TEXT FLY WITHIN
THE BOOK ONLY

UNIVERSAL
LIBRARY

OU_158709

UNIVERSAL
LIBRARY

OSMANIA UNIVERSITY LIBRARY

Call No 547.2 /E 31 P V.3 Accession No. 26846

Author Egloff. G.

Title Physical Constants of hydrocarbo

This book should be returned on or before the date last marked below.

# PHYSICAL CONSTANTS OF HYDROCARBONS

## Volume III
## MONONUCLEAR AROMATIC HYDROCARBONS

GUSTAV EGLOFF

DIRECTOR OF RESEARCH
UNIVERSAL OIL PRODUCTS COMPANY
RESEARCH LABORATORIES
CHICAGO, ILLINOIS

American Chemical Society
Monograph Series

REINHOLD PUBLISHING CORPORATION
330 WEST FORTY-SECOND STREET, NEW YORK, U. S. A.

1946

COPYRIGHT, 1946, BY
REINHOLD PUBLISHING CORPORATION

*All rights reserved*

*Printed in the United States of America by*
THE HADDON CRAFTSMEN, INC., SCRANTON, PA.

Dedicated to
JOSEPH G. ALTHER

# GENERAL INTRODUCTION

## American Chemical Society Series of Chemical Monographs

By arrangement with the Interallied Conference of Pure and Applied Chemistry, which met in London and Brussels in July, 1919, the American Chemical Society was to undertake the production and publication of Scientific and Technologic monographs on chemical subjects. At the same time it was agreed that the National Research Council, in cooperation with the American Chemical Society and the American Physical Society, should undertake the production and publication of Critical Tables of Chemical and Physical Constants. The American Chemical Society and the National Research Council mutually agreed to care for these two fields of chemical development. The American Chemical Society named as Trustees, to make the necessary arrangements for the publication of the monographs, Charles L. Parsons, secretary of the Society, Washington, D. C.; the late John E. Teeple, then treasurer of the Society, New York; and Professor Gellert Alleman of Swarthmore College. The Trustees arranged for the publication of the A.C.S. series of (a) Scientific and (b) Technologic Monographs by the Chemical Catalog Company, Inc. (Reinhold Publishing Corporation, successors) of New York.

The Council of the American Chemical Society, acting through its Committee on National Policy, appointed editors (the present list of whom appears at the close of this introduction) to select authors of competent authority in their respective fields and to consider critically the manuscripts submitted.

The first monograph of the series appeared in 1921. After twenty-three years of experience certain modifications of general policy are indicated. In the beginning there still remained from the preceding five decades a distinct though arbitrary differentiation between so-called "pure science" publications and technologic or applied science literature. This differentiation is fast becoming nebulous. Research in private enterprise has grown apace and not a little of it is pursued on the frontiers of knowledge. Furthermore, most workers in the sciences are coming to see the artificiality of the separation. The methods of both groups of workers are the same. They employ the same instrumentalities, and now frankly recognize that their objectives are common, namely the search for new knowledge for the service of man. The officers of the

Society therefore have combined the two editorial Boards in a single Board of twelve representative members.

Also in the beginning of the series, it seemed expedient to construe rather broadly the definition of a monograph. Needs of workers had to be recognized. Consequently among the first one hundred monographs appeared works in the form of treatises covering in some instances rather broad areas. Because such necessary works do not now want for publishers, it is considered advisable to hew more strictly to the line of the monograph character which means more complete and critical treatment of relatively restricted areas, and where a broader field needs coverage, to subdivide it into logical sub-areas. The prodigious expansion of new knowledge makes such a change desirable.

These monographs are intended to serve two principal purposes: first, to make available to chemists a thorough treatment of a selected area in form usable by persons working in more or less unrelated fields to the end that they may correlate their own work with a larger area of physical science discipline; second, to stimulate further research in the specific field treated. To implement this purpose the authors of monographs are expected to give extended references to the literature. Where the literature is of such volume that a complete bibliography is impracticable, the authors are expected to append a list of references critically selected on the basis of their relative importance and significance.

AMERICAN CHEMICAL SOCIETY

BOARD OF EDITORS

F. W. WILLARD, *Editor of Monographs*

T. H. CHILTON
W. M. CLARK
L. F. FIESER
J. BENNETT HILL
S. C. LIND
C. H. MATHEWSON
LINUS C. PAULING
W. T. READ
WALTER A. SCHMIDT
C. A. THOMAS
E. R. WEIDLEIN
W. G. WHITMAN

# Preface

The abundance of mononuclear aromatic hydrocarbons found in the world's resources, such as coal tar and petroleum, calls for a complete study of their physical constants. The present study is a collation of all melting point, boiling point, density, and refractive index data available before May, 1944. War-time restrictions have prevented the incorporation of some valuable data determined under the auspices of the American Petroleum Institute at the National Bureau of Standards.

We are indeed grateful to the staff of John Crerar Library for valuable guidance in the location of material and for privileges granted in connection with use of the outstanding facilities of this institution.

Deep appreciation is hereby expressed for the assistance of the Universal Oil Products Company and the author's colleagues, Mary Alexander, Prudence Van Arsdell, Nancy Corbin, Madge Spiegler, and M. S. Beyt in this collation and critical study of the physical constants of aromatic hydrocarbons.

GUSTAV EGLOFF

Chicago, Ill.,
May 1, 1945

# Contents

*Volume III*


| | | Page |
|---|---|---|
| | General Introduction | v |
| | Preface | vii |
| I. | Introduction | 1 |
| | Foreword | 1 |
| | History of Benzene | 2 |
| | Organization of Compounds | 6 |
| | Nomenclature | 9 |
| | Critical Evaluation of the Data and Calculation of the Most Probable Values | 14 |
| | Precision and Accuracy of the Data | 14 |
| | Method of Calculation | 15 |
| | Melting Points | 19 |
| | Boiling Points | 20 |
| | Specific Gravity | 21 |
| | Refractive Index | 22 |
| | Additional Data | 23 |
| II. | Benzene and Its Aliphatic Derivatives | 24 |
| 1. | Benzene, $C_nH_{2n-6}$ | 25 |
| 2. | Benzene with Alkyl Substitutions, $C_nH_{2n-6}$ | 47 |
| 3. | Benzene with One Alkenyl Substitution $C_nH_{2n-8}$ | 188 |
| 4. | Benzene with One Alkynyl Substitution, $C_nH_{2n-10}$ | 234 |
| 5. | Benzene with One Alkadienyl Substitution, $C_nH_{2n-10}$ | 242 |
| 6. | Benzene with Two Alkenyl Substitution, $C_nH_{2n-10}$ | 251 |
| 7. | Benzene with One Alkenynyl Substitution, $C_nH_{2n-12}$ | 254 |
| 8. | Benzene with One Alkatrienyl Substitution, $C_nH_{2n-12}$ | 256 |
| 9. | Benzene with One Alkadiynyl Substitution, $C_nH_{2n-14}$ | 257 |
| 10. | Benzene with One Alkatetraenyl Substitution, $C_nH_{2n-14}$ | 258 |
| 11. | Benzene with Two Alkynyl Substitutions, $C_nH_{2n-14}$ | 259 |
| 12. | Benzene with One Alkatriynyl Substitution, $C_nH_{2n-18}$ | 260 |
| III. | Benzene with Alicyclic Substitutions | 261 |
| 1. | Benzene with One Cyclyl Substitution, $C_nH_{2n-8}$ | 262 |
| 2. | Benzene with One Cyclenyl, One Cyclylidenyl, or One Cyclylalkenyl Substitution, $C_nH_{2n-10}$ | 275 |
| 3. | Benzene with One Bicyclyl Substitution, $C_nH_{2n-10}$ | 290 |
| 4. | Benzene with Two Cyclyl Substitutions, $C_nH_{2n-10}$ | 292 |
| 5. | Benzene with One Cyclodienyl, One Alkenylcyclenyl, or One Dialkenylcyclyl Substitution, $C_nH_{2n-12}$ | 296 |
| 6. | Benzene with One Bicyclenyl, One Alkenylbicyclyl, or One Bicylylidene Substitution, $C_nH_{2n-12}$ | 300 |
| 7. | Benzene with One Tricyclyl Substitution, $C_nH_{2n-12}$ | 305 |
| 8. | Benzene with One Cyclyl and One Cyclenyl or Cyclylidene Substitution, $C_nH_{2n-12}$ | 306 |
| 9. | Benzene with Three Cyclyl Substitutions, $C_nH_{2n-12}$ | 307 |
| 10. | Benzene with One Cyclenylalkynyl Substitution, $C_nH_{2n-14}$ | 308 |
| 11. | Benzene with One Alkenylcyclodienyl Substitution, $C_nH_{2n-14}$ | 309 |
| 12. | Benzene with One Bicyclenylalkenyl Substitution, $C_nH_{2n-14}$ | 310 |

| | | Page |
|---|---|---|
| 13. | Benzene with Two Cyclenyl Substitutions, $C_nH_{2n-14}$ | 311 |
| 14. | Benzene with Four Cyclyl Substitutions, $C_nH_{2n-14}$ | 312 |
| 15. | Benzene with One Bicyclenylalkynyl Substitution, $C_nH_{2n-16}$ | 313 |
| 16. | Benzene with Two Cyclylcyclenyl Substitutions, $C_nH_{2n-18}$ | 314 |
| 17. | Benzene with One Bicyclylpentaenyl Substitution, $C_nH_{2n-20}$ | 315 |
| IV. | Biphenyl and Its Aliphatic Derivatives | 316 |
| 1. | Biphenyl, $C_nH_{2n-14}$ | 317 |
| 2. | Biphenyl with Alkyl Substitutions, $C_nH_{2n-14}$ | 324 |
| 3. | Biphenyl with One Alkenyl Substitution, $C_nH_{2n-16}$ | 339 |
| 4. | Biphenyl with Two Alkenyl Substitutions, $C_nH_{2n-18}$ | 341 |
| V. | Two Phenyl Substitutions on Aliphatics | 342 |
| 1. | Two Phenyl Substitutions on Alkanes, $C_nH_{2n-14}$ | 343 |
| 2. | Two Phenyl Substitutions on Alkenes, $C_nH_{2n-16}$ | 390 |
| 3. | Two Phenyl Substitutions on Alkynes, $C_nH_{2n-18}$ | 420 |
| 4. | Two Phenyl Substitutions on Alkadienes, $C_nH_{2n-18}$ | 425 |
| 5. | Two Phenyl Substitutions on Alkenynes, $C_nH_{2n-20}$ | 431 |
| 6. | Two Phenyl Substitutions on Alkatrienes, $C_nH_{2n-20}$ | 432 |
| 7. | Two Phenyl Substitutions on Alkadiynes, $C_nH_{2n-22}$ | 434 |
| 8. | Two Phenyl Substitutions on Alkadienynes, $C_nH_{2n-22}$ | 437 |
| 9. | Two Phenyl Substitutions on Alkatetraenes, $C_nH_{2n-22}$ | 438 |
| 10. | Two Phenyl Substitutions on Alkapentaenes, $C_nH_{2n-24}$ | 439 |
| 11. | Two Phenyl Substitutions on Alkahexaenes, $C_nH_{2n-26}$ | 440 |
| 12. | Two Phenyl Substitutions on Alkaheptaenes, $C_nH_{2n-28}$ | 441 |
| 13. | Two Phenyl Substitutions on Alkatetraynes, $C_nH_{2n-30}$ | 442 |
| 14. | Two Phenyl Substitutions on Alkaoctaenes, $C_nH_{2n-30}$ | 443 |
| 15. | Two Phenyl Substitutions on Alkaundecaenes, $C_nH_{2n-36}$ | 444 |
| VI. | Biphenyl with Alicyclic Substitutions | 445 |
| 1. | Biphenyl with One Cyclyl Substitution, $C_nH_{2n-16}$ | 446 |
| 2. | Biphenyl with One Cyclenyl Substitution, $C_nH_{2n-18}$ | 447 |
| 3. | Biphenyl with Two Cyclyl Substitutions, $C_nH_{2n-18}$ | 448 |
| VII. | Two Phenyl Substitutions on Alicyclics or Alicyclicaliphatics and Alicyclicdiphenyl Substitutions on Aliphatics | 449 |
| 1. | Two Phenyl Substitutions on Cyclanes or Two Phenyl and One Cyclyl Substitutions on Alkanes, $C_nH_{2n-16}$ | 450 |
| 2. | Two Phenyl Substitutions on Cyclenes, Two Phenyl and One Cyclylidene Substitutions on Alkanes, or Two Phenyl and One Cyclyl Substitutions on Alkenes, $C_nH_{2n-18}$ | 456 |
| 3. | Two Phenyl Substitutions on Bicyclanes, $C_nH_{2n-18}$ | 459 |
| 4. | Two Phenylalkyl Substitutions on Dicyclanes, $C_nH_{2n-18}$ | 460 |
| 5. | Two Cyclylphenyl or Two Cyclyl and Two Phenyl Substitutions on Alkanes, $C_nH_{2n-18}$ | 461 |
| 6. | Two Phenyl Substitutions on Cyclodienes, $C_nH_{2n-20}$ | 462 |
| 7. | Two Phenyl Substitutions on Alkenylcyclenes or Alkylidenecyclenes, $C_nH_{2n-20}$ | 464 |
| 8. | Two Phenyl Substitutions on Bicyclenes, $C_nH_{2n-20}$ | 466 |
| 9. | Two Phenyl Substitutions on Tricyclanes, $C_nH_{2n-20}$ | 467 |
| 10. | Two Phenyl Substitutions on Bicyclodienes, $C_nH_{2n-22}$ | 468 |
| 11. | Two Phenyl Substitutions on Tricyclylalkenes or Tricyclenes, $C_nH_{2n-22}$ | 469 |
| 12. | Two Phenyl and One Cyclodienylidene Substitutions on Alkanes, $C_nH_{2n-22}$ | 470 |
| 13. | Two Dicyclylphenyl Substitutions on Alkanes, $C_nH_{2n-22}$ | 471 |
| VIII. | Terphenyls and Their Aliphatic Derivatives | 472 |
| 1. | Terphenyls and Their Alkyl Derivatives, $C_nH_{2n-22}$ | 473 |

Page

IX. Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Aliphatics 479

1. Triphenylalkyl Radicals 480
2. Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Alkanes, or Two Phenylalkyl Substitutions on Benzene, $C_nH_{2n-22}$ 481
3. Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Alkenes, $C_nH_{2n-24}$ 503
4. Three Phenyl Substitutions on Alkynes, $C_nH_{2n-26}$ 512
5. Three Phenyl Substitutions on Alkadienes or Two Phenylalkenyl Substitutions on Benzene, $C_nH_{2n-26}$ 513
6. Three Phenyl Substitutions on Alkenynes, $C_nH_{2n-28}$ 516
7. Three Phenyl Substitutions on Alkatrienes, $C_nN_{2n-28}$ 517

X. Terphenyls with Alicyclic Substitutions 518

1. Terphenyls with Two Cyclyl Substitutions, $C_nH_{2n-26}$ 519

XI. Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Alicyclics 520

1. Three Phenyl Substitutions on Cyclanes or Cyclylalkanes, $C_nH_{2n-24}$ 521
2. Three Phenyl Substitutions on Cyclenes, $C_nH_{2n-26}$ 523
3. Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Cyclodienes, $C_nH_{2n-28}$ 524
4. Three Phenyl Substitutions on Alkylidenecyclodienes, $C_nH_{2n-30}$ 527

XII. Quatraphenyls and Their Aliphatic Derivatives 528

1. Quatraphenyls and Their Alkyl Derivatives, $C_nH_{2n-30}$ 529

XIII. Four Phenyl, Two Phenyl and One Biphenylyl, or Two Biphenylyl Substitutions on Aliphatics 533

1. Four Phenyl, Two Phenyl and One Biphenylyl, or Two Biphenylyl Substitutions on Alkanes, $C_nH_{2n-30}$ 534
2. Four Phenyl, Two Phenyl and One Biphenylyl, or Two Biphenylyl Substitutions on Alkenes, $C_nH_{2n-32}$ 552
3. Four Phenyl or Two Biphenylyl Substitutions, on Alkynes, $C_nH_{2n-34}$ 561
4. Four Phenyl or Two Biphenylyl Substitutions on Alkadienes, $C_nH_{2n-34}$ 563
5. Four Phenyl Substitutions on Alkatrienes, $C_nH_{2n-36}$ 571
6. Four Phenyl Substitutions on Alkadiynes, $C_nH_{2n-38}$ 574
7. Four Phenyl Substitutions on Alkatetraenes, $C_nH_{2n-38}$ 575
8. Four Phenyl Substitutions on Alkapentaenes, $C_nH_{2n-40}$ 576
9. Four Phenyl Substitutions on Alkahexaenes, $C_nH_{2n-42}$ 578

XIV. Four Phenyl Substitutions on Alicyclics 579

1. Four Phenyl Substitutions on Cyclanes or Cyclylalkanes, $C_nH_{2n-32}$ 580
2. Four Phenyl and Two Cyclyl Substitutions on Alkanes, $C_nH_{2n-34}$ 583
3. Four Phenyl Substitutions on Cyclodienes or Cyclodiylidenes, $C_nH_{2n-36}$ 584
4. Four Phenyl Substitutions on Cyclotrienes, Cyclodienylidenes, or Dialkenylspiranes, $C_nH_{2n-38}$ 586
5. Four Phenyl Substitutions on Cyclotetraenes or Cyclodienyldiylidenes, $C_nH_{2n-40}$ 588
6. Four Phenyl Substitutions on Dicyclenes, $C_nH_{2n-40}$ 591

| | | Page |
|---|---|---|
| XV. | Quinquaphenyls and Their Aliphatic Derivatives | 592 |
| | 1. Quinquaphenyls and Their Alkyl Derivatives, $C_nH_{2n-38}$ | 593 |
| XVI. | Five Phenyl, Three Phenyl and One Biphenylyl, or One Phenyl and Two Biphenylyl Substitutions on Aliphatics | 595 |
| | 1. Five Phenyl, Three Phenyl and One Biphenylyl, or One Phenyl and Two Biphenylyl Substitutions on Alkanes, $C_nH_{2n-38}$ | 596 |
| | 2. Five Phenyl, Three Phenyl and One Biphenylyl, or One Phenyl and Two Biphenylyl Substitutions on Alkenes, $C_nH_{2n-40}$ | 601 |
| | 3. Five Phenyl Substitutions on Alkadienes, $C_nH_{2n-42}$ | 603 |
| | 4. Five Phenyl Substitutions on Alkatrienes, $C_nH_{2n-44}$ | 604 |
| XVII. | Five Phenyl Substitutions on Alicyclics | 605 |
| | 1. Five Phenyl Substitutions on Cyclanes, $C_nH_{2n-40}$ | 606 |
| | 2. Five Phenyl Substitutions on Cyclodienes, $C_nH_{2n-44}$ | 607 |
| | 3. Five Phenyl Substitutions on Cyclodienylidenes, $C_nH_{2n-46}$ | 608 |
| XVIII. | Sexaphenyls and Their Aliphatic Derivatives | 609 |
| | 1. Sexaphenyls and Their Alkyl Derivatives, $C_nH_{2n-46}$ | 610 |
| XIX. | Six Phenyl, Four Phenyl and One Biphenylyl, Two Phenyl and Two Biphenylyl, or Three Biphenylyl Substitutions on Aliphatics | 612 |
| | 1. Six Phenyl, Four Phenyl and One Biphenylyl, Two Phenyl and Two Biphenylyl, or Three Biphenylyl Substitutions on Alkanes, $C_nH_{2n-46}$ | 613 |
| | 2. Six Phenyl or Two Phenyl and Two Biphenylyl Substitutions on Alkenes, $C_nH_{2n-48}$ | 621 |
| | 3. Six Phenyl Substitutions on Alkynes, $C_nH_{2n-50}$ | 623 |
| | 4. Six Phenyl Substitutions on Alkadienes, $C_nH_{2n-50}$ | 624 |
| | 5. Six Phenyl Substitutions on Alkatrienes, $C_nH_{2n-52}$ | 626 |
| | 6. Six Phenyl Substitutions on Alkadiynes, $C_nH_{2n-54}$ | 627 |
| | 7. Six Phenyl Substitutions on Alkahexaenes, $C_nH_{2n-58}$ | 628 |
| XX. | Six Phenyl Substitutions on Alicyclics | 629 |
| | 1. Six Phenyl Substitutions on Cyclanes, $C_nH_{2n-48}$ | 630 |
| | 2. Six Phenyl Substitutions on Cyclodienes, $C_nH_{2n-52}$ | 631 |
| | 3. Six Phenyl Substitutions on Cyclodienylidenes, $C_nH_{2n-54}$ | 632 |
| XXI. | Compounds Containing Seven Phenyl Groups | 633 |
| | 1. Septaphenyls, $C_nH_{2n-54}$ | 634 |
| | 2. Seven Phenyl or Three Phenyl and Two Biphenylyl Substitutions on Alkanes, $C_nH_{2n-54}$ | 636 |
| | 3. One Phenylalkynyl Substitution on Sexaphenyl, $C_nH_{2n-58}$ | 638 |
| | 4. Seven Phenyl Substitutions on Cyclanes, $C_nH_{2n-56}$ | 639 |
| XXII. | Compounds Containing Eight Phenyl Groups and Aliphatic Groups | 640 |
| | 1. Octaphenyl, $C_nH_{2n-62}$ | 641 |
| | 2. Eight Phenyl, Two Phenyl and Three Biphenylyl, or Four Biphenylyl Substitutions on Alkanes, $C_nH_{2n-62}$ | 642 |
| | 3. Four Biphenylyl Substitutions on Alkenes, $C_nH_{2n-64}$ | 645 |
| | 4. Eight Phenyl Substitutions on Alkadienes, $C_nH_{2n-66}$ | 646 |

Page

XXIII. Compounds Containing Nine Phenyl Groups 647

1. Nonaphenyl, $C_nH_{2n-70}$ 648
2. One Phenyl and Four Biphenylyl Substitutions on Alkanes, $C_nH_{2n-70}$ 649

XXIV. Compounds Containing Ten Phenyl Groups 651

1. Decaphenyls, $C_nH_{2n-78}$ 652
2. Five Biphenylyl Substitutions on Alkanes, $C_nH_{2n-78}$ 653
3. Ten Phenyl Substitutions on Alkahexaenes, $C_nH_{2n-90}$ 654

XXV. Higher Phenyl Compounds 655

1. Undecaphenyl, $C_nH_{2n-86}$ 656
2. Duodecaphenyl, $C_nH_{2n-94}$ 657
3. Tridecaphenyl, $C_nH_{2n-102}$ 658
4. Tetradecaphenyl, $C_nH_{2n-110}$ 659
5. Quinquedecaphenyl, $C_nH_{2n-118}$ 660
6. Sexadecaphenyl, $C_nH_{2n-126}$ 661

# I. INTRODUCTION

## Foreword

The present volume of Physical Constants of Hydrocarbons, the third of the series, is a collation and evaluation of physical constants of mononuclear aromatic hydrocarbons. This classification excludes hydrocarbons having a fused ring structure, any ring of which is aromatic. *Biphenyl* and *bicycloheptylbenzene* appear in this volume, but polynuclear aromatics such as *indane* and *tetralin* will appear in Volume IV. The constants of aliphatic and alicyclic hydrocarbons were published in Volumes I and II respectively.

The values tabulated in this volume were collected from the literature and unpublished data from Universal Oil Products Company and other research laboratories. The method used for searching is given here to indicate the degree of completeness of the study. References on hydrocarbons were located by a check of the subject and formula indexes of *Chemical Abstracts* from its beginning through 1943 and the subject and formula indexes of *Chemisches Zentralblatt* from 1900 through 1939. The check on these journals was brought up to date through a page by page perusal of *Chemical Abstracts* from January to May 1944 and the issues of *Chemisches Zentralblatt* that have been available since 1940. Beilstein's "Handbuch der Organische Chemie," Volumes V and Supplement V, were covered to find references published before 1900 and to insure thorough coverage of the later literature. The Landolt-Börnstein "Tabellen," which contain references on physical chemistry, were also checked because of the specific nature of the contents. Other secondary sources were covered in part, but sufficient additional material was not found to warrant complete coverage. Some references came to our attention while studying the current chemical literature. The original publications of the references thus located were then covered with the exception of a few which were unavailable or printed in languages other than English, French, German, Italian, Russian, and Spanish. From the bibliographies of the original publications covered, many additional references were found. The research involved a total of about 20,000 references of which approximately 5,500 contained data suitable for this volume and Volume IV.

The constants recorded were melting points at all given pressures, boiling points at all pressures, densities at all temperatures, refractive indices of the sodium D, hydrogen $\alpha$, $\beta$, and $\gamma$, and helium lines at all temperatures, angles of rotation at the sodium D lines at all temperatures, critical temperatures, critical pressures, critical densities, and sublimation points. Melting ranges over two degrees were not recorded except in unusual cases. Pentarylethanes, for example, decompose on melting in

air and consequently give wide melting point ranges. These ranges were recorded as well as wide ranges for compounds on which no other data were available. Boiling point ranges over five degrees were omitted and smaller ranges were eliminated when considerable data were available for a compound.

All figures were recorded as given when the original was read, but during the final editing all units of temperature were converted to degrees centigrade. For the conversion of Absolute or Kelvin temperatures, 273°, 273.2°, or 273.16° was subtracted, according to the number of significant figures of the original reading. All units of pressure were converted to millimeters of mercury except melting point pressures, which were converted to atmospheres. Values from obviously careless determinations were not recorded. At the time they were abstracted, all values were given a rating on a scale on which one unit represented the poorest work and five the best. In cases where considerable data were available, the poorer values were eliminated from the tabulation. For example, benzene values were abstracted from over one thousand references but it was thought worthwhile to record the constants from only the best four hundred of these. Despite our efforts to make the search complete and accurate we have probably omitted some data and erred in some of the tabulations. We should appreciate having any omissions or errors called to our attention.

## History of Benzene

Benzene, the parent mononuclear aromatic hydrocarbon, was discovered by Michael Faraday in 1825.[1] Although liquids of which benzene was doubtless the principal constituent were described in earlier records, Faraday was the first to isolate benzene and determine its physical and chemical properties.[2] The source from which he obtained it was the oil-gas used for illuminating purposes. He named the compound "bicarburet of hydrogen," but Mitscherlich, who prepared the same compound by the distillation of benzoic acid with lime, chose to call it "benzin".[3] This name, with variations in spelling, has been used since that time. Mitscherlich identified his compound with that of Faraday on the basis of corresponding physical and chemical properties, and in addition determined its empirical formula.

Table 1.

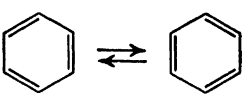
| | Faraday (1825) | Mitscherlich (1833) | Calculated Values[4] (1945) |
|---|---|---|---|
| M. P. | 5.6° | 7° | 5.49° |
| B. P. | 85.6° | 86° | 80.07° |
| D (liquid) | 0.85@15.5° | 0.85 | 0.88343@15.5° |
| D (solid) | 0.956 | | 1.00643@ 5.5° |

1. Faraday, M., Phil. Trans. 1825, 440.
2. Lunge, G., "Coal-Tar and Ammonia," 4th ed., Gurney and Jackson, London, 1909, p. 1148.
3. Mitscherlich, E., Ann. Physik 29, 231 1833.
4. These values were calculated from the equations derived for the present volume of "Physical Constants of Hydrocarbons."

In 1845, Hofmann reported the presence of benzene in coal tar,[5] but prior discovery was claimed by Leigh, who contended that his report of 1842 had not received proper publication.[6,7] This discovery was highly important in that it revealed a source of benzene and other aromatics sufficiently large to meet the commercial demands soon created by Perkin's discovery of mauve in 1856. Another potentially large commercial source was first made known by De La Rue and Müller's discovery of benzene in "Burmese naphtha" or "Rangoon tar" which is known today as petroleum.[8] Coal gas, a source of benzene widely used in the early days of the aromatic industry, was suggested as a source by Faraday, but Berthelot's publications in 1876 were the first to report experimental evidence of the presence of benzene in coal gas.[9]

Although the problem of the structure of benzene and its derivatives has confronted chemists since the compound was known, some features of aromatic behavior have been clarified only since the concept of resonance was set forth. The classical conception of double bonds involves a type of reactivity consistent with their use in aliphatic and alicyclic structures but inconsistent with aromatic behavior. Kekulé's proposal proved for a long time to be the most adequate conception of the structure of benzene and has laid the groundwork for the present theoretical concept.[10] The original formula, a conjugated cyclohexatriene, immediately raised objections, for only one *ortho* disubstitution product was known, whereas two were possible from Kekulé's structure.

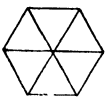
Furthermore, the high degree of unsaturation would result in greater reactivity than was observed with benzene. Kekulé then modified his original theory by proposing a system of oscillating double bonds as represented by the following diagram.[11]



Although this theory has been modified in the light of resonance, the above forms are accepted as two resonance structures.

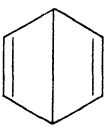
5. Hofmann, A. W., Ann. **55**, 200 **1845**.
6. Leigh, Brit. Assoc. Advancement Sci., Rept. **12**, sec. 2, 39 **1842**.
7. Lunge, G., "Coal-Tar and Ammonia," 4th ed., Gurney and Jackson, London, 1909, p. 177.
8. De La Rue, W., and H. Müller, Proc. Roy. Soc. **8**, 221 **1856**.
9. Berthelot, Compt. rend. **82**, 871 **1876**.
10. Kekulé, A., Bull. soc. chim. [2] **3**, 98 **1863**.
11. Kekulé, A., Ann. **162**, 77 **1872**.

Other structures, proposed by Kekulé's contemporaries, sufficiently plausible to receive some consideration were those of Claus, Dewar, Ladenberg, Armstrong, Baeyer, and Thiele. Claus's formula in which all carbon atoms have one *para* bond is ruled out because such a structure represents a compound with considerable tendency to react.



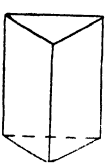
(Claus 1867)

For the same reason, Dewar's formula is highly improbable.[12]



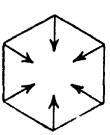
(Dewar 1866)

This symbol has been used, however, to represent one of the less stable resonance structures.[13] Ladenburg's prismatic formula[14] is not possible, since it has been established that the benzene ring lies in one plane.



(Ladenburg 1869)

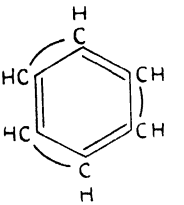
The Armstrong-Baeyer centric formula[15] is meaningless unless the bonds pointing toward the center are interpreted as free valences. Such a condition would result in a compound having a greater tendency to react than is exhibited by benzene.



(Armstrong-Baeyer 1887)

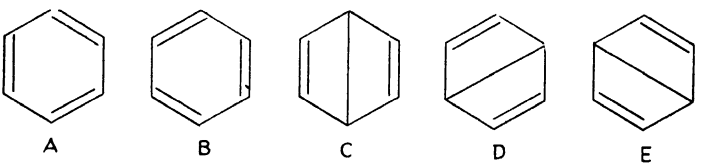
Thiele's partial valence theory[16] is also vague in that the curved lines have no significance in our concept of valences.

12. Dewar, Proc. Roy. Soc. Edinburgh **1866-7**, 82.
13. Pauling, L., and G. W. Wheland, J. Chem. Phys. **3**, 362 **1933**.
14. Ladenburg, A., Ber. **2**, 140 **1869**.
15. Armstrong, H. E., J. Chem. Soc. **51**, 258 **1887**; A. Baeyer, Ann. **245**, 103 **1888**, *ibid.* **251**, 257 **1899**.
16. Thiele, J., Ann. **506**, 87 **1899**.




(Thiele 1899)

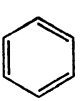
The concept of the benzene molecule set forth by the theory of resonance is a structure which may be represented essentially by the following symbols:[17]




Resonance among these structures imparts to benzene its characteristics which are peculiar to aromatic compounds. The resonance energy resulting from the resonance between these structures causes the molecule to be more stable than if it existed in any one of the resonance structures alone. The molecule does not behave as if its structure shifted from one of these symbols to another. Its behavior coincides with one permanent structure functioning as a composite of the various resonance structures. The Kekulé structures, A and B, are far more important than the others, for the resonance energy between them is about 80 per cent of the total. The excited structures C, D, and E, which are much less stable than A and B, contribute about 20 per cent of the resonance energy. For a detailed discussion of this subject, the reader is referred to Wheland.[18]

The inadequacy of any single formula for benzene has prompted many chemists to adopt the symbol

In the tables of this book we have arbitrarily used the structure

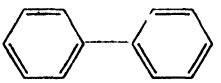


for benzene to avoid confusion with six-carbon alicyclic structures.

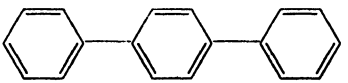
17. Pauling, L., and G. W. Wheland, J. Chem. Phys. 1, 362 1933.
18. Wheland, G. W., "Theory of Resonance," John Wiley and Sons, Inc., New York, 1944.

**Organization of Compounds**

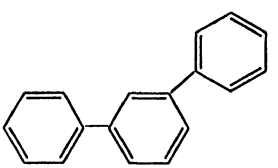
The organization of this volume will be reviewed to facilitate the location of information and to explain the significance of data given in the tables. The titles and corresponding initial pages of all general classifications and sections are found in the Table of Contents. The general classifications are arranged in order with increasing number of benzene rings, *i.e.*, all compounds containing only one benzene ring, are tabulated before *biphenyl*,



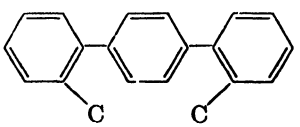
all compounds with two benzene rings before *terphenyl*, etc.



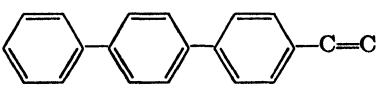
Compounds of more than ten phenyl groups are listed under the general classification, Higher Phenyl Compounds. These general classifications are further limited by the general nature of substituents, *i.e.*, benzene with aliphatic substituents precedes benzene with alicyclic substituents. Classifications of compounds having two or more benzene rings are so made that compounds with phenyl-phenyl linkages are listed separately and precede compounds with two or more phenyl substitutions on aliphatics or alicyclics. For example, classifications including (A), (B), and (C)



1,3-Diphenylbenzene
(A)

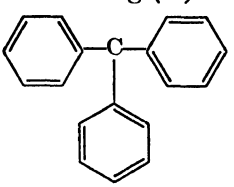



1,4-Di-*o*-tolylbenzene
(B)

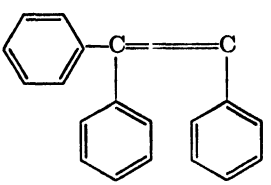



1-Phenyl-4-(4′-ethenylphenyl)-benzene
(C)

precede those including (D) and (E).

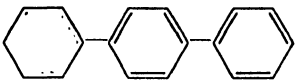



Triphenylmethane
(D)

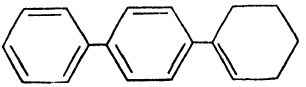



1,1,2-Triphenylethene
(E)

Classifications including compounds such as (F) and (G)



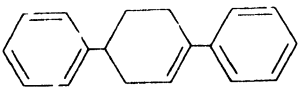
1-Cyclohexyl-4-phenylbenzene
(F)



1-(Cyclohexen-1′-yl)-4-phenylbenzene
(G)

precede those including (H) and (I).

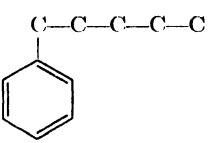
1,4-Diphenylcyclohexane
(H)



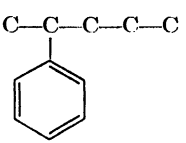
1,4-Diphenylcyclohexene-1
(I)

The sections numbered with arabic numerals under a given classification are listed in order of decreasing hydrogen content of the compounds. If the hydrogen content of the compounds in two or more sections is equal, the sections for aliphatic substituents are listed primarily in order of increasing number of unsaturated linkages, *i.e.*, Alkynylbenzenes ($C_nH_{2n-10}$), Alkadienylbenzenes ($C_nH_{2n-10}$), Dialkenylbenzenes ($C_nH_{2n-10}$); the sections for alicyclic compounds are listed primarily in order of increasing number of alicyclic substituents, secondly in order of increasing complexity within the substituent, *i.e.*, Cyclenylbenzenes ($C_nH_{2n-10}$), Bicyclylbenzenes ($C_nH_{2n-10}$), Dicyclylbenzenes ($C_nH_{2n-10}$).

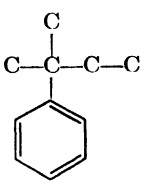
Within each section, the compounds are tabulated primarily in order of increasing carbon content. The order used for compounds having a given carbon content was assigned in accordance with increasing number and complexity of substituents, *e.g.*:



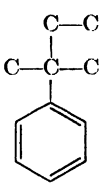
(1) *n*-Pentylbenzene



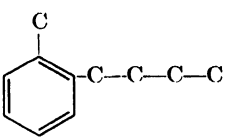
(2) 2-Phenylpentane



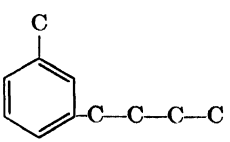
(3) 2-Phenyl-2-methylbutane



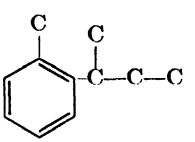
(4) 2-Phenyl-2-ethylpropane



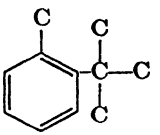
(5) 1-Methyl-2-*n*-butylbenzene



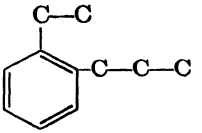
(6) 1-Methyl-3-*n*-butylbenzene



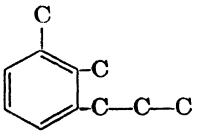
(7) 1-Methyl-2-*sec*-butylbenzene



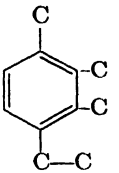
(8) 1-Methyl-2-*tert*-butylbenzene



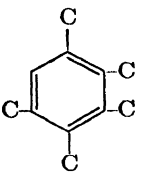
(9) 1-Ethyl-2-*n*-propylbenzene



(10) 1,2-Dimethyl-3-*n*-propylbenzene

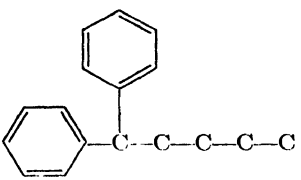


(11) 1,2,3-Trimethyl-4-ethylbenzen

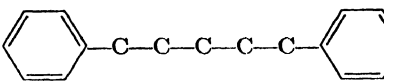


(12) Pentamethylbenzene

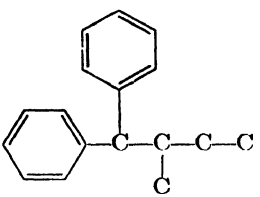
The compounds having two phenyl groups substituted on aliphatics fol in the order:



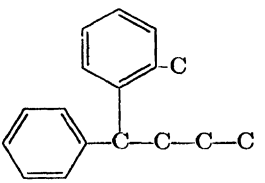
(1) 1,1-Diphenylpentane



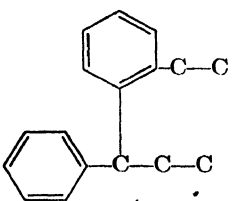
(2) 1,5-Diphenylpentane



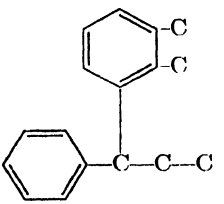
(3) 1,1-Diphenyl-2-methylbutane



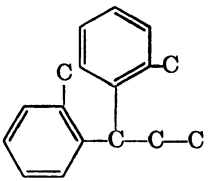
(4) 1-Phenyl-1-*o*-tolylbutane



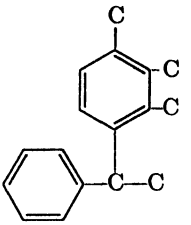
(5) 1-Phenyl-1-(2′-ethylphenyl)-propane



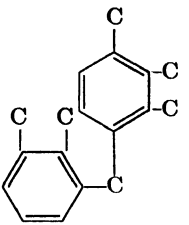
(6) 1-Phenyl-1-(2′,3′-dimethylpheny propane



(7) 1,1-Di-*o*-tolylpropane



(8) 1-Phenyl-1-(2′,3′,4′-trimethylphenyl)-ethane



(9) 2,3-Dimethylphenyl-(2′,3′,4′-trimethylphenyl)-methane

The page number of each group of references is listed in the table of contents. References are found at the end of each section except for those having a large number of references. In these cases, the references will be found immediately following the constants of a single compound or the compounds of a given carbon content. The references include the author's name and initials as stated in the original publication, the standard abbreviation for the periodical, the volume number, first page of the article, and year of publication. References to secondary sources also are given for those articles not read in original form. All Russian names have been transliterated in accordance with *Chemical Abstracts*' practice to standardize spelling and to avoid the duplication of references. For example, the Russian name transliterated to Wolnow in the German literature is recorded in this study as Volnov.

## Nomenclature

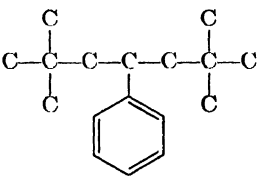
In the absence of a system of nomenclature covering all types of mononuclear aromatics, the compounds in this book have been assigned scientific names compounded from the Geneva rules[19] and Proposed International Rules[20] for numbering ring systems. The deviations which were made in the interests of simplifying some of the nomenclature will be explained. Each compound has primarily been given a name which should not be ambiguous. Secondly, an attempt was made to regard the benzene ring as nuclear, but this practice was not followed when it involved the use of unnecessarily complicated nomenclature. The names used are strictly in accordance with scientific practice except for compounds which have a

19. Patterson, A. M., J. Am. Chem. Soc. **55**, 3905 1933.
20. Patterson, A. M., and L. T. Capell, "The Ring Index," Reinhold Publishing Corp., New York, 1940.

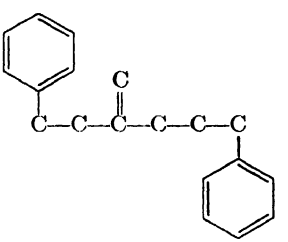
classic trivial name that has been used almost exclusively in the literature. Compounds with a trivial name well known to workers in a specific field but not to chemists in general are given the scientific names with common names and alternative scientific names in parentheses beneath the preferred name. An example of this type is Isopropylbenzene (Cumene).

Illustrations of preferred and alternative scientific nomenclature follow. The name 1,4-Di-*n*-propylbenzene is used in preference to 1-(4′-*n*-Propylphenyl)-propane, but 1-Phenyl-2-methylbutane is preferred to (2′-Methylbutyl)-benzene. Other examples include the use of 1-Phenyl-2,4-dimethylcyclohexane rather than (2′,4′-Dimethylcyclohexyl)-benzene and the use of 4,4′-Diethylbiphenyl in preference to 1-Ethyl-4-(4′-ethylphenyl)-benzene.

When names were assigned with reference to aliphatic nuclei, the longest straight chain was named as the nuclear hydrocarbon. For example, the compound below is named 2,2,6,6-Tetramethyl-4-phenylheptane rather than 1,3-Di-*tert*-butyl-2-phenylpropane.

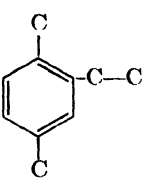


This practice was also followed for compounds having unsaturated substituents, *i.e.*, 1,6-Diphenyl-3-methylenehexane was used in preference to 2-Phenethyl-5-phenylpentene-1.



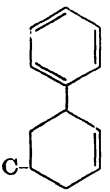
Except for bicyclyl and tricyclyl derivatives, such as 2-Phenylbicyclo-[2,2,0]-hexane and 3-Phenyltricyclo-[2,2,1,$0^{2,5}$]-heptane, numbers were assigned to substituents according to the following specifications:

(1) The sum of numbers assigned to the substituents and unsaturated linkages was the lowest possible numerical value.



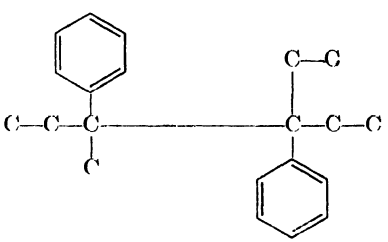
1,4-Dimethyl-2-ethylbenzene, *not* 1,4-Dimethyl-3-ethylbenzene.

(2) After the condition under (1) was satisfied, the lowest number was given first to double bonds, and second to triple bonds.

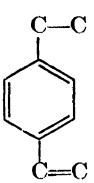


1-Phenyl-5-methylcyclohexene-2, *not* 1-Methyl-3-phenylcyclohexene-4.

(3) After fulfilling the conditions under (1) and (2), the lowest number was assigned primarily to the group having the least carbon atoms (for alicyclic groups, the ring having the fewest carbon atoms), and secondly to the most saturated substituent. This order follows: methyl, ethyl, ethynyl, propyl, isopropyl, etc., hexyl, methylcyclopentyl, cyclohexyl, cyclohexenyl, cyclohexadienyl, phenyl, etc.

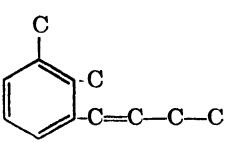


3-Methyl-3,4-diphenyl-4-ethylhexane, *not* 3-Ethyl-3,4-diphenyl-4-methylhexane



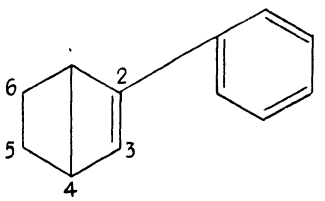
1-Ethyl-4-ethenylbenzene, *not* 1-Ethenyl-4-ethylbenzene

The position of the benzene ring relative to its substituent was assumed to be the 1-position of the substituent unless otherwise specified. This practice was observed to simplify the nomenclature so that a compound could be named 1,2-Dimethyl-3-(buten-1′-yl)-benzene rather than 1,2-Dimethyl-3-[1′-(buten-1′-yl)]-benzene.



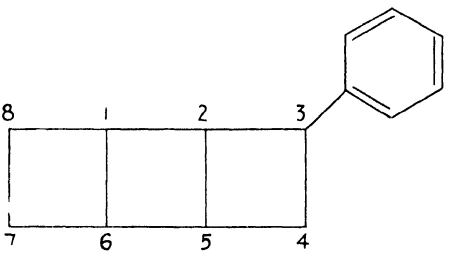
The Proposed International Rules for numbering ring systems were followed in the nomenclature of bicyclo and tricyclo derivatives. A

thorough discussion of these rules is found in the Introduction to Volume II of the "Physical Constants of Hydrocarbons." The previously discussed methods of assigning substituent numbers were adhered to only after the conditions set forth in the International Rules were satisfied. The alicyclic structure was named as the parent hydrocarbon unless a simpler and less ambiguous name resulted from considering the alicyclic as a substituent. Examples of the nomenclature used for these classes of compounds follow:




2-Phenylbicyclo-[2,2,0]-hexene-2

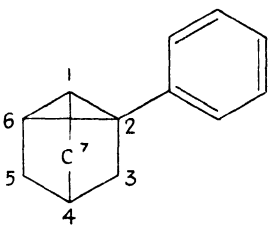
The double bond and phenyl groups cannot be assigned the lowest number when the system for numbering bicyclic compounds is followed.




3-Phenyltricyclo-[4,2,0,$0^{2,5}$]-octane

*not*

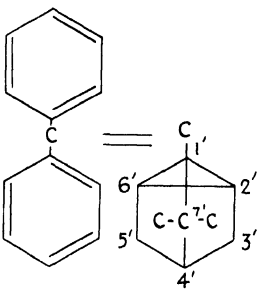
2-Phenyltricyclo-[2,4,$0^{5,8}$,0]-octane




2-Phenyltricyclo-[2,2,1,$0^{2,6}$]-heptane

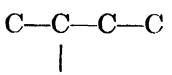
*not*

1-Phenyltricyclo-[$3^{1,5}$,1,1]-heptane

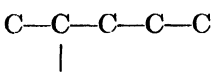



1,1-Diphenyl-2-(7',7'-dimethyltricyclo-[2,2,1,$0^{2,6}$]-heptanyl)-ethene

The prefixes *sec* and *iso*, which are commonly used in the literature to differentiate between aliphatic isomers, were not used in this volume unless their use markedly simplifies the nomenclature. Secondary (*sec*) was used only to refer to 2-Phenylaliphatics.

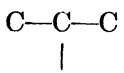



*sec*-Butyl

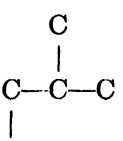



*sec*-Pentyl

*Iso* was used only in connection with propyl and butyl radicals.

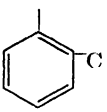



Isopropyl

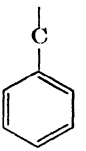



Isobutyl

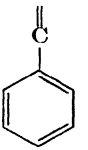
Radicals containing, for example, both an alicyclic and an alkyl group or both a phenyl and an alkenyl group were named as complex radicals. Complex names used were *o*-, *m*-, and *p*-tolyl, benzyl, benzylidene, phenethyl, phenethenyl, phenethylidene, phenethynyl, *o*-, *m*-, and *p*-biphenylyl, benzhydryl, and benzhydrylidene.



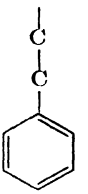
*o*-Tolyl



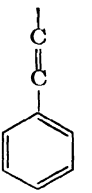
Benzyl



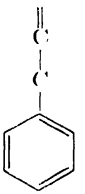
Benzylidene



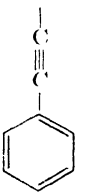
Phenethyl



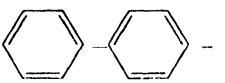
Phenethenyl



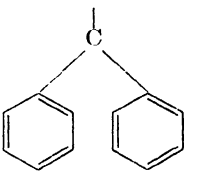
Phenethylidene



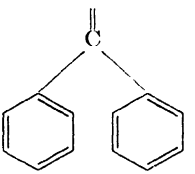
Phenethynyl



*p*-Biphenylyl

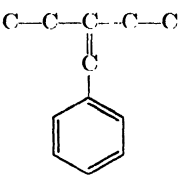


Benzhydryl

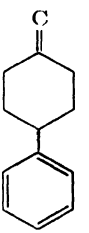


Benzhydrylidene

A group linked to a second group by a double bond was sometimes named as the substituent of the second group; the suffix, -ylidene, was used for these substituents except in the case of a one carbon group which is called methylene.

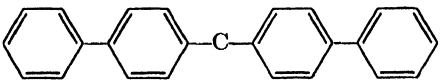


3-Benzylidenepentane

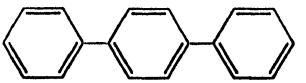


1-Methylene-4-phenylcyclohexane

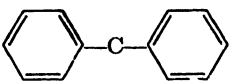
The Greek (di, tri, tetra, etc.) prefixes were used to denote the number of substituents of a given kind and the Latin (bi, ter, quatra, etc.) to indicate the number of units of a given kind in a radical or nucleus.



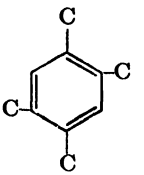
Di-*p*-biphenylylmethane



*p*-Terphenyl



Diphenylmethane



1,2,4,5-Tetramethylbenzene

## Critical Evaluation of the Data and Calculation of the Most Probable Values

### Precision and Accuracy of the Data

Critical evaluation of the experimental data on physical constants is limited by the failure of many investigators to report the extent to which their compounds were purified, the precision of apparatus used and other bases for comparison of data. Each value was given an accuracy rating from 1 to 5 (5 signifies the best) based on the reliability of the experimenter and information given in the article such as carbon and hydrogen analyses, methods of purification, description of apparatus, and date of the investigation. Another important factor in evaluating a constant is the purpose for which it was determined. Data determined for the purpose of finding the actual numerical value of the constant are in general the best available. Constants from experiments in physical chemistry, which necessitate meticulous work, usually are superior to values given when the object of the experiment is the preparation of a compound. A constant reported as a criterion of purity or for identification of a by-product of the main reaction is seldom very accurate.

A precision rating based on the probable error of the determination was also assigned. When the probable error was not given, the usual custom of arbitrarily assuming it to be $\pm 2$ in the last figure was followed. The precision ratings are inversely proportional to the squares of the probable errors. The total weight of the value for the physical constant is the product of the accuracy rating and the precision rating, as shown in the following example:

| Exp. Value | Probable Error | (Error)$^2$ | Precision Rating | Accuracy Rating | Total Weight |
|---|---|---|---|---|---|
| 140.1 | $\pm 0.2$ | 0.04 | 1 | 2 | 2 |
| 140.10 | $\pm 0.02$ | 0.0004 | 100 | 3 | 300 |

The reliability of the data varies considerably from compound to compound. In some cases only one or two determinations of a physical

constant appear in the literature, while in other cases a large amount of data is available. Where very few experimental values are available no "most probable value" has been given, because it is often difficult to tell from the literature which value is most reliable. If several values of a constant have been reported, all or nearly all of which have been determined under the same conditions, the "most probable value" (shown in boldface type at the top of the appropriate column) represents a weighted average. Where the data cover a considerable range of experimental conditions, the constants of an equation relating the physical constant to temperature or pressure have been evaluated by the method of least squares. The "most probable value" at standard conditions is found from this equation, and therefore based on all of the data rather than only on the values determined at standard conditions. Equations calculated in this manner are given under the heading of "Additional Data."

When the constants of an equation were evaluated, the standard deviation ($\tau$) of the experimental values was determined from the formula

$$\tau = \sqrt{\frac{\Sigma v^2}{n}}$$

where $v$ is the difference between the observed values and the calculated values, and $n$ is the number of observations. The Pierce-Chauvenet Criterion[21] was then applied to determine which experimental values were beyond the limits of error. The values lying outside of these limits were discarded and are not published in this volume. Experimental values which were seen graphically to differ widely from the majority of the values were discarded before calculation of the equations. Beyond the range of the equations no experimental values were deleted unless it was obvious from a graph that they were grossly in error.

### Method of Calculation

The method of least squares was used to evaluate the constants of the various equations. A theoretical discussion of this method will not be given here, but may be found in a number of mathematical and statistical books. Some of the books treating this subject are:

Scarborough, J. B., "Numerical Mathematical Analysis," The Johns Hopkins Press, Baltimore, 1930.
Whittaker, E. T., and G. Robinson, "The Calculus of Observations," D. Van Nostrand Company, New York, 2nd ed., 1937.
Mills, F. C., "Statistical Methods," Henry Holt and Company, New York, 1939.
Crumpler, T. B., and J. H. Yoe, "Chemical Computations and Errors," John Wiley and Sons, New York, 1940.
Deming, W. E., "Statistical Adjustment of Data," John Wiley and Sons, New York, 1943.
Worthing, A. G., and J. Geffner, "Treatment of Experimental Data," John Wiley and Sons, New York, 1943.

21. Crumpler, T. B., and J. H. Yoe, "Chemical Computations and Errors," John Wiley and Sons, Inc., New York, 1940, p. 190.

Least squares equations may be set up and solved in several different ways. The method used in this work will be given.

The variation of specific gravity with temperature is expressed by the equation

$$D_4^t = D_4^{t_0} + a(t - t_0) + b(t - t_0)^2.$$

Taking $t_0 = 20°$ C, and writing $(t - t_0)$ as $\Theta$ and $D_4^{t_0}$ (in this case $D_4^{20}$) as $k$ the equation may be written

$$(1) \quad D_4^t = k + a\Theta + b\Theta^2.$$

Because three constants, $k$, $a$, and $b$, are to be evaluated, three simultaneous equations are necessary. The first of these consists simply of the sums of the experimental values for specific gravity, temperature difference, the square of the temperature difference, and the number of observations, $n$.

$$(1a) \quad kn + a\Sigma\Theta + b\Sigma\Theta^2 = \Sigma D$$

The other two equations are obtained by multiplying equation (1) first by $\Theta$, the coefficient of the second unknown, and then by $\Theta^2$, the coefficient of the third unknown and summing the experimental values of the quantities so obtained. The resulting equations are:

$$(2) \quad k\Sigma\Theta + a\Sigma\Theta^2 + b\Sigma\Theta^3 = \Sigma D\Theta$$
$$(3) \quad k\Sigma\Theta^2 + a\Sigma\Theta^3 + b\Sigma\Theta^4 = \Sigma D\Theta^2$$

Equations (1a), (2), and (3) are called "normal equations."

If the experimental values have different weights, $n$ is replaced by $\Sigma W$, the sum of the weights. $\Sigma D$ is then replaced by $\Sigma WD$, the sum of the weighted densities, $\Sigma\Theta$ by $\Sigma W\Theta$, the sum of the weighted temperatures, etc.

The quantities to be calculated in order to evaluate $k$, $a$, and $b$, are seen from the normal equations to be $\Sigma W$, $\Sigma W\Theta$, $\Sigma W\Theta^2$, $\Sigma W\Theta^3$, $\Sigma W\Theta^4$, $\Sigma WD$, $\Sigma WD\Theta$, and $\Sigma WD\Theta^2$.

Several methods for solving the simultaneous equations have been suggested. The one used in this study is relatively simple when a calculating machine is available. For this type of solution the quantities in the normal equations are lined up as follows:

| | $A(k)$ | | $B(a)$ | | $C(b)$ | | $D$ | $E$ |
|---|---|---|---|---|---|---|---|---|
| (1) | $\Sigma W$ | (+) | $\Sigma W\Theta$ | (+) | $\Sigma W\Theta^2$ | (=) | $\Sigma WD$ | $\Sigma W + \Sigma W\Theta + \Sigma W\Theta^2 + \Sigma WD$ |
| (2) | $\Sigma W\Theta$ | (+) | $\Sigma W\Theta^2$ | (+) | $\Sigma W\Theta^3$ | (=) | $\Sigma WD\Theta$ | $\Sigma W\Theta + \Sigma W\Theta^2 + \Sigma W\Theta^3 + \Sigma WD\Theta$ |
| (3) | $\Sigma W\Theta^2$ | (+) | $\Sigma W\Theta^3$ | (+) | $\Sigma W\Theta^4$ | (=) | $\Sigma WD\Theta^2$ | $\Sigma W\Theta^2 + \Sigma W\Theta^3 + \Sigma W\Theta^4 + \Sigma WD\Theta^2$ |

The values in line (1) are then divided by $\Sigma W$, those in line (2) by $\Sigma W\Theta$, and those in line (3) by $\Sigma W\Theta^2$.

| | $A(k)$ | $B(a)$ | $C(b)$ | $D$ | $E$ |
|---|---|---|---|---|---|
| (4) | 1 | $(+)\ \frac{\Sigma W\theta}{\Sigma W}$ | $(+)\ \frac{\Sigma W\theta^2}{\Sigma W}$ | $(=)\ \frac{\Sigma WD}{\Sigma W}$ | $\frac{\Sigma W + \Sigma W\theta + \Sigma W\theta^2 + \Sigma WD}{\Sigma W}$ |
| (5) | 1 | $(+)\ \frac{\Sigma W\theta^2}{\Sigma W\theta}$ | $(+)\ \frac{\Sigma W\theta^3}{\Sigma W\theta}$ | $(=)\ \frac{\Sigma WD\theta}{\Sigma W\theta}$ | $\frac{\Sigma W\theta + \Sigma W\theta^2 + \Sigma W\theta^3 + \Sigma WD\theta}{\Sigma W\theta}$ |
| (6) | 1 | $(+)\ \frac{\Sigma W\theta^3}{\Sigma W\theta^2}$ | $(+)\ \frac{\Sigma W\theta^4}{\Sigma W\theta^2}$ | $(=)\ \frac{\Sigma WD\theta^2}{\Sigma W\theta^2}$ | $\frac{\Sigma W\theta^2 + \Sigma W\theta^3 + \Sigma W\theta^4 + \Sigma WD\theta^2}{\Sigma W\theta^2}$ |

All members of column A are now one, so that by subtracting line (4) from line (5) and line (6) from line (5) (or any other convenient combination) two simultaneous equations in two unknowns are obtained.

| | $B(a)$ | $C(b)$ | $D$ | $E$ |
|---|---|---|---|---|
| | | | | $\frac{\Sigma W\theta + \Sigma W\theta^2 + \Sigma W\theta^3 + \Sigma WD\theta}{\Sigma W\theta}$ |
| (7) 5 − 4) | $\frac{\Sigma W\theta^2}{\Sigma W\theta} - \frac{\Sigma W\theta}{\Sigma W}$ | $(+)\ \frac{\Sigma W\theta^3}{\Sigma W\theta} - \frac{\Sigma W\theta^2}{\Sigma W}$ | $(=)\ \frac{\Sigma WD\theta}{\Sigma W\theta} - \frac{\Sigma WD}{\Sigma W}$ | |
| | | | | $-\frac{\Sigma W + \Sigma W\theta + \Sigma W\theta^2 + \Sigma WD}{\Sigma W}$ |
| | | | | $\frac{\Sigma W\theta^2 + \Sigma W\theta^3 + \Sigma W\theta^4 + \Sigma WD\theta^2}{\Sigma W\theta^2}$ |
| (8) (5 − 6) | $\frac{\Sigma W\theta^3}{\Sigma W\theta^2} - \frac{\Sigma W\theta^2}{\Sigma W\theta}$ | $(+)\ \frac{\Sigma W\theta^4}{\Sigma W\theta^2} - \frac{\Sigma W\theta^3}{\Sigma W\theta}$ | $(=)\ \frac{\Sigma WD\theta^2}{\Sigma W\theta^2} - \frac{\Sigma WD\theta}{\Sigma W\theta}$ | |
| | | | | $-\frac{\Sigma W\theta + \Sigma W\theta^2 + \Sigma W\theta^3 + \Sigma WD\theta}{\Sigma W\theta}$ |

Equations (7) and (8) are divided by the members of the first remaining column ($B$), and one of the resulting equations is subtracted from the other. Thus an equation with only one unknown is obtained, and may be readily solved. The resulting value of $b$ is substituted in the two equations in two unknowns ((7) and (8)) to obtain the second constant, $a$. Substitution of the two known constants in the three original equations will lead to the value of the third constant, $k$. In case a straightline equation with only the constants $k$ and $a$ is sufficient, line 3 and column C are omitted.

The last column, $E$, serves as a check. If no error in calculation is made, the value obtained by dividing $E$ by $A$ will agree with the sum of the values $\frac{B}{A}+\frac{C}{A}+\frac{D}{A}$, and similarly through the rest of the operations.

A set of experimental specific gravity values and the calculation of the constants of an equation representing the data follows. In this example purely mathematical considerations would indicate the use of a straightline equation instead of a quadratic. The $t^2$ term was included because the variation of density with temperature should show an appreciable curvature over the one hundred degree range included in the data.

1,1-Diphenylhexadecane

| Temp. ($t$) | $t-20$ ($\Theta$) | Specific Gravity | Weight |
|---|---|---|---|
| 20 | 0 | 0.9117 | 4 |
| 20 | 0 | 0.9135 | 6 |
| 100 | 80 | 0.8615 | 3 |
| 50 | 30 | 0.8940 | 3 |
| 0 | −20 | 0.9265 | 3 |

| $\Theta$ | $\Theta^2$ | $\Theta^3$ | $\Theta^4$ | $D$ | $D\Theta$ | $D\Theta^2$ | $W$ |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0.9117 | 0 | 0 | 4 |
| 0 | 0 | 0 | 0 | 0.9135 | 0 | 0 | 6 |
| 80 | 6,400 | 512,000 | 40,960,000 | 0.8615 | 68.92 | 5513.6 | 3 |
| 30 | 900 | 27,000 | 810,000 | 0.8940 | 26.82 | 804.6 | 3 |
| −20 | 400 | −9,000 | 160,000 | 0.9265 | −18.53 | 370.6 | 3 |

The weighed sums are:

$\Sigma W = 19$ $\quad$ $\Sigma W\Theta^4 = 125{,}790{,}000$

$\Sigma W\Theta = 270$ $\quad$ $\Sigma WD = 17.1738$

$\Sigma W\Theta^2 = 23{,}100$ $\quad$ $\Sigma WD\Theta = 231.63$

$\Sigma W\Theta^3 = 1{,}593{,}000$ $\quad$ $\Sigma WD\Theta^2 = 20{,}066.4$

The calculations are carried out as follows:

| | $A(k)$ | $B(a)$ | $C(b)$ | $D$ | $E$ |
|---|---|---|---|---|---|
| | 19 | 270 | 23,100 | 17.1738 | 23,406.1739 |
| | 270 | 23,100 | 1,593,000 | 231.63 | 1,616,601.63 |
| | 23.100 | 1,593,000 | 125,790,000 | 20,066.4 | 127,426,166.4 |
| (1) | 1 | 14.21052631 | 1215.789473 | 0.903884210 | 1,231.903884 |
| (2) | 1 | 85.5555555 | 5900.00 | 0.857888888 | 5,987.41344 |
| (3) | 1 | 68.9610389 | 5445.45454 | 0.868675324 | 5,516.28425 |
| (3 − 1) | | 54.75051259 | 4229.665067 | −0.035208886 | 4,284.380366 |
| (2 − 3) | | 16.5945166 | 454.54546 | −0.010786436 | 471.12919 |
| (4) | | 1 | 77.2534331 | −0.000643078655 | 78.2527900 |
| (5) | | 1 | 27.39130466 | −0.000650000012 | 28.39065465 |
| (4 − 5) | | | $49.86212844b = 0.000006921357$ | | |
| | | | $b = 0.0_61388098987$ | | |

$54.75051259a + 4229.665067(0.0_61388098987) = -0.035208886$

$a = -0.000653802196$

$16.5945166a + 454.54546(0.0_61388098987) = -0.010786436$

$a = -0.000653802196$

$19k - 270(0.000653802196) + 23{,}100(0.0_61388098987) = 17.1738$

$k = 0.913006315$

$270k - 23{,}100(0.000653802196) + 1{,}593{,}000(0.0_61388098987) = 231.63$

$k = 0.913007407$

$23{,}100k - 1{,}593{,}000(0.000653802196) + 125{,}790{,}000(0.0_61388098987) = 20{,}066.4$

$k = 0.913006493$

$$D_4^t = 0.913006 - 0.000653802196(t-20) + 0.0_61388098987(t-20)^2$$

The equation as it stands is carried out to more decimal places than are warranted by the accuracy of the data, and may be rounded off to $D_4 = 0.9130 - 0.0006538\ (t-20) + 0.0_61388\ (t-20)^2$. All the decimal places

re kept until the final step has been reached, as rounding off during the calculation may introduce a considerable error.

After the value for constant $b$ has been determined, it is substituted in *both* equations in two unknowns to find constant $a$. Similarly, $a$ and $b$ are substituted in all three original equations in order to determine $k$. These multiple substitutions serve as a check on the accuracy of the work. If the constants differ appreciably, an error has probably been made in the calculations.

The constants of equations for melting point, boiling point, and refractive index are determined in a similar manner. The normal equations needed for the calculations are given below.

Melting point:

$$\Sigma tW = k\Sigma W + a\Sigma Wp - b\Sigma Wp^2$$
$$\Sigma tWp = k\Sigma Wp + a\Sigma Wp^2 - b\Sigma Wp^3$$
$$\Sigma tWp^2 = k\Sigma Wp^2 + a\Sigma Wp^3 - b\Sigma Wp^4$$

Boiling point:

$$\Sigma W\frac{1}{T} = k\Sigma W + a\Sigma W \log p$$
$$\Sigma W\frac{1}{T}\log p = k\Sigma W \log p + a\Sigma W(\log p)^2$$

Specific gravity:

$$\Sigma WD = k\Sigma W + a\Sigma Wt + b\Sigma Wt^2$$
$$\Sigma WDt = k\Sigma Wt + a\Sigma Wt^2 + b\Sigma Wt^3$$
$$\Sigma WDt^2 = k\Sigma Wt^2 + a\Sigma Wt^3 + b\Sigma Wt^4$$

Refractive index:

$$\Sigma Wn = k\Sigma W + a\Sigma Wt + b\Sigma Wt^2$$
$$\Sigma Wnt = k\Sigma Wt + a\Sigma Wt^2 + b\Sigma Wt^3$$
$$\Sigma Wnt^2 = k\Sigma Wt^2 + a\Sigma Wt^3 + b\Sigma Wt^4$$

## Melting Points

The melting points at atmospheric pressure are listed in order of decreasing temperature. Melting points at other pressures follow in order of decreasing pressure. In some cases the pressures were experimentally determined as kilograms per square centimeter but these values were converted to atmospheres for the purpose of uniformity. One kilogram per square centimeter is equivalent to 0.9678 atmosphere.

Some values have been recorded as freezing points. The freezing point of a substance is coincident with the melting point when defined as the temperature at which the liquid and solid phases are in equilibrium. However, the apparent, or experimentally determined, melting point and freezing point sometimes differ. The process of melting seems to occur with an independent finite speed even above the melting point, so that while it always starts at the same temperature, the temperature of the partly melted portion may rise during the process if heat is supplied at a greater rate than it is absorbed for the transition of solid to liquid.[22] Conversely, liquids may be supercooled to varying degrees before crystalliza-

22. Taylor, H. S., "Treatise on Physical Chemistry," D. Van Nostrand Company, New York, 2nd ed. 1931, pp. 272-273.

tion sets in. The observed temperature at which the liquid and solid are apparently in equilibrium differs from the true freezing point if supercooling has occurred. Even when the freezing point has been determined by extrapolation of a time-temperature curve, this value is significantly in error if the amount of supercooling is large compared to the refrigerating head of temperature.[23] When an author has definitely stated that his value is a freezing point rather than a melting point, this fact has been indicated in a footnote.

Some compounds crystallize in two or more crystalline forms which have different melting points. When the literature indicates that a melting point was determined on a specific form, this information is given in a footnote.

Whenever warranted by the amount of data, a weighted average is given in boldface type. In a few cases melting points at high pressures have been reported. The variation of melting point with pressure may be expressed by the equation

$$t = k + ap - bp^2$$ [24]

where $t$ = melting point and $p$ = pressure. Where high-pressure data are given, the constants of this equation have been evaluated. In these cases the boldface value represents the melting point at one atmosphere.

## Boiling Points

For each hydrocarbon the boiling points at 760 mm of mercury are listed first in order of decreasing temperature. The boiling points at other pressures follow in order of decreasing pressure. If the pressure was given in units other than millimeters of mercury, it was converted before being recorded. The pressure in millimeters corresponding to each boiling point is given, unless this pressure is 760 mm, in which case it is omitted.

The variation of boiling point with pressure may be expressed by the integrated form of the Clausius-Clapeyron equation

$$\frac{1}{T} = k + a \log p$$

where $T$ = boiling point in °K and $p$ = pressure in mm of mercury. Where sufficient data at different pressures are given, the constants of this equation have been evaluated. The equation is not valid over a wide range, because the assumptions made in the integration are not strictly true. The differential form of the equation is

$$\frac{dp}{dt} = \frac{\Delta H}{T\Delta V} = \frac{\Delta H}{T(V_g - V_l)}$$

23. Mair, B. J., A. R. Glasgow, Jr., and F. D. Rossini, J. Research Natl. Bur. Standards **26**, 591 **1941**.

24. Tamman, Ann. Physik [N. F.] **66**, 471 **1898**.

where

$p$ = vapor pressure of liquid
$t$ = temperature
$T$ = absolute temperature
$\Delta H$ = heat of vaporization
$\Delta V$ = change in volume on vaporization
$V_g$ = molecular volume of gaseous phase
$V_l$ = molecular volume of liquid phase

In integrating this equation the assumptions are made that (1) the volume of the liquid, $V_l$, is negligible in comparison with the volume of vapor, $V_g$; (2) the heat of vaporization, $\Delta H$, is constant; and (3) the vapor is a perfect gas. These assumptions are only approximately valid, and introduce some errors. The heat of vaporization, $\Delta H$, changes with the temperature so that over a wide range considerable error is caused by assuming it to be constant. The integrated form of the Clausius-Clapeyron equation fits the data well from about 200 to 800 mm of mercury. At higher pressures it is valid over a longer range, at lower pressures over a shorter range.

When boiling points have been determined over a wide range of pressure, separate sets of constants for the equation have been evaluated for different pressure ranges. In this case the boldface value is the boiling point at 760 mm of mercury calculated from the equation valid at 760 mm. When the only available boiling point data were determined at or near 760 mm, the boldface value is the weighted average.

## Specific Gravity

Specific gravities determined at 20°C with reference to water at 4°C are listed first, in order of increasing numerical value. Following these are the specific gravities determined at other temperatures, in order of decreasing temperature. Values referred to water at a temperature differing from 4°C follow values at the same temperature referred to water at 4°C, and in order of decreasing temperature of the water, *i.e.*, $D\,25°$, $D_{25}^{25}$, $D_{0}^{25}$. A specific gravity determined with reference to water at 4°C is listed as $D\,t$. If the determination was made at temperature $t_2$ with reference to water at a temperature other than 4°C, $t_1$, the specific gravity is listed as $D_{t_1}^{t_2}$. This value may be converted to the $D_4^{t_2}$ value by means of the formula

$$D_4^{t_2}\ (\text{hydrocarbon}) = D_{t_1}^{t_2}\ (\text{hydrocarbon}) \times D_4^{t_1}\ (\text{water}).$$

The variation of specific gravity with temperature is expressed by the equation

$$D_4^t = D_{4^0}^{t_0} + a(t - t_0) + b(t - t_0)^2$$

in which $t_0$ is usually taken as 20°C. Over a 30 to 40 degree range the density is very nearly a linear function of the temperature, and the $t^2$ term may be disregarded. When the data permitted, the constants of the equation were evaluated. The differential form, or temperature coefficient

of specific gravity, is given under the heading of additional data. This equation is in the form

$$\frac{dD}{dt} = a + 2b(t - t_0) = a\left[1 + \frac{2b}{a}(t - t_0)\right]$$

For shorter ranges this reduces to

$$\frac{dD}{dt} = a.$$

The value of $dD/dt$ at a given temperature is added to the most probable value at 20°C, since $t$ is taken as 20°C.

Lipkin and Kurtz[25] have determined the relationship between the values of constants $a$ and $b$ and the molecular weight of the compound. With very few exceptions the values for these constants determined in this work agree very well with the values postulated by them.

In the case of some compounds with high melting points, most of the specific gravity determinations fell in a temperature range considerably above 20°C. When this was true, $t_0$ was taken as 50° or 100°C. The boldface value then has the temperature indicated. Boldface values with no indication of temperature are at 20°C.

### Refractive Index

Refractive indices are given for the $Na_D$, $H_\alpha$, $H_\beta$, $H_\gamma$, and He lines whenever these values have been reported in the literature. Lines reported as C, F, and G, were assumed to be $H_\alpha$, $H_\beta$, and $H_\gamma$ respectively. The wave lengths of the above-mentioned lines are given below:

| Line | Wave Length (Å) |
|---|---|
| $He_r$ | 6678 |
| $H_\alpha$ | 6563 |
| $Na_D$ | 5893 |
| $He_y$ | 5876 |
| $He_g$ | 5016 |
| $H_\beta$ | 4861 |
| $H_\gamma$ | 4341 |

In most cases the literature does not specify whether a refractive index for a He line is for the red, yellow, or green line. These values have been recorded simply as $n^t_{He}$ values. $Na_D$ line values at 20°C are listed first, followed by values at other temperatures in order of decreasing temperature. The latter are recorded in the form $n\,t°$. Values for lines other than $Na_D$ are listed in the order $H_\alpha$, $H_\beta$, $H_\gamma$, and He. Within each group they are listed in order of decreasing temperature. A superscript indicates the temperature, a subscript the line, as $n^{20}_{H_\alpha}$. References to refractive indices at lines other than the ones recorded are given in footnotes.

25. Lipkin, M. R., and S. S. Kurtz, Jr., Ind. Eng. Chem. Anal. Ed. 13, 291 1941.

The refractive index varies with the temperature in a manner analogous to specific gravity, though the temperature coefficient is smaller. The equation is of the same type as that used for specific gravity.

When the data permitted, the temperature coefficient of the $Na_D$ line refractive indices was determined. In almost all cases the temperature range was small enough so that a straight line equation represented the data with sufficient accuracy. The boldface value represents the refractive index for the $Na_D$ line at 20°C.

**Additional Data**

The additional data column contains values for critical temperature, critical pressure, critical density, angle of rotation for the $Na_D$ line, and sublimation temperatures when these are available. It also contains equations for calculating melting points, boiling points, specific gravities, and refractive indices at other than standard conditions. The range over which the equation is valid is indicated in parentheses.

## II. BENZENE AND ITS ALIPHATIC DERIVATIVES

1. Benzene $C_nH_{2n-6}$
2. Benzene with Alkyl Substitutions $C_nH_{2n-6}$
3. Benzene with One Alkenyl Substitution $C_nH_{2n-8}$
4. Benzene with One Alkynyl Substitution $C_nH_{2n-10}$
5. Benzene with One Alkadienyl Substitution $C_nH_{2n-10}$
6. Benzene with Two Alkenyl Substitutions $C_nH_{2n-10}$
7. Benzene with One Alkenynyl Substitution $C_nH_{2n-12}$
8. Benzene with One Alkatrienyl Substitution $C_nH_{2n-12}$
9. Benzene with One Alkadiynyl Substitution $C_nH_{2n-14}$
10. Benzene with One Alkatetraenyl Substitution $C_nH_{2n-14}$
11. Benzene with Two Alkynyl Substitutions $C_nH_{2n-14}$
12. Benzene with One Alkatriynyl Substitution $C_nH_{2n-18}$

## 1. BENZENE, $C_nH_{2n-6}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Benzene** | | | | |
| **5.49** | **80.07** | **0.87866** | **1.50096** | Crit. Temp. (°C) |
| 5.91 [313] | 80.67 [201] | 0.8775 [127,206,247] | 1 4993 [236] | 290.8 [131] |
| 5.70 [231] | 80.60 – 80.67 [2] | 0.8776 [268] | 1.4995 [110] | 290.5 [4] |
| 5.61 [206] | 80.5(d) | 0.87771 [315] | 1.49985(h) [352] | 289.9 [96] |
| 5.6 [15,253,405] | 80.35 – 80.5 [398] | 0.87777 [119] | 1.50015 [127] | 288.5 [24,117, 184,329,354,368, 402,404,405] |
| 5.58 [94,223,340,404] | 80.49 [340] | 0.8779 [269] | 1.5003 [125] | |
| 5.56 [240,241] | 80.46 [146] | 0.87806 [129] | 1.500307 [268] | |
| 5.55 [197] | 80.35 – 80.45 [389] | 0.8782 [401] | 1.5004 [242] | |
| 5.54 [113] | 80.4(e) | 0.8784 [89,110] | 1.5008 [147] | 288.4 [140,248, 246,364,372,378] |
| 5.52(a) [271] | 80.36 [52,218] | 0.8784(g) [347] | 1.5009 [174] | |
| 5.51 [152,169] | 80.35 [23] | 0.878434 [282] | 1.50092 [370] | 288.1 [293] |
| 5.51 ± 0.02 [26] | 80.3(f) | 0.87847 [176] | 1.5010 [291] | 288.0 [295] |
| 5.51 ± 0.01 [396,397] | 80.2 – 80.3 [34,172,173] | 0.8786 [102] | 1.50103 [185] | 287.7 [130] |
| 5.50 ± 0.01 [28] | 80.1 – 80.3 [350] | 0.87862 [360] | 1.5011 [193,336] | 283.4 [122] |
| 5.50 [77,89,197,227,350,410] | 80.28 ± 0.01 [363] | 0.87865 [40] | 1.50111 [178] | Crit Pressure (mm Hg) |
| 5.5(b) | 80.26 [382] | 0.878675(g) [185] | 1.50114 [183A] | |
| 5.5(c) [72] | 80.25 [238,361,365] | 0.8787 [248,325,328] | 1.5012 [159] | |
| 5.5 ± 0.2 [171] | 80.15 – 80.25 [390] | 0.8788 [250,299,301,304,305, 358] | 1.50122 [127] | 38,076.0 [4] |
| 5.4974(a) [300] | 80.23 – 80.24 [309,310] | | 1.50132 [306] | 38,053.2 [4] |
| 5.493 ± 0.007 [58] | 80.15 – 80.24 [392] | 0.8789 [104,239,365] | 1.50135 [337,338] | 36,404.0 [184] |
| 5.493 ± 0.007(a) [300] | 80.23 ± 0.002 [149] | 0.87895 [350,411] | 1.50137 [53,169] | 36,396.40 [368, 372] |
| 5.493 ± 0.007(c) [331] | 80.20 – 80.21 [28] | 0.87896 [127] | 1.50138 [191] | |
| 5.49 ± 0.01 [28] | 80.16 – 80.21 [391] | 0.8790 [39,41,91,141,163, 270,277,373,408] | 1.5014 [54,89,232 382] | 36,395 [402,404, 405] |
| 5.49 [211,232,343] | 80.20 [28] | | 1.50148 [329,407,408] | |
| 5.49(c) [65] | 80.20 ± 0.02 [349] | 0.87901 [103] | 1.50149 [179] | |
| 5.485(a) [98] | 80.20 ± 0.05 [306] | 0.87902 [45] | 1.50153 [241] | Crit. Density |
| 5.484 [298] | 80.15 – 80.20 [70,200] | 0.879063(g) [100] | 1.50154 [101] | |
| 5.483 [235,303] | 80.2(j) | 0.879085(g) [69] | 1.50165 [170] | 0.3037 [405] |
| 5.483(a) [302] | 80.18 [148] | 0.8791 [8,303] | 1.50209 [6] | 0.3043 [295] |
| 5.480 [172] | 80.15 – 80.18 [302] | 0.87940 [2] | 1.50222 [369] | 0.3045 [111,373, 404] |
| 5.48 [69,78,79,97,166,297] | 80.173(k) [341] | 0.8794 [66] | 1.00177(m) [160] | |
| 5.48(c) [145] | 80.17 [403] | 0.8796 [193] | 1.46178(h) 79.96° [276] | 0.305 [122] |
| 5.48 ± 0.02 [28,177] | 80.15 – 80.17 [114] | 0.8799 [53,54,329] | 1.465195(h) 75.09° [276] | |
| 5.47 ± 0.01 [177] | 80.15 [80,123] | 0.8802 [14] | 1.467427 70.0° [268] | |
| 5.47 ± 0.02 [69] | 80.10 – 80.15 [392,394] | 0.88029 [83] | 1.470952 65.0° [268] | |
| 5.46 [215] | 80.05 – 80.15 [231] | 0.88041 [170] | 1.471975(h) 65.00° [276] | |
| 5.42 – 5.46 [114] | 80.14 [356] | 0.88048(g) [407] | 1.474218 60.0° [268] | |
| 5.458 [216] | 80.12 – 80.13 [118] | 0.8807 [392] | 1.4744 60° [291] | |
| 5.449 – 5.455 [182] | 80.03 – 80.13 [267] | 0.4514 280° [213, 295,373] | 1.477637 55.0° [268] | |
| 5.45 [87,110,174,202,290] | 80.122 [411] | | 1.480905 50.0° [268] | |
| 5.45 ± 0.05 [61] | 80.12 [89,334] | 0.4708 275° [295] | 1.4811 50° [291] | |
| 5.44 – 5.445 [30,223,353] | 80.08 – 80.12 [12,160] | 0.4984 270° [373] | 1.48520(h) 45.03° [276] | |
| 5.44(a) [234] | 80.110 [342] | 0.4985 270° [296] | 1.4851 45° [112] | |
| 5.432 [145] | 80.10 [105] | | 1.485545 43.0° [268] | |

*The notes designated by letters appear on pages 37 and 38.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **Benzene** *(Continued)* | 80.1(l) | 0.5327 | 260° [213,295] | 1.485641 | 42.6° [268] | * |
| | 80.0 – 80.1 [383] | | | 1.48842(h) | 40.07° [276] | |
| | 80.094 [127,335] | 0.5328 | 260° [373] | 1.487573 | 40.0° [268] | |
| 5.43 [42,181,239,251,254,345,384] | 80.094 ± 0.002 [396] | 0.5609 | 250° [373] | 1.4877 | 40° [291] | |
| 5.42 [190,257,264] | 80.093 ± 0.002 [397] | 0.5610 | 250° [295] | 1.49168(h) | 35.06° [276] | † |
| 5.41 [279] | 80.09 [190] | 0.5851 | 240° [373] | 1.490732 | 35.0° [268] | |
| 5.40 [128] | 80.05 – 80.08 [314] | 0.5852 | 240° [213,295] | 1.4918 | 35° [112] | |
| 5.4(i) | 80.05 – 80.07 [128] | | | 1.493408 | 31.0° [268] | |
| 5.4(c) [158,383] | 80.05 [56,76] | 0.6065 | 230° [373] | 1.49497(h) | 30.05° [276] | |
| 5.4 ± 0.2 [171] | 79.99 – 80.05 [133] | 0.6066 | 230° [295] | 1.4943 | 30° [291] | ‡ |
| 5.35 [5,143,345] | 80.04 [104] | 0.6255 | 220° [373] | 1.494815(h) | 30° [118] | |
| 5.345 [74] | 80.00 ± 0.08 [61] | 0.6256 | 220° [213,295] | 1.49486 | 30° [56] | |
| 5.340 [74] | 80.0(o) | | | 1.494888(h) | 30° [76] | |
| 5.32 [135,344] | 80(p) [193,294,369] | 0.6432 | 210° [295,373] | 1.49534 | 30° [81] | § |
| 5.3 [204,221,366] | 79.6 [93,196,311] | | | 1.4960 | 28.6° [115] | |
| 5.25 [154] | 118(q) [16] | 0.6605 | 200° [373] | 1.497705(h) | 25.2° [309,310] | |
| 5.1 [136] | 106(r) [16] | 0.6610 | 200° [213,295] | 1.496991 | 25.0° [268] | |
| 5.075 [29] | 94(s) [18] | | | 1.4970 | 25° [108] | |
| 6.0(n) [17] | 87(t) [17] | 0.6758 | 190° [295,373] | 1.49765 | 25° [392] | ¶ |
| atm | 82.02(v) [217] | | | 1.49774 | 25° [46] | |
| 204.2 11,000 [49] | 81.35(u) [217] | 0.6906 | 180° [213,295,373] | 1.49779 | 25° [375] | |
| 190.5 10,000 [49] | 81.28(v) [217] | | | 1.4979 | 25° [69] | |
| 176.7 9,000 [49] | 288.0 36.226 [402] | 0.7043 | 170° [295,373] | 1.49794(h) | 25° [151] | ⊙ |
| 162.2 8,000 [49] | 286.7 35,436 [402] | | | 1.49795 | 25° [21,22] | |
| 147.2 7,000 [49] | 284.3 34,594 [402] | 0.7185 | 160° [213,295,373] | 1.49807 | | |
| 131.2 6,000 [49] | 280 33,713 [371] | | | ± 0.00006 | 25° [396,397] | |
| 114.6 5,000 [49] | 280 32,782(w) [402] | 0.7310 | 150.0° [248,295,373] | 1.49815 | 25° [338] | ⊖ |
| 96.6 4,000 [49] | 270 28,852(w) [402] | | | 1.49819 | 25° [391] | |
| 93.2 3,871 [289] | 260 26,372 [371] | 0.7448 | 140.1° [248] | 1.49823 | 25° [227] | |
| 88.3 3,629 [289,290] | 260 25,329 [402] | 0.7440 | 140° [213,295,373] | 1.49825(h) | 25.00° [276] | |
| 86.4 3,532 [290] | 255 24,306.05 [126] | | | 1.4983 | 25° [112] | |
| 84.3 3,436 [289] | 250 22,182(w) [402] | 0.7470 | 130.2° [248] | 1.4992 | 25° [225] | ⊕ |
| 83.4 3,387 [289] | 240 20,231 [371] | 0.7472 | 130.0° [248] | 1.4993 | 23.7° [115] | |

**Additional Data**

* $t_m = 5.459 + 0.028149\ p_{atm} - 0.000001546\ p_{atm}^2$ (1 to 4,000 atm

† $t_m = 5.461 + 0.026732\ p_{atm} - 0.0000009202\ p_{atm}^2$ (1 to 9,000 atm)

‡ $\frac{1}{T_b} = 0.004446498 - 0.00055258 \log_{10} p_{mm}$ (14 to 200 mm)

§ $\frac{1}{T_b} = 0.00452385 - 0.00058937 \log_{10} p_{mm}$ (200 to 790 mm)

¶ $\frac{1}{T_b} = 0.004586504 - 0.00060907 \log_{10} p_{mm}$ (790 to 5,500 mm)

⊙ $\frac{dD}{dt} = -0.00106304[1 + 0.00088019(t-20)]$/°C (0 to 100°C)

⊖ $\frac{dD}{dt} = -0.00108579[1 - 0.0014520(t-20) + 0.00002675(t-20)^2]$/°C (0 to 160°C)

⊕ $\frac{dn}{dt} = -0.00063190[1 + 0.002461(t-20)]$/°C (2 to 80°C)

*The notes designated by letters appear on pages 37 and 38.*

| M. P.,°C | | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|---|
| **Benzene** | | 240 | 19,393.12[126] | 0.7568 | 130°[295, 373] | 1.49898 | 22°[142] | |
| *(Continued)* | | 240 | 19,352(w)[402] | | | 1.49966 | 22°[37] | |
| | | 230 | 16,825(w)[402] | 0.7576 | 130.0°[248] | 1.49982 | 22°[157] | |
| | atm | 220 | 15,192[371] | 0.7692 | 120.2°[248] | 1.4979 | 21.5°[115] | |
| 80.7 | 3,387[345] | 220 | 14,493(w)[402] | 0.7692 | 120°[213, 295] | 1.50008 | 21.37°[124] | |
| 78.5 | 3,145[290] | 210 | 12,453(w)[402] | | | 1.49900 | 21°[163] | |
| 77.7 | 3,000[49] | 200 | 11,134[371] | 0.7692 | 119.9°[373] | 1.4990 | 21°[108] | |
| 73.6 | 2,903[289] | 200 | 10,860[126] | 0.7749 | 110.4°[248] | 1.501545 | 20.5°[64] | |
| 72.7 | 2,903[345] | 200 | 10,650(w)[402] | 0.7807 | 110.0°[248] | 1.50143 | 20.1°[370] | |
| 73.50 | 2,882[344] | 190 | 9,045(w)[402] | 0.7809 | 110°[373] | 1.5007 | 18.5°[108] | |
| 69.99 | 2,754[345] | 180 | 7,630(w)[402] | 0.7810 | 110°[295] | 1.5027 | 18.5°[275] | |
| 66.7 | 2,565[290] | 170 | 6,386(w)[402] | 0.7750 | 109.9°[248] | 1.5030 | 18°[409] | |
| 66.0 | 2,536[345] | 160 | 5,300(w)[402] | 0.79030 | 100.00°[222] | 1.50300 | 17°[163] | |
| 63.8 | 2,420[289] | 162 | 5,274.93[126] | | | 1.502328 | 16.8°[268] | |
| 63.5 | 2,420[345] | 150 | 4,332(w)[402] | 0.79038 | 100°[40] | 1.503771 | 16.7°[217] | |
| 63.67 | 2,418[344] | 140 | 3,520(w)[402] | 0.7919 | 100.0°[248] | ± 0.000007(u) | | |
| 60.00 | 2,232[345] | 130 | 2,815(w)[402] | 0.7927 | 100°[373] | 1.50325 | 16.5°[400] | |
| 56.0 | 2,032[290] | 125 | 2,464[327] | 0.7928 | 100°[213, 295] | 1.5033 | 16.5°[291] | |
| 56.5 | 2,000[49] | 121 | 2,347.4[411] | | | 1.5034 | 16°[163] | |
| 55.02 | 1,974[345] | 121 | 2,259.95[126] | 0.8033 | 90.2°[248] | 1.5038 | 16.0°[194] | |
| 54.0 | 1,936[345] | 120 | 2,243[106,318] | 0.8004 | 90.1°[248] | 1.5038 | 15°[135] | |
| 53.7 | 1,936[289] | 120 | 2,240[333,334] | 0.80190 | 90°[40] | 1.50402 | 15°[142] | |
| 54.99 | 1,918[344] | 120 | 2,236.80[25] | 0.8041 | 90°[373] | 1.50439 | 15°[81,350] | |
| 50.03 | 1,747[345] | 120 | 2,230(w)[402] | 0.8042 | 90°[295] | 1.50453 | 15°[163] | |
| 45.20 | 1,506[344] | 115.624 | 2,026.3[411] | 0.81328 | 80.37°[103] | 1.504551 | 15°[118] | |
| 43.8 | 1,500[290] | 115 | 1,983[333] | 0.8118 | 80.0°[248] | 1.503727 | 14.8°[268] | |
| 43.15 | 1,452[345] | 110 | 1,751[333,334] | 0.8124 | 80°[34] | 1.503819 | 14.4°[268] | |
| 42.6 | 1,452[289] | 110 | 1,746.20[25] | 0.8126 | 80°[247] | 1.50690 | 12.5°[7] | |
| 42.06 | 1,408[345] | 108 | 1,744[59] | 0.8127 | 80°[213,295] | 1.50565 | 12.3°[369] | |
| 40.06 | 1,327[345] | 109.601 | 1,741.0[411] | 0.81331 | 80°[2] | 1.505543 | 12.0°[268] | |
| 34.41 | 1,053[344] | 110 | 1,739(w)[402] | 0.81367 | 80°[103] | 1.50626 | 11.06°[124] | |
| 31.7 | 1,016[49,290] | 105 | 1,542[333] | 0.81374 | 80°[40] | 1.506051 | 11.0°[268] | |
| 32.5 | 1,000[49] | 103.621 | 1,489.2[411] | 0.8145 | 80°[373] | 1.506538 | 10.5°[268] | |
| 32.2 | 968[77] | 100 | 1,371[32] | 0.8146 | 80.0°[248] | 1.506792 | 10°[268] | |
| 31.45 | 968[345] | 100 | 1,348[333,334] | 0.8121 | 79.9°[316] | 1.50871 | 8.5°[274] | |
| 30.2 | 968[289] | 100 | 1,344[106,318, 319] | 0.81297 | 79.9°[256] | 1.50808 | 8.2°[186] | |
| 31.51 | 936[344] | | | 0.81360 | 79.74°[276] | 1.50853 | 8°[142] | |
| 30.05 | 917[345] | 100 | 1,342.20[25] | 0.8121 | 79.7°[248] | 1.5100 | 8°[163] | |
| 29.86 | 902[344] | 100 | 1,339[327] | 0.81380 | 79.70°[222] | 1.50908 | 6.8°[370] | |
| 29.59 | 895[345] | 100 | 1,335(w)[402] | 0.8150 | 79.2°[99] | 1.5103 | 6.5°[163] | |
| 30.00 | 887[77] | 97.683 | 1,268.1[411] | 0.8147 | 78.0°[294] | 1.51011 | 5.6°[370] | |
| 27.99 | 808[344] | 95 | 1,184[326] | 0.81556(g) | 77.98°[276] | 1.5103 | 5.51°[169] | |
| 25.00 | 705[77] | 95 | 1,180[333] | 0.8178 | 75°[189] | 1.5122 | 2.0°[115] | |
| 25.05 | 696[344] | 91.787 | 1,074.6[411] | 0.818721 | 75°[280,281] | 1.49051 | $n_{H\alpha}^{30}$[81] | |
| 24.84 | 696[344] | 90 | 1,039[32] | 0.81886(g) | 75°[276] | 1.49312 | $n_{H\alpha}^{25}$[220] | |
| 21.5 | 629[290] | 90 | 1,018[333,334] | 0.81923 | 75°[2] | 1.49329(h) | $n_{H\alpha}^{25}$[151] | |
| 20.00 | 521[77] | 90 | 1,015[318] | 0.8220 | 72.7°[236] | 1.4933 | $n_{H\alpha}^{25}$[75] | |
| 20.13 | 516[345] | 90 | 1,014.40[25] | 0.82244 | 72.06°[363] | 1.49441 | $n_{H\alpha}^{22}$[142] | |
| 19.96 | 508[344] | 90 | 1,008(w)[402] | 0.82403(g) | 70.36°[276] | | | |
| 20.03 | 499[344] | 90 | 1,008[368] | 0.8226 | 70.2°[248] | | | |

*The notes designated by letters appear on pages 37 and 38.*

| M. P.,°C | | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|---|
| **Benzene** | | 85.912 | 906.1 [411] | 0.8231 | 70.1° [348] | 1.4934 | $n_{H\alpha}^{21.5}$ [115] | |
| *(Continued)* | | 86 | 906 [59] | 0.8234 | 70° [247] | 1.49547 | $n_{H\alpha}^{20.5}$ [64] | |
| | | 85 | 879 [333] | 0.8237 | 70.0° [268] | 1.49638 | $n_{H\alpha}^{20}$ [185] | |
| | atm | 84.079 | 857.82 [335] | 0.8241 | 70° [189] | 1.49646 | $n_{H\alpha}^{20}$ [178] | |
| 19.33 | 486 [344] | 83.285 | 837.56 [335] | 0.82442 | 70° [40] | 1.49668 | $n_{H\alpha}^{20}$ [53] | |
| 19.35 | 484 [345] | 82.606 | 820.59 [335] | 0.8246 | 70° [219] | 1.4967 | $n_{H\alpha}^{20}$ [54] | |
| 18.85 | 484 [77] | 82.022 | 806.21 [335] | 0.8248 | 70° [239,373] | 1.49678 | $n_{H\alpha}^{20}$ [407,408] | |
| 17.8 | 484 [289] | 81.417 | 791.46 [335] | 0.8249 | 70° [358] | 1.49690 | $n_{H\alpha}^{20.0}$ [170] | |
| 17.80 | 432 [344] | 80.822 | 777.20 [336] | 0.82492 | 70° [103] | 1.50043 | $n_{H\alpha}^{17.7}$ [95] | |
| 17.56 | 412 [154] | 80.29 | | 0.82505 | 70° [2] | 1.4988 | $n_{H\alpha}^{16.0}$ [194] | |
| 16.44 | 387 [154] | −80.48 | 770 [278] | 0.8260 | 70.0° [248] | 1.49938 | $n_{H\alpha}^{15}$ [142] | |
| 15.78 | 368 [344] | 80.2 | 768 [113] | 0.8229 | 69.9° [248] | 1.49952 | $n_{H\alpha}^{15}$ [81,350] | |
| 15.32 | 348 [154] | 80.5 | 767.2 [137] | 0.8270 | 67.9° [236] | 1.499659 | $n_{H\alpha}^{15}$ [113] | |
| 15.00 | 338 [77] | 80.299 | 764.84 [335] | 0.8292 | 65.0° [268] | 1.50119 | $n_{H\alpha}^{12.3}$ [369] | |
| 14.77 | 329 [154] | 80.35 | 764.68 [80] | 0.82993(g) | 65° [276] | 1.4983 | $n_{H\alpha}^{10.0}$ [115] | |
| 14.83 | 325 [344] | 80.30 | 763.47 [80] | 0.83078 | 65° [2] | 1.50381 | $n_{H\alpha}^{8.5}$ [274] | |
| 13.95 | 300 [154] | 80.35 | 763.1 [137] | 0.8294 | 64.88° [169] | 1.50370 | $n_{H\alpha}^{8.2}$ [186] | |
| 13.8 | 300 [77] | 80.35 | 763 [360] | 0.83316 | 62.30° [363] | 1.50383 | $n_{H\alpha}^{8}$ [142] | |
| 13.65 | 290 [154] | 80.0 | | 0.8322 | 61.8° [348] | 1.50721 | $n_{H\beta}^{30}$ [81] | |
| 13.25 | 275 [154] | −80.2 | 763 [35] | 0.83496 | 60.70° [227] | 1.5094 | $n_{H\beta}^{28.6}$ [115] | |
| 12.53 | 251 [154] | 80.3 | 762.9 [137] | 0.8337 | 60.3° [348] | 1.50985 | $n_{H\beta}^{25}$ [151] | |
| 12.45 | 250 [154] | 80.27 | | 0.83594 | 60.3° [216] | 1.5109 | $n_{H\beta}^{23.7}$ [115] | |
| 11.99 | 232 [154] | ±0.01 | 762 [174] | 0.8364 | 60.2° [248] | 1.51090 | $n_{H\beta}^{22}$ [142] | |
| 11.80 | 225 [154] | 80.3. | 761.5 [137] | 0.8342 | 60.0° [247, 248] | 1.5095 | $n_{H\beta}^{21.5}$ [115] | |
| 11.10 | 200 [154] | 80.45 | 761.1 [381] | | | 1.511207 | $n_{H\beta}^{20.5}$ [64] | |
| 10.87 | 193 [154] | 79.7 | | 0.8346 | 60° [169] | 1.51301 | $n_{H\beta}^{20}$ [185] | |
| 10.41 | 176 [344] | −80.0 | 761 [116] | 0.8353 | 60° [304] | 1.51323 | $n_{H\beta}^{20}$ [178] | |
| 10.40 | 175 [154] | 80.25 | 760.8 [137] | 0.83546 | 60° [40] | 1.51324 | $n_{H\beta}^{20.0}$ [170] | |
| 10.00 | 161 [77] | 79.9 | 760.4 [256] | 0.8357 | 60° [91,239, 365,373] | 1.51339 | $n_{H\beta}^{20}$ [53] | |
| 10.12 | 156 [345] | 80.16 | 760.23 [80] | | | 1.51350 | $n_{H\beta}^{20}$ [407,40] | |
| 9.78 | 155 [154] | 80.4 | 760.2 [43] | 0.8358 | 60.0° [248] | 1.5144 | $n_{H\beta}^{18.5}$ [275] | |
| 9.60 | 150 [154] | 80 08 | 758.39 [59] | 0.83584 | 60° [102] | 1.51480 | $n_{H\beta}^{17.7}$ [95] | |
| 9.66 | 141 [344] | 80.1 | 758 [191] | 0.8359 | 60° [352] | 1.5156 | $n_{H\beta}^{16.0}$ [194] | |
| 9.24 | 136 [154] | 80.09 | 758.0 [407] | 0.83602(g) | 60.00° [69] | 1.51610 | $n_{H\beta}^{15}$ [142] | |
| 8.90 | 125 [154] | 80 | 757.5 [333,334] | 0.83642 | 60° [2] | 1.51633 | $n_{H\beta}^{15}$ [81,350] | |
| 8.15 | 100 [154] | 80.04 | | 0.83645 | 60° [129] | 1.516392 | $n_{H\beta}^{15}$ [113] | |
| 7.45 | 75 [154] | −80.14 | 757.4 [346] | 0.8368 | 59.54° [243] | 1.51817 | $n_{H\beta}^{12.3}$ [369] | |
| 6.80 | 50 [154] | 80.12 | 757.3 [203] | 0.8352 | 59° [348] | 1.5148 | $n_{H\beta}^{10.0}$ [115] | |
| 6.10 | 25 [154] | 80.03 | 757.24 [80] | 0.8376 | 58 90° [272] | 1.52086 | $n_{H\beta}^{8.5}$ [274] | |
| 5.5006 | 0 [300] | 80.2 | | 0.83751 | 58.33° [363] | 1.52055 | $n_{H\beta}^{8.2}$ [186] | |
| 5.415 | 0 [98] | −80.3 | 757 [338] | 0.8370 | 58.3° [236] | 1.52069 | $n_{H\beta}^{8}$ [142] | |
| 5.35 | 0 [345] | 80.0 | | 0.8392 | 56.7° [120] | | | |
| 5.33 | 0 [154] | −80 2 | 757 [111] | 0.8403(g) | 56.00° [69] | | | |
| | | 80.001 | 756.49 [80] | 0.8397 | 55° [34] | | | |
| | | 79.9 | | 0.8403 | 55.0° [268] | | | |
| | | −80.1 | 756 [357] | 0.84198 | 55° [2] | | | |
| | | 80 | 755 [106,318, 319,368] | 0.8387 | 54.8° [381] | | | |
| | | | | 0.8429 | 52.0° [348] | | | |
| | | 80.0 | 753.6 [157] | 0.844675(g) | 52.00° [69] | | | |
| | | 79.9 | 753.4 [296] | 0.8470 | 50.4° [248] | | | |

*The notes designated by letters appear on pages 37 and 38.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **Benzene** *(Continued)* | 79.796 | 0.8453 | 50.2° [248] | 1.5242 | $n_{H\beta}^{2.0}$ [115] | |
| | 753 08 [335] | | | | | |
| | 79.5 | 0.8450 | 50° [247] | 1.5201 | $n_{H\gamma}^{25}$ [75] | |
| | −79.7 753 [90] | 0.8456 | 50.0° [268] | 1.52015(h) | $n_{H\gamma}^{25}$ [151] | |
| | 80 752.74 [25] | 0.846170 | 50° [280,281] | 1.52119 | $n_{H\gamma}^{22}$ [142] | |
| | 79.78 752.6 [84] | 0.84639 | 50° [40] | 1.5205 | $n_{H\gamma}^{21.5}$ [115] | |
| | 79.6 752 [147] | 0.8466 | 50° [239,347] | 1.522042 | $n_{H\gamma}^{20.5}$ [64] | |
| | 79.7 | 0.8467 | 50° [91,358] | 1.52375 | $n_{H\gamma}^{20}$ [407,408] | |
| | −79.8 751.4 [258] | 0.84678 | 50° [103] | 1 52377 | $n_{H\gamma}^{20}$ [53] | |
| | 79.98 751 [102] | 0.84748 | 50° [2] | 1.52380 | $n_{H\gamma}^{20}$ [178] | |
| | 79.5 | 0.84911(g) | 48.00° [69] | 1.5261 | $n_{H\gamma}^{16.0}$ [194] | |
| | −79.7 750.7 [224] | 0.84874 | 47.95° [363] | 1.52656 | $n_{H\gamma}^{15}$ [142] | |
| | 79.75 750 [362] | 0.8486 | 47.0° [348] | 1.52681 | $n_{H\gamma}^{15}$ [350] | |
| | 79.70 750 [308] | 0.8494 | 46.50° [169] | 1.526963 | $n_{H\gamma}^{15}$ [113] | |
| | 79.64 | 0.8510 | 46.5° [236] | 1.52867 | $n_{H\gamma}^{12.3}$ [369] | |
| | −79.70 749.0 [197] | 0.8500 | 46.0° [294] | 1.5258 | $n_{H\gamma}^{10.0}$ [115] | |
| | 79.6 748.6 [9,10] | 0.85104 | 45.95° [222] | 1.53154 | $n_{H\gamma}^{8.5}$ [274] | |
| | 79.49 | 0.8503 | 45.0° [268] | 1.53097 | $n_{H\gamma}^{8.2}$ [186] | |
| | −79.55 747.7 | 0.85201(g) | 45° [276] | 1.53125 | $n_{H\gamma}^{8}$ [142] | |
| | −748.3 [289] | 0.85291 | 45° [2] | 1.50247 | $n_{He}^{20}$ [87] | |
| | 79.6 748 [33] | 0.8536 | 45° [209] | 1.497005 | $n_{He}^{15}$ [113] | |
| | 79.6 747.5 [408] | 0.8507 | 44.8° [348] | 1.50446 | $n_{He}^{15}$ [350] | |
| | 79.2 747 2 [256] | 0.85343(g) | 44.00° [69] | (x) | | |
| | 79.2 746 7 [256] | 0.8533 | 43.0° [268] | | | |
| | 79.65 746.2 [143] | 0.85462 | 42.65° [272] | | | |
| | 79.6 744.5 [261,268] | 0.85512(g) | 42.16° [276] | | | |
| | 79.47 744.5 [197] | 0.8547 | 41.5° [381] | | | |
| | 79.6 743.1 [296] | 0.8557 | 41° [378] | | | |
| | 79.4 743 [339] | 0.85683 | 40.7° [245] | | | |
| | 79.32 742.3 [143] | 0.8555 | 40.5° [348] | | | |
| | 79.6 742 [57] | 0.8557 | 40° [247] | | | |
| | 79 742 [31] | 0.8559 | 40.0° [268] | | | |
| | 79.2 740.8 [84] | 0.85661 | 40° [119] | | | |
| | 79.2 740 [88] | 0.8569 | 40° [304] | | | |
| | 79 740 [32] | 0.85697(g) | 40° [347] | | | |
| | 79 739.5 [262] | 0.85721 | 40° [40] | | | |
| | 79.201 739.35 [335] | 0.8573 | 40° [358] | | | |
| | 79.3 739 [53] | 0.8575 | 40° [239] | | | |
| | 78.1 735.75 [201] | 0.85750(g) | 40° [276] | | | |
| | 78.70 | 0.85752 | 40° [129] | | | |
| | −78.73 735 [53] | 0.8576 | 40° [91,365, 373] | | | |
| | 78.9 733 [65] | | | | | |
| | 79.2 731.1 [321,322] | 0.85765 | 40° [103] | | | |
| | 78.6 728.9 [315] | 0.85769(g) | 40.00° [69] | | | |
| | 78.606 725.77 [335] | 0.8578 | 40° [267] | | | |
| | 78.45 724 [352] | 0.85829 | 40° [2] | | | |
| | 78.36 720 [124] | 0.8587 | 38.3° [279] | | | |
| | 78.30 718 6 [124] | 0.85963(g) | 38° [276] | | | |
| | 78.0 718 [400] | 0.8617 | 36.15° [248] | | | |
| | 78.015 712.55 [335] | 0.86183(g) | 36° [276] | | | |
| | 78.0 712.5 [162] | 0.8620 | 36.0° [286] | | | |

*The notes designated by letters are shown on pages 37 and 38.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Benzene** *(Continued)* | 77.8 707.52[315] | 0.86205(g) 36.00°[69] | | |
| | 77.7 700 7[321,322] | 0.8612 35.0°[268] | | |
| | 77.9 700[167] | 0.86362 35°[2] | | |
| | 77.430 699.60[335] | 0.8639 35°[209] | | |
| | 76.841 686.81[335] | 0.8609 34.95°[304] | | |
| | 76 65 684.6[296] | 0.86310 34.95°[350] | | |
| | 76.3 675.41[315] | 0.8626 34.0°[348] | | |
| | 76.261 674.35[335] | 0.86393(g) 34°[276] | | |
| | 75.532 658.96[335] | 0.8616 33.51°[169] | | |
| | 75 650[333] | 0.86466 33.51°[350] | | |
| | 74.9 643.7[315] | 0.86531 32.90°[350] | | |
| | 75.0 642.3[157] | 0.8645 32.5°[381] | | |
| | 74.9 640[285] | 0.86613(g) 32°[276] | | |
| | 74.352 633.90[411] | 0.866245(g) 32.00°[69] | | |
| | 74.1 630.3[296] | 0.8658 31.0°[348] | | |
| | 73.4 614.1[256] | 0.8659 31.0°[268] | | |
| | 73.2 610.79[315] | 0.86828 30.10°[222] | | |
| | 72.9 606.6[256] | 0.8665 30°[247] | | |
| | 73.0 601.5[321,322] | 0.86657 30°[60] | | |
| | 73.0 600[167] | 0.86704 30°[287,288] | | |
| | 72.1 600[399] | 0.86719 30°[119] | | |
| | 72.0 588[62] | 0.8672 30°[292] | | |
| | 71.85 582.0[296] | 0.8679 30°[358] | | |
| | 71 575[32] | 0.86796 30°[40] | | |
| | 70 551.5[106,318] | 0.8680 30°[267] | | |
| | 70 551.2(w)[319] | 0.868020(g) 30°[118] | | |
| | | 0.86825(g) 30°[276] | | |
| | 70 551[333,334] | 0.86828(g) 30°[50] | | |
| | 70.1 550[167] | 0.86836 30°[45] | | |
| | 69.5 550[399] | 0.8684 30°[81,91] | | |
| | 70 548.16[368] | 0.86840(g) 30°[68,76] | | |
| | 70 547.41[25] | 0.86844 30°[350] | | |
| | 70.0 547.4[157] | 0.8685 30°[238] | | |
| | 70 547[188] | 0.86856 30°[103] | | |
| | 69.25 534.6[296] | 0.86891 30°[2] | | |
| | 68.625 525.76[411] | 0.8697 30°[14] | | |
| | 69 525.4[59] | 0.8691 28.8°[236] | | |
| | 67.7 510.05[315] | 0.8697 28.8°[350] | | |
| | 67.3 500.5[321,322] | 0.8709 28.6°[115] | | |
| | 67.4 500[167] | 0.870586(g) 28.00°[69] | | |
| | 67.2 497.6[296] | 0.8710 27.3°[36] | | |
| | 66 477[323] | 0.8690 27°[163] | | |
| | 65 463[333,334] | 0.8704 26.9°[36] | | |
| | 65.0 461.2[157] | 0.87178 26.9°[320] | | |
| | 64.2 459.49[315] | 0.8706 26.7°[36] | | |
| | 64.2 454.1[256] | 0.8708 26.5°[36] | | |
| | 64.1 450.1[256] | 0.8713 26.1°[36] | | |
| | 64.4 450[167] | 0.8715 26 0°[268] | | |
| | 63.6 450[399] | 0.8738 25.9°[36] | | |
| | 63.6 440.0[296] | 0.8739 25.8°[36] | | |

*The notes designated by letters are given on pages 37 and 38.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Benzene** (*Continued*) | 62.940 433.6 [411] | 0.8719 25.7° [36] | | |
| | 63 433.0 [59] | 0.87336 25.25° [272] | | |
| | 60.9 401 [321,322] | 0.87343 25.25° [350] | | |
| | 60.3 400 [399] | 0.8732 25.13° [28] | | |
| | 60.0 395.9(w) [319] | 0.8734 25.13° [312] | | |
| | | 0.8724 25° [116] | | |
| | 60 394.75(w) [106,318] | 0.872627 25° [280,291] | | |
| | | 0.8728(g) 25° [179,225] | | |
| | 60 389.34 [25] | 0.87287 25° [46] | | |
| | 60 389 [323] | 0.87288 25° [220] | | |
| | 60.0 388.6 [157] | 0.8729 25° [189] | | |
| | 59.3 380 [323] | 0.8731 25° [385,386, 388] | | |
| | 58.8 371.4 [296] | | | |
| | 58.5 369 [32] | 0.8733(g) 25° [61,387] | | |
| | 57.298 355.1 [411] | 0.8734 25° [353,358] | | |
| | 57.5 354.6 [59] | 0.87345 25° [314] | | |
| | 57.0 350 [167] | 0.8735 25° [99,157] | | |
| | 56.6 350 [399] | 0.8736 25° [26,257] | | |
| | 56.4 339.5 [296] | 0.87360 | | |
| | 55.0 323.3 [157] | ± 0.00005 25.00° [260] | | |
| | 54.7 314.5 [256] | | | |
| | 54.25 313.9 [296] | 0.87362(g) 25° [168,276] | | |
| | 53.2 303.5 [256] | 0.87363 25° [21,22] | | |
| | 52.9 301.4 [321,322] | 0.87366 | | |
| | 52.6 300 [167] | ± 0.00002 25° [396] | | |
| | 52.5 300 [399] | 0.873670 | | |
| | 51.697 289.1 [411] | ± 0.000004 | | |
| | 52 288.5 [59] | 25° [397] | | |
| | 51.85 287.4 [296] | 0.87369 25° [250] | | |
| | 50 274.5(w) [319] | 0.8737 25° [85] | | |
| | | 0.8738 25° [75] | | |
| | 50 273.0 [324] | 0.8741 25° [66] | | |
| | 50 271 [323] | 0 87417 25° [2] | | |
| | 50 270.17 [25] | 0.8742 25° [209] | | |
| | 50.0 269.0 [157] | 0.874212 $D_{25}^{25}$ [384] | | |
| | 50 268 [146,326] | 0.8754 $D_{25}^{25}$ [180] | | |
| | 49.99 268.0 [375] | 0.8758 $D_{25}^{25}$ [224] | | |
| | 50.1 267.0 [296] | 0.87596 $D_{25}^{25}$ [157] | | |
| | 49.36 263.3 [296] | 0.8767 $D_{25}^{25}$ [273] | | |
| | 47.9 250 [167] | 0.87411 24.42° [363] | | |
| | 47.8 250 [399] | 0.87270 24.27° [190] | | |
| | 47.8 249.6 [321,322] | 0.8740 24° [168] | | |
| | 47.94 249.1 [296] | 0.87485(g) 24.00° [69] | | |
| | 46 233.1 [59] | 0.8742 23.8° [36] | | |
| | 45.97 230.0 [296] | 0.8760 23.7° [115] | | |
| | 45 224 [188] | 0.8740 23° [164] | | |
| | 44.7 221.0 [296] | 0.8741 23.0° [288] | | |
| | 45.0 220.7 [157] | 0.8748 23° [107] | | |
| | 43.71 209.6 [296] | | | |
| | 42.5 202.1 [321,322] | | | |

*The notes designated by letters are shown on pages 87 and 88.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Benzene** (*Continued*) | 42.1 200 [167,399] | 0.87575 23° [355] | | |
| | 42.0 200 [32] | 0.8759 22.3° [36] | | |
| | 41.41 190.8 [296] | 0.87648(g) 22° [284] | | |
| | 41.3 187.9 [256] | 0.87651 22° [283] | | |
| | 40 186.9 [59] | 0.8773 21.5° [115] | | |
| | 40 185.7(w) [106] | 0.87790 21° [350] | | |
| | | 0.87811 21° [45] | | |
| | 40 185.5 [318] | 0.87786 20.58° [362] | | |
| | 40 185.3(w) [319] | 0.8773 20.5° [381] | | |
| | | 0.87889 20.5° [64] | | |
| | 40 184.0 [324] | 0.87874 20.2° [350] | | |
| | 41.5 182.5 [214] | 0.87893 20.2° [194] | | |
| | 40 182.35 [25] | 0.8783 20.15° [28] | | |
| | 40.0 181.1 [157] | 0.8789 $D_{20}^{20}$ [147] | | |
| | 40 177.3 [326] | 0.88008 $D_{20}^{20}$ [162] | | |
| | 39.35 174.95 [296] | 0.8790 19.9° [373] | | |
| | 40.1 174.9 [256] | 0.88034 $D_{19.80}^{19.80}$ [61] | | |
| | 38.78 173.0 [296] | 0.88112 19.75° [272] | | |
| | 35.5 150.8 [296] | 0.87948 19.5° [350] | | |
| | 35.4 150.5 [214] | 0.8802 19° [163] | | |
| | 35.4 150.2 [321,322] | 0.8815 18.5° [275] | | |
| | 35.4 150 [167] | 0.88063 18.4° [350] | | |
| | 35.2 150 [399] | 0.88084 18.4° [194] | | |
| | 35 148.8 [59] | 0.8799 18.1° [379] | | |
| | 34.8 147 [323] | 0.8808 18° [376] | | |
| | 35.0 146.3 [157] | 0.88103 18° [246] | | |
| | 35 145.4 [325, 328] | 0.88118 18.0° [402] | | |
| | 33.6 137.9 [296] | 0.88181 18° [228] | | |
| | 31.4 125.85 [296] | 0.8823 18° [164] | | |
| | 30.87 123.45 [296] | 0.8829 18° [325] | | |
| | 30 121.8 [324] | 0.88110 17.95° [350] | | |
| | 31.0 120 [214] | 0.88101 17.90° [363] | | |
| | 30 119.25 [25] | 0.8819 17.7° [95] | | |
| | 30 118.6(w) [319] | 0.8800 17.4° [348] | | |
| | | 0.88190 17.2° [350] | | |
| | 30.0 118.2 [157] | 0.8821 17.2° [236] | | |
| | 30 118 [32] | 0.8804 17.0° [348] | | |
| | 30 117.45 [368] | 0.8830 17° [163] | | |
| | 30 116 [327] | 0.8826 16.35° [169] | | |
| | 30 115.8 [326,328] | 0.88279 16.35° [350] | | |
| | 28.15 109.35 [296] | 0.88284 16.3° [350] | | |
| | 26.4 100 [167] | 0.88307 16.3° [194] | | |
| | 26.3 100 [321,322] | 0.8828 16.20° [169] | | |
| | 26.0 100 [399] | 0.88293 16.2° [350] | | |
| | 25.37 96.4 [296] | 0.88226 16° [315] | | |
| | 25.0 95.90 [332] | 0.88422 16° [165] | | |
| | 25 95.9 [244] | 0.88336 15.8° [350] | | |
| | 25 94.9 [106] | 0.8835 15.8° [236] | | |
| | 25.0 94.0 [157] | | | |

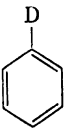
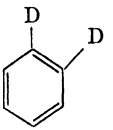
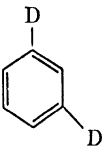
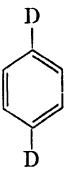
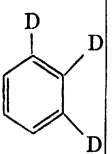
*The notes designated by letters are given on pages 37 and 38.*

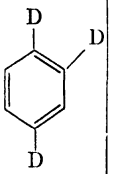
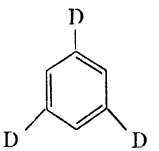
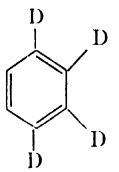
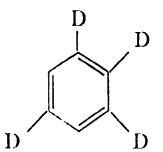
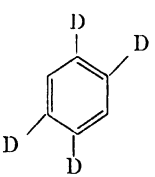
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Benzene** *(Continued)* | 23.5 92.0 [68] | 0.8824 15.5° [268] | | |
| | 22.97 85.5 [296] | 0.8845 15.5° [150] | | |
| | 22.3 80.5 [214] | 0.8846 $D_{15.5}^{15.5}$ [165] | | |
| | 20.54 77.25 [296] | 0.8850 15.4° [163] | | |
| | 20 76.5 [106,318] | 0.8826 15° [110] | | |
| | 20 76.2(w) [319] | 0.8828 15° [82] | | |
| | | 0.883573 15° [280,281] | | |
| | 20 76.0 [324] | 0.8841 15° [81] | | |
| | 20 75.6 [214] | 0.8840 15.0° [122] | | |
| | 20 75.14 [25] | 0.88420 15° [350] | | |
| | 20.0 75.0 [15,167,188] | 0.8842 15° [237] | | |
| | | 0.8844 15° [358] | | |
| | 20.0 74.7 [157] | 0.8846 15° [66,209] | | |
| | 20 74.66 [139] | 0.88462 15° [2] | | |
| | 20 74.13 [368] | 0.8853 $D_{15}^{15}$ [273] | | |
| | 20 74.0 [326,378] | 0.8872 15° [163,164] | | |
| | 18.5 71.4 [69] | 0.88434 14.95° [222] | | |
| | 18 71 [32] | 0.88501 14.5° [191] | | |
| | 18.72 70.75 [296] | 0.8847 14.40° [363] | | |
| | 18 70 [15] | 0.8853 14° [255] | | |
| | 16.85 64.5 [296] | 0.88551 13.5° [45] | | |
| | 15 59 [146] | 0.88578 13.5° [350] | | |
| | 15.0 58.2 [157] | 0.88638 12.87° [359] | | |
| | 14.66 57.8 [296] | 0.8867 12.3° [369] | | |
| | 15 55 [317] | 0.88741 11.92° [363] | | |
| | 14 54.9 [59] | 0.8871 11.2° [294] | | |
| | 12.51 51.65 [296] | 0.8886 10.7° [143] | | |
| | 12.1 50 [167] | 0.8876 10.5° [348] | | |
| | 11.8 50 [399] | 0.8868 10.0° [115] | | |
| | 11.7 49 [167] | 0.8878 10.0° [268] | | |
| | 11.3 48 [167] | 0.8880 10° [247] | | |
| | 10.44 47.25 [296] | 0.88834 10° [119] | | |
| | 10.9 47 [167] | 0.88930 10° [40] | | |
| | 10.5 46 [167] | 0.8894 10° [239] | | |
| | 10 46.0(w) [319] | 0.88915 10° [350] | | |
| | 10.0 45.4 [157] | 0.88946 10° [363] | | |
| | 10 45.34 [25] | 0.8895 10° [91] | | |
| | 10.6 45.19 [368] | 0.88956 10° [245] | | |
| | 10.1 45 [167] | 0.88962 10° [103] | | |
| | 10 44.6 [326] | 0.8898 10° [66] | | |
| | 9.6 44 [167] | 0.88982 10° [2] | | |
| | 9.21 43.0 [296] | 0.8900 $D_{10}^{10}$ [273] | | |
| | 9.2 43 [167] | 0.89137 8.5° [274] | | |
| | 8.8 42 [167] | 0.8896 8.4° [348] | | |
| | 8.5 41.8 [69] | 0.8906 8.2° [186] | | |
| | 8.37 41.8 [296] | 0.8904 8.0° [348] | | |
| | 8.3 41 [167] | 0.89291 7.1° [194] | | |
| | 7.98 40.9 [296] | 0.89260 7° [350] | | |
| | 7.8 40 [167] | | | |

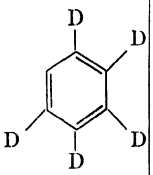
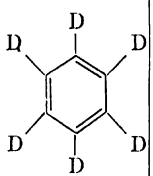
*The notes designated by letters are shown on pages 37 and 38.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Benzene** (*Continued*) | 7 40[15]<br>7.47 39.85[296]<br>7.4 39[167]<br>7.03 38.45[296]<br>6.9 38[167]<br>6.25 37.2[296]<br>6.4 37[167]<br>5.74 36.15[296]<br>5.9 36[167]<br>5.48 35.9[296]<br>5.31 35.4[296]<br>5.06 35.2[296]<br>5.30 35.05[296]<br>5.4 35[167]<br>5.0 34.7[157]<br>4.84 34.7[296]<br>4.9 34[167]<br>4.4 33[167]<br>4 31.5[59]<br>3.13 31.15[296]<br>3.08 30.95[296]<br>2.03 29.15[296]<br>1.23 28.15[296]<br>0.98 27.9[296]<br>0.0 26.8(w)[319]<br>−0.02 26.8[296]<br>0 26.51[25]<br>0.0 26.5[157]<br>−0.97 25.1[296]<br>0.0 25[15]<br>−1.84 24.0[296]<br>−1.0 23.6[59]<br>−5 17.4[59]<br>−10 14.83[25,140]<br>−14 9.2[59]<br>−19 6.5[59]<br>−48.8 0.361[368]<br>−52.4 0.247[368]<br>−56.0 0.173[368]<br>−77.5 0.0151[25] | 0.89262 7°[45]<br>0.8917 6.7°[348]<br>0.89370 6.06°[103]<br>0.89451 5.6°[194]<br>0.8928 5.4°[348]<br>0.89473 5°[103]<br>0.89502 5°[2]<br>0.8949 $D_5^{5}$[273]<br>0.88811 4.96°[98]<br>1.00619 (solid) 4°[98]<br>1.00707 (solid) 3°[98]<br>0.8979 2.0°[115]<br>1.00863 (solid) 2°[98]<br>0.89985 0.15°[350]<br>0.9000 0.15°[236]<br>0.8988(g) 0°[348]<br>0.89888 0°[119]<br>0.89938 0°[103]<br>0.89944 0°[45]<br>0.899487 0°[280,281]<br>0.8997 0°[304]<br>0.89990 0°[222]<br>0.89993 0°[40]<br>0.89996 0°[350]<br>0.90000 0°[405]<br>0.90006 0°[273,402,404]<br>0.90009 0°[365]<br>0.90023 0°[2]<br>0.978 (solid) 0°[247]<br>1.01084 (solid) 0°[98]<br>1.0126 ± 0.0011 0°[312]<br>1.0151 0°[299]<br>1.0235 −8.6°[188]<br>0.985 (solid) −20°[247]<br>1.0519 −22°[55]<br>1.099 −70°[55]<br>1.062 −79°[38]<br>1.101 (y) −183°[38] | | |

*The notes designated by letters are shown on pages 37 and 38.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Monodeuterobenzene**  | | | | |
| 5.5 [150] | 79.60 [195] | | | |
| **1,2-Dideuterobenzene**  | | | | |
| | 79.95 [195] | | | |
| **1,3-Dideuterobenzene**  | | | | |
| | 79.75 [195] | | | |
| **1,4-Dideuterobenzene**  | | | | |
| | 79.70 [195] | | | |
| **1,2,3-Trideuterobenzene**  | | | | |
| | 79.80 [195] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Trideuterobenzene**  | 79.85 [196] | | | |
| **1,3,5-Trideuterobenzene**  | 79.55 [196] | | | |
| **1,2,3,4-Tetradeuterobenzene**  | 79.60 [196] | | | |
| **1,2,3,5-Tetradeuterobenzene**  | 79.65 [196] | | | |
| **1,2,4,5-Tetradeuterobenzene**  | 79.60 [196] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Pentadeuterobenzene**  | 79.60 [195] | | | |
| **Hexadeuterobenzene**  | **79.3** | | | |
| 6.8 [88,89,156,157,895] | 79.4 [89] | 0.9465 [89] | 1.4997 [89] | |
| 6.62 [176] | 79.3 [157] | 0.94829 [176] | 1.49779 22° [157] | |
| 6.5 [1] | 80.0 773.6 [157] | 0.954 [63] | | |
| | 78.5 740 [88] | 0.9417 25° [47] | | |
| | 75.0 659.5 [157] | 0.9429 25° [157] | | |
| | 70.0 562.0 [157] | 0.9404 $D_{25}^{25}$ [1] | | |
| | 65.0 473.8 [157] | 0.94560 $D_{25}^{25}$ [157] | | |
| | 60.0 399.4 [157] | 0.954 | | |
| | 55.0 332.5 [157] | ± 0.0005 17° [67] | | |
| | 50.0 276.7 [157] | | | |
| | 45.0 227.1 [157] | | | |
| | 40.0 186.3 [157] | | | |
| | 35.0 150.7 [157] | | | |
| | 30.0 121.8 [157] | | | |
| | 25.0 96.9 [157] | | | |
| | 20.0 77.1 [157] | | | |
| | 15.0 60.1 [157] | | | |
| | 10.0 45.9 [157] | | | |
| | 5.0 35.9 [157] | | | |
| | 0.0 27.5 [157] | | | |

**Additional Data**

* $\frac{1}{T_b} = 0.004513756 - 0.000582066 \log_{10} p_{mm}$ (120 to 775 mm)

† $\frac{1}{T_b} = 0.004463126 - 0.000558222 \log_{10} p_{mm}$ (25 to 125 mm)

(a) This melting point is the average of two or more determinations.

(b) The melting point 5.5 is found in references 1, 41, 73, 88, 89, 153, 171, 175, 193, 226, 230, 259, 289, 312, 330, 336, 377.

(c) This figure is given as a freezing point in the literature.

(d) The boiling point 80.5 is found in references 48, 67, 134, 151, 161, 187, 207, 225, 269.
(e) The boiling point 80.4 is found in references 11, 108, 110, 144, 192, 367, 374, 380.
(f) The boiling point 80.3 is found in references 21, 22, 121, 165, 167, 273, 321, 322, 323.
(g) This density is the average of two or more determinations.
(h) This refractive index is the average of two or more determinations.
(i) The melting point 5.4 is found in references 19, 20, 25, 49, 81, 139, 183, 208, 210, 265, 266, 285, 311, 329, 356, 367.
(j) The boiling point 80.2 is found in references 32, 69, 79, 86, 132, 198, 227, 249, 343, 404, 405.
(k) This boiling point is the average of two or more determinations.
(l) The boiling point 80.1 is found in references 3, 46, 92, 125, 127, 131, 135, 205, 226, 336, 337, 351, 352, 364.
(m) This refractive index was determined on the vapor.
(n) This sample was dried 10 years over phosphoric oxide. The same material dried one month melted at 5.4.
(o) The boiling point 80.0 is found in references 13, 59, 87, 109, 139, 199, 242, 251, 252, 286.
(p) The boiling point 80 appears very frequently in the literature. Most of the references were excluded because the determinations seemed to be only approximations.
(q) This sample was dried 8 years and 8 months over phosphoric oxide. This sample originally boiled at 80.
(r) This sample was dried 8 years and 6 months over phosphoric oxide. This sample originally boiled at 80.
(s) This sample was dried 3 years. This sample originally boiled at 79.6.
(t) This sample was dried for 10 years over phosphoric oxide.
(u) This sample was especially dried over phosphoric oxide.
(v) These samples were especially dried over sodium and potassium.
(w) This pressure is an average of two or more determinations.
(x) Refractive indices of other lines may be found in references 44, 71, 112, 113, 115, 169, 255, 275, 307.
(y) Densities at various pressures are found in references 59, 256.

## Benzene References


1. Adams, R., and D. S. Tarbell, J. Am. Chem. Soc. **60**, 1260 **1938.**
2. Adrieenz, A., through J. Myers, Ber. **6**, 439 **1873.**
3. Ali, B., Proc. Indian Assoc. Cultivation Sci. **9**, 155 **1923-1926.**
4. Altschul, M., Z. physik. Chem. **11**, 577 **1893.**
5. Anders, A., Z. physik. Chem. **164A**, 145 **1933.**
6. Anosov, V. Y., Ann. inst. anal. phys.-chim. (U.S.S.R.) **3**, 379 **1926**; Chem. Zentr. **1927**, I, 2632.
7. Anosov, V. Y., Ann. inst. anal. phys.-chim. (U.S.S.R.) **3**, 455 **1926**; Chem. Zentr. **1927**, I, 2632.
8. Antonov, G. N., J. chim. phys. **5**, 372 **1907.**
9. Arbusov, A. E., J. Russ. Phys. Chem. Soc. **59**, 357 **1927**; Chem. Zentr. **1927**, II, 1660.
10. Arbusov, A. E., Z. physik. Chem. **131A**, 49 **1927.**
11. Arnold, L. B., Jr., and G. B. Kistiakowsky, J. Am. Chem. Soc. **54**, 1713 **1932.**
12. Atkins, W. R. G., and T. A. Wallace, J. Chem. Soc. **103**, 1461 **1913.**
13. Austin, J. B., and I. A. Black, Phys. Rev. [2] **35**, 452 **1930.**
14. Azim, M. A., S. S. Bhatnagar, and R. M. Mathur, Phil. Mag. [7] **16**, 580 **1933.**
15. Bähre, W., Arch. Electrotechn **31**, 141 **1937.**
16. Baker, H. B., J. Chem. Soc. **121**, 568 **1922.**
17. Baker, H. B., J. Chem. Soc. **123**, 1223 **1923.**
18. Baker, H. B., J. Chem. Soc. **1928**, 1051.
19. Bakker, G., Ann. Physik [4] **61**, 273 **1920.**
20. Bakker, G., Z. physik. Chem. **90**, 89 **1915.**
21. Barbaudy, J., Bull. soc. chim. [4] **39**, 371 **1926.**
22. Barbaudy, J., J. chim. phys. **23**, 289 **1926.**

23. Barbaudy, J., J. chim. phys. **24**, 1 1927.
24. Barbulescu, N., Physik. Z. **31**, 48 1930.
25. Barker, J. T., Z. physik. Chem. **71**, 235 1910.
26. Bartell, F. E., L. O. Case, and H. Brown, J. Am. Chem. Soc. **55**, 2419 1933.
27. Bartell, F. E., and E. G. Almy, J. Phys. Chem. **36**, 985 1932.
28. Bartell, F. E., and G. L. Mack, J. Phys. Chem. **36**, 65 1932.
29. Batson, F. M., and C. A. Kraus, J. Am. Chem. Soc. **56**, 2017 1934.
30. Beckmann, E., Z. physik. Chem. **2**, 715 1888.
31. Beckmann, E., G. Fuchs, and V. Gernhardt, Z. physik. Chem. **18**, 473 1895.
32. Beckmann, E., and O. Liesche, Z. physik. Chem. **88**, 23 1914.
33. Bennewitz, K., and W. Rossner, Z. physik. Chem. **39B**, 126 1938.
34. Berger, G., Z. physik. Chem. **22B**, 283 1933.
35. Berger, G., Z. physik. Chem. **28B**, 95 1935.
36. Bergmann, E., and A. Weizmann, Trans. Faraday Soc. **32**, 1327 1936.
37. Bjerrum, N., and E. Jozefowicz, Z. physik. Chem. **159A**, 194 1932.
38. Biltz, W., W. Fischer, and E. Wünnenberg, Z. physik. Chem. **151A**, 13 1930.
39. Biron, E., J. Russ. Phys. Chem. Soc. **41**, 569 1909; C.A. **5**, 608 1911; Chem. Zentr. 1909, II, 1293.
40. Biron, E., J. Russ. Phys. Chem. Soc. **42**, 135 1910; C.A. **5**, 609 1911; Chem. Zentr. 1910, I, 1912.
41. Bishop, R. L., and E. L. Wallace, Ind. Eng. Chem. Anal. Ed. **15**, 563 1943.
42. Bogoyavlenskiĭ, A., Schriften d. Dorpater Naturfor. Ges. **13**, 1 1904; Chem. Zentr. 1905, II, 945.
43. Boninó, G. B., Gazz. chim. ital. **53**, 583 1923.
44. Bouhet, C., Compt. rend. **185**, 200 1927.
45. Bourion, F., Ann. chim. [9] **14**, 215 1920.
46. Bowden, S. T., and E. T. Butler, J. Chem. Soc. 1939, 79.
47. Bowman, P., W. Benedict, and H. Taylor, J. Am. Chem. Soc. **57**, 960 1935.
48. Bradley, M. J., and S. W. Parr, Chem. & Met. Eng. **27**, 737 1922.
49. Bridgemann, P. W., Phys. Rev. [2] **3**, 153 1914.
50. Brown, F., J. M. A. deBruyne, and P. Gross, J. Am. Chem. Soc. **56**, 1291 1934.
51. Brown, F. D., J. Chem. Soc. **35**, 547 1879.
52. Brown, G. G., and G. B. Watkins, Ind. Eng. Chem. **19**, 280 1927.
53. Brühl, J. W., Ann. **200**, 139 1880.
54. Brühl, J. W., Z. physik. Chem. **1**, 307 1887.
55. Bruni, G., and G. Natta, Atti accad. Lincei [6] **11**, 1058 1930.
56. Bruyne, I. M. A., R. M. Davis, and P. M. Gross, Physik. Z. **33**, 719 1932.
57. Buehler, C. A., T. S. Gardener, and M. L. Clemens, J. Org. Chem. **2**, 167 1937.
58. Bulkley, R., Bur. Standards J. Research **6**, 89 1931.
59. Burk, F., Gas-u. Wasserfach **67**, 523 1924.
60. Burrows, G. J., and A. E. James, J. Proc. Roy. Soc. N. S. Wales **59**, 223 1925.
61. Carter, E. G., and D. C. Jones, Trans. Faraday Soc. **30**, 1027 1934.
62. Castanares, A. P., Anales inst. med. nacional **11**, 75; C. A. **5**, 3186 1911.
63. Cauwood, J. D., and W. E. S. Turner, J. Chem. Soc. **107**, 276 1915.
64. Chilesotti, A., Gazz. chim. ital. **30**, I, 149 1900.
65. Chipman, J., J. Am. Chem. Soc. **46**, 2445 1924.
66. Christomanos, A. C., Z. anorg. Chem. **45**, 132 1905.
67. Clemo, G. R., and A. McQuillen, J. Chem. Soc. 1935, 851.
68. Clemo, G. R., and A. McQuillen, J. Chem. Soc. 1935, 1220.
69. Cohen, E., and J. S. Buij, Z. physik. Chem. **35B**, 270 1937.
70. Cohen, E., W. A. T. deMeester, and A. L. T. Moesveld, Z. physik. Chem. **108**, 103 1924.
71. Colley, A. R., Physik. Z. **11**, 324 1910.
72. Constable, F. H., Proc. Cambridge Phil. Soc. **23**, 593 1925–1927.
73. Crowther, E. M., and A. N. Puri, Proc. Roy. Soc. (London) **106A**, 232 1924.
74. Dahms, A., Ann. Physik [N. F.] **54**, 486 1895.
75. Darmois, E., Compt. rend. **171**, 952 1920.
76. deBruyne, J. A. M., R. M. Davis, and P. M. Gross, J. Am. Chem. Soc. **55**, 3936 1933.

77. Deffet, L., Bull. soc. chim. Belg. 44, 41 1935.
78. Deitz, V. R., J. Am. Chem. Soc. 55, 472 1933.
79. Deitz, V., and D. H. Andrews, J. Chem. Phys. 1, 62 1933.
80. Dejardin, G., Ann. phys. [9] 11, 253 1919.
81. Dessart, Bull. soc. chim. Belg. 35, 9 1926.
82. Desvergnes, L., Ann. chim. anal. chim. appl. [2] 10, 6 1928; Chem. Zentr. 1928, I, 2190.
83. Deutschman, W., Z. physik. Chem. 96, 428 1920.
84. Dunkel, M., Brennstoff-Chem. 5, 145 1924.
85. Dunstan, A. E., Z. physik. Chem. 49, 590 1904.
86. Edwards, A., J. Soc. Chem. Ind. 35, 587 1916.
87. Eisenlohr, F., Fortschr. Chem., Physik u. physik. Chem. 18B, 521 1925.
88. Erlenmeyer, H., H. Lobeck, Helv. Chim. Acta 18, 1464 1935.
89. Erlenmeyer, H., H. Lobeck, H. Gärtner, and A. Epprecht, Helv. Chim. Acta 19, 336 1936.
90. Essex, H., Z. anorg. allgem. Chem. 88, 189 1914.
91. Estermann, J., Z. physik. Chem. 1B, 134 1928.
92. Eucken, A., and L. Meyer, Z. physik. Chem. 5B, 452 1929.
93. Evans, H. C., and D. W. Young, Ind. Eng. Chem. 34, 461 1942.
94. Ewins, A. J., J. Chem. Soc. 105, 350 1914.
95. Eykman, J. F., Rec. trav. chim. 12, 157 1893.
96. Faust, O., Z. anorg. allgem. Chem. 154, 61 1926.
97. Ferguson, A., and J. T. Miller, Proc. Phys. Soc. (London) 45, 194 1933.
98. Fersche, J., Ann. Physik [N. F.] 44, 265 1891.
99. Findlay, A., Z. physik. Chem. 69, 203 1909.
100. Fiock, E. F., D. C. Ginnings, and W. B. Holton, Bur. Standards J. Research 6, 881 1931.
101. Fischer, F., Chem. Markets 23, 587 1928.
102. Fletcher, J., and D. Tyrer, J. Chem. Soc. 103, 517 1913.
103. Flink, G., Oversidet. Svenska Vetenskaps-Soc. Förh. 40, No. 5, 21 1883; Beil. 5, suppl., 98 1930.
104. Foote, H. W., and J. K. Dixon, J. Am. Chem. Soc. 52, 2170 1930.
105. Forziati, A. F., C. B. Willingham, B. J. Mair, and F. D. Rossini, J. Research Natl. Bur. Standards 32, 11 1944.
106. Frank, L., Z. physik. Chem. 114, 257 1924.
107. Friedrich, H., Physik. Z. 38, 318 1937.
108. Galle, E., R. Klatt, and W. Friedl, Petroleum. 31, No. 36, 1 1935.
109. Gardener, A., Bull. soc. chim. [3] 19, 159 1898.
110. Garner, F. H., and E. B. Evans, J. Inst. Petroleum Tech. 18, 751 1932.
111. Getman, F. H., J. Am. Chem. Soc. 50, 2883 1928.
112. Gibson, R. E., and J. F. Kincaid, J. Am. Chem. Soc. 60, 511 1938.
113. Gifford, J. W., and T. M. Lowry, Proc. Roy. Soc. (London) 104A, 430 1923.
114. Gilmann, H. H., and P. Gross, J. Am. Chem. Soc. 60, 1525 1938.
115. Gladstone, J. H., J. Chem. Soc. 59, 290 1891.
116. Glowaski, R. C., and C. C. Lynch, Jr., J. Am. Chem. Soc. 55, 4051 1933.
117. Goldhammer, D. A., Z. physik. Chem. 71, 577 1910.
118. Gorman, M., R. M. Davis, and P. M. Gross, Physik. Z. 39, 181 1938.
119. Götz, I. D., Z. physik. Chem. 94, 181 1920.
120. Graffunder, W., and E. Heyman, Z. Physik 72, 744 1931.
121. Grebe, L., Z. wiss. Phot. 9, 130 1910.
122. Griengl, F., O. Kofler, and M. Radda, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 141, Abt. IIb, 893 1932.
123. Grimm, F. V., and W. A. Patrick, J. Am. Chem. Soc. 45, 2794 1923.
124. Grimm, H. G., Z. physik. Chem. 140A, 321 1929.
125. Grimm, H. G., W. Raudenbusch, and H. Wolff, Z. angew. Chem. 41, 104 1928.
126. Griswold, J., D. Andres, and V. A. Klein, Petroleum Refiner 23, 171 1943.
127. Griswold, J., and E. E. Ludwig, Ind. Eng. Chem. 35, 117 1943.
128. Gross, P. M., and J. H. Saylor, J. Am. Chem. Soc. 53, 1744 1931.

129. Grunert, H., Z. anorg. allgem. Chem. **164**, 256 **1927**.
130. Guldberg, C. M., Z. physik. Chem. **32**, 116 **1900**.
131. Harand, J., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **143**, Abt. IIb, 505 **1935**.
132. Harker, G., J. Proc. Roy. Soc. N. S. Wales **50**, 99 **1916**.
133. Harkins, W. D., and F. E. Brown, J. Am. Chem. Soc. **41**, 499 **1919**.
134. Hartley, W. N., J. Chem. Soc. **39**, 153 **1881**.
135. Hartshorn, L., and D. A. Oliver, Proc. Roy. Soc. (London) **123**, 664 **1929**.
136. Hatcher, W. H., and F. W. Skirrow, J. Am. Chem. Soc. **39**, 1939 **1917**.
137. Haywood, J. K., J. Am. Chem. Soc. **21**, 994 **1899**.
138. Hendricks, S. B., and M. E. Jefferson, J. Optical Soc. Am. **23**, 299 **1933**.
139. Herbst, H., Kolloidchem. Beihefte **23**, 313 **1926**.
140. Herz, W., Z. anorg. allgem. Chem. **96**, 289 **1916**.
141. Herz, W., Z. Electrochem. **25**, 215 **1919**.
142. Hess, V. F., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **114**, Abt. IIa, 1231 **1905**.
143. Heydweiller, A., Ann. Physik [N. F.] **61**, 527 **1897**.
144. Higgins, E., J. Am. Chem. Soc. **30**, 1069 **1908**.
145. Hill, A. E., J. Am. Chem. Soc. **44**, 1163 **1922**.
146. Hoeppener, M., and A. von Antropoff, Z. physik. Chem. **152A**, 95 **1931**.
147. Hofmann, F., K. Lang, K. Berlin, and A. Schmidt, Brennstoff-Chem. **13**, 161 **1932**.
148. Horiuti, J., Sci. Papers Inst. Phys. Chem. Research (Tokyo) **17**, 125 **1931**.
149. Hovorka, F., and D. Dreisbach, J. Am. Chem. Soc. **56**, 1664 **1934**.
150. Howes, D. A., and A. W. Nash, J. Soc. Chem. Ind. **49**, 16T **1930**.
151. Hubbard, J. C., Z. physik. Chem. **74**, 207 **1910**.
152. Hückel, W., K. Kumetat, and H. Severin, Ann. **518**, 184 **1935**.
153. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 **1930**.
154. Hulett, G. A., Z. physik. Chem. **28**, 629 **1899**.
155. Humburg, O., Z. physik. Chem. **12**, 401 **1893**.
156. Ingold, C. K., W. R. Angus, C. R. Bailey, L. J. Gleave, A. H. Leckie, C. G. Raisin, and C. L. Wilson, Nature **135**, 1033 **1935**.
157. Ingold, C. K., C. G. Raisin, and C. L. Wilson, J. Chem. Soc. **1936**, 915.
158. Innes, W. R., J. Chem. Soc. **81**, 682 **1902**.
159. Ipatieff, V. N., B. B. Corson, and I. D. Kurbatov, J. Phys. Chem. **43**, 589 **1939**.
160. Isnardi, H., Z. Physik **9**, 153 **1922**.
161. Jaeger, F. M., Z. anorg. allgem. Chem. **101**, 1 **1917**.
162. Jahn, H., Ann. Physik [N. F.] **43**, 280 **1891**.
163. Janovsky, J. V., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **81**, Abt. II, 539 **1880**.
164. Janovsky, J. V., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **82**, Abt. II, 147 **1880**.
165. Jones, F. B., J. Soc. Chem. Ind. **37**, 324T **1918**.
166. Jones, W. J., J. Soc. Dyers Colourists **35**, 45 **1919**; Chem. Zentr. **1919**, II, 722.
167. Kalulbaum, G. W. A., Z. physik. Chem. **26**, 577 **1898**.
168. Kailan, Z. physik. Chem. **88**, 65 **1914**.
169. Kalff, J., Dissertation, Amsterdam University, 72 pp., **1924**.
170. Kanonnikov, J., J. prakt. Chem. [2] **31**, 321 **1885**.
171. Kendall, J., and J. E. Booge, J. Am. Chem. Soc. **38**, 1712 **1916**.
172. Kendall, J., and K. P. Monroe, J. Am. Chem. Soc. **39**, 1787 **1917**.
173. Kendall, J., and K. P. Monroe, J. Am. Chem. Soc. **43**, 115 **1921**.
174. Kistiakowsky, G. B., J. K. Ruhoff, H. A. Smith, and W. E. Vaughan, J. Am. Chem. Soc. **58**, 146 **1936**.
175. Klemm, L., W. Klemm, and G. Schiemann, Z. physik. Chem. **165A**, 379 **1933**.
176. Klit, A., and A. Langseth, Z. physik. Chem. **176A**, 65 **1936**.
177. Knight, R. W., and C. N. Hinshelwood, J. Chem. Soc. **1927**, 466.
178. Knops, C., Ann. **248**, 175 **1888**.
179. Kolligs through K. von Auwers and H. Kolligs, Ber. **55**, 21 **1922**.
180. Kraemer, E. O., and A. J. Stamm, J. Am. Chem. Soc. **46**, 2709 **1924**.

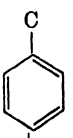
181. Kraus, C. A., and R. M. Fuoss, J. Am. Chem. Soc. **55**, 21 1933.
182. Kraus, C. A., and R. A. Vinger, J. Am. Chem. Soc. **56**, 511 1934.
183. Kremann, R., and V. Borjanovics, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **124**, Abt. IIb, 607 1915.
183A. Kremann, R., and E. Gastinger, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **147**, Abt. IIb, 52 1938.
184. Kremann, R., R. Meingast, and F. Gugl, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **123**, Abt. IIb, 731 1914.
185. Krestinskiĭ, V., and N. Persyantseva, Ber. **64**, 2363 1931.
186. Krollpfeiffer, F., Ber. **56**, 77, 1923.
187. Kryopoulos, S., J. Chem. Phys. **7**, 52 1939.
188. Kubelka, P., and M. Müller, Kolloid-Z. **58**, 189 1932.
189. Kurnakov, N. S., Z. anorg. allgem. Chem. **135**, 81 1924.
190. Lachowicz, B., Ber. **21**, 2206 1888.
191. Lacoss, D. A., and A. W. C. Menzies, J. Am. Chem. Soc. **59**, 2676 1937.
192. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 1918.
193. Laidler, K., and A. Szayna, J. Inst. Petroleum Tech. **20**, 162 1934.
194. Landolt, H., and H. Jahn, Z. physik. Chem. **10**, 289 1892.
195. Langseth, A., and A. Klit, Kgl. Danske Videnskb. Selskab., Biol. Medd. **15**, No. 13, 1937; C. A. **32**, 2515 1938.
196. Lazarev, N. V., and T. W. Sstaryzna, Bull. soc. chim. biol. **18**, 723 1936.
197. LeBlanc, M., and E. Möbius, Ber. Verhandl. K. sächs. Akad. Wiss. Leipzig, Math.-phys. Klasse **85**, II, 75 1933.
198. Lecat, M., Ann. soc. sci. Bruxelles **48B**, 113 1928.
199. Lehfeldt, R. A., Phil. Mag. [5] **46**, 42 1898.
200. Lenher, S., J. Chem. Soc. **1927**, 272.
201. Lenher, S., and F. Daniels, Proc. Natl. Acad. Sci. U. S. **14**, 606 1928.
202. Lespieau, M., Compt. rend. **140**, 855 1905.
203. Linebarger, C. E., Am. J. Sci. [4] **2**, 331 1896.
204. Linebarger, C. E., J. Am. Chem. Soc. **17**, 615 1895.
205. Livingston, J., R. Morgan, and A. J. Scarlett, Jr., J. Am. Chem. Soc. **39**, 2275 1917.
206. Lorenz, R., and I. Posen, Z. anorg. allgem. Chem. **96**, 217 1916.
207. Lowry, T. M., and A. G. Nasini, Proc. Roy. Soc. (London) **123A**, 686 1929.
208. Luder, W. F., J. Am. Chem. Soc. **58**, 255 1936.
209. Lumsden, J. S., J. Chem. Soc. **91**, 24 1907.
210. Maass, O., and J. Russell, J. Am. Chem. Soc. **40**, 1561 1918.
211. Maass, O., and L. J. Waldbauer, J. Am. Chem. Soc. **47**, 1 1925.
212. Mack, G. L., and F. E. Bartell, J. Am. Chem. Soc. **54**, 936 1932.
213. Macleod, D. B., Trans. Faraday Soc. **20**, 525 1924–1925.
214. Mali, S. B., Z. anorg. allgem. Chem. **149**, 150 1925.
215. Malisoff, W. M., and E. M. Marks, Ind. Eng. Chem. **23**, 1114 1931.
216. Malisoff, W. M., and E. M. Marks, Ind. Eng. Chem. **25**, 780 1933.
217. Manley, J. J., Phil. Mag. [7] **13**, 249 1932.
218. Markovnikov, V., Ann. **302**, 1 1898.
219. Martin, A. R., Trans. Faraday Soc. **33**, 191 1937.
220. Martin, A. R., and B. Collie, J. Chem. Soc. **1932**, 2658.
221. Mascarelli, L., and U. Pestalozza, Atti accad. Lincei [5] **16**, II, 567 1907.
222. Massart, L., Bull. soc. chim. Belg. **45**, 76 1936.
223. Masson, I., Nature **128**, 726 1931.
224. Mathews, J. H., and A. J. Stamm, J. Am. Chem. Soc. **46**, 1071 1924.
225. Matsuno, K., and K. Han, Bull. Chem. Soc. Japan **11**, 321 1936.
226. Matteson, R., and W. S. Hanna, Oil Gas J. **41**, No. 2, 33 1942.
227. McAlpine, K. B., and C. P. Smyth, J. Am. Chem. Soc. **55**, 453 1933.
228. McKee, G. W., J. Soc. Chem. Ind. **23**, 403 1904.

229. McKee, R. H., and H. H. Parker, Ind. Eng. Chem. 20, 1169 1928.
230. Meisenheimer, J., and O. Dorner, Ann. 523, 299 1936.
231. Meldrum, R., Chem. News 113, 266 1916.
232. Menzies, A. W. C., and D. A. Lacoss, J. Phys. Chem. 36, 1967 1932.
233. Meyer, J., Wallach-Festschrift, 540 1909.
234. Meyer, J., Z. physik. Chem. 72, 225 1910.
235. Meyer, J., Z. physik. Chem. 90, 721 1915.
236. Meyer, J., and B. Mylius, Z. physik. Chem. 95, 349 1920.
237. Michaud, F., and A. Ballone, Ann. phys. [9] 11, 295 1919.
238. Micheli, L. I. A., Phil. Mag. [7] 3, 895 1927.
239. Mills, J. E., and D. MacRae, J. Phys. Chem. 14, 797 1910.
240. Mitsukuri, S., and A. Nakatsuchi, J. Soc. Chem. Ind. Japan 29, suppl. 6 1926.
241. Mitsukuri, S., and A. Nakatsuchi, Science Repts. Tôhoku Imp. Univ. 15, 45 1925; Chem. Zentr. 1926, II, 545.
242. Montgomery, J. B., and T. DeVries, J. Am. Chem. Soc. 64, 2375 1942.
243. Morgan, J. L. R., and G. K. Daghlian, Z. physik. Chem. 78, 169 1912.
244. Morgan, J. L. R., and H. R. Pyne, J. Phys. Chem. 34, 2045 1930.
245. Morgan, J. L. R., and F. W. Schwartz, Z. physik. Chem. 78, 185 1912.
246. Morgan, J. L. R., and E. G. Thomssen, Z. physik. Chem. 78, 148 1912.
247. Morgan, S. O., and H. H. Lowry, J. Phys. Chem. 34, 2385 1930.
248. Morino, Y., Sci. Papers Inst. Phys. Chem. Research (Tokyo) 23, 49 1933.
249. Mortimer, F. S., J. Am. Chem. Soc. 44, 1429 1922.
250. Müller, F. H., Physik. Z. 38, 283 1937.
251. Nagornov, N., Ann. inst. anal. phys.-chim. (U.S.S.R.) 3, 562; C. A. 22, 4298 1928; Chem. Zentr. 1927, II, 2668.
252. Nagornov, N., and L. Rotinjanz, Z. physik. Chem. 77, 700 1911.
253. Nakatsuchi, A., J. Soc. Chem. Ind. Japan 29, 29 1926; C. A. 20, 1020 1926.
254. Nasini, A. G., Proc. Roy. Soc. (London) 123A, 692 1929.
255. Negreano, Compt. rend. 104, 423 1887.
256. Neubeck, F., Z. physik. Chem. 1, 649 1887.
257. Norris, J. F., and S. W. Prentiss, J. Am. Chem. Soc. 50, 3042 1928.
258. Novák, Z. physik. Chem. 73, 513 1910.
259. Oddo, G., Gazz. chim. ital. 45, I, 413 1915.
260. Olsen, A. L., and E. R. Washburn, J. Am. Chem. Soc. 57, 303 1935.
261. Orndorff, W. R., and F. K. Cameron, Am. Chem. J. 17, 517 1895.
262. Orndorff, W. R., R. C. Gibbs, S. A. McNulty, and C. V. Shapiro, J. Am. Chem. Soc. 50, 831 1928.
263. Orndorff, W. R., and V. A. Howells, Am. Chem. J. 18, 312 1896.
264. Ostwald, W., Z. Chem. Ind. Kolloide 6, 183 1910.
265. Padoa, M., Atti accad. Lincei [5] 27, II, 59 1918.
266. Padoa, M., Gazz. chim. ital. 48, II, 139 1918.
267. Padoa, M., and A. Matteucci, Atti accad. Lincei [5] 23, II, 590 1914.
268. Parker, W. B., and G. Thompson, J. Chem. Soc. 121, 1341 1922.
269. Partington, J. R., and J. F. J. Rule, Phil. Mag. [7] 1, 1035 1926.
270. Parts, A., Z. physik. Chem. 10B, 264 1930.
271. Paterno, E., and G. Ampola, Gazz. chim. ital. 27, I, 481 1897.
272. Patterson, T. S., J. Chem. Soc. 81, 1097 1902.
273. Perkin, W. H., J. Chem. Soc. 69, 1025 1896.
274. Perkin, W. H., J. Chem. Soc. 77, 267 1900.
275. Perkin through Gladstone, J. Chem. Soc. 59, 292 1891.
276. Pesce, B., Gazz. chim. ital. 65, 440 1935.
277. Pestemer, M., and O. Fruhwirth, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 146, Abt. IIb, 146 1937.
278. Petterson, O., J. prakt. Chem. [2] 24, 129 1881.
279. Pickering, S. U., Proc. Roy. Soc. (London) 49, 11 1890–1891.

280. Pisati, G., and E. Paterno, Gazz. chim. ital. **3**, 551 **1873.**
281. Pisati, G., and E. Paterno, J. Chem. Soc. **27**, 686 **1874.**
282. Polovtsov, V., Z. physik. Chem. **75**, 513 **1911.**
283. Pöltz, H., Z. physik. Chem. **20B**, 351 **1933.**
284. Pöltz, Steil, and Strasser, Z. physik. Chem. **17B**, 155 **1932.**
285. Porter, E. W., J. Am. Chem. Soc. **34**, 1290 **1912.**
286. Pound, J. R., J. Chem. Soc. **123**, 578 **1923.**
287. Pound, J. R., J. Phys. Chem. **30**, 791 **1926.**
288. Pound, J. R., J. Soc. Chem. Ind. **53**, 71 **1934.**
289. Pushin, N. A., Z. physik. Chem. **118**, 447 **1925.**
290. Pushin, N. A., and J. V. Grebenshchikov, Z. physik. Chem. **113**, 57 **1924.**
291. Pushin, N. A., and P. G. Matavulj, Z. physik. Chem. **162A**, 415 **1932.**
292. Pushin, N. A., and T. Pinter, Z. physik. Chem. **142A**, 211 **1929.**
293. Radice through A. Guye and E. Mallet, Arch. sci. phys. nat. [4] **13**, 30 **1902.**
294. Ramsay, W., and E. Ashton, Z. physik. Chem. **15**, 89 **1894.**
295. Ramsay, W., and J. Shields, Z. physik. Chem. **12**, 434 **1893.**
296. Ramsay, W., and S. Young, Phil. Mag. [5] **23**, 61 **1887.**
297. Reimann, A., Ann. Physik [4] **80**, 43 **1926.**
298. Richards, T. W., and F. Barry, J. Am. Chem. Soc. **37**, 993 **1915.**
299. Richards, T. W., E. P. Bartlett, and J. H. Hodges, J. Am. Chem. Soc. **43**, 1538 **1921.**
300. Richards, T. W., E. K. Carver, and W. C. Schumb, J. Am. Chem. Soc. **41**, 2019 **1919.**
301. Richards, T. W., and L. B. Coombs, J. Am. Chem. Soc. **37**, 1656 **1915.**
302. Richards, T. W., and J. W. Shipley, J. Am. Chem. Soc. **36**, 1825 **1914.**
303. Richards, T. W., and J. W. Shipley, J. Am. Chem. Soc. **38**, 989 **1916.**
304. Richards, T. W., C. L. Speyers, and E. K. Carver, J. Am. Chem. Soc. **46**, 1196 **1924.**
305. Richards, T. W., W. N. Stull, J. H. Mathews, and C. L. Speyers, J. Am. Chem. Soc. **34**, 971 **1912.**
306. Richards, W. T., and J. H. Wallace, Jr., J. Am. Chem. Soc. **54**, 2705 **1932.**
307. Richardson, S. S., Phil. Mag. [6] **31**, 232 **1916.**
308. Rosanoff, M. A., C. W. Bacon, and J. F. W. Schulze, J. Am. Chem. Soc. **36**, 1993 **1914.**
309. Rosanoff, M. A., and C. W. Easley, J. Am. Chem. Soc. **31**, 953 **1909.**
310. Rosanoff, M. A., and C. W. Easley, Z. physik. Chem. **68**, 641 **1922.**
311. Rosenbaum, C. K., and J. H. Walton, J. Am. Chem. Soc. **52**, 3568 **1930.**
312. Rosental, D., Bull. soc. chim. Belg. **45**, 585 **1936.**
313. Rósza, M., Z. Elektrochem. **17**, 934 **1911.**
314. Sameshima, J., J. Am. Chem. Soc. **40**, 1503 **1918.**
315. Schall, C., and L. Kossakovskiĭ, Z. physik. Chem. **8**, 241 **1891.**
316. Schiff, R., Ann. **223**, 47 **1884.**
317. Schmidt, G., and B. Hinteler, Z. physik. Chem. **91**, 103 **1916.**
318. Schmidt, G. C., Z. physik. Chem. **99**, 71 **1921.**
319. Schmidt, G. C., Z. physik. Chem. **121**, 221 **1926.**
320. Schonrock, O., Z. physik. Chem. **11**, 753 **1893.**
321. Schreinemakers, F. A. H., Arch. néerland. sci. [2] **9**, 279 **1904.**
322. Schreinemakers, F. A. H., Z. physik. Chem. **47**, 445 **1904.**
323. Schreinemakers, F. A. H., Z. physik. Chem. **48**, 257 **1904.**
324. Schulze, A., Ann. Physik [4] **59**, 73 **1919.**
325. Schulze, A., Z. Electrochem. **18**, 77 **1912.**
326. Schulze, A., Z. physik. Chem. **86**, 309 **1913.**
327. Schulze, A., and H. Hock, Z. physik. Chem. **86**, 445 **1914.**
328. Schulze, A., Z. physik. Chem. **97**, 388 **1921.**
329. Schutz, F., Ber. **56**, 162 **1923.**
330. Seyer, W. F., J. Am. Chem. Soc. **60**, 827 **1938.**
331. Sidgwick, N. V., J. Chem. Soc. **117**, 1340 **1920.**
332. Skirrow, F. W., Z. physik. Chem. **41**, 139 **1902.**
333. Smith, A., and A. W. C. Menzies, Ann. Physik [4] **33**, 971 **1910.**

334. Smith, A., and A. W. C. Menzies, J. Am. Chem. Soc. **32**, 1448 **1910**.
335. Smith, E. R., and H. Matheson, Bur. Standards J. Research **20**, 641 **1938**.
336. Smittenberg, J., H. Hoog, and R. A. Henkes, J. Am. Chem. Soc. **60**, 17 **1938**.
337. Smyth, C. P., and H. E. Rogers, J. Am. Chem. Soc. **52**, 1824 **1930**.
338. Smyth, C. P., and W. S. Walls, J. Am. Chem. Soc. **54**, 1854 **1932**.
339. Stohmann, F., P. Rodatz, and H. Herzberg, J. prakt. Chem. [2] **33**, 241 **1886**.
340. Stratton, K., and J. R. Partington, Phil. Mag. **48**, 1085 **1924**.
341. Swictoslawski, W., Roczniki Chem. **7**, 516 **1927**; C. A. **22**, 4013 **1928**.
342. Swietoslawski, W., Roczniki Chem. **13**, 495 **1933**; C. A. **28**, 1586 **1934**.
343. Szeparowicz, M., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **129**, Abt. IIa, 437 **1920**.
344. Tamman, G., Ann. Physik [N. F.] **66**, 471 **1898**.
345. Tamman, G., "Krystallisieren u. Schmelzen," pp. 68, 198, Leipzig, **1903**.
346. Thorpe, T. E., and J. W. Rodger, Trans. Roy. Soc. (London) **185A**, 521 **1894**.
347. Tiganik, L., Z. physik. Chem. **13B**, 425 **1931**.
348. Timberg, G., Ann. Physik [N. F.] **30**, 545 **1887**.
349. Timmermans, J., and F. Martin, J. chim. phys. **23**, 733 **1926**.
350. Timmermans, J., and F. Martin, J. chim. phys. **23**, 747 **1926**.
351. Titani, T., Bull. Chem. Soc. Japan **8**, 255 **1933**.
352. Tongberg, C. O., and F. Johnston, Ind. Eng. Chem. **25**, 733 **1933**.
353. Transue, L. F., E. R. Washburn, and F. H. Kohler, J. Am. Chem. Soc. **64**, 274 **1942**.
354. Traube, I., Z. physik. Chem. **68**, 289 **1909**.
355. Trautz, M., and W. Ries, Ann. Physik [5] **8**, 163 **1931**.
356. Tréhin, R., Ann. phys. [9] **15**, 246 **1921**.
357. Trew, V. C. G., and J. F. Spencer, Proc. Roy. Soc. (London) **131A**, 209 **1931**.
358. Tyrer, D., J Chem. Soc. **97**, 2620 **1910**.
359. Tyrer, D., J. Chem. Soc. **99**, 871 **1911**.
360. Tyrer, D., J. Chem. Soc. **99**, 1633 **1911**.
361. Tyrer, D., J. Chem. Soc. **101**, 81 **1912**.
362. Tyrer, D., J. Chem. Soc. **101**, 1104 **1912**.
363. Tyrer, D., J. Chem. Soc. **105**, 2534 **1914**.
364. Tyrer, D., J. Phys. Chem. **17**, 717 **1913**.
365. Tyrer, D., Z. physik. Chem. **87**, 169 **1914**.
366. Van de Vloed, A., Bull. soc. chim. Belg. **48**, 229 **1939**.
367. van Iterson-Rotgans, J. W., Z. physik. Chem. **87**, 305 **1914**.
368. van Laar, J. J., Rec. trav. chim. **39**, 371 **1920**.
369. von Auwers, K., Ann. **419**, 92 **1919**.
370. von Auwers, K., and H. Kolligs, Ber. **55**, 21 **1922**.
371. von Huhn, W., Dissertation, Technischen Hochschule München, **1931**.
372. von Jüptner, H., Z. physik. Chem. **73**, 343 **1910**.
373. von Jüptner, H., Z. physik. Chem. **85**, 1 **1913**.
374. von Steiger, A. L., Ber. **53**, 666 **1920**.
375. von Zawidski, J., Z. physik. Chem. **35**, 129 **1900**.
376. Vorländer, D., and J. Fischer, Ber. **65**, 1756 **1932**.
377. Vrevskiĭ, M. S., N. A. Held, and S. A. Shchukarev, J. Russ. Phys. Chem. Soc. **59**, 617 **1927**; C. A. **22**, 2694 **1928**.
378. Walden, P., Z. physik. Chem. **66**, 385 **1909**.
379. Walden, P., Z. physik. Chem. **75**, 555 **1911**.
380. Walden, P., Z. physik. Chem. **147A**, 1 **1930**.
381. Walden, P., and R. Swinne, Z. physik. Chem. **79**, 700 **1912**.
382. Ward, A. L., and W. H. Fulweiler, Ind. Eng. Chem. Anal. Ed. **6**, 396 **1934**.
383. Ward, H. L., J. Phys. Chem. **30**, 1316 **1926**.
384. Washburn, E. W., and J. W. Read, J. Am. Chem. Soc. **41**, 729 **1919**.
385. Weissberger, A., and R. Sängewald, Z. physik. Chem. **5B**, 237 **1929**.
386. Weissberger, A., and R. Sängewald, Z. physik. Chem. **9B**, 133 **1930**.

387. Weissberger, A., and R. Sängewald, Z. physik. Chem. 20B, 145 1933.
388. Weissberger, A., and J. W. Williams, Z. physik. Chem. 3B, 367 1929.
389. White, A. G., J. Chem. Soc. 121, 1244 1922.
390. Williams, J. W., and F. Daniels, J. Am. Chem. Soc. 46, 903 1924.
391. Williams, J. W., and F. Daniels, J. Am. Chem. Soc. 46, 1569 1924.
392. Williams, J. W., and F. Daniels, J. Am. Chem. Soc. 47, 1490 1925.
393. Williams, J. W., and I. J. Krchma, J. Am. Chem. Soc. 48, 1888 1926.
394. Williams, J. W., and I. J. Krchma, J. Am. Chem. Soc. 49, 1676 1927.
395. Wilson, C. L., Nature 136, 301 1935.
396. Wojciechowski, M., Bur. Standards J. Research 19, 347 1937.
397. Wojciechowski, M., Roczniki Chem. 16, 524 1936; C. A. 31, 3355 1937.
398. Woodman, R. M., and A. S. Corbet, J. Chem. Soc. 1927, 2461.
399. Woringer, B., Z. physik. Chem. 34, 257 1900.
400. Wulff, P., and S. Takashima, Z. physik. Chem. 39B, 322 1938.
401. Yajnik, N. A., M. D. Bhalla, R. C. Talwar, and M. A. Soofi, Z. physik. Chem. 118, 305 1925.
402. Young, S., J. Chem. Soc. 55, 486 1889.
403. Young, S., J. Chem. Soc. 83, 68 1903.
404. Young, S., Sci. Proc. Roy. Dublin Soc. 12, 374 1910.
405. Young, S., and E. C. Fortey, J. Chem. Soc. 75, 873 1899.
406. Young, S., and E. C. Fortey, J. Chem. Soc. 83, 45 1903.
407. Zelinskiĭ, N., Ber. 57, 264 1924.
408. Zelinskiĭ, N. D., Compt. rend. 177, 882 1923.
409. Zelinskiĭ, N. D., and M. B. Turova-Polyak, Ber. 62, 2865 1929.
410. Ziegler, W. T., and D. H. Andrews, J. Am. Chem. Soc. 64, 2482 1942.
411. Zmaczyński, A., J. chim. phys. 27, 503 1930.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Toluene** (Methylbenzene)  | | | | |
| **−95.18** | **110.56** | **0.86650** | **1.49624** | Crit. Temp. (°C) |
| −93 [139,177] | 111.0 [78,168] | 0.8648 [29] | 1.4947 [55] | 321 [106] |
| −93.5 [39] | 110.9 [234] | 0.8649 [179] | 1.4949 [65] | 320.9 [51] |
| −93.7 [30] | 110.8–110.9 [237] | 0.86502 [163] | 1.4951 [6] | 320 8 [72] |
| −94 [19] | 110.6–110 9 [101] | 0.86516 [68] | 1.4955 [127,136] | 320.6 [1,70,104,137] |
| −94.2 [71] | 110.80 [43,218] | 0.8652 [65] | 1.49552 [22,167] | 320.5 [75,233] |
| −94.5 [132,213] | 110.80 ± 0.02 | 0.8654 [20] | 1.4958 [80,109] | 319.5 [63] |
| −95.0−−94.5 [99] | 760 ± 10 [217] | 0.86549 [248] | 1.49606 [229] | 318.1(f) [145] |
| −94.6 [86] | 110.8 [32,39,62,90,144,169, 206,236] | 0.86550 [248] | 1.49613 [208] | |
| −95.0 [146,167,214,216,217] | | 0.8656 [22,226] | 1.4962 [56,144,206,223] | Crit. Pressure (mm Hg) |
| −95 [37,56,115,140,215] | 110.60–110.80 [244,245] | 0.8657 [223] | 1.49630 [182] | |
| −95.1 [131,135,206,220] | 110 4–110.8 [83] | 0 8658 [178] | 1.4964 [81] | |
| −95.143 ± 0.005 [219] | 110.3–110.8 [167] | 0.86590 [16] | 1.49647 [103] | |
| −95.15 [95,205] | 110.75 [112] | 0 8659 [21,194] | 1.4965 [85,171] | 31,616.0 [1,104,106] |
| −95.2 [251] | 110.74 [67] | 0.86597 [17] | 1.4966 [21,236] | |
| −95.7−−95.4 [143] | 110 72 ± 0.01 [10] | 0.8660 [40,81] | 1.49675 [133] | 31,593.2 [1] |
| −95.70 [97] | 110.70 ± 0.01 [212,219] | 0.86604 [109] | 1.49692 [200] | |
| −95.7 [142,152] | 110.70 [64,220] | 0 86606 [208] | 1.4971 [93,207] | Crit. Density |
| −97 [162] | 110.7 [38,47,104,137,200,213] | 0.8661 [15,69,133,181] | 1.49712 [143] | 0.304 [223] |
| | 110.65–110.70 [133] | 0.8663 [85] | 1.00209(c) [84] | 0.296 [63] |
| | 110.6–110.7 [169,200] | 0.8665 [200] | 1.45639 90.35° [164] | |
| | 110.5–110.7 [241] | 0.86697 [167,252] | 1.48839 35° [130] | |
| | 110.62 [52] | 0.8670 [4] | 1.49178 30° [41] | |
| | 110.615(a) [126] | 0.8677 [236] | 1.4912 27° [154] | |
| | 110.612–110.614 [208] | 0.7025 169.4° [147] | 1.4917 26.3° [7] | |
| | 110.606 [252] | 0.7166 159.2° [147] | 1.49323 25.4° [186] | |
| | 110.6(b) | 0.7286 150.0° [147] | 1.49255 25.2° [42] | |
| | 110.5–110.6 [242,243] | 0.7414 140.0° [147] | 1.4924 25° [7] | |
| | 110.4–110.6 [187] | 0.7535 132.5° [172] | 1.49337 25° [186] | |
| | 110.2–110.6 [183] | 0.7533 129.9° [147] | 1.49365 25° [130] | |
| | 110.56 ± 0.03 [96] | 0 76217 126.85° [131] | 1.49366 25° [231] | |
| | 110.50 [249] | | 1.49375 25° [129,239] | |
| | 110.50 ± 0.05 [182] | 0.7650 120.2° [147] | 1.4938 25° [238] | |
| | 110.5(c) | 0.77694 110.8° [156] | 1.49653 19.9° [229] | |
| | 110.4–110.5 [157] | 0.7767 110.1° [147] | 1.4964 19.4° [209] | |
| | 110.4 [21,61,74,92,150] | 0.7780 109.8° [191] | 1.49750 17° [89] | |
| | 110.4 ± 0 2 [55] | 0.77807 109.2° [190] | 1.49782 16.35° [228] | |
| | 110.3 [14,54,107,120,184,189] | 0.7811 105.17° [148,149] | 1.49811 16.13° [48] | |
| | 110.2–110.3 [153] | | 1.4978 16° [89] | |
| | 110.2 [151] | 0.7823 104.0° [235] | 1.4989 15.7° [100] | |
| | 110.0 [113] | 0.78963 100.25° [131] | 1.49894 15.2° [198] | |
| | | | 1.4988 15° [89] | |

*The notes designated by letters are shown on page 54.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **Toluene** (Methylbenzene) (*Continued*) | 110(d) [18,26,79,108,132,138,192] | 0.7878 | 100.0° [147] | 1.49985 | 15° [41,218] | * |
| | | 0.7931 | 100° [121] | 1.4992 | 14.7° [110] | |
| | 109.5–110 [109] | 0.7873 | 99.19° [148,149] | 1.50236 | 10.7° [164] | |
| | 109.5 ± 0.1 [45] | | | 1.50349 | 8.5° [166] | |
| | 320 6 31,616.0 [38] | 0.7895 | 99.17° [225] | 1.50261 | 8.18° [48] | |
| | 320.0 31,525 [104] | 0.7874 | 99.01° [148,149] | 1.50264 | 7.0° [229] | † |
| | 300 25,399 [230] | | | 1.50496 | 4.9° [229] | |
| | 301.5 24,624 [104] | 0.7939 | 92.15° [235] | 1.45231 | $n_{H\alpha}^{90.35}$ [164] | |
| | 295 23,375.18 [66] | 0.79949 | 90 35° [164] | 1.48725 | $n_{H\alpha}^{30}$ [41] | |
| | 280 19,768 [230] | 0.7981 | 90.3° [117] | 1.49111 | $n_{H\alpha}^{20}$ [22] | |
| | 283.0 19,760 [104] | 0.8004 | 90° [69] | 1.49365 | $n_{H\alpha}^{16.35}$ [228] | ‡ |
| | 280.0 19,076 [104] | 0.8002 | 86.14° [148,149] | 1.49510 | $n_{H\alpha}^{15}$ [218] | |
| | 279.5 18,856 [104] | | | 1.49516 | $n_{H\alpha}^{15}$ [41] | |
| | 264.0 16,256.4 [38,104] | 0.8084 | 80.1° [147] | 1.49428 | $n_{H\alpha}^{14.95}$ [48] | |
| | | 0.8089 | 80° [226] | 1.4944 | $n_{H\alpha}^{14.7}$ [110] | § |
| | 260 15,086 [230] | 0.81017 | 80.00° [131] | 1.49785 | $n_{H\alpha}^{10.7}$ [164] | |
| | 253.5 13,269 [104] | 0.8113 | 80° [121] | 1.49891 | $n_{H\alpha}^{8.5}$ [166] | |
| | 253 13,189.32 [66] | 0.8095 | 79.73° [225] | 1.49309 | $n_{H\alpha}^{8.03}$ [48] | |
| | 250.0 12,958 [104] | 0.8101 | 79.24° [225] | 1.46694 | $n_{H\beta}^{90.35}$ [164] | ¶ |
| | 246.0 12,160 [104] | 0.8080 | 78.4° [172] | 1.50348 | $n_{H\beta}^{30}$ [41] | |
| | 240 11,271 [230] | 0.8084 | 77.8° [235] | 1.5002 | $n_{H\beta}^{24.1}$ [60] | |
| | 234.5 10,070 [104] | 0 8096 | 75° [4] | 1.50700 | $n_{H\beta}^{20}$ [22] | |
| | 227 9,050.13 [66] | 0.8154 | 75° [77] | 1.5080 | $n_{H\beta}^{19.4}$ [209] | ⊙ |
| | 226 0 9,028.8 [104] | 0.8163 | 73.05° [225] | 1.50967 | $n_{H\beta}^{16.35}$ [228] | |
| | 220 8,223 [230] | 0.8136 | 72.46° [148,149] | 1.51130 | $n_{H\beta}^{15}$ [41] | |
| | 214.4 7,516.4 [38,104] | 0.8149 | 71.13° [148,149] | 1.51134 | $n_{H\beta}^{15}$ [218] | |
| | 203.5 6,277.6 [104] | 0.8158 | 70.3° [25] | 1.5104 | $n_{H\beta}^{14.7}$ [110] | ⊖ |
| | 200 5,844 [230] | 0.8188 | 70° [223] | 1.51047 | $n_{H\beta}^{10.7}$ [164] | |
| | 194.0 5,304.8 [104] | 0.8193 | 70° [69] | 1.51528 | $n_{H\beta}^{8.5}$ [166] | |
| | 186.5 4,651.2 [104] | 0.8215 | 70.0° [106] | | | |
| | 180 4,028 [230] | 0.8184 | 69.9° [147] | | | |
| | 175.5 3,936.8 [104] | 0.8206 | 65.3° [235] | | | |
| | 161.0 2,926.0 [101] | | | | | |

**Additional Data**

* $\frac{1}{T_b} = 0.004109562 - 0.00051697 \log_{10} p_{mm}$ (16 to 200 mm)

† $\frac{1}{T_b} = 0.004165504 - 0.00054133 \log_{10} p_{mm}$ (200 to 800 mm)

‡ $\frac{1}{T_b} = 0.004216944 - 0.00055902 \log_{10} p_{mm}$ (800 to 4,000 mm)

§ $\frac{1}{T_b} = 0.00433986 - 0.0005907 \log_{10} p_{mm}$ (4,000 to 32,000 mm)

¶ $\frac{dD}{dt} = -0.000938099[1 + 0.00096907(t - 20)]/°C$ (−20 to 135°C)

⊙ $\frac{dD}{dt} = -0.00093744/°C$ (5 to 40°C)

⊖ $\frac{dn}{dt} = -0.00056541/°C$ (5 to 90°C)

*The notes designated by letters are given on page 54.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Toluene** (Methylbenzene) *(Continued)* | 160 2,683 [230] | 0.8271 60.2° [25] | 1.51697 $n_{H\gamma}^{20}$ [22] | |
| | 155.656 2,347.4 [252] | 0.8278 60.1° [147] | 1.51970 $n_{H\gamma}^{16.35}$ [228] | |
| | 155 2,315 [250] | 0.8258 60.04° [148, 149] | 1.52139 $n_{H\gamma}^{15}$ [218] | |
| | 149.5 2,128.0 [104] | | 1.5203 $n_{H\gamma}^{14.7}$ [110] | |
| | 150 2,072 [250] | 0.8251 60° [4] | 1.52523 $n_{H\gamma}^{8.5}$ [166] | |
| | 149.089 2,026.3 [252] | 0.8284 60° [223,226] | 1.49624 $n_{He}^{20}$ [49] | |
| | 145 1,849 [250] | 0.82922 60° [68] | 1.49995 $n_{He}^{15}$ [218] | |
| | 143 1,744 [26] | 0.8293 60.0° [106] | (h) | |
| | 142.563 1,741.0 [252] | 0.8295 60° [218] | | |
| | 140 1,718 [230] | 0.8296 60° [121] | | |
| | 140 1,646 [250] | 0.8263 59.2° [145] | | |
| | 136 1,491 [26] | 0.8288 56.84° [148] | | |
| | 136.082 1,489.2 [252] | 0.83280 56 40° [131] | | |
| | 135 1,459 [250] | 0.83367 52.1° [173] | | |
| | 129.5 1,276.8 [104] | 0.8371 50.2° [147] | | |
| | 130 1,269 [26,250] | 0.8393 50.13° [225] | | |
| | 129.646 1,268.1 [252] | 0.8361 50.1° [25] | | |
| | 125 1,135 [250] | 0.8338 50° [4] | | |
| | 123 1,075 [26] | 0.8378 50° [223] | | |
| | 123.254 1,074.6 [252] | 0.8380 50° [69] | | |
| | 120 1,052 [230] | 0.8382 50° [77] | | |
| | 120 992 [250] | 0.8393 50.0° [106] | | |
| | 120 973 [53,195, 196] | 0.83915 49.7° [128] | | |
| | | 0.8380 46.6° [172] | | |
| | 116.908 906.1 [252] | 0.84250 46.30° [131] | | |
| | 117 906 [26] | 0.84265 46.10° [131] | | |
| | 112.99 813.5 [250] | 0.8404 45.12° [148, 149] | | |
| | 111.0 800 [247] | | | |
| | 111 800 [26] | 0.8430 42.24° [148, 149] | | |
| | 110.1 –110.6 786 [180] | 0.8477 40.5° [106] | | |
| | 111.69 783.9 [250] | 0.84526 40° [68] | | |
| | 111.35 774.7 [250] | 0.8469 40.00° [225] | | |
| | 111.4 774.4 [235] | 0.8470 40° [223,226] | | |
| | 111 17 770.2 [250] | 0.84730 40° [15] | | |
| | 110.4 –110.6 768 [178] | 0.8476 40° [121] | | |
| | | 0.8484 36.0° [145] | | |
| | 110.2 –110.6 765 [2] | 0.85294 35° [170] | | |
| | | 0.85338 34.50° [131] | | |
| | 110.2 –110.4 763 [151] | 0.8520 32.61° [148, 149] | | |
| | 110.66 762.4 [250] | 0.85263 31.92° [173] | | |
| | 110.6 761.2 [172] | 0.8563 30.12° [123] | | |
| | 110.6 761 [99] | 0.8547 30° [170] | | |
| | 110.5 760.9 [125] | 0 8548 30° [4] | | |
| | 110.8 760.5 [156] | 0.8563 30° [223] | | |
| | 110.2 760.5 [193] | 0.8566 30.0° [106] | | |
| | 109.2 759.7 [30] | 0.8567 30° [69] | | |
| | 109.8 759.4 [191] | 0.8573 30° [227] | | |
| | | 0.8576 30° [41] | | |

*The notes designated by letters are given on page 54.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Toluene** (Methylbenzene) *(Continued)* | 110.7 | 0.85770 30° [218] | | |
| | −110.8 759 [163] | 0.8556 28.74° [148, 149] | | |
| | 110.51 758.4 [250] | | | |
| | 110.7 758.3 [156] | 0.85699 28.65° [163] | | |
| | 110.2 | 0.85806 28.4° [199] | | |
| | −110.8 758 [67] | 0.8571 27.1° [235] | | |
| | 110.56(a) 758.0 [250] | 0.8608 27° [154] | | |
| | 110.1 758.0 [118] | 0.86073 25.3° [7] | | |
| | 110.1 758 [117] | 0.8610 25.13° [10] | | |
| | 109.8 | 0.85956(g) 25° [93] | | |
| | −110 1 758 [119] | 0.8598 25° [246] | | |
| | 110.54 757 [250] | 0.85986 25° [93] | | |
| | 110.35 756.9 [250] | 0.8599 25° [77] | | |
| | 110.37 | 0.86089 25.0° [248] | | |
| | −110.40 756.6 [211] | 0.8612 25° [121] | | |
| | 110.9 756.5 [6] | 0.8614 25° [223] | | |
| | 110.3 | 0.861719 25° [204] | | |
| | −110.4 756 [178] | 0.86216 25° [129] | | |
| | 110.34 755.7 [250] | 0.8622 25° [9,27] | | |
| | 110.2 755 [13] | 0.86221 25° [239] | | |
| | 110.0 755 [49] | 0.86228 25.0° [128] | | |
| | 109.6 | 0.86229 25° [130] | | |
| | −110.0 754 [20] | 0.8623 25° [222] | | |
| | 110.2 753.7 [221] | 0.8625 25° [202] | | |
| | 110 753 [80] | 0.86288 25° [119] | | |
| | 108.8 753 [160] | 0.8639 $D_{25}^{25}$ [44] | | |
| | 109.98 752.6 [175] | 0.86114 24.15° [163] | | |
| | 110.25 751.7 [250] | 0.86314 22.5° [248] | | |
| | 109.43 751.3 ±0.2 [186] | 0.8652 22° [203] | | |
| | 110.4 750.00 [8] | 0.8627 21.2° [235] | | |
| | 109.5 | 0.8640 21.0° [106] | | |
| | −109.8 750 [93] | 0.8667 20.9° [42] | | |
| | 109.59 750 [185] | 0.86542 20.4° [110] | | |
| | 108.8 750 [247] | 0.86687 $D_{20}^{20}$ [87] | | |
| | 110.15 749.05 [250] | 0.8669 $D_{20}^{20}$ [80] | | |
| | 110.11 749 [202] | | | |
| | 110.3 748 [12] | 0.8684 $D_{20}^{20}$ [165] | | |
| | 110.05 747.7 [250] | 0.86525 19.75° [163] | | |
| | 110.1 746.2 [156] | 0.8692 19.0° [36] | | |
| | 110.1 745.3 [156] | 0.86616 18.77° [163] | | |
| | 109.3 744 [93] | 0.8653 18.43° [148, 149] | | |
| | 108.92 743.7 ± 2 [186] | 0.86747 18.2° [110] | | |
| | 109.4 743 [34] | 0.8657 18° [100] | | |
| | 109.3 | 0.8679 18.0° [48,197] | | |
| | −109.6 742 [25] | 0.8685 18° [5,94] | | |
| | 109.7 741.7 [159] | 0.86574 17.9° [173] | | |
| | 110–110.1 740.9 [22] | 0.86773 17.5° [248] | | |
| | 109.5 740 [134] | 0.86774 17.5° [248] | | |
| | 110 738 [155] | | | |

*The notes designated by letters are given on page 54.*

| M. P.,°C | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|---|---|
| **Toluene** (Methylbenzene) *(Continued)* | 109.4 | | 0.8659 | 17° [232] | | |
| | −109.45 | 733 [33] | 0.8684 | 16.36° [228] | | |
| | 109.24 | 731.9 [250] | 0.86919 | 16.33° [110] | | |
| | 109.5 | | 0.86931 | 16.2° [110] | | |
| | −109.6 | 731 [158] | 0.8675 | 16.04° [148, 149] | | |
| | 109.0 | | | | | |
| | −109.1 | 728 [174] | 0.8694 | 16° [82] | | |
| | 106.2 | 714.34 [188] | 0.86983 | 15.6° [110] | | |
| | 107.79 | 701.2 [250] | 0.8714 | 15.5° [89] | | |
| | 107.8 | 700.00 [8] | 0.8720 | $D_{15.5}^{15.5}$ [90] | | |
| | 106.4 | 700 [247] | 0.8702 | 15.2° [198] | | |
| | 105.26 | 651.9 [250] | | | | |
| | 105.3 | 650.00 [8] | 0.8682 | $D_{15.2}^{15.2}$ [172] | | |
| | 103.9 | 650 [247] | 0.8693 | 15° [55] | | |
| | 103.349 | 633.90 [252] | 0.87005 | 15° [248] | | |
| | 103 | 633.7 [26] | 0.8704 | 15° [223] | | |
| | 103.0 | 608.6 [156] | 0.8706 | 15° [121] | | |
| | 102.6 | 603.7 [156] | 0.8712 | 15° [122] | | |
| | 102.5 | 600.00 [8] | 0.8713 | 15° [114] | | |
| | 101.3 | 600 [247] | 0.8715 | 15° [41] | | |
| | 102.17 | 595.1 [250] | 0.87160 | 15° [218] | | |
| | 101.55 | 586 [31] | 0.8723 | 15° [165] | | |
| | 100 | 571 [53,195, 196] | 0.8723 | $D_{15}^{15}$ [3] | | |
| | | | 0.8704 | 14.98° [225] | | |
| | 99.4 | 550.00 [8] | 0.87155 | 14.95° [131] | | |
| | 98.5 | 550 [247] | 0.87103 | 14.3° [110] | | |
| | 99.01 | 540.4 [250] | 0.8692 | 14.13° [148, 149] | | |
| | 98.137 | 525.76 [252] | | | | |
| | 97 | 525.4 [26] | 0.8711 | 14° [154] | | |
| | 96.5 | 500.00 [8] | 0.87131 | 14° [88] | | |
| | 95.5 | 500 [247] | 0.8708 | 13.1° [190] | | |
| | 96.22 | 496.4 [250] | 0.8703 | 13° [210] | | |
| | 93.4 | 454.1 [156] | 0.8723 | 12.87° [224] | | |
| | 93.4 | 451.3 [156] | | | | |
| | 93.2 | 450.00 [8] | 0.87417 | $D_{12.6}^{12.6}$ [161] | | |
| | 92.2 | 450 [247] | 0.87228 | 12.5° [248] | | |
| | 93.04 | 448.8 [250] | 0.87278 | 12.4° [110] | | |
| | 91.971 | 433.6 [252] | 0.8722 | 10.89° [148, 149] | | |
| | 90 | 433 [26] | | | | |
| | 90 | 416 [195,196] | 0.87532 | 10.7° [164] | | |
| | 89.96 | 406.4 [250] | 0.8729 | 10.17° [148, 149] | | |
| | 89.7 | 400.00 [8] | | | | |
| | 88.6 | 400 [247] | 0.8754 | 10° [69] | | |
| | 86.95 | 368.35 [250] | 0.8762 | 10° [165] | | |
| | 85.849 | 355.1 [252] | 0.87757 | 8.5° [166] | | |
| | 84 | 354.6 [26] | 0.8803 | 5° [165] | | |
| | 85.5 | 350.00 [8] | 0.8812 | 4° [165] | | |
| | 84.6 | 350 [247] | 0.8789 | 3.59° [148, 149] | | |
| | 83.90 | 332.8 [250] | | | | |
| | 81.5 | 311.7 [156] | | | | |

*The notes designated by letters are given on page 54.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Toluene** (Methylbenzene) *(Continued)* | 81.2 306.2 [156] | 0.8797 2.77° [148, 149] | | |
| | 80.9 303.00 [8] | | | |
| | 80.1 300 [247] | 0.88218 0° [149] | | |
| | 80 299 [53,195, 196] | 0.8822 0.00° [148] | | |
| | | 0.88108 0° [140] | | |
| | 80.73 298.9 [250] | 0.88412 0.0° [225] | | |
| | 79.772 289.1 [252] | 0.88445 0° [219,220] | | |
| | 77.67 268.55 [250] | 0.88446 0° [43] | | |
| | 75 252.5 [196] | 0.88448 | | |
| | 75.9 250.00 [8] | ± 0.00002 0° [212] | | |
| | 75.0 250 [247] | 0.88450 0° [16] | | |
| | 74.66 241.3 [250] | 0.8845 0° [76,176] | | |
| | 72.21 220.85 [250] | 0.88455 0° [250] | | |
| | 70.84 210.25 [250] | 0.88456 0° [95] | | |
| | 70 210 [196] | 0.8847 0° [226] | | |
| | 70.18 204.95 [250] | 0.8854 0° [27,41] | | |
| | 69.69 201.4 [250] | 0.88543 0° [43] | | |
| | 69.6 200.00 [8] | 0.88545 0° [131,218] | | |
| | 69.0 200 [247] | 0.88547 0.0° [128] | | |
| | 63.5 162.2 [156] | 0.885482(g) | | |
| | 63.3 158.3 [156] | ± 0.000003 0° [11] | | |
| | 62.0 150.00 [8] | 0.89618 −11.70° [221] | | |
| | 61.5 150 [247] | 0.89830 −13.86° [221] | | |
| | 60 148 [53,195] | 0.90368 −19.60° [221] | | |
| | 60 146.8(i) [196] | 0.90480 −21.1° [128] | | |
| | | 0.90665 22.9° [131] | | |
| | 61.2 144.8 [156] | 0.91170 28.25° [221] | | |
| | 51.8 100.00 [8] | 0.91825 −35.17° [221] | | |
| | 51.8 100 [92] | 0.92491 −42.49° [221] | | |
| | 51.6 100 [247] | 0.92718 −45.2° [131] | | |
| | 50 97.5(i) [196] | 0.93423 −52.50° [221] | | |
| | | 0.94393 −62.73° [221] | | |
| | 50 93.5 [201] | 0.94467 −63.50° [131] | | |
| | 46.7 80 [58] | 0.95132 −70.38° [221] | | |
| | 45.2 75.00 [8] | 0.95986 −79.41° [221] | | |
| | 45.2 75 [92] | 0.96462 −83.6° [131] | | |
| | 43.8 70 [58] | 0.96928 −89.27° [221] | | |
| | 40 64 [53,195] | 0.97541 −95.1° [131] | | |
| | 40 63.5(i) [196] | 1.053 −186° [84] (j) | | |
| | 40 60.3 [201] | | | |
| | 40.6 60 [58] | | | |
| | 40.3 60 [92] | | | |
| | 39.9 59 [92] | | | |
| | 39.5 58 [92] | | | |
| | 39.1 57 [92] | | | |
| | 38.7 56 [92] | | | |
| | 38.3 55 [92] | | | |
| | 37 9 54 [92] | | | |
| | 37 5 53 [92] | | | |

*The notes designated by letters are given on page 54.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Toluene** (Methylbenzene) (*Continued*) | 37 52 [92] | | | |
| | 36.7 51 [92] | | | |
| | 36.8 50 [58] | | | |
| | 36.3 50.00 [8] | | | |
| | 36.0 50 [247] | | | |
| | 35.8 49 [92] | | | |
| | 35.4 48 [92] | | | |
| | 34.9 47 [92] | | | |
| | 34.5 46 [92] | | | |
| | 34.0 45.00 [3,92] | | | |
| | 33.5 44 [92] | | | |
| | 33.1 43 [92] | | | |
| | 32.6 42 [92] | | | |
| | 32.1 41 [92] | | | |
| | 31.6 40.00 [8] | | | |
| | 31.6 40 [92] | | | |
| | 30 39.25 [196] | | | |
| | 31.1 39 [92] | | | |
| | 30 5 38 [92] | | | |
| | 30 37.7 [201] | | | |
| | 30 37 [92] | | | |
| | 29.4 36 [92] | | | |
| | 28.8 35.00 [8] | | | |
| | 28.3 35 [92] | | | |
| | 28.3 34 [92] | | | |
| | 27.7 33 [92] | | | |
| | 27.1 32 [92] | | | |
| | 26.4 31 [92] | | | |
| | 25.8 30 [74,92] | | | |
| | 20 24.75(i) [195] | | | |
| | 20 24.5 [53] | | | |
| | 20 22.0 [201] | | | |
| | 14.8 16.80 [8] | | | |
| | 14.7 16.80 [75] | | | |
| | 14.5 14.56 [91] | | | |
| | 0 6.86(i) [8] | | | |
| | −2.75 5.57 [116] | | | |
| | −3.5 5.36 [116] | | | |
| | −3.7 5.30 [116] | | | |
| | −4.35 5.00 [116] | | | |
| | −4.4 4.98 [116] | | | |
| | −7.2 4.17 [116] | | | |
| | −8.7 3.77 [116] | | | |
| | −9.7 3.53 [116] | | | |
| | −20.30 1.74 [8] | | | |
| | −21.0 1.607 (i) [8] | | | |
| | −78 0.0058 (i) [8] | | | |

*The notes designated by letters are given on page 54.*

(a) This boiling point is the average of two determinations.
(b) The boiling point 110.6 is found in references 7, 46, 72, 85, 102, 124, 140, 165, 166, 171, 233.
(c) The boiling point 110.5 is found in references 24, 50, 73, 111, 135, 136, 141, 240.
(d) The boiling point 110 appears frequently in the literature. Most of these references were excluded because the determinations seem to be only approximations.
(e) This refractive index was determined on the vapor.
(f) This temperature is the average of two determinations.
(g) This density is the average of two determinations.
(h) Refractive indices of other lines may be found in references 35, 48, 59, 154, 164, 209.
(i) This pressure is the average of two or more determinations.
(j) Densities at various pressures are found in references 26, 156.

## Toluene References


1. Altschul, M., Z. physik. Chem. **11**, 577 **1893.**
2. Archibald, E. H., and D. McIntosh, J. Am. Chem. Soc. **26**, 305 **1904.**
3. Aschan, O., Z. angew. Chem. **20**, 1811 **1907.**
4. Azim, M. A., S. S. Bhatnagar, and R. M. Mather, Phil. Mag. [7] **16**, 580 **1933.**
5. Bähr, H., and G. Rühl, Glückauf **61**, 574 **1925.**
6. Baker, J. W., and L. G. Groves, J. Chem. Soc. **1939**, 1147.
7. Barbaudy, J., J. chim. phys. **23**, 289 **1926.**
8. Barker, J. T., Z. physik. Chem. **71**, 235 **1910.**
9. Bartell, F. E., L. O. Case, and H. Brown, J. Am. Chem. Soc. **55**, 2119 **1933.**
10. Bartell, F. E., and G. L. Mack, J. Phys. Chem. **36**, 65 **1932.**
11. Batuecas, T., and F. L. Casado, Z. physik. Chem. **181A**, 197 **1937.**
12. Bennewitz, K., and W. Rossner, Z. physik. Chem. **39B**, 126 **1938.**
13. Bergholm, C., Ann. Physik [4] **65**, 128 **1921.**
14. Berthelot, C., Génie civil **112** (58), 141 **1938**; Chem. Zentr. **1938**, I, 3414.
15. Biron, E., J. Russ. Phys. Chem. Soc. **41**, 569 **1909**; C.A. **5**, 608 **1911**; Chem. Zentr. **1909**, II, 1293.
16. Biron, E., J. Russ. Phys. Chem. Soc. **42**, 167 **1910**; C.A. **5**, 609 **1911**; Chem. Zentr. **1910**, I, 1913.
17. Blaise, E. E., and A. Courtot, Bull. soc. chim. [3] **35**, 580 **1906.**
18. Bradley, M. J., and S. W. Parr, Chem. Met. Eng. **27**, 737 **1922.**
19. Bredner, R., Arch. Elektrotech. **31**, 351 **1937.**
20. Briand, M., P. Dumanois, and P. Laffitte, Compt. rend. **197**, 322 **1933.**
21. Bromiley, E. C., and D. Quiggle, Ind. Eng. Chem. **25**, 1136 **1933.**
22. Brühl, J. W., Ann. **200**, 139 **1880.**
23. Bruner, L., and J. Dluska, Bull. intern. acad. sci. Cracovie, **1907**, 691.
24. Bruner, L., and J. Vorbrodt, Bull. intern. acad. sci. Cracovie, **1909**, 221.
25. Buehler, C. A., T. S. Gardner, and M. L. Clemens, J. Org. Chem. **2**, 167 **1937.**
26. Burk, F., Gas-u. Wasserfach **67**, 523 **1924.**
27. Burlew, J. S., J. Am. Chem. Soc. **62**, 690 **1940.**
28. Burrows, G. J., and A. E. James, J. Proc. Roy. Soc. N. S. Wales **59**, 223 **1925.**
29. Busse, W., Ann. Physik [4] **75**, 657 **1924.**
30. Carrarra, G., and A. Coppadoro, Gazz. chim. ital. **33**, I, 329 **1903.**
31. Castanares, A. P., Anales inst. med. nacional **11**, 75; C.A. **5**, 3186 **1911.**
32. Chavanne, G., and L. J. Simon, Compt. rend. **168**, 1111 **1919.**
33. Chipman, J., J. Am. Chem. Soc. **46**, 2445 **1924.**
34. Coffey, S., J. Chem. Soc. **127**, 1029 **1925.**
35. Colley, A. R., Physik. Z. **11**, 324 **1910.**
36. Coolidge, Ann. Physik [N.F.] **69**, 125 **1899.**
37. Crafts, J. M., Compt. rend. **114**, 1110 **1892.**
38. Davis, D. S., Ind. Eng. Chem. **22**, 380 **1930.**
39. de Carli, F., Atti accad. Lincei [6] **4**, 460 **1926.**
40. de Carli, F., Atti accad. Lincei [6] **14**, 120 **1931.**

41. Dessart, Bull soc. chim. Belg. **35**, 9 **1926**.
42. Dobrosserdov, D. K., J. Russ. Phys. Chem. Soc. **44**, 396, 679 **1912**; Chem. Zentr. **1912**, II, 789.
43. Dony, O., Bull. classe sci. Acad. roy. Belg. [5] **15**, 243 **1929**.
44. Driver, J., and J. B. Firth, J. Chem. Soc. **121**, 2409 **1922**.
45. Drucker, C., E. Jiméno, and W. Kangro, Z. physik. Chem. **90**, 513 **1915**.
46. Dufton, S. F., and J. W. Cobb, Gas J. **150**, 588 **1920**.
47. Edwards, A., J. Soc. Chem. Ind. **35**, 587 **1916**.
48. Eisele, I., Ann. Physik [4] **76**, 396 **1925**.
49. Eisenlohr, F., Fortschr. Chem., Physik., u. physik. Chem. **18B**, 521 **1925**.
50. Evans, H. C., and D. W. Young, Ind. Eng. Chem. **34**, 461 **1942**.
51. Faust, O., Z. anorg. allgem. Chem. **154**, 61 **1926**.
52. Forziati, A. F., C. B. Willingham, B. J. Mair, and F. D. Rossini, J. Research Natl. Bur. Standards **32**, 11 **1944**.
53. Frank, L., Z. physik. Chem. **114**, 257 **1924**.
54. Galle, E., R. Klatt, and W. Friedl, Petroleum. **31**, No. 36, 1 **1935**.
55. Garner, F. H., and E. B. Evans, J. Inst. Petroleum Tech. **18**, 751 **1932**.
56. Gaucher, L. P., Ind. Eng. Chem. **27**, 57 **1935**.
57. Getman, F. H., J. Am. Chem. Soc. **50**, 2883 **1928**.
58. Gilliland, E. R., and T. K. Sherwood, Ind. Eng. Chem. **26**, 519 **1934**.
59. Gladstone, J. H., J. Chem. Soc. **45**, 241 **1884**.
60. Gladstone, J. H., J. Chem. Soc. **59**, 290 **1891**.
61. Golodetz, A., J. Russ. Phys. Chem. Soc. **43**, 1041 **1910**; Chem. Zentr. **1912**, I, 68.
62. Grainger, W. E., Army Ordnance **17**, No. 97, 24 **1936**.
63. Griengl, F., O. Kofler, and M. Radda, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **141**, Abt. IIb, 893 **1932**.
64. Grimm, F. V., and W. A. Patrick, J. Am. Chem. Soc. **45**, 2794 **1923**.
65. Grimm, H. G., W. Raudenbusch, and H. Wolff, Z. angew. Chem. **41**, 104 **1928**.
66. Griswold, J., D. Andres, and V. A. Klein, Petroleum Refiner **22**, 171 **1943**.
67. Gross, P. M., and J. H. Saylor, J. Am. Chem. Soc. **53**, 1744 **1931**.
68. Grunert, H., Z. anorg. allgem. Chem. **164**, 256 **1927**.
69. Grützmacher, M., Z. Physik **28**, 342 **1924**.
70. Guldberg, C. M., Z. physik. Chem. **32**, 116 **1900**.
71. Guttmann, L. F., J. Chem. Soc. **87**, 1037 **1905**.
72. Harand, J., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **143**, Abt. IIb, 505 **1935**.
73. Harker, G., J. Proc. Roy. Soc. N. S. Wales **50**, 99 **1916**.
74. Herbst, H., Kolloidchem. Beihefte **23**, 313 **1926**.
75. Herz, W., Z. anorg. allgem. Chem. **96**, 289 **1916**.
76. Herz, W., Z. Electrochem. **25**, 215 **1919**.
77. Herz, W., Z. physik. Chem. **87**, 63 **1914**.
78. Higgins, E., J. Am. Chem. Soc. **30**, 1069 **1908**.
79. Hine, T. B., Phys. Rev. [2] **24**, 79 **1924**.
80. Hofmann, F., K. Lang, K. Berlin, and A. Schmidt, Brennstoff-Chem. **13**, 161 **1932**.
81. Howes, D. A., and A. W. Nash, J. Soc. Chem. Ind. **49**, 16T **1930**.
82. Humburg, O., Z. physik. Chem. **12**, 401 **1893**.
83. Ingold, C. K., and F. R. Shaw, J. Chem. Soc. **1927**, 2918.
84. Isnardi, H., Z. Physik **9**, 153 **1922**.
85. Ivanov, K. I., and V. K. Savinova, J. Applied Chem. (U.S.S.R.) **8**, 64 **1935**; Survey For. Petrol. Liter. Nov. **3**, **1943**, S326.
86. Jaeger, Verslag. Amsterdam Akad. Wetenschappen **25**, 308 **1916**.
87. Jahn, H., Ann. Physik [N.F.] **43**, 280 **1891**.
88. Jahn, H., and G. Möller, Z. physik. Chem. **13**, 385 **1894**.
89. Janovsky, J. V., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **81**, Abt. IIb, 539 **1880**.
90. Jones, F. B., J. Soc. Chem. Ind. **37**, 324T **1918**.
91. Kahlbaum, **Siedetemperatur und Druck in ihren Wechselbeziehungen**, p. 95, Leipzig, **1885**.

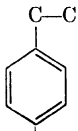
92. Kahlbaum, G. W. A., Z. physik. Chem. **26**, 577 **1898.**
93. Kailan, A., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **128**, Abt. IIa, 831 **1919.**
94. Kattwinkel, R., Glückauf **62**, 529 **1926.**
95. Keeley, K. K., J. Am. Chem. Soc. **51**, 2738 **1929.**
96. Kendall, J., and K. P. Monroe, J. Am. Chem. Soc. **39**, 1787 **1917.**
97. Keyes, F. G., B. Townshend, and L. H. Young, J. Math. Phys. **1**, 243 **1922.**
98. King, H. S., and W. B. Beazley, Proc. Nova Scotian Inst. Sci. **18**, 204 **1933.**
99. Klemm, L., W. Klemm, and G. Schiemann, Z. physik. Chem. **165A**, 379 **1933.**
100. Kling, A., and D. Florentin, Bull. soc. chim. [4] **41**, 864 **1927.**
101. Klingstedt, F. W., Acta Acad. Aboensis, Math. et Phys. **3**, No. 5, 1 **1924.**
102. Kohlrausch, K. W. F., and A. Pongratz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **142**, Abt. IIb, 637 **1933.**
103. Kolligs through K. von Auwers and H. Kolligs, Ber. **55**, 21 **1922.**
104. Krase, N. W., and J. B. Goodman, Ind. Eng. Chem. **22**, 130 **1930.**
105. Kremann, R., and E. Gastinger, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **147**, Abt. IIb, 52 **1938.**
106. Kremann, R., R. Meingast, and F. Gugl, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **123**, Abt. IIb, 731 **1914.**
107. Kryopoulos, S., J. Chem. Phys. **7**, 52 **1939.**
108. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918.**
109. Laidler, K., and A. Szayna, J. Inst. Petroleum Tech. **20**, 162 **1934.**
110. Landolt, H., and H. Jahn, Z. physik. Chem. **10**, 289 **1892.**
111. Lazarev, N. V., and T. W. Sstaryzna, Bull. soc. chim. biol. **18**, 723 **1936.**
112. Lecat, M., Ann. soc. sci. Bruxelles **48B**, 113 **1928.**
113. Lehfeldt, R. A., Phil. Mag. [5] **46**, 42 **1898.**
114. Lehmann, K. B., R. Weissenberg, A. von Wojciechowski, Luig, and Gundermann, Arch. Hyg. **1912**, 1.
115. Leslie, R. T., and W. W. Heuer, Bur. Standards J. Research **18**, 639 **1937.**
116. Linder, J. Phys. Chem. **35**, 531 **1931.**
117. Linebarger, C. E., Am. Chem. J. **18**, 429 **1896.**
118. Linebarger, C. E., Am. J. Sci. [4] **2**, 331 **1896.**
119. Linebarger, C. E., J. Am. Chem. Soc. **17**, 615 **1895.**
120. Lowry, T. M., and A. G. Nasini, Proc. Roy. Soc. (London) **123A**, 686 **1929.**
121. Lumsden, J. S., J. Chem. Soc. **91**, 24 **1907.**
122. Lumsden, J. S., J. Chem. Soc. **115**, 1366 **1919.**
123. Mack, G. L., and F. E. Bartell, J. Am. Chem. Soc. **54**, 936 **1932.**
124. Mair, B. J., and A. F. Forziati, J. Research Natl. Bur. Standards **32**, 165 **1944.**
125. Mangold, C., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **102**, Abt. IIa, 1071 **1893.**
126. Marchlewski, L., and B. Skarzyński, Bull. intern. acad. polon. sci., Classe sci. math. nat. **1935A**, 474 **1935.**
127. Martin, E., Ann. combustibles liquides **12**, 97 **1937.**
128. Mason, L. S., and H. Paxton, J. Am. Chem. Soc. **61**, 67 **1939.**
129. Mason, L. S., and E. R. Washburn, J. Am. Chem. Soc. **59**, 2076 **1937.**
130. Mason, L. S., and E. R. Washburn, J. Phys. Chem. **40**, 481 **1936.**
131. Massart, L., Bull. soc. chim. Belg. **45**, 76 **1936.**
132. Masson through H. Robert, Compt. rend. **168**, 998 **1919.**
133. Mathews, J. H., J. Am. Chem. Soc. **48**, 562 **1926.**
134. Mathews, J. H., and R. D. Cooke, J. Phys. Chem. **18**, 559 **1914.**
135. Matteson, R., and W. S. Hanna, Oil Gas J. **41**, No. 2, 33 **1942.**
136. McAlpine, K. B., and C. P. Smyth, J. Am. Chem. Soc. **55**, 453 **1933.**
137. McKee, R. H., and H. H. Parker, Ind. Eng. Chem. **20**, 1169 **1928.**
138. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **125**, 1743 **1924.**
139. Menshutkin, B. N., J. Russ. Phys. Chem. Soc. **43**, 1275 **1911**; Chem Zentr. **1912**, I, 408.
140. Michel, J., Bull. soc. chim. Belg. **48**, 105 **1939.**

141. Midgley, T., Jr., and A. L. Henne, J. Am. Chem. Soc. **51**, 1215 **1929.**
142. Mitsukuri, S., and A. Nakatsuchi, J. Soc. Chem. Ind. Japan **29**, suppl. 6 **1926.**
143. Mitsukuri, S., and A. Nakatsuchi, Sci. Repts. Tôhoku Imp. Univ. **15**, 45 **1925**; Chem. Zentr. **1926**, II, 545.
144. Montgomery, J. B., and T. DeVries, J. Am. Chem. Soc. **64**, 2375 **1942.**
145. Morgan, J. L. R., and G. K. Daghlian, Z. physik. Chem. **78**, 169 **1912.**
146. Morgan, S. O., and H. H. Lowry, J. Phys. Chem. **34**, 2385 **1930.**
147. Morino, Y., Sci. Papers Inst. Phys. Chem. Research (Tokyo) **23**, 49 **1933.**
148. Naccari, A., and S. Pagliani, Beib. Ann. Physik **6**, 87 **1882.**
149. Naccari, A., and S. Pagliani, Nuovo cimento [3] **10**, 40 **1881.**
150. Nagornov, N., Ann. inst. anal. phys.-chim. (U.S.S.R.) **3**, 584; C.A. **23**, 1325 **1929**; Chem. Zentr. **1927**, II, 2668.
151. Nagornov, N., and L. Rotinjanz, Z. physik. Chem. **77**, 700 **1911.**
152. Nakatsuchi, A., J. Soc. Chem. Ind. Japan **29**, 29 **1926**; C.A. **20**, 1020 **1926.**
153. Nasini, A. G., Proc. Roy. Soc. (London) **123A**, 692 **1929.**
154. Negreano, Compt. rend. **104**, 423 **1887.**
155. Nekrasov, B., Z. physik. Chem. **136**, 18 **1928.**
156. Neubeck, F., Z. physik. Chem. **1**, 649 **1887.**
157. Norris, J. F., and G. T. Vaala, J. Am. Chem. Soc. **61**, 2131 **1939.**
158. Novák, J., Z. physik. Chem. **73**, 513 **1910.**
159. Orndorff, W. R., and F. K. Cameron, Am. Chem. J. **17**, 517 **1895.**
160. Orndorff, W. R., R. C. Gibbs, S. A. McNulty, and C. V. Shapiro, J. Am. Chem. Soc. **50**, 831 **1928.**
161. Orton, K. J. P., and D. C. Jones, J. Chem. Soc. **115**, 1055 **1919.**
162. Ostwald, W., Z. Chem. Ind. Kolloide **6**, 183 **1910.**
163. Patterson, T. S., J. Chem. Soc. **81**, 1097 **1902.**
164. Perkin, W. H., J. Chem. Soc. **61**, 287 **1892.**
165. Perkin, W. H., J. Chem. Soc. **69**, 1025 **1896.**
166. Perkin, W. H., J. Chem. Soc. **77**, 267 **1900.**
167. Plate, A. F., Progress of Chem. (U.S.S.R.) **12**, 189 **1943**; Survey For. Petrol. Liter. March 24, **1944**, T426.
168. Pound, J. R., J. Chem. Soc. **123**, 578 **1923.**
169. Pound, J. R., J. Phys. Chem. **30**, 791 **1926.**
170. Pushin, N. A., and T. Pinter, Z. physik. Chem. **142A**, 211 **1929.**
171. Quiggle, D., and M. R. Fenske, J. Am. Chem. Soc. **59**, 1829 **1937.**
172. Ramsay, W., and E. Ashton, Z. physik. Chem. **15**, 89 **1894.**
173. Ratz, F., Z. physik. Chem. **19**, 96 **1896.**
174. Renard, T., and P. A. Guye, J. chim. phys. **5**, 81 **1907.**
175. Richards, T. W., and F. Barry, J. Am. Chem. Soc. **37**, 993 **1915.**
176. Richards, T. W., E. P. Bartlett, and J. H. Hodges, J. Am. Chem. Soc. **43**, 1538 **1921.**
177. Richards, T. W., and E. K. Carver, J. Am. Chem. Soc. **43**, 827 **1921.**
178. Richards, T. W., and L. B. Coombs, J. Am. Chem. Soc. **37**, 1656 **1915.**
179. Richards, T. W., and J. W. Shipley, J. Am. Chem. Soc. **38**, 989 **1916.**
180. Richards, T. W., and J. W. Shipley, J. Am. Chem. Soc. **41**, 2002 **1919.**
181. Richards, T. W., W. N. Stull, J. H. Mathews, and C. L. Speyers, J. Am. Chem. Soc. **34**, 971 **1912.**
182. Richards, W. T., and J. H. Wallace, Jr., J. Am. Chem. Soc. **54**, 2705 **1932.**
183. Rieman, W., 3rd, and P. A. van der Meulen, J. Am. Chem. Soc. **47**, 2507 **1925.**
184. Ritthausen, H., J. prakt. Chem. [1] **61**, 74 **1854.**
185. Rosanoff, M. A., C. W. Bacon, and J. F. W. Schulze, J. Am. Chem. Soc. **36**, 1993 **1914.**
186. Rosanoff, M. A., C. W. Bacon, and R. H. White, J. Am. Chem. Soc. **36**, 1803 **1914.**
187. Rosenbaum, C. K., and J. H. Walton, J. Am. Chem. Soc. **52**, 3568 **1930.**
188. Schall, C., and L. Kossakowsky, Z. physik. Chem. **8**, 241 **1891.**
189. Schapss, W., Ber. **46**, 2564 **1913.**
190. Schiff, R., Ann. **220**, 71 **1883.**
191. Schiff, R., Ann. **223**, 47 **1884.**

192. Schmidlin, J., Ann. chim. phys. [8] **7**, 195 **1906.**
193. Schmidlin, J., Compt. rend. **136**, 1560 **1903.**
194. Schmidt, A. W., Ber. **75**, 1399 **1942.**
195. Schmidt, G. C., Z. physik. Chem. **99**, 71 **1921.**
196. Schmidt, G. C., Z. physik. Chem. **121**, 221 **1926.**
197. Schmidt, K., Ann. Physik [4] **76**, 571 **1925.**
198. Schmidt, O., Ber. **36**, 2459 **1902.**
199. Schonrock, O., Z. physik. Chem. **11**, 753 **1893.**
200. Schulz, F., Collection Czechoslov. Chem. Commun. **1**, 228 **1929.**
201. Schulze, A., Ann. Physik [4] **59**, 73 **1919.**
202. Schulze, F. W., J. Am. Chem. Soc. **36**, 498 **1914.**
203. Shorygin, P., Ber. **57**, 1627 **1924.**
204. Smith E. R., and M. Wojciechowski, Roczniki Chem. **16**, 104 **1936**; C.A. **30**, 5849 **1936.**
205. Smith, R. H., and D. H. Andrews, J. Am. Chem. Soc. **53**, 3644 **1931.**
206. Smittenberg, J., H. Hoog, and R. A. Henkes, J. Am. Chem. Soc. **60**, 17 **1938.**
207. Spraner, J. W., and J. H. Simons, J. Am. Chem. Soc. **64**, 648 **1942.**
208. Swietoslawski, W., and E. Ramatowski, Roczniki Chem. **15**, 422 **1935**; C.A. **30**, 5191 **1936**; Chem. Zentr. **1936**, I, 2335.
209. Szivessy, G., Z. Physik **18**, 97 **1923.**
210. Tausz, J., Z. angew. Chem. **32**, 175 **1919.**
211. Thorpe, T. E., and J. W. Rodger, Trans. Roy. Soc. (London) **185A**, 521 **1894.**
212. Timmermans, J., Bull. soc. chim. Belg. **24**, 244 **1910.**
213. Timmermans, J., Bull. soc. chim. Belg. **25**, 300 **1911.**
214. Timmermans, J., Bull. soc. chim. Belg. **43**, 626 **1934.**
215. Timmermans, J., Bull. soc. chim. Belg. **44**, 17 **1935.**
216. Timmermans, J., Comm. Phys. Lab. Univ. Leiden, Suppl. No. 64, 3 **1929**; C.A. **23**, 4390 **1929.**
217. Timmermans, J., and F. Martin, J. chim. phys. **23**, 733 **1926.**
218. Timmermans, J., and F. Martin, J. chim. phys. **23**, 747 **1926.**
219. Timmermans, J., H. van der Horst, and H. K. Onnes, Arch. néerland. sci. IIIA, **6**, 180 **1923.**
220. Timmermans, J., H. van der Horst, and H. K. Onnes, Compt. rend. **174**, 365 **1922.**
221. Tonomura, T., and K. Uehara, Bull. Chem. Soc. Japan **6**, 255 **1931.**
222. Transue, L. F., E. R. Washburn, and F. H. Kohler, J. Am. Chem. Soc. **64**, 274 **1942.**
223. Tyrer, D., J. Chem. Soc. **97**, 2620 **1910.**
224. Tyrer, D., J. Chem. Soc. **99**, 871 **1911.**
225. Tyrer, D., J. Chem. Soc. **105**, 2534 **1914.**
226. Tyrer, D., Z. physik. Chem. **87**, 169 **1914.**
227. Venkatarannan, S., Indian J. Phys. **8**, 25 **1933-1934.**
228. von Auwers, K., Ann. **419**, 92 **1919.**
229. von Auwers, K., and H. Kolligs, Ber. **55**, 21 **1922.**
230. von Huhn, W., Thesis, Technischen Hochschule München, **1931.**
231. von Zawidzki, J., Z. physik. Chem. **35**, 129 **1900.**
232. Vorländer, D., and J. Fischer, Ber. **65**, 1756 **1932.**
233. Walden, P., Z. physik. Chem. **66**, 385 **1909.**
234. Walden, P., Z. physik. Chem. **147A**, 1 **1930.**
235. Walden, P., and R. Swinne, Z. physik. Chem. **79**, 700 **1912.**
236. Ward, A. L., and W. H. Fulweiler, Ind. Eng. Chem. Anal. Ed. **6**, 396 **1934.**
237. Ward, H. L., J. Phys. Chem. **30**, 1316 **1926.**
238. Washburn, E. R., and A. E. Beguin, J. Am. Chem. Soc. **62**, 579 **1940.**
239. Washburn, E. R., A. E. Beguin, and O. C. Beckord, J. Am. Chem. Soc. **61**, 1694 **1939.**
240. Wessely, F., A. Münster, and S. Wang, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 14 Abt. IIb, 473 **1937.**
241. White, A. G., J. Chem. Soc. **121**, 1244 **1922.**
242. Williams, J. W., and F. Daniels, J. Am. Chem. Soc. **46**, 903 **1924.**
243. Williams, J. W., and F. Daniels, J. Am. Chem. Soc. **47**, 1490 **1925.**

244. Williams, J. W., and I. J. Krchma, J. Am. Chem. Soc. **48**, 1888 **1926.**
245. Williams, J. W., and I. J. Krchma, J. Am. Chem. Soc. **49**, 1676 **1927.**
246. Woodman, R. M., J. Phys. Chem. **30**, 1283 **1926.**
247. Woringer, B., Z. physik. Chem. **34**, 257 **1900.**
248. Wüstenfeld, H., and C. Foehr, Deut. Essigind. **18**, 114, 125; Chem. Zentr. **1914**, I, 1537.
249. Young, S., J. Chem. Soc. **83**, 68 **1903.**
250. Young, S., and E. C. Fortey, J. Chem. Soc. **83**, 45 **1903.**
251. Ziegler, W. T., and D. H. Andrews, J. Am. Chem. Soc. **64**, 2482 **1942.**
252. Zmaczynski, J. chim. phys. **27**, 503 **1930.**

## Ethylbenzene



| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **−94.91** | **136.06** | **0.86707** | **1.49597** | Crit. Temp. (°C) |
| −92 [20,58] | 136–137 [42] | 0.8663 [15] | 1.4942 [72] | 358.9 [82] |
| −92.4 [60] | 136–136.8 [1] | 0.8667 [23] | 1.4948 [15] | 351.05(f) [70] |
| −93.0 [17,18] | 136.5 [14,56,60,66,88,106] | 0.86690 [95,107] | 1.4950 [111] | 346.4 [2] |
| −93 [30] | 136.3–136.5 [43] | 0.8672 [68] | 1.4951 [9,86,87] | |
| −93.2 [53] | 135.5–136.5 [10] | 0.8674 [33,40] | 1.4952 [36] | Crit. Pressure (mm Hg) |
| −93.9 [94] | 135.9–136.3 [61] | 0.8678 [39] | 1.4955 [104] | |
| −94 [96] | 136.25 [45] | 0.8681 [86,87] | 1.4958 [29,33] | 28,978.80 [2] |
| −94.2 [52] | 136.2 [63,101] | 0.8682 [104] | 1.4959 [5,14,30] | 28,956.0 [2,103] |
| −94.4 [95,107] | 136.19 [26] | 0.8681 [4] | 1.49593 [68] | |
| −94.7 [19] | 136.18 [113] | 0.86875(c) [78] | 1.49594 [11] | |
| −94.96 [14] | 136.13–136.18 [81] | 0.86995 [55] | 1.4960 [19,40,66,98,101] | |
| −95.1 [39] | 136.15 [95,107] | 0.7611 135.9° [85] | 1.49606 [60,99] | $[\alpha]_{5461}$ = −18.7° [47] |
| −95.30 [33] | 136.15 ± 0.02 [94] | 0.7611 135.8° [83,84] | 1.49876(d) [100] | |
| | 136.10–136.13 [7] | | 1.4919 25° [20] | |
| | 136.11 ± 0.01 [8] | 0.7612 135.8° [83] | 1.4928 25° [71] | |
| | 136.1 [68] | 0.77016 125.90° [67] | 1.4931 25° [41] | |
| | 136.1 ± 0.5 [29] | 0.7935 100.9° [13] | 1.49317 25° [107] | |
| | 136.0–136.1 [108] | 0.79695 97.60° [67] | 1.49386 25° [108] | |
| | 136.07 [112] | 0.81373 79.70° [67] | 1.4940 25° [51] | |
| | 136.0 [20,30] | 0.8302 60.2° [13] | 1.4949 25° [69] | |
| | 136(a) | 0.83138 59.95° [67] | 1.4952 21° [61] | |
| | 136 ± 1 [40] | 0.83358 59.5° [70] | 1.49594 20.2° [16] | |
| | 135.4–136.0 [38] | 0.84412 45.50° [67] | 1.4952 18° [114] | |
| | 135–136 [23,28,52,53,98] | 0.8489 40.0° [13] | 1.49621 18° [90] | |
| | 135.9 [102] | 0.8615 30° [4] | 1.49730 18° [44] | |
| | 135.86 [93] | 0.86301 28.2° [89] | 1.49790 17.8° [100] | |
| | 135.8 [84,103,104] | 0.86085 26.90° [67] | 1.49854 16.02° [22] | |
| | 135.5–135.8 [73] | 0.8625 25.13° [8,62] | 1.4957 16° [97] | |
| | 135.5–135.7 [74] | 0.8603 25° [71] | 1.49780 16° [43] | |
| | 135.6 [17,64] | 0.8616 25° [21,35] | 1.49857 15° [95] | |
| | 135.5 [37,74,75] | 0.8624 25° [33] | 1.49828 14.5° [98] | |
| | 135.11 [100] | 0.8629 25° [69] | 1.49933 14.5° [100] | |
| | 141.29 871.5 [113] | 0.8630 25° [51] | 1.4994 14.5° [65] | |
| | 139.44 829.1 [113] | 0.8646 $D_{25}^{25}$ [24] | 1.49881 14.3° [100] | |
| | 137.43 786.8 [113] | | 1.4990 14° [49] | |
| | 137.07 777.9 [113] | 0.8650 $D_{25}^{25}$ [20,74] | 1.50138 10.63° [22] | |
| | 136.92 774.7 [113] | 0.8671 $D_{25}^{25}$ [74] | 1.50206 8.4° [75] | |
| | 136–137 770 [3] | 0.8639 23.4° [39] | 1.50264 7.0° [99] | |
| | 136.35 –136.45(b) 766.7 [78] | 0.8664 22.5° [25] | 1.49174 $n_{H\alpha}^{20.2}$ [16] | |
| | 136.15 –136.27 766.3 [92] | 0.86566 21.0° [70] | 1.49058 $n_{H\alpha}^{20}$ [23] | |
| | | 0.8684 $D_{20}^{20}$ [36] | 1.49169 $n_{H\alpha}^{20}$ [11] | |

*The notes designated by letters are given on page 62.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Ethylbenzene** (*Continued*) | 136.5 766 [34]<br>135.98 ±0.02 765 [19]<br>136.05 −136.10 764.3 [93]<br>136.37 763.2 [113]<br>135–136 763 [24]<br>135.5 −135.8 763 [80]<br>136.24 762.7 [113]<br>136 762 [49]<br>136.03 761.1 [76]<br>136.09 759.0 [113]<br>135.7 −135.9 758.5 [83]<br>135.5 −135.7 756 [39]<br>135.7 −135.9 755.2 [85]<br>135.62 750.2 [112]<br>134.8 −135.2 747 [48]<br>135–136 746.5 [11]<br>135.7 −135.95(b) 745.5 [46]<br>134.2–135 741 [36]<br>135.1 −135.3 740 [13]<br>135.20 739.1 [113]<br>133.5 −134.5 730 [114]<br>133–134 725 [109]<br>134.36 724.4 [113]<br>132.24 684.8 [113]<br>130.32 648.6 [113]<br>127.30 596.5 [113]<br>124.25 546.6 [113]<br>121.06 499.3 [113]<br>118.08 456.8 [113]<br>115.12 417.45 [113]<br>112.13 381.0 [113] | 0.8685 $D_{20}^{20}$ [74]<br>0.8705 $D_{20}^{20}$ [74]<br>0.87186 17.7° [55]<br>0.8722 $D_{17}^{17}$ [97]<br>0.87326 16.0° [55]<br>0.87367 15.6° [55]<br>0.8722 15° [29]<br>0.87426 15° [67]<br>0.8720 $D_{15}^{15}$ [71]<br>0.8741 $D_{15}^{15}$ [71]<br>0.87152 14.85° [67]<br>0.87452 14.6° [55]<br>0.8708 14.5° [98]<br>0.87494 14.1° [55]<br>0.8736 14° [49]<br>0.87545 13.5° [55]<br>0.8759 $D_{10}^{10}$ [74]<br>0.8780 $D_{10}^{10}$ [74]<br>0.8760 9.9° [83]<br>0.87704 8.5° [95]<br>0.87697 8.4° [75]<br>0.8800 $D_5^5$ [74]<br>0.8821 $D_5^5$ [74]<br>0.8809 $D_4^4$ [74]<br>0.8829 $D_4^4$ [74]<br>0.88316 0° [106]<br>0.8832 0° [93]<br>0.88452 0° [95]<br>0.88457 0° [113]<br>0.88458 0° [67]<br>0.8855 0° [79]<br>0.90464 −22.9° [67]<br>0.92415 −45.2° [67]<br>0.95798 −83.6° [67]<br>0.96809 −95.1° [67] | 1.49418 $n_{H\alpha}^{16.12}$ [22]<br>1.49408 $n_{H\alpha}^{15}$ [95]<br>1.49423 $n_{H\alpha}^{14.5}$ [98]<br>1.4948 $n_{H\alpha}^{14.5}$ [55]<br>1.49694 $n_{H\alpha}^{10.86}$ [22]<br>1.49781 $n_{H\alpha}^{8.4}$ [75]<br>1.50693 $n_{H\beta}^{20.2}$ [16]<br>1.50565 $n_{H\beta}^{20}$ [23]<br>1.50693 $n_{H\beta}^{20}$ [11]<br>1.50950 $n_{H\beta}^{15}$ [95]<br>1.50953 $n_{H\beta}^{14.5}$ [98]<br>1.5102 $n_{H\beta}^{14.5}$ [55]<br>1.51316 $n_{H\beta}^{8.4}$ [75]<br>1.51500 $n_{H\gamma}^{20}$ [23]<br>1.51637 $n_{H\gamma}^{20}$ [11]<br>1.51904 $n_{H\gamma}^{14.5}$ [98]<br>1.5196 $n_{H\gamma}^{14.5}$ [55]<br>1.52279 $n_{H\gamma}^{8.4}$ [75]<br>1.49477 $n_{He}^{20}$ [23]<br>1.49868 $n_{He}^{15}$ [95]<br>(c) | |

**Additional Data**

* $\frac{1}{T_b} = 0.00388409 - 0.000500 \log_{10} p_{mm}$ (100 to 875 mm)

† $\frac{dD}{dt} = -0.00089175[1 + 0.0003948(t-20)]/°C$ (−95 to 136°C)

‡ $\frac{dn}{dt} = -0.00051701/°C$ (7 to 25°C)

*The notes designated by letters are given on page 62.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Ethylbenzene** (*Continued*) | 109.11 346.9 [113] | | | |
| | 105.98 313.65 [113] | | | |
| | 102.93 284.15 [113] | | | |
| | 99.90 257.15 [113] | | | |
| | 96.86 231.85 [113] | | | |
| | 93.96 209.45 [113] | | | |
| | 90.87 188.05 [113] | | | |
| | 87.80 168.15 [113] | | | |
| | 84.74 150.65 [113] | | | |
| | 81.60 134.3 [113] | | | |
| | 79.52 123.95 [113] | | | |
| | 78.93 121.2 [113] | | | |
| | 25 21 [27] | | | |
| | 30 10 [49] | | | |
| | −1.38 1.38 [59] | | | |
| | −11.6 0.56 [59] | | | |

(a) The boiling point 136 is found in references 6, 12, 31, 54, 77, 82, 91, 105, 110, 111.
(b) This boiling point is the average of two or more determinations.
(c) This density is the average of two or more determinations.
(d) This refractive index is the average of two or more determinations.
(e) Refractive indices of other lines may be found in reference 22.
(f) This temperature is the average of two or more determinations.

## Ethylbenzene References

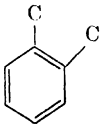

1. Adams, R., and J. R. Marshall, J. Am. Chem. Soc. **50**, 1970 **1928.**
2. Altschul, M., Z. physik. Chem. **11**, 577 **1893.**
3. Austin, J. B., and I. A. Black, J. Am. Chem. Soc. **52**, 4757 **1930.**
4. Azim, M. A., S. S. Bhatnagar, and R. M. Mathur, Phil. Mag. [7] **16**, 580 **1933.**
5. Baker, J. W., and L. G. Groves, J. Chem. Soc. **1939**, 1147.
6. Balsohn, M., Bull. soc. chim. [2] **32**, 618 **1879.**
7. Bartell, F. E., and E. G. Almy, J. Phys. Chem. **36**, 985 **1932.**
8. Bartell, F. E., and G. L. Mack, J. Phys. Chem. **36**, 65 **1932.**
9. Berman, N., and A. Lowry, J. Am. Chem. Soc. **60**, 2596 **1938.**
10. Blacet, F. E., P. A. Leighton, and E. P. Bartlett, J. Phys. Chem. **35**, 1935 **1931.**
11. Brühl, J. W., Ann. **235**, 1 **1886.**
12. Bruner, L., and J. Vorbrodt, Bull. intern. acad. sci. Cracovie **1909**, 221.
13. Buehler, C. A., T. S. Gardner, and M. L. Clemens, J. Org. Chem. **2**, 167 **1937-1938.**
14. Bureau of Standards through Hammond and McArdle, Ind. Eng. Chem. **35**, 809 **1943.**
15. Campbell, K. N., and M. J. O'Connor, J. Am. Chem. Soc. **61**, 2897 **1939.**
16. Cotton, A., and H. Mouton, Ann. chim. phys. [8] **28**, 209 **1913.**
17. de Carli, F., Atti accad. Lincei [6] **4**, 460 **1926.**
18. de Carli, F., Atti accad. Lincei [6] **4**, 523 **1926.**
19. Dolliver, M. A., T. L. Gresham, G. B. Kistiakowsky, and W. E. Vaughan, J. Am. Chem. Soc. **59**, 831 **1937.**
20. Dreisbach, R. R., unpublished data.
21. Dunstan, A. E., and T. P. Hilditch, Z. Elektrochem. **18**, 185 **1912.**
22. Eisele, I., Ann. Physik [4] **76**, 396 **1925.**
23. Eisenlohr, F., and L. Schulz, Ber. **57**, 1808 **1924.**

24. Fischer, W., and W. Klemm, Z. physik. Chem. **147**, 275 1930.
25. Fittig, R., and J. König, Ann. **144**, 277 1867.
26. Forziati, A. F., C. B. Willingham, B. J. Mair, and F. D. Rossini, J. Research Natl. Bur. Standards **32**, 11 1944.
27. Fröschl, N., and C. G. Dahoff, J. prakt. Chem. [2] **144**, 217 1936.
28. Fuson, R. C., J. Am. Chem. Soc. **48**, 2681 1926.
29. Garner, F. H., and E. B. Evans, J. Inst. Petroleum Tech. **18**, 751 1932.
30. Gaucher, L. P., Ind. Eng. Chem. **27**, 57 1935.
31. Grosse, A. V., and V. N. Ipatieff, J. Org. Chem. **2**, 447 1937.
32. Guldberg, C. M., Z. physik. Chem. **32**, 116 1900.
33. Hammond, P. D., and E. H. McArdle, Ind. Eng. Chem. **35**, 809 1943.
34. Hartley, W. N., Trans. Roy. Soc. (London) **208**, 475 1908.
35. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **17**, 929 1911.
36. Hofmann, F., K. Lang, K. Berlin, A. Schmidt, Brennstoff-Chem. **13**, 161 1932.
37. Howard, L. B., and G. E. Hilbert, J. Am. Chem. Soc. **54**, 3628 1932.
38. Howes, D. A., and A. W. Nash, J. Soc. Chem. Ind. **49**, 16T 1930.
39. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 1930.
40. Ipatieff, V. N., and A. V. Grosse, J. Am. Chem. Soc. **58**, 2339 1936.
41. Ipatieff, V. N., and V. I. Komarewsky, J. Am. Chem. Soc. **58**, 922 1936.
42. Ipatieff, V. N., H. Pines, and V. I. Komarewsky, Ind. Eng. Chem. **28**, 222 1936.
43. Janovsky, J. V., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse, **81**, Abt. II, 539 1880.
44. Janovsky, J. V., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse, **82**, Abt. II, 147 1880.
45. Jantzen, E., and W. Haker, Chem. Fabrik **12**, 329 1939.
46. Jesse, R. H., Jr., J. Am. Chem. Soc. **34**, 1337 1912.
47. Kenyon, J., H. Phillips, and V. P. Pittman, J. Chem. Soc. 1935, 1072.
48. Kharasch, M. S., P. C. White, and F. R. Mayo, J. Org. Chem. **3**, 33 1938.
49. Klages, A., and R. Keil, Ber. **36**, 1632 1903.
50. Kolligs through K. von Auwers and H. Kolligs, Ber. **55**, 21 1922.
51. Komatsu, S., and K. Mitsui, Rec. trav. chim. **57**, 586 1938.
52. Ladenburg, A., and C. Krügel, Ber. **32**, 1818 1899.
53. Ladenburg, A., and C. Krügel, Ber. **33**, 637 1900.
54. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 1918.
55. Landolt, H., and H. Jahn, Z. physik. Chem. **10**, 289 1892.
56. Lazarev, N. V., and T. V. Staryzna, Bull. soc. chim. biol. **18**, 723 1936.
57. Leithe, W., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **138**, Abt. IIb, 319 1929.
58. Leslie, R. T., and W. W. Heuer, Bur. Standards J. Research **18**, 639 1937.
59. Linder, E. G., J. Phys. Chem. **35**, 531 1931.
60. Maass, O., and J. Russell, J. Am. Chem. Soc. **40**, 1561 1918.
61. Maess, L., and L. von Müffling, Z. angew. Chem. **50**, 759 1937.
62. Mack, G. L., and F. E. Bartell, J. Am. Chem. Soc. **54**, 936 1932.
63. Mair, B. J., and A. F. Forziati, J. Research Natl. Bur. Standards **32**, 165 1944.
64. Malishew, B. W., J. Am. Chem. Soc. **57**, 883 1935.
65. Mangold, C., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse, **102**, Abt. IIa, 1071 1893.
66. Martin, E., Ann. combustibles liquides **12**, 97 1937.
67. Massart, L., Bull. soc. chim. Belg. **45**, 76 1936.
68. Mathews, J. H., J. Am. Chem. Soc. **48**, 562 1926.
69. McKenna, J. F., and F. J. Sowa, J. Am. Chem. Soc. **59**, 1204 1937.
70. Morgan, J. L. R., and G. K. Daghlian, Z. physik. Chem. **78**, 169 1912.
71. O'Connor, M. J., and F. J. Sowa, J. Am. Chem. Soc. **60**, 125 1938.
72. Packendorff, K., N. D. Zelinskiĭ, and L. Leder-Packendorff, Ber. **66**, 1069 1933.
73. Pauer, J., Ann. Physik [N.F.] **61**, 363 1897.
74. Perkin, W. H., J. Chem. Soc. **69**, 1025 1896.
75. Perkin, W. H., J. Chem. Soc. **77**, 267 1900.

76. Richards, T. W., and F. Barry, J. Am. Chem. Soc. **37**, 993 **1915.**
77. Richards, T. W., and J. H. Mathews, Z. physik. Chem. **61**, 449 **1907.**
78. Richards, T. W., and J. W. Shipley, J. Am. Chem. Soc. **38**, 989 **1916.**
79. Richards, T. W., C. L. Speyers, and E. K. Carver, J. Am. Chem. Soc. **46**, 1196 **1924.**
80. Richards, T. W., W. N. Stull, J. H. Mathews, and C. L. Speyers, J. Am. Chem. Soc. **34**, 971 **1912.**
81. Rintelen, J. C., Jr., J. H. Saylor, and P. M. Gross, J. Am. Chem. Soc. **59**, 1129 **1937.**
82. Sabatier, P., and J. B. Senderns, Compt. rend. **135**, 87 **1902.**
83. Schiff, R., Ann. **220**, 71 **1883.**
84. Schiff, R., Ann. **220**, 278 **1883.**
85. Schiff, R. Ann. **223**, 47 **1884.**
86. Schmidt, A. W., Ber. **75**, 1399 **1942.**
87. Schmidt, A. W., G. Hopp, and F. Schoeller, Ber. **72**, 1893 **1939.**
88. Schmidt, O., Ber. **68**, 795 **1935.**
89. Schonrock, O., Z. physik. Chem. **11**, 753 **1893.**
90. Steinkopf, W., and A. Wolfram, Ann. **430**, 113 **1923.**
91. Straus, F., and H. Grindel, Ann. **439**, 276 **1924.**
92. Thorpe, T. E., and J. W. Rodger, Trans. Roy. Soc. (London) **185A**, 521 **1894.**
93. Thorpe, T. E., and J. W. Rodger, Trans. Roy. Soc. (London) **189A**, 71 **1897.**
94. Timmermans, J., Bull. soc. chim. Belg. **25**, 300 **1911.**
95. Timmermans, J., and F. Martin, J. chim. phys. **23**, 747 **1926.**
96. Trusty, A. W., Petroleum Refiner **22**, 95 **1943.**
97. Tsukervanik, I. P., and G. Vikrova, J. Gen. Chem. (U.S.S.R.) **7**, 632 **1937**; C A. **31**, 5779 **1937.**
98. von Auwers, K., Ann. **419**, 92 **1919.**
99. von Auwers, K., and H. Kolligs, Ber. **55**, 21 **1922.**
100. von Auwers, K., and H. Kolligs, Ber. **55**, 3872 **1922.**
101. Vvedenskiĭ, A. A., J. Gen. Chem. (U.S.S.R.) **2**, 826 **1932**; Chem. Zentr. **1933**, II, 1828.
102. Walden, P., Z. physik. Chem. **65**, 129 **1909.**
103. Walden, P., Z. physik. Chem. **66**, 385 **1909.**
104. Ward, A. L., and W. H. Fulweiler, Ind. Eng. Chem. Anal. Ed. **6**, 396 **1934.**
105. Weber, H. H., Chem.-Ztg. **55**, 201 **1931.**
106. Weger, F., Ann. **221**, 61 **1883.**
107. White, J. D., and F. W. Rose, Jr., Bur. Standards J. Research **10**, 639 **1933.**
108. Williams, J. W., and F. Daniels, J. Am. Chem. Soc. **46**, 903 **1924.**
109. Willstätter, R., and V. L. King, Ber. **46**, 527 **1913.**
110. Wolff, L., Ann. **394**, 86 **1912.**
111. Wooster, C. B., and J. F. Ryan, J. Am Chem. Soc. **56**, 1133 **1934.**
112. Young, S., J. Chem. Soc. **83**, 68 **1903.**
113. Young, S., and E. C. Fortey, J. Chem. Soc. **83**, 45 **1903.**
114. Zelinskiĭ, N. D., K. Packendorff, and L. Leder-Packendorff, Ber. **66**, 872 **1933.**

## *o*-Xylene

(1,2-Dimethylbenzene)



| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **−25.25** | **144.18** | **0.88009** | **1.50516** | Crit. Temp. (°C) |
| −25.0 ± 0.1 [44] | 144.7 [10] | 0.87810 [21] | 1.5040 [66] | 363 [30] |
| −25.0 [12] | 144.6 [48] | 0.8793 [24,47] | 1.5045 [26] | 362.95(a) [7] |
| −25 [34] | 144.5 [9,27,54] | 0.8799 [38] | 1.5049 [66] | 359.05(a) [46] |
| −25.10 [13] | 144.42 [16] | 0.880024 [51] | 1.5053 [20] | 358.3 [42] |
| −25.30 [9,20,69] | 144.4 [20,36,69] | 0.88011 [44] | 1.50538 [67] | 357.7 [25] |
| −25.3 [41] | 143.7–144.2 [45] | 0.88012 [44] | 1.5054 [9] | |
| −25.34 ± 0.1 [57] | 143.95–144.15 [44] | 0.88040 [9,69] | 1.5055 [13,38] | Crit. Pressure (mm Hg) |
| −25.5 [63] | 144.0–144.1 [61] | 0.8809 [20] | 1.5057 [66] | |
| −25.74 [49] | 144.0 [3,17,28,41] | 0.8811 [23,59] | 1.5058 [17,72] | 28,066.80 [1] |
| −27 [4,17] | 144.0 ± 0.3 [65] | 0.8812 [60] | 1.5061 [72] | 28,044.0 [1,36] |
| atm | 144 [23,31] | 0.76429 154.90° [39] | 1.50301 25° [69] | |
| 0.00 1,045 [12] | 143.7 [70] | 0.78782 126.00° [39] | 1.5030 25° [57] | |
| −5.0 837 [12] | 143.6 [33] | 0.80573 106.05° [39] | 1.50294 24.5° [8] | |
| −8.6 692 [12] | 143.2–143.6 [71] | 0.82945 79.45° [39] | 1.5042 22.3° [11] | |
| −10.0 633 [12] | 143.4 [15] | 0.8461 60.80° [59] | 1.50463 21.6° [8,67] | |
| −15.0 423 [12] | 142.1–143.1 [53] | 0.84558 60.47° [39] | 1.5060 19° [73] | |
| −20.0 213 [12] | 143.0 [62] | 0.8432 59.4° [46] | 1.50491 17.9° [66] | |
| | 143 [32] | 0.8500 56.5° [30] | 1.50712 16.57° [44] | |
| | 142.8–143 [19] | 0.8582 47.0° [30] | 1.50721 16.57° [44] | |
| | 142.6–142.8 [40] | 0.85765 46.40° [39] | 1.50664 16.1° [66] | |
| | 142.6–142.7 [29] | 0.8661 37.2° [30] | 1.50777 15.5° [66] | |
| | 144.4 | 0.866286 36.34° [51] | 1.5070 15° [45] | |
| | −144.7 769 [43] | 0.8689 34.47° [59] | 1.5082 14.1° [32] | |
| | 144.35 766.2 [61] | 0.87180 29.70° [39] | 1.51086 9.27° [44] | |
| | 144.07 | 0.872521 28.93° [51] | 1.51136 8.5° [64] | |
| | −144.08 765 [13] | 0.87445 27° [69] | 1.49849 $n_{H\alpha}^{24.5}$ [8] | |
| | 143 | 0.87464 27.0° [62] | 1.5000 $n_{H\alpha}^{22.3}$ [11] | |
| | −143.5 764 [72] | 0.8753 26.0° [30] | 1.50021 $n_{H\alpha}^{21.6}$ [8] | |
| | 143.9 | 0.8759 25° [20] | 1.50090 $n_{H\alpha}^{17.9}$ [66] | |
| | −144.2 763 [58,59,60] | 0.8752 $D_{25}^{25}$ [53] | 1.50273 $n_{H\alpha}^{16.54}$ [44] | |
| | 144 763 [22] | 0.8755 24.5° [8] | 1.50268 $n_{H\alpha}^{16.51}$ [44] | |
| | 144.00 | 0.8758 24.1° [18,55] | 1.50248 $n_{H\alpha}^{16.1}$ [66] | |
| | −144.08 759.1 [64] | 0.8731 23.85° [46] | 1.50368 $n_{H\alpha}^{15.5}$ [66] | |
| | 143.75 | 0.877938 22.44° [51] | 1.5040 $n_{H_\varepsilon}^{14.1}$ [32] | |
| | −144.02 757.6 [64] | 0.8784 21.6° [8] | 1.50632 $n_{H\alpha}^{9.26}$ [44] | |
| | 142–143 755 [72] | 0.88019 20.3° [32] | 1.50687 $n_{H\alpha}^{8.5}$ [54] | |
| | 142 | 0.8783 $D_{20}^{20}$ [53] | 1.5129 $n_{H\beta}^{24.1}$ [18,55] | |
| | −143.5 752 [26] | 0.8808 $D_{20}^{20}$ [26] | 1.5159 $n_{H\beta}^{22.3}$ [11] | |
| | 143–144 751.9 [8] | 0.880776 19.12° [51] | 1.51602 $n_{H\beta}^{21.6}$ [8] | |
| | 143.7 | 0.88192 18.2° [32] | | |
| | −143.9 751.6 [37] | | | |
| | 143.2 750 [70] | | | |

*The notes designated by letters are given on page 66.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **o-Xylene** (1,2-Dimethylbenzene) *(Continued)* | 142 | 0.8798 17.9° [66] | 1.51668 $n_{H\beta}^{17.9}$ [66] | * |
| | −142.5 750 [2] | 0.8825 16.1° [66] | 1.51846 $n_{H\beta}^{16.1}$ [66] | |
| | 142.5 748.7 [38] | 0.8834 16° [68] | 1.51960 $n_{H\beta}^{15.5}$ [66] | |
| | 142–143 746.8 [8] | 0.88381 15.9° [32] | 1.5200 $n_{H\beta}^{14.1}$ [32] | |
| | 141.1 737.2 [50] | 0.8837 15.5° [66] | 1.52291 $n_{H\beta}^{8.5}$ [54] | |
| | 140.6 700 [70] | 0.88425 15.00° [39] | 1.52406 $n_{H\gamma}^{24.5}$ [8] | |
| | 137.8 650 [70] | 0.8845 15° [45] | 1.52578 $n_{H\gamma}^{21.6}$ [8] | † |
| | 134.8 600 [70] | 0.8818 $D_{15}^{15}$ [53] | 1.52659 $n_{H\gamma}^{17.9}$ [66] | |
| | 133.9 597.3 [50] | 0.88491 14.5° [32] | 1.52839 $n_{H\gamma}^{16.54}$ [44] | |
| | 131.7 550 [70] | 0.88524 14.1° [32] | 1.52847 $n_{H\gamma}^{16.54}$ [44] | |
| | 128.3 500 [70] | 0.88573 13.5° [32] | 1.52838 $n_{H\gamma}^{16.1}$ [66] | |
| | 124.6 450 [70] | 0.88584 13.3° [32] | 1.52958 $n_{H\gamma}^{15.5}$ [66] | |
| | 123.8 445(b) [50] | 0.8854 $D_{10}^{10}$ [53] | 1.5300 $n_{H\gamma}^{14.1}$ [32] | ‡ |
| | 120.6 400 [70] | 0.8899 8.5° [54] | 1.53221 $n_{H\gamma}^{9.26}$ [44] | |
| | 116.0 350 [70] | 0.8895 $D_6^{5}$ [53] | 1.53301 $n_{H\gamma}^{8.5}$ [54] | |
| | 112.9 308.4 [50] | 0.8903 $D_4^{4}$ [53] | 1.50506(d) $n_{He}^{20}$ [14] | |
| | 112.7 306.7 [50] | 0.89679 0° [44] | (e) | |
| | 110.9 300 [70] | 0.8968 0° [59] | | |
| | 105.1 250 [70] | 0.89683 0° [44] | | |
| | 98.0 200 [70] | 0.89692 0° [39] | | § |
| | 90.6 150.2 [50] | 0.8932 $D_0^{0}$ [56] | | |
| | 89.3 150 [70] | 0.91595 −22.95° [39] | | |
| | 90.4 147.2 [50] | (c) | | |
| | 77.6 100 [70] | | | |
| | 0.6 1.10 [35] | | | |
| | −10.7 0.42 [35] | | | |
| | −17.0 0.20 [35] | | | |

**Additional Data**

* $t_m = -25.276_4 + 0.02419\ p_{atm}$ (1 to 1050 atm)

† $\frac{1}{T_b} = 0.003808796 - 0.00049026 \log_{10} p_{mm}$ (100 to 770 mm)

‡ $\frac{dD}{dt} = -0.000844595[1 + 0.000703996(t-20)]/°C$ (−23 to 155°C)

§ $\frac{dn}{dt} = -0.00054941/°C$ (8 to 25°C)

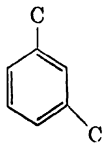
(a) This temperature is the average of two or more determinations.
(b) This pressure is the average of two determinations.
(c) Densities at various pressures are found in reference 50.
(d) This refractive index is the average of two determinations
(e) Refractive indices of other lines may be found in references 5, 8, 18, 55.

**o-Xylene References**

1. Altschul, M., Z. physik. Chem. **11, 577 1893.**
2. Austin, J. B., and I. A. Black, J. Am. Chem. Soc. **52, 4757 1930.**
3. Banerjee, A. N., Indian J. Physics **2, 51 1927.**
4. Bonino, G. B., Gazz. chim. ital. **65, 371 1935.**
5. Bouhet, C., Compt. rend. **185, 200 1927.**

6. Brown, J. C., J. Chem. Soc. **87**, 265 1905.
7. Brown, J. C., J. Chem. Soc. **89**, 311 1906.
8. Brühl, J. W., J. prakt. Chem. [2] **50**, 119 1894.
9. Bureau of Standards through Hammond and McArdle, Ind. Eng. Chem. **35**, 809 1943.
10. Chavanne, G., and P. Becker, Bull. soc. chim. Belg. **31**, 95 1922.
11. Cotton, A., and H. Mouton, Ann. chim. phys. [8] **28**, 209 1913.
12. Deffet, L., Bull. soc. chim. Belg. **44**, 41 1935.
13. Dolliver, M. A., T. L. Gresham, G. B. Kistiakowski, and W. E. Vaughan, J. Am. Chem. Soc. **59**, 831 1937.
14. Eisenlohr, F., Fortschr. Chem., Physik u. physik. Chem. **18B**, 521 1925.
15. Feustel, R., Ann. Physik [4] **16**, 61 1905.
16. Forziati, A. F., C. B. Willingham, B. J. Mair, and F. D. Rossini, J. Research Natl. Bur. Standards **32**, 11 1944.
17. Gaucher, L. P., Ind. Eng. Chem. **27**, 57 1935.
18. Gladstone, J. H., J. Chem. Soc. **59**, 290 1891.
19. Hall, C. C., J. Soc. Chem. Ind. **54**, 208 1935-1936.
20. Hammond, P. D., and E. H. McArdle, Ind. Eng. Chem. **35**, 809 1943.
21. Harkins, W. D., G. L. Clark, and L. T. Roberts, J. Am. Chem. Soc. **42**, 700 1920.
22. Hartley, W. N., Trans. Roy. Soc. (London) **208**, 475 1908.
23. Haworth, W. N., J. Chem. Soc. **103**, 1242 1913.
24. Heil, L. M., Phys. Rev. [2] **39**, 666 1932.
25. Heilbron, E., Z. physik. Chem. **7**, 601 1891.
26. Hofmann, F., K. Lang, K. Berlin, and A. Schmidt, Brennstoff-Chem. **13**, 161 1932.
27. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 1930.
28. Kahlbaum, G. W. A., Z. physik. Chem. **26**, 577 1898.
29. Kohlrausch, K. W. F., and A. Pongratz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **142**, Abt. IIb, 637 1933.
30. Kremann, R., R Meingast, and F. Gugl, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **123**, Abt. IIb, 731 1914.
31. Kryopoulos, S., J. Chem. Phys. **7**, 52 1939.
32. Landolt, H., and H. Jahn, Z. physik. Chem. **10**, 289 1892.
33. Lecat, M., Ann. soc. sci. Bruxelles **49B**, 109 1929.
34. Leslie, R. T., and W. W. Heuer, Bur. Standards J. Research **18**, 639 1937.
35. Linder, E. G., J. Phys. Chem. **35**, 531 1931.
36. Mair, B. J., and A. F. Forziati, J. Research Natl. Bur. Standards **6**, 165 1944.
37. Mangold, C., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **102**, Abt. IIa, 1071 1893.
38. Margolis, E. I., Ber. **69**, 1710 1936.
39. Massart, L., Bull. soc. chim. Belg. **45**, 76 1936.
40. Mathews, J. H., J. Am. Chem. Soc. **48**, 562 1926.
41. Matteson, R., and W. S. Hanna, Oil Gas J. **41**, No. 2, 33 1942.
42. McKee, R. H., and H. H. Parker, Ind. Eng. Chem. **20**, 1169 1928.
43. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **125**, 1743 1924.
44. Miller, O., Bull. soc. chim. Belg. **41**, 217 1932.
45. Mizuta, M., J. Soc. Chem. Ind. Japan **39**, suppl. 417B 1936.
46. Morgan, J. L. R., and G. K. Daghlian, Z. physik. Chem. **78**, 169 1912.
47. Müller, F. H., Physik. Z. **38**, 283 1937.
48. Nagornov, N., and L. Rotinjanz, Z. physik. Chem. **77**, 700 1911.
49. Nakatsuchi, A., J. Soc. Chem. Ind. Japan **32**, suppl. 333B 1929.
50. Neubeck, F., Z. physik. Chem. **1**, 649 1887.
51. Patterson, T. S., J. Chem. Soc. **81**, 1097 1902.
52. Pauer, J., Ann. Physik [N.F.] **61**, 363 1897.
53. Perkin, W. H., J. Chem. Soc. **69**, 1025 1896.
54. Perkin, W. H., J. Chem. Soc. **77**, 267 1900.
55. Perkin through Gladstone, J. Chem. Soc. **59**, 292 1891.

56. Pinette, J., Ann. **243**, 32 **1888.**
57. Pitzer, K. S., and D. W. Scott, J. Am. Chem. Soc. **65**, 803 **1943.**
58. Richards, T. W., and R. H. Jesse, Jr., J. Am. Chem. Soc. **32**, 268 **1910.**
59. Richards, T. W., C. L. Speyers, and E. K. Carver, J. Am. Chem. Soc. **46**, 1196 **1924.**
60. Richards, T. W., W. N. Stull, J. H. Mathews, and C. L. Speyers, J. Am. Chem. Soc. **34**, 971 **1912**
61. Rintelen, J. C., Jr., J. H. Saylor, and P. M. Gross, J. Am. Chem. Soc. **59**, 1129 **1937.**
62. Schonrock, O., Z. physik. Chem. **11**, 753 **1893.**
63. Swallow, J. C., and R. O. Gibson, J. Chem. Soc. **1934**, 440.
64. Thorpe, T. E., and J. W. Rodger, Trans. Roy. Soc. (London) **185A**, 521 **1894.**
65. Timmermans, J., Bull. soc. chim. Belg. **30**, 62 **1921.**
66. von Auwers, K., Ann. **419**, 92 **1919.**
67. von Auwers, K., and H Kolligs, Ber. **55**, 21 **1922.**
68. Vorländer, D., and J. Fischer, Ber. **65**, 1756 **1932.**
69. White, J. D., and F. W Rose, Jr., Bur. Standards J. Research **9**, 711 **1932.**
70. Woringer, B., Z. physik. Chem. **34**, 257 **1900.**
71. Zelinskiĭ, N. D., Ber. **57**, 42 **1924.**
72. Zelinskiĭ, N. D., and E. I. Margolis, Ber. **65**, 1613 **1932.**
73. Zelinskiĭ, N. D., and M. B. Turova-Polyak, Ber. **62**, 2865 **1929.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **m-Xylene**<br>(1,3-Dimethylbenzene) |  | | | |
| **−47.87** | **139.08** | **0.86415** | **1.49717** | Crit. Temp. (°C) |
| −45.5 [93] | 140 [110] | 0.8616 [53] | 1.4961 [53] | 349 [11,43] |
| −47 [71] | 139–140 [1,34] | 0.8622 [15] | 1.4962 [116] | 348.9 [20] |
| −47.4 [56,98] | 139.9 [62] | 0.8634 [116] | 1.4966 [35] | 348.4 [27] |
| −47.89 [78,111] | 139.8 [109] | 0.86351 [59] | 1.4970 [30,100] | 346.35(f) [61] |
| −48.56 [30] | 139.7 [105] | 0.8639 [32] | 1.4971 [11] | 345.6 [2,57] |
| −48.9 [11] | 139.5 [12] | 0.86401 [11] | 1.49720 [102] | 345.5 [106] |
| −49 [7,64] | 139.2–139.5 [68] | 0.864053 [70] | 1.4972 [114] | 344.8 [33] |
| −50–−49 [59] | 139.3–139.4 [55,112] | 0.86412 [111] | 1.4973 [24,100] | |
| −49.13 [111] | 139.2–139.4 [58] | 0.86416 [111] | 1.4975 [109] | Crit. Pressure (mm Hg) |
| −49.3 [12,97] | 139.30 [98] | 0.8650 [30] | 1.49782 [41,102] | |
| −50.5 [63] | 139.3 [28,73,74] | 0.8653 [27] | 1.49785 [14] | 27,208.00 [2,43] |
| | 139.25–139.30 [59] | 0.8655 [10] | 1.49788 [55] | 27,170.00 [2] |
| | 139.2 [11,13,39,58,113] | 0.8656 [81] | 1.4980 [60] | |
| | 139.15 [111] | 0.8657 [55] | 1.4946 25° [78] | Crit. Density |
| | 138.99–139.15 [84] | 0.8658 [31,82] | 1.49467 25° [111] | 0.290 [106] |
| | 139.11 [23] | 0.8661 [109] | 1.49468 25° [111] | 0.294 [27] |
| | 139.1 [36,51] | 0.8662 [4] | 1.49566 25° [112] | |
| | 139.00 ± 0.01 [97] | 0.74561 154.90° [54] | 1.4974 20.2° [94] | |
| | 139.0 [24,37,48,56,96] | 0.75715 139.2°(c) [87,88] | 1.4976 19.1° [59] | |
| | 139(a) | | 1.49830 17.1° [100] | |
| | 138.5–139 [72] | 0.75685 139.1° [67] | 1.4996 15.7° [47] | |
| | 138.9 [76,92] | 0.7571 139° [89] | 1.49962 14.85° [100, 102] | |
| | 138.5–138.9 [36] | 0.7567 $D_0^{138.9}$ [76] | | |
| | 137.9–138.9 [60] | 0.77172 126.00° [54] | 1.50214 11° [44] | |
| | 138.8 [21,91,115] | 0.78820 106° [77] | 1.50324 8.4° [74] | |
| | 138.75 [47] | 0.79476 100.00° [54] | 1.50477 5.15° [102] | |
| | 138 [107,108] | 0.79449 98.86° [99] | 1.49348 $n_{H\alpha}^{20}$ [14] | |
| | 137.5 [100] | 0.81293 78.86° [99] | 1.49518 $n_{H\alpha}^{20}$ [10] | |
| | 310 18,012 [103] | 0.81548 75.92° [99] | 1.49429 $n_{H\alpha}^{17.1}$ [100] | |
| | 300 15,930 [103] | 0.82021 71° [77] | 1.4954 $n_{H\alpha}^{15.7}$ [47] | |
| | 280 12,084 [103] | 0.8281 64° [42] | 1.49548 $n_{H\alpha}^{14.85}$ [100] | |
| | 260 8,976 [103] | 0.8282 64.0° [43] | 1.49878 $n_{H\alpha}^{8.4}$ [74] | |
| | 240 6,513 [103] | 0.82860 61.15° [54] | 1.5079 $n_{H\beta}^{22.5}$ [26,75] | |
| | 220 4,606 [103] | 0.8297 60.80° [81] | 1.5079 $n_{H\beta}^{20.2}$ [94] | |
| | 200 3,163 [103] | 0.8304 59.3° [100] | 1.50918 $n_{H\beta}^{20}$ [14] | |
| | 180 2,101 [103] | 0.83030 59.28° [99] | 1.51099 $n_{H\beta}^{20}$ [10] | |
| | 160 1,344 [103] | 0.8367 54.0° [43] | 1.51007 $n_{H\beta}^{17.1}$ [100] | |
| | 140.7 800 [115] | 0.83689 52° [77] | 1.5112 $n_{H\beta}^{15.7}$ [47] | |
| | 139.8 −140 766.2 [90] | 0.83797 50.54° [99] | | |
| | 140 762.6 [106] | 0.84140 46.00° [54] | | |

*The notes designated by letters are given on page 71.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***m*-Xylene** (1,3-Dimethylbenzene) *(Continued)* | 139.4 762 [6] | 0.8432 44.7° [106] | 1.51108 $n_{H\beta}^{15}$ [98] | * |
| | 139.1 761.6 [67] | 0.84373 44° [77] | 1.51128 $n_{H\beta}^{14.85}$ [100] | |
| | 138.8 | 0.84484 42.10° [70] | 1.51469 $n_{H\beta}^{8.4}$ [74] | |
| | −139.2 761.2 [81] | 0.8478 41.4° [48] | 1.52066 $n_{H\gamma}^{20}$ [10] | |
| | 138.8 | 0.84768 39.37° [99] | 1.51997 $n_{H\gamma}^{17.1}$ [100] | |
| | −139.2 761 [80,82] | 0.8531 34.47° [81] | 1.5211 $n_{H\gamma}^{15.7}$ [47] | † |
| | 139.2 759.7 [89] | 0.85427 31.25° [70] | 1.52112 $n_{H\gamma}^{14.85}$ [100] | |
| | 139.2 759.2 [87] | 0.85551 30° [93] | 1.52462 $n_{H\gamma}^{8.4}$ [74] | |
| | 139 757 [85] | 0.8581 30° [4] | 1.49702 $n_{He}^{20}$ [19] | |
| | 138.5 756 [44] | 0.85611 29.62° [99] | (c) | |
| | 138.3 | 0.85799 28.4° [91] | | |
| | −139.0 754.5 [70] | 0.85817 27° [111] | | |
| | 138–139 754 [53] | 0.85821 27° [111] | | |
| | 138.6 | 0.8605 26.0° [43] | | ‡ |
| | −138.8 752 [22] | 0.85958 25.15° [54] | | |
| | 138–139 750 [35] | 0.8600 25° [30] | | |
| | 138.3 750 [115] | 0.8625 $D_{25}^{25}$ [73] | | |
| | 137–138 750 [3] | 0.8627 $D_{25}^{25}$ [22] | | |
| | 138.7 | 0.8599 24.9° [61] | | § |
| | −139.0 748.3 [52] | 0.8601 24.9° [106] | | |
| | 137.5 | 0.86039 24.15° [70] | | |
| | −138 747.5 [116] | 0.86216 22.62° [99] | | |
| | 137.95 | 0.8641 22.5° [26,75] | | |
| | −138.10 744.3 [95] | 0.86285 21.37° [70] | | |
| | 138.1 739.4 [67] | 0.8620 21.1° [16] | | ¶ |
| | 137.9 | 0.86494 20.2° [47] | | |
| | −138.2 735.0 [69] | 0.8653 $D_{20}^{20}$ [35] | | |
| | 138.5 725 [18] | 0.8656 $D_{20}^{20}$ [73] | | |
| | 137.3 | 0.8637 $D_{15}^{19.5}$ [17] | | |
| | −137.6 724 [79] | 0.86505 19° [77] | | ⊙ |
| | 136.5 | 0.86543 18.83° [99] | | |
| | −137 723 [40] | 0.8656 18.4° [106] | | |
| | 135.7 700 [115] | 0.86650 18.4° [47] | | |
| | 133.0 650 [115] | | | |
| | 130.1 600 [115] | | | |
| | 129.2 583.6(b) [67] | | | |

**Additional Data**

* $\frac{1}{T_b} = 0.00382484 - 0.00048565 \log_{10} p_{mm}$ (100 to 800 mm)

† $\frac{1}{T_b} = 0.00395353 - 0.00052578 \log_{10} p_{mm}$ (800 to 18,012 mm)

‡ $\frac{1}{T_b} = 0.00375932 - 0.00044714 \log_{10} p_{mm}$ (0.90 to 100 mm)

§ $\frac{dD}{dt} = -0.00085791[1 + 0.000542(t - 20)]/°C$ (−52 to 155°C)

¶ $\frac{dD}{dt} = -0.00086094/°C$ (0 to 46°C)

⊙ $\frac{dn}{dt} = -0.00051262/°C$ (5 to 25°C)

*The notes designated by letters are given on page 71.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***m*-Xylene** (1,3-Dimethylbenzene) *(Continued)* | 127.0 550 [115] | 0.8666 17.2° [100] | | |
| | 123.6 500 [115] | 0.8667 17.1° [100] | | |
| | 121.8 458.3 [67] | 0.8678 17° [104] | | |
| | 120.1 450 [115] | 0.86818 16.4° [47] | | |
| | 120.5 449.2 [67] | 0.86762 15° [60] | | |
| | 116.2 400 [115] | 0.86835 15° [98] | | |
| | 111.7 350 [115] | 0.86950 15° [60] | | |
| | 107.0 300 [115] | 0.8691 $D_{15}^{15}$ [73] | | |
| | 108.7 294.0 [67] | 0.86848 14.90° [54] | | |
| | 108.3 292.7 [67] | 0.8686 14.85° [100] | | |
| | 101.4 250 [115] | 0.87002 14.2° [47] | | |
| | 94.9 200 [115] | 0.8715 12.3° [87] | | |
| | 89.3 152.2 [67] | 0.8702 12° [65] | | |
| | 86.9 150 [115] | 0.8721 12° [42] | | |
| | 88.8 148.2 [67] | 0.8728 $D_{10}^{10}$ [73] | | |
| | 76.3 100 [115] | 0.87397 8.4° [74] | | |
| | 59.7 50 [115] | 0.8770 $D_5^5$ [73] | | |
| | −2.8 1.37 [49] | 0.8779 $D_4^4$ [73] | | |
| | −6.75 1.03 [49] | 0.8796 0° [38] | | |
| | −8.4 0.90 [49] | 0.88097 0° [77] | | |
| | | 0.88113 0° [54,98] | | |
| | | 0.88151 0° [99] | | |
| | | 0.8823 0° [61] | | |
| | | 0.8812 $D_0^0$ [76] | | |
| | | 0.89269 −14° [77] | | |
| | | 0.90440 −28° [77] | | |
| | | 0.92148 −48° [77] | | |
| | | 0.92310 −50° [77] | | |
| | | 0.92481 −52° [77] | | |
| | | 0.94876 −70° [77] | | |
| | | 0.95147 −75° [77] | | |
| | | 0.9535 −80° [38] | | |
| | | 1.005 −186° [38,77] (d) | | |

(a) The boiling point 139 is found in references 5, 29, 31, 45, 46, 50, 57, 86, 101.
(b) This pressure is the average of two determinations.
(c) This density is an average of two determinations.
(d) Densities at various pressures are found in reference 67.
(e) Refractive indices of other lines may be found in references 8, 25, 26, 65, 75, 83, 94, 98.
(f) This temperature is the average of two determinations.

### *m*-Xylene References

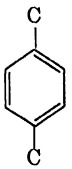
1. Adams, R., and J. R. Marshall, J. Am. Chem. Soc. **50**, 1970 **1928.**
2. Altschul, M., Z. physik. Chem. **11**, 577 **1893.**
3. Austin, J. B., and I. A. Black, J. Am. Chem. Soc. **52**, 4757 **1930.**
4. Azim, M. A., S. S. Bhatnagar, and R. M. Mathur, Phil. Mag. [7] **16**, 580 **1933.**

5. Banerjee, A. N., Indian J. Phys. **2**, 51 1927.
6. Bergholm, C., Ann. Physik [4] **65**, 128 1921.
7. Bonino, G. B., Gazz. chim. ital. **65**, 371 1935.
8. Bouhet, C., Compt. rend. **185**, 200 1927.
9. Brown, J. C., J. Chem. Soc. **89**, 311 1906.
10. Brühl, J. W., Ann. **235**, 1 1886.
11. Bureau of Standards through Hammond and McArdle, Ind. Eng. Chem. **35**, 809 1943.
12. Chavanne, G., and P. Becker, Bull. soc. chim. Belg. **31**, 95 1922.
13. Clarke, L., and E. R. Riegel, J. Am. Chem. Soc. **34**, 674 1912.
14. Cotton, A., and H. Mouton, Ann. chim. phys. [8] **28**, 209 1913.
15. de Carli, Atti accad. Lincei [6] **14**, 200 1931.
16. Dobroserdov, D. K., J. Russ. Phys. Chem. Soc **44**, 396, 679 1912; Chem Zentr. 1912, II, 789.
17. Dobroserdov, D., Kasan. Sapiski Kasaner Univ. 1909, 1; Chem. Zentr. 1911, I, 953.
18. Dutoit, P., and L. Friederich, Arch. sci. phys. nat. [4] **9**, 105 1900.
19. Eisenlohr, F., Fortschr. Chem., Physik u. physik. Chem. **18B**, 521 1925.
20. Faust, O., Z. anorg. allgem. Chem. **154**, 61 1926.
21. Feustel, R., Ann. Physik [4] **16**, 61 1905.
22. Fischer, W., and W. Klemm, Z. physik. Chem. **147**, 275 1930.
23. Forziati, A. F., C. B. Willingham, B. J. Mair, and F. D. Rossini, J. Research Natl. Bur. Standards **32**, 11 1944.
24. Gaucher, L. P., Ind. Eng. Chem. **27**, 57 1935.
25. Gladstone, J. H., J. Chem. Soc. **45**, 241 1884.
26. Gladstone, J. H., J. Chem. Soc. **59**, 290 1891.
27. Griengl, F., O. Kofler, and M. Radda, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **141**, Abt. IIb, 893 1932.
28. Grimm, F. V., and W. A. Patrick, J. Am. Chem. Soc. **45**, 2794 1923.
29. Hall, C. C., J. Soc. Chem. Ind. **54**, 208 1935-1936.
30. Hammond, P. D., and E. H. McArdle, Ind. Eng. Chem. **35**, 809 1943.
31. Haworth, W. N., J. Chem. Soc. **103**, 1242 1913..
32. Heil, L. M., Phys. Rev. [2] **39**, 666 1932.
33. Heilbron, E., Z. physik. Chem. **7**, 601 1891.
34. Hine, T. B., Phys. Rev. [2] **24**, 79 1924.
35. Hofmann, F., K. Lang, K. Berlin, and A. Schmidt, Brennstoff-Chem. **13**, 161 1932.
36. Howes, D. A., and A. W. Nash, J. Soc. Chem. Ind. **49**, 16T 1930.
37. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 1930.
38. Isnardi, H., Z. Physik **9**, 153 1922.
39. Kahlbaum, G. W. A., Z. physik. Chem. **26**, 577 1898.
40. Klingstedt, F. W., Acta Acad Aboensis, Math. et Phys. **3**, No. 5, 1 1924.
41. Kolligs through K. von Auwers and H. Kolligs, Ber. **55**, 21 1922.
42. Kremann, R., F. Gugl, and R. Meingast, Sitzber. Akad. Wiss. Wien, Math. Naturw. Klasse **123**, Abt. IIb, 863 1914.
43. Kremann, R., R. Meingast, and F. Gugl, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **123**, Abt. IIb, 731 1914.
44. Kruyt, H. R., Z. physik. Chem. **65**, 486 1909.
45. Kryopoulos, S., J. Chem. Phys. **7**, 52 1939.
46. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 1918.
47. Landolt, H., and H. Jahn, Z. physik. Chem. **10**, 289 1892.
48. Lecat, M., Ann. soc. sci. Bruxelles **48B**, 113 1928.
49. Linder, E. G., J. Phys. Chem. **35**, 531 1931.
50. Lippmann, A., Z. Elektrochem. **17**, 15 1911.
51. Mair, B. J., and A. F. Forziati, J. Research Natl. Bur. Standards **32**, 165 1944.
52. Mangold, C., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **102**, Abt. IIa, 1071 1893.
53. Margolis, E. I., Ber. **69**, 1710 1936.
54. Massart, L., Bull. soc. chim. Belg. **45**, 76 1936.

55. Mathews, J. H., J. Am. Chem. Soc. **48**, 562 **1926.**
56. Matteson, R., and W. S. Hanna, Oil Gas J. **41**, No. 2, 33 **1942.**
57. McKee, R. H., and H. H. Parker, Ind. Eng. Chem. **20**, 1169 **1928.**
58. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **125**, 1743 **1924.**
59. Miller, O., Bull. soc. chim. Belg. **44**, 513 **1935.**
60. Mizuta, M., J. Soc. Chem. Ind. Japan **39** suppl., 417B **1936.**
61. Morgan, J. L. R., and G. K. Daghlian, Z. physik. Chem. **78**, 169 **1912.**
62. Nagornov, N., and L. Rotinjanz, Z. physik. Chem. **77**, 700 **1911.**
63. Nakatsuchi, A., J. Soc. Chem. Ind. Japan **29**, 29 **1926**; C.A. **20**, 1020 **1926.**
64. Nakatsuchi, A., J. Soc. Chem. Ind. Japan **32** suppl., 333B **1929.**
65. Negreano, Compt. rend. **104**, 423 **1887.**
66. Nelson, W. L., Oil Gas J. **35**, No. 38, 39 **1937.**
67. Neubeck, F., Z. physik. Chem. **1**, 649 **1887.**
68. Norris, J. F., and G. T. Vaala, J. Am. Chem. Soc. **61**, 2131 **1939.**
69. Novák, J., Z. physik. Chem. **73**, 513 **1910.**
70. Patterson, T. S., J. Chem. Soc. **81**, 1097 **1902.**
71. Patterson, T. S., A. McMillan, and R. Somerville, J. Chem. Soc. **125**, 2488 **1924.**
72. Pauer, J., Ann. Physik [N.F.] **61**, 363 **1897.**
73. Perkin, W. H., J. Chem. Soc. **69**, 1025 **1896.**
74. Perkin, W. H., J. Chem. Soc. **77**, 267 **1900.**
75. Perkin through Gladstone, J. Chem. Soc. **59**, 292 **1891.**
76. Pinette, J., Ann. **243**, 32 **1888.**
77. Pinette, Diss. Königsberg through Isnardi, Z. Physik **9**, 153 **1922.**
78. Pitzer, K. S., and D. W. Scott, J. Am. Chem. Soc. **65**, 803 **1943.**
79. Renard, T., and P. A. Guye, J. chim. phys. **5**, 81 **1907.**
80. Richards, T. W., and R. H. Jesse, Jr., J. Am. Chem. Soc. **32**, 268 **1910.**
81. Richards, T. W., C. L. Speyers, and E. K. Carver, J. Am. Chem. Soc. **46**, 1196 **1924.**
82. Richards, T. W., W. N. Stull, J. H. Mathews, and C. L. Speyers, J. Am Chem. Soc. **34**, 971 **1912.**
83. Richardson, S. S., Phil. Mag. [6] **31**, 232 **1916.**
84. Rintelen, J. C., Jr., J. H. Saylor, and P. M. Gross, J. Am. Chem. Soc. **59**, 1129 **1937.**
85. Roth, W. A., and K. von Auwers, Ann. **407**, 145 **1914.**
86. Sabatier, P., R. Mailhe, and G. Gaudion, Compt. rend. **168**, 926 **1919.**
87. Schiff, R., Ann. **220**, 71 **1883.**
88. Schiff, R., Ann. **220**, 278 **1883.**
89. Schiff, R., Ann. **223**, 47 **1884.**
90. Schiff, R., Ann **234**, 300 **1886.**
91. Schonrock, O., Z. physik. Chem. **11**, 753 **1893.**
92. Schutz, F., Ber. **56**, 162 **1923.**
93. Swallow, J. C., and R. O. Gibson, J. Chem. Soc. **1934**, 440.
94. Szivessy, G., Z. Physik **18**, 97 **1923.**
95. Thorpe, T. E., and J. W. Rodger, Trans. Roy. Soc. (London) **185A**, 521 **1894.**
96. Timmermans, J., Bull. soc. chim. Belg. **25**, 300 **1911.**
97. Timmermans, J., Bull. soc. chim. Belg. **30**, 62 **1921.**
98. Timmermans, J., and Hennaut-Roland, J. chim. phys. **27**, 401 **1930.**
99. Tyrer, D., J. Chem. Soc. **105**, 2534 **1914.**
100. von Auwers, K., Ann. **419**, 92 **1919.**
101. von Auwers, K., Ber. **43**, 827 **1910.**
102. von Auwers, K., and H. Kolligs, Ber. **55**, 21 **1922.**
103. von Huhn, W., Thesis, Technischen Hochschule Münschen, **1931.**
104. Vorländer, D., and J. Fischer, Ber. **65**, 1756 **1932.**
105. Walden, P., Z. physik. Chem. **66**, 385 **1909.**
106. Walden, P., and R. Swinne, Z. physik. Chem. **79**, 700 **1912.**
107. Wallach, O., Ann. **395**, 74 **1913.**
108. Wallach, O., Ann. **396**, 264 **1913.**

109. Ward, A. L., and W. H. Fulweiler, Ind. Eng. Chem. Anal. Ed. **6**, 396 **1934.**
110. Weger, M., Z. angew. Chem. **22**, 338 **1909.**
111. White, J. D., and F. W. Rose, Jr., Bur. Standards J. Research **9**, 711 **1932.**
112. Williams, J. W., and F. Daniels, J. Am. Chem. Soc. **46**, 903 **1924.**
113. Wilson, R. E., and E. W. Fuller, J. Ind. Eng. Chem. **14**, 406 **1922.**
114. Wolff, H., Chem. Ztg. **47**, 421 **1923.**
115. Woringer, B., Z. physik. Chem. **34**, 257 **1900.**
116. Zelinskiĭ, N. D., and E. I. Margolis, Ber. **65**, 1613 **1932.**

## *p*-Xylene
(1,4-Dimethylbenzene)



| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **13.27** | **138.35** | **0.86102** | **1.49583** | Crit. Temp. (°C) |
| 14.5 [49,50] | 138.9 [33] | 0.8603 [93] | 1.4951 [27] | 348.9 [18] |
| 14.3 [62] | 138.7 [10] | 0.8604 [48] | 1.4956 [20,28] | 348.5 [7,40] |
| 14 [3,56] | 138.5–138.6 [22] | 0.8609(c) [59] | 1.49568(f) [100] | 345.3(d) [61] |
| 13–14 [30,31] | 138.47–138.52 [58] | 0.860908 [73] | 1.49573(f) [99] | 344.4 [2,54] |
| 13.55 [67] | 138.5 [9,38,53,66,75,77,91,103] | 0.86094 [58] | 1.49577 [52] | 343.6 [26] |
| 13.5 [35] | 138.3–138.5 [105] | 0.86100 [9,97] | 1.4958 [9,107] | |
| 13.45 [88] | 138.46 [32] | 0.8610 [63] | 1.4959 [22] | Crit. Pressure (mm Hg) |
| 13.4 [77,93] | 138.40 [97] | 0.86107 [103] | 1.4965 [108] | 26,600.00 [2,40] |
| 13.35 [14,72,97] | 138.4 [43,46,52,103] | 0.8611 [24,25,85,86,91] | 1.49680 [37] | 26,569.60 [2] |
| 13.30 [58] | 138.3–138.4 [104] | 0.8616 [52] | 1.4968 [48] | |
| 13.25 [36] | 138.27–138.37 [87] | 0.73906 155.00° [51] | 1.49389 25.4° [8] | |
| 13.23 ± 0.05 [80] | 138.35 [19] | 0.75305(c) 138.4° [69] | 1.4931 25° [80] | |
| 13.21 [103] | 138–138.2 [74] | 0.7543 138° [89] | 1.49320 25° [103] | |
| 13.2 [16,29,85,95] | 138.1 [106] | 0.7558 $D_0^{138.0}$ [79] | 1.49396 25° [104] | |
| 13.1–13.2 [86] | 138.0 [79,92] | 0.76658 125.55° [51] | 1.4940 25° [34] | |
| 13.19 [9,68] | 138(b) | 0.78998 100.00° [51] | 1.4942 23.4° [13,91] | |
| 13.15 [10,67] | 137.7 [20] | 0.80866 79.70° [51] | 1.49685 19.9° [37,100] | |
| 13.10 [91] | 140.1 800 [106] | 0.8228 64° [39] | 1.4958 19.7° [94] | |
| 13.1 [53,59,81] | 138.4 | 0.8235 63.0° [40] | 1.4968 19.0° [58] | |
| 13.00 [22,82] | −138.7 769 [55] | 0.82527 61.05° [51] | 1.49682 17.5° [99] | |
| 13.0 [70] | 138.37 | 0.82564 60.60° [51] | 1.49747 16.2° [99,100] | |
| 13 [12,20] | −138.67 766.4 [96] | 0.8261 60.60° [85] | 1.49860 15° [97] | |
| atm | 138.5 765 [23] | 0.8350 50.0° [40] | 1.4985 14.7° [42] | |
| 99.91 2,855(a) [95] | 138.1 761.2 [89] | 0.83851 46.00° [51] | 1.49911 14.4° [77] | |
| 95.00 2,676(a) [95] | 138.4 759.2 [69] | 0.84294 40.65° [73] | 1.50315 6.5° [100] | |
| 89.98 2,478(a) [95] | 137.6 754.3 [90] | 0.8444 40° [85] | 1.48949 $n_{H\alpha}^{25.4}$ [8] | |
| 85.00 2,308(a) [95] | 137.8 | 0.84767 35.20° [5] | 1.4898 $n_{H\alpha}^{23.4}$ [13] | |
| 79.85 2,110(a) [95] | −138.1 754 [83] | 0.8489 34.75° [85] | 1.49273 $n_{H\alpha}^{17.5}$ [99] | |
| 74.90 1,918(a) [95] | 138.0 | 0.84939 33.30° [73] | 1.49346(f) $n_{H\alpha}^{16.2}$ [99] | |
| 69.92 1,744(a) [95] | −138.2 752.2 [47] | 0.84943 33.3° [97] | 1.49420 $n_{H\alpha}^{15}$ [97] | |
| 64.98 1,584(a) [95] | 137.5 750 [106] | 0.85121 31.00° [5] | 1.4943 $n_{H\alpha}^{14.7}$ [42] | |
| 60.00 1,423(a) [95] | 136 | 0.85230 30° [97] | 1.49462 $n_{H\alpha}^{14.4}$ [77] | |
| 54.96 1,253(a) [95] | −136.5 750 [34] | 0.85316 29.01° [5] | 1.5058 $n_{H\beta}^{23.7}$ [21,78] | |
| 49.95 1,103(a) [95] | 137.5 | 0.85498 27° [103] | 1.5055 $n_{H\beta}^{23.4}$ [13] | |
| 46.4 968 [14] | −138 748 [31] | 0.85525 27.0° [92] | 1.5068 $n_{H\beta}^{19.7}$ [94] | |
| 44.90 954(a) [95] | 137.1 737.1 [69] | 0.85448 26.58° [5] | 1.50849 $n_{H\beta}^{17.5}$ [99] | |
| 45.00 926 [14] | 137.1 | 0.85613 25.50° [73] | 1.50919 $n_{H\beta}^{16.2}$ [99] | |
| 39.93 787 [95] | −137.2 730.8 [71] | 0.85622 25.5° [97] | | |
| 40.00 777 [14] | 134.7 700 [106] | 0.8564 25.2° [40] | | |
| 34.94 634 [95] | 131.6 650 [106] | | | |

*The notes designated by letters are given on page 77.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **p-Xylene** (1,4-Dimethylbenzene) *(Continued)* | 129.6 600.1 [69] | 0.85652 25.12° [51] | 1.51000(f) $n_{H\beta}^{15}$ [97] | * |
| | 129.6 599.6 [69] | 0.85665 25.0° [97] | 1.5097 $n_{H\beta}^{14.7}$ [42] | |
| | 119.2 445.6(a) [69] | 0.8574 25° [34] | 1.51050 $n_{H\beta}^{14.4}$ [77] | |
| | 107.1 302.6 [69] | 0.8576 25° [22] | 1.51481 $n_{H\gamma}^{25.1}$ [8] | |
| | 106.9 295.6 [69] | 0.8593 $D_{25}^{25}$ [76] | 1.51841 $n_{H\gamma}^{17.5}$ [99] | |
| 35.00 626 [14] | 86.9 149.2(a) [69] | 0.8595 $D_{25}^{25}$ [1] | 1.51905(f) $n_{H\gamma}^{16.2}$ [99] | |
| 30.15 484 [14] | 0.2 1.16 [44] | 0.85733 23.37° [5] | 1.51285 $n_{H\gamma}^{15}$ [97] | † |
| 30.09 480 [95] | −2.5 0.87 [44] | 0.8587 22.90° [85] | 1.5200 $n_{H\gamma}^{14.7}$ [42] | |
| 30.00 479 [14] | −9.5 0.33 [44] | 0.85925 21.25° [5] | 1.52055 $n_{H\gamma}^{14.4}$ [77] | |
| 25.18 346 [95] | | 0.86112 20.2° [42] | 1.49570(f) $n_{He}^{20}$ [17] | |
| 25.00 332 [14] | | 0.8616 $D_{20}^{20}$ [27] | 1.49860 $n_{He}^{15}$ [97] | |
| 20.13 199 [95] | | 0.8626 $D_{20}^{20}$ [76] | (g) | |
| 20.00 191 [14] | | 0.86058 19.74° [5] | | ‡ |
| 15.00 47 [14] | | 0.86134 19.50° [73] | | |
| | | 0.86143 19.5° [97] | | |
| | | 0.8621 19.5° [65] | | |
| | | 0.86216 19° [42] | | |
| | | 0.86304 18.1° [42] | | |
| | | 0.8625 17.5° [99] | | |
| | | 0.86333 17.23° [5] | | § |
| | | 0.8627 17.2° [99] | | |
| | | 0.86343 17.2° [97] | | |
| | | 0.8636 17.0° [97] | | |
| | | 0.86388 17° [42] | | |
| | | 0.8650 $D_{15}^{17}$ [15] | | |
| | | 0.86412 16.8° [42] | | |
| | | 0.8641(c) 16.2° [99] | | ¶ |
| | | 0.8647 16° [101] | | |
| | | 0.86542 15.02° [5] | | |
| | | 0.86535 15.0° [97] | | |
| | | 0.8656 15° [59] | | |
| | | 0.8661 $D_{15}^{15}$ [76] | | |
| | | 0.86544 14.90° [51] | | |
| | | 0.86590 14.4° [97] | | |
| | | 0.86619 14.4° [77] | | |

**Additional Data**

* $t_m = 13.239 + 0.03570\ p_{atm} - 0.00000191\ p_{atm}^2$ (1 to 2900 atm)

† $\frac{1}{T_b} = 0.00386083 - 0.00049664 \log_{10} p_{mm}$ (100 to 800 mm)

‡ $\frac{dD}{dt} = -0.00086265[1 + 0.000747(t-20)]/°C$ (0 to 135°C)

§ $\frac{dD}{dt} = -0.00087105/°C$ (10 to 50°C)

¶ $\frac{dn}{dt} = -0.00052667/°C$ (6 to 25°C)

*The notes designated by letters are given on page 77.*

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***p*-Xylene** (1,4-Dimethylbenzene) *(Continued)* | | 0.86622 14.3° [42]<br>0.86751 12.2° [42]<br>0.8678 12° [39]<br>0.86865 11.81° [5]<br>0.8779 0° [85]<br>0.87848 0° [51]<br>1.0520 ± 0.0016 0° [88] (e) | | |

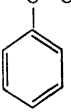
(a) This pressure is the average of two or more determinations.
(b) The boiling point 138 is found in references 4, 11, 12, 41, 42, 45, 49, 50, 60, 64, 84.
(c) This density is the average of two determinations.
(d) This temperature is the average of two determinations.
(e) Densities at various pressures are found in reference 69.
(f) This refractive index is the average of two or more determinations.
(g) Refractive indices of other lines may be found in references 6, 8, 21, 78, 94.

### *p*-Xylene References


1. Adkins, H., K. Folkers, and M. Kinsey, J. Am. Chem. Soc **53**, 2714 **1931.**
2. Altschul, M., Z. physik. Chem. **11**, 577 **1893.**
3. Baddeley, G., and J. Kenner, Ber. **69**, 902 **1936.**
4. Berthelot, C., Génie civil **112**, (58) 141 **1938.**
5. Block, H., Z. physik. Chem. **78**, 385 **1912.**
6. Bouhet, C., Compt. rend. **185**, 200 **1927.**
7. Brown, J. C., J. Chem. Soc. **89**, 311 **1906.**
8. Brühl, J. W., J. prakt. Chem. [2] **50**, 119 **1894.**
9. Bureau of Standards through Hammond and McArdle, Ind. Eng. Chem. **35**, 809 **1943.**
10. Chavanne, G., and P. Becker, Bull. soc. chim. Belg. **31**, 95 **1922.**
11. Clarke, L., and E. R. Riegel, J. Am. Chem. Soc. **34**, 674 **1912.**
12. Clemo, G. R., R. D. Haworth, and E. Walton, J. Chem. Soc. **1929**, 2368.
13. Cotton, A., and H. Mouton, Ann. chim. phys. [8] **28**, 209 **1913.**
14. Deffet, L., Bull. soc. chim. Belg. **44**, 41 **1935.**
15. Dobrosserdov, D., Kasan. Sapiski Kasaner Univ. **1909**, 1; Chem. Zentr. **1911**, I, 953.
16. Dupont, R., Bull. soc. chim. Belg. **45**, 113 **1936.**
17. Eisenlohr, F., Fortschr. Chem., Physik u. physik. Chem. **18B**, 521 **1925.**
18. Faust, O., Z. anorg. allgem. Chem. **154**, 61 **1926.**
19. Forziati, A. F., C. B. Willingham, B. J. Mair, and F. D. Rossini, J. Research Natl. Bur. Standards **32**, 11 **1944.**
20. Gaucher, L. P., Ind. Eng. Chem. **27**, 57 **1935.**
21. Gladstone, J. H., J. Chem. Soc. **59**, 290 **1891.**
22. Hammond, P. D., and E. H. McArdle, Ind. Eng. Chem. **35**, 809 **1943.**
23. Hartley, W. N., Trans. Roy. Soc. (London) **208**, 475 **1908.**
24 Haworth, W. N., J. Chem. Soc. **103**, 1242 **1913.**
25. Heil, L. M., Phys. Rev. [2] **39**, 666 **1932.**
26. Heilbron, E., Z. physik. Chem. **7**, 601 **1891.**
27. Hofmann, F., K. Lang, K. Berlin, and A. Schmidt, Brennstoff-Chem. **13**, 161 **1932.**
28. Howes, D. A., and A. W. Nash, J. Soc. Chem. Ind. **49**, 16T **1930.**
29. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 **1930.**

30. Jacobsen, O., Ber. **17**, 2372 **1884**.
31. Jacobsen, O., Ber. **18**, 357 **1885**.
32. Jantzen, E., and W. Haker, Chem. Fabrik **12**, 329 **1939**.
33. Kahlbaum, G. W. A., Z. physik. Chem. **26**, 577 **1898**.
34. Kazanskiĭ, B. A., and A. F. Plate, Ber. **69**, 1862 **1936**.
35. Kizhner, N., and G. Vendelshtein, J. Russ. Phys. Chem. Soc. **57**, 1 **1926**; C.A. **20**, 2316 **1926**; Chem. Zentr. **1926**, I, 2681.
36. Klingstedt, F. W., Acta Acad. Aboensis, Math. et Phys. **3**, No. 5, 1 **1924**.
37. Kolligs through K. von Auwers and H. Kolligs, Ber. **55**, 21 **1922**.
38. Krafft, F., J. prakt. Chem. [2] **80**, 469 **1909**.
39. Kremann, R., F. Gugl, and R. Meingast, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **123**, Abt. IIb, 863 **1914**.
40. Kremann, R., R. Meingast, and F. Gugl, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **123**, Abt. IIb, 731 **1914**.
41. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918**.
42. Landolt, H., and H. Jahn, Z. physik. Chem. **10**, 289 **1892**.
43. Lecat, M., Ann. soc. sci. Bruxelles **49B**, 109 **1929**.
44. Linder, E. G., J. Phys. Chem. **35**, 531 **1931**.
45. Lippmann, Z. Elektrochem. **17**, 15 **1911**.
46. Mair, B. J., and A. F. Forziati, J. Research Natl. Bur. Standards **32**, 165 **1944**.
47. Mangold, C., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **102**, Abt. IIa, 1071 **1893**.
48. Margolis, E. I., Ber. **69**, 1710 **1936**.
49. Mascarelli, L., and V. Pestalozza, Atti accad. Lincei [5] **16**, II, 567 **1907**.
50. Mascarelli, L., and V. Pestalozza, Gazz. chim. ital. **38**, I, 38 **1908**.
51. Massart, L., Bull. soc. chim. Belg. **45**, 76 **1936**.
52. Mathews, J. H., J. Am. Chem. Soc. **48**, 562 **1926**.
53. Matteson, R., Oil Gas J. **41**, No. 2, 33 **1942**.
54. McKee, R. H., and H. H. Parker, Ind. Eng. Chem. **20**, 1169 **1928**.
55. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **125**, 1743 **1924**.
56. Menshutkin, B. N., J. Russ. Phys. Chem. Soc. **43**, 1303 **1911**; C.A. **6**, 734 **1912**; Chem. Zentr. **1912**, I, 409.
57. Michel, J., Bull. soc. chim. Belg. **48**, 105 **1939**.
58. Miller, O., Bull. soc. chim. Belg. **44**, 513 **1935**.
59. Mizuta, M., J. Soc. Chem. Ind. Japan, suppl. **39**, 311B **1936**.
60. Moore, R. J., J. C. Morrell, and G. Egloff, Chem. Met. Eng. **18**, 396 **1918**.
61. Morgan, J. L. R., and G. K. Daghlian, Z. physik. Chem. **78**, 169 **1912**.
62. Mortimer, F. S., J. Am. Chem. Soc. **44**, 1416 **1922**.
63. Müller, F. H., Physik. Z. **38**, 283 **1937**.
64. Mundici, C. M., Gazz. chim. ital. **34**, II, 114 **1904**.
65. Muthmann, W., Z. Krist. **15**, 387 **1888-1889**.
66. Nagornov, N., and L. Rotinjanz, Z. physik. Chem. **77**, 700 **1911**.
67. Nakatsuchi, A., J. Soc. Chem. Ind. Japan **29**, 29 **1926**; C.A. **20**, 1020 **1926**.
68. Nakatsuchi, J. Soc. Chem. Ind. Japan **32**, suppl. 333B **1929**.
69. Neubeck, F., Z. physik. Chem. **1**, 649 **1887**.
70. Norris, J. F., and G. T. Vaala, J. Am. Chem. Soc. **61**, 2131 **1939**.
71. Novák, J., Z. physik. Chem. **73**, 513 **1910**.
72. Paterno, E., and G. Ampola, Gazz. chim. ital. **27**, I, 481 **1897**.
73. Patterson, T. S., J. Chem. Soc. **81**, 1097 **1902**.
74. Pauer, J., Ann. Physik [N.F.] **61**, 363 **1897**.
75. Paulsen, O., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **147**, Abt. IIb, 320 **1939**.
76. Perkin, W. H., J. Chem. Soc. **69**, 1025 **1896**.
77. Perkin, W. H., J. Chem. Soc. **77**, 267 **1900**.
78. Perkin through Gladstone, J. Chem. Soc. **59**, 292 **1891**.
79. Pinette, J., Ann. **243**, 32 **1888**.

80. Pitzer, K. S., and D. W. Scott, J. Am. Chem. Soc. **65**, 803 **1943.**
81. Reichel, H. P., Chem. Ztg. **55**, 744 **1931.**
82. Reissert, A., Ber. **23**, 2239 **1890.**
83. Richards, T. W., and J. H. Jesse, Jr., J. Am. Chem. Soc. **32**, 268 **1910.**
84. Richards, T. W., and J. H. Mathews, Z. physik. Chem. **61**, 449 **1907.**
85. Richards, T. W., C. L. Speyers, and E. K. Carver, J. Am. Chem. Soc. **46**, 1196 **1924.**
86. Richards, T. W., W. N. Stull, J. H. Mathews, and C. L. Speyers, J. Am. Chem. Soc. **34**, 971 **1912.**
87. Rintelen, J. C., Jr., J. H. Saylor, and P. M. Gross, J. Am. Chem. Soc. **59**, 1129 **1937.**
88. Rosental, D., Bull. soc. chim. Belg. **45**, 585 **1936.**
89. Schiff, R., Ann. **223**, 47 **1884.**
90. Schiff, R., Ann. **234**, 300 **1886.**
91. Schmidt, A. W., and V. Schoeller, Ber. **74**, 258 **1941.**
92. Schonrock, O., Z. physik. Chem. **11**, 753 **1893.**
93. Swallow, J. C., and R. O. Gibson, J. Chem. Soc. **1934**, 440.
94. Szivesay, G., Z. Physik **18**, 97 **1923.**
95. Tammann, G., **Krystallisieren und Schmelzen**, p. 220, Leipzig, **1903.**
96. Thorpe, T. E., and J. W. Rodger, Trans. Roy. Soc. (London) **185A**, 521 **1894.**
97. Timmermans, J., and F. Martin, J. chim. phys. **23**, 747 **1926.**
98. Tomaszewski, F., Ann. Physik [N.F.] **33**, 33 **1888.**
99. von Auwers, K., Ann. **419**, 92 **1919.**
100. von Auwers, K., and H. Kolligs, Ber. **55**, 21 **1922.**
101. Vorländer, D., and J. Fischer, Ber. **65**, 1756 **1932.**
102. Weger, M., Z. angew. Chem. **22**, 338 **1909.**
103. White, J. D., and F. W. Rose, Jr., Bur. Standards J. Research **9**, 711 **1932.**
104. Williams, J. W., and F. Daniels, J. Am. Chem. Soc. **46**, 903 **1924.**
105. Williams, J. W., and I. J. Krchma, J. Am. Chem. Soc. **49**, 1676 **1927.**
106. Woringer, B., Z. physik. Chem. **34**, 257 **1900.**
107. Zelinskiĭ, N. D., and E. I. Margolis, Ber. **65**, 1613 **1932.**
108. Zelinskiĭ, N. D., and M. B. Turova-Polyak, Ber. **62**, 2865 **1929.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| | C—C—C  | | | |
| ***n*-Propylbenzene** | **159.2** | **0.8621** | **1.4919** | Crit. Temp. (°C) |
| −99.2 [162] | 158.3–160.3 [67] | 0.86165(b) [134,142] | 1.4919 [39,46] | 365.6 [2] |
| −101.55(d) [160] | 160 [5] | 0.8617 [143] | 1.4920 [169] | 365.5 [178] |
| | 159.55 ± 0.05 [160] | 0.8622 [52] | 1.4921 [52] | |
| | 159 -159.5 [121] | 0.8628 [39,46] | 1.4922 [142,143] | Crit. Pressure (mm Hg) |
| | 159.45 [162] | 0.8638 [193] | 1.4942 15.7° [86] | 24,548.0 [2] |
| | 159.22 [44] | 0.7399 158.7° [141] | 1.49549 12.25° [169] | 24,532.80 [2] |
| | 159 [68,85,109,122,166] | 0.7399 158.5° [139, 140] | 1.49793 8.3° [122] | |
| | 158–159 [9,38,169] | | 1.49928 5.1° [170] | |
| | 158.9 [88,89] | 0.76608 130.00° [103] | 1.45321 $n_{H\alpha}^{88.9}$ [41] | Crit. Density |
| | 158.7 [177] | 0.79423 99.55° [103] | 1.48717 $n_{H\alpha}^{21.4}$ [41] | 0.277 [178] |
| | 158.6 ± 0.7 [39,46] | 0.8032 88.9° [41] | 1.48851 $n_{H\alpha}^{20}$ [28] | 0.283 [178] |
| | 158.5 [140,146] | 0.81482 76.10° [103] | 1.4891 $n_{H\alpha}^{15.7}$ [86] | |
| | 157.5–158.5 [138] | 0.82642 62.75° [103] | 1.49016 $n_{H\alpha}^{15}$ [162] | |
| | 158.3(a) [178] | 0.84691 38.30° [103] | 1.49176 $n_{H\alpha}^{12.25}$ [169] | |
| | 158.0 [133] | 0.8541 30° [143] | 1.49388 $n_{H\alpha}^{8.3}$ [122] | |
| | 158 [123,175] | 0.85781 25.6° [145] | 1.46645 $n_{H\beta}^{88.9}$ [41] | |
| | 156.0 [189] | 0 8574 25° [7] | 1.50154 $n_{H\beta}^{21.4}$ [41] | |
| | 158.5 800 [189] | 0.8602 $D_{25}^{25}$ [42] | 1.50289 $n_{H\beta}^{20}$ [28] | |
| | 157.9 –158.2 765 [134] | 0.8603 $D_{25}^{25}$ [121] | 1.5045 $n_{H\beta}^{15}$ [86] | |
| | 160 763 [157] | 0.85966 22.85° [103] | 1.50478 $n_{H\beta}^{15}$ [162] | |
| | 158–159 763 [42] | 0.8605 21.4° [41] | 1.50630 $n_{H\beta}^{12.25}$ [169] | |
| | 157.6 –159 758.1 [156] | 0.86228 20.1° [86] | 1.50850 $n_{H\beta}^{8.3}$ [122] | |
| | 158.5 751.6 [139] | 0.8634 $D_{20}^{20}$ [121] | 1.5134 $n_{H\gamma}^{15.7}$ [86] | |
| | 158.7 750 [141] | 0.86363 18 4° [86] | 1.51533 $n_{H\gamma}^{12.25}$ [169] | |
| | 155.4 750 [189] | 0.86550 16.1° [86] | 1.51769 $n_{H\gamma}^{8.3}$ [122] | |
| | 156–158 731 [158] | 0.86613 15.15° [103] | (c) | |
| | 152.5(e) 700 [189] | 0.86629 15° [162] | | |
| | 149.4(e) 650 [189] | 0.8666 15° [39,46] | | |
| | 146.2(e) 600 [189] | 0.8668 $D_{15}^{15}$ [121] | | |
| | 142.8(e) 550 [189] | 0.86711 $D_{15}^{15}$ [122] | | |
| | 139.1(e) 500 [189] | 0.86691 14.4° [86] | | |
| | 135.1(e) 450 [189] | 0.86788 13.2° [86] | | |
| | 130.9(e) 400 [189] | 0.8680 13° [71] | | |
| | 126.2(e) 350 [189] | 0.8681 12.25° [169] | | |
| | 121.0(e) 300 [189] | 0.8705 $D_{10}^{10}$ [121] | | |
| | 115.0(e) 250 [189] | 0.8702 9.8° [139] | | |
| | 107.9(e) 200 [189] | 0.8719 8.3° [122] | | |
| | 99.1(e) 150 [189] | | | |
| | 87.2(e) 100 [189] | | | |
| | 67.7(e) 50 [189] | | | |

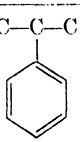
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***n*-Propylbenzene** *(Continued)* | 67-68 15 [71] | 0.8745 $D_5^{5}$ [121] | | * |
| | 47-49 11 [143] | | | |
| | 13.9 1.95 [93] | 0.8753 $D_4^{4}$ [121] | | |
| | 3.6 0.85 [93] | 0.87864 0° [103] | | |
| | −0.7 0.58 [93] | 0.87919(b) 0° [156] | | † |
| | −6.8 0.35 [93] | 0.8792 0° [193] | | |
| | | 0.89754 −22.9° [103] | | |
| | | 0.91584 −45.2° [103] | | |
| | | 0.94830 −83.6° [103] | | ‡ |
| | | 0.95737 −95.1° [103] | | |

* $\frac{dD}{dt} = -0.0008292[1+0.000879(t-20)]$/°C (−23 to 159°C)

† $\frac{dD}{dt} = -0.0008349$/°C (0 to 40°C)

‡ $\frac{dn}{dt} = -0.0004956$/°C (5 to 25°C)

(a) This boiling point is the average of two determinations.
(b) This density is the average of two determinations.
(c) Refractive indices of other lines may be found in reference 162.
(d) This melting point probably refers to the metastable form.
(e) Since 189 is the only reference giving boiling points between 50 and 700 mm, these values were not used in obtaining a boiling-point-pressure equation. The data on other compounds indicates that all boiling points measured at these pressures are too low in this reference.

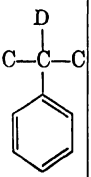
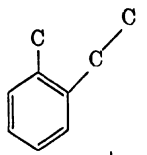
| **Isopropylbenzene** (Cumene)  | | | | |
|---|---|---|---|---|
| **−96.1** | **152.4** | **0.8623** | **1.4915** | Crit. Temp. (°C) |
| −95.2(a) [165] | 152.6-153.8 [67] | 0.8619 [164] | 1.4911 [165] | 362.7 [2] |
| −96.25 [187] | 152.2-153.7 [121] | 0.8620 [134,165] | 1.4912 [155,164] | 347.2 [54] |
| −96.9 [159,161] | 153-153.5 [65] | 0.86231 [86] | 1.4914 [6] | |
| −97 [166] | 152.5-153.5 [77,147,148] | 0.8633 [187] | 1.49145(d) [149] | Crit. Pressure (mm Hg) |
| | 153.4 [40] | 0.8635[130] | 1.4915 [187] | |
| | 152.8-153.4 [169] | 0.7424 152° [119] | 1.4917 [10] | |
| | 153.0 [145] | 0.79324 100° [125,126] | 1.49199 [76,170] | 24,472.0 [2] |
| | 153(b) | 0.81585 75° [125,126] | 1.4922 [57] | |
| | 152.5-153 [92] | 0.83756 50° [125,126] | 1.4883 26° [97] | |
| | 152-153 [11,12,59, 70,139, 150] | 0.85659 26.9° [145] | 1.4879 25° [150] | |
| | | 0.85766 25° [148] | 1.4883 25° [29] | |
| | 152.50-152.55 [161] | 0.8580 25° [29] | 1.4885 25° [104,115] | |
| | 152.5 [102] | 0.8581 25° [104,115] | 1.4947 15.1° [86] | |
| | 151-152.5 [61] | 0.85870 25° [125,126] | 1.49778 7.9° [122] | |
| | 152.40 [44] | 0.8603 $D_{25}^{25}$ [131] | 1.49885 5.8° [170] | |
| | 152.4 [98,136,155] | 0.86064 22.0° [86] | 1.49063 $n_{Hα}^{16.8}$ [169] | |
| | 152.38 [187] | | 1.4900 $n_{Hα}^{15.1}$ [86] | |
| | 151.6-152.2 [97] | 0.8634 $D_{20}^{20}$ [121] | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Isopropylbenzene** (Cumene) *(Continued)* | 152.0 [15]<br>152 [29,119,166]<br>151–152 [43,78]<br>151.5<br>−152.5 770 [130]<br>152.85<br>−153.15 765 [133]<br>152.6<br>−152.8 759 [134]<br>152.5 759 [48]<br>151.9<br>−152.2 758 [57]<br>152.5<br>−152.8 751.4 [133]<br>152.5 750.6 [6]<br>151–152 744 [164]<br>151 742 [150]<br>149.5<br>−151 730 [158]<br>149–150 718 [176]<br>148.2(f) 650 [189]<br>144.9(f) 600 [189]<br>141.5(f) 550 [189]<br>137.6(f) 500 [189]<br>133.6(f) 450 [189]<br>129.3(f) 400 [189]<br>124.4(f) 350 [189]<br>118.9(f) 300 [189]<br>112.7(f) 250 [189]<br>105.1(f) 200 [189]<br>95.9(f) 150 [189]<br>83.2(f) 100 [189]<br>62.6(f) 50 [189]<br>35.5 10 [194]<br>13.7 2.25 [93]<br>1.3 0.93 [93]<br>−8.2 0.43 [93] | 0.86397 18.0° [86]<br>0.86576 17.5° [92]<br>0.8662 16.8° [169]<br>0.86556(c) 16.1° [86]<br>0.86593 15.6° [86]<br>0.8660 $D_{15.4}^{15.4}$ [55]<br>0.8675 15° [182,183]<br>0.8668 $D_{15}^{15}$ [121]<br>0.8705 $D_{10}^{10}$ [121]<br>0.8727 7.9° [122]<br>0.8745 $D_5^5$ [121]<br>0.8753 $D_4^4$ [121]<br>0.87798 0° [148]<br>0.8792 0° [182,183]<br>0.87976 0° [125,126]<br>0.8791 $D_0^0$ [77] | 1.49364 $n_{H\alpha}^{7.9}$ [122]<br>1.50539 $n_{H\beta}^{16.8}$ [169]<br>1.5044 $n_{H\beta}^{15.1}$ [86]<br>1.50826 $n_{H\beta}^{7.9}$ [122]<br>1.51466 $n_{H\gamma}^{16.8}$ [169]<br>1.5134 $n_{H\gamma}^{15.1}$ [86]<br>1.51722 $n_{H\gamma}^{7.9}$ [122]<br>(e) | * |

* $\frac{dD}{dt} = -0.0008365[1+0.0006955(t-20)]$/°C (0 to 100°C)

† $\frac{dn}{dt} = -0.0005186$/°C (5 to 26°C)

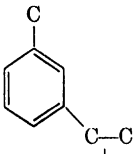
(a) This temperature is recorded as a freezing point in the literature.
(b) The boiling point 153 is found in references 35, 68, 85, 86, 138, 146, 184, 186.
(c) This density is the average of two determinations.
(d) This refractive index is the average of two determinations.
(e) Refractive indices of other lines may be found in reference 50.
(f) Since 189 is the only reference giving boiling point between 50 and 650 mm, these values were not used obtaining a boiling-point-pressure equation. The data on other compounds indicates that all boiling points measured at these pressures are too low in this reference.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Deutero-2-phenylpropane** (Isopropylbenzene-d)  | 151-152 [21]<br>149-151 [18] | | | $[\alpha]_D^{25}$ = 0.019° [21] |
| **1-Methyl-2-ethylbenzene**  | **165.0** | **0.8806** | **1.5038** | * |
| | 165.1 [136] | 0.8786 24.7° [14] | 1.5031(a) [168] | |
| | 165 [68] | 0.8841 15.7° [169] | 1.50381 [70,170] | |
| | 164.8-165 [169] | 0.8884 12.1° [168] | 1.50413 [170] | |
| | 164-165 [100] | 0.8884 11.5° [168] | 1.5042 [169] | |
| | 163 [131] | 0.8885 11.4° [168] | 1.50198 24.7° [14] | |
| | 162 [168] | | 1.50611 15.7° [169,170] | |
| | 163.7 | | 1.50656 12.1° [168] | |
| | -163.9 753 [37] | | 1.50705 11.4° [168] | |
| | 62-63 20-21 [14] | | 1.51053 5.5° [170] | |
| | 54-55.5 10 [75] | | 1.49805 $n_{H\alpha}^{20}$ [37] | |
| | | | 1.50213 $n_{H\alpha}^{15.7}$ [169] | |
| | | | 1.50260 $n_{H\alpha}^{12.1}$ [168] | |
| | | | 1.50301 $n_{H\alpha}^{11.4}$ [168] | |
| | | | 1.51316 $n_{H\beta}^{20}$ [37] | |
| | | | 1.51745 $n_{H\beta}^{15.7}$ [169] | |
| | | | 1.51793 $n_{H\beta}^{12.1}$ [168] | |
| | | | 1.51834 $n_{H\beta}^{11.4}$ [168] | |
| | | | 1.52248 $n_{H\gamma}^{20}$ [37] | |
| | | | 1.52693 $n_{H\gamma}^{15.7}$ [169] | |
| | | | 1.52741 $n_{H\gamma}^{12.1}$ [168] | |
| | | | 1.52789 $n_{H\gamma}^{11.4}$ [168] | |
| | | | 1.50219 $n_{He}^{20}$ [37] | |

* $\frac{dD}{dt} = -0.0009068$/°C (11 to 25°C)

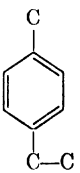
† $\frac{dn}{dt} = -0.0004477$/°C (5 to 25°C)

(a) This refractive index is the average of two or more determinations.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **1-Methyl-3-ethylbenzene**  | | | | | | * |
| | **161.5** | **0.8657** | | **1.4967** | | |
| | 163 [83] | 0.867 [83] | | 1.49641 [170] | | |
| | 162.5 [68] | 0.868 | $D_{20}^{20}$ [94] | 1.4975 [169] | | |
| | 161.5–162.5 [63,169] | 0.8669 | 19.9° [170] | 1.49650 | 19.8° [170] | |
| | 161.6 [136] | 0.8690 | 17.9° [169] | 1.49849 | 17.9° [169] | |
| | 161.5 [131] | | | 1.50220 | 7.0° [170] | |
| | 159.7–160.5 [170] | 0.8692 | $D_{17}^{17}$ [167] | 1.49229 | $n_{H\alpha}^{20}$ [37] | |
| | 160 [24] | 0.871 | $D_{15}^{15}$ [53] | 1.49575 | $n_{H\alpha}^{19.9}$ [170] | |
| | 159.2–159.8 [37] | | | 1.49279 | $n_{H\alpha}^{19.8}$ [170] | † |
| | 159 [146,170] | | | 1.49456 | $n_{H\alpha}^{17.9}$ [169] | |
| | 158–159 [190,191] | | | 1.50734 | $n_{H\beta}^{20}$ [37] | |
| | 157–159 [167] | | | 1.51102 | $n_{H\beta}^{19.9}$ [170] | |
| | 158 [8,23] | | | 1.50767 | $n_{H\beta}^{19.8}$ [170] | |
| | | | | 1.50973 | $n_{H\beta}^{17.9}$ [169] | |
| | | | | 1.51650 | $n_{H\gamma}^{20}$ [37] | |
| | | | | 1.52056 | $n_{H\gamma}^{19.9}$ [170] | |
| | | | | 1.51678 | $n_{H\gamma}^{19.8}$ [170] | |
| | | | | 1.51920 | $n_{H\gamma}^{17.9}$ [169] | |
| | | | | 1.49654 | $n_{He}^{20}$ [37] | |

* $\frac{dD}{dt} = -0.0008621$/°C (15 to 20°C)

† $\frac{dn}{dt} = -0.0004472$/°C (7 to 20°C)

| | | | | | | |
|---|---|---|---|---|---|---|
| **1-Methyl-4-ethylbenzene**  | | | | | | |
| | **162.3** | **0.8626** | | **1.4952** | | |
| −56 [144] | 162–163 [90] | 0.8606 [144] | | 1.4943 [169] | | |
| | 162.5 [72,136] | 0.862 [80,83] | | 1.49481 [170] | | |
| | 161.6–162.5 [169A] | 0.8626 [192] | | 1.4953 [171] | | |
| | 162.0 [177] | 0.863 [171] | | 1.49539 [170] | | |
| | 162 [68,83,107] | 0.7393 | 162° [139] | 1.4959 [144] | | |
| | 161–162(a) | 0.7394 | 162° [139] | 1.49595 [170] | | |
| | 161.5 [131] | 0.7393 | 161.8° [141] | 1.492505 | 25° [90] | |
| | 161 [170] | 0.85740 | 25° [90] | 1.49287 | 24.4° [171] | |
| | 160–161 [49,146] | 0.8597 | 22.8° [169] | 1.49303 | 22.8° [169] | |
| | 160.5 [170] | 0.8601 | 22.3° [169] | 1.4951 | 21° [192] | |

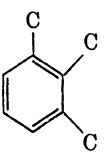
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-ethylbenzene** (*Continued*) | | 0.862 22° [179,180] | 1.4962 16° [167] | * |
| | | 0.863 $D_{20}^{20}$ [94] | 1.49775 15.9° [170] | |
| | | | 1.49750 15.2° [170,171] | |
| | 160 [170] | 0.8620 $D_{18.5}^{18.5}$ [169A] | 1.50088 6.2° [170] | |
| | 159.5 | 0.8644 17° [90] | 1.48921 $n_{H\alpha}^{22.8}$ [169] | |
| | −160.0 763 [87] | 0.8650 16.8° [170] | 1.48957 $n_{H\alpha}^{20}$ [37] | |
| | 161.8 761.3 [141] | 0.8657 15.9° [170] | 1.49068 $n_{H\alpha}^{20}$ [37] | |
| | 161.9 | 0.8664 15.8° [171] | 1.4911 $n_{H\alpha}^{20}$ [171] | |
| | −162.1 756.3 [139] | 0.8667 14.6° [80] | 1.49372 $n_{H\alpha}^{15.9}$ [170] | |
| | 162 755 [117,192] | 0.8690 14° [72] | 1.49325 $n_{H\alpha}^{15.2}$ [171] | |
| | 159–160 750 [87] | 0.8685 13.4° [169] | 1.49514 $n_{H\alpha}^{14.6}$ [80] | |
| | 49.5–50 11 [144] | 0.8687 13.1° [169] | 1.49588 $n_{H\alpha}^{13.4}$ [169] | |
| | | 0.8694 11.3° [139] | 1.50417 $n_{H\beta}^{22.8}$ [169] | |
| | | | 1.50433 $n_{H\beta}^{20}$ [37] | |
| | | | 1.50563 $n_{H\beta}^{20}$ [37] | † |
| | | | 1.50889 $n_{H\beta}^{15.9}$ [170] | |
| | | | 1.50831 $n_{H\beta}^{15.2}$ [171] | |
| | | | 1.51017 $n_{H\beta}^{14.6}$ [80] | |
| | | | 1.51136 $n_{H\beta}^{13.4}$ [169] | |
| | | | 1.51353 $n_{H\gamma}^{22.8}$ [169] | |
| | | | 1.51367 $n_{H\gamma}^{20}$ [37] | |
| | | | 1.51500 $n_{H\gamma}^{20}$ [37] | |
| | | | 1.51833 $n_{H\gamma}^{15.9}$ [170] | |
| | | | 1.51779 $n_{H\gamma}^{15.2}$ [171] | |
| | | | 1.51950 $n_{H\gamma}^{14.6}$ [80] | |
| | | | 1.52116 $n_{H\gamma}^{13.4}$ [169] | |
| | | | 1.49388 $n_{He}^{20}$ [37] | |
| | | | 1.49483 $n_{He}^{20}$ [37] | |

* $\frac{dD}{dt} = -0.0008414$/°C (11 to 25°C)

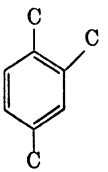
† $\frac{dn}{dt} = -0.0004592$/°C (6 to 25°C)

(a) The boiling point 161-162 is found in references 3, 31, 65, 146, 169, 179, 180.

**1,2,3-Trimethylbenzene**
(Hemellitene)



| | | | |
|---|---|---|---|
| **−25.47** | **176.1** | **0.8947** | **1.5138** |
| −25.4 [91] | 177 [83] | 0.893 [173] | 1.5130 [154] |
| −25.47 [99,154] | 176.10 [99] | 0.8944 [154] | 1.5132 [169] |
| | 176.1 [136] | 0.895 [83,169] | 1.5110 25° [154] |
| | 175–176 [38] | 0.8951 [99] | 1.5116 25° [99] |
| | 175.5 [131] | 0.8866 30° [154] | 1.51335 19.55° [169] |
| | 175–175.5 [62,63,69] | 0.8906 25° [154] | 1.5160 15° [154] |
| | 174.7–175.5 [173] | 0.8913 22.0° [173] | 1.5189 10° [154] |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,3-Trimethylbenzene** (Hemellitene) *(Continued)* | 175.0–175.3 [74]<br>175 [85,185]<br>175.5 744 [169]<br>58 12 [182] | 0.8949 19.55° [169]<br>0.901 15° [69,185]<br>0.9101 0° [154] | 1.5209 5° [154]<br>1.50716 $n_{H\alpha}^{22.0}$ [173]<br>1.50930 $n_{H\alpha}^{19.55}$ [169]<br>1.52287 $n_{H\beta}^{22.0}$ [173]<br>1.52503 $n_{H\beta}^{19.55}$ [169]<br>1.53270 $n_{H\gamma}^{22.0}$ [173]<br>1.53483 $n_{H\gamma}^{19.55}$ [169]<br>1.51173 $n_{He}^{22.0}$ [173]<br>1.51208 $n_{He}^{20}$ [36]<br>1.5126 $n_{He}^{20}$ [173] | *<br><br><br><br><br>†<br><br><br><br> |
| * $\frac{dD}{dt} = -0.0008035$/°C (0 to 30°C)<br>† $\frac{dn}{dt} = -0.0001648$/°C (5 to 25°C) | | | | |
| **1,2,4-Trimethylbenzene** (Pseudocumene)  | | | | |
| **−44.1** | **169.3** | **0.8762** | **1.5049** | Crit. Temp. (°C) |
| −44.09 [99]<br>−44.5 [56,118]<br>−45.00 ± 0.05 [153]<br>−45 [91] | 170.2 ± 0.3 [160]<br>170 [106A,146]<br>169–170 [81]<br>169.8(a)<br>169.75 [86]<br>169.5 [62,85,189]<br>169.27 [133]<br>169.2 [111,136]<br>168.7–169.2 [169]<br>169.18 [99]<br>169 [65,83,101A,127]<br>168.5 [131]<br>168.0–168.5 [121]<br>168.4 [94]<br>168.2 [30,89]<br>168.1 [30]<br>169.4<br>−169.6 764.8 [134]<br>168.8 750 [189]<br>168.0<br>−168.2 742 [151]<br>167.8 738.8 [153]<br>166.0 700 [189]<br>165.9 698.8 [153]<br>163.0 650 [189]<br>162.3 636.3 [153]<br>160.9 612.3 [153] | 0.8762 [99]<br>0.87640 [18]<br>0.8767 [4]<br>0.8465 $D_{95}^{95}$ [121]<br>0.8478 $D_{90}^{90}$ [121]<br>0.8494 $D_{85}^{85}$ [121]<br>0.8510 $D_{80}^{80}$ [121]<br>0.8526 $D_{75}^{75}$ [121]<br>0.8544 $D_{70}^{70}$ [121]<br>0.8560 $D_{65}^{65}$ [121]<br>0.8578 $D_{60}^{60}$ [121]<br>0.8598 $D_{55}^{55}$ [121]<br>0.8620 $D_{50}^{50}$ [121]<br>0.8643 $D_{45}^{45}$ [121]<br>0.86025 40° [18]<br>0.8667 $D_{40}^{40}$ [121]<br>0.8692 $D_{35}^{35}$ [121]<br>0.8685 30° [4]<br>0.8719 $D_{30}^{30}$ [121] | 1.5046 [169]<br>1.5048 [151]<br>1.5051 [47,171]<br>1.50512 [170]<br>1.50523 [76]<br>1.5025 25° [99]<br>1.5032 24° [153]<br>1.50441 21.6° [20]<br>1.5045 21° [45]<br>1.50527 19.9° [76,170]<br>1.50639 17° [28]<br>1.5072 14.7° [86]<br>1.50780 14.1° [171]<br>1.50780 13.9° [170]<br>1.51106 6.8° [170]<br>1.50001 $n_{H\alpha}^{21.6}$ [20]<br>1.5004 $n_{H\alpha}^{20}$ [171]<br>1.50184 $n_{H\alpha}^{17}$ [28]<br>1.50259 $n_{H\alpha}^{15.3}$ [169]<br>1.5030 $n_{H\alpha}^{14.7}$ [86]<br>1.50316 $n_{H\alpha}^{14.1}$ [171]<br>1.50625 $n_{H\alpha}^{8}$ [122]<br>1.51745 $n_{H\beta}^{17}$ [28]<br>1.51841 $n_{H\beta}^{15.3}$ [169] | 381.2 [2]<br><br>Crit. Pressure (mm Hg)<br>25,232.0 [2] |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Trimethylbenzene** (Pseudocumene) *(Continued)* | | 0.8747 $D_{25}^{25}$ [121] | 1.5184 $n_{H\beta}^{14.7}$ [86] | * |
| | | 0.8747 21.6° [20] | 1.51904 $n_{H\beta}^{11.1}$ [171] | |
| | | 0.8778 $D_{20}^{20}$ [121] | 1.52197 $n_{H\beta}^{8}$ [122] | |
| | 159.7 600 [189] | 0.8794 15.3° [169] | 1.52501 $n_{H\gamma}^{21.6}$ [20] | |
| | 158.1 573.3 [153] | 0.8810 $D_{15}^{15}$ [121] | 1.52816 $n_{H\gamma}^{15.3}$ [169] | |
| | 156.3 550 [189] | 0.8805 14.1° [171] | 1.5282 $n_{H\gamma}^{14.7}$ [86] | |
| | 156.2 543.7 [153] | 0.8844 $D_{10}^{10}$ [121] | 1.52878 $n_{H\gamma}^{14.1}$ [171] | |
| | 154.4 516.2 [153] | 0.88567 8° [122] | 1.53192 $n_{H\gamma}^{8}$ [122] | |
| | 152.6 500 [189] | 0.8880 $D_5^5$ [121] | (b) | † |
| | 152.1 483.7 [153] | 0.8888 $D_4^4$ [121] | | |
| | 150.1 458.2 [153] | 0.89260 0° [13] | | |
| | 147.0 417.2 [153] | | | |
| | 143.3 373.7 [153] | | | |
| | 140.1 341.6 [153] | | | |
| | 134.9 290.6 [153] | | | |
| | 130.8 255.1 [153] | | | |
| | 127.7 231.6 [153] | | | |
| | 122.6 196.6 [153] | | | |
| | 115.1 152.5 [153] | | | |
| | 111.1 132 0 [153] | | | ‡ |
| | 105.0 106.0 [153] | | | |
| | 99.6 86.5 [153] | | | |
| | 98.6 83.0 [153] | | | |
| | 92.0 63.0 [153] | | | |
| | 89.1 56.0 [153] | | | |
| | 74 28 [20] | | | |
| | 73.1 28.0 [153] | | | |
| | 68 22 [153] | | | |
| | 61.6 15.5 [153] | | | |
| | 55.56 15 [174] | | | § |
| | 57.6 13 [153] | | | |
| | 50.5 12 [27] | | | |
| | 47.1 7 [153] | | | |

* $\frac{1}{T_b} = 0.0035812 - 0.0004585 \log_{10} p_{mm}$ (180 to 765 mm)

† $\frac{1}{T_b} = 0.0034793 - 0.0004118 \log_{10} p_{mm}$ (7 to 175 mm) ¶

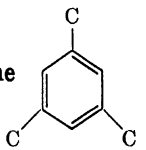
‡ $\frac{dD}{dt} = -0.0008069[1 + 0.0005497(t-20)]/°C$ (0 to 95°C)

§ $\frac{dD}{dt} = -0.0008051/°C$ (0 to 40°C)

¶ $\frac{dn}{dt} = -0.0004704/°C$ (6 to 25°C)

(a) The boiling point 169.8 is found in references 47, 69, 145, 182, 183, 185.
(b) Refractive indices of other lines are found in reference 20.

## 1,3,5-Trimethylbenzene
(Mesitylene)



| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **−44.8** | **164.7** | **0.8637** | | Crit. Temp. (°C) |
| −44.78 [99] | 165 [16,73,85] | 0.8623 [110] | 1.49116 [19] | 370.5 [17] |
| −46.1 [64] | 164.8–164.9 [134] | 0.8628 [181] | 1.4953 [171] | 370.45(c) [108] |
| −51.4(d) [32] | 164.1–164.9 [74] | 0.8634 [134] | 1.4962 [181] | 367.7 [2,51,177] |
| −51.7(d) [91,99] | 164.5–164.8 [113,163] | 0.8638 [4] | 1.4967 [99,169] | 367.6 [178] |
| −52.7(d) [160] | 164.2–164.8 [114] | 0.8642 [36,128] | 1.4974 [151] | |
| −54–−53(d) [25] | 164.72 [133] | 0.8653 [99] | 1.4981 [82] | Crit. Pressure (mm Hg) |
| −53.5(d) [96] | 164.7 [111] | 0.8667 [46] | 1.4992 [99] | |
| −54.4(d) [106] | 164.64 [99] | 0.7372 165° [141] | 1.4995 [32] | |
| | 164.6 [40,87,88,99,136] | 0.7372 164.5° [139, 140] | 1.49961 [170] | 25,232.0 [2] |
| | 164.6 ± 0.2 [160] | | 1.49981 [170] | |
| | 164.5–164.6 [135] | 0.8328 $D_{95}^{95}$ [121] | 1.4958 22.5° [26] | |
| | 164.3–164.6 [112] | | 1.4928 21.5° [58] | |
| | 164.5(a) | 0.8342 $D_{90}^{90}$ [121] | 1.49271 20.6° [172] | |
| | 163.5–164.5 [1] | 0.8358 $D_{85}^{85}$ [121] | 1.4988 19.8° [128] | |
| | 164.4 [30] | | 1.4960 19° [50] | |
| | 164.3 [178] | 0.8374 $D_{80}^{80}$ [121] | 1.49541 18° [28] | |
| | 164.0 [181] | 0.8158 75° [4] | 1.49804 17.05° [169] | |
| | 164.0 ± 0.4 [46] | 0.8392 $D_{75}^{75}$ [121] | 1.4945 17° [66] | |
| | 164 [79,84,137,184] | | 1.4966 14.6° [86] | |
| | 164.6 | 0.8419 $D_{70}^{70}$ [121] | 1.50228 14.2° [170,171] | |
| | −165.5 769 [105] | 0.8429 $D_{65}^{65}$ [121] | 1.50595 6.7° [76,170] | |
| | 165 769 [36] | 0.8310 60° [4] | 1.48832 $n_{H\alpha}^{20.6}$ [172] | |
| | 163.8 | 0.8449 $D_{60}^{60}$ [121] | 1.48701 $n_{H\alpha}^{20}$ [19] | |
| | −164.8 763 [42] | | 1.49127 $n_{H\alpha}^{18}$ [28] | |
| | 165 762 [141] | 0.8471 $D_{55}^{55}$ [121] | 1.49403 $n_{H\alpha}^{17.05}$ [169] | |
| | 164.5 759.2 [139] | 0.8393 50° [4] | 1.4926 $n_{H\alpha}^{14.6}$ [86] | |
| | 163 747 [95] | 0.8493 $D_{50}^{50}$ [121] | 1.49774 $n_{H\alpha}^{14.2}$ [171] | |
| | 164 745 [116] | 0.8516 $D_{45}^{45}$ [121] | 1.49985 $n_{H\alpha}^{7.6}$ [122] | |
| | 161.8 | 0.8476 40° [4] | 1.50341 $n_{H\beta}^{20.6}$ [172] | |
| | −162.8 720 [34] | 0.8540 $D_{40}^{40}$ [121] | 1.50146 $n_{H\beta}^{20}$ [19] | |
| | 66.4 24.5 [124] | 0.8565 $D_{35}^{35}$ [121] | 1.50611 $n_{H\beta}^{18}$ [28] | |
| | 66.0 22 [151] | 0.8557 30° [4] | 1.50936 $n_{H\beta}^{17.05}$ [169] | |
| | 66 22 [152] | 0.8592 $D_{30}^{30}$ [121] | 1.5073 $n_{H\beta}^{14.6}$ [86] | |
| | 10.6 0.91 [93] | 0.855189 29.49° [120] | 1.51333 $n_{H\beta}^{14.2}$ [171] | |
| | 10.2 0.91 [93] | 0.85402 28.6° [145] | 1.51521 $n_{H\beta}^{7.6}$ [122] | |
| | 3.2 0.53 [93] | 0.8614 $D_{25}^{25}$ [42] | 1.51292 $n_{H\gamma}^{20.6}$ [192] | |
| | 2.7 0.50 [93] | 0.8620 $D_{25}^{25}$ [121] | 1.51033 $n_{H\gamma}^{20}$ [19] | |
| | 2.3 0.50 [93] | | | |
| | 1.5 0.43 [93] | | | |
| | −1.7 0.34 [93] | | | |
| | −1.20 0.33 [93] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5-Trimethylbenzene** (Mesitylene) (*Continued*) | | 0.8643 21.0° [172] | 1.51891 $n_{H\gamma}^{17.05}$ [169] | * |
| | | 0.8652 $D_{20}^{20}$ [121] | 1.5165 $n_{H\gamma}^{14.6}$ [86] | |
| | | 0.8632 19° [50] | 1.52311 $n_{H\gamma}^{14.2}$ [171] | |
| | −2.75 0.29 [93] | 0.8646 17.05° [169] | 1.52460 $n_{H\gamma}^{7.8}$ [122] | |
| | −4.2 0.28 [93] | 0.8678 $D_{15}^{15}$ [163] | 1.49957 $n_{He}^{20}$ [36] | |
| | | 0.8685 $D_{15}^{15}$ [121] | (b) | |
| | | 0.8697 14.1° [171] | | † |
| | | 0.8722 $D_{10}^{10}$ [121] | | |
| | | 0.87397 7.6° [122] | | |
| | | 0.8760 $D_5^5$ [121] | | |
| | | 0.8768 $D_4^4$ [121] | | |

* $\frac{1}{T_b} = 0.0036108 - 0.00046055 \log_{10} p_{mm}$ (720 to 770 mm)

† $\frac{dD}{dt} = -0.0008203[1 + 0.0008738(t - 20)]/°C$ (4 to 165°C)

(a) The boiling point 164.5 is found in references 30, 33, 69, 96, 128, 131, 140, 146, 177, 185.
(b) Refractive indices of other lines may be found in reference 50.
(c) This temperature is the average of two determinations.
(d) This melting point probably refers to the metastable form of the compound.

## $C_9H_{12}$ References

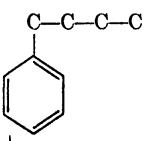

1. Adkins, H., W. H. Zartmann, and H. Cramer, J. Am. Chem. Soc. **53**, 1425 **1931**.
2. Altschul, M., Z. physik. Chem. **11**, 577 **1893**.
3. Anschütz, R., Ann. **235**, 299 **1886**.
4. Azim, M. A., S. S. Bhatnagar, and R. M. Mathur, Phil. Mag. [7] **16**, 580 **1933**.
5. Baddeley, G., and J. Kenner, J. Chem. Soc. **1935**, 303.
6. Baker, J. W., and L. G. Groves, J. Chem. Soc. **1939**, 1147.
7. Bartell, F. E., L. O. Case, and H. Brown, J. Am. Chem. Soc. **55**, 2419 **1933**.
8. Bartow, E., and A. W. Sellards, J. Am. Chem. Soc. **27**, 369 **1905**.
9. Bennett, G. M., and E. E. Turner, J. Chem. Soc. **105**, 1057 **1914**.
10. Berman, N., and A. Lowy, J. Am. Chem. Soc. **60**, 2596 **1938**.
11. Bert, L., Bull. soc. chim. [4] **37**, 1252 **1925**.
12. Bert, L., Bull. soc. chim. [4] **37**, 1397 **1925**.
13. Biron, E., J. Russ. Phys. Chem. Soc. **42**, 167 **1910**; C.A. **5**, 609 **1911**; Chem. Zentr. **1910**, I, 1913.
14. Blaise, E. E., and M. Montagne, Compt. rend. **181**, 122 **1925**.
15. Brame, J. S. S., and T. G. Hunter, J. Inst. Petroleum Tech. **13**, 794 **1927**.
16. Brown, J. C., J. Chem. Soc. **87**, 265 **1905**.
17. Brown, J. C., J. Chem. Soc. **89**, 311 **1906**.
18. Brown, W. G., C. J. Mighton, and M. Senkus, J. Org. Chem. **3**, 62 **1938-1939**.
19. Brühl, J. W., Ann. **200**, 139 **1880**.
20. Brühl, J. W., J. prakt. Chem. [2] **50**, 119 **1894**.
21. Burwell, R. L., Jr., F. Hummel, and E. S. Wallis, J. Org. Chem. **1**, 332 **1936-1937**.
22. Chichibabin, A. E., J. Russ. Phys. Chem. Soc. **26**, 41; Chem. Zentr. **65**, I, 1028.
23. Ciamician, G., Ber. **11**, 269 **1878**.
24. Ciamician, G. L., Ber. **12**, 1658 **1879**.

25. Colson, Ann. chim. phys. [6] 6, 86 1885.
26. Conrad-Billroth, H., Z. physik. Chem. 29B, 170 1935.
27. Conrad-Billroth, H., Z. physik. Chem. 31B, 475 1936.
28. Cotton, A., and H. Moutton, Ann. chim. phys. [8] 28, 209 1913.
29. Croxall, W. J., F. J. Sowa, and J A. Nieuwland, J. Org. Chem. 2, 253 1937.
30. de Carli, F., Atti accad Lincei [6] 4, 460 1926.
31. Defren, G., Ber. 28, 2648 1895.
32. Dolliver, M. A., T. L. Gresham, G. B. Kistiakowsky, and W. E. Vaughan, J. Am. Chem. Soc. 59, 831 1937.
33. Downs, C. R., and A. L. Dean, J. Ind. Eng. Chem. 6, 366 1914.
34. Dutoit, P., and L. Friederich, Arch. sci. phys. nat. [4] 9, 105 1900.
35. Eiloart, A., Am. Chem. J. 12, 231 1890.
36. Eisenlohr, F., Fortschr. Chem., Physik u. physik. Chem. 18B, 521 1925.
37. Eisenlohr, F., and L. Schulz, Ber. 57, 1808 1924.
38. Emde, H., and H. Kull, Arch. Pharm. 274, 173 1936.
39. Evans, E. B., J. Inst. Petroleum Tech. 24, 537 1938.
40. Evans, H. C., and D. W. Young, Ind. Eng. Chem. 34, 461 1942.
41. Eykman, J. F., Rec. trav. chim. 12, 157 1893.
42. Fischer, W., and W. Klemm, Z. physik. Chem. 147, 275 1930.
43. Fittig, R., and E. Glinzer, Ann. 136, 303 1865.
44. Forziati, A F., C. B. Willingham, B. J. Mair, and F. D. Rossini, J. Research Natl. Bur. Standards 32, 11 1944.
45. Français, G., Ann. chim. [11] 11, 212 1939.
46. Garner, F. H., and E. B. Evans, J. Inst. Petroleum Tech. 18, 751 1932.
47. Gaucher, L. P., Ind. Eng. Chem. 27, 57 1935.
48. Genvresse, P., Bull. soc. chim. [3] 9, 508 1893.
49. Gilman, H., and R. E. Hoyle, J. Am. Chem. Soc. 44, 2621 1922.
50. Gladstone, J. H., J. Chem. Soc. 45, 241 1884.
51. Goldhammer, D. A., Z. physik. Chem. 71, 577 1910.
52. Grosse, A. V., and V. N. Ipatieff, J. Org. Chem 2, 447 1937.
53. Hall, C. C., J. Soc. Chem. Ind 54, 208 1935-1936.
54. Heilbron, E., Z. physik. Chem. 7, 601 1891.
55. Howes, D. A., and A. W. Nash, J. Soc. Chem. Ind. 49, 16T 1930.
56. Huffman, H. M., G. S. Parks, and M. Barmore, J. Am. Chem. Soc. 53, 3876 1931.
57. Ipatieff, V. N., B. B. Corson, and H. Pines, J. Am. Chem. Soc 58, 919 1936.
58. Ipatieff, V., B. Dolgov, and J. Volnov, Ber. 63, 3072 1930.
59. Ipatieff, V. N., V. I. Komarewsky, and H. Pines, J. Am. Chem. Soc. 58, 918 1936.
60. Ipatieff, V. N., H. Pines, and B. B. Corson, J. Am. Chem. Soc. 60, 577 1938.
61. Jacobsen, O., Ber. 12, 429 1879.
62. Jacobsen, O., Ber. 19, 2511 1886.
63. Jacobsen, O., Ber. 19, 2517 1886.
64. Jaeger, Verslag. Amsterdam Akad. Wetenschappen 25, 308 1916.
65. Jannasch, P., and A. Dieckmann, Ber. 7, 1513 1874.
66. Janovsky, J. V., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 81, Abt. II, 539 1880.
67. Kahovec, L., and A. W. Reitz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 145, Abt. IIb, 1033 1936.
68. Kazanskiĭ, B. A., and A. F Plate, Ber. 68, 1259 1935.
69. Kattwinkel, R., Glückauf 62, 529 1926.
70. Klages, A., Ber. 35, 3506 1902.
71. Klages, A., Ber. 36, 621 1903.
72. Klages, A., and R. Keil, Ber. 36, 1632 1903.
73. Klages, A., and C. Stamm, Ber. 37, 1715 1904.
74. Kohlrausch, K. W. F., and A. Pongratz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 143, Abt. IIb, 358 1934.

75. Kohlrausch, K. W. F., and R. Seka, Ber. **71**, 1551 **1938.**
76 Kolligs through K. von Auwers and H. Kolligs, Ber. **55**, 21 **1922.**
77. Konovalov, M., Ber. **28**, 1852 **1895.**
78. Konovalov, J. Russ. Phys. Chem. Soc. **26**, 68; Chem. Zentr. **65**, II, 33 **1894.**
79. Kröber, E., Z. physik. Chem. **93**, 641 **1919.**
80. Krollpfeiffer, F., Ann. **430**, 161 **1923.**
81. Kruber, O., Ber. **57**, 1008 **1924.**
82. Kunz, A. H., and J. Spulnik, Ind. Eng. Chem. Anal. Ed. **8**, 485 **1936.**
83. Kurtz, S. S., Jr., and C. E. Headington, Ind. Eng. Chem. Anal. Ed. **9**, 21 **1937.**
84. Ladenberg, A., and C. Kriegel, Ber. **33**, 637 **1900.**
85. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918.**
86. Landolt, H., and H. Jahn, Z. physik. Chem. **10**, 289 **1892.**
87. Lecat, M., Ann. soc. sci. Bruxelles **45**, 284 **1926.**
88 Lecat, M., Ann. soc. sci. Bruxelles **48B**, 113 **1928.**
89. Lecat, M., Ann. soc. sci. Bruxelles **49B**, 109 **1929.**
90. Le Fevre, C. G., R. J. W. Le Fevre, and K. W. Robertson, J. Chem. Soc. **1935**, 480.
91. Leslie, R. T., and W. W. Heuer, Bur. Standards J. Research **18**, 639 **1937.**
92. Liebermann, A., Ber. **13**, 45 **1880.**
93. Linder, E. G., J. Phys. Chem. **35**, 531 **1931.**
94. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. **26**, 475 **1934.**
95. Lucas, A., Ber. **29**, 2884 **1896.**
96 Maass, O., and J. Russell, J. Am. Chem. Soc. **40**, 1561 **1918.**
97. Maess, L., and L. von Müffling, Z. angew. Chem. **50**, 759 **1937.**
98. Mair, B. J., and A. F. Forziati, J. Research Natl. Bur. Standards **32**, 165 **1944.**
99. Mair, B. J., and S. T. Schicktanz, Bur. Standards J. Research **11**, 665 **1933.**
100. Mameli, E., and A. Massini, Giorn. chim. ind applicata **15**, 161 **1933**; Chem. Zentr. **1933, I, 1376.**
101. Mangold, C., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **102**, Abt. IIa, 1071 **1893.**
101A. Markovnikov, V., Ann. **234**, 89 **1886.**
102. Martin, E., Ann. combustibles liquides **12**, 97 **1937.**
103 Massart, L., Bull. soc chim. Belg. **45**, 76 **1936.**
104. McKenna, J. F., and F. J. Sowa, J. Am. Chem. Soc **59**, 470 **1937.**
105. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **125**, 1743 **1924.**
106. Menshutkin, B. N., J. Russ. Phys. Chem. Soc. **43**, 1329 **1911**; C.A. **6**, 735 **1912.**
106A. Meyer, R., and W. Meyer, Ber. **51**, 1571 **1918.**
107. Midgley, T., Jr., and A. L. Henne, J. Am Chem. Soc. **51**, 1215 **1929.**
108. Morgan, J. L. R., and G. K. Daghlian, Z. physik. Chem. **78**, 169 **1912.**
109. Morton, A. A., and I. Hechenbleikner, J. Am. Chem. Soc. **58**, 2599 **1936.**
110. Müller, F. H., Physik. Z. **38**, 283 **1937.**
111. Nelson, W. L., Oil Gas J. **35**, No. 38, 39 **1937.**
112. Norris, J. F., and J. N. Ingraham, J. Am. Chem. Soc. **60**, 1421 **1938.**
113. Norris, J. F., and D. Rubinstein, J. Am. Chem. Soc **61**, 1163 **1939.**
114. Norris, J. F., and G. T. Vaala, J. Am. Chem. Soc. **61**, 2131 **1939.**
115. O'Connor, M. J., and F. J. Sowa, J. Am. Chem. Soc. **60**, 125 **1938.**
116. Orndorff, W. R., and S. W. Young, Am. Chem. J. **15**, 249 **1893.**
117. Packendorff, K., N. D. Zelinskii, and L. Leder-Packendorff, Ber. **66**, 1069 **1933.**
118. Parks, G. S., and H. M. Huffman, Ind Eng. Chem. **23**, 1138 **1931.**
119. Paterno and Pisati through R. Schiff, Ann. **220**, 278 **1883.**
120. Patterson, T. S., J. Chem. Soc. **81**, 1097 **1902.**
121. Perkin, W. H., J. Chem. Soc. **69**, 1025 **1896.**
122. Perkin, W. H., J. Chem. Soc. **77**, 267 **1900.**
123. Pestemer, M., and O. Gübitz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **143**, Abt. IIb, 340 **1934-1935.**
124. Pickett, L. W., G. F. Walter, and H. France, J. Am. Chem. Soc. **58**, 2296 **1936.**
125. Pisati, G., and E. Paterno, Gazz. chim. ital. **3**, 551 **1873.**

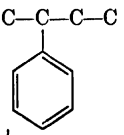
126. Pisati, G., and E. Paterno, J. Chem. Soc. **27**, 686 **1874.**
127. Piutti, A., and P. Badvlato, Atti accad. Lincei [5] **33**, 475; Chem. Zentr. **1924**, II, 1893.
128. Pokrovskaya, E. S., Compt. rend. acad. sci. U.R.S.S. **39**, 26 **1943**; Survey For. Petrol. Liter. T420 **1944.**
129. Potts, W. M., and L. L. Carpenter, J. Am. Chem. Soc. **61**, 663 **1939.**
130. Quist, W., Acta Acad. Aboensis Math. et Phys. **8**, No. 4, **1935.**
131. Reichel, H. P., Chem. Ztg. **67**, 121 **1943.**
132. Reichstein, T., A. Cohen, M. Ruth, and H. F. Meldahl, Helv. Chim. Acta **19**, 412 **1936.**
133. Richards, T. W., and F. Barry, J. Am. Chem. Soc. **37**, 993 **1915.**
134. Richards, T. W., and J. W. Shipley, J. Am. Chem. Soc. **38**, 989 **1916.**
135. Rintelen, J. C., Jr., J. H. Saylor, and P. M. Gross, J. Am. Chem. Soc. **59**, 1129 **1937.**
136. Rossini, F. D., Petroleum Engr. **14**, No. 5, 41 **1943.**
137. Sabatier, P., and B. Kubota, Compt. rend. **173**, 17 **1921.**
138. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915.**
139. Schiff, R., Ann. **220**, 71 **1883.**
140. Schiff, R., Ann. **220**, 278 **1883.**
141. Schiff, R., Ann. **223**, 47 **1884.**
142. Schmidt, A. W., Ber. **75**, 1399 **1942.**
143. Schmidt, A. W., G. Hopp, and F. Schoeller, Ber. **72**, 1893 **1939.**
144. Schmidt, A. W., and V. Schoeller, Ber. **74**, 258 **1941.**
145. Schonrock, O., Z. physik. Chem. **11**, 753 **1893.**
146. Schultz, G., Ber. **42**, 3602 **1909.**
147. Schultz, G., Ber. **43**, 2517 **1910.**
148. Silva, R. D., Bull. soc. chim. [2] **43**, 317 **1885.**
149. Simons, J. H., and S. Archer, J. Am. Chem. Soc. **60**, 2952 **1938.**
150. Slanina, S. J., F. J. Sowa, and J. A. Nieuwland, J. Am. Chem. Soc. **57**, 1547 **1935.**
151. Smith, L. I., and O. W. Cass, J. Am. Chem. Soc. **54**, 1603 **1932.**
152. Smith, L. I., and O. W. Cass, J. Am. Chem. Soc. **54**, 1614 **1932.**
153. Smith, L. I., and A. P. Lund, J. Am. Chem. Soc. **52**, 4144 **1930.**
154. Smith, L. I., and L. J. Spillane, J. Am. Chem. Soc. **62**, 2639 **1940.**
155. Smittenberg, J., H. Hoog, and R. A. Henkes, J. Am. Chem. Soc. **60**, 17 **1938.**
156. Spica, P., Gazz. chim. ital. **8**, 406 **1878.**
157. Straus, F., and H. Grindel, Ann. **439**, 276 **1924.**
158. Thierfelder, H., and E. Klenk, Z. physiol. Chem. **141**, 13 **1924.**
159. Tiffeneau, M., Compt. rend. **134**, 845 **1902.**
160. Timmermans, J., Bull. soc. chim. Belg. **30**, 62 **1921.**
161. Timmermans, J., Bull. soc. chim. Belg. **36**, 502 **1927.**
162. Timmermans, J., and Hennaut-Roland, J. chim. phys. **27**, 401 **1930.**
163. Tishchenko, D., Bull. soc. chim. [4] **53**, 1428 **1933.**
164. Toussaint, N. F., and G. F. Hennion, J. Am. Chem. Soc. **62**, 1145 **1940.**
165. Troyan, J. E., J. Am. Chem. Soc. **64**, 3056 **1942.**
166. Trusty, A. W., Petroleum Refiner **22**, 95 **1943.**
167. Tsukervanik, I. P., and G. Vikrova, J. Gen. Chem. (U.S.S.R.) **7**, 632 **1937**; C.A. **31**, 5779 **1937.**
168. von Auwers, K., Ann. **415**, 98 **1918.**
169. von Auwers, K., Ann. **419**, 92 **1919.**
169A. von Auwers, K., and G. Keil, Ber. **36**, 1861 **1903.**
170. von Auwers, K., and H. Kolligs, Ber. **55**, 21 **1922.**
171. von Auwers, K., and K. Müller, Ber. **44**, 1595 **1911.**
172. von Auwers, K., and G. Peters, Ber. **43**, 3076 **1910.**
173. von Auwers, K., and F. Wieners, Ber. **58**, 2815 **1925.**
174. von Auwers, K., and K. Ziegler, Ann. **425**, 217 **1921.**
175. von Braun, J., and H. Deutsch, Ber. **45**, 2171 **1912.**
176. von Miller, W., and Rhode, Ber. **24**, 1356 **1881.**
177. Walden, P., Z. physik. Chem. **65**, 129 **1909.**

178. Walden, P., Z. physik. Chem. **66**, 385 **1909.**
179. Wallach, O., Ann. **414**, 195 **1917-1918.**
180. Wallach, O., Nachr. Ges. Wiss. Göttingen **1915**, 1.
181. Ward, A. L., and W. H. Fulweiler, Ind. Eng. Chem. Anal. Ed. **6**, 396 **1934.**
182. Warren, C. M., Jahresber. **1865**, 514.
183. Warren, C. M., Mem. Am. Acad. Arts Sci. [2] **9**, 135 **1867.**
184. Weber, H. H., Chem. Ztg. **55**, 201 **1931.**
185 Weger, M., Z. angew. Chem **22**, 338 **1909.**
186. Wheeler, A. S., J. Ind. Eng. Chem. **10**, 359 **1918.**
187. White, J. D., and F. W. Rose, Jr., Bur. Standards J. Research **21**, 151 **1938.**
188. Wispek, P., and R. Zuber, Ann. **218**, 374 **1883.**
189. Woringer, B., Z. physik. Chem. **34**, 257 **1900.**
190. Wroblewsky, E., Ann **192**, 196 **1878.**
191. Wroblewsky, E., Ber. **7**, 1680 **1874.**
192. Zelinskiĭ, N. D., K. Packendorff, and L. Leder-Packendorff, Ber. **66**, 872 **1933.**
193. Zhukovskiĭ, S., Bull. soc. chim. [3] **16**, 126 **1896.**
194. Ziegler, K., H. Grimm, and R. Willer, Ann. **542**, 90 **1940.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| |  | | | * |
| ***n*-Butylbenzene** | **183.3** | **0.8604$_5$** | | |
| −81.2 [210] | 183.1–183.5 [86] | 0.8608 [80] | 1.4880 [86,64] | |
| −88.5 [86,158,209] | 183.46 ± 0.01 [15] | 0.8612 [218] | 1.4899 [181,182] | |
| | 183.3 [65] | 0.8613 [136,181,182] | 1.4900 [80] | |
| | 183.10 [210] | 0.862 [65] | 1.4914 [65] | |
| | 182.1–183.1 [86,64] | 0.8668 [86,64] | 1.4936 [218] | |
| | 183 [1,38,143,176] | 0.72466 181 30° [147] | 1.4895 21.8° [159] | |
| | 181–182 [205] | | 1.4942 17.5° [26] | |
| | 180–181 [218] | 0.74557 156.70° [147] | 1.49210 15° [210] | |
| | 180 [107,123,129,165] | | 1.494 13.5° [107] | |
| | 179.5 | 0.76869 129.80° [147] | 1.4907 13° [1] | |
| | −180.5 748 [13,26] | | 1.48815 $n_{H\alpha}^{15}$ [210] | |
| | 178–179 735 [159] | 0.79445 99.55° [147] | 1.50190 $n_{H\beta}^{15}$ [210] | |
| | 79 23 [80] | 0.81392 76.15° [147] | 1.51030 $n_{H\gamma}^{15}$ [210] | |
| | 72–75 21 [200] | 0.82673 61.55° [147] | 1.49254 $n_{He}^{15}$ [210] | |
| | 91.5–93.0 12 [159] | 0.83901 45.95° [147] | | |
| | 66–68 12 [182] | 0.84527 38.30° [147] | | |
| | 12.2 0.48 [134] | 0.85245 30° [210] | | |
| | 5.5 0.25 [134] | 0.8535 30° [182] | | |
| | −4.7 0.10 [134] | 0.8561 25.13° [15,138] | | |
| | | 0.8561 25° [14] | | |
| | | 0.85760 22.85° [147] | | |
| | | 0.862 $D_{20}^{20}$ [135] | | |
| | | 0.8620 $D_0^{20}$ [110A] | | |
| | | 0.86202 $D_0^{20}$ [111] | | |
| | | 0.8622 16° [165] | | |
| | | 0.86391 15.15° [147] | | |
| | | 0.86475 15° [210] | | |
| | | 0.87608 0° [147] | | |
| | | 0.87695 0° [210] | | |
| | | 0.8761 $D_0^0$ [110A,111] | | |
| | | 0.89440 −22.9° [147] | | |
| | | 0.91210 −45 2° [147] | | |
| | | 0.94226 −83.6° [147] | | |
| | | 0.95132 −95.1° [147] | | |

* $\frac{dD}{dt} = -0.00081118[1 + 0.0004963(t-20)]/°C$ (−95 to 182°C)

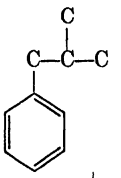
† $\frac{dD}{dt} = -0.0008130/°C$ (0 to 40°C)

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| |  | | | |
| **2-Phenylbutane** (*sec*-Butylbenzene) | | | | |
| | **172.5** | **0.8608** | **1.4898** | |
| −82.7 [208] | 173–174.5 [25] | 0.8606 [85] | 1.4885 [33] | $[\alpha]_D^{180}$ = +1.36°(a) [132] |
| | 174 [159] | 0.86205(c) [80] | 1.4900 [80,85,213] | $[\alpha]_D^{24}$ = +1.18°(a) [131] |
| | 173–174 [85,106,202] | 0.8624 [213] | 1.4902 [88] | $[\alpha]_D^{22}$ = +0.055° [33] |
| | 172.3–173.3 [26] | 0.8639(a) [78] | 1.4863 25° [202] | $[\alpha]_D^{22}$ = +0.03° [33] |
| | 173 [22] | 0.8364 50° [85] | 1.4870(b) 25° [132] | $[\alpha]_D^{24}$ = −1.92°(a) [130] |
| | 172–173 [105] | 0.8404 45° [85] | 1.4878(a) 25° [132] | $[\alpha]_D^{24}$ = −2.13°(b) [133] |
| | 172.5 [208] | 0.8443 40° [85] | 1.4880 25° [148] | $[\alpha]_D^{23}$ = −2.30°(b) [132] |
| | 172(a) [78] | 0.8483 35° [85] | 1.4894 21° [106] | |
| | 170–172 [26] | 0.8563 30° [85] | 1.4895 20.8° [159] | |
| | 171 [148] | 0.8577 25° [148] | 1.49165 16° [26] | |
| | 170–172 744 [213] | 0.8634 21° [106] | | |
| | 173.2 | 0.8615 18° [26] | | |
| | −174.2 742.4 [85] | 0.8646 15° [85] | | |
| | 75–76(b) 24 [132] | 0.8669 15° [186] | | |
| | 71–74(a) 20 [132] | 0.8687 10° [85] | | |
| | 69 20 [80] | 0.8725 5° [85] | | |
| | 68(b) 20 [130,132,133] | 0.8763 0° [85] | | |
| | 65–67 20 [33] | | | |
| | 61–62 16 [73] | | | |
| | 63(a) 15 [131] | | | |
| | 60.2–60.4 15 [159] | | | |
| | 9.8 0.53 [134] | | | |
| | 2.6 0.32 [134] | | | |
| | −3.0 0.18 [134] | | | |
| | −8.6 0.10 [134] | | | |

* $\frac{dD}{dt} = -0.0007947[1 + 0.002322(t-20)]/°C$ (0 to 50°C)

† $\frac{dn}{dt} = -0.0004846/°C$ (16 to 25°C)

(a) This constant was determined on the *dextro*rotatory form.
(b) This constant was determined on the *levo*rotatory form.
(c) This density is the average of two determinations.

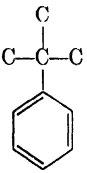
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-2-methylpropane** (Isobutylbenzene)  | **170.1** | **0.8673** | **1.4928** | Crit. Temp. (°C) |
| | 171 [123,146,166] | 0.8628 [237] | 1.4871 [80] | 377.1 [5] |
| | 170 [176] | 0.86726 [124] | 1.49338 18.5° [25] | |
| | 169–169.5 [160,161] | 0.8650 $D_{25}^{25}$ [160] | 1.4957 14.5° [124,146] | Crit. Pressure (mm Hg) |
| | 169.2 [234] | 0.86440 23.6° [184] | 1.49851 7.9° [161] | |
| | 168 [139] | 0.8680 $D_{20}^{20}$ [160] | 1.4916 $n_{H\alpha}^{14.5}$ [124] | |
| | 167–168 [41] | 0.86874 18.2° [124] | 1.49459 $n_{H\alpha}^{7.9}$ [161] | 23,636.0 [5] |
| | 167.5 [165] | 0.87036 16.1° [124] | 1.5056 $n_{H\beta}^{14.5}$ [124] | |
| | 167.0 [124,184] | 0.8714 $D_{15}^{15}$ [160] | 1.50858 $n_{H\beta}^{7.9}$ [161] | |
| | 167 [119,235] | 0.87181 14.3° [124] | 1.5141 $n_{H\gamma}^{14.5}$ [124] | |
| | 169.2 800 [235] | 0.87195 14.1° [124] | 1.51772 $n_{H\gamma}^{7.9}$ [161] | |
| | 170 756 [236] | 0.87243 13.5° [124] | | |
| | 168–171 755 [199A] | 0.8748 $D_{10}^{10}$ [160] | | |
| | 166.8 750(a) [235] | 0.87620 7.9° [161] | | |
| | 164.2 700(a) [235] | 0.8790 $D_5^5$ [160] | | |
| | 161.3 650(a) [235] | 0.8796 $D_4^4$ [160] | | |
| | 158.3 600(a) [235] | | | |
| | 155.1 550(a) [235] | | | |
| | 151.6 500(a) [235] | | | |
| | 147.6 450(a) [235] | | | |
| | 143.4 400(a) [235] | | | |
| | 138.6 350(a) [235] | | | |
| | 133.4 300(a) [235] | | | |
| | 127.1 250(a) [235] | | | |
| | 120.0 200(a) [235] | | | |
| | 110.9 150(a) [235] | | | |
| | 98.7 100(a) [235] | | | |
| | 79.0 50(a) [235] | | | |
| | 59.5 12 [80] | | | |

* $\frac{dD}{dt} = -0.0007641$/°C (4 to 25°C)

† $\frac{dn}{dt} = -0.0004783$/°C (7 to 20°C)

(a) Since 235 is the only reference giving boiling points at pressures of 50 mm to 750 mm, these values were not used to obtain a boiling point-pressure equation. Data on other compounds indicate that the boiling points given at these pressures in this reference are too low.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| | | | | * |



**tert-Butylbenzene**
(2-Phenyl-2-methylpropane)

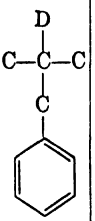
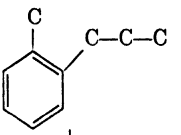
| | | | | | | |
|---|---|---|---|---|---|---|
| **−58.1** | **169.0** | | **0.8669** | | | |
| −58 [65,209] | 168.5–170 [88] | | 0.8660 [213] | | 1.4908 [190] | |
| −58.1 [87,140,158] | 169.5 [11] | | 0.8664 [34] | | 1.4912 [88] | |
| −60.9 [207] | 169.3–169.5 [159] | | 0.8665 [91] | | 1.4918 [213] | |
| | 168.5–169.5 [156] | | 0.867 [119] | | 1.4919 [81] | |
| | 169.3 ± 0.3 [207] | | 0.8671 [71,168] | | 1.4921 [189] | |
| | 169 [71,119] | | 0.8673 [71] | | 1.49235(a) [231] | |
| | 168.7 [65,140] | | 0.86733 [128] | | 1.4929 [12] | |
| | 168.5 [28] | | 0.8077 | 90.7° [34] | 1.4930 [71] | |
| | 170.0 | 772 [12] | 0.8204 | 75.6° [34] | 1.49609 [163] | |
| | 168.6 | | 0.8273 | 67.5° [34] | 1.4963 [17] | |
| | −168.7 | 759.0 [168] | 0.8403 | 51.9° [34] | 1.4969 [65,140] | |
| | 168.5 | | 0.8490 | 41.4° [34] | 1.4970 [85] | |
| | −168.8 | 758 [87] | 0.8570 | 31.5° [34] | 1.4905 | 25° [40,148] |
| | 168.8 | | 0.8623 | 25° [40,148] | 1.4958 | 24° [199] |
| | −169 | 757.7 [34] | 0.8636 | 23.3° [87] | 1.4942 | 23° [198] |
| | 168.8 | | 0.8690 | $D_{15}^{19.5}$ [40] | 1.4920 | 20.8° [159] |
| | −169.0 | 751.4 [167] | 0.8716 | 15° [186] | 1.4924 | 20.4° [231] |
| | 167 | | 0.8718 | 15° [186] | 1.49668 | 18.5° [25] |
| | −167.5 | 736 [186] | 0.8752 | 9.4° [34] | 1.49724 | 18.5° [25] |
| | 103 | 108 [231] | 0.8828 | 0° [34] | | |
| | 84.2 | 50 [31] | | | | |
| | 58–58.2 | 16 [159] | | | | |
| | 13.7 | 1.08 [134] | | | | |
| | 10.8 | 0.82 [134] | | | | |
| | 2.3 | 0.43 [134] | | | | |
| | −2.0 | 0.27 [134] | | | | |

* $\frac{1}{T_b} = 0.00361049 - 0.0004682 \log_{10} p_{mm}$ (100 to 772 mm)

† $\frac{dD}{dt} = -0.0008187[1 + 0.0007479(t - 20)]/°C$ (0 to 91°C)

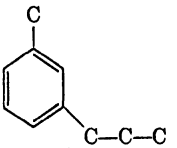
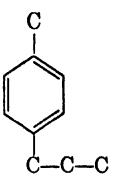
‡ $\frac{dD}{dt} = -0.0008148/°C$ (0 to 32°C)

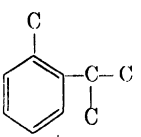
(a) This refractive index is the average of two or more determinations.

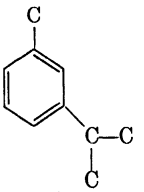
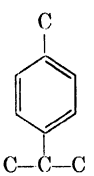
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Deutero-2-benzylpropane** (Benzyldimethylmethane-d)  | 170.5–171.5 [80] | | | |
| **1-Methyl-2-*n*-propylbenzene**  | | **0.8742** | **1.4993** | |
| | 184 [214] | 0.874 [53,214] | 1.49931 [110,216] | |
| | 180–182 [100] | 0.8748 [100] | 1.4995 [214] | |
| | 180.5 | 0.8752 [53] | 1.4999 19° [117] | |
| | –181.5 [53] | 0.8747 19° [117] | 1.50139 15.75° [214] | |
| | 65–68 14 [117] | 0.8770 15.75° [214] | 1.5032 13° [117] | |
| | | 0.8891 0° [100] | 1.50594 5.7° [216] | |
| | | | 1.49476 $n_{H\alpha}^{20}$ [53] | |
| | | | 1.49532 $n_{H\alpha}^{20}$ [53] | |
| | | | 1.49765 $n_{H\alpha}^{15.75}$ [214] | |
| | | | 1.50915 $n_{H\beta}^{20}$ [53] | |
| | | | 1.50980 $n_{H\beta}^{20}$ [53] | |
| | | | 1.51218 $n_{H\beta}^{15.75}$ [214] | |
| | | | 1.51791 $n_{H\gamma}^{20}$ [53] | |
| | | | 1.51857 $n_{H\gamma}^{20}$ [53] | |
| | | | 1.52125 $n_{H\gamma}^{15.75}$ [214] | |
| | | | 1.49909 $n_{He}^{20}$ [53] | |
| | | | 1.49976 $n_{He}^{20}$ [53] | |

* $\frac{dD}{dt} = -0.00073985$/°C (0 to 20°C)

† $\frac{dn}{dt} = -0.0004630$/°C (5 to 20°C)

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-*n*-propylbenzene**  | | | | * |
| | **179.4** | | **1.4937** | |
| | 181.5–182.5 [214] | 0.8601 [216] | 1.49230 [216] | |
| | 180 [216] | 0.862 [214] | 1.49321 [216] | |
| | 176–179 [239] | 0.8625 [53] | 1.49510 [110,216] | |
| | 177–178.5 [216] | 0.864 $D_{20}^{20}$ [135] | 1.4951 [214] | |
| | 176–178 [75] | 0.8646 17.6° [216] | 1.49340 17.6° [216] | |
| | 176.5–177.5 [53] | 0.8651 $D_{17}^{17}$ [239] | 1.49640 17.0° [214] | |
| | 178–180 757 [66] | 0.8648 17.0° [214] | 1.4945 16° [239] | |
| | | 0.865 $D_{15}^{15}$ [75] | 1.50185 5.2° [216] | |
| | | | 1.48978 $n_{H\alpha}^{20}$ [216] | |
| | | | 1.48981 $n_{H\alpha}^{20}$ [53] | |
| | | | 1.48968 $n_{H\alpha}^{17.6}$ [216] | |
| | | | 1.49262 $n_{H\alpha}^{17.0}$ [214] | |
| | | | 1.50392 $n_{H\beta}^{20}$ [216] | |
| | | | 1.50433 $n_{H\beta}^{20}$ [53] | |
| | | | 1.5038 $n_{H\beta}^{17.6}$ [216] | |
| | | | 1.50738 $n_{H\beta}^{17.0}$ [214] | |
| | | | 1.51320 $n_{H\gamma}^{20}$ [53] | |
| | | | 1.51646 $n_{H\gamma}^{17.0}$ [214] | |
| * $\frac{dn}{dt} = -0.0005484$/°C (5 to 20°C) | | | 1.49398 $n_{He}^{20}$ [53] | |
| **1-Methyl-4-*n*-propylbenzene**  | | | | |
| | **183.2** | **0.8588** | **1.4944** | |
| −62 [188] | 182–185 [239] | 0.8570 [53] | 1.49228 [216] | |
| | 183 184 [50,89,136] | 0.858 [216] | 1.4924 [50] | |
| | 183 [216] | 0.8591 [50,183] | 1.49246 [216] | |
| | 182–183 [214] | 0.860 [216] | 1.4930 [183] | |
| | 182.5 [216] | 0.858 $D_{25}^{25}$ [89] | 1.49485 [216] | |
| | 182 [216] | 0.8554 23.7° [216] | 1.4954 [214] | |
| | 181.0–181.4 [216] | | 1.49542 [110,216] | |
| | 179.5–180.0 [53] | 0.861 $D_{20}^{20}$ [135] | 1.49588 [216] | |
| | 183–184 774 [232] | 0.8617 18.8° [216] | 1.49602 [216] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-*n*-propylbenzene** (*Continued*) | | 0.8620 18.8° [216] | 1.49065 23.7° [216] | |
| | | 0.8642 15.4° [214] | 1.49180 21.5° [216] | |
| | | | 1.49641 18.8° [216] | |
| | 66 11 [183] | | 1.49655 18.8° [216] | |
| | | | 1.4943 16° [289] | |
| | | | 1.49749 15.4° [216] | |
| | | | 1.50200 5.1° [216] | |
| | | | 1.48706 $n_{H\alpha}^{23.7}$ [216] | |
| | | | 1.48781 $n_{H\alpha}^{20}$ [53] | |
| | | | 1.49269 $n_{H\alpha}^{18.8}$ [216] | |
| | | | 1.49278 $n_{H\alpha}^{18.8}$ [216] | |
| | | | 1.49371 $n_{H\alpha}^{15.4}$ [214] | |
| | | | 1.50119 $n_{H\beta}^{23.7}$ [216] | |
| | | | 1.50213 $n_{H\beta}^{20}$ [53] | |
| | | | 1.50752 $n_{H\beta}^{18.8}$ [216] | |
| | | | 1.50765 $n_{H\beta}^{18.8}$ [216] | |
| | | | 1.50863 $n_{H\beta}^{15.4}$ [214] | |
| | | | 1.51111 $n_{H\gamma}^{20}$ [53] | |
| * $\frac{dD}{dt} = -0.0009731$/°C (15 to 24°C) | | | 1.51687 $n_{H\gamma}^{18.8}$ [216] | |
| † $\frac{dn}{dt} = -0.0005733$/°C (5 to 25°C) | | | 1.51804 $n_{H\gamma}^{15.4}$ [214] | |
| | | | 1.49197 $n_{He}^{20}$ [53] | |
| **1-Methyl-2-isopropylbenzene** (*o*-Cymene)  | | | | |
| | 175.1 | 0.8752 | | |
| −25.5 [153] | 175–176 [214] | 0.8741 [53] | 1.5003 [214] | |
| | 174.5–175.5 [53] | 0.8754 [44] | 1.501 22° [177,178] | |
| | 175 [53,153,177,178,214] | 0.876 [214] | 1.5022 19° [44] | |
| | 176.6 754 [44] | 0.8740 $D_0^{22}$ [177,178] | 1.50206 16.15° [214] | |
| | | 0.8789 16.15° [214] | 1.49428 $n_{H\alpha}^{20}$ [53] | |
| | | 0.879 $D_{15.5}^{15.5}$ [153] | 1.49513 $n_{H\alpha}^{20}$ [53] | |
| | | 0.8902 $D_0^{0}$ [177,178] | 1.49826 $n_{H\alpha}^{16.15}$ [214] | |
| | | | 1.50858 $n_{H\beta}^{20}$ [53] | |
| | | | 1.50942 $n_{H\beta}^{20}$ [53] | |
| | | | 1.51290 $n_{H\beta}^{16.15}$ [214] | |
| | | | 1.51746 $n_{H\gamma}^{20}$ [53] | |
| | | | 1.51838 $n_{H\gamma}^{20}$ [53] | |
| | | | 1.52185 $n_{H\gamma}^{16.15}$ [214] | |
| | | | 1.49862 $n_{He}^{20}$ [53] | |
| * $\frac{dD}{dt} = -0.0007470$/°C (0 to 22°C) | | | 1.49957 $n_{He}^{20}$ [53] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-isopropylbenzene** (*m*-Cymene)  | | | | |
| | **175.6** | **0.8614** | **$1.4922_5$** | |
| −25 [153] | 173–177 [102] | 0.860 [119,214] | 1.4920 [169] | |
| | 176–176.5 [36] | 0.8606 [169] | 1.49216 [121] | |
| | 176 [9] | 0.8619 [53] | 1.49222 [227] | |
| | 175–176 [79,227] | 0.862 [206,227] | 1.4925 [214] | |
| | 174–176 [206] | 0.8631 [53] | 1.49385 17.05° [214] | |
| | 175.6–175.8 [169] | 0.8584 26.5° [102] | 1.4968 10° [169] | |
| | 175.7 [153] | 0.8590 $D_0^{22}$ [177,178] | 1.4881 $n_{H\alpha}^{20}$ [121] | |
| | 174.5–175 5 [53] | 0.865 $D_{20}^{20}$ [135] | 1.48915 $n_{H\alpha}^{20}$ [53] | |
| | 175 [119,123,214] | 0.8626 $D_{20}^{20}$ [121] | 1.48934 $n_{H\alpha}^{20}$ [53] | |
| | 174–175 [177,178] | 0.8628 17.05° [214] | 1.4885 $n_{H\alpha}^{19.6}$ [169] | |
| | 174.7 | 0.8763 $D_0^{0}$ [121] | 1.49016 $n_{H\alpha}^{17.05}$ [214] | |
| | −175.7 758.6 [121] | | 1.50213 $n_{H\beta}^{20}$ [121] | |
| | 173 750 [66] | | 1.50356 $n_{H\beta}^{20}$ [53] | |
| | 66.5 17.6 [169] | | 1.50366 $n_{H\beta}^{20}$ [53] | |
| | | | 1.5028 $n_{H\beta}^{19.6}$ [169] | |
| | | | 1.50452 $n_{H\beta}^{17.05}$ [214] | |
| | | | 1.51100 $n_{H\gamma}^{20}$ [121] | |
| | | | 1.51263 $n_{H\gamma}^{20}$ [53] | |
| | | | 1.51336 $n_{H\gamma}^{17.05}$ [214] | |
| | | | 1.49340 $n_{He}^{20}$ [53] | |
| | | | 1.49369 $n_{He}^{20}$ [53] | |
| * $\frac{dD}{dt}$ = −0.0007256/°C (0 to 27°C) | | | | |
| † $\frac{dn}{dt}$ = −0.00049025/°C (10 to 20°C) | | | | |
| **1-Methyl-4-isopropylbenzene** (*p*-Cymene)  | | | | |
| **−69.8** | **176.9** | **0.8571** | **1.4903** | Crit. Temp. (°C) |
| −68.9 [86,158] | 178 [188] | 0.85618 [76] | 1.4872 [43] | 394.7(e) [151] |
| −72.3 [169] | 177.0–177.5 [160] | 0.85688(c) [101] | 1.4887 [85] | |
| −73.0 [153] | 177–177.5 [128] | 0.8570 [169] | 1.48894 [110] | |
| −73.25 [207] | 176.5–177.5 [32] | 0.8573 [152] | 1.48935 [225] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-isopropylbenzene** (*p*-Cymene) (*Continued*) | | 0.8575 [53,142]<br>0.8580 [53]<br>0.8581 [164]<br>0.8582 [228] | 1.4894(d) [214]<br>1.4902 [144]<br>1.4904 [169]<br>1.49060 [101] | |
| −73.5 [70] | 177.3–177.4 [85,169] | 0.7248 175.4° [180] | 1.4906 [228] | |
| −73.5(a) [122] | 176.6–177.4 [82] | 0.79963 90° [29] | 1.49083 [120] | |
| −74 [65] | 177.3 [142] | 0.81624 70° [29] | 1.48878 25° [128] | |
| | 177.1–177.2 [27] | 0.82439 60° [128] | 1.4877 24.5° [65] | |
| | 176.2–177.2 [120] | 0.8235 59.45° [151] | 1.48942 24.1° [216] | |
| | 177.1 ± 0.25 [207] | 0.83205 50° [128] | 1.4868 21° [238] | |
| | 177 0 [65] | 0.83588 45° [128] | 1.48895 21° [77] | |
| | 177 [88] | 0.83656 45° [29] | 1.4893 21° [103] | |
| | 176.7–177.0 [86] | 0.83970 40° [128] | 1.48885 20.2° [110] | |
| | 176.6–177 [164] | 0.85266 25° [29] | 1.4920 18° [27] | |
| | 176–177 [70,85,214] | 0.85341 25° [128] | 1.49271 16.1° [115] | |
| | 176.7 [125,126,127] | 0.8558 $D_{25}^{25}$ [160] | 1.49474 15.0° [214,216] | |
| | 176.6 [228] | 0.8552 21° [238] | 1.4930 15° [48] | |
| | 176.5 [69,103] | 0.8574 $D_{21}^{21}$ [103] | 1.49159 14.0° [214,216] | |
| | 176–176.5 [230] | 0.8583 $D_{20}^{20}$ [120] | 1.49325 13.4° [214,216] | |
| | 175.5–176.5 [53] | 0.8586 $D_{20}^{20}$ [160] | 1.49419 11.0° [214] | |
| | 176.0 [153] | 0.8597 $D_{20}^{20}$ [238A] | 1.49664 7.9° [161] | |
| | 175–176 [23,77,214,225] | 0.85875 18° [128] | 1.49752 5.9° [216] | |
| | 175.5 [177,178] | 0.8593 18° [27] | 1.45130 $n_{H\alpha}^{91.2}$ [51] | |
| | 175 [51,54,123,149A] | 0.8584 17° [220] | 1.45849 $n_{H\alpha}^{77}$ [51] | |
| | 174.3–175 [101] | 0.8590 17° [47] | 1.47303 $n_{H\alpha}^{47.0}$ [51] | |
| | 177.0 | 0.8598 17° [27] | 1.48541 $n_{H\alpha}^{20.0}$ [51] | |
| | −177.4 768 [149] | 0.8576 16.4° [214] | 1.4865 $n_{H\alpha}^{20}$ [169] | |
| | 176.0 | 0.8605 16.1° [115] | 1.48664 $n_{H\alpha}^{20.0}$ [101] | |
| | −176.5 762 [53] | 0.8601 15° [226] | 1.48676 $n_{H\alpha}^{20}$ [120] | |
| | 175.4 | 0.8606 15° [27] | 1.48784(d) $n_{H\alpha}^{20}$ [53] | |
| | −175.5 749.5 [180] | 0.8608 15° [225] | 1.48635 $n_{H\alpha}^{16.4}$ [214] | |
| | 174.5 | 0.8615 15° [23] | 1.4884 $n_{H\alpha}^{16.1}$ [115] | |
| | −175 748 [238] | 0.8615 $D_{15}^{15}$ [103] | 1.49105 $n_{H\alpha}^{15.0}$ [214] | |
| | 174.6 747 [144] | 0.8619 $D_{15}^{15}$ [160] | 1.48799 $n_{H\alpha}^{14.0}$ [214] | |
| | 175.5 744 [104] | 0.8610 14.0° [214] | 1.48965 $n_{H\alpha}^{13.4}$ [214] | |
| | 175.4 743.7 [112] | 0.8622 13.4° [214] | 1.48983 $n_{H\alpha}^{11.0}$ [214] | |
| | 175–176 743 [226] | 0.8622 $D_{12.7}^{12.7}$ [101] | 1.49257 $n_{H\alpha}^{7.9}$ [161] | |
| | 175–176 735.5(b) [18] | 0.8634 11.0° [214] | 1.47164 $n_{H\beta}^{77}$ [51] | |
| | 173–175 720 [18,19] | 0.8654 $D_{10}^{10}$ [160] | 1.5007 $n_{H\beta}^{20}$ [169] | |
| | 60–61 11 [174] | 0.86700 7.9° [161] | 1.50073 $n_{H\beta}^{20.0}$ [101] | |
| | 55.5–56 10 [179] | 0.8693 $D_5^5$ [160] | 1.50089 $n_{H\beta}^{20}$ [120] | |
| | 13.3 0.6 [134] | 0.8701 $D_4^4$ [160] | 1.50210(d) $n_{H\beta}^{20}$ [53] | |
| | 0.8 0.25 [134] | 0.8732 0° [113] | 1.50037 $n_{H\beta}^{16.4}$ [214] | |
| | 0.0 0.23 [134] | | 1.50307 $n_{H\beta}^{16.1}$ [115] | |
| | −5.3 0.14 [134] | | 1.50537 $n_{H\beta}^{15.0}$ [214] | |
| | −5.5 0.14 [134] | | | |

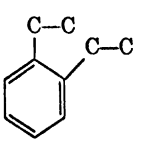
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-isopropylbenzene** (*p*-Cymene) *(Continued)* | | | 1.50208 $n_{H\beta}^{14.0}$ [214]<br>1.50396 $n_{H\beta}^{13.4}$ [214]<br>1.50413 $n_{H\beta}^{11.0}$ [214]<br>1.50698 $n_{H\beta}^{7.9}$ [161]<br>1.5094 $n_{H\gamma}^{20}$ [169]<br>1.50940 $n_{H\gamma}^{20.0}$ [101]<br>1.50930 $n_{H\gamma}^{20}$ [120]<br>1.51103(d) $n_{H\gamma}^{20}$ [53]<br>1.50911 $n_{H\gamma}^{16.4}$ [214]<br>1.51189 $n_{H\gamma}^{16.1}$ [115]<br>1.51449 $n_{H\gamma}^{15.0}$ [214]<br>1.51079 $n_{H\gamma}^{14.0}$ [214]<br>1.51283 $n_{H\gamma}^{13.4}$ [214]<br>1.51305 $n_{H\gamma}^{11.0}$ [214]<br>1.51599 $n_{H\gamma}^{7.9}$ [161]<br>1.45555 $n_{He}^{91.2}$ [51]<br>1.47699 $n_{He}^{47.0}$ [51]<br>1.48972 $n_{He}^{20}$ [51]<br>1.4906 $n_{He}^{20}$ [169]<br>1.49166(d) $n_{He}^{20}$ [53] | |

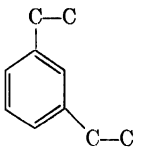
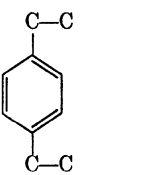
* $\frac{dD}{dt} = -0.0003158[1+0.0005370(t-20)]$/°C (0 to 175°C)

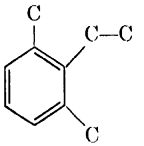
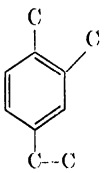
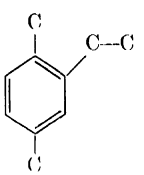
† $\frac{dD}{dt} = -0.0008076$/°C (0 to 25°C)

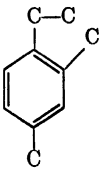
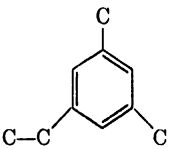
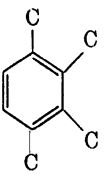
‡ $\frac{dn}{dt} = -0.0004830$/°C (7 to 25°C)

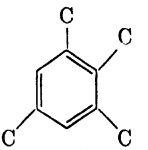
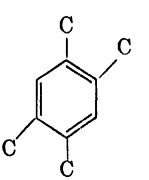
(a) This figure is given as a freezing point in literature.
(b) This pressure is the average of two determinations.
(c) This density is the average of two or more determinations.
(d) This refractive index is the average of two or more determinations.
(e) This temperature is the average of two determinations.

| | | | | |
|---|---|---|---|---|
| **1,2-Diethylbenzene**  | **184.4** | | | |
| | 185 [119]<br>184–184.5 [222]<br>184 [74]<br>66–67 12 [62] | 0.866 [119]<br>0.8662 18° [222]<br>0.8680 15.0° [74] | 1.50257 22° [62]<br>1.49851 $n_{H\alpha}^{22}$ [62]<br>1.51326 $n_{H\beta}^{22}$ [62] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3-Diethylbenzene**  | | | | |
| | **180.7** | **0.8607** | **1.4946** | |
| | 182 [119] | 0.860 [119] | 1.4905 [90] | |
| | 180–182 [221] | 0.8602 [221] | 1.4955 [39] | |
| | 176–181 [204] | 0.8597 $D_{25}^{25}$ [39] | 1.4926 25° [39] | |
| | 180.55 [39] | 0.8635 23° [90] | 1.4978 16° [239] | |
| | 178–180 [90] | 0.860 $D_{20}^{20}$ [135] | 1.4998 10° [39] | |
| | 176–179 [4] | 0.8636 $D_{17}^{17}$ [239] | | |
| | 179–181 715 [239] | 0.8798 $D_0^0$ [39] | | |
| | 15.7 0.74 [134] | | | |
| | 10.8 0.43 [134] | | | |
| | 6.8 0.30 [134] | | | |
| | −0.8 0.15 [134] | | | |
| * $\frac{dD}{dt}$ = −0.0007619/°C (0 to 25°C) | | | | |
| † $\frac{dn}{dt}$ = −0.0005136/°C (10 to 25°C) | | | | |
| **1,4-Diethylbenzene**  | | | | |
| | **182.8** | **0.8633** | **1.4969** | |
| −35 [59] | 183 [119,157,214] | 0.8640 [228] | 1.49671 [110,216] | |
| | 182–183 [118,223] | 0.865 [119] | 1.4973 [214] | |
| | 182 [59] | 0.865 $D_{20}^{20}$ [135] | 1.4974 [228] | |
| | 181–182 [10] | 0.8645 18.2° [57] | 1.4949 25° [157] | |
| | 181.8 [228] | 0.8622 18° [223] | 1.49897 16.2° [214] | |
| | 6.2 1.35 [134] | 0.8678 16.3° [214] | 1.4978 14° [108] | |
| | −0.7 0.83 [134] | 0.8679 16.2° [214] | 1.50341 5.0° [216] | |
| | −5.6 0.54 [134] | 0.8675 14° [108] | 1.49224 $n_{H\alpha}^{18.2}$ [57] | |
| | −6.7 0.49 [134] | | 1.49499 $n_{H\alpha}^{16.2}$ [214] | |
| | | | 1.50665 $n_{H\beta}^{18.2}$ [57] | |
| | | | 1.50993 $n_{H\beta}^{16.2}$ [214] | |
| | | | 1.51924 $n_{H\gamma}^{16.2}$ [214] | |
| * $\frac{dD}{dt}$ = −0.0008340/°C (14 to 20°C) | | | | |
| † $\frac{dn}{dt}$ = −0.00044095/°C (5 to 25°C) | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3-Dimethyl-2-ethylbenzene**  | | | | |
| | 80–83 24 [195] | | 1.5040 24.0° [195] | |
| **1,2-Dimethyl-4-ethylbenzene**  | | | | |
| | **187.6** | | | |
| | 189 [9,116] | 0.8704 [116] | 1.5026 [217] | |
| | 187–188 [201] | 0.873 [217] | 1.5027 [217] | |
| | 187.6 [228] | 0.8792 [228] | 1.5030 [217] | |
| | 186–187 [217] | 0.8777 15.2° [217] | 1.5046 [228] | |
| | 78–80 15 [217] | 0.8776 15.05° [217] | 1.50489 15.05° [217] | |
| | | 0.8782 15.0° [217] | 1.50526 15.0° [217] | |
| | | | 1.50103 $n_{H\alpha}^{15.05}$ [217] | |
| | | | 1.50142 $n_{H\alpha}^{15.0}$ [217] | |
| | | | 1.51606 $n_{H\beta}^{15.05}$ [217] | |
| | | | 1.51647 $n_{H\beta}^{15.0}$ [217] | |
| | | | 1.52531 $n_{H\gamma}^{15.05}$ [217] | |
| | | | 1.52584 $n_{H\gamma}^{15.0}$ [217] | |
| **1,4-Dimethyl-2-ethylbenzene**  | | | | |
| | **185.4** | | | |
| | 185–187 [24] | 0.8750 22° [61] | 1.5051 22° [61] | |
| | 185–186 [61] | 0.8824 17° [108] | 1.5026 17° [108] | |
| | 185 [96,201] | | | |
| | 183–185 [118] | | | |
| | 183–184 [233] | | | |
| | 185.5 759 [108] | | | |
| | 64 10 [108] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethyl-2,4-dimethylbenzene**  | | | | |
| | **185.6** | | | |
| | 186–187 [7]<br>186 [8]<br>185–186 [201]<br>184–186 [96]<br>184 [162]<br>184–185 754 [108]<br>67–68 12 [108] | 0.8686 [7]<br>0.8772 16° [108] | 1.5033 16° [108] | |
| **1,3-Dimethyl-5-ethylbenzene**  | | | | |
| | **184.3** | | | |
| | 185 [224]<br>184–184.6 [155]<br>180–182 [91] | 0.861 [224]<br>0.8644 [91] | | |
| **1,2,3,4-Tetramethylbenzene** (Prehnitene)  | | | | |
| **−6.5** | **205.0** | | **$1.5194_5$** | |
| −4 [83,95,191]<br>−4.9 [153]<br>−5 [211]<br>−6.4 [187,196]<br>−6.8 [197]<br>−7.1– −7.0 [192]<br>−7.1 [193]<br>−7.7 [86,168] | 205.04 [141]<br>205.0 [173]<br>204.5 [187]<br>204.0 [153]<br>204 [95,119,123,154,211]<br>203–204 [214]<br>203 [150]<br>158.46 217.2 [141]<br>119.40 57.3 [141] | 0.9010 [150]<br>0.901 [119,214]<br>0.904 [154]<br>0.9053 [141]<br>0.9015 25° [141]<br>0.9044 16.0° [214]<br>0.905 $D_{15.5}^{15.5}$ [153] | 1.5185 [214]<br>1.51865 [110,216]<br>1.52013 [141]<br>1.5202 [193]<br>1.5203 [150]<br>1.51811 25° [141]<br>1.52031 16.0° [214]<br>1.52454 6.3° [216] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,3,4-Tetramethylbenzene** (Prehnitene) *(Continued)* | | | 1.51362 $n_{H\alpha}^{25}$ [141]<br>1.51563 $n_{H\alpha}^{20}$ [141]<br>1.51621 $n_{H\alpha}^{16.0}$ [214]<br>1.52923 $n_{H\beta}^{25}$ [141]<br>1.53133 $n_{H\beta}^{20}$ [141]<br>1.53192 $n_{H\beta}^{16.0}$ [214]<br>1.54189 $n_{H\gamma}^{16.0}$ [214] | * |
| | 96.5 25 [192]<br>97–98 24–25 [196] | | | |
| * $\frac{dn}{dt} = -0.0003553$/°C (6 to 25°C) | | | | |
| **1,2,3,5-Tetramethylbenzene** (Isodurene)  | | | | |
| **−24.2** | **197.2** | | | |
| −24.0 ± 0.1(a) [197]<br>−24.0 [158]<br>−24.1 [192]<br>−24.5 [86]<br>−28.7 [153] | 198.0–198.6 [109]<br>198.0 [137]<br>197.0 [65,153]<br>196–197 [37,99]<br>195–197 [20,21,52,145]<br>195 [93,123,134]<br>84.6–84.7 17 [197]<br>78.8–79.2 11 [109] | 0.8906 [52]<br>0.895 [154]<br>0.896 [65]<br>0.899 15.5° [153] | 1.5134 [192]<br>1.51126 $n_{He}^{20}$ [68] | |
| (a) This figure is given as a freezing point in the literature. | | | | |
| **1,2,4,5-Tetramethylbenzene** (Durene)  | | | | |
| **79.7** | **195.4** | | | |
| 82–83 [116]<br>81–82 [84]<br>81 [94]<br>80–81 [187,229]<br>80(a)<br>79–80(b)<br>79.3–79.9 [197]<br>79.5 [234]<br>79.3 [158] | 196.2–196.4 [109]<br>196 [95,187,229]<br>195.8 [137]<br>195 [16]<br>193–195 [2,3,72]<br>194.0 [183]<br>193 [154]<br>192 [123]<br>191–192 [67] | 0.736 210.2° [49]<br>0.820 108.5° [49]<br>0.8380 81.3° [67]<br>0.838 $D_{15.5}^{15.5}$ [158]<br>1.03 (solid) [171,172]<br>1.034 (solid) [114] | 1.47896 $n_{H\alpha}^{81.3}$ [67]<br>1.49369 $n_{H\beta}^{81.3}$ [67] | Crit. Temp. (°C)<br>402.5 [49,73]<br>Crit. Pressure (mm Hg)<br>21,736.0 [73] |

| M. P.,°C | B. P.,°C @ 760mm | | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|---|
| **1,2,4,5-Tetramethylbenzene (Durene) (*Continued*)** | | | | | |
| 79 [6,37,52] | 190–191 [52] | | | | |
| 78–79 [192] | 190 [97,212] | | | | |
| 78.9 [58] | 1.3 | 0.033 [134] | | | |
| 78.7 [109] | −1.3 | 0.016 [134] | | | |
| | −1.7 | 0.013 [134] | | | |

(a) The melting point 80 is found in references 67, 92, 97, 153, 170, 171, 172, 194, 219.
(b) The melting point 79-80 is found in references 2, 3, 45, 60, 63, 98, 154, 199A, 203, 212, 215, 217.

## $C_{10}H_{14}$ References

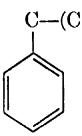
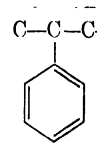

1. Acree, F., Jr., and F. B. Laforge, J. Org. Chem. **4**, 569 1939.
2. Ador, E., and A. Rilliet, Ber. **12**, 329 1879.
3. Ador, E., and A. Rilliet, Bull. soc. chim. [2] **31**, 244 1879.
4. Allen and Underwood, Bull. soc. chim. [2] **40**, 100 1883.
5. Altschul, M., Z. physik. Chem. **11**, 577 1893.
6. Anschütz, R., Ann. **235**, 150 1886.
7. Anschütz, R., Ann. **235**, 299 1886.
8. Anschütz, R., and E. Romig, Ber. **18**, 662 1885.
9. Armstrong, H. E., and A. K. Miller, Ber. **16**, 2255 1883.
10. Aschenbrandt, H., Ann. **216**, 212 1883.
11. Backer, H. J., and J. Kramer, Rec. trav. chim. **53**, 1101 1934.
12. Baker, J. W., and L. G. Groves, J. Chem. Soc. 1939, 1147.
13. Balbino, L., Ber. **10**, 296 1877.
14. Bartell, F. E., L. O. Case, and H. Brown, J. Am. Chem. Soc. **55**, 2419 1933.
15. Bartell, F. E., and G. L. Mack, J. Phys. Chem. **36**, 65 1932.
16. Beaurepaire, Bull. soc. chim. [2] **50**, 676 1888.
17. Berman, N., and A. Lowy, J. Am. Chem. Soc. **60**, 2596 1938.
18. Bert, L., Bull. soc. chim. [4] **37**, 1252 1925.
19. Bert, L., Compt. rend. **176**, 840 1923.
20. Bielefeldt, M., Ann. **198**, 380 1879.
21. Bielefeldt, Thesis, Göttingen, 1880.
22. Blondeau, J., Ann. chim. [10] **2**, 5 1924.
23. Blumann, A., and O. Zeitschel, Ber. **46**, 1178 1913.
24. Bodroux, F., Bull. soc. chim. [3] **19**, 888 1898.
25. Boedtker, E., Bull. soc. chim. [3] **31**, 965 1904.
26. Boedtker, E., Bull. soc. chim. [4] **45**, 645 1929.
27. Boedtker, E., J. pharm. chim. [8] **9**, 417 1929.
28. Bowden, E., J. Am. Chem. Soc. **60**, 645 1938.
29. Bretscher, E., Physik. Z. **32**, 765 1931.
30. Brown, W. G., C. J. Mighton, and M. Senkus, J. Org. Chem. **3**, 62 1938-1939.
31. Buehler, C. A., T. S. Gardner, and M. L. Clemens, J. Org. Chem. **2**, 167 1937-1938.
32. Bulkley, Bur. Standards J. Research **6**, 89 1931.
33. Burwell, R. L., Jr., and S. Archer, J. Am. Chem. Soc. **64**, 1032 1942.
34. Bygdén, A., Thesis, Uppsala, **1916**; C.A. **14**, 1974 1920.
35. Charlton, R. W., and A. R. Day, Ind. Eng. Chem. **29**, 92 1937.
36. Claus, A., Ber. **13**, 896 1880.

37. Claus, A., and C. Foecking, Ber. **20**, 3097 **1887.**
38. Clemmensen, E., Ber. **46**, 1837 **1913.**
39. Copenhauer, J. E., and E. E. Reid, J. Am. Chem. Soc. **49**, 3157 **1927.**
40. Croxall, W. J., F. J. Sowa, and J. A. Nieuwland, J. Org. Chem. **2**, 253 **1937.**
41. Culmann, C., and K. Gasiorowski, J. prakt. Chem. [2] **40**, 97 **1889.**
42. Darzens, G., Compt. rend. **139**, 868 **1904.**
43. Demonbreun, W. A., and R. E. Kremers, J. Am. Pharm. Assoc. **12**, 296 **1923.**
44. Desseigne, G., Compt. rend. **200**, 466 **1935.**
45. Dilthey, W., and G. Hurtig, Ber. **67**, 495 **1934.**
46. Dobrosserdov, D., Kasan. Sapiski Kasaner Univ. **1909**, 1; Chem. Zentr. **1911**, I, 953.
47. Dupont, G., P. Daure, J. Allard, and J. Levy, Chimie & Industrie **27**, 630S **1932.**
48. Dupont, G., P. Daure, and J. Levy, Bull. soc. chim. [4] **51**, 921 **1932.**
49. Dutoit, P., and L. Friederich, Arch. sci. phys. nat. [4] **9**, 105 **1900.**
50. D'yakova, M. K., and A. V. Lozovoi, J. Gen. Chem. (U.S.S.R.) **9**, 26 **1939**; C.A. **33**, 6254 **1939.**
51. Eisenlohr, F., Ber. **54**, 2857 **1923.**
52. Eisenlohr, F., Fortschr. Chem., Physik u. physik. Chem. **18B**, 521 **1925.**
53. Eisenlohr, F., and L. Schulz, Ber. **57**, 1808 **1924.**
54. Elbs, K., J. prakt. Chem. [2] **35**, 465 **1887.**
55. Estreicher, T., Ber. **33**, 436 **1900.**
56. Evans, E. B., J. Inst. Petroleum Tech. **24**, 537 **1938.**
57. Eykman, J. F., Rec. trav. chim. **12**, 157 **1893.**
58. Ferry, J. D., and S. B. Thomas, J. Phys. Chem. **37**, 253 **1933.**
59. Fournier, H., Bull. soc. chim. [3] **7**, 651 **1892.**
60. Frankforter, G. B., and V. R. Kokatnur, J. Am. Chem. Soc. **36**, 1529 **1914.**
61. Freund, M., K. Fleischer, and E. Gofferjé, Ann. **414**, 1 **1918.**
62. Fries, K., and H. Bestian, Ber. **69**, 715 **1936.**
63. Fuson, R. C., and B. C. McKusick, J. Am. Chem. Soc. **65**, 60 **1943.**
64. Garner, F. H., and E. B. Evans, J. Inst. Petroleum Tech. **18**, 751 **1932.**
65. Gaucher, L. P., Ind. Eng. Chem. **27**, 57 **1935.**
66. Genvresse, P., Bull. soc. chim. [3] **9**, 219 **1893.**
67. Gissmann, R., Ann. **216**, 200 **1883.**
68. Gorr, G., Thesis, Königsberg, **1923**, through F. Eisenlohr and L. Schulz, Ber. **57**, 1808 **1924.**
69. Grimm, F. V., and W. A. Patrick, J. Am. Chem. Soc. **45**, 2794 **1923.**
70. Groggins, P. H., Chem Met. Eng. **34**, 291 **1927.**
71. Grosse, A. V., and V. N. Ipatieff, J. Am. Chem. Soc. **57**, 2415 **1935.**
72. Grosse, A. V., and J. M. Mavity, Paper presented before American Chemical Society, Boston, **1939.**
73. Guye, P. A., and E. Mallet, Compt. rend. **133**, 1287 **1901.**
74. Hall, C. C., Fuel **12**, 76 **1933.**
75. Hall, C. C., J. Soc. Chem. Ind. **54**, 208 **1935-1936.**
76. Harkins, W. D., G. L. Clark, and L. T. Roberts, J. Am. Chem. Soc. **42**, 700 **1920.**
77. Harries, C., Ann. **328**, 322 **1903.**
78. Harrison, P. W. B., J. Kenyon, and J. R. Shepherd, J. Chem. Soc. **1926**, 658.
79. Haworth, W. N., W. H. Perkin, Jr., and O. Wallach, Ann. **399**, 155 **1913.**
80. Hennion, G. F., and L. A. Auspos, J Am. Chem. Soc. **65**, 1603 **1943.**
81. Hennion, G. F., and R. A. Kurtz, J. Am. Chem. Soc. **65**, 1001 **1943.**
82. Heuser, E., L. Zeh, and B. Aschan, Z. angew. Chem. **36**, 37 **1923.**
83. Hofmann, K. A., and H. Arnoldi, Ber. **39**, 339 **1906.**
84. Holmberg, B., Svensk Kem. Tid. **40**, 304 **1928.**
85. Howes, D. A., and A. W. Nash, J. Soc. Chem. Ind. **49**, 16T **1930.**
86. Huffman, H. M., G. S. Parks, and M. Barmore, J. Am. Chem. Soc. **53**, 3876 **1931.**
87. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 **1930.**
88. Ipatieff, V. N., B. B. Corson, and H. Pines, J. Am. Chem. Soc. **58**, 919 **1936.**
89. Ipatieff, V. N., N. A. Orlov, and A. D. Petrov, Compt. rend. acad. sci. U.R.S.S. **1928A**, 255.
90. Ipatieff, V. N., H. Pines, and V. I. Komarewsky, Ind. Eng. Chem. **28**, 222 **1936.**

91. Jacobsen, O., Ber. 7, 1430 1874.
92. Jacobsen, O., Ber. 14, 2624 1881.
93. Jacobsen, O., Ber. 15, 1853 1882.
94. Jacobsen, O., Ber. 17, 2372 1884.
95. Jacobsen, O., Ber. 19, 1209 1886.
96. Jacobsen, O., Ber. 19, 2515 1886.
97. Jannasch, P., Ber. 10, 1354 1877.
98. Jannasch, P., and R. Fittig, Z. Chem. 13, 161 1870.
99. Jannasch, P., and M. Weiler, Ber. 27, 3441 1894.
100. Joukovskiĭ, S., J. Russ. Phys. Chem. Soc. 27, 296 1895; Bull. soc. chim. [3] 16, 126 1896.
101. Karvonen, A., Ber. 56, 1824 1923.
102. Kazanskiĭ, B. A., and A. F. Plate, Ber. 69, 1862 1936.
103. Kertész, Z., Chem. Ztg. 40, 945 1916.
104. Kizhner, N., J. Russ. Phys. Chem. 50, 1 1918; Chem. Zentr. 1923, III, 669.
105. Klages, A., Ber. 35, 2633 1902.
106. Klages, A., Ber. 35, 3506 1902.
107. Klages, A., Ber. 37, 2301 1904.
108. Klages, A., and R. Keil, Ber. 36, 1362 1903.
109. Kohlrausch, K. W. F., and A. Pongratz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 143, Abt. IIb, 358 1934.
110. Kolligs through K. von Auwers and H. Kolligs, Ber. 55, 21 1922.
110A. Konovalov, Ber. 28, 1852 1895.
111. Konovalov, J. Russ. Phys. Chem. Soc. 27, 422 1895; Beil. 5, 413 1922.
112. Kopp, H., Ann 94, 257 1855.
113. Kraut, K., Ann. 192, 222 1878.
114. Krishnan, K. S., and S. Banerjee, Trans. Roy. Soc. (London) 234, 265 1935.
115. Krollpfeiffer, F., Ann. 430, 161 1923.
116. Kruber, O., Ber. 57, 1008 1924.
117. Kuhn, R., and A. Deutsch, Ber. 65, 43 1932.
118. Kunckell, F., and G. Ulex, J. prakt. Chem. [2] 87, 227 1912.
119. Kurtz, S. S., Jr., and C. E. Headington, Ind. Eng. Chem. Anal. Ed. 9, 21 1937.
120. Lacourt, A., Bull. soc. chim. Belg. 38, 1 1929.
121. Lacourt, A., Bull. soc. chim. Belg. 39, 133 1930.
122. Ladenburg, A., and C. Kriegel, Ber. 33, 637 1900.
123. Lagerlöf, D., J. prakt. Chem. [2] 98, 136 1918.
124. Landolt, H., and H. Jahn, Z. physik. Chem. 10, 289 1892.
125. Lecat, M., Ann. soc. sci. Bruxelles 47B, I, 63 1927.
126. Lecat, M., Ann. soc. sci. Bruxelles 48B, 113 1928.
127. Lecat, M., Ann. soc. sci. Bruxelles 49B, 109 1929.
128. LeFevre, C. G., R. J. W. LeFevre, and K. W. Robertson, J. Chem. Soc. 1935, 480.
129. Lepin, A., Acta Univ. Latviensis, Kim. Fakultāt. Ser. 1, 145 1932; C.A. 25, 3328 1931.
130. Levene, P. A., and R. E. Marker, J. Biol. Chem. 93, 749 1931.
131. Levene, P. A., and R. E. Marker, J. Biol. Chem. 97, 563 1932.
132. Levene, P. A., and R. E. Marker, J. Biol. Chem. 108, 409 1935.
133. Levene, P. A., R. E. Marker, and A. Rothen, J. Biol. Chem. 100, 589 1933.
134. Linder, E. G., J. Phys. Chem. 35, 531 1931.
135. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. 26, 475 1934.
136. Lozovoĭ, A. V., M. K. Diakova, and T. G. Stepanzeva, J. Gen. Chem. (U.S.S.R.) 9, 540 1939.
137. MacDougall, F. H., and L. I. Smith, J. Am. Chem. Soc. 52, 1998 1930.
138. Mack, G. L., and F. E. Bartell, J. Am. Chem. Soc. 54, 936 1932.
139. Mailhe, A., and F. de Godon, Bull. soc. chim. [4] 21, 61 1917.
140. Mair, B. J., and S. T. Schicktanz, Bur. Standards J. Research 11, 665 1933.
141. Mair, B. J., and A. J. Streiff, Bur. of Standards J. Research 27, 343 1941.
142. Malishev, B. W., J. Am. Chem. Soc. 57, 883 1935.

143. Mameli, E., and A. Mossini, Giorn. chim. ind. applicata **15**, 161 **1933.**
144. Mann, C. A., R. E. Montonna, and M. G. Larian, Ind. Eng. Chem. **28**, 598 **1936.**
145. Markovnikov, V., Ann. **234**, 89 **1886.**
146. Martin, E., Ann. combustibles liquides **12**, 97 **1937.**
147. Massart, L., Bull. soc. chim. Belg. **45**, 76 **1936.**
148. McKenna, J. F., and F. J. Sowa, J. Am. Chem. Soc. **59**, 470 **1937.**
149. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **125**, 1743 **1924.**
149A. Meyer, H., and K. Bernhauer, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **138**, Abt. IIb, 721 **1929.**
150. Mitchell, D. T., and C. S. Marvel, J. Am. Chem. Soc. **55**, 4276 **1933.**
151. Morgan, J. L. R., and G. K. Daghlian, Z. physik. Chem. **78**, 169 **1912.**
152. Müller, F. H., Physik. Z. **38**, 283 **1937.**
153. Nelson, W. L., Oil Gas J. **35**, No. 38, 39 **1937.**
154. Nenitzescu, C. D., D. A. Isacescu, and A. C. Isopescu, Oesterr. Chem.-Ztg. **42**, 350 **1939.**
155. Norris, J. F., and J. N. Ingraham, J. Am. Chem. Soc. **62**, 1298 **1940.**
156. Norris, J. F., and B. M. Sturgis, J. Am. Chem. Soc. **61**, 1413 **1939.**
157. O'Connor, M. J., and F. J. Sowa, J. Am. Chem. Soc. **60**, 125 **1938.**
158. Parks, G. S., and H. M. Huffman, Ind. Eng. Chem. **23**, 1138 **1931.**
159. Pendl, E., and G. Radinger, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **148**, Abt. IIb, **76** **1939.**
160. Perkin, W. H., J. Chem. Soc. **69**, 1025 **1896.**
161. Perkin, W. H., J. Chem. Soc. **77**, 267 **1900.**
162. Philippi, E., R. Seka, and N. Froeschel, Ann. **428**, 300 **1922.**
163. Potts, W. M., and L. L. Carpenter, J. Am. Chem. Soc. **61**, 663 **1939.**
164. Quist, W., Acta Acad. Aboensis, Math. et Phys. **8**, No. 4 **1935.**
165. Radziszewski, B., Ber. **9**, 260 **1876.**
166. Ramart, P., Compt. rend. **179**, 276 **1924.**
167. Richards, T. W., and F. Barry, J. Am. Chem. Soc. **37**, 993 **1915.**
168. Richards, T. W., and J. W. Shipley, J. Am. Chem. Soc. **38**, 989 **1916.**
169. Richter, F., and W. Wolff, Ber. **63**, 1721 **1930.**
170. Robertson, J. M., Proc. Roy. Soc. (London) **141A**, 594 **1933.**
171. Robertson, J. M., Proc. Roy. Soc. (London) **142A**, 659 **1933.**
172. Robertson, J. M., Proc. Roy. Soc. (London) **142A**, 674 **1933.**
173. Rossini, F. D., Petroleum Engr. **14**, No. 5, 41 **1943.**
174. Ruzicka, L., J. Meyer, and M. Mingazzini, Helv. Chim. Acta **5**, 345 **1922.**
175. Sabatier, P., and A. Mailhe, Compt. rend. **145**, 1126 **1907.**
176. Sabatier, P., and A. Mailhe, Compt. rend. **158**, 830 **1914.**
177. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915.**
178. Sabatier, P., and M. Murat, Compt. rend. **156**, 184 **1913.**
179. St. Pfau, A., Helv. Chim. Acta **22**, 382 **1939.**
180. Schiff, R., Ann. **220**, 71 **1883.**
181. Schmidt, A. W., Ber. **75**, 1399 **1942.**
182. Schmidt, A. W., G. Hopp, and F. Schoeller, Ber. **72**, 1893 **1939.**
183. Schmidt, A. W., and V. Schoeller, Ber. **74**, 258 **1941.**
184. Schonrock, O., Z. physik. Chem. **11**, 753 **1893.**
185. Schramm, J., Ann. **218**, 383 **1883.**
186. Schramm, J., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **97**, Abt. IIb, 586 **1888.**
187. Schulze, K., Ber. **18**, 3032 **1885.**
188. Senseman, C. E., and J. J. Stubbs, Ind. Eng. Chem. **24**, 1184 **1932.**
189. Simons, J. H., and S. Archer, J. Am. Chem. Soc. **60**, 2952 **1938.**
190. Simons, J. H., and S. Archer, J. Am. Chem. Soc. **60**, 2953 **1938.**
191. Smith, L. I., Organic Syntheses **10**, 32 **1930.**
192. Smith, L. I., and O. W. Cass, J. Am. Chem. Soc. **54**, 1609 **1932.**
193. Smith, L. I., and O. W. Cass, J. Am. Chem. Soc. **54**, 1614 **1932.**

194. Smith, L. I., and F. J. Dobrovolny, J. Am. Chem. Soc. **48**, 1413 1926.
195. Smith, L. I., and M. A. Kiess, J. Am. Chem. Soc. **61**, 989 1939.
196. Smith, L. I., and A. R. Lux, J. Am. Chem. Soc. **51**, 2994 1929.
197. Smith, L. I., and F. H. MacDougall, J. Am. Chem. Soc. **51**, 3001 1929.
198. Smith, R. A., J. Am. Chem. Soc. **56**, 717 1934.
199. Smith, R. A., J. Am. Chem. Soc. **59**, 899 1937.
199A. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1207 1913.
200. Sprague, J. M., and H. Adkins, J. Am. Chem. Soc. **56**, 2669 1934.
201. Stahl, J., Ber. **23**, 988 1890.
202. Stephens, H. N., and F. L. Roduta, J. Am. Chem. Soc. **57**, 2380 1935.
203. Stohmann, F., C. Kleber, and H. Langbein, J. prakt. Chem. [2] **40**, 77 1899.
204. Stratford, R., Ann. combustibles liquides **4**, 83 1929.
205. Straus, F., and H. Grindel, Ann. **439**, 276 1924.
206. Tiffeneau, T., Ann. chim. phys. [8] **10**, 145 1907.
207. Timmermans, J., Bull. soc. chim. Belg. **30**, 62 1921.
208. Timmermans, J., Bull. soc. chim. Belg. **36**, 502 1927.
209. Timmermans, J., Bull. soc. chim. Belg. **44**, 17 1935.
210. Timmermans, J., and F. Martin, J. chim. phys. **25**, 411 1928.
211. Töhl, A., Ber. **21**, 904 1888.
212. Töhl, A., Ber. **25**, 1522 1892.
213. Toussaint, N. F., and G. F. Hennion, J. Am. Chem. Soc. **62**, 1145 1940.
214 von Auwers, K., Ann. **419**, 92 1919.
215. von Auwers, K., and A. Köckritz, Ann. **352**, 288 1907.
216. von Auwers, K., and H. Kolligs, Ber. **55**, 21 1922.
217. von Auwers, K., and K. Ziegler, Ann. **425**, 217 1921.
218. von Braun, J., and H. Deutsch, Ber. **45**, 2171 1912.
219. von Braun, J., and J. Nelles, Ber. **67**, 1094 1934.
220. Vorländer, D., and J. Fischer, Ber. **65**, 1756 1932.
221. Voswinkel, A., Ber. **21**, 2829 1888.
222. Voswinkel, A., Ber. **21**, 3499 1888.
223. Voswinkel, A., Ber. **22**, 315 1889.
224. Vroblevskiĭ, E., Ann. **192**, 196 1878.
225. Walbaum, H., and O. Hüthig, J. prakt. Chem. [2] **71**, 459 1905.
226. Walbaum, H., and W. Müller, Wallach-Festschrift 654 1909.
227. Wallach, O., Ann. **275**, 145 1893.
228. Ward, A. L., and W. H. Fulweiler, Ind. Eng. Chem. Anal. Ed. **6**, 396 1934.
229. Weger, M., Z. angew. Chem. **22**, 338 1909.
230. Wheeler, A. S., J. Am. Chem. Soc. **42**, 1842 1920.
231. Whitmore, F. C., C. A. Weisgerber, and A. C. Shabica, Jr., J. Am. Chem. Soc. **65**, 1469 1943.
232. Widman, O., Ber. **24**, 439 1891.
233. Willgerodt, C., and T. Scholtz, J. prakt. Chem. [2] **81**, 382 1910.
234. Willstätter, R., and D. Hatt, Ber. **45**, 1471 1912.
235. Woringer, B., Z. physik. Chem. **34**, 257 1900.
236. Wreden, J., and B. Znatovicz, Ber. **9**, 1606 1876.
237. Zelinskiĭ, N. D., and N. V. Gaverdovskaya, Ber. **61**, 1049 1928.
238. Zelinskiĭ, N. D., and R. Y. Levina, Ann **476**, 60 1929.
238A. Zukervanik, I., and K. Tokareva, J. Gen. Chem. (U.S.S.R.) **5**, 764 1935; C.A. **30**, 442 1936.
239. Zukervanik, I. P., and G. Vykhrova, J. Gen. Chem. (U.S.S.R.) **7**, 632 1937; C.A. **31**, 5779 1937; Chem. Zentr. 1938, I, 578.

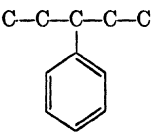
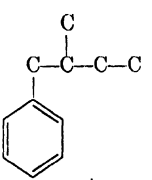
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| |  | | | * |
| ***n*-Pentylbenzene** (*n*-Amylbenzene) | | | | |
| | **202.2** | **0.8627** | **1.4919** | |
| −78.25 [101] | 205.3 ± 0.1 [101] | 0.8585 [61] | 1.4883 [42] | |
| | 205 [42] | 0 8600 [91,92] | 1.4887 [91,92] | |
| | 204–205 [45,98] | 0.8662 [127] | 1.4920 [45] | |
| | 204–204.5 [61] | 0.8039 94.8° [45] | 1.4943 [127] | |
| | 202 [60] | 0.8233 69.8° [45] | 1.4830 40° [45] | |
| | 200.8–201.0 [101] | 0.8384 50.5° [45] | 1.4850 35° [45] | |
| | 198–201 [87] | 0.8385 49.8° [45] | 1.48633 30° [101] | |
| | 201–202 761.2 [84] | 0.8541 30.3° [45] | 1.4878 30° [45] | |
| | 200–201 755 [17] | 0.85100 30° [101] | 1.4900 25° [45] | |
| | 201 752 [63] | 0.8602 22° [84] | 1.4920 19° [21,22] | |
| | 200–202 750 [21,22] | 0.8624 $D_{22}^{22}$ [84] | 1.49062 15° [101] | |
| | 200–201 745 [17,127] | | 1.4944 14.8° [45] | |
| | 200 | 0.862 $D_{20}^{20}$ [67] | 1.48240 $n_{H\alpha}^{25}$ [101] | |
| | −200.5 744 [68] | 0.8665 19° [21,22] | 1.48674 $n_{H\alpha}^{15}$ [101] | |
| | 201.7 | 0.8662 15.56° [98] | 1.49572 $n_{H\beta}^{25}$ [101] | |
| | −203.7 743 [13] | 0.8651 15.5° [84] | 1.50006 $n_{H\beta}^{15}$ [101] | |
| | 200.5 | 0.8664 $D_{15.5}^{15.5}$ [84] | 1.50394 $n_{H\gamma}^{25}$ [101] | |
| | −201.5 743 [114] | 0.86261 15°[101] | 1.50834 $n_{H\gamma}^{15}$ [101] | |
| | 200–201 713 [115] | 0.8681 11.5° [45] | (a) | |
| | 199–201 729 [115] | 0.8702 9.2° [45] | | |
| | 197 720 [115] | 0.87411 0° [101] | | |
| | 87 12 [92] | | | |
| | 81 10 [136] | | | |
| | 77–78 9 [45,98] | | | |
| |  | | | |
| **2-Phenylpentane** | | | | |
| | **191.6** | | | |
| | 190–194 [113] | 0.8529 [97] | 1.4852 [42] | |
| | 192–193 [42] | 0.8550 [97] | 1.4853 [97] | |
| | 191–193 [17] | 0.8576 [42] | 1.4858 [97] | |

* $\frac{dD}{dt} = -0.00077907[1 + 0.0003548(t-20)]/°C$ (9 to 95°C)

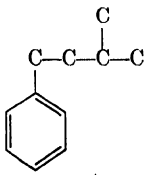
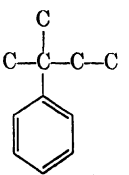
† $\frac{dD}{dt} = -0.00072298/°C$ (9 to 31°C)

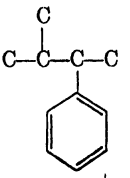
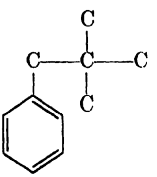
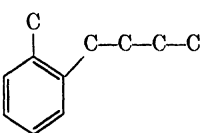
‡ $\frac{dn}{dt} = -0.0004456/°C$ (14 to 10°C)

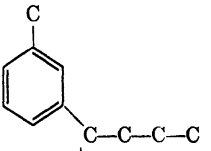
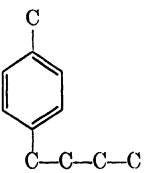
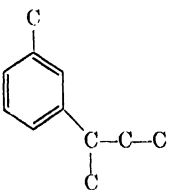
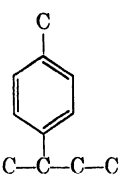
(a) Refractive indices at other lines are found in reference 101.

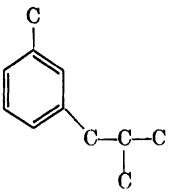
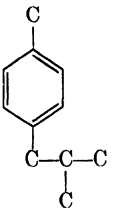
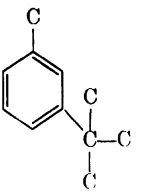
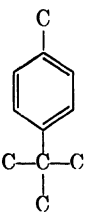
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Phenylpentane** *(Continued)* | 191–192 [111]<br>191 [47]<br>193–195 772 [75]<br>191–193 762 [40]<br>194–195 755.5 [97]<br>191–193 755 [17]<br>195.8<br>–197.2 753.8 [97]<br>191–192 750 [21,22]<br>189–190 744 [110] | 0.860 [116]<br>0.8621 [119]<br>0.8566 17° [21,22] | 1.4890 [119]<br>1.4902 25° [111]<br>1.4850 17.9° [116]<br>1.4845 17° [21,22] | |
| **3-Phenylpentane**  | 190–191 [42]<br>187.5 [10]<br>178–182 [20]<br>180 [65]<br>186–188 755 [17]<br>187 753 [17,48]<br>187–188 752 5 [22]<br>185–188 750 [109]<br>189–191 741 [40]<br>83–85 22 [109]<br>73–74 12 [48] | 0.8649 [42]<br>0.8744 21° [20]<br>0.8742 19° [22]<br>0.8755 15° [48] | 1.4880 [42]<br>1.4868 25° [65]<br>1.4973 19° [22]<br>1 4988 16° [48] | |
| **1-Phenyl-2-methylbutane**  | 193.8<br>194–195 [42]<br>194(a) [66]<br>193 [82]<br>192–193 730 [110]<br>192–193 715 [31]<br>190 710 [12]<br>80(a) 20 [66]<br>102 15 [24]<br>113–115 11 [135] | 0.8584 [42]<br>0.8680 [135]<br>0.855(a) 25° [64]<br>0.8571(b) 25° [83]<br>0.8576 25° [82]<br>0.859 25° [66] | 1.4873 [42]<br>1.4849(a) 25° [64]<br>1.4870(b) 25° [88]<br>1.4884 25° [82] | $[\alpha]_D^{25}$ = +1.80° [66]<br>$[\alpha]_D^{25}$ = +1.25° [64] (c) |

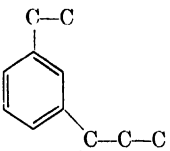
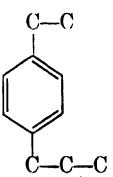
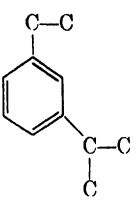
(a) This constant was determined on the *dextro*rotatary form.
(b) This constant was determined on the *levo*rotatory form.
(c) The angle of rotation at various wave lengths is given for the *levo*rotatory compound in reference 88.

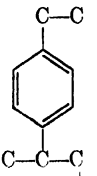
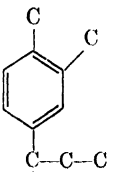
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-3-methylbutane** (Isoamylbenzene)  | **193.4** | | | |
| | 197–199 [42] | 0.856 [30] | 1.4835 [42] | |
| | 194 [60] | 0.8620 $D_{20}^{20}$ [18] | 1.4867 15.6° [49,73] | |
| | 193–194 [19] | 0.885 18° [19] | | |
| | 193 [1,71,73,89] | 0.8627 15.6° [49] | | |
| | 198–199 757 [18,49] | | | |
| | 195 755.5 [68] | | | |
| | 193 736 [94] | | | |
| | 195–196 735 [96] | | | |
| **2-Methyl-2-phenylbutane** (*tert*-Pentylbenzene)  | **189.6** | | | |
| | 190–191 [42] | 0.86248 [4] | 1.4920 [35,38] | |
| | 189–191 [38,55,120] | 0.8660 [35] | 1.4934 [42] | |
| | 189–190 [11,33] | 0.8720 [39] | 1.4860 25° [82] | |
| | 188–190 [108] | 0.8737 [42] | 1.5032 24° [108] | |
| | 189 [82] | 0.8550 25° [82] | 1.49154 23° [38] | |
| | 185–187 [61] | 0.864 24° [108] | | |
| | 186–189 747 [109] | 0.8657 21.5° [33] | | |
| | 189–191 745 [39] | 0.866 $D_{20}^{20}$ [67] | | |
| | 187.5 –189.5 737 [95] | 0.8740 $D_0^{20}$ [55] | | |
| | 191–192 735 [35] | 0.8683 15° [95] | | |
| | 77 15 [4] | 0.8736 15° [95] | | |
| | 78–82 14 [109] | 0.8741 15° [38] | | |
| | 71–74 12 [103] | 0.8889 $D_0^0$ [55] | | |
| | 71–72 12 [102] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Methyl-3-phenylbutane**  | | | | |
| | 186 [42]<br>184 [41]<br>188–189 753 [48] | 0.8795 [41,42]<br>0.8672 16° [48] | 1.4882 [41,42]<br>1.4972 16° [48] | |
| **1-Phenyl-2,2-dimethylpropane**  | | | | |
| | | **0.8569** | | |
| | 186–188 [32]<br>185–186 [42]<br>185.6–<br>–186.0 757.6 [14]<br>185.5<br>–185.9 756.6 [15] | 0.8583 [42]<br>0.7987 91.9° [15]<br>0.8114 76.3° [15]<br>0.8192 66.7° [15]<br>0.8309 52.1° [15]<br>0.8386 42.5° [15]<br>0.8483 30.3° [15]<br>0.8565 20.2° [15]<br>0.8581 18.3° [14]<br>0.8647 10° [15]<br>0.8727 0° [15] | 1.4885 [42]<br>1.48837 18.3° [14] | |
| * $\frac{dD}{dt} = -0.00080231[1+0.0002766(t-20)]/°C$ (0 to 92°C) | | | | |
| **1-Methyl-2-*n*-butylbenzene**  | | | | |
| | 200–201 [77]<br>170–<br>–170.5 743.1 [56] | 0.874 $D_{20}^{20}$ [67]<br>0.87135 18.3° [77] | 1.49662 18.3° [77]<br>1.49423 17° [86] | |

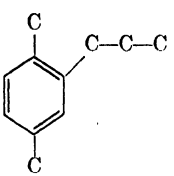
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-*n*-butylbenzene**  | 197–198 [34,77] | 0.869 $D_{20}^{20}$ [67]<br>0.86354 18.4° [77]<br>0.865 $D_{15}^{15}$ [34] | 1.49315 18.4° [77] | |
| **1-Methyl-4-*n*-butylbenzene**  | **198.4**<br>197–200 [74]<br>198–199 [77]<br>197–199 [100]<br>192<br>–192.5 742 [56]<br>82.7–83.3 13 [93] | 0.8586 [93]<br>0.860 $D_{20}^{20}$ [67]<br>0.8651 $D_{20}^{20}$ [100]<br>0.8618 14.2° [77] | 1.4916 [93]<br>1.4940 [100]<br>1.493565 17° [56]<br>1.4912 14.2° [77]<br>1.5009 14° [74] | |
| – 85 [93] | | | | |
| **1-Methyl-3-*sec*-butylbenzene**  | 194–198 [99]<br>193–197 [6] | | 1.4957 [6] | |
| **1-Methyl-4-*sec*-butylbenzene**  | 201–202 [6]<br>196–197 [130,131]<br>195–197 [99]<br>80 19 [35] | 0.8665 [35]<br>0.8640 19° [130,131] | 1.4938 [35]<br>1.4950 [6]<br>1.4917 19° [130,131] | |

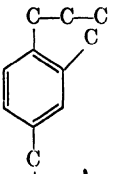
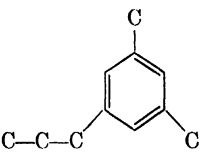
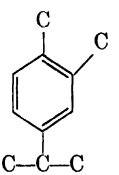
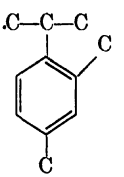
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-isobutylbenzene**  | 186–188 [46]<br>184–185 [26] | | | |
| **1-Methyl-4-isobutylbenzene**  | 200–205 [76] | | | |
| **1-Methyl-3-*tert*-butylbenzene**  | 188.5–190 [99]<br>185–187 [7] | | | |
| **1-Methyl-4-*tert*-butylbenzene**  | **190.25**<br>192–193 [69]<br>189–193 [38]<br>190 [16,122,124]<br>190–192 751 [8] | **0.8621**<br>0.861 [124]<br>0.8628 [35]<br>0.85968 25° [62] | **1.4915**<br>1.4916 [124]<br>1.49187 [69]<br>1.4919 [35,103]<br>1.4922 [5] | |

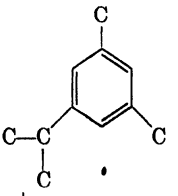
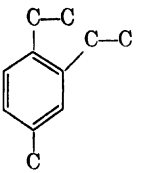
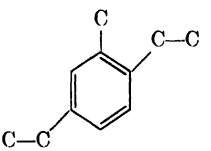
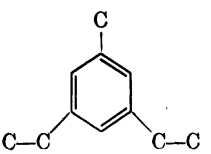
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-*tert*-butylbenzene** *(Continued)* | | 0.8614 $D_{20}^{20}$ [59] | 1.4940 [38] | |
| | | 0.86272 19° [62] | 1.489008 25° [62] | |
| | | 0.8667 13.25° [124] | 1.49465 13.25° [124] | |
| | | 0.8771 0° [122] | 1.48709 $n_{H\alpha}^{20}$ [59] | |
| | 189.8 746 [5] | | 1.49118 $n_{H\alpha}^{13.25}$ [124] | |
| | 188 740 [103] | | 1.50175 $n_{H\beta}^{20}$ [59] | |
| | 186–187 735 [35] | | 1.50513 $n_{H\beta}^{13.25}$ [124] | |
| | 94 25 [122] | | 1.51006 $n_{H\gamma}^{20}$ [59] | |
| | 76 15 [62] | | 1.51400 $n_{H\gamma}^{13.25}$ [124] | |
| | 72–72.5 12 [103] | | | |
| * $\frac{dD}{dt} = -0.0007287$/°C (0 to 25°C) | | | | |
| † $\frac{dn}{dt} = -0.0004940$/°C (13 to 25°C) | | | | |
| **1-Ethyl-3-*n*-propylbenzene**  | 193–195 [85,86] | 0.8588 19° [85] | | |
| **1-Ethyl-4-*n*-propylbenzene**  | 199–200 [128] | 0.867 19° [132] | | |
| | 202–205 765 [132] | | | |
| **1-Ethyl-3-isopropylbenzene**  | 190–192 [128,133] | | | |

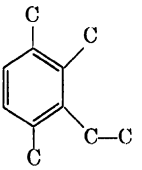
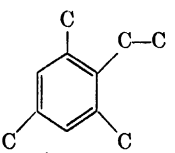
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethyl-4-isopropylbenzene**  | | | | |
| | 197–198 [128,130,131,133] | 0.864 [130,131] | 1.4846 [130,131] | |
| | 196 763 [52] | 0.8606 16° [52] | 1.4928 16° [52] | |
| | 72 10 [52] | | | |
| **1,2-Dimethyl-4-*n*-propylbenzene**  | | | | |
| | 209 [121] | 0.8677 15.3° [126] | 1.4972(a) [126] | |
| | 202–204 [126] | 0.8750 15° [126] | 1.49752 15.3° [126] | |
| | | 0.8718 12.85° [126] | 1.50294 15.1° [126] | |
| | | 0.8719 12.7° [126] | 1.49881 12.7° [126] | |
| | | | 1.49390 $n_{H\alpha}^{15.3}$ [126] | |
| | | | 1.49925 $n_{H\alpha}^{15.1}$ [126] | |
| | | | 1.49504 $n_{H\alpha}^{12.7}$ [126] | |
| | | | 1.50804 $n_{H\beta}^{15.3}$ [126] | |
| | | | 1.51375 $n_{H\beta}^{15.1}$ [126] | |
| | | | 1.50920 $n_{H\beta}^{12.7}$ [126] | |
| | | | 1.51681 $n_{H\gamma}^{15.3}$ [126] | |
| | | | 1.52277 $n_{H\gamma}^{15.1}$ [126] | |
| | | | 1.51784 $n_{H\gamma}^{12.7}$ [126] | |

(a) This refractive index is an average of two or more determinations.

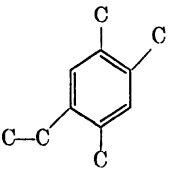
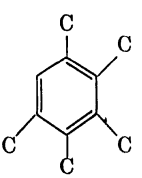
| | | | | |
|---|---|---|---|---|
| **1,4-Dimethyl-2-*n*-propylbenzene**  | | | | |
| | 206–207 [121] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-*n*-Propyl-2,4-dimethylbenzene**  | 208–208.5 [121]<br>206–207 735 [9]<br>95 23 [78]<br>90 18 [9] | 0.8786 19° [9] | 1.4995 25° [78]<br>1.501 19° [9] | |
| **1,3-Dimethyl-5-*n*-propylbenzene**  | 206–210 [121]<br>90–91 18 [78] | | 1.4913 25° [78] | |
| **1,2,-Dimethyl-4-isopropylbenzene**  | 199 [87]<br>198 732 [50]<br>86–87.5 16 [50] | 0.8710 [87]<br>0.8729 21.1° [50]<br>0.8740 15.5° [51] | 1.4991 21.1° [50]<br>1.50001 15.5° [51]<br>1.49601 $n_{H\alpha}^{15.5}$ [51]<br>1.51030 $n_{H\beta}^{15.5}$ [51]<br>1.51913 $n_{H\gamma}^{15.5}$ [51] | |
| **1-Isopropyl-2,4-dimethylbenzene**  | 194–195 [121]<br>77 13 [78,79] | | 1.4998 25° [78,79] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3-Dimethyl-5-isopropylbenzene**  | 83–85 17 [78] | | 1.4935 25° [78] | |
| **1,2-Diethyl-4-methylbenzene**  | 200–203 [68] | | | |
| **1-Methyl-2,5-diethylbenzene**  | 205–207 [70] | | | |
| **1-Methyl-3,5-diethylbenzene**  | 199.8–201.9 [72]<br>199.8–200 [81]<br>198–200 [43] | 0.8790 [43] | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Trimethyl-3-ethylbenzene**  | | | **1.5132** | * |
| | 214 725 [106] | 0.900 $D_{20}^{20}$ [106] | 1.5133 [106]<br>1.5088 30° [106]<br>1.5098 28° [106]<br>1.5106 26° [106]<br>1.5115 24° [106]<br>1.5124 22° [106]<br>1.5142 18° [106]<br>1.5150 16° [106]<br>1.5167 12° [106]<br>1.5185 8° [106]<br>1.5202 4° [106]<br>1.5218 0° [106] | |
| * $\frac{dn}{dt} = -0.0004335$/°C (0 to 30°C) | | | | |
| **1,3,5-Trimethyl-2-ethylbenzene**  | | | **1.5080** | * |
| −15.56(a) [106] | 212–214 [134]<br>207–209 [117]<br>207–208 755 [52]<br>210.2 753 [123]<br>210 725 [106]<br>93–94 16 [52] | 0.866 [123]<br>0.894 $D_{20}^{20}$ [106]<br>0.8907 18.5° [52]<br>0.8885 16.35° [123] | 1.5074 [106]<br>1.5111 [123]<br>1.51167 [54A,125]<br>1.5028 30° [106]<br>1.5039 28° [106]<br>1.5048 26° [106]<br>1.5057 24° [106]<br>1.5066 22° [106]<br>1.5091 18.5° [52]<br>1.5082 18° [106]<br>1.51274 16.35° [123]<br>1.5091 16° [106]<br>1.5110 12° [106]<br>1.5129 8° [106]<br>1.5147 4° [106]<br>1.5161 0° [106]<br>1.50875 $n_{H\alpha}^{16.35}$ [123]<br>1.52416 $n_{H\beta}^{16.35}$ [123]<br>1.53376 $n_{H\gamma}^{16.35}$ [123] | |
| * $\frac{dn}{dt} = -0.0004397$/°C (0 to 30°C) | | | | |

(a) This figure is given as a freezing point in the literature.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Trimethyl-5-ethylbenzene**  | | | **1.5079** | |
| −13.58(a) [106] | 211 [123,126] | 0.889 $D_{20}^{20}$ [106] | 1.5075 [106] | |
| | 206–208 [118,134] | 0.8866 15.85° [123] | 1.5086 [123,126] | |
| | 208 758 [52] | 0.8867 15.75° [123] | 1.5111 [126] | |
| | 210 725 [108] | 0.8890 14° [52] | 1.5029 30° [106] | |
| | 91–93 15 [126] | 0.8937 12.15° [126] | 1.5039 28° [106] | |
| | 88 13 [52] | 0.8938 12.05° [126] | 1.5049 26° [106] | |
| | | | 1.5057 24° [106] | |
| | | | 1.5066 22° [106] | |
| | | | 1.5084 18° [106] | |
| | | | 1.5094 16° [106] | |
| | | | 1.51047 15.75° [123] | |
| | | | 1.5077 14° [52] | |
| | | | 1.51474 12.05° [126] | |
| | | | 1.5113 12° [106] | |
| | | | 1.5128 8° [106] | |
| | | | 1.5145 4° [106] | |
| | | | 1.5161 0° [106] | |
| | | | 1.50654 $n_{H\alpha}^{15.75}$ [123] | |
| | | | 1.51078 $n_{H\alpha}^{12.05}$ [126] | |
| | | | 1.52163 $n_{H\beta}^{15.75}$ [123] | |
| | | | 1.52580 $n_{H\beta}^{12.05}$ [126] | |
| | | | 1.53112 $n_{H\gamma}^{15.75}$ [123] | |
| | | | 1.53481 $n_{H\gamma}^{12.05}$ [126] | |
| $*\frac{dn}{dt} = -0.0004401$/°C (0 to 30°C) | | | | |
| (a) This figure is given as a freezing point in the literature. | | | | |
| **Pentamethylbenzene**  | | | | |
| **53.0** | **231.4** | **0.8580 100°** | | Crit. Temp. (°C) |
| 54.3 [28] | 231.9 [69] | 0.7735 207.4° [25] | 1.5287 [126] | 456 [129] |
| 52.2–53.1 [107] | 231 [44,60] | 0.7822 197.0° [25] | 1.50489 72.8° [126] | |
| 53 [23,29,37] | 230–230.5 [64] | 0.8131 157.8° [25] | 1.48484 $n_{H\alpha}^{107.2}$ [27] | |
| 52–53 [36] | 230 [2,105,129] | 0.8514 108.1° [25] | 1.50104 $n_{H\alpha}^{72.8}$ [126] | |
| 52 [104,106] | 229 [39] | 0.8516 107.8° [25] | | |

| M. P.,:C | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|
| **Pentamethylbenzene** *(Continued)* | | | 0.8472 | 107.2° [27] | 1.49932 | $n_{H\beta}^{107.2}$ [27] | |
| | | | 0.8757 | 75.5° [25] | 1.51609 | $n_{H\beta}^{72.8}$ [126] | |
| | | | 0.8780 | 73.5° [126] | | | |
| 51.5 [44,54,112] | 127–129 | 20 [105] | 0.8786 | 72.8° [126] | | | |
| 51 [90] | 108 | 15 [126] | 1.018 | 0° [137] | | | |
| 50–51 [126] | 104.0 | | | | | | |
| | −104.2 | 11 [54] | | | | | |

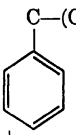
* $\frac{dD}{dt} = -0.00074175[1+0.001133(t-100)]/°C$ (72 to 208°C)

## $C_{11}H_{16}$ References


1. Acree, S. F., Am. Chem. J. **29**, 588 **1903**.
2. Ador, E., and A. Rilliet, Ber. **12**, 329 **1879**.
3. Albesco, G., Ann. chim. [9] **18**, 216 **1922**.
4. Anschütz, R., and H. Beckerhoff, Ann. **327**, 218 **1903**.
5. Baker, J. W., and L. G. Groves, J. Chem. Soc. **1939**, 1147.
6. Barkenbus, C., R. L. Hopkins, and J. F. Allen, J. Am. Chem. Soc. **61**, 2452 **1939**.
7. Baur, A., Ber. **24**, 2832 **1891**.
8. Berg, R., Roczniki Chem. **14**, 1249 **1934**; C.A. **29**, 6223 **1935**; Chem. Zentr. **1935**, I, 2807.
9. Bert, L., and M. Anglade, Compt. rend. **189**, 645 **1929**.
10. Blondeau, J., Ann. chim. [10] **2**, 5 **1924**.
11. Boedtker, E., Bull. soc. chim. [4] **45**, 645 **1929**.
12. Bogert, M. T., and G. Powell, J. Am. Chem. Soc. **53**, 2747 **1931**.
13. Buehler, C. A., T. S. Gardner, and M. L. Clemens, J. Org. Chem. **2**, 167 **1937**.
14. Bygdén, A., Ber. **45**, 3479 **1912**.
15. Bygdén, A., Thesis, Uppsala, **1916**; C.A. **14**, 1974 **1920**.
16. Calcott, W. S., J. M. Tinker, and V. Weinmayr, J. Am. Chem. Soc. **61**, 1010 **1939**.
17. Chromov, S. I., J. Gen. Chem. (U.S.S.R.) **7**, 350 **1937**; C.A. **31**, 4653 **1937**; Chem. Zentr. **1937**, I, 4930.
18. Claisen, L., F. Kremers, F. Rath, and E. Tietze, J. prakt. Chem. [2] **105**, 65 **1922**.
19. Claus, A., J. prakt. Chem. [2] **46**, 474 **1892**.
20. Dafert, F. W., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **87**, Abt. II, 460 **1883**.
21. Denisenko, Y. I., Ber. **69**, 1353 **1936**.
22. Denisenko, Y. I., J. Gen. Chem. (U.S.S.R.) **9**, 1068 **1939**; C.A. **33**, 8578 **1939**.
23. Dilthey, W., and G. Hurtig, Ber. **67**, 495 **1934**.
24. Dumesnil, P., Ann. chim. [9] **8**, 70 **1917**.
25. Dutoit, P., and L. Friederich, Arch. sci. phys. nat. [4] **9**, 105 **1900**.
26. Effront, J., Ber. **17**, 2317 **1884**.
27. Eykman, J. F., Rec. trav. chim. **12**, 157 **1893**.
28. Ferry, J. D., and S. B. Thomas, J. Phys. Chem. **37**, 253 **1933**.
29. Friedel, C., and J. M. Crafts, Ann. chim. phys. [6] **1**, 449 **1884**.
30. Gilman, H., and N. J. Beaber, J. Am. Chem. Soc. **47**, 518 **1925**.
31. Glattfeld, J. W. E., and C. N. Cameron, J. Am. Chem. Soc. **49**, 1043 **1927**.
32. Glattfeld, J. W. E., and C. H. Milligan, J. Am. Chem. Soc. **42**, 2322 **1920**.
33. Gleditsch, E., Bull. soc. chim. [3] **35**, 1094 **1906**.
34. Hall, C. C., J. Soc. Chem. Ind. **54**, 208 **1935-1936**.
35. Hennion, G. F., and R. A. Kurtz, J. Am. Chem. Soc. **65**, 1001 **1943**.
36. Hofmann, A. W., Ber. **18**, 1821 **1885**.
37. Hofmann, K. A., and H. Arnoldi, Ber. **39**, 339 **1906**.

38. Howes, D. A., and A. W. Nash, J. Soc. Chem. Ind. **49**, 16T **1930**.
39. Huston, R. C., W. B. Fox, and M. N. Binder, J. Org. Chem. **3**, 251 **1938**.
40. Huston, R. C., and I. A. Kaye, J. Am. Chem. Soc. **64**, 1576 **1942**.
41. Ipatieff, V., H. Pines, and L. Schmerling, J. Am. Chem. Soc. **60**, 353 **1938**.
42. Ipatieff, V. N., and L. Schmerling, J. Am. Chem. Soc. **60**, 1476 **1938**.
43. Jacobsen, O., Ber. **7**, 1430 **1874**.
44. Jacobsen, O., Ber. **20**, 896 **1887**.
45. Ju, T. Y., G. Shen, and C. E. Wood, J. Inst. Petroleum Tech. **26**, 514 **1940**.
46. Kelbe, W., and A. Baur, Ber. **16**, 2559 **1883**.
47. Klages, A., Ber. **35**, 2633 **1902**.
48. Klages, A., Ber. **36**, 3688 **1903**.
49. Klages, A., Ber. **37**, 2301 **1904**.
50. Klages, A., Ber. **39**, 2306 **1906**.
51. Klages, A., Ber. **40**, 2360 **1907**.
52. Klages, A., and R. Keil, Ber. **36**, 1632 **1903**.
53. Klages, A., and C. Stamm, Ber. **37**, 1715 **1904**.
54. Kohlrausch, K. W. F., and A. Pongratz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **143**, Abt. IIb, 358 **1934**.
54A. Kolligs through K. von Auwers and H. Kolligs, Ber. **55**, 21 **1922**.
55. Konovalov, M., and J. Egorov, J. Russ. Phys. Chem. Soc. **30**, 1031 **1898**; Chem. Zentr. **1899**, I, 776.
56. Kozak, M. J., Anz. Akad. Wiss. Krakau **1906**, 407.
57. Kruber, O., Ber. **57**, 1008 **1924**.
58. Kunckell, F., and G. Ulex, J. prakt. Chem. [2] **87**, 227 **1912**.
59. Lacourt, A., Bull. soc. chim. Belg. **38**, 1 **1929**.
60. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918**.
61. Larsen, R. G., R. E. Thorpe, and F. A. Armfield, Ind. Eng. Chem. **34**, 183 **1942**.
62. LeFevre, C. G., R. J. W. LeFevre, and K. W. Robertson, J. Chem. Soc. **1935**, 480.
63. Lepin, A., Acta Univ. Latviensis, Kim. Fakultat. Ser. 1, 145 **1932**; C.A. **25**, 3328 **1931**; Chem. Zentr. **1931**, I, 2619.
64. Levene, P. A., and M. Kuna, J. Biol. Chem. **110**, 323 **1935**.
65. Levene, P. A., and R. E. Marker, J. Biol. Chem. **108**, 409 **1935**.
66. Levene, P. A., and R. E. Marker, J. Biol. Chem. **110**, 299 **1935**.
67. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. **26**, 475 **1934**.
68. Lozovoi, A. V., M. K. Diakova, and T. G. Stepanzeva, J. Gen. Chem. (U.S.S.R.) **9**, 540 **1939**.
69. MacDougall, F. H., and L. I. Smith, J. Am. Chem. Soc. **52**, 1998 **1930**.
70. Mailhe, A., Bull. soc. chim. [4] **35**, 365 **1924**.
71. Mailhe, A., and F. de Godon, Bull. soc. chim. [4] **21**, 61 **1917**.
72. Markovnikov, V., Ann. **234**, 89 **1886**.
73. Martin, E., Ann. combustibles liquides **12**, 97 **1937**.
74. Marvel, C. S., F. D. Hager, and D. D. Coffman, J. Am. Chem. Soc. **49**, 2323 **1927**.
75. Menshutkin, B. N., J. Russ. Phys. Chem. **43**, 1275 **1911**; C.A. **6**, 734 **1912**.
76. Meyer, H., and K. Bernhauer, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **138**, Abt. IIb, 721 **1929**.
77. Niemczycki, S., Anz. Akad. Wiss. Krakau **1899**, 473.
78. Nightingale, D. V., and B. Carton, Jr., J. Am. Chem. Soc. **62**, 280 **1940**.
79. Nightingale, D. V., and F. Wadsworth, J. Am. Chem. Soc. **63**, 3514 **1941**.
80. Noelting, E., Chimie & industrie **6**, 719 **1921**.
81. Norris, J. F., and D. Rubinstein, J. Am. Chem. Soc. **61**, 1163 **1939**.
82. O'Connor, M. J., and F. J. Sowa, J. Am. Chem. Soc. **60**, 125 **1938**.
83. Pestemer, M., and O. Gübitz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **143**, Abt. IIb, 340 **1934-1935**.
84. Radcliffe, L. G., and N. Simpkin, J. Soc. Chem. Ind. **40**, 119T **1921**.
85. Renard, A., Ann. chim. phys. [6] **1**, 223 **1884**.
86. Renard, A., Compt. rend. **97**, 328 **1883**.

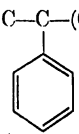
87. Rossander, S. S., and C. S. Marvel, J. Am. Chem. Soc. **50**, 1491 **1928.**
88. Rothen, A., and P. A. Levene, J. Chem. Phys. **7**, 975 **1939.**
89. Sabatier, P., and A. Mailhe, Compt. rend. **158**, 830 **1914.**
90. Savard, J., and R. Hösögüt, Rev. faculté sci. univ. Istanbul [N.S.] **3**, 164 **1938**; C.A. **32**, 5795 **1938.**
91. Schmidt, A. W., Ber. **75**, 1399 **1942.**
92. Schmidt, A. W., G. Hopp, and F. Schoeller, Ber. **72**, 1893 **1939.**
93. Schmidt, A. W., and V. Schoeller, Ber. **74**, 258 **1941.**
94. Schramm, J., Ann. **218**, 383 **1883.**
95. Schramm, J., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **97**, Abt. IIb, 586 **1888.**
96. Senkowski, M., Ber. **24**, 2974 **1891.**
97. Sergienko, S. R., Compt. rend. acad. sci., U.R.S.S., **27**, 960 **1940.**
98. Shen, G., C. E. Wood, and F. H. Garner, J. Inst. Petroleum Tech. **25**, 695 **1939.**
99. Shoesmith, J. B., and J. F. McGechen, J. Chem. Soc. **1930**, 2231.
100. Shorygin, P., V. Issagulyants, and A. Guseva, Ber. **66**, 1426 **1933.**
101. Simon, I., Bull. soc. chim. Belg. **38**, 47 **1929.**
102. Simons, J. H., and S. Archer, J. Am. Chem. Soc. **60**, 2952 **1938.**
103. Simons, J. H., and S. Archer, J. Am. Chem. Soc. **60**, 2953 **1938.**
104. Smith, L. I., Organic Syntheses **10**, 32 **1930.**
105. Smith, L. I., and F. J. Dobrovolny, J. Am. Chem. Soc. **48**, 1413 **1926.**
106. Smith, L. I., and M. A. Kiess, J. Am. Chem. Soc. **61**, 284 **1939.**
107. Smith, L. I., and F. H. McDougall, J. Am. Chem. Soc. **51**, 3001 **1929.**
108. Smith, R. A., J. Am. Chem. Soc. **59**, 899 **1937.**
109. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1207 **1913.**
110. Stenzl, H., and F. Fichter, Helv. Chim. Acta **17**, 669 **1934.**
111. Stephens, H. N., and F. L. Roduta, J. Am. Chem. Soc. **57**, 2380 **1935.**
112. Stohmann, F., C. Kleber, and H. Langbein, J. prakt. Chem. [2] **40**, 77 **1899.**
113. Stratford, R., Ann. combustibles liquides **4**, 83 **1929.**
114. Tafel, J., Ber. **45**, 437 **1912.**
115. Thierfelder, H., and E. Klenk, Z. physiol. Chem. **141**, 13 **1924.**
116. Tilicheev, M. D., Khim. Tverdogo Topliva **9**, 181 **1938.**
117. Töhl, A., Ber. **28**, 2459 **1895.**
118. Töhl, A., and D. von Karchowski, Ber. **25**, 1530 **1892.**
119. Toussaint, N. F., and G. F. Hennion, J. Am. Chem. Soc. **62**, 1145 **1940.**
120. Tsukervanik, I., J. Gen. Chem. (U.S.S.R.) **5**, 117 **1935**; C.A. **29**, 4746 **1935**; Chem. Zentr. **1936**, II, 2896.
121. Uhlhorn, E., Ber. **23**, 2349 **1890.**
122. Verley, A., Bull. soc. chim. [3] **19**, 67 **1898.**
123. von Auwers, K., Ann. **419**, 92 **1919.**
124. von Auwers, K., Ber. **49**, 2389 **1916.**
125. von Auwers, K., and H. Kolligs, Ber. **55**, 21 **1922.**
126. von Auwers, K., and K. Ziegler, Ann. **425**, 217 **1921.**
127. von Braun, J., and H. Deutsch, Ber. **45**, 2171 **1912.**
128. von der Becke, P., Ber. **23**, 3191 **1890.**
129. Walden, P., Z. physik. Chem. **65**, 129 **1909.**
130. Wallach, O., Ann. **414**, 195 **1917-1918.**
131. Wallach, O., Nachr. k. Ges. Wiss. Göttingen **1915**, 1.
132. Widman, O., Ber. **23**, 3080 **1890.**
133. Widman, O., Ber. **24**, 456 **1891.**
134. Willgerodt, C., and T. Scholtz, J. prakt. Chem. [2] **81**, 382 **1910.**
135. Zelinskiĭ, N. D., and M. V. Gaverdovskaya, Ber. **61**, 1049 **1928.**
136. Ziegler, K., F. Dersch, and H. Wollthan, Ann. **511**, 13 **1934.**
137. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **n-Hexylbenzene**  | **226.2** | **0.8602** | **1.4890** | |
| −66.8 [107] | 224–228 [133] | 0.8592 [101,102] | 1.4868 [101,102] | |
| | 227.35 ± 0.1 [107] | 0.8613 [131] | 1.490 [131] | |
| | 226–227 [50,106] | 0.862 [36] | 1.4902 [50] | |
| | 219–223 [121] | 0.8027 94.8° [50] | 1.4811 40° [50] | |
| | 219–220 [131] | 0.8223 69.7° [50] | 1.4860 30° [50] | |
| | 219 [94] | 0.8371 49.8° [50] | 1.48718 25° [107] | |
| | 219–222 768 [53] | 0.8524 30° [102] | 1.4881 25° [50] | |
| | 218–221 750 [21] | 0.85259 30° [107] | 1.49132 15° [107] | |
| | 218–220 750 [22] | 0.8526 29.7° [50] | 1.492 15° [16] | |
| | 223.8 | 0.8646 15.56° [106] | 1.48341 $n_{H\alpha}^{25}$ [107] | |
| | −224.0 748 [107] | 0.86394 15° [107] | 1.48745 $n_{H\alpha}^{15}$ [107] | |
| | 216–218 720 [120] | 0.869 15° [16] | 1.49660 $n_{H\beta}^{25}$ [107] | |
| | 97.5–101 12 [102] | 0.8685 9.0° [50] | 1.50092 $n_{H\beta}^{15}$ [107] | |
| | 93–94 9 [50,106] | 0.87527 0° [107] | 1.50547 $n_{H\gamma}^{25}$ [107] | |
| | | | 1.50976 $n_{H\gamma}^{15}$ [107] | |
| | | | (a) | |

* $\frac{dD}{dt} = -0.0007684$/°C (0 to 95°C)

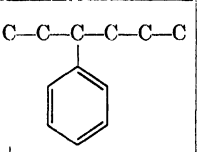
† $\frac{dn}{dt} = -0.0003751$/°C (15 to 40°C)

(a) Refractive indices of other lines are found in reference 107.

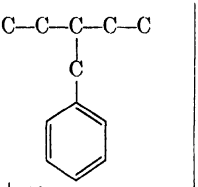
| | | | | |
|---|---|---|---|---|
| **2-Phenylhexane**  | | **0.8612** | | |
| | 208 [15] | 0.855(a) 25° [72] | 1.4902 25° [117] | $[\alpha]_D^{25} =$ +1.96°(a) [7] |
| | 206–207 [117] | 0.8581 23.5° [121] | 1.4860 17.9° [121] | |
| | 210–211 737 [45] | 0.869 15° [15] | 1.492 15° [15] | |
| | 100(a) 22 [72] | 0.8760 4° [121] | | |

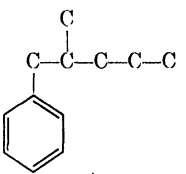
* $\frac{dD}{dt} = -0.0009412$/°C (4 to 25°C)

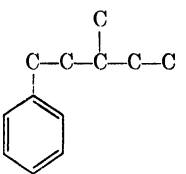
(a) This constant was determined on the *dextro*rotatory form.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **3-Phenylhexane**  | 209–212 [114]<br>106–107 30 [114]<br>105(a) 27 [72]<br>103(a) 25 [72]<br>95–96 18 [114]<br>65–66 2 [114] | 0.8524(b) $D_{20}^{25}$ [114]<br>0.863(a) 24° [72] | 1.4859(c) [114] | $[\alpha]_D^{24}$ = +0.565°(a) (d)[72] |

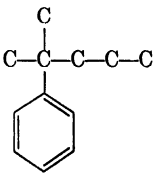
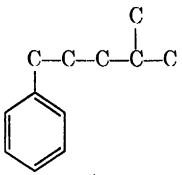
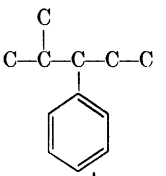
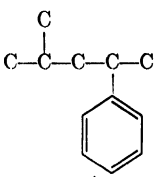
(a) This constant was determined on the *dextro*rotatory form.
(b) This density is the average of two or more determinations.
(c) This refractive index is the average of two or more determinations.
(d) This angle of rotation is the average of two or more determinations.

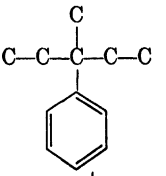
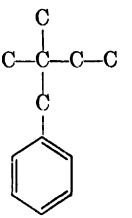
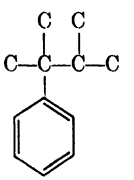
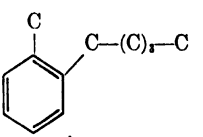
| | | | | |
|---|---|---|---|---|
| **3-Benzylpentane**  | 216.5<br>–217 735 [115] | | | |

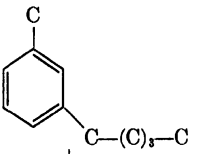
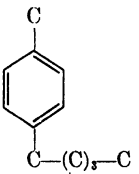
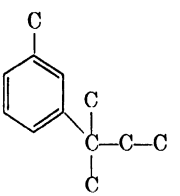
| | | | | |
|---|---|---|---|---|
| **1-Phenyl-2-methylpentane**  | 203–207 [13,115]<br>214 740 [116]<br>110 25 [25] | 0.8584 25° [13] | 1.48273 [13] | |

| | | | | |
|---|---|---|---|---|
| **1-Phenyl-3-methylpentane**  | 219–220 [115]<br>220(b) 757 [61]<br>219 740 [116]<br>112(a) 15 [73]<br>90–91(b) 9 [61] | 0.855(a) 25° [73]<br>0.8585(a) 25° [99]<br>0.8644(b) 14.5° [61] | 1.4859(a) 25° [99]<br>1.4896(b) 14.5° [61] | $[\alpha]_D^{25}$ = −2.94°[73]<br>$[\alpha]_D^{14.5}$ = +17.20° [61] (b) (c) |

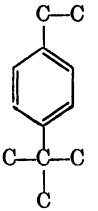
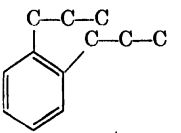
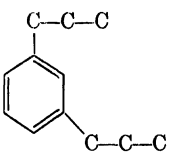
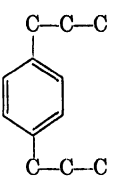
(a) This constant was determined on the *levo*rotatory form.
(b) This constant was determined on the *dextro*rotatary form.
(c) The angle of rotation at various wave lengths is given in reference 99.

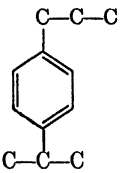
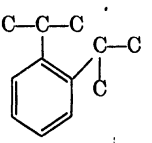
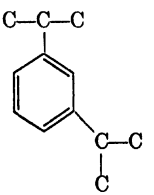
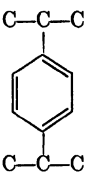
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Methyl-2-phenylpentane**  | 205–206 [105]<br>205–206 745 [44] | 0.8718 [44]<br>0.8796 10° [105] | 1.49554 16.5° [105] | |
| **1-Phenyl-4-methylpentane**  | 214–215 [3]<br>212–213 733 [104] | 0.8568 16° [104] | | |
| **2-Methyl-3-phenylpentane**  | 200 [1] | | | |
| **2-Methyl-4-phenylpentane**  | 197 [9,56]<br>197–198 735 [45]<br>84 13 [56]<br>77 9 [56] | 0.863 15° [9]<br>0.8634 15° [56] | 1.4876 15° [9,56] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
|  3-Methyl-3-phenylpentane | 204–206 [105]<br>205–206 745 [44]<br>86–88 15 [44] | 0.8718 [44]<br>0.8773 15° [105] | 1.49724 16.5° [105] | |
|  2-Methyl-2-benzylbutane | 214.5 753 [119] | 0.860 19° [119] | 1.4882 19° [119] | |
|  2,3-Dimethyl-2-phenylbutane | 209–210 745 [44]<br>86–87 15 [44] | 0.8814 [44] | | |
|  1-Methyl-2-*n*-pentylbenzene | | 0.874 $D_{20}^{20}$ [75] | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-*n*-pentylbenzene**  | | | | |
| | 207–209 [26] | 0.8679 22° [26] | 1.49046 21.6° [20] | |
| | 220.5 | 0.8647 20° [26] | | |
| | −222.5 738 [20] | 0.861 $D_{20}^{20}$ [75] | | |
| | 102–106 16.5 [20] | | | |
| **1-Methyl-4-*n*-pentylbenzene**  | | | | |
| −28 [103] | 98.9–99.5 12 [103] | 0.857 [75] | 1.4904 [103] | |
| | | 0.8582 [103] | | |
| **1-Methyl-3-*tert*-pentylbenzene**  | | | | |
| | | **0.8671** | | |
| | 208–209 [18] | 8673 [18] | | |
| | 208.2–208.8 [86] | 0.8082 100° [18] | | |
| | | 0.8161 90° [18] | | |
| | | 0.8229 80° [18] | | |
| | | 0.8304 70° [18] | | |
| | | 0.8337 60° [18] | | |
| | | 0.8454 50° [18] | | |
| | | 0.8524 40° [18] | | |
| | | 0.8602 30° [18] | | |
| | | 0.8774 10° [18] | | |
| | | 0.8817 0° [18] | | |
| | | 0.8888 −10° [18] | | |
| | | 0.8930 −20° [18] | | |

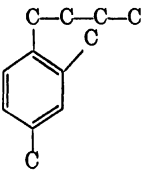
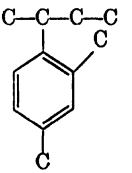
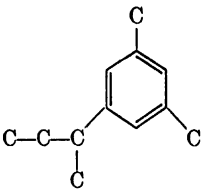
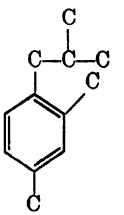
* $\frac{dD}{dt} = -0.00071648[1+0.001016(t-20)]/°C$ (−20 to 100°C)

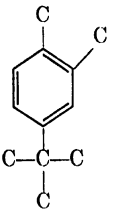
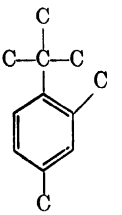
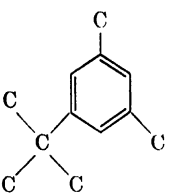
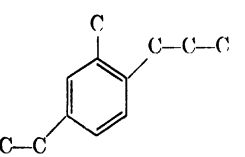
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethyl-4-*tert*-butylbenzene**  | 209–213 [19]<br>207–208 751 [8] | 0.865 $D_{20}^{20}$ | 1.4950 [8] | |
| **1,2-Di-*n*-propylbenzene**  | 184 [38] | 0.8770 15.0° [38] | | |
| **1,3-Di-*n*-propylbenzene**  | 215–218 [123A]<br>105 20 [6] | 0.9137 $D_{17}^{17}$ [123A] | 1.5155 16° [123A] | |
| **1,4-Di-*n*-propylbenzene**  | 220–222 [66]<br>218–220 [65]<br>220–221 745.45 [29]<br>109 22 [130]<br>110 20 [6] | 0.856 [130]<br>0.8563 19.4° [130] | 1.48775 $n_{H\alpha}^{19.4}$ [130]<br>1.50136 $n_{H\beta}^{19.4}$ [130]<br>1.4914 $n_{He}^{20}$ [130]<br>1.49167 $n_{He}^{19.4}$ [130] | |

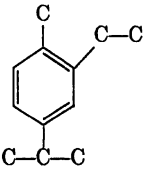
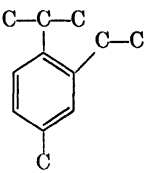
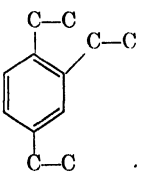
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-*n*-Propyl-4-isopropylbenzene**  | | | | |
| | 213.5 | 0.871 8° [11] | 1.502 8° [11] | |
| | −215.5 745.45 [28] | | | |
| | 210 731 [11] | | | |
| **1,2-Diisopropylbenzene**  | | | | |
| | 209 [124] | | | |
| **1,3-Diisopropylbenzene**  | | | | |
| | 203.5–204.5 [10] | 0.8566 [83] | 1.4884 [83] | |
| | 204 [51,124] | 0.8596 [51] | 1.4838 30° [83] | |
| | 203.0 [83] | 0.8484 30° [83] | | |
| | 203–205 766 [35] | | | |
| | 75–76 9 [51] | | | |
| **1,4-Diisopropylbenzene**  | | | | |
| | **208.9** | **$0.8576_5$** | **1.4900** | |
| | 210.3 [83] | 0.8571 [83] | 1.4895 [83] | |
| | 210 [84] | 0.8494 30° [83] | 1.4907 [47] | |
| | 205–210 [79] | 0.8550 25° [91] | 1.4850 30° [83] | |
| | 204.5 [91] | 0.860 14° [54] | 1.4892 25° [91] | |
| | 205.5– | | 1.492 16° [54] | |
| | 206.5 755 [46] | | | |
| | 85–86 14 [84] | | | |

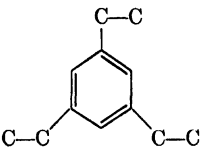
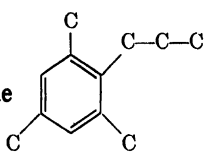
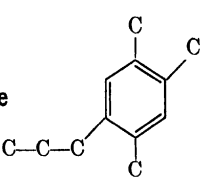
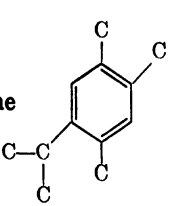
* $\frac{dD}{dt} = -0.0007651$/°C (14 to 30°C)

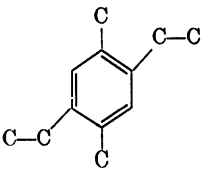
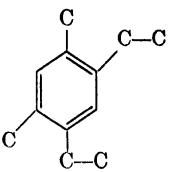
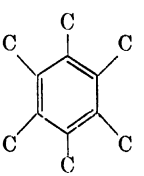
† $\frac{dn}{dt} = -0.0004736$/°C (16 to 30°C)

| M. P.,°C | B. P.,°C @ 760mm | $D_4^2$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-*n*-Butyl-2,4-dimethylbenzene  | 96 8 [85] | 0.8728 $D_{20}^{20}$ [85] | 1.4972 25° [85] | |
| 1-*sec*-Butyl-2,4-dimethylbenzene  | 84 8 [85] | 0.8680 $D_{20}^{20}$ [85] | 1.4939 25° [85] | |
| 1,3-Dimethyl-5-*sec*-butylbenzene  | 98 15 [85] | 0.8631 $D_{20}^{20}$ [85] | 1.4920 25° [85] | |
| 1-Isobutyl-2,4-dimethylbenzene  | 96 15 [85] | 0.8704 $D_{20}^{20}$ [85] | 1.4974 25° [85] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Dimethyl-4-*tert*-butylbenzene**  | | | | |
| | 83–85 3 [84] | | 1.4970 25° [84] | |
| **1-*tert*-Butyl-2,4-dimethylbenzene**  | | | | |
| −31 [85] | 210–214 [112]<br>113–114 28 [112]<br>86 12 [85] | 0.9372 30° [112]<br>0.8634 $D_{20}^{20}$ [85] | 1.5030 37° [112]<br>1.4909 25° [85] | |
| **1,3-Dimethyl-5-*tert*-butylbenzene**  | | | | |
| | **205.1** | | **1.4958** | |
| −21.5 [85] | 205.5–206.5 [90]<br>204–206 [76]<br>200–202 [112]<br>203–206 756 [71]<br>200–202 747 [7]<br>85 11 [27] | 0.8619 30° [112]<br>0.8671 $D_{20}^{20}$ [85]<br>0.870 15° [76] | 1.4890 37° [112]<br>1.4935 25° [85]<br>1.4980 15° [76] | |
| * $\frac{dn}{dt}$ = −0.00040797/°C (15 to 37°C) | | | | |
| **1-Methyl-2-*n*-propyl-5-ethylbenzene**  | | | | |
| | 213–215 [78] | 0.8831 11° [78] | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **-Methyl-2-ethyl-4-isopropylbenzene**  | | **0.8673** | | * |
| | 204 [127] | 0.8665 21.1° [57] | 1.4965 21.1° [57] | |
| | 214 754 [57] | 0.8706 15.7° [58] | 1.49878 15.6° [58] | |
| | 104–105 21 [127] | 0.8708 15.6° [58] | 1.49670 15° [58] | |
| | 103 19 [57] | | 1.49494 $n_{H\alpha}^{15.6}$ [58] | |
| | 100 17 [58] | | 1.49275 $n_{H\alpha}^{15}$ [58] | |
| | | | 1.50878 $n_{H\beta}^{15.6}$ [58] | |
| | | | 1.50669 $n_{H\beta}^{15}$ [58] | |
| | | | 1.51739 $n_{H\gamma}^{15.6}$ [58] | |
| $\frac{dD}{dt} = -0.00077095$/°C (15 to 21°C) | | | 1.51530 $n_{H\gamma}^{15}$ [58] | |
| **-Isopropyl-2-ethyl-4-methylbenzene**  | | | | |
| | 209–213 [128] | 0.8756 15.7° [128] | 1.49819 $n_{H\alpha}^{15.7}$ [128] | |
| | | | 1.51229 $n_{H\beta}^{15.7}$ [128] | |
| | | | 1.52096 $n_{H\gamma}^{15.7}$ [128] | |
| | | | 1.50227 $n_{He}^{15.7}$ [128] | |
| **,2,4-Triethylbenzene**  | | | | |
| 86–87 [109] | 218 [69] | 0.882 [69] | 1.4983 17° [60] | |
| | 216–218 [59] | 0.8819 17° [60] | | |
| | 217–218 755 [60] | | | |
| | 99 15 [60] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5-Triethylbenzene**  | | | | * |
| | **216.2** | **0.8624** | | |
| 100–102 [109] | 218 [24,69] | 0.863 [69] | 1.4951 [60] | |
| | 217.04 [132] | 0.8633 [55] | 1.4956 18.1° [87] | |
| | 217 [55] | 0.8655 [132] | | |
| | 215.2–216.2 [89] | 0.8568 25° [23] | | |
| | 215.4 [88] | 0.8636 17° [60] | | |
| | 215–215.2 [89] | 0.8772 0° [23] | | |
| | 214 765 [81] | | | |
| | 214.8 755.1 [87] | | | |
| | 215 755 [60] | | | |
| | 95 14 [60] | | | |
| | 66 4 [81] | | | |
| * $\frac{dD}{dt} = -0.0008372$/°C (0 to 25°C) | | | | |
| **1,3,5-Trimethyl-2-*n*-propylbenzene**  | | | | |
| | 220–221 [62,123] | 0.8757 25° [62] | 1.5009 25° [62] | |
| | | 0.8773 20° [123] | | |
| **1,2,4-Trimethyl-5-*n*-propylbenzene**  | | | | |
| | 226–228 [42] | 0.887 [42] | 1.5095 [42] | |
| **1,2,4-Trimethyl-5-isopropylbenzene**  | | | | |
| | 221.5–223.5 [129] | 0.8795 21° [129] | 1.50648 21° [129] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Dimethyl-2,5-diethylbenzene**  | 104.5–105 15 [30] | 0.8803 [30] | 1.5091 [30] | |
| **1,5-Dimethyl-2,4-diethylbenzene**  | 105 15 [96] | | | |
| **Hexamethylbenzene**  | | | | |
| **165.3** | **263.8** | | | |
| 166 [37,48,49,63,126] | 265 [37,49,70] | 1.072 0° [134] | (b) | |
| 165.5 [5,93,113,122,125] | 264–265 [48] | 1.020 (solid) [67] | | |
| 165 [108] | 264 [32,33] | 1.042 (solid) [17] | | |
| 164–165 [4,64] | 263.9 [82] | | | |
| 164.3–164.8 [111] | 263.6 [77] | | | |
| 164 (a) | 263 [31] | | | |
| 163.5–164 [14] | | | | |
| 163 [2,40] | | | | |
| 162–163 [52,9a] | | | | |
| 162 [110] | | | | |

(a) The melting point 164 is found in references 17, 24, 31, 32, 33, 41, 43, 74, 80, 97, 98, 100, 118.
(b) Refractive indices of other lines may be found in reference 12.

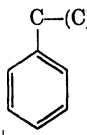
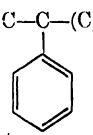
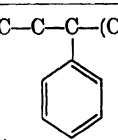
## $C_{12}H_{18}$ References


1. Albesco, G., Ann. chim. [9] **18**, 216 **1922**.
2. Almedingen, J. Russ. Phys. Chem. Soc. **1**, 392 **1881**; Ber. **14**, 2073 **1881**.
3. Aronheim, B., Ann. **171**, 219 **1874**.
4. Ayres, E. B., and C. R. Hauser, J. Am. Chem. Soc. **64**, 2461 **1942**.
5. Backer, H. J., Rec. trav. chim. **54**, 745 **1935**.

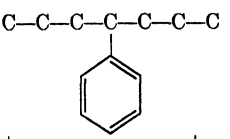
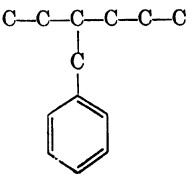
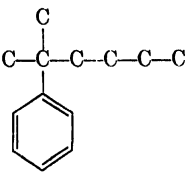
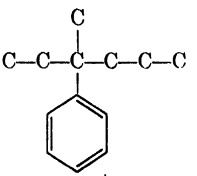
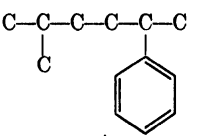
6. Baddeley, G., and J. Kenner, J. Chem. Soc. **1935**, 303.
7. Baur, A., Ber. **24**, 2832 **1891**.
8. Berg, R., Roczniki Chem. **14**, 1249 **1934**; Chem. Zentr. **1935**, I, 2807; C.A. **29**, 6223 **1935**.
9. Berman, N., and A. Lowy, J. Am. Chem. Soc. **60**, 2596 **1938**.
10. Berry, T. M., and E. E. Reid, J. Am. Chem. Soc. **49**, 3142 **1927**.
11. Bert, L., Bull. soc. chim. [4] **37**, 1577 **1925**.
12. Bhagavantum, S., Proc. Roy. Soc. (London) **126A**, 143 **1929**.
13. Bjelouss, E., Ber. **45**, 625 **1912**.
14. Briner, E., W. Plüss, and H. Paillard, Helv. Chim. Acta **7**, 1046 **1924**.
15. Brochet, A., Bull. soc. chim. [3] **9**, 687 **1893**.
16. Brochet, A., Compt. rend. **117**, 115 **1893**.
17. Brockway, L. O., and J. M. Robertson, J. Chem. Soc. **1939**, 1324.
18. Charrier, G., Gazz. chim. ital. **52**, II, 317 **1922**.
19. Darzens, G., Compt. rend. **139**, 868 **1904**.
20. de Capeller, R., Helv. Chim. Acta **11**, 170 **1928**.
21. Denisenko, Y. I., Ber. **69**, 1668 **1936**.
22. Denisenko, Y. I., J. Gen. Chem. (U.S.S.R.) **9**, 1068 **1939**; C.A. **33**, 8578 **1939**.
23. Dillingham, W. B., and E. E. Reid, J. Am. Chem. Soc. **60**, 2606 **1938**.
24. Dilthey, W., and G. Hurtig, Ber. **67**, 495 **1934**.
25. Dumesnil, P., Ann. chim. [9] **8**, 70 **1917**.
26. Essner, J. C., and E. Gossin, Bull. soc. chim. [2] **42**, 213 **1884**.
27. Fichter, F., and R. E. Meyer, Helv. Chim. Acta **17**, 535 **1934**.
28. Fileti, M., Gazz. chim. ital. **21**, I, 4 **1891**.
29. Fileti, M., Gazz. chim. ital. **21**, I, 22 **1891**.
30. Freund, M., and K. Fleischer, Ann. **414**, 1 **1918**.
31. Friedel, C., and J. M. Crafts, Ann. chim. phys. [6] **1**, 449 **1884**.
32. Friedel, C., and J. M. Crafts, Ann. chim. phys. [6] **10**, 411 **1887**.
33. Friedel, C., and J. M. Crafts, Compt. rend. **91**, 257 **1880**.
34. Gattermann, L., S. Fritz, and K. Beck, Ber. **32**, 1122 **1899**.
35. Genvresse, P., Bull. soc. chim. [3] **9**, 219 **1893**.
36. Gilman, H., and N. J. Beaber, J. Am. Chem. Soc. **47**, 518 **1925**.
37. Grosse, A. V., and V. N. Ipatieff, J. Org. Chem. **2**, 447 **1937**.
38. Hall, C. C., Fuel **12**, 76 **1933**.
39. Hennion, G. F., and R. A. Kurtz, J. Am. Chem. Soc. **65**, 1001 **1943**.
40. Hofmann, A. W., Ber. **13**, 1729 **1880**.
41. Hofmann, K. A., and H. Arnoldi, Ber. **39**, 339 **1906**.
42. Holmberg, B., Svensk Kem. Tid. **40**, 304 **1928**.
43. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 **1930**.
44. Huston, R. C., W. B. Fox, and M. N. Binder, J. Org. Chem. **3**, 251 **1938**.
45. Huston, R. C., and I. A. Kaye, J. Am. Chem. Soc. **64**, 1576 **1942**.
46. Ipatieff, V. N., B. B. Corson, and H. Pines, J. Am. Chem. Soc. **58**, 919 **1936**.
47. Ipatieff, V. N., and H. Pines, J. Am. Chem. Soc. **59**, 56 **1937**.
48. Jacobsen, O., Ber. **19**, 1209 **1886**.
49. Jacobsen, O., Ber. **20**, 896 **1887**.
50. Ju, T. Y., G. Shen, and C. E. Wood, J. Inst. Petroleum Tech. **26**, 514 **1940**.
51. Ju, T. Y., C. E. Wood, and F. H. Garner, J. Inst. Petroleum Tech. **28**, 159 **1942**.
52. Kashima, K., Bull. Chem. Soc. Japan **4**, 177 **1929**.
53. Khardin, D., J. Russ. Phys. Chem. Soc. **40**, 592; C.A. **3**, 1008 **1909**.
54. Kirrmann, A., and M. Graves, Bull. soc. chim. [5] **1**, 1494 **1934**.
55. Klages, A., Ber. **32**, 1549 **1899**.
56. Klages, A., Ber. **37**, 2301 **1904**.
57. Klages, A., Ber. **39**, 2306 **1906**.
58. Klages, A., Ber. **40**, 2360 **1907**.
59. Klages, A., J. prakt. Chem. [2] **65**, 394 **1902**.

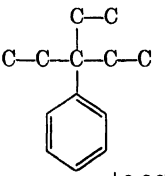
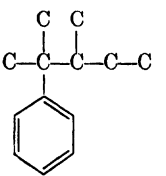
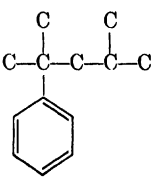
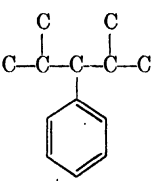
60. Klages, A., and R. Keil, Ber. **36**, 1632 **1903**.
61. Klages, A., and R. Sautter, Ber. **37**, 649 **1904**.
62. Klages, A., and C. Stamm, Ber. **37**, 1715 **1904**.
63. Koch, H., and H. Steinbrink, Brennstoff-Chem. **19**, 277 **1938**.
64. Kohlrausch, K. W. F., and A. Pongratz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **143**, Abt. IIb, 358 **1934**.
65. Körner, H., Ann. **216**, 223 **1883**.
66. Körner, H., Ber. **11**, 1863 **1878**.
67. Krishnan, K. S., and S. Banerjee, Trans. Roy. Soc. (London) **234**, 265 **1935**.
68. Kunckell, F., and G. Ulex, J. prakt. Chem. [2] **87**, 227 **1912**.
69. Kurtz, S. S., Jr., and C. E. Headington, Ind. Eng. Chem. Anal. Ed. **9**, 21 **1937**.
70. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918**.
71. LeFevre, C. G., R. J. W. LeFevre, and K. W. Robertson, J. Chem. Soc. **1935**, 480.
72. Levene, P. A., and R. E. Marker, J. Biol. Chem. **93**, 749 **1931**.
73. Levene, P. A., and R. E. Marker, J. Biol. Chem. **110**, 311 **1935**.
74. Lonsdale, Proc. Roy. Soc. (London) **123A**, 494 **1929**.
75. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. **26**, 475 **1934**.
76. Lur'e, S. I., and I. Y. Golovacheva, J. Gen. Chem. (U.S.S.R.) **13**, 189 **1931**; Survey For. Petrol. Liter. T402, Nov. 19, **1943**.
77. MacDougall, F. H., and L. I. Smith, J. Am. Chem. Soc. **52**, 1998 **1930**.
78. Mailhe, A., Bull. soc. chim. [4] **35**, 365 **1924**.
79. Meyer, H., and K. Bernhauer, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **138**, Abt. IIb, 721 **1929**.
80. Nastyukov, M. A., and N. V. Gurin, J. Russ. Phys. Chem. Soc. **47**, 46 **1915**; Chem. Zentr. **1916**, I, 700.
81. Nauta, W. T., and D. Mulder, Rec. trav. chim. **58**, 514 **1939**.
82. Nelson, W. L., Oil Gas J. **35**, No. 38, 39 **1937**.
83. Newton, A., J. Am. Chem. Soc. **65**, 320 **1943**.
84. Nightingale, D., and J. R. Janes, J. Am. Chem. Soc. **66**, 154 **1944**.
85. Nightingale, D., and L. Smith, J. Am. Chem. Soc. **61**, 101 **1939**.
86. Noelting, E., Chimie & industrie **6**, 719 **1921**.
87. Norris, J. F., and J. N. Ingraham, J. Am. Chem. Soc. **60**, 1421 **1938**.
88. Norris, J. F., and J. N. Ingraham, J. Am. Chem. Soc. **62**, 1298 **1940**.
89. Norris, J. F., and D. Rubinstein, J. Am. Chem. Soc. **61**, 1163 **1939**.
90. Norris, J. F., and B. M. Sturgis, J. Am. Chem. Soc. **61**, 1413 **1939**.
91. O'Connor, M. J., and F. J. Sowa, J. Am. Chem. Soc. **60**, 125 **1938**.
92. Pabst, Ber. **9**, 503 **1876**.
93. Parks, G. S., and H. M. Huffman, Ind. Eng. Chem. **23**, 1138 **1931**.
94. Pestemer, M., and O. Gübitz, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **143**, Abt. IIb, 340 **1934-1935**.
95. Pfeiffer, P., Ann. **412**, 253 **1916**.
96. Philippi, E., R. Seka, and N. Froeschl, Ann. **428**, 300 **1922**.
97. Powell, H. M., and G. Huse, J. Chem. Soc. **1943**, 435.
98. Reckleben, H., and J. Scheiber, Ber. **46**, 2363 **1913**.
99. Rothen, A., and P. A. Levene, J. Chem. Phys. **7**, 975 **1939**.
100. Savard, J., and R. Hösögüt, Rev. faculté sci. univ. Istanbul [N.S.] **3**, 164 **1938**; C.A. **32**, 5795 **1938**.
101. Schmidt, A. W., Ber. **75**, 1399 **1942**.
102. Schmidt, A. W., G. Hopp, and F. Schoeller, Ber. **72**, 1893 **1939**.
103. Schmidt, A. W., and V. Schoeller, Ber. **74**, 258 **1941**.
104. Schramm, J., Ann. **218**, 383 **1883**.
105. Schreiner, E., J. prakt. Chem. [2] **82**, 292 **1910**.
106. Shen, G., C. E. Wood, and F. H. Garner, J. Inst. Petroleum Tech. **25**, 695 **1939**.
107. Simon, I., Bull. soc. chim. Belg. **38**, 47 **1929**.
108. Smith, L. I., and F. J. Dobrovolny, J. Am. Chem. Soc. **48**, 1413 **1926**.

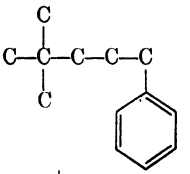
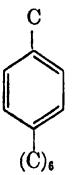
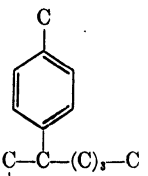
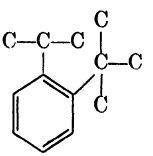
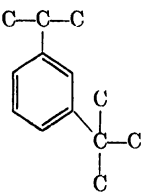
109. Smith, L. I., and C. O. Guss, J. Am. Chem. Soc. **62**, 2625 1940.
110. Smith, L. I., and A. R. Lux, J. Am. Chem. Soc. **51**, 2994 1929.
111. Smith, L. I., and F. H. MacDougall, J. Am. Chem. Soc. **51**, 3001 1929.
112. Smith, L. I., and H. O. Perry, J. Am. Chem. Soc. **61**, 1411 1939.
113. Spaght, M. E., S. B. Thomas, and G. S. Parks, J. Phys. Chem. **36**, 882 1932.
114. Spiegler, L., and J. M. Tinker, J. Am. Chem. Soc. **61**, 1002 1939.
115. Stenzl, H., and F. Fichter, Helv. Chim. Acta **17**, 669 1934.
116. Stenzl, H., and F. Fichter, Helv. Chim. Acta **20**, 846 1937.
117. Stephens, H. N., and F. L. Roduta, J. Am. Chem. Soc. **57**, 2380 1935.
118. Stohmann, F., C. Kleber, and H. Langbein, J. prakt. Chem. [2] **40**, 77 1899.
119. Tafel, J., and W. Jürgens, Ber. **42**, 2548 1909.
120. Thierfelder, H., and E. Klenk, Z. physiol. Chem. **141**, 13 1924.
121. Tilicheev, M. D., and K. S. Kuruindin, Neftyanoe Khozyaistvo **19**, 586 1930; Chem. Zentr. 1931, I, 2559.
122. Timmermans, J., Bull. soc. chim. Belg. **44**, 17 1935.
123. Töhl, A., Ber. **28**, 2459 1895.
123A. Tsukervanik, I. P., and G. Vikrova, J. Gen. Chem. (U.S.S.R.) **7**, 632 1937; C.A. **31**, 5779 1937.
124. Uhlhorn, E., Ber. **23**, 3142 1890.
125. Van de Vloed, A., Bull. soc. chim. Belg. **48**, 229 1939.
126. Vavon, G., and J. Bolle, Compt. rend. **204**, 1826 1937.
127. Verley, A., Bull. soc. chim. [3] **17**, 906 1897.
128. von Auwers, K., Ber. **60**, 2122 1927.
129. von Auwers, K., and A. Köckritz, Ann. **352**, 288 1907.
130. von Auwers, K., M. Lechner, and H. Bundesmann, Ber. **58**, 36 1925.
131. von Braun, J., and H. Deutsch, Ber. **45**, 2171 1912.
132. Ward, A. L., and W. H. Fulweiler, Ind. Eng. Chem. Anal. Ed. **6**, 396 1934.
133. Weygand, C., and L. Mensdorf, Ber. **68**, 1825 1935.
134. Ziegler, K., and F. Ditzel, Ann. **473**, 194 1929.

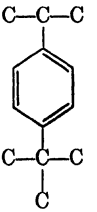
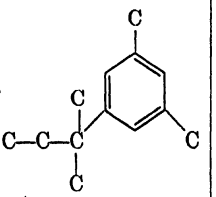
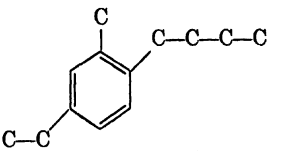
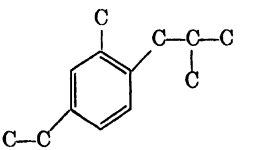
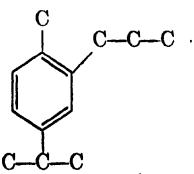
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **n-Heptylbenzene**  | | | | * |
| | **237.8** | **0.8595** | **1.4884** | |
| | 244-246 [54] | 0.8570 [53] | 1.4860 [46,47] | |
| | 240-241 [24,49] | 0.8590 [46,47] | 1.4865 [53] | |
| | 240 [43] | 0.8604 [17] | 1.4888 [24] | |
| | 232-236 [30] | 0.8039 94.8° [24] | 1.4800 40° [24] | |
| | 235 [6,53] | 0.8221 69.7° [24] | 1.4822 35° [24] | |
| | 233 [1] | 0.8370 49.8° [24] | 1.4845 30° [24] | |
| | 229-231 [52] | 0.8522 30° [47] | 1.4868 25° [24] | |
| | 233-234 748.5 [31] | 0.8520 29.7° [24] | 1.4857 18.5° [52] | |
| | 110 15 [1] | 0.867 $D_{20}^{20}$ [35] | 1.4902 16.5° [24] | |
| | 116-118 12 [47] | 0.8637 15.56° [49] | 1.48262 $n_{H\alpha}^{20}$ [17] | |
| | 105 12 [30] | 0.8678 8.4° [24] | 1.49515 $n_{H\beta}^{20}$ [17] | |
| | 110 10 [6] | | 1.50290 $n_{H\gamma}^{20}$ [17] | |
| | 108-110 10 [29] | | 1.48640 $n_{He}^{20}$ [17] | |
| | 108-109 9 [24,49] | | | |
| * $\frac{dD}{dt} = -0.0007486$/°C (0 to 75°C) | | | | |
| † $\frac{dn}{dt} = -0.0004125$/°C (16 to 40°C) | | | | |
| **2-Phenylheptane**  | | | | |
| | | **0.8610** | | |
| | 229-231 [51] | 0.861 [51] | 1.4857 18.5° [51] | |
| | 226.5-227.5 [14] | 0.8598 21.5° [52] | | |
| | | 0.8772 0° [52] | | |
| * $\frac{dD}{dt} = -0.0008094$/°C (0 to 22°C) | | | | |
| **3-Phenylheptane**  | | | | * |
| | 105(a) 16 [32] | 0.8558(b) 25° [42] | 1.4871 [20] | $[\alpha]_D^{25} = +0.75°$(a) [33] |
| | 112(a) 15 [33] | 0.856(a) 25° [32,33] | 1.4848(b) 25° [42] | $[\alpha]_D^{25} = +0.97°$(a) [32] |
| | 68-71 3 [20] | 0.8585 $D_{25}^{25}$ [20] | | (c) |

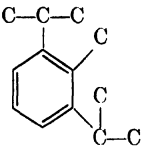
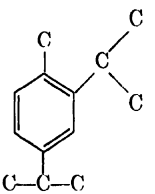
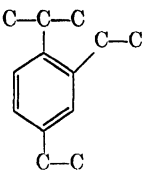
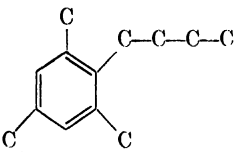
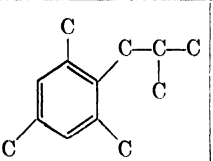
(a) This constant was determined on the *dextro*rotatory form.
(b) This constant was determined on the *levo*rotatory form.
(c) The angle of rotation at various wave lengths is given in reference 42.

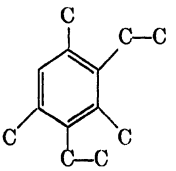
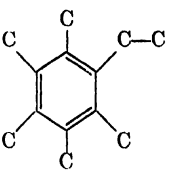
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4-Phenylheptane**  | 221–224 [23] | | | |
| **3-Benzylhexane**  | 120 24 [15]<br>117 18 [16] | | | |
| **2-Methyl-2-phenylhexane**  | 223.5<br>−224.5 745.6 [22]<br>107<br>−107.5 20 [22] | 0.8737 [22] | | |
| **3-Methyl-3-phenylhexane**  | 106–107 20 [22]<br>110–112 15 [19]<br>100 15 [22] | 0.8819 [19] | 1.4964 [22]<br>1.49951 15° [19] | |
| **2-Methyl-5-phenylhexane**  | 223 [26] | 0.8696 15° [26] | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
|  **3-Ethyl-3-phenylpentane** | | **0.8679** | | * |
| | 220–222 [48] | 0.8786 [22] | 1.4975 [22] | |
| | 225–226 757.6 [7] | 0.8262 75.1° [7] | 1.49211 25° [48] | |
| | 225–226 745 [22] | 0.8437 52.2° [7] | 1.4953 25° [22] | |
| | 107–108 20 [22] | 0.8513 42.5° [7] | | |
| | | 0.8593 31.2° [7] | | |
| | | 0.8656 25° [48] | | |
| | | 0.8692 17.8° [7] | | |
| | | 0.8747 10.6° [7] | | |
| | | 0.8826 0° [7] | | |
| * $\frac{dD}{dt} = -0.0007367[1+0.001035(t-20)]$/°C (0 to 75°C) | | | | |
|  **2,3-Dimethyl-2-phenylpentane** | | | | |
| | 222–223 745 [22] | 0.8801 [22] | | |
| | 105–107 20 [22] | | | |
|  **2,4-Dimethyl-2-phenylpentane** | | | | |
| | 218 [48] | 0.8638 [34] | 1.4852 [34] | |
| | 216–217 745.7 [22] | 0.8724 [22] | 1.49383 16.5° [48] | |
| | 101–102 20 [22] | 0.8741 15° [48] | | |
| | 101–102 15 [34] | | | |
|  **2,4-Dimethyl-3-phenylpentane** | | | | |
| | 220–225 [38,39] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2-Dimethyl-5-phenylpentane**  | 115 9 [21] | 0.9443 [21]<br>0.9460 $D_{20}^{20}$ [21] | | |
| **1-Methyl-4-hexylbenzene**  | 236–238 [37]<br>115–115.5 12 [45] | 0.8569 [45] | 1.4890 [45] | |
| −30.5 [45] | | | | |
| **2-*p*-Tolylhexane**  | 162–165 135 [50] | 0.855 $D_{20}^{25}$ [50] | 1.4910 [50] | |
| **1-Isopropyl-2-*tert*-butylbenzene**  | 208 729 [3] | | | |
| **1-Isopropyl-3-*tert*-butylbenzene**  | 216 729 [3] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Isopropyl-4-*tert*-butylbenzene**  | | | | |
| | 222 729 [3]<br>221 727 [2,4]<br>69 3 [2,4] | 0.8648 15° [2,4] | 1.4928 [2,4] | |
| **1,3-Dimethyl-5-*tert*-pentylbenzene**  | | | | |
| | 102–103 14 [40] | | | |
| **1-Methyl-2-*n*-butyl-5-ethylbenzene**  | | | | |
| | 236–237 [36] | 0.8862 11° [36] | | |
| **1-Methyl-2-isobutyl-5-ethylbenzene**  | | | | |
| | 228–229 [36] | 0.8863 11° [36] | | |
| **1-Methyl-2-*n*-propyl-4-isopropylbenzene**  | | | | |
| | 225 [9]<br>226 766 [27]<br>106–107.5 13 [27] | 0.902 17° [9]<br>0.8685 15° [27] | 1.49585 15° [27]<br>1.49198 $n_{H\alpha}^{15}$ [27]<br>1.50549 $n_{H\beta}^{15}$ [27]<br>1.51386 $n_{H\gamma}^{15}$ [27] | |

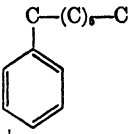
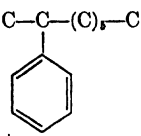
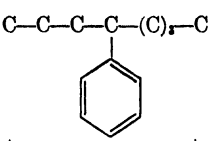
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3-Diisopropyl-2-methylbenzene**  | 228.7 770 [13] | 0.8768 [13] | 1.5040 18° [13] | |
| **1-Methyl-2,4-diisopropylbenzene**  | 220 [5]<br>225 770 [12] | 0.8664 [12]<br>0.880 0° [5] | 1.499 [12] | |
| **1-Isopropyl-2,4-diethylbenzene**  | 224–226 [18] | | | |
| **1,3,5-Trimethyl-2-*n*-butylbenzene**  | 237–241 [25] | | | |
| **1,3,5-Trimethyl-2-isobutylbenzene**  | 228–230 754 [28]<br>125–127 24 [28] | 0.8782 18° [28] | 1.5004 18° [28] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5-Trimethyl-2,4-diethylbenzene**  | 229–236 [41] | | | |
| **Pentamethylethylbenzene**  | | | | |
| 125 [10,44] | | | | Sublimation Temp. (°C) 118 [10,11,44] |

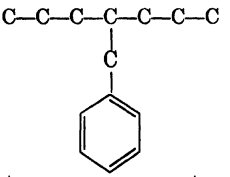
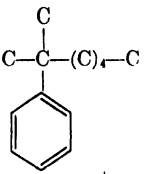
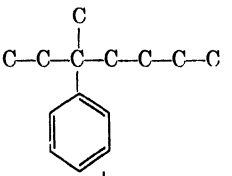
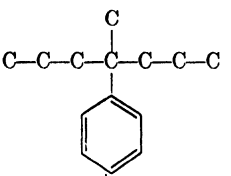
## $C_{13}H_{20}$ References

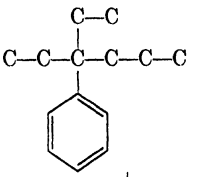
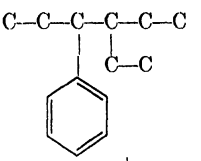
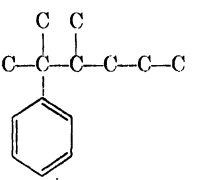
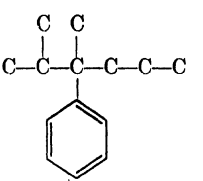

1. Auger, V., Bull. soc. chim. [2] **47**, 42 **1887**.
2. Barbier, H., Compt. rend. congr. chim. ind. **14**, sec. 9 **1934**.
3. Barbier, H., Helv. Chim. Acta **19**, 1345 **1936**.
4. Barbier, H., Rev. Marques parfum. savon. **12**, 325 **1934**; Chem. Zentr. **1935**, I, 2350.
5. Barbier, P., and L. Bouveault, Compt. rend. **120**, 1420 **1895**.
6. Böeseken, J., and A. J. Wildschut, Rec. trav. chim. **51**, 168 **1932**.
7. Bygdén, A., Thesis, Uppsala, **1916**; C.A. **14**, 1974 **1920**.
8. Ciamician, G. L., Ber. **12**, 1658 **1879**.
9. Claus, A., J. prakt. Chem. [2] **46**, 474 **1892**.
10. Clement, H., Bull. soc. chim. [5] **5**, 1011 **1938**.
11. Clement, H., and J. Savard, Compt. rend. **204**, 1742 **1937**.
12. Desseigne, G., Bull. soc. chim. [5] **2**, 617 **1935**.
13. Desseigne, G., Compt. rend. **200**, 466 **1935**.
14. Dobyanskiĭ, A., and Aliev, Neftyanoe Khozyaistvo **9**, 229 **1925**; C.A. **21**, 3736 **1927**; Chem. Zentr. **1926**, II, 676.
15. Dumesnil, P., Ann. chim. [9] **8**, 70 **1917**.
16. Dumesnil, P., Compt. rend. **153**, 111 **1911**.
17. Eisenlohr, F., and L. Schulz, Ber. **57**, 1808 **1924**.
18. Francesconi, L., and L. Venditti, Gazz. chim. ital. **32**, I, 281 **1902**.
19. Halse, O. M., J. prakt. Chem. [2] **89**, 451 **1914**.
20. Harmon, J., and C. S. Marvel, J. Am. Chem. Soc. **54**, 2515 **1932**.
21. Hill, G. A., and W. F. Bruce, J. Am. Chem. Soc. **52**, 347 **1930**.
22. Huston, R. C., W. B. Fox, and M. N. Binder, J. Org. Chem. **3**, 251 **1938**.
23. Huston, R. C., and I. A. Kaye, J. Am. Chem. Soc. **64**, 1576 **1942**.
24. Ju, T. Y., G. Shen, and C. E. Wood, J. Inst. Petroleum Tech. **26**, 514 **1940**.

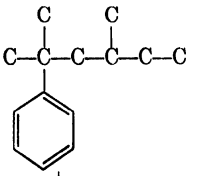
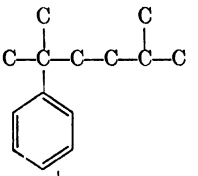
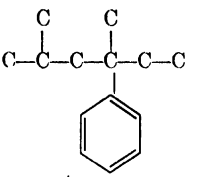
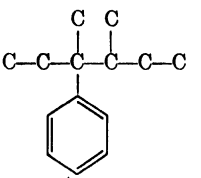
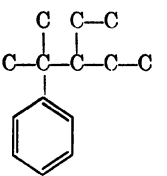
25. Klages, A., Ber. **35**, 2245 **1902.**
26. Klages, A., Ber. **35**, 2633 **1902.**
27. Klages, A., Ber. **40**, 2360 **1907.**
28. Klages, A., and C. Stamm, Ber. **37**, 1715 **1904.**
29. Krafft, F., Ber., **19**, 2982 **1886.**
30. Kruber, O., Brennstoff-Chem. **13**, 187 **1932.**
31. Lepin, A., Acta Univ. Latviensis, Kim. Fakultat. Ser. **1**, 145 **1932**; C.A. **25**, 3328 **1931**; Chem. Zentr. **1931**, I, 2619.
32. Levene, P. A., and R. E. Marker, J. Biol. Chem. **93**, 749 **1931.**
33. Levene, P. A., and R. E. Marker, J. Biol. Chem. **97**, 563 **1932.**
34. Levina, R. Y., A. M. Panyushkina, N. A. Smirnova, K. D. Shcherbakova, and N. I. Shor, J. Gen. Chem. (U.S.S.R.) **11**, 411 **1941**; Survey For. Petrol Liter. Sept. 5, **1941.**
35. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. **26**, 475 **1934.**
36. Mailhe, A., Bull. soc. chim. [4] **35**, 365 **1924.**
37. Morton, A. A., E. L. Little, Jr., and W. O. Strong, Jr., J. Am. Chem. Soc. **65**, 1339 **1943.**
38. Murat and Amouroux, Bull. soc. chim. [4] **15**, 159 **1914.**
39. Murat and Amouroux, J. pharm. chim. [7] **9**, 114 **1914.**
40. Nightingale, D. V., and O. G. Shanhaltzer, J. Org. Chem. **7**, 6 **1942.**
41. Phillipi, E., and G. Rie, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **130**, Abt. IIb, 7 **1921.**
42. Rothen, A., and P. A. Levene, J. Chem. Phys. **7**, 975 **1939.**
43. Sabatier, P., and A. Mailhe, Compt. rend. **158**, 830 **1914.**
44. Savard, J., and R. Hösögüt, Rev. faculté sci. univ. Istanbul [N.S.] **3**, 164 **1938**; C.A. **32**, 5795 **1938.**
45. Schmidt, A. W., Ber. **74**, 258 **1941.**
46. Schmidt, A. W., Ber. **75**, 1399 **1942.**
47. Schmidt, A. W., G. Hopp, and F. Schoeller, Ber. **72**, 1893 **1939.**
48. Schreiner, E., J. prakt. Chem. [2] **82**, 292 **1910.**
49. Shen, G., C. E. Wood, and F. H. Garner, J. Inst. Petroleum Tech. **25**, 695 **1939.**
50. Spiegler, L., and J. M. Tinker, J. Am. Chem. Soc. **61**, 1002 **1939.**
51. Tilicheev, M. D., Khim. Tverdogo Topliva **9**, 181 **1938.**
52. Tilicheev, M. D., and K. S. Kuruindin, Neftyanoe Khozyaistvo **19**, 586 **1930**; Chem. Zentr. **1931**, I, 2559.
53. von Braun, J., and H. Deutsch, Ber. **45**, 2171 **1912.**
54. Weygand, C., and L. Mensdorf, Ber. **68**, 1825 **1935.**

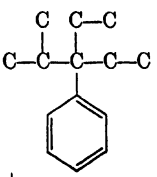
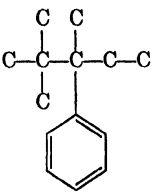
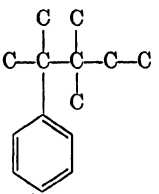
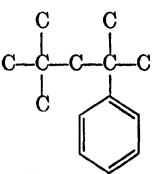
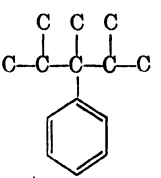
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **n-Octylbenzene**  | **263.6** | **0.8582**[5] | 1.4851[40,41] | |
| | | 0.8582[40,41] | 1.4858[11] | |
| −7[1] | 264–265[12] | 0.8583[12] | 1.4861 18.4°[50] | |
| | 262–264[1] | 0.859[11] | 1.48194 $n_{H\alpha}^{20}$[12] | |
| | 263[28] | 0.8512 30°[41] | 1.49437 $n_{H\beta}^{20}$[12] | |
| | 261–263[54] | 0.8593 20.5°[50] | 1.50193 $n_{H\gamma}^{20}$[12] | |
| | 256–259 761[11,30] | | 1.48534 $n_{He}^{20}$[12] | |
| | 131–134 12[41] | | | |
| | 115.5 | | | |
| | −118.5 9[50] | | | |
| * $\frac{dD}{dt}$ = −0.0007050/°C (20 to 30°C) | | | | |
| **2-Phenyloctane**  | | **0.8611** | | |
| | 123–125 20[52] | 0.854[52] | 1.4837[52] | |
| | 125–127 18[38] | 0.860[49] | 1.4861 18.4°[48,49] | |
| | 115.5 | 0.8526 $D_{60}^{60}$[38] | 1.48790 17°[38] | |
| | −118.5 6[48] | 0.859 20.5°[48] | | |
| | 115–118 6[49] | 0.8593 20.5°[50] | | |
| | | 0.8626 $D_{17}^{17}$[38] | | |
| | | 0.878 0°[48] | | |
| | | 0.8782 0°[50] | | |
| * $\frac{dD}{dt}$ = −0.0007376/°C (0 to 50°C) | | | | |
| **4-Phenyloctane**  | 119 18[29] | 0.855(a) 25°[29] | | $[\alpha]_D^{25}$ = +0.62°(a)[29] |

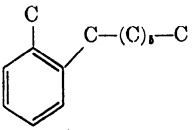
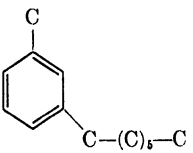
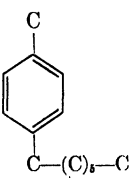
(a) This constant was determined on the *dextro*rotatory form.

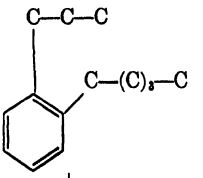
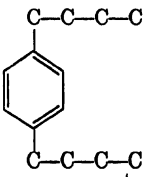
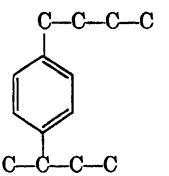
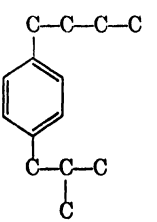
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
|  **4-Benzylheptane** | 241–244 756 [36]<br>241–243 756 [3,35] | 0.854 14° [3,35,36] | 1.487 14° [36] | |
|  **2-Methyl-2-phenylheptane** | 243 738 [20]<br>116–118 16 [20] | 0.8756 [20] | 1.4951 [20] | |
|  **3-Methyl-3-phenylheptane** | 120–121 17 [18] | 0.8738 [18] | 1.4932 [18] | |
|  **4-Methyl-4-phenylheptane** | 242–243 749 [18]<br>120–121 12 [15]<br>109–111 10 [18] | 0.8700 [18]<br>0.8708 [15] | 1.4930 [18]<br>1.49326 15° [15] | |

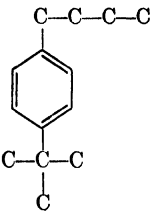
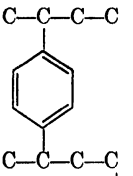
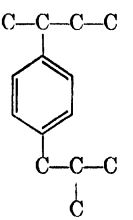
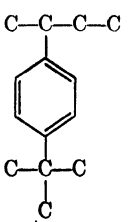
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
|  **3-Ethyl-3-phenylhexane** | 237–238 [15]<br>237–238 745 [18]<br>116–117 14 [18] | 0.8788 [18]<br>0.8748 16° [15] | 1.49383 [15]<br>1.4968 [18] | |
|  **3-Ethyl-4-phenylhexane** | 205 [2] | | | |
|  **2,3-Dimethyl-2-phenylhexane** | 236 748 [20]<br>105–107 14 [20] | 0.8861 [20] | 1.4961 [20] | |
|  **2,3-Dimethyl-3-phenylhexane** | 237–238 748 [18]<br>104.5<br>–106.5 11 [18] | 0.8763 [18] | 1.4958 [18] | |

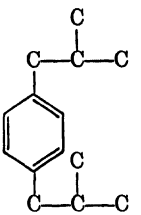
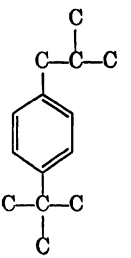
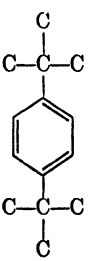
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
|  2,4-Dimethyl-2-phenylhexane | 238 748 [20]<br>112–115 17 [20] | 0.8729 [20] | 1.4920 [20] | |
|  2,5-Dimethyl-2-phenylhexane | 236 748 [20]<br>113–116 19 [20]<br>116–117 14 [15] | 0.8749 [20]<br>0.8844 18° [15] | 1.4939 [20]<br>1.50233 15° [15] | |
|  2,4-Dimethyl-4-phenylhexane | 114–116 10 [18] | 0.8750 [18] | 1.4918 [18] | |
|  3,4-Dimethyl-3-phenylhexane | 112–114 10 [18] | 0.8757 [18] | 1.4929 [18] | |
|  2-Methyl-2-phenyl-3-ethylpentane | 236 748 [20]<br>103–106 12 [20] | 0.8782 [20] | 1.4942 [20] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Methyl-3-ethyl-3-phenylpentane**  | 238–239 745 [18]<br>113–114 14 [18] | 0.8816 [18] | 1.4981 [18] | |
| **2,2,3-Trimethyl-3-phenylpentane**  | 257–259 743 [18]<br>124–127 15 [18] | | | |
| **2,3,3-Trimethyl-2-phenylpentane**  | 235 748 [20]<br>110–113 17 [20] | 0.8939 [20] | 1.5031 [20] | |
| **2,2,4-Trimethyl-4-phenylpentane**  | 234.5 748 [20]<br>103–106 15 [20] | 0.8803 [20] | 1.4938 [20] | |
| **2,3,4-Trimethyl-3-phenylpentane**  | 234–236 743 [18] | 0.8808 [18] | 1.4970 [18] | |

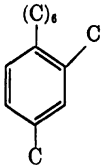
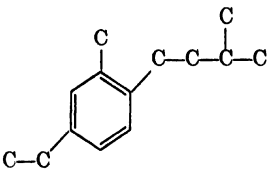
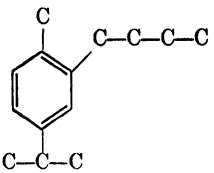
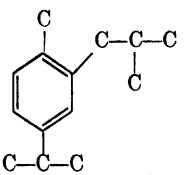
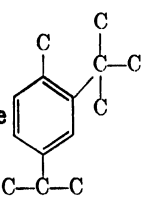
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-2-*n*-heptylbenzene**  | | | | |
| | 263–263.2 [12] | 0.8717 [12] | 1.49124 $n_{H\alpha}^{20}$ [12]<br>1.50452 $n_{H\beta}^{20}$ [12]<br>1.51263 $n_{H\gamma}^{20}$ [12]<br>1.49521 $n_{He}^{20}$ [12] | |
| **1-Methyl-3-*n*-heptylbenzene**  | | | | |
| | 260.0–260.8 [12] | 0.8615 [12] | 1.48722 $n_{H\alpha}^{20}$ [12]<br>1.50089 $n_{H\beta}^{20}$ [12]<br>1.50884 $n_{H\gamma}^{20}$ [12]<br>1.49140 $n_{He}^{20}$ [12] | |
| **1-Methyl-4-*n*-heptylbenzene**  | | | | |
| −28.5 [16] | 265.0–265.2 [12]<br>127–127.5 10 [42] | 0.8560 [12]<br>0.8586 [42] | 1.4886 [42]<br>1.48598 $n_{H\alpha}^{20}$ [12]<br>1.49908 $n_{H\beta}^{20}$ [12]<br>1.50712 $n_{H\gamma}^{20}$ [12]<br>1.48968 $n_{He}^{20}$ [12] | |

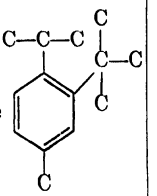
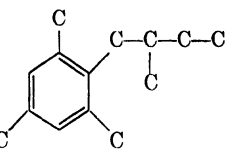
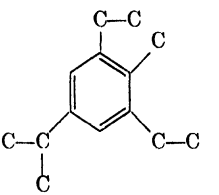
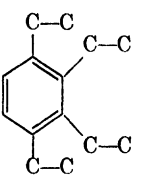
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Propyl-2-*n*-pentylbenzene**  | 128–130 16 [9] | | | |
| **1,4-Di-*n*-butylbenzene**  | 259 745 [16]<br>124 15 [16] | 0.8556 [16] | 1.48792 [16] | |
| −24 [16] | | | | |
| **1-*n*-Butyl-4-*sec*-butylbenzene**  | 250 739 [16]<br>117 15 [16] | 0.8570 [16] | 1.48849 [16] | |
| **1-*n*-Butyl-4-isobutylbenzene**  | 251 743 [16]<br>118 15 [16] | 0.8508 [16] | 1.48580 [16] | |

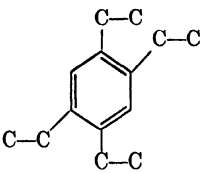
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-*n*-Butyl-4-*tert*-butylbenzene**  | | | | |
| −46[16] | 248 743[16]<br>116 15[16] | 0.8595[16] | 1.48984[16] | |
| **1,4-Di-*sec*-butylbenzene**  | | | | |
| −58[16] | 237[33]<br>233–237[21]<br>236–238 744[52]<br>239 739[16]<br>108 15[16] | 0.8573[16]<br>0.862[52]<br>0.8548 25°[33] | 1.48782[16]<br>1.4884[21]<br>1.489[52]<br>1.4880 25°[33] | |
| **1-*sec*-Butyl-4-isobutylbenzene**  | | | | |
| | 241 739[16]<br>113 15[16] | 0.8511[16] | 1.48560[16] | |
| **1-*sec*-Butyl-4-*tert*-butylbenzene**  | | | | |
| | 235 745[16]<br>108 15[16] | 0.8607[16] | 1.48916[16] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diisobutylbenzene**  | | | | |
| −21[16] | 242 739[16]<br>109 15[16] | 0.8456[16] | 1.48338[16] | |
| **1-Isobutyl-4-*tert*-butylbenzene**  | | | | |
| | 239 751[16]<br>109 15[16] | 0.8547[16] | 1.48753[16] | |
| **1,4-Di-*tert*-butylbenzene**  | | | | |
| **77.8** | **237.0** | | | |
| 78–78.5[21,27,45]<br>78[22]<br>77–78[19,43,44]<br>77.7[16]<br>77[4,33,52]<br>76.5–77[17]<br>76(a)<br>75[39] | 238[47]<br>236.5[7]<br>234–236[32]<br>234–236 746[32]<br>237 743[16]<br>109 15[16] | 0.8659[19] | 1.4624 90°[27] | |

(a) The melting point 76 is found in references 7, 8, 14, 32, 34, 47.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Hexyl-2,4-dimethylbenzene**  | 131–133 13 [13] | 0.886 $D_0^{20}$ [13] | 1.4972 [13] | |
| **1-Methyl-2-(3′-methylbutyl)-5-ethylbenzene**  | 245–246 [31] | 0.8801 11° [31] | | |
| **1-Methyl-2-*n*-butyl-4-isopropylbenzene**  | 235 [10] | 0.892 17° [10] | | |
| **1-Methyl-2-isobutyl-4-isopropylbenzene**  | 230 [10] | 0.916 17° [10] | | |
| **1-Methyl-2-*tert*-butyl-4-isopropylbenzene**  | 237 729 [6] | | | |

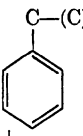
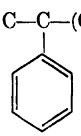
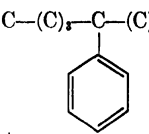
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Isopropyl-2-*tert*-butyl-4-methylbenzene**  | | | | |
| | 227 737 [5]<br>226 729 [6] | | | |
| **1,3,5-Trimethyl-2-(2′-methylbutyl)-benzene**  | | | | |
| | 241–243 747 [26]<br>133–135 19 [26] | 0.8751 23.3° [26] | 1.4976 23° [26] | |
| **1,3-Diethyl-2-methyl-5-isopropylbenzene**  | | | | |
| | 243–245 [53] | 0.8846(a) [53] | 1.5000(a) [53] | |
| (a) The temperature of the density and index of refractive was not given. | | | | |
| **1,2,3,4-Tetraethylbenzene**  | | | | * |
| | | **$0.8881_5$** | | |
| 11.6 [51] | 254 [23] | 0.88780 [37] | 1.50845 19.6° [37] | |
| | 252–254 [37] | 0.88556 25° [37] | 1.50444 $n_{Ha}^{19.6}$ [37] | |
| | 121.7 14 [51] | 0.88664 19.6° [37] | | |

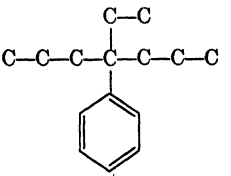
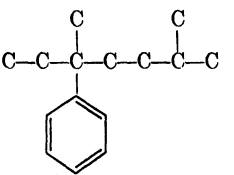
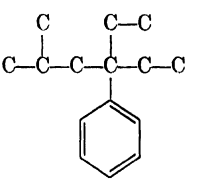
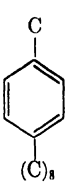
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,3,4-Tetraethylbenzene** *(Continued)* | | 0.89092 15° [37]<br>0.89405 10° [37]<br>0.89822 4° [37] | 1.51890 $n_{H\beta}^{19.6}$ [37]<br>1.52798 $n_{H\gamma}^{19.6}$ [37] | |
| | 119–120 11 [46] | | | |
| * $\frac{dD}{dt} = -0.00060842$/°C (4 to 25°C) | | | | |
| **1,2,4,5-Tetraethylbenzene**  | | | | |
| 13 [24] | 250 [24]<br>248 755 [25] | 0.884 16° [25] | 1 5041 16° [25] | |

$C_{14}H_{22}$ References

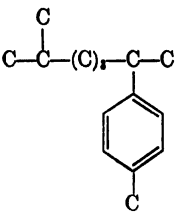
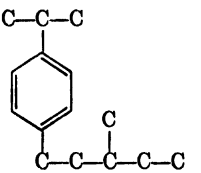
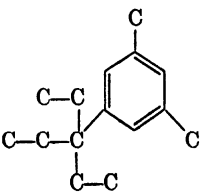
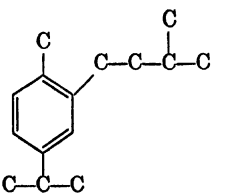
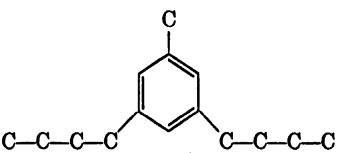

1. Ahrens, F., Ber. **19**, 2718 **1886**.
2. Albesco, G., Ann. chim. [9] **18**, 216 **1922**.
3. Amouroux and Murat, Compt. rend. **154**, 992 **1912**.
4. Backer, H. J., and J. Kramer, Rec. trav. chim. **53**, 1101 **1934**.
5. Barbier, H., Compt. rend. congr. chim. ind. **14**, sec. 9, **1934**.
6. Barbier, H., Helv. Chim. Acta **19**, 1349 **1936**.
7. Boedtker, E., Bull. soc. chim. [3] **31**, 965 **1904**.
8. Boedtker, E., and O. M. Halse, Bull. soc. chim. [4] **19**, 444 **1916**.
9. Bogert, M. T., and G. Powell, J. Am. Chem. Soc. **53**, 2747 **1931**.
10. Claus, A., J. prakt. Chem. [2] **46**, 474 **1892**.
11. D'yakova, M. K., and A. V. Lozovoĭ, J. Gen. Chem. (U.S.S.R.) **9**, 26 **1939**; C.A. **33**, 6254 **1939**; Chem. Zentr. **1939**, II, 4459.
12. Eisenlohr, F., and L. Schulz, Ber. **57**, 1808 **1924**.
13. Français, G., Ann. chim. [11] **11**, 212 **1939**.
14. Grosse, A. V., and V. N. Ipatieff, J. Am. Chem. Soc. **57**, 2415 **1935**.
15. Halse, O. M., J. prakt. Chem. [2] **89**, 451 **1914**.
16. Hennion, G. F., and L. A. Auspos, J. Am. Chem. Soc. **65**, 1603 **1943**.
17. Hennion, G. F., and R. A. Kurtz, J. Am. Chem. Soc. **65**, 1001 **1943**.
18. Huston, R. C., private communication, Michigan State College, May, **1944**.
19. Huston, R. C., W. B. Fox, and M. N. Binder, J. Org. Chem. **3**, 351 **1938**.
20. Huston, R. C., R. L. Guile, J. J. Sculati, and W. N. Wasson, J. Org. Chem. **6**, 252 **1941**.
21. Ipatieff, V. N., B. B. Corson, and H. Pines, J. Am. Chem. Soc. **58**, 919 **1936**.
22. Ipatieff, V. N., and H. Pines, J. Am. Chem. Soc. **58**, 1056 **1936**.
23. Jacobsen, O., Ber. **21**, 2814 **1888**.
24. Jacobsen, O., Ber. **21**, 2819 **1888**.
25. Klages, A., and R. Keil, Ber. **36**, 1632 **1903**.
26. Klages, A., and C. Stamm, Ber. **37**, 1715 **1904**.
27. Koch, H., and H. Steinbrink, Brennstoff-Chem. **19**, 277 **1938**.
28. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918**.

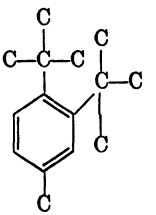
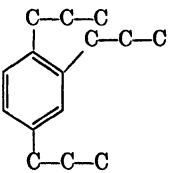
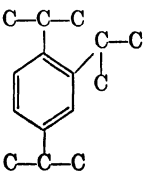
29. Levene, P. A., and R. E. Marker, J. Biol. Chem. **93**, 749 **1931.**
30. Lozovoĭ, A. V., M. K. D'yakova, and T. G. Stepanzeva, J. Gen. Chem. (U.S.S.R.) **9**, 540 **1939.**
31. Mailhe, A., Bull. soc. chim. [4] **35**, 365 **1924.**
32. Malishev, B. W., J. Am. Chem. Soc. **57**, 883 **1935.**
33. McKenna, J. F., and F. J. Sowa, J. Am. Chem. Soc. **59**, 470 **1937.**
34. Meyer, H., and K. Bernhauer, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **138**, IIb, 721 **1929.**
35. Murat and Amouroux, Compt. rend. **154**, 992 **1912.**
36. Murat and Amouroux, J. pharm. chim. [7] **5**, 473 **1912.**
37. Perkin, W. H., J. Chem. Soc. **77**, 267 **1900.**
38. Petrov, A. D., A. P. Baidanov, N. N. Zakotin, and P. I. Suntsov, J. Gen. Chem. (U.S.S.R.) **9**, 509 **1939**; Survey For. Petrol. Liter. Jan. 26, **1940**, Abs. 210B.
39. Potts, W. M., and L. L. Carpenter, J. Am. Chem. Soc. **61**, 663 **1939.**
40. Schmidt, A. W., Ber. **75**, 1399 **1942.**
41. Schmidt, A. W., G. Hopp, and F. Schoeller, Ber. **72**, 1893 **1939.**
42. Schmidt, A. W., and V. Schoeller, Ber. **74**, 258 **1941.**
43. Simons, J. H., and S. Archer, J. Am. Chem. Soc. **60**, 2952 **1938.**
44. Simons, J. H., and S. Archer, J. Am. Chem. Soc. **60**, 2953 **1938.**
45. Simons, J. H., S. Archer, and H. J. Passino, J. Am. Chem. Soc. **60**, 2956 **1938.**
46. Smith, L. I., and C. O. Guss, J. Am. Chem. Soc. **62**, 2625 **1940.**
47. Smith, R. A., J. Am. Chem. Soc. **56**, 717 **1934.**
48. Tilicheev, M. D., J. Inst. Petroleum Tech. **23**, 642 **1937.**
49. Tilicheev, M. D., Khim. Tverdogo Topliva **9**, 181 **1938.**
50. Tilicheev, M. D., and K. S. Kuruindin, Neftyanoe Khozyaistvo **19**, 586 **1930**; Chem. Zentr. **1931**, I, 2559.
51. Timmermans, J., Bull. soc. chim. Belg. **36**, 502 **1927.**
52. Toussaint, N. F., and G. F. Hennion, J. Am. Chem. Soc. **62**, 1145 **1940.**
53. Treibs, W., Ber. **65**, 1324 **1932.**
54. von Schweinitz, E., Ber. **19**, 640 **1886.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **n-Nonylbenzene**  | | **0.8584** | | **1.4863** | | * |
| | 280–281 [26,45,63] | 0.8050 | 94.8° [26] | 1.4863 [26] | | |
| | 145–147 19 [71] | 0.8226 | 69.7° [26] | 1.4781 | 40° [26] | † |
| | 146 14 [81] | 0.8371 | 49.8° [26] | 1.4822 | 30° [26] | |
| | 137.5 | 0.8513 | 29.7° [26] | 1.485 | $n_{H\alpha}^{20}$ [45] | |
| | −138.5 9 [26,63] | 0.8626 | 15.56° [63] | | | |
| | 98–100 1 [79] | 0.8659 | 9.2° [26] | | | |
| * $\frac{dD}{dt} = -0.00071645$/°C (9 to 95°C) | | | | | | |
| † $\frac{dn}{dt} = -0.0004100$/°C (20 to 40°C) | | | | | | |
| **2-Phenylnonane**  | | **0.8627** | | | | * |
| | 145–147 19 [69,70] | 0.862 [70] | | 1.4869 | 21.5° [69,70] | |
| | | 0.860 | 22° [69] | | | |
| | | 0.8616 | 22° [71] | | | |
| | | 0.877 | 0° [69] | | | |
| | | 0.8774 | 0° [71] | | | |
| * $\frac{dD}{dt} = -0.00073333$/°C (0 to 22°C) | | | | | | |
| **5-Phenylnonane**  | | | | | | |
| | 126–127 12 [50] | 0.8477 | $D_{50}^{50}$ [50] | 1.4874 | 18.5° [50] | |
| | | 0.8596 | $D_{20}^{20}$ [50] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4-Ethyl-4-phenylheptane**  | 127–128 15 [19] | 0.8698 [19] | 1.49211 15° [19] | |
| **3,6-Dimethyl-3-phenylheptane**  | 122–123 14 [19] | 0.8788 16° [19] | 1.49894 13° [19] | |
| **2-Methyl-4-ethyl-4-phenylhexane**  | 240–242 [19] | 0.8725 16° [19] | 1.49097 [19] | |
| **1-Methyl-4-Octylbenzene**  | 281–283 [40]<br>269–271 [25]<br>141–141.5 11 [61] | 0.8574 [61]<br>0.8966(a) $D_{20}^{20\ 25}$<br>0.9057 $D_0^{0\ 25}$ | 1.4872 [61]<br>1.49982(b) [25] | |

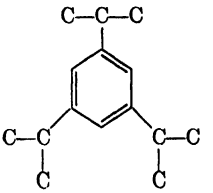
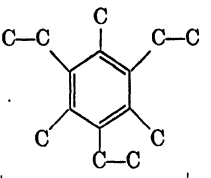
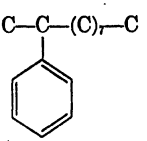
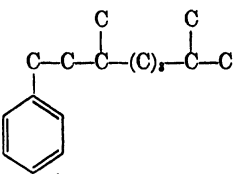
(a) This density is the average of two determinations.
(b) The temperature for this refractive index is not given.

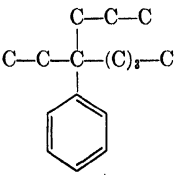
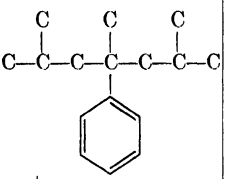
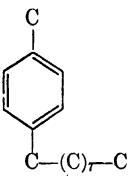
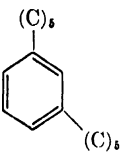
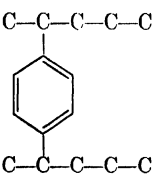
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 2-Methyl-6-*p*-tolylheptane  | 135–136 15 [84] | 0.8524 15° [84] | 1.4832 16° [84] | |
| 1-Isopropyl-4-(3′-methylpentyl)-benzene  | 265 748 [81]<br>131–132 10.2 [31] | 0.8632 15.5° [31] | 1.4921 15° [31] | $[\alpha]_D^{15.5} = +15.91°$ [31] |
| 1,3-Dimethyl-5-[3′-(3′-ethylpentyl)]-benzene  | 257–259 745 [4] | | | |
| 1-Methyl-2-(3′-methylbutyl)-4-isopropylbenzene  | 111–115 12 [83] | | | |
| 1-Methyl-3,5-di-*n*-butylbenzene  | 240–245 [47] | | | |

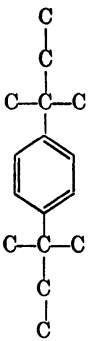
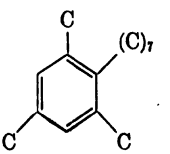
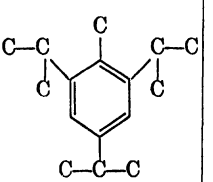
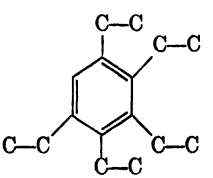
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Di-*tert*-butyl-4-methylbenzene**  | | | | |
| 31.5–32 [8] | 227.5<br>–228 735 [8]<br>117–118 15.5 [8]<br>111–112 12 [8] | | | |
| **1,2,4-Tri-*n*-propylbenzene**  | | | | |
| | 135 20 [3] | | | |
| **1,2,4-Triisopropylbenzene**  | | **0.8620** | **1.4924** | |
| | 244 [30] | 0.862 [21] | 1.4926 [46] | |
| | 240–242 753 [21] | 0.8634 [46] | 1.4929 [21] | |
| | 237– | 0.8556 30° [46] | 1.4883 30° [46] | |
| | 237.5 752 [5] | 0.8593 $D_{25}^{25}$ | 1.4896 25° [64] | |
| | 237.0 736 [64] | 0.8599 $D_{25}^{25}$ [64] | 1.494 16° [30] | |
| | 113–114 14 [30] | 0.863 16° [30] | | |
| | 97–97.5 4 [5] | 0.8674 $D_0^0$ [5] | | |

* $\frac{dD}{dt} = -0.00077953$/°C (0 to 30°C)

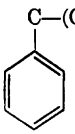
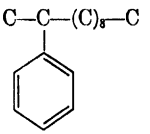
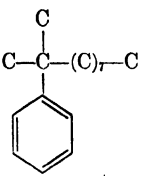
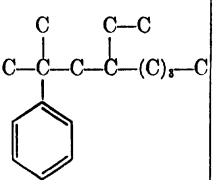
† $\frac{dn}{dt} = -0.00044235$/°C (16 to 30°C)

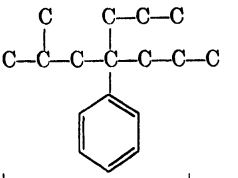
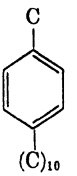
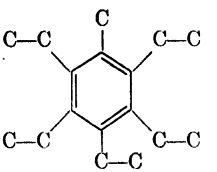
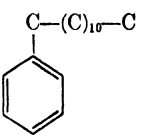
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5-Triisopropylbenzene**  | | | | |
| 118.1–118.8 [46] | 236–236.5 [18]<br>233.5–234.5 [5] | 0.8447 [46]<br>0.8466 30° [46] | 1.4882 [46]<br>1.4836 30° [46] | |
| **1,3,5-Trimethyl-2,4,6-triethylbenzene**  | | | | |
| | 238–247 [52] | | | |
| $C_{16}H_{26}$ | | | | |
| **2-Phenyldecane**  | | | | |
| | | **0.8629** | | |
| | 131–132 3 [69,70,71] | 0.861 [70] | | |
| | | 0.8623 22° [71] | 1.4856 22.0° [69,70,71] | |
| | | 0.862 19° [69] | | |
| | | 0.877 0° [69] | | |
| | | 0.8776 0° [71] | | |
| * $\frac{dD}{dt} = -0.0007242$/°C (0 to 22°C) | | | | |
| **1-Phenyl-3,7-dimethyloctane**  | | | | $[\alpha]_D^{11.5} = -1.82°$ [32] |
| | 275 [32] | 0.8789 10.5° [32] | 1.4960 10.5° [32] | |
| | 140 8.5 [32] | | | |

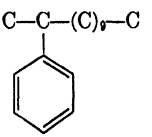
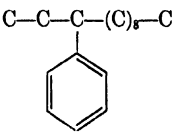
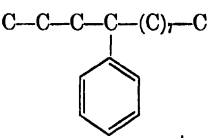
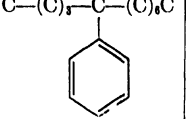
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **3-Propyl-3-phenylheptane**  | 140–141 15 [19] | 0.8694 [19] | 1.4924 15° [19] | |
| **2,4,6-Trimethyl-4-phenylheptane**  | 143–144 18 [19] | 0.8753 [19] | 1.49497 15° [19] | |
| **1-Methyl-4-*n*-nonylbenzene**  | 160–161 12 [20] | | | |
| **1,3-Dipentylbenzene**  | 265 [2] | 0.8868 0° [2] | | |
| **1,4-Di-*sec*-pentylbenzene**  | 265 [48]<br>141–146 20 [72] | 0.863 [72]<br>0.8496 25° [48] | 1.495 [72]<br>1.4845 25° [48] | |

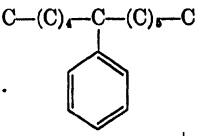
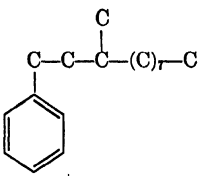
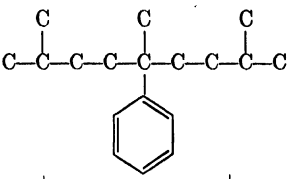
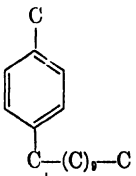
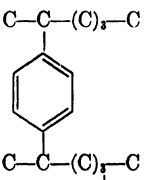
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Di-*tert*-pentylbenzene**  | 260 [48] | 0.8491 25° [48] | 1.4841 [48] | |
| **1,3,5-Trimethyl-2-heptylbenzene** (a)  | 271–272 750 [32A]<br>157–158 15 [32A] | 0.8753 17° [32A] | 1.4970 17° [32A] | |
| **1-Methyl-2,4,6-triisopropylbenzene**  | 252–253 757 [10] | 0.8695 [10] | 1.4995 [10] | |
| **Pentaethylbenzene**  | 277 [28,37] | 0.8336 107.9° [14]<br>0.8963 20.3° [14]<br>0.8985 $D_{19}^{19}$ [23] | 1.48803 $n_{H\alpha}^{107.9}$ [14]<br>1.52700 $n_{H\alpha}^{20.3}$ [14]<br>1.47476 $n_{H\beta}^{107.9}$ [14]<br>1.51270 $n_{H\beta}^{20.3}$ [14] | |

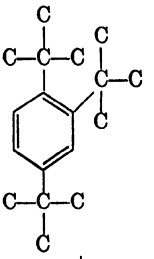
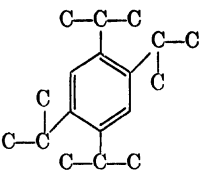
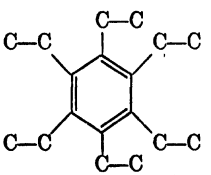
(a) The structure of the heptyl group is not given.

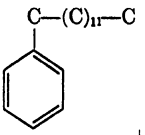
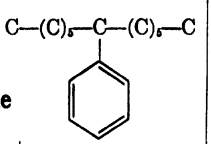
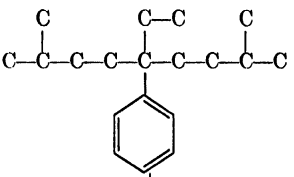
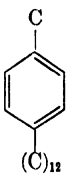
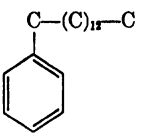
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Dimethyltetraethylbenzene** (a) | | | | |
| | 123-126 0.15 [66A] | 0.8771 [66A]<br>0.8762 19° [66A]<br>0.8804 15° [66A] | 1.4958 [66A]<br>1.4971 19° [66A]<br>1.4994 15° [66A] | |
| (a) The structure of this compound is not given. | | | | |
| $C_{17}H_{28}$  **n-Undecylbenzene** | 296 ± 1 [45] | | 1.4824 $n_{H\alpha}^{20}$ [45] | |
|  **2-Phenylundecane** | 142-146 6 [69,70,71] | 0.8599<br>0.860 [70]<br>0.857 23.5° [69]<br>0.8572 23.5° [71]<br>0.875 0° [69]<br>0.8755 0° [71] | 1.4829 18.7° [69,70,71] | |
| * $\frac{dD}{dt} = -0.00077587$/°C (0 to 24°C) | | | | |
|  **2-Methyl-2-phenyldecane** | 160 20 [83] | 0.8676 [83] | 1.48594 [83] | |
|  **2-Methyl-2-phenyl-4-ethyloctane** | 149 20 [83] | 0.8620 [83] | 1.487749 [83] | |

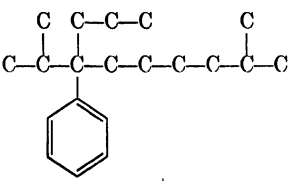
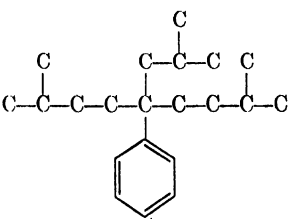
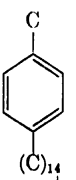
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Methyl-4-propyl-4-phenylheptane**  | 143–144 11 [19] | 0.8750 16° [19] | 1.496 13° [19] | |
| **1-Methyl-4-decylbenzene**  | | | | |
| −11.5 [61] | 169–169.5 11 [61] | 0.8549 [61] | 1.4854 [61] | |
| **Methylpentaethylbenzene**  | | | | |
| 43 [12] | 294 [12] | | | |
| $C_{18}H_{30}$ | | | | |
| ***n*-Dodecylbenzene**  | | **0.8568** | **1.4844** | |
| —3 [26] | 179–180 13 [51] | 0.8564 [58,60] | 1.4822 [58,60] | |
| −7 [51] | 183–185 12 [60] | 0.8013 100.0° [26] | 1.4847 [26] | |
| | 172–173 9 [26,27] | 0.8084 89.8° [26] | 1.4786 35° [26] | |
| | | 0.8225 69.0° [26] | 1.4806 30° [26] | |
| | | 0.8295 59.0° [26] | 1.4826 25° [26] | |
| | | 0.8356 49.8° [26] | 1.47431 17° [51] | |
| | | 0.8419 40.6° [26] | 1.4877 13° [26] | |
| | | 0.8502 30° [60] | | |
| | | 0.8496 29.9° [26] | | |

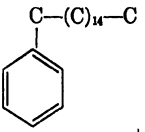
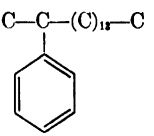
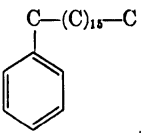
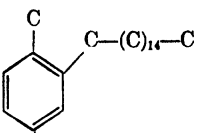
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|---|
| ***n*-Dodecylbenzene** *(Continued)* | | 0.8562 | 21.1° [26] | | |
| | | 0.8598 | $D_{21}^{21}$ [51] | | |
| | | 0.8607 | 15.5° [27] | | |
| | | 0.8636 | 10.5° [26] | | |
| * $\frac{dD}{dt} = -0.0006966$/°C | (10 to 100°C) | | | | |
| † $\frac{dn}{dt} = -0.0003959$/°C | (13 to 35°C) | | | | |
| **2-Phenyldodecane**  | | | | | |
| | 182–184 20 [72] | 0.855 [72] | | 1.4818 [72] | |
| | 143 1.8 [59] | 0.8402 | 40° [59] | 1.4849 [59] | |
| | | 0.8488 | 30° [59] | | |
| **3-Phenyldodecane**  | | | | | |
| | 127 0.8 [59] | 0.8376 | 40° [59] | 1.4829 [59] | |
| | | 0.8466 | 30° [59] | | |
| **4-Phenyldodecane**  | | | | | |
| | 140–142 0.6 [59] | 0.8407 | 40° [59] | 1.4850 [59] | |
| | | 0.8489 | 30° [59] | | |
| **5-Phenyldodecane**  | | | | | |
| | 113 0.4 [59] | 0.8406 | 40° [59] | 1.4850 [59] | |
| | | 0.8485 | 30° [59] | | |

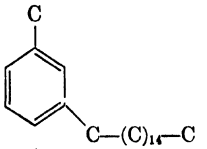
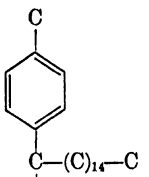
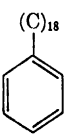
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **6-Phenyldodecane** ·  | 108 0.4 [59] | 0.8392 40° [59]<br>0.8477 30° [59] | 1.4852 [59] | |
| **1-Phenyl-3-methylundecane**  | 143–145 2 [39] | 0.8590 23.5° [39] | 1.4852 24.5° [39] | $[\alpha]_D^{23.5} = -1.31°$ [39] |
| **2,5,8-Trimethyl-5-phenylnonane**  | 153–155 15 [19] | 0.8728 [19] | 1.49326 15° [19] | |
| **1-Methyl-4-*n*-undecylbenzene**  | 171–172 12 [20] | | | |
| **1,4-Di-*sec*-hexylbenzene**  | 104–106 0.3 [66] | 0.914 [66] | 1.5020 [66] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Tri-*tert*-butybenzene**  | | | | |
| 128 [33,62,65] | 291–292 736.6 [62] | | | |
| **1,2,4,5-Tetraisopropylbenzene**  | | | | |
| 118.4 | | | | |
| 119–119.4 [21] | 260 775 [5] | 0.758 150° [33] | | |
| 119 [64] | 169 70 [30] | 0.770 135° [33] | | |
| 118.5 [33] | 133 17 [30] | | | |
| 118 [15,30] | | | | |
| 117–118 [6,78] | | | | |
| 117 [5] | | | | |
| **Hexaethylbenzene**  | | | | |
| 128.3 | 297.2 | | | |
| 130 [12,67] | 298–299 [24] | 0.8550 [38] | 1.47357 $n_{H\alpha}^{130.4}$ [14] | |
| 129 [23,33,49,78] | 298–298.5 [73] | 0.814 150° [33] | 1.48686 $n_{H\beta}^{130.4}$ [14] | |
| 128–129 [41] | 298 [33,37] | 0.824 135° [33] | | |
| 127 [22,38,77] | 296.5 [12] | 0.8305 130.4° [14] | | |
| 126–127 [76] | 294 [5] | 0.997 0° [62] | | |
| 126.5 [42] | | | | |
| 126 [11,16,24,78] | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **n-Tridecylbenzene**  | 188–189.5 10 [81] | | | |
| **7-Phenyltridecane**  | 183–184 20 [50] | 0.8604 $D_{50}^{50}$ [50]<br>0.8723 $D_{20}^{20}$ [50] | 1.49307 18° [50] | |
| **2,8-Dimethyl-5-ethyl-5-phenylnonane**  | 170–172 14 [19] | 0.8955 18.5° [19] | 1.50735 15° [19] | |
| **1-Methyl-4-dodecylbenzene**  | 155.5 1.5 [61] | 0.8560 [61] | 1.4845 [61] | |
| **$C_{20}H_{34}$** | | | | |
| **n-Tetradecylbenzene**  | | **0.8565** | **1.4812** | |
| 8.6 [26] | 195–196 9 [26,27] | 0.8559 [58,60] | 1.4813 [58,60] | |
| | 153 0.5 [60] | 0.8567 [26] | 1.4844 [26] | |
| | | 0.8012 101.9° [26] | 1.4724 50° [26] | |
| | | 0.8078 91.9° [26] | 1.4763 40° [26] | |
| | | 0.8142 82.4° [26] | 1.4805 30° [26] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **n-Tetradecylbenzene** (*Continued*) | | 0.8223 | 70.0° [26] | 1.4824 | 25° [26] | |
| | | 0.8300 | 59.7° [26] | 1.4875 | 12.3° [26] | |
| | | 0.8359 | 49.9° [26] | | | |
| | | 0.8427 | 39.5° [26] | | | |
| | | 0.8496 | 30° [60] | | | |
| | | 0.8500 | 29.5° [26] | | | |
| | | 0.8605 | 15.5° [27] | | | |
| | | 0.8629 | 10.7° [26] | | | |
| * $\frac{aD}{dt} = -0.0006791$/°C | (10 to 102°C) | | | | | |
| † $\frac{dn}{dt} = -0.0003940$/°C | (12 to 50°C) | | | | | |
| **2,8-Dimethyl-3-propyl-3-phenylnonane**  | | | | | | |
| | 180–181 15 [19] | 0.8677 [19] | | 1.48751 | 15° [19] | |
| **Diheptylbenzene** (a) | | | | | | |
| | 163–165 9 [70] | 0.853 | 21.5° [70] | 1.4819 | 25° [70] | |
| (a) The structure of this compound is not given. | | | | | | |
| $C_{21}H_{36}$ | | | | | | |
| **2,8-Dimethyl-5-isobutyl-5-phenylnonane**  | | | | | | |
| | 172–173 11 [19] | 0.89817 [19] | | 1.50623 | 15° [19] | |
| **1-Methyl-4-tetradecylbenzene**  | | | | | | |
| 16.8 [61] | 170 0.8 [61] | 0.8560 [61] | | 1.4839 [61] | | |

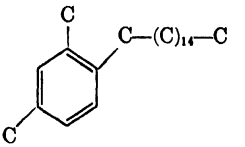
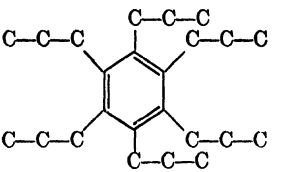
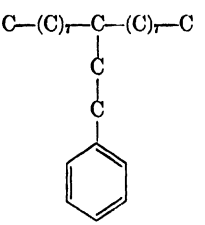
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **n-Hexadecylbenzene** (n-Cetylbenzene)  | | | | |
| 27 [34,35] | 235–237 16 [13] | 0.8558 [58,60] | 1.4814 [58,60] | |
| 22 15mm [1] | 230 15 [34,35] | 0.877 [70] | 1.452 92° [74] | |
| | 171 0.1 [60] | 0.8079 99.2° [35] | 1.47986 21.8° [13] | |
| | 136–137 0 [36] | 0.8493 30° [60] | 1.47677 $n_{H\alpha}^{21.8}$ [13] | |
| | | 0.8567 27° [35] | 1.48750 $n_{H\beta}^{21.8}$ [13] | |
| | | | 1.49409 $n_{H\gamma}^{21.8}$ [13] | |
| **2-Phenylhexadecane**  | | | | |
| | 191–194 9 [69,70,71] | 0.864 [69,70] | 1.4839 18.8° [69,70,71] | |
| | | 0.8640 20.5° [71] | | |
| | | 0.8805 0° [71] | | |
| **Dioctylbenzene** (a) | | | | |
| | 338–343 [21] | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{23}H_{40}$ | | | | |
| **n-Heptadecylbenzene**  | | | | |
| 38 [81] | | | | |
| **1-Methyl-2-n-hexadecylbenzene**  | | | | |
| 8–9 [35] | 238.5–239 15 [35] | 0.8072 99° [35] | | |
| | | 0.8676 9.2° [35] | | |

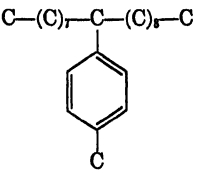
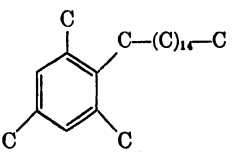
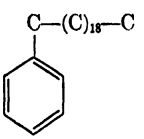
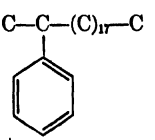
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-*n*-hexadecylbenzene**  | | | | |
| 11–12 [35] | 236.5–237 15 [35] | 0.8029 99.3° [35]<br>0.8617 11° [35] | | |
| **1-Methyl-4-*n*-hexadecylbenzene**  | | | | |
| 27.5 [35] | 239.5–240 15 [35] | 0.8027 99° [35]<br>0.8499 27.5° [35] | | |
| $C_{24}H_{42}$ | | | | |
| **Octadecylbenzene** (a)  | | | | |
| **34.3** | | **0.8568** | **1.4812** | |
| 36.5 [38] | 249 15 [34] | 0.8563 [68] | 1.4826 [68] | |
| 35–36 [43,44] | 183 3 [68] | 0.8566 [68] | 1.4828 [68] | |
| 32.8 [75] | 180–181 3 [68] | 0.8224 71.5° [75] | 1.4600 73.5 [75]° | |
| 32 [34] | 147 0 [36] | 0.8437 41° [75] | 1.4640 63° [75] | |
| 30 [68] | | 0.8439 40° [38] | 1.4730 40° [75] | |
| 25–26 [68] | | | 1.4745 36° [75] | |
| 29 15mm [1] | | | 1.4768 30° [75] | |
| | | | 1.4778 27° [75] | |
| | | | 1.4812 25° [43] | |

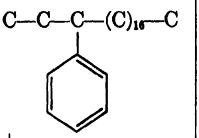
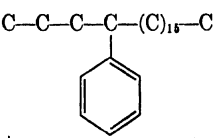
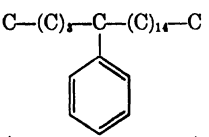
* $\frac{dD}{dt} = -0.0006611$/°C (20 to 72°C)

† $\frac{dn}{dt} = -0.0004012$/°C (20 to 74°C)

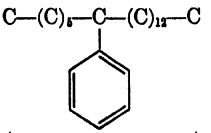
(a) The data tabulated may be for different isomers. The structure of the octadecyl group was given only for the compound referred to in reference 38. This structure is *n*-octadecylbenzene.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,5-Dimethyl-2-*n*-hexadecylbenzene**  | | | | |
| 33.5 [35] | 249.5–250 15 [35]<br>149 0 [35] | 0.8062 99.4° [35]<br>0.8495 33.5° [35] | | |
| **Hexa-*n*-propylbenzene**  | | | | |
| | | **0.8185 100°** | | |
| 103.0 [17]<br>101 [78] | 332.2 [17]<br>278.0 200 [17]<br>253.5 100 [17]<br>231.1 50 [17]<br>204.3 20 [17]<br>185.8 10 [17] | 0.7312 220° [17]<br>0.7457 200° [17]<br>0.7821 150° [17]<br>0.8112 110° [17]<br>0.8163 103° [17] | | |
| * $\frac{dD}{dt} = -0.0007275$/°C (100 to 220°C) | | | | |
| **$C_{25}H_{44}$** | | | | |
| **9-Phenethylheptadecane**  | | | | |
| | | **0.8560** | **1.4806** | |
| −26.7 [55,56] | 189.0 1.00 [55]<br>189 1.00 [56]<br>176 0.50 [56] | 0.8558 [55,56]<br>0.8038 98.9° [56]<br>0.8298 60° [56]<br>0.8439 37.8° [56]<br>0.8697 0° [56] | 1.4806 [55, 56]<br>1.4729 40.0° [56]<br>1.4767 30.0° [56] | |
| * $\frac{dD}{dt} = -0.0006712[1+0.0003912(t-20)]$/°C (0 to 99°C) | | | | |
| † $\frac{dn}{dt} = -0.0003850$/°C (20 to 40°C) | | | | |

| M. P.,°C | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|
| **9-*p*-Tolyloctadecane**  | | | | | | | |
| | | | **0.8549** | | **1.4811** | | |
| | 185 | 1.0 [7] | 0.8549 [7,55] | | 1.4811 [7,55] | | |
| | 173 | 0.5 [7] | 0.8024 | 98.9° [7] | 1.4734 | 40.0° [7] | |
| | | | 0.8283 | 60° [7] | 1.4771 | 30.0° [7] | |
| | | | 0.8433 | 37.8° [7] | | | |
| | | | 0.8681 | 0° [56] | | | |
| * $\frac{dD}{dt} = -0.0006648$/°C (0 to 99°C) | | | | | | | |
| † $\frac{dn}{dt} = -0.0003850$/°C (20 to 40°C) | | | | | | | |
| **1,3,5-Trimethyl-2-*n*-hexadecylbenzene**  | | | | | | | |
| 40 [35] | 258–258.5 | 15 [35] | 0.8065 | 99.2° [35] | | | |
| | 154–155 | 0 [36] | 0.8452 | 40° [35] | | | |
| $C_{26}H_{46}$ **1-Phenyleicosane**  | | | | | | | |
| 42.3 [55] | 212.0 | 1.00 [55] | 0.8039 | 98.9° [55] | 1.4725 | 40.0° [55] | |
| | 197.5 | 0.50 [55] | 0.8235 | 60° [55] | | | |
| **2-Phenyleicosane**  | | | | | | | |
| | | | **0.8547** | | **1.4795** | | |
| 29.0 [55] | 204.5 | 1.00 [55] | 0.8027 | 98.9° [55] | 1.4795 [55] | | |
| | 190.0 | 0.50 [55] | 0.8283 | 60° [55] | 1.4721 | 40.0° [55] | |
| | | | 0.8430 | 37.8° [55] | 1.4758 | 30.0° [55] | |
| * $\frac{dD}{dt} = -0.0006594$/°C (20 to 99°C) | | | | | | | |
| † $\frac{dn}{dt} = -0.000370$/°C (20 to 40°C) | | | | | | | |

| M. P.,°C | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|
| **3-Phenyleicosane**  | | | | | | | |
| | | | **0.8546** | | **1.4796** | | |
| 29.3 [55,56] | 202 | 1.00 [56] | 0.8032 | 98.9° [56] | 1.4796 [55,56] | | |
| | 188 | 0.50 [56] | 0.8282 | 60° [56] | 1.4720 | 40.0° [56] | |
| | | | 0.8432 | 37.8° [56] | 1.4758 | 30.0° [56] | |
| * $\frac{dD}{dt}$ = −0.0006533/°C (20 to 99°C) | | | | | | | |
| † $\frac{dn}{dt}$ = −0.000380/°C (20 to 40°C) | | | | | | | |
| **4-Phenyleicosane**  | | | | | | | |
| | | | **0.8546** | | **1.4794** | | |
| 31.4 [55] | 199.0 | 1.00 [55] | 0.8028 | 98.9° [55] | 1.4794 [55] | | |
| | 184.5 | 0.50 [55] | 0.8281 | 60° [55] | 1.4718 | 40.0° [55] | |
| | | | 0.8430 | 37.8° [55] | 1.4756 | 30 0° [55] | |
| * $\frac{dD}{dt}$ = −0.0006571/°C (20 to 99°C) | | | | | | | |
| † $\frac{dn}{dt}$ = −0.000380/°C (20 to 40°C) | | | | | | | |
| **5-Phenyleicosane**  | | | | | | | |
| | | | **0.8549** | | **1.4796** | | |
| 30.2 [55,56] | 197 | 1.00 [56] | 0.8015 | 98.9° [56] | 1.4796 [55,56] | | |
| | 184 | 0.50 [56] | 0.8275 | 60° [56] | 1.4720 | 40.0° [56] | |
| | | | 0.8430 | 37.8° [56] | 1.4757 | 30.0° [56] | |
| * $\frac{dD}{dt}$ = −0.0006780/°C (20 to 99°C) | | | | | | | |
| † $\frac{dn}{dt}$ = −0.000380/°C (20 to 40°C) | | | | | | | |

| M. P.,°C | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

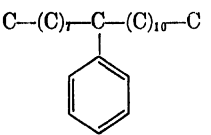


**7-Phenyleicosane**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | **0.8535** | | **1.4794** | | |
| 16.4 [55,56] | 196 | 1.00 [56] | 0.8535 [55,56] | | 1.4794 [55,56] | | |
| | 183 | 0.50 [56] | 0.8014 | 98.9° [56] | 1.4717 | 40.0° [56] | |
| | | | 0.8272 | 60° [56] | 1.4756 | 30.0° [56] | |
| | | | 0.8417 | 37.8° [56] | | | |

* $\frac{dD}{dt} = -0.0006599$/°C (20 to 99°C)

† $\frac{dn}{dt} = -0.000385$/°C (20 to 40°C)



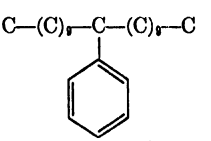
**9-Phenyleicosane**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | **0.8534** | | **1.4790** | | |
| 17.9 [55,56] | 196 | 1.00 [56] | 0.8530 [55,56] | | 1.4790 [55,56] | | |
| | 183 | 0.50 [56] | 0.8011 | 98.9° [56] | 1.4713 | 40.0° [56] | |
| | | | 0.8268 | 60° [56] | 1.4751 | 30.0° [56] | |
| | | | 0.8422 | 37.8° [56] | | | |

* $\frac{dD}{dt} = -0.0006619$/°C (20 to 99°C)

† $\frac{dn}{dt} = -0.000385$/°C (20 to 40°C)

**$C_{27}H_{48}$**

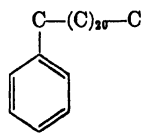
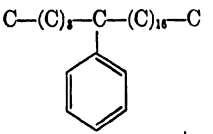
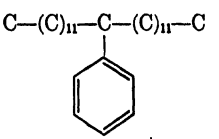


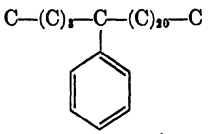
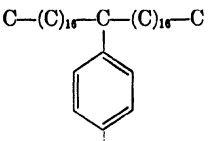
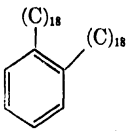
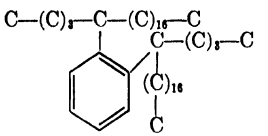
**11-Phenylheneicosane**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | **0.8531** | | **1.4788** | | |
| 20.8 [7,55,80] | 205 | 1.0 [7] | 0.8531 [7,55,80] | | 1.4788 [7,55,80] | | |
| | 204 | 1.0 [80] | 0.8018 | 98.9° [7] | 1.4713 | 40.0° [7] | |
| | 191 | 0.5 [7] | 0.8270 | 60° [7] | 1.4751 | 30.0° [7] | |
| | | | 0.8415 | 37.8° [7] | | | |

* $\frac{dD}{dt} = -0.0006502$/°C (20 to 99°C)

† $\frac{dn}{dt} = -0.000375$/°C (20 to 40°C)

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Bombicestane** (a) | | | | |
| 79 [28] | | | | |
| (a) No clue to the structure of this compound is given. | | | | |
| **$C_{28}H_{50}$** | | | | |
|  | | | | |
| ***n*-Docosylbenzene** | | | | |
| 42–44 [43] | | | 1.4806 25° [43] | |
|  | | | | |
| **5-Phenyldocosane** | | | | |
| 38 [43,44] | 200–201 1 [44] | 0.8554 25° [43] | 1.4777 25° [43] | |
| **$C_{29}H_{52}$** | | | | |
| **Ingostane** (a) | | | | |
| 75 [29] | | | | |
| (a) No clue to the structure of this compound is given. | | | | |
| **$C_{31}H_{56}$** | | | | |
|  | | | | |
| **13-Phenylpentacosane** | | | | |
| | | **0.8537** | **1.4787** | |
| 31.7 [55,56] | 235 1.00 [56] | 0.8030 98.9° [56] | 1.4787 [55,56] | |
| | 220 0.50 [56] | 0.8278 60° [56] | 1.4713 40.0° [56] | |
| | | 0.8424 37.8° [56] | 1.4750 30.0° [56] | |
| * $\frac{dD}{dt} = -0.0006440$/°C (20 to 99°C) | | | | |
| † $\frac{dn}{dt} = -0.000370$/°C (20 to 40°C) | | | | |

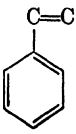
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **5-Phenylhexacosane**  | | | | |
| 32–33 [43] | | 0.8532 25° [43] | 1.4787 25° [43] | |
| $C_{41}H_{76}$  | | | | |
| **18-Phenylpentatriacontane** | | | | |
| 61–62 [67] | | | | |
| $C_{42}H_{78}$  | | | | |
| **1,2-Dioctadecylbenzene** | | | | |
| 69–70 [43] | | | | |
| $C_{50}H_{94}$  | | | | |
| **1,2-Di-(5′-docosyl)-benzene** | | | | |
| 64–66 [43] | | 0.847 [43] | | |
| $C_{60}H_{114}$ **Trioctadecylbenzene** (a) | | | | |
| 46.5–47 [43] | | 0.8520 25° [43] | 1.4813 25° [43] | |

(a) The structure of this compound is not given.

## $C_{15}H_{24}$-$C_{60}H_{114}$ References


1. Adam, N. K., Proc. Roy. Soc. (London) **103A**, 676 **1923**.
2. Austin, A., Bull. soc. chim. [2] **32**, 12 **1879**.
3. Baddeley, G., and J. Kenner, J. Chem. Soc. **1935**, 303.
4. Battegay, M., and M. Kappler, Bull. soc. chim. [4] **35**, 989 **1924**.
5. Berry, T. M., and E. E. Reid, J. Am. Chem. Soc. **49**, 3142 **1927**.
6. Calcott, W. S., J. M. Tinker, and V. Weinmayr, J. Am. Chem. Soc. **61**, 1010 **1939**.
7. Cosby, J. N., and L. H. Sutherland, paper presented before the American Petroleum Institute, November, **1941**.
8. de Capeller, R., Helv. Chim. Acta **11**, 166 **1928**.
9. de Capeller, R., Helv. Chim. Acta **11**, 170 **1928**.
10. Desseigne, G., Bull. soc. chim. [5] **2**, 617 **1935**.
11. Dilthey, W., and G. Hurtig, Ber. **67**, 495 **1934**.
12. Dreisbach, R. R., unpublished data.
13. Eisenlohr, F., and L. Schulz, Ber. **57**, 1808 **1924**.
14. Eykman, J. F., Rec. trav. chim. **12**, 157 **1893**.
15. Firla, T., Roczniki Chem. **14**, 87 **1934**; Chem. Zentr. **1934**, II, 2383.
16. Galle, K., Ber. **16**, 1744 **1883**.
17. Grosse, A. V., and V. N. Ipatieff, J. Org. Chem. **2**, 447 **1937**.
18. Gustavson, G., J. prakt. Chem. [2] **72**, 57 **1905**.
19. Halse, O. M., J. prakt. Chem. [2] **89**, 451 **1914**.
20. Hasan, K. H., and E. Stedman, J. Chem. Soc. **1931**, 2112.
21. Ipatieff, V. N., B. B. Corson, and H. Pines, J. Am. Chem. Soc. **58**, 919 **1936**.
22. Ipatieff, V. N., V. I. Komarewsky, and A. V. Grosse, J. Am. Chem. Soc. **57**, 1722 **1935**.
23. Jacobsen, O., Ber. **21**, 2814 **1888**.
24. Jannasch, P., and A. Bartels, Ber. **31**, 1716 **1898**.
25. Joukovsky, S., J. Russ. Phys. Chem. Soc. **27**, 296 **1895**; Bull. soc. chim. [3] **16**, 126 **1896**.
26. Ju, T. Y., G. Shen, and C. E. Wood, J. Inst. Petroleum Tech. **26**, 514 **1940**.
27. Ju, T. Y., C. E. Wood, and F. H. Garner, J. Inst. Petroleum Tech. **28**, 159 **1942**.
28. Kawasaki, K., J. Pharm. Soc. Japan **55**, 758 **1935**; C.A. **30**, 4510 **1936**; Chem. Zentr. **1936**, I, 785.
29. Kawasaki, C., J. Pharm. Soc. Japan **57**, 742 **1937**; C.A. **32**, 188 **1938**; Chem. Zentr. **1938**, II, 82.
30. Kirrmann, A., and M. Graves, Bull. soc. chim. [5] **1**, 1494 **1934**.
31. Klages, A., and R. Sautter, Ber. **38**, 2312 **1905**.
32. Klages, A., and R. Sautter, Ber. **39**, 1938 **1906**.
32A. Klages, A., and C. Stamm, Ber. **37**, 1715 **1904**.
33. Koch, H., and H. Steinbrink, Brennstoff-Chem. **19**, 277 **1938**.
34. Krafft, F., Ber. **19**, 2982 **1886**.
35. Krafft, F., and J. Göttig, Ber. **21**, 3180 **1888**.
36. Krafft, F., and H. Weilandt, Ber. **29**, 1316 **1896**.
37. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918**.
38. Larsen, R. G., R. E. Thorpe, and F. A. Armfield, Ind. Eng. Chem. **34**, 183 **1942**.
39. Levene, P. A., and S. A. Harris, J. Biol. Chem. **111**, 735 **1935**.
40. Lipinski, P., Ber. **31**, 938 **1898**.
41. Malishev, B. W., J. Am. Chem. Soc. **57**, 883 **1935**.
42. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **125**, 1743 **1924**.
43. Mikeska, L. A., Ind. Eng. Chem. **28**, 970 **1936**.
44. Mikeska, L. A., C. F. Smith, and E. Lieber, J. Org. Chem. **2**, 499 **1938**.
45. Morton, A. A., J. B. Davidson, and R. J. Best, J. Am. Chem. Soc. **64**, 2239 **1942**.
46. Newton, A., J. Am. Chem. Soc. **65**, 320 **1943**.
47. Noelting, E., Chimie & industrie **6**, 719 **1921**.
48. O'Connor, M. J., and F. J. Sowa, J. Am. Chem. Soc. **60**, 125 **1938**.
49. Petrov, A. D., L. I. Anzus, and E. N. Poshilzeva, J. Applied Chem. (U.S.S.R.) **5**, 790 **1932**; Chem. Zentr. **1933**, I, 3655; Refiner National Gasoline Mfr. **12**, 293 **1933**.

50. Petrov, A. D., A. P. Baidanov, N. N. Zakotin, and P. I. Suntsov, J. Gen. Chem. (U.S.S.R.) **9**, 509 **1939**; Survey For. Petrol. Liter. Jan. 26, **1940**, Abs. 210B.
51. Petrov, A. D., and Lapteva, J. Gen. Chem. (U.S.S.R.) **8**, 207 **1938**; C.A. **32**, 5386 **1938**; Chem. Zentr. **1939**, I, 4760.
52. Phillipi, E., and G. Rie, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **130**, Abt. IIb, 7 **1921**.
53. Ruzicka, L., and M. Pfeiffer, Helv. Chim. Acta **9**, 841 **1926**.
54. Ruzicka, L., and A. G. van Veen, Ann. **468**, 143 **1929**.
55. Schiessler, R. W., D. G. Clarke, C. S. Rowland, W. S. Sloatman, and C. H. Herr, paper presented before the American Petroleum Institute, November, **1943**.
56. Schiessler, R. W., J. N. Cosby, D. G. Clarke, C. S. Rowland, W. S. Sloatman, and C. H. Herr, paper presented before the American Petroleum Institute, November, **1942**.
57. Schleicher, A., J. prakt. Chem. [2] **105**, 355 **1923**.
58. Schmidt, A. W., Ber. **75**, 1399 **1942**.
59. Schmidt, A. W., and A. Grosser, Ber. **75**, 829 **1942**.
60. Schmidt, A. W., G. Hopp, and F. Schoeller, Ber. **72**, 1893 **1939**.
61. Schmidt, A. W., and V. Schoeller, Ber. **74**, 258 **1941**.
62. Senkowski, M., Ber. **23**, 2412 **1890**.
63. Shen, G., C. E. Wood, and F. H. Garner, J. Inst. Petroleum Tech. **25**, 695 **1939**.
64. Slanina, S. J., F. J. Sowa, and J. A. Nieuwland, J. Am. Chem. Soc. **57**, 1547 **1935**.
65. Smith, R. A., J. Am. Chem. Soc. **56**, 717 **1934**.
66. Spiegler, L., and J. M. Tinker, J. Am. Chem. Soc. **61**, 1002 **1939**.
66A. Staudinger, H., M. Brunner, and W. Feist, Helv. Chim. Acta **13**, 805 **1930**.
67. Staudinger, H., and W. Kern, Ber. **66**, 373 **1933**.
68. Suida, H., and A. Gemassmer, Ber. **72**, 1168 **1939**.
69. Tilicheev, M. D., J. Inst. Petroleum Tech. **23**, 642 **1937**.
70. Tilicheev, M. D., Khim. Tverdogo Topliva **9**, 181 **1938**.
71. Tilicheev, M. D., and K. S. Kuruindin, Neftyanoe Khozyaistvo **19**, 586 **1930**; Chem. Zentr. **1931**, I, 2559.
72. Toussaint, N. F., and G. F. Hennion, J. Am. Chem. Soc. **62**, 1145 **1940**.
73. Walden, P., and R. Swinne, Z. physik. Chem. **82**, 271 **1913**.
74. Waldman, **Erdoelbestandteile, 1937; Physical Constants of the Principal Hydrocarbons**, 3rd ed., Texas Co., New York.
75. Waterman, H. I., J. J. Leendertse, and D. W. van Krevelen, J. Inst. Petroleum Tech. **25**, 801 **1939**.
76. Wertyporoch, E., Ber. **64**, 1369 **1931**.
77. Wertyporoch, E., Ber. **66**, 1232 **1933**.
78. Wertyporoch, E., and T. Firla, Ann. **500**, 287 **1933**.
79. Weygand, C., and L. Mensdorf, Ber. **68**, 1825 **1935**.
80. Whitmore, F. C., J. N. Cosby, W. S. Sloatman, and D. G. Clarke, J. Am. Chem. Soc. **64**, 1801 **1942**.
81. Ziegler, K., F. Dersch, and H. Wollthan, Ann. **511**, 13 **1934**.
82. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929**.
83. Ziegler, K., H. Grimm, and R. Willer, Ann. **542**, 90 **1940**.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| |  | | | * |
| **Styrene**<br>(Ethenylbenzene)<br>(Cinnamene)<br>(Vinylbenzene) | | | | |
| **−30.6** | **145.3** | **0.90675** | **1.5465** | |
| −30.5 [15] | 146.2 [64] | 0.9031 [37] | 1.5450 [17] | |
| −30.60(a) [49,66] | 146 [8,9,25,27,54,60] | 0.9056 [66] | 1.5450(c) [11] | |
| −31.9 [20] | 145.5–146 [6,30] | 0.9065 [17] | 1.5463 ± 0.0002 [35] | |
| −32 [54] | 145–146 [34,43] | 0.9074 [12,14] | 1.54633 [50] | |
| −33 [50,63] | 144–146 [7,32] | 0.9090 [50,63] | 1.5469 [49] | † |
| −33.3 [48] | 145.99 [20] | 0.7909 145° [66] | 1.5470 [15] | |
| | 145–145.8 [63] | 0 7926 143° [45] | 1.5446 24° [47] | |
| | 145.5 [39] | 0.8138 120° [66] | 1.5440 23° [44] | |
| | 144–145.5 [14] | 0.8322 100° [66] | 1.5446 21.0° [22,42] | |
| | 145.0–145.4 [16] | 0.8506 80° [66] | 1.54633 20.05° [63] | |
| | 145.2 [66] | 0.8689 60° [66] | 1.54486 19.9° [56] | |
| | 145(b) | 0.8873 40° [66] | 1.5472 19° [26] | |
| | 144–145 [24,28,38,59,65] | 0.8938 37.8° [20] | 1.54849 16.6° [56] | |
| | 144.5 [51] | 0.8998 25° [25] | 1.5488 13° [29] | |
| | 144–144.5 [13,19] | 0.9010 25° [66] | 1.50433 $n_{H\alpha}^{75}$ [40] | |
| | 144 [17,52] | 0.9038 23° [44] | 1.53022 $n_{H\alpha}^{25}$ [40] | |
| | 143.8 [62] | 0.9080 21.1° [20] | 1.53983 $n_{H\alpha}^{20.05}$ [63] | ‡ |
| | 145–146 761 [56] | 0.9083 $D_{20}^{20}$ [26] | 1.53666 $n_{H\alpha}^{20}$ [51] | |
| | 146 759 [29] | 0.9073 19.9° [56] | 1.54030 $n_{H\alpha}^{20}$ [12] | |
| | 143.9–144.4 753 [26] | 0.9074 18.5° [18] | 1.53782 $n_{H\alpha}^{19.9}$ [56] | |
| | 143.5–145.5 745 [33] | 0.90595 17° [39] | 1.53699 $n_{H\alpha}^{17}$ [39] | |
| | 76.2–76.7 80 [41] | 0.9072 17° [61] | 1.54191 $n_{H\alpha}^{16.6}$ [56] | |
| | 73–74 73 [7] | 0.9103 16.6° [56] | 1.53853 $n_{H\alpha}^{13.15}$ [55] | |
| | 68 61 [53] | 0.9085 16° [7] | 1.52180 $n_{H\beta}^{75}$ [40] | |
| | 69.5–70.0 60 [48] | 0.9127 15.6° [20] | 1.54677 $n_{H\beta}^{25}$ [40] | |
| | 65.6 50 [15] | 0.9074 15° [13] | 1.5615 $n_{H\beta}^{21.0}$ [22] | |
| | 65.15 50 [15] | 0.911 15° [6] | 1.56377 $n_{H\beta}^{20.05}$ [63] | § |
| | 60.0 45.002 [20] | 0.9121 13° [29] | 1.56312 $n_{H\beta}^{20}$ [12] | |
| | 57–58 32 [21] | 0.9240 0° [66] | 1.55569 $n_{H\beta}^{19.9}$ [56] | |
| | 52.4 31 [1] | 0.9251 0° [64] | 1.56036 $n_{H\beta}^{17}$ [39] | |
| | 54 30 [17] | 0.9259 0° [20] | 1.56593 $n_{H\beta}^{16.6}$ [56] | |
| | 53–54 29 [28] | 0.9297 −4.4° [20] | 1.56184 $n_{H\beta}^{13.15}$ [55] | |
| | 52–53 28 [44] | 0.9410 −17.8° [20] | 1.57888 $n_{H\gamma}^{20}$ [12] | |
| | 48.4 22 [58] | | 1.57249 $n_{H\gamma}^{19.9}$ [56] | |
| | 43 17 [6] | | 1.57588 $n_{H\gamma}^{17}$ [39] | |
| | 40 14 [56,57] | | 1.58163 $n_{H\gamma}^{16.6}$ [56] | |
| | 40 13 [36] | | | |
| | 37.8 12.117 [20] | | | |
| | 36 12 [43] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Styrene** (*Continued*) | 34.2 10 [57]<br>33 10 [29]<br>21.1 4.589 [20]<br>8.2 2.16 [31]<br>0 1.189 [20]<br>−0.5 1.13 [31]<br>−7.7 0.65 [31] | | 1.57729 $n_{H\gamma}^{13.15}$ [55] (d) | |

* $\frac{1}{T_b} = 0.0036886 - 0.0004284 \log_{10} p_{mm}$ (0.65 to 80 mm)

† $\frac{dD}{dt} = -0.0008954[1 + 0.0006252(t-20)]/°C$ (−18 to 145°C)

‡ $\frac{dD}{dt} = -0.0008739/°C$ (0 to 40°C)

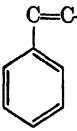
§ $\frac{dn}{dt} = -0.0005186/°C$ (13 to 25°C)

(a) This figure is given as a freezing point in the literature.
(b) The boiling point 145 is found in references 2, 3, 4, 5, 46, 50.
(c) This refractive index is the average of two or more determinations.
(d) Refractive indices at other lines may be found in references 10, 22.

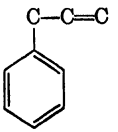
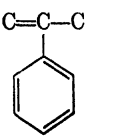
## Styrene References

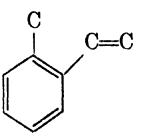

1. Bartlett, P. D., and S. G. Cohen, J. Am. Chem. Soc. **65**, 543 **1943**.
2. Berthelot, Ann. chim. phys. [4] **12**, 161 **1867**.
3. Berthelot, Bull. soc. chim. [2] **6**, 289 **1866**.
4. Berthelot, Bull. soc. chim. [2] **7**, 274 **1867**.
5. Berthelot, Bull. soc. chim. [2] **8**, 226 **1867**.
6. Biltz, H., Ann. **296**, 263 **1897**.
7. Birch, S. F., and E. N. Hague, Ind. Eng. Chem. **26**, 1008 **1934**.
8. Böeseken, J., and M. C. Bastet, Rec. trav. chim. **32**, 184 **1913**.
9. Botsch, K., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **82**, II, 479 **1880**.
10. Bouhet, C., Compt. rend. **185**, 200 **1927**.
11. Breitenbach, I. W., and H. Rudorfer, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **146**, IIb, 37 **1937**.
12. Brühl, J. W., Ann. **235**, 1 **1886**.
13. Charabot, Les Principes Odorants des Végétaux, pp. 65-67, O. Doin et Fils, Paris, **1912**.
14. Descamps, R., Bull. soc. chim. Belg. **33**, 139 **1924**.
15. Dolliver, M. A., T. L. Gresham, G. B. Kistiakowsky, and W. E. Vaughan, J. Am. Chem. Soc. **59**, 831 **1937**.
16. Dow Chemical Co. through Patnode and Scheiber, J. Am. Chem. Soc. **61**, 3449 **1939**.
17. Dykstra, H. B., J. Am. Chem. Soc. **56**, 1625 **1934**.
18. Erfle, H., Ann. Physik [4] **24**, 672 **1907**.
19. Fittig, R., and F. Binder, Ann. **195**, 131 **1879**.
20. Garner, J. B., L. Adams, and R. M. Stuckell, Petroleum Refiner **21**, 321 **1942**.
21. Gauthier, D., and P. Gauthier, Bull. soc. chim. [4] **53**, 323 **1933**.
22. Gladstone, J. H., J. Chem. Soc. **59**, 290 **1891**.
23. Gorman, M., R. M. Davis, and P. M. Gross, Physik. Z. **39**, 181 **1938**.
24. Hibbert, H., and C. P. Burt, J. Am. Chem. Soc. **47**, 2240 **1925**.
25. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **17**, 929 **1911**.
26. Hofmann, F., K. F. Lang, K. Berlin, and A. W. Schmidt, Brennstoff-Chem. **14**, 103 **1933**.

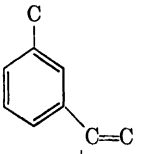
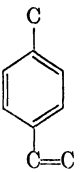
27. Horstmann, A., Ber. 20, 766 1887.
28. Iotsich, Z., J. Russ. Phys. Chem. Soc. 30, 920; Chem. Zentr. 1899, I, 607.
29. Klages, A., and R. Keil, Ber. 36, 1632 1903.
30. Krassilshik, A., Ann. combustibles liquides 10, 923 1935.
31. Linder, E. G., J. Phys. Chem. 35, 531 1931.
32. Mameli, E., and A. Mossini, Giorn. chim. ind. applicata 15, 161 1933.
33. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. 125, 1743 1924.
34. Meyer, R., Ber. 45, 1609 1912.
35. Moore, J. K., R. E. Burk, and H. P. Lankelma, J. Am. Chem. Soc. 63, 2954 1941.
36. Moureu, C., and E. André, Ann. chim. [9] 1, 113 1914.
37. Müller, F. H., Physik. Z. 38, 283 1937.
38. Muller, H., and S. L. Langedijk, Chem. Weekblad 20, 627 1923.
39. Nasini, R., and O. Bernheimer, Gazz. chim. ital. 15, 59 1885.
40. Otto, M. M., and H. H. Wenzke, J. Am. Chem. Soc. 57, 294 1935.
41. Patnode, W., and W. J. Scheiber, J. Am. Chem. Soc. 61, 3449 1939.
42. Pestemer, M., and L. Wiligut, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 144, Abt. IIb, 251 1935.
43. Rupe, H., and H. Proska, Ber. 43, 1231 1910.
44. Sabetay, S., Bull. soc. chim. [4] 45, 69 1929.
45. Schiff, R., Ann. 220, 71 1883.
46. Schmidt, O., Z. physik. Chem. 176A, 237 1936.
47. Shorygin, P. P., and N. V. Shorygina, J. Gen. Chem. (U.S.S.R.) 5, 555 1935; C.A. 29, 6885 1935.
48. Smith, R. H., and D. H. Andrews, J. Am. Chem. Soc. 53, 3644 1931.
49. Smoker, E. H., and P. E. Burchfield, Ind. Eng. Chem. Anal. Ed. 15, 128 1943.
50. Stanley, H. M., Chemistry & Industry 57, 93 1938.
51. Stobbe, H., Ann. 409, 1 1915.
52. Stobbe, H., and G. Posnjak, Ann. 371, 259 1910.
53. Stuurman, J., Proc. Acad. Sci. Amsterdam 38, 450 1935.
54. Trusty, A. W., Petroleum Refiner 22, 95 1943.
55. von Auwers, K., Ann. 413, 253 1917.
56. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] 82, 65 1910.
57. von Auwers, K., W. A. Roth, and F. Eisenlohr, Ann. 373, 267 1910.
58. von Auwers, K., W. A. Roth, and F. Eisenlohr, Ann. 385, 102 1911.
59. von Braun, J., Ann. 382, 1 1911.
60. von Braun, J., and K. Moldänke, Ber. 54, 618 1921.
61. Vorländer, D., and J. Fischer, Ber. 65, 1756 1932.
62. Walden, P., Z. physik. Chem. 66, 385 1909.
63. Waterman, H. I., and W. J. C. DeKok, Rec. trav. chim. 53, 1133 1934.
64. Weger, F., Ann. 221, 61 1883.
65. Weger, M., Z. angew. Chem. 22, 338 1909.
66. Wood, L. A., and C. F. Higgins, India Rubber World 107, 475 1943.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Propen-1-ylbenzene**  | **173.5** | **0.9105** | | * |
| 20 [36] | 176–177 [39,52,78] | 0.9070 [49] | 1.5420 [10] | |
| | 176 [22,53] | 0.9088 [10] | 1.5432 [33] | |
| | 174–176 [61] | 0.913 [37] | 1.549 [72] | |
| | 174–175.25 [32] | 0.9130 [35] | 1.5492 [30] | |
| | 175 [5,67] | 0.914 [72] | 1.5493 [64] | |
| | 174–175 [68] | 0.9141 [8,30] | 1.5494 [8] | |
| | 172–175 [1] | 0.9078 26° [30] | 1.550 [37] | |
| | 174 [9,50] | 0.9083 26° [30] | 1.54967 18.7° [74] | |
| | 172–174 [35] | 0.9076 $D_{25}^{26}$ [52] | 1.55069 17° [49] | |
| | 173 [37] | 0.90902 $D_0^{23}$ [1] | 1.5482 14° [29] | |
| | 171–172 [43] | 0.9109 $D_{20}^{20}$ [52] | 1.5497 12° [30] | |
| | 170–171 [2,55] | 0.9083 19° [26] | 1.558 7° [54] | |
| | 169–171 [77] | 0.9145 18.7° [74] | 1.54257 $n_{H\alpha}^{18.7}$ [74] | |
| | 167–170 [14,33,34] | 0.9188 15° [3] | 1.56600 $n_{H\beta}^{18.7}$ [74] | |
| | 167 [16] | 0.9143 $D_{15}^{15}$ [52] | 1.5803 $n_{H\gamma}^{18.7}$ [74] | |
| | 177 756 [30] | 0.9151 13° [30] | | |
| | 172–173 754 [15] | 0.9181 12° [30] | | |
| | 173–175 750 [3] | 0.9181 $D_{10}^{10}$ [52] | | |
| | 166.7 746 [10] | 0.918 7° [54] | | |
| | 73 20 [49] | 0.922 $D_5^5$ [52] | | |
| | 72–74 15 [29] | 0.9230 $D_4^4$ [52] | | |
| | 72–73 15 [48] | 0.9253 0° [30] | | |
| | 68 15 [72] | | | |
| | 74 13 [26] | | | |
| | 71 13 [63] | | | |
| | 67.5 13 [75] | | | |
| | 65.5 13 [74,75] | | | |
| | 65 13 [64] | | | |
| | 63.5 13 [37] | | | |
| | 68 12 [54] | | | |
| | 66–67 12 [40] | | | |
| | 69–70 11 [35] | | | |
| | 65–70 10 [34] | | | |
| | 64–65 10 [17] | | | |
| | 61 10 [49] | | | |

* $\frac{dD}{dt} = -0.0007588$/°C (0 to 26°C)

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Propen-2-ylbenzene** (Allylbenzene)  | **156.3** | | | |
| −40 [36] | 157–160 [1] | 0.8929 [8] | 1.5118 [64] | |
| | 158–159 [3] | 0.8930 [23] | 1.5126 [23] | |
| | 157–159 [24] | 0.893 [36,37] | 1.514 [37] | |
| | 156–159 [46] | 0.8812 25° [46] | 1.5143 [8,68] | |
| | 157 [7,37] | 0.8929 $D_0^{20}$ [51] | 1.5042 25° [46] | |
| | 156–157 [20,32,44,68] | 0.9012 15° [68] | 1.5126 21.7° [32] | |
| | 156 [6,38,56] | 0.9018 14.5° [3] | 1.5137 21.5° [56] | |
| | 155–156 [6] | 0.90706 $D_0^0$ [1] | 1.52002 14.5° [3] | |
| | 155 [9,11,22,67] | | | |
| | 155–157 750 [4] | | | |
| | 154 730 [54] | | | |
| | 153–154 725 [21] | | | |
| | 52–55 16 [42] | | | |
| | 50 16 [36] | | | |
| | 47 13 [36,37] | | | |
| **Isopropenylbenzene**  | **161.6** | **0.9096** | **1.5363** | |
| | 162–165 [63,74] | 0.908 [71] | 1.535 [71] | |
| | 162–164 [70] | 0.9115 [12] | 1.5364 [74] | |
| | 161–163 [28] | 0.9044 24° [28] | 1.5350 22° [59] | |
| | 162 [27] | 0.9070(a) $D_{22}^{22}$ [59] | 1.5370 22° [59] | |
| | 161–162 [66] | 0.9085 21° [66] | 1.5371 22° [59] | |
| | 160–162 [67] | 0.9142 $D_{20}^{20}$ [12] | 1.53492 19.8° [74] | |
| | 160–161 [2] | 0.9078 19.8° [74] | 1.5377 19° [40] | |
| | 160 [25] | 0.9125 19° [40] | 1.5385 19° [59] | |
| | 165 764 [45] | 0.9134 17.4° [74] | 1.53842 17.4° [74] | |
| | 163 761 [59] | 0.9165 9.6° [18,19] | 1.54207 9.6° [18,19] | |
| | 164–165 754 [40] | 0.9231 0° [67] | 1.52893 $n_{H\alpha}^{19.8}$ [74] | |
| | 163–164 752 [73] | 0.9278 0° [66] | 1.53257 $n_{H\alpha}^{17.4}$ [74] | |
| | 162 752 [59] | 0.92725(a) $D_0^{12}$ | 1.54959 $n_{H\beta}^{19.8}$ [74] | |
| | 164 749 [65] | | 1.55353 $n_{H\beta}^{17.4}$ [74] | |
| | 158–160 748 [18,19] | | 1.56284 $n_{H\gamma}^{19.8}$ [74] | |
| | 159–160 744 [59] | | 1.56637 $n_{H\gamma}^{17.4}$ [74] | |
| | 160–162 743 [59] | | | |
| | 106 126 [19] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Isopropenylbenzene** (*Continued*) | | | | |
| | 68–69 27 [66] | | | |
| | 66 21.5 [76] | | | |
| | 65 20 [76] | | | |
| | 61–62 18 [28] | | | |
| | 60.5–61.5 18 [12] | | | |
| | 60–62 17 [12] | | | |
| | 60–61 17 [66] | | | |
| | 55–60 15 [66] | | | |
| | 56 15 [71] | | | |
| | 54.5–55.0 14 [75] | | | |
| | 54–55 14 [74] | | | |
| | 56 13 [12] | | | |
| | 50.0–50.5 11 [75] | | | |
| * $\frac{dD}{dt} = -0.0008111$/°C (0 to 24°C) | | | | |
| † $\frac{dn}{dt} = -0.00056115$/°C (9 to 22°C) | | | | |
| (a) This density is the average of two or more determinations. | | | | |
| **1-Methyl-2-ethenylbenzene**  | | | **1.5447** | |
| | 169 752 [13] | 0.8912 $D_{24}^{24}$ [62] | 1.54505(a) [71] | |
| | 168 746 [13] | 0.9155 14.1° [71] | 1.5425 24° [62] | |
| | 61–62 18 [57] | 0.9161 13.4° [71] | 1.54765 14.1° [71] | |
| | 59 15 [71] | 0.9168 13.25° [71] | 1.54817 13.25° [71] | |
| | 55.4 12 [71] | 0.9174 12.55° [71] | 1.54175 $n_{H\alpha}^{14.1}$ [71] | |
| | 51 9 [62] | | 1.54219 $n_{H\alpha}^{13.25}$ [71] | |
| | | | 1.56444 $n_{H\beta}^{14.1}$ [71] | |
| | | | 1.56499 $n_{H\beta}^{13.25}$ [71] | |
| | | | 1.57904 $n_{H\gamma}^{14.1}$ [71] | |
| | | | 1.58003 $n_{H\gamma}^{13.25}$ [71] | |
| * $\frac{dn}{dt} = -0.0005117$/°C (13 to 24°C) | | | | |
| (a) This refractive index is the average of two determinations. | | | | |

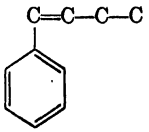
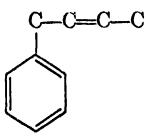
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-ethenylbenzene**  | | | | |
| | 164 [47]<br>61–62 18 [69]<br>52–53 9 [62] | 0.9044 $D_{24}^{24}$ [62] | 1.54 24° [62] | |
| **1-Methyl-4-ethenylbenzene**  | | | | |
| | 170–175 [60]<br>170–173 [58]<br>166–167 724 [17]<br>77–79 33 [73]<br>69–70 20 [51]<br>65–66 19 [73]<br>63 15 [31]<br>60 12 [26]<br>59–60 12 [69]<br>51 10 [62] | 0.8813 25° [51]<br>0.8974 $D_{24}^{24}$ [62]<br>0.896 $D_{20}^{20}$ [41]<br>0.8974 18° [26]<br>0.9003 16.4° [73]<br>0.9010 16.3° [73]<br>0.9011 16.2° [73]<br>0.8978 16° [31] | 1.52336 25° [51]<br>1.5395 24° [62]<br>1.54465 16.4° [73]<br>1.54474 16.3° [73]<br>1.5306 16° [31]<br>1.53811 $n_{H\alpha}^{16.4}$ [73]<br>1.53820 $n_{H\alpha}^{16.3}$ [73]<br>1.56200 $n_{H\beta}^{16.4}$ [73]<br>1.56208 $n_{H\beta}^{16.3}$ [73]<br>1.57784 $n_{H\gamma}^{16.4}$ [73]<br>1.57797 $n_{H\gamma}^{16.3}$ [73] | |

## $C_9H_{10}$ References

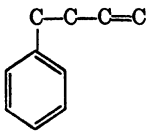
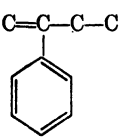
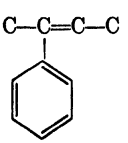

1. Ageeva, M., J. Russ. Phys. Chem. Soc. **37**, 662 **1905**; Chem. Zentr. **1905**, II, 1017.
2. Amagot, P., Bull. soc. chim. [4] **49**, 1410 **1931**.
3. Barbier, P., and V. Grignard, Bull. soc. chim. [3] **31**, 840 **1904**.
4. Bergmann, E., and A. Bondi, Ber. **64**, 1455 **1931**.
5. Böesecken, J., and J. S. P. Blumberger, Rec. trav. chim. **44**, 90 **1925**.
6. Böeseken, J., and G. Elsen, Rec. trav. chim. **48**, 363 **1929**.
7. Bogert, M. T., and D. Davidson, J. Am. Chem. Soc. **56**, 185 **1934**.
8. Briner, E., K. Ryffel, and E. Perrottet, Helv. Chim. Acta **22**, 927 **1939**.
9. Buchner, E., and J. Geronimus, Ber. **36**, 3782 **1903**.
10. Campbell, K. N., and M. J. O'Connor, J. Am. Chem. Soc. **61**, 2897 **1939**.
11. Chojnacki, C., Compt. rend. **76**, 1413 **1873**.
12. Danilov, S., and E. Venus-Danilova, Ber. **60**, 1050 **1927**.
13. Emde, H., Ann. **391**, 88 **1912**.
14. Emde, H., Ber. **42**, 2590 **1909**.
15. Emde, H., Ber. **44**, 3224 **1911**.

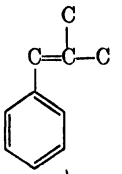
16. Emde, H., and H. Schellback, Arch. Pharm. **249**, 118 **1911.**
17. Gauthier, D., and P. Gauthier, Bull. soc. chim. [4] **53**, 323 **1933.**
18. Grignard, V., Ann. chim. phys. [7] **24**, 433 **1901.**
19. Grignard, V., Ann. Univ. Lyon **1901**, 1.
20. Harries, C., and E. R. von Riedenstein, Ann. **390**, 259 **1912.**
21. Hershberg, E. B., Helv. Chim. Acta **17**, 351 **1934.**
22. Hillmer, A., and P. Schorning, Z. physik. Chem. **167A**, 407 **1933.**
23. Huston, R., and K. Goodemoot, J. Am. Chem. Soc. **56**, 2432 **1934.**
24. Huston, R. C., and D. D. Sager, J. Am. Chem. Soc. **48**, 1955 **1926.**
25. Johnson, J. D. A., and G. A. R. Kon, J. Chem. Soc. **1926**, 2748.
26. Klages, A., Ber. **35**, 2245 **1902.**
27. Klages, A., Ber. **35**, 2633 **1902.**
28. Klages, A., Ber. **35**, 3506 **1902.**
29. Klages, A., Ber. **36**, 621 **1903.**
30. Klages, A., Ber. **36**, 2572 **1903.**
31. Klages, A., and R. Keil, Ber. **36**, 1632 **1903.**
32. Krassilshik, A., Ann. combustibles liquides **10**, 923 **1935.**
33. Kunckell, F., Ber deutsch. pharm. Ges. **22**, 180 **1912.**
34. Kunckell, F., and W. Dettmar, Ber. **36**, 771 **1903.**
35. Lazarev, S. P., and A. A. Shamshurin, J. Gen. Chem. (U.S.S.R.) **9**, 199 **1939**; C.A. **33**, 6258 **1939**; Chem. Zentr. **1939**, II, 1054.
36. Lespieau, R., Bull. soc. chim. [4] **47**, 847 **1930.**
37. Lespieau, Compt. rend. **190**, 1129 **1930.**
38. Levina, R. Y., D. A. Petrov, and D. M. Trakhtenberg, J. Gen. Chem. (U.S.S.R.) **6**, 1469 **1936**; C.A. **31**, 2173 **1937.**
39. Lévy, J., and Dvolcitzka-Gombinska, Bull. soc. chim. [4] **49**, 1765 **1931.**
40. Ley, Z. wiss. Phot. **18**, 177 **1918.**
41. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A Boyd, Ind. Eng. Chem. **26**, 475 **1934.**
42. Lüttringhaus, A., G. von Sääf, and K. Hauschild, Ber. **71**, 1673 **1938.**
43. Mameli, E., Gazz. chim. ital. **39**, II, 154 **1909.**
44. Mameli, E., and A. Mossini, Giorn, chim. ind. applicata **15**, 161 **1933.**
45. Matsubara, K., and W. H. Perkin, J. Chem. Soc. **87**, 661 **1905.**
46. McKenna, J. F., and F. J. Sowa, J. Am. Chem. Soc. **59**, 470 **1937.**
47. Müller, W., Ber. **20**, 1212 **1887.**
48. Murray, M. J., and F. F. Cleveland, J. Am. Chem. Soc. **61**, 3546 **1939.**
49. Nenitzescu, C. D., and D. A. Isăcescu, Ber. **66**, 1100 **1933.**
50. Oddo, B., Gazz. chim. ital. **41**, I, 273 **1911.**
51. Otto, M. M., and H. H. Wenzke, J. Am. Chem. Soc. **57**, 294 **1935.**
52. Perkin, W. H., J. Chem Soc. **69**, 1025 **1896.**
53. Prevost, C., Bull. soc. chim. [4] **49**, 1372 **1931.**
54. Quelet, R., Bull. soc. chim. [4] **45**, 255 **1929.**
55. Ramart-Lucas, and P. Amagat, Bull. soc. chim. [4] **51**, 108 **1932.**
56. Ramart-Lucas, and P. Amagat, Bull. soc. chim. [4] **51**, 965 **1932.**
57. Ramart-Lucas, and J. Hoch, Bull. soc. chim. [5] **2**, 327 **1935.**
58. Sabetay, S., Bull. soc. chim. [4] **45**, 69 **1929.**
59. Sabetay, S., Bull. soc. chim. [4] **47**, 614 **1930.**
60. Schramm, J., Ber. **24**, 1332 **1891.**
61. Senfter, L., and J. Tafel, Ber. **27**, 2309 **1894.**
62. Shorygin, P. P., and N. V. Shorygina, J. Gen. Chem. (U.S.S.R.) **5**, 555 **1935**; C.A. **29**, 6885 **1935.**
63. Stephens, H. N., J. Am. Chem. Soc. **50**, 186 **1928.**
64. Stuurman, J., Proc. Acad. Sci. Amsterdam **38**, 450 **1935.**
65. Thorpe, J. F., and A. S. Wood, J. Chem. Soc. **103**, 1569 **1913.**
66. Tiffeneau, Ann chim. phys. [8] **10**, 145 **1907.**
67. Tiffeneau, M., Compt. rend. **134**, 845 **1902.**

68. Tiffeneau, M., Compt rend. **139**, 481 **1904.**
69. Titley, A. F., J. Chem. Soc. **1926**, 508.
70. Tröger, J., and O. Beck, J. prakt. Chem. [2] **87**, 289 **1913.**
71. von Auwers, K., Ann. **413**, 253 **1917.**
72. von Auwers, K., Ann. **415**, 98 **1918.**
73. von Auwers, K., Ber. **45**, 2764 **1912.**
74. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] **82**, 65 **1910.**
75. von Auwers, K., W. A. Roth, and F. Eisenlohr, Ann. **373**, 267 **1910.**
76. von Auwers, K., W. A. Roth, and F. Eisenlohr, Ann. **385**, 102 **1911.**
77. von Braun, J., Ann. **382**, 1 **1911.**
78. von Braun, J., K. Heidler, and L. Neumann, Ber. **49**, 2613 **1916.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Buten-1-ylbenzene**  | **188.9** | | | |
| | 190–193 [46] | 0.9106 [58] | 1.5387 [58] | |
| | 188–190 [41] | 0.9097 19° [72] | 1.54019 19.4° [72] | |
| | 189 [36] | 0 9124 16° [36] | 1.5381 16° [46] | |
| | 188–189 [1] | 0.9065 13° [41] | 1.5414 16° [36] | |
| | 89–90 15 [36] | 0.907 11° [86] | 1.550 11° [86] | |
| | 81.7–82.7 12.5 [72] | 0.9277 $D_0^4$ [46] | 1.53401 $n_{H\alpha}^{19.4}$ [72] | |
| | 85 12 [18] | | 1.55615 $n_{H\beta}^{19.4}$ [72] | |
| | 80 12 [56] | | 1.57083 $n_{H\gamma}^{19.4}$ [72] | |
| | 78 12 [15] | | | |
| | 76–78(a) 12 [51] | | | |
| | 73–74.5(b) 12 [81] | | | |
| | 77 10 [58] | | | |
| | 83 9 [50] | | | |
| | 70–71 8 [41] | | | |
| **Buten-2-ylbenzene**  | **176.2** | | | |
| | 176–178 [36] | 0.8831 [58] | 1.5101 [44,58] | |
| | 175–177 [63] | 0.9006 [45] | 1.5157 19° [75] | |
| | 176 [10] | 0.9033 [44] | 1.5109 15° [36] | |
| | 176 765 [36] | 0.9069 19° [75] | | |
| | 177–178 754 [2] | 0.8857 15° [36] | | |
| | 81–82 21 [73] | 0.8991 0° [2] | | |
| | 76 18 [36] | | | |
| | 76–77.5 16 [73] | | | |
| | 72–73 13 [2] | | | |
| | 70 12 [15] | | | |
| | 61–63 12 [75] | | | |
| | 68 10 [58] | | | |
| | 65.6–66 4 [45] | | | |

(a) This constant was determined on the *trans* isomer.
(b) This constant was determined on the *cis* isomer.

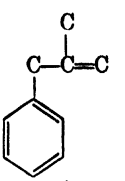
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Buten-3-ylbenzene**  | | | | |
| | **177.2** | | | |
| | 177–178 [48,49] | 0.8831 [53] | 1.5059 [53,61] | |
| | 176–178 [4,5] | 0.8915 [44] | 1.5064 [44] | |
| | 175–178 [26,27] | 0.8878 17° [37] | 1.5090 [26] | |
| | 177 [57] | 0.901 15.5° [4] | 1.5073 21.5° [57] | |
| | 175–177 [19] | 0.9015 15.5° [5] | 1.5078 17° [37] | |
| | 176–178 758 [3] | | | |
| | 73 18 [12] | | | |
| | 73–76 14 [3] | | | |
| | 72–73 13 [61] | | | |
| | 62.5 13 [44] | | | |
| | 65 12 [56] | | | |
| | 65 11 [37] | | | |
| | 64 10 [53] | | | |
| **2-Phenylbutene-1**  | | | | |
| | 81–82 20 [28] | | | |
| **2-Phenylbutene-2**  | | | | |
| | **189.3** | | | |
| | 191–193 [33] | 0.9041 [30] | 1.534 [69] | |
| | 188–191 [34] | 0.909 [69] | 1.52990 25° [23] | |
| | 186–191 [6] | 0.8911 25° [22,24] | 1.5293 25° [61] | |
| | 187–190 [25] | 0.909 22° [34] | 1.5288 22° [34] | |
| | 187–189 [71,72] | 0.9088 19.7° [71] | 1.5299 21° [30] | |
| | 184–187 752.9 [30] | 0.9095 19.7° [71] | 1.53387 19.7° [71] | |
| | 91 20 [73] | 0.9286 19.6° [71] | 1.53496 19.7° [71] | |
| | 80–81 20 [23,34] | 0.9221 15° [33] | 1.51488 $n_{H\alpha}^{25}$ [23] | |
| | 85.5–86.5 19 [73] | | 1.52833 $n_{H\alpha}^{19.7}$ [71] | |
| | 83–84 19 [73] | | 1.52930 $n_{H\alpha}^{19.7}$ [71] | |
| | 81–82 17 [34] | | | |

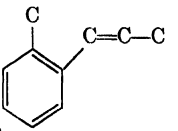
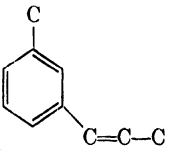
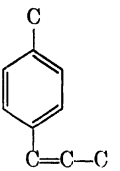
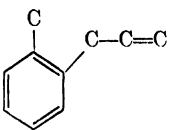
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Phenylbutene-2** (*Continued*) | 78 15 [69]<br>73 14 [61] | | 1.54785 $n_{H\beta}^{19.7}$ [71]<br>1.54895 $n_{H\beta}^{19.7}$ [71]<br>1.56048 $n_{H\gamma}^{19.7}$ [71]<br>1.56172 $n_{H\gamma}^{19.7}$ [71] | |
| **1-Phenyl-2-methylpropene-1**  | **185.5** | **0.9019** | | |
| | 190 [16] | 0.9014 $D_{25}^{25}$ [53] | 1.5235 [31] | |
| | 187.3–188.3 [53] | | 1.5280 [35] | |
| | 184–186 [11] | 0.9047 $D_{20}^{20}$ [53] | 1.5400 [76] | |
| | 181–183 [25,74] | 0.9006 $D_0^{20}$ [31] | 1.5380 22° [76] | |
| | 180–182 [47,66,67] | 0.8986 19.6° [71] | 1.5390 21.0° [53] | |
| | 181 [68] | | 1.5400 20.4° [76] | |
| | 179–181 [65] | 0.9081 $D_{15}^{15}$ [53] | 1.52733 19.6° [71] | |
| | 181–182 761 [35] | 0.9022 14.5° [35] | 1.53707 11° [20,21] | |
| | 183–185 748 [20,21] | 0.9116 $D_{10}^{10}$ [53] | 1.52185 $n_{H\alpha}^{19.6}$ [71] | |
| | 189–192 747 [31] | 0.9154 $D_5^{5}$ [53] | 1.54105 $n_{H\beta}^{19.6}$ [71] | |
| | 101 50 [76] | 0.9163 $D_4^{4}$ [53] | 1.55357 $n_{H\gamma}^{19.6}$ [71] | |
| | 100 50 [76] | 0.9172 0° [65] | (a) | |
| | 90 31 [76] | | | |
| | 79–80 20 [76] | | | |
| | 72 15 [8] | | | |
| | 63.5 10 [9] | | | |

* $\frac{1}{T_b} = 0.0033897 - 0.0004218 \log_{10} p_{mm}$ (10 to 50 mm)

† $\frac{dD}{dt} = -0.0008420/°C$ (0 to 25°C)

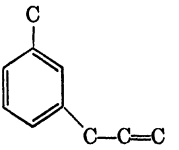
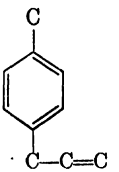
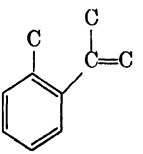
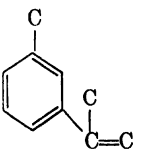
(a) Refractive indices at other lines may be found in reference 53.

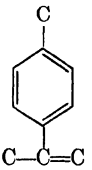
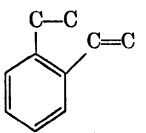
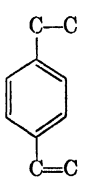
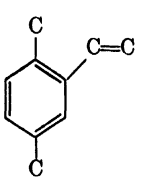
| | | | | |
|---|---|---|---|---|
| **1-Phenyl-2-methylpropene-2**  | 69–70 20 [76] | | 1.5080 [76] | |

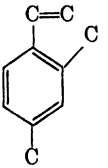
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-2-(propen-1′-yl)-benzene**  | | | | |
| | 79.5 15 [43] | 0.9017 [43] | 1.5393 [43] | |
| **1-Methyl-3-(propen-1′-yl)-benzene**  | | | | |
| | 94.5 22 [43] | 0.8954 [43] | 1.5398 [43] | |
| **1-Methyl-4-(propen-1′-yl)-benzene**  | | | | |
| | 195–197 [40]<br>196 [39]<br>192 [13,14]<br>195–197 758 [42]<br>92–93 20 [32]<br>83–85 10 [39,40] | 0.8896 [42]<br>0.9057 13° [39,40] | 1.5392 [42]<br>1.5477 13° [40] | |
| **1-Methyl-2-(propen-2′-yl)-benzene**  | | | | |
| | | **$0.9005_5$** | **1.5187** | |
| | 182–183 757 [43]<br>181<br>–181.6 750 [27]<br>93–95 30 [27]<br>88–90 25 [27] | 0.9001 [43]<br>0.8890 35° [27]<br>0.8970 24.5° [27]<br>0.9110 7° [27] | 1.5186 [43]<br>1.5171 24° [27]<br>1.5209 14° [27]<br>1.5255 6° [27] | |

* $\frac{dD}{dt} = -0.0007847$/°C (7 to 35°C)

† $\frac{dn}{dt} = -0.0004400$/°C (6 to 24°C)

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-(propen-2′-yl)-benzene**  | | | | |
| | 185–186 [60]<br>185 [59]<br>180–181 756 [43]<br>60–60.5 11 [42] | 0.8795 [42]<br>0.8910 [43]<br>0.9035 $D_0^{22}$ [59,60] | 1.5062 [42]<br>1.5127 [43]<br>1.530 22° [59,60] | |
| **1-Methyl-4-(propen-2′-yl)-benzene**  | | | | |
| | 180–182 755 [42,43]<br>180–181 750 [27]<br>58–60 1.65 [27] | 0.8830 [42,43]<br>0.9043 26.2° [27]<br>0.9157 6.8° [27] | 1.5082 [27]<br>1.5095 [42,43]<br>1.5210 10° [27] | |
| **1-Methyl-2-isopropenylbenzene**  | | | | |
| | 175 [59,60]<br>172–173 756 [29]<br>59–62 11 [7] | 0.9181 $D_0^{15}$ [59,60] | 1.5112 30° [7]<br>1.521 15° [59,60] | |
| **1-Methyl-3-isopropenylbenzene**  | | | | |
| | 185–186 [55]<br>183–185 [64] | 0.9115 0° [64] | | |

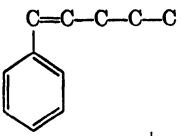
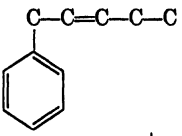
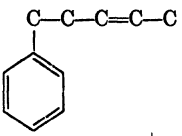
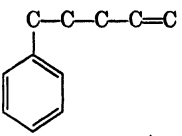
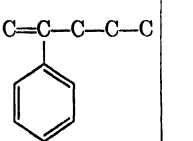
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **1-Methyl-4-isopropenylbenzene**  | | | | | | |
| | **185.3** | | | | | |
| | 186–188 [69] | 0.8936 | 23° [22] | 1.52832 | 23° [22] | |
| | 186 [60] | 0.9022 | 18.7° [70] | 1.53447 | 18.7° [70] | |
| | 184–185 [64] | 0.9024 | 18.5° [70] | 1.528 | 16° [59,60] | |
| | 187 780 [54] | 0.9074 | $D_0^{16}$ [59,60] | 1.52870 | $n_{H\alpha}^{18.7}$ [70] | |
| | 186–189 748 [22] | 0.9122 | 0° [64] | 1.54944 | $n_{H\beta}^{18.7}$ [70] | |
| | 101.5 29 [70] | 0.9121 | $D_0^{0}$ [59,60] | 1.56306 | $n_{H\gamma}^{18.7}$ [70] | |
| **1-Ethyl-2-ethenylbenzene**  | | | | | | |
| | 68–68.5 12 [17] | 0.9119 [17] | | 1.54221 | 22° [17] | |
| | | | | 1.53625 | $n_{H\alpha}^{22}$ [17] | |
| | | | | 1.55796 | $n_{H\beta}^{22}$ [17] | |
| **1-Ethyl-4-ethenylbenzene**  | | | | | | |
| | 86 20 [18, 32] | 0.8901 | 25° [52] | 1.52055 | 25° [52] | |
| | 84–85 19 [52] | 0.8953 | 15° [38] | 1.5377 | 15° [38] | |
| | 68 11 [38] | 0.9074 | 13° [32] | | | |
| **1,4-Dimethyl-2-ethenylbenzene**  | | | | | | |
| | 69 10 [38] | 0.9072 | 17.5° [38] | 1.5236 | 17.5° [38] | |

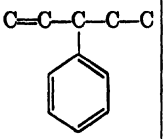
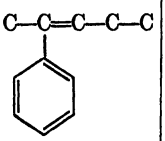
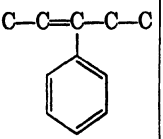
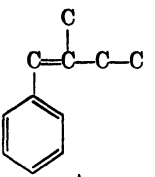
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethenyl-2,4-dimethylbenzene**  | | | | |
| | 79–80 12 [38] | 0.9022 21.5° [38] | 1.5214 21.5° [38] | |

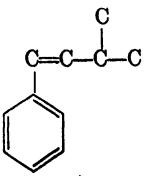
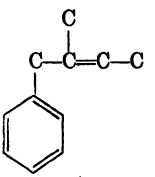
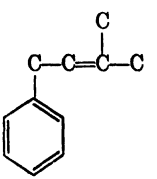
## $C_{10}H_{12}$ References

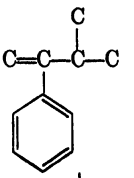
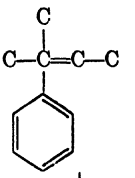
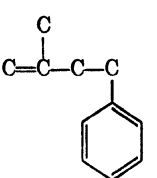

1. Amagat, P., Bull. soc. chim. [4] **49**, 1410 **1931**.
2. André, É., Ann. chim. phys. [8] **29**, 540 **1913**.
3. André, É., Bull. soc. chim. [4] **9**, 192 **1911**.
4. Aronheim, B., Ann. **171**, 219 **1874**.
5. Aronheim, B., Ber. **5**, 1068 **1872**.
6. Backer, H. J., and J. Strating, Rec. trav. chim. **53**, 525 **1934**.
7. Bergmann, E., and A. Weizmann, Trans. Faraday Soc. **32**, 1327 **1936**.
8. Blaise, E. E., and A. Courtot, Bull. soc. chim. [3] **35**, 589 **1906**.
9. Blaise, E. E., and I. Herman, Ann. chim. phys. [8] **23**, 522 **1911**.
10. Böeseken, J., and J. S. P. Blumberger, Rec. trav. chim. **44**, 90 **1925**.
11. Dain, J. Russ. Phys. Chem. Soc. **28**, 166, 171, 173 **1896**; Beil. **5**, 489 **1922**.
12. Doebner, O., and H. Staudinger, Ber. **36**, 4318 **1903**.
13. Errera, G., Gazz. chim. ital. **14**, 277 **1884**.
14. Errera, G., Gazz. chim. ital. **21**, I, 76 **1891**.
15. Fichter, F., J. prakt. Chem. [2] **74**, 297 **1906**.
16. Fittig, R., and P. Ott, Ann. **227**, 61 **1885**.
17. Fries, K., and H. Bestian, Ber. **69**, 715 **1936**.
18. Gauthier, D., and P. Gauthier, Bull. soc. chim. [4] **53**, 323 **1933**.
19. Gilman, H., and N. J. Beaber, J. Am. Chem. Soc. **47**, 518 **1925**.
20. Grignard, V., Ann. chim. phys. [7] **24**, 433 **1901**.
21. Grignard, V., Ann. Univ. Lyon **1901**, 1.
22. Grishkevich-Trokhimovskiĭ, E., J. Russ. Phys. Chem. Soc. **42**, 1543 **1910**; C.A. **5**, 3799 **1911**; Chem. Zentr. **1911**, I, 1511.
23. Haller, A., and E. Bauer, Ann. chim. [9] **9**, 1 **1918**.
24. Haller, A., and E. Bauer, Compt. rend. **155**, 1581 **1912**.
25. Haller, A., and Ramart, Compt. rend. **174**, 1211 **1922**.
26. Hurd, C. D., and H. T. Bollman, J. Am. Chem. Soc. **55**, 699 **1933**.
27. Hurd, C. D., and H. T. Bollman, J. Am. Chem. Soc. **56**, 447 **1934**.
28. Johnson, J. D. A., and G. A. R. Kon, J. Chem. Soc. **1926**, 2748.
29. Kay, F. W., and W. H. Perkin, J. Chem. Soc. **87**, 1066 **1905**.
30. Kazanskiĭ, B. A., and G. T. Tatevosyan, J. Gen. Chem. (U.S.S.R.) **9**, 1458 **1939**.
31. Kizhner, N., J. Russ. Phys. Chem. Soc. **44**, 849 **1912**; C.A. **6**, 2915 **1912**.
32. Klages, A., Ber. **35**, 2245 **1902**.
33. Klages, A., Ber. **35**, 2633 **1902**.
34. Klages, A., Ber. **35**, 3506 **1902**.
35. Klages, A., Ber. **37**, 1721 **1904**.
36. Klages, A., Ber. **37**, 2301 **1904**.
37. Klages, A., Ber. **39**, 2587 **1906**.

38. Klages, A., and R. Keil, Ber. **36**, 1632 **1903.**
39. Kunckell, F., Ber. **36**, 2235 **1903.**
40. Kunckell, F., Ber. deutsch. pharm. Ges. **22**, 180 **1912.**
41. Kunckell, F., and K. Siecke, Ber. **36**, 774 **1903.**
42. Levina, R. Y., J. Gen. Chem. (U.S.S.R.) **7**, 684 **1937**; C.A. **31**, 5772 **1937**; Chem. Zentr. **1937**, II, 1361.
43. Levina, R. Y., and D. K. Grinberg, J. Gen. Chem. (U.S.S.R.) **7**, 2306 **1937**; Chem. Zentr. **1938**, I, 1770.
44. Levina, R. Y., and D. A. Petrov, J. Gen. Chem. (U.S.S.R.) **7**, 747 **1937**; C.A. **31**, 5772 **1937.**
45. Levina, R. Y., and N. A. Shcheglova, J. Gen. Chem. (U.S.S.R.) **11**, 527 **1941**; C.A. **35**, 6935 **1941.**
46. Lévy, J., and Dvoleitzka-Gombinska, Bull, soc. chim. [4] **49**, 1765 **1931.**
47. Lévy, J., and A. Tabart, Bull. soc. chim. [4] **49**, 1776 **1931.**
48. Mameli, E., and A. Mossini, Giorn. chim. ind. applicata **15**, 161 **1933.**
49. Moureu, C., and É. André, Ann. chim. [9] **1**, 113 **1914.**
50. Murray, M. J., and F. F. Cleveland, J. Am. Chem. Soc. **61**, 3546 **1939.**
51. Muskat, I. E., and B. Knapp, Ber. **64**, 779 **1931.**
52. Otto, M. M., and H. H. Wenzke, J. Am. Chem. Soc. **57**, 294 **1935.**
53. Perkin, W. H., J. Chem. Soc. **69**, 1025 **1896.**
54. Perkin, W. H., and S. S. Pickles, J. Chem. Soc. **87**, 639 **1905.**
55. Perkin, W. H., and G. Tattersall, J. Chem. Soc. **87**, 1083 **1905.**
56. Quelet, R., Bull. soc. chim. [4] **45**, 255 **1929.**
57. Ramart-Lucas and P. Amagat, Bull. soc. chim. [4] **51**, 965 **1932.**
58. Riiber, C. N., Ber. **44**, 2391 **1911.**
59. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915.**
60. Sabatier, P., and M. Murat, Compt. rend. **156**, 184 **1913.**
61. Sapiro, R. H., R. P. Linstead, and D. M. Newitt, J. Chem. Soc. **1937**, 1784.
62. Savard, J., Bull. soc. chim. [5] **2**, 633 **1935.**
63. Schlenk, O., J. prakt. Chem. [2] **78**, 49 **1908.**
64. Tiffeneau, Ann. chim. phys. [8] **10**, 145 **1907.**
65. Tiffeneau, Ann. chim. phys. [8] **10**, 322 **1907.**
66. Tiffeneau, M., and J. Lévy, Bull. soc. chim. [4] **39**, 763 **1926.**
67. Tiffeneau, M., and A. Orekhov, Bull. soc. chim. [4] **29**, 809 **1921.**
68. Trotman, E. R., J. Chem. Soc. **127**, 88 **1925.**
69. von Auwers, K., Ann. **415**, 98 **1918.**
70. von Auwers, K., Ber. **45**, 2764 **1912.**
71. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] **82**, 65 **1910.**
72. von Auwers, K., W. A. Roth, and F. Eisenlohr, Ann. **373**, 267 **1910.**
73. von Auwers, K., W. A. Roth, and F. Eisenlohr, Ann. **385**, 102 **1911.**
74. von Braun, J., Ber. **50**, 56 **1917.**
75. von Braun, J., and W. Schirmacher, Ber. **56**, 538 **1923.**
76. Whitmore, F. C., C. A. Weisgerber, and A. C. Shabica, Jr., J. Am. Chem. Soc. **65**, 1469 **1943.**

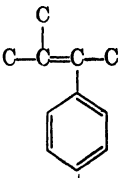
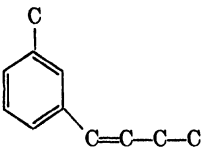
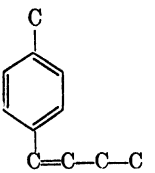
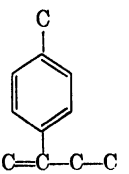
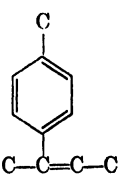
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Penten-1-ylbenzene**  | | | | |
| | 217 [44] | 0.8782 [63] | 1.51575 [63] | |
| | 210–215 [39] | 0.8924 17° [44] | 1.5302 18° [39] | |
| | 202–205 [63] | 0.892 15° [27] | 1.5318 17° [44] | |
| | 87.5 9 [44] | | | |
| | 82 9 [27] | | | |
| **Penten-2-ylbenzene**  | | | | |
| | 201 [28] | 0.8884 16.2° [60] | 1.50890 16.2° [60] | |
| | 111 30 [28] | 0.8837 16° [27] | 1.5059 16° [27] | |
| | 97–98 19 [60] | | 1.50444 $n_{H\alpha}^{16.2}$ [60] | |
| | 92.0–92.3 18.5 [60] | | 1.51986 $n_{H\beta}^{16.2}$ [60] | |
| | 80 12 [27] | | 1.52958 $n_{H\gamma}^{16.2}$ [60] | |
| **Penten-3-ylbenzene**  | | | | |
| | 92–94 16 [2] | 0.876 $D_{21}^{21.2}$ | 1.5090 21° [2] | |
| **Penten-4-ylbenzene**  | | | | |
| | 206 [60] | 0.8889 [62] | 1.5065 [62] | |
| | 203–204 [62] | | 1.5060 23° [46] | |
| | 198 [46,64] | | | |
| | 94–98 16 [61] | | | |
| | 77–78 10 [62] | | | |
| **2-Phenylpentene-1**  | | | | |
| | 198–202 [55] | 0.9138 0° [55,56] | | |
| | 198–200 [55] | | | |

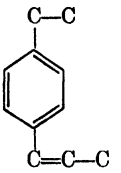
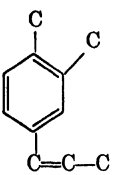
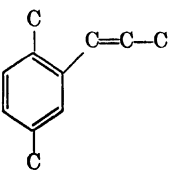
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **3-Phenylpentene-1**  | 173–177 718.8 [9] | 0.8458 23° [9] | | |
| **2-Phenylpentene-2**  | 199.2<br>199–201 [56]<br>199–200 [22]<br>199 [20]<br>197–199 [55]<br>89–90 16 [20]<br>86 14 [22] | 0.8950 26.5° [22]<br>0.8976 21.2° [20]<br>0.9321 0° [55] | 1.5196 26.5° [22] | |
| **3-Phenylpentene-2**  | 197–198 753 [23]<br>195–197 750 [13]<br>91–93 18 [23]<br>87–89 17 [16]<br>90 13 [8]<br>84–86 12 [3] | 0.908 21° [16]<br>0.9173 14° [23] | 1.5300 21° [16]<br>1.5266 15° [23] | |
| **1-Phenyl-2-methylbutene-1**  | 201–202 [40]<br>199–200 769 [57]<br>98–100 23 [57] | | 1.528 18° [40] | |

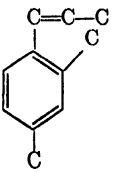
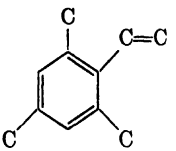
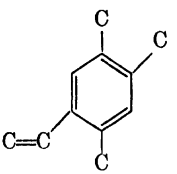
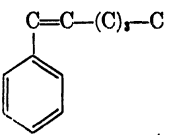
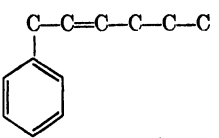
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| 1-Phenyl-3-methylbutene-1  | 201.7 | | | | | |
| | 204–206 [56] | 0.878 | 16° [53] | 1.5251 [37,59] | | |
| | 201–203 [39] | 0.8903 | 14.6° [26,59] | 1.532 | 18° [39] | |
| | 201–202 [37,52,59] | 0.887 | 14.4° [59] | 1.5248 | 14.6° [26,59] | |
| | 207 757 [26,59] | 0.887 | 14° [37] | | | |
| | 200.5 –201.5 737 [53] | 0.9191 | $D_0^{4}$ [39] | | | |
| | 102–103 26 [26,59] | | | | | |
| | 84–86 13 [49] | | | | | |
| 1-Phenyl-2-methylbutene-2  | 198–203 [17] | | | | | |
| 1-Phenyl-3-methylbutene-2  | 205 [26] | 0.891 | 18.3° [26] | 1.5125 | 18.3° [26] | |
| | 198–202 [17] | 0.8944 | 15° [27] | 1.5115 | 15° [27] | |
| | 205 –206.5 751 [7] | 0.8958 | $D_{15}^{15}$ [7] | | | |
| | 92 15 [26] | | | | | |
| | 90 12 [54] | | | | | |
| | 83 11 [27] | | | | | |

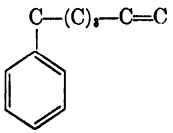
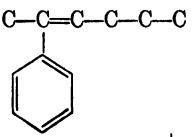
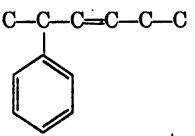
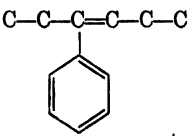
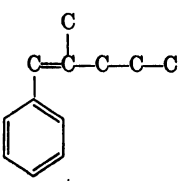
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Phenyl-3-methylbutene-1**  | | | | |
| | 191–192 753 [23]<br>82 12 [23] | 0.8991 13.1° [23] | 1.5181 13.8° [23] | |
| **2-Methyl-2-phenylbutene-2**  | | | | |
| | 192–193.5 [59]<br>190.5–192 [59]<br>89–90 22 [59] | 0.8970 19.8° [59]<br>0.8935 19.4° [59]<br>0.8968 19.1° [59] | 1.51997 19.8° [59]<br>1.51897 19.4° [59]<br>1.51989 19.1° [59]<br>1.51494 $n_{H\alpha}^{19.8}$ [59]<br>1.51389 $n_{H\alpha}^{19.4}$ [59]<br>1.51481 $n_{H\alpha}^{19.1}$ [59]<br>1.53217 $n_{H\beta}^{19.8}$ [59]<br>1.53097 $n_{H\beta}^{19.4}$ [59]<br>1.53200 $n_{H\beta}^{19.1}$ [59]<br>1.54311 $n_{H\gamma}^{19.8}$ [59]<br>1.54185 $n_{H\gamma}^{19.4}$ [59]<br>1.54291 $n_{H\gamma}^{19.1}$ [59] | |
| **2-Methyl-4-phenylbutene-1** (a)  | | | | |
| | 205 [21] | | | |

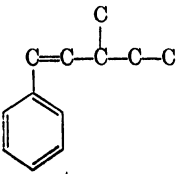
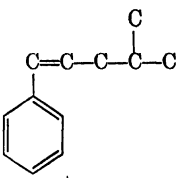
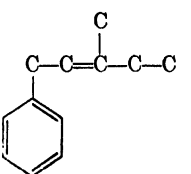
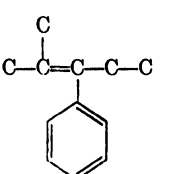
(a) The structure of this compound is questionable.

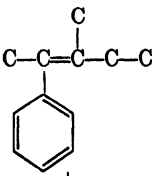
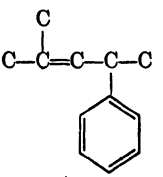
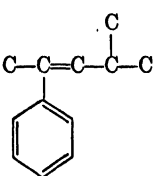
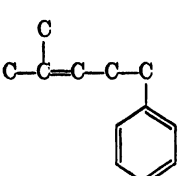
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Methyl-3-phenylbutene-2**  | 190.5–192.0 [80]<br>190 [38]<br>83 12 [38]<br>70 8 [38] | 0.8917 [38]<br>0.9080 6° [38] | 1.51835 [38] | |
| **1-*m*-Tolylbutene-1**  | 208 [15,19] | 0.8901 18° [14,15] | 1.5365 18° [14] | |
| **1-*p*-Tolylbutene-1**  | 210–212 [33,34]<br>92–93 15 [34]<br>88–90 7 [34] | 0.8893 [33,34] | 1.4385 [34] | |
| **2-*p*-Tolylbutene-1**  | 206–209 750 [15] | 0.8926 22.5° [15] | 1.52735 22.5° [15] | |
| **2-*p*-Tolylbutene-2**  | 93.5–94 10 [51] | | | |

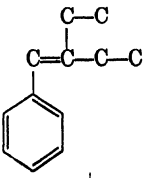
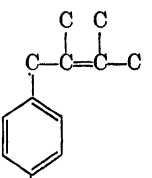
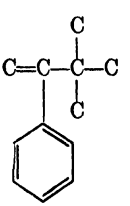
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethyl-4-(propen-1′-yl)-benzene**  | | | | |
| | 216–218 [33,35]<br>105–107 17 [33] | 0.9072 18° [33,35] | 1.5437 18° [35] | |
| **Ethenylisopropylbenzene** (a) | | | | |
| | 203–206 [42]<br>203–204 [43]<br>201–202 [10]<br>76 10 [30] | 0.8799 15° [30]<br>0.8902 15° [42,43] | 1.5198 15° [30] | |
| (a) The structure of this compound is not given. | | | | |
| **1,2-Dimethyl-4-(propen-1′-yl)-benzene**  | | | | |
| | 224–226 [33]<br>165–168 16 [33]<br>110–112 16 [35] | 0.9151 18° [33,35] | 1.5558 18° [35] | |
| **1,4-Dimethyl-2-(propen-1′-yl)-benzene**  | | | | |
| | 220–223 [35]<br>219–223 [36]<br>84–88 8 [35,36] | 0.9259 22° [35,36] | 1.5435 22° [35] | |

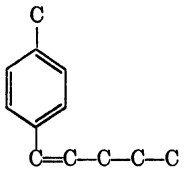
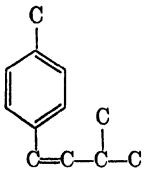
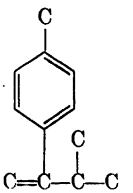
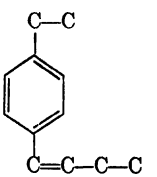
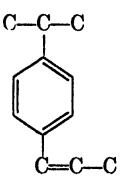
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-(Propen-1′-yl)-2,4-dimethylbenzene**  | | | | |
| | 206–208 [33,35] | 0.9096 17.5° [4] | 1.540 17.5° [4] | |
| | 213–215 735 [4] | 0.903 13° [33,35] | 1.5342 13° [35] | |
| | 100 20 [4] | | | |
| | 85–88 10 [33,35] | | | |
| **1,3,5-Trimethyl-2-ethenylbenzene**  | | | | |
| | 208–210 [29] | 0.9057 [19] | 1.5296 17.5° [30] | |
| | 203–205 [19] | 0.9073 17.5° [30] | | |
| | 92 14 [19] | | | |
| | 83 12 [4A] | | | |
| **1,2,4-Trimethyl-5-ethenylbenzene**  | | | | |
| | 219–220 [29] | 0.9137 17° [30] | 1.5379 17° [30] | |
| | 97 22 [29] | | | |
| | 97 13 [30] | | | |
| $C_{12}H_{16}$ | | | | |
| **Hexen-1-ylbenzene**  | | | | |
| | 97–100 8 [41] | 0.9455 25° [41] | 1.5377 25° [41] | |
| **Hexen-2-ylbenzene**  | | | | |
| | 108 16 [28] | 0.8898 16° [28] | 1.5058 16° [28] | |

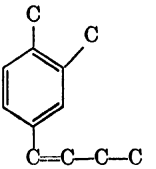
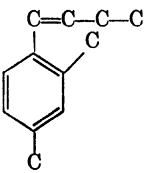
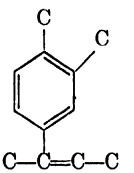
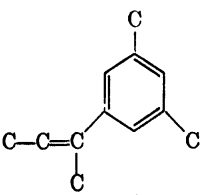
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Hexen-5-ylbenzene**  | 216 [46]<br>119 30 [46]<br>104 17 [50]<br>94.5–95 10 [32]<br>94–95 10 [62] | 0.8839 [62] | 1.5033 [62]<br>1.5010 25° [46] | |
| **2-Phenylhexene-2**  | 223–226 [8] | | | |
| **2-Phenylhexene-3**  | 84 10 [48] | | | |
| **3-Phenylhexene-3**  | 216 [65] | | | |
| **1-Phenyl-2-methylpentene-1**  | 212–215 768 [40] | 0.9926 0° [40] | 1.521 17° [40] | |

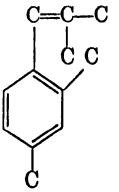
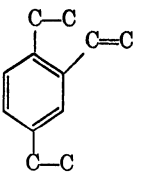
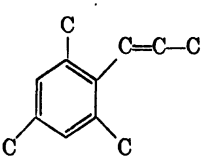
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **1-Phenyl-3-methylpentene-1**  | | | | | | |
| | 126 15 [21] | 0.8906 | 15° [31,59] | 1.5277 | 15° [31,59] | $[\alpha]_D^{15}$ = +50.3° [31] |
| | 100–103 9 [31,59] | 0.9146 | 12° [31] | 1.5243 | 12° [31] | $[\alpha]_D^{12}$ = +43.0° [31] |
| **1-Phenyl-4-methylpentene-1**  | | | | | | |
| | 107–109 11 [47] | | | | | |
| **1-Phenyl-3-methylpentene-2**  | | | | | | |
| | 226 749 [26,27] | 0.9004 | 18° [26] | 1.5100 | 18° [26,27] | |
| | 119–120 20 [27] | 0.9014 | 18° [27] | | | |
| | 103–104 15 [26] | | | | | |
| **2-Methyl-3-phenylpentene-2**  | | | | | | |
| | 195–198 [1] | 0.8886 | 17.5° [59] | 1.51422 | 17.5° [59] | |
| | 206–207 765 [25] | 0.8913 | 14.5° [25] | 1.5134 | 14.5° [25] | |
| | 97.2–97.8 24 [59] | | | 1.50950 | $n_{H\alpha}^{17.5}$ [59] | |
| | 83–84 15 [25] | | | 1.52569 | $n_{H\beta}^{17.5}$ [59] | |
| | | | | 1.53575 | $n_{H\gamma}^{17.5}$ [59] | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
|  **2-Phenyl-3-methylpentene-2** | 204–206 [1]<br>206.5<br>–207 764 [11]<br>99.5–100 22 5 [11] | 0.8859 [11]<br>0.8921 14 7° [11]<br>0.9020 0° [11] | 1.50814 [11] | |
|  **2-Methyl-4-phenylpentene-2** | 210–211 755 [26]<br>98–100 19 [26] | 0.8931 [26] | 1.5162 [26] | |
|  **2-Phenyl-4-methylpentene-2** | 207 764 [26]<br>216–220 738 [5]<br>99–101 20 [26]<br>111–115 18 [5] | 0.909 16° [5]<br>0.8948 15° [26] | 1.5231 16° [5]<br>1.516 15° [26] | |
|  **1-Phenyl-4-methylpentene-3** | 108–112 25 [6] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-2-ethylbutene-1**  | | | | |
| | 216–218 [40] | 0.8924 18.7° [59] | 1.51677 18.7° [59] | |
| | 106–108 19.5 [59,60] | 0.9038 18.5° [25] | 1.5182 18.5° [25] | |
| | 97–98 13 [25] | 0.9038 18° [40] | 1.51656 18° [59] | |
| | 97.3 13 [59] | 0.9040 18° [59] | 1.5182 18° [40] | |
| | | | 1.51199 $n_{H\alpha}^{18.7}$ [63] | |
| | | | 1.51151 $n_{H\alpha}^{18}$ [59] | |
| | | | 1.52837 $n_{H\beta}^{18.7}$ [59] | |
| | | | 1.52983 $n_{H\beta}^{18}$ [59] | |
| | | | 1.53866 $n_{H\gamma}^{18.7}$ [59] | |
| | | | 1.53830 $n_{H\gamma}^{18}$ [59] | |
| **1-Phenyl-2,3-dimethylbutene-2**  | | | | |
| | 220–221 750 [7] | 0.903 $D_{15}^{15.7}$ | | |
| **2-Phenyl-3,3-dimethylbutene-1**  | | | | |
| | 88–92 15 [45] | 0.8839 25° [45] | 1.50133 25° [45] | |
| | | | 1.49708 $n_{H\alpha}^{25}$ [45] | |
| | | | 1.51185 $n_{H\beta}^{25}$ [45] | |
| | | | 1.52106 $n_{H\gamma}^{25}$ [45] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-*p*-Tolylpentene-1  | 221–224 [15] | | | |
| 1-*p*-Tolyl-3-methylbutene-1  | 221–222 [37]<br>106–107 10–11 [37] | 0.885 18° [37] | 1.5316 20° [37] | |
| 2-*p*-Tolyl-3-methylbutene-1  | 210–212 [15] | 0.8838 27° [15] | 1.52543 27° [15] | |
| 1-Ethyl-4-(buten-1′-yl)-benzene  | 230–233 [34]<br>98–102 7 [34] | 0.9074 [34] | 1.5405 [34] | |
| 1-Isopropyl-4-(propen-1′-yl)-benzene  | 141–146 28 [33,35]<br>121–125 19 [33,35] | 0.9308 22° [33,35] | 1.5430 22° [35] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Isopropylpropen-2-ylbenzene** (a) | | | | |
| | 229–230 [43] | 0.8900 15° [43] | | |
| (a) The structure of this compound is not given. | | | | |
| **1,2-Dimethyl-4-(buten-1′-yl)-benzene**  | | | | |
| | 238–239 [34]<br>122–124 18 [34] | 0.9114 15° [34] | 1.5458 [34] | |
| **1-(Buten-1′-yl)-2,4-dimethylbenzene**  | | | | |
| | 226–228 [33,34]<br>114 21 [19]<br>109–111 16 [33,34] | 0.8937 19° [19]<br>0.8967 18° [33,34] | 1.5349 [34] | |
| **1,2-Dimethyl-4-(2′-buten-2′-yl)-benzene**  | | | | |
| | 85–87 10 [12] | 0.891 16° [12] | 1.51255 16° [12] | |
| **1,3-Dimethyl-5-(2′-buten-2′-yl)-benzene**  | | | | |
| | 218–221 [58] | 0.892 [58] | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-(2′-Methylpropen-1′-yl)-2,4-dimethylbenzene**  | | | | |
| | 210 [18] | 0.886 25° [18] | 1.523 25° [18] | |
| | 108–109 16 [18] | 0.916 0° [18] | 1.526 19° [18] | |
| | 96–97 12 [18] | | | |
| **1,4-Dimethylbutenylbenzene** (a) | | | | |
| | 221 [34] | | | |
| | 117–120 17 [34] | 0.8958 18° [34] | 1.5280 [34] | |
| (a) The structure of this compound is not given. | | | | |
| **1,4-Diethyl-2-ethenylbenzene**  | | | | |
| | 96–97 12 [30] | 0.8915 16° [30] | 1.5139 16° [30] | |
| **1,3,5-Trimethyl-2-(propen-1′-yl)-benzene**  | | | | |
| | 223–224 745 [24] | 0.8988 21° [24] | 1.5229 21° [24] | |
| | 109–110 18 [24] | 0.9003 17.5° [19] | | |
| | 103 13 [19] | | | |

## $C_{11}H_{14}$ and $C_{12}H_{16}$ References

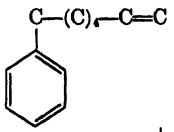
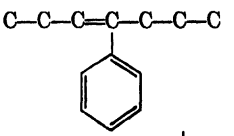
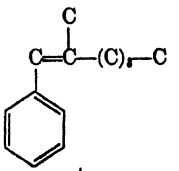
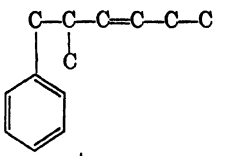
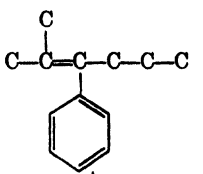

1. Apolit, Ann. chim. [10] **2**, 71 **1924**.
2. Arbusov, B. A., and E. V. Kuznetsov, Compt. rend. acad. sci. U.R.S.S. **39**, 343 **1943**.
3. Bergmann, E., and A. Bondi, Ber. **64**, 1455 **1931**.
4. Bert, L., and M. Anglade, Compt. rend. **189**, 645 **1929**.

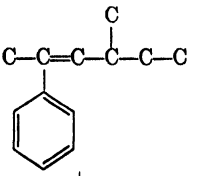
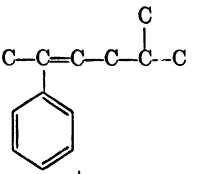
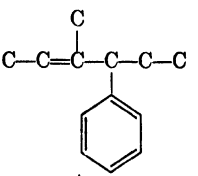
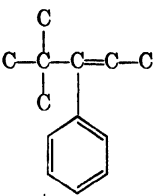
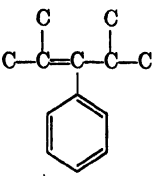
4A. Blaise, E. E., and A. Courtot, Bull. soc. chim. [3] **35**, 580 **1906**.

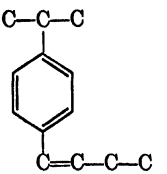
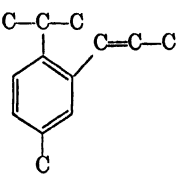
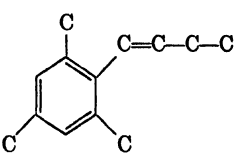
5. Bodroux, F., and F. Taboury, Compt. rend. **148**, 1675 **1909**.

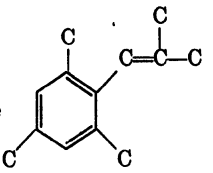
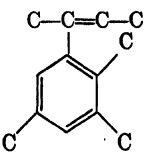
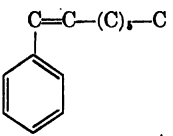
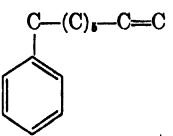
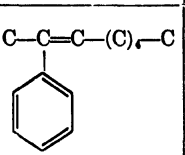
6. Bogert, M. T., D. Davidson, and P. M. Apfelbaum, J. Am. Chem. Soc. **56**, 959 **1934.**
7. Claisen, L., F. Kremers, F. Rath, and E. Tietze, J. prakt. Chem. [2] **105**, 65 **1922.**
8. Crawford, H. M., M. E. Saeger, and F. E. Warneke, J. Am. Chem. Soc. **64**, 2862 **1942.**
9. Dafert, F. W., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **88**, Abt. II, 318 **1883.**
10. Daïn, G. J., Chem. Zentr. **1897**, II, 349.
11. Favorskiĭ, A. E., and P. A. Tikhomolov, J. Gen. Chem. (U.S.S.R.) **5**, 1679 **1935**; C.A. **30**, 3418 **1936**; Chem. Zentr. **1936**, I, 4553.
12. Favorskiĭ, A. E., and A. I. Zakharova, J. Gen. Chem. (U.S.S.R.) **7**, 973 **1937**; C.A. **31**, 5318 **1937**; Chem. Zentr. **1938**, II, 1206.
13. Grignard, V., Bull. soc. chim. [3] **31**, 751 **1904.**
14. Grishkevich-Trokhimovskiĭ, E., J. Russ. Phys. Chem. Soc. **40**, 761 **1908**; C.A. **3**, 1009 **1909.**
15. Grishkevich-Trokhimovskiĭ, E., J. Russ. Phys. Chem. Soc. **42**, 1543 **1910**; C.A **5**, 3799 **1911**; Chem. Zentr. **1911**, I, 1511.
16. Guillemonat, A., Ann. chim. [11] **11**, 143 **1939.**
17. Haller, A., and Ramart, Compt. rend. **174**, 1211 **1922.**
18. Harispe, J. V., Ann. chim. [11] **6**, 249 **1936.**
19. Klages, A., Ber. **35**, 2245 **1902.**
20. Klages, A., Ber. **35**, 2633 **1902.**
21. Klages, A., Ber. **35**, 2649 **1902.**
22. Klages, A., Ber. **35**, 3506 **1902.**
23. Klages, A., Ber. **36**, 3688 **1903.**
24. Klages, A., Ber. **37**, 924 **1904.**
25. Klages, A., Ber. **37**, 1721 **1904.**
26. Klages, A., Ber. **37**, 2301 **1904.**
27. Klages, A., Ber. **39**, 2587 **1906.**
28. Klages, A., Ber. **40**, 1768 **1907.**
29. Klages, A., and P. Allendorff, Ber. **31**, 998 **1898.**
30. Klages, A., and R. Keil, Ber. **36**, 1632 **1903.**
31. Klages, A., and R. Sautter, Ber. **37**, 649 **1904.**
32. Kozacik, A. P., and E. E. Reid, J. Am. Chem. Soc. **60**, 2436 **1938.**
33. Kunckell, F., Ber. **36**, 2235 **1903.**
34. Kunckell, F., Ber. deutsch. pharm. Ges. **22**, 242 **1912.**
35. Kunckell, F., Ber. deutsch. pharm. Ges. **23**, 180 **1912.**
36. Kunckell, F., and W. Dettmar, Ber. **36**, 771 **1903.**
37. Kunckell, F., and K. A. Stahel, Ber. **37**, 1087 **1904.**
38. Lepin, A. I., J. Russ. Phys. Chem. Soc. **44**, 1165 **1912**; C.A. **7**, 982 **1913.**
39. Lévy, J., and Dvoleitzka-Gombinska, Bull. soc. chim. [4] **49**, 1765 **1931.**
40. Lévy, J., and A. Tabart, Bull. soc. chim. [4] **49**, 1776 **1931.**
41. Marvel, C. S., F. D. Hager, and D. D. Coffman, J. Am. Chem. Soc. **49**, 2323 **1927.**
42. Perkin, W. H., Chem. News **36**, 211 **1877.**
43. Perkin, W. H., J. Chem. Soc. **32**, 660 **1877.**
44. Prevost, C., and J. Daujat, Bull. soc. chim. [4] **47**, 588 **1930.**
45. Ramart-Lucas, Ann. chim. phys. [8] **30**, 349 **1913.**
46. Ramart-Lucas, and P. Amagat, Bull. soc. chim. [4] **51**, 965 **1932.**
47. Reich, S., R. van Wijck, and C. Waelle, Helv. Chim. Acta **4**, 242 **1921.**
48. Riiber, C. N., Ber. **36**, 1404 **1903.**
49. Riiber, C. N., Ber. **44**, 2974 **1911.**
50. Roblin, R., Jr., D. Davidson, and M. T. Bogert, J. Am. Chem. Soc. **57**, 151 **1935.**
51. Rupe, H., and J. Burgin, Ber. **44**, 1218 **1911.**
52. Schaarschmidt, A., E. Georgeacopal, and J. Herzenberg, Ber. **51**, 1059 **1918.**
53. Schramm, J., Ann. **218**, 383 **1883.**
54. Staudinger, H., W. Kreis, and W. Schilt, Helv. Chim. Acta **5**, 743 **1922.**
55. Tiffeneau, Ann. chim. phys. [8] **10**, 322 **1907.**
56. Tiffeneau, M., Compt. rend. **143**, 649 **1906.**

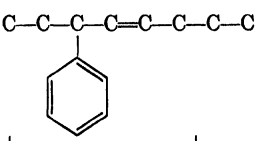
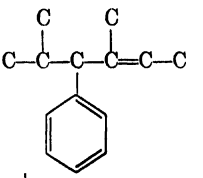
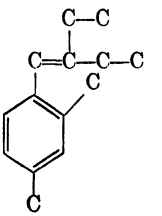
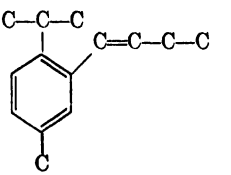
57. Tiffeneau, M., and J. Lévy, Bull. soc. chim. [4] **33**, 759 **1923.**
58. Tishchenko, D., Bull. soc. chim. [4] **47**, 1137 **1930.**
59. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] **82**, 65 **1910.**
60. von Auwers, K., W. A. Roth, and F. Eisenlohr, Ann. **373**, 267 **1910.**
61. von Braun, J., Ber. **43**, 2837 **1911.**
62. von Braun, J., H. Deutsch, and A. Schmatloch, Ber. **45**, 1246 **1912.**
63. von Braun, J., and Z. Köhler, Ber. **51**, 79 **1918.**
64. von Braun, J., and M. Kühn, Ber. **60**, 2557 **1927.**
65. Yéramian, V., Compt. rend. **173**, 362 **1921.**

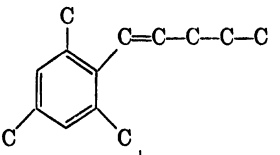
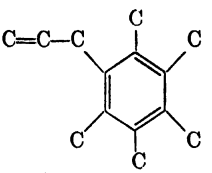
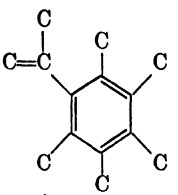
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Hepten-6-ylbenzene**  | 236 [29]<br>123 24 [29] | | 1.5007 22° [29] | |
| **4-Phenylheptene-3**  | 228 [1,24,25] | 0.8855 15° [25] | 1.522 15° [25] | |
| **1-Phenyl-2-methylhexene-1**  | 114–116 12 [30] | 0.8974 17° [30] | 1.51505 17° [30] | |
| **1-Phenyl-2-methylhexene-3**  | 106–110 16 [2] | 0.875 $D_{21}^{21}$ [2] | 1.4905 21° [2] | |
| **2-Methyl-3-phenylhexene-2**  | 210–212 755 [14]<br>94–96 12 [14] | 0.8897 16° [14] | 1.5070 16° [14] | |

| M. P.,°C | B. P.,°C @ 760mm | $D^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Phenyl-4-methylhexene-2**  | 142 50 [6] | 0.8839 25° [6] | 1.5117 25° [6] | |
| **2-Phenyl-5-methylhexene-2**  | 121 20 [12] | 0.8814 15° [12] | | |
| **3-Methyl-4-phenylhexene-2**  | 91.75<br>-92.5 8 [7] | 0.8861 [7]<br>0.891 13.6° [7] | 1.50644 13.6° [7] | |
| **2,2-Dimethyl-3-phenylpentene-3**  | 95–100 14 [28]<br>91–93 12 [28] | 0.9064 25° [28] | 1.51550 25° [28]<br>1.51100 $n_{H\alpha}^{25}$ [28]<br>1.52710 $n_{H\beta}^{25}$ [28]<br>1.53776 $n_{H\gamma}^{25}$ [28] | |
| **2,4-Dimethyl-3-phenylpentene-2**  | 225–228 [25,26] | | | |

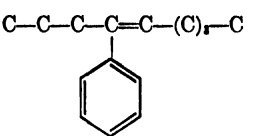
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Isopropyl-4-(buten-1′-yl)-benzene**  | 242–243 [19] | 0.8932 14° [19] | 1.5330 [19] | |
| **Isopropylbuten-1-ylbenzene** (a) | | | | |
| 124–125.5 [9] | | | | |
| (a) The position of the substituents in benzene is not given. | | | | |
| **1-Isopropyl-4-isobutenylbenzene** (a) | | | | |
| | 236–238 [37] | | | |
| (a) The position of the double bond in isobutenyl is not given. | | | | |
| **1-Isopropylphenyl-2-methylpropene-1** (a) | | | | |
| | 235–236 745 [36]<br>105–106 10 [36] | | | |
| (a) The position of the substituents in benzene is not given. | | | | |
| **1-Isopropyl-2-(propen-1′-yl)-4-methylbenzene**  | 226–228 [17,18]<br>128–131 32 [17,18] | 0 8899 19° [18]<br>0.8899 18° [17] | 1.5225 19° [18] | |
| **1,3,5-Trimethyl-2-(buten-1′-yl)-benzene**  | 118–119 14 [11] | 0.8953 14° [11] | | |

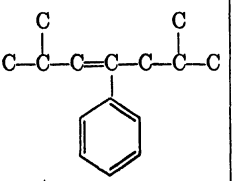
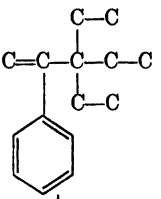
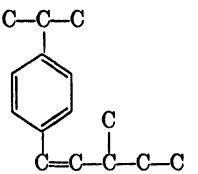
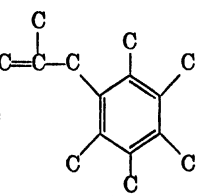
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ,3,5-Trimethyl-2-(isobuten-1′-yl)-benzene  | 226–227 745 [13]<br>118–120 14 [13]<br>103–106 5 [20] | 0.8900 18.8° [13] | 1.5162 18.8° [13] | |
| 1-(2′-Buten-2′-yl)-2,3,5-trimethylbenzene  | 234–236 [12] | 0.8992 15° [12] | | |
| $C_{14}H_{20}$ | | | | |
| Octen-1-ylbenzene  | 136–138 13 [30] | 0.9063 17° [30] | 1.50728 17° [30] | |
| Octen-7-ylbenzene  | 115–117 8 [40] | 0.8792 [40] | 1.4995 [40] | |
| 2-Phenyloctene-2  | 121–122 10 [27] | 0.8810 $D_{17}^{17}$ [27] | 1.49459 17° [27] | |

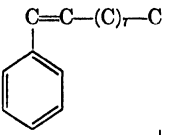
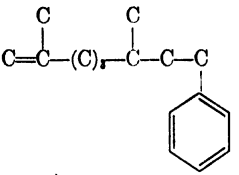
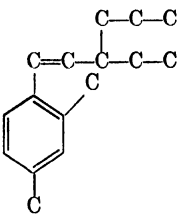
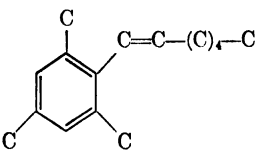
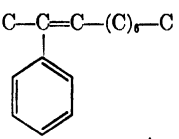
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **3-Phenyloctene-4**  | 104 8 [31] | | | |
| **2,4-Dimethyl-3-phenylhexene-4**  | 224–226 [42]<br>102 13 [42] | 0.8892 19.7° [42] | 1.50444 $n_{H\alpha}^{19.7}$ [42]<br>1.51890 $n_{H\beta}^{19.7}$ [42]<br>1.52793 $n_{H\gamma}^{19.7}$ [42]<br>1.50889 $n_{He}^{19.7}$ [42] | |
| **1-(2-Ethylbuten-1′-yl)-2,4-dimethylbenzene**  | 242 [8]<br>134–135 15 [8]<br>122–123 10–11 [8] | 0.887 28° [8]<br>0.914 10° [8]<br>0.927 0° [8] | 1.513 28° [8] | |
| **1-Isopropyl-2-(buten-1′-yl)-4-methylbenzene**  | 241–244 [19] | 0.9353 14° [19] | 1.5274 [19] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5-Trimethyl-2-(penten-1′-yl)-benzene**  | 239–240 758 [13]<br>136 22 [13] | 0.8901 [13] | 1.5114 [13] | |
| **Pentamethylpropen-2-ylbenzene**  | | | | |
| 135 [3,22] | | | | Sublimation Point 128 [3,4,22] |
| **Pentamethylisopropenylbenzene**  | | | | |
| 134(a) [22] | | | | Sublimation Point 122 [3] 121 [22] |

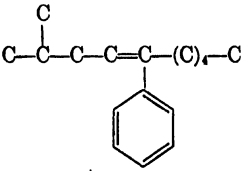
(a) Decomposition takes place at the boiling point.

| | | | | |
|---|---|---|---|---|
| $C_{15}H_{22}$ | | | | |
| **4-Phenylnonene-4**  | 117–121 6 [27] | 0.8882 $D_{20}^{20}$ [27] | 1.5012 [27] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,6-Dimethyl-4-phenylheptene-3**  | 124–126 20 [38]<br>110–112 10 [38] | 0.8731 16.5° [38] | 1.49762 25° [38] | |
| **2-Phenyl-3,3-diethylpentene-1**  | 130–132 15 [28] | | | |
| **1-Isopropyl-4-(3′-methylpenten-1′yl)-benzene**  | 139–140.5 9.5 [15] | 0.8801 16° [15] | 1.5181 16° [15] | $[\alpha]_D^{16}$ = +41.89° [15] |
| **Pentamethyl-(2-methylpropen-2-yl)-benzene**  | | | | Sublimation Point 122 [4] |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Decen-1-ylbenzene**  | 162–163 14 [29] | | | |
| **2,6-Dimethyl-8-phenyloctene-1**  | 145–146 9.5 [16] | 0.8844 11.5° [16] | 1.5029 11.5° [16] | $[\alpha]_D^{17} = -7.26°$ [16] |
| **1-(3′-Propylpenten-1′-yl)-2,4-dimethylbenzene**  | 160.5 23 [8]<br>143 15 [8] | 0.915 19° [8]<br>0.928 0° [8] | 1.508 19° [8] | |
| **1,3,5-Trimethyl-2-(hepten-1′-yl)-benzene**  | 270–272 [13]<br>170–171 23 [13] | 0.8844 17° [13] | 1.5136 17° [13] | |
| $C_{17}H_{26}$ | | | | |
| **2-Phenylundecene-2**  | 166–170 11 [39] | 0.8801(a) [39] | | |

(a) The temperature for this density is not given.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Methyl-5-phenyldecene-4**  | | | | |
| | 153–155 18 [38] | 0.8866 26° [38]<br>0.9171(a) 17° [38]<br>0.8859 0° [38]<br>0.9301(a) 0° [38] | 1.49913 26.5° [38] | |

(a) These densities were determined on a sample treated differently from that on which the other data were determined.

| | | | | |
|---|---|---|---|---|
| $C_{18}H_{28}$<br>**2-Phenyldodecene** (a) | | | | |
| | 125 0.8 [35] | 0.8761 [35]<br>0.8692 30° [35] | 1.5035 [35] | |

(a) The position of the double bond is not given.

| | | | | |
|---|---|---|---|---|
| **3-Phenyldodecene** (a) | | | | |
| | 145–146 2.0 [35] | 0.8712 [35]<br>0.8640 30° [35] | 1.5001 [35] | |

(a) The position of the double bond is not given.

| | | | | |
|---|---|---|---|---|
| **4-Phenyldodecene** (a) | | | | |
| | 118–120 0.8 [35] | 0.8726 [35]<br>0.8662 30° [35] | 1.5025 [35] | |

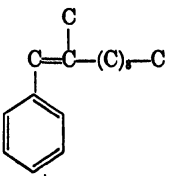
(a) The position of the double bond is not given.

| | | | | |
|---|---|---|---|---|
| **5-Phenyldodecene** (a) | | | | |
| | 131–132 1 [35] | 0.8755 [35]<br>0.8680 30° [35] | 1.5027 [35] | |

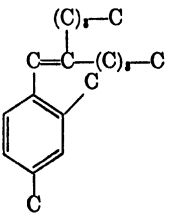
(a) The position of the double bond is not given.

| | | | | |
|---|---|---|---|---|
| **6-Phenyldodecene** (a) | | | | |
| | 127 1.0 [35] | 0.8718 [35]<br>0.8846 30° [35] | 1.5055 [35] | |

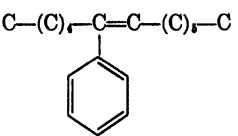
(a) The position of the double bond is not given.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Phenyl-2-methylundecene-1  | 180 13 [39]<br>177–178 12 [39] | 0.8790(a) [39] | | |

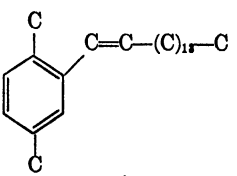
(a) The temperature for this density is not given.

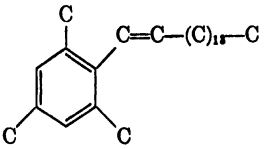
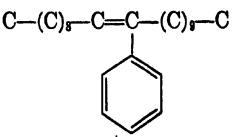
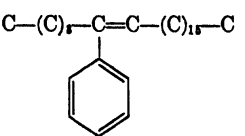
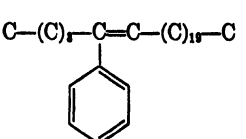
| | | | | |
|---|---|---|---|---|
| 1-(2′-*n*-Butylhexene-1′-yl)-2,4-dimethylbenzene  | 286–288 [8]<br>173 20 [8]<br>145 6 [8] | 0.889 27° [8] | 1.5025 27° [8] | |

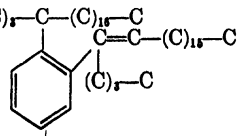
$C_{19}H_{30}$

| | | | | |
|---|---|---|---|---|
| 6-Phenyltridecene-6  | 153–154 8 [27] | 0.8774 $D_{18}^{18}$ [27] | 1.49810 18° [27] | |

$C_{24}H_{40}$

| | | | | |
|---|---|---|---|---|
| 1,4-Dimethyl-2-(hexadecen-1′-yl)-benzene  | 254 17 [11] | 0.868 [11] | | |

| M. P.,°C | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|
| **1,3,5-Trimethyl-2-(hexadecen-1′-yl)-benzene**  | | | | | | | |
| 28.5–29 [11] | 260 | 23 [11] | | | | | |
| $C_{27}H_{46}$  | | | | | | | |
| **11-Phenylheneicosene-10** | | | | | | | |
| | | | 0.8638 | | 1.4922 | | |
| 48.2 [23] | 203 | 1.0 [5,41] | 0.8636 [5,23,41] | | 1.4922 [5,23,41] | | |
| | 190 | 0.5 [5] | 0.8113 | 98.9° [5] | 1.4845 | 40.0° [5] | |
| | | | 0.8376 | 60° [5] | 1.4884 | 30.0° [5] | |
| | | | 0.8520 | 37.8° [5] | | | |
| | | | 0.8770 | 0° [24] | | | |
| * $\frac{dD}{dt} = -0.0006626$/°C (0 to 99°C) | | | | | | | |
| † $\frac{dn}{dt} = -0.000385$/°C (20 to 40°C) | | | | | | | |
| **Bombicestene (a)** | | | | | | | $[\alpha]_D^{26} = -58.2°$ [10] |
| 91–92 [10] | | | | | | | |
| (a) The structure of this compound is not given. | | | | | | | |
| $C_{28}H_{48}$  | | | | | | | |
| **5-Phenyldocosene-5** | | | | | | | |
| | 205–210 | 1 [22] | 0.8675 | 25° [21] | 1.4899 | 25° [21] | |
| $C_{32}H_{56}$  | | | | | | | |
| **5-Phenylhexacosene-5** | | | | | | | |
| | | | 0.8580 | 25° [21] | 1.4909 | 25° [21] | |

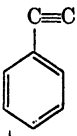
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-(5′-Docosyl)-2-(5″-docosen-5″-yl)-benzene  | | | | |
| 31.5 [21] | | 0.8520(a) 25° [21] | 1.4848 25° [21] | |

(a) This density is an extrapolated value.

## $C_{18}H_{18}$-$C_{50}H_{92}$ References


1. Amouroux and Murat, Compt. rend. **154**, 992 **1912**.
2. Arbusov, B. A., and E. V. Kunstov, Compt. rend. acad. sci. U.R.S.S. **39**, 343 **1943**.
3. Clement, H., Bull. soc. chim. [5] **5**, 1011 **1938**.
4. Clement, H., and J. Savard, Compt. rend. **204**, 1742 **1937**.
5. Cosby, J. N., and L. H. Sutherland, paper presented before the American Petroleum Institute, November, **1941**.
6. Davies, W. C., R. S. Dixon, and W. J. Jones, J. Chem. Soc. **1930**, 468.
7. Favorskiĭ, A. E., and P. A. Tikhomolov, Compt. rend. acad. sci. U.R.S.S. [N.S.] **4**, 365 **1936**.
8. Harispe, J. V., Ann. chim. [11] **6**, 249 **1936**.
9. Kalishev, A., J. Russ. Phys. Chem. Soc. **37**, 905 **1905**; Chem. Zentr. **1906**, I, 347.
10. Kawasaki, K., J. Pharm. Soc. Japan **55**, 758 **1935**; C.A. **30**, 4510 **1936**; Chem. Zentr. **1936**, I, 785.
11. Klages, A., Ber. **35**, 2245 **1902**.
12. Klages, A., Ber. **35**, 2633 **1902**.
13. Klages, A., Ber. **37**, 924 **1904**.
14. Klages, A., Ber. **37**, 1721 **1904**.
15. Klages, A., and R. Sautter, Ber. **38**, 2312 **1905**.
16. Klages, A., and R. Sautter, Ber. **39**, 1938 **1906**.
17. Kunckell, F., Ber. **36**, 2235 **1903**.
18. Kunckell, F., Ber. deutsch. pharm. Ges. **22**, 180 **1912**.
19. Kunckell, F., Ber. deutsch. pharm. Ges **22**, 242 **1912**.
20. Maxwell, R. W., and R. Adams, J. Am. Chem. Soc. **52**, 2959 **1930**.
21. Mikeska, L. A., Ind. Eng. Chem. **28**, 970 **1936**.
22. Mikeska, L. A., C. F. Smith, and E. Lieber, J. Org. Chem. **2**, 499 **1938**.
23. Murat and Amouroux, Bull. soc. chim. [4] **15**, 159 **1914**.
24. Murat and Amouroux, Compt. rend. **154**, 992 **1912**.
25. Murat and Amouroux, J. pharm. chim. [7] **5**, 473 **1912**.
26. Murat and Amouroux, J. pharm. chim. [7] **9**, 114 **1914**.
27. Petrov, A. D., A. P. Baidanov, N. N. Zakotin, and P. I. Suntsov, J. Gen. Chem. (U.S.S.R.) **9**, 509 **1939**; Survey For. Petrol. Liter., Jan. 26, **1940**, Abs. 210B.
28. Ramart-Lucas, Ann. chim. phys. [8] **30**, 349 **1913**.
29. Ramart-Lucas, and P. Amagat, Bull. soc. chim. [4] **51**, 965 **1932**.
30. Reich, S., R. van Wijck, and C. Waelle, Helv. Chim. Acta **4**, 242 **1921**.
31. Riiber, C. N., Ber. **36**, 1404 **1903**.
32. Savard, J., and R. Hösögüt, Rev. faculté sci. univ. Istanbul [N.S.] **3**, 164 **1938**; C.A. **32**, 5795 **1938**.
33. Schiessler, R. W., D. G. Clarke, C. S. Rowland, W. S. Sloatman, and C. H. Herr, paper presented before the American Petroleum Institute, November, **1943**.
34. Schiessler, R. W., J. N. Cosby, D. G. Clarke, C. S. Rowland, W. S. Sloatman, and C. H. Herr, paper presented before the American Petroleum Institute, November, **1942**.

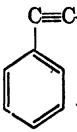
35. Schmidt, A. W., and A. Grosser, Ber. **75**, 829 **1942.**
36. Schubert, F., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **112**, Abt. IIb, 105 **1903.**
37. Shaposhnikov, L., J. Russ. Phys. Chem. Soc. **31**, 250 **1899**; Chem. Zentr. **1899**, I, 1204.
38. Shorygin, P., Ber **40**, 3111 **1907.**
39. Thoms, H., and B. Ambrus, Arch. Pharm. **263**, 264 **1925.**
40. von Braun, J., H. Deutsch, and A. Schmatloch, Ber. **45**, 1246 **1912.**
41. Whitmore, F. C., J. N. Cosby, W. S. Sloatman, and D. G. Clarke, J. Am. Chem. Soc. **64**, 1801 **1942.**
42. Ziegler, K., F. Dersch, and H. Wollthan, Ann. **511**, 13 **1934.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Ethynylbenzene**  | **142.4** | **0.9300** | **1.5489** | * |
| −44.8 [68] | 144–145 [22] | 0.9281 [19] | 1.548 [11] | |
| | 142–144 [29,30,61] | 0.9295 [18,75] | 1.5485 [19] | |
| | 142–143 [11,58,63] | 0.930 [11] | 1.54935 [40] | |
| | 141–143 [2] | 0.93125 [40] | 1.5461 26° [74] | |
| | 140–143 [74] | 0.80832 141.6° [77] | 1.55012 17.4° [21] | |
| | 142(a) | 0.9246 25° [72] | 1.5513 13.4° [71] | |
| | 141–142 [9,54,55,71] | 0.9265 23.1° [75] | 1.5524 12.5° [54] | |
| | 140–142 [20] | 0.927 22° [58] | 1.54095 $n_{H\alpha}^{23.0}$ [75] | |
| | 141.70–141.75 [72] | 0.930 22° [71] | 1.54160 $n_{H\alpha}^{20.0}$ [18,75] | |
| | 141.6 [77] | 0.930 $D_{20}^{20}$ [66] | 1.54304 $n_{H\alpha}^{20.0}$ [40] | |
| | 141.5 [76] | 0.9332 $D_{20}^{20}$ [32] | 1.54374 $n_{H\alpha}^{17.4}$ [21] | |
| | 140.5–141 [13] | 0.9371 12.5° [54] | 1.5446 $n_{H\alpha}^{13.4}$ [71] | |
| | 139–141 [22] | 0.94658 0° [77] | 1.54604 $n_{H\alpha}^{12.5}$ [54] | |
| | 138–141 [56] | | 1.56371 $n_{H\beta}^{23.0}$ [75] | |
| | 139.8–140.6 [49] | | 1.56456 $n_{H\beta}^{20.0}$ [18,75] | |
| | 140 [44,63] | | 1.56569 $n_{H\beta}^{20.0}$ [40] | |
| | 139–140 [18,26] | | 1.5675 $n_{H\beta}^{13.4}$ [71] | |
| | 139 [34] | | 1.57986 $n_{H\beta}^{12.5}$ [54] | |
| | 138–139 [60] | | 1.57843 $n_{H\gamma}^{23.0}$ [75] | |
| | 138 [23] | | 1.57899 $n_{H\gamma}^{20.0}$ [18,75] | |
| | 141–142 758.9 [62] | | 1.5810 $n_{H\gamma}^{13.4}$ [71] | |
| | 140–141 750 [35] | | 1.59856 $n_{H\gamma}^{12.5}$ [54] | |
| | 141–142 720.5 [50] | | 1.5471 $n_{He}^{23.0}$ [75] | |
| | 75 90 [19] | | | |
| | 44 18 [5] | | | |
| | 38 15 [61] | | | |
| | 39–40 14 [36] | | | |

* $\frac{dD}{dt} = -0.0008445/°C$ (0 to 25°C)

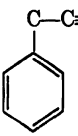
† $\frac{dn}{dt} = -0.0004541/°C$ (12 to 26°C)

(a) The boiling point 142 is found in references 31, 33, 57, 66, 67, 78.

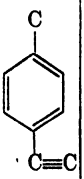
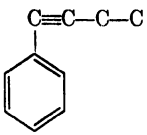
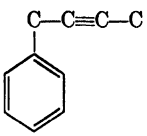
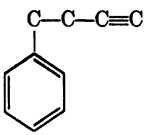
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Propyn-1-ylbenzene**  | | | | * |
| | **182.9** | **0.9380** | | |
| | 185.0 [65] | 0.938 [17] | 1.565 [17] | |
| | 181–185 [70] | 0.9388 [19] | 1.5650 [19] | |
| | 182–183 [79] | 0.939 $D_{20}^{20}$ [48] | 1.56470 [25] | |
| | 181–182 [59] | 0.944 17° [71] | 1.561 18° [71] | |
| | 181(a) [45] | 0 9393 16° [25] | 1.563 15° [15] | |
| | 113 84 [19] | 0.942 15° [15] | | |
| | 76 17 [51] | 0.9545 0° [25] | | |
| | 76 16 [12] | | | |
| | 75 16 [45] | | | |
| | 71–74 15 [71] | | | |
| | 74–75 14 [89] | | | |
| | 73 13 [15,17] | | | |
| | 72 13 [8] | | | |
| | 71–71.5 12 [25] | | | |
| | 70 11 [12,14] | | | |

* $\frac{dD}{dt} = -0.0008119$/°C (0 to 20°C)

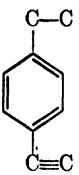
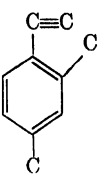
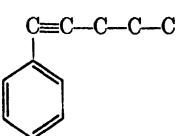
(a) The author states that polymerization takes place at the boiling point.

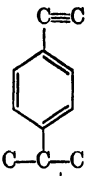
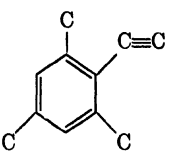
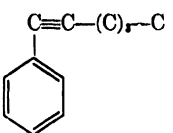
| | | | | |
|---|---|---|---|---|
| **Propyn-2-ylbenzene**  | | | | |
| | 166(a) [45] | 0.932 [15] | 1.5272 [16] | |
| | 70–71 20 [45,46] | 0.936 [16] | 1.535 [15] | |
| | 69.5–70 18 [11] | 0.931 28° [27] | 1.53481 23° [27] | |
| | 68–69 17 [6] | 0.939 $D_{20}^{20}$ [45] | | |
| | 68–68.5 16 [15] | 0.938 15° [12A] | | |
| | 67 16 [16] | | | |
| | 67 15 [11] | | | |
| | 67–68 14 [4] | | | |
| | 65.5–66 14 [12] | | | |
| | 63 11 [14] | | | |

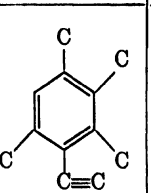
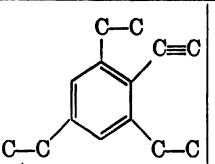
(a) The author states that polymerization take place at the boiling point.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-ethynylbenzene**  | | | | |
| 23 [24,42] | 168–170 [41,42] | 0.9159 [60] | 1.5447 25° [60] | |
| | 168 [24] | 0.903 18° [41] | 1.5475 17° [41] | |
| | 63 20 [36] | 0.912 18° [42] | | |
| | 66–67 18 [64] | | | |
| | 65–67 18 [60] | | | |
| | 55–60 15 [41] | | | |
| $C_{10}H_{10}$ | | | | |
| **Butyn-1-ylbenzene**  | | | | |
| | 201–203 [52,53] | 0.9210 [37] | 1.537 18° [71] | |
| | 87–90 18 [4,71] | 0.923 21° [52,53] | | |
| | 82 5 [37] | 0.915 18° [71] | | |
| **Butyn-2-ylbenzene**  | | | | |
| | 80 10 [47] | 0.9261 [47] | 1.5480 [47] | |
| **Butyn-3-ylbenzene**  | | | | |
| | 190–191 [55] | 0.9375 0° [2] | | |
| | 189–191 [2] | 0.9391 0° [3] | | |
| | 189–191 758 [3] | | | |
| **1-Methyl-2-propynylbenzene** (a) | | | | |
| | 80 15 [7] | 0.940 14° [7] | 1.532 14° [7] | |
| | | 0.951 0° [7] | | |

(a) The position of the triple bond is not given.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-propynylbenzene** (a) | | | | |
| | 83 15 [7] | 0.947 14° [7]<br>0.958 0° [7] | 1.533 14° [7] | |
| (a) The position of the triple bond is not given. | | | | |
| **1-Ethyl-4-ethynylbenzene**  | | | | |
| | 190–192 [41]<br>72–74 16 [60]<br>110 10 [43] | 0.9088 25° [60]<br>0.9086 18° [41,43]<br>0.9128 16° [41] | 1.5360 25° [60]<br>1.547(a) [41] | |
| (a) The temperature for this refractive index is not given. | | | | |
| **1-Ethynyl-2,4-dimethylbenzene**  | | | | |
| | 184–186 756 [28]<br>85 22 [28] | 0.9258 12° [28] | 1.5438 12° [28] | |
| $C_{11}H_{12}$<br>**Pentyn-1-ylbenzene**  | | | | |
| | 212–215 [71]<br>100–101 21 [71]<br>102–103 18.5 [10] | 0.911 18° [71] | 1.540 18° [71]<br>1.5449 14.0° [71]<br>1.5392 $n_{H\alpha}^{14.0}$ [71]<br>1.5601 $n_{H\beta}^{14.0}$ [71]<br>1.5743 $n_{H\gamma}^{14.0}$ [71] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethynyl-4-isopropylbenzene**  | | | | |
| | 79–81 12 [60] | 0.9037 25° [60] | 1.5296 25° [60] | |
| **1-Propynyl-2,4-dimethylbenzene** (a) | | | | |
| | 95 15 [7] | 0.941 14° [7]<br>0.952 0° [7] | 1.534 14° [7] | |
| (a) The position of the triple bond is not given. | | | | |
| **1,4-Dimethyl-2-propynylbenzene** (a) | | | | |
| | 98 15 [7] | 0.939 14° [7]<br>0.951 0° [7] | 1.531 14° [7] | |
| (a) The position of the triple bond is not given. | | | | |
| **1,3,5-Trimethyl-2-ethynylbenzene**  | | | | |
| 2.7–3.5 [73] | 103–107 23 [73]<br>100.6<br>–101.5 20 [73] | 0.9185 25° [73] | 1.5429 25° [73] | |
| $C_{12}H_{14}$ | | | | |
| **Hexyn-1-ylbenzene**  | | | | |
| | 229–232 [71] | 0.9024 [87] | 1.5347 [87] | |
| | 119–121 18 [10] | 0.899 17° [71] | 1.529 14.0° [71] | |
| | 114–115 14 [71] | | 1.5292 $n_{H\alpha}^{20}$ [87] | |
| | 109–110 12 [87] | | 1.5248 $n_{H\alpha}^{14.0}$ [71] | |
| | 94–95 4 [87] | | 1.5485 $n_{H\beta}^{20}$ [87] | |
| | | | 1.5304 $n_{H\beta}^{14.0}$ [71] | |
| | | | 1.521 $n_{H\gamma}^{20}$ [87] | |
| | | | 1.5440 $n_{H\gamma}^{14.0}$ [71] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Propynyl-4-isopropylbenzene** (a) | | | | |
| | 101 15 [7] | 0.924 14° [7]<br>0.933 0° [7] | 1.523 14° [7] | |
| (a) The position of the triple bond is not given. | | | | |
| **1-Methyl-4-isopropylethynyl-benzene** (a) | | | | |
| | 128–130 50 [41,43] | 0.8882 17° [41,43]<br>0.898 10° [41] | 1.527(b) [41] | |
| (a) The position of the ethynyl group is not given.<br>(b) The temperature for this refractive index is not given. | | | | |
| **1,2,3,5-Tetramethyl-4-ethynylbenzene**  | | | | |
| | 86 1 [1] | 0.9463 [1] | 1.5561 [1] | |
| $C_{13}H_{16}$<br>***n*-Pentylethynylbenzene** (a) | | | | |
| | 126–127 15 [10] | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{14}H_{18}$<br>**1-Tolylheptyne-1** (a) | | | | |
| | 260–262 [38] | | | |
| (a) The position of the methyl group in the tolyl radical is not given. | | | | |
| **1,3,5-Triethyl-2-ethynylbenzene**  | | | | |
| | 124–126 14–16 [41] | 0.9004 21° [41] | | |

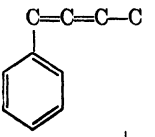
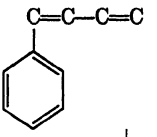
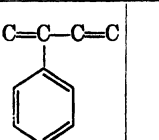
**References on Benzene With One Alkynyl Substitution**

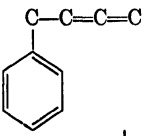
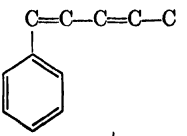
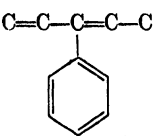
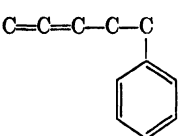
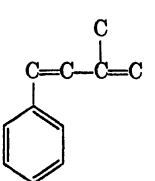

1. Adams, R., and C. W. Theobald, J. Am. Chem. Soc. **65**, 2208 1943.
2. André, É., Ann. chim. phys. [8] **29**, 540 1913.
3. André, É., Bull. soc. chim. [4] **9**, 192 1911.
4. Bergmann, E., and A. Bondi, Ber. **66**, 278 1933.
5. Bergmann, E., and M. Chudnovskiĭ, Z. physik. Chem. **17B**, 116 1932.
6. Bert, L., and P. C. Dorier, Bull. soc. chim. [4] **39**, 1610 1926.
7. Bert, L., P. C. Dorrier, and R. Lamy, Compt. rend. **181**, 555 1925.
8. Bert, L., and M. Raynaud, Compt. rend. **191**, 454 1930.
9. Bodroux, D., Compt. rend. **208**, 1022 1939.
10. Bogert, M. T., and D. Davidson, J. Am. Chem. Soc. **54**, 334 1932.
11. Bourguel, M., Ann. chim. [10] **3**, 191 1925.
12. Bourguel, M., Ann. chim. [10] **3**, 325 1925.

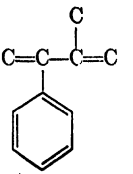
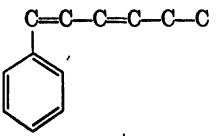
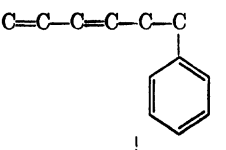
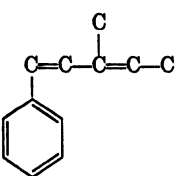
12A. Bourguel, M., Bull. soc. chim. [4] **41**, 192 1927.

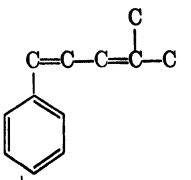
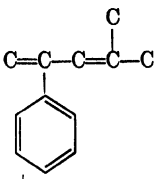
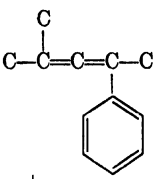
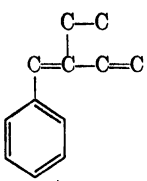
13. Bourguel, M., Compt. rend. **176**, 751 1923.
14. Bourguel, M., Compt. rend. **178**, 1984 1924.
15. Bourguel, Compt. rend. **186**, 1211 1928.
16. Bourguel, M., Compt. rend. **192**, 686 1931.
17. Bourguel through R. Truchet, Ann. chim. [10] **16**, 309 1931.
18. Brühl, J. W., Ann. **235**, 1 1886.
19. Campbell, K. N., and M. J. O'Connor, J. Am. Chem. Soc. **61**, 2897 1939.
20. Conant, J. B., and B. B. Coyne, J. Am. Chem. Soc. **44**, 2530 1922.
21. Cotton, A., and H. Mouton, Ann. chim. phys. [8] **28**, 209 1913.
22. Desgrez, A., Ann. chim. phys. [7] **3**, 209 1894.
23. Dunstan, A. E., and T. P. Hilditch, Z. Elektrochem. **18**, 185 1912.
24. Gattermann, L., Ann. **347**, 347 1906.
25. Ginsburg, Y. I., J. Gen. Chem. (U.S.S.R.) **8**, 1029 1938.
26. Glaser, C., Ann. **154**, 137 1870.
27. Grignard, V., L. Lapayre, and T. Faki, Compt. rend. **187**, 517 1928.
28. Grignard, V., and H. Perrichon, Ann. chim. [10] **5**, 5 1926.
29. Hessler, J. C., J. Am. Chem. Soc. **44**, 425 1922.
30. Hessler, J. C., Org. Syntheses, Coll. Vol. **1**, 428 1932.
31. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **17**, 929 1911.
32. Hofmann, F., K. F. Lang, K. Berlin, and A. W. Schmidt, Brennstoff-Chem. **14**, 103 1933.
33. Horstmann, A., Ber. **20**, 766 1887.
34. Hurd, C. D., and R. E. Christ, J. Org. Chem. **1**, 141 1936.
35. Hurd, C. D., and F. L. Cohen, J. Am. Chem. Soc. **53**, 1068 1931.
36. Johnson, J. R., and W. L. McEwen, J. Am. Chem. Soc. **48**, 469 1926.
37. Johnson, J. R., A. L. Schwartz, and T. L. Jacobs, J. Am. Chem. Soc. **60**, 1882 1938.
38. Kipping, F. S., J. Chem. Soc. **67**, 502 1895.
39. Körner, A., Ber. **21**, 276 1888.
40. Krestinskiĭ, V., and N. Persyanzeva, Ber. **64**, 2363 1931.
41. Kunckell, F., Ber. deutsch. pharm. Ges. **23**, 188 1913.
42. Kunckell, F., and F. Gotsch, Ber. **33**, 2654 1900.
43. Kunckell, F., and R. Koritzky, Ber. **33**, 3261 1900.
44. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 1918.
45. Lespieau, R., Bull. soc. chim. [4] **29**, 528 1921.
46. Lespieau and Garreau, Compt. rend. **171**, 111 1920.
47. Levina, R. Y., and N. A. Shcheglova, J. Gen. Chem. (U.S.S.R.) **11**, 527 1941; C.A. **35**, 6935 1941.
48. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. **26**, 475 1934.
49. Lucas, H. J., and D. Pressman, Ind. Eng. Chem. Anal. Ed. **10**, 140 1938.
50. Malenok, N. M., and I. V. Sologub, J. Gen. Chem. (U.S.S.R.) **6**, 1904 1936; C.A. **31**, 4285 1937.
51. Manchot, W., J. C. Withers, and H. Oltrogge, Ann. **387**, 257 1912.

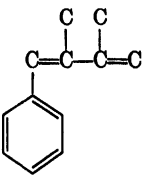
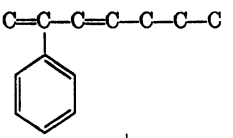
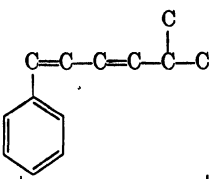
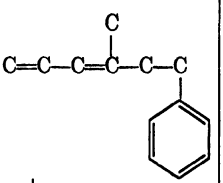
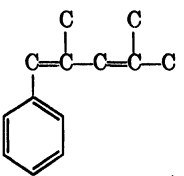
52. Morgan, T. M., Jahresber. Fortschr. Chem. **1876**, 398.
53. Morgan, T. M., J. Chem. Soc. **29**, 162 **1876**.
54. Moureu, C., Ann. chim. phys. [8] **7**, 536 **1906**.
55. Moureu, C., and É. André, Ann. chim. [9] **1**, 113 **1914**.
56. Müller, F. G., and A. Banninger, Helv. Chim. Acta **10**, 763 **1927**.
57. Murray, M. J., and F. F. Cleveland, J. Am. Chem. Soc. **61**, 3546 **1939**.
58. Nef, J. V., Ann. **308**, 264 **1899**.
59. Nef, J. V., Ann. **310**, 316 **1900**.
60. Otto, M. M., J. Am. Chem. Soc. **56**, 1393 **1934**.
61. Palliard, H., and C. Wieland, Helv. Chim. Acta **21**, 1356 **1938**.
62. Peratoner, A., Gazz. chim. ital. **22**, II, 61 **1892**.
63. Radziszewski, B., Ber. **6**, 492 **1873**.
64. Robin, J., Ann. chim. [10] **16**, 421 **1931**.
65. Ryden, L. L., Thesis, Univ. Illinois, **1937**.
66. Sabatier, P., and J. B. Senderns, Ann. chim. phys. [8] **4**, 319 **1905**.
67. Sabatier, P., and J. B. Senderns, Compt. rend. **135**, 87 **1902**.
68. Smith, R. H., and D. H. Andrews, J. Am. Chem. Soc. **53**, 3644 **1931**.
69. Staudinger, H., and H. Schneider, Helv. Chim. Acta **6**, 316 **1923**.
70. Tiffeneau, M., Compt. rend. **135**, 1346 **1902**.
71. Truchet, R., Ann. chim. [10] **16**, 309 **1931**.
72. Vaughn, T. H., J. Am. Chem. Soc. **56**, 2064 **1934**.
73. Vaughn, T. H., and J. A. Nieuwland, J. Am. Chem. Soc. **56**, 1207 **1934**.
74. Vaughn, T. H., R. R. Vogt, and J. A. Nieuwland, J. Am. Chem. Soc. **56**, 2120 **1934**.
75. von Auwers, K., and F. Bergmann, Ann. **476**, 272 **1929**.
76. Walden, P., Z. physik. Chem. **66**, 385 **1909**.
77. Weger, F., Ann. **221**, 61 **1883**.
78. Zalkind, Y. S., and F. B. Fundyler, Ber. **69**, 128 **1936**.
79. Zeberg, E. F., J. Gen. Chem. (U.S.S.R.) **5**, 1016 **1935**; C.A. **30**, 1023 **1936**.

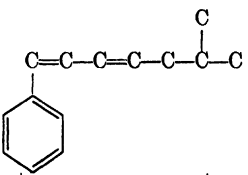
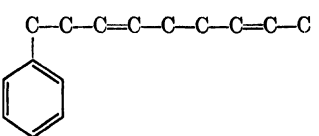
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenylbutadiene-1,2**  | | | | |
| | 76–77 10 [1]<br>44–47 0.5–1.0 [1] | 0.9240 26.5° [1] | 1.5754 [1]<br>1.5698 30° [1]<br>1.5716 24° [1] | |
| **1-Phenylbutadiene-1,3**  | | | | |
| 4.5 [28] | 95 20 [28]<br>96 18 [35]<br>94–96 18 [19]<br>90–92 16 [11]<br>93–96 15 [4]<br>90 15 [22,39]<br>88–89 15 [39]<br>88 14 [36]<br>93–95 12 [10]<br>85–86 12 [27]<br>86(a) 11 [31]<br>83–84 11 [13]<br>76(b) 11 [31]<br>90(a) 10 [37]<br>50–51 0.4 [13] | 0.9286 [28]<br>0.928 $D_{20}^{20}$ [29]<br>0.9309 16° [22,39]<br>0.9316 15° [22]<br>0.9333 14.9° [39] | 1.5920(b) 28° [31]<br>1.5950(a) 28° [31]<br>1.6093 18° [18]<br>1.60895 16.2° [7]<br>1.61283 16° [22,39]<br>1.6140 16° [20]<br>1.60808 14.9° [39]<br>1.59317 $n_{H\alpha}^{20}$ [35]<br>1.59978 $n_{H\alpha}^{16.2}$ [7]<br>1.60345 $n_{H\alpha}^{16}$ [22,39]<br>1.59736 $n_{H\alpha}^{14.9}$ [39]<br>1.62952 $n_{H\beta}^{20}$ [35]<br>1.63410 $n_{H\beta}^{16.2}$ [7]<br>1.64232 $n_{H\beta}^{16}$ [22,39]<br>1.63707 $n_{H\beta}^{14.9}$ [39]<br>1.65044 $n_{H\gamma}^{20}$ [35]<br>1.67190 $n_{H\gamma}^{16}$ [22,39]<br>1.66514 $n_{H\gamma}^{14.9}$ [39] | |
| (a) This constant was determined on the *cis* form.<br>(b) This constant was determined on the *trans* form. | | | | |
| **2-Phenylbutadiene-1,3**  | | | | |
| | 60–61 17 [5]<br>58–59 9 [3] | 0.9226 [5] | 1.5489 [5] | |

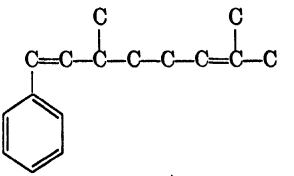
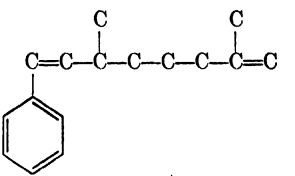
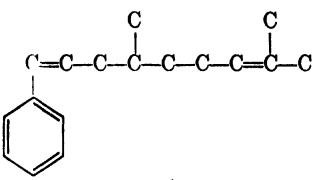
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenylbutadiene-2,3**  | 72–73 17 [5] | 0.9220 [5] | 1.5460 [5] | |
| $C_{11}H_{12}$ **1-Phenylpentadiene-1,3**  | 116 16 [22,32]<br>112–114.5 15 [39]<br>110 13 [4] | 0.9325 15.2° [39]<br>0.9384 13° [22] | 1.59997 15.2° [39]<br>1.61114 13° [22]<br>1.58987 $n_{H\alpha}^{15.2}$ [39]<br>1.60167 $n_{H\alpha}^{13}$ [22]<br>1.62739 $n_{H\beta}^{15.2}$ [39]<br>1.64065 $n_{H\beta}^{13}$ [22]<br>1.66056 $n_{H\gamma}^{15.2}$ [39]<br>1.67038 $n_{H\gamma}^{13}$ [22] | |
| **3-Phenylpentadiene-1,3**  | 85–86 15 [26] | 0.915 21° [26] | 1.5500 21° [26] | |
| **5-Phenylpentadiene-1,2**  | 76–77 7 [5] | 0.9169 [5] | 1.5400 [5] | |
| **1-Phenyl-3-methylbutadiene-1,3**  | 124 32 [19]<br>115 18 [15,16] | 0.9423 23° [19] | | |

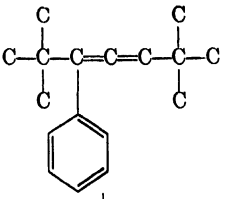
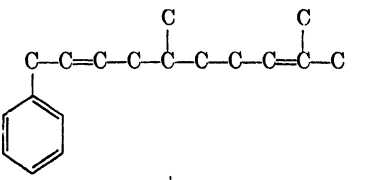
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Phenyl-3-methylbutadiene-1,3**  | 95 24 [8] | | | |
| $C_{12}H_{14}$ **1-Phenylhexadiene-1,3**  | 128 16 [22] | 0.9189 [22]<br>0.9253 12° [22] | 1.60252 12° [22]<br>1.59164 $n_{H\alpha}^{12}$ [22]<br>1.62999 $n_{H\beta}^{12}$ [22]<br>1.65874 $n_{H\gamma}^{12}$ [22] | |
| **6-Phenylhexadiene-1,3**  | 99.5<br>−100.5 11 [6] | 0.9304 13° [6] | 1.5446 13° [6] | |
| **1-Phenyl-3-methylpentadiene-1,3**  | 132–133 21 [19]<br>130 20 [21] | 0.9523 23° [19]<br>0.9593 19° [21] | 1.5366 19° [21] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_t^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-4-methylpentadiene-1,3**  | 123–124 14 [39] | 0.9512 16.2° [39] | 1.54744 16.2° [39]<br>1.54090 $n_{H\alpha}^{16.2}$ [39]<br>1.56509 $n_{H\beta}^{16.2}$ [39]<br>1.59232 $n_{H\gamma}^{16.2}$ [39] | |
| **2-Phenyl-4-methylpentadiene-1,3**  | 77–80 10 [33] | 0.9235 [33] | 1.547 [33] | |
| **2-Methyl-4-phenylpentadiene-2,3**  | 218–220 751 [20]<br>107–108 20 [20] | 0.922 $D_{20}^{20}$ [29]<br>0.9277 19.8° [20] | 1.5236 [20] | |
| **1-Phenyl-2-ethylbutadiene-1,3**  | 110–111 14 [9] | 0.9288 19° [9] | 1.576 [9] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Phenyl-2,3-dimethylbutadiene-1,3  | 165 30 [24] | | | |
| $C_{13}H_{16}$ 2-Phenylheptadiene-1,3  | 246–248 [17] | 0.9384 15° [17] | 1.5422 14° [17] | |
| 1-Phenyl-5-methylhexadiene-1,3  | 143 22 [22,39]<br>136 16 [22,39] | 0.9248 [22, 39] | 1.58727 [22,39]<br>1.57822 $n_{H\alpha}^{20}$ [22,39]<br>1.61401 $n_{H\beta}^{20}$ [22,39]<br>1.64065 $n_{H\gamma}^{20}$ [22,39] | |
| 1-Phenyl-3-methylhexadiene-3,5  | 116 12 [6] | 0.9152 13.3° [6] | 1.5321 13.3° [6] | |
| 1-Phenyl-2,4-dimethylpentadiene-1,3  | 234–236 730 [40] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4-*m*-Xylylpentadiene-1,3** (a) | | | | |
| | 230–233[30]<br>120–121 21.5[30] | 0.9097 21°[30] | 1.53233 21°[30] | |
| (a) The position of the methyl groups in Xylene is not given. | | | | |
| **4-*p*-Xylylpentadiene-1,3** (a) | | | | |
| | 117.5 20[30] | 0.9062 21°[30] | 1.53690 21°[30] | |
| (a) The position of the methyl groups in Xylene is not given. | | | | |
| $C_{14}H_{18}$ | | | | |
| **1-Phenyl-6-methylheptadiene-1,3**  | | | | |
| | 142–144 15.5[39]<br>146–147 15[22] | 0.9508[22]<br>0.9486 14.9°[39] | 1.58547[22]<br>1.58232 14.9°[39]<br>1.57652 $n_{H\alpha}^{20}$[22]<br>1.57364 $n_{H\alpha}^{14.9}$[39]<br>1.61105 $n_{H\beta}^{20}$[22]<br>1.60620 $n_{H\beta}^{14.9}$[39]<br>1.63249 $n_{H\gamma}^{20}$[22]<br>1.63025 $n_{H\gamma}^{14.9}$[39] | |
| **2-Methyl-6-phenylheptadiene** (a) | | | | |
| | 140–142 22[12] | 0.9205 10°[12] | 1.53449 13°[12]<br>1.53619 10°[12] | |
| (a) The position of the double bonds is not given. | | | | |
| $C_{15}H_{20}$ | | | | |
| **1-Phenylnonadiene-3,7**  | | | | |
| | 140–142 16[2] | 0.889 $D_{21}^{21}$[2] | 1.5105 21°[2] | |

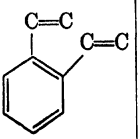
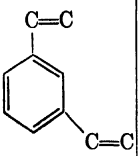
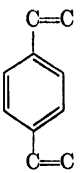
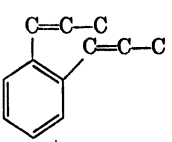
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Methyl-6-benzylheptadiene** (a) | | | | |
| | 136–138 12 [12]<br>101–104 4 [12] | 0.9289 11° [12] | 1.53245 11° [12] | |
| (a) The position of the double bonds is not given. | | | | |
| $C_{16}H_{22}$ | | | | |
| **1-Phenyl-3,7-dimethyloctadiene-1,6**  | | | | |
| | 151–152 9 [34] | 0.8957 [34] | 1.52849 [34] | $[\alpha]_D^{20} = -63.24°$ [34] |
| **1-Phenyl-3,7-dimethyloctadiene-1,7**  | | | | |
| | 152 9.5 [23,33] | 0.8947 17° [23,33] | 1.5276 17° [23,33] | $[\alpha]_D^{17} = -65.11°$ [23] |
| $C_{17}H_{24}$ | | | | |
| **1-Phenyl-4,8-dimethylnonadiene-1,7**  | | | | |
| | 159–160 9 [34] | 0.8894 [34] | 1.51765(a) [34]<br>1.51340(a) $n_{H\alpha}^{20}$ [34]<br>1.52939(a) $n_{H\beta}^{20}$ [34]<br>1.53964 $n_{H\gamma}^{20}$ [34] | $[\alpha]_D^{20} = -3.33°$ [34] |
| (a) This value is an average of two or more determinations | | | | |

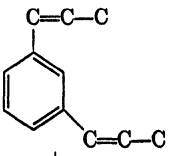
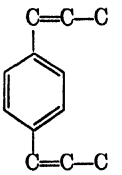
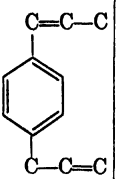
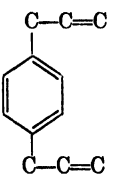
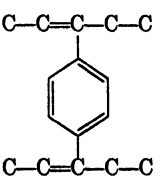
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2,6,6-Tetramethyl-3-phenylheptadiene-3,4**  | 78–80 1 [14] | 0.8808 [14] | 1.5039 [14] | |
| $C_{18}H_{26}$ **1-Phenyl-5,9-dimethyldecadiene-2,8**  | 163–164 9 [34] | 0.8852 [34]<br>0.8851 [34] | 1.50766 [34]<br>1.50375 $n_{H\alpha}^{20}$ [34]<br>1.51768 $n_{H\beta}^{20}$ [34]<br>1.52629 $n_{H\gamma}^{20}$ [34] | $[\alpha]_D^{20} = -5.76°$ [3] |

### References on Benzene with One Alkadienyl Substitution


1. Acree, F., Jr., and F. B. Laforge, J. Org. Chem. **4**, 569 **1939**.
2. Arbusov, B. A., and E. V. Kuznetsov, Compt. rend. acad. sci. U.R.S.S. **39**, 343 **1943**; Survey For. Petrol. Liter. Feb. 25, **1944**.
3. Backer, H. J., and J. Strating, Rec. trav. chim. **53**, 525 **1934**.
4. Bergmann, E., and A. Bondi, Ber. **64**, 1455 **1931**.
5. Carothers, W. H., and G. J. Berchet, J. Am. Chem. Soc. **55**, 2813 **1933**.
6. Cohen, A., J. Chem. Soc. **1935**, 429.
7. Cotton, A., and H. Mouton, Ann. chim. phys. [8] **28**, 209 **1913**.
8. Courtot, Bull. soc. chim. [3] **35**, 969 **1906**.
9. Deux, Y., Compt. rend. **208**, 1090 **1939**.
10. Döbner, O., and G. Schmidt, Ber. **40**, 148 **1907**.
11. Döbner, O., and H. Staudinger, Ber. **36**, 4318 **1903**.
12. Escourrou, R., Bull. soc. chim. [4] **39**, 1249 **1926**.
13. Fischer, F. G., and K. Löwenberg, Ber. **66**, 669 **1933**.
14. Ford, J. H., C. D. Thompson, and C. S. Marvel, J. Am. Chem. Soc. **57**, 2619 **1935**.
15. Grignard, V., Ann. chim. phys. [7] **24**, 433 **1901**.
16. Grignard, V., Ann. Univ. Lyon **1901**, 1.
17. Grignard, V., and M. Dubien, Ann. chim. [10] **2**, 282 **1924**.
18. Ingold, C. K., and C. L. Wilson, J. Chem. Soc. **1933**, 1493.
19. Klages, A., Ber. **35**, 2649 **1902**.
20. Klages, A., Ber. **37**, 2301 **1904**.
21. Klages, A., Ber. **39**, 2587 **1906**.
22. Klages, A., Ber. **40**, 1768 **1907**.

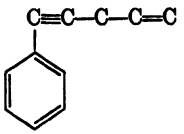
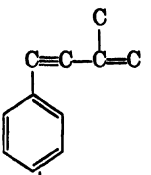
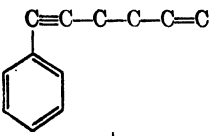
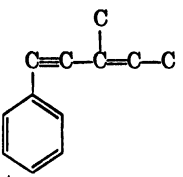
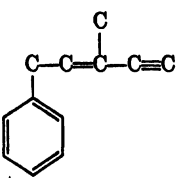
23. Klages, A., and R. Sautter, Ber. **39**, 1938 **1906**.
24. Kohler, E. P., Am. Chem. J. **36**, 529 **1906**.
25. Kohler, E. P., and G. L. Heritage, Am. Chem. J. **43**, 475 **1910**.
26. Kuhn, R., and M. Hoffer, Ber. **66**, 1263 **1933**.
27. Lebedev, S. V., and A. A. Ivanov, J. Russ. Phys. Chem. Soc. **48**, 997 **1916**; C.A. **11**, 787 **1917**; Chem. Zentr. **1923**, I, 1539.
28. Liebermann, C., and C. Riiber, Ber. **35**, 2696 **1902**.
29. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. **26**, 475 **1934**.
30. Matsurevich, I., J. Russ. Phys. Chem. Soc. **46**, 13 **1914**; Chem. Zentr. **1914**, I, 1999.
31. Muskat, I. E., and M. Herrman, J. Am. Chem. Soc. **53**, 252 **1931**.
32. Pestemer, M., and L. Willigut, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **144**, Abt. IIb, 251 **1935**.
33. Ravier, H., Compt. rend. **198**, 1786 **1934**.
34. Rupe, H., Ann. **402**, 149 **1914**.
35. Stobbe, H., and F. Reuss, Ber. **45**, 3496 **1912**.
36. Straus, F., Ann. **342**, 190 **1905**.
37. Terent'ev, A. P., and M. E. Lægelman, Sci. Repts. Moscow State Univ. **1936**, No. 6, 257; Chem. Zentr. **1937**, II, 2222.
38. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] **82**, 65 **1910**.
39. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] **84**, 37 **1911**.
40. von Fellenberg, T., Ber. **39**, 2064 **1906**.

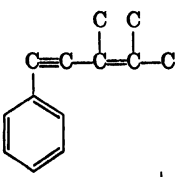
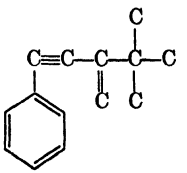
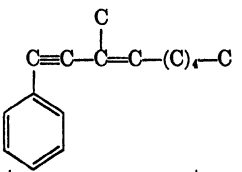
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Diethenylbenzene**  | | | | |
| | 73–74 12 [5]<br>78.5 11 [4]<br>73.5 11 [3] | 0.9325 22° [5]<br>0.934 21° [3,4] | 1.57594 22° [5]<br>1.5760 21° [3,4]<br>1.56827 $n_{H\alpha}^{22}$ [5]<br>1.59630 $n_{H\beta}^{22}$ [5] | |
| **1,3-Diethenylbenzene**  | | | | |
| | 52 3 [3,4] | 0.926 22° [3,4] | 1.5745 22° [3]<br>1.5746 22° [4] | |
| **1,4-Diethenylbenzene**  | | | | |
| 31 [3,7]<br>28–29 [9] | ca.180 [6]<br>85–86 16 [9]<br>52 4 [7]<br>52 3 [3] | 0.913 40° [3,7] | 1.5820 40° [3,7] | |
| $C_{12}H_{14}$ | | | | |
| **1,2-Di-(propen-1′-yl)-benzene**  | | | | |
| −26 [3] | 108.5–109 9 [3]<br>108–108.5 9 [3] | 0.9263 21° [3]<br>0.9185 20.5° [3] | 1.5752 21° [3]<br>1.5760 20.5° [3] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,3-Di-(propen-1′-yl)-benzene  | 117–120 14[3] | 0.9221 24°[3] | 1.5780 24°[3] | |
| 1,4-Di-(propen-1′-yl)-benzene  63.6–64[1] 63–64[8] 63[3] | 123–125 12[8] | | | |
| 1-(Propen-1′-yl)-4-(propen-2′-yl)-benzene  | 107–108 11[8] | 0.918 11°[8] | 1.559 11°[8] | |
| 1,4-Di-(propen-2′-yl)-benzene  | 94 12[8] | 0.915 11°[8] | 1.526 11°[8] | |
| $C_{16}H_{22}$ 1,4-Di-(3′-penten-2′-yl)-benzene  | 149–151 20[2] | | | |

## References on Benzene with Two Alkenyl Substitutions

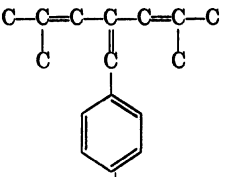
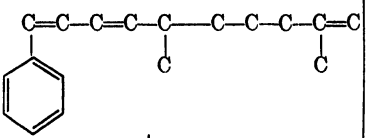
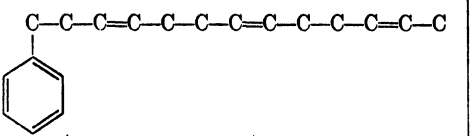
1. Bogert, M. T., and C. P. Harris, J. Am. Chem. Soc. **41**, 1676 **1919.**
2. Bogert, M. T., and P. S. Nisson, Proc. Natl. Acad. Sci. U.S. **10**, 426 **1924.**
3. Deluchat, R., Ann. chim. [11] **1**, 181 **1934.**
4. Deluchat, Compt. rend. **192**, 1387 **1931.**
5. Fries, K., and H. Bestian, Ber. **69**, 715 **1936.**
6. Ingle, H., Ber. **27**, 2526 **1894.**
7. Lespieau and Deluchat, Compt. rend. **190**, 683 **1930.**
8. Quelet, R., Bull. soc. chim. [4] **45**, 255 **1929.**
9. Sabetay, S., Compt. rend. **192**, 1109 **1931.**

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
|  **1-Phenylpenten-4-yne-1** | 103–105 20[5] | 0.940 $D_{15}^{15}$[5] | 1.558 18°[5] | |
|  **1-Phenyl-3-methylbuten-3-yne-1** | 88 7[10] | | | |
| $C_{12}H_{12}$  **1-Phenylhexen-5-yne-1** | 103–105 20[4] | 0.94[4] | 1.558[4] | |
|  **1-Phenyl-3-methylpenten-3-yne-1** | 113–115 15[3,7]<br>102–103 9[1] | 0.9305 $D_{20}^{20}$[1]<br>0.93 13°[3]<br>0.9301 13°[7]<br>0.9452 0°[3]<br>0.9462 $D_0^0$[1] | 1.5828 13°[3]<br>1.58281 13°[7]<br>1.57675 $n_{H\alpha}^{13}$[7]<br>1.6046 $n_{H\beta}^{13}$[7]<br>1.61954 $n_{H\gamma}^{13}$[7] | |
|  **1-Phenyl-3-methylpenten-2-yne-4** | 98 10[9] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Phenyl-3,4-dimethylpenten-3-yne-1  | 120–122 12[2] | | | |
| $C_{14}H_{16}$ 1-Phenyl-3-methylene-4,4-dimethylpentyne-1  | 115–116 10[8] | | | |
| $C_{16}H_{20}$ 1-Phenyl-3-methylnonen-3-yne-1  | 141–142 5[6] | 0.9006 $D_{20}^{20}$[6]<br>0.9137 $D_0^0$[6] | 1.5468 19°[6] | |

**References on Benzene with One Alkenynyl Substitution**

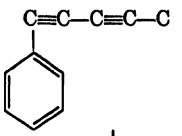

1. Bork, J., J. Russ. Phys. Chem. Soc. **37**, 647 **1905**; Chem. Zentr. **1905**, II, 1019.
2. Bork, J., J. Russ. Phys. Chem. Soc. **37**, 650 **1905**; Chem. Zentr. **1905**, II, 1019.
3. Brachin, M., Bull. soc. chim. [3] **35**, 1163 **1906**.
4. Grignard, V., and L. Lapayre, Bull. soc. chim. [4] **43**, 141 **1928**.
5. Grignard, V., and L. Lapayre, Compt. rend. **192**, 250 **1931**.
6. Malenok, N. M., and I. V. Sologub, J. Gen. Chem. (U.S.S.R.) **6**, 1904 **1936**; C.A. **31**, 4285 **1937**; Chem. Zentr. **1937**, I, 4093.
7. Moureu, C., Ann. chim. phys. [8] **7**, 536 **1906**.
8. Neverovich, N., J. Russ. Phys. Chem. Soc. **37**, 652 **1905**; Chem. Zentr. **1905**, II, 1020.
9. Rupe, H., and H. Hirschmann, Helv. Chim. Acta **14**, 687 **1931**.
10. Skosarevskiĭ, M., J. Russ. Phys. Chem. Soc. **37**, 645 **1905**; Chem. Zentr. **1905**, II, 1018.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,6-Dimethyl-4-benzylideneheptadiene-2,5**  | 277–278 724 [3] | | | |
| $C_{18}H_{24}$ | | | | |
| **1-Phenyl-5,9-dimethyldecatriene-1,3,9**  | 170–173 10 [2]<br>95 ca. 0.05 [2] | 0.9273 [2] | | $[\alpha]_D^{20}$ = +52.85° [2] |
| $C_{19}H_{26}$ | | | | |
| **1-Phenyltridecatriene-3,7,11**  | 188–191 16 [1] | 0.898 $D_{21}^{21}$ [1] | 1.5125 21° [1] | |

**References on Benzene with One Alkatrienyl Substitution**

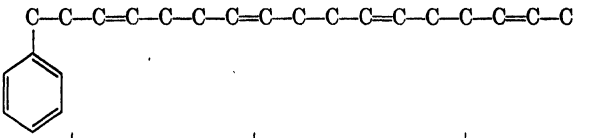
1. Arbusov, B. A., and E. V. Kuznetsov, Compt. rend. acad. sci. U.R.S.S. **39**, 343 **1943**; Survey For. Petrol. Liter., Feb. 25, **1944**.
2. Rupe, H., and R. Rinderknecht, Ann. **442**, 61 **1925**.
3. von Fellenberg, T., Ber. **39**, 2064 **1906**.

9. BENZENE WITH ONE ALKADIYNYL SUBSTITUTION, $C_nH_{2n-14}$

| M. P.,°C | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|
| **1-Phenylpentadiyne-1,3**  | | | | | | | |
| 22.45[1] | 129 | 20[1] | 0.9745 | 21°[2] | 1.6368 | 21°[2] | |
| 22.3[2] | | | 0.9745 | 18°[1] | 1.6368 | 18°[1] | |

**References on Benzene with One Alkadiynyl Substitution**

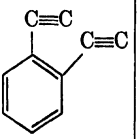
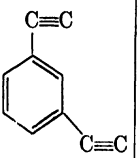
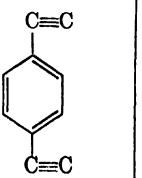
1. Prevost, C., Ann. chim. [10] **10**, 356 1928.
2. Prevost, C., Compt. rend. **180**, 1851 1925.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenylheptadecatetraene-3,7,11,15**  | 210–220 16[1] | 0.920 $D_{21}^{21}$[1] | 1.5135 21°[1] | |

**References on Benzene with One Alkatetraenyl Substitution**

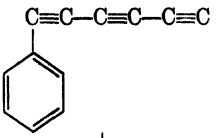
1. Arbusov, B. A., and E. V. Kuznetsov, Compt. rend. acad. sci. U.R.S.S. **39**, 343 **1943**; Survey For. Petrol. Liter., Feb. 25, **1944**.

## 11. BENZENE WITH TWO ALKYNYL SUBSTITUTIONS, $C_nH_{2n-14}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **1,2-Diethynylbenzene**  | 82 14 [1,2] | 0.9788 | 17.5° [1,2] | 1.5915 | 17.5° [1,2] | |
| **1,3-Diethynylbenzene**  | | | | | | |
| −2.5 [1,2] | 78 15 [1,2] | 0.9669 | 18° [1,2] | 1.5841 | 18° [1,2] | |
| **1,4-Diethynylbenzene**  | | | | | | |
| 95 [1,3] | | | | | | |

### References on Benzene with Two Alkynyl Substitutions

1. Deluchat, R., Ann. chim. [11] **1**, 181 **1934.**
2. Deluchat, Compt. rend. **192**, 1387 **1931.**
3. Lespieau and Deluchat, Compt. rend. **190**, 683 **1930.**

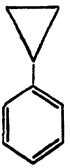
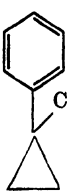
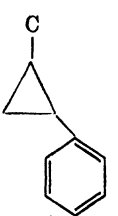
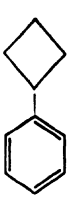
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenylhexatriyne-1,3,5**  | 52 18[1] | | | |

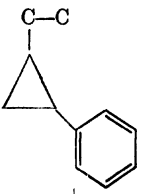
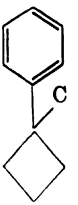
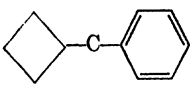
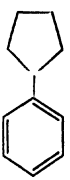
**References on Benzene with One Alkatriynyl Substitution**

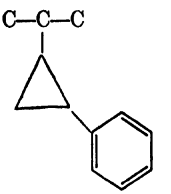
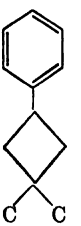
1. Grignard, V., and Tchéoufaki, Compt. rend. **188**, 357 1929.

## III. BENZENE WITH ALICYCLIC SUBSTITUTIONS

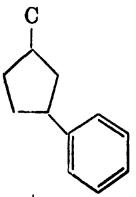
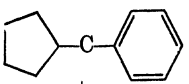
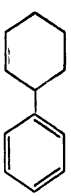
1. Benzene with One Cyclyl Substitution $C_nH_{2n-8}$
2. Benzene with One Cyclenyl, One Cyclylidenyl, or One Cyclylalkenyl Substitution $C_nH_{2n-10}$
3. Benzene with One Bicyclyl Substitution $C_nH_{2n-10}$
4. Benzene with Two Cyclyl Substitutions $C_nH_{2n-10}$
5. Benzene with One Cyclodienyl, One Alkenylcyclenyl, or One Dialkenylcyclyl Substitution $C_nH_{2n-12}$
6. Benzene with One Bicyclenyl, One Alkenylbicyclyl, or One Bicyclylidene Substitution $C_nH_{2n-12}$
7. Benzene with One Tricyclyl Substitution $C_nH_{2n-12}$
8. Benzene with One Cyclyl and One Cyclenyl or Cyclylidene Substitution $C_nH_{2n-12}$
9. Benzene with Three Cyclyl Substitutions $C_nH_{2n-12}$
10. Benzene with One Cyclenylalkynyl Substitution $C_nH_{2n-14}$
11. Benzene with One Alkenylcyclodienyl Substitution $C_nH_{2n-14}$
12. Benzene with One Bicyclenylalkenyl Substitution $C_nH_{2n-14}$
13. Benzene with Two Cyclenyl Substitutions $C_nH_{2n-14}$
14. Benzene with Four Cyclyl Substitutions $C_nH_{2n-14}$
15. Benzene with One Bicyclenylalkynyl Substitution $C_nH_{2n-16}$
16. Benzene with Two Cyclylcyclenyl Substitutions $C_nH_{2n-16}$
17. Benzene with One Bicyclylpentaenyl Substitution $C_nH_{2n-20}$

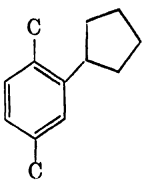
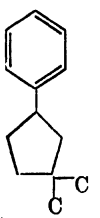
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Cyclopropylbenzene**  | | | | |
| −31 [33] | 170.5 [33,34]<br>171 771 [7]<br>173.6 758 [29]<br>60–61 13 [33,34] | 0.9397 [34]<br>0.9397 24° [33]<br>0.9401 $D_0^{20}$ [29]<br>0.9449 $D_0^{15}$ [29] | 1.5285 [7]<br>1.5291 [34]<br>1.5312 24° [33]<br>1.5342 15° [29] | |
| $C_{10}H_{12}$ | | | | |
| **1-Methyl-1-phenylcyclopropane**  | | | | |
| | 91 50 [64] | | 1.5160 [64]<br>1.5150 20.4° [64] | |
| **1-Methyl-2-phenylcyclopropane**  | | | | |
| | 184–186 [10]<br>186 743 [28A] | 0.925 [10]<br>0.9198 $D_0^{20}$ [28A] | 1.5208 [28A]<br>1.5237 [10] | |
| **Cyclobutylbenzene**  | | | | |
| | 190–191 755 [7] | 0.9378 [7] | 1.5277 [7] | |

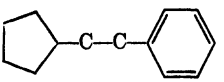
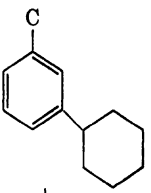
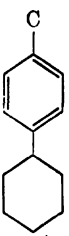
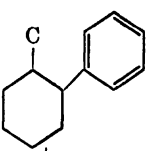
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethyl-2-phenylcyclopropane**  | | | | |
| | 203–205 [10] | 0.918 [10]<br>0.948 17° [5] | 1.5162 [10]<br>1.5276 17° [5] | |
| **1-Methyl-1-phenylcyclobutane**  | | | | |
| | 208.6 [26]<br>69 8 [26] | 0.9192 [26]<br>0.9044 40° [26] | 1.5132 [26] | |
| **Cyclobutylphenylmethane**  | | | | |
| | | 0.9556 [24] | 1.5265 [24] | |
| **Cyclopentylbenzene**  | | | | * |
| | 216.4 | 0.9476 | | |
| | 219.5–220.5 [19] | 0.9462 [19] | 1.5280 [19,68] | |
| | 217 [68] | 0.9470 [18] | 1.5309 [7] | |
| | 215–217 [67] | 0.9471 [17] | 1.531 [45] | |
| | 215 [68] | 0.9474 [68] | 1.52867 25° [2] | |
| | 214–215 [2] | 0.9499 [7] | 1.5330 23° [63] | |
| | 213–215 [5,62] | 0.9504 [45] | 1.5295 19° [11,15] | |
| | 215–218 755 [8] | 0.8838 100° [19] | 1.5305 19° [67] | |
| | 216 755 [7] | 0.9228 50° [19] | 1.5320 17° [5] | |
| | 216–218 750 [11,15] | 0.94319 25° [2] | 1.5301 15° [19] | |
| | 215–216 750 [45] | 0.9503 19° [67] | | |

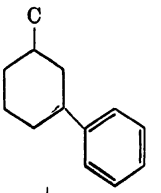
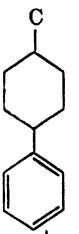
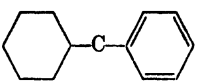
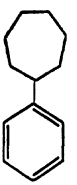
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Cyclopentylbenzene** (*Continued*) | | 0.9509 19° [11,15]<br>0.9618 0° [19]<br>0.9619 0° [17] | 1.52461 $n_{H\alpha}^{25}$ [2]<br>1.53940 $n_{H\beta}^{25}$ [2] | |
| | 102–<br>102.6 18 [17]<br>102.0–<br>102.5 18 [18] | | | |
| * $\frac{dD}{dt}$ = −0.0008362/°C (0 to 100°C) | | | | |
| $C_{12}H_{16}$ | | | | |
| **1-Isopropyl-2-phenylcyclopropane**  | | | | |
| | 213–216 [10] | 0.899 [10] | 1.5072 [10] | |
| **1-Phenyl-3,3-dimethylcyclobutane**  | | | | |
| | 208 [49] | | 1.5101 25° [49] | |
| **Methylcyclopentylbenzene** (a) | | | | |
| | 237.5 757 [48] | 0.9401 [48] | 1.5287 [48] | |

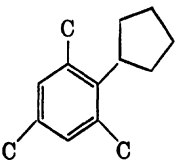
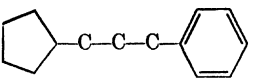
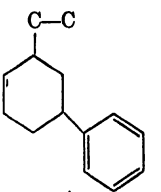
(a) The structure of this compound is not given.

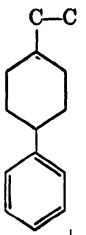
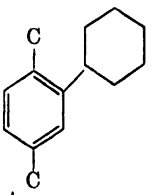
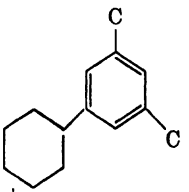
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-phenylcyclopentane**  | | | | |
| | 230–235 [5] | 0.9173 17° [63] | 1.5136 17° [63] | |
| | 230–232 [22] | 0.950 17° [5] | 1.5276 17° [5] | |
| | 93–94 12 [63] | 0.937 16° [22] | 1.5210 16° [22] | |
| **Cyclopentylphenylmethane**  | | | | |
| | 233–235 [63] | 0.9418 [24] | 1.5245 [24] | |
| | 232–234 [63] | 0.9283 21° [12,15] | 1.5170 21° [12,15] | |
| | 234–236 750 [12,15] | 0.9345 18° [63] | 1.5206 18° [63] | |
| | | | 1.5221 17° [63] | |
| **Cyclohexylbenzene**  | | | | |
| **6.9** | **238.1** | **0.9431** | **1.5249** | |
| 7–8 [40,55] | 242 [30] | 0.9428 [19] | 1.5234 [27] | |
| 7 [21,31,57] | 239.0 ± 0.6 [19] | 0.9436 [44] | 1.5237 [58] | |
| 6.6–7.0 [9] | 239 [50,51,53] | 0.944 [9] | 1.5254 [9] | |
| 6.5 [6] | 236–238 [41] | 0.8775 100° [19] | 1.5255 [44] | |
| 6 [44] | 237.5 [23] | 0.9183 50° [19] | 1.5260 [19] | |
| | 235–236 [40] | 0.9338 25° [39] | 1.526 [23] | |
| | 234–236 [28] | 0.9339 25° [37] | 1.5225 25° [37] | |
| | 235 [39] | 0.9431 25° [28] | 1.527 18° [67] | |
| | 238 770 [20] | 0.9405 22° [27] | 1.5274 18° [21] | |
| | 238 761 [27] | 0.9454 $D_{20}^{20}$ [58] | 1.528 16° [3] | |
| | 238 759 [7] | 0.948 $D_{20}^{20}$ [36] | 1.5288 15° [19] | |
| | 238.6 –238.8 756 [9] | 0.9441 $D_0^{20}$ [31] | | |
| | 233–234 755 [6] | 0.947 16° [3] | | |
| | 239 750 [21] | 0.947 15° [23] | | |
| | 236–237 746 [44] | 0.9591 0° [19] | | |
| | 239 745 [31] | | | |
| | 238–240 743 [3] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Cyclohexylbenzene** (*Continued*) | | | | |
| | 234–235 737 [55] | | | |
| | 232–235 715 [58] | | | |
| | 230–233 710 [66] | | | |
| | 156 80 [20] | | | |
| | 132 30 [38] | | | |
| | 115 15 [38] | | | |
| | 110–115 14 [61] | | | |
| | 107 13 [47] | | | |
| | 107–108 12.5 [27] | | | |
| | 106–107 12 [30] | | | |
| | 106 12 [20] | | | |
| | 105–106 10 [65] | | | |
| | 92 5 [37] | | | |
| | 76–78 2 [43] | | | |
| | 12.4 0.017 [35] | | | |
| * $\frac{1}{T_b} = 0.0029920 - 0.0003460 \log_{10} p_{mm}$ (2 to 80 mm) | | | | |
| † $\frac{dD}{dt} = -0.0008201$/°C (0 to 100°C) | | | | |
| ‡ $\frac{dn}{dt} = -0.0006400$/°C (15 to 25°C) | | | | |
| $C_{12}H_{18}$ **1,4-Dimethyl-2-cyclopentylbenzene**  | | | | |
| −44 [48] | 254.5–255 762 [48] | 0.9414 [48] | 1.5291 [48] | |
| **1-Phenyl-3,3-dimethylcyclopentane**  | | | | |
| | 242 [49] | | 1.5269 25° [49] | |

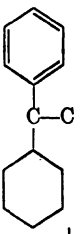
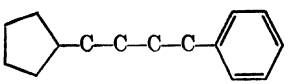
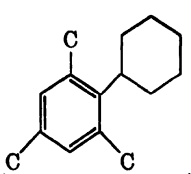
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Cyclopentyl-2-phenylethane**  | | | | |
| | 255–256 752.5 [13] | 0.9276 19° [14,15] | 1.5210 [13] | |
| | 254–256 752 [13] | 0.9401 19° [13] | 1.5150 19° [14,15] | |
| | 254–255 751.5 [14,15] | | 1.5225 19° [13] | |
| **1-Methyl-3-cyclohexylbenzene**  | | | | |
| | 257 – 257.3 754 [32] | 0.9365 18° [32] | 1.5236 18° [32] | |
| **1-Methyl-4-cyclohexylbenzene**  | | | | |
| | 259.8–260 750 [32] | 0.9351 $D_0^{20}$ [32]<br>0.9365 18° [32]<br>0.9494 $D_0^{0}$ [32] | 1.5232 18° [32] | |
| **1-Methyl-2-phenylcyclohexane**  | | | | |
| | 91–92 2 [84] | 0.9569 18.5° [84] | 1.5360 18.5° [84] | |

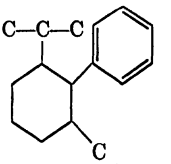
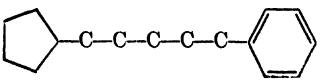
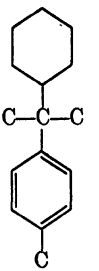
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-phenylcyclohexane**  | | | | |
| | 249 730 [32]<br>123–124 14 [60] | 0.9304 23° [60]<br>0.9426 $D_{20}^{20}$ [32]<br>0.9412 $D_0^{20}$ [32]<br>0.9425 18° [32]<br>0.9556 $D_0^{0}$ [32] | 1.5176 26° [60]<br>1.5246 18° [32] | $[\alpha]_D^{20} =$ −5.26° [60] |
| **1-Methyl-4-phenylcyclohexane**  | | | | |
| | 130 21 [47A] | 0.9442 [47A] | 1.5210 [47A] | |
| **Cyclohexylphenylmethane**  | | | | |
| | 239.5–241.5 736 [24]<br>137 20 [54] | 0.9281 [24]<br>0.9436 17° [54] | 1.5132 [24]<br>1.5255 17° [54] | |
| **Cycloheptylbenzene**  | | | | |
| | 132–135 28 [54]<br>131–132 16 [56]<br>108 7 [47A] | 0.9482 [47A]<br>0.9410 23° [54] | 1.5309 [47A]<br>1.5217 23° [54] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Isopropylcyclopentylbenzene** (a) | | | | |
| | 266.5 -267.5 757 [48] | 0.9222 [48] | 1.5190 [48] | |
| (a) The structure of this compound is not given. | | | | |
| **1,3,5-Trimethyl-2-cyclopentylbenzene**  | | | | |
| | 276– 276.5 767 [48] | 0.9435 [48] | 1.5325 [48] | |
| **1-Cyclopentyl-3-phenylpropane**  | | | | |
| | 271– 272.5 743 [13,15] | 0.9233 19° [13,15] | 1.5130 19° [13,15] | |
| **Methylcyclohexyltoluene** (a) | | | | |
| | 257-262 [42] | 0.9615 $D_{20}^{20}$ [42] | 1.5095 [42] | |
| (a) The structure of this compound is not given. | | | | |
| **1-Ethyl-3-phenylcyclohexane**  | | | | |
| | 103-107 3 [43] | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethyl-4-phenylcyclohexane**  | 264–265 [46]<br>144–147 16 [46] | 0.9328 [46] | 1.52129 [46] | |
| **1,4-Dimethyl-2-cyclohexylbenzene**  | 261–262 [4]<br>262–263 759 [3] | 0.936 18° [3,4] | 1.529 18° [3,4] | |
| **1,3-Dimethyl-5-cyclohexylbenzene**  | 266–268 763 [3,4]<br>265–266 748 [1]<br>142–143 17 [1] | 0.931 18° [3,4] | 1.525 18° [3,4] | |
| **Methylphenylcyclohexylmethane** (a) | 132–133 18 [59] | 0.9503 [59]<br>0.9517 $D_{20}^{20}$ [59]<br>0.9624 $D_0^0$ [59] | 1.53406 [59] | |

(a) The structure of this compound is not given.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-1-cyclohexylethane**  | 264–266 [52] | 0.9773 17° [52] | 1.549 17° [52] | |
| **$C_{15}H_{22}$**<br>**1-Methyl-4-isopropylcyclopentylbenzene (a)** | 121–122 6.5 [48] | 0.9227 [48] | 1.5219 [48] | |
| (a) The position of the cyclopentyl group is not given. | | | | |
| **1-Cyclopentyl-4-phenylbutane**  | 289–290 754 [15] | 0.9237 [15] | 1.5140 [15] | |
| **Isopropylcyclohexylbenzene (a)** | 275–280 [25] | | 1.5170 [25] | |
| (a) The structure of this compound is not given. | | | | |
| **1,3,5-Trimethyl-2-cyclohexylbenzene**  | 283–284.5 740 [3,4] | 0.946 9° [3,4] | 1.535 9° [3,4] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Isopropyl-2-phenyl-3-methylcyclohexane  | | | | |
| | 275 [27]<br>143–144 14 [27] | 0.934 23° [27] | 1.51830 [27]<br>1.5205 17° [27] | $[\alpha]_D^{17}$ = −3.898° [27] |
| 1-Cyclopentyl-5-phenylpentane  | | | | |
| | 304–305 758 [15,16] | 0.9181 [15,16] | 1.5110 [15,16] | |
| 2-Cyclohexyl-2-*p*-tolylpropane  | | | | |
| | 279–283 739 [4] | 0.916 24° [4] | 1.517 24° [4] | |
| $C_{17}H_{26}$<br>Cyclopentylphenylhexane (a) | | | | |
| | 315–317 749 [16] | 0.9187 [16] | 1.5128 [16] | |

(a) The structure of this compound is not given.

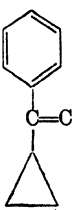
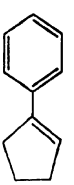
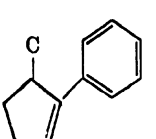
**References on Benzene With One Cyclyl Substitution**

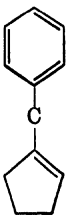
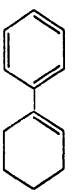

1. Battegay, M., and M. Kappler, Bull. soc. chim. [4] **35**, 989 1924.
2. Bauer, E., Ann. chim. [9] **1**, 342 1914.
3. Bodroux, D., Ann. chim. [10] **11**, 511 1929.
4. Bodroux, D., Compt. rend. **186**, 1005 1928.
5. Borsche, W., and W. Menz, Ber. **41**, 190 1908.
6. Boyd, A. J., P. H. Clifford, and M. E. Probert, J. Chem. Soc. **117**, 1383 1920.
7. Case, F. H., J. Am. Chem. Soc. **56**, 715 1934.
8. Chromov, S. I., J. Gen. Chem. (U.S.S.R.) **7**, 350 1937; C.A. **31**, 4653 1937; Chem. Zentr. **1937, I**, 4930.
9. Corson, B. B., and V. N. Ipatieff, J. Am. Chem. Soc. **59**, 645 1937.

10. Davidson, D., and J. Feldman, J. Am. Chem. Soc. **66**, 488 **1944.**
11. Denisenko, Y. I., Ber. **69**, 1353 **1936.**
12. Denisenko, Y. I., Ber. **69**, 1668 **1936.**
13. Denisenko, Y. I., Ber. **69**, 2183 **1936.**
14. Denisenko, Y. I., Bull. acad. sci. U.R.S.S. **1938**, 1019; C.A. **33**, 7281 **1939.**
15. Denisenko, Y. I., J. Gen. Chem. (U.S.S.R.) **9**, 1068 **1939**; C.A. **33**, 8578 **1939.**
16. Denisenko, Y. I., and A. D. Naber, Bull. acad. sci. U.R.S.S. **1938**, 1025; C.A. **33**, 7280 **1939.**
17. Dupont, P., and G. Chavanne, Bull. soc. chim. Belg. **42**, 537 **1933.**
18. Dupont, R., Bull. soc. chim. Belg. **45**, 113 **1936.**
19. Evans, E. B., J. Inst. Petroleum Tech. **24**, 537 **1938.**
20. Eykman, J. F., Chem. Weekblad **1**, 7 **1903.**
21. Gelissen, H., and P. H. Hermans, Ber. **59**, 662 **1926.**
22. Gustavson, G., Compt. rend. **146**, 640 **1908.**
23. Hall, C. C., and C. M. Cawley, J. Soc. Chem. Ind. **58**, 7 **1939.**
24. Huston, R., and K. Goodemoot, J. Am. Chem. Soc. **56**, 2432 **1934.**
25. Ipatieff, V. N., and H. Pines, J. Am. Chem. Soc. **59**, 56 **1937.**
26. Ipatieff, V. N., and H. Pines, J. Am. Chem. Soc. **61**, 3374 **1939.**
27. Ishikawa, S., and G. Maeda, Science Repts. Tokyo Bunrika Daigaku **3A**, 157 **1937.**
28. Kagehira, I., Bull. Chem. Soc. Japan **6**, 241 **1931.**
28A. Kizhner, N., J. Russ. Phys. Chem. Soc. **44**, 849 **1912**; C.A. **6**, 2915 **1912.**
29. Kizhner, N., J. Russ. Phys. Chem. Soc. **45**, 749 **1913**; C.A. **7**, 3964 **1913**; Chem. Zentr. **1913**, II, 2129.
30. Kruber, O., Brennstoff-Chem. **13**, 187 **1932.**
31. Kursanov, N., Ann. **318**, 309 **1901.**
32. Kursanov, N., J. Russ. Phys. Chem. Soc. **38**, 1304 **1906**; C.A. **1**, 2093 **1907**; Chem. Zentr. **1907**, I, 1744.
33. Lespieau, R., Bull. soc. chim. [4] **47**, 847 **1930.**
34. Lespieau, Compt. rend. **190**, 1129 **1930.**
35. Linder, E. G., J. Phys. Chem. **35**, 531 **1931.**
36. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. **26**, 475 **1934.**
37. Matsuno, K., and K. Han, Bull. Chem. Soc. Japan **11**, 321 **1936.**
38. Mayes, H. A., and E. E. Turner, J. Chem. Soc. **1929**, 500.
39. McKenna, J. F., and F. J. Sowa, J. Am. Chem. Soc. **59**, 470 **1937.**
40. Meerwein, H., Ann. **419**, 121 **1919.**
41. Meyer, H., and K. Bernhauer, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **138**, IIb, 721 **1929.**
42. Moldavskiĭ, B. L., and S. E. Livshits, J. Gen. Chem. (U.S.S.R.) **3**, 603 **1933**; Chem. Zentr. **1934**, II, 3503.
43. Musser, D. M., and H. Adkins, J. Am. Chem. Soc. **60**, 664 **1938.**
44. Nametkin, S. S., and E. S. Pokrovskaya, J. Gen. Chem. (U.S.S.R.) **7**, 962 **1937**; C.A. **31**, 5332 **1937**; Chem. Zentr. **1937**, II, 1569.
45. Nametkin, S. S., and E. S. Pokrovskaya, J. Gen. Chem. (U.S.S.R.) **8**, 699 **1938**; C.A. **33**, 1298 **1939.**
46. Nenitzescu, C. D., and I. G. Gavat, Ann. **519**, 260 **1935.**
47. Neunhöffer, O., J. prakt. Chem. [2] **133**, 95 **1932.**
47A. Pines, H., Universal Oil Products Co., unpublished data.
48. Pokrovskaya, E. S., Compt. rend. acad. sci. U.R.S.S. **39**, 26 **1943**; Survey For. Petrol. Liter. T420 **1944.**
49. Price, D., D. Davidson, and M. T. Bogert, J. Org. Chem. **2**, 540 **1937-1938.**
50. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915.**
51. Sabatier, P., and M. Murat, Compt. rend. **154**, 1390 **1912.**
52. Sabatier, P., and M. Murat, Compt. rend. **154**, 1771 **1912.**
53. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928.**
54. Sidorova, N. G., and I. P. Tsukervanik, J. Gen. Chem. (U.S.S.R.) **10**, 2073 **1941**; Survey For. Petrol. Liter. Aug. **1**, **1941.**
55. Simons, J. H., and S. Archer, J. Am. Chem. Soc. **60**, 2952 **1938.**
56. Tiffeneau, M., P. Weill, J. Gutmann, and B. Tchoubar, Compt. rend. **201**, 277 **1935.**

57. Truffault, R., Compt. rend. **202**, 1286 1936.
58. Tsukervanik, I. P., and N. G. Sidorova, J. Gen. Chem. (U.S.S.R.) **7**, 641 1937; C.A. **31**, 5780 1937; Chem. Zentr. **1938**, I, 579.
59. Venus-Danilova, E. D., and A. I. Bol'shukin, J. Gen. Chem. (U.S.S.R.) **7**, 2823 1937; C.A. **32**, 2925 1938; Chem. Zentr. **1938**, II, 3391.
60. von Braun, J., Ann. **472**, 1 1929.
61. von Braun, J., Ber. **60**, 1180 1927.
62. von Braun, J., and H. Deutsch, Ber. **45**, 1267 1912.
63. von Braun, J., and M. Kuhn, Ber. **60**, 2557 1927.
64. Whitmore, F. C., C. A. Weisgerber, and A. C. Shabica, Jr., J. Am. Chem. Soc. **65**, 1469 1943.
65. Wieland, H., and E. Dorrer, Ber. **63**, 404 1930.
66. Willstätter, R., and R. Lessing, Ber. **34**, 506 1901.
67. Zelinskiĭ, N. D., and I. N. Tits, Ber. **58**, 2755 1925.
68. Zelinskiĭ, N. D., and I. N. Tits, Ber. **64**, 183 1931.

## 2. BENZENE WITH ONE CYCLENYL, ONE CYCLYLIDENYL, OR ONE CYCLYLALKENYL SUBSTITUTION, $C_nH_{2n-10}$

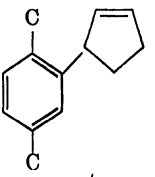
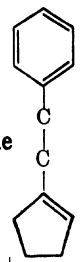
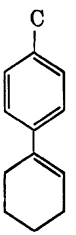
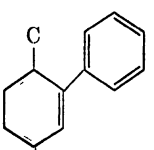
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Cyclobutenylbenzene** (a) | | | | |
| 25 [14,15] | 118–122 12 [14]<br>120–122 10 [15] | | | |
| (a) The position of the double bond in cyclobutene is not given. | | | | |
| **$C_{11}H_{12}$** | | | | |
| **1-Phenyl-1-cyclopropylethene**  | 211–213 758 [23] | 0.9553 $D_0^{19}$ [23] | | |
| **Cyclopenten-1-ylbenzene**  | | | | |
| 23 [2,5,16]<br>22–23 [40] | 230 [2]<br>124.5–125.5 30 [40]<br>118–119 30 [21]<br>120–121 20 [2]<br>109 14 [2,16]<br>92–93 13 [55]<br>95.3 6 [16] | 0.98617 25° [5]<br>0.9862 25° [2]<br>0.9875 23° [40]<br>0.9668 19° [55] | 1.57340 25° [2,5]<br>1.5750 23° [40]<br>1.5396 19° [55]<br>1.56723 $n_{H\alpha}^{25}$ [2,5]<br>1.59017 $n_{H\beta}^{25}$ [2,5] | |
| **$C_{12}H_{14}$** | | | | |
| **1-Methyl-2-phenylcyclopentene-2**  | 116–117 20 [2,4,21] | | | |

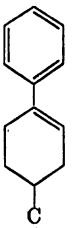
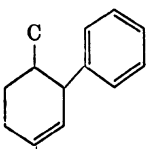
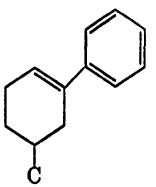
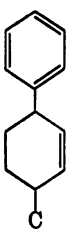
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Cyclopenten-1-ylphenylmethane**  | | | | |
| | 113–117 18 [40,41] | 0.952 23° [41] | 1.5415 [40,41] | |
| | 109–111 15 [41] | 0.9580 22° [40] | 1.5355 23° [41] | |
| | 120–122 10 [10,12] | 0.958 22° [41] | 1.5510 17.5° [19,12] | |
| | | 0.9773 17.5° [10,12] | | |
| **Cyclohexen-1-ylbenzene**  | | | | * |
| | | $0.9908_5$ | $1.5692_5$ | |
| −11 [22] | 250 [3] | 0.9931 [54] | 1.5690 [53] | |
| | 244.8 [7] | 0.98712 25.15° [3] | 1.5694 [53] | |
| | 241–243 [48,49] | 0.9930 14.9° [53] | 1.57179 [54] | |
| | 132 26 [54] | 0.9932 14.7° [53] | 1.56692 25.15° [3] | † |
| | 133 20 [18,30,35,46] | 0.994 14° [46] | 1.569 17° [35] | |
| | | 1.008 0° [35] | 1.57180 14.7° [53] | |
| | 128–132 20 [21] | 1.004 $D_0^0$ [46] | 1.57157 14.2° [53] | |
| | 131 20 [3] | | 1.56131 $n_{H\alpha}^{25.15}$ [3] | |
| | 133 17 [53] | | 1.56636 $n_{H\alpha}^{14.7}$ [53] | |
| | 126–127 15 [53] | | 1.56612 $n_{H\alpha}^{14.2}$ [53] | |
| | 125–126 14 [22] | | 1.58141 $n_{H\beta}^{25.15}$ [3] | |
| | 124–126 14 [39] | | 1.58725 $n_{H\beta}^{14.7}$ [53] | |
| | | | 1.58679 $n_{H\beta}^{14.2}$ [53] | |
| | | | 1.60093 $n_{H\gamma}^{14.7}$ [53] | |
| | | | 1.60026 $n_{H\gamma}^{14.2}$ [53] | |
| **Cyclohexenylbenzene** (a) | | | | |
| | 243.2–244.2 [52] | 0.9793 [52] | 1.5528 [52] | |

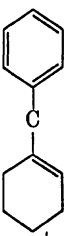
* $\frac{dD}{dt} = -0.0007261$/°C (0 to 25°C)

† $\frac{dn}{dt} = -0.0004383$/°C (14 to 25°C)

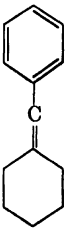
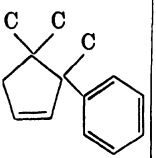
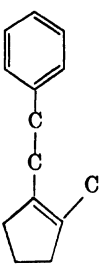
(a) The double bond is in either the 2 or 3 position.

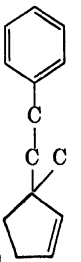
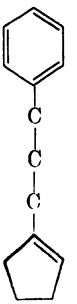
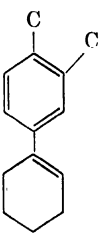
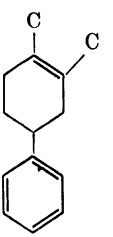
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Dimethyl-2-(cyclopenten-2′-yl)-benzene**  | 125–127 14 [56] | 0.9613 23° [56] | 1.5380 23° [56] | |
| **1-(Cyclopenten-1′-yl)-2-phenylethane**  | 124–125 10 [11] | 0.9527 20.5° [11] | 1.5330 20.5° [11] | |
| **1-Methyl-4-(cyclohexen-1′-yl)-benzene**  | 142 20 [46] | 0.971 12° [46]<br>0.981 $D_0^0$ [46] | | |
| **1-Methyl-2-phenylcyclohexene-2**  | 128 6 [37] | | | |

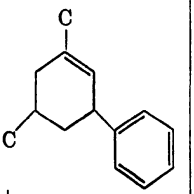
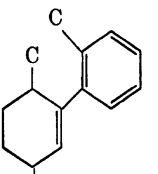
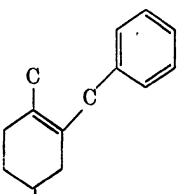
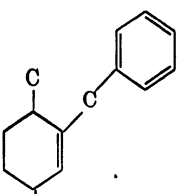
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-4-methylcyclohexene-1**  | 147 23 [35,46,47] | 0.9716 14° [46,47]<br>0.9846 0° [46,47] | 1.536 17° [35]<br>1.555 14° [47] | |
| **1-Methyl-2-phenylcyclohexene-3**  | 110–113 12 [33] | | | |
| **2-Phenyl-4-methylcyclohexene-1**  | 145 20 [36] | 0.9702 [36]<br>0.9859 0° [36] | 1.555 [36] | |
| **1-Phenyl-4-methylcyclohexene-2**  | 132 15–16 [30] | | | |

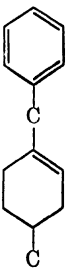
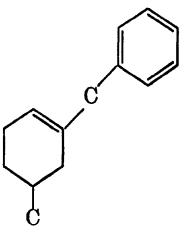
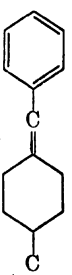
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-3-phenylcyclohexene** (a) | | | | |
| | 248–252 [25] | 0.9581 22° [25] | 1.5402 22° [25] | |
| | 146–150 32 [25] | | | |
| | 128–130 17 [25] | | | |
| (a) The double bond is in either the 4 or 5 position. | | | | |
| **Phenylcyclohexen-1-ylmethane**  | | | | * |
| | | 0.9632 | | |
| | 139–141 22 [53] | 0.9634 [27,29] | 1.5400 [27,29] | |
| | 132–133 19 [53] | 0.964 [18] | 1.5407 [18] | |
| | 133–134 15 [53] | 0.9656 14.3° [53] | 1.5416 [53] | |
| | 127.2–128.4 15 [27,29] | 0.9663 13.7° [53] | 1.5437 [53] | |
| | | 0.9678 13.4° [53] | 1.5449 [53] | |
| | 133 14 [18] | 0.9680 13.2° [53] | 1.5453 [53] | |
| | 125 13 [53] | 0.9802 0° [51] | 1.54774 14.6° [53] | |
| | 125 11.5 [53] | | 1.54426 14.1° [53] | |
| | | | 1.54651 13.7° [53] | |
| | | | 1.54769 13.2° [53] | |
| | | | 1.54327 $n_{H\alpha}^{14.6}$ [53] | |
| | | | 1.54009 $n_{H\alpha}^{14.1}$ [53] | |
| | | | 1.54202 $n_{H\alpha}^{13.7}$ [53] | |
| | | | 1.54303 $n_{H\alpha}^{13.2}$ [53] | |
| | | | 1.56043 $n_{H\beta}^{14.6}$ [53] | |
| | | | 1.55601 $n_{H\beta}^{14.1}$ [53] | |
| | | | 1.55879 $n_{H\beta}^{13.7}$ [53] | |
| | | | 1.55994 $n_{H\beta}^{13.2}$ [53] | |
| | | | 1.57093 $n_{H\gamma}^{14.6}$ [53] | |
| | | | 1.56577 $n_{H\gamma}^{14.1}$ [53] | |
| | | | 1.56939 $n_{H\gamma}^{13.7}$ [53] | |
| | | | 1.57070 $n_{H\gamma}^{13.2}$ [53] | |

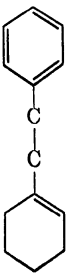
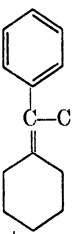
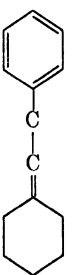
* $\frac{dD}{dt} = -0.0007737$/°C (0 to 20°C)

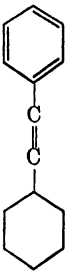
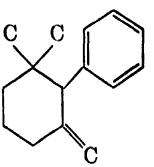
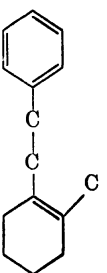
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Benzylidenecyclohexane**  | | | | |
| −36 – −38 [42] | 122–123 11 [44]<br>117–118.5 10 [27]<br>117–118 10 [28]<br>116 9 [42] | 0.9579 [27,28]<br>0.9663 23° [42]<br>0.9640 17° [44] | 1.5437 [27,28]<br>1.55674 23° [42]<br>1.53950 17° [44] | |
| $C_{14}H_{18}$ | | | | |
| **1,1,2-Trimethyl-2-phenylcyclopentene-3**  | 195–200 40 [6] | | | |
| **1-Phenethyl-2-methylcyclopentene-1**  | 143–144 22 [26] | 0.93747 20.3° [26]<br>0.93644 18.5° [26] | 1.52391 20.3° [26]<br>1.52523 18.5° [26] | |

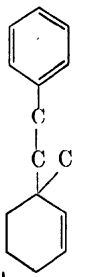
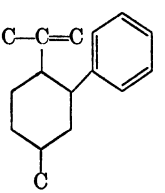
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Methyl-1-phenethylcyclopentene-2  | 142 23 [26] | 0.93055 16.3° [26] | 1.52148 16.3° [26] | |
| 1-(Cyclopenten-1′-yl)-3-phenylpropane  | 117–118 3 [11] | 0.9471 18.5° [11] | 1.5330 18.5° [11] | |
| 1,2-Dimethyl-4-(cyclohexen-1′-yl)-benzene  | 277–278 [20]<br>167–169 5–6 [20] | | | |
| 1,2-Dimethyl-4-phenylcyclohexene-1  | 128–130 11 [1] | | | |

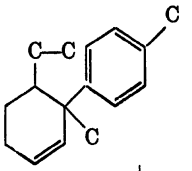
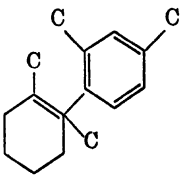
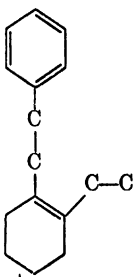
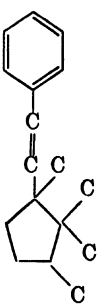
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,5-Dimethyl-3-phenylcyclohexene-1**  | | | | |
| | 141–143 23 [53]<br>131 14 [34] | 0.942 [53]<br>0.9460 15.5° [53]<br>0.9462 15.3° [53] | 1.5431 [53]<br>1.53617 15.3° [53]<br>1.53131 $n_{H\alpha}^{15.3}$ [53]<br>1.54773 $n_{H\beta}^{15.3}$ [53]<br>1.55799 $n_{H\gamma}^{15.3}$ [53] | |
| **1-Methyl-2-*o*-tolylcyclohexene-2**  | | | | |
| | 158–160 12 [37] | 0.961 [37]<br>0.985 0° [37] | 1.541 [37] | |
| **1-Methyl-2-benzylcyclohexene-1**  | | | | |
| | 158–160 19 [9] | 0.9938 17.8° [9] | 1.5445 17.8° [9] | |
| **1-Methyl-2-benzylcyclohexene-2**  | | | | |
| | 170 42 [37] | 0.981 18° [37]<br>0.99 0° [37] | 1.453 18° [37] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Benzyl-4-methylcyclohexene-1**  | 160 30 [47]<br>133 15 [80] | 0.9567 16° [47]<br>0.9687 0° [47] | 1.542 16° [47] | |
| **2-Benzyl-4-methylcyclohexene-1**  | 271 [36]<br>156 20 [36] | 0.9591 [36]<br>0.9693 0° [36] | 1.547 [36] | |
| **1-Benzylidene-4-methylcyclohexane**  | 136–137 15 [80] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenethylcyclohexene-1**  | 145 10 [8]<br>112–113 2 [19] | 0.9587 15° [8] | 1.5351 19.7° [8]<br>1.5402 13.7° [19] | |
| **1-Phenyl-1-cyclohexylidene-ethane**  | 142–143 15 [52A] | 0.9573 [52A]<br>0.9590 $D_{20}^{20}$ [52A]<br>0.9624 $D_0^0$ [52A] | 1.5401 [52A] | |
| **1-Phenyl-2-cyclohexylidene-ethane**  | 126–126.5 3 [52A] | 0.9908 [52A]<br>0.9926 $D_{20}^{20}$ [52A]<br>1.0052 $D_0^0$ [52A] | 1.5540 [52A] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Phenyl-2-cyclohexylethene  | | | | |
| | 145–147 14 [44]<br>145–147 8 [52A] | 0.9595 17° [44] | 1.53701 17° [44] | |
| $C_{15}H_{20}$ | | | | |
| 1,1-Dimethyl-2-phenyl-3-methylenecyclohexane  | | | | |
| | 105–107 5 [17] | 0.9403 11° [17] | 1.53117 11° [17] | |
| 1-Phenethyl-2-methylcyclohexene-1  | | | | |
| | 161–163 23 [26]<br>153–154 14 [26] | 0.95644 [26]<br>0.95142 19.4° [26] | 1.53804 [26]<br>1.53617 19.4° [26] | |

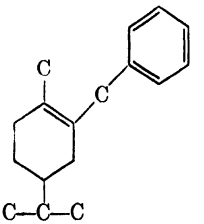
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-1-phenethylcyclohexene-2**  | | | | |
| | 152–153 20 [26] | 0.93492 17.6° [26] | 1.52695 17.6° [26] | |
| $C_{16}H_{22}$ | | | | |
| **Cyclopentenylphenylpentane** (a) | | | | |
| | 157–158 3 [13] | 0.9351 [13] | 1.5225 [13] | |
| (a) The structure of this compound is not given. | | | | |
| **1-Isopropenyl-2-phenyl-4-methylcyclohexane**  | | | | |
| | 139–140 10 [24] | 0.9462 15.7° [24] | 1.5802 15.7° [24] | |
| **1-(4′-Isopropylphenyl)-5-methylcyclohexene** (a) | | | | |
| | 157–158 14 [25]<br>149–150 12 [25] | 0.9376 14° [25] | 1.5283 14° [25] | |
| (a) The double bond is in the 2 or 3 position. | | | | |
| **1-Isopropyl-2-phenyl-4-methylcyclohexene** (a) | | | | |
| | 149–151 18 [43]<br>127–130 8 [43] | 0.9365 25° [43] | 1.5270 [43]<br>1.5275 [43] | $[\alpha]_D^{17}$ = +43.48° [43]<br>$[\alpha]_D^{17}$ = +16.28° [43] |
| (a) The position of the double bond is not given. | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Ethyl-2-methyl-2-*p*-tolylcyclohexene-3  | 136–137 12 [32] | | | |
| 1,2-Dimethyl-2-(2′,4′-dimethylphenyl)-cyclohexene-3  | 155–158 12 [31] | | | |
| 1-Phenethyl-2-ethylcyclohexene-1  | | | 1.5306 13.7° [19] | |
| $C_{17}H_{24}$ | | | | |
| 1-(1′,2′,2′,3′-Tetramethylcyclopentyl)-2-phenylethene  | | | | |
| 51 [45] | 146–149 11 [45] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Cyclopentenylphenylhexane** (a) | | | | |
| | 159–160 2 [13] | 0.9317 18.5° [13] | 1.5220 18.5° [13] | |

(a) The structure of this compound is not given.

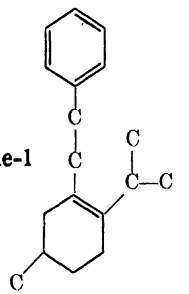
**1-Methyl-2-benzyl-4-isopropylcyclohexene-1**



| | | | |
|---|---|---|---|
| 159 12 [9] | 0.9448 15.8° [9] | 1.5331 15.8° [9] | |

$C_{18}H_{26}$

**1-Phenethyl-2-isopropyl-5-methylcyclohexene-1**

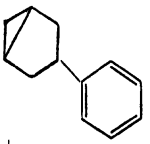
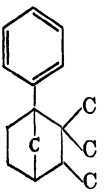
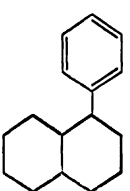


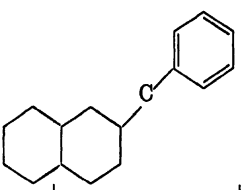
| | | | |
|---|---|---|---|
| 145 4 [38] | | | |

**References on Benzene with One Cyclenyl, Cyclylidenyl, or One Cyclylalkenyl Substitution**


1. Alder, K., and H. F. Rickert, Ber. **71**, 379 1938.
2. Bauer, E., Ann. chim. [9] **1**, 342 1914.
3. Bauer, E., Ann. chim. [9] **1**, 377 1914.
4. Bauer, E., Compt. rend. **156**, 1470 1913.
5. Bauer, E., Compt. rend. **156**, 1684 1913.
6. Blanc, G., Bull. soc. chim. [3] **21**, 830 1899.
7. Brüll, L., Gazz. chim. ital. **65**, 19 1935.
8. Cook, J. W., and C. L. Hewett, J. Chem. Soc. 1933, 1098.
9. Cook, J. W., and C. L. Hewett, J. Chem. Soc. 1936, 62.
10. Denisenko, Y. I., Ber. **69**, 1668 1936.
11. Denisenko, Y. I., Ber. **69**, 2183 1936.
12. Denisenko, Y. I., J. Gen. Chem. (U.S.S.R.) **6**, 1263 1936; Chem. Zentr. 1937, I, 4227.
13. Denisenko, Y. I., and A. D. Naber, Bull. acad. sci. U.R.S.S. 1938, 1025; C.A. **33**, 7280 1939.

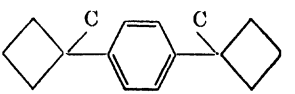
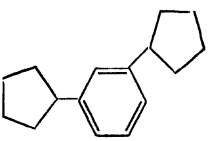
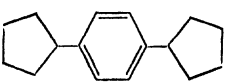
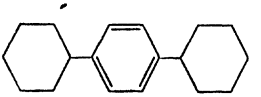
14. Döbner, O., and G. Schmidt, Ber. **40**, 148 **1907**.
15. Döbner, O., and H. Staudinger, Ber. **36**, 4318 **1903**.
16. Dupont, P., and G. Chavanne, Bull. soc. chim. Belg. **42**, 537 **1937**.
17. Escourrou, R., Bull. soc. chim. [4] **39**, 1460 **1926**.
18. Friedemann, Thesis, Heidelberg, **1907**, quoted by von Braun, Heider and Neumann, Ber. **49**, 2613 **1916**; von Auwers and Treppmann, Ber. **48**, 1207 **1915**.
19. Fulton, J. D., and R. Robinson, J. Chem. Soc. **1933**, 1463.
20. Ghigi, E., Ber. **71**, 684 **1938**.
21. Haller, A., Bull. soc. chim. [4] **31**, 1073 **1922**.
22. Hückel, W., and H. Bretschneider, Ann. **540**, 157 **1939**.
23. Kizhner, N., J. Russ. Phys. Chem. Soc. **43**, 1163 **1911**; C.A. **6**, 597 **1912**; Chem. Zentr. **1912**, I, 1458.
24. Klages, A., and R. Sautter, Ber. **39**, 1938 **1906**.
25. Knoevenagel, E., Ann. **303**, 259 **1898**.
26. Kon, G. A. R., and E. S. Narracott, J. Chem. Soc. **1938**, 672.
27. Kursanov, D., Ber. **64**, 2297 **1931**.
28. Kursanov, D. N., J. Gen. Chem. (U.S.S.R.) **1**, 926 **1931**; Chem. Zentr. **1932**, II, 1617.
29. Kursanov, D. N., J. Russ. Phys. Chem. Soc. **62**, 1691 **1930**; C.A. **25**, 2698 **1931**; Chem. Zentr. **1931**, I, 3112.
30. Le Brazidec, M., Bull. soc. chim. [4] **17**, 97 **1915**.
31. Lehmann, E., Ber. **69**, 631 **1936**.
32. Lehamnn, E., Ber. **71**, 1869 **1938**.
33. Lehmann, E., and W. Paasche, Ber. **68**, 1146 **1935**.
34. Lembert, Thesis, Heidelberg, **1905**, quoted by von Auwers and Treppmann, Ber. **48**, 1207 **1915**.
35. Levy, J., and J. Sfiras, Bull. soc. chim. [4] **49**, 1830 **1931**.
36. Mailhe, A., and Murat, Bull. soc. chim. [4] **7**, 1083 **1910**.
37. Murat, M., Ann. chim. phys. [8] **16**, 108 **1909**.
38. Orcutt, R. M., and M. T. Bogert, J. Org. Chem. **4**, 543 **1939**.
39. Pestemer, M., and L. Wiligut, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **144**, Abt. IIb, 251 **1935**.
40. Piaux, L., Ann. chim. [11] **4**, 147 **1935**.
41. Piaux, L., Compt. rend. **199**, 1127 **1934**.
42. Prévost, C., P. Donzelot, and E. Balla, Compt. rend. **198**, 1041 **1934**.
43. Read, J., and A. J. Watters, J. Chem. Soc. **1929**, 2165.
44. Reich, S., R. van Wijck, and C. Waelle, Helv. Chim. Acta **4**, 242 **1921**.
45. Rupe, H., and P. Läuger, Helv. Chim. Acta **3**, 272 **1920**.
46. Sabatier, P., and A. Mailhe, Ann. chim. phys. [8] **10**, 527 **1907**.
47. Sabatier, P., and A. Mailhe, Compt. rend. **142**, 438 **1906**.
48. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915**.
49. Sabatier, P., and M. Murat, Compt. rend. **154**, 1390 **1912**.
50. Tiffeneau, M., and J. Gutman, Compt. rend. **203**, 797 **1936**.
51. Tiffeneau, M., and M. Porcher, Bull. soc. chim. [4] **31**, 324 **1922**.
52. Uspenskiĭ, A. E., J. Russ. Phys. Chem. Soc. **51**, 245 **1920**; C.A. **18**, 1487 **1924**.
52A. Venus-Danilova, E. D., and A. I. Bol'shukin, J. Gen. Chem. **12**, 73 **1942**; Survey For. Petrol. Liter., Oct. **22**, **1943**, 396B.
53. von Auwers, K., and W. Treppmann, Ber. **48**, 1207 **1915**.
54. von Braun, J., K. Heider, and L. Neumann, Ber. **49**, 2613 **1916**.
55. von Braun, J., and M. Kuhn, Ber. **60**, 2551 **1927**.
56. von Braun, J., and M. Kuhn, Ber. **60**, 2557 **1927**.

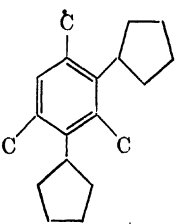
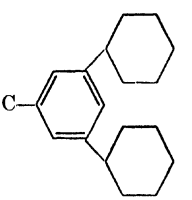
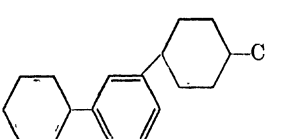
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **3-Phenylbicyclo-[3,1,0]-hexane** (a)  | | | | |
| | 241.5–242.5 745 [9] | 0.9830 [9] | 1.5452 16.5° [9] | |
| (a) This compound may not be pure. | | | | |
| $C_{16}H_{22}$ | | | | |
| **1-Phenyl-2,2,3-trimethylbicyclo-[2,2,1]-heptane**  | | | | |
| 13.5 [6,7] | 147.5–148 14 [6,7] | 0.9817 [6] | 1.5387 [6] | |
| **Phenyldihydropinene** (a) | 286–291 745 [5] | 0.9594 $D_0^{20}$ [5] | 1.52691 [5] | |
| (a) This compound is probably a phenyltrimethylbicycloheptane. | | | | |
| **Bornylbenzene** (a) | 276 | | | |
| | –278.5 756 [3] | 0.9586 $D_0^{20}$ [3] | 1.5262 25° [4] | |
| | 117–118 1.5 [4] | 0.9788 $D_0^{0}$ [4] | 1.5275 21° [3] | |
| (a) This compound is probably a phenyltrimethylbicycloheptane. | | | | |
| **2-Phenylbicyclo-[4,4,0]-decane**  | | | | |
| | 163–164 13 [2] | 0.9799 14° [2] | | |

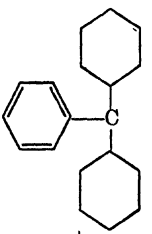
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **ω-Benzylcamphene** (a) | | | | |
| | 138–140 5 [8] | 0.9668 25° [8] | 1.538 25° [8] | |
| (a) This compound is probably a benzylbicycloheptane. | | | | |
| ***p*-Bornyltoluene** (a) (b) | | | | |
| | 163–164 11 [3] | 0.9563 $D_0^{20}$ [3] | 1.5297 [3] | |
| (a) This compound is probably a trimethylbicycloheptyltoluene.<br>(b) This compound may not be pure. | | | | |
| **3-Benzylbicyclo-[4,4,0]-decane**  | | | | |
| | 173–175 10 [1] | | | |

**References on Benzene with One Bicyclyl Substitution**


1. Cook, J. W., and C. L. Hewett, J. Chem. Soc. **1936**, 62.
2. Ferrero, P., and M. Fehlmann, Helv. Chim. Acta **11**, 763 **1928.**
3. Kamieński, L., and P. Lewiówna, Roczniki Chem. **14**, 1348 **1934**; C.A. **29**, 6226 **1935**; Chem. Zentr. **1935**, I, 2185.
4. Kamieński, L., and P. Wierzchowski, Roczniki Chem. **15**, 92 **1935**; Chem. Zentr. **1935**, II, 2216.
5. Konovalov, M. J., J. Russ. Phys. Chem. Soc. **34**, 31 **1902**; Chem. Zentr. **1902**, I, 1296.
6. Nametkin, S., A. Kichkin, and D. Kursanov, J. prakt. Chem. [2] **124**, 144 **1929.**
7. Nametkin, S. S., A. S. Kichkina, and D. N. Kursanov, J. Russ. Phys. Chem. Soc. **61**, 1065 **1929**; Chem. Zentr. **1930**, I, 1300.
8. Ritter, J. J., and G. Vlases, Jr., J. Am. Chem. Soc. **64**, 583 **1942.**
9. Uspenskiĭ, A. E., J. Russ. Phys. Chem. Soc. **51**, 245 **1920**; C.A. **18**, 1487 **1924**; Chem. Zentr. **1923**, III, 756.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Di-(1′-methylcyclobutyl)-benzene**  | | | | |
| 34 [9] | 123–125 6 [9] | 0.9344 [9]<br>0.9198 40° [9] | 1.5203 [9] | |
| **1,3-Dicyclopentylbenzene**  | | | | |
| | 154–155 4 [13] | | | |
| **1,4-Dicyclopentylbenzene**  | | | | |
| 42–43 [13] | | | | |
| **$C_{17}H_{24}$**<br>**Methyldicyclopentylbenzene** (a) | | | | |
| | 150–152 2 [17] | 0.9694 [17] | 1.5391 [17] | |
| (a) The structure of this compound is not given. | | | | |
| **$C_{18}H_{26}$**<br>**Dicyclopentylmethylbenzene** (a) | | | | |
| 101.5–102 [8] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **1,4-Dicyclohexylbenzene**  | | | | |
| **102.0** | | | | |
| 103 [10]<br>102–103 [4,5,20,21]<br>102 [15] | 189–190 14 [21]<br>192–195 13 [4]<br>190 12 [10] | 1.049 0° [26] | | |

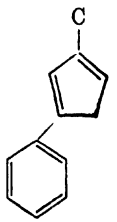
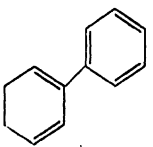
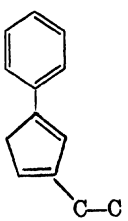
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Dicyclohexylbenzene** (*Continued*) | | | | |
| 101–102 [12] | | | | |
| 100–102 [11] | | | | |
| 101 [24] | | | | |
| 100–101 [6,19] | | | | |
| 100 [22,23] | | | | |
| **Dicylohexylbenzene** (a) | | | | |
| 86 [24] | 335–340 756 [5] | 0.966 [5] | 1.5357 [5] | |
| | 165–168 3.5 [12] | 0.9668 [12] | 1.5362 [12] | |
| (a) The structure of this compound is not given. | | | | |
| $C_{19}H_{28}$ | | | | |
| **1,3,5-Trimethyl-2,4-dicyclopentylbenzene**  | | | | |
| | 164–165 1 [17] | 0.9870 [17] | 1.5227 [17] | |
| **1-Methyl-3,5-dicyclohexylbenzene**  | | | | |
| 93.5 [22] | | | | |
| **Methyldicyclohexylbenzene** (a) | | | | |
| −3 [17] | 165-166 3 [17] | 0.9645 [17] | 1.5378 [17] | |
| (a) The structure of this compound is not given. | | | | |
| **1-Cyclohexyl-3-(4′-methylcyclohexyl)-benzene**  | | | | |
| | 194–198 8 [16] | 0.9552 [16] | 1.5202 [16] | |

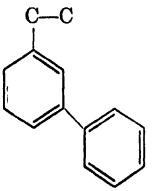
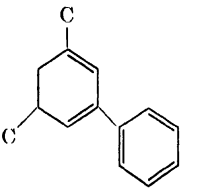
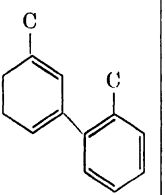
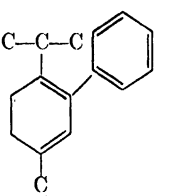
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Methyldicyclohexylbenzene** (a) | | | | |
| 82 [24] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **Phenyldicyclohexylmethane**  | | | | |
| 36.5 [14] | 210–212 20 [7,25] | 0.9774 [18] | 1.5390 [18] | |
| | 146–148 5 [18] | 0.9890 [25] | 1.5391 [18] | |
| | 145–148 5 [18] | 0.9724 $D_{25}^{25}$ [1] | 1.5372 25° [1] | |
| | 169–171 3 [1] | 0.9894 13° [7] | | |
| | 161–163 2 [1] | | | |
| $C_{20}H_{30}$ **Dicyclohexyl-1,3-dimethylbenzene** (a) | | | | |
| 107 [10] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **Dicylclohexyl-1,4-dimethylbenzene** (a) | | | | |
| 156–157 [2] | | | | |
| 155–156 [3] | | | | |
| (a) The position of the cyclohexyl substituents is not given. | | | | |
| **Dimethyldicyclohexylbenzene** (a) | | | | |
| | 230–235 20 [2] | 0.962 22° [2] | 1.533 22° [2] | |
| (a) The structure of this compound is not given. | | | | |

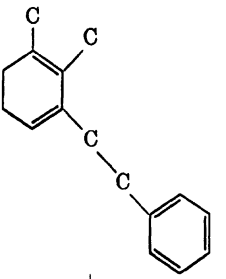
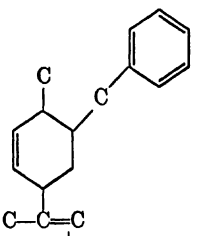
### References on Benzene with Two Cyclyl Substitutions


1. Adkins, H., W. H. Zartmann, and H. Cramer, J. Am. Chem. Soc. 53, 1425 1931.
2. Bodroux, D., Ann. chim. [10] 11, 511 1929.
3. Bodroux, D., Compt. rend. 186, 1005 1928.
4. Buu-Hoï and P. Cagniant, Compt. rend. 216, 381 1943; C.A. 38, 2334 1944.

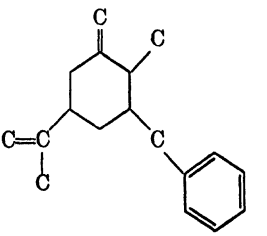
5. Corson, B. B., and V. N. Ipatieff, J. Am. Chem. Soc. 59, 645 1937.
6. Corson, B. B., and V. N. Ipatieff, Org. Syntheses 19, 36 1939.
7. Godchot, M., Compt. rend. 147, 1057 1908.
8. Huston, R., and K. Goodemoot, J. Am. Chem. Soc. 56, 2432 1934.
9. Ipatieff, V. N., and H. Pines, J. Am. Chem. Soc. 61, 3374 1939.
10. Kruber, O., Brennstoff-Chem. 13, 187 1932.
11. McKenna, J. F., and F. J. Sowa, J. Am. Chem. Soc. 59, 470 1937.
12. Nametkin, S. S., and E. S. Pokrovskaya, J. Gen. Chem. (U.S.S.R.) 7, 962 1937; C.A. 31, 5332 1937; Chem. Zentr. 1937, II, 1569.
13. Nametkin, S. S., and E. S. Pokrovskaya, J. Gen. Chem. (U.S.S.R.) 8, 699 1938; C.A. 33, 1298 1939.
14. Neunhöffer, O., Ann. 509, 115 1934.
15. Neunhöffer, O., J. prakt. Chem. [2] 133, 95 1932.
16. Petrov, A. D., and L. I. Anzus, Ber. 66, 420 1933.
17. Pokrovskaya, E. S., Compt. rend. acad. sci. U.R.S.S. 39, 26 1943; Survey For. Petrol. Liter. T420, 1944.
18. Rossander, S. S., L. H. Bock, and C. S. Marvel, J. Am. Chem. Soc. 52, 2976 1930.
19. Truffault, R., Bull. soc. chim. [5] 1, 391 1934.
20. Truffault, R., Bull. soc. chim. [5] 6, 726 1939.
21. Truffault, R., Compt. rend. 202, 1268 1936.
22. Tsukervanik, I. P., and N. G. Sidorova, J. Gen. Chem. (U.S.S.R.) 7, 641 1937; C.A. 31, 5780 1937; Chem. Zentr. 1938, I, 579.
23. von Braun, J., Ber. 60, 1180 1927.
24. von Braun, J., G. Irmisch, and J. Nelles, Ber. 66, 1471 1933.
25. Zelinskiĭ, N. D., and M. V. Gaverdovskaya, Ber. 61, 1049 1928.
26. Ziegler, K., and F. Ditzel, Ann. 473, 194 1929.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-phenylcyclopentadiene-1,4**  | | | | |
| 62 [5] | 151 12 [5] | | | |
| **Benzylcyclopentadiene** (a) | | | | |
| | 115–120 13 [1] | | | |
| (a) The position of benzyl is given as 1 or 2 and the position of the double bonds is not given. | | | | |
| **2-Phenylcyclohexadiene-1,3**  | | | | |
| | 114 12 [7] | | | |
| **Phenylcyclohexadiene** (a) | | | | |
| 66–66.5 [8] | 247–249 [2] | | | |
| | 110 10 [12] | | | |
| (a) The structures were not given. The data may represent more than one compound. | | | | |
| $C_{13}H_{14}$ | | | | |
| **1-Phenyl-3-ethylcyclopentadiene-1,3**   | | | | |
| | 170–175 12 [8] | | | |

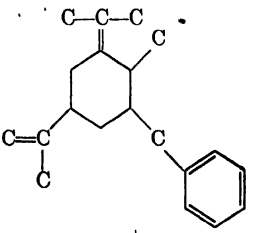
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethyl-3-phenylcyclohexadiene-1,3**  | | | | |
| | 126–128 8 [4] | | | |
| **1,5-Dimethyl-3-phenylcyclohexadiene-1,3**  | | | | |
| | 148 17 [14] | 0.973 [6] | 1.5735 [14] | |
| | 146 17 [6] | 0.9718 17.5° [11] | 1.5800 [6] | |
| | | 0.9772 17.0° [14] | 1.57486 17.0° [14] | |
| | | | 1.56824 $n_{H\alpha}^{17.0}$ [14] | |
| | | | 1.59322 $n_{H\beta}^{17.0}$ [14] | |
| | | | 1.61083 $n_{H\gamma}^{17.0}$ [14] | |
| **1-Methyl-3-*o*-tolylcyclohexadiene-1,3**  | | | | |
| | 145–148 21 [9] | | | |
| $C_{16}H_{20}$ | | | | |
| **1-Isopropyl-2-phenyl-4-methylcyclohexadiene-1,3**  | | | | |
| | 153 18 [13] | 0.9552 25° [10] | 1.5525 25° [10] | |
| | 145–148 15 [10] | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Dimethyl-3-phenethylcyclohexadiene-1,3**  | 155 6 [3] | | | |
| $C_{17}H_{22}$ **1-Methyl-2-benzyl-4-isopropenylcyclohexene-5**  | 167–169 14 [11] | | | $[\alpha]_D^{20} = -71.76°$ [11] (a) |

(a) Angles of rotation for lines other than *D* are given in reference 11.

| | | | | |
|---|---|---|---|---|
| $C_{18}H_{24}$ **1-Methylene-2-methyl-3-benzyl-5-isopropenylcyclohexane**  | 169–172 11 [11] | 0.9456 [11] | 1.54718 [11] | $[\alpha]_D^{20} = -7.25°$ [11] (a) |

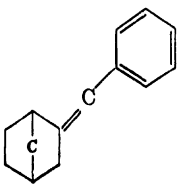
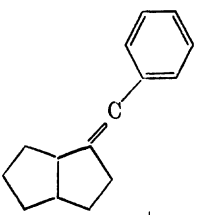
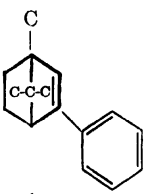
(a) Angles of rotation for lines other than *D* are given in reference 11.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Isopropylidenyl-2-methyl-3-benzyl-5-isopropenylcyclohexane**  | | | | |
| | 183–186 13 [11] | | | $[\alpha]_D^{20} = -13.36°$ [11] |
| (a) Angles of rotation for lines other than $D$ are given in reference 11. | | | | (a) |

**References on Benzene with One Cyclodienyl, One Alkenylcyclenyl, or Dialkenylcyclyl Substitution**


1. Alder, K., and H. Holzrichter, Ann. **524**, 145 1936.
2. Bamberger, E., and W. Lodter, Ber. **21**, 836 1888.
3. Bergmann, E., and A. Weizmann, J. Org. Chem. **4**, 266 1939.
4. Blaise, E. E., and M. Maire, Bull. soc. chim. [4] **3**, 413 1908.
5. Borsche, W., and W. Menz, Ber. **41**, 190 1908.
6. Friedemann, Thesis, Heidelberg, 1907, quoted by von Auwers and Treppmann, Ber. **48**, 1207 1915.
7. Hückel, W., and H. Bretschneider, Ann. **540**, 157 1939.
8. Knoevenagel, E., Ann. **289**, 151 1895.
9. Koelsch, C. F., J. Am. Chem. Soc. **54**, 4744 1932.
10. Read, J., and A. J. Watters, J. Chem. Soc. **1929**, 2165.
11. Rupe, H., and W. Tomi, Ber. **47**, 3064 1914.
12. Schlenk, W., and E. Bergmann, Ann. **463**, 1 1928.
13. Sherwood, I. R., W. F. Short, and R. Stansfield, J. Chem. Soc. **1932**, 1832.
14. von Auwers, K., and W. Treppmann, Ber. **48**, 1207 1915.

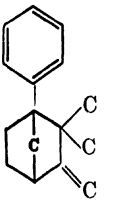
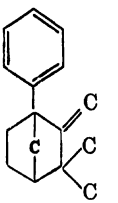
## 6. BENZENE WITH ONE BICYCLENYL, ONE ALKENYLBICYCLYL, OR ONE BICYCLYLIDENE SUBSTITUTION, $C_nH_{2n-12}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Benzylidenebicyclo-[2,2,1]-heptane**  | 146–147 15 [7] | | | |
| $C_{15}H_{18}$<br>**Phenyl-7,7-dimethylbicyclo-[2,2,1]-heptene-2** (a) | 135 13 [14] | 0.9907 [14] | 1.54466 19° [14] | |
| (a) The position of the phenyl group is not given. | | | | |
| **2-Benzylidene-*cis*-[3,3,0]-bicyclooctane**  | 126–127 3 [1] | | | |
| $C_{16}H_{20}$<br>**1,7,7,-Trimethyl-3-phenylbicyclo-[2,2,1]-heptene-2**  | 138<br>−141(a) 10 [8] | 0.9767(b) [17]<br>0.9784(b) [17]<br>0.9865(b) [17]<br>0.9736(a) $D_{11}^{18}$ [8] | 1.54167(b) [17]<br>1.54445(b) [17]<br>1.53724(b) $n_{Ha}^{20}$ [17]<br>1.54010(b) $n_{Ha}^{20}$ [17]<br>1.55331(b) $n_{H\beta}^{20}$ [17]<br>1.55575(b) $n_{H\beta}^{20}$ [17] | $[\alpha]_D^{20}$ = +8.33°(b)[17]<br>$[\alpha]_D^{20}$ = +40.56°(b)[17] (c) |

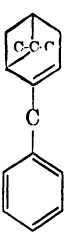
(a) This compound was named β-phenylcamphene by the authors, but the structure indicates that it is 1,7,7-Trimethyl-3-phenylbycyclo-[2,2,1]-heptene-2.

(b) Values for two preparations are given.

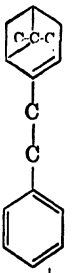
(c) Angles of rotation for lines other than *D* are given in reference 17.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-2,2-dimethyl-3-methylenebicyclo-[2,2,1]-heptane**  | | | | |
| 32.5 [10,11] | 128–129 7 [10,11] | 0.9919 [10,11] | 1.5449 [10,11] | |
| **1-Phenyl-2-methylene-3,3-dimethylbicyclo-[2,2,1]-heptane**  | | | | |
| | 147 16 [10,11]<br>131 9.5 [10,11] | 0.9795 [10,11] | 1.5447 [10,11] | |
| **Phenylmethylenedimethylbicycloheptane** (a) | | | | |
| | 99 2 [2] | 0.9920 140° [2] | | $[\alpha]_D^{19}$ = +3.27° [2] |

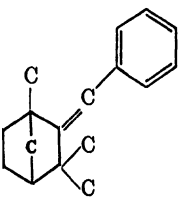
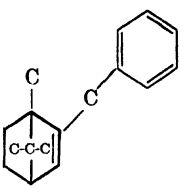
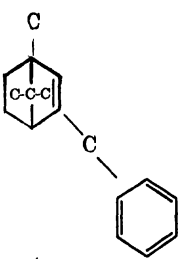
(a) The structure of this compound is not given.

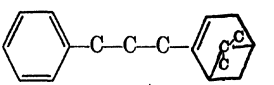
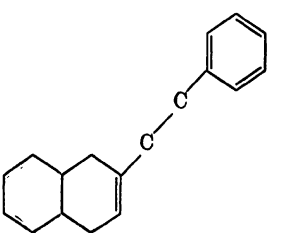
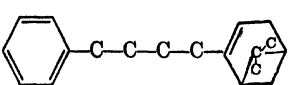
| | | | | |
|---|---|---|---|---|
| **4-Benzyl-7,7-dimethylbicyclo-[3,1,1]-heptene-3**  | | | | |
| | 138–141 12 [16] | 0.9712 [16] | | $[\alpha]_D^{20}$ = +29.486° [16] (a) |

(a) Angles of rotation for lines other than $D$ are given in reference 16.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4-Phenethyl-7,7-dimethylbicyclo-[3,1,1]-heptene-3**  | | | | |
| | 151–152 10 [16] | 0.9633 [16] | | $[\alpha]_D^{20}$ = +16.182° [16] (a) |

(a) Angles of rotation for lines other than *D* are given in reference 16.

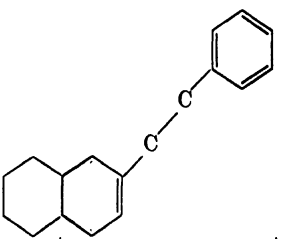
| | | | | |
|---|---|---|---|---|
| **1,3,3-Trimethyl-2-benzylidenebicyclo-[2,2,1]-heptane**  | | | | |
| | 152–154 14–15 [9] | | 1.5472 $n_{H\gamma}^{19.9}$ | $[\alpha]_D^{18}$ = +71.89° [9] |
| **1,7,7-Trimethyl-2-benzylbicyclo-[2,2,1]-heptene-2**  | | | | |
| | 170–171 20 [8]<br>160–161 10 [8]<br>157–160 10 [8] | | | |
| **1,7,7-Trimethyl-3-benzylbicyclo-[2,2,1]-heptene-2**  | | | | |
| | 150–160 11 [8] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Benzyloctahydronaphthalene** (a) | | | | |
| | 151 6 [4]<br>145(b) 3 [1] | | 1.5520 12.8° [4] | |
| (a) The positions of the hydrogen atoms are not given.<br>(b) This constant was determined on the *trans* isomer. | | | | |
| $C_{18}H_{24}$<br>**1,7,7-Trimethyl-ethyl-phenylbicyclo-[2,2,1]-heptene-2** (a) | | | | |
| | 165–168 12 [15] | | | |
| (a) The positions of ethyl and phenyl are not given. | | | | |
| **1-Phenyl-3-[4′-(7′,7′-dimethylbicyclo-[3,1,1]-hepten-3′-yl)]-propane**  | | | | |
| | 167.5<br>–168 10.5 [16]<br>166–167 10 [16] | 0.9574 [16] | 1.53116 [16]<br>1.52715 $n_{H\alpha}^{20}$ [16]<br>1.54119 $n_{H\beta}^{20}$ [16] | $[\alpha]_D^{20}$ = –4.5787° [16] (a) |
| (a) Angles of rotation for lines other than *D* are given in reference 16. | | | | |
| **3-Phenethylbicyclo-[4,4,0]-decene-3**  | | | | |
| | 155 3–4 [8]<br>148–149 0.9 [6] | | 1.5402 18.7° [8]<br>1.5449 16.7° [6] | |
| $C_{19}H_{26}$<br>**1-Phenyl-4-[2′-(7′,7′-dimethylbicyclo-[3,1,1]-hepten-2′-yl)]-butane**  | | | | |
| | 182.5<br>–183.5 10 [16] | 0.9522 [16] | | $[\alpha]_D^{20}$ = +4.957° [16] (a) |
| (a) Angles of rotation for lines other than *D* are given in reference 16. | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Benzylidenecamphane** (a) | | | | |
| 25 [12,13,18] | 160–161 10–11 [12], [18] | 0.9753 30° [12,13]<br>0.9788 25° [12,18] | 1.56280 30.2° [12]<br>1.55717 $n_{H\alpha}^{30.2}$ [12]<br>1.57768 $n_{H\beta}^{30.2}$ [12]<br>1.59116 $n_{H\gamma}^{30.2}$ [12] | |

(a) This compound is probably a benzylidene-2,2,3-trimethylbicyclo-[1,2,2]-heptane.

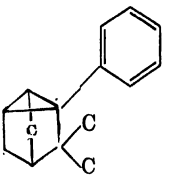
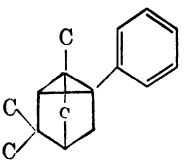
**3-(2′-Methylphenethyl)-bicyclo-[4,4,0]-decene-3**



| | | | | |
|---|---|---|---|---|
| | 160–162 0.7 [6] | | | |

**References on Benzene with One Bicyclenyl, Alkenylbicyclyl, or Bicyclylidene Substitution**

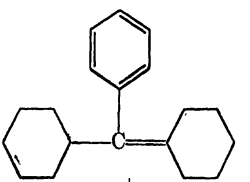

1. Barrett, J. W., and R. P. Linstead, J. Chem. Soc. **1936**, 611.
2. Bredt, J., J. prakt. Chem. [2] **98**, 96 **1918**.
3. Cook, J. W., and C. L. Hewett, J. Chem. Soc. **1934**, 365.
4. Cook, J. W., and C. L. Hewett, J. Chem. Soc. **1936**, 62.
5. Cook, J. W., and C. A. Lawrence, J. Chem. Soc. **1937**, 817.
6. Cook, J. W., A. M. Robinson, and F. Goulden, J. Chem. Soc. **1937**, 393.
7. Diels, O., and K. Alder, Ann. **470**, 62 **1929**.
8. Haller, A., and E. Bauer, Compt. rend. **142**, 677 **1906**.
9. Leroide, J., Compt. rend. **148**, 1611 **1909**.
10. Nametkin, S., A. Kichkin, and D. Kursanov, J. prakt. Chem. [2] **124**, 144 **1929**.
11. Nametkin, S. S., A. S. Kichkin, and D. N. Kursanov, J. Russ. Phys. Chem. Soc. **61**, 1065 **1929**; Chem. Zentr. **1930**, I, 1300.
12. Nametkin, S. S., and M. K. Strugatzkiĭ, Ber. **69**, 2272 **1936**.
13. Nametkin, S. S., and M. K. Strugatzkiĭ, J. Gen. Chem. (U.S.S.R.) **6**, 862 **1936**; C.A. **30**, 6727 **1936**; Chem. Zentr. **1937**, I, 1953.
14. Nordström, A. M., Hyllningsskrift tillägnad Ossian Aschan **1920**, 129; C.A. **16**, 2135 **1922**.
15. Rupe, H., and K. Glenz, Ann. **436**, 184 **1924**.
16. Rupe, H., and A. Héritier, Ann. **459**, 171 **1927**.
17. Rupe, H., and A. Wirz, Verhandl. naturforsch. Ges. Basel **38**, 164 **1927**.
18. Shavrygin, A. I., J. Gen. Chem. (U.S.S.R.) **7**, 2668 **1937**; Chem. Zentr. **1938**, I, 3056.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Phenyl-3,3-dimethyltricyclo-[2,2,1,0 2,6]-heptane**  | | | | |
| | 96–97 5 [1] | 1.00609 10.25° [1] | 1.54710 10.25° [1] | |
| **$C_{16}H_{20}$** | | | | |
| **1,5,5-Trimethyl-2-phenyltricyclo-[2,2,1,0 2,6]-heptane**  | | | | |
| | 127–128 11 [2] | 0.9708 [2] | 1.53202 [2] | |

**References on Benzene with One Tricyclyl Substitution**

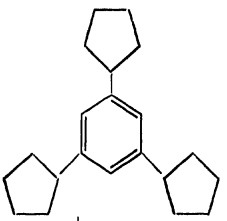
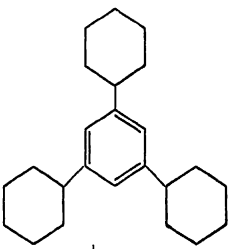
1. Bredt-Savelsberg, M., Ber. **56**, 554 1923.
2. Komppa, G., and G. A. Nyman, Ann. **533**, 290 1938.

## 8. BENZENE WITH ONE CYCLYL AND ONE CYCLENYL OR CYCLYLIDENE SUBSTITUTION, $C_nH_{2n-12}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Cyclohexyl-4-cyclohexenylbenzene** (a) | | | | |
| 97–98 [4] | 225–230 18 [4] | | | |
| (a) The position of the double bond in cyclohexene is not given. | | | | |
| **Methylcyclohexylcyclohexenylbenzene** (a) | | | | |
| 108–110 [4] | 165 0.7 [4] | | | |
| (a) The structure of this compound is not given. | | | | |
| **Phenylcyclohexylcyclohexylidenemethane**  | | | | |
| 45 [3] | 178 11 [3]<br>180 10 [3]<br>134–135 0.3 [1] | 0.982 23° [1] | 1.545 23° [1] | |

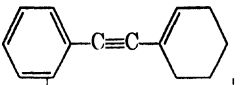
### References on Benzene with One Cyclyl and One Cyclenyl or Cyclylidene Substitution


1. Conant, J. B., L. F. Small, and A. W. Sloan, J. Am. Chem. Soc. **48**, 1743 1926.
2. Godchot, M., Bull. soc. chim. [4] **7**, 956 1910.
3. Neunhöffer, O., Ann. **509**, 115 1934.
4. von Braun, J., G. Irmisch, and J. Nelles, Ber. **66**, 1471 1933.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5-Tricyclopentylbenzene**  | | | | |
| 60–61 [2] | 201–202 4 [2] | | | |
| $C_{24}H_{36}$ **1,3,5-Tricyclohexylbenzene**  | | | | |
| 68.5–69 [1]<br>68 [3] | | | | |

**References on Benzene with Three Cyclyl Substitutions**

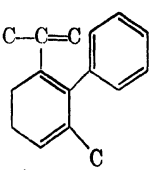
1. Corson, B. B., and V. N. Ipatieff, J. Am. Chem. Soc. **59**, 645 **1937**.
2. Nametkin, S. S., and E. S. Pokrovskaya, J. Gen. Chem. (U.S.S.R.) **8**, 699 **1938**; C.A. **33**, 1298 **1939**.
3. Tsukervanik, I. P., and N. G. Sidorova, J. Gen. Chem. (U.S.S.R.) **7**, 641 **1937**; C.A. **31**, 5780 **1937**; Chem. Zentr. **1938**, I, 579.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Phenylcyclohexen-1-ylethyne**  | | | | |
| | 167–170 16[2]<br>117<br>−118.5 1.5[3] | 0.9391[3] | 1.6033[3] | |
| $C_{15}H_{16}$<br>**Phenyl-3-methylcyclohexenylethyne** (a) | | | | |
| | 167–168 10[1] | | | |

(a) The double bond is in either the one or the six position of the cyclohexene.

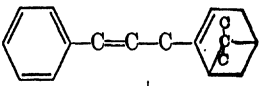
**References on Benzene with One Cyclenylalkynyl Substitution**

1. Bertrond, E., J. Russ. Phys. Chem. Soc. **37**, 655 1905; Chem. Zentr. **1905**, II, 1020.
2. Hurd, C. D., and R. N. Jones, J. Am. Chem. Soc. **56**, 1924 1934.
3. Pinkney, P. S., G. A. Nesty, D. E. Pearson, and C. S. Marvel, J. Am. Chem. Soc. **59**, 2666 1937.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Methylenecyclopentadienylbenzene** (a) | | | | |
| 31 [3] | | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{13}H_{12}$ **Methylenecyclopentadienylmethylbenzene** (a) | | | | |
| | 130.5 10.5 [3] | 1.021 $D_{20}^{20}$ [1] | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{16}H_{18}$ **1-Isopropenyl-2-phenyl-3-methylcyclohexadiene-1,3**  | | | | |
| | 149–150 10 [2] | 0.9714 [2] | 1.56736 [2]<br>1.56106 $n_{Ha}^{20}$ [2]<br>1.58273 $n_{H\beta}^{20}$ [2]<br>1.59686 $n_{H\gamma}^{20}$ [2] | $[\alpha]_D^{20} =$ +67.28° [2]<br>(a) |
| (a) Angles of rotation for lines other than $D$ are given in reference 2. | | | | |

### References on Benzene with One Alkenylcyclodienyl Substitution

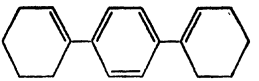
1. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. **26**, 475 **1934.**
2. Rupe, H., and W. Tomi, Ber. **47**, 3064 **1914.**
3. Thiele, J., Ber. **33**, 666 **1900.**

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-3-[4′-(7′,7′-dimethylbicyclo-[3,1,1]-hepten-3′-yl)]-propene-1**  | | | | |
| | 167.5<br>−168.5 10 [2] | 0.9683 [2] | 1.54534 [2]<br>1.54074 $n_{H\alpha}^{20}$ [2] | $[\alpha]_D^{20} =$<br>+13.050° [2]<br>(a) |
| (a) Angles of rotation for lines other than *D* are given in reference 2. | | | | |
| **1-Phenyl-1-camphenylethene** (a) | | | | |
| | 126–127 0.19 [1]<br>104–105.5 0.07 [1] | 1.0033 10.3° [1] | | |
| (a) The structure of this compound is not given. | | | | |

**References on Benzene with One Bicyclenylalkenyl Substitution**

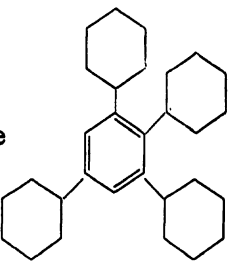
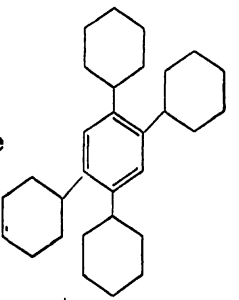
1. Lipp, P., and M. Quaedrlieg, Ber. **62**, 2311 1929.
2. Rupe, H., and A. Héritier, Ann. **459**, 171 1927.

## 13. BENZENE WITH TWO CYCLENYL SUBSTITUTIONS, $C_nH_{2n-14}$

| M. P.,°C | B. P.,°C @ 760mm | $D^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-(Dicyclohexen-1′-yl)-benzene**  | | | | |
| 110[1] | | | | |

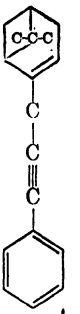
### References on Benzene with Two Cyclenyl Substitutions

1. von Braun, J., G. Irmisch, and J. Nelles, Ber. **66**, 1471 1933.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tetracyclopentylbenzene** (a) | | | | |
| 200–201 [3] | | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{30}H_{46}$ | | | | |
| **1,2,3,5-Tetracyclohexylbenzene**  | | | | |
| 264–265 [1] | | | | |
| **1,2,4,5-Tetracyclohexylbenzene**  | | | | |
| 265–266 [2] | | | | |

**References on Benzene with Four Cyclyl Substitutions**

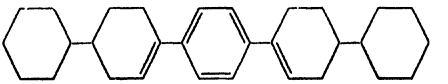
1. Corson, B. B., and V. N. Ipatieff, J. Am. Chem. Soc. **59**, 645 1937.
2. Nametkin, S. S., and E. S. Pokrovskaya, J. Gen. Chem. (U.S.S.R.) **7**, 962 1937; C.A. **31**, 5332 1937; Chem. Zentr. 1937, II, 1569.
3. Nametkin, S. S., and E. S. Pokrovskaya, J. Gen. Chem. (U.S.S.R.) **8**, 699 1938; C.A. **33**, 1298 1939.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-3-[4′-(7′,7′-dimethylbicyclo-[3,1,1]-hepten-4′-yl)]-propyne-1**  | | | | |
| 177.5–178.5 | 10[1] | 0.9896[1] | 1.56336[1] | $[\alpha]_D^{20}$ = +18.725°[1] (a) |
| 89–90 | 0[1] | | 1.55804 $n_{H\alpha}^{20}$[1] | |
| | | | 1.57735 $n_{H\beta}^{20}$[1] | |

(a) Angles of rotation for lines other than *D* are given in reference 1.

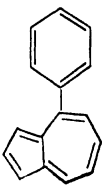
**References on Benzene with One Bicyclenylalkynyl Substitution**

1. Rupe, H., and A. Héritier, Ann. **459**, 171 **1927.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Di-(4′-cyclohexylcyclohexen-1′-yl)-benzene**  | | | | |
| 240–245 [1] | 250 0.7 [1] | | | |

**References on Benzene with Two Cyclylcyclenyl Substitutions**

1. von Braun, J. G. Irmisch, and J. Nelles, Ber. 66, 1471 1933.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2-Phenylbicyclo-[5,3,0]-decapentaene-2,4,6,8,10** (4-Phenylazulene) | | |  | |
| 210–211[1] | | | | |

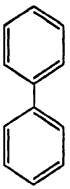
**References on Benzene with One Bicyclopentaenyl Substitution**

1. St. Pfau, A., and P. A. Plattner, Helv. Chim. Acta 19, 858 1936.

# IV. BIPHENYL AND ITS ALIPHATIC DERIVATIVES

1. Biphenyl $C_nH_{2n-14}$
2. Biphenyl with Alkyl Substitutions $C_nH_{2n-14}$
3. Biphenyl with One Alkenyl Substitution $C_nH_{2n-16}$
4. Biphenyl with Two Alkenyl Substitutions $C_nH_{2n-18}$

## 1. BIPHENYL, $C_nH_{2n-14}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Biphenyl** (Diphenyl)  | | | | |
| **70.0** | **254.9** | **0.9712 100°** | | Crit. Temp., °C. |
| 71–72 [30,149] | 255.9 [112] | 1.041 [102] | 1.614 [102] | 495.6 [74,79] |
| 71.0 [202] | 255.27 [136] | 0.5540 482.2° [136] | 1.61589 [101] | 374.5 [86] |
| 71(a) | 255.25 [40] | 0.6104 454.4° [136] | $1.58728_6$ 77.14° [195] | |
| 70.5–71 [18,97] | 255 [22,185] | 0.6551 426.7° [136] | 1.58822 77.1° [193] | Crit. Pressure, mm. Hg |
| 70–71(b) | 254.93 [89] | 0.6934 398.9° [136] | 1.56841 $n_{H\alpha}^{99.0}$ [153] | 24,168.0 [79] |
| 70.8 [123] | 254.9 [23] | 0.7270 371.1° [136] | 1.58112 $n_{H\alpha}^{77.1}$ [193] | |
| 70.5(c) | 254(f) | 0.7578 343.3° [136] | 1.58189 $n_{H\alpha}^{73}$ [54] | |
| 70–70.5 [89] | 252 [190] | 0.7856 315.6° [136] | 1.59441 $n_{H\beta}^{99.0}$ [153] | |
| 70.2 [55] | 250–252 [214] | 0.8127 287.8° [136] | 1.60760 $n_{H\beta}^{77.1}$ [193] | |
| 70.0–70.2 [81] | 257.37 800 [89] | 0.8382 260.0° [136] | 1.60836 $n_{H\beta}^{73}$ [54] | |
| 70.0 [138] | 257.06 795 [89] | 0.8425 255.3° [136] | 1.61158 $n_{H\gamma}^{99.0}$ [153] | |
| 70(d) | 256.76 790 [89] | 0.8620 232.2° [136] | 1.62538 $n_{H\gamma}^{77.1}$ [193] | |
| 69–70 [2,3,73,140,209,211] | 256.45 785 [89] | 0.8849 204.4° [136] | (j) | |
| 69.85 [26] | 256.15 780 [89] | 0.9053 179.4° [48] | | |
| 69.8 [37,53] | 255.85 775 [89] | 0.9075 176.7° [136] | | |
| 69.6–69.7 [94] | 255.54 770 [89] | 0.9272 152.0° [27] | | |
| 69.6 [41] | 255.24 765 [89] | 0.9304 148.7° [136] | | |
| 69.5 [9,93,141,210] | 254 762 [171,172] | 0.9372 138.8° [92] | | |
| 69–69.5 [157] | 253.8 | 0.9526 121.1° [136] | | |
| 68.5–69.5 [91] | −254.4 759 [127] | 0.9593 118.0° [48] | | |
| 69.4 [68,213] | 248–249 756.5 [91] | 0.9611 109.66° [92] | | |
| 69.22 [136] | 254.62 755 [89] | 0.9626 108.6° [27] | | |
| 69.2 [40] | 253.8 754.15 [171] | 0.9649 105° [53] | | |
| 69.1 [86,90,137] | 254 754 [23] | 0.97165 99° [153] | | |
| 69.0 [89,113,114,115] | 254.32 750 [89] | 0.9748 93.3° [136] | | |
| 69(e) | 254.01 745 [89] | 0.9855 83.4° [48] | | |
| 68.5–69 [212] | 253.71 740 [89] | 0.9852 82.33° [26] | | |
| 68–69 [43,119] | 253.40 735 [89] | 0.9845 82.0° [27] | | |
| 68.95 [198] | 253.10 730 [89] | 0.9857 80.1° [92] | | |
| 68.90 [92] | 252.79 725 [89] | 0.9878 79.53° [26] | | |
| 68.9 [50] | 252–253 721.9 [27] | 0.9890 77.14° [195] | | |
| 68.6 [152] | 252.48 720 [89] | 0.9896 77.1° [193] | | |
| 68.5 [66] | 252.9 716 [16] | 0.9902 77.02° [26] | | |
| 68.3 [179] | 252.16 715 [89] | 0.9915 75.03° [26] | | |
| 68 [110,178] | 251.3 | 0.9893 75° [53] | | |
| | −252.8 714.7 [42A] | 0.9919 73.0° [92] | | |
| | 251.85 710 [89] | 0.9919 73° [54] | | |
| | 251.53 705 [89] | 0.9946 72.01° [26] | | |
| | 251.21 700 [89] | 0.9970 70.52° [26] | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Biphenyl** (*Continued*) | 250.57 690 [89] | 0.9961 70.5° [165] | | |
| | 249.92 680 [89] | 1.0002 67.03° [26] | | |
| | 249.27 670 [89] | 1.0032 62.61° [26] | | |
| | 248.61 660 [89] | 1.0046 61.12° [26] | | |
| | 247.94 650 [89] | 1.0031 60° [92] | | |
| | 247.26 640 [89] | 1.0072 58.56° [26] | | |
| | 246.57 630 [89] | 1.1453 30.53° | | |
| | 245.87 620 [89] | (solid) [26] | | |
| | 245.15 610 [89] | 1.17466(g) 24.9° [82] | | |
| | 244.42 600 [89] | 1.17470(g) 24.8° [82] | | |
| | 243.68 590 [89] | 1.17507(g) 24.8° [82] | | |
| | 242.93 580 [89] | 1.17455(g) 24.4° [82] | | |
| | 242.18 570 [89] | 1.17544(g) 24.4° [82] | | |
| | 241.41 560 [89] | 1.17560(g) 24.2° [82] | | |
| | 240.63 550 [89] | 1.17520(g) 24.1° [82] | | |
| | 239.84 540 [89] | 1.1545 19.05° | | |
| | 239.04 530 [89] | (solid) [26] | | |
| | 238.23 520 [89] | 1.120(g) 17° [82] | | |
| | 237.41 510 [89] | 1.1632 9.02° | | |
| | 236.58 500 [89] | (solid) [26] | | |
| | 235.74 490 [89] | 1.180(g) 0° [215] | | |
| | 234.89 480 [89] | 1.154(h) (solid) [139] | | |
| | 234.02 470 [89] | 1.165(i)(h) (solid) [169] | | |
| | 233.14 460 [89] | | | |
| | 230 458 [23] | | | |
| | 232.22 450 [89] | | | |
| | 231.28 440 [89] | | | |
| | 230.33 430 [89] | | | |
| | 229.36 420 [89] | | | |
| | 228.38 410 [89] | | | |
| | 227.39 400 [89] | | | |
| | 226.38 390 [89] | | | |
| | 225.36 380 [89] | | | |
| | 224.32 370 [89] | | | |
| | 223.26 360 [89] | | | |
| | 222.19 350 [89] | | | |
| | 221.09 340 [89] | | | |
| | 220.00 330 [89] | | | |
| | 218.90 320 [89] | | | |
| | 217.79 310 [89] | | | |
| | 216.65 300 [89] | | | |
| | 215.50 290 [89] | | | |
| | 214.34 280 [89] | | | |
| | 213.18 270 [89] | | | |
| | 212.01 260 [89] | | | |
| | 210.80 250 [89] | | | |
| | 188 200 [23] | | | |
| | 145 22 [198] | | | |
| | 127–128 14 [30] | | | |
| | 130–132 10 [183] | | | |

* $\frac{1}{T_b} = 0.0029665 - 0.0003724 \log_{10} p_{mm}$ (340 to 800 mm)

† $\frac{dD}{dt} = -0.0008170[1 + 0.0004558(t - 100)]/°C$ (58 to 233°C)

(a) The melting point 71 is found in references 42, 47, 51, 55, 80, 84, 88, 100, 118, 121, 122, 124, 125, 126, 131, 133, 143, 144, 145, 159, 162, 167, 170, 177, 190, 199, 207.
(b) The melting point 70-71 is found in references 8, 11, 24, 28, 33, 99, 106, 150, 180, 200.
(c) The melting point 70.5 is found in references 1, 6, 10, 15, 20, 21, 31, 35, 49, 55, 56, 60, 67, 70, 76, 101, 111, 117, 130, 132, 135, 155, 158, 163, 164, 165, 166, 168, 182, 186, 189, 191, 192, 193, 204, 208.
(d) The melting point 70 is found in references 7, 12, 13, 14, 17, 19, 25, 29, 32, 34, 36, 38, 39, 45, 57, 58, 61, 62, 64, 65, 69, 71, 72, 75, 77, 78, 83, 87, 95, 96, 103, 104, 105, 107, 109, 116, 120, 128, 129, 134, 146, 147, 148, 151, 154, 156, 161, 174, 175, 176, 178, 181, 184, 188, 205.
(e) The melting point 69 is found in references 44, 46, 98, 160, 187, 196, 201, 203.
(f) The boiling point 254 is found in references 4, 5, 17, 32, 63, 64, 80, 85, 100, 101, 108, 117, 130, 162, 163, 168, 191, 194, 197, 200, 206.
(g) These densities were apparently determined on the solid.
(h) The temperature of this density is not given.
(i) This density is the average of two determinations.
(j) Refractive indices at other lines may be found in references 92, 142, 153.

## Biphenyl References

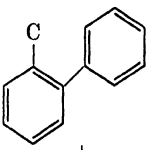
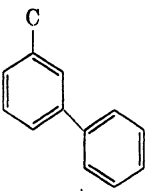
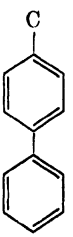

1. Abeljanz, H., Ber. **5**, 1027 **1872.**
2. Acree, S. F., Am. Chem. J. **29**, 588 **1903.**
3. Acree, S. F., Ber. **37**, 2753 **1904.**
4. Adam, P., Ann. chim. phys. [6] **15**, 224 **1898.**
5. Adam, P., Bull. soc. chim. [2] **47**, 686 **1887.**
6. Adam, T. C. C., and A. Russell, J. Chem. Soc. **1930**, 202.
7. Alder, K., and H. F. Rickert, Ber. **71**, 379 **1938.**
8. Aronheim, B., Ann. **194**, 145 **1878.**
9. Austin, J. B., and I. A. Black, J. Am. Chem. Soc. **52**, 4552 **1930.**
10. Bamberger, E., Ber. **28**, 403 **1895.**
11. Bamberger, E., Ber. **30**, 366 **1897.**
12. Bamberger, E., Ber. **53**, 2308 **1920.**
13. Bamberger, E., and S. C. Hooker, Ann. **229**, 102 **1885.**
14. Bamberger, E., and S. C. Hooker, Ber. **18**, 1030 **1885.**
15. Bamberger, E., and K. Landsteiner, Ber. **26**, 482 **1893.**
16. Bamberger, E., and W. Lodter, Ber. **20**, 3073 **1887.**
17. Bamberger, E., and W. Lodter, Ber. **21**, 836 **1888.**
18. Bamberger, E., and L. Storch, Ber. **26**, 471 **1893.**
19. Barbier, P., and L. Roux, Bull. soc. chim. [2] **46**, 268 **1886.**
20. Barth, L., and J. Schreder, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **86**, 767 **1882.**
21. Beckmann, C. O., and K. Cohen, J. Chem. Phys. **4**, 784 **1936.**
22. Beckmann, E., and R. Hanslian, Z. anorg. Chem. **80**, 221 **1913.**
23. Beckmann, E., and O. Liesche, Z. physik. Chem. **89**, 111 **1915.**
24. Bennett, G. M., and E. E. Turner, J. Chem. Soc. **105**, 1057 **1914.**
25. Berthelot, Ann. chim. phys. [4] **9**, 445 **1866.**
26. Block, H., Z. physik. Chem. **78**, 385 **1912.**
27. Bolle, J., and P. A. Guye, J. chim. phys. **3**, 38 **1905.**
28. Boyd, D. R., and H. H. Hatt, J Chem. Soc. **1927**, 898.
29. Bradley, M. J., and S. W. Parr, Chem. Met. Eng. **27**, 737 **1922.**
30. Bretscher, E., Helv. Phys. Acta **1**, 355 **1928.**
31. Brönner, R., Ann. **151**, 50 **1869.**
32. Brüll, L., Gazz. chim. ital. **65**, 19 **1935.**
33. Büchner, E., Ber. **8**, 22 **1875.**
34. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 **1936.**
35. Carnelley, T., J. Chem. Soc. **29**, 13 **1876.**
36. Carnelley, T., J. Chem. Soc. **37**, 701 **1880.**

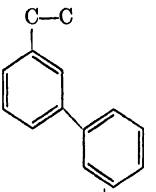
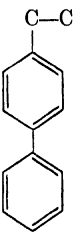
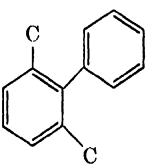
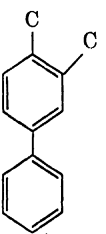
37. Castille, A., Bull. classe sci. Acad. roy. Belg. [5] **12**, 498 **1926.**
38. Chandra-Sircar, A., and J. Naryan Majumder, J. Indian Chem. Soc. **5**, 417 **1928.**
39. Charrier, G., and E. Ghigi, Gazz. chim. ital. **63**, 685 **1933.**
40. Chipman, J., and S. B. Peltier, Ind. Eng. Chem. **21**, 1106 **1929.**
41. Christomanos, A., Gazz. chim. ital. **5**, 402 **1875.**
42. Claisen, L., Ber. **59**, 144 **1926.**
42A. Crafts through R. Otto, Ber. **19**, 2425 **1886.**
43. de Saint-Aunay, R. V., Chimie & industrie **29**, 1011 **1933.**
44. Diels, O., and K. Alder, Ber. **62**, 2081 **1929.**
45. Dietrich, W., Helv. Chim. Acta **8**, 149 **1925.**
46. Dreher, E., and R. Otto, Ann. **154**, 93 **1870.**
47. Dunstan, A. E., and T. P. Hilditch, Z. Elektrochem. **18**, 185 **1912.**
48. Dutoit, P., and L. Friederich, Arch. sci. phys. nat. [4] **9**, 105 **1900.**
49. Efremov, N. N., J. Russ. Phys. Chem. Soc. **50**, 372 **1918**; Chem. Zentr. **1923**, III, 379.
50. Ellis, S. J., J. Inst. Civil Engrs. (London) **10**, 227 **1938-1939.**
51. Erlenmeyer, H., Helv. Chim. Acta **10**, 620 **1927.**
52. Estermann, J., Z. physik. Chem. **1B**, 134 **1928.**
53. Evans, E. B., J. Inst. Petroleum Tech. **24**, 537 **1938.**
54. Eykman, J. F., Rec. trav. chim. **12**, 157 **1893.**
55. Eykman, J. F., Z. physik. Chem. **4**, 497 **1889.**
56. Ferns, J., and A. Lapworth, J. Chem. Soc. **101**, 273 **1912.**
57. Fichter, F., and H. Erlenmeyer, Helv. Chim. Acta **9**, 144 **1926.**
58. Fichter, F., and A. Fritsch, Helv. Chim. Acta **6**, 329 **1923.**
59. Fichter, F., and H. Stenzl, Helv. Chim. Acta **22**, 970 **1939.**
60. Fittig, R., Ann. **121**, 361 **1862.**
61. Fittig, R., and O. Döbner, Ann. **172**, 109 **1874.**
62. Fittig, R., and E. Ostermeyer, Ann. **166**, 361 **1873.**
63. Friedel and Crafts, Bull. soc. chim. [2] **39**, 306 **1883.**
64. Friedel, C., and J. M. Crafts, Compt. rend. **100**, 692 **1885.**
65. Fuchs, W., Ber. **61**, 2599 **1928.**
66. Gardner, J. H., and P. Borgstrom, J. Am. Chem. Soc. **51**, 3375 **1929.**
67. Garelli, F., Gazz. chim. ital. **23**, II, 354 **1893.**
68. Garrick, F. J., Trans. Faraday Soc. **23**, 560 **1927.**
69. Gasopoulos, I., Praktika Akad. Athenon **7**, 180 **1932**; C.A. **28**, 4726 **1934**; Chem. Zentr. **1933**, I, 534.
70. Gelissen, H., and P. H. Hermans, Ber. **58**, 285 **1925.**
71. Gelissen, H., and P. H. Hermans, Ber. **58**, 476 **1925.**
72. Gelissen, H., and P. H. Hermans, Ber. **58**, 770 **1925.**
73. Gilman, H., and R. McCracken, J. Am. Chem. Soc. **51**, 821 **1929.**
74. Goldhammer, D. A., Z. physik. Chem. **71**, 577 **1910.**
75. Goldschmidt, G., and M. von Schmidt, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **83**, Abt. IIb, **7 1881.**
76. Gomberg, M., and W. E. Bachmann, J. Am. Chem. Soc. **46**, 2339 **1924.**
77. Graebe, C., Ber. **6**, 63 **1873.**
78. Groth, P., "Chemische Kristallographie" **5**, 7 **1919.**
79. Guye, P. A., and E. Mallet, Compt. rend. **133**, 1287 **1901.**
80. Haehn, H., Z. angew. Chem. **19**, 1669 **1906.**
81. Hall, C. C., and C. M. Cawley, J. Soc. Chem. Ind. **58**, 7 **1939.**
82. Hendricks, S. B., and M. E. Jefferson, J. Optical Soc. Am. **23**, 299 **1933.**
83. Hiedemann, E., Ann. Physik [5] **2**, 221 **1929.**
84. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **18**, 881 **1912.**
85. Hofmann, F., and P. Damm, Brennstoff-Chem. **3**, 73, 81 **1922.**
86. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 **1930.**
87. Ipatieff, V. N., and V. I. Komarewsky, J. Am. Chem. Soc. **56**, 1926 **1934.**
88. Jacobson, P., Ber. **28**, 2541 **1895.**

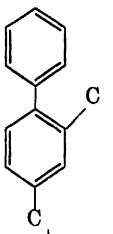
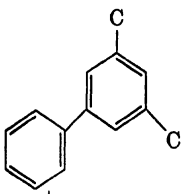
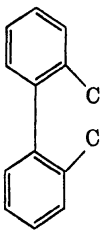
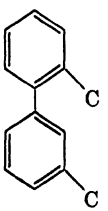
89. Jaquerod, A., and E. Wassmer, Ber. **37**, 2531 **1904.**
90. Ju, T. Y., C. E. Wood, and F. H. Garner, J. Inst. Petroleum Tech. **28**, 159 **1942.**
91. Kagehira, I., Bull. Chem. Soc. Japan **6**, 241 **1931.**
92. Kalff, J., Thesis, Amsterdam Univ., **1924.**
93. Kempf, R., J. prakt. Chem. [2] **78**, 201 **1908.**
94. Kendall, J., and K. P. Monroe, J. Am. Chem. Soc. **39**, 1802 **1917.**
95. Kenyon, J., H. Phillips, and V. P. Pittman, J. Chem. Soc. **1935**, 1072.
96. Kharasch, M. S., and H. S. Isbell, J. Am. Chem. Soc. **52**, 2919 **1930.**
97. Kizhner, N., J. Russ. Phys. Chem. Soc. **42**, 1227 **1910**; C.A. **6**, 84 **1912**; Chem. Zentr. **1911**, I, 544.
98. Klemm, L., W. Klemm, and G. Schiemann, Z. physik. Chem. **165A**, 379 **1933**
99. Knoevenagel, E., Ann. **289**, 171 **1895.**
100. Krafft, F., and W. Vorster, Ber. **26**, 2813 **1893.**
101. Kramers, J. G., Ann. **189**, 129 **1877.**
102. Krollpfeiffer, F., Ann. **430**, 161 **1923.**
103. Kuhn, R., Ann. **475**, 131 **1929.**
104. Kuhn, R., and A. Deutsch, Ber. **65**, 43 **1932.**
105. Kuhn, R., and A. Winterstein, Ber. **60**, 432 **1927.**
106. La Coste, W., and A. Michaelis, Ann. **201**, 184 **1880.**
107. Ladenburg, A., Ann. **159**, 251 **1871.**
108. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918.**
109. Lal, J. B., and S. Dutt, J. Indian Chem. Soc. **9**, 565 **1932.**
110. Lal, J. B., and S. Dutt, J. Indian Chem. Soc. **12**, 389 **1935.**
111. Lautsch, W., Z. physik. Chem. **1B**, 115 **1928.**
112. Lecat, M., Ann. soc. sci. Bruxelles **49B**, 109 **1929.**
113. Lee, H. H., and J. C. Warner, J. Am. Chem. Soc. **55**, 209 **1933.**
114. Lee, H. H., and J. C. Warner, J. Am. Chem. Soc. **55**, 4474 **1933.**
115. Lee, H. H., and J. C. Warner, J Am. Chem. Soc. **57**, 318 **1935.**
116. Liebermann, C., Ann. **169**, 221 **1873.**
117. Lippmann, A., Z Elektrochem. **17**, 15 **1911.**
118. Lippmann, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **94**, Abt. IIb, 525 **1886.**
119. Losanich, S. M., Bul. Soc. Română Stiinte **23**, 3 **1914**; Chem. Zentr. **1914**, II, 812.
120. Mailhe, A., and F. de Godon, Bull. soc. chim. [4] **19**, 449 **1916.**
121 Majima, R., K. Nagaoka, and K. Yamada, Ber. **55**, 215 **1922.**
122. Mascarelli, L., Atti accad. Lincei [3] **17**, II, 580 **1908.**
123. Mascarelli, L., and V. Babini, Atti accad. Lincei [5] **18**, II, 222 **1909.**
124. Mascarelli, L., and D. Gatti, Gazz. chim. ital. **67**, 807 **1937.**
125. Mascarelli, L., and P. Malaguti, Gazz. chim. ital. **41**, I, 63 **1911.**
126. Matla, W. P. M., Chem. Weekblad **32**, 502 **1935.**
127. McVickers, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **127**, 999 **1925.**
128. Merz, V., and W. Weith, Ber. **10**, 746 **1877.**
129. Meyer, H., and A. Hofmann, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **126**, Abt. IIb, 543 **1917.**
130. Meyer, R., Ber. **45**, 1609 **1912.**
131. Meyer, R., and W. Meyer, Ber. **51**, 1571 **1918.**
132. Meyer, R., and K. Tögel, Ann. **347**, 55 **1906.**
133. Michael, A., and J. E. Bucher, Am. Chem. J. **20**, 89 **1898.**
134. Mieleitner, K., Z. Krist. **55**, 51 **1915-1920.**
135. Möhlau, R., and R. Berger, Ber. **26**, 1994 **1893.**
136. Montillon, G. H., K. L. Rohrbach, and W. L. Badger, Ind. Eng. Chem. **23**, 763 **1931.**
137. Morris, R. E., and W. A. Cook, J. Am. Chem. Soc. **57**, 2403 **1935.**
138. Mortimer, F. S., J. Am. Chem. Soc. **44**, 1416 **1922.**
139. Mukherjee, A., Indian J. Phys. **8**, 147 **1933.**
140. Müller, E., and T. Töpel, Ber. **72**, 273 **1939.**
141. Müller, F. G., and A. Banninger, Helv. Chim. Acta **10**, 763 **1927.**

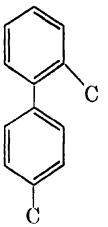
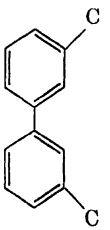
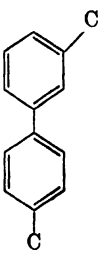
142. Narasimham, K. L., Indian J. Phys. **6**, 233 **1931**.
143. Nenitzescu, C. D., and D. Curcăneanu, Ber. **70**, 346 **1937**.
144. Oddo, G., Gazz. chim. ital. **20**, 631 **1890**.
145. Oddo, B., and R. Binaghi, Gazz. chim. ital. **51**, II, 330 **1921**.
146. Oddo, G., and A. Curatolo, Atti accad. Lincei [5] **4**, 211 **1895**.
147. Oddo, G., and A. Curatolo, Gazz. chim. ital. **25**, I, 126 **1895**.
148. Ogawa, T., Bull. Chem. Soc. Japan **6**, 174 **1931**.
149. Orlov, N. A., and M. A. Belopolskiĭ, Ber. **62**, 1226 **1929**.
150. Otto, R., Ber. **19**, 2425 **1886**.
151. Palméro, J., III Nordiska Kemistmötet **1926**, 195 **1928**; Chem. Zentr. **1929**, I, 1446
152. Parks, G. S., and H. M. Huffman, Ind. Eng. Chem. **23**, 1138 **1931**.
153. Perkin, W. H., J. Chem. Soc. **69**, 1025 **1896**.
154. Pestemer, M., and J. Cecelsky, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **140**, Abt IIb, 541 **1931**.
155. Pfankuch, J. prakt. Chem. [2] **6**, 97 **1872**.
156. Pfeiffer, P., H. Schmitz, and T. Inoue, J. prakt. Chem. [2] **121**, 70 **1929**.
157. Pickett, L. W., G. F. Walter, and H. France, J. Am. Chem. Soc. **58**, 2296 **1936**.
158. Pyl, G., Ber. **60**, 1133 **1927**.
159. Reingruber, F., Ann. **206**, 367 **1880**.
160. Riese, F., Ann. **164**, 161 **1872**.
161. Sabatier, P., and A. Mailhe, Compt. rend. **159**, 217 **1914**.
162. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915**.
163. Sabatier, P., and M. Murat, Compt. rend. **156**, 1951 **1913**.
164. Sakellarios, E., and T. Kyrimis, Ber. **57**, 322 **1924**.
165. Schiff, R., Ann. **223**, 247 **1884**.
166. Schlubach, H. H., and E. C. Goes, Ber. **55**, 2889 **1922**.
167. Schmidt, E., J. prakt. Chem. [2] **9**, 241 **1874**.
168. Schmidt, H., and G. Schultz, Ann. **203**, 118 **1880**.
169. Schröder, H., Ber. **14**, 2516 **1881**.
170. Schröter, G., Ber. **36**, 3005 **1903**.
171. Schultz, G., Ann. **174**, 201 **1874**.
172. Schultz, G., Ber. **6**, 415 **1873**.
173. Schulze, K. E., Ber. **17**, 1203 **1884**.
174. Schutz, F., Ber. **56**, 162 **1923**.
175. Sherwood, I. R., W. F. Short, and R. Stansfield, J. Chem. Soc. **1932**, 1832.
176. Shorygin, P., Ber. **56**, 176 **1923**.
177. Smedley, I., J. Chem. Soc. **93**, 372 **1908**.
178. Smith, W., Chem. News **35**, 271 **1877**.
179. Spaght, M. E., S. B. Thomas, and G. S. Parks, J. Phys. Chem. **36**, 882 **1932**.
180. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1207 **1913**.
181. Spencer, J. F., and E. M. Stokes, J. Chem. Soc. **93**, 68 **1908**.
182. Stohmann, F., E. Kleber, and H. Langbein, J. prakt. Chem. [2] **40**, 77 **1899**.
183. Swarts, F., Bull. soc. chim. [4] **25**, 145 **1919**.
184. Tamman, G., and K. L. Dreyer, Z. anorg. allgem. Chem. **182**, 289 **1929**.
185. Taylor, E. H., and H. S. Taylor, J. Am. Chem. Soc. **61**, 503 **1939**.
186. Tröger, J., and O. Beck, J. prakt. Chem. [2] **87**, 289 **1913**.
187. Truffault, R., Bull. soc. chim. [5] **1**, 391 **1934**.
188. Tsukervanik, I. P., and N. G. Sidorova, J. Gen. Chem. (U.S.S.R.) **7**, 641 **1937**; C.A. **31**, 5780 **1937**; Chem. Zentr. **1935**, I, 579.
189. Ullmann, F., Ann. **332**, 38 **1904**.
190. Valeur, A., Bull. soc. chim. [3] **29**, 683 **1903**.
191. van Hove, T., Bull. classe sci. Acad. roy. Belg. [5] **8**, 505 **1922**.
192. van Hove, T., Bull. soc. chim. Belg. **32**, 52 **1923**.
193. von Auwers, K., and A. Frühling, Ann. **422**, 196 **1921**.

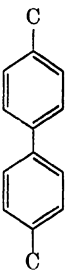
194. von Steiger, A. L., Ber. **53**, 666 **1920.**
195. von Steiger, A. L., Ber. **55**, 1968 **1922.**
196. Votoček, E., and J. Köhler, Ber. **47**, 1219 **1914.**
197. Wallach, O., and F. Heusler, Ann. **243**, 219 **1888.**
198. Washburn, E. W., and J. W. Read, J. Am. Chem. Soc. **41**, 729 **1919.**
199. Wedekind, E., and D. Schenck, Ber. **54**, 1604 **1921.**
200. Weger, M., Z. angew. Chem. **22**, 338 **1909.**
201. Weissberger, A., and J. W. Williams, Z. physik. Chem. **3B**, 367 **1929.**
202. Wendt, G., J. prakt. Chem. [2] **46**, 317 **1892.**
203. Wertyporoch, E., and H. Sagel, Ber. **66**, 1306 **1933.**
204. Wieland, H., K. Heymann, T. Tsatsas, D. Juchum, G. Varvoglis, G. Labriola, O. Dobbelstein, and H. S. Boyd-Barrett, Ann. **514**, 145 **1934.**
205. Wieland, H., and G. Razuvayev, Ann. **480**, 157 **1930.**
206. Willgerodt, C., and T. Scholtz, J. prakt. Chem. [2] **81**, 382 **1910.**
207. Wolf, K. L., and H. Weghofer, Z. physik. Chem. **39B**, 194 **1938.**
208. Zanetti, J. E., and G. Egloff, J. Ind. Eng. Chem. **9**, 350 **1917.**
209. Zartman, W. H., and H. Adkins, J. Am. Chem. Soc. **54**, 3398 **1932.**
210. Zechmeister, L., and J. Csabay, Ber. **60**, 1617 **1927.**
211. Zelinskiĭ, N. D., S. E. Mikhlina, and M. S. Eventova, Ber. **66**, 1422 **1933.**
212. Zelinskiĭ, N. D., and I. N. Tits, Ber. **58**, 2755 **1925.**
213. Zelinskiĭ, N. D., and I. N. Tits, Ber. **64**, 183 **1931.**
214. Zelinskiĭ, N. D., I. Tits, and M. Gaverdovskaya, Ber. **59**, 2950 **1926.**
215. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-2-phenylbenzene**  | | | | |
| | **260** | | | |
| | 261–264 [18,55,56] | 1.010 [34] | | |
| | 261–263 [22,55] | | | |
| | 260 [69] | | | |
| | 255–258 [11,26,34,43] | | | |
| | 130–136 27 [72] | | | |
| **1-Methyl-3-phenylbenzene**  | | | | |
| | **270** | | | |
| | 272–277 [1] | 1.0121 [41] | 1.6029 [78] | |
| | 272–274 [78] | 1.010 22° [72] | 1.60355 [41] | |
| | 270–272 [34] | 1.012 17° [34] | 1.5916 22° [72] | |
| | 270 [57] | 1.0182 16.7° [78] | 1.60443 16.7° [78] | |
| | 267–269 [11,26] | 1.031 0° [1] | 1.59747 $n_{H\alpha}^{16.7}$ [78] | |
| | 269 748 [41] | | 1.62386 $n_{H\beta}^{16.7}$ [78] | |
| | 148–150 20 [72] | | | |
| **1-Methyl-4-phenylbenzene**  | | | | |
| **48.5** | **267** | | | |
| 51 [61] | 267–268 [26] | | | |
| 50 [11] | 263–268 [13] | | | |
| 49–50 [37] | 267 [69] | | | |
| 48 [41] | 263–267 [18,22] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-phenylbenzene** *(Continued)* | | | | |
| 47–48 [21,28,81]<br>47.7 [26]<br>47.5 [72] | 134–136 15 [72] | | | |
| $C_{14}H_{14}$ | | | | |
| **1-Ethyl-3-phenylbenzene**  | 286–288 774 [1]<br>283–284 763 [1] | 1.043 0° [1] | | |
| **1-Ethyl-4-phenylbenzene**  | 140 15 [78] | | | |
| **1,3-Dimethyl-2-phenylbenzene**  | 260–265 [33] | | | |
| **1,2-Dimethyl-4-phenylbenzene**  | 284–287 [32]<br>281–283 [23,24] | | | |

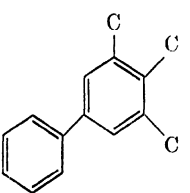
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-2,4-dimethylbenzene**  | 264–267 [27] | | | |
| **1,3-Dimethyl-5-phenylbenzene**  | 273–276 [32] | | | |
| **2,2′-Dimethylbiphenyl**  | 18 [75]<br>17–18 [47]<br>17.8 [76]<br>17.0 [4,20]<br>257–259 [46]<br>258 [7]<br>256–258 [47]<br>258 737.6 [76] | | | |
| **2,3′-Dimethylbiphenyl**  | 273–276 [46]<br>270 [69A] | 0.9984 22° [46] | 1.5848 22° [46] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,4′-Dimethylbiphenyl**  | 283–288 [12]<br>273–276 [26] | | | |
| **3,3′-Dimethylbiphenyl**  | 287–288 [57]<br>286 [46]<br>280–284 [50]<br>283 [11]<br>283 718 [76]<br>287–288 716 [70]<br>286 716 [73]<br>286–287 713 [70]<br>154 14 [58]<br>138–139 5 [9] | 0.9993 16° [73] | | |
| **3,4′-Dimethylbiphenyl**  | 288–289 752 [41] | 0.998 [41] | 1.59713 [41] | |

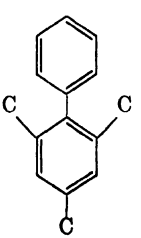
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4,4′-Dimethylbiphenyl**  | | | | |
| **121.6** | | | | |
| 125 [30,48]<br>122–123 [79]<br>122 [76,77]<br>121–122 [28,41,74]<br>121(a)<br>120.8–121 [67]<br>120–121 [82]<br>120 [62]<br>119.5–120 [53]<br>119–120 [25]<br>118–119 [5] | 296 [69]<br>295 [76]<br>292–293 752 [41] | 0.9172 121° [67]<br>0.9993 $D_0^{20}$ [65]<br>1.102 (solid) [46,49] | 1.531 22° [85] | |

(a) The melting point 121 is found in references 6, 11, 12, 16, 19, 26, 54, 63, 65, 66, 69, 71, 83.

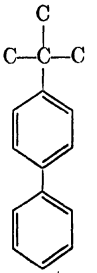
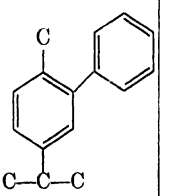
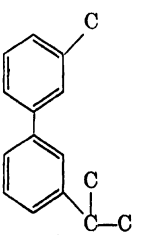
**$C_{15}H_{16}$**

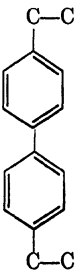
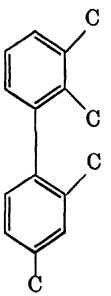
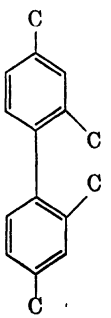
**1,2,3-Trimethyl-5-phenylbenzene** 

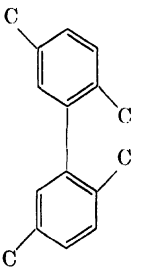
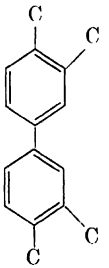
175–185 23 [32]

**1-Phenyl-2,4,6-trimethylbenzene** 

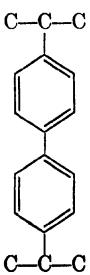
275–277 [31]

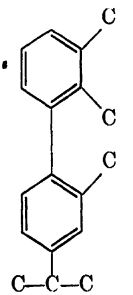
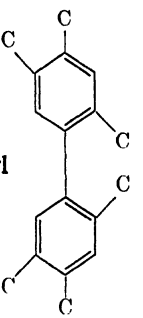
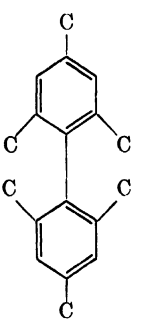
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-*tert*-Butyl-4-phenylbenzene**  | | | | |
| 51–52 [29] | | | | |
| **1-Methyl-2-phenyl-4-isopropylbenzene**  | | | | |
| | 268 752 [35] | 0.9676 [64] | 1.56764 [64] | |
| | 156–157 14 [64] | 0.9776 15° [36] | 1.56797 15° [36] | |
| | 153–154 14 [35] | 0.9822 13.8° [35] | 1.5670 13.8° [35] | |
| | 143 14 [36] | | 1.56149 $n_{H\alpha}^{20}$ [64] | |
| | 148.5 | | 1.56228 $n_{H\alpha}^{15}$ [36] | |
| | –149.5 10 [64] | | 1.58239 $n_{H\beta}^{20}$ [64] | |
| | | | 1.58266 $n_{H\beta}^{15}$ [36] | |
| | | | 1.59553 $n_{H\gamma}^{20}$ [64] | |
| | | | 1.59626 $n_{H\gamma}^{15}$ [36] | |
| **3-Methyl-3′-isopropylbiphenyl**  | | | | |
| | 158 19.5 [72] | | | |

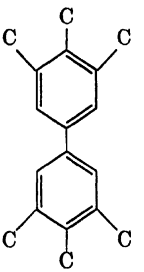
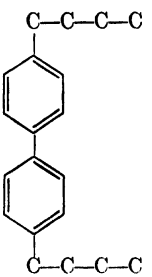
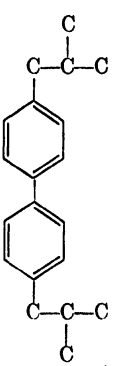
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4,4′-Diethylbiphenyl**  | | | | |
| 80[68] | | | | |
| **2,2′,3,4′-Tetramethylbiphenyl**  | | | | |
| | 162–163 12[42] | | | |
| **2,2′,4,4′-Tetramethylbiphenyl**  | | | | |
| 41[76] | 288 722[76] | | | |

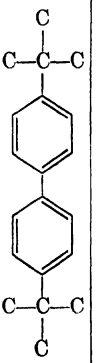
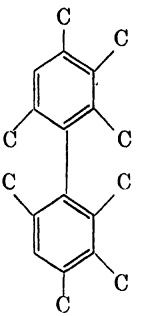
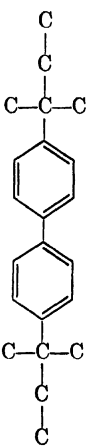
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2′,5,5′-Tetramethylbiphenyl**  | | | | |
| 50 [76] | 284 732 [76] | | | |
| **3,3′,4,4′-Tetramethylbiphenyl**  | | | | |
| 76–77 [17,60] | | | | |
| **$C_{18}H_{22}$** **Hexylphenylbenzene** (a) | | | | |
| −36 [59] | 149-151 4 [59] | 0.9613 [59] | 1.5640 [59] | |
| −40 [59] | 141–143 2.5 [59] | 0.9648 [59] | 1.5641 [59] | |
| | | | 1.5660 15° [59] | |
| | | | 1.5665 15° [59] | |

(a) The structure of this compounds is not given, but the author indicates that there are two isomeric forms.

| | | | | |
|---|---|---|---|---|
| **4,4′-Diisopropylbiphenyl**  | | | | |
| 64–65 [8] 49 [10,68] | 335 [8] | | | |

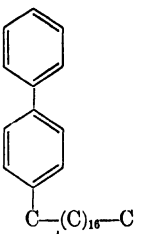
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2′,3-Trimethyl-4′-isopropylbiphenyl**  | | | | |
| 197 [7] | | | | |
| **2,2′,4,4′,5,5′-Hexamethylbiphenyl**  | | | | |
| 52 [76] | 320 | 738 [76] | | |
| **2,2′,4,4′,6,6′-Hexamethylbiphenyl**  | | | | |
| **100.2** | | | | |
| 100.5 [50,76]<br>100–100.5 [3,58]<br>100 [45]<br>99.5–100 [53] | 296 | 735 [76] | 1.023 (solid) [40] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **3,3′,4,4′,5,5′-Hexamethylbiphenyl**  | | | | |
| 132–133 [44] | | | | |
| $C_{20}H_{26}$ | | | | |
| **4,4′-Di-*n*-butylbiphenyl**  | | | | |
| 58–59 [10] | 228–230 14 [10] | 0.9499 15° [10] | 1.5503 19° [10] | |
| **4,4′-Di-*sec*-butylbiphenyl**  | | | | |
| | 222–224 20 [10] | 0.9530 15° [10] | 1.5577 16° [10] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4,4′-Di-*tert*-butylbiphenyl**  | | | | |
| 128–129 [14,15]<br>122 [68] | 190–192 13 [14,15] | | | |
| **2,2′,3,3′,4,4′,6,6′-Octamethylbiphenyl**  | | | | |
| 121–122 [38] | | | | |
| $C_{22}H_{30}$<br>**4,4′-Di-*tert*-pentylbiphenyl**  | | | | |
| | 224 16 [10] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Dihexylbiphenyl** (a) | | | | |
| −28 [59] | 185–188 3.5 [59] | 0.9343 [59] | 1.5449 [59] | |
| −30 [59] | 192–194 2.5 [59] | 0.9349 [59] | 1.5452 [59] | |
| | 180–181 2.5 [59] | 0.9353 [59] | 1.5467 15° [59] | |
| | | | 1.5470 15° [59] | |
| | | | 1.5473 15° [59] | |

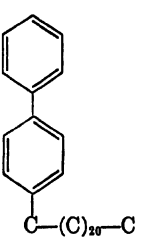
(a) The structure of this compound is not given, but the author indicates that there are three isomeric forms.

| | | | | |
|---|---|---|---|---|
| $C_{30}H_{46}$ | | | | |
| **1-Phenyl-4-octadecylbenzene**  | | | | |
| 79.81 [52] 77.5–78 [51] | 270–275 5 [52] | 0.9138(a) 25° [51] | 1.5031 80° [80] | |

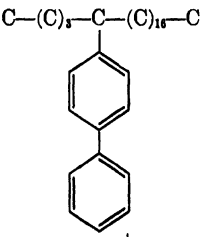
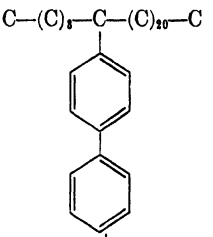
(a) This density is an extrapolated value.

| | | | | |
|---|---|---|---|---|
| **Trihexylbiphenyl** (a) | | | | |
| −22 [59] | 228–231 2.5 [59] | 0.9140 [59] | 1.5302 [59] | |
| −23 [59] | 220–222 2.5 [59] | 0.9154 [59] | 1.5327 [59] | |
| | 210–212 2 [59] | 0.9167 [59] | 1.5332 [59] | |
| | | | 1.5330 15° [59] | |

(a) The structure of this compound is not given but the author indicates that there are three isomeric forms.

| | | | | |
|---|---|---|---|---|
| $C_{34}H_{54}$ | | | | |
| **1-Phenyl-4-docosylbenzene**  | | | | |
| 82–84.5 [51] | | 0.9092(a) 25° [51] | | |

(a) This density is probably an extrapolated value.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **5-*p*-Biphenylyldocosane**  | | | | |
| 41.5–43 [51,52] | 200–201 2 [52] | 0.899 25° [51] | 1.5158 [51] | |
| $C_{38}H_{62}$ **5-*p*-Biphenylylhexacosane**  | | | | |
| 44–45 [51] | | 0.9269(a) 25° [51] | | |

(a) This density is an extrapolated value.

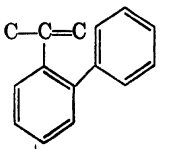
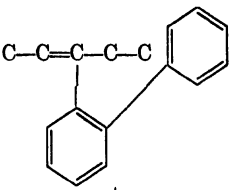
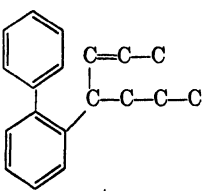
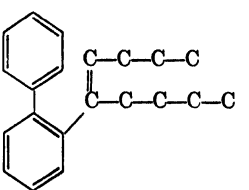
### References on Biphenyl with Alkyl Substitutions

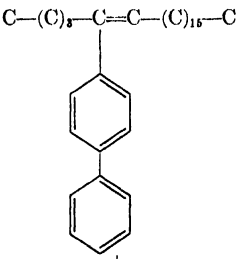
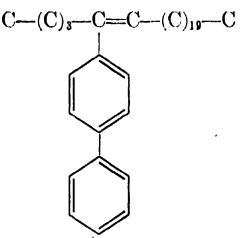

1. Adam, P., Ann. chim. phys. [6] **15**, 224 **1888.**
2. Adam, P., Bull. soc. chim. [2] **47**, 686 **1887.**
3. Adkins, H., W. H. Zartmann, and H. Cramer, J. Am. Chem. Soc. **53**, 1425 **1931.**
4. Austin, J. B., and I. A. Black, J. Am. Chem. Soc. **52**, 4552 **1930.**
5. Austin, P. R., J. Am. Chem. Soc. **54**, 3726 **1932.**
6. Bennett, G. M., and E. E. Turner, J. Chem. Soc. **105**, 1057 **1914.**
7. Berger, H., J. prakt. Chem. [2] **133**, 331 **1932.**
8. Bert, L., Compt. rend. **177**, 452 **1923.**
9. Bock, L. H., W. W. Moyer, and R. Adams, J. Am. Chem. Soc. **52**, 2054 **1930.**
10. Boedtker, E., Bull. soc. chim. [4] **45**, 645 **1929.**
11. Brüll, L., Gazz. chim. ital. **65**, 19 **1935.**
12. Carnelley, T., J. Chem. Soc. **32**, 653 **1872.**
13. Carnelley, T., J. Chem. Soc. **37**, 701 **1880.**
14. Chichibabin, S. Elgazin, and V. Lengold, Bull. soc. chim. [4] **43**, 238 **1928.**
15. Chichibabin, A., S. Elgazin, and V. Lengold, J. Russ. Phys. Chem. Soc. **60**, 347 **1928**; C.A. **22**, 2744 **1928.**
16. Corbellini, A., and C. Viganò, Gazz. chim. ital. **65**, 735 **1935.**
17. Crossley, A. W., and C. H. Hampshire, J. Chem. Soc. **99**, 721 **1911.**
18. Dietrich, W., Helv. Chim. Acta **8**, 149 **1925.**
19. Döbner, O., Ber. **9**, 271 **1876.**
20. Egloff, G., B. L. Levinson, and H. T. Bollman, Universal Oil Products Co. Booklet, No. 132.

21. Gattermann, L., Ann. **347**, 347 1906.
22. Gelissen, H., and P. H. Hermans, Ber. **58**, 476 1925.
23. Ghigi, E., Ber. **70**, 2469 1937.
24. Ghigi, E., Ber. **71**, 684 1938.
25. Gilman, H., and J. E. Kirby, J. Am. Chem. Soc. **51**, 1571 1929.
26. Gomberg, M., and J. C. Pernert, J. Am. Chem. Soc. **48**, 1372 1926.
27. Grieve, W. S. M., and D. H. Hey, J. Chem. Soc. 1934, 1797.
28. Grimm, H. G., M. Günther, and H. Tittus, Z. physik. Chem. **14B**, 169 1931.
29. Grosse, A. V., J. M. Mavity, and V. N. Ipatieff, J. Org. Chem. **3**, 448 1938.
30. Grüttner, Gerhard, and Gertrud Grüttner, Ber. **51**, 1293 1918.
31. Hey, D. H., J. Chem. Soc. 1932, 2636.
32. Hey, D. H., and E. R. B. Jackson, J. Chem. Soc. 1934, 645.
33. Jacobson, P., Ann. **427**, 142 1922.
34. Jacobson, P., Ber. **28**, 2541 1895.
35. Klages, A., Ber. **39**, 2306 1906.
36. Klages, A., Ber. **40**, 2360 1907.
37. Kliegl, A., and H. Huber, Ber. **53**, 1646 1920.
38. Knauf, A. E., and R. Adams, J. Am. Chem. Soc. **55**, 4704 1933.
39. Koelsch, C. F., J. Am. Chem. Soc. **54**, 4744 1932.
40. Krishnan, K. S., and S. Banerjee, Trans. Roy. Soc. (London) **234**, 265 1935.
41. Kruber, O., Ber. **65**, 1382 1932.
42. Lehmann, E., Ber. **71**, 1869 1938.
43. Lehmann, E., and W. Pasche, Ber. **68**, 1146 1935.
44. Liebermann, C., and M. Kardos, Ber. **46**, 198 1913.
45. Loevenich, J., and K. Sipmann, J. prakt. Chem. [2] **124**, 127 1929.
46. Mayer, F., and K. Freitag, Ber. **54**, 347 1921.
47. Meyer, H., and A. Hoffmann, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **125/126**, Abt. IIb, 449 1916-1917.
48. Mieleitner, K., Z. Kryst. Mineral. **55**, 51 1915-1920.
49. Mieleitner, K., Z. Kryst. Mineral. **55**, 631 1920.
50. Mieleitner quoted by P. Groth, "Chemische Krystallographie" **5**, 7 1919.
51. Mikeska, L. A., Ind. Eng. Chem. **28**, 970 1936.
52. Mikeska, L. A., C. F. Smith, and E. Lieber, J. Org. Chem. **2**, 499 1938.
53. Moyer, W. W., and R. Adams, J. Am. Chem. Soc. **51**, 630 1929.
54. Müller, E., and T. Töpel, Ber. **72**, 273 1939.
55. Oddo, G., and A. Curatolo, Atti accad. Lincei [5] **4**, 211 1895.
56. Oddo, G., and A. Curatolo, Gazz. chim. ital. **25**, I, 126 1895.
57. Perrier, G., Bull. soc. chim. [3] **7**, 180 1892.
58. Pickett, L. W., G. F. Walter, and H. France, J. Am. Chem. Soc. **58**, 2296 1936.
59. Pokrovskaya, E. S., and R. Y. Sushchik, J. Gen. Chem. (U.S.S.R.) **11**, 170 1941; C.A. **35**, 7388 1941.
60. Pope, G. W., and M. T. Bogert, J. Org. Chem. **2**, 276 1937-1938.
61. Pummerer, R., and L. Selisberger, Ber. **64**, 2477 1931.
62. Razuvaev, G. A., and M. M. Koton, Ber. **66**, 1210 1933.
63. Rupe, H., and J. Burgin, Ber. **44**, 1218 1911.
64. Rupe, H., and W. Tomi, Ber. **47**, 3064 1914.
65. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 1915.
66. Sakellarios, E., and T. Kyrimis, Ber. **57**, 322 1924.
67. Schiff, R., Ann. **223**, 247 1884.
68. Schreiner, E., J. prakt. Chem. [2] **81**, 422 1910.
69. Schultz, G., Ann. **207**, 361 1881.
69A. Schultz, G., Ber. **17**, 463 1884.
70. Schultz, G., G. Rohde, and F. Vicari, Ann. **352**, 111 1907.
71. Schulze, K. E., Ber. **17**, 1203 1884.
72. Sherwood, I. R., W. F. Short, and R. Stansfield, J. Chem. Soc. 1932, 1832.

73. Stolle, E., Ber. **21**, 1096 **1888.**
74. Szperl, L., Congr. intern. quim. pura aplicada, 9th Congress, Madrid **4**, 233 **1934**; C.A. **32**, 2105 **1938.**
75. Turner, E. E., J. Proc. Roy. Soc. N.S. Wales **54**, 37 **1920.**
76. Ullmann, F., Ann. **332**, 38 **1904.**
77. van Alpen, J., Rec. trav. chim. **50**, 1111 **1931.**
78. von Auwers, K., and W. Jülicher, Ber. **55**, 2167 **1922.**
79. Weiler, M., Ber. **29**, 111 **1896.**
80. Willingham, C. B., J. Research Natl. Bur. Standards **22**, 321 **1937.**
81. Wittig, G., and M. Leo, Ber. **63**, 943 **1930.**
82. Zartman, W. H., and H. Adkins, J. Am. Chem. Soc. **54**, 3398 **1932.**
83. Zincke, T., Ber. **4**, 396 **1871.**

3. BIPHENYL WITH ONE ALKENYL SUBSTITUTION, $C_nH_{2n-16}$

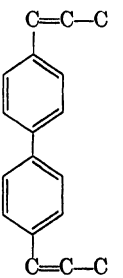
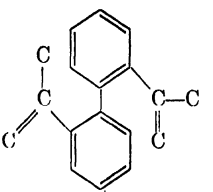
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Isopropenyl-2-phenylbenzene  | 125–128 7[1] | | | |
| $C_{17}H_{18}$ | | | | |
| 3-*o*-Biphenylylpentene-2  | 138–141 7[1] | | | |
| $C_{19}H_{22}$ | | | | |
| 4-*o*-Biphenylylheptene-2  | 155–157 8[1] | | | |
| $C_{21}H_{26}$ | | | | |
| 5-*o*-Biphenylylnonene-4  | 178–179 7[1] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **5-*p*-Biphenylyldocosene-5**  | | | | |
| 37–38 [2] | | 0.9120(a) 25° [2] | 1.5306 25° [2] | |
| (a) This density is an extrapolated value. | | | | |
| $C_{38}H_{60}$ **5-*p*-Biphenylylhexacosene-5**  | | | | |
| 37–39 [2] | | 0.9052(a) 25° [2] | 1.5252 25° [2] | |
| (a) This density is an extrapolated value. | | | | |

**References on Biphenyl with One Alkenyl Substitution**

1. Bradsher, C. K., and S. T. Amore, J. Am. Chem. Soc. **65**, 2016 **1943.**
2. Mikeska, L. A., Ind. Eng. Chem. **28**, 970 **1936.**

4. BIPHENYL WITH TWO ALKENYL SUBSTITUTIONS, $C_nH_{2n-18}$

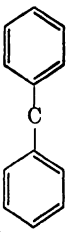
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4,4′-Di-(propen-1″-yl)-biphenyl**  | | | | |
| 186[2] | | | | |
| **2,2′-Diisopropenylbiphenyl**  | | | | |
| 97–98[1] | | | | |

**References on Biphenyl with Two Alkenyl Substitutions**

1. Cook, D. E., and E. E. Turner, J. Chem. Soc. 1937, 117.
2. Quelet, R., Bull. soc. chim. [4] 45, 255 1929.

## V. TWO PHENYL SUBSTITUTIONS ON ALIPHATICS

1. Two Phenyl Substitutions on Alkanes $C_nH_{2n-14}$
2. Two Phenyl Substitutions on Alkenes $C_nH_{2n-16}$
3. Two Phenyl Substitutions on Alkynes $C_nH_{2n-18}$
4. Two Phenyl Substitutions on Alkadienes $C_nH_{2n-18}$
5. Two Phenyl Substitutions on Alkenynes $C_nH_{2n-20}$
6. Two Phenyl Substitutions on Alkatrienes $C_nH_{2n-20}$
7. Two Phenyl Substitutions on Alkadiynes $C_nH_{2n-22}$
8. Two Phenyl Substitutions on Alkadienynes $C_nH_{2n-22}$
9. Two Phenyl Substitutions on Alkatetraenes $C_nH_{2n-22}$
10. Two Phenyl Substitutions on Alkapentaenes $C_nH_{2n-24}$
11. Two Phenyl Substitutions on Alkahexaenes $C_nH_{2n-26}$
12. Two Phenyl Substitutions on Alkaheptaenes $C_nH_{2n-28}$
13. Two Phenyl Substitutions on Alkatetraynes $C_nH_{2n-30}$
14. Two Phenyl Substitutions on Alkaoctaenes $C_nH_{2n-30}$
15. Two Phenyl Substitutions on Alkaundecaenes $C_nH_{2n-36}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Diphenylmethane**  | | | | |
| **25.9** | **263.2** | **1.0059** | | Crit. Temp., (°C) |
| 28 [66] | 264–266 [82] | 1.0060 [95] | 1.57683 [95] | 555.8 [83] |
| 27–28 [5] | 265.6 [54] | 1.006 [47] | 1.5770 [36] | 529.0 [100] |
| 27.04 [8] | 265 [6] | 1.008 [25] | 1.577 [47] | 497.0 [33,34,72] |
| 27(a) | 264–265 [74] | 1.0152 210.0° [23] | 1.5772 [79] | Crit. Pressure, (mm Hg) |
| 26–27 [14,84,95,110] | 264.7 [71] | 1.0879 153.0° [23] | 1.5709 28.4° [105] | |
| 26.5 [80] | 264 [106] | 0.9181 131.1° [26] | 1.5649 25° [91] | |
| 26–26.5 [98,112] | 262–264 [40] | 1.1264 107.9° [23] | 1.5697 25° [59] | 21,432.0 [34] |
| 26.4 [2,41] | 263 [88,108] | 0.9443 100° [49] | 1.57390 25° [7] | |
| 26.3 [15,27] | 262–263 [80,84] | 0.94402 99° [71] | 1.5745 25° [73] | |
| 26.1 [64,93] | 262 [11,75,76,100] | 0.9844 $D_{95}^{95}$ [71] | 1.5782 25° [67] | |
| 26(b) | 261–262(c) | | 1.57884 16.8° [2] | |
| 25–26 [6,81,83,87,107] | 260–262 [18,32,51] | 0.9851 $D_{90}^{90}$ [71] | 1.56957 16° [44] | |
| 25.64 [62] | 261.5 [50] | 0.9860 $D_{85}^{85}$ [71] | 1.51975 $n_{H\alpha}^{131.1}$ [26] | |
| 25.6 [27] | 261 [24,59,67,77,104] | | 1.53474 $n_{H\alpha}^{99.0}$ [71] | |
| 25.5 [13,61,96] | 260–261 [44,97,107] | 0.9870 $D_{80}^{80}$ [71] | 1.54655 $n_{H\alpha}^{75.7}$ [26] | |
| 25–25.5 [36] | 259–261 [87] | 1.1519 75.9° [23] | 1.56954 $n_{H\alpha}^{26}$ [26] | |
| 25.2 [38,69] | 260 [20,29,43] | 0.9626 75.7° [26] | 1.57145 $n_{H\alpha}^{20.0}$ [95] | |
| 25.09 ± 0.01 [19] | 258–260 [92] | 0.9881 $D_{75}^{75}$ [71] | 1.57304 $n_{H\alpha}^{16.8}$ [2] | |
| 25 [30,31] | 259 [57,58] | 0.9893 $D_{70}^{70}$ [71] | 1.57653 $n_{H\alpha}^{11}$ [26] | |
| 24–25 [68,102,111] | 258–259 [91] | 0.9906 $D_{65}^{65}$ [71] | 1.53839 $n_{H\beta}^{131.1}$ [26] | |
| 24.8 [35,42] | 262.3 766 [2] | | 1.55390 $n_{H\beta}^{99.0}$ [71] | |
| 24.68 [70] | 261.0 | 0.9919 $D_{60}^{60}$ [71] | 1.56616 $n_{H\beta}^{75.7}$ [26] | |
| 24.5 [3,86] | –261.8 745 [60] | 0.9746 59.0° [63] | 1.59002 $n_{H\beta}^{26}$ [26] | |
| 24–24.5 [92] | 250.0 551.5 [17] | 0.9934 $D_{55}^{55}$ [71] | 1.59183 $n_{H\beta}^{20.0}$ [95] | |
| 24.45 [70] | 217.0 240.1 [17] | 1.1724 54.3° [23] | 1.59390 $n_{H\beta}^{16.8}$ [2] | |
| 24.0 [46] | 175.4– | 0.9950 $D_{50}^{50}$ [71] | 1.59730 $n_{H\beta}^{11}$ [26] | |
| 24 [28,90,94] | 175.5 72 [53] | 0.9967 $D_{45}^{45}$ [71] | 1.56615 $n_{H\gamma}^{99.0}$ [71] | |
| | 158 35 [44] | 1.1806 43.59° [8] | 1.60483 $n_{H\gamma}^{20.0}$ [95] | |
| | 141 27 [44] | 0.9987 $D_{40}^{40}$ [71] | 1.61731 $n_{H\gamma}^{16.8}$ [2] | |
| | 138–143 24 [10] | 1.1851 39.24° [8] | (e) | |
| | 134 21 [105] | 1.1876 37.43° [8] | | |
| | 133–135 16 [95] | 1.1893 35.20° [8] | | |
| | 142–144 15 [84] | 1.0009 $D_{35}^{35}$ [71] | | |
| | 128–131 12 [10] | 1.0032 $D_{30}^{30}$ [71] | | |
| | 128–129 11 [65] | | | |
| | 125–128 10 [85] | | | |
| | 117–118 9 [42] | | | |
| | 90–91 4 [88] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Diphenylmethane** (*Continued*) | 99–102 1 [28] | 1.1962 29.27° [8]<br>1.1983 27.15° [8]<br>1.0008 26° [26]<br>1.2016 25.01° [8]<br>1.0000 25° [67]<br>1.0024 25° [73]<br>1.0043 25° [59]<br>1.0056 $D_{25}^{25}$ [71]<br>1.2037 23.20° [8]<br>1.2058 21.07° [8]<br>1.006 $D_{20}^{20}$ [55]<br>1.2076 19.41° [8]<br>1.3333 17.79° (solid) [8]<br>1.00790 16.8° [2]<br>1.0126 11° [26]<br>1.3421 10.18° (solid) [8] (d) | | * |

* $\frac{dD}{dt} = -0.0007539[1 + 0.0009326(t-20)]/°C$ (10 to 131°C)

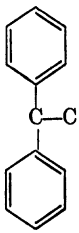
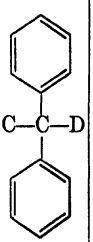
(a) The melting point 27 is found in references 1, 4, 9, 11, 22, 27, 37, 74, 75, 76, 77, 78, 106.
(b) The melting point 26 is found in references 10, 12, 14, 21, 24, 39, 45, 48, 49, 52, 56, 57, 58, 82, 88, 89, 99, 103, 104.
(c) The boiling point 261-262 is found in references 5, 7, 16, 22, 101, 110, 111.
(d) The densities on this compound fall into two distinct and widely separated ranges. The bold face value is calculated on the lower range since it contains more data.
(e) Refractive indices at other lines may be found in reference 71.

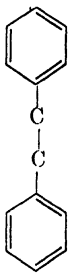
## Diphenylmethane References


1. Adams, R., and J. R. Marshall, J. Am. Chem. Soc. **50**, 1970 **1928.**
2. Anderlini, F., Gazz. chim. ital. **25**, II, 127 **1895.**
3. Ardaliane, D., J. Gen. Chem. (U.S.S.R.) **8**, 1887 **1938.**
4. Bergmann, E., L. Engel, and H. A. Wolff, Z. physik. Chem. **17B**, 81 **1932.**
5. Biltz, H., Ann. **296**, 219 **1897.**
6. Biltz, H., and K. Seydel, Ber. **46**, 138 **1913.**
7. Blacet, F. E., P. A. Leighton, and E. P. Bartlett, J. Phys. Chem. **35**, 1935 **1931.**
8. Block, H., Z. physik. Chem. **78**, 385 **1912.**
9. Boeseken, J., Rec trav. chim. **22**, 301 **1903.**
10. Bredereck, H., G. Lehmann, C. Schönfeld, and E. Fritzsche, Ber. **72**, 1414 **1939.**
11. Busch, M., and M. Fleischmann, Ber. **43**, 740 **1910.**
12. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 **1936.**
13. Castille, A., Bull. classe sci. Acad. roy. Belg. [5] **12**, 498 **1926.**
14. Cawley, C. M., Fuel **12**, 366 **1933.**
15. Centnerszwer, M., Z. physik. Chem. **46**, 427 **1903.**
16. Chichibabin, A. E, Ber. **44**, 441 **1911.**
17. Crafts, J. M., J. chim. phys. **13**, 103 **1915.**

18. Danilov, S., and E. Venus-Danilova, Ber. **59**, 377 **1926.**
19. De Vries, T., and H. A. Strow, J. Am. Chem. Soc. **61**, 1796 **1939.**
20. Döbner, O., Ann. **210**, 246 **1881.**
21. Doer, W. H., Ber. **5**, 795 **1872.**
22. Dupont, J., Am. Perfumer **6**, 167; J. Soc. Chem. Ind. **30**, 1230 **1911.**
23. Dutoit, P., and L. Friederich, Arch. sci. phys. nat. [4] **9**, 105 **1900.**
24. Engler, C., Ber. **11**, 926 **1878.**
25. Estermann, J., Z. physik. Chem. **1B**, 134 **1928.**
26. Eykman, J. F., Rec. trav. chim. **12**, 157 **1893.**
27. Eykman, J. F., Z. physik. Chem. **4**, 497 **1889.**
28. Földi, Z., Ber. **61**, 1609 **1928.**
29. Friedel, C., and J. M. Crafts, Ann. chim. phys. [6] **1**, 449 **1884.**
30. Friedel, C., and J. M. Crafts, Ann. chim. phys. [6] **11**, 263 **1887.**
31. Friedel and Crafts, Bull. soc. chim. [2] **41**, 322 **1884.**
32. Gasopoulos, I., Praktika Akad. Athenon **7**, 47 **1932**; Chem. Zentr. **1933**, II, 43.
33. Goldhammer, D. A., Z. physik. Chem. **71**, 577 **1910.**
34. Guye, P. A., and E. Mallet, Compt. rend. **133**, 1287 **1901.**
35. Hare, W. A., and E. Mack, Jr., J. Am. Chem. Soc. **54**, 4272 **1932.**
36. Hennion, G. F., and R. A. Kurtz, J. Am. Chem. Soc. **65**, 1001 **1943.**
37. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **18**, 881 **1912.**
38. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 **1930.**
39. Hurd, C. D., R. Christ, and C. L. Thomas, J. Am. Chem. Soc. **55**, 2589 **1933.**
40. Huston, R. C., and T. E. Friedemann, J. Am. Chem. Soc. **38**, 2527 **1916.**
41. Jena, A., Ann. **155**, 77 **1870.**
42. Ju, T. Y., C. E. Wood, and F. H. Garner, J. Inst. Petroleum Tech. **28**, 159 **1942.**
43. Kashtanov, L. I., J. Gen. Chem. (U.S.S.R.) **2**, 515 **1932**; C.A. **27**, 975 **1933.**
44. Klages, A., and P. Allendorff, Ber. **31**, 998 **1898.**
45. Kotyukov, I., J. Russ. Phys. Chem. Soc. **47**, 1087 **1915**; Chem. Zentr. **1916**, I, 1071.
46. Kremann, R., and J. Fritsch, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **129**, Abt. IIb, 633 **1920.**
47. Krollpfeiffer, F., Ann. **430**, 161 **1923.**
48. Kubota, B., and T. Hayashi, Bull. Chem. Soc. Japan **1**, 67 **1926.**
49. Kurnakov, N. S., D. Krotkov, M. Oksmann, N. Beketov, S. Perelmutter, F. Kanov, and J. Finkel, J. Russ. Phys. Chem. Soc. **47**, 558 **1915**; Z. anorg. allgem. Chem. **135**, 81 **1924.**
50. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918.**
51. Lal, J. B., and S. Dutt, J. Indian Chem. Soc. **9**, 565 **1932.**
52. Lal, J. B., and S. Dutt, J. Indian Chem. Soc. **12**, 389 **1935.**
53. Larsen, R. G., R. E. Thorpe, and F. A. Armfield, Ind. Eng. Chem. **34**, 183 **1942.**
54. Lecat, M., Ann. soc. sci. Bruxelles **48B**, 113 **1928.**
55. Lovell, W. G., J. M. Campbell, F. K. Signaigo, and T. A. Boyd, Ind. Eng. Chem. **26**, 475 **1934.**
56. Majima, R., K. Nagaoka, and K. Yamada, Ber. **55**, 215 **1922.**
57. Mascarelli, L., and I. Musatty, Atti accad. Lincei [5] **19**, I, 213 **1910.**
58. Mascarelli, L., and I. Musatty, Gazz. chim. ital. **41**, I, 103 **1911.**
59. McKenna, J. F., and F. J. Sowa, J. Am. Chem. Soc. **59**, 470 **1937.**
60. McVickers, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **127**, 999 **1925.**
61. Meyer, V., and C. Wurster, Ber. **6**, 963 **1873.**
62. Miolati, A., Z. physik. Chem. **9**, 649 **1892.**
63. Morgan, J. L. R., and G. K. Daghlian, Z. physik. Chem. **78**, 169 **1912.**
64. Mortimer, F. S., J. Am. Chem. Soc. **44**, 1416 **1922.**
65. Nametkin, S. S., and D. Kursanov, J. Russ. Phys. Chem. Soc. **60**, 917 **1928**; C.A. **23**, 2162 **1929.**
66. Nef, J. V., Ann. **298**, 202 **1897.**
67. O'Connor, M. J., and F. J. Sowa, J. Am. Chem. Soc. **60**, 125 **1938.**
68. Oliviet, S. C. J., Rec. trav. chim. **45**, 817 **1926.**
69. Parks, G. S., and H. M. Huffman, Ind. Eng. Chem. **23**, 1138 **1931.**

70. Paterno, E., and. G. Ampola, Gazz. chim. ital. 27, I, 481 1897.
71. Perkin, W. H., J. Chem. Soc. 69, 1025 1896.
72. Radice quoted by A. Guye and E. Mallet, Arch. sci. phys. nat. [4] 13, 30 1902.
73. Riedinger, A., Physik. Z. 39, 380 1938.
74. Sabatier, P., and M. Murat, Ann. chim. [9] 4, 253 1915.
75. Sabatier, P., and M. Murat, Compt. rend. 156, 1430 1913.
76. Sabatier, P., and M. Murat, Compt. rend. 156, 1951 1913.
77. Sabatier, P., and M. Murat, Compt. rend. 157, 1496 1913.
78. Sabatier, P., and M. Murat, Compt. rend. 158, 760 1914.
79. Schlubach, H. H., and H. Miedel, Ber. 57, 1682 1924.
80. Schmidlin, J., Compt. rend. 136, 1560 1903.
81. Sharma, V. N., and S. Dutt, J. Indian Chem. Soc. 12, 774 1935.
82. Shima, G., Mem. Coll. Sci. Kyoto Imp. Univ. 13A, 315 1930.
83. Shorygin, P., Ber. 59, 2510 1926.
84. Sornet, R., Rev. chim. ind. 38, 8 1929.
85. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 122, Abt. IIb, 1563 1913.
86. Sreerangachar, H. B., and M. Sreenivassaya, Biochem. J. 29, 295 1935.
87. Stadnikov, G., and L. Kashtanov, Ber. 61, 1389 1928.
88. Staedel, W., Ann. 194, 307 1878.
89. Staudinger, H., and A. Rheiner, Helv. Chim. Acta 7, 8 1924.
90. Steinkopf, W., and A. Wolfram, Ann. 430, 113 1923.
91. Stephens, H. N., and F. L. Roduta, J. Am. Chem. Soc. 57, 2380 1935.
92. Straus, F., and H. Grindel, Ann. 439, 276 1924.
93. Tammann, G., Nachr. Ges. Wiss. Göttingen, Math. physik. Klasse Fachgruppen III 1913, 335.
94. Vansheidt, A., and B. Moldavski, Ber. 64, 917 1931.
95. von Auwers, K., and A. Fruhling, Ann. 422, 196 1921.
96. von Baeyer, Ber. 6, 963 1873.
97. von Liebig, H., J. prakt. Chem. [2] 72, 105 1905.
98. von Meyer, E., J. prakt. Chem. [2] 82, 538 1910.
99. Vorländer, D., and C. Siebert, Ber. 39, 1024 1906.
100. Walden, P., Z. physik. Chem. 65, 129 1909.
101. Waser, E., Helv. Chim. Acta 8, 758 1925.
102. Wittig, G., Ber. 64, 437 1931.
103. Wolf, K. L., and H. Weghofer, Z. physik. Chem. 39B, 194 1938.
104. Wolff, L., Ann. 394, 86 1912.
105. Wooster, C. B., and J. F. Ryan, J. Am. Chem. Soc. 56, 1133 1934.
106. Zelinskiĭ, N. D., and M. V. Gaverdovskaya, Ber. 64, 435 1931.
107. Zelinskiĭ, N. D., I. Tits, and M. Gaverdovskaya, Ber. 59, 2590 1926.
108. Ziegler, J. H., Ber. 21, 779 1888.
109. Ziegler, K., and F. Ditzel, Ann. 473, 194 1929.
110. Zincke, T., Ann. 159, 367 1871.
111. Zincke, T., Ber. 4, 298 1871.
112. Zincke, T., Ber. 4, 509 1871.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenylethane**  | **268.8** | | | |
| | 270–272 [134,135] | 0.9875 [170] | 1.5761 [168] | |
| | 268–271 [60] | 0.9997 [148] | 1.5702 25° [149] | |
| | 268–270 [73,80,123] | 1.001 [174] | 1.573 21° [134,135] | |
| | 268–269 [6,170] | 1.0039 [64] | 1.5755 14° [80] | |
| | 267–269 [149] | 0.9877 25° [79] | 1.56837 $n_{H\alpha}^{20}$ [174] | |
| | 148 22 [79] | 0.9998 25° [64] | 1.58776 $n_{H\beta}^{20}$ [174] | |
| | 148–153 20 [58] | 1.006 21° [135] | 1.57380 $n_{He}^{20}$ [174] | |
| | 150 20 [174] | 1.006 $D_0^{21}$ [134] | | |
| | 150 16 [5,7] | 1.006 14° [80] | | |
| | 148 15 [148] | | | |
| | 147 15 [1] | | | |
| | 143–144 15 [142] | | | |
| | 143 15 [16] | | | |
| | 145 13 [7] | | | |
| | 137–138 12.5 [20] | | | |
| | 136 12 5 [145] | | | |
| | 136 12 [80,164] | | | |
| | 131–132 11 [98] | | | |
| | 130–133 10 [169] | | | |
| | 128–129 8 [2] | | | |
| **Methyldiphenylmethane-d**  | 136–137 12 [20] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **1,2-Diphenylethane** (Dibenzyl)  | | | | | | |
| **52.0** | **284.7** | **0.9661** | **50°** | | | Crit. Temp., (°C) |
| 53.6 [61] | 286.3 [82] | 0.8438 | 210.2° [41] | 1.5704 | 25° [128] | 492 [161] |
| 53.4 [99] | 285 [54] | 0.867 | 178° [86] | 1.53385 | $n_{H\alpha}^{80.6}$ [47] | |
| 52.5–53.2 [162] | 284–285 [71] | 0.8828 | 158.8° [41] | 1.55257 | $n_{H\beta}^{80.6}$ [47] | |
| 53.0 [46,75] | 284.9 [88] | 0.891 | 147° [86] | | | |
| 53(a) | 284(e) | 0.913 | 120° [86] | | | |
| 52.5–53 [1,28,143] | 283–284 [69] | 0.9212 | 107.8° [41] | | | |
| 52–53 [3,66,169] | 283 [87] | 0.9283 | 100° [46] | | | |
| 52.5 [90,91,120,134,137,155] | 281–282 [121] | 0.939 | 85° [86] | | | |
| 52–52.5 [6] | 281–282 758 [33] | 0.9416 | 80.6° [47] | | | |
| 51.5–52.5 [27,34] | 276–278 756 [104] | 0.9454 | 75.7° [41] | | | |
| 52.3 [140] | 240.1 250 [82] | 0.9713 | $D_{75}^{75}$ [121] | | | |
| 52.21 [15] | 205.7 100 [82] | 0.9725 | $D_{70}^{70}$ [121] | | | |
| 52.0 [11,29] | 170 17 [7] | 1.0254 | 68.83° [15] | | | |
| 52(b) | 150–155 17 [37] | 1.0283 | 65.63° [15] | | | |
| 51.5–52 [30,56,96,97] | 150–155 11 [124] | 0.9738 | $D_{65}^{65}$ [121] | | | |
| 51–52(c) | 158 10 [126] | 1.0319 | 62.32° [15] | | | |
| 51.8 [19,163] | 135 10 [145] | 1.0324 | 60.71° [15] | | | |
| 51.65 [56] | | 0.9581 | 60° [46] | | | |
| 51.5 [4,7,156] | | 0.9752 | $D_{60}^{60}$ [121] | | | |
| 51.4 [119,121] | | 1.0342 | 58.63° [15] | | | |
| 51.3 [10,48,56,87] | | 0.958 | 58° [86] | | | |
| 51.25 [89] | | 1.0371 | 55.23° [15] | | | |
| 51.2 [48] | | 0.9766 | $D_{55}^{55}$ [121] | | | |
| 51.0 [70] | | 1.0140 | $D_{13}^{53.0}$ [11] | | | |
| 51(d) | | 1.0423 | 52.3° [140] | | | |
| 50–51 [3,53,146] | | 1.0401 | 52.21° [15] | | | |
| 50.8 [94] | | 1.0421 | 50.12° [15] | | | |
| 50.5 [9,43] | | 0.9655 | 50° [46] | | | |
| 50 [59,92,145,151,165] | | 0.9782 | $D_{50}^{50}$ [121] | | | |
| | | 1.0452 | 46.79° [15] | | | |
| | | 1.1011 ± 0.0015 | 46° [130] | | | |
| | | 1.0495 | 42.61° [15] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^0$ | Additional Data |
|---|---|---|---|---|
| **1,2-Diphenylethane** (*Continued*) | | 0.9876 25° [128]<br>1.1772 16.00° (solid) [15]<br>1.1811 12.21° (solid) [15]<br>1.1865 3.85° (solid) [15]<br>1.0027 0° [46]<br>1.104 0° [175]<br>1.100(f) [12]<br>1.105(f) [65,129]<br>1.110(f) (solid) [105] (g) | | * |

* $\frac{dD}{dt} = -0.0007643[1+0.00001317(t-50)]/°C$ (0 to 210°C)

(a) The melting point 53 is found in references 22, 25, 35, 110, 131, 157, 158, 171.

(b) The melting point 52 is found in references 7, 8, 13, 14, 17, 21, 23, 24, 26, 31, 32, 33, 40, 42, 45, 49, 50, 52, 54, 57, 63, 67, 68, 69, 72, 76, 77, 78, 81, 85, 86, 93, 95, 101, 102, 103, 109, 111, 113, 116, 118, 122, 124, 125, 127, 129, 133, 138, 139, 147, 150, 152, 153, 154, 159, 160, 166, 167, 172.

(c) The melting point 51-52 is found in references 38, 44, 83, 100, 107, 112, 141.

(d) The melting point 51 is found in references 7, 18, 36, 39, 51, 55, 106, 108, 114, 115, 117, 126, 132, 134, 135.

(e) The boiling point 284 is found in references 7, 27, 74, 84, 103, 134, 135, 136, 137, 144, 157, 158, 161, 173.

(f) The temperature for this density is not given.

(g) The densities on this compound fall into two distinct and widely separated ranges. The bold face value is calculated on the lower range since it contains more data.

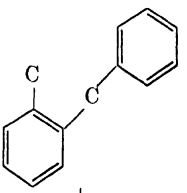
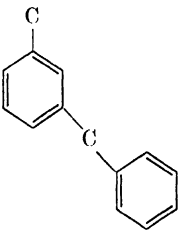
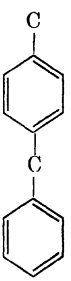
## Diphenylethane References

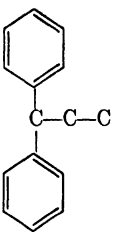
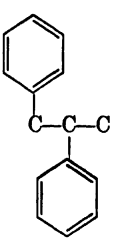

1. Adams, R., and J. R. Marshall, J. Am. Chem. Soc. **50**, 1970 **1928.**
2. Adkins, H., B. Wojcik, and L. Covert, J. Am. Chem. Soc. **55**, 1669 **1933.**
3. Alexander, L. L., and R. C. Fuson, J. Am. Chem. Soc. **58**, 1745 **1936.**
4. Alexander, L. L., Jacoby, and R. C. Fuson, J. Am. Chem. Soc. **57**, 2208 **1935.**
5. Angelbis, A., and R. Anschütz, Ber. **17**, 165 **1884.**
6. Anschütz, R., Ann. **235**, 150 **1886.**
7. Anschütz, R., Ann. **235**, 299 **1886.**
8. Aronheim, B., Ann. **171**, 219 **1874.**
9. Austin, J. B., and I. A. Black, J. Am. Chem. Soc. **52**, 4552 **1930.**
10. Banse, H., and G. S. Parks, J. Am. Chem. Soc. **55**, 3223 **1933.**
11. Beck, K., Z. physik. Chem. **48**, 641 **1904.**
12. Becker, K., and H. Rose, Z. Physik **14**, 369 **1923.**
13. Bennett, G. M., and E. E. Turner, J. Chem. Soc. **105**, 1057 **1914.**
14. Bergmann, M., and G. Weil, Ber. **63**, 1911 **1930.**
15. Block, H., Z. physik. Chem. **78**, 385 **1912.**
16. Bodendorf, K., J. prakt. Chem. [2] **129**, 337 **1931.**
17. Boedtker, E., Bull. soc. chim. [3] **25**, 843 **1901.**
18. Böeseken, J., and M. C. Bastet, Rec. trav. chim. **32**, 184 **1913.**

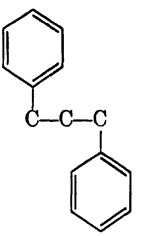
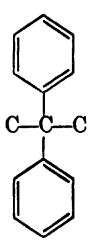
19. Bogoyavlenskiĭ, A., and N. Vinogradov, Z. physik. Chem. **64**, 251 1908.
20. Brown, W. G., C. J. Mighton, and M. Senkus, J. Org. Chem. **3**, 62 1938-1939.
21. Bruni, G., Atti accad. Lincei [5] 13, I, 626 1904.
22. Bruni, G., and M. Padoa, Atti accad. Lincei [5] 12, II, 119 1903.
23. Brunner, L., Ann. **151**, 133 1869.
24. Brunner, L., Bull. soc. chim. [2] **13**, 65 1870.
25. Buck, J. S., and S. S. Jenkins, J. Am. Chem. Soc. **51**, 2163 1929.
26. Busch, M., and B. Weiss, Ber. **33**, 2701 1900.
27. Cannizzaro, S., and A. Rossi, Ann. **121**, 250 1862.
28. Cannizzaro and Rossi, Compt. rend. **89**, 606 1879.
29. Castille, A., Bull. classe sci. Acad. roy. Belg. [5] **12**, 498 1926.
30. Cawley, C. M., Fuel **12**, 366 1933.
31. Ciamician, G., and P. Silber, Atti accad. Lincei [5] 19, I, 645 1910.
32. Ciamician, G., and P. Silber, Ber. **43**, 1536 1910.
33. Clemmensen, E., Ber. **47**, 681 1914.
34. Coleman, G. H., W. H. Holst, and R. D. Maxwell, J. Am. Chem. Soc. **58**, 2310 1936.
35. Corbellini, A., and C. Viganò, Gazz. chim. ital. **65**, 735 1935.
36. Crymble, C. R., A. W. Stewart, and R. Wright, Ber. **43**, 1188 1910.
37. Dean, P. M., and G. Berchet, J. Am. Chem. Soc. **52**, 2823 1930.
38. de Fazi, R., Atti congr. nazl. chim. pura applicata, 2nd Congr. 1926, 1287.
39. de Saint-Aunay, R. V., Chimie & industrie 29, 1011 1933.
40. Dewar, J., and J. Read, J. Soc. Chem. Ind. **55**, 347T 1936.
41. Dutoit, P., and L. Friederich, Arch. sci. phys. nat. [4] 9, 105 1900.
42. Eckert, A., Ber. **58**, 313 1925.
43. Egloff, G., B. L. Levinson, and H. T. Bollman, Universal Oil Products Co. Booklet No. 132.
44. Ekstrand, A. G., Ber. 9, 855 1876.
45. Erlenmeyer, E., Ann. **372**, 247 1910.
46. Evans, E. B., J. Inst. Petroleum Tech. **24**, 537 1938.
47. Eykman, J. F., Rec. trav. chim. **12**, 157 1893.
48. Ferry, J. D., and S. B. Thomas, J. Phys. Chem. **37**, 253 1933.
49. Fichter, F., and H. Stenzl, Helv. Chim. Acta **22**, 970 1939.
50. Forst, C., Ann. **178**, 370 1875.
51. Franchimont, A. P. N., Compt. rend. **75**, 1624 1872.
52. Freund, M., and P. Remse, Ber. **23**, 2859 1890.
53. Fuson, R. C., J. Am. Chem. Soc. **48**, 2681 1926.
54. Gardeur, A., Bull. classe sci. Acad. roy. Belg. [3] **34**, 920 1898.
55. Gardner, J. H., and P. Borgstrom, J. Am. Chem. Soc. **51**, 3375 1929.
56. Garelli, F., and F. Calzolari, Gazz. chim. ital. **29**, II, 258 1899.
57. Gasopoulos, I., Praktika Akad. Athenon **7**, 180 1932; C.A. **28**, 4726 1934; Chem. Zentr. **1933**, I, 534.
58. Gilman, H., and J. E. Kirby, J. Am. Chem. Soc. **48**, 1733 1926.
59. Goldenberg, H., Ann. **174**, 332 1874.
60. Goldschmeidt, G., Ber. **6**, 1501 1873.
61. Grimm, H. G., M. Günther, and H. Tittus, Z. physik. Chem. **14B**, 169 1931.
62. Guerbet, M., Bull. soc. chim [4] 3, 500 1908.
63. Hanhart, V., Ber. **15**, 898 1882.
64. Harkins, W. D., and D. T. Ewing, J. Am. Chem. Soc. **41**, 1977 1919.
65. Hengstenberg, J., and H. Mark, Z. Krist. **70**, 283 1929.
66. Henze, M., Ber. **31**, 3059 1898.
67. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **17**, 929 1911.
68. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **18**, 881 1912.
69. Houben, J., and L. Kesselkaul, Ber. **35**, 2519 1902.
70. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 1930.
71. Hugel, G., and J. Friess, Ann. combustibles liquides **6**, 1109 1931.
72. Hugel, G., and Gidaly, Bull. soc. chim. [4] **51**, 639 1932.

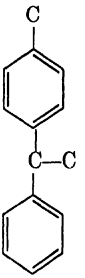
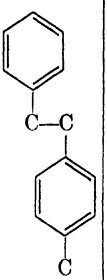
73. Huston, R. C., and T. E. Friedemann, J. Am. Chem. Soc. 40, 785 1918.
74. Jacobsen, O., Ber. 19, 1209 1886.
75. Ju, T. Y., C. E. Wood, and F. H. Garner, J. Inst. Petroleum Tech. 28, 159 1942.
76. Kade, R., J. prakt. Chem. [2] 19, 461 1879.
77. Keber, C., and A. Schwarz, Ber. 45, 1946 1912.
78. Kharasch, M. S., and H. S. Isbell, J. Am. Chem. Soc. 52, 2919 1930.
79. Klages, A., Ber. 35, 2646 1902.
80. Klages, A., and S. Heilmann, Ber. 37, 1447 1904.
81. Kuhn, R., and A. Winterstein, Helv. Chim. Acta 11, 123 1928.
82. Kurbatov, Comm. Trav. sci. Rep. 17, 24 1925; M. P. Doss, "Physical Constants of Principal Hydrocarbons", 3rd ed., New York, 1942.
83. Kursanov, D. N., A. S. Kursanov, and A. N. Blokhina, J. Gen. Chem. (U.S.S.R.) 8, 1786 1938; C.A 33, 4979 1939.
84. Lagerlöf, D., J. prakt. Chem. [2] 98, 136 1918.
85 Lange, H., Ber. 8, 502 1875.
86. Lautsch, W., Z. physik. Chem. 1B, 115 1928.
87. Lebeau, P., and M. Picon, Compt. rend. 159, 70 1914.
88. Lecat, M., Ann. soc. sci. Bruxelles 49B, 109 1929.
89. Lee, H. H., and J. C. Warner, J. Am. Chem. Soc. 57, 318 1935.
90. Lettre, H., H. Barnbeck, and W Lege, Ber. 69, 1151 1936.
91. Ley, H., and H. Dirking, Ber. 67B, 1331 1934.
92 Limpricht, H., and H. Schwanert, Ann. 155, 59 1870.
93. Majima, R., K. Nagaoka, and K. Yamada, Ber. 55, 215 1922.
94. Maloteux, R. N. M. A., and J. Straub, Rec. trav. chim. 56, 263 1937.
95. Mascarelli, L., and V. Babini, Atti accad. Lincei [5] 18, II, 222 1909.
96. Mascarelli, L., and I. Musatty, Atti accad. Lincei [5] 19, I, 213 1910.
97. Mascarelli, L., and I. Musatty, Gazz. chim. ital. 41, I, 103 1911.
98. McKenzie, A., and J. R. Myles, Ber. 65, 209 1932.
99. McVickers, W. H., J K. Marsh, and A. W. Stewart, J. Chem. Soc. 127, 999 1925.
100. Meyer, H., and A. Hoffmann, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 125/126, Abt. IIb, 449 1916-1917.
101. Michaelis, A., and H. Lange, Ber. 8, 1313 1875.
102. Michaelson, C., and E. Lippmann, Ann., suppl. 4, 113 1864-1866.
103. Miller, H. F., and J. Backman, J. Am. Chem. Soc. 57, 766 1935.
104. Moritz, C., and R. Wolffenstein, Ber. 32, 432 1899.
105. Mukherjee, A., Indian J. Phys. 8, 147 1933.
106. Müller, A., Deut. Parfüm-Ztg. 17, 498 1931; Chem. Zentr. 1932, I, 811.
107. Müller, E., and T. Töpel, Ber. 72, 273 1939.
108. Murat and Amouroux, J pharm. chim. [7] 5, 473 1912.
109. Nenhaus, A., Ber. 67, 1627 1934.
110. Onufrowicz, A., Ber. 17, 833 1884.
111. Ott, E., and R. Schröter, Ber. 60, 624 1927.
112. Paal, C., Ber. 49, 1567 1916.
113. Padoa, M., Atti accad. Lincei [5] 13, I, 329 1904.
114. Padoa, M., Atti accad. Lincei [5] 27, II, 59 1918.
115. Padoa, M., Atti accad. Lincei [5] 28, II, 239 1919.
116. Padoa, M., Gazz. chim. ital. 24, II, 232 1904.
117. Padoa, M., Gazz. chim. ital. 48, II, 139 1918.
118. Palméro, J., III Nordiska Kemismötet 1926, 195 1928; Chem. Zentr. 1929, I, 1446.
119. Parks, G. S., and H. M. Huffman, Ind. Eng. Chem. 23, 1138 1931.
120. Pascal, P., and L. Normand, Bull. soc. chim. [4] 13, 151 1913.
121. Perkin, W. H., J. Chem. Soc. 69, 1025 1896.
122. Radcliffe, L. G., and N. Simpkin, J. Soc. Chem. Ind. 40, 119T 1921.
123. Radziszewski, B., Ber. 7, 140 1874.

124. Ramart-Lucas, Ann. chim. [8] **30**, 349 **1913.**
125. Razuvaev, G. A., and M. M. Koton, Ber. **66**, 1210 **1933.**
126. Reichstein, T., and R. Oppenauer, Helv. Chim. Acta **16**, 1373 **1933.**
127. Reimer, Ber. **14**, 1802 **1881.**
128. Riedinger, A., Physik. Z. **39**, 380 **1938.**
129. Robertson, J. M., Proc. Roy. Soc. (London) **150A**, 348 **1935.**
130. Rosental, D., Bull. soc. chim. Belg. **45**, 585 **1936.**
131. Ruggli, P., and A. Staub, Helv. Chim. Acta **20**, 37 **1937.**
132. Sabatier, P., and A. Mailhe, Compt. rend. **138**, 1321 **1904.**
133. Sabatier, P., and A. Mailhe, Compt. rend. **145**, 1126 **1907.**
134. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915.**
135. Sabatier, P., and M. Murat, Compt. rend. **154**, 1771 **1912.**
136. Sabatier, P., and M. Murat, Compt. rend. **155**, 385 **1912.**
137. Sabatier, P., and M. Murat, Compt. rend. **156**, 1951 **1913.**
138. Sabatier, P., and M. Murat, Compt. rend. **158**, 760 **1914.**
139. Sakellarios, E., and T. Kyrimis, Ber. **57**, 322 **1924.**
140. Schiff, R., Ann. **223**, 247 **1884.**
141. Schmerda, F., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **118**, Abt. IIb, 165 **1909.**
142. Sieglitz, A., Ber. **35**, 2040 **1922.**
143. Silva, R. D., Compt. rend. **89**, 606 **1879.**
144. Späth, E., Ber. **60**, 702 **1927.**
145. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1207 **1913.**
146. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1691 **1913.**
147. Späth, E., and F. Galinovsky, Ber. **70**, 235 **1937.**
148. Spilker, A., and W. Schade, Ber. **65**, 1686 **1932.**
149. Stephens, H. N., and F. L. Roduta, J. Am. Chem. Soc. **57**, 2380 **1935.**
150. Tamman, G., Nachr. Kgl. Ges. Wiss. Göttingen **1918**, 296.
151. Tasaki, T., Acta Phytochim. (Japan) **3**, 259 **1922-1927.**
152. Thiele, J., Ann. **376**, 239 **1910.**
153. Thoms, H., and B. Ambrus, Arch. Pharm. **263**, 264 **1925.**
154. Timmermans, J., Bull. soc. chim. Belg. **44**, 17 **1935.**
155. Vanstone, E., J. Chem. Soc. **103**, 1826 **1913.**
156. Vanstone, E., J. Chem. Soc. **105**, 1491 **1914.**
157. Varet, R., and G. Vienne, Bull. soc. chim. [2] **47**, 917 **1887.**
158. Varet, R., and G. Vienne, Compt. rend. **104**, 1375 **1887.**
159. von Braun, J., H. Deutsch, and O. Koscielski, Ber. **46**, 1511 **1913.**
160. von Walther, R., and W. Raetze, J. prakt. Chem. [2] **65**, 258 **1902.**
161. Walden, P., Z. physik. Chem. **65**, 129 **1909.**
162. Weissberger, A., J. Chem. Soc. **1935**, 855.
163. Wessels, H., Z. physik. Chem. **87**, 215 **1914.**
164. Wieland, H., and E. Dorrer, Ber. **63**, 404 **1930.**
165. Wislicenus, J., Ber. **7**, 286 **1874.**
166. Wolf, K. L., and H. Weghofer, Z. physik. Chem. **39B**, 194 **1938.**
167. Wooster, C. B., and N. W. Mitchell, J. Am. Chem. Soc. **52**, 688 **1930.**
168. Wooster, C. B., and J. F. Ryan, J. Am. Chem. Soc. **56**, 1133 **1934.**
169. Zartman, W. H., and H. Adkins, J Am. Chem. Soc. **54**, 1668 **1932.**
170. Zelinskiĭ, N. D., and M. V. Gaverdovskaya, Ber. **61**, 1049 **1928.**
171. Zelinskiĭ, N. D., K. Packendorff, and L. Leder-Packendorff, Ber. **66**, 872 **1933.**
172. Zelinskiĭ, N. D , and I. N. Tits, Ber. **62**, 2869 **1929.**
173. Zelinskiĭ, N. D., and I. N. Tits, Ber. **64**, 183 **1931.**
174. Ziegler, K., H. Colonius, and O. Schäfer, Ann. **473**, 36 **1929.**
175. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**

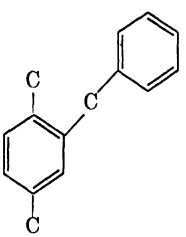
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-2-benzylbenzene**  | | | | |
| | 275–280 [38]<br>279–282 [76]<br>148–158 16 [76] | | | |
| **1-Methyl-3-benzylbenzene**  | | | | |
| | 274–276 [51]<br>275 747 [106]<br>268<br>~269.5 725 [1]<br>120(a) 0.2 [135]<br>128(a) 0.11 [135] | 0.997 17.5° [106] | | |
| (a) These boiling points represent two different preparations. | | | | |
| **1-Methyl-4-benzylbenzene**  | | | | |
| | **278.7** | | | |
| | 279–280 [57,63,136]<br>278–280 [6,130]<br>279 [80]<br>278 [85,99]<br>277 [144]<br>279–280 761.5 [143] | 0.9976 [44]<br>0.9978 19.3° [127]<br>0.994 18° [57]<br>0.995 17.5° [143, 144]<br>0.9976 15.0° [42] | 1.5712 [44]<br>1.57103 19.3° [127]<br>1.56579 $n_{H\alpha}^{19.3}$ [127]<br>1.58571 $n_{H\beta}^{19.3}$ [127]<br>1.59804 $n_{H\gamma}^{19.3}$ [127] | |

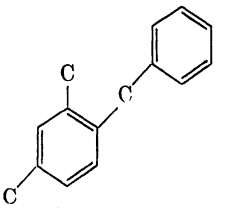
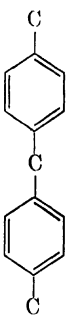
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Methyl-4-benzylbenzene** (*Continued*) | | | | |
| | 271–272 750.2 [42] | | | |
| | 153–154 16 [82] | | | |
| | 144 16 [127] | | | |
| | 159.5 15 [42] | | | |
| | 145.5 –145.7 13.5 [147] | | | |
| | 114–115 3 [44] | | | |
| | 110 1 [82] | | | |
| $C_{15}H_{16}$ **1,1-Diphenylpropane**  | | | | |
| | 278.5 | 0.990 [142] | 1 569 24° [95,96] | |
| | –280.5 [95,96] | 0 9998 [43] | 1.5681 18.5° [59] | |
| | 280 [142] | 0.9962 25° [43] | 1.56810 14.1° [142] | |
| | 278–279 759 [139] | 0.9881 $D_0^{24}$ [95,96] | 1.5657 14° [58] | |
| | 278.5 –280.5 754 [59] | 0.9938 18.5° [59] | | |
| | 153–154 20 [56] | 0.9951 14.1° [142] | | |
| | 149–151 18 [12] | 0.9919 14° [58] | | |
| | 140–141 13 [142] | | | |
| | 140–142 11 [79] | | | |
| | 139 11 [58] | | | |
| | 142 10 [77] | | | |
| | 139 10 [115] | | | |
| | 129–131 7 [49] | | | |
| **1,2-Diphenylpropane**  | | | | |
| 52 [68] | 280–282 [95,96] | 0.9807 [139] | 1.5700 [112] | |
| 50 [139] | 277–280 [141] | 0.9812 [141] | 1.5591 23.5° [59] | |
| | 280–281 758 [59] | 0.9809 23.5° [59] | 1.555 23° [95,96] | |

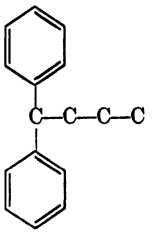
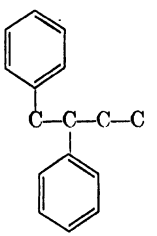
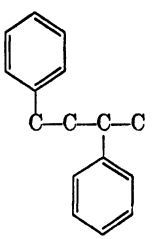
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Diphenylpropane** *(Continued)* | | | | |
| | 278 751 [139] | 0.9824 23° [66] | | |
| | 277–280 745 [50] | 0.9953 0° [141] | | |
| | 166–167 28 [66] | | | |
| | 155–157 22 [101] | | | |
| | 145–148 13 [129] | | | |
| | 147 10 [112] | | | |
| | 109 2 [18] | | | |
| **1,3-Diphenylpropane**  | | | | |
| | 300.3 | | | |
| 6 [95] | 301–303 [120] | 1.007 [121] | 1.5760 [59] | |
| | 302 [95] | 0.9930 25° [93] | 1.5782 [93] | |
| | 299–301 [8] | 1.007 $D_{20}^{20}$ [82] | 1.5745 18° [82] | |
| | 300 [81,98,99] | | 1.5712 17.5° [140] | |
| | 299–300 [34] | 1.0071 $D_0^{20}$ [59] | 1.5634 15° [111] | |
| | 298–300 [111] | 0.9982 17.5° [140] | | |
| | 297–300 [82] | 0.9855 $D_{15}^{15}$ [111] | | |
| | 298–299 758 [59] | | | |
| | 163–167 21 [121] | | | |
| | 166–168 16 [120] | | | |
| | 155–157 12 [118] | | | |
| | 124 2 [75] | | | |
| **2,2-Diphenylpropane**  | | | | |
| 29 [95,96] | 282–283 [95,96] | 0.9958 $D_0^{25}$ [95,96] | 1.570 25° [95,96] | |
| | 282 [110] | | | |
| | 281 [39,109] | | | |

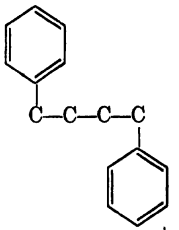
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-1-*p*-tolylethane**  | | | | |
| | 154 | 0.9847 17.2° [126] | 1.5646 [126] | |
| | −155.8 14 [126] | 0.9849 16.9° [126] | 1.56590 [126] | |
| | 143–144 11 [78] | | 1.56038 $n_{H\alpha}^{17.2}$ [126] | |
| | | | 1.57962 $n_{H\beta}^{17.2}$ [126] | |
| | | | 1.59192 $n_{H\gamma}^{17.2}$ [126] | |
| **1-Phenyl-2-*p*-tolylethane**  | | | | |
| 27 [74] | 286 [74] | | | |
| **Benzylethylbenzene** (a) | | | | |
| | 294–295 754 [132] | 0.985 18.9° [132] | | |

(a) The structure of this compound is not given.

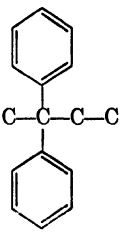
| | | | | |
|---|---|---|---|---|
| **1,4-Dimethyl-2-benzylbenzene**  | | | | |
| | 294–295 [107] | 0.9950 [107] | | |
| | 293.5 | | | |
| | −294.5 [145] | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,5-Dimethyl-2-benzylbenzene**  | 295–296 [146] | | | |
| **Benzyl-1,2-dimethylbenzene** (a) | | | | |
| 33–34 [107] | 295–298 [107] | | | |
| (a) The position of the benzyl substitution is not given. | | | | |
| **Benzyl-1,3-dimethylbenzene** (a) | | | | |
| | 293–298 [107] | 0.9951 [107] | | |
| (a) The position of the benzyl substitution is not given. | | | | |
| **Di-*p*-tolylmethane**  | | | | |
| 28–29 [114]<br>28.5 [92]<br>28 [64] | 301.5 773 [114]<br>302 768 [114]<br>165 12 [92] | | | |
| **Ditolylmethane** (a) | | | | |
| | 289–291 [85]<br>290 [35,134]<br>289 [65]<br>163–165 20 [108] | 0.9800 [43]<br>0.9777 25° [43] | | |
| (a) The structure of this compound is not given. | | | | |

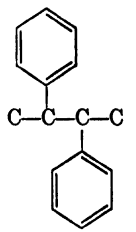
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenylbutane**  | 286–288 [95,97]<br>265–266 751 [58]<br>178–179 20 [116]<br>161–163 20 [12]<br>170–175 15 [45]<br>160–162 12 [117]<br>148–152 12 [58]<br>140–142 11 [58]<br>150 10 [77]<br>103–104 0.05 [103] | 0.9758 [103]<br>1.006 [58]<br>0.9748 $D_0^{16}$ [95,97] | 1.5577 [103]<br>1.554 16° [95,97]<br>1.577 16° [58] | |
| **1,2-Diphenylbutane**  | 285–287 [95,97]<br>288–289 751 [58]<br>161 19 [11]<br>152 11 [58]<br>149–151 10 [115] | 1.0092 $D_0^{18}$ [95,97] | 1.587 18° [95,97] | |
| **1,3-Diphenylbutane**  | 295 [119] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diphenylbutane**  | | | | |
| **52** | | | | |
| 52–53 [30]<br>52(a)<br>51–52 [137] | 317 [95,97,98,100,138]<br>315–317 [52] | 0.9719 25° [93] | 1.5493 25° [93] | |

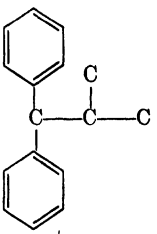
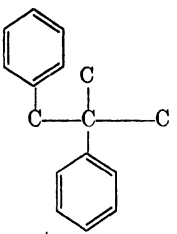
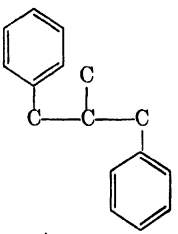
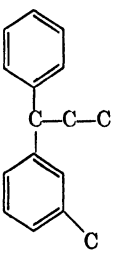
(a) The melting point 52 is found in references 7, 25, 29, 33, 46, 47, 48, 52, 53, 54, 62, 73, 95, 97, 98, 100, 124, 128, 138.

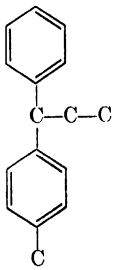
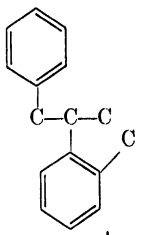
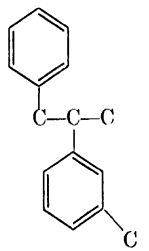
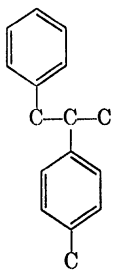
| | | | | |
|---|---|---|---|---|
| **2,2-Diphenylbutane**  | | | | |
| 127.5–128.5 [122] | 152 10(a) [2] | | | |

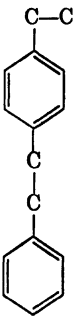
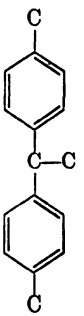
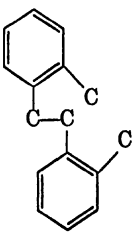
(a) This boiling point may be for 1,1-Diphenylbutane.

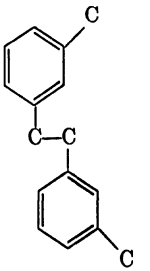
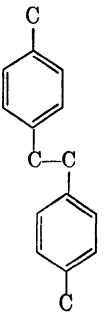
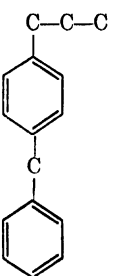
| | | | | |
|---|---|---|---|---|
| **2,3-Diphenylbutane**  | | | | |
| **124.4** | | | | |
| 126–127(a) [26,67]<br>126(a) [9,66,67]<br>124–125 [23,26,88]<br>124 [15,65]<br>123.5–124 [40]<br>123–124 [61,69]<br>123.5 [27,28,63,104,105]<br>8(b) [66,67] | 283–284 752(b) [67]<br>162–164 25(b) [69]<br>150–151 20 [26]<br>140 10(b) [67]<br>103 1(b) [67] | 0.9756(b) [67]<br>0.9755 20.7° [125]<br>0.9906(b) 0° [67]<br>0.9917 $D_0^{26}$ | 1.55516(b) [67]<br>1.5594 [26]<br>1.54964 $n_{H\alpha}^{20.7}$ [125]<br>1.56734 $n_{H\beta}^{20.7}$ [125]<br>1.57841 $n_{H\gamma}^{20.7}$ [125]<br>1.55479 $n_{He}^{20.7}$ [125] | |

(a) This constant was determined on the *meso* inactive form of the compound.
(b) This constant was determined on the *dl* form of the compound.

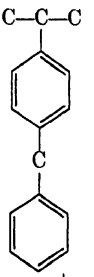
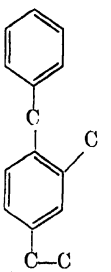
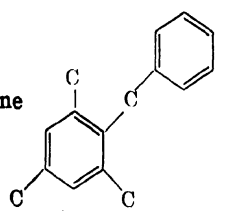
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Data Additional |
|---|---|---|---|---|
| **1,1-Diphenyl-2-methylpropane**  | | | | |
| 128 [2] | 285–286 [95,97]<br>157 18 [102]<br>145 13 [2] | 0.9780 $D_0^{15}$ [95,97] | 1.560 16° [95,97] | |
| **1,2-Diphenyl-2-methylpropane**  | | | | |
| | 284–287 750 [13] | 0.984 15° [13] | | |
| **1,3-Diphenyl-2-methylpropane**  | | | | |
| | 297–298 [96]<br>290–294 [123] | | | |
| **1-Phenyl-1-*m*-tolylpropane**  | | | | |
| | 143–144 17 [94] | | 1.5650 16° [94] | |

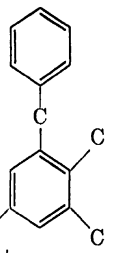
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-1-*p*-tolylpropane**  | 154–156 23 [94] | | 1.5683 [94] | |
| **1-Phenyl-2-*o*-tolylpropane**  | 316–317 [60,133] | | | |
| **1-Phenyl-2-*m*-tolylpropane**  | 311–312 [60,133]<br>240 110 [60] | 0.987 15° [60] | | |
| **1-Phenyl-2-*p*-tolylpropane**  | 302–303 [60,133] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Ethyl-4-phenethylbenzene**  | 293–295 [118] | | | |
| **1-Phenyl-1-ethylphenylethane** (a) | | | | |
| 124 [89] | | | | |
| (a) The position of the ethyl group is not given. | | | | |
| **1,1-Di-*p*-tolylethane**  | 293–295 723 [41]<br>155–157 12 [3]<br>144–145 8 [90] | | | |
| **1,2-Di-*o*-tolylethane**  | 177–178 20 [19,20] | | | |
| 66.5 [19,20,84]<br>65.5–66 [22]<br>65 [91] | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Di-*m*-tolylethane**  | | | | |
| 298 [4] | | 0.9623 42° [24] | 1.5566 22° [24] | |
| 296 [84] | | 0.9661 32° [24] | | |
| 294–296 [36] | | 0.9703 22° [24] | | |
| 163 | 10 [19,20,24] | 0.9756 12° [24] | | |
| | | 0.9796 5° [24] | | |
| **1,2-Di-*p*-tolylethane**  | | | | |
| 82 | | | | |
| 82–83 [19,20,21] | 296–298 730 [31] | | | |
| 82 [10,16,17,84,92] | 178 18 [19,20] | | | |
| 81–82 [4] | | | | |
| 81–81.5 [22] | | | | |
| 81 [5] | | | | |
| **1-*n*-Propyl-4-benzylbenzene**  | | | | |
| 152–155 | 10 [37] | 0.9737 18° [37] | 1.5552(a) [37] | |

(a) It is not clear whether this refractive index is at 18° or 20°.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Isopropyl-4-benzylbenzene**  | 310 [67]<br>176 13 [67] | 1.007 18° [67] | | |
| **1-Benzyl-2-methyl-4-ethylbenzene**  | 298–300 [72] | 1.0141 11° [72] | | |
| **1,3,5-Trimethyl-2-benzylbenzene**  | 300–303 [67,70,71]<br>291–294 755 [86]<br>183 11 [67] | | | |
| 36 [14,67] | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Benzyl-2,3,5-trimethylbenzene  | 308–312 [57]<br>190–191 20 [57] | 1.0151 18° [57] | | |

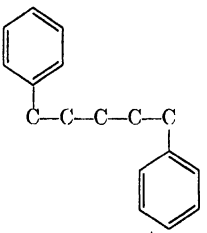
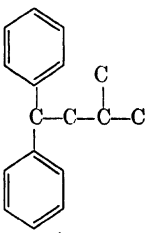
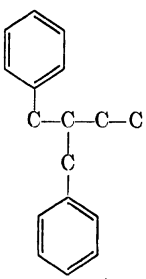
**References on Other $C_{14}H_{14}$-$C_{16}H_{18}$ Compounds**

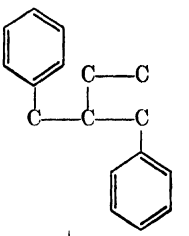
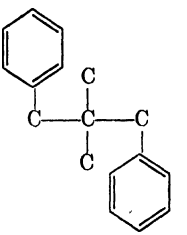
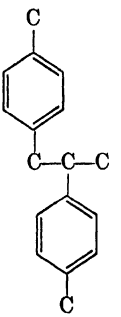
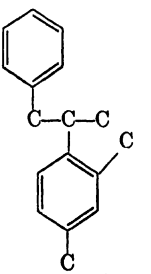

1. Ador, E., and A. Rilliet, Ber. **12**, 2298 1879.
2. Albesco, G., Ann. chim. [9] **18**, 216 1922.
3. Anschütz, R., and A. Hilbert, Ber. **57**, 1697 1924.
4. Aronstein, L., and A. S. van Nierop, Rec. trav. chim. **21**, 448 1902.
5. Austin, J. B., and I. A. Black, J. Am. Chem. Soc. **52**, 4552 1930.
6. Bandrowski, E., Ber. **7**, 1016 1874.
7. Barbot, A., Bull. soc. chim. [4] **47**, 1314 1930.
8. Bergmann, E., and Shin-ichiro Fujise, Ann. **483**, 65 1930.
9. Bergmann, E., and H. Weisz, Ber. **63**, 1173 1930.
10. Bertho, A., Ber. **57**, 1138 1924.
11. Blondeau, J., Ann. chim. [10] **2**, 5 1924.
12. Bodendorf, K., J. prakt. Chem. [2] **129**, 337 1931.
13. Bodroux, F., Compt. rend. **132**, 1333 1901.
14. Bredereck, H., G. Lehmann, C. Schönfeld, and E. Fritzsche, Ber. **72**, 1414 1939.
15. Brown, R. L., Ind Eng. Chem. **20**, 1178 1928.
16. Bruni, G., Atti accad. Lincei [5] **13**, I, 626 1904.
17. Bruni, G., and F. Gorni, Atti accad. Lincei [5] **9**, II, 151 1900.
18. Calcott, W. S., J. M. Tinker, and V. Weinmayr, J. Am. Chem. Soc. **61**, 1010 1939.
19. Carré, P., Bull. soc. chim. [4] **5**, 486 1909.
20. Carré, P., Compt. rend. **148**, 1108 1909.
21. Ciamician, G., and P. Silber, Ber. **43**, 1536 1910.
22. Coleman, G. H., W. H. Holst, and R. D. Maxwell, J. Am. Chem. Soc. **58**, 2310 1936.
23. Conant, J. B., and A. H. Blatt, J. Am. Chem. Soc. **50**, 551 1928.
24. Dover, M. V., and W. A. Hensley, Ind. Eng. Chem. **27**, 337 1935.
25. Dupont, G., Compt. rend. **156**, 1623 1913.
26. Ellingboe, E., and R. C. Fuson, J. Am. Chem. Soc. **55**, 2960 1933.
27. Engler, C., and H. E. Berthold, Ber. **7**, 1123 1874.
28. Engler, C., and H. Berthge, Ber. **7**, 1125 1874.
29. Fichter, F., and R. Senti, Festschrift A. Tschirch **1926**, 410.
30. Fichter, F., and H. Stenzel, Helv. Chim. Acta **22**, 970 1939.
31. Fischer, O., and L. Castner, J. prakt. Chem. [2] **82**, 280 1910.
32. Földi, Z., Ber. **61**, 1609 1928.
33. Freund, M., and P. Immerwahr, Ber. **23**, 2845 1890.
34. Frézouls, J., Compt. rend. **155**, 42 1912.

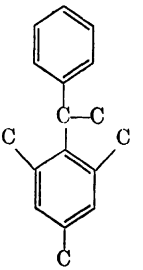
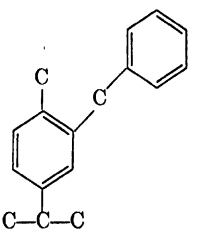
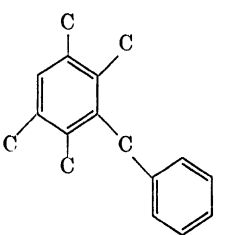
35. Friedel and Crafts, Bull. soc. chim. [2] **41**, 322 **1884.**
36. Friedmann, W., Petroleum **11**, 978 **1916.**
37. Fuson, R. C., J. Am. Chem. Soc. **48**, 2937 **1926.**
38. Gattermann, L., and K. Koppert, Ber. **26**, 2810 **1893.**
39. Goudet, H., and F. Schenker, Helv. Chim. Acta **10**, 132 **1927.**
40. Grignard, V., and K. Ono, Bull. soc. chim. **39**, 1589 **1926.**
41. Haiss, A., Ber. **15**, 1474 **1882.**
42. Halleman, A. F., and J. J. Polak, Rec. trav. chim. **27**, 435 **1908.**
43. Harkins, W. D., and D. T. Ewing, J. Am. Chem. Soc. **41**, 1977 **1919.**
44. Hennion, G. F., and R. A. Kurtz, J. Am. Chem. Soc. **65**, 1001 **1943.**
45. Hey, L., and C. K. Ingold, J. Chem. Soc. **1933**, 531.
46. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **17**, 929 **1911.**
47. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **18**, 881 **1912.**
48. Hugel, G., and Gidaly, Bull. soc. chim. [4] **51**, 639 **1932.**
49. Hussey, S. C., C. S. Marvel, and F. D. Hager, J. Am. Chem. Soc. **52**, 1122 **1930.**
50. Huston, R. C., and D. D. Sager, J. Am. Chem. Soc. **48**, 1955 **1926.**
51. Huston, R. C., H. A. Swartout, and G. K. Wardwell, J. Am. Chem. Soc. **52**, 4484 **1930.**
52. Ipatieff, V. N., N. A. Orlov, and B. N. Dolgov, Compt. rend. acad. sci. U.R.S.S. **1928A**, 1; C.A. **25**, 4543 **1931**; Chem. Zentr. **1930**, I, 1783.
53. Kelber, C., Ber. **49**, 55 **1916.**
54. Kelber, C., and A. Schwarz, Ber. **45**, 1946 **1912.**
55. Kharasch, M. S., and M. Kleiman, J. Am. Chem. Soc. **65**, 11 **1943.**
56. Klages, A., Ber. **35**, 2646 **1902.**
57. Klages, A., and P. Allendorff, Ber. **31**, 998 **1898.**
58. Klages, A., and S. Heilmann, Ber. **37**, 1447 **1904.**
59. Konovalov and Dobrovolskiĭ, J. Russ. Phys. Chem. Soc. **37**, 547 **1905**; Chem Zentr. **1905**, II, 825.
60. Kraemer, G., A. Spilker, and P. Eberhardt, Ber. **23**, 3269 **1890.**
61. Kubota, B., and T. Hayashi, Bull. Chem. Soc. Japan **1**, 67 **1926.**
62. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 123 **1928.**
63. Lal, J. B., and S. Dutt, J. Indian Chem. Soc. **9**, 565 **1932.**
64. Lavaux, J., Compt. rend. **152**, 1400 **1911.**
65. Lavaux, P., Ann. chim. phys. [8] **20**, 436 **1910.**
66. Lepin, A., Acta Univ. Latviensis, Kīm. Fakultāt. Ser. **1**, 145 **1932**; C.A. **25**, 3328 **1931**; Chem. Zentr. **1931**, I, 2619.
67. Lepin, A. L., J. Russ. Phys. Chem. Soc. **44**, 1190 **1912**; C.A. **7**, 982 **1913**; Chem. Zentr. **1912**, II, 2082.
68. Levene, P. A., L. A. Mikeska, and K. Passoth, J. Biol. Chem. **88**, 27 **1930.**
69. Ley, H., and F. Rinke, Ber. **56**, 771 **1923.**
70. Louise, E., Ann. chim. phys. [6] **6**, 174 **1885.**
71. Louise, E., Compt. rend. **95**, 1163 **1882.**
72. Mailhe, A., Bull. soc. chim. [4] **35**, 365 **1924.**
73. Majima, R., K. Nagaoka, and K. Yamada, Ber. **55**, 215 **1922.**
74. Mann, W., Ber. **14**, 1645 **1881.**
75. Marion, L., Can. J. Research **16B**, 213 **1938.**
76. Mascarelli, L., and M. Pirona, Atti congr. intern. chim., 10th Congr., Rome **3**, 249 **1939.**
77. Masson, H., Compt. rend. **135**, 533 **1902.**
78. McKenzie, A., and J. R. Myles, Ber. **65**, 209 **1932.**
79. Meerwein, H., Ann. **419**, 121 **1919.**
80. Meyer, H., and K. Bernhauer, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **138**, Abt. IIb, 721 **1929.**
81. Michaelis, A., and A. Fleming, Ber. **34**, 1291 **1901.**
82. Montagne, M., Ann. chim. [10] **13**, 40 **1930.**
83. Moritz, C., and R. Wolffenstein, Ber. **32**, 432 **1899.**
84. Moritz, C., and R. Wolffenstein, Ber. **32**, 2531 **1899.**

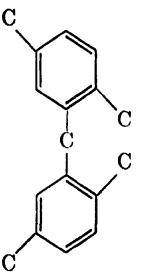
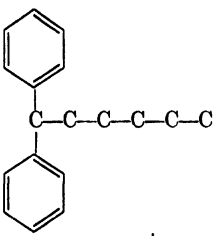
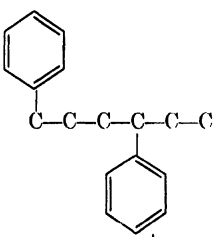
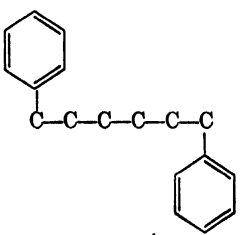
85. Nastyukov, A. M., J. Russ. Phys. Chem. Soc. 40, 1376 1908; Chem. Zentr. 1909, I, 534.
86. Nenitzescu, C. D., D. A. Isăcescu, and C. D. Ionescu, Ann. 491, 210 1931.
87. Ott, E., Ber. 61, 2124 1928.
88. Paternò, E., and G. Chieffli, Gazz. chim. ital. 39, II, 415 1909.
89. Radziszewski, B., Ber. 7, 140 1874.
90. Reichert, J. S., and J. A. Nieuwland, Org. Syntheses 4, 23 1925.
91. Reichstein, T., A. Cohen, M. Ruth, and H. F. Meldahl, Helv. Chim. Acta 19, 412 1936.
92. Reichstein, T., and R. Oppenauer, Helv. Chim. Acta 16, 1373 1933.
93. Riedinger, A., Physik. Z. 39, 380 1938.
94. Roger, R., and A. M. Roberts, J. Chem. Soc. 1937, 1753.
95. Sabatier, P., and M. Murat, Ann. chim. [9] 4, 253 1915.
96. Sabatier, P., and M. Murat, Compt. rend. 155, 385 1912.
97. Sabatier, P., and M. Murat, Compt. rend. 156, 1430 1913.
98. Sabatier, P., and M. Murat, Compt. rend. 156, 1951 1913.
99. Sabatier, P., and M. Murat, Compt. rend. 158, 760 1914.
100. Sabatier, P., and J. B. Senderns, Compt. rend. 135, 87 1902.
101. Schlenk, W., and E. Bergmann, Ann. 479, 42 1930.
102. Schlenk, W., and E. Bergmann, Ann. 479, 58 1930.
103. Schmidt, A. W., and C. Hartmann, Ber. 74, 1325 1941.
104. Schramm, J., Ber. 18, 350 1885.
105. Schramm, J., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 95, Abt. II, 388 1887.
106. Senff, P., Ann. 220, 225 1883.
107. Shima, G., Mem. Coll. Sci. Kyoto Imp. Univ. 13A, 315 1930.
108. Shorygin, P. P., and S. A. Shoblinskaya, J. Gen. Chem. (U.S.S.R.) 6, 1578 1936; C.A. 31, 2196 1937; Chem. Zentr. 1937, I, 1678.
109. Silva, Bull. soc. chim. [2] 34, 674 1880.
110. Silva, R. D., Bull. soc. chim. [2] 35, 289 1881.
111. Sirks, J. F., Rec. trav. chim. 62, 193 1943.
112. Smith, R. A., and S. Natelson, J. Am. Chem. Soc. 53, 3476 1931.
113. Söllscher, C., Ber. 15, 1680 1882.
114. Sommelet, M., Compt. rend. 180, 1349 1925.
115. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse 122, Abt. IIb, 1207 1913.
116. Stadnikov, G., Ber. 46, 2496 1913.
117. Stadnikov, G., J. Russ. Phys. Chem. Soc. 44, 1219 1912; Chem. Zentr. 1913, I, 21.
118. Staudinger, H., and A. Steinhofer, Ann. 517, 35 1935.
119. Stobbe, H., and G. Posnjak, Ann. 371, 287 1909.
120. Störmer, R., and C. Thier, Ber. 58, 2607 1925.
121. Straus, F., and H. Grindel, Ann. 439, 276 1924.
122. Thörner, W., and T. Zincke, Ber. 11, 1988 1878.
123. Trotman, E. R., J. Chem. Soc. 127, 88 1925.
124. Turner, E. E., and F. W. Bury, J. Chem. Soc. 123, 2489 1923.
125. von Auwers, K., Ann. 499, 123 1932.
126. von Auwers, K., Ber. 49, 2389 1916.
127. von Auwers, K., and A. Frühling, Ann. 422, 196 1921.
128. von Braun, J., and H. Deutsch, Ber. 45, 2171 1912.
129. von Braun, J., and G. Manz, Ann. 468, 258 1929.
130. von Meyer, E., J. prakt. Chem. [2] 82, 538 1910.
131. Vorländer, D., and R. Walter, Z. physik. Chem. 118, 1 1925.
132. Walker, J. T., Ber. 5, 686 1872.
133. Weger, M., Z. angew. Chem. 22, 338 1909.
134. Weiler, J., Ber. 7, 1181 1874.
135. Wertyporoch, E., and A. Farnik, Ann. 491, 265 1931.
136. Willgerodt, C., Ber. 20, 2467 1887.
137. Zalkind, Y. S., and F. B. Fundyler, Ber. 69, 128 1936.

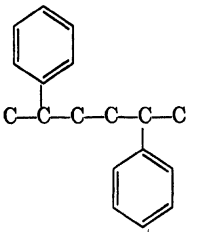
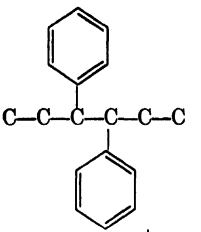
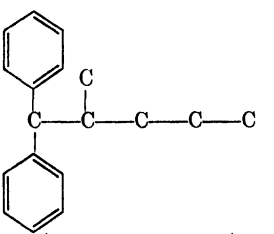
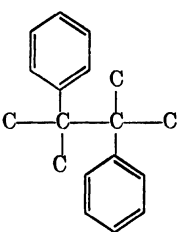
138. Zalkind, Y. S., and Z. Neishtab, J. Russ. Phys. Chem. Soc. 49, 34 1917; Chem. Zentr. 1923, III, 1392.
139. Zelinskiĭ, N. D., and M. V. Gaverdovskaya, Ber. 61, 1049 1928.
140. Zelinskiĭ, N. D., and I. N. Tits, Ber. 62, 2869 1929.
141. Zhukovskiĭ, S., J. Russ. Phys. Chem. Soc. 27, 296 1895; Bull. soc. chim. [3] 16, 126 1896.
142. Ziegler, K., and P. Tiemann, Ber. 55, 3406 1922.
143. Zincke, T., Ann. 161, 93 1872.
144. Zincke, T., Ber. 4, 298 1871.
145. Zincke, T., Ber. 5, 799 1872.
146. Zincke, T., Ber. 9, 1761 1876.
147. Zonev, N. S., J. Russ. Phys. Chem. Soc. 48, 550 1916; Chem. Zentr. 1923, I, 1497.

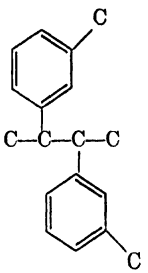
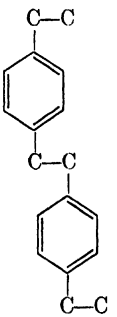
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **1,5-Diphenylpentane**  | | | | | | |
| | 324 [58,59] | 0.9601 | 25° [54] | 1.5582 [31] | | |
| | 323–324 [31] | 0.9788 | $D_{20}^{20}$ [31] | 1.5457 | 25° [54] | |
| | 326–327 747 [15] | 0.9814 | $D_0^{19}$ [58,59] | 1.559 | 19° [58,59] | |
| | 185 20 [67] | 0.985 | 13° [72] | | | |
| | 187–189 10 [11] | 0.9924 | $D_0^0$ [58,59] | | | |
| **1,1-Diphenyl-3-methylbutane**  | | | | | | |
| | 297 [58,59] | 0.9641 | $D_0^{21}$ [58,59] | 1.551 | 21° [58,59] | |
| | | 0.9756 | $D_0^0$ [59] | | | |
| **1-Phenyl-2-benzylbutane**  | | | | | | |
| | 166 16 [42] | | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,3-Diphenyl-2-ethylpropane  | 304–305 [53] | 0.9736 $D_0^{21}$ [53]<br>0.9855 $D_0^{0}$ [53] | 1.553 21° [53] | |
| 1,3-Diphenyl-2,2-dimethylpropane  | | | | |
| 68–69 [68] | 293-294 [68] | | | |
| 1,2-Di-*p*-tolylpropane  | | | | |
| | 142–144 5 [29] | 0.9726 [29] | 1.5565 [29] | |
| 1-Phenyl-2-(2′,4′-dimethylphenyl)-propane  | | | | |
| | 324 [36] | | | |

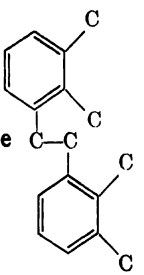
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-1-(2′,4′,6′-trimethylphenyl)-ethane**  | | | | |
| 38–39 [23] | | | | |
| **1-Methyl-2-benzyl-4-isopropylbenzene**  | | | | |
| | 296–297 [46]<br>296–297 743 [32]<br>176–177 17 [32]<br>165–167 12 [56] | 0.9628 [56]<br>0.9690 15° [32]<br>0.98701 0° [46] | 1.55638 [56]<br>1.55650 15° [32]<br>1.55138 $n_{H\alpha}^{15}$ [32]<br>1.56958 $n_{H\beta}^{15}$ [32]<br>1.58098 $n_{H\gamma}^{15}$ [32] | |
| **1-Methylbenzyl-4-isopropylbenzene** (a) | | | | |
| | 307–310 [64] | 0.9916 [64] | | |
| (a) The position of the benzyl substitution is not given. | | | | |
| **1,2,4,5-Tetramethyl-3-benzylbenzene**  | | | | |
| 145 [4] | 325–327 [4] | | | |

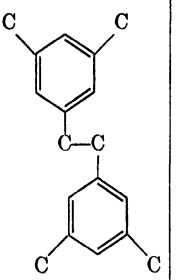
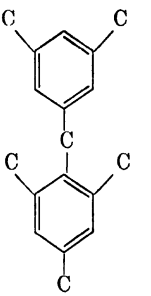
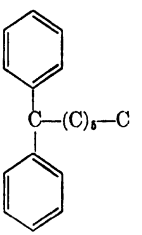
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Di-2,5-dimethylphenylmethane**  | | | | |
| 60–60.5 [30] | 313–316 [30] | | | |
| $C_{18}H_{22}$ | | | | |
| **1,1-Diphenylhexane**  | | | | |
| | 164 10 [45] | | | |
| **1,4-Diphenylhexane**  | | | | |
| 89 [12] | 147–149 3–4 [26]<br>147–148 3 [26] | 0.9608 $D_{20}^{20}$ [26]<br>0.9660 $D_{20}^{20}$ [26] | 1.5456 [26]<br>1.5460 [26] | |
| **1,6-Diphenylhexane**  | | | | |
| 137 [36]<br>29 [62] | 206–208 20 [71]<br>140 0.05 [62] | 0.9528 25° [54] | 1.5380 25° [54] | |

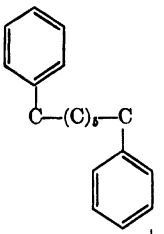
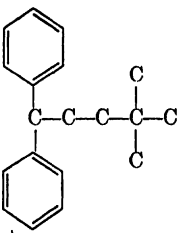
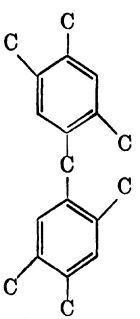
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,5-Diphenylhexane**  | 185 12 [19] | 0.9634 15° [19] | 1.5440 15° [19] | |
| **3,4-Diphenylhexane**  | | | | |
| 92–93 [66] | 304–306 767 [41] | 0.9591(a) [41] | 1.54622(a) [41] | |
| 92 [34] | 297–298 767(a) [41] | 0.9742(a) 0° [41] | | |
| 89.5–90.5 [27] | 175 20 [34] | | | |
| 90 [41] | | | | |
| 88 [48] | | | | |
| (a) This compound is the *dl* modification and exists in liquid state at room temperature. | | | | |
| **1,1-Diphenyl-2-methylpentane**  | | | | |
| | 160–161 14 [5] | | | |
| | 163–164 13 [6] | | | |
| **2,3-Dimethyl-2,3-diphenylbutane**  | | | | |
| 55–56 [73] | 138–140 15 [73] | | | |
| | 162–165 14 [48] | | | |

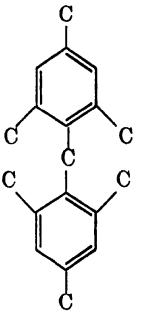
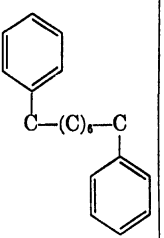
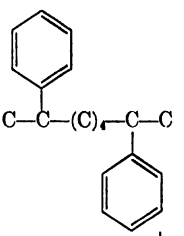
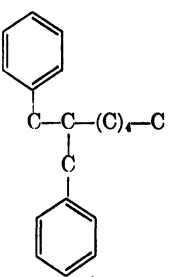
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,3-Di-*m*-tolylbutane**  | | | | |
| 97 [69] | | | | |
| **1,2-Di-(4′-ethylphenyl)-ethane**  | | | | |
| 69.8–70.2 [16] | | | | |
| **1,1-Di-*m*-Xylylethane** (a) | | | | |
| | 323–325 [3] | | | |

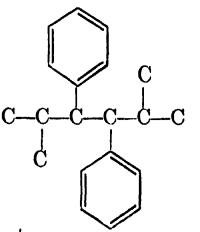
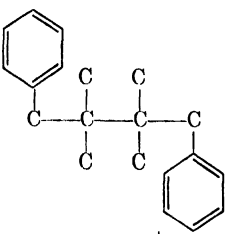
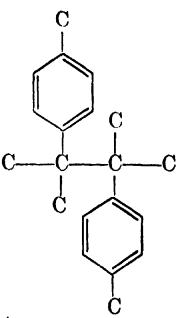
(a) The position of the methyl groups relative to the substitution of the phenyl group on the ethane is not given.

| | | | | |
|---|---|---|---|---|
| **1,2-Di-(2′,3′-dimethylphenyl)-ethane**  | | | | |
| 111–112 [82] | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Di-(3′,5′-dimethylphenyl)-ethane**  | | | | |
| 86–86.6 [16]<br>78 [13,14]<br>77–78 [48,76] | 332<br>–332.5 763 [76]<br>210 15 [13,14] | | | |
| **3,5-Dimethylphenyl-2′,4′,6′-trimethylphenylmethane**  | | | | |
| 67–68 [73,74,75] | 328.5<br>–329 763 [76] | | | |
| $C_{19}H_{24}$ | | | | |
| **1,1-Diphenylheptane**  | | | | |
| 14 [3,33,37] | 333–334 751 [33]<br>193 15 [37]<br>190–192 13 [3,33]<br>186 10 [37]<br>180 10 [38] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,7-Diphenylheptane**  | 207–208 12 [11] | | | |
| **1,1-Diphenyl-4,4-dimethylpentane**  | 122–127 1 [1]<br>114–116 0.65 to 0.70 [1] | 0.9520 [1]<br>0.9522 [1] | 1.5411 [1]<br>1.5418 [1] | |
| **2,2-Dixylylpropane** (a) | | | | |
| 174.5 [25] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **Di-2,4,5-trimethylphenylmethane**  | | | | |
| 100 [80]<br>99 [70] | 189–190 12 [70] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Di-2,4,6-trimethylphenylmethane**  | | | | |
| 135 [35,78]<br>130 [50,70] | | | | |
| $C_{20}H_{26}$<br>**1,8-Diphenyloctane**  | | | | |
| 10 [38] | 215 12 [11]<br>208–210 8 [71] | 0.9364 25° [84] | 1.5298 25° [84] | |
| **2,7-Diphenyloctane**  | | | | |
| | 190–191 11 [67] | | | |
| **1-Phenyl-2-benzylheptane**  | | | | |
| | 135–136 [28] 7 | 0.9060 $D_{20}^{20}$ [28] | 1.48596 [28] | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,5-Dimethyl-3,4-diphenylhexane**  150–150.5 [17] | | | | |
| **1,4-Diphenyl-2,2,3,3-tetramethylbutane**  131–132 [17] | | | | |
| **2,3-Dimethyl-2,3-di-*p*-tolylbutane**  157 [7,8] | | | | |
| **1,1-Di-*n*-propyldiphenylethane** (a) | 192–194 42(b) [53]<br>244–248 37(b) [53] | | | |
| **1,2-Di-*n*-propyldiphenylethane** (a) | 97–98(b) [40] | 178–179 13(c) [40] | 0.9452(c) [40]<br>0.9596(c) 0° [40] | 1.53663(c) [40] |

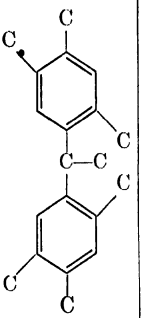
(a) The position of the propyl groups is not given.
(b) These boiling points represent two different isomers.

(a) The position of the propyl groups is not given.
(b) This constant was determined on the *meso* form.
(c) This constant was determined on the *dl* form.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diisopropyldiphenylethane** (a) | | | | |
| | 240–245 15 [53] | | | |

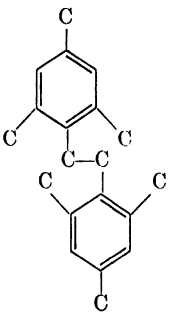
(a) The position of the isopropyl groups is not given.

**1,1-Di-(2′,4′,5′-trimethylphenyl)-ethane**



| | | | | |
|---|---|---|---|---|
| 126–127 [79] | | | | |

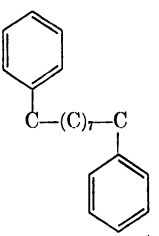
**1,2-Di-(2′,4′,6′-trimethylphenyl)-ethane**



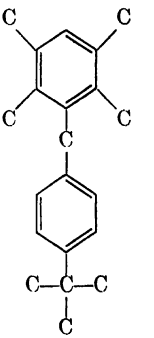
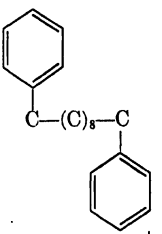
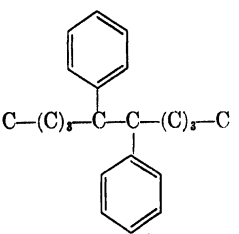
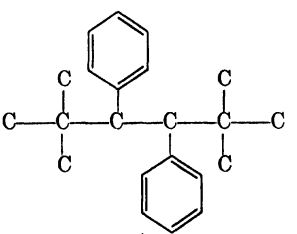
| | | | | |
|---|---|---|---|---|
| 117–118 [78] | 344–348 [81] | | | |

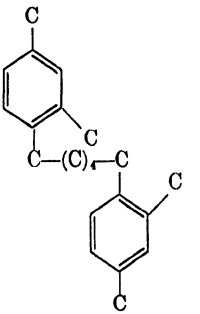
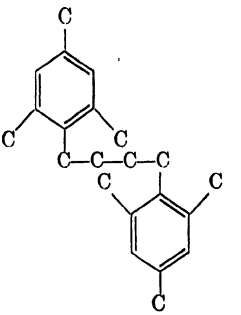
$C_{21}H_{28}$

**1,9-Diphenylnonane**



| | | | | |
|---|---|---|---|---|
| | 235 12 [11] | | | |

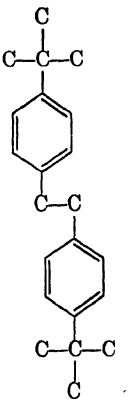
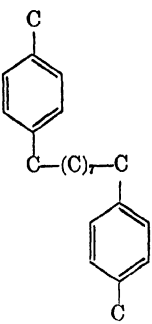
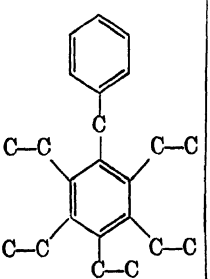
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,3,5,6-Tetramethylphenyl-4′-*tert*-butylphenylmethane**  | | | | |
| 116–117 [24] | | | | |
| $C_{22}H_{30}$ | | | | |
| **1,10-Diphenyldecane**  | | | | |
| 17.5 [62] | 234 12 [10] | 0 9180 40° [62] | 1.5282 [62] | |
| 16–17 [10] | 224–225 9 [71] | 0.9232 30° [62] | | |
| 16 [71] | 169–170 0.03 [62] | | | |
| **5,6-Diphenyldecane**  | | | | |
| 80 [17] | | | | |
| **2,2,5,5-Tetramethyl-3,4-diphenylhexane**  | | | | |
| 185–186 [21]<br>180–181 [17] | | | | |

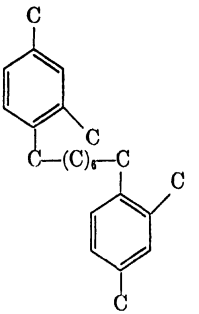
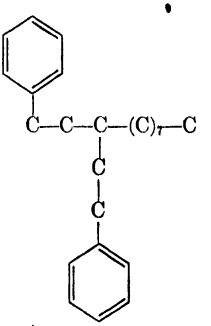
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,6-Di-(2′,4′-dimethylphenyl)-hexane**  | | | | |
| 76–77 [9] | 247–248 20 [9] | | | |
| **Di-1,4-(2′,4′,6′-trimethylphenyl)-butane**  | | | | |
| 124 [65]<br>123–124 [44] | | | | |
| **Di-*n*-butyldiphenylethane** (a) | | | | |
| 79–79.5(b) [40] | 183–184 10(c) [40] | 0.9337(c) [40]<br>0.9490(c) 0° [40] | 1.52857 [40] | |

(a) The structure of this compound is not given.
(b) This constant was determined on the *meso* form.
(c) This constant was determined on the *dl* form.

| | | | | |
|---|---|---|---|---|
| **1,1-Di-*sec*-butylphenylethane** (a) | | | | |
| | 250–252 11 [65] | | | |

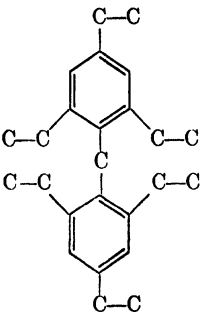
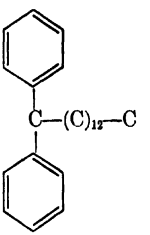
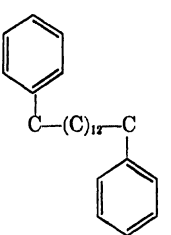
(a) The position of the butyl groups is not given.

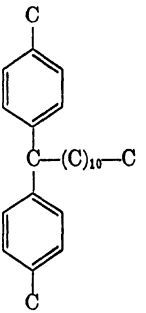
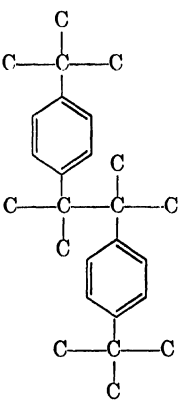
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Di-*tert*-butylphenylethane** (a) | | | | |
| 94 [51] | 212–214 16 [51] | | | |
| (a) The position of the butyl groups is not given. | | | | |
| **1,2-Di-(4′-*tert*-butylphenyl)-ethane**  | | | | |
| 149 [46] | | | | |
| $C_{23}H_{32}$  **1,9-Di-*p*-tolylnonane** | | | | |
| 48–49 [9] | 248–252 18 [9] | | | |
| **Phenylpentaethylphenylmethane**  | | | | |
| 88–89 [22] | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,8-Di-(2′,4′-dimethylphenyl)-octane**  | | | | |
| 63–64 [9] | 253–254 13 [9] | | | |
| **Di-2,4,6-trimethylphenylhexane** (a) | | | | |
| 74 [65] | | | | |
| (a) The position of the trimethylphenyl substitutions is not given. | | | | |
| **1,1-Di-[x′-(3″-pentyl)-phenyl]-ethane** (a) | | | | |
| | 234–236 29 [63] | | | |
| (a) The position of the pentyl groups is not given. | | | | |
| $C_{25}H_{36}$ | | | | |
| **1-Phenyl-3-phenethylundecane**  | | | | |
| | | **0.9215** | **1.5192** | |
| −54 [60] | | | | |
| | 197.0 1.00 [60,61] | 0.9211 [60,61] | 1.5192 [60,61] | |
| | 184 0.50 [61] | 0.8689 98.9° [61] | 1.5116 40.0° [61] | |
| | | 0.8948 60° [61] | 1.5154 30.0° [61] | |
| | | 0.9093 37.8° [61] | | |
| | | 0.9356 0° [61] | | |

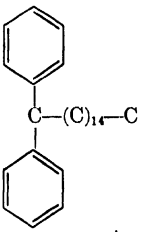
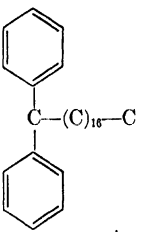
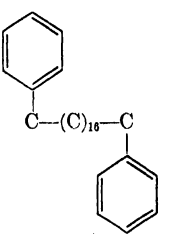
* $\frac{dD}{dt} = -0.0006873[1 - 0.0008031(t-20)]/°C$ (0 to 99°C)

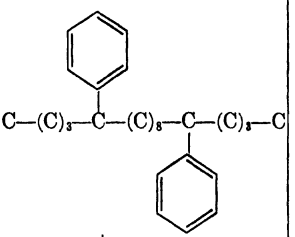
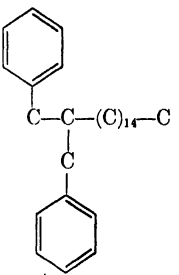
† $\frac{dn}{dt} = -0.000380/°C$ (20 to 40°C)

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Di-2,4,6-triethylphenylmethane**  | | | | |
| 71–72 [49] | | | | |
| $C_{26}H_{38}$ | | | | |
| **1,1-Diphenyltetradecane**  | | | | |
| | | **0.9187** | **1.5202** | |
| 17.9 [18,60,61] | 207 1.00 [18,61] | 0.9186 [18,60,61] | 1.5202 [18,60,61] | |
| | 194 0.5 [18] | 0.8659 98.9° [18] | 1.5123 40.0° [18] | |
| | | 0.8916 60° [18] | 1.5162 30.0° [18] | |
| | | 0.9068 37.8° [18] | | |
| $*\frac{dD}{dt} = -0.0006787[1-0.0003577(t-20)]/°C$ (20 to 99°C) | | | | |
| $\dagger\frac{dn}{dt} = -0.000395/°C$ (20 to 40°C) | | | | |
| **1,14-Diphenyltetradecane**  | | | | |
| | 262–265 8 [71] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Di-*p*-tolyldodecane**  | | | | * |
| | | **0.9117** | **1.5001** | † |
| | 197.0 1.00 [60] | 0.9117 [80] | 1.5001 [60] | |
| | 183.0 0.50 [60] | 0.8607 98.9° [60] | 1.4927 40.0° [60] | |
| | | 0.8859 60° [60] | 1.4964 30.0° [60] | |
| | | 0.9000 37.8° [60] | | |
| | | 0.9248 0° [60] | | |
| * $\frac{dD}{dt} = -0.0006514[1 - 0.0002067(t-20)]$/°C (0 to 99°C) | | | | |
| † $\frac{dn}{dt} = -0.000370$/°C (20 to 40°C) | | | | |
| **2,3-Dimethyl-2,3-di-(4′-*tert*-butylphenyl)-butane**  | | | | |
| 225 [74] | | | | |
| **1,2-Di-*n*-hexyldiphenylethane** (a) | | | | |
| 59(b) [40] | 223 | 0.9174(c) [40] | 1.51770(c) [40] | |
| | −224(c) 10 [40] | 0.9310(c) 0° [40] | | |

(a) The position of the hexyl substitutions is not given.
(b) This constant was determined on the *meso* form.
(c) This constant was determined on the *dl* form.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenylhexadecane**  | | | | * |
| | | **0.9130** | 1.5156 [63] | |
| 26 [63] | 279–281 15 [39] | 0.9117 [63] | 1.5121 25° [65] | |
| | 273–275 10 [39] | 0.9135 [39,55] | 1.51569 16° [39] | |
| | 211–213 0.1 [63] | 0.8615 100° [20] | 1.51209 $n_{H\alpha}^{16}$ [39] | |
| | | 0.8940 50° [20] | 1.52508 $n_{H\beta}^{16}$ [39] | |
| | | 0.9265 0° [20] | 1.53346 $n_{H\gamma}^{16}$ [39] | |
| * $\frac{dD}{dt} = -0.0006538[1-0.0004246(t-20)]$/°C (0 to 100°C) | | | | |
| $C_{30}H_{46}$ | | | | |
| **1,1-Diphenyloctadecane**  | | | | |
| | | 0.9260(a) 25° [47] | 1.5138 25° [47] | |
| (a) This density is an extrapolated value. | | | | |
| **1,18-Diphenyloctadecane**  | | | | |
| 61 [62] | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **5,14-Diphenyloctadecane**  | | | | |
| | | 0.9051 25° [47] | 1.5110 25° [47] | |
| **1-Phenyl-2-benzylheptadecane**  | | | | |
| | | 0.9165 | | |
| 34.5–35 [39] | 294–296 16 [39] | 0.9165 [39,55] | 1.5123 25° [85] | |
| | 287–289 10 [39] | 0.8642 100° [20] | 1.51596 15.9° [39] | |
| | | 0.8969 50° [20] | 1.51218 $n_{H\alpha}^{15.9}$ [39] | |
| | | 0.9296 0° [20] | 1.52536 $n_{H\beta}^{15.9}$ [39] | |
| | | | 1.53373 $n_{H\gamma}^{15.9}$ [39] | |
| * $\frac{dD}{dt} = -0.0006539$/°C | (0 to 100°C) | | | |

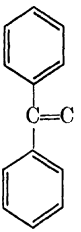
## References on $C_{17}H_{20}$-$C_{30}H_{46}$ Compounds


1. Althausen, D., and C. S. Marvel, J. Am. Chem. Soc. **54**, 1174 1932.
2. Anschütz, R., Ann. **235**, 299 1886.
3. Auger, V., Bull. soc. chim [2] **47**, 42 1887.
4. Beaurepaire, Bull. soc. chim. [2] **50**, 676 1888.
5. Bergmann, E., Helv. Chim. Acta **20**, 590 1937.
6. Bergmann, E., and R. Hartrott, J. Chem. Soc. **1935**, 1218.
7. Boedtker, E., J. pharm. chim. [8] **9**, 417 1929.
8. Boedtker, E., and R. Kerlor, Compt. rend. **188**, 1681 1929.
9. Borsche, W., Ber. **52**, 2077 1919.
10. Borsche, W., and J. Wollemann, Ber. **44**, 3185 1911.
11. Borsche, W., and J. Wollemann, Ber. **45**, 3713 1912.
12. Busch, M., and M. Fleischmann, Ber. **43**, 740 1910.
13. Carré, P., Bull. soc. chim. [4] **7**, 841 1910.
14. Carré, P., Compt. rend. **151**, 149 1910.

15. Clemmensen, E., Ber. **47**, 681 **1914**.
16. Coleman, G. H., W. H. Holst, and R. D. Maxwell, J. Am. Chem. Soc. **58**, 2310 **1936**.
17. Conant, J. B., and A. H. Blatt, J. Am. Chem. Soc. **50**, 551 **1928**.
18. Cosby, J. N., and L. H. Sutherland, Proc. Am. Petroleum Inst. **22**, III, 13 **1941**.
19. Dupont, G., Compt. rend. **156**, 1623 **1913**.
20. Evans, E. B., J. Inst. Petroleum Tech. **24**, 537 **1938**.
21. Ford, J. H., C. D. Thompson, and C. S. Marvel, J. Am. Chem. Soc. **57**, 2619 **1935**.
22. Fournier, H., Bull. soc. chim. [3] **7**, 653 **1892**.
23. Fuson, R. C., J. J. Denton, and C. E. Best, J. Org. Chem. **8**, 64 **1943**.
24. Fuson, R. C., and B. C. McKusick, J. Am. Chem. Soc. **65**, 60 **1943**.
25. Gaudet, H., and F. Schenker, Helv. Chim. Acta **10**, 132 **1927**.
26. Gilman, H., and S. A. Harris, J. Am. Chem. Soc. **54**, 2072 **1932**.
27. Grignard, V., and K. Ono, Bull. soc. chim. [4] **39**, 1589 **1926**.
28. Grinberg, I. V., Research Communications Kiev Ind. Inst. **2**, 30 **1940**; Survey For. Petrol. Liter. June 6, **1941**.
29. Hennion, G. F., and R. A. Kurtz, J. Am. Chem. Soc. **65**, 1001 **1943**.
30. Huston, R. C., and D. T. Ewing, J. Am. Chem. Soc. **37**, 2394 **1915**.
31. Ipatieff, V. N., N. A. Orlov, and B. N. Dolgov, Compt. rend. acad. sci. U R.S.S. **1928A**, 1; C.A. **25**, 4543 **1931**; Chem Zentr. **1930**, I, 1783.
32. Klages, A., Ber. **40**, 2360 **1907**.
33. Klages, A., and S. Heilmann, Ber **37**, 1447 **1904**.
34. Kohler, E. P., Am. Chem. J. **35**, 386 **1906**.
35. Kohler, E. P., and R. Baltzly, J. Am. Chem. Soc. **54**, 4015 **1932**.
36. Kraemer, G., A. Spilker, and P. Eberhardt, Ber. **23**, 3269 **1890**.
37. Krafft, F., Ber. **19**, 2982 **1886**.
38. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 123 **1928**.
39. Landa, S., and J. Čech, Collection Czechoslov. Chem. Commun. **6**, 423 **1934**; C.A. **29**, 768 **1935**; Chem. Zentr. **1935**, I, 1227.
40. Lepin, A., Acta Univ. Latviensis, Kīm. Fakultāt. Ser. **1**, 145 **1932**; C.A. **25**, 3328 **1931**; Chem. Zentr. **1931**, I, 2619.
41. Lepin, A., and W. Reich, J. Russ. Phys. Chem. Soc. **47**, 149 **1915**; Chem. Zentr. **1916**, I, 787.
42. Leuchs, H., and H. S. Overberg, Ber. **64**, 1896 **1931**.
43. Losahich, S. M., Bul. Soc. Române Stiinte **23**, 3 **1914**.
44. Lutz, R. E., and J. L. Wood, J. Am. Chem. Soc. **60**, 713 **1938**.
45. Masson, H., Compt. rend. **135**, 533 **1902**.
46. Mazzara, G., Gazz. chim. ital. **8**, 508 **1878**.
47. Mikeska, L. A., Ind. Eng. Chem. **28**, 970 **1936**.
48. Moritz, C., and R. Wolffenstein, Ber. **32**, 2531 **1899**.
49. Nauta, W. T., and D. Mulder, Rec. trav. chim **58**, 514 **1939**.
50. Nauta, W. T., and P. J. Wuis, Rec. trav. chim. **57**, 41 **1938**.
51. Reichert, J. S., and J. A. Nieuwland, J. Am. Chem. Soc **45**, 3090 **1923**.
52. Reichstein, T., A. Cohen, M. Ruth, and H. F. Meldahl, Helv. Chim. Acta **19**, 412 **1936**.
53. Reilly, J. A., and J. A. Nieuwland, J. Am. Chem. Soc. **50**, 2564 **1928**.
54. Riedinger, A., Physik. Z **39**, 380 **1938**.
55. Rossini, F. D., Refiner Natural Gasoline Mfr. **14**, 268 **1935**.
56. Rupe, H., and W. Tomi, Ber. **47**, 3064 **1914**.
57. Rupe, H., and F. van Walraven, Helv. Chim. Acta **13**, 361 **1930**.
58. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915**.
59. Sabatier, P., and M. Murat, Compt. rend. **156**, 1951 **1913**.
60. Schiessler, R. W., D. G. Clarke, C. S. Rowland, W. S. Sloatman, and C. H. Herr, preprint of paper presented at Am. Petroleum Inst. Nov. 10, **1943**.
61. Schiessler, R. W., J. N. Cosby, D. G. Clarke, C. S. Rowland, W. S. Sloatman, and C. H. Herr, Proc. Am. Petroleum Inst. **23**, III, 15 **1942**.
62. Schmidt, A. W., and A. Grosser, Ber. **75**, 826 **1942**.

63. Schmidt, A. W., and C. Hartmann, Ber. **74**, 1325 **1941**.
64. Shima, G., Mem. Coll. Sci., Kyoto Imp. Univ. **13A**, 315 **1930**.
65. Sordes, J., Compt. rend. **195**, 247 **1932**.
66. Späth, E, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1207 **1913**.
67. Straus, F., and H. Grindel, Ann. **439**, 276 **1924**.
68. Trotman, E. R., J. Chem Soc. **127**, 88 **1925**.
69. von Auwers, K., and H. Kolligs, Ber. **55**, 21 **1922**.
70. von Baeyer, A., Ber. **5**, 1094 **1872**.
71. von Braun, J., and H. Deutsch, Ber. **45**, 2171 **1912**.
72. Vorländer, D., and R. Walter, Z. physik. Chem **118**, 1 **1925**.
73. Wallach, O., Nachr. Kgl. Ges. Wiss. Göttingen **1899**, II, 4; Chem Zentr. **1899**, II, 1047.
74. Walther, M., J. pharm. chim. **27**, 476 **1938**.
75. Weiler, M., Ber. **32**, 1908 **1899**.
76. Weiler, M., Ber. **33**, 334 **1900**.
77. Weiler, M., Ber. **33**, 464 **1900**.
78. Wenzel, F., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **123**, Abt. IIb, 447 **1914**.
79. Wenzel, F, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **123**, Abt. IIb, 467 **1914**.
80. Wenzel, F., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **123**, Abt. IIb, 481 **1914**.

## 1,1-Diphenylethene

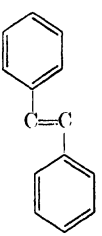


277

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 8–9 [96,111] | 277–280 [101,102] | 1.0232 [128] | 1.6075 [103] | |
| 8.2 [109] | 277 [2,3,47] | 1.0253 25° [57] | 1.60849 [128] | |
| 7–9(a) [135] | 276–277 [112] | 1.028 $D_0^{21}$ [101,102] | 1.6100 [51] | |
| | 274–276 [34,35] | 1.0278 18° [52] | 1.6035 30° [135] | |
| | 164 34 [57] | 1.0278 15° [96] | 1.606 21° [101,102] | |
| | 156 30 [14] | 1.038 14° [58] | $1.6091_4$ 19° [30] | |
| | 156 25 [57] | 1.0415 0° [96] | 1.610 14° [58] | |
| | 155 25 [135] | | 1.60089 $n_{H\alpha}^{20.0}$ [128] | |
| | 152.5–154 19 [128] | | $1.6018_8$ $n_{H\alpha}^{19}$ [30] | |
| | 147 16 [58] | | 1.62730 $n_{H\beta}^{20.0}$ [128] | |
| | 148 15 [103] | | 1.64482 $n_{H\gamma}^{20.0}$ [128] | |
| | 139 11 [58] | | | |
| | 134–134.5 10 [51] | | | |
| | 134 10 [63] | | | |
| | 123–125 5 [1] | | | |
| | 113 2 [1] | | | |
| | 94–95 1 [109] | | | |

(a) This figure is given as a freezing point in the literature.

## *cis*-1,2-Diphenylethene
(*cis*-Stilbene)



| | | | | |
|---|---|---|---|---|
| 154–154.5 | 21 [33] | 1.014 [127] | 1.6083 [28] | |
| 150 | 19 [106] | 1.0143 [28] | 1.6032 | 25° [66] |
| 148–149 | 17 [15] | 1.014 24° [22] | 1.620 | 13° [22] |
| 145 | 13 [104] | 1.020 16° [22] | 1.60454 $n_{H\alpha}^{15.9}$ | [126] |
| 143 | 13 [108] | 1.0171 15.9° [126] | 1.60526 $n_{H\alpha}^{15.9}$ | [126] |
| 140.5–141 | 13 [23,93] | 1.0183 15.9° [126] | 1.63385 $n_{H\beta}^{15.9}$ | [126] |
| 140 | 12 [20] | 1.023 13° [22] | 1.63527 $n_{H\beta}^{15.9}$ | [126] |
| 139–140 | 12 [22] | | | |
| 137 | 10 [127] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***cis*-1,2-Diphenylethene** (*cis*-Stilbene) (*Continued*) | | | 1.65609 $n_{H\gamma}^{15.9}$ [126]<br>1.6220 $n_{He}^{20}$ [127]<br>1.61277 $n_{He}^{15.9}$ [126]<br>1.61367 $n_{He}^{15.9}$ [126] | |
| | 136–137 10 [116]<br>134 10 [121,122]<br>133 8 [28]<br>132 1 [118]<br>92 0.1 [81] | | | |
| ***trans*-1,2-Diphenylethene** (*trans*-Stilbene) | | | | |
| **124.2** | **306.5** | | | |
| 124.5–125.5 [25]<br>125.0 [125]<br>125(a)<br>124–125(b)<br>124.5–124.8 [109]<br>124–124.5 [113]<br>124.4 [89]<br>124.2 [89]<br>124.0 [11]<br>124(c)<br>123–124(d)<br>123.5 [17,90,124]<br>123 [94,95,131,141]<br>121–123 [38]<br>122 [118]<br>121–122 [10]<br>121 [13,36,97] | 307 [105]<br>306–307 [137,138]<br>306.5 [62]<br>302–304 [72]<br>305.0<br>–307.5 744 [70]<br>305 720 [61]<br>168 13 [23]<br>167 12 [127]<br>166–167 12 [22,137] | 1.039 [127]<br>0.9544 125° [124]<br>0.9703 125.0° [11]<br>0.9707 125.0° [11]<br>1.0883 21.7° [129]<br>1.0888 19.9° [129]<br>1.164 0° [145]<br>1.155 (solid) [74]<br>1.156(e) [12]<br>1.159(e) [46] | 1.62179 $n_{H\alpha}^{21.7}$ [129]<br>1.62213 $n_{H\alpha}^{19.9}$ [129]<br>1.65474 $n_{H\beta}^{21.7}$ [129]<br>1.65506 $n_{H\beta}^{19.9}$ [129]<br>1.63108 $n_{He}^{21.7}$ [129]<br>1.6820 $n_{He}^{20}$ [127]<br>1.63134 $n_{He}^{19.9}$ [129] | |

(a) The melting point 125 is found in references 40, 48, 55, 64, 67, 71, 104, 108, 119, 142.

(b) The melting point 124-125 is found in references 16, 21, 80, 114, 133, 134, 136, 139.

(c) The melting point 124 is found in references 4, 5, 6, 7, 8, 9, 19, 22, 24, 26, 27, 29, 31, 32, 33, 37, 41, 42, 43, 44, 45, 49, 50, 53, 54, 56, 59, 60, 61, 73, 75, 76, 79, 82, 83, 84, 85, 86, 87, 88, 91, 92, 98, 99, 100, 106, 107, 110, 115, 117, 120, 122, 127, 129, 132, 137, 138, 140, 143, 144.

(d) The melting points 123-124 is found in references 18, 65, 69, 72, 77, 78, 81, 116, 123, 130.

(e) The temperature for this density is not given.

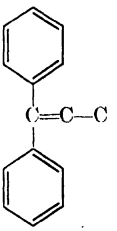
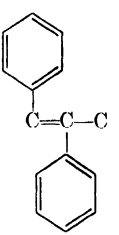
## Diphenylethene References


1. Allen, C. F. H., and S. Converse, Org. Syntheses **6**, 32 **1926.**
2. Anschütz, R., Ann. **235**, 150 **1886.**
3. Anschütz, R., Ann. **235**, 299 **1886.**
4. Anschütz, R., Ber. **18**, 1945 **1885.**
5. Anschütz, R., and Q. Wirtz, Ber. **18**, 1947 **1885.**
6. Arends, B., Ber. **64**, 1936 **1931.**

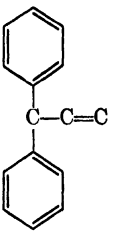
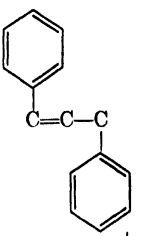
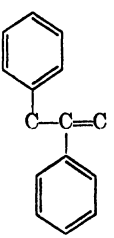
7. Aronstein, L., and A. F. Hollemann, Ber. **21**, 2831 **1888**.
8. Aronstein, L., and A. S. van Nierop, Rec. trav. chim. **21**, 448 **1902**.
9. Bamberger, E., and W. Lodter, Ber. **21**, 51 **1888**.
10. Barbaglia, G. A., and A. Marquardt, Gazz. chim. ital. **21**, 195 **1891**.
11. Beck, K., Z. physik. Chem. **48**, 641 **1904**.
12. Becker, K., and H. Rose, Z. Physik **14**, 369 **1923**.
13. Bender, F., and G. Schultz, Ber. **19**, 3234 **1886**.
14. Berger, G., Z. physik. Chem. **28B**, 95 **1935**.
15. Bergmann, E., J. Chem. Soc. **1936**, 402.
16. Bergs, H., Ber. **67**, 238 **1934**.
17. Berthoud, A., and J. Béraneck, J. chim. phys. **24**, 213 **1927**.
18. Bigelow, L. A., J. Am. Chem. Soc. **47**, 193 **1925**.
19. Blank, A., Ann. **248**, 1 **1888**.
20. Böeseken, J., and J. S. P. Blumberger, Rec. trav. chim. **44**, 90 **1925**.
21. Borsche, W., Ber. **42**, 4072 **1909**.
22. Bourguel, M., Bull. soc. chim. [4] **45**, 1067 **1929**.
23. Bourguel, M., Compt. rend. **180**, 1753 **1925**.
24. Bradley, M. J., and S. W. Parr, Chem. Met. Eng. **27**, 737 **1922**.
25. Breslow, D. S., and C. R. Hauser, J. Am. Chem. Soc. **61**, 786 **1939**.
26. Bruni, G., Atti accad. Lincei [5] **13**, I, 626 **1904**.
27. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 **1936**.
28. Campbell, K. N., and M. J. O'Connor, J. Am. Chem. Soc. **61**, 2897 **1939**.
29. Castille, A., Bull. classe sci. Acad. roy. Belg. [5] **12**, 498 **1926**.
30. Cotton, A., and H. Moutton, Ann. chim. phys. [8] **28**, 209 **1913**.
31. Crymble, C. R., A. W. Stewart, and R. Wright, Ber. **43**, 1188 **1910**.
32. Curtius, T., and R. Jay, J. prakt. Chem. [2] **39**, 27 **1889**.
33. Dadieu, A., A. Pongratz, and K. W. F. Kohlrausch, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **140**, Abt. IIa, 647 **1931**.
34. Demole, E., through Anschütz, Ann. **235**, 150 **1886**.
35. Demole, E., Ber. **12**, 2245 **1879**.
36. Elbs, K., and H. Förster, J. prakt. Chem. [2] **39**, 298 **1889**.
37. Erlenmeyer, E., Ann. **372**, 247 **1910**.
38. Errera, G., Gazz. chim. ital. **16**, 310 **1886**.
39. Ferry, J. D., and S. B. Thomas, J. Phys Chem. **37**, 253 **1933**.
40. Forst, C., and T. Zincke, Ann. **182**, 246 **1876**.
41. Fromm, E., and O. Achert, Ber. **36**, 534 **1903**.
42. Garelli, F., and F. Calzolari, Atti accad. Lincei [5] **8**, I, 579 **1899**.
43. Garelli, F., and F. Calzolari, Gazz. chim. ital. **29**, II, 258 **1899**.
44. Goswami, M. N., J. Indian Chem. Soc. **7**, 647 **1930**.
45. Harris, E. E., J. Am. Chem. Soc. **52**, 3633 **1938**.
46. Hengstenberg, J., and H. Mark, Z. Krist. **70**, 283 **1929**.
47. Hepp, E., Ber. **7**, 1409 **1874**.
48. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **17**, 929 **1911**.
49. Ingle, H., J. Soc. Chem. Ind. **21**, 587 **1902**.
50. Irvine, J. C., and J. Weir, J. Chem. Soc. **91**, 1384 **1907**.
51. Jones, R. N., J. Am. Chem. Soc. **65**, 1818 **1943**.
52. Kauffmann, H., Z. physik. Chem. **55**, 547 **1906**.
53. Kayser, F., Compt. rend. **196**, 1127 **1933**.
54. Kern, J. W., R. L. Shriner, and R. Adams, J. Am. Chem. Soc. **47**, 1147 **1925**.
55. Kharasch, M. S., and T. A. Ashford, J. Am. Chem. Soc. **58**, 1733 **1936**.
56. Kistiakowsky, G. B., and W. R. Smith, J. Am. Chem. Soc. **56**, 638 **1934**.
57. Klages, A., Ber. **35**, 2646 **1902**.
58. Klages, A., and S. Heilmann, Ber. **37**, 1447 **1904**.
59. Klages, A., and E. Knoevenagel, Ber. **26**, 447 **1893**.

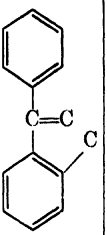
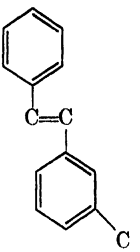
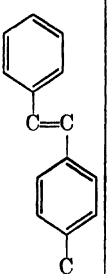
60. Krassilshik, A., Ann. combustibles liquides **10**, 923 **1935.**
61. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 87 **1928.**
62. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918.**
63. Lebedev, S. V., J. Andrevskil. and A. Matyushkina, Ber. **56**, 2349 **1923.**
64. Lettre, H., H. Barnbeck, and W. Lege, Ber. **69**, 1151 **1936.**
65. Levy, J., and P. Gallais, Bull. soc. chim. [4] **43**, 862 **1928.**
66. Lewis, G. N., J. J. Magel, and D. Lipkin, J. Am. Chem. Soc. **62**, 2973 **1940.**
67. Ley, H., and U. Kirchner, Z. anorg. allgem. Chem. **173**, 395 **1928.**
68. Lipp, P., Ber. **56**, 567 **1923.**
69. Mascarelli, L., Atti accad. Lincei [5] **15**, II, 375 **1906.**
70. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **127**, 999 **1925.**
71. Meisenheimer, J., and F. Heim, Ann. **355**, 260 **1907.**
72. Meyer, H., and A. Hoffmann, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **125/126**, Abt. IIb, 449 **1916-1917.**
73. Michaelis, A., and H. Lange, Ber. **8**, 1313 **1875.**
74. Mukherjee, A., Indian J. Phys. **8**, 147 **1933.**
75. Müller, E., and I. Dammerau, Ber. **70**, 2561 **1937.**
76. Müller, R., Ber. **26**, 659 **1893.**
77. Nametkin, S., and D. Kursanov, J. prakt. Chem. [2] **112**, 164 **1926.**
78. Nelson, J. M., and A. M. Collins, J. Am. Chem. Soc. **46**, 2256 **1924.**
79. Nenitzescu, C. D., and D. A. Isăsescu, Ber. **63**, 2484 **1930.**
80. Osipov, I., Z. physik. Chem. **2**, 646 **1888.**
81. Ott, E., and R. Schröter, Ber. **60**, 624 **1927.**
82. Otto, R., J. prakt. Chem. [2] **53**, 1 **1896.**
83. Otto, R., and F. Stoffel, Ber. **30**, 1799 **1897.**
84. Paal, C., and H. Schiedewitz, Ber. **63**, 766 **1930.**
85. Padoa, M., Atti accad. Lincei [5] **27**, II, 59 **1918.**
86. Padoa, M., Atti accad. Lincei [5] **28**, II, 239 **1919.**
87. Padoa, M., Gazz. chim. ital. **48**, II, 139 **1918.**
88. Parks, G. S., and H. M. Huffman, Ind. Eng. Chem. **23**, 1138 **1931.**
89. Parks, G. S., and H. M. Huffman, J. Am. Chem. Soc. **52**, 4381 **1930.**
90. Pascal, P., and L. Normand, Bull. soc. chim. [4] **13**, 151 **1913.**
91. Pascal, P., and L. Normand, Bull. soc. chim. [4] **13**, 878 **1913.**
92. Pearl, I. A., and W. M. Dehn, J. Am. Chem. Soc. **60**, 57 **1938.**
93. Price, C. C., and M. Meister, J. Am. Chem. Soc. **61**, 1595 **1939.**
94. Ramart, P., and P. Amagat, Ann. chim. [10] **8**, 263 **1927.**
95. Ramart-Lucas and P. Amagat, Bull. soc. chim. [4] **51**, 108 **1932.**
96. Redsko, J. Russ. Phys. Chem. Soc. **22**, 365 **1890**; Beil. **5**, 639 **1922.**
97. Reimer, C. L., Ber. **13**, 742 **1880.**
98. Reimer, Ber. **14**, 1802 **1881.**
99. Ruggli, P., and A. Staub, Helv. Chim. Acta **20**, 37 **1937.**
100. Ryan, H., and N. Cullinane, Proc. Roy Irish Acad. **36B**, 155 **1924.**
101. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915.**
102. Sabatier, P., and M. Murat, Compt. rend. **154**, 1771 **1912.**
103. Sapiro, R. H., R. P. Linstead, and D. M. Newitt, J. Chem. Soc. **1937**, 1784.
104. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928.**
105. Schmidt, O., Z. physik. Chem. **176A**, 237 **1936.**
106. Shima, G., Mem. Coll. Sci., Kyoto Imp. Univ. **13A**, 315 **1930.**
107. Sieburg, E., and E. Harloff, Z. physiol. Chem. **108**, 195 **1919-1920.**
108. Smakula, A., and A. Wassermann, Z. physik. Chem. **155A**, 353 **1931.**
109. Smith, R. H., and D. H. Andrews, J. Am. Chem. Soc. **53**, 3644 **1931.**
110. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1691 **1913.**
111. Stadnikov, G., Ber. **47**, 2133 **1914.**
112. Stadnikov, G. L., J. Russ. Phys. Chem. Soc. **47**, 2037, 2115 **1915**; Chem. Zentr. **1916**, II, 388.

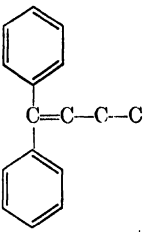
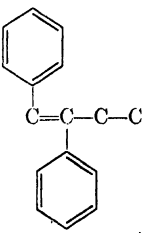
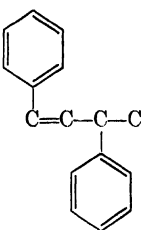
113. Steinkopf, W., and A. Wolfram, Ann. **430**, 113 **1923.**
114. Stobbe, H., and F. Zschoch, Ber. **56**, 676 **1923.**
115. Störmer, R., Ber. **42**, 4865 **1909.**
116. Störmer, R., and G. Voht, Ann. **409**, 36 **1915.**
117. Straus, F., Ann. **342**, 190 **1905.**
118. Stuurman, J., Proc. Acad. Sci. Amsterdam **38**, 450 **1935.**
119. Sudborough, J. J., J. Chem. Soc. **67**, 604 **1895.**
120. Tammann, G., Nachr. kgl. Ges. Wiss. Göttingen **1918**, 296.
121. Taylor, T. W. J., and C. E. J. Crawford, J. Chem. Soc. **1934**, 1130.
122. Taylor, T. W. J., and A. R. Murray, J. Chem. Soc. **1938**, 2078.
123. Upson, F. W., R. T. Maxwell, and H. M. Parmeler, J. Am. Chem. Soc. **52**, 1971 **1930.**
124. Vanstone, E., J. Chem. Soc. **103**, 1826 **1913.**
125. Vanstone, E., J. Chem. Soc. **105**, 1491 **1914.**
126. von Auwers, K., Ann. **499**, 123 **1932.**
127. von Auwers, K., Ber. **68**, 1346 **1935.**
128. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] **84**, 37 **1911.**
129. von Auwers, K., and R. Kraul, Ann. **443**, 181 **1925.**
130. von Miller, W., and G. Rohde, Ber. **23**, 1070 **1890.**
131. von Pechmann, H., Ber. **31**, 2640 **1898.**
132. von Walther, R., and A. Wetzlich, J. prakt. Chem. [2] **61**, 169 **1900.**
133. Wagner-Jauregg, T., Ber. **63**, 3213 **1930.**
134. Wedekind, E., and D. Schenk, Ber. **44**, 198 **1911.**
135. Welsh, L. H., and N. L. Drake, J. Am. Chem. Soc. **60**, 59 **1938.**
136. Wieland, H., and E. Blümich, Ann. **424**, 75 **1921.**
137. Wislicenus, J., Ber. Verhandl. K. sächs Ges. Wiss. Leipzig, Math.-phys. Klasse **52**, 117 **1900.**
138. Wislicenus, J., and F. Seeler, Ber. **28**, 2693 **1895.**
139. Wislicenus, W., and A. Endres, Ber. **36**, 1194 **1903.**
140. Wittig, G., and U. Pockels, Ber. **72**, 884 **1939.**
141. Wolf, K. L., and H. Weghofer, Z. physik. Chem. **39B**, 194 **1938.**
142. Wolff, L., Ann. **394**, 86 **1912.**
143. Wood, J. H., J. A. Bacon, A. W. Meibohm, W. H. Throckmorton, and G. P. Turner, J. Am. Chem. Soc. **63**, 1334 **1941.**
144. Zelinskiĭ, N. D., and I. N. Tits, Ber. **62**, 2869 **1929.**
145. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**

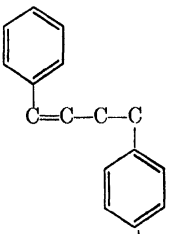
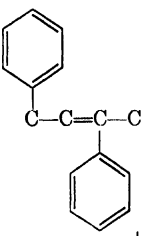
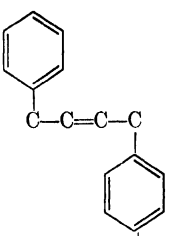
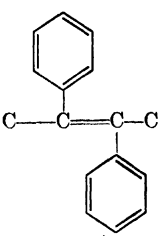
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenylpropene-1**  | | | | * |
| **51** | | **1.0096** | | |
| 52 [5,32,38] | 284.5 [66,67] | 0.9710 78.2° [88] | 1.57913 63.5° [90] | |
| 51–52 [88] | 280–281 [56] | 0.9813 63.5° [90] | 1.5815 60° [39] | |
| 51.5 [66,67] | 182–184 34 [90] | 0.9841 60° [39] | 1.593 23° [66,67] | |
| 51 [43,56] | 169–170 28 [5,38] | 1.0076 $D_0^{23}$ [66,67] | 1.56534 $n_{H\alpha}^{78.2}$ [88] | |
| 50.5–51 [35] | 149 11 [39] | 1.127 0° [102] | 1.57197 $n_{H\alpha}^{63.5}$ [90] | |
| 50–50.5 [90] | | | 1.58958 $n_{H\beta}^{78.2}$ [88] | |
| 48–49 [97,98] | | | 1.59638 $n_{H\beta}^{63.5}$ [90] | |
| 48.5 [72] | | | 1.61169 $n_{H\gamma}^{63.5}$ [90] | |
| | | | 1.57329 $n_{He}^{78.2}$ [88] | |
| * $\frac{dD}{dt} = -0.0006542$/°C | (20 to 60°C) | | | a |
| **1,2-Diphenylpropene-1**  | | | | |
| **82** | | | | |
| 83 [52,70] | 285–286 [39] | 0.9565 99.9° [92] | 1.5635 17° [39] | |
| 82–83 [18,31,38,47,64,92] | 285 [66] | 0.9857 17° [39] | 1.58358 $n_{H\alpha}^{99.9}$ [92] | |
| 82 [34,37,50,66,67,82] | 183 26 [38] | | 1.61469 $n_{H\beta}^{99.9}$ [92] | |
| 81–82 [84] | 167(b) 24 [70] | | 1.59180 $n_{He}^{99.9}$ [92] | |
| 80–81.5 [26] | 176–180 19 [84] | | | |
| 81 [19,93,95] | 165 13 [92] | | | |
| 80–81 [83] | 162–165 13 [64] | | | |
| 48(a) [18] | | | | |

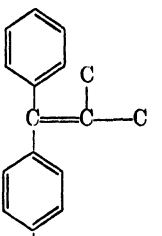
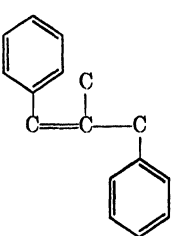
(a) This constant was probably determined on the *cis* isomer.
(b) This constant was determined on the *cis-trans* isomer.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenylpropene-2**  | | | | |
| | 293 [48]<br>279–281 [66,67]<br>94 14 [63] | 1.0038 $D_0^{24}$ [66,67]<br>0.8886 21° [63] | 1.596 [48]<br>1.587 24° [66,67]<br>1.5337 21° [63] | |
| **1,3-Diphenylpropene-1**  | | | | |
| 57 [24]<br>15–16 [80] | 276 [24]<br>175–176 17 [46]<br>174–175 16 [20]<br>171–173 16 [6]<br>178–179 15 [15]<br>178–179 14 [80]<br>174–175 12 [74]<br>164 12 [87]<br>164–168 11 [9]<br>170 10 [7] | 1.012 19.5° [20]<br>1.0003 17° [9] | 1.5949 19.5° [20]<br>1.6010 17.5° [9] | |
| **1,2-Diphenylpropene-2**  | | | | |
| 48 [87] | 289 757 [87]<br>140–143 0 [94] | 1.10143 [94] | 1.5903 [94] | |

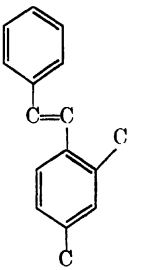
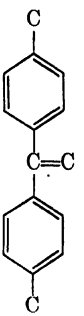
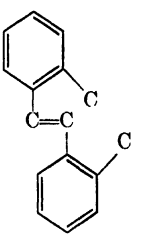
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-1-*o*-tolylethene**  | 145–146 13 [6] | | | |
| **1-Phenyl-2-*m*-tolylethene**  | | | | |
| 52.5–53.5 [91] | 206–207 30 [91] | 1.026 [42]<br>0.9891 60.5° [91] | 1.655 [42]<br>1.63628 60.5° [91]<br>1.62501 $n_{H\alpha}^{60.5}$ [91]<br>1.66983 $n_{H\beta}^{60.5}$ [91] | |
| **1-Phenyl-2-*p*-tolylethene**  | | | | |
| 119.5 | | | | |
| 120 [1] | 192 30 [40] | | | |
| 119–120 [64] | 175–180 17 [64] | | | |
| 119.6 [62] | 160–161 11 [64] | | | |
| 117 [40,58,75] | 145–146 6 [64] | | | |

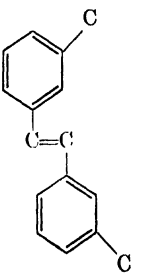
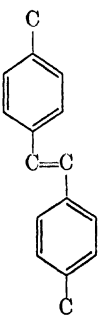
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenylbutene-1**  | | | | |
| | 295–297 [66,68]<br>291–292 [56]<br>286 750 [39]<br>154 20 [39]<br>157–158 14 [70]<br>158–159 13 [5]<br>108–110 0.4 [71] | 0.9937 [71]<br>1.030 18° [39]<br>1.0039 $D_0^{16}$ [66,68] | 1.5904 [71]<br>1.5915 18° [39]<br>1.595 16° [66,68] | |
| **1,2-Diphenylbutene-1**  | | | | |
| 57 [39,78]<br>56.5 [78] | 296–297 [39]<br>296 [68]<br>294–296 [66]<br>162–167 12–14 [78] | 1.0124 $D_0^{18}$ [66,68] | 1.593 18° [66,68] | |
| **1,3-Diphenylbutene-1**  | | | | |
| 47–47.5 [54] | 312 [76,77]<br>175–176 14 [79] | | 1.590 [79] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diphenylbutene-1**  | | | | |
| 124 [77,86] | 310–312 [22] | 1.016 15° [22] | | |
| 39 [25] | 310 [41] | 1.027 0° [22] | | |
| $C_{16}H_{16}$ **1,3-Diphenylbutene-2**  | | | | |
| | 169–170 12 [79] | 1.0149 20.6° [79] | | |
| **1,4-Diphenylbutene-2**  | | | | |
| 45–45.5 [81,81,101] | 73 14 [81] | | | |
| ***cis*-2,3-Diphenylbutene-2**  | | | | |
| 66 | | | | |
| 66–67 [36] | | 1.004 [89] | 1.55466 $n_{H\alpha}^{77.8}$ [87] | |
| 66 [60,89] | | 0.9537 77.8° [87] | 1.57742 $n_{H\beta}^{77.8}$ [87] | |
| 65–66 [65] | | | 1.56116 $n_{H\gamma}^{77.8}$ [87] | |
| 64–66 [87] | | | 1.5919 $n_{He}^{20}$ [89] | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***trans*-2,3-Diphenylbutene-2** | | | | |
| 106.5<br>108 [65]<br>107 [60,87,89]<br>105 [86,69]<br>104–105 [44,45] | 156–158 16 [69] | 0.987 [89] | 1.6173 $n_{He}^{20}$ [89] | |
| **1,1-Diphenyl-2-methylpropene-1**  | | | | |
| 11–11.5 [100]<br>11.2–11.3 [23] | 293 [66,68]<br>280–282 775 [44]<br>150–152 15 [65]<br>152–154 14 [88]<br>152–153 14 [69]<br>146–147 12 [99]<br>145.5<br>–146.0 10 [28] | 1.000 [65]<br>1.0021 17.6° [88]<br>1.0240 $D_0^{15}$ [66,68]<br>1.010 0° [44] | 1.596 16° [66,68]<br>1.58167 $n_{H\alpha}^{17.6}$ [88]<br>1.60512 $n_{H\beta}^{17.6}$ [88]<br>1.62055 $n_{H\gamma}^{17.6}$ [88]<br>1.5875 $n_{He}^{20}$ [88]<br>1.58855 $n_{He}^{17.6}$ [88] | |
| **1,3-Diphenyl-2-methylpropene-1**  | | | | |
| | 315 [99]<br>304 [66,68]<br>188–189 25 [65]<br>175–177 20 [49] | 1.0181 $D_0^{15}$ [66,68]<br>1.037 0° [49] | 1.587 18° [49]<br>1.593 16° [66,68] | |
| **1-Phenyl-2-ethylphenylethene (a)** | | | | |
| 89–90 [73] | | | | |

(a) The position of the ethyl group is not given.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-2-(2′,4′-dimethylphenyl)-ethene**  | | | | |
| 40–41 [23] | | | | |
| **1,1-Di-*p*-tolylethene**  | | | | |
| 61–62 [21]<br>61 [2,3] | 163–165 13 [2] | | | |
| **1,2-Di-*o*-tolylethene**  | | | | |
| 82.5–83.0 [96]<br>82–83 [76] | | | | |

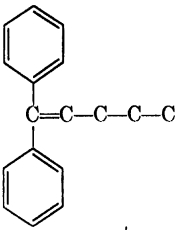
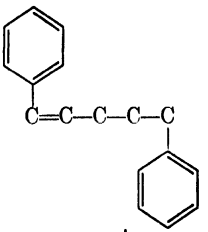
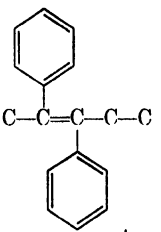
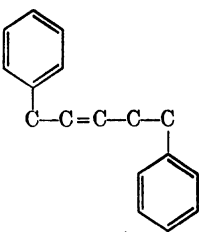
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,2-Di-*m*-tolyethene  | | | | |
| 55–56 [4] | 134–139 5 [55]<br>118 3 [55] | 1.0003 [55] | 1.5922 [55] | |
| 1,2-Di-*p*-tolylethene  | | | | |
| 178 | | | | |
| 181 [61]<br>179–180 [59,96]<br>179 [8,10]<br>178 [11,75]<br>177–178 [33]<br>177 [12,13,16,17,30]<br>176–177 [4,14,27,58] | 304–305 [16] | | | |

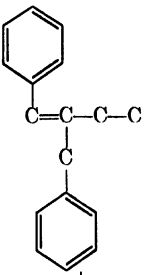
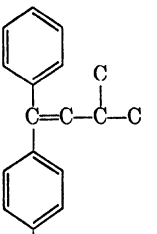
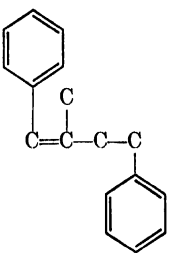
## References on $C_{15}H_{14}$ and $C_{16}H_{16}$ Compounds

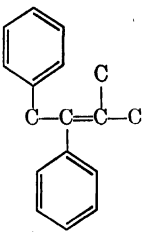
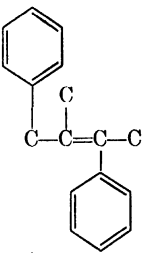
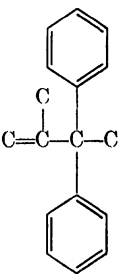
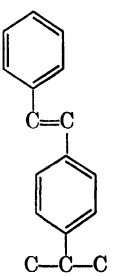

1. Anschütz, R., Ber. **18**, 1945 1885.
2. Anschütz, R., and A. Hilbert, Ber. **57**, 1697 1924.
3. Anschütz, R., and Q. Wirtz, Ber. **18**, 1947 1885.
4. Aronstein, L., and A. S. van Nierop, Rec. trav. chim. **21**, 448 1902.
5. Bergmann, E., and A. Bondi, Ber. **64**, 1455 1931.
6. Bergmann, E., and A. Bondi, Ber. **66**, 286 1933.
7. Bergmann, E., and T. Ukai, Ber. **66**, 54 1933.
8. Bistrzycki, A., and E. Reintke, Ber. **38**, 839 1905.
9. Böeseken, J., and G. Elsen, Rec. trav. chim. **48**, 363 1929.

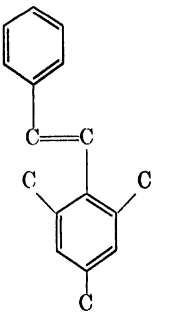
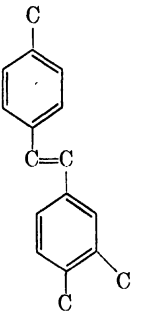
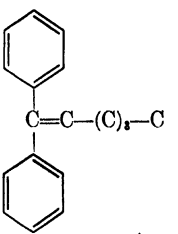
10. Brand, K., Ber. **46**, 2935 **1913.**
11. Brand, K., and G. Wendel, J. prakt. Chem. [2] **115**, 335 **1927.**
12. Bruni, G., Atti accad. Lincei [5] **13**, I, 626 **1904.**
13. Bruni, G., and F. Gorni, Atti accad. Lincei [5] **9**, II, 151 **1900.**
14. Buttenberg, W. P., Ann. **279**, 324 **1894.**
15. Dieckmann, W., and H. Kämmerer, Ber. **39**, 3046 **1906.**
16. Elbs, K., J. prakt. Chem. [2] **47**, 44 **1893.**
17. Elbs, K., and H. Förster, J. prakt. Chem. [2] **39**, 298 **1889.**
18. Ellingboe, E., and R. C. Fuson, J. Am. Chem. Soc. **55**, 2960 **1933.**
19. Favorskiĭ, A., J. Russ. Phys. Chem. Soc. **50**, 43 **1920**; Chem. Zentr. **1923**, III, 666.
20. Fischer, F. G., and O. Stoffers, Ann. **500**, 253 **1932.**
21. Fischer, O., and L. Costner, J. prakt. Chem. [2] **82**, 280 **1910.**
22. Fittig, R., and E. Erdmann, Ann. **216**, 179 **1883.**
23. Français, G., Ann. chim. [11] **11**, 212 **1939.**
24. Francis, F., J. Chem. Soc. **75**, 865 **1899.**
25. Freund, M., and P. Immerwahr, Ber. **23**, 2845 **1890.**
26. Geissman, T. A., and C. F. Koelsch, J. Org. Chem. **3**, 489 **1938.**
27. Goldschmiedt, G., and E. Hepp, Ber. **6**, 1504 **1873.**
28. Gorman, M., R. M. Davis, and P. M. Gross, Physik. Z. **39**, 181 **1938.**
29. Grumez, M., Ann. chim. [11] **10**, 378 **1938.**
30. Harris, E. E., J. Am. Chem. Soc. **52**, 3633 **1930.**
31. Hell, C., Ber. **37**, 453 **1904.**
32. Hell, C., and H. Bauer, Ber. **37**, 230 **1904.**
33. Howard, L. B., and G. E. Hilbert, J. Am. Chem. Soc. **54**, 3628 **1932.**
34. Kayser, F., Ann. chim. [11] **6**, 145 **1936.**
35. Kazanskiĭ, B. A., and G. T. Tatevosyan, J. Gen. Chem. (U.S.S.R.) **9**, 1458 **1939.**
36. Kharasch, M. S., and M. Kleiman, J. Am. Chem. Soc. **65**, 11 **1943.**
37. Kizhner, N., J. Russ. Phys. Chem. Soc. **47**, 1102 **1915**; C.A. **9**, 3051 **1915**; Chem. Zentr. **1916**, I, 1063.
38. Klages, A., Ber. **35**, 2646 **1902.**
39. Klages, A., and S. Heilmann, Ber. **37**, 1447 **1904.**
40. Klages, A., and F. Tetzner, Ber. **35**, 3965 **1902.**
41. Königs, W., and C. Mai, Ber. **25**, 2658 **1892.**
42. Krollpfeiffer, F., Ann. **430**, 161 **1923.**
43. Lagrave, R., Ann. chim. [10] **8**, 363 **1927.**
44. Lévy, J., Bull. soc. chim. [4] **29**, 878 **1921.**
45. Lévy, J., Compt. rend. **172**, 383 **1921.**
46. Lévy, J., and Dvoleitzka-Gombinska, Bull. soc. chim. [4] **49**, 1765 **1931.**
47. Lévy, J., and P. Gallais, Bull. soc. chim. [4] **43**, 862 **1928.**
48. Lévy, J., P. Gallais, and D. Albragam, Bull. soc. chim. [4] **43**, 868 **1928.**
49. Lévy, J., and A. Tabart, Bull. soc. chim. [4] **49**, 1776 **1931.**
50. Ley, H., Ber. **50**, 243 **1917.**
51. Ley, H., and H. Dirking, Ber. **67**, 1331 **1934.**
52. Ley, H., and U. Kirchner, Z. anorg. allgem. Chem. **173**, 395 **1928.**
53. Mann, W., Ber. **14**, 1645 **1881.**
54. Marion, L., Can. J. Research **16B**, 213 **1938.**
55. Marvel, C. S., and V. E. Nichols, J. Am. Chem. Soc **60**, 1455 **1938.**
56. Masson, H., Compt. rend. **135**, 533 **1902.**
57. Mastagli, P., Ann. chim. [11] **10**, 281 **1938.**
58. Meyer, H., and A. Hoffmann, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **125/126**, Abt. IIb, 449 **1916-1917.**
59. Nenitzescu, C. D., and D. A. Isăcescu, Ber. **63**, 2484 **1930.**
60. Ott, E., Ber. **61**, 2124 **1928.**
61. Pascal, P., and L. Normand, Bull. soc. chim. [4] **9**, 1029 **1911.**

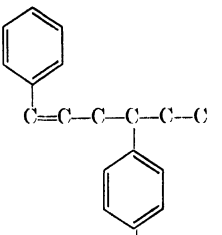
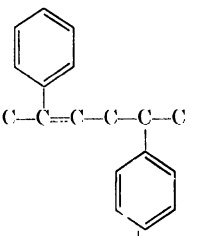
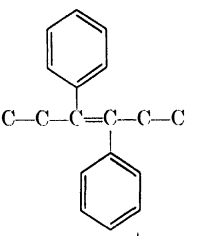
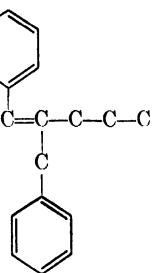
62. Pascal, P., and L. Normand, Bull. soc. chim. [4] **9**, 1059 **1911.**
63. Prevost, C., and J. Daujat, Bull. soc. chim [4] **47**, 588 **1930.**
64. Ramart, P., and P. Amagat, Ann. chim. [10] **8**, 263 **1927.**
65. Ramart-Lucas, P., and E. Salmon-Legagneur, Bull. soc. chim. [4] **45**, 718 **1929.**
66. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915.**
67. Sabatier, P., and M. Murat, Compt. rend. **155**, 385 **1912.**
68. Sabatier, P., and M. Murat, Compt. rend. **156**, 1430 **1913.**
69. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928.**
70. Schlenk, W., and E. Bergmann, Ann. **479**, 42 **1930.**
71. Schmidt, A. W., and C. Hartmann, Ber. **74**, 1325 **1941.**
72. Shorygin, P., Ber. **41**, 2717 **1908.**
73. Söllscher, C., Ber. **15**, 1680 **1882.**
74. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **121**, Abt. IIb, 683 **1912.**
75. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1691 **1913.**
76. Steinkopf, W., and R. Wolfram, Ann. **430**, 113 **1923.**
77. Stobbe, H., and G. Posnjak, Ann. **371**, 287 **1909.**
78. Störmer, R., and W. Becker, Ber. **56**, 1440 **1923.**
79. Störmer, R., and H. Kootz, Ber. **61**, 2330 **1928.**
80. Störmer, R., and C. Thier, Ber. **58**, 2607 **1925.**
81. Straus, F., Ann. **342**, 190 **1905.**
82. Tapia, E., and M. A. Hernández, Anales soc. españ. fís. quím. **28**, 691 **1930**; C.A. **24**, 4265 **1930**; Chem. Zentr. **1930**, II, 1697.
83. Tiffeneau, Ann. chim. phys. [8] **10**, 145 **1907.**
84. Tiffeneau, Ann. chim. phys. [8] **10**, 322 **1907.**
85. Tiffeneau, M., and J. Lévy, Bull. soc. chim. [4] **33**, 759 **1923.**
86. Tschirch, A., and J. O. Werdmüller, Arch. Pharm. **248**, 420 **1910.**
87. von Auwers, K., Ann. **499**, 123 **1932.**
88. von Auwers, K., Ber. **62**, 693 **1929.**
89. von Auwers, K., Ber. **68**, 1346 **1935.**
90. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] **84**, 37 **1911.**
91. von Auwers, K., and A. Fruhling, Ann. **422**, 196 **1921.**
92. von Auwers, K., and R. Kraul, Ann. **443**, 181 **1925.**
93. von Braun, J., and G. Manz, Ann. **468**, 258 **1929.**
94. von Braun, J., J. Seemann, and A. Schultheisz, Ber. **55**, 3803 **1922.**
95. Vorländer, D., and M. Schrödter, Ber. **36**, 1490 **1903.**
96. Wislicenus, W., and H. Wren, Ber. **38**, 502 **1905.**
97. Wittig, G., Ber. **64**, 437 **1931.**
98. Wittig, G., and M. Leo, Ber. **63**, 943 **1930.**
99. Wittig, G., and H. Pook, Ber. **70**, 2485 **1937.**
100. Ziegler, K., and K. Bähr, Ber. **62**, 1695 **1929.**
101. Ziegler, K., F. Crössmann, H. Kleiner, and O. Schäfer, Ann. **473**, 1 **1929.**
102. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**

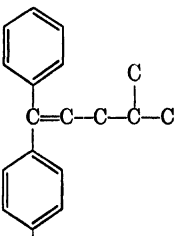
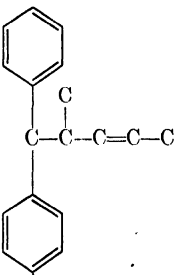
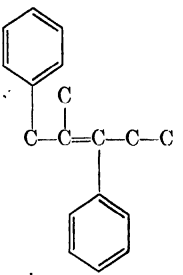
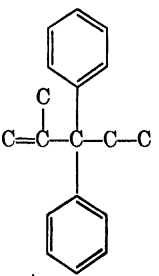
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenylpentene-1**  | 174–175 14 [43]<br>170 13 [20] | 1.0139 0° [20] | 1.57768 15° [20] | |
| **1,5-Diphenylpentene-1**  | 186 11 [8] | | | |
| **2,3-Diphenylpentene-2**  | 297–299 [28]<br>297–299 765 [22] | 1.040 0° [22] | | |
| **1,5-Diphenylpentene-2**  | 184–185 10 [8] | | | |

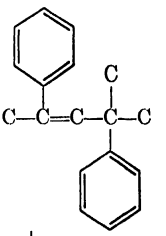
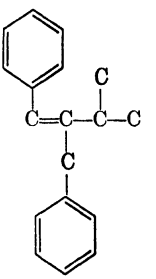
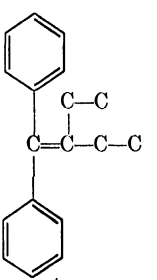
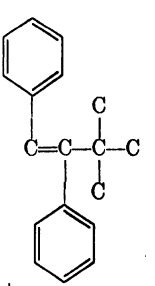
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Phenyl-2-benzylbutene-1  | 304–305 [40]<br>177–178 15 [7]<br>183–185 14 [24] | 0.9736 $D_0^{21}$ [40]<br>1.012 0° [24]<br>0.9855 $D_0^{0}$ [40] | 1.553 21° [40]<br>1.5785 18° [24] | |
| 1,1-Diphenyl-3-methylbutene-1  | 298–299 [39,40]<br>296–299 [41]<br>169–170 20 [20]<br>166–168 18 [49] | 0.978 [49]<br>0.9792 $D_0^{21}$ [39,40]<br>0.9813 17.0° [49]<br>0.9946 0° [20] | 1.581 21° [39,40]<br>1.5754 15° [20]<br>1.57015 $n_{H\alpha}^{17.0}$ [49]<br>1.59269 $n_{H\beta}^{17.0}$ [49]<br>1.60724 $n_{H\gamma}^{17.0}$ [49]<br>1.5753 $n_{He}^{20}$ [49]<br>1.57667 $n_{He}^{17.0}$ [49] | |
| 1,4-Diphenyl-2-methylbutene-1  | 205–206 40 [30] | | | |

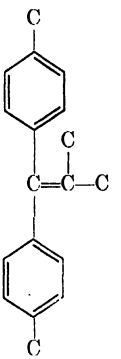
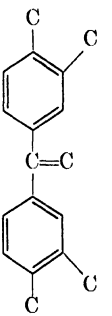
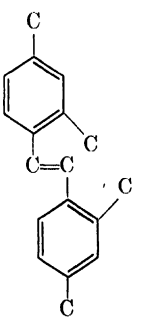
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Diphenyl-3-methylbutene-2**  | 176–178 26 [19]<br>170–172 20 [1]<br>168 20 [1]<br>150 10 [19] | | 1.5632 24° [19] | |
| **1,3-Diphenyl-2-methylbutene-2**  | 176–177 20 [1] | | | |
| **2-Methyl-3,3-diphenylbutene-1**  | 132–133 4.5 [2] | 1.0060 [2] | 1.5757 [2] | |
| **1-Phenyl-2-(4′-isopropylphenyl)-ethene**  | 86 [55]<br>85 [12]<br>84 [18]<br>83–84 [27] | | | |

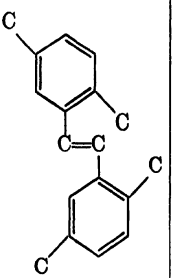
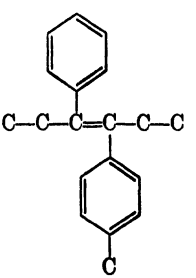
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Phenyl-2-(2′,4′,6′-trimethylphenyl)-ethene  | | | | |
| 55–56 [14] | | | | |
| 1-*p*-Tolyl-2-(3′,4′-dimethylphenyl)-ethene  | | | | |
| 120–121 [47] | | | | |
| $C_{18}H_{20}$ | | | | |
| 1,1-Diphenylhexene-1  | | | | |
| 73 [33] | 314 [26]<br>188 18 [20]<br>184 15 [43] | | | |

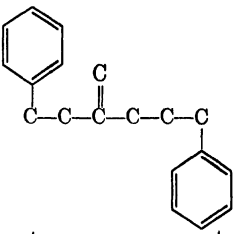
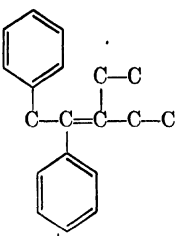
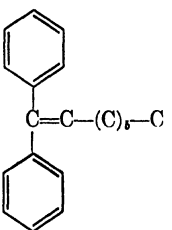
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diphenylhexene-1**  | | | | |
| | 217–219 30 [52] | 0.9915 [37,50] | 1.58800 [37,50] | |
| | 190–191 11 [51] | 0.9892 21.8° [51] | 1.58749 22.8° [51] | |
| | 190 11 [37,50] | | 1.58083 $n_{H\alpha}^{22.8}$ [51] | |
| | | | 1.60490 $n_{H\beta}^{22.8}$ [51] | |
| | | | 1.62049 $n_{H\gamma}^{22.8}$ [51] | |
| **2,5-Diphenylhexene-2**  | | | | |
| | 302 [16] | 0.9724 21° [16] | | |
| | 175 16 [48] | 1.012 0° [48] | | |
| **3,4-Diphenylhexene-3**  | | | | |
| 76 [54] | 168 14 [35,36] | | | |
| | 165 14 [54] | | | |
| **1-Phenyl-2-benzylpentene-1**  | | | | |
| | 315–317 [24] | 0.9775 [24] | 1.57 18° [24] | |

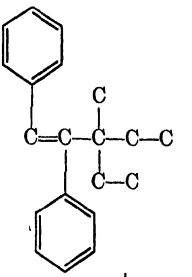
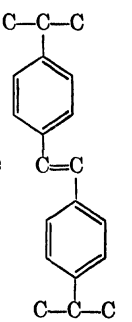
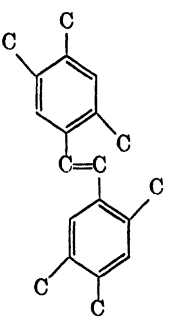
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,1-Diphenyl-4-methylpentene-1  | 178–180 17 [20]<br>178 16 [45] | 0.9725 25° [45]<br>0.9907 0° [45] | 1.57463 17.8° [45] | |
| 1,1-Diphenyl-2-methylpentene-3  | 174 20 [3]<br>153–154 14 [3] | | | |
| 1,3-Diphenyl-2-methylpentene-2  | 178–180 18 [1] | | | |
| 2-Methyl-3,3-diphenylpentene-1  | 175–177 16 [1] | | | |

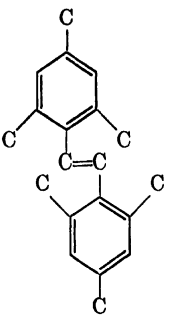
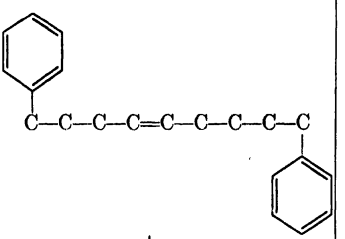
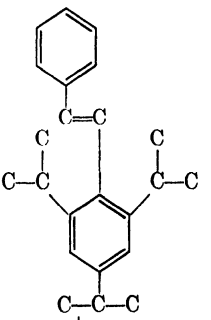
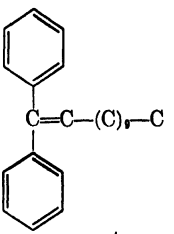
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,4-Diphenyl-4-methylpentene-2**  | 170–171 17 [4] | | | |
| **1-Phenyl-2-benzyl-3-methylbutene-1**  | 315–317 [24] | | 1.571 18° [24] | |
| **1,1-Diphenyl-2-ethylbutene-1**  | 160 11 [35,36] | | | |
| **1,2-Diphenyl-3,3-dimethylbutene-1**  | 164–165 11 [24] | | | |
| 48–49 [24] | | | | |

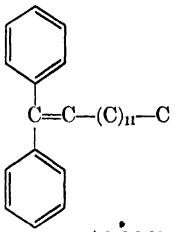
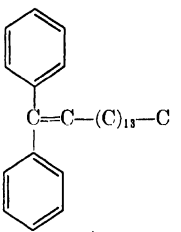
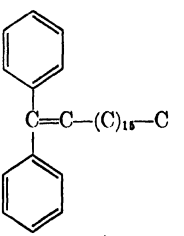
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Di-*p*-tolyl-2-methylpropene-1**  | | | | |
| 50 [43] | | | | |
| **1,2-Di-(ethylphenyl)-ethene** (a) | | | | |
| 134.5 [15] | | | | |
| (a) The position of the ethyl groups is not given. | | | | |
| **1,1-Di-(3′,4′-dimethylphenyl)-ethene**  | | | | |
| 73–74 [6] | | | | |
| **1,2-Di-(2′,4′-dimethylphenyl)-ethene**  | | | | |
| 125.5–126(a) [29] | | | | |
| 106 [11] | | | | |
| 105–106 [15] | | | | |

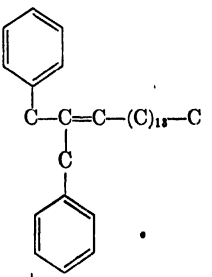
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Di-(2′,4′-dimethylphenyl)-ethene** *(Continued)* | | | | |
| 105 [10]<br>104–105 [47]<br>65–65.5(b) [29] | | | | |
| (a) This constant was determined on the *cis* isomer.<br>(b) This constant was determined on the *trans* isomer. | | | | |
| **1,2-Di-(2′,5′-dimethylphenyl)-ethene**  | | | | |
| 157 [5,10,16] | | | | |
| $C_{19}H_{22}$ | | | | |
| **1,1-Diphenyl-*n*-heptene** (a) | | 0.9673 18° [17] | 1.5648 18° [17] | |
| (a) The position of the double bond is not given. | | | | |
| **1,7-Diphenylheptene** (a) | 201–203 10 [8] | | | |
| (a) The position of the double bond is not given. | | | | |
| **3-Phenyl-4-*p*-tolylhexene-3**  | | | | |
| | 170 11 [85,86] | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,6-Diphenyl-3-methylenehexane**  | | | | |
| | 199–200 14 [68] | 0.915 18° [68] | 1.5517 18° [68] | |
| **1,2-Diphenyl-3-ethylpentene-2**  | | | | |
| | 180–182 15 [1] | | | |
| **1-Phenyl-1-*p*-tolyl-2-ethylbutene** (a) | | | | |
| | 172 11 [35,36] | | | |
| (a) The position of the double bond is given as 1 in reference 36 and as 2 in reference 35 | | | | |
| $C_{20}H_{24}$ | | | | |
| **1,1-Diphenyloctene-1**  | | | | |
| −6−−5.5 [44] | 133–134 0.05 [44] | 0.9937 [44] | 1.5608 [44] | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Diphenyl-3-methyl-3-ethylpentene-1**  | 175–180 12 [34] | 0.9791 25° [34] | 1.56671 25° [34]<br>1.56110 $n_{H\alpha}^{25}$ [34]<br>1.58131 $n_{H\beta}^{25}$ [34]<br>1.59467 $n_{H\gamma}^{25}$ [34] | |
| **1,2-Di-(4′-isopropylphenyl)-ethene**  | 131–132 [25]<br>129 [31] | | | |
| **1,2-Di-(2′,4′,5′-trimethylphenyl)-ethene**  | 161 [5,10]<br>159–161 [32] | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,2-Di-(2′,4′,6′-trimethylphenyl)-ethene  | | | | |
| 132.5–133.5 [14] | | | | |
| $C_{21}H_{26}$ | | | | |
| 1,9-Diphenylnonene-4  | | | | |
| | 231–233 12 [8] | | | |
| 1-Phenyl-2-(2′,4′,6′-triisopropylphenyl)-ethene  | | | | |
| 33–34 [14] | 155–161 4 [14] | | | |
| $C_{24}H_{32}$ | | | | |
| 1,1-Diphenyldodecene-1  | | | | |
| 5–6 [44] | 170–171 0.05 [44] | 0.9334 [44] | 1.5429 [44] | |

| M. P., °C | B. P., °C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|
| **1,1-Diphenyltetradecene-1**  | | | | | | | |
| | | | **0.9268** | | **1.5363** | | |
| 16.3 [9,42] | 205 | 1.0 [9] | 0.9267 [9,42] | | 1.5363 [9,42] | | |
| | 192 | 0.5 [9] | 0.8725 | 98.9° [9] | 1.5280 | 40.0° [9] | |
| | | | 0.8986 | 60° [9] | 1.5322 | 30.0° [9] | |
| | | | 0.9143 | 37.8° [9] | | | |
| $*\frac{dD}{dt} = -0.0007152[1 - 0.0004820(t-20)]$/°C (37 to 99°C) | | | | | | | |
| $\dagger\frac{dn}{dt} = -0.000415$/°C (20 to 40°C) | | | | | | | |
| $C_{28}H_{40}$ **1,1-Diphenylhexadecene-1**  | | | | | | | |
| | | | **0.9188** | | | | |
| 25.5 [44] | 265–270 | 13 [46] | 0.9186 [21] | | 1.5312 [44] | | |
| 21.5–22.5 [21] | 274–275 | 12 [21] | 0.9191 [44] | | 1.52964 | 21.5° [21] | |
| 17–18 [46] | 196–197 | 0.04 [44] | 0.8666 | 100° [13] | 1.52008 | $n_{H\alpha}^{21.5}$ [21] | |
| | | | 0.8991 | 50° [13] | 1.54146 | $n_{H\beta}^{21.5}$ [21] | |
| | | | 0.9316 | 0° [13] | 1.55160 | $n_{H\gamma}^{21.5}$ [21] | |
| $*\frac{dD}{dt} = -0.0006520$/°C (0 to 100°C) | | | | | | | |
| $C_{30}H_{44}$ **1,1-Diphenyloctadecene-1**  | | | | | | | |
| −1 [46] | 282–283 | 18 [46] | 0.9186 [44] | | 1.5308 [44] | | |
| | 202–203 | 0.04 [44] | 0.9170 | 25° [28] | 1.5269 | 25° [28] | |

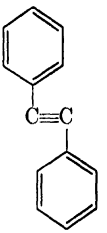
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-2-benzylheptadecene-2**  | | | | * |
| | | 0.9237 | | |
| 58.5 [21] | 290-292 16 [21] | 0.9237 [21] | 1.52303 23.5° [21] | |
| | | 0.8717 100° [13] | 1.51882 $n_{H\alpha}^{23.5}$ [21] | |
| | | 0.9042 50° [13] | 1.53302 $n_{H\beta}^{23.5}$ [21] | |
| | | 0.9367 0° [13] | 1.54220 $n_{H\gamma}^{23.5}$ [21] | |
| $*\frac{dD}{dt} = -0.0006500$/°C | (6 to 100°C) | | | |
| **$C_{42}H_{68}$** | | | | |
| **1,1-Di-(methylphenyl)-octacosene-1** (a) | | | | |
| 47 [38] | | | | |

(a) The position of the methyl substituents is not given.

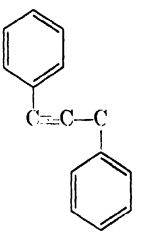
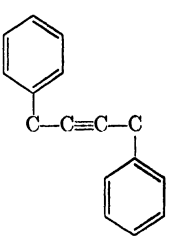
### References on $C_{17}H_{16}$-$C_{42}H_{68}$ Compounds

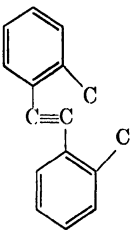
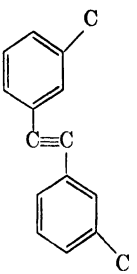
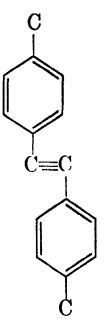

1. Apolit, Ann. chim. [10] 2, 71 1924.
2. Bateman, D. E., and C. S. Marvel, J. Am. Chem. Soc. 49, 2914 1927.
3. Bergmann, E., Helv. Chim. Acta 20, 590 1937.
4. Bergmann, E., H. Taubadel, and H. Weiss, Ber. 64, 1493 1931.
5. Billows, E., Riv. di Min. e. crist. ital. 30, 34 1903.
6. Bistrzycki, A., and E. Reintke, Ber. 38, 839 1905.
7. Blondeau, J., Ann. chim. [10] 2, 5 1924.
8. Borsche, W., and J. Wollemann, Ber. 45, 3713 1912.
9. Cosby, J. N., and L. H. Sutherland, Proc. Am. Petroleum Inst. 22, III, 13 1941.
10. Elbs, K., J. prakt. Chem. [2] 47, 44 1893.
11. Elbs, K., and H. Förster, J. prakt. Chem. [2] 39, 298 1889.
12. Erlenmeyer, E., Jr., and C. Kehren, Ann. 333, 238 1904.
13. Evans, E. B., J. Inst. Petroleum Tech. 24, 537 1938.
14. Fuson, R. C., J. J. Denton, and C. E. Best, J. Org. Chem. 8, 64 1943.
15. Hepp, E., Ber. 7, 1409 1874.
16. Klages, A., Ber. 35, 2633 1902.
17. Klages, A., and S. Heilmann, Ber. 37, 1447 1904.
18. Klages, A., and F. Tetzner, Ber. 35, 3965 1902.
19. Koelsch, C. F., and P. R. Johnson, J. Am. Chem. Soc. 65, 565 1943.
20. Lagrave, R., Ann. chim. [10] 8, 363 1927.

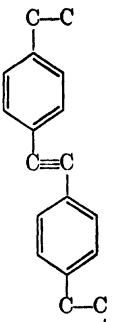
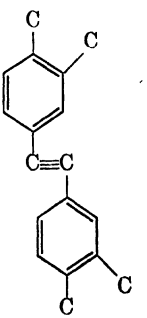
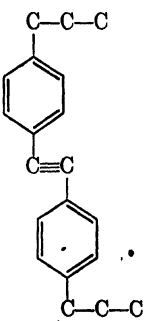
21. Landa, L., and J. Čech, Collection Czechoslov. Chem. Commun. **6**, 423 **1934**; C.A. **29**, 768 **1935**; Chem. Zentr. **1935**, I, 1227.
22. Lévy, J., Bull. soc. chim. [4] **29**, 878 **1921**.
23. Lévy, J., Compt. rend. **172**, 383 **1921**.
24. Lévy, J., and A. Tabart, Bull. soc. chim. [4] **49**, 1776 **1931**.
25. Low, H. D., J. Chem. Soc. **91**, 748 **1907**.
26. Masson, H., Compt. rend. **135**, 533 **1902**.
27. Michael, A., Am. Chem. J. **1**, 312 **1879**.
28. Mikeska, L. A., Ind. Eng. Chem. **28**, 970 **1936**.
29. Oddy, H. G., J. Am. Chem. Soc. **45**, 2156 **1923**.
30. Orekhov, A., and S. Meerzon, Ber. **45**, 1926 **1912**.
31. Pascal, P., and L. Normand, Bull. soc. chim. [4] **9**, 1029 **1911**.
32. Pfeiffer, P., Ann. **412**, 253 **1916**.
33. Prelog, V., E. Cerkovnikov, and S. Heinbach, Collection Czechoslov. Chem. Commun. **10**, 399 **1938**; Brit. Chem. Abstracts **IIA**, 457 **1938**.
34. Ramart-Lucas, Ann. chim. phys. [8] **30**, 349 **1913**.
35. Ramart-Lucas and Anagnostopoulos, Bull. soc. chim. [4] **43**, 1345 **1928**.
36. Ramart-Lucas and Anagnostopoulos, Compt. rend. **186**, 1626 **1928**.
37. Rupe, H., and J. Burgin, Ber. **43**, 172 **1910**.
38. Ryan, H., and J. Algar, Proc. Roy. Irish Acad. **30**, 97 **1912-1913**.
39. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915**.
40. Sabatier, P., and M. Murat, Compt. rend. **156**, 1951 **1913**.
41. Schaarschmidt, A., L. Hermann, and B. Szemző, Ber. **58**, 1914 **1925**.
42. Schiessler, R. W., D. G. Clarke, C. S. Rowland, W. L. Sloatman, and C. H. Herr, preprint of paper presented at Am. Petroleum Inst., Nov. 10, **1943**.
43. Schlenk, W., and E. Bergmann, Ann. **479**, 42 **1930**.
44. Schmidt, A. W., and C. Hartmann, Ber. **74**, 1325 **1941**.
45. Shorygin, P., Ber. **41**, 2711 **1908**.
46. Skraup, S., and E. Schwamberger, Ann. **462**, 135 **1928**.
47. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1691 **1913**.
48. Tiffeneau, Ann. chim. phys. [8] **10**, 145 **1907**.
49. von Auwers, K., Ber. **62**, 693 **1929**.
50. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] **82**, 65 **1910**.
51. von Auwers, K., and F. Eisenlohr, J. prakt. Chem. [2] **84**, 1 **1911**.
52. von Auwers, K., W. A. Roth, and F. Eisenlohr, Ann. **385**, 102 **1911**.
53. von Braun, J., and W. Teuffert, Ber. **62**, 235 **1929**.
54. von Vargha, L., and E. Kovács, Ber. **75**, 794 **1942**.
55. von Walther, R., and A. Wetzlich, J. prakt. Chem. [2] **61**, 169 **1900**.

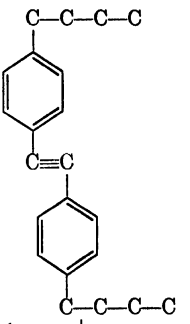
| M. P.,°C | B. P.,°C @ 760mm | | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|---|
| **Diphenylethyne** (Diphenylacetylene) (Tolane)  | | | | | | | |
| **60.9** | | | | | | | |
| 62–63.5 [45] | 170 | 19 [35] | 0.9657 | 99.8° [42] | 1.60600 | $n_{H\alpha}^{99.8}$ [42] | |
| 62.5 [32,41] | 158 | 12 [3] | | | 1.64302 | $n_{H\beta}^{99.8}$ [42] | |
| 62 [2,30,44] | 158–160 | 10.5 [25] | | | 1.6163 | $n_{H\gamma}^{99.8}$ [42] | |
| 60.5–61.5 [43] | 133 | 8 [5] | | | | | |
| 61 [18,34] | 111–112 | 1 [23] | | | | | |
| 60–61 [10,11,27,34,36] | | | | | | | |
| 59–61 [38] | | | | | | | |
| 59.5–60.5 [39] | | | | | | | |
| 60(a) | | | | | | | |
| 59 [5] | | | | | | | |
| 58–59 [35] | | | | | | | |

(a) The melting point 60 is found in references 1, 3, 4, 9, 12, 17, 18, 19, 24, 25, 26, 27, 28, 29, 31, 33, 40.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $C_{15}H_{12}$ | | | | | | | |
| **1,3-Diphenylpropyne**  | | | | | | | |
| | 128–129 | 1–2 [21] | 1.0273 [21] | | 1.5946 [21] | | |
| | | | | | 1.5881 | $n_{H\alpha}^{20}$ [21] | |
| | | | | | 1.6113 | $n_{H\beta}^{20}$ [21] | |
| $C_{16}H_{14}$ | | | | | | | |
| **1,4-Diphenylbutyne-2**  | | | | | | | |
| 80 [14,15,16] | | | | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Di-*o*-tolylethyne** |  | | 1.6228 [6] | |
| **Di-*m*-tolylethyne** 73.5–74 [6] |  | | | |
| **Di-*p*-tolylethyne** 136 [4,8,13,20] 135 [17] |  | | | |

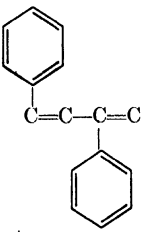
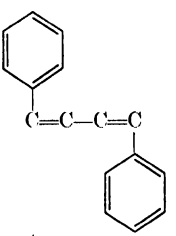
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Di-(4-ethylphenyl)-ethyne**  71.5–72.5 [7] 72 [23] | | | | |
| **Di-(3,4-dimethylphenyl)-ethyne**  143–144 [7] | | | | |
| $C_{20}H_{22}$ **Di-(4-*n*-propylphenyl)-ethyne**  69.5–70.5 [7] | | | | |

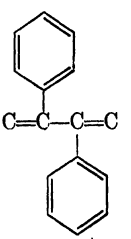
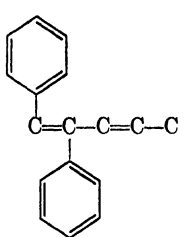
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| Di-(4-*n*-butylphenyl)-ethyne  | | | | |
| 41–42[7] | | | | |

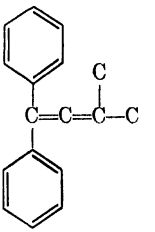
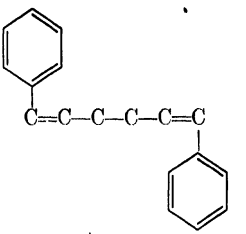
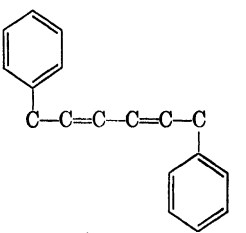
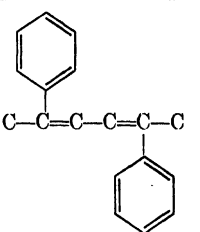
## References on Two Phenyl Substitutions on Alkynes


1. Aronstein, L., and A. F. Hollemann, Ber. **21**, 2831 **1888**.
2. Berger, G., Z. physik. Chem. **28B**, 95 **1935**.
3. Bergmann, E., J. Chem. Soc. **1936**, 402.
4. Buttenberg, W. P., Ann. **279**, 324 **1894**.
5. Campbell, K. N., and M. J. O'Connor, J. Am. Chem. Soc. **61**, 2897 **1939**.
6. Coleman, G. H., W. H. Holst, and R. D. Maxwell, J. Am. Chem. Soc. **58**, 2310 **1936**.
7. Coleman, G. H., and R. D. Maxwell, J. Am. Chem. Soc. **56**, 132 **1934**.
8. Curtius, T., and R. Kastner, J. prakt. Chem. [2] **83**, 215 **1911**.
9. Curtius, T., and K. Thun, J. prakt. Chem. [2] **44**, 161 **1891**.
10. Dadieu, A., A. Pongratz, and K. W. F. Kohlrausch, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **140**, Abt. IIa, 647 **1931**.
11. Desgrez, A., Ann. chim. phys. [7] **3**, 209 **1894**.
12. Dorn, J., Ann. **153**, 349 **1870**.
13. Goldschmiedt, G., and E. Hepp, Ber. **6**, 1504 **1873**.
14. Grignard, V., L. Lapayre, and T. Faki, Compt. rend. **187**, 517 **1928**.
15. Grignard, V., and Tchéoufaki, Compt. rend. **188**, 1531 **1929**.
16. Grignard, V., and Tchéoufaki, Rec. trav. chim. **48**, 899 **1929**.
17. Harris, E. E., J. Am. Chem. Soc. **52**, 3633 **1930**.
18. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **17**, 929 **1911**.
19. Howard, L. B., and G. E. Hilbert, J. Am. Chem. Soc. **60**, 1918 **1938**.
20. Irvine, J. C., and A. M. Moodie, J. Chem. Soc. **91**, 536 **1907**.
21. Johnson, J. R., T. L. Jacobs, and A. M. Schwartz, J. Am. Chem. Soc. **60**, 1885 **1938**.
22. Kunckell, F., Ber. deut. pharm. Ges. **23**, 188 **1913**.
23. Laitinen, H. A., and S. Wawzonek, J. Am. Chem. Soc. **64**, 1765 **1942**.
24. Limpricht, H., and H. Schwanert, Ann. **145**, 330 **1868**.
25. Lipp, P., Ber. **56**, 567 **1923**.
26. McVicker, W. H., J. K. Marsh, and A. W. Stewart, J. Chem. Soc. **127**, 999 **1925**.
27. Otto, R., J. prakt. Chem. [2] **53**, 1 **1896**.
28. Paal, C., and H. Schiedewitz, Ber. **63**, 766 **1930**.
29. Padoa, M., Atti accad. Lincei [5] **28**, II, 239 **1919**.
30. Palliard, H., and C. Wieland, Helv. Chim. Acta **21**, 1356 **1938**.
31. Parks, G. S., and H. M. Huffman, Ind. Eng. Chem. **23**, 1138 **1931**.

32. Pascal, P., and L. Normand, Bull. soc. chim. [4] **13**, 151 **1913.**
33. Pfankuch, F., J. prakt. Chem. [2] **6**, 97 **1872.**
34. Ruggli, P., and F. Lang, Helv. Chim. Acta **21**, 38 **1938.**
35. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928.**
36. Smith, L. I., and M. M. Falkof, Org. Syntheses **22**, 50 **1942.**
38. Smith, R. H., and D. H. Andrews, J. Am. Chem. Soc. **53**, 3644 **1931.**
39. Straus, F., Ann. **342**, 190 **1905.**
40. Timmermans, J., Bull. soc. chim. Belg. **44**, 17 **1935.**
41. Vanstone, E., J. Chem. Soc. **103**, 1826 **1913.**
42. von Auwers, K., and F. Bergmann, Ann. **476**, 272 **1929.**
43. Weissberger, A., and R. Sängewald, Z. physik. Chem. **20B**, 145 **1933.**
44. Wolf, K. L., and H. Weghofer, Z. physik. Chem. **39B**, 194 **1938.**
45. Zalkind, J. S., and N. V. Il'in, J. Russ. Phys. Chem. Soc. **58**, 994 **1926**; C.A. **21**, 2267 **1927.**

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3-Diphenylbutadiene-1,3** (a)  | | | | |
| 138 [43] | | | | |
| 137 [8] | | | | |
| (a) This compound is given as 2,5-diphenylbutadiene but is probably the 1,3-compound. | | | | |
| ***cis,cis*-1,4-Diphenylbutadiene-1,3**  | | | | |
| 70–70.5 [40] | | 0.9697 100.6° [45] | 1.61831 $n_{H\alpha}^{100.6}$ [45] | |
| 70 [11,13,22,24] | | 0.9707 99.5° [45] | 1.66748 $n_{H\beta}^{100.6}$ [45] | |
| | | | 1.63473 $n_{He}^{100.6}$ [45] | |
| ***cis,trans*-1,4-Diphenylbutadiene-1,3** | | | | |
| | | | 1.59679 $n_{H\alpha}^{22.2}$ [45] | |
| 150–151 [40] | 133–135 0.1 [24] | 0.999 [45] | 1.61716 $n_{H\alpha}^{19.7}$ [45] | |
| 88 [13] | | 1.007 [45] | 1.62830 $n_{H\beta}^{22.2}$ [45] | |
| | | 0.9974 22.2° [45] | 1.65481 $n_{H\beta}^{19.7}$ [45] | |
| | | 1.0072 19.7° [45] | 1.65212 $n_{H\gamma}^{22.2}$ [45] | |
| | | | 1.68419 $n_{H\gamma}^{19.7}$ [45] | |
| | | | 1.60532 $n_{He}^{22.2}$ [45] | |
| | | | 1.6063 $n_{He}^{20}$ [45] | |
| | | | 1.6272 $n_{He}^{20}$ [45] | |
| | | | 1.62737 $n_{He}^{19.7}$ [45] | |
| ***trans,trans*-1,4-Diphenylbutadiene-1,3** | | | | |
| **149.7** | | | | |
| 152.5–153.5 [9] | 350 720 [18] | | | |
| 152–153.5 [16] | | | | |
| 152–153 [39] | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***trans, trans*-1,4-Diphenylbutadiene-1,3** *(Continued)* | | | | |
| 152.5 [18] | | | | |
| 152–152.5 [41] | | | | |
| 152 [38] | | | | |
| 151 [17] | | | | |
| 150–151 [40] | | | | |
| 150 [11,12,13,17,47] | | | | |
| 149 [43] | | | | |
| 148–149 [3] | | | | |
| 148.4 [25] | | | | |
| 148 [7,13,21,37,48,49] | | | | |
| 147–148 [28,31] | | | | |
| 147 [32,33] | | | | |
| **2,3-Diphenylbutadiene-1,3**  | | | | |
| **49** | | | | |
| 50 [23] | | 0.9842 65.9° [44] | 1.57939 $n_{H\alpha}^{65.9}$ [44] | |
| 49 [15] | | 0.9829 65.8° [44] | 1.57920 $n_{H\alpha}^{65.8}$ [44] | |
| 47–49 [44] | | | 1.60496 $n_{H\beta}^{65.9}$ [44] | |
| 47–48 [1] | | | 1.60469 $n_{H\beta}^{65.8}$ [44] | |
| 46–48 [44] | | | 1.62213 $n_{H\gamma}^{65.9}$ [44] | |
| 46–47 [1] | | | 1.62186 $n_{H\gamma}^{65.8}$ [44] | |
| | | | 1.58669 $n_{He}^{65.9}$ [44] | |
| | | | 1.58633 $n_{He}^{65.8}$ [44] | |
| $C_{17}H_{16}$ | | | | |
| **1,2-Diphenylpentadiene-1,3**  | | | | |
| 48–49 [6] | 158–160 5–6 [6] | | | |

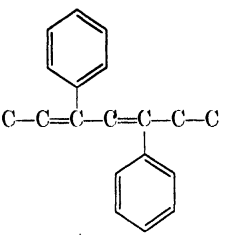
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenyl-3-methylbutadiene-1,2**  | | | | |
| | 147–148 20 [2] | | | |
| $C_{18}H_{18}$ | | | | |
| **1,6-Diphenylhexadiene-1,5**  | | | | |
| 82 [30] | 211 11 [30] | 0.9919 $D_{20}^{20}$ [10] | 1.5890 [10] | |
| 81–82 [5,46] | 180 5 [46] | | | |
| 81 [27,34] | 157–160 2 [10] | | | |
| **1,6-Diphenylhexadiene-2,4**  | | | | |
| 79 [18A] | | | | |
| 78 [19] | | | | |
| **2,5-Diphenylhexadiene-2,4**  | | | | |
| 138 [42] | | | | |
| 134–136 [14] | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Isodicinnamyl** (a) | | | | |
| | 187–189 13 [26] | 0.9986 18° [26] | 1.58724 18° [26] | |

(a) The structure is not given, but the compound is probably a diphenylhexadiene.

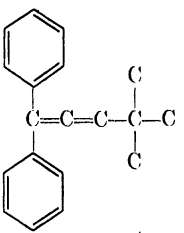
**$C_{19}H_{20}$**

**3,5-Diphenylheptadiene-2,4**



| | | | |
|---|---|---|---|
| 191–195 20 [29] | | | |

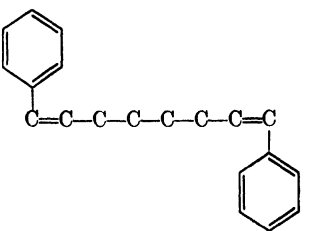
**1,1-Diphenyl-4,4-dimethylpentadiene-1,2**



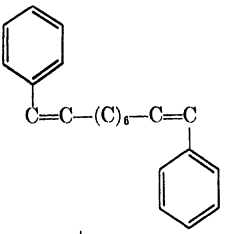
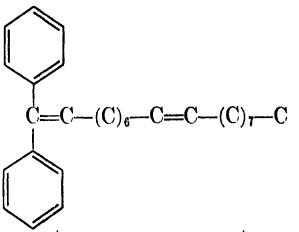
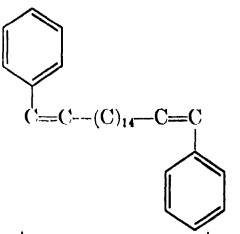
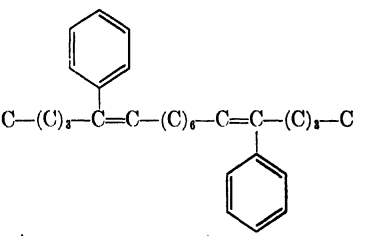
| | | | |
|---|---|---|---|
| 115–118 | 0.55 [36] | 0.9661 [36] | 1.569 [36] |

**$C_{20}H_{22}$**

**1,8-Diphenyloctadiene-1,7**



| | | | |
|---|---|---|---|
| 61–62 [5] | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,10-Diphenyldecadiene-1,9**  | | | | |
| 53 [4,34] | | | | |
| **$C_{30}H_{42}$** | | | | |
| **1,1-Diphenyloctadecadiene-1,9**  | | | | |
| | 285–290 20 [35]<br>285–286 15 [35] | | | |
| **1,18-Diphenyloctadecadiene-1,17**  | | | | |
| 93 [34] | | | | |
| **5,14-Diphenyloctadecadiene-5,13**  | | | | |
| | | 0.9306 25° [20] | 1.5398 25° [20] | |

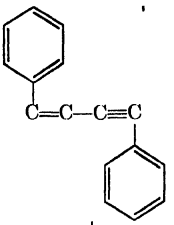
## References on Two Phenyl Substitutions on Alkadienes


1. Allen, C. F. H., C. G. Eliot, and A. Bell, Can. J. Research **17B**, 75 1939.
2. Berberianu, M. I., Bul. Soc. Române Stiinte **22**, 11 1913.
3. Borsche, W., and G. Heimbürger, Ber. **48**, 966 1915.
4. Borsche, W., and J. Wollemann, Ber. **44**, 3185 1911.
5. Borsche, W., and J. Wollemann, Ber. **45**, 3713 1912.
6. Burton, H., J. Chem. Soc. **1932**, 748.
7. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 1936.
8. Castille, A., Bull. classe sci. Acad. roy. Belg. [5] **12**, 498 1926.
9. Corson, B. B., Organic Syntheses **16**, 28 1936.
10. Gilman, H., and S. A. Harris, J. Am. Chem. Soc. **54**, 2072 1932.
11. Grignard, V., and Tchéoufaki, Compt. rend. **188**, 1531 1929.
12. Grignard, V., and Tchéoufaki, Rec. trav. chim. **48**, 899 1929.
13. Hilditch, T. P., and A. E. Dunstan, Z. Elektrochem. **17**, 929 1911.
14. Hurd, C. D., and C. N. Webb, J. Am. Chem. Soc. **49**, 546 1927.
15. Johlin, J., J. Am. Chem. Soc. **39**, 291 1917.
16. Kuhn, R., and T. Wagner-Jauregg, Ber. **63**, 2662 1930.
17. Kuhn, R., and T. Wagner-Jauregg, Helv. Chim. Acta **13**, 9 1930.
18. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 87 1928.

18A. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 123 1928.

19. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **12**, 493 1929.
20. Mikeska, L. A., Ind. Eng. Chem. **28**, 970 1936.
21. Muller, E., and I. Dammerau, Ber. **70**, 2561 1937.
22. Ott, E., Ber. **61**, 2119 1928.
23. Ott, E., Ber. **61**, 2124 1928.
24. Ott, E., and R. Schröter, Ber. **60**, 624 1927.
25. Pascal, P., Bull. soc. chim. [4] **15**, 451 1914.
26. Prevost, C., Bull. soc. chim. [4] **49**, 1372 1931.
27. Prevost, C., and J. Daujat, Bull. soc. chim. [4] **47**, 588 1930.
28. Rebuffat, O., Gazz. chim. ital. **15**, 105 1885.
29. Reynolds, G. P., Am. Chem. J. **44**, 305 1910.
30. Rupe, H., and J. Burgin, Ber. **43**, 172 1910.
31. Rupe, H., and H. Proske, Ber. **43**, 1231 1910.
32. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 1915.
33. Sakellarios, E., and T. Kyrèmis, Ber. **57**, 322 1924.
34. Schmidt, A. W., and A. Grosser, Ber. **75**, 826 1942.
35. Skraup, S., and E. Schwamberger, Ann. **462**, 135 1928.
36. Stampfli, J. G , and C. S. Marvel, J. Am. Chem. Soc. **53**, 4057 1931.
37. Staudinger, H., and E. Dreher, Ann. **517**, 73 1935.
38. Störmer, R., and W. Keller, Ber. **64**, 2783 1931.
39. Störmer, R., and F. Schenck, Ber. **60**, 2566 1927.
40. Straus, F., Ann. **342**, 190 1905.
41. Straus, F., Ber. **42**, 2866 1909.
42. Tiffeneau, Ann. chim. phys. [8] **10**, 145 1907.
43. Tiffeneau, M., Compt. rend. **135**, 1346 1902.
44. von Auwers, K., Ann. **499**, 123 1932.
45. von Auwers, K., Ber. **65**, 146 1932.
46. von Braun, J., and Z. Köhler, Ber. **51**, 79 1918.
47. Whitby, G. S., and W. Gallay, Can. J. Research **6**, 280 1932.
48. Wieland, H., and H. Stenzl, Ann. **360**, 299 1908.
49. Ziegler, K., F. Crössmann, H. Kleiner, and O. Schäfer, Ann. **473**, 1 1929.

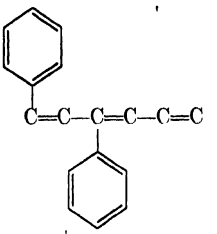
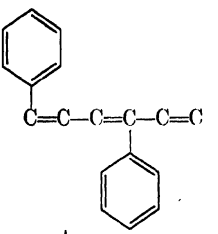
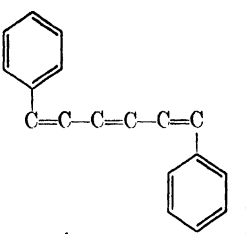
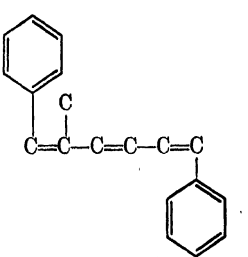
## 5. TWO PHENYL SUBSTITUTIONS ON ALKENYNES, $C_nH_{2n-20}$

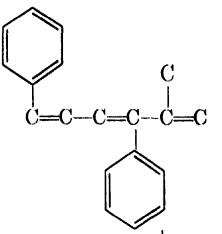
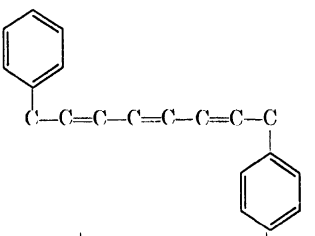
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diphenylbuten-1-yne-3**  | | | | |
| 96.5–97 [3] | 188(b) | 12 [1,2] | | |
| 95.5–96.25(a) [3] | 187.5 | | | |
| 95–96(a) [1,2] | –188(c) | 12 [3] | | |

(a) This constant was determined on the *trans* isomer.
(b) This constant was determined on a mixture of *cis* and *trans* isomers.
(c) This constant was determined on the *cis* isomer.

### References on Two Phenyl Substitutions on Alkenynes

1. Grignard, V., and Tchéoufaki, Compt. rend. 188, 1531 1929.
2. Grignard, V., and Tchéoufaki, Rec. trav. chim. 48, 899 1929.
3. Straus, F., Ann. 342, 190 1905.

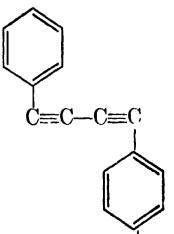
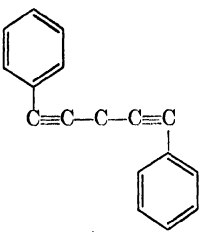
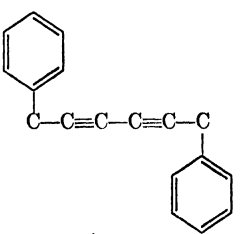
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3-Diphenylhexatriene-1,3,5**  194 [13,18] | | | | |
| **1,4-Diphenylhexatriene-1,3,5**  196 [3] | | | | |
| **1,6-Diphenylhexatriene-1,3,5**  202 [9]<br>201 [8]<br>200 [6] | | 1.139 [4] | | |
| $C_{19}H_{18}$<br>**1,6-Diphenyl-2-methylhexatriene-1,3,5**  115-116 [4] | | | | |

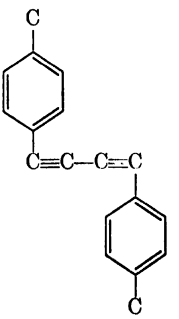
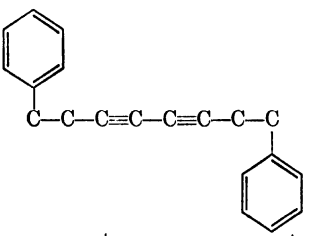
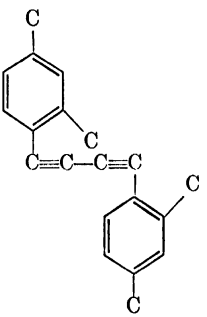
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diphenyl-5-methylhexatriene-1,3,5**  | | | | |
| 97–98 [11] | | | | |
| $C_{20}H_{20}$ | | | | |
| **1,8-Diphenyloctatriene-2,4,6**  | | | | |
| 68 [7] | | | | |
| **Diphenyldibutadiene** (a) | | | | |
| | 221 | 17 [8] | 1.0325 [8] | 1.6016 [8] |
| | 217–220 | 17 [2] | | |
| | 205 | 10(b)[10] | | |
| | 194 | 3(c)[10] | | |

(a) Structures were not given. The constants were probably determined on more than one compound.
(b) The author stated that this constant was determined on the dimer of *cis*-phenylbutadiene.
(c) The author stated that this constant was determined on the dimer of *trans*-phenylbutadiene.

### References on Two Phenyl Substitutions on Alkatrienes


1. Bauer, H., Ber. **38**, 688 1905.
2. Döbner, O., and H. Staudinger, Ber. **36**, 4318 1903.
3. Farmer, E. H., B. D. Laroia, T. Switz, and J. Thorpe, J. Chem. Soc. **1927**, 2937.
4. Hengstenberg, J., and R. Kuhn, Z. Krist. **75**, 301 1930.
5. Kuhn, R., and K. Hallenfels, Ber. **71**, 1889 1938.
6. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 87 1928.
7. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 123 1928.
8. Liebermann, C., and C. Rüber, Ber. **35**, 2696 1902.
9. Müller, E., and I. Dammerau, Ber. **70**, 2561 1937.
10. Muskat, I. E., and M. Herrman, J. Am. Chem. Soc. **53**, 260 1931.
11. Reimer, M., and G. P. Reynolds, Am. Chem. J. **40**, 428 1908.
12. Smedley, I., J. Chem. Soc. **93**, 372 1908.
13. Smedley, I., Proc. Chem. Soc. **23**, 162 1907.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diphenylbutadiyne** (Diphenyldiacetylene)  | | | | |
| **88** | | | | |
| 87–88.5 [14] | | 0.88674 [9] | 1.50513 [9] | |
| 88.0 [11] | | 0.9056 13° [9] | 1.5300 13° [9] | |
| 88 [2,6,8] | | | 1.50275 $n_{H\alpha}^{20}$ [9] | |
| 87–88 [10,17] | | | 1.5240 $n_{H\alpha}^{13}$ [9] | |
| 87 [1,8] | | | | |
| 86.5–87 [5] | | | | |
| 86–87 [12,15,16] | | | | |
| 85–87 [13] | | | | |
| **$C_{17}H_{12}$** | | | | |
| **1,5-Diphenylpentadiyne-1,4**  | | | | |
| 88–90 [3] | | | | |
| **$C_{18}H_{14}$** | | | | |
| **1,6-Diphenylhexadiyne-2,4**  | | | | |
| 101 [5] | | | | |

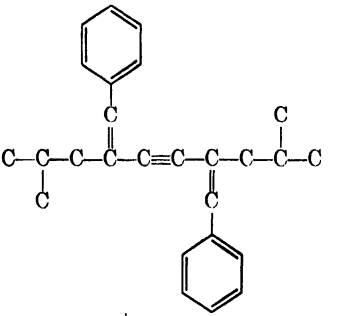
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,4-Di-*p*-tolylbutadiyne  | | | | |
| 183[7] | | | | |
| $C_{20}H_{18}$ | | | | |
| 1,8-Diphenyloctadiyne-3,5  | | | | |
| 118[8] | | | | |
| 1,4-Di-(2′·4′-dimethylphenyl)-butadiyne  | | | | |
| 145.5–146[8] | | | | |
| 138[4] | | | | |


**References on Two Phenyl Substitutions on Alkadiynes**

1. Danehy, J. P., and J. A. Nieuwland, J. Am. Chem. Soc. **58**, 1609 **1936**.
2. Gilman, H., and R. McCracken, J. Am. Chem. Soc. **51**, 821 **1929**.
3. Grignard, V., and L. Lapayre, Compt. rend. **192**, 250 **1931**.

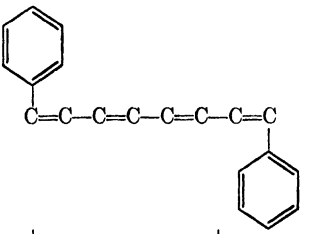
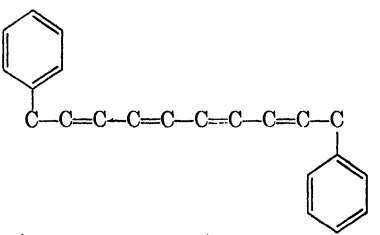
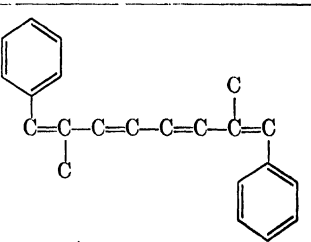
4. Grignard, V., and H. Perrichon, Ann. chim. [10] **5**, 5 **1926**.
5. Grignard, V., and Tchéoufaki, Compt. rend. **188**, 357 **1929**.
6. Holleman, A. F., Ber. **20**, 3080 **1887**.
7. Kunckell, F., Ber. deut. pharm. Ges. **23**, 188 **1913**.
8. Manchot, W., J. C. Withers, and H. Oltrogge, Ann. **387**, 257 **1912**.
9. Moureu, C., Ann. chim. phys. [8] **7**, 536 **1906**.
10. Ott, E., and R. Schröter, Ber. **60**, 624 **1927**.
11. Pascal, P., Bull. soc. chim. [4] **15**, 451 **1914**.
12. Straus, F., Ann. **342**, 190 **1905**.
13. Straus, F., and L. Kollek, Ber. **59**, 1664 **1926**.
14. Yoriek, J. Russ. Phys. Chem. Soc. **35**, 555 **1903**; Gilman and McCracken, J. Am. Chem. Soc. **51**, 821 **1928**.
15. Zalkind, Y. S., and B. M. Fundyler, J. Gen. Chem. (U.S.S.R.) **6**, 530 **1936**; Chem Zentr. **1937**, I, **1933**.
16. Zalkind, Y. S., and F. B. Fundyler, Ber. **69**, 128 **1936**.
17. Zalkind, Y., and A. Kruglov, Ber. **59**, 1936 **1926**.

## 8. TWO PHENYL SUBSTITUTIONS ON ALKADIENYNES, $C_nH_{2n-22}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,9-Dimethyl-4,7-dibenzylidenedecyne-5**  | | | | |
| | 179–180 2[1] | 0.9951[1] | 1.5872[1] | |

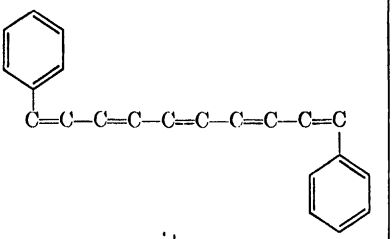
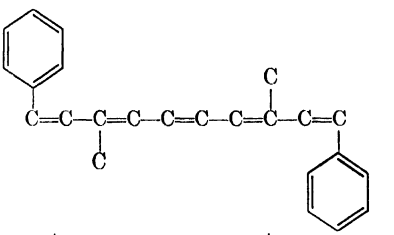
### References on Two Phenyl Substitutions on Alkadienynes

1. Pinkney, P. S., and C. S. Marvel, J. Am. Chem. Soc. 59, 2669 1937.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,8-Diphenyloctatetraene-1,3,5,7**  | | | | |
| 235–237[7]<br>233[3]<br>232[4,6] | | 1.144[2] | | |
| $C_{22}H_{22}$ | | | | |
| **1,10-Diphenyldecatetraene-2,4,6,8**  | | | | |
| 109–110[5] | | | | |
| **1,8-Diphenyl-2,7-dimethyloctatetraene-1,3,5,7**  | | | | |
| 176.5[3]<br>174[1] | | | | |

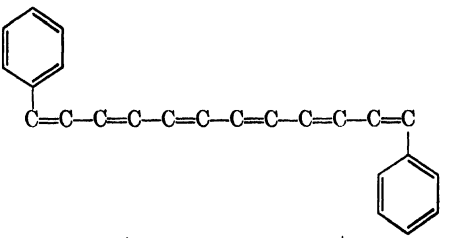
**References on Two Phenyl Substitutions on Alkatetraenes**

1. Bernhauer, K., and I. Skudezyk, J. prakt. Chem. [2] 155, 310 1940.
2. Hengstenberg, J., and R. Kuhn, Z. Krist. 75, 301 1930.
3. Kuhn, R., and K. Wallenfels, Ber. 71, 1889 1938.
4. Kuhn, R., and A. Winterstein, Helv. Chim. Acta 11, 87 1928.
5. Kuhn, R., and A. Winterstein, Helv. Chim. Acta 11, 123 1928.
6. Müller, E., and I. Dammerau, Ber. 70, 2561 1937.
7. Zechmeister, L., and A. L. LeRosen, J. Am. Chem. Soc. 64, 2755 1942.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,10-Diphenyldecapentaene-1,3,5,7,9**  | | | | |
| 253 [3,4] | | 1.152(a)[1] | | |
| (a) The temperature for this density is not given. | | | | |
| $C_{24}H_{24}$ | | | | |
| **1,10-Diphenyl-3,8-dimethyldecapentaene-1,3,5,7,9**  | | | | |
| 196–197 [2] | | | | |

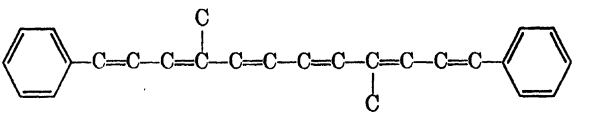
**References on Two Phenyl Substitutions on Alkapentaenes**

1. Hengstenberg, J., and R. Kuhn, Z. Krist. **75**, 301 **1930**.
2. Kuhn, R., and K. Wallenfels, Ber. **71**, 1889 **1938**.
3. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 87 **1928**.
4. Müller, E., and I. Dammerau, Ber. **70**, 2561 **1937**.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,12-Diphenyldodecahexaene-1,3,5,7,9,11**  | | | | |
| 268 [4]<br>267 [3,5] | | 1.135(a) [3] | | |

(a) The temperature for this density is not given.

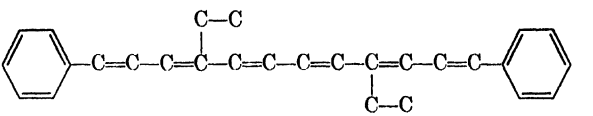
**$C_{26}H_{26}$**

**1,12-Diphenyl-4,9-dimethyldodecahexaene-1,3,5,7,9,11** 

217(a) [1]

(a) Decomposition takes place at the melting point.

**$C_{28}H_{30}$**

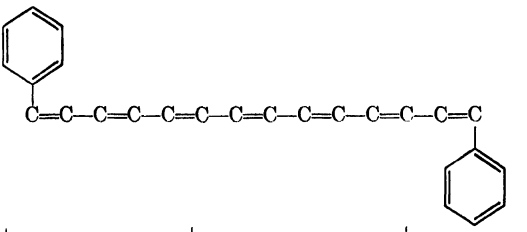
**1,12-Diphenyl-4,9-diethyldodecahexaene-1,3,5,7,9,11** 

206.5–209.5 [1]

### References on Two Phenyl Substitutions on Alkahexaenes

1. Bernhauer, K., and I. Skudrzyk, J. prakt. Chem. [2] 155, 310 1940.
2. Hengstenberg, J., and R. Kuhn, Z. Krist. 75, 301 1930.
3. Kuhn, R., Angew. Chem. 50, 703 1937.
4. Kuhn, R., and K. Wallenfels, Ber. 70, 1331 1937.
5. Kuhn, R., and A. Winterstein, Helv. Chim. Acta 11, 87 1928.

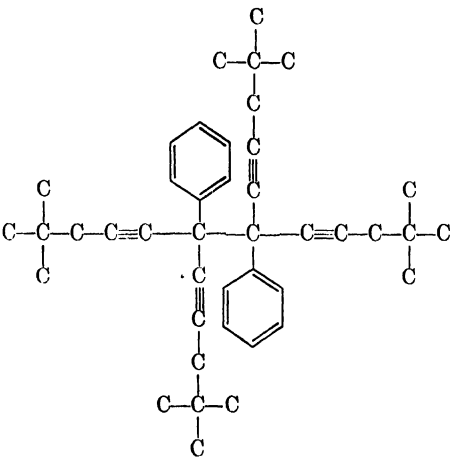
12. TWO PHENYL SUBSTITUTIONS ON ALKAHEPTAENES, $C_nH_{2n-26}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,14-Diphenyltetradecaheptaene-1,3,5,7,9,11,13**  | | | | |
| 279 [2] | | 1.130(a) [1] | | |

(a) The temperature for this density is not given.

**References on Two Phenyl Substitutions on Alkaheptaenes.**

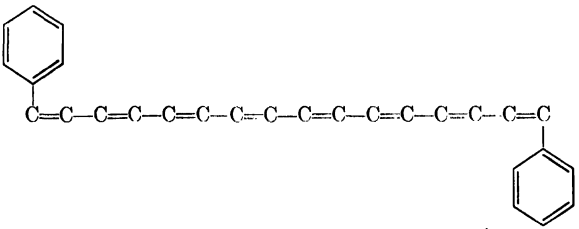
1. Hengstenberg, J., and R. Kuhn, Z. Krist. **75**, 301 1930.
2. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 87 1928.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2,11,11-Tetramethyl-6,7-di-(4′,4′-dimethylpentyn-1′-yl)-6,7-diphenyldodecadiyne-4,8**  | | | | |
| 98–99[1] | | | | |

**References on Two Phenyl Substitutions on Alkatetraynes**

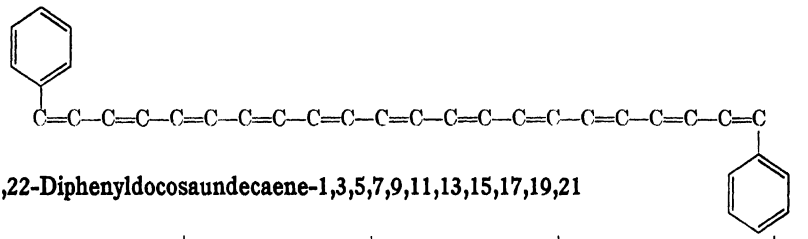
1. Rossander, S. S., and C. S. Marvel, J. Am. Chem. Soc. **51**, 932 **1929.**

## 14. TWO PHENYL SUBSTITUTIONS ON ALKAOCTAENES, $C_nH_{2n-30}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,16-Diphenylhexadeca-octaene-1,3,5,7,9,11,13,15**  | | | | |
| 285 [1] | | | | |

### References on Two Phenyl Substitutions on Alkaoctaenes

1. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 87 1928.

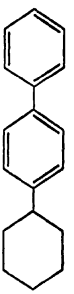
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
|  | | | | |
| **1,22-Diphenyldocosaundecaene-1,3,5,7,9,11,13,15,17,19,21** | | | | |
| 318[1] | | | | |

**References on Two Phenyl Substitutions on Alkaundecaenes**

1. Kuhn, R., Angew. Chem. 50, 703 1937.

## VI. BIPHENYL WITH ALICYCLIC SUBSTITUTIONS

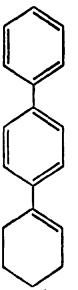
1. Biphenyl with One Cyclyl Substitution $C_nH_{2n-16}$
2. Biphenyl with One Cyclenyl Substitution $C_nH_{2n-18}$
3. Biphenyl with Two Cyclyl Substitutions $C_nH_{2n-18}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4-Cyclohexylbiphenyl**  | | | | |
| 75 | | | | |
| 75–76[2] | 213–222 15[4] | | | |
| 75[3] | 207–210 12[3] | | | |
| 73–75[5] | | | | |
| 74 5[1] | | | | |

**References on Biphenyl with One Cyclyl Substitution**

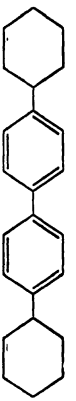
1. Basford, F. R., J. Chem. Soc. **1936**, 1593.
2. Bodroux, D., Ann. chim. [10] **11**, 511 **1929**.
3. Buu-Hoï and P. Cagniant, Compt. rend. **216**, 381 **1943**; C.A. **38**, 2334 **1938**.
4. France, H., I. N. Heilbron, and D. H. Hey, J. Chem. Soc. **1938**, 1364.
5. Hückel, W., and H. Bretschneider, Ann. **540**, 157 **1939**.

## 2. BIPHENYL WITH ONE CYCLENYL SUBSTITUTION, $C_nH_{2n-18}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 4-(Cyclohexen-1′-yl)-biphenyl  | | | | |
| 146–148[1] | 190 1[1] | | | |

### References on Biphenyl with One Cyclenyl Substitution

1. von Braun, J., G. Irmisch, and J. Nelles, Ber. 66, 1471 1933.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 4,4′-Dicyclohexylbiphenyl  | | | | |
| 205 | | | | |
| 205–206 [2] | | | | |
| 205 [1,6,7] | | | | |
| 202–203 [3,4] | | | | |
| 202 [5] | | | | |

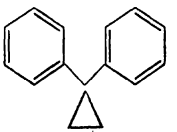
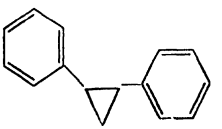
**References on Biphenyl with Two Cyclyl Substitutions**

1. Basford, F. R., J. Chem. Soc. 1936, 1593.
2. Bodroux, D., Ann. chim. [10] 11, 511 1929.
3. Bodroux, D., and R. Thomassin, Bull. soc. chim. [5] 6, 1411 1939.
4. Bodroux, D., and R. Thomassin, Compt. rend. 205, 991 1937.
5. Buu-Hoï and P. Cagniant, Compt. rend. 216, 381 1943; C.A. 38, 2334 1944.
6. Hückel, W., K. Kumetat, and H. Severin, Ann. 518, 184 1935.
7. Neunhöffer, O., Ann. 526, 58 1936.

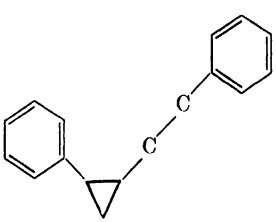
## VII. TWO PHENYL SUBSTITUTIONS ON ALICYCLICS OR ALICYCLICALIPHATICS AND ALICYCLICDIPHENYL SUBSTITUTIONS ON ALIPHATICS

1. Two Phenyl Substitutions on Cyclanes or Two Phenyl and One Cyclyl Substitutions on Alkanes $C_nH_{2n-16}$
2. Two Phenyl Substitutions on Cyclenes, Two Phenyl and One Cyclylidene Substitutions on Alkanes, or Two Phenyl and One Cyclyl Substitutions on Alkenes $C_nH_{2n-18}$
3. Two Phenyl Substitutions on Bicyclanes $C_nH_{2n-18}$
4. Two Phenylalkyl Substitutions on Dicyclanes $C_nH_{2n-18}$
5. Two Cyclylphenyl or Two Cyclyl and Two Phenyl Substitutions on Alkanes $C_nH_{2n-18}$
6. Two Phenyl Substitutions on Cyclodienes $C_nH_{2n-20}$
7. Two Phenyl Substitutions on Alkenylcyclenes or Alkylidenecyclenes $C_nH_{2n-20}$
8. Two Phenyl Substitutions on Bicyclenes $C_nH_{2n-20}$
9. Two Phenyl Substitutions on Tricyclanes $C_nH_{2n-20}$
10. Two Phenyl Substitutions on Bicyclodienes $C_nH_{2n-22}$
11. Two Phenyl Substitutions on Tricyclylalkenes or Tricyclenes $C_nH_{2n-22}$
12. Two Phenyl and One Cyclodienylidene Substitutions on Alkanes $C_nH_{2n-22}$
13. Two Dicyclylphenyl Substitutions on Alkanes $C_nH_{2n-22}$

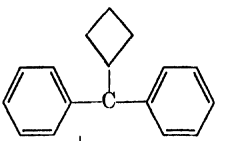
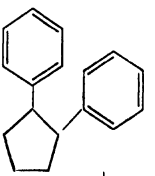
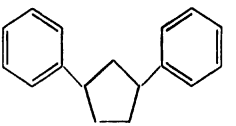
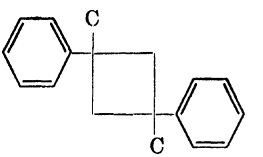
1. TWO PHENYL SUBSTITUTIONS ON CYCLANES OR TWO PHENYL AND ONE CYCLYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-16}$

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenylcyclopropane**  | | | | |
| | 140 12 [35] | | | |
| **1,2-Diphenylcyclopropane**  | | | | |
| | 307.5 741 [18] | 1.0317 [18] | 1.5967 [18] | |
| | 164–166 13 [22] | 1.0316 21° [22] | 1.5897 21° [22] | |
| | 149 9.5 [18] | | | |
| $C_{16}H_{16}$ | | | | |
| **1,3-Diphenylcyclobutane** (a) | | | | |
| | 157–158 8 [26] | | | |

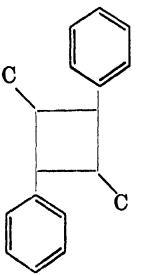
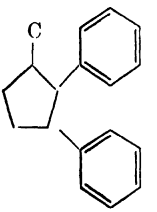
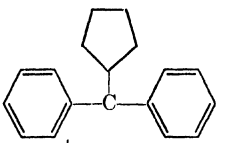
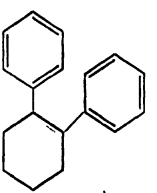
(a) This is the probable structure of the compound. The author has named it 1,3-Diphenyltetramethylene.

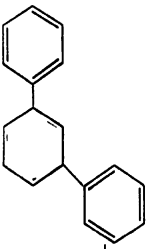
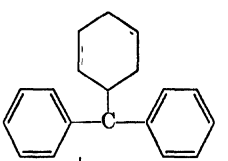
| | | | | | | |
|---|---|---|---|---|---|---|
| $C_{17}H_{18}$ | | | | | | |
| **1-Phenyl-2-phenethylcyclopropane** (a)  | | | | | | |
| 65.5 [19] | 321.5 | 735 [19] | 0.9995 | 15° [19] | 1.5666 | 15° [19] |
| | 204.5 | 28 [19] | 1.0063 | 15° [19] | 1.5718 | 15° [19] |
| | 176 | 8 [19] | 1.0165 | 0° [19] | | |

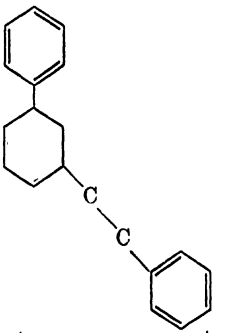
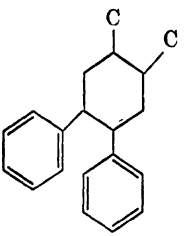
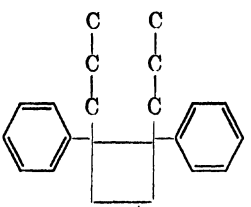
(a) These values represent two preparations of the compound.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Cyclobutyldiphenylmethane**  | | | | |
| 39.5 [17] | | 1.0003 $D_0^{43.5}$ [17] | 1.5636 43.5° [17] | |
| **1,2-Diphenylcyclopentane**  | | | | |
| 65(a) [34]<br>63(a) [2]<br>47(b)(c) | 189 12 [13] | | | |
| **1,3-Diphenylcyclopentane**  | | | | |
| | 140–141 3 [6] | 1.0196 25° [6] | 1.5696 25° [6] | |
| $C_{18}H_{20}$ | | | | |
| **1,3-Dimethyl-1,3-diphenylcyclobutane**  | | | | |
| 52 [27]<br>51–52 [30] | 299–300 [30]<br>163–164 14–15 [30]<br>118–120 0.1 [27] | 1.0038 [27]<br>1.1183 (solid) [27] | 1.5633 [27] | |

(a) This constant was determined on the *cis* isomer.
(b) This constant was determined on the *trans* isomer.
(c) The melting point 47 is found in references 2, 10, 11, 13, 31, 32, 34.

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3-Dimethyl-2,4-diphenylcyclobutane**  | | | | |
| 52.6 [7] | 307.5 [7] | 0.9904 $D_{25}^{25}$ [7] | 1.5660 25° [7] | |
| **1-Methyl-2,3-diphenylcyclopentane**  | | | | |
| 62–63 [13,14] | | | | |
| **Cyclopentyldiphenylmethane**  | | | | |
| 32.5–33 [15,16]<br>32–33 [38] | 126 15 [38] | | | |
| **1,2-Diphenylcyclohexane**  | | | | |
| 172 | | | | |
| 173 [9]<br>172 [38]<br>170–171 [20]<br>169–170 [1] | | | | |

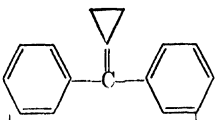
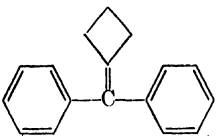
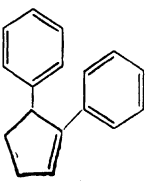
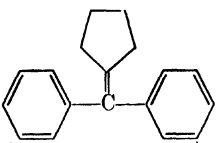
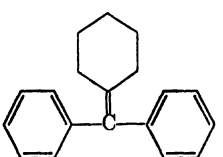
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3-Diphenylcyclohexane**  | | | | |
| | 196–198 17 [24] | 1.0022(a) [24] | | |
| (a) The temperature for this density is not given. | | | | |
| **1,4-Diphenylcyclohexane** | | | | |
| 170 [24] | 190 29 [29] | | | |
| $C_{19}H_{22}$ | | | | |
| **Diphenylcyclohexylmethane**  | | | | |
| 58 | | | | |
| 58.5 [4,5] | 252–257 [1] | 1.005 [1] | 1.571 [1] | |
| 56–57 [27] | 156–158 0.25 [23] | 1.029 8° [1] | 1.575 [22] | |
| 56.5 [26] | | 1.106 0° [26] | 1.587 8° [1] | |
| 56 [25] | | | | |

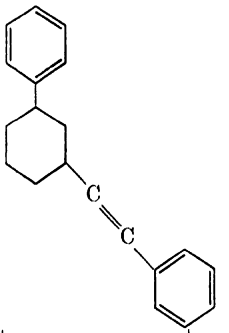
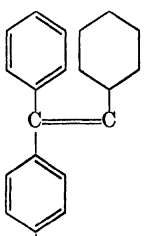
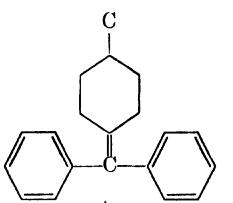
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-3-phenethylcyclohexane**  | | | | |
| | 205–206 11 [21] | | 1.55787 [21]<br>1.55324 $n_{H\alpha}^{20}$ [21]<br>1.56936 $n_{H\beta}^{20}$ [21]<br>1.57944 $n_{H\gamma}^{20}$ [21] | |
| **1,2-Dimethyl-4,5-diphenylcyclohexane**  | | | | |
| 97 [8] | 270 [8] | | | |
| **Cyclohexylphenethylbenzene** (a) | | | | |
| 68–69 [1] | | | | |
| (a) The position of the cyclohexyl substitution is not given. | | | | |
| $C_{22}H_{28}$ | | | | |
| **1,2-Di-*n*-propyl-1,2-diphenylcyclobutane**  | | | | |
| | 208–212 [8] | 0.9601 23° [8] | | |

## References on Two Phenyl Substitutions on Cyclanes or Two Phenyl and One Cyclyl Substitutions on Alkanes


1. Bodroux, D., Ann. chim. [10] **11**, 511 **1929.**
2. Burton, H., and C. W. Shoppee, J. Chem. Soc. **1939**, 567.
3. Dafert, F. W., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **88**, Abt. II, 318 **1883.**
4. Danilov, S., J. Russ. Phys. Chem. Soc. **58**, 129 **1926**; Chem. Zentr. **1926**, II, 2298.
5. Danilov, S., and E. Venus-Danilova, Ber. **59**, 377 **1926.**
6. Drake, N. L., and J. R. Adams, J. Am. Chem. Soc. **61**, 1326 **1939.**
7. Dreisbach, R. R., unpublished data.
8. Harries, C., and G. Eschenbach, Ber. **29**, 2121 **1896.**
9. Ishikawa, S., and G. Maeda, Science Repts. Tokyo Bunrika Daigaku **3A**, 157 **1937.**
10. Japp, F. R., and C. I. Burton, J. Chem. Soc. **51**, 420 **1887.**
11. Japp, F. R., and G. D. Lander, J. Chem. Soc. **71**, 123 **1897.**
12. Japp, F. R., and A. N. Meldrum, J. Chem. Soc. **79**, 1024 **1901.**
13. Japp, F. R., and A. C. Michie, J. Chem. Soc. **79**, 1010 **1901.**
14 Japp, F. R., and T. S. Murray, J. Chem. Soc. **71**, 144 **1897.**
15. Kazanskiĭ, B. A., A. F. Plate, and K. M. Gnatenko, Ber. **69**, 954 **1936.**
16. Kazanskiĭ, B. A., A. F. Plate, and K. M. Gnatenko, J. Gen. Chem. (U.S.S.R.) **6**, 1593 **1936**; Brit. Chem. Abstracts **1937A**, 91.
17. Kizhner, N., J. Russ. Phys. Chem. Soc. **42**, 1227 **1910**; C.A. **6**, 84 **1912**; Chem. Zentr. **1911**, I, 544.
18. Kizhner, N., J. Russ. Phys. Chem. Soc. **47**, 1102 **1915**; C.A. **9**, 3051 **1915**; Chem. Zentr **1916**, I, 1063.
19. Kizhner, N., J. Russ. Phys. Chem. Soc. **47**, 1819 **1915**; C.A. **10**, 1338 **1916**; Chem. Zentr. **1916**, II, 318.
20. Kursanov, N., Ann. **318**, 309 **1901.**
21. Lebedev, S. V., and A. A. Ivahov, J. Russ. Phys. Chem. Soc. **48**, 997 **1916**; C.A. **11**, 787 **1917**; Chem. Zentr. **1923**, I, 1539.
22. Lespieau, R., and R. L. Wakeman, Bull. soc. chim. [4] **51**, 384 **1932.**
23. Levene, P. A., and P. G. Stevens, J. Biol. Chem. **89**, 471 **1930.**
24. Nenitzescu, C. D., and D. Curcăneanu, Ber. **70**, 346 **1937.**
25. Neunhöffer, O., Ann. **509**, 115 **1934.**
26. Schmidlin, J., and R. von Escher, Ber. **45**, 889 **1912.**
27. Staudinger, H., and F. Breusch, Ber. **62**, 442 **1929.**
28. Stoermer, R., and T. Beisenbach, Ber. **38**, 1958 **1905.**
29. Thorpe, J. F., and A. S. Wood, J. Chem. Soc. **103**, 1569 **1913.**
30. Tiffeneau, Ann. chim. phys. [8] **10**, 145 **1907.**
31. von Liebig, H. J., and G. Metge, Ann. **405**, 209 **1914.**
32. Vorländer, D., and H. von Liebig, Ber. **37**, 1133 **1904.**
33. Wertyporoch, E., and H. Sagel, Ber. **66**, 1306 **1933.**
34. Wiedlich, H. A., Ber. **71**, 1601 **1938.**
35. Wieland, H., and O. Probst, Ann. **530**, 274 **1937.**
36. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**
37. Ziegler, K., and B. Schnell, Ann. **437**, 227 **1924.**
38. Ziegler, K., A. Seib, F. Knövenagel, P. Herte, and F. Andreas, Ann. **551**, 150 **1942.**

2. TWO PHENYL SUBSTITUTIONS ON CYCLENES, TWO PHENYL AND ONE CYCLYLIDENE SUBSTITUTIONS ON ALKANES, OR TWO PHENYL AND ONE CYCLYL SUBSTITUTIONS ON ALKENES, $C_nH_{2n-18}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Cyclopropylidenediphenylmethane**  | | | | |
| | 110–114 0.5[7] | | | |
| $C_{17}H_{16}$ | | | | |
| **Cyclobutylidenediphenylmethane**  | | | | |
| 58[4] | | | | |
| **1,2-Diphenylcyclopentene-2**  | | | | |
| 15–16[9] | 321.5 747[6] | 1.0355[6] | 1.5873[6] | |
| | 184 19[6] | 1.036[6] | 1.5881[6] | |
| | 177 13[6] | | | |
| $C_{18}H_{18}$ | | | | |
| **Cyclopentylidenediphenylmethane**  | | | | |
| 62–63[10] | 183–185 9[3] | | | |
| 62–62.5[3] | 180–181 6–7[3] | | | |
| $C_{19}H_{20}$ | | | | |
| **Cyclohexylidenediphenylmethane**  | | | | |
| 84–85[1] | | | | |
| 84[2] | | | | |
| 83[8] | | | | |

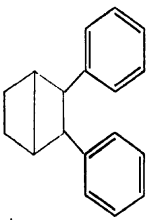
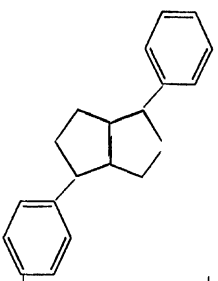
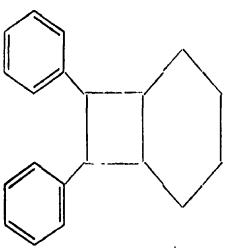
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Phenyl-3-phenethenylcyclohexane  | 191–192 3.5[6] | | | |
| 1,1-Diphenyl-2-cyclohexylethene  | 210–215 15[9] | | | |
| Diphenyl-4-methylcyclohexylidenemethane  | 200 12[9] | | | |
| 65[9] | | | | |

**References on Two Phenyl Substitutions on Cyclenes, Two Phenyl and One Cyclylidene Substitutions on Alkanes, or Two Phenyl and One Cyclyl Substitutions on Alkenes**


1. Arbusov, A. J., and I. A. Arbusov, J. Gen. Chem. (U.S.S.R.) **2**, 388 1932; C.A. **27**, 974 1933.
2. Hell, C., and O. Schaal, Ber. **40**, 4162 1907.
3. Kazanskiĭ, B. A., and G. T. Tatevosyan, J. Gen. Chem. (U.S.S.R.) **8**, 1428 1938; C.A. **33**, 4204 1939; Chem. Zentr. 1939, II, 2633.
4. Kizhner, N., J. Russ. Phys. Chem. Soc. **42**, 1227 1910; C.A. **6**, 84 1912; Chem. Zentr. 1911, I, 544.
5. Kizhner, N., J. Russ. Phys. Chem. Soc. **47**, 1819 1915; C.A. **10**, 1338 1916; Chem. Zentr. 1916, II, 318.

6. Lebedev, S. V., and A. A. Ivanov, J. Russ. Phys. Chem. Soc. **48**, 997 **1916**; C.A. **11**, 787 **1917**; Chem. Zentr. **1923**, I, 1539.
7. Lipp, P., J. Buchkremer, and H. Seeles, Ann. **499**, 1 **1932**.
8. Schmidlin, J., and R. von Escher, Ber. **45**, 889 **1912**.
9. Skraup, S., and E. Schwamberger, Ann. **462**, 135 **1928**.
10. Ziegler, K., A. Seib, F. Knövenagel, P. Herte, and F. Andreas, Ann. **551**, 150 **1942**; C.A. **37**, 5388 **1943**.

3. TWO PHENYL SUBSTITUTIONS ON BICYCLANES, $C_nH_{2n-18}$

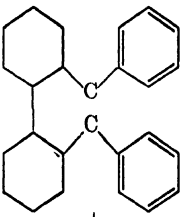
| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,3-Diphenylbicyclo-[2,2,0]-hexane**  | | | | |
| 56[1] | 212-215 12[1] | | | |
| $C_{20}H_{22}$ | | | | |
| **2,6-Diphenylbicyclo-[3,3,0]-octane**  | | | | |
| 110-112[3] | | | | |
| **7,8-Diphenylbicyclo-[4,2,0]-octane** (a)  | | | | |
| 89-90[2] | | | | |

(a) The author states that the compound is either this or the preceding one. Because the data does not agree, it is assumed to have this structure.

### References on Two Phenyl Substitutions on Bicyclanes

1. Döbner, O., and G. Schmidt, Ber. 40, 148 1907.
2. Fichter, F., and K. Kestenhalz, Helv. Chim. Acta 25, 785 1942.
3. Wawzonek, L., J. Am. Chem. Soc. 65, 839 1943.

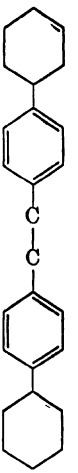
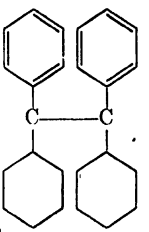
4. TWO PHENYLALKYL SUBSTITUTIONS ON DICYCLANES, $C_nH_{2n-18}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2′-Dibenzyldicyclohexane**  | | | | |
| 180–181 [1] | | | | |

**References on Two Phenylalkyl Substitutions on Dicyclanes**

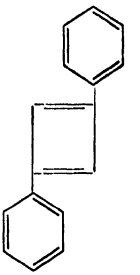
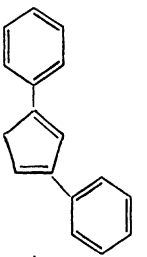
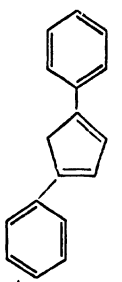
1. Cook, J. W., C. L. Hewett, and C. A. Lawrence, J. Chem. Soc. 1936, 71.

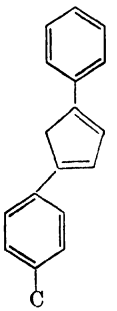
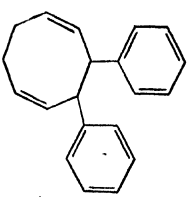
## 5. TWO CYCLYLPHENYL OR TWO CYCLYL AND TWO PHENYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-18}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Di-1,2-*p*-cyclohexylphenylethane**  | | | | |
| 148–149 [1,2] | | | | |
| **1,2-Dicyclohexyl-1,2-diphenylethane**  | | | | |
| 198–200 [3] | | | | |

### References on Two Cyclylphenyl or Two Cyclyl and Two Phenyl Substitutions on Alkanes

1. Bodroux, D., and R. Thomassin, Bull. soc. chim. [5] 6, 1411 1939.
2. Bodroux, D., and R. Thomassin, Compt. rend. 205, 1417 1937.
3. Busch, M., and W. Weber, J. prakt. Chem. [2] 146, 1 1936.

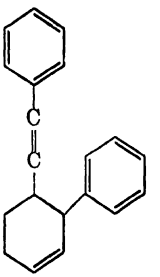
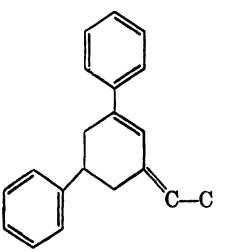
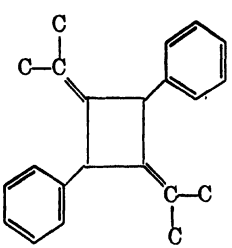
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,4-Diphenylcyclobutadiene-1,3**  130[5] | | | | |
| $C_{17}H_{14}$ **1,3-Diphenylcyclopentadiene-1,3**  156[1] | | | | |
| **1,4-Diphenylcyclopentadiene-1,3**  158–158.5[4] | | | | |

| M. P.,°C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-4-*p*-tolylcyclopentadiene-1,3**  | | | | |
| 153–153.5[4] | | | | |
| $C_{20}H_{20}$ **Dimethyldiphenylcyclohexadiene** (a) | | | | |
| | 205 10[6] | | | |
| (a) The structure of this compound is not given. | | | | |
| **3,4-Diphenylcyclooctadiene-1,5**  | | | | |
| | 204–206 $10^3$<br>204–205 $10^2$ | 1.018 15.3°[2] | | |

**References on Two Phenyl Substitutions on Cyclodienes**

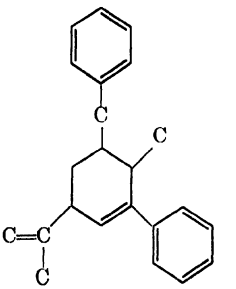

1. Borsche, W., and W. Menz, Ber. **41**, 190 1908.
2. Döbner, O., Ber. **35**, 2129 1902.
3. Döbner, O., and H. Staudinger, Ber. **36**, 4318 1903.
4. Drake, N. L., and J. R. Adams, J. Am. Chem. Soc. **61**, 1326 1939.
5. Gastaldi, C., and F. Cherchi, Gazz. chim. ital. **44**, I, 283 1914.
6. von der Heide, C., Ber. **37**, 2101 1904.

## 7. TWO PHENYL SUBSTITUTIONS ON ALKENYLCYCLENES OR ALKYLIDENECYCLENES, $C_nH_{2n-10}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Phenethenyl-2-phenylcyclohexene-3  | 210–212 12[1] | | | |
| 1,5-Diphenyl-3-ethylidenecyclohexene-1  | 152 22[2] | | | |
| $C_{28}H_{24}$ 1,3-Diisopropylidene-2,4-diphenylcyclobutane  | 202 11[4] | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|

**1-Benzyl-2-methyl-3-phenyl-5-isopropenylcyclohexene-3**

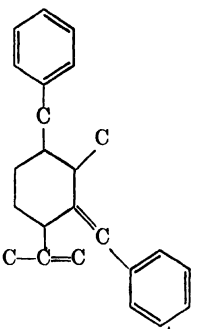


| | | | | |
|---|---|---|---|---|
| | 234–237 13[3] | | | $[\alpha]_D^{20} = -73.51°$ [3] (a) |

(a) Angles of rotation for lines other than D are given in reference 3.

$C_{24}H_{28}$

**1-Benzyl-2-methyl-3-benzylidene-4-isopropenylcyclohexane**

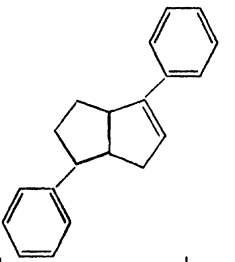


| | | | | |
|---|---|---|---|---|
| | 232–235 11[3] | 1.0015[3] | 1.58159[3] | $[\alpha]_D^{20} = +7.42°$ [3] (a) |

(a) Angles of rotation for lines other than D are given in reference 3.


**References on Two Phenyl Substitutions on Alkenylcyclenes or Alkylidenecyclenes**

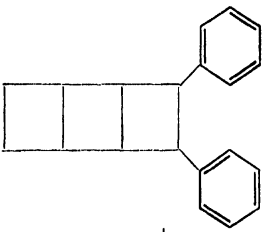
1. Bergmann, E., J. Chem. Soc. 1935, 1359.
2. Kohler, E. P., Am. Chem. J. 37, 369 1907.
3. Rupe, H., and W. Tomi, Ber. 47, 3064 1914.
4. Störmer, R., and H. Strok, Ber. 68, 2102 1935.

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,6-Diphenylbicyclo-[3,3,0]-octene-2**  | | | | |
| 115–116[1] | | | | |

**References on Two Phenyl Substitutions on Bicyclenes**

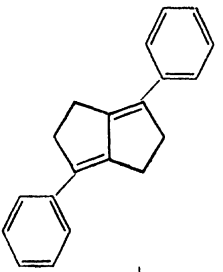
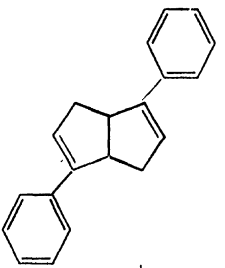
1. Wawzonek, S., J. Am. Chem. Soc. 65, 839 1943.

9. TWO PHENYL SUBSTITUTIONS ON TRICYCLANES, $C_nH_{2n-20}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 3,4-Diphenyltricyclo-[4,2,0,$0^{2,5}$]-octane  | | | | |
| | 204–206 12[1] | | | |

**References on Two Phenyl Substitutions on Tricyclanes**

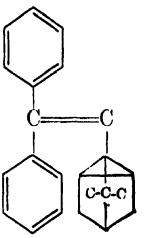
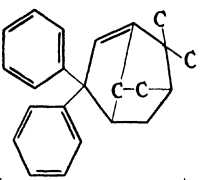
1. Döbner, O., and G. Schmidt, Ber. **40**, 148 1907.

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,6-Diphenylbicyclo-[3,3,0]-octadiene-1,5**  188–190[1] | | | | |
| **2,6-Diphenylbicyclo-[3,3,0]-octadiene-2,6**  136–138[1] | | | | |

**References on Two Phenyl Substitutions on Bicyclodienes**

1. Wawzonek, S., J. Am. Chem. Soc. **65**, 839 1943.

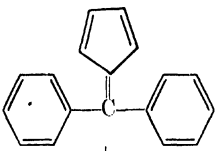
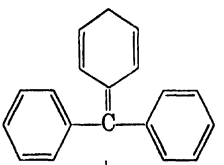
## 11. TWO PHENYL SUBSTITUTIONS ON TRICYCLYLALKENES OR TRICYCLENES, $C_nH_{2n-22}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenyl-2-(7′,7′-dimethyltricyclo-[2,2,1,$0^{2',6'}$]-heptanyl)-ethene**  | | | | |
| 71[1]<br>70–71[2] | 154 0.06[1] | | | |
| **2,2-Dimethyl-6,6-diphenyltricyclo-[3,2,1,$1^{3,8}$]-nonene-7**  | | | | |
| 83–84[2] | | | | |

### References on Two Phenyl Substitutions on Tricyclylalkenes or Tricyclenes

1. Asahina, Y., and T. Sano, Ber. **73**, 747 1940.
2. Lipp, P., and M. Quadvlieg, Ber. **62**, 2311 1929.

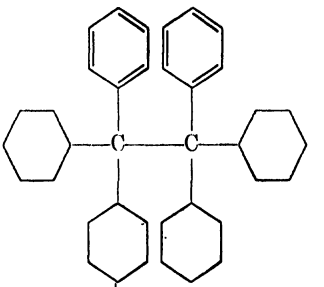
## 12. TWO PHENYL AND ONE CYCLODIENYLIDENE SUBSTITUTIONS ON ALKANES, $C_nH_{2n-22}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Cyclopentadien-2,4-ylidenediphenylmethane** (Diphenylfulvene)  | | | | |
| 82[1,3,4,5] | | | | |
| $C_{19}H_{16}$ | | | | |
| **Cyclohexadien-2,5-ylidenediphenylmethane**  | | | | |
| 81[2,6] | | | | |

### References on Two Phenyl and One Cyclodienylidene Substitutions on Alkanes


1. Courtot, C., Ann. chim. [9] **4**, 168 1915.
2. Gaverdovskaya-Yushkevich, M. V., Sci. Repts. Moscow State Univ. **1936**, No. 6, 263; C.A. **32**, 2524 1938.
3. Grignard, V., and C. Courtot, Compt. rend. **158**, 1763 1914.
4. Hofmann, K. A., A. Metzler, and K. Höbold, Ber. **43**, 1080 1910.
5. Thiele, J., Ber. **33**, 666 1900.
6. Zelinskiĭ, N. D., and M. V. Gaverdovskaya, Ber. **61**, 1049 1928.

## 13. TWO DICYCLYLPHENYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-22}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,2-Tetracyclohexyl-1,2-diphenylethane**  | | | | |
| | 170–171 1.75[1] | | 1.6710 23°[1] | |
| **Tetracyclohexyldiphenylethane** (a) | | | | |
| 157–158(in $N_2$)[2] | | | | |

(a) The structure of this compound is not given.

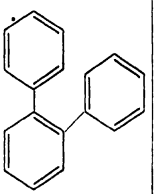
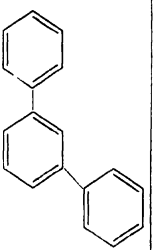
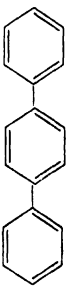
### References on Two Dicyclylphenyl Substitutions on Alkanes

1. Gray, A. E., and C. S. Marvel, J. Am. Chem. Soc. **47**, 2796 1925.
2. Ziegler, K., and P. Herte, Ann. **551**, 222 1942; C.A. **37**, 5390 1943.

# VIII. TERPHENYLS AND THEIR ALIPHATIC DERIVATIVES

## 1. Terphenyls and Their Alkyl Derivatives $C_nH_{2n-22}$

## 1. TERPHENYLS AND THEIR ALKYL DERIVATIVES, $C_nH_{2n-12}$

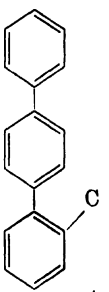
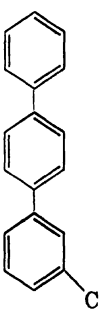
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Diphenylbenzene**  | | | | |
| **57** | | | | |
| 58 [56] | 332 [6,21] | | | |
| 57 [6,21] | 20.0 <0.02 [45] | | | |
| 56–57 [12] | | | | |
| 55 [50] | | | | |
| **1,3-Diphenylbenzene**  | | | | |
| **87** | **364** | | | |
| 89 [29,34,69] | 365 [6] | | | |
| 87 [6,19,37,53,56] | 364 [4] | | | |
| 85(a) | 363 [60] | | | |
| 84–85 [20,51] | 360 [61] | | | |
| | 369 766 [20] | | | |
| **1,4-Diphenylbenzene** (Terphenyl)  | | | | |
| **210** | **383** | | | |
| 214 [4] | 385 [4] | 1.234 [71] | | |
| 213 [6,9,10] | 383 [22,60,63] | 1.226(b) (solid) [41] | | |
| 212–213 [17,18] | 376 [6] | | | |
| 211.5–212.5 [42] | 250 45 [60] | | | |

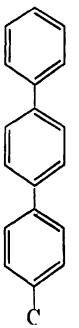
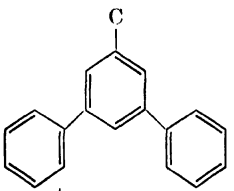
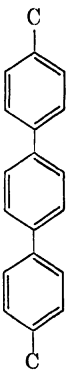
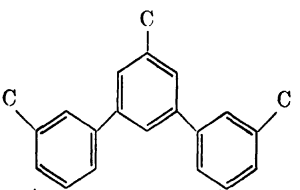
(a) The melting point 85 is found in references 2, 3, 4, 13, 16, 49, 60, 61, 70.

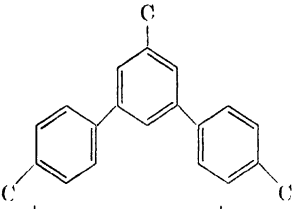
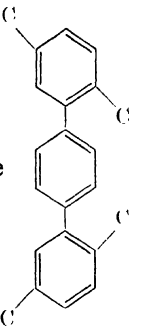
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diphenylbenzene** *(Continued)* | | | | |
| 212[16,27,34] | | | | |
| 211–212[65] | | | | |
| 211.5[56] | | | | |
| 210–211.5[5] | | | | |
| 211[46,55] | | | | |
| 210–211[47] | | | | |
| 210[51,52,53] | | | | |
| 209–210[35,43,44] | | | | |
| 209.5[32] | | | | |
| 209[57,66,68,69] | | | | |
| 208[24,25,33] | | | | |
| 207[14] | | | | |
| 206[8,15,21,38,39,40] | | | | |
| 205–206[59] | | | | |
| 205(a) | | | | |

(a) The melting point 205 is found in references 1, 2, 3, 7, 11, 13, 23, 26, 30, 38, 48, 49, 58, 60, 61, 62, 63, 64, 70.

(b) The temperature for this density is not given.

| | | | | |
|---|---|---|---|---|
| $C_{19}H_{16}$ **1-Phenyl-4-*o*-tolylbenzene**  | | | | |
| 91–92[5,28] | | | | |
| **1-Phenyl-4-*m*-tolylbenzene**  | | | | |
| 169–170[28] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-Phenyl-4-*p*-tolybenzene  207–208 [28] 206–208 [69] | | | | |
| 1-Methyl-3,5-diphenylbenzene  130 [19] | | | | |
| $C_{20}H_{18}$ 1,4-Di-*p*-tolylbenzene  249–250 [36] | | | | |
| $C_{21}H_{20}$ 1-Methyl-3,5-di-*m*-tolylbenzene  65 [16] | | | | |

| | M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|---|
| **1-Methyl-3,5-di-*p*-tolylbenzene**  | 117[19] | | | | |
| $C_{22}H_{22}$ **Diethylterphenyl** (a) | 280[67] | | | | |
| (a) The structure of this compound is not given. | | | | | |
| **1,4-(Di-2′,5′-dimethylphenyl)-benzene**  | 112–113[28] | | | | |

## References on Terphenyls and Their Alkyl Derivatives

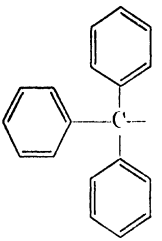

1. Abeljanz, H., Ber. **9**, 10 **1876.**
2. Adam, P., Ann. chim. phys. [6] **15**, 224 **1888.**
3. Adam, P., Bull. soc. chim [2] **49**, 97 **1888.**
4. Andrianov, K., F. Kvitner, and V. Titova, Org. Chem. Ind. (U.S.S.R.) **4**, 161 **1937**; C.A. **32**, 2104 **1938.**
5. Arnold, R. T., C. Collins, and W. Zenk, J. Am. Chem. Soc. **62**, 983 **1940.**
6. Bachmann, W. E., and H. T. Clarke, J. Am. Chem. Soc. **49**, 2089 **1927.**
7. Barbier, P., and L. Roux, Bull. soc. chim. [2] **46**, 268 **1886.**
8. Barth, L., and J. Schreder, Ber. **11**, 1332 **1878.**
9. Basford, F. R., J. Chem. Soc. **1936**, 1593.
10. Basford, F. R., J. Chem. Soc. **1936**, 1780.

11. Berthelot, Bull. soc. chim. [2] **22**, 437 **1874.**
12. Blum-Bergmann, O., J. Am Chem. Soc. **60**, 1999 **1938.**
13. Borsche, W., Ann. **312**, 211 **1900.**
14. Bradley, M. J., and S. W. Parr, Chem. & Met. Eng. **27**, 737 **1922.**
15. Busch, M., and W. Schmidt, Ber. **62**, 2612 **1929.**
16. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 **1936.**
17. Carnelley, T., J. Chem. Soc. **37**, 701 **1880.**
18. Carnelley, T., through Nierenstein, J. Chem. Soc. **107**, 1217 **1915.**
19. Castaldi, C., and F. Cherchi, Gazz. chim. ital. **45**, II, 251 **1915.**
20. Chattaway, F. D., and R. C. T. Evans, J. Chem. Soc. **69**, 980 **1896.**
21. Clews, C. J. B., and K. Lonsdale, Proc. Roy. Soc. (London) **161A**, 493 **1937.**
22. Crafts, through Schmidt and Schultz, Ann. **203**, 124 **1880.**
23. Davis, A. P., J. Phys. Chem. **35**, 3330 **1931.**
24. Diels, O., and K. Alder, Ber. **62**, 2081 **1929.**
25. Fichter, F., and H. Erlenmeyer, Helv. Chim. Acta **9**, 144 **1926.**
26. Fichter, F., and E. Grether, Ber. **36**, 1407 **1903.**
27. France, H., I. M. Heilbron, and D. H. Hey, J. Chem. Soc. **1938**, 1364.
28. France, H., I. M. Heilbron, and D. H. Hey, J. Chem. Soc. **1939**, 1283.
29. France, H., I. M. Heilbron, and D. H. Hey, J. Chem. Soc. **1939**, 1288.
30. Gelissen, H., and P. H. Hermans, Ber. **58**, 285 **1925.**
31. Gelissen, H., and P. H. Hermans, Ber. **58**, 479 **1925.**
32. Gerngross, O., and M. Dunkel, Ber. **57**, 739 **1924.**
33. Gerngross, O., C. Shakhnov, and R. Jones, Ber. **57**, 747 **1924.**
34. Gillam, A. E., and D. H. Hey, J. Chem. Soc. **1939**, 1170.
35. Gomberg, M., and W. E. Bachmann, J. Am. Chem. Soc. **46**, 2339 **1924.**
36. Gomberg, M., and J. C. Pernert, J. Am. Chem. Soc. **48**, 1372 **1926.**
37. Goodman, H. G., Jr., and A. Lowy, J. Am. Chem. Soc. **60**, 2155 **1938.**
38. Kögl, F., and H. Erxleben, Ann. **479**, 11 **1930.**
39. Kögl, F., and I. I. Postkovskiĭ, Ann. **445**, 159 **1925.**
40. Kramers, J. G., Ann. **189**, 135 **1877.**
41. Krishnan, K. S., and S. Banerjee, Trans. Roy. Soc. (London) **234**, 265 **1935.**
42. Kuhn, R., and T. Wagner-Jauregg, Ber. **63**, 2662 **1930.**
43. Kuhn, R., and A. Winterstein, Ber. **60**, 432 **1927.**
44. Kuhn, R., and A. Winterstein, Helv. Chim. Acta **11**, 87 **1928.**
45. Linder, E. G., J. Phys. Chem. **35**, 531 **1931.**
46. Lohaus, H., Ann. **516**, 295 **1935.**
47. Mayer, F., and R. Schiffner, Ber. **65**, 1337 **1932.**
48. Meyer, R., Ann. **219**, 231 **1883.**
49. Möhlau, R., and R. Berger, Ber. **26**, 1994 **1893.**
50. Morton, A. A., J. I. Massengale, and G. M. Richardson, J. Am. Chem. Soc. **62**, 126 **1940.**
51. Müller, E., and H. Pfanz, Ber. **74**, 1051 **1941.**
52. Müller, E., and G. Sok, Ber. **70**, 1990 **1937.**
53. Nenitzescu, C. D., and D. Curcăneanu, Ber. **70**, 346 **1937.**
54. Olgiati, L., Ber. **27**, 3385 **1894.**
55. Pickett, L. W., Proc. Roy. Soc. (London) **142A**, 333 **1933.**
56. Pickett, L. W., G. F. Walter, and H. France, J. Am. Chem. Soc. **58**, 2296 **1936.**
57. Pummerer, R., J. Binapfl, K. Bittner, and K. Schügraf, Ber. **55**, 3095 **1922.**
58. Riese, F., Ann. **164**, 161 **1872.**
59. Schmidt, E., Ber. **7**, 1365 **1874.**
60. Schmidt, H., and G. Schultz, Ann. **203**, 118 **1880.**
61. Schultz, G., Ann. **174**, 201 **1874.**
62. Schultz, G., Ann. **196**, 1 **1879.**
63. Schultz, G., Ann. **207**, 361 **1881.**
64. Schultz, G., Ber. **6**, 415 **1873.**

65. Shorygin, P., V. Isagulyants, and A. Guseva, Ber. **66**, 1426 **1933.**
66. Truffault, R., Bull. soc. chim. [5] **1**, 391 **1934.**
67. Tsukervanik, I. P., and G. Vikrova, J. Gen. Chem. (U.S.S.R.) **7**, 632 **1937**; C.A. **31**, 5779 **1937.**
68. von Braun, J., Ber. **60**, 1180 **1927.**
69. von Braun, J., G. Irmisch, and J. Nelles, Ber. **66**, 1471 **1933.**
70. Zanetti, J. E., and G. Egloff, J. Ind. Eng. Chem. **9**, 350 **1917.**
71. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**

## IX. THREE PHENYL OR ONE PHENYL AND ONE BIPHENYLYL SUBSTITUTIONS ON ALIPHATICS

1. Triphenylalkyl Radicals
2. Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Alkanes, or Two Phenylalkyl Substitutions on Benzene $C_nH_{2n-22}$
3. Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Alkenes $C_nH_{2n-24}$
4. Three Phenyl Substitutions on Alkynes $C_nH_{2n-26}$
5. Three Phenyl Substitutions on Alkadienes or Two Phenylalkenyl Substitutions on Benzene $C_nH_{2n-28}$
6. Three Phenyl Substitutions on Alkenynes $C_nH_{2n-28}$
7. Three Phenyl Substitutions on Alkatrienes $C_nH_{2n-36}$

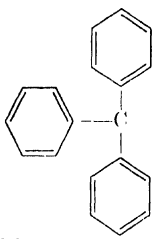
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Triphenylmethyl**  | | | | |
| 145–147[1,2] | | | | |

**References on Triphenylalkyl Radicals**

1. Gomberg, M., and L. H. Cone, Ber. **37**, 2033 **1904.**
2. Gomberg, M., and C. S. Schöpfle, J. Am. Chem. Soc. **39**, 1652 **1917.**

## 2. THREE PHENYL OR ONE PHENYL AND ONE BIPHENYLYL SUBSTITUTIONS ON ALKANES, OR TWO PHENYLALKYL SUBSTITUTIONS ON BENZENE, $C_nH_{2n-22}$

### Triphenylmethane



| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | | $n_D^{20}$ | | Additional Data |
|---|---|---|---|---|---|---|
| **92.6** | **360** | **1.0134** | **100°** | | | Sublimation Temp., °C |
| 96[81] | 360.7[72] | 0.954 | 180°[103] | 1.558 | 180°[103] | 200[47] |
| 95[28,43,71] | 358–360[5,73,112] | 0.969 | 160°[103] | 1.568 | 160°[103] | |
| 94–95[59,119,120,121,122] | 359[68,74] | 0.983 | 140°[103] | 1.5775 | 140°[103] | |
| 94[33,41,42] | 358[65,130] | 0.996 | 120°[103] | 1.5865 | 120°[103] | |
| 93.5–94[16] | 357 758[80] | 1.0081 | 106.5°[36] | 1.595 | 100°[103] | |
| 93–94[136,137] | 307.5 250[42] | 1.0155 | 100.5°[128] | 1.50746 | 18.4°[6] | |
| 93.4[80] | 306.0 250[94] | 1.009 | 100°[103] | 1.57879 | $n_{H\alpha}^{106.5}$[36] | |
| 93.2[87] | 266.2 100[72] | 1.0195 | 100°[73] | 1.57883 | $n_{H\alpha}^{100.5}$[128] | |
| 93–93.2[123] | 239 47[51] | 1.0570 | $D_{100}^{100}$[94] | 1.57776 | $n_{H\alpha}^{99.0}$[94] | |
| 93(a) | 132 0[68] | 1.01405 | 99.0°[94,128] | 1.57779 | $n_{H\alpha}^{99.0}$[128] | |
| 92.5–93[92,116] | | 1.0029 | 96.78°[20] | 1.50266 | $n_{H\alpha}^{18.4}$[6] | |
| 92–93(b) | | 1.0032 | 95.09°[20] | 1.60208 | $n_{H\beta}^{106.5}$[36] | |
| 92.8[120] | | 1.0191 | 95°[73] | 1.60079 | $n_{H\beta}^{100.5}$[128] | |
| 92.8[39,88] | | 1.0568 | $D_{95}^{95}$[94] | 1.59965 | $n_{H\beta}^{99.0}$[94,128] | |
| 92.6[70] | | 1.0049 | 91.98°[20] | 1.61364 | $n_{H\gamma}^{99.0}$[94,128] | |
| 92.5(c) | | 1.0078 | 87.64°[20] | 1.58516 | $n_{He}^{100.5}$[128] | |
| 92.2–92.5[3] | | 1.0097 | 83.95°[20] | | (g) | |
| 92–92.5[61] | | 1.0114 | 80.86°[20] | | | |
| 92.3[58] | | 1.0130 | 77.75°[20] | | | |
| 92.2[12] | | 1.0150 | 74.41°[20] | | | |
| 92.1 ± 0.1[31] | | 1.1106 | 37.34° (solid)[20] | | | |
| 92.1[93,118] | | 1.1169 | 22.04° (solid)[20] | | | |
| 92(d) | | 1.1210 | 12.85° (solid)[20] | | | |
| 91–92[19] | | 1.147 | 0° (solid)[139] | | | |
| 91.9[28] | | 1.148 | 0° (solid)[139] | | | |
| 91–91.5[84] | | 1.135(f)[13] | | | | |
| 91(e) | | | | | | |
| atm. | | | | | | |
| 176.8 2,904[35] | | | | | | |
| 170.6 2,629[35] | | | | | | |
| 170 2,601[35] | | | | | | |
| 165.8 2,420[35] | | | | | | |
| 160 2,181[35] | | | | | | |
| 153.9 1,936[35] | | | | | | |
| 153.6 1,926[35] | | | | | | |
| 150 1,795[35] | | | | | | |
| 140.3 1,452[35] | | | | | | |
| 140 1,445[35] | | | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Triphenylmethane** (*Continued*) | | | | * |
| 136.2 | 1,318[35] | | | |
| 130 | 1,111[35] | | | |
| 125.7 | 968[35] | | | |
| 120.3 | 803[35] | | | † |
| 120 | 794[35] | | | |
| 110 | 489[35] | | | |
| 109.7 | 484[35] | | | |
| 102.0 | 262[35] | | | |
| 100 | 208[35] | | | |

* $t_m = 92.58 + 0.03672p_{atm} - 0.000002662p_{atm}^2$ (1 to 2,904 atm)

† $\frac{dD}{dt} = -0.0007457$/°C (95 to 180°C)

(a) The melting point 93 is found in references 6, 15, 22, 32, 38, 39, 75, 86, 97, 99, 101, 102, 112, 114, 124, 129, 131.

(b) The melting point 92-93 is found in references 1, 4, 10, 17, 18, 21, 25, 30, 34, 49, 57, 73, 116, 117, 133, 140.

(c) The melting point 92.5 is found in references 5, 26, 60, 63, 95, 100, 108, 111, 113.

(d) The melting point 92 is found in references 2, 5, 7, 8, 9, 11, 14, 24, 27, 29, 37, 40, 44, 45, 46, 47, 48, 50, 52, 53, 54, 55, 56, 62, 64, 66, 67, 76, 77, 79, 82, 83, 85, 89, 90, 91, 96, 98, 104, 105, 106, 110, 125, 127, 130, 132, 135, 138.

(e) The melting point 91 is found in references 23, 69, 78, 107, 109, 126, 134.

(f) The temperature for this density is not given.

(g) Refractive indices at other lines may be found in reference 94.

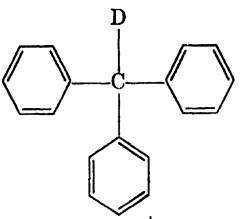
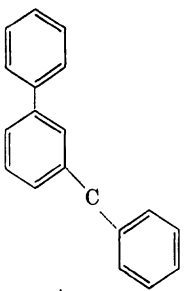
## Triphenylmethane References


1. Acree, S. F., Am. Chem. J. **29**, 588 **1903.**
2. Acree, S. F., Ber. **37**, 616 **1904.**
3. Adams, R., and J. R. Marshall, J. Am. Chem. Soc. **50**, 1970 **1928.**
4. Adkins, H., W. H. Zartmann, and H. Cramer, J. Am. Chem. Soc. **53**, 1425 **1931.**
5. Allen, W., and A. Kölliker, Ann. **227**, 107 **1885.**
6. Anderlini, F., Gazz. chim. ital. **25**, II, 127 **1895.**
7. Anderson, L. C., J. Am. Chem. Soc. **50**, 208 **1928.**
8. Anderson, L. C., J. Am. Chem. Soc. **55**, 809 **1933.**
9. Anschütz, R., Ann. **235**, 150 **1886.**
10. Anschütz, R., Ann. **235**, 299 **1886.**
11. Arbusov, A. E., and B. A. Arbusov, Ber. **62**, 1871 **1929.**
12. Batson, F. M., and C. A. Kraus, J. Am. Chem. Soc. **56**, 2017 **1934.**
13. Becker, K., and H. Rose, Z. Physik **14**, 369 **1923.**
14. Bergmann, E., J. Chem. Soc. **1936**, 412.
15. Bergmann, E., L. Engel, and H. A. Wolff, Z. physik. Chem. **17B**, 81 **1932.**
16. Biltz, H., Ann. **296**, 219 **1897.**
17. Binaghi, R., Gazz. chim. ital. **52**, II, 132 **1922.**
18. Blicke, F. F., J. Am. Chem. Soc. **46**, 1515 **1924.**
19. Blicke, F. F., and J. F. Oneto, J. Am. Chem. Soc. **57**, 749 **1935.**
20. Block, H., Z. physik. Chem. **78**, 385 **1912.**

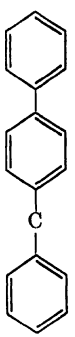
21. Blum-Bergmann, O., Ann. **492**, 277 1932.
22. Bodroux, F., Compt. rend. **161**, 131 1915.
23. Boedtker, E., Bull. soc. chim. [4] **3**, 726 1908.
24. Boeseken, J., Rec. trav. chim. **22**, 301 1903.
25. Bredereck, H., G. Lehmann, C. Schönfeld, and E. Fritsche, Ber. **72**, 1414 1939.
26. Brown, W. G., C. J. Mighton, and M. Senkus, J. Org. Chem. **3**, 62 1938-1939.
27. Bruni, G., and M. Padoa, Atti accad. Lincei [5] **12**, II, 119 1903.
28. Centnerszwer, M., Z. physik. Chem. **46**, 427 1903.
29. Chichibabin, A. E., Ber. **44**, 441 1911.
30. Chichibabin, A. E., and S. A. Elgazin, Ber. **47**, 48 1914.
31. Cuthbertson, G. R., and H. E. Bent, J. Am. Chem. Soc. **58**, 2000 1936.
32. Danilov, S. N., J. Russ. Phys. Chem. Soc. **51**, 97 1920; Chem. Zentr. 1923, III, 760.
33. Danilov, S., and E. Venus-Danilova, Ber. **59**, 377 1926.
34. Delacre, M., Bull. classe sci. Acad. roy. Belg. [3] **20**, 99 1890.
35. Denecke, W., Z. anorg. Allgem. Chem. **108**, 1 1919.
36. Eijkman, J. F., Rec. trav. chim. **12**, 268 1893.
37. Elbs, K., Ber. **16**, 1274 1883.
38. Fischer, E., and O. Fischer, Ann. **194**, 242 1878.
39. Fischer, E., and O. Fischer, Ber. **11**, 195 1878.
40. Fischer, O., Ann. **206**, 83 1881.
41. Fosse, R., Bull. soc. chim. [4] **7**, 231 1910.
42. Friedel, C., and J. M. Crafts, Ann. chim. phys. [6] **1**, 449 1884.
43. Friedel, C., and J. M. Crafts, Compt. rend. **84**, 1450 1877.
44. Garelli, F., and F. Calzolari, Gazz. chim. ital. **29**, II, 258 1899.
45. Gaverdovskaya-Yushkevich, M. V., Sci. Repts. Moscow State Univ. 1936, No. 6, 263; C.A. **32**, 2524 1938.
46. Gilliland, W. L., and A. A. Blanchard, J. Am. Chem. Soc. **48**, 410 1926.
47. Godchot, M., Bull. soc. chim. [4] **7**, 956 1910.
48. Godchot, M., Compt. rend. **147**, 1057 1908.
49. Gomberg, M., Ber. **36**, 376 1903.
50. Gomberg, M., J. Am. Chem. Soc. **22**, 757 1900.
51. Gomberg, M., and L. H. Cone, Ber. **39**, 2957 1906.
52. Griepentrog, H., Ann. **242**, 329 1887.
53. Griepentrog, H., Ber. **19**, 1876 1886.
54. Hemilian, W., Ber. **7**, 1203 1874.
55. Hemilian, W., Ber. **11**, 837 1878.
56. Hemilian, W., Ber. **16**, 2360 1883.
57. Herzig, J., and P. Wengraf, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **110**, Abt. IIb, 518 1901.
58. Hildebrand, J. H., A. D Duschak, A. H. Footer, and C. W. Beebe, J. Am. Chem. Soc. **39**, 2293 1917.
59. Hintze, C., Z. Krist. **9**, 536 1884.
60. Huffman, H. M., G. S. Parks, and A. C. Daniels, J. Am. Chem. Soc. **52**, 1547 1930.
61. Huston, R. C., and T. E. Friedemann, J. Am. Chem. Soc. **40**, 785 1918.
62. Jaeger, Proc. Acad. Sci. Amsterdam **25**, 308 1916.
63. Kekulé, A., and A. Franchimont, Ber. **5**, 906 1872.
64. Klingemann, F., Ann. **275**, 83 1893.
65. Knövenagel, E., and A. Tomasczewski, Ber. **36**, 2829 1903.
66. Koelsch, C. F., and R. H. Rosenwald, J. Am. Chem. Soc. **59**, 2170 1937.
67. Kovache, A., Ann. chim. [9] **10**, 184 1918.
68. Krafft, F., and H. Wielandt, Ber. **29**, 1316 1896.
69. Kraus, C. A., and R. A. Vinger, J. Am. Chem. Soc. **56**, 511 1934.
70. Kruyt, H. R., Z. physik. Chem. **65**, 486 1909.
71. Kunze-Fenchner, M., Ber. **36**, 472 1903.

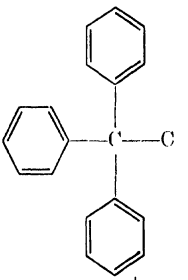
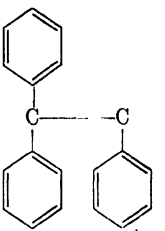
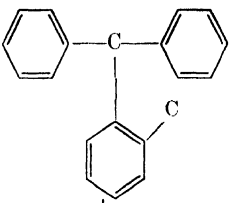
72. Kurbatov, Comm. Trav. sci. Rep. **17**, 24 **1925**; Doss, M. P., Physical Constants of the Principal Hydrocarbons, 3rd ed., New York, **1942**, 187.
73. Kurnakov, I., D. Krotkov, and M. Oksman, J. Russ. Phys. Chem. Soc. **47**, 558 **1915**; Z. anorg. allgem. Chem. **135**, 81 **1924**.
74. Lagerlöf, D., J. prakt. Chem. [2] **98**, 136 **1918**.
75. Lagrave, R., Ann. chim. [10] **8**, 363 **1927**.
76. Lal, J. B., and S. Dutt, J. Indian Chem. Soc. **9**, 565 **1932**.
77. Lal, J. B., and S. Dutt, J. Indian Chem. Soc. **12**, 389 **1935**.
78. Lautsch, Z. physik. Chem. **1B**, 115 **1928**.
79. Liebermann, C., and L. Landshoff, Ber. **14**, 455 **1881**.
80. Linebarger, C. E., Am. Chem. J. **13**, 556 **1891**.
81. Magati, G., quoted by O. Döbner, Ber. **12**, 1462 **1879**.
82. Mark, H., and K. Weissenberg, Z. Physik **17**, 347 **1923**.
83. McKenzie, A., and J. R. Myles, Ber. **65**, 209 **1932**.
84. McKenzie, A., R. Roger, and W. B. McKay, J. Chem. Soc. **1932**, 2597.
85. Meissel, N., Ber. **32**, 2419 **1899**.
86. Meyer, R., and K. Tögel, Ann. **347**, 55 **1906**.
87. Morris, R. E., and W. A. Cook, J. Am. Chem. Soc. **57**, 2403 **1935**.
88. Mortimer, F. S., J. Am. Chem. Soc. **44**, 1416 **1922**.
89. Mouneyrat, A., Bull. soc. chim. [3] **19**, 557 **1898**.
90. Norris, J. F., Organic Syntheses **4**, 81 **1925**.
91. Norris, J. F., and R. C. Young, J. Am. Chem. Soc. **46**, 2580 **1924**
92. Orndorff, W. R., R. C. Gibbs, S. A. McNulty, and C. V. Shapiro, J. Am. Chem. Soc. **49**, 1541 **1927**.
93. Parks, G. S., and H. M. Huffman, Ind. Eng. Chem. **23**, 1138 **1931**.
94. Perkin, W. H., J. Chem. Soc. **69**, 1025 **1896**.
95. Pfeiffer, P., and B. Eistert, J. prakt. Chem. [2] **124**, 168 **1930**.
96. Ramart-Lucas, Ann. chim. phys. [8] **30**, 349 **1913**.
97. Reychler, A., Bull. soc. chim. [3] **35**, 737 **1906**.
98. Rheinholdt, H., and M. Kirchheisen, J. prakt. Chem. [2] **112**, 187 **1926**.
99. Rosentiehl and Gerber, Ann. chim. phys. [6] **2**, 331 **1884**.
100. Rothrock, D. A., Jr., and C. A. Kraus, J. Am. Chem. Soc. **59**, 1699 **1937**.
101. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915**.
102. Sabatier, P., and M. Murat, Compt. rend. **158**, 760 **1914**.
103. Salceanu, C., Compt. rend. **193**, 161 **1931**.
104. Schaum, K., and K. Rosenberger, Z. anorg. allgem. Chem. **136**, 329 **1924**.
105. Scheibler, H., and H. Cobler, Ber. **67**, 314 **1934**.
106. Scheibler, H., and H. J. Schmidt, Ber. **69**, 12 **1936**.
107. Schlenk, W., and E. Bergmann, Ann. **464**, 1 **1928**.
108. Schlenk, W., and E. Bergmann, Ann. **479**, 58 **1930**.
109. Schlenk, W., and E. Bergmann, Ann. **480**, 183 **1930**.
110. Schlenk, W., and E. Marcus, Ber. **47**, 1664 **1914**.
111. Schmidlin, J., Ber. **39**, 628 **1906**.
112. Schmidlin, J., Compt. rend. **136**, 1560 **1903**.
113. Schmidlin, J., Compt. rend. **137**, 59 **1903**.
114. Schönberg, A., and A. Stephenson, Ber. **66**, 250 **1933**.
115. Schwartz, H., Ber. **14**, 1516 **1881**.
116. Shorygin, P., Ber. **59**, 2502 **1926**.
117. Shorygin, P., Ber. **59**, 2510 **1926**.
118. Spaght, M. E., S. B. Thomas, and G. S. Parks, J. Phys. Chem. **36**, 882 **1932**.
119. Stadnikov, G., Ber. **44**, 1157 **1911**.
120. Stadnikov, G., Ber. **47**, 2133 **1914**.
121. Stadnikov, G., J. prakt. Chem. [2] **88**, 1 **1913**.
122. Stadnikov, G., J. Russ. Phys. Chem. Soc. **43**, 1244 **1911**; Chem. Zentr. **1912**, I, 1614.
123. Straus, F., and W. Thiel, Ann. **525**, 151 **1936**.

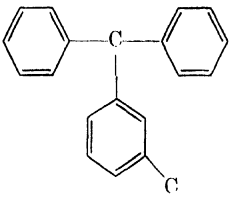
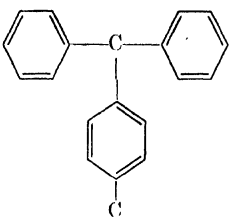
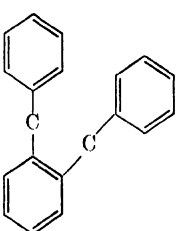
124. Tammann, G., Nachr. Ges. Wiss. Göttingen, Math. physik. Klasse Fachgruppen III, **1913**, 335.
125. van Alphen, J., Ber. **61**, 276 **1928.**
126. Vansheĭdt, A., and B. Moldavskiĭ, Ber. **63**, 1362 **1930.**
127. Vansheĭdt, A., and B. Moldavskiĭ, Ber. **64**, 917 **1931.**
128. von Auwers, K., and F. Bergmann, Ann. **476**, 272 **1929.**
129. Vorländer, D., and E. Mittag, Ber. **46**, 3450 **1913.**
130. Waser, E., Helv. Chim. Acta **8**, 758 **1925.**
131. Wertheimer, F., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **114**, Abt. IIb, 1071 **1905.**
132. Wertyporoch, E., Ber. **66**, 1232 **1933.**
133. Wieland, H., and C. Müller, Ann. **401**, 233 **1913.**
134. Wieland, H., E. Popper, and H. Seefried, Ber. **55**, 1816 **1922.**
135. Wieland, H., and B. Rosenfeld, Ann. **484**, 236 **1930.**
136. Zagoumennyĭ, J. Russ. Phys. Chem. Soc. **12**, 426 **1880**; Ber. **14**, 1402 **1881.**
137. Zagoumennyĭ, through correspondence of A. Krakau, Bull. soc. chim. [2] **34**, 329 **1880.**
138. Zelinskiĭ, N. D., and M. V. Gaverdovskaya, Ber. **61**, 1049 **1928.**
139. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**
140. Ziegler, K., and F. Thielmann, Ber. **56**, 1740 **1923.**

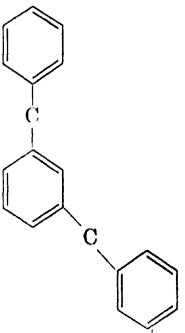
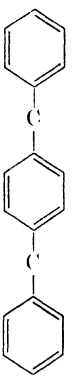
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Triphenylmethane-d**  | | | | |
| 92 [17]<br>91–92 [17] | | | | |
| **1-Phenyl-3-benzylbenzene** (a)  | | | | |
| 54 [27] | 283–287 650 [27] | | | |

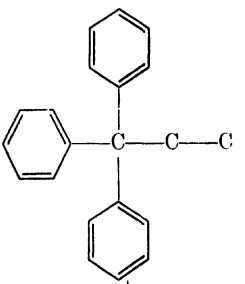
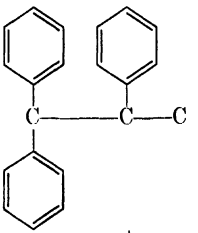
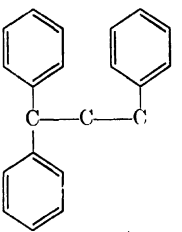
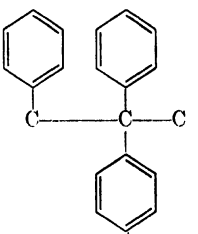
(a) This compound was named isobenzyldiphenyl and is probably 1-phenyl-3-benzylbenzene.

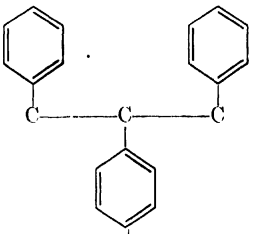
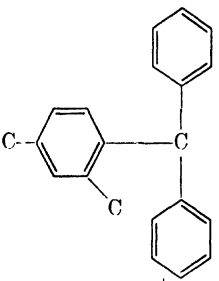
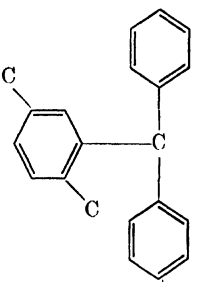
| | | | | |
|---|---|---|---|---|
| **1-Phenyl-4-benzylbenzene**  | | | | |
| 85 [13,27,49] | 285–286 650 [27] | 1.171 0° [81] | | |

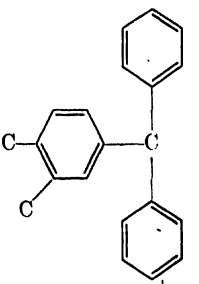
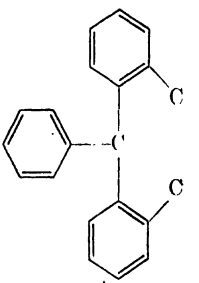
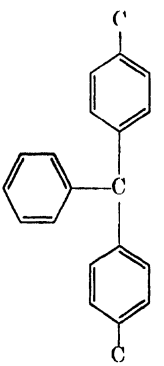
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1-Triphenylethane**  | | | | |
| 95 [60,74,77]<br>94–95 [29,63] | 220–226 25 [30] | | | |
| **1,1,2-Triphenylethane**  | | | | |
| **55** | | | | |
| 56 [58]<br>54–55 [80]<br>54.5 [14]<br>53.5–54.5 [7,78]<br>54 [21,39,52]<br>53 [51]<br>52–53 [2] | 356 [61]<br>348–349 751 [39]<br>216–217 14 [39]<br>211 14 [6]<br>209–211 12 [80]<br>206–210 12 [2] | | | |
| **Diphenyl-*o*-tolylmethane**  | | | | |
| **82** | | | | |
| 82–83 [10]<br>81–83 [3]<br>82 [41]<br>80 [1] | 354 706 [10] | | | |

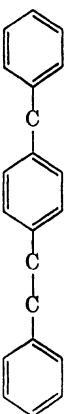
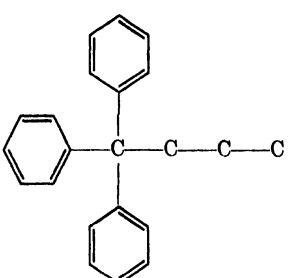
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Diphenyl-*m*-tolylmethane**  | | | | |
| **60.3** | | | | |
| 62[1,33]<br>61–62[25]<br>60.5–61.5[10,35]<br>60.2[15]<br>59.5[55]<br>59–59.5[24] | 353–354.7 774[55] | 1.0072 90°[15] | 1.58264 90°[15]<br>1.57666 $n_{H\alpha}^{90}$ [15]<br>1.59824 $n_{H\beta}^{90}$ [15] | |
| **Diphenyl-*p*-tolylmethane**  | | | | |
| **72** | | | | |
| 74[A]<br>72[12,18,21,41]<br>71[24,34]<br>69–70[9] | | | | |
| **1,2-Dibenzylbenzene**  | | | | |
| 78[8,16,27,53]<br>67–68[52] | | | | |

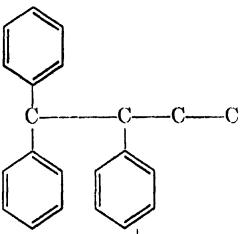
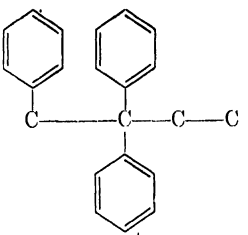
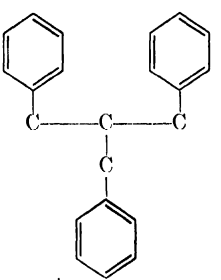
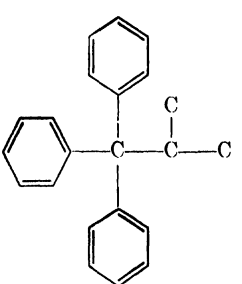
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3-Dibenzylbenzene**  | | | | |
| 59 [38]<br>58–59 [64] | 229–231 14 [56] | 1.0535 $D_0^{20}$ [56]<br>1.0663 $D_0^{0}$ [56] | | |
| **1,4-Dibenzylbenzene**  | | | | |
| 86<br>87–87.5 [56]<br>87 [48]<br>85–87 [53]<br>86 [38]<br>85–86 [37,64]<br>84–85 [45]<br>84 [50]<br>83–84 [67]<br>83 [16] | 252–255 20 [37] | | | |

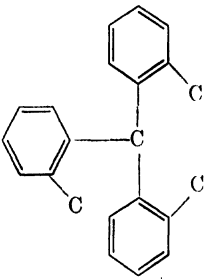
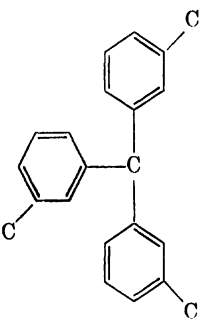
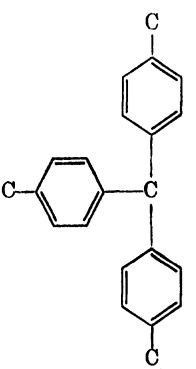
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1-Triphenylpropane**  | | | | |
| 51 [30] | 248–249 41 [30] | | | |
| **1,1,2-Triphenylpropane**  | | | | |
| 76 [5] | 365 [20] | | | |
| 73–75 [58] | 220 16 [5] | | | |
| **1,1,3-Triphenylpropane**  | | | | |
| 47 [5] | 225 21 [5] | | | |
| 46–47 [82,83] | | | | |
| 46 [76] | | | | |
| **1,2,2-Triphenylpropane**  | | | | |
| 118–119 [84] | | | | |
| 116–117 [85] | | | | |

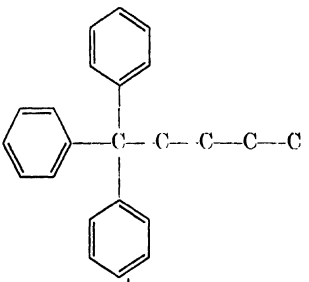
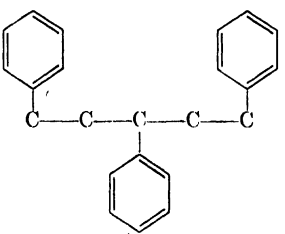
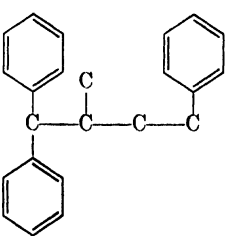
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,3-Triphenylpropane**  | 340[18]<br>225–230 10[26,63]<br>179–181 2[26] | 1.0482 18°[26] | 1.6042 23°[26] | |
| **Diphenyl-2,4-dimethylphenylmethane**  | | | | |
| 61.5[34] | | | | |
| **Diphenyl-2,5-dimethylphenylmethane**  | | | | |
| 92[38] | | | | |

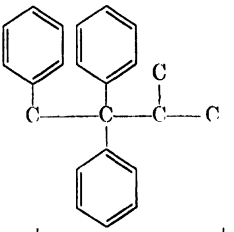
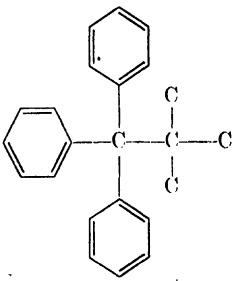
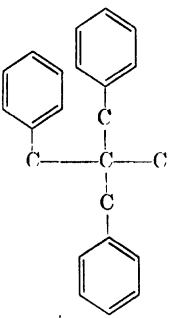
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Diphenyl-3,4-dimethylphenylmethane**  | | | | |
| 68.5 [34] | | | | |
| **Phenyldi-*o*-tolylmethane**  | | | | |
| 106 [16] | 286–289 | 12 [16] | | |
| 104 [73] | 180–185 | 12 [73] | | |
| 102–104 [3] | 64 | 2 [16] | | |
| **Phenyldi-*p*-tolylmethane**  | | | | |
| 54 | | | | |
| 55–56 [68] | 218–220 | 12 [16] | | |
| 54–54.5 [40] | 193 | 3 [16] | | |
| 53 [71] | | | | |
| 52 [31, 41] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Methyldibenzylbenzene** (a) | | | | |
| | 214–217 4 [35] | 1.0413 [35] | 1.5991 [35] | |
| (a) The structure of this compound is not given. | | | | |
| **Benzyltolylbenzene** (a) | | | | |
| | 392–396 [73] | 1.049(b) [73] | | |
| (a) The structure of this compound is not given.<br>(b) The temperature for this density is not given. | | | | |
| **1-Benzyl-4-phenethylbenzene**  | | | | |
| | 225–230 10 [26]<br>213–216 5 [26] | 1.0394 18° [26] | 1.5929 23° [26] | |
| $C_{22}H_{22}$ | | | | |
| **1,1,1-Triphenylbutane**  | | | | |
| 79 [30] | 262–265 62 [30] | | | |

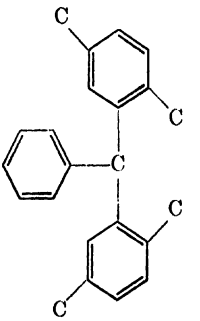
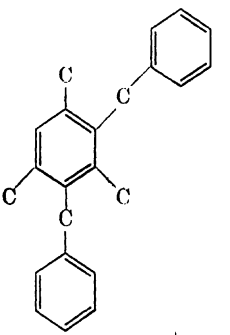
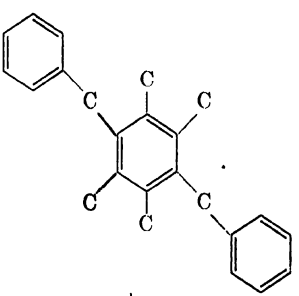
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2-Triphenylbutane**  77–78 [22] | | | | |
| **1,2,2-Triphenylbutane**  79–79.5 [79] | | | | |
| **1,3-Diphenyl-2-benzylpropane**  81.8–82 [36] | | | | |
| **1,1,1-Triphenyl-2-methylpropane**  | 233–234 21 [30] | | | |

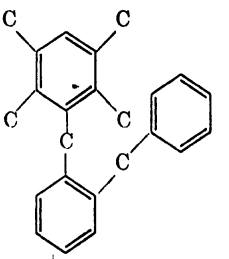
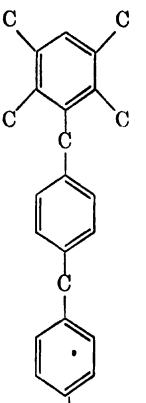
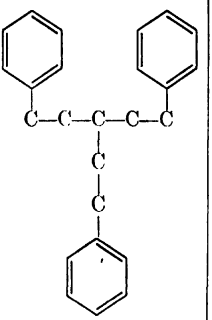
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tri-*o*-tolylmethane**  | | | | |
| 130.5–131.5 [3] | | | | |
| **Tri-*m*-tolylmethane**  | | | | |
| 73 [55] | 376–377.3 767 [55] | | | |
| **Tri-*p*-tolylmethane**  | | | | |
| 63.5 [28] | 260–262 28 [60] | | | |
| 57 [44] | 232 11 [3] | | | |
| 53–54 [47] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **p-Dimethyltriphenyldimethane** (a) | | | | |
| 83.5[19] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **Benzyl-(phenylxylyl)-methane** (a) | | | | |
| | 240–245 14[16] | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{23}H_{24}$ | | | | |
| **1,1,1-Triphenylpentane**  | | | | |
| 153–154[43] | | | | |
| **1,3,5-Triphenylpentane**  | | | | |
| | 170–172 0.5[65] | 1.0180 25°[54] | 1.5770 25°[54] | |
| **1,1,4-Triphenyl-2-methylbutane**  | | | | |
| 69[59] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,2-Triphenyl-3-methylbutane**  | | | | |
| 80[59] | 225–227 20[59] | | | |
| **1,1,1-Triphenyl-2,2-dimethylpropane**  | | | | |
| 189.5[75]<br>185[32] | | | | |
| **1-Phenyl-2,2-dibenzylpropane**  | | | | |
| 113[70] | | | | |
| **Benzylphenyl-2,4,6-trimethylphenylmethane** (a) | | | | |
| 76[16] | | | | |

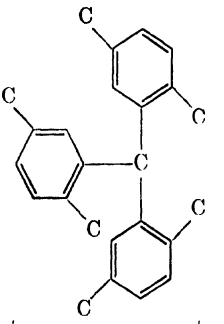
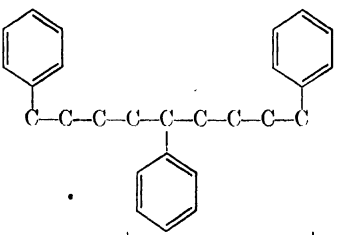
(a) The structure of this compound is questionable.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Phenyl-di-2,5-dimethylphenylmethane**  | | | | |
| 92.5 [23] | | | | |
| **1,3,5-Trimethyl-2,4-dibenzylbenzene**  | | | | |
| 131 [42]<br>89 [46] | | | | |
| $C_{24}H_{26}$ | | | | |
| **1,2,4,5-Tetramethyl-3,6-dibenzylbenzene**  | | | | |
| 176–177 [26A] | 495 [4] | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,3,5,6-Tetramethyl-2′-benzyldiphenylmethane**  | | | | |
| 126.5–127.5 [26A] | | | | |
| **2,3,5,6-Tetramethyl-4′-benzyldiphenylmethane**  | | | | |
| 69–70 [26A] | | | | |
| $C_{25}H_{28}$ | | | | * |
| **1,5-Diphenyl-3-phenethylpentane**  | | | | |
| | | 1.0086 | 1.5725 | † |
| −32 [57] | 209.5 1.00 [57] | 1.0087 [57] | 1.5725 [57] | |
| | 195.0 0.50 [57] | 0.9537 98.9° [57] | 1.5644 40.0° [57] | |
| | | 0.9801 60° [57] | 1.5685 30.0° [57] | |
| | | 0.9952 37.8° [57] | | |

* $\frac{dD}{dt} = -0.0007407[1 - 0.0001579(t - 20)]/°C$ (20 to 99°C)

† $\frac{dn}{dt} = -0.0004035/°C$ (20 to 40°C)

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tri-2,5-dimethylphenylmethane**  | | | | |
| 188[23] | | | | |
| $C_{27}H_{32}$ | | | | |
| **1,5,9-Triphenylnonane**  | | | | |
| | 216–218 0.04[54] | 0.9955 25°[54] | 1.5580 25°[54] | |

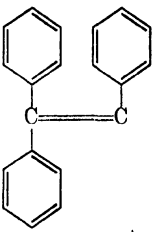
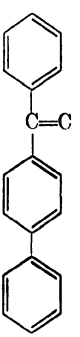
## References on Other $C_{19}H_{16}$-$C_{27}H_{32}$ Compounds

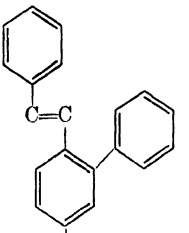
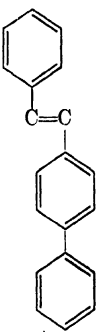
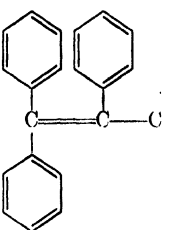

A. Acree, S. F., Am. Chem. J. **29**, 588 1903.
1. Acree, S. F., Am. Chem. J. **33**, 180 1905.
2. Alexander, L. L., and R. C. Fuson, J. Am. Chem. Soc. **58**, 1745 1936.
3. Bartlett, P. D., and J. E. Jones, J. Am. Chem. Soc. **64**, 1837 1942.
4. Bèaurepaire, Bull. soc. chim. [2] **50**, 676 1888.
5. Bergmann, E., J. Chem. Soc. **1936**, 412.
6. Bert, P., Compt. rend. **213**, 792 1941; C.A. **37**, 4065 1943.
7. Biltz, H., Ann. **296**, 219 1897.
8. Bistrzycki, A., and B. Brinken, Helv. Chim. Acta **5**, 20 1922.
9. Bistrzycki, A., and J. Gyr, Ber. **37**, 655 1904.
10. Bistrzycki, A., and J. Gyr, Ber. **37**, 1245 1904.
11. Bodroux, D., Ann. chim. [10] **11**, 511 1929.
12. Bodroux, F., Bull. soc. chim. [4] **17**, 318 1915.
13. Bodroux, F., Compt. rend. **161**, 131 1915.
14. Böeseken, J., and M. C. Bastet, Rec. trav. chim. **32**, 184 1913.
15. Brand, K., W. Gabel, and E. Rosenkranz, Ber. **70**, 296 1937.
16. Bredereck, H., G. Lehmann, C. Schönefeld, and E. Fritzsche, Ber. **72**, 1414 1939.
17. Brown, W. G., C. J. Mighton, and M. Senkus, J. Org. Chem. **3**, 62 1938-1939.
18. Claus, A., and H. Mercklin, Ber. **18**, 2932 1885.

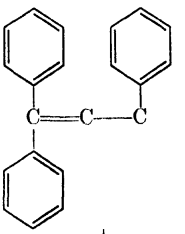
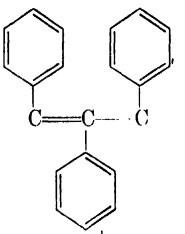
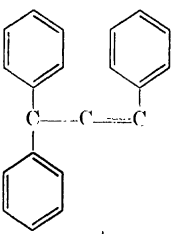
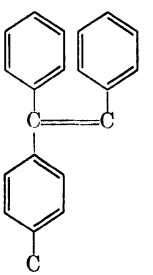
19. Connerade, E., Bull. soc. chim. Belg. **40**, 144 **1931**.
20. Dahl, A., Ber. **29**, 2839 **1896**.
21. Danilov, S. N., J. Russ. Phys. Chem. Soc. **51**, 97 **1920**; C.A. **18**, 1488 **1924**; Chem. Zentr. **1923**, III, 760.
22. Dodds, E. C., L. Goldberg, E. I. Grünfeld, W. Lawson, C. M. Saffer, and R. Robinson, Proc. Roy. Soc. (London) **132B**, 83 **1944**.
23. Elbs, K., J. prakt. Chem. [2] **35**, 465 **1887**.
24. Fischer, E., and O. Fischer, Ann. **194**, 242 **1878**.
25. Fischer, E., and O. Fischer, Ber. **37**, 3355 **1904**.
26. Fuson, R. C., J. Am. Chem. Soc. **48**, 2937 **1926**.
26A. Fuson, R. C., and B. C. McKusick, J. Am. Chem. Soc. **65**, 60 **1943**.
27. Goldschmiedt, G., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **84**, Abt. IIb, 305 **1881**.
28. Gomberg, M., Ber. **35**, 2397 **1902**.
29. Gomberg, M., and L. H. Cone, Ber. **39**, 1461 **1906**.
30. Gomberg, M., and L. H. Cone, Ber. **39**, 2957 **1906**.
31. Guyot, A., Bull. soc. chim. [3] **17**, 966 **1897**.
32. Hantzsch, A., and K. H. Meyer, Ber. **43**, 336 **1910**.
33. Hemilian, W., Ber. **16**, 2360 **1883**.
34. Hemilian, W., Ber. **19**, 3061 **1886**.
35. Hennion, G. F., and R. A. Kurtz, J. Am. Chem. Soc. **65**, 1001 **1943**.
36. Hill, G. A., M. H. Little, S. Wray, Jr., and R. J. Trimbey, J Am. Chem. Soc. **56**, 911 **1934**.
37. Huston, R. C., and T. E. Friedemann, J. Am. Chem. Soc. **38**, 2527 **1916**.
38. Kashtanov, L. I., J. Gen. Chem. (U.S.S.R.) **2**, 515 **1932**; C.A. **27**, 975 **1933**.
39. Klages, A., and S. Heilmann, Ber. **37**, 1447 **1904**.
40. Kliegl, A., Ber. **38**, 84 **1905**.
41. Kovache, A., Ann. chim. [9] **10**, 184 **1918**.
42. Louise, E., Ann. chim. phys. [6] **6**, 174 **1885**.
43. Marvel, C. S., F. D. Hager, and D. D. Coffman, J. Am. Chem. Soc. **49**, 2323 **1927**.
44. Marvel, C. S., W. H. Rieger, and M. B. Mueller, J. Am. Chem. Soc. **61**, 2769 **1939**.
45. McKenna, J. F., and F. J. Sowa, J. Am. Chem. Soc. **59**, 470 **1937**.
46. Mills, W. H., and L. H. Easterfield, J. Chem. Soc. **81**, 1311 **1902**.
47. Mothwurf, A., Ber. **37**, 3153 **1904**.
48. Nametkin, S. S., and D. N. Kursanov, J. Russ. Phys. Chem. Soc. **60**, 917 **1928**; Chem. Zentr. **1929**, I, 996.
49. Nenitzescu, C. D., D. A. Isăcescu, and C. D. Ionescu, Ann. **491**, 210 **1931**.
50. O'Connor, M. J., and F. J. Sowa, J. Am. Chem. Soc. **60**, 125 **1938**.
51. Ramart, P., and P. Amagat, Ann. chim. [10] **8**, 263 **1927**.
52. Ramart-Lucas and F. Salmon-Legagneur, Bull. soc. chim. [4] **43**, 321 **1928**.
53. Reindel, F., and F. Siegel, Ber. **56**, 1550 **1923**.
54. Riedinger, A., Physik. Z. **39**, 380 **1938**.
55. Rosentiehl and Gerber, Ann. chim. phys. [6] **2**, 331 **1884**.
56. Rubtsevich-Zulkovskiĭ, I. L., J. Russ. Phys. Chem. Soc. **46**, 698 **1914**; Beil. **5**, suppl. 351 **1930**.
57. Schiessler, R. W., D. G. Clarke, C. S. Rowland, W. S. Sloatman, and C. H. Herr, paper presented at Am. Petroleum Inst., Nov. 10, **1943**.
58. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928**.
59. Schlenk, W., and E. Bergmann, Ann. **479**, 58 **1930**.
60. Schlenk, W., and E. Marcus, Ber. **47**, 1664 **1914**.
61. Schmidt, O., Ber. **68**, 795 **1935**.
62. Sharma, V. N., and S. Dutt, J. Indian Chem. Soc. **12**, 774 **1935**.
63. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1207 **1913**.
64. Stadnikov, G., and L. Kashtanov, Ber. **61**, 1389 **1928**.
65. Staudinger, H., and A. Steinhofer, Ann. **517**, 35 **1935**.
66. Staudinger, H., and A. Steinhofer, Ann. **517**, 54 **1935**.
67. Thiele, J., and H. Balhorn, Ber. **37**, 1463 **1904**.

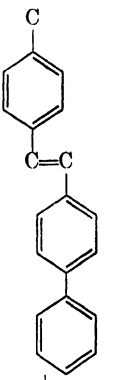
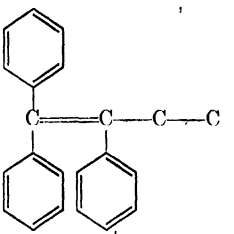
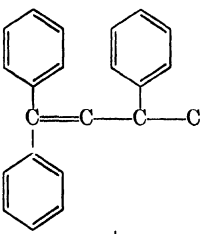
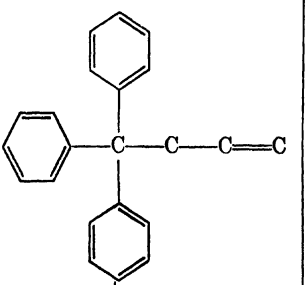
68. Thörner, W., and T. Zincke, Ber. **11**, 65 **1878.**
69. Tousley, V. E., and M. Gomberg, J. Am. Chem. Soc. **26**, 1516 **1904.**
70. Trotman, E. R., J. Chem. Soc. **127**, 88 **1925.**
71. Vorländer, D., Ber. **44**, 2455 **1911.**
72. Weber, E., and T. Zincke, Ber. **7**, 1153 **1874.**
73. Weiss, R., and J. Reichel, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **138**, suppl., Abt. IIb, 187 **1929.**
74. Wieland, H., K. Heymann, T. Tsatsas, D. Juchum, G. Varvoglis, G. Labriola, O. Dobbelstein, and H. S. Boyd-Barrett, Ann. **514**, 145 **1934.**
75. Wieland, H., A. Hintermaier, and I. Dennstedt, Ann. **452**, 1 **1927.**
76. Wieland, H., and H. Kloss, Ann. **470**, 201 **1929.**
77. Wooster, C. B., and N. W. Mitchell, J. Am. Chem. Soc. **52**, 688 **1930.**
78. Wooster, C. B., and N. W. Mitchell, J. Am. Chem. Soc. **52**, 1042 **1930.**
79. Wooster, C. B., and J. F. Ryan, J. Am. Chem. Soc. **54**, 2419 **1932.**
80. Zartman, W. H., and H. Adkins, J. Am. Chem. Soc. **54**, 1668 **1932.**
81. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**
82. Ziegler, K., H. Grabbe, and F. Ulrich, Ber. **57**, 1983 **1924.**
83. Ziegler, K., K. Richter, and B. Schnell, Ann. **443**, 161 **1925.**
84. Ziegler, K., and O. Schäfer, Ann. **479**, 150 **1930.**
85. Ziegler, K., and B. Schnell, Ann. **437**, 227 **1924.**

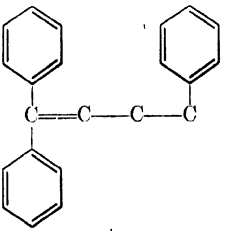
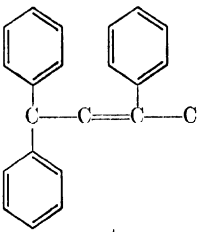
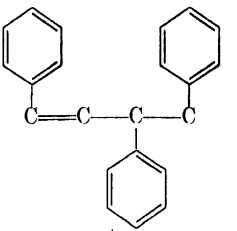
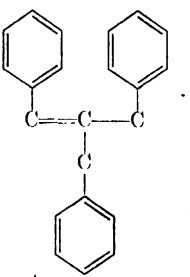
## 3. THREE PHENYL OR ONE PHENYL AND ONE BIPHENYLYL SUBSTITUTIONS ON ALKENES, $C_nH_{2n-24}$

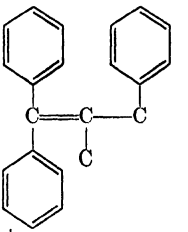
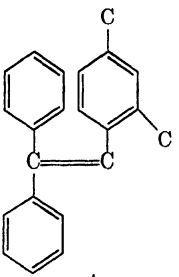
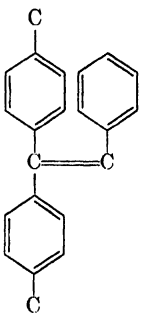
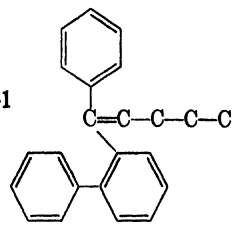
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2-Triphenylethene**  | | | | * |
| **70** | | **1.0757** | | |
| 72–73 [42] | 219–221 15 [47] | 1.0373 78.4° [47] | 1.66784 25° [25] | |
| 72 [25,43] | 220–221 14 [17] | 1.0649 35° [25] | 1.62918 $n_{H\alpha}^{78.4}$ [47] | |
| 70–71 [14,26] | | 1.0684 30° [25] | 1.65698 $n_{H\alpha}^{25}$ [25] | |
| 70–70.5 [15] | | 1.0712 26° [25] | 1.66798 $n_{H\beta}^{78.4}$ [47] | |
| 70 [21,22] | | 1.0719 25° [25] | 1.69840 $n_{H\beta}^{25}$ [25] | |
| 69 [41] | | 1.0726 24.5° [25] | 1.64012 $n_{He}^{78.4}$ [47] | |
| 68–69 [1,13] | | 1.0750 21° [25] | | |
| 67–69 [47] | | 1.0765 19° [25] | | |
| 68 [27,44] | | 1.0793 15° [25] | | |
| 67–68 [12] | | 1.0813 12° [25] | | |
| 66–68 [18] | | | | |
| * $\frac{dD}{dt} = -0.0007200$/°C (12 to 35°C) | | | | |
| **1-Phenyl-1-*p*-biphenylylethene**  | | | | |
| **95** | | | | |
| 96 [40] | | | | |
| 94–95 [22] | | | | |
| 94 [40] | | | | |
| 93 [9] | | | | |

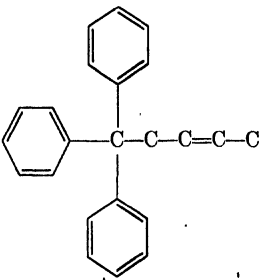
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-2-*o*-biphenylethene**  | | | | |
| 59–61 [7]<br>55–56 [8] | 201–202.5 12 [7] | | | |
| **1-Phenyl-2-*p*-biphenylylethene**  | | | | |
| 220.5–221.5 [20] | | | | |
| $C_{21}H_{18}$ | | | | |
| **1,1,2-Triphenylpropene-1**  | | | | |
| 92–93 [28]<br>89–90 [23,24] | | 0.9956 100.2° [47] | 1.58414 $n_{H\alpha}^{100.2}$ [47]<br>1.61146 $n_{H\beta}^{100.2}$ [47]<br>1.59253 $n_{He}^{100.2}$ [47] | |

| M. P., °C | B. P., °C @ 760mm | | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|---|
| **1,1,3-Triphenylpropene-1**  | | | | | |
| | 229–230 | 17 [29] | | | |
| 89 [36,37] | 225–227 | 16 [3] | | | |
| 87–89 [21] | 228–229 | 15 [21] | | | |
| | 222 | 10 [39] | | | |
| **1,2,3-Triphenylpropene-1**  | | | | | |
| 63–64 [37] | 224 | 12 [5] | | | |
| 63 [5,36] | | | | | |
| 62–63 [28] | | | | | |
| **1,1,3-Triphenylpropene-2**  | | | | | |
| 97–98 [50] | 230 | 15 [50] | | | |
| | 180 | 0.2 [50] | | | |
| **1,2-Diphenyl-1-*p*-tolylethene**  | | | | | |
| | 245–250 | 27 [19] | | | |

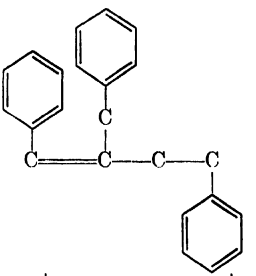
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-*p*-Tolyl-2-*p*-biphenylylethene**  | | | | |
| 102–103 [3] | | | | |
| $C_{22}H_{20}$ | | | | |
| **1,1,2-Triphenylbutene-1**  | | | | |
| 80–81 [10] | | | | |
| **1,1,3-Triphenylbutene-1**  | | | | |
| | 244 | 33 [51] | | |
| **1,1,1-Triphenylbutene-3**  | | | | |
| 69.5–70.5 [1] | | | | |

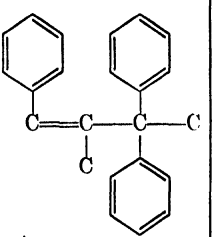
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,1,4-Triphenylbutene-1  | | | | |
| 122–124 [48]<br>122–123 [16] | | | | |
| 1,1,3-Triphenylbutene-2  | | | | |
| | 234 12 [51] | | | |
| 1,3,4-Triphenylbutene-1  | | | | |
| | 240–242 40 [4] | | | |
| 1,3-Diphenyl-2-benzylpropene-1  | | | | |
| 29–30 [45,46] | 241–245 20 [45]<br>245–246 18 [5]<br>231–232 11 [29,45] | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,1,3-Triphenyl-2-methylpropene-1  | | | | |
| 70–71[6] | | | | |
| 1,1-Diphenyl-2-(2′,4′-dimethylphenyl)-ethene  | | | | |
| 69–70[11] | | | | |
| 1,1-Di-*p*-tolyl-2-phenylethene  | | | | |
| | 258–259 24[19] | | | |
| $C_{23}H_{22}$ | | | | |
| 1-Phenyl-1-(2′-*o*-biphenylyl)-pentene-1  | | | | |
| 78–79[8] | 207–208[8] | | | |

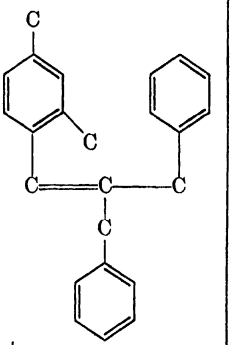
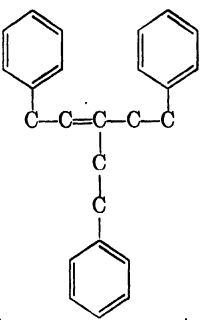
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1-Triphenylpentene-3**  | | | | |
| 83(a) [49]<br>124(b) [49] | | | | |

(a) This constant was determined on the *cis* isomer.
(b) This constant was determined on the *trans* isomer.

| | | | | |
|---|---|---|---|---|
| **1,4-Diphenyl-2-benzylbutene-1**  | | | | |
| 57–58 [30] | 245–247 22 [30] | | | |

| | | | | |
|---|---|---|---|---|
| **1,3,3-Triphenyl-2-methylbutene-1**  | | | | |
| 110(a) [33,34,35]<br>90(a) [33,34] | | | | |

(a) These melting points represent two stereoisomers.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1-(2′,4′-Dimethylphenyl)-2-benzyl-3-phenylpropene-1  | | | | |
| | 246 13[11] | 1.028 24°[11] | 1.600 24°[11] | |
| $C_{25}H_{26}$  | | | | * |
| 1,5-Diphenyl-3-phenethylpentene-2 | | 1.0159 | 1.5816 | † |
| | 210.5 1.00[38] | 1.0159[38] | 1.5816[38] | |
| | 195.5 0.50[38] | 0.9611 98.9°[38] | 1.5735 40.0°[38] | |
| | | 0.9880 60°[38] | 1.5775 30.0°[38] | |
| | | 1.0029 37.8°[38] | | |
| | | 1.0304 0°[38] | | |

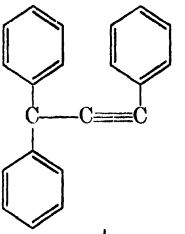
* $\frac{dD}{dt} = -0.0007166[1 - 0.0008158(t-20)]/°C$ (0 to 99°C)

† $\frac{dn}{dt} = -0.000405/°C$ (20 to 40°C)

**References on Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Alkenes**


1. Adkins, H., and W. Zartman, Org. Syntheses **17**, 89 1937.
2. Bachmann, W. E., and R. F. Cockerill, J. Am. Chem. Soc. **55**, 2932 1933.
3. Bergmann, E., and A. Bondi, Ber. **64**, 1455 1931.
4. Bergmann, E., and T. Ukai, Ber. **66**, 54 1933.
5. Bergmann, E., and H. Weiss, Ann. **480**, 64 1930.
6. Bergmann, E., and H. Weiss, Ber. **64**, 1485 1931.
7. Bradsher, C. K., J. Am. Chem. Soc. **66**, 45 1944.

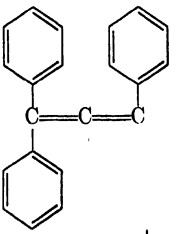
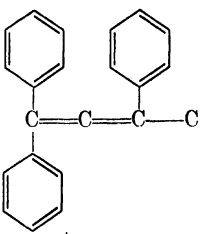
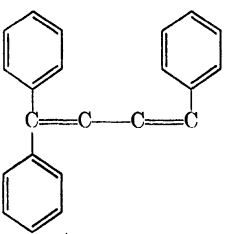
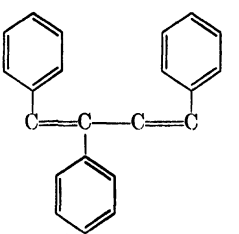
8. Bradsher, C. K., and S. T. Amore, J. Am. Chem. Soc. **66**, 1280 **1944.**
9. Delàville, M., Compt. rend. **184**, 462 **1927.**
10. Dodds, E. C., L. Goldberg, E. I. Grünfeld, W. Lawson, C. M. Saffer, and R. Robinson, Proc. Roy. Soc. (London) **132B**, 83 **1944.**
11. Harispe, J. V., Ann. chim. [11] **6**, 249 **1936.**
12. Hell, C., and F. Wiegandt, Ber. **37**, 1429 **1904.**
13. Hellerman, L., and R. L. Garner, J. Am. Chem. Soc. **57**, 139 **1935.**
14. Hughes, E. D., and C. K. Ingold, J. Chem. Soc. **1933**, 69.
15. Kazanskiĭ, B. A., and G. T. Tatevosyan, J. Gen. Chem. (U.S.S.R.) **9**, 1458 **1939.**
16. Kharasch, M. S., and S. Weinhouse, J. Org. Chem. **1**, 209 **1936.**
17. Klages, A., and S. Heilmann, Ber. **37**, 1447 **1904.**
18. Koelsch, C. F., J. Am. Chem. Soc. **54**, 2045 **1932.**
19. Koelsch, C. F., J. Am. Chem. Soc. **54**, 2487 **1932.**
20. Kuhn, R., and T. Wagner-Jauregg, Ber. **63**, 2662 **1930.**
21. Lagrave, R., Ann. chim. [10] **8**, 363 **1927.**
22. Lettre, H., H. Barnbeck, and W. H. Lege, Ber. **69**, 1151 **1936.**
23. Lévy, J., Bull. soc. chim. [4] **29**, 878 **1921.**
24. Lévy, J., Compt. rend. **172**, 383 **1921.**
25. Ley, H., and U. Kirchner, Z. anorg. allgem. Chem. **173**, 395 **1928.**
26. Ley, Z. wiss. Phot. **18**, 177 **1918.**
27. Meisenheimer, J., Ann. **456**, 126 **1927.**
28. Orekhov, A., Ber. **47**, 89 **1914.**
29. Orekhov, A. P., and R. Grinberg, J. Russ. Phys. Chem. Soc. **48**, 1713 **1916**; C.A. **11**, 3275 **1917**; Chem. Zentr. **1923**, I, 1619.
30. Orekhov, A., and R. Konovalov, Ber. **45**, 861 **1912.**
31. Paterno, E., and G. Chieffli, Gazz. chim. ital. **39**, II, 415 **1909.**
32. Pfeiffer, P., and P. Schneider, J. prakt. Chem. [2] **129**, 129 **1931.**
33. Ramart, P., Bull. soc. chim. [4] **35**, 1075 **1924.**
34. Ramart, P., Compt. rend. **179**, 400 **1924.**
35. Ramart, P., Compt. rend. **179**, 634 **1924.**
36. Ramart, P., and P. Amagat, Ann. chim. [10] **8**, 263 **1927.**
37. Ramart and Amagat, Compt. rend. **182**, 1342 **1926.**
38. Schiessler, R. W., D. G. Clarke, C. S. Rowland, W. S. Sloatman, and C. H. Herr, preprint of paper presented at Am. Petroleum Inst. Nov. 10, **1943.**
39. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928.**
40. Schlenk, W., and E. Bergmann, Ann. **464**, 1 **1928.**
41. Schlenk, W., and E. Bergmann, Ann. **479**, 58 **1930.**
42. Stadnikov, G., Ber. **47**, 2133 **1914.**
43. Staudinger, H., and N. Kon, Ann. **384**, 38 **1911.**
44. Staudinger, H., and A. Rheiner, Helv. Chim. Acta **7**, 8 **1924.**
45. Tiffeneau, M., and J. Lévy, Bull. soc. chim. [4] **39**, 763 **1926.**
46. Tiffeneau, and J. Lévy, Compt. rend. **182**, 391 **1926.**
47. von Auwers, K., Ber. **62**, 693 **1929.**
48. Wooster, C. B., and J. F. Ryan, J. Am. Chem. Soc. **54**, 2419 **1932.**
49. Ziegler, K., and L. Jakob, Ann. **511**, 45 **1934.**
50. Ziegler, K., K. Richter, and B. Schnell, Ann. **443**, 161 **1925.**
51. Ziegler, K., and W. Sauermilch, Ber. **63**, 1851 **1930.**

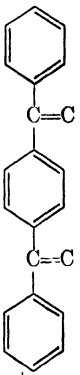
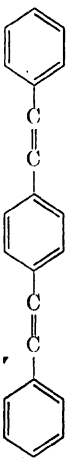
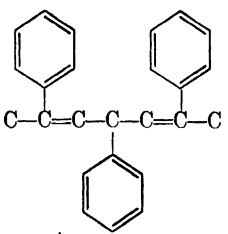
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,3-Triphenylpropyne-2**  | | | | |
| 79[1] | | | | |

**References on Three Phenyl Substitutions on Alkynes**

1. Wieland, H., and H. Kloss, Ann. **470**, 201 **1929.**

5. THREE PHENYL SUBSTITUTIONS ON ALKADIENES OR TWO PHENYLALKENYL SUBSTITUTIONS ON BENZENE, $C_nH_{2n-26}$

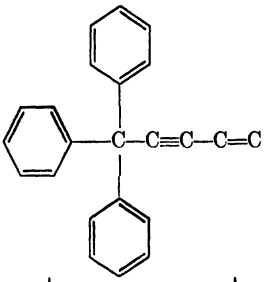
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Triphenylpropadiene**  210 [5,7] | | | | |
| $C_{22}H_{18}$ **1,1,3-Triphenylbutadiene-1,2**  102 [8] | | | | |
| **1,1,4-Triphenylbutadiene-1,3**  101.5–102 [6] | | | | |
| **1,2,4-Triphenylbutadiene-1,3**  103–104 [2] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ p | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Di-(1′-phenethenyl)-benzene**  138–139[1] | | | | |
| **1,4-Di-(2′-phenethenyl)-benzene**  258[4] | | | | |
| $C_{25}H_{24}$ **2,4,6-Triphenylheptadiene-2,5**  145[3] | | | | |

**References on Three Phenyl Substitutions on Alkadienes or Two Phenylalkenyl Substitutions on Benzene**

1. Bergmann, E., and A. Bondi, Ber. **64**, 1455 1931.
2. Bergmann, E., and T. Ukai, Ber. **66**, 54 1933.
3. Delacre, M., Bull. classe sci., Acad. roy. Belg. [3] **22**, 470 1891.
4. Kauffmann, H., Ber. **50**, 515 1917.
5. Meyer, K. H., and K. Schuster, Ber. **55**, 815 1922.
6. Staudinger, H., Ber. **42**, 4249 1909.
7. Ziegler, K., K. Richter, and B. Schnell, Ann. **443**, 161 1925.
8. Ziegler, K., and W. Sauermilch, Ber. **63**, 1851 1930.

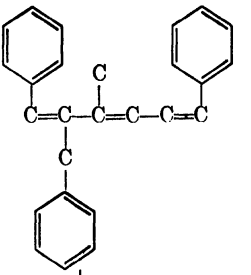
## 6. THREE PHENYL SUBSTITUTIONS ON ALKENYNES, $C_nH_{2n-28}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1-Triphenylpenten-4-yne-2**  | | | | |
| 134–135[1] | | | | |

### References on Three Phenyl Substitutions on Alkenynes

1. Carothers, W. H., and G. J. Berchet, J. Am. Chem. Soc. **55**, 1094 1933.

## 7. THREE PHENYL SUBSTITUTIONS ON ALKATRIENES, $C_nH_{2n-28}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,6-Diphenyl-2-benzyl-3-methylhexatiene-1,3,5**  | | | | |
| 117[1] | | | | |

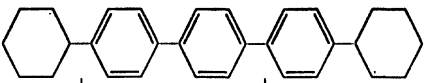
**References on Three Phenyl Substitutions on Alkatrienes**

1. Reimer, M., and G. P. Reynolds, Am. Chem. J. **48**, 206 1913.

# X. TERPHENYLS WITH ALICYCLIC SUBSTITUTIONS

## 1. Terphenyls with Two Cyclyl Substitutions $C_nH_{2n-18}$

1. TERPHENYLS WITH TWO CYCLYL SUBSTITUTIONS, $C_nH_{2n-26}$

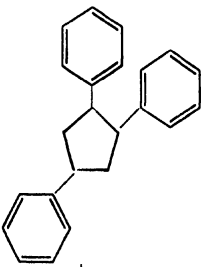
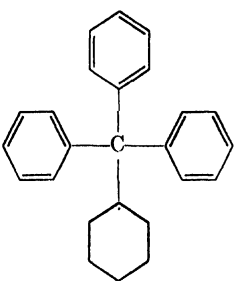
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 4′,4″-Dicyclohexylterphenyl  | | | | |
| | 270 2.5[1] | | | |

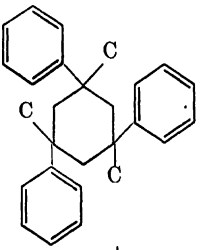
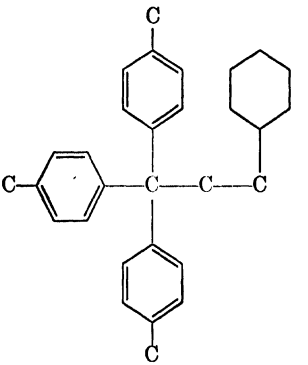
**References on Terphenyl with Two Cyclyl Substitutions**

1. Buu-Hoï and P. Cagniant, Compt. rend. 216, 381 1943; C.A. 38, 2334 1944.

## XI. THREE PHENYL OR ONE PHENYL AND ONE BIPHENYLYL SUBSTITUTIONS ON ALICYCLICS

1. Three Phenyl Substitutions on Cyclanes or Cyclylalkanes $C_nH_{2n-24}$
2. Three Phenyl Substitutions on Cyclenes $C_nH_{2n-26}$
3. Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Cyclodienes $C_nH_{2n-28}$
4. Three Phenyl Substitutions on Alkylidenecyclodienes $C_nH_{2n-30}$

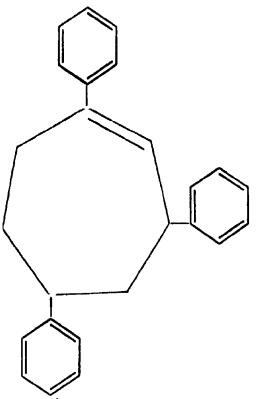
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Triphenylcyclopentane**  | | | | |
| | 285 50[2,6] | | | |
| $C_{24}H_{24}$ | | | | |
| **Triphenylmethylcyclopentane** (a) | | | | |
| 121–122(b)[1] | 260–262 28(b)[1] | | | |
| (a) The structure of this compound is not given. (b) The melting and boiling points represent two different isomeric forms. | | | | |
| $C_{25}H_{26}$ | | | | |
| **Triphenyldimethylcyclopentane** (a) | | | | |
| 80–81(b)[1] | 246–248 25(b)[1] | | | |
| (a) The structure of this compound is not given. (b) The melting and boiling points represent two different isomeric forms. | | | | |
| **Cyclohexyltriphenylmethane**  | | | | |
| 143–145[5] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,3,5-Triphenyl-1,3,5-trimethylcyclohexane  | | | | |
| | 172–178 0.1[3] | 1.0455[3] | 1.58429[3] | |
| $C_{30}H_{36}$ | | | | |
| 1,1,1-Tri-*p*-tolyl-3-cyclohexylpropane  | | | | |
| 126[4] | | | | |

**References on Three Phenyl Substitutions on Cyclanes or Cyclylalkanes**


1. Abell, R. D., J. Chem. Soc. **83**, 367 1903.
2. Newmann, F. H., Ann. **302**, 236 1898.
3. Staudinger, H., and F. Breusch, Ber **62**, 442 1929.
4. Wieland, H., and K. Kloss, Ann. **470**, 201 1929.
5. Wieland, H., and A. Meyer, Ann. **551**, 249 1942; C.A. **37**, 5048 1942.
6. Wislicenus, J., and F. H. Newmann, Ann. **302**, 236 1898.

| M. P. °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5-Triphenylcycloheptene-1** (Tetrahydromerodypnopinacolene) | | | | |
| 145(a)[1] 115(a)[1] | | | | |

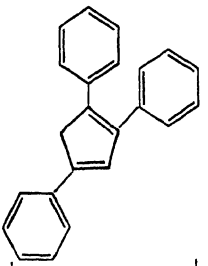
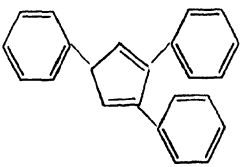
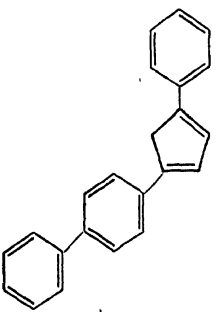
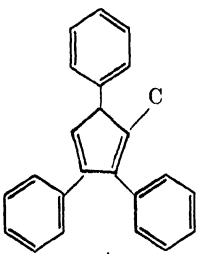


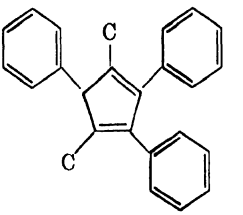
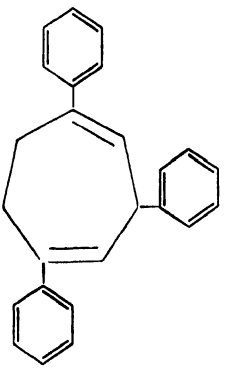
(a) These melting points represent two different forms of the compound.

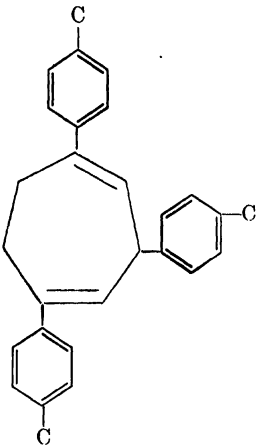
**References on Three Substitutions on Cyclenes**

1. Delacre, M., Ann. chim [9] **2**, 63 **1914.**

3. THREE PHENYL OR ONE PHENYL AND ONE BIPHENYLYL SUBSTITUTIONS ON CYCLODIENES, $C_nH_{2n-28}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Triphenylcyclopentadiene-1,3**  149–150[4] 149[8] | | | | |
| **2,3,5-Triphenylcyclopentadiene-1,3**  149[9] | | | | |
| **1-Phenyl-4-*p*-biphenylylcyclopentadiene-1,3**  217–218[5] | | | | |
| $C_{24}H_{20}$ **1,3,4-Triphenyl-2-methylcyclopentadiene-2,4**   162–163[1,2] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,4-Triphenylcyclohexadiene** (a) | | | | |
| 111[7] | | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{25}H_{22}$ | | | | |
| **1,4-Dimethyl-2,3,5-triphenylcyclopentadiene-1,3**  | | | | |
| 127–128[1] | | | | |
| **1,3,5-Triphenylcycloheptadiene-1,4** (Dihydromerodypnopinacolene)  | | | | |
| 135–136[8]<br>94–95[6] | | | | |

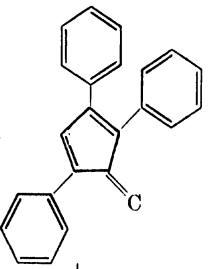
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,3,5-Tri-*p*-tolylcycloheptadiene-1,4 (a)  | | | | |
| 122[6] | | | | |

(a) This structure is probable, although no structure was definitely assigned by the author.

**References on Three Phenyl or One Phenyl and One Biphenylyl Substitutions on Cyclodienes**


1. Abell, R. D., J. Chem. Soc. **83**, 367 1903.
2. Abell, R. D., Proc. Chem. Soc. **19**, 18 1903.
3. Delacre, M., Ann. chim. [9] **2**, 63 **1914**.
4. Dilthey, W., and W. Schommer, J. prakt. Chem. [2] **136**, 293 **1933**.
5. Drake, N. L., and J. R. Adams, J. Am. Chem. Soc. **61**, 1326 **1939**.
6. Gastaldi, C., Gazz. chim. ital. **51**, II, 289 1921.
7. Kohler, E. P., Am. Chem. J. **37**, 369 **1907**.
8. Newmann, F. H., Ann. **302**, 236 **1898**.
9. Wislicenus, J., and F. H. Newmann, Ann. **302**, 236 **1898**.

4. THREE PHENYL SUBSTITUTIONS ON ALKYLIDENECYCLODIENES, $C_nH_{2n-36}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Triphenyl-3-methylenecyclopentadiene-1,4**  | | | | |
| 148[1] | | | | |

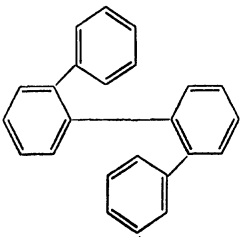
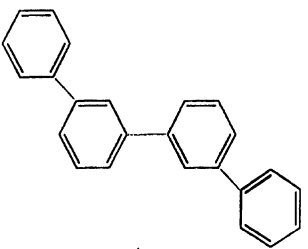
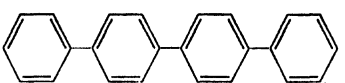
**References on Three Phenyl Substitutions on Alkylidenecyclodienes**

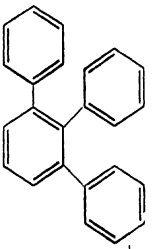
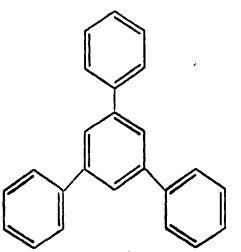
1. Dilthey, W., and P. Huchtemann, J. prakt. Chem. [2] 154, 238 1940.

# XII. QUATRAPHENYLS AND THEIR ALIPHATIC DERIVATIVES

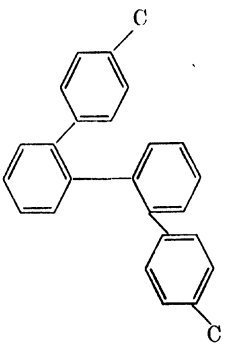
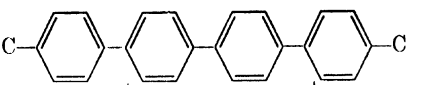
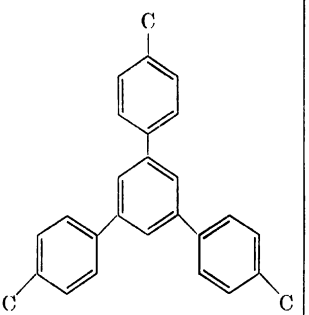
## 1. Quatraphenyls and Their Alkyl Derivatives $C_nH_{2n-20}$

## 1. QUATRAPHENYLS AND THEIR ALKYL DERIVATIVES, $C_nH_{2n-30}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2′-Diphenylbiphenyl**  | | | | |
| 118–119 [6,40]<br>117–119 [44]<br>118 [2,32] | 420 [2]<br>193–195 1 [44] | | | |
| **3,3′-Diphenylbiphenyl**  | | | | |
| 86 [6] | | | | |
| **4,4′-Diphenylbiphenyl**<br>(Quaterphenyl)<br>(Benzerythrene)  | | | | |
| **318** | | | | |
| 320 [3,6,7,13,15,29,53]<br>318–319 [46]<br>318 [25]<br>317 [14,19,34]<br>313–314 [26]<br>312 [17]<br>310 [38,38]<br>308 [30,34]<br>307–308 [43,47] | 520 [34]<br>428 18 [34] | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,3-Triphenylbenzene**  | | | | |
| 157 [50] | | | | |
| **1,3,5-Triphenylbenzene**  | | | | |
| **173.7** | | | | |
| 174.3–174.5 [4,18] | 459 717 [34] | 1.199 30.3° [4] | | |
| 174.2–174.5 [18] | | 1.200 30.3° [4] | | |
| 173–174 [27] | | 1.200 (solid)(a) [4] | | |
| 172–173 [1] | | 1.201 (solid)(a) [4] | | |
| 172 [21,29,35,37,48] | | 1.205 (solid)(a) [49] | | |
| 171–172 [45] | | 1.206 (solid)(a) [19,49] | | |
| 171 [5,19,54] | | 1.205 0° [56] | | |
| 170–171 [36,52] | | | | |
| 170 [8,16,22,28,34] | | | | |
| 169.5–170 [31] | | | | |
| 169–170 [12,23,41,42,51] | | | | |
| 169 [20,55] | | | | |
| 168–169 [10] | | | | |
| 168 [11] | | | | |

(a) The temperature of these densities is not given.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 2,2′-Di-*p*-tolylbiphenyl  113–114 [44] | | | | |
| 4,4′-Di-*p*-tolylbiphenyl  334 [39] | | | | |
| $C_{27}H_{24}$ 1,3,5-Tri-*p*-tolylbenzene  171 [9] 170 [5,11] | | | | |

**References on Quatraphenyls and Their Alkyl Derivatives**

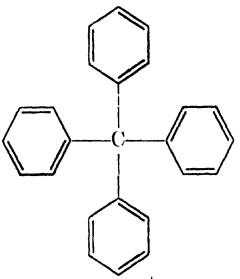
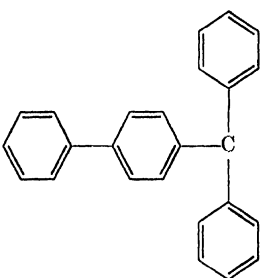

1. Adkins, H., W. H. Zartmann, and H. Kramer, J. Am. Chem. Soc. **53**, 1425 **1931.**
2. Bachmann, W. E., and H. T. Clarke, J. Am. Chem. Soc. **49**, 2089 **1927.**
3. Basford, F. R., J. Chem. Soc. **1936**, 1593.
4. Baxter, G. P., and A. H. Hale, J. Am. Chem. Soc. **58**, 510 **1936.**
5. Bernhauer, K., P Müller, and F. Neiser, J. prakt. Chem. [2] **145**, 301 **1936.**
6. Bowden, S. T., J. Chem. Soc. **1931**, 1111.
7. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 **1936.**
8. Castaldi, C., and F. Cherchi, Gazz. chim. ital. **45**, II, 251 **1915.**

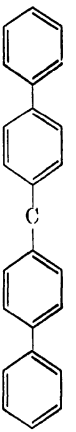
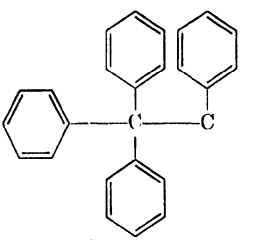
9. Claus, A., J. prakt. Chem. [2] **41**, 396 **1890.**
10. Delacre, M., Bull. classe sci. Acad. roy. Belg. [3] **22**, 470 **1891.**
11. Dolgov, B. N., and Y. N. Volnov, J. Gen. Chem. (U.S S.R.) **1**, 340 **1931**; C.A. **26**, 2186 **1932.**
12. Engler, C., and H. E. Berthold, Ber. **7**, 1123 **1874.**
13. Gelissen, H., and P. H. Hermans, Ber. **58**, 285 **1925.**
14. Gelissen, H., and P. H. Hermans, Ber. **58**, 764 **1925.**
15. Gerngross, O., and M. Dunkel, Ber. **57**, 739 **1924.**
16. Gesché, L., Bull. classe sci. Acad. roy. Belg. **1900**, 293.
17. Gillam, A. E., and D. H. Hey, J. Chem. Soc. **1939**, 1170.
18. Herschberg, reported by G. P. Baxter and A. H. Hale, J. Am. Chem. Soc. **59**, 506 **1937.**
19. Hertel, E., and G. H. Römer, Z. physik. Chem. **23B**, 226 **1933.**
20. Ipatieff, V. N., and A. D. Petrov, Ber. **60**, 1956 **1927.**
21. Kohler, E. P., Am. Chem. J. **37**, 369 **1907.**
22. Koslov, N. S., P. N. Fedoseev, and I. Drabkin, J. Gen. Chem. (U.S.S.R.) **6**, 1686 **1936**; C.A. **31**, 2591 **1937.**
23. Krasouskiĭ, K., and A. Kiprianov, J. Russ. Phys. Chem. Soc. **56**, 1 **1925**; C.A. **19**, 2817 **1925**; Chem. Zentr. **1926**, I, 896.
24. Krishnan, K. S., and S. Banerjee, Trans. Roy. Soc. (London) **234**, 265 **1935.**
25. Kuhn, R., Ann. **475**, 131 **1929.**
26. Kuhn, R., and T. Wagner-Jauregg, Ber. **63**, 2662 **1930.**
27. Leone, P., and A. Braicovic, Atti accad. Lincei [5] **33**, II, 567 **1924.**
28. Mastagli, P., Ann. chim. [11] **10**, 281 **1938.**
29. Mayer, F., and R. Schiffner, Ber. **65**, 1337 **1932.**
30. Meyer, H., and A. Hoffmann, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **125-126**, Abt. IIb, 449 **1916-1917.**
31. Morton, A. A., C. F. Branch, and D. B. Clapp, Am. J. Cancer **26**, 754 **1936.**
32. Morton, A. A., J. T. Messengale, and G. M. Richardson, J. Am. Chem. Soc. **62**, 126 **1940.**
33. Müller, E., and T. Töpel, Ber. **72**, 273 **1939.**
34. Noyes, A. A., and R. M. Ellis, Am. Chem. J. **17**, 620 **1895.**
35. Odell, A. F., and C. W. Hines, J. Am. Chem. Soc. **35**, 81 **1913.**
36. Parks, G. S., S. S. Todd, and W. A. Moore, J. Am. Chem. Soc. **58**, 398 **1936.**
37. Pascal, P., Bull. soc. chim. [4] **37**, 836 **1925.**
38. Pickett, L. W., J. Am. Chem. Soc. **58**, 2299 **1936.**
39. Pummerer, R., and L. Geligsberger, Ber. **64**, 2477 **1931.**
40. Rapson, W. S., R. G. Shuttleworth, and J. N. van Niekerk, J. Chem. Soc. **1943**, 326.
41. Reddelien, G., Ann. **388**, 165 **1912.**
42. Reddelien, G., Ber. **46**, 2712 **1913.**
43. Rupe, H., and M. Iselin, Ber. **49**, 25 **1916.**
44. Sadler, A. M., and G. Powell, J. Am. Chem. Soc. **56**, 2650 **1934.**
45. Schlenk, W., and M. Karplus, Ber. **61**, 1675 **1928.**
46. Schmidlin, J., Ber. **45**, 3171 **1912.**
47. Schmidt, H., and G. Schultz, Ann. **203**, 118 **1880.**
48. Schneider, W., and G. Gramms, Ber. **69**, 2543 **1936.**
49. Schröder, H., Ber. **14**, 2516 **1881.**
50. Smith, A., Ber. **26**, 65 **1893.**
51. Staudinger, H., and A. Steinhofer, Ann. **517**, 35 **1935.**
52. Stoermer, R., and T. Biesenbach, Ber. **38**, 1958 **1905.**
53. Ullmann, F., Ann. **332**, 38 **1904.**
54. von Niementowski, S., Ber. **38**, 2044 **1905.**
55. Vorländer, D., E. Fischer, and H. Wille, Ber. **62**, 2836 **1929.**
56. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**

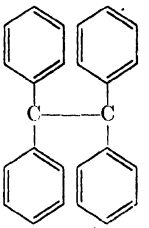
## XIII. FOUR PHENYL, TWO PHENYL AND ONE BIPHENYLYL, OR TWO BIPHENYLYL SUBSTITUTIONS ON ALIPHATICS.

1. Four Phenyl, Two Phenyl and One Biphenylyl, or Two Biphenylyl Substitutions on Alkanes $C_nH_{2n-30}$
2. Four Phenyl, Two Phenyl and One Biphenylyl, or Two Biphenylyl Substitutions on Alkenes $C_nH_{2n-32}$
3. Four Phenyl or Two Biphenylyl Substitutions on Alkynes $C_nH_{2n-34}$
4. Four Phenyl or Two Biphenylyl Substitutions on Alkadienes $C_nH_{2n-34}$
5. Four Phenyl Substitutions on Alkatrienes $C_nH_{2n-36}$
6. Four Phenyl Substitutions on Alkadiynes $C_nH_{2n-38}$
7. Four Phenyl Substitutions on Alkatetraenes $C_nH_{2n-38}$
8. Four Phenyl Substitutions on Alkapentaenes $C_nH_{2n-40}$
9. Four Phenyl Substitutions on Alkahexaenes $C_nH_{2n-42}$

1. FOUR PHENYL, TWO PHENYL AND ONE BIPHENYLYL, OR TWO BIPHENYLYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-30}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tetraphenylmethane**  | | | | |
| **282.5** | | | | |
| 285 [22,25] | 429 [7] | | | |
| 283 [62] | 429 | 735 [77] | | |
| 282 [77] | | | | |
| 281.5–282 [45] | | | | |
| 281–282 [82] | | | | |
| 281.5 [41] | | | | |
| 281 [7] | | | | |
| 280–281 [32] | | | | |
| **Diphenyl-*p*-biphenylylmethane**  | | | | |
| 112–113 [60] | | 1.161 0° [90] | | |

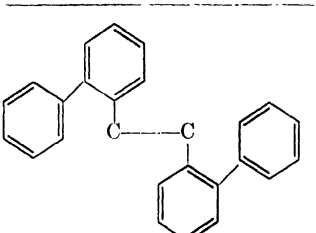
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Di-*p*-biphenylylmethane**  | | | | |
| 161[1,2,43]<br>159[42]<br>158–159[83] | 360[1] | 1.178[43]<br>1.176 0°[90] | | |
| $C_{26}H_{22}$<br>**1,1,1,2-Tetraphenylethane**  | | | | |
| **143**<br>144[26,61]<br>143–144[80]<br>142–143[27]<br>140–142[63]<br>140–141[38]<br>140[79] | 277–280 21[27] | | | |

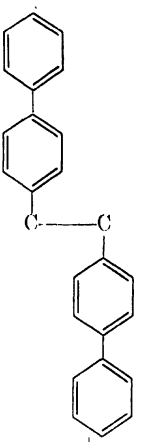
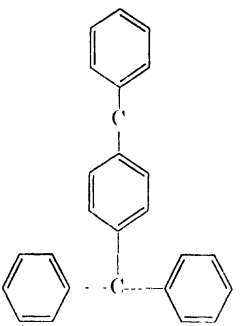
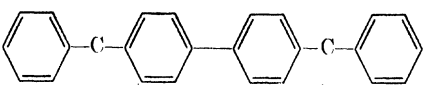
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,2-Tetraphenylethane**  | | | | |
| **209.2** | | | | |
| 211–212[68] | 379–383[11,12,91] | 1.170 0°[90] | | |
| 211–211.5[6] | 277–280 21[91] | 1.182 (solid)(c)[64] | | |
| 211[44,53,54,55] | 260 16[44] | | | |
| 209–211[18] | | | | |
| 210[35] | | | | |
| 209–210[30,57] | | | | |
| 208–210[37,51] | | | | |
| 209.5[5] | | | | |
| 209(a) | | | | |
| 208–209(b) | | | | |
| 207–208.5[16] | | | | |
| 208[3,86] | | | | |
| 207–208[4] | | | | |
| 206.5–208[33] | | | | |
| 206–208[4] | | | | |
| 207.5[12] | | | | |
| 207[8,23,75] | | | | |
| 205–207[36] | | | | |
| 206[17,23,29,76] | | | | |
| 205–206[39,71,72,74] | | | | |

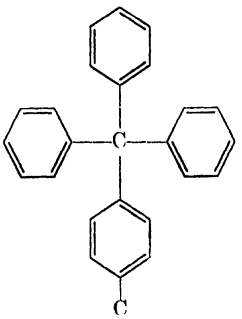
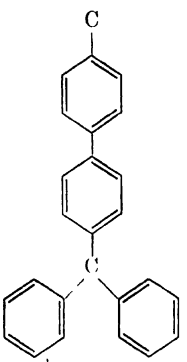
(a) The melting point 209 is found in references 10, 13, 14, 21, 31, 34, 40, 46, 47, 48, 49, 50, 52, 56, 58, 87, 88, 91.

(b) The melting point 208-209 is found in references 15, 59, 65, 66, 69, 70, 73, 89.

(c) This density is the average of two determinations. The temperature for this density is not given.

| | | | | |
|---|---|---|---|---|
| **1,2-Di-o-biphenylylethane**  | | | | |
| | 260 12[78] | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Di-*p*-biphenylylethane**  | | | | |
| 198–199 [84] | | | | |
| **Diphenyl-*p*-benzylphenylmethane**  | | | | |
| 78–78.5 [9] | | | | |
| **Methyldiphenylbenzylbenzene** (a) | | | | |
| 125 [20] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **4,4′-Dibenzylbiphenyl**  | | | | |
| 114–115 [19] | | | | |
| 113 [24,67,85] | | | | |

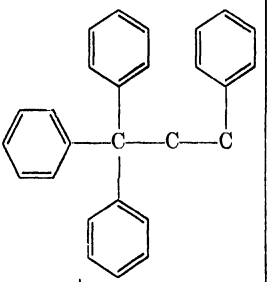
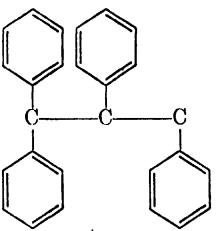
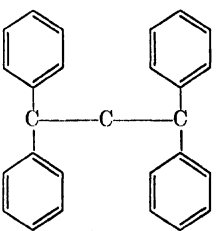
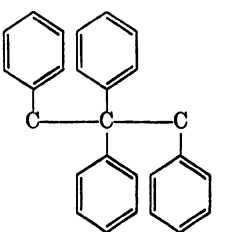
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Triphenyl-*p*-tolylmethane**  163 [31] | | | | |
| **4-Methyl-4′-benzhydrylbiphenyl**  131 [28] | | | | |

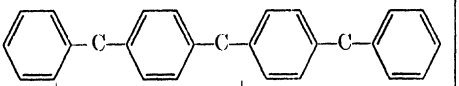
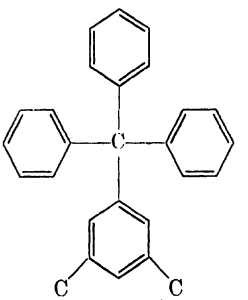
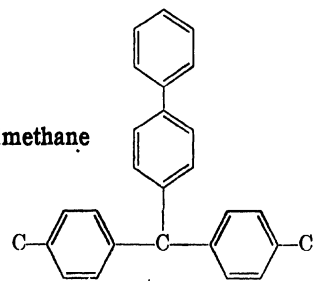
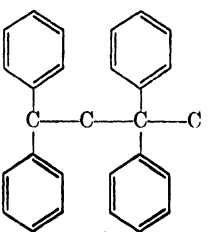
## References on $C_{25}H_{20}$ and $C_{26}H_{22}$ Compounds

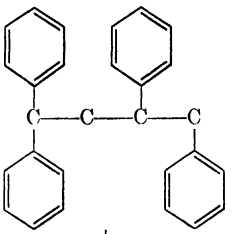
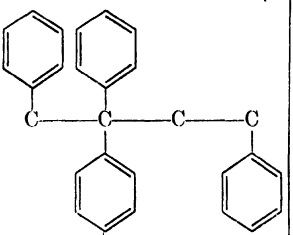
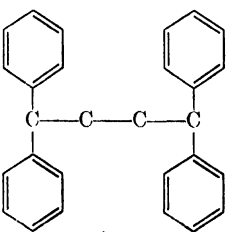

1. Adam, P., Ann. chim. phys. [6] **15**, 224 **1888**.
2. Adam, P., Bull. soc. chim. [2] **47**, 686 **1887**.
3. Albesco, G., Ann. chim. [9] **18**, 216 **1922**.
4. Alexander, L. L., and R. C. Fuson, J. Am. Chem. Soc. **58**, 1745 **1936**.
5. Anschütz, Ann. **235**, 150 **1886**.
6. Arbusov, A. J., and I. A. Arbusov, J. Gen. Chem. (U.S.S.R.) **2**, 388 **1932**; C.A. **27**, 974 **1933**.
7. Battegay, M., and M. Kappler, Bull. soc. chim. [4] **35**, 989 **1924**.
8. Bergmann, E., Ber. **63**, 1037 **1930**.
9. Bergmann, E., Ber. **63**, 1617 **1930**.
10. Bergmann, E., J. Chem Soc. **1936**, 412.
11. Biltz, H., Ann. **296**, 219 **1897**.
12. Biltz, H., Ber. **26**, 1952 **1893**.
13. Binaghi, R., Gazz. chim. ital. **52**, II, 132 **1922**.
14. Binaghi, R., Gazz. chim. ital. **57**, 669 **1927**.
15. Blicke, F. F., and J. F. Oneto, J. Am. Chem. Soc. **57**, 749 **1935**.

16. Blum-Bergmann, O., Ann. **484**, 26 **1930**.
17. Böeseken, J., and M. C. Bastet, Rec. trav. chim. **32**, 184 **1913**.
18. Busch, M., and M. Fleischmann, Ber. **43**, 740 **1910**.
19. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 **1936**.
20. Castaldi, C., Gazz. chim. ital. **50**, I, 71 **1920**.
21. Darapsky, A., J. prakt. Chem. [2] **67**, 164 **1903**.
22. Drew, H. D. K., and J. K. Landquist, J. Chem. Soc. **1935**, 1480.
23. Engler, C., Ber. **11**, 926 **1878**.
24. Friedel, C., and J. M. Crafts, Ann. chim. phys. [6] **1**, 449 **1884**.
25. Gomberg, M., and H. W. Berger, Ber. **36**, 1088 **1903**.
26. Gomberg, M., and L. H. Cone, Ber. **39**, 1461 **1906**.
27. Gomberg, M., and L. H. Cone, Ber. **39**, 2957 **1906**.
28. Gomberg, M., and J. C. Pernert, J. Am. Chem. Soc. **48**, 1372 **1926**.
29. Graebe, C., Ber. **8**, 1054 **1875**.
30. Grignard, V., and K. Ono, Bull. soc. chim. [4] **39**, 1589 **1926**.
31. Hintze, C., Z. Krist. Mineral. **9**, 536 **1884**.
32. Ipatieff, V. N., and B. N. Dolgov, Bull. soc. chim. **41**, 1621 **1927**.
33. Kenner, J., and R. L. Wain, Ber. **72**, 456 **1939**.
34. Kliegl, A., Ber. **62**, 1327 **1929**.
35. Klinger, H., and C. Lonnes, Ber. **29**, 2158 **1896**.
36. Knoevenagel, E., and J. Arndts, Ber. **35**, 1982 **1902**.
37. Kohler, E. P., Am. Chem. J., **36**, 529 **1906**.
38. Kunze-Fenchner, M., Ber. **36**, 472 **1903**.
39. Kursanov, D. N., A. S. Kursanov, and A. N. Blokhina, J. Gen. Chem. (U.S.S.R.) **8**, 1786 **1938**; C.A. **33**, 4979 **1939**.
40. Ley, H., and F. Rinke, Ber. **56**, 771 **1923**.
41. Medvedev, S. S., and E. N. Alekseeva, Ber. **65**, 137 **1932**.
42. Meyer, R., W. Meyer, and K. Taeger, Ber. **53**, 2034 **1920**.
43. Mieleitner, K., Z. Kryst. **55**, 51 **1915-1920**.
44. Montagne, P. J., Rec. trav. chim. **25**, 379 **1906**.
45. Morton, A. A., C. F. Branch, and D. B. Clapp, Am. J. Cancer **26**, 754 **1936**.
46. Nef, J. U., Ann. **298**, 202 **1897**.
47. Oddo, B., Gazz. chim. ital. **37**, II, 356 **1907**.
48. Oddo, B., Gazz. chim. ital. **38**, I, 625 **1908**.
49. Oddo, B., and R. Binaghi, Gazz. chim. ital. **51**, II, 330 **1921**.
50. Oliveri-Mandalá, E., G. Caronna, and E. Delao, Gazz. chim. ital. **68**, 327 **1938**.
51. Paterno, E., and G. Chieffli, Gazz. chim. ital. **39**, II, 415 **1909**.
52. Reychler, A., Bull. soc. chim. [3] **35**, 737 **1906**.
53. Sabatier, P., and M. Murat, Ann. chim. [9] **4**, 253 **1915**.
54. Sabatier, P., and M. Murat, Compt. rend. **157**, 1496 **1913**.
55. Sabatier, P., and M Murat, Compt. rend. **158**, 534 **1914**.
56 Schlenk, W., J. Appenrodt, A. Michael, and Thal, Ber. **47**, 473 **1914**.
57. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928**.
58. Schlenk, W., and E. Bergmann, Ann. **479**, 78 **1930**.
59. Schlenk, W., and A Herzenstein, Ber. **43**, 3541 **1910**.
60. Schlenk, W., A Herzenstein, and T. Weikel, Ann. **372**, 1 **1910**.
61. Schlenk, W., and E. Marcus, Ber. **47**, 1664 **1914**.
62. Schmidlin, J., Compt. rend. **136**, 1560 **1903**.
63. Schmidlin, J., and H. Hodgson, Ber. **41**, 430 **1908**.
64. Schröder, H., Ber. **14**, 2516 **1881**.
65. Shorygin, P., Ber. **59**, 2510 **1926**.
66. Späth, E., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **122**, Abt. IIb, 1207 **1913**.
67. Speer, J. H., and A. J. Hill, J. Org. Chem. **2**, 139 **1937-1938**.
68. Spielman, M. A., and C. W. Martenson, J. Am. Chem. Soc. **61**, 666 **1939**.

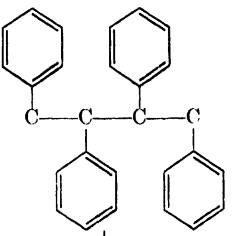
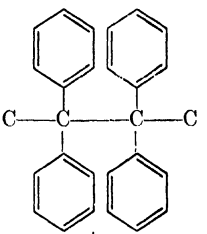
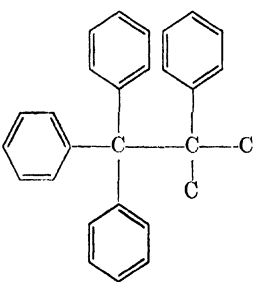
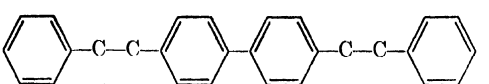
69. Stadnikov, G., Ber. **46**, 2496 **1913**.
70. Stadnikov, G., Ber. **47**, 2133 **1914**.
71. Stadnikov, G., J. prakt. Chem. [2] **88**, 1 **1913**.
72. Stadnikov, G., J. Russ. Phys. Chem. Soc. **44**, 1219 **1912**; Chem. Zentr. **1913**, I, 21.
73. Stadnikov, G. L., J. Russ. Phys. Chem. Soc. **48**, 1875 **1917**; Chem. Zentr. **1923**, III, 1408
74. Stadnikov, G., and S. Kuz'mina-Aron, J. Russ. Phys. Chem. Soc. **44**, 1247 **1912**; Chem. Zentr. **1913**, I, 21.
75. Staedel, W., Ann. **194**, 307 **1878**.
76. Tseou, H.-F., and Y.-T. Wang, J. Chinese Chem. Soc. **5**, 224 **1937**.
77. Ullman, F., and A. Münzhuber, Ber. **36**, 404 **1903**.
78. von Braun, J., and G. Manz, Ann. **468**, 258 **1929**.
79. von Meyer, E., and P. Fischer, J. prakt. Chem. [2] **82**, 521 **1910**.
80. Wieland, H., A. Hintermaier, and I. Dennstedt, Ann. **452**, 1 **1927**.
81. Wieland, H., and A. Meyer, Ann. **551**, 249 **1942**; C.A. **37**, 5048 **1942**.
82. Wieland, H., E. Popper, and H. Seefried, Ber. **55**, 1816 **1922**.
83. Wittig, G., and H. Kosack, Ann. **529**, 167 **1937**.
84. Wittig, G., and M. Leo, Ber. **63**, 943 **1930**.
85. Wolf, N., Ber. **14**, 2031 **1881**.
86. Wolff, L., Ann. **394**, 86 **1912**.
87. Zagoumennyĭ, A., Ann. **184**, 174 **1876**.
88. Zagoumennyĭ through A. Kuhlberg, Ber. **9**, 276 **1876**.
89. Zartman, W. H., and H. Adkins, J. Am. Chem. Soc. **54**, 1668 **1932**.
90. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929**.
91. Ziegler, K., and F. Thielmann, Ber. **56**, 1740 **1923**.

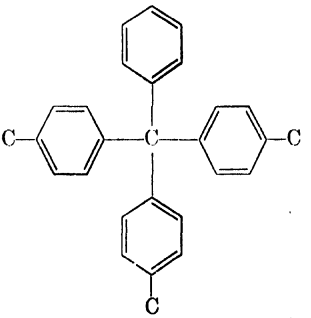
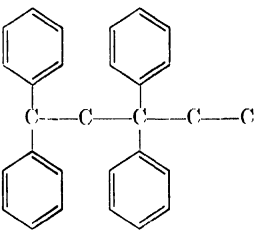
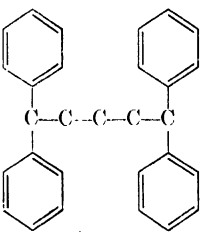
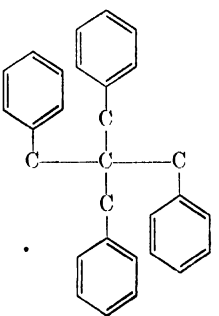
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1,3-Tetraphenylpropane**  126 [35]<br>125–126 [35] | | | | |
| **1,1,2,3-Tetraphenylpropane**  121 [20]<br>87–89 [8] | | | | |
| **1,1,3,3-Tetraphenylpropane**  139 [34]<br>135–136 [41] | | | | |
| **1,2,2,3-Tetraphenylpropane**  125–127 [45] | | | | |

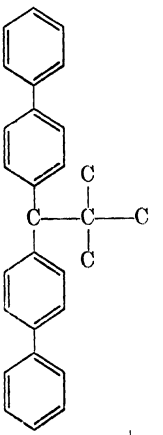
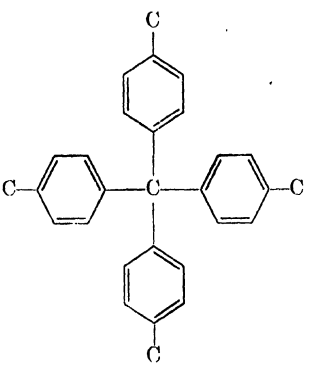
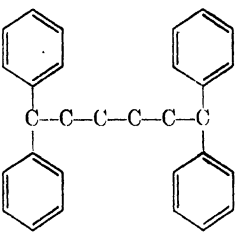
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4,4′-Dibenzyldiphenylmethane**  91.5[16] | | | | |
| **Triphenyl-3,5-dimethylphenylmethane**  154[5] | 450[5] | | | |
| **Di-*p*-tolyl-*p*-biphenylylmethane**  123–125[3] | | | | |
| $C_{28}H_{26}$ **1,1,3,3-Tetraphenylbutane**  122[7] 118[46] | | | | |

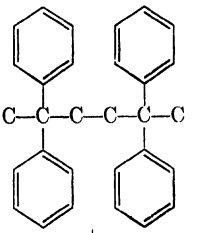
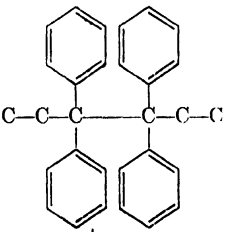
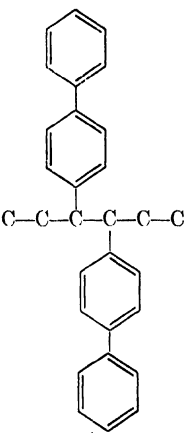
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,3,4-Tetraphenylbutane**  | 270–273 21 [25] | | | |
| **1,2,2,4-Tetraphenylbutane**  | 172 [25] | | | |
| **1,1,4,4-Tetraphenylbutane**  | **121**<br>122 [23]<br>121–122 [24]<br>121(a)<br>120 [48]<br>118–119.5 [42] | | | |

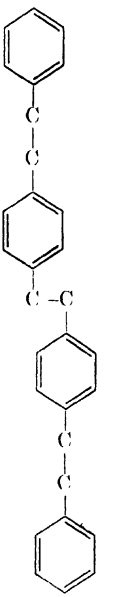
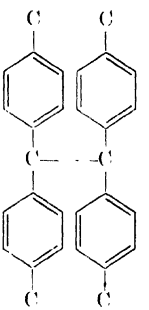
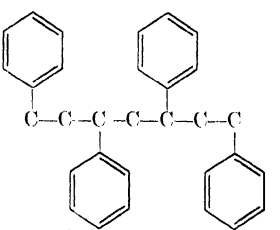
(a) The melting point 121 is found in references 9, 10, 21, 31, 32, 35, 47.

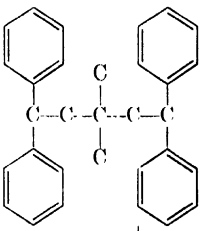
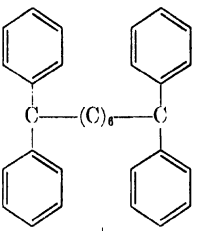
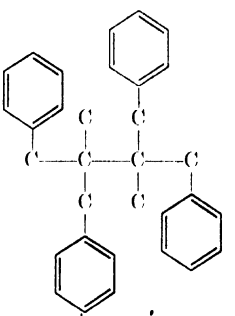
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,3,4-Tetraphenylbutane**  | | | | |
| 255 [4,17]<br>254–255 [3]<br>251.5–252.0 [29] | | | | |
| **2,2,3,3-Tetraphenylbutane**  | | | | |
| 126–127 [49] | | | | |
| **1,1,1,2-Tetraphenyl-2-methylpropane**  | | | | |
| | 272 [37] | | | |
| **4,4′-Diphenethylbiphenyl**  | | | | |
| 146 [37] | | | | |

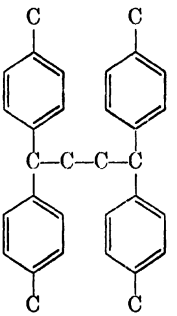
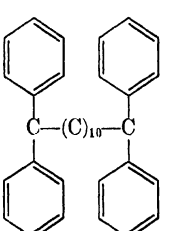
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Phenyltri-*p*-tolylmethane**  | | | | |
| 177–178 [26] | | | | |
| $C_{29}H_{28}$ **1,1,3,3-Tetraphenylpentane**  | | | | |
| 128 [46] | | | | |
| **1,1,5,5-Tetraphenylpentane**  | | | | |
| 80 [6]<br>79–80 [41] | | | | |
| **1,3-Diphenyl-2,2-dibenzylpropane**  | | | | |
| 164 [18,30] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Di-*p*-biphenylyl-2,2-dimethylpropane**  | | | | |
| 178–179[15] | | | | |
| **Tetra-*p*-tolylmethane**  | | | | |
| 132[36] | | | | |
| $C_{30}H_{30}$ | | | | |
| **1,1,6,6-Tetraphenylhexane**  | | | | |
| **125** | | | | |
| 126–127[35] | | | | |
| 124.5–126[40] | | | | |
| 124–125.5[19] | | | | |
| 124–125[33] | | | | |
| 123–124[6] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2,5,5-Tetraphenylhexane**  110[23] | | | | |
| **3,3,4,4-Tetraphenylhexane**  85-86[49] | | | | |
| **3,4-Di-*p*-biphenylylhexane**  254[13] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-(Di-4′-phenethylphenyl)-ethane**  | | | | |
| 97–98 [39] | | | | |
| **1,1,2,2-Tetra-*p*-tolylethane**  | | | | |
| 278–279 [1] | | | | |
| $C_{31}H_{32}$ | | | | |
| **1,3,5,7-Tetraphenylheptane**  | | | | |
| | 260–262 3 [28] | 1.0452 25° [22] | 1.5960 [22] | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,5,5-Tetraphenyl-3,3-dimethylpentane**  | | | | |
| 88–89 [41] | | | | |
| **$C_{32}H_{34}$** | | | | |
| **1,1,8,8-Tetraphenyloctane**  | | | | |
| 120–121.5 [43] | | | | |
| **Tetraphenyldipropylethane** (a) | | | | |
| 70 (in $N_2$) [50] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **Tetraphenyldiisopropylethane** (a) | | | | |
| 140–141 (in $N_2$) [50] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **1,4-Diphenyl-2,3-dimethyl-2,3-dibenzylbutane**  | | | | |
| 171 [30] | | | | |

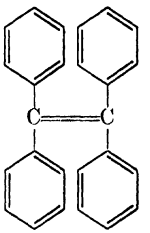
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,4,4-Tetra-*p*-tolylbutane**  | | | | |
| 126[11,13] | | | | |
| **$C_{34}H_{38}$** | | | | |
| **Tetraphenyldibutylethane** (a) | | | | |
| 67–68 (in $N_2$)[50] | | | | |
| 62–63[50] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **Tetraphenyldi-*tert*-butylethane** (a) | | | | |
| 138–141 (in $N_2$)[14] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **$C_{36}H_{42}$** | | | | |
| **1,1,12,12-Tetraphenyldodecane**  | | | | |
| 74–75[44] | | | | |

References on $C_{27}H_{24}$-$C_{36}H_{42}$ Compounds


1. Bachmann, W. E., J. Am. Chem. Soc. **55**, 3837 1933.
2. Bachmann, W. E., and F. H. Moser, J. Am. Chem. Soc. **54**, 1124 1932.
3. Bacon, R. F., Am. Chem. J., **33**, 68 1905.
4. Bacon, R. F., Philippine J. Sci. **4A**, 166 1909.
5. Battegay, M., and M. Kappler, Bull. soc. chim. [4] **35**, 989 1924.

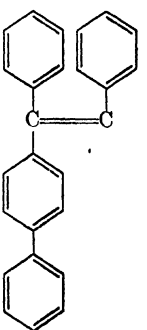
6. Bauer, K. H., and H. Herzog, J. prakt. Chem. [2] **147**, 4 **1936**.
7. Bergmann, E., and H. Weiss, Ann. **480**, 49 **1930**.
8. Bergmann, E., and H. Weiss, Ber. **64**, 1485 **1931**.
9. Brand, K., Ber. **54**, 1987 **1921**.
10. Brand, K., Z. Elektrochem. **16**, 669 **1910**.
11. Brand, K., and M. Matsui, Ber. **46**, 2942 **1913**.
12. Brand, K., and G. Wendel, J. prakt. Chem. [2] **115**, 335 **1927**.
13. Campbell, N. R., and F. W. Chattaway, Proc. Roy. Soc. (London) **130B**, 435 **1942**.
14. Conant, J. B., and N. M. Bigelow, J. Am. Chem. Soc. **50**, 2041 **1928**.
15. Conant, J. B., and R. F. Schultz, J. Am. Chem. Soc. **55**, 2098 **1933**.
16. Connerade, E., Bull. soc. chim. Belg. **44**, 411 **1935**.
17. Fromm, E., and O. Achert, Ber. **36**, 534 **1903**.
18. Hill, G. A., and A. J. Cofrancesco, J. Am. Chem. Soc. **57**, 2426 **1935**.
19. Koelsch, C. F., and H. J. Richter, J. Org. Chem. **3**, 473 **1938**.
20. Kohler, E. P., and W. E. Mydans, J. Am. Chem. Soc. **54**, 4667 **1932**.
21. Purdie, T., and P. S. Arup, J. Chem. Soc. **97**, 1537 **1910**.
22. Riedinger, A., Physik. Z. **39**, 380 **1938**.
23. Schlenk, W., J. Appenrodt, A. Michael, and Thal, Ber. **47**, 473 **1914**.
24. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928**.
25. Schlenk, W., and E. Bergmann, Ann. **479**, 78 **1930**.
26. Schoepfle, C. S., and S. G. Trepp, J. Am. Chem. Soc. **58**, 791 **1936**.
27. Speer, J. H., and A. J. Hill, J. Org. Chem. **2**, 139 **1937-1938**.
28. Staudinger, H., and A. Steinhofer, Ann. **517**, 54 **1935**.
29. Szperl, L., and M. Gradstein, Roczniki Chem. **12**, 478 **1932**; C.A. **28**, 123 **1934**; Chem. Zentr. **1932**, II, 3393.
30. Trotman, E. R., J. Chem. Soc. **127**, 88 **1925**.
31. Valeur, A., Bull. soc. chim. [3] **29**, 683 **1903**.
32. Valeur, A., Compt. rend. **136**, 694 **1903**.
33. Vorländer, D., E. Rack, and W. Leister, Ber. **56**, 1131 **1923**.
34. Vorländer, D., and C. Siebert, Ber. **39**, 1024 **1906**.
35. Wieland, H., and H. Kloss, Ann. **470**, 201 **1929**.
36. Wieland, H., and A. Meyer, Ann. **551**, 249 **1942**; C.A. **37**, 5048 **1942**.
37. Willgerodt, C., and S. Schiff, J. prakt. Chem. [2] **41**, 515 **1890**.
38. Wittig, G., and A. Klein, Ber. **69**, 2087 **1936**.
39. Wittig, G., and M. Leo, Ber. **61**, 854 **1928**.
40. Wittig, G., and M. Leo, Ber. **63**, 943 **1930**.
41. Wittig, G., and B. Obermann, Ber. **67**, 2053 **1934**.
42. Wittig, G., and F. von Lupin, Ber. **61**, 1627 **1928**.
43. Wittig, G., and G. Waltnitzki, Ber. **67**, 667 **1934**.
44. Wittig, G., and R. Wietbrock, Ann. **529**, 162 **1937**.
45. Wooster, C. B., and J. F. Ryan, J. Am. Chem. Soc. **54**, 2419 **1932**.
46. Wooster, C. B., and J. F. Ryan, J. Am. Chem. Soc. **56**, 1133 **1934**.
47. Zalkind, Y., and A. Kruglov, Ber. **61**, 2306 **1928**.
48. Ziegler, K., and O. Schäfer, Ann. **479**, 150 **1930**.
49. Ziegler, K., and B. Schnell, Ann. **437**, 227 **1924**.
50. Ziegler, K., A. Seib, F. Knövenagel, P. Herte, and F. Andreas, Ann. **551**, 150 **1942**; C.A. **37**, 5388 **1943**.

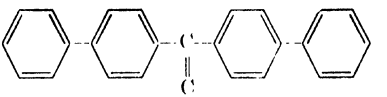
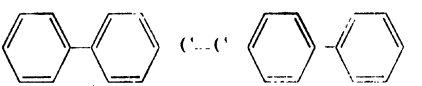
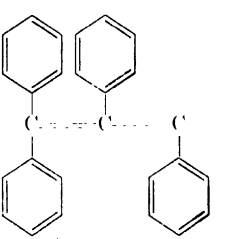
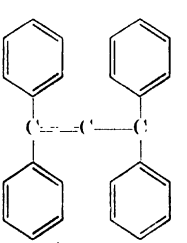
2. FOUR PHENYL, TWO PHENYL AND ONE BIPHENYLYL, OR TWO BIPHENYLYL SUBSTITUTIONS ON ALKENES, $C_nH_{2n-32}$

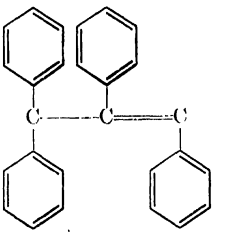
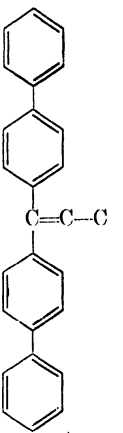
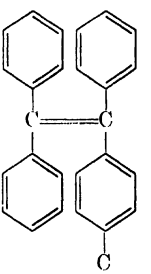
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tetraphenylethene**  | | | | |
| **222.4** | | | | |
| 225 [87] | 425 [19] | 1.155 0° [83] | | |
| 224.6–224.9 [63] | | | | |
| 223.5–224.5 [9,28] | | | | |
| 224 [43] | | | | |
| 223–224 [34,58] | | | | |
| 222.8 [50] | | | | |
| 222 [4,6,54] | | | | |
| 221–222 [75,78,80] | | | | |
| 220–222 [48] | | | | |
| 221(a) | | | | |
| 220–221 [5,41,49] | | | | |
| 219–221 [10] | | | | |
| 220(b) | | | | |
| 219 [20,51,57] | | | | |

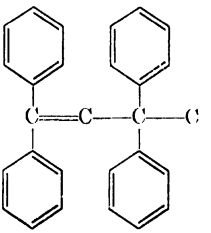
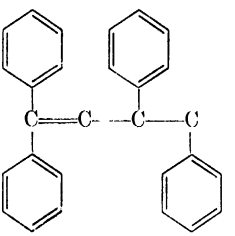
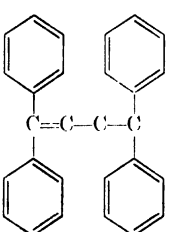
(a) The melting point 221 is found in references 1, 2, 15, 16, 19, 21, 24, 26, 27, 38, 39, 40, 42, 44, 46, 47, 60, 64, 66, 69, 73, 77, 81.

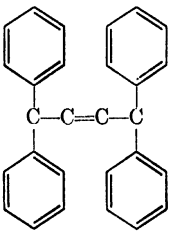
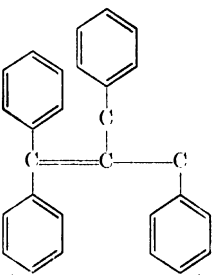
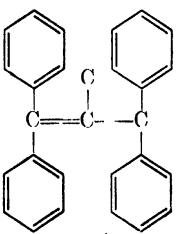
(b) The melting point 220 is found in references 17, 18, 22, 53, 59, 65, 68.

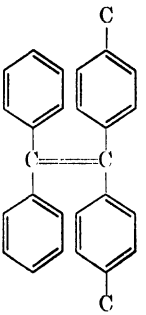
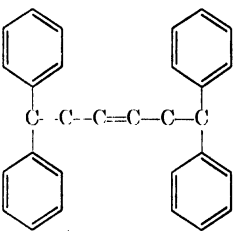
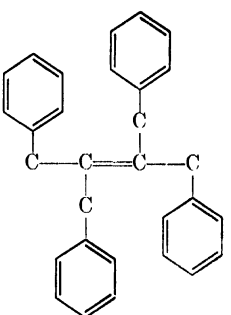
| | | | | |
|---|---|---|---|---|
| **1,2-Diphenyl-1-*p*-biphenylylethene**  | | | | |
| **134–135** [55] | | | | |

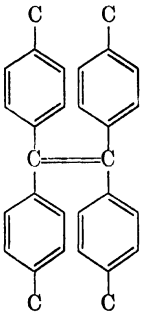
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Di-*p*-biphenylylethene**  | | | | |
| 211 [52,54]<br>204–205.5 [79] | | | | |
| **1,2-Di-*p*-biphenylylethene**  | | | | |
| 198.5–200 [62] | | | | |
| $C_{27}H_{22}$ | | | | |
| **1,1,2,3-Tetraphenylpropene-1**  | | | | |
| 142 [8]<br>139 [15] | | | | |
| **1,1,3,3-Tetraphenylpropene-1**  | | | | |
| 127 | | | | |
| 128–129 [82]<br>127–128 [72,84]<br>126–127 [12]<br>125–127 [70]<br>125 [54]<br>124 [7] | | 1.135 | 0° [83] | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,3-Tetraphenylpropene-2**  | | | | |
| 131 [8] | | | | |
| **1,1-Di-*p*-biphenylylpropene-1**  | | | | |
| 165–166 [52] | | | | |
| **1,1,2-Triphenyl-2-*p*-tolylethene**  | | | | |
| 153 [68] | | | | |
| 150–151 [29] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,3,3-Tetraphenylbutene-1**  | | | | |
| 113.5[35,36]<br>113[7]<br>112[25]<br>111[54] | | | | |
| **1,1,3,4-Tetraphenylbutene-1**  | | | | |
| 63[56] | 270–275 19[56]<br>260–265 14[56] | | | |
| **1,1,2,3-Tetraphenylbutene** (a) | | | | |
| 104–106[38] | | | | |
| (a) The position of the double bond is not given. | | | | |
| **1,1,4,4-Tetraphenylbutene-1**  | | | | |
| 97–98[76] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,4,4-Tetraphenylbutene-2**  | | | | |
| 140–141(a) [11]<br>140.5(a) [54]<br>139–140 [31]<br>132–133 [79]<br>126.5–127.5(a) [11]<br>123–124(a) [54] | | | | |
| (a) These melting points represent two different isomers. | | | | |
| **Distilbene** (a) | | | | |
| 163 [14]<br>118–119 [74] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **1,1,3-Triphenyl-2-benzylpropene-1**  | | | | |
| 78 [54] | | | | |
| **1,1,3,3-Tetraphenyl-2-methylpropene-1**  | | | | |
| 132–133 [88] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,1-Diphenyl-2,2-di-*p*-tolylethene  | | | | |
| 161 [6] | | | | |
| $C_{30}H_{28}$ | | | | |
| 1,1,6,6-Tetraphenylhexene-3  | | | | |
| 79–80 [30] | | | | |
| 1,4-Diphenyl-2,3-dibenzylbutene-2  | | | | |
| | 304 [43] | | | |

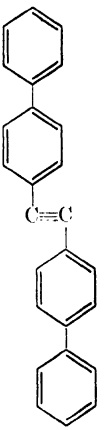
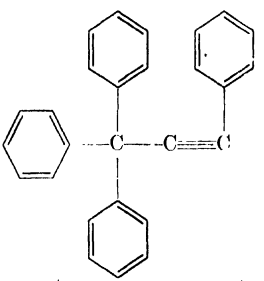
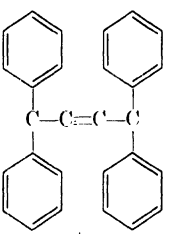
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tetra-*p*-tolylethene**  | | | | |
| 151 [23,67]<br>142 [8] | | | | |
| **Tetratolyethene** (a) | | | | |
| 215 [61] | | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{32}H_{32}$<br>**1,1,4,4-Tetratolylbutene** (a) | | | | |
| 151 [13] | | | | |
| (a) The double bond is in either the 1 or the 2 position. | | | | |
| $C_{34}H_{36}$<br>**Tetradimethylphenylethene** (a) | | | | |
| 244–245 [61] | | | | |
| (a) The structure of this compound is not given. | | | | |

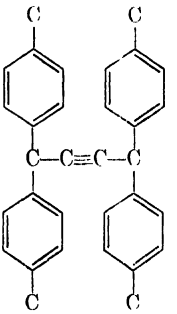
**References on Four Phenyl, Two Phenyl and One Biphenylyl, or Two Biphenylyl Substitutions on Alkenes**


1. Anschütz, R., Ann. **235**, 150 **1886.**
2. Anschütz, R., and J. Klein, Ber. **17**, 1039 **1884.**
3. Bachmann, W. E., J. Am. Chem. Soc. **55**, 3837 **1933.**
4. Bacon, R. F., Am. Chem. J. **33**, 68 **1905.**
5. Bent, H. E., and N. B. Keevil, J. Am. Chem. Soc. **58**, 1367 **1936.**
6. Bergmann, E., and D. Wagenberg, Ber. **63**, 2585 **1930.**
7. Bergmann, E., and H. Weiss, Ann. **480**, 49 **1930.**
8. Bergmann, E., and H. Weiss, Ber. **64**, 1485 **1931.**

9. Biltz, H., Ann. **296**, 219 1897.
10. Blicke, F. F., and J. F. Oneto, J. Am. Chem. Soc. **57**, 749 1935.
11. Blum, O., Ber. **62**, 881 1929.
12. Blum-Bergmann, O., Ann. **484**, 26 1930.
13. Brand, K., and G. Wendel, J. prakt. Chem. [2] **115**, 335 1927.
14. Ciamician, G., and P. Silber, Ber. **35**, 4128 1902.
15. Clar, E., Ber. **72**, 1645 1939.
16. Cone, L. H., and C. S. Robinson, Ber. **40**, 2160 1907.
17. DeBoissieu, P., Bull. soc. chim. [2] **49**, 681 1888.
18. Delacre, M., Bull. soc. chim. [4] **5**, 1144 1909.
19. Eichelberger, W. C., J. Am. Chem. Soc. **53**, 2025 1931.
20. Finkelstein, H., Ber. **43**, 1528 1910.
21. Gardeur, A., Bull. classe sci. Acad. roy. Belg. [3] **34**, 920 1898.
22. Gilliland, W. L., and A. A. Blanchard, J. Am. Chem. Soc. **48**, 410 1926.
23. Gilman, H., and F. B. Flick, Rec. trav. chim. **48**, 461 1929.
24. Hanriot, M., and O. Saint-Pierre, Bull. soc. chim. [3] **1**, 774 1889.
25. Hildebrand, Thesis, Strassburg, 1909, 27; Beil. **5**, 377 1930.
26. Hintze, C., Z. Kryst. Mineral **9**, 536 1884.
27. Hurd, C. D., R. Christ, and C. L. Thomas, J. Am. Chem. Soc. **55**, 2589 1933.
28. Kliegl, A., Ber. **64**, 2420 1931.
29. Koelsch, C. F., J. Am. Chem. Soc. **54**, 2049 1932.
30. Koelsch, C. F., and H. J. Richter, J. Org. Chem. **3**, 473 1938.
31. Koelsch, C. F., and R. H. Rosenwald, J. Am. Chem. Soc. **59**, 2170 1937.
32. Koelsch, C. F., and R. V. White, J. Am. Chem. Soc. **65**, 1639 1943.
33. Kohler, E. P., and E. M. Nygaard, J. Am. Chem. Soc. **52**, 4128 1930.
34. Kursanov, D. N., J. Russ. Phys. Chem. Soc. **60**, 921 1928; C.A. **23**, 2171 1929; Chem. Zentr. **1929**, I, 997.
35. Lebedev, S. V., J. Russ. Phys. Chem. Soc. **54**, 223 1922; Chem. Zentr. 1923, III, 1014.
36. Lebedev, S. V., I. Andreevskiĭ, and A. Matyushkina, Ber **56**, 2349 1923.
37. Lettre, H., H. Barnbeck, and W. Lege, Ber. **69**, 1151 1936.
38. Ley, H., and U. Kirchner, Z. anorg. allgem. Chem. **173**, 395 1928.
39. Ley, H., and F. Rinke, Ber. **56**, 771 1923.
40. Lohse, O., Ber. **29**, 1789 1896.
41. MacKenzie, J. E., J. Chem. Soc. **121**, 1695 1922.
42. Magidson, O. I., Ber. **58**, 433 1925.
43. Manchot, W., and P. Krische, Ann. **337**, 170 1904.
44. Maxim, N., and R. Mavrodineaunu, Bull. soc. chim. [5] **3**, 1084 1936.
45. Meisenheimer, J., Ann. **456**, 126 1927.
46. Müller, E., and I. Dammerau, Ber. **70**, 2561 1937.
47. Nef, J. V., Ann. **298**, 202 1897.
48. Norris, J. F., R. Thomas, and B. M. Brown, Ber. **43**, 2940 1910.
49. Orekhov, A., Bull. soc. chim. [4] **25**, 186 1919.
50. Pascal, P., and L. Normand, Bull. soc. chim. [4] **13**, 878 1913.
51. Paterno, E., and G. Chieffli, Gazz. chim. ital. **39**, II, 415 1909.
52. Pfeiffer, P., and P. Schneider, J. prakt. Chem. [2] **129**, 129 1931.
53. Sabatier, P., and A. Mailhe, Compt. rend. **153**, 1204 1911.
54. Schlenk, W., and E. Bergmann, Ann. **463**, 1 1928.
55. Schlenk, W., and E. Bergmann, Ann. **464**, 1 1928.
56. Schlenk, W., and E. Bergmann, Ann. **479**, 78 1930.
57. Schlenk, W., and A. Herzenstein, Ber. **43**, 3541 1910.
58. Schmidlin, J., Ber. **39**, 4198 1906.
59. Schönberg, A., A. Stephenson, H. Kaltschmitt, E. Peterson, and H. Schulten, Ber. **66**, 237 1933.
60. Schönberg, A., and T. Stolpp, Ann. **483**, 90 1930.
61. Schwartz, H., Ber. **14**, 1516 1881.

62. Shilov, E. A., and F. K. Yudin, J. Gen. Chem. (U.S.S.R.) 9, 167 1939; C.A. 33, 6283 1939.
63. Smith, R. H., and D. H. Andrews, J. Am. Chem. Soc. 53, 3644 1931.
64. Städel, W., Ann. 194, 307 1878.
65. Städel, W., Ber. 9, 562 1876.
66. Staudinger, H., Ber. 39, 3062 1906.
67. Staudinger, H., and J. Goldstein, Ber. 49, 1923 1916.
68. Staudinger, H., and N. Kon, Ann. 384, 38 1911.
69. Steinkopf, W., and A. Wolfram, Ann. 430, 113 1923.
70. Straus, F., and M. Ehrenstein, Ann. 442, 93 1925.
71. Vorländer, D., and C. Siebert, Ber. 39, 1024 1906.
72. Vorländer, D., and P. Weinstein, Ber. 56, 1122 1923.
73. Wieland, H., Ber. 44, 2550 1911.
74. Wieland, H., and E. Dorrer, Ber. 63, 404 1930.
75. Wieland, H., and B. Rosenfeld, Ann. 484, 236 1930.
76. Wittig, G., Ber. 64, 437 1931.
77. Wittig, G., and H. Kröhne, Ann. 529, 142 1937.
78. Wittig, G., and B. Obermann, Ber. 67, 2053 1934.
79. Wittig, G., and F. vonLupin, Ber. 61, 1627 1928.
80. Zartman, W. H., and H. Adkins, J. Am. Chem. Soc. 54, 1668 1932.
81. Ziegler, J. H., Ber. 21, 779 1888.
82. Ziegler, K., Ann. 434, 34 1923.
83. Ziegler, K., and F. Ditzel, Ann. 473, 194 1929.
84. Ziegler, K., and F. Thielman, Ber. 56, 1740 1923.

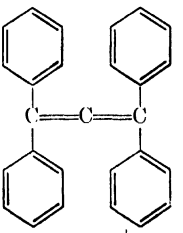
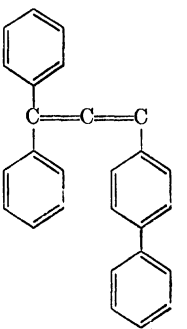
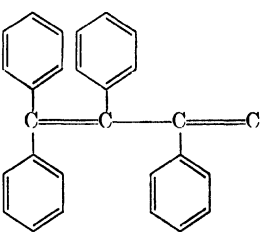
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Di-*p*-biphenylylethyne**  | | | | |
| 243–244 [4] | | | | |
| $C_{27}H_{20}$ | | | | |
| **1,1,1,3-Tetraphenylpropyne-2**  | | | | |
| 139 [5] | | | | |
| $C_{28}H_{22}$ | | | | |
| **1,1,4,4-Tetraphenylbutyne-2**  | | | | |
| 116 [1]<br>114–115 [2]<br>114 [5] | | | | |

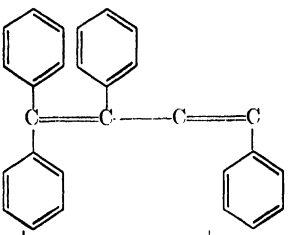
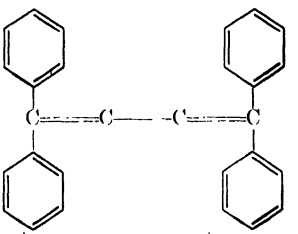
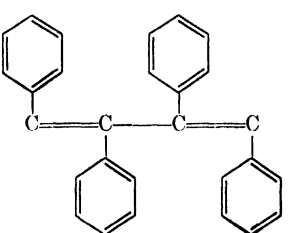
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Phenyltri-*p*-tolylpropyne** (a) | | | | |
| 141 [5] | | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{32}H_{30}$ | | | | |
| **1,1,4,4-Tetra-*p*-tolylbutyne-2**  | | | | |
| 123 [3] | | | | |

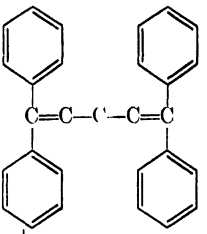
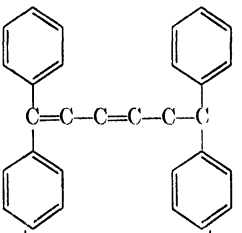
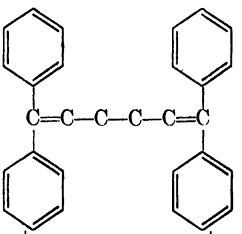
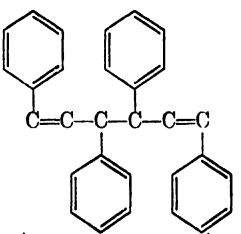
### References on Four Phenyl or Two Biphenylyl Substitutions on Alkynes

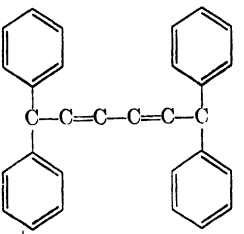
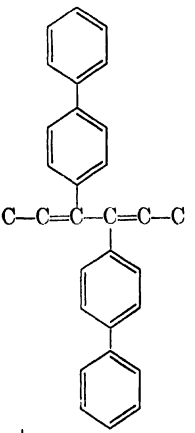
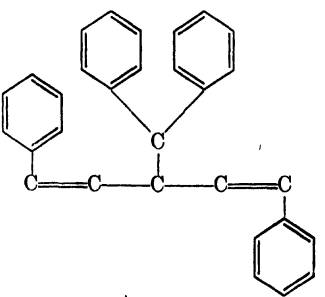

1. Brand, K., Ber. **54**, 1987 1921.
2. Brand, K., Z. Elektrochem. **16**, 669 1910.
3. Brand, K., and G. Wendel, J. prakt. Chem. [2] **115**, 335 1927.
4. Coleman, G. H., and R. D. Maxwell, J. Am. Chem. Soc. **56**, 132 1934.
5. Wieland, H., and H. Kloss, Ann. **470**, 201 1929.

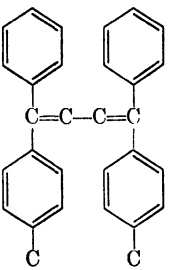
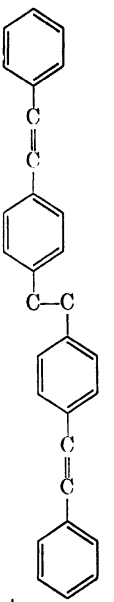
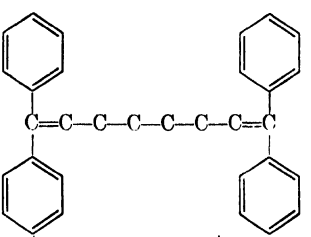
4. FOUR PHENYL OR TWO BIPHENYLYL SUBSTITUTIONS ON ALKADIENES, $C_nH_{2n-34}$

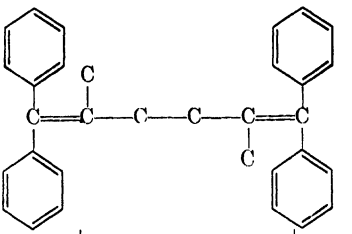
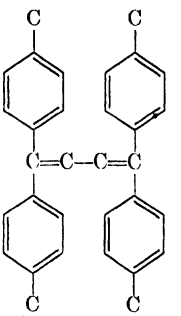
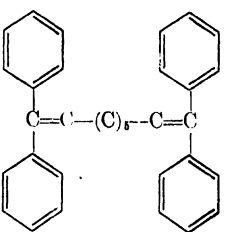
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tetraphenylpropadiene**  | | | | |
| 165 | | | | |
| 166 [25]<br>165 [27]<br>164–165 [7,23,30]<br>164 [23,40] | | | | |
| **1,1-Diphenyl-3-*p*-biphenylylpropadiene**  | | | | |
| 139–140 [4] | | | | |
| $C_{28}H_{22}$ | | | | |
| **1,1,2,3-Tetraphenylbutadiene-1,3**  | | | | |
| 118.5–120 [17] | | | | |

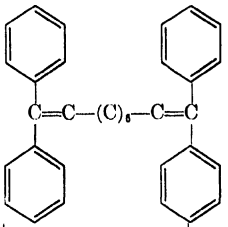
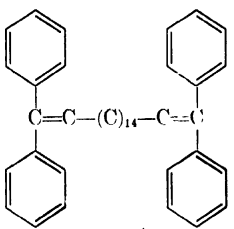
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,4-Tetraphenylbutadiene-1,3**  | | | | |
| 148–149[5]<br>146–148[26] | | | | |
| **1,1,4,4-Tetraphenylbutadiene-1,3**  | | | | |
| **202.6**<br>205–206[19]<br>203–204[20,24]<br>202[1,8,9,28,29,31]<br>201–202[18]<br>201[38]<br>200–201[6]<br>200[23,32] | | | | |
| **1,2,3,4-Tetraphenylbutadiene-1,3**  | | | | |
| 183–184[21] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{30}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,1,5,5-Tetraphenylpentadiene-1,4  | | | | |
| 76–77 [36] | | | | |
| $C_{30}H_{26}$ | | | | |
| 1,1,6,6,-Tetraphenylhexadiene-1,3  | | | | |
| 196–197 [16] | | | | |
| 1,1,6,6-Tetraphenylhexadiene-1,5  | | | | |
| 108–109 [3]<br>108 [8,34] | | | | |
| 1,3,4,6-Tetraphenylhexadiene-1,5  | | | | |
| 137–138 [5] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,1,6,6-Tetraphenylhexadiene-2,4  148–149 [33] | | | | |
| 3,4-Di-*p*-biphenylylhexadiene-2,4  151 [13] | | | | |
| 1,5-Diphenyl-3-benzhydrylpentadiene-1,4  151–152 [28] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diphenyl-1,4-di-*p*-tolylbutadiene-1,3**  | | | | |
| 207–210[15] | | | | |
| **1,2-Di-*p*-phenethenylphenylethane**  | | | | |
| 117–119[35] | | | | |
| **$C_{32}H_{30}$** | | | | |
| **1,1,8,8-Tetraphenyloctadiene-1,7**  | | | | |
| 92–93[3,13,14,39] | | | | |

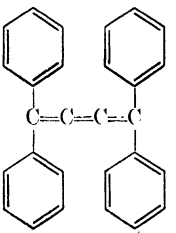
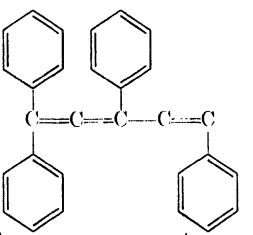
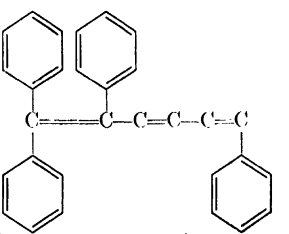
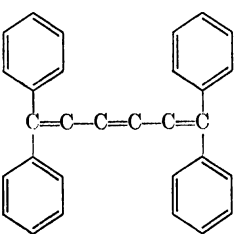
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,1,6,6-Tetraphenyl-2,5-dimethylhexadiene-1,5  | | | | |
| 145–146[37] | | | | |
| 1,1,4,4-Tetra-*p*-tolylbutadiene-1,3  | | | | |
| 255[10,11] | | | | |
| $C_{33}H_{32}$ | | | | |
| 1,1,9,9-Tetraphenylnonadiene-1,8  | | | | |
| | 310 | $20^{13,14}$ | 1.047[14] | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,10,10-Tetraphenyldecadiene-1,9**  | | | | |
| 113[24] 107[13,14] | | | | |
| $C_{42}H_{50}$ | | | | |
| **1,1,18,18-Tetraphenyloctadecadiene-1,17**  | | | | |
| 77[24] | | | | |

**References on Four Phenyl or Two Biphenylyl Substitutions on Alkadienes**


1. Arbusov, G., J. Russ. Phys. Chem. Soc. **53**, 293 **1921**; Chem. Zentr. **1923**, III, 1015.
2. Bauer, K. H., and H. Herzog, J, prakt. Chem. [2] **147**, 4 **1936**.
3. Bergmann, E., Ber. **63**, 2593 **1930**.
4. Bergmann, E., H. Hoffman, and H. Meyer, J. prakt. Chem. [2] **135**, 245 **1932**.
5. Bergmann, E., and T. Ukai, Ber. **66**, 54 **1933**.
6. Blum, O , Ber. **62**, 881 **1929**.
7. Blum-Bergmann, O., Ann. **484**, 26 **1930**.
8. Bouvet, M., Bull. soc. chim. [4] **17**, 202 **1915**.
9. Brand, K., Ber. **54**, 1987 **1921**.
10. Brand, K., and M. Matsui, Ber. **46**, 2942 **1913**.
11. Brand, K., and G. Wendel, J. prakt. Chem. [2] **115**, 335 **1927**.
12. Campbell, N. R., and F. W. Chattaway, Proc. Roy. Soc. (London) **130B**, 435 **1942**.
13. Godchot, M., Bull. soc. chim. [4] **29**, 66 **1921**.
14. Godchot, M., Compt. rend. **171**, 797 **1920**.
15. Hurd, C. D., and C. N. Webb, J. Am. Chem. Soc. **49**, 546 **1927**.
16. Koelsch, C. F., and H. J. Richter, J. Org. Chem. **3**, 473 **1938**.
17. Koelsch, C. F., and R. V. White, J. Org. Chem. **6**, 602 **1941**.
18. Kuhn, R., and K. Wallenfels, Ber. **71**, 1889 **1938**.
19. Lipp, P., Ber. **56**, 567 **1923**.
20. Müller, E., and I. Dammerau, Ber. **70**, 2561 **1937**.
21. Orekhov, A., Ber. **47**, 89 **1914**.
22. Reynolds, G. P., Am. Chem. J. **44**, 305 **1910**.

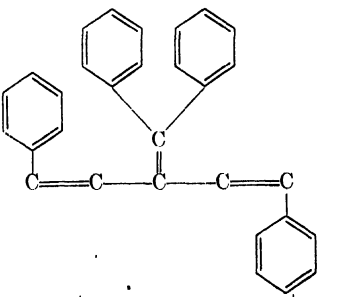
23. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928.**
24. Schmidt, A. W., and C. Hartmann, Ber. **74**, 1325 **1941.**
25. Smedley, I., J. Chem. Soc. **97**, 1484 **1910.**
26. Staudinger, H., Ber. **42**, 4249 **1909.**
27. Staudinger, H., and P. Meyer, Helv. Chim. Acta **5**, 656 **1922.**
28. Valeur, A., Bull. soc. chim. [3] **29**, 683 **1903.**
29. Valeur, A., Compt. rend. **136**, 694 **1903.**
30. Vorländer, D., and C. Siebert, Ber. **39**, 1024 **1906.**
31. Whitby, G. S., and W. Gallay, Can. J. Research **6**, 280 **1932.**
32. Wittig, G., Ber. **64**, 437 **1931.**
33. Wittig, G., and A. Klein, Ber. **69**, 2087 **1936.**
34. Wittig, G., and H. Kröhne, Ann. **529**, 142 **1937.**
35. Wittig, G., and M. Leo, Ber. **61**, 854 **1928.**
36. Wittig, G., and B. Obermann, Ber. **68**, 2214 **1935.**
37. Wittig, G., and H. Pook, Ber. **70**, 2485 **1937.**
38. Wittig, G., and F. von Lupin, Ber. **61**, 1627 **1928.**
39. Wittig, G., and G. Waltnitzski, Ber. **67**, 667 **1934.**
40. Ziegler, K., Ann. **434**, 34 **1923.**

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tetraphenylbutatriene**  | | | | |
| 237 | | | | |
| 240[1,2] | | | | |
| 237[9] | | | | |
| 236.5–237[8] | | | | |
| 235[16,17] | | | | |
| $C_{29}H_{22}$ | | | | |
| **1,1,3,5-Tetraphenylpentatriene-1,2,4**  | | | | |
| 158[6] | | | | |
| $C_{30}H_{24}$ | | | | |
| **1,1,2,6-Tetraphenylhexatriene-1,3,5**  | | | | |
| 158–160[12] | | | | |
| **1,1,6,6-Tetraphenylhexatriene-1,3,5**  | | | | |
| 206–207[9] | | | | |
| 204–205[10,15] | | | | |
| 202–204[14] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,6,6-Tetraphenylhexatriene** (a) | | | | |
| 172–174 [5] | | | | |

(a) The position of the double bonds in not given.

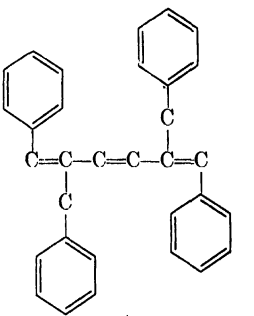
**1,5-Diphenyl-3-benzhydrylidenepentadiene-1,4**



| | | | | |
|---|---|---|---|---|
| 173–174 [11] | | | | |

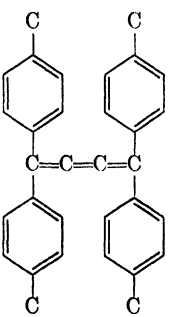
**$C_{32}H_{28}$**

**1,6-Diphenyl-2,5-dibenzylhexatriene-1,3,5**



| | | | | |
|---|---|---|---|---|
| 184 [13] | | | | |

**Tetra-*p*-tolylbutatriene**



| | | | | |
|---|---|---|---|---|
| 242 [4]<br>240 [3,7] | | | | |

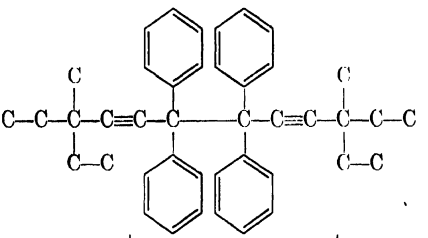
## References on Four Phenyl Substitutions on Alkatrienes


1. Brand, K., Ber. **54**, 1987 **1921**.
2. Brand, K., Ber. **54**, 2017 **1921**.
3. Brand, K., and O. Horn, J. prakt. Chem. [2] **115**, 351 **1927**.
4. Brand, K., and G. Wendel, J. prakt. Chem. [2] **115**, 335 **1927**.
5. Koelsch, C. F., and H. J. Richter, J. Org. Chem. **3**, 473 **1938**.
6. Kohler, E. P., and F. R. Butler, J. Am. Chem. Soc. **48**, 1036 **1926**.
7. Kuhn. R., and G. Platzer, Ber. **73**, 1410 **1940**.
8. Kuhn, R., and K. Wallenfels, Ber. **71**, 783 **1938**.
9. Kuhn, R., and K. Wallenfels, Ber. **71**, 1889 **1938**.
10. Müller, E., and I. Dammerau, Ber. **70**, 2561 **1937**.
11. Staudinger, H., Ber. **41**, 1493 **1908**.
12. Staudinger, H., Ber. **42**, 4249 **1909**.
13. Weizmann, C., and F. Bergmann, J. Am. Chem. Soc. **60**, 2647 **1938**.
14. Wittig, G., and A. Klein, Ber. **69**, 2087 **1936**.
15. Wittig, G., and H. Kröhne, Ann. **529**, 142 **1937**.
16. Zalkind, Y., and A. Kruglov, Ber. **61**, 2306 **1928**.
17. Zalkind, Y., and A. Kruglov, J. Russ. Phys. Chem. Soc. **61**, 803 **1929**; C.A. **23**, 4678 **1929**.

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2,11,11-Tetramethyl-6,6,7,7-tetraphenyldodecadiyne** (a) | | | | |
| 116–118[2] | | | | |
| (a) The triple bonds are in either the 3,9 or 4,8 positions. | | | | |

$C_{42}H_{46}$

**3,10-Dimethyl-3,10-diethyl-6,6,7,7-tetraphenyldodecadiyne-4,8**

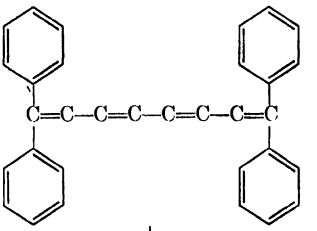
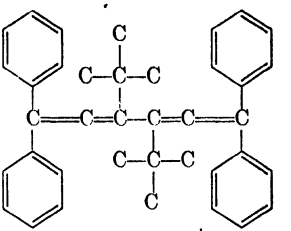


| | | | | |
|---|---|---|---|---|
| 140–142[1] | | | | |

**References on Four Phenyl Substitutions on Alkadiynes**

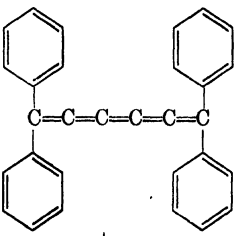
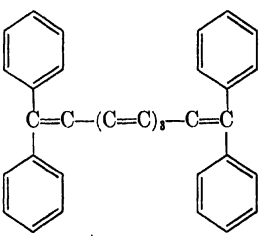
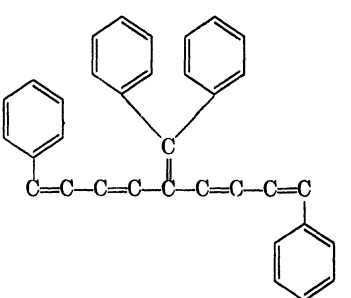
1. Harmon, J., and C. S. Marvel, J. Am. Chem. Soc. 55, 1716 1933.
2. Ozanne, I. L., and C. S. Marvel, J. Am. Chem. Soc. 52, 5267 1930.

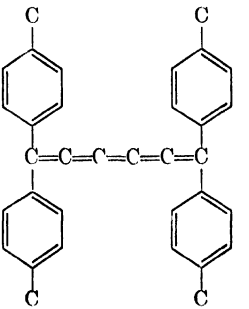
## 7. FOUR PHENYL SUBSTITUTIONS ON ALKATETRAENES, $C_nH_{2n-18}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,8,8-Tetraphenyloctatetraene-1,3,5,7**  | | | | |
| 200 [2,4]<br>198–199 [3] | | | | |
| **$C_{38}H_{38}$** | | | | |
| **1,1,6,6-Tetraphenyl-3,4-di-*tert*-butylhexatetraene-1,2,4,5**  | | | | |
| 152 [1] | | | | |

### References on Four Phenyl Substitutions on Alkatetraenes

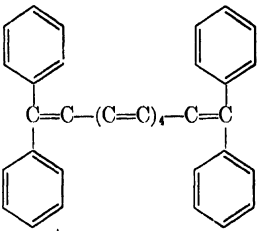

1. Farley, E. D., and C. S. Marvel, J. Am. Chem. Soc. **58**, 29 1936.
2. Müller, E., and I. Dammerau, Ber. **70**, 2561 1937.
3. Wittig, G., and A. Klein, Ber. **69**, 2087 1936.
4. Wittig, G., and H. Kröhne, Ann. **529**, 142 1937.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tetraphenylhexapentaene**  | | | | |
| 302 [2] | | | | |
| **$C_{34}H_{28}$** | | | | |
| **1,1,10,10-Tetraphenyldecapentaene-1,3,5,7,9**  | | | | |
| 227–228 [6]<br>227 [3,7] | | | | |
| **1,9-Diphenyl-5-benzhydrylidenenonatetraene-1,3,6,8**  | | | | |
| 150–151 [5]<br>149 [4] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,6,6-Tetra-*p*-tolylhexapentaene-1,2,3,4,5**  | | | | |
| 326[1] | | | | |

**References on Four Phenyl Substitutions on Alkapentaenes.**


1. Kuhn, R., and G. Platzer, Ber. **13**, 1410 **1940.**
2. Kuhn, R., and K. Wallenfels, Ber. **71**, 783 **1938.**
3. Müller, E., and I. Dammerau, Ber. **70**, 2561 **1937.**
4. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928.**
5. Staudinger, H., Ber. **41**, 1493 **1908.**
6. Wittig, G., and A. Klein, Ber. **69**, 2087 **1936.**
7. Wittig, G., and H Kröhne, Ann. **529**, 142 **1937.**

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,12,12-Tetraphenyldodecahexaene-1,3,5,7,9,11**  | | | | |
| 213–214.5[1,2] | | | | |

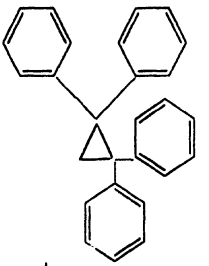
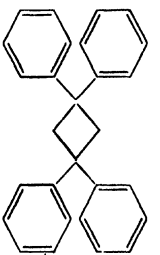
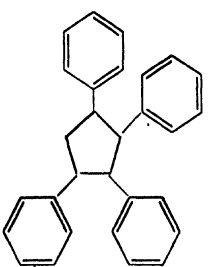
**References on Four Phenyl Substitutions on Alkahexaenes**

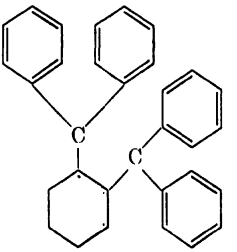
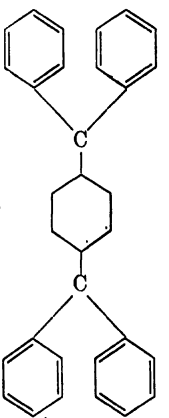
1. Wittig, G., and H. Kröhne, Ann. **529**, 142 1937.
2. Wittig, G., and R. Wietbrock, Ann. **529**, 162 1937.

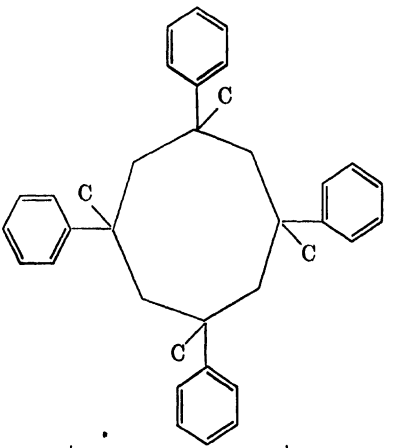
## XIV. FOUR PHENYL SUBSTITUTIONS ON ALICYCLICS

1. Four Phenyl Substitutions on Cyclanes or Cyclylalkanes $C_nH_{2n-22}$
2. Four Phenyl and Two Cyclyl Substitutions on Alkanes $C_nH_{2n-34}$
3. Four Phenyl Substitutions on Cyclodienes or Cyclodiylidenes $C_nH_{2n-36}$
4. Four Phenyl Substitutions on Cyclotrienes, Cyclodienylidenes, or Dialkenylspiranes $C_nH_{2n-38}$
5. Four Phenyl Substitutions on Cyclotetraenes or Cyclodienyldiylidenes $C_nH_{2n-40}$
6. Four Phenyl Substitutions on Dicyclenes $C_nH_{2n-40}$

1. FOUR PHENYL SUBSTITUTIONS ON CYCLANES OR CYCLYLALKANES, $C_nH_{2n-22}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,2-Tetraphenylcyclopropane**  | | | | |
| 165.5[8] | | | | |
| $C_{28}H_{24}$ | | | | |
| **1,1,3,3-Tetraphenylcyclobutane**  | | | | |
| 143.5[7] | | | | |
| 143[4,5] | | | | |
| $C_{29}H_{26}$ | | | | |
| **1,2,3,4-Tetraphenylcyclopentane**  | | | | |
| 80.5–81[2,3] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| *cis*-1,2-Dibenzhydrylcyclohexane  174–175[10] | | | | |
| *trans*-1,2-Dibenzhydrylcyclohexane 212–213[1] 210–212[10] | | | | |
| *cis*-1,4-Dibenzhydrylcyclohexane  224–225[9] | | | | |
| *trans*-1,4-Dibenzhydrylcyclohexane 248–250[9] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5,7-Tetramethyl-1,3,5,7-tetraphenylcyclo-octane**  | | | | |
| 127–129[6] | | 1.0594 (amorphous)[6]<br>1.1452 (solid)[6] | | |

**References on Four Phenyl Substitutions on Cyclanes or Cyclylalkanes**

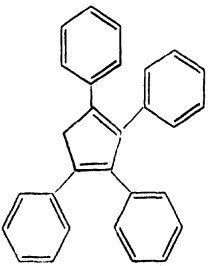
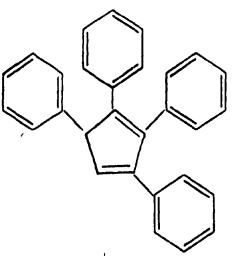
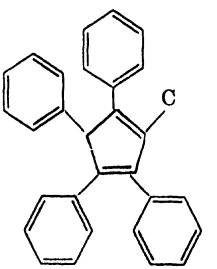
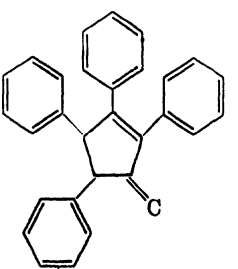

1. Bergmann, E., Ber. **63**, 2593 1930.
2. Carpenter, H., Ann. **302**, 223 1898.
3. Henderson, G. G., and R. H. Corstorphine, J. Chem. Soc. **79**, 1256 1901.
4. Lebedev, S. V., J. Russ. Phys. Chem. Soc. **54**, 223 1922; Chem. Zentr. 1923, III, 1014.
5. Lebedev, S. V., Y. Andreevskiĭ, and A. Matyushkina, Ber. **56**, 2349 1923.
6. Staudinger, H., and F. Breusch, Ber. **62**, 442 1929.
7. Wieland, H., and E. Dorrer, Ber. **63**, 404 1930.
8. Wittig, G., and B. Obermann, Ber. **67**, 2053 1934.
9. Wittig, G., and H. Pook, Ber. **70**, 2485 1937.
10. Wittig, G., and G. Waltnitzki, Ber. **67**, 667 1934.

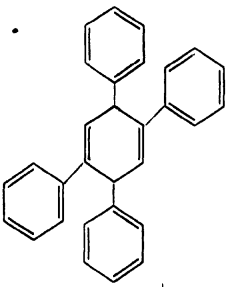
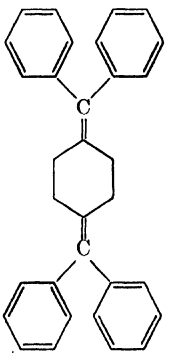
2. FOUR PHENYL AND TWO CYCLYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-34}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tetraphenyldicyclopentylethane** (a) | | | | |
| 117–119 (in $N_2$)[1] | | | | |
| 87–89[1] | | | | |
| (a) The structure of this compound is not given. | | | | |

**References on Four Phenyl and Two Cyclyl Substitutions on Alkanes**

1. Ziegler, K., A. Seib, F. Knövenagel, P. Herte, and F. Andreas, Ann. **551**, 150 **1942**; C.A. **37**, 5388 **1943**.

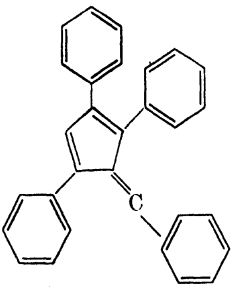
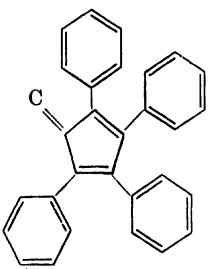
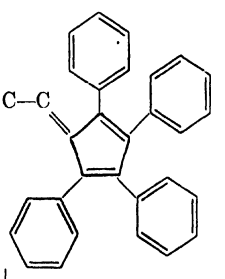
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,3,4-Tetraphenylcyclopentadiene-1,3**<br>  <br>178 [4]<br>177 [3] | | | | |
| **1,2,3,5-Tetraphenylcyclopentadiene-1,3**<br>  <br>177–178 [3] | | | | |
| $C_{30}H_{24}$<br>**1,3,4,5-Tetraphenyl-2-methylcyclopentadiene-1,3**<br>or<br>**1,2,4,5-Tetraphenyl-3-methylenecyclopentene-1**<br>  <br>or<br>  <br>163 [1] | | | | |

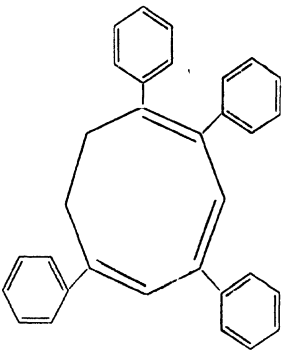
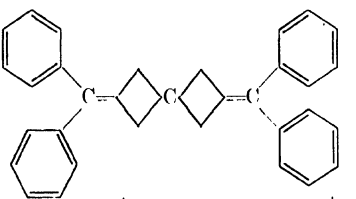
| M. P., °C | B.. P.,°C @ 760mm | $D_4^{20}$ p | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4,5-Tetraphenylcyclohexadiene-2,5**  | | | | |
| 208–210[5] | | | | |
| $C_{32}H_{28}$ | | | | |
| **1,4-Dibenzhydrylidenecyclohexane**  | | | | |
| 258–260[6] | | | | |

**References on Four Phenyl Substitutions on Cyclodienes or Cyclodiylidenes**


1. Allen, C. F. H , and J. A. Van Allan, J. Am. Chem. Soc. 65, 1384 1943.
2. Auerbach, E. B., Ber. 36, 933 1903.
3. Carpenter, H., Ann. 302, 223 1898.
4. Dilthey, W., W. Braun, and O. Trösken, J. prakt. Chem. [2] 139, 1 1933.
5. Schlenk, W., and E. Bergmann, Ann. 463, 1 1928.
6. Wittig, G., and H. Pook, Ber. 70, 2485 1937.

4. FOUR PHENYL SUBSTITUTIONS ON CYCLOTRIENES, CYCLODIENYLIDENES, OR DIALKENYLSPIRANES, $C_nH_{2n-38}$

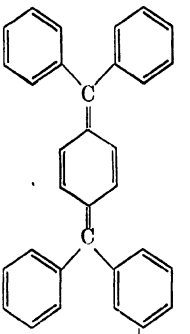
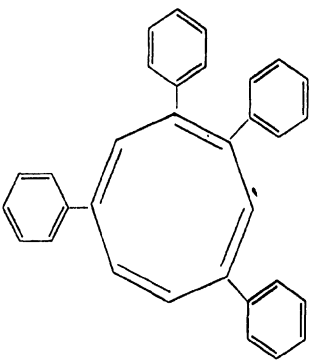
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Triphenyl-3-benzylidenecyclopentadiene-1,4**  156[4] | | | | |
| **1,2,3,4-Tetraphenyl-5-methylenecyclopentadiene-1,3**  211[4] | | | | |
| $C_{31}H_{24}$ **1,2,3,4-Tetraphenyl-5-ethylidenecyclopentadiene-1,3**  194–195[4] | | | | |

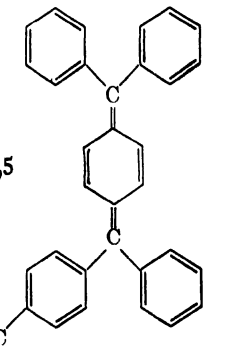
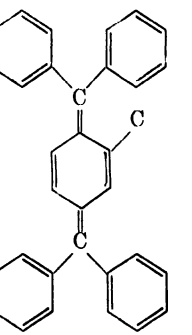
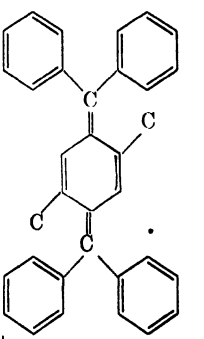
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4,6-Tetraphenylcyclooctatriene-1,3,5** (Dypnopinacolene-α)  | | | | |
| 95.5–96 [2]<br>95–96 [3] | | | | |
| **Dypnopinacolene-γ** (a) | | | | |
| 81–82 [3] | | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{33}H_{28}$ | | | | |
| **2,6-Dibenzhydrylidenespiro-[3,3]-heptane**  | | | | |
| 116–116.5 [1] | | | | |

**References on Four Phenyl Substitutions on Cyclotrienes, Cyclodienylidenes or Dialkenylspiranes**

1. Backer, H. J , and H. G. Kemper, Rec. trav. chim. **57**, 1249 1938.
2. Delacre, M., Bull. classe sci. Acad. roy. Belg. [3] **22**, 470 1891.
3. Delacre, M., Bull. classe sci. Acad. roy. Belg. [3] **27**, 36 1894.
4. Dilthey, W., and P. Huchtemann, J. prakt. Chem. [2] **154**, 238 1940.

## 5. FOUR PHENYL SUBSTITUTIONS ON CYCLOTETRAENES OR CYCLODIENYLDIYLIDENES, $C_nH_{2n-40}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Dibenzhydrylidenecyclohexadiene-2,5**  | | | | |
| 286 (in $CO_2$)[1]<br>239–242[6]<br>240[1]<br>238–240[5] | | | | |
| **1,2,4,7-Tetraphenyloctatetraene-1,3,5,7**  | | | | |
| 200–200.5[2]<br>200[3] | | | | |
| **Isodypnopinacolene-$\alpha$** (a) | | | | |
| 175.5[7] | | | | |
| (a) The structure of this compound is not given. | | | | |
| **Isodypnopinacolene-$\beta$** (a) | | | | |
| 172[3]<br>171[7] | | | | |
| (a) The structure of this compound is not given. | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Benzhydrylidene-4-(phenyl-*p*-tolylmethylene)-cyclohexadiene-2,5**  | | | | |
| 197 (in $CO_2$)[1] | | | | |
| **1,4-Dibenzhydrylidene-2-methylcyclohexadiene-2,5**  | | | | |
| 200–210[5] | | | | |
| $C_{34}H_{28}$ **1,4-Dibenzhydrylidene-2,5-dimethylcyclohexadiene-2,5**  | | | | |
| 200[4,6] | | | | |

**References on Four Phenyl Substitutions on Cyclotetraenes or Cyclodienyldiylidenes**

1. Chichibabin, A. E., Ber. **41**, 2770 1908.
2. Delacre, M., Bull. classe sci. Acad. roy. Belg. [3] **22**, 470 1891.
3. Delacre, M., Bull. classe sci. Acad. roy. Belg [3] **29**, 849 1895.
4. Staudinger, H., Ber. **41**, 1355 1908.
5. Staudinger, H., and S. Bereza, Ann. **380**, 243 1911.
6. Thiele, J., and H. Balhorn, Ber. **37**, 1463 1904.
7. Terlinck, E., Bull. classe sci. Acad. roy. Belg. 1904, 1049

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tetrabenzyldicyclopentene** (a) | | | | |
| 88[1] | | | | |

(a) The structure of this compound is not given.

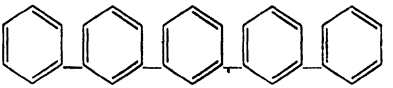
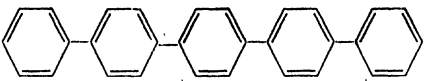
**References on Four Phenyl Substitutions on Dicyclenes**

1. Alder, K., and H. Holzrichter, Ann. **524**, 145 1936.

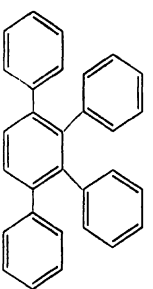
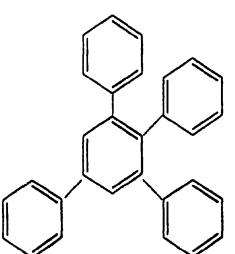
# XV. QUINQUAPHENYLS AND THEIR ALIPHATIC DERIVATIVES

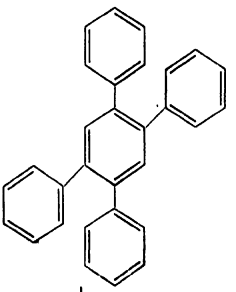
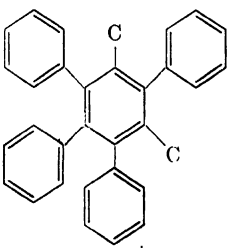
## 1. Quinquaphenyls and Their Alkyl Derivatives $C_nH_{2n-38}$

## 1. QUINQUAPHENYLS AND THEIR ALKYL DERIVATIVES, $C_nH_{2n-38}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **m-Quinquaphenyl**  | | | | |
| 112[1] | | | | |
| **p-Quinquaphenyl**  | | | | |
| 395[1] | | | | |
| 388–389[6] | | | | |
| 388.5[4,5] | | | | |
| **Pentaphenyl** (a) | | | | |
| 445(b)[9] | | | | |
| 401(c)[9] | | | | |

(a) The structure of this compound is not given.
(b) The solid becomes a crystalline liquid at this temperature.
(c) The solid becomes an amorphous liquid at this temperature.

| | | | | |
|---|---|---|---|---|
| **1,2,3,4-Tetraphenylbenzene**  | | | | |
| 193–194[2] | | | | |
| 190–191[3] | | | | |
| **1,2,3,5-Tetraphenylbenzene**  | | | | |
| 277–278[10] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4,5-Tetraphenylbenzene**  269–270[3] | | | | Sublimation Temp., °C 264[7] |
| $C_{32}H_{26}$ **1,3-Dimethyl-2,4,5,6-tetraphenylbenzene**  110–111[8] | | | | |



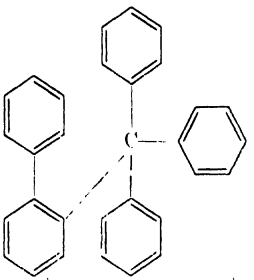
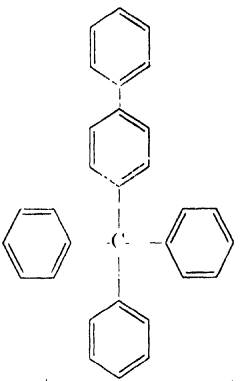
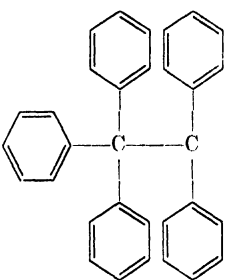
**References on Quinquaphenyls and Their Alkyl Derivatives**

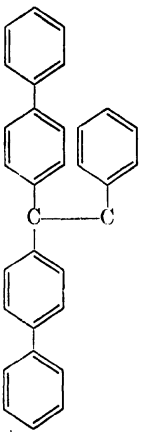
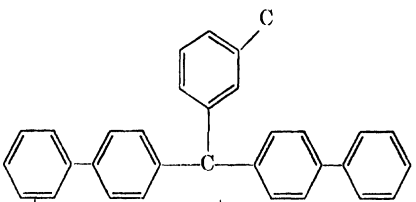
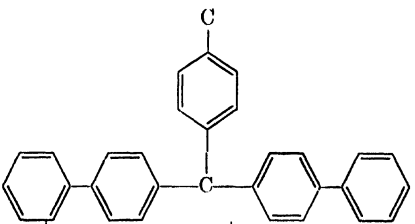
1. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 1936.
2. Dilthey, W., and G. Hurtig, Ber. **67**, 495 1934.
3. Dilthey, W., and G. Hurtig, Ber. **67**, 2004 1934.
4. Gerngross, O., and M. Dunkel, Ber. **57**, 739 1924.
5. Gerngross, O., C Shakhnov, and R. Jones, Ber. **57**, 747 1924.
6. Müller, E., and T. Töpel, Ber. **72**, 273 1939.
7. Schönberg, A., and A. F. A. Ismail, J. Chem. Soc. **1942**, 585.
8. Stark, O., and L. Klebahn, Ber. **47**, 125 1914.
9. Vorländer, D., Z. physik. Chem. **126**, 449 1927.
10. Wislicenus, J., and A. Lehmann, Ann. **302**, 195 1898.

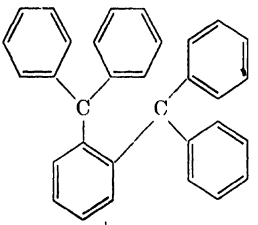
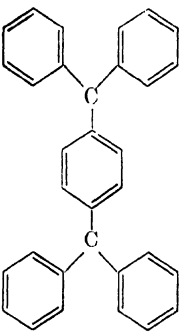
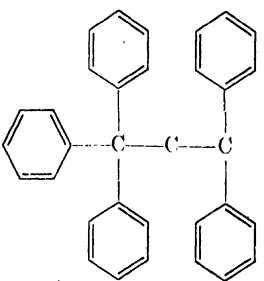
## XVI. FIVE PHENYL, THREE PHENYL AND ONE BIPHENYLYL, OR ONE PHENYL AND TWO BIPHENYLYL SUBSTITUTIONS ON ALIPHATICS

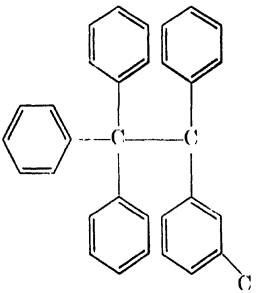
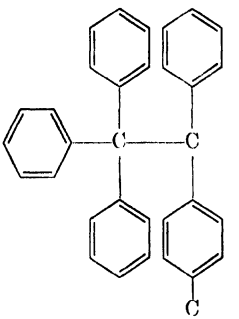
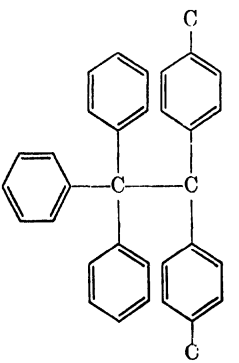
1. Five Phenyl, Three Phenyl and One Biphenylyl, or One Phenyl and Two Biphenylyl Substitutions on Alkanes $C_nH_{2n-38}$
2. Five Phenyl, Three Phenyl and One Biphenylyl, or One Phenyl and Two Biphenylyl Substitutions on Alkenes $C_nH_{2n-40}$
3. Five Phenyl Substitutions on Alkadienes $C_nH_{2n-42}$
4. Five Phenyl Substitutions on Alkatrienes $C_nH_{2n-44}$

1. FIVE PHENYL, THREE PHENYL AND ONE BIPHENYLYL, OR ONE PHENYL AND TWO BIPHENYLYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-38}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Triphenyl-*o*-biphenylylmethane**  | | | | |
| 171[14] | | | | |
| **Triphenyl-*p*-biphenylylmethane**  | | | | |
| 197–198[11] | | | | |
| **Phenyldibiphenylylmethane** (a) | | | | |
| 161[9] | | | | |
| (a) The structure of this compound is not given. | | | | |
| $C_{32}H_{26}$ | | | | |
| **Pentaphenylethane**  | | | | |
| 182–185 (in $N_2$)[1] | | | | |
| 182–183 (in $N_2$)[4] | | 1.166 | 0°/18 | |
| 179[7] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Pentaphenylethane** (*Continued*) | | | | |
| 178–179[5] | | | | |
| 178–179 (in $CO_2$)[6] | | | | |
| 176[10] | | | | |
| 166-178[1] | | | | |
| 160–170[6] | | | | |
| **1,1-Di-*p*-biphenylyl-2-phenylethane**  | | | | |
| 195–196[12] | | | | |
| ***m*-Tolyldi-*p*-biphenylylmethane**  | | | | |
| 144–145[3] | | | | |
| ***p*-Tolyldi-*p*-biphenylylmethane**  | | | | |
| 162–163[3] | | | | |

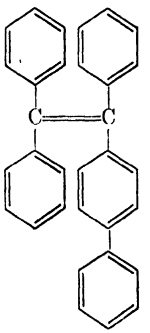
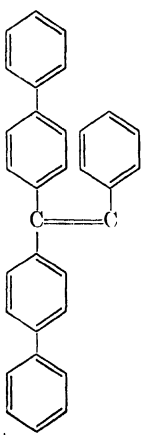
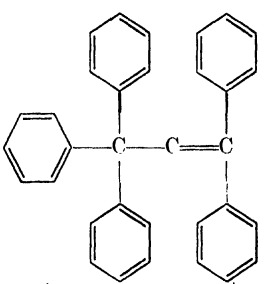
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Dibenzhydrylbenzene**  | | | | |
| 146.5[17] | | | | |
| **1,4-Dibenzhydrylbenzene**  | | | | |
| 172[13,16]<br>170–171[15] | | | | |
| $C_{33}H_{28}$ | | | | |
| **1,1,1,3,3-Pentaphenylpropane**  | | | | |
| 158–159[8] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1,2-Tetraphenyl-2-*m*-tolylethane**  | | | | |
| 157–159 (in $N_2$) [2]<br>149–157 [2] | | | | |
| **1,1,1,2-Tetraphenyl-2-*p*-tolylethane**  | | | | |
| 183–185 (in $N_2$) [1]<br>176–181 [1] | | | | |
| $C_{34}H_{30}$<br>**1,1,1-Triphenyl-2,2-di-*p*-tolylethane**  | | | | |
| 170–180 (in $N_2$) [1]<br>163–172 [1] | | | | |

**References on Five Phenyl, Three Phenyl and One Biphenylyl, or One Phenyl and Two Biphenylyl Substitutions on Alkanes**

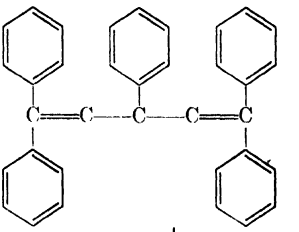

1. Bachmann, W. E., J. Am. Chem. Soc. **55**, 2135 **1939**.
2. Bachmann, W. E., R. Hoffman, and F. Whitehead. J. Org. Chem. **8**, 320 **1943**.
3. Bachmann, W. E., and F. H. Moser, J. Am. Chem. Soc. **54**, 1124 **1932**.
4. Bachmann, W. E., and F. Y. Wiselogle, J. Org. Chem. **1**, 354 **1936-1937**.
5. Chichibabin, A. E., Ber. **40**, 367 **1907**.
6. Chichibabin, A. E., J. Russ. Phys. Chem. Soc. **39**, 160 **1907**; C.A. **1**, 2105 **1907**.
7. Gilliland, W. L., and A. A. Blanchard, J. Am. Chem. Soc. **48**, 410 **1926**.
8. Koelsch, C. F., and R. H. Rosenwald, J. Am. Chem. Soc. **59**, 2170 **1937**.
9. Schlenk, W., A. Herzenstein, and T. Weickel, Ann. **372**, 1 **1910**.
10. Schlenk, W., and H. Mark, Ber. **55**, 2285 **1922**.
11. Schoepfle, C. S., and S. G. Trepp, J. Am. Chem. Soc. **54**, 4059 **1932**.
12. Shilov, Y. A., J. Russ. Phys. Chem. Soc. **62**, 95 **1930**; Chem. Zentr. **1930**, II, 2524.
13. Ullmann, F., and C. Schläpfer, Ber. **37**, 2001 **1904**.
14. Wieland, H., K. Heymann, T. Tsatsas, D. Juchum, G. Varvoglis, G. Labriola, O. Dobbelstein, and H. S. Boyd-Barrett, Ann. **514**, 145 **1934**.
15. Wittig, G., and A. Klein, Ber. **69**, 2087 **1936**.
16. Wittig, G., and H. Kröhne, Ann. **529**, 142 **1937**.
17. Wittig, G., and M. Leo, Ber. **64**, 2395 **1931**.
18. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929**.

## 2. FIVE PHENYL, THREE PHENYL AND ONE BIPHENYLYL, OR ONE PHENYL AND TWO BIPHENYLYL SUBSTITUTIONS ON ALKENES, $C_nH_{2n-40}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2-Triphenyl-2-*p*-biphenylylethene**  | | | | |
| 189–190 [2] | | | | |
| **1,1-Di-*p*-biphenylyl-2-phenylethene**  | | | | |
| 195–196 [4] | | | | |
| 192–193 [3] | | | | |
| **$C_{33}H_{26}$** | | | | |
| **1,1,1,3,3-Pentaphenylpropene-2**  | | | | |
| 132–133 [1] | | | | |

**References on Five Phenyl, Three Phenyl and One Biphenylyl, or One Phenyl and Two Biphenylyl Substitutions on Alkenes**

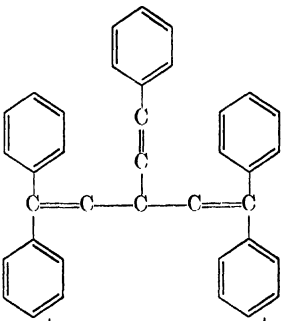
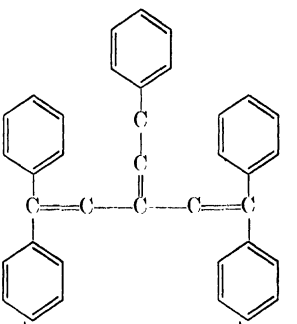
1. Koelsch, C. F., and R. H. Rosenwald, J. Am. Chem. Soc. **59**, 2170 **1937.**
2. Norris, J. F., R. Thomas, and B. M. Brown, Ber. **43**, 2940 **1910.**
3. Pfeiffer, P., and P. Schneider, J. prakt. Chem. [2] **129**, 129 **1931,**
4. Shilov, E. A., J. Russ. Phys. Chem. Soc. **62**, 95 **1930;** Chem. Zentr. **1930, II,** 2524.

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,3,5,5-Pentaphenylpentadiene-1,4**  | | | | |
| 168–169[1] | | | | |

**References on Five Phenyl Substitutions on Alkadienes**

1. Wittig, G., and H. Kosak, Ann. **529**, 167 **1937.**

4. FIVE PHENYL SUBSTITUTIONS ON ALKATRIENES, $C_nH_{2n-44}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,5,5-Tetraphenyl-3-phenethenylpentadiene-1,4**  | | | | |
| 141–142[1] | | | | |
| **1,1,5,5-Tetraphenyl-3-phenethylidenepentadiene-1,4**  | | | | |
| 130–131[1] | | | | |

**References on Five Phenyl Substitutions on Alkatrienes**

1. Wittig, G., and H. Kosack, Ann. 529, 167 1937.

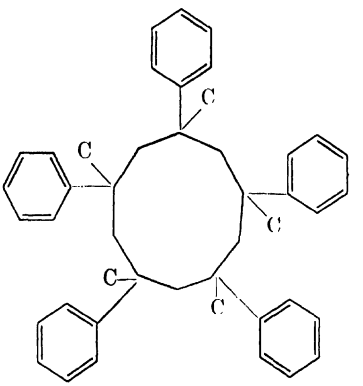
# XVII. FIVE PHENYL SUBSTITUTIONS ON ALICYCLICS

1. Five Phenyl Substitutions on Cyclanes $C_nH_{2n-40}$
2. Five Phenyl Substitutions on Cyclodienes $C_nH_{2n-44}$
3. Five Phenyl Substitutions on Cyclodienylidenes $C_nH_{2n-46}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Pentaphenylcyclopentane** (a) | | | | |
| 145[1,3] | | | | |
| (a) The structure of this compound is not given. | | | | |

$C_{45}H_{50}$

**1,3,5,7,9-Pentaphenyl-1,3,5,7,9-pentamethylcyclodecane**

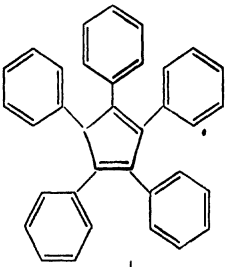
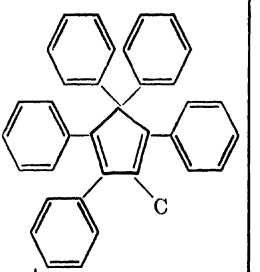


| | | | |
|---|---|---|---|
| 240–244 | 0.1[2] | 1.0624[2] | 1.5960[2] |

**References on Five Phenyl Substitutions on Cyclanes**

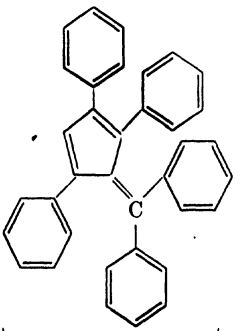
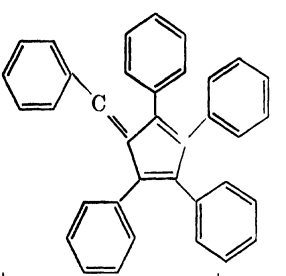
1. Newmann, F. H., Ann. 302, 236 1898.
2. Staudinger, H., and F. Breusch, Ber. 62, 442 1929.
3. Wislicenus, J., and F. H. Newmann, Ann. 302, 236 1898.

## 2. FIVE PHENYL SUBSTITUTIONS ON CYCLODIENES, $C_nH_{2n-44}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,3,4,5-Pentaphenylcyclopentadiene-1,3**  | | | | |
| 252–254[2]<br>250[1,4] | | 1.206 0°[3] | | |
| **$C_{36}H_{28}$**<br>**1,1,2,4,5-Pentaphenyl-3-methylcyclopentadiene-2,4**  | | | | |
| 159[1] | | | | |

### References on Five Phenyl Substitutions on Cyclodienes

1. Allen, C. F. H., and J. A. Van Allan, J. Am. Chem. Soc. **65**, 1384 **1943.**
2. Koelsch, C. F., and T. A. Geissman, J. Org. Chem. **3**, 480 **1938.**
3. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**
4. Ziegler, K., and B. Schnell, Ann. **445**, 266 **1925.**

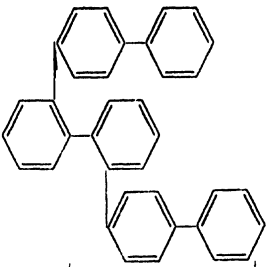
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,4-Triphenyl-3-benzhydrylidenecyclopentadiene-1,4**  | | | | |
| 181[1] | | | | |
| **1,2,3,4-Tetraphenyl-5-benzylidenecyclopentadiene-1,3**  | | | | |
| 204[2]<br>200–201[1] | | | | |

**References on Five Phenyl Substitutions on Cyclodienylidenes.**

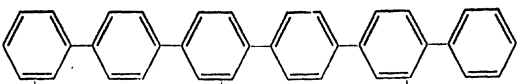
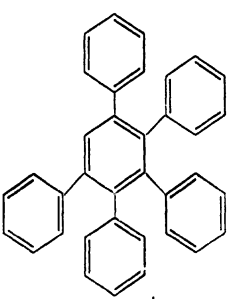
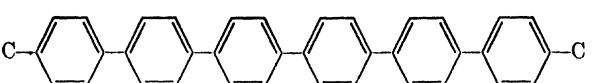
1. Dilthey, W., and P. Huchtemann, J. prakt. Chem. [2] 154, 238 1940.
2. Löwenbein, A., and G. Ulich, Ber. 58, 2662 1925.

# XVIII. SEXAPHENYLS AND THEIR ALIPHATIC DERIVATIVES

## 1. Sexaphenyls and Their Alkyl Derivatives $C_nH_{2n-46}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2′-Dibiphenylylbiphenyl** (a)  | | | | |
| 185[1] | | | | |

(a) The name given to this compound by the author was 2,2″-Diphenylyldiphenyl, which is probably the above compound.

| | | | | |
|---|---|---|---|---|
| ***p*-Sexaphenyl**  | | | | |
| 475[3,7,9]<br>465[8,10] | | | | |
| **Pentaphenylbenzene**  | | | | |
| 252–253[5]<br>251[6]<br>246[2] | | | | |
| $C_{38}H_{30}$ | | | | |
| ***p*-Ditolyl-*p*-quatraphenyl** C  C | | | | |
| 469 (in $CO_2$) [10]<br>162–163[4] | | | | |

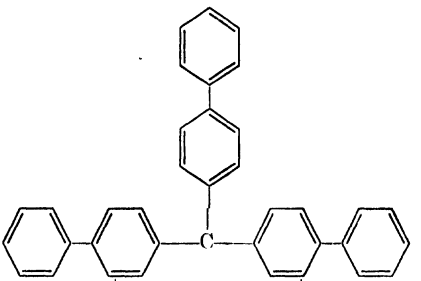
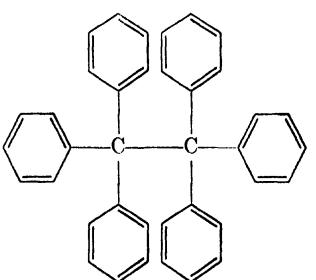
**References on Sexaphenyls and Their Alkyl Derivatives.**


1. Adam, T. C. C., and A. Russell, J. Chem. Soc. 1930, 202.
2. Allen, C. F. H., and A. Bell, J. Am. Chem. Soc. 61, 521 1939.
3. Busch, M., and W. Weber, J. prakt. Chem. [2] 146, 1 1936.
4. Chichibabin, A. E., J. Russ. Phys. Chem. Soc. 39, 925 1907; C.A. 2, 405 1908.
5. Dilthey, W., and G. Hurtig, Ber. 67, 495 1934.
6. Dilthey, W., and G. Hurtig, Ber. 67, 2004 1934.
7. Kuhn, R., Ann. 475, 131 1929.
8. Pummerer, R., Ber. 66, 802 1933.
9. Pummerer, R., and K. Bittner, Ber. 57, 84 1924.
10. Pummerer, R., and L. Seligsberger, Ber. 64, 2477 1931.

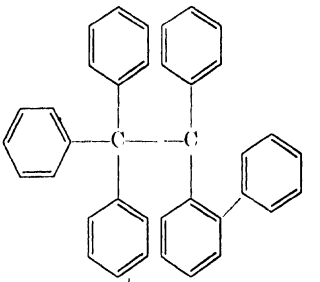
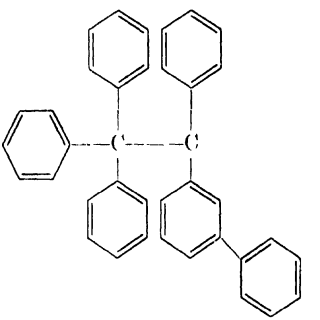
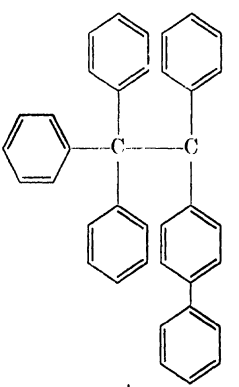
## XIX. SIX PHENYL, FOUR PHENYL AND ONE BIPHENYLYL, TWO PHENYL AND TWO BIPHENYLYL, OR THREE BIPHENYLYL SUBSTITUTIONS ON ALIPHATICS

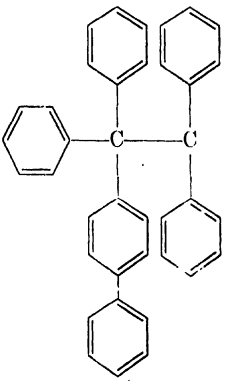
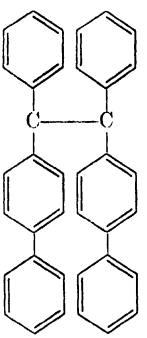
1. Six Phenyl, Four Phenyl and One Biphenylyl, Two Phenyl and Two Biphenylyl, or Three Biphenylyl Substitutions on Alkanes $C_nH_{2n-46}$
2. Six phenyl or Two Phenyl and Two Biphenylyl Substitutions on Alkenes $C_nH_{2n-48}$
3. Six Phenyl Substitutions on Alkynes $C_nH_{2n-50}$
4. Six Phenyl Substitutions on Alkadienes $C_nH_{2n-50}$
5. Six Phenyl Substitutions on Alkatrienes $C_nH_{2n-52}$
6. Six Phenyl Substitutions on Alkadiynes $C_nH_{2n-54}$
7. Six Phenyl Substitutions on Alkahexaenes $C_nH_{2n-58}$

1. SIX PHENYL, FOUR PHENYL AND ONE BIPHENYLYL, TWO PHENYL AND TWO BIPHENYLYL, OR THREE BIPHENYLYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-46}$

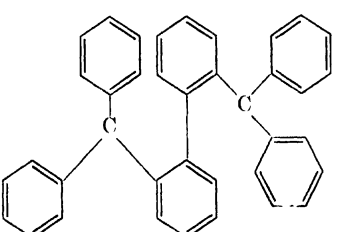
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_{20}^{20}$ | Additional Data |
|---|---|---|---|---|
| **Tri-*p*-biphenylylmethane**  | | | | |
| **237** | | | | |
| 241–242 [23] | | | | |
| 235–237 [16] | | | | |
| 235–236 [25] | | | | |
| 231 [29] | | | | |
| $C_{38}H_{30}$ | | | | |
| **Hexaphenylethane**  | | | | |
| **227** | | | | |
| 227–230 [6] | | 1.141 | 0°(a) [33] | |
| 227 [24] | | 1.168 | 0°(b) [33] | |
| 226–227 [14] | | | | |
| 225 [1,15] | | | | |

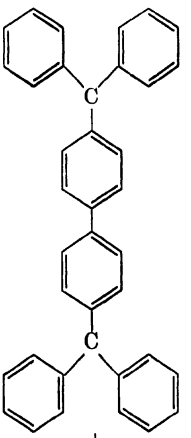
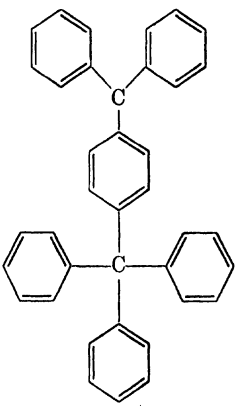
(a) This density is an average of three determinations on the compound precipitated from acetone.
(b) This density is an average of three determinations on the compound precipitated from formic ester.

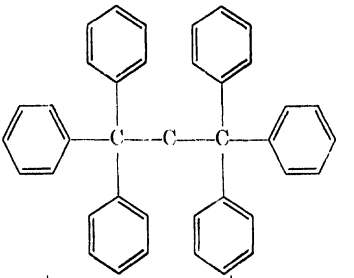
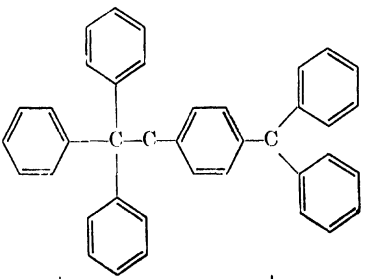
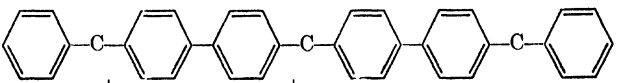
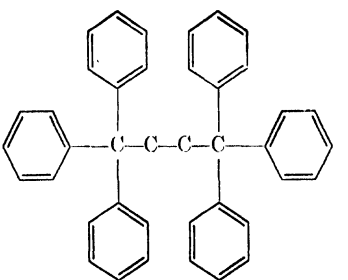
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1,2-Tetraphenyl-2-*o*-biphenylylethane**  | | | | |
| 175–178 (in $N_2$) [3]<br>167–173 [3] | | | | |
| **1,1,1,2-Tetraphenyl-2-*m*-biphenylylethane**  | | | | |
| 168–169 (in $N_2$) [3]<br>146–153 [3] | | | | |
| **1,1,1,2-Tetraphenyl-2-*p*-biphenylylethane**  | | | | |
| 166–175 (in $N_2$) [2]<br>161–171 [2] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,2-Tetraphenyl-1-*p*-biphenylylethane**  | | | | |
| 190–192 (in $N_2$) [4] | | | | |
| **1,2-Diphenyl-1,2-di-*p*-biphenylylethane**  | | | | |
| 247 [18] | | | | |
| 245–246 [5] | | | | |
| 205–206(a) [18] | | | | |
| 202–203(b) [5] | | | | |

(a) This melting point was determined on the *meso*-racemic isomer of the compound melting at 247.
(b) This melting point was determined on an isomer of the compound melting at 245-246.

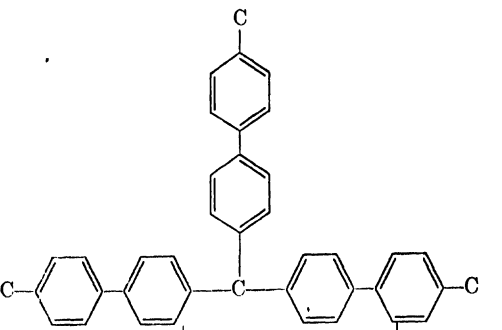
| | | | | |
|---|---|---|---|---|
| **2,2′-Dibenzhydrylbiphenyl**  | | | | |
| 238.5–239 [32] | | | | |
| 236–237.5 [11] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **4,4′-Dibenzhydrylbiphenyl**  | | | | |
| 162–163 [8] | | | | |
| **(4-Benzhydrylphenyl)-triphenylmethane**  | | | | |
| **229** | | | | |
| 232 [22] | | | | |
| 231 [27] | | | | |
| 230 [13] | | | | |
| 228 [28] | | | | |
| 227 [9,10] | | | | |
| 226–227 [21] | | | | |
| 225 [31] | | | | |
| 223–224 [17] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1,3,3,3-Hexaphenylpropane**  | | | | |
| 216[19] | | | | |
| **1,1,1-Triphenyl-2-(4′-benzhydrylphenyl)-ethane**  | | | | |
| 177[30] | | | | |
| **Di-(4-benzyl-*p*-biphenylyl)-methane**  | | | | |
| 179–180[7] | | | | |
| $C_{40}H_{34}$ | | | | |
| **1,1,1,4,4,4-Hexaphenylbutane**  | | | | |
| 271[29] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|

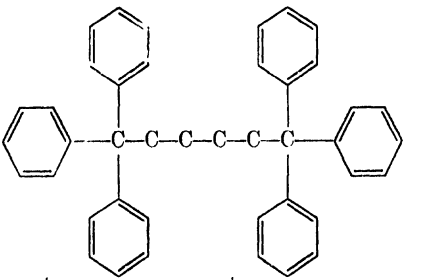
**Tri-(4-methyl-*p*-biphenylyl)-methane**



174.0–174.5[16]

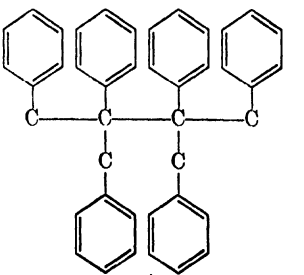
$C_{42}H_{38}$

**1,1,1,6,6,6,-Hexaphenylhexane**

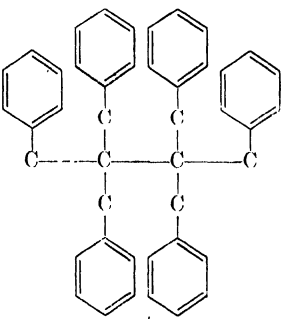


189[12]

**1,2,3,4-Tetraphenyl-2,3-dibenzylbutane**



126–127[24]

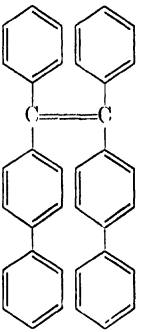
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,4-Diphenyl-2,2,3,3-tetrabenzylbutane**  | | | | |
| 82–83 [26]<br>80–81 [20] | | | | |

**References on Six Phenyl, Four Phenyl and One Biphenylyl, Two Phenyl and Two Biphenylyl, or Three Biphenylyl Substitutions on Alkanes**

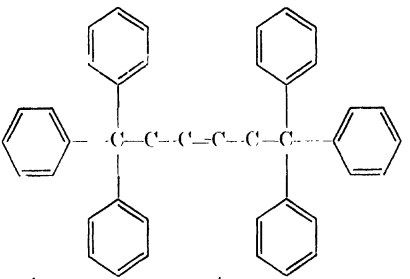
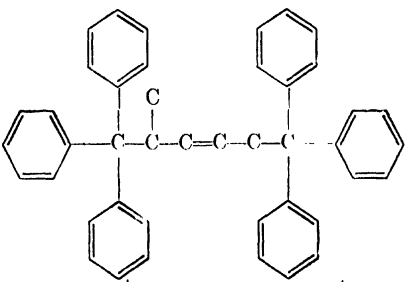

1. Acree, S. F., Ber. **37**, 616 **1904.**
2. Bachmann, W. E., J. Am. Chem. Soc. **55**, 2135 **1939.**
3. Bachmann, W. E., R. Hoffman, and F. Whitehead, J. Org. Chem. **8**, 320 **1943.**
4. Bachmann, W. E., and F. Y. Wiselogle, J. Org. Chem. **1**, 354 **1936-1937.**
5. Bergmann, E., Ber. **63**, 1617 **1930.**
6. Binaghi, R., Gazz. chim. ital. **53**, 879 **1923.**
7. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 **1936.**
8. Chichibabin, A. E., Ber. **40**, 1810 **1907.**
9. Chichibabin, A. E., Ber. **41**, 2421 **1908.**
10. Chichibabin, J. Russ. Phys. Chem. Soc. **40**, 1367 **1908**; Beil. **5**, 761 **1922.**
11. Chichibabin, A. E., and P. Sergeev, Ber. **59**, 654 **1926.**
12. Conant, J. B., and B. F. Chow, J. Am. Chem. Soc. **55**, 3475 **1933.**
13. Gomberg, M., Ber. **35**, 3914 **1902.**
14. Gomberg, M., Ber. **36**, 376 **1903.**
15. Gomberg, M., and L. H. Cone, Ber. **37**, 2033 **1904.**
16. Morton, A. A., and W. S. Emerson, J. Am. Chem. Soc. **59**, 1947 **1937.**
17. Müller, E., Ann. **491**, 251 **1931.**
18. Schlenk, W., and E. Bergmann, Ann. **463**, 1 **1928.**
19. Schlenk, W., L. Mair, C. Bornhardt, and J. Renning, Ann. **394**, 178 **1912.**
20. Schmerda, F., Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **118**, Abt IIb, 165 **1909.**
21. Schmid, L., and R. Falke, Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse **141**, Abt. IIb, 215 **1932.**
22. Schmidlin, J., Ber. **39**, 628 **1906.**
23. Schmidlin, J., Ber. **45**, 3171 **1912.**
24. Schmidlin, J., Compt. rend. **137**, 59 **1903.**
25. Schmidlin, J., and A. Garcia-Banus, Ber. **45**, 3188 **1912.**
26. Trotman, E. R., J. Chem. Soc. **127**, 88 **1925.**
27. Ullmann, F., and W. Borsum, Ber. **35**, 2877 **1902.**
28. Vansheidt and Moldavskil, Ber. **63**, 1362 **1930.**
29. Wieland, H., K. Heymann, T. Tsatsas, D. Juchum, G. Varvoglis, G. Labriola, O. Dobbelstein, and H. S. Boyd-Barrett, Ann. **514**, 145 **1934.**

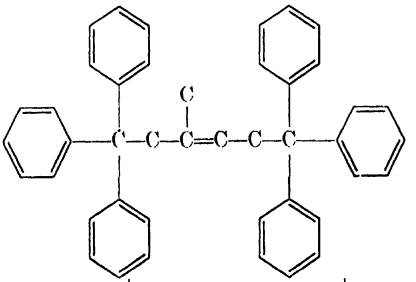
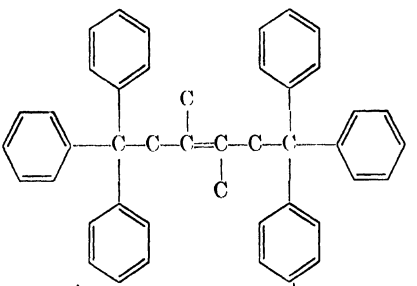
30. Wieland, H., and H. Kloss, Ann. **470**, 201 **1929.**
31. Wieland, H., and C. Müller, Ann. **401**, 233 **1913.**
32. Wittig, G., and H. Petri, Ann. **505**, 17 **1933.**
33. Ziegler, K., and F. Ditzel, Ann. **473**, 194 **1929.**
34. Ziegler, K., and B. Schnell, Ann. **437**, 227 **1924.**

## 2. SIX PHENYL OR TWO PHENYL AND TWO BIPHENYLYL SUBSTITUTIONS ON ALKENES, $C_nH_{2n-48}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2-Diphenyl-1,2-di-*p*-biphenylylethene**  | | | | |
| 255[3] | | | | |
| 218(a)[3] | | | | |

(a) This constant was determined on the *cis-trans* isomer.

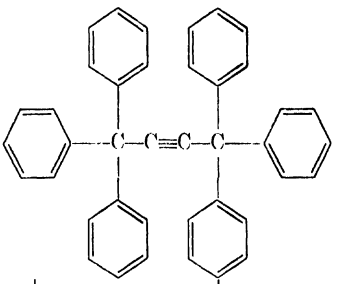
| | | | | |
|---|---|---|---|---|
| $C_{42}H_{36}$ | | | | |
| **1,1,1,6,6,6-Hexaphenylhexene-3**  | | | | |
| 224[1] | | | | |
| $C_{48}H_{38}$ | | | | |
| **1,1,1,6,6,6-Hexaphenyl-2-methylhexene-3**  | | | | |
| 174[1] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1,6,6,6-Hexaphenyl-3-methylhexene-3**  | | | | |
| 166[2] | | | | |
| $C_{44}H_{40}$ | | | | |
| **1,1,1,6,6,6-Hexaphenyl-3,4-dimethylhexene-3**  | | | | |
| 240[2] | | | | |

**References on Six Phenyl or Two Phenyl and Two Biphenylyl Substitutions on Alkenes**

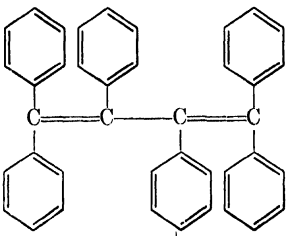
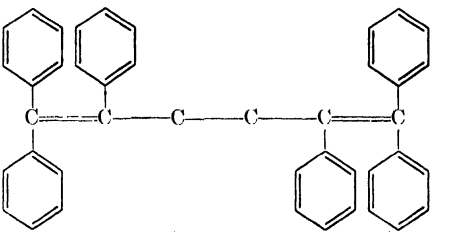
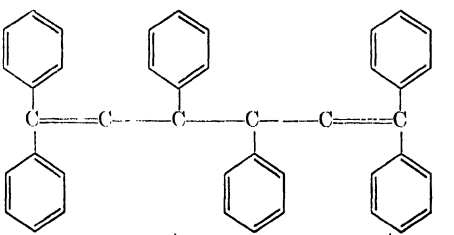
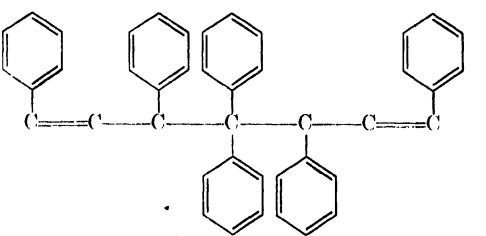
1. Conant, J. B., and B. F. Chow, J. Am. Chem. Soc. **55**, 3475 1933.
2. Conant, J. B., and H. W. Scherp, J. Am. Chem. Soc. **53**, 1941 1931.
3. Schlenk, W., and E. Bergmann, Ann. **463**, 1 1928.

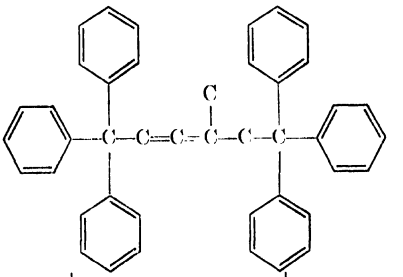
3. SIX PHENYL SUBSTITUTIONS ON ALKYNES, $C_nH_{2n-50}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1,4,4,4-Hexaphenylbutyne-2**  | | | | |
| 260[1] | | | | |

**References on Six Phenyl Substitutions on Alkynes**

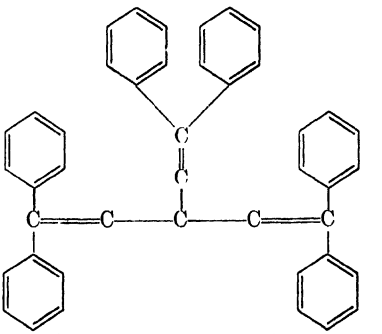
1. Wieland, H., and H. Kloss, Ann. **470**, 201 1929.

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,3,4,4-Hexaphenylbutadiene-1,3**  | | | | |
| 213–214[4] | | | | |
| $C_{42}H_{34}$ | | | | |
| **1,1,2,5,6,6-Hexaphenylhexadiene-1,5**  | | | | |
| 222[2] | | | | |
| **1,1,3,4,6,6-Hexaphenylhexadiene-1,5**  | | | | |
| 212–213[3] | | | | |
| 211–212[7] | | | | |
| 210–211[5] | | | | |
| $C_{42}H_{36}$ | | | | |
| **1,3,4,4,5,7-Hexaphenylheptadiene-1,6**  | | | | |
| 145[1] | | | | |

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1,6,6,6-Hexaphenyl-4-methylhexadiene-2,3**  | | | | |
| 184–185.5[6] | | | | |

**References on Six Phenyl Substitutions on Alkadienes**

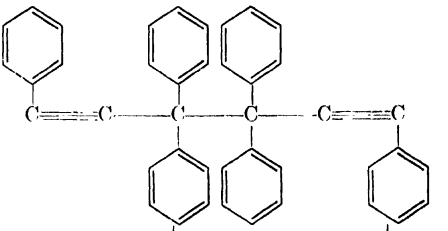

1. Bergmann, E., and T. Ukai, Ber. **66**, 54 **1933.**
2. Bergmann, E., and H. Weiss, Ber. **64**, 1485 **1931.**
3. Grabbe, Thesis, Marburg, **1924**, quoted by Wittig and Kosack, Ann. **529**, 184 **1937.**
4. Koelsch, C. F., J. Am Chem. Soc. **54**, 3384 **1932.**
5. Marvel, C. S., M. B. Mueller, and W. Peppel, J. Am. Chem. Soc. **60**, 410 **1938.**
6. Thompson, A. F., Jr., and D. M. Surgenor, J. Am. Chem. Soc. **65**, 486 **1943.**
7. Wittig, G., and H. Kosak, Ann. **529**, 167 **1937.**

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,5,5-Tetraphenyl-3-(di-2′,2′-phenylethenyl)-pentadiene-1,4**  | | | | |
| 223–224[1] | | | | |

**References on Six Phenyl Substitutions on Alkatrienes**

1. Wittig, G., and H. Kosack, Ann. 529, 167 1937.

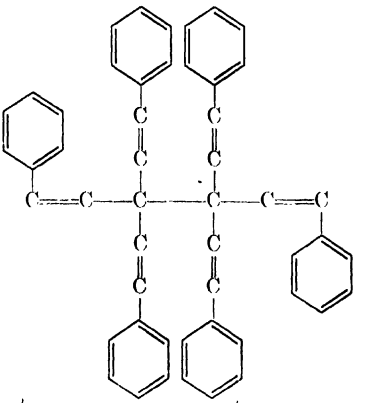
## 6. SIX PHENYL SUBSTITUTIONS ON ALKADIYNES, $C_nH_{2n-54}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,3,4,4,6-Hexaphenylhexadiyne-1,5**  | | | | |
| 179[1] | | | | |
| 174–175[3] | | | | |
| 169[2] | | | | |

### References on Six Phenyl Substitutions on Alkadiynes


1. Dufraisse, C., and A. Willemart, Bull. soc. chim. [5] **1**, 576 **1934.**
2. Munro, H. E., and C. S. Marvel, J. Am. Chem. Soc. **54**, 4445 **1932.**
3. Wieland, H., and H. Kloss, Ann. **470**, 201 **1929.**

7. SIX PHENYL SUBSTITUTIONS ON ALKAHEXAENES, $C_nH_{2n-58}$

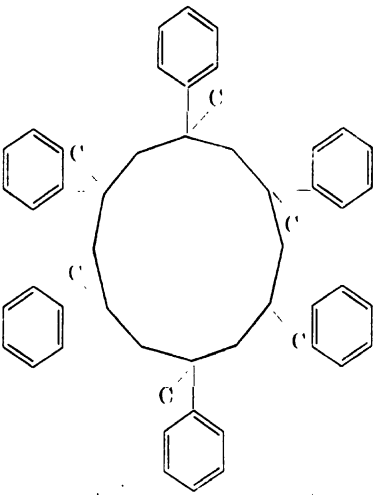
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,6-Diphenyl-3,3,4,4-tetraphenethenylhexadiene-1,5**  | | | | |
| 173–174[1] | | | | |

**References on Six Phenyl Substitutions on Alkahexaenes**

1. Marvel, C. S., M. B. Mueller, and W. Peppel, J. Am. Chem. Soc. **60**, 410 1938.

## XX. SIX PHENYL SUBSTITUTIONS ON ALICYCLICS

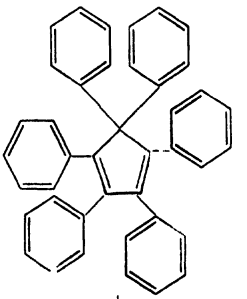
1. Six Phenyl Substitutions on Cyclanes $C_nH_{2n-48}$
2. Six Phenyl Substitutions on Cyclodienes $C_nH_{2n-52}$
3. Six Phenyl Substitutions on Cyclodienylidenes $C_nH_{2n-54}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5,7,9,11-Hexaphenyl-1,3,5,7,9,11-hexamethylcyclododecane**  | | | | |
| | 275–285 0.1[1] | 1.0657[1] | 1.6050[1] | |

**References on Six Phenyl Substitutions on Cyclanes**

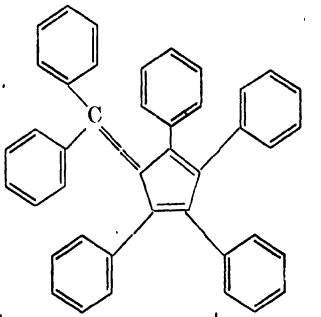
1. Staudinger, H., and F. Breusch, Ber. **62**, 442 **1929.**

2. SIX PHENYL SUBSTITUTIONS ON CYCLODIENES, $C_nH_{2n-52}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,3,4,5-Hexaphenylcyclopentadiene-2,4**  | | | | |
| 172[1] | | | | |

**References on Six Phenyl Substitutions on Cyclodienes**

1. Allen, C. F. H., and J. A. Van Allan, J. Am. Chem. Soc. **65**, 1384 **1943.**

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,2,3,4-Tetraphenyl-5-benzhdrylidene-cyclopentadiene-1,3**  | | | | |
| 301-302[1] | | | | |

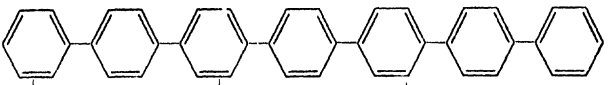
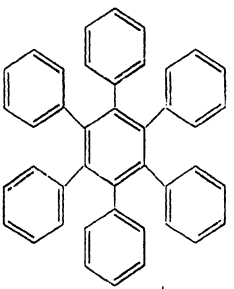
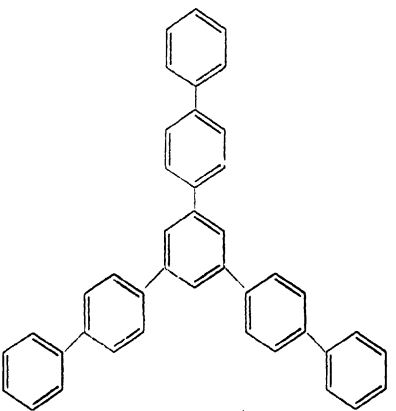
**References on Six Phenyl Substitutions on Cyclodienylidenes**

1. Dilthey, W., and P. Huchtemann, J. prakt. Chem. [2] **154**, 238 1940.

## XXI. COMPOUNDS CONTAINING SEVEN PHENYL GROUPS

1. Septaphenyls $C_nH_{2n-54}$
2. Seven Phenyl or Three Phenyl and Two Biphenylyl Substitutions on Alkanes $C_nH_{2n-64}$
3. One Phenylalkynyl Substitution on Sexaphenyl $C_nH_{2n-58}$
4. Seven Phenyl Substitutions on Cyclanes $C_nH_{2n-56}$

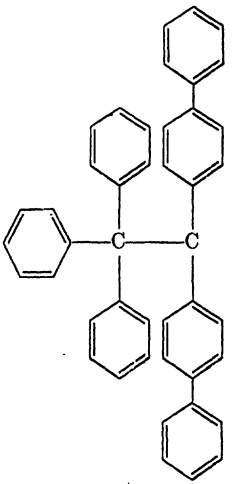
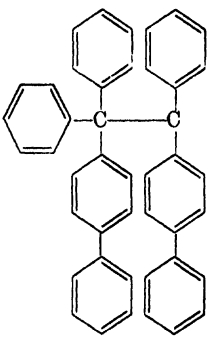
1. SEPTAPHENYLS, $C_nH_{2n-54}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***p*-Septaphenyl**  | | | | |
| 545 [2] | | | | |
| **Hexaphenylbenzene**  | | | | |
| 449–450 [4]<br>426 [5] | | | | |
| **1,3,5-Tri-*p*-biphenylylbenzene**  | | | | |
| 232 [6]<br>230.5–231 [3]<br>230–231 [1] | 400 | 12 [1] | | |

## References on Septaphenyls

1. Bernhauer, K., P. Müller, and F. Neiser, J. prakt. Chem. [2] **145**, 301 **1936**.
2. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 **1936**.
3. Clapp, D. B., and A. A. Morton, J. Am. Chem. Soc. **58**, 2172 **1936**.
4. Dilthey, W., and G. Hurtig, Ber. **67**, 495 **1934**.
5. Dilthey, W., and G. Hurtig, Ber. **67**, 2004 **1934**.
6. Skrowaczewska, Z., and E. Sucharda, Roczniki Chem. **16**, 151 **1936**; C.A. **31**, 2196 **1937**.

## 2. SEVEN PHENYL OR THREE PHENYL AND TWO BIPHENYLYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-54}$

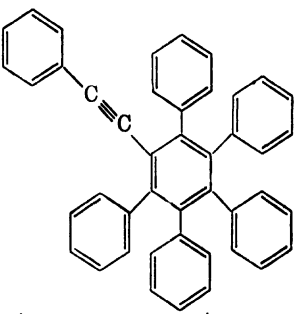
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,1-Triphenyl-2,2-di-*p*-biphenylylethane**  | | | | |
| 180–190 (in $N_2$)[1]<br>171–180[1] | | | | |
| **1,1,2-Triphenyl-1,2-di-*p*-biphenylylethane**  | | | | |
| 180–185 (in $N_2$)[2] | | | | |
| **$C_{50}H_{46}$**<br>**Di-(tribenzylmethyl)-benzene** (a) | | | | |
| 72–73[3] | | | | |

(a) The structure of this compound is not given.

**References on Seven Phenyl or Three Phenyl and Two Biphenylyl Substitutions on Alkanes**

1. Bachmann, W. E., J. Am. Chem. Soc. **55**, 2135 **1939.**
2. Bachmann, W. E., and F. Y. Wiselogle, J. Org. Chem. **1**, 354 **1936-1937.**
3. Kothe, R., Ann. **248**, 56 **1888.**

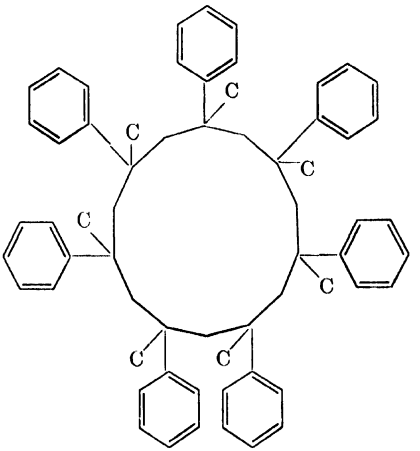
3. ONE PHENYLALKYNYL SUBSTITUTION ON SEXAPHENYL, $C_nH_{2n-58}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **Pentaphenylphenethynylbenzene**  | | | | |
| 258[1] | | | | |

**References on One Phenylalkynyl Substitution on Sexaphenyl**

1. Dilthey, W., W. Schommer, W. Höschen, and H. Dietrichs, Ber. 68, 1159 1935.

4. SEVEN PHENYL SUBSTITUTIONS ON CYCLANES, $C_nH_{2n-56}$

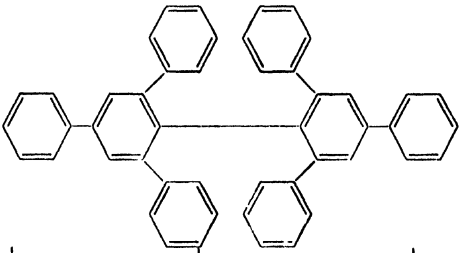
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,3,5,7,9,11,13-Heptaphenyl-1,3,5,7,9,11,13-heptamethylcyclotetradecane**  | | | | |
| | 312–316 0.1[1] | 1.0671[1] | 1.6010[1] | |

**References on Seven Phenyl Substitutions on Cyclanes**

1. Staudinger, H., and F. Breusch, Ber. **62**, 442 **1929.**

## XXII. COMPOUNDS CONTAINING EIGHT PHENYL GROUPS AND ALIPHATIC GROUPS

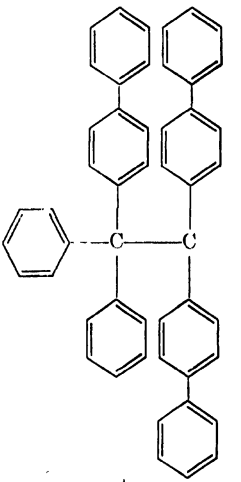
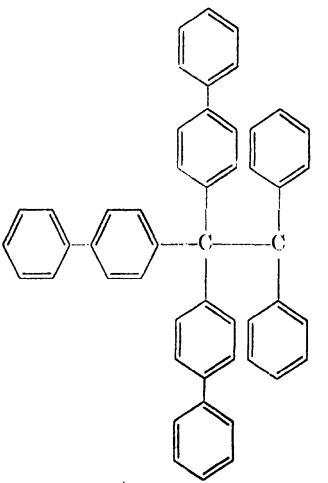
1. Octaphenyl $C_nH_{2n-82}$
2. Eight Phenyl, Two Phenyl and Three Biphenylyl, or Four Biphenylyl Substitutions on Alkanes $C_nH_{2n-82}$
3. Four Biphenylyl Substitutions on Alkenes $C_nH_{2n-84}$
4. Eight Phenyl Substitutions on Alkadienes $C_nH_{2n-86}$

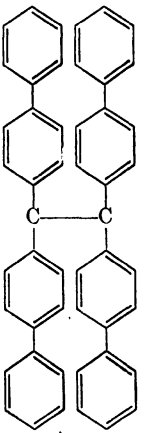
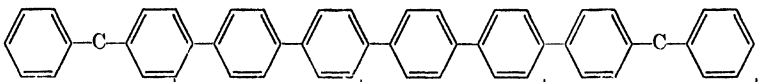
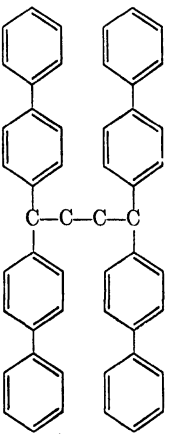
| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2′,4,4′,6,6′-Hexaphenylbiphenyl**  | | | | |
| 348[1] | | | | |

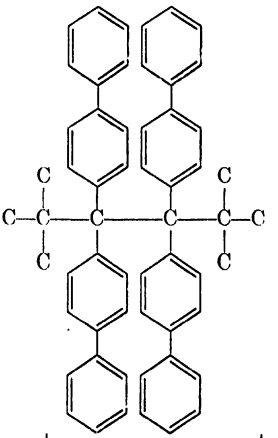
**References on Octaphenyl**

1. Kohler, E. P., and L. W. Blanchard, J. Am. Chem. Soc. **57**, 367 **1935.**

2. EIGHT PHENYL, TWO PHENYL AND THREE BIPHENYLYL, OR FOUR BIPHENYLYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-62}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1-Diphenyl-1,2,2-tri-*p*-biphenylylethane**  | | | | |
| 227–230 (in $N_2$)[1] | | | | |
| **1,1,1-Tri-*p*-biphenylyl-2,2-diphenylethane**  | | | | |
| 164–167 (in $N_2$)[1] | | | | |

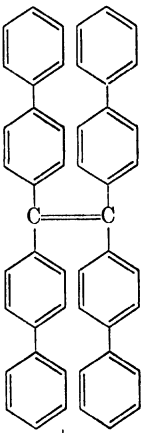
| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,2-Tetrabiphenylylethane**  | | | | |
| 276–279 [5,6] | | | | |
| **4,4′-Di-(4‴-benzyl-*p*-biphenylyl)-biphenyl**  | | | | |
| 239–240 [2] | | | | |
| $C_{52}H_{42}$ | | | | |
| **1,1,4,4-Tetrabiphenylylbutane**  | | | | |
| 236 [4] | | | | |
| 234–235 [7] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **2,2,5,5-Tetramethyl-3,3,4,4-tetrabiphenylylhexane**  | | | | |
| 136–137[8] | | | | |

**References on Eight Phenyl, Two Phenyl and Three Biphenylyl, or Four Biphenylyl Substitutions on Alkanes**

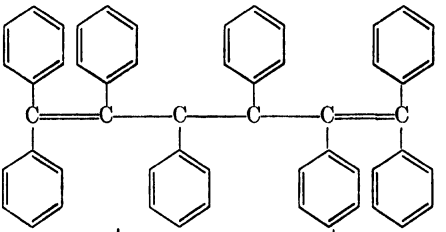

1. Bachmann, W. E., and F. Y. Wiselogle, J. Org. Chem. **1**, 354 1936-1937.
2. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 1936.
3. Conant, J. B., and R. F. Schultz, J. Am. Chem. Soc. **55**, 2098 1933.
4. Schlenk, W., and E. Bergmann, Ann. **463**, 1 1928.
5. Schlenk, W., J. Renning, and G. Racky, Ber. **44**, 1178 1911.
6. Wittig, G., and H. Kosak, Ann. **529**, 167 1937.
7. Wittig, G., and F. von Lupin, Ber. **61**, 1627 1928.

3. FOUR BIPHENYLYL SUBSTITUTIONS ON ALKENES, $C_nH_{2n-64}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,2-Tetrabiphenylylethene**  | | | | |
| 330[1] | | | | |

**References on Four Biphenylyl Substitutions on Alkenes**

1. Schlenk, W., J. Renning, and G. Racky, Ber. **44**, 1178 1911.

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,2,3,4,5,6,6-Octaphenylhexadiene-1,5**  | | | | |
| 255[1] | | | | |

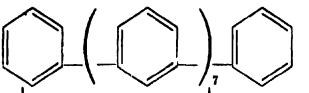
**References on Eight Phenyl Substitutions on Alkadienes**

1. Bergmann, E., and H. Weiss, Ber. **64**, 1485 1931.

## XXIII. COMPOUNDS CONTAINING NINE PHENYL GROUPS

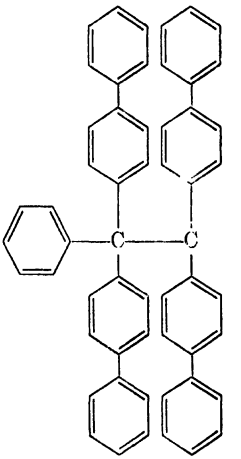
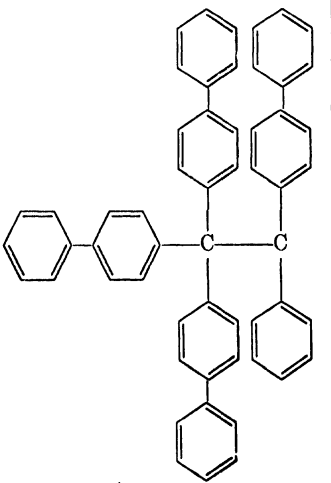
1. Nonaphenyl $C_nH_{2n-70}$
2. One Phenyl and Four Biphenylyl Substitutions on Alkanes $C_nH_{2n-70}$

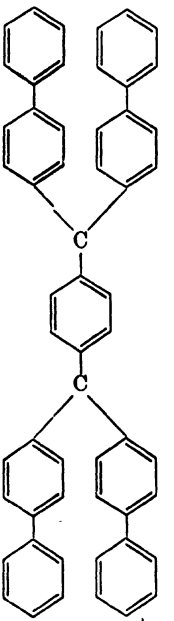
1. NONAPHENYL, $C_nH_{2n-70}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***m*-Nonaphenyl**  | | | | |
| 166[1] | | | | |

## References on Nonaphenyl

1. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 1936.

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1-Phenyl-1,1,2,2-tetra-*p*-biphenylylethane**  222–228 (in $N_2$)[1] | | | | |
| **1,1,1,2-Tetra-*p*-biphenylyl-2-phenylethane**  223–226 (in $N_2$)[1] | | | | |

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,4-Di-(di-*p*-biphenylylmethyl)-benzene  | | | | |
| 338–341(a) [1] | | | | |

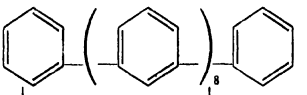
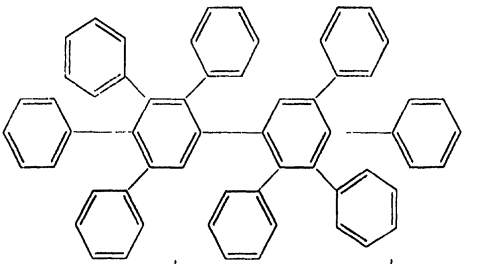
(a) This compound decomposes at the melting point.

**References on One Phenyl and Four Biphenylyl Substitutions on Alkanes**

1. Bachmann, W. E., and F. Y. Wiselogle, J. Org. Chem. 1, 354 1936-1937.
2. Wittig, G., and H. Krōhne, Ann. 529, 142 1937.

# XXIV. COMPOUNDS CONTAINING TEN PHENYL GROUPS

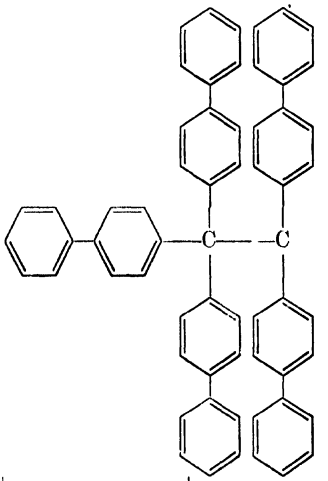
1. Decaphenyls $C_nH_{2n-78}$
2. Five Biphenylyl Substitutions on Alkanes $C_nH_{2n-78}$
3. Ten Phenyl Substitutions on Alkahexaenes $C_nH_{2n-96}$

| M. P., °C | B. P., °C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***m*-Decaphenyl**  184[1] | | | | |
| **2,2′,3,3′,4,4′,5,5′-Octaphenylbiphenyl**  318–319[2] | | | | |

**References on Decaphenyls**

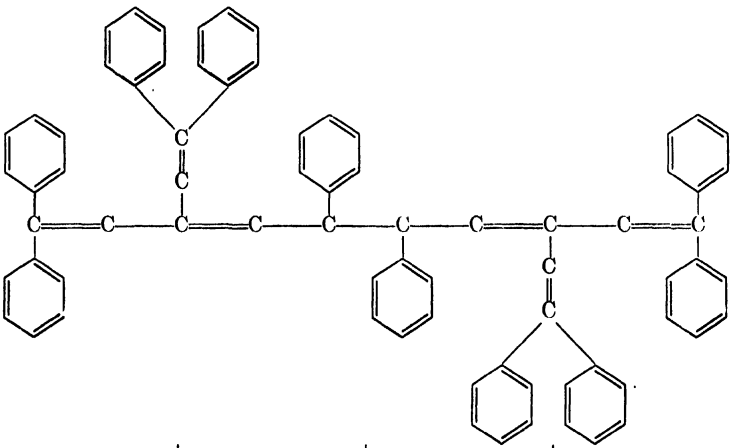
1. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 1936.
2. Dilthey, W., W. Schommer, W. Höschen, and H. Dietrichs, Ber. **68**, 1159 1935.

2. FIVE BIPHENYLYL SUBSTITUTIONS ON ALKANES, $C_nH_{2n-78}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| 1,1,1,2,2-Penta-*p*-biphenylylethane  | | | | |
| 226–234 (in $N_2$)[1] | | | | |

**References on Five Biphenylyl Substitutions on Alkanes**

1. Bachmann, W. E., and F. Y. Wiselogle, J. Org. Chem. 1, 354 1936-1937.

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **1,1,5,6,10,10-Hexaphenyl-3,8-di-(2′,2′-diphenylethenyl)-decatetraene-1,3,7,9**  | | | | |
| 180(a)[1] | | | | |

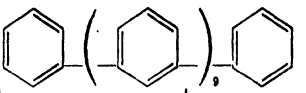
(a) Decomposition takes place at 180.

**References on Ten Phenyl Substitutions on Alkahexaenes**

1. Wittig, G., and H. Kosack, Ann. 529, 167 1937.

## XXV. HIGHER PHENYL COMPOUNDS

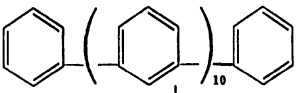
1. Undecaphenyl $C_nH_{2n-86}$
2. Duodecaphenyl $C_nH_{2n-94}$
3. Tridecaphenyl $C_nH_{2n-102}$
4. Tetradecaphenyl $C_nH_{2n-110}$
5. Quinquedecaphenyl $C_nH_{2n-118}$
6. Sexadecaphenyl $C_nH_{2n-126}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***m*-Undecaphenyl**  | | | | |
| 202[1] | | | | |

**References on Undecaphenyl**

1. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 1936.

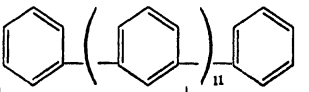
## 2. DUODECAPHENYL, $C_nH_{2n-94}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **m-Duodecaphenyl**  | | | | |
| 223[1] | | | | |

References on Duodecaphenyl

1. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 **1936.**

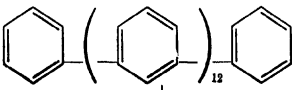
3. TRIDECAPHENYL, $C_nH_{2n-10}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **m-Tridecaphenyl**  | | | | |
| 245[1] | | | | |

**References on Tridecaphenyl**

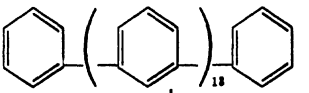
1. Busch. M., and W. Weber, J. prakt. Chem. [2] 146, 1, 1936.

4. TETRADECAPHENYL, $C_nH_{2n-110}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **m-Tetradecaphenyl**  | | | | |
| 270–271[1] | | | | |

**References on Tetradecaphenyl**

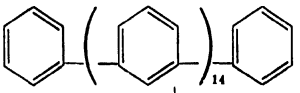
1. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 1936.

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| **m-Quinquedecaphenyl**  | | | | |
| 292[1] | | | | |

## References on Quinquedecaphenyl

1. Busch, M., and W. Weber, J. prakt. Chem. [2] **146**, 1 1936.

## 6. SEXADECAPHENYL, $C_nH_{2n-126}$

| M. P., °C | B. P.,°C @ 760mm | $D_4^{20}$ | $n_D^{20}$ | Additional Data |
|---|---|---|---|---|
| ***m*-Sexadecaphenyl**  | | | | |
| 321[1] | | | | |

### References on Sexadecaphenyl

1. Busch, M., and W. Weber, J. prakt. Chem. [2] 146, 1 1936.

## CHAPTER IX.

### Loyalty to Government.

**Royal Visit.**—I was invited by the First Assistant to the Honourable the Resident on the occasion of the unveiling of Her Majesty the Queen's Statue at 4-30 P.M. on the 5th February 1906 during the Royal Visit.

**The Jubilee in 1908.**—The following letter No. G. 3375 Gnl. 163-08-21, dated 2nd October 1908 from the Secretary to the Government of Mysore, General and Revenue Departments to the Deputy Commissioner of Bangalore District, will bear testimony to the loyalty of my family to the British Government :—

**"Chennapatna Mohammadans fed the poor in honour of the Day and offered prayers for His Majesty and His Highness' long life and prosperity and Mosque illuminated."**—In forwarding the telegram dated 3rd November 1908 from Sowcar Mohammad Mustan Sahib of Chennapatna to the Honourable the Resident in Mysore, I am directed to request that you will be so good as to communicate to the Sowcar