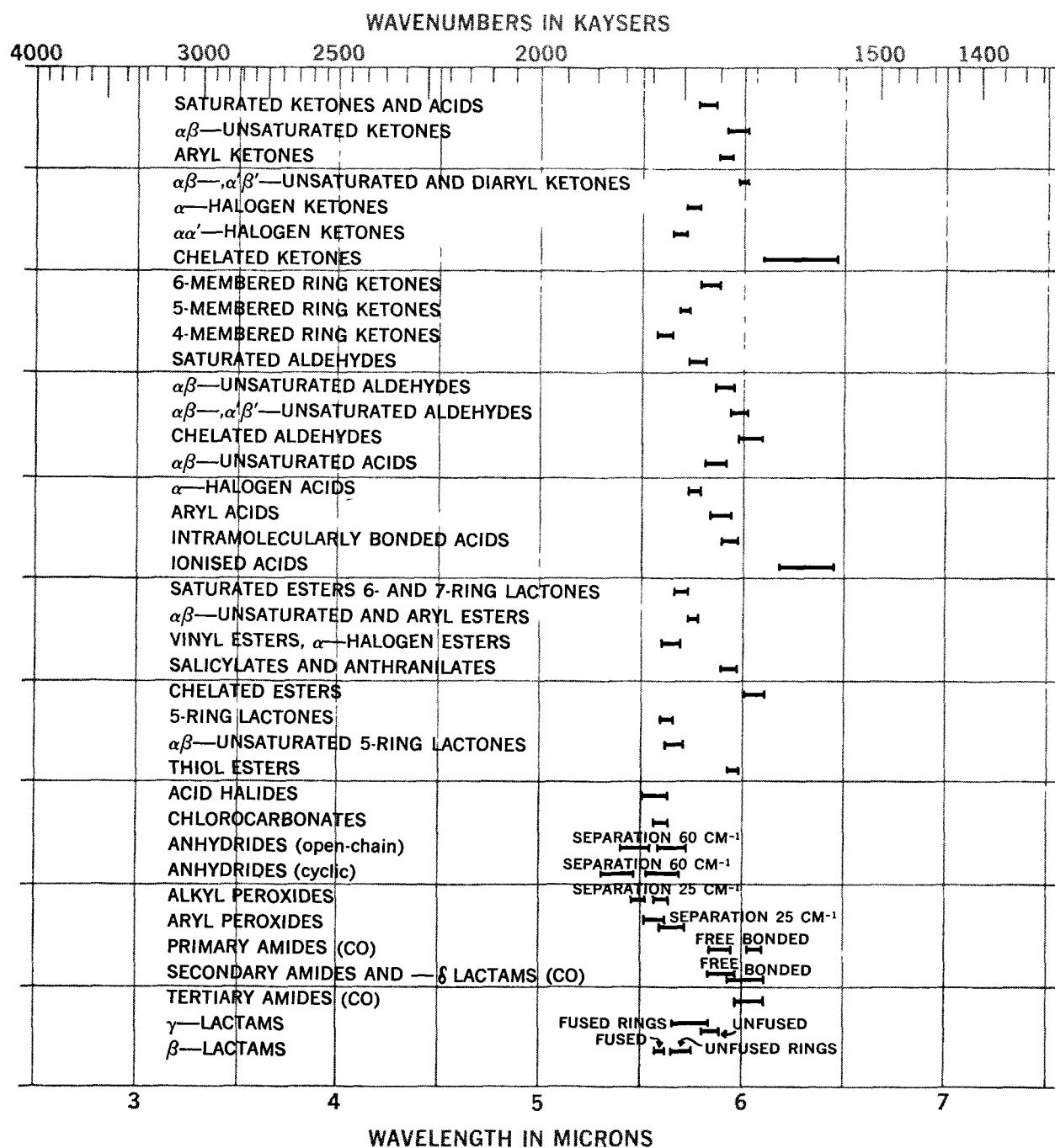
WAVENUMBERS IN KAYSERS



## INFRARED CORRELATION CHART No. 3

Prepared from information supplied by Beckman Instruments

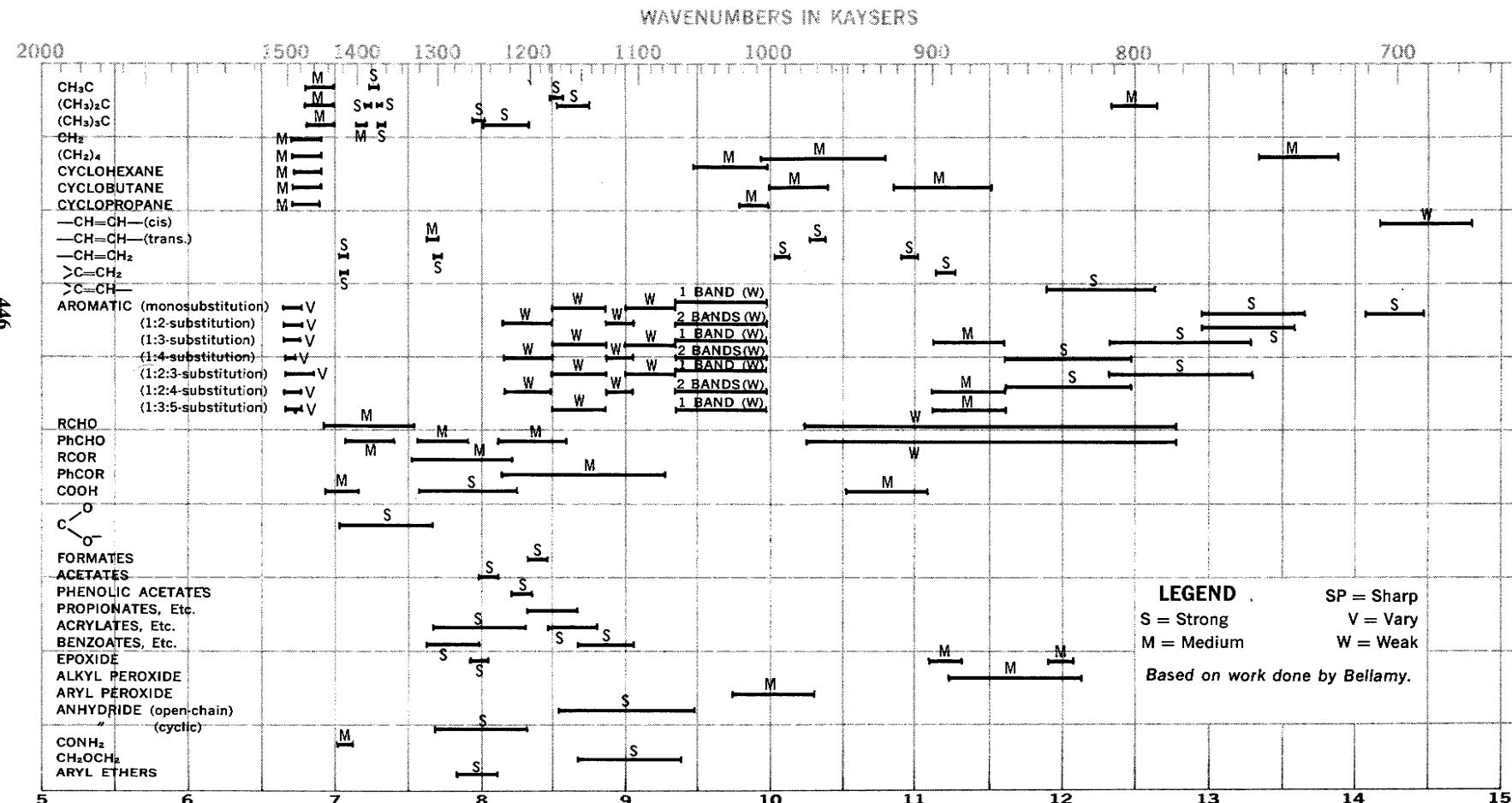
This chart presents some correlations between structure and the carbonyl vibrations of some classes of organic compounds. In all cases the absorption bands are strong and fall within the range of 1900-1500 cm<sup>-1</sup>.



# INFRARED CORRELATION CHART No. 4

Prepared from information supplied by Beckman Instruments

This chart presents some correlations between structure and single-bond vibrations for a number of classes of compounds having absorption between 1500-650 cm<sup>-1</sup>.

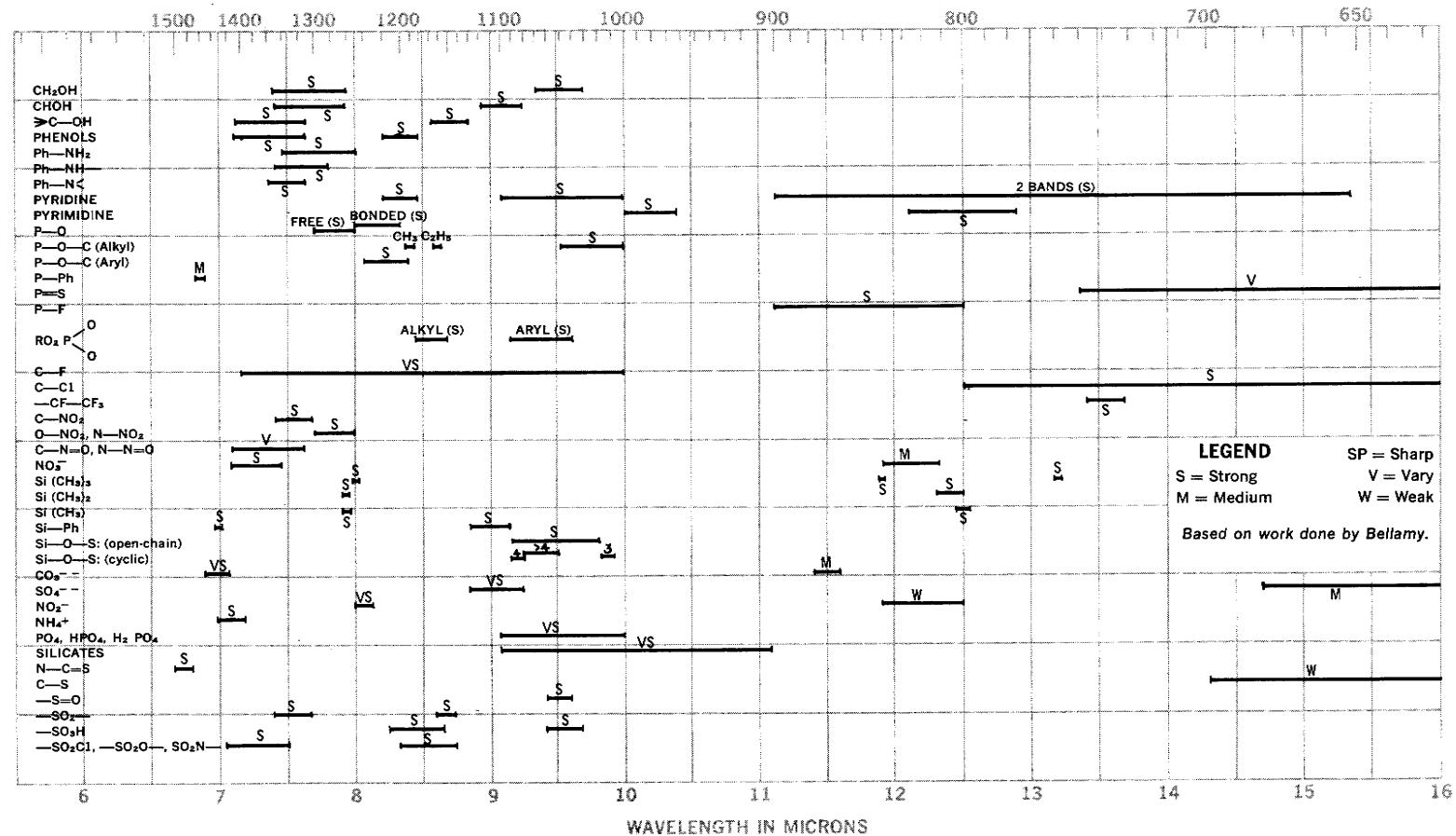


# INFRARED CORRELATION CHART No. 4 (Con't.)

Prepared from information supplied by Beckman Instruments

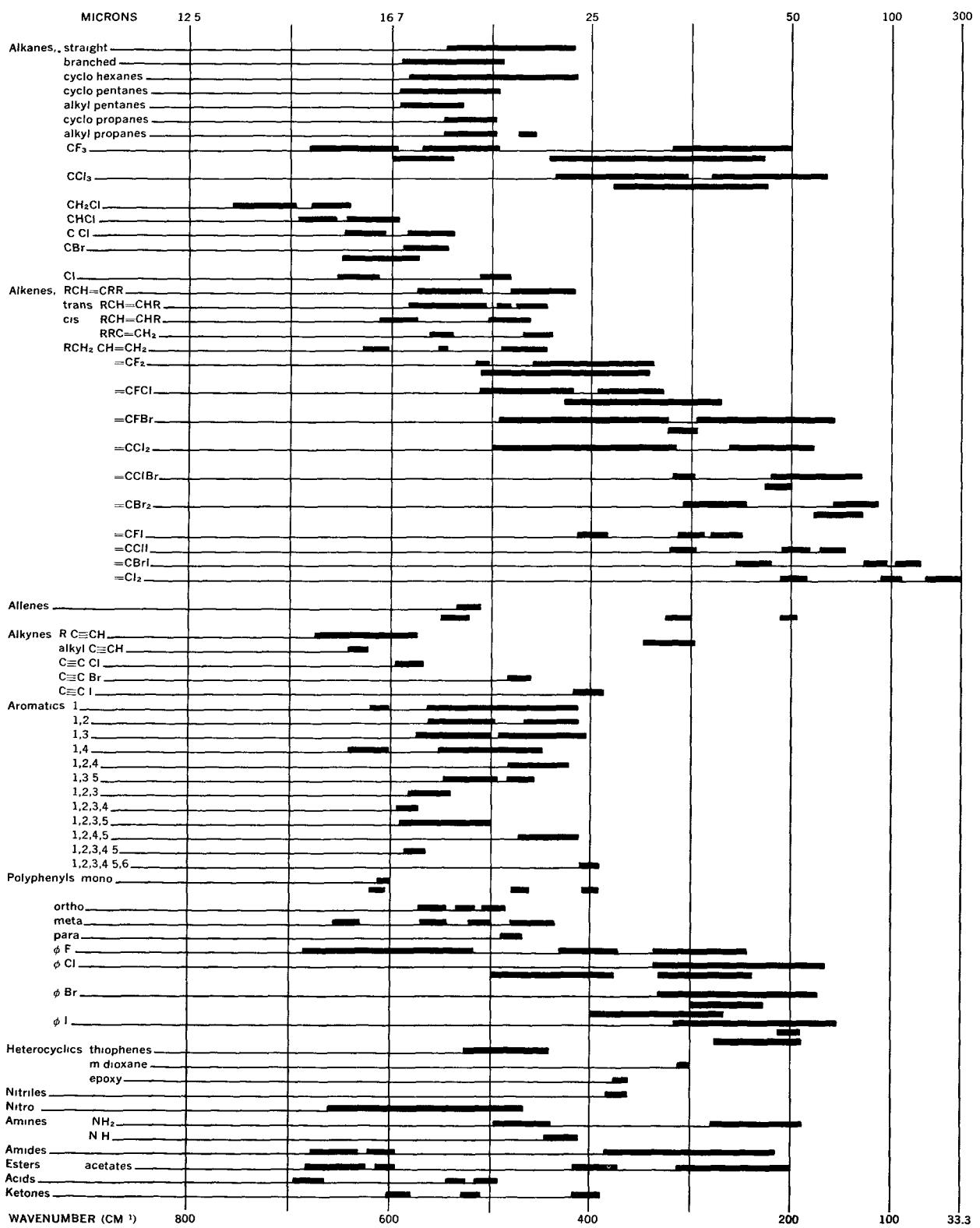
This chart presents some correlations between structure and single-bond vibrations for a number of classes of compounds having absorption between 1500-650 cm<sup>-1</sup>.

WAVENUMBERS IN KAYERS

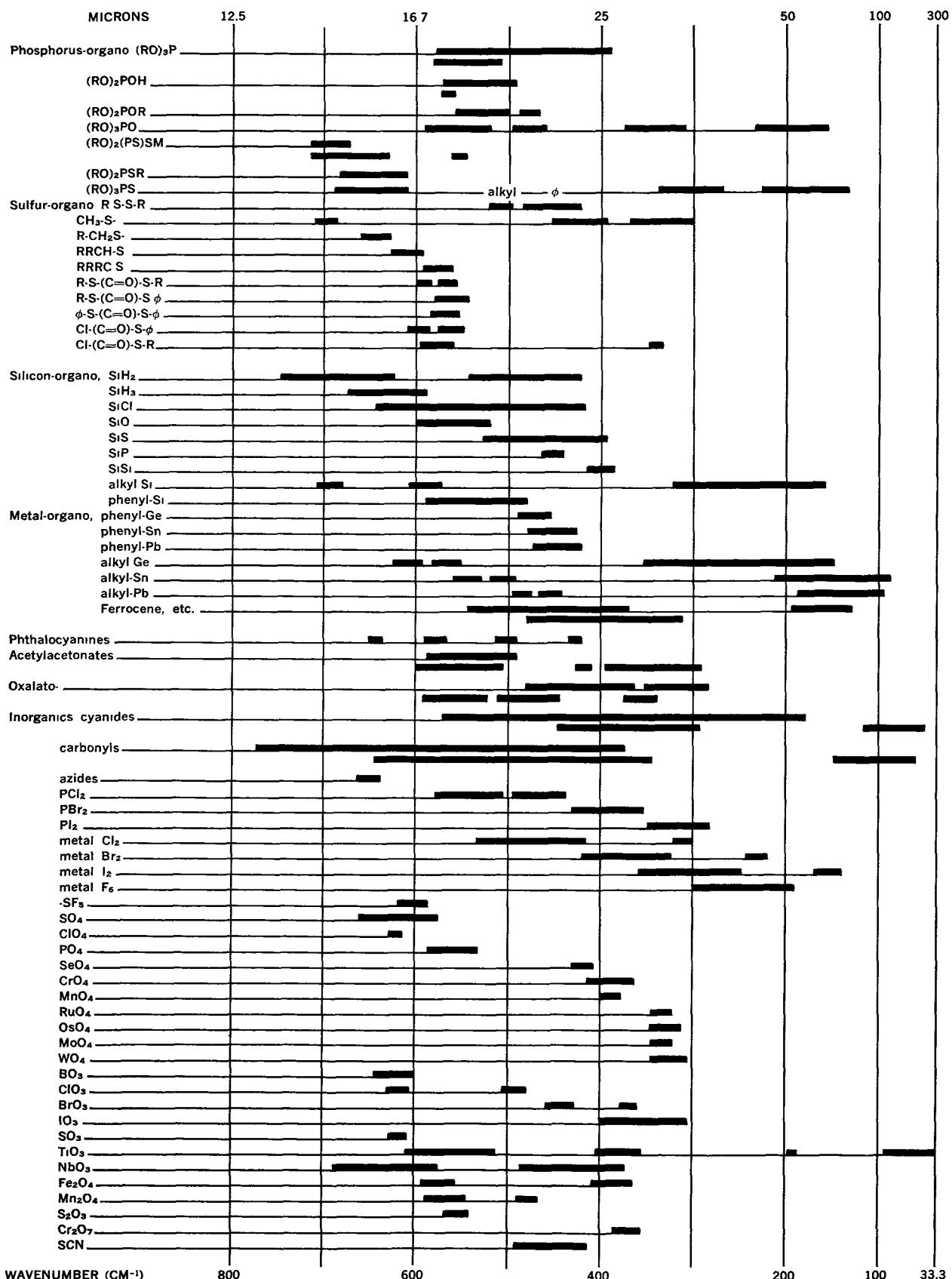


## FAR INFRARED VIBRATIONAL FREQUENCY CORRELATION CHART

Based on evidence compiled by James E. Stewart of Beckman Instruments.  
 This chart shows the vibrational frequency correlation in the far infrared region.  
 Because research is continuing in the far infrared region, this chart is not  
 all-inclusive.



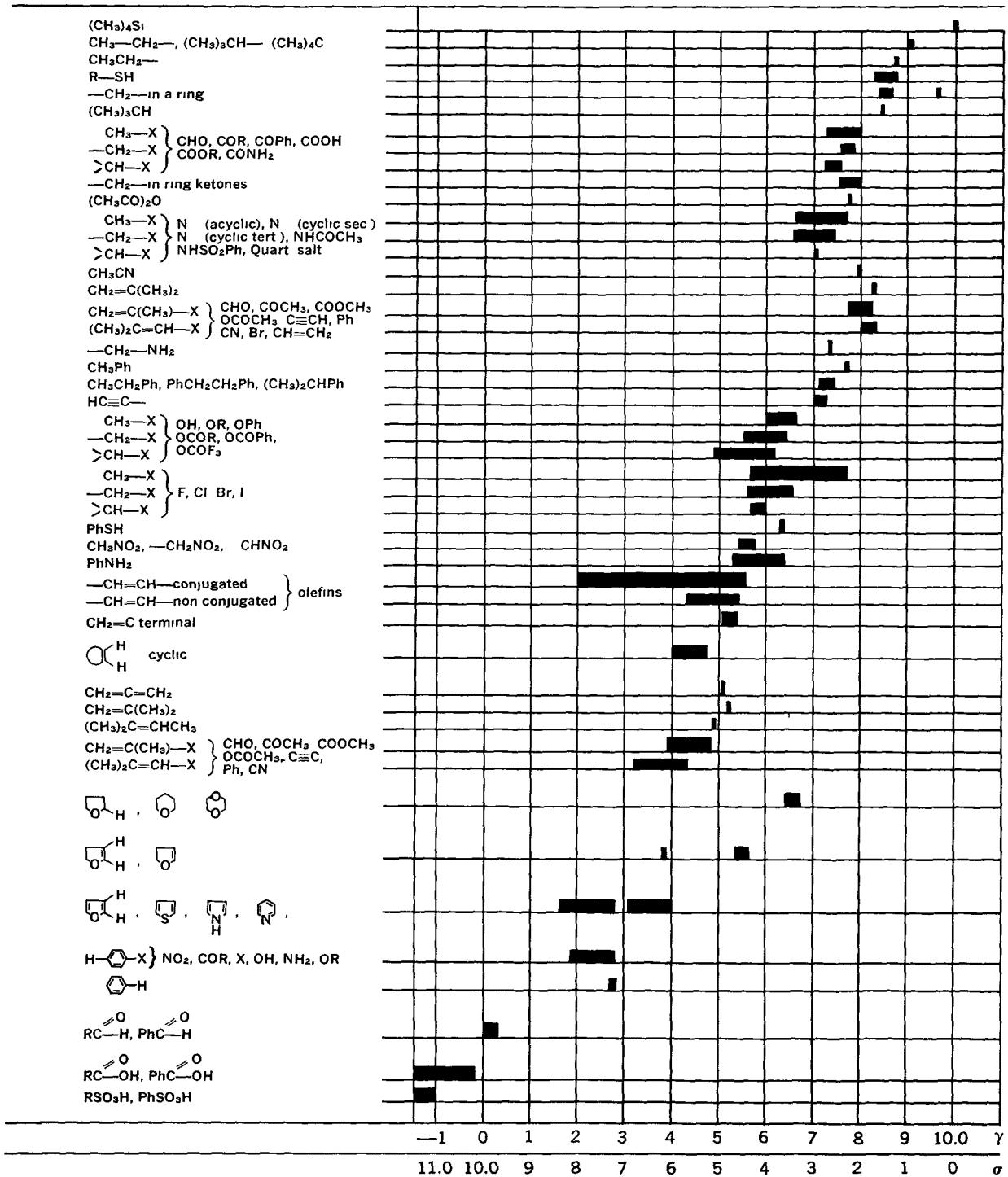
# FAR INFRARED VIBRATIONAL FREQUENCY CORRELATION CHART (Con't.)



# CHARACTERISTIC NMR SPECTRAL POSITIONS FOR HYDROGEN IN ORGANIC STRUCTURES

By permission from Erno Mohacs, J. of Chemical Education, 41, 38 (1964)

This table is useful for quick qualitative determination of proton spectrum lines by providing a tabulation of line positions obtained using tetramethylsilane as an internal reference. The listing has been kept as simple as possible for this purpose. The proton spectrum lines are arranged according to the chemical shift relative to tetramethylsilane and are given in values of  $\tau$  and  $\sigma$ . The purpose of this table is to supplement tables available in standard references and to summarize information available in the literature.



## MISCIBILITY OF ORGANIC SOLVENT PAIRS

Table A

Doctor J. S. Drury

Industrial and Engineering Chemistry

Vol. 44, No. 11, Nov. 1952

(Reprinted by permission)

The classifications were made by shaking together 5 ml. of each of the solvents listed in a test tube for 1 minute, then allowing the mixture to settle. If no interfacial meniscus was observed, the solvent pair was considered miscible. If such a meniscus was present, the solvent pair was regarded as immiscible. The classification of immiscible is a qualitative one since solvent pairs may exhibit some degree of partial miscibility while existing as separate phases. Solvent pairs possessing a pronounced degree of partial miscibility are designated by the symbol Is.

Compound number	Compounds																											
	Acetone	Acetyl acetone	2-Amino-2-methyl-1-propanol	Aniline	Benzaldehyde	Benzene	Benzin	Benzyl alcohol	Butyl acetate	Butyl alcohol	n-Butyl ether	Capryl alcohol	Carbon tetrachloride	Diacetone alcohol	Diethanolamine	Diethyl cellosolve	Diethyl ether	Dimethylaniline	Ethyl alcohol	Ethyl benzoate	Ethylene glycol	Glycerol	Hydroxyethyl-ethylenediamine	Isoamyl alcohol	Methyl isobutyl ketone	Nitromethane	Dibutoxytetraethylene glycol	Pyridine
1 Acetone	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
2 Acetyl acetone	M	M	..	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	R	M	M	M	M	M	M			
3 Adiponitrile	M	M	..	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M			
4 2-Amino-2-methyl-1-propanol	M	R	..	M	M	I	M	M	M	Is	M	M	R	M	M	M	M	M	M	M	M	M	M	M	M			
5 Benzaldehyde	M	M	..	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	Is	M	M	M	M	M	M			
6 Benzene	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
7 Benzin	M	M	I	..	M	M	M	M	M	M	M	M	I	I	M	M	M	M	M	I	I	M	M	M	M			
8 Benzonitrile	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
9 Benzothiazole	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
10 Benzyl alcohol	M	M	M	..	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
11 Benzyl mercaptan	M	M	I	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M			
12 Butyl acetate	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	Is	M	M	M	M	M	M			
13 Butyl alcohol	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
14 n-Butyl ether	M	M	Is	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
15 Capryl alcohol	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
16 Carbon tetrachloride	M	M	M	..	M	M	M	M	M	M	M	M	Is	I	M	M	M	M	M	M	M	M	M	M	M			
17 Diacetone alcohol	M	M	R	..	M	Is	I	M	M	M	M	M	Is	M	M	M	M	M	M	R	M	M	M	M	M			
18 Diethanolamine	M	R	M	..	I	I	I	M	I	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
19 Diethyl cellosolve	M	M	M	..	M	M	M	M	M	M	M	M	M	I	I	I	Is	M	M	M	M	M	M	M	M			
20 Diethyl ether	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
21 Dimethylaniline	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
22 Di-N-propylaniline	M	M	I	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	I			
23 Ethyl alcohol	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
24 Ethyl benzoate	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
25 Ethyl isothiocyanate	M	M	R	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	I			
26 Ethyl thiocyanate	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I			
27 Ethylene glycol	M	M	M	..	Is	I	M	M	Is	M	M	M	I	M	M	M	M	M	M	M	M	M	M	I	M			
28 2-Ethylhexanol	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M			
29 Formamide	M	M	M	..	M	I	M	M	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
30 Furfuryl alcohol	M	M	M	..	M	M	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
31 Glycerol	I	I	M	..	I	I	I	M	I	M	I	I	M	I	I	M	I	M	M	M	M	I	I	I	M			
32 Hydroxyethyl-ethylenediamine	M	R	M	..	R	I	Is	M	I	M	I	M	R	M	I	I	M	M	M	M	M	M	M	M	M	M		
33 Isoamyl alcohol	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
34 Isoamyl sulfide	M	M	I	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	I	I	I	M	M	M	I			
35 Isobutyl mercaptan	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	R			
36 Methyl disulfide	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R			
37 Methyl isobutyl ketone	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	I	I			
38 Nitromethane	M	M	M	..	M	I	M	M	M	I	Is	M	M	I	M	M	M	M	M	M	M	M	M	M	I			
39 Dibutoxytetraethylene glycol	M	M	M	..	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
40 Pyridine	M	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
41 Tri-n-butylamine	M	M	I	I	M	M	M	M	M	M	M	M	I	M	M	M	M	M	I	M	M	M	M	I	I			
42 Trimethylene glycol	M	M	M	..	M	I	I	M	Is	M	I	I	M	M	M	M	M	M	M	M	M	M	M	M	M			

**MISCIBILITY OF ORGANIC SOLVENT PAIRS (Continued)**

Tables B and C  
W. M. Jackson and J. S. Drury

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The classifications were made at 20°C in the following manner. One-milliliter portions of each solvent comprising a pair were shaken together for approximately one minute. If no interfacial meniscus was observed after the contents of the tube were allowed to settle, the solvent pair was considered to be miscible, M. If a meniscus was observed without apparent change in the volume of either solvent the pair was regarded as immiscible, I. This classification is a qualitative one since solvent pairs may exhibit various degrees of partial miscibility while existing as separate phases. If an obvious change occurred in the volume of each solvent but a meniscus was present, the pair was classified as partially miscible, S. The designation R indicates that the two solvents reacted.

**Table B**

Compound number	Compounds																					Compound number										
		Acetone	Isoamyl acetate	n-Amyl cyanide	Benzene	Benzyl ether	2-Bromoethyl acetate	Chloroform	Cinnamaldehyde	Di-n-amylamine	Di-n-butyl carbonate	Diethyl acetic acid	Diethylbenzene	Diethyl formamide	Diisobutyl ketone	Diisopropylamine	Di-n-propyl amine	Ethyl alcohol	Ethyl benzoate	Ethyl ether	Ethyl phenylacetate	Heptadecanol*	3-Heptanol	n-Heptyl acetate	n-Hexyl ether	Methyl isopropyl ketone	4-Methyl n-valeric acid	o-Phenetidine	Sulfuric acid (concd.)	Tetradecanol*	Tri-n-butyl phosphate	Triethylene glycol
1	Acetone	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	R	M	M	M	M	M	1			
2	Isoamyl acetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	2				
3	n-Amyl cyanide	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	3				
4	Benzene	M	M	M	M	S	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	4				
5	Benzyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	5				
6	2-Bromoethyl acetate	M	M	S	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	6				
7	Chloroform	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	7				
8	Cinnamaldehyde	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	8				
9	Di-n-amylamine	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	9				
10	Di-n-butyl carbonate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	10				
11	Diethylacetic acid	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	11				
12	Diethylenetriamine	M	M	M	M	M	M	R	I	M	R	R	M	M	M	M	M	M	R	I	M	R	M	M	M	M	M	12				
13	Diethyl formamide	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	13				
14	Dusobutyl ketone	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	14				
15	Dusopropylamine	M	V	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	15				
16	Di-n-propylamine	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	16				
17	Ethyl alcohol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	17				
18	Ethyl benzoate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	18				
19	Ethyl ether	M	M	M	V	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	19				
20	Ethyl phenylacetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	20				
21	Heptadecanol*	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	21				
22	3-Heptanol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	22				
23	n-Heptyl acetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	23				
24	n-Hexyl ether	M	M	M	M	S	M	M	M	M	M	M	I	I	M	M	M	M	M	M	M	M	I	I	R	M	24					
25	Methyl isopropyl keton	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	M	M	M	M	M	M	M	R	25					
26	4-Methyl-n-valeric acid	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	26					
27	o-Phenetidine	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	27					
28	Sulfuric acid (concd.)	P	R	R	I	R	I	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	28					
29	Tetradecanol*	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	29				
30	Tri-n-butyl phosphate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	30				
31	Triethylene glycol	M	I	M	S	I	M	M	S	I	M	M	I	M	I	M	I	M	I	M	I	M	I	M	I	M	I	31				
32	Triethylenetetramine	M	M	M	M	R	M	I	I	R	M	R	M	M	M	M	M	M	R	M	M	M	M	M	I	I	32					
33	2,6,8-Trimethyl 4-nonanone	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	I	I	I	I	I	I	I	33				

\* Union Carbide name.

**MISCIBILITY OF ORGANIC SOLVENT PAIRS (Continued)**  
Table C

Compound number	Compounds																												
	Acetone	Isoamyl acetate	n-Amyl cyanide	Anisaldehyde	Benzene	Benzyl ether	Chloroform	c-Cresol	Diisobutyl ketone	Diethylacetic acid	Diethyl formamide	Di-n-propyl aniline	Ethyl alcohol	Ethyl ether	3-Hexanol	n-Heptyl acetate	n-Hexyl ether	α-Methylbenzylamine	α-Methylbenzyl diethanolamine	α-Methylbenzyl dimethylamine	α-Methylbenzylethanolamine	o-Phenetidine	2-Phenylethylamine	Methyl isopropyl ketone	4-Methyl-n-valeric acid	Salicylaldehyde	Tetradecanol*	Tri-n-butyl phosphate	Triethylenetetramine
1	1,3-Butylene glycol	M	I	M	I	I	M	M	I	M	M	S	M	I	I	M	M	M	M	M	M	M	M	M	M	M	I	M	
2	2,3-Butylene glycol	M	M	M	M	S	I	M	M	M	M	I	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M	M	
3	2-Chloroethanol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	M	M	M	M	M	M	M	M	
4	3-Chloro-1,2-propanediol	M	M	M	M	I	M	M	M	M	I	M	M	M	M	I	R	M	M	M	M	M	R	M	S	R	S		
5	Dibutyl hydrogen phosphite	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
6	Diethylene glycol dibutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	S	M	M	R	M	M	M	M		
7	Diethylene glycol diethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	R	M		
8	Diethylene glycol monobutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
9	Diethylene glycol monoethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M		
10	Diethylene glycol monomethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M		
11	Dipropylene glycol	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M		
12	Ethylene diacetate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	M	M	M	M		
13	Ethylene glycol	M	I	I	I	I	I	S	M	I	M	I	M	I	M	I	I	M	M	M	M	I	M	M	I	S	I		
14	Ethyl glycol ethylbutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
15	Ethylene glycol monobutyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
16	Ethylene glycol monoethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
17	Ethylene glycol monomethyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
18	Ethylene glycol monophenyl ether	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
19	Glycerol	I	I	I	I	I	I	I	M	I	I	M	I	M	I	I	I	I	M	M	I	I	M	I	I	I	I		
20	1,2-Propanediol	M	M	M	M	I	I	M	M	I	M	M	I	M	S	M	I	I	M	M	M	M	M	M	M	M	I		
21	1,3-Propanediol	M	I	I	I	I	I	M	M	I	M	M	I	M	I	M	I	I	M	M	M	M	M	M	I	S	M		
22	Triethylene glycol	M	I	M	S	I	M	M	I	M	M	I	M	I	M	I	I	M	M	M	M	M	M	M	I	M	I		
23	Triethyl phosphate	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
24	Trimethylene chlorohydrin	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	R	M	M	R	M	M	M	R	M			

\* Union Carbide name.

### EMERGENT STEM CORRECTION FOR LIQUID-IN-GLASS THERMOMETERS

Accurate thermometers are calibrated with the entire stem immersed in the bath which determines the temperature of the thermometer bulb. However, for reasons of convenience it is common practice when using a thermometer to permit its stem to extend out of the apparatus. Under these conditions both the stem and the mercury in the exposed stem are at a temperature different from that of the bulb. This introduces an error into the observed temperature. Since the coefficient of thermal expansion of glass is less than that of mercury, the observed temperature will be less than the true temperature if the bulb is hotter than the stem and greater than the true temperature, providing the thermal gradient is reversed. For exact work the magnitude of this error can only be determined by experiment. However, for most purposes it is sufficiently accurate to apply the following equation which takes into account the difference of the thermal expansion of glass and mercury:

$$T_c = T_o + F \times L(T_o - T_m)$$

Where  $T_c$  = corrected temperature

$T_o$  = observed temperature

$T_m$  = mean temperature of exposed stem. The mean temperature of the exposed stem may be determined by fastening the bulb of a second thermometer against the mid-point of the exposed liquid column.

$L$  = the length of the exposed column in degrees above the surface of the substance whose temperature is being determined.

$F$  = correction factor. For approximate work and when the liquid in the thermometer is mercury a value for  $F$  of 0.00016 is generally used. For more accurate work with mercury filled thermometers values as given in the following table are used. For thermometers filled with organic liquids it is customary to use 0.001 for the value of  $F$ .

Values of  $F$  for various glasses

Tm°C.	Corning 0041	Corning 8800	Corning 8810	Jena 16 III	Jena 59 III
50	0.000157	0.000166	0.000156	0.000158	0.000164
150	0.000159	0.000167	0.000157	0.000158	0.000165
250	0.000163	0.000168	0.000161	0.000161	0.000170
350	0.000168	0.000173	0.000166	.....	0.000177

**CORRECTION OF BOILING POINTS TO STANDARD PRESSURE**

By H. B. HASS AND R. F. NEWTON

This correction may be made by using the equation:

$$\Delta t = \frac{(273.1 + t)(2.8808 - \log p)}{\phi + .15(2.8808 - \log p)} \quad (1)$$

where  $\Delta t$  = degrees C to be added to the observed boiling point. $t$  = the observed boiling point. $\log p$  = the logarithm of the observed pressure in millimeters of mercury. $\phi$  = the entropy of vaporization at 760 mm.

The value of  $\phi$  may be estimated from the graph and the table. Substances not included in the table may be classified by grouping them with compounds which bear a close physical or structural resemblance to them.

Example 1. Benzene boils at 20°C. at 75 mm pressure. What is its normal boiling point? We do not find benzene in the table but we find hydrocarbons in group 2, and a group 2 compound with a boiling point of 20° has a  $\phi$  of 4.6.

Substituting in the equation

$$\Delta t = \frac{(273.1 + 20)(2.8808 - 1.8751)}{4.60 + .15(2.8808 - 1.8751)} = 62^\circ$$

Adding this to 20° gives 82° as a first approximation.

The graph shows that the  $\phi$  for a compound of group 2 boiling at 82° is 4.72 instead of 4.60 which we originally used. Since  $\phi$  is in the denominator, this increase will lower our  $\Delta t$  by the ratio, 4.60/4.72, or the corrected  $\Delta t$  is  $62 \times 4.60/4.72 = 60.4$ . Adding  $\Delta t$  to  $t$ , gives 80.4° as a second approximation.

The formula can best be used in a slightly different form when the reverse calculation is desired, i.e., when one calculates the vapor pressure at a given temperature, lower than the normal boiling point.

$$2.8808 - \log p = \frac{\phi \Delta t}{273.1 + t - .15 \Delta t} \quad (2)$$

Example 2. Alcohol boils at 78.4°C. What is its vapor pressure at 20°C.? Substituting in equation 2:

$$2.8808 - \log p = \frac{6.06 \times 58.4}{293.1 - (.15 \times 58.4)} = 1.245$$

$$\log p = 2.8808 - 1.245 = 1.6358$$

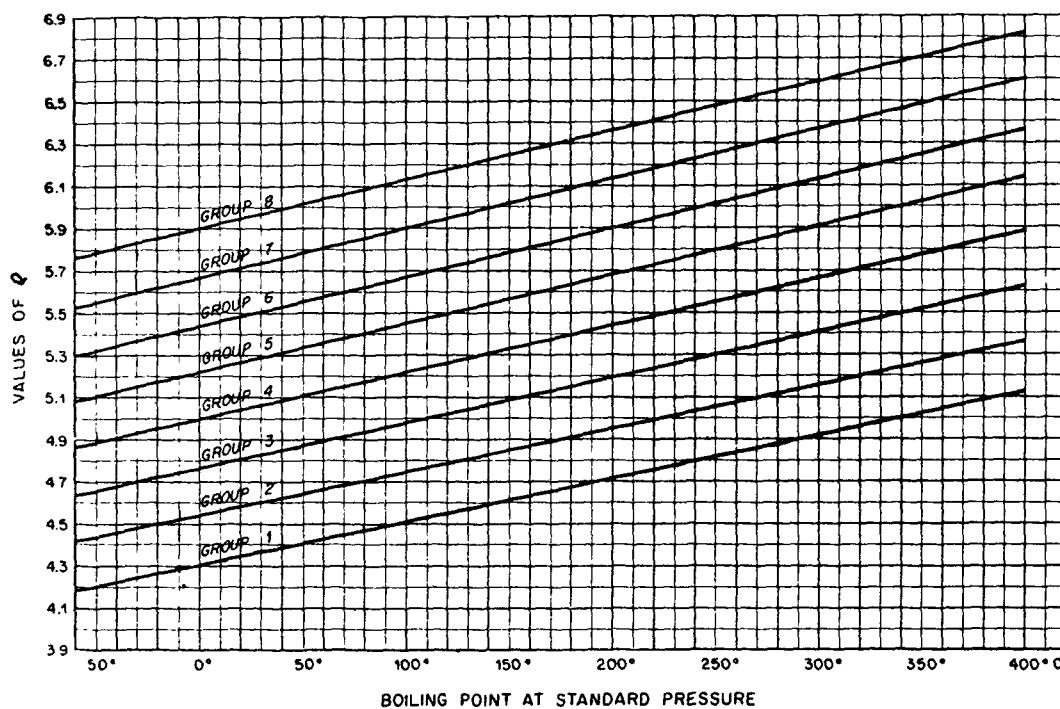
$$p = 43.2 \text{ mm.}$$

Here no second approximation is necessary, since the correct value of  $\phi$  was taken immediately, the normal boiling point having been known.

Compound	Group	Compound	Group
Acetaldehyde .....	3	Benzyl alcohol .....	5
Acetic acid .....	4	Butylethylene .....	1
Acetic anhydride.....	6	Butyric acid .....	7
Acetone .....	3	Camphor.....	2
Acetophenone .....	4	Carbon monoxide .....	1
Amines.....	3	Carbon oxysulfide .....	2
<i>n</i> -Amyl alcohol .....	8	Carbon suboxide .....	2
Anthracene .....	1	Carbon sulfoselenide .....	2
Anthraquinone .....	1	<i>m.p.</i> Chloroanilines.....	3
Benzaldehyde .....	2	Chlorinated derivatives.....	Same group as though Cl was H
Benzoic acid .....	5	<i>o.m.p.</i> Cresols.....	4
Benzonitrile .....	2	Cyanogen .....	4
Benzophenone .....	2		

**CORRECTION OF BOILING POINTS (Continued)**

Compound	Group	Compound	Group
Cyanogen chloride.....	3	Methyl benzoate.....	3
Dibenzyl ketone .....	2	Methyl ether .....	3
Dimethyl amine .....	4	Methyl ethyl ether .....	3
Dimethyl oxalate .....	4	Methyl ethyl ketone .....	2
Dimethyl silicane .....	2	Methyl fluoride .....	3
Esters .....	3	Methyl formate .....	4
Ethanol .....	8	Methyl salicylate .....	2
Ethers .....	2	Methyl silicane .....	1
Ethylamine .....	4	$\alpha,\beta$ Naphthols .....	3
Ethylene glycol .....	7	Nitrobenzene .....	3
Ethylene oxide .....	3	Nitromethane.....	3
Formic acid .....	3	o.m.p. Nitrotoluenes .....	2
Glycol diacetate .....	4	o.m.p. Nitrotoluidines.....	2
Halogen derivatives .....	Same group as though halogen were hydrogen.	Phenanthrene .....	1
Heptylic acid.....	7	Phenol .....	5
Hydrocarbons .....	2	Phosgene .....	2
Hydrogen cyanide .....	3	Phthalic anhydride .....	2
Isoamyl alcohol.....	7	Propionic acid .....	5
Isobutyl alcohol .....	8	n-Propyl alcohol .....	8
Isobutyric acid.....	6	Quinoline .....	2
Isocaproic acid .....	7	Sulfides.....	2
Methane .....	1	Tetranitromethane .....	3
Methanol .....	7	Trichloroethylene.....	1
Methyl amine .....	5	Valeric acid .....	7
		Water .....	6



**MOLECULAR ELEVATION OF THE BOILING POINT**

(Most values from Hoyt, C.S. and Fink, C.K., Journal of Physical Chemistry, Vol. 41, No. 3., March, 1937.)  
 Molecular elevation of the boiling point showing the elevation of the boiling point in degrees C due to the addition of one gram molecular weight of the dissolved substance to 1000 grams of any one of the solvents below. The correction in the last column gives the number of degrees to be subtracted for each mm. of difference between the barometric reading and 760 mm.

Solvent	$K_B$	Barometric Correction per mm.
Acetic acid.....	3.07	0.0008
Acetone.....	1.71	0.0004
Aniline.....	3.52	0.0009
Benzene.....	2.53	0.0007
Bromobenzene.....	6.26	0.0016
Carbon bisulfide.....	2.34	0.0006
Carbon tetrachloride.....	5.03	0.0013
Chloroform.....	3.63	0.0009
Cyclohexane.....	2.79	0.0007
Ethanol (ethyl alcohol).....	1.22	0.0003
Ethyl acetate.....	2.77	0.0007
Ethyl ether.....	2.02	0.0005
<i>n</i> -Hexane.....	2.75	0.0007
Methanol (methyl alcohol).....	0.83	0.0002
Methyl acetate.....	2.15	0.0005
Nitrobenzene.....	5.24	0.0013
<i>n</i> -Octane.....	4.02	0.0010
Phenol.....	3.56	0.0009
Toluene .....	3.33	0.0008
Water.....	0.512	0.0001

**MOLECULAR DEPRESSION OF THE FREEZING POINT**

Showing the depression of the freezing point due to the addition of one gram molecular weight of solute, for various solvents.

Solvent	Depression for one gram molecular weight dissolved in 1000 grams, °C	Solvent	Depression for one gram molecular weight dissolved in 1000 grams, °C
Acetic acid	3.90	Diphenyamine	8.60
Acetophenone	5.65	Diphenyl ether	8.00
Aniline	5.87	Ethylene dibromide	11.80
Anthracene	14.65	Ethyl ether	11.79
Anthraquinone	14.80	Formic acid	2.77-2.80
Benzene	4.90-5.23	Hexachlorobenzene	20.75
Benzoic acid	7.85-8.79	Menthol	12.4
Benzophenone	9.88	Naphthalene	6.90-7.10
<i>d</i> -Bromocamphor	11.87	$\beta$ -Naphthol	11.25
Bromoform	14.25	Nitrobenzene	6.89-7.10
<i>tert</i> -Butyl alcohol	12.80	Phenanthrene	12.0
Camphor	49.80	Phenol	7.20-7.50
Carbazole	12.30	Phenylhydrazine	5.86
Carbon disulfide	3.83	Pyridine	4.97
Carbon tetrachloride	29.8-34.8	Stearic acid	4.50
Chloroform	4.67-4.90	Triphenylmethane	12.45
Cyclohexane	20.0-20.30	Urethane	5.00-5.14
Dicyclohexyl	14.50	Water	1.85-1.87
<i>m</i> -Dinitrobenzene	10.60	<i>p</i> -Xylene	4.30
Diphenyl	8.00-8.35		

## CARBOHYDRATES

These data for carbohydrates were compiled originally for the Biology Data Book by M. L. Wolfram, G. G. Maher and R. G. Pagnucco (1964). Data are reproduced here by permission of the copyright owners of the above publication, the Federation of American Societies for Experimental Biology, Washington, D.C. pp. 351-359.

All data are for crystalline substances, unless otherwise specified. Selection of substances was restricted to natural carbohydrates found free (or in chemical combination and released on hydrolysis) and to biological oxidation products of the natural carbohydrates. The nomenclature conforms with that of the British-American report as published in the *Journal of Organic Chemistry*, 28 281 (1963). Substances have been arranged alphabetically under the name of the parent sugar within groups formulated according to increasing carbon content (excluding carbon in substituents), with synonymous common names in parentheses. **Melting Point:** b.p. = boiling point, d. = decomposes, s. = sinters. **Specific Rotation** was determined in water at concentrations of 1-5 g per 100 ml of solution and at 20°-25°C, unless otherwise specified, other temperatures or wavelengths are shown in brackets. c = grams solute per 100 ml of solution.

## Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Aldoses			
1. D-Glyceraldehyde	C <sub>3</sub> H <sub>6</sub> O <sub>3</sub>		+13.5 ± 0.5 (syrup)
2. D-Glyceraldehyde, 3-deoxy-3,3-C-bis-(hydroxymethyl)- (Cordycepose)	C <sub>6</sub> H <sub>10</sub> O <sub>4</sub>		-26 (c 0.6, C <sub>2</sub> H <sub>5</sub> OH)
3. D-Glyceraldehyde, 3,3-bis(C-hydroxy-methyl)- (Apiose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>		+5.6 (c 10) [15°] syrup
4. β-D-Arabinose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	155	-175 → -103
5. D-Arabinose, 2-O-methyl-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	Syrup	-102
6. α-L-Arabinose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	158 amorphous	+55.4 → +105
7. β-L-Arabinose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	160	+190.6 → +104.5
8. DL-Arabinose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	163.5-164.5	None
9. α-L-Lyxose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	105	+5.8 → +13.5
10. L-Lyxose, 5-deoxy-3-C-formyl- (Streptose)	C <sub>6</sub> H <sub>10</sub> O <sub>5</sub>		
11. L-Lyxose, 3-C-formyl- (Hydroxy-streptose)	C <sub>6</sub> H <sub>10</sub> O <sub>6</sub>		
12. Pentose, 4,5-anhydro-5-deoxy-D-erythro-	C <sub>5</sub> H <sub>8</sub> O <sub>3</sub>		
13. Pentose, 2-deoxy-D-erythro-	C <sub>5</sub> H <sub>10</sub> O <sub>4</sub>	96-98	-91 → -58
14. D-Ribose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	87	-23.1 → -23.7
15. D-Ribose, 2-C-hydroxymethyl- (Hamamelose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		-7.1 [λ578]
16. α-D-Xylose	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	145	+93.6 → +18.8
17. D-Xylose, 5-deoxy-	C <sub>5</sub> H <sub>10</sub> O <sub>4</sub>		+16
18. β-D-Xylose, 2-O-methyl-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	137-138	-21 → +34
19. α-D-Xylose, 3-O-methyl-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	95	+45 → +19
20. D-Allose, 6-deoxy-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	140-143 146-148	+1.6 [18°] (c 0.6) -4.7 → 0
21. D-Allose, 6-deoxy-2,3-di-O-methyl- (Mycinose)	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>	102-106	-46 → -29
22. Amicetose (a trideoxy hexose)	C <sub>6</sub> H <sub>12</sub> O <sub>3</sub>	Oil, b.p. 65-70	+28.6 (CHCl <sub>3</sub> )
23. Antiarose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		Levo
24. α-D-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	167	+150.7 → +80.2
25. β-D-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	143-145	+52.8 → +80.2
26. D-Galactose, 3,6-anhydro-	C <sub>6</sub> H <sub>10</sub> O <sub>5</sub>		+21.3 [10°]
27. α-D-Galactose, 6-deoxy- (D-Fucose, Rhodeose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	140-145	+127 → +76.3 (c 10)
28. D-Galactose, 6-deoxy-3-O-methyl- (Digitalose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	106 <sup>1</sup> , 119 <sup>2</sup>	+106

**CARBOHYDRATES (Continued)**

**Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation
			[ $\alpha$ ]D
(A)	(B)	(C)	(D)
Aldoses (Con't)			
29 D-Galactose, 6-deoxy-4-O-methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	131-132	+82
30 D-Galactose, 6-deoxy-2,3-di-O-methyl-	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>		+73
31 $\alpha$ -D-Galactose, 3-O-methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	144-147	+150.6 → +108.6
32 $\alpha$ -D-Galactose, 6-O-methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	122-123	+117 → +77.3
33 L-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		See D-Galactose
34 $\alpha$ -L-Galactose, 3,6-anhydro-	C <sub>6</sub> H <sub>10</sub> O <sub>5</sub>		-39.4 → -25.2
35 $\alpha$ -L-Galactose, 6-deoxy- (L-Fucose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	145	-124.1 → -76.4
36 L-Galactose, 6-deoxy-2-O-methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	149-150	-75 ± 4 (c 0.5)
37 L-Galactose, 6-sulfate	C <sub>6</sub> H <sub>12</sub> O <sub>9</sub> S		-47 (c 0.2) (Na salt)
38 DL-Galactose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	143-144, 163	None (racemic)
39 $\alpha$ -D-Glucose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	146, 83 (H <sub>2</sub> O)	+112 → +52.7
40 $\beta$ -D-Glucose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	148-150	+18.7 → +52.7
41 D-Glucose, 6-acetate	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	135	+48
42 D-Glucose, 2,3-di-O-methyl-	C <sub>8</sub> H <sub>16</sub> O <sub>6</sub>	85-86, 121	+50
43 D-Glucose, 6-O-benzoyl- (Vaccinian)	C <sub>13</sub> H <sub>16</sub> O <sub>7</sub>	Amorphous	+48 (C <sub>2</sub> H <sub>5</sub> OH)
44 $\alpha$ -D-Glucose, 6-deoxy- (Chinovose, Epihamnose, Glucomethylose, Isorhamnose, Isorhodeose Quino- vose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	139-140	+73.3 → +29.7 (c 8)
45 $\alpha$ -D-Glucose, 6-deoxy-3-O-methyl- (D-Thevetose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	116	+84 → +33
46 D-Glucose, 6-sulfonic acid, 6-deoxy- (6-Sulfoquinovose)	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub> S	173-174	+87 <sup>3</sup>
47 D-Glucose, 3-O-methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	162-167	+98 → +59.5
48 $\alpha$ -L-Glucose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	141-143	-95.5 → -51.4
49 L-Glucose, 6-deoxy-3-O-methyl- (L-Thevetose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	126-129	-36.9 ± 2
50 D-Gulose, 6-deoxy-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>		
51 Hexose, 2-deoxy-D-arabino- <sup>4</sup>	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	148	+46.6 [18°]
52 Hexose, 2,6-dideoxy-3-O-methyl-D- arabino- (D-Oleandrose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>		-11
53 Hexose, 3,6-dideoxy-D-arabino- (Tyvelose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		+24 ± 2
54 Hexose, 2,6-dideoxy-3-O-methyl-L- arabino- (L-Oleandrose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	62-63	+11.9 ± 2.5
55 Hexose, 3,6-dideoxy-L-arabino- (Ascaryllose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		-24 ± 2
56 Hexose, 2,6-dideoxy-3-O-methyl-D- lyxo- (Digynose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	90-92	+56 ± 4
57 Hexose, 2,6-dideoxy-L-lyxo- (L-Fucose, 2-deoxy-)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	103-106	-61.6
58 Hexose, 2,6-dideoxy-3-O-methyl-L- lyxo-	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	78-85	-65
59 Hexose, 2,6-dideoxy-D-ribo- (Digi- toxose, D-Altrose, 2,6-dideoxy-)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	110	+46.4
60 Hexose, 2,6-dideoxy-3-O-methyl-D-ribo- (Cymarose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	93	+52
61 Hexose, 3,6-dideoxy-D-ribo- (Paratose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		+10 ± 2 (c 0.9)
62 Hexose, 4,6-dideoxy-3-O-methyl-D- ribo- (D-Gulose, 4,6-dideoxy-3-O- methyl-, Chalcose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	96-99	+120 → +76
63 Hexose, 2,6-dideoxy-D-xylo- (Boivin- ose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	96-98	-3.9 → +3.9

**CARBOHYDRATES (Continued)**

**Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)**

Substance (Synonym) (A)	Chemical Formula (B)	Melting Point °C (C)	Specific Rotation [α] <sub>D</sub> (D)
Aldoses (Con't)			
64 Hexose, 2,6-dideoxy-3-O-methyl-D- <i>xylo-</i> (Sarmentonose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	78-79	+12 → +15 8
65 Hexose, 3,6-dideoxy-D- <i>xylo-</i> (Abequose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		-3 2 ± 0 6
66 Hexose, 2,6-dideoxy-3-C-methyl-L- <i>xylo-</i> (Mycarose)	C <sub>7</sub> H <sub>14</sub> O <sub>4</sub>	129-129	-31 1
67 Hexose, 2,6-dideoxy-3-C-methyl-3-O-methyl-L- <i>xylo-</i> (Cladinose)	C <sub>8</sub> H <sub>16</sub> O <sub>4</sub>	oil, b p 120-132 (0.25 mm)	-23 1
68 Hexose, 3,6-dideoxy-L- <i>xylo-</i> (Colitose)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>		+4 (H <sub>2</sub> O), -51 ± 2 (CH <sub>3</sub> OH)
69 D-Idose <sup>5</sup>	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		
70 L-Idose, 1,6-anhydro-	C <sub>6</sub> H <sub>10</sub> O <sub>5</sub>		
71 α-D-Mannose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	133	+29 3 → +14 5
72 β-D-Mannose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	132	-16 3 → +14 5
73 D-Mannose, 6-deoxy- (D-Rhamnose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	86-90	-7 0
74 α-L-Mannose, 6-deoxy-monohydrate (L-Rhamnose)	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	93-94	-8 6 → +8 2
75 β-L-Mannose, 6-deoxy-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	123-125	+38 4 → +8 9
76 L-Mannose, 6-deoxy-2-O-methyl-	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>		
77 L-Mannose, 6-deoxy-3-O-methyl- (L-Acofriose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>	114-115	+30 [18°]
78 L-Mannose, 6-deoxy-2,4-di-O-methyl-	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>	82	-19 [16°]
79 L-Mannose, 6-deoxy-5-C-methyl-4-O-methyl- (Noviose)	C <sub>8</sub> H <sub>16</sub> O <sub>5</sub>	128-130	+19 9 (50% C <sub>2</sub> H <sub>5</sub> OH)
80 Rhodinose (a 2,3,6-trideoxyhexose)	C <sub>6</sub> H <sub>12</sub> O <sub>3</sub>		-11 ± 1 6
81 D-Talose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	128-132	+16 9
82 D-Talose, 6-deoxy- (D-Talomethylose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	129-131	+20 6
83 L-Talose, 6-deoxy- (L-Talomethylose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	116-118	-19 5 ± 2 [18°]
84 L-Talose, 6-deoxy-2-O-methyl- (L-Acovenose)	C <sub>7</sub> H <sub>14</sub> O <sub>5</sub>		-19 4
85 Heptose, D-glycero-D-galacto-	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	139-140	+47 → +64 (c 0.5)
86 Heptose, D-glycero-D-manno-	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>		
87 Heptose, D-glycero-L-manno-	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>		
Ketoses			
88 Dihydroxyacetone	C <sub>3</sub> H <sub>6</sub> O <sub>3</sub>	80 (dimer)	None
89 Tetrulose, L-glycero- <sup>8</sup> (L-Erythrulose, Ketoerythritol, L-Threulose)	C <sub>4</sub> H <sub>8</sub> O <sub>4</sub>	Syrup	+12
90 Pentulose, D-erythro- (Adonose, D-Ribulose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	Syrup	+16 6 [27°]
91 Pentulose, L-erythro- (L-Ribulose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>		-16 6
92 Pentulose, D-threo- (D-Xylulose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>		-33
93 Pentulose, 5-deoxy-D-threo-	C <sub>5</sub> H <sub>10</sub> O <sub>4</sub>		-5 ± 1 (CH <sub>3</sub> OH)
94 Pentulose, L-threo- (L-Xylulose, L-Lyxulose, Xyloketose)	C <sub>5</sub> H <sub>10</sub> O <sub>5</sub>	Syrup	+33 1
95 Hexulose, β-D-arabino-(β-D-Fructose, Levulose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	102-104 <sup>7</sup>	-133 5 → -92
96 Hexulose, 6-deoxy-D-arabino- (D-Rhamnulose)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>		-13 ± 2
97 Hexulose, D-lyxo- (D-Tagatose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	131-132	+2 7 → -4, -5
98 5-Hexulose, D-lyxo	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	158	-86 6
99 Hexulose, 6-deoxy-L-lyxo- (L-Fuculose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		

**CARBOHYDRATES (Continued)**

**Part I. NATURAL MONOSACCHARIDES: ALDOSES AND KETOSES (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Ketoses (Con't)			
100 Hexulose, D-ribo- (D-Psicose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	Amorphous	+4.7
101 Hexulose, L-xylo- (L-Sorbose)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	159-161	-43.1
102 Hexulose, 6-deoxy-L-xylo-	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	88	-25 ± 2 (c 0.7)
103 Heptulose, D-altro- (Sedoheptulose, Sedoheptose)	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	Amorphous	+2.5 (c 10)
104 Heptulose·hemihydrate, L-galacto- (Perseulose)	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub> ½H <sub>2</sub> O	110-115	-90 → -80
105 Heptulose, L-gulo-	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>		-28
106 Heptulose, D-idoo-	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	172	-34 ± 8 (c 0.3)
107 Heptulose, D-manno- (Mannoketo-heptose, D-Mannotagatoheptose)	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>	152	+29.4
108 Heptulose, D-talo-	C <sub>7</sub> H <sub>14</sub> O <sub>7</sub>		
109 Octulose, D-glycero-L-galacto-	C <sub>8</sub> H <sub>16</sub> O <sub>8</sub>		-57, -43.4 → -13.4
110 Octulose, D-glycero-D-manno-	C <sub>8</sub> H <sub>16</sub> O <sub>8</sub>		+20 (CH <sub>3</sub> OH)

<sup>1</sup> Original melting point. <sup>2</sup> Melting point after four-months' storage <sup>3</sup> As a methyl glycoside cyclohexylamine salt. <sup>4</sup> Included because of speculations concerning it in biological processes. <sup>5</sup> Either D-idose or L-altrose is in the polysaccharide varianose. <sup>6</sup> Early literature refers to this as D-erythrose. <sup>7</sup> The ·½H<sub>2</sub>O and ·2H<sub>2</sub>O forms also exist.

**Part II. NATURAL MONOSACCHARIDES: AMINO SUGARS**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Aldosamines			
1 D-Ribose, 3-amino-3-deoxy-	C <sub>5</sub> H <sub>11</sub> NO <sub>4</sub>	158-158.5 d.	-24.6 (hydrochloride)
2 D-Galactose, 2-amino-2-deoxy- (Galactosamine; Chondrosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	185	+121 → +80 (hydrochloride)
3 α-L-Galactose, 2-amino-2,6-dideoxy- (L-Fucosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>4</sub>	192-193 d.	-119 → -92 [27°] (hydrochloride)
4 α-D-Glucose, 2-amino-2-deoxy- (Glucosamine; Chitosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	88	+100 → +47.5
5 β-D-Glucose, 2-amino-2-deoxy-	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	110-111	+28 → +47.5
6 D-Glucose, 3-amino-3-deoxy- (Kanose-amine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	128 d.	+19 [14°]
7 D-Glucose, 6-amino-6-deoxy-	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	161-162 d.	+23 → +50.1 (hydrochloride)
8 D-Glucose, 2,6-diamino-2,6-dideoxy- (Neosamine C)	C <sub>6</sub> H <sub>14</sub> N <sub>2</sub> O <sub>4</sub>	>230	+61.5 (dihydrochloride)
9 D-Glucose, 3,6-dideoxy-3-dimethylamino- (Mycaminose)	C <sub>8</sub> H <sub>17</sub> NO <sub>4</sub>	115-116	+31 (hydrochloride)
10 D-Glucose, 4,6-dideoxy-4-dimethylamino-	C <sub>8</sub> H <sub>17</sub> NO <sub>4</sub>	192-193	+45.5 (hydrochloride)
11 L-Glucose, 2-deoxy-2-methylamino-	C <sub>7</sub> H <sub>15</sub> NO <sub>5</sub>	130-132	-64
12 D-Gulose, 2-amino-1,6-anhydro-2-deoxy-	C <sub>6</sub> H <sub>11</sub> NO <sub>4</sub>	250-260 d.	+41 ± 2 (hydrochloride)
13 D-Gulose, 2-amino-2-deoxy-	C <sub>6</sub> H <sub>11</sub> NO <sub>5</sub>	152-162 d.	+5.6 → -18.7 (hydrochloride)

**CARBOHYDRATES (Continued)**  
**Part II. NATURAL MONOSACCHARIDES: AMINO SUGARS (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Aldosamines (Con't)			
14 Hexose, 3,4,6-trideoxy-3-dimethylamino- <i>D</i> -xylo- (Desosamine, Pierocine)	C <sub>8</sub> H <sub>17</sub> NO <sub>3</sub>	189-191 d	+49.5 (c 10) (hydrochloride)
15 Hexose, a 4-acetamido-2-amino-2,4,6-trideoxy-	C <sub>8</sub> H <sub>16</sub> N <sub>2</sub> O <sub>4</sub>	216-219	+115 → +94 [26°] (c 0.05)
16 Hexose, an amino-deoxy-3- <i>O</i> -carboxyethyl-	C <sub>9</sub> H <sub>17</sub> NO <sub>7</sub>		
17 Hexose, a 2,6-diamino-2,6-dideoxy- (Neosamine B, Paramose)	C <sub>6</sub> H <sub>14</sub> N <sub>2</sub> O <sub>4</sub>	135-150 d	+17.5 (c 0.9 (hydrochloride))
18 Hexose, a 3-dimethylamino-2,3,6-trideoxy- (Rhodosamine)	C <sub>8</sub> H <sub>17</sub> NO <sub>3</sub>		
19 <i>D</i> -Mannose, 2-amino-2-deoxy- (Mannosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	142 d	-4.3 (c 9) (hydrochloride)
20 <i>D</i> -Mannose, 3-amino-3,6-dideoxy- (Mycosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>4</sub>	162	-11.5 (hydrochloride)
21 <i>D</i> -Talose, 2-amino-2-deoxy- (Talosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	151-153	+3.4 → -5.7 (c 0.9) (hydrochloride)
22 <i>L</i> -Talose, 2-amino-2,6-dideoxy- (Pneumosamine)	C <sub>6</sub> H <sub>13</sub> NO <sub>4</sub>	162-163	+6.9 → +10.4 (hydrochloride)

Ketosamines

23 Pentulose, 1-( <i>o</i> -carboxyanilino)-1-deoxy- <i>D</i> -erythro-	C <sub>12</sub> H <sub>14</sub> NO <sub>6</sub>		
24 Hexulose, 1-( <i>o</i> -carboxyanilino)-1-deoxy- <i>D</i> -arabin-	C <sub>13</sub> H <sub>16</sub> NO <sub>7</sub>		
25 Hexulose, 5-amino-5-deoxy- <i>L</i> -xylo-	C <sub>6</sub> H <sub>13</sub> NO <sub>5</sub>	174-176	-62
26 Hexulose, 6-deoxy-6-( <i>N</i> -methylacetamido)- <i>L</i> -xylo-	C <sub>9</sub> H <sub>17</sub> NO <sub>6</sub>		.

**Part III. NATURAL ALDITOLS AND INOSITOLS (with Inososes and Inosamines)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Alditols			
1 Glycerol	C <sub>3</sub> H <sub>8</sub> O <sub>3</sub>	20	None
2 Glycerol, 1-deoxy- (1,2-Propane-diol) <sup>1</sup>	C <sub>3</sub> H <sub>8</sub> O <sub>2</sub>	Oil, b p 188-189	None (racemic)
3 Erythritol	C <sub>4</sub> H <sub>10</sub> O <sub>4</sub>	118-120	None (meso)
4 Erythritol, 1,4-dideoxy- (2,3-Butylene-glycol)	C <sub>4</sub> H <sub>10</sub> O <sub>2</sub>	25, 34	None (meso)
5 <i>D</i> -Threitol, 1,4-dideoxy-	C <sub>4</sub> H <sub>10</sub> O <sub>2</sub>	19	-13.0
6 <i>L</i> -Threitol, 1,4-dideoxy-	C <sub>4</sub> H <sub>10</sub> O <sub>2</sub>		+10.2
7 <i>D,L</i> -Threitol, 1,4-dideoxy-	C <sub>4</sub> H <sub>10</sub> O <sub>2</sub>	7.6	None (racemic)
8 <i>D</i> -Arabinitol	C <sub>5</sub> H <sub>12</sub> O <sub>5</sub>	103	+7.82 (c 8, borax solution)
9 <i>L</i> -Arabinitol	C <sub>5</sub> H <sub>12</sub> O <sub>5</sub>	101-102	-32 (c 0.4, 5% molybdate)
10 Ribitol (Adomitol)	C <sub>5</sub> H <sub>12</sub> O <sub>5</sub>	102	None (meso)
11 Galactitol (Dulcitol)	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	186-188	None (meso)

**CARBOHYDRATES (Continued)**  
**Part III. NATURAL ALDITOLS AND INOSITOLS**  
 (with Inososes and Inosamines) (Continued)

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Alditols (Con't)			
12 D-Glucitol (Sorbitol)	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	112	-1.8 [15°]
13 D-Glucitol, 1,5-anhydro- (Polygalitol)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	140-141	+42.4
14 L-Iditol	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	73.5	-3.5 (c 10)
15 D-Mannitol	C <sub>6</sub> H <sub>14</sub> O <sub>6</sub>	166	-0.21
16 D-Mannitol, 1,5-anhydro- (Styrracitol)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	157	-49.9
17 Heptitol, D-glycero-D-galacto- (Heptitol, L-glycero-D-manno-; Perseitol)	C <sub>7</sub> H <sub>16</sub> O <sub>7</sub>	183-185, 188	-1.1
18 Heptitol, D-glycero-D-glucosidic acid (Heptitol, L-glycero-D-talo-; β-Sedoheptitol)	C <sub>7</sub> H <sub>16</sub> O <sub>7</sub>	131-132	+46 (5% NH <sub>4</sub> molybdate)
19 Heptitol, D-glycero-D-manno- (Heptitol, D-glycero-D-talo-; Volemitol)	C <sub>7</sub> H <sub>16</sub> O <sub>7</sub>	153	+2.65
20 Octitol, D-erythro-D-galacto-	C <sub>8</sub> H <sub>18</sub> O <sub>8</sub> . H <sub>2</sub> O	169-170	-11 (5% NH <sub>4</sub> molybdate)
Inositols			
21 Betitol (a dideoxy inositol)	C <sub>6</sub> H <sub>12</sub> O <sub>4</sub>	224	.
22 Bioinosose ( <i>scyllo</i> -Inosose; <i>myo</i> -Inosose-2, a deoxy keto inositol)	C <sub>6</sub> H <sub>10</sub> O <sub>6</sub>	198-200	None (meso)
23 D-Bornesitol (a <i>myo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	200	+31.6
24 L-Bornesitol (a <i>myo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	205-206	-32.1
25 Conduritol (a 2,3-dehydro-2,3-dideoxyinositol)	C <sub>6</sub> H <sub>10</sub> O <sub>4</sub>	142-143	None (meso)
26 Cordycepic acid (a tetrahydroxycyclohexanecarboxylic acid) <sup>2</sup>	C <sub>7</sub> H <sub>12</sub> O <sub>6</sub>		.
27 Dambonitol (a <i>myo</i> -inositol dimethyl ether)	C <sub>8</sub> H <sub>16</sub> O <sub>6</sub>	206	None (meso)
28 DL-Inositol	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	253	None (racemic)
29 D-Inositol	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		+60
30 L-Inositol	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	240	-65
31 Laminitol (a C-methyl <i>myo</i> -inositol)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	266-269	-3
32 Liriodendritol (a <i>myo</i> -inositol dimethyl ether)	C <sub>8</sub> H <sub>16</sub> O <sub>6</sub>	224	-25
33 <i>muco</i> -Inositol monomethyl ether	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	322-325	.
34 <i>myo</i> -Inositol ( <i>meso</i> -Inositol)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	217-218	None (meso)
35 D- <i>myo</i> -Inosose-1 (a deoxy keto inositol)	C <sub>6</sub> H <sub>10</sub> O <sub>6</sub>	138-139	+19.6
36 Mytilitol (a C-methyl <i>scyllo</i> -inositol)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	259	None (meso)
37 neo-Inosamine-2 (a deoxy amino inositol)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub> N	239-241 d.	None (meso)
38 D-Ononitol (a <i>myo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	172	+6.6
39 D-Pinitol (a <i>dextro</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	186	+65.5
40 L-Pinitol (a <i>levo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	186	-65
41 L-Quebrachitol (a <i>levo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	190-191	-80.2 [28°]
42 D-Quercitol (a deoxy <i>dextro</i> -inositol)	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	235	+24.2
43 D-Quinic acid (a trideoxy carboxy <i>dextro</i> -inositol)	C <sub>7</sub> H <sub>12</sub> O <sub>6</sub>	164	+44 (c 10)

**CARBOHYDRATES (Continued)**  
**Part III. NATURAL ALDITOLS AND INOSITOLS**  
 (with Inososes and Inosamines) (Continued)

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Inositols (Con't)			
44 <i>l</i> -Quinic acid (a trideoxy carboxy <i>levo</i> -inositol)	C <sub>7</sub> H <sub>12</sub> O <sub>6</sub>	162	-42.1
45 Quinic acid, 5-dehydro-	C <sub>7</sub> H <sub>10</sub> O <sub>6</sub>	140-142 (138 s.)	-82.4 [28°]
46 Scyllitol ( <i>scyllo</i> -Inositol; Cocositol)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	352-353	None (meso)
47 Sequoyitol (a <i>myo</i> -inositol monomethyl ether)	C <sub>7</sub> H <sub>14</sub> O <sub>6</sub>	234-235	None (meso)
48 Shikimic acid (a 3,4-anhydro-quinic acid)	C <sub>7</sub> H <sub>10</sub> O <sub>5</sub>	183-184	-200 [16°]
49 Shikimic acid, 5-dehydro-	C <sub>7</sub> H <sub>8</sub> O <sub>5</sub>	150-152	-57.5 [28°] (EtOH)
50 Streptamine (2,4-diaminodideoxy-scyllitol)	C <sub>6</sub> H <sub>14</sub> O <sub>4</sub> N <sub>2</sub>	88, 210-250 d.	None (meso)
51 Streptamine, 2-deoxy-	C <sub>6</sub> H <sub>14</sub> O <sub>3</sub> N <sub>2</sub>	.....	None (meso)
52 Streptadine (1,3-Dideoxy-1,3-diguano-dino-scyllitol)	C <sub>8</sub> H <sub>18</sub> N <sub>6</sub> O <sub>4</sub>	.....	None (meso)
53 Viburnitol (a deoxy <i>levo</i> -inositol) <sup>1</sup>	C <sub>6</sub> H <sub>12</sub> O <sub>5</sub>	174	-73.9

<sup>1</sup> The 1-phosphate ester of this diol is said to occur in brain tissue and sea-urchin eggs. <sup>2</sup> Strong evidence that cordycepic acid is really *D*-mannitol. <sup>3</sup> Not an enantiomorph of *d*-quercitol; other isomeric relationship is involved.

**Part IV. NATURAL ALDONIC, URONIC, AND ALDARIC ACIDS**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α] <sub>D</sub>
(A)	(B)	(C)	(D)
Aldonic Acids			
1 <i>D</i> -Glyceric acid	C <sub>3</sub> H <sub>6</sub> O <sub>4</sub>	Gum	Dextro
2 <i>L</i> -Glyceric acid	C <sub>3</sub> H <sub>6</sub> O <sub>4</sub>	Gum	Levo
3 <i>D</i> -Arabinonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	114-116	+10.5 (c 6)
4 <i>L</i> -Arabinonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	118-119	-9.6 → -41.7 <sup>1</sup>
5 <i>L</i> -Arabinonic-1,4-lactone	C <sub>5</sub> H <sub>8</sub> O <sub>5</sub>	97-99	-72
6 <i>D</i> -Ribonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	112-113	-17.0
7 <i>D</i> -Xyloonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	.....	-2.9 → +20.1 <sup>1</sup>
8 <i>L</i> -Xyloonic acid	C <sub>5</sub> H <sub>10</sub> O <sub>6</sub>	.....	-91.8 <sup>1</sup>
9 <i>D</i> -Altronic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	.....	+11.5 → +24.8 <sup>1</sup> (Ca salt, N HCl)
10 <i>D</i> -Galactonic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	122	-11.2 → +57.6 <sup>1</sup>
11 <i>D</i> -Gluconic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	130-132 (110-112 s.)	-6.7 → +11.9 <sup>1</sup>
12 <i>L</i> -Gulonic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	Exists only in soln.	[ca. 0°]
13 Hexonic acid, 2-deoxy- <i>D</i> -arabino-	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	93-95	+68 (lactone)
14 2-Hexulosonic acid, <i>D</i> -arabino-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	.....	-81.7 (Na salt)
15 2-Hexulosonic acid, 3-deoxy- <i>D</i> -erythro-	C <sub>6</sub> H <sub>10</sub> O <sub>6</sub>	.....	-29.2 (c 6, Ca salt)
16 2-Hexulosonic acid, <i>D</i> -lyxo-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	169	-5
17 5-Hexulosonic acid, <i>D</i> -arabino-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	108-109	.....
18 5-Hexulosonic acid, <i>D</i> -xylo-	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	.....	-14.5
19 <i>D</i> -Mannonic acid	C <sub>6</sub> H <sub>12</sub> O <sub>7</sub>	.....	-15.6
20 <i>D</i> -Gluconic acid, <i>O</i> - <i>β</i> - <i>D</i> -galactopyranosyl- (1 → 4)- (Lactobionic acid)	C <sub>12</sub> H <sub>22</sub> O <sub>12</sub>	.....	+25.1 (Ca salt)

**CARBOHYDRATES (Continued)**

**Part IV. NATURAL ALDONIC, URONIC, AND ALDARIC ACIDS (Continued)**

Substance (Synonym)	Chemical Formula	Melting Point °C	Specific Rotation [α]D
(A)	(B)	(C)	(D)
Uronic Acids			
21 L-Lyxuronic acid	C <sub>5</sub> H <sub>8</sub> O <sub>6</sub>		
22 β-D-Galacturonic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	160	+27 → +55 6
23 α-D-Galacturonic acid-monohydrate	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub>	159-160 (110-115 s)	+97 9 → +50 9
24 D-Galacturonic acid, 2-amino-2-deoxy-	C <sub>6</sub> H <sub>11</sub> O <sub>6</sub> N	160 d.	+84 5 (pH 2 HCl)
25 β-D-Glucuronic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	156	+11 7 → +36.3
26 D-Glucuronic acid, 2-amino-2-deoxy-	C <sub>6</sub> H <sub>11</sub> O <sub>6</sub> N	120-172 d.	+55
27 D-Glucuronic acid, 3-O-methyl-	C <sub>7</sub> H <sub>12</sub> O <sub>7</sub>	Syrup	+6
28 L-Guluronic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>		
29 L-Iduronic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>		+30
30 β-D-Mannuronic acid	C <sub>6</sub> H <sub>10</sub> O <sub>7</sub>	165-167	-47 9 → -23.9
31 α-D-Mannuronic acid-monohydrate	C <sub>6</sub> H <sub>12</sub> O <sub>8</sub>	110 s, 120-130 d.	+16 → -6 1 (c 6.8)
Aldaric Acids			
32 D-Tartaric acid	C <sub>4</sub> H <sub>6</sub> O <sub>6</sub>	170	-15
33 L-Tartaric acid	C <sub>4</sub> H <sub>6</sub> O <sub>6</sub>	170	+15 [15°]
34 L-Malic acid	C <sub>4</sub> H <sub>6</sub> O <sub>5</sub>	100	-2 3 (c 8.4)

<sup>1</sup> Equilibrates with the lactone.

**FATS AND OILS**

These data for fats and oils were compiled originally for the Biology Data Book by H. J. Harwood, and R. P. Geyer, 1964. Data are reproduced here by permission of the copyright owners of the above publication, the Federation of American Societies for Experimental Biology, Washington, D.C. pp. 380-382.

Values are typical rather than average, and frequently were derived from specific analyses for particular samples (especially the constituent fatty acids). Extreme variations may occur, depending on a number

	Fat or Oil	Source	Constants				
			Melting (or Solidifi- cation) Point, °C	Specific Gravity (or Density)	Refrac- tive Index $n_{40}^D$	Iodine Value	Saponi- fication Value
(A)	(B)	(C)	(D)	(E)	(F)	(G)	
1	Land Animals Butterfat	<i>Bos taurus</i>	32 2	0 911 <sup>10°/15°</sup>	1 4548	36 1	227
2	Depot fat	<i>Homo sapiens</i>	(15)	0 918 <sup>1°</sup>	1 4602	67 6	196 2
3	Lard oil	<i>Sus scrofa</i>	(30 5)	0 919 <sup>15°</sup>	1 4615	58 6	194 6
4	Neat's-foot oil	<i>B. taurus</i>		0 910 <sup>25°</sup>	1 464 <sup>25°</sup>	69-76	190-199
5	Tallow, beef	<i>B. taurus</i>				49 5	197
6	Tallow, mutton	<i>Ovis aries</i>	(42 0)	0 945 <sup>1°</sup>	1 4565	40	194
7	Marine Animals Cod-liver oil	<i>Gadus morhua</i>		0 925 <sup>25°</sup>	1 481 <sup>25°</sup>	165	186
8	Herring oil	<i>Clupea harengus</i>		0 900 <sup>60°</sup>	1 4610 <sup>60°</sup>	140	192
9	Menhaden oil	<i>Brevoortia tyrannus</i>		0 903 <sup>60°</sup>	1 4645 <sup>60°</sup>	170	191
10	Sardine oil	<i>Sardinops caerulea</i>		0 905 <sup>60°</sup>	1 4660 <sup>60°</sup>	185	191
11	Sperm oil, body	<i>Physeter macrocephalus</i>				76-88	122-130
12	Sperm oil, head	<i>P. macrocephalus</i>				70	140-144
13	Whale oil	<i>Balaena mysticetus</i>		0 892 <sup>60°</sup>	1 460 <sup>60°</sup>	120	195
14	Plants Babassu oil	<i>Attalea funifera</i>	22-26	(0 893 <sup>60°</sup> )	1 443 <sup>60°</sup>	15 5	247
15	Castor oil	<i>Ricinus communis</i>	(-18 0)	0 961 <sup>1°</sup>	1 4770	85 5	180 3
16	Cocoa butter	<i>Theobroma cacao</i>	34 1	0 964 <sup>15°</sup>	1 4568	36 5	193 8
17	Coconut oil	<i>Cocos nucifera</i>	25 1	0 924 <sup>15°</sup>	1 4493	10 4	268
18	Corn oil	<i>Zea mays</i>	(-20 0)	0 922 <sup>1°</sup>	1 4734	122 6	192 0
19	Cotton seed oil	<i>Gossypium hirsutum</i>	(-1 0)	0 917 <sup>2°</sup>	1 4735	105 7	194 3
20	Linseed oil	<i>Linum usitatissimum</i>	(-24 0)	0 938 <sup>1°</sup>	1 4782 <sup>25°</sup>	178 7	190 3
21	Mustard oil	<i>Brassica hirta</i>		0 9145 <sup>1°</sup>	1 475	102	174
22	Neem oil	<i>Melia azadirachta</i>	-3	0 917 <sup>1°</sup>	1 4615	71	194 5
23	Niger-seed oil	<i>Guizotia abyssinica</i>		0 925 <sup>1°</sup>	1 471	128 5	190
24	Oiticica oil	<i>Licania rigula</i>		0 974 <sup>2°</sup>		140-180	
25	Olive oil	<i>Olea europaea sativa</i>	(-6 0)	0 918 <sup>15°</sup>	1 4679	81 1	189 7
26	Palm oil	<i>Elaeis guineensis</i>	35 0	0 915 <sup>15°</sup>	1 4578	54 2	199 1
27	Palm-kernel oil	<i>E. guineensis</i>	24 1	0 923 <sup>15°</sup>	1 4569	37 0	219 9
28	Peanut oil	<i>Arachis hypogaea</i>	(3 0)	0 914 <sup>15°</sup>	1 4691	93 4	192 1
29	Perilla oil	<i>Perilla frutescens</i>		(0 935 <sup>15°</sup> )	1 481 <sup>25°</sup>	195	192
30	Poppy-seed oil	<i>Papaver somniferum</i>	(-15)	0 925 <sup>15°</sup>	1 4685	135	194
31	Rapeseed oil	<i>Brassica campestris</i>	(-10)	0 915 <sup>15°</sup>	1 4706	98 6	174 7
32	Safflower oil	<i>Carthamus tinctorius</i>		(0 900 <sup>60°</sup> )	1 462 <sup>60°</sup>	145	192
33	Sesame oil	<i>Sesamum indicum</i>	(-6 0)	0 919 <sup>25°</sup>	1 4646	106 6	187 9
34	Soybean oil	<i>Glycine soja</i>	(-16 0)	0 927 <sup>15°</sup>	1 4729	130 0	190 6
35	Sunflower-seed oil	<i>Helianthus annuus</i>	(-17 0)	0 923 <sup>15°</sup>	1 4694	125 5	188 7
36	Tung oil	<i>Aleurites fordii</i>	(-2 5)	0 934 <sup>15°</sup>	1 5174 <sup>25°</sup>	168 2	193 1
37	Wheat-germ oil	<i>Triticum aestivum</i>				125	

<sup>1</sup> Caproic. <sup>2</sup> Capryli. <sup>3</sup> Capric. <sup>4</sup> Butyric. <sup>5</sup> Decenoic. <sup>6</sup> C<sub>12</sub> monoethenoic. <sup>7</sup> C<sub>14</sub> monoethenoic. <sup>8</sup> Gadoleic plus erucic. <sup>9</sup> C<sub>12</sub> n-pentadecanoic. <sup>10</sup> C<sub>17</sub> margaric. <sup>11</sup> 12-Methyl tetradecanoic. <sup>12</sup> C<sub>20</sub> polyethenoic.

## FATS AND OILS

of variables such as source, treatment, and age of a fat or oil. **Specific Gravity** (column D) was calculated at the specified temperature (degrees centigrade) and referred to water at the same temperature, unless otherwise specified. **Density**, shown in parentheses (column D), was measured at the specified temperature (degrees centigrade). **Refractive Index** (column E) was measured at 50°C, unless otherwise specified.

Constituent Fatty Acids, g/100 g total fatty acids

Saturated						Unsaturated				
Lauric	Myristic	Palmitic	Stearic	Ara-chidic	Other	Palmit-oleic	Oleic	Lino-leic	Lino-lenic	Other
(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)
1 2 5	11 1	29 0	9 2	2 4	2 0 <sup>1</sup> , 0 5 <sup>2</sup> , 2 3 <sup>3</sup>	4 6	26 7	3 6	3 6 <sup>4</sup> , 0 1 <sup>5</sup> , 0 1 <sup>6</sup> , 0 9 <sup>7</sup> , 1 4 <sup>8</sup> , 1 0 <sup>9</sup> , 1 0 <sup>10</sup> , 0 4 <sup>11</sup>	
2	2 7	24 0	8 4			5	46 9	10 2	2 5 <sup>8</sup>	
3	1 3	28 3	11 9			2 7	47 5	6	0 2 <sup>7</sup> , 2 1 <sup>8</sup>	
4		17-18	2 3				74 76			
5	6 3	27 4	14 1				49 6	2 5		
6	4 6	24 6	30 5				36 0	4 3		
7	5 8	8 4	0 6			20 0	← 29 1 →		25 4 <sup>12</sup> , 9 6 <sup>13</sup>	
8	7 3	13 0	Trace			4 9			30 1 <sup>12</sup> , 23 2 <sup>13</sup>	
9	5 9	16 3	0 6	0 6		15 5			19 0 <sup>12</sup> , 11 7 <sup>13</sup> , 0 8 <sup>14</sup>	
10	5 1	14 6	3 2			11 8	← 17 8 →		18 1 <sup>12</sup> , 14 0 <sup>13</sup> , trace <sup>7</sup> , 15 4 <sup>15</sup>	
11	1	5	6 5			26 5	37	19	1 <sup>13</sup> , 4 <sup>7</sup> , 19 <sup>16</sup>	
12	16	14	8	2		15	17	6 5	4 <sup>6</sup> , 14 <sup>7</sup> , 6 5 <sup>16</sup>	
13	0 2	9 3	15 6	2 8		14 4	35 2		13 6 <sup>12</sup> , 5 9 <sup>13</sup> , 2 5 <sup>7</sup> , 0 2 <sup>17</sup>	
14	44 1	15 4	8 5	2 7	0 2	0 2 <sup>1</sup> , 4 8 <sup>2</sup> , 6 6 <sup>3</sup>	16 1	1 4		
15	← 2 4						7 4	3 1	87 <sup>18</sup>	
16		24 4	35 4				38 1	2 1		
17	45 4	18 0	10 5	2 3	0 4 <sup>19</sup>	0 8 <sup>1</sup> , 5 4 <sup>2</sup> , 8 4 <sup>3</sup>	0 4	7 5	Trace	
18		1 4	10 2	3 0			1 5	49 6	34 3	
19		1 4	23 4	1 1	1 3		2 0	22 9	47 8	
20			6 3	2 5	0 5			19 0	24 1	47 4
21		1 3 <sup>20</sup>						27 2 <sup>20</sup>	16 6 <sup>20</sup>	0 2 <sup>11</sup> , 1 1 <sup>11</sup> , 1 0 <sup>21</sup> , 51 0 <sup>22</sup>
22		2 6 <sup>20</sup>	14 1 <sup>20</sup>	24 0 <sup>20</sup>	0 8 <sup>20</sup>				58 5 <sup>20</sup>	
23		3 3 <sup>20</sup>	8 2 <sup>20</sup>	4 8 <sup>20</sup>	0 5 <sup>20</sup>				30 3 <sup>20</sup>	57 3 <sup>20</sup>
24	← 11 3 <sup>23</sup>						6 2			82 5 <sup>21</sup>
25		Trace	6 9	2 3	0 1					
26		1 4	40 1	5 5						
27	46 9	14 1	8 8	1 3		2 7 <sup>2</sup> , 7 0 <sup>3</sup>				
28			8 3	3 1	2 4					
29	← 9 6 <sup>23</sup>									
30			4 8 <sup>20</sup>	2 9 <sup>20</sup>						
31			1							
32	← 6 8 <sup>23</sup>									
33			9 1	4 3	0 8					
34	0 2	0 1	9 8	2 4	0 9					
35			5 6	2 2	0 9					
36	← 4 6 <sup>23</sup>									
37	← 16 0 <sup>23</sup>									

<sup>13</sup> C<sub>22</sub> polyethenoic   <sup>14</sup> Behenic   <sup>15</sup> C<sub>14</sub> polyethenoic   <sup>16</sup> Gadoleic   <sup>17</sup> C<sub>24</sub> polyethenoic.   <sup>18</sup> Ricinoleic.   <sup>19</sup> Includes behenic and lignoceric   <sup>20</sup> Percent by weight   <sup>21</sup> Lignoceric   <sup>22</sup> Erucic   <sup>23</sup> Includes behenic, lignoceric, behenic and elcostearic

## WAXES

These data for waxes were compiled originally for the Biology Data Book by A H Warth Data are reproduced here by permission of the copyright owners of the above publication, the American Societies for Experimental Biology, Washington, D C p 382

**Specific Gravity** (column C) was calculated at the specified temperature, degrees centigrade, and referred to water at the same temperature. **Density**, shown in parentheses (column C), and **Refractive Index** (column D) were measured at the specified temperature, degrees centigrade

Wax	Melting Point °C	Specific Gravity or (Density)	Refractive Index $n^{\circ}\text{C}$ D	Iodine Value	Acid Value	Saponification Value
(A)	(B)	(C)	(D)	(E)	(F)	(G)
1 Bamboo leaf	79-80	(0 961 <sup>25°</sup> )		7 8 <sup>1</sup>	14 5	43 4
2 Bayberry (myrtle)	46 7-48 8	(0 985 <sup>15°</sup> )	1 436 <sup>80°</sup>	2 9 <sup>2</sup> -3 9 <sup>3</sup>	3 5	20 5-21 7
3 Beeswax, crude	62-66	(0 927-0 970 <sup>15°</sup> )	1 439-1 483 <sup>40°</sup>	6 8-16 4 <sup>2</sup>	16 8-35 8	89 3-149 0
4 Beeswax, white, U S P	61-69	(0 959-0 975 <sup>15°</sup> )	1 447-1 465 <sup>65°</sup>	7-11 <sup>3</sup>	17-24	90-96
5 Beeswax, yellow	62-65	(0 960-0 964 <sup>15°</sup> )	1 443-1 449 <sup>65°</sup>	6-11	18-24	90-97
6 Candelilla, refined	67-69	(0 982-0 986 <sup>15°</sup> )	1 454-1 463 <sup>85°</sup>	14 4-20 4	12 7-18 1	35-86
7 Cape berry <sup>4</sup>	40 5-45 0	(1 004-1 007 <sup>15°</sup> )	1 450 <sup>40°</sup>	0 6-2 4	2 5-3 7	211-215
8 Carandá	79 7-84 5	(0 990 <sup>25°</sup> )		8 0-8 9	5 0-9 5	64 5-78 5
9 Carnauba	83-86	0 990-1 001 <sup>15°</sup>	1 467-1 472 <sup>40°</sup>	7 2-13 5	2 9-9 7	78-95
10 Castor oil, hydro- genated	83-88	(0 980-0 990 <sup>20°</sup> )		2 5-8 5	1 0-5 0	177-181
11 Chinese insect	81 5-84 0	0 950-0 970 <sup>15°</sup>	1 457 <sup>40°</sup>	1 4	0 2-1 5	73-93
12 Cotton	68-71	0 959 <sup>15°</sup>		24 5	32	70 6
13 Cranberry	207-218	(0 970-0 975 <sup>15°</sup> )		44 2-53 2 <sup>2</sup>	42 2-59 1	131-134
14 Douglas-fir bark	59 0-72 8	(1 030 <sup>25°</sup> )	1 468 <sup>80°</sup>	25 8-62 5	58 6-80 7	112-200
15 Esparto	67 5-78 1	0 988 <sup>15°</sup>		22-23	22 7-23 9	69 8-79 3
16 Flax	61 5-69 8	0 908-0 985 <sup>15°</sup>		21 6-28 8	17 5-48 3	77 5-101 5
17 Ghedda, E Indian beeswax	60 5-66 4	0 956-0 973 <sup>15°</sup>	1 440 <sup>50°</sup>	5 6-12 6	5 8-7 9	84 5-118 3
18 Indian corn	80-81			4 2 <sup>2</sup>	1 9	120 3
19 Japan wax	48-53	0 975-0 993 <sup>15°</sup>		4 5-12 5	6-20	206 5-237 5
20 Jojoba	11 2-11 8	0 864-0 899 <sup>25°</sup>	1 465 <sup>25°</sup>	81 7-88 4 <sup>2</sup>	0 2-0 6	92 2-95 0
21 Madagascar	88			3 2-5 3	17 7-28 0	140 0-159 6
22 Microcrystalline, amber	64-91	0 913-0 943 <sup>15°</sup>	1 424-1 452 <sup>80°</sup>	0	0	0
23 Microcrystalline, white	71-89	0 928-0 941 <sup>15°</sup>	1 441 <sup>80°</sup>	0	0	0
24 Montan, crude	76-86	(1 010-1 020 <sup>25°</sup> )		13 9-17 6	22 7-31 0	59 4-92 0
25 Montan, refined	77-84	(1 010-1 030 <sup>25°</sup> )		10-14	24-43	72-103
26 Orange peel	44 0-46 5	0 985 <sup>15°</sup>	1 502 <sup>20°</sup>	115 7 <sup>2</sup>	48 3	120 9
27 Ouricury, refined	79 0-83 8	1 053 <sup>15°</sup>		6 9-7 8 <sup>2</sup>	3 4-21 1	61 8-85 8
28 Ozocerite, refined	74 4-75 0	0 907-0 920 <sup>15°</sup>		0	0	0
29 Palm	74-86	(0 991-1 045 <sup>15°</sup> )		8 9-16 9 <sup>2</sup>	5 0-10 6	64 5-104 0
30 Paraffin, American	49-63	0 896-0 925 <sup>15°</sup>	1 442-1 448 <sup>80°</sup>	0	0	0
31 Peat wax, natural	73-76	0 980 <sup>15°</sup>		16-40	60 0-73 3	73 9-136 0
32 Rice bran, refined	75 3-79 9		1 469 <sup>30°</sup>	11 1-19 4	15-17	56 9-104 4
33 Shellac wax	79-82	0 971-0 980 <sup>15°</sup>		6 0-8 8 <sup>3</sup>	12 1-24 3	63 8-83 0
34 Sisal hemp	74-81	1 007-1 010 <sup>15°</sup>		28-29 <sup>2</sup>	16-19 <sup>2</sup>	56-58
35 Sorghum grain	77-82			15 7-20 9	10 1-16 2	16-44
36 Spanish moss	79-80			33 0	25 0	120 4
37 Spermaceti	42-50	0 905-0 945 <sup>15°</sup>	1 440 <sup>70°</sup>	4 8-5 9	2 0-5 2	108-134
38 Sugarcane, crude	52-67	0 988-0 998 <sup>25°</sup>		32-84	24-57	128-177
39 Sugarcane, double- refined	77-82	0 961-0 979 <sup>25°</sup>	1 510 <sup>25°</sup>	13-29	8-23	55-95
40 Wool wax, refined	36-43	0 932-0 945 <sup>15°</sup>	1 478-1 482 <sup>40°</sup>	15 0-46 9	5 6-22 0	80-127

<sup>1</sup> Wijs test <sup>2</sup> Hanus test <sup>3</sup> Hubl test <sup>4</sup> Myrica cordifolia

## DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS

Compiled by George W. Smith

The following table contains values for the molar susceptibility of  $\chi_M$ , specific susceptibility  $\chi$ , and volumetric susceptibility  $K$ . The cgs Gaussian system of units is employed. In the Gaussian units the relation between magnetic induction  $B$  and magnetic field strength  $H$  is

$$B = H + 4\pi I \quad (1)$$

where  $I$  is the magnetization or magnetic moment per unit volume. Actually the quantities involved in equation (1) are all vectors, but one may assume that all three are collinear, a reasonable assumption for organic diamagnetic substances in the liquid state. For crystals  $I$  may vary with crystal orientation. Equation (1) may be rewritten

$$B = H + 4\pi K H = (I + 4\pi K)H \quad (2)$$

Here,  $K$  is the magnetic susceptibility often called the volumetric susceptibility and is a unitless quantity.

Other susceptibilities of use to chemists and physicists are the specific or mass susceptibility which is defined

$$\chi = K/\rho \quad (3)$$

where  $\rho$  is the density of the sample in grams per cc., and the molar susceptibility which is defined as

$$\chi_M = M\chi = MK/\rho \quad (4)$$

where  $M$  is the molecular weight of the substance in grams.

Temperatures, when listed, are enclosed in parentheses and are listed in degrees C.

Literature references for values contained in this table may be found in General Motors Research Laboratories publication GM-R-317.

Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$	Compound	$-\chi_M \times 10^6$	$-\chi \times 10^6$	$-K \times 10^6$
Acenaphthanthracene	184	73		Amyl iodide	(118.7)	5996 (18°)	(910) (20°)
Acenaphthene	109.3	(709)	(726) (99°)	n-Amyl methyl ketone	80.50	70.3	(580) (15°)
Acetal	81.39	688 (32°)	(568) (32°)	Amyl nitrate	(76.4)	574	
Acetaldehyde	22.70	515 <sub>s</sub>	(403) (18°)	iso-Amyl propionate	101.73	70.5 (25°)	(609) (25°)
Acetamide	34.1	577	(618) (20°)	n-Amyl valerate	124.55	723 <sub>s</sub> (638) (0°)	
Acetic acid	31.54	525 (32°)	(551) (32°)	Anethole	(96.0)	648 (644) (15°)	
Acetic anhydride	(52.8)	517	(562) (15°)	Aniline	62.95	(676) (691) (20°)	
Acetoaminofluorene	(141)	63		Anisidine	(80.5)	654 (72) (20°)	
Acetone	33.7 <sub>s</sub>	581 <sub>s</sub>	(460) (20°)	Anisole	72.79	(673) (672) (15°)	
Acetonitrile	28.0	(682)	(534) (20°)	Anthanthrene	204.2	739	
Acetylacetone	62.51	547 <sub>s</sub>	(531) (20°)	Anthanthrone	178.1	581	
Acetophenone	72.05	599 <sub>s</sub>	(615) (20°)	Anthracene	(130)	731 (914) (27°)	
Acetophenone oxime	79.9 <sub>s</sub>	592 <sub>s</sub>		Anthracenedinitrile	154.6	(678)	
Acetophenone oxime-O-methyl ether	92.31	618 <sub>s</sub>		Anthracenonitrile	142.1	(700)	
Acetoxime	44.4 <sub>s</sub>	607 <sub>s</sub>	(480) (20°)	Anthraquinone	(119.6)	575 (825) (20°)	
Acetoxime-O-benzyl ether	104.8 <sub>s</sub>	642		Anthrazine	245.7	646	
Acetoxime-O-methyl ether	54.8	629 <sub>s</sub>		Arabinose	85.70	571 (905) (20°)	
Acetylacetone	54.88	548 <sub>s</sub>	(535) (20°)	Arbutoside	158.0	(589)	
Acetyl chloride	38.9	496	(548) (20°)	Asarone	131.4	(631) (735) (18°)	
Acetylene	12.5	(480)		Asparagine	69.5	(526) (812) (15°)	
Acetylphenylacetylene	86.9	508		Aspartic acid	64.2 ± 4	(482) (800) (12°)	
Acetylthiophene	71.7	(568)		Aurin	(161.4)	556	
Acridine	(123.3)	688	(757) (20°)	p-Azoanisole	(147.7)	610	
Adonitol	91.30	600		Azobenzene	(106.8)	586	611 (70.5°)
Alanine	50.5	(567)		p-Azophenetole	(171.7)	635	
Allyl acetate	(56.7)	566	(525) (20°)	m-Azotoluene	(127.8)	608	643 (58°)
Allyl alcohol	36.70	632	540 (20°)	Azulene	98.5	768	
1-Allylpyrrole	73.80	685 (20°)		Barbituric acid (Anh.)	53.8	(420)	
Aminoazobenzene	(118.3)	600		Barbituric acid (2H <sub>2</sub> O)	78.6	(479)	
Aminoazotoluene	(142.2)	631		Benzalazine	(123.7)	504	
o-Aminoazotoluene	(138)	61 ± 02		Benzaldehyde	60.78	(573) (602) (15°)	
α-Aminobutyric acid	62.1	(602)		Benzaldoxime	(69.8)	576 (639) (20°)	
Aminomethylidihydiazine	114.8	(696)		Benzamide	(72.3)	597 (801) (4°)	
4-Aminostilbene	122.5	(628)		Benzanthrone	142.9	620	
2-Aminothiazole	56.0	564		Benzene	54.84	702 (32°) 611	
n-Amyl acetate	89.06	684 <sub>s</sub>	5979 (20.7°)	Benzidine	110.9	603 (754) (20°)	
iso-Amyl acetate	89.40	687	599 (20°)	Benzil	(118.6)	564 (616) (100°)	
n-Amyl alcohol	(67.5)	766	(624) (20°)	Benzoinic acid	70.28	(575) (728) (15°)	
γ-Amyl alcohol	(71.0)	8060	(655) (25°)	Benzoinic anhydride	(124.9)	552 (662) (15°)	
Inactive Amyl alcohol	69.06	783 <sub>s</sub> (25°)		Benzonitrile	65.19	(632) (638) (15°)	
iso-Amyl alcohol	68.96	782 <sub>s</sub> (25°)	(64) (15°)	Benzophenone	109.60	601 <sub>s</sub> (66) (50°)	
sec-Amyl alcohol	69.1	785	(635) (20°)	3,4-Benzoprene	135.7	538	
tert-Amyl alcohol	(70.9)	804	(634) (15°)	Benzopyrene	194.0		
n-Amylamine	69.4	(796)	(606) (20°)	Benzoyl acetone	(95.0)	586 (639) (60°)	
iso-Amylamine	71.6	(821)	(616) (20°)	Benzoyl chloride	(75.8)	539 (20°) (657) 15°	
n-Amylbenzene	112.55	(759)	(652) (20°)	Benzyl acetate	93.18	(620) (655) (16°)	
iso-Amyl bromide	(88.7)	587	(706) (20°)	Benzyl alcohol	71.83	(664) (697) (15°)	
iso-Amyl-n-butylate	113.52	717 <sub>s</sub> (25°)	(616) (25°)	Benzylamine	75.26	(702) (690) (10°)	
iso-Amyl chloride	(79.0)	741	(662) (20°)	Benzyl chloride	81.98	(647) (713) (18°)	
iso-Amyl cyanide	73.4	(755)	(609) (20°)	Benzyl formate	81.43	(598) (646) (20°)	
Amylene bromide	(114.5)	498		Benzylidene aniline	(100.4)	554	
Amylene chloride	(95.2)	675		Benzylidene chloride	(97.9)	608 (763) (14°)	
iso-Amyl ether	(129)	813	(635) (15°)	Benzylidene methylaniline	(73.1)	613	
iso-Amyl formate	78.38	674 <sub>s</sub>	(591) (25°)	Benzyl methyl ketone	83.44	621 <sub>s</sub> (624) (20°)	
Amylidene chloride	(93.4)	662		Biphenyl	(126.8)	696 (671) (54.5°)	

**DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)**

Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$	Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$
3,4-Bis (p-hydroxyphenyl)-2,4-hexadiene	(157)	59		Chlorofumaric acid	67.02	( 445)	
m,m'-Bitolyl	(127.4)	6993 (27.4°)	( 699) (16°)	p-Chlorooiodo benzene	99.42	( 417)	( 786) (57°)
m,m'-Bitolyl sulfide	(140.0)	6530 (27.4°)		Chloromaleic acid	67.36	( 448)	
Borneol	126.0	( 817)	( 826) (20°)	Chloromethylstilbene	144.8	( 633)	
Bromobenzene	78.92	5030 (20°)	( 753) (20°)	$\alpha$ -Chloronaphthalene	107.60	661	789 (20°)
Bromobenzenediazocyanide	86.88	( 414)	( 846) (19°)	m-Chlorotriphenylene	(74.8)	475	638 (48°)
Bromochloromethane	55.0 ± 6	( 425)	( 812) (15°)	$\alpha$ -Chlorophenol	77.4	( 602)	( 747) (18°)
Bromodichloromethane	66.3 ± 3	( 405)	( 948) (20°)	p-Chlorophenol	77.6	( 604)	( 789) (20°)
Bromoform	82.60	327		1-( $\alpha$ -Chlorophenylazo) 2-naphthol	161.0	( 570)	
Bromonaphthalene	(123.8)	598		1-( $\beta$ -Chlorophenylazo) 2-naphthol	161.4	( 571)	
$\alpha$ -Bromonaphthalene	115.90	560	840 (20°)	Chlorotrifluoroethylene	49.1	422	
m-Bromotoluene	(93.4)	546	( 770) (20°)	Chlorotrifluoromethane	45.3 ± 1.5	( 434)	
Bromotrichloromethane	73.1 ± 7	( 369)	( 758) (0°)	Cholesterol	(284.2)	735	( 784) (20°)
Butane	57.4	( 988)		Chrysene	166.67	731	
iso-Butane	51.7	( 890)		Chrysodine	(126.3)	505	
1,4-Butanediol	61.5	( 682)	( 696) (20°)	Cinnamic acid	78.36	529	( 660) (4°)
2-Butene (cis)	42.6	( 759)		Cinnamic acid ( $\alpha$ trans)	78.2	( 528)	
2-Butene (trans)	43.3	( 772)		Cinnamic acid ( $\beta$ trans)	79.0	( 533)	
1-Butene 3,4-diacetate	95.5	( 555)		Cinnamic acid (cis-MP 68°)	77.6	( 524)	
2-Butene-1,4-diacetate (cis)	95.2	( 553)		Cinnamic acid (cis-MP 58°)	77.9	( 526)	
2-Butene-1,4-diacetate (trans)	95.1	( 552)		Cinnamic acid (cis-MP 42°)	83.2	( 562)	
2-Butene-1,4-diol (cis)	54.3	( 616)		Cinnamic aldehyde	(74.8)	566	( 629) (15°)
2-Butene-1,4-diol (trans)	53.5	( 607)		Cinnamyl alcohol	(87.2)	650	( 679) (20°)
n-Butyl acetate	77.47	666 (25°)	( 583) (25°)	Citral	(98.9)	650	( 577) (20°)
iso-Butyl acetate	78.52	676	( 584) (25°)	Coronene	(243.3)	810	
n-Butyl alcohol	56.536 (20°)	( 7627)	( 6176) (20°)	Coumarin	82.5	( 565)	( 528) (20°)
iso-Butyl alcohol	57.704 (20°)	( 7785)	( 621) (20°)	$\alpha$ -Cresol	72.90	673	( 706) (20°)
sec-Butyl alcohol	57.683 (20°)	( 7782)	( 629) (20°)	m-Cresol	72.02	667 (26°)	( 690) (20°)
tert-Butyl alcohol	57.42	774 (25°)	( 611) (20°)	$\omega$ -Cresol	72.1	667 (26°)	( 690) (20°)
n-Butylamine	58.9	( 805)	( 506) (20°)	$\alpha$ -Cresylmethyl ether	81.94	671 (40°)	( 661) (15°)
iso-Butylamine	59.8	( 818)	( 590) (20°)	$\beta$ -Cresylmethyl ether	77.91	638 (40°)	( 623) (15°)
9-Butylanthracene	176.0	( 751)		Cumene	79.13	648 (40°)	( 620) (19°)
n-Butylbenzene	100.79	( 751)	( 646) (20°)	Cyanide	89.53	744 <sub>9</sub>	( 642)
iso-Butylbenzene	101.81	( 759)	( 648) (20°)	Cyanuric acid	(56.1)	435	490 (15°)
tert-Butylbenzene	102.5	( 764)	( 662) (20°)	9-Cyanoanthracene	101.1 (10°)	( 437)	
n-Butyl benzoate	116.69	654	( 656) (25°)	Cyanogen	142.1	( 699)	
Butyl bromide	77.14	563 (20°)	( 730) (20°)	Cyanuric acid	(21.6)	415	( 359) (liq. 17°)
iso-Butyl bromide	79.88	583 (20°)	( 737) (20°)	Cyclobutane	61.5	476	( 842) (u°)
1-n-Butyl chloride	67.10	725	( 642) (20°)	Cyclobutanecarboxylic acid	58.16	5816 (30°)	( 613) (30°)
2-n-Butyl chloride	67.40	728	( 635) (20°)	1,3-Cyclohexadiene	48.6	( 607)	( 510) (20°)
n-Butyl cyanide	(62.8)	7558 (27.4°)	( 606) (20°)	1,4-Cyclohexadiene	48.7	( 608)	( 515) (20°)
tert-Butyl cyclohexane	115.09	8205	( 6670) (20°)	Cyclohexane	68.13	8100 (27.5°)	( 627) (20°)
1,4-Butyl diacetate	103.4	( 594)	( 822) (20°)	Cyclohexanecarboxylic acid	83.24	6199 (30°)	( 668) (30°)
n-Butyl ethyl ketone	80.73	707	( 579) (20°)	Cyclohexanol	73.40	732	694 (20°)
n-Butyl formate	65.83	644	( 571) (25°)	Cyclohexanone	62.0	632 <sub>3</sub>	( 599) (20°)
iso-Butyl formate	66.79	654	( 574) (25°)	Cyclohexanone oxime	71.5	632 <sub>1</sub>	
iso-Butylideneazine	(95.8)	683		Cyclohexanone oxime O-methyl ether	82.9	632 <sub>3</sub>	
Butyl iodide	(93.6)	5086 (18°)	( 822) (20°)	Cyclohexene	57.5	( 700)	( 567) (20°)
iso-Butyl methyl ketone	70.05	690	( 561) (20°)	Cyclohexenol	64.1	( 633)	
tert-Butyl methyl ketone	69.86	697 <sub>9</sub>	( 558) (16°)	Cyclooctane	91.4	( 815)	( 684) (20°)
n-Butyl phenyl n-butylate	126.7	( 469)		Cyclooctene	84.6	( 769)	( 654) (20°)
p-tert-Butylphenol	108.0	( 719)	( 653) (114°)	Cyclooctatetraene	(53.9)	518	
Butyl sulfide	(113.7)	7774 (27.4°)	( 652) (16°)	Cyclopentane	59.18	8439	6290 (20°)
Butyl thiocyanate	(79.38)	6891 (27.4°)	( 659) (25°)	Cyclopentanecarboxylic acid	73.48	6446 (30°)	( 677) (30°)
2-Butyne 1,4-diacetate	93.9	( 564)		Cyclopentanone	51.63	6141 (30°)	( 582) (30°)
2-Butyne 1,4-dibenzoylate	93.9	( 561)		Cyclopropane	39.9	( 948)	( 683) (-70°)
2-Butyne 1-4-diol	169.0	( 561)		Cyclopropanecarboxylic acid	45.33	5271 (30°)	( 569) (30°)
n-Butynaldehyde	50.3	( 584)		p-Cymene	102.8	766 (20°)	( 656) (20°)
iso-Butynaldehyde	46.08	639	( 522) (20°)	Decalin	106.70	7718	6814 (20°)
iso-Butynaldimine	46.38	643	( 511) (20°)	cis-Decalin	(107.0)	774	( 686) (35°)
n-Butynic acid	56.1 <sup>a</sup>	644 <sub>3</sub>	( 576) (20°)	trans-Decalin	(107.7)	779	( 670) (33°)
n-Butynic acid	55.10	625	( 598) (20°)	n-Decane	119.74	( 8416)	( 6143) (20°)
iso-Butynic acid	56.06	636 <sub>6</sub> (25°)	( 601) (25°)	1-Deuterio pvrrole	48.75	716 (20°)	
Butynonitrile	49.4	( 713)	( 569) (15°)	Deuteriobindene	80.88	690	( 692) (13°)
Butynylphenylacetylene	(106.4)	618		Diacetal	(153.8)	668	
Acetyl	(99.9)	476	( 689) (15°)	Di-iso-amylamine	(133.1)	846	( 649) (21°)
Cacodylic acid	(79.9)	579		Diazoacetic ester	57	( 50)	( 54) (24°)
Camphor	(103)	68	( 67) (25°)	Dibenzoconene	289.4	778	
Camphoric acid	120.0	( 644)	( 791) (20°)	1,2,5,6-Dibenzofluorene	184	69 ± 03	
Camphoric anhydride	(113)	620	( 740) (20°)	3,4,5,6-Dibenzophenanthrene	(203)	73 ± 03	
n-Propionic acid	78.55	676	( 624) (25°)	Dibenzenophenanthrone	200.5	716	
n-Propylphenylacetylene	(130.4)	651		Dibenzopyrene	213.6	706	
n-Propylphenylacetylene	101.60	7033	( 642) (20°)	Dibenzopyrenequinone	183.1	551	
Carbanilide	134.05	( 6316)	( 783) (20°)	iso-Dibenzopyrenequinone	194.6	586	
Carbazole	117.4	( 702)		Dibenzyl ketone	131.70	626	
Carbon disulfide	44.2	554	( 699) (22°)	p-Dibromobenzene	(101.4)	430	786 (100°)
Carbon tetrabromide	93.73	2826 (20°)	( 966)	2,3-Dibromo-2-butene-1,4-diol	94.2	( 383)	
Carbon tetrachloride	66.60	433	( 601) (20°)	Dibromodichloromethane	81.1 ± 4	( 334)	( 808) (25°)
Carvacrol	(136)	261	( 113) (20°)	1,2-Dibromo-3,3-dioctylidene	(140.1)	320	
Carvone	(109.1)	726	( 709) (20°)	1,2-Dibromoethylene	(71.7)	386	( 877) (17.5°)
Cetyl alcohol	(92.2)	614	( 590) (20°)	1,2-Dibromo-2-fluoroethane	(78.0)	379	( 855) (17°)
Cetyl mercaptan	(183.5)	757 (17.5°)	( 619) (50°)	Dibromo-4-nitrophenol	(167.5)	564	
Chloral	390.4	1510		1,2-Dibromotetrachloroethane	(126.0)	387	( 1049)
Chloranil	(67.7)	459	( 694) (20°)	Di- <i>n</i> -butylamine	103.7	( 802)	( 767) (20°)
Chloroacetic acid	(112.6)	458		Di-iso-butylamine	105.7	( 817)	( 609) (20°)
Chloroacetone	48.1	( 509)	( 804) (20°)	Di-sec-butylamine	105.9	( 819)	( 641) (0°)
Chloroacetylchloride	(50.9)	550	( 633) (20°)	Di-iso-butyl ketone	104.30	733	( 591) (20°)
p-Chloranisole	53.7	( 475)	( 710) (0°)	Di- <i>tert</i> -butyl ketone	104.06	732	
Chlorobenzene	69.97	( 6216)	( 688) (20°)	Dibromo-4-nitrophenol	(167.5)	564	
Chlorophenol diazocyanide	65.02	( 393)		2,6-Di- <i>tert</i> -butyl-4-methyl phenol	165.3	( 750)	
Chlorodibromomethane	75.1 ± 4	( 361)	( 883) (15°)	2,4-Di- <i>tert</i> -butyl phenol	155.6	( 754)	
Chlorodifluoromethane	38.6	446		DiButyl phthalate	175.1	( 620)	( 657) (21°)
1-Chloro-2,3-dihydroxypropane	(77.9)	604		Di-iso-butylvaleracetylene	(125.6)	738	
Chlorodiphenylmethane	131.9	( 651)		DiCetyl sulfide	401.7	( 832)	
Chlorothylene	35.9	574	( 528) (liq., 15°)	Dichloroacetic acid	58.2	( 451)	( 705) (20°)
Chloroform	59.30	497	( 740) (20°)	Dichloroacetyl chloride	69.0	( 468)	

## DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)

Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$	Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$
o-Dichlorobenzene	84.26	5734	(748) (20°)	2,5-Dimethylpyrrole	71.92	756 (20°)	(707) (20°)
m-Dichlorobenzene	83.19	5661	(729) (20°)	$\alpha$ , $\omega$ -Dimethyl styrene	(90.7)	686	
p-Dichlorobenzene	82.93	5644	(823) (20°)	Dimethyl succinate	81.50	5581	(625) (18°)
1,4-Dichloro-2-butyne	74.2	(603)		Dimethyl sulfate	(62.2)	493	(657) (20°)
1,2-Dichloro-1,2-dibromoethane	(108.6)	423		Dimethyl sulfide	(44.9)	723	(612) (21°)
1,1-Dichloro-difluoroethylene	60.0	451		Dimethyltrichloromethylcarbinol	(105)	59	
Dichlorodifluoromethane	52.2	432	(642) (-30°)	N,N-Dimethyl urea	55.1	(625)	(784)
1,1-Dichloroethylene	49.2	508	(635) (15°)	N,N'-Dimethyl urea	56.3	(639)	(730)
cis-1,2-Dichloroethylene	51.0	526	(679) (15°)	o-Dinitrobenzene	65.98	3921	(614) (17°)
trans-1,2-Dichloroethylene	48.9	504	(638) (15°)	m-Dinitrobenzene	70.53	4197	(659) (0°)
1,3-Dichloro-2-hydroxypropane	(80.1)	621		p-Dinitrobenzene	68.30	4064	(660) (30°)
Dicyandiamide	44.55	(530)	(742) (14°)	2,4-Dinitrophenol	(73.1)	397	(668) (24°)
Dicyclohexanol acetylene	(151.6)	682		Dinitroresorcinol	(62.4)	312	
Dicyclohexyl	129.31	7776	6889 (20°)	1,4-Dioxane	52.16	592 (32°)	(606) (32°)
1,1-Dicyclohexylnonane	231.98	7930	7001 (20°)	Diphenyl	103.25	6695	(664) (73°)
Diethanolacetylene	(75.3)	660		1,1-Diphenylallyl-3-chloride	146.1	(639)	
Diethyl acetalddehyde	70.71	705 <sub>e</sub>	(576) (20°)	1,3-Diphenylallyl-3-chloride	140.7	(615)	
Diethylallylacetophenone	146.2	(676)	(663) (16°)	Diphenylamine	(109.7)	648	686 (55.5°)
Diethyl allylmalonate	118.8	(593)	(602) (14°)	Diphenyl-bis-diazo cyanide	85.03	(327)	
Diethylamine	56.8	(777)	(552) (18°)	Diphenylbutadiene	129.6	(629)	
Diethylcyclohexylamine	(124.5)	802	(699) (0°)	Diphenylchloroethylene	(145.5)	550	(871) (40°)
Diethyl ethylmalonate	115.2	(612)	(614) (20°)	Diphenyldecapentaene	180.5	(635)	
Diethyl ketone	58.14	675 <sub>i</sub>	(551) (19°)	Diphenylidiacetene	(134.6)	640	
Diethyl ketoxime	68.31	6754		Diphenylidiazomethane	115	(592)	
Diethyl malonate	(92.6)	5782	(611) (20°)	Diphenylidihydrotetrazine	129.9	(545)	
Diethyl-3-(1-methyl butane) ethyl-malonate	175	(677)		1,1-Diphenylethylen	(118.0)	655	(680) (14°)
Diethyl oxalate	81.71	5595	(603) (15°)	1,6-Diphenylhexane	171.81	7208	6877 (20°)
Diethyl phthalate	127.5	(574)	(645) (25°)	Diphenylhexatriene	146.9	(632)	
Diethyl sebacate	(177.0)	685	(661) (20°)	Diphenylmethane	(115.7)	688	684 (35.5°)
Diethylstilbestrol	172.0	(547)		Diphenylmethanol	119.1	647	
Diethylstilbestrol dipropionate	265.2	720		1,1-Diphenylnonane	206.32	7357	6935 (20°)
Diethyl succinate	105.07	6035	(628) (20°)	Diphenyloctatetraene	164.3	(636)	
Diethyl sulfate	(86.8)	563	(667) (15°)	Diphenyloxyarsine	(225.2)	567	
Diethyl sulfide	(67.9)	753	(630) (20°)	N,N-Diphenyl urea	126.3	(595)	(739)
Diethyl tartrate	(113.4)	550	(662) (20°)	Di-n-propyl ketone	127.5	(600)	(743) (20°)
Difluoroacetamide	(41.2)	433		Di-isopropyl ketone	80.45	705 <sub>e</sub>	(576) (20°)
1-Difluoro-2-dibromoethane	(85.5)	382	(883) (20°)	Diisopropyl oxalate	81.14	711 <sub>e</sub>	(573) (20°)
1,1-Difluoro-2,2 dichloroethyl amyl ether	129.84	(587)	(694) (20°)	Diisopropyl oxalate	105.27	6046	(628) (0°)
1,1-Difluoro-2,2-dichloroethyl butyl-ether	119.48	(577)	(703) (20°)	Dodecyl alcohol	106.02	6089	
1,1-Difluoro-2-dichloroethyl ethyl ether	96.13	(537)	(723) (20°)	Dulcitol	147.70	7849 (20.7°)	(652) (24°)
1,1-Difluoro-2,2-dichloroethyl methyl-ether	80.68	(489)	(696) (20°)	Flaudic acid	204.8	(725)	(619) (79°)
1,1-Difluoro-2,2-dichloroethyl propyl-ether	107.19	(555)	(701) (20°)	Erythritol	73.80	604	(876) (20°)
Difluoroethanol	(41.3)	503		Ethane	27.3	(910)	(511) (-100°)
Di-n-heptylamine	171.5	(805)		4-Ethoxy-3-methoxybenzyl acetate	138.5	619	
Di-n-heptylamine	148.9	(803)		4-Ethoxy-3-methoxybenzyl benzoate	177.3	620	
Dihydronaphthalene	(85.1)	654	(652) (12°)	1-Ethoxynaphthalene	119.9	(696)	(738) (20°)
o-Dimethoxybenzene	87.39	6329	(686) (25°)	2-Ethoxynaphthalene	119.2	(692)	(734) (25°)
m-Dimethoxybenzene	87.21	6316	(682) (0°)	Ethyl acetate	54.10	614	554 (20°)
p-Dimethoxybenzene	86.65	6275	(661) (55°)	Ethyl acetoacetate	71.67	550 <sub>e</sub>	(565) (20°)
o-(2,5-Dimethoxybenzoyl)-benzoic acid	161.0	(562)		Ethylacetophenone	95.5	(644)	(639) (16°)
Dimethoxymethane	(47.3)	621	(532)	Ethyl alcohol	33.60	723	575 (20°)
Dimethylacetophenone	96.8	(653)	(645) (16°)	Ethyl amylpropionate	122.5	(651)	(634) (16°)
Dimethylallylacetophenone	122.4	(650)	(635) (16°)	Fthylinanine	89.30	(737)	(709)
Dimethylaminine	89.66	(740)		9-Ethyl anthracene	153.0	(741)	(771) (99°)
2,2-Dimethylbutane	76.24	8848	5744 (20°)	Ethylbenzene	77.20	7272	6341 (20°)
2,3-Dimethylbutane	76.22	8845	5853 (20°)	Ethyl benzoate	98.32	621 <sub>e</sub>	(648) (25°)
2,3-Dimethyl-2-butene	65.9	(783)	(557)	Ethyl benzoylacetate	(115.3)	600	(673) (20°)
Dimethylcyclohexanone	(84.8)	672		Fthyl benzylmalonate	(116.3)	578	
1,2 and 1,3 Dimethylcyclopentanes	81.31	8281	6224 (20°)	Fthyl bromide	154.5	6172	(663) (20°)
2,5-Dimethyl-2,5 dibromo-3-hexene	(135.6)	506		Fthyl bromoacetate	54.70	502	719 (20°)
Dimethyl diethylketo tetrahydro-furan	(116.2)	753		Fthyl bromoacetate	(82.8)	496	(747) (20°)
2,5-Dimethyl-1-ethylpyrrole	94.61	768 (20°)		Fthyl-1-isobutyacetatoacetate	(121.4)	652	
2,5-Dimethyl-3-ethylpyrrole	93.87	762 (20°)		Ethyl butylmalonate	139.3	644 <sub>e</sub>	(629) (20°)
2,5-Dimethylfuran	66.37	687 (20°)	(620) (18°)	Ethyl n-butyrate	(77.7)	6693	(585) (25°)
Dimethyl furan	57.27	584		Fthyl iso-butyrate	78.32	674 <sub>e</sub>	(583) (25°)
2,5-Dimethyl-4-heptene	100.6	(797)		Ethyl chloroacetate	(72.3)	590	(684) (20°)
2,4 Dimethyl-2,4-hexadiene	(78.7)	714		Fthyl cinnamate	(107.5)	610	(640) (20°)
2,3-Dimethylhexane	98.77	8648	6164 (20°)	Ethyl cyanoacetate	(67.3)	595	(632) (20°)
2,5-Dimethylhexane	98.15	8593	5669 (20°)	Fthyl cyclohexane	91.09	8118	6324 (20°)
3,4-Dimethylhexane	99.06	8673	6240 (20°)	Lithiodiallylacetophenone	147.4	(646)	(636) (16°)
2,6-Dimethyl-4 hexanol	116.9	812		Ethyl dibromocinnamate	174.5	519	
2,5-Dimethyl-3 hexene-2,5-diol	(103.0)	724		Fthyl dichloroacetate	85.2	(543)	(696) (20°)
Dimethyl isoxazole	59.7	(615)		Fthyl diethylacetooacetate	(117.9)	6328	(615) (20°)
Dimethylketone tetrahydrafuranone	(68.5)	600		Fthyl diethylmalonate	(140.4)	6492	(641) (20°)
Dimethyl malonate	69.69	5277	(609) (20°)	Fthyl dithiolacetate	(71.0)	5904 (27.4°)	
1,6-Dimethyl-naphthalene	113.3	(725)		Fthylene	12.0	(428)	(242) (-102°)
2,4-Dimethylnonane	134.68	(862)	(636) (20°)	Ethylene	15.30	546 (32°)	(309) (-102°)
3,4-Dimethylnonane	134.70	(862)	(647) (20°)	Ethylene bromide	78.80	419	915 (20°)
4,5-Dimethylnonane	134.52	(861)	(647) (20°)	Ethylene iodide	46.26	771 (32°)	(686) (20°)
2,6-Dimethyl-1,2,6,8-nonatetraene	(108.8)	724		Ethylene oxide	104.7	371 (32°)	(791) (10°)
Dimethyl-2,4-nonatriene	(148.8)	990		Fthylene ether	30.7	(697)	(618) (7°)
2,6-Dimethyloctane	122.54	(861)	(627) (20°)	Ethyl ethylacetooacetate	55.10	743	534 (20°)
3,4-Dimethyloxadiazole	57.17	583		Ethyl ethylbutylmalonate	(163.3)	6683	(650) (20°)
Dimethyl oxalate	(55.7)	472	(542) (54°)	Ethyl ethylpropylmalonate	(152.4)	6619	(648) (20°)
Dimethyl oxamide	(63.2)	544		Ethyl formate	43.00	580	531 (20°)
2,2-Dimethylpentane	86.97	8680	5849 (20°)	Ethyl hexylpropylpropionate	93.9	5937	(582) (20°)
2,3-Dimethylpentane	87.51	8733	6070 (20°)	Ethyl hydroxylamine	(43.0)	704	
2,4-Dimethylpentane	87.48	8732	5876 (20°)	Ethylidene chloride	(57.4)	580	(684) (20°)
2,2-Dimethylpropane	63.1	(875)	(536) (0°)	Ethyl iodide	(69.7)	4470 (17.5°)	(681) (20°)
2,5-Dimethyl-3-propyl-pyrrole	106.07	773 (20°)	(679) (14°)	Ethyl iodoacetate	(97.6)	456	(829) (13°)
2,4-Dimethylpyrrole	69.64	732 (20°)	(679) (14°)	Ethyl lactate	(72.6)	615	(633) (25°)

## DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)

Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$	Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$
Ethyl methylacetacetate	(81 9)	5684	( 569) (20°)	Indene (natural)	84 79	( 730)	( 723) (25°)
Ethyl methyl ketoxime	57 3 <sub>2</sub>	658 <sub>0</sub>	( 530) (20°)	Indene (synthetic)	80 89	( 696)	( 690) (25°)
Ethyl-1-methyl-2-oxyocyclohexane-carboxylate	112 1	( 608)		Indole	85 0	( 726)	
Ethyl methylphenylmalonate	(153 2)	6121	( 658) (20°)	Iodo benzene	92 00	451	826 (20°)
Ethyl nitrophenylpropionate	114 6	523		Iodoform (in sol'n)	117 1	2974 (20°)	(1 192) (17°)
Ethyl oxamate	62 0	( 529)	( 427) (19°)	1 Iodo-2 phenylacetylene	(110 1)	483	
Ethyl perfluor-n-butrate	103 5	( 427)		o-Iodotoluene	(112 2)	5145 (30°)	( 874) (20°)
Ethyl phenylacetate	104 27	( 635)	( 656) (20°)	m-Iodotoluene	(112 3)	5152 (30°)	( 875) (20°)
Ethyl phenylmalonate	(142 2)	6017	( 659) (20°)	p-Iodotoluene	101 31	( 465)	( 780) (40°)
Ethyl phenylpropionate	(104 2)	598	( 636) (13°)	Leucine	84 9	( 647)	
Ethyl phosphate	(98 2)	539	( 576) (25°)	iso-Leucine	84 9	( 647)	
Ethyl propionate	(66 5)	6514	( 584) (15°)	Maleic acid	49 71	( 428)	( 681) (20°)
Ethyl propylacetacetate	(105 7)	6135	( 593) (20°)	Maleic anhydride	(35 8)	365	( 341) (20°)
Ethyl-n-propyl ketone	69 03	689 <sub>1</sub>	( 560) (22°)	Malonic acid	(46 3)	4453	( 726) (15°)
Ethyl succinimide	(72 0)	566		Mannitol	111 20	610	( 908) (20°)
Ethyl sulfine	(67 0)	631		Mannose	102 90	571	( 879)
Ethyl sulfite	(75 4)	546	( 604) (0°)	Mesitylene	92 32	7682 (20°)	( 665) (20°)
Ethylsulfone ethyl ether	(81 8)	592		Methane	12 2 <sub>7</sub>	( 765)	
Ethyl thiocyanate	(55 7)	6392 (27 4°)	( 637) (25°)	Methione	91 0	( 610)	
Ethyl isothiocyanate	(59 0)	6772 (27 4°)	( 680) (15°)	p-Methoxyazobenzene	(118 9)	560	
Ethyl thioacetate	(62 7)	6019 (27 4°)	( 586) (25°)	o-Methoxybenzaldehyde	76 0	( 558)	( 632) (20°)
Ethyl tribromacetate	(63 5)	6098 (27 4°)		p-Methoxybenzaldehyde	78 0	( 572)	( 642) (20°)
Ethyl tribromoacetate	(119 5)	368	( 821) (20°)	o-Methoxybenzyl alcohol	87 9	637	( 664) (25°)
Ethyl trichloroacetate	(99 6)	520	( 719) (20°)	1-Methoxynaphthalene	107 0	( 676)	( 741) (14°)
N-Ethyl urea	55 5	( 630)	( 764) (18°)	2-Methoxynaphthalene	107 6	( 680)	
Ethyl isoovalerate	(91 1)	700	( 607) (20°)	1-(o-Methoxyphenylazo)-2-naphthol	163 6	( 588)	
Eucalyptol	(116 3)	754	( 699) (20°)	Methoxysaligenin acetate	110 3	613	
Eugenol and iso-eugenol	(102 1)	622	( 663) (20°)	Methyl acetate	42 60	575	537 (20°)
Flavanthrone	241 0	590		Methyl acetoacetate	59 60	513 <sub>2</sub>	( 553) (20°)
Fluorene	110 5	655		Methyl acetylacetone	(65 0)	569	
Fluorenone	99 4	552	( 623) (100°)	Methyl alcohol	21 40	668	530 (20°)
Fluorobenzene	(58 4)	608	( 623) (20°)	Methylallylaketone	111 9	( 1 330)	
Fluorobromoacetic acid	(59 5)	379		Methylamidine	(27 0)	870	( 608) (-11°)
Fluorodichloromethane	48 8	474	( 676) (0°)	N-Methylaniline	82 74	( 773)	( 762) (20°)
p-Fluorophenol	(88 0)	628		9-Methylanthracene	146 5	762	( 812) (99°)
Fluorotrichloroethylene	72 5	485	( 742) (25°)	Methyl benzoate	81 59	599 <sub>2</sub>	( 651) (25°)
Fluorotrichloromethane	58 7	427	( 638) (17°)	Methyl-o-benzoylbenzoate	139 4	( 580)	( 690) (19°)
Formaldehyde	(18 6)	62	( 51) (-20°)	Methylbenzylamine	(132 2)	670	
Formamide	(21 9)	486	( 551) (20°)	Methyl bromide	42 8	451	( 1 044) (0°)
Formic acid	19 90	432	527 (20°)	2-Methylbutane	64 40	8925	5531 (20°)
<i>g</i> -Formylpropionic acid	55 3	( 542)		2-Methyl-2-butene	54 14	( 772)	( 516) (13°)
Fructose	102 60	570		Methyl butyl ketone	(69 1)	690	( 563) (15°)
Fulvene (Benzene $x_M$ measured to be 49)	42 9	( 549)	( 452) (20°)	Methyl iso-butyl ketone	(69 3)	692	( 554) (20°)
Fulvene ( $\frac{54 8}{49}$ )	48 0	( 614)	( 505) (20°)	Methyl tert-butyl ketone	(70 4)	703	( 562) (16°)
Fumaric acid	49 11	( 423)	( 692) (20°)	p-Methyl-o-tert-butylphenol	120 3	( 732)	
Furan	43 09	633 (20°)	( 598) (15°)	Methyl butyrate	(66 4)	6498	( 588) (16°)
Furfural	47 1	( 490)	( 568) (20°)	o-Methylcarbanilide	154 0	( 681)	
Galactose	103 00	572		Methyl chloride	(32 0)	633	
Gallic acid	90 0	( 529)	( 896) (4°)	Methyl chloroacetate	58 1	( 535)	( 661) (20°)
Geraniol formate	(119 9)	658	( 610) (20°)	Methylchloranthrene	(182)	68 ± 04	
Glucose	102 60	570		3-Methylchloranthrene	194 0	( 723)	
D-Glucose	101 5	( 563)	( 869) (25°)	Methylcyclohexane	78 91	8038	6181 (20°)
Glutamic acid	78 5	( 533)		2-Methylcyclohexanone	(74 0)	660	( 610) (18°)
Glycerol	57 06	619	( 779) (20°)	3-Methylcyclohexanone	(74 8)	667	( 610) (20°)
Glycine	40 3	( 537)	( 846) (50°)	4-Methylcyclohexanone	(63 5)	566	( 516) (24°)
Glycol	38 80	624	698 (20°)	Methylicyclopentane	70 17	8338	6245 (20°)
Guaiacol	(79 2)	638	( 720) (21°)	4-Methyl-2,6-di-tert-butylphenol	167 6	( 761)	
Heanthrone	189 9	497		Methyl dichloroacetate	73 1	( 511)	
1,2-Heptadiene	73 5	( 764)		Methylidiphenyloxaphosphine oxide	(152 9)	616	
2,3-Heptadiene	72 1	( 749)		Methylidiphenyltriazine	(155 1)	627	
Heptaldehyde	81 02	709 <sub>6</sub>	( 603) (20°)	Methylene bromide	65 10	375	935 (20°)
n-Heptane	85 24	8507	( 5817) (20°)	Methylene chloride	(46 6)	549	( 733) (20°)
4-Heptanol	91 5	789	( 647) (20°)	Methylene iodide	93 10	348	1 156 (20°)
n-Heptanoic acid	88 60	680	( 626) (20°)	Methylene succinic acid	57 57	( 443)	( 723)
n-Heptyl amine	93 1	( 808)	( 628) (20°)	Methyl ether	26 3	571	
n-Heptyl benzene	134 41	7625	6528 (20°)	Methyl ethyl ketone	133 3	( 659)	( 643) (16°)
Heptyl cyclohexane	147 40	8084	6559 (20°)	Methyl formate	45 5 <sub>8</sub>	632-	( 509) (20°)
n-Heptylic acid	89 74	6900	( 630) (25°)	Methylfumaric acid	(32 0)	5327	( 519) (20°)
1-Heptyne	77 0	( 801)	( 584) (25°)	3-Methylheptane	56 98	( 438)	( 642)
2 Heptyne	79 5	( 826)	( 615) (25°)	2-Methyl-1 heptene	97 99	8580	6056 (20°)
Hexabromoethane	(148 0)	294	( 1 124) (20°)	5-Methyl-1,2 hexadiene	88 0	( 784)	
Hexachlorobenzene	(147 5)	518	( 1 059) (24°)	2-Methylhexane	73 6	( 765)	( 553) (19°)
Hexachloroethane	(112 7)	476	( 995) (20°)	Methyl hexyl ketone	86 24	8607	5841 (20°)
Hexachlorohexatrone	(145 0)	433		Methyl-hydroxybenzoate	(93 3)	728	( 596) (20°)
n-Hexadecane	187 63	8286	( 6421) (20°)	Methyl-p-hydroxybenzoate	88 4	( 581)	
1,5-Hexadiene	(55 1)	671	( 462) (20°)	Methyl iodide	88 7	( 583)	
2,3-Hexadiene	60 9	( 741)		Methylmaleic acid	(57 2)	403	( 918) (20°)
n-Hexaldehyde	69 40	693 <sub>0</sub>		9-Methyl-10 methoxyanthracene	57 84	( 446)	( 721)
2,2,7,9,9,9-Hexamethyldecane	191 52	8458	6596 (20°)	Methyl-o-methoxybenzoate	158 1	( 711)	
Hexamethyl disiloxane	118 9	7324		Methyl-p-methoxybenzoate	95 6	( 575)	( 665) (19°)
Hexamethylene glycol	84 30	713		Methyl- <i>a</i> -methoxy isobutyrate	(81 9)	620	
n-Hexane	(74 6)	8654 (27 4°)	( 565)	1-Methylnaphthalene	102 8	( 723)	( 741) (14°)
Hexene	65 7	( 781)		2-Methylnaphthalene	102 6	( 722)	( 743) (20°)
Hexestrol	(165)	61 ± 02		4-Methylnonane	121 39	( 853)	( 625) (20°)
n-Hexyl alcohol	79 20	774	( 637) (20°)	5-Methyl-5-nonenone	111 6	( 796)	
n-Hexyl benzene	124 23 (20°)	( 767)	( 658) (20°)	4-Methyloctane	109 63	( 855)	( 618) (20°)
n-Hexyl methyl ketone	91 4 <sub>2</sub>	713 <sub>1</sub>	( 583)	Methylol urea	48 3	( 493)	
n-Hexyl methyl ketoxime	102 5 <sub>8</sub>	716 <sub>2</sub>	( 634) (20°)	2 Methylpentane	75 26	8734	5705 (20°)
Hexylpropionamide	(103 7)	677		3-Methylpentane	75 52	8764	5823 (20°)
Hydrindene	(78 5)	664	( 639) (16°)	4-Methyl 2-pentanol	80 4	788	( 641) (20°)
Hydroquinone	64 63	587	( 797) (20°)	Methyl perfluor-n-butvrate	92 5	( 406)	
Hydroxyazobenzene	(99 7)	503		Methyl phenylacetate	92 73	( 618)	( 645) (16°)
p-Hydroxybenzaldehyde	66 8	( 547)	( 618) (130°)	Methyl phenylpropionate	95 6	597	
4-Hydroxy-2-butanoone	48 5	55	( 573) (14°)	2-Methylpropene	44 4	( 791)	
				Methyl propionate	(55 0)	6240	( 571) (20°)

**DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)**

Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$	Compound	$-x_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$
Methyl n-propyl ketone	57.41	666 <sub>1</sub>	( 541) (15°)	Pentachloroethane	(99.1)	490	( 819) (25°)
Methyl-iso-propyl ketone	58.45	679 <sub>0</sub>	( 545) (20°)	Pentachlorohexadione	(129.5)	452	
1 Methylpyrrole	58.56	722 (20°)	( 664) (10°)	2,3 Pentadiene	49.1	( 721)	( 501) (20°)
2-Methylpyrrole	60.10	741 (20°)	( 700)	n-Pentane	63.05	8739	5472 (20°)
Methyl salicylate	86.30	567	668 (20°)	2,4 Pentanediol	70.4	677	
Methyl silicone	(172.7)	730		Perfluoroacetic acid	43.3	( 380)	
$\alpha$ -Methyl styrene	(80.1)	678	( 620) (20°)	Perfluoro-n-butryc acid	81.0	( 378)	
2 Methylthiazole	59.56	601 (20°)		Perfluorobutyric anhydride	149.4	( 387)	
2-Methylthiophene	66.35	676 (20°)	( 689) (20°)	Perfluorocyclooctane oxide	157.6	( 379)	
Methyl trichloroacetate	84.2	( 475)	( 707) (19°)	Perfluoropropionic acid	61.0	( 372)	
N-Methyl urea	44.6	( 602)	( 725)	Perhydroanthracene	146.01	7592	7178 (20°)
Morpholine	55.0	( 631)	( 631)	Perylene	166.8	662	
Myleran	169.7	69	( 834) (4°)	Phenanthrene	(127.9)	718	( 763) (100°)
Myristic acid	176.0	( 771)	( 661) (60°)	Phenanthrenequonone	104.5	502	( 698)
Naphthalene hydrodic acid	117.6	( 588)		Phenanthrenonitrile	139.0	( 685)	
Naphthalene	(91.9)	717	( 821) (20°)	$\alpha$ -Phenetidine	(101.7)	741 (25°)	
Naphthalene picrate	185.9	( 523)		$\alpha$ -Phenetidine	(96.8)	706 (25°)	( 749) (15°)
2-Naphthalenesulfonylamine	127.6	( 616)		Phenetole	(84.5)	692	( 689) (20°)
2-Naphthalenesulfonyl chloride	121.91	( 538)		Phenol	60.21	( 640)	( 675) (45°)
meso-Naphthodianthrene	214.6	612		Phenothiazine	114.8	( 576)	
meso-Naphthodianthrene	221.8	583		Phenylacetaldehyde	72.01	599 <sub>4</sub>	( 614) (20°)
1-Naphthol	98.2	681	( 834) (4°)	Phenyl acetate	82.04	( 603)	( 647) (25°)
	97.0	673	( 819) (4°)	Phenylacetic acid	82.72	( 608)	( 657) (80°)
2-Naphthol	98.25	( 682)	( 829) (4°)	Phenylacetylene	72.01	( 705)	( 655) (20°)
$\alpha$ -Naphtho nitrile	103.3	( 674)	( 753) (5°)	1-Phenylazo-2 naphthol	137.6	( 554)	
$\beta$ -Naphtho nitrile	101.0	( 659)	( 721) (60°)	2-Phenylbenzofuran	130.5	( 672)	
$\alpha$ -Naphtho quinone	73.5	( 465)	( 661)	1 Phenyl 4-benzoyl 1,3 butadiene	(140.3)	599	
$\beta$ -Naphtho quinone	67.9	( 429)		Phenylbutadiene	(85.7)	658	
N-1-Naphthylacetamide	117.8	( 636)		4 Phenyl 1-butene	93.49	( 7077)	( 6239) (20°)
N-2-Naphthylacetamide	117.8	( 636)		Phenylbutyl acetate	134.5	653	
1-Naphthylamine	98.8	690	757 (54°)	Phenyl n-butyrate	105.46	( 643)	
2-Naphthylamine	98.00	( 684)	( 726) (98°)	Phenyl iso-cyanate	(72.7)	610	( 699) (20°)
1-Naphthylamine hydrochloride	(127.6)	710		$\alpha$ Phenylenediamine	71.98	6662	
Nicotine	113.328	( 699)	( 705) (20°)	m Phenylenediamine	70.53	6529	( 723) (58°)
$\alpha$ -Nitroaniline	66.47	( 481)	( 694) (15°)	p Phenylenediamine	70.28	6503	
m-Nitroaniline	70.09	( 507)	( 725) (20°)	Phenyl ether	(108.1)	635	( 681) (20°)
p-Nitroaniline	66.43	( 481)	( 691) (14°)	Phenylethyl sulfide	(94.4)	6826 (27 4°)	
$\alpha$ -Nitrobenzaldehyde	68.23	4517		Phenylfluoriform	(77.3)	529	
m-Nitrobenzaldehyde	68.55	4538		Phenylhydrazine	67.82	( 627)	( 688) (23°)
p-Nitrobenzaldehyde	66.57	4407	( 507) (0°)	Phenylhydroxylamine	(68.2)	625	
Nitrobenzene	61.80	502	604 (20°)	Phenyl mercaptan	(70.8)	6425 (27 4°)	( 693) (20°)
Nitrobenzen diazo cyanide	59.22	( 336)		1-Phenyl 2 Methylbutane	113.53	( 766)	( 660) (20°)
$\alpha$ -Nitrobenzoic acid	76.11	4556	( 718) (4°)	Phenylmethyl sulfide	(83.2)	6695 (27 4°)	
m-Nitrobenzoic acid	80.22	4802	( 717) (4°)	Phenylpropylamide	(83.3)	574	
p-Nitrobenzoic acid	78.81	4718	( 731) (32°)	Phenyl propionate	93.79	( 625)	( 654) (25°)
$\alpha$ -Nitrobromobenzene	87.3	( 432)	( 700) (80°)	Phenylsulfone	(129.0)	591	( 740) (20°)
m-Nitrobromobenzene	89.5	( 443)	( 755) (20°)	Phenyl thiocyanate	(81.5)	6027 (27 4°)	( 677) (24°)
p-Nitrobromobenzene	89.6	( 444)	( 859) (22°)	Phenyl isothiocyanate	(86.0)	6365 (27 4°)	( 719) (24°)
m-Nitro carbanilide	148.1	( 576)		1-Phenyl 4,6-trimethylheptane	173.90	( 796)	( 682) (20°)
Nitroethane	(35.4)	472	( 497) (20°)	$\gamma$ Nitro urea	82.1	( 603)	( 785)
Nitromethane	21.1	3457	( 391) (25°)	Phloroglucinol	(73.4)	532	
1-Nitronaphthalene	98.47	( 569)	( 696) (62°)	Phthalamide	(91.3)	556	
$\alpha$ -Nitrophenol	73.3	527 (24°)	( 873) (20°)	Phthalic acid	83.61	5035	( 802) (20°)
m-Nitrophenol	70.8	.509 (25°)	( 756)	iso Phthalic acid	84.64	5097	
p-Nitrophenol	69.5	500 (22°)	( 740)	tere-Phthalic acid	83.51	5029	( 759)
1-(m-Nitrophenylazo)-2-naphthol	142.0	( 484)		Phthalic anhydride	67.31	( 454)	( 694) (4°)
1-(p-Nitrophenylazo)-2-naphthol	141.7	( 483)		Phthalimide	(78.4)	533	
Nitrophenylfluorform	(84.1)	440		Picric acid	84.38	( 368)	( 649)
2-Nitropropane	45.73	5135	( 509) (20°)	Piperazine	56.8	( 659)	( 650) (20°)
Nitrosobenzene	59.1	( 552)		Piperidine	64.2	( 754)	( 538) (-45°)
N-Nitrosodithylamine	59.3	( 580)	( 546) (20°)	Propane	40.5	( 919)	
p-Nitrosodithylamine	92.6	( 520)	( 644) (15°)	Propene	31.5	( 749)	( 456) (-47°)
N-Nitrosodimethylamine	73.3	( 488)		Propionaldehyde	34.32	5910	( 477) (20°)
N-Nitrosodiphenylamine	110.7	( 558)		Propionic acid	43.50	586	582 (20°)
1-Nitro-2-naphthol	83.9	( 485)		Propionitrile	38.5	( 699)	( 547) (21°)
2-Nitro-1-naphthol	82.7	( 478)		Propionylphenylacetylene	(95.1)	601	
4-Nitro-1-naphthol	91.8	( 530)		Propiophenone	83.73	6240	( 631) (20°)
m-Nitronitrobenzene	66.0	( 433)		n-Propyl acetate	65.91	645 <sub>5</sub> (25°)	( 569) (25°)
p-Nitrosotriobenzene	65.8	( 433)		n-Propyl alcohol	67.04	656 <sub>6</sub>	( 566) (25°)
p-Nitrosophenol	50.7	( 412)		9-Propylbenzene	45.176 (20°)	( 7518)	( 6047) (20°)
Nitrosoperidine	(63.4)	555	( 590) (20°)	9-Propyl alcohol	45.794 (20°)	( 7621)	( 5985) (20°)
p-Nitrosotoluene	70.4	( 581)		9-Propylanthracene	164.0	( 744)	
$\alpha$ -Nitrotoluene	72.28	5272	( 613) (20°)	n-Propylbenzene	89.24	( 742)	( 640) (20°)
m-Nitrotoluene	72.71	5304	( 614) (20°)	n-Propyl benzoate	105.00	( 640)	( 646) (25°)
p-Nitrotoluene (in sol'n)	72.06	5257	( 676) (20°)	n-Propyl bromide	(65.6)	533	( 721) (20°)
$\eta$ -Nonane	108.13	8431	6057 (20°)	iso-Propyl bromide	(65.1)	529	( 633) (20°)
1,2-Octadiene	83.6	( 750)		Propyl butyrate	(89.4)	6867	( 604) (15°)
n-Octane	96.63	8460	5949 (20°)	propyl-chloride	56.10	715	633 (20°)
Octanoxime	(102.7)	717		iso-Propyl cyclohexane	102.65	8131	6528 (20°)
Octyl alcohol	102.65	7766 (20°)	( 640) (20°)	Propylenediamine	(58.1)	784	( 688) (15°)
Octyl chloride	(114.9)	773	( 676) (20°)	Propylene oxide	42.5	( 732)	( 629) (0°)
Oetylcylohexane	158.09	8051	6578 (20°)	Propyl formate	(55.0)	6248	( 563) (20°)
Octylene	(89.5)	798	( 576) (17°)	Propyl hexylpropionate	(136.8)	697	
Octylene bromide	(150.4)	553		Propyl iodide	(84.3)	4958 (30°)	( 864) (20°)
n-Octyl mercaptan	(115.1)	7866 (27 4°)		Propyl propionate (extrap.)	(77.95)	6711	( 593) (20°)
Oenanthyldiene chloride	(116.5)	689		Propyl sulfide	(92.1)	7787 (27 4°)	( 634) (17°)
Oleic acid	208.5	( 738)	( 661) (18°)	N-Propyl urea	67.4	( 660)	
Opicanic acid	111.5	( 530)		Pseudocumene	(101.6)	845 (20°)	( 740) (20°)
Ovalene	353.8	888		Pyramidone	149.0	( 645)	
Oxalic acid (anh.)	33.8	( 375)		Pyranthrene	266.9	709	
Oxalic acid	60.05	( 4763)	( 787)	Pyranthrone	250.3	616	
Oxamide	(39.0)	443	( 738)	Pyrazine	37.6	( 469)	( 484) (61°)
Palmic acid	198.6	( 775)	( 661) (62°)	Pyrene	147.9	731	( 933) (0°)
Paraldehyde	(86.2)	652	( 648) (20°)	Pyridine	49.21	( 622)	( 611) (20°)
Pentabromophenol	(194.0)	397		Pyrocatechol	68.76	6248	( 857) (15°)
Pentacene	(205.4)	738		Pyrrole	47.6	( 709)	( 688) (20°)

## DIAMAGNETIC SUSCEPTIBILITIES OF ORGANIC COMPOUNDS (Continued)

Compound	$-X_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$	Compound	$-X_M \times 10^6$	$-x \times 10^6$	$-K \times 10^6$
Pyrrolidine	54 8	( 771)	( 657) (23°)	Trianthrophosphine oxide	(201 7)	624	
Quinoline	86 0	( 666)	( 729) (20°)	1,2,3-Tribromopropane	(117 9)	420	( 1023) (23°)
Quinone	38 4	( 355)	( 468) (20°)	Tri-iso-butylamine	(156 8)	846	( 646) (25°)
Quinonoxime	(50 4)	409		Trichloroacetic acid (in sol n)	73 0	( 44)	( 723) (46°)
Resorcinol	67 26	6112	( 785) (15°)	Trichlorobenzene	(106 5)	587	
Rhamnose	99 20	605	( 890) (20°)	Trichloro-tert-butyl alcohol (in sol n)	98 01	552	
Safrole and iso-Safrole	(97 5)	601	( 66) (20°)	Trichloroethylene	65 8	501	( 734) (20°)
Salicylaldehyde	64 4	( 527)	( 615) (20°)	Trichloronitromethane	(75 3)	458	( 756) (20°)
Salicylic acid	72 23	523	( 755) (20°)	Triethylamine	81 4	( 804)	( 586) (20°)
Saligenin	76 9	620	( 720) (25°)	Triethyl citrate	(161 9)	586	( 666) (20°)
Salol	(123 2)	575	678 (45°)	Triethyl phosphate	(125 3)	688	( 735) (20°)
Salvarsan dihydrochloride	(246 1)	518		Triethylphosphine	(90 0)	762	( 610) (15°)
Selenophene	66 82	510		Triethylphosphine oxide	(91 6)	683	
iso-Selenophene	110-111	84-85		Triethyl phosphite	(104 8)	631	( 611) (20°)
trans-Selenophene	70-77	53 59		Triethyl triazinetrifluorocarbonate	(164 1)	552	
Sorbitol	107 80	592		Trifluorocresol	(83 8)	517	
Stearic acid	220 8	( 776)	( 657) (60°)	Tri-n-heptylamine	251 3	( 806)	
Stilbene	(120 0)	666	( 646) (125°)	Tri-n hexylamine	221 7	( 823)	
Stilbestrol	(130)	62 63		Trimethylacetophenone	108 2	( 667)	( 648) (16°)
Styrene	(68 2)	655	( 594) (20°)	2,2,3-Trimethylbutane	88 36	8818	6086 (20°)
Succinic acid	(57 9)	4902	( 767) (15°)	2,2,3 Trimethylpentane	99 86	8743	6261 (20°)
Succinic anhydride	(47 5)	475	( 524)	2,2,4-Trimethylpentane	98 34	8610	5958 (20°)
Succinimide	(47 3)	477	( 674) (16°)	2,3,5-Trimethylpyrrole	82 31	754 (20°)	
Sulfamide	44 4	( 462)	( 832)	1,3,5 Trimitrobenzene	74 55	( 350)	( 591) (20°)
p-Sulfanilamide	80 15	( 465)		Triperfluorobutylamine	253 0	( 377)	
Terpineol	111 9	( 725)	( 678) (room temp)	Triphenoxylarsine	(195 2)	551	
Tetraethylmonosilane	266 2	( 678)		Triphenylarsine	(177 0)	578	
1,1,2,2-Tetrabromoethane	(123 4)	357	( 1058) (20°)	Triphenylarsine dihydroxide	(270 5)	795	
Tetra bromoethylene	(114 8)	334		Triphenylarsine oxide	(199 1)	618	
Tetracene	(168 0)	736		Triphenylbismuthine	(196 8)	447	( 708) (20°)
1,1,2,2-Tetrachloroethane	(89 8)	535	( 856) (20°)	Triphenylbismuthine dimitate	(254 5)	451	
Tetrachloroethylene	81 6	492	( 802) (15°)	Triphenylcarbinol	(173 7)	675	( 802) (20°)
Tetrahydroquinoline	(89 0)	668	( 715) (4°)	Triphenylmethane	(165 6)	678	686 (100°)
Tetraiodoethylene	(164 3)	309	( 922) (20°)	Triphenylphosphine	(166 8)	636	( 759)
Tetraiodopyrrole	(188 9)	331		Triphenyl phosphite	(183 7)	592	( 701) (18°)
Tetramethyltetotetrahydrofuran	(104 7)	736		Triphenylstibine	(182 2)	516	
Tetranitromethane	43 02	2195	( 360) (20°)	Triphenylstibine dihydroxide	(238 5)	616	
Tetraphenylbutadiene	228 0	( 636)		N,N',N Triphenyl urea	176 5	( 613)	
Tetraphenyldecapentaene	280 8	( 643)		Triquinoyl	(133 0)	426	
Tetraphenylhexatriene	246 4	( 641)		Tropolone	61	50	
Tetraphenyloctatetraene	264 1	( 643)		Tryptophan	132 0	( 646)	
Tetraphenylrubene	344 0	( 646)		Tyrosine	105 3	( 581)	
Tetra-p-tolylmonosilane	276 4	( 704)		Undecane	131 84	( 8435)	( 6247) (20°)
Tetronic acid	(97 8)	688		Urea	33 4	( 556)	( 742) (20°)
Tetrolic acetal	(52 5)	525		Urethan	(57)	64	( 63) (21°)
Thiacoumerin	93 6	577		iso-Valeraldehyde	(57 5)	668	( 536) (17°)
Thazole	50 55	595 (20°)	( 714) (17°)	n Valeric acid	66 85	6548	( 617) (20°)
Thiobarbituric acid	72 9	( 506)		iso-Valeric acid	(67 7)	663	( 621) (15°)
Thiophene	57 38	682 (20°)	( 726) (20°)	Valerylphenylacetylene	(119 0)	639	
Tolane	(118 9)	667	( 644) (100°)	Valine	74 3	( 634)	
Toluene	66 11	7176	6179 (20°)	Violanthrene	273 5	641	
o-Toluidine	76 0	710 (24°)	( 709) (20°)	Violanthrone	204 8	449	
m-Toluidine	74 6	697 (25°)	( 680) (20°)	iso-Violanthrone	215 9	473	
p-Toluidine	72 1	673 (25°)	( 704) (20°)	Water (value usually used as standard)	(13 00)	7218 (20°)	( 7205) (20°)
$\alpha$ -Tolunitrile	76 87	( 656)	( 666) (18°)	Xanthone	(108 1)	551	
1-(o-Tolylazo)-2-naphthol	148 7	( 567)		o-Xylene	77 78	7327	6440 (20°)
1-(p-Tolylazo)-2-naphthol	157 6	( 601)		m-Xylene	76 56	7212	6235 (20°)
Triallylacetonaphone	152 5	( 634)		p-Xylene	76 78	7232	6226 (20°)
Tri iso-amylamine	192	845	( 647) (25°)	Xylose	84 80	565	( 862) (20°)

## FOUR-PLACE LOGARITHMS

N	0 1 2 3 4					5 6 7 8 9					Proportional Parts								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	*4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	*3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7

\* Interpolation in this section of the table is inaccurate.

## FOUR-PLACE LOGARITHMS (Continued)

N	0 1 2 3 4					5 6 7 8 9					Proportional Parts								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4

# PERIODIC TABLE OF THE ELEMENTS

## PERIODIC TABLE OF THE ELEMENTS

*Lanthanides	<b>58</b>	<sup>+3</sup>	<b>59</b>	<sup>+3</sup>	<b>60</b>	<sup>+3</sup>	<b>61</b>	<sup>+3</sup>	<b>62</b>	<sup>+2</sup>	<b>63</b>	<sup>+2</sup>	<b>64</b>	<sup>+3</sup>	<b>65</b>	<sup>+3</sup>	<b>66</b>	<sup>+3</sup>	<b>67</b>	<sup>+3</sup>	<b>68</b>	<sup>+3</sup>	<b>69</b>	<sup>+3</sup>	<b>70</b>	<sup>+2</sup>	<b>71</b>	<sup>+3</sup>
	<b>Ce</b>	<sup>+4</sup>	<b>Pr</b>		<b>Nd</b>		<b>Pm</b>		<b>Sm</b>		<b>Eu</b>		<b>Gd</b>		<b>Tb</b>		<b>Dy</b>		<b>Ho</b>		<b>Er</b>		<b>Tm</b>		<b>Yb</b>	<sup>+3</sup>	<b>Lu</b>	
	140.12 -19-9-2		140.907 -20-9-2		144.24 -22-8-2		(145) -23-8-2		150.35 -24-8-2		151.96 -25-8-2		157.25 -25-9-2		158.924 -26-9-2		162.50 -28-8-2		164.930 -29-8-2		167.26 -30-8-2		168.934 -31-8-2		173.04 -32-8-2		174.97 -32-9-2	
**Actinides	<b>90</b>	<sup>+4</sup>	<b>91</b>	<sup>+5</sup>	<b>92</b>	<sup>+3</sup>	<b>93</b>	<sup>+3</sup>	<b>94</b>	<sup>+3</sup>	<b>95</b>	<sup>+3</sup>	<b>96</b>	<sup>+3</sup>	<b>97</b>	<sup>+3</sup>	<b>98</b>	<sup>+3</sup>	<b>99</b>		<b>100</b>		<b>101</b>		<b>102</b>		<b>103</b>	
	<b>Th</b>		<b>Pa</b>	<sup>+4</sup>	<b>U</b>	<sup>+5</sup>	<b>Np</b>	<sup>+5</sup>	<b>Pu</b>	<sup>+4</sup>	<b>Am</b>	<sup>+5</sup>	<b>Cm</b>		<b>Bk</b>	<sup>+4</sup>	<b>Cf</b>		<b>Es</b>		<b>Fm</b>		<b>Md</b>		<b>Lw</b>			
	232.038 -19-9-2		(231) -20-9-2		238.03 -21-9-2		(237) -22-9-2		(242) -23-9-2		(243) -24-9-2		(247) -25-9-2		(249) -26-9-2		(251) -28-8-2		(254) -29-8-2		(252) -30-8-2		(256) -31-8-2		(254) -32-8-2			

Numbers in parentheses are mass numbers of most stable isotope of that element.

## ATOMIC WEIGHTS

For the sake of completeness all known elements are included in the list. Several of those more recently discovered are represented only by the unstable isotopes. The value in parenthesis in the atomic weight column is, in each case, the mass number of the most stable isotope.\*\*

Name	Symbol	At. No.	International atomic weight		Valence	Name	Symbol	At. No.	International atomic weight		Valence
			1961	1959					1961	1959	
Actinium.....	Ac	89	.....	(227)	.....	Neodymium.....	Nd	60	144.24	144.27	3
Aluminum.....	Al	13	26.9815	26.98	3	Neon.....	Ne	10	20.183	20.183	0
Americium.....	Am	95	.....	(243)	3, 4, 5, 6	Neptunium.....	Np	93	.....	(237)	4, 5, 6
Antimony, stibium.....	Sb	51	121.75	121.76	3, 5	Nickel.....	Ni	28	58.71	58.71	2, 3
Argon.....	Ar	18	39.948	39.944	0	Niobium.....	Nb	41	92.906	92.91	3, 5
Arsenic.....	As	33	74.9216	74.92	3, 5	Nitrogen.....	N	7	14.0067	14.008	3, 5
Astatine.....	At	85	.....	(210)	1, 3, 5, 7	Nobelium.....	No	102	.....	(254)	.....
Barium.....	Ba	56	137.34	137.36	2	Osmium.....	Os	76	190.2	190.2	2, 3, 4, 8
Berkelium.....	Bk	97	.....	(217)	3, 4	Oxygen.....	O	8	15.9994	16.000	2
Beryllium.....	Be	4	9.0122	9.013	2	Palladium.....	Pd	46	106.4	106.4	2, 4, 6
Bismuth.....	Bi	83	208.980	208.99	3, 5	Phosphorus.....	P	15	30.9738	30.975	3, 5
Boron.....	B	5	10.811	10.82	3	Platinum.....	Pt	78	195.09	195.09	2, 4
Bromine.....	Br	35	79.909	79.916	1, 3, 5, 7	Plutonium.....	Pu	94	.....	(244)	3, 4, 5, 6
Cadmium.....	Cd	48	112.40	112.41	2	Polonium.....	Po	84	.....	(209)	.....
Calcium.....	Ca	20	40.08	40.08	2	Potassium.....	K	19	39.102	39.100	1
Californium.....	Cf	98	.....	(251)	.....	Praseodymium.....	Pr	59	140.907	140.92	3
Carbon.....	C	6	12.01115	12.011	2, 4	Promethium.....	Pm	61	.....	(145)	3
Cerium.....	Ce	58	140.12	140.13	3, 4	Protactinium.....	Pa	91	.....	(231)	.....
Cesium.....	Cs	55	132.905	132.91	1	Radium.....	Ra	88	.....	(226)	2
Chlorine.....	Cl	17	35.453	35.457	1, 3, 5, 7	Radon.....	Rn	86	.....	(222)	0
Chromium.....	Cr	24	51.996	52.01	2, 3, 6	Rhenium.....	Re	75	186.2	186.22	.....
Cobalt.....	Co	27	58.9332	58.94	2, 3	Rhodium.....	Rh	45	102.905	102.91	3
Columbium, see Niobium.....						Rubidium.....	Rb	37	85.47	85.48	1
Copper.....	Cu	29	63.54	63.54	1, 2	Ruthenium.....	Ru	44	101.07	101.1	3, 4, 6, 8
Curium.....	Cm	96	.....	(247)	3	Samarium.....	Sm	62	150.35	150.35	2, 3
Dysprosium.....	Dy	66	162.50	162.51	3	Scandium.....	Sc	21	44.956	44.96	3
Einsteinium.....	Es	99	.....	(254)	.....	Selenium.....	Se	34	78.96	78.96	2, 4, 6
Erbium.....	Er	68	167.28	167.27	3	Silicon.....	Si	14	28.086	28.09	4
Europium.....	Eu	63	151.98	152.0	2, 3	Silver, argentum.	Ag	47	107.870	107.873	1
Fermium.....	Fm	100	.....	(257)	.....	Sodium, natrium.	Na	11	22.9898	22.991	1
Fluorine.....	F	9	18.9984	19.00	1	Strontium.....	Sr	38	87.62	87.63	2
Francium.....	Fr	87	.....	(223)	1	Sulfur.....	S	16	32.064	32.066*	2, 4, 6
Gadolinium.....	Gd	64	157.25	157.26	3	Tantalum.....	Ta	73	180.948	180.95	5
Gallium.....	Ga	31	69.72	69.72	2, 3	Technetium.....	Tc	43	.....	(97)	6, 7
Germanium.....	Ge	32	72.59	72.60	4	Tellurium.....	Te	52	127.60	127.61	2, 4, 6
Gold, aurum.....	Au	79	196.987	197.0	1, 3	Terbium.....	Tb	65	158.924	158.93	3
Hafnium.....	Hf	72	178.49	178.50	4	Thallium.....	Tl	81	204.37	204.39	1, 3
Helium.....	He	2	4.0026	4.003	0	Thorium.....	Th	90	232.038	(232)	4
Holmium.....	Ho	67	164.930	164.94	3	Thulium.....	Tm	69	168.934	168.94	3
Hydrogen.....	H	1	1.00797	1.0080	1	Tin, stannum.....	Sn	50	118.69	118.70	2, 4
Indium.....	In	49	114.82	114.82	3	Titanium.....	Ti	22	47.90	47.90	3, 4
Iodine.....	I	53	126.9044	126.91	1, 3, 5, 7	Tungsten.....					
Iridium.....	Ir	77	192.2	192.2	3, 4	(wolfram).....	W	74	183.85	183.86	6
Iron, ferrum.....	Fe	26	55.847	55.85	2, 3	Uranium.....	U	92	238.03	238.07	4, 6
Krypton.....	Kr	36	83.80	83.80	0	Vanadium.....	V	23	50.942	50.95	3, 5
Lanthanum.....	La	57	138.91	138.92	3	Xenon.....	Xe	54	131.30	131.30	0
Lead, plumbum.....	Pb	82	207.19	207.21	2, 4	Ytterbium.....	Yb	70	173.04	173.04	2, 3
Lithium.....	Li	3	6.939	6.940	1	Yttrium.....	Y	39	88.905	88.91	3
Lutetium.....	Lu	71	174.97	174.99	3	Zinc.....	Zn	30	65.37	65.38	2
Magnesium.....	Mg	12	24.312	24.32	2	Zirconium.....	Zr	40	91.22	91.22	4
Manganese.....	Mn	25	54.9380	54.94	2, 3, 4, 6, 7						
Mendelevium.....	101	.....	(256)	.....							
Mercury, hydrargyrum.....	Hg	80	200.59	200.61	1, 2						
Molybdenum.....	Mo	42	95.94	95.95	3, 4, 6						

\* Because of natural variations in the relative abundances of the isotopes of sulfur the atomic weight of this element has a range of  $\pm 0.003$ .

\*\* The 1959 atomic weights are based on O = 16.000 whereas those of 1961 are based on the isotope Cl<sup>37</sup>.

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A	Compound No.	Page No.	Compound No.	Page No.	
Aceanthrenequinone . . . . .	48	184	<i>d, l</i> -N-Acetylalanine . . . . .	240	431
Acenaphthene . . . . .	99	47	3-(Acetylamino) propionic acid . . . . .	381	432
Acenaphthene-1-carbonitrile . . . . .	84	361	2-Acetylalaniline . . . . .	42	436
Acenaphthene-5-carbonitrile . . . . .	155	364	3-Acetylalaniline . . . . .	102	436
Acenaphthene-5-carboxylic acid . . . . .	347	207	4-Acetylalaniline . . . . .	41	436
5,6-Acenaphthenediol . . . . .	497	122	2-Acetylanirole . . . . .	199	167
Acenaphthenequinone . . . . .	44	183	3-Acetylanirole . . . . .	200	167
Acenaphthene-3-sulfonamide . . . . .	309	404	Acetylanthranilamide . . . . .	365	241
Acenaphthene-5-sulfonamide . . . . .	369	406	Acetylanthranilantide . . . . .	332	240
Acenaphthene-5-sulfonanilide . . . . .	224	400	Acetylanthranilic acid . . . . .	293	205
Acenaphthene-3-sulfonic acid . . . . .	144	376	2-Acetylbenzoic acid . . . . .	144	198
Acenaphthene-3-sulfonyl chloride . . . . .	175	386	Acetylbenzoylketone . . . . .	178	167
Acenaphthene-5-sulfonyl chloride . . . . .	172	386	2-Acetyl biphenyl . . . . .	80	170
1-Acenaphthol . . . . .	353	114	3-Acetyl biphenyl . . . . .	94	170
7-Acenaphthenone . . . . .	151	177	4-Acetyl biphenyl . . . . .	152	177
1-Acenaphthoic acid . . . . .	387	209	Acetyl bromide . . . . .	2	218
cis-Acenaphthylene glycol . . . . .	527	124	4-Acetylbutyric acid . . . . .	410	432
Acepleiadene . . . . .	123	48	Acetyl carbinol . . . . .	40	82
Acetaldehyde . . . . .	3	144	3-Acetyl catechol . . . . .	188	106
Acetaldehyde cyanohydrin . . . . .	54	349	" "	123	176
Acetaldehyde trimer . . . . .	34	145	4-Acetyl catechol . . . . .	266	110
Acetamide . . . . .	56	232	" "	148	177
Acetamidine . . . . .	470	439	Acetyl chloride . . . . .	1	212
4-Acetamidobenzene sulfonamide . . . . .	359	406	0-Acetyl citric acid . . . . .	98	429
4-Acetamidobenzene sulfonanilide . . . . .	345	405	1-Acetyl cyclohexene . . . . .	157	166
4-Acetamidobenzene-1-sulfonic acid . . . . .	164	377	1-Acetyl cyclopentene . . . . .	88	170
4-Acetamidobenzenesulfonyl chloride . . . . .	237	388	2-Acetyl <i>p</i> -cymene . . . . .	202	167
4-Acetamidobenzonitrile . . . . .	180	365	2-Acetyl dibenzothiophene . . . . .	144	177
4-Acetamidonaphthalene-1-sulfonamide . . . . .	417	408	Acetyl diethyl carbinol . . . . .	47	162
4-Acetamidonaphthalene-1-sulfonanilide . . . . .	197	399	1-Acetyl 2,2-dimethylcyclohexene . . . . .	82	170
4-Acetamidonaphthalene-1-sulfonic acid . . . . .	192	378	Acetylene . . . . .	1	28
2-Acetamidophenol . . . . .	511	123	Acetylenedicarboxylic acid . . . . .	277	204
3-Acetamidophenol . . . . .	375	115	Acetylenedicarboxylic acid diamide . . . . .	505	246
Acetanilide . . . . .	174	235	9-Acetylfluorene . . . . .	101	175
Acetic acid . . . . .	3	190	Acetyl fluoride . . . . .	1	211
" "	431	432	2-Acetyl furan . . . . .	15	172
Acetic anhydride . . . . .	4	223	3-Acetyl furan . . . . .	33	169
Acetoacetamide . . . . .	15	231	$\beta$ -Acetylglutaric acid . . . . .	49	194
Acetoacetanilide . . . . .	64	232	N-Acetyl glycine . . . . .	233	431
4-Acetobutanoic acid . . . . .	51	191	Acetyl glycyl chloride . . . . .	17	212
$\gamma$ -Acetobutyric acid . . . . .	51	191	8-Acetylguanine . . . . .	39	173
<i>d, l</i> -Acetoin . . . . .	39	82	2-Acetylhydroquinone . . . . .	512	123
" "	54	162	1-Acetyl-2-hydroxynaphthalene . . . . .	83	174
Acetol . . . . .	40	82	2-Acetyl-1-hydroxynaphthalene . . . . .	130	176
Acetone . . . . .	1	161	3-Acetylindazole . . . . .	193	178
Acetone cyanohydrin . . . . .	18	346	N-Acetylindole . . . . .	313	239
Acetone-1,3-dicarboxylic acid . . . . .	189	200	3-Acetylindole . . . . .	195	179
Acetonitrile . . . . .	5	345	Acetyl iodide . . . . .	1	221
Acetonylacetone . . . . .	148	165	0-Acetyl lactic acid . . . . .	48	194
2-Acetophenelide . . . . .	51	232	0-Acetyl lactonitrile . . . . .	46	348
3-Acetophenelide . . . . .	100	233	0-Acetyl lactoyl chloride . . . . .	30	212
4-Acetophenelide . . . . .	242	237	Acetyl methyl carbinol . . . . .	39	82
Acetophenone . . . . .	160	166	1-Acetyl-2-methylcyclohexane . . . . .	155	166
Acetophenone-o-carboxylic acid . . . . .	144	198	<i>d,l</i> -1-Acetyl-3-methylcyclohexanone . . . . .	50	169
Acefо-N-piperidide . . . . .	7	230	1-Acetyl-4-methylcyclohexanone . . . . .	151	166
Acetopyruvic acid . . . . .	117	197	2-Acetyl-5-methylfuran . . . . .	69	170
2-Acetotoluclidide . . . . .	171	235	2-Acetyl-5-methylthiophene . . . . .	89	170
3-Acetotoluclidide . . . . .	31	231	$\alpha$ -Acetyl- $\beta$ -methylurea . . . . .	376	242
4-Acetotoluclidide . . . . .	290	239	1-Acetyl naphthalene . . . . .	215	168
Acetoveratron . . . . .	55	174	2-Acetyl naphthalene . . . . .	57	174
Acetoxyacetic acid . . . . .	62	195	Acetyl naphthionic acid . . . . .	192	378
Acetoxyacetone . . . . .	120	165	1-Acetyl-2-naphthol . . . . .	73	100
$\omega$ -Acetoxyacetophenone . . . . .	60	276	2-Acetyl-1-naphthol . . . . .	196	106
2-Acetoxyethylamine . . . . .	310	438	$\delta$ -Acetyl pentanoic acid . . . . .	23	193
3-Acetoxyphenol . . . . .	29	95	2-Acetylphenanthrene . . . . .	172	178
$\alpha$ -Acetoxypropionic acid . . . . .	48	194	3-Acetylphenanthrene . . . . .	95	175
2-Acetoxypropionitrile . . . . .	46	348	9-Acetylphenanthrene . . . . .	99	175
$\alpha$ -Acetoxypropionyl chloride . . . . .	30	212	N-Acetyl- $\alpha$ -phenetidine . . . . .	51	232
Acetylacetone . . . . .	44	162	2-Acetylphenol . . . . .	10	96

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Compound No.	Page No.	Compound No.	Page No.
3-Acetylphenol . . . . .	180	105	Allylacetic acid . . . . .
" " . . . . .	64	434	Allylacetone . . . . .
4-Acetylphenol . . . . .	223	107	Allylacetyl chloride . . . . .
" " . . . . .	141	176	Allylacetylene . . . . .
" " . . . . .	36	434	Allyl alcohol . . . . .
Acetyl phenyl carbinol . . . . .	74	170	Allylamine . . . . .
Acetyl $\beta$ -phenylhydrazine . . . . .	203	236	N-Allylaniline . . . . .
Acetylphloroglucinol . . . . .	545	125	Allyl benzoate . . . . .
N-Acetylpiiperidine . . . . .	7	230	Allyl bromide . . . . .
$\beta$ -Acetylpropionic Acid . . . . .	16	172	Allyl <i>n</i> -butyrate . . . . .
" " " . . . . .	18	193	Allyl chloride . . . . .
2-Acetylpyridine . . . . .	144	165	Allyl cyanide . . . . .
3-Acetylpyridine . . . . .	84	436	Allylcyclohexane . . . . .
2-Acetylquinoline . . . . .	42	173	4-Allyl-1,2-dimethoxybenzene . . . . .
4-Acetylresorcinol . . . . .	362	115	Allyl ethyl ether . . . . .
5-Acetylresorcinol . . . . .	368	115	Allyl ethyl sulfide . . . . .
Acetylsalicylaldehyde diacetate . . . . .	141	280	Allyl formate . . . . .
Acetyl salicylanilide . . . . .	246	237	Allyl iodide . . . . .
0-Acetysalicylic acid . . . . .	186	200	Allyl isobutyrate . . . . .
" " " . . . . .	400	432	Allylmalonic acid . . . . .
6-Acetyltetralin . . . . .	99	170	Allyl malononitrile . . . . .
3-Acetylthianaphthene . . . . .	102	171	Allyl mercaptan . . . . .
2-Acetylthiophene . . . . .	169	166	2-Allyl-6-methoxyphenol . . . . .
N-Acetyl- <i>m</i> -toluidine . . . . .	31	231	4-Allyl-2-methoxyphenol . . . . .
N-Acetyl- <i>p</i> -toluidine . . . . .	290	239	" " . . . . .
Acetylurea . . . . .	461	244	4-Allyl-1,2-methylenedioxybenzene . . . . .
5-Acetyl- <i>n</i> -valeric acid . . . . .	23	193	Allyl methyl ether . . . . .
cis-Aconitanilide . . . . .	344	240	Allyl methyl sulfide . . . . .
trans-Aconitic acid . . . . .	314	206	1-Allylnaphthalene . . . . .
Aconitic acid dianilide . . . . .	400	242	2-Allylphenol . . . . .
cis-Aconitic acid diamide . . . . .	427	243	4-Allylphenol . . . . .
trans-Aconityl trichloride . . . . .	37	215	Allyl phenyl sulfide . . . . .
Acraldehyde . . . . .	6	144	1-Allylpiperidine . . . . .
Acridine . . . . .	69	324	Allyl propionate . . . . .
" " . . . . .	420	439	Allylsulfide . . . . .
2,3-Acrindiol . . . . .	564	126	2-Allylthiophene . . . . .
2,8-Acrindiol . . . . .	588	127	Allylurea . . . . .
3,7-Acrindiol . . . . .	590	127	D-Altrose . . . . .
Acrolein . . . . .	6	144	L-Altrose . . . . .
Acrylamide . . . . .	62	232	2-Aminoacenaphthene . . . . .
Acrylanilide . . . . .	139	234	3-Aminoacenaphthene . . . . .
Acrylic acid . . . . .	5	190	4-Aminoacenaphthene . . . . .
" " . . . . .	334	431	5-Aminoacenaphthene . . . . .
Acrylonitrile . . . . .	3	345	Aminoacetamide . . . . .
Acrylyl chloride . . . . .	4	212	3-Aminoacetanilide . . . . .
Adamantane . . . . .	80	9	4-Aminoacetanilide . . . . .
Adipic acid . . . . .	232	202	" " . . . . .
" " . . . . .	377	432	Aminoacetonitrile . . . . .
Adipic acid dianilide . . . . .	490	245	" " . . . . .
Adipic acid monoamide . . . . .	204	236	2-Aminoacetophenone . . . . .
Adipic acid monoamidate . . . . .	286	238	" " . . . . .
Adipic aldehyde . . . . .	26	151	" " . . . . .
Adiponitrile . . . . .	104	354	3-Aminoacetophenone . . . . .
Adipyl dichloride . . . . .	34	215	" " . . . . .
$\beta$ -Alanine . . . . .	32	285	" " . . . . .
DL-Alanine . . . . .	103	289	4-Aminoacetophenone . . . . .
" " . . . . .	80	429	" " . . . . .
L-Alanine . . . . .	105	289	" " . . . . .
3-Aldehydobenzoic acid . . . . .	271	204	3-Aminoalizarin . . . . .
Aldol . . . . .	23	150	1-Aminoanthracene . . . . .
Aletheine . . . . .	29	417	1-Amino-9,10-anthraquinone . . . . .
Aleuritic acid . . . . .	121	197	" " . . . . .
Altzarin . . . . .	54	184	2-Amino-9,10-anthraquinone . . . . .
Allene . . . . .	4	12	" " . . . . .
L-(+)-Alloisoleucine . . . . .	128	290	2-Amino-9,10-anthraquinone-1-carboxylic acid . . . . .
Allomucic acid . . . . .	274	204	4-Aminoantipyrine . . . . .
$\beta$ -D-Allose . . . . .	19	330	2-Aminoazobenzene . . . . .
$\beta$ -L-Allose . . . . .	20	330	4-Aminoazobenzene . . . . .
DL-Allothreonine . . . . .	65	287	4-Aminobenzalacetophenone . . . . .
Alloxanic acid . . . . .	249	203	2-Aminobenzaldehyde . . . . .
Allyl acetate . . . . .	32	251	4-Aminobenzaldehyde . . . . .

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2-Aminobenzamide .....	224	309	DL- $\alpha$ -Aminobutyric acid .....	115	290
3-Aminobenzamide .....	167	235	" " "	72	429
4-Aminobenzamide .....	173	235	L-(+)- $\alpha$ -Aminobutyric acid .....	100	289
" .....	395	315	DL- $\beta$ -Aminobutyric acid .....	29	285
3-Aminobenzoilide .....	254	237	$\gamma$ -Aminobutyric acid .....	35	285
4-Aminobenzene-1,3-disulfonamide .....	398	407	" " .....	289	431
4-Aminobenzene-1,3-disulfonic acid .....	181	377	4-Aminobutyrophenone .....	143	307
2-Aminobenzene sulfonamide .....	136	397	3-Aminocamphor .....	228	310
3-Aminobenzene sulfonamide .....	102	395	$\gamma$ -Amino-n-caproic acid .....	37	285
4-Aminobenzene sulfonamide .....	178	398	w-Amino-n-caproic acid .....	34	285
4-Aminobenzene sulfonanilide .....	311	404	3-Aminocarbazole .....	460	318
2-Aminobenzene sulfonic acid .....	54	372	4-Aminochalcone .....	337	313
3-Aminobenzene sulfonic acid .....	37	372	1-Amino-4-chloroanthraquinone .....	392	315
4-Aminobenzene sulfonic acid .....	70	373	1-Amino-5-chloroanthraquinone .....	443	317
4-Aminobenzhydrol .....	260	311	4-Amino-2-chlorobenzaldehyde .....	329	313
2-Aminobenzoic acid .....	9	284	2-Amino-5-chloro-p-cresol .....	213	107
3-Aminobenzoic acid .....	15	284	2-Amino-6-chloro-p-cresol .....	157	104
" "	149	430	4-Amino-6-chloro-m-cresol .....	551	125
4-Aminobenzoic acid .....	26	285	6-Amino-4-chloro-o-cresol .....	218	107
" "	94	429	2-Amino-4-chloro-N,N-dimethylaniline .....	178	300
2-Aminobenzonitrile .....	58	359	2-Amino-5-chloro-4-methylphenol .....	213	107
3-Aminobenzonitrile .....	61	359	2-Amino-6-chloro-4-methylphenol .....	157	104
4-Aminobenzonitrile .....	150	307	4-Amino-6-chloro-3-methylphenol .....	551	125
" "	111	362	6-Amino-4-chloro-2-methylphenol .....	218	107
2-Aminobenzophenone .....	135	176	1-Amino-2-chloronaphthalene .....	72	305
" "	209	309	1-Amino-3-chloronaphthalene .....	80	305
4-Aminobenzophenone .....	155	177	" "	65	436
" "	272	311	1-Amino-4-chloronaphthalene .....	190	308
" "	40	436	1-Amino-5-chloronaphthalene .....	91	436
3-Aminobenzopyrazole .....	345	314	1-Amino-6-chloronaphthalene .....	97	436
6-Aminobenzopyrazole .....	433	317	1-Amino-7-chloronaphthalene .....	96	436
2-Aminobenzothiazole .....	297	312	2-Amino-1-chloronaphthalene .....	70	305
2-Aminobenzyl alcohol .....	136	307	2-Amino-4-chloronaphthalene .....	92	436
3-Aminobenzyl alcohol .....	186	308	2-Amino-7-chloronaphthalene .....	110	436
4-Aminobenzyl alcohol .....	92	305	2-Amino-4-chloro-5-nitrophenol .....	554	126
DL- $\alpha$ -Aminobenzyl cyanide .....	63	304	2-Amino-4-chloro-6-nitrophenol .....	382	115
$\alpha$ -Aminobenzyl cyanide .....	65	360	4-Amino-2-chloro-3-nitrophenol .....	434	118
2-Aminobenzyl cyanide .....	91	361	4-Amino-2-chloro-5-nitrophenol .....	445	119
4-Aminobenzyl cyanide .....	36	304	2-Amino-3-chlorophenol .....	278	110
" " " "	42	358	2-Amino-4-chlorophenol .....	334	113
2-Aminobiphenyl .....	46	304	2-Amino-5-chlorophenol .....	387	116
" " "	113	436	4-Amino-2-chlorophenol .....	385	116
3-Aminobiphenyl .....	142	437	4-Amino-3-chlorophenol .....	402	117
4-Aminobiphenyl .....	60	304	2-Amino-4-chloropyridine .....	294	312
" " "	140	437	8-Amino-6-chloroquinoline .....	113	306
1-Amino-3-bromoanthraquinone .....	455	317	trans-2-Aminocinnamic acid .....	12	284
2-Amino-3-bromoanthraquinone .....	473	318	trans-3-Aminocinnamic acid .....	20	285
2-Amino-4-bromobenzaldehyde .....	146	307	trans-4-Aminocinnamic acid .....	16	284
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4-Amino-3-nitrophenol .....	390	116	6-Amino- $\alpha$ -picoline .....	28	303
5-Amino-2-nitrophenol .....	414	117	1-Amino-2-propanethiol .....	20	416
5-Amino-3-nitrophenol .....	427	118	3-Amino-1-propanethiol .....	36	417
3-Amino-4'-nitrophenyl sulfide .....	57	426	2-(3-Aminopropionamido)ethanethiol .....	29	417
4-Amino-3-nitropyridine .....	418	316	3-Aminopropionic acid .....	212	430
2-Amino-8-nitroquinoline .....	355	314	2-Aminopropiophenone .....	46	173
6-Amino-5-nitroquinoline .....	388	315	" .....	37	304
8-Amino-6-nitroquinoline .....	411	316	3-Aminopropiophenone .....	34	173
2-Amino-4-nitroresorcinol .....	473	121	4-Aminopropiophenone .....	170	178
4-Amino-6-nitrosorcinol .....	405	117	" .....	315	312
2-Amino-4-nitrostilbene .....	320	313	$\beta$ -Aminopropiophenone .....	233	310
4-Amino-2-nitrostilbene .....	227	310	2-Aminopropyl alcohol .....	73	297
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2-Aminoocadane .....	401	439	3-Aminopropyl methyl sulfide .....	36	421
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5-Aminoquinaldine . . . . .	246	310	4-Amino- <i>o</i> -xylene . . . . .	43	304
2-Aminoquinizarin . . . . .	474	318	<i>n</i> -Amyl acetate . . . . .	94	254
5-Aminoquinizarin . . . . .	437	317	<i>sec</i> .-Amyl(2) acetate . . . . .	65	252
$\gamma$ -Aminoquinoline . . . . .	344	314	<i>sec</i> .-Amyl(3) acetate . . . . .	64	252
2-Aminoquinoline . . . . .	289	312	<i>tert</i> .-Amyl acetate . . . . .	50	252
" . . . . .	276	438	<i>active</i> - <i>e</i> -Amylactic acid . . . . .	42	191
3-Aminoquinoline . . . . .	173	308	<i>active</i> -Amyl alcohol . . . . .	23	81
" . . . . .	185	437	<i>n</i> -Amyl alcohol . . . . .	32	81
4-Aminoquinoline . . . . .	344	314	<i>sec</i> -Amyl alcohol . . . . .	15	80
" . . . . .	312	438	<i>sym-sec</i> -Amyl alcohol . . . . .	13	80
5-Aminoquinoline . . . . .	226	310	<i>tert</i> -Amyl alcohol . . . . .	8	80
" . . . . .	217	437	<i>active</i> -Amylamine . . . . .	29	296
6-Aminoquinoline . . . . .	238	310	<i>n</i> -Amylamine . . . . .	32	296
" . . . . .	223	437	<i>sec-n</i> -Amylamine . . . . .	27	295
7-Aminoquinoline . . . . .	171	308	<i>n</i> -Amyl bromide . . . . .	17	58
" . . . . .	267	438	<i>tert</i> -Amyl bromide . . . . .	12	58
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" " "	114	430	<i>n</i> -Amyl- <i>n</i> -enanthate . . . . .	277	265
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3-Aminostyrene . . . . .	1	302	<i>n</i> -Amyl ethyl ether . . . . .	43	133
4-Aminostyrene . . . . .	2	303	<i>tert</i> -Amyl ethyl ether . . . . .	35	132
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2-Amino-1,2,3,4-tetrahydronaphthalene . . . . .	354	438	<i>n</i> -Amyl iodide . . . . .	15	60
1-Amino-5,6,7,8-tetrahydronaphthalene . . . . .	175	300	<i>tert</i> -Amyl iodide . . . . .	10	60
" " " "	157	437	<i>n</i> -Amyl levulinate . . . . .	292	266
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Bromoethyl sulfide.....	8	425	4-Bromo-2-methylbenzoic acid .....	298	205
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5-Bromofuran-2-carboxylic acid .....	295	205	2-Bromo-4-methyl-5-nitrobenzoic acid.....	324	206
2-Bromohexane .....	19	58	4-Bromo-2-methyl-6-nitrobenzoic acid.....	352	208
6-Bromo-2-hexanone .....	171	166	6-Bromo-4-methyl-1,2-nitrobenzoic acid .....	330	207
6-Bromo- <i>n</i> -hexylamine .....	407	439	2-Bromo-4-methyl-1,3-nitrophenol .....	115	102
Bromohydroquinone .....	228	108	2-Bromo-4-methyl-5-nitrophenol .....	203	106
3-Bromo-4-hydroxyaniline .....	370	315	2-Bromo-4-methyl-6-nitrophenol .....	90	101
4-Bromo-3-hydroxyaniline .....	335	313	6-Bromo-2-methyl-4-nitrophenol .....	270	110
5-Bromo-2-hydroxyaniline .....	283	311	3-Bromo-2-methylbenzoic acid .....	190	430
3-Bromo-2-hydroxybenzoic acid .....	289	204	6-Bromo-2-methylbenzoic acid .....	69	429
5-Bromo-2-hydroxybenzoic acid .....	255	203	2-Bromo-4-methylphenol .....	54	99
3-Bromo-2-hydroxybenzonitrile .....	50	359	3-Bromo-4-methylphenol .....	50	99
5-Bromo-2-hydroxybenzonitrile .....	202	366	4-Bromo-2-methylphenol .....	72	100
3-Bromo-4-hydroxybiphenyl .....	174	105	4-Bromo-3-methylphenol .....	71	100
3-Bromo-2-hydroxy-5-methylaniline .....	165	308	5-Bromo-2-methylphenol .....	124	103
5-Bromo-2-hydroxy-3-methylaniline .....	236	310	5-Bromo-3-methylphenol .....	55	99
5-Bromo-2-hydroxy-4-methylaniline .....	243	310	6-Bromo-2-methylquinoline .....	62	324
5-Bromo-4-hydroxy-2-methylaniline .....	439	317	1-Bromo-2-naphthaldehyde .....	105	159
5-Bromo-2-hydroxy-3-methylbenzoic acid .....	366	208	1-Bromonaphthalene .....	16	73
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5-Bromo-2-hydroxy-3-toluic acid .....	366	208	3-Bromo-1,2-naphthalenediol .....	253	109
$\alpha$ -Bromoisobutanoic acid .....	36	194	4-Bromo-1,5-naphthalenediol .....	250	109
2-Bromoisobutyraldehyde .....	28	145	1-Bromonaphthalene-2-sulfonamide .....	451	409
$\alpha$ -Bromoisobutyramide .....	277	238	2-Bromonaphthalene-1-sulfonamide .....	98	395
$\alpha$ -Bromoisobutyranilide .....	59	232	4-Bromonaphthalene-1-sulfonamide .....	295	403
$\alpha$ -Bromoisobutyric acid .....	36	194	5-Bromonaphthalene-1-sulfonamide .....	393	407
$\alpha$ -Bromoisobutyric anhydride .....	23	225	5-Bromonaphthalene-2-sulfonamide .....	360	406
2-Bromoisobutyrone .....	27	347	6-Bromonaphthalene-1-sulfonamide .....	353	405
$\alpha$ -Bromoisobutyryl bromide .....	10	218	6-Bromonaphthalene-2-sulfonamide .....	334	405
$\alpha$ -Bromoisobutyryl chloride .....	21	214	7-Bromonaphthalene-1-sulfonamide .....	335	405
1-Bromo-2-isopropylbenzene .....	7	73	7-Bromonaphthalene-2-sulfonamide .....	355	405
1-Bromo-4-isopropylbenzene .....	11	73	8-Bromonaphthalene-2-sulfonamide .....	262	402
4-Bromo-5-isopropyl-2-methylphenol .....	37	98	2-Bromonaphthalene-1-sulfonic acid .....	35	372
4-Bromoisoquinoline .....	14	323	4-Bromonaphthalene-1-sulfonic acid .....	140	376
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$\alpha$ -Bromoisovaleramide .....	237	237	2-Bromonaphthalene-1-sulfonyle chloride .....	140	385
$\alpha$ -Bromoisovaleranilide .....	181	235	4-Bromonaphthalene-1-sulfonyle chloride .....	111	384
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DL- $\alpha$ -Bromoisovaleryl chloride .....	19	214	6-Bromonaphthalene-1-sulfonyle chloride .....	90	383
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Bromomalononitrile .....	77	360	7-Bromonaphthalene-2-sulfonyle chloride .....	151	385
3-Bromomandelic acid .....	183	430	8-Bromonaphthalene-2-sulfonyle chloride .....	186	387
2-Bromo-6-methoxyaniline .....	93	305	5-Bromo-1-naphthoic acid .....	390	209
3-Bromo-4-methoxyaniline .....	87	305	7-Bromo-1-naphthoic acid .....	369	208
" "	131	437	8-Bromo-1-naphthoic acid .....	275	204
5-Bromo-2-methoxyaniline .....	187	308	1-Bromo-2-naphthol .....	141	103
2-Bromo-4-methylaniline .....	154	300	3-Bromo-2-naphthol .....	142	103
3-Bromo-2-methylaniline .....	169	300	4-Bromo-1-naphthol .....	305	112
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5-Bromo-1-naphthonitrile.....	194	365	(4-Bromophenyl)acetonitrile.....	45	359
1-Bromo-2-naphthylamine.....	83	305	2-Bromo- <i>p</i> -phenylenediamine.....	122	306
3-Bromo-1-naphthylamine.....	107	306	2-Bromophenyl ethyl ketone.....	57	170
4-Bromo-1-naphthylamine.....	197	309	4-Bromophenylhydrazine.....	212	309
5-Bromo-2-naphthylamine.....	23	303	4-Bromophenyl methyl sulfide.....	11	425
6-Bromo-2-naphthylamine.....	282	311	4-Bromophenyl sulfide.....	63	426
2-Bromo-4-nitroacetanilide.....	219	236	3-Bromophthalic acid.....	304	205
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4-Bromo-2-nitroaniline.....	229	310	4-Bromophthalic anhydride.....	49	226
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4-Bromo-3-nitrobenzenesulfonic acid.....	94	374	<i>d,l</i> - $\alpha$ -Bromopropionic acid.....	6	193
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2-Bromo-6-nitrobenzoic acid.....	13	429	$\beta$ -Bromopropionic acid.....	57	195
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2-Bromo-4-nitrophenol.....	241	108	3-Bromopyridine.....	39	319
2-Bromo-5-nitrophenol.....	262	109	4-Bromopyridine.....	73	436
2-Bromo-6-nitrophenol.....	83	100	4-Bromopyridine.....	10	322
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5-Bromo-2-nitrophenol.....	32	98	6-Bromopyralidine.....	295	205
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4-Bromo-3-nitrotoluene.....	7	337	6-Bromoquinizarin.....	46	184
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5-Bromo-3-nitro-2-toluenoic acid.....	352	208	2-Bromoquinoline.....	25	323
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5-Bromo-3-nitro-2-tolunitrile.....	147	363	4-Bromoquinoline.....	64	436
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5-Bromo- <i>n</i> -pentylamine.....	337	438	5-Bromoquinoline.....	24	323
3-Bromophenacyl bromide.....	53	173	6-Bromoquinoline.....	108	436
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2-Bromo-9,10-phenanthraquinone.....	37	183	$\alpha$ -Bromoquinoline.....	111	321
3-Bromo-9,10-phenanthraquinone.....	47	184	$\beta$ -Bromoquinoline.....	25	323
4-Bromo- <i>o</i> -phenetidine.....	65	304	$\gamma$ -Bromoquinoline.....	103	321
2-Bromo- <i>p</i> -phenetidine.....	38	304	3-Bromosalicylic acid.....	4	323
3-Bromo- <i>p</i> -phenetidine.....	2	302	5-Bromosalicylic acid.....	289	204
2-Bromophenetole.....	90	135	$\beta$ -Bromostyrene.....	255	203
4-Bromophenetole.....	97	135	$\alpha$ -Bromostyrene.....	28	58
2-Bromophenol.....	2	94	<i>p</i> -Bromostyrene.....	6	73
".....	44	434	Bromosuccinic acid.....	8	73
3-Bromophenol.....	14	96	Bromoterephthalic acid.....	112	430
".....	62	434	4-Bromothiophenol.....	403	210
4-Bromophenol.....	74	100	2-Bromotoluene.....	21	416
".....	69	434	3-Bromotoluene.....	2	73
(2-Bromophenoxy)acetic acid.....	214	201	4-Bromotoluene.....	3	73
" " "	157	430	3-Bromo-4-toluenoic acid.....	1	74
(3-Bromophenoxy)acetic acid.....	155	430	3-Bromo-4-toluenoic acid.....	205	201
(4-Bromophenoxy)acetic acid.....	233	202	5-Bromo-2-toluenoic acid.....	298	205
" " "	159	430	5-Bromo- <i>m</i> -toluidine.....	16	303
<i>d,l</i> - $\alpha$ -Bromophenylacetic acid.....	91	196	6-Bromo- <i>m</i> -toluidine.....	132	307
(2-Bromophenyl)acetic acid.....	122	198	4-Bromo- <i>o</i> -toluidine.....	8	303
" " "	294	431	5-Bromo- <i>o</i> -toluidine.....	69	304
(4-Bromophenyl)acetic acid.....	143	198	6-Bromo- <i>o</i> -toluidine.....	169	300

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3-Bromo- <i>p</i> -toluidine . . . . .	154	300	" " . . . . .	412	439
$\alpha$ -Bromo-2-tolunitrile . . . . .	89	361	Di- <i>n</i> -butylamine . . . . .	65	297
$\alpha$ -Bromo-3-tolunitrile . . . . .	122	362	DL- <i>sec-n</i> -Butylamine . . . . .	13	295
$\alpha$ -Bromo-4-tolunitrile . . . . .	160	364	<i>tert</i> -Butylamine . . . . .	6	295
2-Bromo-4-tolunitrile . . . . .	38	358	" " . . . . .	427	439
3-Bromo-4-tolunitrile . . . . .	44	359	( <i>tert</i> -Butylamino)cyclohexane . . . . .	463	439
5-Bromo-2-tolunitrile . . . . .	88	361	2-(Butylamino)ethylamine . . . . .	381	439
1-Bromo-2-vinylbenzene . . . . .	6	73	<i>N-n</i> -Butylaniline . . . . .	159	300
1-Bromo-4-vinylbenzene . . . . .	8	73	..... . . . . .	198	437
5-Bromo- <i>m</i> -4-xylylidine . . . . .	48	304	2- <i>n</i> -Butylaniline . . . . .	4	302
1,2-Butadiene . . . . .	11	12	4- <i>n</i> -Butylaniline . . . . .	174	300
1,3-Butadiene . . . . .	7	12	<i>N-tert</i> -Butylaniline . . . . .	273	438
1,3-Butadiyne . . . . .	4	28	2- <i>tert</i> -Butylaniline . . . . .	147	299
Butanal . . . . .	11	144	" " . . . . .	192	437
<i>n</i> -Butane . . . . .	6	3	3- <i>tert</i> -Butylaniline . . . . .	171	437
Butanediol . . . . .	59	147	4- <i>tert</i> -Butylaniline . . . . .	139	299
Butane-1,4-dicarboxylic acid . . . . .	232	202	" " . . . . .	187	437
Butanedioic acid . . . . .	294	205	<i>N-n</i> -Butylaziridine . . . . .	287	438
<i>d,l</i> -1,3-Butanediol . . . . .	105	85	<i>n</i> -Butylbenzene . . . . .	26	36
1,4-Butanediol . . . . .	119	86	<i>sec</i> -Butylbenzene . . . . .	16	35
2,3-Butanediol . . . . .	83	84	<i>tert</i> -Butylbenzene . . . . .	13	35
2,3-Butanedione . . . . .	5	161	<i>n</i> -Butyl benzoate . . . . .	288	266
1,4-Butanedithiol . . . . .	34	414	2- <i>tert</i> -Butylbenzoic acid . . . . .	211	430
Butane-1-sulfonamide . . . . .	5	392	4- <i>tert</i> -Butylbenzoic acid . . . . .	368	432
Butane-1,2,3,4-tetracarboxylic acid (low melting form) . . . . .	306	205	<i>n</i> -Butyl bromide . . . . .	11	58
Butane-1,2,3,4-tetracarboxylic acid (high melting form) . . . . .	368	208	<i>sec</i> -Butyl bromide . . . . .	10	58
1-Butanethiol . . . . .	9	413	<i>tert</i> -Butyl bromide . . . . .	8	58
2-Butanethiol . . . . .	6	413	<i>n</i> -Butyl <i>tert</i> -butyl ketone . . . . .	100	164
Butane-1,1,4-tricarboxylic acid . . . . .	202	201	<i>n</i> -Butyl <i>n</i> -butyrate . . . . .	115	255
<i>n</i> -Butanoic acid . . . . .	10	190	<i>tert</i> -Butyl <i>n</i> -butyrate . . . . .	84	253
" " . . . . .	441	432	<i>n</i> -Butyl <i>n</i> -caproate . . . . .	185	259
1-Butanol . . . . .	14	80	<i>n</i> -Butyl <i>n</i> -caprylate . . . . .	275	265
2-Butanol . . . . .	7	80	<i>n</i> -Butyl carbamate . . . . .	13	231
2-Butanone . . . . .	3	161	<i>d-sec</i> -Butyl carbinol . . . . .	23	81
2-Butenal . . . . .	22	145	<i>tert</i> -Butyl carbinol . . . . .	28	89
1-Butene . . . . .	6	12	<i>n</i> -Butyl carbonate . . . . .	184	259
<i>cis</i> -2-Butene . . . . .	10	12	<i>n</i> -Butyl cellosolve . . . . .	60	134
<i>trans</i> -2-Butene . . . . .	8	8	Butyl cellosolve benzoate . . . . .	4	272
<i>cis</i> -Butenedioic acid . . . . .	175	200	<i>n</i> -Butyl chloral . . . . .	58	147
<i>trans</i> -Butenedioic acid . . . . .	399	209	<i>n</i> -Butyl chloride . . . . .	13	55
<i>cis</i> -2-Butenoic acid . . . . .	13	190	<i>sec</i> -Butyl chloride . . . . .	10	55
<i>trans</i> -2-Butenoic acid . . . . .	71	195	<i>tert</i> -Butyl chloride . . . . .	8	55
3-Butenoic acid . . . . .	12	190	<i>n</i> -Butyl chloroacetate . . . . .	129	256
3-Buten-1-ol . . . . .	11	80	<i>n</i> -Butyl chloroformate . . . . .	80	253
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3-Buten-2-one . . . . .	2	161	6- <i>tert</i> -Butyl- <i>m</i> -cresol . . . . .	38	98
<i>n</i> -Butoxybenzene . . . . .	82	135	<i>tert</i> -Butyl cyanide . . . . .	10	345
2-Butoxybenzoic acid . . . . .	332	431	Butyl cyanoacetate . . . . .	6	355
2- <i>n</i> -Butoxyethanol . . . . .	61	83	<i>n</i> -Butylcyclohexane . . . . .	243	7
2- <i>sec</i> -Butoxyethanol . . . . .	52	82	<i>n</i> -Butyl cyclooctatetraene . . . . .	3	25
2-(2- <i>n</i> -Butoxyethoxy)ethanol . . . . .	118	86	<i>n</i> -Butylcyclopentane . . . . .	164	5
$\beta$ - <i>n</i> -Butoxyethyl benzoate . . . . .	4	272	<i>n</i> -Butyl dimethyl amine . . . . .	375	439
2-Butoxytoluene . . . . .	93	135	<i>tert</i> -Butyl dimethyl amine . . . . .	428	439
<i>tert</i> -Butylacetaldehyde . . . . .	21	145	4- <i>tert</i> -Butyl-1,3-dimethylbenzene . . . . .	94	38
4- <i>n</i> -Butylacetanilide . . . . .	138	234	<i>n</i> -Butyl <i>n</i> -enanthate . . . . .	227	262
<i>n</i> -Butyl acetate . . . . .	54	252	<i>d,l</i> -1,3-Butylene glycol . . . . .	105	85
<i>sec</i> -Butyl acetate . . . . .	40	251	2,3-Butylene glycol . . . . .	83	84
<i>tert</i> -Butyl acetate . . . . .	22	250	$\alpha$ -Butylene oxide . . . . .	13	131
<i>tert</i> -Butylacetic acid . . . . .	17	190	<i>n</i> -Butyl ether . . . . .	54	133
<i>tert</i> -Butylacetone . . . . .	21	358	Butyl ethyl acetylene . . . . .	44	29
4- <i>n</i> -Butylacetophenone . . . . .	62	170	1- <i>tert</i> -Butyl-4-ethylbenzene . . . . .	97	39
<i>n</i> -Butyl acetylene . . . . .	17	28	<i>n</i> -Butyl ethyl ether . . . . .	31	132
<i>sec</i> -Butyl acetylene . . . . .	16	28	<i>sec</i> -Butyl ethyl ether . . . . .	24	132
<i>tert</i> -Butyl acetylene . . . . .	8	28	<i>tert</i> -Butyl ethyl ether . . . . .	20	132
<i>n</i> -Butyl alcohol . . . . .	14	80	<i>n</i> -Butyl ethyl ketone . . . . .	64	163
<i>d,l</i> - <i>sec</i> -Butyl alcohol . . . . .	7	80	<i>sec</i> -Butyl ethyl ketone . . . . .	35	162
<i>tert</i> -Butyl alcohol . . . . .	7	88	<i>tert</i> -Butyl ethyl ketone . . . . .	23	161
<i>n</i> -Butylallene . . . . .	135	16	<i>n</i> -Butyl ethyl sulfide . . . . .	27	420
<i>tert</i> -Butylallene . . . . .	77	14	<i>sec</i> -Butyl ethyl sulfide . . . . .	21	420
			<i>n</i> -Butyl formate . . . . .	35	251
			<i>sec</i> -Butyl formate . . . . .	21	250

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<i>n</i> -Butyl <i>n</i> -heptanoate.....	227	262	4- <i>tert</i> -Butylphenol.....	192	106
<i>n</i> -Butyl <i>n</i> -hexanoate.....	185	259	<i>n</i> -Butyl phenylacetate.....	293	266
<i>n</i> -Butyl 2-hydroxybenzoate.....	27	95	(4- <i>tert</i> -Butylphenyl) acetic acid.....	374	432
<i>n</i> -Butyl 4-hydroxybenzoate.....	47	434	<i>n</i> -Butyl phenyl ether.....	82	135
<i>n</i> -Butyl iodide.....	11	60	<i>n</i> -Butyl phenyl ketone.....	207	168
<i>sec</i> -Butyl iodide.....	8	60	<i>tert</i> -Butyl phenyl ketone.....	181	167
<i>tert</i> -Butyl iodide.....	7	60	<i>n</i> -Butyl phthalate.....	355	271
<i>n</i> -Butyl isobutyl ketone.....	102	164	1- <i>n</i> -Butylpiperidine.....	392	439
<i>sec</i> -Butyl isobutyl ketone.....	103	175	<i>tert</i> -Butylpropionic acid.....	37	194
<i>tert</i> -Butyl isobutyl ketone.....	85	163	<i>n</i> -Butyl propionate.....	88	254
<i>tert</i> -Butyl isobutyrate.....	56	252	<i>n</i> -Butyl propyl acetylene.....	46	29
3- <i>tert</i> -Butyl-1-isopropylbenzene.....	118	39	<i>n</i> -Butyl <i>n</i> -propyl ketone.....	107	164
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<i>n</i> -Butyl isopropyl ether.....	40	133	2- <i>tert</i> -Butylpyridine.....	233	437
<i>sec</i> -Butyl isopropyl ketone.....	53	162	3- <i>tert</i> -Butylpyridine.....	236	437
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<i>sec</i> -Butylmalonic acid.....	76	196	<i>n</i> -Butyl sulfide.....	41	421
<i>n</i> -Butyl mercaptan.....	9	413	<i>tert</i> -Butyl sulfide.....	29	420
<i>sec</i> -Butyl mercaptan.....	6	413	2- <i>n</i> -Butylthiophene.....	46	424
<i>tert</i> -Butyl mercaptan.....	4	413	3- <i>n</i> -Butylthiophene.....	48	424
<i>n</i> -Butyl methoxymethyl ketone.....	106	164	2- <i>tert</i> -Butylthiophene.....	39	424
<i>sec</i> -Butyl methoxymethyl ketone.....	95	164	3- <i>tert</i> -Butylthiophene.....	40	424
<i>tert</i> -Butyl methoxymethyl ketone.....	87	163	2-Butyltoluene.....	67	38
<i>n</i> -Butyl methylacetic acid.....	37	191	3-Butyltoluene.....	79	38
<i>n</i> -Butyl methyl acetylene.....	39	29	4-Butyltoluene.....	86	38
<i>tert</i> -Butyl methyl acetylene.....	23	29	2- <i>sec</i> -Butyltoluene.....	54	37
<i>n</i> -Butyl methyl amine.....	25	295	3- <i>sec</i> -Butyltoluene.....	48	37
DL- <i>sec</i> -Butyl methyl amine.....	19	295	4- <i>sec</i> -Butyltoluene.....	64	37
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3-Butyl-1-methylbenzene.....	79	38	3- <i>tert</i> -Butyltoluene.....	38	36
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2- <i>sec</i> -Butyl-1-methylbenzene.....	54	37	<i>n</i> -Butyl 2-tolyl ether.....	93	135
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<i>n</i> -Butyl methyl ether.....	19	132	<i>n</i> -Butyraldehyde.....	11	144
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3-Chlorobenzoic anhydride . . . . .	39	225	4-Chloro-3,5-dibromophenol . . . . .	275	110
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Di-4-aminobenzyl sulfide .....	59	426	2,4-Diaminophenol .....	120	102
2,2'-Diaminobiphenyl .....	134	307	" "	130	306
2,4'-Diaminobiphenyl .....	33	303	3,4-Diaminophenol .....	450	119
3,4-Diaminobiphenyl .....	199	309	" "	374	315
1,3-Diaminobutane .....	54	296	3,5-Diaminophenol .....	442	119
1,4-Diaminobutane .....	66	297	Di-(2-aminophenyl) sulfide .....	52	426
" "	437	439	Di-(4-aminophenyl) sulfide .....	60	426
d,l-2,3-Diaminobutane .....	360	438	1,2-Diaminopropane .....	361	438
meso-2,3-Diaminobutane .....	359	438	D,L-1,2-Diaminopropane .....	42	296
2,7-Diaminocarbazole .....	461	318	1,3-Diaminopropane .....	50	296
cis-1,2-Diaminocyclohexane .....	353	438	" "	382	439
trans-1,2-Diaminocyclohexane .....	357	438	2,4-Diaminopyridine .....	214	309
1,2-Diaminocyclohexane .....	84	297	2,5-Diaminopyridine .....	217	309
2,2'-Diaminodibenzyl .....	104	306	2,6-Diaminopyridine .....	258	311
2,2'-Diaminodibenzyl disulfide .....	159	307	3,4-Diaminopyridine .....	442	317
2,2'-Diaminodibenzyl sulfide .....	133	307	5,8-Diaminoquinizarin .....	57	184
4,4'-Diaminodibenzyl sulfide .....	203	309	" "	471	318
2,2'-Diaminodimethyl sulfide .....	145	299	cis-2,2'-Diaminostilbene .....	269	311
1,4-Diamino-5,8-dihydroxy-9,10-antraquinone....	57	184	trans-2,2'-Diaminostilbene .....	387	315

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trans-4,4'-Diaminostilbene . . . . .	451	317	" " . . . . .	48	136
DL-2,3-Diaminosuccinic acid . . . . .	126	290	1,2-Dibromobenzene . . . . .	12	73
meso-2,3-Diaminosuccinic acid . . . . .	119	290	1,3-Dibromobenzene . . . . .	10	73
4,4'-Diamino-2,5,2',5'-tetramethyltrifluoromethane . . . . .	434	317	1,4-Dibromobenzene . . . . .	5	74
2,4-Diaminotoluene . . . . .	194	308	2,4-Dibromobenzenesulfonamide . . . . .	271	402
2,5-Diaminotoluene . . . . .	88	305	2,5-Dibromobenzenesulfonamide . . . . .	297	403
3,4-Diaminotoluene . . . . .	157	307	3,4-Dibromobenzenesulfonamide . . . . .	212	399
4,4'-Diaminotriphenylcarbinol . . . . .	375	315	2,4-Dibromobenzenesulfonic acid . . . . .	130	375
3,4-Diaminotriphenylmethane . . . . .	111	306	2,5-Dibromobenzene sulfonic acid . . . . .	141	376
$\alpha, \alpha'$ -Diamino- <i>m</i> -xylene . . . . .	161	300	3,4-Dibromobenzenesulfonic acid . . . . .	90	374
2,4-Diamino- <i>m</i> -xylene . . . . .	94	305	2,4-Dibromobenzenesulfonyl chloride . . . . .	93	383
4,6-Diamino- <i>m</i> -xylene . . . . .	205	309	2,5-Dibromobenzenesulfonyl chloride . . . . .	81	383
Di- <i>n</i> -amylamine . . . . .	97	298	3,4-Dibromobenzenesulfonyl chloride . . . . .	16	381
Di- <i>n</i> -amyl ether . . . . .	72	134	2,4-Dibromobenzoic acid . . . . .	270	204
Di- <i>n</i> -amyl ketone . . . . .	183	167	2,4-Dibromobenzonitrile . . . . .	119	362
2,5-Dianilino-1,4-benzoquinone . . . . .	477	318	2,5-Dibromobenzonitrile . . . . .	176	365
Dianisalacetone . . . . .	160	177	2,6-Dibromobenzonitrile . . . . .	198	366
Dianisidine . . . . .	309	312	3,5-Dibromobenzonitrile . . . . .	130	363
9,9'-Dianthranyl-10,10'-quinone . . . . .	58	184	2,4'-Dibromobenzophenone . . . . .	77	174
Dianthraquinone . . . . .	58	184	3,3'-Dibromobenzophenone . . . . .	171	178
Dibenzalacetone . . . . .	145	177	4,4'-Dibromobenzophenone . . . . .	191	178
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1,2,7,8-Dibenzanthracene . . . . .	183	50	1,2-Dibromobutane . . . . .	11	65
Dibenzofuran . . . . .	50	139	1,3-Dibromobutane . . . . .	14	65
Dibenzofuran-2-carboxaldehyde . . . . .	57	156	1,4-Dibromobutane . . . . .	16	65
4-Dibenzofurylacetic acid . . . . .	340	207	2,3-Dibromobutane . . . . .	10	65
Dibenzoyl . . . . .	119	176	1,2-Dibromo-1-butene . . . . .	6	65
1,2-Dibenzoylbenzene . . . . .	178	178	1,3-Dibromo-2-butene . . . . .	13	65
1,3-Dibenzoylbenzene . . . . .	129	176	3,5-Dibromo- <i>o</i> -cresol . . . . .	194	106
1,4-Dibenzoylbenzene . . . . .	184	178	4,6-Dibromo- <i>o</i> -cresol . . . . .	58	99
N,N'-Dibenzoylbenzidine . . . . .	511	247	2,6-Dibromo- <i>p</i> -cresol . . . . .	43	98
1,2-Dibenzylethane . . . . .	174	178	1,3-Dibromo-2,4-dihydroxynaphthalene . . . . .	303	111
cis-1,2-Dibenzylethylene . . . . .	163	177	1,5-Dibromo-4,8-dihydroxynaphthalene . . . . .	367	115
trans-1,2-Dibenzylethylene . . . . .	142	176	2,6-Dibromo-1,5-dihydroxynaphthalene . . . . .	589	127
N,N'-Dibenzylethylenediamine . . . . .	491	246	2,3-Dibromo-5,6-dimethylphenol . . . . .	186	106
Dibenzoymethane . . . . .	111	175	2,5-Dibromo-1,4-dinitrobenzene . . . . .	53	339
1,3-Dibenzoylpropane . . . . .	87	175	1,1-Dibromoethane . . . . .	2	65
Dibenzoyl sulfide . . . . .	20	425	1,2-Dibromoethane . . . . .	3	65
N,N-Dibenzoyltetramethylenediamine . . . . .	364	241	2,2-Dibromoethanol . . . . .	81	84
4-Dibenzothienylacetic acid . . . . .	248	203	Di-(2-bromoethyl)sulfide . . . . .	8	425
N,N'-Dibenzoyltrimethylenediamine . . . . .	274	238	Dibromogalic acid . . . . .	336	113
1,2,7,8-Dibenzphenanthrene . . . . .	202	51	1,7-Dibromoheptane . . . . .	1	66
2,3,5,6-Dibenzphenanthrene . . . . .	199	51	2,6-Dibromohydroquinone . . . . .	425	118
2,3,6,7-Dibenzphenanthrene . . . . .	198	51	Dibromomalononitrile . . . . .	169	364
Dibenzylacetanilide . . . . .	299	239	Dibromomethane . . . . .	1	65
Dibenzylacetic acid . . . . .	94	196	2,6-Dibromo-4-methylphenol . . . . .	43	98
Dibenzylacetone . . . . .	221	168	3,5-Dibromo-2-methylphenol . . . . .	194	106
Dibenzyl acetonitrile . . . . .	63	350	4,6-Dibromo-2-methylphenol . . . . .	58	99
Dibenzylacetyl chloride . . . . .	17	214	1,2-Dibromo-2-methylpropane . . . . .	5	65
Dibenzylamine . . . . .	184	301	1,1-Dibromo-2-methylpropene . . . . .	9	65
N,N-Dibenzylaniline . . . . .	40	323	1,2-Dibromonaphthalene . . . . .	3	74
Dibenzyl ether . . . . .	109	136	1,4-Dibromonaphthalene . . . . .	4	74
Dibenzyl ketone . . . . .	19	172	1,3-Dibromo-2,4-naphthalenediol . . . . .	303	111
4,5-Dibenzylnaphthalene-1-sulfonamide . . . . .	192	399	1,3-Dibromo-2-naphthol . . . . .	107	102
4,5-Dibenzylnaphthalene-1-sulfonyl chloride . . . . .	239	389	1,6-Dibromo-2-naphthol . . . . .	212	107
1,2-Dibenzylxyloxybenzene . . . . .	39	138	2,4-Dibromo-1-naphthol . . . . .	208	107
1,4-Dibenzylxyloxybenzene . . . . .	55	139	4,6-Dibromo-2-naphthol . . . . .	320	112
Dibenzyl phthalate . . . . .	48	275	2,5-Dibromo-1-nitrobenzene . . . . .	56	339
Dibenzyl succinate . . . . .	64	276	2,4-Dibromo-6-nitrophenol . . . . .	259	109
2,2-Dibenzylsuccinic acid . . . . .	274	431	2,6-Dibromo-4-nitrophenol . . . . .	348	114
Dibenzyl sulfide . . . . .	21	425	1,9-Dibromononane . . . . .	21	65
Dibenzyl <i>d</i> -tartarate . . . . .	63	276	1,8-Dibromooctane . . . . .	20	65
Dibiphenyleneethylene . . . . .	182	50	1,5-Dibromopentane . . . . .	18	65
Dibromoacetamide . . . . .	308	239	2,4-Dibromophenol . . . . .	18	97
3,5-Dibromoacetic acid . . . . .	35	194	2,5-Dibromophenol . . . . .	104	102
3,5-Dibromoacetophenone . . . . .	88	175	2,6-Dibromophenol . . . . .	52	99
2,4-Dibromoaniline . . . . .	127	306	3,5-Dibromophenol . . . . .	127	103
" " . . . . .	47	436	Di-(4-bromophenyl)sulfide . . . . .	63	426
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			1,3-Dibromopropane . . . . .	12	65

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3,4-Dibromotoluene .....	15	73	2,4-Dichlorobenzenesulfonamide .....	236	401
2,6-Dibromo-3,4,5-trihydroxybenzoic acid.....	336	113	2,5-Dichlorobenzenesulfonamide .....	233	400
Di-( $\beta$ -n-butoxyethyl)carbonate .....	344	270	3,4-Dichlorobenzenesulfonamide .....	99	395
Butibutyl acetylene .....	54	30	2,5-Dichlorobenzenesulfonamide .....	165	398
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" "	464	439	3,4-Dichlorobenzenesulfonic acid .....	34	372
N,N-Di-n-butylaniline .....	99	321	2,4-Dichlorobenzensulfonyl chloride .....	48	382
" "	256	438	2,5-Dichlorobenzensulfonyl chloride .....	22	381
3,5-Di- <i>tert</i> -butylaniline .....	188	437	3,4-Dichlorobenzensulfonyl chloride .....	9	381
1,4-Di- <i>sec</i> -butylbenzene .....	139	40	2,4-Dichlorobenzoic acid .....	117	430
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Di-n-butyl ether.....	54	133	3,4-Dichlorobenzoic acid .....	322	206
Di- <i>sec</i> -butyl ether.....	44	133	2,2'-Dichlorobenzoin .....	63	174
Di-n-butyl ketone .....	140	165	2,4-Dichlorobenzonitrile .....	73	360
Di- <i>sec</i> -butyl ketone .....	93	164	2,5-Dichlorobenzonitrile .....	175	365
Di- <i>tert</i> -butyl ketone .....	74	163	3,4-Dichlorobenzonitrile .....	92	361
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Di-n-butyl sulfide .....	41	421	2,2'-Dichlorobiphenyl .....	15	71
Di- <i>tert</i> -butyl sulfide .....	29	420	4,4'-Dichlorobiphenyl .....	30	71
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3,4-Dicarboxybenzenesulfonyl chloride .....	259	389	2,6-Dichloro-p-cresol .....	23	97
Dichloroacetaldehyde .....	15	144	4,6-Dichloro-m-cresol .....	99	101
Dichloroacetamide .....	106	233	2,5-Dichloro-3,6-dihydroxy-1,4-benzoquinone .....	51	184
Dichloroacetanilide .....	184	235	1,5-Dichloro-4,8-dihydroxynaphthalene .....	495	122
2,4-Dichloroacetanilide .....	268	238	2,3-Dichloro-1,4-dihydroxynaphthalene .....	321	112
2,5-Dichloroacetanilide .....	231	237	2,5-Dichloro-1,4-dimethylbenzene .....	21	71
Dichloroacetic acid .....	25	190	3,6-Dichloro-2,5-dimethylbenzenesulfonamide .....	179	398
" "	11	429	4,6-Dichloro-2,5-dimethylbenzenesulfonamide .....	130	396
Dichloroacetic anhydride .....	12	223	3,6-Dichloro-2,5-dimethylbenzenesulfonamide .....	202	399
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1,3-Dichloroacetone .....	41	173	3,6-Dichloro-2,5-dimethylbenzenesulfonic acid .....	71	373
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3,5-Dichloroacetophenone .....	4	172	4,6-Dichloro-2,5-dimethylbenzenesulfonyl		
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" "	37	436	1,2-Dichloroethane .....	9	63
2,5-Dichloroaniline .....	49	304	cis-1,2-Dichloroethylene .....	4	63
" "	32	436	trans-1,2-Dichloroethylene .....	2	63
9,10-Dichloroanthracene .....	34	72	2,2'-Dichloroethyl ether .....	42	133
meso-Dichloroanthracene .....	34	72	$\beta,\beta'$ -Dichloroethyl ether .....	69	134
9,10-Dichloroanthracene-2-sulfonamide .....	457	409	Di-2-chloroethyl sulfide .....	52	421
9,10-Dichloroanthracene-2-sulfonanilide .....	428	408	2,6-Dichlorohydroquinone .....	27	434
9,10-Dichloroanthracene-2-sulfonic acid .....	212	378	2,4-Dichloro-3-hydroxybenzaldehyde .....	114	159
9,10-Dichloroanthracene-2-sulfonyl chloride .....	275	390	2,6-Dichloro-3-hydroxybenzaldehyde .....	113	159
2,3-Dichlorobenzaldehyde .....	55	155	3,5-Dichloro-2-hydroxybenzaldehyde .....	81	157
2,4-Dichlorobenzaldehyde .....	63	156	3,5-Dichloro-4-hydroxybenzaldehyde .....	119	159
2,5-Dichlorobenzaldehyde .....	45	155	4,6-Dichloro-3-hydroxybenzaldehyde .....	109	159
2,6-Dichlorobenzaldehyde .....	58	156	3,5-Dichloro-2-hydroxybenzonitrile .....	184	365
3,4-Dichlorobenzaldehyde .....	19	154	3,5-Dichloro-4-hydroxybenzonitrile .....	192	365
3,5-Dichlorobenzaldehyde .....	54	155	Dichloromethane .....	1	63
2,5-Dichlorobenzamide .....	297	239	2,3-Dichloro-4-methylbenzenesulfonamide .....	405	407
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2,3-Dichloro-6-methylbenzenesulfonic acid .....	115	375	2,6-Dichloro-4-nitroaniline .....	5	436
2,6-Dichloro-3-methylbenzenesulfonic acid .....	125	375	2,4-Dichloro-1-nitrobenzene .....	6	337
2,6-Dichloro-4-methylbenzenesulfonic acid .....	56	372	2,5-Dichloro-1-nitrobenzene .....	24	337
3,4-Dichloro-2-methylbenzenesulfonic acid .....	174	377	2,4-Dichloro-5-nitrophenol .....	209	107
3,5-Dichloro-2-methylbenzenesulfonic acid .....	118	375	2,4-Dichloro-6-nitrophenol .....	283	111
3,5-Dichloro-4-methylbenzenesulfonic acid .....	133	375	2,3-Dichlorophenol .....	57	99
4,6-Dichloro-2-methylbenzenesulfonic acid .....	79	373	2,4-Dichlorophenol .....	33	98
2,3-Dichloro-4-methylbenzenesulfonyl chloride .....	26	381	" .....	32	434
2,6-Dichloro-3-methylbenzenesulfonyl chloride .....	7	381	2,5-Dichlorophenol .....	62	99
2,6-Dichloro-4-methylbenzenesulfonyl chloride .....	52	382	2,6-Dichlorophenol .....	81	100
3,4-Dichloro-2-methylbenzenesulfonyl chloride .....	39	382	3,5-Dichlorophenol .....	85	101
3,5-Dichloro-2-methylbenzenesulfonyl chloride .....	46	382	(2,4-Dichlorophenoxy)acetic acid .....	224	431
3,5-Dichloro-4-methylbenzenesulfonyl chloride .....	77	383	2,5-Dichlorophenyl methyl sulfide .....	22	425
4,5-Dichloro-3-methylbenzenesulfonyl chloride .....	107	384	D <sub>1</sub> -(4-chlorophenyl)sulfide .....	56	426
4,6-Dichloro-2-methylbenzenesulfonyl chloride .....	27	381	3,5-Dichlorophthalic anhydride .....	37	225
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2,6-Dichloro-3-methylphenol .....	61	99	4,5-Dichlorophthalic anhydride .....	72	226
2,6-Dichloro-4-methylphenol .....	23	97	1,2-Dichloropropane .....	11	63
4,6-Dichloro-3-methylphenol .....	99	101	1,3-Dichloropropane .....	16	63
(2,4-Dichloro-6-methylphenoxy)acetic acid .....	162	430	2,2-Dichloropropane .....	6	63
1,3-Dichloro-2-methylpropane .....	17	63	1,3-Dichloro-2-propanol .....	72	83
Dichloromethyl sulfide .....	31	420	2,3-Dichloropropanol .....	85	84
Dichloromethyl sulfide .....	43	421	1,1-Dichloro-2-propanone .....	19	161
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1,3-Dichloronaphthalene .....	16	71	d,l-2,3-Dichloropropionaldehyde .....	3	152
1,4-Dichloronaphthalene .....	20	71	3,5-Dichlorosalicylaldehyde .....	81	157
1,5-Dichloronaphthalene .....	26	71	d,l-2,3-Dichlorosuccinic acid .....	18	429
1,6-Dichloronaphthalene .....	9	71	meso-2,3-Dichlorosuccinic acid .....	21	429
1,7-Dichloronaphthalene .....	18	71	2,3-Dichlorotoluene .....	23	70
1,8-Dichloronaphthalene .....	25	71	2,4-Dichlorotoluene .....	20	70
2,6-Dichloronaphthalene .....	28	71	2,5-Dichlorotoluene .....	19	70
2,7-Dichloronaphthalene .....	27	71	2,6-Dichlorotoluene .....	18	70
1,5-Dichloronaphthalene-2-sulfonamide .....	458	409	3,4-Dichlorotoluene .....	24	70
3,6-Dichloronaphthalene-2-sulfonamide .....	356	405	3,5-Dichlorotoluene .....	21	70
3,7-Dichloronaphthalene-1-sulfonamide .....	448	409	α,α-Dichloro-m-tolunitrile .....	99	353
4,5-Dichloronaphthalene-1-sulfonamide .....	389	407	α,α-Dichloro-o-tolunitrile .....	94	353
4,5-Dichloronaphthalene-2-sulfonamide .....	306	403	α,α-Dichloro-p-tolunitrile .....	100	353
4,6-Dichloronaphthalene-1-sulfonamide .....	375	406	2,6-Dichloro-3,4,5-tribromophenol .....	524	123
4,6-Dichloronaphthalene-2-sulfonamide .....	354	405	2,5-Dichloro-p-xylene .....	21	71
4,7-Dichloronaphthalene-1-sulfonamide .....	352	405	Dicinnamalacetone .....	173	178
4,7-Dichloronaphthalene-2-sulfonamide .....	300	403	D <sub>1</sub> -m-cresyl carbonate .....	61	276
4,8-Dichloronaphthalene-2-sulfonamide .....	322	404	D <sub>1</sub> -o-cresyl carbonate .....	85	277
5,6-Dichloronaphthalene-1-sulfonamide .....	368	406	D <sub>1</sub> -p-cresyl carbonate .....	145	280
5,6-Dichloronaphthalene-2-sulfonamide .....	282	402	D <sub>1</sub> -m-cresyl oxalate .....	138	280
5,7-Dichloronaphthalene-1-sulfonamide .....	452	409	D <sub>1</sub> -o-cresyl oxalate .....	128	279
5,8-Dichloronaphthalene-2-sulfonamide .....	422	408	D <sub>1</sub> -p-cresyl oxalate .....	164	281
6,7-Dichloronaphthalene-1-sulfonamide .....	447	409	D <sub>1</sub> -p-cresyl succinate .....	153	281
6,8-Dichloronaphthalene-2-sulfonamide .....	387	407	Dicrotyl sulfide .....	40	421
7,8-Dichloronaphthalene-1-sulfonamide .....	364	406	m-Dicyanobenzene .....	204	366
7,8-Dichloronaphthalene-2-sulfonamide .....	380	406	o-Dicyanobenzene .....	188	365
1,5-Dichloronaphthalene-1-sulfonyl chloride .....	201	387	p-Dicyanobenzene .....	229	367
3,6-Dichloronaphthalene-2-sulfonyl chloride .....	257	389	4,4'-Dicyanobiphenyl .....	231	367
3,7-Dichloronaphthalene-1-sulfonyl chloride .....	214	388	1,1-Dicyanobutane .....	69	350
4,5-Dichloronaphthalene-1-sulfonyl chloride .....	180	387	1,4-Dicyanobutane .....	104	354
4,5-Dichloronaphthalene-2-sulfonyl chloride .....	246	389	4,4-Dicyano-1-butene .....	72	350
4,6-Dichloronaphthalene-1-sulfonyl chloride .....	183	387	cis-1,4-Dicyanocyclohexane .....	76	360
4,6-Dichloronaphthalene-2-sulfonyl chloride .....	208	388	trans-1,4-Dicyanocyclohexane .....	185	365
4,7-Dichloronaphthalene-1-sulfonyl chloride .....	240	389	Dicyanodimethylamine .....	94	361
4,7-Dichloronaphthalene-2-sulfonyl chloride .....	244	389	4,4'-Dicyanodiphenylmethane .....	211	366
4,8-Dichloronaphthalene-2-sulfonyl chloride .....	229	388	1,12-Dicyanododecane .....	17	356
5,6-Dichloronaphthalene-1-sulfonyl chloride .....	159	386	1,1-Dicyanoethane .....	11	357
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1,1-Dicyano-3-methylbutane .....	75	351	N,N-Diethylbenzylamine .....	326	438
Dicyanomethyl ethyl amine .....	9	436	Diethyl benzyl malonate .....	345	270
1,3-Dicyano-2-methylpropane .....	97	353	N,N-Diethylbenzylsulfonamide .....	2	392
1,2-Dicyanonaphthalene.....	220	367	Diethyl bromomalonate .....	252	263
1,3-Dicyanonaphthalene.....	216	367	Diethyl butylmalonate .....	254	264
1,4-Dicyanonaphthalene.....	224	367	Diethyl d-camphorate .....	334	269
1,5-Dicyanonaphthalene .....	226	367	Diethyl carbinol .....	13	80
1,6-Dicyanonaphthalene .....	225	367	Diethylcarbonyl acetate .....	64	252
1,7-Dicyanonaphthalene .....	210	366	Diethyl carbonate .....	55	252
1,8-Dicyanonaphthalene .....	230	367	Diethyl citraconate .....	241	263
2,3-Dicyanonaphthalene .....	234	368	Diethylcyanoacetic acid .....	80	360
2,6-Dicyanonaphthalene .....	236	368	Diethylene glycol .....	126	86
2,7-Dicyanonaphthalene .....	235	368	Diethylene glycol diacetate .....	274	265
1,8-Dicyanonoctane .....	19	356	Diethylene glycol diethyl ether .....	73	134
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1,1-Dicyanopropane .....	67	350	Diethylene glycol mono-n-butyl ether .....	118	86
1,2-Dicyanopropane .....	89	352	Diethylene glycol mono-n-butyl ether acetate .....	280	265
1,3-Dicyanopropane .....	102	353	Diethylene glycol monoethyl ether .....	100	85
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2,3-Dicyanopyridine .....	215	367	Diethylene glycol monomethyl ether .....	96	85
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Di-dichloromethyl sulfide .....	43	421	Diethyl (2-hydroxyethyl) amine .....	350	438
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Di-(2-diphenoxymethyl)sulfide .....	26	420	Diethyl itaconate .....	235	262
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Didodecyl sulfide .....	12	425	Diethyl maleate .....	219	262
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Diethylacetonitrile .....	33	347	N,N-Diethyl-4-methylaniline .....	69	320
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" .....	454	439	2,6-Diethyl-1-methylbenzene .....	90	38
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" "	16	323	Diethyl methylmalonate .....	167	258
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2-Diethylaminoethyl alcohol .....	29	319	Diethyl naphthalate .....	83	277
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2-(N,N-Diethylamino)naphthalene .....	189	301	Diethyl 4-nitrophthalate .....	36	274
3-(Diethylamino)phenol .....	116	102	Diethyl oxalate .....	145	257
3-Diethylaminopropyl alcohol .....	49	320	3,3-Diethylpentane .....	133	5
N,N-Diethylaniline .....	67	320	2,4-Diethylphenol .....	21	97
" "	268	438	β,β-Diethylphenylhydrazine .....	5	322
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2,4-Diethyltoluene .....	80	38	4,4'-Dihydroxyazoxybenzene .....	552	125
2,5-Diethyltoluene .....	87	38	2,3-Dihydroxybenzaldehyde .....	94	158
2,6-Diethyltoluene .....	90	38	2,4-Dihydroxybenzaldehyde .....	110	159
3,5-Diethyltoluene .....	66	38	3,4-Dihydroxybenzaldehyde .....	117	159
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N,N-Diethyl-p-toluidine .....	69	320	1,2-Dihydroxybenzene .....	207	107
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" "	9	429	1,4-Dihydroxybenzene .....	452	119
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1,2-Difluorobenzene .....	4	69	2,4-Dihydroxybenzoic acid .....	530	124
1,3-Difluorobenzene .....	1	69	" "	338	207
1,4-Difluorobenzene .....	3	69	" "	179	430
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Di-n-heptyl ketone .....	36	173	4,4'-Dihydroxy-1,1'-binaphthyl .....	587	127
Di-n-heptyl sulfide .....	62	422	2,2'-Dihydroxybiphenyl .....	227	108
Dihexadecyl sulfide .....	33	425	2,4'-Dihydroxybiphenyl .....	418	118
Di-n-hexylamine .....	450	439	3,3'-Dihydroxybiphenyl .....	290	111
Di-n-hexyl ether .....	95	135	3,4-Dihydroxybiphenyl .....	357	114
Di-n-hexyl ketone .....	114	177	4,4'-Dihydroxybiphenyl .....	579	127
Dihydroacetic acid monoanilide .....	178	235	2,4-Dihydroxy-n-caprylbenzene .....	62	174
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5,6-Dihydroxyacenaphthene .....	497	122	$\beta,\beta'$ -Dihydroxydiethylamine .....	10	88
1,3-Dihydroxyacetone .....	42	89	$\beta,\beta'$ -Dihydroxydiethyl ether .....	126	86
" "	94	175	2,2'-Dihydroxy-3,3'-dimethylbiphenyl .....	237	108
" "	1	329	2,2'-Dihydroxy-4,4'-dimethylbiphenyl .....	271	110
2,3-Dihydroxyacetophenone .....	188	106	2,2'-Dihydroxy-5,5'-dimethylbiphenyl .....	386	116
" "	123	176	2,2'-Dihydroxy-6,6'-dimethylbiphenyl .....	423	118
2,4-Dihydroxyacetophenone .....	362	115	4,4'-Dihydroxy-2,2'-dimethylbiphenyl .....	240	108
" "	175	178	4,4'-Dihydroxy-3,3'-dimethylbiphenyl .....	406	117
2,5-Dihydroxyacetophenone .....	512	123	2,2'-Dihydroxy-1,1'-dinaphthylmethane .....	504	123
" "	197	179	1,2-Dihydroxy-3,5-dinitrobenzene .....	422	118
3,4-Dihydroxyacetophenone .....	266	110	2,4'-Dihydroxydiphenylmethane .....	256	109
" "	148	177	3,3'-Dihydroxydiphenylmethane .....	200	106
3,5-Dihydroxyacetophenone .....	368	115	4,4'-Dihydroxydiphenylmethane .....	398	116
" "	176	178	erythro-2,3-Dihydroxy-1,4-dithiobutane .....	26	417
2,3-Dihydroxyacridine .....	564	126	threo-2,3-Dihydroxy-1,4-dithiobutane .....	10	416
2,8-Dihydroxyacridine .....	588	127	2,5-Dihydroxy-3-n-dodecyl-1,4-benzoquinone .....	18	182
3,7-Dihydroxyacridine .....	590	127	Di-(2-hydroxyethyl)amine .....	180	301
3,9-Dihydroxyacridine .....	487	122	2,2'-Dihydroxyhydrazobenzene .....	332	313
1,3-Dihydroxyacridone .....	592	128	1,4-Dihydroxyisoquinoline .....	573	126
3,5-Dihydroxyaniline .....	361	114	1,3-Dihydroxy-4-methyl-9,10-anthraquinone .....	45	184
" "	328	313	1,8-Dihydroxy-2-methyl-9,10-anthraquinone .....	23	182
1,2-Dihydroxyanthracene .....	408	117	1,3-Dihydroxy-2-methylbenzene .....	265	110

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1,4-Dihydroxy-2-methylnaphthalene . . . . .	447	119	2,4-Di-iodophenol . . . . .	100	101
3,5-Dihydroxy-2-methyl-1,4-naphthoquinone . . . . .	25	182	2,5-Di-iodophenol . . . . .	191	106
2,7-Dihydroxy-4-methylquinoline . . . . .	585	127	2,6-Di-iodophenol . . . . .	86	101
1,2-Dihydroxynaphthalene . . . . .	64	99	3,4-Di-iodophenol . . . . .	133	103
1,3-Dihydroxynaphthalene . . . . .	291	111	3,5-Di-iodophenol . . . . .	202	106
1,4-Dihydroxynaphthalene . . . . .	461	120	3,4-Di-iodophthalic anhydride . . . . .	76	226
" " "	71	434	1,3-Di-iodopropane . . . . .	2	67
1,5-Dihydroxynaphthalene . . . . .	575	127	DL-3,5-Di-iodotyrosine . . . . .	52	429
1,6-Dihydroxynaphthalene . . . . .	330	113	L-3,5-Di-iodotyrosine . . . . .	44	286
1,7-Dihydroxynaphthalene . . . . .	462	120	Di-isoamylamine . . . . .	86	297
1,8-Dihydroxynaphthalene . . . . .	343	114	Di-isoamyl carbonate . . . . .	440	439
2,3-Dihydroxynaphthalene . . . . .	407	117	Di-isoamyl ether . . . . .	246	263
2,6-Dihydroxynaphthalene . . . . .	535	124	Di-isoamyl oxalate . . . . .	64	134
2,7-Dihydroxynaphthalene . . . . .	484	121	Di-isoamyl phthalate . . . . .	312	268
2,4-Dihydroxy-5-nitroaniline . . . . .	360	314	Di-isobutylamine . . . . .	357	271
2,5-Dihydroxy-4-nitroaniline . . . . .	346	314	Di-isobutylcarbinol . . . . .	52	296
1,2-Dihydroxy-3-nitrobenzene . . . . .	148	104	Di-isobutyl carbonate . . . . .	438	439
1,3-Dihydroxy-2-nitrobenzene . . . . .	143	103	Di-isobutyl ether . . . . .	63	83
1,3-Dihydroxy-4-nitrobenzene . . . . .	280	110	Di-isobutyl ketone . . . . .	154	257
1,2-Dihydroxyphenanthrene . . . . .	463	120	Di-isobutyl oxalate . . . . .	46	133
1,9-Dihydroxyphenanthrene . . . . .	477	121	Di-isobutyl sulfide . . . . .	101	164
2,5-Dihydroxyphenanthrene . . . . .	467	120	Di-isobutyl sulfate . . . . .	237	263
2,6-Dihydroxyphenanthrene . . . . .	561	126	Di-isobutyl d-tartarate . . . . .	37	421
2,7-Dihydroxyphenanthrene . . . . .	576	127	Di-isobutyl l-tartarate . . . . .	106	278
2,8-Dihydroxyphenanthrene . . . . .	513	123	Di-isobutyl d,l-tartarate . . . . .	80	277
3,4-Dihydroxyphenanthrene . . . . .	345	114	Di-isobutyryl . . . . .	63	163
3,6-Dihydroxyphenanthrene . . . . .	548	125	Di-isopropylamine . . . . .	23	295
3,8-Dihydroxyphenanthrene . . . . .	570	126	N,N-Di-isopropylaniline . . . . .	460	439
9,10-Dihydroxyphenanthrene . . . . .	371	115	1,2-Di-isopropylbenzene . . . . .	277	438
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Di-(3-hydroxyphenyl)sulfide . . . . .	67	426	Di-isopropyl ether . . . . .	90	254
Di-(4-hydroxyphenyl)sulfide . . . . .	72	427	Di-isopropylideneacetone . . . . .	18	131
1,3-Dihydroxy-2-propanone . . . . .	42	89	Di-isopropyl ketone . . . . .	8	172
2,3-Dihydroxypropylamine . . . . .	179	300	2,4-Di-isopropyl-1-methylbenzene . . . . .	20	161
1,2-Dihydroxy-3-propylbenzene . . . . .	97	101	2,6-Di-isopropyl-1-methylbenzene . . . . .	122	39
1,2-Dihydroxy-4-propylbenzene . . . . .	63	99	Di-isopropyl oxalate . . . . .	126	39
1,3-Dihydroxy-5-propylbenzene . . . . .	135	103	Di-isopropyl phthalate . . . . .	160	258
1,4-Dihydroxy-2-propylbenzene . . . . .	159	104	Di-isopropyl sulfide . . . . .	347	270
1,6-Dihydroxypyrene . . . . .	568	126	Di-isopropyl d-tartarate . . . . .	17	420
3,5-Dihydroxypyrene . . . . .	547	125	Di-isopropyl l-tartarate . . . . .	323	268
3,8-Dihydroxypyrene . . . . .	591	127	2,4-Di-isopropyltoluene . . . . .	34	274
2,5-Dihydroxypyridine . . . . .	572	126	2,6-Di-isopropyltoluene . . . . .	122	39
2,3-Dihydroxyquinoline . . . . .	574	126	2,4-Di-isopropylbenzene . . . . .	126	39
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4,4'-Dihydroxystilbene . . . . .	583	127	Dimedone . . . . .	181	178
o,4-Dihydroxytoluene . . . . .	294	111	1,4-Dimercaptobenzene . . . . .	31	417
2,3-Dihydroxytoluene . . . . .	84	101	sym-Dimethoxyacetone . . . . .	19	169
2,5-Dihydroxytoluene . . . . .	293	111	3,4-Dimethoxyacetophenone . . . . .	55	174
2,6-Dihydroxytoluene . . . . .	265	110	3,4-Dimethoxyaniline . . . . .	148	307
3,4-Dihydroxytoluene . . . . .	76	100	3,5-Dimethoxyaniline . . . . .	114	436
3,5-Dihydroxytoluene . . . . .	217	107	2,3-Dimethoxybenzaldehyde . . . . .	32	154
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" "	82	436	2,6-Dimethyltetralin .....	138	40
3,5-Dimethylpyrazole .....	151	437	2,7-Dimethyltetralin .....	137	40
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" "	265	438	5,6-Dimethyltetralin .....	147	40
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1,2-Dinitrobenzene .....	80	340	3,4-Dinitrophenol .....	10	434
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Ethylenediamine-N,N,N',N'-tetraacetic acid.....	471	433	2-Ethyl-1-hexene.....	204	18
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" "	148	280	Ethyl methyl carbinol .....	7	80
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Ethyl-3-nitrocinnamate .....	117	279	1-Ethyl-3-propylbenzene .....	68	38
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2-Ethylphenol .....	6	94	2-Ethyltetralin .....	132	40
" "	106	435	5-Ethyltetralin .....	144	40
3-Ethylphenol .....	9	94	6-Ethyltetralin .....	142	40
" "	90	434	2-Ethyltetramethylene sulfide .....	28	423
4-Ethylphenol .....	40	98	Ethyl $\alpha$ -thienyl ketone .....	185	167
" "	99	434	2-Ethylthiurane .....	6	423
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4-Hydridamine .....	150	299	4-Hydroxybenzene-1,3-disulfonyl chloride .....	115	384
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" " .....	291	431	1-Hydroxynaphthalene-2-sulfonic acid .....	8	380
2-Hydroxyisobutyronitrile .....	18	346	3-Hydroxynaphthalene-2-sulfonic acid .....	11	371
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2-Hydroxy-3-methoxybenzaldehyde .....	33	434	2-Hydroxy-1-naphthalenthio .....	17	416
3-Hydroxy-4-methoxybenzaldehyde .....	54	434	4-Hydroxy-1-naphthalenthio .....	38	417
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3-Hydroxyphenanthrene . . . . .	282	111	8-Hydroxyquinoline . . . . .	110	102
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(2-Hydroxyphenyl)acetonitrile . . . . .	163	364	2-Hydroxythiophenol . . . . .	40	415
(4-Hydroxyphenyl)acetonitrile . . . . .	87	361	3-Hydroxythiophenol . . . . .	1	416
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" " "	130	306	3-Hydroxy- <i>p</i> -toluidine . . . . .	363	314
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4-Hydroxyphenyl methyl sulfide . . . . .	78	434	1-Hydroxytriacontane . . . . .	48	89
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3-Iodoacetanilide.....	187	235	5-Iodonaphthalene-1-sulfonyl chloride .....	230	388
4-Iodoacetanilide.....	387	242	6-Iodonaphthalene-1-sulfonyl chloride .....	121	384
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".....	172	430	7-Iodonaphthalene-1-sulfonyl chloride .....	255	389
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".....	107	436	3-Iodo-1-nitrobenzene .....	11	337
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4-Idobenzaldehyde.....	68	156	4-Iodo-2-nitrophenol .....	125	103
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3-Idobenzamide.....	394	242	5-Iodo-2-nitrophenol .....	181	105
4-Idobenzamide.....	458	244	5-Iodo-3-nitrophenol .....	328	113
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4-Idobenzanilide.....	447	244	2-Iodophenetole .....	100	136
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4-Idobenzenesulfonamide.....	240	401	2-Iodophenol .....	31	98
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4-Idobenzenesulfonic acid.....	105	374	3-Iodophenol .....	25	97
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3-Nitrobenzamide .....	263	238	trans-2-Nitrocinnamic acid .....	371	208
4-Nitrobenzamide .....	429	243	" ....." .....	307	431
2-Nitrobenzamide-4-sulfonamide .....	376	406	trans-3-Nitrocinnamic acid .....	317	206
2-Nitrobenzamide-4-sulfonamide .....	300	239	" ....." .....	303	431
3-Nitrobenzamide .....	294	239	trans-4-Nitrocinnamic acid .....	398	209
4-Nitrobenzamide .....	449	244	" ....." .....	293	431
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5-Nitrobenzene-1,3-disulfonic acid .....	194	378	2-Nitro-m-cresol .....	27	97
5-Nitrobenzene-1,3-disulfonyl chloride .....	142	385	2-Nitro-p-cresol .....	19	97
2-Nitrobenzenesulfonamide .....	288	403	3-Nitro-o-cresol .....	365	115
3-Nitrobenzenesulfonamide .....	185	398	3-Nitro-p-cresol .....	121	102
4-Nitrobenzenesulfonamide .....	228	400	4-Nitro-m-cresol .....	306	112
2-Nitrobenzenesulfonamide .....	52	394	4-Nitro-o-cresol .....	183	105
3-Nitrobenzenesulfonamide .....	69	394	5-Nitro-o-cresol .....	260	109
4-Nitrobenzenesulfonamide .....	204	399	6-Nitro-m-cresol .....	49	99
2-Nitrobenzenesulfonic acid .....	137	376	6-Nitro-o-cresol .....	96	101
3-Nitrobenzenesulfonic acid .....	77	373	Nitrocyclohexane .....	19	335
4-Nitrobenzenesulfonic acid .....	98	374	2-Nitro-p-cymene .....	31	336
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2-Nitrodiphenylamine-4-sulfonic acid . . . . .	65	373	1-Nitro-2-naphthylamine . . . . .	276	311
4-Nitrodiphenylamine-2-sulfonyl chloride . . . . .	155	386	2-Nitro-1-naphthylamine . . . . .	322	313
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Nitroethylene . . . . .	1	335	5-Nitro-2-naphthylamine . . . . .	323	313
2-Nitrofluorene . . . . .	106	341	8-Nitro-1-naphthylamine . . . . .	185	308
9-Nitrofluorene . . . . .	118	342	8-Nitro-2-naphthylamine . . . . .	201	309
1-Nitroheptane . . . . .	17	335	1-Nitrooctane . . . . .	20	335
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1-Nitrohexane . . . . .	16	335	DL-2-Nitropentane . . . . .	10	335
2-Nitrohexane . . . . .	15	335	3-Nitrophenacyl alcohol . . . . .	51	89
2-Nitrohydroquinone . . . . .	29	434	4-Nitrophenacyl alcohol . . . . .	55	90
4-Nitroindane . . . . .	16	337	2-Nitrophenanthrene . . . . .	70	339
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5-Nitronaphthalene-2-sulfonamide . . . . .	246	401	(3-Nitrophenoxy)acetic acid . . . . .	133	430
6-Nitronaphthalene-1-sulfonamide . . . . .	370	406	(4-Nitrophenoxy)acetic acid . . . . .	128	430
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8-Nitronaphthalene-1-sulfonamide . . . . .	275	402	4-Nitrophenylacetamide . . . . .	422	243
8-Nitronaphthalene-2-sulfonamide . . . . .	386	407	4-Nitrophenylacetanilide . . . . .	423	243
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8-Nitronaphthalene-1-sulfonanilide . . . . .	226	400	(3-Nitrophenyl)acetic acid . . . . .	157	199
8-Nitronaphthalene-2-sulfonanilide . . . . .	206	399	' . . . . .	278	431
1-Nitronaphthalene-2-sulfonic acid . . . . .	160	376	(4-Nitrophenyl)acetic acid . . . . .	229	202
4-Nitronaphthalene-1-sulfonic acid . . . . .	126	375	' . . . . .	259	431
5-Nitronaphthalene-1-sulfonic acid . . . . .	183	377	(4-Nitrophenyl)acetonitrile . . . . .	161	364
5-Nitronaphthalene-2-sulfonic acid . . . . .	108	374	4-Nitrophenylacetyl chloride . . . . .	10	216
7-Nitronaphthalene-1-sulfonic acid . . . . .	207	378	$\beta$ -(2-Nitrophenyl)acrylonitrile . . . . .	120	362
8-Nitronaphthalene-1-sulfonic acid . . . . .	131	375	2-Nitro-p-phenylenediamine . . . . .	307	312
8-Nitronaphthalene-2-sulfonic acid . . . . .	166	377	4-Nitro-m-phenylenediamine . . . . .	361	314
1-Nitronaphthalene-2-sulfonyl chloride . . . . .	189	387	4-Nitro-o-phenylenediamine . . . . .	415	316
4-Nitronaphthalene-1-sulfonyl chloride . . . . .	149	385	2-Nitrophenylhydrazine . . . . .	158	307
4-Nitronaphthalene-2-sulfonyl chloride . . . . .	224	388	3-Nitrophenylhydrazine . . . . .	170	308
5-Nitronaphthalene-1-sulfonyl chloride . . . . .	174	386	4-Nitrophenylhydrazine . . . . .	352	314
5-Nitronaphthalene-2-sulfonyl chloride . . . . .	203	387	2-Nitro-5-phenylphenol . . . . .	20	434
6-Nitronaphthalene-1-sulfonyl chloride . . . . .	204	387	2-Nitrophenyl phenylsulfide . . . . .	49	426
7-Nitronaphthalene-1-sulfonyl chloride . . . . .	263	389	3-Nitrophenyl phenyl sulfide . . . . .	16	425
8-Nitronaphthalene-1-sulfonyl chloride . . . . .	254	389	4-Nitrophenyl phenyl sulfide . . . . .	29	425
8-Nitronaphthalene-2-sulfonyl chloride . . . . .	260	389	3-(2-Nitrophenyl)propanoic acid . . . . .	391	432
4-Nitro-1-naphthalenethiol . . . . .	24	416	3-(4-Nitrophenyl)propanoic acid . . . . .	384	432
1-Nitro-2-naphthol . . . . .	199	106	2-Nitrophenyl sulfide . . . . .	65	426
2-Nitro-1-naphthol . . . . .	302	111	3-Nitrophenyl sulfide . . . . .	75	427
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4-Nitro-2-naphthol . . . . .	272	110	4-Nitrophthalamide . . . . .	426	243
5-Nitro-1-naphthol . . . . .	451	119	4-Nitrophthalanilide . . . . .	408	243
5-Nitro-2-naphthol . . . . .	364	115	3-Nitrophthalic acid . . . . .	346	207
6-Nitro-1-naphthol . . . . .	471	121	4-Nitrophthalic acid . . . . .	253	203
8-Nitro-1-naphthol . . . . .	311	112	3-Nitrophthalic acid diamide . . . . .	432	243
8-Nitro-2-naphthol . . . . .	351	114	3-Nitrophthalic acid dianilide . . . . .	484	245
1-Nitro-2-naphthonitrile . . . . .	183	365	3-Nitrophthalic anhydride . . . . .	70	226
4-Nitro-1-naphthonitrile . . . . .	179	365	4-Nitrophthalic anhydride . . . . .	51	226
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2-Nitropropane . . . . .	4	335	1-Nonadecene . . . . .	1	26
3-Nitropropene . . . . .	5	335	Nonadecylcyclohexane . . . . .	22	8
3-Nitropropylene . . . . .	5	335	Nonadecylcyclopentane . . . . .	13	8
3-Nitropyridine . . . . .	17	323	1-Nonadecyne . . . . .	5	31
" . . . . .	20	436	1,8-Nonadiene . . . . .	255	20
5-Nitroquinoline . . . . .	39	323	2,7-Nonadiene . . . . .	280	21
" . . . . .	66	436	1,8-Nonadiyne . . . . .	51	30
6-Nitroquinoline . . . . .	81	324	2,7-Nonadiyne . . . . .	56	30
" . . . . .	67	436	Nonanal . . . . .	67	147
7-Nitroquinoline . . . . .	78	324	n-Nonane . . . . .	144	5
" . . . . .	49	436	1-Nonanethiol . . . . .	43	415
8-Nitroquinoline . . . . .	56	436	n-Nonanoic acid . . . . .	48	191
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4-Nitroresorcinol . . . . .	280	110	1-Nonanol . . . . .	107	85
5-Nitroresorcinol . . . . .	397	116	d,l-2-Nonanol . . . . .	102	85
3-Nitrosalicylamide . . . . .	296	239	5-Nonanol . . . . .	97	85
3-Nitrosalicylamide (hydrate) . . . . .	267	238	2-Nonanone . . . . .	150	166
5-Nitrosalicylamide . . . . .	474	245	3-Nonanone . . . . .	142	165
5-Nitrosalicylanilide . . . . .	473	245	5-Nonanone . . . . .	140	165
3-Nitrosalicylic acid . . . . .	374	115	Nonanonitrile . . . . .	76	351
" . . . . .	166	199	n-Nonanoyl chloride . . . . .	45	213
5-Nitrosalicylic acid . . . . .	358	208	Nonantriactane . . . . .	74	9
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3-Nitro-1,2,4,5-tetramethylbenzene . . . . .	77	340	2-Nonenal . . . . .	16	150
2-Nitrothiophenol . . . . .	19	416	1-Nonene . . . . .	268	21
3-Nitrothiophenol . . . . .	22	416	2-Nonene . . . . .	275	21
4-Nitrothiophenol . . . . .	23	416	3-Nonene . . . . .	269	21
2-Nitrotoluene . . . . .	22	335	4-Nonene . . . . .	260	20
3-Nitrotoluene . . . . .	26	336	n-Nonylacetylene . . . . .	57	30
4-Nitrotoluene . . . . .	21	337	n-Nonyl alcohol . . . . .	107	85
3-Nitrotoluene- $\alpha$ -sulfonamide . . . . .	162	398	n-Nonylamine . . . . .	95	298
4-Nitrotoluene- $\alpha$ -sulfonamide . . . . .	320	404	" . . . . .	419	439
4-Nitrotoluene- $\alpha$ -sulfonanilide . . . . .	361	406	n-Nonylbenzene . . . . .	166	41
2-Nitro-p-toluidine . . . . .	126	306	n-Nonyl bromide . . . . .	27	58
3-Nitro-o-toluidine . . . . .	164	307	n-Nonyl chloride . . . . .	46	56
3-Nitro-p-toluidine . . . . .	245	310	n-Nonylcyclohexane . . . . .	270	7
4-Nitro-o-toluidine . . . . .	216	309	n-Nonylcyclopentane . . . . .	266	7
5-Nitro-o-toluidine . . . . .	293	312	n-Nonyl iodide . . . . .	20	60
6-Nitro-m-toluidine . . . . .	303	312	n-Nonyl mercaptan . . . . .	43	415
6-Nitro-o-toluidine . . . . .	163	307	1-Nonylnaphthalene . . . . .	184	42
2-Nitro-3-tolunitrile . . . . .	106	362	2-Nonylnaphthalene . . . . .	185	42
2-Nitro-4-tolunitrile . . . . .	148	363	1-Nonyne . . . . .	47	30
3-Nitro-2-tolunitrile . . . . .	152	364	2-Nonyne . . . . .	50	30
3-Nitro-4-tolunitrile . . . . .	136	363	3-Nonyne . . . . .	48	30
4-Nitro-2-tolunitrile . . . . .	145	363	4-Nonyne . . . . .	46	29
4-Nitro-3-tolunitrile . . . . .	123	362	Nopinane . . . . .	140	5
5-Nitro-3-tolunitrile . . . . .	143	363	Nopinene . . . . .	291	22
6-Nitro-2-tolunitrile . . . . .	86	361	Norbornane . . . . .	77	9
6-Nitro-3-tolunitrile . . . . .	102	362	Norbricyclene . . . . .	33	8
1-Nitro-2,4,6-tribromobenzene . . . . .	89	340	DL-Norleucine . . . . .	106	289
2-Nitro-3,4,6-tribromophenol . . . . .	301	111	" . . . . .	79	429
2-Nitro-4,5,6-tribromophenol . . . . .	287	111	L-(+)-Norleucine . . . . .	111	289
3-Nitro-2,4,6-tribromophenol . . . . .	156	104	DL-Norvaline . . . . .	112	289
1-Nitro-2,3,6-trimethylbenzene . . . . .	3	337	L-(+)-Norvaline . . . . .	120	290
3-Nitro-2,4,6-trimethylphenol . . . . .	57	434	NW-acid . . . . .	14	380
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2-Nitro-p-xylene . . . . .	27	336			
3-Nitro-o-xylene . . . . .	30	336			
4-Nitro-m-xylene . . . . .	29	336			
4-Nitro-o-xylene . . . . .	4	337	O		
5-Nitro-m-4-xylidine . . . . .	123	306	Octachloronaphthalene . . . . .	33	72
5-Nitro-p-2-xylidine . . . . .	325	313	n-Octacosane . . . . .	42	8
n-Nonacosane . . . . .	45	8	Octacosylcyclohexane . . . . .	53	9
Nonacosylcyclohexane . . . . .	56	9	Octacosylcyclopentane . . . . .	41	8
Nonacosylcyclopentane . . . . .	44	8	1-Octacosyne . . . . .	15	31
1-Nonacosyne . . . . .	16	31	Octadecanal . . . . .	14	153
n-Nonadecane . . . . .	11	8	n-Octadecane . . . . .	8	8
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2-Octanethiol.....	30	414	Oxalic acid diamide .....	513	247
n-Octanoic acid.....	47	191	Oxalic acid dianilide .....	497	246
" .....	456	432	Oxaloacetic acid .....	102	429
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4-Octanone.....	107	164	Oxine .....	110	102
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n-Octylbenzene .....	156	41	Pelargonaldehyde .....	67	147
n-Octyl bromide .....	24	58	Pelargonamide .....	113	233
n-Octyl n-butyrate .....	268	264	Pelargonanilide .....	19	231
n-Octyl n-caproate .....	325	269	Pelargonic acid .....	48	191
n-Octyl n-caprylate .....	348	270	" " .....	459	432
n-Octyl chloride .....	39	56	Pelargonyl chloride .....	45	213
n-Octylcyclohexane .....	267	7	Pentabromophenol .....	560	126
n-Octylcyclopentane .....	263	7	Pentachlorobenzaldehyde .....	126	160
n-Octyl n-enanthate .....	338	270	Pentachlorobenzene .....	24	71
n-Octyl formate .....	170	258	Pentachloroethane .....	21	63
n-Octyl n-heptanoate .....	338	270	Pentachlorophenol .....	488	122
n-Octyl n-hexanoate .....	325	269	n-Pentacosane .....	29	8
n-Octyl iodide .....	21	60	1-Pentacosene .....	8	26
n-Octyl mercaptan .....	36	414	Pentacosylcyclohexane .....	43	8
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n-Octyl propionate .....	234	262	n-Pentadecane .....	268	7
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" "	398	432	1,2,3,4-Tetrachlorobenzene . . . . .	6	71
Succinic acid . . . . .	294	205	1,2,3,5-Tetrachlorobenzene . . . . .	10	71
" "	310	431	1,2,4,5-Tetrachlorobenzene . . . . .	29	71
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" "	398	432	1,1,2,2-Tetrachloroethylene . . . . .	14	63
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4-Sulfobenzoic acid . . . . .	184	377	Tetracyanoethylene . . . . .	222	367
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<i>d</i> -Tartaric acid . . . . .	263	203	1-Tetradecanol . . . . .	17	88
" "	141	430	2-Tetradecanone . . . . .	17	172
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<i>meso</i> -Tartaric acid . . . . .	203	201	1-Tetradecene . . . . .	332	24
" " "	177	430	<i>n</i> -Tetradecylacetylene . . . . .	64	30
D-Tartaric acid diamide . . . . .	418	243	<i>n</i> -Tetradecyl bromide . . . . .	30	58
<i>meso</i> -Tartaric acid diamide . . . . .	401	242	<i>n</i> -Tetradecylcyclohexane . . . . .	6	8
D-Tartaric acid dianilide . . . . .	500	246	<i>n</i> -Tetradecylcyclopentane . . . . .	278	7
D, L-Tartaric acid monoamide . . . . .	478	245	<i>n</i> -Tetradecyl sulfide . . . . .	25	425
D-Tartaric acid monoanilide . . . . .	375	242	1-Tetradecyne . . . . .	62	30
D, L-Tartaric acid monoanilide . . . . .	486	245	Tetraethylene glycol dimethyl ether . . . . .	105	136
Tartronic acid . . . . .	240	202	Tetraethyl pyromellitate . . . . .	74	276
Taurine . . . . .	110	289	Tetraethyl silicate . . . . .	113	255
Terephthalaldehyde . . . . .	103	158	1,2,3,4-Tetrahydroanthracene . . . . .	108	47
Terephthalic acid . . . . .	404	210	1,2,3,4-Tetrahydroanthranol . . . . .	221	107
" "	210	430	Tetrahydrofuran . . . . .	16	131
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" "	353	432	2,4,6-Trimethylbenzenesulfonyl chloride .....	
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