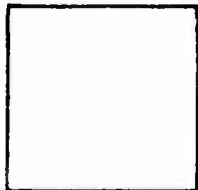


PHOTOGRAPH THIS SHEET

AD A 951 936

DTIC ACCESSION NUMBER



LEVEL



INVENTORY

The TPRC Data Series. Volume 2

DOCUMENT IDENTIFICATION

1971

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

DISTRIBUTION STATEMENT

ACCESSION FOR	
NTIS	GRA&I <input checked="" type="checkbox"/>
DTIC	TAB <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	
(1971)	
BY	
DISTRIBUTION /	
AVAILABILITY CODES	
DIST	AVAIL AND/OR SPECIAL
A	21

DISTRIBUTION STAMP

UNANNOUNCED



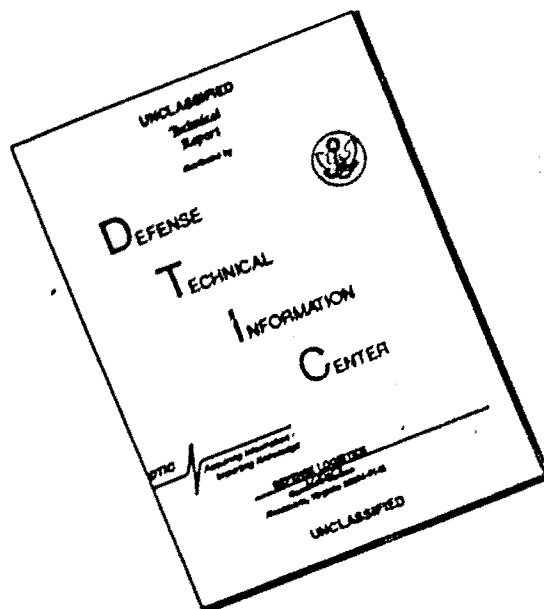
DATE ACCESSIONED

83 05 18 003

DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

T009

THEMOPHYSICAL PROPERTIES OF MATTER
The TPRC Data Series
VOLUME 2

AD A 951 936

THERMAL CONDUCTIVITY

Nonmetallic Solids

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

After this book has been put
on microfiche, please return
to address below:
Telephone No. (317) 494-6300

TEPIAC/Purdue University
Attn: Wade H. Shafer
2595 Yeager Road
West Lafayette, IN 47906

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Thermophysical Properties of Matter-The TPRC Data Series--Vol 2. Thermal Conductivity-Nonmetallic Solids		5. TYPE OF REPORT & PERIOD COVERED Data Book (see block 18)
7. AUTHOR(s) Touloukian, Y.S.; Powell, R.W.; Ho, C.Y. and Klemens, P.G.		6. PERFORMING ORG. REPORT NUMBER TPRC Data Series/Vol. 2
9. PERFORMING ORGANIZATION NAME AND ADDRESS CINDAS/Purdue University 2595 Yeager Road West Lafayette, IN 47906		8. CONTRACT OR GRANT NUMBER(s) F33615-71-C-1182
11. CONTROLLING OFFICE NAME AND ADDRESS Defense Logistics Agency DTIC-AI/Cameron Station Alexandria, VA 22314		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Army Materials & Mechanics Research Center Attn: DRXMR-P/Arsenal Street Watertown, MA 02172		12. REPORT DATE 1971
		13. NUMBER OF PAGES 1,302
		15. SECURITY CLASS. (of this report) Unclassified
16. DISTRIBUTION STATEMENT (of this Report) Unlimited		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES TEPIAC Publication (DTIC source code 413571) Limited hard copies on Data Book available from publisher: Plenum Publishing Corp, 227 W. 17th St., New York, NY 10011 Price: \$115/copy. Microfiche copy available from DTIC		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) *Thermal Conductivity-- *Thermophysical Properties--*Nonmetallics--Alum--Alumina--Aluminum oxides--cermets--oxides--oxide mixtures--silicates--laminates--asbestos-- (continue on reverse side)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The TPRC Data Series published in 13 volumes plus a Master Index volume constitutes a permanent and valuable contribution to science and technology. This 17,000 page Data Series should form a necessary acquisition to all scientific and technological libraries and laboratories. These volumes contain an enormous amount of data and information for thermophysical properties on more than 5,000 different materials of interest to researchers in government laboratories and the defense industrial establishment. (continue on reverse side)		

DD FORM 1473

1 JAN 73

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

19. KEYWORDS (cont)

Fluorides--concrete--basalt--bauxite--minerals--benzene--beryl--beryllium
 oxides--carbides--bricks--calcite--carbonates--carbon--cement--ceramics--
 silicides--clay--coal--coatings--composites--diamond--diatomite--soil--
 rubber compounds--fibers--fiberboard--fiberglass--wood--firebrick--glass--
 borosilicate glass--corning glasses--silica glass--lime glass--plate glass--
 soda glass--graphite--nitrides--iodine--ivory--limestone--aluminates--marble--
 nitrides--iodine--ivory--limestone--aluminates--marble--mica--mineral wool--
 phosphorus--plaster--plexiglas--polymers--plastics--polyethylene--polystyrene--
 porcelain--pyrocerams--quartz--resin--rocks--rubber--ruby--rutile--salt--sand--
 sandstone--sapphire--silica--sodium chloride--hydroxides--sulfates--nitrates--
 spinel--sulfur--honeycomb structures--teflon--inorganic compounds

20. ABSTRACT (cont)

Volume 2. 'Thermal Conductivity - Nonmetallic Solids,' Touloukian,
 Y.S., Powell, R. W., Ho, C. Y., and Klemens, P.G., 1302
 pp., 1970.

Volume 2 in this 14 volume TPRC Data Series covers nonmetallic materials which
 are in the solid state at normal temperature and pressure, including five
 elements (with over 100 varieties of graphite), 53 simple and complex oxides,
 82 systems of oxide mixtures, 83 nonoxide compounds, seven systems of mixtures
 of oxides and nonoxides, 15 organic compounds, 22 kinds of cermets, 10 groups
 of systems, eight kinds of refractory materials, over 40 kinds of glasses, 24
 minerals, 16 polymers, 26 animal and vegetable natural substances, 30 processed
 composites and processed natural and mineral substances, and 10 aggregate mixes,
 slags, scales, and residues. Data for the elements and for a few oxides have
 been critically evaluated, analyzed, and synthesized, and recommended values
 or provisional values are presented in addition to the original experimental
 data.

1302 pages, 1971

\$115.00(\$138.00 outside US)

#61233

T009[#]₂

PROPERTY OF
THERMOPHYSICAL PROPERTIES RESEARCH CENTER

**THERMAL
CONDUCTIVITY**
Nonmetallic Solids

THERMOPHYSICAL PROPERTIES OF MATTER
The TPRC Data Series

A Comprehensive Compilation of Data by the
Thermophysical Properties Research Center (TPRC), Purdue University

Y. S. Touloukian, Series Editor
C. Y. Ho, Series Technical Editor

- Volume 1. Thermal Conductivity—Metallic Elements and Alloys
- Volume 2. Thermal Conductivity—Nonmetallic Solids
- Volume 3. Thermal Conductivity—Nonmetallic Liquids and Gases
- Volume 4. Specific Heat—Metallic Elements and Alloys
- Volume 5. Specific Heat—Nonmetallic Solids
- Volume 6. Specific Heat—Nonmetallic Liquids and Gases
- Volume 7. Thermal Radiative Properties—Metallic Elements and Alloys
- Volume 8. Thermal Radiative Properties—Nonmetallic Solids
- Volume 9. Thermal Radiative Properties—Coatings
- Volume 10. Thermal Diffusivity
- Volume 11. Viscosity
- Volume 12. Thermal Expansion—Metallic Elements and Alloys
- Volume 13. Thermal Expansion—Nonmetallic Solids

New data on thermophysical properties are being constantly accumulated at TPRC. Contact TPRC and use its interim updating services for the most current information.

THERMOPHYSICAL PROPERTIES OF MATTER
VOLUME 2

THERMAL CONDUCTIVITY

Nonmetallic Solids

Y. S. Touloukian

Director
Thermophysical Properties Research Center
and
Distinguished Atkins Professor of Engineering
School of Mechanical Engineering
Purdue University
and
Visiting Professor of Mechanical Engineering
Auburn University

R. W. Powell

Senior Researcher
Thermophysical Properties Research Center
Purdue University
Formerly
Senior Principal Scientific Officer
Basic Physics Division
National Physical Laboratory
England

C. Y. Ho

Head of Data Tables Division
and
Associate Senior Researcher
Thermophysical Properties Research Center
Purdue University

P. G. Klemens

Professor and Head
Department of Physics
University of Connecticut
and
Visiting Research Professor
Thermophysical Properties Research Center
Purdue University

IFI/PLENUM • NEW YORK-WASHINGTON • 1970

Library of Congress Catalog Card Number 73-129616

SBN (13-Volume Set) 306-67020-8

SBN (Volume 2) 306-67022-4

Copyright © 1970, Purdue Research Foundation

IFI/Plenum Data Corporation is a subsidiary of
Plenum Publishing Corporation
227 West 17th Street, New York, N.Y. 10011

Distributed in Europe by Heyden & Son, Ltd.
Spectrum House, Alderton Crescent
London N.W. 4, England

Printed in the United States of America

"In this work, when it shall be found that much is omitted, let it not be forgotten that much likewise is performed..."

SAMUEL JOHNSON, A.M.

From last paragraph of Preface to his two-volume *Dictionary of the English Language*, Vol. I, page 5, 1755, London, Printed by Strahan.

Foreword

In 1957, the Thermophysical Properties Research Center (TPRC) of Purdue University, under the leadership of its founder, Professor Y. S. Touloukian, began to develop a coordinated experimental, theoretical, and literature review program covering a set of properties of great importance to science and technology. Over the years, this program has grown steadily, producing bibliographies, data compilations and recommendations, experimental measurements, and other output. The series of volumes for which these remarks constitute a foreword is one of these many important products. These volumes are a monumental accomplishment in themselves, requiring for their production the combined knowledge and skills of dozens of dedicated specialists. The Thermophysical Properties Research Center deserves the gratitude of every scientist and engineer who uses these compiled data.

The individual nontechnical citizen of the United States has a stake in this work also, for much of the science and technology that contributes to his well-being relies on the use of these data. Indeed, recognition of this importance is indicated by a mere reading of the list of the financial sponsors of the Thermophysical Properties Research Center; leaders of the technical industry of the United States and agencies of the Federal Government are well represented.

Experimental measurements made in a laboratory have many potential applications. They might be used, for example, to check a theory, or to help design a chemical manufacturing plant, or to compute the characteristics of a heat exchanger in a nuclear power plant. The progress of science and technology demands that results be published in the open literature so that others may use them. Fortunately for progress, the useful data in any single field are not scattered throughout the tens of thousands of technical journals published throughout the world. In most fields, fifty percent of the useful work appears in no more than thirty or forty journals. However, in the case of TPRC, its field is so broad

that about 100 journals are required to yield fifty percent. But that other fifty percent! It is scattered through more than 3500 journals and other documents, often items not readily identifiable or obtainable. Nearly 50,000 references are now in the files.

Thus, the man who wants to use existing data, rather than make new measurements himself, faces a long and costly task if he wants to assure himself that he has found all the relevant results. More often than not, a search for data stops after one or two results are found—or after the searcher decides he has spent enough time looking. Now with the appearance of these volumes, the scientist or engineer who needs these kinds of data can consider himself very fortunate. He has a single source to turn to; thousands of hours of search time will be saved, innumerable repetitions of measurements will be avoided, and several billions of dollars of investment in research work will have been preserved.

However, the task is not ended with the generation of these volumes. A critical evaluation of much of the data is still needed. Why are discrepant results obtained by different experimentalists? What undetected sources of systematic error may affect some or even all measurements? What value can be derived as a "recommended" figure from the various conflicting values that may be reported? These questions are difficult to answer, requiring the most sophisticated judgment of a specialist in the field. While a number of the volumes in this Series do contain critically evaluated and recommended data, these are still in the minority. The data are now being more intensively evaluated by the staff of TPRC as an integral part of the effort of the National Standard Reference Data System (NSRDS). The task of the National Standard Reference Data System is to organize and operate a comprehensive program to prepare compilations of critically evaluated data on the properties of substances. The NSRDS is administered by the National Bureau of Standards under a directive from the Federal Council for Science

and Technology, augmented by special legislation of the Congress of the United States. TPRC is one of the national resources participating in the National Standard Reference Data System in a united effort to satisfy the needs of the technical community for readily accessible, critically evaluated data.

As a representative of the NBS Office of Standard Reference Data, I want to congratulate Professor Touloukian and his colleagues on the accomplishments represented by this Series of reference data

books. Scientists and engineers the world over are indebted to them. The task ahead is still an awesome one and I urge the nation's private industries and all concerned Federal agencies to participate in fulfilling this national need of assuring the availability of standard numerical reference data for science and technology.

EDWARD L. BRADY
*Associate Director for Information Programs
National Bureau of Standards*

Preface

Thermophysical Properties of Matter, the TPRC Data Series, is the culmination of twelve years of pioneering effort in the generation of tables of numerical data for science and technology. It constitutes the restructuring, accompanied by extensive revision and expansion of coverage, of the original *TPRC Data Book*, first released in 1960 in loose-leaf format, 11" x 17" in size, and issued in June and December annually in the form of supplements. The original loose-leaf *Data Book* was organized in three volumes: (1) metallic elements and alloys, (2) nonmetallic elements, compounds, and mixtures which are solid at N.T.P., and (3) nonmetallic elements, compounds, and mixtures which are liquid or gaseous at N.T.P. Within each volume, each property constituted a chapter.

Because of the vast proportions the *Data Book* began to assume over the years of its growth and the greatly increased effort necessary in its maintenance by the user, it was decided in 1967 to change from the loose-leaf format to a conventional publication. Thus, the December 1966 supplement of the original *Data Book* was the last supplement disseminated by TPRC.

While the manifold physical, logistic, and economic advantages of the bound volume over the loose-leaf oversize format are obvious and welcome to all who have used the unwieldy original volumes, the assumption that this work will no longer be kept on a current basis because of its bound format would not be correct. Fully recognizing the need of many important research and development programs which require the latest available information, TPRC has instituted a *Data Update Plan* enabling the subscriber to inquire, by telephone if necessary, for specific information and receive, in many instances, same-day response on any new data processed or revision of published data since the latest edition. In this context, the TPRC Data Series departs drastically from the conventional handbook and giant multivolume classical works, which are no longer adequate media for the dissemination of

numerical data of science and technology without a continuing activity on contemporary coverage. The loose-leaf arrangements of many works fully recognize this fact and attempt to develop a combination of bound volumes and loose-leaf supplement arrangements as the work becomes increasingly large. TPRC's *Data Update Plan* is indeed unique in this sense since it maintains the contents of the TPRC Data Series current and live on a day-to-day basis between editions. In this spirit, I strongly urge all purchasers of these volumes to complete in detail and return the *Volume Registration Certificate* which accompanies each volume in order to assure themselves of the continuous receipt of annual listing of corrigenda during the life of the edition.

The TPRC Data Series consists initially of 13 independent volumes. The initial ten volumes will be published in 1970, and the remaining three by 1972. It is also contemplated that subsequent to the first edition, each volume will be revised, updated, and reissued in a new edition approximately every fifth year. The organization of the TPRC Data Series makes each volume a self-contained entity available individually without the need to purchase the entire Series.

The coverage of the specific thermophysical properties represented by this Series constitutes the most comprehensive and authoritative collection of numerical data of its kind for science and technology.

Whenever possible, a uniform format has been used in all volumes, except when variations in presentation were necessitated by the nature of the property or the physical state concerned. In spite of the wealth of data reported in these volumes, it should be recognized that all volumes are not of the same degree of completeness. However, as additional data are processed at TPRC on a continuing basis, subsequent editions will become increasingly more complete and up to date. Each volume in the Series basically comprises three sections, consisting of a text, the body of numerical data with source references, and a material index.

The aim of the textual material is to provide a complementary or supporting role to the body of numerical data rather than to present a treatise on the subject of the property. The user will find a basic theoretical treatment, a comprehensive presentation of selected works which constitute reviews, or compendia of empirical relations useful in estimation of the property when there exists a paucity of data or when data are completely lacking. Established major experimental techniques are also briefly reviewed.

The body of data is the core of each volume and is presented in both graphical and tabular format for convenience of the user. Every single point of numerical data is fully referenced as to its original source and no secondary sources of information are used in data extraction. In general, it has not been possible to critically scrutinize all the original data presented in these volumes, except to eliminate perpetuation of gross errors. However, in a significant number of cases, such as for the properties of liquids and gases and the thermal conductivity of all the elements, the task of full evaluation, synthesis, and correlation has been completed. It is hoped that in subsequent editions of this continuing work, not only new information will be reported but the critical evaluation will be extended to increasingly broader classes of materials and properties.

The third and final major section of each volume is the material index. This is the key to the volume, enabling the user to exercise full freedom of access to its contents by any choice of substance name or detailed alloy and mixture composition, trade name, synonym, etc. Of particular interest here is the fact that in the case of those properties which are reported in separate companion volumes, the material index in each of the volumes also reports the contents of the other companion volumes.* The sets of companion volumes are as follows:

Thermal conductivity:	Volumes 1, 2, 3
Specific heat:	Volumes 4, 5, 6
Radiative properties:	Volumes 7, 8, 9
Thermal expansion:	Volumes 12, 13

The ultimate aims and functions of TPRC's Data Tables Division are to extract, evaluate, reconcile, correlate, and synthesize all available data for the thermophysical properties of materials with

*For the first edition of the Series, this arrangement was not feasible for Volume 7 due to the sequence and the schedule of its publication. This situation will be resolved in subsequent editions.

the result of obtaining internally consistent sets of property values, termed the "recommended reference values." In such work, gaps in the data often occur, for ranges of temperature, composition, etc. Whenever feasible, various techniques are used to fill in such missing information, ranging from empirical procedures to detailed theoretical calculations. Such studies are resulting in valuable new estimation methods being developed which have made it possible to estimate values for substances and/or physical conditions presently unmeasured or not amenable to laboratory investigation. Depending on the available information for a particular property and substance, the end product may vary from simple tabulations of isolated values to detailed tabulations with generating equations, plots showing the concordance of the different values, and, in some cases, over a range of parameters presently unexplored in the laboratory.

The TPRC Data Series constitutes a permanent and valuable contribution to science and technology. These constantly growing volumes are invaluable sources of data to engineers and scientists, sources in which a wealth of information heretofore unknown or not readily available has been made accessible. We look forward to continued improvement of both format and contents so that TPRC may serve the scientific and technological community with ever-increasing excellence in the years to come. In this connection, the staff of TPRC is most anxious to receive comments, suggestions, and criticisms from all users of these volumes. An increasing number of colleagues are making available at the earliest possible moment reprints of their papers and reports as well as pertinent information on the more obscure publications. I wish to renew my earnest request that this procedure become a universal practice since it will prove to be most helpful in making TPRC's continuing effort more complete and up to date.

It is indeed a pleasure to acknowledge with gratitude the multisource financial assistance received from over fifty of TPRC's sponsors which has made the continued generation of these tables possible. In particular, I wish to single out the sustained major support being received from the Air Force Materials Laboratory-Air Force Systems Command, the Office of Standard Reference Data-National Bureau of Standards, and the Office of Advanced Research and Technology-National Aeronautics and Space Administration. TPRC is indeed proud to have been designated as a National Information Analysis Center for the Department of Defense as well as a component of the National

Standard Reference Data System under the cognizance of the National Bureau of Standards.

While the preparation and continued maintenance of this work is the responsibility of TPRC's Data Tables Division, it would not have been possible without the direct input of TPRC's Scientific Documentation Division and, to a lesser degree, the Theoretical and Experimental Research Divisions. The authors of the various volumes are the senior staff members in responsible charge of the work. It should be clearly understood, however, that many have contributed over the years and their contributions are specifically acknowledged in each volume. I wish to take this opportunity to personally

thank those members of the staff, research assistants, graduate research assistants, and supporting graphics and technical typing personnel without whose diligent and painstaking efforts this work could not have materialized.

Y. S. TOULOUKIAN

*Director
Thermophysical Properties Research Center
Distinguished Atkins Professor of Engineering*

Purdue University
Lafayette, Indiana
July 1969

Introduction to Volume 2

This volume of *Thermophysical Properties of Matter*, the TPRC Data Series, is among the more comprehensive of all the volumes of the Series. Indeed, it is the result of one of TPRC's oldest data tables programs, initiated in 1960.

The volume comprises three major sections: namely, the front text material together with its bibliography, the main body of numerical data and its references, and the material index.

The text material is intended to assume a role complementary to the main body of numerical data which is the primary purpose of this volume. It is felt that a concise discussion of the theoretical nature of the property under consideration together with a review of predictive procedures and recognized experimental techniques will be appropriate in a major reference work of this kind. The extensive reference citations given in the text should lead the interested reader to sufficient literature for a detailed study. It is hoped, however, that enough detail is presented for this volume to be self-contained for the practical user.

The main body of the volume consists of the presentation of numerical data compiled over the years in a most comprehensive and meticulous manner. The scope of coverage includes most nonmetallic materials of engineering importance which are in the solid state at normal temperature and pressure. The extraction of all data directly from their original sources ensures freedom from errors of transcription. Furthermore, some gross errors appearing in the original source documents have been corrected. The organization and presentation of the data together with other pertinent information on the use of the tables and figures are discussed in detail in the text of the section entitled *Numerical Data*.

While only a very limited number of the materials reported have been critically evaluated, it is planned that the policy of Volume 1 will be extended and that future editions of this volume will include the "recommended values" for an

increasing number of materials which can be reasonably well characterized to enable critical analysis.

As stated earlier, all data have been obtained from their original sources and each data set is so referenced. TPRC has in its files all documents cited in this volume. Those that cannot be readily obtained elsewhere are available from TPRC in microfiche form.

The material index at the end of the volume covers the contents of all three companion volumes (Volumes 1, 2, and 3) on thermal conductivity. It is hoped that the user will find these comprehensive indices helpful.

This volume has grown out of activities made possible by TPRC's Founder Sponsors and through the principal support of the Air Force Materials Laboratory—Air Force Systems Command, under the monitorship of Mr. John H. Charlesworth. The limited effort on the critical analysis of the data for the elements and some oxides was made possible through the support of the Office of Standard Reference Data—National Bureau of Standards, under the monitorship of Dr. Howard J. White, Jr. Over the past nine years, many graduate students and research assistants have rendered assistance for long or short periods under the authors' supervision. We wish to acknowledge in chronological order of their association with TPRC, the contributions of Messrs. C. Y. Wang, K. C. Lin, D. Y. Nee, R. L. Feng, J. J. G. Hsia, M. Mangkornkanok, M. Nalbantyan, G. K. Kirjilian, and Mrs. E. K. C. Lee and Mr. K. Y. Wu. The two last mentioned are still at TPRC and participated in the final organization of the tables and figures and the demanding task of checking details. We also wish to acknowledge the benefit of extensive discussions with Dr. J. Kaspar, Senior Staff Scientist, Materials Sciences Laboratory, Aerospace Corporation. He is also a Visiting Research Professor at TPRC.

Inherent to the character of this work is the fact that in the preparation of this volume, we have

drawn most heavily upon the scientific literature and feel a debt of gratitude to the authors of the referenced articles. While their often discordant results have caused us much difficulty in reconciling their findings, we consider this to be our challenge and our contribution to negative entropy of information, as an effort is made to create from the randomly distributed data a condensed, more orderly state.

While this volume is primarily intended as a reference work for the designer, researcher, experimentalist, and theoretician, the teacher at the graduate level may also use it as a teaching tool to point out to his students the topography of the state of knowledge on the thermal conductivity of non-metallic solids. We believe there is also much food for reflection by the specialist and the academician concerning the meaning of "original" investigation and its "information content."

The authors and their contributing associates are keenly aware of the possibility of many weaknesses in a work of this scope. We hope that we will not be judged too harshly and that we will receive the benefit of your suggestions regarding references omitted, additional material groups needing more detailed treatment, improvements in presentation, and, most important, any inadvertent errors. If the *Volume Registration Certificate* accompanying this volume is returned, the reader will assure himself of receiving annually a list of corrigenda as possible errors come to our attention.

Lafayette, Indiana
July 1969

Y. S. TOULOUKIAN
R. W. POWELL
C. Y. HO
P. G. KLEMENS

Contents

Foreword	vii
Preface	ix
Introduction to Volume 2	xiii
Grouping of Materials and List of Figures and Tables	xviii

Theory, Estimation, and Measurement

<i>Notation</i>	1a
<i>Theory of Thermal Conductivity of Nonmetallic Solids</i>	3a
1. Introduction	3a
2. Lattice Waves	4a
3. Lattice Thermal Conductivity	5a
4. Intrinsic Resistivity at High Temperatures	6a
5. Intrinsic Resistivity at Low Temperatures	7a
6. Boundary Resistance	8a
7. Thermal Resistances due to Lattice Imperfections	9a
8. Amorphous Solids	10a
9. Resonant Scattering	10a
10. Other Cases	10a
<i>Experimental Determination of Thermal Conductivity</i>	13a
1. Introduction	13a
2. Steady-State Methods	14a
A. Longitudinal Heat Flow Methods	14a
a. Absolute Methods	14a
(i) Rod Method	14a
(ii) Plate (or Disk) Method	15a
b. Comparative Methods	16a
(i) Divided-Rod (or Cut-Bar) Method	16a
(ii) Plate (or Disk) Method	16a
c. Combined Method	16a
B. Forbes' Bar Method	16a
C. Radial Heat Flow Methods	17a
a. Absolute Methods	17a
(i) Cylindrical Method	17a
(ii) Spherical and Ellipsoidal Methods	18a
(iii) Concentric Sphere and Concentric Cylinder Methods	18a
(iv) de Sénarmont's Plate Method	18a
b. Comparative Methods	19a
(i) Concentric Cylinder Method	19a
(ii) Disk Method	19a

D. Direct Electrical Heating Methods	19a
a. Cylindrical Rod Methods	20a
(i) Longitudinal Heat Flow Method	20a
(ii) Radial Heat Flow Method	20a
(iii) Thin-Rod-Approximation Method	20a
b. Rectangular Bar Method	21a
E. Thermoelectrical Method	22a
F. Thermal Comparator Method	22a
3. Nonsteady-State Methods	22a
A. Periodic Heat Flow Methods	23a
a. Longitudinal Heat Flow Method	23a
b. Radial Heat Flow Method	23a
B. Transient Heat Flow Methods	23a
a. Longitudinal Heat Flow Method	23a
b. Flash Method	24a
c. Radial Heat Flow Method	24a
d. Line Heat Source and Probe Methods	24a
e. Moving Heat Source Method	24a
f. Comparative Method	25a
<i>References to Text</i>	27a

Numerical Data

<i>Data Presentation and Related General Information</i>	41a
1. Scope of Coverage	41a
2. Presentation of Data	41a
3. Classification of Materials	42a
4. Symbols and Abbreviations used in the Figures and Tables	43a
5. Convention for Bibliographic Citation	43a
6. Conversion Factors for Thermal Conductivity Units	45a
7. Crystal Structures, Transition Temperatures, and Other Pertinent Physical Constants of the Elements	45a
<i>Numerical Data on Thermal Conductivity of Nonmetallic Solids</i> (See pp. xviii to xxix for detailed listing of entries for each of the following groups of materials)	1
1. Elements	1
2. Single Oxides	93
3. Oxide Compounds	251
4. Binary Mixtures of Single Oxides and/or Oxide Compounds	321
5. Multiple Mixtures of Single Oxides and/or Oxide Compounds	453
6. Mixtures of Oxide and Nonoxide	541
7. Borides	561
8. Bromides	565
9. Carbides	571
10. Chlorides	613
11. Fluorides and Their Mixtures	627
12. Nitrates	647
13. Nitrides	653
14. Phosphates	679
15. Sulfates	687
16. Sulfides and Their Mixtures	697
17. Cermets	707

18. Miscellaneous Inorganic Compounds and Mixtures	757
19. Minerals	797
20. Aggregate Mixes	861
21. Miscellaneous Refractory Materials <i>and Glasses</i>	889
22. Polymers	943
23. Miscellaneous Organic Compounds	985
24. Systems	1009
25. Animal and Vegetable Natural Substances and Their Derivatives	1059
26. Fabrics, Yarns, and Hairs	1093
27. Processed Composites	1107
28. Processed Mineral Substances	1135
29. Slags and Scales	1147
30. Residues	1155
<i>References to Data Sources</i>	1159

Material Index

<i>Material Index to Thermal Conductivity Companion Volumes 1, 2, and 3</i>	A1
---	----

GROUPING OF MATERIALS AND LIST OF FIGURES AND TABLES

1. ELEMENTS

Figure and/or Table No.	Name	Symbol	Page No.
1*	Boron	B	1
2	Carbon	C	5
3*	Carbon (Diamond)	C	9
	Carbon (Graphite)	C	
4	AGOT Graphite	. . . . .	13
5*	ATJ Graphite	. . . . .	20
6	AWG Graphite	. . . . .	24
7*	Pyrolytic Graphite	. . . . .	30
8	SA-25 Graphite	. . . . .	42
9*	875S Graphite	. . . . .	45
10*	890S Graphite	. . . . .	49
11	Miscellaneous Graphite ⁸	. . . . .	53
12*	Iodine	I	83
13*	Phosphorus	P	86
14*	Sulfur	S	89

2. SINGLE OXIDES

Figure and/or Table No.	Name	Formula	Page No.
15*	Aluminum Oxide (Sapphire)	Al ₂ O ₃	93
16*	Aluminum Oxide	Al ₂ O ₃	98
17	Barium Oxide	BaO	120
18*	Beryllium Oxide	BeO	123
19	Boron Oxide	B ₂ O ₃	138
20	Calcium Oxide	CaO	141
21	Cerium Dioxide	CeO ₂	144
22	(di)Copper Oxide	Cu ₂ O	147
23	Hafnium Dioxide	HfO ₂	150
24	Indium Oxide	InO	153
25	(tri)Iron Tetraoxide	Fe ₃ O ₄	154
26	Lithium Oxide	Li ₂ O	157
27*	Magnesium Oxide	MgO	158
28	Manganese Oxide	MnO	168
29	(tri)Manganese Tetraoxide	Mn ₃ O ₄	170
30	Nickel Oxide	NiO	171
31*	Silicon Dioxide (Crystalline)	SiO ₂	174
32*	Silicon Dioxide (Fused)	SiO ₂	183
33	Strontium Oxide	SrO	194
34*	Thorium Dioxide	ThO ₂	195

*Number marked with an asterisk indicates that recommended values are also reported for this material on separate figure and table of the same number followed by the letter R.

2. SINGLE OXIDES (continued)

Figure and/or Table No.	Name	Formula	Page No.
35	Tin Dioxide	SnO_2	199
36*	Titanium Dioxide	TiO_2	202
37	Tungsten Trioxide	WO_3	209
38	Uranium Dioxide	UO_2	210
39	(tri)Uranium Octoxide	U_3O_8	237
40	Yttrium Oxide	Y_2O_3	240
41	Zinc Oxide	ZnO	243
42	Zirconium Dioxide	ZrO_2	246

3. OXIDE COMPOUNDS

43	Aluminum Fluosilicate (Topaz)	$2\text{AlFO} \cdot \text{SiO}_2$	251
44	Aluminum Silicate (Mullite)	$3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	254
45	Barium Metatitanate	BaTiO_3	257
46	Barium Dtitanate	$\text{BaO} \cdot 2\text{TiO}_2$	260
47	Bismuth Stannate	$\text{Bi}_2(\text{SnO}_3)_3$	261
48	Calcium Stannate	CaSnO_3	264
49	Calcium Metatitanate	CaTiO_3	267
50	Calcium Tungstate	CaWO_4	270
51	(tri)Cobalt Strontium Metatitanate	$\text{Co}_3\text{SrTiO}_3$	271
52	Cobalt Zinc Ferrate	$\text{Co}(\text{Zn})\text{Fe}_2\text{O}_4$	272
53	Forsterite	Mg_2SiO_4	275
54	Garnet	$[\text{M}_1^{\text{II}}\text{M}_2^{\text{III}}](\text{SiO}_4)_3$	278
55	Lead Metatitanate	PbTiO_3	279
56	Lead Zirconate	PbZrO_3	282
57	Magnesium Aluminate	$\text{MgO} \cdot \text{Al}_2\text{O}_3$	283
58	Magnesium Aluminate	$\text{MgO} \cdot 3, 5\text{Al}_2\text{O}_3$	286
59	Magnesium Stannate	MgSnO_3	289
60	Manganese Ferrate	MnFe_2O_4	292
61	Manganese Zinc Ferrate	$\text{Mn}(\text{Zn})\text{Fe}_2\text{O}_4$	295
62	Nickel Zinc Ferrate	$\text{Ni}(\text{Zn})\text{Fe}_2\text{O}_4$	298
63	Sodium Tungsten Bronze	Na_xWO_3	301
64	Strontium Metatitanate	SrTiO_3	304
65	Strontium Zirconate	SrZrO_3	307
66	Yttrium Aluminate	$\text{Y}_3\text{Al}_5\text{O}_{12}$	308
67	Yttrium Ferrate	$\text{Y}_3\text{Fe}_2(\text{FeO}_4)_3$	311
68	Zinc Ferrate	ZnFe_2O_4	314
69	Zirconium Orthosilicate	ZrSiO_4	317

* Number marked with an asterisk indicates that recommended values are also reported for this material on separate figure and table of the same number followed by the letter R.

xx *Grouping of Materials and List of Figures and Tables*

4. BINARY MIXTURES OF SINGLE OXIDES AND/OR OXIDE COMPOUNDS

Figure and/or Table No.	Name		Page No.
70	Aluminum Oxide + Aluminum Silicate	$Al_2O_3 + 3Al_2O_3 \cdot 2SiO_2$	321
71	Aluminum Oxide + (di)Chromium Trioxide	$Al_2O_3 + Cr_2O_3$	324
72	Aluminum Oxide + (di)Manganese Trioxide	$Al_2O_3 + Mn_2O_3$	327
73	Aluminum Oxide + Silicon Dioxide	$Al_2O_3 + SiO_2$	328
74	Aluminum Oxide + Zirconium Dioxide	$Al_2O_3 + ZrO_2$	331
75	Aluminum Silicate + Aluminum Oxide	$3Al_2O_3 \cdot 2SiO_2 + Al_2O_3$	334
76	Barium Oxide + Strontium Oxide	$BaO + SrO$	337
77	Barium Metatitanate + Calcium Metatitanate	$BaTiO_3 + CaTiO_3$	340
78	Barium Metatitanate + Magnesium Zirconate	$BaTiO_3 + MgZrO_3$	343
79	Barium Metatitanate + Manganese Niobate	$BaTiO_3 + Mn_2Nb_2O_7$	344
80	Beryllium Oxide + Uranium Dioxide	$BeO + UO_2$	347
81	Cerium Dioxide + Magnesium Oxide	$CeO_2 + MgO$	350
82	Cerium Dioxide + Uranium Dioxide	$CeO_2 + UO_2$	353
83	Gadolinium Oxide + Samarium Oxide	$Gd_2O_3 + Sm_2O_3$	356
84	Lead Oxide + Silicon Dioxide	$PbO + SiO_2$	359
85	Magnesium Aluminate + Magnesium Oxide	$MgO \cdot Al_2O_3 + MgO$	362
86	Magnesium Aluminate + Silicon Dioxide	$MgO \cdot Al_2O_3 + SiO_2$	365
87	Magnesium Aluminate + (di)Sodium Oxide	$MgO \cdot Al_2O_3 + Na_2O$	368
88	Magnesium Oxide + Beryllium Oxide	$MgO + BeO$	371
89	Magnesium Oxide + Clay	$MgO + Clay$	374
90	Magnesium Oxide + Magnesium Aluminate	$MgO + MgO \cdot Al_2O_3$	375
91	Magnesium Oxide + Magnesium Orthosilicate	$MgO + 2MgO \cdot SiO_2$	378
92	Magnesium Oxide + Nickel Oxide	$MgO + NiO$	381
93	Magnesium Oxide + Silicon Dioxide	$MgO + SiO_2$	384
94	Magnesium Oxide + Tin Dioxide	$MgO + SnO_2$	387
95	Magnesium Oxide + Uranium Dioxide	$MgO + UO_2$	390
96	Magnesium Oxide + Zinc Oxide	$MgO + ZnO$	391
97	Magnesium Orthosilicate + Magnesium Oxide	$2MgO \cdot SiO_2 + MgO$	394
98	(di)Manganese Trioxide + Aluminum Oxide	$Mn_2O_3 + Al_2O_3$	397
99	(di)Manganese Trioxide + Magnesium Oxide	$Mn_2O_3 + MgO$	398
100	(di)Manganese Trioxide + Silicon Dioxide	$Mn_2O_3 + SiO_2$	399
101	Silicon Dioxide + Aluminum Oxide	$SiO_2 + Al_2O_3$	402
102	Silicon Dioxide + Calcium Oxide	$SiO_2 + CaO$	407
103	Silicon Dioxide + (di)Iron Trioxide	$SiO_2 + Fe_2O_3$	410
104	Thorium Dioxide + Uranium Dioxide	$ThO_2 + UO_2$	413
105	Tin Dioxide + Magnesium Oxide	$SnO_2 + MgO$	416
106	Tin Dioxide + Zinc Oxide	$SnO_2 + ZnO$	419
107	Tungsten Trioxide + Zinc Oxide	$WO_3 + ZnO$	422
108	Uranium Dioxide + Beryllium Oxide	$UO_2 + BeO$	423
109	Uranium Dioxide + Calcium Oxide	$UO_2 + CaO$	426
110	Uranium Dioxide + (di)Niobium Pentoxide	$UO_2 + Nb_2O_5$	427
111	Uranium Dioxide + Yttrium Oxide	$UO_2 + Y_2O_3$	428
112	Uranium Dioxide + Zirconium Dioxide	$UO_2 + ZrO_2$	429
113	Yttrium Oxide + Uranium Dioxide	$Y_2O_3 + UO_2$	432
114	Zinc Oxide + Magnesium Oxide	$ZnO + MgO$	435
115	Zinc Oxide + Tin Dioxide	$ZnO + SnO_2$	438

4. BINARY MIXTURES OF SINGLE OXIDE AND/OR OXIDE COMPOUNDS (continued)

Figure and/or Table No.	Name	Formula	Page No.
116	Zirconium Dioxide + Aluminum Oxide	$ZrO_2 + Al_2O_3$	441
117	Zirconium Dioxide + Calcium Oxide	$ZrO_2 + CaO$	442
118	Zirconium Dioxide + Magnesium Oxide	$ZrO_2 + MgO$	446
119	Zirconium Dioxide + Yttrium Oxide	$ZrO_2 + Y_2O_3$	449

5. MULTIPLE MIXTURES OF SINGLE OXIDES AND/OR OXIDE COMPOUNDS

120	Aluminum Oxide + Silicon Dioxide + ΣX_1	$Al_2O_3 + SiO_2 + \Sigma X_1$	453
121	Aluminum Oxide + Titanium Dioxide + ΣX_1	$Al_2O_3 + TiO_2 + \Sigma X_1$	456
122	Barium Oxide + Silicon Dioxide + ΣX_1	$BaO + SiO_2 + \Sigma X_1$	457
123	Barium Oxide + Strontium Oxide + ΣX_1	$BaO + SrO + \Sigma X_1$	460
124	Beryllium Oxide + Aluminum Oxide + ΣX_1	$BeO + Al_2O_3 + \Sigma X_1$	461
125	Beryllium Oxide + Magnesium Oxide + ΣX_1	$BeO + MgO + \Sigma X_1$	464
126	Beryllium Oxide + Thorium Dioxide + ΣX_1	$BeO + ThO_2 + \Sigma X_1$	467
127	Beryllium Oxide + Zirconium Dioxide + ΣX_1	$BeO + ZrO_2 + \Sigma X_1$	470
128	(di)Chromium Trioxide + Magnesium Oxide + ΣX_1	$Cr_2O_3 + MgO + \Sigma X_1$	473
129	Lead Oxide + Silicon Dioxide + ΣX_1	$PbO + SiO_2 + \Sigma X_1$	474
130	Magnesium Oxide + Calcium Oxide + ΣX_1	$MgO + CaO + \Sigma X_1$	477
131	Magnesium Oxide + (di)Chromium Trioxide + ΣX_1	$MgO + Cr_2O_3 + \Sigma X_1$	480
132	Magnesium Oxide + (di)Iron Trioxide + ΣX_1	$MgO + Fe_2O_3 + \Sigma X_1$	483
133	Magnesium Oxide + Silicon Dioxide + ΣX_1	$MgO + SiO_2 + \Sigma X_1$	484
134	Silicon Dioxide + Aluminum Oxide + ΣX_1	$SiO_2 + Al_2O_3 + \Sigma X_1$	487
135	Silicon Dioxide + Barium Oxide + ΣX_1	$SiO_2 + BaO + \Sigma X_1$	495
136	Silicon Dioxide + Boron Oxide + ΣX_1	$SiO_2 + B_2O_3 + \Sigma X_1$	498
137	Silicon Dioxide + Calcium Oxide + ΣX_1	$SiO_2 + CaO + \Sigma X_1$	501
138	Silicon Dioxide + Lead Oxide + ΣX_1	$SiO_2 + PbO + \Sigma X_1$	504
139	Silicon Dioxide + (di)Potassium Oxide + ΣX_1	$SiO_2 + K_2O + \Sigma X_1$	507
140	Silicon Dioxide + (di)Sodium Oxide + ΣX_1	$SiO_2 + Na_2O + \Sigma X_1$	510
141	Strontium Oxide + Lithium Aluminate + ΣX_1	$SrO + Li_2O \cdot Al_2O_3 + \Sigma X_1$	513
142	Strontium Oxide + Lithium Zirconium Silicate + ΣX_1	$SrO + Li_2O \cdot ZrO \cdot SiO_2 + \Sigma X_1$	514
143	Strontium Oxide + Titanium Dioxide + ΣX_1	$SrO + TiO_2 + \Sigma X_1$	517
144	Strontium Oxide + Zinc Oxide + ΣX_1	$SrO + ZnO + \Sigma X_1$	520
145	Tin Dioxide + Magnesium Oxide + ΣX_1	$SnO_2 + MgO + \Sigma X_1$	523
146	Tin Dioxide + Zinc Oxide + ΣX_1	$SnO_2 + ZnO + \Sigma X_1$	524
147	Zinc Oxide + Strontium Oxide + ΣX_1	$ZnO + SrO + \Sigma X_1$	527
148	Zinc Oxide + Tin Dioxide + ΣX_1	$ZnO + SnO_2 + \Sigma X_1$	528
149	Zirconium Dioxide + Calcium Oxide + ΣX_1	$ZrO_2 + CaO + \Sigma X_1$	531
150	Zirconium Dioxide + Silicon Dioxide + ΣX_1	$ZrO_2 + SiO_2 + \Sigma X_1$	534
151	Zirconium Dioxide + Yttrium Oxide + ΣX_1	$ZrO_2 + Y_2O_3 + \Sigma X_1$	537

6. MIXTURES OF OXIDE AND NONOXIDE

Figure and/or Table No.	Name	Formula	Page No.
152	(tetra)Boron Carbide + Sodium Metasilicate	$B_4C + Na_2O \cdot SiO_2$	541
153	Graphite + Thorium Dioxide	$C + ThO_2$	544
154	Graphite + Uranium Dioxide	$C + UO_2$	547
155	Magnesium Oxide + Talc	$MgO + H_2Mg_3(SiO_3)_4$	550
156	Silicon Carbide + Silicon Dioxide	$SiC + SiO_2$	553
157	Silicon Carbide + Silicon Dioxide + ΣX_1	$SiC + SiO_2 + \Sigma X_1$	554
158	Thorium Dioxide + Graphite	$ThO_2 + C$	557

7. IODIDE

159	Cesium Iodide	CsI	561
160	Copper Iodide	CuI	562
161	Silver Iodide	AgI	563

8. BROMIDES

162	Cesium Bromide	CsBr	565
163	Potassium Bromide	KBr	566
164	Silver Bromide	AgBr	569
165	Thallium Bromide	TlBr	570

9. CARBIDES

166	(di)Beryllium Carbide	Be_2C	571
167	(tetra)Boron Carbide	B_4C	572
168	Hafnium Carbide	HfC	575
169	(tri)Iron Carbide	Fe_3C	578
170	(di)Molybdenum Carbide	Mo_2C	579
171	Niobium Carbide	NbC	582
172	Silicon Carbide	SiC	585
173	Tantalum Carbide	TaC	589
174	Thorium Carbide	ThC	592
175	Thorium Dicarbide	ThC_2	593
176	Titanium Carbide	TiC	594
177	Tungsten Carbide	WC	598
178	Uranium Carbide	UC	601
179	Uranium Dicarbide	UC_2	605
180	Vanadium Carbide	VC	606
181	Zirconium Carbide	ZrC	609

10. CHLORIDES

Figure and/or Table No.	Name	Formula	Page No.
182	Potassium Chloride	KCl	613
183	Silver Chloride	AgCl	620
184	Sodium Chloride	NaCl	621
185	Thallium Chloride	TlCl	625
186	Zinc Dichloride	ZnCl ₂	626

11. FLUORIDES AND THEIR MIXTURES

187	Barium Difluoride	BaF ₂	627
188	Calcium Difluoride	CaF ₂	630
189	Lanthanum Trifluoride	LaF ₃	633
190	Lithium Fluoride	LiF	636
191	Lithium Fluoride + Potassium Fluoride + ΣX ₁	LiF + KF + ΣX ₁	641
192	Sodium Fluoride	NaF	642
193	Sodium Fluoride + Beryllium Difluoride	NaF + BeF ₂	645
194	Sodium Fluoride + Zirconium Tetrafluoride + ΣX ₁	NaF + ZrF ₄ + ΣX ₁	646

12. NITRATES

195	Potassium Nitrate	KNO ₃	647
196	Silver Nitrate	AgNO ₃	650
197	Sodium Nitrate	NaNO ₃	651

13. NITRIDES

198	Aluminum Nitride	AlN	653
199	Boron Nitride	BN	656
200	Hafnium Nitride	HfN	659
201	(tri)Silicon Tetranitride	Si ₃ N ₄	662
202	Tantalum Nitride	TaN	665
203	Titanium Nitride	TiN	668
204	Uranium Nitride	UN	672
205	Zirconium Nitride	ZrN	675

14. PHOSPHATES

206	Ammonium Dihydrogen Phosphate	NH ₄ H ₂ PO ₄	679
207	Potassium Dihydrogen ^{Dideuterium} Phosphate	KD ₂ PO ₄	680
208	Potassium Dihydrogen Phosphate	KH ₂ PO ₄	683

15. SULFATES

Figure and/or Table No.	Name	Formula	Page No.
209	Ammonium Hydrogen Sulfate	NH_4HSO_4	687
210	Potassium Chromium Sulfate (Alum)	$\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$	688
211	Potassium Hydrogen Sulfate	KHSO_4	691
212	Sodium Hydrogen Sulfate	NaHSO_4	692
213	Sodium Thiosulfate	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$	693
214	Zinc Sulfate Heptahydrate	$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$	694

16. SULFIDES AND THEIR MIXTURES

215	Cerium Sulfide	CeS	697
216	(di)Cerium Trisulfide	Ce_2S_3	698
217	(di)Copper Sulfide	Cu_2S	699
218	(di)Copper Sulfide + Iron Sulfide + (tri)Nickel Disulfide	$\text{Cu}_2\text{S} + \text{FeS} + \text{Ni}_3\text{S}_2$	700
219	(di)Copper Sulfide + (tri)Nickel Disulfide	$\text{Cu}_2\text{S} + \text{Ni}_3\text{S}_2$	701
220	Lanthanum Sulfide	LaS	702
221	(tri)Nickel Disulfide	Ni_3S_2	705

17. CERMETS

222	Aluminum Oxide + Chromium	$\text{Al}_2\text{O}_3 + \text{Cr}$	707
223	Beryllium Oxide + Beryllium	$\text{BeO} + \text{Be}$	708
224	Beryllium Oxide + Beryllium + Molybdenum	$\text{BeO} + \text{Be} + \text{Mo}$	711
225	Beryllium Oxide + Beryllium + Silicon	$\text{BeO} + \text{Be} + \text{Si}$	714
226	(tetra)Boron Carbide + Aluminum	$\text{B}_4\text{C} + \text{Al}$	717
227	Silicon Carbide + Silicon	$\text{SiC} + \text{Si}$	718
228	(di)Sodium Oxide + Sodium	$\text{Na}_2\text{O} + \text{Na}$	721
229	Strontium Metatitanate + Cobalt	$\text{SrTiO}_3 + \text{Co}$	722
230	Titanium Carbide + Cobalt	$\text{TiC} + \text{Co}$	725
231	Titanium Carbide + Cobalt + Niobium Carbide	$\text{TiC} + \text{Co} + \text{NbC}$	726
232	Titanium Carbide + Nickel + Molybdenum + Niobium Carbide	$\text{TiC} + \text{Ni} + \text{Mo} + \text{NbC}$	727
233	Titanium Carbide + Nickel + Niobium Carbide	$\text{TiC} + \text{Ni} + \text{NbC}$	730
234	Uranium Carbide + Uranium	$\text{UC} + \text{U}$	731
235	Uranium Dioxide + Chromium	$\text{UO}_2 + \text{Cr}$	732
236	Uranium Dioxide + Molybdenum	$\text{UO}_2 + \text{Mo}$	735
237	Uranium Dioxide + Niobium	$\text{UO}_2 + \text{Nb}$	738
238	Uranium Dioxide + Stainless Steel	$\text{UO}_2 + \text{Stainless Steel}$	741
239	Uranium Dioxide + Uranium	$\text{UO}_2 + \text{U}$	744
240	Uranium Dioxide + Zirconium	$\text{UO}_2 + \text{Zr}$	746
241	Zirconium Dioxide + Titanium	$\text{ZrO}_2 + \text{Ti}$	749
242	Zirconium Dioxide + Zirconium	$\text{ZrO}_2 + \text{Zr}$	752
243	Zirconium Dioxide + Yttrium Oxide + Zirconium	$\text{ZrO}_2 + \text{Y}_2\text{O}_3 + \text{Zr}$	753

18. MISCELLANEOUS INORGANIC COMPOUNDS AND MIXTURES

Figure and/or Table No.	Name	Formula	Page No.
244	Ammonium Perchlorate	NH_4ClO_4	757
245	Cadmium Germanium Phosphide	CdGeP_2	758
246	Calcium Carbonate	CaCO_3	759
247	Calcium Phosphate + Lithium Carbonate + Magnesium Carbonate	$\text{Ca}_3(\text{PO}_4)_2 + \text{Li}_2\text{CO}_3 + \text{MgCO}_3$	763
248	Carbon + Oxygen	$\text{C} + \text{O}$	764
249	Carbon + Volatile Materials	$\text{C} + \text{Volatile Materials}$	765
250	Gallium Phosphide	GaP	766
251	Graphite + Bromine	$\text{C} + \text{Br}$	767
252	Graphite + Uranium Dicarbide	$\text{C} + \text{UC}_2$	770
253	Lithium Hydride	LiH	773
254	Magnesium Carbonate	MgCO_3	776
255	Potassium Bromide + Potassium Chloride	$\text{KBr} + \text{KCl}$	779
256	Potassium Chloride + Potassium Bromide	$\text{KCl} + \text{KBr}$	782
257	Potassium Dihydrogen Arsenate	KH_2AsO_4	785
258	Potassium Thiocyanate	KSCN	788
259	Silicon Carbide + Graphite	$\text{SiC} + \text{C}$	789
260	Sodium Hydroxide	NaOH	790
261	Strontium Difluoride + ΣX_1	$\text{SrF}_2 + \Sigma\text{X}_1$	791
262	Zinc Germanium Phosphide	ZnGeP_2	792
263	Zirconium Hydride	ZrH	793

19. MINERALS

264	Basalt	797
265	Beryl	800
266	Clay	803
267	Coal	807
268	Dolomite	810
269	Earth	813
270	Gabbro	816
271	Granite	817
272	Limestone	820
273	Mica	823
274	Perlite	827
275	Rock	828
276	Salt	832
277	Sand	833
278	Sandstone	840
279	Sillimanite	845
280	Slate	846
281	Soil	847
282	Spinel	848
283	Spodumene	851
284	Steatite	852
285	Tourmaline	855

19. MINERALS (continued)

Figure and/or Table No.	Name	Page No.
286	Tuff	856
287	Wollastonite	859

20. AGGREGATE MIXES

288	Cement	861
289	Concrete	862
290	Plaster	887

21. MISCELLANEOUS REFRACTORY MATERIALS AND GLASSES

291	Bricks	889
292	Ceramics, Miscellaneous	915
293	Cordierite	918
294	Enamel	921
295*	Glasses	922
296	Mullite	934
297	Petalite	935
298	Porcelains	936
299*	Pyroceram Brand Glass - Ceramic.	939

22. POLYMERS

300	Copoly(chloroethylene-vinyl acetate)	943
301	Copoly(formaldehyde-urea), Mipora	944
302	Nylon	945
303	Phenolic Resin	949
304	Pliofam	950
305	Polychloroethylene(polyvinyl chloride).	953
306	Polyethylene	956
307	Polyhexahydro-2H-azepin-2-one, Silon	959
308	Poly(methyl methacrylate) [Plexiglas]	960
309	Polystyrene	963
310	Polytetrafluoroethylene [Teflon].	967
311	Polytrifluorochloroethylene	970
312	Rubber (Ebonite)	971
313	Rubber (Elastomer)	974
314	Rubber (GR-S)	977
315	Rubber (Miscellaneous).	980

* Number marked with an asterisk indicates that recommended values are also reported for this material on separate figure and table of the same number followed by the letter R.

23. MISCELLANEOUS ORGANIC COMPOUNDS

Figure and/or Table No.	Name	Formula	Page No.
316	Anthracene	$[C_6H_4(CH)_2C_6H_4]$	985
317	Benzene, P-dibromo	$C_6H_4Br_2$	986
318	Benzene, P-dichloro	$C_6H_4Cl_2$	987
319	Benzene, P-diiodo	$C_6H_4I_2$	988
320	Diphenyl	$C_6H_5C_6H_5$	989
321	Diphenyl Oxide	$(C_6H_5)_2O$	990
322	Diphenylamine	$(C_6H_5)_2NH$	991
323	Diphenylmethane + Naphthalene	$(C_6H_5)_2CH_2 + C_{10}H_8$	994
324	Naphthalene	$C_{10}H_8$	995
325	Naphthol	$C_{10}H_7OH$	998
326	Nitrophenol	$NO_2C_6H_4OH$	1001
327	Phenanthren	$C_{14}H_{10}$	1004
328	Santowax R		1005
329	Sodium Acetate	$NaC_2H_3O_2 \cdot 3H_2O$	1006
330	Trinitrotoluene	$CH_2C_6H_2(NO_2)_3$	1007

24. SYSTEMS

331	Applied Coatings (Nonmetallic)	1009
332	Honeycomb Structures (Nonmetallic)	1010
333	Honeycomb Structures (Metallic - Nonmetallic)	1015
334	Laminates (Nonmetallic)	1021
335	Laminates (Metallic - Nonmetallic)	1036
336	Powders (Nonmetallic)	1040
337	Sandwiches (Nonmetallic)	1044
338	Sandwiches (Metallic - Nonmetallic)	1047
339	Miscellaneous Systems (Nonmetallic)	1051
340	Miscellaneous Systems (Metallic - Nonmetallic)	1055

25. ANIMAL AND VEGETABLE NATURAL SUBSTANCES AND THEIR DERIVATIVES

341	Ash	1059
342	Balsa	1060
343	Boxwood	1061
344	Cedar	1062
345	Cork	1063
346	Cotton	1068
347	Fat	1072
348	Fir	1073
349	Greenheart	1074
350	Hardwood	1075
351	Ivory	1076
352	Kapok	1077

xxviii *Grouping of Materials and List of Figures and Tables*

25. ANIMAL AND VEGETABLE NATURAL SUBSTANCES AND THEIR DERIVATIVES (continued)

Figure and/or Table No.	Name	Page No.
353	Lignum Vitae	1079
354	Mahogany	1080
355	Maple	1081
356	Oak	1082
357	Pines	1083
358	Redwood	1084
359	Sawdust	1085
360	Spruce	1086
361	Teak	1087
362	Vulcanized Fiber	1088
363	Walnut	1089
364	White Wood	1090
365	Wood Fiber	1091
366	Wool	1092

26. FABRICS, YARNS, AND HAIRS

367	Cotton Fabric	1093
368	Cotton Wool	1096
369	Hair Felt	1099
370	Pluton Cloth	1100
371	Rene 41 Cloth	1102
372	Silk Fabric	1105

27. PROCESSED COMPOSITES

373	Asbestos Cement Board	1107
374	Asphalt - Glass Wool Pad	1108
375	Cardboard	1109
376	Cellulose Fiberboard	1110
377	Cornstalk Wallboard	1111
378	Diatomite Aggregate	1112
379	Excelsior	1113
380	Fir Plywood	1114
381	Glass Fiber Blanket [Fiberglass].	1115
382	Glass Fiber Board	1124
383	Koldboard	1125
384	Monolithic Wall	1126
385	Paper	1127
386	Sea-weed Product	1128
387	Vegetable Fiberboards, Miscellaneous	1129
388	Wallboards, Miscellaneous	1131
389	Wood Products, Miscellaneous	1132
390	Wool Felt	1133

28. PROCESSED MINERAL SUBSTANCES

Figure and/or Table No.	Name	Page No.
391	Asbestos Fiber	1135
392	Micanite	1138
393	Mineral Fiber	1139
394	Processed Mineral Wool	1140
395	Quartz Fiber	1143
396	Rock Cork	1146

29. SLAGS AND SCALES

397	Mineral Wool	1147
398	Mystic Slag	1150
399	Slag Wool	1151

30. RESIDUES

400	Bitumen	1155
401	Bone Char	1156
402	Charcoal	1187
403	Coal Tar Fractions	1158

Theory, Estimation, and Measurement

Notation

A	Cross-sectional area	r	Radial distance
a	Cube root of atomic volume; Half the focal length of an ellipsoid; Axis of ellipse	S	Seebeck coefficient
b	Amplitude of lattice wave; Axis of ellipse	T	Temperature
\mathbf{b}	Inverse lattice vector	ΔT	Temperature difference
C	Specific heat per unit volume	t	Time
$C(\nu)$	Spectral specific heat	$t_{1/2}$	Time required for the back-face temperature of a thin-disk specimen to reach half its maximum value
C_s	Lattice specific heat per unit volume	U	Coefficient of equation (13)
c	Defect concentration	\mathbf{u}	Displacement of an atom
D	Thermal diffusivity	V	Electrical potential
E	Voltage drop	v	Velocity of lattice waves; Sound velocity
\mathbf{e}	Unit vector in the direction of polarization	W	Thermal resistivity
G	Number of atoms in a crystal	W_s	Lattice thermal resistivity
h	Planck constant	W_i	Intrinsic lattice thermal resistivity
I	Electric current	x	Reduced frequency ($x = h\nu/\kappa T$)
i	Suffix denoting the type of carrier	\mathbf{x}	Equilibrium site of an atom
j	Index denoting the possible polarizations of a wave	Δx	Distance difference
K	Kelvin	α	Index denoting various scattering processes
k	Thermal conductivity	β	Parameter
k_s	Lattice thermal conductivity	γ	Anharmonicity coefficient
k_i	Intrinsic lattice thermal conductivity	δ	Amplitude decrement
k_r	Thermal conductivity of a reference material	ϵ	Local thermal strain
L	Phonon mean free path for boundary scattering	θ	Debye temperature
l	Mean free path; Effective length of a specimen	κ	Boltzmann constant
l_s	Phonon mean free path	λ	Wavelength
M	Atomic mass	λ_m	Minimum wavelength of lattice waves corresponding to the maximum wave frequency ν_m
N	Number of atoms per unit volume	ν	Wave frequency
n	Exponent	ν_m	Upper frequency limit of the spectrum of lattice waves
P	Slope	π	Peltier coefficient; Ratio of the circumference of a circle to its diameter
q	Heat flow per unit time; Wave number	ρ	Electrical resistivity
\mathbf{q}	Wave vector		

Theory of Thermal Conductivity of Nonmetallic Solids

1. INTRODUCTION

Heat in solids is conducted by various carriers: electrons, lattice waves (or phonons), magnetic excitations, and, in some cases, electromagnetic radiation. The total thermal conductivity is additively composed of contributions from each type of carrier. It can be shown that

$$k = \frac{1}{3} \sum_i C_i v_i l_i \quad (1)$$

where the subscript i denotes the type of carrier, C_i is the contribution of each carrier to the specific heat per unit volume, v_i is the velocity of the carrier (we regard the carrier as a particle; if the carrier is a wave, the appropriate velocity is the group velocity), and l_i is a suitably defined mean free path.

The theory of the thermal conductivity of solids has been the subject of numerous investigations and several review articles [1-4]. It is the purpose of this introductory text to present the major results of the theory only to the extent to which it is needed by the user of these tables: to caution him as to which results are likely to be structure sensitive and thus likely to vary from specimen to specimen, and to help him judge which materials are likely to have similar properties, and thus to guide him in guessing the thermal conductivities of materials which have not been measured. For detailed theoretical developments and discussions, the reader is referred to the aforementioned review articles and to the references given to the individual topics discussed later. Other useful review articles (some are short) and books which contain articles pertaining to this subject are [5-12].

The occurrence of a mean free path in equation (1) opens up the possibility that in some cases one cannot uniquely define the thermal conductivity of a material. This happens whenever a carrier mean free path becomes comparable to the smallest

external dimension of the specimen. It happens particularly in dielectric crystals at low temperatures, where the phonon mean free paths are long; it also happens in transparent solids at high temperatures, where photons contribute significantly to the heat transport, provided the specimens are continuous in their optical properties (i.e., single crystals or vitreous solids, but not polycrystalline aggregates). In that case, we can speak of a size-dependent thermal conductivity, though this is only an approximation. The effective thermal conductivity will depend not only on the shortest linear dimension, but also on whether this dimension is parallel or perpendicular to the heat flow. It will also depend on the nature of the external surface: in the former case, on the degree of specularity of the reflection of the carriers, in the latter case, on the ability of the surface to absorb and emit carriers.

While in metals and alloys the free electrons are important carriers of heat, and frequently overshadow the thermal conductivity of the lattice vibrations, the lattice vibrations are the most important carriers in insulating crystals, and in many cases the only carriers. The electrons become important as carriers in semiconductors at higher temperatures, though they may sometimes play a role in other cases, not as carriers, but as a mechanism limiting the mean free path of the lattice waves.

The theory of thermal conductivity of metallic solids, where both the electrons and the lattice waves contribute significantly to the thermal conductivity, has been reviewed in Volume 1.

For purposes of the theory of conduction properties, we distinguish between three temperature regimes: high, intermediate, and low, with rough divisions at temperatures (on the absolute scale) of θ and $\theta/3$, respectively, where θ is the Debye temperature. For our purposes this temperature is related to the upper frequency limit ν_m of the spectrum of lattice waves by $h\nu_m = \kappa\theta$, where h and

κ are the Planck and Boltzmann constants, respectively. Roughly speaking, at high temperatures each atom vibrates independently of its neighbors, and the theories of lattice vibrations simplify. At low temperatures the vibrations are highly correlated and are best described by elastic waves in a continuum, with corresponding simplification. The intermediate temperature regime is somewhat awkward, and theoretical results are obtained by interpolation.

Most solids have Debye temperatures θ around 300 K, but atomically heavy solids have lower θ 's (well below 200 K for solids containing gold or lead), while light atom solids (diamond, beryllia, etc.) have much higher Debye temperatures. Another group of solids with low θ 's are the solidified rare gases, where binding forces are unusually weak.

2. LATTICE WAVES

The thermal vibrations of atoms in a perfect crystal can be described in terms of vibrations of each atom about its equilibrium site. Although such a simple description would suffice for many purposes, it does not take account of the correlation in the vibrations of neighboring atoms, or of the transfer of vibrational energy from one atomic site to the next. A better description is to regard the thermal vibrations as arising from a superposition of progressive displacement waves (lattice waves), which are the normal modes of the crystal and at the same time the carriers of thermal energy.

The lattice waves occupy a spectrum of frequencies, ν , from the lowest frequencies to some upper limit, ν_m , typically of the order of 10^{13} Hz. At low frequencies these waves are identical to elastic waves in the corresponding elastic continuum; at higher frequencies the atomic structure of the crystal lattice leads to dispersion effects. The corresponding wavelengths range from long waves down to waves of length comparable to atomic dimensions.

The displacement of an atom from its equilibrium site (at \mathbf{x}) may thus be written as a superposition of waves, i.e.,

$$\mathbf{u}(\mathbf{x}) = \frac{1}{\sqrt{G}} \sum_{j, \mathbf{q}} \mathbf{e}(\mathbf{q}, j) b(\mathbf{q}, j) \exp(i\mathbf{q} \cdot \mathbf{x} - i2\pi\nu_j t) \quad (2)$$

where \mathbf{q} is the wave vector, so that the wavelength $\lambda = 2\pi/q$, q is the wave number, G is the number of atoms in the crystal, j is an index denoting the possible polarizations of a wave of given wave-vector, \mathbf{e} is a

unit vector in the direction of polarization, and b is the amplitude of each wave.

The density of \mathbf{q} -values (usually derived in terms of idealized boundary conditions) is such that the number of \mathbf{q} -values in an element d^3q of \mathbf{q} -space is $G(2\pi)^{-3}d^3q$. There are three polarizations to each value of \mathbf{q} , and there is an upper limit to the admissible values of \mathbf{q} . The physically distinct wave-vectors must lie in a region of \mathbf{q} -space, called the fundamental zone, which is defined in terms of the crystal lattice, or rather in terms of the reciprocal lattice of the crystal. It can be shown that the number of physically distinct lattice waves is $3G$, equal to the number of normal modes which a system of G mutually bound atoms should have.

Under certain idealized conditions these displacement waves, equation (2), are the normal modes of the lattice, i.e., the energy content of each wave would be preserved in time. These conditions are:

- (a) The interatomic forces are perfectly harmonic (obey Hooke's law).
- (b) The lattice is structurally perfect.
- (c) The lattice has no external boundaries, or the displacement of the atoms at the boundaries satisfy certain artificial boundary conditions.

Departures from these idealized conditions lead to interchange of energy between these waves and limit their effective mean free path. As seen from equation (1), these processes control the lattice thermal conductivity

$$k_{\epsilon} = \frac{1}{3} C_{\epsilon} v l_{\epsilon} \quad (3)$$

where C_{ϵ} is the contribution of the lattice waves to the specific heat per unit volume, and v is the velocity of the lattice waves at low frequencies. When λ is large compared with the interatomic spacing, v is a linear function of $1/\lambda$ and v is constant. At higher frequencies or shorter wavelengths the atomic structure leads to dispersion, i.e., to a departure from the linear relation between v and $1/\lambda$. In that case the appropriate velocity describing energy transport and entering equation (3) is the group velocity $dv/d(1/\lambda)$.

In crystals of complex structure there are also lattice waves describing the relative motion of atoms in the unit cell. These waves, the optical modes, usually have a small group velocity and contribute relatively little to the energy transport. They are often disregarded for purposes of thermal con-

ductivity; however, this neglect may not always be justified.

Because there is some interaction between the different lattice waves, they will tend to be randomly excited, but with an average energy content given by the considerations of statistical mechanics. In thermal equilibrium at temperature T , the lattice specific heat of solids varies as T^3 at very low temperatures, and is independent of T at high temperatures. The contribution to the specific heat per unit volume from waves in the frequency interval ν and $\nu + d\nu$ is given, to a first approximation, by the Debye theory, and is of the form

$$C(\nu) d\nu = 9N\kappa \left(\frac{T}{\theta}\right)^3 \frac{x^4 e^x}{(e^x - 1)^2} dx \quad (4)$$

when $x = h\nu/\kappa T$ is the reduced frequency and N the number of atoms per unit volume. This holds for $\nu \leq \nu_m$; for $\nu > \nu_m$, $C(\nu) = 0$.

The Debye approximation disregards the dispersion of the high-frequency lattice waves, disregards differences in polarization, and smears out the crystal structure of the solid. It is thus a better approximation at low temperature, when all the important waves are long, than at intermediate and high temperatures. The only concession it makes to the discreteness of the lattice is the choice of a cutoff frequency ν_m or the corresponding minimum wavelength $\lambda_m = v/\nu_m$, where v is an average sound velocity. The cutoff is chosen so that the total number of waves corresponds to the correct number of normal modes ($3N$ per unit volume) which this assembly of atoms ought to have.

The lower limit λ_m of the wavelength is related to a^3 , the volume per atom, by $4\pi a^3 = 3\lambda_m^3$.

In spite of the obvious inadequacy of the Debye approximation, it is frequently chosen as a basis for discussing thermal conductivity because the theoretical uncertainties in the phonon mean free path usually overshadow errors introduced into the specific heat by the Debye approximation.

3. LATTICE THERMAL CONDUCTIVITY

Since the phonon mean free path is usually a function of frequency ν (it may, of course, also depend on polarization and in extreme cases even on the direction of the wave vector \mathbf{q}), the expression (3) for the lattice thermal conductivity has to be generalized to

$$k_g(T) = \frac{1}{3} \int_0^{\nu_m} C(\nu) v l(\nu) d\nu \quad (5)$$

where $C(\nu)$ is given by equation (4). The lattice thermal conductivity is thus governed both by the magnitude and the frequency dependence of the mean free path.

The mean free path is limited by several processes which cause interchange of energy among the lattice waves, or scatter phonons from one mode into another. These are broadly grouped into processes due to anharmonicities of the interatomic forces, i.e., departures from Hooke's law, into scattering due to the various kinds of lattice imperfections, and, as a special case of the last, into scattering of phonons by the external boundaries.

The effective scattering probabilities or reciprocals of the mean free path of each group of lattice waves is composed additively of contributions from each process, so that

$$\frac{1}{l(\nu)} = \sum_{(\alpha)} \frac{1}{l_{\alpha}(\nu)} \quad (6)$$

where α denotes the various processes. If two interaction processes have the same dependence on frequency (ν), then it follows from equations (5) and (6) that the corresponding thermal resistivities follow an additive resistance rule, i.e.,

$$\frac{1}{k_g} = W_g = \sum_{(\alpha)} W_{(\alpha)} \quad (7)$$

where $W_{(\alpha)}$ is the lattice thermal resistivity if only one process (α) were to act. However, if two or more processes have different frequency dependences of $l_{(\alpha)}(\nu)$, then in general

$$W_g > \sum_{(\alpha)} W_{(\alpha)} \quad (7a)$$

The bigger the difference in frequency dependence, the more pronounced will be the deviation from the additive resistance rule.

The interactions due to anharmonicities, which may also be viewed as the scattering by thermal vibrations, lead to a mean free path which depends both on T and ν . The other interactions lead to a mean free path which depends on ν only, since the imperfection structure is practically independent of T , except possibly at very high temperatures.

At high temperatures, $k_g(T)$ is mainly a reflection of the temperature dependence of l , but at low temperatures it depends also on the ν -dependence of $l(\nu)$. This follows because in equation (5)

$$C(\nu) \propto T^3 x^4 e^x (e^x - 1)^{-2} \quad (8)$$

and if $l(\nu) \propto \nu^{-n} \propto T^{-n} x^{-n}$, it follows from equa-

tion (5) that

$$k_r \propto T^{3-n} \quad (9)$$

Since different imperfections lead, in the low-frequency limit, to different frequency dependences, or different values of the exponent n , the temperature dependence of the thermal conductivity at low temperatures will differ from case to case and depend upon the nature of the principal imperfections.

For point defects $n = 4$; for long but thin defects (cylinders) $n = 3$; for thin sheets $n = 2$. Dislocations, by virtue of their long-range strain field, do not act as thin cylinders, but scatter with an exponent $n = 1$. Scattering by boundaries, both external boundaries and internal grain boundaries, scatter independently of frequency, with $n = 0$.

Generally speaking, the more extended imperfections have a scattering cross-section which varies less strongly with frequency, and which is relatively more important at low frequencies, and thus more important at low temperatures.

Relation (9) does not hold, strictly speaking, for point defects ($n = 4$) or line defects ($n = 3$), for the integral (5) would then diverge at low frequencies, where $C(\nu)$ of equation (8) varies as ν^2 . Relation (9) is then only a rough rule. Point defects or line defects must always be considered in conjunction with another resistive process, such as boundary scattering or intrinsic (anharmonic) scattering.

General reviews of lattice thermal conductivity are given in references [1-4]. Individual research papers on the theory of lattice thermal conductivity include [13-53].

4. INTRINSIC RESISTIVITY AT HIGH TEMPERATURES

At elevated temperatures in good crystals, the major source of thermal resistance is the interchange of energy, or scattering of phonons, due to departures from Hooke's law. A local strain ϵ introduces a fractional change $\gamma\epsilon$ in the local value of the sound velocity. This local change scatters the lattice wave. The coefficient γ , a measure of the anharmonicity, is of order unity (frequently $\gamma \simeq 2$). At high temperatures the thermal strain at neighboring atomic sites is practically uncorrelated. Scattering from each atomic site is thus proportional to $\langle \epsilon^2 \rangle$, the mean square thermal strain, which in turn is proportional to T . The intrinsic mean free path thus varies as

$$l_i \propto 1/T \quad (10)$$

so that at high temperatures, where C_r is independent of temperature, k_r varies as $1/T$. This theoretical result, explaining early data on the temperature dependence of the thermal conductivity of insulating crystals [13-15], was derived by Debye [16].

There is, however, a serious theoretical difficulty. The lattice waves have a continuous spectrum of frequencies, all contributing to the specific heat and the thermal conductivity. At high temperatures, the major contribution to the specific heat, according to equation (4), comes from the upper range of the phonon spectrum. However, if $l(\nu)$ increases sufficiently rapidly with decreasing frequency, the major contribution to k would come from lower frequencies. In the Debye model, where every atomic site scatters independently from each other, $l_i(\nu) \propto \nu^{-4}$ and the expression for k diverges at low frequencies. Debye's model, while correctly describing $l_i(\nu)$ at high frequencies, and even producing a good quantitative estimate, fails at low frequencies, where correlations between the displacements of neighboring atomic sites become increasingly important.

To avoid this difficulty, Peierls [17] set up a theory of the anharmonic interaction between lattice waves, which recognizes that the thermal strain which scatters a lattice wave is itself the consequence of other lattice waves. This theory thus treats in detail the interchange of energy which, as a result of cubic anharmonicities (terms in the Hamiltonian which are not quadratic in strain, as Hooke's law would indicate, but cubic), leads to an interchange between groups of three lattice waves. The interchange is such that a phonon in a mode \mathbf{q}_1 combines with a phonon in mode \mathbf{q}_2 to form a phonon in mode \mathbf{q}_3 , satisfying certain interference conditions between the frequencies and wave vectors of the participating modes. The frequency conservation condition is

$$\nu_1 + \nu_2 = \nu_3$$

and can also be regarded as energy conservation between the participating phonons. The wave vectors satisfy conservation conditions

$$\mathbf{q}_1 + \mathbf{q}_2 = \mathbf{q}_3 \quad (11a)$$

or

$$\mathbf{q}_1 + \mathbf{q}_2 = \mathbf{q}_3 \pm \mathbf{b} \quad (11b)$$

when \mathbf{b} is one of the inverse lattice vectors of the crystal lattice. The three-phonon processes are accordingly divided into "normal" processes (11a), or "Umklapp" processes (11b), the latter word being derived from the German for "flip-over."

The conservation condition (11a) corresponds roughly to momentum conservation among the phonons. Umklapp processes must be regarded as a combination of three-phonon processes and Bragg reflection. In an elastic continuum only normal processes would occur.

The Peierls' theory is the basis of all subsequent theoretical work. The theory is quite complicated, and has been put into a form suitable for detailed work only by subsequent authors. At low temperatures there is a rigid distinction between the roles of normal and Umklapp processes—only the latter produce thermal resistance, though the former can indirectly influence the effectiveness of other processes. At higher temperatures the distinction between the two types of processes becomes blurred. The theory, since it involves the inverse lattice vector, and thus the details of the crystal structure, becomes quite complicated; however, some rough estimates have been made [3, 27].

The intrinsic phonon mean free path, with some approximations, takes the following form at high temperatures

$$1/l_i(\nu) \propto \nu^2 T \quad (12)$$

so that the divergence difficulties are avoided [3]. The intrinsic thermal resistivity is of the form [3, 27]

$$W_i = U \left(\frac{h}{\kappa} \right)^3 \gamma^2 \frac{1}{Ma} \frac{T}{\theta^3} \quad (13)$$

where M is the atomic mass and a^3 the atomic volume. The numerical coefficient U , typically of the order 1/3, is somewhat uncertain, and depends on the details of the crystal structure.

The major factor controlling the intrinsic lattice conductivity is the Debye temperature θ : solids of high θ will in general have higher values of k_i . Another factor is the crystal structure—solids of complex crystal structure have more inverse lattice vectors and zone boundaries and a greater variety of Umklapp processes; such solids will have a lower thermal conductivity. However, the effect of crystal structure on the intrinsic thermal conductivity is still not well understood from a theoretical point of view.

While the theory predicts the intrinsic thermal resistivity to vary as T at high temperatures, small deviations could arise from several causes. Quartic anharmonicities, i.e., terms in the potential energy quartic in the strain, would lead to four-phonon processes and a contribution to the resistivity proportional to T^2 . One would expect the T^2 term to be of

lower magnitude by a factor of order $\langle \epsilon^2 \rangle$, which in most solids is about 1 percent at room temperature. A similar effect, also leading to a T^2 term, results from thermal expansion. This would lower the effective value of θ with increasing T , and since W_i varies as $1/\theta^3$, it would lead to an increase in thermal resistivity roughly proportional to T^2 . This effect should also be small.

Besides the general review articles, other pertinent references to the theory of intrinsic thermal resistivity at high temperatures are [20, 21, 23, 45, 54-58].

5. INTRINSIC RESISTIVITY AT LOW TEMPERATURES

At low temperatures the vibrations of the lattice cannot be represented as independent vibrations of individual atoms, but the representation of these vibrations in terms of a superposition of lattice waves becomes essential. At this point, the Peierls' theory must be used. The thermal resistance arises from Umklapp processes of type (11b). Since the important thermal waves at low temperatures have low frequencies, these processes occur only as a result of the occasional encounter with a high-frequency wave, of wave vector \mathbf{q} comparable to $\mathbf{b}/2$, where \mathbf{b} is an inverse lattice vector. Such a wave has a frequency ν_m/β , when β is some parameter, usually of the order of 2, which depends on the details of the zone structure and on the dispersion of the high-frequency phonons. The probability of finding such a phonon decreases exponentially with decreasing temperature, so that

$$W_i \propto e^{-\theta/\beta T} \quad (14)$$

and the intrinsic thermal conductivity increases sharply with decreasing temperature, i.e.,

$$k_i(T) \propto e^{\theta/\beta T} \quad \text{for } T < \theta/6 \quad (14a)$$

Although there are theoretical expressions for the preexponential factor [1, 3, 17], these are somewhat uncertain, and in practice this factor is unimportant in comparison with the theoretical uncertainty relating to the exponent θ/β .

In anisotropic crystals both the preexponential factor and exponent θ/β can depend on the direction of heat flow. Since θ/β depends on the zone structure, it can also be changed by phase transition, with important consequences to the thermal conductivity.

In spite of the theoretical uncertainties, we can clearly expect, as Peierls had originally predicted

[17], that the thermal conductivity of perfect crystals, which varies roughly as $1/T$ at intermediate and high temperatures, should increase much more rapidly with decreasing temperature at low temperatures, until the phonon mean free path attains macroscopic dimensions. At this point k attains a maximum, and at lower temperatures k decreases as T is further decreased, since l is kept fixed and $k(T)$ is now controlled by the specific heat.

However, this presupposes a structurally perfect crystal. Near the conductivity maximum the thermal conductivity is particularly sensitive to all kinds of crystal imperfections. In some cases, even the mass variation due to the naturally occurring isotopic distribution is enough to appreciably depress the thermal conductivity around its maximum.

In the exponential region also, crystals of higher Debye temperature θ generally have higher thermal conductivities.

The role of normal processes in the low-temperature thermal resistivity has been discussed in [1]. The phonon mean free path for the normal processes has been given in [22, 59, 60].

6. BOUNDARY RESISTANCE

At sufficiently low temperatures, the phonon mean free path is limited by the external boundaries. Under those conditions

$$k(T) = \frac{1}{3}C(T)vL \quad (15)$$

where L is of the order of the shortest linear dimension of the specimen. The temperature dependence of thermal conductivity would then parallel the temperature dependence of the specific heat due to lattice waves, and $k(T)$ would vary as T^3 at lowest temperatures.

In many cases $C(T)$ is not only due to lattice waves, but there are additional thermal excitations which contribute to the specific heat, and cause substantial deviations from the T^3 dependence expected for lattice waves. Those excitations would have to be treated as separate carriers according to equation (1). In many cases they have either a low group velocity, or a short mean free path, or both. It is thus possible that crystals having substantial deviations from a T^3 dependence of $C(T)$ may still have a T^3 variation of $k(T)$ at low temperatures.

In a polycrystalline aggregate the phonon mean path L would be given not by the external dimensions, but by the size of the individual crystallites or grains. Such grain sizes, typically of the

order of tens of microns, would result in a corresponding depression of $k(T)$, and the extension of the region where $k(T) \propto C(T)$ to higher temperatures than in the case of single crystals. In that case, the temperature range where boundary scattering dominates would include a temperature range where $C(T)$ varies more slowly than T^3 . Such cases have been reviewed by Berman [5].

The effective value of L has been calculated by Casimir [61] for the case of heat flow along the axis of a narrow cylinder with perfectly rough surfaces. He assumed that phonons are diffusively scattered at the surface and that there is no effect from the end surfaces. In this case, L depends entirely on the geometry. In many cases, however, phonons arriving at the surfaces may be scattered with a forward bias—this would lengthen the effective values of L correspondingly. This forward bias (often crudely expressed as a fraction specularly reflected) may be a function of phonon frequency. This would make $k(\nu)$ dependent on frequency, and lead to corresponding deviations from the T^3 dependence of the thermal conductivity. Casimir's theory has been extended to apply to short cylinders with smooth surfaces [1, 62, 63]. The factors controlling the degree of specularity of real surfaces for phonons of the relevant wavelength (typically several hundred angstroms) are at present not understood.

The long cylinder is not the only important geometry. Another extreme case is the thin slab, with conduction across the slab. In this case, L is of the order of the slab thickness, and is governed by the acoustic emissivity and reflectivity, respectively, of the surfaces.

Since boundary resistance is a resistive process which is not uniformly distributed throughout the volume of the specimen, one should not really use the additivity relation (6) to obtain the combined effect of boundary scattering and other scattering processes. Deviations from (6) are likely to be significant, but will not change the order of magnitude of the corresponding resistances.

An interesting case, first discussed in reference [3], is the case when the important processes are boundary scattering and "normal" three-phonon processes (11a). The normal processes actually decrease the resistivity by slowing down the rate at which phonon "momentum" is brought to the surface and obliterated. One can define an effective viscosity of the phonon gas in terms of the normal-process mean free path. The heat transport or

phonon flow is then analogous to Poiseuille flow in a pipe, while the more usual boundary resistance, as discussed by Casimir [61], corresponds to Knudsen flow. This phenomenon occurs only in very perfect crystals near the conductivity maximum.

7. THERMAL RESISTANCES DUE TO LATTICE IMPERFECTIONS

Nearly all imperfections scatter lattice waves and reduce the lattice thermal conductivity, particularly at low and intermediate temperatures, where the intrinsic phonon mean free path is long. In all cases, one can regard the imperfection as a local change in the velocity of the lattice wave, either because of a change in mass or density, or because of a change in the elastic properties. These local changes in wave velocity act as a perturbation, and scattering is usually calculated by perturbation theory [3, 71], though in the simpler defects it has been possible to arrive at a more self-consistent solution of the wave equation in the presence of a defect through Green's function techniques [87, 88].

According to the simplest perturbation technique, the Born approximation, the perturbation, which is a function of position, can be Fourier analyzed, and the scattering of a wave or phonon from mode \mathbf{q} into \mathbf{q}' involves the $(\mathbf{q} - \mathbf{q}')$ th Fourier component of the perturbation. The amplitude of the scattered wave \mathbf{q}' is proportional to that Fourier component, the intensity of scattering to the square of the perturbation, so that total scattering cross sections are generally proportional to the square of the perturbation. This has been reviewed by several authors [1, 3, 4, 7]. The theory bears close resemblance to other theories describing scattering of waves by obstacles.

It follows that, for waves of a particular wavelength, the most important obstacles are those having dimensions comparable to the wavelength. At intermediate and high temperatures, the important defects are thus mainly point defects, while extended defects are more important at lower temperatures.

Another factor to be considered, particularly when the defect scattering cross section varies rapidly with frequency (e.g., point defects and concentrated line defects, where $1/l$ varies as ν^4 and ν^3 , respectively), is the interplay with other interaction processes. Not only is it essential to consider other interaction processes such as boundary or anharmonic scattering to remove the low-frequency divergence, but one must consider in detail the

role of the "normal" three-phonon processes. These do not reduce the momentum or heat flow of the phonon gas, but they can move momentum from one group of lattice waves to another, and by moving momentum to a group of modes for which the defect scattering is highly effective (such as modes of higher frequency), these processes can contribute indirectly to the thermal resistivity. The exact description of this interplay of processes is mathematically complicated; approximations have been given by Klemens [25] and Callaway [32]; for a recent review see reference [1].

Point defects will depress k_x near the thermal conductivity maximum and, less spectacularly, at higher temperatures. They will tend to obliterate the exponential dependence expected for the intrinsic thermal conductivity (14a), and lead to a thermal conductivity roughly proportional to $1/T$.

At high temperatures, however, point defects will lead to a slower temperature dependence of the thermal conductivity; furthermore, the resistivity due to point defects will not increase linearly with concentration. This is a consequence of the properties of the integral of equation (5), with $C(\nu)$ given by the high-temperature limit of equation (8), i.e., $C(\nu) \propto \nu^2$, and $1/k(\nu)$ being additively composed of point-defect scattering, proportional to ν^4 , and intrinsic scattering given by equation (12). In the limit of high temperatures and high defect concentration c , one can show [65]

$$k_x \propto [c(1-c)]^{-1/2} T^{-1/2} \quad (16)$$

Quantitative estimates of the strength of point defect scattering can be made in terms of the difference between the mass of a normal site and a defect site [25] and in terms of the volume misfit [1, 7].

The magnitude and frequency dependence of the scattering by point defects is also sensitive to short-range order or other types of correlation. The formal theory [122] is analogous to the theory of x-ray scattering, however, there is little information about such correlations in nonmetals and no detailed calculations have been made.

Extended defects which have been treated theoretically include dislocations and stacking faults. In the simple theory the dislocations are treated as fixed in position, scattering because of their long-range strain fields. In nonmetals, where dislocation densities are usually lower, this may not be an adequate model. Whether one must seek a solution in terms of the flutter of dislocations under the applied stress of a low-frequency lattice wave, or in

terms of electrostatic interactions between a charged core and other charges in the solid is not clear at present.

Pertinent references to the theory of thermal resistance due to lattice imperfections at high temperatures are [64-69] and at low temperatures include [70-120], of which the references [92-120] deal with point defects of the general type and explain the thermal resistance in terms of phonon-defect resonant scattering processes.

8. AMORPHOUS SOLIDS

In amorphous solids, the mean free path of lattice waves is short; in fact, it is questionable whether one may describe the thermal vibrations in terms of lattice waves. Kittel [121] suggested that the thermal conductivity can be described by equation (3) with a mean free path which is quite short (typically of the order of 10 angstroms) and independent of temperature. This seems to hold at high and intermediate temperatures. At low temperatures, however, when the wavelength of the lattice waves becomes longer, the amorphous solid resembles more and more an elastic continuum, and the randomness of the underlying atomic structure becomes less important. This means that, at low temperatures, λ_r should increase with decreasing temperature, as is indeed found. A formal theory of the scattering of elastic waves in such random structures has been given [122]. One interesting consequence is that the role of order is reversed from what one would expect intuitively. The role of order or structural coherence is now to reinforce the scattering process. However, our knowledge of the structure of amorphous material is so rudimentary that we have at the moment no predictive theory. Other references to the theory of the thermal conductivity of amorphous solids include [123-126].

9. RESONANT SCATTERING

So far we have considered defects which scatter passively, that is, scattering is due to local variations in the wave velocity. There are geometrical interferences, leading to reinforcement or destructive interference of the scattered wave. However, it is also possible to have dynamic or time-like interferences. The defect may have internal mechanical resonance frequencies [92-120], or it may have an electronic level structure [127-136]. Lattice waves at or near the corresponding resonance frequencies will

be scattered much more strongly than one would expect from passive defects of comparable size. This leads to changes in the temperature dependence of the thermal conductivity, in extreme cases to dips in the conductivity. The theory of mechanical resonances is not well understood. In the case of some paramagnetic impurities whose electronic level structure is strongly strain dependent, the resonant scattering of lattice waves can be calculated from the spin-lattice relaxation. Effects of this type are clearly important in many crystals at low temperatures, particularly in the case of semiconductors with donor or acceptor impurities or radiation damage.

10. OTHER CASES

We have so far discussed the contribution of lattice waves (or phonons) to the thermal conductivity of ordinary nonmetallic solids and the various scattering mechanisms which reduce the phonon mean free path and cause thermal resistances. For other special kinds of solids such as magnetic insulators, solids partially transparent to infrared radiation, and semiconductors which are practically insulators for purposes of thermal conductivity, we have to consider other mechanisms of heat transfer and other mechanisms of resistivity.

In a magnetic insulator at low temperatures, cooperative effects between the magnetic moments arranged in a regular lattice, leading to the concept of spin waves or magnons, can act both as a new mechanism of heat transport and at the same time as a resistive mechanism of phonon transport [137-164]. The exchange energy between neighboring spins of atoms is probably a rough criterion of the upper limit of temperature at which these effects need to be considered. At very low temperatures the spin-wave thermal conductivity of a ferromagnetic insulator is roughly proportional to T^2 . Consequently, at sufficiently low temperatures where the mean free paths of both magnons and phonons become boundary limited, frequency independent, and of equal magnitude, the magnon conductivity, varying as T^2 , should exceed the phonon conductivity, which varies as T^3 under these conditions. The total thermal conductivity is the sum of the magnon and phonon conductivities.

It is well known that the apparent thermal conductivity of glasses increases very rapidly at high temperatures and that the thermal conductivity versus temperature curves for many translucent crystals turn up at high temperatures after steady

decrease and thus exhibit minima in the curve. This is due to the enhanced radiative (photon) heat transfer through the material at high temperatures in addition to the lattice (phonon) thermal conduction. If the material is completely transparent to infrared radiation, there is no interaction between radiation and material. If the material is opaque, heat transfer is entirely by conduction processes. Only for the intermediate case where the material is partially transparent to infrared radiation one can speak of a radiative component of thermal conductivity, which has been the subject of numerous investigations [165-178].

In a material which is partially transparent to infrared radiation, each volume element absorbs a part of the incident radiation and also reradiates radiant energy. A certain amount of energy is therefore transmitted through the material by these radiation and reradiation processes in addition to that conducted by lattice waves. The apparent total thermal conductivity is the sum of the lattice and radiative conductivities. In the limiting case, where the sample is optically thick, i.e., the thickness of the sample is much larger than the mean free path of the photons, the apparent radiative thermal conductivity is proportional to T^3 and inversely proportional to the Rosseland mean extinction coefficient of the material. In the opposite limiting case where the sample is optically thin, the apparent radiative thermal conductivity is proportional to the thickness of the sample as well as to T^3 , and is therefore not an intrinsic property of the material.

Finally we must consider the thermal conductivity of semiconductors. In many semiconductors the lattice thermal conductivity is predominant and the electronic component is small enough to be neglected. There are, however, a few cases where the electronic component of thermal conductivity is not negligible at higher temperatures. At sufficiently low temperatures, a typical semiconductor is extrinsic, with only one band, either the conduction or valence band, making a contribution to con-

duction. At sufficiently high temperatures, it becomes intrinsic and both the conduction and valence bands make comparable contributions. This leads to the ambipolar diffusion of electrons and holes [179-181] and gives rise to the transport of ionization energy in addition to the normal direct transport of energy by the carriers. In the ambipolar diffusion process, electron-hole pairs are created at the hot end of the specimen and absorb energy from the heat source. They move down to the cold end of the specimen under the influence of the temperature gradient and recombine there at the cold end, giving up the ionization energy to the surroundings. The enhancement of the Lorenz function of an intrinsic semiconductor associated with the ambipolar diffusion process can be very significant.

In certain semiconductors the additional heat transport at high temperatures, which cannot be explained in terms of the conduction processes so far mentioned, has been attributed to the exciton contribution to thermal conductivity [182-184]. Excitons are bound electron-hole pairs which remain associated so that they are electrically neutral and can transport excitation energy but no electrical charge. However, the exciton contribution to heat transport is only a rather remote possibility and the experimental evidence is conflicting. The exciton contribution could be significant only if the excitons have sufficiently low excitation energy.

In semiconductors the lattice thermal resistances are caused by the same factors as those for dielectric crystals except for scattering of phonons by electrons [185-194]. However, this phonon-electron scattering is important only at very low temperatures. In the case of semiconductors having high carrier concentrations, the phonons are scattered by electrons (or holes) free to move in some sort of band which is not full [185, 186]. For low carrier concentrations, the phonons are scattered by bound electrons [189-191].

The thermal conductivity of semiconductors has been comprehensively reviewed in [11]. Some less extensive reviews are also available [195-201].

Experimental Determination of Thermal Conductivity

1. INTRODUCTION

In the experimental determination of the thermal conductivity of solids, a number of different methods of measurement are required for different ranges of temperature and for various classes of materials having different ranges of thermal conductivity values. A particular method may thus be preferable over the others for a given material and temperature range, and no one method is suitable for all the required conditions of measurement. The appropriateness of a method is further determined by such considerations as the physical nature of the material, the geometry of samples available, the required accuracy of results, the speed of operation, and the time and funds entailed.

The various methods for the measurement of thermal conductivity fall into two categories: the steady-state and the nonsteady-state methods. In the steady-state methods of measurement, the test specimen is subjected to a temperature profile which is time invariant, and the thermal conductivity is determined directly by measuring the rate of heat flow per unit area and temperature gradient after equilibrium has been reached. In the nonsteady-state methods, the temperature distribution in the specimen varies with time, and measurement of the rate of temperature change, which normally determines the thermal diffusivity, replaces the measurement of the rate of heat flow. The thermal conductivity is then calculated from the thermal diffusivity with a further knowledge of the density and specific heat of the test material.

The primary concern in most methods of measurement is to obtain a controlled heat flow in a prescribed direction such that the actual boundary conditions in the experiment agree with those assumed in the theory. Theoretically, the simplest method to obtain a controlled heat flow is to use a specimen in the form of a hollow sphere with a

heater in the center. The heat supplied by the internal heater passes through the specimen in a radial direction without loss. However, in reality it is very difficult to fabricate a spherical heater which produces uniform heat flux in all radial directions. It is also difficult to fabricate spherical specimens and to measure the heat input and the temperature gradient in this experimental arrangement.

A more commonly used method of controlling heat flow in the prescribed direction is the use of guard heaters (combined with thermal insulation in most cases) so adjusted that the temperature gradient is zero in all directions except in the direction of desired heat flow. In most methods of measuring thermal conductivity, a cylindrical specimen geometry ranging from long rod to short disk is utilized, and the heat flow is controlled to be in either the longitudinal (axial) or the radial direction. Thus most methods can be subdivided into longitudinal and radial heat flow methods, as discussed in more detail later.

Experimental study of the thermal conductivity of solids was started in the eighteenth century. Benjamin Franklin in 1753 [202] seems to have been the first to point out the different ability of different materials "to receive and convey away the heat." He observed materials such as metal and wood to be good or poor conductors of heat by the degree of coldness felt when touched. Fordyce [203] pioneered in 1787 to make some experiments on the "conducting powers" of pasteboard and iron. The first steady-state *comparative* method for the measurement of the thermal conductivity of solids was suggested by Franklin and carried out by Ingen-Hausz as reported in 1789 [204]. This method was improved by Despretz as reported in 1822 [205]; Despretz's method was later used by Wiedemann and Franz as reported in 1853 [206] to determine the relative thermal conductivity of a number of metals leading to the postulation of the Wiedemann-Franz law. Since the

first steady-state *absolute* method was reported in 1851 by Forbes [207, 208] (see also [209, 210]) and the first nonsteady-state *absolute* method was reported in 1861 by Ångström [211], a number of different methods and their variants have been developed over the years. Several general surveys [212–222] are available for the experimental developments of the methods. The mathematical theories of the methods have been reviewed in several books [223–227].

In the sections that follow, the major methods and the extent of their applicability will be briefly described and discussed. For finer details of experimental designs and techniques, the reader is referred to the references given to the individual methods.

In the category of steady-state methods, we will discuss the longitudinal heat flow method, the Forbes' bar method (which is a quasi-longitudinal heat flow method), the radial heat flow method, the direct electrical heating method, the thermoelectrical method, and the thermal comparator method. In the longitudinal and radial heat flow methods, a distinction is made between absolute and comparative methods according to the means of measuring the heat flow. In an absolute method, the rate of heat flow into a specimen is directly determined, usually by measuring the electrical power input to a heater at one end of the specimen. The rate of heat flow out of a specimen may be measured with a flow calorimeter or boil-off calorimeter. With the latter the rate of heat flow is determined by the boil-off rate of a liquid, such as water, of known heat of vaporization, while with the former it is determined by the flow rate and temperature rise of a circulating liquid, such as water, of known heat capacity. In a comparative method the rate of heat flow is calculated usually from the temperature gradient over a reference sample of known thermal conductivity which is placed in series with the specimen and in which hopefully the same heat flow occurs. The methods are subdivided further according to the various specimen geometries.

In the category of nonsteady-state methods, we will discuss the periodic and the transient heat flow methods. According to the direction of heat flow, each of them is also subdivided into longitudinal and radial heat flow methods. Within the transient heat flow methods, we will discuss also the flash method (which is a variant of the longitudinal heat flow method), the line heat source and probe methods (which are variants of the radial heat flow method), the moving heat source method, and two comparative methods.

2. STEADY-STATE METHODS

A. Longitudinal Heat Flow Methods

In the longitudinal heat flow methods, the experimental arrangement is so designed that the flow of heat is only in the axial direction of a rod (or disk) specimen. The radial heat loss or gain of the specimen is prevented or minimized and evaluated. Under steady-state conditions and assuming no radial heat loss or gain, the thermal conductivity is determined by the following expression from the one-dimensional Fourier–Biot heat-conduction equation [228, 229]:

$$k = \frac{-q\Delta x}{A\Delta T} \quad (17)$$

where k is the average thermal conductivity corresponding to the temperature $\frac{1}{2}(T_1 + T_2)$, $\Delta T = T_2 - T_1$, q is the rate of heat flow, A is the cross-sectional area of the specimen, and Δx is the distance between points of temperature measurements for T_1 and T_2 . The different variants of this method are discussed separately below.

a. Absolute Methods

(i) *Rod Method.* This method is suitable for good conductors such as beryllium oxide and for all temperatures except for very high temperatures. In fact, this method has been used for most measurements below room temperature. The specimen used is in the form of a relatively long rod so as to produce an appreciable temperature drop along the specimen for precise measurement. A source of heat at a constant temperature is supplied at one end of the rod and flows axially through the rod to the other end where a heat sink at a lower constant temperature is located. The radial heat loss or gain of the rod should be negligible. In order to calculate the thermal conductivity from equation (17), it is necessary to measure the rate of heat flow into and/or out of the rod, the cross-sectional area, the temperatures of at least two points along the rod, and the distance between points of temperature measurements.

For measurements at cryogenic temperatures, radial heat loss does not constitute a serious problem, and thermal insulation and guard heaters are normally not necessary. The measurement is usually made under high vacuum to prevent gas conduction and convection, and a radiation shield surrounding the specimen may be used to minimize radiation losses. The heat is supplied to one end of the specimen by a heating coil of fine resistance wire (which may

be wound directly onto the specimen to eliminate contact resistance between heater and specimen) or by a carbon resistor attached to the end. The temperatures may be measured by gas thermometers, vapor-pressure thermometers, thermocouples, resistance thermometers, or magnetic-susceptibility thermometers. General reviews of the low-temperature measurements and experimental techniques have been presented by White [230, 231]. For details of some of the useful low-temperature apparatus the reader may consult references [232-243].

For measurements at high temperatures, heat loss becomes a serious problem because radiant heat transfer increases rapidly with temperature. To prevent radial heat losses, a guard tube surrounding the specimen with controlled guard heaters may be utilized. Insulating powder is usually used to fill the space between the rod specimen and the guard tube, which should have the same temperature distribution along it as does the rod specimen. In fact, as early as 1887, Berget [244, 245] started the use of a guard ring surrounding and with the same temperature distribution as the specimen to prevent heat losses.

The rate of heat flow into the specimen may be determined by measuring the power input to a guarded electrical heater at the free end of the rod specimen [246-248] or by measuring the heat flow out of the specimen with a water-flow calorimeter at the low-temperature end [249], or by both [250-252]. Temperature measurements are made usually with thermocouples. In order to get correct temperature measurements and to minimize heat conduction along thermocouple leads, the thermocouples should be made of fine wires of low-conductivity alloys and the leads from the junction should be along isothermal lines.

This method, as used for measurements at high temperatures, has been comprehensively reviewed and discussed by Laubitz [253] and Flynn [254]. Systematic errors in measurements caused by the effects of heat losses, thermal contact resistance, poor thermocouple contacts, and temperature drift have been analyzed by Bauerle [255].

A variation of this method has been used [256-258] in which the specimen heater is located in a cavity at the center of the rod specimen and a heat sink is at each end. A mean value of the temperature gradient established toward the two ends is used for the thermal conductivity calculation.

(ii) *Plate (or Disk) Method.* This method is suitable for poor conductors and insulators. It is similar to

the rod method except for the specimen length-to-width ratio being greatly reduced to a small fraction. This specimen geometry is favorable for measuring poor conductors because the smaller the length to width ratio, the smaller is the ratio of lateral heat losses to the heat flow through the specimen, and the shorter is the equilibrium time. The size of specimen used in various apparatus designed for different kinds of materials varies greatly. For apparatus designed to measure semiconductors, the specimen used may be about 1 cm wide [259], while the apparatus for measuring less homogeneous insulating or refractory materials may require a specimen of over one foot in width [260].

In this method, the thermal conductivity is also given by equation (17). The rate of heat flow may be determined by the electrical power input to a guarded heater [260-262], by a guarded water-flow calorimeter [263], by a boil-off calorimeter [264-267], or by a heat flow meter [268]. Temperature measurements are made generally with thermocouples inserted in the specimen or embedded in grooves on the specimen surfaces depending on the materials tested. Lateral heat losses may be prevented either by utilizing guard heaters or by using a large specimen, of which only a relatively small central area is used for measurement. In the first detailed mathematical analysis of the plate method reported in 1898, Peirce and Willson [269] found already that, if the radius of the specimen is five times larger than that of the central test section whose thickness equals its radius, the temperature at any point within the central test section would not sensibly differ from the temperature at the corresponding point in an infinite disk of the same thickness and same face temperatures. Further mathematical analyses of the errors due to lateral heat loss in guarded hot plate apparatus have been given in [270-272].

Detailed descriptions of recent apparatus for measurements at cryogenic temperatures can be found in the articles collected in [273], and for measurements at high temperatures in [274]. A comprehensive review of the plate method has been given in [275]. A description of the NBS steam calorimeter apparatus and some useful discussions on this method have also been given in [254].

There are two main kinds of experimental arrangements for the absolute plate (or disk) method: the single-plate system and the twin-plate system. The single-plate system [259, 262-269] requires only one specimen, which is placed between a hot plate and a cold plate, while the twin-plate system [260-261]

requires two similar specimens to be sandwiched between a hot plate in the middle and two cold plates on the outside. The plate method employing the single-plate system was probably first used by Clément, whose experiment on copper was quoted by Péclet [276] in 1841. Péclet also used this method to measure the thermal conductivity of copper, and both of them obtained erroneous results. Later improvements on this method have been made by Peirce and Willson [269] and Lees [277] among others. The idea of a twin-plate system was developed by Lees [277] in 1898, but he did not actually adopt the twin-plate system for his plate method in the series of measurements reported in [277]. However, he used the twin-plate system in his experiments on the effect of pressure on thermal conductivity reported in 1899 [278]. Great improvement on the plate method employing the twin-plate system was made by Poensgen [261] in 1912, who introduced the guard-ring heater to the system as the prototype of the modern guarded hot-plate apparatus.

b. Comparative Methods

In the earliest steady-state comparative method suggested by Franklin and carried out by Ingen-Hausz [204] as reported in 1789, rods of various metals were coated with wax and heated at one end to a common temperature in a bath of hot water or oil. The wax melted over a greater distance on a rod of better conducting material, and under steady-state conditions the ratio of the conductivities of the rods is roughly proportional to the squares of these distances. The modern comparative methods are the divided-rod (or cut-bar) method and the comparative plate method as discussed below.

(i) *Divided-Rod (or Cut-Bar) Method.* The divided-rod method was originated by Lodge [279] in 1878 and later used by Berget [280], Lees [281], and many others. In this method a reference sample (or samples) of known thermal conductivity is placed in series with the unknown specimen with hopefully the same rate of heat flow through both the reference and the specimen. Under such ideal conditions, the thermal conductivity of the specimen is given by

$$k = k_r \frac{A_r(\Delta T/\Delta x)_r}{A(\Delta T/\Delta x)} \quad (18)$$

where the subscript r designates the reference sample.

This method may be divided into two distinct groups: the "long-specimen" type [280, 282, 283]

for measuring the thermal conductivity of good conductors, and the "short-specimen" type [279, 281, 284–287] for measuring poor conductors.

Comparative methods have the advantages of simpler apparatus, easier specimen fabrication, and easier operation. Their disadvantages include additional measurement errors due to the required additional measurements of temperatures and thermocouple separations, difficulty in matched guarding, and lower accuracy due to the additional uncertainty in the conductivity of the reference sample, due to the conductivity mismatch between specimen and reference sample, and due to the interfacial thermal contact resistance. These have been carefully analyzed by Laubitz [253] and Flynn [254]. Flynn [254] has pointed out that the ASTM standard cut-bar method C408-58 [286] is not well designed and the data obtained by using this method can be subject to large errors.

(ii) *Plate (or Disk) Method.* This comparative method is suitable for poor conductors and insulators and is similar to the divided rod method in principle except that the specimen and the reference samples are now flat plates (or disks) sandwiched between a hot and a cold plate. Christiansen [288] was the first to report in 1881 the use of this type of comparative method in which he compared the thermal conductivity of liquids with that of air. Peirce and Willson [269] used this method to measure the thermal conductivity of marble slabs with glass plates as reference material for comparison. Sieg [289] employed the guard ring in his apparatus to prevent lateral heat loss.

c. Combined Method

In using a "combined" method, the apparatus combines the features of both absolute and comparative methods. The rate of heat flow is determined both through a reference sample placed in series with the specimen and simultaneously by a water-flow calorimeter [290–292] or by measuring the electrical power input to a heater [293]. In the measurements reported in [293], a "dual combined" method was employed in which a heater is located at the center of the divided rod between two short specimens with two longer reference samples at the two ends which are cooled by flowing water.

B. Forbes' Bar Method

Forbes' original method [207–210] consists of two separate experiments. The first was termed by Forbes the *statical*, and the second the *dynamical*, or

cooling, experiment. In the *statical* experiment a square wrought iron bar with 1.25-inch side and 8 feet long was heated at one end by molten lead or solder at a fixed high temperature, and the steady-state temperature distribution along the bar was determined with the surface of the bar losing heat by convection and radiation to a constant-temperature environment. In the *dynamical* or cooling experiment a similar bar, but only about 20 inches long, was cooled in the same environment from a high uniform temperature and the rate of heat loss was determined. From these two experiments, the thermal conductivity may be computed as follows.

Replacing $\Delta x/\Delta T$ in equation (17) by dx/dT , differentiating the resulting equation with respect to x and rearranging gives

$$k = \frac{1}{A} \frac{dq}{dx} \frac{1}{d^2T/dx^2} \quad (19)$$

The statical experiment provides values for d^2T/dx^2 , and the heat loss per unit time per unit length of the bar in the cooling experiment is

$$\frac{dq}{dx} = AC \frac{dT}{dt} \quad (20)$$

where dT/dt is the measured cooling rate and C the specific heat per unit volume.

Hogan and Sawyer [294] have improved this method so that it is not necessary to know the specific heat of the material. They used a thin long rod enclosed in an isothermal furnace. Radial heat loss from the specimen was determined by passing an electric current through the specimen and measuring the electric power required to maintain it at a temperature slightly above that of the furnace. This replaces Forbes' cooling experiment, and it is not necessary to know the specific heat since a steady-state condition is prevailing.

Hogan and Sawyer's method was further improved by Laubitz [295]. In his comprehensive review Laubitz [253] has discussed in detail the generalized Forbes' bar method, including the other major variants currently in use [296-298].

C. Radial Heat Flow Methods

There are several different types of apparatus all employing radial heat flow. The classification is mainly based upon specimen geometry. In the following we will briefly describe the cylindrical, spherical, ellipsoidal, concentric sphere, concentric cylinder, and plate methods. The reader is referred

to the references given for individual methods for finer details. A comprehensive review of radial heat flow methods has been made by McElroy and Moore [299].

a. Absolute Methods

(i) *Cylindrical Method.* The cylindrical method uses a specimen in the form of a right circular cylinder with a coaxial central hole, which contains either a heater or a heat sink, depending on whether the desired heat flow direction is to be radially outward or inward. The use of this method was first reported by Callendar and Nicolson [300] in 1897 for measuring the thermal conductivity of cast iron and mild steel. The cylindrical specimens used were 5 inches in diameter and 2 feet long with 1-inch coaxial holes heated by steam under pressure. The outside of the cylinder was cooled by water circulating rapidly in a spiral tube. Niven [301] in 1905 also used the radial heat flow method for measurements on wood, sand, and sawdust. His method is close to the so-called hot-wire method developed by Andrews [302] in 1840 and Schleiermacher [303] in 1888 for measurements on gases. Kannuliik and Martin [304] used the hot-wire method for measurements on powders as well as on gases.

In the early experiments and also in many later designs [305-308], end guards are not employed. The effect of heat losses from the ends of the specimen is minimized by using a long specimen and monitoring the electric power within only a small section of the specimen away from the ends.

The guarded cylindrical method employing end guards at both ends of the specimen to prevent axial heat losses was developed by Powell [309] and first reported in 1939 for measurements on Armco iron at high temperatures. In the guarded cylindrical method the specimen is generally composed of stacked disks with a coaxial central hole containing either a heater or a heat sink. Temperatures within the specimen are measured either by thermocouples or by an optical pyrometer. For details of some of the useful apparatus employing the guarded cylindrical method, the reader may consult references [299, 309-314].

The thermal conductivity is calculated from the expression

$$k = \frac{q \ln(r_2/r_1)}{2\pi l(T_1 - T_2)} \quad (21)$$

where l is the length of the central heater and T_1 and T_2 are temperatures measured at radii r_1 and r_2 , respectively.

Hoch *et al.* [315] have developed a quasi-radial heat flow method in which a metallic specimen in the form of a disk or short cylinder is heated at its convex cylindrical surface in high vacuum by means of high frequency induction and is losing heat from its flat circular end faces by radiation. In this method the inward flow of heat from the cylindrical surface, at which the heat generation is localized, into the interior of the specimen is, of course, not strictly radial, and the temperature gradient of the flat circular end faces along the radius is related to the thermal conductivity. For measurements on non-metallic solids such as Al_2O_3 [316], the convex surface of the specimen is covered with a metallic envelope. The theory of this method is improved by Vardi and Lemlich [317], and some of the previously published data are revised.

(ii) *Spherical and Ellipsoidal Methods.* In a spherical method, the heater is completely enclosed inside the specimen which is in the form of a hollow sphere. The heat supplied by the internal heater passes through the specimen radially without loss. Theoretically, this method is ideal. However, there are a number of practical difficulties such as difficult fabrication of a spherical heater which produces uniform heat flux in all radial directions, difficult fabrication of spherical specimen, difficult positioning of thermocouples along spherical isotherms, etc., which have prevented this method from being popular. Laws, Bishop, and McJunkin [318] seem the first to have used this method on solids (not loose-filled materials). A detailed description of a modern design may be found in [305]. The thermal conductivity is calculated from the expression

$$k = \frac{q(1/r_1 - 1/r_2)}{4\pi(T_1 - T_2)} \quad (22)$$

The ellipsoidal method is similar, but has some advantages over the spherical method. It was developed by a group of researchers at MIT [319–321]. The major advantage of using a specimen in the form of an ellipsoid instead of a sphere is that the isothermal surfaces near the plane of the minor axes of an ellipsoid are rather flat so that straight thermocouple wires can be used without ill effect. If a is half the focal length of the ellipsoid and T_1 and T_2 are temperatures measured at respectively two radii r_1 and r_2 on the minor axis, the thermal conductivity is determined by the expression

$$k = \frac{q}{8\pi a(T_1 - T_2)} \times \ln \left[\frac{\sqrt{(a^2 + r_2^2)} - a}{\sqrt{(a^2 + r_2^2)} + a} \cdot \frac{\sqrt{(a^2 + r_1^2)} + a}{\sqrt{(a^2 + r_1^2)} - a} \right] \quad (23)$$

Despite the aforementioned advantage, the ellipsoidal method is also rarely used due to the other experimental difficulties common to both the ellipsoidal and spherical methods.

(iii) *Concentric Sphere and Concentric Cylinder Methods.* Concentric sphere and concentric cylinder methods are used mainly for measurements on powders, fibers, and other loose-filled materials. The specimen is filled in the space between two concentric spherical (or cylindrical) shells, with the inner sphere (or cylinder) being a heater or a heat sink. In a concentric cylinder apparatus, end guards are usually used to prevent axial heat flow.

A concentric sphere method was first used by Péclet [322] and reported in 1860 with the inner sphere filled with hot water as heater. However, a steady-state condition was not achieved in his pioneering measurements. Later Nusselt [323] succeeded in using this method for measurements on insulating materials with an electric heater installed inside the inner spherical shell. A modern apparatus using a boil-off calorimeter in the inner sphere was described in [324].

A concentric cylinder method was used by Stefan [325] and reported in 1872 for the measurements on gases. It was later adopted for measuring loose-filled materials. Reference [326] describes a modern apparatus employing a guarded boil-off calorimeter inside the inner cylinder. Recently, Flynn and Watson [327] used a concentric cylinder method to measure the high-temperature thermal conductivity of soil.

(iv) *de Sénarmont's Plate Method.* de Sénarmont [328–332] in 1847–48 used a radial heat flow plate method to determine the anisotropy in thermal conductivity of crystalline substances. However, this method does not yield absolute values of thermal conductivity, and furthermore the axial heat loss is not prevented.

In his method, a thin plate of the sample was coated with a thin film of white wax; and heat was applied at a central point by means of a hot, thin silver tube tightly fitted in a hole at the center of the plate. The wax melted around the region where heat was supplied and the bounding line of the melted wax was the visible isotherm, the shape of

which indicated the variation of thermal conductivity in the different directions.

If the substance is isotropic, the bounding curve of the melted wax is a circle, whereas for anisotropic substances, this curve is elliptical. In such a case, the ratio of the two thermal conductivities k_a and k_b along the two axes a and b of the ellipse is given by the expression

$$\frac{k_a}{k_b} = \left(\frac{a}{b}\right)^2 \quad (24)$$

Powell [333] has modified the method in his simple test for anisotropic materials. In testing gallium, he cooled a slice of crystal locally by means of a piece of solid carbon dioxide and observed the contours of the dew and frost areas which formed around the cooled zone. For testing graphite, he followed de Sénarmont's original method, but the surface of the plate used was covered with frost by precooling instead of being coated with wax.

b. Comparative Methods

(i) *Concentric Cylinder Method.* This method has been used for measurements on some special materials such as those that are radioactive or reactive [334-336] and not for ordinary materials, because it does not have any major advantage over the absolute method. A typical apparatus of this kind consists of a cylindrical specimen which is surrounded by a concentric cylindrical reference sample of known thermal conductivity. A coaxial central hole in the specimen contains a heat source, which produces heat flowing radially through both the specimen and the reference sample. The advantage of using this method for measuring radioactive or reactive materials is that the reference sample which encloses the specimen serves also as a means of containment. The thermal conductivity is determined from the expression

$$k = k_r \frac{(T_3 - T_4) \ln(r_2/r_1)}{(T_1 - T_2) \ln(r_4/r_3)} \quad (25)$$

where T_1 and T_2 are two temperatures measured in the specimen at two radii r_1 and r_2 , respectively, and T_3 and T_4 in the reference sample respectively at r_3 and r_4 .

(ii) *Disk Method.* Robinson [337] developed a method, which he termed the "conductive-disk method," for comparative measurements on insulators. This method employs inward radial heat flow

from a heater at the circular edge of a disk of suitable conductive reference material sandwiched between two like specimens, which are in turn sandwiched between two circular cold plates at a constant lower temperature. However, the heat flow in this case is not strictly radial, since, as the heat flows radially in the conductive disk toward the center, it flows also from the disk through the specimens to the cold plates. As a result, the steady-state temperature of the disk decreases toward its center, and the rate of decrease depends on the thermal conductivity of the specimens. Robinson obtained an expression for calculating the thermal conductivity of the specimens from the known thermal conductivity and thickness of the disk and from the temperatures of the cold plates and of the disk at its center and at a suitable radius.

D. Direct Electrical Heating Methods

In direct electrical heating methods, the specimen is heated directly by passing an electric current through it. These methods are therefore limited to measurements on reasonably good electrical conductors. Furthermore, they usually yield thermal conductivity in terms of electrical conductivity rather than directly. However, direct electrical heating methods also have certain advantages over other methods, and at high temperatures an increasing number of materials become sufficiently good electrical conductors. Direct electrical heating offers a means of easily attaining very high temperatures, uses simpler apparatus and experimental techniques than other methods at high temperatures, uses relatively small specimens, requires relatively short time to reach equilibrium, and also offers the possibility of concurrent determinations of a number of physical properties on the same specimen. According to specimen geometry, these methods fall into two major categories: cylindrical rod and rectangular bar. They will be briefly discussed below. Comprehensive reviews [338-340] on direct electrical heating methods are available.

The thermoelectrical method to be discussed later involves also the direct passage of an electric current through the specimen. However, in that method the specimen is heated (and cooled) by the Peltier effect which is totally different from the Joulean heating responsible for maintaining the specimen temperature in the direct electrical heating methods discussed here. It is therefore preferable to discuss the thermoelectrical method separately in another section.

a. Cylindrical Rod Methods

The direct electrical heating methods in this category involve heating specimens in the form of rods, thin wires, or tubes by the passage of regulated electric current and measuring potential drops and temperatures for the calculation of thermal conductivity.

There are many different techniques and variants that have been employed over the years since Kohlrausch [341-344] first developed this method. The different variants may be divided into three categories as discussed below.

(i) *Longitudinal Heat Flow Method.* In this method the rod is well insulated or guarded to prevent radial heat losses, so that the Joule heat generated in the specimen flows to the two ends. This is the method originally developed by Kohlrausch [341-344]. If the two ends of the rod are held at the same temperature and assuming that in a small temperature range the thermal and electrical conductivities are independent of temperature, the thermal conductivity is given by the simple relation

$$k = \frac{1}{8\rho} \frac{(V_1 - V_3)^2}{(T_2 - T_1)} \quad (26)$$

where ρ is the electrical resistivity, V_1 and V_3 are the electrical potentials at locations 1 and 3 on the specimen which are at equal and opposite distances from the midpoint 2, and T_1 and T_2 are temperatures at locations 1 and 2. This method was first used for actual measurements by Jaeger and Diesselhorst [345]. A variant of it has been used by Mikryukov [338]. The so-called "necked-down-sample method" [346] may also be considered as a longitudinal heat flow method.

(ii) *Radial Heat Flow Method.* This method uses a thick rod or tube and allows radial heat transfer. Under steady-state conditions the Joule heat generated in the specimen at regions remote from the ends flows radially to the surface and is then transferred by convection and radiation to the surroundings. This method was first suggested by Mendenhall and applied by Angell [347]. In the case of a cylindrical rod specimen and assuming that in a small temperature range the thermal and electrical conductivities are independent of temperature, the thermal conductivity is given by the simple relation

$$k = \frac{EI}{4\pi l(T_1 - T_2)} \quad (27)$$

where I is the electric current, E is the electrical potential drop over a length l at the central region of the specimen, and T_1 and T_2 are the temperatures at the axis and surface, respectively, of the rod at the central region. These temperatures were too small for precise measurements on metals, but Powell and Schofield [348] used it for poorer conducting carbon and graphite, and they also took account of the variation of thermal and electrical conductivities with temperature.

(iii) *Thin-Rod-Approximation Method.* The general form of the present method uses a long thin filament heated electrically in vacuum and allows both longitudinal heat conduction and lateral heat transfer by radiation. The "thin-rod approximation" involves the assumption that the temperatures and potentials in all planes normal to the specimen axis are uniform, i.e., their differences in the radial direction are negligible. Worthing [349] first employed this method for measurements on U-shaped filaments at incandescent temperatures. There are many variants [350-364] of this method, all with more or less different experimental designs, mathematical assumptions, and/or computational techniques.

Taylor, Powell, and co-workers [360, 362-364] at TPRC have made improvements and advancements on this method. They have taken the Thomson effect into account, which had never been done before, and have included the temperature dependence of various physical properties. They used the general equation directly, and their advanced computational techniques have eliminated the need for mathematical approximations and for matching certain experimental conditions.

It seems appropriate to mention the considerable discrepancies which have resulted from the data obtained by various workers, all of whom used different variants of the direct electrical heating method. One of the most recent of the TPRC papers [364] contains an interesting graphical presentation of all the determinations made on tungsten by these methods for the temperature range 1600 to 2800 K. Six of the fourteen groups of workers obtained results lying well above the recommended curve of Powell, Ho, and Liley [365], and one was well below it; the spread being of the order of 50 percent, 80 percent, and 70 percent at 1800, 2200, and 2600 K, respectively. The other seven had results within about 10 percent of the recommended curve, while the curve fitting the new results of [364] was some 3 to 5 percent below the recommended curve.

Earlier reports [339, 362] had contained examples of similar discrepancies for other high-melting-point metals, such as molybdenum, stainless steel, and platinum. The main reasons for these differences include failure to measure accurately small temperature gradients at high temperature, failure to match boundary conditions, errors resulting from simplifying mathematical approximations, and the use of temperature regions in which the thermal conduction term is small compared with the Joulean heating and radiation loss terms.

These have been quoted as examples of current experimental work at the TPRC, which became necessary because of the need to resolve some seriously discordant data and to gain further insight into their causes. The impression must not be given, however, that such discrepancies are confined to metals or to direct electrical heating methods. This is by no means the case, and the literature of heat conduction contains many examples of discordant results for all types of methods used. Titanium carbide, one of the materials dealt with in this volume may be mentioned. The first determinations reported on titanium carbide by Vasilos and Kingery [366] to high temperatures showed the thermal conductivity to decrease from about $0.2 \text{ W cm}^{-1} \text{ C}^{-1}$ at 200 C to $0.1 \text{ W cm}^{-1} \text{ C}^{-1}$ at 500 C and $0.04 \text{ W cm}^{-1} \text{ C}^{-1}$ at 1000 C. Two methods had been used: the divided-rod comparative method for a cube sample up to about 800 C and an ellipsoidal radial-flow method from about 500 to 1100 C. The former method gave results which were greater by 20 percent to 30 percent over their common temperature range. In 1961 Taylor [367] used a better-substantiated radial heat flow method for cylindrical samples of titanium carbide, and found the thermal conductivity to increase linearly from $0.38 \text{ W cm}^{-1} \text{ C}^{-1}$ at 600 C to $0.47 \text{ W cm}^{-1} \text{ C}^{-1}$ at 1600 C.

These two sets of values, differing at about 1000 C by about one order of magnitude and having temperature coefficients of opposite sign naturally aroused interest, and subsequent contributions by Laubitz [368], Hoch and Vardi [369], Powell [370, 371], and the nonsteady-state measurements of Taylor and Morreale [372] all supported the higher values of Taylor [367]. It would seem that the higher thermal conductivity of titanium carbide led to serious errors being associated with the method of Vasilos and Kingery, which were not apparent for substances of lower thermal conductivity. Incidentally, had the much simpler measurement of

electrical resistivity also been made, the unusually low resultant Lorenz function should have provided warning that abnormal data were being obtained. It might well be added that the inclusion of electrical resistivity measurements on all possible occasions is a simple extra measurement which also serves to provide very useful information about the properties of the material under test and its behavior on temperature cycling.

The foregoing example also indicates that users of the data tables of these volumes should, in the absence of any analysis that has produced a curve of recommended values, tend to be critical of the values presented, until these are seen to be well supported by independent experiments, correlations, or by additional checks such as that of a reasonable Lorenz function.

An additional outcome of the current TPRC investigation has been the development of a method and of equipment capable of determining a large number of high-temperature physical properties [373]. Their multiple-purpose apparatus is the first operational model that can accurately measure the thermal conductivity, electrical resistivity, total and spectral hemispherical emittance, Thomson coefficient, and Lorenz function on one and the same specimen. This apparatus can also measure the specific heat, enthalpy, thermal diffusivity, thermal expansion, Seebeck coefficient, Peltier coefficient, and Richardson coefficient. The merit of obtaining many different physical properties from one and the same specimen so as to permit meaningful quantitative cross-correlations between properties need not be emphasized here.

b. Rectangular Bar Method

This method was developed by Longmire [374] and is a geometrically-deformed variant of the radial heat flow method. The specimen used is in the form of a long rectangular bar. This special specimen geometry enables all temperature measurements to be made on the surface of the specimen. As the specimen is heated electrically in vacuum, the heat loss by radiation establishes a radial temperature gradient, and the temperature at the center line of the wider surface of the rectangular bar will be higher than that at the center line of the narrower surface. From measurements of these two temperatures, the electrical conductivity, and total hemispherical emittance of the bar, the thermal conductivity can be calculated using the equation derived by Longmire.

Longmire's method was improved by Pike and Doar [375-377] both in mathematical analysis and in experimental techniques. They further extended this method to the determination of anisotropy in thermal conductivity.

E. Thermoelectrical Method

The thermoelectrical method was developed by Borelius [378] and reported in 1917 for the combined measurement of the Peltier heat and thermal conductivity of the same material, and is particularly applicable to the measurements on thermoelectric materials.

In this method, the specimen is held between metallic contacts through which a small direct electric current is passed. Peltier heating thus occurs at one end of the specimen and Peltier cooling at the other end, which establishes a temperature gradient along the specimen. Under steady-state conditions, the rate of Peltier heat generation at the hot end is just balanced by the rate of heat conduction from the hot to the cold end. Thus the thermal conductivity can be calculated from the rate of Peltier heat production πI (π being the Peltier coefficient), the temperature difference between the ends ΔT , the cross-sectional area A , and the length l by the expression

$$k = \frac{\pi I l}{A \Delta T} \quad (28)$$

Since $\pi = ST$, S being the Seebeck coefficient, π can be determined by measuring the Seebeck coefficient from the potential difference between the ends after the temperature difference ΔT is established.

When the direct electric current is passed through the specimen, Joulean heating will occur, of course. However, the Joulean heating effect can be made negligibly small in a good thermoelectric material by choosing the current small enough, because the Joule heat production is proportional to I^2 while the Peltier heat production is proportional to I . The Thomson heat effect is generally small.

Borelius' method was used by Sedström [379, 380] for measurements on alloys. Some forty years later, Putley [381] and Harman [382, 383] reinvented this method. A recent apparatus is described in [384].

A transient thermoelectrical method was developed by Héringx and Monfils [385]. In this method a direct electric current is passed through the specimen and the time dependence of the resulting potential drop across the specimen is observed.

The thermal conductivity can be derived from the shape and asymptote of this potential drop versus time curve provided that the Seebeck coefficient is known.

F. Thermal Comparator Method

The thermal comparator method was developed by Powell [386-389] and is a simple comparative method for the rapid, easy measurement of thermal conductivity.

The essential part of the thermal comparator is an insulated probe with a projecting tip. The probe is integral with a thermal reservoir held at a temperature about 15 to 20 degrees above room temperature. A surface thermocouple is mounted at the tip of the probe and is differentially connected to the thermal reservoir for the measurement of the temperature difference between the reservoir and the tip.

In operation, the probe is gently placed on the surface of the test material. Upon contact of the probe tip of known thermal conductivity k_1 and originally at temperature T_1 with the surface of the test material of thermal conductivity k_2 and at room temperature, T_2 , the temperature of the probe tip drops quickly to an intermediate temperature, T , giving the expression

$$T_1 - T = (T_1 - T_2) \left(\frac{k_2}{k_1 + k_2} \right) \quad (29)$$

This temperature difference is registered by the emf reading of the differential thermocouple after a brief transient period (1 to 2 seconds) has elapsed.

From the emf readings of tests on a series of reference samples of known thermal conductivity, a calibration curve is obtained, and the thermal conductivity of an unknown specimen can thus be determined from the emf reading through the calibration curve.

Powell [390] has made a comprehensive review on this method. Some subsequent developments are discussed in [391]. The *thermal comparator* has been developed by TPRC as an instrument [391] for the rapid determination of the thermal conductivity of solids and liquids and is commercially available from The McClure Park Corp., West Lafayette, Indiana.

3. NONSTEADY-STATE METHODS

In nonsteady-state methods, the temperature distribution in the specimen varies with time. The rate of temperature change at certain positions along the specimen is measured in the experiment, and no

measurement of the rate of heat flow is required. These methods normally determine the thermal diffusivity, from which the thermal conductivity can be calculated with an additional knowledge of the density and specific heat of the test material. Nonsteady-state methods fall into two major categories, the periodic and the transient heat flow methods, as briefly discussed below. These methods have been comprehensively reviewed by Danielson and Sidles [392], and will be dealt with in Volume 10 of the present TPRC Data Series.

A. Periodic Heat Flow Methods

In periodic heat flow methods, the heat supplied to the specimen is modulated to have a fixed period. The resulting temperature wave which propagates through the specimen with the same period is attenuated as it moves along. Consequently, the thermal diffusivity can be determined from measurements of the amplitude decrement and/or phase difference of the temperature waves between certain positions in the specimen. In most of the periodic heat flow methods, heat flow is in the longitudinal (axial) direction. However, methods with heat flow in the radial direction have also been used.

a. Longitudinal Heat Flow Method

The periodic heat flow method was first developed by Ångström [211, 393] and reported in 1861. In his method a variable heat source capable of producing a sinusoidal temperature variation was attached to the center of a long thin rod specimen, and the temperatures as a function of time at two positions l apart towards the ends of the rod, were measured. From these temperature-time measurements, the velocity, v , and the amplitude decrement, δ , of the temperature wave can be determined for the calculation of thermal diffusivity. This method has been modified and improved by King [394] and others [395-397]. The thermal diffusivity may be calculated from the expression [396]

$$D = \frac{vl}{2 \ln \delta} \quad (30)$$

The Ångström method, which uses a long rod, has its limitations. In some cases, specimens in the form of long rods may not be available, and in other cases, such as in the measurements on poor conductors at high temperatures, heat guarding to prevent lateral heat losses from a long rod may be difficult.

Consequently, methods using specimens in the form of a small plate or disk have been developed [398-400].

b. Radial Heat Flow Method

In this method, the specimen in the form of a cylinder is heated by a heat source capable of producing a periodical temperature variation either at the axis or at the circumference, and the radial temperature variations with time are measured. The thermal diffusivity may be calculated from the phase change of the temperature oscillations, or from the amplitude variation of the oscillations with frequency.

Tanasawa [401] used this method in 1935 for the measurements on humid materials. In his method, a sinusoidal temperature was produced on the surface of a cylindrical specimen, and the temperatures at different radial distances were measured for the calculation of thermal diffusivity.

Filippov and his co-workers have further developed a method of this type [402] and used it for the measurements on metals [403] and molten metals [404, 405] at high temperatures.

The nonsteady-state radial heat flow method has also been employed for measurements on insulators [406, 407].

B. Transient Heat Flow Methods

Transient heat flow methods, both longitudinal and radial, were first used by Neumann [408, 409] and reported in 1862. In his method, one end of a bar was heated by a flame until the temperature attained the equilibrium state. The flame was then suddenly removed and the temperatures at two positions along the bar were measured as a function of time. Thermal diffusivity can then be calculated from these measurements. For the measurements on poor conductors he used another method in which a cube or sphere was heated uniformly to a high temperature and then was allowed to cool in the air. The temperatures at the surface and at the center were measured as a function of time.

The modern transient heat flow methods have a wide variety. In the following a number of the major variants are briefly discussed.

a. Longitudinal Heat Flow Method

Similar to the longitudinal periodic heat flow method, the longitudinal transient heat flow method can also be subdivided into two major categories: those using a long rod and those using a small plate (or disk)

Methods in which one end of a long rod, which is initially at a uniform temperature, is subjected to a short heating pulse have been developed [410, 411]. There are also methods in which steady heating is provided at one end of a rod and the temperatures as a function of time at two or more positions along the rod are observed [412-414].

Transient heat flow methods in which the specimen used is in the form of a small plate or disk have been developed by a number of workers [415-418].

b. Flash Method

Although the flash method is a variant of the longitudinal transient heat flow method using a small thin disk specimen geometry, it has a very special feature which makes it a class of its own. In the "flash" method, a flash of thermal energy is supplied to one of the surfaces of a disk specimen within a time interval that is short compared with the time required for the resulting transient flow of heat to propagate through the specimen. This method was developed by Parker, Jenkins, Butler, and Abbott [419] and reported in 1961.

In use, a heat source such as flash tube or laser supplies a flash of energy to the front face of a thin disk specimen and the temperature as a function of time at the rear face is automatically recorded. The thermal diffusivity is given from the thickness of the specimen, l , and a specific time, $t_{1/2}$, at which the back face temperature reaches half its maximum value by the expression

$$D = 1.37 l^2 / \pi^2 t_{1/2} \quad (31)$$

Other expressions for the calculation of thermal diffusivity have also been used.

Subsequent improvements on this method have been made [420, 421] by the application of corrections for the finite pulse-time effect and the radiation-loss effect.

c. Radial Heat Flow Method

As mentioned before, a radial heat flow method was used by Neumann [408, 409] for measurements on poor conductors. His specimens were of spherical shape.

In modern apparatus, specimens in the form of cylinders are used. A long cylindrical specimen, hollow or solid, which is initially at uniform temperature, is heated either at the axis or at the outer surface and the temperatures as a function of time

at different radial distances are measured. In the methods developed by Ginnings [422] and by Cape, Lehman, and Nakata [423], cylindrical specimens were continuously heated at the outer surface.

Specimens in the form of hollow disks stacked on an axial heater with outer disks as end guards have been used by Carter, Maycock, Klein, and Danielson [424].

Although the line heat source and probe methods are also radial transient heat flow methods, they are quite different from other methods and will be discussed in a separate section below.

d. Line Heat Source and Probe Methods

The line heat source method was originally developed by Stalhane and Pyk [425] in 1931 and used for measurements on ceramic materials [426]. This method is suitable for the measurements on loose-filled materials such as powders.

In this method, a long thin heater wire which serves as a line heat source was embedded in a large specimen initially at uniform temperature. The heater is then turned on, which produces constant heat, q , per unit length and time, and the temperature at a point in the specimen is recorded as a function of time. The thermal conductivity is given by the expression

$$k = \frac{q}{4\pi(T_2 - T_1)} \ln \frac{t_2}{t_1} \quad (32)$$

where $(T_2 - T_1)$ is the temperature difference at two times t_1 and t_2 . Subsequently, this method was also developed by van der Held and his co-workers [427, 428] and others.

The probe method is a more practical line heat source method in which the heat source is enclosed inside a probe for protection and for easy insertion into a sample. This method was developed by Hooper and his co-workers [429, 430] and others. Blackwell [431, 432] has derived theoretical treatments for practical departures from a true line source, and in the discussion of a paper [433] dealing with the use of a probe method in connection with the routing of electric power cables, he advocated the use of very small thermistors as an alternative to thermocouples.

e. Moving Heat Source Method

The moving heat source method was developed by Rosenthal and his co-workers [434-436] and involves the establishment of a quasi-steady-state

temperature distribution in a long tubular-shaped specimen heated by a moving localized heat source of constant intensity. As the heat source approaches and moves away, each point in the specimen is subjected to a temperature rise and fall. When the heat source passes over the specimen, the temperature at a point remote from the ends is recorded as a function of time. From this record, a curve of the logarithm of the temperature variation with time is made. The thermal diffusivity is given from the velocity of the heat source, v , and the slopes P_r and P_f on the rising and falling portions of the curve at the same temperature by the expression

$$D = \frac{v^2}{P_r + P_f} \quad (33)$$

f. Comparative Method

A comparative method employing transient heat flow was developed by Hsu [437, 438]. In this method, two identical sets of composite blocks are used. Each set consists of a test specimen and a reference

sample whose properties are known. Initially the two sets are heated separately to uniform but different temperatures, and then they are suddenly brought into contact, with the two test specimens touching each other. The transient temperature at the contact plane between the test specimen and reference sample corresponding to a certain time is measured, and from this the thermal diffusivity of the specimen can be calculated.

Another transient-heat-flow comparative method has been used by Deem *et al.* [439] for the measurements on irradiated materials. The method of measurement is to place the lower ends of a specimen and a reference sample, which are of the same size and initially at room temperature, in molten tin maintained at a constant elevated temperature and then measure the times required for the tops of them to reach a predetermined intermediate temperature. The ratio of the thermal diffusivities is assumed directly proportional to the ratio of the two times measured for the specimen and the reference material.

References to Text

Review Papers and Books

1. Klemens, P. G., "Theory of the Thermal Conductivity of Solids," in *Thermal Conductivity* (Tye, R. P., ed.), Vol. 1, Chap. 1, Academic Press, London, 1-68, 1969.
2. Klemens, P. G., "Thermal Conductivity of Solids at Low Temperatures," in *Handbuch der Physik* (Flügge, S., ed.), Vol. 14, Springer-Verlag, Berlin, 198-281, 1956.
3. Klemens, P. G., "Thermal Conductivity and Lattice Vibrational Modes," in *Solid State Physics*, Vol. 7, Academic Press, New York, 1-99, 1958.
4. Ziman, J. M., *Electrons and Phonons*, Oxford University Press, 554 pp., 1960.
5. Berman, R., "The Thermal Conductivity of Dielectric Solids at Low Temperatures," *Advan. in Phys.* (Phil. Mag. Suppl.), 2, 103-40, 1953.
6. Leibfried, G., "Lattice Theory of the Mechanical and Thermal Properties of Crystals," in *Handbuch der Physik*, Vol. 7, 105-324, 1955.
7. Carruthers, P., "Theory of Thermal Conductivity of Solids at Low Temperatures," *Rev. Modern Phys.*, 33(1), 92-138, 1961.
8. Berman, R., "Heat Conductivity of Non-Metallic Crystals at Low Temperatures," *Cryogenics*, 5(6), 297-305, 1965.
9. Berman, R., "Heat Conduction in Non-Metallic Crystals," *Sci. Progr. (Oxford)*, 55, 357-77, 1967.
10. Peierls, R. E., *Quantum Theory of Solids*, Oxford University Press, 229 pp., 1955.
11. Drabble, J. R. and Goldsmid, H. J., *Thermal Conduction in Semiconductors*, Pergamon Press, New York, 235 pp., 1961.
12. Rosenberg, H. M., *Low Temperature Solid State Physics*, Oxford University Press, 420 pp., 1963.
13. Peierls, R. E., "The Kinetic Theory of Heat Conduction in Crystals," *Ann. Physik*, 5, 3, 1055-1101, 1929; English translation: *OTS, AEC-TR-1849*, 1-67. [TPRC No. 28 528].
14. Peierls, R. E., "Some Typical Properties of Solid Bodies," *Ann. Inst. Henri Poincaré*, 5, 177-222, 1935.
15. Fröhlich, H. and Heitler, W., "Time Effects in the Magnetic Cooling Method. II—The Conductivity of Heat," *Proc. Roy. Soc. (London)*, A155, 640-52, 1936.
16. Pomeranchuk, I., "Thermal Conductivity of Dielectrics at Temperatures Higher than the Debye Temperature," *J. Exptl. Theoret. Phys. (USSR)*, 11, 246-54, 1941; English translation: *J. Phys. (USSR)*, 4(3), 259-68, 1941.
17. Pomeranchuk, I., "The Thermal Conductivity of Dielectrics," *Phys. Rev.*, 60, 820-1, 1941.
18. Pomeranchuk, I., "On the Thermal Conductivity of Dielectrics at Temperatures Lower than that of Debye," *J. Phys. (USSR)*, 6(6), 237-50, 1942.
19. Pomeranchuk, I., "Heat Conductivity of Dielectrics at High Temperatures," *J. Exptl. Theoret. Phys. (USSR)*, 12, 419-24, 1942; English translation: *J. Phys. (USSR)*, 7(5), 197-201, 1943.
20. Akhieser, A. and Pomeranchuk, I., "Heat Conductivity of Salts used in the Magnetic Cooling Method," *J. Phys. (USSR)*, 8, 216-8, 1944.
21. Klemens, P. G., "The Thermal Conductivity of Dielectric Solids at Low Temperatures (Theoretical)," *Proc. Roy. Soc. (London)*, A208, 108-33, 1951.
22. Herpin, A., "The Kinetic Theory of Solids," *Ann. Physik*, 7, 91-139, 1952.
23. Leibfried, G. and Schlömann, E., "Heat Conduction in Electrically Insulating Crystals," *Nacir. Akad. Wiss. Göttingen, Math.-Physik. Kl.*, 2a(4), 71-93, 1954; English translation: *AEC-tr-5892*, 1-36, 1963.
24. Mori, H., "A Quantum-Statistical Theory of Transport Processes," *J. Phys. Soc. Japan*, 11(10), 1029-44, 1956.
25. Ziman, J. M., "The General Variational Principle of Transport Theory," *Can. J. Phys.*, 34(12A), 1256-73, 1956.
26. Kubo, R., "Statistical-Mechanical Theory of Irreversible Processes. I. General Theory and Simple Applications to Magnetic and Conduction Problems," *J. Phys. Soc. Japan*, 12(6), 570-86, 1957.
27. Kubo, R., Yokota, M., and Nakajima, S., "Statistical-Mechanical Theory of Irreversible Processes. II. Response to Thermal Disturbance," *J. Phys. Soc. Japan*, 12(11), 1203-11, 1957.
28. Callaway, J., "Model for Lattice Thermal Conductivity at Low Temperatures," *Phys. Rev.*, 113(4), 1046-51, 1959.

Lattice Thermal Conductivity

13. Eucken, A., "On the Temperature Dependence of the Thermal Conductivity of Nonmetallic Solids," *Ann. Physik*, 4, 34(2), 185-221, 1911.
14. Eucken, A., "Thermal Conductivity of Some Crystals at Low Temperatures," *Physik. Z.*, 12, 1005-8, 1911.
15. Eucken, A., "Thermal Conductivity of Some Crystals at Low Temperatures," *Verhandl. Deut. Physik Ges.*, 13, 829-35, 1911.
16. Debye, P., "Equation of State and the Quantum Hypothesis with an Appendix on Thermal Conduction," in *Vorträge über die kinetische Theorie der Materie und der Elektrizität*, von Planck, M., et al. (Mathematische Vorlesungen an der Universität Göttingen: VI.), Teubner, Leipzig and Berlin, 19-60, 1914.

33. Keyes, R. W., "Laws of Corresponding States for the Thermal Conductivity of Molecular Solids," *J. Chem. Phys.*, **31**, 452-4, 1959.
34. Callaway, J., "Low-Temperature Lattice Thermal Conductivity," *Phys. Rev.*, **122**(3), 787-90, 1961.
35. Shieve, W. C. and Peterson, R. L., "Correlation Function Calculation of Thermal Conductivity," *Phys. Rev.*, **126**(4), 1458-60, 1962.
36. Hashin, Z. and Shtrikman, S., "Conductivity of Polycrystals," *Phys. Rev.*, **130**(1), 129-33, 1963.
37. Holland, M. G., "Analysis of Lattice Thermal Conductivity," *Phys. Rev.*, **132**(6), 2461-71, 1963.
38. Nettleton, R. E., "Foundation of the Callaway Theory of Thermal Conductivity," *Phys. Rev.*, **132**(5), 2032-8, 1963.
39. Gurzhi, R. N., "Thermal Conductivity of Dielectrics and Ferroelectrics at Low Temperatures," *Zh. Ekspl. i Teoret. Fiz.*, **46**(2), 719-24, 1964; English translation: *Soviet Physics—JETP*, **19**(2), 490-3, 1964.
40. Luttinger, J. M., "Theory of Thermal Transport Coefficients," *Phys. Rev.*, **135**(6A), A1505-14, 1964.
41. Schieve, W. C. and Leaf, B., "Correlation Function Calculation of the Lattice Thermal Conductivity by Classical Liouville Methods," *Physica*, **30**, 1208-16, 1964.
42. Erdős, P., "Low-Temperature Thermal Conductivity of Insulators Containing Impurities," *Phys. Rev.*, **138**(4A), A1200-7, 1965.
43. Krumhansl, J. A., "Thermal Conductivity of Insulating Crystals in the Presence of Normal Processes," *Proc. Phys. Soc. (London)*, **5**, 85(547), 921-30, 1965.
44. Krumhansl, J. A. and Guyer, R. A., "Extension of the Relaxation-Time Approximation to Solution of the Phonon Boltzmann Equation," *Bull. Am. Phys. Soc.*, **10**, 530, 1965.
45. Ranninger, J., "Lattice Thermal Conductivity," *Phys. Rev.*, **140**(6A), A2031-46, 1965.
46. Deo, B. and Behera, S. N., "Calculation of Thermal Conductivity by the Kubo Formula," *Phys. Rev.*, **141**(2), 738-41, 1966.
47. Guyer, R. A. and Krumhansl, J. A., "Solution of the Linearized Phonon Boltzmann Equation," *Phys. Rev.*, **148**(2), 766-78, 1966.
48. Guyer, R. A. and Krumhansl, J. A., "Thermal Conductivity, Second Sound, and Phonon Hydrodynamic Phenomena in Nonmetallic Crystals," *Phys. Rev.*, **148**(2), 778-88, 1966.
49. Ranninger, J., "Thermal Conductivity in Nonconducting Crystals," *Ann. Phys.*, **45**, 452-78, 1967.
50. Allen, K. R. and Ford, J., "Lattice Thermal Conductivity for a One-Dimensional, Harmonic Isotopically Disordered Crystal," *Phys. Rev.*, **176**(3), 1046-55, 1968.
51. Nil'sen, Kh. and Shklovskii, B. I., "Nonlinear Thermal Conductivity of Dielectrics in the Region of Viscous Flow of a Phonon Gas," *Fiz. Tverdogo Tela*, **10**(12), 3602-7, 1968; English translation: *Soviet Phys.—Solid State*, **10**(12), 2857-61, 1969.
52. Ranninger, J., "A Simple Microscopic Model for the Lattice Thermal Conductivity," *Ann. Phys.*, **49**(2), 297-308, 1968.
53. Hamilton, R. A. H. and Parrott, J. E., "Variational Calculation of the Thermal Conductivity of Germanium," *Phys. Rev.*, **178**(3), 1284-92, 1969.

Intrinsic Thermal Resistivity at High Temperatures

54. Akhieser, A., "On the Absorption of Sound in Solids," *J. Phys. (USSR)*, **1**(4), 277-87, 1939.
55. Dugdale, J. S. and MacDonald, D. K. C., "Lattice Thermal Conductivity," *Phys. Rev.*, **98**(6), 1751-2, 1955.
56. Kontorova, T. A., "Thermal Expansion and Thermal Conductivity of Some Crystals," *Zh. Tekh. Fiz.*, **26**(9), 2021-31, 1956; English translation: *Soviet Phys.—Tech. Phys.*, **1**(9), 1959-69, 1956.
57. Lawson, A. W., "On the High Temperature Heat Conductivity of Insulators," *Phys. Chem. Solids*, **3**, 155-6, 1957.
58. Keyes, R. W., "High-Temperature Thermal Conductivity of Insulating Crystals: Relationship to the Melting Point," *Phys. Rev.*, **115**(3), 564-7, 1959.

Normal Processes

59. Landau, L. and Rumer, G., "On the Acoustic Absorption in Solids," *Physik. Z. Sowjetunion*, **11**(1), 18-25, 1937.
60. Herring, C., "Role of Low-Energy Phonons in Thermal Conduction," *Phys. Rev.*, **95**(4), 954-65, 1954.

Boundary Resistance

61. Casimir, H. B. G., "Note on the Conduction of Heat in Crystals," *Physica*, **5**(6), 495-500, 1938.
62. Berman, R., Simon, F. E., and Ziman, J. M., "The Thermal Conductivity of Diamond at Low Temperatures," *Proc. Roy. Soc. (London)*, **A220**(1141), 171-83, 1953.
63. Berman, R., Foster, E. L., and Ziman, J. M., "Thermal Conduction in Artificial Sapphire Crystals at Low Temperatures. I. Nearly Perfect Crystals," *Proc. Roy. Soc. (London)*, **A231**(1184), 130-44, 1955.

Thermal Resistance due to Lattice Imperfections at High Temperatures

64. Ambegaokar, V., "Thermal Resistance due to Isotopes at High Temperatures," *Phys. Rev.*, **114**(2), 488-9, 1959.
65. Klemens, P. G., "Thermal Resistance due to Point Defects at High Temperatures," *Phys. Rev.*, **119**(2), 507-9, 1960.
66. Klemens, P. G., "Lattice Thermal Resistance at Normal and High Temperatures due to Point Defects," Westinghouse Research Lab., Research Rept. 929-8904-R3, 1-8, 1961. [AD 277 223]
67. Klemens, P. G., White, G. K., and Tainsh, R. J., "Scattering of Lattice Waves by Point Defects," *Phil. Mag.*, **7**(80), 1323-35, 1962.
68. Parrott, J. E., "The High-Temperature Thermal Conductivity of Semiconductor Alloys," *Proc. Phys. Soc. (London)*, **81**, 726-35, 1963.
69. Abeles, B., "Lattice Thermal Conductivity of Disordered Semiconductor Alloys at High Temperatures," *Phys. Rev.*, **131**(5), 1906-11, 1963.

Thermal Resistance due to Lattice Imperfections at Low Temperatures

70. Pomeranchuk, I., "Thermal Conductivity of Dielectrics at Temperatures Lower than the Debye Temperature,"

- J. Exptl. Theoret. Phys. (USSR)*, **12**, 245-63, 1942; English translation: *J. Phys. (USSR)*, **6**(6), 237-50, 1942.
71. Klemens, P. G., "The Scattering of Low-Frequency Lattice Waves by Static Imperfections," *Proc. Phys. Soc. (London)*, **A68**, 1113-28, 1955.
 72. Berman, R., Foster, E. L., and Ziman, J. M., "The Thermal Conductivity of Dielectric Crystals: The Effect of Isotopes," *Proc. Roy. Soc. (London)*, **A237**(1210), 344-54, 1956.
 73. Klemens, P. G., "Thermal Resistance due to Isotopic Mass Variation," *Proc. Phys. Soc. (London)*, **A70**(11), 833-6, 1957.
 74. Slack, G. A., "Effect of Isotopes on Low-Temperature Thermal Conductivity," *Phys. Rev.*, **105**(3), 829-31, 1957.
 75. Berman, R., Nettley, P. T., Sheard, F. W., Spencer, A. N., Stevenson, R. W. H., and Ziman, J. M., "The Effect of Point Imperfections on Lattice Conduction in Solids," *Proc. Roy. Soc. (London)*, **A253**, 403-19, 1959.
 76. Carruthers, P., "Electric and Thermal Resistivity of Dislocations," *Phys. Rev. Letters*, **2**, 336-8, 1959.
 77. Carruthers, P., "Scattering of Phonons by Elastic Strain Fields and the Thermal Resistance of Dislocations," *Phys. Rev.*, **114**(4), 995-1001, 1959.
 78. Klemens, P. G., "Thermal Resistance due to Isotopes and Other Point Defects," *J. Phys. Chem. Solids*, **8**, 345-7, 1959.
 79. Sproull, R. L., Moss, M., and Weinstock, H., "Effect of Dislocations on the Thermal Conductivity of LiF," *J. Appl. Phys.*, **30**(3), 334-7, 1959.
 80. Callaway, J. and von Baeyer, H. C., "Effect of Point Imperfections on Lattice Thermal Conductivity," *Phys. Rev.*, **120**(4), 1149-54, 1960.
 81. Bross, H., "The Effect of Defects on Lattice Thermal Conductivity at Low Temperatures," *Phys. Status Solidi*, **2**(5), 481-516, 1962; English translation: *CFSTI, NP-TR-963*, 1-73, 1962. [TPRC No. 23110]
 82. Carruthers, P., "Thermal Conductivity of Solids, III. Modification of Three-Phonon Processes by Isotopic Scattering," *Phys. Rev.*, **126**(4), 1448-52, 1962.
 83. Bross, H., Seegar, A., and Haberkorn, R., "Lattice Thermal Resistance of Edge Dislocations," *Phys. Status Solidi*, **3**(6), 1126-40, 1963.
 84. Greig, D., "Lattice Imperfections and the Thermal Conductivity of Solids," *Progr. in Solid State Chemistry*, **1**, 175-208, 1964.
 85. Bross, H., Gruner, P., and Kirschenmann, P., "Normal Processes and Their Effect on the Lattice Thermal Conductivity in Solids with Step Dislocations," *Z. Naturforsch.*, **20a**(12), 1611-25, 1965.
 86. Bross, H., "Effect of Defect Configuration on the Lattice Thermal Conductivity of Dielectrics," *Z. Physik*, **189**(1), 33-54, 1966.
 87. Maradudin, A. A., "Theoretical and Experimental Aspects of the Effects of Point Defects and Disorder on the Vibration of Crystals-1," in *Solid State Physics*, Vol. 18, Academic Press, New York, 273-420, 1966.
 88. Maradudin, A. A., "Theoretical and Experimental Aspects of the Effects of Point Defects and Disorder on the Vibrations of Crystals-2," in *Solid State Physics*, Vol. 19, Academic Press, New York, 1-134, 1966.
 89. Moss, M., "Scattering of Phonons by Dislocations," *J. Appl. Phys.*, **37**(11), 4168-72, 1966.
 90. Klemens, P. G., "Phonon Scattering by Cottrell Atmospheres Surrounding Dislocations," *J. Appl. Phys.*, **39**(11), 5304-5, 1968.
 91. Ohashi, K., "Scattering of Lattice Waves by Dislocations," *J. Phys. Soc. Japan*, **24**, 437-45, 1968.
- Thermal Resistance due to Phonon-Defect Resonant Scattering at Low Temperatures**
92. Lifshitz, I. M., "Scattering of Short Elastic Waves in Crystalline Lattices," *Zh. Eksperim. i Teor. Fiz.*, **18**(3), 293-300, 1948.
 93. Lifshitz, I. M., "Some Problems of the Dynamic Theory of Non-Ideal Crystal Lattices," *Nuovo Cimento Supplento*, **3**(4), 716-34, 1956.
 94. Pohl, R. O., "Thermal Conductivity and Phonon Resonance Scattering," *Phys. Rev. Letters*, **8**, 481-3, 1962.
 95. Callaway, J., "Thermal Resistance Produced by Point Imperfections in Crystals," *Nuovo Cimento*, **10**, **29**(4), 883-91, 1963; USAF Rept. AFOSR-64-1235, 1-9, 1963. [AD 442 806]
 96. Klein, M. V., "Phonon Scattering by Lattice Defects," *Phys. Rev.*, **131**(4), 1500-10, 1963.
 97. Pohl, R. O., "Phonon-Defect Resonance Interaction," in *Proceedings of the Eighth International Conference on Low Temperature Physics*, Butterworths, London, 308-9, 1963.
 98. Pohl, R. O., "The Applicability of the Debye Model to Thermal Conductivity," *Z. Physik*, **176**, 358-69, 1963.
 99. Takeno, S., "Resonance Scattering of Lattice Waves by Isotopes," *Progr. Theoret. Phys. (Kyoto)*, **29**(2), 191-205, 1963.
 100. Takeno, S., "Mass-Difference Scattering and Lattice Thermal Conductivity," *Progr. Theoret. Phys. (Kyoto)*, **30**(1), 144-5, 1963.
 101. Wagner, M., "Influence of Localized Modes on Thermal Conductivity," *Phys. Rev.*, **131**(4), 1443-55, 1963.
 102. Walker, C. T. and Pohl, R. O., "Phonon Scattering by Point Defects," *Phys. Rev.*, **131**(4), 1433-42, 1963.
 103. Baumann, F. C., "Resonance States in Crystals Containing Point Defects," *Bull. Am. Phys. Soc.*, **9**, 644, 1964.
 104. Callaway, J., "Theory of Scattering in Solids," *J. Math. Phys.*, **5**(6), 783-98, 1964.
 105. McCombie, C. W. and Slater, J., "The Scattering of Lattice Vibrations by a Point Defect. I," *Proc. Phys. Soc. (London)*, **84**(540), 499-509, 1964.
 106. Gunther, L., "Lattice-Vibration Effects due to Impurities in an Alkali-Halide," *Phys. Rev.*, **138**(6), A1697-705, 1965.
 107. Krumhansl, J. A., "The Scattering of Lattice Vibrations by Vacancy-Type Defects," in *Lattice Dynamics* (Proceedings of the International Conference held at Copenhagen, Denmark, Aug. 5-9, 1963), (Wallis, R. F., ed.), Pergamon Press, London, 523-35, 1965.
 108. Krumhansl, J. A. and Matthew, J. A. D., "Scattering of Low-Wavelength Phonons by Point Imperfections in Crystals," *Phys. Rev.*, **140**(5A), A1812-7, 1965.
 109. Yussouff, M. and Mahanty, J., "Scattering of Phonons from a Substitutional Impurity," *Proc. Phys. Soc. (London)*, **85**(548), 1223-35, 1965.

110. Klein, M. V., "Phonon Scattering by Lattice Defects. II," *Phys. Rev.*, **141**(2), 716-23, 1966.
111. Seward, W. D. and Narayanamurti, V., "Rotational Degrees of Freedom of Molecules in Solids. I. The Cyanide Ion in Alkali Halides," *Phys. Rev.*, **148**(1), 463-81, 1966.
112. Yussouff, M. and Mohanty, J., "Scattering of Phonons from a Substitutional Impurity in Body-Centered Cubic and Face-Centered Cubic Lattices," *Proc. Phys. Soc. (London)*, **87**(557), 689-701, 1966.
113. Baumann, F. C., Harrison, J. P., Pohl, R. O., and Seward, W. D., "Thermal Conductivity in Mixed Alkali Halides: KCl:Li and KBr:Li," *Phys. Rev.*, **159**(3), 691-9, 1967.
114. Baumann, F. C. and Pohl, R. O., "Scattering of Phonons by Monatomic Impurities in Potassium Halides," *Phys. Rev.*, **163**(3), 843-50, 1967.
115. Benedek, G. and Nardelli, G. F., "Lattice Response Functions of Imperfect Crystals: Effects due to a Local Change of Mass and Short-Range Interaction," *Phys. Rev.*, **155**(3), 1004-19, 1967.
116. Caldwell, R. F. and Klein, M. V., "Experimental and Theoretical Study of Phonon Scattering from Simple Point Defects in Sodium Chloride," *Phys. Rev.*, **158**(3), 851-75, 1967.
117. Radosevich, L. G. and Walker, C. T., "Mass Independence of U-Center-Induced Phonon Resonances in KCl," *Phys. Rev.*, **156**(3), 1030-1, 1967.
118. Schwartz, J. W. and Walker, C. T., "Thermal Conductivity of Some Alkali Halides Containing Divalent Impurities. I. Phonon Resonances," *Phys. Rev.*, **155**(3), 959-69, 1967.
119. Pohl, R. O., "Localized Excitations in Thermal Conductivity," in *Localized Excitations in Solids* (Proceedings of the First International Conference on Localized Excitations in Solids, 1967), (Wallis, R. F., ed.), Plenum Press, New York, 434-50, 1968.
120. Peressini, P. P., Harrison, J. P., and Pohl, R. O., "Thermal Conductivity of KCl: Li. Isotope and Electric Field Effects," *Phys. Rev.*, **180**(3), 926-30, 1969.
126. Dreyfus, B., Fernandes, N. C., and Maynard, R., "Low Temperature Thermal Conductivity of Amorphous Solids," *Phys. Letters*, **26A**(12), 647-8, 1968.

Thermal Resistance due to Phonon-Spin Resonant Scattering at Low Temperatures

127. Morton, I. P. and Rosenberg, H. M., "Scattering of Phonons by Spins at Low Temperatures," *Phys. Rev. Letters*, **8**(5), 200-1, 1962.
128. Orbach, R., "Thermal Resistance of Holmium Ethyl Sulphate," *Phys. Rev. Letters*, **8**(10), 393-6, 1962.
129. Berman, R., Brock, J. C. F., and Huntley, D. J., "The Effect of Spin-Phonon Interactions on the Thermal Conductivity of Lanthanum Cobalt Nitrate," *Phys. Letters*, **3**(6), 310-2, 1963.
130. Orbach, R., "A Note on the Thermal Resistance of Kramers Salts," *Phys. Letters*, **3**(6), 269-70, 1963.
131. Huber, D. L., "A Note on the Thermal Resistivities of Paramagnetic Salts," *Phys. Letters*, **12**(4), 309-10, 1964.
132. McClintock, P. V. E., Morton, I. P., and Rosenberg, H. M., "The Thermal Conductivity of Paramagnetic Crystals at Low Temperatures in Magnetic Fields," in *Proceedings of the International Conference on Magnetism* (Nottingham), Institute of Physics, London, 455-6, 1964.
133. Walton, D., "Phonon Scattering by Paramagnetic Ions and Scattering by Other Defects," *Phys. Rev.*, **151**, 627-8, 1966.
134. McClintock, P. V. E., Morton, I. P., Orbach, R., and Rosenberg, H. M., "The Effect of a Magnetic Field on the Thermal Conductivity of Paramagnetic Crystals: Holmium Ethylsulphate," *Proc. Roy. Soc. (London)*, **A298**(1454), 359-78, 1967.
135. Walton, D., "Study of the Li Ion in KCl Using the Spin-Phonon Interaction," *Phys. Rev. Letters*, **19**, 305-7, 1967.
136. McClintock, P. V. E. and Rosenberg, H. M., "The Effects of a Magnetic Field on the Thermal Conductivity of Paramagnetic Crystals: Cerium Ethylsulphate," *Proc. Roy. Soc. (London)*, **A302** (1470), 419-36, 1968.

Thermal Conductivity of Amorphous Solids

121. Kittel, C., "Interpretation of Thermal Conductivity of Glasses," *Phys. Rev.*, **75**(6), 972-4, 1949.
122. Klemens, P. G., "The Thermal Conductivity of Glasses," in *Noncrystalline Solids* (Conference on Noncrystalline Solids, Alfred, New York, 1958), Wiley, New York, 508-30, 1960.
123. Eiermann, K., "Thermal Conductivity of High Polymers," *J. Polymer Science*, Part C, No. 6, 157-65, 1963 (publ. 1964).
124. Klemens, P. G., "Thermal Conductivity in Vitreous Systems," in *Physics of Noncrystalline Solids* (Proceedings of the International Conference, Delft, Netherlands, 1964), North-Holland, Amsterdam, 162-78, 1965.
125. Dreyfus, B., Fernandes, N. C., and Maynard, R., "Low Temperature Thermal Conductivity of Amorphous Solids," in *Proceedings of the Eleventh International Conference on Low Temperature Physics* (St. Andrews, Scotland, 1968), Vol. 1, University of St. Andrews Printing Dept., 589-92, 1968.

Thermal Resistance due to Phonon-Magnon Scattering and Spin-Wave Thermal Conductivity

137. Pomeranchuk, I., "The Thermal Conductivity of the Paramagnetic Dielectrics at Low Temperatures," *J. Exptl. Theoret. Phys. (USSR)*, **11**, 226-45, 1941; English translation: *J. Phys. (USSR)*, **4**(4), 357-74, 1941.
138. Akhiezer, A., "Theory of the Relaxation Processes in Ferromagnetics at Low Temperatures," *J. Phys. (USSR)*, **10**(3), 217-30, 1946.
139. Kittel, C. and Abraham, E., "Relaxation Processes in Ferromagnetism," *Rev. Modern Phys.*, **25**(1), 233-8, 1953.
140. Sato, H., "Thermal Conductivity of Ferromagnetic Substances," *Busseiron Kenkyu*, No. 77, 68-73, 1954.
141. Sato, H., "On the Thermal Conductivity of Ferromagnetics," *Progr. Theoret. Phys. (Kyoto)*, **13**, 119-20, 1955.
142. Dyson, F. J., "General Theory of Spin-Wave Interactions," *Phys. Rev.*, **102**(5), 1217-30, 1956.
143. Akhiezer, A. I. and Shishkin, L. A., "On the Theory of Thermal Conductivity and Absorption of Sound in Ferromagnetic Dielectrics," *Zh. Eksptl. i Teoret. Fiz.*,

- 34(5), 1267-71, 1958; English translation: *Soviet Phys.—JETP*, 7(5), 875-8, 1958.
144. Kittel, C., "Interaction of Spin Waves and Ultrasonic Waves in Ferromagnetic Crystals," *Phys. Rev.*, 110(4), 836-41, 1958.
145. Akhiezer, A. I. and Bar'yakhtar, V. G., "Theory of Heat Conductivity in Ferrodielectric Materials at Low Temperatures," *Fiz. Tverdogo Tela*, 2(10), 2446-9, 1960; English translation: *Soviet Physics—Solid State*, 2(10), 2178-82, 1961.
146. Bar'yakhtar, V. G. and Urushadze, G. I., "The Scattering of Spin Waves and Phonons by Impurities in Ferromagnetic Dielectrics," *Zh. Eksptl. i Teoret. Fiz.*, 39, 355-61, 1960; English translation: *Soviet Phys.—JETP*, 12, 251-5, 1961.
147. Kaganov, M. I., Tsukernik, V. M., and Chupis, I. E., "Theory of Relaxation Process in Antiferromagnetics," *Fiz. Metal. i Metalloved.*, Akad. Nauk SSSR, Vral. Filial, 10, 797-8, 1960.
148. Bethoux, O., Thomas, P., and Weil, L., "Heat Conductivity of UO_2 at Low Temperatures," *Compt. Rend.*, 253(19), 2043-5, 1961.
149. Douthett, D. and Friedberg, S. A., "Effects of a Magnetic Field on Heat Conduction in Some Ferrimagnetic Crystals," *Phys. Rev.*, 121(6), 1662-7, 1961.
150. Luthi, B., "Thermal Conductivity of Yttrium Iron Garnet," *J. Phys. Chem. Solids*, 23, 35-8, 1962.
151. Sinha, K. P. and Upadhyaya, U. N., "Phonon-Magnon Interaction in Magnetic Crystals," *Phys. Rev.*, 127(2), 432-9, 1962.
152. Callaway, J., "Scattering of Spin Waves by Magnetic Defects," *Phys. Rev.*, 132(5), 2003-9, 1963.
153. Douglass, R. L., "Heat Transport by Spin Waves in Yttrium Iron Garnet," *Phys. Rev.*, 129(3), 1132-5, 1963.
154. Friedberg, S. A. and Harris, E. D., "Heat Transport by Magnons at Low Temperatures," in *Proceedings of the Eighth International Conference on Low Temperature Physics*, Butterworths, London, 302-3, 1963.
155. Kawasaki, K., "On the Behavior of Thermal Conductivity Near the Magnetic Transition Point," *Progr. Theoret. Phys. (Kyoto)*, 29(6), 801-16, 1963.
156. Callaway, J. and Boyd, R., "Scattering of Spin Waves by Magnetic Defects," *Phys. Rev.*, 134(6A), A1655-62, 1964.
157. Chupis, I. E., "Theory of Relaxation Processes in a Uniaxial Antiferrodielectric," *Zh. Eksptl. i Teoret. Fiz.*, 46, 307-19, 1964; *Soviet Phys.—JETP*, 19, 212-9, 1964.
158. Devyatkova, E. D., Golubkov, A. V., Kudinov, E. K., and Smirnov, I. A., "The Thermal Conductivity of MnTe as Affected by Spin-Phonon Interaction," *Soviet Phys.—Solid State*, 6(6), 1425-8, 1964.
159. McCollum, D. C., Wild, R. L., and Callaway, J., "Spin-Wave Thermal Conductivity of Ferromagnetic EuS," *Phys. Rev.*, 136(2A), A426-8, 1964.
160. Stern, H., "Thermal Conductivity at the Magnetic Transition," *J. Phys. Chem. Solids*, 26(1), 153-61, 1965.
161. Bhandari, C. M. and Verma, G. S., "Scattering of Magnons and Phonons in the Thermal Conductivity of Yttrium-Iron Garnet," *Phys. Rev.*, 152, 731-6, 1966.
162. Gurevich, L. E. and Roman, G. A., "Heat Conductivity of Ferrites at Low Temperatures and the Entrainment of Phonons and Magnons," *Fiz. Tverdogo Tela*, 8(2), 525-31, 1966; English translation: *Soviet Phys.—Solid State*, 8(2), 416-20, 1966.
163. Devyatkova, E. D. and Tikhonov, V. V., "Thermal Conductivity and Specific Heat of Yttrium-Calcium Garnets," *Fiz. Tverdogo Tela*, 9(3), 772-7, 1967; English translation: *Soviet Phys.—Solid State*, 9(3), 604-8, 1967.
164. Gurevich, L. E. and Roman, G. A., "Thermal Conductivity of Antiferromagnets at Low Temperatures under Conditions of Mutual Magnon and Phonon Drag," *Fiz. Tverdogo Tela*, 8(9), 2628-32, 1966; English translation: *Soviet Phys.—Solid State*, 8(9), 2102-5, 1967.

Radiative Thermal Conductivity

165. McCauley, G. V., "Fundamentals of Heat Flow in Molten Glass and in Walls for Use Against Glass," *J. Am. Ceram. Soc.*, 8(4), 493-504, 1925.
166. Hamaker, H. C., "Radiation and Heat Conduction in Light-Scattering Material," *Philips Research Rept.*, 2, 55-67, 103-11, 112-125, 420-425, 1947.
167. Preston, F. W., "Meaning of the Term 'Diathermancy' and Heating of Glass in Tank Furnaces," *J. Soc. Glass Technol.*, 31 (142), 134-40, 1947.
168. Genzel, L., "Measurement of the Infrared Absorption of Glass between 20 C and 1360 C," *Glastech. Ber.*, 24(3), 55-63, 1951.
169. Czerny, M. and Genzel, L., "On the Depth to which Diffuse Radiation Penetrates Glass," *Glastech. Ber.*, 25(5), 134-9, 1952.
170. Czerny, M. and Genzel, L., "Energy Flux and Temperature Distribution in The Glass Baths of Melting Tanks Resulting from Conduction and Radiation," *Glastech. Ber.*, 25(12), 387-92, 1952.
171. Geffcken, W., "The Transmission of Heat in Glass at High Temperatures, Part I," *Glastech. Ber.*, 25(12), 392-6, 1952.
172. van der Held, E. F. M., "The Contribution of Radiation to the Conduction of Heat," *Appl. Sci. Res.*, A3, 237-49, 1952.
173. Genzel, L., "Calculation of the Radiation Conductivity of Glasses," *Glastech. Ber.*, 26(3), 69-71, 1953.
174. Genzel, L., "The Role of Heat Radiation in the Heat Conduction Process," *Z. Physik*, 135, 177-95, 1953.
175. Monroe, J. E., Jr., "Infrared Transmission and Radiation Conductivity of Alumina from Room Temperature to 1800 C," in *Study of Heat Transfer of Ceramic Materials*, U.S. Office of Naval Research, Metallurgy Branch, NR032-022, Final Rept., Part II, 38-66, 1957.
176. Gardon, R., "A Review of Radiant Heat Transfer in Glass," *J. Am. Ceram. Soc.*, 44(7), 305-12, 1961.
177. Sparrow, E. M. and Cess, R. D., *Radiation Heat Transfer*, Brooks/Cole, Belmont, Calif., 322 pp., 1966.
178. Condon, E. U., "Radiative Transport in Hot Glass," *J. Quant. Spectrosc. Radiat. Transfer*, 8, 369-85, 1968.

Ambipolar Diffusion, Exciton Thermal Conductivity, and Thermal Resistance due to Phonon-Electron Scattering in Semiconductors

179. Davydov, B. I. and Shmushkevich, I. M., "Electron Theory of Semiconductors," *Uspekhi Fiz. Nauk*, 24(1), 21-67, 1940.

180. Price, P. J., "Electronic Thermal Conduction in Semiconductors," *Phys. Rev.*, **95**, 596, 1954.
181. Price, P. J., "Ambipolar Thermodiffusion of Electrons and Holes in Semiconductors," *Phil. Mag.*, **46**, 1252-60, 1955.
182. Pikus, G. E., "Thermomagnetic and Galvanomagnetic Effects in Semiconductors, Taking into Account the Variations in the Concentration of Current Carriers. II. Galvanomagnetic Effects in Strong Fields. Electron and Phonon Thermal Conductivity," *Zh. Tekh. Fiz.*, **26**(1), 36-50, 1956; English translation: *Soviet Phys.—Tech. Phys.*, **1**(1), 32-46, 1956.
183. Joffé, A. F., "Heat Transfer in Semiconductors," *Can. J. Phys.*, **34**(12A), 1342-55, 1956.
184. Korolyuk, S. L., "On the Theory of Exciton Thermal Conductivity," *Fiz. Tverdogo Tela*, **4**(3), 790-800, 1962; English translation: *Soviet Phys.—Solid State*, **4**(3), 580-6, 1962.
185. Ziman, J. M., "The Effect of Free Electrons on Lattice Conduction," *Phil. Mag.*, **8**, 1(2), 191-8, 1956.
186. Ziman, J. M., "Corrigendum to 'The Effect of Free Electrons on Lattice Conduction,'" *Phil. Mag.*, **8**, 2(14), 292, 1957.
187. Carruthers, J. A., Geballe, T. H., Rosenberg, H. M., and Ziman, J. M., "The Thermal Conductivity of Germanium and Silicon Between 2 and 300 K," *Proc. Roy. Soc. (London)*, **A238**, 502-14, 1957.
188. Stratton, R., "The Effect of Free Electrons on Lattice Conduction at High Temperature," *Phil. Mag.*, **8**, 2, 422-4, 1957.
189. Keyes, R. W., "Low Temperature Thermal Resistance of *n*-type Germanium," *Phys. Rev.*, **122**(4), 1171-6, 1961.
190. Pyle, I. C., "The Scattering of Phonons by Bound Electrons in a Semiconductor," *Phil. Mag.*, **6**, 609-16, 1961.
191. Griffin, A. and Carruthers, P., "Thermal Conductivity of Solids. IV. Resonance Fluorescence Scattering of Phonons by Donor Electrons in Germanium," *Phys. Rev.*, **131**(5), 1976-95, 1963.
192. Kwok, F. C., "Acoustic Attenuation by Neutral Donor Impurity Atoms in Germanium," *Phys. Rev.*, **149**, 666-74, 1966.
193. Spector, H. N., "Interaction of Acoustic Waves and Conduction Electrons," *Solid State Phys.*, **19**, 291-361, 1966.
194. Mathur, M. P. and Pearlman, N., "Phonon Scattering by Neutral Donors in Germanium," *Phys. Rev.*, **180**(3), 833-45, 1969.
195. ter Haar, D. and Neaves, A., "On the Thermal Conductivity and Thermoelectric Power of Semiconductors," *Advan. in Phys.*, **5**(18), 241-69, 1956.
196. Madelung, O., "Semiconductor," in *Handbuch der Physik*, Vol. 20, Springer-Verlag, Berlin, 1-245, 1957.
197. Appel, J., "Thermal Conductivity of Semiconductors," *Progr. in Semiconductors*, **5**, 141-87, 1960.
198. Keyes, R. W. and Bauerle, J. E., "Thermal Conduction in Thermoelectric Materials," Chap. 5 in *Thermoelectricity: Science and Engineering* (Heikes, R. R. and Ure, R. W., Jr., eds.), Interscience Publishers, New York, 91-119, 1961.
199. Holland, M. G., "Thermal Conductivity," in *Semiconductors and Semimetals* (Villardson, R. K. and Beer, A. C., eds.), Vol. 2 (Physics of III-V Compounds), Academic Press, New York, 3-31, 1966.
200. Probert, S. D. and Thomas, C. B., "The Thermal Conductivity of Semiconductors at Low Temperatures," UKAEA, TRG Report 977 (R/X), 1-34, 1966.
201. Steigmeier, E. F., "Thermal Conductivity of Semiconducting Materials," in *Thermal Conductivity* (Tye, R. P., ed.), Vol. 2, Chap. 4, Academic Press, London, 203-51, 1969.

Experimental Methods

202. Franklin, B., "Meteorological Observations," (written in reply to Cadwallader Colden, Nov. 10, 1753 and read at the Royal Society of London, Nov. 4, 1756), in *The Writings of Benjamin Franklin* (Smyth, A. H., ed.), Vol. III (1750-59), The Macmillan Co., New York, 186-8, 1905.
203. Fordyce, G., "An Account of an Experiment on Heat," *Phil. Trans. Roy. Soc. (London)*, **77**, 310-7, 1787.
204. Ingen-Hausz, J., "On Metals as Conductors of Heat," *J. de Physique*, **34**, 68, 380, 1789.
205. Despretz, C., "On the Conductivity of Several Solid Substances," *Ann. Chim. Phys.*, **19**, 97-106, 1822.
206. Wiedemann, G. and Franz, R., "The Thermal Conductivity of Metals," *Ann. Physik*, **89**, 497-531, 1853.
207. Forbes, J. D., "On the Progress of Experiments on the Conduction of Heat, undertaken at the Meeting of the British Association at Edinburgh, in 1850," *Brit. Assoc. Adv. Sci., Rept. Ann. Meeting*, **21**, 7-8, 1851.
208. Forbes, J. D., "On Experiments on the Laws of the Conduction of Heat," *Brit. Assoc. Adv. Sci., Rept. Ann. Meeting*, **22**, 260-1, 1852.
209. Forbes, J. D., "Experimental Inquiry into the Laws of the Conduction of Heat in Bars, and into the Conducting Power of Wrought Iron," *Trans. Roy. Soc. Edinburgh*, **23**, 133-46, 1864.
210. Forbes, J. D., "Experimental Inquiry into the Laws of the Conduction of Heat in Bars. Part II. On the Conductivity of Wrought Iron, Deduced from the Experiments of 1851," *Trans. Roy. Soc. Edinburgh*, **24**, 73-110, 1865.
211. Ångström, A. J., "A New Method of Determining the Thermal Conductivity of Solids," *Ann. Physik*, **2**, 114, 513-30, 1861.
212. Thomson, W. (Lord Kelvin), "Heat," in *Encyclopaedia Britannica*, Vol. 11, 9th Ed., 1880; reprinted in *Mathematical and Physical Papers*, Vol. 3, Cambridge University Press, 113-235, 1890.
213. Preston, T., *The Theory of Heat*, Macmillan and Co., London, 719 pp., 1894; 4th Ed. (J. R. Cotter, ed.), Macmillan and Co., Ltd., London, 836 pp., 1929.
214. Chwolson, O. D., "Thermal Conductivity," in *Traité de Physique* (Translated into French by Davaux, E. and reviewed and augmented by the author), Vol. 3, Chap. VII, Librairie Scientifique A. Hermann et Fils, Paris, 320-408, 1909.
215. Schofield, F. H., "Conduction of Heat," in *A Dictionary of Applied Physics* (Glazebrook, R., ed.), Vol. 1, The Macmillan Co., New York, 429-66, 1922 (reprinted 1950).
216. Ingersoll, L. R., "Methods of Measuring Thermal

- Conductivity in Solids and Liquids," *J. Optical Soc. Am.*, **9**, 495-501, 1924.
217. Griffiths, "A Survey of Heat Conduction Problems," *Proc. Roy. Soc. (London)*, **41**, 151-79, 1929.
 218. Partington, J. R., "Thermal Conductivity of Solids," in *An Advanced Treatise on Physical Chemistry*, Vol. III, Longmans, Green and Co., London, 410-61, 1952.
 219. Seibel, R. D., "Survey and Bibliography of the Determination of Thermal Conductivity of Metals at Elevated Temperatures," Watertown Arsenal Lab. Rept. No. WAL 821/9, 1-65, 1954. [AD 51 228]
 220. Kingery, W. D., *Property Measurements at High Temperatures*, John Wiley and Sons, Inc., New York, 416 pp., 1959.
 221. Slack, G. A., "Heat Conduction in Solids, Experimental," in *Encyclopaedic Dictionary of Physics* (Thewlis, J., editor-in-chief), Vol. 3, Pergamon Press, Oxford, 601-6, 1961.
 222. Tye, R. P. (ed.), *Thermal Conductivity*, Vol. 1 and 2, Academic Press, London, 422 pp. and 353 pp., 1969.
 223. Carslaw, H. S. and Jaeger, J. C., *Conduction of Heat in Solids*, Oxford University Press, 1946; 2nd Ed., 510 pp., 1959.
 224. Ingersoll, L. R., Zobel, O. J., and Ingersoll, A. C., *Heat Conduction*, McGraw-Hill, New York, 1948; 2nd Ed., University of Wisconsin Press, 325 pp., 1954.
 225. Jakob, M., *Heat Transfer*, Vol. 1, John Wiley and Sons, Inc., New York, 758 pp., 1949.
 226. Schneider, P. J., *Conduction Heat Transfer*, Addison-Wesley Publ. Co., Cambridge, Mass., 395 pp., 1955.
 227. Arpaci, V. S., *Conduction Heat Transfer*, Addison-Wesley Publ. Co., Reading, Mass., 550 pp., 1966.
 228. Biot, J. B., *Traité de Physique*, Vol. 4, Paris, 669, 1816.
 229. Fourier, J. B. J., *The Analytical Theory of Heat*, Gauthier-Villars, Paris, 1822; English translation by Freeman, A., Cambridge University Press, 466 pp., 1878; Republication of the English translation, Dover Publications, New York, 1955.
 230. White, G. K., *Experimental Techniques in Low Temperature Physics*, Oxford University Press, 1959; 2nd Ed., 1968.
 231. White, G. K., "Measurement of Solid Conductors at Low Temperatures," in *Thermal Conductivity* (Tye, R. P., ed.), Vol. 1, Chap. 2, Academic Press, London, 69-109, 1969.
 232. Lees, C. H., "The Effects of Temperature and Pressure on the Thermal Conductivities of Solids. Part II. The Effects of Low Temperatures on the Thermal and Electrical Conductivities of Certain Approximately Pure Metals and Alloys," *Phil. Trans. Roy. Soc. (London)*, **A208**, 381-443, 1908.
 233. Berman, R., "The Thermal Conductivities of Some Dielectric Solids at Low Temperatures (Experimental)," *Proc. Roy. Soc. (London)*, **A208**, 90-108, 1951.
 234. White, G. K., "The Thermal Conductivity of Gold at Low Temperatures," *Proc. Phys. Soc. (London)*, **A66**, 559-64, 1953.
 235. Mendelssohn, K. and Renton, C. A., "The Heat Conductivity of Superconductors below 1 K," *Proc. Roy. Soc. (London)*, **A230**, 157-69, 1955.
 236. Rosenberg, H. M., "The Thermal Conductivity of Metals at Low Temperatures," *Phil. Trans. Roy. Soc. (London)*, **A247**, 441-97, 1955.
 237. White, G. K. and Woods, S. B., "Thermal and Electrical Conductivities of Solids at Low Temperatures," *Can. J. Phys.*, **33**, 58-73, 1955.
 238. Powell, R. L., Rogers, W. M., and Coffin, D. O., "An Apparatus for Measurement of Thermal Conductivity of Solids at Low Temperatures," *J. Res. Nat. Bur. Stand.*, **59**(5), 349-55, 1957.
 239. Slack, G. A., "Thermal Conductivity of Potassium Chloride Crystals containing Calcium," *Phys. Rev.*, **105**(3), 832-42, 1957.
 240. Williams, W. S., "Phonon Scattering in KCl-KBr Solid Solutions at Low Temperatures," *Phys. Rev.*, **119**(3), 1021-4, 1960.
 241. Slack, G. A., "Thermal Conductivity of CaF_2 , MnF_2 , CoF_2 , and ZnF_2 Crystals," *Phys. Rev.*, **122**(5), 1451-64, 1961.
 242. Berman, R., Bounds, C. L., and Rogers, S. J., "The Effects of Isotopes on Lattice Heat Conduction. II. Solid Helium," *Proc. Roy. Soc. (London)*, **A289**(1416), 46-65, 1965.
 243. Jericho, M. H., "The Lattice Thermal Conductivity of Silver Alloys between 4 K and 0.3 K," *Phil. Trans. Roy. Soc. (London)*, **A257**, 385-407, 1965.
 244. Berget, A., "Measurement of the Thermal Conductivity of Mercury, of Its Absolute Value," *Compt. Rend.*, **105**, 224-7, 1887.
 245. Berget, A., "Thermal Conductivity of Mercury and Certain Metals," *J. Phys. (Paris)*, **2**, 7, 503-18, 1888.
 246. "The Physical Society's Exhibition. No. III," *Engineer*, **159**, 68-70, 1935.
 247. Armstrong, L. D. and Dauphinee, T. M., "Thermal Conductivity of Metals at High Temperatures. I. Description of the Apparatus and Measurements on Iron," *Can. J. Phys.*, **A25**, 357-74, 1947.
 248. Ditmars, D. A. and Ginnings, D. C., "Thermal Conductivity of Beryllium Oxide from 40 to 750 C," *J. Res. Nat. Bur. Stand.*, **59**(2), 93-9, 1957.
 249. Wilkes, G. B., "An Apparatus for Determining the Thermal Conductivity of Metals," *Chem. Met. Eng.*, **21**(5), 241-3, 1919.
 250. Powell, R. W., "The Thermal and Electrical Conductivities of Some Magnesium Alloys," *Phil. Mag.*, **27**, 677-86, 1939.
 251. Powell, R. W. and Tye, R. P., "High Alloy Steels for Use as a Thermal Conductivity Standard," *Brit. J. Appl. Phys.*, **11**, 195-8, 1960.
 252. Larsen, D. C., Powell, R. W., and DeWitt, D. P., "The Thermal Conductivity and Electrical Resistivity of a Round-Robin Armco Iron Sample. Initial Measurements from 50 to 300 C," in *Thermal Conductivity—Proceedings of the Eighth Conference* (Ho, C. Y. and Taylor, R. E., eds.), Plenum Press, New York, 675-87, 1969.
 253. Laubitz, M. J., "Measurement of the Thermal Conductivity of Solids at High Temperatures by Using Steady-State Linear and Quasi-Linear Heat Flow," in *Thermal Conductivity* (Tye, R. P., ed.), Vol. 1, Chap. 3, Academic Press, London, 111-83, 1969.
 254. Flynn, D. R., "Thermal Conductivity of Ceramics," in

- Mechanical and Thermal Properties of Ceramics* (Wachtman, J. B., Jr., ed.), NBS Spec. Publ. 303, 63-123, 1969.
255. Bauerle, J. E., "Thermal Conductivity," Section 10.1 in *Thermoelectricity: Science and Engineering* (Heikes, R. R. and Ure, R. W., Jr., eds.), Interscience Publishers, New York, 285-311, 1961.
 256. Honda, K. and Simidu, T., "On the Thermal and Electrical Conductivities of Carbon Steels at High Temperatures," *Sci. Repts. Tôhoku Univ.*, 1, 6, 219-33, 1917.
 257. Schofield, F. H., "The Thermal and Electrical Conductivities of Some Pure Metals," *Proc. Roy. Soc. (London)*, A107, 206-27, 1925.
 258. Powell, R. W., "The Thermal and Electrical Conductivities of Metals and Alloys: I. Iron from 0 to 800 C," *Proc. Phys. Soc. (London)*, 46, 659-78, 1934.
 259. Goldsmid, H. J., "The Thermal Conductivity of Bismuth Telluride," *Proc. Phys. Soc. (London)*, B69, 203-9, 1956.
 260. ASTM, "Standard Method of Test for Thermal Conductivity of Materials by Means of the Guarded Hot Plate," ASTM Designation: C177-63, in *1967 Book of ASTM Standards*, Part 14, 17-28, 1967.
 261. Poensgen, R., "A Technical Method for Investigating the Thermal Conductivity of Slabs of Material," *VDI Zeitschrift*, 56(41), 1653-8, 1912.
 262. Jakob, M., "Measurement of the Thermal Conductivity of Liquids, Insulating Materials and Metals," *VDI Zeitschrift*, 66, 688-93, 1922.
 263. ASTM, "Standard Method of Test for Thermal Conductivity of Refractories," ASTM Designation: C201-47 (1958), in *1967 Book of ASTM Standards*, Part 13, 170-7, 1967.
 264. Wilkes, G. B., "Thermal Conductivity, Expansion, and Specific Heat of Insulators at Extremely Low Temperatures," *Refrig. Eng.*, 52(1), 37-42, 1946.
 265. Schröder, J., "A Simple Method of Determining the Thermal Conductivity of Solids," *Philips Tech. Rev.*, 21(12), 357-61, 1959-60.
 266. Schröder, J., "Apparatus for Determining the Thermal Conductivity of Solids in the Temperature Range from 20 to 200 C," *Rev. Sci. Instr.*, 34(6), 615-21, 1963.
 267. ASTM, "Tentative Method of Test for Thermal Conductivity of Insulating Materials at Low Temperatures by Means of the Wilkes Calorimeter," ASTM Designation: C420-62T in *1967 Book of ASTM Standards*, Part 14, 172-9, 1967.
 268. ASTM, "Standard Method of Test for Thermal Conductivity of Materials by Means of the Heat Flow Meter," ASTM Designation: C518-67, in *1967 Book of ASTM Standards*, Part 14, 230-8, 1967.
 269. Peirce, B. O. and Willson, R. W., "On the Thermal Conductivities of Certain Poor Conductors.—I," *Proc. Am. Acad. Arts and Sci.*, 34(1), 1-56, 1898.
 270. van Dusen, M. S., "The Thermal Conductivity of Heat Insulators," *J. Am. Soc. Heating Vent. Engrs.*, 26(7), 625-56, 1920.
 271. Somers, E. V. and Cyphers, J. A., "Analysis of Errors in Measuring Thermal Conductivity of Insulating Materials," *Rev. Sci. Instr.*, 22(8), 583-6, 1951.
 272. Woodside, W., "Analysis of Errors due to Edge Heat Loss in Guarded Hot Plates," ASTM Spec. Tech. Publ. 217, 49-62, 1957.
 273. ASTM, *Thermal Conductivity Measurements of Insulating Materials at Cryogenic Temperatures*, ASTM Spec. Tech. Publ. 411, 118 pp., 1967.
 274. Ferro, V. and Sacchi, A., "An Automatic Plate Apparatus for Measurements of Thermal Conductivity of Insulating Materials at High Temperatures," in *Thermal Conductivity—Proceedings of the Eighth Conference* (Ho, C. Y. and Taylor, R. E., eds.), Plenum Press, New York, 737-60, 1969.
 275. Pratt, A. W., "Heat Transmission in Low Conductivity Materials," in *Thermal Conductivity* (Tye, R. P., ed.), Vol. 1, Chap. 6, Academic Press, London, 301-405, 1969.
 276. Péclet, M. E., "Note on the Determination of the Conductivity Coefficients of Metals for Heat," *Ann. Chim. Physique*, 3, 2(1), 107-15, 1841.
 277. Lees, C. H., "On a Thermal Conductivities of Single and Mixed Solids and Liquids and Their Variation with Temperature," *Phil. Trans. Roy. Soc. (London)*, A191, 399-440, 1898.
 278. Lees, C. H., "Some Preliminary Experiments on the Effect of Pressure on Thermal Conductivity," *Manchester Memoirs*, 43(8), 1-6, 1899.
 279. Lodge, O. J., "On a Method of Measuring the Absolute Thermal Conductivity of Crystals and Other Rare Substances. Part I," *Phil. Mag.*, 5, 5, 110-7, 1878.
 280. Berget, A., "Measurement of the Coefficients of Thermal Conductivity of Metals," *Compt. Rend.*, 107, 227-9, 1888.
 281. Lees, C. H., "On the Thermal Conductivities of Crystals and Other Bad Conductors," *Phil. Trans. Roy. Soc. (London)*, A183, 481-509, 1892.
 282. van Dusen, M. S. and Shelton, S. M., "Apparatus for Measuring Thermal Conductivity of Metals up to 600 C," *J. Res. Nat. Bur. Stand.*, 12, 429-40, 1934.
 283. Powell, R. W., "The Thermal and Electrical Conductivity of a Sample of Acheson Graphite from 0 to 800 C," *Proc. Phys. Soc. (London)*, 49, 419-25, 1937.
 284. Francl, J. and Kingery, W. D., "Apparatus for Determining Thermal Conductivity by a Comparative Method. Data for Pb, Al₂O₃, BeO, and MgO," *J. Am. Ceram. Soc.*, 37, 80-4, 1954.
 285. Stuckes, A. D. and Chasmar, R. P., "Measurement of the Thermal Conductivity of Semiconductors," *Rept. Meeting on Semiconductors (Phys. Soc., London)*, 119-25, 1956.
 286. ASTM, "Standard Method of Test for Thermal Conductivity of Whiteware Ceramics," ASTM Designation: C408-58, in *1967 Book of ASTM Standards*, Part 13, 348-52, 1967.
 287. Mirkovich, V. V., "Comparative Method and Choice of Standards for Thermal Conductivity Determinations," *J. Am. Ceram. Soc.*, 48(8), 387-91, 1965.
 288. Christiansen, C., "Some Experiments on Heat Conduction," *Ann. Physik*, 3, 14, 23-33, 1881.
 289. Sieg, L. P., "An Attempt to Detect a Change in the Heat Conductivity of a Selenium Crystal with a Change in Illumination," *Phys. Rev.*, 6, 213-8, 1915.
 290. Powell, R. W., "The Thermal and Electrical Conductivities of Metals and Alloys: II. Some Heat-Resistant Alloys from 0 to 800 C," *Proc. Phys. Soc. (London)*, 48, 381-92, 1936.
 291. Powell, R. W. and Hickman, M. J., "The Physical Properties of a Series of Steels. 3. Thermal Conductivity

- and Electrical Resistivity," Iron and Steel Institute, Special Report No. 24, 242-51, 1939.
292. Powell, R. W. and Tye, R. P., "The Thermal and Electrical Conductivities of Some Nickel-Chromium (Nimonic) Alloys," *The Engineer*, **209**, 729-32, 1960.
 293. Sugawara, A., "The Precise Determination of Thermal Conductivity of Pure Fused Quartz," *J. Appl. Phys.*, **39**(13), 5994-7, 1968.
 294. Hogan, C. L. and Sawyer, R. B., "The Thermal Conductivity of Metals at High Temperatures," *J. Appl. Phys.*, **23**(2), 177-80, 1952.
 295. Laubitz, M. J., "Transport Properties of Pure Metals at High Temperatures. I. Copper," *Can. J. Phys.*, **45**(11), 3677-96, 1967.
 296. Watson, T. W. and Robinson, H. E., "Thermal Conductivity of Some Commercial Iron-Nickel Alloys," *ASME J. of Heat Transfer*, Part C, **83**(4), 403-8, 1961.
 297. Laubitz, M. J., "The Unmatched Guard Method of Measuring Thermal Conductivity at High Temperatures," *Can. J. Phys.*, **41**(10), 1663-78, 1963.
 298. Laubitz, M. J., "The Unmatched Guard Method of Measuring Thermal Conductivity. II. The Guardless Method," *Can. J. Phys.*, **43**(2), 227-43, 1965.
 299. McElroy, D. L. and Moore, J. P., "Radial Heat Flow Methods for the Measurement of the Thermal Conductivity of Solids," in *Thermal Conductivity* (Tye, R. P., ed.), Vol. 1, Chap. 4, Academic Press, London, 185-239, 1969.
 300. Callendar, H. L. and Nicolson, J. T., "Experiments on the Condensation of Steam. Part I. A New Apparatus for Studying the Rate of Condensation of Steam on a Metal Surface at Different Temperatures and Pressures," *Brit. Assoc. Adv. Sci., Rept. Ann. Meeting*, 418-22, 1897.
 301. Niven, C. "On a Method of Finding the Conductivity for Heat," *Proc. Roy. Soc. (London)*, **A76**, 34-48, 1905.
 302. Andrews, T., *Proc. Roy. Irish Acad.*, **1**, 465, 1840.
 303. Schleiermacher, A., "On the Heat Conduction in Gases," *Ann. Physik Chemie*, **34**(8a), 623-46, 1888.
 304. Kannuluik, W. G. and Martin, L. H., "Conduction of Heat in Powders," *Proc. Roy. Soc.*, **A141**, 144-58, 1933.
 305. Kingery, W. D., "Thermal Conductivity. VI. Determination of Conductivity of Al_2O_3 by Spherical Envelope and Cylinder Methods," *J. Am. Ceram. Soc.*, **37**, 88-90, 1954.
 306. Feith, A. D., "A Radial Heat Flow Apparatus for High-Temperature Thermal Conductivity Measurements," USAEC Rept. GEMP-296, 1-29, 1964.
 307. Glassbrenner, C. J. and Slack, G. A., "Thermal Conductivity of Silicon and Germanium from 3 K to the Melting Point," *Phys. Rev.*, **134**(4A), A1058-69, 1964.
 308. Banaev, A. M. and Chekhovskoi, V. Ya., "Experimental Determination of the Coefficient of Thermal Conductivity of Solid Materials in the Temperature Range 200-1000 C," *Teplofiz. Vysokikh Temperatur*, **3**(1), 57-63, 1965; English translation: *High Temperature*, **3**(1), 47-52, 1965.
 309. Powell, R. W., "Further Measurements of the Thermal Electrical Conductivity of Iron at High Temperatures," *Proc. Phys. Soc. (London)*, **51**, 407-18, 1939.
 310. Powell, R. W. and Hickman, M. J., "The Physical Properties of a Series of Steels. Part II. Section IIIc. Thermal Conductivity of a 0.8% Carbon Steel (Steel 7)," *J. Iron Steel Inst. (London)*, **154**, 112-21, 1946.
 311. Rasor, N. S. and McClelland, J. D., "Thermal Properties of Materials. Part I. Properties of Graphite, Molybdenum and Tantalum to Their Destruction Temperatures," WADC Tech. Rept. 56-400 Pt I, 1-53, 1957. [AD 118 144]
 312. Rasor, N. S. and McClelland, J. D., "Thermal Property Measurements at Very High Temperatures," *Rev. Sci. Instr.*, **31**(6), 595-604, 1960.
 313. McElroy, D. L., Godfrey, T. G., and Kollie, T. G., "The Thermal Conductivity of INOR-8 between 100 and 800 C," *Trans. Am. Soc. Metals*, **55**(3), 749-51, 1962.
 314. Fulkerson, W., Moore, J. P., and McElroy, D. L., "Comparison of the Thermal Conductivity, Electrical Resistivity, and Seebeck Coefficient of a High-Purity Iron and an Armco Iron to 1000 C," *J. Appl. Phys.*, **37**(7), 2639-53, 1966.
 315. Hoch, M., Nitti, D. A., Gottschlich, C. F., and Blackburn, P. E., "New Method for the Determination of Thermal Conductivities between 1000 C and 3000 C," in *Progress in International Research on Thermodynamic and Transport Properties* (Masi, J. F. and Tsai, D. H., eds.), ASME Second Symposium on Thermophysical Properties, Academic Press, New York, 512-8, 1962.
 316. Hoch, M., Silberstein, A., and Chapman, H., "Thermal Conductivity of Aluminum Oxide," in *Proceedings of the Fourth Symposium on Thermophysical Properties* (Moszynski, J. R., ed.), ASME, New York, 150-4, 1968.
 317. Vardi, J. and Lemlich, R., "Theoretical Approach to a Technique for Measuring Thermal Conductivity at High Temperature," to be published in *J. Appl. Phys* in 1970.
 318. Laws, F. A., Bishop, F. L., and McJunkin, P., "A Method of Determining Thermal Conductivity," *Proc. Am. Acad. Arts Sci.*, **41**(22), 455-64, 1906.
 319. Adar s, M. and Loeb, A. L., "Thermal Conductivity: II. Development of a Thermal Conductivity Expression for the Special Case of Prolate Spheroids," *J. Am. Ceram. Soc.*, **37**(2), 73-4, 1954.
 320. Adams, M., "Thermal Conductivity: III. Prolate Spheroidal Envelope Method; Data for Al_2O_3 , BeO, MgO, ThO_2 , and ZrO_2 ," *J. Am. Ceram. Soc.*, **37**(2), 74-9, 1954.
 321. McQuarrie, M., "Thermal Conductivity: V. High Temperature Method and Results for Alumina, Magnesia, and Beryllia from 1000 to 1800 C," *J. Am. Ceram. Soc.*, **37**(2), p. 84, 1954.
 322. Péclet, E., *Traité de la Chaleur*, Vol. I, Paris, 1860.
 323. Nusselt, W., "Thermal Conductivity of Thermal Insulators," *VDI Zeitschrift*, **52**(23), 906-12, 1908.
 324. "Design Aspects of Plant for Production of Heavy Water by Distillation of Hydrogen," USAEC Rept. NYO-2134, 1957.
 325. Stefan, J., "Investigations on the Thermal Conductivity of Gases," *Sitzber Akad.-Wiss. Wien. Math-Naturw. Kl. IIA*, **65**, 45-69, 1872.
 326. Kropschot, R. H., Schrodt, J. E., Fulk, M. M., and Hunter, D. J., "Multiple-Layer Insulation," in *Advances in Cryogenic Engineering*, Vol. 5, Plenum Press, 189-97, 1960.

327. Flynn, D. R. and Watson, T. W., "High Temperature Thermal Conductivity of Soils," in *Thermal Conductivity—Proceedings of the Eighth Conference* (Ho, C. Y. and Taylor, R. E., eds.), Plenum Press, New York, 913-39, 1969.
328. de Sénarmont, H., "Memoir on the Conductivity of Crystalline Substances for Heat," *Ann. Chim. Phys.*, 3, 21, 457-70, 1847.
329. de Sénarmont, H., "Memoir on the Conductivity of Crystalline Substances for Heat," *Compt. Rend.*, 2, 25, 459-61, 1847.
330. de Sénarmont, H., "Memoir on the Conductivity of Crystalline Substances for Heat," *Ann. Chim. Phys.*, 3, 22, 179-211, 1848.
331. de Sénarmont, H., "Experiments on the Effects of Mechanical Agents on the Thermal Conductivity of Homogeneous Solids," *Ann. Chim. Phys.*, 3, 23, 257-67, 1848.
332. de Sénarmont, H., "Thermal Conductivity in Crystallized Substances," *Ann. Physik*, 73, 191-2, 1848.
333. Powell, R. W., "A Simple Test for Anisotropic Materials," *J. Sci. Instr.*, 30, 210, 1953.
334. Cohen, I., Lustman, B., and Eichenberg, J. D., "Measurement of the Thermal Conductivity of Metal-Clad Uranium Oxide Rods during Irradiation," *J. Nuclear Materials*, 3(3), 331-53, 1961.
335. Dumas, J. P., Mansard, B., and Rausset, P., "Uranium Monocarbide Shaping and Irradiation Study. Final Report No. 2, March 1, 1962—December 31, 1963," *United States-Euratom Joint Research and Development Program, Rept. EURAEC-1179*, 1-110, 1964. [English translation of the original French report.]
336. Clough, D. J. and Sayers, J. B., "The Measurement of the Thermal Conductivity of UO_2 under Irradiation in the Temperature Range 150-1600 C," UKAEA Rept. AERE-R-4690, 1-55, 1964.
337. Robinson, H. E., "The Conductive-Disk Method of Measuring the Thermal Conductivity of Insulations," *Bull. Intl. Inst. Refrig. Annexe* 1962-1, 43-50, 1962.
338. Mikryukov, V. E., "The Thermal Conductivity and Electrical Conductivity of Metals and Alloys, Metalurgizdat, Moscow, 260 pp., 1959.
339. Powell, R. W., DeWitt, D. P., and Nalbantyan, M., "The Precise Determination of Thermal Conductivity and Electrical Resistivity of Solids at High Temperatures by Direct Electrical Heating Methods," Air Force Materials Laboratory Techn. Rept. AFML-TR-67-241, 1-100, 1967.
340. Flynn, D. R., "Measurement of Thermal Conductivity by Steady-State Methods in Which the Sample is Heated Directly by Passage of an Electric Current," in *Thermal Conductivity* (Tye, R. P., ed.), Vol. 1, Chap. 5, 241-300, 1969.
341. Kohlrausch, F., "On the Thermoelectricity, Heat and Electricity Conduction," *Göttingen Nachr.*, Feb. 7, 1874.
342. Kohlrausch, F., "The Activities at Physical-Technical Institute in the Year 1 February 1897 to 31 January 1898," *Z. Instrumentenkunde*, 18(5), 138-51, 1898.
343. Kohlrausch, F., "On the Stationary Temperature State of a Conductor Heated by an Electric Current," *Sitz. Berlin Acad.*, 38, 711-8, 1899.
344. Kohlrausch, F., "On the Stationary Temperature State of an Electrically Heated Conductor," *Ann. Physik*, 1, 132-58, 1900.
345. Jaeger, W. and Diesselhorst, H., "Thermal Conductivity, Electrical Conductivity, Heat Capacity, and Thermal Power of Some Metals," *Wiss. Abhandl. Physik-tech. Reichsanstalt*, 3, 269-425, 1900.
346. Holm, R. and Störmer, R., "Measurement of the Thermal Conductivity of a Platinum Probe in the Temperature Range 19-1020 C," *Wiss. Veröff. Siemens-Konzern*, 9(2), 312-22, 1930.
347. Angell, M. F., "Thermal Conductivity at High Temperatures," *Phys. Rev.*, 33(5), 421-32, 1911.
348. Powell, R. W. and Schofield, F. H., "The Thermal and Electrical Conductivities of Carbon and Graphite to High Temperatures," *Proc. Phys. Soc. (London)*, 51(1), 153-72, 1939.
349. Worthing, A. G., "The Thermal Conductivities of Tungsten, Tantalum and Carbon at Incandescent Temperatures by an Optical Pyrometer Method," *Phys. Rev.*, 4(6), 535-43, 1914.
350. Osborn, R. H., "Thermal Conductivities of Tungsten and Molybdenum at Incandescent Temperatures," *J. Opt. Soc. Am.*, 31, 428-32, 1941.
351. Krishnan, K. S. and Jain, S. C., "Determination of Thermal Conductivities at High Temperatures," *Brit. J. Appl. Phys.*, 5, 426-30, 1954.
352. Lebedev, V. V., "Determination of the Coefficient of Thermal Conductivity for Metals in the High Temperature Range," *Phys. Metals Metallog. (USSR)*, 10(2), 31-4, 1960.
353. Bode, K. H., "A New Method to Measure the Thermal Conductivity of Metals at High Temperatures," *Allgem. Wärmetech.* 10(6), 110-20, and 10(7), 125-42, 1961.
354. Gumenyuk, V. S. and Lebedev, V. V., "Investigation of the Thermal and Electrical Conductivity of Tungsten and Graphite at High Temperatures," *Phys. Metals Metallog. (USSR)*, 11(1), 30-5, 1961.
355. Bode, K. H., "Measurements of the Thermal Conductivity of Metals at High Temperatures," in *Progress in International Research on Thermodynamic and Transport Properties*, (Masi, J. F. and Tsai, D. H., eds.), ASME Second Symposium on Thermophysical Properties, Academic Press, New York, 481-99, 1962.
356. Gumenyuk, V. S., Ivanov, V. E., and Lebedev, V. V., "Determination of the Heat and Electric Conductivity of Metals at Temperatures in Excess of 1000 C," *Instrum. Exper. Techn.*, No. 1, 185-92, 1962.
357. Rudkin, R. L., Parker, W. J., and Jenkins, R. J., "Measurements of the Thermal Properties of Metals at Elevated Temperatures," in *Temperature—Its Measurement and Control in Science and Industry*, Vol. 3, Part 2, 523-34, 1962.
358. Filippov, L. P. and Simonova, Yu. N., "Measurement of Thermal Conductivity of Metals at High Temperatures," *High Temperature*, 2(2), 165-8, 1964.
359. Platunov, E. S., "Measurement of Heat Capacity and Heat Conductivity of Rod Subjected to Monotonic Heating and Cooling," *High Temperature*, 2(3), 346-50, 1964.
360. Taylor, R. E., Powell, R. W., Nalbantyan, M., and Davis, F., "Evaluation of Direct Electrical Heating Methods for the Determination of Thermal Conductivity

- at Elevated Temperatures," Air Force Materials Laboratory Tech. Rept. AFML-TR-68-227, 1-74, 1968.
361. Bode, K. H., "Possibilities to Determine Thermal Conductivity Using New Solutions for Current-Carrying Electrical Conductors," in *Thermal Conductivity—Proceedings of the Eighth Conference* (Ho, C. Y. and Taylor, R. E., eds.), Plenum Press, New York, 317-37, 1969.
 362. Taylor, R. E., Powell, R. W., Davis, F., and Nalbantyan, M., "Evaluation of Direct Electrical Heating Methods," in *Thermal Conductivity—Proceedings of the Eighth Conference* (Ho, C. Y. and Taylor, R. E., eds.), Plenum Press, New York, 339-54, 1969.
 363. Taylor, R. E., Davis, F. E., Powell, R. W., and Kimbrough, W. D., "Determination of Thermal and Electrical Conductivity, Emittance and Thomson Coefficient at High Temperatures by Direct Heating Methods," Air Force Materials Laboratory Techn. Rept. AFML-TR-69-277, 1-90, 1969.
 364. Taylor, R. E., Davis, F. E., and Powell, R. W., "Direct Heating Methods for Measuring Thermal Conductivity of Solids at High Temperatures," *High Pressures—High Temperatures*, 1, 663-73, 1959.
 365. Powell, R. W., Ho, C. Y., and Liley, P. E., "Thermal Conductivity of Selected Materials," National Standard Reference Data Series—National Bureau of Standards NSRDS-NBS 8, 1-168, 1966.
 366. Vasilos, T. and Kingery, W. D., "Thermal Conductivity. XI. Conductivity of Some Refractory Carbides and Nitrides," *J. Am. Ceram. Soc.*, 37, 409-14, 1954.
 367. Taylor, R. E., "Thermal Conductivity of Titanium Carbide at High Temperatures," *J. Am. Ceram. Soc.*, 44(10), 525, 1961.
 368. Laubitz, M. J., "On the Series Comparator Methods of Measuring Thermal Conductivity," in *Proceedings of the Black Hills Summer Conference on Transport Phenomena* (1962), S. Dakota School of Mines and Technology, Rapid City, Issued under Office of Navai Research, Contract No. Nonr(G)-00064-62, 8-22, 1962.
 369. Hoch, M. and Vardi, J., "Thermal Conductivity of TiC," *J. Am. Ceram. Soc.*, 46(5), 245, 1963.
 370. Powell, R. W., "Correlation of the Thermal and Electrical Conductivity of Metals, Alloys and Compounds," in *Proceedings of the Third Conference on Thermal Conductivity* (1963), Vol. 1, Oak Ridge National Laboratory, 79-112, 1963.
 371. Powell, R. W. and Tye, R. P., "The Thermal Conductivities of Some Electrically Conducting Compounds," in *Special Ceramics, 1964* (Popper, P., ed.), Academic Press, London, 243-59, 1965.
 372. Taylor, R. E. and Morreale, J., "Thermal Conductivity of Titanium Carbide, Zirconium Carbide and Titanium Nitride at High Temperatures," *J. Am. Ceram. Soc.*, 47(2), 69-73, 1964.
 373. Powell, R. W. and Taylor, R. E., "Multi-Property Apparatus and Procedure for High Temperature Determinations," *Rev. Int. Hautes Temp. Réfract.*, in course of publication in 1970.
 374. Longmire, C. L., "Method for Determining Thermal Conductivity at High Temperatures," *Rev. Sci. Instrum.*, 28(11), 904-6, 1957.
 375. Pike, J. N. and Doar, J. F., Union Carbide Research Institute Rept. UCRI-2787, Appendix 1, 1960.
 376. Pike, J. N. and Doar, J. F., "High Temperature Thermal Conductivity Measurements. Part 2. The Rectangular Bar Method, Experimental Techniques," Union Carbide Corp. Parma Research Lab. Res. Rept. No. C-10, 1-43, 1961.
 377. Pike, J. N. and Doar, J. F., "High Temperature Thermal Conductivity Measurements. Theory of Longmire's Method and the Rectangular Bar Method," Appendix X to Volume II of the Final Report "Research on Physical and Chemical Principles Affecting High Temperature Materials for Rocket Nozzles" (Submitted by Aspinall, S. R.), Union Carbide Research Institute, 1965.
 378. Borelius, G., "A Method for the Combined Measurements of Peltier Heat and Thermal Conductivity," *Ann. Physik*, 4, 52, 398-414, 1917.
 379. Sedström, E., "Peltier Heat and Thermal and Electrical Conductivity of Some Solid Metallic Solutions," *Ann. Physik*, 4, 59, 134-44, 1919.
 380. Sedström, E., "On the Knowledge of Gold-Copper Alloys," *Ann. Physik*, 75, 549-55, 1924.
 381. Putley, E. H., "Thermoelectric and Galvanomagnetic Effects in Lead Selenide and Telluride," *Proc. Phys. Soc. (London)*, B68, 35-42, 1955.
 382. Harman, T. C., "Special Techniques for Measurement of Thermoelectric Properties," *J. Appl. Phys.*, 29(9), 1373-4, 1958.
 383. Harman, T. C., Cahn, J. H. and Logan M. J., "Measurement of Thermal Conductivity by Utilization of the Peltier Effect," *J. Appl. Phys.*, 30(9), 1351-9, 1959.
 384. Calvet, E., Bros, J.-P., and Pinelli, H., "Perfection of an Apparatus for the Measurement of Thermal Conductivities of Solids, under Steady-State Conditions, by Use of the Peltier and Joule Effects," *C. R. Acad. Sci. (France)*, 260(4), 1164-7, 1965.
 385. Héringckx, C. and Monfils, A., "Electrical Determination of the Thermal Parameters of Semiconducting Thermo-Elements," *Brit. J. Appl. Phys.*, 10(5), 235-6, 1959.
 386. Powell, R. W., "Improvements in and Relating to the Measurement of Thermal Conductivity," British Patent No. 855 658, application date 29 November 1956, complete specification published 7 December 1960.
 387. Powell, R. W., "Experiments Using a Simple Thermal Comparator for Measurement of Thermal Conductivity, Surface Roughness and Thickness of Foils or of Surface Deposits," *J. Sci. Instrum.*, 34, 485-92, 1957.
 388. Powell, R. W., "Thermal Conductivity as a Non-destructive-Testing Technique," in *Progress in Non-Destructive Testing*, Vol. 1, Messrs. Heywood & Co. Ltd., 199-226, 1958.
 389. Powell, R. W., "Single-End Probe, or Modified Thermal Comparator," British Patent No. 1 036 124, application date 19 January 1962, complete specification published 13 July 1966.
 390. Powell, R. W., "Thermal Conductivity Determinations by Thermal Comparator Methods," in *Thermal Conductivity* (Tye, R. P., ed.), Vol. 2, Chap. 6, Academic Press, London, 275-338, 1969.
 391. Powell, R. W., DeWitt, D. J., Wolfla, L. H., and Finch, R. A., "An Instrument Embodying the Thermal Comparator Technique for Thermal Conductivity Measure-

- ments," in *Temperature Measurements Society—Sixth Conference and Exhibit*, Western Periodicals, Co., North Hollywood, Calif., 233-44, 1969.
392. Danielson, G. C. and Sidles, P. H., "Thermal Diffusivity and Other Nonsteady-State Methods," in *Thermal Conductivity* (Tye, R. P., ed.), Vol. 2, Chap. 3, Academic Press, London, 149-201, 1969.
 393. Ångström, A. J., "New Method of Determining the Thermal Conductivity of Bodies," *Phil. Mag.*, **25**, 130-42, 1863.
 394. King, R. W., "A Method of Measuring Heat Conductivities," *Phys. Rev.*, **6**(6) 437-45, 1915.
 395. Starr, C., "An Improved Method for the Determination of Thermal Diffusivities," *Rev. Sci. Instrum.*, **8**(1), 61-4, 1937.
 396. Sidles, P. H. and Danielson, G. C., "Thermal Diffusivity of Metals at High Temperature," *J. Appl. Phys.*, **25**(1), 58-66, 1954.
 397. Abeles, B., Cody, G. D., and Beers, D. S., "Apparatus for the Measurement of the Thermal Diffusivity of Solids at High Temperatures," *J. Appl. Phys.*, **31**(9), 1585-92, 1960.
 398. Cowan, R. D., "Proposed Method of Measuring Thermal Diffusivity at High Temperatures," *J. Appl. Phys.*, **32**(7), 1363-70, 1961.
 399. Hirschman, A., Dennis, J., Derksen, W., and Monahan, T., "An Optical Method for Measuring the Thermal Diffusivity of Solids," in *International Developments in Heat Transfer, Part IV*, ASME, New York, 863-9, 1961.
 400. Wheeler, M. J., "Thermal Diffusivity at Incandescent Temperatures by a Modulated Electron Beam Technique," *Brit. J. Appl. Phys.*, **16**(3), 365-76, 1965.
 401. Tanasawa, T., "A New Method for the Measurement of the Thermal Constants of Wet Substance (The Second Report)," *Trans. Soc. Mech. Engrs. Japan*, **1**(3), 217-26, 1935.
 402. Filippov, L. P. and Pigal'skaya, L. A., "Measurement of the Thermal Diffusivity of Metals at High Temperatures," *High Temperature*, **2**(3), 351-8, 1964.
 403. Pigal'skaya, L. A. and Filippov, L. P., "Measurement of the Thermal Diffusivity of Metals at High Temperatures. Part 2. Experimental Method of Alternating Heating in a High-Frequency Furnace," *High Temperature*, **2**(4), 501-4, 1964.
 404. Yurchak, R. P. and Filippov, L. P., "Measuring the Thermal Diffusivity of Molten Metals," *Teplofiz. Vysokikh Temperatur*, **2**(5), 696-704, 1964; English translation: *High Temperature*, **2**(5), 628-30, 1964.
 405. Yurchak, R. P. and Filippov, L. P., "Thermal Properties of Molten Tin and Lead," *Teplofiz. Vysokikh Temperatur*, **3**(2), 323-5, 1965; English translation: *High Temperature*, **3**(2), 290-1, 1965.
 406. van Zee, A. F. and Babcock, C. L., "A Method for the Measurement of Thermal Diffusivity of Molten Glass," *J. Am. Ceram. Soc.*, **34**, 244-50, 1951.
 407. Kirichenko, Yu. A., Oleinik, B. N., and Chadovich, T. Z., "Thermal Properties of Polymers," *Inzh-Fiz. Zh.*, **7**(5), 70-5, 1964.
 408. Neumann, F., "Experiments on the Thermal Conductivity of Solids," *Ann. Chlm. Phys.*, **3**, 66, 183-7, 1862.
 409. Neumann, F., "Experiments on the Calorific Conductibility of Solids," *Phil. Mag.*, **25**, 63-5, 1863.
 410. Oualid, J., "Determination of the Diffusivity Coefficient of Metals and Semi-Conductors," *J. Phys. Radium*, **22**, 124-6, 1961.
 411. Woisard, E. L., "Pulse Method for the Measurement of Thermal Diffusivity of Metals," *J. Appl. Phys.*, **32**(1), 40-5, 1961.
 412. Butler, C. P. and Inn, E. C. Y., "Thermal Diffusivity of Metals at Elevated Temperatures," in *Thermodynamic and Transport Properties of Gases, Liquids and Solids*, (Touloukian, Y. S., ed.), *Am. Soc. Mech. Engrs. Symp. Thermal Prop.*, McGraw-Hill, N.Y., 377-90, 1959.
 413. Kennedy, W. L., Sidles, P. H., and Danielson, G. C., "Thermal Diffusivity Measurements on Finite Samples," *Adv. Energy Conv.*, **2**, 53-8, 1962.
 414. Penniman, F. G., "A Long-Pulse Method of Determining Thermal Diffusivity," *Sol. Energy*, Pt. II, **9**(3), 113-6, 1965.
 415. Fitch, A. L., "A New Thermal Conductivity Apparatus," *Am. Phys. Teacher*, **3**, 135-6, 1935.
 416. Joffé, A. V. and Joffé, A. F., "Measurement of Thermal Conductivity of Semi-conductors in the Vicinity of Room Temperatures," *Soviet Phys.—Tech. Phys.*, **3**(11), 2163-8, 1958.
 417. Plummer, W. A., Campbell, D. E., and Comstock, A. A., "Method of Measurement of Thermal Diffusivity to 1000 C.," *J. Am. Ceram. Soc.*, **45**(7), 310-6, 1962.
 418. Cutler, M. and Cheney, G. T., "Heat-Wave Methods for the Measurement of Thermal Diffusivity," *J. Appl. Phys.*, **34**(7), 1902-9, 1963.
 419. Parker, W. J., Jenkins, R. J., Butler, C. P., and Abbott, G. I., "Flash Method of Determining Thermal Diffusivity, Heat Capacity, and Thermal Conductivity," *J. Appl. Phys.*, **32**(9), 1679-84, 1961.
 420. Cape, J. A. and Lehman, G. W., "Temperature and Finite Pulse-Time Effects in the Flash Method for Measuring Thermal Diffusivity," *J. Appl. Phys.*, **34**(7), 1909-13, 1963.
 421. Taylor, R. E. and Cape, J. A., "Finite Pulse-Time Effect in the Flash Diffusivity Technique," *Appl. Phys. Letters*, **5**(10), 212-23, 1964.
 422. Ginnings, D. C., "Standards of Heat Capacity and Thermal Conductivity," in *Thermoelectricity* (Egli, P. H., ed.), Chap. 20, John Wiley & Sons., New York, 320-41, 1960.
 423. Cape, J. A., Lehman, G. W., and Nakata, M. M., "Transient Thermal Diffusivity Technique for Refractory Solids," *J. Appl. Phys.*, **34**(12), 3550-5, 1963.
 424. Carter, R. L., Maycock, P. D., Klein, A. H., and Danielson, G. C., "Thermal Diffusivity Measurements with Radial Sample Geometry," *J. Appl. Phys.*, **36**(8), 2333-7, 1965.
 425. Stalhane, B. and Pyk, S., "New Method for Measuring the Thermal Conductivity Coefficients," *Tekn. Tidskr.*, **61**(28), 389-93, 1931.
 426. Stalhane, B. and Pyk, S., "Determination of the Thermal Conductivity of Ceramic Bodies at High Temperature," *Tekn. Tidskr.*, **64**(48), 445-8, 1934.
 427. van der Held, E. F. and van Drunen, F. G., "A Method of Measuring the Thermal Conductivity of Liquids," *Physica*, **15**(10), 865-81, 1949.
 428. van der Held, E. F., Hardebol, J., and Kalshoven, J., "The Measurement of the Thermal Conductivity of

- Liquids by a Nonstationary Method," *Physica*, **19**(3), 208-16, 1953.
429. Hooper, F. C. and Lepper, F. R., "Transient Heat Flow Apparatus for the Determination of Thermal Conductivities," *Heating, Piping and Air Conditioning*, ASHVE J. Sect. **22**(8), 129-34, 1950.
420. Hooper, F. C. and Chang, S. C., "Development of the Thermal Conductivity Probe," *Heating, Piping, and Air Conditioning*, ASHVE J. Sect. **24**(10), 125-9, 1952.
431. Blackwell, J. H., "Radial-Axial Heat Flow in Regions Bounded Internally by Circular Cylinders," *Can. J. Phys.*, **31**(4), 472-9, 1953.
432. Blackwell, J. H., "A Transient-Flow Method for Determination of Thermal Constants of Insulating Materials in Bulk. I. Theory," *J. Appl. Phys.*, **25**, 137-44, 1954.
433. Makowski, M. W. and Mochlinski, K., "An Evaluation of Two Rapid Methods of Assessing the Thermal Resistivity of Soil," *Proc. Instn. Elect. Engrs.*, **103A**(11), 453-70, 1956.
434. Rosenthal, D. and Ambrosio, A., "A New Method of Determining Thermal Diffusivity of Solids at Various Temperatures," *Trans. ASME*, **73**(7), 971-4, 1951.
435. Rosenthal, D. and Friedmann, N. E., "Thermal Diffusivity of Metals at High Temperatures," *J. Appl. Phys.*, **25**(8), 1059-60, 1954.
436. Rosenthal, D. and Friedmann, N. E., "The Determination of Thermal Diffusivity of Aluminum Alloys at Various Temperatures by Means of a Moving Heat Source," *Trans. ASME*, **78**(8), 1175-80, 1956.
437. Hsu, S. T., "Theory of a New Apparatus for Determining the Thermal Conductivities of Metals," *Rev. Sci. Instr.*, **28**(5), 333-6, 1957.
438. Hsu, S. T., "Determination of Thermal Conductivities of Metals by Measuring Transient Temperatures in Semi-Infinite Solids," *Trans. ASME*, **79**, 1197-1203, 1957.
439. Deem, H. W., Pobereskin, M., Lusk, E. C., Lucks, C. F., and Calkins, G. D., "Effect of Radiation on the Thermal Conductivity of Uranium-1.6 Wt. % Zirconium," USAEC Rept. BMI-986, 1-19, 1955.

Numerical Data

Data Presentation and Related General Information

1. SCOPE OF COVERAGE

Presented in this volume are the thermal conductivity data for 5 elements, over 100 different grades of graphites, 53 oxides and oxide compounds, 82 systems of oxide mixtures, 83 nonoxide compounds, 7 systems of mixtures of oxides and nonoxides, 15 organic compounds, 22 kinds of cermets, 10 groups of systems, 8 kinds of refractory materials, over 40 different kinds of glasses, 24 minerals, 16 polymers, 26 animal and vegetable natural substances, 30 processed composites and processed natural and mineral substances, and 10 aggregate mixes, slags, scales, and residues. These data are obtained by processing over 1260 research documents on the thermal conductivity of nonmetallic solids dated from around 1800 to 1967, of which about 590 contain usable data. Materials within each group are arranged in alphabetical order by name, as listed in the *Grouping of Materials and List of Figures and Tables* in the front of the volume. Totally, this volume reports 4627 sets of data on 812 materials, which are listed in the *Material Index* at the end of the volume. The *Material Index* lists also the materials contained in the companion volumes (Volumes 1 and 3) on thermal conductivity.

The ranges of temperatures covered by the thermal conductivity data for some materials are from near absolute zero to past the melting point, though, for most high-temperature materials, the available data are limited to the solid range.

The data for the elements and a number of oxides have been critically evaluated, analyzed, and synthesized, and recommended reference values are presented. This procedure involves critical evaluation of the validity of available data and related information, resolution and reconciliation of disagreements of conflicting data, correlation of data in terms of various affecting parameters, and comparison of the resulting values with theoretical predictions, or with

results derived from semi-theoretical relationships, or from generalized empirical correlations. Besides critical evaluation and analysis of the existing data, thermodynamic principles and semi-empirical techniques are employed to fill in gaps and to extrapolate existing data so that the resulting recommended values are internally consistent and cover as wide a range of the controlling parameters as possible. Future editions of this volume will contain recommended values for an increasing number of materials.

2. PRESENTATION OF DATA

The thermal conductivity data and information on test specimens for each material are generally presented in three sections arranged in the following order: Original Data Plot, Specification Table, and Data Table. For the elements and a number of oxides, Graph and Table of Recommended Values is added as a fourth section. Furthermore, for a number of materials for which there exists only a small amount of data, the original data plot may be omitted.

The Original Data Plot is a full-page log-log-scale graphical presentation of the original thermal conductivity data as a function of temperature. When several sets of data are coincident, some of the data sets may be omitted from the plot for the sake of clarity. They are, however, invariably reported in the Data Table and Specification Table.

The Specification Table provides in a concise form the comprehensive information on the test specimens for which the data are reported. The curve numbers in the Specification Table correspond exactly to the numbers which also appear in the Original Data Plot and in the Data Table. The Specification Table gives for each set of data the reference number which corresponds to the number in the list of *References to Data Sources*, the year of publication of the original data, the method of

measurement, the temperature range, the reported estimate of error of the data, the specimen designation, and the specimen characterization and test conditions. The information of the last category, which is reported to the extent provided in the original source document, includes the following:

- (1) Purity, chemical composition;
- (2) Type of crystal, crystal axis orientation, type and concentration of crystal defects;
- (3) Microstructure, grain size, pore size and shape, inhomogeneity, additional phases;
- (4) Specimen shape and dimensions, method and procedure of fabrication;
- (5) Thermal history, heat treatment, mechanical, irradiative, and other treatments;
- (6) Manufacturer and supplier, stock number, and catalog number;
- (7) Test environment, degree of vacuum or pressure, heat flow direction, strength and orientation of the applied magnetic field;
- (8) Pertinent physical properties, such as density, porosity, hardness, ~~transition temperatures,~~ etc. ^{and its property values};
- (9) Reference material ^{for a comparative method of measurement};
- (10) Form in which the extracted data are presented in the original source document other than raw data points;
- (11) Additional information obtained directly from the author.

Unfortunately, in the majority of cases the authors do not report in their research papers all the necessary pertinent information to fully characterize and

identify the materials for which their data are reported. This is particularly true for the authors of earlier investigations. Consequently, the amount of information on specimen characterization reported in the Specification Tables varies greatly from specimen to specimen.

In the Data Table, tabular presentation is given for all the data described in the Specification Table and shown or not shown in the Original Data Plot. Many tabular data which are not presented in the original source documents are obtained directly from the authors through private communications. Attempts have often been made to contact the authors of recent publications for tabular data whenever the original data are given in the research paper only in a figure too small to warrant accurate data extraction compatible with the reported accuracy of the measurement. The thermal conductivity data are given in watts per centimeter per degree Kelvin, and the temperatures in degrees Kelvin. For data conversion, the reader is referred to the *Conversion Factors for Thermal Conductivity Units* given later.

The recommended thermal conductivity values for a material are reported in a separate graph and table following the Data Table. The estimated accuracy of the recommended values and special remarks on material characterization and identification are also noted in the table.

3. CLASSIFICATION OF MATERIALS

The classification scheme as shown in the table for nonmetallic elements, compounds, and mixtures

Classification of Materials

Classification	Limits of composition (weight percent)*				
	X ₁	X ₁ + X ₂	X ₂	X ₃	
1. Elements	>99.5	—	<0.2	<0.2	
2. Mixtures (or solutions) of elements or of elements and compounds	A. Binary	—	≥99.5	≥0.2	≤0.2
		—	≥99.5	>0.2	>0.2
	B. Multiple	—	<99.5	≥0.2	≤0.2
		—	<99.5	>0.2	>0.2
		≤99.5	—	>0.2	<0.2
3. Compounds	>95.0	—	<2.0	<2.0	
4. Mixtures (or solutions) of compounds	A. Binary	—	≥95.0	≥2.0	≤2.0
		—	≥95.0	>2.0	>2.0
	B. Multiple	—	<95.0	≥2.0	≤2.0
		—	<95.0	>2.0	>2.0
		≤95.0	—	<2.0	<2.0

*X₁ ≥ X₂ ≥ X₃ ≥ X₄ ≥

contained in this volume is based strictly upon the chemical composition of the material. This scheme is mainly for the convenience of material grouping and data organization, and is not intended to be used as basic definitions for the various material groups.

4. SYMBOLS AND ABBREVIATIONS USED IN THE FIGURES AND TABLES

In the Specification Tables, the code designations used for the experimental methods are as follows:

C	Comparative method
E	Direct electrical heating method
F	Forbes' bar method
L	Longitudinal heat flow method
P	Periodic or transient heat flow method
R	Radial heat flow method
T	Thermoelectrical method

Other symbols and abbreviations used in the figures and/or tables are as follows:

b.c.c.	Body-centered cubic
c.	Cubic
c.p.h.	Close-packed hexagonal
d	Density
d.	Diamond (crystal structure)
Decomp.	Decomposition
f.c.c.	Face-centered cubic
f.c.t.	Face-centered tetragonal
h.	Hexagonal
I.D.	Inside diameter
k	Thermal conductivity
M.P.	Melting point
monocl.	Monoclinic
NTP	Normal temperature and pressure
O.D.	Outside diameter
orthorh.	Orthorhombic
r.	Rhombohedral
s.c.	Superconducting
Subl.	Sublimation
T	Temperature
t.	Tetragonal
Temp.	Temperature
T.P.	Transition point
Vit.	Vitreous
ρ	Electrical resistivity
μ	Micro
>	Greater than
<	Less than
~	Approximately

③
④

Curve number
Single data point number

5. CONVENTION FOR BIBLIOGRAPHIC CITATION

For the following types of documents the bibliographic information is cited in the sequences given below.

Journal Article:

- Author(s)—The names and initials of all authors are given. The last name is written first, followed by initials.
- Title of article—In this volume, the titles of the journal articles listed in the *References to Text* are given, but not of those listed in the *References to Data Sources*.
- Journal title—The abbreviated title of the journal as used in *Chemical Abstracts* is given.
- Series, volume, and number—If the series is designated by a letter, no comma is used between the letter for series and the numeral for volume, and they are underlined together. In case series is also designated by a numeral, a comma is used between the numeral for series and the numeral for volume, and only the numeral representing volume is underlined. No comma is used between the numerals representing volume and number. The numeral for number is enclosed in parentheses.
- Pages—The inclusive page numbers of the article.
- Year—The year of publication.

Report:

- Author(s)
- Title of report—In this volume, the titles of the reports listed in the *References to Text* are given, but not of those listed in the *References to Data Sources*.
- Name of the responsible organization.
- Report, or bulletin, circular, technical note, etc.
- Number
- Part
- Pages
- Year
- ASTIA's AD number—This is given in square brackets whenever available.

CONVERSION FACTORS FOR UNITS OF THERMAL CONDUCTIVITY

MULTIPLY by appropriate factor to OBTAIN	$\text{Btu}_T \text{hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$	$\text{Btu}_T \text{in. hr}^{-1} \text{ft}^{-2} \text{F}^{-1}$	$\text{Btu}_T \text{in. hr}^{-1} \text{ft}^{-2} \text{F}^{-1}$	$\text{Btu}_T \text{hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$	$\text{Btu}_T \text{in. hr}^{-1} \text{ft}^{-2} \text{F}^{-1}$	$\text{Btu}_T \text{in. hr}^{-1} \text{ft}^{-2} \text{F}^{-1}$	$\text{cal}_T \text{sec}^{-1} \text{cm}^{-1} \text{C}^{-1}$	$\text{cal}_T \text{in. hr}^{-1} \text{ft}^{-2} \text{F}^{-1}$	$\text{cal}_T \text{sec}^{-1} \text{cm}^{-1} \text{C}^{-1}$	$\text{kcal}_T \text{hr}^{-1} \text{m}^{-1} \text{C}^{-1}$	$\text{J sec}^{-1} \text{cm}^{-1} \text{K}^{-1}$	$\text{W cm}^{-1} \text{K}^{-1}$	$\text{W m}^{-1} \text{K}^{-1}$	$\text{W cm}^{-1} \text{K}^{-1}$	$\text{W m}^{-1} \text{K}^{-1}$	$\text{mW cm}^{-1} \text{K}^{-1}$
$\text{Btu}_T \text{hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$	1	12	12	1.00067	12.0090	12.0090	4.1868×10^{-2}	4.1868×10^{-2}	4.1868×10^{-2}	1.48516	1.7073×10^{-2}	1.7073×10^{-2}	1.7073	1.7073×10^{-2}	1.7073	17.3073
$\text{Btu}_T \text{in. hr}^{-1} \text{ft}^{-2} \text{F}^{-1}$	8.33333×10^{-2}	1	1	8.33333×10^{-2}	1.00067	1.00067	3.44713×10^{-4}	3.44713×10^{-4}	3.44713×10^{-4}	0.124097	1.44228×10^{-3}	1.44228×10^{-3}	0.144228	1.44228×10^{-3}	0.144228	1.44228
$\text{Btu}_T \text{hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$	0.999331	11.9920	11.9920	1	12	12	4.18102×10^{-2}	4.18102×10^{-2}	4.18102×10^{-2}	1.48816	1.72958×10^{-2}	1.72958×10^{-2}	1.72958	1.72958×10^{-2}	1.72958	17.2958
$\text{Btu}_T \text{in. hr}^{-1} \text{ft}^{-2} \text{F}^{-1}$	8.32776×10^{-2}	0.999331	0.999331	8.33333×10^{-2}	1	1	3.44252×10^{-4}	3.44252×10^{-4}	3.44252×10^{-4}	0.124018	1.44131×10^{-3}	1.44131×10^{-3}	0.144131	1.44131×10^{-3}	0.144131	1.44131
$\text{cal}_T \text{sec}^{-1} \text{cm}^{-1} \text{C}^{-1}$	2.41509×10^2	2.90291×10^3	2.90291×10^3	2.42071×10^2	2.90485×10^3	2.90485×10^3	1	1	1.00067	3.60241	4.1868×10^2	4.1868×10^2	4.1868×10^2	4.1868×10^2	4.1868×10^2	4.1868×10^2
$\text{cal}_T \text{in. hr}^{-1} \text{ft}^{-2} \text{C}^{-1}$	2.41747×10^2	2.90396×10^3	2.90396×10^3	2.41909×10^2	2.90291×10^3	2.90291×10^3	0.999331	1	0.999331	3.6	4.1868×10^2	4.1868×10^2	4.1868×10^2	4.1868×10^2	4.1868×10^2	4.1868×10^2
$\text{kcal}_T \text{hr}^{-1} \text{m}^{-1} \text{C}^{-1}$	0.673520	8.03824	8.03824	0.673549	8.06361	8.06361	2.77592×10^{-2}	2.77778×10^{-2}	2.77778×10^{-2}	1	1.16222×10^{-2}	1.16222×10^{-2}	1.16222	1.16222×10^{-2}	1.16222	11.6222
$\text{J sec}^{-1} \text{cm}^{-1} \text{K}^{-1}$	57.7749	6.93347×10^2	6.93347×10^2	57.8176	6.93811×10^2	6.93811×10^2	0.238846	0.238846	0.238846	86.0421	1	1	1×10^2	1	1×10^2	1×10^2
$\text{W cm}^{-1} \text{K}^{-1}$	57.7749	6.93347×10^2	6.93347×10^2	57.8176	6.93811×10^2	6.93811×10^2	0.238846	0.238846	0.238846	86.0421	1	1	1×10^2	1	1×10^2	1×10^2
$\text{W m}^{-1} \text{K}^{-1}$	0.577749	6.93347	6.93347	0.578176	6.93811×10^2	6.93811×10^2	2.38846×10^{-2}	2.38846×10^{-2}	2.38846×10^{-2}	0.860421	1×10^{-2}	1×10^{-2}	1	1×10^{-2}	1	10
$\text{mW cm}^{-1} \text{K}^{-1}$	57.7749	6.93347×10^2	6.93347×10^2	57.8176	6.93811×10^2	6.93811×10^2	2.38846×10^{-4}	2.38846×10^{-4}	2.38846×10^{-4}	8.60421	1×10^{-4}	1×10^{-4}	0.1	1×10^{-4}	0.1	1

Books:

- a. Author(s)
- b. Title
- c. Volume
- d. Edition
- e. Publisher
- f. Place of publication
- g. Pages
- h. Year

6. CONVERSION FACTORS FOR THERMAL CONDUCTIVITY UNITS

The conversion factors given in the table on page 44a are based upon the following basic definitions:

1 in.	= 0.0254 (exactly) m*
1 lb	= 0.45359237 kg*
1 cal _{th}	= 4.184 (exactly) J*
1 cal _{IT}	= 4.1868 (exactly) J*
1 Btu _{th} lb ⁻¹ F ⁻¹	= 1 cal _{th} g ⁻¹ C ⁻¹ †
1 Btu _{IT} lb ⁻¹ F ⁻¹	= 1 cal _{IT} g ⁻¹ C ⁻¹ †

*National Bureau of Standards, "New Values for the Physical Constants Recommended by NAS-NRC," *NBS Tech. News Bull.*, 47(10), 175-7, 1963.

†Mueller, E. F. and Rossini, F. D., "The Calory and the Joule in Thermodynamics and Thermochemistry," *Am. J. Phys.*, 12(1), 1-7, 1944.

The subscripts "th" and "IT" designate "thermochemical" and "International Steam Table," respectively.

7. CRYSTAL STRUCTURES, TRANSITION TEMPERATURES, AND OTHER PERTINENT PHYSICAL CONSTANTS OF THE ELEMENTS

The table on the following pages contains information on the crystal structures, transition temperatures, and certain other pertinent physical constants of the elements. This information is very useful in data analysis and synthesis. For example, the thermal conductivity of a material generally changes abruptly when the material undergoes any transformation. One must therefore be extremely cautious in attempting to extrapolate the thermal conductivity values across any phase, state, magnetic, or superconducting transition temperature, as given in the table.

No attempt has been made to critically evaluate the temperatures/constants given in the table, and they should not be considered recommended values. This table has an independent series of numbered references which immediately follows the table.

CRYSTAL STRUCTURES, TRANSITION TEMPERATURES, AND OTHER PERTINENT PHYSICAL CONSTANTS OF THE ELEMENTS

Name	Atomic Number	Atomic Weight ^a	Density, ^b kg m ⁻³ · 10 ⁻²	Crystal Structure	Phase Transition Temp., K	Superconducting Transition Temp., K	Curie Temp., K	Néel Temp., K		Debye Temperature at 0 K, K		Melting Point, K		Boiling Point, K		Critical Temp., K
								K	K	K	K	K	K	K	K	
Actinium	89	(227)	10.07 ^{1c}	f. c. c. ²					124 ³	100 ⁴ (at ~50 K)	1323 ⁵	3200 ± 300 ⁶				
Aluminum	13	26.9815	2.702 ⁵	f. c. c. ⁷		1.196 ⁵ 1.17 ⁸ 1.18 ⁹			423 ± 5 ³	390 ³	933.2 ^{3,16}	2723 ²⁰			8650 ¹¹ 7740 ¹⁰⁰	
Americium	95	(243)	11.7 ⁵	Double c. p. h. ²							1473 ²⁰	2880 ¹⁰⁰				
Antimony	51	121.75	6.684 ²⁰	r. (?) ? (?) ? (?)	367.8 (γ-?) 690 ¹³ (γ-?) high-pressure modification	2.6 ⁸ (Sb II, high-pressure modification)			150 ³	200 ¹⁴	903.7 ¹³ 903.65 ²³	1907 ± 10 ³			2969 ¹⁵	
Argon	18	39.948	0.0017824 ²⁰ (at 273.2 K and 1 atm)	f. c. c. ¹⁶						90 ⁴ (at ~45 K)	83.8 ¹⁷	87.29 ²⁰			151 ¹⁵	
Arsenic	33	74.9216	5.73 (gray, at 287.2 K) 4.7 (black) 2.0 (yellow)	r. (gray) c. (yellow)					236 ³	275 ¹⁸	1090 ¹³ (35.8 atm) (35.8 atm) subl. 896	1090 ¹³			3663 ¹⁰ 3520 ¹⁰⁰	
Asuthe	85	(210)										573.2 ¹⁹			650 ²⁰	
Barium	56	137.34	3.5 ²⁰	b. c. c. (γ) ? (β)	648 ^{13,21} (α-β)				110.5 ± 1.8 ²²	116 ²³	998.2 ⁵	1910 ³				
Berkelium	97	(249)														
Beryllium	4	9.0122	1.85 ²⁰	c. p. h. ² (α) b. c. c. (β)	1533 ²⁴ (α-β) ~6 ¹⁰⁰ ~8.4 ¹⁰⁰				1160 ²⁵	1001 ³	1550 ²⁶	3142 ± 100 ³			6153 ¹⁶	
Bismuth	83	208.980	9.78 ²⁰	r. ²		3.9 (BI II, at 25 kbar) 7.2 (BI III, at 27 kbar)			119 ± 2 ³	116 ± 5 ³	544.525 ^{3,11}	1624 ± 8 ³			4620 ²⁷	
Boron	5	10.811	2.50 ²²	Simple r. ² (α) r. ² (β)	1473 ² (α-β)				1315 ²⁸	1362 ³	2573 ⁵	4050 ± 100 ²⁸				
Bromine	35	79.909	3.119 ²⁰	orthorh. ²⁸							266.0 ¹⁷	331.93 ²⁹			584 ¹⁶	

^a Atomic weights are based on ¹²C = 12 as adopted by the International Union of Pure and Applied Chemistry in 1961; those in parentheses are the mass numbers of the isotopes of longest known half-life.

^b Density values are given at 293.2 K unless otherwise noted.

^c Superscript numbers designate references listed at the end of the table.

Name	Atomic Number	Atomic Weight	Density ^b , kg m ⁻³ · 10 ⁻³	Crystal Structure	Phase Transition Temp., K	Superconducting Transition Temp., K	Curie Temp., K	Niel Temp., K	Debye Temperature at 0 K, K	Debye Temperature at 298 K, K	Melting Point, K	Boiling Point, K	Critical Temp., K
Cadmium	48	112.40	8.65 ²⁹	c. p. h. ² b. c. c. (γ)		0.56 ⁵ 0.52 ⁹			252 ± 48 ³	221	594.18 ^{1,10} 170 (b. c. c., Subl. β at ~85 K) 594.1 (at 0.11 mm Hg)	1038 ³	1903 ¹⁰ 3560 ¹⁰
Calcium	20	40.08	1.55 ²⁹	f. c. c. (α) b. c. c. (β)	737 (α-β) ⁶²				234 ± 5 ³	230	1123 ¹⁰ Subl. 1123 (at 0.35 mm Hg)	1765 ³	3267 ¹⁰
Californium	98	(251)									Subl. 4473 ³ 3925-3970		
Carbon (amorphous)	6	12.01115	1.8-2.1 ²⁹						2240 ± 5 ¹¹	1874 ³	> 3823 ⁵	5100 ³	
Carbon (diamond)	6	12.01115	3.51 ²⁹	d. ¹⁶					402 ± 11 ³	1550 ³	3925-3970 ⁵	4473 ⁵	
Carbon (graphite)	6	12.01115	2.26 (α) ²⁹	h. ² (α) r. ² (β)					146 ³	138 ³⁴	1077 ²⁸	3972 ³	10400 ¹⁰⁰
Cerium	58	140.12	6.90 ²⁹	f. c. c. (α) ³² Double c. p. h. ² (β) f. c. c. (γ) ³² b. c. c. (δ) ³² b. c. c. ²	103 ± 5 (α-β) ³³ 263 ± 5 (β-γ) ³³ 1003 (γ-δ) ³²				13 ³²				
Cesium	55	132.905	1.873 ²⁹	b. c. c. ²					40 ± 5 ³	43 ²³	301.9 ²⁹ Subl. 301.9 (at 1.2 μHg)	939 ³⁵	113,114,115 ¹⁰⁰ 2060 ¹⁰⁰ 1900
Chlorine	17	35.453	0.003214 (at 273.2 K) ²⁹	t. ¹⁶						115 ^{4,36} (at ~58 K)	172.2 ²⁵	239.10 ¹³	417 ¹⁵
Chromium	24	51.996	7.16 ⁶²	c. p. h. ¹⁷ (α) b. c. c. (β)	~299 (α-β) ^d				598 ± 32 ³	424 ³	2118 ³⁰	2918 ± 35 ³	
Cobalt	27	58.9332	8.862 ⁶²	c. p. h. ¹⁷ (α) f. c. c. (β)	690 (α-β) ¹⁷		1400 ⁶⁰		452 ± 17 ³	386 ³	1765 ^{3,10}	3229 ³	
Copper	29	63.54	8.903 ²⁹	f. c. c. ²					342 ± 2 ³	310 ³	1356 ^{3,10}	2871 ± 20 ⁴¹	8500 ¹¹ 8290 ¹⁰⁰
Curium	96	(247)	7 ⁶²	Double c. p. h. ⁸									
Dysprosium	66	162.50	8.556 ⁶²	c. p. h. ² (α) b. c. c. (β)	Near m. p. (γ-β) ²				174 ⁴³ 172 ± 35 ³ 83.5 (ferro-antiferromag.) ⁴³	158 ⁴⁴	1773 ¹²	3011 ⁴⁴	7640 ¹⁰⁰

^d Close-packed hexagonal crystalline modification of chromium may be formed by electrodeposition below 293 K under special conditions of deposition process. This c. p. h. form is unstable and will irreversibly transform into b. c. c. form on heating.

Name	Atomic Number	Atomic Weight	Density, ^b kg m ⁻³ · 10 ⁻³	Crystal Structure	Phase Transition Temp., K	Superconducting Transition Temp., K	Curie Temp., K	Neel Temp., K	Debye Temperature at 0 K, K	Debye Temperature at 296 K, K	Melting Point, K	Boiling Point, K	Critical Temp., K
Einsteinium	99	(254)											
Erbium	68	167.26	9.06 ⁴²	c. p. h. (α) b. c. c. (β)	1643 (α-β)		19 ⁴	80 ⁴	134 ± 10 ⁴⁶	163 ⁴⁴	1770 ³⁶	3000 ³	7250 ¹⁰⁹
Europium	63	151.96	5.245 ¹⁰	b. c. c. ⁷				~90 ⁴	127 ³		1099 ⁵	1971 ⁴⁸	4600 ¹⁰⁹
Fermium	100	(253)											
Fluorine	9	18.9984	0.001695 ²⁹ (at 273.2 K and 1 atm)	c. (β-F ₂)							53.58 ⁵	85.24 ¹³	144 ¹⁵
Francium	87	(223)							39 ³		300.2 ¹⁹	879 ¹⁰⁶	
Cadmium	64	157.25	7.87 ⁴³	c. p. h. (α) b. c. c. (β)	1535 (α-β)		292 ⁴⁰		170 ³	155 ± 3 ³	1579 ¹⁹	3540 ³	8670 ¹⁰⁹
Callium	31	69.72	5.91 ²⁹	orthorh. (α) t. (β)	275.6 (α-β) (at 8.86 × 10 ⁴ mm Hg)	1.091 ⁵ 7.2 ³⁴ (Ca II, high-pressure modification)			317 ³	240 ¹⁴ 125 ⁴	302.93 ⁵ 275.6 ¹³	2510 ³	7620 ²⁷
Germanium	32	72.59	5.36 ²⁹	d. ⁷		5.5 ⁴⁷ (at ~118 kbar) 8.4 ¹⁰⁸			378 ± 22 ³	403 ³	1210.6 ⁵	3100 ³	5642 ¹⁸
Gold	79	196.967	19.3 ⁴²	f. c. c. ⁷					165 ± 1 ³	178 ± 8 ³	1336.2 ^{2,10} 1336.15 ²³	3240 ³	9500 ¹¹ 8060 ¹⁰⁹
Hafnium	72	178.49	13.28 ⁴²	c. p. h. (α) b. c. c. (β)	2023 ± 20 (α-β)	0.16 ³ 0.35 ¹⁰⁸			256 ± 5 ³	213 ²³	2495 ¹⁹	4575 ± 150 ⁴⁰	
Helium	2	4.0026	0.0001785 ²⁹ (at 273.2 K and 1 atm)	c. p. h. ¹⁶						30 ⁴ (at ~15 K)	3.45 ²⁹ 1.8 ± 0.2 ¹⁷ (at 30 atm)	4.216 ¹³ 4.22 ²³	5.3 ²⁵
Holmium	67	164.930	8.80 ²⁹	c. p. h. (α) b. c. c. (β)	Near m. p. (α-β)		20 ⁴	132 ⁴	114 ± 7 ⁴⁶	161 ⁴⁷	1734 ¹⁹	3228 ⁵¹	
Hydrogen	1	1.00797	0.00008987 ²⁹ (at 273.2 K and 1 atm)	c. p. h. ¹⁶						116 (para., 13.8 ± 0.1 ¹⁷ at ~59 K) 105 (ortho., at ~33 K)	20.39 ¹³ 20.37 ²³	20.39 ¹³ 20.37 ²³	33.3 ²⁵
Indium	49	114.82	7.3 ²⁹	f. c. c. ⁷		3.4035 ⁵			106.8 ± 0.3 ³	129 ¹⁴ 108.76 ^{3,110}	429.76 ³ 2279 ± 6 ³	4377 ¹⁰⁹ 7050 ¹⁰⁹	4377 ¹⁰⁹ 7050 ¹⁰⁹
Iodine	53	126.9044	4.93 ²⁹	orthorh. ¹⁸						105 ⁴ (at ~53 K) 101.298.16 ¹⁹ (at 0.31 mm Hg)	386.2 ²⁹ 457.50 ²⁹	457.50 ²⁹	785 ¹⁸
Iridium	77	192.2	22.5 ⁴²	f. c. c. ⁷		0.14 ^{5,9}			425 ± 5 ³	228 ³	2716 ^{3,19}	4820 ± 30 ³	

Name	Atomic Number	Atomic Weight	Density ^b g cm ⁻³ · 10 ⁻³	Crystal Structure	Phase Transition Temp., K	Superconducting Transition Temp., K	Curie Temp., K	Neel Temp., K	Debye Temperature at 0 K, K	Melting Point, K	Boiling Point, K	Critical Temp., K
Iron	26	55.847	7.87 ²⁸	b.c.c.-ferromag. ¹ b.c.c.-paramag. ² f.c.c. ³ b.c.c. ⁴ f.c.c. ⁵	1183 ⁷ (β-γ) 1673 ¹³ (γ-δ)	1043 ⁴⁰	1043 ⁴⁰	373 ³	457 ± 12 ³	1810 ¹⁹	3160 ²⁹	9400 ¹⁰⁹
Krypton	36	83.80	0.003708 ²⁹ (at 273.2 K and 1 atm)	b.c.c. ¹⁶				60 ⁴ (at -30 K)	116.6 ⁵	119.93 ¹³	209.4 ¹⁵	6750 ¹²³
Lanthanum	57	138.91	6.18 ⁴²	Double c.p.h. ¹ f.c.c. ² b.c.c. ³	583 ²⁷ (α-β) 1141 ²⁸ (β-γ)	4.9 ¹ (α) 6.3 ² (β)		135 ± 5 ⁴⁴	142 ± 3 ²²	1193 ⁵	3713 ± 70 ³	10500 ¹⁰⁹
Lawrencium	103	(257)		f.c.c. ²		7.193 ⁵		87 ± 1 ³	102 ± 5 ³	600.576 ^{3,111}	2022 ± 10 ⁴¹	5400 ²⁷ 4760 ¹⁰⁹
Lead	82	207.19	11.34 ²⁹	f.c.c. ¹				448 ³	352 ± 17 ³	453.7 ¹⁹	1599 ¹³	4150 ¹⁰⁹ 3720 ¹⁰⁹
Lithium	3	6.939	0.534 ²⁹	b.c.c. ¹	Martensitic transformation at low temp. ⁵⁴							
Lutetium	71	174.97	9.85 ²⁹	c.p.h. ¹ b.c.c. ²	Near m.p. ⁵⁴ (α-β)			116 ³	210 ⁴⁴	1923 ¹⁹	4140 ³	
Magnesium	12	24.312	1.74 ²⁹	c.p.h. ¹				330 ³	396 ± 54 ³	923 ⁵⁴	1385 ³	3530 ¹⁰⁹
Manganese	25	54.9380	7.43 ²⁸ 7.29 ²⁸ 7.18 ²⁸ (γ)	b.c.c. ¹ c. (β) f.c.c. ² b.c.c. ³ (e)	1000 ¹³ (α-β) 1374 ¹³ (β-γ) 1410 ¹³ (γ-δ)			363 ³	418 ± 32 ³	1517 ± 3 ⁵	2360 ¹³	6050 ¹⁰⁹
Mendelevium	101	(256)										
Mercury	80	200.59	13.546 ²⁹ 14.19 ²⁹ (at 234.25 K) induced structure (β)	r. (α) b.c.t.-pressure induced structure (β)	Martensitic transformation at low temp. ⁵⁴	4.153 ⁵ (α) 3.949 ⁵ (β)		92 ± 8 ³	~ 75 ⁵⁸	234.28 ^{3,10}	629.73 ^{3,10}	1733 ¹⁰⁹ 1705 ¹⁰⁹
Molybdenum	42	95.94	10.24 ⁴²	b.c.c. ²		0.92 ^{5,9}		377 ³	459 ± 11 ³	2883 ¹³	5785 ± 175 ³	17000 ¹⁰⁹ 16800 ¹⁰⁹
Neodymium	60	144.24	7.007 ²⁹	Double c.p.h. ¹ b.c.c. ² (β)	1135 ²⁷ (α-β)			148 ± 8 ³	159 ³	1292 ¹⁹	2956 ⁶⁸	7900 ¹⁰⁹
Neon	10	20.183	0.0009002 ²⁹ (at 273.2 K and 1 atm)	f.c.c. ¹⁶				60 ⁴ (at -30 K)		24.48 ⁵	27.23 ⁵	44.5 ¹⁵ 27.06 ²⁵

Name	Atomic Number	Atomic Weight	Density ^b kg m ⁻³ · 10 ⁻³	Crystal Structure	Phase Transition Temp., K	Superconducting Transition Temp., K	Curie Temp., K	Néel Temp., K	Debye Temperature at 0 K, K	Melting Point, K	Boiling Point, K	Critical Temp., K
Nepthunium	93	(237)	20.46 ⁴²	orthorh. ² (α) r. ² (β) b. c. c. (γ)	551 ² (α-β) 813 ² (β-γ)				121 ³	163 ³	913.2 ⁵	4150 ³
Nichel	28	58.71	8.90 ⁴²	f. c. c. ⁷		631 ⁴⁰			427 ± 14 ⁷	345 ³	1726 ^{3,10} 1726 ± 4 ⁴¹	3055 ⁴³ 6294 ¹⁵ 11750 ¹⁰⁹
Niobium	41	92.906	6.57 ⁴²	b. c. c. ⁷		9.13 ⁷ 9.09 ⁸ 9.1 ⁹			241 ± 13 ³	260 ⁴⁴	2741 ± 27 ³ 2688 ⁶⁵	4813 ⁴⁴ 19000 ¹⁰⁰
Nitrogen	7	14.0067	0.0012506 ²⁸	c. m. ¹¹ (α) h. m. ¹¹ (β)	35.62 ¹¹ (α-β)				70 ⁴ (at -35 K)	63.29 ⁵	77.34 ^{13,23}	126.2 ¹⁵
Nobelium	102	(254)										
Osmium	76	190.2	22.48 ²⁸	c. p. h. ²		0.655 ⁵ 0.65 ⁸			500 ⁴⁷	400 ⁴⁸	3283 ± 10 ⁴⁹	5300 ± 100 ⁷⁰
Oxygen	8	15.9994	0.001429 ²⁸ (at 273.2 K and 1 atm)	b. c. orthorh. ⁷ (α) r. ⁷ (β) c. (γ)	23.876 ± 0.01 ¹¹² (α-β) 43.815 ± 0.01 ¹¹³ (β-γ)				250 ⁴ (at -125 K) 500 ³⁸ (at -250 K)	54.8 ⁵	90.19 ¹² 90.18 ²⁵	154.8 ¹⁵
Palladium	46	106.4	12.02 ²⁸	f. c. c. ²					283 ± 16 ³	275 ¹⁴	1825 ^{3,16}	3200 ³
Phosphorus	15	30.9738	1.82 ²⁸ (β) 2.22 ²⁸ (γ) 2.69 ²⁸ (δ)	h. r. ⁷ (α) b. c. c. ¹ (β) c. (γ)	196 ¹¹ (α-β) 298.16 ¹³ (β-γ) 298.16 ¹³ (β-δ)				193 (white) 576 (white) 317.3 (white) 553 ¹³ 325 (red) 800 (red) 1300 (black)	2042 ^{3,16}	4100 ³ 912.7 ⁵ 3727 ⁷⁵	993.8 ¹⁵
Platinum	78	195.09	21.45 ²⁸	f. c. c. ²					234 ± 1 ³	225 ± 5 ³	2042 ^{3,16}	4100 ³ 8280 ¹⁵
Plutonium	94	(242)	19.737 ²⁹ (at 296.2 K)	Simple monocl. ⁷ (α) b. c. monocl. ² (β) f. c. orthorh. ² (γ) f. c. c. ² (δ) b. c. t. ² (δ') b. c. c. ² (θ)	396.7 ⁷⁵ (α-β) 475 ⁷⁵ (β-γ) 591.4 ⁷⁵ (γ-δ) 729 ⁷⁵ (δ-δ') 757 ± 3 ⁷⁵ (δ'-ε)				171 ¹⁴	176 ¹⁴	912.7 ⁵	3727 ⁷⁵
Polonium	84	(210)	9.3 ²⁹ (α) 9.5 ²⁹ (β)	Simple c. (α) r. (β)	327 ± 1.5 ⁷⁶ (α-β)				81 ³	527.2 ⁵	1235 ²⁰	2281 ¹⁵
Potassium	19	39.102	0.86 ²⁹	b. c. c. ⁷					89.4 ± 0.5 ³	100 ³	336.8 ⁵	1027 ²⁵ 2450 ¹⁰⁶ 2140 ¹⁰⁶
Praseodymium	59	140.907	6.769 ²⁹	Double c. p. h. ⁶ (α) b. c. c. ¹ (β)	1071 ²² (α-β)				85 ± 1 ⁶⁶	138 ⁷⁷	1192 ± 2 ⁷⁹	3616 ⁸⁰ 8900 ¹⁰⁰

Name	Atomic Number	Atomic Weight	Density, ^b kg m ⁻³ · 10 ⁻³	Crystal Structure	Phase Transition Temp., ^c K	Superconducting Transition Temp., ^d K	Curie Temp., ^e K	Néel Temp., ^f K	Debye Temperature at 0 K, ^g K	Debye Temperature at 296 K, ^h K	Melting Point, ⁱ K	Boiling Point, ^j K	Critical Temp., ^k K
Promethium	61	(145)		b. (α) ¹⁰ b. c. c. ²	1185 ¹⁰ (α-β)			6 ¹⁰			1353 ± 10 ⁸¹	2730 ³	
Protactinium	91	(231)	15.37 ⁶²	b. c. c. ²		1.4 ⁹			159 ³	262 ³	1503 ⁵	4680 ³	
Radium	88	(226)							89 ³		973.2 ⁵	1960 ³	
Radon	86	(222)	0.00973 ²⁰ (at 273.2 K and 1 atm)	f. c. c. ¹					400 ⁴ (at ~200 K)		202.2 ⁵	211 ¹³	377.16 ¹⁵
Rhenium	75	186.2	21.1 ⁶²	c. p. h. ²		1.698 ²⁶			429 ± 22 ³	275 ²³	3453 ⁵	6035 ± 135 ³	20000 ¹¹
Rhodium	45	102.905	12.45 ⁶²	f. c. c. ¹	possible transformation at 1373-1473 K ⁸⁷				480 ± 32 ³	350 ³	2233 ^{3,10,82}	3960 ± 60 ³	
Rubidium	37	85.47	1.53 ²⁹	b. c. c. ²					54 ± 4 ³	59 ²³	312.04 ⁵	959 ¹⁶	2100 ¹⁰⁹ 2030 ¹⁰⁹
Ruthenium	44	101.07	12.2 ²⁹	c. p. h. ¹ ? (β) ? (γ) ? (δ)	1308 ^{11,111} (α-β) 1473 ^{11,111} (β-γ) 1773 ^{11,111} (γ-δ)	0.49 ^{5,9}	14 ⁹	106 ⁹	600 ⁶⁷	415 ³	2523 ± 10 ⁶⁹	4325 ± 25 ³	
Samarium	62	150.35	7.54 ²⁹	f. (α) ³² b. c. c. ² (β)	1190 ³² (α-β)				116 ⁶⁵	184 ± 4 ³	1345.2 ²⁸	2140 ³	5400 ¹⁰⁹
Scandium	21	44.956	3.00 ⁶²	c. p. h. ² b. c. c. ² (β)	1607 ² (α-β)				470 ± 80 ⁸¹	476 ³	1812 ⁵	3537 ± 30 ³	
Selenium	34	78.96	4.50 ²⁹ 4.80 ²⁹ (β)	monocl. (α) ¹ h. (β) ¹ amorphous ¹	304 ¹¹⁷ 398 ¹¹ (vitr.-β) 423 ¹¹ (α-β)	7.3 ⁸⁵ (at ~118 kbar)			151.7 ± 0.4 ^{89,99} (at ~45 K) ¹² 150 ¹⁵ (at ~75 K) ¹⁵	490.2 ⁵	1009 ¹¹ (Se ₄) 958.0 ¹² (Se ₄ , 3T) ¹² 1027 ¹⁵ (Se ₂) ¹⁵	1757 ¹⁵	
Silicon	14	28.086	2.33 ⁶²	d. ¹		7.5 ⁶⁷ (at 118-126 kbar)			647 ± 11 ³	692 ³	1685 ± 2 ⁸⁷	2753 ²⁸	5159 ¹⁵
Silver	47	107.870	10.5 ²⁹	f. c. c. ²					228 ± 3 ³	221 ³	1234.0 ^{3,13}	2468 ± 15 ⁴¹	7460 ¹¹
Sodium	11	22.9898	0.9712 ²⁹	b. c. c. ²	Martensitic transformation at low temp. ⁸⁴				157 ± 1 ³	155 ± 5 ³	371.0 ¹⁵	1154 ³⁵	2800 ¹¹ 2400 ¹⁰⁹
Strontium	38	87.62	2.60 ²⁹	f. c. c. ¹ (α) c. p. h. ¹ (β) b. c. c. ² (γ)	488 ¹⁰ (α-β) 878 ¹⁰ (β-γ)				147 ± 1 ²²	148 ²³	1042 ⁵	1645 ³	3059 ¹⁵ 3810 ¹⁰⁹
Sulfur	16	32.064	2.07 ²⁹ (α) 1.96 ²⁹ (β)	r. (α) ¹ monocl. (β)	368.6 ¹³ (α-β)				200 ³	527 ¹⁸ (α) 250 ¹⁸ (β) at 40 K Subl. 368.6 ¹² (at 0.0047 mm Hg)	386.0 ⁵ (α) 392.2 ⁵ (β)	717.75 ^{5,10} 1313 ¹⁵	
Tantalum	73	180.948	16.6 ⁶²	b. c. c. ²		4.48 ¹ 4.48 ⁷			247 ± 13 ³	225 ¹⁴	3269 ⁵	5760 ± 60 ³	22000 ¹¹

Name	Atomic Number	Atomic Weight	Density, ^b kg m ⁻³ · 10 ⁻³	Crystal Structure	Phase Transition Temp., K	Superconducting Transition Temp., K	Neel Temp., K	Debye Temperature at 0 K, K	Temperature at 298 K, K	Melting Point, K	Boiling Point, K	Critical Temp., K
Technetium	43	(99)	11.50 ²⁹	c.p.h. ²		8.22 ⁵ 11.2 ⁹		351 ³	422 ³	2473 ± 50 ⁵	5300 ³	
Tellurium	52	127.60	6.24 ²⁹ 6.00 ⁵ (amorph.)	h. ¹ (α) γ ¹ (β) ¹	621 ¹³ (α-β)	3.3 ⁵ (Te II, at 56 kbar)		141 ± 12 ³		722.7 ⁵	1163 ± 1 ³	2329 ¹⁵
Terbium	55	158.924	8.25 ²⁹	c.p.h. ² ₁ ² (α) amorph. ⁵ b.c.c. ² (β)	Near m.p. ² (α-β)		230 ¹⁰	150 ¹¹	138 ¹⁴	1629 ¹⁹	3810 ³	
Thallium	81	204.37	11.85 ²⁹	c.p.h. ² ₁ ² (α) b.c.c. ² (β)	508.3 ⁵ (α-β)	2.39 ⁵ 2.38 ⁹ 2.37 ⁹		88 ± 1 ³	96 ¹⁴	576.2 ¹⁹	1939 ²²	3219 ¹⁵
Thorium	90	232.038	11.7 ²⁹	f.c.c. ² (α) b.c.c. ² (β)	1673 ± 25 ¹⁰ (α-β)	1.368 ⁵ 1.37 ⁹		170 ¹⁴	100 ¹⁴	2023 ¹⁹	4500 ²⁶	14550 ¹⁰⁰
Thulium	69	168.934	9.32 ²⁹	c.p.h. ² (α) b.c.c. ² (β)	Near m.p. ¹⁰ (α-β)		53 ¹⁰	127 ± 1 ⁴⁵	167 ⁴⁴	1818 ⁵	2266 ²⁷	6430 ¹⁰⁰
Tin	50	118.69	5.750 ²⁹ 7.31 ²⁹ (β)	f.c.c. ¹ (α) b.c.t. ¹ (β) r. ¹ (γ)	286.2 ± 3 ¹⁰ (α-β)	3.722 ⁵ (β)		236 ± 24 ³ (gray) 196 ± 9 ³ (white)	254 ³ (gray) 170 ¹⁴ (white)	505.06 ^{3,10} 2766 ± 14 ³	6000 ± 200 ³	8000 ¹¹ 9300 ¹⁰⁰
Titanium	22	47.90	4.5 ²⁹	c.p.h. ¹ (α) b.c.c. ² (β)	1155 ¹³ (α-β)	0.39 ^{5,9}		426 ± 5 ³	390 ¹⁴	1963 ¹⁰⁰	3586 ¹⁰⁰	
Tungsten	74	183.85	19.3 ²⁹	b.c.c. ²		0.011 ^{12a}		388 ± 17 ³	312 ± 3 ³	3653 ^{3,10,13}	6000 ± 200 ³	23000 ¹¹
Uranium	92	238.03	19.07 ²⁹	orthorh. ¹ (α) t. ¹ (β) b.c.c. ² (γ)	37 ± 2 ¹⁰ (α-γ) 939 ¹⁰ (α-β) 1049 ¹⁰ (β-γ)	0.68 ⁵ (α) 1.80 ⁵ (γ)		200 ¹⁴	300 ³	1405.6 ± 0.6 ¹⁰¹	2950 ± 250 ¹⁰²	12500 ³⁷ 12000 ¹⁰⁰
Vanadium	23	50.942	6.1 ²⁹	b.c.c. ²		5.3 ⁵ 5.03 ⁹		326 ± 54 ³	390 ¹⁴	2182 ± 2 ⁶¹	3582 ± 42 ³	11200 ¹⁰⁰
Xenon	54	131.30	0.005851 ²⁹ (at 273.2 K and 1 atm)	f.c.c. ¹⁰						161.2 ²⁵	165.1 ¹³	289.75 ¹⁵
Ytterbium	70	173.04	7.02 ²⁹	f.c.c. ²² (α) b.c.c. ²² (β)	1071 ^{5,1} (α-β)			118 ¹⁰⁰		1097 ¹²	1970 ³	4420 ¹⁰⁰
Yttrium	39	88.905	4.47 ²⁹	c.p.h. ²² (α) b.c.c. ²² (β)	1753 ¹¹⁹ (α-β)			268 ± 32 ³	214 ¹⁰⁴	1793 ¹¹⁹	3670 ¹⁰⁰	8950 ¹⁰⁰
Zinc	30	65.37	7.140 ²⁹	c.p.h. ²		0.875 ⁵ 0.85 ⁹		316 ± 20 ³	237 ± 3 ³	692.655 ^{3,119}	1175 ¹⁰⁴	2139 ¹⁵ 2910 ¹⁰⁰
Zirconium	40	91.22	6.57 ²⁹	c.p.h. ¹ (α) b.c.c. ² (β)	1135 ¹³ (α-β)	0.546 ⁵ 0.55 ⁹		289 ± 24 ³	250 ¹⁴	2135 ¹⁸	4650 ²⁶	12300 ¹⁰⁰

REFERENCES

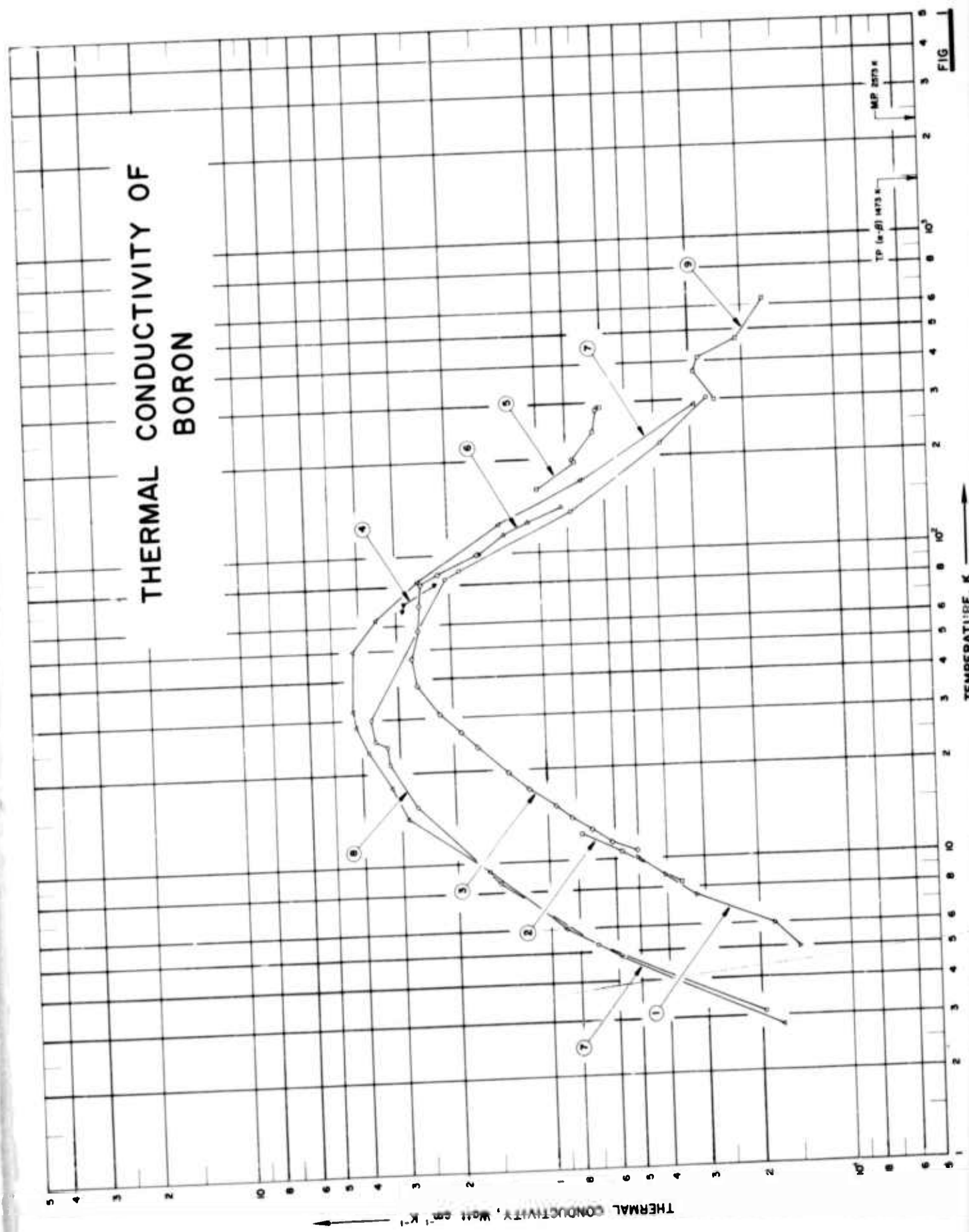
(Crystal Structures, Transition Temperatures, and Other Pertinent Physical Constants of the Elements)

1. Farr, J. D., Giorgi, A. L., and Bowman, M. G., USAEC Rept. LA-1545, 1-13, 1953.
2. Elliott, R. P., Constitution of Binary Alloys, 1st Suppl., McGraw-Hill, 1965.
3. Gschneider, K. A., Jr., Solid State Physics (Sletzer, F. and Turnbull, D., Editors), 16, 275-426, 1964.
4. Gopal, E. S. R., Specific Heat at Low Temperatures, Plenum Press, 1966.
5. Weast, R. C. (Editor), Handbook of Chemistry and Physics, 47th Ed., The Chemical Rubber Co., 1966-67.
6. Foster, K. W. and Fauble, L. G., J. Phys. Chem., 64, 958-60, 1960.
7. The Institution of Metallurgists, Annual Yearbook, pp. 68-73, 1960-61.
8. Meaden, G. T., Electrical Resistance of Metals, Plenum Press, 1965.
9. Matthias, B. T., Geballe, T. H., and Compton, V. B., Rev. Mod. Phys., 35, 1-22, 1963.
10. Stimson, H. F., J. Res. NBS, 42, 209, 1949.
11. Grosse, A. V., Rev. Hautes Tempér. et Réfract., 3, 115-46, 1966.
12. Spedding, F. H. and Daane, A. H., J. Metals, 6 (5), 504-10, 1954.
13. Rossini, F. D., Wagman, D. D., Evans, W. H., Levine, S., and Jaffe, I., NBS Circ. 500, 537-822, 1952.
14. deLaunay, J., Solid State Physics, 2, 213-303, 1956.
15. Gates, D. S. and Thodos, G., AIChE J., 6 (1), 50-4, 1960.
16. Gray, D. E. (Coordinating Editor), American Institute of Physics Handbook, McGraw-Hill, 1957.
17. Sasaki, K. and Sekito, S., Trans. Electrochem. Soc., 59, 437-60, 1931.
18. Anderson, C. T., J. Am. Chem. Soc., 52, 2296-300, 1930.
19. Trombe, F., Bull. Soc. Chim. (France), 20, 1010-2, 1953.
20. Stull, D. R. and Sinke, G. C., Thermodynamic Properties of the Elements in Their Standard State, American Chemical Soc., 1956.
21. Ringk, E., Ann. Chim. (Paris), 18 (10), 455-531, 1932.
22. Roberts, L. M., Proc. Phys. Soc. (London), B70, 738-43, 1957.
23. Zemansky, M. W., Heat and Thermodynamics, 4th Ed., McGraw-Hill, 1957.
24. Martin, A. J. and Moore, A., J. Less-Common Metals, 1, 85, 1959.
25. Hill, R. W. and Smith, P. L., Phil. Mag., 44 (7), 636-44, 1953.
26. Moffatt, W. G., Pearsall, G. W., and Wulff, J., The Structure and Properties of Materials, Vol. I, pp. 205-7, 1964.
27. Grosse, A. V., Temple Univ. Research Institute Rept., 1-40, 1960.
28. Lyman, T. (Editor), Metals Handbook, Vol. 1, 8th Ed., American Soc. for Metals, 1961.
29. Lange, N. A. (Editor), Handbook of Chemistry, Revised 10th Edition, McGraw-Hill, 1967.
30. Paule, R. C., Dissertation Abstr., 22, 4200, 1962.
31. Burk, D. L. and Friedberg, S. A., Phys. Rev., 111 (5), 1275-82, 1958.
32. Spedding, F. H. and Daane, A. H. (Editors), The Rare Earths, John Wiley, 1961.
33. McHargue, C. J., Yakel, H. L., and Letter, C. K., ACTA Cryst., 10, 832-33, 1957.
34. Arajs, S. and Colvin, R. V., J. Less-Common Metals, 4, 159-68, 1962.
35. Bonilla, C. F., Sawhney, D. L., and Makansi, M. M., Trans. Am. Soc. Metals, 55, 877, 1962.
36. Rosenberg, H. M., Low Temperature Solid State Physics, Oxford at Clarendon Press, 1965.
37. Arajs, S., J. Less-Common Metals, 4, 46-51, 1962.
38. Edwards, A. R. and Johnstone, S. T. M., J. Inst. Metals, 84 (8), 313-7, 1956.
39. Lagneborg, R. and Kaplow, R., ACTA Metallurgica, 15 (1), 13-24, 1967.
40. Kittel, C., Introduction to Solid State Physics, 3rd Ed., John Wiley, 1967.
41. Kirshenbaum, A. D. and Cahill, J. A., J. Inorg. and Nucl. Chem., 25 (2), 232-34, 1963.
42. Touloukian, Y. S. (Ed.), Thermophysical Properties of High Temperature Solid Materials, MacMillan, Vol. 1, 1967.
43. Griffel, M., Skochdopole, R. E., and Spedding, F. H., J. Chem. Phys., 25 (1), 75-9, 1956.
44. Gschneidner, K. A., Jr., Rare Earth Alloys, Van Nostrand, 1961.
45. Dreyfus, B., Goodman, B. B., Lacaze, A., and Trolliet, G., Compt. Rend., 253, 1764-6, 1961.

46. Spedding, F.H., Hanak, J.J., and Daane, A.H., *Trans. ADME*, 212, 379, 1958.
47. Buckel, W. and Wittig, J., *Phys. Lett. (Netherlands)*, 17 (3), 187-8, 1965.
48. Deardorff, D.K. and Kata, H., *Trans. ADME*, 215, 876-7, 1959.
49. Panish, M.B. and Reif, L., *J. Chem. Phys.*, 38 (1), 253-6, 1963.
50. Miller, A.E. and Daane, A.H., *Trans. AP'E*, 230, 568-72, 1964.
51. Spedding, F.H. and Daane, A.H., *USAEC Rept. IS-350*, 22 4, 1961.
52. Montgomery, H. and Pells, G.P., *Proc. Phys. Soc. (London)*, 78, 622-5, 1961.
53. Kaufman, L. and Clougherty, E.V., *ManLabs, Inc., Semi-Annual Rept. No. 2*, 1963.
54. Lounasmaa, O.V., *Proc. 3rd Rare Earth Conf.*, 1963, Gordon and Breach, New York, 1964.
55. Baker, H., *WADC TR 57-194*, 1-24, 1957.
56. Reed, R.P. and Breedis, J.F., *ASTM STP 387*, pp. 60-132, 1966.
57. Hansen, M., *Constitution of Binary Alloys*, 2nd Edition, McGraw-Hill, p. 1268, 1958.
58. Smith, P.L., *Conf. Phys. Basses Temp.*, *Inst. Intern. du Froid, Paris*, 281, 1956.
59. Powell, R.W. and Tye, R.P., *J. Less-Common Metals*, 3, 202-15, 1961.
60. Yamamoto, A.S., Lundin, C.E., and Nachman, J.F., *Denver Res. Inst. Rept.*, NP-11023, 1961.
61. Oriena, R.A. and Jones, T.S., *Rev. Sci. Instr.*, 25, 248-51, 1954.
62. Smith, J.F., Carlson, O.N., and Vest, R.W., *J. Electrochem. Soc.*, 103, 409-13, 1956.
63. Edwards, J.W. and Marshal, A.L., *J. Am. Chem. Soc.*, 62, 1382, 1940.
64. Morin, F.J. and Malta, J.P., *Phys. Rev.*, 129 (3), 1115-20, 1963.
65. Pendleton, W.N., *ASD-TDR-63-164*, 1963.
66. Woerner, P.F. and Wakefield, G.F., *Rev. Sci. Instr.*, 33 (12), 1456-7, 1962.
67. Walcott, N.M., *Conf. Phys. Basses Temp.*, *Inst. Intern. du Froid, Paris*, 286, 1956.
68. White, G.K. and Woods, S.B., *Phil. Trans. Roy. Soc. (London)*, A251 (995), 273-302, 1959.
69. Douglass, R.W. and Adkins, E.F., *Trans. ADME*, 221, 248-9, 1961.
70. Panish, M.B. and Reif, L., *J. Chem. Phys.*, 37 (1), 128-31, 1962.
71. Bridgman, P.W., *J. Am. Chem. Soc.*, 36 (7), 1344-63, 1914.
72. Slack, G.A., *Phys. Rev.*, A139 (2), 507-15, 1965.
73. Sandenaw, T.A. and Gibney, R.B., *J. Phys. Chem. Solids*, 6 (1), 81-8, 1958.
74. Sandenaw, T.A., Olsen, C.E., and Gibney, R.B., *Plutonium 1960, Proc. 2nd Intern. Conf. (Grisson, E., Lord, W.B.H., and Fowler, R.D., Editors)*, 66-79, 1961.
75. Mulford, R.N.R., *USAEC Rept. LA-2913*, 1-11, 1963.
76. Goode, J.M., *J. Chem. Phys.*, 26 (5), 1269-71, 1957.
77. Cable, J.W., Moon, R.M., Koehler, W.C., and Wollan, E.O., *Phys. Rev. Letters*, 12 (20), 553-5, 1964.
78. Murao, T., *Progr. Theoret. Phys. (Kyoto)*, 20 (3), 277-86, 1958.
79. Grigor'ev, A.T., Sokolovskaya, E.M., Budennaya, L.D., Iyutina, I.A., and Maksimona, M.V., *Zhur. Neorg. Khim.*, 1, 1052-63, 1956.
80. Daane, A.H., *USAEC AECD-3209*, 1950.
81. Welgel, F., *Angew. Chem.*, 75, 451, 1963.
82. Nassau, K. and Broyer, A.M., *J. Am. Ceram. Soc.*, 45 (10), 474-8, 1962.
83. McKeown, J.J., *State Univ. of Iowa, Ph.D. Dissertation*, 1-113, 1958.
84. Abdullaev, G.B., Mekhtiyeva, S.I., Abdinov, D.Sh., and Alliev, G.M., *Phys. Letters*, 23 (3), 215-6, 1966.
85. Wittig, J., *Phys. Rev. Letters*, 15 (4), 159, 1965.
86. Fukuroi, T. and Muto, Y., *Tohoku Univ. Res. Inst. Sci. Rept.*, A8, 213-22, 1956.
87. Olette, M., *Compt. Rend.*, 244, 1033-6, 1957.
88. Sheldon, E.A., and King, A.J., *ACTA Cryst.*, 6, 100, 1953.
89. Eastman, E.D. and McGavock, W.C., *J. Am. Chem. Soc.*, 59, 145-51, 1937.
90. Arajs, S. and Colvin, R.V., *Phys. Rev.*, A136 (2), 439-41, 1964.
91. Roach, P.R. and Lounasmaa, O.V., *Bull. Am. Phys. Soc.*, 7, 408, 1962.
92. Shchukarev, S.A., Semenov, G.A., and Rat'kovskid, I.A., *Zh. Neorgan. Khim.*, 7, 469, 1962.
93. Pearson, W.B., *A Handbook of Lattice Spacings and Structures of Metals and Alloys*, Pergamon Press, 1953.

94. Smith, P.L. and Walcott, N.M., *Conf. Phys. Basses Temp., Inst. Intern. du Froid*, 283, 1956.
95. Davis, D.D. and Bozorth, R.M., *Phys. Rev.*, 118 (6), 1543-5, 1960.
96. Aliev, N.G. and Volkenstein, N.V., *Soviet Physics - JETP*, 22 (5), 997-8, 1966.
97. Spedding, F.H., Barton, R.J., and Daane, A.H., *J. Am. Chem. Soc.*, 79, 5160, 1957.
98. Raynor, G.V. and Smith, R.W., *Proc. Roy. Soc. (London)*, A244, 101-9, 1958.
99. Savitskiĭ, E.M. and Burhkanov, G.S., *Zhur. Neorg. Khim.*, 2, 2609-16, 1957.
100. Argent, B.B. and Milne, J.G.C., *Niobium, Tantalum, Molybdenum and Tungsten*, Elsevier Publ. Co. (Quarrell, A.G., Editor), pp. 160-8, 1961.
101. Argonne National Laboratory, USAEC Rept. ANL-5717, 1-67, 1957.
102. Holden, A.N., *Physical Metallurgy of Uranium*, Addison-Wesley, 1958.
103. Lounasmaa, O.V., *Phys. Rev.*, 129, 2460-4, 1963.
104. Jennings, L.D., Miller, R.E., and Spedding, F.H., *J. Chem. Phys.*, 33 (6), 1849-52, 1960.
105. Ackerman, R.J. and Rauh, E.G., *J. Chem. Phys.*, 36 (2), 448-52, 1962.
106. Rosenblatt, G.M. and Birchenall, C.E., *J. Chem. Phys.*, 35 (3), 788-94, 1961.
107. Streib, W.E., Jordan, T.H., and Lipscomb, W.N., *J. Chem. Phys.*, 37 (12), 2962-5, 1962.
108. Samsonov, G.V. (Editor), *Handbook of the Physicochemical Properties of the Elements*, Plenum Press, 1968.
109. Kopp, I.Z., *Russ. J. Phys. Chem.*, 41 (6), 782-3, 1967.
110. Stimson, H.F., in *Temperature, Its Measurement and Control in Science and Industry* (Herzfeld, C.M., Ed.), Vol. 3, Part 1, Reinhold, New York, pp. 59-66, 1962.
111. McLaren, E.H., in *Temperature, Its Measurement and Control in Science and Industry* (Herzfeld, C.M., Ed.), Vol. 3, Part 1, Reinhold, New York, pp. 185-98, 1962.
112. Orlova, M.P., in *Temperature, Its Measurement and Control in Science and Industry* (Herzfeld, C.M., Ed.), Vol. 3, Part 1, Reinhold, New York, pp. 179-83, 1962.
113. Grosse, A.V., *J. Inorg. Nucl. Chem.*, 28, 2125-9, 1966.
114. Hochman, J.M. and Bonilla, C.F., in *Advances in Thermophysical Properties at Extreme Temperatures and Pressures* (Gratch, S., Ed.), ASME 3rd Symposium on Thermophysical Properties, Purdue University, March 22-25, 1965, ASME, pp. 122-30, 1965.
115. Dillon, I.G., *Illinois Institute of Technology, Ph.D. Thesis*, June 1965.
116. Hochman, J.M., Silver, I.L., and Bonilla, C.F., USAEC Rept. CU-2660-13, 1964.
117. Abdullaev, G.B., Mekhtieva, S.I., Abidinov, D.Sh., Aliev, G.M., and Alieva, S.G., *Phys. Status Solidi*, 13(2), 315-23, 1966.
118. Fisher, E.S. and Dover, D., *Phys. Rev.*, 2, 170(3), 607-13, 1968.
119. Beaudry, B.J., *J. Less-Common Metals*, 14(3), 570-2, 1968.
120. Williams, R.K. and McElroy, D.L., USAEC Rept. ORNL-TM 1424, 1-32, 1966.
121. Jaeger, F.M. and Rosenbaum, E., *Proc. Nederland Akademie van Wetenschappen*, 44, 144-52, 1941.
122. Gibson, J.W. and Hein, R.A., *Phys. Letters*, 12(25), 688-90, 1964.
123. Grosse, A.V., *Research Institute of Temple Univ., Report on USAEC Contract No. AT (80-1) -2082, 1-71, 1965.*

THERMAL CONDUCTIVITY OF BORON



SPECIFICATION TABLE NO. 1 THERMAL CONDUCTIVITY OF BORON

[For Data Reported in Figure and Table No. 1]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	790	L	1963	5-10			99.9 B (by difference), 0.1 C; cylindrical specimen 0.26 cm average diameter 3.8 cm long made from single crystal of the beta-rhombohedral phase, provided by Texaco Experiment Inc.; density $2.342 \pm 0.005 \text{ g cm}^{-3}$; electrical resistivity $> 5 \times 10^6 \text{ ohm cm}$ at room temperature; Debye temperature 1219 K.
2	790	L	1963	8-12			Rerun of the above specimen.
3	790	L	1963	10-100			Rerun of the above specimen.
4	790	L	1963	67-80			Rerun of the above specimen.
5	790	L	1963	162-290			Rerun of the above specimen.
6	790	L	1963	100-140			Rerun of the above specimen.
7	776	L	1965	2.8-291		R4	Major impurities: $10 \times 10^{18} \text{ Si}$, $20 \times 10^{18} \text{ Al}$, $20 \times 10^{18} \text{ Mn}$, $6 \times 10^{18} \text{ Ti}$, and $4 \times 10^{18} \text{ Cu}$ atoms cm^{-3} , also about 0.1% (by volume) of precipitated particles 5-50 μ in diameter (probably of boron nitride, silicon inclusions or small voids); polycrystalline with numerous columnar crystals of β -rhombohedral phase 1 cm long 0.3 cm average diameter; specimen 3.8 cm long 0.7 cm average diameter grown by partially purified boron by General Electric Research Lab.; density 2.33 g cm^{-3} .
8	776	L	1965	3.1-305		R46	As above but composed of columns 2 cm long 0.1 cm average diameter; specimen 2.6 cm long, 0.6 cm average diameter; provided by Eagle-Picher Research Lab, Miami, Okla. (crystal reference No. M6005CP); grown from the melt by floating zone process.
9	335		1965	300-630			No details reported.
10	1009	R	1959	293, 353			99.7 B, 0.7 W, and 0.02 total of Ca, Cu, Fe, Mg, and Si; polycrystalline specimen 1 mm in dia and several cm long with a 0.025 mm; tungsten filament at the center amounting to about 0.7% by weight; prepared by the reduction of boron tribromide by hydrogen near the tungsten filament at about 1250 C; data reported as the average for the range 20 to 80 C.

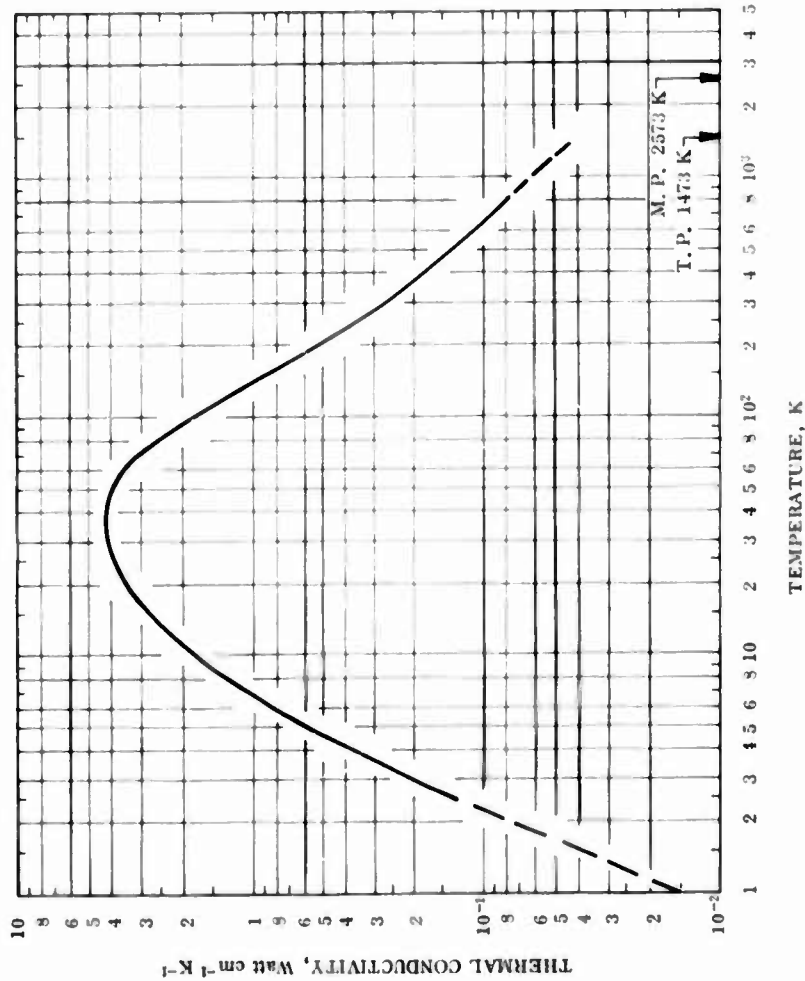
DATA TABLE NO. 1 THERMAL CONDUCTIVITY OF BORON

[Temperature, T, K, Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k
<u>CURVE 1</u>					
5.00	0.148	196.6	0.745*	84.0	2.05
5.97	0.1793	197.1	0.763	89.0	1.85
7.50	0.320	242.0	0.648	135.0	0.78
8.80	0.405	285.4	0.630	220.0	0.35
10.09	0.501	290.0	0.608	305.0	0.265
		290.1	0.616		
<u>CURVE 2</u>					
8.31	0.357	<u>CURVE 6</u>			
10.54	0.570	100.6	1.595	300	0.25
12.21	0.773	116.2	1.304	370	0.29
		126.9	1.095	410	0.28
		140.9	0.840	470	0.21
				630	0.17
<u>CURVE 3</u>					
10.61	0.502	<u>CURVE 7</u>			
11.44	0.613	2.8	0.17	293	0.0126
12.60	0.712	4.8	0.58	353	0.0126
13.82	0.834	6.0	0.89		
15.07	0.936	9.4	1.57		
17.23	1.115	14.2	2.85		
19.57	1.335	18.0	3.21		
23.95	1.674	23.5	3.80		
26.88	1.893	26.5	4.15		
30.75	2.205	32.0	4.25		
38.06	2.595	50.0	4.20		
46.92	2.688	63.0	3.50		
57.53	2.546	83.0	2.52		
79.23	2.515	125.0	1.35		
80.86	2.476	170.0	0.715		
86.86	2.157	291.0	0.29		
99.74	1.612				
<u>CURVE 4</u>					
66.70	2.85	3.1	0.195		
70.36	2.80	5.3	0.700		
80.54	2.219	8.6	1.450		
		15.5	2.65		
		21.5	3.25		
		24.5	3.30		
		25.5	3.60		
		30.0	3.70		
<u>CURVE 5</u>					
161.8	1.019				
194.4	0.747				

* Not shown on plot

FIGURE AND TABLE NO. 1R RECOMMENDED THERMAL CONDUCTIVITY OF BORON



REMARKS

The recommended values are for high-purity boron. The values that are supported by experimental thermal conductivity data are thought to be accurate to within 5% of the true values near room temperature and 5 to 10% at other temperatures above 80 K. The thermal conductivity near and below the corresponding temperature of its maximum is highly sensitive to small physical and chemical variations of the specimens, and the values below 80 K are intended as typical values for indicating the general trend.

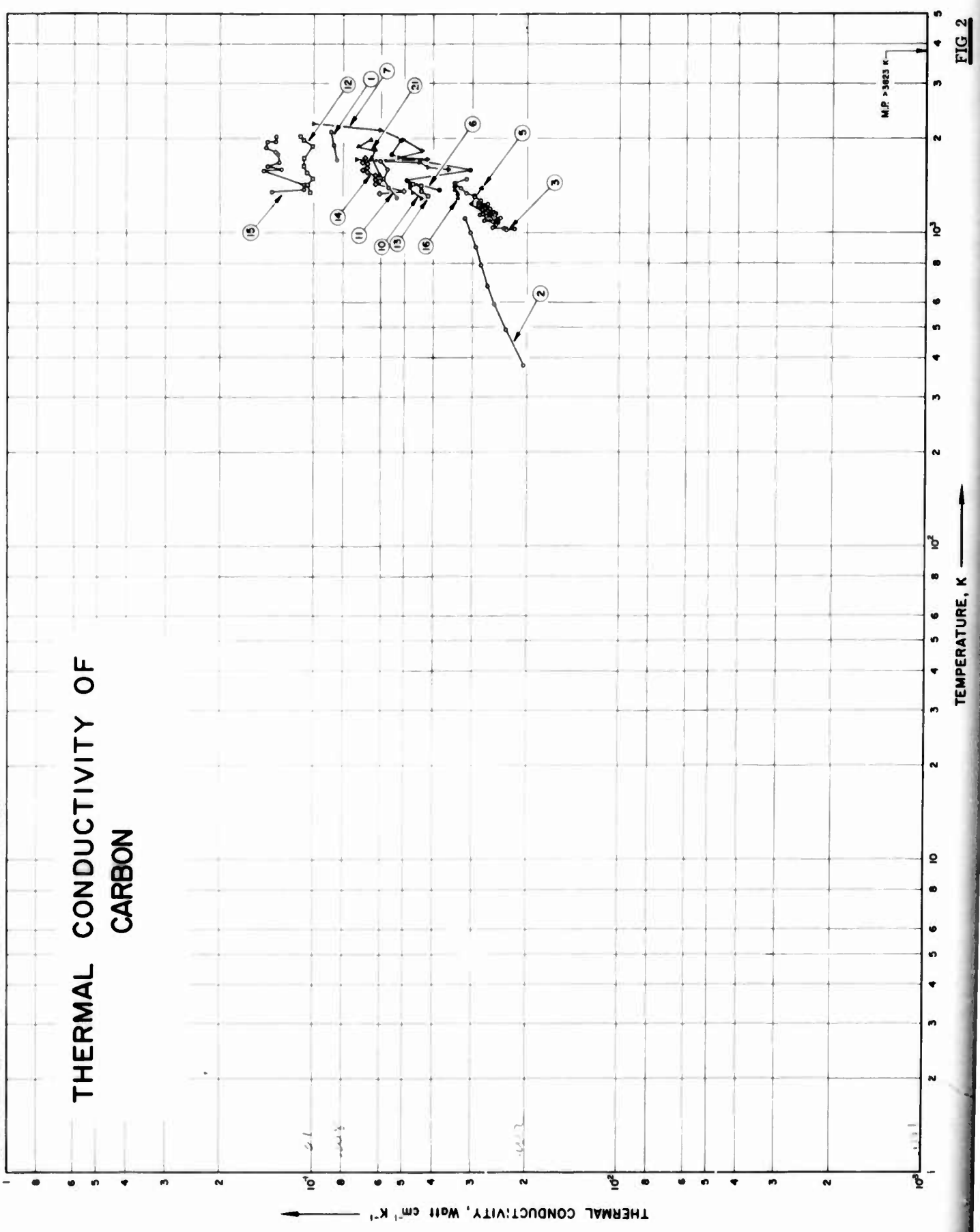
* T_1 in K, k_1 in $\text{Watt cm}^{-1} \text{K}^{-1}$, T_2 in F, and k_2 in $\text{Btu hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$.

† Values in parentheses are extrapolated.

RECOMMENDED VALUES* (For Polycrystalline)									
T_1	k_1	k_2	T_2	T_1	k_1	k_2	T_2	T_1	T_2
0	0	0	-459.7	500	0.141	8.15	440.3		
1	(0.0150)†	(0.867)	-457.9	600	0.113	6.53	620.3		
2	(0.0781)	(4.31)	-456.1	700	(0.0941)	(5.44)	806.3		
3	0.198	11.4	-454.3	800	(0.0809)	(4.67)	980.3		
4	0.375	21.7	-452.5	900	(0.0708)	(4.09)	1160		
5	0.588	34.0	-450.7	1000	(0.0629)	(3.63)	1340		
6	0.826	47.7	-448.9	1100	(0.0569)	(3.29)	1520		
7	1.07	61.8	-447.1	1200	(0.0518)	(2.99)	1700		
8	1.31	75.7	-445.3	1300	(0.0472)	(2.73)	1880		
9	1.54	89.0	-443.5	1400	(0.0437)	(2.52)	2060		
10	1.77	102	-441.7						
11	1.98	114	-439.9						
12	2.19	127	-438.1						
13	2.39	138	-436.3						
14	2.58	149	-434.5						
15	2.76	159	-432.7						
16	2.93	169	-430.9						
18	3.22	186	-427.3						
20	3.46	200	-423.7						
25	3.92	226	-414.7						
30	4.21	243	-405.7						
35	4.30	248	-396.7						
40	4.28	247	-387.7						
45	4.19	242	-378.7						
50	4.04	233	-369.7						
60	3.63	210	-351.7						
70	3.10	179	-333.7						
80	2.63	152	-315.7						
90	2.24	129	-297.7						
100	1.90	110	-279.7						
150	0.910	52.6	-189.7						
200	0.525	30.3	-99.7						
250	0.363	21.0	9.7						
273.2	0.317	18.3	32.0						
300	0.276	15.9	80.0						
350	0.224	12.9	170.3						
400	0.187	10.8	260.3						

FIGURE SHOWS ONLY 14 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF CARBON



SPECIFICATION TABLE NO. 2 THERMAL CONDUCTIVITY OF CARBON

[For Data Reported in Figure and Table No. 2]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	16	E	1914	1700-2100		Petroleum Coke	Pure; untreated carbon filament.
2	17	R	1951	377-1107		1	Petroleum coke electrode; tubular, 6 in. O. D., 1.5 in. I. D., 2.25 in. long.
3	18	R	1939	1023-1477		2	80% petroleum coke; 20% lampblack; baked at approx 1100 C.
4	18	R	1939	1033-1290		3	Similar to the above specimen.
5	18	R	1939	1076-1394		4	Similar to the above specimen.
6	18	R	1939	1373-1963		5	Similar to the above specimen.
7	18	R	1939	1598-2238		Lampblack	Compressed under 10 lb in. ⁻² from 0.375 in. to 0.25 in. thick; specimen previously used in a high temp neutron absorption experiment.
8	159	L	1955	373.2		Lampblack	Specimen 0.476 in. thick; specific gravity 0.165; prepared from Eagle brand German-town lampblack.
9	108	L	1920	313.368			
10	367	R	1963	1293-1433			Prepared by mixing 50 parts 65/100 mesh and 50 parts < 2 mesh soft filler (soft Texas coke), and 40 parts soft binder (M-30 pitch); extruded to 0.5 in. dia; baked for 4 days to 1000 C; heat treated at 1200 C for 10 min; densely after baking 1.55 g cm ⁻³ ; measured in an argon atmosphere (approx one atmosphere pressure).
11	367	R	1963	1293-1718			The above specimen heat treated at 1500 C for 10 min.
12	367	R	1963	1343-2033			The above specimen heat treated at 1800 C for 10 min.
13	367	R	1963	1318-1438			Prepared by mixing 50 parts 65/100 mesh and 50 parts 200/270 mesh soft filler (soft Texas coke), and 35 parts hard binder (phenol benzaldehyde); extruded to 0.5 in. dia; baked for 4 days to 1000 C; heat treated at 1200 C for 10 min; density after baking 1.56 g cm ⁻³ ; measured in an argon atmosphere (approx one atmosphere pressure).
14	367	R	1963	1338-1738			The above specimen heat treated at 1500 C for 10 min.
15	367	R	1963	1353-2038			The above specimen heat treated at 1800 C for 10 min.
16	367	R	1963	1293-1418			Prepared by mixing 50 parts 100/150 mesh and 50 parts < 270 mesh hard filler (phenol formaldehyde), and 45 parts soft binder (M-30 pitch); extruded to 0.5 in. dia; baked for 4 days to 1000 C; heat treated at 1200 C for 10 min; density after baking 1.14 g cm ⁻³ ; measured in an argon atmosphere (approx one atmosphere pressure).
17	367	R	1963	1293-1675			The above specimen heat treated at 1500 C for 10 min.
18	367	R	1963	1298-1938			The above specimen heat treated at 1800 C for 10 min.

SPECIFICATION TABLE NO. 2 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
19	367	R	1963	1273-1428			Prepared by mixing 50 parts 100/150 mesh and 50 parts <270 mesh hard filler (phenol formaldehyde), and 43 parts hard binder (phenol benzaldehyde); extruded to 0.5 in. dia; baked for 4 days to 1000 C; heat treated at 1200 C for 10 min; density after baking 1.22 g cm ⁻³ , measured in an argon atmosphere (approx. one atmosphere pressure).
20	367	R	1963	1318-1718			The above specimen heat treated at 1500 C for 10 min.
21	367	R	1963	1373-1988			The above specimen heat treated at 1800 C for 10 min.

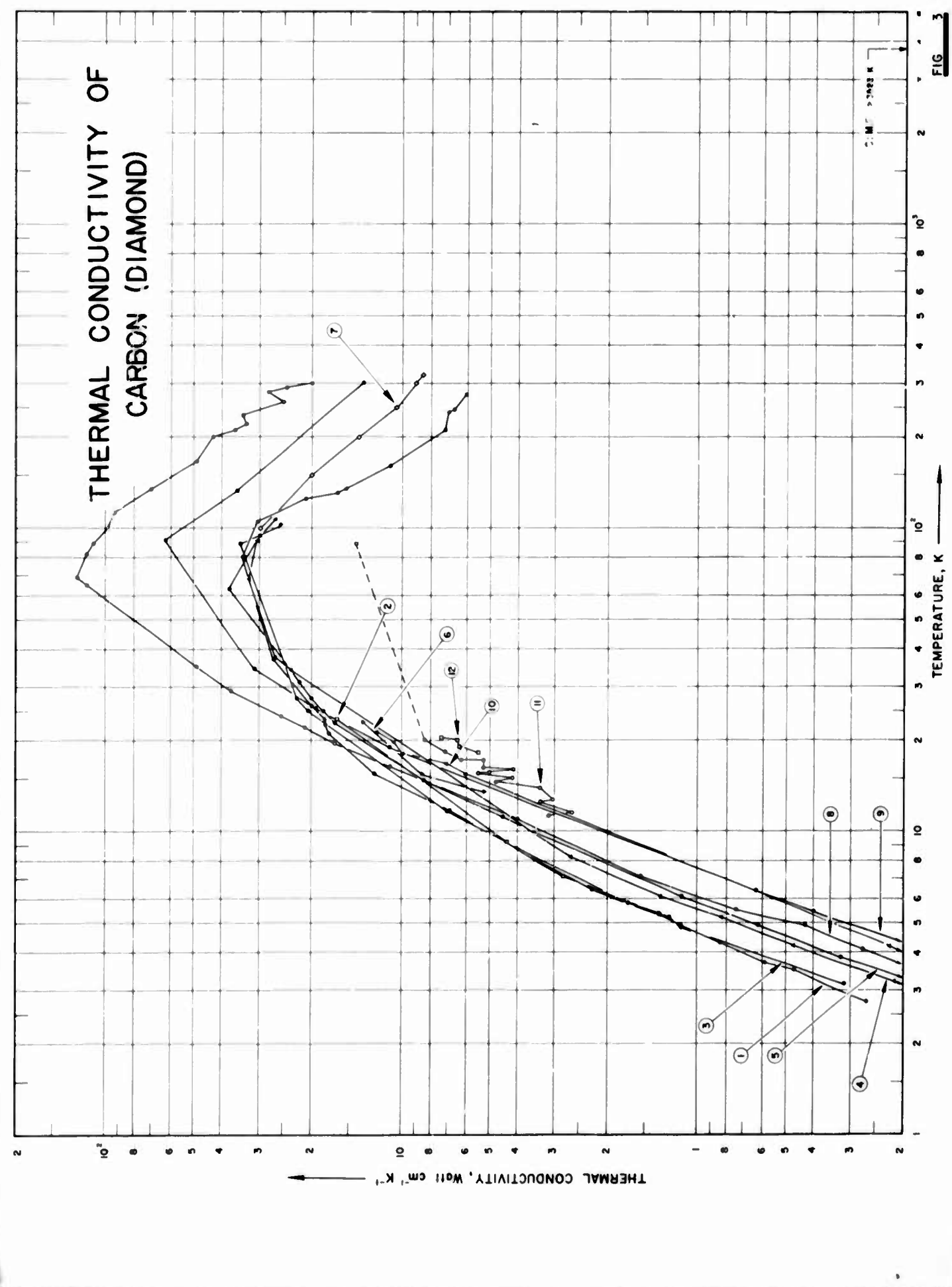
DATA TABLE NO. 2 THERMAL CONDUCTIVITY OF CARBON

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>													
1700	0.084	1311.2	0.0295	1615.2	0.0418	1883.2	0.101	1783.2	0.132	1273.2	0.0416	<u>CURVE 19*</u>	
1900	0.086	1339.3	0.0314	1678.2	0.0444	1983.2	0.108	1808.2	0.134	1343.2	0.0416		
2100	0.088	1390.3	0.0326	1713.2	0.0722	2033.2	0.111	1873.2	0.144	1388.2	0.0418		
<u>CURVE 2</u>													
377.2	0.0205	1443.2	0.0342	1715.7	0.0418	<u>CURVE 13</u>		1953.2	0.142	1428.2	0.0418	<u>CURVE 20*</u>	
490.2	0.0234	1477.2	0.0313	1741.2	0.0523	1318.2	0.0418	2023.2	0.134*	1318.2	0.0481		
591.2	0.0255	<u>CURVE 4*</u>		1828.2	0.0433	1338.2	0.0418*	2038.2	0.134	1423.2	0.0481		
676.2	0.0268	1033.2	0.0244	1983.2	0.0506	1358.2	0.0439	<u>CURVE 16</u>		1538.2	0.0502		
789.2	0.0280	1071.7	0.0246	2133.2	0.0601	1373.2	0.0439*	1293.2	0.0335	1618.2	0.0523		
899.2	0.0293	1073.2	0.0251	2238.2	0.1004	1389.2	0.0439*	1338.2	0.0335	1718.2	0.0565		
996.2	0.0305	1094.2	0.0249	<u>CURVE 8*</u>		1403.2	0.0439	1383.2	0.0343	<u>CURVE 21</u>			
1107.2	0.0318	1111.2	0.0276	373.2	0.000209	1423.2	0.0469	1418.2	0.0343				
<u>CURVE 3</u>													
1023.2	0.0233	1132.2	0.0262	<u>CURVE 9*</u>		1438.2	0.0481*	<u>CURVE 17</u>					
1024.2	0.0220	1139.2	0.0291	313.2	0.000653	1438.2	0.0481*	1293.2	0.0314	1373.2	0.0552*		
1026.2	0.0237	1150.7	0.0289	368.2	0.000695	1468.2	0.0628	1353.2	0.0314	1533.2	0.0607		
1036.2	0.0258	1181.7	0.0289	<u>CURVE 10</u>		1478.2	0.0628	1358.2	0.0314	1738.2	0.0649		
1061.2	0.0252	1192.2	0.0283	1293.2	0.0439	1488.2	0.0607*	1408.2	0.0322	1843.2	0.0628		
1085.7	0.0258	1193.2	0.0288	1353.2	0.0469	1498.2	0.0628	1433.2	0.0356	1883.2	0.0711		
1090.7	0.0275	1223.2	0.0293	1408.2	0.0481	1478.2	0.0628	1433.2	0.0356	1988.2	0.0649		
1116.8	0.0244	1249.7	0.0295	1433.2	0.0481	1523.2	0.0628	1488.2	0.0356				
1125.2	0.0271	1290.2	0.0297	<u>CURVE 11</u>		1563.2	0.0669	1583.2	0.0356				
1140.2	0.0254	1076.2	0.0248	1293.2	0.0607	1593.2	0.0690	1643.2	0.0356				
1141.2	0.0285	1170.2	0.0277*	1353.2	0.0502	1613.2	0.0690	1675.2	0.0356				
1145.2	0.0278	1195.2	0.0278*	1403.2	0.0565*	1663.2	0.0669	1675.2	0.0356				
1150.6	0.0253	1247.7	0.0304	1413.2	0.0628*	1673.2	0.0690	1298.2	0.0385				
1154.2	0.0271	1394.2	0.0281	1433.2	0.0628*	1703.2	0.0669*	1338.2	0.0418				
1158.0	0.0257	<u>CURVE 5</u>		1468.2	0.0607	1730.2	0.0678	1398.2	0.0418				
1185.2	0.0278	1076.2	0.0248	1488.2	0.0607*	<u>CURVE 15</u>		1443.2	0.0439				
1191.2	0.0264	1170.2	0.0277*	1523.2	0.0628	1353.2	0.0439	1513.2	0.0439				
1192.2	0.0274	1195.2	0.0278*	1563.2	0.0669	1373.2	0.0439	1583.2	0.0439				
1195.9	0.0283	1247.7	0.0304	1593.2	0.0690	1433.2	0.0439	1623.2	0.0439				
1209.7	0.0276	1343.2	0.0305	1613.2	0.0669	1488.2	0.0439	1643.2	0.0418				
1210.7	0.0281	1473.2	0.0319	1663.2	0.0669	1538.2	0.0439	1748.2	0.0460				
1215.2	0.0287	1473.2	0.0319	1673.2	0.0690	1583.2	0.0439	1778.2	0.0460				
1236.2	0.0267	1473.2	0.0319	1693.2	0.0607	1633.2	0.0439	1853.2	0.0439				
1249.9	0.0287	1473.2	0.0319	1718.2	0.0628*	1683.2	0.0439	1883.2	0.0439				
1265.7	0.0282	1343.2	0.0305	1730.2	0.0678	1728.2	0.0439	1938.2	0.0460				
1300.8	0.0295	1553.2	0.0356	1778.2	0.0678	1778.2	0.0439	1938.2	0.0460				
<u>CURVE 7</u>													
1300.8	0.0295	1553.2	0.0356	1728.2	0.107	1583.2	0.138	1778.2	0.138				
<u>CURVE 12</u>													
1343.2	0.103	1433.2	0.105	1373.2	0.107	1433.2	0.107	1778.2	0.107				
1473.2	0.101	1473.2	0.101	1433.2	0.105	1433.2	0.105	1853.2	0.0439				
1553.2	0.105	1473.2	0.101	1583.2	0.146	1583.2	0.146	1938.2	0.0460				
1633.2	0.107	1553.2	0.105	1598.2	0.128	1598.2	0.128	1938.2	0.0460				
1728.2	0.107	1633.2	0.107	1633.2	0.142	1633.2	0.142	1938.2	0.0460				
1728.2	0.130	1683.2	0.130	1683.2	0.130	1683.2	0.130	1938.2	0.0460				

* Not shown on plot

THERMAL CONDUCTIVITY OF CARBON (DIAMOND)



SPECIFICATION TABLE NO. 3 THERMAL CONDUCTIVITY OF CARBON (DIAMOND)

(For Data Reported in Figure and Table No. 3)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	25	L	1953	2.8-275	5	Type I	Type I stone (gem quality); as classified according to its ultra-violet transparency limit; original dimensions of 3.9 x 3.9 x 10.9 mm; sawn <i>à la</i> ground to other sizes.
2	25	L	1953	5.4-24	5	Type I	Similar to the above specimen (from same stone) except dimensions of 3.9 x 3.9 x 5.8 mm.
3	25	L	1953	3.2-100	5	Type I	Similar to the above specimen (from same stone) except 3.1 x 3.1 mm cross section.
4	25	L	1953	2.4-107	5	Type I	Similar to the above specimen (from same stone) except 1.7 x 1.7 mm cross section.
5	25	L	1953	2.8-94	5	Type I	Similar to the above specimen (from same stone) except dimensions of 1.1 x 1.1 x 6.9 mm.
6	25	L	1953	14-23	5	Type I	Similar to the above specimen (from same stone) except dimensions of 1.1 x 1.1 x 5.2 mm.
7	28	L	1956	100-320		Type I	Type I stone, approx. 1.1 x 1.1 x 11 mm in size; apparatus improved over prior apparatus (Berman, Simon and Ziman, 1953).
8	28	L	1956	2.7-300		Type IIa	Type IIa stone; approx. 0.7 x 1.25 x 10 mm, an electrical insulator.
9	28	L	1956	3.0-300		Type IIb	Type IIb stone, approx. 1.1 x 1.2 x 7 mm, an electrical conductor.
10	231	L	1938	3.0-22			6 mm long; cross sectional area 0.59 mm ² ; supplied by I. J. Asscher, Amsterdam, copper wire used for thermal contacts.
11	231	L	1938	11-89			The above specimen remounted; larger copper wire used for thermal contacts.
12	231	L	1938	18-21	20		9 mm long; cross sectional area 0.82 mm ² ; supplied by I. J. Asscher, Amsterdam; mercury in copper cups used for thermal contacts.

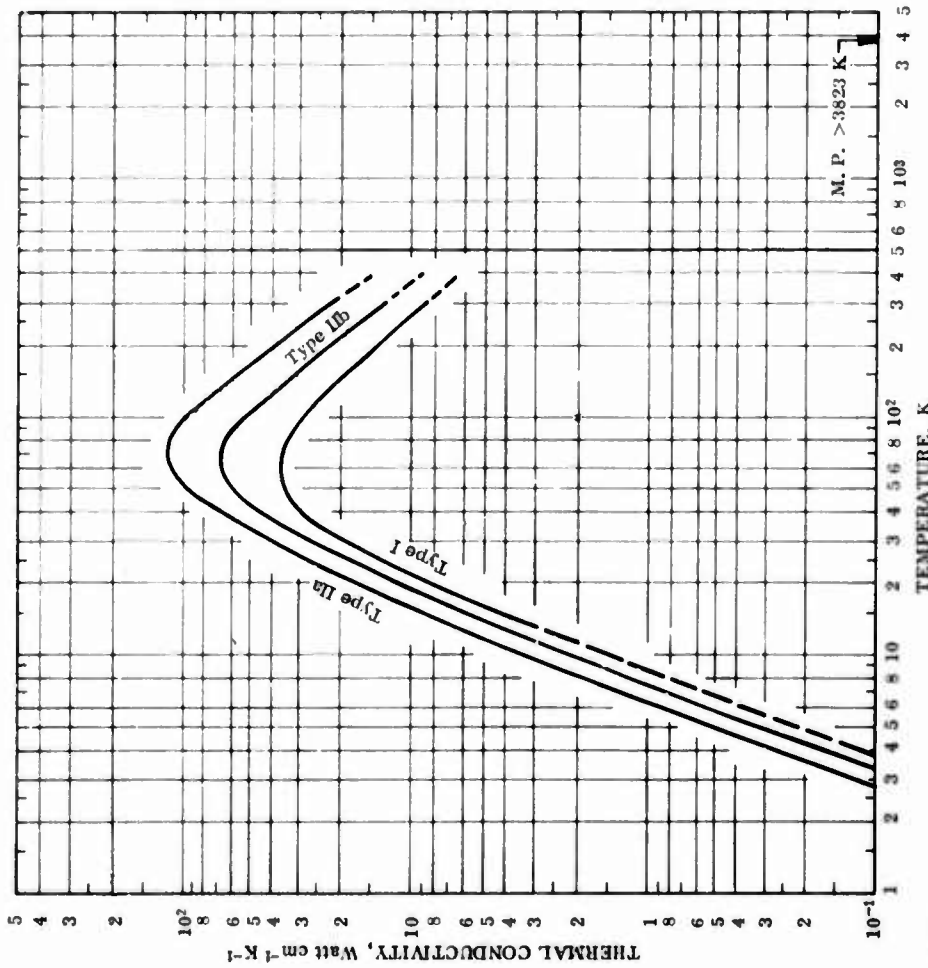
DATA TABLE NO. 3 THERMAL CONDUCTIVITY OF CARBON (DIAMOND)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k																																																		
<u>CURVE 1</u>				<u>CURVE 3 (cont.)</u>				<u>CURVE 7</u>				<u>CURVE 9</u>				<u>CURVE 12</u>																																													
2.75	0.267	80.0	33.5	100	29.7	100	29.7	2.95	0.073*	2.95	0.073*	18.4	5.50	3.90	0.146*	19.2	6.33	5.46	0.400	20.1	6.49	6.46	0.63	20.5	7.35																																				
3.50	0.470	89.0	34.5	150	20.0	150	20.0	3.90	0.146*	3.90	0.146*	19.2	6.33	5.46	0.400	20.1	6.49	6.46	0.63	20.5	7.35	19.0	11.0	25.5	19.5																																				
3.70	0.590	100.3	25.5	200	14.0	200	14.0	5.46	0.400	5.46	0.400	20.1	6.49	6.46	0.63	20.5	7.35	19.0	11.0	25.5	19.5	34.5	31.0	91.0	63.0																																				
4.30	0.840	<u>CURVE 4</u>		250	11.0	300	9.0	300	9.0	300.0	13.5	<u>CURVE 10</u>		2.99	0.125*	3.59	0.153*	4.21	0.221*	15.6	6.10	16.7	7.09	18.2	9.90																																				
4.90	1.13	2.4	0.105*	320	8.5	<u>CURVE 5</u>		320	8.5	2.65	0.078*	4.10	0.275	16.4	11.0	7.1	1.55	4.0	4.0	16.4	11.0	19.5	16.7	22.0	21.0																																				
5.30	1.34	2.75	0.144*	<u>CURVE 8</u>		2.65	0.078*	2.65	0.078*	3.30	0.155*	4.9	0.43	22.0	21.0	5.5	0.74	4.0	4.0	16.4	11.0	19.5	16.7	22.0	21.0																																				
6.40	2.25	3.2	0.215	4.2	0.47	3.30	0.155*	4.10	0.275	4.9	0.43	5.5	0.74	24.0	23.5	7.1	1.55	4.0	4.0	16.4	11.0	19.5	16.7	22.0	21.0																																				
11.7	6.9	4.2	0.47	5.2	0.83	4.9	0.43	5.5	0.74	7.1	1.55	11.0	4.0	29.0	37.0	11.0	4.0	16.4	11.0	19.5	16.7	22.0	21.0	24.0	23.5																																				
15.5	12.4	6.1	1.33	6.1	1.33	8.2	2.65	34.0	23.5	8.2	2.65	11.0	4.0	35.0	49.0	16.4	11.0	19.5	16.7	22.0	21.0	24.0	23.5	29.0	37.0																																				
21.0	17.5	8.2	2.65	8.2	2.65	34.0	23.5	68.0	32.5	8.2	2.65	11.0	4.0	65.0	116.0	16.4	11.0	19.5	16.7	22.0	21.0	24.0	23.5	35.0	49.0																																				
22.5	18.0	34.0	23.5	34.0	23.5	68.0	32.5	91.0	30.5	68.0	32.5	16.4	11.0	65.0	116.0	16.4	11.0	19.5	16.7	22.0	21.0	24.0	23.5	29.0	37.0																																				
23.5	18.0	107.0	26.7	107.0	26.7	107.0	26.7	107.0	30.5	107.0	26.7	16.4	11.0	65.0	116.0	16.4	11.0	19.5	16.7	22.0	21.0	24.0	23.5	29.0	37.0																																				
26.0	20.0	<u>CURVE 5</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>		<u>CURVE 6</u>																																			
27.0	21.0	2.75	0.126*	3.85	0.323	4.9	0.62	6.1	1.13	8.2	2.65*	11.2	4.5	14.7	8.4	22.7	16.7	25.0	18.2	27.5	20.0	31.0	22.0	63.0	37.5	54.9	30.0																																		
30.0	24.0	3.85	0.323	4.9	0.62	6.1	1.13	8.2	2.65*	11.2	4.5	14.7	8.4	22.7	16.7	25.0	18.2	27.5	20.0	31.0	22.0	63.0	37.5	54.9	30.0	13.5	5.2																																		
34.0	30.5	4.9	0.62	6.1	1.13	8.2	2.65*	11.2	4.5	14.7	8.4	22.7	16.7	25.0	18.2	27.5	20.0	31.0	22.0	63.0	37.5	54.9	30.0	13.5	5.2	8.5	13.5																																		
105	30.5	6.1	1.13	8.2	2.65*	11.2	4.5	14.7	8.4	22.7	16.7	25.0	18.2	27.5	20.0	31.0	22.0	63.0	37.5	54.9	30.0	13.5	5.2	8.5	13.5	23.0	13.5																																		
125	21.0	8.2	2.65*	11.2	4.5	14.7	8.4	22.7	16.7	25.0	18.2	27.5	20.0	31.0	22.0	63.0	37.5	54.9	30.0	13.5	5.2	8.5	13.5	23.0	13.5	23.0	13.5																																		
130	16.5	11.2	4.5	14.7	8.4	22.7	16.7	25.0	18.2	27.5	20.0	31.0	22.0	63.0	37.5	54.9	30.0	13.5	5.2	8.5	13.5	23.0	13.5	23.0	13.5	23.0	13.5																																		
135	15.5	14.7	8.4	22.7	16.7	25.0	18.2	27.5	20.0	31.0	22.0	63.0	37.5	54.9	30.0	13.5	5.2	8.5	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5																																		
160	11.0	22.7	16.7	25.0	18.2	27.5	20.0	31.0	22.0	63.0	37.5	54.9	30.0	13.5	5.2	8.5	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5																																		
210	7.2	25.0	18.2	27.5	20.0	31.0	22.0	63.0	37.5	54.9	30.0	13.5	5.2	8.5	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5																																		
240	7.0	31.0	22.0	63.0	37.5	54.9	30.0	13.5	5.2	8.5	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5																																		
245	6.7	63.0	37.5	54.9	30.0	13.5	5.2	8.5	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5																																		
275	6.1	54.9	30.0	13.5	5.2	8.5	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5	23.0	13.5																																		
<u>CURVE 2</u>				<u>CURVE 3</u>				<u>CURVE 4</u>				<u>CURVE 5</u>				<u>CURVE 6</u>				<u>CURVE 7</u>				<u>CURVE 8</u>				<u>CURVE 9</u>				<u>CURVE 10</u>				<u>CURVE 11</u>				<u>CURVE 12</u>																					
5.35	1.35	3.15	0.315	4.88	1.13	5.20	1.25	5.80	1.70	11.7	7.0	25.0	20.5	27.5	22.5	3.15	0.315	4.88	1.13	5.20	1.25	5.80	1.70	11.7	7.0	25.0	20.5	27.5	22.5	11.4	3.13	11.7	2.63	12.7	3.33	12.8	3.03	14.0	3.33	14.7	4.76	15.1	4.17	15.7	5.46	15.8	5.00	16.1	4.17	16.45	5.26	17.4	5.26	17.45	6.25	18.5	7.14	20.15	8.33	29.4	14.29

* Not shown on plot

FIGURE AND TABLE NO. 3R RECOMMENDED THERMAL CONDUCTIVITY OF CARBON (Diamond)



RECOMMENDED VALUES*
(High-purity, high-perfection, water-white diamond).

T ₁	Type I		Type IIa		Type IIb		T ₂
	k ₁	k ₂	k ₁	k ₂	k ₁	k ₂	
0	0	0	0	0	0	0	-459.7
1	(0.00182)*	(0.105)	(0.00437)	(0.252)	(0.00263)	(0.152)	-457.9
2	(0.0142)	(0.820)	(0.0341)	(1.97)	0.0206	1.19	-456.1
3	(0.0471)	(2.72)	0.115	6.64	0.0692	4.00	-454.3
4	(0.111)	(6.41)	0.266	15.4	0.164	9.48	-452.5
5	(0.211)	(12.2)	0.502	29.0	0.313	18.1	-450.7
6	(0.351)	(20.3)	0.836	48.3	0.521	30.1	-448.9
7	(0.540)	(31.2)	1.27	73.4	0.795	45.9	-447.1
8	(0.770)	(44.5)	1.80	104	1.14	65.9	-445.3
9	(1.08)	(62.4)	2.46	142	1.57	90.7	-443.5
10	(1.42)	(82.0)	3.24	187	2.07	120	-441.7
11	(1.82)	(105)	4.09	236	2.63	152	-439.9
12	(2.28)	(132)	5.10	295	3.29	190	-438.1
13	(2.81)	(162)	6.20	358	4.02	232	-436.3
14	3.39	196	7.45	430	4.87	281	-434.5
15	4.03	233	8.77	507	5.77	333	-432.7
16	4.72	273	10.2	589	6.75	390	-430.9
18	6.27	362	13.5	780	8.90	514	-427.3
20	8.00	462	17.1	988	11.4	659	-423.7
25	13.1	757	27.4	1580	18.5	1070	-414.7
30	19.0	1100	39.5	2280	26.9	1550	-405.7
35	24.9	1440	52.5	3030	35.6	2060	-396.7
40	29.7	1720	66.7	3850	44.6	2580	-387.7
45	33.2	1920	80.2	4630	53.0	3060	-378.7
50	35.6	2060	93.0	5370	59.6	3440	-369.7
60	37.5	2170	113	6530	68.0	3930	-351.7
70	37.1	2140	120	6930	69.1	3990	-333.7
80	35.3	2040	117	6760	65.9	3810	-315.7
90	32.8	1900	110	6360	60.3	3480	-297.7
100	30.1	1740	100	5790	54.5	3150	-279.7
150	19.5	1130	60.5	3500	32.6	1880	-189.7
200	14.2	820	40.4	2330	22.6	1310	-99.7
250	11.1	641	29.7	1720	17.1	988	-
273.2	10.0	578	26.3	1520	15.3	884	32.0
300	9.00	520	23.1	1330	13.5	780	80.3
350	(7.58)	(438)	(18.6)	(1070)	(11.2)	(647)	170.3
400	(6.52)	(377)	(15.5)	(896)	(9.36)	(541)	260.3

REMARKS

The recommended values are for high-purity high-perfection water-white diamond. The recommended values that are supported by experimental data are thought to be accurate to within 10% of the true values at temperatures above 100 K. The thermal conductivity near and below the corresponding temperature of its maximum is highly sensitive to small physical and chemical variations of the specimens, and the recommended values below 100 K are intended as typical values for indicating the general trend.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹.

† Values in parentheses are extrapolated.

FIGURE SHOWS ONLY 31 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF AGOT GRAPHITE

Continued on Figures 4-2

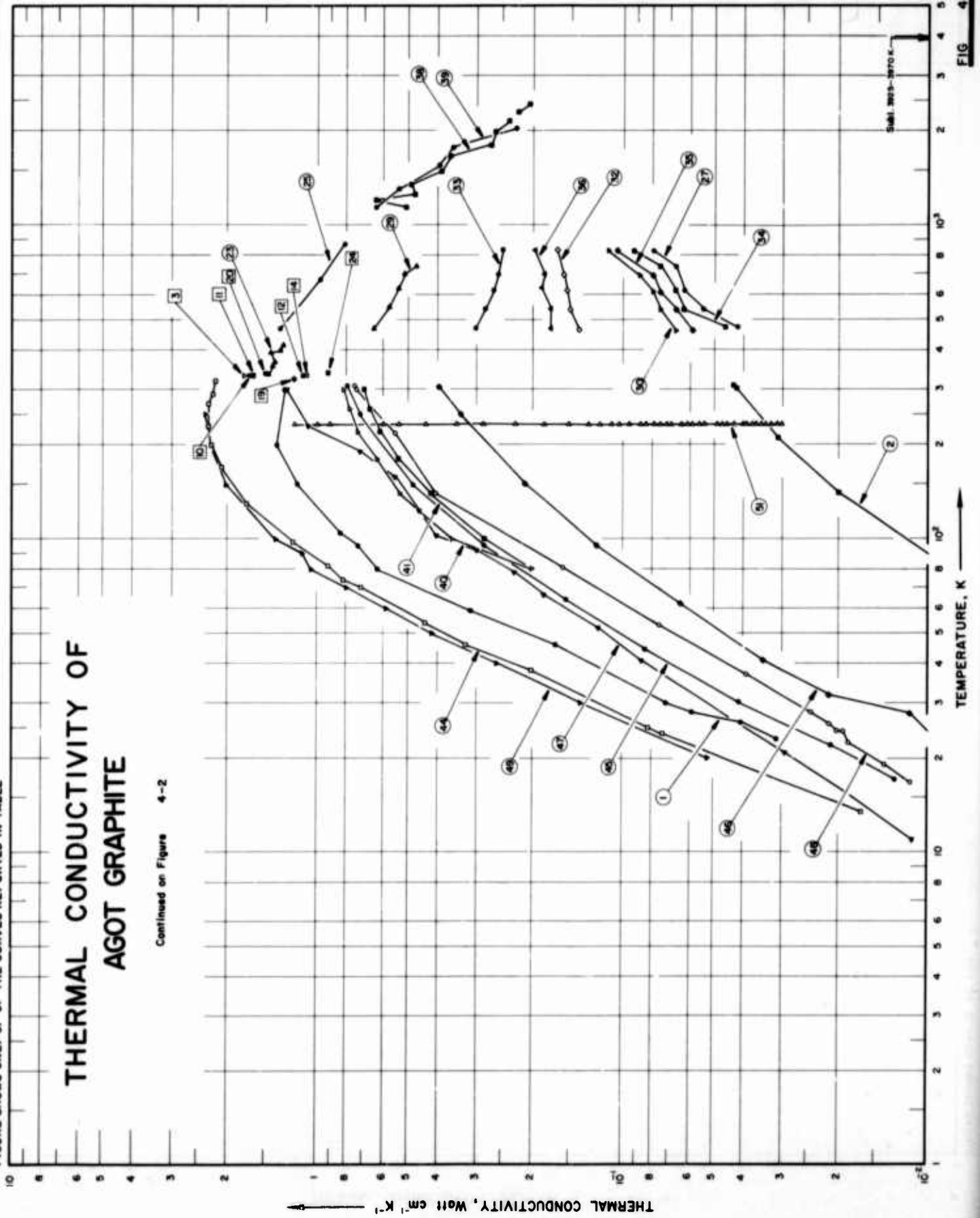
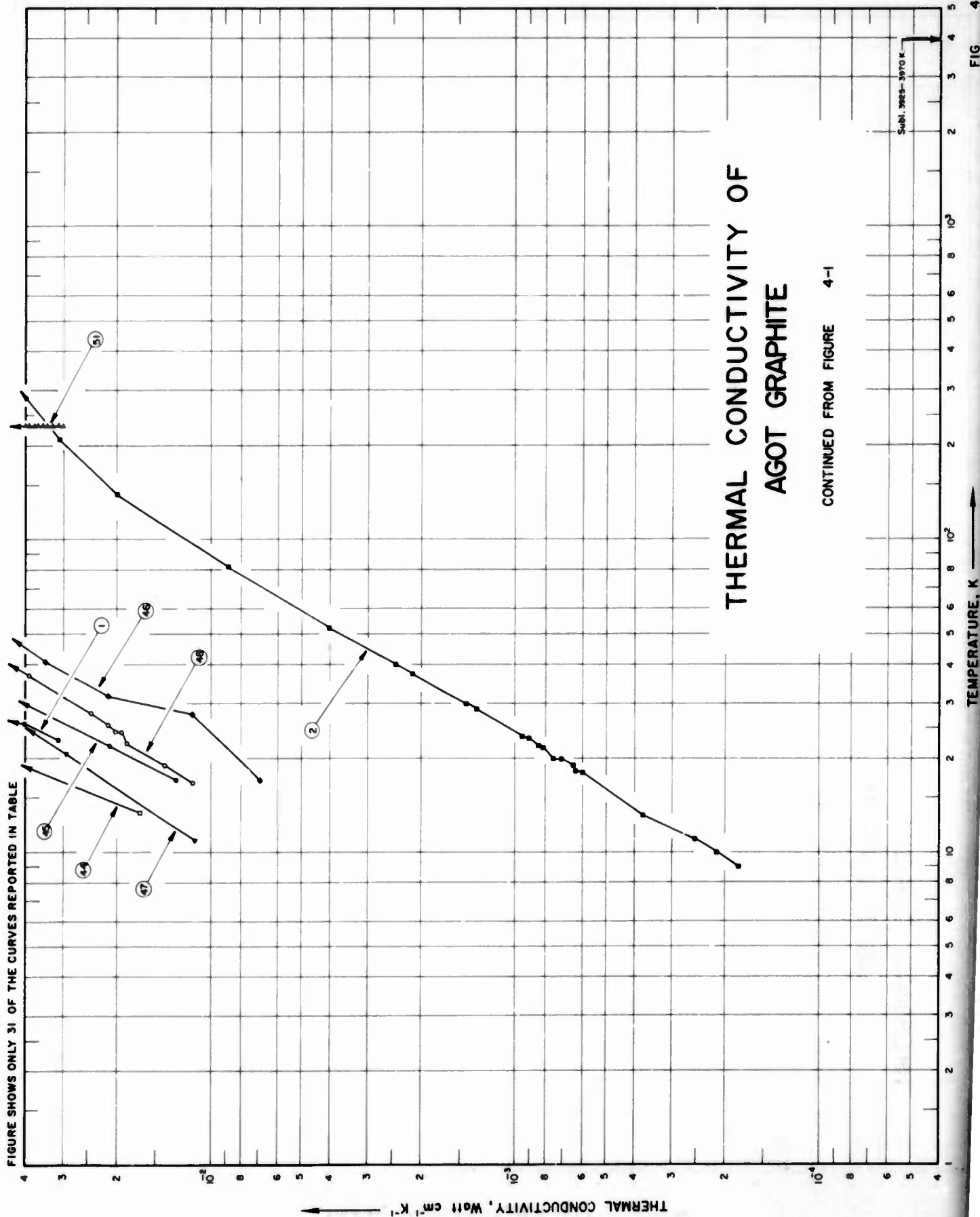


FIGURE SHOWS ONLY 31 OF THE CURVES REPORTED IN TABLE



THERMAL CONDUCTIVITY OF AGOT GRAPHITE

CONTINUED FROM FIGURE 4-1

Subl. 3925-3970 K

TEMPERATURE, K

SPECIFICATION TABLE NO. 4 THERMAL CONDUCTIVITY OF AGOT GRAPHITE

[For Data Reported in Figure and Table No. 4]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	49	L	1953	23-300	< 10	B	Polycrystal; from National Carbon Co.; extruded; bulk density ~1.70 g cm ⁻³ ; measured perpendicular to the c-axis.
2	163, 53	E	1954	9.0-309	± 5		Index rod made from gas-baked coke (ungraphitized AGOT); extruded; room temp properties: density 1.56 g cm ⁻³ , thermoelectric power + 1.3 μvolt K ⁻¹ , Hall coefficient -0.21 emu, magneto resistivity -0.01 x 10 ⁻¹⁰ emu, electrical resistivity 65.3 milliohm cm, total magnetic susceptibility -3.08 x 10 ⁻⁴ cgs unit, orientation factor (ρ_{max}/ρ_{min}) = 1.8.
3	359	L	1949	333.2	5	I	Cylindrical specimen 3.5 in. in dia and 4 in. long; cylinder axis parallel to the axis of extrusion.
4	359	L	1949	333.2	5	I	The above specimen, run No. 2.
5	359	L	1949	333.2	5	I	The above specimen, run No. 3.
6	359	L	1949	333.2	5	I	The above specimen, run No. 4.
7	359	L	1949	333.2	5	I	The above specimen, run No. 5.
8	359	L	1949	333.2	5	I	The above specimen, run No. 6.
9	359	L	1949	333.2	5	I	Measurement of the above specimen to show the "Bashing effect" by striking each end of the cylinder 10 times and 12 times around the circumference with a plastic hammer on a piece of wood on top of the cylindrical specimen. (Bashing is the hitting of the specimen hard enough to break crystallites apart but not enough to break the specimen.)
10	359	L	1949	333.2	5	I	The above specimen treated again with 20 blows on each end and 20 blows on the circumference.
11	359	L	1949	333.2	5	I	The above specimen treated again with 10 blows on each end and 20 blows around the circumference but with steel hammer with 2 steel plates at each end of the specimen.
12	359	L	1949	333.2	5	I	Cylindrical specimen 3.5 in. in dia and 4 in. long; cylinder axis at right angle to the extrusion axis.
13	359	L	1949	333.2	5	I	The above specimen measured after striking each end 10 times and 12 times around the circumference with a plastic hammer on a piece of wood on top of the specimen.
14	359	L	1949	333.2	5	I	The above specimen treated again with 20 blows on each end and 20 blows on the circumference with the same hammer.
15	359	L	1949	331.2	5	II	Cylindrical specimen 3.5 in. in dia and 4 in. long; cylinder axis parallel to the extrusion axis.
16	359	L	1949	331.2	5	II	The above specimen, run No. 2.
17	359	L	1949	331.2	5	II	The above specimen, run No. 3.
18	359	L	1949	331.2	5	II	The above specimen, run No. 4.

SPECIFICATION TABLE NO. 4 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
19	359	L	1949	324.2	5	II	Cylindrical specimen 3.5 in. in dia and 4 in. long; cylinder axis at right angle to the extrusion axis.
20	359	L	1949	337.2	5	V	Similar to the above specimen but the cylinder axis parallel to the extrusion axis.
21	359	L	1949	338.2	5	V	Similar to the above specimen but the cylinder axis perpendicular to the extrusion axis.
22	359	L	1949	335.2	5	VI	Similar to the above specimen but the cylinder axis parallel to the extrusion axis.
23	359	L	1949	335-415	5	VI	Similar to the above specimen.
24	359	L	1949	339.2	5	VI	Similar to the above specimen but the cylinder axis perpendicular to the extrusion axis.
25	392		1961	446-868			Density 1.73 g cm ⁻³ ; grain size > 0.032 in.
26	392		1961	473-737		AK-2	Obtained from Brookhaven pile; density 1.73 g cm ⁻³ ; grain size > 0.032 in.
27	392		1961	475-829		AK-1	Similar to the above specimen; irradiated in Brooklyn National Laboratory reactor at 30-50 C by a neutron flux of 1655 megawatt days/adjacent ton.
28	392		1961	474-830		JK-1	Similar to the above specimen except irradiated in Brooklyn National Laboratory reactor at 30-50 C by a neutron flux of 1685 megawatt days/adjacent ton.
29	392		1961	469-836		JK-1	The above specimen annealed at 1400 C for one hr.
30	392		1961	463-829		JK-2	Similar to the above specimen except annealed at 800 C for one hr.
31	392		1961	475-829		LK-1	Obtained from Brookhaven pile; density 1.73 g cm ⁻³ ; grain size > 0.032 in.; irradiated in Brooklyn National Laboratory reactor at 30-50 C by a neutron flux of 1685 megawatt days/adjacent ton.
32	392		1961	465-835		LK-1	The above specimen annealed at 1000 C for one hr.
33	392		1961	469-835		LK-2	Similar to the above specimen except annealed at 1200 C for one hr.
34	392		1961	475-829		CK-1	Obtained from Brookhaven pile; density 1.73 g cm ⁻³ ; grain size > 0.032 in.; irradiated in Brooklyn National Laboratory reactor at 30-50 C by a neutron flux of 1685 megawatt days/adjacent ton.
35	392		1961	464-829		CK-1	The above specimen annealed at 600 C for one hr.
36	392		1961	468-834		PK-1	Similar to the above specimen except annealed at 1100 C for one hr.
37	393	C	1963	324-1069			1 in. dia x 0.250 in. thick; supplied by National Carbon Co.; Armco iron used as comparative standard.
38	393	-	1963	1145-2443			1 x 0.25 x 0.05 in.; supplied by National Carbon Co.; measured in vacuum, the method consists of obtaining the steady-state temp at centers of the narrow and wide faces of specimen by optical pyrometry; specimen electrically heated, thermal conductivity calculated from measured temp, emittance of the specimen, dimensions of the specimen and the Stefan-Boltzmann constant.

SPECIFICATION TABLE NO. 4 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
39	393	R	1963	1145-2044			Cylindrical specimen obtained from National Carbon Co.
40	346	R	1956	80-300		AGOT-CSF-MTR	Specimen size 0.02 x 0.125 x 1 in.; exposed to 6.4×10^{19} fast neutrons cm^{-2} and 5.8×10^{20} thermal neutrons cm^{-2} at 698 K.
41	346	R	1956	80-300		AGOT-CSF-MTR	Similar to the above specimen but exposed to 4.3×10^{19} f. neutrons cm^{-2} and 2.6×10^{20} thermal neutrons cm^{-2} at 933 K.
42	346	R	1956	80-300		AGOT-CSF-MTR	Similar to the above specimen but exposed to 8.5×10^{19} fast neutrons cm^{-2} and 2.6×10^{20} thermal neutrons cm^{-2} at 908 K.
43	346	R	1956	220-300		AGOT-CSF-MTR	Similar to the above specimen but exposed to 4.9×10^{19} fast neutrons cm^{-2} and 1.5×10^{20} thermal neutrons cm^{-2} at 938 K.
44	163, 50, 53	E	1954	14-320	± 5	AGOT-KC	Polycrystalline; extruded petroleum coke, pitch bonded; particle size 50 μ ; crystallite size 0.3 μ ; specimen size 0.10 x 0.03 x 1.25 in.; density 1.65 g cm^{-3} at 25 C; thermoelectric power -0.5 $\mu\text{volt K}^{-1}$; Hall coefficient -0.6 emu; magneto resistivity 5.4×10^{-16} emu; electrical resistivity 6.2 milliohm cm; total magnetic susceptibility -20.44×10^{-6} cgs unit; orientation factor ($\phi_{\text{max}}/\rho_{\text{min}}$) = 2.0; measured parallel to the axis of extrusion.
45	163, 50	E	1954	17-308	± 5	AGOT-KC	The above specimen exposed to neutron irradiation of 12.5 MWD/T (megawatt-days per ton) at <30 C.
46	163, 50	E	1954	17-305	± 5	AGOT-KC	The above specimen exposed to neutron irradiation of 48 MWD/T at <30 C.
47	163, 50	E	1954	11-300	± 5	AGOT-KC	The above specimen exposed to neutron irradiation of 460 MWD/T at <30 C.
48	163, 50	E	1954	17-308	± 5	AGOT-KC	The above specimen exposed to neutron irradiation of 1927 MWD/T at <30 C.
49	50	E	1956	20-250	± 5	AGOT-KC	The virgin specimen before bromination (experiment to show the effect of Br on thermal conductivity of graphite).
50	50	E	1956	10-300	± 5	AGOT-KC (Brom-Graphite)	Brominated AGOT-KC graphite; 0.13 Br.
51	178	L	1950	233.2			AGOT-KC graphite specimen 0.03 x 0.125 x 1 in.; irradiated with neutrons of 1927MWD/T; pulse annealed for 1 min; measured under vacuum (<10 ⁻⁶ mm Hg) at constant temp of -40 C to show the effect on thermal conductivity of the specimen after being annealed (except the ends) at different temp.
52	178	L	1950	233.2		AGOT-KC	The above specimen irradiated at 212 MWD/T; both ends annealed.
53	178	L	1950	233.2		AGOT-KC	The above specimen irradiated at 1927 MWD/T with both ends annealed.

DATA TABLE NO. 4 THERMAL CONDUCTIVITY OF AGOT GRAPHITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k	CURVE J	T k	CURVE 4*	T k	CURVE 15*	T k	CURVE 24	T k	CURVE 30 (cont.)	T k	CURVE 36	T k	CURVE 40 (cont.)
23	0.0310	333.2	1.77	331.2	1.63	339.2	0.920	694.2	0.0879	468.2	0.176	140	0.534
26	0.0402	CURVE 5*	CURVE 16*	CURVE 25	CURVE 31*	CURVE 32	CURVE 37*	829.2	0.113	541.2	0.176	180	0.628
28	0.0586	CURVE 6*	CURVE 17*	CURVE 26*	CURVE 32	CURVE 38	CURVE 41	CURVE 33	CURVE 33	623.2	0.188	220	0.732
30	0.0711	CURVE 7*	CURVE 18*	CURVE 27	CURVE 34	CURVE 39	CURVE 42*	CURVE 34	CURVE 34	697.2	0.184	260	0.780
46	0.167	CURVE 8*	CURVE 19	CURVE 28*	CURVE 35	CURVE 40	CURVE 43*	CURVE 35	CURVE 35	834.2	0.197	300	0.816
59	0.314	333.2	1.71	331.2	1.65	466.2	1.34	475.2	0.0418	CURVE 37*	CURVE 37*	80	0.201*
80	0.628	CURVE 9*	CURVE 20	CURVE 29	CURVE 36	674.2	0.983	541.2	0.0544	CURVE 38	CURVE 38	100	0.285
95	0.732	CURVE 10	CURVE 21*	CURVE 30	CURVE 37	868.2	0.812	621.2	0.0628	CURVE 39	CURVE 39	140	0.423
105	0.837	CURVE 11	CURVE 22*	CURVE 31	CURVE 38	473.2	1.35	736.2	0.0699	CURVE 40	CURVE 40	180	0.536
150	1.17	CURVE 12	CURVE 23	CURVE 32	CURVE 39	542.2	1.18	829.2	0.0795	CURVE 41	CURVE 41	220	0.615
200	1.39	CURVE 13*	CURVE 24	CURVE 33	CURVE 40	619.2	1.04	465.2	0.141	CURVE 42*	CURVE 42*	260	0.669
300	1.30	CURVE 14	CURVE 25	CURVE 34	CURVE 41	737.2	0.950	539.2	0.151	CURVE 43*	CURVE 43*	300	0.696
CURVE 2		CURVE 15	CURVE 26	CURVE 35	CURVE 42*	829.2	0.167	620.2	0.155	CURVE 44	CURVE 44	80	0.188
9.0	0.000179	CURVE 16	CURVE 27	CURVE 36	CURVE 43*	475.2	0.0418	695.2	0.159	CURVE 45	CURVE 45	100	0.272
10.0	0.000213	CURVE 17	CURVE 28*	CURVE 37	CURVE 44	541.2	0.0544	829.2	0.167	CURVE 46	CURVE 46	140	0.410
11.1	0.000251	CURVE 18*	CURVE 29	CURVE 38	CURVE 45	621.2	0.0628	469.2	0.305	CURVE 47	CURVE 47	180	0.519
13.2	0.000372	CURVE 19	CURVE 30	CURVE 39	CURVE 46	736.2	0.0669	544.2	0.285	CURVE 48	CURVE 48	220	0.598
18.1	0.000598	CURVE 20	CURVE 31	CURVE 40	CURVE 47	829.2	0.0795	624.2	0.268	CURVE 49	CURVE 49	260	0.657
18.2	0.000634	CURVE 21*	CURVE 32	CURVE 41	CURVE 48	474.2	0.0418	698.2	0.259	CURVE 50	CURVE 50	300	0.673
19.0	0.000644	CURVE 22*	CURVE 33	CURVE 42*	CURVE 49	620.2	0.0628	835.2	0.251	CURVE 51	CURVE 51	220	0.598
19.9	0.000703	CURVE 23	CURVE 34	CURVE 43*	CURVE 50	830.2	0.0795	475.2	0.0460	CURVE 52	CURVE 52	260	0.657
20.0	0.000749	CURVE 24	CURVE 35	CURVE 44	CURVE 51	469.2	0.649	541.2	0.0628	CURVE 53	CURVE 53	300	0.686
21.7	0.000812	CURVE 25	CURVE 36	CURVE 45	CURVE 52	548.2	0.577	621.2	0.0669	CURVE 54	CURVE 54	13.5	0.0167
22.0	0.000840	CURVE 26	CURVE 37	CURVE 46	CURVE 53	631.2	0.540	737.2	0.0753	CURVE 55	CURVE 55	24	0.0732
23.3	0.000895	CURVE 27	CURVE 38	CURVE 47	CURVE 54	698.2	0.515	829.2	0.0920	CURVE 56	CURVE 56	25	0.0916
23.6	0.000941	CURVE 28*	CURVE 39	CURVE 48	CURVE 55	836.2	0.473	464.2	0.0586	CURVE 57	CURVE 57	38	0.201
28.8	0.00132	CURVE 29	CURVE 40	CURVE 49	CURVE 56	463.2	0.0669	538.2	0.0669	CURVE 58	CURVE 58	46	0.326
30.0	0.00143	CURVE 30	CURVE 41	CURVE 50	CURVE 57	539.2	0.0753	614.2	0.0753	CURVE 59	CURVE 59	54	0.439
37.4	0.00213	CURVE 31	CURVE 42*	CURVE 51	CURVE 58	693.2	0.0795	693.2	0.0795	CURVE 60	CURVE 60	70	0.711
40.0	0.00243	CURVE 32	CURVE 43*	CURVE 52	CURVE 59	829.2	0.0795	829.2	0.105	CURVE 61	CURVE 61	100	0.816
52.5	0.00402	CURVE 33	CURVE 44	CURVE 53	CURVE 60	463.2	0.0669	464.2	0.0586	CURVE 62	CURVE 62	80	0.201
82.0	0.00879	CURVE 34	CURVE 45	CURVE 54	CURVE 61	538.2	0.0669	538.2	0.0669	CURVE 63	CURVE 63	46	0.326
140	0.0199	CURVE 35	CURVE 46	CURVE 55	CURVE 62	614.2	0.0753	614.2	0.0753	CURVE 64	CURVE 64	54	0.439
210	0.0308	CURVE 36	CURVE 47	CURVE 56	CURVE 63	693.2	0.0795	693.2	0.0795	CURVE 65	CURVE 65	70	0.711
302	0.0420	CURVE 37	CURVE 48	CURVE 57	CURVE 64	829.2	0.0795	829.2	0.105	CURVE 66	CURVE 66	100	0.816
309	0.0431	CURVE 38	CURVE 49	CURVE 58	CURVE 65	463.2	0.0669	464.2	0.0586	CURVE 67	CURVE 67	80	0.201
CURVE 3*		CURVE 50	CURVE 51	CURVE 52	CURVE 66	538.2	0.0669	538.2	0.0669	CURVE 68	CURVE 68	46	0.326
333.2	1.76	CURVE 53	CURVE 54	CURVE 55	CURVE 67	614.2	0.0753	614.2	0.0753	CURVE 69	CURVE 69	54	0.439
		CURVE 56	CURVE 57	CURVE 58	CURVE 68	693.2	0.0795	693.2	0.0795	CURVE 70	CURVE 70	70	0.711
		CURVE 59	CURVE 60	CURVE 61	CURVE 69	829.2	0.0795	829.2	0.105	CURVE 71	CURVE 71	100	0.816

* Not shown on plot

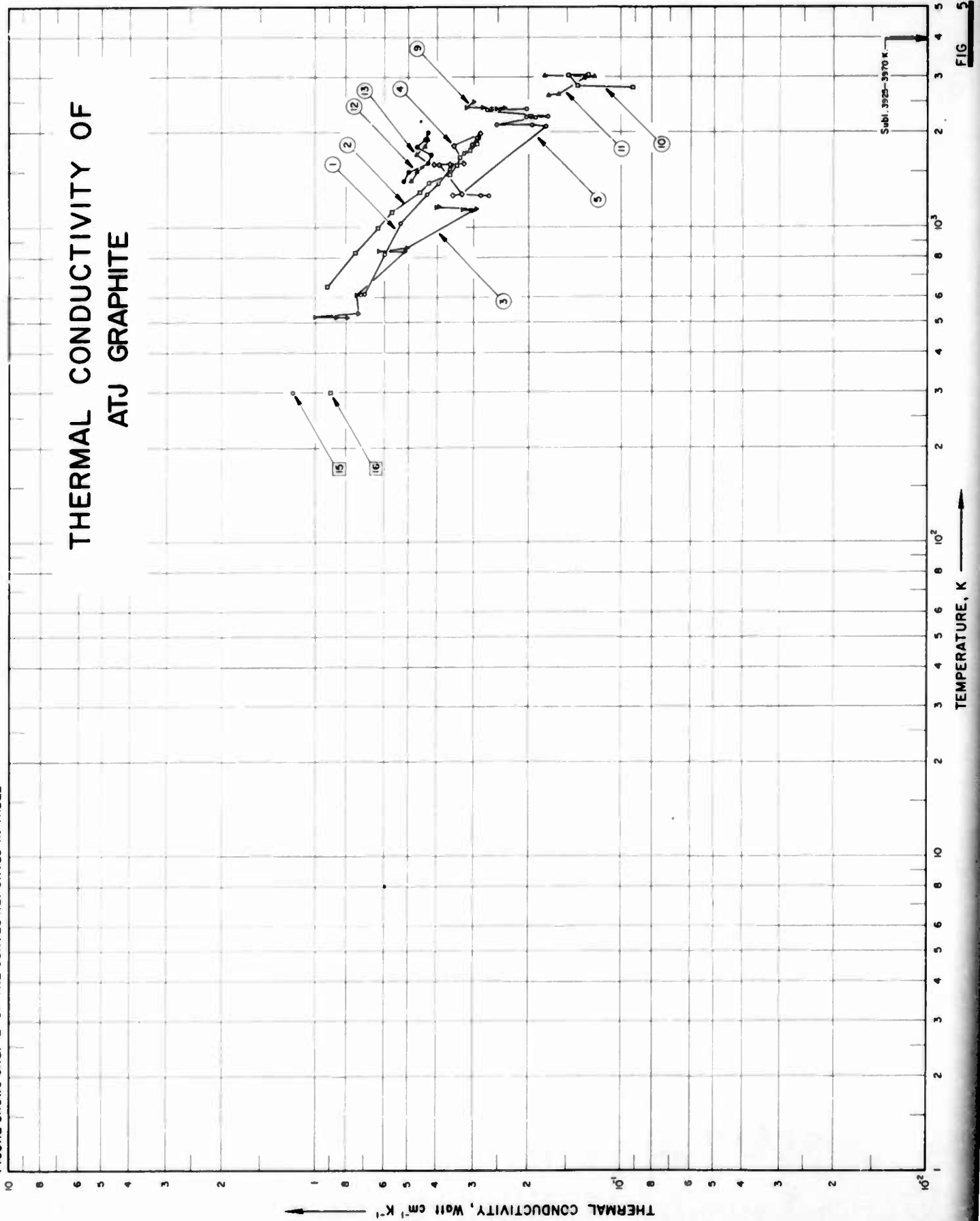
DATA TABLE NO. 4 (continued)

CURVE 44 (cont.)		CURVE 47 (cont.)		CURVE 50 (cont.)		CURVE 51 (cont.)		CURVE 52 (cont.)		CURVE 53* T = 233.2K		CURVE 53 (cont.)*	
T	k	T	k	T	k	T _A	k	T _A	k	T _A	k	T _A	k
82	0.920	190.4	0.718	90	1.05	1345.2	0.0950	748.2	0.199	298.2	0.0249	1423.2	0.0971
98	1.21	230	1.060	190	1.21	1373.2	0.102	773.2	0.209	323.2	0.0249	1448.2	0.112
130	1.72	300	1.289	150	1.76	1398.2	0.109	798.2	0.217	348.2	0.0248	1473.2	0.138
170	2.09			200	2.0	1423.2	0.112*	823.2	0.226	373.2	0.0248	1498.2	0.173
200	2.26	CURVE 48		250	2.09	1448.2	0.120	848.2	0.238	398.2	0.0248	1523.2	0.204
230	2.30			300	2.09	1473.2	0.131	873.2	0.246	423.2	0.0248	1548.2	0.239
270	2.30	16.7	0.0114			1498.2	0.153	898.2	0.251	448.2	0.0251		
290	2.22	19.1	0.0140	T _A	k	1523.2	0.184	923.2	0.258	473.2	0.0256		
320	2.18	22.5	0.0185			1548.2	0.227	948.2	0.270	498.2	0.0262		
CURVE 45		24.4	0.0192			1573.2	0.287	973.2	0.277	523.2	0.0268		
		24.5	0.0201	CURVE 51		1598.2	0.349	998.2	0.287	548.2	0.0274		
		25.7	0.0213	T = 233.2K		1623.2	0.439	1023.2	0.299	573.2	0.0282		
17.1	0.0129	28.0	0.0243	498.2	0.0300	1648.2	0.536	1048.2	0.303	598.2	0.0288		
22.0	0.0210	37.0	0.0389	523.2	0.0311	1673.2	0.598	1073.2	0.310	623.2	0.0294		
30.2	0.0411	53.3	0.0753	548.2	0.0326	1698.3	0.644*	1098.2	0.327	648.2	0.0301		
44.4	0.0837	81.0	0.159	573.2	0.0341	1723.2	0.695*	1123.2	0.335	673.2	0.0308		
64.4	0.155	140.4	0.406	598.2	0.0351	1748.2	0.908	1148.2	0.349	698.2	0.0314		
95.4	0.285	218.0	0.550	623.2	0.0364	1773.2	0.891*	1173.2	0.364	723.2	0.0320		
148.5	0.481	300.0	0.741	648.2	0.0374	1798.2	0.929*	1198.2	0.380	748.2	0.0327		
250	0.724	308.0	0.753	673.2	0.0391	1823.2	0.996	1223.2	0.391	773.2	0.0333		
308	0.795	CURVE 49		698.2	0.0400	1848.2	1.05*	1248.2	0.406	798.2	0.0339		
CURVE 46		723.2	0.0405*	723.2	1.05*	1873.2	1.10*	1273.2	0.431	823.2	0.0343		
17.1	0.00690	20	0.0523	748.2	0.0410*	1898.2	1.10*	1298.2	0.435	848.2	0.0354		
27.7	0.0115	30	0.138	773.2	0.0418*	1935.2	1.20	1323.2	0.452	873.2	0.0364		
31.8	0.0213	40	0.259	798.2	0.0427	CURVE 52		1348.2	0.477	898.2	0.0375		
41.0	0.0344	50	0.418	823.2	0.0435*	T = 233.2K		1373.2	0.485	923.2	0.0382		
62.2	0.0640	60	0.586	848.2	0.0444*			1398.2	0.536	948.2	0.0392		
95	0.122	70	0.795	873.2	0.0448*			1423.2	0.590	973.2	0.0402		
150	0.211	80	1.05	898.2	0.0452			1473.2	0.653	998.2	0.0412		
250	0.339	90	1.13	923.2	0.0469			1498.2	0.695	1023.2	0.0427		
305	0.397	100	1.38	948.2	0.0490			1523.2	0.720	1048.2	0.0435		
CURVE 47		150	2.01	973.2	0.0531*			1548.2	0.732	1073.2	0.0448		
		200	2.26*	998.2	0.0540			1573.2	0.749	1098.2	0.0464		
		250	2.34	1023.2	0.0561			1598.2	0.761	1123.2	0.0481		
				1048.2	0.0569*			1623.2	0.837	1148.2	0.0502		
		CURVE 50*		1073.2	0.0586			1648.2	0.870	1173.2	0.0519		
10.9	0.0113	10	0.00837	1098.2	0.0611			1673.2	0.908	1198.2	0.0540		
20.8	0.0293	20	0.0460	1123.2	0.0640			1698.2	0.929	1223.2	0.0565		
40.8	0.0866	30	0.121	1148.2	0.0657*			1723.2	0.950	1248.2	0.0590		
66.5	0.184	40	0.230	1173.2	0.0686			1748.2	0.908	1273.2	0.0615		
78.0	0.227	50	0.368	1198.2	0.0715			1773.2	0.891	1298.2	0.0649		
92.0	0.299	60	0.502	1223.2	0.0753			1798.2	0.929	1323.2	0.0682		
103.0	0.404	70	0.650	1248.2	0.0808*			1823.2	1.005	1348.2	0.0724		
124.6	0.460	80	0.920	1298.2	0.0837			1848.2	1.05	1373.2	0.0787		
158.4	0.551			1323.2	0.0874			1873.2	1.10	1398.2	0.0862		
								1898.2	1.10				
								1935.2	1.20				

* Not shown on plot

THERMAL CONDUCTIVITY OF ATJ GRAPHITE

FIGURE SHOWS ONLY 12 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 5 THERMAL CONDUCTIVITY OF ATJ GRAPHITE

[For Data Reported in Figure and Table No. 5]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	348	R	1960	610-1922			Ash content 0.2%; specimen composed of 15 disks; three of which 1 in. thick, twelve others 0.5 in. thick; each with a dia of 3 ± 0.002 in.; maximum grain size ~ 0.006 in.; made from blocks of ATJ graphite size $9 \times 20 \times 24$ in.; machined perpendicular to grain orientation; siliconized.
2	348	R	1960	650-1929			Similar to the above specimen but machined parallel to grain orientation.
3	243	R	1962	517-1160			Molded and fired; maximum exposure temp 2843 C; specimen 0.75 in. in dia and 0.75 in. long; no deterioration observed after the experiment.
4	243	R	1962	1261-1992			Another run of the above specimen.
5	243	R	1962	1258-2369			Another run of the above specimen.
6	243	R	1962	1425-1769			Another run of the above specimen.
7	243	R	1962	832-837			Another run of the above specimen.
8	243	R	1962	558-560			Another run of the above specimen.
9	243	R	1962	2383-2505			Another run of the above specimen.
10	243	R	1962	2783-3050			Another run of the above specimen.
11	243	R	1962	2622-3022			Another run of the above specimen.
12	343	E	1959	1400-2000			Rectangular bars fabricated by molding; size $1 \times 1 \times 10$ cm; specific gravity 1.74; measured perpendicular to the direction of molding pressure; data averaged from measurements of 4 specimens.
13	343	E	1959	1400-1900			Similar to the above specimens but data averaged from 3 other specimens.
14	343	E	1959	1300-1900			Similar to the above specimens but with specific gravity of 1.69; data averaged from 4 specimens; measured parallel to the direction of molding pressure.
15	338		1962	298.2			Graphite stocks size $9 \times 20 \times 24$ in.; grain size 0.006 in.; bulk density 1.73 g cm^{-3} ; electrical resistivity $1100 \mu\text{ohm cm}$; with grain orientation.
16	338		1962	298.2			Similar to the above but electrical resistivity $1450 \mu\text{ohm cm}$; across grain orientation.

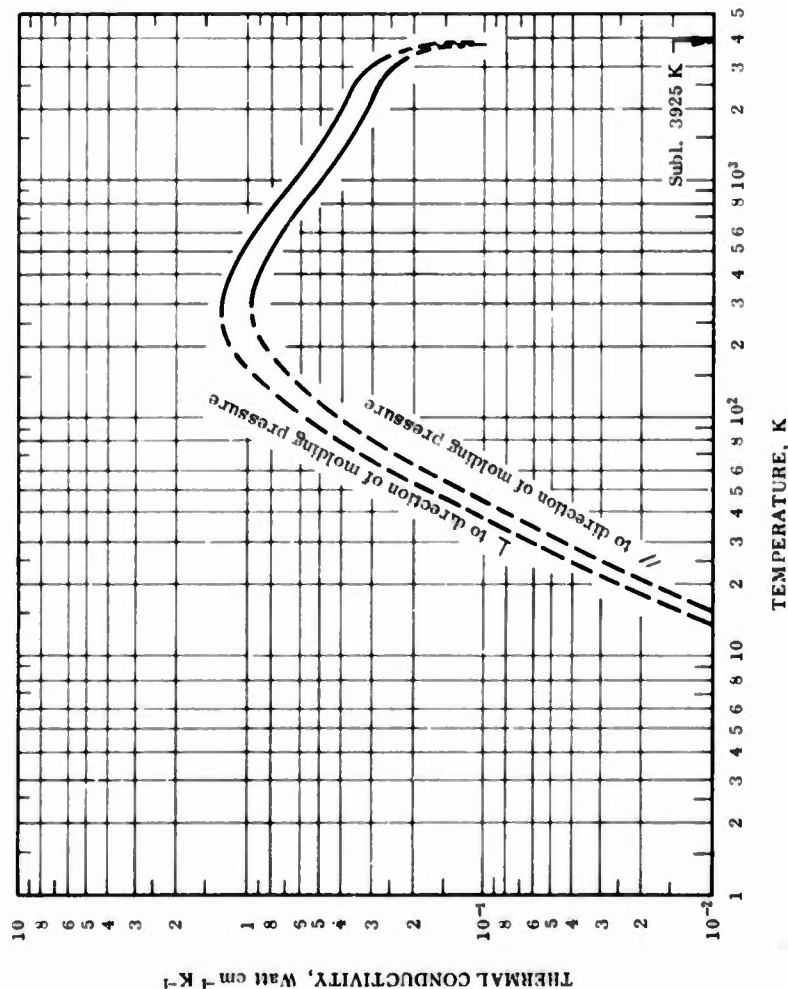
DATA TABLE NO. 5 THERMAL CONDUCTIVITY OF ATJ GRAPHITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 4</u>		<u>CURVE 9</u>		<u>CURVE 13 (cont.)</u>		<u>CURVE 14*</u>	
610.4	0.722	1260.9	0.355	558.2	0.826	1600	0.430*	1300	0.430
614.3	0.697	1272.1	0.330	559.8	0.795	1700	0.470	1400	0.390
824.8	0.599	1590.4	0.394	559.8	0.854	1800	0.441	1500	0.350
1035.4	0.531	1583.2	0.410	560.4	0.762	1900	0.430	1600	0.370
1266.5	0.433	1585.9	0.363	<u>CURVE 11</u>		<u>CURVE 15</u>		<u>CURVE 16</u>	
1371.5	0.396	1594.3	0.326	2622.0	0.172	298.2	1.18	298.2	0.895
1540.9	0.363	1602.6	0.346*	2641.5	0.160				
1710.9	0.325	1811.0	0.352	2972.1	0.133				
1833.2	0.305	1813.7	0.345*	3002.6	0.123				
1922.1	0.294	1991.5	0.286	3022.1	0.177				
<u>CURVE 2</u>		<u>CURVE 5</u>		<u>CURVE 12</u>					
649.8	0.917	1258.2	0.267	1400	0.520				
830.9	0.748	1263.7	0.286	1500	0.500				
991.5	0.633	1266.5	0.332*	1600	0.430				
1113.7	0.568	2091.5	0.176	1700	0.420				
1297.1	0.459	2102.6	0.195	1800	0.470				
1378.2	0.426	2108.2	0.252	1900	0.440				
1469.8	0.362	2236.0	0.189	2000	0.430				
1574.8	0.344	2238.7	0.202	<u>CURVE 13</u>					
1655.4	0.336	2244.3	0.172	1400	0.489				
1680.9	0.332*	2247.0	0.203*	1500	0.468				
1753.7	0.310	2358.2	0.271						
1842.1	0.294	2369.3	0.203						
1929.3	0.292	<u>CURVE 6*</u>							
<u>CURVE 3</u>		<u>CURVE 7*</u>							
516.5	0.793	1424.8	0.264						
518.2	0.858	1427.6	0.261						
519.3	1.00	1769.3	0.264						
524.3	0.733	1769.3	0.232						
608.7	0.743	<u>CURVE 8*</u>							
614.3	0.728*	831.5	0.490						
836.5	0.513	833.2	0.577						
840.4	0.629	836.5	0.646						
856.5	0.505								
1133.7	0.303								
1142.1	0.329								
1147.6	0.294								
1157.1	0.404								
1159.8	0.395								

Not shown on plot

FIGURE AND TABLE NO. 5R RECOMMENDED THERMAL CONDUCTIVITY OF ATJ GRAPHITE



RECOMMENDED VALUES*	
(L to direction of molding pressure)	
T ₁	k ₁
0	0
10	(0.0049) ‡
20	(0.025)
30	(0.06)
40	(0.11)
50	(0.17)
60	(0.24)
70	(0.32)
80	(0.41)
90	(0.49)
100	(0.58)
150	(0.94)
200	(1.20)
250	(1.31)
273.2	(1.31)
300	1.29
350	1.24
400	1.18
500	1.06
600	0.95
700	0.85
800	0.77
900	0.70
1000	0.64
1200	0.55
1400	0.49
1600	0.45
1800	0.42
2000	0.40
2200	0.38
2400	0.36
2600	0.35
2800	0.33
3000	0.31
3200	0.28
3400	(0.25)
3600	(0.20)
3800	(0.113)

RECOMMENDED VALUES*	
(|| to direction of molding pressure)	
T ₂	k ₂
-459.7	0
-431.7	(0.231)
-423.7	(1.10)
-405.7	(2.66)
-387.7	(4.80)
-369.7	(7.51)
-351.7	(10.4)
-333.7	(13.9)
-315.7	(17.3)
-297.7	(20.8)
-279.7	(24.3)
-189.7	(38.7)
-99.7	(49.7)
-9.7	(56.0)
32.0	(56.6)
80.3	56.6
170.3	54.9
260.3	52.0
440.3	46.8
620.3	42.2
800.3	37.6
980.3	34.1
1160	31.2
1340	28.3
1700	24.8
2060	22.5
2420	20.8
2780	19.6
3140	18.5
3500	17.9
3860	16.8
4220	16.2
4580	15.6
4940	14.4
5300	(13.3)
5660	(12.1)
6020	(9.82)
6380	(5.49)

REMARKS

ATJ graphite is a pitch-bonded petroleum-coke-base graphite with typical room-temperature density 1.73 g cm⁻³ and is produced by the Carbon Products Division of Union Carbide Corporation. It is formed by molding into blocks and it has very fine grains (0.006 inch maximum). This graphite was previously designated in the development stage as GBH graphite. The uncertainty of the recommended values that are supported by experimental data is probably of the order of ±10 to ±20%, and that of the values obtained by extensive extrapolation is probably twice as great.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹; T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹.

‡ Values in parentheses are extrapolated or estimated.

FIGURE SHOWS ONLY 17 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF AWG GRAPHITE

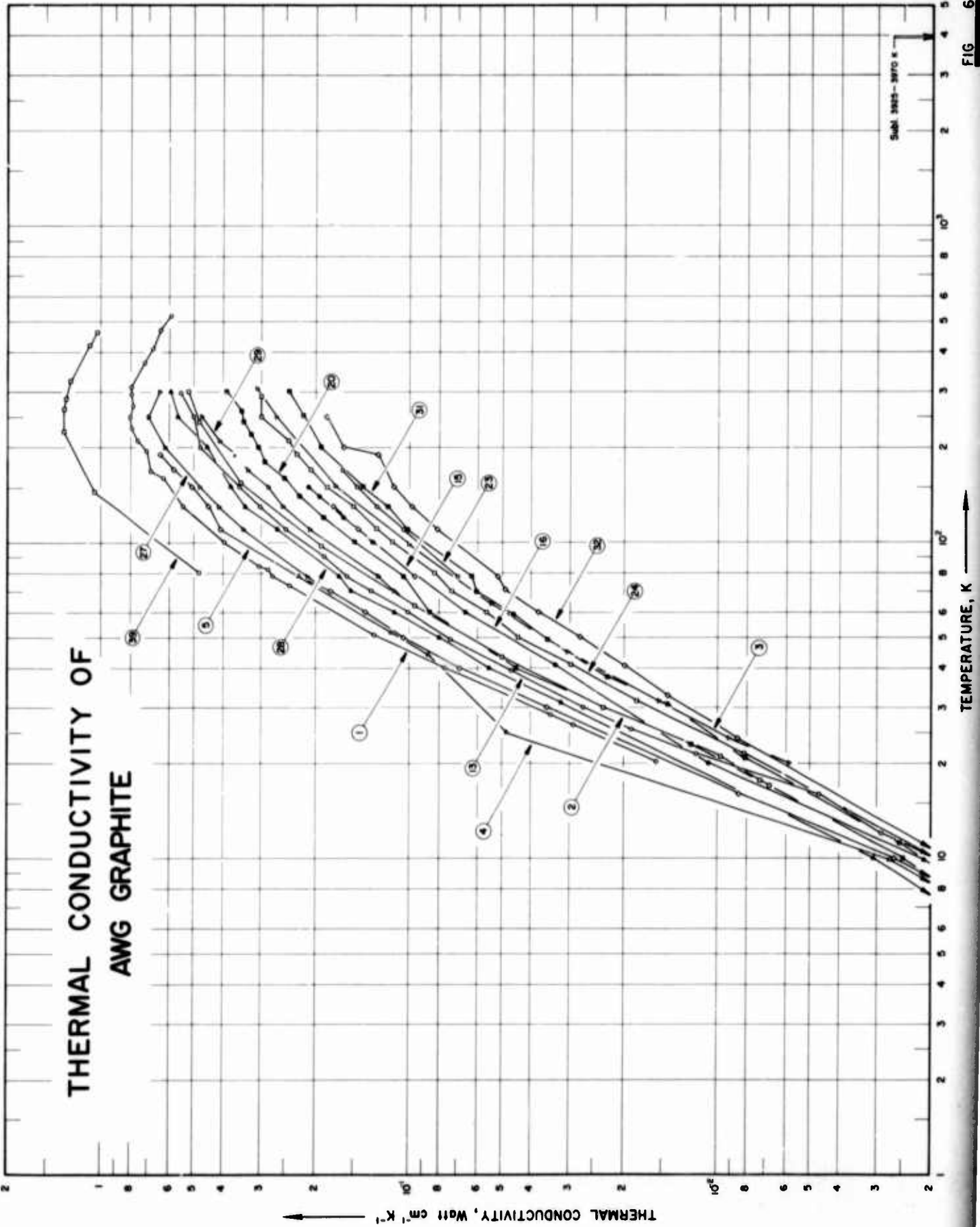


FIG 6

SPECIFICATION TABLE NO. 6 THERMAL CONDUCTIVITY OF AWG GRAPHITE

[For Data Reported in Figure and Table No. 6]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	163, 50, 53	E	1954	20-520	±5		Polycrystalline; molded petroleum coke; particle size 25 μ; crystallite size 0.2 μ; density 1.75 g cm ⁻³ at 25 C; thermoelectric power 2.3 μvolt K ⁻¹ ; Hall coefficient -0.47 emu; magneto resistivity 1.9 x 10 ⁻¹⁶ emu; electrical resistivity 14.3 milliohm cm; total susceptibility -20.60 x 10 ⁻⁴ cgs unit; orientation factor (ρ _{max} /ρ _{min}) = 1.3; measured parallel to the direction of the molding pressure.
2	163, 50	E	1954	17-300	±5		The above specimen exposed to neutron bombardment of 6 MWD/T at <60 C.
3	163, 50	E	1954	20-308	±5		The above specimen exposed to neutron bombardment of 22.7 MWD/T at <30 C.
4	51	E	1956	5.6-78	<2	C-369, No. 1	Specimen 10 mil thick cut from a block of pitch-bonded artificial graphite; electrical resistivity varied from 4.009 to 3.418 milliohm cm at 5, 6 to 78 K respectively; irradiated at 103 K by 8.6 Mev protons of 0.65 μah cm ⁻² (micro ampere hour per square centimeter); measured parallel to molding pressure.
5	51	E	1956	6.0-190	<2	C-369, No. 1	The above specimen pulse-annealed for 5 min at 225 K before irradiation; electrical resistivity varied from 3.901 to 2.439 milliohm cm at 6, 0 to 190 K respectively.
6	51	E	1956	78-250	<2	C-369, No. 1	The above specimen pulse-annealed at 375 K before irradiation; electrical resistivity varied from 2.968 to 1.924 milliohm cm at 78 to 250 K respectively.
7	51	E	1956	78	<2	C-369, No. 1	The above specimen measured at 78 K after being pulse-annealed at temp ranging from 125 to 375 K.
8	51	E	1956	110	<2	C-369, No. 1	The above specimen measured at 110 K after being pulse-annealed at 225 and 375 K.
9	51	E	1956	130	<2	C-369, No. 1	The above specimen measured at 130 K after being pulse-annealed at 225 and 375 K.
10	51	E	1956	150	<2	C-369, No. 1	The above specimen measured at 150 K after being pulse-annealed at 225 and 375 K.
11	51	E	1956	170	<2	C-369, No. 1	The above specimen measured at 170 K after being pulse-annealed at 225 and 375 K.
12	51	E	1956	190	<2	C-369, No. 1	The above specimen measured at 190 K after being pulse-annealed at 225 and 375 K.
13	51	E	1956	8.6-297	<2	C-369, No. 2	Similar to the above specimen but isothermal-annealed for 2 weeks at 300 K; electrical resistivity varied from 4.139 to 2.372 milliohm cm at 8, 6 to 297 K respectively; irradiated by protons of 0.31 μah cm ⁻² .
14	51	E	1956	6.3-78	<2	C-369, No. 3	Similar to the above specimen but electrical resistivity varies from 5.155 to 4.822 milliohm cm at 6, 3 to 78 K respectively; irradiated with protons at 103 K of 7.9 μah cm ⁻² .
15	51	E	1956	78-130	<2	C-369, No. 3	The above specimen pulse-annealed for 5 min at 150 K; electrical resistivity varied from 4.895 to 4.736 milliohm cm at 78 to 130 K respectively.
16	51	E	1956	6.0-150	<2	C-369, No. 3	The above specimen pulse-annealed at 175 K; electrical resistivity varied from 5.155 to 4.633 milliohm cm at 6, 0 to 150 K respectively.
17	51	E	1956	78-170	<2	C-369, No. 3	The above specimen pulse-annealed at 200 K; electrical resistivity varied from 4.754 to 4.408 milliohm cm at 78 to 170 K respectively.

SPECIFICATION TABLE NO. 6 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
18	51	E	1956	6.0-78	<2	C-369, No. 3	The above specimen pulse-annealed at 250 K; electrical resistivity at 6.0 and 78 K being, respectively, 4.557 and 4.291 milliohm cm.
19	51	E	1956	6.0-78	<2	C-369, No. 3	The above specimen pulse-annealed at 300 K; electrical resistivity at 6.0 and 78 K being, respectively, 4.179 and 4.30 milliohm cm.
20	51	E	1956	6.0-300	<2	C-369, No. 3	The above specimen pulse-annealed at 375 K; electrical resistivity varied from 4.295 to 2.92 milliohm cm at 6.0 to 300 K respectively.
21	51	E	1956	78	<2	C-369, No. 3	The above specimen measured at 78 K after being pulse-annealed at temperatures from 125 to 375 K.
22	51	E	1956	5.5-78	<2	C-369, No. 4	Similar to the above specimen but not annealed; irradiated at 103 K by protons of 12.8 $\mu\text{ah cm}^{-2}$; electrical resistivity (before irradiation) varied from 5.261 to 4.943 milliohm cm at 5.5 to 78 K respectively.
23	51	E	1956	78-170	<2	C-369, No. 4	The above specimen pulse-annealed for 5 min at 200 K; electrical resistivity varied from 4.935 to 4.700 milliohm cm at 78 to 170 K respectively.
24	51	E	1956	6.6-290	<2	C-369, No. 4	The above specimen pulse-annealed at 375 K; electrical resistivity varied from 4.362 to 3.44 milliohm cm at 6.6 to 290 K respectively.
25	51	E	1956	78	<2	C-369, No. 4	The above specimen measured at 78 K after being pulse-annealed at temperatures ranging from 125 to 375 K.
26	51	E	1956	78	<2	Brookhaven	Similar to the above specimen but being exposed to $\sim 10^{18}$ neutrons cm^{-2} .
27	51	E	1956	5.6-300	<2	C-376, No. 1	Similar to the above specimen but irradiated at 300 K with an exposure of protons 1.46 $\mu\text{ah cm}^{-2}$; electrical resistivity varied from 3.923 to 1.964 milliohm cm at 5.6 to 300 K respectively; not annealed.
28	51	E	1956	5.2-300	<2	C-376, No. 2	Similar to the above specimen but being irradiated with an exposure of protons at 2.47 $\mu\text{ah cm}^{-2}$; electrical resistivity varied from 4.083 to 2.214 milliohm cm at 5.2 to 300 K respectively.
29	51	E	1956	6.2-250	<2	C-376, No. 3	Similar to the above specimen but being irradiated with an exposure of protons at 5.8 $\mu\text{ah cm}^{-2}$; electrical resistivity varied from 4.290 to 2.945 milliohm cm at 6.2 to 250 K respectively.
30	51	E	1956	6.4-250	<2	C-376, No. 4	Similar to the above specimen but being irradiated with an exposure of 9.3 $\mu\text{ah cm}^{-2}$; electrical resistivity varied from 4.350 to 3.308 milliohm cm at 6.4 to 250 K respectively.
31	51	E	1956	5.6-250	<2	C-376, No. 5	Similar to the above specimen but being irradiated with an exposure of 15.9 $\mu\text{ah cm}^{-2}$; electrical resistivity varied from 4.465 to 3.567 milliohm cm at 5.6 to 250 K respectively.
32	51	E	1956	5.2-250	<2	C-376, No. 6	Similar to the above specimen but being irradiated with an exposure of 27.5 $\mu\text{ah cm}^{-2}$; electrical resistivity varied from 4.653 to 3.988 milliohm cm at 5.2 to 250 K respectively.

SPECIFICATION TABLE NO. 6 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
33	51	E	1956	7.6-300	<2	C-381, No. 1	Similar to the above specimen but being irradiated at 423 K with an exposure of $0.95 \mu\text{h cm}^{-2}$; electrical resistivity varied from 3.568 to 1.743 milliohm cm at 7.6 to 300 K respectively.
34	51	E	1956	7.2-300	<2	C-381, No. 2	Similar to the above specimen but being irradiated with an exposure of $3.1 \mu\text{h cm}^{-2}$; electrical resistivity varied from 3.711 to 1.827 milliohm cm at 7.2 to 300 K respectively.
35	51	E	1956	6.8-300	<2		Similar to the above specimen but being irradiated by protons of $4.96 \mu\text{h cm}^{-2}$; electrical resistivity varied from 3.939 to 2.016 milliohm cm at 6.8 to 300 K respectively.
36	51	E	1956	7.6-300	<2		Similar to the above specimen but being irradiated by protons of $11.9 \mu\text{h cm}^{-2}$; electrical resistivity varied from 4.186 to 2.304 milliohm cm at 7.6 to 300 K respectively.
37	51	E	1956	6.8-250	<2		Similar to the above specimen but being irradiated by protons of $19.7 \mu\text{h cm}^{-2}$; electrical resistivity varied from 4.426 to 2.875 milliohm cm at 6.8 to 250 K respectively.
38	51	E	1956	6.4-300	<2		Similar to the above specimen but being irradiated by protons of $30.2 \mu\text{h cm}^{-2}$; electrical resistivity varied from 4.545 to 2.978 milliohm cm at 6.4 to 300 K respectively.
39	53	E	1955	80-460	± 5		Made from petroleum coke; molded; specimen size $0.100 \times 0.020 \times 1.25 \text{ in.}$; room temp properties: density 1.75 g cm^{-3} , thermoelectric power $+2.3 \mu\text{volt K}^{-1}$, Hall coefficient -0.47 emu , magneto resistivity $1.9 \times 10^{-16} \text{ emu}$, electrical resistivity 14.3 milliohm cm , total magnetic susceptibility $-20.6 \times 10^{-4} \text{ cgs unit}$, orientation factor $(\rho_{\text{max}}/\rho_{\text{min}}) = 1.0$; measured perpendicular to the direction of the molding pressure.

DATA TABLE NO. 6 THERMAL CONDUCTIVITY OF AWG GRAPHITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

CURVE 1		CURVE 3 (cont.)		CURVE 7*		CURVE 12*		CURVE 16		CURVE 20 (cont.)		CURVE 23 (cont.)	
T	k	T	k	T _A	k	T _A	k	T	k	T	k	T	k
20.05	0.0157	45.0	0.0305	0	0.228	225	0.644	6.0	0.000979*	180	0.293	130	0.127
26.5	0.0293	64.0	0.0544	125	0.224	375	0.611	9.9	0.00210	200	0.307	150	0.147
28.5	0.0347	99.0	0.100	150	0.230			20.0	0.0107	220	0.325	170	0.164
40.0	0.0774	151.0	0.172	175	0.228	T	k	41.0	0.0335	240	0.342	CURVE 24	
51.0	0.130	250.0	0.268	200	0.233			60.0	0.0661	260	0.349	6.6	0.000941*
73.0	0.243	308.0	0.310	225	0.228	CURVE 13		78.0	0.0954*	300	0.390	10.0	0.00193*
82.0	0.285	CURVE 4		250	0.228	8.6	0.00138*	100.0	0.131	T _A k		21.6	0.00816
84.0	0.305	5.6	0.000962	275	0.232	12.0	0.00291	120	0.162	CURVE 21*		31.6	0.0182
100.0	0.397	9.9	0.00272	300	0.230	16.0	0.00469	140	0.195	T = 78 K		41.0	0.0298
130.0	0.544	25.0	0.0485	325	0.229	21.4	0.0118	150	0.211	0	0.0946	50.0	0.0444
160.0	0.628	44.0	0.0866	350	0.232	25.6	0.0190	CURVE 17*		125	0.0933	60.0	0.0565
168.0	0.686	52.0	0.115	375	0.233	30.0	0.0271	78.0	0.0950	150	0.0958	70.0	0.0732
195.0	0.711	78.0	0.228	CURVE 8*		39.2	0.0469	100	0.131	175	0.0954	80.0	0.0828
210.0	0.761	CURVE 5		275	0.232	49.4	0.0736	120	0.162	200	0.0950	100	0.114
230.0	0.795	6.0	0.000991*	300	0.230	60.0	0.101	140	0.195	225	0.0941	110	0.127
250.0	0.808	10.0	0.00264	325	0.229	78.0	0.133	160	0.225	250	0.0954	130	0.151
270.0	0.787	16.0	0.00849	350	0.232	90.0	0.188	170	0.246	275	0.0975	150	0.184
295.0	0.799	30.0	0.0356	CURVE 9*		110.0	0.249	CURVE 18*		300	0.0979	170	0.208
310.0	0.799	30.0	0.0356	225	0.410	130	0.303	6.0	0.00105	325	0.101	190	0.230
370.0	0.724	40.0	0.0690	375	0.379	150	0.354	6.0	0.00105	350	0.103	210	0.244
470.0	0.640	50.0	0.105	CURVE 10*		200	0.477	78.0	0.0954	375	0.105	250	0.300
520.0	0.594	60.0	0.138	225	0.448	250	0.502	CURVE 19*		T k		290	0.300
CURVE 2		70.0	0.179	375	0.473	297	0.552	6.0	0.00105	CURVE 22*		T _A	k
17.0	0.00682	78.0	0.228*	CURVE 10*		CURVE 14*		6.0	0.00105	5.5	0.000707	T = 78 K	
17.6	0.00728	110	0.410	225	0.506	6.3	0.000992	78.0	0.0979	10.0	0.00188	0	0.0699
21.0	0.00979	130	0.448	375	0.540	10.0	0.00233	CURVE 20		20.0	0.00900	125	0.0674
30.0	0.0232	150	0.506	CURVE 11*		17.0	0.00628	6.0	0.00113*	31.0	0.0181	150	0.0703
43.5	0.0502	170	0.582	225	0.582	20.0	0.00937	10.0	0.00247	41.0	0.0281	175	0.0711
63.0	0.0962	190	0.644	375	0.582	30.0	0.0187	23.0	0.0122	50.0	0.0386	200	0.0699
97.0	0.192	CURVE 6*		225	0.582	48.0	0.0657	40.0	0.0452	60.0	0.0515	225	0.0686
155.0	0.351	78	0.233	375	0.582	78.0	0.0946	60.0	0.0658	70.0	0.0611	250	0.0703
240.0	0.481	116	0.379	CURVE 15		78.0	0.195	78.0	0.0699	275	0.0724	300	0.0749
300.0	0.523	130	0.473	150	0.540	80	0.0958	100	0.149	CURVE 23		325	0.0766
CURVE 3		150	0.540	170	0.582	110	0.146	140	0.189	78.0	0.0699*	350	0.0778
20.0	0.00586	190	0.611	210	0.632	130	0.176	160	0.253	110	0.105	375	0.0828
24.0	0.00920	230	0.665	250	0.703								
31.5	0.0155												

* Not shown on plot

DATA TABLE NO. 6 (continued)

T _A	k	T	k	T	k	T	k	T	k	T	k				
CURVE 26*															
T = 78 K															
0	0.0686	200	0.452	30.8	0.0145	150	0.506	7.6	0.00144	40.0	0.0290				
125	0.0682	250	0.565	37.6	0.0226	200	0.661	10.4	0.00268	50.0	0.0444				
150	0.0720	300	0.594	49.5	0.0355	250	0.695	15.0	0.00573	60.0	0.0615				
175	0.0711	CURVE 29													
200	0.0707	78.0	0.0607	70.2	0.0607	300	0.695	23.0	0.0143	70.0	0.0816				
225	0.0703	6.2	0.00109*	78.0	0.0632	CURVE 34*									
250	0.0711	10.2	0.00264*	110	0.102	7.2	0.00146	30.0	0.0239	110	0.143				
275	0.0736	21.2	0.0142*	130	0.117	40.8	0.0448	40.8	0.0448	130	0.178				
300	0.0745	30.8	0.0255*	150	0.141	50.2	0.0644	50.2	0.0644	150	0.206				
325	0.0757	41.6	0.0435*	200	0.193	60.0	0.0933	60.0	0.0933	200	0.267				
350	0.0782	48.6	0.0644*	252	0.220	70.0	0.118	70.0	0.118	250	0.308				
375	0.0816	60.0	0.0879*	300	0.244	78.0	0.138	78.0	0.138	300	0.317				
CURVE 31															
T = 78 K															
5.6	0.00120*	70.0	0.113	5.2	0.000766*	110	0.126	110	0.126	110	0.126				
10.2	0.00331*	110	0.126	10.0	0.00175*	130	0.141	130	0.141	130	0.141				
22.4	0.0161*	150	0.255	24.0	0.00858	150	0.284	150	0.284	150	0.284				
30.8	0.0389*	170	0.332	32.8	0.0144	170	0.364	170	0.364	170	0.364				
41.4	0.0682*	190	0.412	40.8	0.0199	190	0.442	190	0.442	190	0.442				
50.4	0.100*	210	0.473	50.2	0.0277	210	0.519	210	0.519	210	0.519				
59.4	0.137*	250	0.644	60.2	0.0377	250	0.690	250	0.690	250	0.690				
70.0	0.185*	CURVE 30*													
78.0	0.213	6.4	0.00113	110	0.0912	6.4	0.00113	6.8	0.00111	80	0.481				
110	0.344	10.2	0.00247	130	0.0983	10.2	0.00247	10.8	0.00245	145	1.05				
130	0.414	20.0	0.00962	150	0.113	20.0	0.00962	15.2	0.00523	225	1.32				
150	0.477	30.2	0.0225	190	0.126	30.2	0.0225	26.4	0.0156	265	1.32				
200	0.619	41.0	0.0368	200	0.162	41.0	0.0368	40.8	0.0369	285	1.30				
250	0.699	50.0	0.0749	250	0.185	50.0	0.0749	60.0	0.0728	325	1.26				
300	0.644	60.0	0.0695	60.0	0.0695	60.0	0.0695	70.6	0.0958	420	1.09				
CURVE 28															
T = 78 K															
5.2	0.00109*	78.0	0.0967	7.6	0.00164	6.8	0.00133	21.2	0.0117	460	1.03				
10.0	0.00307	110	0.141	10.8	0.00350	10.4	0.00284	6.8	0.00111	80	0.481				
31.0	0.0321	130	0.195	15.4	0.00770	15.4	0.00674	10.8	0.00245	145	1.05				
40.0	0.0552	150	0.216	21.2	0.0156	21.8	0.0147	15.2	0.00523	225	1.32				
50.0	0.0799	170	0.246	25.2	0.0239	25.8	0.0207	26.4	0.0156	265	1.32				
60.0	0.112	190	0.272	31.0	0.0377	31.0	0.0302	30.6	0.0219	285	1.30				
70.0	0.154	210	0.300	41.2	0.0686	40.8	0.0531	40.8	0.0369	325	1.26				
78.0	0.169	250	0.331	49.6	0.101	49.6	0.0886	40.8	0.0369	420	1.09				
110	0.265	CURVE 31													
130	0.339	60.0	0.144	60.0	0.144	60.0	0.144	6.4	0.000912	80	0.481				
150	0.377	70.2	0.194	70.2	0.194	70.2	0.194	10.0	0.00215	145	1.05				
CURVE 32															
T = 78 K															
5.6	0.00086*	5.6	0.00086*	5.6	0.00086*	5.6	0.00086*	5.6	0.00086*	5.6	0.00086*				
11.2	0.00254	11.2	0.00254	11.2	0.00254	11.2	0.00254	11.2	0.00254	11.2	0.00254				
20.8	0.00808	20.8	0.00808	20.8	0.00808	20.8	0.00808	20.8	0.00808	20.8	0.00808				

* Not shown on plot

FIGURE SHOWS ONLY 61 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF PYROLYTIC GRAPHITE

Continued on Figure 7-2

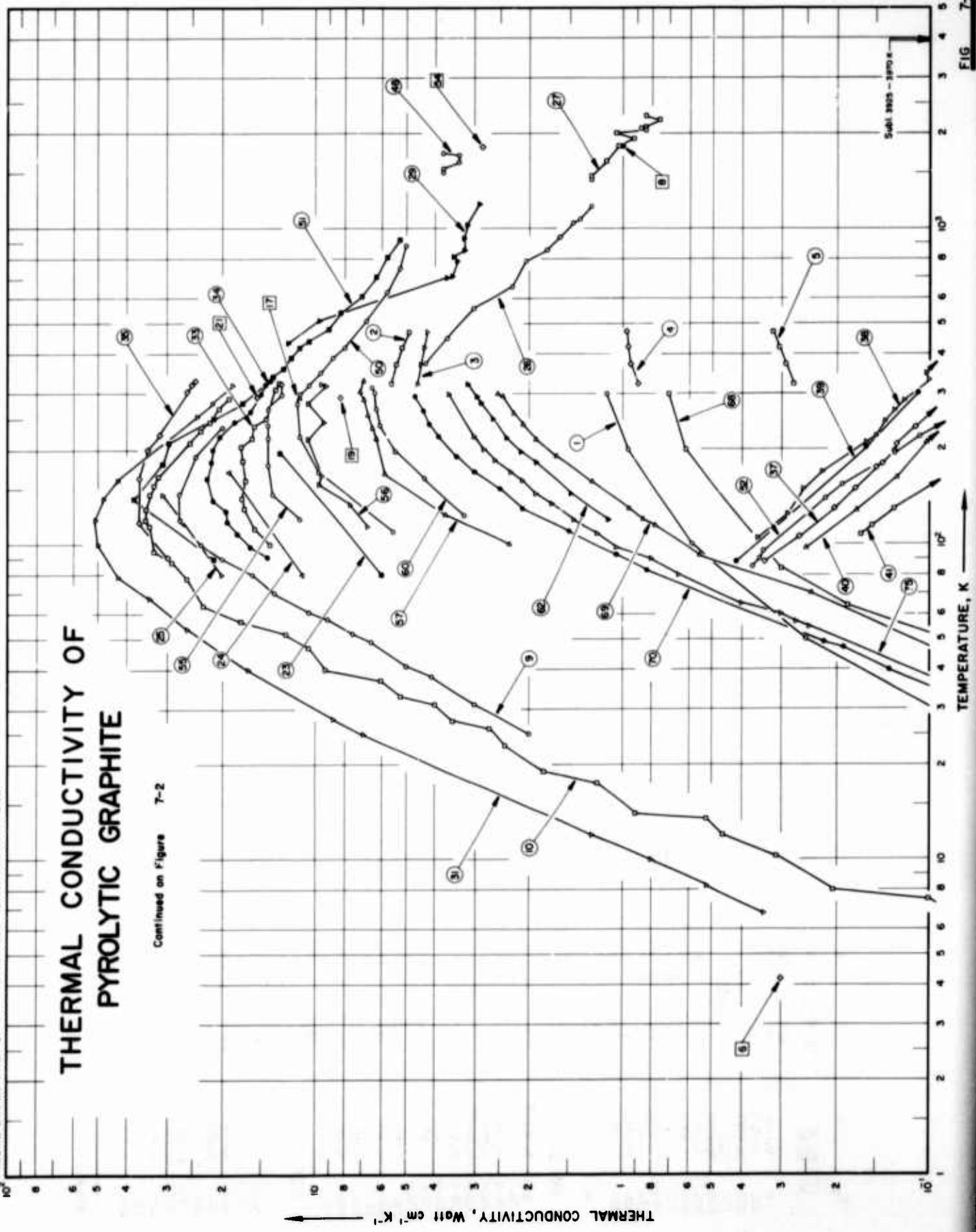
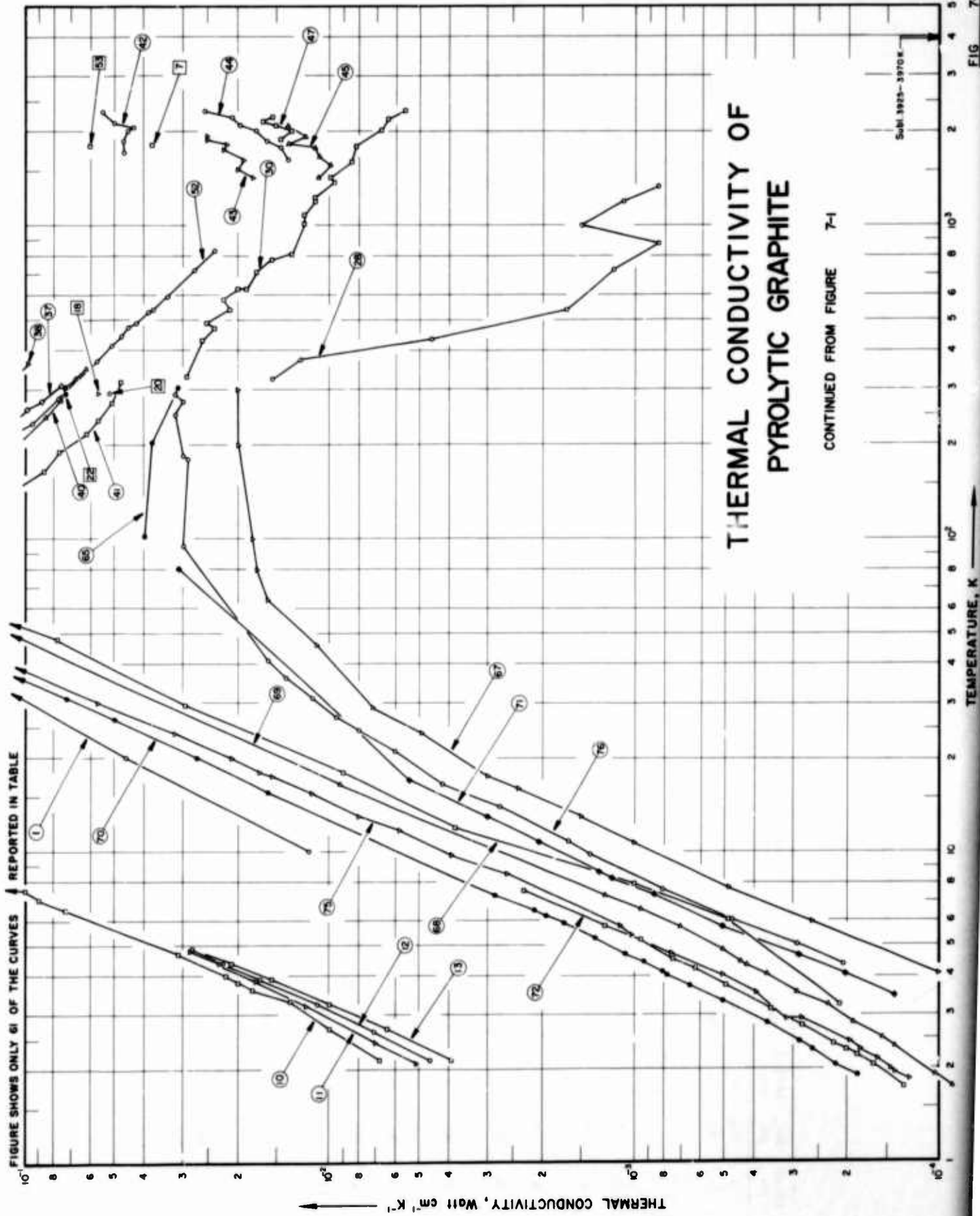


FIG 7-1



SPECIFICATION TABLE NO. 7 THERMAL CONDUCTIVITY OF PYROLYTIC GRAPHITE

[For Data Reported in Figure and Table No. 7]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	50	E	1956	10-300	±5	Deposited carbon	Obtained by pyrolytic decomposition of a hydrocarbon; no pitch bonding.
2	19	C	1956	323-473		Deposited carbon	Also known as pyrolytic graphite, 99.75 ± 0.2 pure with undetectable ash content; deposited from AR grade benzene at 2100 C in a vacuum of 10 ⁻⁵ cm Hg; tubular specimen 4.5 cm long, 0.95 cm O. D., and 0.75 cm I. D.; density 1.65 g cm ⁻³ ; electrical resistivity at 20, 50, 100, 150, and 200 C being, respectively, 245, 230, 215, 200, and 195 μohm cm; measured parallel to axis of tube and parallel to the pronounced layered structure of the specimen.
3	19	C	1956	323-473		Deposited carbon	Similar to the above specimen but deposited at 2000 C; electrical resistivity at 20, 50, 100, 150, and 200 C being, respectively, 380, 360, 330, 305, and 290 μohm cm.
4	19	C	1956	323-473		Deposited carbon	Similar to the above specimen but deposited at 1900 C; electrical resistivity at 20, 50, 100, 150, and 200 C being, respectively, 1.645, 1.585, 1.47, 1.37, and 1.27 milliohm cm.
5	19	C	1956	323-473		Deposited carbon	Similar to the above specimen but deposited at 1800 C; electrical resistivity at 20, 50, 100, 150 and 200 C being, respectively, 3.23, 3.17, 3.065, 2.96, and 2.86 milliohm cm.
6	355	L	1965	4.2		Deposited carbon	Rectangular block of pyrolytic graphite provided by G. E. Research Lab; reheated to 3500 C after deposition; electrical conductivity in zero magnetic field 7.8 x 10 ⁸ ohm ⁻¹ cm ⁻¹ .
7	340	-	1962	1817	12		Pyrolytic graphite obtained from General Electric Co.; 2.3 cm dia x 0.1-0.4 cm thick; k _x determined by using the same method as that for the above specimen.
8	340	-	1962	1817	12		k _y determined simultaneously with the above curve.
9	345	L	1958	25-235		Pyrolytic graphite filament	Specimen of fibrous structures prepared by pyrolysis of methane on a hot carbon wire, measurements made under high vacuum.
10	349	L	1966	2.2-290			Well graphitized and highly heat treated (at 3250 C) pyrolytic graphite; measured in the layer-plane direction; in zero magnetic field.
11	349	L	1966	2.1-4.8			The above specimen measured in a magnetic field of 550 gauss applied in the c-axis direction.
12	349	L	1966	2.2-4.9			The above specimen in a field of 1015 gauss.
13	349	L	1966	2.2-4.9			The above specimen in a field of 2115 gauss.
14	349	L	1966	2.2-3.6			The above specimen in a field of 3805 gauss.
15	349	L	1966	2.2-3.9			The above specimen in a field of 8405 gauss.
16	349	L	1966	3.1-4.8			The above specimen in a field of 12600 gauss.
17	350	P	1965	293.2			Specimen ~0.5 in. long; graphitized at 2910 C; specific heat 0.165 cal g ⁻¹ C ⁻¹ at 20 C; measured in the a-axis direction.

SPECIFICATION TABLE NO. 7 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
18	350	P	1965	293.2			Similar to the above specimen but about 0.2 in. long; measured in the c-axis direction.
19	350	P	1965	293.2			Specimen ~0.5 in. long; graphitized at 2500 C; specific heat 0.169 cal g ⁻¹ C ⁻¹ at 20 C; measured in the a-axis direction.
20	350	P	1965	293.2			Similar to the above specimen but ~0.2 in. long; measured in the c-axis direction.
21	350	P	1965	293.2			Similar to the above specimen but ~0.5 in. long; strain annealed at 3300 C; measured in the a-axis direction.
22	350	P	1965	293.2			Similar to the above specimen but ~0.2 in. long; measured in the c-axis direction.
23	351	L	1965	80, 195			Specimen ~0.2 mm thick; cut from a pyrolytic graphite bar which was made at a deposition temp of 2700 C.
24	351	L	1965	80, 170			Similar to the above specimen but deposition temp 2920 C.
25	351	L	1965	80, 144			Similar to the above specimen but deposition temp 2980 C.
26	361	C	1961	375-1175			Highly regenerative pyrolytic graphite; as deposited; the pyrolytic graphite obtained by passing methane on a graphite slab in the resistance furnace at 2100 C; density 220 g cm ⁻³ ; measured parallel to the basal planes using dense sintered alumina as a comparative material.
27	361	R	1961	1430-2275			Similar to the above specimen but using another apparatus for higher temp range.
28	361	R	1961	325-1350			Similar to the above specimen but being heat treated for 3 hrs at 2900 C; measured perpendicular to the basal planes.
29	361	C	1961	435-1205			Similar to the above specimen but heat treated for 1 hr at 2900 C; measured parallel to the basal plane using dense sintered alumina as a comparative material.
30	361	R	1961	330-2340			Similar to the above specimen but without heat treatment; measured perpendicular to the basal plane.
31	360	L	1965	6.8-320	±5	No. 1	Pyrolytic graphite specimen size 1 x 5 x 50 mm; the graphite deposition temp 2100 C; annealed under a pressure of 100 bars for 10-15 min at 2800 C; measured parallel to the graphite basal planes.
32	360	L	1965	5.5-320	±5	No. 2	Similar to the above specimen.
33	362	L	1965	100-325	5	AB3	Pyrolytic graphite deposited at 2150 C; annealed at 3000 C; measured parallel to the basal planes.
34	362	L	1965	91-330	5	IFP41	Similar to the above specimen but also hot pressed at 2850 C under 400 Kg cm ⁻² ; measured parallel to the basal planes.
35	362	L	1965	91-330	5	IFP56	Similar to the above specimen.
36	362	L	1965	84-318	5	IFPA57	Similar to the above specimen but hot pressed at 2850 C and annealed at 3500 C under 10 Kg cm ⁻² for 0.5 hr; measured parallel to the basal planes.

SPECIFICATION TABLE NO. 7 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
37	362	L	1965	88-310	5	IFPA57	The above specimen measured in the c-axis direction.
38	362	L	1965	105-365	5	AB4	Pyrolytic graphite deposited at 2150 C; annealed at 3250 C in induction furnace; measured in the c-axis direction.
39	362	L	1965	88-303	5	AB1	Similar to the AB3 specimen but measured in the c-axis direction.
40	362	L	1965	97-350	5	IFP25	Similar to the IFP41 specimen but measured in the c-axis direction.
41	362	L	1965	107-318	5	IFP25/N4	The above specimen exposed to 2×10^{18} fast neutron cm^{-2} at 30 C; measured in the c-axis direction.
42	365	R	1963	1712-2308	12.5	A1	Specimen 11 cm long, 1.713 cm O. D., and 1.465 cm I. D.; pyrolytic graphite deposited from hexane at 1500 C and at a total pressure of 35 cm Hg (partial pressure of hexane 7 cm Hg); the hydrogen carrier gas flows at a rate of 500 $\text{cm}^3 \text{min}^{-1}$, the specimen being heat treated for 2 hrs at 2500 C; density 1.71 g cm^{-3} ; data obtained by the first method (direct heating of the graphite tube).
43	365	R	1963	1426-1945		A1	The above specimen measured by the third method (separate heater inserted in the tube).
44	365	R	1963	1637-2313	12.5	A2	Specimen 11 cm long, 1.725 cm O. D., and 1.39 cm I. D.; deposited from hexane at 2100 C and by a method similar to the above; heat treated for 2 hrs at 2800 C; density 2.21 g cm^{-3} ; data obtained by the first method.
45	365	R	1963	1420-2009		A2	The above specimen measured by the third method.
46	365	R	1963	1530-2043	12.5	B1	Specimen 11 cm long, 1.75 cm O. D., and 1.394 cm I. D.; deposited in the same way as the above specimen; heat treated for 1.25 hrs at 2600 C; density 2.20 g cm^{-3} ; data obtained by the second method (an improvement of the first method to decrease the end contact resistance of the graphite tube).
47	365	R	1963	1895-2231		B1	The above specimen measured by the third method.
48	365	L	1963	1504-1736	30	B1	Thermal conductivity parallel to the basal planes of the above specimen.
49	365	R	1963	1422-2056		B2	Specimen 11 cm long, 1.75 cm O. D., and 1.351 cm I. D.; deposited and heat treated in the same way as the above specimen; density 2.20 g cm^{-3} ; data obtained by the third method.
50	369	P	1966	110-880		Specimen 42	Specimen 0.5 in. long, made from as deposited pyrolytic graphite; annealed at 2900 C for 1 hr in an inert gas atm; thermal conductivity parallel to the deposition plane calculated from measurements of thermal diffusivity, a constant density of 2.20 g cm^{-3} , and the best fit specific heat data from Magnus 1923, Schlaper and Debrunner 1924, Jacobs and Deem 1956, Wagmar et al. 1945, and Roesini et al. 1953.
51	369	P	1966	90-920		Specimen 90	Specimen also 0.5 in. long supplied by General Electric Co. (structurally more perfect than the above specimen); annealed at 3300 C in inert gas; thermal conductivity parallel to the deposition plane calculated by using the same information as the above specimen.

SPECIFICATION TABLE NO. 7 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
52	369	P	1966	85-830		Specimen 90	The above specimen measured perpendicular to the deposition plane.
53	340	-	1962	1808	large	P1	Supplied by General Electric Co.; 2.540 cm dia x 0.238 cm thick; kz determined by using the same method as that for the above specimen.
54	340	-	1962	1908	large	P1	k _r determined simultaneously with the above curve.
55	395	L	1963	122-324		A ₂	Specimen approx 0.2 x 1.5 x 8 cm thickness parallel to c-axis; made from pyrolytic graphite (inner layer of sample) deposited at 2150 C from methane atm at 10 cm Hg pressure; in its "as deposited" condition; scattering length 18000 Å; heat flow perpendicular to c-axis.
56	395	L	1963	115-324		A ₁	Specimen approx 0.2 x 1.5 x 8 cm, thickness parallel to c-axis; made from pyrolytic graphite deposited at 2180 C from methane atm at 10 cm Hg pressure; in its "as deposited" condition; scattering length 12000 Å; heat flow perpendicular to c-axis.
57	395	L	1963	100-331		A ₃	Similar to the above specimen but deposited at 2000 C with scattering length 5000 Å; heat flow perpendicular to c-axis.
58	395	L	1963	116-335		AB ₁	Similar to the above specimen but deposited at 2150 C and annealed at 3000 C for 30 min; scattering length 36000 Å; heat flow perpendicular to c-axis.
59	395	L	1963	115-327		AB ₂	Similar to the above specimen except scattering length 33000 Å; heat flow perpendicular to c-axis.
60	395	L	1963	125-316		A ₂	Specimen approx 0.2 x 1.5 x 8 cm thickness parallel to c-axis; made from pyrolytic graphite (outer layer of sample) deposited at 2150 C and at 10 cm Hg pressure, in its "as deposited" condition; scattering length 5000 Å; heat flow perpendicular to c-axis.
61	395	L	1963	115-327		AB ₂	Specimen 0.2 x 1.5 x 8 cm, thickness parallel to c-axis; made from pyrolytic graphite deposited at 2150 C from methane atm at 10 cm Hg pressure; annealed at 3000 C for 30 min; scattering length 36000 Å; measured in vacuum of <10 ⁻⁴ mm Hg pressure; heat flow parallel to c-axis.
62	395	L	1963	120-324		N ₁	Specimen obtained by sealing AB ₂ in an evacuated silica tube and irradiating it in a cooled (~30 C) hollow fuel element in B. E. P. O. at Harwell to an integrated fast neutron dose of about 4 x 10 ¹⁸ n. v. t.; heat flow parallel to c-axis; measured in vacuum of <10 ⁻⁴ mm Hg pressure.
63	395	L	1963	111-316		N ₂	The above specimen annealed in vacuo at 240 C for 70 hrs; heat flow parallel to c-axis; measured in vacuum of <10 ⁻⁴ mm Hg pressure.
64	395	L	1963	118-331		N ₃	The above specimen annealed in vacuo at 1220 C for 6 hrs; heat flow parallel to c-axis; measured in vacuum of <10 ⁻⁴ mm Hg pressure.
65	395	L	1963	104-306		A ₁	Specimen 0.2 x 1.5 x 8 cm, thickness parallel to c-axis; made from pyrolytic graphite deposited at 2180 C from methane atm at 10 cm Hg pressure; in its "as deposited" condition; scattering length 12000 Å; measured in vacuum of <10 ⁻⁴ mm Hg pressure; heat flow parallel to c-axis.

SPECIFICATION TABLE NO. 7 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
66	395	L	1963	89-302		AB ₁	Similar to the above specimen except deposited at 2150 C and annealed at 3000 C for 30 min; scattering length 36000 Å; heat flow parallel to c-axis.
67	352	L	1962	4.0-300		PG-0	Specimen 0.7 cm long and having a square cross sectional area of 0.17 cm ² ; made from pyrolytic graphite deposited on a substrate of commercial graphite in a methane atm at 2250 C and at a total pressure of 20 mm Hg; graphite crystallites shaped like oblate ellipsoids (with rotational symmetry about the c-axis), of minor dia (parallel to c-axis) = 140 Å and major dia (perpendicular to c-axis) = 280 Å; these crystallites with an average angular tilt of 22 degrees from the c-axis formed columnar bundles of 0.1 cm in dia; density of the specimen 2.194 g cm ⁻³ ; electrical conductivity 1.98 ohm ⁻¹ cm ⁻¹ at 298 K; sound velocity 3.4 x 10 ⁵ cm sec ⁻¹ at 9.8 megacycles sec ⁻¹ and at 300 K, free from any visible cracks along the [0001] planes; heat flow parallel to the c-axis.
68	352	L	1962	3.2-300		PG-0	Similar to the above specimen but 1.9 cm long with a square cross sectional area of 0.14 cm ² ; electrical conductivity 1.85 x 10 ⁵ ohm ⁻¹ cm ⁻¹ at 298 K; sound velocity 4.7 x 10 ⁵ cm sec ⁻¹ at the same conditions as above; heat flow perpendicular to c-axis.
69	353	L	1964	1.8-300	±3	RAY-17	Specimen of pyrolytic graphite in its "as-deposited" condition; manufactured by Raytheon's Adv. Mat. Dept. with a deposition temp of 1700 C; crystallite size 180 Å; density 2.13 g cm ⁻³ ; cut parallel to the layer plane.
70	353	L	1964	1.9-295	±3	RAY-23	Similar to the above specimen but the deposition temp 2300 C; density 2.22 g cm ⁻³ and crystallite size 255 Å; parallel to the layer plane.
71	353	L	1964	3.4-80	±3	RAY-23	Similar to the above specimen; but cut perpendicular to the layer plane.
72	353	L	1964	1.8-7.5	±3	RAY-19	Similar to the above specimen but the deposition temp 1900 C; crystallite size 240 Å, and density 2.19 g cm ⁻³ ; cut parallel to the layer plane.
73	353	L	1964	2.0-6.8	±3	RAY-21	Similar to the above specimen but the deposition temp 2100 C; crystallite size 270 Å, and density 2.20 g cm ⁻³ ; cut parallel to the layer plane.
74	353	L	1964	3.1-300	±3	RAY-21	Similar to the above specimen but cut perpendicular to the layer plane.
75	353	L	1964	1.9-300	±3	HTM	Specimen of pyrolytic graphite in its "as-deposited" condition; obtained from High Temp. Mat. Inc.; deposition temp ~2100 C; density 2.19 g cm ⁻³ ; cut parallel to the layer plane.
76	353	L	1964	4.3-290	±3	HTM	Similar to the above specimen but cut perpendicular to the layer plane.

DATA TABLE NO. 7 THERMAL CONDUCTIVITY OF PYROLYTIC GRAPHITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>													
10	0.0117												
20	0.046												
50	0.251												
100	0.586												
200	0.962												
300	1.13												
<u>CURVE 2</u>													
323	5.6												
373	5.4												
423	5.15												
473	4.9												
<u>CURVE 3</u>													
323	4.6												
373	4.45												
423	4.35												
473	4.25												
<u>CURVE 4</u>													
323	0.89												
373	0.94												
423	0.96												
473	0.97												
<u>CURVE 5</u>													
323	0.275												
373	0.290												
423	0.305												
473	0.320												
<u>CURVE 6</u>													
4.2	0.30												
<u>CURVE 7</u>													
1817	0.0377												
<u>CURVE 8</u>													
1817	0.996												
<u>CURVE 9</u>													
25	2.0												
31	3.0												
38	4.1												
41	5.0												
49	6.5												
52	7.5												
58	9.1												
61	10.5												
70	13.6												
80	16.0												
90	20.0												
100	23.5												
120	27.5												
145	27.6												
190	24.5												
235	20.0												
<u>CURVE 10</u>													
2.15	0.0068												
2.70	0.0100												
3.30	0.0135												
3.60	0.0180												
3.80	0.020												
4.00	0.022												
4.70	0.031												
6.50	0.073												
7.00	0.090												
7.50	0.100												
8.00	0.205												
10.30	0.310												
12.00	0.460												
13.50	0.520												
14.00	0.900												
17.50	1.20												
19.00	1.80												
23.00	2.40												
26.00	2.70												
<u>CURVE 11</u>													
2.1	0.0051												
2.45	0.0070												
3.2	0.0120												
3.85	0.0175												
4.4	0.0230												
4.8	0.0285												
<u>CURVE 12</u>													
2.15	0.0046												
2.65	0.0071												
3.25	0.0110												
3.90	0.0170												
4.40	0.0225												
4.90	0.0280												
<u>CURVE 13</u>													
2.15	0.0039												
2.70	0.0064												
3.25	0.0100												
3.90	0.0155												
4.40	0.0210												
4.90	0.0260*												
<u>CURVE 14*</u>													
2.15	0.0037												
2.75	0.0065												
3.60	0.0118												
3.60	0.0123												
<u>CURVE 15*</u>													
2.15	0.0038												
2.75	0.0064												
3.25	0.0095												
3.70	0.0150												
3.90	0.0150												
<u>CURVE 16*</u>													
3.1	0.0084												
3.4	0.0108												
3.5	0.0115												
3.9	0.0160												
4.8	0.0240												
<u>CURVE 17</u>													
293.2	11.3												
<u>CURVE 18</u>													
1045	1.46												
1065	1.38												
1175	1.26												
<u>CURVE 19</u>													
293.2	0.0569												
<u>CURVE 20</u>													
293.2	0.0523												
<u>CURVE 21</u>													
2000	1.05												
<u>CURVE 22</u>													
293.2	15.5												
<u>CURVE 23</u>													
293.2	0.0732												
<u>CURVE 24</u>													
80	6.0												
195	13.0												
<u>CURVE 25</u>													
80	20.0												
144	31.0												
<u>CURVE 26</u>													
375	4.31												
450	3.66												
560	3.01												
655	2.28												
790	2.05												
855	1.76												
940	1.61												
<u>CURVE 27</u>													
1045	1.46												
1065	1.38												
1175	1.26												
<u>CURVE 28</u>													
325	0.0156												
375	0.0126												
435	0.00456												
540	0.00167												
725	0.00117												
882	0.000711												
1000	0.00151												
1200	0.00109												
1350	0.000836												
<u>CURVE 29</u>													
435	12.3												
515	9.67												
700	3.66												
710	3.51												
795	3.37												
815	3.47												
855	3.20												
1035	3.14												
1205	2.89												
<u>CURVE 30</u>													
580	0.0222												
630	0.0200												
630	0.0188												
715	0.0175												
780	0.0156												
810	0.0134												
1012	0.0122												
1090	0.0122												
1200	0.0113												
1235	0.0113												
1380	0.00966												
1430	0.0100												
1610	0.00849												
1800	0.00820												
2025	0.00678												
2200	0.00644												
2340	0.00561												
<u>CURVE 31</u>													
6.75	0.34												
8.25	0.52												
10.0	0.80												
12.0	1.25												
25.0	6.90												
28.0	8.75												
40.0	16.5												
67.5	34.0												
79.0	43.0												
100.0	50.0												
120.0	51.0												
140.0	48.0												
160.0	43.0												
255.0	24.0												
280.0	21.5												
320.0	18.5												
<u>CURVE 32*</u>													
330	0.0293												
431	0.0259												
473	0.0238												
490	0.0251												
540	0.0213												

* Not shown on plot

DATA TABLE NO. 7 (continued)

CURVE 32 (cont.)*		CURVE 34		CURVE 37		CURVE 40 (cont.)		CURVE 45		CURVE 50		CURVE 52 (cont.)	
T	k	T	k	T	k	T	k	T	k	T	k	T	k
6.1	0.24	91	14.3	88	0.339	325	0.0680	1420	0.0105	110	5.5	280	0.0775
6.5	0.28	98	16.3	106	0.262	350	0.0625	1559	0.0100	170	9.75	300	0.0725*
7.75	0.40	108	17.9	107	0.263*			1657	0.0109	220	11.3	325	0.0675*
9.0	0.625	118	19.2	130	0.204	<u>CURVE 41</u>		1772	0.0113	280	11.3	370	0.0575
10.5	0.875	128	19.4	150	0.175	107	0.167	1835	0.0138	300	11.3	415	0.0513
12.0	1.15	138	21.5	175	0.149	115	0.154	1924	0.0121	320	10.5	445	0.0475
15.5	2.20	163	22.5	180	0.142	130	0.130	2009	0.0138	350	9.60	475	0.0450
17.0	2.9	183	21.7	198	0.130	165	0.0870	<u>CURVE 46*</u>		350	8.75	490	0.0425
22.5	5.8	209	21.5	208	0.127	190	0.0769	1530	0.0117	390	8.00	530	0.0387
23.5	6.1	220	20.4	235	0.111	218	0.0625	1667	0.0126	420	6.75	540	0.0375
27.0	7.75	245	18.2	260	0.0990	240	0.0571	1715	0.0126	630	5.25	595	0.0337
31.0	11.0	263	16.4	275	0.0885	272	0.0513	1818	0.0130	750	5.00	720	0.0275
35.0	13.0	300	15.0	310	0.0758	318	0.0476	<u>CURVE 47</u>		880	5.00	830	0.0237
39.0	15.0	320	14.5					1899	0.0130	<u>CURVE 51</u>			
43.0	18.0	330	13.9	<u>CURVE 38</u>		<u>CURVE 42</u>		1972	0.0134	90	21.3	<u>CURVE 53</u>	
58.0	28.5			105	0.357	1712	0.0469	2043	0.0138	140	38.3	1808	0.0699
75.0	38.0	<u>CURVE 35</u>		125	0.286	1364	0.0469	<u>CURVE 48</u>		420	11.3	<u>CURVE 54</u>	
85.0	43.0	91	20.0	150	0.256	2002	0.0452	1504	3.77	480	9.00	<u>CURVE 55</u>	
92.5	47.0	118	26.7	170	0.222	2056	0.0435	1553	3.77	540	8.25		
125	46.0	163	26.7	210	0.161	2131	0.0502	1621	3.35	610	7.00		
135	43.0	200	24.7	220	0.149	2308	0.0552	1705	3.35	700	6.25		
150	40.0	222	21.7	245	0.140			1736	3.77	810	5.75		
165	36.0	305	16.1	265	0.130	<u>CURVE 43</u>		<u>CURVE 49*</u>		920	5.25		
180	34.0	320	15.2	285	0.121	1426	0.0180	1422	0.0121	<u>CURVE 52</u>			
225	27.0	330	14.5	330	0.100	1519	0.0201	1545	0.0117	85	0.370		
245	25.0			348	0.102	1639	0.0192	1670	0.0121	90	0.353		
265	23.0	<u>CURVE 36*</u>		365	0.0980	1750	0.0222	1776	0.0138	140	0.218		
290	21.0	84	31.3			1819	0.0218	1843	0.0138	155	0.193		
320	19.5	103	37.0	<u>CURVE 39</u>		1883	0.0251	1901	0.0146	195	0.130		
		104	37.3	88	0.117	1945	0.0251	2056	0.0155	220	0.108		
		108	37.7	203	0.161	<u>CURVE 44</u>		<u>CURVE 49*</u>		235	0.0950		
		123	38.5	303	0.109	1637	0.0138	1422	0.0121	<u>CURVE 52</u>			
		128	37.7	<u>CURVE 40</u>		1780	0.0146	1545	0.0117				
		135	37.3	97	0.250	1867	0.0163	1670	0.0121				
		148	35.7	128	0.172	2006	0.0176	1776	0.0138				
		162	32.9	163	0.127	2093	0.0197	1843	0.0138				
		197	28.6	210	0.102	2221	0.0209	1901	0.0146				
		215	25.6	245	0.0862	2313	0.0255	2056	0.0155				
		238	23.0	278	0.0762								
		265	20.2	305	0.073E								
		295	18.2	315	0.0704*								
		318	16.7										

* Not shown on plot

DATA TABLE NO. 7 (continued)

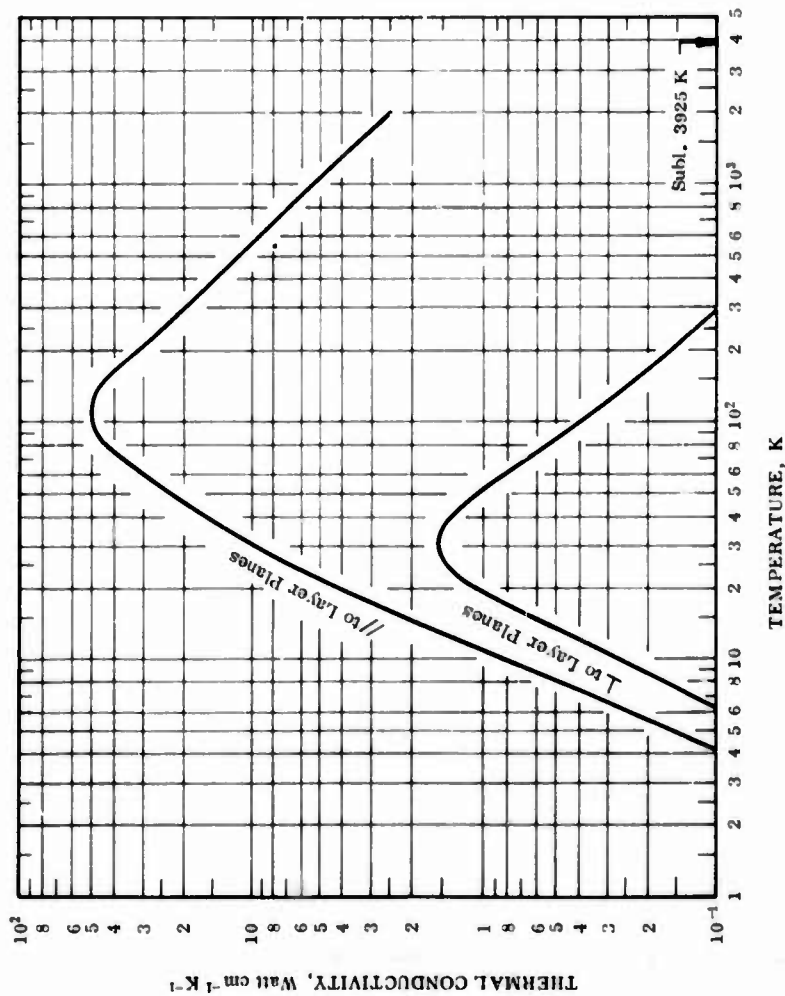
T	k	T	k	T	k	T	k	T	k	T	k		
CURVE 57													
100	2.33	114.8	16.66	245.5	18.51	84	0.30	4.7	0.00108	2.75	0.00028		
124.5	3.70	136.5	20.83	266.1	18.51	200	0.62	5.3	0.00135	3.1	0.00035		
167.9	5.88	158.5	21.27	288.4	17.85	300	0.70	5.9	0.00170	3.7	0.00049		
216.3	6.25	186.2	21.27	309.0	15.38	CURVE 69						4.2	0.00062
234.4	6.45	206.5	20.83	331.1	14.28	1.75	0.00009	7.25	0.00285	4.5	0.00074		
257.0	6.67	213.8	20.40	CURVE 65		1.90	0.000102	15.5	0.016	5.2	0.00095		
288.4	6.90	231.7	19.60	103.5	0.04	2.35	0.00014	20.0	0.027	5.8	0.00125		
305.5	7.14	248.3	19.23	204.2	0.0377	2.50	0.000155	26.5	0.050	7.5	0.00226		
331.1	6.90	288.4	18.51	305.5	0.0312	2.80	0.00019	31.0	0.0725	CURVE 73*			
CURVE 58*													
116.1	18.52	327.3	15.15	327.3	0.0312	3.20	0.00023	40.0	0.135	2.0	0.000175		
134.9	22.22	CURVE 62		CURVE 66*		3.50	0.00029	47.0	0.19	2.45	0.00026		
162.2	23.26	120.2	1.11	89.1	0.455	4.00	0.00036	49.0	0.22	2.70	0.00032		
192.8	23.91	146.2	1.48	204.2	0.154	4.30	0.00042	82.5	0.825	3.90	0.00060		
211.3	23.81	182.0	1.89	302.0	0.100	4.4	0.00044	110.0	1.50	4.40	0.00075		
245.5	22.73	197.2	2.13	CURVE 67		4.8	0.0005	130	2.1	4.60	0.00085		
266.1	21.74	218.8	2.38	4.0	0.00010	5.7	0.0007	150	2.5	5.0	0.0010		
309.0	19.61	251.2	2.63	5.9	0.00026	6.5	0.00095	170	3.0	6.0	0.00153		
335.0	17.86	281.8	2.86	7.6	0.00048	7.25	0.00125	190	3.4	6.75	0.0019		
CURVE 59*													
114.8	17.24	323.6	3.13	10.7	0.0010	16.5	0.0025	220	3.9	CURVE 74*			
136.5	20.83	CURVE 63*		13.0	0.0015	70.0	0.24	240	4.2	3.1	0.000105		
158.5	21.28	110.9	2.701	15.0	0.0024	92.5	0.55	265	4.4	3.7	0.000165		
184.1	21.28	128.8	3.33	158	1.25	115.0	0.755	295	4.7	4.5	0.000250		
204.2	20.83	144.5	4.00	190	1.65	120	0.850	CURVE 71				5.25	0.000350
213.8	20.41	164.1	4.55	215	1.90	130	0.950	3.4	0.00014	5.7	0.000440		
229.1	20.00	182.0	5.41	240	2.10	158	1.25	4.0	0.0002	6.5	0.000620		
245.5	19.23	192.8	5.41	260	2.25	158	1.25	4.6	0.000285	9.3	0.00150		
263.0	18.52	216.3	5.71	295	2.45	190	1.65	5.7	0.0005	11.5	0.00240		
288.4	18.52	239.9	6.06	300	2.55	240	2.25	7.25	0.00085	12.5	0.00270		
309.0	16.00	251.2	6.41	CURVE 70		260	2.45	8.25	0.00118	15.5	0.00440		
327.3	14.81	260.0	6.45	1.9	0.000185	295	2.55	10.8	0.00205	18.5	0.0060		
CURVE 60													
124.7	3.23	316.2	7.14	2.05	0.000218	300	2.55	13.0	0.003	21.0	0.0075		
162.2	4.35	CURVE 64*		2.3	0.00026	4.0	0.00014	17.0	0.0054	300	0.0290		
198.6	5.41	117.5	15.38	2.45	0.000286	120	0.850	80.0	0.031	CURVE 75			
239.9	6.06	141.3	16.66	2.80	0.00036	130	0.950	4.3	0.000205	4.3	0.000205		
269.2	6.25	182.0	20.00	3.3	0.00050	158	1.25	6.0	0.00047	5.0	0.00029		
302.0	6.33	211.3	19.23	3.7	0.00065	190	1.65	7.5	0.00080	6.0	0.00047		
316.2	6.45	216.3	19.60	4.0	0.00075	240	2.25	8.0	0.0014	7.5	0.00080		
		231.7	18.86	4.1	0.00080	260	2.45	10.8	0.00165	9.8	0.0014		
				4.4	0.000925	295	2.55	12.5	0.00185	10.8	0.00165		
				64	0.184	300	2.55	15.5	0.00440	14.0	0.00275		
								18.5	0.0060	16.5	0.0042		
								21.0	0.0075	21.0	0.0060		
								300	0.0290				

* Not shown on plot

DATA TABLE NO. 7 (continued)

T	k
24.5	0.0080
27.0	0.0095
31.0	0.0115
36.0	0.0140
41.0	0.0160
95.0	0.0300
180	0.029
185	0.030
250	0.032
275	0.030
290	0.032

FIGURE AND TABLE NO. 7R RECOMMENDED THERMAL CONDUCTIVITY OF PYROLYTIC GRAPHITE

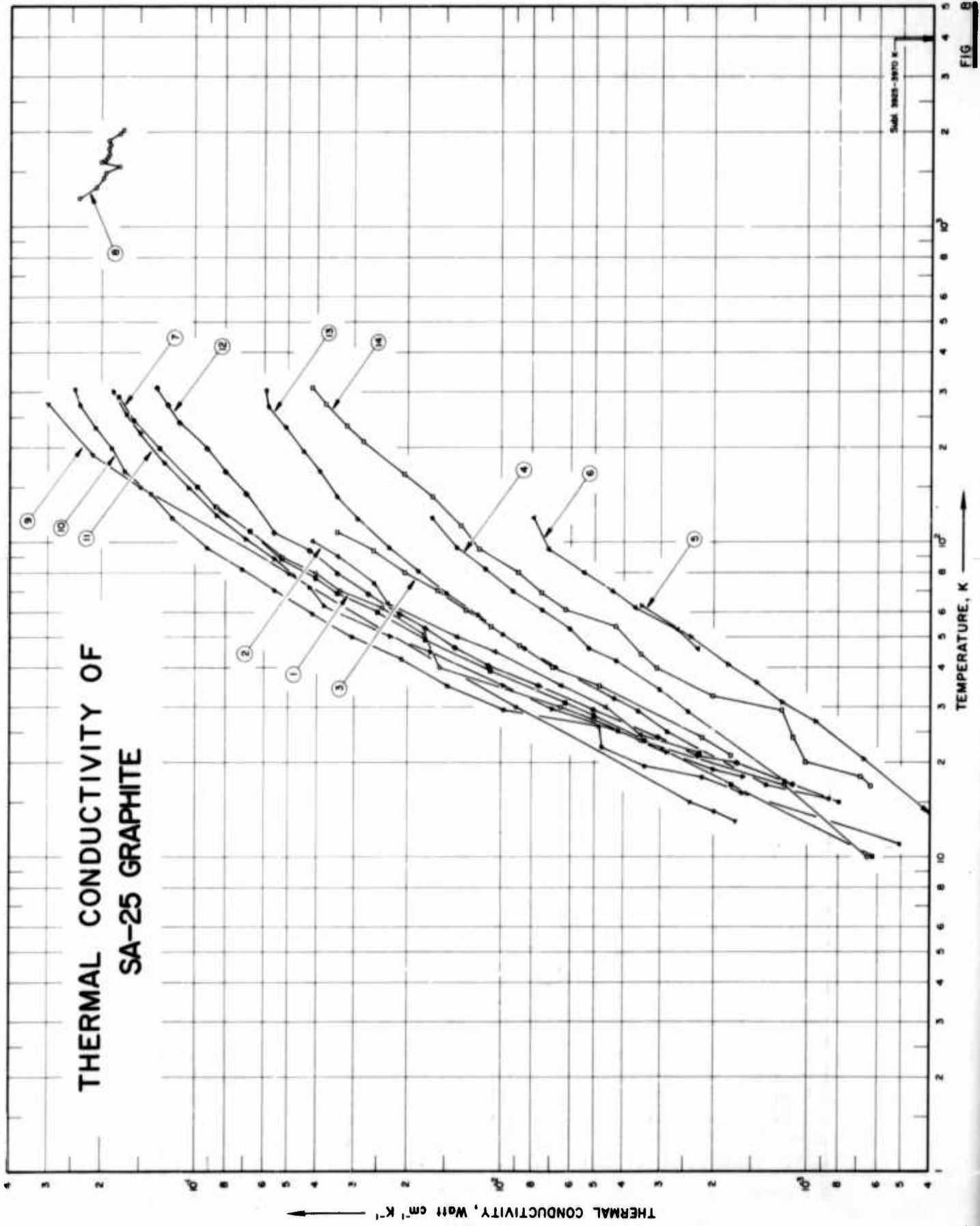


REMARKS

Pyrolytic graphite is produced by the deposition of carbon from a gaseous hydrocarbon onto a heated surface at high temperature of the order of 2300 K. The uncertainty of the recommended values for the direction parallel to the layer planes at temperatures below 1500 K is probably of the order of ± 10 to $\pm 20\%$, and that at temperatures above 1500 K is probably twice as great. The values for the direction perpendicular to the layer planes are intended as typical values for indicating the general trend.

T ₁	RECOMMENDED VALUES*		(// to Layer Planes)		(⊥ to Layer Planes)		T ₂
	k ₁	k ₂	k ₁	k ₂	k ₁	k ₂	
0	0	0	0	0	0	0	-459.7
10	0.81	46.8	0.27	39.0	0.27	39.0	-441.7
20	4.2	243	1.08	62.4	1.08	62.4	-423.7
30	9.9	572	1.55	89.6	1.55	89.6	-405.7
40	16.3	942	1.35	78.0	1.35	78.0	-387.7
50	23.0	1330	1.03	59.5	1.03	59.5	-369.7
60	29.8	1720	0.81	46.8	0.81	46.8	-351.7
70	36.5	2110	0.65	37.6	0.65	37.6	-333.7
80	42.9	2480	0.54	31.2	0.54	31.2	-315.7
90	47.3	2730	0.46	26.6	0.46	26.6	-297.7
100	49.8	2890	0.39	22.5	0.39	22.5	-279.7
150	45.3	2620	0.23	13.3	0.23	13.3	-189.7
200	32.5	1880	0.15	8.67	0.15	8.67	-99.7
250	24.5	1420	0.116	6.70	0.116	6.70	-9.7
273.2	22.3	1290	0.106	6.12	0.106	6.12	32.0
300	20.0	1160	0.095	5.49	0.095	5.49	80.3
350	16.9	976	0.080	4.62	0.080	4.62	170.3
400	14.6	844	0.070	4.04	0.070	4.04	260.3
500	11.3	653	0.054	3.12	0.054	3.12	440.3
600	9.3	537	0.044	2.54	0.044	2.54	620.3
700	7.9	456	0.038	2.20	0.038	2.20	800.3
800	6.8	393	0.032	1.85	0.032	1.85	980.3
900	6.0	347	0.028	1.62	0.028	1.62	1160
1000	5.3	306	0.025	1.44	0.025	1.44	1340
1100	4.8	277	0.023	1.33	0.023	1.33	1520
1200	4.4	254	0.021	1.21	0.021	1.21	1700
1300	4.0	231	0.019	1.10	0.019	1.10	1880
1400	3.7	214	0.017	0.982	0.017	0.982	2060
1500	3.4	196	0.016	0.924	0.016	0.924	2240
1600	3.2	185	0.015	0.867	0.015	0.867	2420
1700	3.0	173	0.014	0.809	0.014	0.809	2600
1800	2.8	162	0.013	0.751	0.013	0.751	2780
1900	2.6	150	0.0125	0.722	0.0125	0.722	2960
2000	2.5	144	0.012	0.693	0.012	0.693	3140

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹.

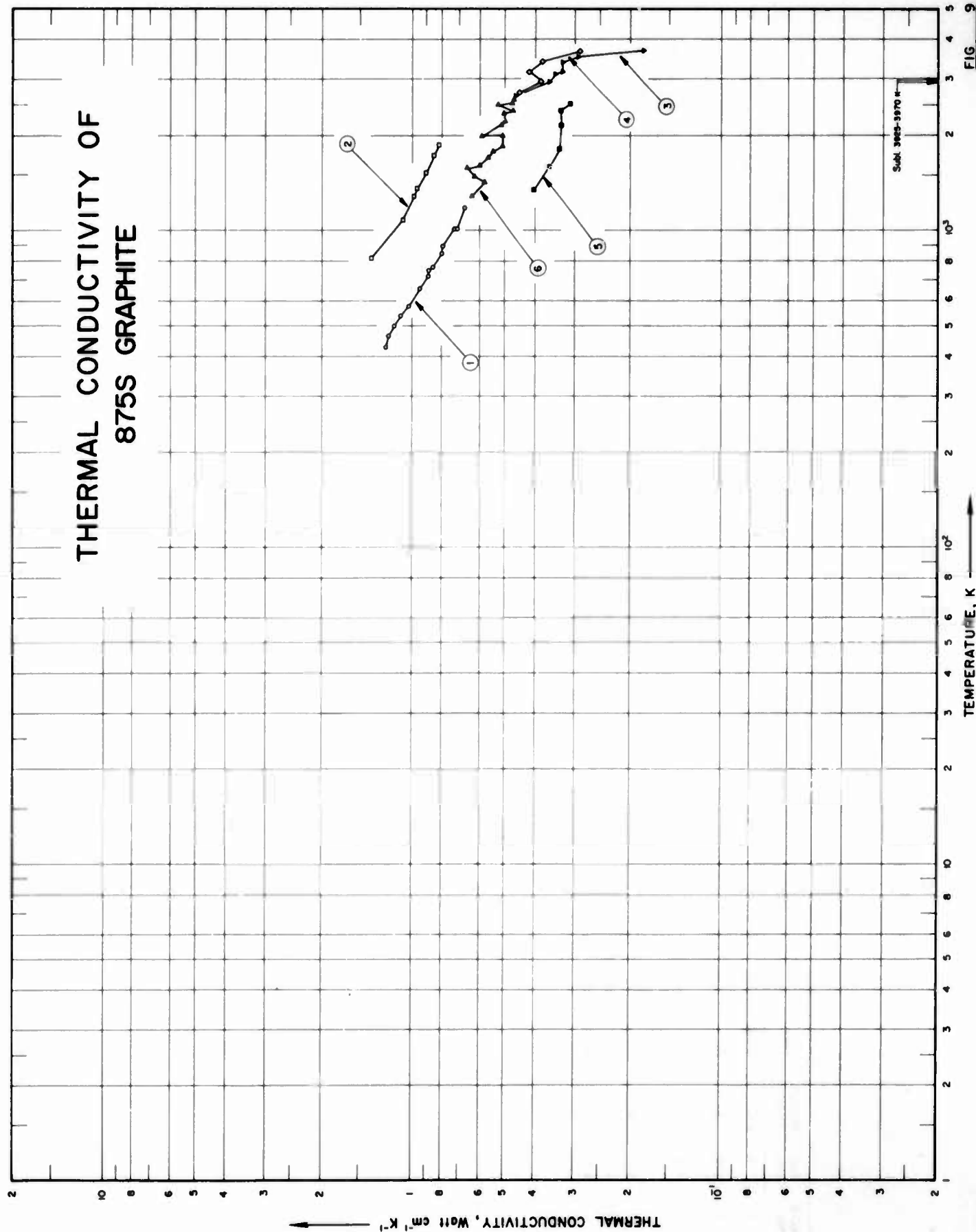


SPECIFICATION TABLE NO. 8 THERMAL CONDUCTIVITY OF SA-25 GRAPHITE

[For Data Reported in Figure and Table No. 8]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	50	E	1956	10-205	± 5		Polycrystalline; molded from lampblack; pitch bonded; particle size 0.3 μ , crystallite size 0.05 μ ; density 1.55 g cm ⁻³ at 25 C.
2	50	E	1956	22-101	± 5		The above specimen exposed to neutron bombardment of 12.5 MWD/T at ~30 C.
3	50	E	1956	21-115	± 5		The above specimen exposed to neutron bombardment of 22.7 MWD/T at ~30 C.
4	50	E	1956	15-120	± 5		The above specimen exposed to neutron bombardment of 146 MWD/T at ~30 C.
5	50	E	1956	13-63	± 5		The above specimen exposed to neutron bombardment of 460 MWD/T at ~30 C.
6	50	E	1956	46-112	± 5		The above specimen exposed to neutron bombardment of 460 MWD/T at ~30 C (probably second run of the above specimen).
7	53	E	1955	10-290	± 5		Made from lampblack; molded; room temp properties: density 1.55 g cm ⁻³ , thermoelectric power +9.6 μ volt K ⁻¹ , Hall coefficient +0.14 emu, magneto resistivity 0.2 x 10 ⁻⁶ ohm cm, electrical resistivity 43 milliohm cm, total magnetic susceptibility -21.02 x 10 ⁻⁴ cgs unit, orientation factor (ρ_{\max}/ρ_{\min}) = 1.0.
8	357	L	1959	1246-2045			Emissivity 0.83.
9	345	L	1958	13-275	4		Specimen prepared from lampblack base, molded with a coal-tar pitch binder, measurements made under high vacuo.
10	163	E	1954	10-306			Molded lampblack; density 1.55 g cm ⁻³ at room temp; thermoelectric power +9.0 μ volt K ⁻¹ ; Hall coefficient +0.14 emu; magneto resistivity 0.2 x 10 ⁻⁶ ohm cm; electrical resistivity 65.3 x 10 ⁻³ ohm cm; total susceptibility -21.02 x 10 ⁻⁴ cgs unit, and orientation factor (ρ_{\max}/ρ_{\min}) = 1.0.
11	163	E	1954	18-302			The above specimen exposed to neutron irradiation of 12.5 MWD/CT (metawatt days per central metric ton of uranium) at <30 C.
12	163	E	1954	17-310			The virgin specimen exposed to neutron irradiation of 22.7 MWD/CT at <30 C.
13	163	E	1954	15-305			The virgin specimen exposed to neutron irradiation of 146 MWD/CT at <30 C.
14	163	E	1954	17-309			The virgin specimen exposed to neutron irradiation of 460 MWD/CT at <30 C.

THERMAL CONDUCTIVITY OF 875S GRAPHITE



SPECIFICATION TABLE NO. 9 THERMAL CONDUCTIVITY OF 875S GRAPHITE

[For Data Reported in Figure and Table No. 9]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	55	C	1956	433-1182			Extruded graphite; density 1.71 g cm ⁻³ ; measured perpendicular to the direction of extrusion.
2	176	L	1956	820-1865			Grade 7057 graphite from Speer Carbon Co.; density 1.698 g cm ⁻³ ; measured with heat flow parallel to the axis of extrusion.
3	177	R	1957	2661-3708	± 8		Extruded; coarse grain with small voids and fissures; specific gravity 1.63; anisotropy ratio (ratio of electrical resistances measured normal and parallel to the extrusion axis) = 1.19; measured normal to the extrusion axis in inert gas at >150 psi pressure.
4	177	R	1957	2733-3694	± 8		Rerun of the above specimen with smaller heat rate.
5	177	R	1957	1351-2527	± 5		The above specimen measured with heat flow radially inward.
6	177	R	1957	1289-2600	± 5		The above specimen measured after prolonged heating at >2200 C.

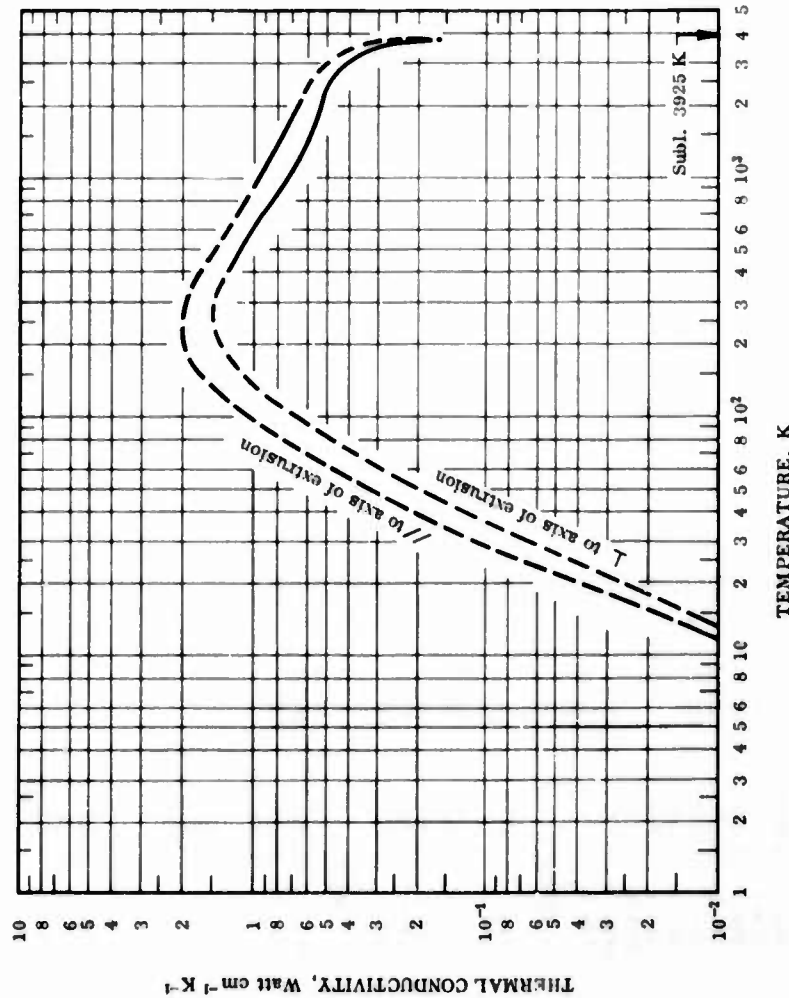
DATA TABLE NO. 9 THERMAL CONDUCTIVITY OF 875S GRAPHITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
433.2	1.23	3422.1	0.379
467.6	1.20	3694.3	0.289
503.2	1.15	<u>CURVE 5</u>	
540.9	1.09	1351.0	0.403
578.7	1.03	1594.8	0.360
658.7	0.943	1818.2	0.336
662.1	0.950*	2158.7	0.331
723.7	0.883	2395.4	0.332
754.8	0.884	2527.1	0.310
772.6	0.852	<u>CURVE 6</u>	
849.8	0.796	1288.7	0.639
863.2	0.798*	1427.6	0.582
895.4	0.794	1483.2	0.625
1015.9	0.725	1588.7	0.663
1015.9	0.710	1610.9	0.604
1182.1	0.673	1705.4	0.568
<u>CURVE 2</u>			
820.1	1.37	1783.2	0.545
1084.0	1.08	1855.4	0.509
1287.9	0.985	1999.5	0.509
1366.2	0.964	1999.5	0.594
1538.8	0.897	2166.5	0.512
1728.6	0.847	2222.1	0.498
1664.7	0.817	2355.4	0.504
<u>CURVE 3</u>			
2661.0	0.459	2394.3	0.470
2953.2	0.360	2505.4	0.528
3137.1	0.346	2533.2	0.474
3181.0	0.329	2599.8	0.466
3406.0	0.329		
3555.4	0.292		
3708.2	0.180		
<u>CURVE 4</u>			
2733.2	0.447		
2960.9	0.384		
3183.2	0.419		

* Not shown on plot

FIGURE AND TABLE NO. 9R RECOMMENDED THERMAL CONDUCTIVITY OF 875S GRAPHITE



REMARKS

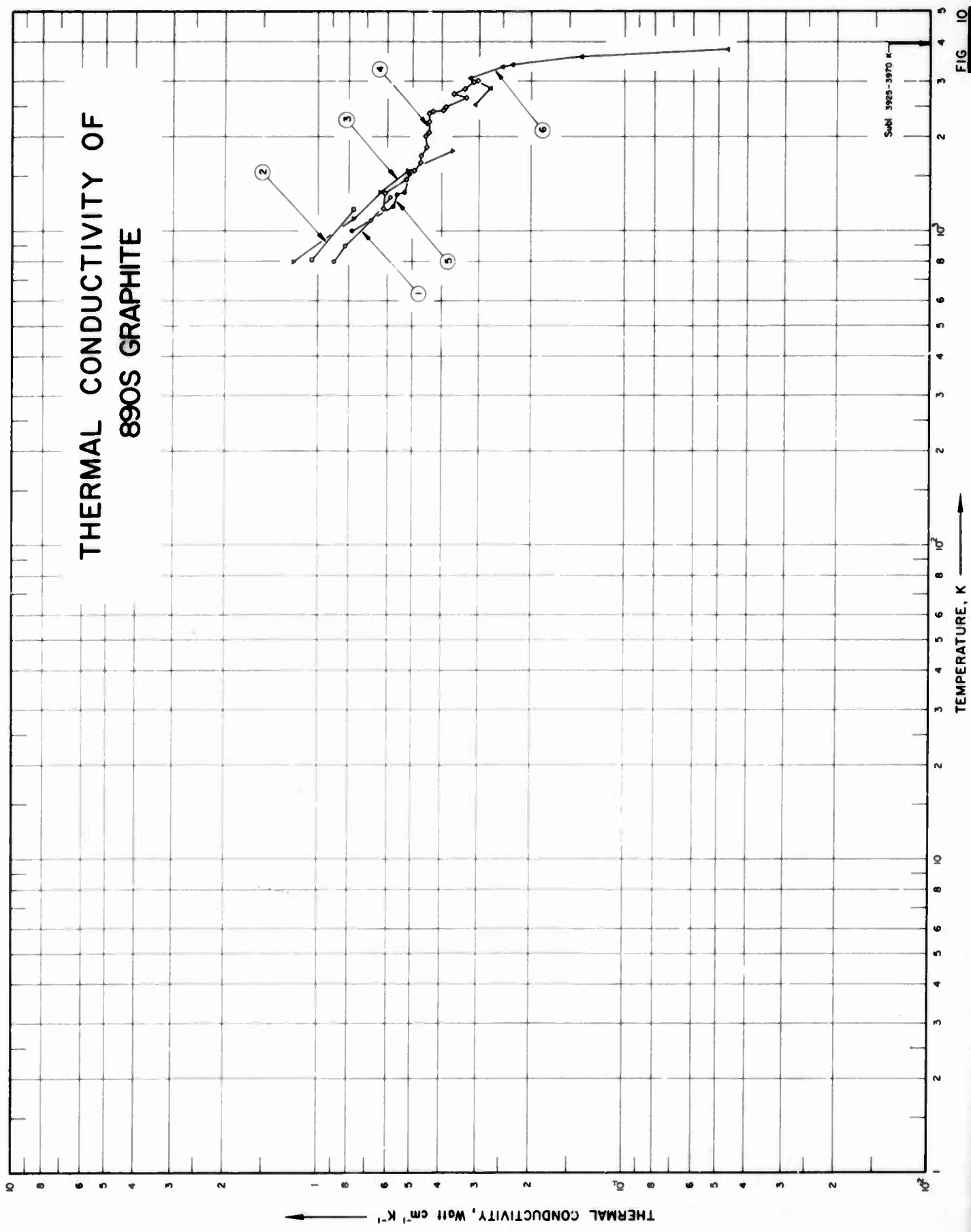
875S graphite is a medium-grain (0.032 inch maximum) pitch-bonded petroleum-coke-base graphite with typical room-temperature density 1.67 g cm⁻³. It is formed by extrusion into rods and is produced by Speer Carbon Company. This graphite was previously designated as 7087 graphite. The uncertainty of the recommended values for the direction perpendicular to the axis of extrusion that are supported by experimental data is probably of the order of ±10 to ±20%, and that of the values obtained by extensive extrapolation is probably twice as great. The values for the direction parallel to the axis of extrusion are intended only for indicating the general trend.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹.

† Values in parentheses are extrapolated or estimated.

T ₁	RECOMMENDED VALUES*				T ₂
	(|| to axis of extrusion)		(⊥ to axis of extrusion)		
	k ₁	k ₂	k ₁	k ₂	
0	0	0	0	0	-459.7
10	(0.0075) †	(0.433)	(0.0053)	(0.306)	-441.7
20	(0.041)	(2.37)	(0.027)	(1.56)	-423.7
30	(0.106)	(6.12)	(0.067)	(3.87)	-405.7
40	(0.20)	(11.6)	(0.123)	(7.11)	-387.7
50	(0.32)	(18.5)	(0.193)	(11.2)	-369.7
60	(0.46)	(26.6)	(0.275)	(15.9)	-351.7
70	(0.62)	(35.8)	(0.37)	(21.4)	-333.7
80	(0.77)	(44.5)	(0.46)	(26.6)	-315.7
90	(0.93)	(53.7)	(0.56)	(32.4)	-297.7
100	(1.08)	(62.4)	(0.66)	(38.1)	-279.7
150	(1.67)	(96.5)	(1.10)	(63.6)	-189.7
200	(1.95)	(113)	(1.39)	(80.3)	-99.7
250	(1.99)	(115)	(1.49)	(86.1)	-9.7
273.2	(1.97)	(114)	(1.48)	(86.1)	32.0
300	(1.92)	(111)	(1.46)	(84.4)	80.3
350	(1.81)	(105)	(1.38)	(79.7)	170.3
400	(1.69)	(97.6)	(1.29)	(74.5)	260.3
500	(1.49)	(86.1)	1.14	65.9	440.3
600	(1.32)	(76.3)	1.01	58.4	620.3
700	(1.19)	(68.8)	0.92	53.2	800.3
800	(1.09)	(63.0)	0.84	48.5	980.3
900	1.01	58.4	0.78	45.1	1160
1000	0.94	54.3	0.73	42.2	1340
1200	0.86	49.7	0.67	38.7	1700
1400	0.79	45.6	0.62	35.8	2060
1600	0.74	42.8	0.58	33.5	2420
1800	0.70	40.4	0.55	31.8	2780
2000	(0.66)	(38.1)	0.53	30.6	3140
2200	(0.63)	(36.4)	0.51	29.5	3500
2400	(0.60)	(34.7)	0.49	28.3	3860
2600	(0.57)	(32.9)	0.47	27.2	4220
2800	(0.54)	(31.2)	0.45	26.0	4580
3000	(0.51)	(29.5)	0.42	24.3	4940
3200	(0.47)	(27.2)	0.39	22.5	5300
3400	(0.42)	(24.3)	0.35	20.2	5660
3600	(0.34)	(19.6)	0.28	16.2	6020
3800	(0.19)	(11.0)	(0.16)	(9.24)	6380

THERMAL CONDUCTIVITY OF 890S GRAPHITE



SPECIFICATION TABLE NO. 10 THERMAL CONDUCTIVITY OF 890S GRAPHITE

[For Data Reported in Figure and Table No. 10]

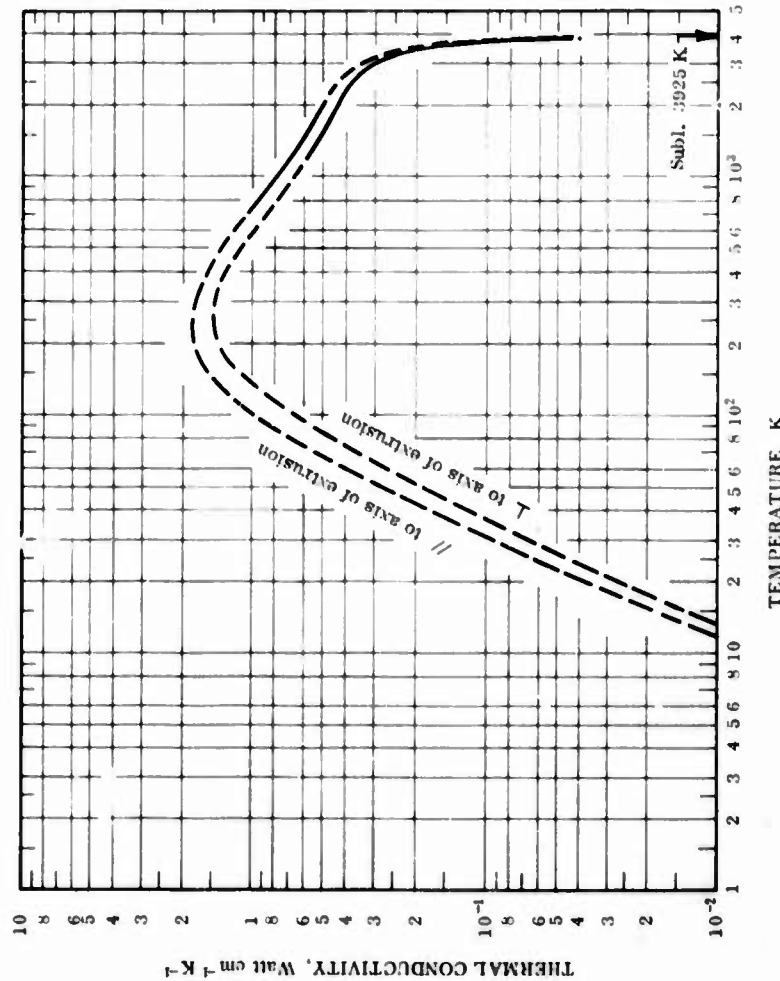
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	48	L	1956	832-1284	±5	1	7 in. dia x 1.5 in. thick; density 1.612 g/cm ³ ; measured with unidirectional heat flow through the disk.
2	48	L	1956	813, 1172	±5	2	Similar to the above specimen but the specimen being heated twice.
3	48	L	1956	798-1809	±5	3	Similar to the above specimen but the specimen being heated three times.
4	177	R	1957	1174-3017	±5		Extruded; very fine grained and uniform; specific gravity 1.67; anisotropy ratio 1.08; measured with heat flow radially inward and normal to the extrusion axis; pyrometer used to measure temp; measured in inert gas at >150 psi pressure.
5	177	R	1957	1002-1533	±5		The above specimen measured by using thermocouples to obtain temp.
6	177	R	1957	2546-3786	±5		The above specimen measured with heat flow radially outward and normal to the extrusion axis.

DATA TABLE NO. 10 THERMAL CONDUCTIVITY OF 890S GRAPHITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
831.5	0.891	1002.1	0.781
897.1	0.824	1207.1	0.575
1083.2	0.678	1313.2	0.562
1284.3	0.588	1335.4	0.531
		1533.2	0.514
<u>CURVE 2</u>			
812.6	1.05		
1172.1	0.772		
<u>CURVE 3</u>			
797.6	1.20	2539.9	0.310
1099.8	0.774	2853.2	0.275
1330.4	0.633	3075.1	0.322
1553.2	0.516	3348.7	0.251
1808.7	0.367	3396.0	0.232
		3598.2	0.138
		3786.0	0.0467
<u>CURVE 4</u>			
1173.7	0.616		
1322.6	0.614		
1466.5	0.524		
1557.6	0.493		
1655.4	0.469		
1749.3	0.469		
1860.9	0.448		
2005.4	0.452		
2068.3	0.440		
2244.3	0.440		
2374.9	0.440		
2410.9	0.427		
2437.1	0.395		
2494.3	0.389		
2661.5	0.331		
2744.3	0.365		
2847.1	0.336		
2996.5	0.313		
3016.5	0.303		

FIGURE AND TABLE NO. 10R RECOMMENDED THERMAL CONDUCTIVITY OF 890S GRAPHITE



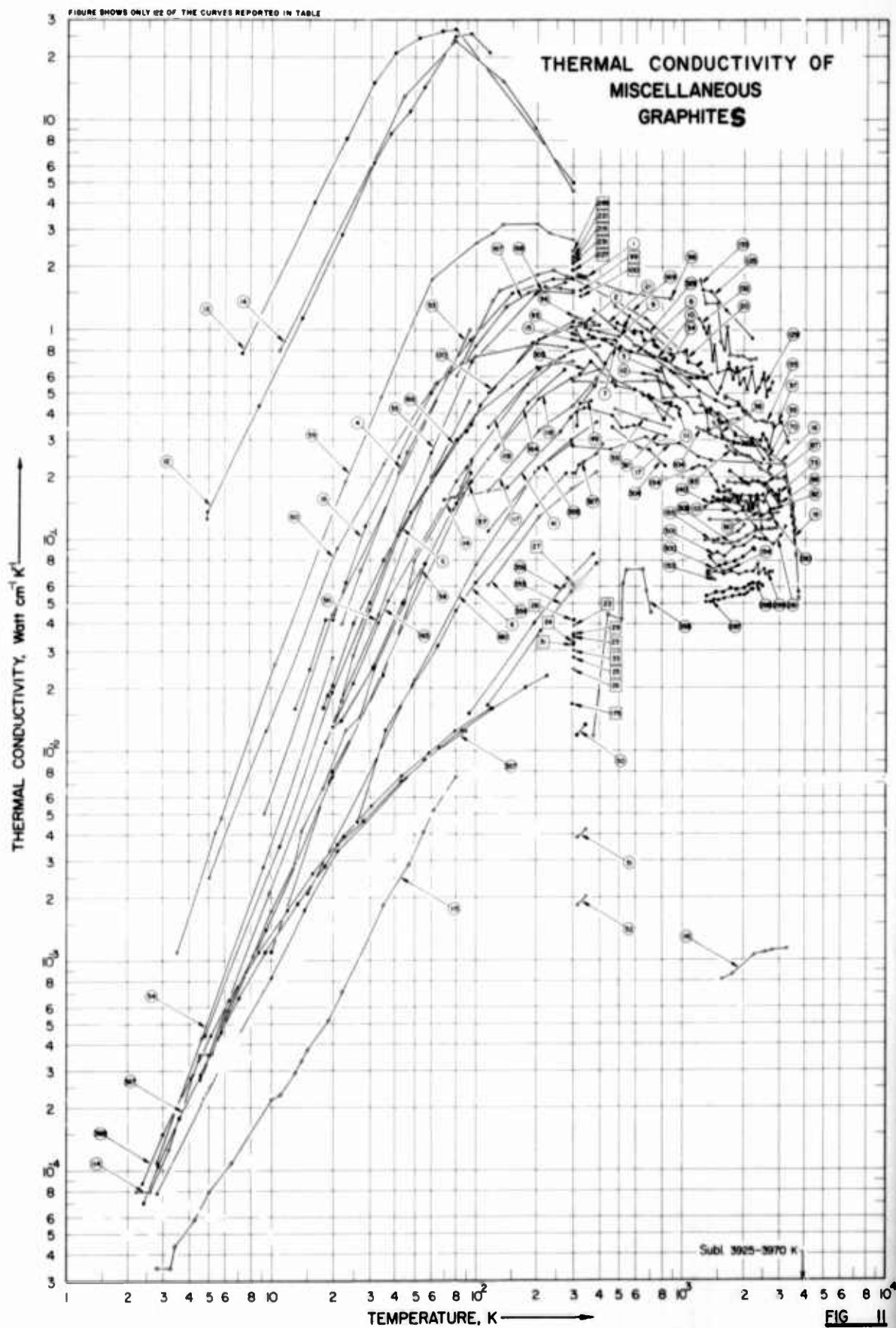
T ₁	// to axis of extrusion)		⊥ to axis of extrusion)		T ₂
	k ₁	k ₂	k ₁	k ₂	
0	0	0	0	0	-459.7
10	(0.007) ‡	(0.404)	(0.0054)	(0.312)	-441.7
20	(0.038)	(2.20)	(0.028)	(1.62)	-423.7
30	(0.097)	(5.60)	(0.069)	(3.99)	-405.7
40	(0.18)	(10.4)	(0.127)	(7.34)	-387.7
50	(0.29)	(16.8)	(0.20)	(11.6)	-369.7
60	(0.42)	(24.3)	(0.29)	(16.8)	-351.7
70	(0.56)	(32.4)	(0.38)	(22.0)	-333.7
80	(0.71)	(41.0)	(0.48)	(27.7)	-315.7
90	(0.85)	(49.1)	(0.58)	(33.5)	-297.7
100	(1.00)	(57.8)	(0.69)	(39.3)	-279.7
150	(1.55)	(89.6)	(1.14)	(65.9)	-189.7
200	(1.83)	(106)	(1.42)	(82.0)	-99.7
250	(1.89)	(109)	(1.52)	(87.8)	-9.7
273.2	(1.87)	(108)	(1.51)	(87.2)	32.0
300	(1.82)	(105)	(1.48)	(85.5)	80.3
350	(1.71)	(98.8)	(1.40)	(80.9)	170.3
400	(1.59)	(91.9)	(1.32)	(76.3)	260.3
500	(1.38)	(79.7)	(1.16)	(67.0)	440.3
600	(1.21)	(69.9)	(1.01)	(58.4)	620.3
700	(1.08)	(62.4)	(0.90)	(52.0)	800.3
800	0.97	56.0	(0.82)	(47.4)	980.3
900	0.88	50.8	(0.75)	(43.3)	1160
1000	0.81	46.8	(0.69)	(39.9)	1340
1200	0.70	40.4	0.60	34.7	1700
1400	0.63	36.4	0.54	31.2	2060
1600	0.57	32.9	0.50	28.9	2420
1800	0.53	30.6	0.46	26.6	2780
2000	(0.50)	(28.9)	0.44	25.4	3140
2200	(0.48)	(27.7)	0.42	24.3	3500
2400	(0.45)	(26.0)	0.40	23.1	3860
2600	(0.42)	(24.3)	0.38	22.0	4220
2800	(0.39)	(22.5)	0.35	20.2	4580
3000	(0.36)	(20.8)	0.32	18.5	4940
3200	(0.31)	(17.9)	0.28	16.2	5300
3400	(0.25)	(14.4)	0.23	13.3	5660
3600	(0.16)	(9.24)	0.15	8.67	6020
3800	(0.043)	(2.48)	(0.04)	(2.31)	6380

REMARKS

890S graphite is a fine-grain (0.008 inch maximum) pitch-bonded petroleum-coke-base graphite with typical room-temperature density 1.63 g cm⁻³. It is formed by extrusion into rods and is produced by Speer Carbon Company. This graphite was previously designated as 3474D graphite. The uncertainty of the recommended values at temperatures above 1000 K that are supported by experimental data is probably of the order of ±10 to ±20%, and that of the values obtained by extensive extrapolation is probably twice as great. The values below 1000 K are intended only for indicating the general trend.

[†] T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹.

[‡] Values in parentheses are extrapolated or estimated.



SPECIFICATION TABLE NO. 11 THERMAL CONDUCTIVITY OF MISCELLANEOUS GRAPHITES

[For Data Reported in Figure and Table No. 11]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	47	L	1944	317-345		No. 1583	Specimen 2.697 cm long and circular cross sectional area 5.068 cm ² ; measured lengthwise.
2	47	L	1944	321-344		No. 1583	Similar to the above specimen but only 2.523 cm long and measured crosswise.
3	48	L	1956	789-1869	± 5	GBE	Specimen 7 in. in dia and 1.5 in. thick; density 1.596 g cm ⁻³ ; measured with unidirectional heat flow through the disk.
4	49	L	1953	22-280	<10	Grade CS, Sample A	Grade CS graphitic (conventional coke base, pitch bonded and extruded); polycrystal; form National Carbon Co.; bulk density ~1.70 g cm ⁻³ ; specimen axis perpendicular to the preferred c-axis orientation.
5	49	L	1953	21-300	<10	Sample C	Polycrystal; natural graphite base, pitch bonded and molded; bulk density ~1.80 g cm ⁻³ ; specimen axis perpendicular to the preferred c-axis orientation.
6	49	L	1953	26-280	<10	Sample D	Similar to the above specimen but pitch bonded and molded from lampblack; bulk density ~1.65 g cm ⁻³ .
7	8	L	1960	351-497	3	Grade RT-0003 (Sample 1)	Specimen cut from a RT-0003 graphite block (National Carbon Co.); density ~1.90 g cm ⁻³ ; heat flow perpendicular to grain orientation.
8	8	L	1960	500-1294	10	Grade RT-0003 (Sample 2)	Similar to the above specimen.
9	8	L	1960	339-495	3	Grade RT-0003 (Sample 3)	Similar to the above specimen but heat flow parallel to grain orientation; run No. 1.
10	8	L	1960	597-1394	10	Grade RT-0003 (Sample 3)	Second run of the above specimen.
11	8	L	1960	612-1384	10	Grade RT-0003 (Sample 3)	Third run of the above specimen.
12	358, 50	C	1954	4.9-116	5-10	Canadian Natural Graphite	Large crystallite (in the order of 10 ⁻² cm); very low ash content; specimen size 0.25 x 0.05 x 0.01 in.; grade AWG graphite used as comparative material.
13	358, 50	C	1954	7.3-300	5-10	Canadian Natural Graphite	Similar to the above specimen.
14	358, 50	C	1954	11-299	5-10	Canadian Natural Graphite	Similar to the above specimen.
15	19	C	1956	323-473		Commercial graphite	High purity; specimen (tubular) 4.5 cm long, 6.95 cm O.D., and 0.75 cm I.D.; density 1.65 g cm ⁻³ ; electrical resistivity at 20, 50, 100, 150, and 200 C being respectively, 762, 760, 772, 790, and 816 μohm cm; a bar of iron of known thermal conductivity used as comparative material.
16	52	E	1956	300-3710	20	Spektral kohle 1	Large grained artificial graphitized carbon; measured in vacuum.
17	52	E	1956	300-3710	20	Spektral kohle 1	Fine grained artificial graphitized carbon; measured in vacuum.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
18	53	E	1955	13-300	± 5	Natural Ceylon block	Natural Ceylon graphite; size 0.100 x 0.020 x 1.25 in., skew orientation.
19	54	E	1952	3150-3700			Manufactured graphite rod.
20	55	C	1956	484-1227		Grade GBH	Molded graphite; from National Carbon Co.; density 1.75 g cm ⁻³ ; measured perpendicular to the direction of molding; Armco iron used as comparative material.
21	364	C	1954	373-1073			Polycrystal; bulk density 1.55 g cm ⁻³ ; porosity 30.2%; dense Al ₂ O ₃ used as comparative material.
22	56		1957	303.2		Korite	Manufactured from Korite petroleum asphalt (from Standard Oil Co., Indiana) and coke prepared from this asphalt; irradiated by exposing to neutrons of 150 MWD/T (mega watt-days per ton).
23	56		1957	303.2		Korite	The above specimen with neutron exposure of 325 MWD/T.
24	56		1957	303.2		Korite	The above specimen with neutron exposure of 530 MWD/T.
25	56		1957	303.2		Korite	The above specimen with neutron exposure of 1100 MWD/T.
26	56		1957	303.2		Korite	The above specimen with neutron exposure of 4270 MWD/T.
27	56		1957	303.2		CSF	Made from Cleves coke (Gulf Oil Co.) with standard pitch (Barrett No. 2, medium hard coal tar pitch); purified; exposed to neutrons of 500 MWD/T.
28	56		1957	303.2		CSF	The above specimen with exposure of 1000 MWD/T.
29	56		1957	303.2		CSF	The above specimen with exposure of 1500 MWD/T.
30	56		1957	303.2		CSF	The above specimen with exposure of 2000 MWD/T.
31	56		1957	303.2		CSF	The above specimen with exposure of 2500 MWD/T.
32	56		1957	303.2		CSF	The above specimen with exposure of 3000 MWD/T.
33	56		1957	303.2		CSF	The above specimen with exposure of 3500 MWD/T.
34	176	L	1956	829-1866	5	GBH	Grade GBH graphite from National Carbon Co.; density 1.762 g cm ⁻³ ; measured with heat flow parallel to the axis of extrusion (should be axis of molding since it was molded).
35	177	R	1957	1220-2700	± 8	GBE	Extruded; extremely coarse grained and fragile; voids and fissures up to 0.125 in. in dia; specific gravity 1.97; anisotropy ratio 1.18; measured normal to the extrusion axis in the heating-up period, in inert gas at >150 psi pressure.
36	177	R	1957	1510-2507	± 8	GBE	The above specimen in the cooling-down period.
37	177	R	1957	1319-3277	± 8	GBH	Molded; very fine grained and uniform; specific gravity 1.77; anisotropy ratio 0.78; measured normal to the molding pressure, in inert gas at >150 psi pressure.
38	133	C	1954	353-1093		Grade CS	Cubic specimen 1 x 1 x 1 in.; density 1.55 g cm ⁻³ ; dense-alumina used as comparative material.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
39	133	C	1954	328-1093		Grade CS	Similar to the above specimen but with cylindrical pores 0.146 cm in dia; porosity 9.5%.
40	133	C	1954	378-1123		Grade CS	Similar to the above specimen but the porosity 19.6%.
41	179	L	1912	352-828	0.1		Specimen 15 mm in dia and 0.79 cm long.
42	106	C	1956	328.7	3	Domestic (Japan) No. 1	Artificial graphite electrode; 80 mm dia x 125 mm long; apparent density 1.501 g cm ⁻³ ; electrical resistivity 0.00108 ohm cm; copper used as comparative material.
43	106	C	1956	329.7	3	Domestic (Japan) No. 2	Similar to the above specimen but the apparent density 1.520 g cm ⁻³ ; electrical resistivity 0.00118 ohm cm.
44	106	C	1956	326.7	3	Domestic (Japan) No. 3	Similar to the above specimen but the apparent density 1.533 g cm ⁻³ ; electrical resistivity 0.00093 ohm cm.
45	106	C	1956	331.7	3	Domestic (Japan) No. 4	Similar to the above specimen but the apparent density 1.59 g cm ⁻³ ; electrical resistivity 0.00085 ohm cm.
46	106	C	1956	337.2	3	Domestic (Japan) No. 5	Similar to the above specimen but the apparent density 1.586 g cm ⁻³ ; electrical resistivity 0.00094 ohm cm.
47	106	C	1956	344.7	3	Domestic (Japan) No. 6	Similar to the above specimen but the apparent density 1.591 g cm ⁻³ ; electrical resistivity 0.00096 ohm cm.
48	106	C	1956	337.2	3	Domestic (Japan) No. 7	Similar to the above specimen but the apparent density 1.60 g cm ⁻³ ; electrical resistivity 0.00099 ohm cm.
49	108	L	1920	323, 363			Solid specimen 1.04 in. thick; specific gravity 1.56.
50	108	L	1920	313, 343			Powder (through 20-mesh on 40-mesh) specimen 0.476 in. thick; specific gravity 0.70.
51	108	L	1920	313, 343			Powder (through 40-mesh) specimen 0.476 in. thick; specific gravity 0.42.
52	108	L	1920	313, 343			Powder (through 100-mesh) specimen 0.476 in. thick; specific gravity 0.48.
53	158	L	1962	9.3-93	2	I	Artificial graphite; made by extrusion which produced a slight anisotropy; crystal size (perpendicular to c-axis) 2000 Å; density 1.80 g cm ⁻³ ; electrical resistivity 1.09 and 0.6 milliohm cm at 90 and 290 K respectively; measured parallel to the axis of extrusion.
54	158	L	1962	2.8-20	2	I	Similar to the above specimen but the density 1.78 g cm ⁻³ ; electrical resistivity 1.76 and 1.09 milliohm cm at 90 and 290 K respectively; measured perpendicular to the axis of extrusion.
55	158	L	1962	4.8-275	2	II	Similar to the above specimen but the crystal size 1000 Å; density 1.60 g cm ⁻³ ; electrical resistivity at 4, 20, 90 and 290 K being respectively 2.3, 2.3, 1.7, and 1.08 milliohm cm; measured parallel to the axis of extrusion.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
56	158	L	1952	5-93	2	II	The above specimen measured perpendicular to the axis of extrusion; electrical resistivity at 4, 20, 90, and 290 K being respectively, 3.0, 2.9, 2.2, and 1.35, milliohm cm.
57	158	L	1952	4.5-93	2	III	Similar to the above specimen but the crystal size 300Å; density 1.77 g cm ⁻³ ; electrical resistivity at 90 and 290 K being 3.01 and 2.33 milliohm cm; measured parallel to the extrusion axis.
58	158	L	1952	10-95	2	III	Similar to the above specimen but the density 1.76 g cm ⁻³ ; electrical resistivity 3.91 and 2.77 milliohm cm at 90 and 290 K respectively; measured perpendicular to the extrusion axis.
59	158	L	1952	3.5-300	2	IV	Natural graphite; highly anisotropic; crystal size 2000Å; density ~2.25 g cm ⁻³ ; electrical resistivity 1.16, 1.17, 1.21 and 0.98 milliohm cm at 4, 20, 90, and 290 K respectively; measured perpendicular to the preferred direction of c-axis.
60	158	L	1952	5.0-280	2	IV	The above specimen measured parallel to c-axis; electrical resistivity at 4, 20, 90, and 290 K being respectively 5.3, 5.4, 5.4, and 4.1 milliohm cm.
61	359	L	1949	336.2	5	AGHT, III	Cylindrical specimen; 3.5 in. dia x 4 in. long; cylinder axis parallel to the extrusion axis.
62	359	L	1949	336.2	5	AGHT, III	Similar to the above specimen but the cylinder axis at right angle to the extrusion axis.
63	359	L	1949	339.2	5	AGHT, III	Similar to the above specimen but the direction of cutting the specimen perpendicular to the above specimen.
64	359	L	1949	343.2	5	AGHT, IV	Similar to the above specimen but the cylinder axis parallel to the axis of extrusion.
65	359	L	1949	337.2	5	AGHT, IV	Similar to the above specimen but the cylinder axis perpendicular to the extrusion axis.
66	359	L	1949	344.2	5	AGHT, IV	Similar to the above specimen with the cylinder axis perpendicular to the extrusion axis but the direction of cutting the specimen perpendicular to that of the above specimen.
67	359	L	1949	343.2	5	AGHT, VII	Similar to the above specimen but the cylinder axis parallel to the extrusion axis.
68	359	L	1949	341.2	5	AGHT, VII	Similar to the above specimen but the cylinder axis perpendicular to the extrusion axis.
69	359	L	1949	344.2	5	AGHT, VII	Similar to the above specimen with the cylinder axis perpendicular to the extrusion axis but the direction of cutting of the specimen normal to the above specimen.
70	180	L	1961	1428-3148		AGSR	Graphite rod from National Carbon Company; apparent density 1.54 g cm ⁻³ (grade AGSR); heat treated to 3100 C; measured at 1 in. Hg above the atmospheric pressure.
71	180	L	1961	1838.2		AGSR	The above specimen measured at a fixed temperature to show the effect of pressure (approx. from 0 to 60 in. Hg pressure).
72	180	L	1961	2423.2		AGSR	The above specimen measured within the same pressure range but at a higher temperature.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
73	180	L	1961	2973.2		AGSR	The above specimen measured within the same pressure range but at a higher temperature.
74	180	L	1961	1838.2		Lab. prepared rod	Made from soft filler-soft binder mixture particles (200/270 mesh size); heat treated to 3190 C; apparent density 1.58 g cm ⁻³ ; measured in the same pressure range as the above specimen.
75	180	L	1961	2394.2		Lab. prepared rod	The above specimen measured in the same pressure range at a higher temperature.
76	180	L	1961	2913.2		Lab. prepared rod	The above specimen measured in the same pressure range at a higher temperature.
77	180	L	1961	1829.2		Lab. prepared rod	Made from a soft filler-soft binder mixture; coke (28/35 mesh size) used as filler; very porous; apparent density 1.25 g cm ⁻³ ; measured in the same pressure range as the above specimen.
78	180	L	1961	2433.2		Lab. prepared rod	The above specimen measured under pressures ranging from 0 to 55.5 in. Hg.
79	180	L	1961	2973.2		Lab. prepared rod	The above specimen measured under pressures ranging from 31 to 55.5 in. Hg.
80	180	L	1961	1473-2933		Test Rod No. 1	Material from National Carbon Co.; graphitized to 3000 C; the pressure within the test chamber kept at 1-2 in. Hg above atmospheric pressure by releasing or admitting argon at various temperature levels.
81	180	L	1961	1773-2523		Test Rod No. 1	Second run of the above specimen.
82	180	L	1961	1478-2968		Test Rod No. 1	Third run of the above specimen.
83	180	L	1961	1643-2433		Test Rod No. 2 (U. B. carbon)	Specimen made from 50 parts of Texas coke (65/100 mesh as the first filler), another 50 parts of Texas coke (200/270 mesh as the second filler), and 40 parts of M-30 coal tar pitch as the binder; extruded, graphitized to 3000 C; apparent density 1.53 g cm ⁻³ ; measured in argon atmosphere at 1-2 in. Hg above atmospheric pressure.
84	180	L	1961	1513-2933		Test Rod No. 2 (U. B. carbon)	Second run of the above specimen.
85	180	L	1961	1983.2		Test Rod No. 2 (U. B. carbon)	Third run of the above specimen.
86	180	L	1961	1638-2448		Test Rod No. 2 (U. B. carbon)	Fourth run of the above specimen.
87	180	L	1961	1713-2983		Test Rod No. 3 (U. B. carbon)	Specimen made from 100 parts of 200/270 mesh size Texas coke as filler, 50 parts of M-30 coal tar pitch as binder; extruded; heat treated to 3000 C; apparent density 1.57 g cm ⁻³ ; measured in argon atmosphere at 1-2 in. Hg above the atmospheric pressure.
88	180	L	1961	1663-2993		Test Rod No. 3 (U. B. carbon)	Second run of the above specimen.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
89	180	L	1961	1783-3273		Test Rod No. 4 (U. B. carbon)	Specimen similarly prepared as the above with slight increase in density to 1.58 g cm ⁻³ .
90	181		1959	298.2		TS-148	Specimen made by National Carbon Co.; baked to 1425 C; typical impurities after baking 0.15 ash, and 0.042 H; apparent density 1.682 g cm ⁻³ ; electrical resistivity 1557 μohm cm; measured with grain.
91	181		1959	298.2		TS-148	Similar to the above specimen but electrical resistivity 2594 μohm cm; measure against grain.
92	181		1959	298.2		TS-160	Similar to the above specimen but with 0.13 ash after baking; apparent density 1.655 g cm ⁻³ ; electrical resistivity 2122 μohm cm; measured with grain.
93	181		1959	298.2		TS-160	Similar to the above specimen but measured against grain; electrical resistivity 3006 μohm cm.
94	181		1959	298.2		TS-160	Similar to the above specimen but baked to 2800 C; apparent density 1.785 g cm ⁻³ ; electrical resistivity 1942 μohm cm; measured with grain.
95	159, 356	L	1955, 1942	308-903			Glycerine coated; specimen sandwiched between 2 copper disks; the heater being electrically operated.
96	159	L	1955	308,373			Similar to the above specimen but being sandwiched between 2 silver disks.
97	159	C	1955	323.2			Glycerine coated graphite; boiling water used as heater; brass and steel used as comparative materials.
98	159	L	1955	313-873			Long graphite rod used as specimen; intended to eliminate errors due to uneven flow at heat into and out of the specimen.
99	159	C	1955	323.2		Karbate 2	Commercial impregnated graphite; brass used as the comparative material.
100	159	C	1955	323.2		Karbate 22	Similar to the above specimen.
101	182	R	1961	1422-2422		Sample A	Limited impregnated graphite normal to the extrusion axis; specimen in the form of a short tube with an outer dia of about 3 in. and a wall thickness of about 0.25 in.; experiment performed in helium for temperatures < 1540 C, for temperatures higher than this, argon was used instead.
102	182	R	1961	1367-2255		Sample B	Similar to the above specimen but more fully impregnated.
103	182	R	1961	1417-2255		Sample C	Similar to the above specimen.
104	183	E	1961	1173-2273	< 6		Spectrally pure; two thin rods each ~ 1 mm in dia used as the test specimens; annealed in high vacuum at 1700 C for 1 hr; measured in high vacuum.
105	184	P	1961	1193			Measured in a vacuum of 10 ⁻⁵ mm Hg; run No. 1.
106	184	P	1961	1185			The above specimen run No. 2.
107	184	P	1961	1185			The above specimen run No. 3.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
108	184	P	1961	1194			The above specimen run No. 4.
109	184	P	1961	1189			The above specimen run No. 5.
110	184	P	1961	1189			The above specimen run No. 6.
111	185	R	1960	953-963		LBR (grade TSP)	Nuclear graphite grade TSP from Nat. Carbon Co.; irradiated with 5×10^{26} neutron cm^{-2} at about 315 C.
112	185	R	1960	703-898		LBR (grade TSP)	The above specimen annealed in vacuum at 1000 C for 1 hr.
113	185	R	1960	723-898		LBR (grade TSP)	The above specimen before irradiation and not annealed.
114	339	L	1956	2.2-95		AUG-4	Resin bonded graphite; annealed to 2000 C.
115	339	L	1956	2.8-80		AUG-3	Resin bonded graphite; annealed to 1500 C.
116	161	P	1960	1573-3273		Graphitized Carbon black	99.65 C, 0.27 H, 0.08 O and 0.01 ash; particle size < 1 μ ; heat treated at 2500 C for 30 min (equivalent to a degree of graphitization of 0.77).
117	15	L	1956	115-385			Polycrystalline; made from 69.14% Kendall coke (soft type carbon), 29.17% medium grade coal tar pitch, and 1.43% Vacwax 80 (from Sococo Vacuum Oil Co.); extruded; baked for five days to 1100 C; density after baking 1.49 g cm^{-3} ; heat treated again to 2100 C; crystallite dia 98 Å.
118	15	L	1956	115-385			Similar to the above specimen but heat treated to 2200 C; crystallite dia 128 Å.
119	15	L	1956	118-385			Similar to the above specimen but heat treated to 2300 C; crystallite dia 184 Å.
120	15	L	1956	115-385			Similar to the above specimen but heat treated to 2430 C; crystallite dia 290 Å.
121	366		1960	1170-2450		Sample No. 1 (R-0008)	Grade R-0008 (a high quality graphite).
122	366		1960	1170-2600		Sample No. 2 (R-0008)	Similar to the above specimen.
123	366		1960	1115-2725		Sample No. 3 (R-0008)	Similar to the above specimen.
124	340	-	1962	1260-2199	<10	ZT type graphite; G-5, G-9	Thermal conductivity data in the z-direction (k_z) determined simultaneously with thermal conductivity in the r-direction k_r (see next curve) from 4 cylindrical specimens made from ZT type graphite of National Carbon Co.; density 2.00 g cm^{-3} ; anisotropy ratio of electrical resistivity $\rho(z\text{-direction})/\rho(r\text{-direction})$ 2.86 at room temperature; the specimens each about 2.54 cm in dia and about 0.3-0.6 cm thick; during measurement the specimens were heated in vacuum by high frequency induction; thermal conductivity determined by equating the heat conduction in specimen to the heat loss by radiation assuming the emissivity of a gray body, the analysis required 2 specimens of different thickness to solve simultaneously for k_x and k_r at a certain temperature.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
125	340	-	1962	1260-2199	<10	ZT type graphite; G-5, G-9	k_f determined simultaneously with the above curve.
126	334	L	1963	1353-2303			Made from soft filler and hard binder carbon; heat treated to 2100 C for 15 min.
127	334	L	1963	1383-2533			The above specimen heat treated to 2400 C for 15 min.
128	335		1963	1170-2340		ZT type; No. 1	Specimen 7 cm long, 1 cm wide and 1 mm thick; made by molding a selected coke-base mixture in one particular direction; impregnated and pressed at high temperatures; all surfaces milled, slightly sandblasted; apparent density 2.15 g cm ⁻³ ; measured approx. parallel to the grain direction with a tilt angle of 8.1 degrees; room temperature anisotropy in electrical resistivity ≈ 7.0 .
129	335		1963	1180-2760		ZT type; No. 1	Second run of the above specimen.
130	335		1963	1180-2400		ZT type; No. 2	Similar to the above specimen but measured perpendicular to the grain direction with a tilt angle of 8.1 degrees.
131	335		1963	1180-2350		ZT type; No. 2	Second run of the above specimen.
132	335		1963	1200-2180		ZT type; No. 3	Similar to the above specimen but measured parallel to the grain direction with a tilt angle of 8.1 degrees.
133	335		1963	1220-2280		ZT type; No. 4	Similar to the above specimen.
134	335		1963	1220-2630		ZT type; No. 5	Similar to the above specimen but with different dimensions of 7 x 6 x 0.1 cm; measured perpendicular to the grain direction with a tilt angle of 8.1 degrees.
135	341	L	1958	1623-2773		H4LM graphite	Specimen 8 in. long and 0.50 in. in dia, density 1.72 g cm ⁻³ ; heat flow parallel to grain, zero uranium content.
136	341	L	1958	1593-2823		LDH graphite	Specimen 8 in. long and 0.50 in. in dia, density 1.73 g cm ⁻³ ; heat flow parallel to grain; uranium content 0.125 mg cm ⁻³ of carbon.
137	341	L	1958	1623-2823		CK graphite	Specimen 8 in. long and 0.50 in. in dia, density 1.71 g cm ⁻³ ; heat flow parallel to grain; zero uranium content.
138	341	L	1958	1653-2823		LDC graphite	Specimen 8 in. long and 0.50 in. in dia, density 1.66 g cm ⁻³ ; heat flow parallel to grain; uranium content 0.250 mg cm ⁻³ of carbon.
139	343	E	1959	1300-2200		Boronated graphite	Rectangular specimen 0.1 x 1 x 10 cm (after extrusion and baking at 3273 K); cut from the portion near the parent rod center; the rod being made of a mixture of lamp black, coke, boron carbide, and pitch with a boron content of 1.3% and specific gravity of 1.79.
140	343	E	1959	1300-2465		Boronated graphite	Similar to the above specimen but cut from the central portion of the parent rod.
141	343	E	1959	1300-2200		Boronated graphite	Similar to above specimen but cut from the portion near the center of the parent rod.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
142	344	R	1962	1513-204b			Extruded test rod made from a mixture of 100 parts of soft filler coke particles (200/270 mesh) and 50 parts of M-30 soft binder, baked and heat treated to 3273 K, apparent density 1.54 g cm ⁻³ .
143	344	R	1962	1533-1933			The above specimen, run 2.
144	344	R	1962	1653-2393			The above specimen, run 3.
145	344	R	1962	1833-3268			The above specimen, run 4.
146	344	R	1962	1833-2743			The above specimen, run 5.
147	344	R	1962	1683-1963			The above specimen, run 6.
148	344	R	1962	1643-1703			Test rod made from 100 parts of soft coke (50 parts 65/100 mesh and 50 parts 200/270 mesh) and 35 parts of hard binder, baked and graphitized to a temperature of 3273 K prior to testing; apparent density 1.65 g cm ⁻³ .
149	344	R	1962	1643-2013			The above specimen, run 2.
150	344	R	1962	1753-2453			The above specimen, run 3.
151	344	R	1962	1683-2093			The above specimen, run 4.
152	344	R	1962	1643-2123			The above specimen, run 5.
153	344	R	1962	1363-1453		U. B. Graphite	Carbon rod sample extruded from a soft filler, soft binder mixture, baked to a temperature of 1273 K, heat treated at 1473 K.
154	344	R	1962	1393-1733		U. B. Graphite	Similar to above specimen except heat treated at 1773 K.
155	344	R	1962	1293-2013		U. B. Graphite	Similar to above specimen except heat treated at 2073 K.
156	344	R	1962	1393-2333		U. B. Graphite	Similar to above specimen except heat treated at 2373 K.
157	344	R	1962	1393-2603		U. B. Graphite	Similar to above specimen except heat treated at 2673 K.
158	344	R	1962	1403-2933		U. B. Graphite	Similar to above specimen except heat treated at 2773 K.
159	344	R	1962	1293-3093		U. B. Carbon	Carbon rod sample extruded from a mixture of soft filler and hard binder, baked and graphitized to a temperature of 3373 K.
160	344	R	1962	1603-3073		U. B. Carbon	The above specimen, run 2.
161	344	R	1962	1413-3103		U. B. Carbon	The above specimen, run 3.
162	344	R	1962	1513-3153		U. B. Carbon	The above specimen, run 4.
163	344	R	1962	1953-2953		U. B. Carbon	The above specimen, run 5.
164	345	L	1958	20-273		C-15	Specimen prepared from petroleum-coke base, molded with coal-tar pitch binder, baked at 2673 K, equivalent bromine residue 0.75 weight percent; measurements made under high temperatures.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
165	345	L	1958	18.5-273		C-15	Similar to the above specimen but baked at 2873 K and with an equivalent bromine residue of 0.5%.
166	345	L	1958	18-300		C-15	Similar to the above specimen but baked at 3073 K and with an equivalent bromine residue of 0.25%.
167	346	R	1956	80-300		CSF-MTR	Virgin 10 mil sample.
168	346	R	1956	200, 300		CSF-MTR	Virgin 20 mil sample.
169	296		1958	283-1273			Impervious graphite.
170	338		1948	1273, 1873		EBP	Rectangular block; 24 x 20 x 6 in.; molded; baked; cut at an angle to give both against and with the grain orientation.
171	338		1948	1273, 1873		AUC	Rod; 12 in. in dia; extruded; baked; specially cut to give an across grain orientation.
172	338		1948	1273, 1873		CS-312	Similar to the above specimen.
173	338		1948	1273, 1873		C-18	Rectangular block; 24 x 20 x 6 in.; molded; baked; cut at angle to give both against and with the grain orientation.
174	338		1948	1273, 1873		L-117	Rod; 5 in. in dia; extruded; baked; specially cut to give an across grain orientation.
175	338		1955	298.2		Porous-40	Molded; baked at 1000 C; specially cut to give with the grain orientation.
176	338		1955	298.2		Porous-60	Similar to the above specimen.
177	338		1955	298.2		255	Molded; baked.
178	338		1955	298.2		CS-112	Rod; 1.125 in. in dia; extruded; baked; specially cut to give with the grain orientation.
179	338		1955	1355-2303		CS-312	Similar to the above specimen but the dia, 12 in.
180	338		1956	15.2-296		CEQ	Rectangular block; 6 x 5 x 3 in.; molded; baked; specially cut to give with the grain orientation.
181	338		1962	298.2		AGSR	Graphite stocks 1-2.75 in. in dia; grain size 0.016 in.; bulk density 1.58 g cm ⁻³ ; electrical resistivity 839 μohm cm; with grain orientation.
182	338		1962	298.2		AGSR	Similar to the above but electrical resistivity 1500 μohm cm; across grain orientation.
183	338		1962	298.2		AGSR	Graphite stocks 3-5.75 in. in dia; grain size 0.03; bulk density 1.58 g cm ⁻³ ; electrical resistivity 864 μ ohm cm; with grain orientation.
184	338		1962	298.2		AGSR	Similar to the above but electrical resistivity 1280 μohm cm; across grain orientation.
185	338		1962	298.2		AGSR	Graphite stocks 6-12 in. in dia; grain size 0.06 in.; bulk density 1.57 g cm ⁻³ ; electrical resistivity 885 μohm cm; with grain orientation.
186	338		1962	298.2		AGSR	Similar to the above but electrical resistivity 1110 μohm cm; across grain orientation.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
187	338		1962	298.2		AGSR	Graphite stocks 14-35 in. in dia; grain size 0.25 in.; bulk density 1.54 g cm ⁻³ ; electrical resistivity 965 μohm cm; with grain orientation.
188	338		1962	298.2		AGSR	Similar to the above but electrical resistivity 1130 μohm cm; across grain orientation.
189	338		1962	298.2		AGA	Graphite stocks 35 in. in dia; grain size 0.5 in.; bulk density 1.65 g cm ⁻³ ; electrical resistivity 1040 μohm cm; with grain orientation.
190	338		1962	298.2		AGA	Similar to the above but electrical resistivity 1090 μohm cm; across grain orientation.
191	338		1962	298.2		AGSX	Graphite stocks 1-2.75 in. in dia; grain size 0.016 in.; bulk density 1.67 g cm ⁻³ ; electrical resistivity 799 μohm cm; with grain orientation.
192	338		1962	298.2		AGSX	Similar to the above but electrical resistivity 1330 μohm cm; across grain orientation.
193	338		1962	298.2		AGSX	Graphite stocks 3-5.75 in. in dia; grain size 0.03 in.; bulk density 1.69 g cm ⁻³ ; electrical resistivity 821 μohm cm; with grain orientation.
194	338		1962	298.2		AGSX	Similar to the above but electrical resistivity 1390 μohm cm; across grain orientation.
195	338		1962	298.2		AGSX	Graphite stocks 6-12 in. in dia; grain size 0.06 in.; bulk density 1.71 g cm ⁻³ ; electrical resistivity 820 μohm cm; with grain orientation.
196	338		1962	298.2		AGSX	Similar to the above but electrical resistivity 1010 μohm cm; across grain orientation.
197	338		1962	298.2		CS	Graphite stocks 1-2.75 in. in dia; grain size 0.016 in.; bulk density 1.68 g cm ⁻³ ; electrical resistivity 819 μohm cm; with grain orientation.
198	338		1962	298.2		CS	Similar to the above but electrical resistivity 1310 μohm cm; across grain orientation.
199	338		1962	298.2		CS	Graphite stocks 3-18 in. in dia; grain size 0.03 in.; bulk density 1.72 g cm ⁻³ ; electrical resistivity 860 μohm cm; with grain orientation.
200	338		1962	298.2		CS	Similar to the above but electrical resistivity 1100 μohm cm; across grain orientation.
201	338		1962	298.2		ATL	Graphite stocks 20-24 in. in dia; grain size 0.03 in.; bulk density 1.70 g cm ⁻³ ; electrical resistivity 890 μohm cm; with grain orientation.
202	338		1962	298.2		ATL	Similar to the above but electrical resistivity 1070 μohm cm; across grain orientation.
203	338		1962	298.2		ATL	Graphite stocks 30-50 in. in dia; grain size 0.03 in.; bulk density 1.78 g cm ⁻³ ; electrical resistivity 1130 μohm cm; with grain orientation.
204	336		1962	298.2		ATL	Similar to the above but electrical resistivity 1180 μohm cm; across grain orientation.
205	336		1962	298.2		AUC	Graphite stocks 1-8 in. in dia; grain size 0.016 in.; bulk density 1.68 g cm ⁻³ ; electrical resistivity 790 μohm cm; with grain orientation.
206	338		1962	298.2		AUC	Similar to the above but electrical resistivity 1230 μohm cm; across grain orientation.
207	338		1962	298.2		AUC	Graphite stocks 9-18 in. in dia; grain size 0.03 in.; bulk density 1.69 g cm ⁻³ ; electrical resistivity 767 μohm cm; with grain orientation.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
208	338		1962	298.2		AUC	Similar to the above but electrical resistivity 1230 $\mu\text{ohm cm}$; across grain orientation.
209	338		1962	298.2		CEQ	Graphite stocks size 6 x 5 x 2.875 in.; grain size 0.008 in.; bulk density 1.55 g cm^{-3} ; electrical resistivity 5029 $\mu\text{ohm cm}$; with grain orientation.
210	338		1962	298.2		CDA	Graphite stocks size 6 x 5 x 2.6875 in.; grain size 0.006 in.; bulk density 1.62 g cm^{-3} ; electrical resistivity 1972 $\mu\text{ohm cm}$; with grain orientation.
211	338		1962	298.2		CDA	Similar to the above but electrical resistivity 1640 $\mu\text{ohm cm}$; across grain orientation.
212	338		1962	298.2		CDG	Graphite stocks size 12 x 12 x 0.25 to 12 x 12 x 1 in.; grain size 0.016 in.; bulk density 1.36 g cm^{-3} ; electrical resistivity 1351 $\mu\text{ohm cm}$; with grain orientation.
213	338		1962	298.2		CIDG	Similar to the above but the sizes 15 x 18 x 0.25 to 15 x 18 x 2 in.; bulk density 1.40 g cm^{-3} ; electrical resistivity 1522 $\mu\text{ohm cm}$.
214	337		1914	290, 373		Pencil Lead Graphite	Cylindrical rod; 0.183 cm in dia 10.4 cm long; specific gravity 2.11; specimen made from a 'Kohinor' pencil lead grade 6H.
215	347	L	1964	298.2		ZTA	Bulk density 1.940 g cm^{-3} ; electrical resistivity 6.97 x 10 ⁻⁴ ohm cm; with grain.
216	347	L	1964	298.2		ZTA	Bulk density 1.940 g cm^{-3} ; electrical resistivity 21.87 x 10 ⁻⁴ ohm cm; across grain.
217	347	L	1964	298.2		ZTA	Bulk density 1.924 g cm^{-3} ; electrical resistivity 7.24 x 10 ⁻⁴ ohm cm; with grain.
218	347	L	1964	298.2		ZTA	Bulk density 1.924 g cm^{-3} ; electrical resistivity 21.90 x 10 ⁻⁴ ohm cm; across grain.
219	347	L	1964	298.2		ZTA	Bulk density 1.953 g cm^{-3} ; electrical resistivity 6.91 x 10 ⁻⁴ ohm cm; with grain.
220	347	L	1964	298.2		ZTA	Bulk density 1.953 g cm^{-3} ; electrical resistivity 23.18 x 10 ⁻⁴ ohm cm; across grain.
221	347	L	1964	298.2		ZTA	Bulk density 1.942 g cm^{-3} ; electrical resistivity 6.70 x 10 ⁻⁴ ohm cm; with grain.
222	347	L	1964	298.2		ZTA	Bulk density 1.942 g cm^{-3} ; electrical resistivity 18.95 x 10 ⁻⁴ ohm cm; across grain.
223	347	L	1964	298.2		ZTA	Bulk density 1.955 g cm^{-3} ; electrical resistivity 6.87 x 10 ⁻⁴ ohm cm; with grain.
224	347	L	1964	298.2		ZTA	Bulk density 1.955 g cm^{-3} ; electrical resistivity 22.04 x 10 ⁻⁴ ohm cm; across grain.
225	347	L	1964	298.2		ZTA	Bulk density 1.923 g cm^{-3} ; electrical resistivity 7.07 x 10 ⁻⁴ ohm cm; with grain.
226	347	L	1964	298.2		ZTA	Bulk density 1.923 g cm^{-3} ; electrical resistivity 22.67 x 10 ⁻⁴ ohm cm; across grain.
227	347	L	1964	298.2		ZTA	Bulk density 1.932 g cm^{-3} ; electrical resistivity 7.43 x 10 ⁻⁴ ohm cm; with grain.
228	347	L	1964	298.2		ZTA	Bulk density 1.932 g cm^{-3} ; electrical resistivity 16.09 x 10 ⁻⁴ ohm cm; across grain.
229	347	L	1964	298.2		ZTA	Bulk density 1.92 g cm^{-3} ; electrical resistivity 7.76 x 10 ⁻⁴ ohm cm; with grain.
230	347	L	1964	298.2		ZTA	Bulk density 1.92 g cm^{-3} ; electrical resistivity 16.45 x 10 ⁻⁴ ohm cm; across grain.
231	347	L	1964	298.2		ZTA	Bulk density 1.93 g cm^{-3} ; electrical resistivity 7.54 x 10 ⁻⁴ ohm cm; with grain.
232	347	L	1964	298.2		ZTA	Bulk density 1.93 g cm^{-3} ; electrical resistivity 15.84 x 10 ⁻⁴ ohm cm; across grain.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Rel. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
233	347	L	1964	298.2		ZTA	Bulk density 1.95 g cm ⁻³ ; electrical resistivity 6.66 x 10 ⁻⁴ ohm cm; with grain.
234	347	L	1964	298.2		ZTA	Bulk density 1.95 g cm ⁻³ ; electrical resistivity 15.82 x 10 ⁻⁴ ohm cm; across grain.
235	347	L	1964	298.2		ZTA	Bulk density 1.94 g cm ⁻³ ; electrical resistivity 7.42 x 10 ⁻⁴ ohm cm; with grain.
236	347	L	1964	298.2		ZTA	Bulk density 1.94 g cm ⁻³ ; electrical resistivity 16.18 x 10 ⁻⁴ ohm cm; across grain.
237	347	L	1964	298.2		ZTB	Bulk density 1.98 g cm ⁻³ ; electrical resistivity 6.88 x 10 ⁻⁴ ohm cm; with grain.
238	347	L	1964	298.2		ZTB	Bulk density 1.98 g cm ⁻³ ; electrical resistivity 19.74 x 10 ⁻⁴ ohm cm; across grain.
239	347	L	1964	298.2		ZTB	Bulk density 1.97 g cm ⁻³ ; electrical resistivity 6.96 x 10 ⁻⁴ ohm cm with grain.
240	347	L	1964	298.2		ZTB	Bulk density 1.97 g cm ⁻³ ; electrical resistivity 17.81 x 10 ⁻⁴ ohm cm; across grain.
241	347	L	1964	298.2		ZTB	Bulk density 1.99 g cm ⁻³ ; electrical resistivity 6.43 x 10 ⁻⁴ ohm cm; with grain.
242	347	L	1964	298.2		ZTB	Bulk density 1.99 g cm ⁻³ ; electrical resistivity 21.13 x 10 ⁻⁴ ohm cm; across grain.
243	347	L	1964	298.2		ZTC	Bulk density 1.93 g cm ⁻³ ; electrical resistivity 6.97 x 10 ⁻⁴ ohm cm; with grain.
244	347	L	1964	298.2		ZTC	Bulk density 1.93 g cm ⁻³ ; electrical resistivity 11.97 x 10 ⁻⁴ ohm cm; across grain.
245	347	L	1964	298.2		ZTC	Bulk density 1.92 g cm ⁻³ ; electrical resistivity 7.15 x 10 ⁻⁴ ohm cm; with grain.
246	347	L	1964	298.2		ZTC	Bulk density 1.92 g cm ⁻³ ; electrical resistivity 11.00 x 10 ⁻⁴ ohm cm; across grain.
247	347	L	1964	298.2		ZTC	Bulk density 1.94 g cm ⁻³ ; electrical resistivity 6.90 x 10 ⁻⁴ ohm cm; with grain.
248	347	L	1964	298.2		ZTC	Bulk density 1.94 g cm ⁻³ ; electrical resistivity 13.21 x 10 ⁻⁴ ohm cm; across grain.
249	347	L	1964	298.2		ZTD	Bulk density 2.01 g cm ⁻³ ; electrical resistivity 5.41 x 10 ⁻⁴ ohm cm; with grain.
250	347	L	1964	298.2		ZTD	Bulk density 2.01 g cm ⁻³ ; electrical resistivity 7.88 x 10 ⁻⁴ ohm cm; across grain.
251	347	L	1964	298.2		ZTE	Bulk density 1.96 g cm ⁻³ ; electrical resistivity 8.94 x 10 ⁻⁴ ohm cm; with grain.
252	347	L	1964	298.2		ZTE	Bulk density 1.96 g cm ⁻³ ; electrical resistivity 20.40 x 10 ⁻⁴ ohm cm; across grain.
253	347	L	1964	298.2		ZTF	Bulk density 1.99 g cm ⁻³ ; electrical resistivity 7.31 x 10 ⁻⁴ ohm cm; with grain.
254	347	L	1964	298.2		ZTF	Bulk density 1.99 g cm ⁻³ ; electrical resistivity 20.50 x 10 ⁻⁴ ohm cm; across grain.
255	347	L	1964	298.2		ZTF	Bulk density 1.99 g cm ⁻³ ; electrical resistivity 7.24 x 10 ⁻⁴ ohm cm; with grain.
256	347	L	1964	298.2		ZTF	Bulk density 1.99 g cm ⁻³ ; electrical resistivity 21.49 x 10 ⁻⁴ ohm cm; across grain.
257	347	L	1964	298.2		RVA	Bulk density 1.84 g cm ⁻³ ; electrical resistivity 12.21 x 10 ⁻⁴ ohm cm; with grain.
258	347	L	1964	298.2		RVA	Bulk density 1.84 g cm ⁻³ ; electrical resistivity 15.73 x 10 ⁻⁴ ohm cm; across grain.
259	347	L	1964	298.2		RVA	Bulk density 1.825 g cm ⁻³ ; electrical resistivity 12.25 x 10 ⁻⁴ ohm cm; with grain.
260	347	L	1964	298.2		RVA	Bulk density 1.825 g cm ⁻³ ; electrical resistivity 16.87 x 10 ⁻⁴ ohm cm; across grain.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
261	347	L	1964	298.2		RVA	Bulk density 1.842 g cm ⁻³ ; electrical resistivity 12.34 x 10 ⁻⁴ ohm cm; with grain.
262	347	L	1964	298.2		RVA	Bulk density 1.842 g cm ⁻³ ; electrical resistivity 15.20 x 10 ⁻⁴ ohm cm; across grain.
263	347	L	1964	298.2		RVA	Bulk density 1.844 g cm ⁻³ ; electrical resistivity 12.06 x 10 ⁻⁴ ohm cm; with grain.
264	347	L	1964	298.2		RVA	Bulk density 1.844 g cm ⁻³ ; electrical resistivity 15.65 x 10 ⁻⁴ ohm cm; across grain.
265	347	L	1964	298.2		RVC	Bulk density 1.84 g cm ⁻³ ; electrical resistivity 13.08 x 10 ⁻⁴ ohm cm; with grain.
266	347	L	1964	298.2		RVC	Bulk density 1.84 g cm ⁻³ ; electrical resistivity 16.41 x 10 ⁻⁴ ohm cm; across grain.
267	347	L	1964	298.2		RVC	Bulk density 1.84 g cm ⁻³ ; electrical resistivity 12.71 x 10 ⁻⁴ ohm cm; with grain.
268	347	L	1964	298.2		RVC	Bulk density 1.84 g cm ⁻³ ; electrical resistivity 16.03 x 10 ⁻⁴ ohm cm; across grain.
269	347	L	1964	298.2		RVC	Bulk density 1.85 g cm ⁻³ ; electrical resistivity 13.13 x 10 ⁻⁴ ohm cm; with grain.
270	347	L	1964	298.2		RVC	Bulk density 1.85 g cm ⁻³ ; electrical resistivity 16.75 x 10 ⁻⁴ ohm cm; across grain.
271	347	L	1964	298.2		RVD	Bulk density 1.87 g cm ⁻³ ; electrical resistivity 12.62 x 10 ⁻⁴ ohm cm; with grain.
272	347	L	1964	298.2		RVD	Bulk density 1.87 g cm ⁻³ ; electrical resistivity 21.64 x 10 ⁻⁴ ohm cm; across grain.
273	347	L	1964	298.2		RVD	Bulk density 1.87 g cm ⁻³ ; electrical resistivity 12.52 x 10 ⁻⁴ ohm cm; with grain.
274	347	L	1964	298.2		RVD	Bulk density 1.87 g cm ⁻³ ; electrical resistivity 21.72 x 10 ⁻⁴ ohm cm; across grain.
275	347	L	1964	298.2		RVD	Bulk density 1.87 g cm ⁻³ ; electrical resistivity 12.72 x 10 ⁻⁴ ohm cm; with grain.
276	347	L	1964	298.2		RVD	Bulk density 1.87 g cm ⁻³ ; electrical resistivity 21.54 x 10 ⁻⁴ ohm cm; across grain.
277	347	L	1964	298.2		CFW	Bulk density 1.90 g cm ⁻³ ; electrical resistivity 11.98 x 10 ⁻⁴ ohm cm; with grain.
278	347	L	1964	298.2		CFW	Bulk density 1.90 g cm ⁻³ ; electrical resistivity 12.60 x 10 ⁻⁴ ohm cm; across grain.
279	347	L	1964	298.2		CFZ	Bulk density 1.91 g cm ⁻³ ; electrical resistivity 12.77 x 10 ⁻⁴ ohm cm; with grain.
280	347	L	1964	298.2		CFZ	Bulk density 1.91 g cm ⁻³ ; electrical resistivity 16.08 x 10 ⁻⁴ ohm cm; across grain.
281	160	R	1958	1593-3198			Specimen 0.5 in. in dia, 8 in. long; prepared by mixing 100 parts (by weight) of raw Texas coke (calined for 4 hrs at 1200 C in a baking furnace, crushed and ground) and 40 parts of Medium No. 30 coal tar pitch (supplied by Barrett Co.) for 15 min at 160 C and also 3 parts of extrusion oil (VacWax 80 of Socony Vacuum Co.) mixed again at 150 C for 5 hrs; extruded and baked at 1000 C; graphitized in nitrogen atmosphere at 2100 C for 10 min.
282	160	R	1958	2189-3033			Similar to the above but using Texas coke of 200/270 mesh as raw material and extruded at 8200 psi.
283	160	R	1958	1906-3200			Similar to the above but using Texas coke of 100/150 mesh as raw material and extruded at 6100 psi.
284	160	R	1958	2078-3134			Similar to the above but using Texas coke of 28/35 mesh as raw material and extruded at 4100 psi.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
285	160	R	1958	2068-2815		Graphitized carbon rod	The above specimen measured in high vacuum chamber.
286	265	R	1960	1403-3273		Graphitized carbon rod	Specimen 1.57 in. in dia; made from 100 parts of filler (50 parts of 100/150 mesh and 50 parts of <270 mesh phenol formaldehyde) and 43 parts binder; extruded at 11500 psi; graphitized to 3100 C.
287	265	R	1960	1418-3188		Graphitized carbon rod	Specimen made from 100 parts of calcined Texas coke (28/35 mesh), 44 parts of coal tar; extruded and baked to 1200 C; density after baking 1.25 g cm ⁻³ ; graphitized to 3100 C; measured in argon atmosphere at 1-2 in. Hg above atmospheric pressure.
288	265	R	1960	1503-3073		Graphitized carbon rod	Specimen 1.36 in. in dia; made from 100 parts of filler (50 parts of 65/100 mesh and 50 parts of 200/270 mesh Texas coke) and 40 parts of M-30 coal tar pitch as binder; extruded at 7000 psi; graphitized to 3190 C.
289	265	R	1960	1363-3183		Graphitized carbon rod	Specimen 1.61 in. in dia; made from 100 parts of filler (50 parts of 65/100 mesh and 50 parts 200/270 mesh) and 35 parts of phenol benzaldehyde as binder; extruded at 5300 psi; graphitized to 3100 C.
290	265	R	1960	1373-2773		Graphitized carbon rod	Specimen 1.24 in. in dia; made from 100 parts of filler (50 parts of 100/150 mesh and 50 parts of <270 mesh phenol formaldehyde) and 48 parts of M-30 coal tar pitch as binder; extruded at 2300 psi; graphitized to 3100 C.
291	367	R	1963	1343-2313		Graphitized carbon rod	Prepared by mixing 50 parts 65/100 mesh and 50 parts <200 mesh soft filler (soft Texas coke), and 40 parts soft binder (M-30 pitch); extruded to 0.50 in. dia; baked for four days to 1000 C; density after baking 1.55 g cm ⁻³ ; heat treated at 2100 C for 10 min; measured in an argon atmosphere (pressure approx. one atm).
292	367	R	1963	1303-2603			The above specimen heat treated at 2400 C for 10 min.
293	367	R	1963	1303-2948			The above specimen heat treated at 2800 C for 10 min.
294	367	R	1963	1353-2303			Prepared by mixing 50 parts 65/100 mesh and 50 parts 200/270 mesh soft filler (soft Texas coke), and 35 parts hard binder (phenol benzaldehyde); extruded to 0.50 in. dia; baked for four days to 1000 C; density after baking 1.56 g cm ⁻³ ; heat treated at 2100 C for 10 min; measured in an argon atmosphere (pressure approx. one atm).
295	367	R	1963	1363-2583			The above specimen heated at 2400 C for 10 min.
296	367	R	1963	1373-2973			The above specimen heated at 2800 C for 10 min.
297	367	R	1963	1318-2233			Prepared by mixing 50 parts 100/150 mesh and 50 parts <270 mesh hard filler (phenol formaldehyde); and 48 parts soft binder (M-30 pitch); extruded to 0.50 in. dia; baked for four days to 1000 C; density after baking 1.14 g cm ⁻³ ; heat treated at 2100 C for 10 min; measured in an argon atmosphere (pressure approx. one atm).

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
298	367	R	1963	1323-2473			The above specimen heat treated at 2400 C for 10 min.
299	367	R	1963	1333-2763			The above specimen heat treated at 2800 C for 10 min.
300	367	R	1963	1343-2263			Prepared by mixing 50 parts 100/150 mesh and 50 parts <270 mesh hard filler (phenol formaldehyde), and 43 parts hard binder (phenol benzaldehyde); extruded to 0.50 in. dia; baked for four days to 1000 C; density after baking 1.22 g cm ⁻³ ; heat treated at 2100 C for 10 min; measured in an argon atmosphere (pressure approx. one atm).
301	367	R	1963	1368-2523			The above specimen heat treated at 2400 C for 10 min.
302	367	R	1963	1438-2893			The above specimen heat treated at 2800 C for 10 min.
303	354	C	1962	323-873	5-10	EY9	Specimen made from Morgan Crucible Co. graphite; cut parallel to the direction of extrusion; density 1.64 g cm ⁻³ ; electrical resistivity reported as 1.93, 1.71, 1.53, 1.40, and 1.30 milliohm cm at 85, 205, 320, 450, and 545 C, respectively; Armco iron used as the comparative material.
304	354	C	1962	313-828	5-10	EY9	Similar to the above specimen but cut perpendicular to the direction of extrusion; electrical resistivity reported as 2.87, 2.58, 2.21, and 2.05 milliohm cm at 70, 185, 350, and 425 C, respectively.
305	354	C	1962	321-916	5-10	HX10	Specimen made from material of Harwell Graphite Plant; cut parallel to the direction of extrusion; density 1.87 g cm ⁻³ ; electrical resistivity at 83, 195, 360, and 450 C being respectively, 1.50, 1.30, 1.10, and 1.02 milliohm cm.
306	354	C	1962	321-838	5-10	British Reactor Grade A	Specimen cut parallel to the direction of extrusion; density 1.73 g cm ⁻³ ; electrical resistivity at 100, 200, 300, 400, and 450 C being respectively, 0.60, 0.53, 0.48, 0.45 and 0.44 milliohm cm.
307	354	C	1962	321-846	5-10	British Reactor Grade A	Similar to the above specimen but cut perpendicular to the direction of extrusion; electrical resistivity at 100, 200, and 300 C being respectively, 1.03, 0.90, and 0.82 milliohm cm.
308	354	C	1962	318-816	5-10	British Reactor Grade A	Similar to the above specimen but cut parallel to the direction of extrusion.
309	354	C	1962	318-823	5-10	British Reactor Grade A	Similar to the above specimen but cut perpendicular to the direction of extrusion.
310	354	C	1962	313-831	5-10	British Reactor Grade Carbon	British Reactor Grade Carbon Stock graphitized to 2100 C; not impregnated; cut parallel to the direction of extrusion; density 1.62 g cm ⁻³ ; electrical resistivity at 100, 200, 300, 400, and 500 C being respectively 3.10, 2.87, 2.67, 2.49, and 2.33 milliohm cm.
311	354	C	1962	313-798	5-10	British Reactor Grade Carbon	Similar to the above specimen but graphitized to 2300 C; density 1.68 g cm ⁻³ ; electrical resistivity at 100, 200, 300, 400, and 500 C being respectively, 2.35, 2.08, 1.85, 1.64, and 1.46 milliohm cm.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
312	354	C	1962	313-753	5-10	British Reactor Grade Carbon	Similar to the above specimen but graphitized to 2600 C; density 1.62 g cm ⁻³ ; electrical resistivity at 100, 200, 300, 400, and 500 C being respectively, 1.17, 1.02, 0.92, 0.85, and 0.80 milliohm cm.
313	354	C	1962	303-901	5-10	British Reactor Grade Carbon	Similar to the above specimen but graphitized to 2820 C; density 1.65 g cm ⁻³ ; electrical resistivity at 100, 200, 300, 400, 500, and 700 C being respectively, 0.78, 0.71, 0.67, 0.65, 0.64, 0.65, and 0.67 milliohm cm.
314	336		1965	323.2		EY9	Grade EY9 graphite from Morgon Crucible Company; electrical resistivity 1.71 milliohm cm at room temperature.
315	336		1965	323.2		EY9	Similar to the above specimen but electrical resistivity 1.86 milliohm cm at room temperature.
316	336		1965	323.2		EY9	Similar to the above specimen but electrical resistivity 1.89 milliohm cm at room temperature.
317	397		1966	364-2239		JTA; 7-F-12	Measured in the with-the-grain direction.
318	363	P	1965	1575-2400		EY9A	Density 1.76 g cm ⁻³ ; data calculated from measurements of thermal diffusivity; specific heat data from "Nuclear Graphite" by Nightingale, R. E., Yoshikawa, H. H., and Losty, H. H. W., 1962.
319	363	P	1965	1320-2380		Moderator graphite	Density 1.71 g cm ⁻³ ; data calculated from measurements of thermal diffusivity; specific heat data from the same source as above.
320	391	E	1964	295-511		ZTA	Prepared from coke L, supplied by Pechiney Company, by extruding into a 10 mm dia bar; the graphite was impregnated once with tar; measured along the a-axis.
321	391	E	1964	298-536		ZTA	Similar to the above specimen measured along the c-axis.
322	391	E	1964	306-714		ZTA	Similar to the above specimen; the dia was a bit smaller and measured along the a-axis.
323	391	E	1964	321-721		ZTA	Similar to the above specimen; measured along the c-axis.
324	391	E	1964	302-598		ZTA	Prepared from coke L, supplied by Pechiney Company, by extruding into 10 mm dia; the graphite was impregnated once with tar; measured along the c-axis.
325	391	E	1964	307-605		ZTA	Similar to the above specimen, except neutron-irradiated at 350 C.
326	391	E	1964	311-506		ZTA	Similar to the above specimen, except neutron-irradiated at 250 C.
327	391	E	1964	393-411		ZTA	Similar to the above specimen, except neutron-irradiated at 150 C.
328	392		1961	469-873		MH4LM	Density 1.90 g cm ⁻³ ; grain size > 0.032 in.
329	392		1961	471-875		MH4LM	Similar to the above specimen except irradiated in Material Testing Reactor at 475 C by a neutron flux of 3.5 x 10 ¹⁹ neutrons with energy > 0.1 Mev.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
330	392	-	1961	471-874		ATL-82-1	Grain size 0.016 to 0.03 in.
331	392	-	1961	471-873		ATL-82-2	Similar to the above specimen; irradiated in Hanford reactor at 360 to 420 C by a neutron flux of 3.2×10^{19} nvt with energy > 0.1 Mev.
332	392	-	1961	472-874		ATL-82-3	Similar to the above specimen except irradiated in Material Testing Reactor at 475 C by a neutron flux of 3.6×10^{19} nvt with energy > 0.1 Mev.
333	392	-	1961	468-868		R0025-1	Obtained from National Carbon Co.; grain size < 0.016 in.
334	392	-	1961	468-869		R0025-2	Similar to the above specimen.
335	392	-	1961	472-867		R0025-3	Similar to the above specimen; irradiated in Testing Reactor at 360 to 420 C by a neutron flux of 3.6×10^{19} nvt with energy > 0.1 Mev.
336	392	-	1961	471-865		R0025-3A	The above specimen annealed at 925 C for 16 hrs.
337	340	-	1962	1671	< 10	ZT type graphite; G3A	Thermal conductivity data in the z-direction (k_z) determined simultaneously with thermal conductivity in the r-direction (k_r , see next curve) from 4 cylindrical specimens made from ZT type graphite of National Carbon Co.; density 1.990 g cm ⁻³ ; anisotropy ratio of electrical resistivity $\rho(z\text{-direction})/\rho(r\text{-direction}) = 2.50$ at room temperature; the specimens each about 2.537 cm dia x 1.126 cm thick being heated in vacuum by high frequency induction, thermal conductivity determined by equating the heat conduction in specimen to the heat loss by radiation assuming the emissivity of a gray body, the analysis required 2 specimens of different thickness to solve simultaneously for k_z and k_r at a certain temperature.
338	340	-	1962	1671	< 10	ZT type graphite; G3A	k_r determined simultaneously with the above curve.
339	340	-	1962	1671	< 10	ZT type graphite; G7	Similar to the above specimen except with size 2.539 cm dia x 0.287 cm thick and density 1.978 g cm ⁻³ ; k_z was measured.
340	340	-	1962	1671	< 10	ZT type graphite; G7	k_r determined simultaneously with the above curve.
341	336	-	1965	673-1173		EY's graphite	Obtained from Morgan Crucible Co.; electrical resistivity 1790-1850 $\mu\text{ohm cm}$ at room temperature; data reported were mean values.
342	394	R	1965	1367-3311	5-7	CFZ grade	99.74 C, < 0.6 H, 0.19 ash, 0.07 CaO, 0.02 Al ₂ O ₃ , 0.04 total sulfur, and < 0.01 sulfide sulfur; specimens 1 in. long, 1 in. O.D. and 0.25 in. I.D.; supplied by Union Carbide Co.; heat flow measured parallel to cylindrical axis; with grain; bulk density (mean value) 1.899 g cm ⁻³ ; thermal conductivity data calculated from the mean values of 9 specimens (standard deviation 0.0946, 0.0609, 0.0786, 0.0963, and 0.111 at 1366.5, 2199.8, 2755.4, 3033.2, and 3310.9 K, respectively).
343	394	R	1965	1367-3311	5-7	CFZ grade	Similar to the above specimens except bulk density (mean value) 1.908 g cm ⁻³ ; standard deviation 0.0891, 0.129, 0.0986, 0.0963, and 0.0544 at 1366.5, 2199.8, 2755.4, 3033.2, and 3310.9 K, respectively.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
344	394	R	1965	1367-3311	5-7	CFZ grade	Similar to the above specimens except specimen orientation across grain; bulk density (mean value) 1.896 g cm ⁻³ ; standard deviation 0.0661, 0.0749, 0.0711, 0.0606, and 0.0526 at 1366.5, 2199.8, 2755.4, 3033.2, and 3310.9 K, respectively.
345	394	R	1965	1367-3311	5-7	CFZ grade	Similar to the above specimens except bulk density (mean value) 1.906 g cm ⁻³ ; standard deviation 0.0535, 0.0362, 0.0799, 0.0862, and 0.0539 at 1366.5, 2199.8, 2755.4, 3033.2, and 3310.9 K, respectively.
346	394	C	1965	338.7	5	CFZ grade	99.74 C, <0.6 H, 0.19 ash, 0.07 CaO, 0.02 Al ₂ O ₃ , 0.04 total sulfur and <0.01 sulfide sulfur; specimens 1 in. in dia and 1 in. long; supplied by Union Carbide Co.; with grain; bulk density (mean value) 1.903 g cm ⁻³ ; thermal conductivity data from the mean values of 10 specimens (standard deviation 0.0937 at 338.7 K); Armco iron used as comparative material.
347	394	C	1965	338.7	5	CFZ grade	Similar to the above specimens except bulk density (mean value) 1.907 g cm ⁻³ ; standard deviation 0.108 at 338.7 K.
348	394	C	1965	338.7	5	CFZ grade	Similar to the above specimens except bulk density (mean value) 1.881 g cm ⁻³ ; standard deviation 0.0317 at 338.7 K.
349	394	C	1965	338.7	5	CFZ grade	Similar to the above specimens except bulk density (mean value) 1.907 g cm ⁻³ ; standard deviation 0.0288 at 338.7 K.
350	396		1967	1068-3030		Supertemp Pyrolytic graphite	Annealed; electrical conductivity 9.54, 7.73, 6.40, 5.42, 4.72, 4.19, 3.71 and 3.25 x 10 ³ ohm ⁻¹ cm ⁻¹ at 1088, 1365, 1643, 1920, 2198, 2475, 2753, and 3030 K, respectively.
351	397		1966	372-2205		JTA; 14-G-1	Measured with the grain.
352	397		1966	354-2222		JTA; 14-G-1	Measured across the grain.
353	15	L	1956	115-385			Polycrystalline; prepared from a mix consisted of 100 parts of Kendall coke, 42 parts of medium grade coal tar pitch and 3 parts of Socony Vacuum Oil Co. Vacwax 80, the coke calcined to 1100 C, crushed into powder, passed two times through a small Raymond mill, then the mix made and extruded through a 0.5 in. die, cut into 6 in. long rods; the rods baked for 5 days to reach the top temperature of 1100 C, subsequently heat treated at 1200 C for about 5 min; density 1.49 g cm ⁻³ ; crystallite dia 37 Å.
354	15	L	1956	115-385			Similar to the above specimen except heat treated at 1750 C and the crystallite dia 61.5 Å.
355	15	L	1956	115-385			Similar to the above specimen except heat treated at 1950 C and the crystallite dia 79 Å.
356	20	F	1944	93-373			Cut from a carbon electrode; supplied by National Carbon Co.; 2.9 cm dia x 32 cm long.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used*	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
357	158	L	1952	2.8-90		Carbon resistor	L.A.B. 33 ohm, 0.5 watt resistor.
358	129	L	1909	373-713		Acheson	Ordinary carbon supplied by National Carbon Co.; made of petroleum coke.
359	13	C	1953	343.2	± 3	Acheson	Density 1.7 g cm ⁻³ ; heat flow direction perpendicular to the axis of extrusion; Armco iron used as the comparative standard.
360	13	C	1953	343.2	± 3	Acheson	Similar to the above specimen but heat flow parallel to the axis of extrusion.
361	129	L	1909	373-873		Acheson	Specimen 8.5 in. long and 1 in. in dia.
362	354	C	1962	311-853		Reactor Grade Carbon stock	Heat-treated at 1500 C; density 1.64 g cm ⁻³ ; Armco iron used as comparative material; heat flow parallel to extrusion.
363	354	C	1962	310-804		Reactor Grade Carbon stock	Heat-treated at 1800 C; density 1.61 g cm ⁻³ ; electrical resistivity measured parallel to extrusion reported as 3.59, 3.49, 3.37, 3.22, and 3.15 milliohm cm at 61, 148, 328, 447, and 516 C, respectively.
364	106	C	1956	336.7	3	Acheson; 1	Artificial graphite electrode 80 mm in dia, 125 mm long; apparent density 1.40 g cm ⁻³ ; electrical resistivity 0.00123 ohm cm; copper used as comparative material.
365	106	C	1956	334.2	3	Acheson; 2	Similar to the above specimen but the apparent density 1.399 g cm ⁻³ ; electrical resistivity 0.00121 ohm cm.
366	326	R	1952	363-873		Acheson 2301	Powder; 99 pure; apparent density 0.69 g cm ⁻³ ; measured after repeated heating.
367	541	L	1962	2.4-227		Ohmite	Carbon resistor 100 ohm 2 W; specimen 0.58 cm in diameter and 1.38 cm long; measured in vacuum.
368	541	L	1962	2.4-118		Ohmite	Similar to the above specimen 3900 ohm 2 W, 0.58 cm in dia and 1.4 cm long.
369	18	L	1939	318-611		Acheson; 1	Tubular specimen 75 cm long, 2.54 cm O.D., and 0.3 cm I.D.; electrical resistivity at 0 C = 0.00110 ohm cm.
370	18	R	1939	1048-1363	<10	Acheson; 2	Similar to the above specimen but $\rho(0 C) = 0.00105$ ohm cm.
371	18	R	1939	1723-2713	<10	Acheson; 3	Similar to the above specimen but $\rho(0 C) = 0.00077$ ohm cm.
372	18	R	1939	1798-3048	<10	Acheson; 4	Similar to the above specimen but $\rho(0 C) = 0.00077$ ohm cm.
373	18	R	1939	1683-2343	<10	Acheson; 5	Similar to the above specimen but $\rho(0 C) = 0.00067$ ohm cm.
374	20	F	1944	93-373		Acheson	Specimen 16 cm long, 2.9 cm in dia; cut from Acheson graphite electrode (from National Carbon Co.); specimen axis parallel to the electrode axis.
375	20	F	1944	93-373		Acheson	Similar to the above specimen but cut perpendicular to the electrode axis.
376	175	C	1937	613-1128		Acheson	Specimen 1.47 cm in dia and 20 cm long; machined from an Acheson graphite rod; electrical conductivity 1218, 1369, 1445, 1497, 1515, 1517, 1503, 1476, and 1444 ohm ⁻¹ cm ⁻¹ at 0, 100, 200, 300, 400, 500, 600, 700, and 1000 C respectively; Armco iron used as comparative material; measured in vacuum.

SPECIFICATION TABLE NO. 11 (continued)

Curve No.	Ref. No.	Method Used*	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
377	175	C	1937	483-1113		Acheson	Similar to the above specimen.
378	175	L	1937	303-423		Acheson	Specimen 3.85 cm in dia and 38 cm long; measured in air.
379	175	L	1937	313-588		Acheson	Specimen 7.34 cm in dia and 38 cm long; measured in air.
380	342	L	1933	123-973		Acheson	Two cylindrical blocks of graphite 10.2 cm in dia and 17.8 cm long placed in a vertical position end to end with a flat electric heater between them.
381	368	E	1954	1300-2000		Acheson	Long thin rod of Acheson graphite electrically heated in vacuo; electrical resistivity at 470, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000, and 2070 K being, respectively, 0.7, 0.645, 0.606, 0.615, 0.640, 0.675, 0.715, 0.765, 0.8175, and 0.840 milliohm cm.
382	368	E	1954	1200-1450		Acheson	Data for a short rod of Acheson graphite.

DATA TABLE NO. 11 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
328.2	0.92	331.7	1.17	4.8	0.00044	5	0.0025	1428.2	0.364	0	0.259	1513.2	0.285	1638.2	0.247	1773.2	0.161	1923.2	0.197
393.2	0.877	CURVE 45*		11	0.0035	9.5	0.0125	1828.2	0.266	10	0.262	1768.2	0.157	1818.2	0.257	2073.2	0.155	2048.2	0.188
468.2	0.774	CURVE 46*		20	0.019	21	0.09	2138.2	0.251	20	0.282	1608.2	0.161	2058.2	0.253	2223.2	0.163	2048.2	0.188
543.2	0.669	CURVE 47*		30	0.05	35	0.23	2408.2	0.218	30	0.265	1788.2	0.163	2163.2	0.249*	2443.2	0.142	2448.2	0.209
653.2	0.586	CURVE 48*		60	0.26	63	0.56	2688.2	0.207	40	0.270	1688.2	0.155	2433.2	0.242	2523.2	0.142		
763.2	0.544	CURVE 49		95	0.70	100	0.75	2923.2	0.197	50	0.274	1533.2	0.153						
913.2	0.481	CURVE 50		196	1.5	200	0.86	3148.2	0.197	60	0.282	1478.2	0.172						
1043.2	0.460	CURVE 51		275	1.70	280	0.83					1658.2	0.155						
1093.2	0.460	CURVE 52										1948.2	0.163						
		CURVE 53										1918.2	0.161						
378.2	0.628	CURVE 54										1968.2	0.165						
513.2	0.502	CURVE 55										2148.2	0.163						
623.2	0.460	CURVE 56																	
713.2	0.397	CURVE 57																	
828.2	0.377	CURVE 58																	
893.2	0.356	CURVE 59																	
953.2	0.356	CURVE 60																	
1023.2	0.314	CURVE 61*																	
1068.2	0.293	CURVE 62*																	
1123.2	0.293	CURVE 63*																	
		CURVE 64*																	
79	0.155	CURVE 65*																	
142	0.178	CURVE 66*																	
261	0.328	CURVE 67*																	
292	0.384	CURVE 68*																	
375	0.544	CURVE 69*																	
423	0.692	CURVE 70																	
535.5	1.08	CURVE 71*																	
555	1.17	CURVE 72*																	
		CURVE 73																	
329.7	1.13	CURVE 74*																	
		CURVE 75*																	
329.7	1.09	CURVE 76*																	
		CURVE 77*																	
		CURVE 78*																	
		CURVE 79*																	
		CURVE 80																	
		CURVE 81*																	
		CURVE 82 (cont.)*																	
		CURVE 83																	
		CURVE 84*																	
		CURVE 85*																	
		CURVE 86*																	
		CURVE 87																	
		CURVE 88																	
		CURVE 89																	
		CURVE 90																	
		CURVE 91*																	
		CURVE 92																	
		CURVE 93*																	
		CURVE 94																	
		CURVE 95																	
		CURVE 96																	
		CURVE 97																	
		CURVE 98																	
		CURVE 99																	
		CURVE 100																	

* Not shown on plot

DATA TABLE NO. 11 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 129 (cont.)</u>		<u>CURVE 132 (cont.)</u>		<u>CURVE 135 (cont.)</u>		<u>CURVE 139*</u>		<u>CURVE 143*</u>		<u>CURVE 151*</u>		<u>CURVE 158*</u>		<u>CURVE 163*</u>			
2580	0.48	1810	0.625	2023.2	0.411	1300	0.180	1533.2	0.188	1683.2	0.201	1403.2	0.253	1953.2	0.180		
2600	0.515	1890	0.635	2128.2	0.392	1400	0.164	1933.2	0.163	1953.2	0.214	1613.2	0.218	2953.2	0.163		
2680	0.52	1995	0.66	2148.2	0.390*	1500	0.187	2043.2	0.163	1973.2	0.193	1893.2	0.206				
2760	0.565	2180	0.67	2263.2	0.369	1600	0.163	2093.2	0.207	2093.2	0.207	2263.2	0.192				
<u>CURVE 130*</u>		<u>CURVE 133</u>		<u>CURVE 136*</u>		<u>CURVE 140</u>		<u>CURVE 145*</u>		<u>CURVE 152*</u>		<u>CURVE 159*</u>		<u>CURVE 164</u>			
1180	0.50	1220	1.73	1593.2	0.249	1300	0.143	1833.2	0.167	1643.2	0.186	1293.2	0.163	20	0.0190		
1310	0.30	1300	1.34	1733.2	0.249	1400	0.152	2158.2	0.163	1803.2	0.187	1533.2	0.169	22	0.0140		
1425	0.245	1490	1.35	1893.2	0.212	1500	0.156	2323.2	0.171	1903.2	0.193	1743.2	0.169	31	0.0250		
1525	0.225	1540	0.88	1993.2	0.230	1600	0.155	2543.2	0.142	2083.2	0.192	2033.2	0.167	44	0.0500		
1590	0.21	1610	0.8	2093.2	0.238	1700	0.153	2773.2	0.146	2123.2	0.203	2443.2	0.168	80	0.150		
1680	0.23	1670	1.04	2163.2	0.218	1800	0.156*	2983.2	0.127	2298.2	0.166	2783.2	0.167	95	0.190		
1740	0.20	1700	0.76	2323.2	0.230	1900	0.151*	3037.2	0.120	2998.2	0.166	2998.2	0.166	180	0.450		
1880	0.20	1890	0.75	2473.2	0.217	2000	0.150*	3268.2	0.109	3093.2	0.180	3093.2	0.180	273	0.650		
2150	0.185	1970	0.72	2509.2	0.198	2100	0.153*										
2290	0.195	2150	0.72	2663.2	0.202	2200	0.142										
2400	0.195	2280	0.73	2823.2	0.192	2300	0.164										
<u>CURVE 131*</u>		<u>CURVE 134</u>		<u>CURVE 137*</u>		<u>CURVE 141*</u>		<u>CURVE 147*</u>		<u>CURVE 155</u>		<u>CURVE 160*</u>		<u>CURVE 165</u>			
1180	0.345	1220	0.227	1623.2	0.220	1300	0.145	1833.2	0.134	1293.2	0.100	1603.2	0.155	18.5	0.011		
1240	0.365	1290	0.224	1773.2	0.205	1400	0.143	2220	0.142	1593.2	0.0711	1793.2	0.167	25	0.021		
1340	0.31	1380	0.205	1853.2	0.206	1500	0.141	2478.2	0.121	1733.2	0.0732	2113.2	0.172	33	0.0400		
1420	0.27	1460	0.19	2023.2	0.190	1600	0.150	2743.2	0.114	1833.2	0.111	2493.2	0.172	37	0.0510		
1480	0.24	1510	0.17	2253.2	0.184	1700	0.141			1963.2	0.119	2853.2	0.172	80	0.190		
1570	0.205	1620	0.17	2578.2	0.180	1800	0.141							90	0.222		
1700	0.205	1700	0.173	2773.2	0.178	1900	0.137							95	0.240		
1800	0.19	1770	0.164	2823.2	0.170	2000	0.138							180	0.550		
1870	0.185	1860	0.15			2100	0.146							273	0.750		
2070	0.19	1900	0.155*			2200	0.160										
2140	0.175	1980	0.143			2300	0.143										
2240	0.2	2080	0.153*			2465	0.114										
2350	0.18	2240	0.15														
<u>CURVE 132</u>		<u>CURVE 135</u>		<u>CURVE 138*</u>		<u>CURVE 142*</u>		<u>CURVE 148*</u>		<u>CURVE 156*</u>		<u>CURVE 161*</u>		<u>CURVE 166</u>			
1200	1.14	1260	0.95	1653.2	0.205	1300	0.145	1643.2	0.184	1393.2	0.131	1413.2	0.153	18	0.0160		
1326	0.95	1326	0.476	1943.2	0.180	1400	0.143	1703.2	0.205	1533.2	0.101	1853.2	0.169	19	0.0185		
1350	1.05	1623.2	0.476	2093.2	0.181	1500	0.141	2013.2	0.119	1858.2	0.111	2463.2	0.174	20	0.0205		
1420	0.71	1623.2	0.486	2423.2	0.175	1600	0.150							25	0.0400		
1440	0.845	1863.2	0.455	2493.2	0.170	1700	0.141							35	0.0800		
1490	0.625	1973.2	0.420	2823.2	0.170	1800	0.137							48	0.135		
1670	0.655	1993.2	0.415			1900	0.159							80	0.300		
1740	0.645	2008.2	0.404			2000	0.138							90	0.330		
						2100	0.146							95	0.355		
						2200	0.160							100	0.400*		
														105	0.440		
														190	0.860		
														300	1.10		

* Not shown on plot

DATA TABLE NO. 11 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k
	<u>CURVE 167</u>	<u>CURVE 176*</u>	<u>CURVE 186*</u>	<u>CURVE 196*</u>	<u>CURVE 210*</u>	<u>CURVE 222*</u>	<u>CURVE 234*</u>	<u>CURVE 246*</u>					
80	0.605	298.2	0.0335	298.2	1.17	298.2	0.982	298.2	1.21	298.2	0.987	298.2	0.946
100	0.845	<u>CURVE 177*</u>	<u>CURVE 187*</u>	<u>CURVE 199*</u>	<u>CURVE 211*</u>	<u>CURVE 223*</u>	<u>CURVE 235*</u>	<u>CURVE 247*</u>					
140	1.30	298.2	0.448	298.2	1.34	298.2	1.51	298.2	0.791	298.2	2.30	298.2	1.78
180	1.52	<u>CURVE 178*</u>	<u>CURVE 188*</u>	<u>CURVE 200*</u>	<u>CURVE 212*</u>	<u>CURVE 224*</u>	<u>CURVE 236*</u>	<u>CURVE 248*</u>					
220	1.62	298.2	1.31	298.2	1.15	298.2	1.18	298.2	0.958	298.2	0.849	298.2	0.950
260	1.59	<u>CURVE 179*</u>	<u>CURVE 189*</u>	<u>CURVE 201*</u>	<u>CURVE 213*</u>	<u>CURVE 225*</u>	<u>CURVE 237*</u>	<u>CURVE 249</u>					
300	1.56	1353.2	0.347	298.2	1.25	298.2	1.46	298.2	0.849	298.2	2.15	298.2	1.96
	<u>CURVE 169</u>	1503.2	0.339	<u>CURVE 190*</u>	<u>CURVE 202*</u>	<u>CURVE 214*</u>	<u>CURVE 238*</u>	<u>CURVE 250*</u>					
		1873.2	0.318	298.2	1.21	290.2	0.155	298.2	0.828	298.2	0.736	298.2	0.736
		2303.2	0.301	<u>CURVE 191*</u>	<u>CURVE 203*</u>	CU...E 215	373.2	0.159	<u>CURVE 227</u>	<u>CURVE 239*</u>	<u>CURVE 251*</u>		
		<u>CURVE 180</u>	15.2	298.2	1.62	298.2	2.16	<u>CURVE 228*</u>	<u>CURVE 240*</u>	<u>CURVE 252*</u>			
		<u>CURVE 170*</u>	50.2	298.2	1.58	298.2	1.15	<u>CURVE 216*</u>	<u>CURVE 241*</u>	<u>CURVE 253*</u>			
		1273.2	0.492	<u>CURVE 192*</u>	<u>CURVE 204*</u>	<u>CURVE 217*</u>	298.2	0.870	<u>CURVE 242*</u>	<u>CURVE 254*</u>			
		1873.2	0.452	298.2	0.975	<u>CURVE 193*</u>	<u>CURVE 205*</u>	<u>CURVE 218*</u>	<u>CURVE 243*</u>	<u>CURVE 255*</u>			
		<u>CURVE 171*</u>	100.2	298.2	1.58	298.2	1.64	298.2	2.01	298.2	1.98	298.2	1.56
		1873.2	0.444	<u>CURVE 194*</u>	<u>CURVE 206*</u>	<u>CURVE 219*</u>	<u>CURVE 230*</u>	<u>CURVE 244*</u>	<u>CURVE 245*</u>	<u>CURVE 256*</u>			
		<u>CURVE 172*</u>	296.2	298.2	0.933	298.2	1.05	<u>CURVE 246*</u>	<u>CURVE 247*</u>	<u>CURVE 257*</u>			
		1273.2	0.586	<u>CURVE 195*</u>	<u>CURVE 207*</u>	<u>CURVE 220*</u>	0.833	<u>CURVE 248*</u>	<u>CURVE 249*</u>	<u>CURVE 258*</u>			
		1873.2	0.444	298.2	1.58	298.2	1.69	<u>CURVE 250*</u>	<u>CURVE 251*</u>	<u>CURVE 259*</u>			
		<u>CURVE 173*</u>	298.2	298.2	0.933	298.2	1.05	<u>CURVE 252*</u>	<u>CURVE 253*</u>	<u>CURVE 260*</u>			
		1273.2	0.431	<u>CURVE 196*</u>	<u>CURVE 208*</u>	<u>CURVE 221*</u>	298.2	0.770	<u>CURVE 254*</u>	<u>CURVE 261*</u>			
		1873.2	0.310	298.2	1.28	298.2	1.33	<u>CURVE 255*</u>	<u>CURVE 256*</u>	<u>CURVE 262*</u>			
		<u>CURVE 174*</u>	298.2	298.2	1.28	298.2	1.33	<u>CURVE 257*</u>	<u>CURVE 258*</u>	<u>CURVE 263*</u>			
		1273.2	0.272	<u>CURVE 197*</u>	<u>CURVE 209*</u>	<u>CURVE 222*</u>	298.2	0.770	<u>CURVE 259*</u>	<u>CURVE 264*</u>			
		1873.2	0.226	298.2	1.58	298.2	0.259	<u>CURVE 260*</u>	<u>CURVE 261*</u>	<u>CURVE 265*</u>			
		<u>CURVE 175</u>	298.2	298.2	1.58	298.2	0.259	<u>CURVE 262*</u>	<u>CURVE 263*</u>	<u>CURVE 266*</u>			
		298.2	0.0167					<u>CURVE 264*</u>	<u>CURVE 265*</u>	<u>CURVE 267*</u>			

* Not shown on plot

DATA TABLE NO. 11 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
CURVE 302																			
1438.2	0.0983	321.2	1.04	1575	0.47	489.6	1.03	310.8	0.431	1366.5	0.638	468.2	0.849	1366.5	0.638	468.2	0.849	1366.5	0.638
1598.2	0.0962	358.2	1.31	1640	0.46	536.2	0.98	321.4	0.435	2199.8	0.644	672.2	0.711	2199.8	0.644	672.2	0.711	2199.8	0.644
1743.2	0.0971	473.2	1.01	1710	0.46	488.2	0.937	332.8	0.431	2755.4	0.594	868.2	0.582	2755.4	0.594	868.2	0.582	2755.4	0.594
1833.2	0.0992	606.2	0.736	1845	0.46	613.2	0.711	345.3	0.439	3033.2	0.629	374.8	0.448	3033.2	0.629	374.8	0.448	3033.2	0.629
2073.2	0.105	711.2	0.628	1870	0.46	753.2	0.615	374.8	0.448	3310.9	0.594	410.8	0.464	3310.9	0.594	410.8	0.464	3310.9	0.594
2288.2	0.112	846.2	0.494	1910	0.44	846.2	0.494	326.2	0.44	3310.9	0.594	410.8	0.464	3310.9	0.594	410.8	0.464	3310.9	0.594
2473.2	0.113*			2045	0.435			326.2	0.44	3310.9	0.594	410.8	0.464	3310.9	0.594	410.8	0.464	3310.9	0.594
2548.2	0.113			2055	0.45			326.2	0.44	3310.9	0.594	410.8	0.464	3310.9	0.594	410.8	0.464	3310.9	0.594
2893.2	0.115			2085	0.45			326.2	0.44	3310.9	0.594	410.8	0.464	3310.9	0.594	410.8	0.464	3310.9	0.594
CURVE 303																			
323.2	0.619	318.2	1.83	2175	0.45	390.2	1.55	292.5	0.209	1366.5	0.643	472.2	0.410	1366.5	0.643	472.2	0.410	1366.5	0.643
361.2	0.707	352.2	2.21	2275	0.44	448.2	1.41	307.5	0.209	2199.8	0.573	670.2	0.439	2199.8	0.573	670.2	0.439	2199.8	0.573
478.2	0.544	451.2	1.43	2400	0.46	623.2	1.05	337.3	0.238	2755.4	0.588	867.2	0.452	2755.4	0.588	867.2	0.452	2755.4	0.588
593.2	0.527	593.2	1.20	2400	0.46	718.2	0.858	384.3	0.259	3033.2	0.592	867.2	0.452	3033.2	0.592	867.2	0.452	3033.2	0.592
693.2	0.485	816.2	0.941	2400	0.46	901.2	0.615	410.7	0.259	3310.9	0.536	867.2	0.452	3310.9	0.536	867.2	0.452	3310.9	0.536
818.2	0.377			1320	0.41			321.2	1.43	1366.5	0.553	867.2	0.452	1366.5	0.553	867.2	0.452	1366.5	0.553
873.2	0.460			1490	0.43			321.2	1.43	2199.8	0.553	867.2	0.452	2199.8	0.553	867.2	0.452	2199.8	0.553
CURVE 304																			
313.2	0.431*	318.2	1.20	1640	0.43	323.2	0.705	321.2	1.43	2755.4	0.572	471.2	0.649	2755.4	0.572	471.2	0.649	2755.4	0.572
343.2	0.464*	356.2	1.15	1725	0.44	373.2	1.17	359.2	1.35	3033.2	0.554	669.2	0.515	3033.2	0.554	669.2	0.515	3033.2	0.554
458.2	0.343	468.2	0.887	1825	0.44	468.2	0.887	463.2	1.29	3310.9	0.483	865.2	0.460	3310.9	0.483	865.2	0.460	3310.9	0.483
623.2	0.276	513.2	0.795	1875	0.43	513.2	0.795	533.2	1.19	1366.5	0.457	865.2	0.460	1366.5	0.457	865.2	0.460	1366.5	0.457
698.2	0.268	631.2	0.682	1895	0.44	631.2	0.682	619.2	1.11	2199.8	0.452	865.2	0.460	2199.8	0.452	865.2	0.460	2199.8	0.452
828.2	0.226	696.2	0.653	2070	0.45	696.2	0.653	721.2	1.03	2755.4	0.468	865.2	0.460	2755.4	0.468	865.2	0.460	2755.4	0.468
823.2	0.552	823.2	0.552	2380	0.47	823.2	0.552	721.2	1.03	3033.2	0.497	865.2	0.460	3033.2	0.497	865.2	0.460	3033.2	0.497
CURVE 305																			
321.2	0.954	364.3	1.23	295.2	1.69	323.2	0.695	302.3	1.44	1366.5	0.457	1671	0.326	1366.5	0.457	1671	0.326	1366.5	0.457
386.2	0.904	383.2	1.19	306.4	1.59	323.2	0.695	346.8	1.24	2199.8	0.452	1671	0.326	2199.8	0.452	1671	0.326	2199.8	0.452
468.2	0.941	552.6	1.11	321.7	1.49	323.2	0.695	397.0	1.17	2755.4	0.468	1671	0.326	2755.4	0.468	1671	0.326	2755.4	0.468
633.2	0.653	553.7	1.10	341.5	1.44	323.2	0.695	447.9	1.11	3033.2	0.497	1671	0.326	3033.2	0.497	1671	0.326	3033.2	0.497
723.2	0.594	553.7	1.10	365.5	1.39	323.2	0.695	497.8	1.05	1366.5	0.457	1671	0.326	1366.5	0.457	1671	0.326	1366.5	0.457
838.2	0.402	769.3	0.952	376.2	1.33	323.2	0.695	598.4	0.941	2199.8	0.452	1671	0.326	2199.8	0.452	1671	0.326	2199.8	0.452
831.2	0.314	773.2	0.922	396.6	1.30	323.2	0.695	598.4	0.941	2755.4	0.468	1671	0.326	2755.4	0.468	1671	0.326	2755.4	0.468
831.2	0.314	991.5	0.852	427.2	1.30	323.2	0.695	598.4	0.941	3033.2	0.497	1671	0.326	3033.2	0.497	1671	0.326	3033.2	0.497
831.2	0.314	993.2	0.884	463.0	1.28	323.2	0.695	598.4	0.941	1366.5	0.457	1671	0.326	1366.5	0.457	1671	0.326	1366.5	0.457
831.2	0.314	1375	0.884	511.4	1.23	323.2	0.695	598.4	0.941	2199.8	0.452	1671	0.326	2199.8	0.452	1671	0.326	2199.8	0.452
CURVE 306																			
321.2	1.71	1672	0.725	1672	0.725	321.2	1.71	307.0	0.573	1366.5	0.457	1671	0.326	1366.5	0.457	1671	0.326	1366.5	0.457
363.2	2.00	1925	0.737	1925	0.737	321.2	1.71	322.2	0.594	2199.8	0.452	1671	0.326	2199.8	0.452	1671	0.326	2199.8	0.452
468.2	1.39	2239	0.694	2239	0.694	321.2	1.71	342.4	0.586	2755.4	0.468	1671	0.326	2755.4	0.468	1671	0.326	2755.4	0.468
656.2	0.920			297.5	1.42	321.2	1.71	364.4	0.586	3033.2	0.495	1671	0.326	3033.2	0.495	1671	0.326	3033.2	0.495
723.2	0.904			309.5	1.27	321.2	1.71	389.8	0.607	1366.5	0.457	1671	0.326	1366.5	0.457	1671	0.326	1366.5	0.457
838.2	0.816			326.7	1.20	321.2	1.71	421.7	0.623	2199.8	0.452	1671	0.326	2199.8	0.452	1671	0.326	2199.8	0.452
				348.9	1.17	321.2	1.71	449.2	0.636	2755.4	0.468	1671	0.326	2755.4	0.468	1671	0.326	2755.4	0.468
				376.9	1.13	321.2	1.71	478.0	0.653	3033.2	0.495	1671	0.326	3033.2	0.495	1671	0.326	3033.2	0.495
				408.5	1.10	321.2	1.71	512.2	0.640	1366.5	0.457	1671	0.326	1366.5	0.457	1671	0.326	1366.5	0.457
				444.9	1.07	321.2	1.71	545.4	0.657	2199.8	0.452	1671	0.326	2199.8	0.452	1671	0.326	2199.8	0.452
						321.2	1.71	605.2	0.628	2755.4	0.468	1671	0.326	2755.4	0.468	1671	0.326	2755.4	0.468

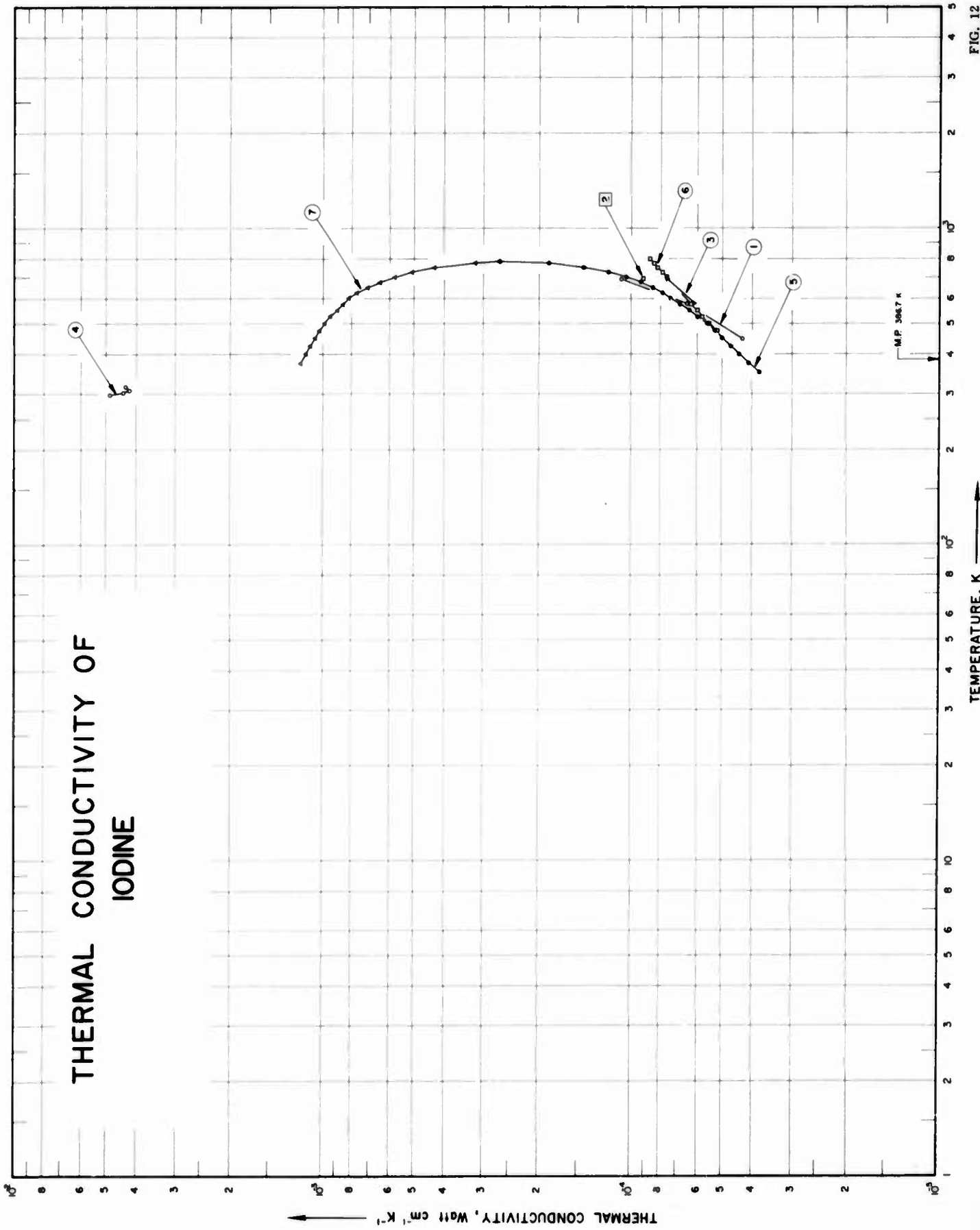
* Not shown on plot

DATA TABLE NO. 11 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
CURVE 350*																	
1088	1.193	115	0.061	343.2	0.253	363.2	0.00272	43.4	0.00760	1683	0.341	818.2	0.895	1500	0.500		
1365	0.906	205	0.128	CURVE 361*		378.2	0.00270	58.6	0.00984	1773	0.257	898.2	0.837	1700	0.445		
1643	0.734	295	0.176	388.2	0.00274	423.2	0.00276	79.6	0.0125	1743	0.209	918.2	0.795	1800	0.430		
1920	0.682	385	0.212	448.2	0.00276	448.2	0.00276	118.3	0.0161	1846	0.264	998.2	0.753	1900	0.420		
CURVE 355																	
2198	0.682	473.2	2.10	463.2	0.00276	463.2	0.00276	CURVE 369*		1886	0.202	1048	0.753	2000	0.400		
2475	0.693	573.2	1.44	493.2	0.00276	493.2	0.00276	318.2	1.16	2343	0.151	1113	0.711	CURVE 382*			
2753	0.697	673.2	1.29	523.2	0.00282	523.2	0.00282	323.2	1.18	CURVE 374*							
3030	0.703	773.2	1.20	643.2	0.00282	643.2	0.00282	338.2	1.16	303.2	1.64	323.2	1.58	1200	0.660		
CURVE 351*																	
295	0.302	873.2	1.13	703.2	0.00287	703.2	0.00287	353.2	1.04	193.2	2.05	353.2	1.53	1320	0.580		
385	0.365	873.2	0.00301	763.2	0.00289	763.2	0.00289	413.2	1.04	408.2	1.42	408.2	1.42	1450	0.520		
CURVE 356																	
371.5	1.25	CURVE 362*		873.2	0.00301	CURVE 367		435.2	1.02	373.2	1.46	423.2	1.41				
374.8	1.24	311.2	0.0544	CURVE 363*		2.41	0.0000703	543.2	0.900	CURVE 375*							
492.6	1.16	311.2	0.0795	311.2	0.0544	2.85	0.000107	568.2	0.858	318.2	1.75	398.2	1.46				
494.8	1.18	341.2	0.0402	341.2	0.0879	3.58	0.000178	511.2	0.816	CURVE 370*							
752.1	0.957	456.2	0.0879	456.2	0.0879	4.54	0.000287	CURVE 371*									
760.4	0.945	582.2	0.0711	582.2	0.0711	5.78	0.000459	1723	0.268	93.2	1.75	320.7	1.60				
1015	0.874	676.2	0.0711	676.2	0.0711	7.05	0.000667	1923	0.243	193.2	1.40	320.7	1.60				
1017	0.886	753.2	0.0711	753.2	0.0711	9.38	0.00109	1963	0.126	273.2	1.15	338.2	1.57				
1325	0.770	853.2	0.0669	853.2	0.0669	13.4	0.00187	2173	0.176	373.2	0.931	358.2	1.52				
1633	0.762	CURVE 363*		CURVE 363*		18.3	0.00284	2713	0.137	CURVE 376*							
1942	0.711	310.2	0.167	310.2	0.167	22.1	0.00359	2713	0.137	613.2	1.07	398.2	1.46				
2205	0.710	329.2	0.184	329.2	0.184	27.9	0.00465	2713	0.137	505.7	1.26	440.7	1.38				
CURVE 357																	
2.8	0.000078	345.2	0.201	345.2	0.201	43.5	0.00718	673.2	1.00	508.2	1.25	588.2	1.11				
4.7	0.00022	465.2	0.192	465.2	0.192	66.4	0.0104	798.2	0.946	588.2	1.11						
10.0	0.00083	470.2	0.201	470.2	0.201	86.3	0.0127	943.2	0.778								
14.5	0.00175	601.2	0.167	601.2	0.167	122.2	0.0161	943.2	0.778								
21	0.0033	609.2	0.176	609.2	0.176	177.8	0.0201	943.2	0.778								
56	0.0091	643.2	0.167	643.2	0.167	227.0	0.0228	943.2	0.778								
90	0.0125	696.2	0.159	696.2	0.159	CURVE 368		943.2	0.778								
CURVE 358																	
373.2	0.0646	706.2	0.146	706.2	0.146	1798	0.241	1018	0.728								
438.2	0.0717	788.2	0.138	788.2	0.138	1848	0.146	1076	0.669								
515.2	0.0465	794.2	0.151	794.2	0.151	1907	0.130	1128	0.628								
523.2	0.0670	804.2	0.142	804.2	0.142	2.38	0.0000875	1128	0.628								
543.2	0.0728	CURVE 364*		CURVE 364*		3.00	0.006150	1798	0.241								
1911	0.358	336.7	1.09	336.7	1.09	4.06	0.00277	1848	0.146								
2222	0.343	336.7	1.09	336.7	1.09	5.12	0.000443	1907	0.130								
CURVE 353																	
115	0.0165	336.7	1.09	336.7	1.09	6.32	0.000652	2013	0.176								
205	0.0369	343.2	0.154	343.2	0.154	8.75	0.00110	2013	0.176								
295	0.0571	343.2	0.154	343.2	0.154	11.8	0.00175	2013	0.176								
385	0.0775	343.2	0.154	343.2	0.154	15.9	0.00262	2013	0.176								
CURVE 359*																	
115	0.0165	343.2	0.154	343.2	0.154	22.3	0.00393	2013	0.176								
205	0.0369	343.2	0.154	343.2	0.154	30.5	0.00547	2013	0.176								
295	0.0571	343.2	0.154	343.2	0.154	CURVE 365*		2798	0.117								
385	0.0775	343.2	0.154	343.2	0.154	334.2	1.05	3048	0.142								

* Not shown on plot

THERMAL CONDUCTIVITY OF IODINE



SPECIFICATION TABLE NO. 12 THERMAL CONDUCTIVITY OF IODINE

[For Data Reported in Figure and Table No. 12

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	543	-	1951	447-693	±2.1		In gaseous state; measured at a pressure of 55 mm Hg by the hot-wire method; argon was used for comparison.
2	543	-	1951	693			Similar to above, except measured at a pressure of 120 mm Hg.
3	543	-	1951	579, 693	±1.7		Pure iodine; purified by quadruple sublimation; disk specimen 3 cm in dia and 0.27 cm thick; density 4.7 g cm ⁻³ ; electrical resistivity reported as (data arbitrarily selected from 35 points) 113.2, 106.7, 94.3, 85.2, 67.7, 60.4, 30.9, 19.0, 10.7, 8.6, 6.1, 4.3, 2.9, 1.5, 1.1, and 1.1 x 10 ⁸ ohm cm at 4.1, 5.0, 6.0, 7.0, 8.2, 9.2, 14.5, 17.3, 20.9, 24.0, 27.3, 31.0, 34.8, 37.7, 41.5, and 42.7 C, respectively; graphite used as comparative material.
4	450	C	1923	298-316			Saturated vapor; recommended values based on the correlation of Schaefer and Thodos (A.I.Ch.E. Journal, 5, 367-72, 1959).
5	*			350-785			Gas at 1 atm; recommended values based on the correlation of Schaefer and Thodos. (A.I.Ch.E. Journal, 5, 367-72, 1959).
6	*			350-800			Saturated liquid; recommended values based on the correlation of Schaefer and Thodos (A.I.Ch.E. Journal, 5, 367-72, 1959).
7	*			375-795			

DATA TABLE NO. 12 THERMAL CONDUCTIVITY OF IODINE

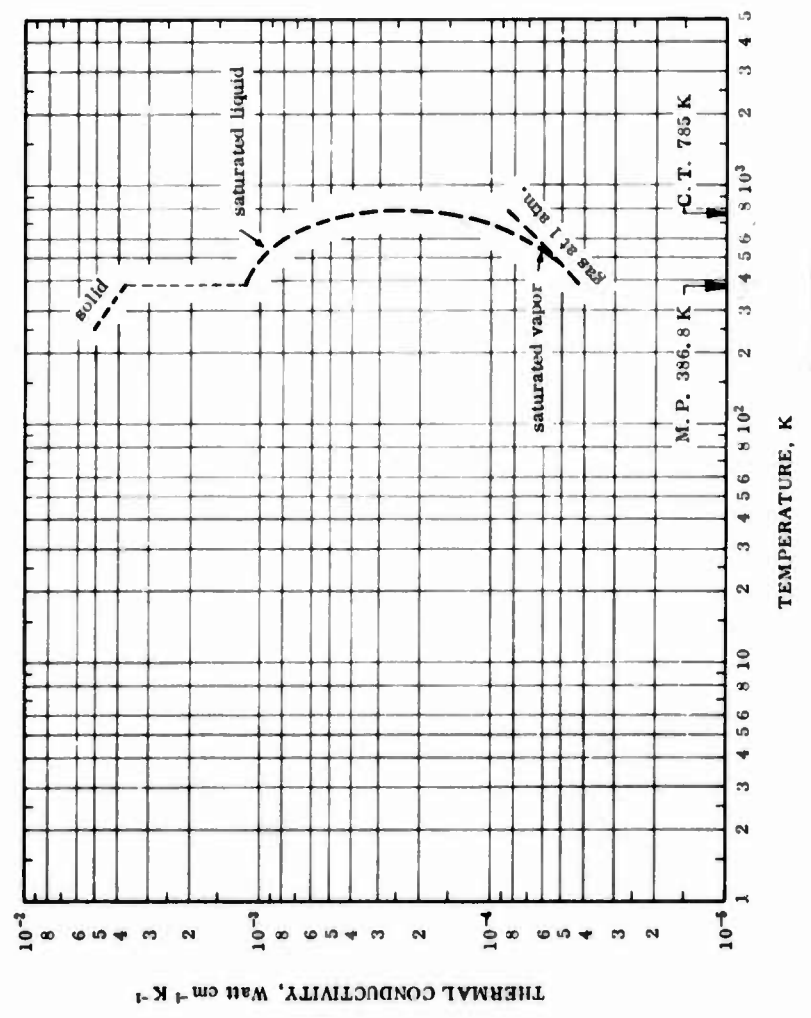
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	CURVE 1		CURVE 4		CURVE 5 (cont.)		CURVE 6 (cont.)		CURVE 7		CURVE 7 (cont.)		
	k	T	k	T	k	T	k	T	k	T	k	T	
447	0.0000431	297.6	0.00487	475	0.00053	775	0.00196	525	0.00058	375	1.18	675	0.65
578	0.0000653	302.7	0.00441	500	0.00056	795	0.00265	550	0.00060	400	1.14	700	0.58
693	0.000108	308.6	0.00421	525	0.00060			575	0.00063	425	1.11	725	0.51
		316.1	0.00434	550	0.00064	CURVE 6		600	0.00065**	450	1.07	750	0.43
				575	0.00069			625	0.00069**	475	1.03	775	0.32
				600	0.00075			650	0.00071**	500	0.99	785	0.265
				625	0.00079			675	0.00073**	525	0.95		
693	0.0000912	350	0.000038	650	0.00085	400	0.00044**	700	0.00076	550	0.90		
		375	0.000041	675	0.00093	425	0.00047**	725	0.00079	575	0.86		
		400	0.000044	700	0.00104	450	0.00050**	750	0.00082	600	0.82		
579	0.0000619	425	0.000047	725	0.00119	475	0.00052	775	0.00084	625	0.77		
693	0.0000761	450	0.000050	750	0.00143	500	0.00055	800	0.00087	650	0.71		

* Lilley, P. E., in course of publication

** Not shown on plot

FIGURE AND TABLE NO. 12R RECOMMENDED THERMAL CONDUCTIVITY OF IODINE



RECOMMENDED VALUES*		
Polycrystalline		
T_1	k_1	k_2
250	(0.00512) †	(0.296)
273.2	(0.00481)	(0.278)
300	0.00449	0.259
350	(0.00401)	(0.232)
386.8	(0.00375)	(0.217)
Saturated Liquid		
386.8	(0.00116)	(0.0670)
400	(0.00114)	(0.0659)
500	(0.00099)	(0.0572)
600	(0.00082)	(0.0474)
700	(0.00058)	(0.0335)
785	(0.000265)	(0.0153)
Saturated Vapor		
386.8	(0.0000426)	(0.00246)
400	(0.000044)	(0.00254)
500	(0.000056)	(0.00324)
600	(0.000074)	(0.00428)
700	(0.000104)	(0.00601)
785	(0.000265)	(0.0153)
Gas at 1 atm		
386.8	(0.0000426)	(0.00246)
400	(0.000044)	(0.00254)
500	(0.000055)	(0.00318)
600	(0.000065)	(0.00376)
700	(0.000076)	(0.00439)
785	(0.000087)	(0.00503)

REMARKS

The recommended values are for high-purity iodine. The values for polycrystalline iodine near room temperature are thought to be accurate to within 10% of the true values. The values for saturated liquid, saturated vapor, and gaseous iodine at 1 atm are estimated and their accuracy is uncertain.

* T_1 in K, k_1 in Watt $cm^{-1} K^{-1}$, T_2 in F, and k_2 in Btu $hr^{-1} ft^{-1} F^{-1}$.

† Values in parentheses are estimated.

THERMAL CONDUCTIVITY OF PHOSPHORUS

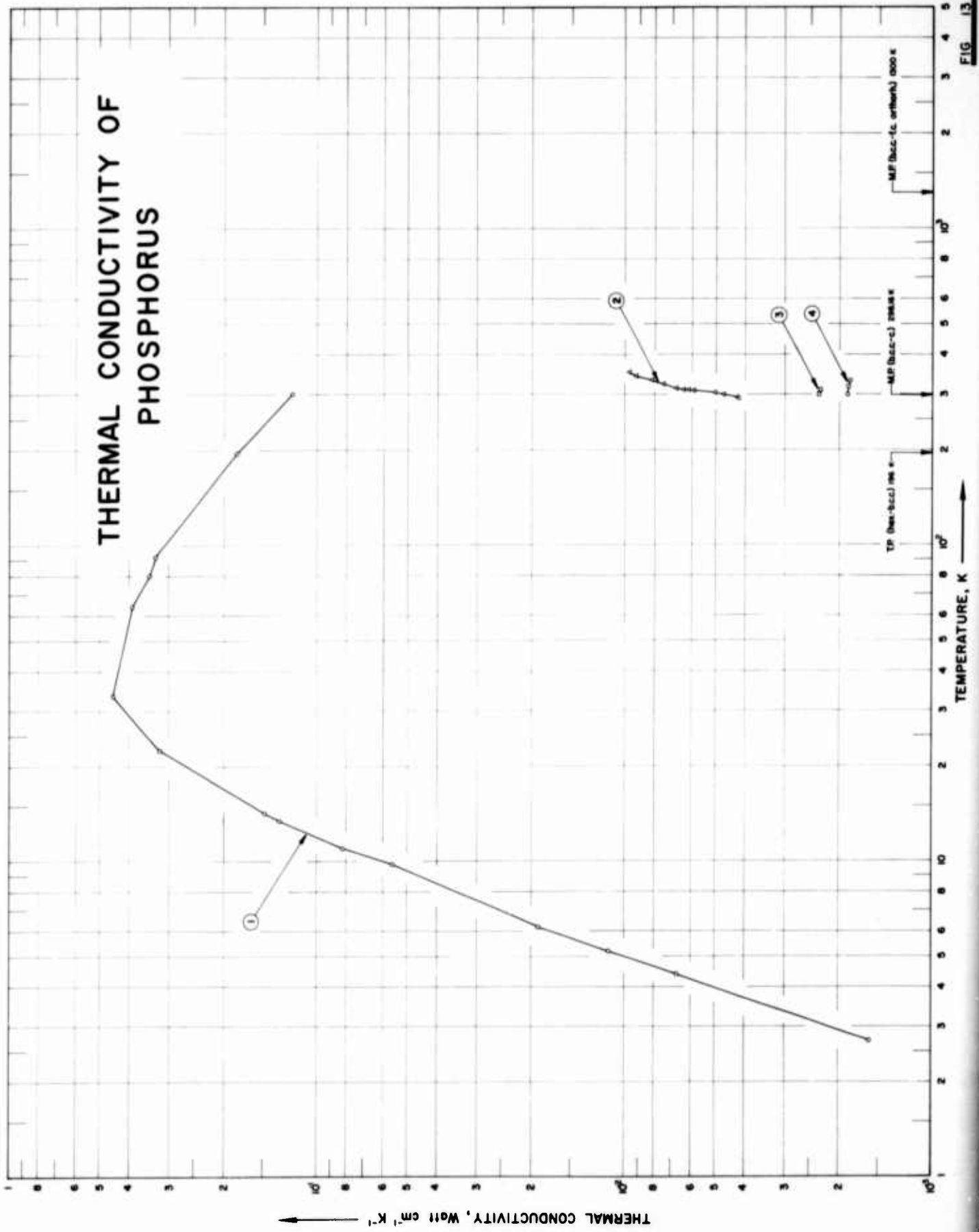


FIG. 13

SPECIFICATION TABLE NO. 13 THERMAL CONDUCTIVITY OF PHOSPHORUS

[For Data Reported in Figure and Table No. 13]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	371	L	1965	2.7-300			Prepared from 99.8 pure phosphorus; p-type; polycrystalline with crystal size ~200 μ ; orthorhombic (black) phosphorus rod of dimensions 1.2 x 0.35 x 0.35 cm; cut from a larger ingot prepared by R. H. Wentorf of the General Electric Research Lab.; raw material for the ingot from the Fisher Scientific Co.; electrical resistivity 3.1 ohm cm at 300 K; carrier concentration 10^{18} cm $^{-3}$; heat flow approx in the a-b plane of the crystallites.
2	370	P	1962	289-353	± 2		Yellow phosphorus; melting point 44.1 C; includes liquid phase.
3	544	P	1964	299,311	± 1		0.36 dissolved water, <0.01 other total impurities; solid white α -phase (b. c. c.) phosphorus prepared from chemically pure yellow phosphorus which was treated with warm chromic acid and distilled water until water-white; melting point 44.0 ± 0.1 C.
4	544	P	1964	301-331	± 2		Similar to the above specimen except in liquid state (the first data point for super-cooled liquid).

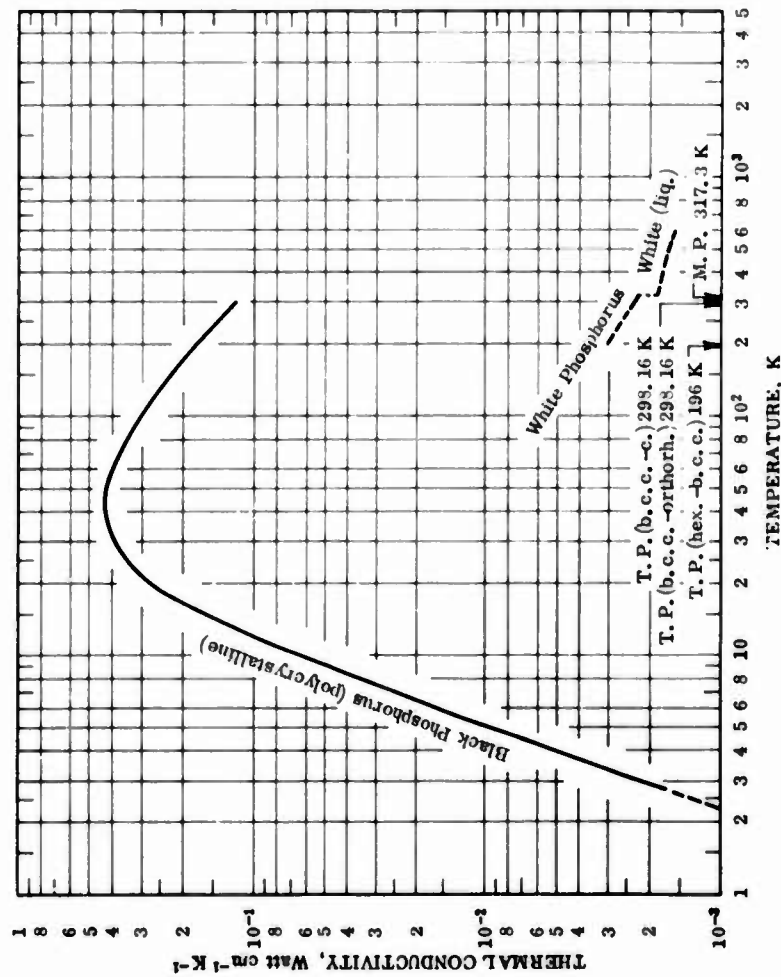
DATA TABLE NO. 13 THERMAL CONDUCTIVITY OF PHOSPHORUS

[Temperature, T, K; Thermal Conductivity, k, Watt cm $^{-1}$ K $^{-1}$]

T	k	CURVE 1 (cont.)		CURVE 2 (cont.)		CURVE 3*	
		T	k	T	k	T	k
2.71	0.0016	64.0	0.390	298.2	0.00471	299.2	0.00234
4.40	0.0067	80.0	0.345	304.2	0.00501	310.7	0.00231
5.20	0.0113	92.0	0.330	306.2	0.00507*		
6.20	0.0190	196.0	0.182	308.2	0.00592		
9.80	0.0560	300.0	0.121	309.2	0.00616		
11.0	0.0820			310.2	0.00640	300.6	0.00188
13.5	0.133			313.2	0.00679	317.7	0.00187
14.2	0.148			323.2	0.00746	331.0	0.00185
22.1	0.320	289.2	0.0042	333.2	0.00818		
33.5	0.450	293.2	0.00424	342.2	0.00920		
				353.2	0.00967		

* Not shown on plot

FIGURE AND TABLE NO. 13R RECOMMENDED THERMAL CONDUCTIVITY OF PHOSPHORUS



RECOMMENDED VALUES*

Polycrystalline Black Phosphorus				White Phosphorus			
T ₁	k ₁	k ₂	T ₂	T ₁	k ₁	k ₂	T ₂
0	0	0	-459.7	0	0	0	-459.7
1	(0.0000796)‡	(0.00456)	-457.9	200	(0.00308)	(0.178)	-99.7
2	(0.000645)	(0.0373)	-456.1	250	(0.00265)	(0.153)	-9.7
3	0.00220	0.127	-454.3	273.2	(0.00250)	(0.144)	32.0
4	0.00511	0.295	-452.5	300	0.00235	0.136	80.3
5	0.00998	0.577	-450.7	317.3	(0.00226)	(0.131)	111.4
6	0.0167	0.965	-448.9				
7	0.0255	1.47	-447.1				
8	0.0367	2.12	-445.3				
9	0.0497	2.87	-443.5				
10	0.0653	3.77	-441.7				
11	0.0822	4.75	-439.9				
12	0.101	5.84	-438.1				
13	0.122	7.05	-436.3				
14	0.144	8.32	-434.5				
15	0.165	9.53	-432.7				
16	0.187	10.8	-430.9				
18	0.230	13.3	-427.3				
20	0.272	15.7	-423.7				
25	0.357	20.6	-414.7				
30	0.401	23.2	-405.7				
35	0.425	24.6	-396.7				
40	0.435	25.1	-387.7				
45	0.434	25.1	-378.7				
50	0.427	24.7	-369.7				
60	0.402	23.2	-351.7				
70	0.377	21.8	-333.7				
80	0.352	20.3	-315.7				
90	0.328	19.0	-297.7				
100	0.307	17.7	-279.7				
150	0.227	13.1	-189.7				
200	0.177	10.2	-99.7				
250	0.144	8.32	-9.7				
273.2	0.132	7.63	32.0				
300	0.121	6.99	80.3				

Liquid White Phosphorus

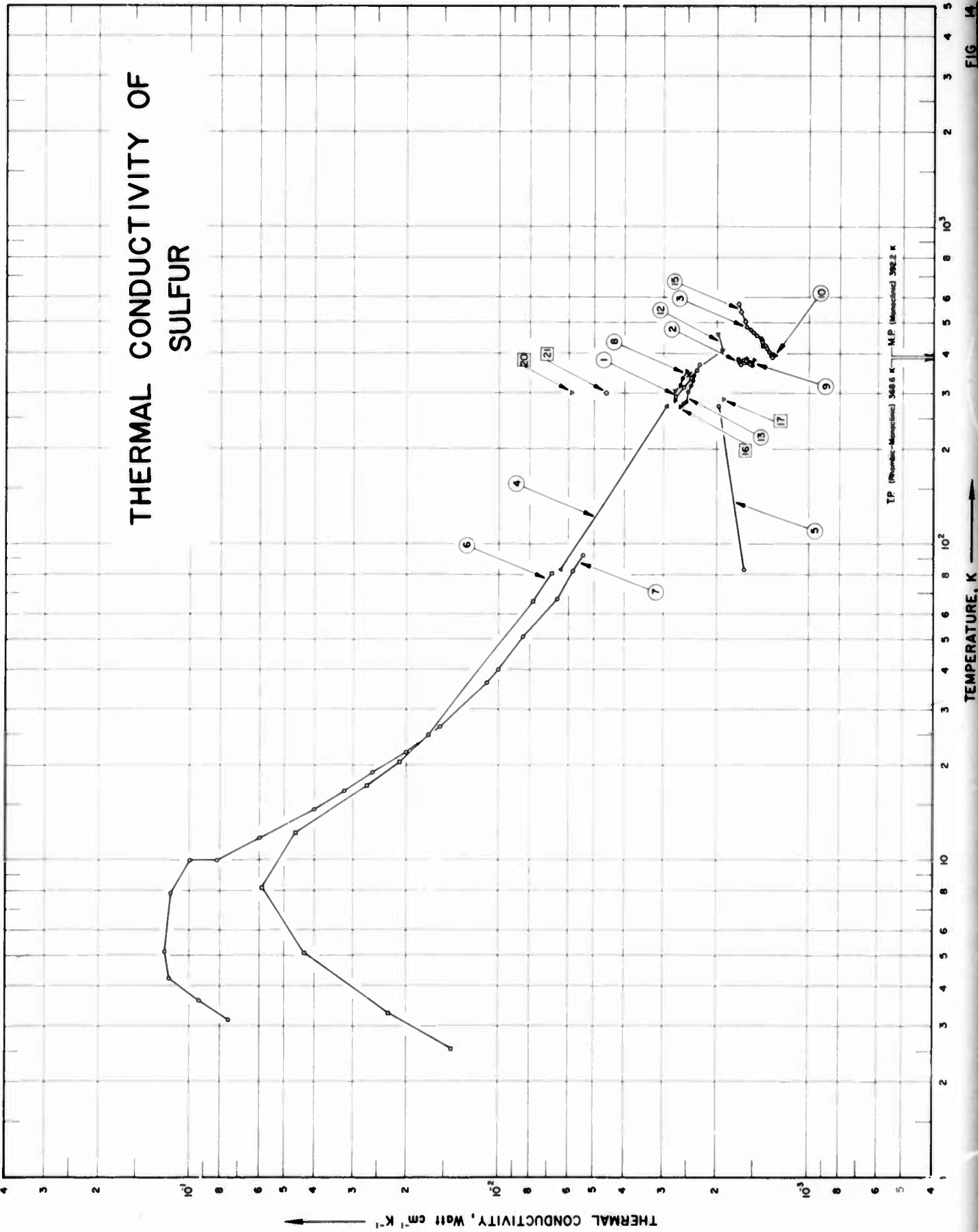
0.00187	0.108	111.4
(0.00183)	(0.106)	170.3
(0.00178)	(0.103)	260.3
(0.00167)	(0.0965)	440.3
(0.00157)	(0.0907)	620.3

REMARKS

The recommended values are for high-purity phosphorus. The recommended values that are supported by experimental thermal conductivity data are thought to be accurate to within 5% of the true values near room temperature and 5 to 10% at other temperatures above 150 K. The thermal conductivity near and below the corresponding temperature of its maximum is highly sensitive to small physical and chemical variations of the specimens, and the values below 150 K are intended as typical values for indicating the general trend.

*T₁ in K, k₁ in Watt cm⁻¹K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ft⁻¹F⁻¹. ‡Values in parentheses are extrapolated.

FIGURE SHOWS ONLY 14 OF THE CURVES REPORTED IN TABLE



TEMPERATURE, K

SPECIFICATION TABLE NO. 14 THERMAL CONDUCTIVITY OF SULFUR

[For Data Reported in Figure and Table No. 14]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	21	L	1929	293-368			Commercial purity; crystalline variety of rhombic aggregate state; specimen prepared at temp not exceeding 160 C.
2	21	L	1929	368-383			The above specimen in monoclinic aggregate state.
3	21	L	1929	388-483			Commercial purity; in liquid state.
4	22	L	1911	83, 273			Rhombic crystalline sulfur.
5	22	L	1911	83, 273			Amorphous; made by casting boiling sulfur.
6	371	L	1965	2.6-81		R 124	Single crystal of the stable orthorhombic modification slowly grown from a CS ₂ solution at room temp in one week; sulfur starting material > 98 pure; rod-shaped sample about 0.2 cm in dia and 0.7 cm long; transparent with a yellow color; a few small internal growth flaws visible in the sample; heat flow perpendicular to the c-axis. Similar to the above specimen but heat flow parallel to the c-axis.
7	371	L	1965	3.2-92		R 127	
8	442, 333	C	1964, 1965	285-354	±1		99.98 pure; α (rhombic) sulfur; polycrystalline; crown glass plate used as comparative material, the thermal conductivity of which is given as $k = 0.803 + 0.00054 t$ with k in kcal m ⁻¹ hr ⁻¹ C ⁻¹ and t in C.
9	333	C	1965	370-389	±1		99.98 pure; β (monoclinic) sulfur; polycrystalline; same comparative material used as above.
10	333	C	1965	395-428	±1		99.98 pure; liquid sulfur; same comparative material used as above.
11	443	L	1898	306, 334			4 cm dia x 0.193 cm thick.
12	444, 445	P	1964	305-460			Data cover both solid and liquid states.
13	446	R	1932	277-353			Rhombic crystal; spherical shell specimen with O. D. 10.200 cm and I. D. 5.514 cm; prepared by melting sulfur flowers at 170 C, cast in a brass mould, cooling to complete solidification in about 1.5 hrs, lowering the temp to about 60 C for 30 min, then allowing to cool in the lagging; density 1.90 g cm ⁻³ .
14	446	R	1932	280-358			Rhombic crystal; spherical shell specimen with O. D. 10.208 cm and I. D. 5.508 cm; prepared by melting sulfur flowers at 127 C, poured into a brass mould, heated to 135 C, cooled to the melting point in about 5 hrs, completely solidified after another 40 min; density 1.94 g cm ⁻³ .
15	447	P	1959	460-574	< ±3		Chemically pure; molten specimen contained in a cell made from 2 thick-walled silver tubes; the liquid annulus has an outer dimension of 28.5 mm dia x 100 mm long and a width of 8 mm; held for 24 hrs at each temp during measurements.
16	448	P	1904	373.2			10.8 cm cubic specimen; density 2.03 g cm ⁻³ ; thermal conductivity values calculated from measured thermal diffusivity and the specific heat value of 0.187 cal g ⁻¹ C ⁻¹ .

SPECIFICATION TABLE NO. 14 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
17	325	C	1892	287.4			Irregular shaped plate specimen 0.0584 cm in thickness; prepared by pressing between 2 microscope slides having plane surfaces; brass used as comparative material.
18	449	L	1912	276.7		Thin plate specimen.	
19	451	L	1952	300		Amorphous sulfur.	
20	451	L	1952	300		Single crystal; heat flow along one crystal axis.	
21	451	L	1952	300		Single crystal; heat flow along another crystal axis perpendicular to the above.	

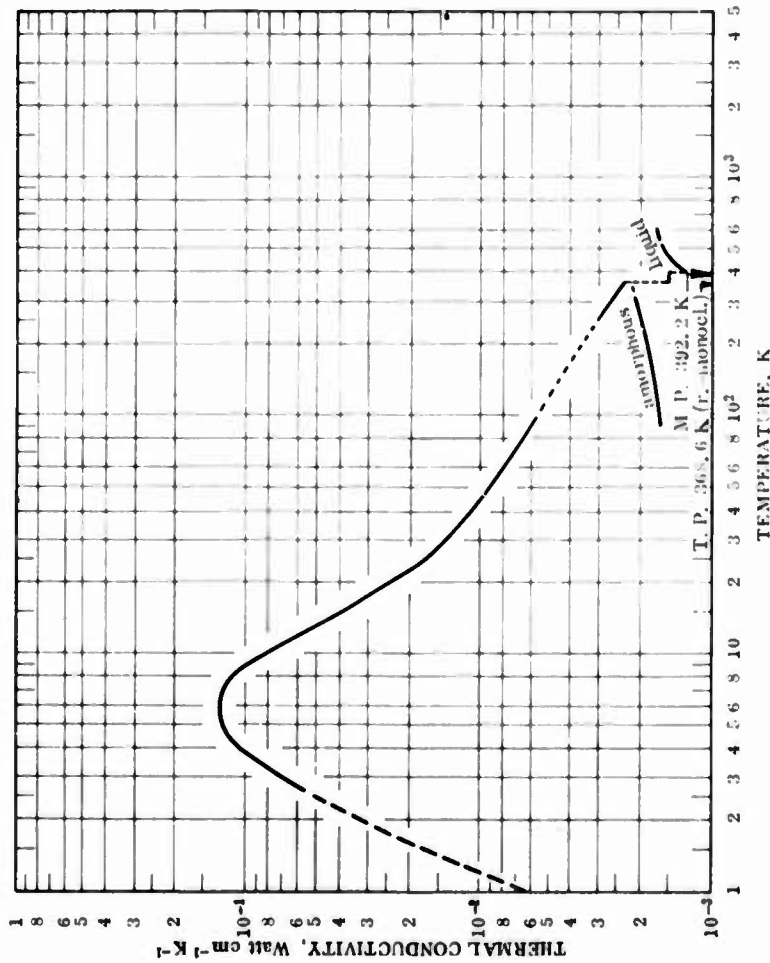
DATA TABLE NO. 14 THERMAL CONDUCTIVITY OF SULFUR

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>													
293.2	0.00273	403.2	0.00134	2.55	0.0141	16.60	0.032	369.65	0.00154	306.2	0.00234	352.7	0.00233*
313.2	0.00256	413.2	0.00136	3.30	0.0229	19.0	0.026	370.93	0.00153	334.2	0.00254	352.8	0.00231*
333.2	0.00243	423.2	0.00138	5.10	0.0430	22.0	0.020	371.41	0.00150			353.3	0.00233*
353.2	0.00233	433.2	0.00141	8.20	0.0590	26.5	0.0155	376.17	0.00153	<u>CURVE 12</u>			
368.2	0.00229	438.2	0.00141	12.20	0.0460	36.5	0.0109	378.38	0.00156	305.2	0.00275	<u>CURVE 14*</u>	
		443.2	0.00142	17.20	0.0270	40.0	0.010	382.13	0.00150	346.2	0.00247	278.8	0.00261
		453.2	0.00147	20.50	0.0210	51.0	0.0084	383.10	0.00152	409.2	0.00193	298.2	0.00256
		463.2	0.00151	25.0	0.0168	67.0	0.0065	384.16	0.00148	460.2	0.00199	303.3	0.00255
		473.2	0.00154	66.0	0.0078	82.0	0.0058	384.75	0.00156			307.8	0.00254
		483.2	0.00158	81.0	0.0068	92.0	0.0054	385.38	0.00150	<u>CURVE 13</u>			
								386.92	0.00159	277.2	0.00259	318.9	0.00252
								388.11	0.00148	281.5	0.00253	327.8	0.00247
								388.67	0.00152	303.3	0.00249	338.3	0.00243
										358.0	0.00238		
										<u>CURVE 15</u>			
										277.2	0.00259	460.1	0.00149*
										281.5	0.00253	501.2	0.00161
										303.3	0.00249	537.3	0.00166
										303.7	0.00250*	574.3	0.00169
										304.0	0.00247*	300	0.00586
										304.6	0.00244		
										316.6	0.00244		
										328.0	0.00244*		
										328.5	0.00241*		
										328.8	0.00241		
										328.8	0.00239		
										420.57	0.00136		
										427.71	0.00139		
										427.71	0.00139		
										354.80	0.00251		
										285.03	0.00275		
										292.61	0.00274		
										306.38	0.00268		
										316.76	0.00265		
										322.26	0.00263		
										332.26	0.00260		
										337.27	0.00258		
										347.23	0.00254		
										354.80	0.00251		
										3.15	0.075		
										3.60	0.093		
										4.25	0.116		
										5.15	0.120		
										7.90	0.115		
										10.00	0.099		
										10.00	0.082		
										11.80	0.060		
										14.50	0.040		

* Not shown on plot

FIGURE AND TABLE NO. 14R RECOMMENDED THERMAL CONDUCTIVITY OF SULFUR



RECOMMENDED VALUES*					
T ₁	k ₁	T ₂	k ₂	T ₁	T ₂
Polycrystalline					
1	(0.00662) † (0.383)	-457.9	0.00163	90	-297.7
2	(0.0320) (1.85)	-456.1	0.00165	100	-279.7
3	0.0694	-454.5	0.00175	150	-189.7
4	0.106	-452.5	0.00185	200	-99.7
5	0.124	-450.7	0.00195	250	-9.7
6	0.128	-448.9	0.00200	273.2	32.0
7	0.123	-447.1	0.00206	300	80.3
8	0.112	-445.3	(0.00216)	350	170.3
9	0.0970	-443.5			
10	0.0917	-441.7			
11	0.0688	-439.9			
12	0.0581	-438.1			
13	0.0499	-436.3			
14	0.0435	-434.5			
15	0.0384	-432.7			
16	0.0343	-430.9			
18	0.0280	-427.3			
20	0.0235	-423.7			
25	0.0169	-414.7			
30	0.0140	-405.7			
35	0.0122	-396.7			
40	0.0109	-387.7			
45	0.00993	-378.7			
50	0.00917	-369.7			
60	0.00799	-351.7			
70	0.00717	-333.7			
80	0.00654	-315.7			
90	0.00602	-297.7			
100	(0.00562)	-279.7			
150	(0.00430)	-189.7			
200	(0.00355)	-99.7			
250	(0.00305)	-9.7			
273.2	0.00287	32.0			
300	0.00269	80.3			
350	0.00242	170.3			
368.6	0.00233	203.8			
368.6	0.00154	203.8			
392.2	0.00150	246.3			
Amorphous					
392.2	0.00129	246.3			
400	0.00132	260.3			
500	0.00160	440.3			
600	(0.00170)	620.3			

In Liquid State

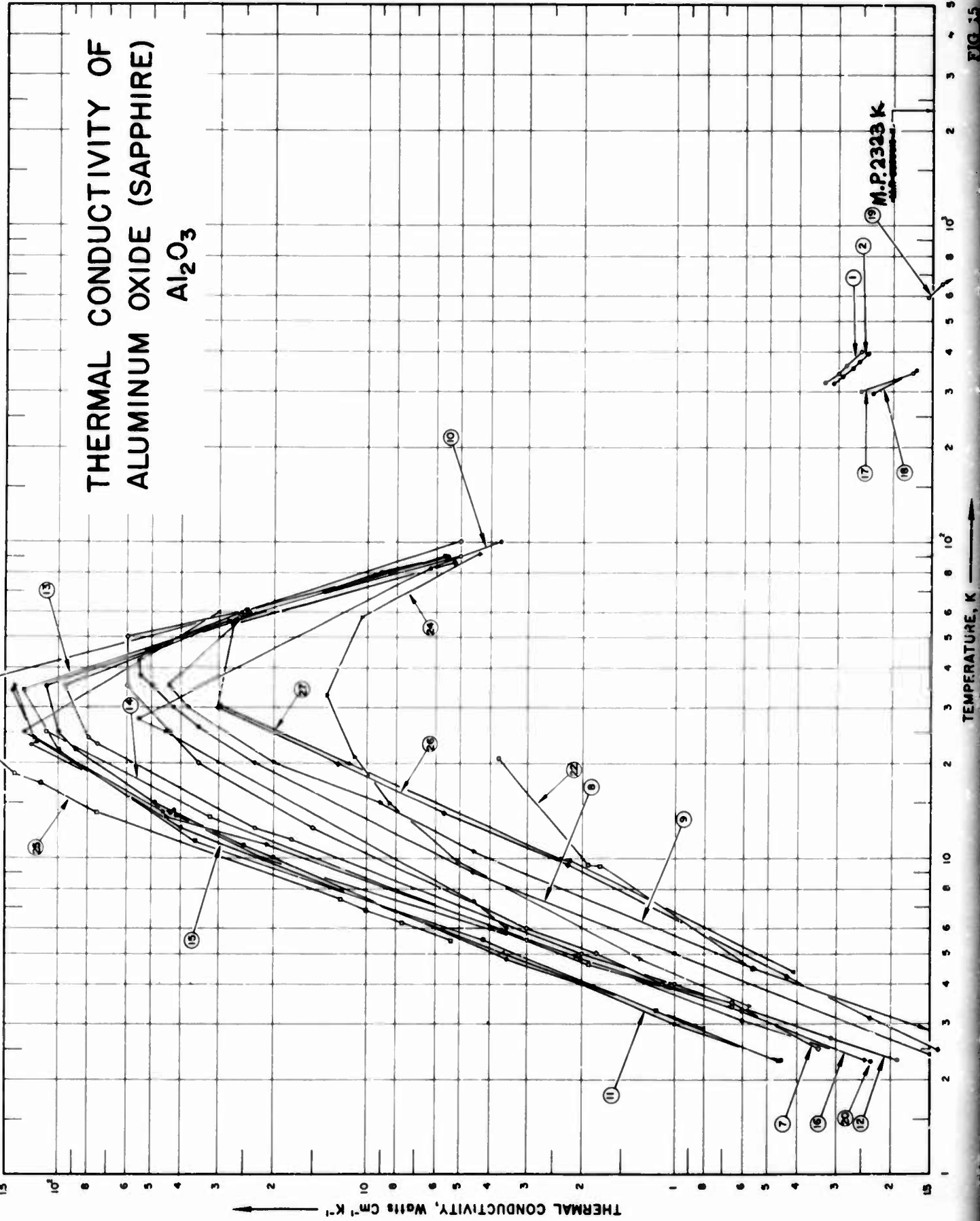
REMARKS

The recommended values are for high-purity sulfur. The recommended values that are supported by experimental thermal conductivity data are thought to be accurate to within 4% of the true values near room temperature and 4 to 10% at other temperatures above 10 K. The thermal conductivity near and below the corresponding temperature of its maximum is highly sensitive to small physical and chemical variations of the specimens, and the values below 10 K are intended as typical values for indicating the general trend.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹.

† Values in parentheses are extrapolated

FIGURE SHOWS ONLY 21 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 15 THERMAL CONDUCTIVITY OF ALUMINUM OXIDE (SAPPHIRE) Al_2O_3

[For Data Reported in Figure and Table No. 15]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	42	C	1953	322-399		93B-1	Single crystal; supplied by Linde Air Products Co.; 0.25 in. dia x 0.25 in. long; a-axis parallel to cylinder axis within 3 degrees; heat flow direction parallel to c-axis.
2	42	C	1953	318-394		93C-1	The above specimen measured with heat flow direction within 3 degrees to the a-axis.
3	548, 13	C	1952	343.2			Heat flow direction at 60 degrees to the c-axis; density 4.0 g cm ⁻³ .
4	34	C	1943	392-763			Synthetic, colorless specimen 1 cm cube cut from a single crystal with c-axis normal to two opposite faces and parallel to other surfaces; heat flow perpendicular to c-axis.
5	68	C	1954	319-382	±3	93B-2	Single crystal; measured in the direction of c-axis.
6	68	C	1954	316-424	±3	93C-2	Single crystal; measured in the direction of a-axis.
7	69	L	1951	2.5-100		Corundum	Single crystal; prepared by Salford Electrical Instruments Ltd.; specimen dia 3 mm, length 6 cm; rod axis at 36 degrees to the principal axis.
8	70	L	1955	2.4-90		I-b	Pure Al_2O_3 crystal produced by usual commercial techniques; 1.55 mm in dia, 6 cm long; with mat surfaces; rod axis at 36 degrees to the optic axis.
9	70	L	1955	2.3-90		I-c	Similar to the above specimen except the dimensions, 1.02mm in dia, 13 mm long.
10	70	L	1955	6.0-100		II	Pure Al_2O_3 crystal produced by usual commercial techniques; 2.8 mm in dia, 15 mm long; with marked mosaic structure as shown by x-rays.
11	70	L	1955	2.3-90		IIIa	Pure Al_2O_3 crystal; 2.52 mm in dia, 6 cm long; with polished surfaces; annealed at a temperature slightly below the melting point.
12	70	L	1955	2.3-90		IIIb	Pure Al_2O_3 crystal; 2.47 mm in dia, 6 cm long; with mat surfaces; annealed at a temperature slightly below the melting point.
13	70	L	1955	2.3-90		IV	As above but 2.54 mm in dia, 6 mm long; with polished surfaces.
14	70	L	1955	3.4-25		V	As above but with mat surfaces.
15	70	L	1955	2.9-60		VI	As above but with polished surfaces, annealed at a temperature slightly below the melting point.
16	70	L	1955	2.3-35			As above but with mat surfaces.
17	71	C	1951	299, 343			Linde synthetic sapphire; single crystal; heat flow parallel to the optic axis.
18	71	C	1951	296, 350			As above, but heat flow perpendicular to the optic axis.
19	72	R	1955	592-1508		Linde synthetic sapphire	Single crystal; measured with heat flow direction at about 60 degrees with the c-axis.

SPECIFICATION TABLE NO. 15 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
20	215		1960	2.3-34		Synthetic sapphire	Single crystal; 2.5 mm dia rod.
21	215		1960	2.5-91		Synthetic sapphire	Single crystal; 2.5 mm dia rod; measured after receiving 3×10^7 roentgens γ -ray dose.
22	215		1960	4.5-21		Synthetic sapphire	Single crystal; 2.5 mm dia rod; reactor irradiated.
23	215		1960	3.4-93		Synthetic sapphire	Single crystal; 2.5 mm dia rod; annealed in vacuum at 1000 to 1100 C for about 12 hrs.
24	215		1960	2.8-92		Synthetic sapphire	The above specimen γ irradiated.
25	215		1960	5.5-90		Synthetic sapphire	Single crystal; 2.5 mm dia rod.
26	215		1960	2.5-87		Synthetic sapphire	Single crystal; 2.5 mm dia rod; stretched at 1400 C.
27	215		1960	4.4-31		Synthetic sapphire	The above specimen γ -ray irradiated.

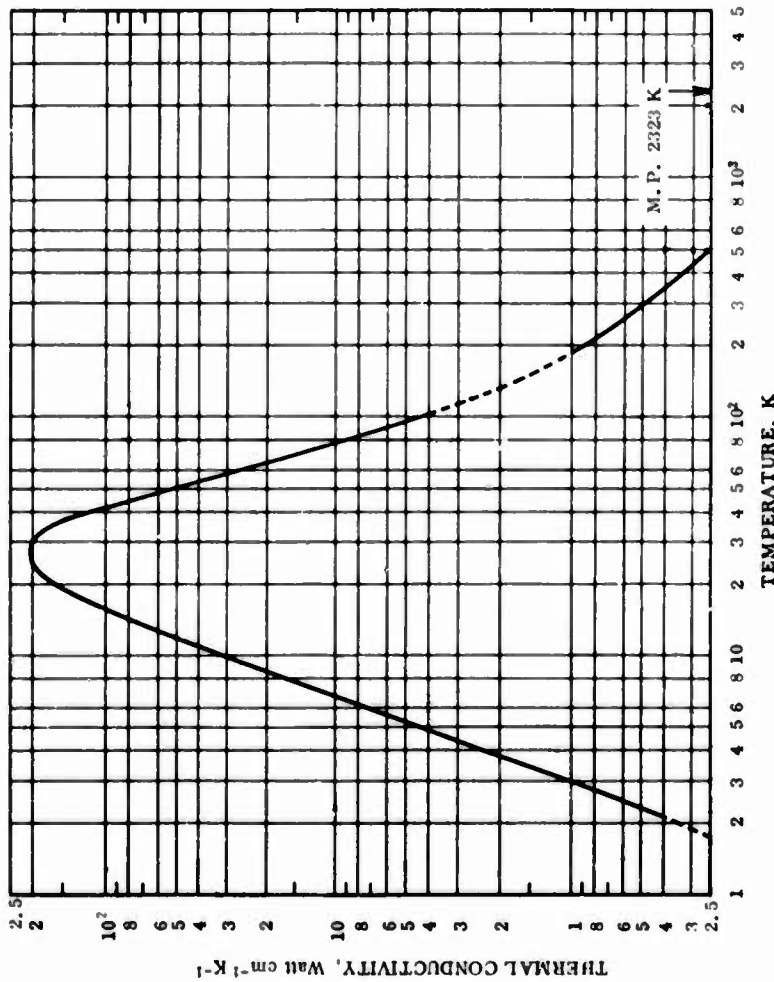
DATA TABLE NO. 15 THERMAL CONDUCTIVITY OF ALUMINUM OXIDE (SAPPHIRE) Al_2O_3

[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k	Curve	T	k	Curve	T	k	Curve	T	k	Curve	T	k	Curve									
321.8	0.330	CURVE 1	5.0	1.80	CURVE 7 (cont.)	25.0	45.00	CURVE 10 (cont.)	3.4	0.650	CURVE 14	1173.2	0.0768*	CURVE 19 (cont.)	9.68	5.59	CURVE 23* (cont.)	4.4	0.414				
342.4	0.299		6.0	3.00		27.5	55.00		4.6	1.90		1257.2	0.0759*		14.5	9.26		14.5	9.26				
361.3	0.282		12.5	15.00		82.5	6.30		5.5	3.00		1313.2	0.0761*		20.5	12.3		20.5	12.3				
398.6	0.251	20.0	35.00	100.0	3.70	13.5	32.00	1394.2	0.0786*	33.0	14.4	33.0	14.4	20.0	11.5								
		CURVE 2	25.0	44.00	CURVE 8	25.0	110.00	CURVE 11	25.0	110.00	CURVE 15	1439.2	0.0813*	CURVE 20	58.0	12.2	CURVE 24	30.5	30.2				
318.4	0.310		35.0	60.00		2.3	0.450		3.4	0.650		1508.2	0.0849*		2.9	0.800		14.0	43.1	21.0	11.0	11.0	11.0
335.9	0.290		60.0	25.00		3.0	1.00		4.6	1.90		2.9	0.800		2.9	0.800		14.2	42.2	33.0	13.6	33.0	13.6
355.3	0.268	100.0	5.00	4.0	2.00	4.8	3.50	4.0	2.00	5.0	3.60	2.3	0.230	2.78	0.327	2.78	0.327						
370.5	0.256	CURVE 3*	4.8	3.50	CURVE 9	10.0	20.00	CURVE 12	12.5	40.00	CURVE 16	24.0	120.00	CURVE 21*	3.1	0.606	CURVE 25	3.44	0.571				
394.0	0.239		2.4	0.15		20.0	23.00		25.0	100.00		23.1	122.1		23.1	122.1		23.1	122.1	58.0	10.5	58.0	10.5
			5.0	1.00		30.0	42.50		35.0	110.00		30.0	42.50		35.0	110.00		23.9	120.5*	92.0	4.33	92.0	4.33
343.2	0.297	CURVE 4*	9.0	4.50	CURVE 10	90.0	5.50*	CURVE 13	2.3	0.240	CURVE 17	2.3	0.240	CURVE 22	5.5	5.30	CURVE 26	5.5	5.30				
			26.0	35.00		2.7	0.310		4.0	1.00		11.0	21.00		4.9	2.10		4.5	1.79	6.24	7.62	6.24	7.62
392.2	0.0331		30.0	50.00		5.0	2.00		11.5	17.50		24.0	120.00		13.5	45.00		12.0	23.7	7.4	12.2	7.4	12.2
511.2	0.0387	37.5	54.50	11.5	17.50	12.5	23.00	24.0	120.00	14.0	46.00	23.2	98.0	14.1	75.0	14.1	75.0						
576.2	0.0423	42.0	55.00	12.5	23.00	23.0	75.00	24.0	120.00	295.2	0.251	32.5	128.5	17.3	115.0	18.6	138.0						
763.2	0.0602	50.0	40.00	23.0	75.00	24.0	80.00	24.0	120.00	343.2	0.172	63.9	27.0	24.0	189.0	24.0	189.0						
		60.0	25.00	2.7	0.310	35.0	95.00	35.0	95.00	35.0	95.00	89.5	6.10	35.5	168.0	37.0	160.0						
		80.0	8.50	4.0	1.00	58.0	26.00	58.0	26.00	90.7	5.81	90.7	5.81	61.0	24.5	61.0	24.5						
		90.0	5.50	5.0	2.00	90.0	5.00	90.0	5.00	296.2	0.230	296.2	0.230	90.1	5.4	90.1	5.4						
318.6	0.327	CURVE 5*	10.5	4.500	CURVE 11	2.3	0.190	CURVE 14	4.5	0.552	CURVE 18	4.5	0.552	CURVE 23*	2.51	0.14	CURVE 27	2.51	0.14				
341.7	0.299		15.0	9.000		2.3	0.190		3.3	1.150		3.3	1.150		9.5	1.75		9.5	1.75	3.18	0.23	3.18	0.23
361.1	0.277		20.0	20.000		5.5	4.20		5.5	4.20		5.5	4.20		20.7	3.77		20.7	3.77	4.39	0.43	4.39	0.43
382.4	0.259	30.0	38.000	11.3	36.00	11.3	36.00	11.3	36.00	591.5	0.155	591.5	0.155	14.1	5.60	14.1	5.60						
		35.0	44.000	22.0	100.00	22.0	100.00	22.0	100.00	651.2	0.139	651.2	0.139	19.9	12.4	19.9	12.4						
315.6	0.302	60.0	24.000	34.0	130.00	34.0	130.00	34.0	130.00	690.2	0.124*	690.2	0.124*	30.2	30.1	30.2	30.1						
335.5	0.289	90.0	5.500*	56.0	28.00	56.0	28.00	56.0	28.00	775.2	0.106*	775.2	0.106*	55.2	27.1	55.2	27.1						
357.9	0.265	CURVE 6*	90.0	5.500*	90.0	5.60	90.0	5.60	90.0	1073.2	0.0804*	1073.2	0.0804*	86.5	5.25	86.5	5.25						
393.5	0.237		2.3	0.055*	2.3	0.466	2.3	0.466	2.3	0.466	3.35	0.633	3.35	0.633									
424.3	0.219		2.5	0.100*	3.3	1.150	3.3	1.150	3.3	1.150	3.95	0.991	3.95	0.991									
		4.5	0.550	5.5	4.20	5.5	4.20	5.5	4.20	5.22	1.85	5.22	1.85										
		10.5	4.500	11.3	36.00	11.3	36.00	11.3	36.00														
		15.0	9.000	22.0	100.00	22.0	100.00	22.0	100.00														
		20.0	20.000	34.0	130.00	34.0	130.00	34.0	130.00														
		30.0	38.000	56.0	28.00	56.0	28.00	56.0	28.00														
		35.0	44.000	90.0	5.500*	90.0	5.500*	90.0	5.500*														
		60.0	24.000	90.0	5.60	90.0	5.60	90.0	5.60														
		90.0	5.500*	90.0	5.60	90.0	5.60	90.0	5.60														
		CURVE 7	2.5	0.34	CURVE 12	2.3	0.190	CURVE 15	4.5	0.552	CURVE 19	4.5	0.552	CURVE 24	2.51	0.14	CURVE 27	2.51	0.14				
			3.5	0.65		2.3	0.190		3.3	1.150		3.3	1.150		9.5	1.75		9.5	1.75	3.18	0.23	3.18	0.23
			4.0	1.10		5.5	4.20		5.5	4.20		5.5	4.20		20.7	3.77		20.7	3.77	4.39	0.43	4.39	0.43

* Not shown on plot

FIGURE AND TABLE NO. 15R RECOMMENDED THERMAL CONDUCTIVITY OF ALUMINUM OXIDE (SAPPHIRE) Al_2O_3



RECOMMENDED VALUES*
(High-purity synthetic sapphire single crystal)

T_1	k_1	k_2	T_2
0	0	0	-459.7
1	(0.039)‡	(2.25)	-457.9
5	4.1	237	-450.7
10	29	1680	-441.7
15	87	5030	-432.7
20	157	9070	-423.7
25	202	11700	-414.7
30	207	12000	-405.7
35	177	10200	-396.7
40	120	6930	-387.7
45	77	4450	-378.7
50	52	3010	-369.7
60	26.5	1530	-351.7
70	15.3	884	-333.7
80	9.6	555	-315.7
90	6.4	370	-297.7
100	4.5	260	-279.7
150	(1.5)	(86.7)	-189.7
200	(0.82)	(47.4)	-99.7
250	(0.54)	(33.5)	-9.7
273.2	(0.52)	(30.0)	32.0
300	0.46	26.6	80.3
350	0.38	22.0	170.3
400	0.324	18.7	260.3
450	0.279	16.1	350.3
500	0.242	14.0	440.3
600	0.189	10.9	620.3
700	0.154	8.90	800.3
800	0.130	7.51	980.3
900	0.115	6.64	1160
1000	0.105	6.07	1340

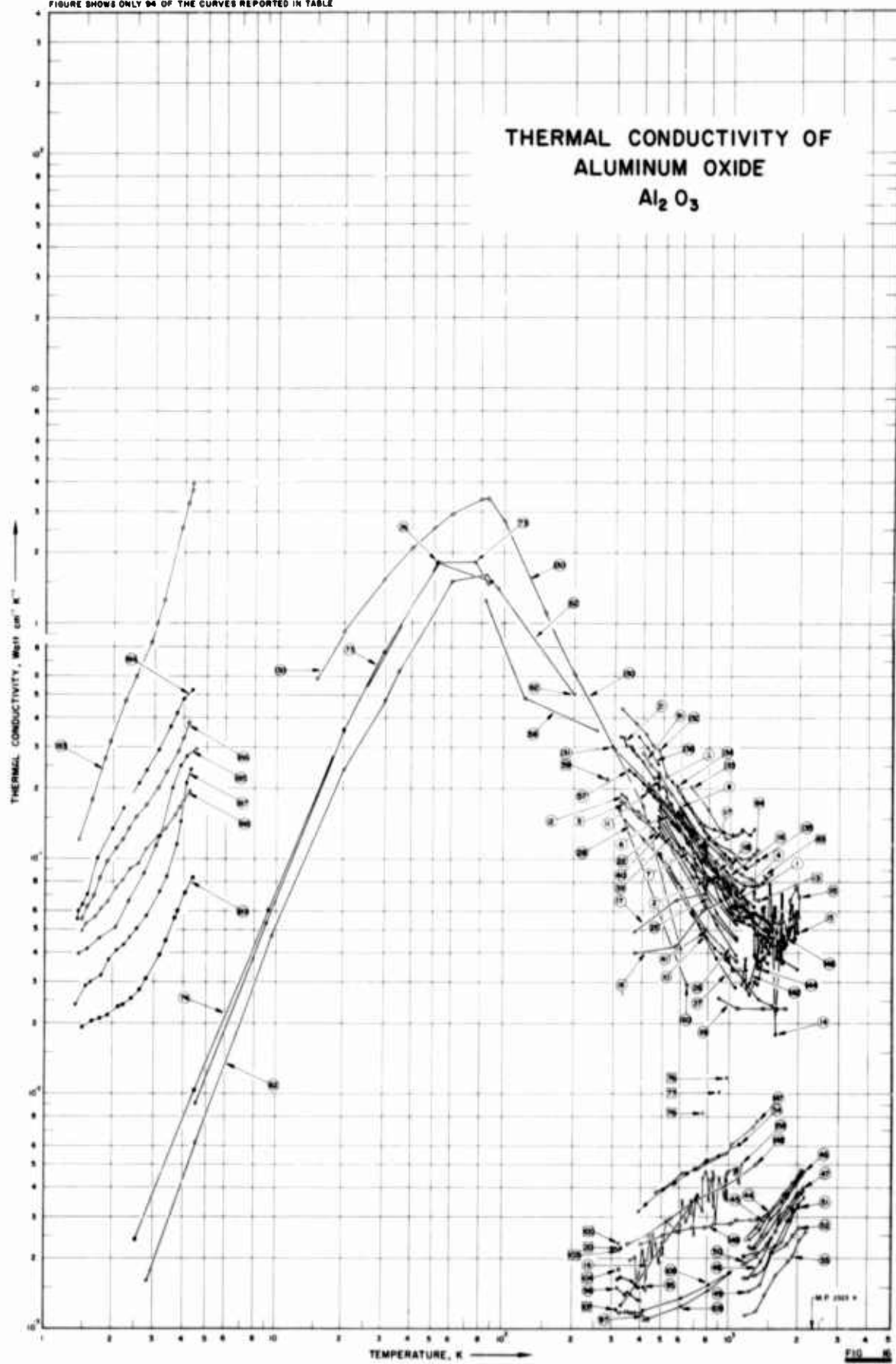
REMARKS

The recommended values are for high-purity synthetic sapphire single crystal with heat flow at 60 degrees to the hexagonal axis. The recommended values that are supported by experimental thermal conductivity data are thought to be accurate to within 10 to 15% of the true values at temperatures above 60 K. The thermal conductivity near and below the corresponding temperature of its maximum is highly sensitive to small physical and chemical variations of the specimens, and the recommended values below 60 K are intended as typical values for indicating the general trend.

* T_1 in K, k_1 in Watt $cm^{-1} K^{-1}$, T_2 in F, and k_2 in Btu $hr^{-1} ft^{-1} F^{-1}$.

‡ Values in parentheses are extrapolated or interpolated.

FIGURE SHOWS ONLY 94 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 16 THERMAL CONDUCTIVITY OF ALUMINUM OXIDE Al_2O_3

[For Data Reported in Figure and Table No. 16]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	1	R	1950	846-1737			Sintered.
2	2	R	1951	758-1535			Pure; polycrystalline; heat-treated.
3	3		1953	333.2			Maximum moisture absorption = 0.05%; flexural strength = 33,000 psi; coefficient of expansion (25-700 C) = 8.0×10^{-6} .
4	4	R	1951	873-1473	±5		Sintered.
5	5	R	1954	423-1553			Hemispherical samples prepared by slipcasting in plaster molds and refiring to 1100 C; 1.75 in. inside dia and 3.5 in. outside dia.
6	5	R	1954	483-1553			Similar to the above specimen.
7	5	R	1954	613-1258			Made by slip-casting; hollow cylinder with inside dia 0.6 in., outside dia 1.5 in., entire length 18 in., test zone 4 in.
8	5	R	1954	593-1253			Same as the above specimen.
9	302	P	1962	293-1263			Density 3.04 g cm ⁻³ .
10	7	R	1949	769-1631			Sintered; open pores 10.65%, closed pores 2.35%; bulk density 3.48 g cm ⁻³ .
11	8	L	1960	419-1067		AP-30	99.5 Al ₂ O ₃ ; supplied by McDanel Refractory Porcelain Co.; porosity 25.6%; bulk density 2.95 g cm ⁻³ .
12	9	C	1953	322-425		Hi alumina; 6 N1-1	No details reported.
13	294	L	1963	1333			
14	89	R	1952	1397-1973	5-7	M-2	Dense alumina; measured by the "Unmatched Guard Method", the given value is the average of 5 runs of two specimens; R, M, S. deviation from average 1.5%.
15	89	R	1952	1273-1983	5-7	M-4	Prepared by slip casting and firing.
16	89	R	1952	1336-2028	5-7	M-5	Similar to the above specimen.
17	34	C	1943	373-769		Corundum (African)	Similar to the above specimen.
18	34	C	1943	372-985		Corundum (African)	Red; single crystal; measured parallel to c-axis; 18-8 stainless steel used as comparative material.
19	79	L	1942	328, 728			Red; single crystal; measured normal to c-axis; 18-8 stainless steel used as comparative material.
20	79	L	1942	328.2			Porous; measured in the presence of air atmosphere; density 0.77 g cm ⁻³ .
21	131	C	1954	318-900	<3		Same as the above specimen but measured in the presence of hydrogen atmosphere. 1 x 1 x 1 in.; slip-cast from suspension of finely ground material; fired to zero apparent porosity; bulk density 3.79 g cm ⁻³ .

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
22	132	R	1958	323-1876	<3		Polycrystal; specimen disks were three annular rings having inside dia 0.625 in., outside dia 3.0 in., and thickness 1 in., with six 0.5 in. thick disks located at each end as guard section.
23	133	C	1954	473-1073	<3		1 x 1 x 1 in.; prepared from Norton Co. 38X 220F alumina by grinding in steel mills, acid treating, and casting in plaster molds from an acid suspension; dense.
24	133	C	1954	473-1073	<3		1 x 1 x 1 in.; prepared from Norton Co. 38X 220F alumina by grinding in steel mills, acid-treating incorporating up to 50 vol. % naphthalene flakes in casting slip, dried for an extended period at 60 to 70 C, then fired at 1830 C for 3 hrs; 12.3% porosity with 0.031 cm dia spherical pores.
25	133	C	1954	473-1073	<3		Same preparation as the above specimen; 23.4% porosity with 0.031 cm dia spherical isometric pores.
26	133	C	1954	473-1073	<3		Same preparation as the above specimen; 30.0% porosity with 0.031 cm dia spherical isometric pores.
27	133	C	1954	473-1073	<3		Same preparation as the above specimen; 44.2% porosity with 0.031 cm dia spherical isometric pores.
28	133	C	1954	333-1183	<3		Same preparation as the above specimen; 48.7% porosity with 0.031 cm dia spherical isometric pores.
29	133	C	1954	473-1073	<3		1 x 1 x 1 in.; prepared from Norton Co. 38X 220F alumina by grinding in steel mills, acid treating and casting in plaster molds from an acid suspension; dense.
30	133	C	1954	473-1073	<3		1 x 1 x 1 in.; prepared from Norton Co. 38X 220F alumina by grinding in steel mills, acid treating, and casting around drill rods firmly set in a plaster mold from an acid suspension; porosity 7.54 with cylindrical pores of dia 0.082 cm; pore axes parallel to heat flow.
31	133	C	1954	428-1093	<3		Same preparation as the above specimen; 11.97% porosity with cylindrical pores of dia 0.082 cm; cylinders parallel to heat flow.
32	133	C	1954	473-1073	<3		Same preparation as the above specimen; 17.95% porosity with cylindrical pores of dia 0.082 cm; cylinders parallel to heat flow.
33	133	C	1954	473-1073	<3		Same preparation as the above specimen; 22.4% porosity with cylindrical pores of dia 0.082 cm; cylinders parallel to heat flow.
34	133	C	1954	473-1073	<3		Same preparation as the above specimen; 4.5% porosity with cylindrical pores of dia 0.146 cm; cylinders parallel to heat flow.
35	133	C	1954	473-1073	<3		Same preparation as the above specimen; 9.75% porosity with cylindrical pores of dia 0.146 cm; cylinders parallel to heat flow.
36	133	C	1954	473-1073	<3		Same preparation as the above specimen; 13.5% porosity with cylindrical pores of dia 0.146 cm; cylinders parallel to heat flow.

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
37	133	C	1954	473-1073			Same preparation as the above specimen; 19.75% porosity with cylindrical pores of dia 0.146 cm; cylinders parallel to heat flow.
38	133	C	1954	473-1073			Same preparation as the above specimen; 4.5% porosity with cylindrical pores of dia 0.146 cm; cylinders perpendicular to heat flow.
39	133	C	1954	473-1073			Same preparation as the above specimen; 9.75% porosity with cylindrical pores of dia 0.146 cm; cylinders perpendicular to heat flow.
40	133	C	1954	473-1073			Same preparation as the above specimen; 13.5% porosity with cylindrical pores of dia 0.146 cm; cylinders perpendicular to heat flow.
41	133	C	1954	473-1073			Same preparation as the above specimen; 19.75% porosity with cylindrical pores of dia 0.146 cm; cylinders perpendicular to heat flow.
42	65	C	1958	452-973	2-3	Wesgo Alumina (Al-300)	97.6 Al ₂ O ₃ ; bulk density 3.70 g cm ⁻³ ; porosity 6.8%; M. I. T. alumina standard used as comparative material.
43	65	C	1958	452-973	2-3	Wesgo Alumina (Al-300)	2nd run of the above specimen using different alumina as the comparative material.
44	134	R	1952	1193-2093			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
45	134	R	1952	1248-2083			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
46	134	R	1952	1268-2143			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
47	134	R	1952	1243-2143			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
48	134	R	1952	1223-2093			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
49	134	R	1952	1233-2143			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
50	134	R	1952	1193-2123			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
51	134	R	1952	1173-2043			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
52	134	R	1952	1173-2043			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
53	134	R	1952	1193-2193			Porous layer coated cathoretically on a tungsten wire and then heated to 1600-1700 C.
54	400	R	1966	388-1119	±10	B45F	0.01-0.1 Fe, 0.01-0.1 Na, and 0.01-0.1 Si principal impurities; powder specimen contained in a ~4 in. I. D., 4.5 in. O. D., and ~2.4 in. long container; supplied by Norton Co.; mean particle size 211 μ; volume fraction solid 0.49; pore-free density 3.95 g cm ⁻³ .
55	400	R	1966	379-1104	±10	E99	Similar to the above specimen except mean particle size 263 μ, packed to 0.58 volume fraction solid, and pore-free density 3.98 g cm ⁻³ .
56	136	C	1959	373-1128	±4		Polycrystalline; containing 0.30 vol. % Cr ₂ O ₃ ; prepared by mixing calcined Cr ₂ O ₃ and Al ₂ O ₃ in a water suspension and either slip-casting or hydrostatically pressing, and fired at 1800 C to total porosity of 17.2%.

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
57	136	C	1959	348-1150	±4		Polycrystalline; preparation same as the above specimen; containing 1.26 vol. % Cr ₂ O ₃ ; total porosity 19.8%.
58	137	P	1957	84-249		AV30	96.0 Al ₂ O ₃ ; in vitreous form; 3 mm dia thin rod supplied by McDanel Refractory Porcelain Co.
59	137	P	1957	276		AV30	Same as the above specimen.
60	137	P	1957	317, 639		AV30	Same as the above specimen.
61	316	C	1951	387-693	2		Alumina of known thermal conductivity used as comparative material.
62	158	L	1952	2.8-200	2		Polycrystalline; a rod of 0.25 in. dia; obtained from Royal Aircraft Establishment; sintered; density 3.70 g cm ⁻³ .
63	72	R	1955	573-1573			Polycrystalline; prepared from high purity powders; calcined, hydrostatically pressed, and fired.
64	170	R	1953	473.2			Four specimens with porosity 7.5 to 22.3%; heat flow perpendicular to the 0.82 mm dia cylindrical pores.
65	170	R	1953	773.2			Four specimens with porosity 7.5 to 22.1%; heat flow perpendicular to the 0.82 mm dia cylindrical pores.
66	170	R	1953	1073.2			Four specimens with porosity 7.5 to 22.2%; heat flow perpendicular to the 0.82 mm dia cylindrical pores.
67	170	R	1953	473.2			Four specimens with porosity 4.6 to 19.6%; heat flow perpendicular to the 1.46 mm dia cylindrical pores.
68	170	R	1953	473.2			Four specimens with porosity 4.5 to 19.7%; heat flow parallel to the 1.46 mm dia cylindrical pores.
69	170	R	1953	773.2			Four specimens with porosity 4.3 to 19.8%; heat flow perpendicular to the 1.46 mm dia cylindrical pores.
70	170	R	1953	773.2			Four specimens with porosity 4.5 to 19.7%; heat flow parallel to the 1.46 mm dia cylindrical pores.
71	170	R	1953	1073.2			Four specimens with porosity 4.7 to 19.7%; heat flow perpendicular to the 1.46 mm dia cylindrical pores.
72	170	R	1953	1073.2			Four specimens with porosity 4.7 to 19.7%; heat flow parallel to the 1.46 mm dia cylindrical pores.
73	215		1960	4.5-86			2.5 mm dia rod; sintered.
74	215		1960	2.5-89			The above specimen γ-irradiated.
75	216	R	1951	763.7			No. 8 grain; measured from the inner half of test annulus.
76	216	R	1951	977.6			Measured from the outer half of the above test annulus.

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
77	216	R	1951	901.5			Measured from the entire above annulus.
78	184	-	1961	1318			Polycrystalline; measured in a vacuum of 10^{-4} mm Hg. run No. 1; thermal conductivity was calculated from the measured emissivity data.
79	184	-	1961	1333.5			The above specimen run No. 2.
80	184	-	1961	1284			The above specimen run No. 3.
81	184	-	1961	1289.5			The above specimen run No. 4.
82	184	-	1961	1407.7			The above specimen run No. 5.
83	184	-	1961	1409			The above specimen run No. 6.
84	184	-	1961	1276			The above specimen run No. 7.
85	73	C	1954	573-1473			No details.
86	217	C	1960	354-1171		Gulton HS. B Alumina No. 1	99.3 Al ₂ O ₃ , 0.23 Fe ₂ O ₃ , 0.22 SiO ₂ , 0.5 C, 0.05 Ca, 0.05 TiO ₂ , 0.02 MgO, 0.01 Na ₂ O, and 0.07 others; polycrystalline with average grain size supplied by Gulton Ind.; pressed and heat treated; density 3.86 g cm ⁻³ and 2.6% porosity; impurity analysis made after heat treatment; MIT alumina standard used as comparative material.
87	217	C	1960	403-1213		Gulton HS. B Alumina No. 2	Same composition, structure, and supplier as the above specimen; average grain size 3 μ; density 3.90 g cm ⁻³ and porosity 1.5%; MIT alumina standard used as comparative material.
88	217	C	1960	423-1292		Gulton HS. B Alumina No. 3	The above specimen heat treated for 100 hrs at 1500 C; average grain size 6 μ; density 3.84 g cm ⁻³ and porosity 3.0%; MIT alumina standard used as comparative material.
89	217	C	1960	379-1234		Gulton HS. B Alumina No. 4	Same composition, structure, and supplier as the above specimen; average grain size 4 μ; density 3.90 g cm ⁻³ and porosity 1.6%; MIT alumina standard used as comparative material.
90	217	C	1960	376-1243		Gulton HS. B Alumina No. 5	Same composition, structure, and supplier as the above specimen; average grain size 10 μ; density 3.91 g cm ⁻³ and porosity 1.4%; MIT alumina standard used as comparative material.
91	217	C	1960	403-1241		Norton H. P. Alumina	96.5 Al ₂ O ₃ , 0.40 MgO, 0.05 Ca, 0.01 SiO ₂ , 0.01 Fe ₂ O ₃ , 0.01 CaO, 0.01 Na ₂ O, and 0.05 others; supplied by Norton Co.; polycrystalline with average grain size 3 μ; hot pressed and heat treated; density 3.97 g cm ⁻³ and zero porosity; impurity analysis made after heat treatment; MIT alumina standard used as comparative material.
92	217	C	1960	371-1243		Norton H. P. Alumina	The above specimen heat treated for 100 hrs at 1500 C in helium; average grain size 5 μ; density 3.83 g cm ⁻³ and porosity 3.3%; MIT alumina standard used as comparative material.
93	217	C	1960	373-1273		Norton 38-900	99.8 Al ₂ O ₃ , 0.05 Fe ₂ O ₃ , 0.05 Na ₂ O, 0.05 Ca, 0.03 CaO, 0.02 SiO ₂ , 0.01 MgO, and 0.04 others; polycrystalline with average grain dia 10-11 μ; hot pressed; density 3.89 g cm ⁻³ and porosity 1.8%; data corrected to theoretical density; MIT alumina standard used as comparative material.

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
94	217	C	1960	373-1273		Norton 38-900	99.3 Al ₂ O ₃ , 0.44 MgO, 0.05 Fe ₂ O ₃ , 0.05 C, 0.05 Na ₂ O, 0.03 CaO, 0.02 SiO ₂ , and 0.0; others; polycrystalline with average grain dia 8-9 μ; hot pressed; density 3.92 g cm ⁻³ and porosity 1.1%; data corrected to theoretical density; MIT alumina standard used as comparative material.
95	272	R	1962	318-417	5	FW-5	Prepared from spray-dried alumina powder supplied by the American Cyanamid Co.; Alpha-monohydrate (boehmite) crystal structure; drying loss: 16.4 weight % at 500 F, and 27.0 % at 1800 F; true density of solid (monohydrate) 2.45 g cm ⁻³ ; B. E. T. surface area 362 m ² g ⁻¹ and pore volume 0.475 cm ³ g ⁻¹ ; particle size distribution: 61% of 90 μ mesh, 32.5% of 60 μ; 23.5% of 45 μ, 11.5% of 20 μ, and 7.0% of 10 μ; measured in vacuum of 10-25 μ of Hg.
96	272	R	1962	313-400	5	FW-4.5	Prepared from the same powder as the above specimen; pellet density 1.010 g cm ⁻³ , micro pore volume 0.383 cm ³ g ⁻¹ , macro pore volume 0.198 cm ³ g ⁻¹ , micro void fraction 0.387, and macro void fraction 0.200; measured in vacuum (pressure 10-25 microns of Hg).
97	272	R	1962	322-437	5	FW-4	Prepared from the same powder as the above specimen; pellet density 0.896 g cm ⁻³ , micro pore volume 0.400 cm ³ g ⁻¹ , macro pore volume 0.308 cm ³ g ⁻¹ , micro void fraction 0.359; and macro void fraction 0.275; measured in vacuum (pressure 10-25 microns of Hg).
98	272	R	1962	318-444	5	FW-3.5	Prepared from the same powder as the above specimen; pellet density 0.785 g cm ⁻³ , micro pore volume 0.416 cm ³ g ⁻¹ , macro pore volume 0.451 cm ³ g ⁻¹ , micro void fraction 0.327, and macro void fraction 0.353; measured in vacuum (pressure 10-25 microns of Hg).
99	272	R	1962	318-378	5	FW-3	Prepared from the same powder as the above specimen; pellet density 0.672 g cm ⁻³ , micro pore volume 0.434 cm ³ g ⁻¹ , macro pore volume 0.670 cm ³ g ⁻¹ , micro void fraction 0.275, and macro void fraction 0.450; measured in vacuum (pressure 10-25 microns of Hg).
100	272	R	1962	322.1	5	FW-5	Same as the above specimen FW-5 but measured in helium at 1 atm. pressure.
101	272	R	1962	322.1	5	FW-4	Same as the above specimen FW-4 but measured in helium at 1 atm. pressure.
102	272	R	1962	322.1	5	FW-3	Same as the above specimen FW-3 but measured in helium at 1 atm. pressure.
103	272	R	1962	322.1	5	FW-5	Same as the above specimen FW-5 but measured in air at 1 atm. pressure.
104	272	R	1962	322.1	5	FW-4	Same as the above specimen FW-4 but measured in air at 1 atm. pressure.
105	272	R	1962	322.1	5	FW-3	Same as the above specimen FW-3 but measured in air at 1 atm. pressure.
106	272	L	1963	293, 313	<2	Powder	Produced at the NBS by ignition of hydrated aluminum chloride in a muffle furnace at 1150 C; density 0.41 g cm ⁻³ .
107	273	L	1963	313.2	<2		Powder; same method of production as the above except density 0.46 g cm ⁻³ .

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
108	273	R	1963	413-1363	<3			Powder; same method of production as the above except density 0.44 g cm ⁻³ .
109	273	R	1963	413-1198	<3			Powder; same method of production as the above except density 0.40 g cm ⁻³ .
110	274	R	1953	813-1513	<±5			Specimen in prolate spheroid shape; fabricated in MIT Ceramics Laboratory; fired to a total porosity of 6.35-7.11% with a bulk density of 3.66-3.69 g cm ⁻³ .
111	274	R	1953	848-1473	<±5			Same material as the above; separate run.
112	274	R	1953	813-1403	<±5			Same material as the above; separate run.
113	274	R	1953	833-1503	<±5			Same material as the above; separate run.
114	274	R	1953	813-1513	<±5			Same material as the above; separate run.
115	274.130	R	1953	1343-2023	<5			0.31 Fe ₂ O ₃ , 0.245 O ₂ , and 0.01 TiO ₂ ; specimen in prolate spheroid shape; slip-cast; fired to zero apparent porosity at 1850 C and had a final total porosity of 5-10%.
116	293	C	1957	533-1508	±4	No. 1		Single crystal; 99.5% pure; 0.875 in. cubic specimen; supplied by Linde Co.; data corrected to zero porosity; polycrystalline alumina used as standard.
117	293	C	1957	548-1158	±4	No. 1		Polycrystalline; 99.5% pure; 0.875 in. cubic specimen; supplied by Baker Chemical Co.; gravimetric porosity 3.78%; microscopic porosity 4%; average grain size 9 μ; data corrected to zero porosity.
118	293	C	1957	583-1473	±4	No. 2		Similar to the above specimen except for gravimetric porosity 12.09%; microscopic porosity 15%; average grain size 17 μ; data corrected to zero porosity.
119	135,364	R	1957	893-1773	<2			In cylindrical form 30 mm long, inside dia 30 mm, outside dia 60 mm; porosity 22%.
120	135,364	R	1957	803-1533	<2			Similar to the above specimen except 10% porosity.
121	330	C	1957	298.2	±6			Commercially pure; thermal comparator applied on the machined curved surface of the 1 in. dia bar specimen.
122	330	C	1957	298.2				Thermal comparator loaded with 100 gram weight applied on the plane surface of the specimen.
123	284	C	1958	473-973		Weego Al-300		97.6 Al ₂ O ₃ ; 1 in. cube ground and polished on diamond laps.
124	286	C	1958	347-900		Norton 38-900		One in. cube; grain size distribution ranging from 5 to 9 microns with a peak at 7.5 microns; hot pressed.
125	287	L	1965	683-883		Specimen a		0.1 MgO, 0.1 NiO; specimen 12.7 mm in dia and 12.7 mm long; sintered; 99.5% theoretical density.
126	287	L	1965	723-843		Specimen b		Similar to above specimen.
127	287	R	1965	1163-1643		Specimen c		Similar to above specimen except 24.00 mm in dia and 25 mm long.
128	287	R	1965	1253-1563		Specimen d		Similar to above specimen; slight melting and cracking were found around the center of the specimen after the measurement.

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
129	287	R	1965	1723-1993		Specimen e	Similar to above specimen.
130	288		1963	15-600		Lucalox	Polycrystalline; 99.9% Al ₂ O ₃ ; density 3.98 g cm ⁻³ ; gas-tight, essentially zero porosity; melting point 2040 C; manufactured by General Electric Co.
131	296		1959	293-1273			Battelle-developed sinterable alumina powder hydrostatically pressed at 100,000 psi, presintered in air at 1800 F for 1 hr and final sintered at 2500 F for 2 hrs; 98.5% μ theoretical density; average crystal size about 2 μ , with some crystals as large as 70 μ .
132	295	C	1960	323-1323		A-1	Commercial single crystal; gravimetric density 3.98 g cm ⁻³ ; zero porosity; c-axis inclined at 60 degrees to the direction of heat flow; polycrystalline Al ₂ O ₃ and ZrO ₂ used as reference materials.
133	295	C	1960	663-1123		A-2	Commercial single crystal; gravimetric density not determined; c-axis inclined at 60 degrees to the direction of heat flow; polycrystalline Al ₂ O ₃ and ZrO ₂ used as reference materials.
134	295	C	1960	571-1271		A-3	Commercial single crystal; gravimetric density 3.98 g cm ⁻³ ; zero porosity; c-axis inclined at 60 degrees to the direction of heat flow; polycrystalline Al ₂ O ₃ and ZrO ₂ used as reference materials.
135	295	C	1960	543-1323		A-4	Polycrystalline specimen fabricated by pressing hydrostatically and sintering; grain size 13 μ ; gravimetric density 3.97 g cm ⁻³ ; microscopic porosity 0.5%; gravimetric porosity 0.25%; pore size 1.0 to 1.5 μ ; data corrected for the effect of porosity and presented as at zero porosity.
136	295	C	1960	363-1403		A-5	Polycrystalline specimen fabricated by pressing hydrostatically and sintering; grain size 28 μ ; gravimetric density 3.86 g cm ⁻³ ; microscopic porosity 3.3%; gravimetric porosity 3.0%; pore size 4.0 μ ; data corrected for the effect of porosity and presented as at zero porosity.
137	295	C	1960	683-1423		A-6	Polycrystalline specimen fabricated by pressing hydrostatically and sintering; grain size 19 μ ; gravimetric density 3.48 g cm ⁻³ ; microscopic porosity 14.0%; gravimetric porosity 12.5%; pore size 6 to 10 μ ; data corrected for the effect of porosity and presented as at zero porosity.
138	314	L	1959	389.8	14	Ignited alumina	Compressed powder, supplied by Anachemia Chemicals, Ltd.; specimen in the shape of a disc of 0.182 in. thick and 9 in. dia, pressed at 63 psi; bulk density 1.02 g cm ⁻³ ; load reduced to 0.5 psi prior to making measurements.
139	314	L	1959	393.2	14	Ignited alumina	Compressed powder; 9 in. dia x 0.145 in. thick; same supplier as the above specimen; pressed at 940 psi; bulk density 1.27 g cm ⁻³ .
140	314	L	1959	396.5		Norton Alundum R. R.	Powder; -90 mesh; supplied by Fisher Scientific Co.; disc of 0.189 in. thick and 9 in. dia, pressed at 63 psi; bulk density 1.92 g cm ⁻³ ; load reduced to 0.5 psi prior to making measurements.

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
141	314	L	1959	403-2		Norton Alundum R. R.	Compressed powder; 9 in. dia x 0.166 in. thick; same supplier as the above specimen; pressed 940 psi; density 2.19 g cm ⁻³ .
142	317	K	1960	1238-1473		TC 352	99.3 pure; supplied by Gladding McBean; sintered; bulk density 3.8 g cm ⁻³ (95% of theoretical value); run No. 6.
143	317	R	1960	1336-1609		TC 352	The above specimen; run No. 7.
144	317	R	1960	1144-1471		TC 352	The above specimen; run No. 14.
145	317	R	1960	1252-1601		TC 352	The above specimen; run No. 15.
146	317	R	1960	1365-1895		TC 352	The above specimen; run No. 16.
147	373	R	1959	473-1348	±20	Al ₂ O ₃ D(35-50)	Powder specimen composed of dense crystalline particles; contained in a 1.125 in. dia cylinder; particle dia 0.04 ± 0.01 cm; porosity < 4%; apparent density 1.82 g cm ⁻³ ; volume fraction of particles 0.475.
148	373	R	1959	353-377	±20	Al ₂ O ₃ B(35-50)	Powder specimen in the form of porous bubbles; contained in a 1.125 in. dia cylinder; bubble dia 0.04; apparent powder density 1.15 g cm ⁻³ ; volume fraction of bubbles 0.29.
149	373	R	1959	405-1328	±20	Al ₂ O ₃ R	Highly porous specimen of a reagent grade alumina contained in a 1.125 in. dia cylinder; apparent density 1.00 g cm ⁻³ ; volume fraction 0.25.
150	368	R	1954	813-1503	±5		Hollow prolate spheroidal specimens with inner minor axis ~2 cm, inner major axis ~10 cm, outer minor axis ~4 cm and outer major axis long enough to make the outer and inner surfaces concave; prepared by slip-casting from suspensions of finely-ground alumina; total porosity 6.35-7.11; bulk density 3.66-3.69 g cm ⁻³ ; measured with 4 different specimens.
151	368	R	1954	853-1478	±5		The above specimens; run No. 2.
152	368	R	1954	813-1493	±5		The above specimens; run No. 3.
153	368	R	1954	832-1498	±5		The above specimens; run No. 4.
154	368	K	1954	813-1489	±5		The above specimens; run No. 5.
155	374	C	1965	419-942	0.5	Al-300	Fired alumina; 97.55 Al ₂ O ₃ , 1.35 SiO ₂ , 1.05 CaO, 0.03 Fe ₂ O ₃ , 0.02 Na ₂ O; grain size in the range 0.01 to 0.15 mm with 80% less than 0.10 mm; bulk density 3.75 g cm ⁻³ , true density 3.92 g cm ⁻³ ; porosity 5% of total volume; material not permeable; prepared to a tolerance of ±0.001 in. in the form of a cylinder 1 in. in dia and 1 in. high; manufactured by the Western Gold and Platinum Co.; alumina Al-300 as reference standard (thermal conductivity of the standard determined by a thermal diffusivity method by J. J. Swica, Alfred University).
156	374	C	1965	442-1225	0-2	Al-300	Similar to the above specimen except Pyroceram 9606 as reference standard (made by Corning Glass Works, thermal conductivity determined by NBS).

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
157	375	C	1960	373-1273		Wesgo AI-300	Specimen obtained from Western Gold and Platinum Co.; alumina cubes used as reference standard obtained from W. D. Klegery, MIT.
158	401, 402	R	1960	360-1139			Granular specimen contained in 18 in. dia sphere; produced in a pilot fluidized bed calciner operated at 672 K at Idaho Chemical Processing Plant, from a liquid feed of the composition (concentration in g mole liter ⁻¹): 8.0 NO ₂ , 2.2 Al ⁺⁺⁺ , 1.25 H ⁺ , 0.15 Na ⁺ , and 0.008 Hg ⁺⁺ ; porosity 4 to 60; bulk density 1.5 to 0.6 g cm ⁻³ ; measured in the spherical apparatus.
159	401, 402	R	1960	700, 768		AIJ-1	Granular specimen contained in 12 in. dia x 48 in. long cylinder; same fabrication method, supplier, and physical properties as the above specimen; measured in the cylindrical apparatus.
160	401, 402	R	1960	838, 1038		AIJ-2	Similar to the above specimen.
161	401, 402	R	1960	975-1255		AIJ-3	Similar to the above specimen.
162	401, 402	R	1960	789, 889		AIJ-4	Similar to the above specimen.
163	401, 402	R	1960	821, 1064		AIJ-5	Similar to the above specimen.
164	401, 402	R	1960	1001-1229		AIJ-6	Similar to the above specimen.
165	401, 402	R	1960	923-1145		AIJ-7	Similar to the above specimen.
166	401, 402	R	1960	980-1198		AIJ-8	Similar to the above specimen.
167	401, 402	R	1960	458-738		B-1	Similar to the above specimen.
168	401, 402	R	1960	765-1379		B-2	Similar to the above specimen.
169	401, 402	R	1960	910-1499		B-3	Similar to the above specimen.
170	401, 402	R	1960	1040-1698		B-4	Similar to the above specimen.
171	401, 402	R	1960	558-933		C-1	Similar to the above specimen.

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
172	401, 402	R	1960	479-1023		C-2	Similar to the above specimen.
173	401, 402	R	1960	536-1145		C-3	Similar to the above specimen.
174	401, 402	R	1960	463-959		D-1	Similar to the above specimen.
175	401, 402	R	1960	604-1254		D-2	Similar to the above specimen.
176	401, 402	R	1960	788-1335		D-3	Similar to the above specimen.
177	401, 402	R	1960	763-1534		E-1	Similar to the above specimen.
178	401, 402	R	1960	796-1725		E-2	Similar to the above specimen.
179	401, 402	R	1960	915-1830		E-3	Similar to the above specimen.
180	401, 402	R	1960	945-1614		E-4	Similar to the above specimen.
181	401, 402	R	1960	752-1798		E-5	Similar to the above specimen.
182	401, 402	R	1960	342-595			Granular specimen of the size of -100 mesh contained in 12 in. dia sphere; same fabrication method and supplier as the above specimen.
183	403	L	1967	1.4-4.3		1	Pure; single crystal; 8 mm dia x 40 mm; specimen axis made an angle of 60 degrees to the crystal axis.
184	403	L	1967	1.4-4.3		1	0.1 MnO ₂ , 0.0017 Mn; single crystal; 8 mm dia x 40 mm long; specimen axis made an angle of 60 degrees to the crystal axis.
185	403	L	1967	1.4-4.5		1	Above specimen measured in a magnetic field with strength 11800 oersted along the specimen axis.
186	403	L	1967	1.5-4.2		2	0.2 MnO ₂ ; single crystal; 8 mm dia x 40 mm long; specimen axis made an angle of 60 degrees to the crystal axis.
187	403	L	1967	1.4-4.3		2	Above specimen measured in a magnetic field with strength 11800 oersted along the specimen axis.
188	403	L	1967	1.5-4.2		3	0.35 MnO ₂ , 0.0014 Mn; single crystal; 8 mm dia x 40 mm long; specimen axis made an angle of 60 degrees to the crystal axis.

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
189	403	L	1967	1.5-4.4	3		Above specimen measured in a magnetic field with strength 11800 oriented along the specimen axis.
190	404, 405	P	1960	333-832			Al ₂ O ₃ powder filled into a cylindrical vessel 32.2 mm inside dia and 300 mm long of a foamed refractory fire clay with specific weight 800 kg cm ⁻³ ; thermal conductivity data calculated from the measurement of thermal diffusivity, specific heat and density.
191	406	L	1965	4.2			Powder; grain size 6 ± 2 μ; load applied to specimen 6 kg cm ⁻² ; measured in helium under a pressure 3.27 x 10 ⁻³ μ Hg.
192	406	L	1965	4.2			Similar to the above specimen; measured under pressure in the range 1.00 x 10 ⁻⁴ ~20.2 mm Hg.
193	406	L	1965	4.2			Similar to the above specimen except grain size 35 ± 5 μ; measured under pressure in the range 1.84 x 10 ⁻³ ~3.20 x 10 ⁻⁴ μ Hg.
194	406	L	1965	4.2			Similar to the above specimen; measured under pressure in the range 2.24 x 10 ⁻⁴ ~63.1 mm Hg.
195	406	L	1965	4.2			Similar to the above specimen; measured under pressure in the range 7.33 x 10 ⁻³ ~94.4 μ Hg.
196	406	L	1965	4.2			Similar to the above specimen except grain size 150 ± 10 μ; measured under pressure in the range 1.93 x 10 ⁻³ ~2.95 x 10 ⁻² μ Hg.
197	406	L	1965	4.2			Similar to the above specimen; measured under pressure in the range 1.37 x 10 ⁻⁴ ~67.6 mm Hg.
198	406	L	1965	4.2			Powder; grain size 35 μ; measured in vacuum under a load varying in a cycle.
199	406	L	1965	2.5-4.9			Powder; grain size 6 μ; load applied to specimen 6 kg cm ⁻² ; measured in a vacuum of 100 μ Hg.
200	406	L	1965	2.5-4.9			Similar to the above specimen except measured in a vacuum of 10 μ Hg.
201	406	L	1965	2.0-4.1			Powder; grain size 35 μ; load applied to specimen 6 kg cm ⁻² ; measured in a vacuum of 1 μ Hg.
202	406	L	1965	2.0-4.2			Similar to the above specimen except measured in a vacuum of 10 μ Hg.
203	406	L	1965	2.8-4.8			Powder; grain size 6 μ; load applied to specimen 6 kg cm ⁻² ; measured in a vacuum of <10 ⁻⁴ μ Hg.
204	406	L	1965	1.9-4.8			Similar to the above specimen except grain size 35 μ.
205	406	L	1965	2.1-4.1			Similar to the above specimen except grain size 150 μ.

SPECIFICATION TABLE NO. 16 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
206	407	L	1949	318-412		C-5	No details reported.
207	407	L	1949	317-421			No details reported.
208	408	C	1967	664-1208			Foam specimen; density 0.593 g cm ⁻³ ; Min-K 1301 (Johns Manville Corp.) used as comparative material.

DATA TABLE NO. 16 THERMAL CONDUCTIVITY OF ALUMINUM OXIDE Al_2O_3 [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k			
<u>CURVE 1</u>		<u>CURVE 5 (cont.)</u>		<u>CURVE 7 (cont.)</u>		<u>CURVE 11</u>		<u>CURVE 15 (cont.)</u>		<u>CURVE 16*</u>		<u>CURVE 21 (cont.)</u>		<u>CURVE 21 (cont.)</u>		<u>CURVE 21 (cont.)</u>				
846.2	0.0833	953.2	0.0745	1033.2	0.0586	419.2	0.195	1338.2	0.0477	1336.2	0.0464	388.2	0.275*	766.2	0.108	323.0	0.175			
983.2	0.0715	1013.2	0.0753	1093.2	0.0565	481.2	0.178	1393.2	0.0615	1443.2	0.0477	398.2	0.264*	770.2	0.112	385.8	0.150			
1152.2	0.0623	1053.2	0.0628	1203.2	0.0565	524.2	0.164	1393.2	0.0410*	1508.2	0.0460	400.2	0.259	773.2	0.114	449.2	0.134			
1381.2	0.0569	1113.2	0.0586	1258.2	0.0565	604.2	0.142	1403.2	0.0498*	1628.2	0.0368	413.2	0.249*	780.2	0.106	490.0	0.123			
1574.2	0.0536	1153.2	0.0607	<u>CURVE 8</u>				661.2	0.124	1413.2	0.0460*	1753.2	0.247*	786.2	0.103	789.8	0.0820			
1674.2	0.0527	1228.2	0.0586	593.2	0.165	743.2	0.105	1415.2	0.0623	1778.2	0.0410	418.2	0.244*	813.2	0.0962*	1345.7	0.0561*			
1737.2	0.0540	1293.2	0.0586	683.2	0.132	839.2	0.0904	1428.2	0.0423	1826.2	0.0418	426.2	0.241*	818.2	0.0900*	1512.0	0.0550*			
<u>CURVE 2</u>		1353.2	0.0565	763.2	0.0983	964.2	0.0803	1448.2	0.0439*	1943.2	0.0556	430.2	0.236*	833.2	0.0933*	1589.8	0.0549*			
758.2	0.0828	1393.2	0.0544	853.2	0.0900	1067.2	0.0715	1483.2	0.0473*	1963.2	0.0632	443.2	0.229*	836.2	0.0891*	1694.4	0.0550*			
913.2	0.0741	1453.2	0.0502	933.2	0.0782	<u>CURVE 12</u>				2023.2	0.0464	450.2	0.220*	853.2	0.0891*	1875.8	0.0556*			
1050.2	0.0619	1553.2	0.0502	1013.2	0.0711	322.4	0.188	1504.2	0.0435	2028.2	0.0577	463.2	0.219*	863.2	0.0920*	900.2	0.0866*			
1176.2	0.0561	<u>CURVE 6</u>				339.2	0.182	1553.2	0.0561	<u>CURVE 17</u>				470.2	0.223	<u>CURVE 22</u>				
1181.2	0.0567	483.2	0.167	1083.2	0.0628	360.9	0.162	1573.2	0.0368*	<u>CURVE 18</u>				473.2	0.215*					
1313.2	0.0527	543.2	0.142	1113.2	0.0628	382.4	0.159	1573.2	0.0406*	<u>CURVE 19</u>				473.2	0.204					
1401.2	0.0498	588.2	0.132	1193.2	0.0607	425.2	0.145	1607.2	0.0377	<u>CURVE 20</u>				496.2	0.203					
1442.2	0.0506	663.2	0.117	1253.2	0.0586	<u>CURVE 13</u>				1608.2	0.0377	<u>CURVE 21</u>				498.2	0.197			
1504.2	0.0490	703.2	0.094	<u>CURVE 9</u>				1618.2	0.0444	<u>CURVE 22</u>				508.2	0.198*					
1535.2	0.0527	763.2	0.0816	293.2	0.251	1333.2	0.0669	1666.2	0.0406*	<u>CURVE 23</u>				516.2	0.195					
<u>CURVE 3</u>		803.2	0.0669	323.2	0.213	<u>CURVE 14</u>				1668.2	0.0460*	<u>CURVE 24*</u>				533.2	0.183			
333.2	0.173	903.2	0.0669	373.2	0.169	1387.2	0.0402	1703.2	0.0364	<u>CURVE 25*</u>				543.2	0.170					
<u>CURVE 4</u>		973.2	0.0607	423.2	0.142	1447.2	0.0502	1723.2	0.0473*	<u>CURVE 26*</u>				548.2	0.164					
873.2	0.0837	1008.2	0.0596	473.2	0.121	1463.2	0.0456	1723.2	0.0510*	<u>CURVE 27*</u>				550.2	0.169*					
1073.2	0.0693	1063.2	0.0544	523.2	0.109	1487.2	0.0732	1735.2	0.0469	<u>CURVE 28*</u>				578.2	0.158*					
1273.2	0.0588	1113.2	0.0544	573.2	0.0962	1492.2	0.0502	1738.2	0.0540*	<u>CURVE 29*</u>				578.2	0.154					
1473.2	0.0535	1223.2	0.0523	673.2	0.0820	1463.2	0.0456	1743.2	0.0414	<u>CURVE 30*</u>				583.2	0.156*					
<u>CURVE 5</u>		1293.2	0.0502	773.2	0.0732	1487.2	0.0732	1748.2	0.0498*	<u>CURVE 31*</u>				583.2	0.155*					
423.2	0.209	1298.2	0.0473	873.2	0.0669*	1523.2	0.0573	1753.2	0.0427*	<u>CURVE 32*</u>				592.2	0.155*					
483.2	0.172	1373.2	0.0473	973.2	0.0607*	1595.2	0.0178	1773.2	0.0431	<u>CURVE 33*</u>				600.2	0.154					
548.2	0.157	1473.2	0.0460	1073.2	0.0586*	1598.2	0.0266	1808.2	0.0481	<u>CURVE 34*</u>				633.2	0.139*					
593.2	0.136	1518.2	0.0460	1263.2	0.0569*	1641.2	0.0531*	1813.2	0.0477*	<u>CURVE 35*</u>				636.2	0.135*					
663.2	0.117	1553.2	0.0460	1681.2	0.0707	1663.2	0.0402	1818.2	0.0498*	<u>CURVE 36*</u>				648.2	0.132*					
688.2	0.100	<u>CURVE 7</u>				1692.2	0.0372	1843.2	0.0506*	<u>CURVE 37*</u>				657.2	0.135					
710.2	0.105	769.2	0.0473	1737.2	0.0339	1793.2	0.0339	1853.2	0.0552*	<u>CURVE 38*</u>				696.2	0.120*					
783.2	0.094	864.2	0.0372	1769.2	0.0473	1873.2	0.0339	1873.2	0.0632	<u>CURVE 39*</u>				708.2	0.116*					
833.2	0.090	964.2	0.0372	1815.2	0.0305	1908.2	0.0339	1873.2	0.0632	<u>CURVE 40*</u>				732.2	0.116*					
893.2	0.0837	1155.2	0.0305	1947.2	0.0251	1918.2	0.0582*	1908.2	0.0632	<u>CURVE 41*</u>				743.2	0.111*					
<u>CURVE 6</u>		1347.2	0.0251	1273.2	0.0515*	1930.2	0.0577*	1930.2	0.0632	<u>CURVE 42*</u>				756.2	0.113					
873.2	0.090	1373.2	0.0238	1275.2	0.0531*	1943.2	0.0456	1953.2	0.0594	<u>CURVE 43*</u>				760.2	0.106*					
893.2	0.0837	1433.2	0.0230	1298.2	0.0389	1953.2	0.0594	1953.2	0.0594	<u>CURVE 44*</u>				760.2	0.106*					
893.2	0.0837	1433.2	0.0230	1333.2	0.0343	1983.2	0.0481	1983.2	0.0481	<u>CURVE 45*</u>				760.2	0.106*					

DATA TABLE NO. 16 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 25</u>		<u>CURVE 31*</u>		<u>CURVE 37*</u>		<u>CURVE 43*</u>		<u>CURVE 49</u>		<u>CURVE 55 (cont.)</u>		<u>CURVE 55</u>		<u>CURVE 61*</u>		<u>CURVE 60</u>	
473.2	0.161	429.2	0.205	473.2	0.182	452.2	0.219	1403.2	0.0025	1173.2	0.00205	379.2	0.00411	317.0	0.163		
673.2	0.0920	468.2	0.188	773.2	0.0854	466.2	0.205	1533.2	0.00295	1353.2	0.0021*	423.2	0.00433	639.0	0.029		
873.2	0.0586	503.2	0.167	1073.2	0.0586	507.2	0.193	1668.2	0.0032	1478.2	0.0025*	517.2	0.00518				
1073.2	0.0460	523.2	0.161	973.2	0.0740	525.2	0.173	1803.2	0.00365	1613.2	0.00255	599.2	0.00568				
		553.2	0.146			597.2	0.157	1963.2	0.0041	1823.2	0.0029	701.2	0.00621				
<u>CURVE 26</u>		<u>CURVE 32*</u>		<u>CURVE 38*</u>		<u>CURVE 44</u>		<u>CURVE 45</u>		<u>CURVE 56*</u>		<u>CURVE 56</u>		<u>CURVE 62</u>		<u>CURVE 62</u>	
473.2	0.144	473.2	0.138	473.2	0.168	473.2	0.155	1233.2	0.00165	1173.2	0.00235*	373.2	0.276	2.8	0.0016		
673.2	0.0837	623.2	0.123	773.2	0.0816	773.2	0.075	1393.2	0.00195	1303.2	0.0017	393.2	0.258	4.5	0.0062		
873.2	0.0523	643.2	0.117	1073.2	0.0554	800.2	0.0983	1543.2	0.00245	1453.2	0.0016	423.2	0.230	9.5	0.047		
1073.2	0.0397	678.2	0.109			835.2	0.0946	1693.2	0.00285	1533.2	0.0021	448.2	0.213	20.0	0.24		
		713.2	0.100			869.2	0.0874	2033.2	0.00375	1703.2	0.00235*	648.2	0.125	30.5	0.47		
<u>CURVE 27</u>		<u>CURVE 33*</u>		<u>CURVE 39</u>		<u>CURVE 46</u>		<u>CURVE 46 (cont.)</u>		<u>CURVE 57</u>		<u>CURVE 57</u>		<u>CURVE 63*</u>		<u>CURVE 63*</u>	
473.2	0.105	473.2	0.0900	473.2	0.184	473.2	0.155	1403.2	0.0025	1173.2	0.00165	348.2	0.238	573.2	0.159		
673.2	0.0586	783.2	0.0879	773.2	0.0887	773.2	0.075	1543.2	0.0033	1303.2	0.0017	368.2	0.229	623.2	0.143		
873.2	0.0377	853.2	0.0795	1073.2	0.0586	800.2	0.0946	1693.2	0.00375	1453.2	0.0016	403.2	0.209	673.2	0.126		
1073.2	0.0293	913.2	0.0669			835.2	0.0946	2033.2	0.00375	1613.2	0.00170	448.2	0.186	723.2	0.112		
		1013.2	0.0628			869.2	0.0874	2083.2	0.0038	1833.2	0.00195	570.2	0.138	773.2	0.104		
<u>CURVE 28</u>		<u>CURVE 34*</u>		<u>CURVE 40</u>		<u>CURVE 46</u>		<u>CURVE 46 (cont.)</u>		<u>CURVE 58</u>		<u>CURVE 58</u>		<u>CURVE 64*</u>		<u>CURVE 64*</u>	
333.2	0.146	473.2	0.159	473.2	0.136	473.2	0.105	1233.2	0.00145	1173.2	0.00240	348.2	0.238	1073.2	0.0686		
403.2	0.121	673.2	0.100	773.2	0.0628	773.2	0.0502	1373.2	0.00155	1553.2	0.00215	368.2	0.229	1173.2	0.0637		
533.2	0.0921	1073.2	0.0565	1073.2	0.0450	1073.2	0.0366	1583.2	0.0033	1713.2	0.00235	403.2	0.209	1273.2	0.0590		
723.2	0.0523							1753.2	0.00375	1893.2	0.0029	448.2	0.186	1463.2	0.0532		
853.2	0.0418							1913.2	0.0042	2033.2	0.0034	570.2	0.138	1573.2	0.0527		
973.2	0.0377							2033.2	0.0045	2143.2	0.00355	643.2	0.117				
1038.2	0.0335							2093.2	0.00475			743.2	0.0967				
1183.2	0.0335											788.2	0.0782				
												872.0	0.0870				
<u>CURVE 29*</u>		<u>CURVE 35*</u>		<u>CURVE 42*</u>		<u>CURVE 46</u>		<u>CURVE 46 (cont.)</u>		<u>CURVE 59</u>		<u>CURVE 59</u>		<u>CURVE 65*</u>		<u>CURVE 65*</u>	
473.2	0.209	473.2	0.189	452.2	0.216	473.2	0.189	1233.2	0.00145	1173.2	0.00240	348.2	0.238	1073.2	0.0686		
673.2	0.126	673.2	0.105	466.2	0.199	705.2	0.113	1373.2	0.00155	1553.2	0.00215	368.2	0.229	1273.2	0.0590		
873.2	0.0879	1073.2	0.0657	507.2	0.190	743.2	0.106	1583.2	0.0033	1713.2	0.00235	403.2	0.209	1463.2	0.0532		
1073.2	0.0711			525.2	0.171	800.2	0.0946	1753.2	0.00375	1893.2	0.0029	448.2	0.186	1573.2	0.0527		
				597.2	0.149			1913.2	0.0042	2033.2	0.0034	570.2	0.138				
<u>CURVE 30*</u>		<u>CURVE 36*</u>		<u>CURVE 42*</u>		<u>CURVE 46</u>		<u>CURVE 46 (cont.)</u>		<u>CURVE 60</u>		<u>CURVE 60</u>		<u>CURVE 66*</u>		<u>CURVE 66*</u>	
473.2	0.192	473.2	0.189	452.2	0.216	473.2	0.189	1233.2	0.00145	1173.2	0.00240	348.2	0.238	1073.2	0.0686		
673.2	0.115	673.2	0.105	466.2	0.199	705.2	0.113	1373.2	0.00155	1553.2	0.00215	368.2	0.229	1273.2	0.0590		
873.2	0.0795	1073.2	0.0617	507.2	0.190	743.2	0.106	1583.2	0.0033	1713.2	0.00235	403.2	0.209	1463.2	0.0532		
1073.2	0.0628			525.2	0.171	800.2	0.0946	1753.2	0.00375	1893.2	0.0029	448.2	0.186	1573.2	0.0527		
				597.2	0.149			1913.2	0.0042	2033.2	0.0034	570.2	0.138				

* Not shown on plot

DATA TABLE NO. 16 (continued)

Porosity (%)	k	Porosity (%)	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 64*</u> (T = 473.2 K)		<u>CURVE 70*</u> (T = 773.2 K)		<u>CURVE 75</u>		<u>CURVE 86*</u>		<u>CURVE 88*</u>		<u>CURVE 91 (cont.)</u>		<u>CURVE 94* (cont.)</u>		<u>CURVE 99*</u>	
7.5	0.168	4.5	0.0961	763.7	0.00829	354.2	0.234	1179.2	0.0640	900.2	0.103	317.6	0.0674	317.6	0.000675
11.8	0.147	9.7	0.0907	<u>CURVE 76</u>		410.2	0.209	1292.2	0.0587	931.2	0.0992	1273.2	0.0594	326.5	0.000675
17.5	0.117	14.66	0.0970	<u>CURVE 77</u>		493.2	0.175	<u>CURVE 89*</u>		1008.2	0.0920	<u>CURVE 95</u>		339.8	0.000658
22.25	0.0943	19.7	0.0806	977.6	0.0117	551.2	0.153	379.2	0.221	1125.2	0.0858	317.6	0.00163	355.4	0.000692
<u>CURVE 65*</u> (T = 773.2 K)		<u>CURVE 71*</u> (T = 1073.2 K)		<u>CURVE 77</u>		611.2	0.135	389.2	0.227	1241.2	0.0816	328.7	0.00166	366.5	0.000675
7.25	0.0818	4.7	0.0600	901.5	0.0102	741.2	0.106	465.2	0.196	<u>CURVE 92*</u>		368.7	0.00159	377.6	0.000640
11.75	0.0701	9.6	0.0529	<u>CURVE 78*</u>		819.2	0.0929	503.2	0.180	371.2	0.296	<u>CURVE 100</u>			
17.8	0.0565	14.87	0.0449	1318.0	0.0567	862.2	0.0874	542.2	0.164	423.2	0.249	322.1	0.00232		
22.1	0.0471	19.7	0.0372	<u>CURVE 79*</u>		925.2	0.0791	628.2	0.136	474.2	0.216	322.1	0.00151		
<u>CURVE 66*</u> (T = 1073.2 K)		<u>CURVE 72*</u> (T = 1073.2 K)		<u>CURVE 79*</u>		962.2	0.0753	633.2	0.132	562.2	0.164	322.1	0.00152		
7.5	0.0546	4.7	0.0656	1333.5	0.0482	1032.2	0.0690	712.2	0.117	630.2	0.140	<u>CURVE 96</u>			
12.0	0.0474	9.7	0.0620	<u>CURVE 80*</u>		1080.2	0.0657	802.2	0.100	667.2	0.129	315.4	0.00149		
17.75	0.0387	14.75	0.0588	1284.0	0.0583	1171.2	0.0602	839.2	0.0916	751.2	0.109	340.9	0.00140		
22.15	0.0320	19.7	0.0557	<u>CURVE 81*</u>		<u>CURVE 87*</u>		893.2	0.0862	810.2	0.0983	349.8	0.00144		
<u>CURVE 67*</u> (T = 473.2 K)		<u>CURVE 73</u>		1289.5	0.0547	403.2	0.259	946.2	0.0812	895.2	0.0870	322.1	0.00166		
4.6	0.184	4.5	0.0091	<u>CURVE 82*</u>		406.2	0.232	1019.2	0.0736	956.2	0.0795	322.1	0.00133		
9.65	0.155	9.01	0.0532	<u>CURVE 83</u>		466.2	0.215	1036.2	0.0724	1029.2	0.0741	322.1	0.00132		
13.4	0.136	20.0	0.35	<u>CURVE 84</u>		507.2	0.194	1138.2	0.0661	1120.2	0.0686	322.1	0.00216		
19.6	0.104	30.3	0.76	1407.5	0.0776	571.2	0.159	1234.2	0.0619	1243.2	0.0640	321.5	0.00117		
<u>CURVE 68*</u> (T = 473.2 K)		<u>CURVE 74</u>		1409.0	0.0845	625.2	0.138	376.2	0.249	451.2	0.295	346.5	0.00118		
4.5	0.200	4.45	0.0024	<u>CURVE 85*</u>		680.2	0.120	451.2	0.220	489.2	0.182	363.2	0.00117		
9.7	0.189	4.45	0.0103	<u>CURVE 86*</u>		746.2	0.107	489.2	0.196	526.2	0.170	377.6	0.00118		
13.5	0.182	9.2	0.0608	<u>CURVE 87*</u>		800.2	0.100	526.2	0.155	593.2	0.119	405.4	0.00118		
19.7	0.168	19.9	0.351	<u>CURVE 88*</u>		892.2	0.0862	660.2	0.136	792.2	0.107	433.2	0.00109		
<u>CURVE 69*</u> (T = 773.2 K)		<u>CURVE 75</u>		1476.0	0.0676	1036.2	0.0728	792.2	0.107	911.2	0.0891	318.2	0.000987		
4.25	0.0885	4.45	0.0024	<u>CURVE 89*</u>		1123.2	0.0644	1036.2	0.0640	1073.2	0.0795	318.2	0.000987		
9.64	0.0749	4.45	0.0103	<u>CURVE 90*</u>		1213.2	0.0640	423.2	0.258	1073.2	0.0795	318.2	0.000987		
14.75	0.0628	9.2	0.0608	<u>CURVE 91</u>		<u>CURVE 88*</u>		458.2	0.225	1154.2	0.0674	318.2	0.000987		
19.75	0.0502	52.2	1.80	1473.2	0.0536	486.2	0.195	486.2	0.195	1243.2	0.0628	337.6	0.000987		
		89.0	1.50			524.2	0.187	524.2	0.187	<u>CURVE 94*</u>		350.9	0.000987		
						549.2	0.167	403.2	0.282	373.2	0.278	365.4	0.00104		
						583.2	0.157	429.2	0.251	473.2	0.212	384.3	0.000935		
						629.2	0.135	468.2	0.232	573.2	0.169	403.2	0.000969		
						666.2	0.127	537.2	0.189	673.2	0.134	430.9	0.000935		
						798.2	0.0992	602.2	0.161	773.2	0.111	444.3	0.000952		
						917.2	0.0849	674.2	0.139	873.2	0.0862	413.2	0.00120		
						1010.2	0.0749	762.2	0.119	973.2	0.0845	613.2	0.00136		
						1100.2	0.0678	1100.2	0.0678	1073.2	0.0757	813.2	0.00154		

* Not shown on plot

DATA TABLE NO. 16 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k
CURVE 108 (cont.)													
1023.2	0.00174	1333.2	0.0582	548.2	0.165*	473.2	0.231	1503.2	0.0586	1203.2	0.100	953.2	0.079*
1223.2	0.00195*	1433.2	0.0565	623.2	0.136	573.2	0.148	1563.2	0.0649	1273.2	0.105	1183.2	0.067*
1363.2	0.00215*	1503.2	0.0552	738.2	0.113	673.2	0.123	1723.2	0.079*	1323.2	0.109	1403.2	0.059*
CURVE 109													
413.2	0.00108	813.2	0.0937	1158.2	0.067	973.2	0.0761	1753.2	0.0596	663.2	0.201	683.2	0.130
613.2	0.00125	973.2	0.0774	CURVE 123*				1993.2	0.0711	793.2	0.163	823.2	0.096
803.2	0.00146	1083.2	0.0669	CURVE 124*				953.2	0.121	983.2	0.087	893.2	0.097
1003.2	0.00173	1203.2	0.0619	347.1	0.316	366.5	0.303	CURVE 125*				1073.2	0.079
1198.2	0.00195*	1323.2	0.0586	477.6	0.230	477.6	0.230	683.2	0.140	703.2	0.134	773.2	0.111
CURVE 110*													
813.2	0.0900	1513.2	0.0540	588.7	0.176	599.8	0.176	85.0	0.586	15.0	0.586	20.0	0.920
983.2	0.0711	CURVE 111				699.8	0.132	30.0	1.53	20.0	0.920	30.0	1.53
1133.2	0.0628	1343.2	0.0544*	898.8	0.0941	810.9	0.107	40.0	2.09	50.0	2.55	60.0	2.93
1253.2	0.0577	1443.2	0.0565*	CURVE 126*				80.0	3.37	843.2	0.134	923.2	0.130
1373.2	0.0544	1503.2	0.0544*	683.2	0.140	703.2	0.134	100.0	2.72	933.2	0.129	1028.2	0.126
1433.2	0.0536	1558.2	0.0439	783.2	0.109	793.2	0.113	200.0	1.11	1135.2	0.134	1223.2	0.126
1513.2	0.0515	1703.2	0.0586	883.2	0.100	883.2	0.100	300.0	0.293	1271.2	0.134	CURVE 135	
CURVE 111*													
848.2	0.0837	1773.2	0.0494	CURVE 127*				323.2	0.439	373.2	0.377	1183.2	0.090
973.2	0.0720	1823.2	0.0502	723.2	0.128	783.2	0.121	293.2	0.301	653.2	0.159*	1336.2	0.0303
1143.2	0.0623	1943.2	0.0665	803.2	0.117	803.2	0.117	673.2	0.130	793.2	0.124	1405.2	0.0425
1223.2	0.0586	1968.2	0.0753	823.2	0.111	843.2	0.107	1273.2	0.0628	943.2	0.105	1497.2	0.0402
1343.2	0.0552	2023.2	0.0690	CURVE 128*				413.2	0.340	443.2	0.310	1537.2	0.0540
1473.2	0.0544	2023.2	0.0561	1163.2	0.0753	1293.2	0.0669	473.2	0.285	513.2	0.226	1609.2	0.0485
CURVE 112*													
813.2	0.0887	533.2	0.184*	1573.2	0.0586	1643.2	0.0586	623.2	0.176	723.2	0.142	603.2	0.159*
948.2	0.0745	593.2	0.155*	CURVE 129*				863.2	0.117	998.2	0.109	708.2	0.126*
1073.2	0.0678	648.2	0.138*	1183.2	0.095	1253.2	0.0690	1118.2	0.100	1118.2	0.100	CURVE 136 (cont.)	
1093.2	0.0586	688.2	0.123*	1298.2	0.188	CURVE 137*				1203.2	0.100	953.2	0.079*
1403.2	0.0552	773.2	0.107*	CURVE 120*				1753.2	0.0596	1273.2	0.105	1183.2	0.067*
CURVE 113*													
833.2	0.0920	803.2	0.0581	1508.2	0.086	CURVE 121*				663.2	0.201	683.2	0.130
973.2	0.0774	848.2	0.0558	CURVE 122*				298.2	0.187	793.2	0.124	823.2	0.096
1093.2	0.0669	888.2	0.0544	298.2	0.188	CURVE 116				983.2	0.100	1238.2	0.0295
1198.2	0.0628	963.2	0.0586	1508.2	0.086	533.2	0.184*	593.2	0.155*	648.2	0.138*	688.2	0.123*
CURVE 114*													
413.2	0.00108	813.2	0.0937	1508.2	0.086	648.2	0.138*	688.2	0.123*	773.2	0.107*	868.2	0.097
613.2	0.00125	973.2	0.0774	1508.2	0.086	773.2	0.107*	868.2	0.097	963.2	0.088	1073.2	0.0586
803.2	0.00146	1083.2	0.0669	1508.2	0.086	868.2	0.097	963.2	0.088	1073.2	0.081	1173.2	0.077
1003.2	0.00173	1203.2	0.0619	1508.2	0.086	963.2	0.088	1073.2	0.081	1173.2	0.077	1253.2	0.0765
1198.2	0.00195*	1323.2	0.0586	1508.2	0.086	1073.2	0.081	1173.2	0.077	1253.2	0.0765	1313.2	0.077
CURVE 115													
813.2	0.0900	1513.2	0.0540	1508.2	0.086	1173.2	0.077	1253.2	0.0765	1313.2	0.077	1393.2	0.079
983.2	0.0711	1703.2	0.0586	1508.2	0.086	1253.2	0.0765	1313.2	0.077	1393.2	0.079	1443.2	0.082
1133.2	0.0628	1823.2	0.0502	1508.2	0.086	1313.2	0.077	1393.2	0.079	1443.2	0.082	1508.2	0.086
1253.2	0.0577	1943.2	0.0665	1508.2	0.086	1393.2	0.079	1443.2	0.082	1508.2	0.086	CURVE 138*	
1373.2	0.0544	1968.2	0.0753	1508.2	0.086	1443.2	0.082	1508.2	0.086	CURVE 139*			
1433.2	0.0536	2023.2	0.0690	1508.2	0.086	1508.2	0.086	CURVE 140*					
1513.2	0.0515	2023.2	0.0561	1508.2	0.086	CURVE 141*							
CURVE 116													
533.2	0.184*	593.2	0.155*	1508.2	0.086	CURVE 142							
648.2	0.138*	688.2	0.123*	1508.2	0.086	CURVE 143*							
773.2	0.107*	868.2	0.097	1508.2	0.086	CURVE 144							
963.2	0.088	1073.2	0.081	1508.2	0.086	CURVE 145*							
1073.2	0.081	1173.2	0.077	1508.2	0.086	CURVE 146							
1253.2	0.0765	1313.2	0.077	1508.2	0.086	CURVE 147							
1393.2	0.079	1443.2	0.082	1508.2	0.086	CURVE 148							
1508.2	0.086	CURVE 149*						353.2	0.00230	429.2	0.00253	553.2	0.00295

* Not shown on plot

DATA TABLE NO. 16 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 143 (cont.)</u>		<u>CURVE 152 (cont.)</u>		<u>CURVE 157</u>		<u>CURVE 158 (cont.)</u>		<u>CURVE 164*</u>		<u>CURVE 170 (cont.)</u>		<u>CURVE 176*</u>			
733.2	0.00358	1293.2	0.0577	373.2	0.252	849.8	0.00467	1000.9	0.00438	1628.2	0.00710	787.6	0.00337		
973.2	0.00405	1408.2	0.0548	473.2	0.202	852.1	0.00329	1075.4	0.00492	1697.6	0.00850	905.9	0.00362		
1113.2	0.00440	1493.2	0.0533	573.2	0.156	854.8	0.00450	1165.9	0.00595	<u>CURVE 171*</u>		1061.5	0.00403		
1377.2	0.00500	<u>CURVE 153*</u>		673.2	0.121	872.1	0.00291	1228.7	0.00742			1186.5	0.00429		
<u>CURVE 149</u>		833.2	0.0916	773.2	0.101	903.7	0.00438	<u>CURVE 165*</u>				1334.8	0.00402		
405.2	0.00230	873.2	0.0862	873.2	0.0862	961.5	0.00358			<u>CURVE 172*</u>		<u>CURVE 177*</u>			
513.2	0.00250	973.2	0.0766	973.2	0.0757	966.5	0.00441	922.6	0.00453	557.6	0.00227	682.6	0.00308	762.6	0.00332
593.2	0.00260	1093.2	0.0665	1073.2	0.0669	977.1	0.00455	1032.1	0.00452	682.6	0.00308	845.4	0.00362	829.8	0.00355
693.2	0.00270	1203.2	0.0628	1173.2	0.0611	978.2	0.00350	1144.8	0.00452	845.4	0.00362	932.6	0.00434	895.4	0.00363
793.2	0.00269	1333.2	0.0577	1273.2	0.0561	995.4	0.00469	<u>CURVE 166*</u>		932.6	0.00434	<u>CURVE 178*</u>		1020.9	0.00391
873.2	0.00280	1433.2	0.0561	<u>CURVE 158</u>		1063.7	0.00478			1022.6	0.00465	1124.8	0.00396	1533.7	0.00422
1033.2	0.00280	1498.2	0.0544	359.8	0.00196	1068.7	0.00457	<u>CURVE 167*</u>		478.7	0.00199	1533.7	0.00422		
1093.2	0.00290	<u>CURVE 154*</u>		378.7	0.00201	1099.3	0.00481	980.4	0.00453	535.4	0.00267	<u>CURVE 179*</u>			
1253.2	0.00290	813.2	0.0941	386.5	0.00151	1102.1	0.00419	1087.1	0.00452	598.7	0.00292	795.9	0.00374		
1328.2	0.00290	983.2	0.0778	409.8	0.00216	1139.3	0.00500	1197.6	0.00452	1022.6	0.00465	874.8	0.00362		
<u>CURVE 150*</u>		983.2	0.0778	417.1	0.00194	<u>CURVE 159*</u>				457.6	0.00222	874.8	0.00362		
813.2	0.0883	1083.2	0.0665	424.8	0.00145	699.8	0.00234	457.6	0.00222	563.2	0.00241	979.8	0.00377		
993.2	0.0703	1328.2	0.0586	437.6	0.00251	767.6	0.00324	563.2	0.00241	649.8	0.00277	1278.2	0.00414		
1143.2	0.0623	1343.2	0.0573	443.2	0.00232	<u>CURVE 160*</u>		649.8	0.00277	738.2	0.00315	1553.7	0.00427		
1283.2	0.0531	1423.2	0.0573	454.3	0.00199	837.6	0.00362	738.2	0.00315	<u>CURVE 168*</u>		1724.8	0.00460		
1368.2	0.0544	1498.2	0.0536	455.4	0.00254	1037.6	0.00476	<u>CURVE 169*</u>		1108.2	0.00415	<u>CURVE 180*</u>			
1433.2	0.0527	<u>CURVE 155*</u>		471.5	0.00228	<u>CURVE 161*</u>		765.4	0.00376	604.3	0.00313	944.8	0.00408		
1503.2	0.0515	422.2	0.169	488.2	0.00190	1037.6	0.00476	1015.4	0.00441	628.7	0.00251	1333.7	0.00426		
<u>CURVE 151*</u>		462.2	0.156	503.2	0.00232	<u>CURVE 162*</u>		1225.9	0.00469	1123.7	0.00460	1614.3	0.00466		
853.2	0.0828	454.2	0.155	505.4	0.00206	975.4	0.00424	1225.9	0.00469	1442.6	0.00479	<u>CURVE 181*</u>			
993.2	0.0715	651.2	0.109	525.9	0.00279*	1032.1	0.00511	1343.2	0.00481	1498.7	0.00519	751.5	0.00388		
1113.2	0.0619	789.2	0.092	529.8	0.00258*	1144.8	0.00559	1378.7	0.00505	604.3	0.00313	818.2	0.00353		
1223.2	0.0590	786.2	0.091	600.4	0.00256	1255.4	0.00668	<u>CURVE 170*</u>		728.7	0.00331	962.1	0.00379		
1443.2	0.0552	917.2	0.081	620.4	0.00273	<u>CURVE 163*</u>		909.8	0.00393	818.2	0.00353	1125.9	0.00400		
1473.2	0.0544	924.2	0.081	644.3	0.00284	820.9	0.00350	1123.7	0.00460	1039.8	0.00450	1352.6	0.00415		
<u>CURVE 152*</u>		945.2	0.078	671.5	0.00310	936.5	0.00350	1442.6	0.00479	1235.9	0.00509	1707.6	0.00448		
813.2	0.0879	938.2	0.079	677.6	0.00350	992.1	0.00514	1498.7	0.00519	1474.8	0.00538	<u>CURVE 170*</u>			
958.2	0.0736	<u>CURVE 156*</u>		698.7	0.00303	1064.3	0.00583	789.3	0.00339	<u>CURVE 171*</u>		<u>CURVE 175*</u>			
1083.2	0.0669	442.2	0.1610	698.7	0.00251	<u>CURVE 164*</u>		893.3	0.00389	604.3	0.00313	728.7	0.00331		
1213.2	0.0615	679.2	0.1049	709.8	0.00358	820.9	0.00350	1498.7	0.00519	818.2	0.00353	818.2	0.00353		
		1004.2	0.0748	764.8	0.00317	936.5	0.00436	<u>CURVE 165*</u>		909.8	0.00393	962.1	0.00379		
		1007.2	0.0735	764.8	0.00436	992.1	0.00427	820.9	0.00350	1123.7	0.00460	1125.9	0.00400		
		1225.2	0.0624	812.1	0.00427	992.1	0.00514	1039.8	0.00450	1442.6	0.00479	1254.3	0.00412		
				814.8	0.00350	1064.3	0.00583	1235.9	0.00509	1498.7	0.00519	<u>CURVE 176*</u>			
				814.8	0.00350	1064.3	0.00583	1474.8	0.00538	1498.7	0.00519	<u>CURVE 181*</u>			

* Not shown on plot

DATA TABLE NO. 16 (continued)

CURVE 182*			CURVE 185			CURVE 187 (cont.)			CURVE 190*			CURVE 194*			CURVE 197 (cont.)*			
T	k	Stress (Kg cm ⁻²)	T	k	Stress (Kg cm ⁻²)	T	k	Stress (Kg cm ⁻²)	T	k	Stress (Kg cm ⁻²)	T	k	Stress (Kg cm ⁻²)	T	k	Stress (Kg cm ⁻²)	
342.1	0.00149	0.0394	1.41	0.0394	3.70	0.115	333.0	0.00144	333.0	0.00144	0.684	240	0.684	0.0380	0.0380	0.0380	0.0380	
355.4	0.00151	0.0414	1.53	0.0414	3.85	0.143	363.9	0.00167	363.9	0.00167	1.97	327	1.97	0.0395	0.0395	0.0395	0.0395	
382.6	0.00152	0.0458	1.74	0.0458	4.06	0.209	402.5	0.00168	402.5	0.00168	5.31	432	5.31	1.14	1.14	1.14	1.14	
404.8	0.00156	0.0506	2.03	0.0506	4.27	0.240	445.7	0.00165	445.7	0.00165	67.6	617	67.6	2.28	2.28	2.28	2.28	
422.6	0.00163	0.0661	2.32	0.0661			506.9	0.00162	506.9	0.00162				5.01	5.01	5.01	5.01	
445.5	0.00173	0.0867	2.69	0.0867			526.0	0.00174	526.0	0.00174				8.47	8.47	8.47	8.47	
462.3	0.00178	0.113	3.03	0.113			575.4	0.00189	575.4	0.00189				12.9	12.9	12.9	12.9	
492.1	0.00187	0.125	3.16	0.125			627.3	0.00191	627.3	0.00191				18.4	18.4	18.4	18.4	
519.3	0.00199	0.200	3.56	0.200			666.6	0.00181	666.6	0.00181				209	209	209	209	
542.1	0.00211	0.250	3.83	0.250			733.1	0.00196	733.1	0.00196								
594.8	0.00222	0.273	4.06	0.273			832.3	0.00205	832.3	0.00205								
		0.294	4.47	0.294														
<u>CURVE 183</u>			<u>CURVE 186</u>			<u>CURVE 189</u>			<u>CURVE 191*</u>			<u>CURVE 195*</u>			<u>CURVE 198*</u>			
1.41	0.120	0.0551	1.45	0.0551	2.19	0.0807	2.35	0.0902	4.2	0.125 x 10 ⁻⁴	4.2	0.125 x 10 ⁻⁴	0.0733	0.944	0.0733	0.944	0.0733	0.944
1.60	0.178	0.0625	1.53	0.0625	2.55	0.0951	2.76	0.110					0.355	1.72	0.355	1.72	0.355	1.72
1.83	0.267	0.0695	1.63	0.0695	2.76	0.110	3.10	0.125					13.3	11.8	13.3	11.8	13.3	11.8
1.92	0.313	0.0828	1.74	0.0828	3.33	0.134	3.33	0.153					94.4	44.7	94.4	44.7	94.4	44.7
2.23	0.470	0.0975	1.87	0.0975	3.66	0.153	3.66	0.166										
2.48	0.596	0.111	2.05	0.111	3.81	0.166	3.81	0.177										
2.87	0.830	0.121	2.18	0.121	4.24	0.177	4.24	0.194										
3.04	0.998	0.134	2.32	0.134														
3.27	1.36	0.150	2.49	0.150														
3.88	2.53	0.169	2.76	0.169														
4.14	3.25	0.200	3.11	0.200														
4.29	3.72	0.234	3.37	0.234														
4.31	3.99	0.288	3.77	0.288														
		0.327	3.95	0.327														
		0.381	4.17	0.381														
<u>CURVE 184</u>			<u>CURVE 187</u>			<u>CURVE 193*</u>			<u>CURVE 196*</u>			<u>CURVE 199*</u>			<u>CURVE 200*</u>			
1.58	0.0551	0.0239	1.37	0.0239	2.10	0.0235	2.10	0.0235										
1.39	0.0598	0.0286	1.52	0.0286	2.21	0.0239	2.21	0.0254										
1.46	0.0738	0.0299	1.63	0.0299	2.39	0.0254	2.39	0.0277										
1.53	0.0802	0.0319	1.77	0.0319	2.58	0.0277	2.58	0.0308										
1.70	0.100	0.0372	1.91	0.0372	2.76	0.0308	2.76	0.0388										
1.97	0.133	0.0409	2.21	0.0409	3.15	0.0388	3.15	0.0449										
2.21	0.164	0.0431	2.49	0.0431	3.33	0.0449	3.33	0.0560										
2.57	0.208	0.0463	2.66	0.0463	3.64	0.0560	3.64	0.0598										
2.77	0.238	0.0501	2.96	0.0501	3.74	0.0598	3.74	0.0718										
3.11	0.290	0.0569	3.47	0.0569	4.02	0.0718	4.02	0.0834										
3.47	0.366	0.0636	3.72	0.0636														
3.72	0.419	0.0719	4.02	0.0719														
3.96	0.478	0.0836	4.31	0.0836														
4.32	0.524		4.37															

* Not shown on plot

DATA TABLE NO. 16 (continued)

T	k x 10 ⁴	T	k
<u>CURVE 202*</u>			
2.00	5.42	316.9	0.0548
2.57	5.60	354.3	0.0540
3.09	6.70	394.6	0.0515
3.76	6.55	421.1	0.0485
4.16	7.02		
<u>CURVE 203*</u>			
2.77	0.589	664	0.00303
3.58	1.06	750	0.00303
4.24	1.41	830	0.00317
4.75	2.25	1011	0.00375
		1208	0.00346

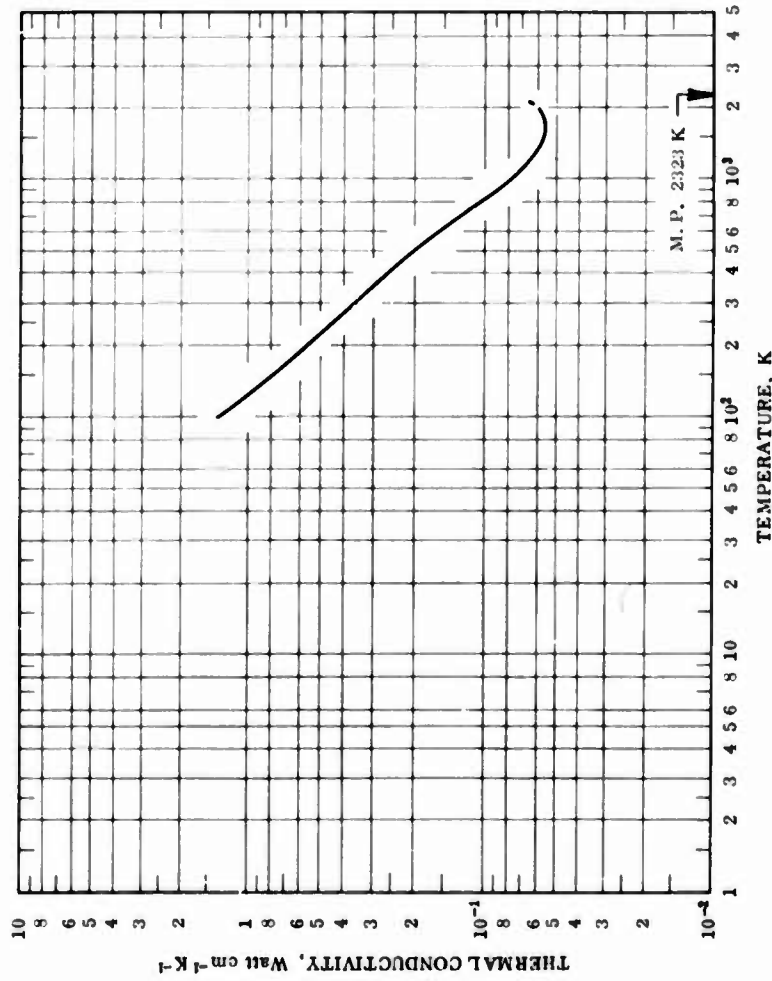
T	k
<u>CURVE 204*</u>	
1.88	0.592
2.48	1.17
2.81	2.00
3.02	2.48
3.26	2.98
3.54	3.96
3.67	3.96
3.89	5.22
3.96	5.83
4.31	6.03
4.37	6.49
4.61	7.76
4.80	11.6

T	k
<u>CURVE 205*</u>	
2.13	2.29
2.58	3.65
3.05	4.92
3.28	6.52
3.60	9.59
4.14	15.6

T	k
<u>CURVE 206*</u>	
317.7	0.183
331.0	0.177
383.1	0.149
412.1	0.141

* Not shown on plot

FIGURE AND TABLE NO. 16R RECOMMENDED THERMAL CONDUCTIVITY OF ALUMINUM OXIDE Al_2O_3



RECOMMENDED VALUES*
(For 99.5% pure, 98% dense, polycrystalline Al_2O_3)

T_1	k_1	k_2	T_2
0	0	0	-459.7
100	1.33	76.9	-279.7
150	0.77	44.5	-189.7
200	0.55	31.8	-99.7
250	0.434	25.1	9.7
273.2	0.397	22.9	32.0
300	0.360	20.8	80.3
350	0.307	17.7	170.3
400	0.264	15.3	260.3
500	0.202	11.7	440.3
600	0.158	9.13	620.3
700	0.126	7.28	800.3
800	0.104	6.01	980.3
900	0.089	5.14	1160
1000	0.0785	4.54	1340
1100	0.0710	4.10	1520
1200	0.0655	3.79	1700
1300	0.0613	3.54	1880
1400	0.0583	3.37	2060
1500	0.0566	3.27	2240
1600	0.0556	3.21	2420
1700	0.0554	3.20	2600
1800	0.0559	3.23	2780
1900	0.0574	3.32	2960
2000	0.0600	3.47	3140
2100	(0.0644)‡	(3.72)	3320

REMARKS

The recommended values are for 99.5% pure, 98% dense, polycrystalline Al_2O_3 . The recommended values are thought to be accurate to within 6% of the true values at temperatures from 500 to 1000 K and 6 to 10% at other temperatures.

* T_1 in K, k_1 in Watt $cm^{-1} K^{-1}$, T_2 in F, and k_2 in Btu $hr^{-1} ft^{-1} F^{-1}$.

‡ Values in parentheses are extrapolated.

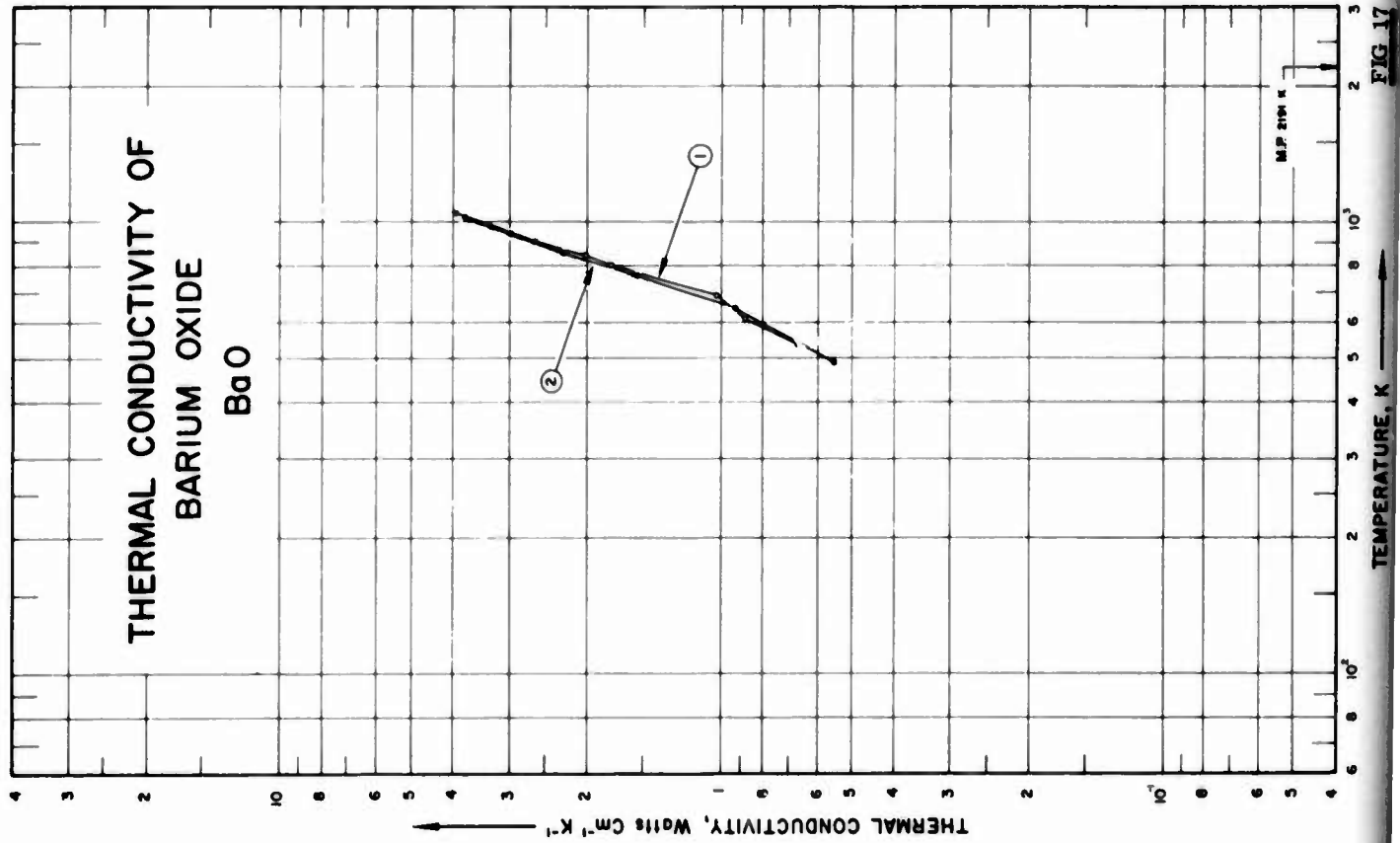


FIG 17

SPECIFICATION TABLE NO. 17 THERMAL CONDUCTIVITY OF BARIUM OXIDE BaO

[For Data Reported in Figure and Table No. 17]

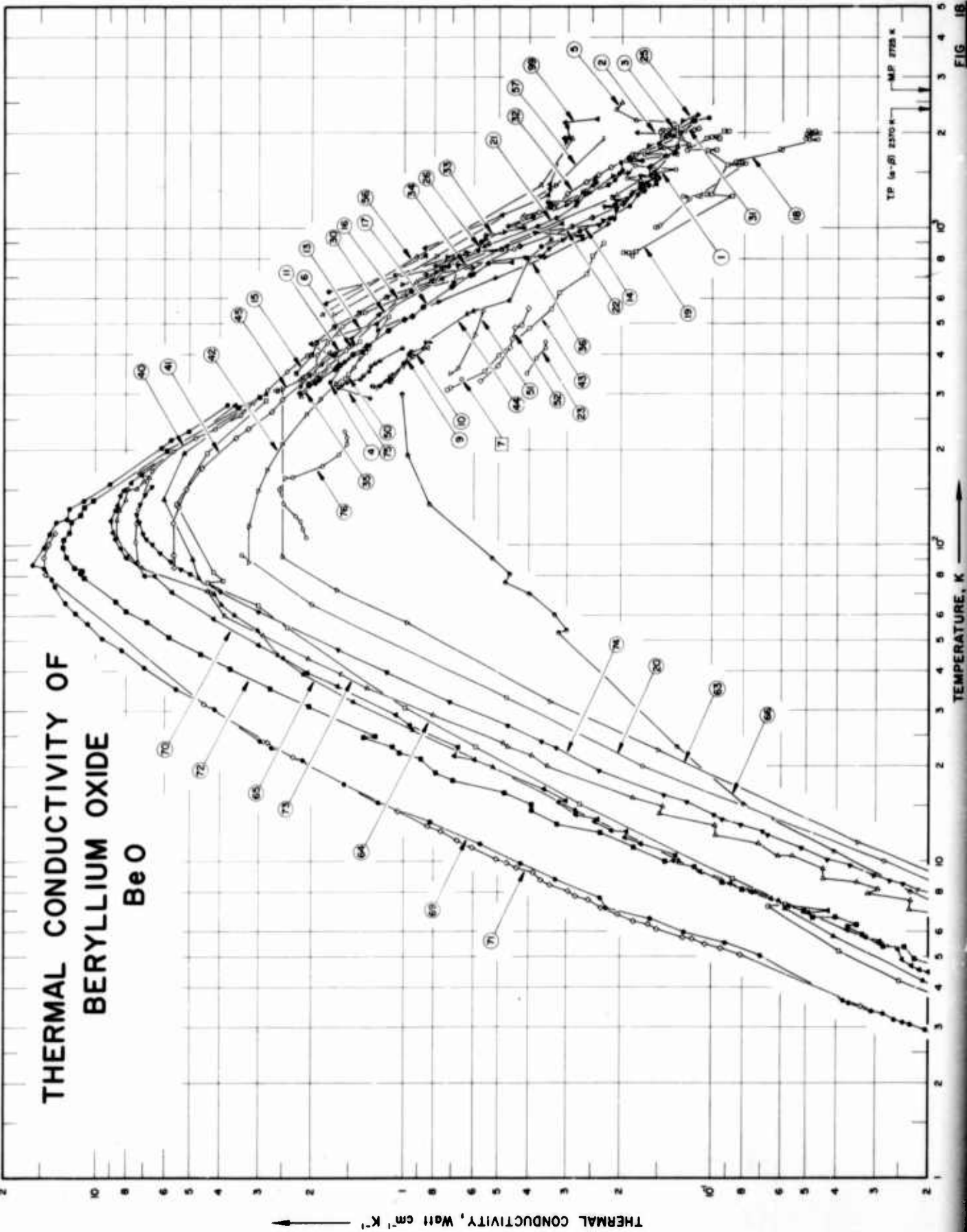
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	75	L	1955	538-1033	~ 10	Tube No. 3	Pure; polycrystalline; apparent thermal conductivity (effects due to radiation at high temperatures not considered).
2	75	L	1955	490-1033	~ 10	Tube No. 5	Pure; polycrystalline; apparent thermal conductivity.

DATA TABLE NO. 17 THERMAL CONDUCTIVITY OF BARIUM OXIDE BaO
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
538.2	0.67
613.2	0.87
690.2	1.03
803.2	1.77
843.2	2.03
908.2	2.65
990.2	3.35
1053.2	3.95
<u>CURVE 2</u>	
490.2	0.55
643.2	0.93
763.2	1.55
853.2	2.27
948.2	3.00
1033.2	3.77

FIGURE SHOWS ONLY 54 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE BeO



SPECIFICATION TABLE NO. 18 THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE BeO

[For Data Reported in Figure and Table No. 18]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	274, 130	R	1953	1303-2041		M-14	0.01 Fe ₂ O ₃ , 0.08 Al ₂ O ₃ , and 0.18 MgO; specimen in shape of a prolate spheroid; slip-cast, fired to zero apparent porosity at 1850 C and had a final total porosity of 5-10%.
2	274, 130	R	1953	1303-1998		M-13	Same material as the above; separate run.
3	274, 130	R	1953	1813-2073		M-15	Same material as the above; separate run.
4	141	L	1950	326-407		BeO porcelain	99.9 pure; supplied by Norton Co.; density (25 C) = 2.969 g cm ⁻³ ; water absorption 0.03%.
5	291	R	1964	1273-2493			Made from UOX-grade BeO powder by isostatically pressing at 7000 psi; the cold compacts crushed and screened through a 20-mesh sieve, cold pressed at about 6500 psi, and then isostatically pressed into a disc at 20,000 psi; sintered in dry hydrogen at 1700 C for approximately 6 hrs and then machined to the final configuration; 2.00 in. outside dia and 0.375 in. inside dia, data corrected to 100% theoretical density (original; 97.8% theoretical density).
6	12	C	1953	322-439		94A-1	Pure; hot-pressed; water absorption 0.03%; density 2.97 g cm ⁻³ .
7	3		1953	333.2			65% beryllia in unfired state; max. water absorption = 0.05%; flexural strength 34,000 psi; coefficient of expansion (25-700 C) = 8.4 x 10 ⁻⁴ .
8	3		1953	333.2			85% beryllia in unfired state; max. water absorption = 0.05%; flexural strength 34,500 psi; coefficient of expansion (25-700 C) = 8.2 x 10 ⁻⁴ .
9	9	C	1953	318-439		273A-1	4811 BeO porcelain supplied by Coors Co.; 0.09% water absorption 0.09%; density 2.90 g cm ⁻³ .
10	9	C	1953	315-420		273A-2	Similar to the above specimen.
11	9	C	1953	317-436		94A-3	Pure; hot pressed; water absorption 0.03; density 2.97 g cm ⁻³ .
12	13	C	1953	343.2	±3		Hot-pressed; density = 3.0 g cm ⁻³ ; Armco iron used as comparative material.
13	89	C	1952	370-780			Al ₂ O ₃ used as comparative material.
14	89	R	1952	873-1373			1 x 1 x 1 in.; supplied by Bernard Schwartz of MIT; slip-cast from suspensions of finely ground material; fired to zero apparent porosity; bulk density 2.86 g cm ⁻³ .
15	131	C	1954	348-853			Second run of the above specimen.
16	131	C	1954	348-853			Impurities (other than carbon) less than 0.2%; fabricated by Norton Co.; hot-pressed and fired at about 1700 C; dia 0.4524 in.; density 2.62 g cm ⁻³ .
17	138	L	1957	301-712	±5.4		

SPECIFICATION TABLE NO. 18 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
18	144	R	1963	1006-2009	5-7	1	Poorly bonded structure; specimen 0.75 in. long, 0.75 in. outside dia and 0.25 in. inside dia; supplied by Zirconium Corp. of America; pressed and sintered; density 3.0 g cm ⁻³ at 25 C; specimen broke during experiment.
19	144	R	1963	818-2018	5-7	2	Similar to the above specimen except specimen cracked during experiment.
20	158	L	1952	2.6-93	2		A rod with a square cross section of side 5 mm; sintered; density 2.94 g cm ⁻³ (97% of the single crystal value).
21	72		1955	710-1431			Prepared by K. A. P. L.; density 2.78 g cm ⁻³ .
22	72		1955	713-1431			Same as the above specimen.
23	407	L	1949	347-436		Commercial	No details reported.
24	220		1947	573-1173		3008-13-3	Extruded from refractory-grade BeO of minus 200 mesh and followed by burning 3 hrs at 3100 F; density 2.818 g cm ⁻³ .
25	218	R	1960	665-2290		ORNL-1	Brush SP grade of 0.27 metallic impurities; obtained from ORNL; specimen 3 in. long, 2 in. O. D. and 0.5 in. in I. D.; hot-pressed; average grain size 50 μ; density 2.89 g cm ⁻³ .
26	218	R	1960	630-2242		ORNL-2	Similar to the above specimen except density of 2.87 g cm ⁻³ .
27	218	R	1960	750-1669		NBC-1	"Pure beryles" of the Nation Beryllia Corp.; slip cast; density 2.72 g cm ⁻³ .
28	218	R	1960	970-2256		Al-1	0.07 metallic impurities; supplied by Atomics International; hot pressed at 1700 C and 4000 psi for 4 hrs; density 2.98 g cm ⁻³ ; average grain size 60 μ.
29	218	R	1960	1175-2293		Al-2	As above, separate run.
30	251	C	1963	450-1039	±4		99.5 BeO, 0.009 Si, 0.005 Al, 0.002 Mo, 0.001 Ca, 0.001 Cr, 0.001 Fe, 0.001 Na, 0.001 Ni, 0.0003 Mn, ≤0.0001 B, Cd, Li, and ≤0.0001 Co, Cu; specimen 2 in. dia by 1 in. thick; cold pressed; firing temperature 1855 K; density 2.87 g cm ⁻³ ; Armco iron used as comparative material.
31	251	P	1963	1250-2200			Similar to the above specimen; thermal conductivity calculated from the measured thermal diffusivity data, values of density and specific heat were obtained by independent measurements, reported as 2.79, 2.77, 2.74, 2.72, and 2.69 g cm ⁻³ and 2.00, 2.14, 2.27, 2.36, and 2.44 W g ⁻¹ K ⁻¹ , respectively, at 1249.8, 1505.4, 1794.3, 1994.3, and 2199.8 K.
32	275	P	1963	1073-2053		BD-98	97% of the theoretical density; manufactured by the Coors Porcelain Co.
33	218	R	1960	761-2131		Al-3	1.0 MgO; hot-pressed at 1700 C and 4000 psi for 4 hrs; specimen 3 in. long, 2 in. O. D. and 0.5 in. in I. D.; average grain size 60 μ; density 2.99 g cm ⁻³ .
34	316, 274	R	1951	673-1487	±5		99.6% pure; slip-cast in an acid suspension; density 2.85 g cm ⁻³ ; total porosity 10%; apparent porosity <1%.

SPECIFICATION TABLE NO. 18 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
35	296		1958	293-1273			A commercial beryllia powder was hydrostatically pressed at 10,000 psi then screened through a 40-mesh sieve; hydrostatically pressed again at 100,000 psi, and then presintered at 1255 K for 1 hr in a hydrogen atmosphere, after machining, then sintered at 1811 K for 1 hr in hydrogen; 93.5% of theoretical density.
36	292	C	1961	367-1478		No. 1	Specimen 0.5 x 0.5 x 0.875 in.; fabricated by dry pressing and isostatic compaction; sintered at 1894 K in H ₂ for 2 hrs and then heat treated at 2033 K in H ₂ for 1 hr; 96-97% of theoretical density; manufactured by Brush Beryllium Co. (Type UOX); sintered aluminum oxide used as reference.
37	292	C	1961	367-1478		No. 2	Same as the above specimen.
38	292	C	1961	367-1367			Average value of the above specimen No. 1 and No. 2 corrected to zero porosity.
39	276	R	1961	700-1700			99 BeO and 1 Al ₂ O ₃ ; ground cylinder 3.4 cm in dia and 11 cm long; prepared from isostatically pressed bodies using a wax emulsion as binder; calculated at 1740 C for 2 hrs; density (25 C) 2.89 g cm ⁻³ ; measured in a vacuum of 10 ⁻⁴ mm Hg.
40	290	L	1963	88-398	<3-4		98 BeO, 1 Al ₂ O ₃ , 0.5 MgO + CaO, and 0.5 SiO ₂ ; ground cylinder 3.4 ± 0.01 cm in dia and 11 cm long; prepared from isostatically pressed bodies using a wax emulsion as binder; calculated at 1730 C for 3 hrs; density 2.87 g cm ⁻³ ; measured in a vacuum of 10 ⁻⁴ mm Hg.
41	290	L	1963	85-408	<4		96 BeO, 1 Al ₂ O ₃ , 1.5 MgO + CaO, and 1.5 SiO ₂ ; ground cylinder 3.4 ± 0.01 cm in dia and 11 cm long; prepared from isostatically pressed bodies using a wax emulsion as a binder; calculated at 1690 C for 2 hrs; density 2.87 g cm ⁻³ ; measured in a vacuum of 10 ⁻⁴ mm Hg.
42	290	L	1963	88-418	<4		99 [*] BeO, main impurity being Al ₂ O ₃ ; 10.84 x 0.883 x 0.801 cm; cut from the center of a "triangle" beryllia disc, type Y. 1029; fired at 1750 C; baked to about 800 C (to drive off moisture introduced during cutting) before measurement; mean density 1.85 g cm ⁻³ ; Armco iron used as comparative material.
43	297	C	1954	308-898		"Triangle" Beryllia; 1	99 [*] BeO, main impurity being Al ₂ O ₃ ; 11.41 x 1.006 x 1.002 cm; cut from the center of a "triangle" beryllia disc, type Y. 1033; fired at 1750 C; baked to about 800 C; mean density 2.3 g cm ⁻³ ; Armco iron used as comparative material.
44	297	C	1954	318-913		"Triangle" Beryllia; 2	A rod of hot-molded beryllia; length 9.94 cm, dia 1.00 cm; mean density 2.82 g cm ⁻³ ; Armco iron used as comparative material.
45	297	C	1954	313-778		Hot-molded beryllia; 3	The heavier portion of specimen No. 4 of hot-molded beryllia; 1.00 cm dia x 9.56 cm long; mean density 2.80 g cm ⁻³ ; Armco iron used as comparative material.
46	297	C	1954	318-748		Hot-molded beryllia; 4a	The lighter portion of specimen No. 4 of hot-molded beryllia; 1.00 cm dia x 9.95 cm long; mean density 2.72 g cm ⁻³ ; Armco iron used as comparative material.
47	297	C	1954	358-748		Hot-molded beryllia; 4b	

SPECIFICATION TABLE NO. 18 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
48	297	C	1954	303-628		Norton's beryllia; 5	Norton's BeO, shipment B1866, Clifton M ^{al} grade; hot-molded; specimen as a strip 0.5 cm wide cut from the center of a disc; density 3.0 g cm ⁻³ ; Armco iron used as comparative material.
49	319	C	1962	339-568		AOX-BeO(329)	AOX-grade BeO; cylinder 1 in. long by 0.238 in. dia; about 97.5% theoretical density; grain size 20 microns; high density graphite (AGOT) used as comparative material.
50	319	C	1962	335-525		AOX-BeO(329)	Similar to the above specimen but irradiated by 8.6×10^{18} neutrons cm ⁻² .
51	319	C	1962	348-548		AOX-BeO(329)	Similar to the above specimen but irradiated by 2.0×10^{20} neutrons cm ⁻² .
52	319	C	1962	328-560		AOX-BeO(329)	Similar to the above specimen but irradiated by 3.7×10^{20} neutrons cm ⁻² .
53	320	R	1962	1118-1773		Sample 23	Wafer ~2 in. outside dia, 0.375 inside dia, and 0.5 to 2 in. thick; density ~0.9 g cm ⁻³ ; pore size 0.010 to 0.025 cm; sintered in air at 1565 C for 1.5 hrs.
54	320	R	1962	1133-1833		Sample 23	The above specimen (after the above measurement) sintered in hydrogen for 1.5 hrs at 1590 C to eliminate contained phosphates; density 0.75 g cm ⁻³ ; pore size 0.01 to 0.025 cm.
55	320	R	1962	1118-1798		Sample 25	Same dimensions as the above specimen; density ~1.0 g cm ⁻³ ; pore size from 0.01 to 0.02 cm, and sintered at 1566 C for 1.5 hrs.
56	331	R	1963	533-1922			99 pure; specimen of 1 in. in dia and 1 in. long, hot pressed in graphite dies; 98% theoretical density.
57	331	R	1963	533-1922			98 pure; specimen of 1 in. in dia and 1 in. long, cold pressed and fired; 96% of theoretical density.
58	307	R	1954	663-1473	±5		Hollow prolate spheroidal specimen with outer and inner surface confocal, inner minor axis about 2 cm, inner major axis about 10 cm, outer minor axis 4 cm, outer major axis long enough to make both surfaces confocal; specimen prepared by slip casting from suspension of finely ground material fired to a porosity of 9.7%; bulk density 2.7 g cm ⁻³ .
59	356		1942	323-658	5-10		Powder.
60	376	C	1959	361-759			Specimen about 1 cm ³ in section and 10 cm in length; density 2.60 g cm ⁻³ ; Armco iron as reference material.
61	376	C	1959	368-431			Specimen about 1 cm ³ in section and 10 cm in length; density 2.72 g cm ⁻³ ; irradiated at 5×10^{18} neutrons cm ⁻² at 458 K; Armco iron as reference material.
62	376	C	1959	401-803			The above specimen; 2nd run.
63	377	L	1964	4.8-310	<±2	2.24 No. 2175	Impurities: 0.0800 C, 0.0250 Fe, 0.0050 Al, 0.0050 Ca, 0.0040 Si, and 0.0100 Cu + Ni + Cr + Mg + Na; polycrystalline; 0.77 cm dia x 5 cm long; supplied by Dr. K.D. Reeve; grain size not uniform, about 1 μ to 10 μ; cold-pressed and sintered from "UOX" powder supplied by Brush Beryllium Corp. at 1723 K for 1 to 1.5 hrs; 98% theoretical density.

SPECIFICATION TABLE NO. 18 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
64	377	L	1964	2.2-285	< ±2	12 μ No. 2176	Similar to the above specimen except the grain size was 12 μ
65	377	L	1964	2.25-300	< ±2	35 μ No. 2189	Similar to the above specimen except the grain size was 25 μ to 45 μ and was sintered at 2023 K.
66	377	L	1964	3.0-300	±2	35 μ No. 2189	Similar to the above specimen except irradiated at 1×10^{18} neutrons cm ⁻² at 75 C.
67	378	L	1962	673-1173	±4	1A	BeO grade I; cylindrical specimen 1.625 in. dia, 1 in. long; bulk density 2.95 g cm ⁻³ ; 98% theoretical density; smoothed data without correction to zero porosity.
68	378	L	1962	673-1173	±4	2A	BeO grade II; cylindrical specimen 1.625 in. dia, 1 in. long; bulk density 2.823 g cm ⁻³ ; 94% theoretical density; smoothed data without correction to zero porosity.
69	409		1965	1.4-277		Type I	Prepared by sintering under pressure; density 2.98 g cm ⁻³ .
70	409		1965	2.1-277		Type I	The above specimen irradiated by a dose of $10^{18} \sim 2 \times 10^{18}$ n > 1 MeV/cm ² ; identical results obtained with a dose of 3×10^{16} roentgens.
71	409		1965	1.6-110		Type I	The above specimen annealed at 500 C for 10 hrs.
72	409		1965	1.6-292		Type II	Prepared by sintering with the addition of 0.6 CaO; density 2.77 g cm ⁻³ ; no measurable change on irradiation.
73	409		1965	1.4-281		Type III	Prepared by sintering under pressure; density 2.75 g cm ⁻³ .
74	409		1965	1.8-284		Type III	The above specimen irradiated by a dose of 10^{18} to 2×10^{18} n > 1 MeV/cm ² .
75	278	L	1963	291-415	±10		96 BeO; extruded rod; fired to 1680 C; density 2.80 g cm ⁻³ ; using water-ice as coolant.
76	278	L	1963	107-228	±10		Similar to the above specimen except used liquid nitrogen as coolant.
77	278	L	1963	231-368	±10		Similar to the above specimen except used solid CO ₂ as coolant.
78	410	P	1966	573-1273		UOX grade	0.5 MgO impurities; unirradiated specimen with grain size 4 microns; density 2.92 g cm ⁻³ ; open porosity 0.1%; thermal conductivity data calculated from the measurements of density, thermal diffusivity and specific heat (specific heat data obtained from High Temp. Materials programs, Part A, "GE-NMPO, GEMP-400A, 1966).
79	410	P	1966	573-1273		UOX grade	Similar to the above specimen except grain size 5 microns; density 2.905 g cm ⁻³ ; open porosity 0.4%; extruded to about 5% in c-axis orientation.
80	410	P	1966	573-1273		UOX grade	Similar to the above specimen except grain size 20 microns; density 2.930 g cm ⁻³ ; extruded to about 50% in c-axis orientation; no porosity value was given.
81	410	P	1966	573-1273		UOX grade	0.5 MgO impurities; unirradiated specimen with grain size 64 microns; density 2.917 g cm ⁻³ ; open porosity 0.2%; thermal conductivity data calculated from the measurements of density, thermal diffusivity and specific heat (specific heat data obtained from High Temp. Materials programs, Part A, "GE-NMPO, GEMP-400A, 1966).

SPECIFICATION TABLE NO. 18 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
82	410	P	1966	873-1273		AOX grade	Unirradiated specimen with grain size 8 microns; density 2.904 g cm ⁻³ ; open porosity 0.4%; see above curve for method of calculation of thermal conductivity.
83	410	P	1966	573-1273		AOX grade	Similar to the above specimen except grain size 17 microns; density 2.866 g cm ⁻³ ; open porosity 0.1%.
84	410	P	1966	573-1273		AOX grade	Similar to the above specimen except grain size 46 microns; density 2.938 g cm ⁻³ ; open porosity 0.2%.
85	410	P	1966	573-1273		AOX grade	Similar to the above specimen except grain size 76 microns; density 2.950 g cm ⁻³ ; open porosity 0.1%.
86	410	P	1966	573-1273		UOX grade	0.5 MgO impurities; similar to the above specimen except grain size 6 microns; density 2.609 g cm ⁻³ ; open porosity 0.3%.
87	410	P	1966	573-1273		UOX grade	Similar to the above specimen except grain size 4 microns; density 2.453 g cm ⁻³ ; open porosity 17.9%.
88	410	P	1966	573-1273		UOX grade	Similar to the above specimen except grain size 5 microns; density 2.772 g cm ⁻³ ; open porosity 0.1%; extruded to about 9% in c-axis orientation.
89	410	P	1966	582-971		UOX grade	0.5 MgO impurities; irradiated specimen with grain size 5 microns; bulk density 2.89 g cm ⁻³ ; irradiated at 300 C to 2.1 x 10 ¹⁶ nvt (E _n > 1 Mev); thermal conductivity data calculated from the measurements of density, thermal diffusivity and specific heat (specific heat data obtained from High Temp. Materials Programs, Part A, "GE-NMPO, GEMP-400A, 1966).
90	410	P	1966	1066-1272		UOX grade	The above specimen remained at 793 C for approx. 20 hrs.
91	410	P	1966	569-1270		UOX grade	The above specimen annealed at 997 C for 65 hrs.
92	410	P	1966	570-1263		UOX grade	0.5 MgO impurities; irradiated specimen with grain size 4 microns; bulk density 2.90 g cm ⁻³ ; irradiated at 600 C to 3.1 x 10 ¹⁶ nvt (E _n > 1 Mev); thermal conductivity data calculated as the above specimen.
93	410	P	1966	571-1268		UOX grade	The above specimen annealed at 995 C for 17 hrs; measured with decreasing temp.
94	410	P	1966	576-1281		UOX grade	0.5 MgO impurities; irradiated specimen with grain size 5 microns; bulk density 2.89 g cm ⁻³ ; irradiated at 500 C to 10 x 10 ¹⁶ nvt (E _n > 1 Mev); thermal conductivity data calculated as the above specimen.
95	410	P	1966	574-1278		UOX grade	The above specimen annealed at 1005 C for 16 hrs; measured with decreasing temp.
96	411		1960	373-1273	< ±5		0.495 in. dia x 2 in. long; density 94% of theoretical value; data obtained from smoothed curve.
97	412	R	1963	558-565		Specimen 1	> 99.3 commercial high purity BeO; not pressed; density 2.79 g cm ⁻³ (> 98% of theoretical value); first run.

SPECIFICATION TABLE NO. 18 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
98	412	R	1963	575-2412		Specimen 1	Second run of the above specimen.
99	412	R	1963	576-2222		Specimen 2	Similar to the above specimen.
100	412	R	1963	512-2269		Specimen 1	Commercial high purity BeO; hot pressed; density 2.98 g cm^{-3} ($\sim 95\%$ of theoretical value).
101	412	R	1963	533-2227		Specimen 2	Similar to the above specimen.
102	412	R	1963	517-2110		Specimen 1	Commercial high purity BeO; cold pressed; density 2.9 g cm^{-3} (96-97% of theoretical value).
103	412	R	1963	546-2397		Specimen 2	Similar to the above specimen.
104	412	R	1963	563-2163		Specimen 1	Commercial high purity BeO; cold pressed; density 92-94% of theoretical value.
105	412	R	1963	539-2293		Specimen 2	Similar to the above specimen.

DATA TABLE NO. 18 THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE BeO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>													
1303.2	0.1726	1273.2	0.180*	392.4	0.941	748.2	0.766	1005.9	0.153	2015.9	0.0917*	873.2	0.28
1415.2	0.1736	1313.2	0.170*	419.6	0.945	833.2	0.636	1009.3	0.156	2017.6	0.0932*	1023.2	0.22
1438.2	0.1925	1343.2	0.200*	<u>CURVE 11</u>		853.2	0.490	1022.6	0.151	<u>CURVE 20</u>		1173.2	0.19
1532.2	0.1328	1443.2	0.150*	317.3	2.19	<u>CURVE 16</u>		1247.1	0.120	2.6	0.00095*	<u>CURVE 25</u>	
1573.2	0.1803	1443.2	0.210*	348.2	1.996	348.2	1.996	1255.4	0.126	4.5	0.0040*	665	1.020
1633.2	0.1946	1653.2	0.190*	398.2	2.05	398.2	1.925	1255.4	0.111	10.0	0.028	721	0.789
1703.2	0.1318	1763.2	0.170*	401.6	1.68	435.2	1.787	1607.6	0.112	20.0	0.17	810	0.729
1708.2	0.1690	1823.2	0.135*	436.1	1.47	488.2	1.577	1610.4	0.0822	33.0	0.47	922	0.557
1793.2	0.1464	1973.2	0.130*	<u>CURVE 12*</u>		540.2	1.326	1612.1	0.0837	65.0	2.0	971	0.481
1833.2	0.1203	2043.2	0.130*	343.2	1.82	608.2	1.046	1762.1	0.0600	93.0	3.4	1180	0.303
1913.2	0.1276	2173.2	0.140*	<u>CURVE 13</u>		633.2	0.929*	1785.4	0.0613	<u>CURVE 21</u>		1300	0.258
1963.2	0.1402	2193.2	0.180	370.2	1.62	748.2	0.803	1786.5	0.0617*	710.2	1.071	1470	0.216
2020.7	0.1245	2363.2	0.210	398.2	1.71	833.2	0.594	1909.8	0.0466	742.2	0.770*	1493	0.181
2040.7	0.1402	2493.2	0.200	433.2	2.02	853.2	0.448	1912.6	0.0493	785.2	0.556	1695	0.177*
<u>CURVE 2</u>													
1303.2	0.1695	321.7	2.06	498.2	1.23	<u>CURVE 17</u>		1920.9	0.0508	1016.2	0.377	1823	0.162
1373.2	0.1548	345.6	1.88	531.4	2.19	301.4	2.19	1995.9	0.0462	1087.2	0.328	1950	0.136*
1463.2	0.1621	368.6	1.76	319.4	2.04	319.4	2.04	2001.5	0.0475	1180.2	0.281	2008	0.131*
1553.2	0.1642	388.3	1.66	325.8	1.94	325.8	1.94	2009.3	0.0496	1283.2	0.267	2075	0.130*
1563.7	0.1611	410.0	1.54	332.9	1.879	332.9	1.879	<u>CURVE 19</u>		1431.2	0.246	2160	0.127
1688.2	0.1443	439.4	1.39	359.4	1.674	359.4	1.674	817.6	0.185	1431.2	0.246	2290	0.112
1743.2	0.1333	780.2	0.456	360.1	1.668*	360.1	1.668*	832.1	0.188	<u>CURVE 22</u>		<u>CURVE 26</u>	
1847.2	0.1506	<u>CURVE 7</u>		360.5	1.672*	360.5	1.672*	834.3	0.198	713.2	0.858	630	1.722
1947.2	0.1448	333.2	0.658	367.6	1.647	367.6	1.647	842.6	0.179	743.2	0.615	756	0.721
1973.2	0.1391	<u>CURVE 14</u>		397.0	1.454	397.0	1.454	846.2	0.162*	871.2	0.435	850	0.583
1998.2	0.1778	873.2	0.368	1073.2	0.220	1073.2	0.220	853.2	0.159*	1015.2	0.292	905	0.571
<u>CURVE 3</u>													
1813.2	0.1496	973.2	0.274	1173.2	0.188	1173.2	0.188	873.2	0.185	1080	0.391	1080	0.391
1998.2	0.1496	1073.2	0.274	1273.2	0.176	1273.2	0.176	873.2	0.185	1183.2	0.199	1182	0.343
2030.7	0.1475	1373.2	0.172	1373.2	0.172	1373.2	0.172	873.2	0.185	1290.2	0.177*	1270	0.261*
2073.2	0.1318	<u>CURVE 8*</u>		317.7	1.20	317.7	1.20	873.2	0.185	1431.2	0.151	1405	0.223
<u>CURVE 4</u>													
326.2	1.745	334.0	1.12	334.0	1.12	334.0	1.12	873.2	0.185	1490	0.212	1490	0.212
378.2	1.561	373.0	1.01	399.4	0.967	399.4	0.967	873.2	0.185	1591.5	0.0803*	1503	0.205
407.2	1.372	439.4	0.824	439.4	0.824	439.4	0.824	873.2	0.185	1591.5	0.0909*	1503	0.200
<u>CURVE 5</u>													
326.2	1.745	348.2	2.251	348.2	2.251	348.2	2.251	873.2	0.185	347.2	0.409	1610	0.202
378.2	1.561	398.2	2.017	398.2	2.017	398.2	2.017	873.2	0.185	387.9	0.350	1631	0.171
407.2	1.372	435.2	1.946	435.2	1.946	435.2	1.946	873.2	0.185	419.8	0.357	1648	0.190
<u>CURVE 6</u>													
314.5	1.23	488.2	1.695	488.2	1.695	488.2	1.695	873.2	0.185	435.9	0.357	2046	0.132*
342.6	1.11	540.2	1.406	540.2	1.406	540.2	1.406	873.2	0.185	2060	0.130*	2060	0.130*
366.6	1.02	608.2	1.138	608.2	1.138	608.2	1.138	873.2	0.185	2144	0.116	2144	0.116
<u>CURVE 7</u>													
573.2	0.42	633.2	0.967*	633.2	0.967*	633.2	0.967*	873.2	0.185	723.2	0.35	723.2	0.35
698.2	0.824	698.2	0.824	698.2	0.824	698.2	0.824	873.2	0.185	2005.9	0.0932	2005.9	0.0932

* Not shown on plot

DATA TABLE NO. 18 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k		
<u>CURVE 27*</u>															
750	0.669	1610	0.207	761	0.797	942.2	0.270	366.5	1.71	218.2	4.91	813.2	0.25		
851	0.540	1755	0.176	890	0.540	968.2	0.387	477.6	1.19	233.2	4.18	898.2	0.23		
952	0.451	1780	0.184	949	0.551	1024.7	0.238	588.7	0.767	258.2	3.45	<u>CURVE 44</u>			
989	0.384	1920	0.159	1006	0.419	1063.2	0.232	699.8	0.485	308.2	2.82	318.2	1.27		
1156	0.317	1920	0.167	1010	0.470	1071.2	0.213	810.9	0.339	353.2	2.41	328.2	1.11		
1229	0.251	1985	0.158	1162	0.346*	1140.2	0.209	922.1	0.265	398.2	2.09	338.2	1.10*		
1365	0.237	2065	0.149	1168	0.321*	1169.2	0.209	1033.2	0.218	<u>CURVE 41</u>					
1516	0.211	2134	0.148	1181	0.342	1170.2	0.229	1144.3	0.192	85.2	5.54	418.2	0.87		
1530	0.190	2242	0.151	1210	0.352	1177.2	0.211	1255.4	0.177	93.2	5.65	408.2	0.95		
1636	0.176	2293	0.156	1217	0.281	1210.2	0.197	1366.5	0.171	119.2	5.65	538.2	0.63		
1669	0.171	2293	0.156	1301	0.268	1230.2	0.210	1477.6	0.168	133.2	5.44	548.2	0.60		
<u>CURVE 30</u>															
449.8 1.48 1383 0.243 1281.2 0.186 1300.2 0.184 366.5 1.78															
533.2 1.21 1393 0.254* 1300.2 0.186 1300.2 0.184 477.6 1.24															
694.3 0.762 1440 0.242* 1333.2 0.174 1333.2 0.174 588.7 0.807															
877.6 0.476 1501 0.203* 1362.2 0.163 1362.2 0.163 699.8 0.518															
1038.7 0.315 1501 0.203* 1368.2 0.174 1368.2 0.174 810.9 0.360															
1219 0.344 1549 0.213* 1389.2 0.165 1389.2 0.165 922.1 0.277															
1371 0.250 1550 0.194* 1425.2 0.175* 1425.2 0.175* 1033.2 0.228															
1410 0.236 1564 0.190* 1440.2 0.155 1440.2 0.155 1144.3 0.204															
1430 0.239 1605 0.202* 1455.2 0.174 1455.2 0.174 1255.4 0.190															
1470 0.242 1605 0.202* 1463.2 0.155 1463.2 0.155 1366.5 0.185															
1557 0.199 1742 0.176* 1487.2 0.155* 1487.2 0.155* 699.8 0.709															
1559 0.204 1770 0.185* 1770 0.185* 1770 0.185* 810.9 0.554															
1575 0.202 1775 0.181* 1775 0.181* 1775 0.181* 922.1 0.450															
1587 0.196 1779 0.176* 1779 0.176* 1779 0.176* 1033.2 0.363															
1739 0.162 1880 0.169* 1880 0.169* 1880 0.169* 1144.3 0.312															
1745 0.171 1920 0.168* 1920 0.168* 1920 0.168* 1255.4 0.225															
1833 0.176 1930 0.174* 1930 0.174* 1930 0.174* 1477.6 0.208															
1882 0.158 1943 0.173* 1943 0.173* 1943 0.173* 1588.7 0.173															
1921 0.153 1979 0.172* 1979 0.172* 1979 0.172* 1699.8 0.173															
1938 0.160 2000 0.173* 2000 0.173* 2000 0.173* 1033.2 0.268															
2070 0.144 2050 0.171* 2050 0.171* 2050 0.171* 1033.2 0.268															
2120 0.142 2080 0.201* 2080 0.201* 2080 0.201* 88.2 3.24															
2195 0.154 2116 0.184* 2116 0.184* 2116 0.184* 115.2 3.24															
2256 0.160 2131 0.184* 2131 0.184* 2131 0.184* 148.2 3.03															
<u>CURVE 29*</u>															
1175	0.337	1698.2	0.180	1698.2	0.180	293.2	2.176	699.8	0.709	208.2	2.51	318.2	2.22		
1369	0.249	1843.2	0.158*	1843.2	0.158*	673.2	0.920	810.9	0.554	173.2	2.82	323.2	2.17		
1442	0.260	1953.2	0.131*	1953.2	0.131*	1273.2	0.209	922.1	0.450	258.2	2.09	338.2	2.05		
1490	0.216	1953.2	0.127*	1953.2	0.127*	<u>CURVE 36</u>		1033.2	0.363	288.2	1.88	403.2	1.65		
1522	0.207	2033.2	0.116	2033.2	0.116	366.5	1.71*	1144.3	0.312	323.2	1.67	458.2	1.36		
1600	0.209	2053.2	0.113	2053.2	0.113	477.6	1.21	1255.4	0.260	363.2	1.46	543.2	1.09		
815.2 0.413 1477.6 0.177* 588.7 0.788 699.8 0.511 810.9 0.357 922.1 0.268 308.2 0.73															
860.2 0.347 916.2 0.313 1033.2 0.222 922.1 0.268 1033.2 0.222 313.2 0.71															
1144.3 0.201* 1144.3 0.201* 1144.3 0.201* 88.2 7.32 323.2 0.64*															
1953.2 0.131* 1953.2 0.131* 1953.2 0.131* 103.2 7.45 353.2 0.58															
2033.2 0.116 2033.2 0.116 2033.2 0.116 118.2 7.41 398.2 0.50															
2053.2 0.113 2053.2 0.113 2053.2 0.113 133.2 7.32 483.2 0.40															
2053.2 0.113 2053.2 0.113 2053.2 0.113 173.2 6.59 553.2 0.34															
2053.2 0.113 2053.2 0.113 2053.2 0.113 198.2 5.65 628.2 0.32															
2053.2 0.113 2053.2 0.113 2053.2 0.113 718.2 0.26 748.2 0.70															
<u>CURVE 47*</u>															
358.2	1.76	408.2	1.51	493.2	1.19									358.2	1.76
408.2	1.51	493.2	1.19									408.2	1.51	493.2	1.19

* Not shown on plot

DATA TABLE NO. 18 (continued)

T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 47 (cont.)*</u>		<u>CURVE 52 (cont.)</u>		<u>CURVE 58*</u>		<u>CURVE 60 (cont.)*</u>		<u>CURVE 63</u>		<u>CURVE 65 (cont.)</u>	
633.2	0.85	494.2	0.426	663.2	0.703	436.2	1.33	4.8	0.0032*	26.0	0.940
748.2	0.66	560.2	0.402	703.2	0.685	488.2	1.15	7.2	0.0105*	32.0	1.45
<u>CURVE 48*</u>		<u>CURVE 53*</u>		<u>CURVE 59*</u>		<u>CURVE 61*</u>		<u>CURVE 64</u>		<u>CURVE 66</u>	
303.2	2.26	1118.2	0.0092	1153.2	0.234	1153.2	0.577	2.2	0.00500*	3.0	0.00240*
343.2	2.05	1343.2	0.0100	1193.2	0.201	1193.2	0.201	3.5	0.0154*	3.5	0.00353*
383.2	1.81	1443.2	0.0105	1213.2	0.210	1213.2	0.210	4.2	0.0250	4.2	0.0117*
408.2	1.78	1558.2	0.0109	1231.2	0.199	1231.2	0.199	5.2	0.0392	5.2	0.0141*
443.2	1.55	1663.2	0.0134	1263.2	0.188	1263.2	0.188	7.3	0.0580	7.3	0.0148*
538.2	1.20	1738.2	0.0184	1281.2	0.190	1281.2	0.190	7.2	0.0660	4.25	0.00490*
628.2	0.98	1773.2	0.0192	1313.2	0.176	1313.2	0.176	8.8	0.0960	4.8	0.00730*
<u>CURVE 49*</u>		<u>CURVE 54*</u>		<u>CURVE 62</u>		<u>CURVE 65</u>		<u>CURVE 67*</u>		<u>CURVE 69</u>	
339.7	1.799	1133.2	0.0130	1349.2	0.167	1349.2	0.167	2.8	0.00890*	2.01	0.00719*
360.7	1.707	1363.2	0.0138	1353.2	0.178	1353.2	0.178	3.5	0.0154*	2.32	0.0110*
415.7	1.485	1473.2	0.0138	1373.2	0.167	1373.2	0.167	4.2	0.0250	2.39	0.0117*
425.7	1.414	1578.2	0.0147	1405.2	0.163	1405.2	0.163	5.2	0.0392	2.51	0.0141*
470.2	1.356	1683.2	0.0147	1443.2	0.163	1443.2	0.163	7.3	0.0580	2.58	0.0148*
482.2	1.309	1833.2	0.0173	1473.2	0.163	1473.2	0.163	7.2	0.0660	2.72	0.0173*
537.2	1.213			1501.2	0.178	1501.2	0.178	8.8	0.0960	2.83	0.0190*
568.2	1.171			1533.2	0.167	1533.2	0.167	15.2	0.271	2.95	0.0205
<u>CURVE 50</u>		<u>CURVE 55*</u>		<u>CURVE 63</u>		<u>CURVE 66</u>		<u>CURVE 68</u>		<u>CURVE 70</u>	
334.7	1.552	1118.2	0.00556	401.2	1.50	401.2	1.50	30.6	0.990	10.7	0.0409
345.7	1.523	1348.2	0.00736	418.2	1.41	418.2	1.41	30.6	0.990	15.2	0.0800
405.7	1.339	1453.2	0.00757	431.2	0.661	431.2	0.661	54.7	2.40	23.1	0.0260
420.7	1.318	1563.2	0.00908	441.2	1.37	441.2	1.37	64.5	3.01	53.0	0.300
525.2	1.125	1673.2	0.00996	483.2	1.45	483.2	1.45	76.0	4.40	54.5	0.320
<u>CURVE 51</u>		<u>CURVE 56</u>		<u>CURVE 64</u>		<u>CURVE 67</u>		<u>CURVE 70</u>		<u>CURVE 72</u>	
348.2	0.711	533	1.86	401.2	1.48	401.2	1.48	77.0	3.98	82.0	4.20
460.2	0.598	811	0.92	405.2	1.48	405.2	1.48	82.0	4.20	70.2	0.399
548.2	0.565	1366	0.37	411.2	1.38	411.2	1.38	135	5.46	76.5	0.475
<u>CURVE 52</u>		<u>CURVE 57</u>		<u>CURVE 65</u>		<u>CURVE 68</u>		<u>CURVE 71</u>		<u>CURVE 73</u>	
328.2	0.573	533	1.70	418.2	1.41	418.2	1.41	195	4.40	81.0	0.460
368.2	0.502	811	0.79	423.2	1.31	423.2	1.31	285	2.85	91.0	0.525
420.5	0.460	1366	0.33	441.2	1.37	441.2	1.37	300	1.02	135	0.830
448.2	0.452	1922	0.23	483.2	1.23	483.2	1.23	300	1.02	193	0.975
486.2	0.444	361.2	1.87	497.2	1.11	497.2	1.11	300	1.02	300	1.02
<u>CURVE 53</u>		<u>CURVE 58</u>		<u>CURVE 66</u>		<u>CURVE 69</u>		<u>CURVE 72</u>		<u>CURVE 74</u>	
328.2	0.573	374.2	1.79	501.2	1.13	501.2	1.13	2.25	0.00425*	673.2	0.726
368.2	0.502	382.2	1.55	505.2	1.27	505.2	1.27	2.89	0.00835*	773.2	0.595
420.5	0.460	419.2	1.38	518.2	1.10	518.2	1.10	3.5	0.0137*	873.2	0.498
448.2	0.452	427.2	1.38	530.2	1.10	530.2	1.10	3.6	0.0153*	973.2	0.427
486.2	0.444	434.2	1.38	605.2	0.900	605.2	0.900	4.2	0.0208	1073.2	0.370
<u>CURVE 54</u>		<u>CURVE 59</u>		<u>CURVE 70</u>		<u>CURVE 73</u>		<u>CURVE 75</u>		<u>CURVE 76</u>	
328.2	0.573	361.2	1.87	613.2	0.874	613.2	0.874	5.8	0.0408	1173.2	0.321
368.2	0.502	374.2	1.79	633.2	0.879	633.2	0.879	7.1	0.0580	13.4	0.820
420.5	0.460	419.2	1.38	689.2	0.774	689.2	0.774	7.5	0.0610	15.4	1.22
448.2	0.452	427.2	1.38	701.2	0.749	701.2	0.749	8.0	0.0730	17.6	1.56
486.2	0.444	434.2	1.38	782.2	0.594	782.2	0.594	10.0	0.128	20.9	2.72
<u>CURVE 55</u>		<u>CURVE 60*</u>		<u>CURVE 71</u>		<u>CURVE 74</u>		<u>CURVE 76</u>		<u>CURVE 78</u>	
328.2	0.573	361.2	1.87	801.2	0.594	801.2	0.594	14.5	0.280	22.9	2.99
368.2	0.502	374.2	1.79	803.2	0.602	803.2	0.602	19.95	0.523	24.0	2.99
420.5	0.460	419.2	1.38								
448.2	0.452	427.2	1.38								
486.2	0.444	434.2	1.38								

* Not shown on plot

DATA TABLE NO. 18 (continued)

	T	k	T	k	T	k	T	k	T	k	T	k				
<u>CURVE 74 (cont.)</u>	4.78	0.00447*	135.5	7.23	307.0	1.60	773	0.648	573	0.761	569	0.748	373.2	1.46	575.2	1.77
	5.09	0.00528*	145.5	6.95	316.3	1.44	873	0.548	673	0.656	669	0.669	473.2	1.02	575.2	1.76
	5.77	0.00730*	153.5	6.61	324.6	1.32	973	0.472	773	0.573	766	0.560	573.2	0.82	596.2	1.77
	6.01	0.00836*	283.8	2.97*	330.1	1.43	1073	0.393	873	0.460	863	0.481	573.2	0.88	788.2	0.929
	6.18	0.00902*			338.3	1.47	1173	0.343	973	0.389	1055	0.359	573.2	0.58	831.2	0.935
	6.40	0.0102*	<u>CURVE 75</u>		348.3	1.33	1273	0.301	1073	0.338	1157	0.313	773.2	0.50	1125.2	0.562
	6.75	0.0118*	291.1	1.28	357.1	1.24			1173	0.292	1270	0.271*	773.2	0.44	1127.2	0.596
	6.90	0.0125*	313.4	1.64	368.1	1.19	<u>CURVE 82*</u>		1273	0.259			975.2	0.39	1153.2	0.421
	7.10	0.0135*	320.3	1.59			873	0.569	<u>CURVE 87*</u>				1073.2	0.34	1336.2	0.404
	7.26	0.0149*	326.5	1.53			973	0.460	573	0.627	570	0.606	1173.2	0.30	1374.2	0.420
	8.11	0.0217*	333.5	1.38	573	0.941	1073	0.397	673	0.627	668	0.539	1273.2	0.30	1398.2	0.391
	8.45	0.0242	341.2	1.36	673	0.807	1173	0.343	773	0.627	769	0.460	<u>CURVE 91*</u>		1653.2	0.291
	8.69	0.0268	353.5	1.30	773	0.677	1273	0.292	873	0.468	864	0.418	558.2	1.72	1652.2	0.284
	9.00	0.0303	366.5	1.28	873	0.560			973	0.405	867	0.410	562.2	1.66	1653.2	0.317
	9.66	0.0361	374.4	1.24	973	0.472	<u>CURVE 83*</u>		1073	0.334	968	0.368	565.2	1.67	1694.2	0.286
	10.1	0.0428	382.5	1.20	1073	0.405	573	0.887	1073	0.292	1067	0.322	<u>CURVE 92*</u>		1960.2	0.245
	11.0	0.0518	391.8	1.13*	1173	0.351	673	0.761	1173	0.251	1171	0.284	1993.2	0.251	1997.2	0.219
	12.2	0.0662	401.6	1.13*	1273	0.309	773	0.661	1273	0.217	1263	0.259	2016.2	0.237	2016.2	0.237
	12.4	0.0693	414.8	1.02			873	0.539	<u>CURVE 86*</u>				2263.2	0.188	2263.2	0.188
	13.0	0.0813			<u>CURVE 76</u>		973	0.451	573	0.769	571	0.715	2297.2	0.196	2297.2	0.196
	13.7	0.0927	106.7	2.08	673	0.782	1073	0.393	673	0.690	714	0.602	2412.2	0.232	2412.2	0.232
	14.0	0.0980	112.5	2.14	773	0.656	1173	0.351	773	0.573	811	0.489				
	15.3	0.121	118.4	2.18	873	0.548	1273	0.297	873	0.502	952	0.401	<u>CURVE 93*</u>			
	16.2	0.143	123.1	2.26	973	0.460			973	0.418	1143	0.309	575.2	1.77		
	19.3	0.236	135.6	2.48	1073	0.389	<u>CURVE 84*</u>		1073	0.359	1268	0.263	575.2	1.76		
	22.8	0.327	150.1	2.56	1173	0.330	573	0.979	1173	0.309			596.2	1.77		
	23.8	0.364	163.2	2.46	1273	0.288	673	0.857	1275	0.267			788.2	0.929		
	26.8	0.466	163.2	2.46			773	0.702	<u>CURVE 89*</u>				831.2	0.956		
	32.0	0.710	177.9	1.85			873	0.585	573	0.769	576	0.690	849.2	0.935		
	39.5	1.13	192.7	1.63			973	0.506	673	0.690	714	0.602	1125.2	0.562		
	46.9	1.63	208.5	1.53	573	0.899	1073	0.426	673	0.690	811	0.489	1127.2	0.596		
	55.9	2.44*	218.7	1.53	673	0.769	1173	0.364	873	0.426	1076	0.422	1153.2	0.621		
	61.7	3.01	228.3	1.56	773	0.652	1273	0.317	973	0.384	1176	0.317	1336.2	0.421		
	71.0	3.97			873	0.535			1073	0.309	1281	0.276	1374.2	0.420		
	81.1	4.99			973	0.447	<u>CURVE 85*</u>		1173	0.267			1398.2	0.391		
	84.1	5.33	231.0	1.47	1073	0.372	573	0.956	582	0.393	576	0.690	1420.2	0.420		
	88.7	5.75	243.5	1.41	1173	0.326	673	0.820	584	0.397	714	0.602	1453.2	0.420		
	94.6	6.22	253.3	1.48	1273	0.284	773	0.690	594	0.397	811	0.489	1486.2	0.420		
	100.5	6.59	265.9	1.58			873	0.581	673	0.384	952	0.401	1519.2	0.420		
	104.7	6.89	279.5	1.62			973	0.489	774	0.359	1143	0.309	1552.2	0.420		
	107.9	7.05	286.6	1.49			1073	0.410	872	0.334	1268	0.263	1585.2	0.420		
	117.8	7.26	295.1	1.49			1173	0.355	971	0.309			1618.2	0.420		
	121.6	7.38*			<u>CURVE 81*</u>		1273	0.309	574	0.748			1651.2	0.420		
	125.0	7.41			573	0.866	573	0.956	574	0.748			1684.2	0.420		
	129.7	7.33*			673	0.769	673	0.820	672	0.677			1717.2	0.420		
									773	0.690			1750.2	0.420		
									873	0.581			1783.2	0.420		
									973	0.489			1816.2	0.420		
									1073	0.410			1849.2	0.420		
									1173	0.355			1882.2	0.420		
									1273	0.309			1915.2	0.420		

* Not shown on plot

DATA TABLE NO. 15 (continued)

CURVE 99		CURVE 101*		CURVE 103*		CURVE 105*	
T	k	T	k	T	k	T	k
576.2	1.85*	533.2	1.63	546.2	1.72	539.2	1.84
576.2	1.83*	533.2	1.61	568.2	1.74	539.2	1.81
576.2	1.81	574.2	1.65	585.2	1.71	563.2	1.75
813.2	0.857	817.2	0.770	797.2	0.768	828.2	0.839
841.2	0.851*	817.2	0.759	834.2	0.708	828.2	0.825
866.2	0.864	817.2	0.740	855.2	0.692	1079.2	0.483
1098.2	0.493	1118.2	0.430	1071.2	0.431	1114.2	0.475
1104.2	0.476*	1138.2	0.453	1091.2	0.424	1131.2	0.485
1121.2	0.476*	1158.2	0.453	1102.2	0.433	1292.2	0.372
1274.2	0.350	1164.2	0.437	1283.2	0.325	1309.2	0.362
1293.2	0.335*	1279.2	0.365	1310.2	0.317	1320.2	0.379
1316.2	0.345	1304.2	0.345	1611.2	0.242	1589.2	0.257
1372.2	0.346	1331.2	0.362	1630.2	0.237	1642.2	0.260
1890.2	0.306	1637.2	0.258	1661.2	0.247	1645.2	0.229
1910.2	0.314*	1655.2	0.248	1863.2	0.199	1865.2	0.189
1925.2	0.310	1670.2	0.264	1878.2	0.190	1891.2	0.170
1931.2	0.299	1941.2	0.229	1896.2	0.216	1900.2	0.187
2098.2	0.304	1979.2	0.222	2194.2	0.183	2074.2	0.173
2136.2	0.304*	2121.2	0.215	2217.2	0.179	2125.2	0.196
2161.2	0.307	2227.2	0.180	2236.2	0.200	2150.2	0.213
2222.2	0.242			2397.2	0.189	2293.2	0.193

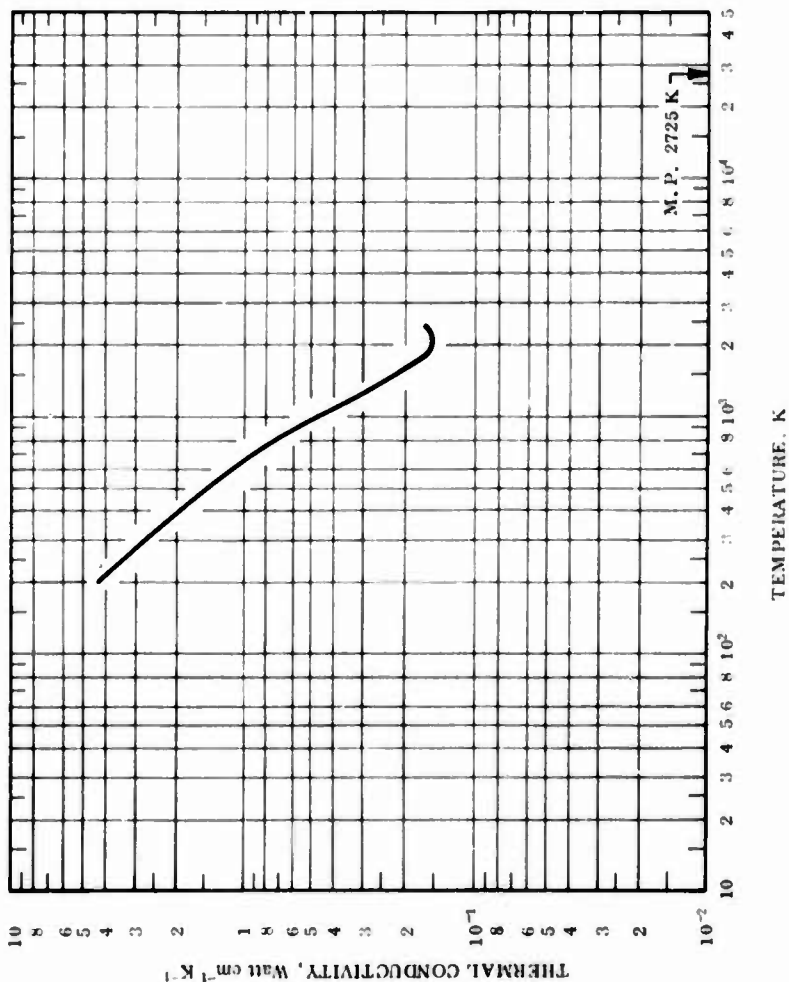
CURVE 100*		CURVE 102*		CURVE 104*	
T	k	T	k	T	k
512.2	1.65	517.2	1.50	563.2	1.86
533.2	1.66	543.2	1.56	566.2	1.80
788.2	0.655	543.2	1.57	578.2	1.85
833.2	0.668	768.2	0.760	802.2	0.813
1067.2	0.381	846.2	0.764	836.2	0.813
1075.2	0.395	1101.2	0.496	836.2	0.800
1075.2	0.363	1113.2	0.479	864.2	0.816
1087.2	0.394	1136.2	0.485	1061.2	0.418
1263.2	0.274	1287.2	0.389	1106.2	0.395
1284.2	0.255	1312.2	0.378	1106.2	0.431
1312.2	0.273	1328.2	0.401	1294.2	0.325
1821.2	0.257	1360.2	0.352	1319.2	0.309
1844.2	0.226	1747.2	0.303	1326.2	0.322
1851.2	0.267	1771.2	0.326	1670.2	0.248
1874.2	0.255	1793.2	0.307	1683.2	0.232
2087.2	0.176	1972.2	0.261	1717.2	0.247
2088.2	0.187	2007.2	0.262	1950.2	0.244
2088.2	0.198	2048.2	0.268	2002.2	0.244
2122.2	0.190	2093.2	0.219	2053.2	0.244
2269.2	0.183	2110.2	0.222	2163.2	0.190

* Not shown on plot

FIGURE AND TABLE NO. 18R. RECOMMENDED THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE BeO

RECOMMENDED VALUES*
(For 99.5% Pure, 98% Dense, Polycrystalline BeO)

T ₁	k ₁	k ₂	T ₂
0	0	0	-459.7
200	4.24	245	-99.7
250	3.34	193	-
273.2	3.02	175	32.0
300	2.72	157	80.3
350	2.28	132	170.3
400	1.96	113	260.3
500	1.46	84.4	440.3
600	1.11	64.1	620.3
700	0.87	50.3	800.3
800	0.70	40.4	980.3
900	0.57	32.9	1160
1000	0.47	27.2	1340
1100	0.39	22.5	1520
1200	0.33	19.1	1700
1300	0.283	16.4	1880
1400	0.245	14.2	2060
1500	0.215	12.4	2240
1600	0.195	11.3	2420
1700	0.180	10.4	2600
1800	0.167	9.65	2780
1900	0.156	9.01	2960
2000	0.150	8.67	3140
2100	0.150	8.67	3320
2200	0.152	8.78	3500
2300	0.164	9.48	3680



REMARKS

The recommended values are for 99.5% pure, 98% dense, polycrystalline BeO. The recommended values are thought to be accurate to within 8% of the true values at temperatures from 500 to 1000 K and 8 to 15% at other temperatures.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹.

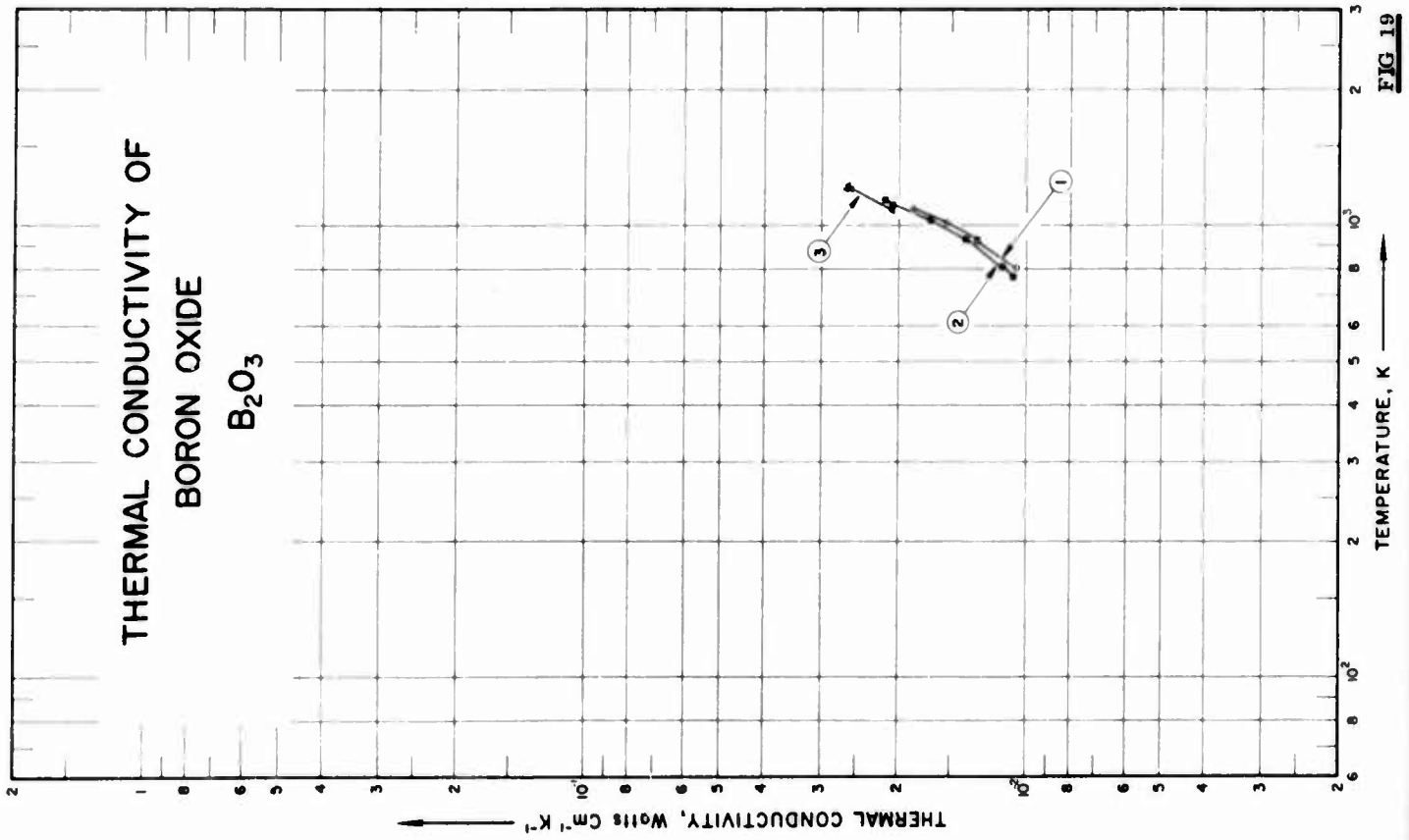


FIG 19

SPECIFICATION TABLE NO. 19 THERMAL CONDUCTIVITY OF BORON OXIDE B_2O_3

[For Data Reported in Figure and Table No. 19]

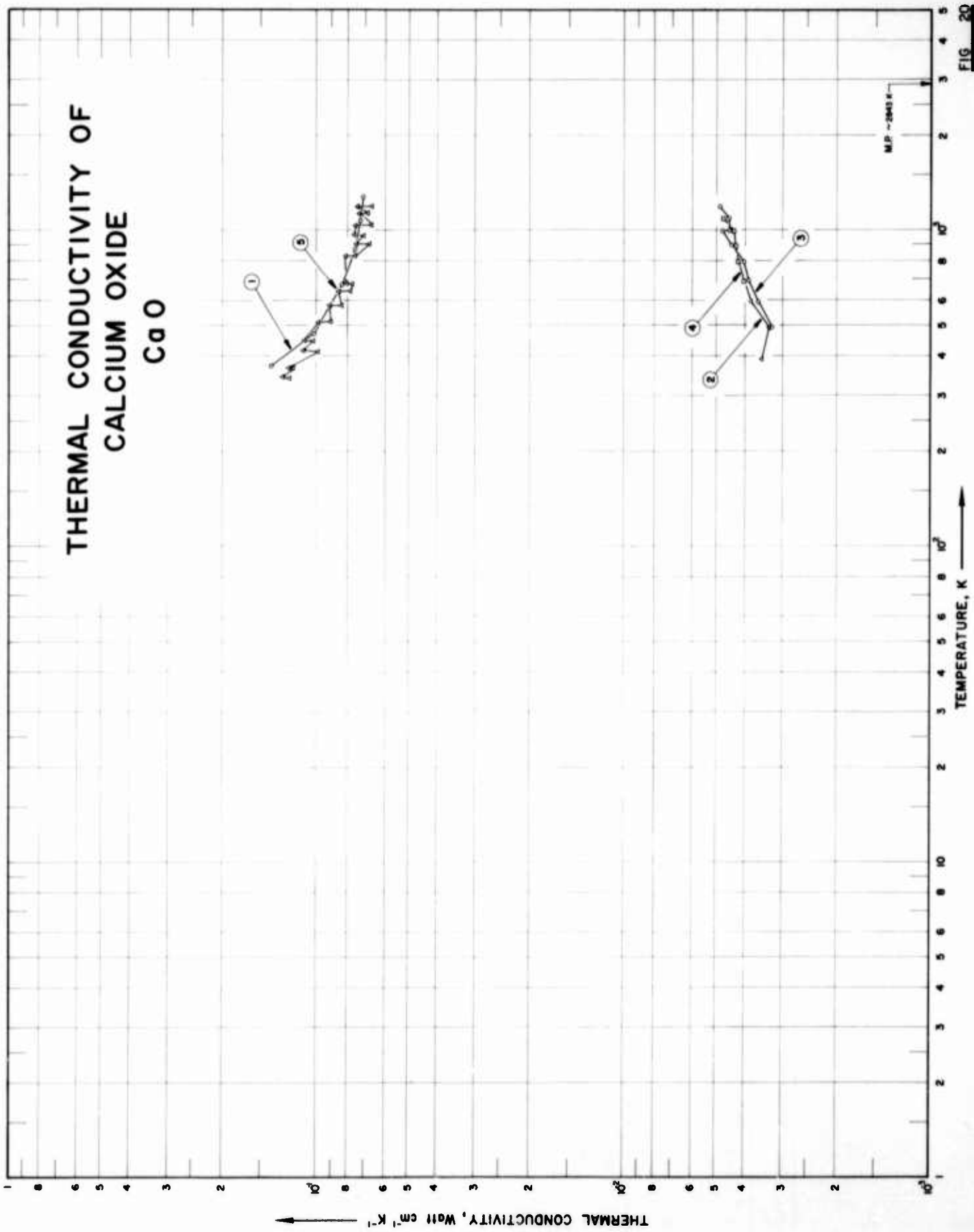
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	248	R	1959	809-1098			In liquid state; contained in the annulus of two concentric stainless steel tubes (1.22 cm radius difference), with a very thin stainless steel cylinder placed midway between the two measuring surfaces.
2	248	R	1959	769-1144			In liquid state; measured after the above specimen was heated to 950 C for two days in the apparatus.
3	248	R	1959	1085-1217			In liquid state; measured after the specimen was heated to 950 C for a period of a week and half in the apparatus.

DATA TABLE NO. 19 THERMAL CONDUCTIVITY OF BORON OXIDE B_2O_3 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
808.8	0.0106
809.1	0.0106*
809.4	0.0106*
812.6	0.0107*
921.2	0.0130
922.6	0.0130*
925.7	0.0130
925.7	0.0129*
1016.9	0.0154
1017.6	0.0154*
1097.4	0.0185
1097.9	0.0184*
<u>CURVE 2</u>	
768.6	0.0107
770.9	0.0107*
810.4	0.0113
931.3	0.0139
931.3	0.0138*
1024.6	0.0168
1024.9	0.0168*
1117.4	0.0206
1121.6	0.0208*
1140.7	0.0215
1143.7	0.0217*
<u>CURVE 3</u>	
1085.0	0.0207
1091.8	0.0207*
1207.0	0.0258
1207.6	0.0265
1210.7	0.0264*
1211.3	0.0264*
1214.0	0.0261
1217.3	0.0263*

* Not shown on plot

THERMAL CONDUCTIVITY OF
CALCIUM OXIDE
CaO



SPECIFICATION TABLE NO. 20 THERMAL CONDUCTIVITY OF CALCIUM OXIDE CaO

[For Data Reported in Figure and Table No. 20]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	364	C	1954	373-1273			
2	221	R	1959	390-897	5.9		Polycrystal; prepared by calcining reagent grade calcium carbonate at 1600 C for 2 hr; resulting powder hydrostatically pressed and fired at 1900 C in a zirconia gas-oxygen furnace (oxidizing atmosphere); bulk density 3.03 g cm ⁻³ ; porosity 8.75%.
3	221	R	1959	494-1199	5.9		Packed powdered CaO; 90% of the particles in 0.3-6.6 micron range; density 1.86 g cm ⁻³ .
4	221	R	1959	693-1197	5.9		Similar to the above specimen except 1.57 g cm ⁻³ density.
5	45	C	1953	341-1196			Second run of the above specimen. Pure; crystalline cube specimen; prepared from reagent grade calcium carbonate by calcining for 2 hrs at 1600 C; hydrostatically pressed and fired at 1900 C in zirconia gas-oxygen furnace; bulk density 3.03 g cm ⁻³ ; total porosity 8.75% (true density 3.32).

DATA TABLE NO. 20 THERMAL CONDUCTIVITY OF CALCIUM OXIDE CaO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
373.2	0.139	341.2	0.123
473.2	0.101	345.2	0.128
673.2	0.0837	367.2	0.118
873.2	0.0757	367.2	0.123
1073.2	0.0728	419.2	0.110
1273.2	0.0711	418.2	0.0987
<u>CURVE 2</u>			
390.0	0.00353	448.2	0.103
492.2	0.00330	448.2	0.109
593.3	0.00382	512.2	0.0983
896.8	0.00439*	517.2	0.0900
<u>CURVE 3</u>			
493.8	0.00326	580.2	0.0908
593.2	0.00361	580.2	0.0837
693.2	0.00390	644.2	0.0856
796.4	0.00405	644.2	0.0787
896.8	0.00445	678.2	0.0874
996.6	0.00480	681.2	0.0808
997.2	0.00451	833.2	0.0812
1099.2	0.00454	833.2	0.0757
1199.2	0.00489	908.2	0.0749
<u>CURVE 4</u>			
692.5	0.00402	908.2	0.0678
692.8	0.00403*	968.2	0.0703
790.6	0.00421	972.2	0.0761
892.2	0.00432	1042	0.0753
995.2	0.00437	1093	0.0665
1095.3	0.00475	1138	0.0736
1097.2	0.00450*	1141	0.0686
1197.2	0.00488*	1196	0.0741
		1196	0.0661

* Not shown on plot

THERMAL CONDUCTIVITY OF CERIUM DIOXIDE CeO₂

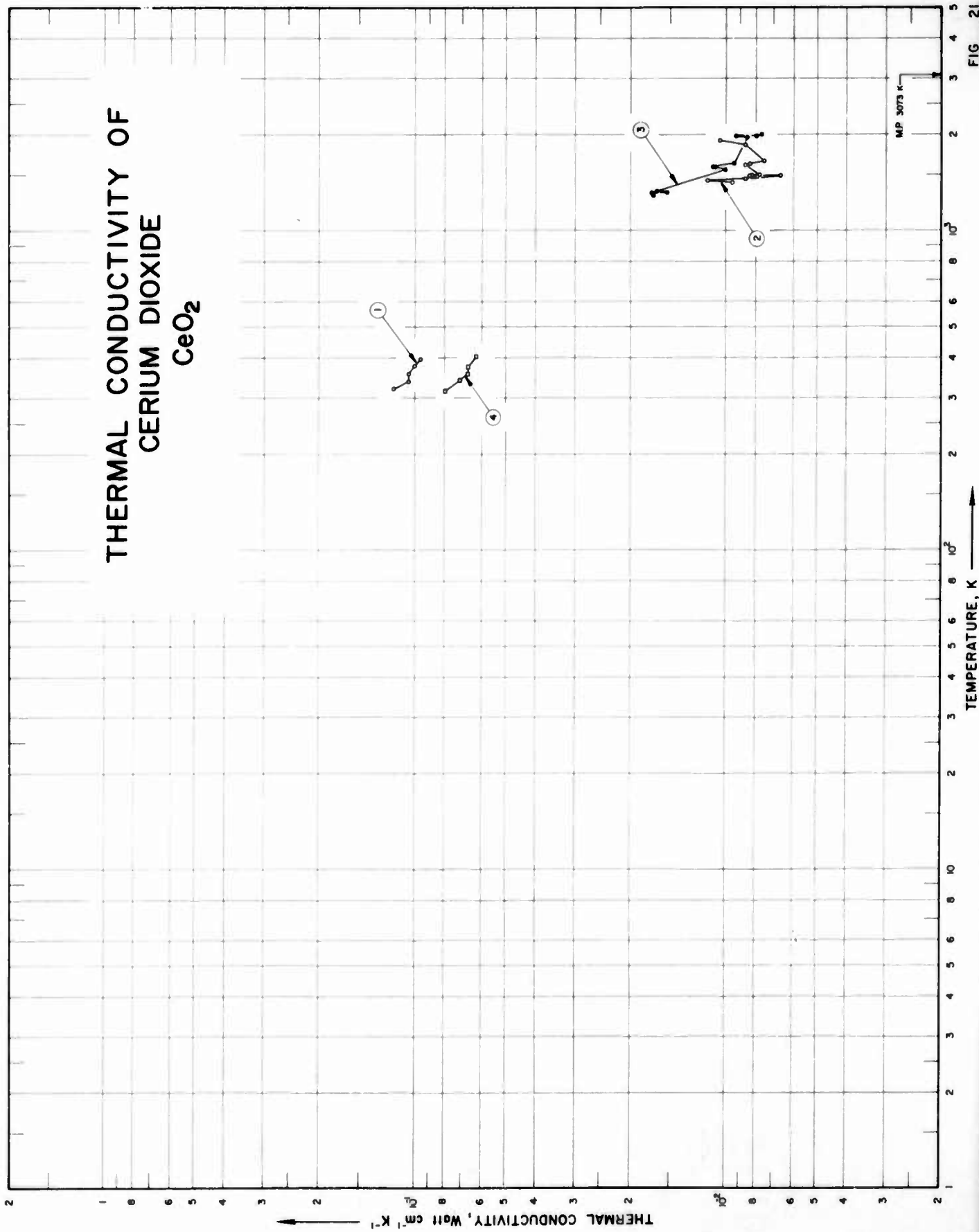


FIG. 21

SPECIFICATION TABLE NO. 21 THERMAL CONDUCTIVITY OF CERUM DIOXIDE CeO₂

[For Data Reported in Figure and Table No. 21]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	23		1952	320-397		98 A-2	Fired at 1482 C; 0.0042% water absorption; density 6.20 g cm ⁻³ ; specimen buff color.
2	144	R	1963	1410-1915	5-7	1	0.2 Zr, 0.1 Ca; specimen 0.75 in. long, 0.75 in. O.D. and 0.25 in. I.D.; supplied by Zirconium Corp of America; pressed and sintered; density 6.87 g cm ⁻³ at 25 C; specimen melted during test.
3	144	R	1963	1292-2006	5-7		Similar to the above specimen except for size, 3 in. long, 2.5 in. O.D. and 0.75 in. I.D.
4	23		1952	317-404		16 OA-1	2.0 MgO; fired at 1567 C; 0.59% water absorption; density 5.58 g cm ⁻³ ; specimen buff color.

DATA TABLE NO. 21 THERMAL CONDUCTIVITY OF CERUM DIOXIDE CeO₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1

320.3	0.117
338.2	0.105
358.5	0.105
378.8	0.100
397.4	0.096

CURVE 2

1410.4	0.00952
1440.4	0.0115
1456.5	0.00865
1490.4	0.00663
1492.6	0.00837
1496.5	0.00822
1499.8	0.00779
1510.4	0.00865
1627.1	0.00837
1652.6	0.00750
1859.8	0.00865
1914.8	0.0105

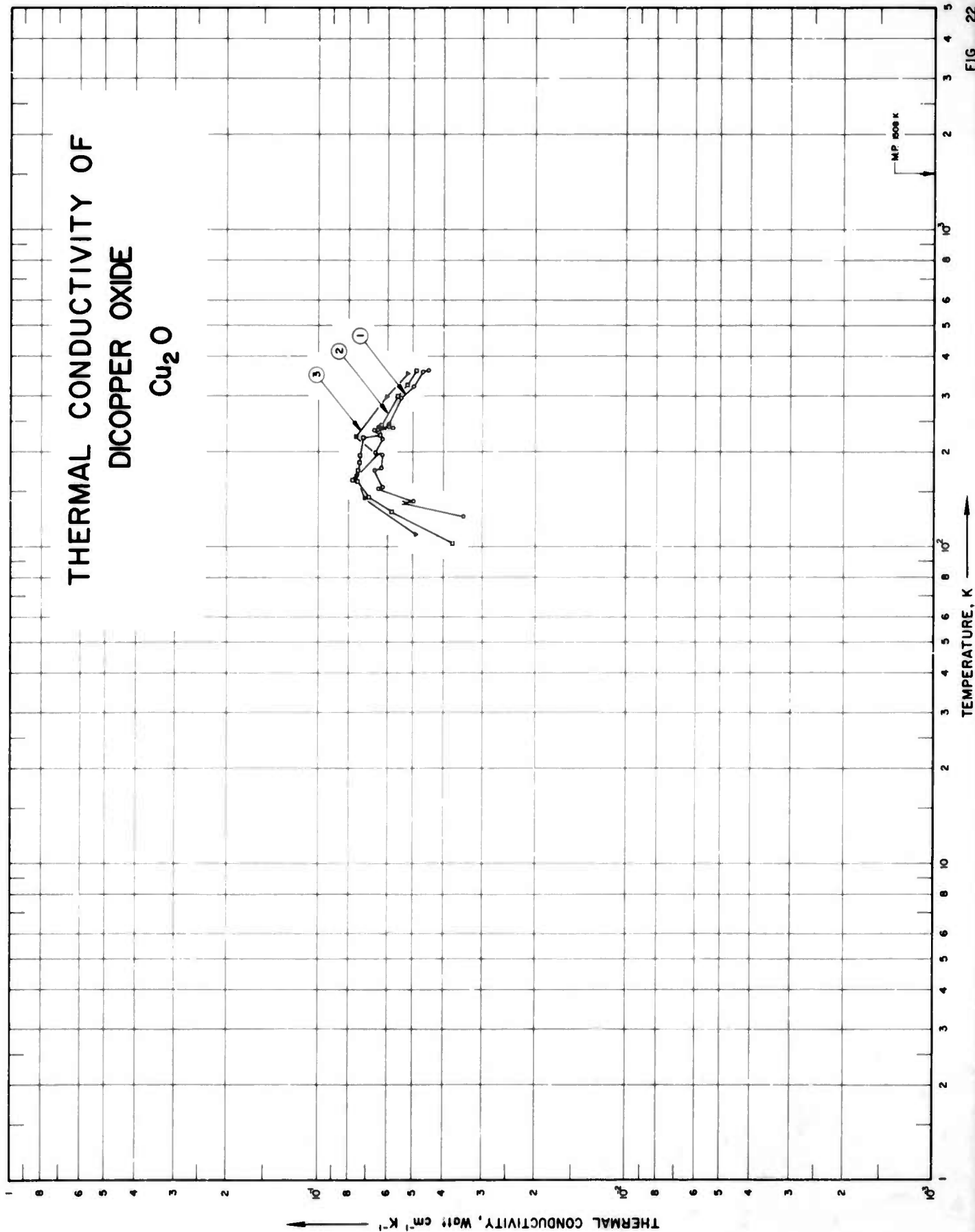
CURVE 3

1292.1	0.0170
1313.7	0.0172
1322.1	0.0154
1327.1	0.0166
1555.9	0.0100
1585.4	0.0108
1588.2	0.0111
1628.2	0.00938
1969.2	0.00851
1977.1	0.00923
1978.2	0.00793
2005.9	0.00765

CURVE 4

316.5	0.0795
371.4	0.0711
356.4	0.0669
375.3	0.0669
404.1	0.0628

THERMAL CONDUCTIVITY OF
DICOPPER OXIDE
 Cu_2O



SPECIFICATION TABLE NO. 22 THERMAL CONDUCTIVITY OF DICOPPER OXIDE Cu_2O

[For Data Reported in Figure and Table No. 22]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	459	L	1950	125-362	3.3	B	99.9 pure; electrolytic; single crystals containing a polycrystalline interface; specimens prepared by oxidizing machined copper disks of dia 2.86 cm in a furnace at 1020 C for 30 to 210 hrs, flushing nitrogen over the oxide for 1 hr during the slow cooling process; electrical resistivity reported as 47.0, 41.0, 15.9, 4.02, 3.92, 3.25, 3.06, 2.83, 2.42, 1.93, and 1.91 10^3 ohm cm at 206, 208, 234, 276, 277, 288, 293, 295, 306, 336, and 338 K, respectively.
2	459	L	1950	102-360	3.3	E	99.96 pure; electrolytic O. F. H. C.; large single crystal; specimen prepared by oxidizing machined copper disks of dia 2.86 cm in a furnace at 1020 C for 30 to 210 hrs, heated to 1200 C, cooled rapidly.
3	459	L	1950	110-353	3.3	F	Specimen prepared by fusing small pieces of sintered Cu_2O in oxygen in a porcelain ignition capsule.

DATA TABLE NO. 22 THERMAL CONDUCTIVITY OF DICOPPER OXIDE Cu_2O
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
125.2	0.0346	236.8	0.0656*
137.0	0.0536	297.0	0.0604
139.3	0.0498	353.2	0.0519
152.4	0.0642		
155.4	0.0623		
174.0	0.0662		
177.2	0.0627		
196.9	0.0625		
198.2	0.0657		
219.1	0.0624		
234.7	0.0662		
235.0	0.0645		
237.8	0.0578		
239.7	0.0644		
239.8	0.0595		
244.3	0.0594		
296.6	0.0544		
321.6	0.0497		
357.0	0.0465		
361.8	0.0448		
<u>CURVE 2</u>			
102.3	0.0374		
129.8	0.0582		
144.2	0.0690		
161.9	0.0749		
163.2	0.0776		
174.1	0.0748		
185.0	0.0739		
195.0	0.0736		
221.8	0.0720		
226.6	0.0635		
239.5	0.0632*		
243.2	0.0628		
299.6	0.0558		
325.6	0.0524		
359.5	0.0486		
<u>CURVE 3</u>			
109.6	0.0489		
143.9	0.0709		
168.0	0.0755		
196.9	0.0648		
222.8	0.0756		

* Not shown on plot

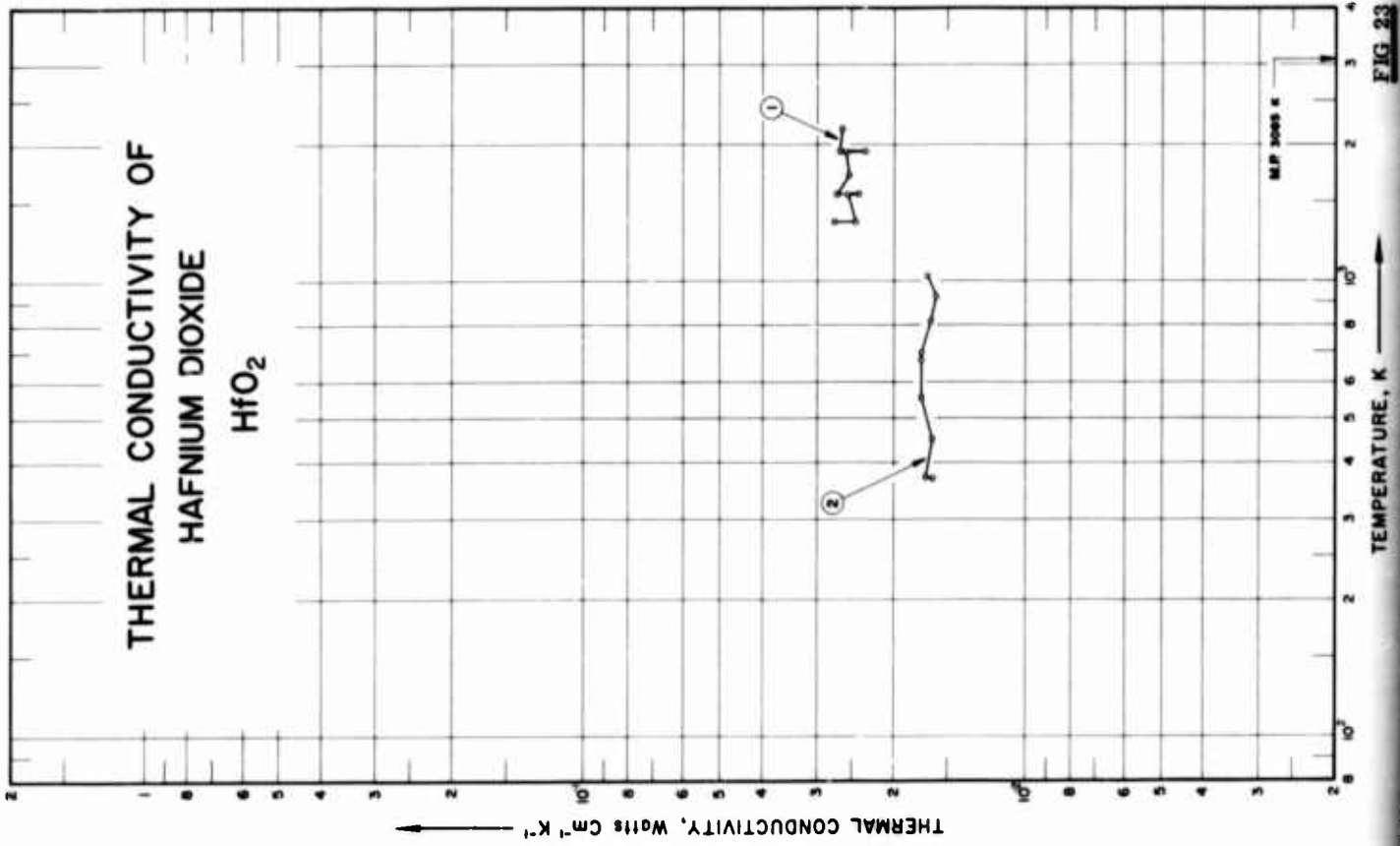


FIG 23

SPECIFICATION TABLE NO. 23 THERMAL CONDUCTIVITY OF HAFNIUM DIOXIDE HfO_2

[For Data Reported in Figure and Table No. 23]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	144	R	1963	1365-2173	5-7	1	2.5 Fe, 0.3 Mg, 0.1 Ca, 0.1 Ti; poorly bonded structure; specimen 0.75 in. long, 0.75 in. O. D. and 0.25 I. D.; pressed and sintered; density 10.5 10.5 g cm^{-3} at 25 C; specimen found blistered and partially melted on post inspection. 9.55
2	233		1955	368-1033			No details reported.

DATA TABLE NO. 23 THERMAL CONDUCTIVITY OF HAFNIUM DIOXIDE HfO_2 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
1364.8	0.0273
1364.8	0.0245
1553.7	0.0255
1565.4	0.0241
1565.4	0.0270
1715.9	0.0254
1727.6	0.0251*
1736.5	0.0252*
1929.8	0.0257
1933.2	0.0232
1937.1	0.0267
2173.2	0.0264
<u>CURVE 2</u>	
368.2	0.0161
373.2	0.0167
453.2	0.0163
558.2	0.0172
673.2	0.0172
698.2	0.0172
818.2	0.0163
928.2	0.0159
1033.2	0.0167

* Not shown on plot

SPECIFICATION TABLE NO. 24 THERMAL CONDUCTIVITY OF INDIUM OXIDE InO

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	363	P	1965	1204-1722			Density 6.3 g cm ⁻³ ; thermal conductivity values calculated from measured thermal diffusivity data and the assumed constant specific heat at 0.2 cal g ⁻¹ c ⁻¹ .

DATA TABLE NO. 24 THERMAL CONDUCTIVITY OF INDIUM OXIDE InO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

1204	0.05649
1298	0.05675
1334	0.05675
1342	0.05675
1416	0.05675
1469	0.05675
1497	0.05675
1522	0.05834
1560	0.05585
1662	0.05649
1722	0.05649

* No graphical presentation

THERMAL CONDUCTIVITY OF
TRIIRON TETRAOXIDE (MAGNETITE)
 Fe_3O_4

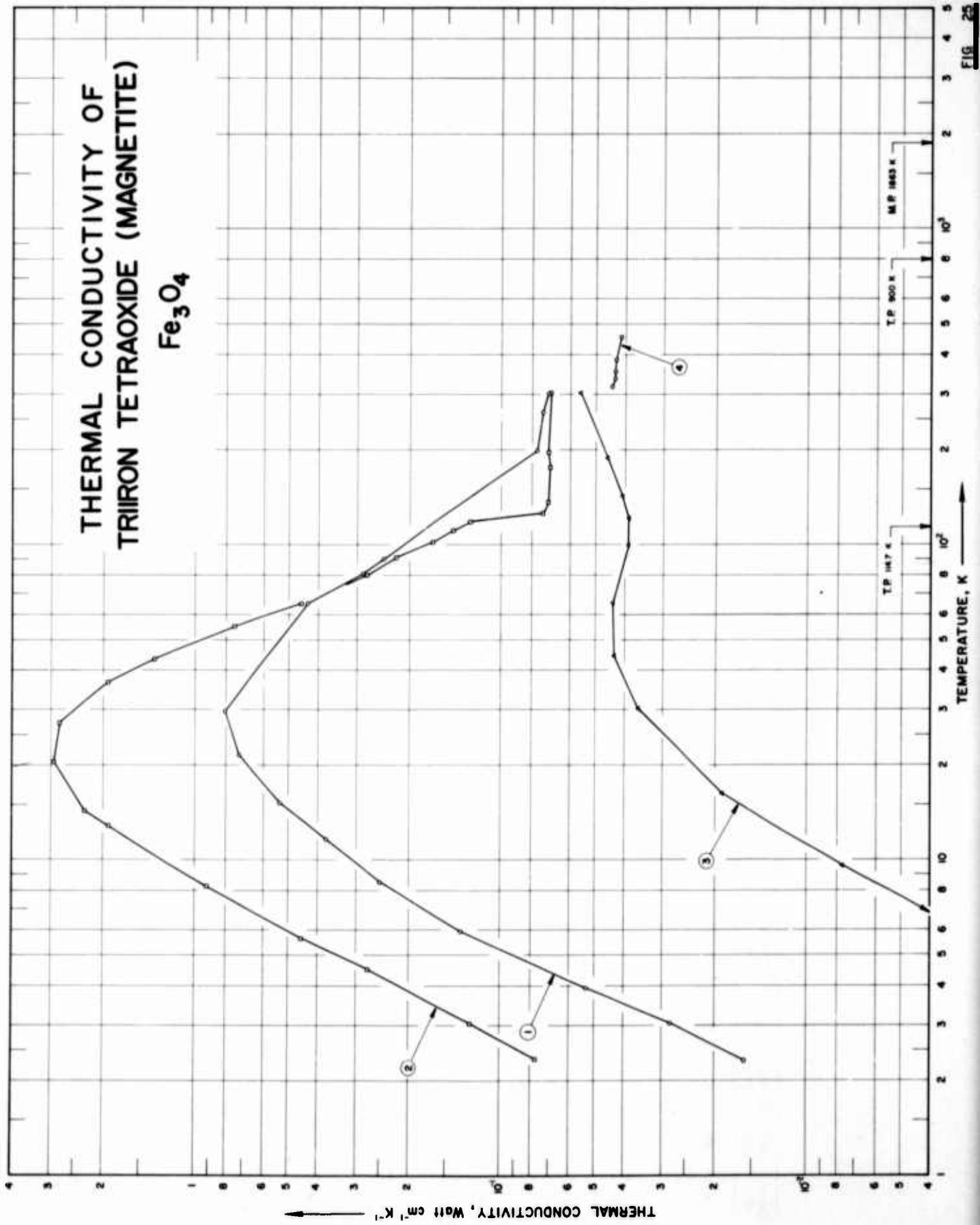


FIG. 25

SPECIFICATION TABLE NO. 25 THERMAL CONDUCTIVITY OF TRIRON TETRAOXIDE (MAGNETITE) Fe_3O_4

[For Data Reported in Figure and Table No. 25]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	300	L	1962	2.3-301		R-37	10^{18} , 1 atom cm^{-3} Al, $<10^{18}$, 2 atom cm^{-3} Be, $<10^{18}$, 9 atom cm^{-3} Ca, 10^{18} , 8 atom cm^{-3} Cr, $<10^{18}$, 9 atom cm^{-3} K, $<10^{18}$, 1 atom cm^{-3} Li, 10^{18} , 8 atom cm^{-3} Mg, 10^{18} , 1 atom cm^{-3} Mn, 10^{18} , 1 atom cm^{-3} Na, 10^{18} , 8 atom cm^{-3} Ni, $<10^{18}$, 8 atom cm^{-3} Si, $<10^{18}$, 8 atom cm^{-3} Ti, $<10^{18}$, 8 atom cm^{-3} V, $<10^{18}$, 9 atom cm^{-3} Zn, and $<10^{18}$, 8 atom cm^{-3} Zr; single crystal; black luster, opaque specimen 1.26 cm long, 0.54 cm dia; lattice constant 8.397 Å; vacancy concentration 2.6×10^{20} cm^{-3} . A section of the above specimen (1.23 cm long, 0.2 cm av. dia) annealed at 1500 K in a CO_2 atmosphere; lattice constant 8.398 Å; vacancy concentration 2×10^{20} cm^{-3} .
2	300	L	1962	2.3-304		R-57	
3	300	L	1962	3.0-302		R-63 (Co_2 , 97 Fe_2 , 18 O_4)	Similar to specimen R-37 curve No. 1 except 9.9×10^{20} atom cm^{-3} Co; annealed at 1620 K in a 2×10^{-4} atm. O_2 ; specimen 0.80 cm long, 0.24 cm av. dia; vacancy concentration 8×10^{18} cm^{-3} lattice constant 8.394 Å.
4	68	C	1954	317-453	± 3	298 A-1	Single crystal.

DATA TABLE NO. 25 THERMAL CONDUCTIVITY OF IRON OXIDE (MAGNETITE) Fe_3O_4 [Temperature, T, K; Thermal Conductivity, k, Watts $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
2.31	0.016	3.04	0.0081*
3.04	0.028	4.97	0.00224*
3.93	0.053	9.60	0.0077
5.92	0.134	16.26	0.019
8.49	0.250	30.25	0.036
11.71	0.376	44.37	0.0435
15.04	0.534	65.70	0.044
21.54	0.725	99.55	0.039
29.56	0.808	120.16	0.039
65.23	0.436	143.21	0.041
81.02	0.286	188.29	0.046
90.26	0.245	302.36	0.056
198.60	0.077		
261.63	0.074		
300.51	0.071		
<u>CURVE 2</u>			
2.34	0.0773	317.1	0.0444
3.03	0.125	335.7	0.0435
4.50	0.274	353.9	0.0435
5.64	0.454	385.6	0.0431
8.27	0.917	453.2	0.0414
12.91	1.92		
14.42	2.31		
20.51	2.93		
27.21	2.80		
36.65	1.93		
43.32	1.36		
54.98	0.751		
65.38	0.458		
79.85	0.278		
90.90	0.223		
102.25	0.167		
111.07	0.143		
118.43	0.127		
126.55	0.074		
137.47	0.071		
175.63	0.070		
195.80	0.071		
303.67	0.070		
<u>CURVE 3</u>			
<u>CURVE 4</u>			

* Not shown on plot

SPECIFICATION TABLE NO. 26 THERMAL CONDUCTIVITY OF LITHIUM OXIDE Li_2O

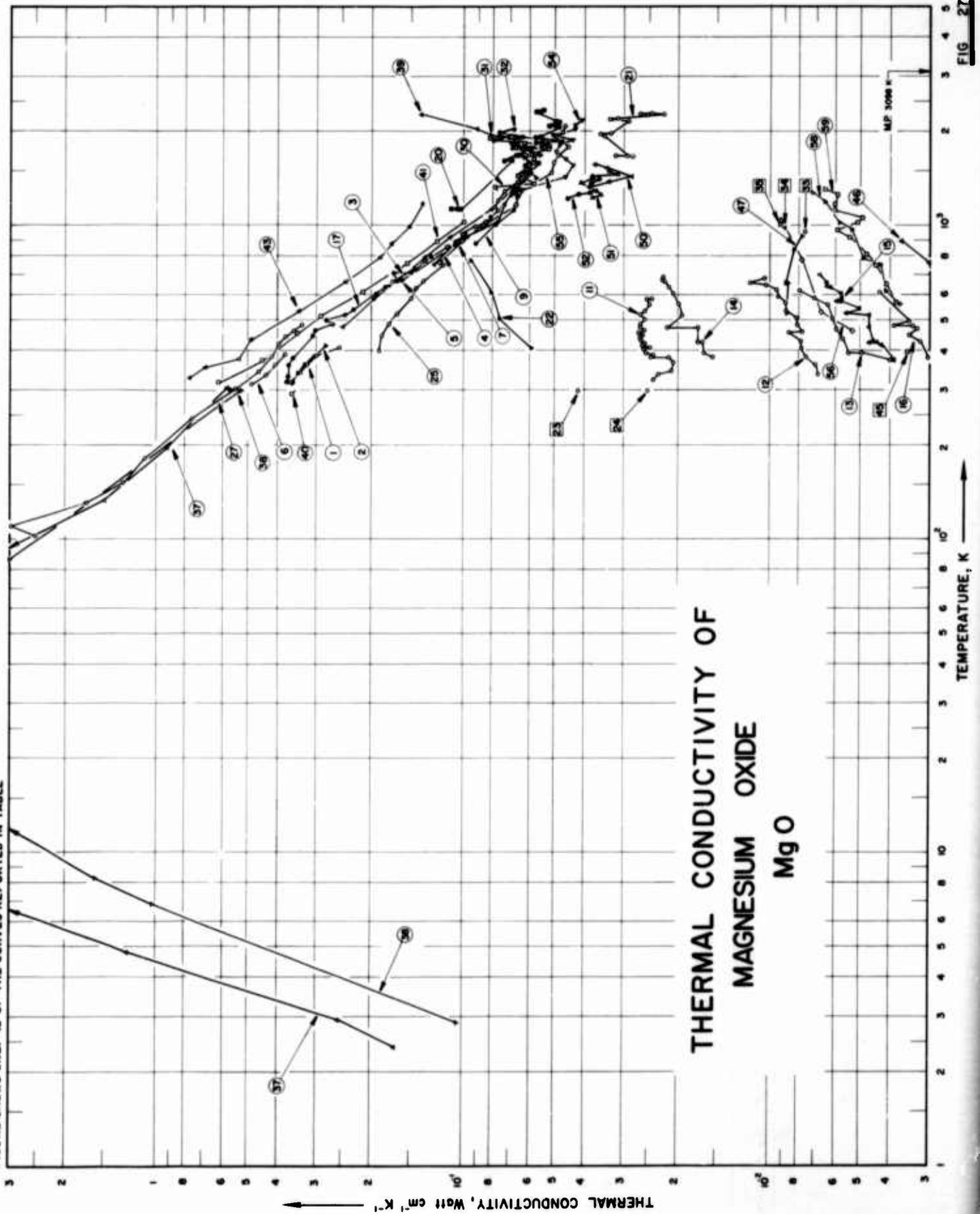
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3		1963	333.2		β -Spodumene	Maximum water absorption 0.05%; flexural strength 7000 psi.

DATA TABLE NO. 26 THERMAL CONDUCTIVITY OF LITHIUM OXIDE Li_2O
 [Temperature, T, K; Thermal Conductivity k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T k
 CURVE 1*
 333.2 0.0173

* No graphical presentation

FIGURE SHOWS ONLY 45 OF THE CURVES REPORTED IN TABLE



THERMAL CONDUCTIVITY OF
MAGNESIUM OXIDE
MgO

FIG 27

SPECIFICATION TABLE NO. 27 THERMAL CONDUCTIVITY OF MAGNESIUM OXIDE MgO

[For Data Reported in Figure and Table No. 27]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	3	C	1953	319-411		236A-1		Spectroscopically pure; polycrystalline; supplied by Bell Telephone Laboratories; density (25 C) = 3.21 g cm ⁻³ ; water absorption = 0.83%.
2	3	C	1953	315-419		236A-2		Same sample as above; separate run.
3	2	R	1951	666-1520				Polycrystalline; 0.30 SiO ₂ , 0.14 Al ₂ O ₃ , 0.35 CaO, 0.05 Fe ₂ O ₃ ; hydrostatically pressed (30,000 psi); test run No. 1.
4	2	R	1951	751-1517				Same specimen as above; test run No. 2.
5	4	R	1951	673-1473	5	83A-1		Sintered.
6	23	C	1952	312-388		A		Single crystal.
7	57	R	1950	764-1611		A		Sintered; open pores 0.49%, closed pores 5.44%, total porosity 5.93% bulk density 3.26 g cm ⁻³ .
8	57	R	1950	789-1619		A		The second run of the above specimen.
9	57	R	1950	876-1633		B		Sintered; without open pores, closed pores 8.66%, total porosity 8.66%; bulk density 3.27 g cm ⁻³ .
10	293	C	1957	707-1692				Single crystal; 99.92 pure, 0.02 SiO ₂ , 0.05 total Na ₂ O, CaO, and K ₂ O, 0.01 Fe ₂ O ₃ ; data corrected to zero porosity.
11	166	R	1953	324-583				Powder form; 0.64 volume fraction occupied by solid particles; measured in helium.
12	166	R	1953	335-679				Similar to the above specimen except measured in air.
13	166	R	1953	371-620				Similar to the above specimen except measured in argon.
14	239	R	1952	380-683				Powder form; 0.55 fractional volume occupied by the solid particles; measured in helium; gas pressure in range where pressure change does not affect conductivity of powder.
15	239	R	1952	372-694				Similar to the above specimen except measured in air.
16	239	R	1952	378-611				Similar to the above specimen except measured in argon.
17	131	C	1954	318-896				Slip cast from suspensions of finely ground material; fired to zero apparent porosity; bulk density 3.45 g cm ⁻³ .
18	131	C	1954	316-898				The second run of the above specimen.
19	240	R	1919	429, 453				Sample size; 12.2 mm I. D., 19 mm O. D., and 8 cm long.
20	144	R	1963	1133-2322	5-7	1		0.3 Fe, 0.3 Si, 0.2 Ca, 0.1 Al; poorly bonded structure; supplied by Zirconium Corp. of America; 0.75 in. long, 0.75 in. O. D., and 0.25 in. I. D.; pressed and sintered; density 3.51 g cm ⁻³ ; specimen broken and partially melted on post test inspection.
21	144	R	1963	1668-2269	5-7			Similar to the above specimen except dimensions; 3 in. long, 2.5 in. O. D., and 0.75 in. I. D.; specimen found cracked and color changed on post test inspection.

SPECIFICATION TABLE NO. 27 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
22	34	C	1943	409-772		Periclase	Synthetic, colorless, isotropic 1 cm cube; cut from a single crystal.
23	152	L	1956	298.2		MgO	Specimen in the form of wafers made of 4 pieces, each 0.75 in. dia x 0.02 in. thick.
24	152	L	1956	298.2		MgO	The above specimen exposed with 3×10^{18} epithermal neutrons per cm^2 for 480 megawatt day in the Material Testing Reactor.
25	153	C	1951	400-756	± 5		
26	211	C, R	1954	573-1473		MgO	
27	285	P	1962	103-483	± 5		
28	274	R	1953	653-1513	< 5	Run 1	
29	274	R	1953	748-1523	< 5	Run 2	
30	274	R	1953	1283-1908	< 10.7	M-10	
31	274	R	1953	1423-1953	< 10.7	M-11	Single crystal.
32	274	R	1953	1573-2023	< 10.7	M-12	Fired to total porosity of 8.10-8.95% to a bulk density of 3.25-3.29 g cm^{-3} .
33	299	R	1958	951.7	± 10	Periclase	Same material as the above; separate run.
34	299	R	1958	980.7	± 10	Periclase	0.05 Fe_2O_3 , 0.30 SiO_2 , 0.14 Al_2O_3 , and 0.35 CaO ; slip cast; fired to zero apparent porosity at 1850 C; final total porosity 5-10%.
35	299	R	1958	1000.7	± 10	Periclase	Same material as the above, separate run.
36	302	P	1962	313-1263			Same material as the above; separate run.
37	300	L	1962	2.4-305		R-38	Compressed granular specimen; porosity 23.5%. Compressed granular specimen; porosity 15.2%. Compressed granular specimen; porosity 13.7%. Density 3.39 g cm^{-3} .
38	300	L	1962	2.9-300		R-14	Single synthetic crystal; transparent, colorless, well-formed and free of visible defects; grown from the melt in an arc furnace using carbon electrodes and a self-crucible technique by R. L. Hansler, Lamp Division, General Electric Co.; specimen 1.11 cm long and 0.28 cm average dia; 4.213 Angstrom lattice constant; impurity (ρ_{imp} in atms cm^{-2}) given in $\log_{10} \rho_{\text{imp}} = 18.4 \text{ Al}, 18.4 \text{ Be}, 18.7 \text{ Ca}, 17.6 \text{ Cr}; 17.6 \text{ Fe}, < 18.4 \text{ K}, 17.5 \text{ Li}, < 17.3 \text{ Mn}, 18.7 \text{ Na}, < 17.2 \text{ Ni}, 17.9 \text{ Si}, < 17.6 \text{ Ti}, < 17.3 \text{ V}, < 17.8 \text{ Zn}, < 17.7 \text{ Zr}$.
39	298	R	1961	478-2264			Similar to above specimen except 1.24 cm long and 0.41 cm average dia; impurity (ρ_{imp} in atms cm^{-2}) given in $\log_{10} \rho_{\text{imp}} = 18.4 \text{ Al}, 18.4 \text{ Be}, 18.3 \text{ Ca}, 17.6 \text{ Cr}, 17.6 \text{ Fe}, 18.4 \text{ K}, 17.5 \text{ Li}, < 17.3 \text{ Mn}, 18.7 \text{ Na}, < 17.2 \text{ Ni}, 18.7 \text{ Si}, < 17.6 \text{ Ti}, < 17.3 \text{ V}, < 17.8 \text{ Zn}, 18.1 \text{ Zr}$.
40	296		1958	293-1273			99% MgO, 0.5% Si, 0.3% Mn; specimen composed of 5 one-in. disks; density 2.98 g cm^{-3} . Sintered; 97% of theoretical density; with an average grain size of about 15 microns.
41	293	C	1957	319-1036	± 4	No. 1	Polycrystalline; 99.54 pure, 0.20 SiO_2 ; 0.12 Al_2O_3 ; 0.11 total Na_2O , CaO , and K_2O ; 0.02 Fe_2O_3 ; 0.01 TiO_2 ; gravimetric porosity 4.75%; microscopic porosity 6%; average grain size 8 μ ; data corrected to zero porosity; polycrystalline alumina used as comparative material.

SPECIFICATION TABLE NO. 27 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
42	293	C	1957	373-1073	± 4	No. 2	Polycrystalline; 99.16 pure, 0.30 SiO ₂ , 0.14 Al ₂ O ₃ , 0.35 total Na ₂ O, CaO, and K ₂ O, 0.05 Fe ₂ O ₃ , trace TiO ₂ ; gravimetric porosity 13.7%; microscopic porosity 14%; average grain size 12μ; data corrected to zero porosity; same comparative material as above.
43	293	C	1957	328-1168	± 4		Single crystal; 99.92 pure, 0.02 SiO ₂ , 0.05 total Na ₂ O, CaO, and K ₂ O, 0.01 Fe ₂ O ₃ ; data corrected to zero porosity; same comparative material as above.
44	314	L	1959	395.9			Compressed powder; calcined; manufactured by Fisher Scientific Co.; specimen of 0.152 in. thick and 9 in. dia; pressed at 63 psi; bulk density 0.73 g cm ⁻³ ; heat flow parallel to the axis of the specimen; load reduced to 0.5 psi prior to making measurements.
45	314	L	1959	398.2			Same as the above specimen except 0.089 in. thick, 1.25 g cm ⁻³ bulk density, and 940 psi load.
46	315	R	1948	380-894			Powder; ≤ 200 mesh; porosity 47%; tested in air atmosphere.
47	315	R	1948	525-922			Same as the above specimen except in hydrogen atmosphere.
48	316	C	1951	519-755			Thermal conductivity of alumina determined by ellipsoidal sample used as reference; a crack was discovered in the sample.
49	316	R	1951	665-1673	± 5		Data from 6 runs with 3 specimens.
50	317	R	1960	1332-1565		MgO FPM-1	Fused MgO; 98.9 overall purity; composition: 45% fused MgO with -40 + 60 mesh and 99.0 purity, 15% fused MgO with -80 + 100 mesh and 99.0 purity, 35% fused MgO with -325 mesh and 98.5 purity, and 5% precipitated MgO with 0.02-0.03 μ, and 99.5 purity; bulk density 2.95 g cm ⁻³ (83.5% theoretical density); fabricated at JPL; cold pressed at 30,000 psi and sintered at 1783 K for 3 hrs; run No. 11.
51	317	R	1960	1221-1492		MgO FPM-1	The above specimen run No. 12.
52	317	R	1960	1219-1409		MgO FPM-1	The above specimen run No. 20.
53	317	R	1960	1390-1638		MgO FPM-1	The above specimen run No. 21.
54	318	R	1960	1301-2163			Polycrystalline; right cylinder 3 in. long, 2 in. dia with coaxial hole of 0.5 in. dia; density 3.22 g cm ⁻³ , supplied by Norton Co.; all data corrected to theoretical density of 3.58 g cm ⁻³ ; measured during increasing temperatures.
55	318	R	1960	1358-2122			The above specimen measured during decreasing temperatures.
56	373	R	1959	463-1258	± 20	MgO D(10-20)	Powder specimen of dense crystalline particles with porosity no larger than 4% and of irregular shape; particle dia 0.140 ± 0.060 cm, powder density 1.60 g cm ⁻³ , volume fraction of particles 0.469, central heater power input 4 watts cm ⁻¹ .
57	373	R	1959	573-1223	± 20	MgO D(10-20)	Similar to the above specimen except central heater power input 2 watts cm ⁻¹ .

SPECIFICATION TABLE NO. 27 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
58	373	R	1959	473-1273	± 20	MgO D(35-50)	Powder specimen of dense crystalline particles with porosity no larger than 4%, and of irregular shape; particle dia 0.040 ± 0.010 cm; powder density 1.70 g cm^{-3} , volume fraction of particles 0.475.
59	373	R	1959	473-1308	± 20	MgO D(100-200)	Powder specimen of dense crystalline particles with porosity no larger than 4%, and of irregular shape, mesh of the sieves limiting particle size 100-200, particle dia 0.011 ± 0.004 cm; powder density 1.54 g cm^{-3} , volume fraction of particles 0.430.
60	368	R	1954	460-1511	± 5		Hollow prolate spheroidal specimen with inner minor axis ~2 cm, inner major axis ~10 cm, outer minor axis ~4 cm and outer major axis long enough to make the outer and inner surfaces confocal; prepared by slip casting from suspension of finely ground material in the M.I.T. Ceramics Lab., fired to a total porosity of 8.10 to 8.95%, bulk density of 3.26 to 3.29 g cm^{-3} .
61	368	R	1954	750-1506	± 5		The above specimen, run 2.
62	400	P	1966	375-810	± 11	MgO(E-98)	0.01-0.1 Al, 0.01-0.1 Fe, 0.01-0.1 Si principal impurities; powder specimen contained in a ~4 in. in I. D., 4.5 in. in O. D. and ~24 in. long container; supplied by Norton Co.; as received; volume fraction solid 0.58; thermal conductivity data calculated from the measurement of thermal diffusivity, specific heat and density; mean particle size 265 μ ; pore-size density 3.59 g cm^{-3} .
63	400	P	1966	373-842	± 11	MgO(E-98)	Similar to the above specimen except specimen packed to 0.64 volume fraction solid.
64	400	R	1966	380-1101	± 10	MgO(E-98)	Similar to the above specimen except thermal conductivity data obtained by different method and volume fraction solid 0.58.
65	400	R	1966	369-1099	± 10	MgO(E-98)	Similar to the above specimen except specimen packed to 0.61 volume fraction solid.
66	400	R	1966	366-1113	± 10	MgO(E-98)	Similar to the above specimen except specimen packed to 0.64 volume fraction solid.
67	400	R	1966	368-1094	± 10	MgO(E-98)	Similar to the above specimen except specimen packed to 0.65 volume fraction solid.
68	400	R	1966	371-1095	± 10	MgO(E-227)	Similar to the above specimen except mean particle size 369 μ and were packed to 0.61 volume fraction solid; pore-free density 3.58 g cm^{-3} .
69	400	R	1966	378-1022	± 10	MgO(E-98)	Similar to the above specimen except mean particle size 268 μ and were packed to 0.58 volume fraction solid; run 34; pore-free density 3.59 g cm^{-3} .
70	400	R	1966	718-1099		MgO(E-98)	Similar to the above specimen except different run, No. 26.

DATA TABLE NO. 27 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 22</u>		<u>CURVE 26*</u>		<u>CURVE 31</u>		<u>CURVE 36 (cont.)*</u>		<u>CURVE 38 (cont.)</u>		<u>CURVE 43</u>		<u>CURVE 49 (cont.)*</u>	
409.2	0.0590	653.2	0.171	1423.2	0.0577	673.2	0.188	85.19	3.19	328.2	0.753	775.2	0.135
509.2	0.0757	773.2	0.134	1553.2	0.0628	773.2	0.167	86.73	3.035	353.2	0.686	789.2	0.106
610.2	0.0803	848.2	0.114	1593.2	0.0607	873.2	0.142	298.32	0.523	378.2	0.586	851.2	0.111
772.2	0.0946	943.2	0.102	1653.2	0.0628	973.2	0.126	300.30	0.571	433.2	0.490	859.2	0.113
<u>CURVE 23</u>		943.2 0.0996		1698.2 0.0556		1073.2 0.109		<u>CURVE 39</u>		533.2 0.342		873.2 0.0912	
298.2 0.0418		1023.2 0.0845		1743.2 0.0598		1173.2 0.0962		477.6 0.247		663.2 0.242		892.2 0.101	
<u>CURVE 24</u>		1113.2 0.0770		1793.2 0.0556		<u>CURVE 37</u>		589.8 0.196		798.2 0.188		894.2 0.106	
298.2 0.0251		1143.2 0.0795		1843.2 0.0661		2.40 0.167		703.2 0.154*		994.2 0.172		912.2 0.0925	
<u>CURVE 25</u>		1193.2 0.0770		1858.2 0.0669		2.93 0.255		795.4 0.134		994.2 0.151		942.2 0.0987	
400.2 0.189		1283.2 0.0732		1898.2 0.0795		4.81 1.25		920.4 0.111		1168.2 0.139		946.2 0.100	
448.2 0.185		1373.2 0.0661		1903.2 0.0736		6.59 3.05		1145.9 0.0801		<u>CURVE 44*</u>		956.2 0.102	
486.7 0.175		1458.2 0.0640		1923.2 0.0745		8.83 7.70		1361.5 0.0668*		395.9 0.00123		994.2 0.0916	
599.2 0.148		1513.2 0.0619		1948.2 0.0707		10.39 12.52		1593.7 0.0562		<u>CURVE 45</u>		1013.2 0.0774	
632.2 0.144		<u>CURVE 29*</u>		<u>CURVE 32</u>		13.17 19.61		1816.5 0.0687		398.2 0.00351		1023.2 0.0833	
668.2 0.136		748.2 0.121		1573.2 0.0628*		15.47 24.23		2042.6 0.0902		1101.2 0.0690		1038.2 0.0837	
756.2 0.116		893.2 0.107		1773.2 0.0644*		21.40 28.76		2263.7 0.139		1121.2 0.0674		1043.2 0.0761	
<u>CURVE 26*</u>		1033.2 0.0770		1813.2 0.0527		27.17 32.37		<u>CURVE 40</u>		<u>CURVE 46</u>		1191.2 0.0757	
573.2 0.203		1163.2 0.0732		1843.2 0.0577		34.02 28.46		293.2 0.360		379.8 0.00218		1121.2 0.0674	
873.2 0.115		1273.2 0.0703		1863.2 0.0473		47.02 13.48		673.2 0.163*		502.6 0.00270		1143.2 0.0795	
1473.2 0.0611		1373.2 0.0649		1863.2 0.0544		49.72 14.96		1273.2 0.0711*		769.3 0.00301		1153.2 0.0787	
<u>CURVE 27</u>		1473.2 0.0611		1863.2 0.0636		63.63 8.27		<u>CURVE 41</u>		894.3 0.00368		1175.2 0.0720	
103.2 2.49		1523.2 0.0598		1903.2 0.0753		78.19 4.79		319.2 0.619		<u>CURVE 47</u>		1196.2 0.0636	
111.2 2.97		<u>CURVE 30</u>		1988.2 0.0753		88.10 3.46		373.2 0.448		524.8 0.00880		1201.2 0.0761	
133.2 1.70		1283.2 0.0686*		2023.2 0.0678		133.34 1.50		456.2 0.346		651.0 0.00874		1223.2 0.0745	
153.2 1.28		1328.2 0.0787		<u>CURVE 33</u>		196.93 0.922		516.2 0.290		658.7 0.00886		1233.2 0.0657	
183.2 1.09		1448.2 0.0653		951.7 0.00761		304.75 0.584		618.2 0.218		838.7 0.00832		1270.2 0.0590	
243.2 0.753		1553.2 0.0602		<u>CURVE 34</u>		<u>CURVE 38</u>		755.2 0.152		922.1 0.00785		1281.2 0.0686	
303.2 0.544		1578.2 0.0586		980.7 0.00695		2.88 0.104		890.2 0.121		<u>CURVE 48*</u>		1293.2 0.0715	
343.2 0.460		1643.2 0.0586		<u>CURVE 35</u>		6.85 1.03		1036.2 0.0996		519.2 0.165		1301.2 0.0682	
383.2 0.418		1698.2 0.0598		1000.7 0.00925		9.39 1.60		<u>CURVE 42*</u>		679.2 0.135		1356.2 0.0548	
443.2 0.377		1773.2 0.0669		<u>CURVE 36*</u>		15.02 4.48		373.2 0.360		755.2 0.115		1358.2 0.0602	
463.2 0.356		1798.2 0.0523		313.2 0.406		15.36 5.23		473.2 0.280		<u>CURVE 49*</u>		1368.2 0.0640	
483.2 0.335		1848.2 0.0628		373.2 0.326		23.44 8.80		673.2 0.159		665.2 0.171		1368.2 0.0653	
		1873.2 0.0657		473.2 0.262		24.92 9.29		873.2 0.113		715.2 0.146		1383.2 0.0653	
		1898.2 0.0669		573.2 0.218		37.70 10.39		1073.2 0.088		755.2 0.125		1394.2 0.0640	
		1908.2 0.0787		573.2 0.218		52.65 7.81				766.2 0.119		1426.2 0.0615	
						63.75 6.29						1443.2 0.0523	
						65.40 5.67*						1455.2 0.0635	
						83.09 3.40						1467.2 0.0632	
												1473.2 0.0606	

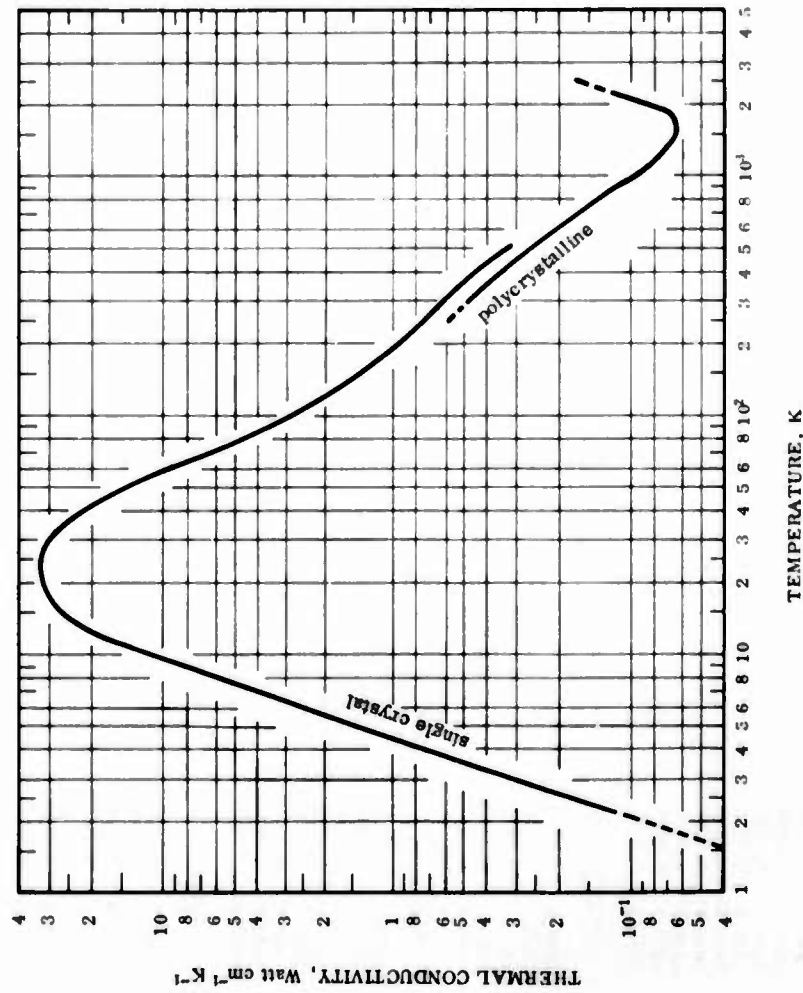
* Not shown on plot

DATA TABLE NO. 27 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 49 (cont.)*</u>													
1476.2	0.0565	1390.2	0.0343	973.2	0.00760	750.2	0.126	369.2	0.00495	998.2	0.00869		
1494.2	0.0515	1478.2	0.0366	1223.2	0.00809	883.2	0.107	418.2	0.00535	1047.2	0.00912		
1506.2	0.0606	1502.2	0.0337	<u>CURVE 58</u>				1035.2	0.0766	503.2	0.00628	1052.2	0.00886
1523.2	0.0565	1539.2	0.0326	473.2	0.00338*	1173.2	0.0736	601.2	0.00681	1087.2	0.00941		
1525.2	0.0615	1603.2	0.0310	1273.2	0.00690	1273.2	0.0690	693.2	0.00766	1095.2	0.00915		
1537.2	0.0577	1603.2	0.0301	1373.2	0.0642	1463.2	0.0607	798.2	0.00828	<u>CURVE 69*</u>			
1539.2	0.0556	1638.2	0.0314	563.2	0.00370	1463.2	0.0607	894.2	0.00874	378.2	0.00418		
1547.2	0.0573	1638.2	0.0314	623.2	0.00414	1506.2	0.0598	893.2	0.00884	415.2	0.00428		
1555.2	0.0510	<u>CURVE 54</u>				1099.2	0.00942	1099.2	0.00942	507.2	0.00528		
1570.2	0.0577	1301.2	0.0635	788.2	0.00486	<u>CURVE 62*</u>				605.2	0.00569		
1599.2	0.0586	1438.2	0.0464	973.2	0.00530	375.1	0.00433	<u>CURVE 66*</u>				707.2	0.00628
1615.2	0.0586	1438.2	0.0464	1023.2	0.00580	502.6	0.00502	366.2	0.00671	431.2	0.00709		
1618.2	0.0598	1558.2	0.0439	1198.2	0.00650	372.3	0.00552	568.2	0.00859	507.2	0.00696		
1624.2	0.0510	1638.2	0.0464	1273.2	0.00715	643.6	0.00604	622.2	0.00921	918.2	0.00730		
1629.2	0.0561	1713.2	0.0498	<u>CURVE 59</u>				724.0	0.00661	711.2	0.01000		
1639.2	0.0561	1813.2	0.0485	473.2	0.00330*	801.6	0.00689	716.2	0.01021	1022.2	0.00781		
1673.2	0.0586	1873.2	0.0439	573.2	0.00382	809.5	0.00666	814.2	0.01060	<u>CURVE 70*</u>			
<u>CURVE 50</u>													
1332.2	0.0388	1948.2	0.0510	653.2	0.00410	<u>CURVE 63*</u>				718.2	0.00657		
1383.2	0.0337	2023.2	0.0431	748.2	0.00444	373.2	0.00635	915.2	0.01108	719.2	0.00665		
1443.2	0.0285	2088.2	0.0431	811.2	0.00475	443.7	0.00717	1012.2	0.01163	721.2	0.00648		
1528.2	0.0343	2163.2	0.0410	918.2	0.00588	503.2	0.00786	1113.2	0.01158	820.2	0.00680		
1565.2	0.0372	<u>CURVE 55</u>				682.9	0.00981	<u>CURVE 67*</u>				918.2	0.00742
<u>CURVE 51</u>													
1221.2	0.0379	1358.2	0.0582*	1023.2	0.00508	368.2	0.00720	498.2	0.00892	1015.2	0.00771		
1251.2	0.0356	1473.2	0.0515	1063.2	0.00490	756.0	0.01005	596.2	0.00997	1098.2	0.00813		
1293.2	0.0368	1593.2	0.0502	1123.2	0.00600	842.4	0.01018	692.2	0.01086	1099.2	0.00802		
1369.2	0.0412	1678.2	0.0490	1173.2	0.00600	<u>CURVE 64*</u>				797.2	0.01086		
1407.2	0.0377	1773.2	0.0452	1263.2	0.00589	380.2	0.00420	892.2	0.01176	<u>CURVE 68*</u>			
1443.2	0.0350	2063.2	0.0464	1308.2	0.00650	413.2	0.00431	1094.2	0.01269	371.2	0.00482		
1451.2	0.0316	2122.2	0.0423*	<u>CURVE 60*</u>				509.2	0.00529	433.2	0.00533		
1492.2	0.0337	460.2	0.171	769.2	0.135	603.2	0.00567	702.2	0.00632	528.2	0.00624		
<u>CURVE 52</u>													
1219.2	0.0454	463.2	0.00530	853.2	0.114	718.2	0.00658	719.2	0.00643	628.2	0.00699		
1252.2	0.0420	633.2	0.00666	944.2	0.102	805.2	0.00690	805.2	0.00690	699.2	0.00750		
1273.2	0.0396	783.2	0.00780	991.2	0.0929	818.2	0.00673	818.2	0.00673	724.2	0.00756		
1288.2	0.0370*	1043.2	0.00917	1033.2	0.0854	821.2	0.00698	917.2	0.00739	799.2	0.00788		
1320.2	0.0368*	1258.2	0.0101	1113.2	0.0770	1016.2	0.00769	799.2	0.00823	897.2	0.00837		
1352.2	0.0379*	<u>CURVE 57*</u>				1193.2	0.0770	1094.2	0.00811	898.2	0.00854		
1357.2	0.0383	573.2	0.00582	1283.2	0.0728	1373.2	0.0661	898.2	0.00868	998.2	0.00905		
1409.2	0.0360	698.2	0.00634	1453.2	0.0636	1511.2	0.0619						

* Not shown on plot

FIGURE AND TABLE NO. 27R RECOMMENDED THERMAL CONDUCTIVITY OF MAGNESIUM OXIDE MgO



T ₁	k ₁	k ₂	T ₂
0	0	0	-459.7
1	(0.012) †	(0.693)	-457.9
5	1.55	89.6	-450.7
10	11.7	676	-441.7
15	26.9	1550	-432.7
20	32.5	1880	-423.7
25	33.1	1910	-414.7
30	30.9	1790	-405.7
35	26.5	1530	-396.7
40	21.6	1250	-387.7
50	14.2	820	-369.7
60	9.3	537	-351.7
70	6.3	364	-333.7
80	4.5	260	-315.7
90	3.4	196	-297.7
100	2.7	156	-279.7
150	1.35	78.0	-189.7
200	0.94	54.3	-99.7
250	0.73	42.2	-9.7
273.2	0.665	38.4	32.0
300	0.600	34.7	80.3
350	0.507	29.3	170.3
400	0.431	24.9	260.3
450	0.37	21.4	350.3
500	0.32	18.5	440.3

RECOMMENDED VALUES*
(99.96% Pure Single Crystal)

REMARKS

The recommended values for 99.96% pure single crystal are thought to be accurate to within 10 to 15% of the true values at temperatures above 60 K, and the values below 60 K are intended as typical values for indicating the general trend.

The recommended values for 99.5% pure, 98% dense, polycrystalline MgO are thought to be accurate to within 8% of true values at temperatures from 500 to 1000 K and 8 to 15% at other temperatures.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹. † Values in parentheses are extrapolated.

TABLE NO. 27R (continued)

99.5% Pure, 98% Dense, Polycrystalline Mgo

T_1	k_1	k_2	T_2
0	0	0	-459.7
250	(0.58)*	(33.5)	- 9.7
273.2	(0.53)	(30.6)	32.0
300	0.484	28.0	80.3
350	0.412	23.8	170.3
400	0.356	20.6	260.3
500	0.269	15.5	440.3
600	0.207	12.0	620.3
700	0.165	9.53	800.3
800	0.134	7.74	980.3
900	0.112	6.47	1160
1000	0.097	5.60	1340
1100	0.085	4.91	1520
1200	0.077	4.45	1700
1300	0.072	4.16	1880
1400	0.068	3.93	2060
1500	0.065	3.76	2240
1600	0.064	3.70	2420
1700	0.064	3.70	2600
1800	0.066	3.81	2780
1900	0.074	4.28	2960
2000	0.085	4.91	3140
2100	0.099	5.72	3320
2200	0.115	6.64	3500
2300	0.132	7.63	3680
2400	(0.150)	(8.67)	3860
2500	(0.170)	(9.82)	4040

* T_1 in K, k_1 in Watt $\text{cm}^{-1} \text{K}^{-1}$, T_2 in F, and k_2 in Btu $\text{hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$.

† Values in parentheses are extrapolated.

THERMAL CONDUCTIVITY OF
MANGANESE OXIDE
MnO

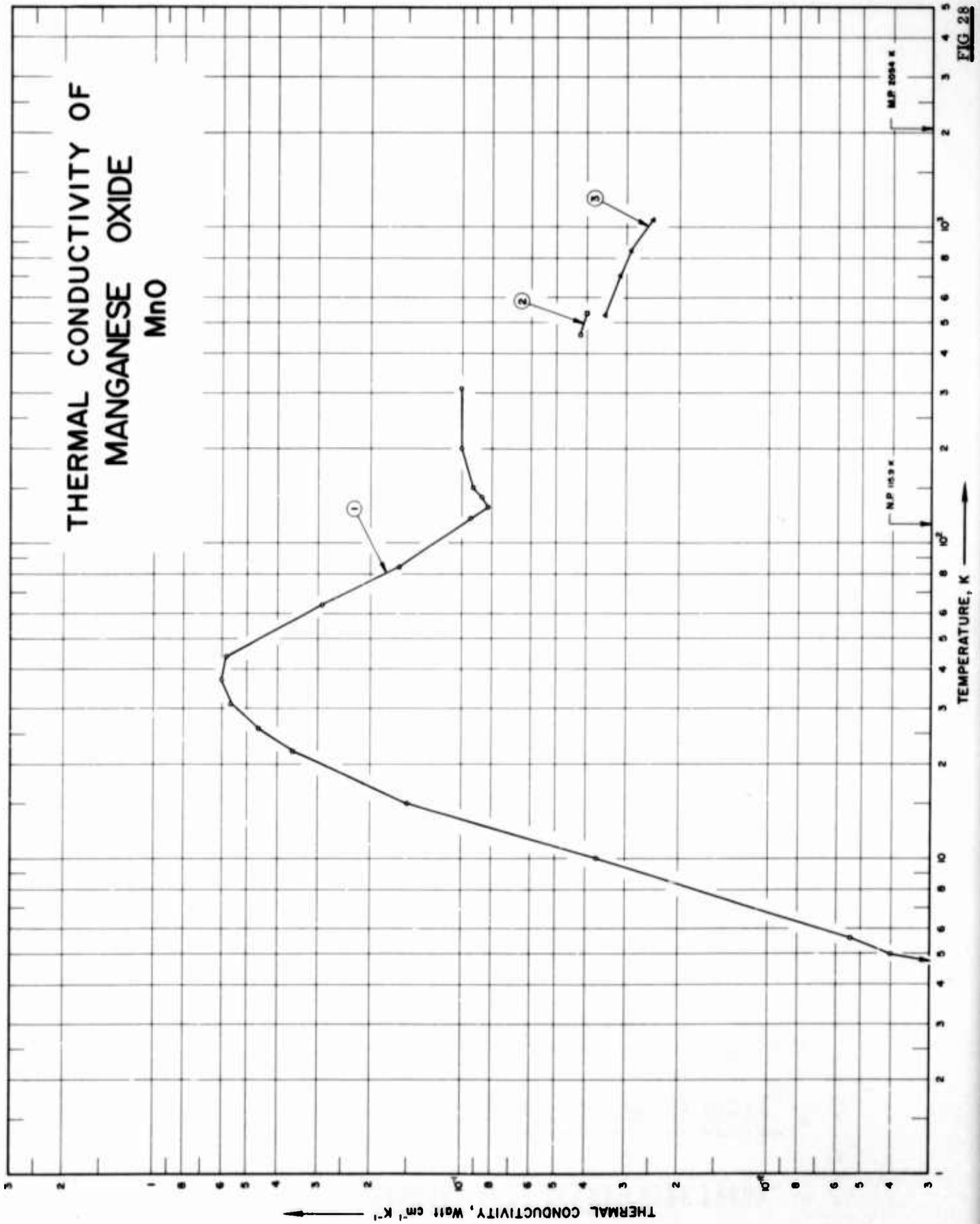


FIG 28

SPECIFICATION TABLE NO. 28 THERMAL CONDUCTIVITY OF MANGANESE OXIDE MnO

[For Data Reported in Figure and Table No. 28]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	64	L	1958	4-310	8		Single c.; stal; grown by the Verneuil process; dia 0.5 cm, length 2 cm; unannealed.
2	323	C	1961	458, 538	12		0.5 in. dia and 0.5 in. long; dense, polycrystalline Al ₂ O ₃ used as comparative material; measured in air.
3	323	C	1961	526-1053	15		0.5 in. dia and 0.5 in. long; fused SiO ₂ used as comparative material; measured in air.

DATA TABLE NO. 28 THERMAL CONDUCTIVITY OF MANGANESE OXIDE MnO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
CURVE 1			
4.0	0.0011*	458.2	0.0420
5.0	0.0040	538.2	0.0400
5.6	0.0054	CURVE 3	
10.0	0.037	526.2	0.0350
15.0	0.15	703.2	0.0315
22.0	0.36	843.2	0.0290
26.0	0.46	1053.2	0.0245
31.0	0.56		
37.0	0.60		
44.0	0.58		
64.0	0.29		
84.0	0.16		
120.0	0.094		
130.0	0.082		
140.0	0.086		
150.0	0.092		
200.0	0.10		
310.0	0.10		

* Not shown on plot

SPECIFICATION TABLE NO. 29 THERMAL CONDUCTIVITY OF TRIMANGANESE TETRAOXIDE Mn_2O_4

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	23		1952	325-400		134A	Fired at 1547 K; water absorption 0.024%; density 4.21 g cm ⁻³ .

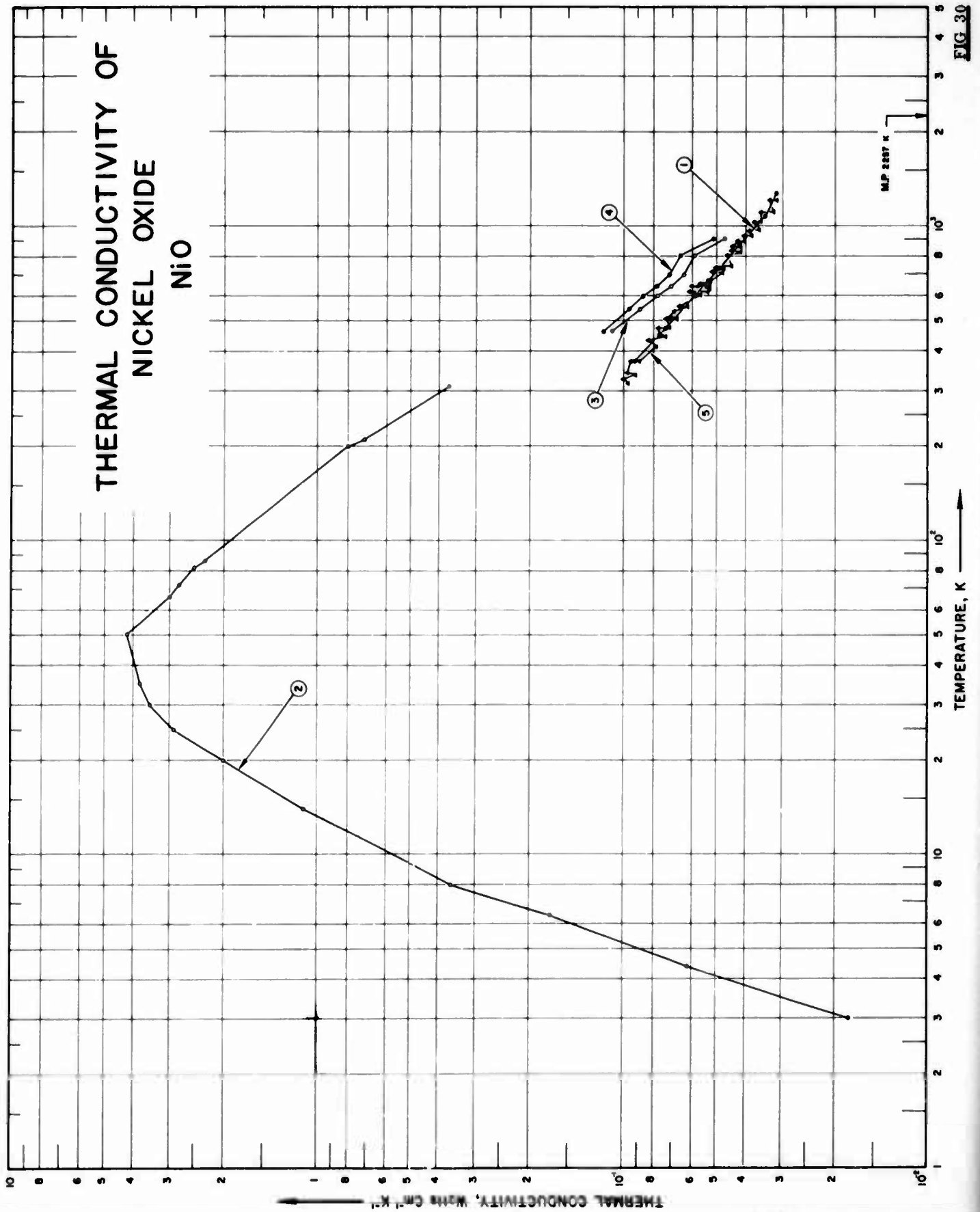
DATA TABLE NO. 29 THERMAL CONDUCTIVITY OF TRIMANGANESE TETRAOXIDE Mn_2O_4 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
317.6	0.0343
341.2	0.0351
360.0	0.0356
381.3	0.0356
399.7	0.0347

CURVE 1*

* No graphical presentation

THERMAL CONDUCTIVITY OF NICKEL OXIDE NiO



SPECIFICATION TABLE NO. 30 THERMAL CONDUCTIVITY OF NICKEL OXIDE NiO

[For Data Reported in Figure and Table No. 30]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent).	Specifications and Remarks
1	329	C	1953	373-1273				Polycrystal; prepared by calcining chemically pure NiO at 1000 C, hydrostatically pressing, and firing at 1500 C in oxidizing atmosphere; bulk density 5.05 g cm ⁻³ ; porosity 25.7%.
2	64	L	1958	30-310	±8			Single crystal; grown by the Verneuil process; specimen 0.5 cm dia, 2 cm long.
3	65	C	1958	467-913	±2			Sintered specimen; prepared from calcined (at 1000 C for 1 hr), ball milled (in steel mill with steel balls for 8 hrs) and lubricated (with stearic acid, also used as binder) -325 mesh chemical pure NiO powder; sintered at 1500 C for 4 hrs in an oxidizing atmosphere; bulk density 6.00 g cm ⁻³ ; porosity 11.5%; alumina (Body Al-300) used as standard.
4	65	C	1958	467-913	±2			The above specimen measured with another alumina standard.
5	73	C	1954	318-1209				Bulk density 5.05 g cm ⁻³ ; total porosity 32%.

DATA TABLE NO. 30 THERMAL CONDUCTIVITY OF NICKEL OXIDE NiO
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 4 (cont.)</u>		<u>CURVE 5 (cont.)</u>	
373.2	0.0920	806.2	0.0657	933.-	0.0381
473.2	0.0736	913.2	0.0510	968.2	0.0392
673.2	0.0531	<u>CURVE 5</u>		972.2	0.0360
873.2	0.0418	318.2	0.0966	1035.2	0.0377
1073.2	0.0343	326.2	0.100	1038.2	0.0356
1273.2	0.0314	336.2	0.0914	1112.2	0.0356
<u>CURVE 2</u>		343.2	0.0975	1114.2	0.0323
3.0	0.018	373.2	0.0949	1208.2	0.0315
4.4	0.062	373.2	0.0886	1209.2	0.0334
6.4	0.17	414.2	0.0787		
8.0	0.36	432.2	0.0833		
14	1.1	446.2	0.0732		
20	2.0	451.2	0.0764		
25	2.9	476.2	0.0771		
30	3.5	478.2	0.0715		
35	3.8	509.2	0.0736		
50	4.2	509.2	0.0677		
65	3.0	516.2	0.0711		
72	2.8	536.2	0.0690		
82	2.5	552.2	0.0624		
86	2.3	557.2	0.0669		
200	0.80	603.2	0.0562		
210	0.71	619.2	0.0616		
310	0.37	620.2	0.0533		
<u>CURVE 3</u>		635.2	0.0628		
467.2	0.108	646.2	0.0602		
546.2	0.0883	647.2	0.0525		
597.2	0.0778	657.2	0.0569		
643.2	0.0703	673.2	0.0527		
700.2	0.0640	712.2	0.0475		
806.2	0.0590	713.2	0.0519		
913.2	0.0469	738.2	0.0473		
<u>CURVE 4</u>		740.2	0.0502		
467.2	0.116	749.2	0.0446		
546.2	0.0962	803.2	0.0461		
597.2	0.0862	827.2	0.0418		
643.2	0.0782	832.2	0.0447		
700.2	0.0711	862.2	0.0418		
		863.2	0.0444		
		895.2	0.0427		
		896.2	0.0403		
		931.2	0.0408		

THERMAL CONDUCTIVITY OF
SILICON DIOXIDE (CRYSTALLINE)
SiO₂

FIGURE SHOWS ONLY 46 OF THE CURVES REPORTED IN TABLE

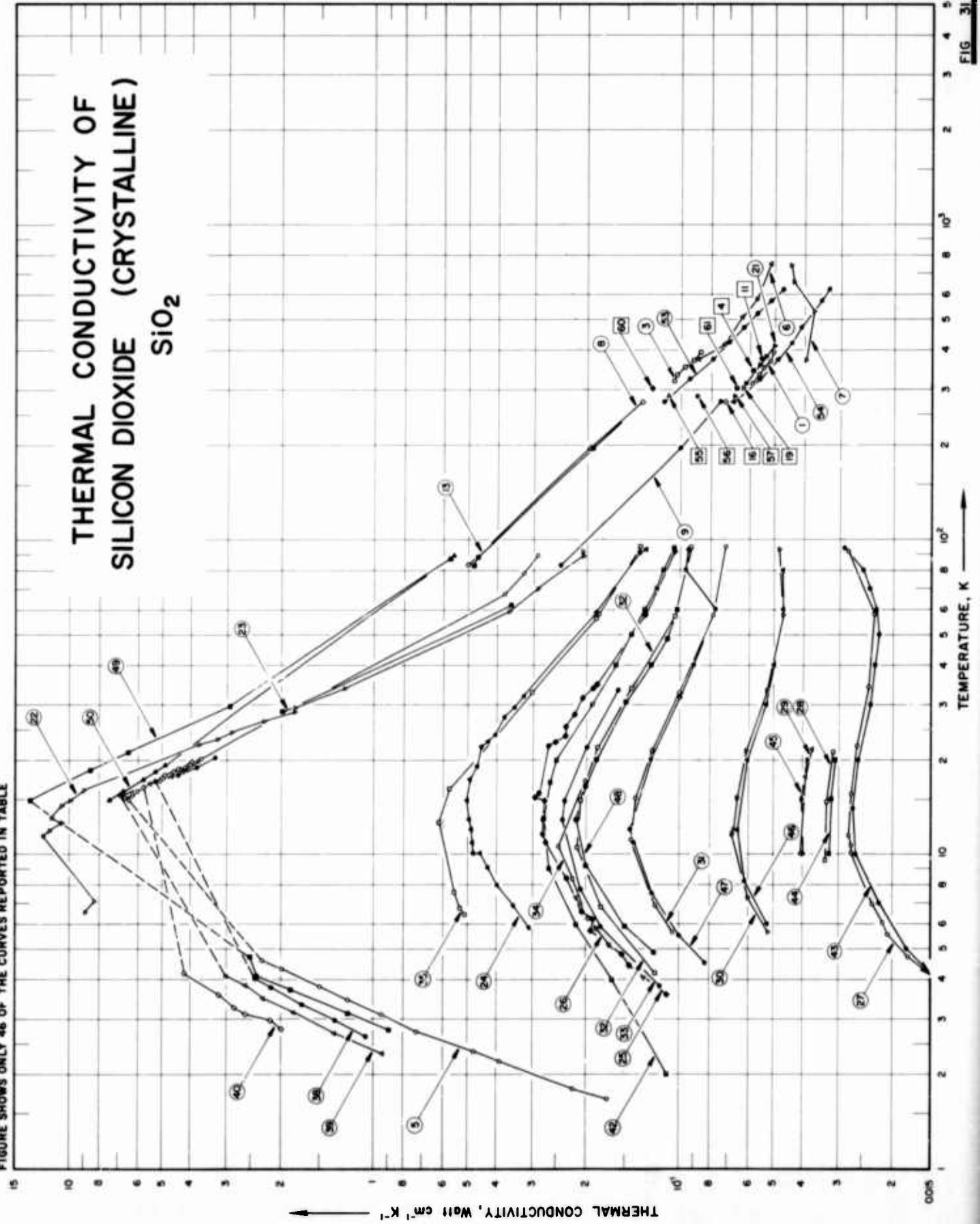


FIG. 31

SPECIFICATION TABLE NO. 31 THERMAL CONDUCTIVITY OF SILICON DIOXIDE (CRYSTALLINE) SiO₂

[For Data Reported in Figure and Table No. 31]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	23, 35	C	1952	314-394		162A-2	Clear; ground and polished; free from twinning and inclusions; the base of the 0.5 in. cylindrical specimen coated with a special silver paste (No. 45a); c-axis perpendicular to direction of heat flow.
2	23, 35	C	1952	313-390		162B-2	Similar to the above specimen.
3	23, 35	C	1952	318-395		162C-2	Similar to the above specimen except c-axis parallel to direction of heat flow.
4	13	C	1953	343.2	± 3		Measured perpendicular to optical axis; density = 2.6 g cm ⁻³ ; Armco iron used as the comparative standard.
5	32	L	1937	1.7-89			Length 3.20 cm and dia 0.216 cm, measured perpendicular to the principal axis and in the direction of a binary axis.
6	34	C	1943	373-748		domestic (USA)	1-cm colorless cube; cut from a single crystal; heat flow direction parallel to the c-axis; 18-8 stainless steel used as comparative material.
7	34	C	1943	370-741		domestic (USA)	The above specimen measured with heat flow direction perpendicular to the c-axis.
8	22	L	1911	83-373		1	Single crystal; 3.00 x 3.00 x 2.60 cm; measured parallel to the principal axis in hydrogen.
9	22	L	1911	83-273		1	Above specimen measured perpendicular to the principal axis in hydrogen.
10	22	L	1911	195, 273		1	Same as above.
11	22	L	1911	373.2		1	Same as the above specimen except measured in carbon dioxide.
12	22	L	1911	373.2		1	Same as above.
13	22	L	1911	83-273		2	Single crystal; 3.00 x 3.00 x 2.08 cm; measured parallel to the principal axis in hydrogen.
14	22	L	1911	83-273		2	Same as above.
15	22	L	1911	83, 273		2	Above specimen measured perpendicular to the principal axis in hydrogen.
16	22	L	1911	273.2		2	Same as above.
17	22	L	1911	83-273		3	Single crystal; 3.00 x 3.00 x 2.00 cm; measured perpendicular to the principal axis in hydrogen.
18	22	L	1911	273, 373		3	Same as above.
19	222	L	1959	123-323	± 2~± 5		Single crystal; heat-flow at 90 degrees to the optic axis.
20	68	C	1954	314-415	± 3	162D-1	Natural single crystal of hexagonal type; measured along c-axis.
21	68	C	1954	315-413	± 3	162E-1	The above specimen measured along a-axis.
22	69	L	1951	6.6-92		No. 1	Single crystal; 3.05 x 0.50 x 0.50 cm; measured perpendicular to the principal axis.
23	69	L	1951	29, 62		No. 2	Similar to the above specimen except length 2.15 cm.

SPECIFICATION TABLE NO. 31 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
24	69	L	1951	5.8-93			The above specimen No. 1 irradiated in the Harwell pile with a dose of 1.8×10^{18} thermal neutron cm^{-2} .
25	69	L	1951	3.0-92			Same as the above specimen but irradiated with a dose of 2.5×10^{18} thermal neutron cm^{-2} .
26	69	L	1951	4.0-7.3			The above specimen subsequently heated at 100 C for 3 weeks.
27	69	L	1951	3.3-92			The above specimen irradiated with a dose of 29.7×10^{18} thermal neutron cm^{-2} .
28	69	L	1951	9.6-21			The above specimen heated at 300 C for 8 hrs.
29	69	L	1951	10-22			The above specimen heated at 400 C for 6 hrs.
30	69	L	1951	5.7-93			The above specimen heated at 510 C for 6 hrs.
31	69	L	1951	5.6-95			The above specimen heated at 565 C for 6 hrs.
32	69	L	1951	4.2-94			The above specimen heated at 540 C for 60 hrs.
33	69	L	1951	3.8-94			The above specimen heated at 540 C for 677 hrs.
34	69	L	1951	6.3-22			The above specimen heated at 600 C for 1 hr.
35	69	L	1951	6.5-95			The above specimen heated at 700 C for 6 hrs.
36	125	L	1923	298.2	1		Single crystal 0.253 cm thick with heat flow perpendicular to the principal axis of the crystal and measured under pressure of 21 lb in^{-2} .
37	125	L	1923	313.2	1		Single crystal 0.253 cm thick with heat flow parallel to the principal axis of the crystal and measured under pressure of 21 lb in^{-2} .
38	224	L	1938	2.6-20		II A	Length 4.48 cm, dia 0.359 cm; measured perpendicular to the principal axis.
39	224	L	1938	2.3-20		II	Length 4.80 cm, dia 0.454 cm; measured perpendicular to the principal axis.
40	224	L	1938	2.7-20			Length 4.40 cm, dia 0.775 cm; measured perpendicular to the principal axis.
41	225	L	1938	1.7-20			Specimen dia 0.216 cm; heat flow in the direction of the bisector of the angle between the two binary axes.
42	226	L	1950	2-94			Single crystal; irradiated with cumulative irradiation dose $2.4 \times 1.8 \times 10^{18}$ neutrons cm^{-2} .
43	226	L	1950	3.5-94			The above specimen irradiated again with cumulative irradiation dose $19 \times 1.8 \times 10^{18}$ neutrons cm^{-2} .
44	226	L	1950	10-20			The above specimen annealed at 300 C for 8 hrs.
45	226	L	1950	10-20			The above specimen annealed at 400 C for 6 hrs.
46	226	L	1950	6-92			The above specimen annealed at 510 C for 6 hrs.
47	226	L	1950	4.5-93			The above specimen annealed at 565 C for 6 hrs.

SPECIFICATION TABLE NO. 31 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
48	226	L	1950	4.9-93		Rod I	The above specimen annealed at 540 C for 60 hrs.
49	227, 308	L	1936	2.8-87			Specimen length 5.9 cm, dia 0.308 cm in the first part of the measurement, later cut to 3.033 cm in length and 0.1336 cm in dia when being measured at lower temperatures; heat flow parallel to the c-axis of the crystal.
50	308, 227	L	1935	15-89		Rod II	Specimen 5.58 cm in length and 0.1356 cm in dia cut out of the same crystal as the above specimen Rod I; heat flow parallel to the c-axis of the crystal.
51	308, 227	L	1935	15-20		Rod II	The above specimen heated at 340 C for 8 hrs.
52	308, 227	L	1935	15-20		Rod II	The above specimen again heated at 570 C for 5 hrs.
53	303	L	1940	273-623			Single crystal; less than 0.01 Cu; measured with heat flow direction parallel to the optic axis; specimen 0.250 in. thick and 1.500 in. dia cut from a single crystal about a foot long with well-developed external form, obtained from the Harvard Mineralogical Museum; the whole crystal perfectly transparent except for a few visible fractures; deviation from the intended orientation less than one degree; density 2.652 g cm ⁻³ .
54	303	L	1940	273-623		I	As above but heat flow direction perpendicular to the optic axis.
55	324		1884	285		II	Heat flow direction parallel to the optic axis.
56	324		1884	285		III	Heat flow direction at 45 degrees with the optic axis.
57	324		1884	285			Heat flow direction perpendicular to the optic axis.
58	140	C	1926	341, 378			Clear quartz (rock crystal) of 1.25 in. in dia and 0.10 in. thick; the faces of the disc were made optically flat and parallel; heat flow direction parallel to the optic axis; aluminum (99.75 pure) used as comparative material.
59	140	C	1926	373, 379			As above but heat flow direction perpendicular to the optic axis.
60	325	C	1892	301.8			Quartz disc 1.91 cm dia and 1.065 cm thick; heat flow direction parallel to the optic axis; brass used as comparative material.
61	325	C	1892	302.8			Quartz disc 1.93 cm dia and 0.811 cm thick; heat flow direction perpendicular to the optic axis; brass used as comparative material.
62	326	R	1952	373-723		I	Powder; derived from coarse grain quartz of about 50% grains of 0.3 mm dia, 40% of 0.6 mm and 10% of 1 mm dia; density 0.54 g cm ⁻³ .
63	326	R	1952	423-863		II	Powder; derived from coarse grain quartz of 1.0-1.8 mm dia; density 0.44 g cm ⁻³ .
64	326	R	1952	378-893		III	Coarse grains of cylindrical form of 3 mm dia and 3-7 mm long; density 0.45 g cm ⁻³ .
65	327	R	1958	313-868		Quartz	Powder; grain size 100-200 μ; density 1.35 g cm ⁻³ ; measured in a vacuum of 5 x 10 ⁻³ mm Hg.
66	327	R	1958	453-677		Quartz	Above specimen measured in a vacuum of 0.5 mm Hg.

SPECIFICATION TABLE NO. 31 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
67	327	R	1958	370-585		Quartz	Above specimen measured under a pressure of 1 atm.
68	328	P	1957	303.2	<7	Quartz; 7	3.49 cm dia and 0.952 cm thick; heat flow perpendicular to optic axis of crystal-line quartz; thermal conductivity values calculated from author's experimental data of thermal diffusivity and specific heat.
69	328	P	1957	303.2	<7	Quartz; 8	Similar to the above specimen but the thickness, 0.635 cm.
70	330	C	1957	298.2	±6		1.375 in. dia x 0.25 in. thick; measured with thermal comparator No. 4; heat flow perpendicular to c-axis.
71	330	C	1957	298.2	±6		Similar to the above specimen but measured with thermal comparator No. 5; loaded with 100 g weight.

DATA TABLE NO. 31 THERMAL CONDUCTIVITY OF SILICON DIOXIDE (CRYSTALLINE) SiO₂

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 5 (cont.)</u>		<u>CURVE 12*</u>		<u>CURVE 20*</u>		<u>CURVE 24</u>		<u>CURVE 25 (cont.)</u>		<u>CURVE 30</u>					
313.5	0.0594	18.89	4.16*	373.2	0.0554	313.9	0.108	5.85	0.311	33.6	0.190	5.66	0.0520				
333.6	0.0565	19.07	4.15*	<u>CURVE 13</u>		333.9	0.105	6.89	0.352	34.7	0.185	7.30	0.0600				
351.2	0.0544	20.12	3.69	359.6	0.0954	359.6	0.0954	7.96	0.398	57.7	0.130	11.6	0.0682				
369.9	0.0519	67.6	0.379	382.8	0.0891	382.8	0.0891	9.06	0.430	91.8	0.105	12.0	0.0671				
383.8	0.0506	78.0	0.325	414.6	0.0816	414.6	0.0816	10.1	0.458	15.1	0.0652	15.1	0.0652				
<u>CURVE 2*</u>		89.4	0.291	<u>CURVE 21</u>		10.1	0.484	<u>CURVE 26</u>		21.4	0.0610	32.1	0.0525				
312.5	0.0602	<u>CURVE 6</u>		314.5	0.0619	10.9	0.484	4.05	0.131	37.8	0.0469	57.8	0.0469				
336.0	0.0561	373.2	0.0887	338.2	0.0582*	12.0	0.489	5.18	0.169	93.3	0.0481	93.3	0.0481				
352.5	0.0540	418.2	0.0728	357.6	0.0561	12.9	0.496	5.81	0.186	<u>CURVE 31</u>							
370.0	0.0527	509.2	0.0640	381.3	0.0536	14.8	0.502	7.33	0.217	5.65	0.107	6.89	0.120				
389.9	0.0527	581.2	0.0573	412.6	0.0502	22.0	0.454	<u>CURVE 27</u>				11.2	0.143				
<u>CURVE 3</u>		748.2	0.0515	<u>CURVE 22</u>		24.1	0.407	3.33	0.0120*	11.2	0.143	15.1	0.139				
318.4	0.1060	<u>CURVE 7</u>		6.56	8.85	24.8	0.403*	4.17	0.0151*	21.3	0.123	21.3	0.123				
333.8	0.1030	370.2	0.0395	7.11	8.28	29.4	0.348	4.72	0.0178	32.7	0.100	32.7	0.100				
352.6	0.0971	373.2	0.0397*	11.5	12.2	31.8	0.324	5.55	0.0206	57.3	0.0785	57.3	0.0785				
370.4	0.0908	533.2	0.0370	11.9	11.6	59.2	0.187	6.04	0.0213	94.6	0.0715	94.6	0.0715				
394.6	0.0866	656.2	0.0435	12.6	10.6	90.8	0.137	6.90	0.0231	<u>CURVE 32</u>							
<u>CURVE 4</u>		741.2	0.0444	13.2	11.4	93.3	0.130	10.7	0.0271	4.23	0.121	6.82	0.178				
343.2	0.0586	<u>CURVE 8</u>		14.3	10.6	<u>CURVE 25</u>		11.5	0.0277	15.6	0.272	10.5	0.214				
<u>CURVE 5</u>		83.2	0.502	14.9	9.93	3.57	0.110	22.2	0.0261	34.0	0.0239	14.9	0.208				
1.67	0.171	195.2	0.197	16.0	8.97	4.44	0.146	22.2	0.0261	58.2	0.0229	21.9	0.183				
2.20	0.390	273.2	0.133	22.4	3.73	4.84	0.153	57.3	0.193	91.8	0.0280	33.7	0.143				
2.37	0.477	373.2	0.0900*	24.2	2.89	5.73	0.193	6.22	0.190	<u>CURVE 28</u>							
2.73	0.728	<u>CURVE 9</u>		26.5	2.27	6.56	0.206	6.56	0.206	9.55	0.0333	3.81	0.117				
3.10	0.943	83.2	0.243	28.4	1.82	8.41	0.232	8.41	0.232	14.7	0.0330	5.88	0.180				
3.45	1.22	83.2	0.250	29.2	1.82	10.9	0.272	10.9	0.272	21.2	0.0314	7.75	0.208				
3.81	1.50	195.2	0.103	33.7	1.25	11.7	0.277	11.7	0.277	14.7	0.0330	12.9	0.239				
4.33	1.99	273.2	0.0735	33.7	1.25	12.9	0.277	12.9	0.277	17.7	0.0392	14.8	0.236				
4.62	2.30	<u>CURVE 10*</u>		91.8	0.206	14.8	0.275	14.8	0.275	21.6	0.0372	21.9	0.199				
14.90	6.49	273.2	0.0728	<u>CURVE 23</u>		15.2	0.296	15.2	0.296	10.1	0.0407	33.9	0.158				
15.11	6.62	373.2	0.0567	28.3	1.98	15.7	0.288	15.7	0.288	17.7	0.0392	21.9	0.199				
15.38	6.29	<u>CURVE 19</u>		61.9	0.358	22.1	0.266	22.1	0.266	21.6	0.0372	33.9	0.158				
15.82	6.03	301.2	0.0630	<u>CURVE 24</u>		22.7	0.252	22.7	0.252	10.1	0.0407	33.9	0.158				
17.17	5.10	<u>CURVE 11</u>		27.9	0.219	23.9	0.234	23.9	0.234	17.7	0.0392	21.9	0.199				
18.80	4.22	373.2	0.0552	27.9	0.219	25.5	0.234	25.5	0.234	21.6	0.0372	33.9	0.158				
		373.2	0.0552	31.3	0.207	31.3	0.207	31.3	0.207	10.1	0.0407	33.9	0.158				

* Not shown on plot

DATA TABLE NO. 31 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 34</u>		<u>CURVE 39 (cont.)</u>		<u>CURVE 42</u>		<u>CURVE 46 (cont.)</u>		<u>CURVE 49 (cont.)</u>		<u>CURVE 54 (cont.)</u>		<u>CURVE 62 (cont.)*</u>	
6.28	0.197	15.40	6.85	2	0.110	8.2	0.0620	14.95	13.3	323.2	0.056	523.2	0.00188
8.36	0.221	15.99	6.08*	4	0.165	12	0.0655	18.55	8.58	373.2	0.049	553.2	0.00190
10.6	0.247	16.75	5.49	6	0.215	15.1	0.0655*	21.07	6.49	423.2	0.044	568.2	0.00201
22.2	0.201	17.75	4.68	9	0.264	20	0.0610	29.6	2.94	473.2	0.041	588.2	0.00209
<u>CURVE 35</u>		18.27	4.23	13	0.275	30	0.0530	86.9	0.570	523.2	0.037*	623.2	0.00218
6.47	0.511	19.81	3.76	17	0.261	40	0.0500	<u>CURVE 50</u>		573.2	0.035	673.2	0.00230
6.76	0.530	<u>CURVE 40</u>		20	0.250	60	0.0470	<u>CURVE 55</u>		623.2	0.033	693.2	0.00243
7.59	0.551	2.78	1.98	30	0.192	80	0.0470	14.82	7.46	<u>CURVE 63*</u>		723.2	0.00259
12.7	0.622	2.97	2.17	40	0.162	92	0.0485*	15.85	6.78				
16.1	0.575	3.11	2.61	50	0.144	<u>CURVE 47</u>		17.35	5.90				
22.0	0.451*	3.26	2.83	60	0.131	4.5	0.0830	18.32	5.27				
32.8	0.303	3.59	3.20	70	0.120	5.5	0.100	19.24	4.83	<u>CURVE 56</u>			
56.1	0.186	4.20	4.20	80	0.114	7.5	0.123	19.70	4.96*	285	0.0887		
58.1	0.184	4.20	5.78	94	0.105	10.8	0.142	19.90	4.90	<u>CURVE 57</u>			
94.8	0.136	17.32	5.21*	<u>CURVE 43</u>		12	0.145	<u>CURVE 51*</u>					
<u>CURVE 36*</u>		17.84	4.90	3.5	0.0125*	20	0.125	14.8	6.88				
<u>CURVE 37*</u>		18.36	4.59	5.0	0.0180	31.7	0.100	15.1	6.76				
298.2	0.0615	18.71	4.41	7.0	0.0220	40	0.0905	17.1	5.62	<u>CURVE 58*</u>			
<u>CURVE 38</u>		19.73	3.95	10	0.0263	60	0.0770	17.5	5.52				
313.2	0.102	<u>CURVE 41*</u>		14	0.0269	80	0.0965	19.8	4.60				
<u>CURVE 39</u>		1.67	0.171	20	0.0258	93	0.0940	20.1	4.53				
2.64	1.07	1.80	0.220	30	0.0235	<u>CURVE 48</u>		<u>CURVE 52*</u>					
2.96	1.34	2.20	0.390	40	0.0229	4.9	0.122	<u>CURVE 59*</u>					
3.33	1.71	2.37	0.477	50	0.0222	5.9	0.150	<u>CURVE 60</u>					
4.04	2.16	2.73	0.728	60	0.0227	9.2	0.200	343.6	0.0540				
17.08	5.26	3.10	0.943	70	0.0238	12.8	0.215	378.7	0.0485				
17.97	4.44	3.45	1.22	80	0.0250	16.5	0.200	<u>CURVE 61</u>					
18.96	3.82	3.81	1.50	94	0.0290	20.0	0.185	<u>CURVE 62*</u>					
20.32	3.30	4.33	1.99	<u>CURVE 44</u>		30.5	0.150	<u>CURVE 65*</u>					
<u>CURVE 39</u>		4.62	2.30	10	0.0325	40	0.125						
2.32	0.336	14.90	6.49	15	0.0320	48.5	0.111	273.2	0.114				
2.68	1.34	15.11	6.62	20	0.0310	60	0.103	323.2	0.094				
3.13	1.82	15.38	6.29	<u>CURVE 45</u>		80	0.0970*	373.2	0.079				
3.47	2.28	15.82	6.03	10	0.0400	93.3	0.0938*	423.2	0.070				
3.83	2.59	17.17	5.10	15	0.0401	<u>CURVE 49</u>		473.2	0.063				
4.10	3.02	18.80	4.22	20	0.0385	2.77	0.893	523.2	0.057				
<u>CURVE 39</u>		18.99	4.16	15	0.0401	3.12	1.22	573.2	0.0515				
2.68	0.336	19.07	4.16	20	0.0385	3.71	1.87	<u>CURVE 54</u>					
3.13	1.82	20.12	3.69	6	0.0525	4.09	2.39	373.2	0.00178				
3.47	2.28					4.74	3.51	413.2	0.00178				
3.83	2.59							423.2	0.00178				
4.10	3.02							443.2	0.00178				
								483.2	0.00184				
								503.2	0.00186				
								573.2	0.00186				
								617.2	0.000448				
								667.2	0.000515				

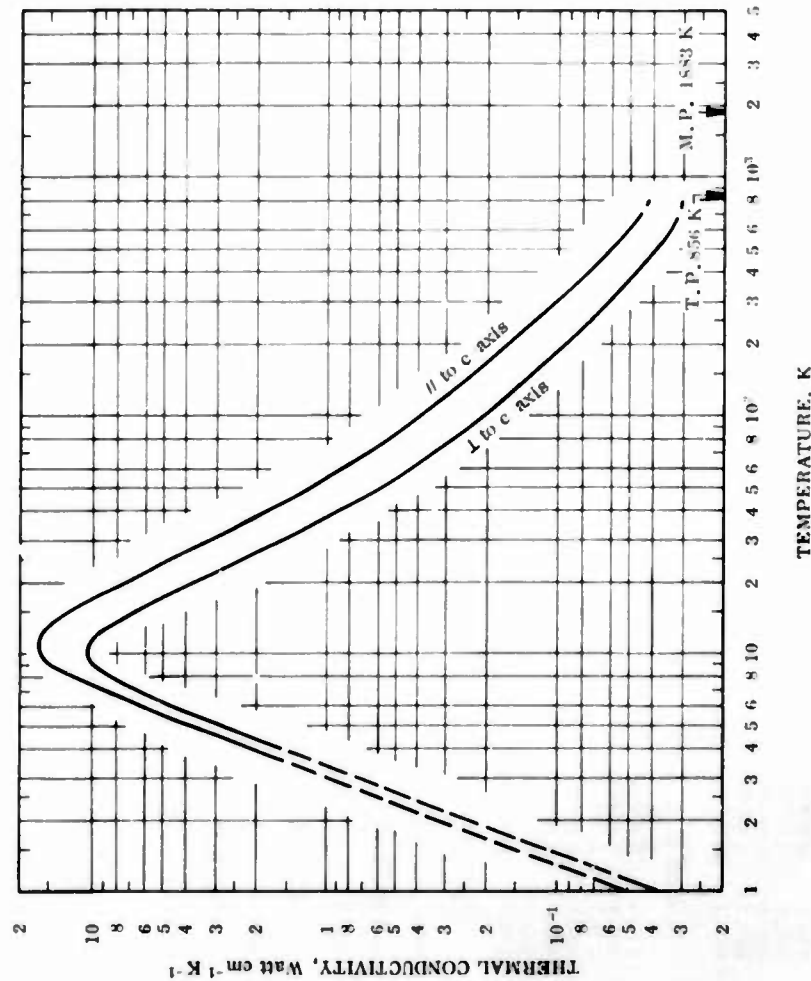
* Not shown on plot

DATA TABLE NO. 31 (continued)

T	k
<u>CURVE 65 (cont.)*</u>	
713.2	0.000669
811.2	0.000753
863.2	0.000812
868.2	0.000837
<u>CURVE 66*</u>	
453.2	0.00136
533.2	0.00133
593.2	0.00138
608.2	0.00140
677.2	0.00149
<u>CURVE 67*</u>	
370.2	0.00481
389.2	0.00473
408.2	0.00477
461.2	0.00485
490.2	0.00490
533.2	0.00490
585.2	0.00485
<u>CURVE 68*</u>	
303.2	0.0678
<u>CURVE 69*</u>	
303.2	0.0670
<u>CURVE 70*</u>	
298.2	0.067
<u>CURVE 71*</u>	
298.2	0.067

*Not shown on plot

FIGURE AND TABLE NO. 31R RECOMMENDED THERMAL CONDUCTIVITY OF SILICON DIOXIDE (CRYSTALLINE) SiO₂



T ₁	RECOMMENDED VALUES* Quartz Single Crystal		T ₂
	(// to c-axis)	(⊥ to c-axis)	
	k ₁	k ₂	
0	0	0	-459.7
1	(0.05) ‡	(2.89)	-457.9
5	4.0	231	-450.7
7	9.0	520	-447.1
8	12.1	699	-445.3
9	15.0	867	-443.5
10	16.5	953	-441.7
11	16.8	971	-439.9
12	16.3	942	-438.1
13	15.2	878	-436.3
15	12.5	722	-432.7
20	7.2	416	-423.7
25	4.6	266	-414.7
30	3.18	184	-405.7
35	2.33	135	-396.7
40	1.79	103	-387.7
45	1.43	82.6	-378.7
50	1.18	68.2	-369.7
60	0.85	49.1	-351.7
70	0.66	38.1	-333.7
80	0.54	31.2	-315.7
90	0.45	26.0	-297.7
100	0.39	22.5	-279.7
150	0.231	13.3	-189.7
200	0.164	9.48	-99.7
250	0.127	7.34	-
273	0.116	6.70	32
300	0.104	6.01	80.3
350	0.088	5.08	170.3
400	0.076	4.39	260.3
450	0.067	3.87	350.3
500	0.060	3.47	440.3
600	0.050	2.89	620.3
700	0.0447	2.58	800.3
800	(0.0429)	(2.43)	980.3

REMARKS

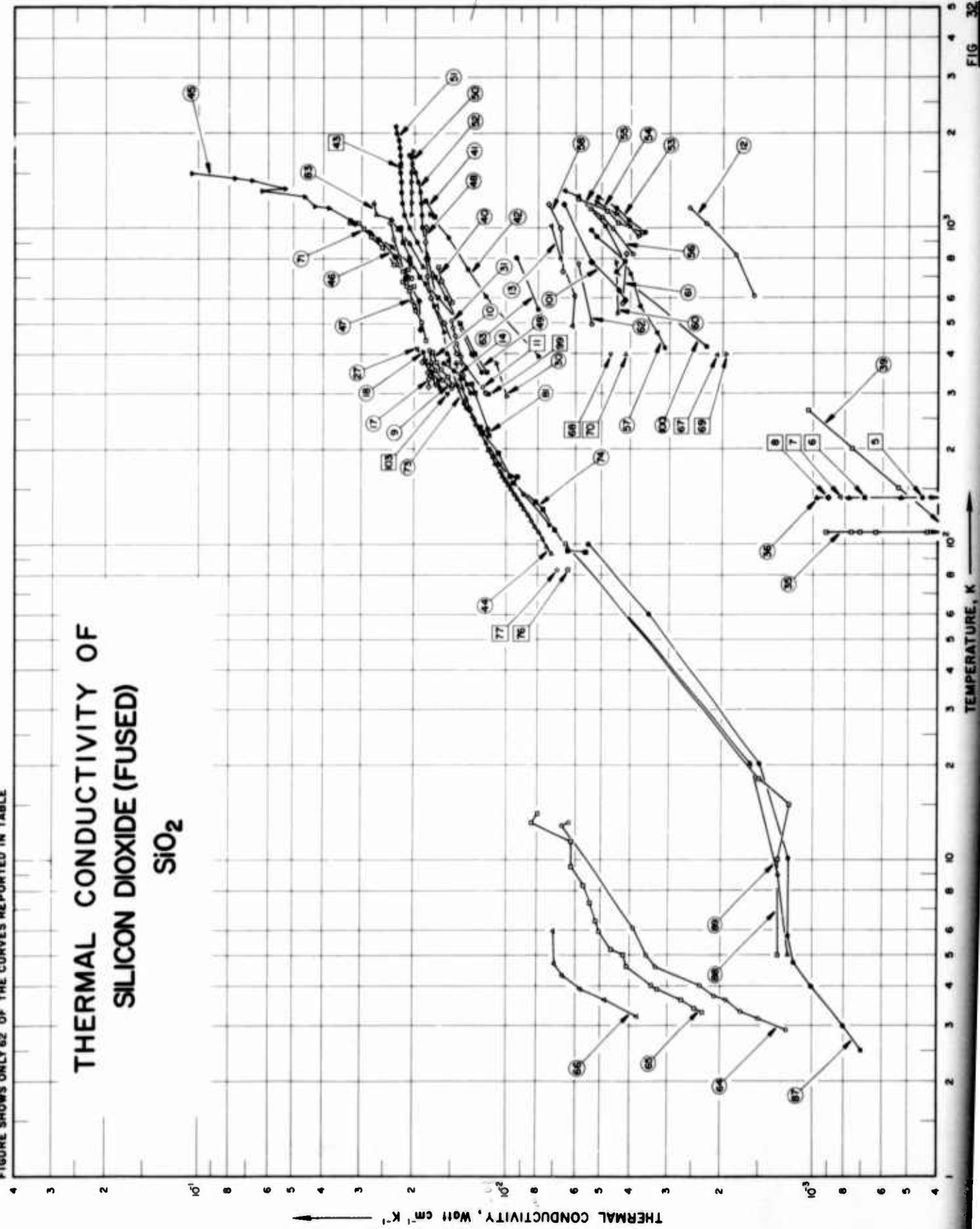
The recommended values are for high-purity quartz single crystal. The recommended values that are supported by experimental data are thought to be accurate to within 5% of the true values at temperatures from 300 to 500 K and 5 to 10% at other temperatures above 20 K. The thermal conductivity near and below the corresponding temperature of its maximum is highly sensitive to small physical and chemical variations of the specimens, and the recommended values below 20 K are intended as typical values for indicating the general trend.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹.

‡ Values in parentheses are extrapolated.

FIGURE SHOWS ONLY 62 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF SILICON DIOXIDE (FUSED) SiO₂



SPECIFICATION TABLE NO. 32 THERMAL CONDUCTIVITY OF SILICON DIOXIDE (FUSED) SiO_2

[For Data Reported in Figure and Table No. 32]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	41	L	1948	140.0		Linde Silica	Measured in the presence of helium gas at pressure of 0.0016 mm Hg.
2	41	L	1948	140.3		Linde Silica	Measured in the presence of helium gas at pressure of 0.139 mm Hg.
3	41	L	1948	140.3		Linde Silica	Measured in the presence of helium gas at pressure of 1.304 mm Hg.
4	41	L	1948	140.4		Linde Silica	Measured in the presence of helium gas at pressure of 16.0 mm Hg.
5	41	L	1948	140.6		Linde Silica	Measured in the presence of helium gas at pressure of 51.0 mm Hg.
6	41	L	1948	140.5		Linde Silica	Measured in the presence of helium gas at pressure of 208.0 mm Hg.
7	41	L	1948	140.6		Linde Silica	Measured in the presence of helium gas at pressure of 408.0 mm Hg.
8	41	L	1948	140.6		Linde Silica	Measured in the presence of helium gas at pressure of 597.5 mm Hg.
9	3	L	1953	311-412		53R-1	Silky fused vitreous silica; cylindrical specimen with silky lines parallel to the specimen axis.
10	3	L	1953	317-406		53J-1	Silky fused vitreous silica; cylindrical specimen with silky lines perpendicular to the specimen axis.
11	312	C	1950	314.2		Fused Silica	High optical homogeneity variety "Homosil", manufactured by the W. C. Heraeus Co. of Hanau, Germany; 10 mm ² cross sectional area and 2-10 mm thick; crystalline quartz used as standard reference.
12	313	L	1959	611-1165		Foamed fused silica	9 in. dia x 1 in. thick; fired; density 46 lb ft ⁻³ (0.74 g cm ⁻³).
13	313	L	1959	489-1002		Slip cast fused silica	Similar to the above specimen except density 117 lb ft ⁻³ (1.91 g cm ⁻³).
14	42		1953	322-375		53M-1	Vitreous; 0.350 in. in dia and 0.499 in. in length.
15	42		1953	318-408		53P-1	Vitreous; 0.449 in. in dia and 0.498 in. in length.
16	42		1953	319-373		53J-1	Vitreous; 0.251 in. in dia and 0.250 in. in length.
17	42		1953	314-375		53L-1	Vitreous; 0.303 in. in dia and 0.500 in. in length.
18	42		1953	314-406		53N-1	Vitreous; 0.409 in. in dia and 0.500 in. in length.
19	42		1953	319-394		53Q-1	Vitreous; 0.500 in. in dia and 0.500 in. in length.
20	42		1953	318-397		53Q-2	Vitreous; 0.500 in. in dia and 0.499 in. in length.
21	23,35		1952	319-394		53C-2	Clear vitreous silica sample with a clear platinum alloy glaze on its end faces.
22	23,35		1952	318-397		53D-2	Clear vitreous silica sample with a clear silver glaze on its end faces.
23	23,35		1952	316-397		53E-2	Clear vitreous silica sample with silky platinum alloy glaze on its end faces.
24	23,35		1952	314-398		53F-2	Clear vitreous silica sample with silky platinum alloy glaze on its end faces.
25	23,35		1952	318-394		53G-2	Clear vitreous silica sample with silky silver alloy glaze on its end faces.
26	23,35		1952	320-393		53H-2	Clear vitreous silica sample with silky silver alloy glaze on its end faces.

SPECIFICATION TABLE NO. 32 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
27	9	C	1953	319-417	± 5	53NI-1	Vitreous silica.
28	9	C	1953	316-407	± 5	53NI-2	Vitreous silica.
29	43	L	1954	132-160			Fine powder contained in a cylindrical container of 1 in. thickness; dried at 380 K for at least 24 hrs; density (25 C) = 6.7 lb ft ⁻³ (0.197 g cm ⁻³).
30	44	F	1914	293, 373			Fused silica; 0.332 cm dia x 6.1 cm long; density = 2.17 g cm ⁻³ .
31	140	C	1926	342-510			Clear transparent vitreous silica; obtained from Thermal Syndicate; circular plate 1.25 in. in dia, 1 mm thick; surfaces optically flat and parallel to a high degree of accuracy, with air films on the surfaces; density 2.295 g cm ⁻³ .
32	140	C	1926	344-510			Similar to the above specimen except with 1.503 mm thickness and 2.294 g cm ⁻³ density.
33	140	C	1926	345-509			Similar to the above specimen except with 2.002 mm thickness and 2.293 g cm ⁻³ density.
34	140	C	1926	348.3			Similar to the above specimen except with glycerine films on the surfaces and 2.204 g cm ⁻³ density.
35	122	R	1953	109.4			Specimen supplied by Linde Air Products Co., packing density 0.9528 g cm ⁻³ ; measured at constant temperature 109.4 K and at various hydrogen pressures ranging from 0.0053 to 596.5 mm Hg.
36	122	R	1953	140.8			Similar to the above specimen except measured at constant temperature 140.8 K and at various hydrogen pressures ranging from 0.057 to 603 mm Hg.
37	122	R	1953	109.2			Similar to the above specimen except measured at constant temperature 109.4 K and at various nitrogen pressures ranging from 0.0022 to 584 mm Hg.
38	122	R	1953	140.8			Similar to the above specimen except measured at constant temperature 140.8 K and at various nitrogen pressures ranging from 0.939 to 594 mm Hg.
39	139	R	1950	93-265		Silica gel	Density 0.820 g cm ⁻³ .
40	79	L	1942	582-752		Silica refractory brick	95.16 SiO ₂ , 1.46 Al ₂ O ₃ , 1.96 CaO, 0.85 Fe ₂ O ₃ , 0.08 MgO, 1.57 TiO ₂ , and 0.21 alkali oxides; cross-section 18 in. x 18 in.; prepared from ganister-type quartzite rocks; fired at 1410 to 1420 C for 60 hrs; density 1.81 g cm ⁻³ (113 lb ft ⁻³); porosity 22.77%; weight lost on ignition 0.14%.
41	79	C	1942	1091, 1223		Silica refractory brick	Similar to the above specimen but in disc form of dimensions 8 in. dia x 1 in. thick; steel used as comparative material.
42	80	L	1934	393-1101		Star-brand brick	95.9 SiO ₂ , 1.0 Al ₂ O ₃ , 1.0 Fe ₂ O ₃ , 2.0 CaO, 0.1 MgO, and 0.1 alkalis; supplied by Harbison-Walker Refractories, Co.; approx. composition; bulk density 1.52 g cm ⁻³ ; porosity 28.0%.
43	80	L	1934	1568, 7		Star-brand brick	The above specimen measured with insulating brick placed between the calorimeter and the lower surface of the brick.

SPECIFICATION TABLE NO. 32 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
44	147		1960	93-373		Glass M	Specimen in the form of a pair of 3 in. dia discs; density 2.20 g cm^{-3} ; measured in two apparatus for different temperature ranges.
45	72,295	C	1955	368-1481			Specimen obtained from commercial source; cut and polished; data corrected for zero porosity using Loeb's expression (Loeb, A. L., J. Am. Ceram. Soc., 37(2), Pt II, 96-9, 1954).
46	39	L	1960	367-1033			Clear-fused; specimen 3 in. in dia and 0.25 in. in thickness; prepared by Hanovia Chemical Co.; density 2.20 g cm^{-3} at 273.2 K; Armco iron used as comparative material.
47	39	C	1960	367-1033			Same as the above specimen except having low-emissivity aluminum foil discs adjacent to the specimen surface.
48	237	R	1959	300-1000		CQ3	Clear-fused; cylindrical specimen, 0.549 cm dia and 10.2 cm long.
49	237	R	1959	350-1000		CQ3	The third run of the above specimen, CQ3.
50	237	R	1959	1100-1750		CQ3	The fourth run of the above specimen, CQ3.
51	237	R	1959	350-2100		CQ4	Clear-fused; cylindrical specimen, dia 0.478 cm and 8.30 cm long.
52	237	R	1959	300-1700		CQ7	Clear-fused; cylindrical specimen, dia 0.598 cm and 5.34 cm long.
53	238	P	1921	974-1256		Brick No. 1; A ₁	95.4 SiO ₂ , 0.90 Al ₂ O ₃ , and 1.68 CaO; brick size: 9 x 4.5 x 2.5 in.; texture very open, and many large and sub-angular rock fragments; bonding of coarse and fine fairly good, although adherence of some of the grains is only fair; abundant large fissures; apparent density 1.75 g cm^{-3} ; porosity 24.0%; heat flow in the direction of the length of the brick with thermocouple at a distance of 4.0 cm from the hot face of the specimen; thermal conductivity values calculated from authors measured thermal diffusivity data and the specific heat data of Bradshaw and Emery, (Trans., 19, 94, 1919).
54	238	P	1921	940-1208		Silica brick No. 1; A ₂	The above specimen measured with thermocouple at a distance of 5.4 cm from the hot face of the specimen.
55	238	P	1921	968-1229		Silica brick No. 2; A ₃	Similar to the above specimen except apparent density 1.80 g cm^{-3} and porosity 22.3%; heat flow in the direction of the length of the brick with thermocouple at a distance of 4.3 cm from the hot face of the specimen.
56	238	P	1921	830-1159		Silica brick No. 2; A ₄	The above specimen measured with the thermocouple at a distance of 6.4 cm from the hot face of the specimen.
57	311	L	1959	417-1317		Sample A	Slip cast from fused silica; dried four days at 333 K before being tested; 9 in. in dia and 1 in. thick; unfired; density 1.75 g cm^{-3} .
58	311	L	1959	730-1182		Sample A	The above specimen, 2nd run
59	311	L	1959	393,1282		Sample A	Same as sample A; unfired.

SPECIFICATION TABLE NO. 32 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
60	311	L	1959	537, 778			Same as the above specimen, fired at 1089 K for 3.5 hrs.
61	311	L	1959	578, 829			Same as the above specimen, fired at 1200 K for 3.5 hrs.
62	311	L	1959	499, 775			Same as the above specimen, fired at 1422 K for 3.5 hrs.
63	311	L	1959	553, 805			Same as the above specimen, fired at 1533 K for 3.5 hrs; fine cracks appeared over all surfaces.
64	322		1957	2.9-13.2		Vitreous silica	High purity fused silica; obtained from Corning Works; square cross sectional area 19.8 mm ² ; unirradiated; density (determined by hydrostatic weighing) 2.1994 g cm ⁻³ ; measured by a static method.
65	322		1957	3.30-14.0		Vitreous silica	The above specimen irradiated to 1.71 x 10 ¹⁹ fast neutrons cm ⁻² ; density after irradiation 2.2412 g cm ⁻³ ; measured by a static method.
66	322		1957	3.2-6.0		Vitreous silica	The above specimen after an additional exposure to 4.13 x 10 ¹⁹ neutrons cm ⁻² ; density after second irradiation 2.2602 g cm ⁻³ ; measured by a static method.
67	314	L	1959	395.4	14		Floated powder; supplied by Fisher Scientific Co.; 0.124 in. thick, 9 in. dia; pressed at 63 psi; -240 mesh; bulk density 1.493 g cm ⁻³ ; load reduced to 0.5 lb in ⁻² prior to making measurements.
68	314	L	1959	397.0	14		Same as the above specimen except 0.110 in. thick; pressed at 940 psi; bulk density 1.682 g cm ⁻³ .
69	314	L	1959	398.7	14		Powder; supplied by Fisher Scientific Co.; 0.107 in. thick, 9 in. dia; pressed at 63 psi; 140 mesh; bulk density 1.552 g cm ⁻³ ; load reduced to 0.5 lb in ⁻² prior to making measurements.
70	314	L	1959	399.8	14		Same as the above specimen except 0.104 in. thick; pressed at 940 psi; bulk density 1.592 g cm ⁻³ .
71	33	C	1954	441-1037			Clear; fused; Armco iron used as comparative material.
72	33	C	1954	445-1065			The above specimen measured with low emissivity foil adjacent to the surface.
73	246	L	1963	116-474	1-3	Fused quartz	$L/s = 0.4$ (L , the sample thickness and s , its transverse cross-sectional area); $\Delta T = 7-10$ C (ΔT , the temperature drop across the sample).
74	246	L	1963	94-463	1-3	Fused quartz	$L/s = 0.4$, $\Delta T = 2-4$ C.
75	246	L	1963	96-305	1-3	Fused quartz	$L/s = 0.2$, $\Delta T = 4-6$ C.
76	22	L	1911	83.2		Quartz glass	Measured in hydrogen.
77	22	L	1911	83.2		Quartz glass	Another run of the above specimen.
78	22	L	1911	195-373		Quartz glass	Measured in carbon dioxide.
79	22	L	1911	195-373		Quartz glass	Another run of the above specimen.
80	222	L	1959	123-323	$\pm 2 \sim \pm 5$		Data obtained from smoothed curve of author's experimental results.

SPECIFICATION TABLE NO. 32 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
81	223	R	1928	220-360			Clear fused quartz; hollow cylindrical specimen with one end closed hemispherically; obtained from General Electric Company; heated rapidly to about 900 C, outside surface ground.
82	223	R	1928	490-770			Above specimen measured with another apparatus.
83	223	R	1928	500-1220			Another run of the above specimen.
84	170	R	1953	418-1253		Fused quartz	Ellipsoidal specimen; prepared by grinding from a block of fused quartz.
85	170	R	1953	343-1273			Similar to the above specimen.
86	267	P	1962	297-422			Clear.
87	69	L	1951	2.5-100		Quartz glass	Specimen dia 6.1 mm, length 2.3 cm.
88	69	L	1951	5.0-100		Quartz glass	Specimen dia 7.7 mm, length 2.25 cm.
89	69	L	1951	5.0-100		Quartz glass	Specimen dia 7.4 mm, length 4.6 cm.
90	309	L	1960	50-1100	± 4-5		Fused quartz; five specimens of dimensions 1 x 1 x 1 cm ³ cut out from a single piece obtained from the M. V. Lomonosov Factory in Leningrad; data from three different experimental arrangements.
91	45	C	1953	328-949		Fused quartz	Prepared by grinding.
92	321	P	1961	300-426	± 5	Fused quartz; 1	Tubing; thermal conductivity values calculated from author's measured thermal diffusivity data and values of specific heat C taken from correlated data of Lord, R. C., and Morrow, J. C., J. Chem. Phys. 26, 230-2, 1957.
93	328	P	1957	303.2	< 7	Fused quartz; 2	7 cm dia and 2.496 cm thick; thermal conductivity values calculated from author's measured thermal diffusivity and specific heat data.
94	328	P	1957	303.2	< 7	Fused quartz; 3	Similar to the above specimen but the thickness, 1.518 cm.
95	328	P	1957	303.2	< 7	Fused quartz; 4	Similar to the above specimen but the thickness, 0.0732 cm.
96	328	P	1957	303.2	< 7	Fused quartz; 5	Similar to the above specimen except the dimensions 3.49 cm dia x 1.206 cm thick; measured in another apparatus.
97	328	P	1957	303.2	< 7	Fused quartz; 6	Similar to the above specimen but the thickness, 0.507 cm.
98	328	P	1957	303.2	< 7	Fused quartz; 7	Similar to the above specimen but the thickness, 0.305 cm.
99	415	L	1963	298.2	5	Fused quartz	99.95 pure SiO ₂ ; specimen 0.5 in. in dia and 0.75 in. long; measured in a vacuum of 1.0 x 10 ⁻⁴ mm Hg.
100	416	L	1959	420-984	5.6	Slip 18	Specimen 0.25 in. thick; density 1.82 g cm ⁻³ ; density after firing 1.85-1.95 g cm ⁻³ ; water absorption 5-6%; porosity 10-14%; particle size; 4-6% greater than 4μ, 23-26% less than 2μ.

SPECIFICATION TABLE NO. 32 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
101	416	L	1959	593-1196	±6	Slip 10	Similar to the above specimen except 0.5 in. thick and particle size: 2-4%, greater than 44 μ 31-34%, less than 2 μ
102	330	C	1957	298.2	±6		3 in. dia x 0.188 in. thick; measured with thermal comparator No. 4; heat flow perpendicular to c-axis.
103	330	C	1957	298.2	±6		Similar to the above specimen but measured with thermal comparator No. 5 loaded with 100 g weight.

DATA TABLE NO. 32 THERMAL CONDUCTIVITY OF SILICON DIOXIDE (fused) SiO₂

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

Curve	T	k	Curve	T	k	Curve	T	k	Curve	T	k	Curve	T	k
<u>CURVE 1*</u>	140.05	0.000013	<u>CURVE 11</u>	314.0	0.0165	<u>CURVE 24*</u>	313.5	0.0159	<u>CURVE 35</u>	93.2	0.00030*	<u>CURVE 44 (cont.)</u>	163.2	0.0103
<u>CURVE 2*</u>	330.9	0.0166	<u>CURVE 12</u>	330.9	0.0175		334.2	0.0159	($\bar{T} = 109.4\text{K}$)	100	0.00033*		168.2	0.0104
	351.9	0.0175		351.9	0.0180*		353.4	0.0172		150	0.000535		173.2	0.0106*
	369.1	0.0180*		369.1	0.0180*	<u>CURVE 31</u>	372.9	0.0169		200	0.000760		178.2	0.0108
	406.0	0.0187		406.0	0.0187		397.9	0.0174		265	0.00104		183.2	0.0109*
<u>CURVE 3*</u>	610.9	0.00156	<u>CURVE 19*</u>	319.1	0.0159		341.9	0.0138		265	0.000277		188.2	0.0111
	620.4	0.00180		335.4	0.0159	<u>CURVE 25*</u>	376.1	0.0141		53.5	0.000435	<u>CURVE 40</u>	193.2	0.0113*
	1033.2	0.00227		353.0	0.0167		392.3	0.0141		211.5	0.000635		198.2	0.0114
	164.8	0.00256		369.3	0.0173		403.6	0.0144*		596.5	0.000762		203.2	0.0116*
<u>CURVE 4*</u>	488.7	0.00616		393.6	0.0175		430.7	0.0145		582.2	0.0151		208.2	0.0117
	908.7	0.00606	<u>CURVE 20*</u>	318.0	0.0151	<u>CURVE 26*</u>	317.7	0.0151	<u>CURVE 36</u>	683.2	0.0163	<u>CURVE 41</u>	213.2	0.0118*
	797.1	0.00675		333.5	0.0159		352.7	0.0164	($\bar{T} = 140.8\text{K}$)	752.2	0.0167		218.2	0.00120*
	1902.1	0.00727		350.2	0.0167		369.9	0.0170		223.2	0.0121		223.2	0.0121
<u>CURVE 5</u>	140.38	0.000333		396.7	0.0179		394.3	0.0181		1.204	0.000209*		228.2	0.0122*
			<u>CURVE 14</u>	318.0	0.0151	<u>CURVE 26*</u>	320.4	0.0154		16.0	0.000371*		233.2	0.0123*
				333.5	0.0159		333.8	0.0160		1223.3	0.0184		238.2	0.0125*
				370.3	0.0176	<u>CURVE 27</u>	320.4	0.0154		53.5	0.000528		243.2	0.0126*
				396.7	0.0179		351.5	0.0165		202.5	0.000780	<u>CURVE 42</u>	248.2	0.0127*
<u>CURVE 6</u>	140.56	0.000452		318.0	0.0151		376.0	0.0165		398.5	0.000908*		253.2	0.0128
				332.0	0.0135		392.9	0.0172		603.0	0.000977		258.2	0.0129*
				336.7	0.0138	<u>CURVE 21*</u>	319.1	0.0170					263.2	0.0130*
				353.2	0.0148		339.1	0.0173	<u>CURVE 37*</u>				268.2	0.0131
				374.7	0.0160		360.1	0.0177*	($\bar{T} = 109.2\text{K}$)				273.2	0.0132*
<u>CURVE 7</u>	140.52	0.000692		371.0	0.0174		381.1	0.0183		0.0022	0.00000460		278.2	0.0133*
				408.1	0.0175		416.7	0.0197		0.175	0.0000205		284.2	0.0134*
<u>CURVE 8</u>	140.61	0.000826	<u>CURVE 15*</u>	319.1	0.0159		432.2	0.0145		1100.9	0.0175		291.2	0.0135
				338.3	0.0160	<u>CURVE 28*</u>	316.2	0.0165					293.2	0.0136*
				334.5	0.0161		335.8	0.0172					298.2	0.0137*
				353.8	0.0171	<u>CURVE 29*</u>	351.6	0.0179					303.2	0.0138*
				371.0	0.0174		375.8	0.0185					308.2	0.0139*
				408.1	0.0175		406.8	0.0201					313.2	0.0139
<u>CURVE 9</u>	140.58	0.000900	<u>CURVE 22*</u>	318.0	0.0151		460.8	0.0149					318.2	0.0140*
				333.5	0.0159		485.6	0.0150					323.2	0.0140*
				353.0	0.0167	<u>CURVE 23*</u>	351.6	0.0172					328.2	0.0141*
				371.0	0.0174		508.5	0.0151					333.2	0.0141*
				408.1	0.0175		406.8	0.0201					338.2	0.0142*
<u>CURVE 10</u>	310.8	0.0151	<u>CURVE 24*</u>	318.0	0.0151		460.8	0.0149					343.2	0.0143*
				338.3	0.0160	<u>CURVE 25*</u>	316.1	0.0153					348.2	0.0144*
				334.5	0.0161		333.7	0.0156					353.2	0.0144*
				353.8	0.0171		349.7	0.0180					358.2	0.01450*
				371.0	0.0174		367.8	0.0179					363.2	0.0146*
				408.1	0.0175		375.3	0.0189					368.2	0.0146*
													373.2	0.0146

* Not shown on plot

DATA TABLE NO. 32 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	
CURVE 45																		
368.2	0.0151*	350	0.0116	600	0.0171*	906.5	0.00457*	6.10	0.00290	441.2	0.0183	754.2	0.0213	304	0.0137*	CURVE 74 (cont.)		
488.2	0.0159	400	0.0127	700	0.0174*	1014.8	0.00488	12.8	0.00660	502.2	0.0190	731.2	0.0220	338	0.0145*			
568.2	0.0172	500	0.0142	800	0.0180	1173.2	0.00543*	13.2	0.00631	546.2	0.0199	825.2	0.0213	344	0.0146*			
668.2	0.0184	600	0.0167	900	0.0187*	1258.7	0.00590	CURVE 65		554.2	0.0200*	831.2	0.0226	354	0.0148*			
773.2	0.0206	700	0.0192	1000	0.0188	1316.5	0.00658	3.30	0.00230	568.2	0.0200	917.2	0.0233	361	0.0149*			
871.2	0.0238	800	0.0209	1100	0.0189	CURVE 58		3.40	0.00245	588.2	0.0202*	937.2	0.0237	370	0.0150*			
968.2	0.0280	900	0.0219	1200	0.0190	730.9	0.00661	3.60	0.00270	631.2	0.0209	1003.2	0.0243	378	0.0151*			
1069.2	0.0327	1000	0.0224	1300	0.0192	996.5	0.00675	4.00	0.00325	654.2	0.0201	1065.2	0.0251	384	0.0151*			
1169.2	0.0385	1400	0.0195	1400	0.0199	1182.1	0.00742	4.60	0.00410	657.2	0.0214	CURVE 73			392	0.0152*		
1265.2	0.0464	1500	0.0199	1500	0.0203*	CURVE 59		5.00	0.00420	659.2	0.0214*	116	0.00728	446	0.0152*			
1313.2	0.0628	1600	0.0205	1600	0.0208	393.2	0.00318	5.20	0.00460	677.2	0.0220	144	0.00987	463	0.0162*			
1339.2	0.0534	1200	0.0205	974.2	0.00360	1282.1	0.00602	6.40	0.00520	693.2	0.0205	CURVE 75			96	0.00594		
1412.2	0.0674	1300	0.0205	1061.2	0.00406	578.2	0.00426	7.30	0.00540	714.2	0.0209*	179	0.0105	108	0.00674			
1441.2	0.0766	1400	0.0205	1156.2	0.00448	828.7	0.00415	8.30	0.00570	728.2	0.0218*	249	0.0127	130	0.00803			
1481.2	0.105	1500	0.0205	1255.7	0.00515	CURVE 61		9.50	0.00620	737.2	0.0210	270	0.0134	164	0.00954			
CURVE 46																		
366.5	0.0182	350	0.0119	940.2	0.00377	537.1	0.00443	11.50	0.00620	755.2	0.0237*	332	0.0146*	226	0.0146*			
477.6	0.0192	400	0.0128	1019.7	0.00402	778.2	0.00447	13.2	0.00840	766.2	0.0256*	357	0.0146*	294	0.0138			
588.7	0.0193	500	0.0142*	1114.2	0.00448	CURVE 62		14.0	0.00798	796.2	0.0265*	381	0.0153	305	0.0140			
699.8	0.0215	600	0.0157	1208.2	0.00519	578.2	0.00426	3.20	0.00380	838.2	0.0274*	402	0.0156*	CURVE 76				
811.0	0.0234	700	0.0170	1298.2	0.00519	828.7	0.00415	3.60	0.00490	940.2	0.0282*	418	0.0156*	83.2	0.00636			
1033.2	0.0318	800	0.0181*	CURVE 55		CURVE 63		4.30	0.00660	991.2	0.0277*	453	0.0158*	CURVE 77				
CURVE 47																		
366.5	0.0183*	900	0.0196	967.7	0.00368	499.3	0.00535	4.70	0.00696	1025.2	0.0308	94	0.00561	83.2	0.00686			
477.6	0.0192*	1000	0.0208	1044.7	0.00444	774.8	0.00588	5.95	0.00700	1037.2	0.0329	95	0.00636	CURVE 78				
588.7	0.0203	1100	0.0217	1134.2	0.00481	552.6	0.00798	395.4	0.00209	445.2	0.0187	112	0.00770	128	0.00770			
699.8	0.0215*	1200	0.0222	1229.2	0.00590	804.8	0.00928	397.0	0.00469	494.2	0.0197	128	0.00770	136	0.00812			
811.0	0.0225	1300	0.0222	1298.2	0.00590	CURVE 64		3.60	0.00580	511.2	0.0195	136	0.00812	157	0.00950			
922.1	0.0265	1400	0.0222	1400	0.0222	2.90	0.00122	397.0	0.00469	548.2	0.0206	157	0.00950	163	0.00950			
1033.2	0.0318	1500	0.0223	1600	0.0223	3.15	0.00150	397.0	0.00469	560.2	0.0206	164	0.00979	164	0.00979			
CURVE 48																		
300	0.0117	3000	0.0232	1159.2	0.00540	2.90	0.00122	397.0	0.00469	576.2	0.0206	195	0.0107	195	0.0107			
400	0.0146	4000	0.0232	1159.2	0.00540	3.15	0.00150	397.0	0.00469	602.2	0.0197	200	0.0113*	200	0.0113*			
500	0.0160	5000	0.0232	1159.2	0.00540	3.32	0.00170	397.0	0.00469	613.2	0.0213	205	0.0113*	205	0.0113*			
600	0.0177	6000	0.0232	1159.2	0.00540	3.60	0.00190	397.0	0.00469	620.2	0.0209	220	0.0118*	220	0.0118*			
700	0.0182	7000	0.0232	1159.2	0.00540	3.70	0.00210	397.0	0.00469	643.2	0.0210	225	0.0119	225	0.0119			
800	0.0184	8000	0.0232	1159.2	0.00540	4.00	0.00235	397.0	0.00469	660.2	0.0213	230	0.0121*	230	0.0121*			
900	0.0185	9000	0.0232	1159.2	0.00540	4.60	0.00330	397.0	0.00469	673.2	0.0204	235	0.0122	235	0.0122			
1000	0.0184	10000	0.0232	1159.2	0.00540	5.00	0.00354	397.0	0.00469	714.2	0.0214	253	0.0137*	253	0.0137*			
										735.2	0.0216	302	0.0142*	302	0.0142*			

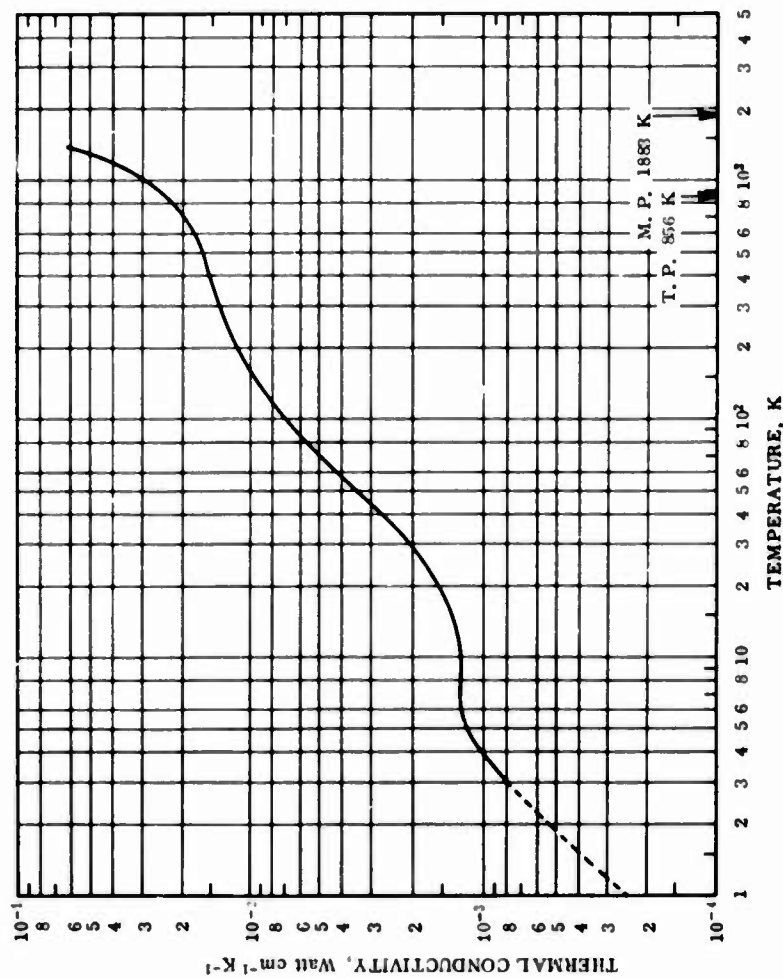
* Not shown on plot

DATA TABLE NO. 32 (continued)

T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 80*</u>											
123.2	0.00887	861.2	0.0241	5.75	0.00120	328.2	0.0160	303.2	0.0131		
148.2	0.00979	941.2	0.0263	10.15	0.00120	328.2	0.0149			<u>CURVE 97*</u>	
173.2	0.0107	1013.2	0.0297	20.25	0.00150	378.2	0.0169			<u>CURVE 98*</u>	
197.2	0.0115	1074.2	0.0326	60.0	0.00350	378.2	0.0157			<u>CURVE 99</u>	
243.2	0.0126	1091.2	0.0344	100.0	0.00550	440.2	0.0175	303.2	0.0133		
303.2	0.0136	1160.2	0.0393	<u>CURVE 88</u>		503.2	0.0175			<u>CURVE 102*</u>	
303.2	0.0137	1215.2	0.0423	5.0	0.00130	505.2	0.0155			<u>CURVE 103</u>	
323.2	0.0141	1253.2	0.0448	10.0	0.00130	624.2	0.0203	298.2	0.014		
<u>CURVE 81</u>											
220	0.0113	343.2	0.0155	15.0	0.00120	626.2	0.0179			<u>CURVE 100</u>	
230	0.0114	423.2	0.0162	18.0	0.00150	723.2	0.0204			<u>CURVE 101</u>	
300	0.0126	461.2	0.0156	100.0	0.00650	723.2	0.0192	420.38	0.00225		
320	0.0130	479.2	0.0167	<u>CURVE 89</u>		815.5	0.0224	713.16	0.00448		
360	0.0134*	517.2	0.0167	5.0	0.00120	817.2	0.0213	784.83	0.00419		
<u>CURVE 82*</u>											
490	0.0142	583.2	0.0176	9.0	0.00130	890.2	0.0247	939.27	0.00519		
550	0.0146	624.2	0.0188	20.25	0.00160	890.2	0.0234	984.27	0.00537		
560	0.0159	673.2	0.0187	100.0	0.00650*	949.2	0.0278			<u>CURVE 101</u>	
700	0.0176	726.2	0.0205	<u>CURVE 90*</u>		300	0.0138	592.60	0.00417		
<u>CURVE 83</u>											
500	0.0151*	1035.2	0.0302	50	0.00343	324	0.0146	646.49	0.00438		
575	0.0155*	1091.2	0.0314	100	0.00665	370	0.0160	782.60	0.00538		
750	0.0186	1113.2	0.0335	150	0.00925	400	0.0167	1195.94	0.00658		
890	0.0209	1183.2	0.0377	200	0.0112	415	0.0183			<u>CURVE 102*</u>	
990	0.0228	1243.2	0.0418	250	0.0127	426	0.0181	298.2	0.0138		
1060	0.0238	1273.2	0.0450	300	0.0138	<u>CURVE 93*</u>				<u>CURVE 103</u>	
1100	0.0270	<u>CURVE 86*</u>		350	0.0146	303.2	0.0138	298.2	0.0156		
1220	0.0276	297	0.0145	400	0.0153	<u>CURVE 94*</u>					
<u>CURVE 84*</u>											
418.2	0.0155	325	0.0147	450	0.0159	303.2	0.0139				
451.2	0.0153	362	0.0157	500	0.0164	<u>CURVE 95*</u>					
478.2	0.0159	372	0.0163	550	0.0168	303.2	0.0138				
505.2	0.0159	400	0.0168	600	0.0172	<u>CURVE 96*</u>					
571.2	0.0167	413	0.0184	700	0.0184	303.2	0.0131				
668.2	0.0188	422	0.0182	750	0.0193						
705.2	0.0199	<u>CURVE 87</u>		800	0.0205						
785.2	0.0218	2.5	0.00070	850	0.0218						
<u>CURVE 88</u>											
<u>CURVE 89</u>											
<u>CURVE 90*</u>											
<u>CURVE 91*</u>											
<u>CURVE 92*</u>											
<u>CURVE 93*</u>											
<u>CURVE 94*</u>											
<u>CURVE 95*</u>											
<u>CURVE 96*</u>											
<u>CURVE 97*</u>											
<u>CURVE 98*</u>											
<u>CURVE 99</u>											
<u>CURVE 100</u>											
<u>CURVE 101</u>											
<u>CURVE 102*</u>											
<u>CURVE 103</u>											

* Not shown on plot

FIGURE AND TABLE NO. 32R RECOMMENDED THERMAL CONDUCTIVITY OF SILICON DIOXIDE (FUSED) SiO₂



RECOMMENDED VALUES*
(High-purity clear fused SiO₂)

T ₁	k ₁	k ₂	T ₂
0	0	0	-459.7
1	(0.00024)‡	(0.0139)	-457.9
2	(0.00054)	(0.0312)	-456.1
3	0.00080	0.0462	-454.3
5	0.00118	0.0682	-450.7
6	0.00124	0.0716	-448.9
8	0.00126	0.0728	-445.3
10	0.00127	0.0734	-441.7
15	0.00136	0.0786	-432.7
20	0.00153	0.0884	-423.7
30	0.00202	0.117	-405.7
40	0.00266	0.154	-387.7
50	0.00340	0.196	-369.7
60	0.0041	0.237	-351.7
70	0.0048	0.277	-333.7
80	0.0055	0.318	-315.7
90	0.0062	0.358	-297.7
100	0.0069	0.399	-279.7
125	0.0083	0.480	-234.7
150	0.0095	0.549	-189.7
175	0.0105	0.607	-144.7
200	0.0114	0.659	-99.7
250	0.0128	0.740	-
273.2	0.0133	0.768	32.0
300	0.0138	0.797	80.3
350	0.0145	0.838	170.3
400	0.0151	0.872	260.3
450	0.0157	0.907	350.3
500	0.0162	0.936	440.3
600	0.0175	1.01	620.3
700	0.0192	1.11	800.3
800	0.0217	1.25	980.3
900	0.0248	1.43	1160
1000	0.0287	1.66	1340
1100	0.0336	1.94	1520
1200	0.0400	2.31	1700
1300	0.0482	2.78	1880
1400	0.0620	3.58	2060

REMARKS

The uncertainty of the recommended values is thought to be within ±3% at temperatures from 200 to 500 K and increases to about ±8% at 50 K and 900 K and ± 15% below 10 K and near 1400 K.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹. † Values in parentheses are extrapolated.

SPECIFICATION TABLE NO. 33 THERMAL CONDUCTIVITY OF STRONTIUM OXIDE SrO

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	75	L	1955	493-1003	10	Tube No. 2	Polycrystalline; prepared from SrCO ₃ ; measured under vacuum 10 ⁻⁶ mm Hg; apparent thermal conductivity (effects due to radiation at high temperature not considered).

DATA TABLE NO. 33 THERMAL CONDUCTIVITY OF STRONTIUM OXIDE SrO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u> *	
493.2	0.50
676.2	0.80
798.2	1.25
893.2	1.76
1003.2	2.50

* No graphical presentation

FIGURE SHOWS ONLY 6 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF THORIUM DIOXIDE ThO_2

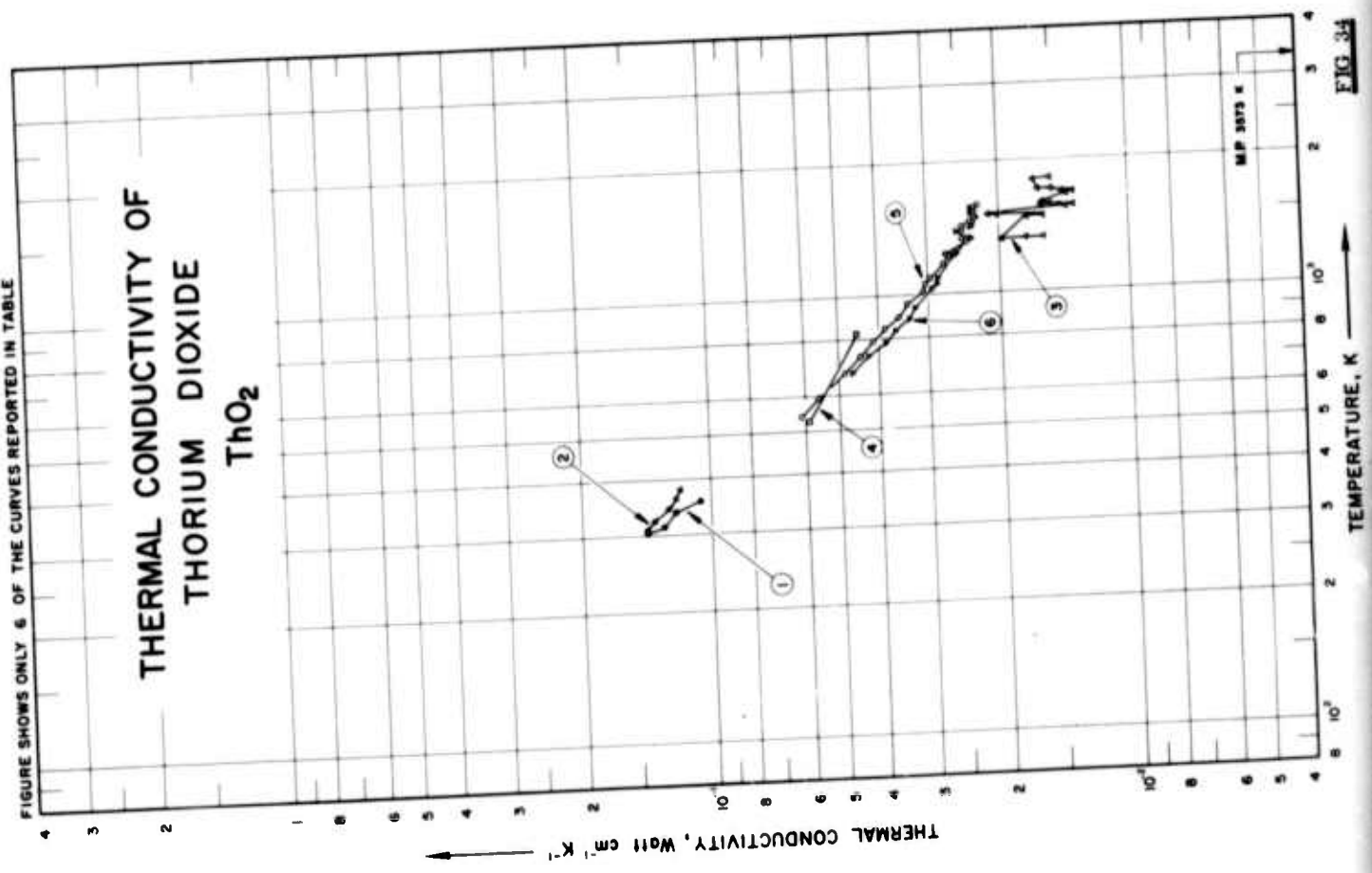


FIG. 34

SPECIFICATION TABLE NO. 34 THERMAL CONDUCTIVITY OF THORIUM DIOXIDE ThO₂

[For Data Reported in Figure and Table No. 34]

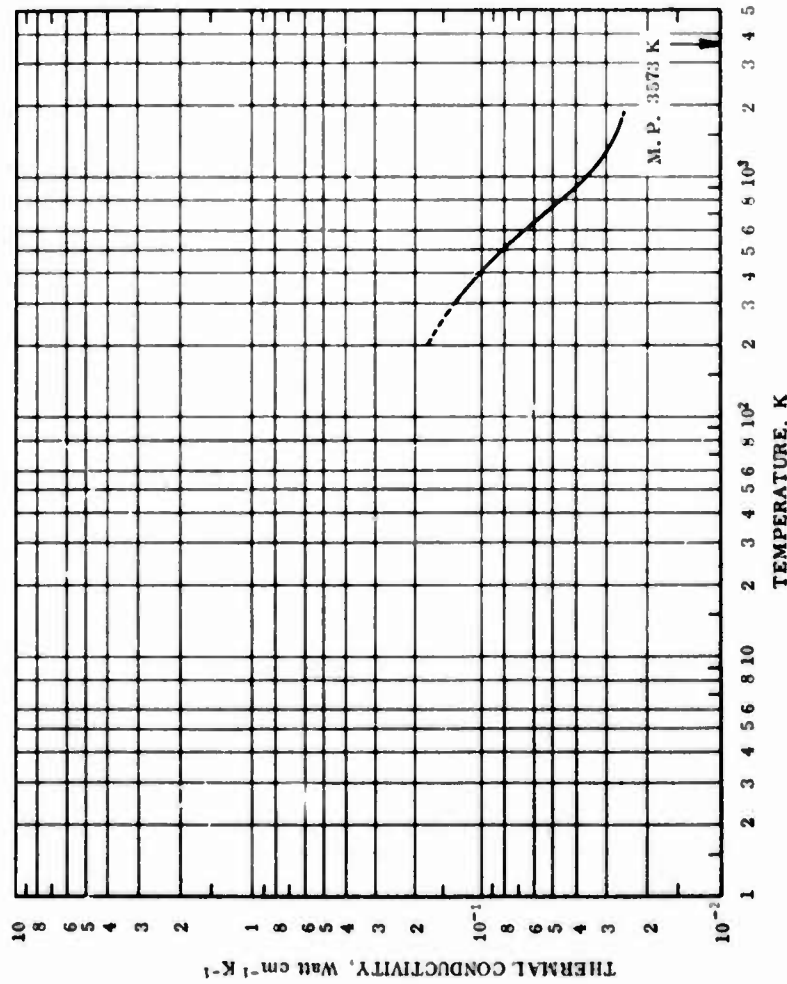
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3	C	1953	304-356		239A-1	Spectroscopically pure; supplied by Carbide and Carbon Chemicals Co.; formed by hot pressing at 1790-1820 C; density (25 C) = 3.58 g cm ⁻³ ; measurements made by using a gold coating on the ends of the cylindrical specimen.
2	3	C	1953	306-379		239A-2	Same specimen as above except using platinum alloy glaze.
3	144	R	1963	1331-1821	5.0-7.0	1	Poorly bonded structure; ground and polished to eliminate all the scratches on the surface of the specimen; 0.75 in. long, 0.75 in. O. D., and 0.25 I. D.; supplied by the Zirconium Corp. of America; density 9.69 g cm ⁻³ at 25 C; specimen found broken on post inspection.
4	204	R	1957	527.824			0.5 CaF ₂ ; specimen consists of 6 discs of average dia 60.03 mm and total height 114.05 mm; hot-pressed at 1500 ± 50 C and at pressure of about 100 psi for 30 min; average bulk density 9.37 g cm ⁻³ .
5	307	R	1954	543-1593			Specimen in the shape of prolate spheroid prepared by slip casting from suspension of finely ground thorium; total porosity 16.7% and bulk density 8.07 g cm ⁻³ ; the first run.
6	307	R	1954	538-1593		a	The above specimen; second run.
7	472		1963	1219-2009		a	Precipitated from thorium nitrate and solution of ammonium hydroxide; bulk density 0.26 g cm ⁻³ ; measured in increasing temperature order.
8	472		1963	1218-2009		a	The above specimen; measured in decreasing temperature order.
9	472		1963	1225-1816		c	Prepared by drying and igniting in air a cotton cloth soaked in thorium nitrate solution; measured in increasing temperature order.
10	472		1963	1520-1816		c	The above specimen; measured in decreasing temperature order.

DATA TABLE NO. 34 THERMAL CONDUCTIVITY OF THORIUM DIOXIDE ThO₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>									
303.7	0.141	673.2	0.048	1533.2	0.023	1520	0.000509		
312.6	0.129	733.2	0.044	1563.2	0.023	1601	0.000553		
336.7	0.121	793.2	0.041	1593.2	0.0222*	1700	0.000613		
355.9	0.106	843.2	0.0384			1752	0.000649		
<u>CURVE 2</u>									
		893.2	0.0351	<u>CURVE 7*</u>		1816	0.000702		
		953.2	0.0335	1219	0.000456				
306.0	0.141	1013.2	0.0305	1300	0.000533				
322.0	0.136	1063.2	0.0301	1400	0.000618				
342.1	0.126	1093.2	0.0293	1500	0.000698				
361.4	0.122	1173.2	0.0276	1600	0.000784				
379.0	0.118	1223.2	0.0264	1701	0.000889				
<u>CURVE 3</u>									
		1243.2	0.0268	1800	0.001006				
1330.9	0.0156	1303.2	0.0238	1893	0.00115				
1330.9	0.0172	1348.2	0.0243	1942	0.00128				
1330.9	0.0195	1398.2	0.0243	1989	0.00135				
1490.9	0.0170	1423.2	0.0243	2009	0.00144				
1498.2	0.0156	1453.2	0.0234	<u>CURVE 8*</u>					
1522.1	0.0209	1493.2	0.0226	1301	0.00105				
1522.1	0.0209	1563.2	0.0226	1400	0.00111				
1576.5	0.0138	1593.2	0.0222	1500	0.00117				
1580.9	0.0133	<u>CURVE 5 (cont.)</u>							
1581.5	0.0157	538.2	0.062	1600	0.00123				
1587.6	0.0149	598.2	0.054	1700	0.00128				
1597.6	0.0156	673.2	0.046	1800	0.00134				
1673.7	0.0137	733.2	0.042	1902	0.00139				
1687.6	0.0133	783.2	0.038	2009	0.00144				
1691.5	0.0141	833.2	0.036	<u>CURVE 9*</u>					
1705.9	0.0149	883.2	0.033	1225	0.000466				
1708.7	0.0160	933.2	0.032	1301	0.000539				
1801.5	0.0164	1003.2	0.029	1400	0.000630				
1820.9	0.0149	1053.2	0.028	1500	0.000708				
<u>CURVE 4</u>									
		1093.2	0.028	1555	0.000746				
526.8	0.0586	1173.2	0.027	1600	0.000766				
824.1	0.0448	1223.2	0.0255	1653	0.000782				
<u>CURVE 5</u>									
		1303.2	0.0243*	1700	0.000783				
543.2	0.061	1348.2	0.023	1760	0.000761				
593.2	0.0552	1393.2	0.025	1799	0.000725				
		1423.2	0.023	1816	0.000702				
		1453.2	0.0225*						
		1493.2	0.0225						

* Not shown on plot

FIGURE AND TABLE NO. 34R RECOMMENDED THERMAL CONDUCTIVITY OF THORIUM DIOXIDE ThO₂



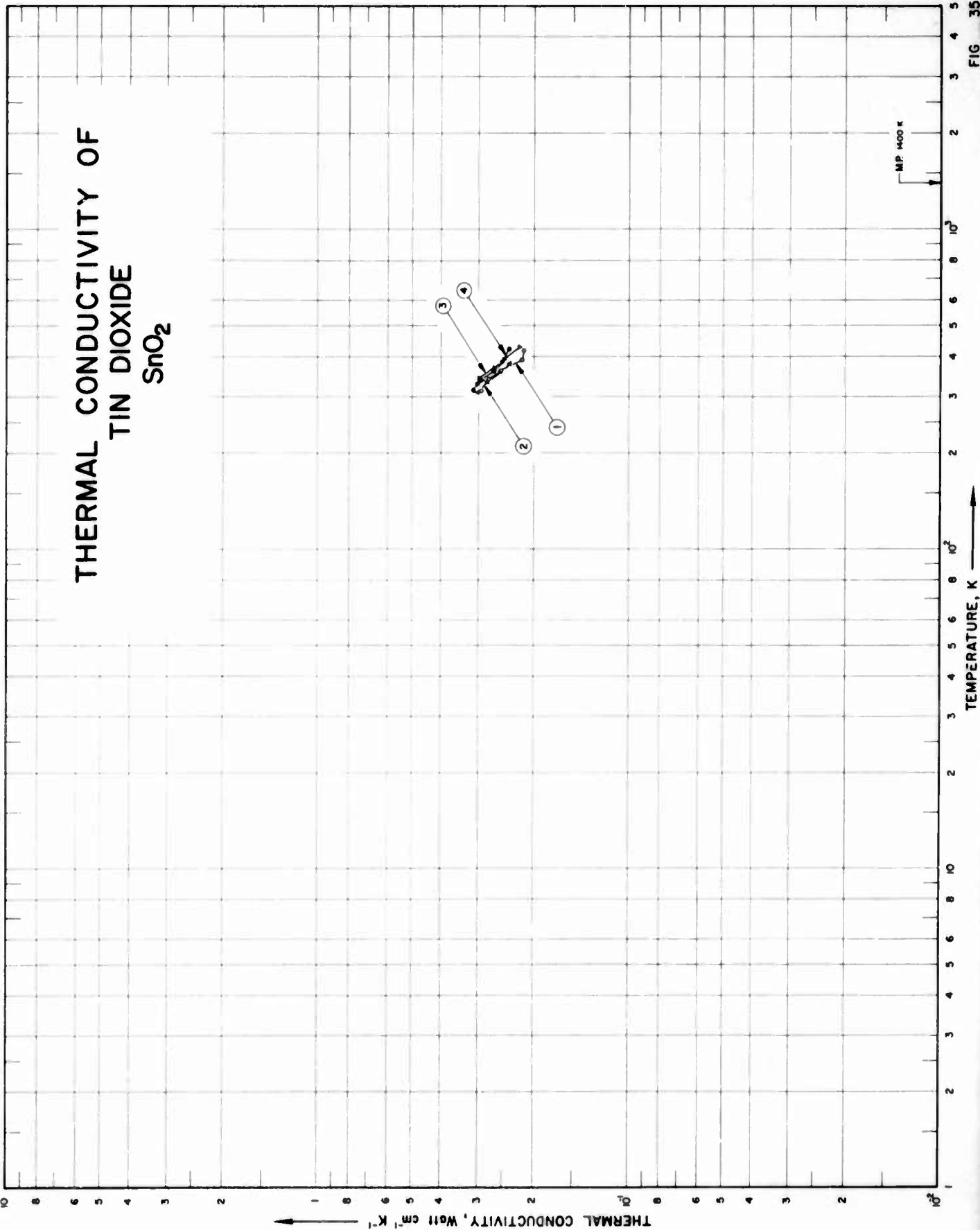
RECOMMENDED VALUES* Polycrystalline (99.5% pure, 98% dense)			
T ₁	k ₁	k ₂	T ₂
250	(0.152)‡	(6.78)	-9.7
273.2	(0.142)	(6.20)	32.0
390	(0.132)	(7.63)	80.3
350	0.115	6.64	170.3
400	0.102	5.89	260.3
500	0.081	4.68	440.3
600	0.066	3.81	620.3
700	0.055	3.18	800.3
800	0.047	2.72	980.3
900	0.041	2.37	1160
1000	0.0368	2.13	1340
1100	0.0336	1.94	1520
1200	0.0312	1.80	1700
1300	0.0296	1.71	1880
1400	0.0284	1.64	2060
1500	0.0273	1.58	2240
1600	0.0266	1.54	2420
1700	0.0259	1.50	2600
1800	0.0254	1.47	2780
1900	(0.0252)	(1.46)	2960

REMARKS

The recommended values are for 99.5% pure, 98% dense, polycrystalline ThO₂. The recommended values that are supported by experimental data are thought to be accurate to within 15% of the true values at temperatures from 350 to 1000 K and 15 to 20% at other temperatures.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹. ‡ Values in parentheses are extrapolated.

FIGURE SHOWS ONLY 4 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 35 THERMAL CONDUCTIVITY OF TIN DIOXIDE SnO₂

[For Data Reported in Figure and Table No. 35]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3	L	1953	315-420		166 A-1	98 SnO ₂ ; furnished by Metal and Thermit Corp; density 6.62 g cm ⁻³ ; water absorption 0.03%.
2	3	L	1953	311-383		166 B-1	98 SnO ₂ ; furnished by Metal and Thermit Corp; density (25 C) = 6.56 g cm ⁻³ ; water absorption 0.11%.
3	3	L	1953	328-430		47 A-1	98 SnO ₂ .
4	12, 3	L	1953	315-424		47 A-2	98 SnO ₂ ; calcined at 1992 C; dry pressed at 1500 psi; fired at 1427 C and soaked for 1 hr; density 6.5 g cm ⁻³ ; water absorption 0.021%.
5	74	C	1954	313.2			97 SnO ₂ , 0.9 ZnO, 0.1-1.0 Si, 0.05-0.5 Fe, 0.01-0.1 Ca, and 0.01 other impurities; prepared from -200 mesh tin oxide and zinc oxide powder by ball milling dry for 4 hrs in rubber-lined, one-gallon ball mill containing steel balls, pressed in steel die at 6000 to 10,000 psi and sintered in air for 2 to 3 hrs at 1427 C (maximum); apparent porosity 2.6%.

DATA TABLE NO. 35 THERMAL CONDUCTIVITY OF TIN OXIDE SnO₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1

314.6	0.295
340.6	0.279
364.1	0.256
391.4	0.218
420.0	0.216

CURVE 2

310.5	0.302
335.2	0.281
361.4	0.256
382.8	0.239

CURVE 3

328.4	0.304
338.1	0.293
344.1	0.299
370.1	0.267
393.3	0.249
429.9	0.221

CURVE 4

315.0	0.311
338.2	0.295
361.6	0.269
387.4	0.251
423.5	0.238

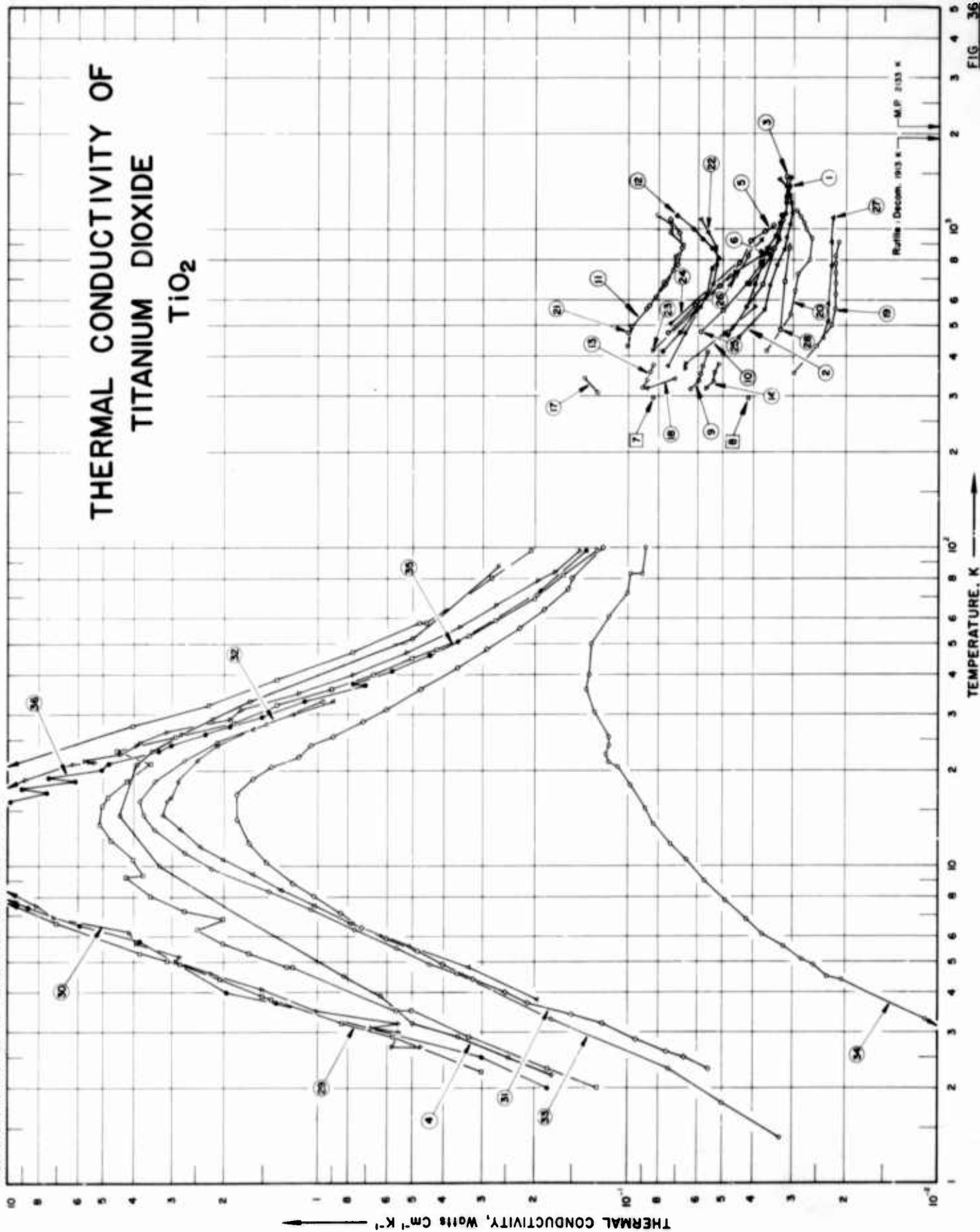
CURVE 5*

313.2	0.293
-------	-------

* Not shown on plot

THERMAL CONDUCTIVITY OF TITANIUM DIOXIDE TiO₂

FIGURE SHOWS ONLY 34 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 36 THERMAL CONDUCTIVITY OF TITANIUM DIOXIDE TiO₂

For Data Reported in Figure and Table No. 36

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	10	R	1952	468-1463			Specimen spheroidal in shape; bulk density 4.11 g cm ⁻³ .
2	10	R	1952	463-1448			Similar to the above specimen.
3	364	R	1954	473-1473			Polycrystal; prepared by calcining commercially pure TiO ₂ at 1000 C., grinding for 12 hrs in a steel mill, acid leaching slip-casting at a pH of 3.5 with specific gravity 3.5, and then fired at 1700 C in an oxidizing atmosphere; bulk density 4.11 g cm ⁻³ ; porosity 3.5%.
4	28	L	1956	2,2-88		Rutile	Single crystal; specimen 2 mm in dia and 60 mm long; supplied by Linde Air Products.
5	146		1955	473-1035		1	Polycrystal with crystal size of 15 microns; pressed hydrostatically and sintered for 2 hrs at 1250 C; porosity 2.1%.
6	146		1955	674-1123		11	Polycrystal with crystal size 28 microns; pressed hydrostatically and sintered 5 hrs at 1450 C; porosity 3.0%.
7	152	L	1956	298.2		TiO ₂ 192	Specimen in water form made up of 4 pieces of 0.75 in. in dia and 20 mils thick each.
8	152	L	1956	298.2		TiO ₂ 192	The above specimen exposed to 5 x 10 ¹⁹ epithermal neutrons per cm ² for 480 megawatt day in the Material Testing Reactor.
9	68	C	1954	317-414	± 3	Rutile; 2176-1	Natural single crystal with tetragonal crystal system; obtained from commercial source; flawless piece cut out and ground to 0.250 in. dia x 0.250 in. long; copper used as comparative material.
10	38	C	1960	363-573		Rutile	Disk specimen; porosity 13.4%; measured in a vacuum of 10 ⁻¹ mm Hg; pure iron used as comparative material; data correct to zero porosity.
11	145		1955	432-1105			Single crystal; heat flow parallel to c-axis.
12	145		1955	419-1102			Single crystal; heat flow perpendicular to c-axis.
13	42	C	1953	319-376		217 A-1	Clear single crystal; heat flow direction parallel to the c-axis.
14	42	C	1953	317-377		217 B-1	Clear single crystal; a-axis parallel to the axis of the cylindrical specimen within 11 degrees; 0.250 ± 0.001 in. in dia and 0.250 ± 0.001 in. in length; heat flow perpendicular to c-axis.
15	42	C	1953	338.2			Same specimen as 217 A-1.
16	42	C	1953	338.2			Same specimen as 217 B-1.
17	71	C	1951	309, 341		Rutile	Single crystal; from Linde Air Products Co. of Tonawanda, N. Y.; measured with heat flow parallel to the optical axis; Pyrex glass used as comparative material.
18	71	C	1951	317, 340		Rutile	Same as above; heat flow perpendicular to the optical axis.

SPECIFICATION TABLE NO. 36 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
19	332, 282	R	1955	353-910		Porous sample	Composed of a mixture of 70% Titanox TG and 30% RA10MO, the former being previously calcined at 1550 C for one hr and ground to -100 mesh in a micro-pulverizer; the batch mixed in a porcelain mill using distilled water and flint pebbles; pressed by using 7% binder (composition: 500 g carbowax, 10 g methocel and 1000 cc water) at a pressure of approx. 4400 psi and fired in a Pereny globar kiln at a rate of 120 C per hr and held at 1375 for 30 min; 3.31 sp gr; 11,900 psi mod rupture; 17.1% apparent porosity; 5.6% shrinkage; specimen size: 5.40 cm O. D., 2.8 cm I. D. and 0.5 in. thick, eleven rings stacked to form a cylinder of 5.5 in. high but measurements made only over the centrally-placed rings.
20	332, 282	R	1955	481-1145		Dense titania	Pressed from Titanium Alloy Manufacturing Co. heavy grade titania with 7% binder (same composition as the above); set on c. p. zirconia powder, heated at a rate of 60 C per hr. and held for 20 min at a peak temperature of 1390 C; 3.95 sp gr; 0.1% apparent porosity; 14.0% shrinkage; specimen size: 4.92 cm O. D., 2.61 cm I. D., and 0.5 in. thick; same specimen assembly as the above.
21	293	C	1957	473-1073	± 4		99.5% pure; single crystal; specimen cubic in shape of 0.875 in. sides; supplied by Lindt Co.; cut from fired slugs; heat flow parallel to the c-axis; polycrystalline alumina used as comparative material.
22	293	C	1957	373-1073	± 4		Similar to the above specimen except heat flow measured perpendicular to c-axis.
23	293	C	1957	419-1173	± 4	No. 1	99.5% pure; polycrystalline; specimen cubic in shape of 0.875 in. sides, supplied by Baker Chemical Co.; gravimetric porosity 2.1%; microscopic porosity 2.5%; polycrystalline alumina used as comparative material.
24	293	C	1957	503-923	± 4	No. 1	Above specimen, second run.
25	293	C	1957	478-1073	± 4	No. 2	99.5% pure; polycrystalline; gravimetric porosity 3.0%, microscopic porosity 3%; measured before reheating; same comparative material as above.
26	293	C	1957	508-1015	± 4	No. 2	The above specimen measured after reheating; same comparative material as above.
27	293	C	1957	458-1068	± 4	No. 3	99.5% pure; polycrystalline; gravimetric porosity 5.7%, microscopic porosity 5%; measured before reheating; same comparative material as above.
28	293	C	1957	488-1023	± 4	No. 3	The above specimen measured after reheating; gravimetric porosity 3.9%, microscopic porosity 5%; same comparative material as above.
29	310	L	1965	2.3-98		1c0	0.0001 ~ 0.001 each Ba, Cu, and Si, and perhaps smaller quantities of Al, Ca, and Fe; impurity concentration 10^{17} ~ 10^{18} atoms cm^{-3} ; single crystal cut from a boule grown by the Verneuil Method; specimen 1 x 4 x 24 mm; supplied by National Lead Co.; specimen axis parallel to the c-axis of the crystal with heat flow in the c direction; oxidized in air for two days at 700 C; specimen surfaces roughened with silicon carbide paper with No. 600 used for the final finish.

SPECIFICATION TABLE NO. 36 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
30	310	L	1965	2.7-98		1aO	Similar to the above specimen except for size 1 x 4 x 17 mm and specimen axis parallel to the a-axis of the crystal.
31	310	L	1965	2.3-100		1aOVR	The above specimen 1aO heated at 1175 C in vacuum of about 10^{-3} mm Hg for 27 hrs and then, while still in vacuum, cooled to near room temperature in 1 or 2 min, specimen 1 x 4 x 19 mm; defect concentration $1 \times 10^{19} \text{ cm}^{-2}$; electrical resistivity 3.5 ohm cm at 300 K.
32	310	L	1965	3.8-33		1aOVRO	The above specimen 1aOVR reoxidized at 600 C in flowing oxygen for 2 days.
33	310	L	1965	1.4-33		1aOVROO	The above specimen 1aOVRO reoxidized at 700 C for 7 days and at 800 C for 10 days in flowing oxygen.
34	310	L	1965	2.5-100		2aOHR	Cut from the same boule as the above specimen 1cO; specimen axis parallel to the a-axis of the crystal; specimen 1 x 4 x 19mm; heated at 900 C in flowing hydrogen gas for 2 hrs, then the hydrogen flushed out with argon and the furnace cooled to near room temperature in 2 or 3 hrs; defect concentration $1 \times 10^{20} \text{ cm}^{-2}$; electrical resistivity 0.35 ohm cm at 300 K.
35	310	L	1965	2.0-98		2aOHR	The above specimen 2aOHR oxidized at 700 C in flowing oxygen for 10 days.
36	310	L	1965	2.0-98		3aNb	0.1 Nb ₂ O ₅ ; cut from a boule grown from rutile powder which contained 0.1% Nb ₂ O ₅ ; specimen 1 x 3.5 x 14 mm; supplied by the National Lead Co.; niobium concentration 1.6×10^{19} atoms cm^{-2} ; electrical resistivity 3.1 ohm cm at 300 K.
37	474		1958	500-1000			Reduced; electrical resistivity reported as 2.9, 3.3, 1.7, and 1.4 ohm cm at 500, 620, 830, and 1000 K, respectively.
38	468	L	1950	327-403		41B	0.452 in. dia x 0.509 in. long.
39	407	L	1949	322-392			No details reported.

DATA TABLE NO. 36 THERMAL CONDUCTIVITY OF TITANIUM DIOXIDE TiO_2
 [Temperature, T, K; Thermal Conductivity, k, Watts $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k	T	k	T	k	T	k	T	k	T	k		
<u>CURVE 1</u>				<u>CURVE 10</u>				<u>CURVE 15*</u>				<u>CURVE 20</u>			
468.2	0.0487	363.2	0.066	338.2	0.0883	473.2	0.100	783.2	0.038	508.2	0.069*	88.2	0.033		
571.2	0.0425	378.2	0.066	<u>CURVE 16*</u>				573.2	0.0866	853.2	0.036	92.0	0.036		
673.2	0.0399	473.2	0.049	338.2	0.0537	673.2	0.077	963.2	0.034*	563.2	0.062	15.0	17.5*		
783.2	0.0377	573.2	0.040	<u>CURVE 17</u>				1073.2	0.033*	623.2	0.055*	16.2	16.0*		
873.2	0.0366	<u>CURVE 11</u>				338.2	0.069	773.2	0.070	713.2	0.046	18.0	12.5*		
951.2	0.0343	432.2	0.102	338.2	0.0537	873.2	0.069	873.2	0.069	908.2	0.038*	20.0	11.0*		
1055.7	0.0333	496.2	0.0983	<u>CURVE 18</u>				1073.2	0.074	1015.2	0.034*	27.5	4.0		
1133.2	0.0320	565.5	0.0883	309.2	0.126	373.2	0.075	<u>CURVE 22</u>				32.0	2.25		
1218.2	0.0318	616.2	0.0824	341.2	0.138	473.2	0.066	473.2	0.075	58.0	0.475	38.5	1.35		
1293.2	0.0316	681.8	0.0774	<u>CURVE 19</u>				573.2	0.059	58.0	0.475	47.0	0.77		
1373.2	0.0310	743.0	0.0725	317.2	0.0879	820.4	0.0710	773.2	0.054	59.0	0.45	80.0	0.28		
1463.2	0.0308	820.4	0.0672	340.2	0.0711	892.2	0.0672	873.2	0.0527	98.0	0.205	98.0	0.205		
<u>CURVE 2</u>				975.2	0.0737	<u>CURVE 21</u>				<u>CURVE 25 (cont.)</u>					
473.2	0.0751	1044.9	0.0732	430.2	0.0251	973.2	0.053	458.2	0.024	513.2	0.023	2.7	0.47		
580.7	0.0619	1105.2	0.0812	500.2	0.0224	1073.2	0.056	533.2	0.023	593.2	0.023	2.7	0.58		
688.2	0.0519	<u>CURVE 12</u>				565.2	0.0218	565.2	0.0235	768.2	0.0225	3.0	0.55		
784.7	0.0445	419.2	0.0782	565.2	0.0218	626.2	0.0217	768.2	0.0225	903.2	0.0225	3.1	0.67		
871.2	0.0340	474.6	0.0690	679.2	0.0218	679.2	0.0218	1068.2	0.022	903.2	0.0225	3.2	0.55		
983.2	0.0322	559.2	0.0615	730.2	0.0217	730.2	0.0217	<u>CURVE 26</u>				4.1	1.5		
1034.5	0.0348	628.2	0.0565	825.2	0.0217	825.2	0.0217	<u>CURVE 26</u>				4.6	2.2		
<u>CURVE 5</u>				753.2	0.0547	898.2	0.0274	<u>CURVE 26</u>				4.75	2.55		
473.2	0.0751	874.2	0.0544	910.2	0.0213	998.2	0.0274	<u>CURVE 26</u>				5.0	2.9		
580.7	0.0619	933.2	0.0586	<u>CURVE 20</u>				<u>CURVE 28</u>				5.2	2.8		
688.2	0.0519	1018.2	0.0628	481.2	0.0367	1043.2	0.034*	<u>CURVE 28</u>				5.7	3.9		
784.7	0.0445	1102.2	0.0706	543.2	0.0307	1173.2	0.033*	<u>CURVE 28</u>				6.2	5.1		
871.2	0.0340	<u>CURVE 13</u>				673.2	0.0377	<u>CURVE 29</u>				6.9	7.1		
983.2	0.0322	318.7	0.0904	723.2	0.0298	873.2	0.033	<u>CURVE 29</u>				7.5	8.1		
1034.5	0.0348	338.4	0.0874	798.2	0.0266	938.2	0.0263	<u>CURVE 29</u>				8.6	10.5*		
<u>CURVE 6</u>				375.9	0.0837	873.2	0.0260	<u>CURVE 29</u>				9.2	12.8*		
674.2	0.0418	375.9	0.0837	998.2	0.0274	998.2	0.0274	<u>CURVE 29</u>				10.0	14.3*		
820.7	0.0357	317.0	0.0569	1053.2	0.0278	1053.2	0.0278	<u>CURVE 29</u>				10.2	13.0*		
943.2	0.0337	335.3	0.0540	1101.2	0.0286	1101.2	0.0286	<u>CURVE 29</u>				11.1	13.2*		
1123.2	0.0330	356.9	0.0536	1145.2	0.0295	1145.2	0.0295	<u>CURVE 29</u>				11.6	12.7*		
<u>CURVE 7</u>				377.0	0.0519	<u>CURVE 25</u>				<u>CURVE 29</u>				13.0	15.0*
298.2	0.0837	316.7	0.0636	478.2	0.059	478.2	0.059	<u>CURVE 25</u>				15.0	14.0*		
<u>CURVE 8</u>				336.2	0.0598	553.2	0.050	<u>CURVE 25</u>				15.5	12.0*		
298.2	0.0418	377.5	0.0586	673.2	0.042	673.2	0.042	<u>CURVE 25</u>				18.7	8.8		
<u>CURVE 9</u>				414.0	0.0561	<u>CURVE 25</u>				<u>CURVE 29</u>				21.0	6.2
2.2	0.175	414.0	0.0561	<u>CURVE 25</u>				<u>CURVE 29</u>				21.2	5.3		
2.5	0.245	<u>CURVE 14</u>				<u>CURVE 29</u>				<u>CURVE 29</u>					
2.9	0.360	317.0	0.0569	481.2	0.0367	503.2	0.074	2.25	0.30	503.2	0.074	2.7	0.47		
3.2	0.500	338.4	0.0874	543.2	0.0307	581.2	0.062*	2.90	0.575	581.2	0.062*	2.7	0.58		
<u>CURVE 4</u>				358.5	0.0858	723.2	0.0291	3.2	0.93	723.2	0.0291	3.0	0.55		
2.2	0.175	375.9	0.0837	798.2	0.0266	873.2	0.0260	3.2	0.93	873.2	0.0260	3.1	0.67		
2.5	0.245	377.0	0.0519	873.2	0.0260	938.2	0.0263	3.2	0.93	938.2	0.0263	3.2	0.55		
2.9	0.360	414.0	0.0561	998.2	0.0274	998.2	0.0274	3.2	0.93	998.2	0.0274	3.5	1.0		
3.2	0.500	414.0	0.0561	1053.2	0.0278	1053.2	0.0278	3.2	0.93	1053.2	0.0278	4.1	1.5		
<u>CURVE 4</u>				1101.2	0.0286	1101.2	0.0286	3.2	0.93	1101.2	0.0286	4.6	2.2		
2.2	0.175	1145.2	0.0295	1145.2	0.0295	1145.2	0.0295	3.2	0.93	1145.2	0.0295	4.75	2.55		
2.5	0.245	377.0	0.0519	377.0	0.0519	377.0	0.0519	3.2	0.93	377.0	0.0519	5.0	2.9		
2.9	0.360	414.0	0.0561	414.0	0.0561	414.0	0.0561	3.2	0.93	414.0	0.0561	5.2	2.8		
3.2	0.500	414.0	0.0561	414.0	0.0561	414.0	0.0561	3.2	0.93	414.0	0.0561	5.7	3.9		

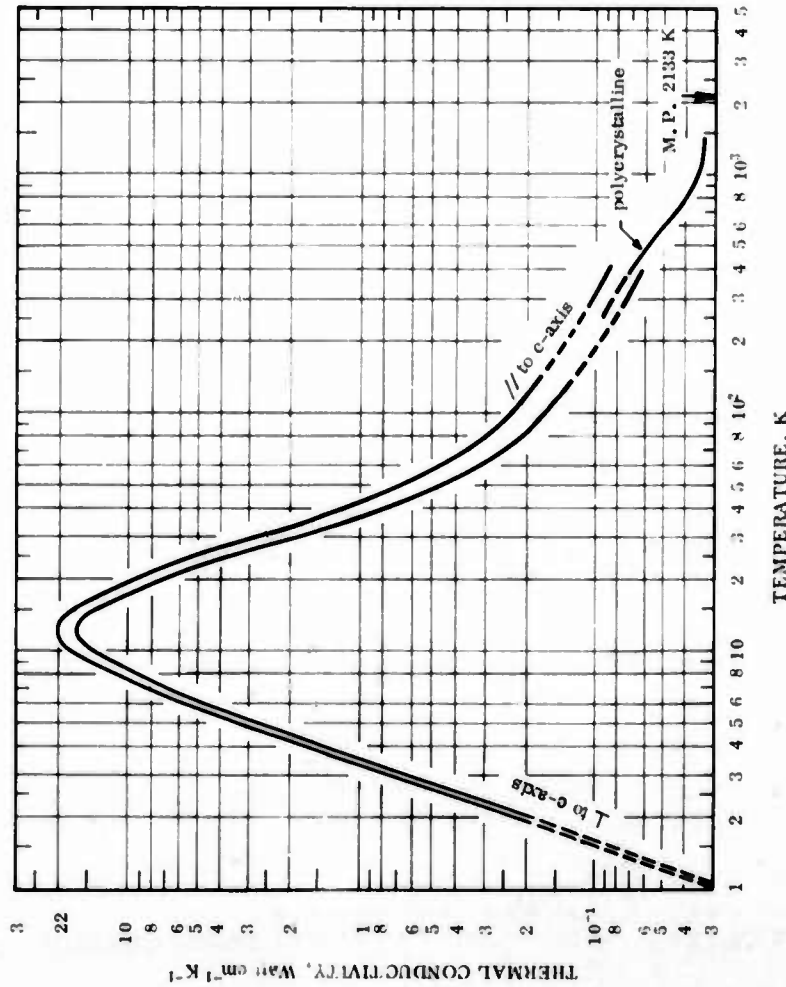
* Not shown on plot

DATA TABLE NO. 36 (continued)

CURVE 30 (cont.)		CURVE 31 (cont.)		CURVE 33 (cont.)		CURVE 35		CURVE 36 (cont.)		CURVE 39*		
T	k	T	k	T	k	T	k	T	k	T	k	
21.5	5.7	36.0	0.47	13.0	3.4	2.0	0.125	5.8	3.8	312.4	0.0427	
22.5	4.4	42.0	0.36	14.5	3.7	2.3	0.18	6.5	5.9	339.1	0.0452	
24.0	3.9	48.0	0.29	16.0	3.8	2.9	0.33	7.4	8.6	353.8	0.0437	
24.5	3.8	56.0	0.225	18.5	3.4	3.5	0.50	8.3	11.5	392.4	0.0423	
26.5	3.1	64.0	0.185	21.5	2.7	3.5	0.56	9.1	15.0			
29.0	1.9	74.0	0.155	24.5	2.1	4.8	1.2	10.2	18.0			
31.0	1.75	80.0	0.15	28.0	1.45	4.8	1.25	11.2	21.5			
35.0	1.15	100.0	0.12	33.0	0.96	5.3	1.65	12.3	24.0			
40.0	0.77					5.7	2.0	12.4	23.0			
47.0	0.52	CURVE 32		CURVE 34		6.3	2.45	14.0	18.0			
56.5	0.355					6.8	2.0	15.5	13.5			
66.0	0.27	3.8	0.195	2.45	0.0059*	7.2	2.7	16.0	9.8			
79.0	0.195	4.8	0.33	2.9	0.0086*	8.0	3.5	17.0	7.5			
84.0	0.17	5.6	0.51	3.3	0.011	9.2	4.2	17.5	9.0			
98.0	0.142	6.6	0.78	4.4	0.0205	9.3	3.7	18.5	6.1			
		7.5	1.02	4.5	0.023	10.5	4.0	19.0	7.4			
		8.4	1.3	4.9	0.0255	12.0	4.7	20.0	5.0			
		9.4	1.6	5.1	0.028	13.5	5.1	21.0	4.8			
		10.5	2.0	5.6	0.032	15.5	5.0	23.0	3.3			
		11.5	2.4	6.1	0.0375	16.5	4.8	24.0	3.0			
		13.0	2.8	6.8	0.042	18.5	4.2	26.0	2.3			
2.85	0.094	14.5	3.2	7.8	0.049	21.0	3.5	27.5	1.9			
3.2	0.12	16.0	3.1	9.0	0.057	23.0	4.5	28.5	1.5			
3.4	0.15	16.5	3.0	10.5	0.065	25.5	2.9	33.0	1.1			
3.7	0.21	18.5	2.85	11.7	0.073	28.0	1.85	37.0	0.7			
4.0	0.25	21.5	2.45	13.6	0.083	32.0	1.35	37.5	0.77			
4.4	0.32	24.0	2.1	15.2	0.088	36.0	0.90	41.0	0.58			
4.9	0.40	27.0	1.6	18.0	0.098	40.0	0.66	46.0	0.44			
5.4	0.48	30.0	1.2	20.5	0.107	45.0	0.50	51.0	0.36*			
5.9	0.60	33.0	0.89	21.2	0.115	48.0	0.42	58.0	0.27*			
6.4	0.72			22.5	0.117	53.0	0.33	73.0	0.19			
7.1	0.84			24.0	0.115	59.0	0.27	83.0	0.17*			
8.0	1.02			25.5	0.115	69.0	0.20	98.0	0.135			
8.8	1.2			30.5	0.127	82.0	0.16					
10.2	1.45			36.0	0.135	98.0	0.125	CURVE 37*				
11.8	1.65			40.0	0.132			CURVE 36				
14.0	1.8			50.0	0.130			500	0.0478			
16.7	1.8			61.0	0.115			700	0.0410			
18.7	1.6			72.0	0.10			900	0.0303			
20.5	1.4			83.0	0.098			1000	0.0340			
22.0	1.15			83.0	0.090							
24.0	1.05			100.0	0.088			CURVE 38*				
25.5	0.89							327.4	0.0502			
28.5	0.71							354.9	0.0515			
31.0	0.60							384.1	0.0532			
								402.9	0.0514			

* Not shown on plot

FIGURE AND TABLE NO. 36R RECOMMENDED THERMAL CONDUCTIVITY OF TITANIUM DIOXIDE TiO₂



T ₁	RECOMMENDED VALUES*						T ₂
	99.997% Pure Rutile Single Crystal (⊥ to c-axis)			Polycrystalline (99.5% pure, 98% dense)			
	k ₁	k ₂	k ₃	k ₁	k ₂	k ₃	
0	0	0	0	0	0	0	-459.7
1	(0.026)†	(1.50)	(0.023)	(0.023)	(1.33)	0	-457.9
5	3.13	181	2.65	153			-450.7
10	17.9	1030	14.6	844			-441.7
11	20.0	1160	16.3	942			-439.9
12	20.6	1190	17.0	982			-438.1
13	20.2	1170	16.5	953			-436.3
14	19.1	1100	15.4	890			-434.5
15	17.7	1020	13.8	797			-432.7
20	10.0	578	6.9	399			-423.7
25	5.4	312	3.6	208			-414.7
30	2.85	165	1.88	109			-405.7
40	1.17	67.6	0.80	46.2			-387.7
50	0.66	38.1	0.45	26.0			-369.7
60	0.45	26.0	0.315	18.2			-351.7
70	0.35	20.2	0.252	14.6			-333.7
80	0.30	17.3	0.213	12.3			-315.7
90	0.264	15.3	0.187	10.8			-297.7
100	0.235	13.6	0.169	9.76			-279.7
150	(0.168)	(8.71)	(0.120)	(6.93)			-189.7
200	(0.137)	(7.92)	(0.097)	(5.60)			- 99.7
250	(0.118)	(6.82)	(0.083)	(4.80)			- 9.7
273.2	(0.111)	(6.41)	(0.078)	(4.51)			32.0
300	0.104	6.01	0.074	4.28			80.3
350	0.094	5.43	0.066	3.81			170.3
400	0.095	4.91	0.060	3.47			260.3
500							440.3
600							620.3
700							800.3
800							980.3
900							1160
1000							1340
1100							1520
1200							1700
1300							1880
1400							2060

REMARKS

The recommended values for 99.997% pure rutile single crystal are thought to be accurate to within 10 to 15% of the true values at temperatures above 30 K. The thermal conductivity near and below the corresponding temperature of its maximum is highly sensitive to small physical and chemical variations of the specimens, and the recommended values below 30 K are intended as typical values for indicating the general trend.

The recommended values for 99.5% pure, 98% dense, polycrystalline TiO₂ that are supported by experimental data are thought to be accurate to within 10% of the true values at temperatures from 400 to 1000 K and 10 to 15% at other temperatures.

* T₁ in K, k₁ in Watt cm⁻¹ K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ ft⁻¹ F⁻¹.

† Values in parentheses are extrapolated or interpolated.

SPECIFICATION TABLE NO. 37 THERMAL CONDUCTIVITY OF TUNGSTEN TRIOXIDE WO₃

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	254	E	1955	396-568	3		0.28 ZnO; coarse crystalline structure; prepared by firing H ₂ WO ₃ and ZnO; considerable porosity.

DATA TABLE NO. 37 THERMAL CONDUCTIVITY OF TUNGSTEN TRIOXIDE WO₃[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

396.2	0.249
428.2	0.251
487.2	0.254
523.2	0.257
568.2	0.258

* No graphical presentation

THERMAL CONDUCTIVITY OF URANIUM DIOXIDE UO₂

FIGURE SHOWS ONLY 76 OF THE CURVES REPORTED IN TABLE

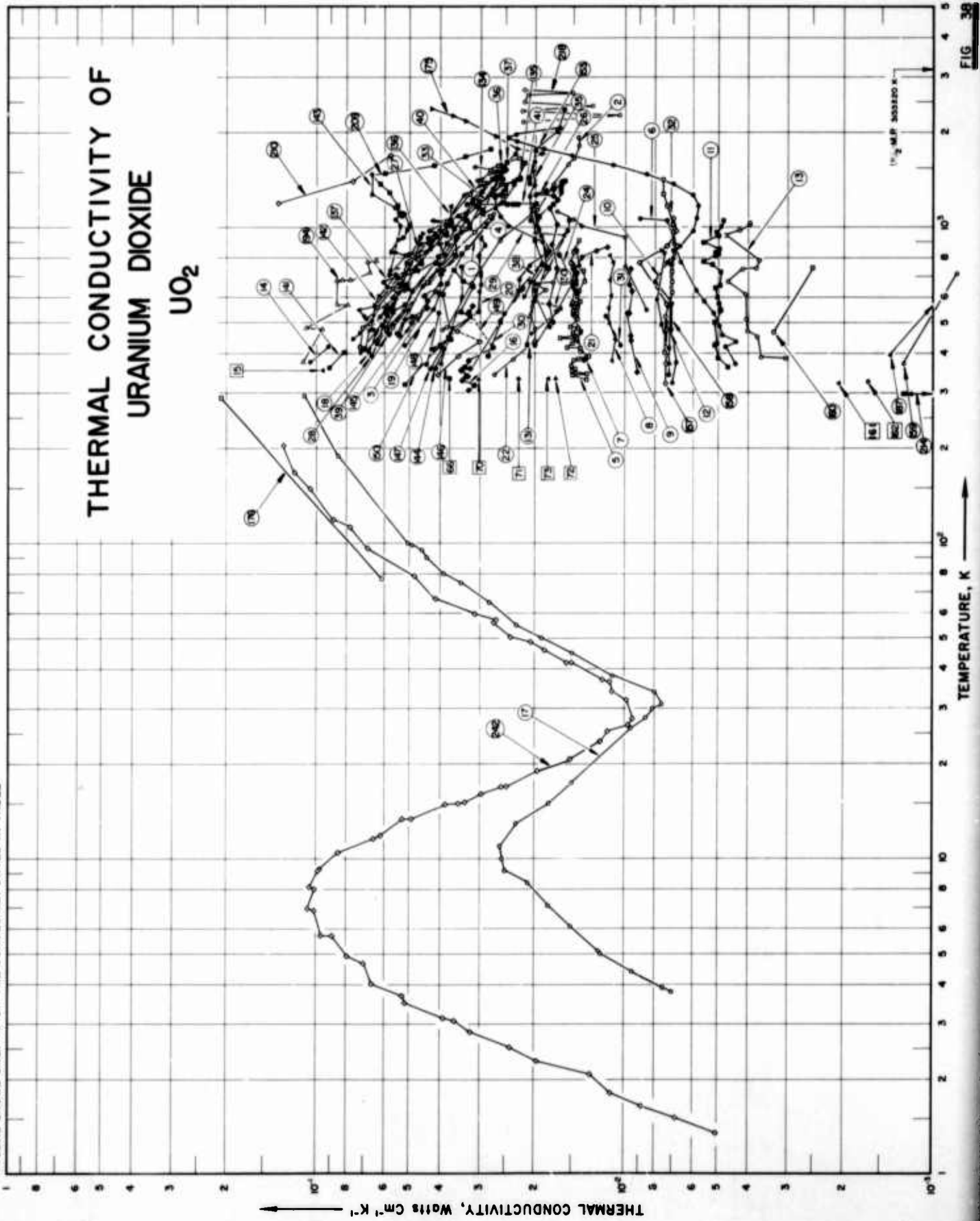


FIG. 38

SPECIFICATION TABLE NO. 38 THERMAL CONDUCTIVITY OF URANIUM DIOXIDE UO₂

[For Data Reported in Figure and Table No. 38]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	364	C	1954	473-1273			Polycrystalline; cast from a suspension prepared by Argonne National Laboratory and fired at 1980 C in vacuum; measured in vacuum; bulk density 8.0 g cm ⁻³ ; porosity 26.7%.
2	29	R	1956	476-1941			Specimens made up of 15 pieces of 0.5 in. I. D. and 3.0 in. O. D. with a total height of 9 in.; prepared from a mill batch consisting of 500 g of uranium oxide, 1.75 g of stearic acid, 3.5 g of methyl cellulose, 2.5 cm ³ of 0.5% Aerosol OT in octyl alcohol and 160 cm ³ of water, ground for 16 hrs and dried at 80 C for 24 hrs, then crushed and cold pressed at 20 tons cm ⁻² ; again dried for 24 hrs at 80 C after which heated in dry hydrogen up to 1400 C then up to 1500 C in steam finally cooled to room temperature in a hydrogen atmosphere; density 8.17 g cm ⁻³ .
3	30	C	1960	457-1058	±5 (T<673) ±10 (T>673)	No. 4	Oxygen-uranium ratio 2.01; specimen 0.625 in. in dia and 2.242 in. long; prepared from 46W high fired grade (-400 mesh) UO ₂ powder with isotropic, coarse, crystalline grains and particles of 14.9 μ average size; pressure bonded for 3 hrs at 1423 K and 10,000 psi and then bonded again at 1533 K for 3 hrs at 10,000 psi; density 10.1 g cm ⁻³ (92% of theoretical density).
4	45	C	1953	486-1298			Pure; crystalline; cubic specimen, supplied by Argonne National Laboratory; prepared by hydrostatical pressing and slowly firing to 1980 C in vacuum; bulk density 8.0 g cm ⁻³ ; total porosity 26%.
5	166	R	1953	330-917			In powder form; 63% solid particles by volume; measured in helium.
6	166	R	1953	373-1066			Similar to the above specimen except measured in argon.
7	167	R	1955	379-849			In powder form; 40.5% void volume; measured in helium at pressures ranging from 59.3 to 136.9 psia.
8	167	R	1955	379-819			Similar to the above specimen except measured in a helium and argon mixture of 1.857 to 1 volumetric ratio at pressures ranging from 47.3 to 84.3 psia.
9	167	R	1955	348-742			Similar to the above specimen except measured in a helium and argon mixture of 0.953 to 1 volumetric ratio at pressures ranging from 39.4 to 96.3 psia.
10	167	R	1955	372-846			Similar to the above specimen except measured in a helium and argon mixture of 0.333 to 1 volumetric ratio at pressures ranging from 46.3 to 84.3 psia.
11	167	R	1955	364-1061			Similar to the above specimen except measured in argon at pressures ranging from 44.3 to 94.4 psia.
12	167	R	1955	443-904			Similar to the above specimen except measured in nitrogen at pressures ranging from 49.3 to 83.3 psia.
13	167	R	1955	385-1035			Similar to the above specimen except measured in a xenon and krypton mixture of 4.989 to 1 volumetric ratio at pressures ranging from 15.78 to 74.3 psia.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
14	136	C	1959	375-421	±4	UO ₂ , 00	Bulk density 10.08 g cm ⁻³ ; porosity 7.5%.
15	136	C	1959	354.2	±4	UO ₂ , x	The above specimen heated in air at 150 to 175 C; composition undetermined.
16	136	C	1959	306-359	±4	UO ₂ , 10	Bulk density 9.83 g cm ⁻³ ; porosity 10%.
17	168	L	1961	3.8-294			Prepared by extrusion and sintering; density 9.97 g cm ⁻³ ; grain 5 to 20 μ in dia; crystal distortion not more than 1000 Å.
18	169	R	1961	403-958		WAPD 22-11	Pressurized Water Reactor Core I production pellets of natural uranium dioxide supplied by Mallinckrodt Chemical Works; molten uranyl nitrate hexahydrate pyrolyzed to UO ₃ and reduced to UO ₂ with cracked ammonia to an apparent density of 3 g cm ⁻³ , then particles agglomerated with polyvinyl alcohol, blended with sterotex and compacted at 125 psi to a green density of 73-74% of theoretical; sintered for 8 hrs at 1675 C into pellets with density of 10.4 g cm ⁻³ (99.9% theoretical density); UO ₂ pellets center mass ground on their lateral surfaces and end ground to a height of 0.7976 cm; fuel capsule (containing 15 UO ₂ pellets) 0.907 cm I.D., 2.8575 cm O.D.; 11.96 cm nominal length pellets assembled into fuel capsule with zero diametral clearance; fuel chamber atmosphere 1 Kr + 3 Xe by volume at 14.7 psi; irradiated in Material Testing Reactor for 45 days with estimated total exposure of 0.57 x 10 ²¹ nvt and total burn-up 4.1 x 10 ¹⁸ fission cm ⁻² ; data taken as the effective thermal conductivity (the average thermal conductivity from the fuel center to the inner surface of the cladding of the capsule) versus the temperature at the center of the specimen measured in the Material Testing Reactor (in-pile measurements); this experiment contained a gamma heat capsule, and the gamma heat values used in the thermal conductivity calculations for this test.
19	169	R	1961	423-768		WAPD 22-4	Same supplier, fabrication method, and measuring condition as the above specimen; density 10.27 g cm ⁻³ (93.7% theoretical density); diametral clearance 0.0038 cm; fuel chamber filled with helium; irradiated for one day with estimated total exposure 0.43 x 10 ¹⁸ nvt and total burn-up 3.6 x 10 ¹⁸ fission cm ⁻² .
20	169	R	1961	373-1023		WAPD 22-14	Same supplier, fabrication method, and measuring condition as the above specimen; density 10.31 g cm ⁻³ (94.1% theoretical density); diametral clearance 0.0064 cm; irradiated for 30 days with estimated total exposure 0.32 x 10 ²¹ nvt and total burn-up 2.4 x 10 ¹⁸ fission cm ⁻² .
21	169	R	1961	423-863		WAPD 22-1	Same supplier, fabrication method, and measuring condition as the above specimen; density 10.3 g cm ⁻³ (94% theoretical density); diametral clearance 0.0089 cm; fuel chamber filled with helium; irradiated for 15 days with an estimated total exposure 0.8 x 10 ¹⁸ nvt and total burn-up 6.5 x 10 ¹⁸ fission cm ⁻² ; no gamma heat measuring capsule in the assembly; gamma heat values assumed in the thermal conductivity calculations for this test.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
22	169	R	1961	343-675		WAPD 22-3	Same supplier, fabrication method, and measuring condition as the above specimen; density 10.15 g cm^{-3} (92.6% theoretical density); diametral clearance 0.020 cm; fuel chamber filled with helium; irradiated for 15 days with estimated total exposure $0.67 \times 10^{20} \text{ nvt}$ and total burn-up $5.3 \times 10^{18} \text{ fission cm}^{-2}$.
23	169	R	1961	623, 663		WAPD 22-9	Same supplier, fabrication method, and measuring condition as the above specimen; density 10.25 g cm^{-3} (93.8% theoretical density); diametral clearance 0.020 cm; irradiated for one day at estimated total exposure $0.46 \times 10^{20} \text{ nvt}$ and total burn-up $3.8 \times 10^{18} \text{ fission cm}^{-2}$.
24	169	R	1961	623, 823		WAPD 22-2	Same supplier, fabrication method, and measuring condition as the above specimen; density 10.25 g cm^{-3} (93.5 theoretical density); diametral clearance 0.020 cm; fuel chamber evacuated to less than 10^{-5} mm ; irradiated for one day with estimated total exposure $0.19 \times 10^{20} \text{ nvt}$ and total burn-up $1.6 \times 10^{18} \text{ fission cm}^{-2}$.
25	169	R	1961	548-1123		WAPD 22-7	Same supplier, fabrication method, and measuring condition as the above specimen; density 10.41 g cm^{-3} (95% theoretical density); diametral clearance 0.033 cm; irradiated for 15 days with an estimated total exposure $0.19 \times 10^{21} \text{ nvt}$ and total burn-up $1.5 \times 10^{19} \text{ fission cm}^{-2}$, first run.
26	169	R	1961	503-1403		WAPD 22-7	The above specimen; second run.
27	169	R	1961	413-948		WAPD 22-5	Laboratory-prepared natural UO_2 pellets; pellets preparation: UNH converted to UO_2 in porcelain ware at 260-400 C. milled for 16 hrs in a zircaloy-2 ball mill into 200 mesh particles, reduced with dry hydrogen at 800 C to UO_2 in platinum boats, and then ball-milled using 0.953 cm dia uranium balls in a rubber-lined vessel, granulated with 102% polyethylene glycol binder and pressed at 20-4 psi into pellets; sintered green pellets at 1750 C for 14 hrs to a density of 94.1% theoretical density; the UO_2 pellets ground to the same dimension as that of specimen WAPD 22-11; same fuel capsule dimensions as that of specimen WAPD 22-11; pellets put into fuel capsule with 0.0035 cm diametral clearance; fuel chamber filled with helium at 14.7 psi; irradiated in MTR for 38 days with estimated total exposure $0.5 \times 10^{21} \text{ nvt}$ and total burn-up $3.6 \times 10^{19} \text{ fission cm}^{-2}$; data taken as the effective thermal conductivity versus the temperature of the centre of the specimen measured in MTR (in-pile measurement); contained a gamma heat capsule, and the gamma heat values used in the thermal conductivity calculations for this test; first run.
28	169	R	1961	393-1033		WAPD 22-5	The above specimen; second run.
29	169	R	1961	488-1448		WAPD 22-15	UO_2 being 1.02% enriched; same supplier, fabrication method, and measuring condition as the above specimen; density 10.55 g cm^{-3} ; diametral clearance 0.0059 cm; fuel chamber filled with 1 Kr + 3 Xe by volume at 14.7 psi; irradiated for 15 days with an estimated total exposure $0.14 \times 10^{21} \text{ nvt}$ and total burn-up $1.6 \times 10^{19} \text{ fission cm}^{-2}$.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
30	169	R	1961	393-1413		WARD 22-6	Non-stoichiometric UO_2 ; same supplier, fabrication method, and measuring condition as the above specimen; density 10.59 g cm^{-3} ; no diametral clearance; irradiated for 15 days with an estimated total exposure of 0.19×10^{21} nvt and total burn-up 1.5×10^{18} fissions cm^{-2} .
31	170	R	1953	425, 528			Ellipsoidal specimen prepared by Knolls Atomic Power Lab; bulk density 6.01 g cm^{-3} ; porosity 45%, measured in air.
32	170	R	1953	404-1425			The above specimen measured in vacuo.
33	171	R	1958	1073-1423	± 10		Tubular specimen; 9.44 mm O. D., 3.86 mm I. D., and 102 mm long; prepared by hydrostatic pressing of non-stoichiometric UO_2 at 10 tons in^{-2} ; sintered in a nitrogen atmosphere at 1400 C for 2 hrs, followed by reduction in hydrogen at 1200 C for 2 hrs; oxygen-uranium ratio of sintered specimen 2.00 ± 0.005 ; grain size 2 to 10 μ ; density 10.5 g cm^{-3} (96% theoretical density).
34	411	L	1960	373-873		1000	0.248 in. dia x 3.12 in. long; isostatically pressed at 40,000 psi; irradiated by a neutron flux of 1.14×10^{18} nvt; density 10.27 g cm^{-3} (93.7% of theoretical value); electrical resistivity reported as 11.0×10^4 , 286, 59, 9, 39.1, 20.1, 11.8, 8.47, 6.76 and 5.81 ohm cm at 25, 100, 200, 300, 400, 500, 600, 700 and 800 C, respectively (averaged over data from one cycle of heating and cooling periods of measurement); measured in a vacuum of $\sim 10^{-4}$ mm Hg; data corrected to UO_2 of 100% of theoretical density.
35	172	R	1961	338-1623	± 6	UO_2 , No. 1	Non-stoichiometric; specimen consisting of a stack of 7 discs 2 in. in dia and 0.5 in. thick; prepared from UO_2 powder, cold-pressed at 167 psi in a die, then hydrostatically pressed at 20,000 lb in^{-2} and sintered at 1400 C in nitrogen for 2 hrs; measured in argon atmosphere; grain size after test 1.5 μ .
36	172	R	1961	466-1598	± 6	No. 2	Stoichiometric; specimen consisting of a stack of 7 discs 2 in. in dia and 0.5 in. thick; prepared from UO_2 powder; cold pressed at 167 lb in^{-2} in a die, then hydrostatically pressed at 20,000 lb in^{-2} and sintered at 1400 C in nitrogen for two hrs, followed by 2 hrs reduction in hydrogen at the same temperature; measured in 85 nitrogen + 15 hydrogen atmosphere; density 10.50 g cm^{-3} .
37	172	R	1961	430-1613	± 6	No. 3	Stoichiometric; specimen consisting of a stack of 7 discs 2 in. in dia and 0.5 in. thick; prepared from UO_2 + Cranko powder, enriched to 1.25 Co; same treatment and test atmosphere as the above specimen; density 10.45 g cm^{-3} ; grain size (after test) 2.5 μ .
38	172	R	1961	605-1196	± 6	UO_2 , No. 3	Non-stoichiometric; the above specimen oxidized to UO_3 .
39	172	R	1961	463-1555	± 6	No. 4	Stoichiometric; specimen consisting of a stack of 7 discs 2 in. in dia and 0.5 in. thick; prepared from UO_2 powder with 1 mole % TiO_2 added as an aid for sintering; having the same treatment and test atmosphere as specimen No. 2; density 10.42 g cm^{-3} ; grain size (after test) 17.5 μ .

SPECIFICATION TABLE NO. 3^a (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
40	172	R	1961	419-1656	±6	No. 5	Stoichiometric; specimen consisting of a stack of 7 discs 2 in. in dia and 0.5 in. thick; prepared from UO ₂ powder; cold pressed at 167 psi in a die, then hydrostatically pressed at 20,000 lb in. ⁻² , pre-sintered at 1400 C for 1 hr in hydrogen, followed by final sintering at 1700 C in cracked ammonia for 10 hrs; measured in 85 nitrogen + 15 hydrogen atmosphere; density 10.34 g cm ⁻³ ; grain size (after test) 6.6 μ
41	172	R	1961	1193		UO ₂ x	Stoichiometric; specimen No. 3 measured at 920 C with increasing oxygen content 0 ≤ x ≤ 0.13.
42	165	C	1960	333.2	±2	A ₁	Total impurities < 0.003; single-phase polycrystalline; 1.27 cm in dia and in length, prepared from UO ₂ powder obtained from hydrogen reduction of ammonium diuranate; pressed in a hardened-steel die at a pressure of 2500 Kg cm ⁻² and sintered at 1650 C for 2 hrs in a hydrogen atmosphere; heat flow parallel to the direction of pressing; a constant axial pressure of 56 Kg cm ⁻² exerted on the specimen during measurement; bulk density 8.40 g cm ⁻³ .
43	165	C	1960	333.2	±2	A ₂	Similar to the above specimen except bulk density 8.45 g cm ⁻³ , grain dia 4 x 10 ⁻⁴ cm, and coefficient of variation 14%.
44	165	C	1960	333.2	±2	B ₁	Similar to specimen A ₁ except bulk density 9.55 g cm ⁻³ , grain dia 4.5 x 10 ⁻⁴ cm, and coefficient of variation 36%.
45	165	C	1960	333.2	±2	B ₂	Similar to specimen A ₁ except bulk density 9.65 g cm ⁻³ .
46	165	C	1960	333.2	±2	C ₁	Similar to specimen A ₁ except bulk density 10.20 g cm ⁻³ .
47	165	C	1960	333.2	±2	C ₂	Similar to specimen A ₁ except bulk density 10.30 g cm ⁻³ , grain dia 10.4 x 10 ⁻⁴ cm and coefficient of variation 4%.
48	165	C	1960	333.2	±2	D ₁	Similar to specimen A ₁ except bulk density 10.40 g cm ⁻³ , grain dia 9.10 x 10 ⁻⁴ cm and coefficient of variation 4.5%.
49	165	C	1960	333.2	±2	D ₂	Similar to specimen A ₁ except bulk density 10.45 g cm ⁻³ .
50	165	C	1960	333.2	±2	E ₁	Similar to specimen A ₁ except bulk density 10.60 g cm ⁻³ , grain dia 17.5 x 10 ⁻⁴ cm and coefficient of variation 9%.
51	165	C	1960	333.2	±2	A _T	Similar to specimen A ₁ except bulk density 8.9 g cm ⁻³ , grain dia 2.4 x 10 ⁻⁴ cm and coefficient of variation 20%; measured with heat flow perpendicular to the direction of pressing.
52	165	C	1960	333.2	±2	B _T	Similar to specimen A _T except bulk density 9.25 g cm ⁻³ , grain dia 3.8 x 10 ⁻⁴ cm, and coefficient of variation 32%.
53	165	C	1960	333.2	±2	C _T	Similar to specimen A _T except bulk density 10.20 g cm ⁻³ , grain dia 4.8 x 10 ⁻⁴ cm, and coefficient of variation 15%.
54	165	C	1960	333.2	±2	D _T	Similar to specimen A _T except bulk density 10.35 g cm ⁻³ , grain dia 8.3 x 10 ⁻⁴ cm, and coefficient of variation 20%.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
55	165	C	1960	333.2	±2	A	Single-phase polycrystal; 1.27 cm in dia and in length, prepared from Mallinckrodt Ceramic Grade UO_2 , bulk density 9.90 g cm^{-3} , grain dia $14.3 \times 10^{-4} \text{ cm}$; coefficient of variation 17%; measured with a constant axial pressure of 56 Kg cm^{-2} exerted on the specimen and heat flow parallel to the direction of pressing.
56	165	C	1960	333.2	±2	B	Similar to specimen A except bulk density 10.00 g cm^{-3} , grain dia $16.7 \times 10^{-4} \text{ cm}$, and coefficient of variation 12%.
57	165	C	1960	333.2	±2	C	Single-phase polycrystal; 1.27 cm in dia and in length, commercially manufactured from ammonium diuranate; bulk density 10.50 g cm^{-3} , grain dia $14.3 \times 10^{-4} \text{ cm}$; coefficient of variation 10%; measured with a constant axial pressure exerted on the specimen and heat flow parallel to the direction of pressing.
58	165	C	1960	333.2	±2	D	Similar to the above specimen except bulk density 10.70 g cm^{-3} , grain dia $15.4 \times 10^{-4} \text{ cm}$ and coefficient of variation 17%; total impurity < 0.04; first run.
59	165	C	1960	333.2	±2	E	From the same batch as specimen D.
60	165	C	1960	333.2	±2	E	Second run of the above specimen.
61	165	C	1960	333.2	±2	UO_2 , 01, A	Polycrystalline; 1.27 cm in dia and in length; first prepared by the hydrogen-sintering method, then progressively oxidized at 900 C in a static gas mixture of helium and air (30 cm Hg of helium to 2 cm Hg of air); annealed in pure helium at 900 C for 4 hrs after each oxidation, then cooled to room temperature over a period of 20 hrs; heat flow parallel to the direction of pressing; a constant axial pressure of 56 Kg cm^{-2} exerted on the specimen during measurement; data corrected to zero porosity.
62	165	C	1960	333.2	±2	UO_2 , 04, A	The above specimen re-oxidized and re-measured in the same way.
63	165	C	1960	333.2	±2	UO_2 , 05, A	The above specimen re-oxidized and re-measured in the same way.
64	165	C	1960	333.2	±2	UO_2 , 01, A	The above specimen re-oxidized and re-measured in the same way.
65	165	C	1960	333.2	±2	UO_2 , 06, A	The above specimen re-oxidized and re-measured in the same way.
66	165	C	1960	333.2	±2	UO_2 , 06, A	The above specimen re-oxidized and re-measured in the same way.
67	165	C	1960	333.2	±2	UO_2 , 11, A	The above specimen re-oxidized and re-measured in the same way.
68	165	C	1960	333.2	±2	UO_2 , 01, B	0.1 TrO_2 ; polycrystalline; 1.27 cm in dia and in length; prepared and treated the same way as the above specimen and measured under the same conditions; density 10.25 g cm^{-3} , data corrected to zero porosity.
69	165	C	1960	333.2	±2	UO_2 , 05, B	The above specimen re-oxidized and re-measured in the same way.
70	165	C	1960	333.2	±2	UO_2 , 01, B	The above specimen re-oxidized and re-measured in the same way.
71	165	C	1960	333.2	±2	UO_2 , 14, B	The above specimen re-oxidized and re-measured in the same way.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
72	165	C	1960	333.2	±2	UO ₂ 21, C	Polycrystalline; 1.27 cm in dia and in length; prepared by pressing the green uranium dioxide powder in a hardened steel die at a pressure of 2500 Kg cm ⁻² ; the pressed powder sintered in an atmosphere of steam at 1400 C for 2 hrs and cooled in steam from the sintering temperature; heat flow parallel to the direction of pressing; a constant axial pressure of 56 Kg cm ⁻² exerted on the specimen during measurement; density 10.6 g cm ⁻³ , data corrected to zero porosity.
73	165	C	1960	333.2	±2	UO ₂ 21, D	Similar to the above specimen.
74	165	C	1960	333.2	±2	UO ₂ 21, E	Similar to the above specimen.
75	165	C	1960	333.2	±2	UO ₂ 66, F	Polycrystalline; 1.27 cm in dia and in length; ammonium diuranate powder ignited in air at 650 C for 6 hrs, pressed in a hardened steel die at a pressure of 2500 Kg cm ⁻² , sintered in air at 1500 C for 3 hrs, sintered again at 1500 C in oxygen for 1.5 hrs and cooled in oxygen from sintering temperature; heat flow parallel to the direction of pressing; a constant axial pressure of 56 Kg cm ⁻² exerted on the specimen during measurement; density 8.05 g cm ⁻³ , data corrected to zero porosity.
76	165	C	1960	333.2	±2	UO ₂ 66, G	Similar to the above specimen.
77	165	C	1960	333.2	±2	UO ₂ 66, H	Similar to the above specimen.
78	165	C	1960	333.2	±2	S ₃	Total impurities < 0.004; 0.736 cm in dia; prepared by cold-pressing hydrogen-sintering method; irradiated in an air-cooled self-serve facility in the Chalk River NRX reactor for 20 min with integrated thermal-neutron flux 6.4×10^{16} n cm ⁻² , density 10.1 g cm ⁻³ .
79	165	C	1960	333.2	±2	L ₃	Similar to the above specimen.
80	165	C	1960	333.2	±2	S ₄	Similar to specimen S ₃ except irradiated for 1 hr with integrated thermal-neutron flux 1.9×10^{16} n cm ⁻² .
81	165	C	1960	333.2	±2	L ₄	Similar to the above specimen except density 10.0 g cm ⁻³ .
82	165	C	1960	333.2	±2	S ₅	Similar to specimen S ₃ except irradiated for 3 hrs with integrated thermal-neutron flux 6.25×10^{16} n cm ⁻² .
83	165	C	1960	333.2	±2	L ₅	Similar to the above specimen.
84	165	C	1960	333.2	±2	S ₆	Similar to specimen S ₃ except irradiated for 10 hrs with integrated thermal-neutron flux 2.3×10^{16} n cm ⁻² , density 10.0 g cm ⁻³ .
85	165	C	1960	333.2	±2	L ₆	Similar to the above specimen.
86	165	C	1960	333.2	±2	S ₇	Similar to specimen S ₃ except irradiated for 31 hrs with integrated thermal-neutron flux 7.55×10^{16} n cm ⁻² ; density 10.0 g cm ⁻³ .
87	165	C	1960	333.2	±2	L ₇	Similar to the above specimen.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
88	165	C	1960	333.2	±2	S ₃	Similar to specimen S ₃ except irradiated for 31 hrs with integrated thermal-neutron flux 8.9×10^{14} n cm ⁻² ; density 10.2 g cm ⁻³ .
89	165	C	1960	333.2	±2	L ₄	Similar to the above specimen except density 10.3 g cm ⁻³ .
90	165	C	1960	333.2	±2	S ₁	Similar to specimen S ₃ except irradiated for 4 days with integrated thermal-neutron flux 2.3×10^{16} n cm ⁻² ; density 10.0 g cm ⁻³ .
91	165	C	1960	333.2	±2	L ₁	Similar to the above specimen except density 10.1 g cm ⁻³ .
92	165	C	1960	333.2	±2	S ₂	Similar to specimen S ₃ except irradiated 13 days with integrated thermal-neutron flux 7.4×10^{16} n cm ⁻² .
93	165	C	1960	333.2	±2	L ₂	Similar to the above specimen except density 10.0 g cm ⁻³ .
94	165	C	1960	333.2	±2	L ₃	Similar to specimen S ₃ except irradiated for 13 days with integrated thermal-neutron flux 8.15×10^{16} n cm ⁻² ; density 10.3 g cm ⁻³ .
95	165	C	1960	333.2	±2	L ₁₀	Similar to specimen S ₃ except irradiated for 38 days with integrated thermal-neutron flux 2.25×10^{16} n cm ⁻² ; density 10.3 g cm ⁻³ .
96	165	C	1960	333.2	±2	S ₁₁	Similar to specimen S ₃ except irradiated for 120 days with integrated thermal-neutron flux 6.8×10^{16} n cm ⁻² ; density 10.2 g cm ⁻³ .
97	165	C	1960	333.2	±2	L ₁₁	Similar to the above specimen.
98	165	C	1960	333.2	±2	A _{1a}	Total impurity < 0.004; prepared by cold-pressing hydrogen-sintered method; irradiated in a water cooled "g"-rod in the Chalk River NRX reactor for 30 days with integrated thermal-neutron flux 1.0×10^{16} n cm ⁻² ; density 10.1 g cm ⁻³ .
99	165	C	1960	333.2	±2	A _{2a}	Similar to the above specimen.
100	165	C	1960	333.2	±2	B _{2a}	Similar to the above specimen.
101	165	C	1960	333.2	±2	B _{2a}	Similar to the above specimen.
102	165	C	1960	333.2	±2	A _{2b}	Total impurity < 0.004, prepared by cold-pressing hydrogen-sintering method.
103	165	C	1960	333.2	±2	A _{2c}	The above specimen annealed in vacuum for one hr at 400 ± 5 C.
104	165	C	1960	333.2	±2	A _{2b}	Similar to specimen A _{2b} .
105	165	C	1960	333.2	±2	A _{2c}	The above specimen annealed in vacuum for one hr at 900 ± 5 C.
106	165	C	1960	333.2	±2	B _{2b}	Similar to specimen A _{2b} .
107	165	C	1960	333.2	±2	B _{2c}	The above specimen annealed in vacuum for one hr at 600 ± 5 C.
108	165	C	1960	333.2	±2	B _{2b}	Similar to specimen A _{2b} .
109	165	C	1960	333.2	±2	B _{2c}	The above specimen annealed in vacuum for one hr at 700 ± 5 C.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
110	165	C	1960	333.2	±2	S _{5a}	Similar to specimen S ₅ ; measured before being irradiated.
111	165	C	1960	333.2	±2	S _{5b}	The above specimen annealed in vacuum for one hr at 600 ± 5 C.
112	165	C	1960	333.2	±2	L _{4a}	Similar to specimen L ₄ ; measured before being irradiated.
113	165	C	1960	333.2	±2	L _{4b}	The above specimen annealed in vacuum for one hr at 1000 ± 5 C.
114	165	C	1960	333.2	±2	S _{5a}	Similar to specimen S ₅ ; measured before being irradiated.
115	165	C	1960	333.2	±2	S _{5b}	The above specimen annealed in vacuum for one hr at 700 ± 5 C.
116	165	C	1960	333.2	±2	L _{4a}	Similar to specimen L ₄ ; measured before being irradiated.
117	165	C	1960	333.2	±2	L _{4b}	The above specimen annealed in vacuum for one hr at 900 ± 5 C.
118	165	C	1960	333.2	±2	L _{2a}	Similar to specimen L ₂ ; measured before being irradiated.
119	165	C	1960	333.2	±2	L _{2b}	The above specimen annealed in vacuum for one hr at 800 ± 5 C.
120	165	C	1960	333.2	±2	S _{7a}	Similar to specimen S ₇ ; measured before being irradiated.
121	165	C	1960	333.2	±2	S _{7b}	The above specimen annealed in vacuum for one hr at 600 ± 5 C.
122	165	C	1960	333.2	±2	L _{7a}	Similar to specimen L ₇ ; measured before being irradiated.
123	165	C	1960	333.2	±2	L _{7b}	The above specimen annealed in vacuum for one hr at 500 ± 5 C.
124	165	C	1960	333.2	±2	S _{11a}	Similar to specimen S ₁₁ ; measured before being irradiated.
125	165	C	1960	333.2	±2	S _{11b}	The above specimen annealed in vacuum for one hr at 600 ± 5 C.
126	165	C	1960	333.2	±2	S _{11c}	The above specimen annealed again in vacuum for 30 min at 700 C.
127	165	C	1960	333.2	±2	S _{11d}	The above specimen annealed again in vacuum for one hr at 1000 C.
128	165	C	1960	333.2	±2	L _{11a}	Similar to specimen L ₁₁ ; measured before being irradiated.
129	165	C	1960	333.2	±2	L _{11b}	The above specimen annealed in vacuum for one hr at 800 ± 5 C.
130	173	C	1962	461-1161	±5	UO ₂ , 0.008, E-1	Mixture of single crystal particles with 60% + 4 mesh, 30% -10 + 20 mesh, 6% -35 + 65 mesh, 4% -100 + 200 mesh; compacted vibrationally in stainless steel cup with wall thickness 0.029 in.; specimen 8.738 cm in dia and 2.502 cm long; density 9.52 g cm ⁻³ (86.8% of theoretical value); measured in argon.
131	173	C	1962	424-1168	±5	UO ₂ , 0.008, E-1	Similar to the above specimen; measured in helium.
132	173	C	1962	546-705	±5	A	Polycrystalline; prepared from high purity UO ₂ ; specimen 7.513 cm in dia and 2.256 cm long; die pressed; sintered in hydrogen at 1650-1800 C; fine hairline cracks resulting from fabrication method used; measured in argon; first run.
133	173	C	1962	674-1335	±5	A	Second run.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
134	173	C	1962	403-1552	±5	A	Third run.
135	173	C	1962	747-1614	±5	A	The above specimen cooled to room temperature and measured again in argon; one of the cracks markedly widened.
136	173	C	1962	526-1317	±5	UO ₂ 008; D(L)	Polycrystalline; prepared from high purity UO ₂ ; 7.600 cm in dia and 2.222 cm long, machined from large sample, hydrostatically pressed and sintered in hydrogen at 1650-1800 C; density 0.22 g cm ⁻³ ; specimen axis coincided with long axis of original sample; edge chipped; measured in argon.
137	173	C	1962	514-1705	±5	UO ₂ 008; D(I)	Similar to the above specimen except dia 7.104 cm, density 10.19 g cm ⁻³ and disc axis transverse to the long axis of original piece; edge unchipped.
138	173	L	1962	363-1007	±5	UO ₂ 008; No. 65	Polycrystalline; prepared from high purity UO ₂ ; cylindrical specimen 0.6325 cm in dia and 7.704 cm long; extruded to near final size and shape followed by hydrostatically pressing and sintering in hydrogen at 1650-1800 C; density 9.55 cm ⁻³ ; measured in vacuum of about 2 x 10 ⁻⁴ mm Hg.
139	173	L	1962	364-882	±5	UO ₂ 008; No. 68	Similar to the above specimen except dia 0.6350 cm, length 7.622 cm and density 10.06 g cm ⁻³ .
140	173	L	1962	378-1031	±5	UO ₂ 008; No. 70	Similar to specimen No. 65 except dia 0.6375 cm, length 7.658 cm and density 10.45 g cm ⁻³ .
141	173	L	1962	361-799	±5	UO ₂ 008; No. 1000	Polycrystalline; prepared from high purity UO ₂ ; cylindrical specimen 0.6299 cm in dia and 7.925 cm long; machined from larger compacts, hydrostatically pressed and sintered in hydrogen at 1650-1800 C; density 10.22 g cm ⁻³ ; measured in vacuum of about 2 x 10 ⁻⁴ mm Hg.
142	173	C	1962	416-1118	±5	UO ₂ 008; G	Monocrystalline; 1.137 x 0.793 x 4.464 cm; prepared by commercial arc-fusion process; density 10.89 g cm ⁻³ ; measured in vacuum of about 2 x 10 ⁻⁴ mm Hg.
143	173	C	1962	660-1489	±5	UO ₂ 008; G	Similar to the above specimen.
144	173	L	1962	330-886	±5	UO ₂ 008; No. 11	Polycrystalline; prepared from high purity UO ₂ ; 0.6375 cm in dia and 7.669 cm long; extruded, hydrostatically pressed and sintered in hydrogen at 1650-1800 C; irradiation dose 1.40 x 10 ¹⁸ fission cm ⁻² ; maximum UO ₂ temperature during irradiation less than 100 C; density 10.07 g cm ⁻³ ; measured in vacuum of about 2 x 10 ⁻⁴ mm Hg.
145	173	L	1962	498-686	±5	UO ₂ 008; No. 11	The above specimen measured at decreasing temperature.
146	173	L	1962	341-472	±5	UO ₂ 008; No. 19a	Similar to specimen No. 11 except dia 0.6350 cm, length 7.675 cm, density 10.32 g cm ⁻³ and irradiation dose 4.11 x 10 ¹⁸ fission cm ⁻² .
147	173	L	1962	357-752	±5	UO ₂ 008; No. 19b	Similar to the above specimen.
148	173	L	1962	368-752	±5	UO ₂ 008; No. 19b	The above specimen measured at decreasing temperature.
149	173	L	1962	332-565	±5	UO ₂ 008; No. 51a	Similar to specimen No. 11 except dia 0.6325 cm, length 7.6634 cm, density 10.37 g cm ⁻³ and irradiation dose 1.1 x 10 ¹⁸ fission cm ⁻² .

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
150	173	L	1962	319-879	± 5	UO ₂ , 002; No. 51b	Similar to the above specimen.
151	173	L	1962	504-879	± 5	UO ₂ , 002; No. 51b	The above specimen measured at decreasing temperature.
152	173	L	1962	334-1159	± 5	UO ₂ , 002; No. 51c	Similar to specimen No. 51a.
153	174	R	1961	1106-2385	< ±15		42.0 to 42.2 mm O.D., 8 mm I.D., 3.5 to 4.0 mm thick; prepared from Mallinckrodt PWR-grade powder; pressed and sintered in dry hydrogen to 85% of the theoretical density and then ground flat on both faces.
154	269	R	1958	373-1173			15 mm in dia and 20 mm long; sintered in a carbon furnace; run 1.
155	269	R	1958	323-1073			The above specimen; run 2.
156	269	R	1958	323-1073			The above specimen; run 3.
157	269	R	1958	323-1073			The above specimen; run 4.
158	269	R	1958	323-2073			The above specimen; run 5.
159	159	L	1955	373,713		Ty O ₂	Powder; pressing pressure 100 lb in. ⁻² ; previously used in neutron absorption experiment.
160	159	L	1955	468,749		Ty O ₂	Pressed in a 150 ton press.
161	159	C	1955	323.2	20.0	Ty O ₂	Sintered; iron used as comparative material.
162	159	L	1955	323.2	25.0	Ty O ₂	Fused; extremely porous; with several cracks and fissures in it; surface sanded flat and coated with glycerine.
163	417	R	1964	328-1146	± 3.8		0.0593 O (excess), 0.03 Ca, 0.0265 Fe, 0.0062 Nb, 0.004 C, 0.0037 Sn, 0.003 N, 0.0006 Al, 0.00056 Mo, 0.0002-0.0011 Ni, 0.0002-0.0014 Cr, 0.0001 Cd, 0.0001 Na, 0.00002 Cu, <0.002 F, <0.001 Si, <0.0005 Pb, <0.0004 Sm, <0.00005 Ag, <0.00005 B, <0.00005 Eu, and <0.00003 Gd; specimen in disk form, prepared by cold pressing nuclear grade depleted UO ₂ powder (produced by the thermal decomposition and reduction of ammonium diuranate), sintering in hydrogen at 1850 C for 4 hrs; density 93.4% of theoretical value (10.97 g cm ⁻³); grain dia 10 to 20 μ; oxygen to uranium ratio 2.012 ± 0.002; run No. 1, heating; data corrected for core expansion and corrected to theoretical density.
164	417	R	1964	496-874	± 3.8		The above specimen, run No. 1, cooling; data corrected for core expansion and corrected to theoretical density.
165	417	R	1964	327-1074	± 3.8		The above specimen, run No. 2; data corrected for core expansion and corrected to theoretical density.
166	417	R	1964	373-1465	± 3.8		The above specimen run No. 3; data corrected for core expansion and corrected to theoretical density.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
167	417	R	1964	572-1571	±3.8		The above specimen run No. 3; data corrected for core expansion and corrected to theoretical density.
168	417	R	1964	382-1569	±3.8		The above specimen run No. 5; data corrected for core expansion and corrected to theoretical density.
169	417	R	1964	323-874	±3.8		The above specimen run No. 6; data corrected for core expansion and corrected to theoretical density.
170	417	R	1964	216-382	±3.8		The above specimen run No. 7; data corrected for core expansion and corrected to theoretical density.
171	287	L	1965	543-853		Specimen a	Oxygen to uranium ratio 2.063; 12.70 mm in dia and 12.7 mm long; prepared by compacting nuclear grade UO_2 powder (United Nuclear Corp) at 3 to 5 ton cm^{-2} , sintered in hydrogen at 1700 C for 2 hrs; 96% of theoretical density; measured in argon atmosphere; values corrected to zero porosity using simplified Loeb's equation.
172	287	L	1965	553-878		Specimen b	Similar to the above specimen.
173	287	R	1965	1233-2153		Specimen c	Similar to the above specimen except 24.10 mm in dia and 25 mm long; structural changes and slight cracks were observed after the measurement.
174	287	R	1965	1873, 1953		Specimen c'	The above specimen measured with decreasing temperature.
175	287	R	1965	1603-2373		Specimen d	Similar to specimen c except the characteristic structure with columnar grains and flat pores observed to have grown about 3 mm from the center, an area 2 mm thick from the outer surface of the specimen remained unchanged.
176	418		1963	77.4, 288			Single crystal; 8 mm thick.
177	419	-	1963	2153-2713			Polycrystalline; fuel capsules containing 95% dense UO_2 pellets irradiated (30 min) at thermal-performance conditions; data determined indirectly from measurements of the radial temperature profiles in fuel capsules which were established by measurement of the size distribution of equiaxed grains in the UO_2 and translation of the observed grain size into temperature on the basis of out-of-pile measurements of UO_2 grain growth as a function of time and temperature and calculated by using the highest value of grain growth activation energy reported in the literature; thermal conductivity values calculated from slopes of the temperature profiles.
178	420	R	1964	373-949		Bett 69-4	Thin-walled (0.076 cm thick) fuel cylinder, 0.907 cm O. D. and 12 cm long; pressure-bonded between a nickel capsule and a thin inner tube supported by shrink-fitted alumina pellets from inside after pressure-bonding; 21.4 w/o U^{235} in total μ ; 51.0×10^{20} atoms cm^{-3} μ^{235} ; average fuel density $10.6 g cm^{-3}$ (97% of theoretical value); total thermal exposure $0.00004 \times 10^{25} - 0.014 \times 10^{25}$ nvt; thermocouples A pair and B pair used; measured in vacuum; first start up.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
179	420	R	1964	674-966		Bett 69-4	The above specimen; total thermal exposure 0.040×10^{26} - 0.35×10^{26} nvt; total burn-up 0.4×10^{26} fission. cm^{-2} ; first start-up.
180	420	R	1964	649-948		Bett 69-4	The above specimen; total thermal exposure 0.39×10^{26} - 0.56×10^{26} nvt; total burn-up 0.9×10^{26} fission. cm^{-2} ; B pair thermocouple used (usually lower); second start-up.
181	420	R	1964	437-977		Bett 69-4	The above specimen; total thermal exposure 0.57×10^{26} - 0.84×10^{26} nvt; total burn-up 1.6×10^{26} fission. cm^{-2} ; B pair thermocouple used (usually lower); third start-up.
182	420	R	1964	679-979		Bett 69-4	The above specimen; total thermal exposure 0.85×10^{26} - 1.1×10^{26} nvt; total burn-up 2.4×10^{26} fission. cm^{-2} ; B pair thermocouple used (usually lower); fourth start-up.
183	420	R	1964	491-966		Bett 69-4	The above specimen; total thermal exposure 1.2×10^{26} - 1.7×10^{26} nvt; total burn-up 3.5×10^{26} fission. cm^{-2} ; B pair thermocouple used (usually lower); fifth start-up.
184	420	R	1964	404-945		Bett 69-4	The above specimen; total thermal exposure 1.7×10^{26} - 2.2×10^{26} nvt; total burn-up 5.2×10^{26} fission. cm^{-2} ; B pair thermocouple used (usually lower); sixth start-up.
185	420	R	1964	396-942		Bett 69-4	The above specimen; total thermal exposure 2.2×10^{26} - 2.6×10^{26} nvt; total burn-up 6.6×10^{26} fission. cm^{-2} ; A pair and B pair thermocouples used; seventh start-up.
186	420	R	1964	356-693		Bett 69-4	The above specimen; total thermal exposure 15.6×10^{26} - 15.9×10^{26} nvt; total burn-up 25×10^{26} fission. cm^{-2} ; A pair and B pair thermocouples used; 47th start-up. Powder; mean temperature values taken.
187	356		1942	356, 713	5-10		
188	356		1942	362, 2	5-10	Bett 69-4	Powder; pressed; mean temperature value taken.
189	411	L	1960	323-1073		65	0.249 in. dia x 3.033 in. long; extruded and isostatically pressed at 40,000 psi; density 9.58 g cm^{-3} (87.4% of theoretical value); electrical resistivity reported 103, 63.7, 38.9, 24.9, 16.6, 8.47, 4.02, 1.89, and 1.01 ohm cm at 25, 100, 200, 300, 400, 500, 600, 700, and 800 C, respectively (averaged over data from 2 cycles of heating and cooling periods of measurement); measured in a vacuum of $\sim 10^{-4}$ mm Hg; data corrected to UO_2 of 100% of theoretical density.
190	411	L	1960	323-1073		68	0.250 in. dia x 3.001 in. long; extruded and isostatically pressed at 40,000 psi; density 10.07 g cm^{-3} (91.9% of theoretical value); electrical resistivity reported 39, 1 x 10^4 , 592, 105, 33.8, 15.7, 7.09, 2.85, 1.27, and 0.667 ohm cm at 25, 100, 200, 300, 400, 500, 600, 700, and 800 C, respectively (averaged over data from one cycle of heating and cooling periods of measurement); measured in a vacuum of $\sim 10^{-4}$ mm Hg; data corrected to UO_2 of 100% of theoretical density.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
191	411	L	1960	323-1073		70	0.251 in. dia x 3.015 in. long; extruded and isostatically pressed at 40,000 psi; density 10.45 g cm ⁻³ (95.3% of theoretical value); electrical resistivity reported 47.9 x 10 ⁵ , 649, 105, 30.8, 12.9, 6.62, 4.00, 2.76, and 2.13 ohm cm at 25, 100, 200, 300, 400, 500, 600, 700, and 800 C, respectively (averaged over data from one cycle of heating and cooling periods of measurement); measured in a vacuum of ~10 ⁻³ mm Hg; data corrected to UO ₂ of 100% of theoretical density.
192	13	C	1953	343	±3		Specimen in the form of rectangular parallelepiped 0.1875 x 0.1875 x 1.75 in.; supplied by Argonne National Laboratory; density 10.2 g cm ⁻³ ; Armco iron used as comparative material.
193	421	R	1963	1311-2116		Test 34	No details reported.
194	422	P	1965	373-1376		B-15	Single crystal; specimen 0.635 cm in dia and 0.076 cm thick; density 10.97 g cm ⁻³ ; thermal conductivity data calculated from the measured data of thermal diffusivity (measurements were conducted in an atmosphere of purified argon containing <0.0001 O and <0.002 H ₂ O), specific heat (data obtained from Kelley, K. K., Bulletin 476 U.S. Bureau of Mines, 1949) and density.
195	422	P	1965	299-973		B-29	0.01 Fe, 0.001 Cl and 0.6 ccg of sorbed gases impurities; single crystal; specimen 0.635 cm in dia and 0.051-0.102 cm thick; density ~10.95 g cm ⁻³ ; thermal conductivity data calculated same as the above specimen.
196	422	P	1965	371-1279		1000	Polycrystalline; specimen 0.635 cm in dia and 0.132 cm thick; density 10.22 g cm ⁻³ ; thermal conductivity data calculated same as the above specimen.
197	423		1963	358-617		57	Polycrystalline; having an exposure of 1.34 x 10 ²³ fissions cm ⁻² .
198	424		1959	373-873		68	Specimen 0.250 in. in dia and 3.001 in. long; density 10.07 g cm ⁻³ (91.9% of theoretical density).
199	425	C	1963	373-1473		G	Single crystal; oxygen to uranium ratio 2.003; specimen 0.31 x 0.45 x 1.76 in.; density 99.4% of theoretical value; unirradiated; stainless steel used as comparative material.
200	425	C	1963	473-1273		G	The above specimen after first irradiation with a dose of 10 ¹⁵ nvt; same comparative material as above.
201	425	C	1963	473-1073		G	The above specimen after second irradiation with a dose of 10 ¹⁵ nvt (total 2 x 10 ¹⁵ nvt); same comparative material as above.
202	425	C	1963	471, 473		51	Single crystal; specimen 0.25 in. in dia and 3 in. long; extruded, hydrostatically pressed and sintered; 0.062 atomic % burn-up; density 94.5% of theoretical value; same comparative material as above.
203	425	C	1963	379-609		57	Similar to the above specimen except 0.12 atomic % burn-up and density 85.7% of theoretical value.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
204	426	R	1958	430-803			Prepared by cold pressing and hydrogen sintering natural UO ₂ obtained from Mallinckrodt Chemical Works; pellets centerless ground to 0.3535 in. dia; placed in a stainless-steel-304 capsule and irradiated in the Material Testing Reactor (MTR) for one day at a power of 10 megawatt-day; 1 w/g gamma heating in stainless steel capsule assumed; density 93.5 to 95% of theoretical value based on a theoretical density of 10.96 g cm ⁻³ ; effective thermal conductivity vs center temperature reported.
205	426	R	1958	432-790			The above specimen after being irradiated in the MTR for six days at an additional power of 10 megawatt-day (total 20 megawatt-day).
206	426	R	1958	555-795			The above specimen after being irradiated in the MTR for six days at an additional power of 10 megawatt-day (total 30 megawatt-day).
207	426	R	1958	409-748			The above specimen after being irradiated in the MTR for one day at an additional power of 10 megawatt-day (total 40 megawatt-day); estimated exposure 0.7 x 10 ²⁰ nvt thermal.
208	427	R	1963	834-2518 ± 5 at >1370K ±10 at <1370K			<0.08 total impurity; prepared by compacting UO ₂ powder at 4000 psi in a 3 in. dia steel die; isostatic pressing at 3000 psi, sintered in a hydrogen atmosphere for 12 hrs at 1700 C, machined into a disk of O.D. ~2 in. and I.D. ~0.38 in. and thickness >0.5 in.; density 93.63% of theoretical value.
209	428	R	1963	1077-2073		UO ₂ , No. 1	Single crystal; specimen cylindrical in form with I.D. 0.1 in. and O.D. 0.25 in.; data obtained from smoothed curve.
210	429	R	1959	1189-1673		UO ₂ , No. 2	Specimen 0.630 cm in dia and 0.551 cm long; cut from extruded rods; surface sand-blasted; density 9.91 g cm ⁻³ (90.3 ± 5% of theoretical value).
211	429	R	1959	1145-1395		UO ₂ , No. 2	Specimen 0.633 cm in dia and 0.625 cm long; cut from extruded rods; surface sand-blasted; density 9.87 g cm ⁻³ (90.0 ± 0.5% of theoretical value).
212	429	R	1962	327-1146			Pressed and sintered to a density of 93.4% of theoretical value.
213	430	-	1966	298.2			2.54 O (calculated); spherical uranium powder obtained from National Lead Co. containing impurities: 0.05 Fe, 0.01 Mg, 0.008 Mo, 0.005 Ni, <0.005 K, <0.005 P, <0.005 Ti, <0.005 Zn, <0.002 Ca, <0.001 As, <0.001 Na, 0.0005 Si, <0.0005 Al, <0.0005 Co, <0.0005 Sn, 0.0004 Mn, 0.0002 Cu, 0.0001 Pb, traces of Ag, Bi, Cr, Li, Sb, Be, and B; oxidized by spreading over the bottom of a Petri dish and placed in an oven at 150 C; specimen contained in a 0.75 in. dia x 2 in. long stainless steel cylindrical cell; mesh size: -70 + 80; thermal conductivity measured by using the transient line source method, the heat source was a 36-gauge constantan wire contained in a 0.025 in. O.D. hypodermic tube soldered along the axis of the cylindrical cell, data calculated from the measured line temperatures at two certain times; measured in nitrogen at 1 atm.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
214	430	-	1966	298.2			Similar to the above specimen, measured in nitrogen under pressures in the range 5.50×10^{-3} - 6.31×10^3 mm Hg.
215	430	-	1966	298.2			0.06 O (calculated); same source, fabrication, and measuring method as the above specimen except the mesh size -230 + 325; measured in nitrogen at 1 atm.
216	430	-	1966	298.2			1.17 O (calculated); same source, fabrication, and measuring method as the above specimen; mesh size -230 + 325; measured in nitrogen under pressures in the range 1.05×10^{-4} - 5.188×10^4 mm Hg.
217	431	R	1961	331-2390			Stoichiometric; 0.5 in. in dia, 0.5 in. high pellets; 95% dense, cold pressed and sintered; irradiated in the General Electric Test Reactor cable facility, UO_2 enrichment 17%.
218	431	R	1966	2154-2713			Similar to the above specimen.
219	432	R	1962	499-882			93.4% dense; pressed and sintered.
220	433	R	1962	300-468	± 5		93.4% dense.
221	434	R	1962	373-1465			93.4% dense; pressed and sintered.
222	434	R	1962	512-1571			Similar to the above specimen.
223	435	R	1958	352-1300		Type-1	Specimen 15 mm in dia and 10 cm long made up of 20 mm thick pellets; manufactured from ammonium uranate calcined to UO_3 , reduced to UO_2 as powder, oxidized in air to $UO_2 \cdot n$, cold pressed and sintered in a carbon-resistance furnace at 1800 C for 1.5 hrs in an atmosphere of H_2 and H_2O ; density 10.2 g cm^{-3} ; measured with large clearance between the pellets and the can wall.
224	435	R	1958	329-2101		Type-1	Similar to above specimen except measured in aluminum can with argon as filling gas.
225	435	R	1958	325-1306		Type-2	Specimen 15 mm in dia and 10 cm long made up of 20 mm thick pellets; UO_2 powder produced in a similar way as type-1 but giving UO_3 , as sintered in a molybdenum resistance furnace at 1600 to 1620 C for 8 hrs in an atmosphere of cracked NH_3 ; pellets centerless grained to an accuracy of 0.001 cm and the ends plane parallel grained; density 10.0 to 10.1 g cm^{-3} ; measured with large clearance between the pellets and the can wall.
226	435	R	1958	472-1273		Type-3	Specimen 15 mm in dia and 10 cm long made up of 20 mm thick pellets; same UO_2 powder as for type-2 used, sintered at 1550 C for 8 hrs in an atmosphere of cracked $NH_3 + H_2O$; pellets centerless grained to an accuracy of 0.001 cm and the ends plane parallel grained; density 10.2 to 10.3 g cm^{-3} ; measured with 0.1 mm clearance; average of several runs.
227	435	R	1958	470-1273		Type-3	Similar to the above specimen measured without clearance; average of several runs.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
228	436	R	1963	639.8		CC2-GG	UO ₂ pellets, obtained by calcining the powder (specific surface 3 m ² g ⁻¹) at 1650 C in hydrogen; 1.47% enriched ($\mu_{235}^{238}/\mu_{total}$); irradiated in EL3 successively first for 24 days in peripheral position at a constant power of 17.5 megawatts ($\alpha = \text{neutron flux}/\text{max EL3 flux} = 0.52$) and then for 3 days (at $\alpha = 1$); density 10.6 g cm ⁻³ ; average value of thermal conductivity at mean temperature reported.
229	436	R	1963	640.7		CC2-GG	The above specimen with a total burn-up of 5.0 x 10 ¹⁸ fissions. cm ⁻³ .
230	436	R	1963	670.7		CC2-GG	The above specimen with a total burn-up of 2 x 10 ¹⁸ fissions. cm ⁻³ .
231	436	R	1963	680.7		CC2-GG	The above specimen with a total burn-up of 3.4 x 10 ¹⁸ fissions. cm ⁻³ .
232	436	R	1963	738.2		CC2-GG	The above specimen with a total burn-up of 7.1 x 10 ¹⁸ fissions. cm ⁻³ .
233	363	P	1965	1252-1697			No details reported.
234	437	L	1962	338-724			UO ₂ wafers prepared from ammonium diuranate; after dry ball milling with Al ₂ O ₃ balls and adding 2% "carb Wax 20 M" as a binder, wafers pressed and sintered at 1700 C in a dry hydrogen atmosphere for 4 hrs; specimen ground flat with a surface roughness ranging from 15 to 150 μ in.; density 95% of theoretical density.
235	438	C	1959	785-821			0.25 Nb ₂ O ₅ ; specimen 0.856 \pm 0.001 in. in dia and 1.000 \pm 0.001 in. high; prepared from ceramic grade, low-bulk-density UO ₂ supplied by Mallinckrodt Chemical Works and 99 pure, 325 mesh Nb ₂ O ₅ supplied by Fansteel Metallurgical Corp; solid solution of U ₂ O ₇ with Nb ₂ O ₅ prepared by dissolving equal weights of the additive oxide and UO ₂ in acid, then the additive and UO ₂ coprecipitated with ammonium hydroxide, filtered and calcined in air at 600 C; after granulation, pressed at 20 tsi then heated to 1300 C in argon and soaked for 4 hrs, reduced at 1300 C in an atmosphere of about 10 volume % hydrogen - 90 volume % argon for 1 to 1.5 hrs, cooled to 900 C in the same atmosphere and to room temperature in argon; centerless ground; electrical resistivity 2 x 10 ⁵ to 1.1 x 10 ⁴ ohm cm; density 10.34 g cm ⁻³ (94.6% of theoretical); Mallinckrodt ceramic grade UO ₂ used as comparative material.
236	438	C	1959	684-1093			0.21 Y ₂ O ₃ ; specimen 0.856 \pm 0.001 in. in dia and 1.000 \pm 0.001 in. high; prepared from ceramic grade low-bulk-density UO ₂ supplied by Mallinckrodt Chemical Works and 99.9 pure, 325 mesh Y ₂ O ₃ supplied by Rare Earths, Inc.; prepared in the same way as the above specimen; electrical resistivity 330 ohm cm; density 10.53 g cm ⁻³ (96.3% of theoretical); same comparative material as above.
237	438	C	1959	455-1498			Similar to the above specimen except 0.84 Y ₂ O ₃ , electrical resistivity 74 ohm cm, and density 10.42 g cm ⁻³ (95.9% of theoretical).
238	438	C	1959	633-783			0.59 excess; Mallinckrodt ceramic grade UO ₂ used as comparative material.

SPECIFICATION TABLE NO. 38 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
239	439	R	1962	881-1613		1	Specimen made up of 60% -4 + 5 mesh, 15% -50 + 70 mesh and 25% -400 mesh UO_2 ; mean density of compressed UO_2 9.69 $g\ cm^{-3}$ (88% of theoretical); density of sintered UO_2 grains 10.67 $g\ cm^{-3}$ (97% of theoretical); mean size of elementary grains 10 μ ; measured in a helium atmosphere; the data on those of the effective thermal conductivity.
240	439	R	1962	538-1723		2	Similar to the above specimen except mean density of compressed UO_2 9.46 $g\ cm^{-3}$ (86% of theoretical).
241	439	R	1962	623-1648		3	95.5 UO_2 , 1.0665 ZrO_2 , 0.7875 MoO_3 , 0.5605 Nb_2O_5 , 0.5535 CeO_2 , 0.504 $SrCO_3$, 0.2565 $BaCO_3$, 0.18 Y_2O_3 , 0.171 La_2O_3 , 0.1359 Sm_2O_3 , 0.135 Pr_2O_3 , 0.06795 TeO_2 , 0.05085 Sc_2O_3 , 0.00495 Eu_2O_3 , 0.0018 SnO_2 , 0.00135 Sb_2O_5 , 0.00135 CdO , 0.00090 Ag_2O , 0.00045 Gd_2O_3 ; specimen granulometry 63.5% -4 + 6 mesh, 15% -50 + 70 mesh, 17% -400 mesh; mean density of compressed UO_2 9.34 $g\ cm^{-3}$ (87% of theoretical); mean size of elementary grains 10 μ ; measured in a helium atmosphere; the data are those of the effective thermal conductivity.
242	440		1964	1.4-204			Single crystal; supplied by the Hanford Laboratories of the General Electric Co.
243	441		1962	523.2			Specimen prepared by Compagnie Industrielle Des Combustibles Atomiques Frittes; extruded rod; density range 10.40-10.60 $g\ cm^{-3}$.
244	441		1962	523.2			Specimen prepared by Compagnie Industrielle Des Combustibles Atomiques Frittes; sintered pellet; density range 10.40-10.60 $g\ cm^{-3}$.

DATA TABLE NO. 39 THERMAL CONDUCTIVITY OF URANIUM DIOXIDE UO₂

[Temperature, T, K; Thermal Conductivity, k, Watts cm⁻¹K⁻¹]

CURVE 1		CURVE 5		CURVE 6 (cont.)		CURVE 9		CURVE 12		CURVE 17		CURVE 18 (cont.)	
T	k	T	k	T	k	T	k	T	k	T	k	T	k
473.2	0.0594	330.4	0.0135	480.5	0.00497	348.2	0.00912	442.6	0.00722	3.8	0.0070	923.2	0.0468
673.2	0.0431	341.6	0.0150	537.4	0.00517	439.3	0.00954	514.8	0.00723	3.9	0.0075	938.2	0.0467
873.2	0.0331	345.7	0.0134	584.8	0.00554	455.4	0.00957	772.1	0.00715	4.4	0.0094	958.2	0.0458
1073.2	0.0276	353.4	0.0151	636.5	0.00590	538.7	0.00987	799.3	0.00697	5.0	0.0120	CURVE 19	
1273.2	0.0255	357.3	0.0147	782.8	0.00661	538.7	0.00974	849.3	0.00696	5.1	0.0122	423.2	0.052
CURVE 2		366.8	0.0152	892.4	0.00696	630.4	0.00952	903.7	0.00694*	6.1	0.0151	553.2	0.042
475.5	0.0395	380.0	0.0149	1058.6	0.00732	660.9	0.00971	CURVE 13		7.1	0.0180	618.2	0.0405
486.7	0.0384	384.4	0.0143	1066.4	0.00897	741.5	0.00961	385.4	0.00306	8.4	0.0210	768.2	0.0405
664.5	0.0320	391.0	0.0132	CURVE 7		CURVE 10		388.7	0.00365	9.2	0.0250	CURVE 20	
911.4	0.0260	405.8	0.0142	379.3	0.0137	372.1	0.00720	451.5	0.00376	10	0.0255	373.2	0.040
1140.0	0.0197	418.9	0.0142	383.2	0.0135	495.9	0.00768	451.5	0.00402	11	0.0280	483.2	0.037
1376.9	0.0175	419.8	0.0158	439.3	0.0145	593.7	0.00791	513.2	0.00407	13	0.0230	543.2	0.0305
1592.8	0.0156	440.7	0.0149	466.5	0.0142	848.8	0.00749	618.8	0.00410	15	0.0180	628.2	0.0305
1677.8	0.0149	445.3	0.0145	466.5	0.0142	848.8	0.00749	675.4	0.00467	17.5	0.0150	663.2	0.030
1836.1	0.0144	448.6	0.0166	469.8	0.0141	848.9	0.00765	693.7	0.00419	26	0.0095	708.2	0.030
1941.1	0.0145	456.8	0.0147	486.5	0.0145*	CURVE 11		744.3	0.00379	30	0.0081	728.2	0.030
CURVE 3		468.3	0.0150	531.5	0.0150	570.4	0.0145	789.7	0.00370	31	0.0076	813.2	0.0306
457.2	0.054	483.4	0.0144	532.6	0.0146*	570.4	0.0145	944.3	0.00474	34	0.0080	881.2	0.029
513.2	0.052	485.6	0.0153	570.4	0.0145	572.6	0.0151	944.3	0.00474	38	0.0110	925.2	0.030
522.2	0.049	516.9	0.0145	572.6	0.0151	580.4	0.0150*	1022.1	0.00396	45	0.0150	1023.2	0.0288
557.2	0.044	536.1	0.0146	580.4	0.0150*	625.4	0.00511	1034.8	0.00396	50	0.0190	CURVE 21	
589.2	0.044	543.2	0.0146	632.1	0.0148	425.3	0.00509	375.2	0.105	55	0.0230	423.2	0.020
610.2	0.045	546.4	0.0150	651.5	0.0151	508.2	0.00516	421.2	0.0912	65	0.0280	543.2	0.017
663.2	0.040	558.8	0.0145	664.3	0.0147	549.8	0.00490	375.2	0.105	75	0.0345	663.2	0.015
713.2	0.040	581.9	0.0151	688.7	0.0147	574.8	0.00498	604.3	0.0502	80	0.0390	728.2	0.0147
737.2	0.039	589.2	0.0142	710.9	0.0147	604.3	0.00502	645.9	0.00511	80	0.0440	803.2	0.0140
815.2	0.036	609.8	0.0146	723.2	0.0145	645.9	0.00511	645.9	0.00511	90	0.0440	863.2	0.0115
937.2	0.036	635.3	0.0143	745.4	0.0151	654.3	0.00495	724.8	0.00493	95	0.0455	CURVE 22	
1058.2	0.033	691.4	0.0138	760.9	0.0143	724.8	0.00493	305.7	0.0329	99	0.0490	343.2	0.027
CURVE 4		731.5	0.0139	848.7	0.0146	765.4	0.00524	319.2	0.0314	100	0.0505	383.2	0.0235
485.7	0.0569	787.7	0.0151	780.9	0.00559	809.9	0.00559	328.2	0.0343	190	0.0850	438.2	0.020
672.2	0.0439	778.5	0.0153	818.2	0.00509	818.2	0.00509	354.2	0.0347	294	0.1100	478.2	0.020
841.7	0.0361	839.4	0.0150	828.2	0.00500	828.2	0.00500	359.2	0.0324	CURVE 18		523.2	0.0206
968.2	0.0314	916.6	0.0143	837.7	0.00512	837.7	0.00512	403.2	0.068	403.2	0.068	478.2	0.0206
1098.2	0.0280	959.8	0.0114	898.2	0.00498	898.2	0.00498	463.2	0.0645	463.2	0.0645	523.2	0.0206
1298.2	0.0251	559.8	0.0114	942.1	0.00500	942.1	0.00500	508.2	0.060	508.2	0.060	523.2	0.0206
		609.3	0.0112	970.4	0.00507	970.4	0.00507	598.2	0.056	598.2	0.056	523.2	0.0206
		684.3	0.0113	1019.3	0.00490	1019.3	0.00490	663.2	0.054	663.2	0.054	523.2	0.0206
		769.3	0.0110	1060.9	0.00483	1060.9	0.00483	773.2	0.0516	773.2	0.0516	523.2	0.0206
		818.7	0.0113	818.7	0.0113	818.7	0.0113	828.2	0.050	828.2	0.050	523.2	0.0206

* Not shown on plot

DATA TABLE NO. 38 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 22 (cont.)</u>		<u>CURVE 27</u>		<u>CURVE 30</u>		<u>CURVE 34*</u>		<u>CURVE 37 (cont.)</u>		<u>CURVE 40 (cont.)</u>		<u>CURVE 47*</u>			
563.2	0.0205	413.2	0.070	393.2	0.0285	373.2	0.0842	998.2	0.0364	1390.2	0.0301	333.2	0.067		
593.2	0.020	473.2	0.068	503.2	0.026	473.2	0.0696	1103.2	0.0335	1513.2	0.0280				
636.2	0.0185	523.2	0.0625	643.2	0.022	573.2	0.0593	1198.2	0.0318	1586.2	0.0264				
663.2	0.020	553.2	0.060	763.2	0.019	673.2	0.0517	1308.2	0.0297	1656.2	0.0226				
675.2	0.0175	598.2	0.057	913.2	0.020	773.2	0.0458	1423.2	0.0276						
<u>CURVE 23*</u>		888.2	0.0465	1063.2	0.0195	873.2	0.0411	1513.2	0.0259	<u>CURVE 41</u>		333.2	0.066		
		898.2	0.044	1198.2	0.0175			1613.2	0.0247	<u>(T = 1193.2)</u>		<u>CURVE 49*</u>			
		928.2	0.044	1303.2	0.0165					333.2	0.0655				
		948.2	0.042	1373.2	0.0165*			<u>CURVE 38</u>							
		<u>CURVE 28</u>		1393.2	0.0165*	338.2	0.0335	605.2	0.0218	0.00	0.0337	<u>CURVE 50*</u>			
		488.2	0.061	1403.2	0.0165*	628.2	0.0226	673.2	0.0209	0.00	0.0327*				
		558.2	0.057	1413.2	0.016	688.2	0.0226	749.2	0.0192	0.02	0.0264*	333.2	0.069		
		668.2	0.053	<u>CURVE 31</u>		758.2	0.0209	830.2	0.0184	0.03	0.0258*				
		768.2	0.050	425.2	0.0104	843.2	0.0130	917.2	0.0197*	0.04	0.0248	<u>CURVE 51*</u>			
		838.2	0.0445	528.2	0.0117	943.2	0.0192	1015.2	0.0197	0.05	0.0237	333.2	0.054		
<u>CURVE 25</u>		883.2	0.043	<u>CURVE 32</u>		1068.2	0.0209	1111.2	0.0197	0.06	0.0229				
548.2	0.0085	978.2	0.040	404.2	0.00745	1263.2	0.0201	1185.2	0.0201	0.07	0.0209*	<u>CURVE 52*</u>			
753.2	0.010	1018.2	0.0375	523.2	0.00742	1373.2	0.0201	1194.2	0.0197*	0.08	0.0211*	333.2	0.0605		
933.2	0.010	1033.2	0.037	624.2	0.00707	1503.2	0.0205	1196.2	0.0197*	0.09	0.0209*				
1013.2	0.014	<u>CURVE 29</u>		674.2	0.00705	1623.2	0.0201			0.10	0.0206*				
1063.2	0.015	488.2	0.018	724.0	0.00709			<u>CURVE 39</u>		0.11	0.0203*				
1133.2	0.017	603.2	0.020	797.0	0.00697			463.2	0.0586	0.12	0.0199	<u>CURVE 53*</u>			
<u>CURVE 26</u>		753.2	0.0185	874.2	0.00686			550.2	0.0515*	0.13	0.0199				
503.2	0.0175	803.2	0.019	968.2	0.00703			632.2	0.0490	<u>CURVE 42*</u>		333.2	0.0645		
576.2	0.018	903.2	0.019	1022.2	0.00701			773.2	0.0414			<u>CURVE 54*</u>			
743.2	0.017	1013.2	0.0245	1174.2	0.00732			915.2	0.0360*	333.2	0.0485				
863.2	0.0177	1033.2	0.026	1267.2	0.00753			970.2	0.0347	<u>CURVE 43*</u>		333.2	0.0645		
1023.2	0.017	1163.2	0.027	1425.2	0.00753			1137.2	0.0297	<u>CURVE 44*</u>		<u>CURVE 55*</u>			
1153.2	0.018	1258.2	0.027	<u>CURVE 33</u>				1333.2	0.0276*	333.2	0.050				
1233.2	0.017	1270.2	0.027	1073.2	0.0341			1454.2	0.0264	<u>CURVE 45*</u>		<u>CURVE 56*</u>			
1263.2	0.0175	1273.2	0.026	1173.2	0.0311			1555.2	0.0251	333.2	0.056	333.2	0.0695		
1273.2	0.020	1308.2	0.0255	1273.2	0.0276			<u>CURVE 40</u>		333.2	0.056	<u>CURVE 57*</u>			
1293.2	0.0185	1333.2	0.025	1373.2	0.0276			419.2	0.0724	<u>CURVE 45*</u>					
1308.2	0.0185	1348.2	0.025*	1423.2	0.0256			481.2	0.0715	<u>CURVE 46*</u>					
1323.2	0.0175	1403.2	0.023	<u>CURVE 37</u>				496.2	0.0674	333.2	0.0575				
1353.2	0.0175*	1423.2	0.023	430.2	0.0636			559.2	0.0636	<u>CURVE 46*</u>					
1378.2	0.0165	1428.2	0.0225*	543.2	0.0565			641.2	0.0569	333.2	0.071				
1403.2	0.0165	1433.2	0.0225*	570.2	0.0519			825.2	0.0477	<u>CURVE 46*</u>					
		1448.2	0.0225	893.2	0.0381			923.2	0.0435*	<u>CURVE 58*</u>					
				1045.2	0.0385			1045.2	0.0385	333.2	0.066				
				1277.2	0.0326			1277.2	0.0326	333.2	0.0715				

* Not shown on plot

DATA TABLE NO. 38 (continued)

T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 59*</u>		<u>CURVE 71</u>		<u>CURVE 83*</u>		<u>CURVE 95*</u>		<u>CURVE 107*</u>		<u>CURVE 119*</u>	
333.2	0.069	333.2	0.0225	333.2	0.0505	333.2	0.048	333.2	0.044	333.2	0.058
<u>CURVE 60*</u>		<u>CURVE 72</u>		<u>CURVE 84*</u>		<u>CURVE 96*</u>		<u>CURVE 108*</u>		<u>CURVE 120*</u>	
333.2	0.0685	333.2	0.017	333.2	0.0455	333.2	0.0445	333.2	0.062	333.2	0.062
<u>CURVE 61*</u>		<u>CURVE 73</u>		<u>CURVE 85*</u>		<u>CURVE 97*</u>		<u>CURVE 109*</u>		<u>CURVE 121*</u>	
333.2	0.071	333.2	0.018	333.2	0.0465	333.2	0.047	333.2	0.050	333.2	0.0505
<u>CURVE 62*</u>		<u>CURVE 74*</u>		<u>CURVE 86*</u>		<u>CURVE 98*</u>		<u>CURVE 110*</u>		<u>CURVE 122*</u>	
333.2	0.064	333.2	0.018	333.2	0.044	333.2	0.044	333.2	0.062	333.2	0.062
<u>CURVE 63*</u>		<u>CURVE 75*</u>		<u>CURVE 87*</u>		<u>CURVE 99*</u>		<u>CURVE 111*</u>		<u>CURVE 123*</u>	
333.2	0.061	333.2	0.018	333.2	0.047	333.2	0.043	333.2	0.062	333.2	0.0515
<u>CURVE 64*</u>		<u>CURVE 76*</u>		<u>CURVE 88*</u>		<u>CURVE 100*</u>		<u>CURVE 112*</u>		<u>CURVE 124*</u>	
333.2	0.054	333.2	0.018	333.2	0.045	333.2	0.041	333.2	0.062	333.2	0.062
<u>CURVE 65*</u>		<u>CURVE 77*</u>		<u>CURVE 89*</u>		<u>CURVE 101*</u>		<u>CURVE 113*</u>		<u>CURVE 125*</u>	
333.2	0.0475	333.2	0.018	333.2	0.046	333.2	0.0435	333.2	0.062	333.2	0.045
<u>CURVE 66</u>		<u>CURVE 78*</u>		<u>CURVE 90*</u>		<u>CURVE 102*</u>		<u>CURVE 114*</u>		<u>CURVE 126*</u>	
333.2	0.0375	333.2	0.059	333.2	0.046	333.2	0.062	333.2	0.062	333.2	0.0475
<u>CURVE 67*</u>		<u>CURVE 79*</u>		<u>CURVE 91*</u>		<u>CURVE 103*</u>		<u>CURVE 115*</u>		<u>CURVE 127*</u>	
333.2	0.033	333.2	0.060	333.2	0.047	333.2	0.046	333.2	0.0575	333.2	0.054
<u>CURVE 68*</u>		<u>CURVE 80*</u>		<u>CURVE 92*</u>		<u>CURVE 104*</u>		<u>CURVE 116*</u>		<u>CURVE 128*</u>	
333.2	0.0535	333.2	0.0565	333.2	0.032	333.2	0.062	333.2	0.062	333.2	0.062
<u>CURVE 69*</u>		<u>CURVE 81*</u>		<u>CURVE 93*</u>		<u>CURVE 105*</u>		<u>CURVE 117*</u>		<u>CURVE 129*</u>	
333.2	0.043	333.2	0.056	333.2	0.0465	333.2	0.0545	333.2	0.0615	333.2	0.054
<u>CURVE 70</u>		<u>CURVE 82*</u>		<u>CURVE 94*</u>		<u>CURVE 106*</u>		<u>CURVE 118*</u>		<u>CURVE 130</u>	
333.2	0.031	333.2	0.049	333.2	0.047	333.2	0.062	333.2	0.062	<u>CURVE 131</u>	
										461.2	0.0207
										554.2	0.0167
										583.2	0.0204
										670.2	0.0204
										945.2	0.0161
										963.2	0.0199
										1161.2	0.0205
										<u>CURVE 131</u>	
										424.2	0.0212
										637.2	0.0199
										747.2	0.0181
										980.2	0.0157
										1045.2	0.0311*
										1069.2	0.0152
										1168.2	0.0308*
										<u>CURVE 132*</u>	
										546.2	0.0542
										566.2	0.0535
										670.2	0.0487
										705.2	0.0447
										<u>CURVE 133*</u>	
										674.2	0.0469
										877.2	0.0392
										1081.2	0.0326
										1157.2	0.0337
										1191.2	0.0299
										1308.2	0.0256
										1335.2	0.0246
										<u>CURVE 134</u>	
										403.2	0.0727
										413.2	0.0711
										529.2	0.0588
										536.2	0.0598
										550.2	0.0565*
										558.2	0.0564
										622.2	0.0542

*Not shown on plot

DATA TABLE NO. 38 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 134 (cont.)</u>		<u>CURVE 137</u>		<u>CURVE 139*</u>		<u>CURVE 142 (cont.)</u>		<u>CURVE 146</u>		<u>CURVE 150 (cont.)</u>		<u>CURVE 154 (cont.)*</u>					
634.2	0.0520	514.2	0.0692	364.2	0.0752	703.2	0.0550	341.2	0.0407	776.2	0.0342*	708.2	0.0613				
653.2	0.0520	638.2	0.0513	440.2	0.0685	704.2	0.0580	394.2	0.0352	777.2	0.0370*	773.2	0.0587				
661.2	0.0516	646.2	0.0591	528.2	0.0597	813.2	0.0517	436.2	0.0301	806.2	0.0371*	806.2	0.0270				
749.2	0.0480	670.2	0.0608	586.2	0.0517	834.2	0.0560	472.2	0.0356	806.2	0.0348*	908.2	0.0250				
790.2	0.0460	763.2	0.0461	656.2	0.0470	837.2	0.0579			845.2	0.0358*	973.2	0.0427				
965.2	0.0382	815.2	0.0505	751.2	0.0395	917.2	0.0548			879.2	0.0349*	1006.2	0.0613				
1022.2	0.0386	821.2	0.0374	821.2	0.0374	924.2	0.0527					1073.2	0.0610				
1271.2	0.0337	905.2	0.0423	980.2	0.0514	980.2	0.0514					1173.2	0.0360				
1393.2	0.0284	910.2	0.0430*														
1407.2	0.0306	945.2	0.0386														
1506.2	0.0264	979.2	0.0438														
1552.2	0.0314	986.2	0.0400*														
<u>CURVE 135</u>		<u>CURVE 140*</u>		<u>CURVE 143</u>		<u>CURVE 148</u>		<u>CURVE 151*</u>		<u>CURVE 155*</u>							
747.2	0.0403*	1037.2	0.0383*	378.2	0.0779	431.2	0.0718	357.2	0.0430	504.2	0.0487	323.2	0.0450				
803.2	0.0397*	1095.2	0.0354	463.2	0.0640	680.2	0.061*	450.2	0.0378	520.2	0.0454	363.2	0.0563				
1011.2	0.0292*	1210.2	0.0304	604.2	0.0538	729.2	0.058	538.2	0.0404	879.2	0.0349	373.2	0.0567				
1103.2	0.0297	1328.2	0.0320	661.2	0.0474	1019.2	0.054	729.2	0.0346*			433.2	0.0357				
1220.2	0.0256	1359.2	0.0282*	747.2	0.0397	1067.2	0.056	752.2	0.0346*			473.2	0.0400				
1371.2	0.0256*	1385.2	0.0291*	881.2	0.0376	1112.2	0.054					553.2	0.0497				
1392.2	0.0236	1439.2	0.0268*	1031.2	0.0302	1166.2	0.056					573.2	0.0493				
1424.2	0.0236*	1449.2	0.0286*			1284.2	0.067					726.5	0.0337				
1614.2	0.0218	1705.2	0.0233			1489.2	0.067					773.2	0.0450				
<u>CURVE 136</u>		<u>CURVE 141</u>		<u>CURVE 144</u>		<u>CURVE 149</u>		<u>CURVE 152*</u>		<u>CURVE 153</u>		<u>CURVE 156*</u>					
526.2	0.0706	363.2	0.0767	361.2	0.0906	330.2	0.0452*	332.2	0.0345*	1106.2	0.025*	323.2	0.0360				
542.2	0.0579*	440.2	0.0679	402.2	0.0811	358.2	0.0415	344.2	0.0339*	1395.2	0.021	363.2	0.0500				
548.2	0.0733	494.2	0.0622	460.2	0.0686*	413.2	0.0389	377.2	0.0327	1441.2	0.021	373.2	0.0597				
565.2	0.0632*	531.2	0.0619	555.2	0.0601*	448.2	0.0377	417.2	0.0275	1766.2	0.020	373.2	0.0597				
692.2	0.0549	572.2	0.0527	691.2	0.0505*	614.2	0.0398	440.2	0.0306*	2011.2	0.017	399.9	0.0500				
733.2	0.0472	631.2	0.0455	799.2	0.0479*	657.2	0.0383	540.2	0.0327	2385.2	0.016	473.2	0.0167				
821.2	0.0389	711.2	0.0390			886.2	0.0341*	565.2	0.0317			573.2	0.0107				
897.2	0.0405	828.2	0.0337									673.2	0.00940				
997.2	0.0325	914.2	0.0368									673.2	0.00733				
1052.2	0.0426	1007.2	0.0312									873.2	0.00700				
1052.2	0.0374											973.2	0.00650				
1172.2	0.0373											1073.2	0.00633				
1172.2	0.0295*																
1317.2	0.0296*																

* Not shown on plot

DATA TABLE NO. 35 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k				
CURVE 157																			
323.2	0.00740	323.2	0.00167	327.2	0.07923	571.7	0.05472	377.2	0.07118	1733.2	0.0201	2498.2	0.0172	649.2	0.021				
373.2	0.00736	396.2	0.07273	396.2	0.07273	673.2	0.04913	377.2	0.07124	1833.2	0.0201	2518.2	0.0155	868.2	0.025				
573.2	0.00733	462.7	0.06699	673.2	0.04879	774.2	0.04365	378.2	0.06991	1983.2	0.0259	2538.2	0.0135	913.2	0.027				
673.2	0.00800*	574.2	0.05786	774.2	0.04365	874.2	0.03973	378.2	0.06996	1993.2	0.0272	2573.2	0.0155	930.2	0.028				
773.2	0.00900	672.7	0.05090	774.2	0.04385	874.7	0.03973	379.2	0.07162	2023.2	0.0280	2588.2	0.0167	932.2	0.027				
873.2	0.00733	767.2	0.04627	874.7	0.03973	973.2	0.03999	380.2	0.07157	2073.2	0.0285	2613.2	0.0178	938.2	0.028				
973.2	0.00683	875.7	0.03811	973.2	0.03657	1071.2	0.03658	382.2	0.07157	2123.2	0.0331	2623.2	0.0215	948.2	0.028				
1073.2	0.00700	1074.2	0.03496	1071.2	0.03496	1171.2	0.03393	CURVE 171*								2648.2	0.0122	948.2	0.027
CURVE 158																			
323.2	0.00700	427.7	0.06513	427.7	0.06513	527.7	0.06226	543.2	0.06238	1603.2	0.0222*	2668.2	0.0155	CURVE 181*					
373.2	0.00684	447.7	0.06376	447.7	0.06376	547.2	0.05957	563.2	0.06070	1633.2	0.0222*	2675.2	0.0185	437.2	0.018				
473.2	0.00713	499.2	0.05757	547.2	0.05757	647.2	0.05596	563.2	0.05822	1673.2	0.0209*	2708.2	0.0198	491.2	0.019				
573.2	0.00713	556.2	0.05596	647.2	0.05596	747.2	0.05192	643.2	0.0523	1953.2	0.0255	2713.2	0.022	666.2	0.021				
673.2	0.00800	594.2	0.05382	747.2	0.05382	847.2	0.04938	693.2	0.0498	CURVE 175									
773.2	0.00730	621.2	0.05192	847.2	0.04938	947.2	0.04793	803.2	0.0431	1603.2	0.0222*	373.2	0.047	822.2	0.023				
873.2	0.00667	648.2	0.05046	947.2	0.04793	1047.2	0.04607	853.2	0.0385	1633.2	0.0222*	446.2	0.044	892.2	0.026				
973.2	0.00601	664.2	0.04938	1047.2	0.04607	1147.2	0.04793	853.2	0.0385	1673.2	0.0209*	458.2	0.043	901.2	0.026				
1073.2	0.00587	697.2	0.04793	1147.2	0.04793	1247.2	0.04607	853.2	0.0385	1713.2	0.0188	518.2	0.041	908.2	0.026				
1173.2	0.00580	709.2	0.04758	1247.2	0.04758	1347.2	0.04607	853.2	0.0385	1763.2	0.0230	597.2	0.038	920.2	0.025				
1273.2	0.00600	716.2	0.04715	1347.2	0.04715	1447.2	0.04607	853.2	0.0385	1833.2	0.0268	769.2	0.038	921.2	0.026				
1373.2	0.00700	746.2	0.04558	1447.2	0.04558	1547.2	0.04607	853.2	0.0385	1933.2	0.0335	773.2	0.038	923.2	0.025				
1473.2	0.00850	773.2	0.04487	1547.2	0.04487	1647.2	0.04607	853.2	0.0385	2173.2	0.0368	813.2	0.038	926.2	0.027				
1573.2	0.0110	802.2	0.04372	1647.2	0.04372	1747.2	0.04607	853.2	0.0385	2243.2	0.0368	862.2	0.038	928.2	0.026				
1673.2	0.0150	832.7	0.04246	1747.2	0.04246	1847.2	0.04607	853.2	0.0385	2373.2	0.0427	910.2	0.036	936.2	0.027				
1773.2	0.0187	857.7	0.04168	1847.2	0.04168	1947.2	0.04607	853.2	0.0385	CURVE 176									
1873.2	0.0230	882.2	0.04106	1947.2	0.04106	2047.2	0.04607	853.2	0.0385	77.4	0.061	947.2	0.035	946.2	0.026				
1933.2	0.0245	885.7	0.04081	2047.2	0.04081	2147.2	0.04607	853.2	0.0385	288	0.210	948.2	0.035	975.2	0.026				
1973.2	0.0233	923.2	0.03943	2147.2	0.03943	2247.2	0.04607	853.2	0.0385	CURVE 179*									
2073.2	0.0187	966.2	0.03792	2247.2	0.03792	2347.2	0.04607	853.2	0.0385	674.2	0.025	679.2	0.027	979.2	0.025				
CURVE 159																			
373.2	0.00126	1063.7	0.03500	1171.2	0.03654	1175.2	0.03073	1279.2	0.02970	2153.2	0.0223	674.2	0.025	679.2	0.022				
713.2	0.000836	1103.7	0.03496	1377.2	0.02775	1377.2	0.02775	1279.2	0.02970	2258.2	0.0198	753.2	0.027	813.2	0.023				
CURVE 160																			
468.2	0.00335	1146.2	0.03297	1474.7	0.02601	1475.2	0.02549	1443.2	0.0243	2268.2	0.0105	932.2	0.032	912.2	0.025				
743.2	0.00251	1571.2	0.02529	1571.2	0.02529	1571.2	0.02529	1443.2	0.0243	2270.2	0.0105	941.2	0.032	917.2	0.025				
CURVE 161																			
323.2	0.00209	496.2	0.06346	216.2	0.06795	216.2	0.06795	1473.2	0.0213	2271.2	0.0205	945.2	0.032	979.2	0.025				
CURVE 162																			
468.2	0.00335	500.2	0.06310	217.2	0.06985	217.2	0.06985	1493.2	0.0209	2338.2	0.025	946.2	0.030	491.2	0.019				
743.2	0.00251	374.2	0.04116	382.2	0.06953	382.2	0.06953	1513.2	0.0222	2348.2	0.0122	948.2	0.033	507.2	0.020				
CURVE 163*																			
323.2	0.00209	383.2	0.06962	252.2	0.07102	252.2	0.07102	1583.2	0.0218	2393.2	0.0192	966.2	0.032	570.2	0.020				
CURVE 164*																			
473.2	0.06166	473.2	0.06166	255.2	0.06729	255.2	0.06729	1593.2	0.0201	2408.2	0.0125	966.2	0.032	643.2	0.021				
474.2	0.06216	474.2	0.06216	255.2	0.06729	255.2	0.06729	1613.2	0.0218	2423.2	0.0165	966.2	0.032	643.2	0.021				
569.7	0.05503	569.7	0.05503	324.2	0.07555	324.2	0.07555	1633.2	0.0218	2428.2	0.0175	966.2	0.032	666.2	0.022				
325.2	0.07613	325.2	0.07613	1713.2	0.0205	1713.2	0.0205	1713.2	0.0205	2488.2	0.0225	966.2	0.032	738.2	0.022				

* Not shown on plot

DATA TABLE NO. 38 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	
<u>CURVE 183 (cont.)*</u>																
761.2	0.025	396.2	0.020	2046.2	0.0206	474.2	0.0657	373.2	0.080	430.2	0.0261	1077.2	0.0531			
817.2	0.024	491.2	0.023	2060.2	0.0198	574.2	0.0577	473.2	0.069	540.2	0.0204	1173.2	0.0550			
857.2	0.023	556.2	0.024	2071.2	0.0251	674.2	0.0543	673.2	0.058	685.2	0.0179	1273.2	0.0583			
870.2	0.023	635.2	0.025	2106.2	0.0210	774.2	0.0491	873.2	0.054	738.2	0.0179	1373.2	0.0624			
880.2	0.024	720.2	0.025	2116.2	0.0194	875.2	0.0421	1073.2	0.054	803.2	0.0165	1459.2	0.0667*			
889.2	0.023	801.2	0.025	<u>CURVE 194</u>		973.2	0.0409	1273.2	0.059	<u>CURVE 205*</u>		1473.2	0.0598			
903.2	0.023	842.2	0.025	373.2	0.112	973.2	0.0409	1473.2	0.071	432.2	0.0336	1573.2	0.0419			
909.2	0.025	874.2	0.025	472.2	0.0960	<u>CURVE 196*</u>		1673.2	0.0336	548.2	0.0233	1773.2	0.0279			
913.2	0.027	911.2	0.024	476.2	0.108	371.2	0.0997	1773.2	0.0342	668.2	0.0212	1873.2	0.0232*			
914.2	0.024	915.2	0.025	565.2	0.0795	452.2	0.0832	473.2	0.058	731.2	0.0198	2073.2	0.020*			
918.2	0.023	915.2	0.025	576.2	0.0863	532.2	0.0722	673.2	0.044	<u>CURVE 206*</u>						
919.2	0.024	928.2	0.025	606.2	0.0639	606.2	0.0639	1073.2	0.040	555.2	0.0230					
930.2	0.025	929.2	0.025	697.2	0.0562	697.2	0.0562	1273.2	0.040	635.2	0.0208					
954.2	0.025	934.2	0.025	787.2	0.0828	787.2	0.0828	1273.2	0.041	684.2	0.0206					
957.2	0.025	934.2	0.026	775.2	0.0644	1053.2	0.0379	1073.2	0.041	739.2	0.0199					
960.2	0.024	936.2	0.025	837.2	0.0525*	1179.2	0.0340	1273.2	0.041	795.2	0.0194					
963.2	0.026	941.2	0.025	875.2	0.0530*	1279.2	0.0314	<u>CURVE 201*</u>								
966.2	0.023	942.2	0.024	875.2	0.0530*	<u>CURVE 197*</u>		473.2	0.069							
<u>CURVE 184*</u>																
404.2	0.016	356.2	0.011	974.2	0.0500*	358.2	0.0287	1073.2	0.054	<u>CURVE 207*</u>						
480.2	0.020	405.2	0.016	976.2	0.0480*	378.2	0.0279	1073.2	0.054	409.2	0.0409					
504.2	0.019	453.2	0.015	1009.2	0.0415*	395.2	0.0275	<u>CURVE 202*</u>		537.2	0.0296					
560.2	0.020	496.2	0.015	1020.2	0.0429*	408.2	0.0282	471.2	0.0607	639.2	0.0212					
631.2	0.021	496.2	0.015	1071.2	0.0416*	419.2	0.0292	473.2	0.0592	701.2	0.0203					
731.2	0.023	544.2	0.016	1075.2	0.0435*	471.2	0.0294	<u>CURVE 203*</u>		748.2	0.0202					
801.2	0.024	588.2	0.017	1076.2	0.0448*	501.2	0.0299	379.2	0.0288							
835.2	0.023	617.2	0.016	1170.2	0.0399*	513.2	0.0306	393.2	0.0277							
857.2	0.023	671.2	0.017	1173.2	0.0419*	421.2	0.0321	394.2	0.0286							
868.2	0.023	673.2	0.017	1192.2	0.0390*	431.2	0.0335	396.2	0.0298							
879.2	0.023	686.2	0.017	1270.2	0.0377*	442.2	0.0339	408.2	0.0271							
885.2	0.023	689.2	0.017	1271.2	0.0386*	573.2	0.0328	411.2	0.0296							
891.2	0.024	693.2	0.017	1272.2	0.0343*	617.2	0.0310	429.2	0.0294							
895.2	0.023	<u>CURVE 192*</u>		1273.2	0.0356*	<u>CURVE 196*</u>		429.2	0.0294							
899.2	0.023	343.2	0.0962	1371.2	0.0300*	373.2	0.071	501.2	0.0299							
902.2	0.023	<u>CURVE 193*</u>		1376.2	0.0363*	473.2	0.057	527.2	0.0342							
906.2	0.022	1311.2	0.0459	<u>CURVE 195*</u>		573.2	0.048	544.2	0.0314							
914.2	0.023	1855.2	0.0256	299.2	0.0809	673.2	0.042	553.2	0.0331							
916.2	0.022	1866.2	0.0246	307.2	0.0938	873.2	0.037	577.2	0.0346							
931.2	0.023	1874.2	0.0213	332.2	0.0976	873.2	0.033	609.2	0.0309							
943.2	0.024	1905.2	0.0167	372.2	0.0752											
944.2	0.023	2005.2	0.0253													
945.2	0.023															

* Not shown on plot

DATA TABLE NO. 38 (continued)

Table with 5 columns: T, k, CURVE ID, T, k. CURVE IDs include CURVE 215 through CURVE 240. Each entry lists a T value and a corresponding k value.

* Not shown on plot

DATA TABLE NO. 38 (continued)

T	k
<u>CURVE 242 (cont.)</u>	
23.7	0.0121
25.4	0.0113
26.7	0.00973
27.9	0.00935
31.8	0.00980
33.9	0.0110
36.5	0.0112
36.9	0.0118
41.9	0.0150
41.9	0.0156
45.7	0.0185
48.6	0.0205
50.4	0.0239
56.0	0.0270
57.0	0.0266
59.6	0.0310
66.7	0.0414
78.5	0.0483
96.2	0.0684
112.5	0.0778
117.8	0.0879
148.9	0.105
167.5	0.118
204.2	0.128

CURVE 243*

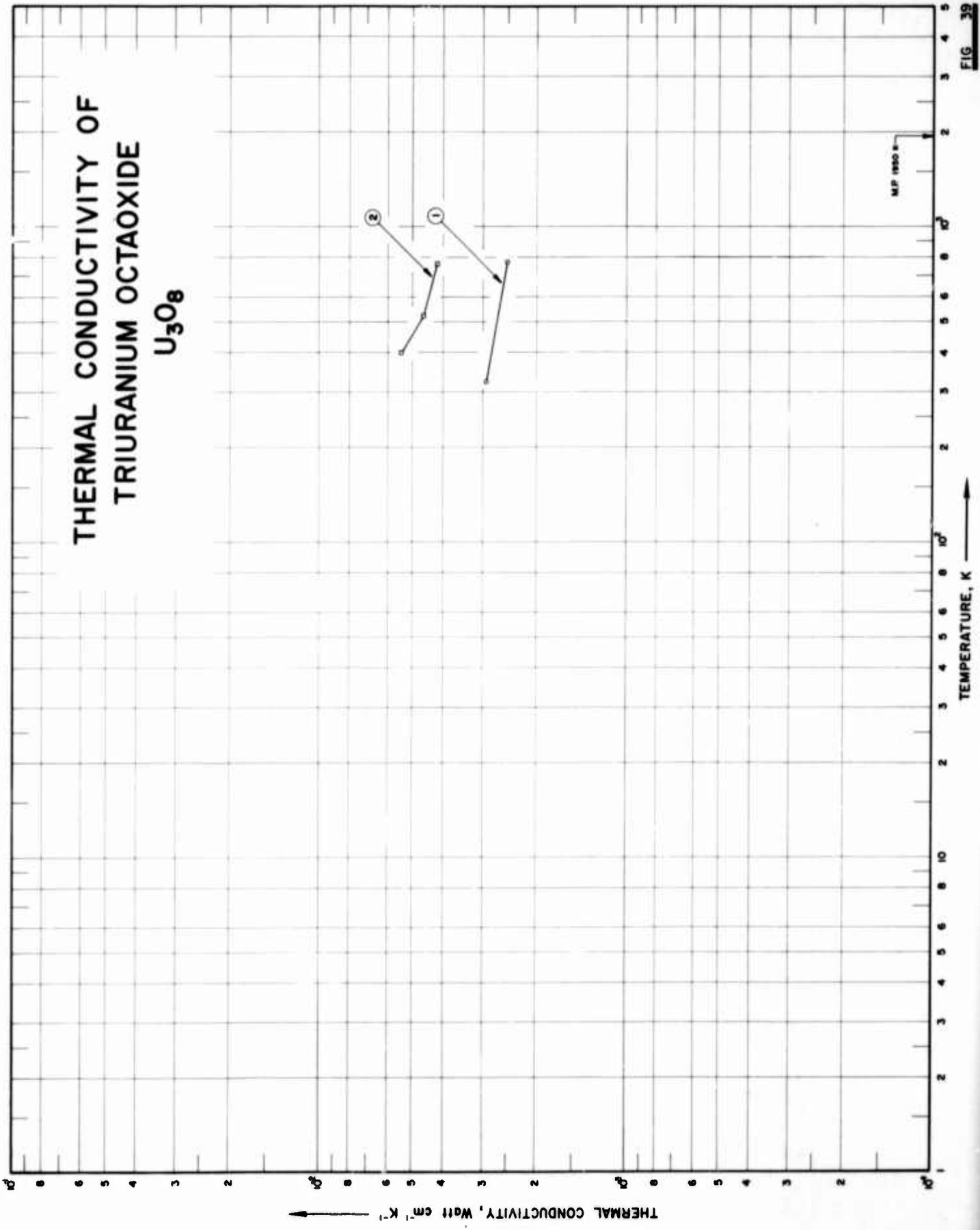
523.2 0.0699

CURVE 244*

523.2 0.0678

* Not shown on plot

THERMAL CONDUCTIVITY OF TRIURANIUM OCTAOXIDE U_3O_8



SPECIFICATION TABLE NO. 39 - THERMAL CONDUCTIVITY OF (tri)URANIUM OCTOXIDE U_3O_8

[For Data Reported in Figure and Table No. 39]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	159	L	1955	323, 773			
2	159	L	1955	398-763			Powder; measured under 100 lb in. ⁻² pressure. Specimen 3 in. long, 3 in. dia; pressed in 150 ton press.

DATA TABLE NO. 35 THERMAL CONDUCTIVITY OF (tr)URANIUM OXTOXIDE U_3O_8 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
323.2	0.00293
773.2	0.00251
<u>CURVE 2</u>	
398.2	0.00544
523.2	0.00460
763.2	0.00418

THERMAL CONDUCTIVITY OF YTTRIUM OXIDE Y_2O_3

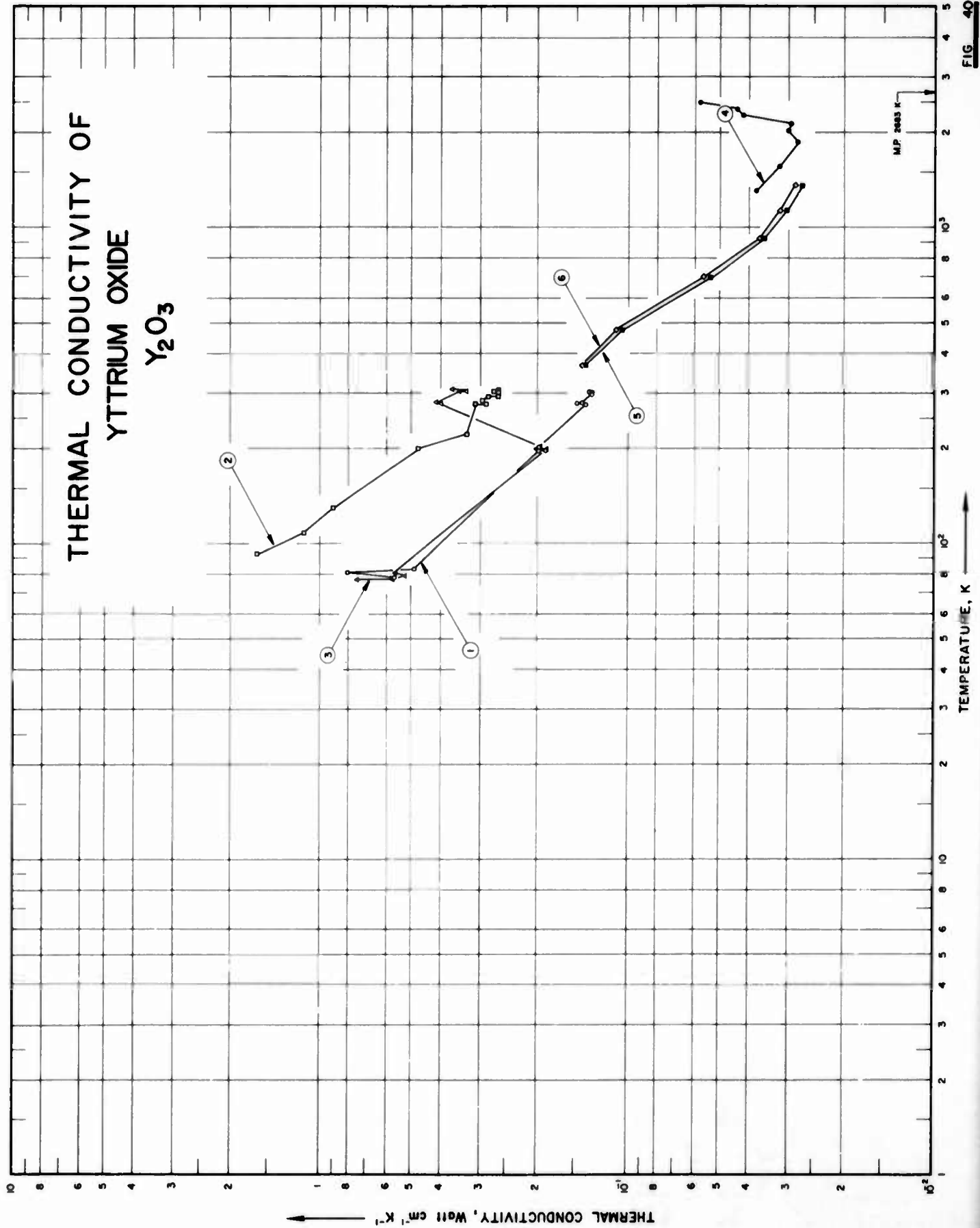


FIG 40

SPECIFICATION TABLE NO. 40 THERMAL CONDUCTIVITY OF YTTRIUM OXIDE Y_2O_3

[For Data Reported in Figure and Table No. 40]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	460	L	1967	78-304			1. 05 Nd_2O_3 ; single crystal; 0.210 ± 0.005 cm dia x 1.040 cm long; prepared by the flame-fusion process, grounded.
2	461	L	1967	93-307			Single crystal; prepared from 99.999 ⁺ pure materials by using the flame-fusion technique; density reported as 5.061, 5.055, 5.055, 5.051, 5.045, 5.044, and 5.038 $g\ cm^{-3}$ at 108, 166, 207, 246, 295, 299, and 324 K, respectively.
3	461	L	1967	77-306			Single crystal; prepared from 99.999 ⁺ pure materials by using the flame-fusion technique; Nd^{3+} concentration $2.7 \times 10^{20}\ cm^{-3}$; density reported as 5.071, 5.071, 5.069, 5.066, 5.065, 5.057, and 5.055 $g\ cm^{-3}$ at 132, 137, 166, 198, 217, 296, and 337 K, respectively.
4	291	R	1964	1313-2493			Fabricated by a powder process in which high-purity Y_2O_3 powder (<0.02% total impurities) was cold-pressed in a 3-in. dia steel die at 4000 psi, isostatically pressed at 20,000 psi, and sintered for 19 hrs at 1700 C in a hydrogen atmosphere; the sintered disc were then machined into specimens and guards; disc specimen 2 in. O. D. and 0.375 I. D.; density 93.7% of theoretical and increased to 95.8% of theoretical after measurement; data corrected to 100% of theoretical density; measured in effective thermal conductivity.
5	292	C	1961	367-1367			Fabricated by dry pressing followed by isostatic compaction and then sintered at 1894 C in H_2 for 2 hrs; specimen $1/2 \times 1/2 \times 7/8$ in. rectangular prisms; supplied by Michigan Chemical Co.; 96.3% of theoretical density; commercial stabilized ZrO_2 used as comparative material.
6	292	C	1961	367-1367			The above specimen corrected to zero porosity.

DATA TABLE NO. 40 THERMAL CONDUCTIVITY OF YTTRIUM OXIDE Y_2O_3 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
78	0.568	1313.2	0.0380
81	0.581	1563.2	0.0320
83	0.549	1853.2	0.0280
196	0.198	2023.2	0.0300
197	0.187	2143.2	0.0295
201	0.198	2273.2	0.0420
276	0.139	2383.2	0.0440
278	0.147	2493.2	0.0580
279	0.143		
299	0.133		
302	0.133		
304	0.135		
<u>CURVE 2</u>			
93	1.64	366.5	0.138
108	1.14	477.6	0.105
130	0.909	699.8	0.0537
200	0.478	922.1	0.0357
222	0.332	1144.3	0.0305
276	0.313	1366.5	0.0272
276	0.289		
284	0.299		
292	0.285		
292	0.265		
301	0.265		
302	0.274		
307	0.265		
<u>CURVE 3</u>			
77	0.704		
78	0.575		
79	0.529		
81	0.568		
198	0.187		
199	0.200		
201	0.196		
277	0.140		
279	0.142		
279	0.147		
302	0.135		
302	0.133		
306	0.137		
<u>CURVE 4</u>			
<u>CURVE 5</u>			
<u>CURVE 6</u>			

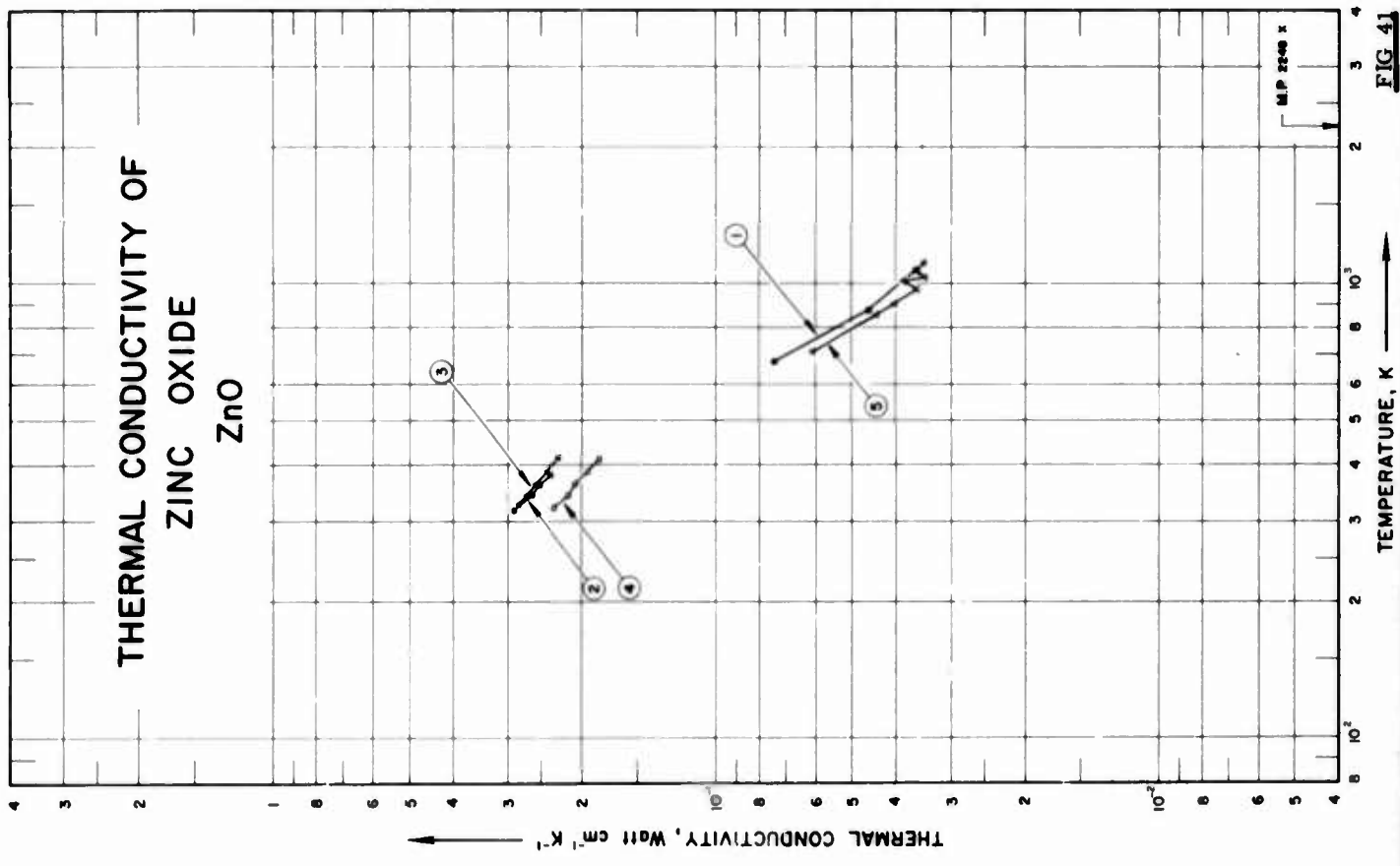


FIG. 41

SPECIFICATION TABLE NO. 41 THERMAL CONDUCTIVITY OF ZINC OXIDE ZnO

[For Data Reported in Figure and Table No. 41]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	364	C	1954	673-1073			Polycrystal; prepared by calcining commercially pure ZnO at 900 C. and slip-casting from a neutral suspension using Daxad No. 23 as a dispersing agent; bulk density 3.72 g cm ⁻³ ; porosity 34.0%.
2	12		1953	319-380		133A-1	Yellow; prepared by calcining at 1367 K and dry pressing at 15000 psi; fired at 1583 K and soaked for 1 hr; density 5.28 g cm ⁻³ .
3	12		1953	328-418		133A-2	Second run of the above specimen.
4	12		1953	322-413		133B-1	Grey; specimen preparation same as the above specimen; fired at 1644 K and soaked for 1 hr; 0.031% water absorption; density 5.20 g cm ⁻³ .
5	153	R, C	1951	712-1124			Pure; prepared by slip-casting commercially pure ZnO, using Daxad No. 23 as a dispersant, heated to 1100 C, shaped and then fired at 1300 C; porosity 34%.

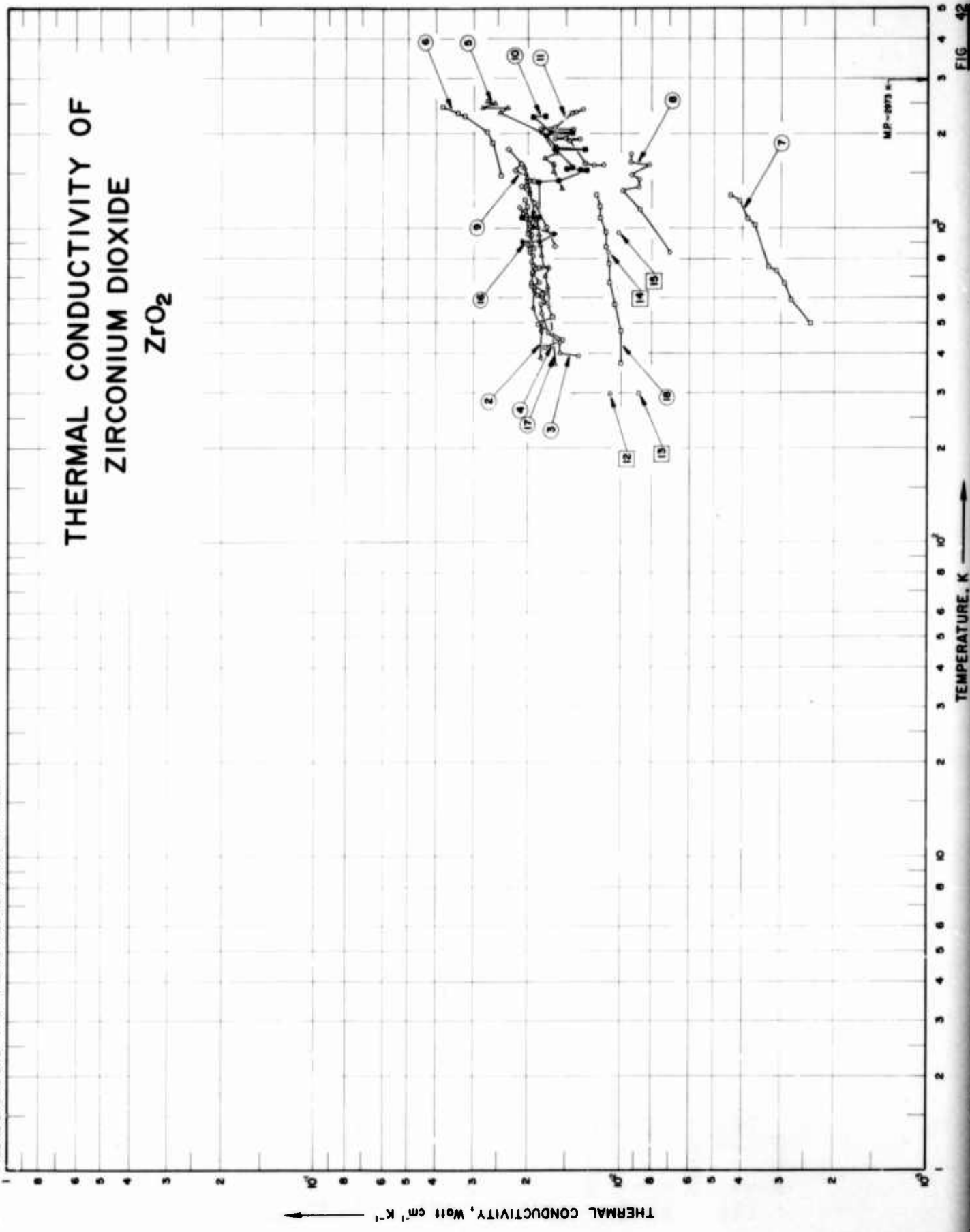
DATA TABLE NO. 41 THERMAL CONDUCTIVITY OF ZINC OXIDE ZnO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
673.2	0.0741
873.2	0.0460
1073.2	0.0360
<u>CURVE 2</u>	
319.3	0.290
343.0	0.263
361.0	0.252
380.2	0.236
<u>CURVE 3</u>	
327.5	0.283
344.7	0.271
364.5	0.257
387.0	0.242
418.4	0.226
<u>CURVE 4</u>	
322.4	0.232
342.8	0.215
365.6	0.206
386.8	0.194
413.2	0.182
<u>CURVE 5</u>	
712.2	0.0611
860.2	0.0441
910.2	0.0400
978.2	0.0358
1020.7	0.0385
1048.2	0.0344
1078.2	0.0358
1123.5	0.0344

THERMAL CONDUCTIVITY OF ZIRCONIUM DIOXIDE ZrO₂

FIGURE SHOWS ONLY 17 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 42 THERMAL CONDUCTIVITY OF ZIRCONIUM DIOXIDE ZrO_2

[For Data Reported in Figure and Table No. 42]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	57	R	1950	766-1233		No. 1	Pure; crystalline; slip-cast; treated four times with 1 N HCl and washed with distilled water; porosity 2.37% (0.25% closed pores, 2.12% open pores); bulk density 5.35 g cm ⁻³ .
2	57	R	1950	386-1203		No. 1	The second run of the above specimen.
3	2	R	1951	391-1168		No. 1	The third run of the above specimen.
4	2	R	1951	419-1226		No. 2	Similar to the above specimen except fired at 1550 C; porosity 4.74% (zero open pores); bulk density 5.22 g cm ⁻³ .
5	291	R	1964	1343-2523			CaO stabilized ZrO ₂ ; disc shaped specimen 2.00 O. D., 0.375 in. I. D.; density 4.046 g cm ⁻³ (66.3% of theoretical).
6	291	R	1964	1473-2423			The above specimen; data corrected to 100% theoretical density.
7	373	R	1959	498-1273	20		Powdered specimen (powder in the form of porous bubbles, 0.040 ± 0.01 cm dia); density 2.02 g cm ⁻³ ; volume fraction 0.33.
8	135	R	1957	833-1723	<20		Cylindrical specimen 30 mm long, 60 mm O. D., 30 mm I. D.; porosity 40%.
9	135	R	1957	873-1773	<20		Similar to the above except porosity 16%.
10	144	R	1963	1089-2281	5-7		Specimen 0.75 in. long, 0.75 in. O. D., 0.25 in. I. D.; supplied by Zirconium Corp. of America; pressed and sintered; ground and polished to eliminate surface scratches; density 5.63 g cm ⁻³ ; broke during test.
11	144	R	1963	1592-2374	5-7		Similar to the above specimen except dimensions 3 in. long, 2.5 in. O. D., and 0.75 in. I. D.; cracked and discolored during test.
12	152	L	1956	298.2		550	No details reported.
13	152	L	1956	298.2		550	The above specimen irradiated with an integrated flux of 6×10^{19} epithermal neutrons cm ⁻² above 100 ev for 480 megawatt day in the Material Testing Reactor.
14	228	P	1961	836.2	4.5	C	Specimen 1 in. dia, 0.4 cm thick (cut from a ZrO ₂ cylinder); density 4.34 g cm ⁻³ ; 0.001 in. silver foil placed between the specimen and electrodes.
15	228	P	1961	963.2	4.5	B	Similar to the above specimen (cut from the same ZrO ₂ cylinder).
16	228	P	1961	907-1127	4.5	D	Specimen 0.8 in. dia, 0.4 cm thick; density 5.48 g cm ⁻³ ; 0.001 in. silver foil placed between the specimen and electrodes.
17	307	R	1954	369-1569	5		Hollow prolate spheroidal specimen (inner minor axis ~2 cm, inner major axis ~10 cm, outer minor axis ~4 cm); prepared by slip-casting, fired; total porosity 7.76 to 10.00%; bulk density 5.22 to 5.35 g cm ⁻³ .
18	375	C	1960	373-1273		Zirconia; SFCR-50	Specimen supplied by Titanium Alloy Division, National Lead Co.; alumina (Wesgo Al-300) used as standard.

SPECIFICATION TABLE NO. 42 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent). Specifications and Remarks
19	430	-	1966	298.2			Powder specimen contained in a 0.75 in. dia x 2 in. long stainless steel cylindrical cell; mesh size -70 +50; thermal conductivity measured by using the transient line source method, the heat source was a 36-gauge constantan wire contained in a 0.025 in. O. D. hypodermic tube soldered along the axis of the cylindrical cell, data calculated from the measured line temperatures at two certain times; measured in nitrogen at 1 atm.
20	408	C	1962	553-1180			Foam specimen, density 0.721 g cm ⁻³ ; Min-K 1301 (Johns Manville Corp.) used as comparative material.
21	463	R	1961	473-1259			Powder specimen contained in a hollow cylinder of 203 mm long and 91 mm internal dia; grain size <0.2 mm; bulk density 2.53 g cm ⁻³ .
22	463	R	1961	654-1274			Similar to the above specimen except grain size 0.2~1 mm and bulk density 2.30 g cm ⁻³ .
23	463	R	1961	473-1273			Similar to the above specimen except grain size 2~5 mm and bulk density 1.62 g cm ⁻³ .

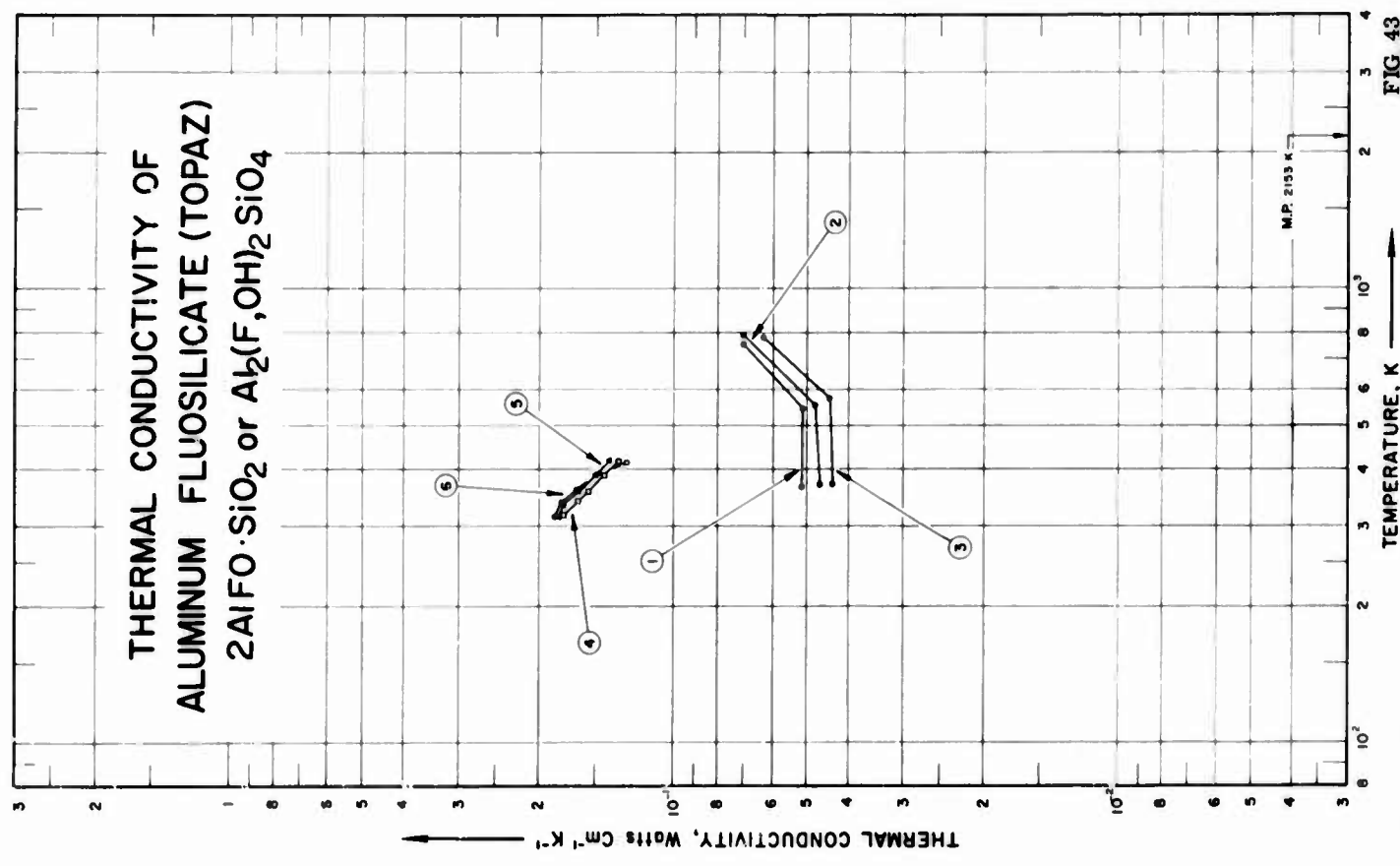


FIG 43

PRECEDING PAGE BLANK-NOT FILLED

SPECIFICATION TABLE NO. 43 THERMAL CONDUCTIVITY OF ALUMINUM FLUOSILICATE (TOPAZ) $Al_2(F, OH)_2SiO_2$ or $2AlFO \cdot SiO_2$

[For Data Reported in Figure and Table No. 43]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	34	C	1943	367-757				Domestic; colorless; specimen 1 x 1 x 1 cm cut from a single crystal with its axes a, b and c normal to their corresponding surfaces; heat flow parallel to c-axis; 18-8 stainless steel used as comparative material.
2	34	C	1943	372-793				The above specimen measured with heat flow parallel to b-axis.
3	34	C	1943	373-785				The above specimen measured with heat flow parallel to a-axis.
4	68	C	1954	315-417	±3.0	Brazil topaz; 293A-1		Orthorhombic single crystal (cell dimensions: a = 4.64 Å, b = 8.78 Å, and c = 8.38 Å); specimen 0.25 in. in dia and 0.25 in. long; measured in vacuum; heat flow parallel to c-axis; copper used as comparative material.
5	68	C	1954	314-420	±3.0	Brazil topaz; 293B-1		The above specimen measured along b-axis.
6	68	C	1954	315-417	±3.0	Brazil topaz; 293C-1		The above specimen measured along a-axis.

DATA TABLE NO. 43 THERMAL CONDUCTIVITY OF ALUMINUM FLUOSILICATE (TOPAZ) $Al_2(F, OH)_2SiO_2$ or $2AlFO \cdot SiO_2$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k
<u>CURVE 1</u>	
367.2	0.0515
549.2	0.0515
757.2	0.0703
<u>CURVE 2</u>	
372.2	0.0469
556.2	0.0481
793.2	0.0703
<u>CURVE 3</u>	
373.2	0.0439
573.2	0.0444
785.2	0.0632
<u>CURVE 4</u>	
315.3	0.177
339.6	0.165
357.5	0.156
388.1	0.144
416.5	0.133
<u>CURVE 5</u>	
314.2	0.182
334.7	0.177
356.4	0.163
388.9	0.150
419.8	0.140
<u>CURVE 6</u>	
314.8	0.185
337.6	0.178
357.4	0.165*
390.0	0.149
416.8	0.128

* Not shown on plot

SPECIFICATION TABLE NO. 44 THERMAL CONDUCTIVITY OF ALUMINUM SILICATE (MULLITE) $3Al_2O_3 \cdot 2SiO_2$

[For Data Reported in Figure and Table No. 44]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	364	C	1954	373-1473		Mullite	69.0 Al ₂ O ₃ , 31.9 SiO ₂ ; polycrystal; supplied by Babcock and Wilcox Co.; prepared from pure fused material; ground for 24 hrs in a steel ball mill; particle size 50% < 5 microns; slip cast from slip of pH 3.0, specific gravity 2.1 and fired at 1780 C; bulk density 2.79 g cm ⁻³ ; porosity 11.4%; alumina used as comparative material.
2	364	C	1954	473-1473		Mullite	Similar to the above specimen except bulk density 2.21 g cm ⁻³ and porosity 29.8%.
3	10	R	1952	431-1633		Mullite	Bulk density 2.79 g cm ⁻³ ; total porosity 11.43%.
4	10	R	1952	428-1636		Mullite	Similar to the above specimen.
5	34	C	1943	392-740		Mullite	Specimen 1 cm cube; electrocast; polycrystalline with needles well aligned; measured parallel to c (principal) axis; 18-8 stainless steel used as comparative material.
6	34	C	1943	392-744		Mullite	The above specimen measured normal to c (principal) axis.
7	68	C	1954	315-402	±3.0	Mullite; 5A2	Measured in vacuum; copper used as comparative material.
8	153	R	1951	502-1652		Mullite No. 2	Crystalline specimen; porosity 28%; fired at 1710 C.
9	153	R	1951	502-1629		Mullite No. 2	2nd run of the above specimen.
10	73	C	1954	573-1473		Mullite	Prepared by slip casting; fired.

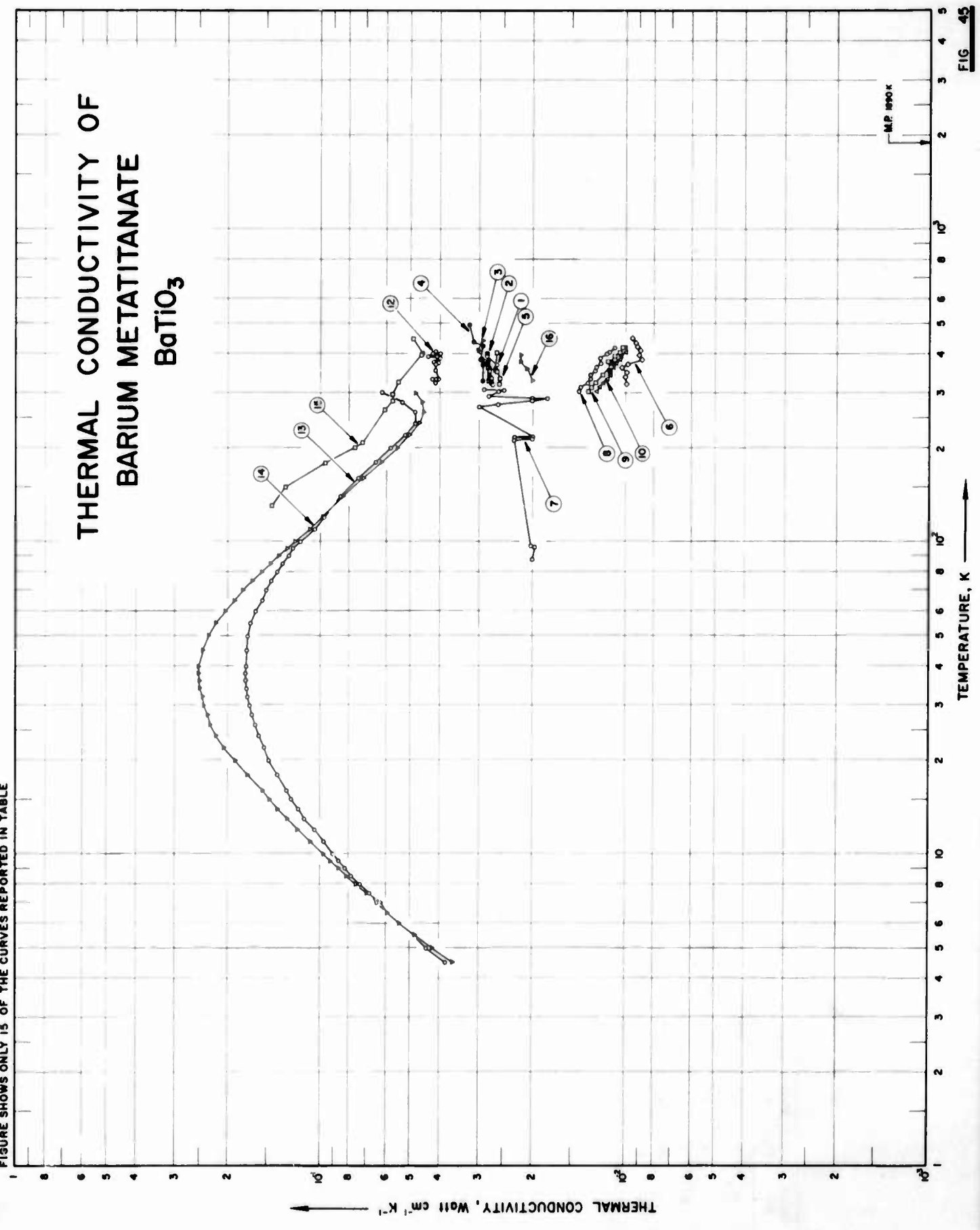
DATA TABLE NO. 44 THERMAL CONDUCTIVITY OF ALUMINUM SILICATE (MULLITE) $3Al_2O_3 \cdot 2SiO_2$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k	T	k	T	k
<u>CURVE 1</u>					
373.2	0.0540	698.2	0.0414	746.2	0.0192
473.2	0.0490	748.2	0.0397	846.2	0.0187
673.2	0.0418	825.7	0.0381	961.2	0.0182
873.2	0.0381	903.2	0.0379	1048.2	0.0175
1073.2	0.0360	943.2	0.0370	1172.2	0.0167
1273.2	0.0351	1019.2	0.0364	1260.2	0.0162
1473.2	0.0343	1053.2	0.0356	1335.2	0.0159
<u>CURVE 2</u>					
473.2	0.0360	1108.2	0.0347	1409.2	0.0158
673.2	0.0310	1136.2	0.0349	1478.2	0.0154
873.2	0.0285	1185.7	0.0345	1515.2	0.0150
1073.2	0.0272	1218.2	0.0345	1552.2	0.0149
1273.2	0.0268	1278.2	0.0339	1594.2	0.0142
1473.2	0.0268	1335.7	0.0345	1634.2	0.0141
<u>CURVE 3</u>					
430.7	0.0536	1438.2	0.0335	1652.2	0.0138
535.7	0.0481	1473.2	0.0326	<u>CURVE 9</u>	
598.2	0.0452	1573.2	0.0328	502.2	0.0179
673.2	0.0446	1583.2	0.0324	634.2	0.0187
745.7	0.0414	1635.7	0.0331	746.2	0.0171
825.7	0.0412	<u>CURVE 5</u>		846.2	0.0172
898.2	0.0406	392.2	0.0372	961.2	0.0165
935.7	0.0406	477.2	0.0387	1048.2	0.0164
1018.2	0.0387	563.2	0.0395	1169.2	0.0157
1053.2	0.0381	740.2	0.0502	1254.2	0.0155
1098.2	0.0372	<u>CURVE 6</u>		1329.2	0.0153
1133.2	0.0377	392.2	0.0243	1402.2	0.0151
1175.7	0.0370	500.2	0.0264	1468.2	0.0149
1218.2	0.0370	608.2	0.0321	1501.2	0.0146
1273.2	0.0370	744.2	0.0382	1543.2	0.0143
1328.2	0.0364	<u>CURVE 7</u>		1579.2	0.0142*
1372.2	0.0366	315.2	0.0349	1613.2	0.0136
1463.2	0.0360	333.6	0.0375	1629.2	0.0136*
1565.7	0.0360	354.5	0.0377	<u>CURVE 10</u>	
1583.2	0.0360	373.8	0.0378	573.2	0.0470
1633.2	0.0360	401.7	0.0372	873.2	0.0418
<u>CURVE 4</u>					
428.2	0.0496	<u>CURVE 8</u>		1173.2	0.0383
533.2	0.0446	502.2	0.0218	1473.2	0.0366
583.2	0.0435	634.2	0.0214		

* Not shown on plot

THERMAL CONDUCTIVITY OF BARIUM METATITANATE $BaTiO_3$

FIGURE SHOWS ONLY 15 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 45 THERMAL CONDUCTIVITY OF BARIUM METATITANATE BaTiO₃

[For Data Reported in Figure and Table No. 45]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	9	C	1953	317-392		159A-1	Specimen 0.100 in. long, 0.410 in. in dia; bulk density 5.34 g cm ⁻³ ; copper used as standard.
2	9	C	1953	322-398		159B-1	Specimen 0.100 in. long, 0.410 in. in dia; copper used as standard.
3	9	C	1953	328-440		159C-2	Specimen 0.100 in. long, 0.410 in. in dia; copper used as standard.
4	9	C	1953	327-495		159C-3	Specimen 0.100 in. long, 0.410 in. in dia; copper used as standard.
5	68		1954	318-403	±3	38A2	No other information supplied.
6	201	C	1952	320-450			Specimen 0.12 cm thick, 2.75 cm in dia; copper used as standard.
7	38	L	1960	88-307		No. 2	Specimen 2.06 cm in dia, 1.45 cm thick; made from powdered raw materials of BaO and TiO ₂ mixed together with water, pressed into a disc and fired in a silicofite furnace; the product crushed, well pulverized and meshed, then pressed (1.3 tons. cm ⁻²) into disc form and sintered for 6.5 hrs at 1300 C; density 5.03 g cm ⁻³ ; porosity 16.0%; measurements made in a vacuum better than 10 ⁻⁴ mm Hg.
8	202	F	1961	303-418			Pure; specific heat; 0.14 cal g ⁻¹ deg ⁻¹ ; velocity of sound in specimen 4.5 x 10 ⁵ cm sec ⁻¹ , mean free path 16.2 Å.
9	202	F	1961	303-418			Similar to above except impurity 0.5 mol % of Mn ₂ Nb ₂ O ₇ .
10	202	F	1961	303-418			Similar to above, except impurity 1.0 mol % Mn ₂ Nb ₂ O ₇ .
11	203	C	1958	323-458			Specimen sintered from BaCO ₃ and TiO ₃ powder of special reagent grade; pure iron used as standard.
12	289	C	1963	323-405	<15		Disc specimen cut from a 1 in. long, 0.75 in. dia cylinder; disc dia to thickness ratio greater than 10; faces of disc lapped parallel.
13	465	L	1965	4.5-300	±5		0.02 Fe ₂ O ₃ major impurity; single crystal; specimen ~1 x 1 x 7 mm; supplied by Kinsekisha Laboratory; sintered; heat flowed in the direction of <100>; transition temp from rhombohedral to orthorhombic and from orthorhombic to tetragonal at 193 and 273 K, respectively; grown by flux method; thermal conductivity data obtained directly from the author.
14	465	L	1965	4.5-300	±5		Polycrystalline; specimen 1 x 1 x 7 mm; supplied by Kinsekisha Laboratory; sintered; grown by flux method; thermal conductivity data obtained directly from the author.
15	467	L	1967	132-447			1.5 Sr doped; single crystal; specimen 3 mm in dia and 1 mm thick was grown by floating zone process; supplied by Dr. F. Brown of Williams College, Williamstown, Mass.
16	468	L	1950	329-397		39A	Specimen 0.476 in. dia and 0.488 in. long.

DATA TABLE NO. 45 THERMAL CONDUCTIVITY OF BARIUM METATITANATE BaTiO₃
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 6 (cont.)</u>		<u>CURVE 9</u>		<u>CURVE 11 (cont.)^a</u>		<u>CURVE 13 (cont.)</u>		<u>CURVE 14</u>		<u>CURVE 14 (cont.)</u>			
316.6	0.0271	370.7	0.06983	303.2	0.0132	383.2	0.032	12	0.104	4.5	0.036	160	0.071		
334.8	0.0274	384.2	0.00879	313.2	0.0129	388.2	0.032	13	0.112	5.0	0.042	180	0.062		
351.6	0.0277	396.2	0.00900	323.2	0.0126	391.2	0.031	14	0.117	5.5	0.048	200	0.055		
368.9	0.0263	410.7	0.00891	343.2	0.0119	392.2	0.031	15	0.124	6.0	0.054	220	0.050		
392.1	0.0283	421.2	0.00912	363.2	0.0113	395.2	0.029	16	0.128	6.5	0.059	240	0.0465		
<u>CURVE 2</u>		433.2	0.00925	368.2	0.0113	403.2	0.028	18	0.137	7.0	0.062	260	0.045		
321.8	0.0275	449.7	0.00950	373.2	0.0113	418.2	0.027	20	0.147	7.5	0.069	280	0.0455		
335.9	0.0276	<u>CURVE 7</u>		378.2	0.0115	428.2	0.029	22	0.153	8.0	0.075	300	0.048		
359.8	0.0279	88.2	0.0200	383.2	0.0109	445.2	0.027	24	0.159	8.5	0.081	<u>CURVE 15</u>			
375.7	0.0281	96.2	0.0198	393.2	0.0108	451.2	0.026	26	0.163	9.0	0.086	131.8	0.144		
397.6	0.0282	97.2	0.0202	403.2	0.0105	458.2	0.025	28	0.167	9.5	0.092	150.7	0.129		
<u>CURVE 3</u>		211.2	0.0230	418.2	0.0103	<u>CURVE 12</u>		30	0.170	10	0.097	179.5	0.0960		
327.6	0.0280	213.2	0.0200	<u>CURVE 10</u>		32.7	0.0415	32	0.173	11	0.107	200.0	0.0762		
360.2	0.0280	215.2	0.0230	303.2	0.0126	331.7	0.0425	34	0.174	12	0.118	208.4	0.0716		
380.4	0.0289	218.2	0.0200	313.2	0.0122	331.7	0.0415	36	0.175	13	0.127	266.7	0.0605		
410.3	0.0301	271.2	0.0300	323.2	0.0118	333.7	0.0405	38	0.175	14	0.137	282.5	0.0570		
440.4	0.0293	275.2	0.0260	333.2	0.0115	355.7	0.0415	40	0.174	15	0.146	298.5	0.0572		
<u>CURVE 4</u>		283.2	0.0200	343.2	0.0113	369.7	0.0415	45	0.173	16	0.154	325.8	0.0545		
326.9	0.0293	288.2	0.0180	348.2	0.0113	375.0	0.0405	50	0.169	18	0.173	397.2	0.0459		
368.9	0.0293	288.2	0.0200	353.2	0.0113	375.7	0.0420	55	0.162	20	0.189	402.7	0.0455		
384.2	0.0297	293.2	0.0280	358.2	0.0113 ^a	387.2	0.0400	60	0.155	22	0.205	446.7	0.0488		
424.8	0.0293	301.2	0.0260	363.2	0.0110	391.2	0.0410	65	0.150	24	0.227	<u>CURVE 16</u>			
437.8	0.0314	305.2	0.0250	373.2	0.0107	392.2	0.0400	70	0.144	26	0.240	329.4	0.0199		
495.2	0.0322	307.2	0.0290	383.2	0.0105	395.7	0.0435 ^a	75	0.137	28	0.250	360.3	0.0208		
<u>CURVE 5</u>		<u>CURVE 8</u>		393.2	0.0104	400.2	0.0422	80	0.132	30	0.243	378.7	0.0218		
317.8	0.0259	303.2	0.0142	403.2	0.0100	405.2	0.0415	85	0.126	32	0.249	397.4	0.0218		
334.7	0.0257	313.2	0.0140	<u>CURVE 11^a</u>		<u>CURVE 13</u>		90	0.122	34	0.249				
352.4	0.0263	323.2	0.0133	323.2	0.029	4.5	0.038	95	0.116	36	0.249				
360.7	0.0268	343.2	0.0130	338.2	0.032	5.0	0.044	100	0.104	38	0.250				
403.3	0.0263	353.2	0.0126	353.2	0.033	5.5	0.048 ^a	110	0.097	40	0.250				
<u>CURVE 6</u>		363.2	0.0125	363.2	0.030	6.0	0.054 ^a	120	0.097	45	0.242				
320.0	0.00992	373.2	0.0121	355.2	0.031	6.5	0.059 ^a	140	0.085	50	0.230				
338.7	0.0100	383.2	0.0121 ^a	358.2	0.030	7.0	0.064	160	0.074	55	0.217				
348.2	0.00992	388.2	0.0122	362.2	0.027	7.5	0.068	180	0.065	60	0.203				
364.7	0.0103	393.2	0.0121 ^a	367.2	0.028	8.0	0.073	200	0.058	65	0.190				
		396.2	0.0116	370.2	0.030	8.5	0.078	220	0.052	70	0.178				
		403.2	0.0113	378.2	0.026	9.0	0.082	240	0.048	75	0.166				
		418.2	0.0109	380.2	0.029	9.5	0.086	260	0.048	80	0.155				
				379.2	0.030	10	0.090	280	0.053	85	0.145				
				380.2	0.032	11	0.097	300	0.062	90	0.136				
								300	0.062	95	0.127				
								100	0.120	100	0.120				
								110	0.108	110	0.108				
								120	0.098	120	0.098				
								140	0.083	140	0.083				

^a Not shown on plot

SPECIFICATION TABLE NO. 46 THERMAL CONDUCTIVITY OF BARIUM DITITANATE BaO·2TiO₂

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	468	L	1950	328-394		38A	Specimen 0.492 in. dia x 0.491 in. long.

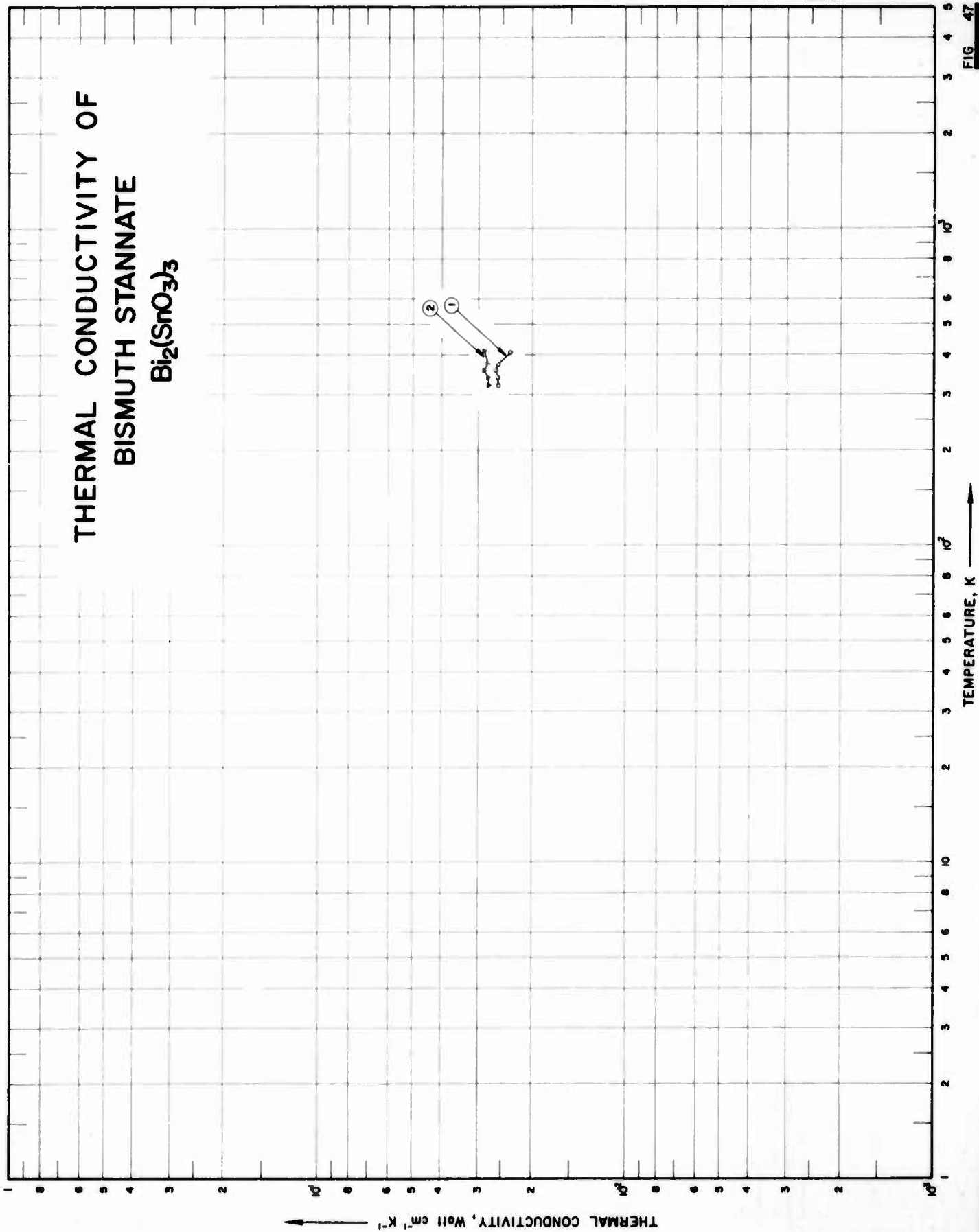
DATA TABLE NO. 46 THERMAL CONDUCTIVITY OF BARIUM DITITANATE BaO·2TiO₂

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
	<u>CURVE 1*</u>
328.3	0.0302
359.1	0.0304
394.3	0.0304

* No graphical presentation

THERMAL CONDUCTIVITY OF BISMUTH STANNATE $\text{Bi}_2(\text{SnO}_3)_3$



SPECIFICATION TABLE NO. 47 THERMAL CONDUCTIVITY OF BISMUTH STANNATE $\text{Bi}_2(\text{SnO}_3)_3$

[For Data Reported in Figure and Table No. 47]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3	L	1953	319-408		169A-1	Specimen supplied by Metal and Thermit Corp.; density 7.64 g cm^{-3} at 25 C; water absorption 0.011%.
2	3	L	1953	319-412		169B-1	Specimen supplied by Metal and Thermit Corp.; density 7.60 g cm^{-3} at 25 C; water absorption 0.011%.

DATA TABLE NO. 47 THERMAL CONDUCTIVITY OF BISMUTH STANNATE $\text{Bi}_2(\text{SnO}_3)_2$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
319.1	0.0258
339.3	0.0259
357.8	0.0263
374.9	0.0257
408.3	0.0235
<u>CURVE 2</u>	
319.1	0.0277
339.3	0.0278
357.5	0.0287
375.5	0.0280
412.1	0.0287

THERMAL CONDUCTIVITY OF CALCIUM STANNATE CaSnO_3

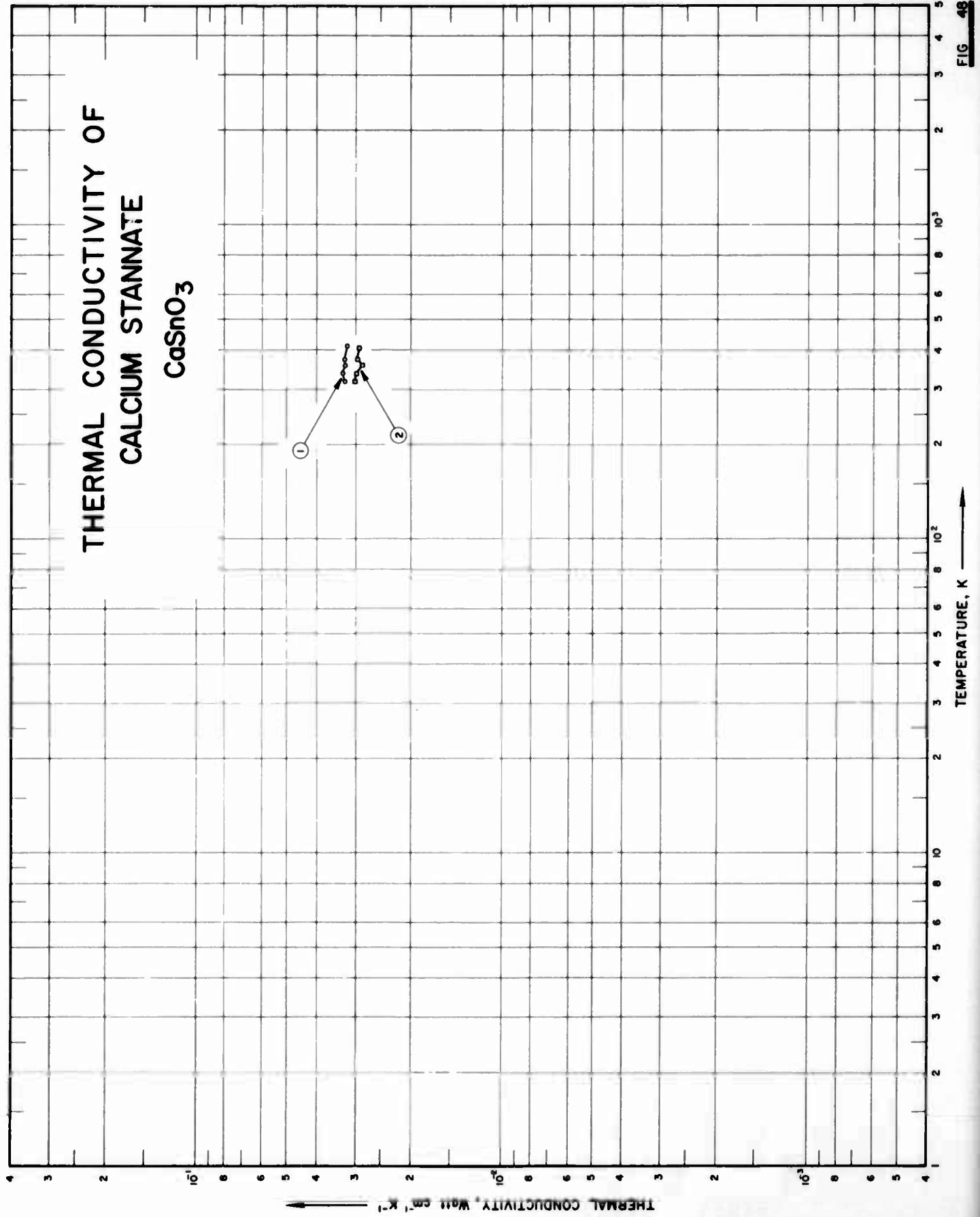


FIG. 48

SPECIFICATION TABLE NO. 48 THERMAL CONDUCTIVITY OF CALCIUM STANNATE CaSnO_3

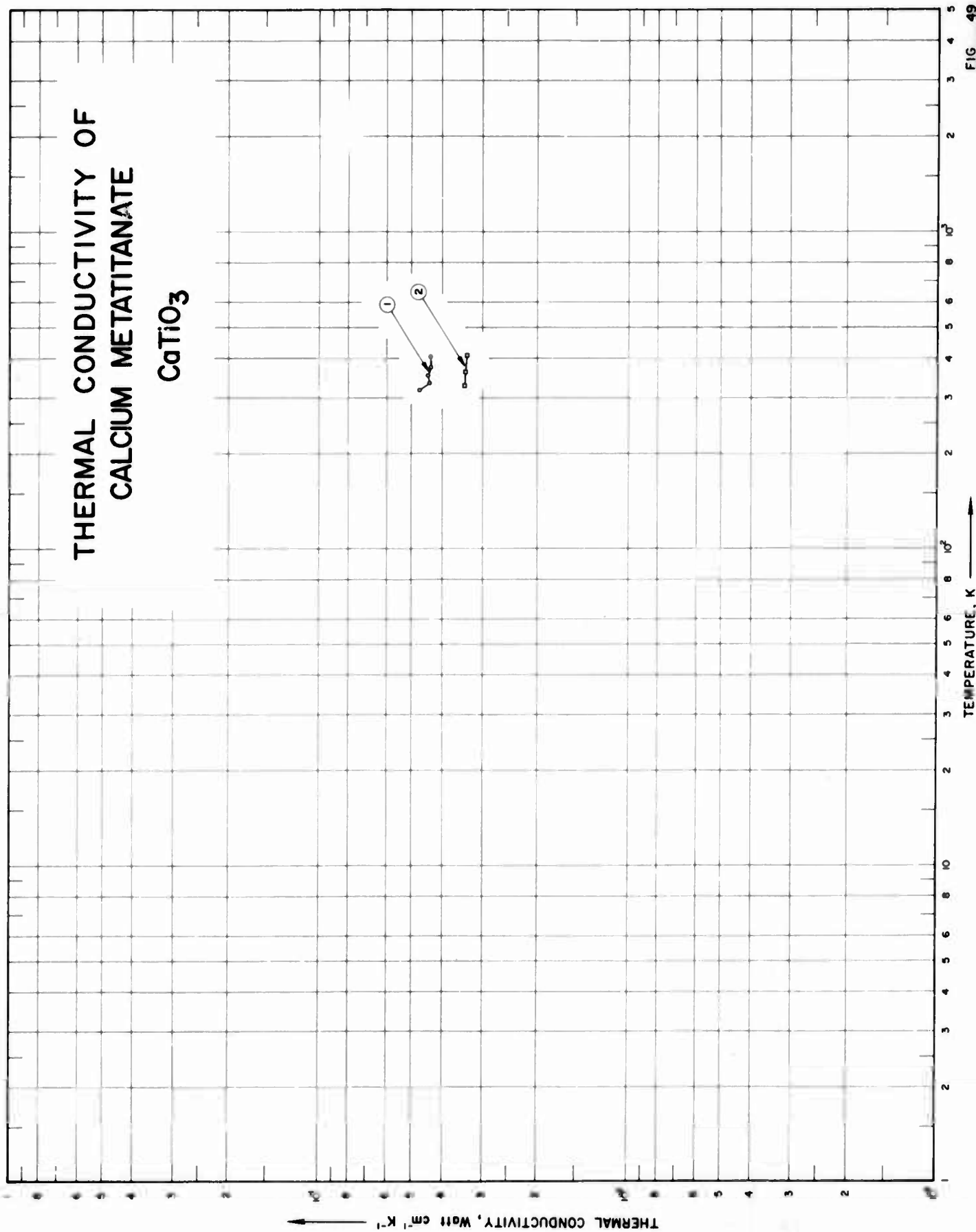
[For Data Reported in Figure and Table No. 48]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3	L	1963	319-411		167B-1	Density (25 C) 5.08 g cm^{-3} ; water absorption 0.57%.
2	3	L	1963	318-407		167B-2	Separate run of the above specimen.

DATA TABLE NO. 48 THERMAL CONDUCTIVITY OF CALCIUM STANNATE CaSnO_3 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
318.7	0.0327
338.6	0.0333
357.7	0.0327
373.5	0.0328
411.0	0.0323
<u>CURVE 2</u>	
317.9	0.0302
337.4	0.0300
359.3	0.0288
374.0	0.0298
406.8	0.0295

THERMAL CONDUCTIVITY OF CALCIUM METATITANATE CaTiO₃



SPECIFICATION TABLE NO. 49 THERMAL CONDUCTIVITY OF CALCIUM METATITANATE CaTiO_3

[For Data Reported in Figure and Table No. 49]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	68		1954	318-406	±3	35A2	No other details reported.
2	468	L	1950	327-407		42B	0.417 in. dia x 0.513 in. long.

DATA TABLE NO. 49 THERMAL CONDUCTIVITY OF CALCIUM METATITANATE CaTiO_3 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
317.8	0.0473
335.2	0.0439
353.5	0.0444
374.5	0.0435
405.5	0.0435
<u>CURVE 2</u>	
327.4	0.0341
362.3	0.0340
407.4	0.0336

SPECIFICATION TABLE NO. 50 THERMAL CONDUCTIVITY OF CALCIUM TUNGSTATE CaWO₄

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	584	C	1962	422	15		Copper used as comparative material.

DATA TABLE NO. 50 THERMAL CONDUCTIVITY OF CALCIUM TUNGSTATE CaWO₄
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k
CURVE 1*
 422 0.113

* No graphical presentation

SPECIFICATION TABLE NO. 51 THERMAL CONDUCTIVITY OF TRICOBALT STRONTIUM METATITANATE $\text{Co}_3\text{SrTiO}_3$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	283		1959	298.2		No. 3	94 pure $\text{Co}_3\text{SrTiO}_3$.

DATA TABLE NO. 51 THERMAL CONDUCTIVITY OF TRICOBALT STRONTIUM METATITANATE $\text{Co}_3\text{SrTiO}_3$

[Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

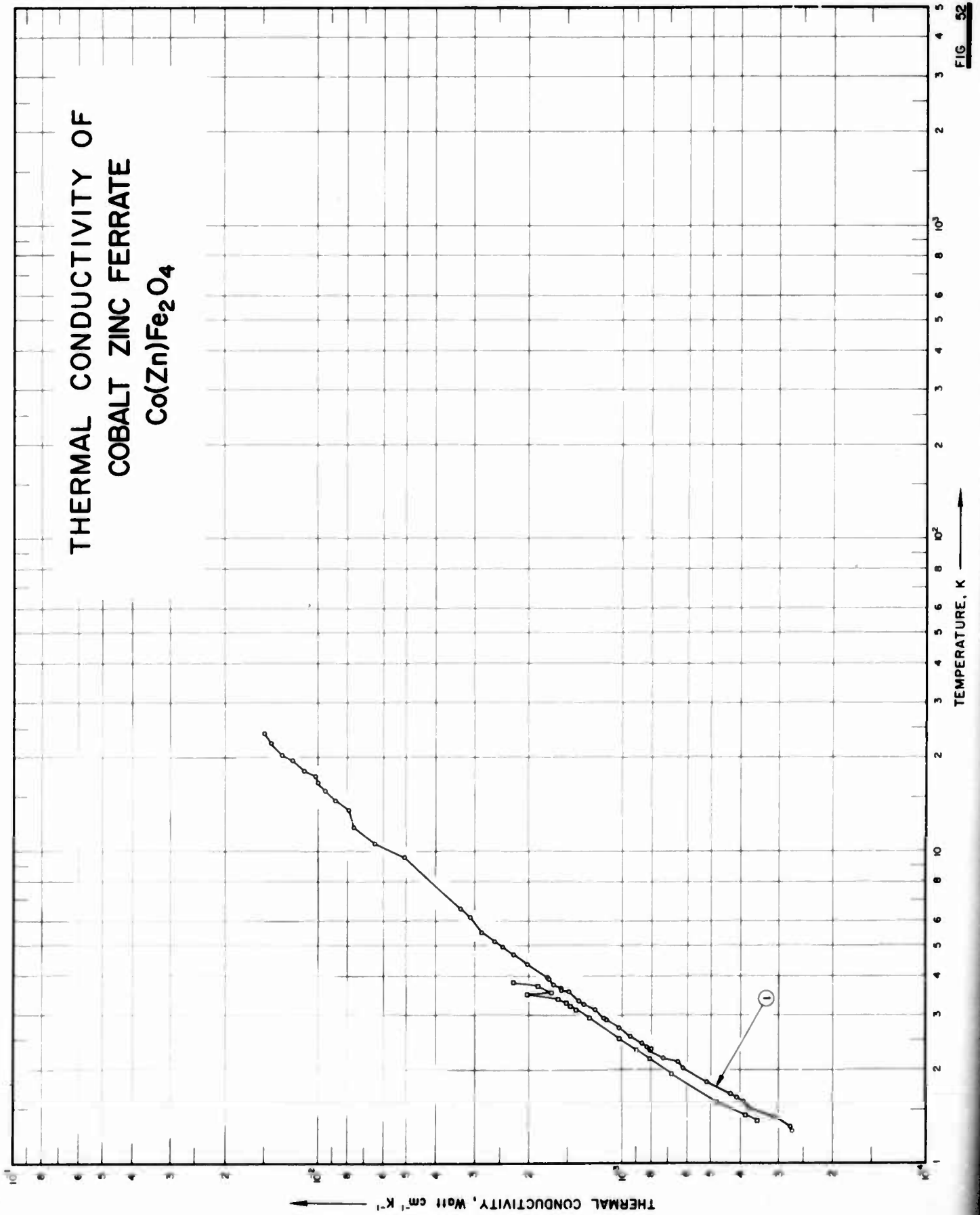
T k

CURVE 1 *

298.2 0.0724

* No graphical presentation

THERMAL CONDUCTIVITY OF
COBALT ZINC FERRATE
 $\text{Co}(\text{Zn})\text{Fe}_2\text{O}_4$



SPECIFICATION TABLE NO. 52 THERMAL CONDUCTIVITY OF COBALT - ZINC FERRATES $\text{Co}(\text{Zn})\text{Fe}_2\text{O}_4$

[For Data Reported in Figure and Table No. 52]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	466	L	1961	1.3-24			Major metallic components: 55.8 Fe, 11.6 Co, and 6.46 Zn; specimen 4.37 cm in length and 0.329 cm ² in cross section; single crystal bar with orientation of the long axis [534]; average electrical resistivity 0.2, 53, and $\geq 3 \times 10^{10}$ ohm cm at room temperature, 77 K, and 4.2 K respectively; measured in vacuum.
2	466	L	1961	1.4-3.8			The above specimen measured in a magnetic field of 9400 gauss parallel to the direction of heat flow.

DATA TABLE NO. 52 THERMAL CONDUCTIVITY OF COBALT ZINC FERRATE $\text{Co}(\text{Zn})\text{Fe}_2\text{O}_4$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k
1.27	0.000270	19.5	0.0121
1.32	0.000275	20.5	0.0131
1.41	0.000310	22.5	0.0143
1.52	0.000375	24.0	0.0150
1.58	0.000390		
1.64	0.000410		
1.66	0.000430		
1.82	0.00515	1.36	0.000360
2.02	0.00620	1.43	0.000385
2.12	0.00645	1.57	0.000475
2.18	0.00725	1.67	0.000535
2.31	0.00810	1.95	0.000680
2.33	0.00890	2.18	0.000810
2.36	0.00830	2.32	0.000895
2.43	0.00860	2.53	0.00103
2.56	0.00940	2.92	0.00128
2.74	0.00103	3.12	0.00142
2.90	0.00113	3.20	0.00147
2.93	0.00115	3.29	0.00153
3.11	0.00123	3.39	0.00161
3.25	0.00133	3.46	0.00204
3.33	0.00138	3.51	0.00170
3.56	0.00149	3.72	0.00186
3.60	0.00157	3.76	0.00226
3.65	0.00157		
3.75	0.00167		
3.90	0.00172		
3.93	0.00174		
4.36	0.00203		
4.70	0.00225		
4.95	0.00245		
5.15	0.00260		
5.50	0.00285		
6.15	0.00310		
6.55	0.00355		
9.60	0.00570		
9.90	0.00590		
10.6	0.00645		
12.0	0.00765		
13.6	0.00795		
14.6	0.00885		
15.6	0.00945		
16.7	0.0100		
17.5	0.0105		
18.2	0.0112		

THERMAL CONDUCTIVITY OF FORSTERITE Mg_2SiO_4

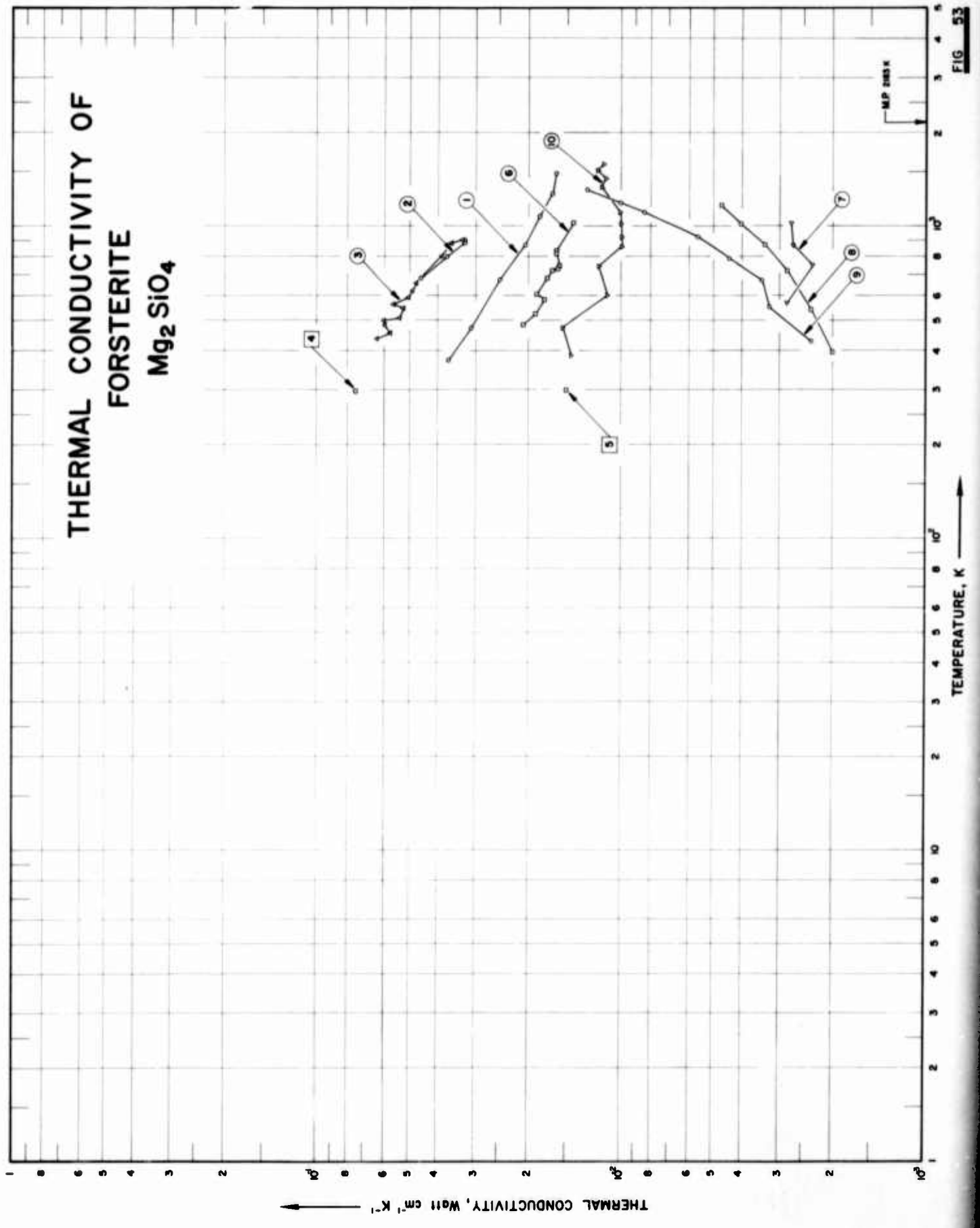


FIG. 53

SPECIFICATION TABLE NO. 53 THERMAL CONDUCTIVITY OF FORSTERITE Mg_2SiO_4

[For Data Reported in Figure and Table No. 53]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	364	C	1954	373-1473		Forsterite	59.0 MgO, 41.0 SiO_2 ; polycrystal; prepared from calcined chemically pure magnesium carbonate and silicate acid, ground for 5 hrs in a rubber-lined mill, hydrostatically pressed and fired to 1430 C to form crystalline forsterite, then crushed, ground for 15 hrs and prepared as a casting slip in an ethanol suspension with specific gravity 2.05; fired at 1650 C; bulk density 2.22; porosity 31.1%; dense alumina used as comparative material.	
2	65	C	1958	683-901	± 2	Forsterite	Milled 45.0 treasure talc, 45.0 $Mg(OH)_2$, 3.6 rex ball clay, and 6.4 $BaCO_3$ in a porcelain mill with porcelain balls for 14 hrs, poured on plaster, dried, pulverized and calcined at 1260 C for 3 hrs, then pulverized again, mixed with equal parts of raw batch, and milled for 12 hrs in a porcelain ball mill, cold-pressed in a steel die at 16000 psi then fired at 1510 C for 8 hrs; bulk density 3.06 $g\ cm^{-3}$; porosity 4.4%; alumina (Body Al-300) used as comparative material.	
3	65	C	1958	437-901	± 2	Forsterite	The above specimen measured with nickelous oxide as standard at temp. below 400 C; measured with another piece of alumina (Body Al-300) as standard at temp. above 400 C.	
4	152	L	1958	298.2		Forsterite 243	Specimen 20 mils thick and 0.75 in. in dia; preirradiated with 6×10^{19} epithermal neutrons per cm^2 for 490 MWD in the MTR.	
5	152	L	1958	298.2		Forsterite 243	The above specimen postirradiated with 6×10^{19} epithermal neutrons per cm^2 for megawatt days in the material testing reactor.	
6	374	C	1965	483-1023	0-11	Forsterite L (brick)	29.5 SiO_2 , 10.9 Al_2O_3 , 7.6 Fe_2O_3 , 0.7 CaO, 50.3 MgO, 1.0 Cr_2O_3 ; bulk density 2.6 $g\ cm^{-3}$; apparent porosity 21%; specimen prepared to a tolerance of ± 0.001 in. in the form of a cylinder 1 in. in dia and 1 in. in length; produced by Harbison-Walker Refractories Co.; alumina AL-300 as reference standard (thermal conductivity determined by J.J. Swica, Alfred University).	
7	463,464	R	1961	568-1029			Powder specimen contained in a hollow cylinder of 203 mm long and 91 mm internal dia; grain size < 0.2 mm; bulk density 1.40 $g\ cm^{-3}$.	
8	463,464	R	1961	396-1167			Similar to the above specimen except grain size 0.2-1 mm and bulk density 0.97 $g\ cm^{-3}$.	
9	463,464	R	1961	428-1319			Similar to the above specimen except grain size 2-5 mm and bulk density 0.72 $g\ cm^{-3}$.	
10	463,464	R	1961	384-1581			Prepared from the powder of grain size 0.2-1 mm by pressing and firing at 1650 C; bulk density 1.75 $g\ cm^{-3}$.	

DATA TABLE NO. 53 THERMAL CONDUCTIVITY OF FORSTERITE Mg₂SiO₄

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 6 (cont.)</u>		<u>CURVE 10 (cont.)</u>	
373.2	0.0368	607.2	0.0187	1110	0.0101
473.2	0.0310	682.2	0.0174	1343	0.0116
673.2	0.0247	722.2	0.0167	1417	0.0112
873.2	0.0205	730.2	0.0161	1510	0.0119
1073.2	0.0184	745.2	0.0159	1581	0.0114
1273.2	0.0167	822.2	0.0163		
1473.2	0.0163	836.2	0.0163		
		1023.2	0.0143		
<u>CURVE 2</u>		<u>CURVE 7</u>			
663.2	0.0460	568.2	0.00282		
798.2	0.0372	753.2	0.00232		
883.2	0.0326	871.2	0.00270		
901.2	0.0326	1029	0.00275		
<u>CURVE 3</u>		<u>CURVE 8</u>			
437.2	0.0636	396.2	0.00199		
456.2	0.0577	541.2	0.00235		
481.2	0.0598	723.2	0.00282		
499.2	0.0602	873.2	0.00335		
509.2	0.0540	1019	0.00401		
548.2	0.0523	1167	0.00470		
563.2	0.0561				
581.2	0.0506	<u>CURVE 9</u>			
621.2	0.0490	428.2	0.00235		
658.2	0.0477	552.2	0.00324		
683.2	0.0460*	673.2	0.00343		
798.2	0.0389	787.2	0.00442		
883.2	0.0360	925.2	0.00561		
901.2	0.0331	1108	0.00837		
<u>CURVE 4</u>		1192	0.0100		
298.2	0.0753	1319	0.0129		
<u>CURVE 5</u>		<u>CURVE 10</u>			
298.2	0.0151	384.2	0.0145		
		473.2	0.0154		
<u>CURVE 6</u>		596.2	0.0111		
483.2	0.0208	742.2	0.0118		
525.2	0.0189	857.2	0.00988		
583.2	0.0178	922.2	0.00993		
		1020	0.00997		

* Not shown on plot

SPECIFICATION TABLE NO. 54 THERMAL CONDUCTIVITY OF GARNET $M_2^{II} M_2^{III} (SiO_4)_3$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	68		1984	315-377	± 3	Garnet [$M_2^{II} R_2^{III} (SiO_4)_3$]	Natural single crystal with cubic crystal system.

DATA TABLE NO. 54 THERMAL CONDUCTIVITY OF GARNET $M_2^{II} M_2^{III} (SiO_4)_3$

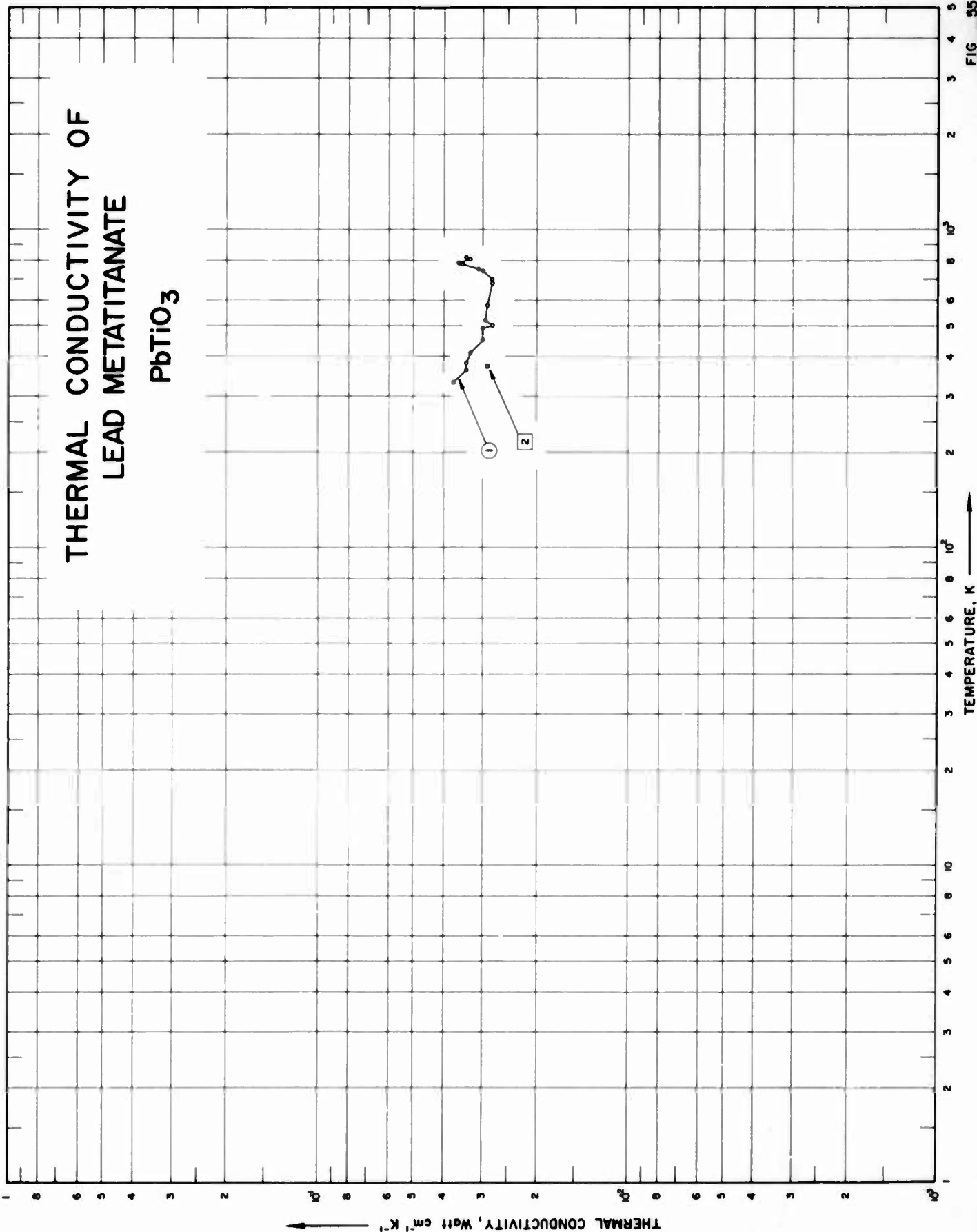
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
315.0	0.0358
324.6	0.0361
357.9	0.0354
376.8	0.0356

CURVE 1*

* No graphical presentation

THERMAL CONDUCTIVITY OF
LEAD METATITANATE
 $PbTiO_3$



SPECIFICATION TABLE NO. 55 THERMAL CONDUCTIVITY OF LEAD METATITANATE $PbTiO_3$

[For Data Reported in Figure and Table No. 55]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	38	C	1960	333-823			Powdered raw materials of chemical pure PbO and special grade TiO_2 were mixed together with water, pressed into a disc and fired in a silicon furnace; the product was crashed, well pulverized and milled (pressure 0.53 cm^{-2}) into a disc, 2.235 cm in dia and 0.195 cm thick; sintered at 1250 C for 2 hrs; density 6.86 g cm^{-3} ; porosity 14.6%; measured in vacuum.
2	203	C	1958	373.2			No details reported.

DATA TABLE NO. 55 THERMAL CONDUCTIVITY OF LEAD METATITANATE $PbTiO_3$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k
<u>CURVE 1</u>	
333.2	0.0375
363.2	0.034
383.2	0.034
413.2	0.033
453.2	0.030
493.2	0.030
503.2	0.028
523.2	0.0295
583.2	0.029
683.2	0.028
698.2	0.028
743.2	0.030
753.2	0.031
778.2	0.035*
783.2	0.035
788.2	0.036
808.2	0.033
823.2	0.034
<u>CURVE 2</u>	
373.2	0.029

* Not shown on plot

SPECIFICATION TABLE NO. 56 THERMAL CONDUCTIVITY OF LEAD ZIRCONATE $PbZrO_3$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	38	C	1960	345-530			Powdered raw materials of special grade PbO and chemically pure grade ZrO_2 mixed together with water, pressed into a disc and fired in a siliconit furnace; the product crushed, well pulverized and meshed, then pressed (pressure 0.53 ton cm^{-2}) into a disc, with dia 2.12 cm and thickness 0.3274 cm, and sintered at 1200 C for 2 hrs; density 6.05 g cm^{-3} ; porosity 25.5%; measured in vacuum.

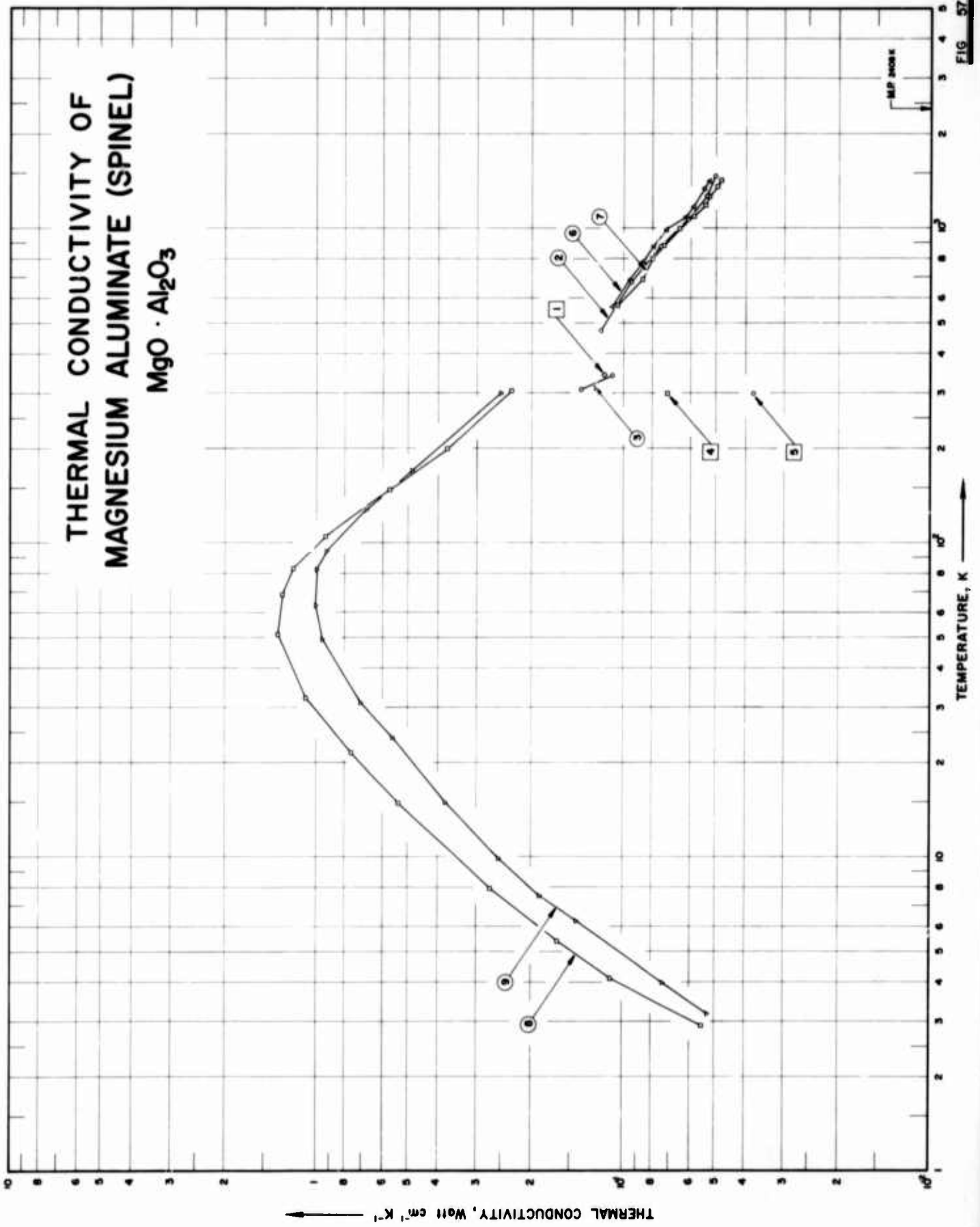
DATA TABLE NO. 56 THERMAL CONDUCTIVITY OF LEAD ZIRCONATE $PbZrO_3$

[Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
345.2	0.0136
348.2	0.0136
393.2	0.0130
400.2	0.0130
428.2	0.0130
433.2	0.0130
460.2	0.0138
479.2	0.0145
505.2	0.0145
528.2	0.0145
530.2	0.0150

* No graphical presentation

THERMAL CONDUCTIVITY OF
MAGNESIUM ALUMINATE (SPINEL)
 $MgO \cdot Al_2O_3$



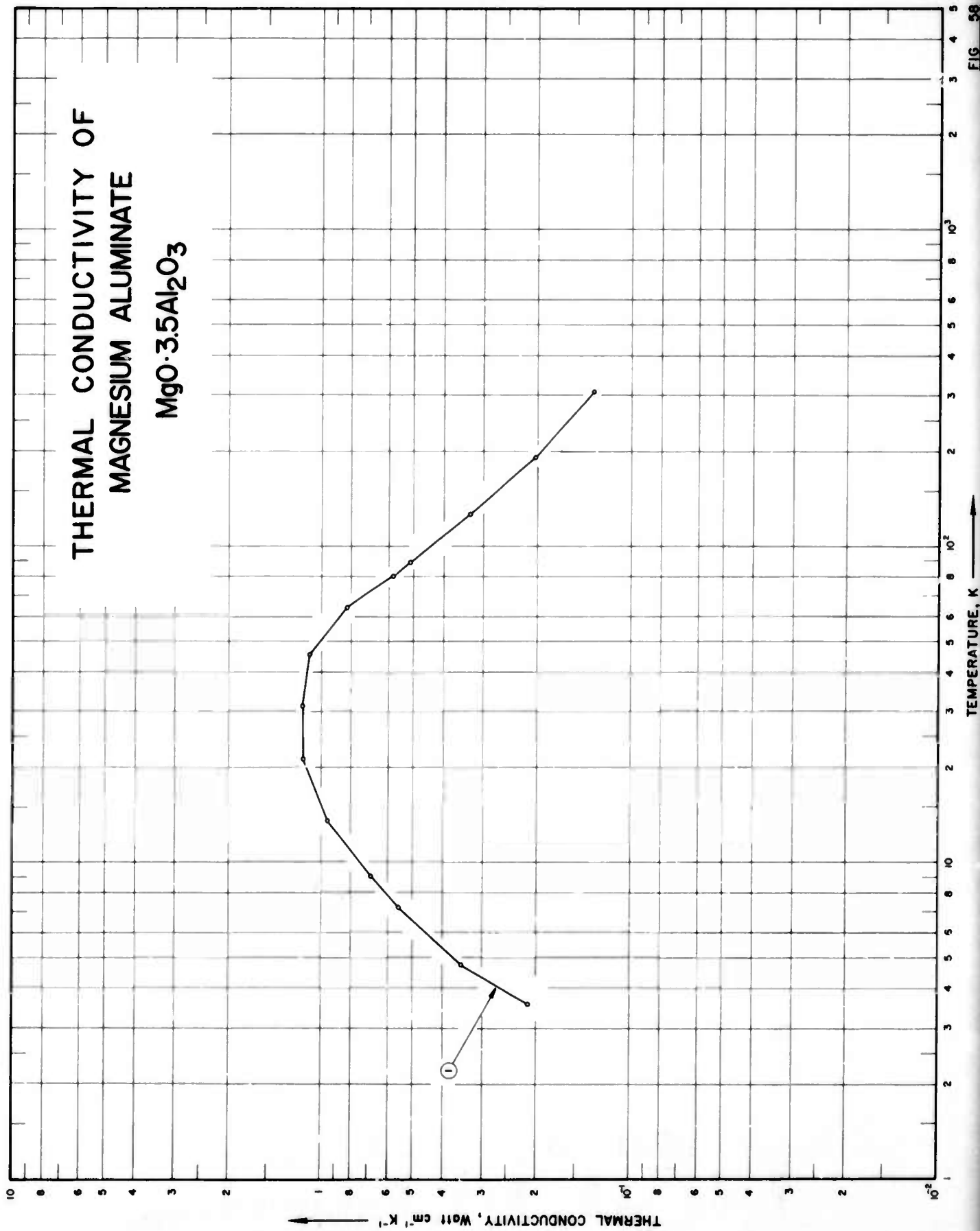
SPECIFICATION TABLE NO. 57 THERMAL CONDUCTIVITY OF MAGNESIUM ALUMINATE $MgO \cdot Al_2O_3$

[For Data Reported in Figure and Table No. 57]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	13	C	1953	343.2	±3.0	Spinel	Single crystal; specimen 1.75 in. long and 0.22 in. in dia; supplied by Linde Air Products Co.; density 3.6 g cm^{-3} ; Armco iron used as comparative material.
2	364	C	1954	473-1473		Spinel	$71.9 \text{ Al}_2\text{O}_3$, 29.0 MgO by chemical analysis; polycrystal; slip-cast from suspension with specific gravity 2.2, pH 3.0; prepared with 1 to 1 molar ratio of MgO to Al_2O_3 ; bulk density 3.27 g cm^{-3} ; porosity 7.65%; dense alumina used as comparative material.
3	71	C	1951	308, 341		Spinel	Cubic isotropic crystal; supplied by Linde Air Products Co. of Tonawanda; z-cut crystalline quartz used as comparative material.
4	152	L	1955	298.2		Spinel	Single crystal; specimen 20 mils thick and 0.75 in. in dia; preirradiated with 7×10^{18} epithermal neutrons per cm^2 for 480 Mwd in the MTR.
5	152	L	1955	298.2		Spinel	The above specimen postirradiated with 7×10^{19} epithermal neutrons per cm^2 for 480 megawatt days in the material testing reactor.
6	153	R	1951	563-1418			Specimen prepared from pure crystalline spinel formed by calcining a mixture of the oxides, reduced to 20-100 mesh, ground dry for 24 hrs in rubber lined ball mill with spinel balls, then acid-treated, filtered and prepared into a slip and fired at 1200 C, trimmed and fired again to 1840 C for 3 hrs; bulk density 3.27 g cm^{-3} .
7	153	R	1951	568-1423			2nd run of the above specimen.
8	300	L	1962	2.9-305		R-42; Natural Ruby Spinel	Single natural crystal; impurity (epi in atom cm^{-3}) given in \log_{10} epi: <18.1 Be, <17.7 Ca, 19.2 Cr, 18.9 Fe, 17.7 K, 18.2 Li, 18.1 Mn, 18.3 Na, <17.6 Ni, 18.2 Si, 18.6 Ti, 18.8 V, 20.1 Zn and 17.6 Zr; specimen 0.29 cm long and 0.18 cm avg. dia; lattice constant 8.0866 Å.
9	300	L	1962	3.2-300		R-54 Natural Ruby Spinel	Single natural crystal; impurity (epi in atom cm^{-3}) given in \log_{10} epi: <18.1 Be, <17.7 Ca, 19.3 Cr, 19.2 Fe, 18.3 K, 18.2 Li, 17.9 Mn, 18.3 Na, <17.6 Ni, 18.2 Si, 18.3 Ti, 19.4 V, 19.5 Zn and <17.4 Zr; specimen 0.45 cm long and 0.25 in. avg. dia; lattice constant 8.0866 Å.

DATA TABLE NO. 57 THERMAL CONDUCTIVITY OF MAGNESIUM ALUMINATE $MgO \cdot Al_2O_3$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
343.2	0.117	1183.2	0.0540
<u>CURVE 2</u>			
473.2	0.119	1268.2	0.0528
673.2	0.0941	1356.2	0.0494
873.2	0.0749	1423.2	0.0481
1073.2	0.0615	<u>CURVE 8</u>	
1273.2	0.0536	2.91	0.055
473.2	0.0502	4.11	0.110
<u>CURVE 3</u>			
308.2	0.138	5.39	0.165
341.2	0.109	7.94	0.271
<u>CURVE 4</u>			
298.2	0.0711	14.85	0.538
<u>CURVE 5</u>			
298.2	0.0377	21.50	0.758
<u>CURVE 6</u>			
563.2	0.109	32.04	1.08
683.2	0.0952	51.11	1.35
783.2	0.0858	68.56	1.30
875.2	0.0791	82.62	1.19
980.2	0.0720	105.8	0.927
1080.2	0.0624	147.51	0.572
1173.2	0.0590	199.76	0.375
1348.2	0.0544	305.35	0.233
1418.2	0.0528	<u>CURVE 9</u>	
<u>CURVE 7</u>			
568.2	0.105	3.18	0.053
688.2	0.0864	3.97	0.073
798.2	0.0799	6.25	0.143
883.2	0.0732	7.53	0.188
998.2	0.0653	9.92	0.254
1091.2	0.0589	14.91	0.379
		24.03	0.560
		31.15	0.705
		49.42	0.950
		63.41	1.00
		82.96	0.992
		94.40	0.921
		128.87	0.678
		170.46	0.475
		299.64	0.251



SPECIFICATION TABLE NO. 58 THERMAL CONDUCTIVITY OF MAGNESIUM ALUMINATE $MgO \cdot 3.5 Al_2O_3$

[For Data Reported in Figure and Table No. 58]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	300	L	1962	3.6-301		Synthetic Spinel R-53	Single synthetic crystal; made with the Verneuil process by Linde Air Products Co. N. Y.; impurity (epi in. atoms cm^{-3}) given in $\log_{10}(\text{epi}) = <18.1 \text{ Be}, 17.4 \text{ Ca}, <17.6 \text{ Cr}, 18.8 \text{ Fe}, <17.7 \text{ K}, 18.0 \text{ Li}, <17.6 \text{ Mn}, 18.0 \text{ Na}, <17.6 \text{ Ni}, 19.1 \text{ Si}, 18.5 \text{ Ti}, <17.6 \text{ V}, <17.8 \text{ Zn}, <17.4 \text{ Zr}$; specimen 1.12 cm long and 0.40 cm avg dia; lattice constant 7.979 \AA .

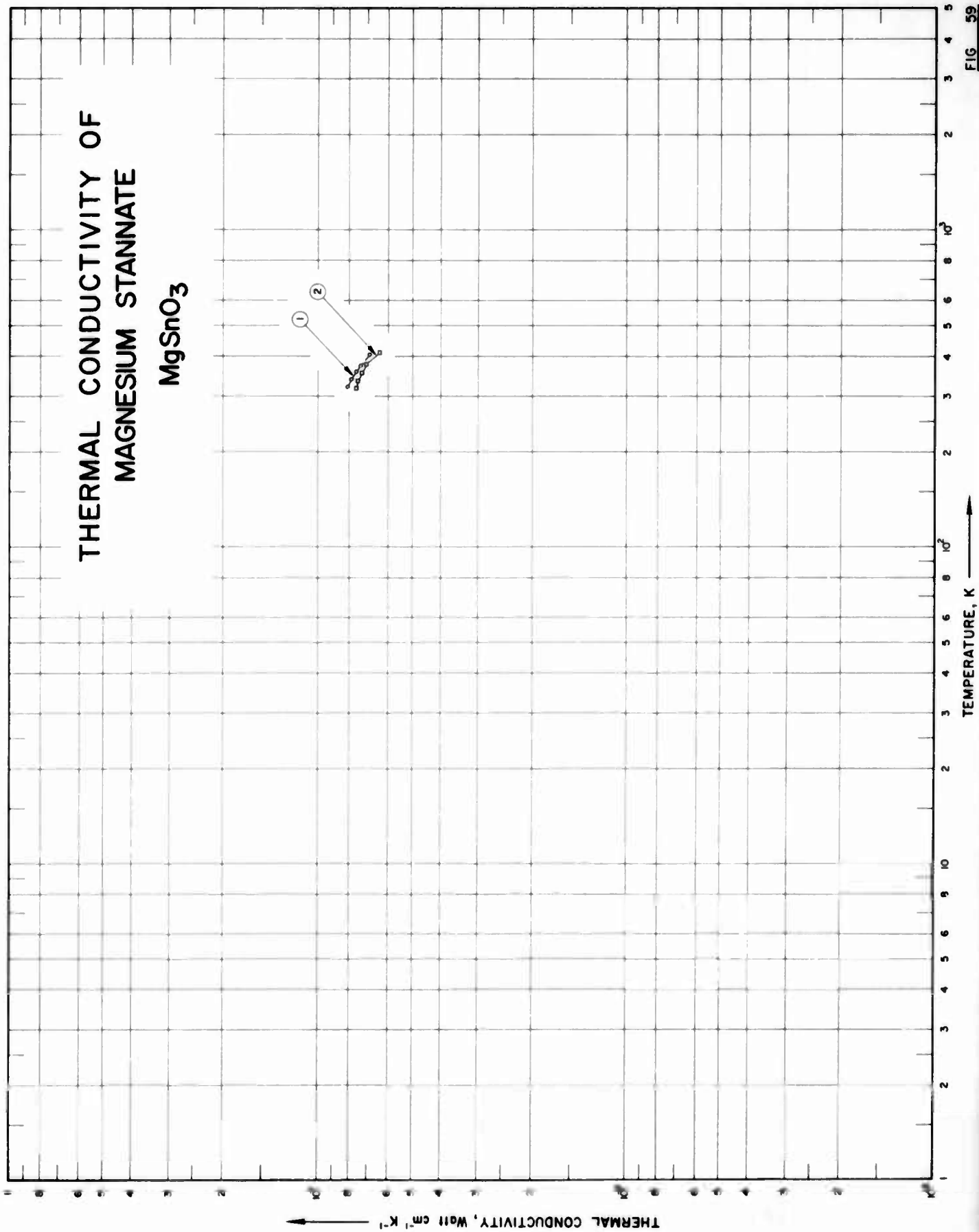
DATA TABLE NO. 58 THERMAL CONDUCTIVITY OF MAGNESIUM ALUMINATE MgO · 3.5 Al₂O₃

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
3.58	0.212
4.76	0.350
7.21	0.559
9.04	0.685
13.56	0.954
21.44	1.15
31.46	1.16
45.97	1.10
64.38	0.830
80.49	0.585
89.52	0.519
126.47	0.332
190.52	0.204
300.67	0.133

CURVE 1

THERMAL CONDUCTIVITY OF
MAGNESIUM STANNATE



TEMPERATURE, K

10^3

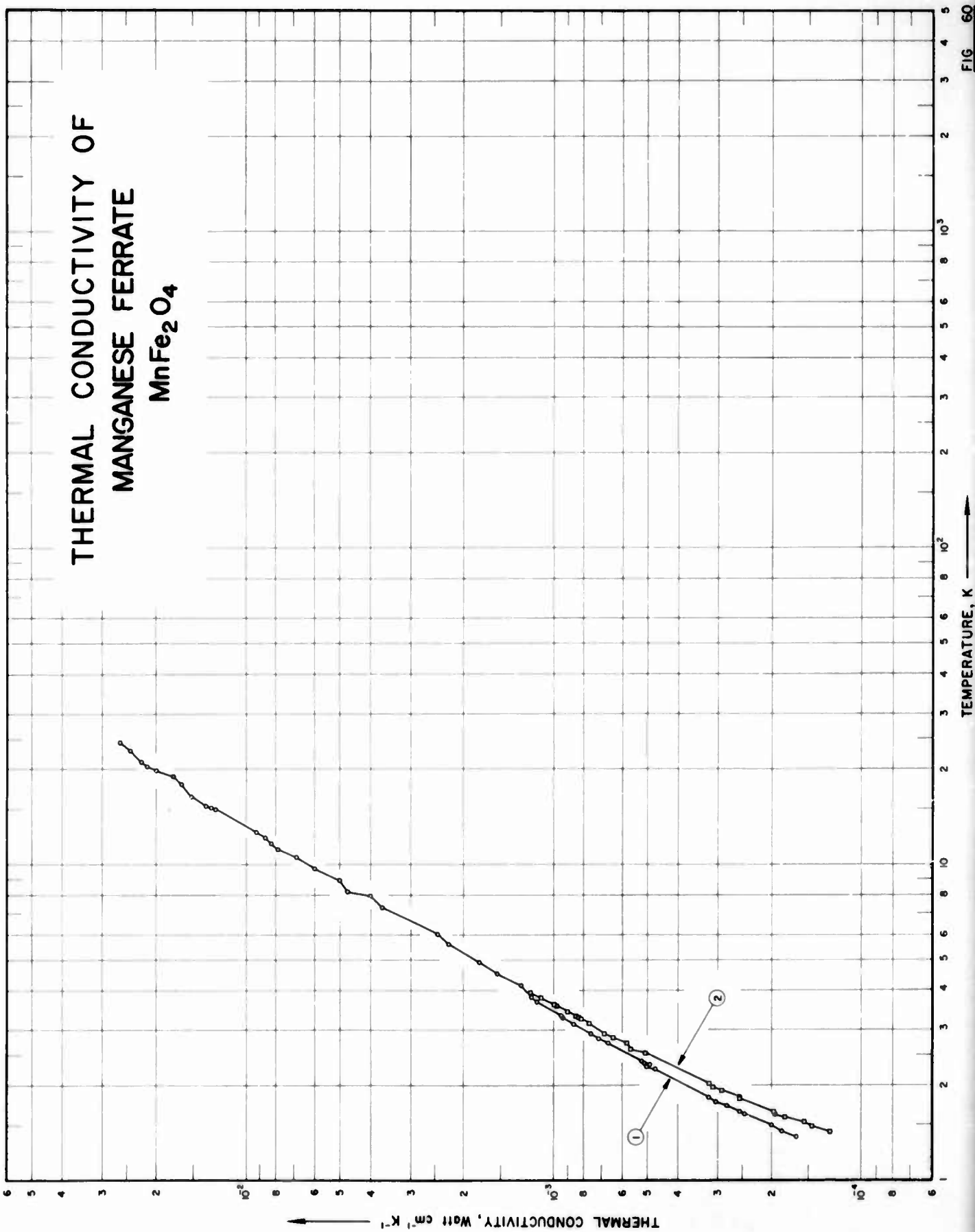
SPECIFICATION TABLE NO. 59 THERMAL CONDUCTIVITY OF MAGNESIUM STANNATE $MgSnO_3$

[For Data Reported in Figure and Table No. 59]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3		1953	322-406		168A-1	Density (25 C) 5.18 g cm ⁻³ ; water absorption 0.26%.
2	3		1953	317-413		168A-2	Separate run of the above specimen.

DATA TABLE NO. 59 THERMAL CONDUCTIVITY OF MAGNESIUM STANNATE MgSnO_3 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
321.7	0.0908
339.4	0.0787
357.3	0.0761
375.5	0.0736
405.5	0.0690
<u>CURVE 2</u>	
317.3	0.0761
335.6	0.0753
355.6	0.0732
377.1	0.0707
412.9	0.0644





SPECIFICATION TABLE NO. 60 THERMAL CONDUCTIVITY OF MANGANESE FERRATE

[For Data Reported in Figure and Table No. 60]

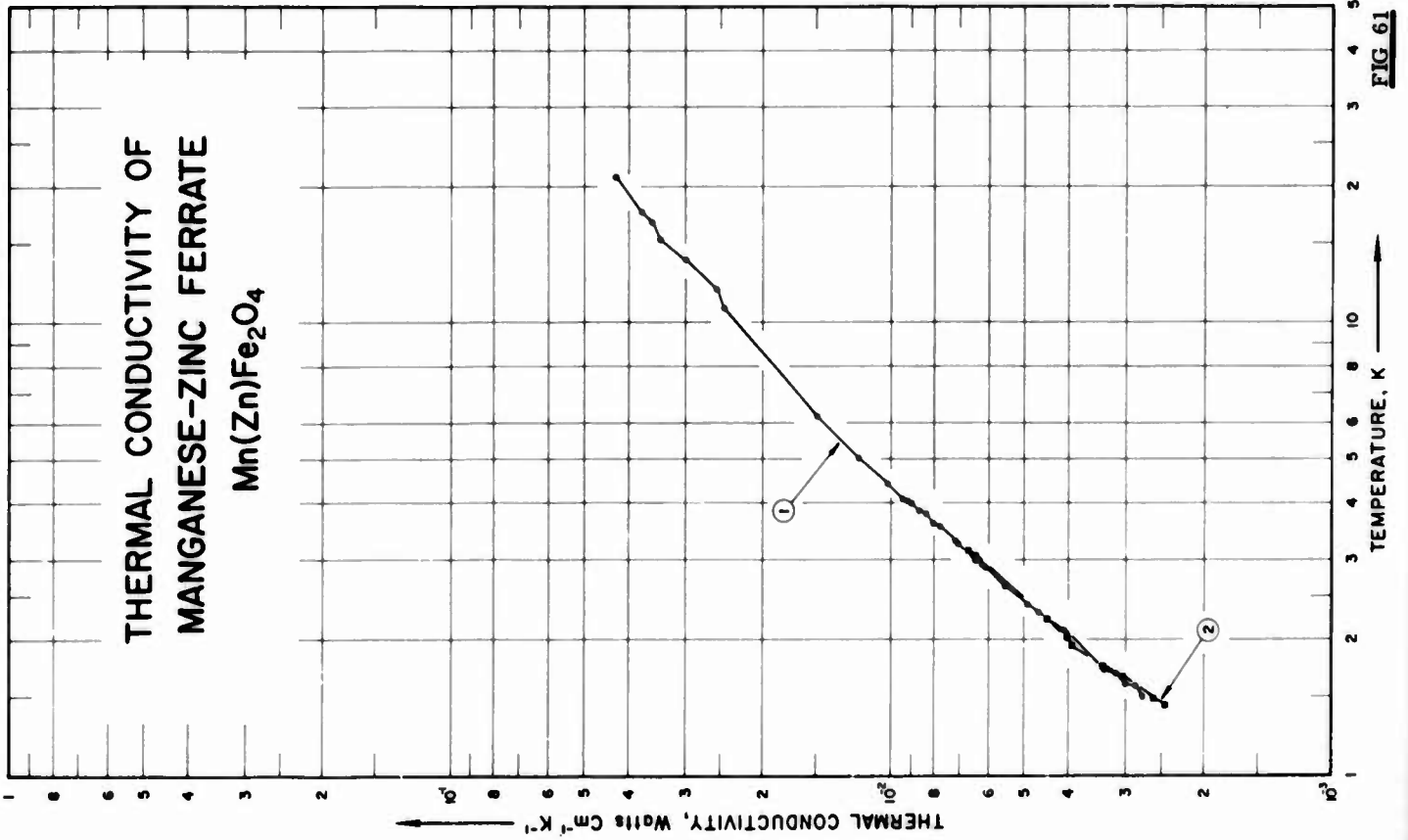
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent). Specifications and Remarks
1	466	L	1961	1.4-25			Major metallic compositions: 38.4 Fe and 33.7 Mn; specimen 4.92 cm in length and 0.434 cm ² in cross section; single crystal bar with orientation of the long axis [110]; average electrical resistivity 2×10^4 , $\sim 10^{12}$, and $> 10^5$ ohm cm at room temperature, 77 K, and 4.2 K; measured in vacuum.
2	466	L	1961	1.4-3.9			The above specimen measured in a magnetic field of 9400 gauss parallel to the direction of heat flow.

DATA TABLE NO. 60 THERMAL CONDUCTIVITY OF MANGANESE FERRATE $MnFe_2O_4$

[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

CURVE 1		CURVE 1 (cont.)	
T	k	T	k
1.38	0.000165	21.3	0.0225
1.43	0.000185	23.0	0.0245
1.50	0.000200	24.5	0.0265
1.62	0.000245		
1.65	0.000255		
1.72	0.000280		
1.77	0.000305		
1.83	0.000320		
2.25	0.000470		
2.29	0.000500		
2.32	0.000495		
2.35	0.000505		
2.37	0.000520		
2.72	0.000665		
2.80	0.000715		
2.90	0.000755		
3.13	0.000860		
3.27	0.000935		
3.32	0.000940		
3.68	0.00114		
3.80	0.00119		
4.15	0.00128		
4.50	0.00155		
4.90	0.00177		
5.60	0.00225		
6.00	0.00245		
7.30	0.00370		
7.95	0.00405		
8.20	0.00475		
8.95	0.00500		
9.70	0.00600		
10.6	0.00690		
11.3	0.00790		
11.7	0.00830		
12.3	0.00870		
12.7	0.00930		
15.0	0.0127		
15.2	0.0131		
15.4	0.0137		
16.5	0.0153		
18.0	0.0175		
19.0	0.0185		
19.8	0.0200		
20.5	0.0215		

CURVE 2	
1.43	0.000127
1.48	0.000145
1.53	0.000155
1.58	0.000180
1.61	0.000195
1.65	0.000197
1.82	0.000255
1.83	0.000255
1.93	0.000290
1.97	0.000310
2.02	0.000317
2.53	0.000505
2.68	0.000565
2.71	0.000580
2.83	0.000640
2.93	0.000683
3.15	0.000765
3.25	0.000815
3.27	0.000827
3.30	0.000845
3.42	0.000900
3.58	0.000972
3.60	0.000990
3.78	0.00110
3.93	0.00120



SPECIFICATION TABLE NO. 61 THERMAL CONDUCTIVITY OF MANGANESE-ZINC FERRATE $Mn(Zn)Fe_2O_4$

[For Data Reported in Figure and Table No. 61]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	466	L	1961	1.5-21			Major metallic composition: 49.2 Fe, 20.95 Mn, and 6.17 Zn; single crystal bar with long axis oriented [252]; specimen 4.29 cm long and 0.218 cm ² in cross-section; electrical resistivity 0.2, 172, $\approx 7 \times 10^8$ ohm cm at room temperature, 77 K and 4.2 K, respectively; room temperature saturation magnetization 86 c.g.s. units; supplied by Linde Air Products Corp.; measured in vacuum at zero gauss.
2	466	L	1961	1.4-4.4			The above specimen measured in a magnetic field of 9400 gauss parallel to the direction of heat flow.

DATA TABLE NO. 61 THERMAL CONDUCTIVITY OF MANGANESE-ZINC FERRATE $Mn(Zn)Fe_2O_4$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
1.50	0.00275	2.56	0.00535*
1.57	0.00285	2.65	0.00550
1.60	0.00300	2.79	0.00585*
1.65	0.00315	2.89	0.00600*
1.72	0.00333	3.05	0.00645
2.08	0.00410	3.13	0.00670
2.30	0.00463	3.33	0.00723*
2.39	0.00490	3.43	0.00750*
2.62	0.00550	3.82	0.00850*
2.88	0.00610	4.43	0.0101*
2.92	0.00620		
2.99	0.00645		
3.25	0.00705		
3.27	0.00715		
3.55	0.00775		
3.61	0.00800		
3.77	0.00835		
3.85	0.00865		
3.94	0.00895		
4.02	0.00920		
4.09	0.00940		
4.40	0.0102		
5.00	0.0120		
6.20	0.0150		
10.7	0.0245		
11.8	0.0265		
13.7	0.0300		
15.3	0.0340		
16.7	0.0355		
17.5	0.0375		
21.0	0.0430		
<u>CURVE 2</u>			
1.44	0.00245		
1.48	0.00260		
1.65	0.00305		
1.75	0.00335		
1.94	0.00390		
2.03	0.00400		
2.06	0.00410*		
2.22	0.00445		
2.33	0.00475*		
2.52	0.00515*		

* Not shown on plot

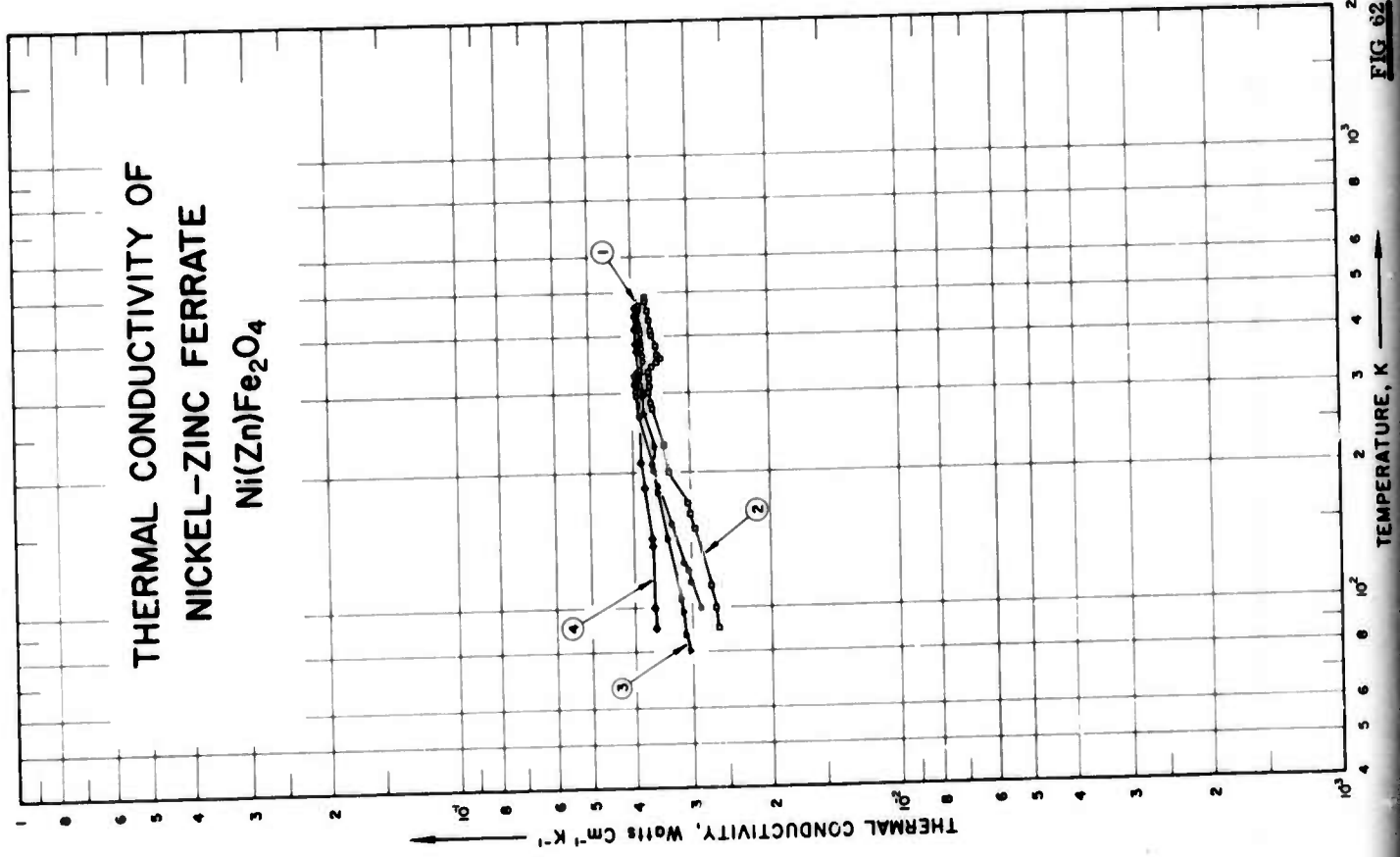


FIG 62

SPECIFICATION TABLE NO. 62 THERMAL CONDUCTIVITY OF NICKEL-ZINC FERRATE $\text{Ni}(\text{Zn})\text{Fe}_2\text{O}_4$

[For Data Reported in Figure and Table No. 62]

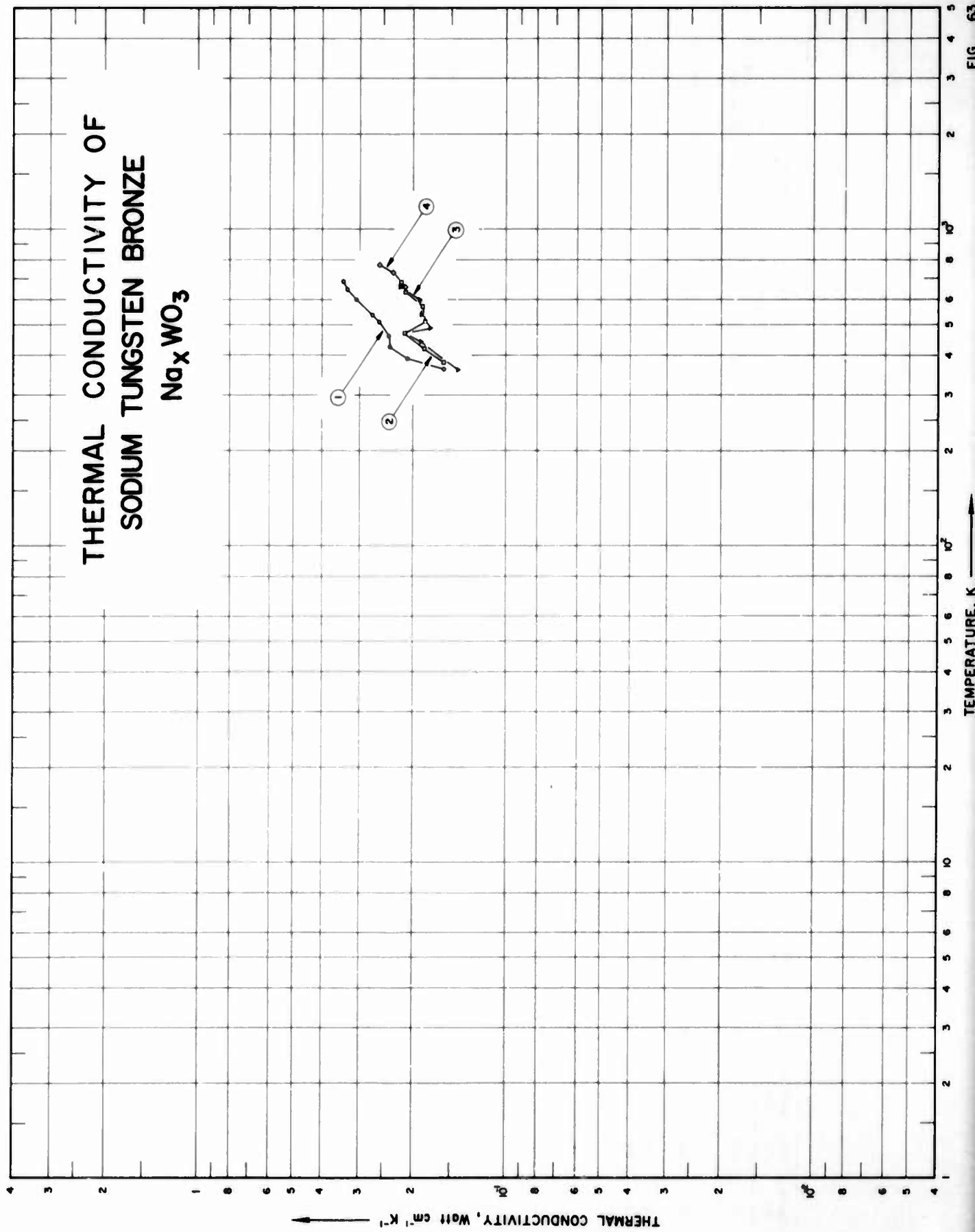
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	246	L	1963	100-468	1-3	$\text{Ni}_{0.3}\text{Zn}_{0.1}\text{Fe}_2\text{O}_4$ No. 3		Initial composition: 66.80 Fe_2O_3 , 9.37 NiO and 23.83 ZnO; large grained; specimen $29 \times 10 \times (2-5)$ mm; heated at 300-400 C for 3 hrs at a rate of heating and cooling of 50 C per hr; density 5.1 g cm^{-3} ; measured in vacuum of 10^{-4} to 10^{-5} mm Hg.
2	246	L	1963	90-487	1-3	$\text{Ni}_{0.3}\text{Zn}_{0.1}\text{Fe}_2\text{O}_4$ No. 4		Initial composition: 66.80 Fe_2O_3 , 9.37 NiO and 23.83 ZnO; similar to the above specimen except small grained; density 4.3 g cm^{-3} .
3	246	L	1963	80-487	1-3	$\text{Ni}_{0.2}\text{Zn}_{0.15}\text{Fe}_2\text{O}_4$ No. 6		Initial composition: 66.52 Fe_2O_3 , 4.67 NiO and 28.81 ZnO; similar to the above specimen.
4	246	L	1963	90-463	1-3	$\text{Ni}_{0.1}\text{Zn}_{0.1}\text{Fe}_2\text{O}_4$ No. 5		Initial composition: 66.42 Fe_2O_3 , 3.11 NiO and 30.47 ZnO; similar to the above specimen.

DATA TABLE NO. 62 THERMAL CONDUCTIVITY OF NICKEL - ZINC FERRATE Ni(Zn) Fe₂O₄[Temperature, T, K; Thermal Conductivity, k, Watts cm⁻¹K⁻¹]

T	k	T	k	T	k
<u>CURVE 1</u>					
100	0.0287	332	0.0368	210	0.0385
114	0.0301	342	0.0363	260	0.0385*
121	0.0305	350	0.0351	270	0.0385*
126	0.0312	355	0.0347	290	0.0385*
153	0.0331	362	0.0351	294	0.0385*
201	0.0360	380	0.0354	297	0.0385*
209	0.0364	400	0.0360	300	0.0387*
266	0.0387	412	0.0362	310	0.0387*
296	0.0391	432	0.0366	320	0.0387
302	0.0393	451	0.0368	350	0.0389*
313	0.0395	477	0.0374	370	0.0389
328	0.0395	487	0.0374	385	0.0389
332	0.0389	<u>CURVE 3</u>			
338	0.0383	80	0.0303	415	0.0391
351	0.0379	87	0.0310	442	0.0391
364	0.0379	98	0.0314	463	0.0391
376	0.0379	105	0.0316		
385	0.0380	142	0.0337		
392	0.0381	180	0.0351		
402	0.0381	210	0.0362*		
408	0.0382*	227	0.0356		
416	0.0383	270	0.0377		
424	0.0385	295	0.0379		
458	0.0385	300	0.0379		
468	0.0385	305	0.0379*		
<u>CURVE 2</u>					
90	0.0264	330	0.0381		
100	0.0266	340	0.0381*		
112	0.0272	372	0.0381*		
150	0.0295	382	0.0383*		
161	0.0300	427	0.0383		
171	0.0304	470	0.0383*		
172	0.0308*	487	0.0387*		
200	0.0324	<u>CURVE 4</u>			
230	0.0341	90	0.0360		
276	0.0360	100	0.0362		
285	0.0364	137	0.0364		
300	0.0366	142	0.0364		
310	0.0366	185	0.0377		
322	0.0366				

* Not shown on plot

THERMAL CONDUCTIVITY OF
SODIUM TUNGSTEN BRONZE
 Na_xWO_3



SPECIFICATION TABLE NO. 63 THERMAL CONDUCTIVITY OF SODIUM TUNGSTEN BRONZE Na_xWO_3

[For Data Reported in Figure and Table No. 63]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	469	C	1966	362-685		$\text{Na}_{0.515}\text{WO}_3$	75.5 W, 19.7 O, 4.8 Na; single crystal; 12 mm dia x 7.2 mm thick; prepared by electrolytic reduction of a melt of Na_2WO_4 and WO_3 ; heat flow in the <100> direction; Battelle Armco iron used as comparative material.
2	469	C	1966	381-680		$\text{Na}_{0.804}\text{WO}_3$	73.4 W, 19.2 O, 7.4 Na; single crystal; same dimension, fabrication method, and measuring condition as the above specimen.
3	469	C	1966	361-659		$\text{Na}_{0.804}\text{WO}_3$	2nd run of the above specimen.
4	469	C	1966	656-771		$\text{Na}_{0.804}\text{WO}_3$	3rd run of the above specimen.

DATA TABLE NO. 63 THERMAL CONDUCTIVITY OF SODIUM TUNGSTEN BRONZE Na_xWO_3 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
362	0.157
391	0.208
426	0.238
464	0.240
511	0.258
537	0.273
602	0.308
646	0.330
685	0.340
<u>CURVE 2</u>	
381	0.158
420	0.184
473	0.212
512	0.183
570	0.186
634	0.211
680	0.218
<u>CURVE 3</u>	
361	0.143
443	0.188
472	0.212*
486	0.175
537	0.187
596	0.190
659	0.219
<u>CURVE 4</u>	
656	0.212
683	0.219*
730	0.233
771	0.257

* Not shown on plot

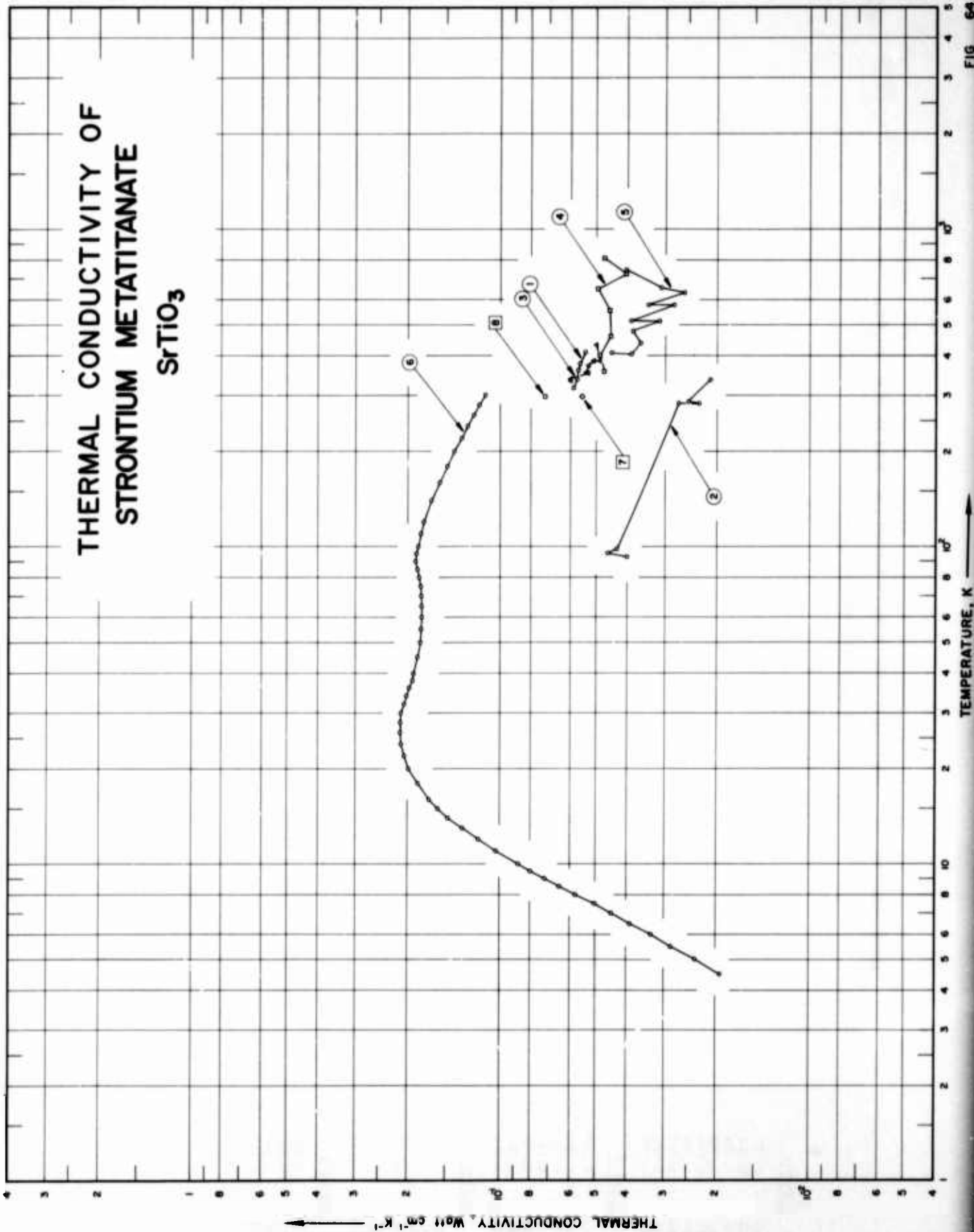


FIG. 64

SPECIFICATION TABLE NO. 64 THERMAL CONDUCTIVITY OF STRONTIUM METATITANATE SrTiO_3

[For Data Reported in Figure and Table No. 64]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	68	C	1954	316-410	±3.0	33 B2	Measured in vacuum; copper used as comparative material.
2	38	L	1960	93-337		No. 2	Powdered raw materials of special grade SrO and special grade TiO_2 were mixed together with water, pressed into a disc and fired in a Silicomit furnace; the product was crushed, well pulverized and meshed, then pressed (pressure 0.53 ton cm^{-2}) into a disc; specimen 2.18 cm in dia and 2.47 cm long; sintered at 1400 C for 8 hrs; density 4.01 g cm^{-3} ; porosity 19.5%; measured in vacuum less than 10^{-4} mm Hg . Specimen sintered from SrO and TiO_2 powder of special reagent grade; pure iron used as comparative material.
3	203	C	1956	333-433			
4	283		1959	358-608			Pure; 1st run.
5	283		1959	403-743			2nd run of the above specimen.
6	465	L	1965	4.5-300			Single crystal; specimen $1 \times 1 \times 7 \text{ mm}$; supplied by Fujii Titanium Industry Co.; heat flowed in the direction of $<100>$; thermal conductivity data obtained directly from the author.
7	470	L	1959	298.2			88.8% theoretical density.
8	470	L	1959	298.2			94% theoretical density.

DATA TABLE NO. 64 THERMAL CONDUCTIVITY OF STRONTIUM METATITANATE SrTiO₃[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k
<u>CURVE 1</u>					
316.4	0.0586	513.2	0.0314	70	0.181
337.4	0.0573	578.2	0.0280	75	0.182
359.7	0.0569	633.2	0.0259	80	0.184
377.6	0.0561	653.2	0.0310	85	0.186
410.3	0.0540	743.2	0.0406	90	0.188
<u>CURVE 2</u>					
93.2	0.040	<u>CURVE 6</u>			
95.2	0.046	4.5	0.0194	100	0.185
98.2	0.043	5.0	0.0236	110	0.181
283.2	0.027	5.5	0.0284	120	0.177
283.2	0.023	6.0	0.0333	140	0.168
286.2	0.025	6.5	0.0390	160	0.158
337.2	0.021	7.0	0.0447	180	0.149
<u>CURVE 3</u>					
333.2	0.060	7.5	0.0504	200	0.141
338.2	0.060	8.0	0.0576	220	0.134
353.2	0.053	8.5	0.0648	240	0.128
354.2	0.054	9.0	0.0721	260	0.122
373.2	0.053	9.5	0.0798	280	0.117
385.2	0.051	10	0.0875	300	0.112
385.2	0.049	11	0.103	<u>CURVE 7</u>	
433.2	0.050	12	0.118	298.2	0.0552
<u>CURVE 4</u>					
358.2	0.0473	13	0.132	<u>CURVE 8</u>	
398.2	0.0490	14	0.147	298.2	0.0724
458.2	0.0452	15	0.159		
553.2	0.0456	16	0.170		
648.2	0.0494	18	0.185		
723.2	0.0406	20	0.198		
808.2	0.0473	22	0.205		
<u>CURVE 5</u>					
403.2	0.0389	24	0.210		
408.2	0.0448	26	0.211		
438.2	0.0364	28	0.211		
478.2	0.0385	30	0.210		
513.2	0.0389	32	0.205		
		34	0.201		
		36	0.197		
		38	0.193		
		40	0.192		
		45	0.186		
		50	0.182		
		55	0.181		
		60	0.180		
		65	0.180		

SPECIFICATION TABLE NO. 65 THERMAL CONDUCTIVITY OF STRONTIUM ZIRCONATE SrZrO_3

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	470	L	1959	298.2			98% theoretical density.

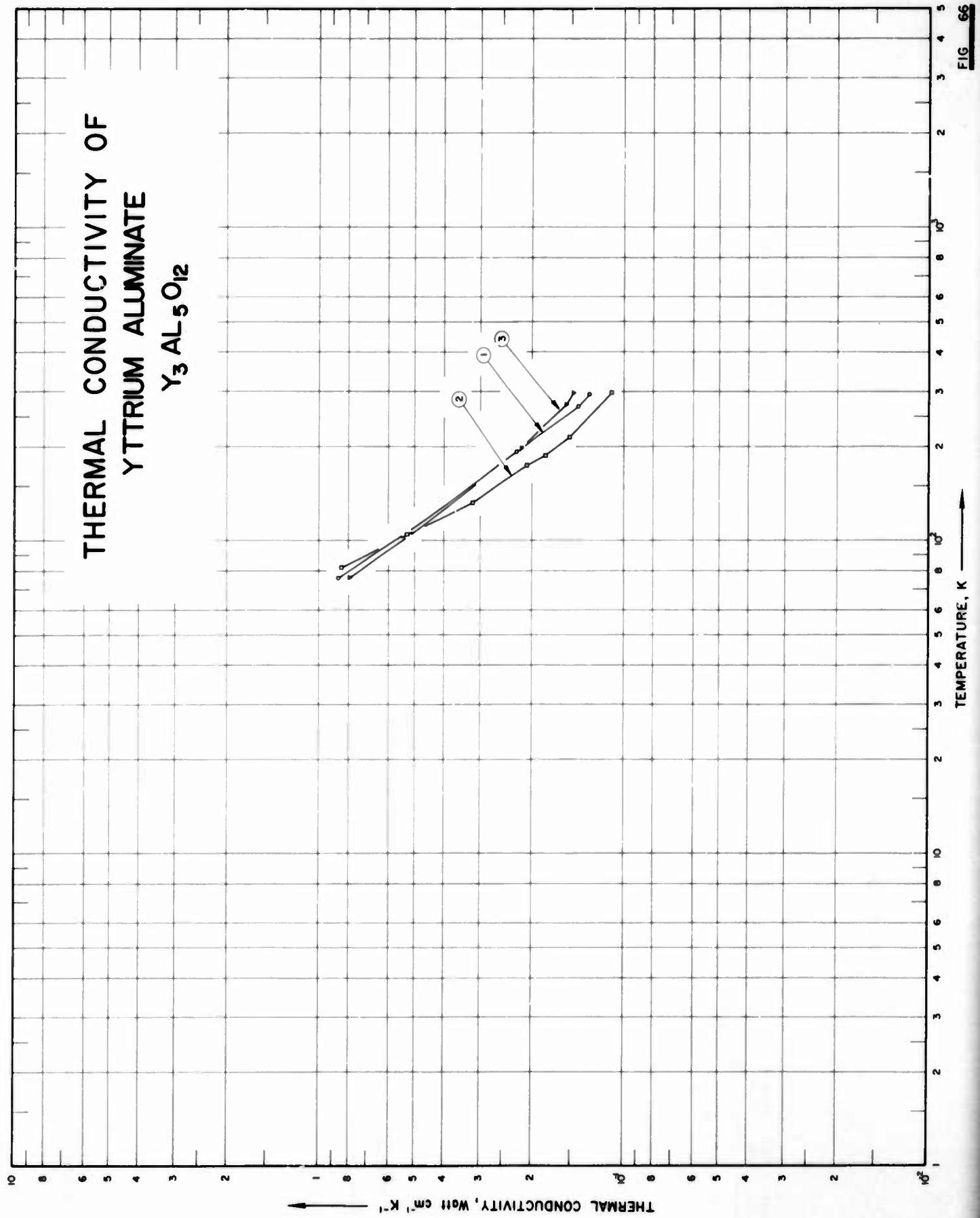
DATA TABLE NO. 65 THERMAL CONDUCTIVITY OF STRONTIUM ZIRCONATE SrZrO_3

[Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

T k
CURVE 1*
 298.2 0.0226

* No graphical presentation

THERMAL CONDUCTIVITY OF
YTTRIUM ALUMINATE
 $Y_3Al_5O_{12}$



SPECIFICATION TABLE NO. 66 THERMAL CONDUCTIVITY OF YTTRIUM ALUMENATE $Y_3Al_5O_{12}$

[For Data Reported in Figure and Table No. 66]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	461	L	1967	76-294		YAG	Single crystal; prepared from 99.999 ⁺ pure materials by using the Czochralski method; density reported as 4.564, 4.563, 4.563, 4.560, 4.561, 4.558, 4.554, and 4.552 g cm ⁻³ at 100, 117, 136, 170, 190, 215, 270, and 297 K, respectively.
2	461	L	1967	82-298		YAG	Single crystal; prepared from 99.999 ⁺ pure materials by using the Czochralski method; Nd ³⁺ concentration 4.2 x 10 ¹⁹ cm ⁻³ .
3	461	L	1967	76-297		YAG	Single crystal; prepared from 99.999 ⁺ pure materials by using the Czochralski method; Nd ³⁺ concentration 1.4 x 10 ²⁰ cm ⁻³ ; density reported as 4.556, 4.567, 4.556, 4.563, 4.561, and 4.554 g cm ⁻³ at 104, 110, 146, 181, 226, and 294 K, respectively.

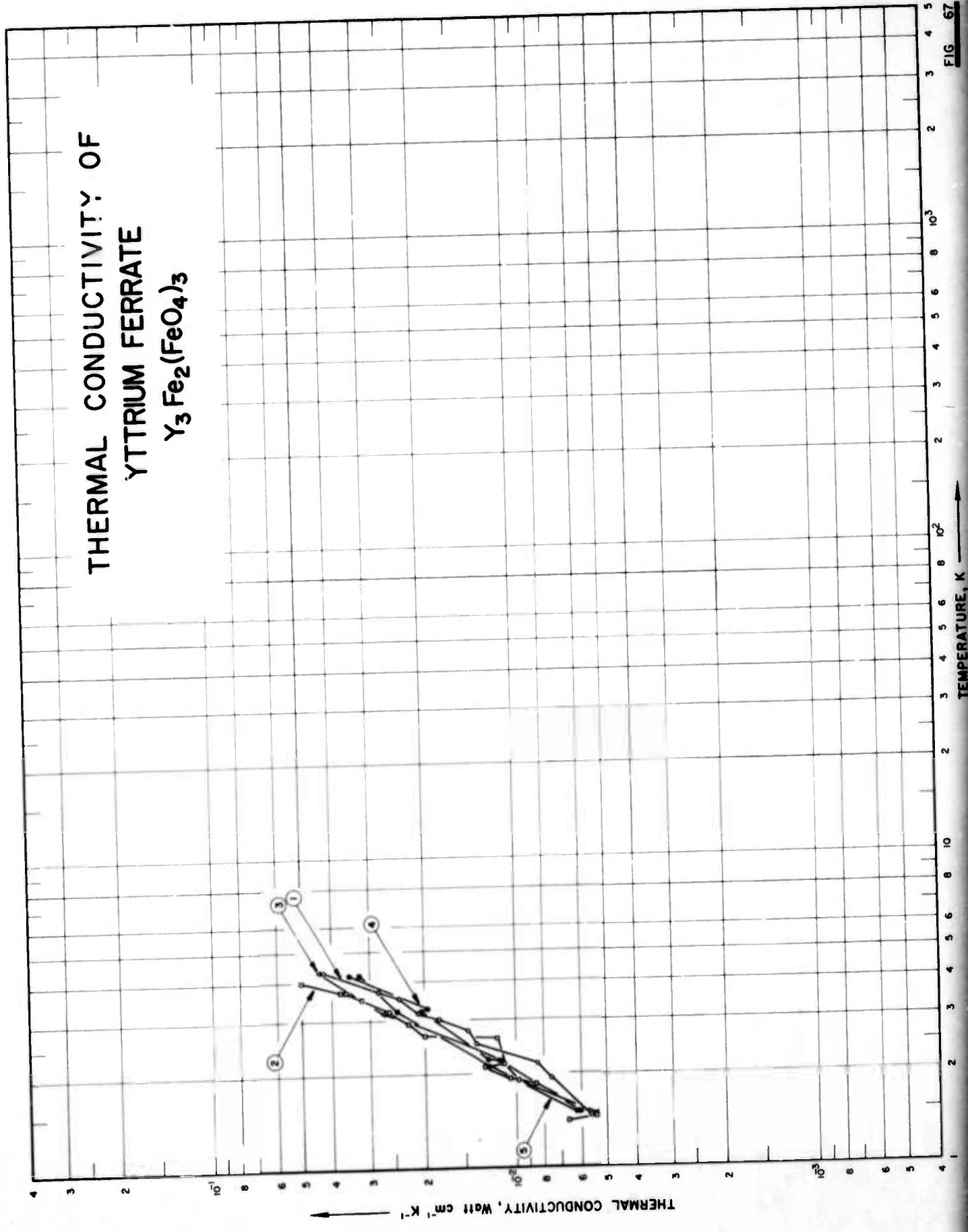


DATA TABLE NO. 66 THERMAL CONDUCTIVITY OF YTTRIUM ALUMINATE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
76	0.862
193	0.225
269	0.142
294	0.131
<u>CURVE 2</u>	
82	0.840
105	0.529
133	0.319
174	0.208
187	0.181
215	0.152
298	0.110
<u>CURVE 3</u>	
76	0.794
197	0.216
273	0.156
297	0.148

THERMAL CONDUCTIVITY OF
YTTRIUM FERRATE
 $Y_3Fe_2(FeO_4)_3$



SPECIFICATION TABLE NO. 67 THERMAL CONDUCTIVITY OF YTTRIUM FERRATE $Y_3Fe_2(FeO_4)_3$

[For Data Reported in Figure and Table No. 67]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	517	L	1962	1.5-4.3		YIG I	Single crystal; orientation of axis (321); length between the thermometers 0.81 cm; cross-sectional area 2.31 mm ² ; measured in a vacuum of 10 ⁻⁷ mm Hg.
2	517	L	1962	1.4-4.2		YIG II	Single crystal; orientation of axis (210); length between the thermometers 0.71 cm; cross-sectional area 1.26 mm ² ; measured in a vacuum of 10 ⁻⁷ mm Hg.
3	517	L	1962	1.5-4.3		YIG II	The above specimen with a longitudinal field of 300 G; measured in a vacuum of 10 ⁻⁷ mm Hg.
4	517	L	1962	1.5-4.2		YIG III	Single crystal; orientation of axis (130); length between the thermometers 0.87 cm; cross-sectional area 0.63 mm ² ; measured in a vacuum of 10 ⁻⁷ mm Hg.
5	517	L	1962	1.5-4.2		YIG III	The above specimen with a longitudinal field of 300 G; measured in a vacuum of 10 ⁻⁷ mm Hg.

DATA TABLE NO. 67 THERMAL CONDUCTIVITY OF YTTRIUM FERRATE $Y_3Fe_2(FeO_4)_3$

[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k	T	k
1.45	0.0056	1.5	0.0062
1.93	0.0075	2.1	0.0125
2.15	0.0084	3.2	0.0245
2.5	0.0137	4.2	0.0325
2.75	0.0146		
3.0	0.018		
3.15	0.021		
3.5	0.024		
3.7	0.028		
4.3	0.0425		

CURVE 2

1.4	0.0066
1.45	0.0054
1.85	0.0085
1.90	0.0098
1.93	0.0105
2.1	0.0128
2.15	0.011
2.6	0.016
2.65	0.020
2.9	0.0225
3.2	0.026
3.5	0.032
3.7	0.036
3.7	0.0375
4.2	0.05

CURVE 3

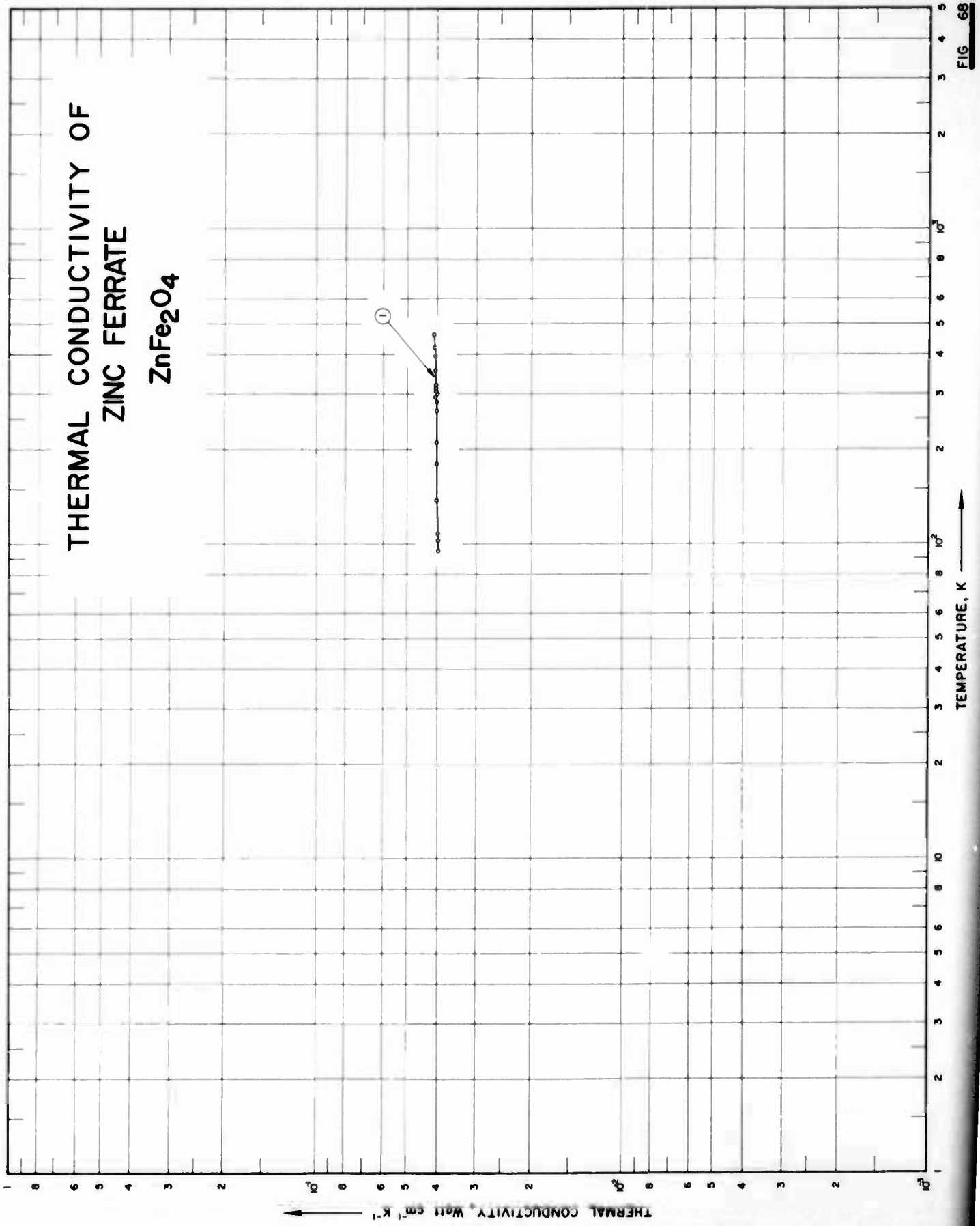
1.46	0.0054
1.9	0.0098*
2.2	0.0113
3.15	0.027
4.3	0.044

CURVE 4

1.5	0.006
2.2	0.0115
2.23	0.0125
3.2	0.0205
3.25	0.0195
4.2	0.035

* Not shown on plot

THERMAL CONDUCTIVITY OF
ZINC FERRATE
 $ZnFe_2O_4$



SPECIFICATION TABLE NO. 68 THERMAL CONDUCTIVITY OF ZINC FERRATE $ZnFe_2O_4$

[For Data Reported in Figure and Table No. 68]

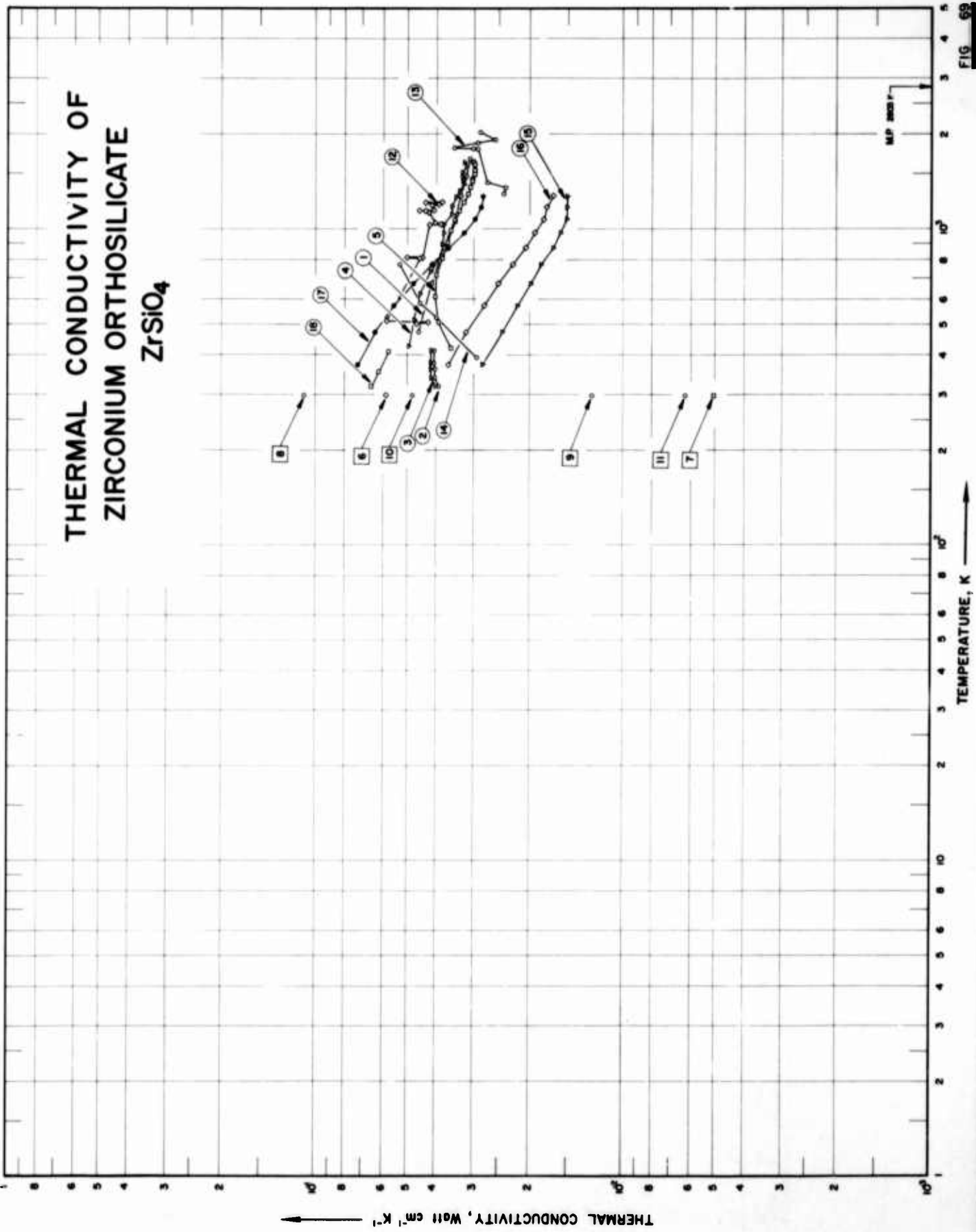
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	246	L	1963	95-463	1-3	No. 3	Mixture of ground 66.24 analytically pure Fe_2O_3 (CHDA) and 33.76 ZnO ; prepared by mixing for 3 days by wet method with raw alcohol as binder and then by special ball mills; powder produced by rubbing the dried charge processed as described, sifted, fired at 700 C, again sifted, and finally pressed at 1500-300 Kg cm^{-2} after polyvinyl alcohol (6-8% weight of the charge) was added; heated at 300-400 C for 3 hrs to remove alcohol and then finally fired at 1300 C for 3 hrs in a furnace with heating and cooling rates at 50 C per hr; specimen 20 x 10 x 2 - 5 mm; measured in a vacuum of 10^{-4} to 10^{-3} mm Hg.

DATA TABLE NO. 68 THERMAL CONDUCTIVITY OF ZINC FERRATE $ZnFe_2O_4$

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
95	0.0397
102	0.0397
107	0.0397
137	0.0402
180	0.0402
210	0.0402
265	0.0402
282	0.0402
293	0.0406
300	0.0400
305	0.0404
312	0.0404
320	0.0404
355	0.0406
395	0.0406
420	0.0408
463	0.0410

THERMAL CONDUCTIVITY OF
ZIRCONIUM ORTHOSILICATE
ZrSiO₄



SPECIFICATION TABLE NO. 69 THERMAL CONDUCTIVITY OF ZIRCONIUM ORTHOSILICATE $ZrSiO_4$

[For Data Reported in Figure and Table No. 69]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	364	C	1954	473-1673		Zircon		Polycrystalline; supplied by National Lead Co.; prepared from superpax with a mean particle size of 5 microns; as received; acid-treated with 1 N HCl, slip-cast from slip with pH 3.0 and specific gravity 2.4; fired at 1550 C; bulk density 3.69-3.79 g cm ⁻³ ; porosity 4.5-7.3%.
2	3	L	1953	319-412		254A-1		Single crystal with some impurity; from Zredell County, North Carolina; ground and polished; c (principle) axis parallel to the direction of heat flow.
3	3	L	1953	319-414		254B-1		Similar to the above specimen except c-axis perpendicular to the direction of heat flow.
4	10	R	1952	426-1623		Zircon		Bulk density 3.69 g cm ⁻³ ; porosity 19.1%.
5	10	R	1952	421-1648		Zircon		Similar to the above specimen.
6	152	L	1955	298.2		Zircon		Specimen 20 mils thick and 0.75 in. in dia; sintered; preirradiated with 3 x 10 ¹⁹ epi-thermal neutrons per cm ² for 480 Mwd in the MTR.
7	152	L	1955	298.2		Zircon		The above specimen postirradiated with 3 x 10 ¹⁹ epithermal neutrons per cm ² for 480 Mwd in the MTR.
8	152	L	1955	298.2		Zircon Tam		Specimen 20 mils thick and 0.75 in. in dia; preirradiated with 3 x 10 ¹⁹ epithermal neutrons per cm ² for 480 Mwd in the MTR.
9	152	L	1955	298.2		Zircon Tam		The above specimen postirradiated with 3 x 10 ¹⁹ epithermal neutrons per cm ² for 480 Mwd in the MTR.
10	152	L	1955	298.2		Zircon 475		Specimen 20 mils thick and 0.75 in. in dia; preirradiated with 5 x 10 ¹⁹ epithermal neutrons per cm ² for 480 Mwd in the MTR.
11	152	L	1955	298.2		Zircon 475		The above specimen postirradiated with 5 x 10 ¹⁹ epithermal neutrons per cm ² for 480 Mwd in the MTR.
12	243	R	1962	503-1219	2-4	Taylor Zircon CZ-5		65-66 ZrO ₂ , 33-34 SiO ₂ , 1.0 max Al ₂ O ₃ , 0.3 max TiO ₂ , 0.1 max Fe ₂ O ₃ , and 0.2 max others; specimen 0.75 in. long, 0.75 in. O. D. and 0.25 in. I. D.; slip-cast and sintered; max exposure temp 2317 K; density 4.04 g cm ⁻³ ; SRI run number C51.
13	243	R	1962	1300-2117	2-4	Taylor Zircon CZ-5		Similar to the above specimen but partially melted; SRI run number C58.
14	34	C	1943	391-772		Brazil Zircon		Green single crystal; specimen 1 x 1 x 1 cm; measured normal to c (principal) axis; 18-8 stainless steel used as comparative material.
15	375	C	1960	373-1273		Zircon-149D		Specimen supplied by Titanium Alloy Division, National; Wesgo alumina Al-300 obtained from Western Gold and Platinum Co. as reference standard.
16	375	C	1960	373-1273		Zircon-ZRI-46		Specimen and Wesgo alumina Al-300 reference standard obtained from the above sources.
17	375	C	1960	373-1273		Zircon ZRG-4		Specimen and Wesgo alumina Al-300 reference standard obtained from the above sources.
18	407	L	1949	317-411		B-1		No details reported.

DATA TABLE NO. 69 THERMAL CONDUCTIVITY OF ZIRCONIUM ORTHOSILICATE ZrSiO₄

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 5</u>		<u>CURVE 12</u>		<u>CURVE 15</u>			
473.2	0.0460	420.7	0.0356	502.6	0.0469	373.2	0.0280		
673.2	0.0418	508.2	0.0393	507.6	0.0428	473.2	0.0243		
873.2	0.0377	610.7	0.0402	512.6	0.0588	573.2	0.0218		
1073.2	0.0347	713.2	0.0400	805.9	0.0453	673.2	0.0197		
1273.2	0.0331	808.2	0.0383	812.1	0.0500	773.2	0.0184		
1473.2	0.0318	909.2	0.0366	812.6	0.0447	873.2	0.0167		
1673.2	0.0310	988.2	0.0358	1034.3	0.0424	973.2	0.0159		
<u>CURVE 2</u>		1063.2	0.0347	1040.9	0.0384	1073.2	0.0151		
318.8	0.0392	1148.2	0.0335	1044.8	0.0404	1173.2	0.0151		
339.8	0.0405	1213.2	0.0324	1123.2	0.0427	1273.2	0.0151		
362.2	0.0403	1293.2	0.0314	1132.1	0.0433	<u>CURVE 16</u>			
377.7	0.0408	1353.2	0.0308	1138.2	0.0433*	373.2	0.0364		
411.6	0.0407	1410.7	0.0303	1146.5	0.0456	473.2	0.0318		
<u>CURVE 3</u>		1433.2	0.0303	1148.2	0.0408	573.2	0.0276		
318.7	0.0401	1493.2	0.0299	1199.8	0.0414	673.2	0.0251		
338.3	0.0416	1533.2	0.0299	1209.3	0.0436	773.2	0.0226		
361.2	0.0418	1600.2	0.0299	1218.7	0.0381	873.2	0.0205		
378.6	0.0418	1648.2	0.0301	<u>CURVE 13</u>		973.2	0.0192		
414.2	0.0418	<u>CURVE 6</u>		1299.8	0.0241	1073.2	0.0180		
<u>CURVE 4</u>		298.2	0.0586	1360.3	0.0239	1173.2	0.0176		
425.7	0.0494	<u>CURVE 7</u>		1377.6	0.0238*	1273.2	0.0167		
518.2	0.0475	298.2	0.00502	1402.6	0.0273	<u>CURVE 17</u>			
623.2	0.0452	1794.3	0.0291	1797.1	0.0301	373.2	0.0724		
733.2	0.0418	<u>CURVE 8</u>		1799.8	0.0313*	473.2	0.0636		
823.2	0.0385	298.2	0.109	1799.8	0.0317*	573.2	0.0552		
893.2	0.0381	<u>CURVE 9</u>		1805.4	0.0303*	673.2	0.0477		
970.7	0.0377	298.2	0.0126	1805.4	0.0348	773.2	0.0414		
1038.2	0.0377	<u>CURVE 10</u>		1872.1	0.0293	873.2	0.0364		
1121.2	0.0354	298.2	0.0481	1894.3	0.0291*	973.2	0.0322		
1188.2	0.0354	<u>CURVE 11</u>		1916.5	0.0257	1073.2	0.0297		
1263.2	0.0343	298.2	0.00628	2116.5	0.0287	1173.2	0.0285		
1323.2	0.0333	<u>CURVE 12</u>		<u>CURVE 14</u>		1273.2	0.0280		
1378.2	0.0324	391.2	0.0294	391.2	0.0294	<u>CURVE 18</u>			
1411.2	0.0325	525.2	0.0397	525.2	0.0397	317.0	0.0657		
1463.2	0.0326	582.2	0.0452	582.2	0.0452	354.0	0.0623		
1503.2	0.0326	772.2	0.0531	772.2	0.0531	410.7	0.0577		
1578.2	0.0316	<u>CURVE 13</u>		<u>CURVE 15</u>					
1623.2	0.0322	298.2	0.00628	298.2	0.00628				

* Not shown on plot

THERMAL CONDUCTIVITY OF
 ALUMINUM OXIDE + ALUMINUM SILICATE
 $Al_2O_3 + 3Al_2O_3 \cdot 2SiO_2$

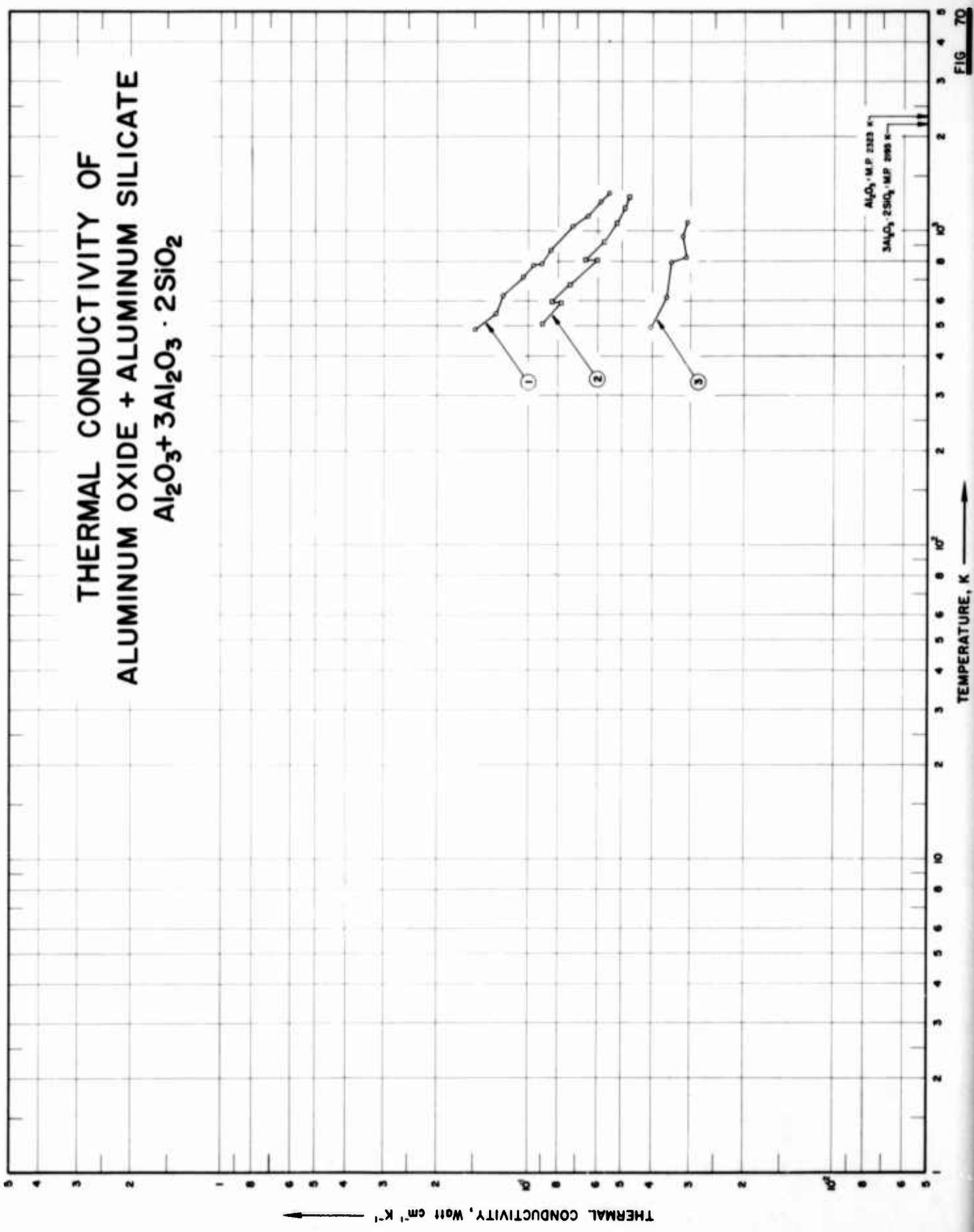


FIG 70

SPECIFICATION TABLE NO. 70 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + ALUMINUM SILICATE] $\text{Al}_2\text{O}_3 + 3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$

[For Data Reported in Figure and Table No. 70]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition Al_2O_3	Composition (weight percent) $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	Composition (continued), Specifications and Remarks
1	136	C	1959	486-1323	±4	Alumina + Mullite	90	10	Fired at 1750 C to bulk density 3.20 g cm^{-3} ; total porosity 17.5%; data corrected to zero porosity.
2	136	C	1959	505-1288	±4	Alumina + Mullite	75	25	Fired at 1750 C to bulk density 3.08 g cm^{-3} ; total porosity 17.4%; data corrected to zero porosity.
3	136	C	1959	493-1070	±4	Alumina + Mullite	50	50	Fired at 1750 C to bulk density 2.68 g cm^{-3} ; total porosity 23.8%; data corrected to zero porosity.

DATA TABLE NO. 70 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + ALUMINUM SILKATE] $Al_2O_3 + 3Al_2O_3 \cdot 2SiO_2$

[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T k

CURVE 1

486.2 0.149
 548.2 0.128
 623.2 0.121
 713.2 0.104
 779.2 0.0962
 783.2 0.0905
 869.2 0.0845
 1038.2 0.0720
 1113.2 0.0649
 1243.2 0.0589
 1323.2 0.0552

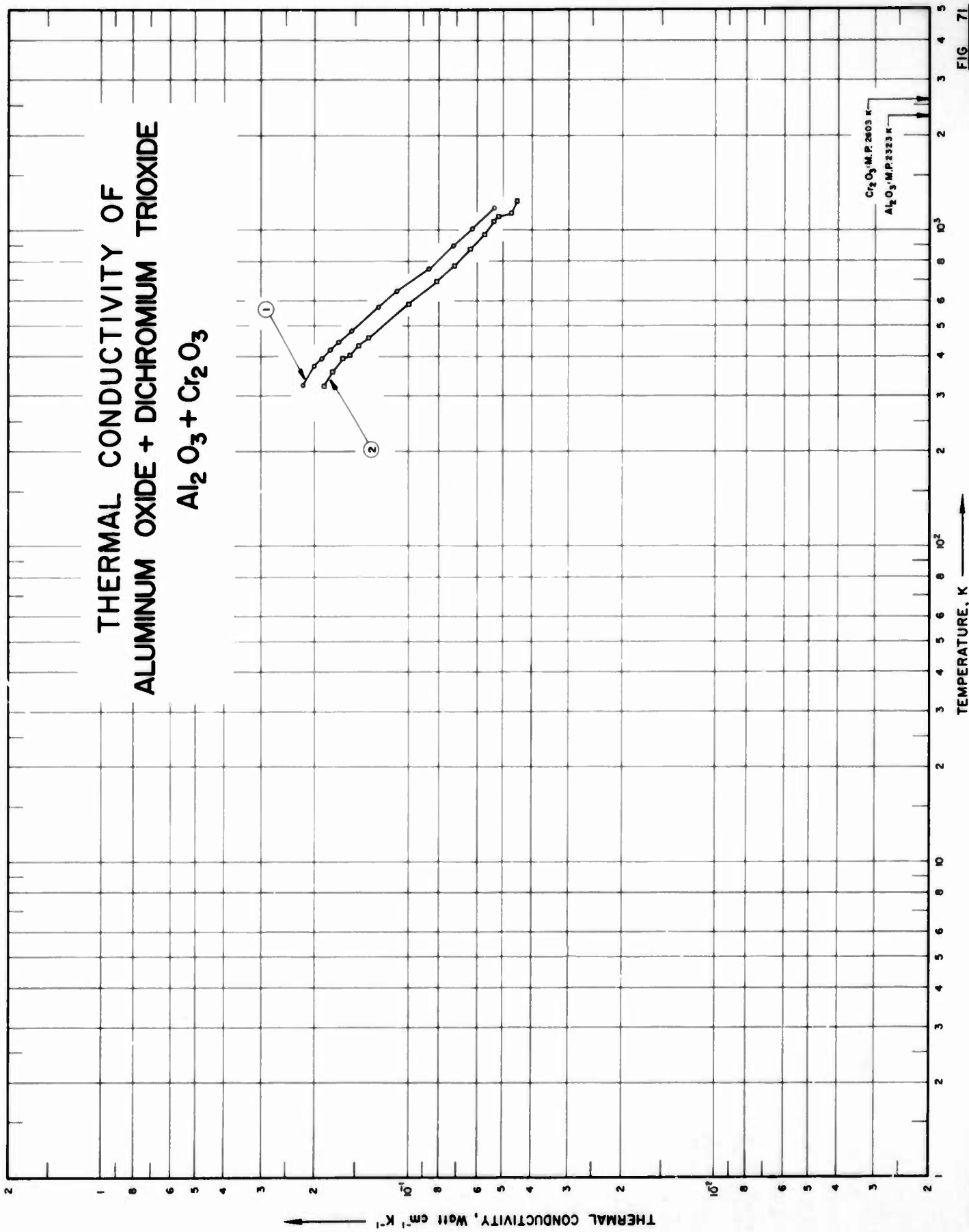
CURVE 2

505.2 0.0900
 590.2 0.0787
 595.2 0.0837
 673.2 0.0736
 807.2 0.0602
 808.2 0.0657
 921.2 0.0573
 1063.2 0.0521
 1180.2 0.0490
 1288.2 0.0473

CURVE 3

493.2 0.0404
 616.2 0.0360
 793.2 0.0348
 821.2 0.0310
 962.2 0.0318
 1070.2 0.0308

THERMAL CONDUCTIVITY OF
ALUMINUM OXIDE + DICHRONIUM TRIOXIDE
 $\text{Al}_2\text{O}_3 + \text{Cr}_2\text{O}_3$



TEMPERATURE, K

SPECIFICATION TABLE NO. 71 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + DICHRONIUM TRIOXIDE] $Al_2O_3 + Cr_2O_3$

[For Data Reported in Figure and Table No. 71]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	136, 295	C	1959	325-1193	± 4	C-6	2.88 vol % Cr_2O_3 ; polycrystalline solid solution; prepared by mixing calcined Cr_2O_3 and Al_2O_3 in a water suspension and either slip-casting or hydrodynamically pressing and fired at 1800 C; density 3.21 g cm^{-3} ; total porosity 20.1, polycrystalline Al_2O_3 and ZrO_2 used as comparative material; data corrected to theoretical density.
2	1-3, 295	C	1959	323-1249	± 4	C-7	6.42 vol % Cr_2O_3 ; same structure, fabrication method and comparative material as the above specimen; density 3.17 g cm^{-3} ; total porosity 22.1; data corrected to theoretical density.

DATA TABLE NO. 71 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + DICHRONIUM TRIOXIDE] $\text{Al}_2\text{O}_3 + \text{Cr}_2\text{O}_3$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
325.2	0.219
372.2	0.201
395.2	0.190
420.2	0.179
448.2	0.168
481.2	0.154
573.2	0.126
643.2	0.109
756.2	0.0870
896.2	0.0720
1008.2	0.0628
1190.2	0.0531
<u>CURVE 2</u>	
323.2	0.186
356.2	0.176
393.2	0.164
403.2	0.156
432.2	0.147
460.2	0.136
587.2	0.100
690.2	0.0815
773.2	0.0715
873.2	0.0632
973.2	0.0573
1069.2	0.0536
1114.2	0.0519
1148.2	0.0469
1249.2	0.0448

SPECIFICATION TABLE NO. 72 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + DIMANGANESE TRIOXIDE] $\text{Al}_2\text{O}_3 + \text{Mn}_2\text{O}_3$

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Al_2O_3	Composition (weight percent) Mn_2O_3	Composition (continued), Specifications and Remarks
1	23	1952	313-401		157A	72.1	27.9	Mn_2O_3 : 4 Al_2O_3 ; firing temperature 1811 K; water absorption 0.007%; density 3.65 g cm^{-3} .

DATA TABLE NO. 72 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + DIMANGANESE TRIOXIDE] $\text{Al}_2\text{O}_3 + \text{Mn}_2\text{O}_3$

[Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u> *	
312.7	0.0749
335.7	0.0657
357.8	0.0657
378.0	0.0636
400.9	0.0615

* No graphical presentation

THERMAL CONDUCTIVITY OF ALUMINUM OXIDE + SILICON DIOXIDE $Al_2O_3 + SiO_2$

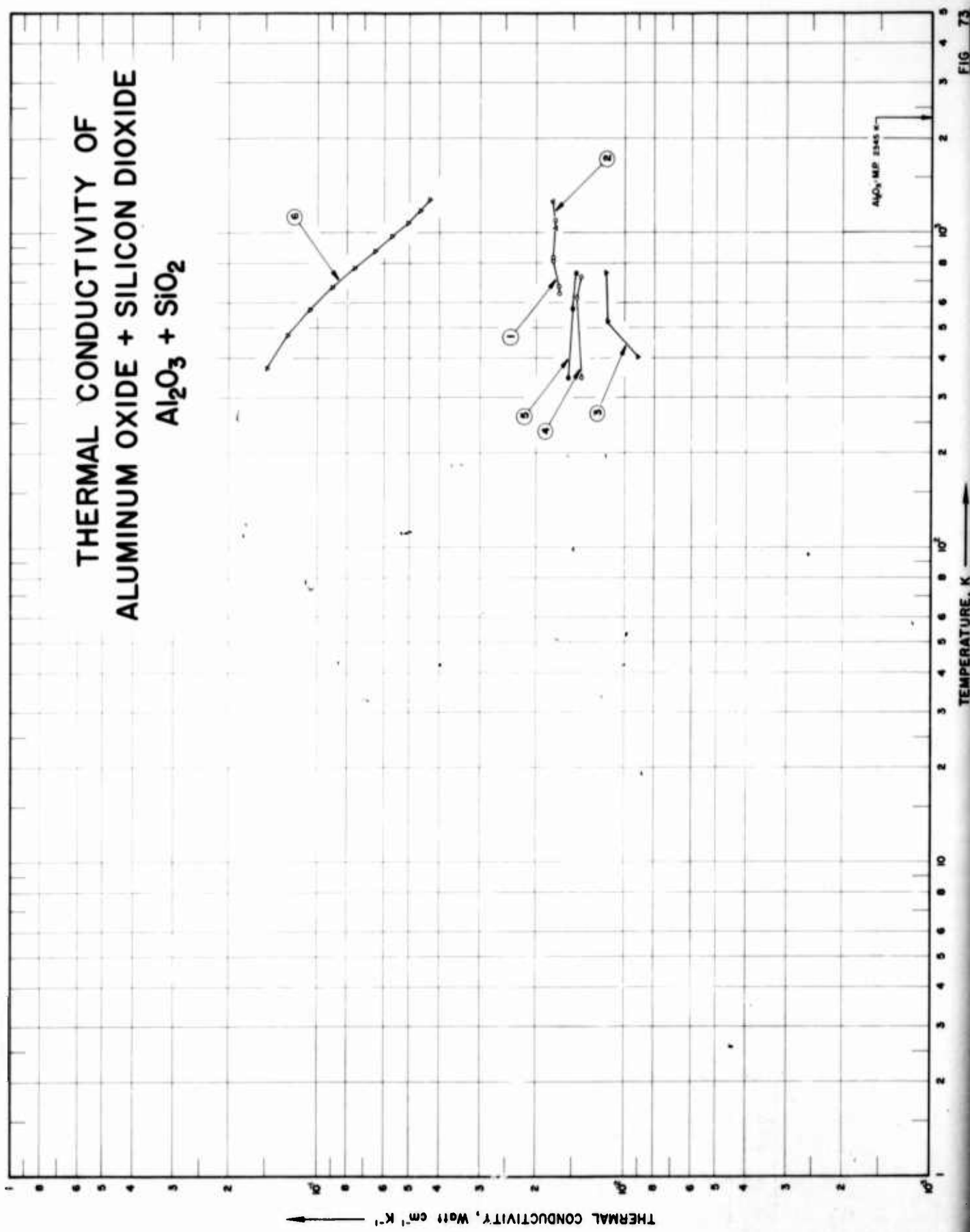


FIG. 73

SPECIFICATION TABLE NO. 73 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + SILICON DIOXIDE] $Al_2O_3 + SiO_2$

[For Data Reported in Figure and Table No. 73]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							Al_2O_3	SiO_2	
1	79,475	L	1942	640-1098		Sillimanite refractory brick; 4	58.08	39.6	1.49 TiO_2 , 0.53 Fe_2O_3 , 0.39 CaO , 0.15 MgO , and 0.25 alkali oxides; specimen in the form of a slab measuring 18 in. x 18 in., prepared from well calcined and graded sillimanite bonded with highly refractory plastic clays; fired at 1410 to 1420 C for 60 hrs; fired material showing considerable mullite development; porosity 23.16%; weight lost on ignition 0.06%.
2	79,475	C	1942	1029, 1253		Sillimanite refractory brick; 4			Similar to the above specimen but in disc form 8 in. in dia and 1 in. thick, steel used as comparative material.
3	247	L	1932	403-749	1	Bauxite brick 20	59.89	36.62	1.12 CaO , 0.87 Fe_2O_3 , 0.66 MgO , 0.62 TiO_2 ; density 3.029 $g\ cm^{-3}$; porosity 35.9%; gas permeability 0.010 $m^3 - cm\ per\ m^2 - hr - mm\ H_2O$.
4	247	L	1932	348-723	1	Sillimanite brick E	59.70	36.88	1.44 TiO_2 , 1.01 Fe_2O_3 , 0.50 CaO , 0.07 MgO , 0.06 Mn_2O_4 ; density 2.989 $g\ cm^{-3}$; porosity 20.7%; gas permeability 0.100 $m^3 - cm\ per\ m^2 - hr - mm\ H_2O$.
5	247	L	1932	346-744	1	Sillimanite brick G	59.47	37.00	1.54 TiO_2 , 0.91 Fe_2O_3 , 0.44 CaO , 0.09 MgO , 0.06 Mn_2O_4 ; density 3.053 $g\ cm^{-3}$; porosity 20.6%; gas permeability 0.073 $m^3 - cm\ per\ m^2 - mm\ H_2O$.
6	375	C	1960	373-1273			92.5	7.5	1 in. cube specimen; hot pressed; MIT standard alumina used as comparative material.

DATA TABLE NO. 73 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + SILICON DIOXIDE] $\text{Al}_2\text{O}_3 + \text{SiO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
640.2	0.0167
675.2	0.0167
811.2	0.0176
823.2	0.0176
1088.2	0.0172
<u>CURVE 2</u>	
1029.2	0.0172
1253.2	0.0176
<u>CURVE 3</u>	
403.4	0.00907
523.0	0.0115
749.4	0.0117
<u>CURVE 4</u>	
347.7	0.0140
620.5	0.0146
723.1	0.0141
<u>CURVE 5</u>	
346.1	0.0156
573.2	0.0151
744.2	0.0147
<u>CURVE 6</u>	
373.2	0.148
473.2	0.126
573.2	0.106
673.2	0.0891
773.2	0.0753
873.2	0.0644
973.2	0.0565
1073.2	0.0502
1173.2	0.0460
1273.2	0.0427

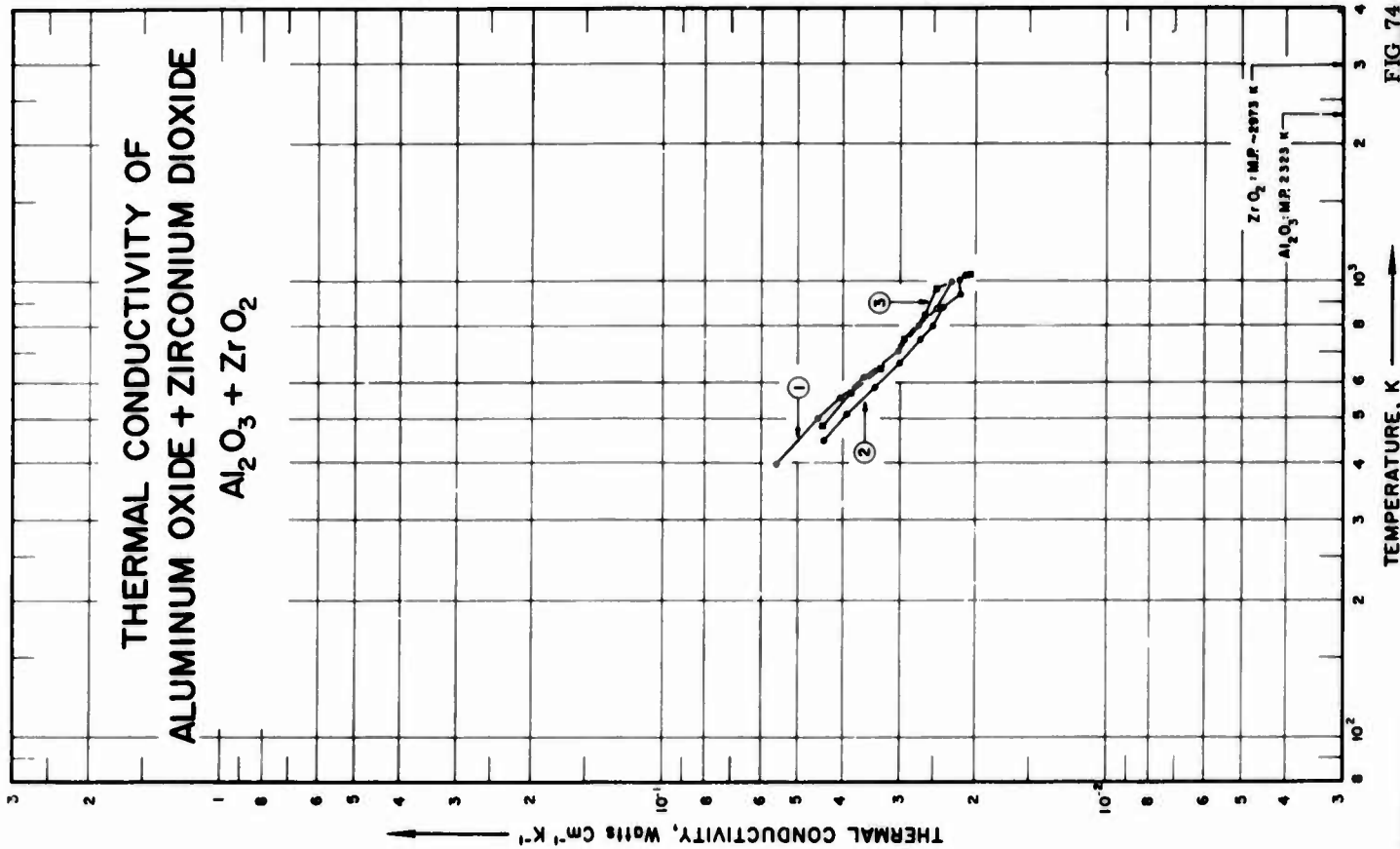


FIG 74

SPECIFICATION TABLE NO. 74 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + ZIRCONIUM DIOXIDE] $\text{Al}_2\text{O}_3 + \text{ZrO}_2$

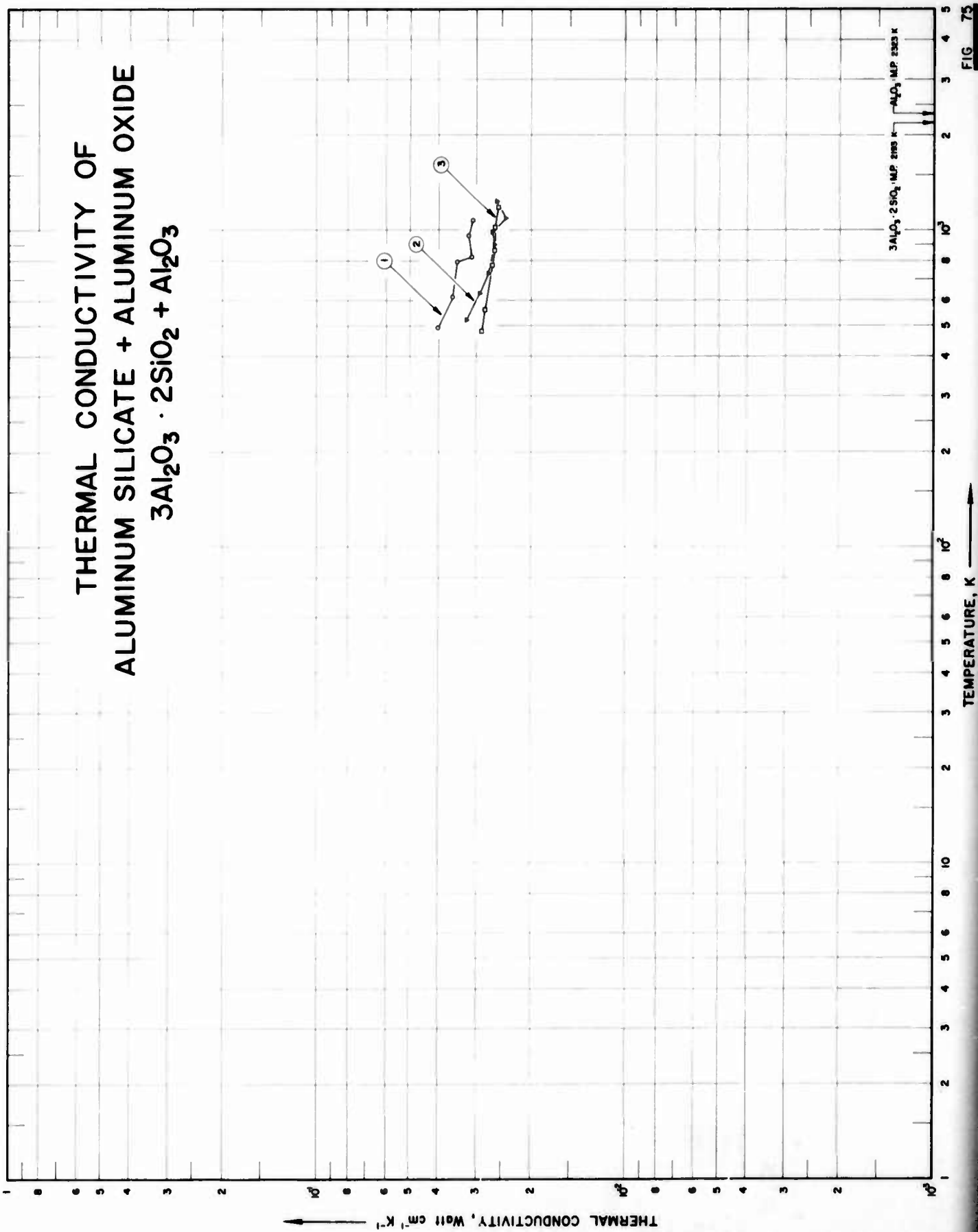
[For Data Reported in Figure and Table No. 74]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Al_2O_3	Composition (weight percent) ZrO_2	Composition (continued), Specifications and Remarks
1	146	L	1955	400-1008			60	40	Sintered.
2	146	L	1955	451-1078			80	20	Sintered.
3	146	L	1955	488-1093			90	10	Sintered.

DATA TABLE NO. 74 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + ZIRCONIUM DIOXIDE] $\text{Al}_2\text{O}_3 + \text{ZrO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
400.2	0.0556
503.2	0.0454
559.2	0.0404
621.2	0.0360
712.5	0.0303
808.7	0.0271
873.2	0.0247
1008.2	0.0228
<u>CURVE 2</u>	
451.2	0.0441
517.2	0.0393
589.2	0.0343
663.2	0.0302
748.2	0.0271
802.2	0.0252
879.2	0.0239
936.2	0.0218
1015.7	0.0220
1078.2	0.0213
<u>CURVE 3</u>	
488.2	0.0431
572.2	0.0389
648.2	0.0333
745.2	0.0295
847.2	0.0262
968.2	0.0247
1093.2	0.0209

THERMAL CONDUCTIVITY OF
ALUMINUM SILICATE + ALUMINUM OXIDE
 $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 + \text{Al}_2\text{O}_3$



SPECIFICATION TABLE NO. 75 THERMAL CONDUCTIVITY OF [ALUMINUM SILICATE + ALUMINUM OXIDE] $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 + \text{Al}_2\text{O}_3$

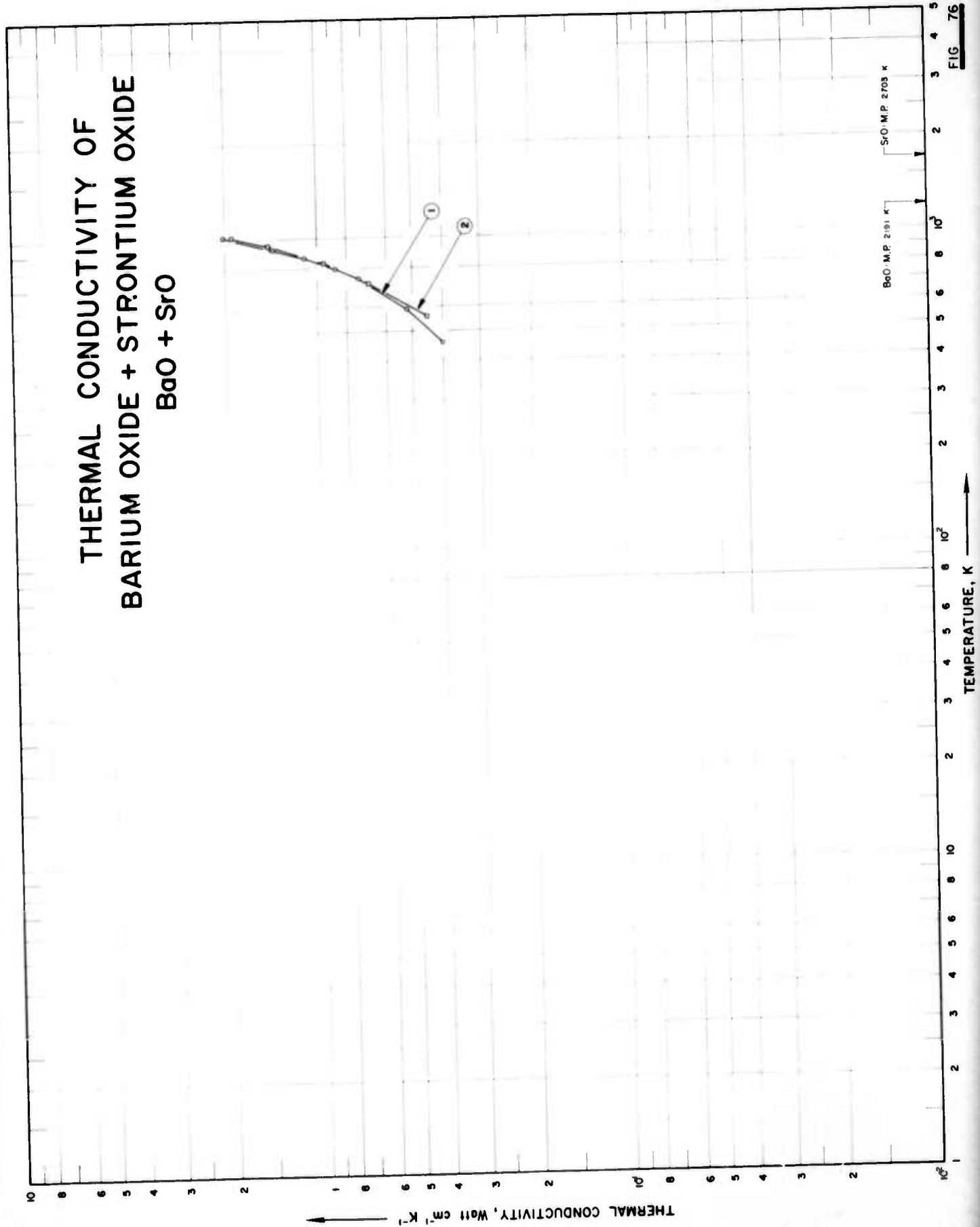
[For Data Reported in Figure and Table No. 75]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	Composition (weight percent) Al_2O_3	Composition (continued), Specifications and Remarks
1	C	1959	493-1070	±4	Mullite + Alumina	50	50	Fired at 1750 C; bulk density 2.68 g cm ⁻³ ; porosity 23.8%; data corrected to zero porosity.
2	C	1959	523-1241	±4	Mullite + Alumina	74	26	Similar to the above specimen except bulk density 2.35 g cm ⁻³ ; porosity 29.3%.
3	C	1959	481-1188	±4	Mullite + Alumina	90	10	Similar to the above specimen except bulk density 2.42 g cm ⁻³ ; porosity 25.3%.

DATA TABLE NO. 75 THERMAL CONDUCTIVITY OF [ALUMINUM SILICATE + ALUMINUM OXIDE] $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 + \text{Al}_2\text{O}_3$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
493.2	0.0404
616.2	0.0360
793.2	0.0348
821.2	0.0310
962.2	0.0318
1070.2	0.0308
<u>CURVE 2</u>	
523.2	0.0322
631.2	0.0293
730.2	0.0276
901.2	0.0264
988.2	0.0267
1094.2	0.0243
1241.2	0.0259
<u>CURVE 3</u>	
481.2	0.0289
560.2	0.0282
775.2	0.0268
865.2	0.0264
1022.2	0.0262
1188.2	0.0255

**THERMAL CONDUCTIVITY OF
BARIUM OXIDE + STRONTIUM OXIDE
BaO + SrO**



SPECIFICATION TABLE NO. 76 THERMAL CONDUCTIVITY OF [BARIUM OXIDE + STRONTIUM OXIDE] BaO + SrO

[For Data Reported in Figure and Table No. 76]

Curve No.	Ref. No. Used	Method	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) BaO	Composition (weight percent) SrO	Composition (continued), Specifications and Remarks
1	75	L	1955	458-1018	10	Tube No. 7	59.676	40.324	Calculated composition (equimolecular mixture of BaO and SrO); polycrystalline; specimen 15 mm in. dia and 0.9 mm thick; prepared by decomposing BaCO ₃ and SrCO ₃ in a vacuum; apparent thermal conductivity (effects of radiation at high temperatures not considered).
2	75	L	1955	558-1013	10	Tube No. 9	59.676	40.324	Similar to the above specimen.

DATA TABLE NO. 76 THERMAL CONDUCTIVITY OF [BARIUM OXIDE + STRONTIUM OXIDE] BaO + SrO
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
458.2	0.40
588.2	0.52
743.2	0.73
798.2	0.87
868.2	1.10
923.2	1.40
1018.2	2.03
<u>CURVE 2</u>	
558.2	0.45
713.2	0.68
833.2	0.95
948.2	1.45
1013.2	1.90

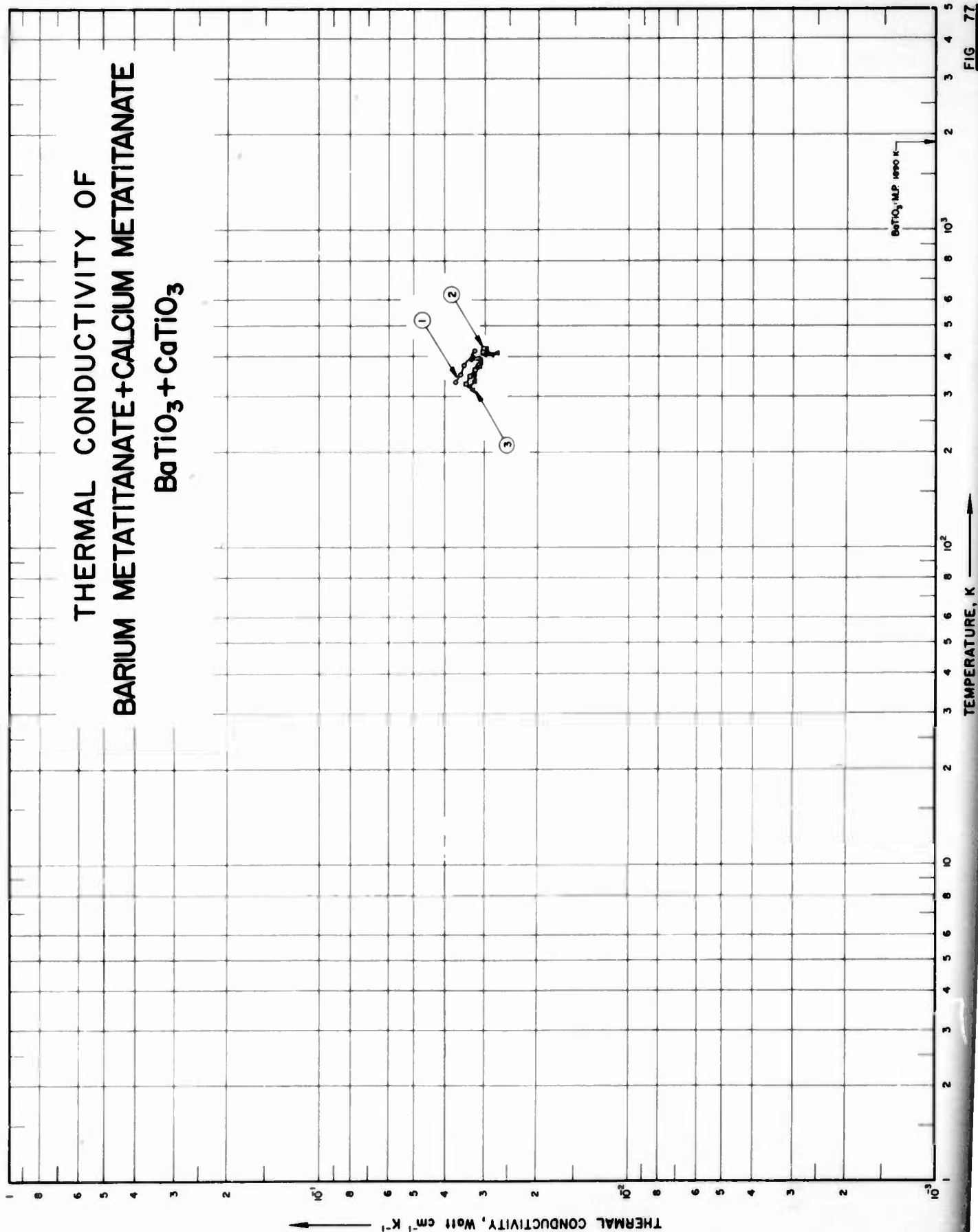


FIG 77

SPECIFICATION TABLE NO. 77 THERMAL CONDUCTIVITY OF [BARIUM METATITANATE + CALCIUM METATITANATE] $\text{BaTiO}_3 + \text{CaTiO}_3$

[For Data Reported in Figure and Table No. 77]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							BaTiO_3	CaTiO_3	
1	289	C	1962	333-416	<10	$\text{Ca}_{0.024}\text{Ba}_{0.976}\text{TiO}_3$	97.99	2.01	Disk specimen with dia to thickness ratio greater than 10; density 5.8 g cm^{-3} . Armco iron used as comparative material.
2	289	C	1962	328-423	<10	$\text{Ca}_{0.099}\text{Ba}_{0.901}\text{TiO}_3$	93.98	6.02	Similar to the above specimen except density 5.6 g cm^{-3} .
3	289	C	1962	314-422	<10	$\text{Ca}_{0.119}\text{Ba}_{0.881}\text{TiO}_3$	87.97	12.03	Similar to the above specimen except density 5.28 g cm^{-3} .

DATA TABLE NO. 77 THERMAL CONDUCTIVITY OF [BARIUM METATITANATE + CALCIUM METATITANATE] $\text{BaTiO}_3 + \text{CaTiO}_3$
 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
333.2	0.037
350.7	0.036
375.7	0.035
416.2	0.0325
<u>CURVE 2</u>	
328.2	0.0345
347.7	0.0335
362.7	0.0325
413.2	0.0307
422.7	0.0305
<u>CURVE 3</u>	
314.2	0.033
320.7	0.034
335.2	0.0325
353.2	0.0325
373.2	0.0315
382.2	0.031
390.2	0.031
392.7	0.0335
395.2	0.033
402.7	0.0287
407.2	0.031
410.2	0.0275
414.7	0.03
418.2	0.03
421.7	0.03

SPECIFICATION TABLE NO. 78 THERMAL CONDUCTIVITY OF [BARIUM METATITANATE + MAGNESIUM ZIRCONATE] BaTiO₃ + MgZrO₃

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	468	L	1950	331-413		40 B	Specimen 0.456 in. dia x 0.488 in. long.

DATA TABLE NO. 78 THERMAL CONDUCTIVITY OF [BARIUM METATITANATE + MAGNESIUM ZIRCONATE] BaTiO₃ + MgZrO₃

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
330.6	0.0435
363.9	0.0456
388.1	0.0444
412.5	0.0439

* No graphical presentation

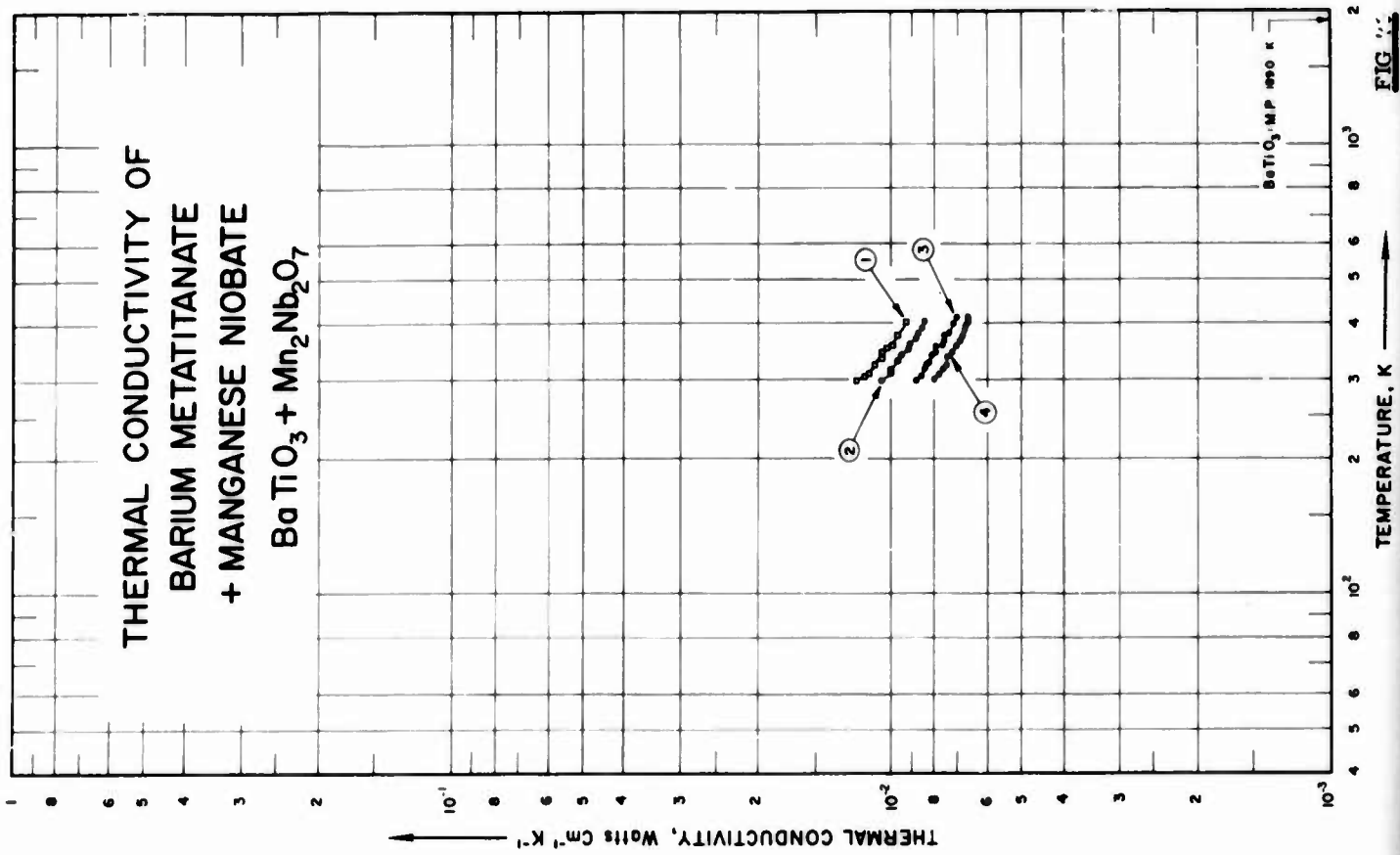


FIG. 10

SPECIFICATION TABLE NO. 79 THERMAL CONDUCTIVITY OF [BARIUM METATITANATE + MANGANESE NIOBATE] $\text{BaTiO}_3 + \text{Mn}_2\text{Nb}_2\text{O}_7$

[For Data Reported in Figure and Table No. 79]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) BaTiO_3	Composition (weight percent) $\text{Mn}_2\text{Nb}_2\text{O}_7$	Composition (continued), Specifications and Remarks
1	202	F	1961	303-403			—	—	2.0 mole % $\text{Mn}_2\text{Nb}_2\text{O}_7$.
2	202	F	1961	303-403			—	—	3.0 mole % $\text{Mn}_2\text{Nb}_2\text{O}_7$.
3	202	F	1961	303-418			—	—	5.0 mole % $\text{Mn}_2\text{Nb}_2\text{O}_7$.
4	202	F	1961	303-418			—	—	7.0 mole % $\text{Mn}_2\text{Nb}_2\text{O}_7$.

DATA TABLE NO. 79 THERMAL CONDUCTIVITY OF [BARIUM METATITANATE + MANGANESE NIOBATE] BaTiO₃ + Mn₂Nb₂O₇
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
303.2	0.0121	303.2	0.00795
308.2	0.0115	308.2	0.00774
313.2	0.0112	318.2	0.00761
328.2	0.0109	328.2	0.00745
338.2	0.0105	338.2	0.00745
348.2	0.0105	348.2	0.00720
358.2	0.0102	358.2	0.00703
363.2	0.0100	368.2	0.00690
373.2	0.0100	378.2	0.00686
383.2	0.00971	388.2	0.00678
403.2	0.00929	398.2	0.00674
		403.2	0.00669
		418.2	0.00665
<u>CURVE 2</u>			
303.2	0.0105		
313.2	0.0100		
319.2	0.0100		
333.2	0.00971		
343.2	0.00954		
353.2	0.00920		
363.2	0.00912		
373.2	0.00883		
383.2	0.00875		
393.2	0.00858		
403.2	0.00849		
<u>CURVE 3</u>			
303.2	0.00879		
308.2	0.00858		
318.2	0.00845		
328.2	0.00837		
333.2	0.00828		
343.2	0.00816		
348.2	0.00795		
358.2	0.00791		
363.2	0.00761		
368.2	0.00761		
378.2	0.00753		
383.2	0.00745		
388.2	0.00745*		
403.2	0.00720		
418.2	0.00703		

* Not shown on plot

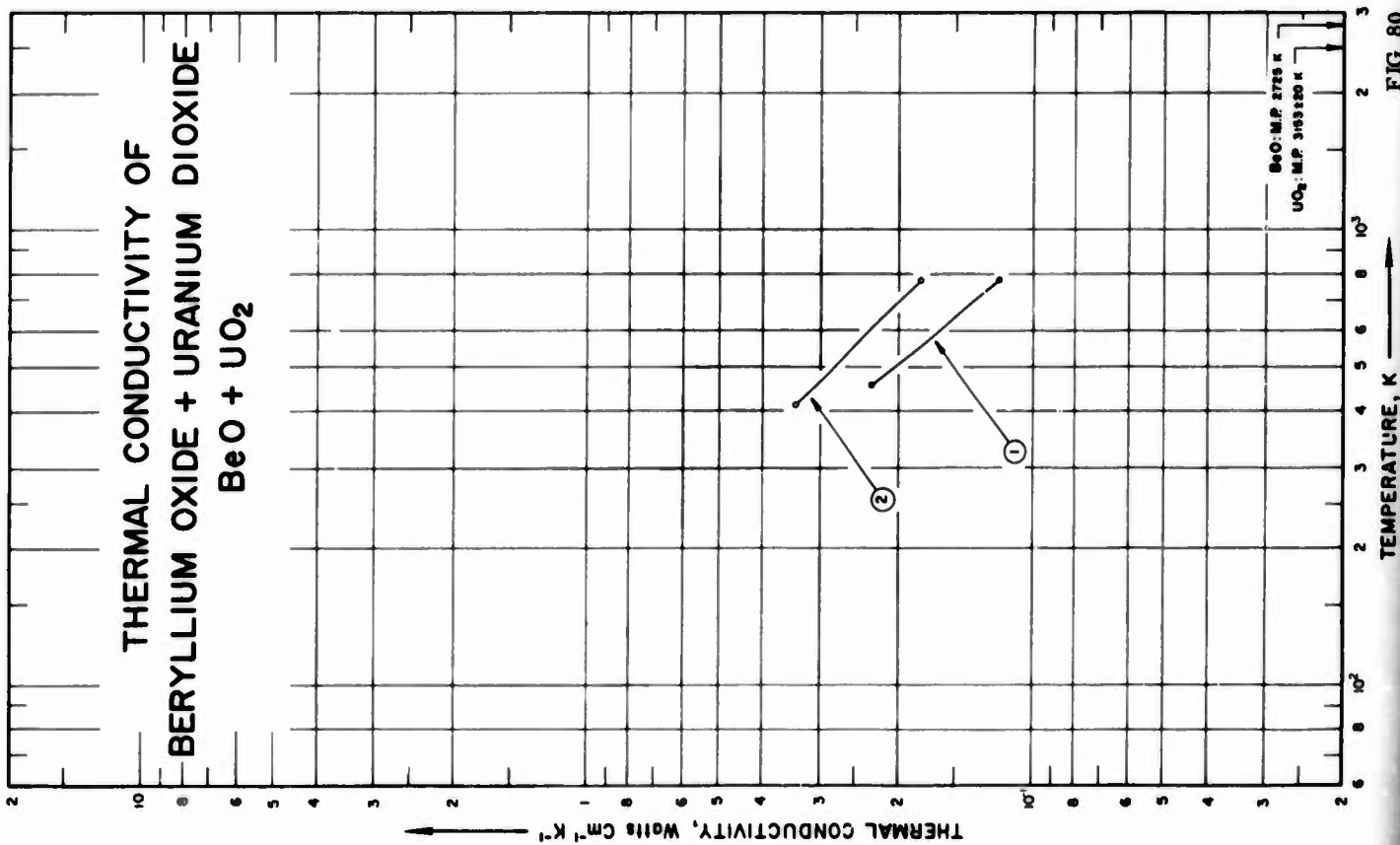


FIG 80

SPECIFICATION TABLE NO. 80 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + URANIUM DIOXIDE] BeO + UO₂

[For Data Reported in Figure and Table No. 80]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) BeO	Composition (weight percent) UO ₂	Composition (continued), Specifications and Remarks
1	76	L	1952	453.773			53	47	80.0% of theoretical density.
2	76	L	1952	413.773			53	47	71.2% of theoretical density.

DATA TABLE NO. 80 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + URANIUM DIOXIDE] BeO + UO₂
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
453.2	0.230
773.2	0.120
<u>CURVE 2</u>	
413.2	0.340
773.2	0.180

THERMAL CONDUCTIVITY OF
 CERMIUM DIOXIDE + MAGNESIUM OXIDE
 $CeO_2 + MgO$

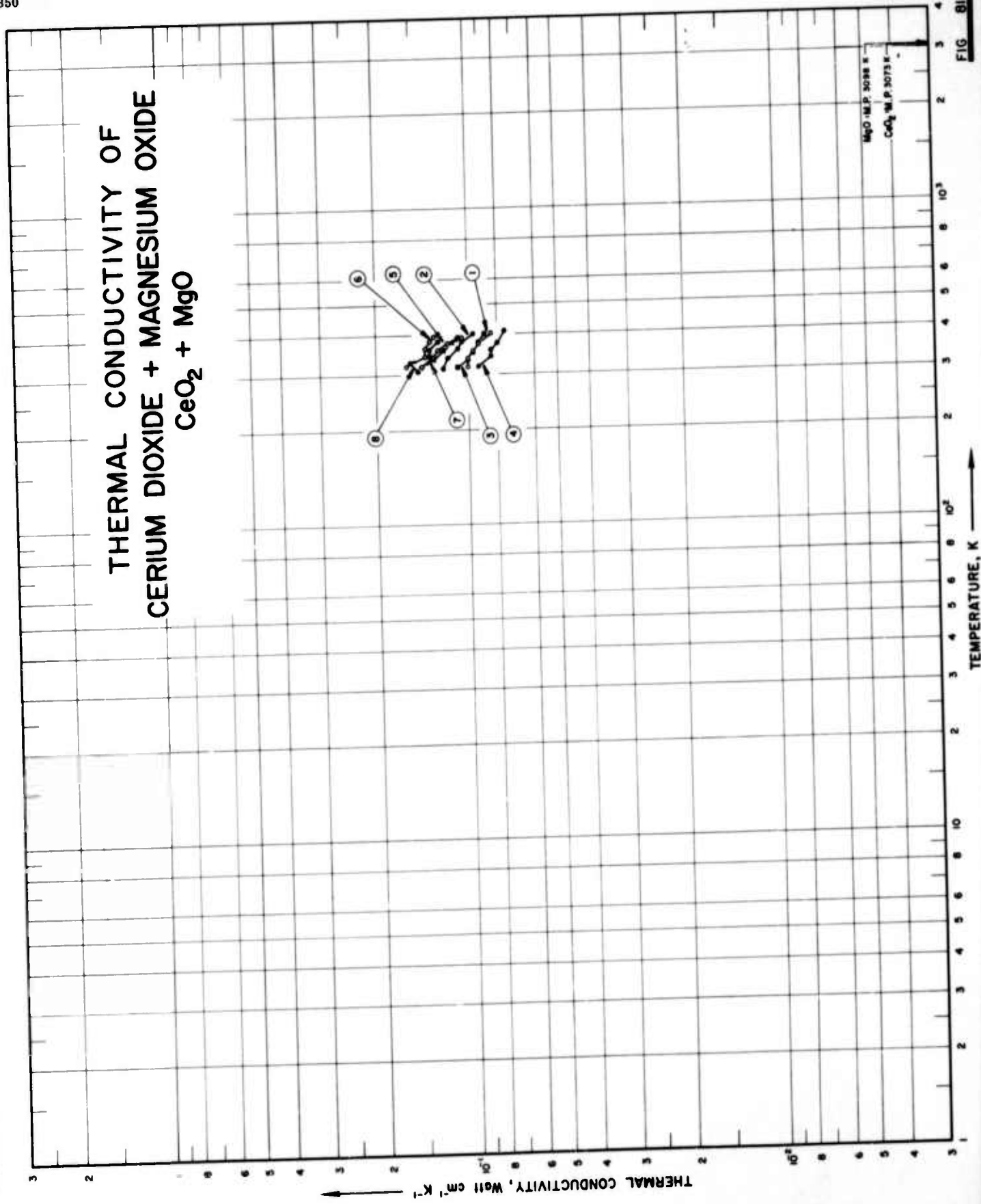


FIG. 81

SPECIFICATION TABLE NO. 81 THERMAL CONDUCTIVITY OF [CERIUM DIOXIDE + MAGNESIUM OXIDE] $\text{CeO}_2 + \text{MgO}$

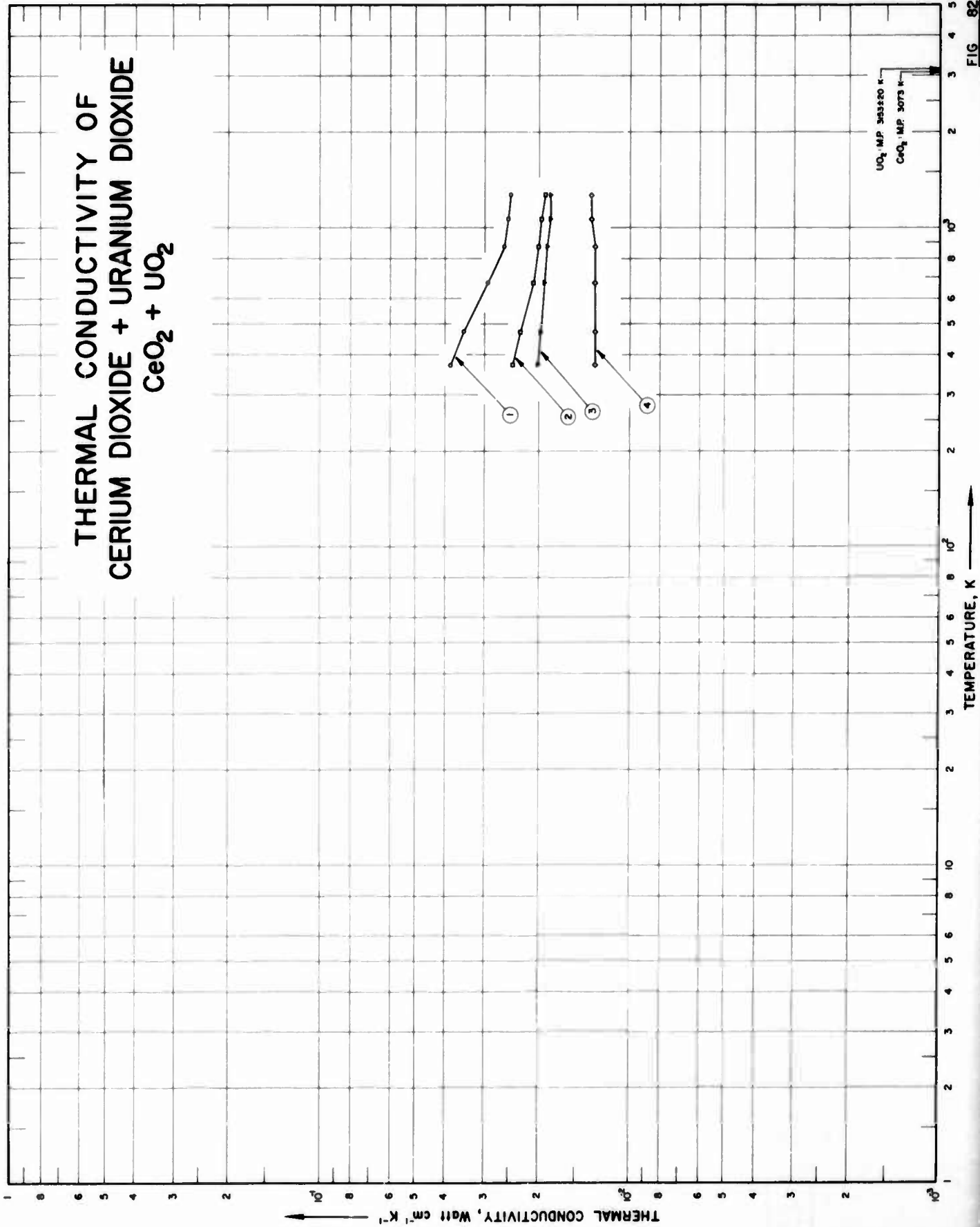
[For Data Reported in Figure and Table No. 81]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) CeO_2	Composition (weight percent) MgO	Composition (continued), Specifications and Remarks
1	23		1952	316-404		161A-1	96	4	Fire temp 1833 K; water absorption 0.00%; density 6.02 g cm^{-3} ; with buff color.
2	23		1952	315-404		186A-1	94	6	Fire temp 1800 K; water absorption 0.95%; density 5.58 g cm^{-3} ; with buff color.
3	23		1952	316-403		138A-1	92	8	Fire temp 1711 K; water absorption 0.033%; density 5.63 g cm^{-3} ; with buff color.
4	23		1952	319-410		185A-1	92	8	Fire temp 1800 K; water absorption 0.21%; density 5.82 g cm^{-3} ; with buff color.
5	23		1952	319-394		106A-1	90	10	Fire temp 1755 K; water absorption 0.34%; density 4.59 g cm^{-3} ; with buff color.
6	23		1952	320-396		107A-1	90	10	Fire temp 1769 K; water absorption 0.136%; density 4.68 g cm^{-3} ; with buff color.
7	23		1952	319-395		108A-1	80	20	Fire temp 1755 K; water absorption 0.054%; density 4.94 g cm^{-3} ; with buff color.
8	23		1952	310-382		109A-1	80	20	Fire temp 1755 K; water absorption 0.003%; density 5.05 g cm^{-3} ; with buff color.

DATA TABLE NO. 81 THERMAL CONDUCTIVITY OF [CERUM DIOXIDE + MAGNESIUM OXIDE] CeO₂ + MgO[Temperature, T, K; Thermal Conductivity, k, Watts cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
315.8	0.100	318.6	0.142
337.1	0.100	337.1	0.130
356.7	0.096	357.4	0.121
375.6	0.092	390.7	0.113
403.5	0.0837	394.9	0.109
<u>CURVE 2</u>			
314.9	0.121	309.5	0.146
338.6	0.117	326.7	0.155
362.1	0.108	344.8	0.134
380.8	0.105	360.7	0.134
404.0	0.096	382.2	0.126
<u>CURVE 3</u>			
316.3	0.108		
335.8	0.100		
354.9	0.0960		
376.1	0.0920		
402.7	0.0879		
<u>CURVE 4</u>			
319.2	0.0920		
341.7	0.0837		
358.6	0.0837		
376.9	0.0795		
410.3	0.0753		
<u>CURVE 5</u>			
318.7	0.142		
340.3	0.130		
359.9	0.126		
376.8	0.117		
393.5	0.105		
<u>CURVE 6</u>			
319.9	0.159		
342.9	0.138		
364.5	0.138		
381.7	0.134		
395.8	0.130		

THERMAL CONDUCTIVITY OF
 CERIUM DIOXIDE + URANIUM DIOXIDE
 $CeO_2 + UO_2$



SPECIFICATION TABLE NO. 82 THERMAL CONDUCTIVITY OF [CERIUM DIOXIDE + URANIUM DIOXIDE] $\text{CeO}_2 + \text{UO}_2$

[For Data Reported in Figure and Table No. 82]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition CeO_2	Composition (weight percent) UO_2	Composition (continued), Specifications and Remarks
1	24	C	1958	373-1273	± 10	216B	80.2	19.8	15.0 volume % UO_2 ; bulk density 6.34 g cm^{-3} ; specimen dry pressed from $\text{U}_3\text{O}_8 - \text{CeO}_2$, fired in hydrogen atmosphere to 1600 C for 1 hr, and machined to final size; not oxidized; densed alumina and stabilized zirconia used as comparative material.
2	24	C	1958	373-1273	± 10	216B	80.2	19.8	Similar to the above specimen but fired in air; somewhat oxidized.
3	24	C	1958	373-1273	± 10	217B	62.5	37.5	30.0 volume % UO_2 ; bulk density 5.22 g cm^{-3} ; specimen dry pressed from $\text{U}_3\text{O}_8 - \text{CeO}_2$, fired in hydrogen atmosphere to 1600 C for 1 hr, and machined to final size; not oxidized.
4	24	C	1958	373-1273	± 10	217B	62.5	37.5	Similar to the above specimen except fired in air; somewhat oxidized.

DATA TABLE NO. 82 THERMAL CONDUCTIVITY OF [CERIUM DIOXIDE + URANIUM DIOXIDE] $\text{CeO}_2 + \text{UO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
373.2	0.0385
473.2	0.0347
673.2	0.0293
873.2	0.0259
1073.2	0.0251
1273.2	0.0247
<u>CURVE 2</u>	
373.2	0.0243
473.2	0.0230
673.2	0.0209
873.2	0.0201
1073.2	0.0197
1273.2	0.0192
<u>CURVE 3</u>	
373.2	0.0201
473.2	0.0197
673.2	0.0192
873.2	0.0188
1073.2	0.0184
1273.2	0.0184
<u>CURVE 4</u>	
373.2	0.0130
473.2	0.0130
673.2	0.0130
873.2	0.0130
1073.2	0.0134
1273.2	0.0134

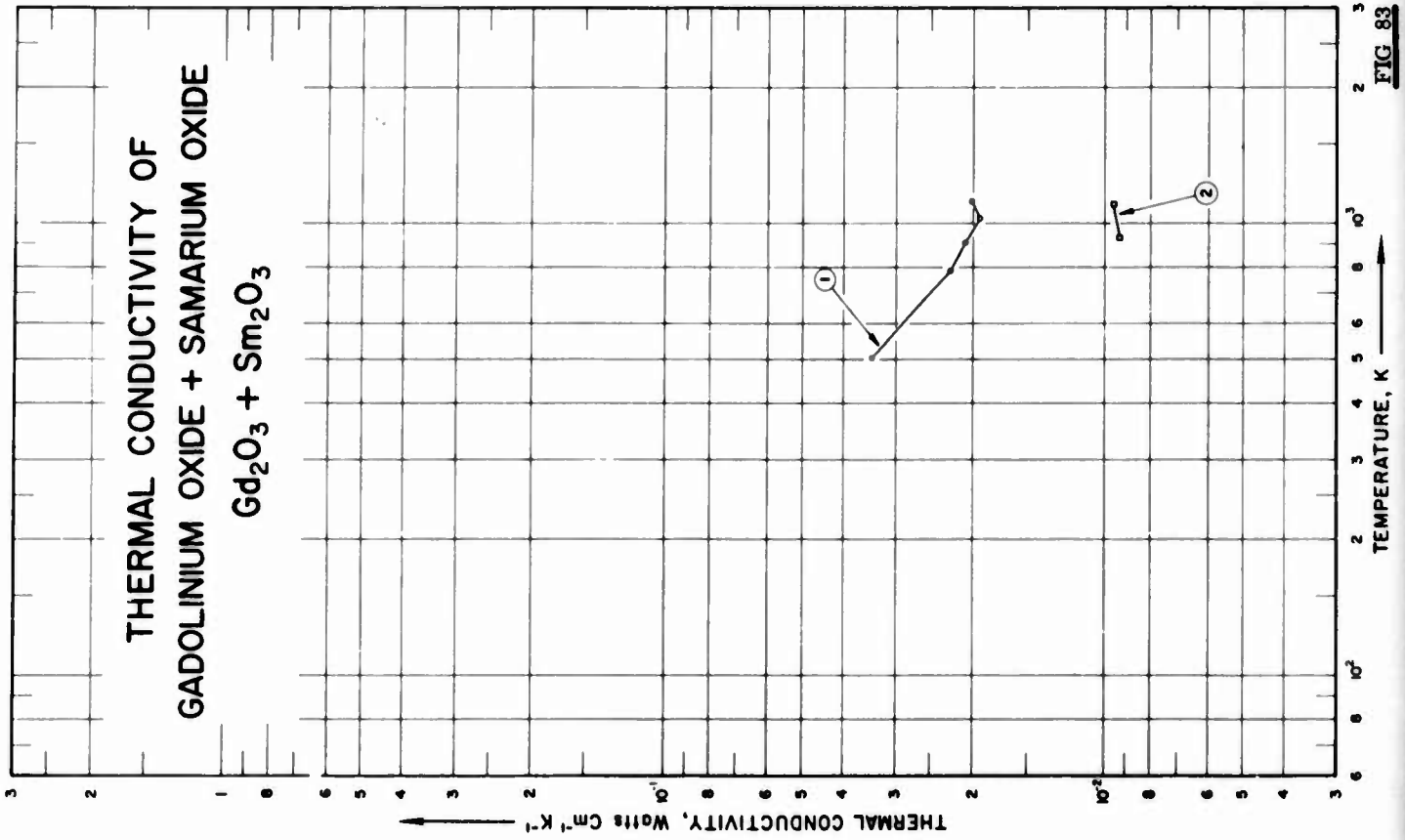


FIG 83

SPECIFICATION TABLE NO. 83 THERMAL CONDUCTIVITY OF [GADOLINIUM OXIDE + SAMARIUM OXIDE] $Gd_2O_3 + Sm_2O_3$

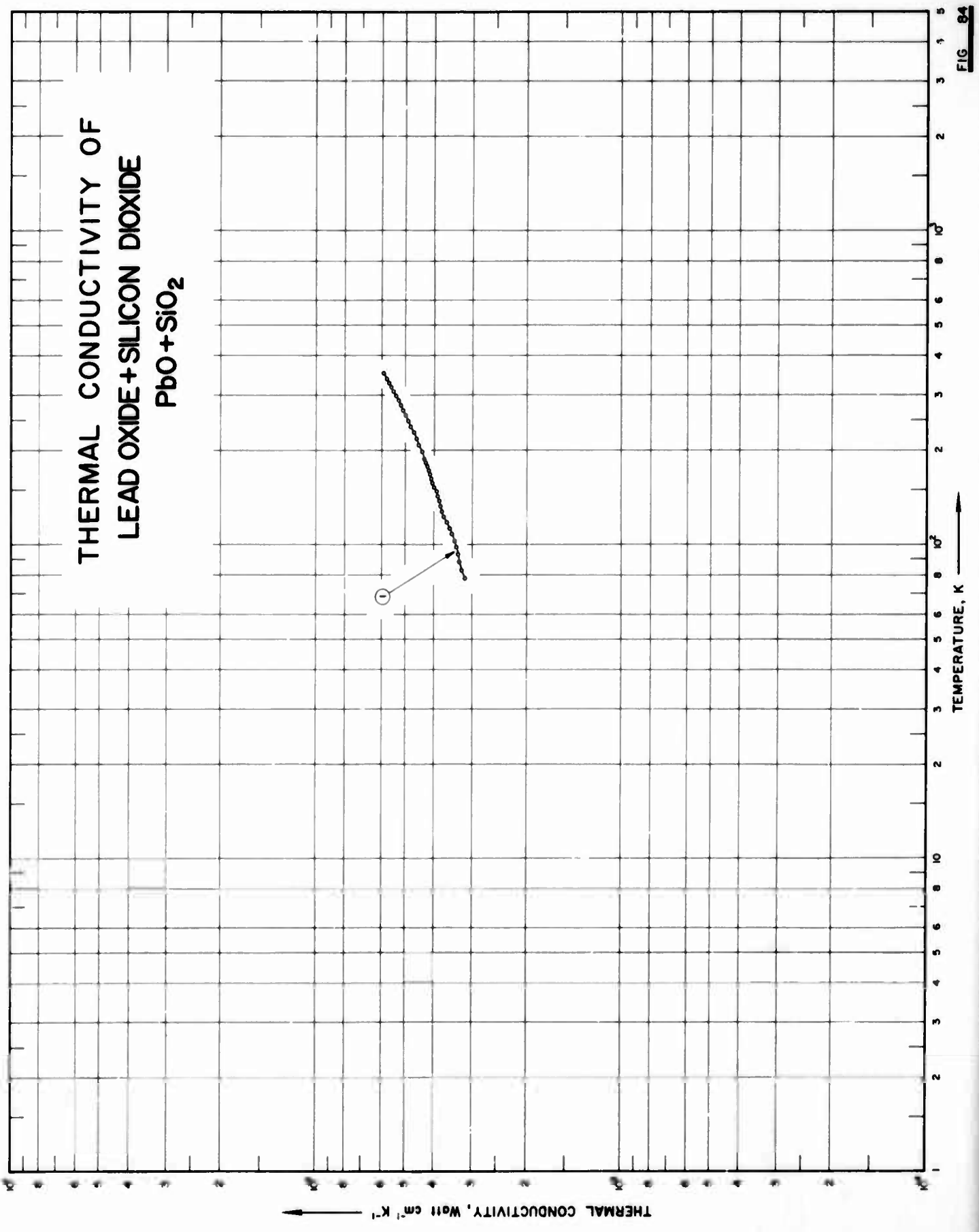
[For Data Reported in Figure and Table No. 83]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Composition (continued), Specifications and Remarks
1	145		1955	505-1120				Solid solution; prepared by ORNL; fired to dense condition.
2	145		1955	931, 1110				Solid solution; prepared by ORNL; fired at low temperature; specimen quite porous.

DATA TABLE NO. 83 THERMAL CONDUCTIVITY OF [GADOLINIUM OXIDE + SAMARIUM OXIDE] $Gd_2O_3 + Sm_2O_3$
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
505.2	0.0341
790.2	0.0225
907.2	0.0209
1023.2	0.0194
1119.7	0.0201
<u>CURVE 2</u>	
930.7	0.00929
1109.7	0.00954

THERMAL CONDUCTIVITY OF
LEAD OXIDE+SILICON DIOXIDE
PbO+SiO₂



SPECIFICATION TABLE NO. 84 THERMAL CONDUCTIVITY OF [LEAD OXIDE + SILICON DIOXIDE] $PbO + SiO_2$

[For Data Reported in Figure a.d Table No. 84]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						PbO	SiO_2	
1	L	1960	78-353		L	80.0	20.0	Specimen 3 in. in dia and 0.375 in. thick; density 6.10 $g\ cm^{-3}$.

DATA TABLE NO. 84 THERMAL CONDUCTIVITY OF [LEAD OXIDE + SILICON DIOXIDE] PbO + SiO₂
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

CURVE 1		CURVE 1 (cont.)	
T	k	T	k
78.2	0.00318	303.2	0.00540*
83.2	0.00326	308.2	0.00548
88.2	0.00331	313.2	0.00552*
93.2	0.00335	318.2	0.00556
98.2	0.00339	323.2	0.00561*
103.2	0.00343	328.2	0.00569
108.2	0.00351	333.2	0.00573*
113.2	0.00356	338.2	0.00577
118.2	0.00364	343.2	0.00582*
123.2	0.00372	348.2	0.00586*
128.2	0.00377	353.2	0.00594
133.2	0.00381		
138.2	0.00385		
143.2	0.00389		
148.2	0.00393		
153.2	0.00402		
158.2	0.00405		
163.2	0.00410		
168.2	0.00414		
173.2	0.00418		
178.2	0.00423		
183.2	0.00427		
188.2	0.00431		
193.2	0.00435*		
198.2	0.00439		
203.2	0.00444*		
208.2	0.00452		
213.2	0.00456*		
218.2	0.00460		
223.2	0.00464*		
228.2	0.00469		
233.2	0.00473*		
238.2	0.00481		
243.2	0.00485*		
248.2	0.00490		
253.2	0.00494*		
258.2	0.00498		
263.2	0.00502*		
268.2	0.00510		
273.2	0.00515*		
278.2	0.00519		
283.2	0.00523*		
288.2	0.00527		
293.2	0.00531*		
298.2	0.00536		

* Not shown on plot

**THERMAL CONDUCTIVITY OF
MAGNESIUM ALUMINATE + MAGNESIUM OXIDE
MgO · Al₂O₃ + MgO**

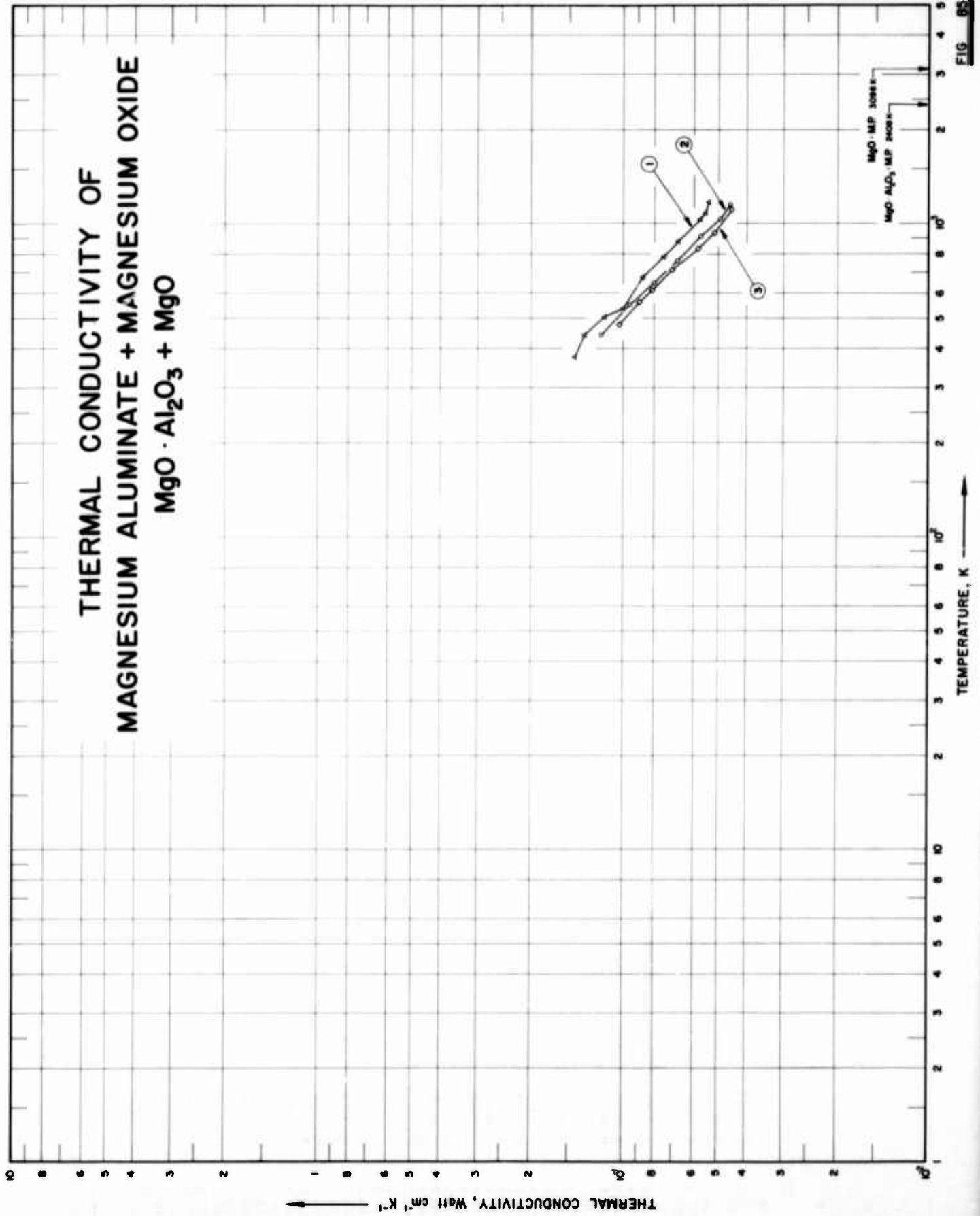


FIG. 85

SPECIFICATION TABLE NO. 85 THERMAL CONDUCTIVITY OF [MAGNESIUM ALUMINATE + MAGNESIUM OXIDE] $MgO \cdot Al_2O_3 + MgO$

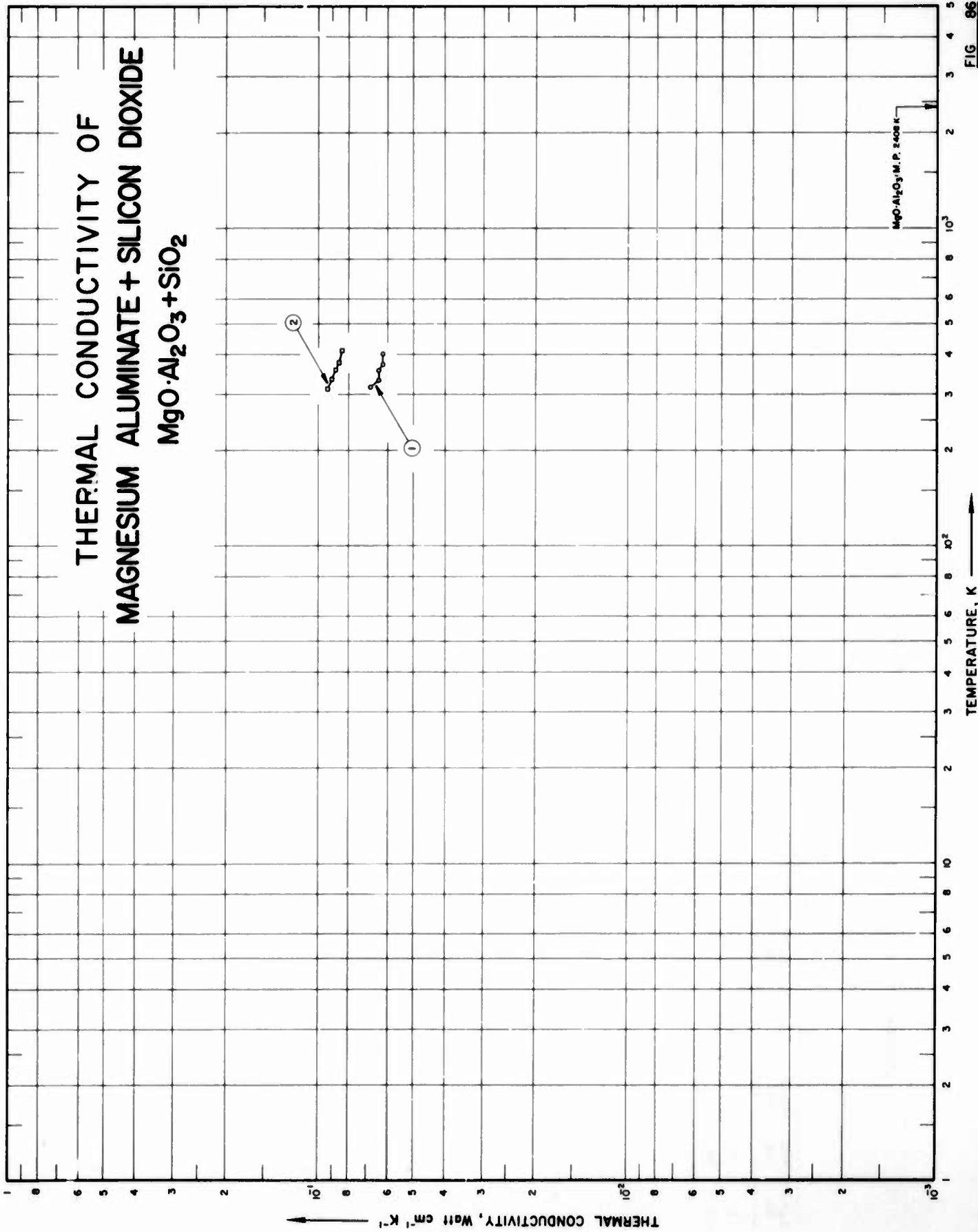
[For Data Reported in Figure and Table No. 85]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) $MgO \cdot Al_2O_3$	Composition (continued), Specifications and Remarks	
1	136	C	1959	376-1173	±4		50.1	49.9	Corresponding to 49.8 volume % magnesium aluminate; fired at 1800 C to bulk density of 3.19 g cm ⁻³ ; porosity 11.4 volume %; data corrected for porosity; theoretical calculated composition.
2	136	C	1959	443-1166	±4		77.4	22.6	Corresponding to 77.5 volume % magnesium aluminate; fired at 1800 C to bulk density of 3.04 g cm ⁻³ ; porosity 14.8 volume %; data corrected for porosity; theoretical calculated composition.
3	136	C	1959	478-1118	±4		91.1	8.9	Corresponding to 91.2 volume % magnesium aluminate; fired at 1800 C to bulk density of 2.99 g cm ⁻³ ; porosity 15.4 volume %; data corrected for porosity; theoretical calculated composition.

DATA TABLE NO. 85 THERMAL CONDUCTIVITY OF [MAGNESIUM ALUMINATE + MAGNESIUM OXIDE] $\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{MgO}$
 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
376.2	0.144
443.2	0.133
503.2	0.116
537.2	0.100
673.2	0.0872
787.2	0.0749
880.2	0.0678
1033.2	0.0578
1098.2	0.0554
1173.2	0.0540
<u>CURVE 2</u>	
443.2	0.118
553.2	0.0954
650.2	0.0801
765.2	0.0681
914.2	0.0571
1045.2	0.0495
1166.2	0.0457
<u>CURVE 3</u>	
478.2	0.103
563.2	0.0892
615.2	0.0815
716.2	0.0709
833.2	0.0586
935.2	0.0516
1118.2	0.0452

THERMAL CONDUCTIVITY OF
MAGNESIUM ALUMINATE + SILICON DIOXIDE
 $MgO \cdot Al_2O_3 + SiO_2$



SPECIFICATION TABLE NO. 86 THERMAL CONDUCTIVITY OF [MAGNESIUM ALUMINATE + SILICON DIOXIDE] $MgO \cdot Al_2O_3 + SiO_2$

[For Data Reported in Figure and Table No. 86]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	68		1954	317-401	+3.0	Spinel; 17A2	20.0 SiO ₂ .
2	68		1954	315-413	+3.0	Spinel; 27A2	10.0 SiO ₂ .

DATA TABLE NO. 86 THERMAL CONDUCTIVITY OF [MAGNESIUM ALUMINATE + SILICON DIOXIDE] $\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{SiO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
317.0	0.0682
333.9	0.0644
356.1	0.0644
373.6	0.0628
400.8	0.0628
<u>CURVE 2</u>	
314.7	0.0941
335.4	0.0912
358.8	0.0883
378.5	0.0862
412.5	0.0824

**THERMAL CONDUCTIVITY OF
MAGNESIUM ALUMINATE + DISODIUM OXIDE
 $MgO \cdot Al_2O_3 + Na_2O$**

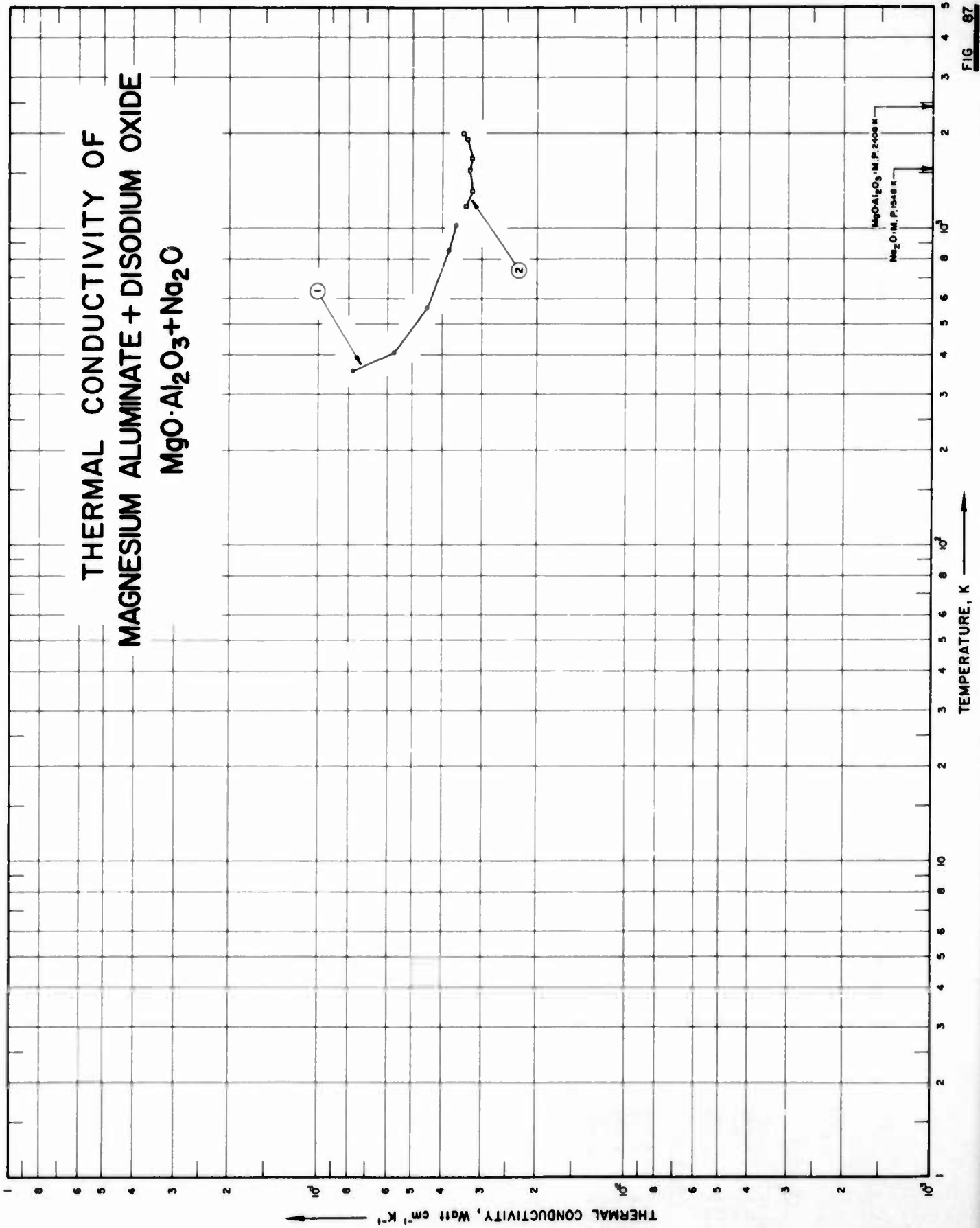


FIG. 87

SPECIFICATION TABLE NO. 87 THERMAL CONDUCTIVITY OF [MAGNESIUM ALUMINATE + DISODIUM OXIDE] $MgO \cdot Al_2O_3 + Na_2O$

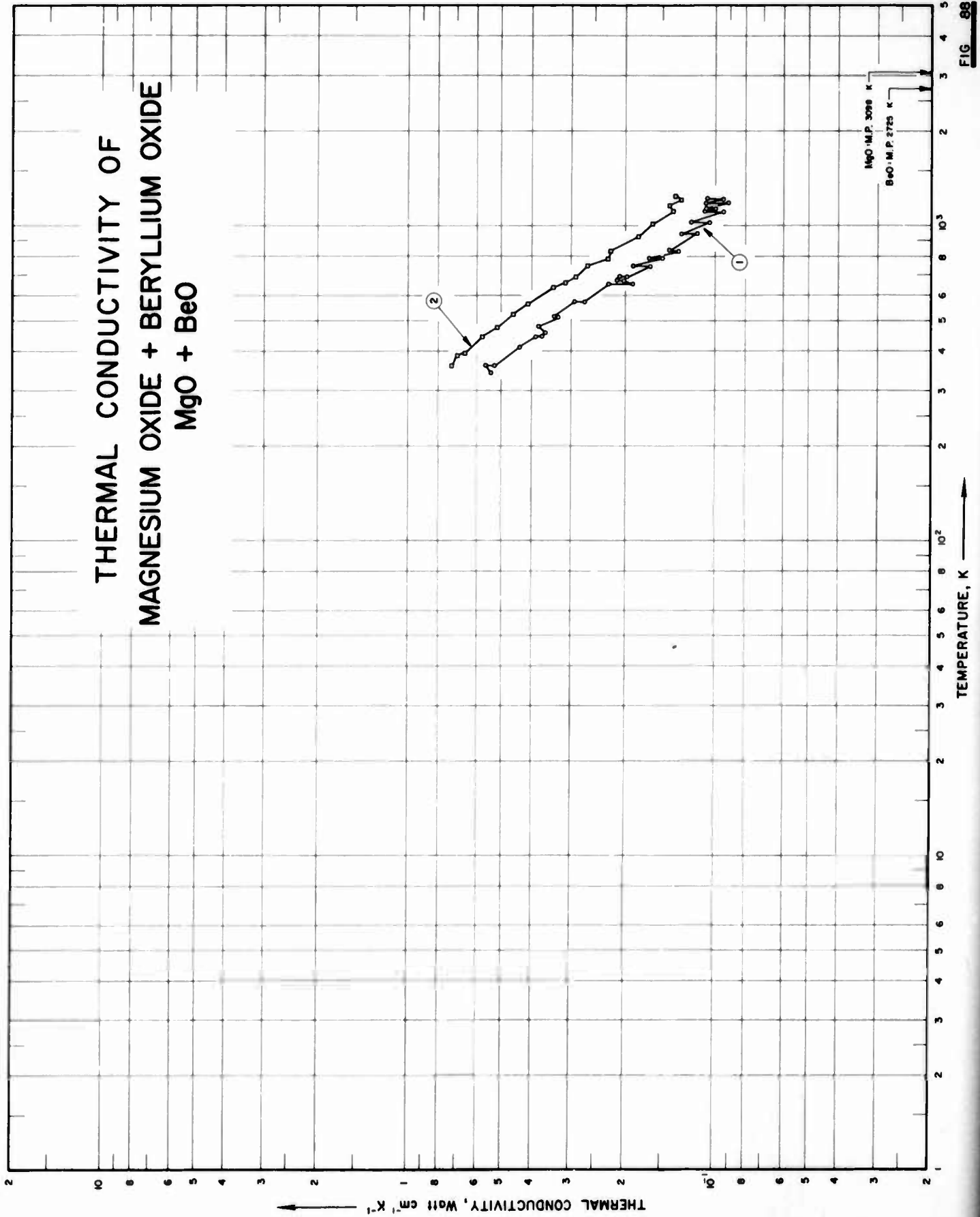
[For Data Reported in Figure and Table No. 87]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	251	C	1963	355-1022	± 4.0	Spinel	68.26 Al_2O_3 , 26.74 MgO , 3.17 Na_2O , 0.33 SiO_2 , 0.026 Fe_2O_3 , and 1.20 B; specimen 2 in. in dia and 1 in. in thickness; cold pressed; firing temperature 3300 F; both faces of the disc ground flat and parallel; measured in a helium atmosphere; Armco iron used as comparative material.
2	251	P	1963	1174-2000		Spinel	The above specimen measured by another method; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.

DATA TABLE NO. 87 THERMAL CONDUCTIVITY OF [MAGNESIUM ALUMINATE + DISODIUM OXIDE] $\text{MgO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Na}_2\text{O}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
355.4	0.0779
505.4	0.0571
660.9	0.0450
849.8	0.0391
1022.1	0.0363
<u>CURVE 2</u>	
1174.8	0.0339
1313.7	0.0322
1527.6	0.0329
1663.7	0.0324
1908.2	0.0334
1999.8	0.0344

**THERMAL CONDUCTIVITY OF
MAGNESIUM OXIDE + BERYLLIUM OXIDE
MgO + BeO**



SPECIFICATION TABLE NO. 88 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + BERYLLIUM OXIDE] MgO + BeO

[For Data Reported in Figure and Table No. 88]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	Composition (weight percent) BeO	Composition (continued), Specifications and Remarks
1	232	L	1954	343-1223			61.5	38.5	Specimen prepared by slip casting BeO + MgO suspensions containing 54.3 volume % BeO; fired bulk density 2.43 g cm ⁻³ ; total porosity 25.7%.
2	136	C	1959	361-1243	±4.0		61.5	38.5	Mixture; specimen prepared by slip casting a composition containing 54.3 volume % BeO, which was sintered at 1800 C; fired bulk density 2.43 g cm ⁻³ ; total porosity 25.7%; data corrected for porosity.

DATA TABLE NO. 88 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + BERYLLIUM OXIDE] MgO + BeO
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 2 (cont.)</u>	
343.2	0.541	566.2	0.410
363.2	0.563	639.2	0.343
363.2	0.524	663.2	0.314
413.2	0.438	688.2	0.289
448.2	0.390	746.2	0.264
448.2	0.373	788.2	0.226
460.2	0.365	835.2	0.222
480.2	0.381	923.2	0.180
513.2	0.331	1012.2	0.161
518.2	0.341	1114.2	0.138
578.2	0.293	1160.2	0.142
578.2	0.270	1203.2	0.130
655.2	0.226	1243.2	0.136
655.2	0.189		
673.2	0.201		
673.2	0.213		
693.2	0.209		
693.2	0.197		
743.2	0.164		
748.2	0.188		
790.2	0.151		
792.2	0.166		
835.2	0.133		
840.2	0.143		
945.2	0.115		
945.2	0.130		
1027.2	0.105		
1029.2	0.121		
1105.2	0.0946		
1111.2	0.109		
1138.2	0.100		
1138.2	0.108		
1193.2	0.0908		
1193.2	0.108		
1215.2	0.0941		
1223.2	0.107		
<u>CURVE 2</u>			
361.2	0.724		
389.2	0.695		
395.2	0.657		
444.2	0.573		
474.2	0.519		
523.2	0.460		

SPECIFICATION TABLE NO. 89 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + CLAY] MgO + Clay

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	Composition (continued), Specifications and Remarks Clay
1	23	1952	310-421		171 A-1	97.5	2.5 Old mine (No. 4) ball clay; specimen fired at 2800 F and soaked for 0.5 hr; white color; water absorption 0.45%; density 3.031 g cm ⁻³ .

DATA TABLE NO. 89 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + CLAY] MgO + Clay

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u> *	
310.0	0.244
335.4	0.233
360.0	0.217
383.4	0.203
421.0	0.187

* No graphical presentation

THERMAL CONDUCTIVITY OF MAGNESIUM OXIDE + MAGNESIUM ALUMINATE $MgO + MgO \cdot Al_2O_3$

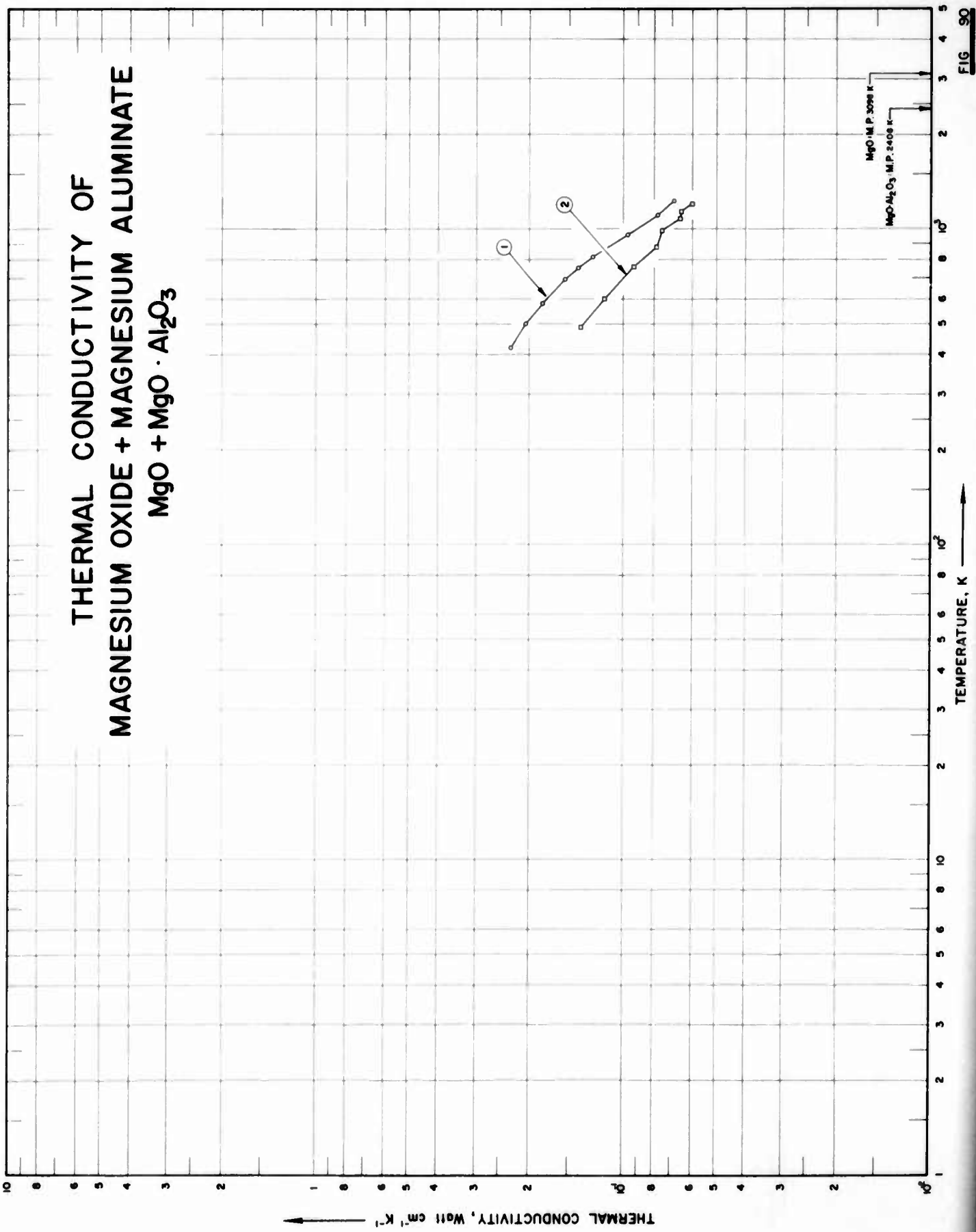


FIG 90

SPECIFICATION TABLE NO. 90 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + MAGNESIUM ALUMINATE] $\text{MgO} + \text{MgO} \cdot \text{Al}_2\text{O}_3$

[For Data Reported in Figure and Table No. 90]

Curve No.	Rel. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) $\text{MgO} \cdot \text{Al}_2\text{O}_3$	Composition (continued), Specifications and Remarks
1	C	1959	423-1239	± 4		84.2	15.8 Corresponding to 14.4 vol % magnesium aluminate; fired at 1800 C; bulk density 3.25 g cm^{-3} , porosity 10.7 vol %; data corrected for porosity; calculated composition.
2	C	1959	490-1202	± 4		70.5	29.5 Corresponding to 28.7 vol % magnesium aluminate; fired at 1800 C; bulk density 3.39 g cm^{-3} , porosity 6.4 vol %; data corrected for porosity; calculated composition.

DATA TABLE NO. 90 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + MAGNESIUM ALUMINATE] $MgO + MgO \cdot Al_2O_3$

[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k
<u>CURVE 1</u>	
423.2	0.230
502.2	0.205
583.2	0.181
695.2	0.154
753.2	0.140
818.2	0.126
960.2	0.0967
1111.2	0.0776
1239.2	0.0686
<u>CURVE 2</u>	
490.2	0.137
602.2	0.115
760.2	0.0929
877.2	0.0787
989.2	0.0751
1087.2	0.0658
1145.2	0.0651
1202.2	0.0601

**THERMAL CONDUCTIVITY OF
MAGNESIUM OXIDE + MAGNESIUM OTHOSILICATE
MgO + 2MgO · SiO₂**

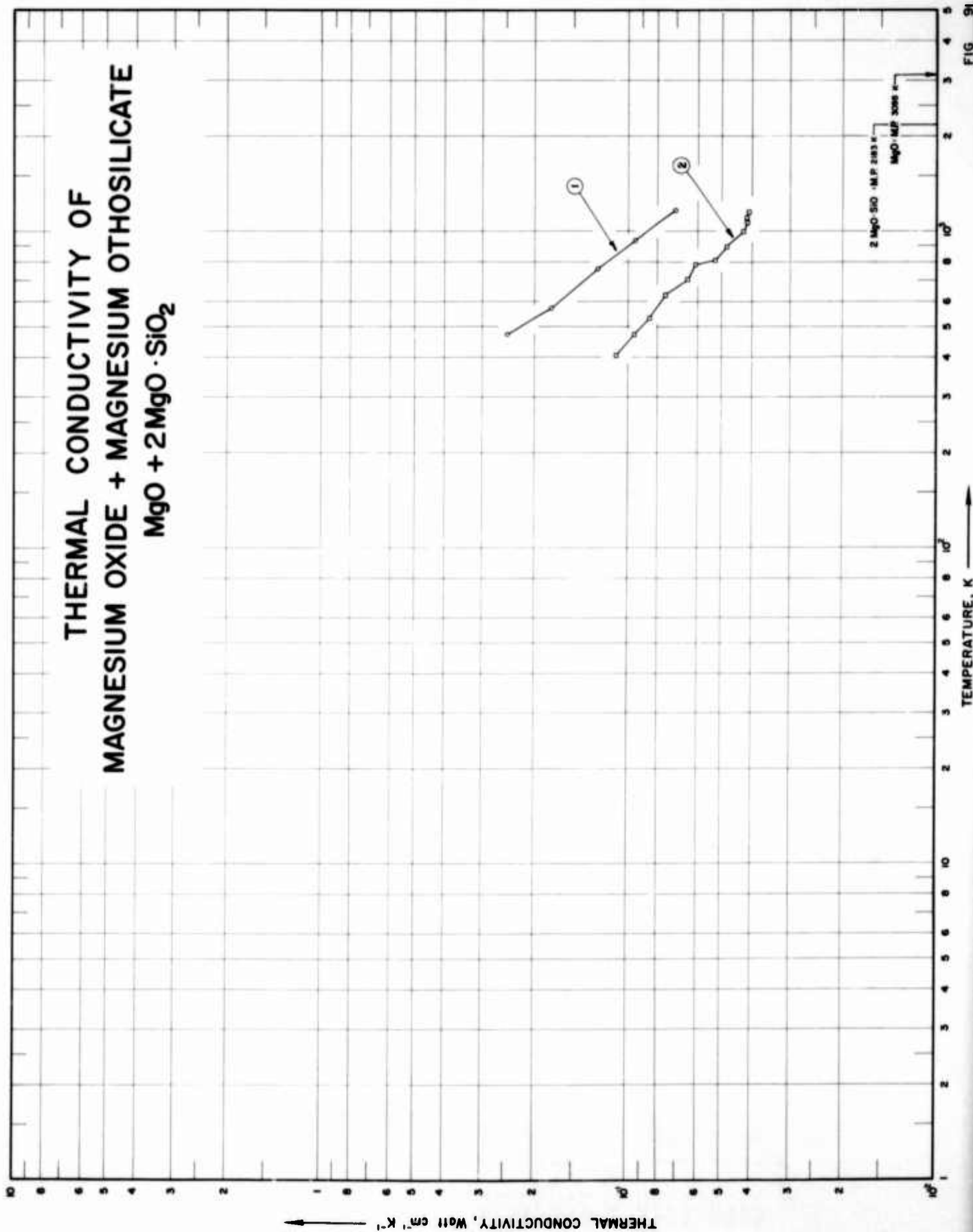


FIG. 91

SPECIFICATION TABLE NO. 91 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + MAGNESIUM ORTHOSILICATE] $\text{MgO} + 2\text{MgO} \cdot \text{SiO}_2$

[For Data Reported in Figure and Table No. 91]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	Composition (weight percent) $2\text{MgO} \cdot \text{SiO}_2$	Composition (continued), Specifications and Remarks
1	136	C	1959	473-1166	±4		87.5	12.5	Corresponding to 86.8 vol % MgO; total porosity 11.7%; data corrected to theoretical density; theoretical calculated composition.
2	136	C	1959	406-1153	±4		63.2	36.8	Corresponding to 61.6 vol % MgO; total porosity 13.8%; data corrected to theoretical density; theoretical calculated composition.

DATA TABLE NO. 91 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + MAGNESIUM ORTHOSILICATE] $\text{MgO} + 2\text{MgO} \cdot \text{SiO}_2$

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
473.2	0.247
573.2	0.177
763.2	0.126
937.2	0.0950
1166.2	0.0703
<u>CURVE 2</u>	
406.2	0.109
473.2	0.0962
533.2	0.0849
630.2	0.0753
708.2	0.0649
783.2	0.0611
810.2	0.0327
895.2	0.0481
988.2	0.0427
1070.2	0.0416
1111.2	0.0418
1153.2	0.0410

THERMAL CONDUCTIVITY OF MAGNESIUM OXIDE + NICKEL OXIDE MgO + NiO

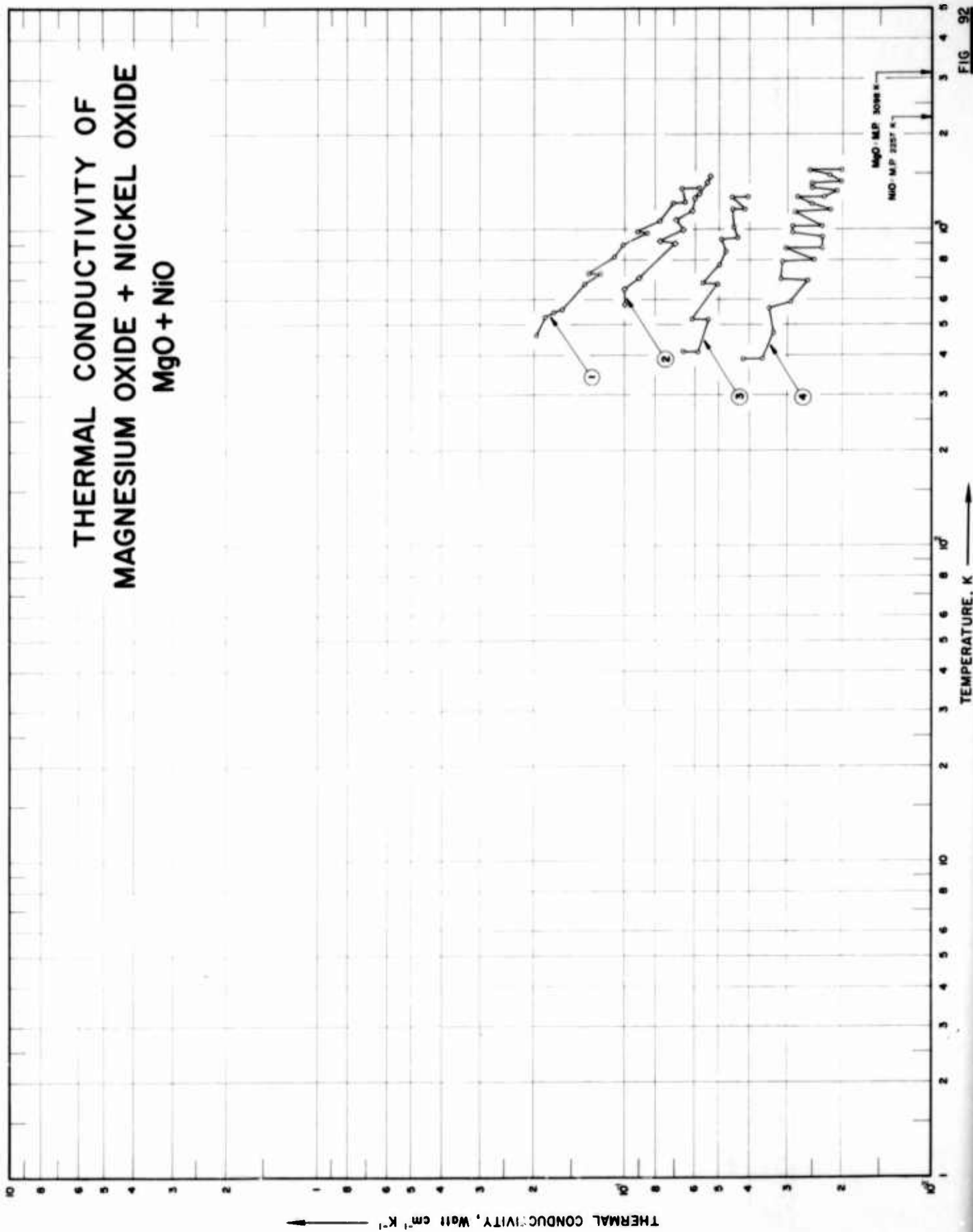


FIG. 92

SPECIFICATION TABLE NO. 92 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + NICKEL OXIDE] MgO + NiO

[For Data Reported in Figure and Table No. 92]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	NiO	Composition (continued), Specifications and Remarks
1	136	C	1959	464-1361	±4.0				99.5 MgO + NiO, 0.25 SiO ₂ , 0.1 Al ₂ O ₃ ; solid solution with 1.0 vol % NiO; prepared by grinding together high-purity fused MgO with analytical reagent-grade NiO in a porcelain ball mill, preparing as a suspension with alcohol, slip-casting, and firing; bulk density 3.12 g cm ⁻³ , total porosity 14.7%; data corrected to theoretical density.
2	136	C	1959	579-1468	±4.0				Similar to the above specimen except having 2.8 vol % NiO; bulk density 3.10 g cm ⁻³ ; total porosity 18%; data corrected to theoretical density.
3	136	C	1959	413-1272	±4.0				Similar to the above specimen except having 15 vol % NiO; bulk density 3.34 g cm ⁻³ ; total porosity 19%; data corrected to theoretical density.
4	136	C	1959	389-1548	±4.0				Similar to the above specimen except having 34.5 vol % NiO; bulk density 3.26 g cm ⁻³ ; total porosity 30.5%; data corrected to theoretical density.

DATA TABLE NO. 92 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + NICKEL OXIDE] MgO + NiO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
464.2	0.197	1023.2	0.0448
530.2	0.184	1162.2	0.0452
548.2	0.172	1163.2	0.0414
561.2	0.162	1269.2	0.0456
676.2	0.136	1272.2	0.0402
723.2	0.121	<u>CURVE 4</u>	
730.2	0.132	389.2	0.0418
823.2	0.108	391.2	0.0364
895.2	0.102	472.2	0.0335
978.2	0.0845	565.2	0.0347
989.2	0.0908	591.2	0.0293
1073.2	0.0774	690.2	0.0259
1213.2	0.0699	697.2	0.0318
1215.2	0.0644	792.2	0.0314
1356.2	0.0657	807.2	0.0247
1361.2	0.0582	875.2	0.0305
<u>CURVE 2</u>			
579.2	0.0996	878.2	0.0234
648.2	0.101	948.2	0.0234
704.2	0.0895	973.2	0.0289
903.2	0.0689	1035.2	0.0289
920.2	0.0774	1038.2	0.0234
1013.2	0.0657	1149.2	0.0285
1078.2	0.0690	1153.2	0.0222
1152.2	0.0615	1218.2	0.0251
1268.2	0.0602	1278.2	0.0276
1300.2	0.0586	1278.2	0.0230
1421.2	0.0544	1332.2	0.0209
1468.2	0.0536	1362.2	0.0251
<u>CURVE 3</u>			
413.2	0.0657	1417.2	0.0251
413.2	0.0586	1426.2	0.0201
521.2	0.0544	1492.2	0.0222
523.2	0.0615	1546.2	0.0255
676.2	0.0502	1548.2	0.0201
676.2	0.0565		
773.2	0.0498		
858.2	0.0477		
933.2	0.0490		
943.2	0.0435		

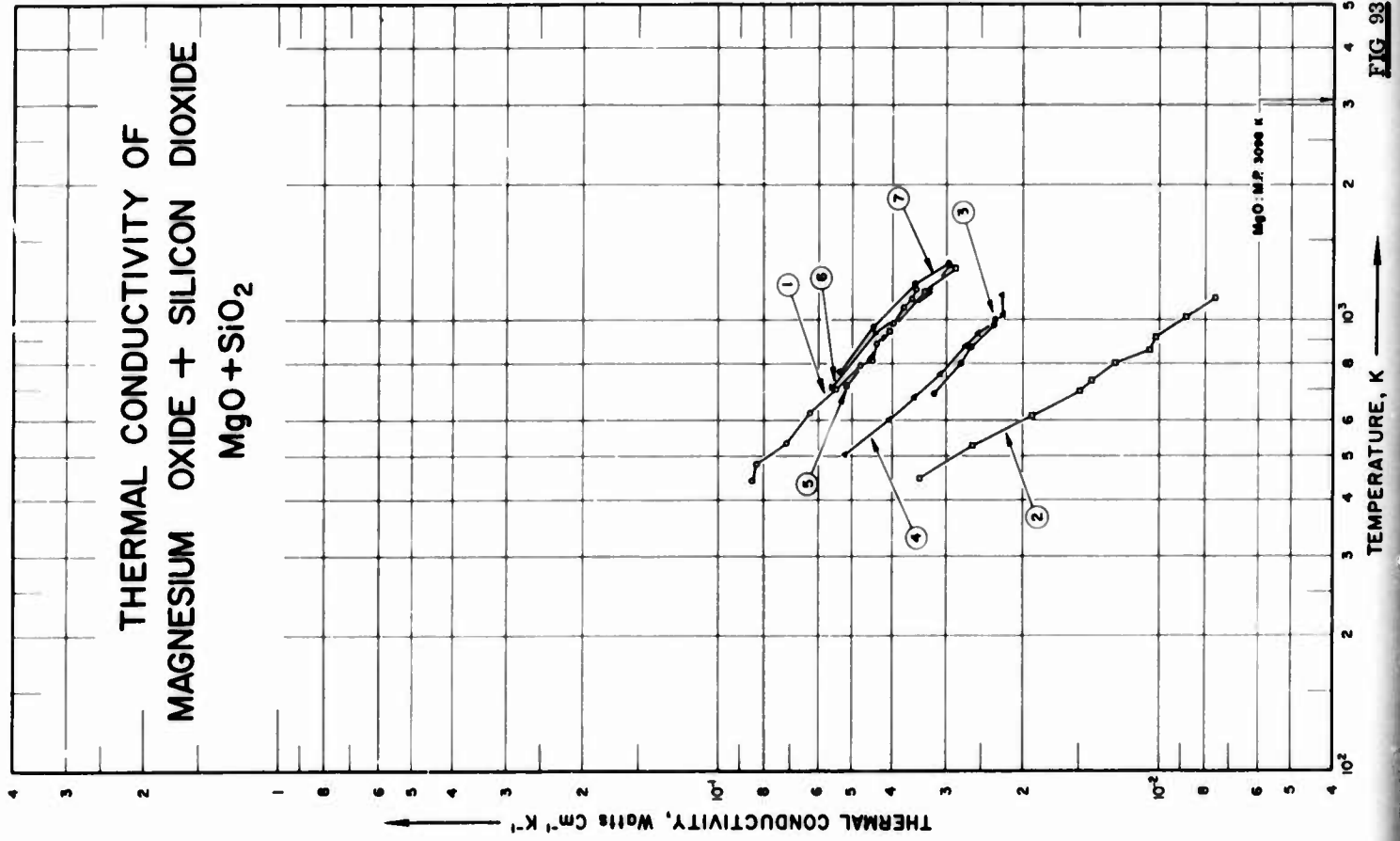


FIG 93

SPECIFICATION TABLE NO. 93 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + SILICON DIOXIDE] MgO + SiO₂

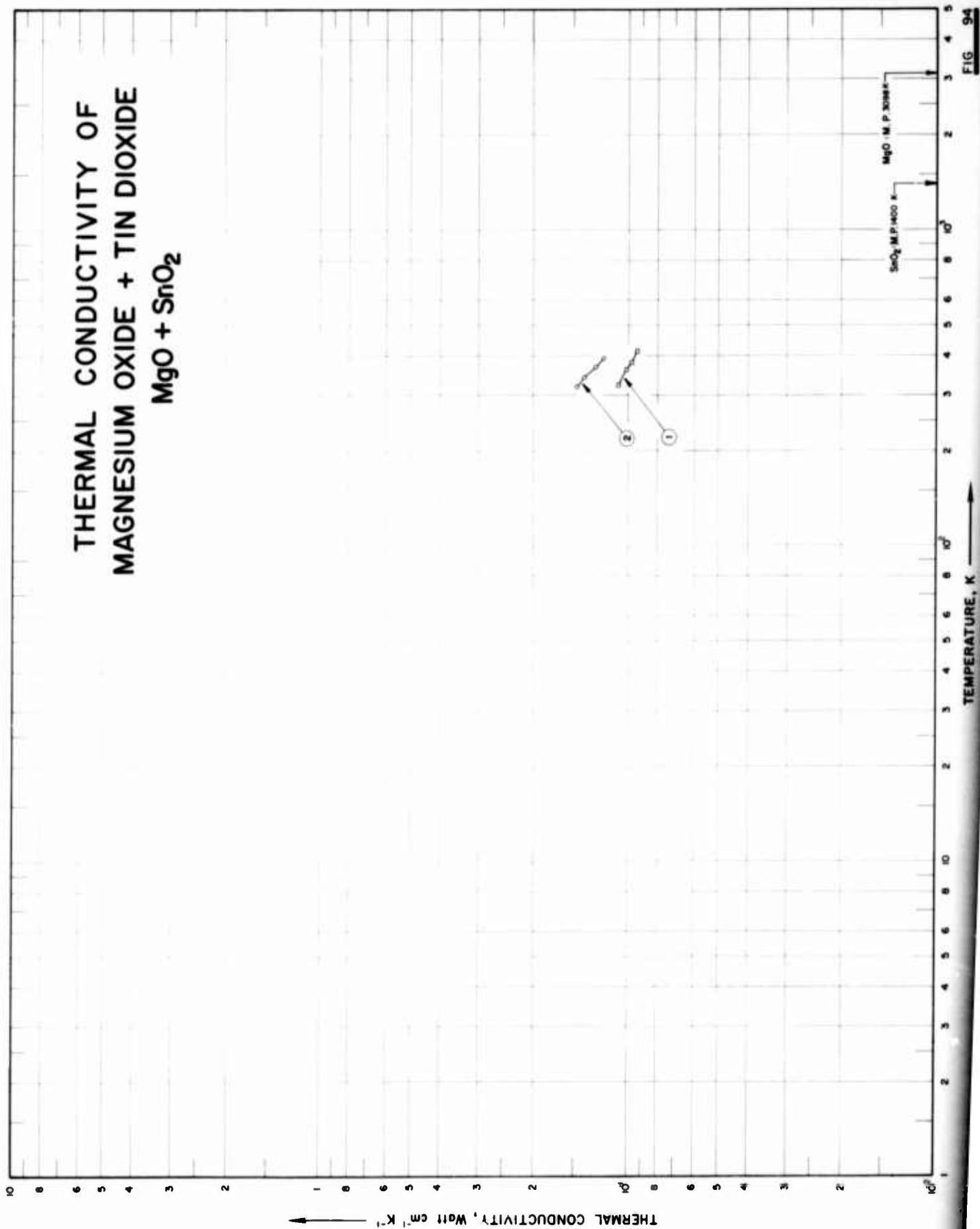
[For Data Reported in Figure and Table No. 93]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	SiO ₂	Composition (continued), Specifications and Remarks
1	145	R	1955	441-1170			95	5	Sintered.
2	145	R	1955	447-1125			85	15	Sintered.
3	145	R	1955	688-1002			75	25	Sintered.
4	146	L	1955	503-1143			65	35	Sintered.
5	143	L	1955	723-1313		Magnezit; 1	93.88	2.08	0.83 (0.05 TiO ₂) Al ₂ O ₃ , 1.63 Fe ₂ O ₃ , 1.24 CaO, and 0.20 total Ca, Mg, Fe, and Mn; magnesite basic refractory brick; density 2.81 g cm ⁻³ ; apparent porosity 22.0%; gas permeability 1.34 ml m ⁻² hr ⁻¹ per mm H ₂ O.
6	143	L	1955	713-1303		Magnezit; 2			Similar to the above specimen.
7	143	L	1955	773-1348		Magnezit; 3			Similar to the above specimen.

DATA TABLE NO. 93 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + SILICON DIOXIDE] MgO + SiO₂[Temperature, T, K; Thermal Conductivity, k, Watts cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
441.2	0.0845	723.2	0.0516
480.2	0.0828	953.2	0.0407
536.7	0.0741	1163.2	0.0337
621.8	0.0628	1313.2	0.0284
704.2	0.0544	<u>CURVE 6</u>	
793.2	0.0478	713.2	0.0558
812.6	0.0447	943.2	0.0437
883.2	0.0435	1163.2	0.0330
982.2	0.0397	1303.2	0.0293
1069.2	0.0376	<u>CURVE 7</u>	
1115.5	0.0360	773.2	0.0535
1170.2	0.0351	973.2	0.0442
<u>CURVE 2</u>			
447.2	0.0346	1203.2	0.0354
528.4	0.0262	1348.2	0.0294
617.2	0.0192	<u>CURVE 3</u>	
697.2	0.0149	688.2	0.0318
735.5	0.0140	801.2	0.0277
800.7	0.0125	871.2	0.0262
858.2	0.0105	974.2	0.0233
918.2	0.0102	1001.7	0.0232
1012.2	0.00879	<u>CURVE 4</u>	
1125.2	0.00757	503.2	0.0520
<u>CURVE 5</u>			
441.2	0.0845	601.2	0.0404
480.2	0.0828	676.2	0.0356
536.7	0.0741	759.2	0.0309
621.8	0.0628	878.2	0.0270
704.2	0.0544	934.2	0.0254
793.2	0.0478	1027.2	0.0202
812.6	0.0447	1143.2	0.0203

THERMAL CONDUCTIVITY OF
MAGNESIUM OXIDE + TIN DIOXIDE
MgO + SnO₂



SPECIFICATION TABLE NO. 94 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + TIN DIOXIDE] MgO + SnO₂

[For Data Reported in Figure and Table No. 94]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	Composition (weight percent) SnO ₂	Composition (continued), Specifications and Remarks
1	12		1953	323-415		225A-1	51.7	48.3	4 MgO + SnO ₂ by mole; prepared by milling pure oxides in water, calcining at 1367 K after drying, then dry-pressing in a 0.5 in. steel die at 15,000 psi; fired at 1755 K and soaked for 1.5 hrs; water absorption 0.028%; density 4.18 g cm ⁻³ .
2	12		1953	320-392		226A-1	70.7	29.3	9 MgO + SnO ₂ by mole; same specimen preparation as the above; fired at 1811 K and soaked for 1.5 hrs; water absorption 0.17%; density 3.84 g cm ⁻³ .

DATA TABLE NO. 94 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + TIN DIOXIDE] MgO + SnO₂
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
322.6	0.108
343.2	0.105*
364.2	0.102
383.6	0.0975
415.0	0.0937
<u>CURVE 2</u>	
319.7	0.146
340.6	0.139
368.1	0.128
391.8	0.121

* Not shown on plot

SPECIFICATION TABLE NO. 95 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + URANIUM DIOXIDE] MgO + UO₂

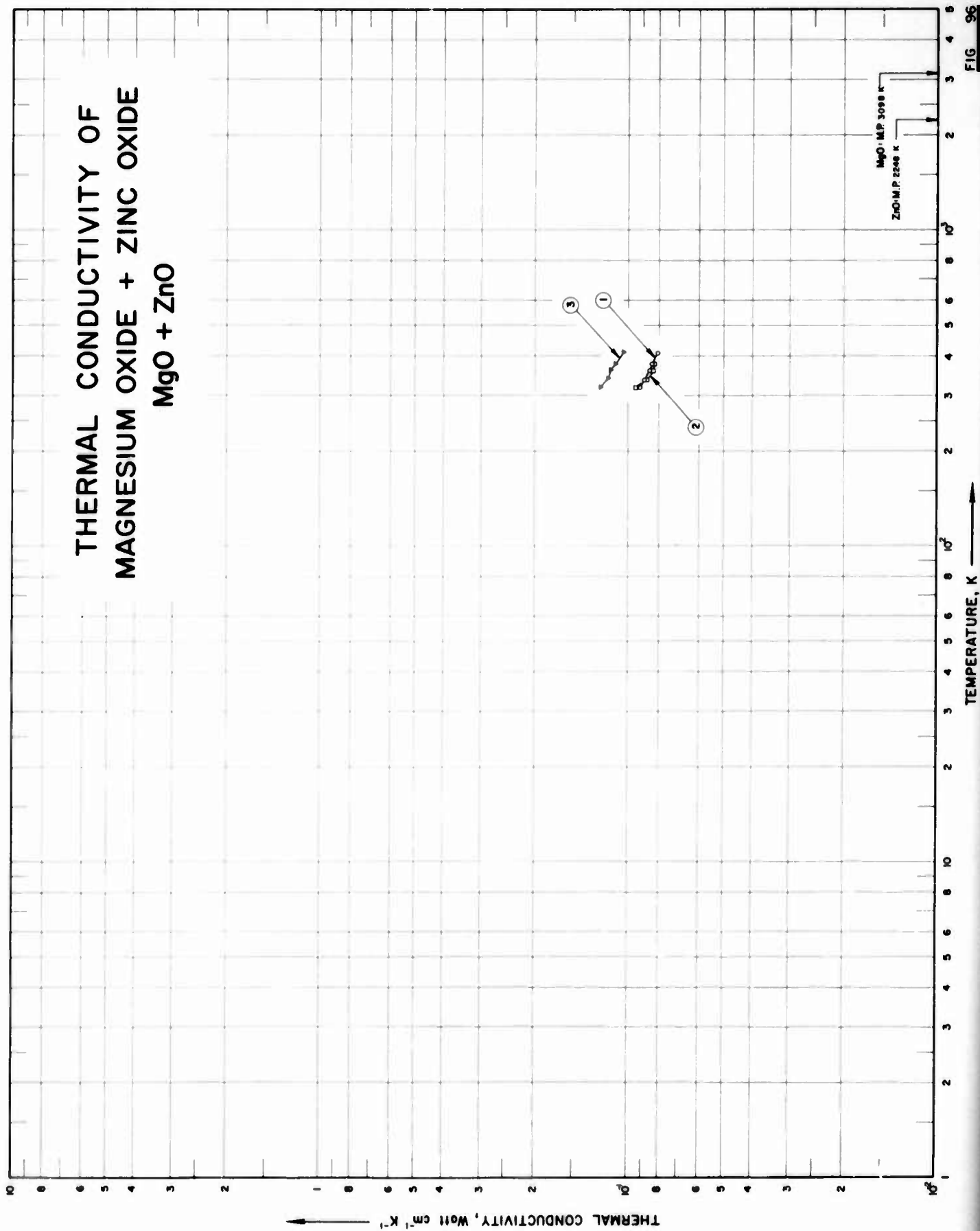
Curve No.	R. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	Composition (weight percent) UO ₂	Composition (continued), Specifications and Remarks
1	76	L	1952	383-793		53	47	87% theoretical density.

DATA TABLE NO. 95 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + URANIUM DIOXIDE] MgO + UO₂
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u> *	
383.2	0.150
573.2	0.115
793.2	0.065

* No graphical presentation

THERMAL CONDUCTIVITY OF
MAGNESIUM OXIDE + ZINC OXIDE
MgO + ZnO



SPECIFICATION TABLE NO. 96 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + ZINC OXIDE] MgO + ZnO

[For Data Reported in Figure and Table No. 96]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	ZnO	Composition (continued), Specifications and Remarks
1	12		1953	319-410		264A-1	53.6	46.4	7 MgO + 3 ZnO by mole; prepared from pure oxides, milled in water, dried, calcined at 1367 K, then dry-pressed in 0.5 in. steel die at 15,000 psi; fired at 1700 K and soaked for 2 hrs; water absorption 0.003%; density 5.00 g cm ⁻³ .
2	12		1953	318-409		265A-1	66.5	33.5	4 MgO + ZnO by mole; same preparation as that of the above specimen except fired at 1644 K; water absorption 0.015%; density 5.02 g cm ⁻³ .
3	12		1953	320-413		266A-1	81.7	18.3	9 MgO + ZnO by mole; same preparation as that of the above specimen; water absorption 0.029%; density 5.22 g cm ⁻³ .

DATA TABLE NO. 96 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + ZINC OXIDE] MgO + ZnO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
319.4	0.0916
338.5	0.0887
361.0	0.0854
378.1	0.0841
410.2	0.0808
<u>CURVE 2</u>	
318.2	0.0946
338.1	0.0874
361.8	0.0833
379.7	0.0828
408.8	0.0803*
<u>CURVE 3</u>	
320.4	0.123
340.3	0.116
361.2	0.114
378.2	0.109
412.5	0.103

* Not shown on plot

THERMAL CONDUCTIVITY OF MAGNESIUM ORTHOSILICATE + MAGNESIUM OXIDE $2\text{MgO} \cdot \text{SiO}_2 + \text{MgO}$

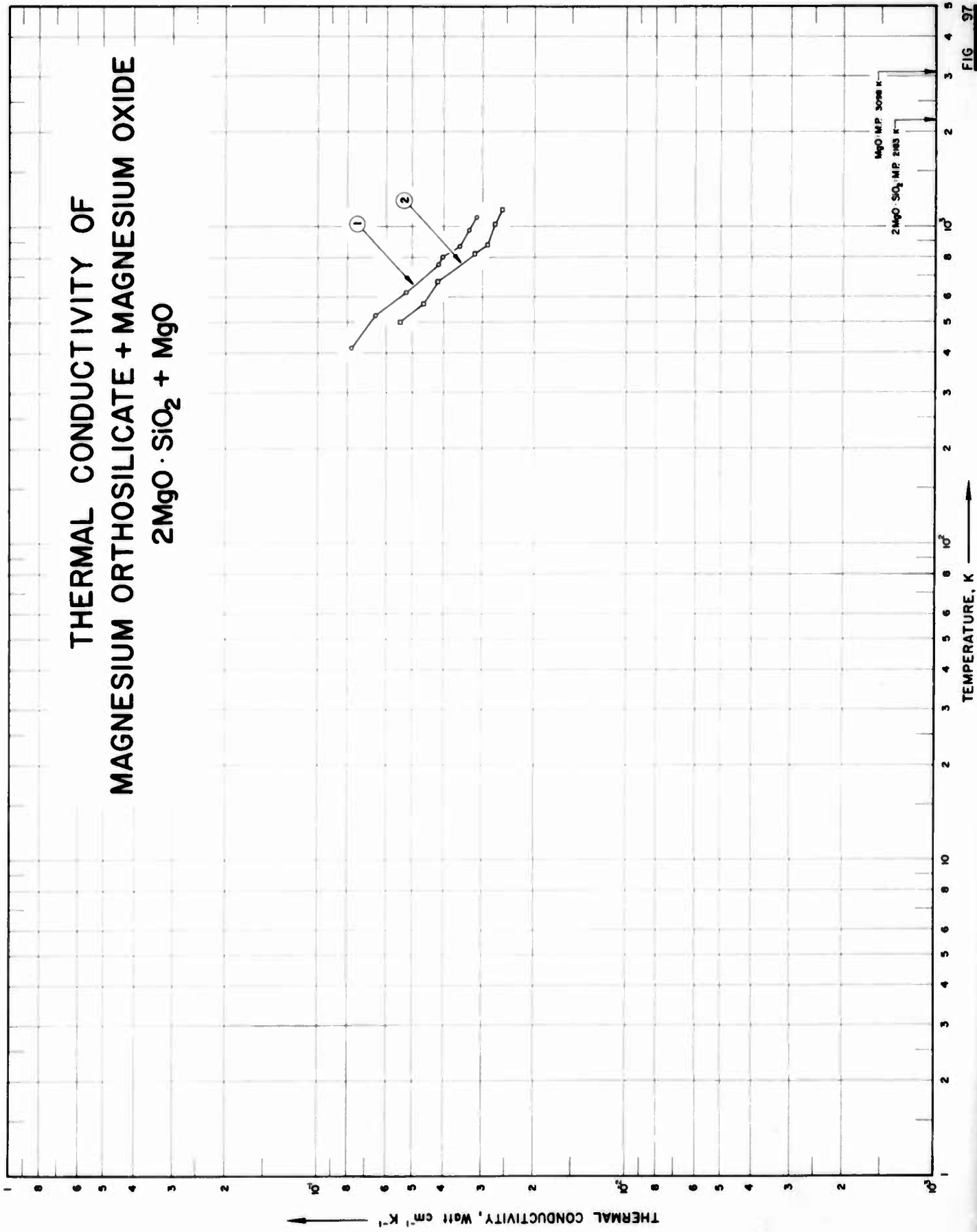


FIG. 97

SPECIFICATION TABLE NO. 97 THERMAL CONDUCTIVITY OF [MAGNESIUM ORTHOSILICATE + MAGNESIUM OXIDE] $2\text{MgO} \cdot \text{SiO}_2 + \text{MgO}$

[For Data Reported in Figure and Table No. 97]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) $2\text{MgO} \cdot \text{SiO}_2$	MgO	Composition (continued), Specifications and Remarks
1	136	C	1959	417-1078	±4		60.4	39.6	Corresponding to 38.0 vol % MgO; total porosity 14.3%; data corrected to theoretical density; calculated composition.
2	136	C	1959	502-1144	±4		83.4	16.6	Corresponding to 15.7 vol % MgO; total porosity 16.8%; data corrected to theoretical density; calculated composition.

DATA TABLE NO. 97 THERMAL CONDUCTIVITY OF [MAGNESIUM ORTHOSILICATE + MAGNESIUM OXIDE] $2\text{MgO} \cdot \text{SiO}_2 + \text{MgO}$
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
417.2	0.0776
529.2	0.0653
623.2	0.0521
762.2	0.0415
805.2	0.0402
870.2	0.0356
980.2	0.0333
1078.2	0.0314
<u>CURVE 2</u>	
502.2	0.0544
574.2	0.0464
673.0	0.0418
823.2	0.0318
879.2	0.0288
1021.2	0.0273
1144.2	0.0259

SPECIFICATION TABLE NO. 98 THERMAL CONDUCTIVITY OF [DIMANGANESE TRIOXIDE + ALUMINUM OXIDE] $Mn_2O_3 + Al_2O_3$

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Mn_2O_3	Composition (weight percent) Al_2O_3	Composition (continued), Specifications and Remarks
1	23	1952	315-403		156 A	69.89	30.11	$3Mn_2O_3 \cdot 2Al_2O_3$; firing temperature 1811 K; water absorption 0.006%; density 4.13 g cm ⁻³ .

DATA TABLE NO. 98 THERMAL CONDUCTIVITY OF [DIMANGANESE TRIOXIDE + ALUMINUM OXIDE] $Mn_2O_3 + Al_2O_3$ [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

314.6	0.0195
330.7	0.0188
351.9	0.0199
369.9	0.0205
402.7	0.0213

* No graphical presentation

SPECIFICATION TABLE NO. 99 THERMAL CONDUCTIVITY OF [DIMANGANESE TRIOXIDE + MAGNESIUM OXIDE] $Mn_2O_3 + MgO$

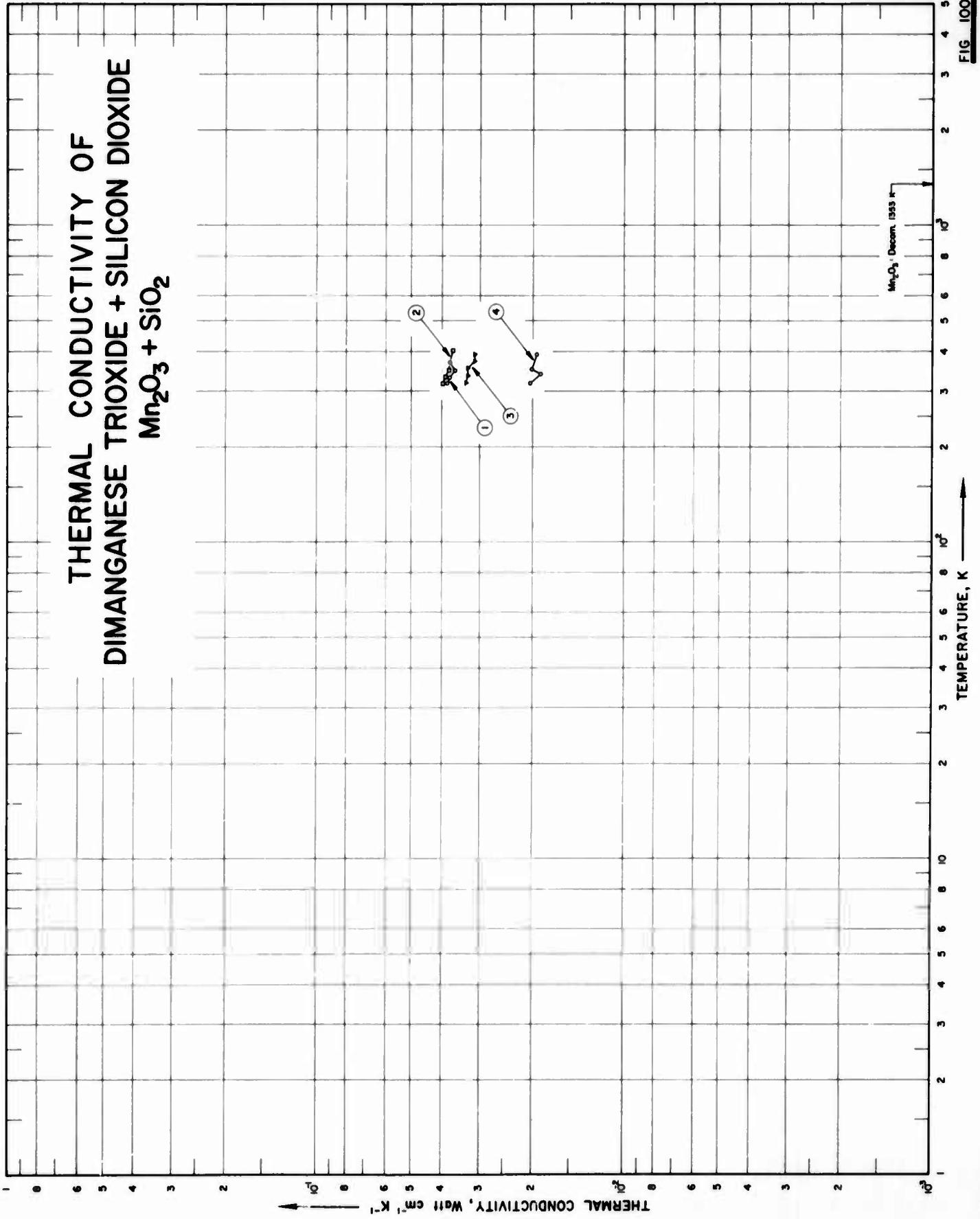
Curve No.	Ref. Method No.	Year Used	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Mn_2O_3	Composition (weight percent) MgO	Composition (continued), Specifications and Remarks
1	23	1952	319-408		177 A	94	6	$4Mn_2O_3$; MgO ; fired at 1644 K; density 4.11 g cm^{-3} ; water absorption 0.45%.

DATA TABLE NO. 99 THERMAL CONDUCTIVITY OF [DIMANGANESE TRIOXIDE + MAGNESIUM OXIDE] $Mn_2O_3 + MgO$
[Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

T	k
CURVE 1*	
319.2	0.0372
334.9	0.0376
355.6	0.0380
375.2	0.0370
408.2	0.0367

* No graphical presentation

THERMAL CONDUCTIVITY OF
 DIMANGANESE TRIOXIDE + SILICON DIOXIDE
 $Mn_2O_3 + SiO_2$



SPECIFICATION TABLE NO. 100 THERMAL CONDUCTIVITY OF [MANGANESE TRIOXIDE + SILICON DIOXIDE] $Mn_2O_3 + SiO_2$

[For Data Reported in Figure and Table No. 100]

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition Mn_2O_3 (weight percent)	Composition SiO_2 (weight percent)	Composition (continued), Specifications and Remarks
1	23	1952	319-371		172A	91.18	8.82	Composition $4Mn_2O_3 : SiO_2$; firing temperature 1561 K; water absorption 0.01%; density 3.82 g cm^{-3} .
2	23	1952	318-402		172B	91.18	8.82	Composition $4Mn_2O_3 : SiO_2$; firing temperature 1533 K; water absorption 0.012%; density 3.88 g cm^{-3} .
3	23	1952	319-394		173A	79.49	20.51	Composition $3Mn_2O_3 : 2Si_2$; firing temperature 1533 K; water absorption none; density 3.71 g cm^{-3} .
4	23	1952	317-394		174A	63.27	36.73	Composition $2Mn_2O_3 : 3SiO_2$; firing temperature 1478 K; water absorption 0.053%; density 3.53 g cm^{-3} .

DATA TABLE NO. 100 THERMAL CONDUCTIVITY OF [MANGANESE TRIOXIDE + SILICON DIOXIDE] $\text{Mn}_2\text{O}_3 + \text{SiO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
318.7	0.0385
332.8	0.0378
350.4	0.0364
370.8	0.0377
<u>CURVE 2</u>	
317.6	0.0396
334.8	0.0390
351.6	0.0380
372.5	0.0377*
401.5	0.0369
<u>CURVE 3</u>	
318.8	0.0333
335.1	0.0329
354.7	0.0329
373.5	0.0312
393.8	0.0312
<u>CURVE 4</u>	
317.3	0.0205
339.3	0.0188
353.5	0.0202
393.5	0.0195

* Not shown on plot

THERMAL CONDUCTIVITY OF SILICON DIOXIDE + ALUMINUM OXIDE

$\text{SiO}_2 + \text{Al}_2\text{O}_3$

FIGURE SHOWS ONLY 17 OF THE CURVES REPORTED IN TABLE

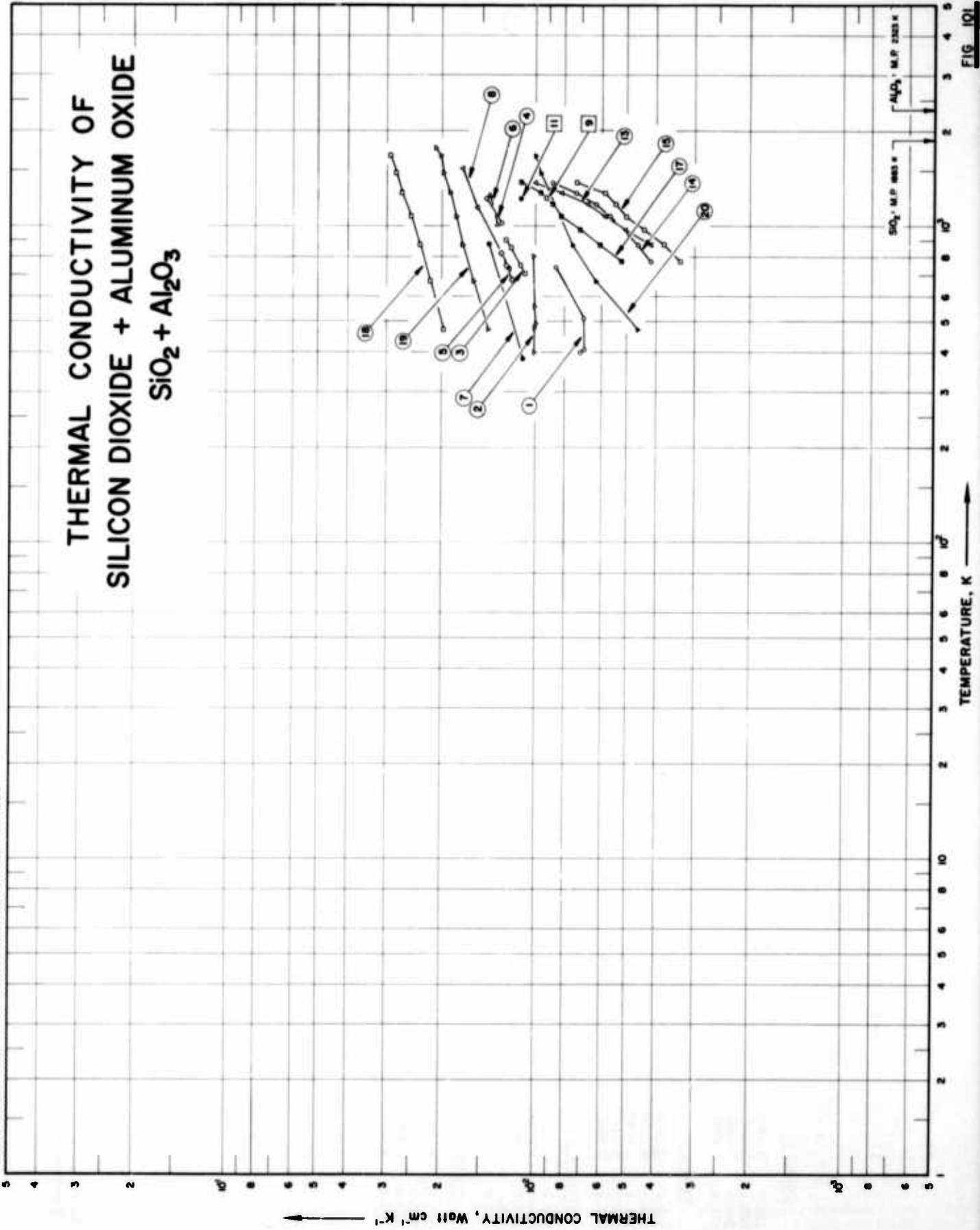


FIG. 101

SPECIFICATION TABLE NO. 101 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + ALUMINUM OXIDE] $\text{SiO}_2 + \text{Al}_2\text{O}_3$

[For Data Reported in Figure and Table No. 101]

Curve No.	Ref. No. Used	Method	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) SiO_2	Composition (weight percent) Al_2O_3	Composition (continued), Specifications and Remarks
1	247	L	1932	399-740	1	Fireclay brick 17	53.56	42.23	1.59 Fe_2O_3 , 1.01 CaO , 0.83 MgO , and 0.62 TiO_2 ; density 2.710 g cm^{-3} ; porosity 31.5%; gas permeability 3.00 $\text{m}^3 \text{cm per m}^2\text{-hr-mm H}_2\text{O}$. Porosity 21.0%.
2	247	L	1932	398-804	1	Fireclay brick 725	<60	>40	0.89 TiO_2 , 0.63 Fe_2O_3 , 0.38 CaO , 0.10 MgO , and 0.29 alkali oxides; specimen in the form of a slab measuring 18 in. x 18 in.; made from natural quartzitic silica sands bonded with clays; fired at 1360 C for 14 hrs; after being fired specimen is of fine texture, containing finely divided cristobalite and considerable residual free quartz in a clayey matrix; porosity 21.36%; weight lost on ignition 0.14%.
3	79, 475	L	1942	709-902		Sillimanite refractory brick; 6	88.29	9.24	Similar to the above specimen but in disc form 8 in. in dia and 1 in. in thickness; steel used as comparative material.
4	79, 345	C	1942	1023, 1225		Sillimanite refractory brick; 6			0.75 TiO_2 , 0.53 Fe_2O_3 , 0.13 MgO , 0.10 CaO , and 0.17 alkali oxides; specimen in the form of a slab measuring 18 in. x 18 in.; similar raw material to the above specimen No. 6; fired at 1360 C for 14 hrs; mineralogical constitution of the fired product similar to the above specimen No. 6; porosity 24.10%; weight lost on ignition 0.12%.
5	79, 345	L	1942	679-822		Sillimanite refractory brick; 7	89.11	9.04	Similar to the above specimen but in disc form 8 in. in dia and 1 in. in thickness; steel used as comparative material.
6	79, 345	C	1942	1006, 1252		Sillimanite refractory			2.0 TiO_2 , 1.6 Fe_2O_3 , 0.5 CaO , trace MgO , and 0.6 alkali; approximate composition; bulk density 2.29 g cm^{-3} ; porosity 15.2%.
7	80	L	1934	382, 877		Dense fireclay brick (Mexko-brand)	52.5	42.07	The above specimen measured with insulating brick placed between the calorimeter and the lower surface of the brick.
8	80	L	1934	733-1527		Dense fireclay brick (Mexko-brand)			1.61 Fe_2O_3 , 1.60 MgO , 1.30 TiO_2 , 0.8 CaO , 0.48 ($\text{K}_2\text{O} + \text{Na}_2\text{O}$), and 0.27 loss; (consists of 12.5% sandy fire clay and 37.5% of plastic fire clay with 50% by volume of 3-mesh to 16-mesh fire clay frog); specimen 8.5 in. in dia and 2.04 in. in thickness; porosity 24.9% calculated from the dry saturated and suspended weight; measured at 740 mm Hg pressure.
9	81	L	1924	1223.2		Pressed fireclay; 2	67.11	28.20	Similar to the above specimen except measured at 745.8 mm Hg pressure.
10	81	L	1924	1223.2		Pressed fireclay; 3			
11	81	L	1924	1223.2		Light weight fireclay	66.77	28.94	2.0 TiO_2 , 1.52 Fe_2O_3 , 0.95 ($\text{K}_2\text{O} + \text{Na}_2\text{O}$), trace CaO , trace MgO , and 0.18 loss; (consists of 40% plastic fire clay, 40% lignitic clay, 10% 3-mesh to 16-mesh frog, and 10% 16 F frog) specimen 8.5 in. in dia and 1.97 in. thick; porosity 42.5% calculated from the dry saturated and suspended weight; bulk specific gravity 1.7; measured at 744.0 mm Hg pressure.

SPECIFICATION TABLE NO. 101 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	SiO ₂	Al ₂ O ₃	Composition (continued), Specifications and Remarks
12	81	L	1924	1223-2		Light weight fireclay; 2			Similar to the above specimen except porosity 41.2% and measured in 745.8 mm Hg pressure.
13	238	P	1921	873-1373		Firebrick E	57.9	32.96	Very close structure: specimen 9 x 4.5 x 2.5 in.; abundance of fine grained rounded grog and a little larger grained grog; exceptionally good adherence; marked by a fair number of black cores, generally with cavities; faces smooth and edges sharp; porosity 15.9%; heat flow in the length-wise direction.
14	238	P	1921	773-1373		Firebrick F	67.49	27.15	Very open texture; specimen 9 x 4.5 x 2.5 in.; abundance of rounded clay grog of uneven grading, some grains approx to pebbles; unweathered pellets detected; adherence poor - in fact, material is very friable; highly fissured; porosity 24.6%; heat flow in the direction of the length of the specimen.
15	238	P	1921	773-1373		Retort material G	67.1	27.17	Very open texture; specimen 9 x 4.5 x 2.5 in.; very heavily grogged with medium to fine rounded material of uneven grading; abundance of small fissures; adherence of grog very poor; matrix appears to have contracted away from the grog; porosity 24%; heat flow in the direction of the length of the specimen.
16	238	P	1921	773-1373		Retort material H	65.7	28.47	Somewhat closer in texture than G; specimen 9 x 4.5 x 2.5 in.; the above specimen heavily grogged with rounded material of slightly more even grading than G; adherence as a whole fairly good, although some are easily detached; some fissures; very white color with well-defined skin; porosity 28.2%; heat flow in the direction of the length of the specimen.
17	238	P	1921	773-1373		Retort material I	72.46	23.65	Very close in texture; specimen 9 x 4.5 x 2.5 in.; abundant grog which, tending to be rounded, evenly graded, possibly some quartz fragments; black cores present, but scarce; tendency toward layering; fissures, present but scarce, are parallel to outside faces; superficial skin; signs of possible reduction toward end of fire; porosity 24.7%; heat flow in the direction of the length of the specimen.
18	383	L	1927	473-1673	±15	Kaolin firebrick	52.02	45.92	1.51 Fe ₂ O ₃ , 0.35 TiO ₂ , trace of alkalis; specimen 10.8 cm in dia and 22.8 cm long; apparent density 2.66 g cm ⁻³ , bulk density 2.36 g cm ⁻³ ; porosity 10.8%; made of sedimentary kaolin by mixing 65% of 20-mesh pre-fired grog and 35% of raw clay, and firing to 1575 C for 4 hrs.

SPECIFICATION TABLE NO. 101 (continued)

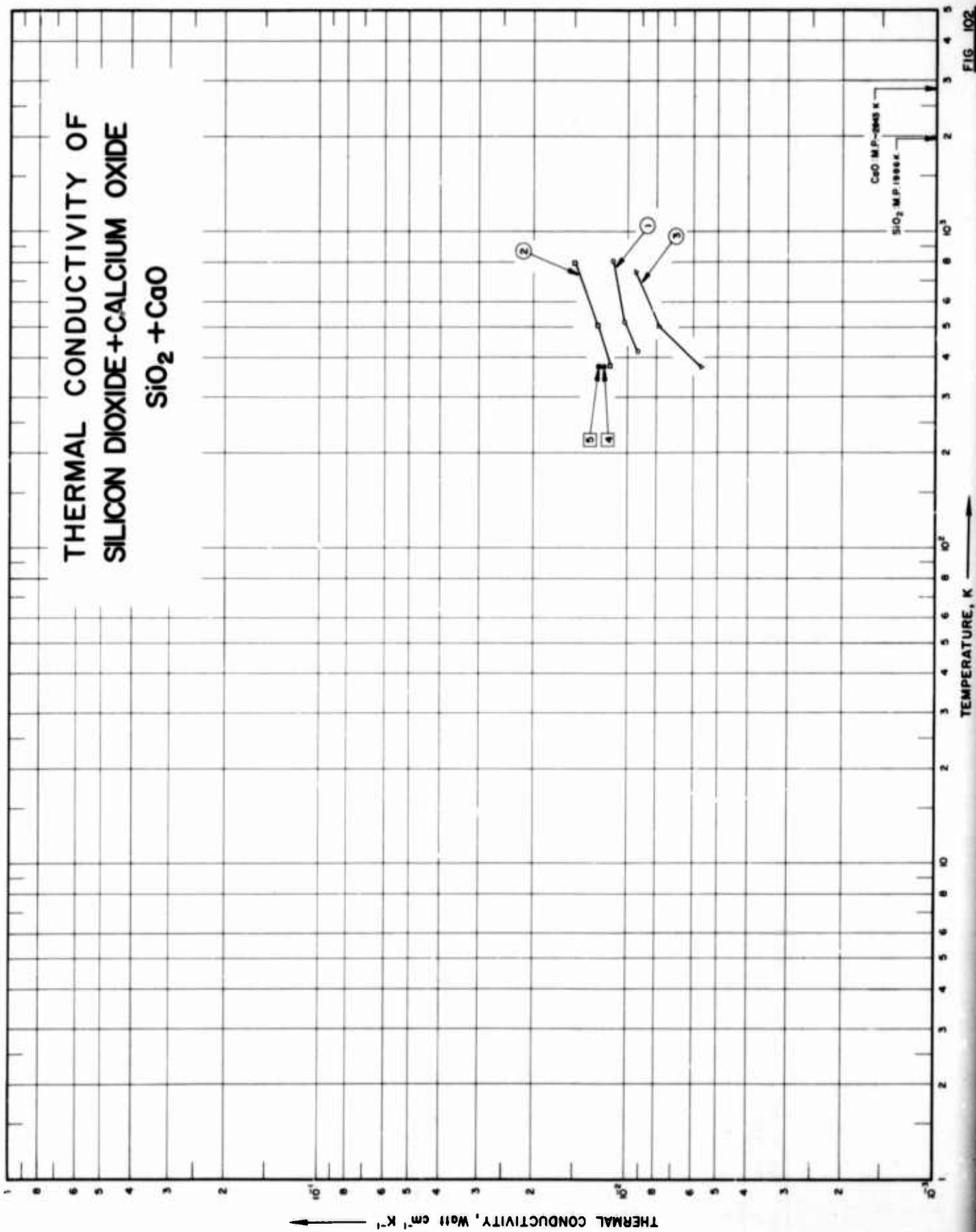
Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	SiO ₂	Al ₂ O ₃	Composition (weight percent)	Composition (continued), Specifications and Remarks
19	383 L	1927	473-1773	±15	Kaolin firebrick	52.02	45.92		1.51 Fe ₂ O ₃ , 0.35 TiO ₂ , trace of alkalis; specimen 10, 8 cm in dia and 22.8 cm long; apparent density 2.65 g cm ⁻³ , bulk density 2.10 g cm ⁻³ ; porosity 23.2%; made of secondary kaolin by mixing 65% of 4-mesh pre-fired grog and 35% of raw clay, and firing to 1575 C for 4 hrs.
20	383 L	1927	473-1673	±15	Kaolin firebrick	52.02	45.92		1.51 Fe ₂ O ₃ , 0.35 TiO ₂ , trace of alkalis; specimen 10, 8 cm in dia and 22.8 cm long; apparent density 2.50 g cm ⁻³ , bulk density 1.27 g cm ⁻³ ; porosity 49.1%.
21	268 L	1946	573-1573			69.7	27.5		Trace of iron oxide and CaO; density 1.87 g cm ⁻³ ; porosity 25.5%.
22	458 P	1921	373.2		Red brick	76.32	21.96		1.88 Fe ₂ O ₃ , traces of CaO and MgO; commercial brick 4 cm in dia and 8 cm long, density 1.795 g cm ⁻³ ; thermal conductivity value calculated from measured data of thermal diffusivity, specific heat, and density.
23	458 P	1921	373.2		White Shamotte brick	79.98	19.48		0.40 Fe ₂ O ₃ , traces of CaO and MgO; specimen 4 cm in dia and 8 cm long; supplied by Imperial Steel Works; density 1.565 g cm ⁻³ ; same measuring method as above.
24	458 P	1921	373.2		Red Shamotte brick	71.74	25.56		1.02 Fe ₂ O ₃ , 0.82 CaO, and 0.53 MgO; specimen 4 cm in dia and 8 cm long; supplied by Imperial Steel Works; density 1.784 g cm ⁻³ ; same measuring method as above.

DATA TABLE NO. 101 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + ALUMINUM OXIDE] $\text{SiO}_2 + \text{Al}_2\text{O}_3$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 9</u>		<u>CURVE 16*</u>		<u>CURVE 20 (cont.)</u>			
398.2	0.00709	1223.2	0.00920	773.2	0.00397	1473.2	0.00962		
408.6	0.00687	<u>CURVE 10*</u>		873.2	0.00460	1673.2	0.0100		
511.6	0.00688	1223.2	0.00782	973.2	0.00502	<u>CURVE 21*</u>			
740.0	0.00853	<u>CURVE 11</u>		1073.2	0.00586	573.2	0.0108		
<u>CURVE 2</u>		1223.2	0.0113	1173.2	0.00669	673.2	0.0115		
398.2	0.0101	<u>CURVE 12*</u>		1273.2	0.00732	773.2	0.0122		
477.9	0.0101	1223.2	0.00975	1373.2	0.00879	873.2	0.0129		
492.0	0.00996	<u>CURVE 13</u>		<u>CURVE 17</u>		973.2	0.0135		
559.5	0.0101	873.2	0.00418	773.2	0.00523	1073.2	0.0140		
804.0	0.0102	973.2	0.00502	873.2	0.00607	1173.2	0.0145		
<u>CURVE 3</u>		1073.2	0.00586	973.2	0.00711	1273.2	0.0150		
709.2	0.0109	1173.2	0.00669	1073.2	0.00816	1373.2	0.0154		
754.2	0.0113	1273.2	0.00816	1173.2	0.00879	1473.2	0.0158		
853.2	0.0121	1373.2	0.0100	1273.2	0.00962	1573.2	0.0161		
902.2	0.0126	<u>CURVE 14</u>		1373.2	0.0113	<u>CURVE 22*</u>			
<u>CURVE 4</u>		773.2	0.00418	<u>CURVE 18</u>		373.2	0.00674		
1023.2	0.0130	873.2	0.00460	473.2	0.0197	<u>CURVE 23*</u>			
1225.2	0.0146	973.2	0.00502	573.2	0.0218	373.2	0.00523		
<u>CURVE 5</u>		1073.2	0.00586	673.2	0.0234	<u>CURVE 24*</u>			
679.2	0.0121	1173.2	0.00669	773.2	0.0251	373.2	0.00661		
748.2	0.0126	1273.2	0.00732	873.2	0.0268				
822.2	0.0130	1373.2	0.00879	973.2	0.0280				
<u>CURVE 6</u>		<u>CURVE 15</u>		1073.2	0.0280				
1006.2	0.0134	773.2	0.00418	1173.2	0.0293				
1252.2	0.0142	873.2	0.00460	1273.2	0.0293				
<u>CURVE 7</u>		973.2	0.00502*	<u>CURVE 19</u>					
381.5	0.0111	1073.2	0.00585	473.2	0.0142				
876.5	0.0142	1173.2	0.00628	573.2	0.0159				
<u>CURVE 8</u>		1273.2	0.00732	673.2	0.0172				
732.6	0.0123	1373.2	0.00879	773.2	0.0180				
1145.4	0.0156	773.2	0.00335	873.2	0.0188				
1526.5	0.0173	873.2	0.00377	973.2	0.0197				
		973.2	0.00439	1073.2	0.0201				
		1073.2	0.00502	1173.2	0.0209				
		1173.2	0.00544	<u>CURVE 20*</u>					
		1273.2	0.00596	473.2	0.00460				
		1373.2	0.00732	573.2	0.00628				
				673.2	0.00753				
				773.2	0.00837*				
				873.2	0.00920*				

*Not shown on plot

THERMAL CONDUCTIVITY OF
SILICON DIOXIDE+CALCIUM OXIDE
 $\text{SiO}_2 + \text{CaO}$



SPECIFICATION TABLE NO. 102 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + CALCIUM OXIDE] $\text{SiO}_2 + \text{CaO}$

[For Data Reported in Figure and Table No. 102]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) SiO_2	Composition (weight percent) CaO	Composition (continued), Specifications and Remarks
1	247	L	1932	423-808	1.0	Silica brick 1	2.37	0.55 Al_2O_3 , 0.69 Fe_2O_3 , 0.19 MgO , 0.72 TiO_2 ; density 2.342 g cm^{-3} , porosity 19.0%; gas permeability 0.184 $\text{m}^3\text{-cm per m}^2\text{-hr-mm H}_2\text{O}$.
2	247	L	1932	377-798	1.0	Silica brick 8	2.98	0.91 Al_2O_3 , 0.79 Fe_2O_3 , 0.22 MgO , 0.50 TiO_2 ; density 2.327 g cm^{-3} , porosity 23.1%; gas permeability 0.582 $\text{m}^3\text{-cm per m}^2\text{-hr-mm H}_2\text{O}$.
3	247	L	1932	372-744	1.0	Silica brick 9	3.26	1.84 Al_2O_3 , 0.55 Fe_2O_3 , 0.23 MgO , 0.41 TiO_2 ; density 2.350 g cm^{-3} , porosity 27.6%; gas permeability 1.750 $\text{m}^3\text{-cm per m}^2\text{-hr-mm H}_2\text{O}$.
4	458	R	1921	373.2		Silica brick	3.06	1.18 Al_2O_3 , and 1.13 Fe_2O_3 ; specimen 10 cm in dia and 4.5 cm thick; density 1.840, 1.836, 1.829, 1.814, and 1.804 g cm^{-3} at 20, 50, 100, 200, and 300 C, respectively.
5	458	P	1921	373.2		Silica brick		Similar to the above specimen; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.

DATA TABLE NO. 122 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + CALCIUM OXIDE] $\text{SiO}_2 + \text{CaO}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
422.9	0.00527
520.9	0.0103
807.7	0.0112
<u>CURVE 2</u>	
377.1	0.0115
504.3	0.0126
798.0	0.0149
<u>CURVE 3</u>	
372.4	0.00564
501.6	0.00787
743.5	0.00939
<u>CURVE 4</u>	
373.2	0.0121
<u>CURVE 5</u>	
373.2	0.0124

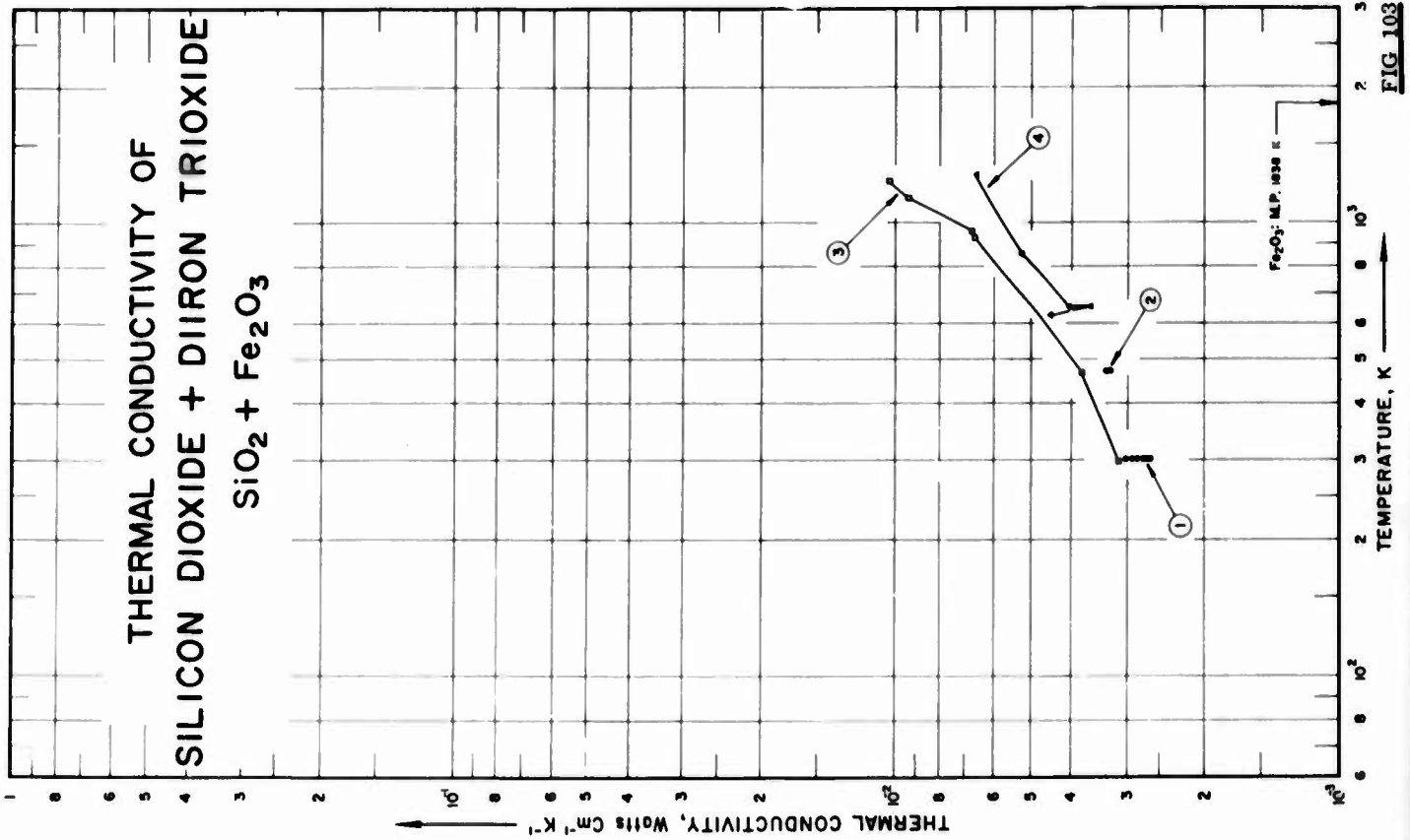


FIG. 103

SPECIFICATION TABLE NO. 103 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + BIRON TRIOXIDE] $\text{SiO}_2 + \text{Fe}_2\text{O}_3$

[For Data Reported in Figure and Table No. 103]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition SiO_2 (weight percent)	Composition Fe_2O_3 (weight percent)	Composition (continued), Specifications and Remarks
1	249	R	1953	303.2		Special No. 4 Silica Sand	96.2	2.15	0.74 CaO, 0.25 Al_2O_3 , and trace MgO; trace of ignition loss; grain size 100-120 mesh; measured at constant temperature with increasing apparent specific gravity.
2	249	R	1953	473.2		Special No. 4 Silica Sand	96.2	2.15	0.74 CaO, 0.25 Al_2O_3 , and trace MgO; trace of ignition loss; grain size 100-120 mesh; measured at constant temperature with increasing apparent specific gravity.
3	249	R	1953	298-1248		Special No. 4 Silica Sand	96.2	2.15	0.74 CaO, 0.25 Al_2O_3 , and trace of ignition loss; grain size 14-20 mesh; apparent specific gravity 1.29.
4	249	R	1953	628-1293		Special No. 4 Silica Sand	96.2	2.15	0.74 CaO, 0.25 Al_2O_3 , and trace MgO; trace of ignition loss; grain size 140-200 mesh; apparent specific gravity 1.31.

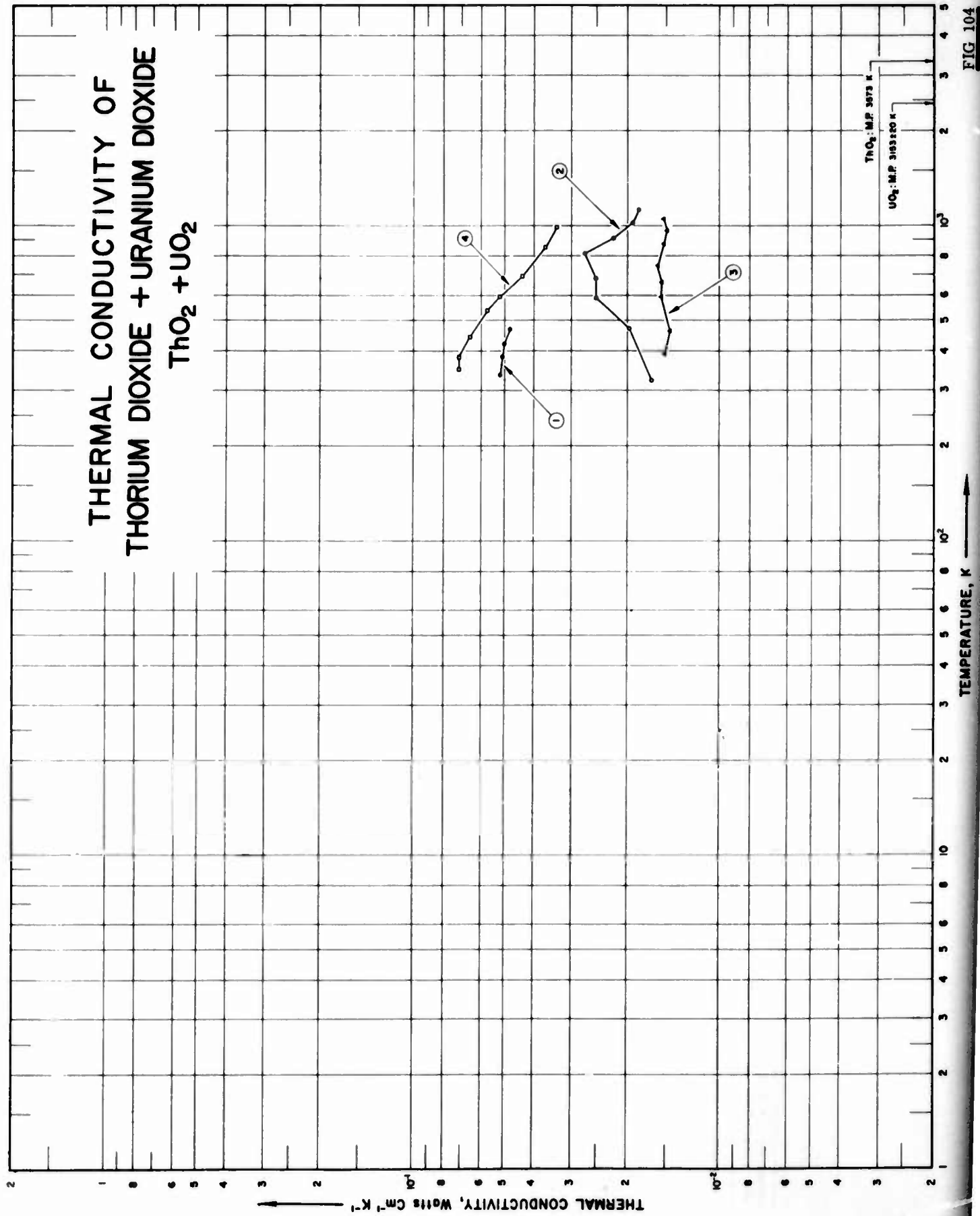
DATA TABLE NO. 103 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + BIRON TRIOXIDE] $\text{SiO}_2 + \text{Fe}_2\text{O}_3$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

Apparent specific gravity	k
<u>CURVE 1</u> (T = 303.2 K)	
1.220	0.00264
1.228	0.00267
1.228	0.00273
1.296	0.00284
1.296	0.00292
1.296	0.00302
<u>CURVE 2</u> (T = 473.2 K)	
1.216	0.00329
1.228	0.00335
1.292	0.00336*
T	k
<u>CURVE 3</u>	
298.2	0.00314
468.2	0.00378
928.2	0.00668
963.2	0.00674
1138.2	0.00936
1248.2	0.0104
<u>CURVE 4</u>	
628.2	0.00453
653.2	0.00360
658.2	0.00407
853.2	0.00523
1293.2	0.00662

*Not shown on plot

THERMAL CONDUCTIVITY OF THORIUM DIOXIDE + URANIUM DIOXIDE

$\text{ThO}_2 + \text{UO}_2$



SPECIFICATION TABLE NO. 104 THERMAL CONDUCTIVITY OF [THORIUM DIOXIDE + URANIUM DIOXIDE] $\text{ThO}_2 + \text{UO}_2$

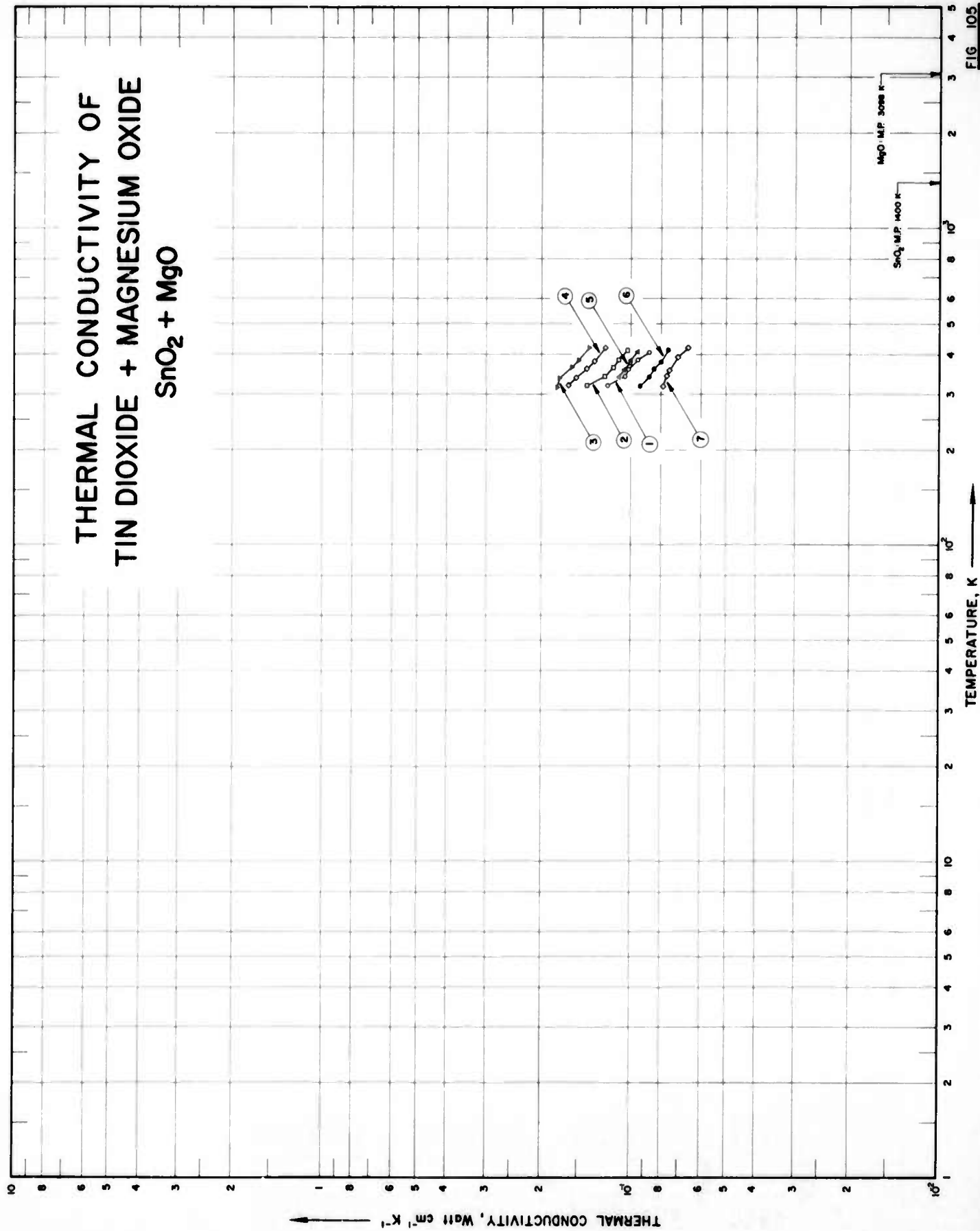
[For Data Reported in Figure and Table No. 104]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ThO_2	Composition (weight percent) UO_2	Composition (continued), Specifications and Remarks
1	136	C	1959	336-471	±4%	$\text{Th}_{0.736}\text{U}_{0.264}\text{O}_2$	73.2	26.8	Corresponding to 26.4 mole % UO_2 , 73.6 mole % ThO_2 ; solid solution.
2	136	C	1959	324-1123	±4%	$\text{Th}_{0.736}\text{U}_{0.264}\text{O}_2 + x$	73.2	26.8	Corresponding to 26.4 mole % UO_2 , 73.6 mole % ThO_2 , heated in air above 500 C before testing; having an undetermined oxygen content $0 < x \leq 0.25$; solid solution; density 9.48 g cm^{-3} ; porosity 5.0%; data corrected according to theoretical density.
3	136	C	1959	393-1053	±4%	$\text{Th}_{0.60}\text{U}_{0.40}\text{O}_2 + x$	68.5	31.5	Similar to the above specimen except corresponding to 31 mole % UO_2 , 69 mole % ThO_2 and density 8.16 g cm^{-3} , porosity 18.0%.
4	136	C	1959	351-991	±4%	$\text{Th}_{0.90}\text{U}_{0.10}\text{O}_2 + x$	89.8	10.2	Similar to the above specimen except corresponding to 10 mole % UO_2 , 90 mole % ThO_2 and density 8.89 g cm^{-3} , porosity 9.4%.

DATA TABLE NO. 104 THERMAL CONDUCTIVITY OF [THORIUM DIOXIDE + URANIUM DIOXIDE] ThO₂ + UO₂
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
336.2	0.0519
384.2	0.0510
423.2	0.0502
471.2	0.0481
<u>CURVE 2</u>	
324.2	0.0167
472.2	0.0198
591.2	0.0251
682.2	0.0251
818.2	0.0272
916.2	0.0222
1022.2	0.0192
1123.2	0.0184
<u>CURVE 3</u>	
393.2	0.0151
464.2	0.0146
593.2	0.0155
661.2	0.0156
749.2	0.0159
879.2	0.0152
968.2	0.0149
1053.2	0.0153
<u>CURVE 4</u>	
351.2	0.0715
383.2	0.0715
448.2	0.0657
540.2	0.0573
598.2	0.0523
691.2	0.0439
851.2	0.0366
991.2	0.0335

**THERMAL CONDUCTIVITY OF
TIN DIOXIDE + MAGNESIUM OXIDE
SnO₂ + MgO**



SPECIFICATION TABLE NO. 105 THERMAL CONDUCTIVITY OF [TIN DIOXIDE + MAGNESIUM OXIDE] $\text{SnO}_2 + \text{MgO}$

[For Data Reported in Figure and Table No. 105]

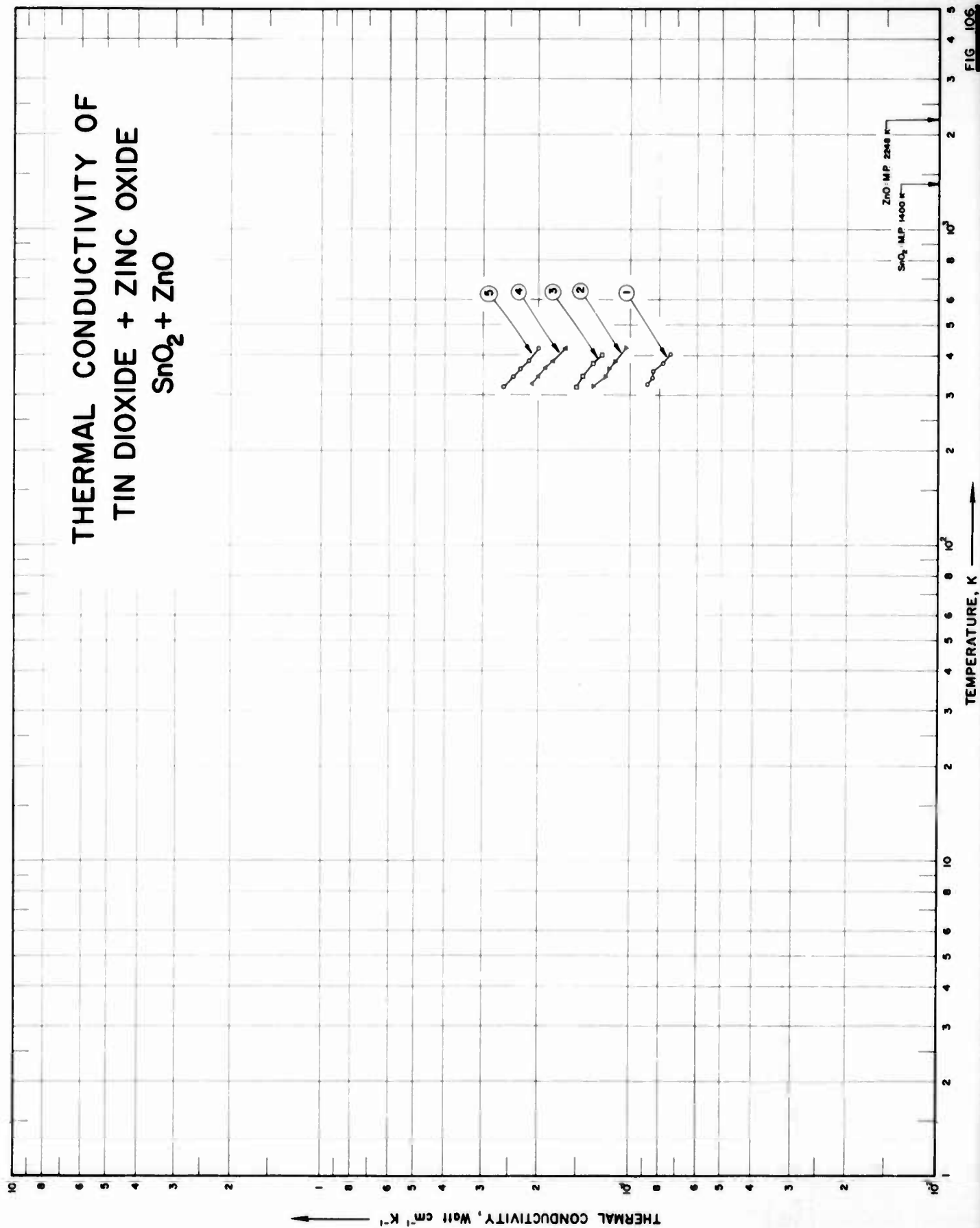
Curve No.	Ref. No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition SnO_2 (weight percent)	Composition MgO (weight percent)	Composition (continued), Specifications and Remarks
1	12	1953	321-408		218A-1	97.1	2.9	1 $\text{MgO} + 9 \text{SnO}_2$ by mole; prepared by milling pure oxides in water, calcining at 1367 K after drying and then dry-pressing in a 0.5 in. steel die at 15,000 psi; fired at 1755 K and soaked for 1 hr; water absorption 6.59%; density 4.42 g cm^{-3} .
2	12	1953	321-414		219A-1	93.7	6.3	1 $\text{MgO} + 4\text{SnO}_2$ by mole; same specimen preparation as the above; fired at 1755 K and soaked for 1 hr; water absorption 6.86%; density 4.49 g cm^{-3} .
3	12	1953	316-421		220A-1	89.7	10.3	3 $\text{MgO} + 7 \text{SnO}_2$ by mole; same specimen preparation as the above; fired at 1783 K and soaked for 1.5 hrs; water absorption 0.70%; density 5.54 g cm^{-3} .
4	12	1953	320-421		221A-1	84.9	15.1	2 $\text{MgO} + 3 \text{SnO}_2$ by mole; same specimen preparation as the above; fired at 1783 K and soaked for 1.5 hrs; 0.46% water absorption 0.46%; density 5.45 g cm^{-3} .
5	12	1953	319-409		222A-1	78.9	21.1	1 $\text{MgO} + \text{SnO}_2$ by mole; same specimen preparation as the above; fired at 1783 K and soaked for 1.5 hrs; water absorption 0.19%; density 5.20 g cm^{-3} .
6	12	1953	317-415		223A-1	71.4	28.6	3 $\text{MgO} + 2 \text{SnO}_2$ by mole; same specimen preparation as the above; fired at 1755 K and soaked for 1.5 hrs; water absorption 0.098%; density 4.81 g cm^{-3} .
7	12	1953	319-422		224A-1	61.6	38.4	7 $\text{MgO} + 3 \text{SnO}_2$ by mole; same specimen preparation as the above; fired at 1783 K and soaked for 1.5 hrs; water absorption 0.12%; density 4.26 g cm^{-3} .

DATA TABLE NO. 105 THERMAL CONDUCTIVITY OF [TIN DIOXIDE + MAGNESIUM OXIDE] SnO₂ + MgO
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
320.5	0.120	379.7	0.0799
342.0	0.105	414.6	0.0761
360.2	0.102	<u>CURVE 7</u>	
385.0	0.0946	318.7	0.0787
407.7	0.0874	343.1	0.0766
<u>CURVE 2</u>			
320.9	0.141	356.5	0.0753
341.0	0.123	393.8	0.0707
364.5	0.115	421.9	0.0657
384.0	0.110	<u>CURVE 3</u>	
413.9	0.103	315.9	0.177
<u>CURVE 3</u>			
337.4	0.174	337.4	0.174
365.0	0.158	365.0	0.158
385.8	0.150	385.8	0.150
421.4	0.138	421.4	0.138
<u>CURVE 4</u>			
320.4	0.162	320.4	0.162
338.8	0.153	338.8	0.153
362.7	0.141	362.7	0.141
382.8	0.133	382.8	0.133
420.6	0.122	420.6	0.122
<u>CURVE 5</u>			
319.2	0.119*	319.2	0.119*
339.2	0.110	339.2	0.110
358.2	0.106	358.2	0.106
376.5	0.101	376.5	0.101
382.0	0.100	382.0	0.100
408.6	0.0950	408.6	0.0950
<u>CURVE 6</u>			
317.2	0.0933	317.2	0.0933
340.2	0.0874	340.2	0.0874
361.8	0.0841	361.8	0.0841

* Not shown on Plot

THERMAL CONDUCTIVITY OF
TIN DIOXIDE + ZINC OXIDE
 $\text{SnO}_2 + \text{ZnO}$



SPECIFICATION TABLE NO. 106 THERMAL CONDUCTIVITY OF [TIN DIOXIDE + ZINC OXIDE] $\text{SnO}_2 + \text{ZnO}$

[For Data Reported in Figure and Table No. 106]

Curve No.	Ref. No. Used	Method	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) SnO_2	Composition (weight percent) ZnO	Composition (continued), Specifications and Remarks
1	12		1953	324-403		191A-1	64.9	35.1	1 SnO_2 to 1 ZnO by mole; prepared by milling pure oxides in water, calcining at 1367 K after drying; pressing at 15000 psi; fired at 1644 K and soaked for 1 hr; water absorption 0.224%; density 6.02 g cm^{-3} .
2	12		1953	321-424		192C-1	73.5	26.5	3 SnO_2 to 2 ZnO by mole; same preparation as the above specimen; fired at 1700 K and soaked for 2 hrs; water absorption 0.201%; density 6.24 g cm^{-3} .
3	12		1953	317-402		193A-1	81.2	18.8	7 SnO_2 to 3 ZnO by mole; same preparation as the above specimen; fired at 1700 K and soaked for 1 hr; water absorption 0.303%; density 6.16 g cm^{-3} .
4	12		1953	326-421		194A-1	88.1	11.9	4 SnO_2 to 1 ZnO by mole; same preparation as the above specimen; fired at 1728 K and soaked for 2 hrs; density 6.25 g cm^{-3} .
5	12		1953	319-422		195A-1	94.3	5.7	9 SnO_2 to 1 ZnO by mole; same preparation as the above specimen; fired at 1728 K and soaked for 1 hr; water absorption 0.009%; density 6.32 g cm^{-3} .

DATA TABLE NO. 106 THERMAL CONDUCTIVITY OF [TIN DIOXIDE + ZINC OXIDE] $\text{SnO}_2 + \text{ZnO}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
324.4	0.0879
340.2	0.0845
357.7	0.0841
379.3	0.0778
402.8	0.0736
<u>CURVE 2</u>	
320.6	0.133
342.6	0.121
362.0	0.118
382.6	0.113
424.0	0.103
<u>CURVE 3</u>	
317.2	0.152
344.0	0.145
378.6	0.134
402.0	0.125
<u>CURVE 4</u>	
326.4	0.210
344.9	0.200
365.4	0.189
385.1	0.179
421.0	0.163
<u>CURVE 5</u>	
319.3	0.261
343.2	0.244
363.2	0.231
385.0	0.216
421.5	0.199

SPECIFICATION TABLE NO. 107 THERMAL CONDUCTIVITY OF [TUNGSTEN TRIOXIDE + ZINC OXIDE] $WO_3 + ZnO$

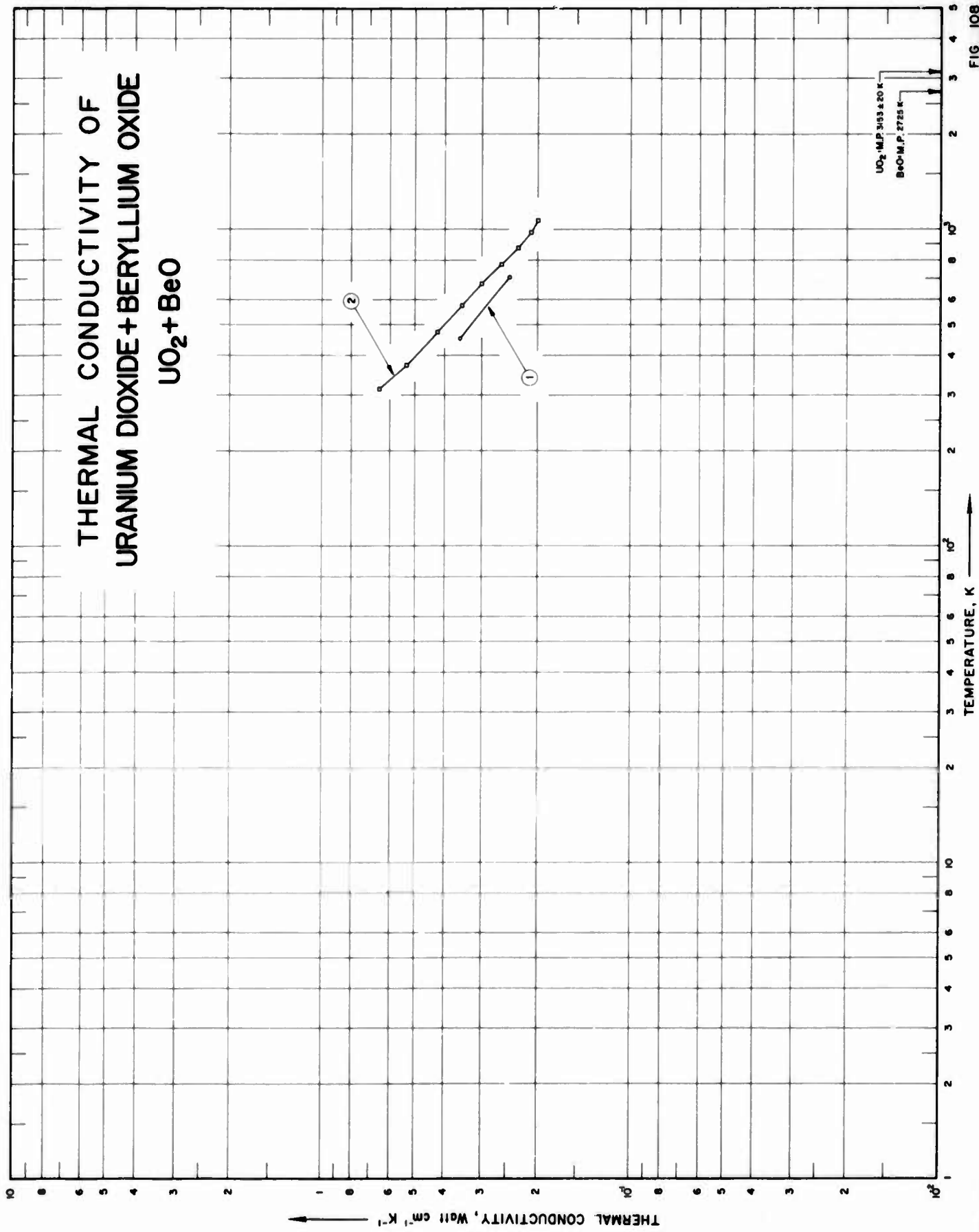
Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZnO	Composition (continued), Specifications and Remarks
1	254	E	1955	400-564		94.0	6.0 Coarse crystalline structure; prepared by firing H_2WO_3 and ZnO ; considerable porosity.

DATA TABLE NO. 107 THERMAL CONDUCTIVITY OF [TUNGSTEN TRIOXIDE + ZINC OXIDE] $WO_3 + ZnO$ [Temperature, T, K; Thermal Conductivity, k, $Watt\ cm^{-1}\ K^{-1}$]

T	k
CURVE 1*	
400.2	0.208
438.2	0.211
473.2	0.218
497.2	0.210
533.2	0.211
564.2	0.218

* No graphical presentation

THERMAL CONDUCTIVITY OF URANIUM DIOXIDE + BERYLLIUM OXIDE UO₂ + BeO



SPECIFICATION TABLE NO. 108 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE - BERYLLIUM OXIDE] $UO_2 + BeO$

[For Data Reported in Figure and Table No. 108]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) UO_2	Composition (weight percent) BeO	Composition (continued), Specifications and Remarks
1	76	L	1952	453, 708		70.9	29.1	79.5% of theoretical density.
2	76	L	1952	313-1073		70.9	29.1	80.5% of theoretical density.

DATA TABLE NO. 108 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + BERYLLIUM OXIDE] $\text{UO}_2 + \text{BeO}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
453.2	0.355
708.2	0.245
<u>CURVE 2</u>	
313.2	0.650
373.2	0.530
473.2	0.425
573.2	0.350
673.2	0.300
773.2	0.260
873.2	0.230
973.2	0.210
1073.2	0.200

SPECIFICATION TABLE NO. 109 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + CALCIUM OXIDE] $UO_2 + CaO$

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) UO_2	Composition (weight percent) CaO	Composition (continued), Specifications and Remarks
1	518 C	1960	1054, 1079		CA 8-1	98.37	1.63	Prepared by sintering large samples of UO_2 containing CaO for 3 hrs at 1300 C under argon followed by 1 hr in 10% H_2 -90% H_2O at 1300 C; initial oxygen to uranium ratio 2.58, final oxygen to Uranium ratio 1.98; electrical resistivity 59 ohm-cm at 300 K; water absorption 0.02%; density 10.13 $g\ cm^{-3}$ (97.9% of theoretical value); lattice constant 5.452 Å; measured in vacuum.

DATA TABLE NO. 109 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + CALCIUM OXIDE] $UO_2 + CaO$
[Temperature, T, K; Thermal Conductivity, k, $Watt\ cm^{-1}\ K^{-1}$]

T	k
<u>CURVE 1 *</u>	
1054.2	0.0326
1079.2	0.0227

* No graphical presentation

SPECIFICATION TABLE NO. 110 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + NIOBIUM PENTOXIDE] $UO_2 + Nb_2O_5$

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition UO_2 (weight percent)	Composition Nb_2O_5 (weight percent)	Composition (continued), Specifications and Remarks
1	518 C	1960	933, 956			96.06	3.94	Specimen 0.810 in. in dia; electrical resistivity 12.090 ohm-cm at 300 K; density 9.56 g cm ⁻³ ; measured in static argon atmosphere.

DATA TABLE NO. 110 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + NIOBIUM PENTOXIDE] $UO_2 + Nb_2O_5$

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
933.2	0.0364
956.2	0.0355

* No graphical presentation

SPECIFICATION TABLE NO. 111 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + YTTRIUM OXIDE] $UO_2 + Y_2O_3$

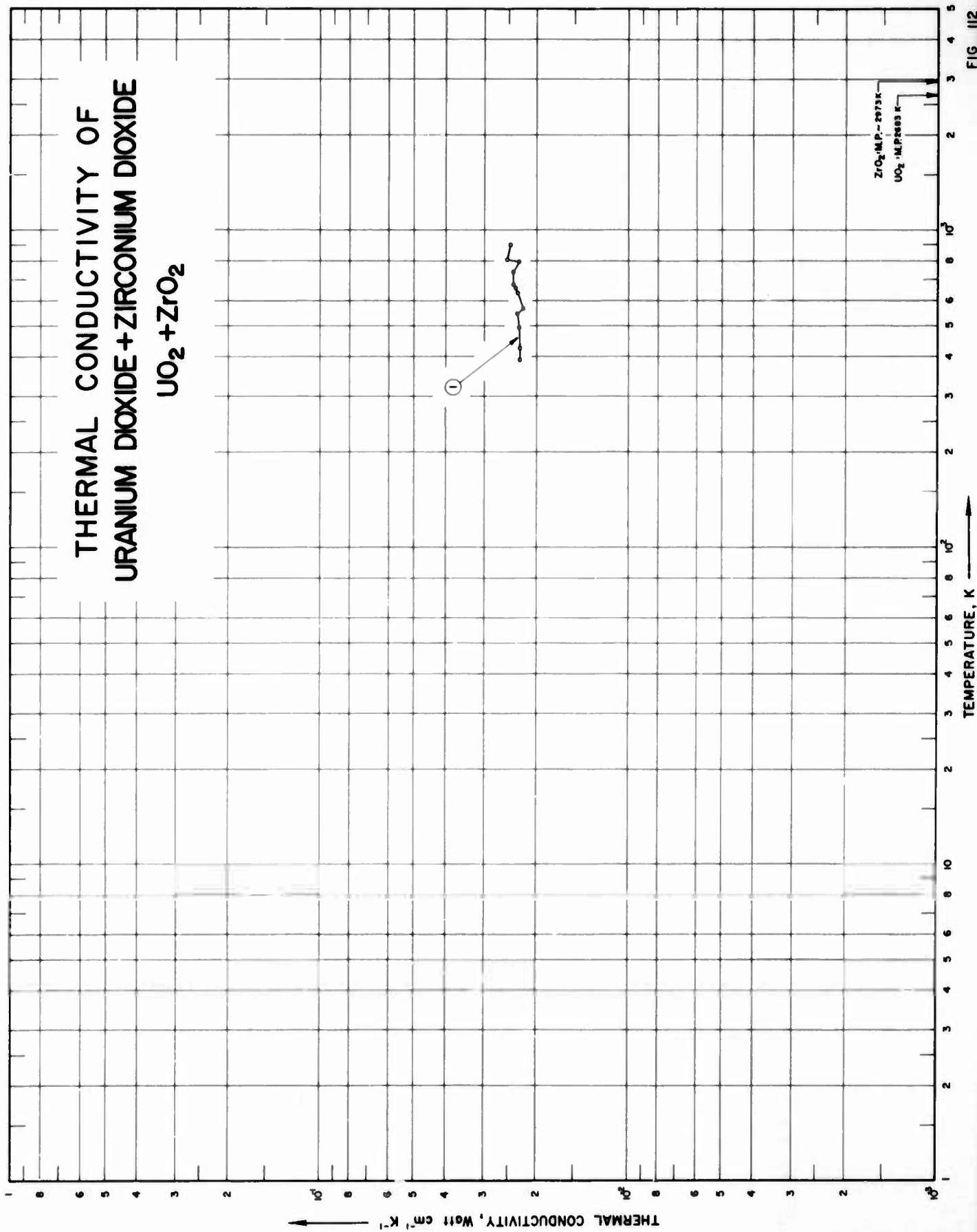
Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) UO_2	Composition (weight percent) Y_2O_3	Composition (continued), Specifications and Remarks
1	438 C	1959	928-1137			96.63	3.37	Specimen 0.856 ± 0.001 in. in dia and 1.00 ± 0.001 in. height; prepared from ceramic grade low-bulk density UO_2 (supplied by Mallinckrodt Chemical Works) and 99.9 pure, 325 mesh Y_2O_3 (supplied by Rare Earths, Inc.); Yttrium added to UO_2 powder in the form of a nitric acid solution containing 0.11 grams of Yttrium per milliliter; the batch calcined at 600 or 900 C in argon, sintered and reduced in hydrogen at 650 C and re-oxidized in air at 140 C to an U/O 2.5 and sintered again; final density of the stoichiometric specimen 10.05 g cm ⁻³ (95.3% of theoretical value).
2	518 C	1960	771-1103		Y-47-1	96.76	3.24	Pellets prepared from calcined UO_2 and $Y(NO_3)_3$; sintered for 3 hrs at 1300 C under argon followed by 1 hr in 90% A -10% H mixture at the same temperature; initial oxygen to uranium ratio 2.5, final oxygen to uranium ratio 2.0; electrical resistivity 69 ohm-cm at 300 K; density 10.01 g cm ⁻³ (95.3% of theoretical value); lattice constant 5.455 Å; measured in vacuum.

DATA TABLE NO. 111 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + YTTRIUM OXIDE] $UO_2 + Y_2O_3$ [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k
CURVE 1*		CURVE 1 (cont.)*		CURVE 2 (cont.)*	
928.2	0.0433	1137.2	0.0471	870.2	0.0359
928.2	0.0518	1137.2	0.0490	876.2	0.0351
1017.2	0.0509			1103.2	0.0322
1017.2	0.0526	CURVE 2*			
1095.2	0.0493	771.2	0.0372		
1095.2	0.0471	869.2	0.0355		

* No graphical presentation

THERMAL CONDUCTIVITY OF
URANIUM DIOXIDE + ZIRCONIUM DIOXIDE
 $UO_2 + ZrO_2$



SPECIFICATION TABLE NO. 112 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + ZIRCONIUM DIOXIDE] $UO_2 + ZrO_2$

[For Data Reported in Figure and Table No. 112]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							UO_2	ZrO_2	
1	519	C	1963	390-899	± 5		68.7	31.3	1 $UO_2 + 1 ZrO_2$, by mole; pressed at 50 tsi and homogenized by sintering for 20 hrs at 1700 C; measured in a vacuum of approximately 2×10^{-5} mm Hg.

DATA TABLE NO. 112 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + ZIRCONIUM DIOXIDE] $\text{UO}_2 + \text{ZrO}_2$

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
390.2	0.0229
424.2	0.0229
493.2	0.0230
545.2	0.0233
567.2	0.0222
636.2	0.0232
657.2	0.0236
671.2	0.0240
739.2	0.0240
792.2	0.0230
807.2	0.0250
899.2	0.0247

CURVE 1

THERMAL CONDUCTIVITY OF
YTTRIUM OXIDE + URANIUM DIOXIDE
 $Y_2O_3 + UO_2$

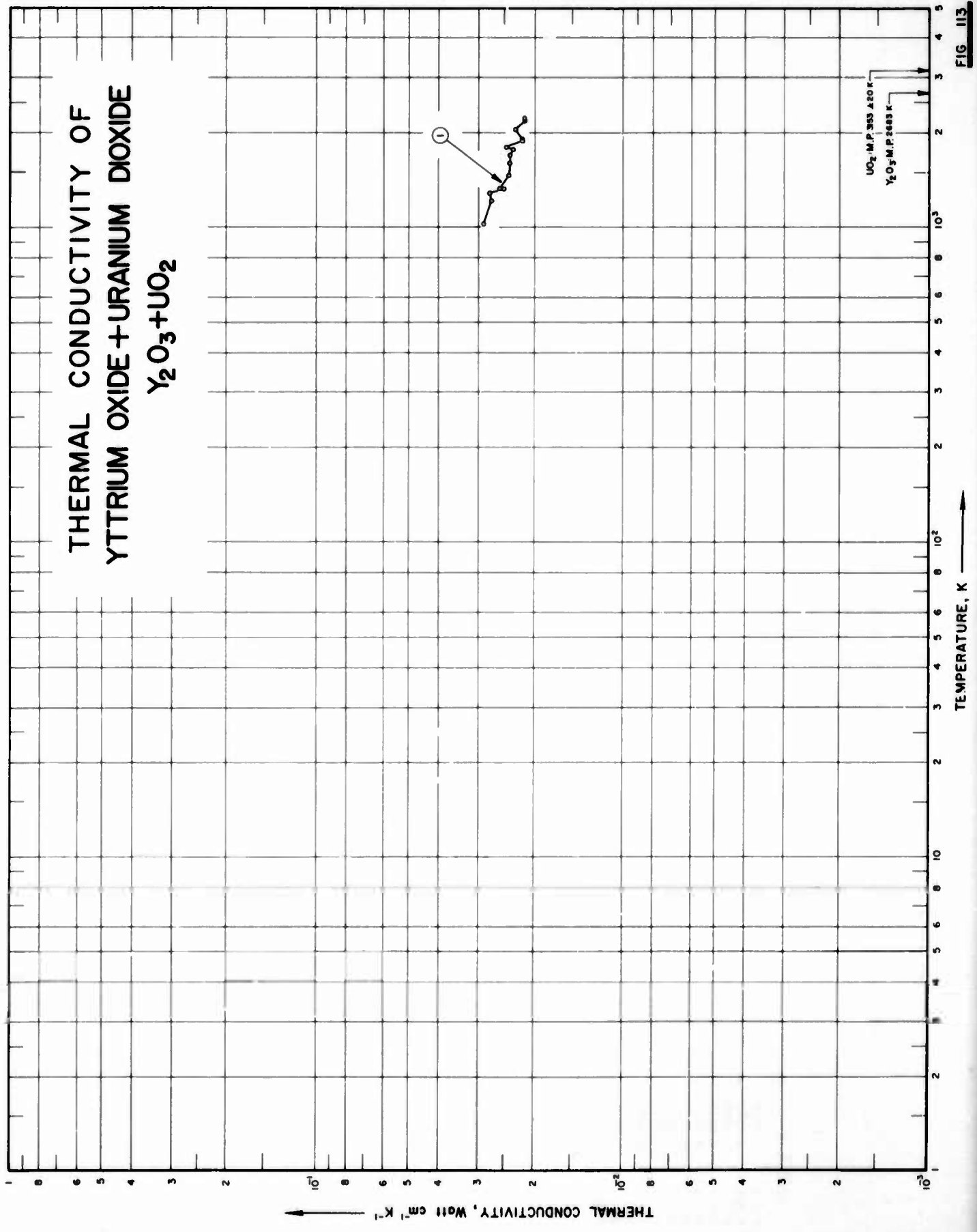


FIG. 113

SPECIFICATION TABLE NO. 113 THERMAL CONDUCTIVITY OF [YTRIUUM OXIDE + URANIUM DIOXIDE] $Y_2O_3 + UO_2$

[For Data Reported in Figure and Table No. 113]

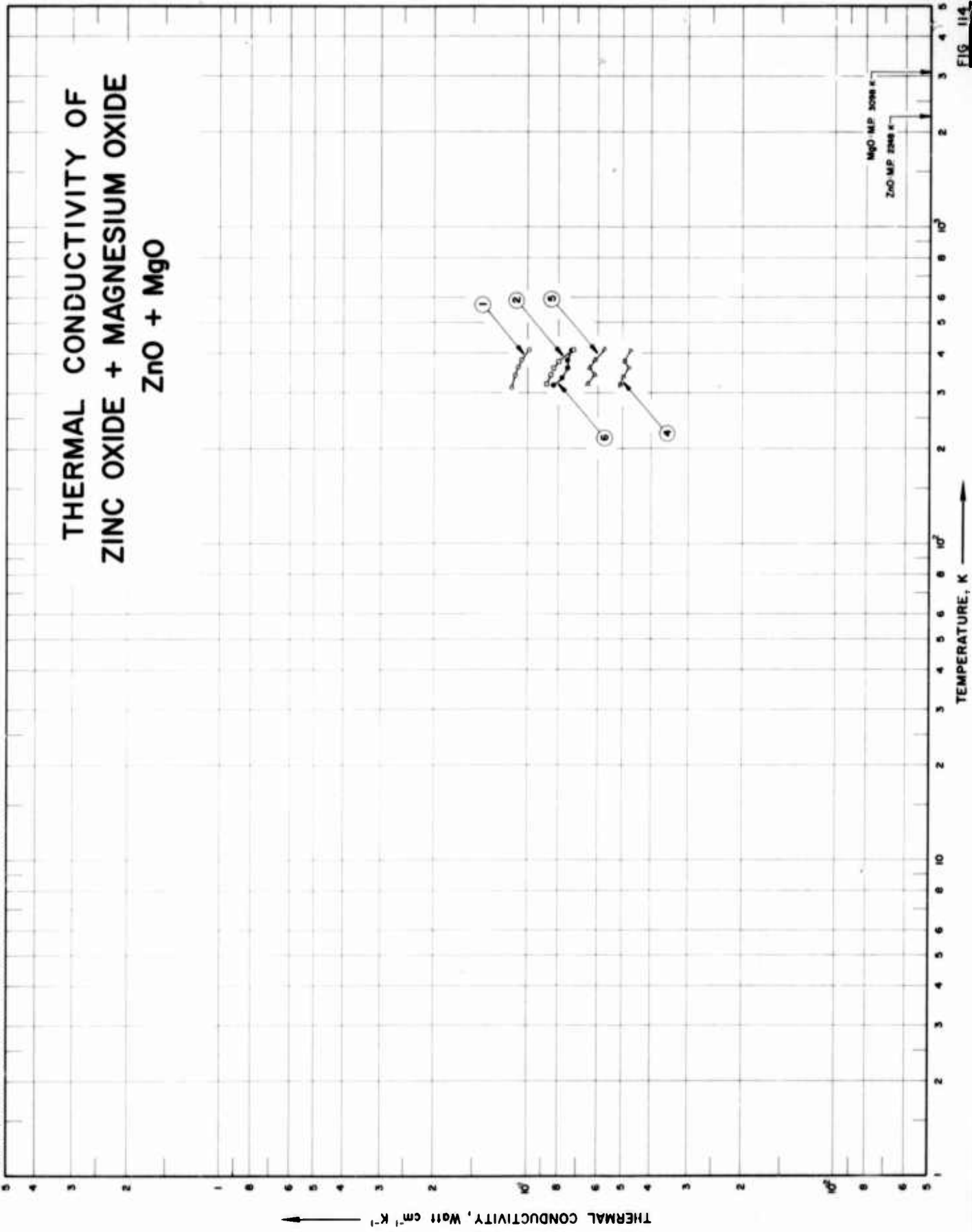
Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						Y_2O_3	UO_2	
1	R	1964	1038-2233		$3Y_2O_3 + UO_2$	71.5	28.5	Specimen in disc form of 2 in. O. D. and 0.375 in. I. D. ; 99% of theoretical density.

DATA TABLE NO. 113 THERMAL CONDUCTIVITY OF [YTTRIUM OXIDE + URANIUM DIOXIDE] $Y_2O_3 + UO_2$
 [Temperature, T, K. Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k
1038.2	0.029
1223.2	0.0275
1298.2	0.0277
1333.2	0.025
1348.2	0.0259
1473.2	0.0242
1603.2	0.024
1703.2	0.024
1773.2	0.0235
1813.2	0.0246
1893.2	0.0218
1913.2	0.022
2063.2	0.0231
2133.2	0.0215
2233.2	0.0216

FIGURE SHOWS ONLY 5 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF ZINC OXIDE + MAGNESIUM OXIDE ZnO + MgO



SPECIFICATION TABLE NO. 114 THERMAL CONDUCTIVITY OF [ZINC OXIDE + MAGNESIUM OXIDE] ZnO + MgO

[For Data Reported in Figure and Table No. 114]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, °K	Reported Error, %	Name and Specimen Designation	Composition ZnO	Composition (weight percent) MgO	Composition (continued), Specifications and Remarks
1	12		1953	313-411		258A-1	94.8	5.2	9ZnO + MgO by mole; prepared from pure oxides, milled in water, dried, calcined at 1367 K; then dry pressed in 0.5 in. steel die at 15000 psi; fired at 1755 K and soaked for 2 hrs; water absorption 0.077%; density 5.04 g cm ⁻³ .
2	12		1953	320-412		259A-1	89.0	11.0	4ZnO + MgO by mole; same preparation as that of the above specimen; water absorption 0.002%; density 4.86 g cm ⁻³ .
3	12		1953	319-411		260A-1	82.5	17.5	7ZnO + 3MgO by mole; same preparation as that of the above specimen; water absorption 0.020%; density 4.99 g cm ⁻³ .
4	12		1953	319-409		261A-1	75.2	24.8	3ZnO + 2MgO by mole; same preparation as that of the above specimen except fired at 1700 K; water absorption 0.006%; density 4.64 g cm ⁻³ .
5	12		1953	321-414		262A-1	66.9	33.1	ZnO + MgO by mole; same preparation as that of the above specimen; water absorption 0.040%; density 4.87 g cm ⁻³ .
6	12		1953	318-410		263A-1	57.4	42.6	2ZnO + 3MgO by mole; same preparation as that of the above specimen; water absorption 0.010%; density 4.86 g cm ⁻³ .

DATA TABLE NO. 114 THERMAL CONDUCTIVITY OF [ZINC OXIDE + MAGNESIUM OXIDE] ZnO + MgO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
312.7	0.113
341.5	0.110
363.5	0.107
382.5	0.105
411.2	0.0992
<u>CURVE 2</u>	
320.2	0.0874
343.7	0.0845
359.0	0.0828
377.2	0.0799
412.0	0.0720
<u>CURVE 3*</u>	
319.2	0.0904
338.4	0.0858
359.8	0.0841
379.3	0.0812
411.0	0.0778
<u>CURVE 4</u>	
318.9	0.0510
337.7	0.0498
360.8	0.0477
378.2	0.0494
409.0	0.0473
<u>CURVE 5</u>	
320.8	0.0649
342.2	0.0615
359.3	0.0640
381.1	0.0615
413.5	0.0573
<u>CURVE 6</u>	
318.0	0.0833
336.8	0.0782
361.6	0.0753
381.1	0.0753
410.1	0.0724

* Not shown on Plot

THERMAL CONDUCTIVITY OF
ZINC OXIDE + TIN DIOXIDE
 $ZnO + SnO_2$

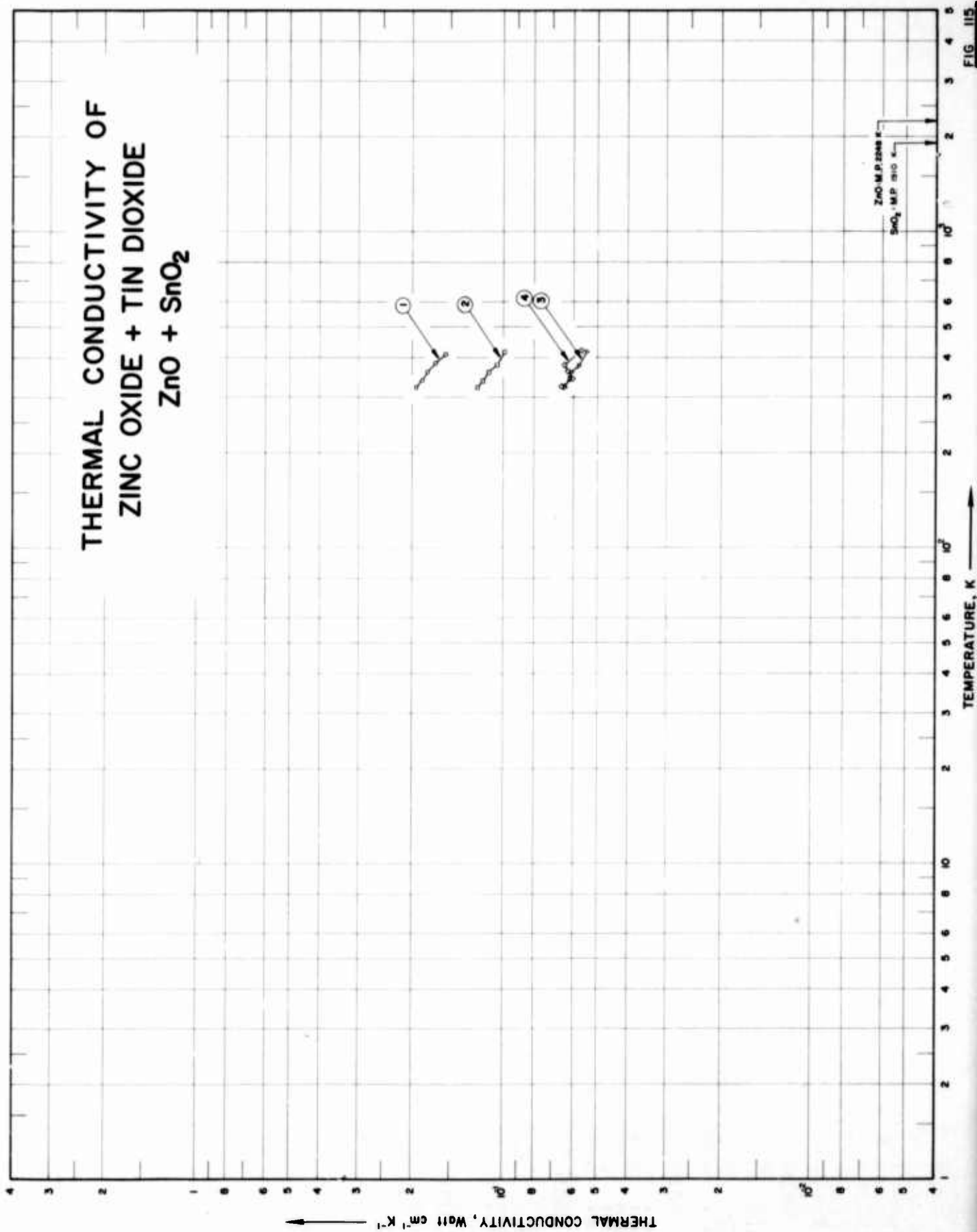


FIG. 115

SPECIFICATION TABLE NO. 115 THERMAL CONDUCTIVITY OF [ZINC OXIDE + TIN DIOXIDE] ZnO + SnO₂

[For Data Reported in Figure and Table No. 115]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZnO	Composition (weight percent) SnO ₂	Composition (continued), Specifications and Remarks
1	12		1953	323-411		187A-1	82.9	17.1	9 ZnO + 1 SnO ₂ by mole; prepared by milling pure oxides in water, calcining at 1367 K after drying and then dry pressing in a 0.5 in. steel die at 15000 psi; fired at 1645 K and soaked for 1.5 hrs; density 5.73 g cm ⁻³ .
2	12		1953	323-418		188A-1	68.4	31.6	4 ZnO + 1 SnO ₂ by mole; same preparation as the above specimen; fired at 1645 K and soaked for 1.5 hrs; density 5.90 g cm ⁻³ .
3	12		1953	322-417		189A-1	55.8	44.2	7 ZnO + 3 SnO ₂ by mole; same preparation as the above specimen; fired at 1645 K and soaked for 1 hr; water absorption 1.062%; density 5.67 g cm ⁻³ .
4	12		1953	326-421		190B-1	55.8	44.2	Similar to the above specimen 189A-1 except water absorption 1.57% and density 5.62 g cm ⁻³ .

DATA TABLE NO. 115 THERMAL CONDUCTIVITY OF [ZINC OXIDE + TIN DIOXIDE] ZnO + SnO₂
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
322.9	0.194
340.3	0.186
361.6	0.177
385.0	0.167
411.3	0.156
<u>CURVE 2</u>	
323.1	0.122
338.3	0.117
360.0	0.112
378.9	0.106
418.1	0.0992
<u>CURVE 3</u>	
322.3	0.0640
345.6	0.0619
360.3	0.0611
378.3	0.0577
417.1	0.0544
<u>CURVE 4</u>	
325.5	0.0653
344.7	0.0602
362.3	0.0628
379.0	0.0644
421.1	0.0565

SPECIFICATION TABLE NO. 116 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + ALUMINUM OXIDE] $ZrO_2 + Al_2O_3$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZrO_2	Composition (weight percent) Al_2O_3	Composition (continued), Specifications and Remarks
1	522	P	1963	373-823	± 4		91.6	8.4	As received; density 5.13 g cm^{-3} (92.5% of theoretical value); thermal conductivity values calculated from the measured data of thermal diffusivity, specific heat and density.

DATA TABLE NO. 116 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + ALUMINUM OXIDE] $ZrO_2 + Al_2O_3$

[Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

T	k
CURVE 1 *	
373.2	0.0439
473.2	0.0439
573.2	0.0427
673.2	0.0427
773.2	0.0435
823.2	0.0439

* No graphical presentation

THERMAL CONDUCTIVITY OF ZIRCONIUM DIOXIDE + CALCIUM OXIDE $ZrO_2 + CaO$

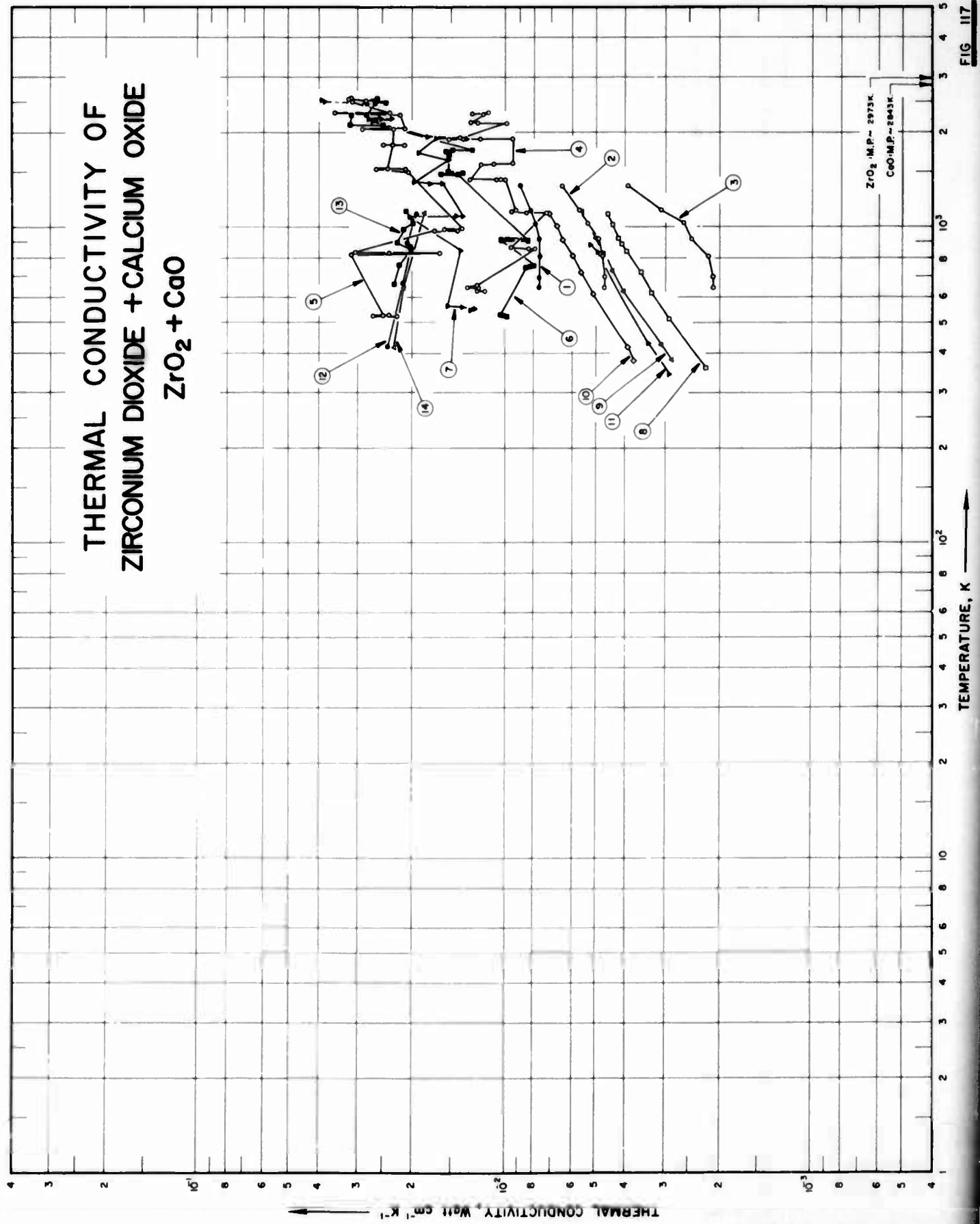


FIG. 117

SPECIFICATION TABLE NO. 117 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + CALCIUM OXIDE] $ZrO_2 + CaO$

[For Data Reported in Figure and Table No. 117]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZrO_2	Composition (weight percent) CaO	Composition (continued), Specifications and Remarks
1	210		1952	644-1366		Dense brick; A	Bal	4.5/5.0	<2.0 HfO ₂ , 0.2-0.5 Fe ₂ O ₃ , 0.5-1.0 SiO ₂ , and 0.4-1.0 TiO ₂ ; stabilized; density (25°C) 4.0 g cm ⁻³ ; 28 vol % pores.
2	210		1952	644-1366		Insulating brick; B	Bal	4.5/5.0	<2.0 HfO ₂ , 0.2-0.5 Fe ₂ O ₃ , 0.5-1.0 SiO ₂ , and 0.4-1.0 TiO ₂ ; stabilized; density (25°C) 2.72 g cm ⁻³ and 50 vol % pores.
3	210		1952	644-1366		Insulating brick; C	Bal	4.5/5.0	<2.0 HfO ₂ , 0.2-0.5 Fe ₂ O ₃ , 0.5-1.0 SiO ₂ , and 0.4-1.0 TiO ₂ ; stabilized; density (25°C) 1.81 g cm ⁻³ and 68 vol % pores.
4	82	R	1962	626-2320			96.0	2.99	0.34 SiO ₂ , 0.26 CaSO ₄ , 0.21 MgO, and 0.18 SO ₃ ; specimen 1 in. dia and 1 in. long; sintered, stabilized, and molded; fine grain; density 5.92 g cm ⁻³ ; porosity 0.53%; melting point 2850 K.
5	82	R	1962	526-2565			97.12	2.17	0.267 CaSO ₄ , 0.063 MgO, 0.186 SiO ₂ , and 0.173 SO ₃ ; specimen 1 in. dia and 1 in. long; sintered, stabilized and molded; coarse grain; formulated by 30% fines (composition: 96 ZrO ₂ , 2.99 CaO, 0.34 SiO ₂ , 0.21 MgO, 0.26 CaSO ₄ , 0.18 SO ₃) and 70% grog (composition: 97.6 ZrO ₂ , 1.82 CaO, 0.12 SiO ₂ , 0.27 CaSO ₄ , 0.17 SO ₃); density 4.65 g cm ⁻³ ; porosity 18.58%; melting point 2816 K.
6	82	R	1962	525-2540					Similar to the above specimen except porosity 25%.
7	82	R	1962	551-2537					Similar to the above specimen except being extruded; density 4.57 g cm ⁻³ ; porosity 19.4%; melting point 2839 K.
8	400	R	1966	359-1108	±10	H30F	Bal	3.58	0.01-0.1 Al principal impurity; powder specimen contained in a ~4 in. I.D., 4.5 in. O.D. and ~24 in. long container; supplied by Norton Co.; as-received; mesh: particle size 292 μ; volume fraction solid 0.58; pore-free density 5.60 g cm ⁻³ .
9	400	R	1966	380-1123	±10	H30T			Similar to the above specimen except volume fraction solid 0.64.
10	400	R	1966	378-1118	±10	H14F			Similar to the above specimen except mean particle size 1023 μ; volume fraction solid 0.70; pore-free density 5.63 g cm ⁻³ .
11	400	P	1966	343-884	±11	H30F			Similar to the above specimen except mean particle size 292 μ; volume fraction solid 0.64; pore-free density 5.60 g cm ⁻³ ; thermal conductivity data obtained from the measurement of thermal diffusivity, specific heat and density.
12	374	C	1965	420-1106	0-±2				c-Type, lime-stabilized zirconia, 93.7 ZrO ₂ , 3.35 CaO, 1.38 HfO ₂ , 0.30 SiO ₂ , 1.07 Al ₂ O ₃ , 0.17 Fe ₂ O ₃ , 0.03 TiO ₂ ; composed of polygonal grains of anisotropic material with most grains in the range 0.10 to 0.15 mm; prepared to a tolerance of ±0.091 in. in the form of a cylinder 1 in. in dia and 1 in. high; fabricated by the Zirconium Corp. of America; bulk density 5.4 g cm ⁻³ ; true density 5.7 g cm ⁻³ ; true porosity 5% of the total volume; pyroceram 9606 used as comparative material; unknown and standard used for the first time.

SPECIFICATION TABLE NO. 117 (continued)

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						ZrO ₂	CaO	
13	C	1965	661-1126	0-±3				Similar to the above specimen; unknown used for the first time, standard used several times up to 1273 K.
14	C	1965	417-1116	0-±4				Similar to the above specimen; unknown used several times up to 1373 K, standard used for the first time.
15	C	1965	1313, 1373					Similar to the above specimen except alumina AL-300 used as comparative material.

DATA TABLE NO. 117 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + CALCIUM OXIDE] ZrO₂ + CaO

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>													
644.2	0.00764	1427.6	0.0107	1846.5	0.0229*	550.9	0.0132	390.2	0.00285	<u>CURVE 13 (cont.)</u>			
699.2	0.00764	1427.6	0.0102	2062.6	0.0231	558.2	0.0126	425.2	0.00309	895.2	0.0225	985.2	0.0214
811.2	0.00764	1427.6	0.0131	2069.3	0.0290	562.1	0.0139	628.2	0.00403	1035	0.0200	1126.4	0.0210
921.2	0.00764	1599.5	0.0121	2077.6	0.0213	562.6	0.0155	726.2	0.00439	<u>CURVE 14</u>			
1033.2	0.00793	1599.8	0.0109	2083.2	0.0213*	849.8	0.0141	825.2	0.00473	417.2	0.0230	646.2	0.0215
1144.2	0.00822	1602.6	0.00946	2287.1	0.0219*	852.1	0.0140*	922.2	0.00501	1078	0.0186*	1116	0.0184
1366.2	0.00894	1602.6	0.00952*	2290.4	0.0221	853.2	0.0143*	1023.2	0.00529*	<u>CURVE 15*</u>			
<u>CURVE 2</u>													
644.2	0.00469	1909.8	0.0122	2320.9	0.0358	1092.1	0.0205	1123.2	0.00557	1313	0.0180	1373	0.016
699.2	0.00469	1909.8	0.0138	2526.5	0.0313	1093.2	0.0139	<u>CURVE 10</u>					
811.2	0.00476	1919.3	0.0155	2529.8	0.0284	1381.5	0.0161	378.2	0.00376	616.2	0.00512	721.2	0.00560
921.2	0.00490	1923.2	0.0142	2562.1	0.0323	1386.5	0.0176	417.2	0.00392	616.2	0.00512	813.2	0.00596
1033.2	0.00534	2147.6	0.00989	2565.4	0.0317	1663.2	0.0154	912.2	0.00643	1016.2	0.00674	1118.2	0.00709
1144.2	0.00570	2147.6	0.0124	<u>CURVE 11</u>									
1366.2	0.00649	2167.1	0.0130	524.8	0.00984	1732.1	0.0191	343.2	0.00291	430.4	0.00339	835.9	0.00493
<u>CURVE 3</u>													
644.2	0.00209	2303.2	0.0128	526.5	0.0101	1935.4	0.0135	430.4	0.00339	835.9	0.00493	883.5	0.00523
699.2	0.00209	2303.2	0.0118	531.5	0.0103	1937.6	0.0180	835.9	0.00493	<u>CURVE 12</u>			
811.2	0.00216	2303.2	0.0114	747.1	0.00851	2185.4	0.0270	420.2	0.0240	665.2	0.0216	873.2	0.0204
921.2	0.00245	2319.8	0.0114	750.4	0.00825	2218.7	0.0235	726.2	0.00332	894.2	0.0209	1106	0.0195
1033.2	0.00260	2319.8	0.0111*	756.5	0.00793	2257.6	0.0276	894.2	0.00394	<u>CURVE 13</u>			
1144.2	0.00310	2319.8	0.0111*	756.5	0.00793	2257.6	0.0276	894.2	0.00394	661.2	0.0229	665.1	0.0216*
1366.2	0.00392	2319.8	0.0111*	756.5	0.00793	2257.6	0.0276	894.2	0.00394	661.2	0.0229	665.1	0.0216*
<u>CURVE 4</u>													
626.0	0.0117	526	0.0225	528.7	0.0267	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
633.2	0.0124	529.8	0.0247	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
645.4	0.0123	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
650.4	0.0133	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
654.3	0.0124	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
654.3	0.0124	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
857.1	0.00795	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
858.7	0.00832	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
869.3	0.00958	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
1122.6	0.00723	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
1126.5	0.00855	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
1130.4	0.00956	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
1132.6	0.00929	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237
1423.2	0.0100	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237	529.8	0.0237

* Not shown on plot

THERMAL CONDUCTIVITY OF ZIRCONIUM DIOXIDE + MAGNESIUM OXIDE ZrO₂+MgO

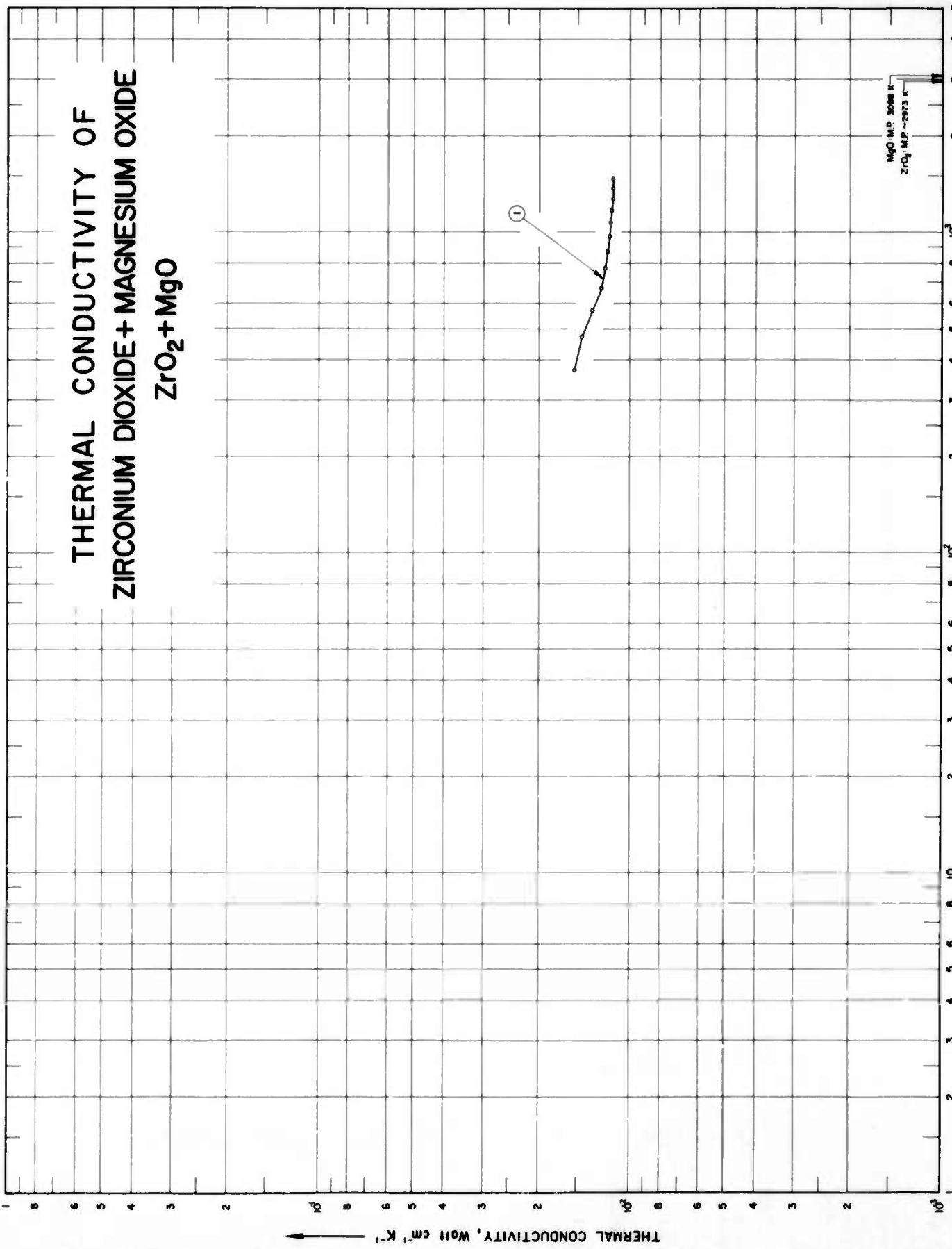


FIG. 118

SPECIFICATION TABLE NO. 118 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + MAGNESIUM OXIDE] $ZrO_2 + MgO$

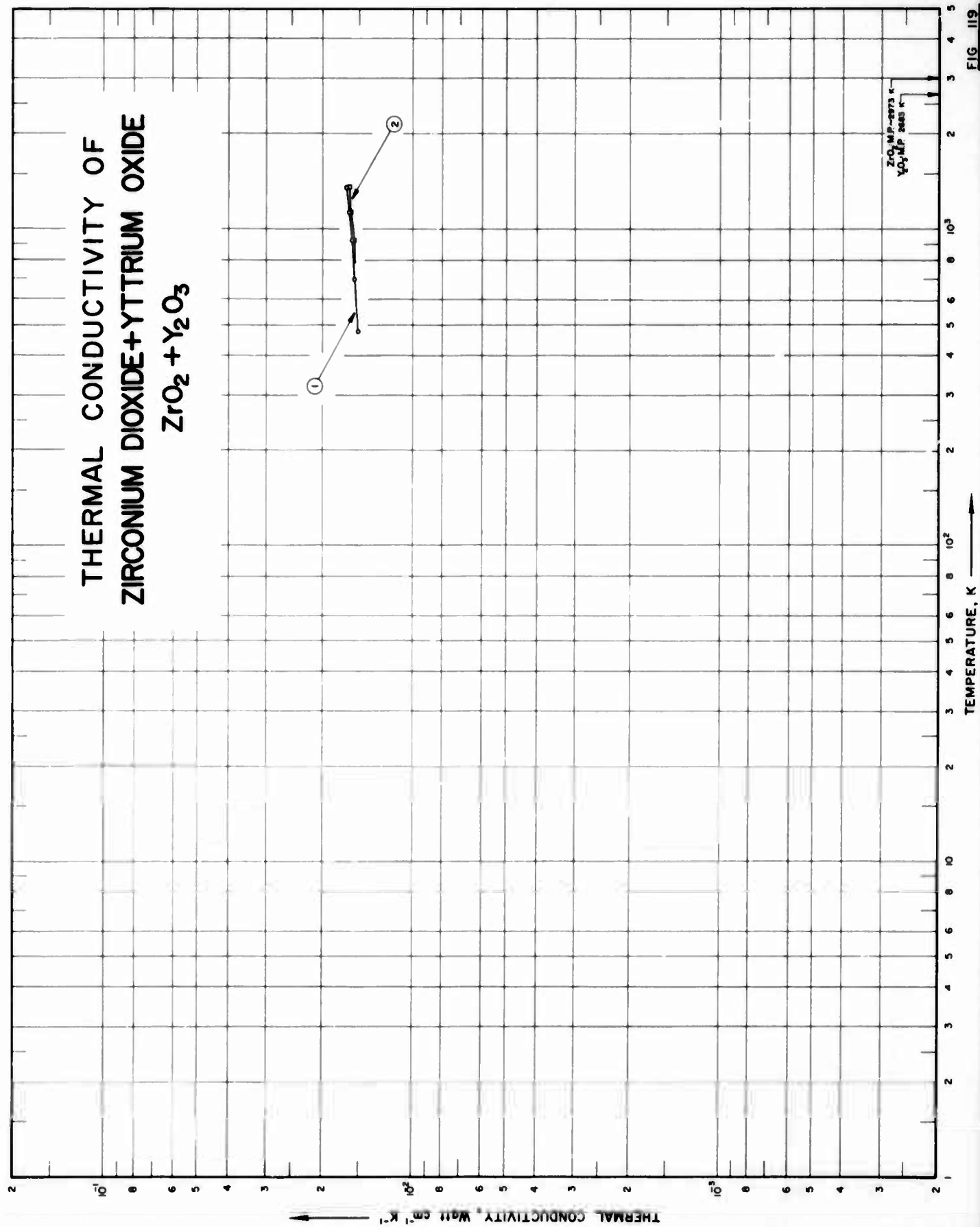
[For Data Reported in Figure and Table No. 118]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						ZrO ₂	MgO	
1	P	1957	373-1473		E-109	95.6	4.1	0.01-0.1 CaO, 0.01-0.1 SiO ₂ , 0.01-0.1 TiO ₂ , 0.005-0.05 Al ₂ O ₃ , 0.001-0.01 Fe ₂ O ₃ , < 0.005 Na ₂ O, < 0.005 K ₂ O, < 0.005 Li ₂ O, < 0.005 BaO; specimen from Corning Glass Works; fired at ~1000 C for 4 hrs; bulk density 3.65 g cm ⁻³ at 25 C; porosity 35%.

DATA TABLE NO. 118 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + MAGNESIUM OXIDE] $\text{ZrO}_2 + \text{MgO}$
 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
373.2	0.0154
473.2	0.0146
573.2	0.0135
673.2	0.0126
773.2	0.0122
873.2	0.0120
973.2	0.0118
1073.2	0.0117
1173.2	0.0116
1273.2	0.0115
1373.2	0.0115
1473.2	0.0115

THERMAL CONDUCTIVITY OF
ZIRCONIUM DIOXIDE+YTTTRIUM OXIDE
 $ZrO_2 + Y_2O_3$



SPECIFICATION TABLE NO. 119 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE] $ZrO_2 + Y_2O_3$

[For Data Reported in Figure and Table No. 119]

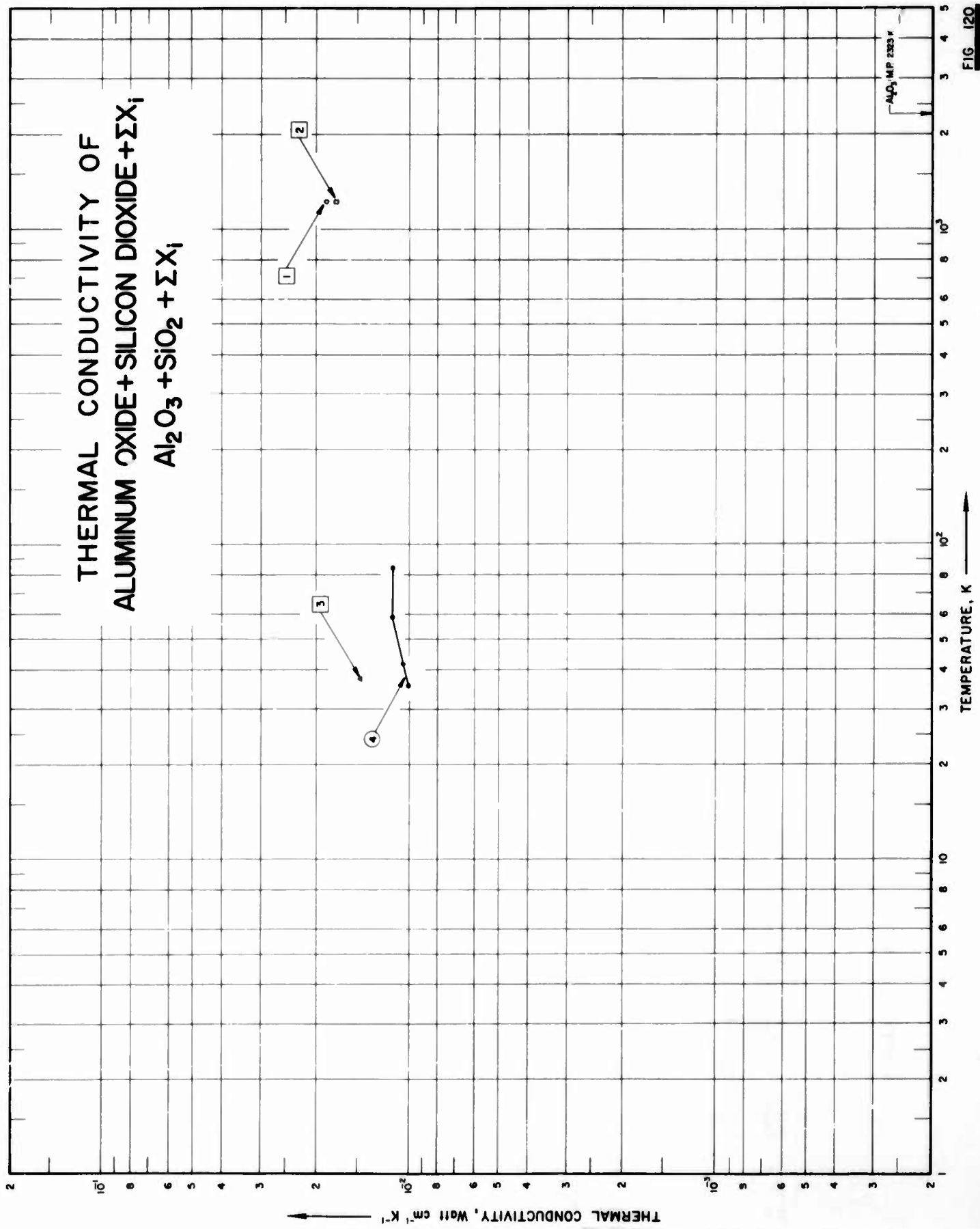
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							ZrO_2	Y_2O_3	
1	292	C	1961	478-1367		No. 1	85.0	15.0	Specimen 0.5 x 0.5 x 0.875 in.; prepared from Columbia-Nation ^{al} , ZrO_2 , and Michigan Chemical Y_2O_3 , prereacted at 1922 K; fabricated by dry pressing followed by isostatic compaction and then sintered at 1978 K in air for 2 hrs; 86.7% of theoretical density; commercial stabilized ZrO_2 used as comparative material, data corrected to zero porosity.
2	292	C	1961	478-1367		No. 2			Similar to the above specimen.

DATA TABLE NO. 119 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE] $\text{ZrO}_2 + \text{Y}_2\text{O}_3$
 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
477.6	0.0152
699.8	0.0156
922.1	0.0159
1144.2	0.0163
1366.5	0.0166
<u>CURVE 2</u>	
477.6	0.0152*
699.8	0.0156*
922.1	0.0157
1144.3	0.0161
1366.5	0.0163

* Not shown on plot

FIG. 120



PRECEDING PAGE BLANK-NOT FILLED

SPECIFICATION TABLE NO. 120 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + SILICON DIOXIDE + ΣX_1] $Al_2O_3 + SiO_2 + \Sigma X_1$

[For Data Reported in Figure and Table No. 120]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks
							Al_2O_3	SiO_2	TiO_2	Fe_2O_3	
1	41	L	1924	1223.2		Sillimanite No. 3	59.75	35.75	2.60	1.92	Specimen 8.5 in dia; 2.053 in. thick; prepared by crushing electric furnace products to pass a No. 14 screen and bonding with fire clay (25.41 Al_2O_3 , 59.55 SiO_2 , 2.31 Fe_2O_3 , 1.33 TiO_2 , 1.01 total K_2O and Na_2O , 0.46 CaO , 0.33 MgO and 9.10 loss); fired to cone 16; porosity 15.2%; measured in 748.21 mm Hg pressure.
2	81	L	1924	1223.2		Sillimanite No. 3	59.75	35.75	2.60	1.92	Similar to the above but measured in a pressure of 747.7 mm Hg.
3	458	P	1921	373.2		Chrome brick	30.12	21.80		13.67	19.47 Cr_2O_3 , 12.47 MgO , and 0.86 CaO ; 4 cm dia x 8 cm long; made of the powder of chrome brick burned at the temperature of Serger's No. 12 cone and pressed into the desired form; density 2.546 $g\ cm^{-3}$; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
4	247	L	1932	356-840	1.0	Corundum brick	78.82	14.72	2.85	1.35	0.66 MgO , 0.39 CaO , and 0.06 Mn_2O_4 ; density 3.472 $g\ cm^{-3}$; porosity 35.3%; gas permeability 0.068 $m^3\ cm\ m^{-2}\ hr^{-1}$ ($mm\ H_2O$) ⁻¹ .

DATA TABLE NO. 120 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + SILICON DIOXIDE + ΣX_1] $Al_2O_3 + SiO_2 + \Sigma X_1$
[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k
<u>CURVE 1</u>	
1223.2	0.0187
<u>CURVE 2</u>	
1223.2	0.0174
<u>CURVE 3</u>	
373.2	0.0146
<u>CURVE 4</u>	
355.6	0.01012
419.4	0.01051
586.5	0.01147
840.3	0.01146

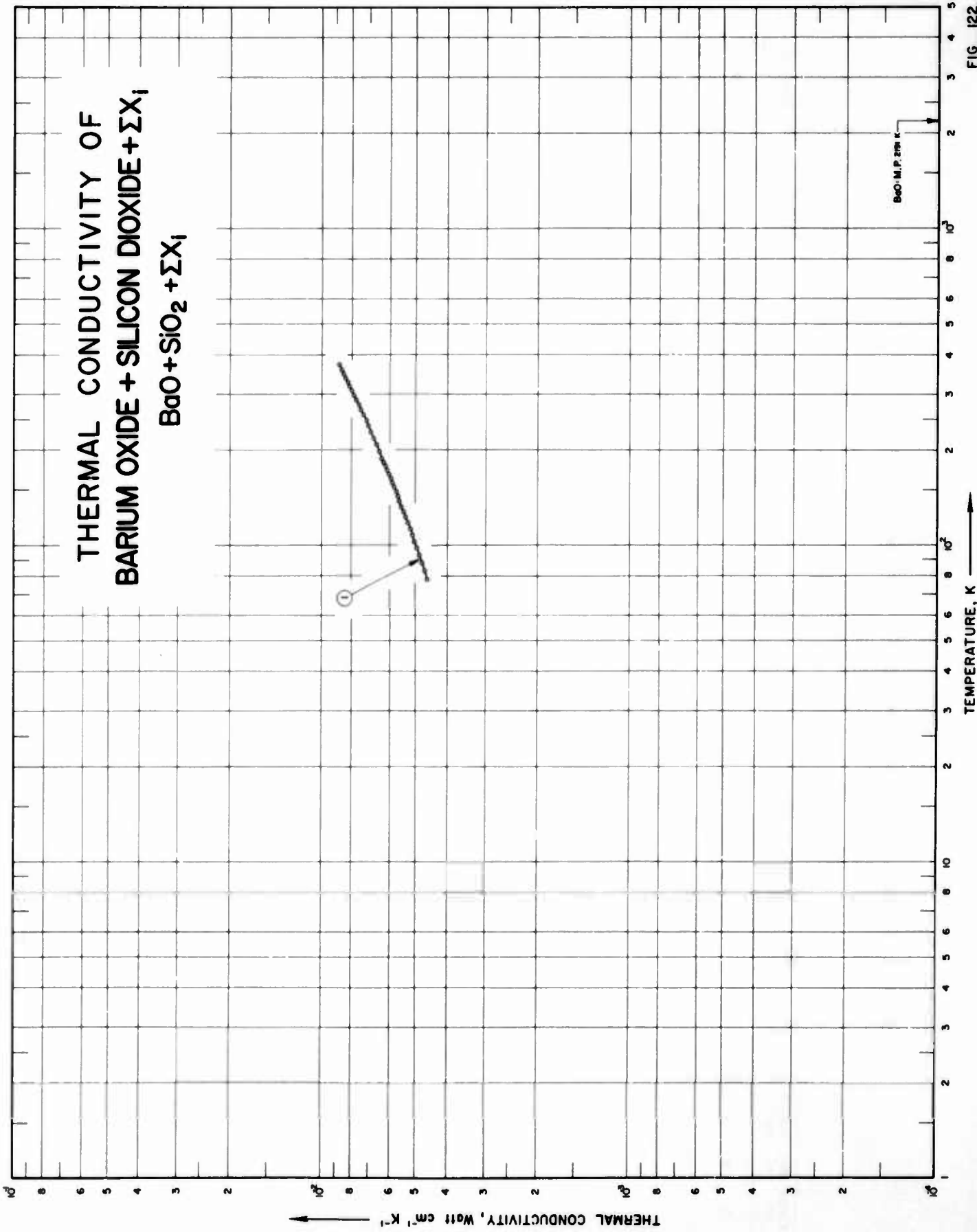
SPECIFICATION TABLE NO. 121 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + TITANIUM DIOXIDE + ΣX_i] $Al_2O_3 + TiO_2 + \Sigma X_i$

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Al_2O_3 TiO_2 SiO_2	Composition (continued), Specifications and Remarks
1	81 L	1924	1223.2		Fused Alumundum No. 1	92-96 1.5-4.0 1.0-2.5	0.25-1.0 Fe_2O_3 , 0-1.25 ZrO_2 ; traces of CaO , MgO , and Na_2O ; specimen 8.5 in. in dia, 2.54 in. thick; prepared by crushing the electric furnace products to pass a No. 14 screen and by bonding with 10% fire clay (25.41 Al_2O_3 , 59.55 SiO_2 , 2.31 Fe_2O_3 , 1.33 TiO_2 , 1.01 total K_2O and Na_2O , 0.46 CaO , 0.33 MgO , and 9.10 loss); fired to cone 16; measured at 752.8 mm Hg pressure; porosity 14.3%.
2	81 L	1924	1223.2		Fused Alumundum No. 2	92-96 1.5-4.0 1.0-2.5	0.25-1.0 Fe_2O_3 , 0-1.25 ZrO_2 ; similar to the above specimen but 2.53 in. thick; measured at 736.7 mm Hg pressure; porosity 13.6%.

DATA TABLE NO. 121 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + TITANIUM DIOXIDE + ΣX_i] $Al_2O_3 + TiO_2 + \Sigma X_i$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k
	<u>CURVE 1*</u>
1223.2	0.0365
	<u>CURVE 2*</u>
1223.2	0.0332

* No graphical presentation



SPECIFICATION TABLE NO. 122 THERMAL CONDUCTIVITY OF [BARIUM OXIDE + SILICON DIOXIDE + ΣX_i] BaO + SiO₂ + ΣX_i

[For Data Reported in Figure and Table No. 122]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						BaO	SiO ₂	ZnO B ₂ O ₃	
1	L	1960	78-373		Glass; J	42.9	40.5	7.7 6.5	1.8 Al ₂ O ₃ , 0.3 Sb ₂ O ₃ , and 0.2 As ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 3.56 g cm ⁻³ .

DATA TABLE NO. 122 THERMAL CONDUCTIVITY OF [BARIUM OXIDE + SILICON DIOXIDE + ΣX_i] BaO + SiO₂ + ΣX_i [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
78.2	0.00460	308.2	0.00799
83.2	0.00469	313.2	0.00803*
88.2	0.00477	318.2	0.00812
93.2	0.00485	323.2	0.00820*
98.2	0.00494	328.2	0.00824
103.2	0.00502	333.2	0.00828*
108.2	0.00510	338.2	0.00837
113.2	0.00519	343.2	0.00845*
118.2	0.00527	348.2	0.00849
123.2	0.00536	353.2	0.00854*
128.2	0.00544	358.2	0.00862
133.2	0.00552	363.2	0.00866*
138.2	0.00561	368.2	0.00870*
143.2	0.00565	373.2	0.00879
148.2	0.00573		
153.2	0.00582		
158.2	0.00590		
163.2	0.00594		
168.2	0.00602		
173.2	0.00611		
178.2	0.00619		
183.2	0.00628		
188.2	0.00636		
193.2	0.00640*		
198.2	0.00649		
203.2	0.00657*		
208.2	0.00661		
213.2	0.00669*		
218.2	0.00678		
223.2	0.00682*		
228.2	0.00690		
233.2	0.00699*		
238.2	0.00703		
243.2	0.00711*		
248.2	0.00715		
253.2	0.00724*		
258.2	0.00732		
263.2	0.00736*		
268.2	0.00745		
273.2	0.00753*		
278.2	0.00757		
283.2	0.00766*		
288.2	0.00774		
293.2	0.00778*		
298.2	0.00787		
303.2	0.00791*		

* Not shown on plot

SPECIFICATION TABLE NO. 123 THERMAL CONDUCTIVITY OF [BARIUM OXIDE + STRONTIUM OXIDE + ΣX_i] BaO + SrO + ΣX_i

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	75	L	1955	458-853	<10	Tube No. 6	56.7 BaO, 38.3 SrO, and 5.0 Zr; a mixture of 1 mole BaO, 1 mole SrO and 5 weight percent Zr; BaO and SrO added in the form of their carbonates and heated to 1040 C to drive off the CO ₂ ; apparent thermal conductivity (effects due to radiation at high temperatures not considered).
2	75	L	1955	618-1043		Tube No. 4	An equimolecular mixture of polycrystalline BaO and SrO with 2.5% ZrO added.

DATA TABLE NO. 123 THERMAL CONDUCTIVITY OF [BARIUM OXIDE + STRONTIUM OXIDE + ΣX_i] BaO + SrO + ΣX_i [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

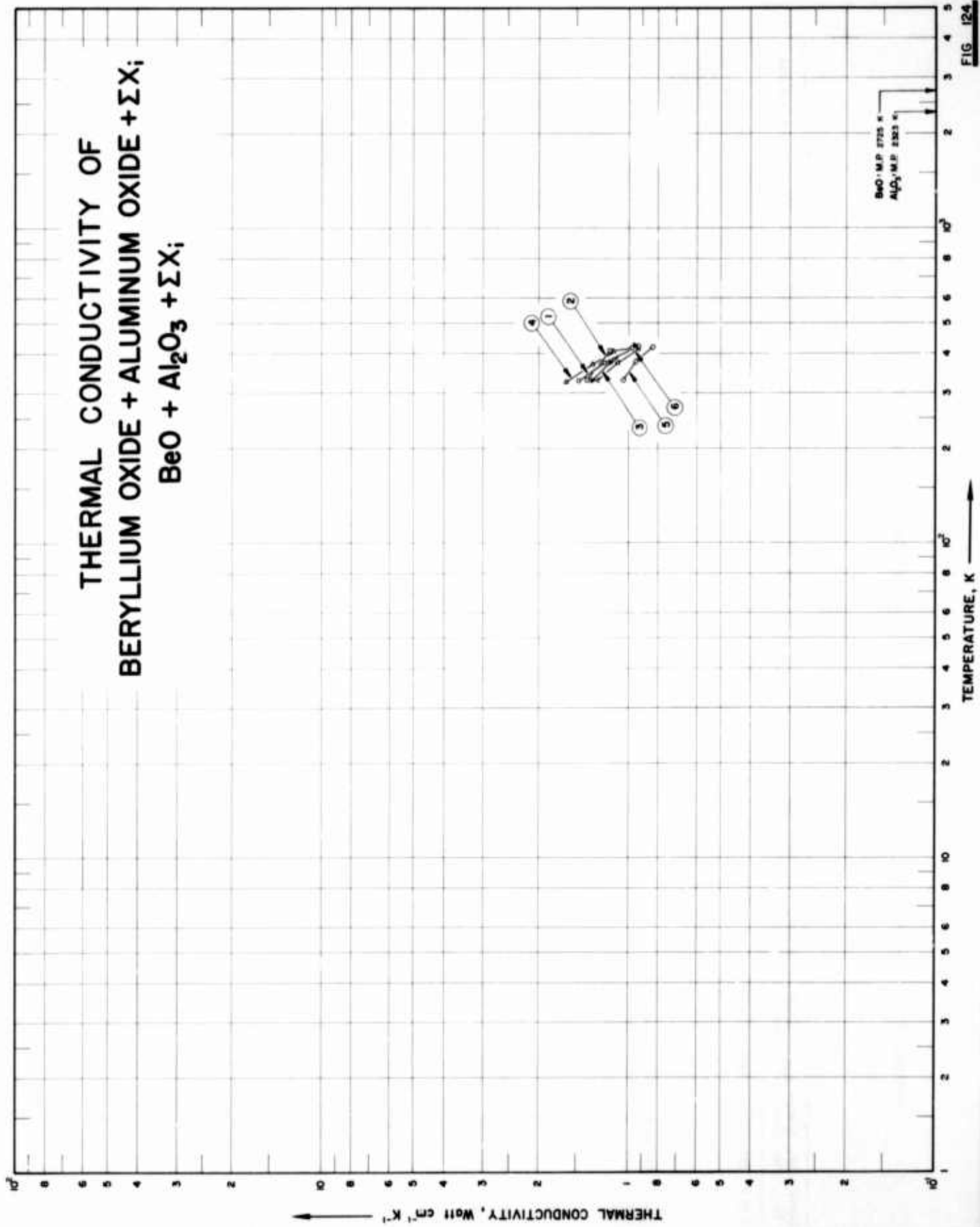
458.2 0.000033
 583.2 0.000040
 663.2 0.000048
 773.2 0.000068
 813.2 0.000070
 853.2 0.000091

CURVE 2*

618.2 0.0000480
 918.2 0.000123
 978.2 0.000148
 1043.2 0.000178

* No graphical presentation

THERMAL CONDUCTIVITY OF
 BERYLLIUM OXIDE + ALUMINUM OXIDE + ΣX_i
 $\text{BeO} + \text{Al}_2\text{O}_3 + \Sigma X_i$



SPECIFICATION TABLE NO. 124 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + ALUMINUM OXIDE + EX₁] BeO + Al₂O₃ + EX₁

[For Data Reported in Figure and Table No. 124]

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						BeO	Al ₂ O ₃	ThO ₂ ZrO ₂	
1	141 L	1950	329-423		A	95.0	2.5	2.5	Blended minus 325 mesh or finer size particles of fluorescent grade BeO and special acid-washed Al ₂ O ₃ in the form of a heavy slip, then dried, and pressed (pressure 10,000 lb in ⁻²) with sufficient 2% dextrine solution added to facilitate the pressing; maturing temp 1700 C based on linear firing shrinkage and absorption.
2	141 L	1950	330-415		B	90.5	5.0	5.0	Similar to the above specimen.
3	141 L	1950	330-426		C	80.0	10.0	10.0	Similar to the above specimen.
4	141 L	1950	326-408		N	95.0	2.5	2.5	Prepared by minus 325 mesh or finer sized particles of fluorescent grade BeO, special acid-w. shc. Al ₂ O ₃ , and chemically pure ZrO ₂ ; blended in the form of a heavy slip, then dried and pressed (pressure 10,000 lb in ⁻²) with sufficient 2% dextrine solution added to facilitate pressing; maturing temp 1700 C based on linear firing shrinkage and absorption.
5	141 L	1950	330-420		O	90.0	5.0	5.0	Similar to the above specimen.
6	141 L	1950	329-418		P	80.0	10.0	10.0	Similar to the above specimen.

DATA TABLE NO. 124 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + ALUMINUM OXIDE + ΣX_1] BeO + Al₂O₃ + ΣX_1

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
329.2	1.477
377.2	1.201
423.2	0.925
<u>CURVE 2</u>	
330.2	1.339
410.2	1.167
415.2	0.975
<u>CURVE 3</u>	
330.2	1.339
379.2	1.163
426.2	0.956
<u>CURVE 4</u>	
326.2	1.62
370.2	1.33
408.2	1.13
<u>CURVE 5</u>	
330.2	1.05
378.2	0.946
420.2	0.833
<u>CURVE 6</u>	
329.2	1.27
375.2	1.09
418.2	0.928

FIGURE SHOWS ONLY 7 OF THE CURVES REPORTED IN TABLE

**THERMAL CONDUCTIVITY OF
BERYLLIUM OXIDE + MAGNESIUM OXIDE + ΣX_i ;
BeO + MgO + ΣX_i**

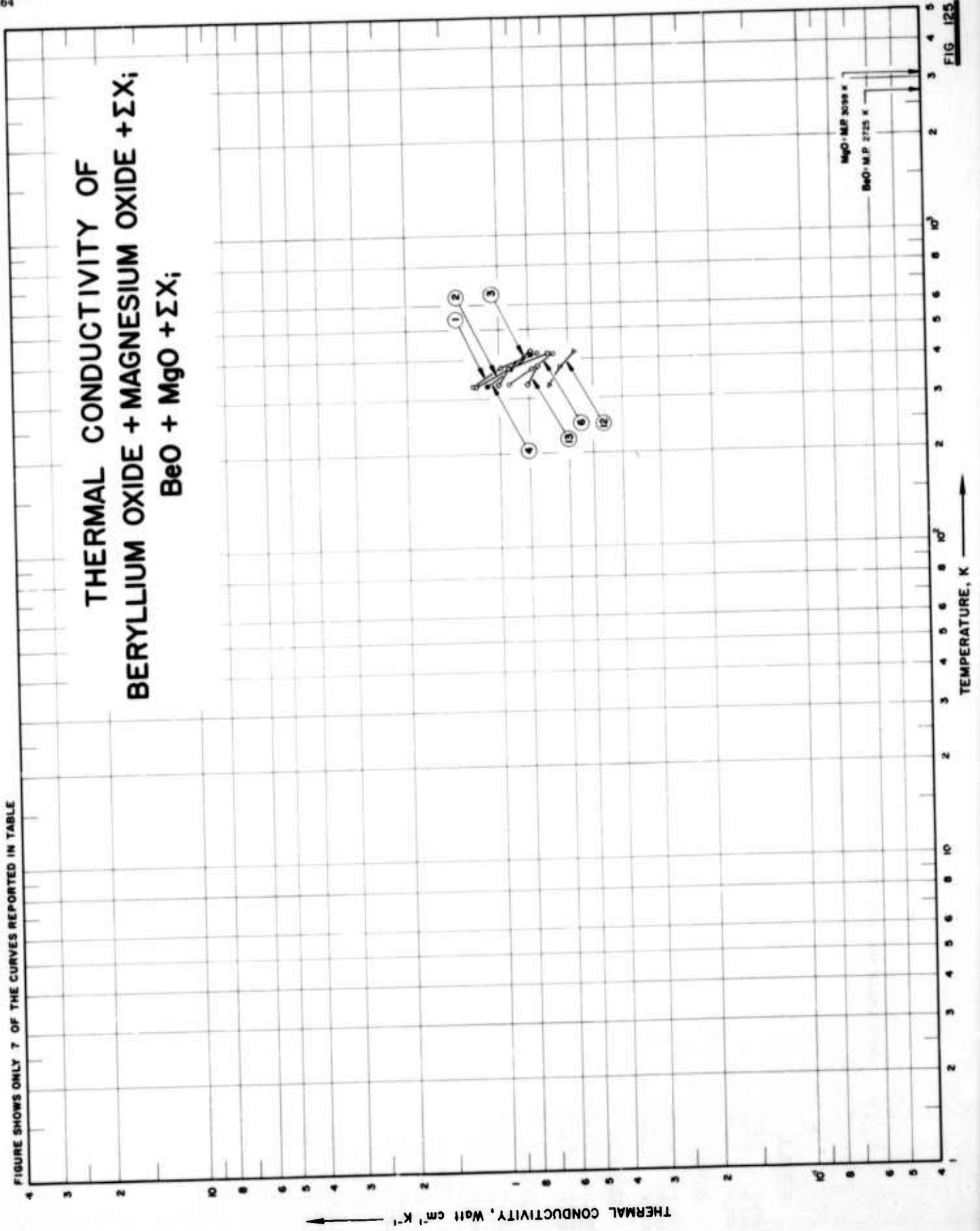


FIG. 125

SPECIFICATION TABLE NO. 125 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + MAGNESIUM OXIDE + ΣX_1] BeO + MgO + ΣX_1

[For Data Reported in Figure and Table No. 125]

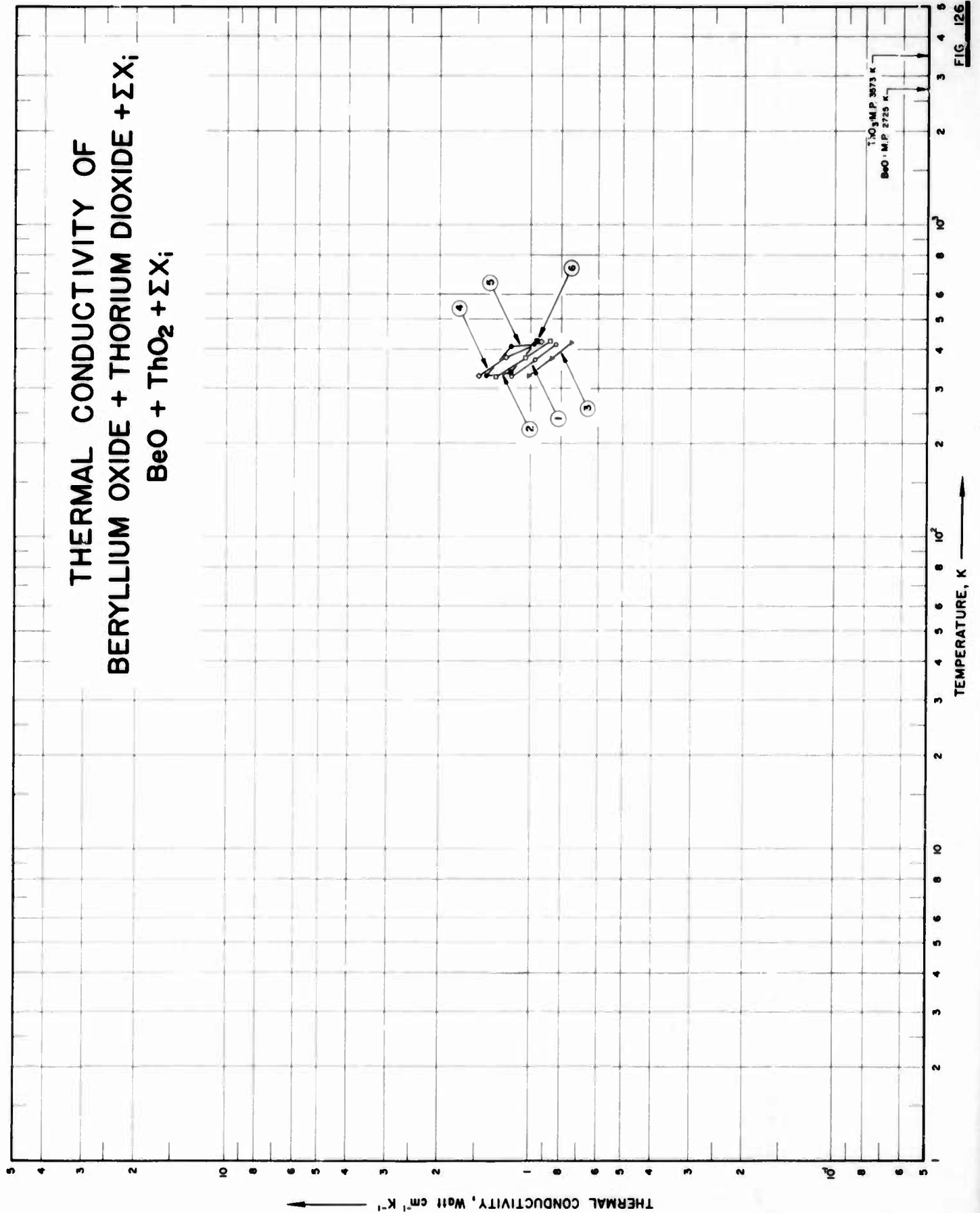
Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks	
						BeO	MgO	Al ₂ O ₃		
1	141	L	1950	329-419	A 4	91.2	4.0	2.4	2.4	Fluorescent grade BeO; special acid-washed Al ₂ O ₃ , particle size of all the raw materials was minus 325 mesh or finer; materials were blended first in the proper proportions in the form of a heavy slip, then dried, and then sufficient 2% dextrine solution was added to facilitate pressing; specimen was formed at a pressure of 10,000 lb in ⁻² ; maturing temp of 1600 C based on linear firing shrinkage and absorption.
2	141	L	1950	329-418	A 8	87.4	8.0	2.3	2.3	Same description as the above specimen.
3	141	L	1950	331-425	A 15	80.8	15.0	2.1	2.1	Same description as the above specimen.
4	141	L	1950	329-415	B 8	82.8	8.0	4.6	4.6	Same description as the above specimen except maturing temp 1600 C.
5	141	L	1950	327-414	B 15	76.5	15.0	4.25	4.25	Same description as the above specimen.
6	141	L	1950	328-417	C 15	68.0	15.0	8.5	8.5	Same description as the above specimen except maturing temp 1650 C.
7	141	L	1950	327-404	N 4	91.2	4.0	2.4	2.4	2.4 ZrO ₂ ; fluorescent grade BeO; special acid-washed Al ₂ O ₃ ; chemically pure grade ZrO ₂ ; MgCO ₃ was calcined to 2200 F before being added to the batch; particle size of all the raw materials was minus 325 mesh or finer; materials were blended first in the proper proportions in the form of a heavy slip, then dried, and then sufficient 2% dextrine solution was added to facilitate pressing; specimen was formed at a pressure of 10,000 psi; maturing temp 1500 C based on linear firing shrinkage and absorption.
8	141	L	1950	328-413	N 8	87.4	8.0	2.3	2.3	2.3 ZrO ₂ ; same description as the above specimen.
9	141	L	1950	325-409	N 15	80.8	15.0	2.1	2.1	2.1 ZrO ₂ ; same description as the above specimen.
10	141	L	1950	329-414	O 8	82.8	8.0	4.6	4.6	4.6 ZrO ₂ ; same description as specimen N 4.
11	141	L	1950	328-415	O 15	76.5	15.0	4.25	4.25	4.25 ZrO ₂ ; same description as specimen N 4 except maturing temp 1550 C.
12	141	L	1950	331-423	P 15	68.0	15.0	8.5	8.5	8.5 ZrO ₂ ; same description as the specimen above.
13	141	L	1950	332-420	Y 8	77.5	8.0	6.5	6.5	8.0 ZrO ₂ ; same description as the specimen above.

DATA TABLE NO. 125 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + MAGNESIUM OXIDE + ΣX_i] BeO + MgO + ΣX_i
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
329.2	1.218	325.2	1.079
377.2	0.987	367.2	0.908
419.2	0.749	408.7	0.791
<u>CURVE 2</u>			
329.2	1.184	329.2	1.008
375.2	0.929	372.2	1.025
418.2	0.695	414.2	0.749
<u>CURVE 3</u>			
331.2	1.008	328.2	0.908
374.2	0.925*	375.2	0.795
425.2	0.782	415.2	0.699
<u>CURVE 4</u>			
329.2	1.092	331.2	0.690
373.2	0.920	378.2	0.636
415.2	0.787	423.2	0.573
<u>CURVE 5*</u>			
327.2	1.017	332.2	0.808
371.2	0.900	380.2	0.749
414.2	0.778	420.2	0.699*
<u>CURVE 6</u>			
328.2	0.929		
374.2	0.782		
417.2	0.669		
<u>CURVE 7*</u>			
327.2	1.117		
375.2	1.075		
404.2	0.874		
<u>CURVE 8*</u>			
328.2	1.079		
373.2	0.925		
413.2	0.757		

* Not shown on Plot

**THERMAL CONDUCTIVITY OF
BERYLLIUM OXIDE + THORIUM DIOXIDE + ΣX_i
BeO + ThO₂ + ΣX_i**



SPECIFICATION TABLE NO. 126 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + THORIUM DIOXIDE + ΣX_1] BeO + ThO₂ + ΣX_1

[For Data Reported in Figure and Table No. 126]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks	
							BeO	ThO ₂	Al ₂ O ₃ MgO		
1	141	L	1950	328-415		B 4	86.4	4.8	4.8	4.0	Prepared from minus 325 mesh fluorescent grade BeO and special acid-washed Al ₂ O ₃ by blending in the form of a slip, drying, and pressing at 10,000 lb in ⁻² with dextrine as binder; fired at 1650 C.
2	141	L	1950	328-425		C 4	76.8	9.6	9.6	4.0	Similar to the above specimen.
3	141	L	1950	329-421		C 8	73.6	9.2	9.2	8.0	Similar to the above specimen.
4	141	L	1950	329-423		A	95.0	2.5	2.5		Blended minus 325 mesh or finer sized particles of fluorescent grade BeO and special acid-washed Al ₂ O ₃ in the form of a heavy slip, then dried, and pressed (pressure 10,000 lb in ⁻²) with sufficient 2% dextrine solution added to facilitate the pressing; maturing temp 1700 C based on linear firing shrinkage and absorption.
5	141	L	1950	330-415		B	90.0	5.0	5.0	5.0	Similar to the above specimen.
6	141	L	1950	330-426		C	80.0	10.0	10.0	10.0	Similar to the above specimen.

DATA TABLE NO. 126 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + THORIUM DIOXIDE + ΣX_i] BeO + ThO₂ + ΣX_i
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
328.2	1.151
369.2	0.967
415.2	0.833
<u>CURVE 2</u>	
328.2	1.297
376.2	1.042
425.2	0.870
<u>CURVE 3</u>	
329.2	1.013*
375.2	0.858
421.2	0.741
<u>CURVE 4</u>	
329.2	1.477
377.2	1.201
423.2	0.925
<u>CURVE 5</u>	
330.2	1.339
410.2	1.167
415.2	0.975
<u>CURVE 6*</u>	
330.2	1.339
379.2	1.163
426.2	0.958

* Not shown on Plot

THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE + ZIRCONIUM DIOXIDE + ΣX_i BeO + ZrO₂ + ΣX_i

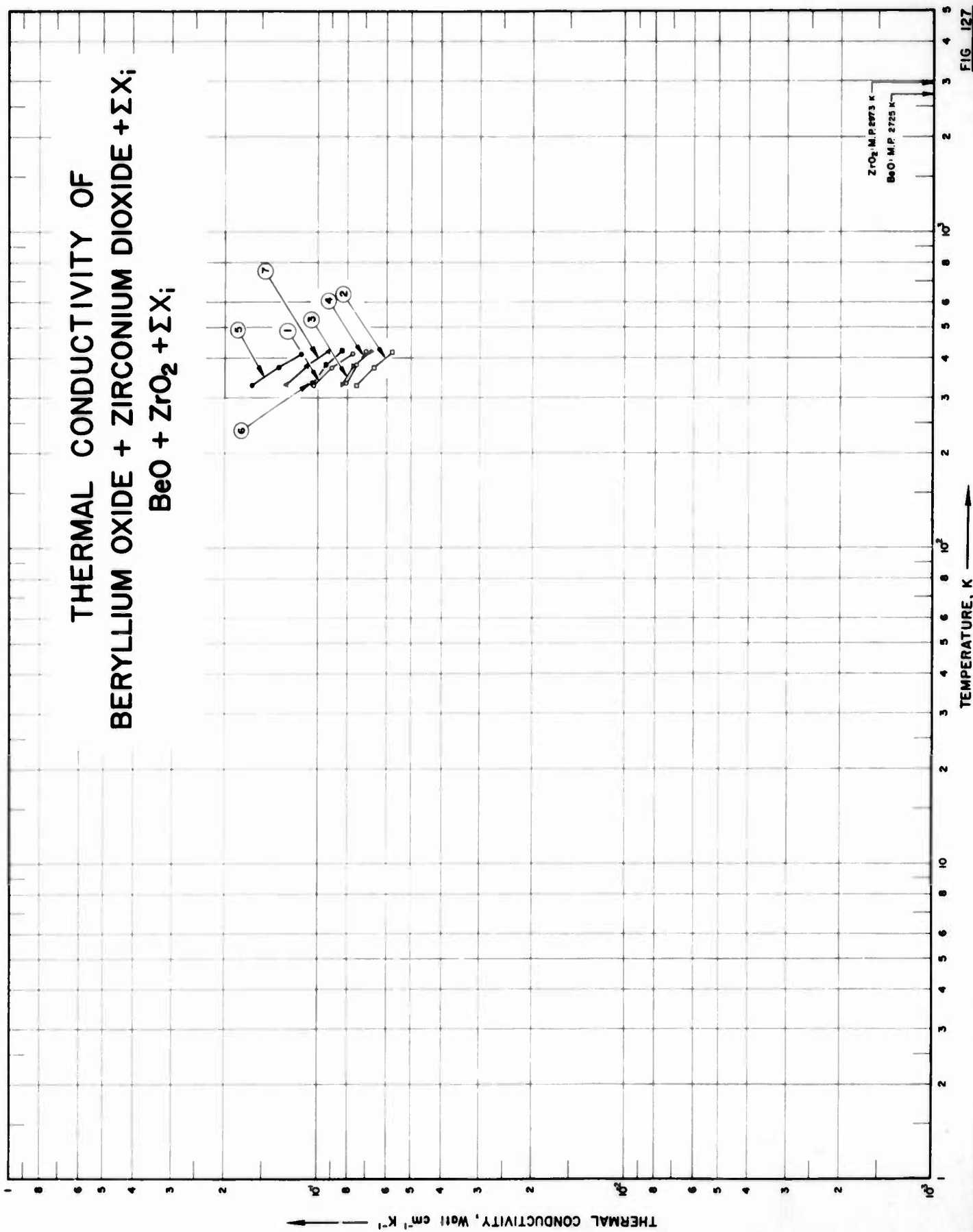


FIG. 127

SPECIFICATION TABLE NO. 127 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + ZIRCONIUM DIOXIDE + ΣX_i] BeO + ZrO₂ + ΣX_i

[For Data Reported in Figure and Table No. 127]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks	
							BeO	ZrO ₂	Al ₂ O ₃ MgO		
1	141	L	1950	328-414		O 4	86.4	4.8	4.8	4.0	Prepared from -325 mesh fluorescent grade BeO special acid-washed Al ₂ O ₃ , chemically pure ZrO ₂ , and calcined at 2200 F MgCO ₃ by blending in the form of a slip, drying, and pressing at 10,000 lb in ⁻² with dextrine as binder; fired at 1550 C.
2	141	L	1950	323-417		P 4	76.8	9.6	9.5	4.0	Similar to the above specimen except fired at 1650 C.
3	141	L	1950	330-420		P 8	73.6	9.2	9.2	8.0	Similar to the above specimen except fired at 1550 C.
4	141	L	1950	332-420		Y 8	77.5	8.0	6.5	8.0	Similar to the above specimen.
5	141	L	1950	326-408		N	95.0	2.5	2.5		Prepared by minus 325 mesh or finer sized particles of fluorescent grade BeO, special acid-washed Al ₂ O ₃ and chemically pure ZrO ₂ ; blended in the form of a heavy slip, then dried and pressed (pressure 10,000 lb in ⁻²) with sufficient 2% dextrine solution added to facilitate pressing; maturing temp 1700 C based on linear firing shrinkage and absorption.
6	141	L	1950	330-420		O	90.0	5.0	5.0		Similar to the above specimen.
7	141	L	1950	329-418		P	80.0	10.0	10.0		Similar to the above specimen.

DATA TABLE NO. 127 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + ZIRCONIUM DIOXIDE + ΣX_i] BeO + ZrO₂ + ΣX_i
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
328.2	1.042
373.2	0.900
414.2	0.770
<u>CURVE 2</u>	
328.2	0.745
373.2	0.661
417.2	0.577
<u>CURVE 3</u>	
330.2	0.833
377.2	0.766
420.2	0.674
<u>CURVE 4</u>	
332.2	0.808
380.2	0.749
420.2	0.699
<u>CURVE 5</u>	
326.2	1.62
370.2	1.33
408.2	1.13
<u>CURVE 6</u>	
330.2	1.05
378.2	0.946
420.2	0.833
<u>CURVE 7</u>	
329.2	1.27
375.2	1.09
418.2	0.928

SPECIFICATION TABLE NO. 128 THERMAL CONDUCTIVITY OF [DICHROMIUM TRIOXIDE + MAGNESIUM OXIDE + ΣX_i] $Cr_2O_3 + MgO + \Sigma X_i$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)					Composition (continued), Specifications and Remarks	
							Cr_2O_3	MgO	Fe_2O_3	Al_2O_3	SiO_2		Mn_2O_4
1	247	L	1932	379-794	1.0	Chromite Brick 23	40.09	22.68	13.16	10.48	10.53	2.32	0.68 CaO, trace ThO_2 ; density 3.868 g cm^{-3} ; porosity 27.3%; gas permeability 0.565 m^3 -cm per m^2 hr per mm of H_2O .

DATA TABLE NO. 128 THERMAL CONDUCTIVITY OF [DICHROMIUM TRIOXIDE + MAGNESIUM OXIDE + ΣX_i] $Cr_2O_3 + MgO + \Sigma X_i$ [Temperature, T, K. Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k
379.4	0.0232
490.5	0.0217
793.9	0.0163

* No graphical presentation

THERMAL CONDUCTIVITY OF
LEAD OXIDE + SILICON DIOXIDE + ΣX_i
 $PbO + SiO_2 + \Sigma X_i$

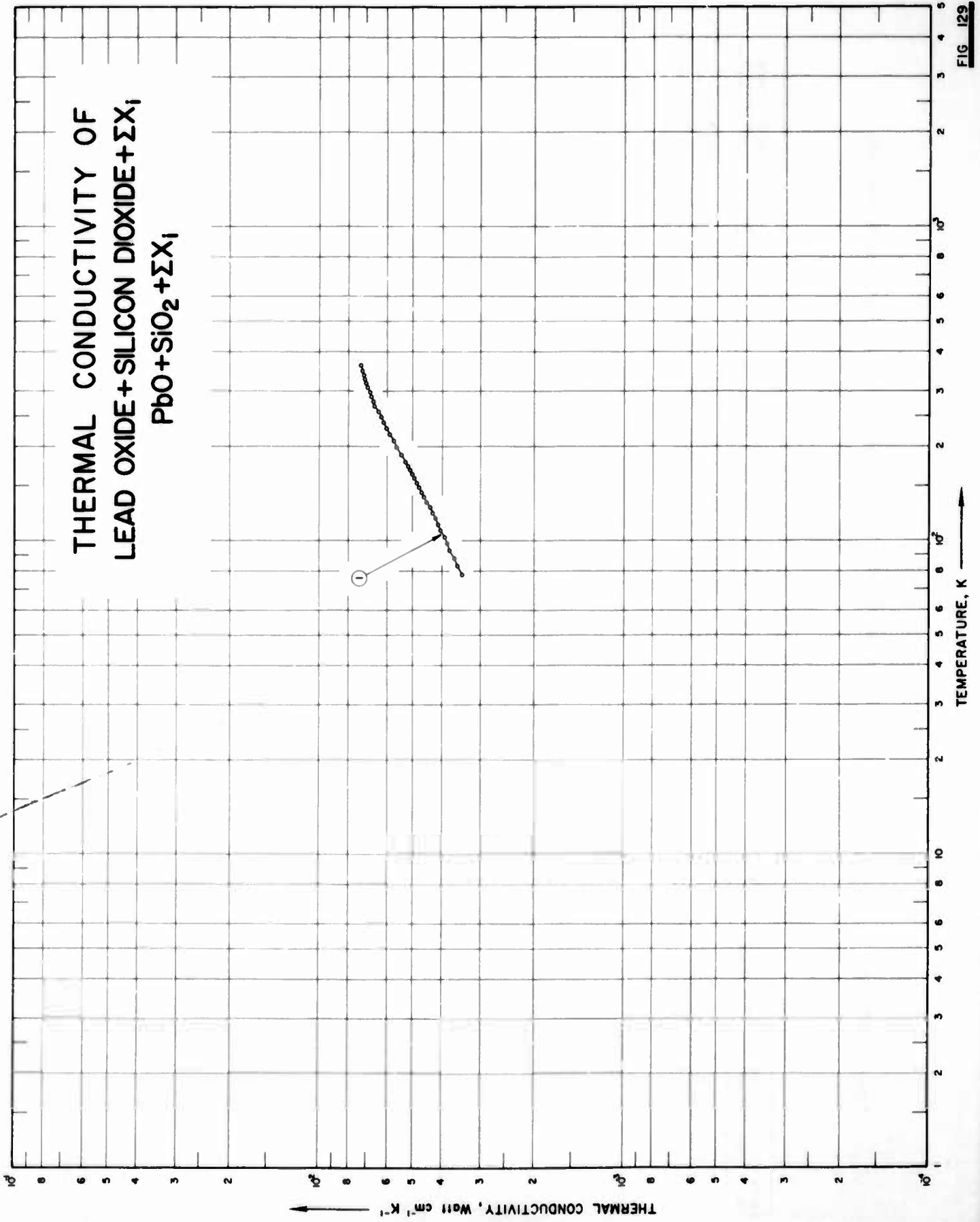


FIG. 129

SPECIFICATION TABLE NO. 129 THERMAL CONDUCTIVITY OF [LEAD OXIDE + SILICON DIOXIDE + ΣX_i] PbO + SiO₂ + ΣX_i

[For Data Reported in Figure and Table No. 129]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks	
							PbO	SiO ₂	K ₂ O		
1	147	L	1960	78-363		K	59.7	35.6	4.4	0.2	3 in. dia x 0.375 in. thick; density 4.29 g cm ⁻³ .

DATA TABLE NO. 129 THERMAL CONDUCTIVITY OF [LEAD OXIDE + SILICON DIOXIDE + ΣX_1] PbO + SiO₂ + ΣX_1
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	CURVE 1	k	T	CURVE 1 (cont.)	k
78.2	0.00343		303.2	0.00690*	
83.2	0.00356		308.2	0.00695	
88.2	0.00364		313.2	0.00699*	
93.2	0.00377		318.2	0.00703	
98.2	0.00385		323.2	0.00707*	
103.2	0.00393		328.2	0.00711	
108.2	0.00406		333.2	0.00715*	
113.2	0.00414		338.2	0.00715	
118.2	0.00423		343.2	0.00720*	
123.2	0.00431		348.2	0.00724	
128.2	0.00439		353.2	0.00728*	
133.2	0.00452		358.2	0.00732*	
138.2	0.00460		363.2	0.00732	
143.2	0.00469				
148.2	0.00477				
153.2	0.00485				
158.2	0.00494				
163.2	0.00502				
168.2	0.00510				
173.2	0.00519				
178.2	0.00527				
183.2	0.00536*				
188.2	0.00544				
193.2	0.00552*				
198.2	0.00561				
203.2	0.00569*				
208.2	0.00573				
213.2	0.00582*				
218.2	0.00590				
223.2	0.00598*				
228.2	0.00602				
233.2	0.00611*				
238.2	0.00619				
243.2	0.00623*				
248.2	0.00628				
253.2	0.00636*				
258.2	0.00640				
263.2	0.00649*				
268.2	0.00663				
273.2	0.00661*				
278.2	0.00665				
283.2	0.00669*				
288.2	0.00674				
293.2	0.00678*				
298.2	0.00682				

* Not shown on plot

**THERMAL CONDUCTIVITY OF
MAGNESIUM OXIDE + CALCIUM OXIDE + ΣXi
MgO + CaO + ΣXi**

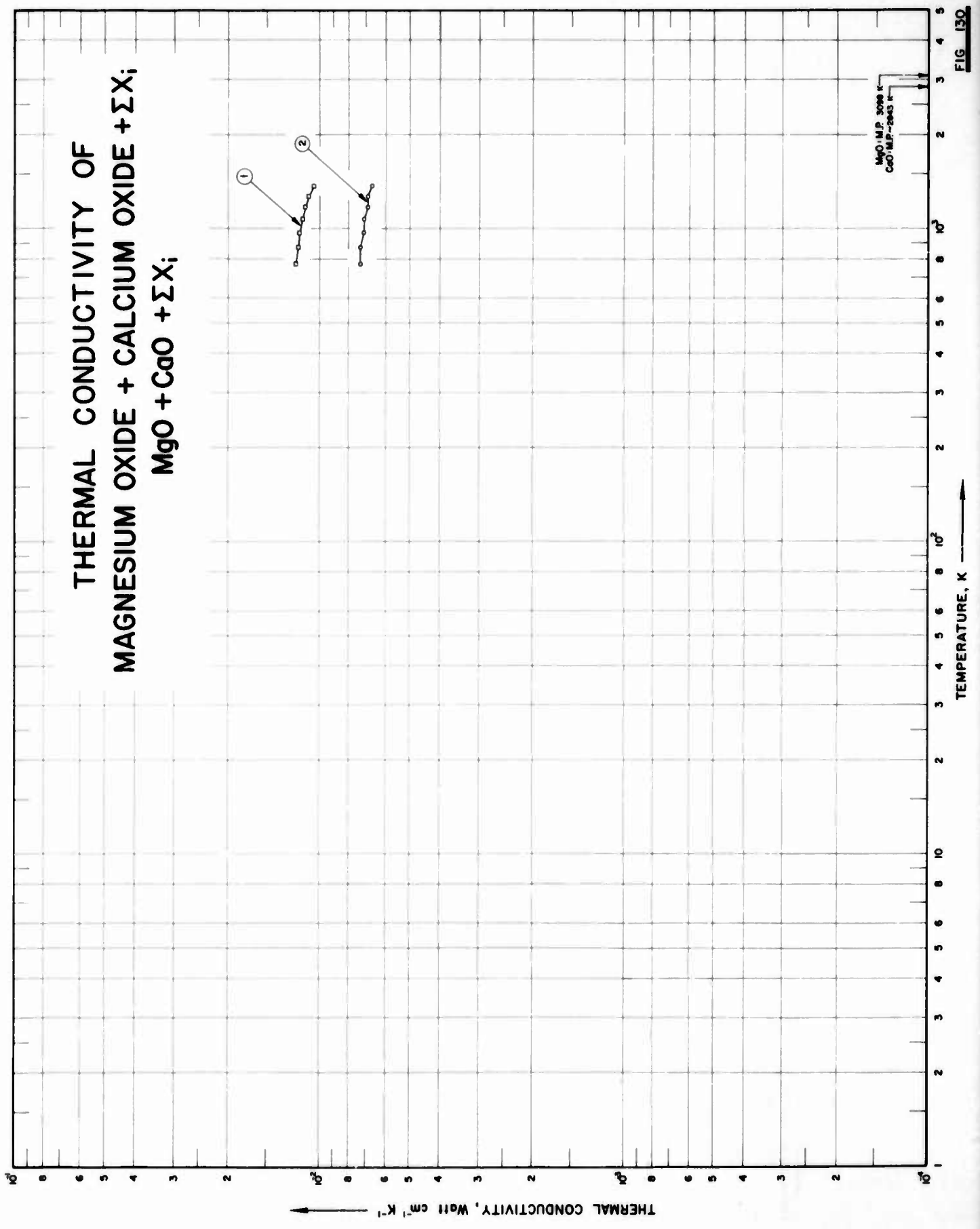


FIG. 130

SPECIFICATION TABLE NO. 130 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + CALCIUM OXIDE + ΣX_i] MgO + CaO + ΣX_i

[For Data Reported in Figure and Table No. 130]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
							MgO	CaO	Fe ₂ O ₃	
1	238	P	1921	773-1373		Magnesite brick J	81.79	5.24	1.87	Very close texture; brick size: 9 x 4.5 x 2.5 in.; apparent density 2.63 g cm ⁻³ ; true density 3.29 g cm ⁻³ ; porosity 20.0%; heat flow in the direction of the length of the brick.
2	238	P	1921	773-1373		Magnesite brick L	87.88	4.68	2.56	Texture not so close; porosity 24.5%; apparent density 2.56 g cm ⁻³ ; true density 3.28 g cm ⁻³ .

DATA TABLE NO. 130 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + CALCIUM OXIDE + ΣX_i] MgO + CaO + ΣX_i

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

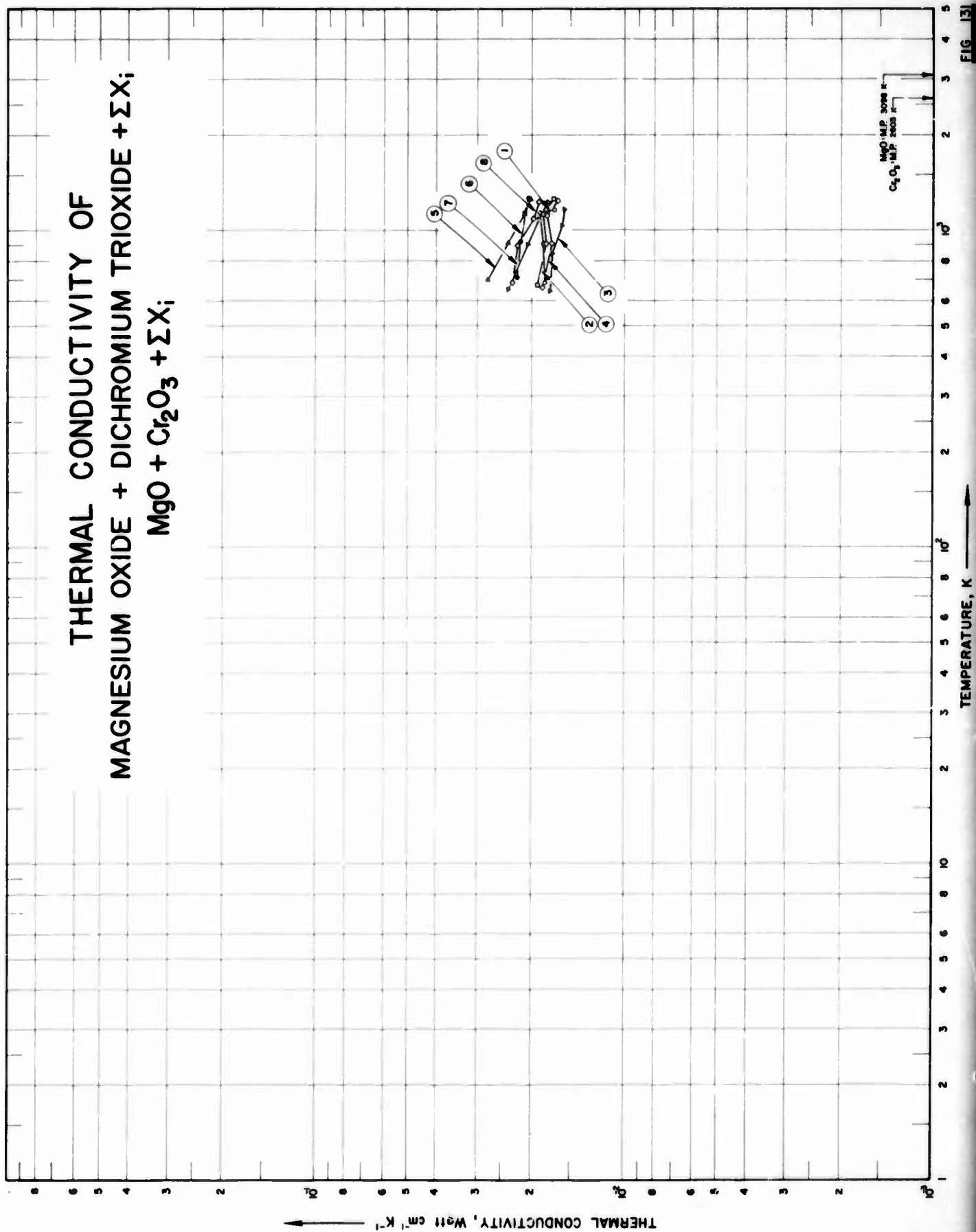
CURVE 1

773.2	0.00732
873.2	0.00732
973.2	0.00711
1073.2	0.00711
1173.2	0.00690
1273.2	0.00690
1373.2	0.00690

CURVE 2

773.2	0.0121
873.2	0.0119
973.2	0.0117
1073.2	0.0115
1173.2	0.0113
1273.2	0.0109
1373.2	0.0105

THERMAL CONDUCTIVITY OF
MAGNESIUM OXIDE + DICHRONIUM TRIOXIDE + ΣX_i
 $MgO + Cr_2O_3 + \Sigma X_i$



SPECIFICATION TABLE NO. 131 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + DICHRONIUM TRIOXIDE + ΣX_i] MgO + Cr₂O₃ + ΣX_i

[For Data Reported in Figure and Table No. 131]

Curve No.	Ref. Method Used	Year	Temp. Range, °K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks	
						Al ₂ O ₃	Cr ₂ O ₃	Fe ₂ O ₃	MgO		SiO ₂
1	L	1955	683-1263		Magnezit; 4	12.59	20.48	9.15	49.46	5.24	1.26 CaO, 1.90 FeO, 0.09 total Ca, Mg, Fe, and Mn; chromomagnesite refractory brick; density 2.95 g cm ⁻³ ; apparent porosity 22.8%; gas permeability 0.455 m ³ x cm m ⁻² hr ⁻¹ (mm H ₂ O) ⁻¹ .
2	L	1955	673-1253		Magnezit; 5	12.59	20.48	9.15	49.46	5.24	1.26 CaO, 1.90 FeO, 0.09 total Ca, Mg, Fe, and Mn; same as the above specimen.
3	L	1955	643-1168		Magnezit; 6	12.59	20.48	9.15	49.46	5.24	1.26 CaO, 1.90 FeO, 0.09 total Ca, Mg, Fe, and Mn; same as the above specimen.
4	L	1955	658-1248		K Marksa; 11	12.34	24.35	11.94	42.31	6.14	1.65 CaO, 1.71 FeO, 0.13 total Ca, Mg, Fe, and Mn; chromomagnesite refractory brick; density 3.03 g cm ⁻³ ; apparent porosity 23.5%; gas permeability 0.303 m ³ x cm m ⁻² hr ⁻¹ (mm H ₂ O) ⁻¹ .
5	L	1955	698-1258		Magnezit; 7	8.51	12.28	5.80	64.85	4.28	1.44 CaO, 1.67 FeO, 0.21 total Ca, Mg, Fe, and Mn; chromomagnesite heat resistant refractory brick; density 3.04 g cm ⁻³ ; apparent porosity 19.1%; gas permeability 0.480 m ³ x cm m ⁻² hr ⁻¹ (mm H ₂ O) ⁻¹ .
6	L	1955	708-1263		Magnezit; 8	8.51	12.28	5.80	64.85	4.28	1.44 CaO, 1.67 FeO, 0.21 total Ca, Mg, Fe, and Mn; chromomagnesite heat resistant refractory brick; similar to the above specimen.
7	L	1955	653-1233		Magnezit; 9	8.51	12.28	5.80	64.85	4.28	1.44 CaO, 1.67 FeO, 0.21 total Ca, Mg, Fe, and Mn; chromomagnesite heat resistant refractory brick; similar to the above specimen.
8	L	1955	683-1228		Ordzhonikidze; 10	11.46	22.34	13.04	42.87	5.42	2.88 FeO, 1.76 CaO, trace total Cr, Mg, Fe, and Mn; chromomagnesite heat resistant refractory brick; density 2.95 g cm ⁻³ ; apparent porosity 25.6%; gas permeability 0.598 m ³ x cm m ⁻² hr ⁻¹ (mm H ₂ O) ⁻¹ .

DATA TABLE NO. 131 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + DICHRONIUM TRIOXIDE + ΣX_i] MgO + Cr₂O₃ + ΣX_i

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
683.2	0.0182	653.2	0.0238
903.2	0.0184	896.2	0.0206
1143.2	0.0188	1088.2	0.0189
1263.2	0.0169	1233.2	0.0177
<u>CURVE 2</u>			
673.2	0.0192	683.2	0.0231
903.2	0.0180	893.2	0.0222
1123.2	0.0184	1083.2	0.0198
1253.2	0.0171	1228.2	0.0189
<u>CURVE 3</u>			
643.2	0.0175		
843.2	0.0173		
1033.2	0.0160		
1168.2	0.0157		
<u>CURVE 4</u>			
658.2	0.0185		
903.2	0.0173		
1113.2	0.0179		
1248.2	0.0136		
<u>CURVE 5</u>			
698.2	0.0277		
913.2	0.0238		
1123.2	0.0211		
1238.2	0.0201		
<u>CURVE 6</u>			
708.2	0.0223		
918.2	0.0217		
1133.2	0.0213		
1263.2	0.0205		

SPECIFICATION TABLE NO. 132 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + DIIRON TRIOXIDE + ΣX_i] MgO + Fe₂O₃ + ΣX_i

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks		
						MgO	Fe ₂ O ₃	CaO		SiO ₂	Al ₂ O ₃
1	252	L	1933	409-1561	Magnesite brick	86.8	6.3	3.0	2.6	0.8	Vol. density 2.54 g cm ⁻³ , true density 3.59 g cm ⁻³ , porosity 26-29%.

DATA TABLE NO. 132 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + DIIRON TRIOXIDE + ΣX_i] MgO + Fe₂O₃ + ΣX_i

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
409.3	0.0398
565.4	0.0342
755.4	0.0298
883.2	0.0272
1150	0.0213
1167	0.0220
1467	0.0190
1561	0.0193

* No graphical presentation

THERMAL CONDUCTIVITY OF
MAGNESIUM OXIDE + SILICON DIOXIDE + ΣX_i
 $MgO + SiO_2 + \Sigma X_i$

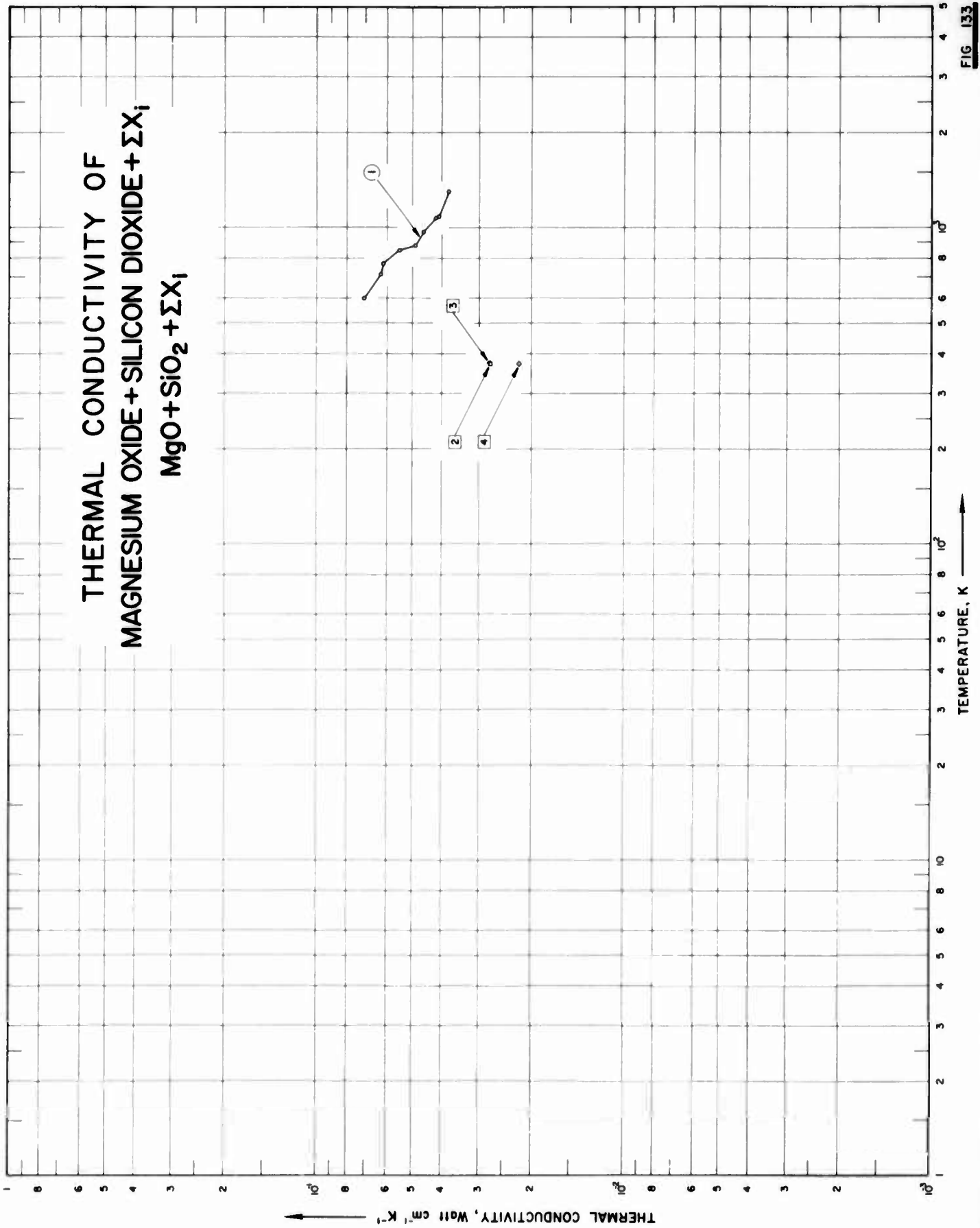


FIG. 133

SPECIFICATION TABLE NO. 133 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + SILICON OXIDE + ΣX_i] MgO + SiO₂ + ΣX_i

[For Data Reported in Figure and Table No. 133]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks
							MgO	SiO ₂	Fe ₂ O ₃	CaO	
1	462	L	1915	598-1303		Magnesia brick (Mabor)	92.1	5.0	1.6	1.7	0.4 Al ₂ O ₃ ; commercial brand; specimen 2.5 in. thick; fine grained; apparent density 2.40 g cm ⁻³ .
2	458	R	1921	373.2		Magnesia brick (Mabor)	53.27	32.46	2.5	4.91	14.78 Al ₂ O ₃ ; 10 cm dia x 4.5 cm thick; density reported as 2.295, 2.294, 2.291, 2.285, 2.275, and 2.266 g cm ⁻³ at 20, 50, 100, 200, 300, and 400 C, respectively.
3	458	P	1921	373.2		Magnesia brick (Mabor)					Similar to the above specimen; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
4	458	L	1921	373.2		Magnesia brick (Mabor)	76.43	18.26	0.80	trace	2.56 Al ₂ O ₃ , and 0.21 MnO; 4 cm dia x 8 cm long; supplied by Imperial Steel Works; density 2.370 g cm ⁻³ ; thermal conductivity value calculated from measured data of thermal diffusivity, specific heat, and density.

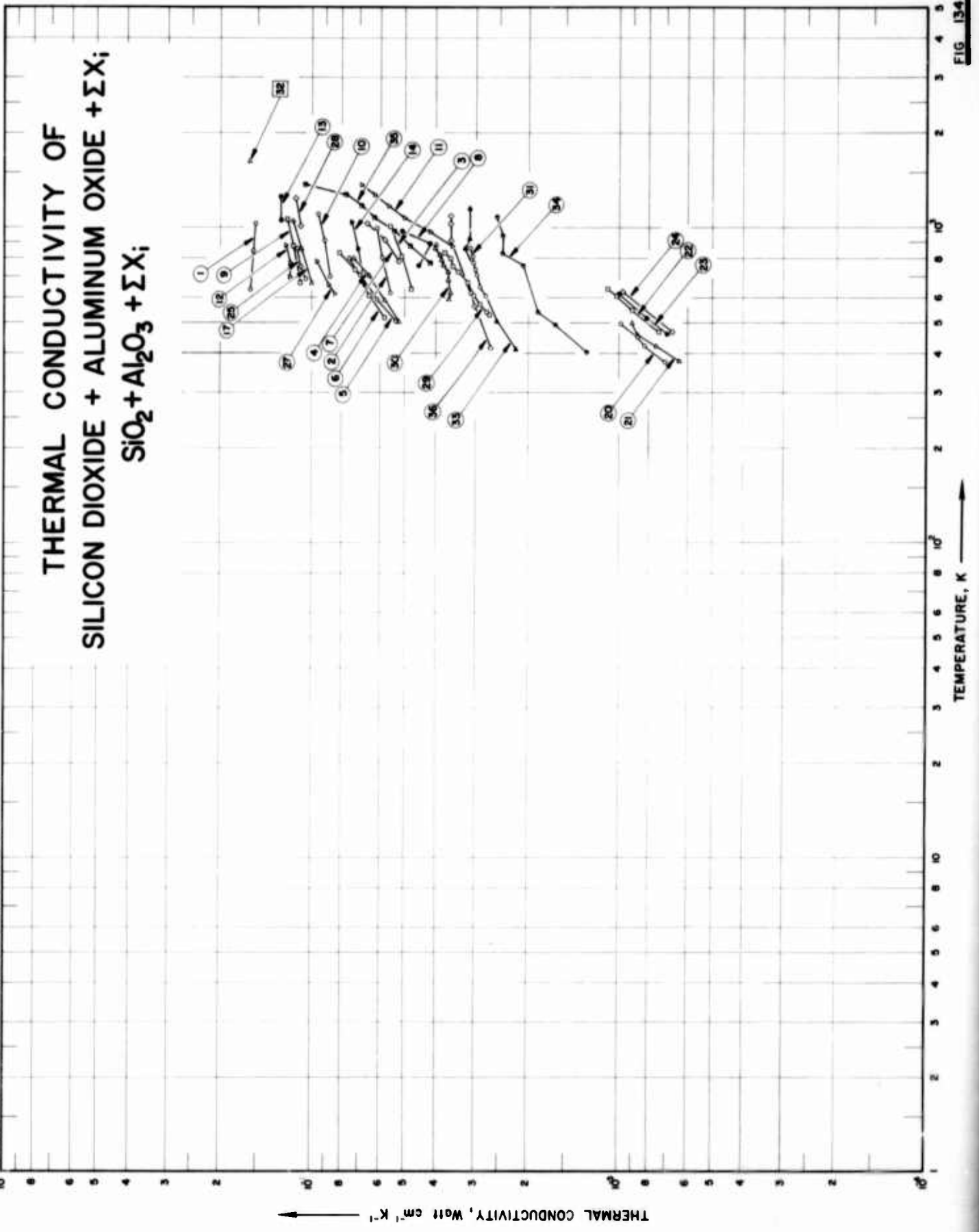
DATA TABLE NO. 1.3 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + SILICON DIOXIDE + ΣX_1] MgO + SiO₂ + ΣX_1

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
598	0.071
715.7	0.063
773	0.062
848	0.055
883	0.049
973	0.046
1075.7	0.042
1088	0.041
1303	0.038
<u>CURVE 2</u>	
373.2	0.0276
<u>CURVE 3</u>	
373.2	0.0277
<u>CURVE 4</u>	
373.2	0.0221

FIGURE SHOWS ONLY 31 OF THE CURVES REPORTED IN TABLE

**THERMAL CONDUCTIVITY OF
SILICON DIOXIDE + ALUMINUM OXIDE + ΣXi;
SiO₂ + Al₂O₃ + ΣXi;**



THERMAL CONDUCTIVITY, W/cm-K

TEMPERATURE, K

SPECIFICATION TABLE NO. 134 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + ALUMINUM OXIDE + ΣX_i] $\text{SiO}_2 + \text{Al}_2\text{O}_3 + \Sigma X_i$

[For Data Reported in Figure and Table No. 134]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks		
						SiO_2	Al_2O_3	Fe_2O_3			
1	85	L	1949	636-1036	5.0-7.0	High temp. insulating blast furnace brick	56.42	-	1.42	-	40.18 total Al_2O_3 and TiO_2 , 0.88 CaO, and 0.36 MgO; semidry pressed; from Semiluk factory; density 2.16 g cm^{-3} and open porosity 17.8%; no additional shrinkage when exposed at 1350 C for 2 hrs.
2	85	L	1949	623-993	5.0-7.0	Light weight brick	66.08	-	1.04	-	30.48 total Al_2O_3 and TiO_2 , 0.92 CaO, and 0.52 MgO; from Shekensk factory; density 1.30 g cm^{-3} and open porosity 49.9%; 0.1% additional shrinkage when exposed at 1350 C for 2 hrs.
3	85	L	1949	636-1003	5.0-7.0	Light weight brick	70.98	-	1.38	-	25.08 total Al_2O_3 and TiO_2 , 0.96 CaO, and 0.25 MgO; from Snigirevsk factory; density 1.17 g cm^{-3} and open porosity 56.6%; 2.0% additional shrinkage when exposed at 1350 C for 2 hrs.
4	86	C	1946	503-798	3	II	65.72	-	1.93	-	29.02 total TiO_2 and Al_2O_3 , 1.08 CaO, and 0.62 MgO; open porosity 68.4%; water absorption 81.0%; gas permeability 211 $\text{ml m}^{-2}\text{hr}^{-1}$; refractoriness 1630-1650 C; light gray color; pore size up to 1.5 mm in dia; pore distribution even.
5	86	C	1948	505-797	3	III	66.38	-	1.63	-	29.05 total TiO_2 and Al_2O_3 , 1.12 CaO, and 0.51 MgO; density 0.86 g cm^{-3} ; open porosity 66.3%; water absorption 75.4%; gas permeability 230 $\text{ml m}^{-2}\text{hr}^{-1}$; refractoriness 1630-1650 C; yellowish red color; pores heterogeneous, a small number of pores of 3-5 mm size by side with pores of 1.5 mm.
6	86	C	1948	518-834	3	IV	67.89	-	1.93	-	27.81 total TiO_2 and Al_2O_3 , 0.64 CaO, and 0.52 MgO; density 0.98 g cm^{-3} ; open porosity 63%; water absorption 62.6%; gas permeability 46 $\text{ml m}^{-2}\text{hr}^{-1}$; refractoriness 1630-1650 C; white color; large number of pores with diameters 6-7 mm.
7	86	L	1948	783-1028		IV	67.89	-	1.93	-	27.81 total TiO_2 and Al_2O_3 , 0.64 CaO and 0.52 MgO; same as the above specimen.
8	86	L	1948	758-973		II	65.72	-	1.93	-	29.02 total TiO_2 and Al_2O_3 , 1.08 CaO, and 0.62 MgO; same as the specimen II.
9	85	L	1949	666-1064	5.0-7.0	Normal brick; 2	63.06	-	1.21	-	33.91 total Al_2O_3 + TiO_2 , 1.00 CaO, and 0.67 MgO; semidry pressed; from Semiluk factory; density 1.86 g cm^{-3} ; open porosity 29.1%; no additional shrinkage when exposed at 1350 C for 2 hrs.

SPECIFICATION TABLE NO. 134 (continued)

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks			
						SiO ₂	Al ₂ O ₃	Fe ₂ O ₃ TiO ₂				
10	85	L	1949	698-1101	5.0-7.0	Normal brick; 5	56.32	-	0.92	-	40.72 Al ₂ O ₃ and TiO ₂ , 1.02 CaO, and 0.48 MgO; semi-dry pressed; from Borovitchsk factory; density 1.92 g cm ⁻³ ; open porosity 28.1%; 0.5% additional shrinkage when exposed at 1350 C for 2 hrs.	
11	238	P	1921	873-1373		Silica brick C	93.36		2.97		2.20 CaO; specimen 9 x 4.5 x 2.5 in.; open texture with large number of fissures of appreciable size; bonding of coarse (angular rock fragments of 0.25 in. and downward) and fine fairly good except fine material easily detached; porosity 20.7%; heat flow in lengthwise direction.	
12	79	L	1942	696-880		No.3,aluminous fire clay	52.0		41.3	2.5	2.7	Refractory standard cone 33; 18 in. x 18 in. dimension.
13	79	C	1942	1062,1254		No.3,aluminous fire clay	52.0		41.3	2.5	2.7	In disc form; steel used as comparative material.
14	85	L	1949	661-1048	5.0-7.0	Light weight brick	54.56	-	2.59	-	-	40.73 Al ₂ O ₃ + TiO ₂ , 0.92 CaO and 0.48 MgO; from Borovitchsk factory; density 1.24 g cm ⁻³ ; open porosity 53.0%; 0.5% additional shrinkage when exposed at 1350 C for 2 hrs.
15	86	C	1948	513-827			68.12	-	2.04	-	-	27.38 Al ₂ O ₃ + TiO ₂ , 0.88 CaO and 0.59 MgO; density 0.91 g cm ⁻³ ; open porosity 65.1%, water absorption 64.5%; gas permeability 216 ml m ⁻² hr ⁻¹ , and refractoriness 1630 C; light yellow color; numerous pores with size up to 1.5 mm in dia and small number of pores with dia up to 5-6 mm; distribution of pores even.
16	86	L	1948	753-993			68.12	-	2.04	-	-	27.38 Al ₂ O ₃ + TiO ₂ , 0.88 CaO and 0.59 MgO; other descriptions same as the above.
17	85	L	1949	668-1053	5.0-7.0	Normal brick; 3	75.70	-	2.59	-	-	20.41 Al ₂ O ₃ + TiO ₂ , 0.68 CaO and 0.53 MgO; semi-acid; of sheet form from Latnensk factory; density 1.85 g cm ⁻³ ; open porosity 30.4%; 0.1% additional shrinkage when exposed at 1350 C for 2 hrs.
18	85	L	1949	668-1053	5.0-7.0	Normal brick; 4	48.40	-	2.24	-	-	37.36 Al ₂ O ₃ + TiO ₂ , 0.62 CaO and 0.59 MgO; in sheet form from Borovitchsk factory; density 1.919 g cm ⁻³ ; open porosity 29.0%; 0.5% additional shrinkage when exposed at 1350 C for 2 hrs.
19	262	L	1939	416-1094		β	77.2	15.6	1.9			3.7 alkalis, and 1.6 MgO; density 1.770 g cm ⁻³ ; porosity 32%.

SPECIFICATION TABLE NO. 134 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks
							SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	
20	213	C	1956	376-496		Expanded Vermiculite	35.76	18.7	18.3		7.82 MgO, 3.61 K ₂ O, 1.40 CaO, 1.02 Na ₂ O, 0.42 MnO; ignition loss 14.85% (1200 C), 10.10% (1000 C); from Fukushima, Japan; the grain sizes of the vermiculite by sieve analysis as follows: 99 cumulative % (by wt) 100 mesh, (Tyler standard scale, meshes to the in.), 97 cumulative % 60 mesh., 92 cumulative % 28 mesh., 77 cumulative % 12 mesh., 44 cumulative % 7 mesh., 4 cumulative % 4 mesh.; produced by firing (with heat rate 2 C min ⁻¹) the unsieved vermiculite at 700 C for 5 min (dehydration) then loose-filling into a plate form box (size 19 cm x 19 cm x 2 cm) and pressing it until the volume is 20% less than the original; bulk density (before pressing) 0.25; use diatomaceous earth plate as comparative material.
21	213	C	1956	378-499		Expanded Vermiculite	35.76	18.7	18.3		7.82 MgO, 3.61 K ₂ O, 1.40 CaO, 1.2 Na ₂ O, 0.42 MnO; same preparation as the above specimen except firing at 800 C for 2 min; bulk density (before pressing) 0.225; use diatomaceous earth plate as comparative material.
22	213	C	1956	468-640		Expanded Vermiculite	35.76	18.7	18.3		7.82 MgO, 3.61 K ₂ O, 1.40 CaO, 1.02 Na ₂ O, 0.42 MnO; same preparation as the above specimen except firing at 900 C for 1 min; bulk density (before pressing) 0.200; use diatomaceous earth plate as comparative material.
23	213	C	1956	463-618		Expanded Vermiculite	35.76	18.7	18.3		7.82 MgO, 3.61 K ₂ O, 1.40 CaO, 1.02 Na ₂ O, 0.42 MnO; same preparation as the above specimen except firing at 1000 C for 0.25 min; bulk density (before pressing) 0.175; use diatomaceous earth plate as comparative material.
24	213	C	1956	468-628		Expanded Vermiculite	35.76	18.7	18.3		7.82 MgO, 3.61 K ₂ O, 1.40 CaO, 1.02 Na ₂ O, 0.42 MnO; same preparation as the above specimen except firing at 1100 C for 5 sec.; bulk density (before pressing) 0.15; use diatomaceous earth plate as comparative material.
25	79	L	1942	688-857		Fire clay brick; 1	56.46	36.79	2.58	1.84	1.24 alkali oxides, 0.60 MgO, and 0.38 CaO; refractory test cone 31; in slab form 18 in. x 18 in.
26	79	C	1942	1066, 1301		Fire clay brick; 1	56.45	36.79	2.58	1.84	1.24 alkali oxides, 0.60 MgO, and 0.38 CaO; same as the above specimen but in disc form 8 in. in dia, and 1 in. in thickness; steel used as comparative material.

SPECIFICATION TABLE NO. 134 (continued)

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks	
						SiO ₂	Al ₂ O ₃	Fe ₂ O ₃		TiO ₂
27	79	L	1942	618-784		56.46	36.79	2.58	1.34	1.24 alkali oxides 0.60 MgO, and 0.38 CaO; specimen in slab form 18 in. x 18 in.; same firing temp as the above specimen.
28	79	C	1942	1009-1242		56.46	36.79	2.58	1.84	1.24 alkali oxides, 0.60 MgO, and 0.38 CaO; specimen 8 in. in dia and 1 in. in thickness; firing temp same as the above specimen; steel used as comparative material.
29	83	L	1956	531-833		64.5	26.0	7.0		1.1 CaO and 1.0 MgO; bulk density 1.01 g cm ⁻³ ; apparent porosity 72.7%.
30	83	L	1956	593-891		65.3	29.5	3.5		0.9 MgO and 0.8 CaO; bulk density 1.09 g cm ⁻³ ; apparent porosity 60.0%.
31	83	L	1956	606-858		71.0	24.0	2.5		0.8 CaO and 0.7 MgO; bulk density 0.780 g cm ⁻³ ; apparent porosity 68.5%.
32	84	L	1925	1623.2		58.50	34.48	3.52	1.80	0.62 MgO, 0.29 CaO, and 0.31 ignition loss; original coarse, fairly open, first quality fire clay; apparent density 2.05 g cm ⁻³ ; porosity 26.8% calculated by assuming specific gravity 2.60 for fire clay; the wall under test was built with standard 2.5 x 4.5 x 9 in. bricks laid up with cement of the same composition as the brick.
33	262	L	1939	413-1151		78.3	17.3	2.2		1.4 alkali oxides, 0.7 CaO, and trace MgO; density 0.805 g cm ⁻³ ; porosity 68%.
34	262	L	1939	404-1083		61.9	34.1	2.2		1.4 CaO and 0.4 alkali oxides; density 0.710 g cm ⁻³ ; porosity 73%.
35	238	P	1921	773-1373		68.38	26.12	2.50		Close structure; not much clay frog, but large proportion of angular quartz grains; adherence very good; very few fissures; quartz grains very evenly graded; possibly all would pass an 8's lawn; faces of brick not good; very fine black cores; appearance of many pinholes; brick size 9 x 4.5 x 2.5 in.; porosity 17.3%; heat flow is in the direction of the length of the brick.
36	262	L	1939	415-1094		77.2	15.6	1.9		3.7 alkali, 1.6 MgO; density 1.77 g cm ⁻³ ; porosity 32%.
37	462	L	1915	816-1268		66	31	1.2		1.0 alkali, 0.9 MgO, 0.3 CaO; commercial brand; specimen 1.5 in. thick; apparent density 1.95 g cm ⁻³ ; hard fired to Seger cone 10-11.
38	462	L	1915	1033-1203		56	31	1.2		1.0 alkali, 0.9 MgO, 0.3 CaO; similar to the above specimen.

SPECIFICATION TABLE NO. 134 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	Composition (continued), Specifications and Remarks
39	462	L	1915	1278-1293		Fire clay brick (Farnley)	66	31	1.2		1.0 alkali, 0.9 MgO, 0.3 CaO; similar to the above specimen except apparent density 1.99 g cm ⁻³ ; soft fired to Seger cone 8-9.
40	462	L	1915	1078		Silicious brick (Farnley)	82.5	16.1	1.2		1.3 alkali, trace CaO and MgO; specimen 3 in. thick; apparent density 1.82 g cm ⁻³ ; with many silica grains.
41	462	L	1915	1113		Silica brick (Gregory)	95.3	2.0	1.1		1.5 CaO; specimen 2.5 in. thick; coarse grained; apparent density 1.75 g cm ⁻³ .
42	462	L	1915	918-1191		Silica brick (Gregory)	95.3	2.0	1.1		1.5 CaO; similar to the above specimen except apparent density 1.74 g cm ⁻³ .
43	458	R	1921	373.2		Common brick	76.52	13.67	6.77		1.77 CaO, 0.42 MgO, and 0.27 MnO; 10 cm dia x 4.5 cm thick.
44	458	P	1921	373.2		Common brick					Similar to the above specimen; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
45	458	R	1921	373.2		Shamotte brick	60.78	33.95	4.37		0.79 CaO, traces of MgO and MnO; 10 cm dia x 4.5 cm thick; density reported as 1.917, 1.916, 1.913, 1.905, 1.901, 1.896, and 1.892 g cm ⁻³ at 20, 50, 100, 200, 300, 400, and 500 C, respectively.
46	458	P	1921	373.2		Shamotte brick					Similar to the above specimen; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
47	458	P	1921	373.2		Red brick	76.45	21.13	2.02		Traces of CaO and MgO; commercial brick; 4 cm dia x 8 cm long; density 1.782 g cm ⁻³ ; thermal conductivity value calculated from measured data of thermal diffusivity, specific heat, and density.
48	383	L	1927	473-1673	±15	Penn. fire brick	54.16	38.84	2.70	2.72	1.14 MgO, 0.39 sulphates, 0.10 CaO; specimen in the form of a cylinder 10.8 cm in dia and 22.8 cm long; apparent density 2.59 g cm ⁻³ ; bulk density 1.90 g cm ⁻³ ; porosity 26.7%.
49	383	L	1927	473-1673	±15	Missouri fire brick	53.12	43.3	2.48		0.64 CaO, 0.46 MgO, 0.15 alkalis; specimen in the form of a cylinder 10.8 cm in dia, and 22.8 cm long; apparent density 2.64 g cm ⁻³ , bulk density 2.15 g cm ⁻³ porosity 18.4%.
50	147	L	1960	83-363		Glass; F	57.9	11.1			9.7 ZnO, 9.4 Na ₂ O, 4.9 CaO, 2.7 F, 2.3 K ₂ O, 1.9 B ₂ O ₃ , and other oxides < 0.1 each; 3 in. dia x 0.375 in. thick; density 2.55 g cm ⁻³ .

DATA TABLE NO. 134 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + ALUMINUM OXIDE + ΣX_i] $SiO_2 + Al_2O_3 + \Sigma X_i$

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>													
636.2	0.0158	758.2	0.00453	513.2	0.00558	468.2	0.000744	573.2	0.00290	404.2	0.00128	1078	0.0104
843.2	0.0155	898.2	0.00418	603.2	0.00628	548.2	0.000907	610.2	0.00305	492.2	0.00163	<u>CURVE 40*</u>	
1036.2	0.0153	973.2	0.00511	729.2	0.00709	608.2	0.00102	620.2	0.00309	540.2	0.00186	<u>CURVE 41*</u>	
<u>CURVE 2</u>													
623.2	0.00558	<u>CURVE 9</u>		827.2	0.00779	640.2	0.00109	670.2	0.00319	758.7	0.00209	1113	0.016
803.2	0.00593	666.2	0.0109	<u>CURVE 16*</u>				723.2	0.00343	829.7	0.00244	<u>CURVE 42*</u>	
993.2	0.00616	871.2	0.0115	753.2	0.00488	463.2	0.000697	753.2	0.00355	942.2	0.00244	<u>CURVE 43*</u>	
<u>CURVE 3</u>													
636.2	0.00477	<u>CURVE 10</u>		518.2	0.000814	518.2	0.00100	798.2	0.00361	1082.7	0.00256	918	0.013
813.2	0.00511	698.2	0.00872	<u>CURVE 17</u>				833.2	0.00376	773.2	0.00418	1063	0.015
1003.2	0.00558	907.2	0.00907	668.2	0.0100	468.2	0.000674	620.2	0.00366	873.2	0.00461	1190.7	0.018
<u>CURVE 4</u>													
503.2	0.00523	1101.2	0.00953	858.2	0.0108	628.2	0.000976	725.2	0.00368	1073.2	0.00628	<u>CURVE 43*</u>	
589.2	0.00581	<u>CURVE 11</u>		1083.2	0.0115	<u>CURVE 25</u>				759.2	0.00379	1273.2	0.00774
701.2	0.00651	873.2	0.00356	<u>CURVE 18*</u>				788.2	0.00384	1373.2	0.0105	373.2	0.00732
798.2	0.00732	973.2	0.00418	668.2	0.0102	688.2	0.0105	818.2	0.00389	<u>CURVE 36</u>			
<u>CURVE 5</u>													
505.2	0.00535	1273.2	0.00628	753.2	0.0109	753.2	0.0109	860.2	0.00401	415.7	0.00267	373.2	0.00732
593.2	0.00616	1373.2	0.00690	857.2	0.0113	857.2	0.0113	881.2	0.00398	564.7	0.00302	<u>CURVE 45*</u>	
709.2	0.00697	<u>CURVE 12</u>		<u>CURVE 26*</u>				881.2	0.00398	750.7	0.00360	373.2	0.00950
797.2	0.00755	696.2	0.0117	1066.2	0.0121	1066.2	0.0121	605.2	0.00278	909.7	0.00360	<u>CURVE 46*</u>	
<u>CURVE 6</u>													
518.2	0.00581	772.2	0.0117	1301.2	0.0126	1301.2	0.0126	649.2	0.00290	1032.2	0.00360	<u>CURVE 47*</u>	
608.2	0.00651	880.2	0.0121	<u>CURVE 27</u>				706.2	0.00297	1094.2	0.00360	<u>CURVE 48*</u>	
735.2	0.00721	<u>CURVE 13</u>		618.2	0.00837	660.2	0.00879	773.2	0.00306	<u>CURVE 37*</u>			
834.2	0.00814	1062.2	0.0126	1032.2	0.00360	784.2	0.00962	806.2	0.00307	815.7	0.012	373.2	0.00569
<u>CURVE 7</u>													
783.2	0.00523	1254.2	0.0126	<u>CURVE 28</u>				1623.2	0.0159	978	0.015	<u>CURVE 38*</u>	
913.2	0.00581	423.2	0.000825	1009.2	0.0109	1242.2	0.0113	605.2	0.00278	1268	0.017	473.2	0.0100
1028.2	0.00662	496.2	0.000988	1242.2	0.0113	<u>CURVE 33</u>				750.7	0.00360	763.2	0.0113
<u>CURVE 8</u>													
661.2	0.00674	<u>CURVE 14</u>		413.2	0.00221	413.2	0.00221	736.2	0.00301	1033	0.014	873.2	0.0126
858.2	0.00709	661.2	0.00674	506.2	0.00256	506.2	0.00256	773.2	0.00306	1203	0.016	1073	0.0134
1048.2	0.00744	858.2	0.00709	659.7	0.00291*	659.7	0.00291*	806.2	0.00307	<u>CURVE 39*</u>			
<u>CURVE 9</u>													
783.2	0.00523	378.2	0.000639	729.2	0.00302*	729.2	0.00302*	858.2	0.00313	1278	0.0066	1473	0.0151
913.2	0.00581	423.2	0.000755	530.7	0.00269	530.7	0.00269	864.7	0.00325	1293	0.0050	<u>CURVE 44*</u>	
1028.2	0.00662	496.2	0.000872	540.7	0.00276	540.7	0.00276	881.2	0.00325	<u>CURVE 45*</u>			
<u>CURVE 10</u>													
499.2	0.000907	499.2	0.000907	1151.2	0.00314	1151.2	0.00314	<u>CURVE 30</u>					
<u>CURVE 11</u>													
<u>CURVE 15*</u>													
<u>CURVE 16*</u>													
<u>CURVE 17</u>													
<u>CURVE 18*</u>													
<u>CURVE 19</u>													
<u>CURVE 20</u>													
<u>CURVE 21</u>													
<u>CURVE 22</u>													
<u>CURVE 23</u>													
<u>CURVE 24</u>													
<u>CURVE 25</u>													
<u>CURVE 26*</u>													
<u>CURVE 27</u>													
<u>CURVE 28</u>													
<u>CURVE 29 (cont.)</u>													
<u>CURVE 30</u>													
<u>CURVE 31</u>													
<u>CURVE 32</u>													
<u>CURVE 33</u>													
<u>CURVE 34</u>													
<u>CURVE 35</u>													
<u>CURVE 36</u>													
<u>CURVE 37*</u>													
<u>CURVE 38*</u>													
<u>CURVE 39*</u>													
<u>CURVE 40*</u>													
<u>CURVE 41*</u>													
<u>CURVE 42*</u>													
<u>CURVE 43*</u>													
<u>CURVE 44*</u>													
<u>CURVE 45*</u>													
<u>CURVE 46*</u>													
<u>CURVE 47*</u>													
<u>CURVE 48*</u>													

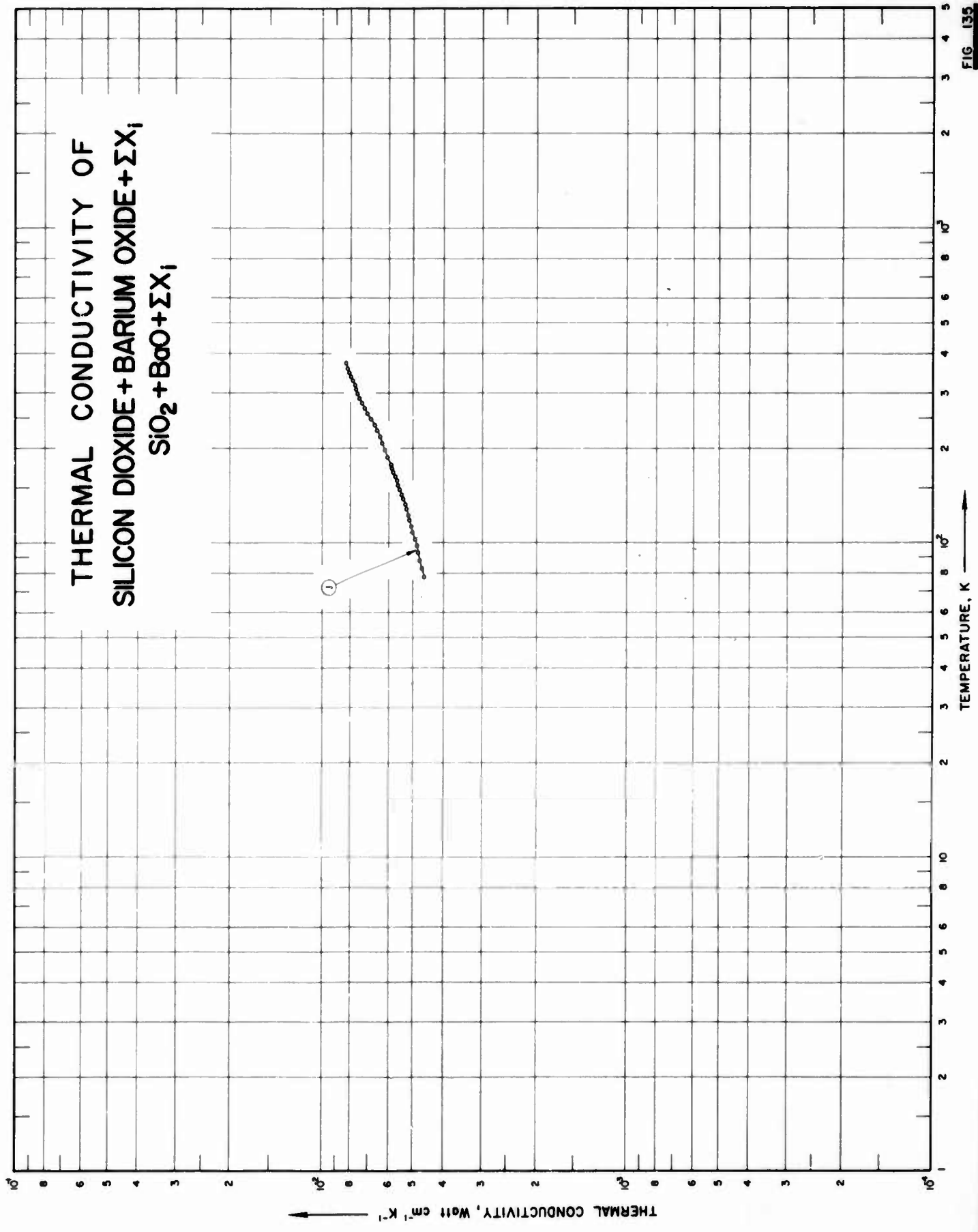
* Not shown on plot

DATA TABLE NO. 134 (continued)

T	k	T	k
<u>CURVE 49*</u>			
473.2	0.0100	263.2	0.01092
673.2	0.0126	268.2	0.01100
873.2	0.0146	273.2	0.01105
1073.2	0.0155	278.2	0.01113
1273.2	0.0163	283.2	0.01117
1473.2	0.0172	288.2	0.01125
1673.2	0.0176	293.2	0.01130
		298.2	0.01134
		303.2	0.01142
		308.2	0.01146
		313.2	0.01151
		318.2	0.01155
		323.2	0.01163
		328.2	0.01167
		333.2	0.01172
		338.2	0.01176
		343.2	0.01184
		348.2	0.01188
		353.2	0.01192
		358.2	0.01197
		363.2	0.01201
<u>CURVE 50*</u>			
83.2	0.00653		
88.2	0.00674		
93.2	0.00690		
98.2	0.00711		
103.2	0.00732		
108.2	0.00749		
113.2	0.00766		
118.2	0.00778		
123.2	0.00795		
128.2	0.00812		
133.2	0.00828		
138.2	0.00841		
143.2	0.00854		
148.2	0.00870		
153.2	0.00883		
158.2	0.00895		
163.2	0.00908		
168.2	0.00916		
173.2	0.00929		
178.2	0.00941		
183.2	0.00950		
188.2	0.00962		
193.2	0.00975		
198.2	0.00983		
203.2	0.00992		
208.2	0.01004		
213.2	0.01013		
218.2	0.01021		
223.2	0.01029		
228.2	0.01038		
233.2	0.01046		
238.2	0.01054		
243.2	0.01063		
248.2	0.01071		
253.2	0.01079		
258.2	0.01084		

* Not shown on plot

FIG. 135



SPECIFICATION TABLE NO. 135 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + BARIUM OXIDE + ΣX_i] $\text{SiO}_2 + \text{BaO} + \Sigma X_i$

[For Data Reported in Figure and Table No. 135]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						SiO_2	BaO	K_2O ZnO	
1	L	1960	78-373		Glass; H	49.8	24.2	8.5 7.8	5.9 PbO, 2.9 Na ₂ O, 0.7 Sb ₂ O ₃ , and 0.2 As ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 3.18 g cm ⁻³ .

DATA TABLE NO. 135 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + BARIUM OXIDE + ΣX_i] $\text{SiO}_2 + \text{BaO} + \Sigma X_i$
 [Temperature, T. K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k
CURVE 1		CURVE 1 (cont.)	
78.2	0.00460	303.2	0.00761*
83.2	0.00469	308.2	0.00766
88.2	0.00477	313.2	0.00700*
93.2	0.00481	318.2	0.00774
98.2	0.00485	323.2	0.00782*
103.2	0.00494	328.2	0.00787
108.2	0.00502	333.2	0.00795*
113.2	0.00506	338.2	0.00799
118.2	0.00515	343.2	0.00803*
123.2	0.00519	348.2	0.00808
128.2	0.00527	353.2	0.00816*
133.2	0.00531	358.2	0.00820
138.2	0.00540	363.2	0.00824*
143.2	0.00548	368.2	0.00828*
148.2	0.00552	373.2	0.00833
153.2	0.00561		
158.2	0.00565		
163.2	0.00573		
168.2	0.00582		
173.2	0.00586		
178.2	0.00590		
183.2	0.00598*		
188.2	0.00607		
193.2	0.00615*		
198.2	0.00619		
203.2	0.00628*		
208.2	0.00632		
213.2	0.00640*		
218.2	0.00644		
223.2	0.00653*		
228.2	0.00657		
233.2	0.00661*		
238.2	0.00669		
243.2	0.00678*		
248.2	0.00686		
253.2	0.00695*		
258.2	0.00703		
263.2	0.00711*		
268.2	0.00720		
273.2	0.00724*		
278.2	0.00732		
283.2	0.00736*		
288.2	0.00745		
293.2	0.00753*		
298.2	0.00757		

* Not shown on plot

**THERMAL CONDUCTIVITY OF
SILICON DIOXIDE+BORON OXIDE+ ΣX_i
 $SiO_2 + B_2O_3 + \Sigma X_i$**

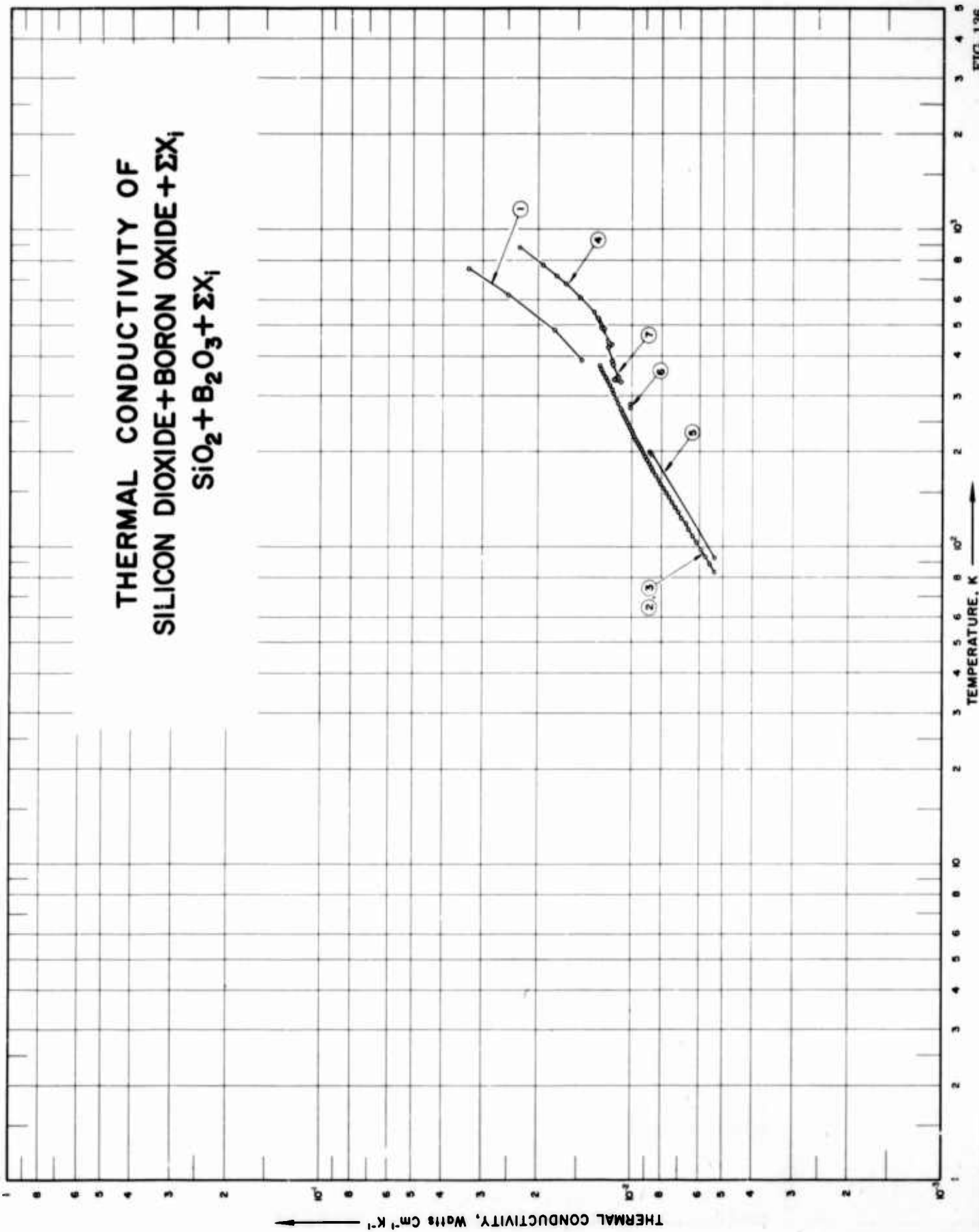


FIG. 136

SPECIFICATION TABLE NO. 136 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + BORON OXIDE] $\text{SiO}_2 + \text{B}_2\text{O}_3 + \Sigma X_i$

[For Data Reported in Figure and Table No. 136]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						B_2O_3	SiO_2	Na_2O Al_2O_3	
1	34	C	1943	388-751	Pyrex-brand glass	12.9	80.5	3.8 2.2	0.4 PbO, specimen 1 cm cube; ground; 18-8 stainless steel used as standard.
2	147	L	1960	83-373	Glass A	12.8	80.8	4.2 2.2	Oxides < 0.1 omitted; approx composition; specimen measured in a stack of a pair of 3 in. dia discs; density 2.22 g cm ⁻³ . (Additional data from the author.)
3	147	L	1960	83-373	Glass B	13.1	79.5	5.3 2.1	Similar to the above specimen except density 2.27 g cm ⁻³ . (Additional data from the author.)
4	136	C	1959	430-871	Pyrex 7740	12.5	81.0	4.0 2.0	A platinum wire threaded through a 60 to 70 cm long Pyrex capillary tube of approximately 0.1 cm internal and 1.0 cm external dia, then heated so that the glass was carefully melted around the wire, and finally bent to a form of U-tube; measured in a bath of liquid air and a mixture of solid carbon dioxide; density 2.233 g cm ⁻³ at 21 C.
5	187	R	1932	92-198	Pyrex glass	12.5	80.5	4.0 2.0	
6	187	R	1932	275, 279	Pyrex glass	12.5	80.5	4.0 2.0	Above specimen measured in a bath containing crushed ice and water.
7	187	R	1932	328-523	Pyrex glass	12.5	80.5	4.0 2.0	Above specimen measured in an oil bath.

DATA TABLE NO. 136 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + BORON OXIDE + ΣX_i] $\text{SiO}_2 + \text{B}_2\text{O}_3 + \Sigma X_i$

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k	T	k	T	k
<u>CURVE 1</u>							
388.2	0.0153	268.2	0.0109*	178.2	0.00966	488.2	0.0128
482.2	0.0177	273.2	0.0109	183.2	0.00879	548.2	0.0135
625.2	0.0250	278.2	0.0111*	188.2	0.00895	608.2	0.0150
751.2	0.0331	283.2	0.0111	193.2	0.00908	671.2	0.0166
<u>CURVE 2</u>							
83.2	0.00536	288.2	0.0112*	198.2	0.00920	715.2	0.0178
88.2	0.00552	293.2	0.0113	203.2	0.00933	768.2	0.0197
93.2	0.00573	298.2	0.0114*	208.2	0.00946	871.2	0.0234
98.2	0.00594	303.2	0.0115	213.2	0.00958	<u>CURVE 5</u>	
103.2	0.00615	308.2	0.0116*	218.2	0.00971	92.2	0.00540
108.2	0.00632	313.2	0.0117*	223.2	0.00983	195.5	0.00879
113.2	0.00653	318.2	0.0117*	228.2	0.00992	198.3	0.00891
118.2	0.00669	323.2	0.0118	233.2	0.0100	<u>CURVE 6</u>	
123.2	0.00690	328.2	0.0119*	238.2	0.0102	275.0	0.0103
128.2	0.00707	333.2	0.0120	243.2	0.0103	279.2	0.0103
133.2	0.00724	338.2	0.0120*	248.2	0.0104	<u>CURVE 7</u>	
138.2	0.00741	343.2	0.0121*	253.2	0.0105	328.2	0.0110
143.2	0.00757	348.2	0.0122	258.2	0.0106	332.7	0.0110*
148.2	0.00774	353.2	0.0124	263.2	0.0107	338.8	0.0113
153.2	0.00791	358.2	0.0125*	268.2	0.0108	343.7	0.0112
158.2	0.00808*	363.2	0.0126	273.2	0.0109	372.2	0.0116
163.2	0.00820	368.2	0.0125*	278.2	0.0111	378.4	0.0116*
168.2	0.00837*	373.2	0.0127	283.2	0.0112	385.2	0.0117
173.2	0.00854	<u>CURVE 3*</u>		288.2	0.0114	423.2	0.0121
178.2	0.00866*	83.2	0.00536	293.2	0.0113	428.2	0.0121*
183.2	0.00879	88.2	0.00552	298.2	0.0114	482.2	0.0126
188.2	0.00895*	88.2	0.00573	303.2	0.0115	488.6	0.0127*
193.2	0.00908	93.2	0.00594	308.2	0.0116	523.2	0.0131
198.2	0.00920*	98.2	0.00594	313.2	0.0116	<u>CURVE 4 (cont.)</u>	
203.2	0.00933	103.2	0.00615	318.2	0.0117	488.2	0.0128
208.2	0.00946*	108.2	0.00632	323.2	0.0118	548.2	0.0135
213.2	0.00958	113.2	0.00653	328.2	0.0119	608.2	0.0150
218.2	0.00971*	118.2	0.00669	333.2	0.0120	671.2	0.0166
223.2	0.00983	123.2	0.00690	338.2	0.0121	715.2	0.0178
228.2	0.00992*	128.2	0.00707	343.2	0.0122	768.2	0.0197
233.2	0.0100	133.2	0.00724	348.2	0.0123	871.2	0.0234
238.2	0.0102*	138.2	0.00741	353.2	0.0124	<u>CURVE 4</u>	
243.2	0.0103	143.2	0.00757	358.2	0.0125*	430.2	0.0118
248.2	0.0104*	148.2	0.00774	363.2	0.0126		
253.2	0.0105	153.2	0.00791	368.2	0.0125*		
258.2	0.0106*	158.2	0.00808*	373.2	0.0127		
263.2	0.0107	163.2	0.00820				
		168.2	0.00837				
		173.2	0.00854				

* Not shown on plot

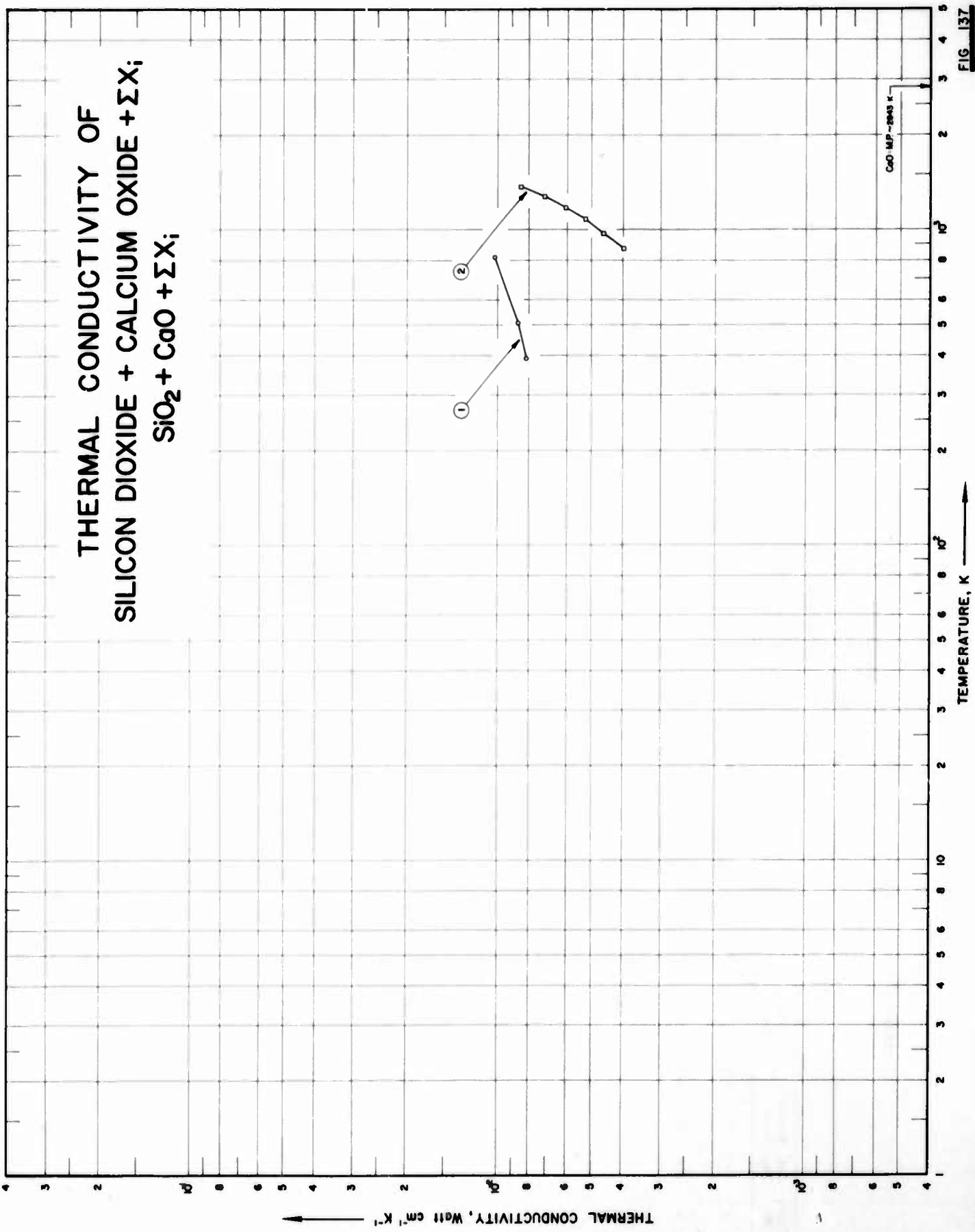


FIG. 137

SPECIFICATION TABLE NO. 137 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + CALCIUM OXIDE + ΣX_1] SiO_2 + CaO + ΣX_1

[For Data Reported in Figure and Table No. 137]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks
							SiO_2	CaO	Al_2O_3	Fe_2O_3	
1	247	L	1932	594-817	1.0	Silica brick B	92.14	2.95	2.21	1.11	0.34 TiO_2 and 0.23 MgO; density 2.328 g cm^{-3} ; porosity 28.1%; gas permeability 2.354 $\text{m}^3 \cdot \text{cm m}^{-2} \cdot \text{hr}^{-1}$ (mm of H_2O) $^{-1}$.
2	238	P	1921	873-1373		Silica brick B	94.02	2.64	1.78		Exceptionally fine-grained, close, and uniform texture throughout the brick; major portion of material of sand size; with very few fragments of rock of appreciable size; porosity 38.2%, with pores of even size; friable; brick size: 9 x 4.5 x 2.5 in.; bent flow in the lengthwise direction of the brick.

DATA TABLE NO. 137 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + CALCIUM OXIDE + ΣX_i] $\text{SiO}_2 + \text{CaO} + \Sigma X_i$

[Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1

393.5 0.00811
507.3 0.00860
817.3 0.0102

CURVE 2

873.2 0.00397
973.2 0.00460
1073.2 0.00523
1173.2 0.00607
1273.2 0.00711
1373.2 0.00837

THERMAL CONDUCTIVITY OF
SILICON DIOXIDE+LEAD OXIDE+ ΣX_i
 $SiO_2 + PbO + \Sigma X_i$

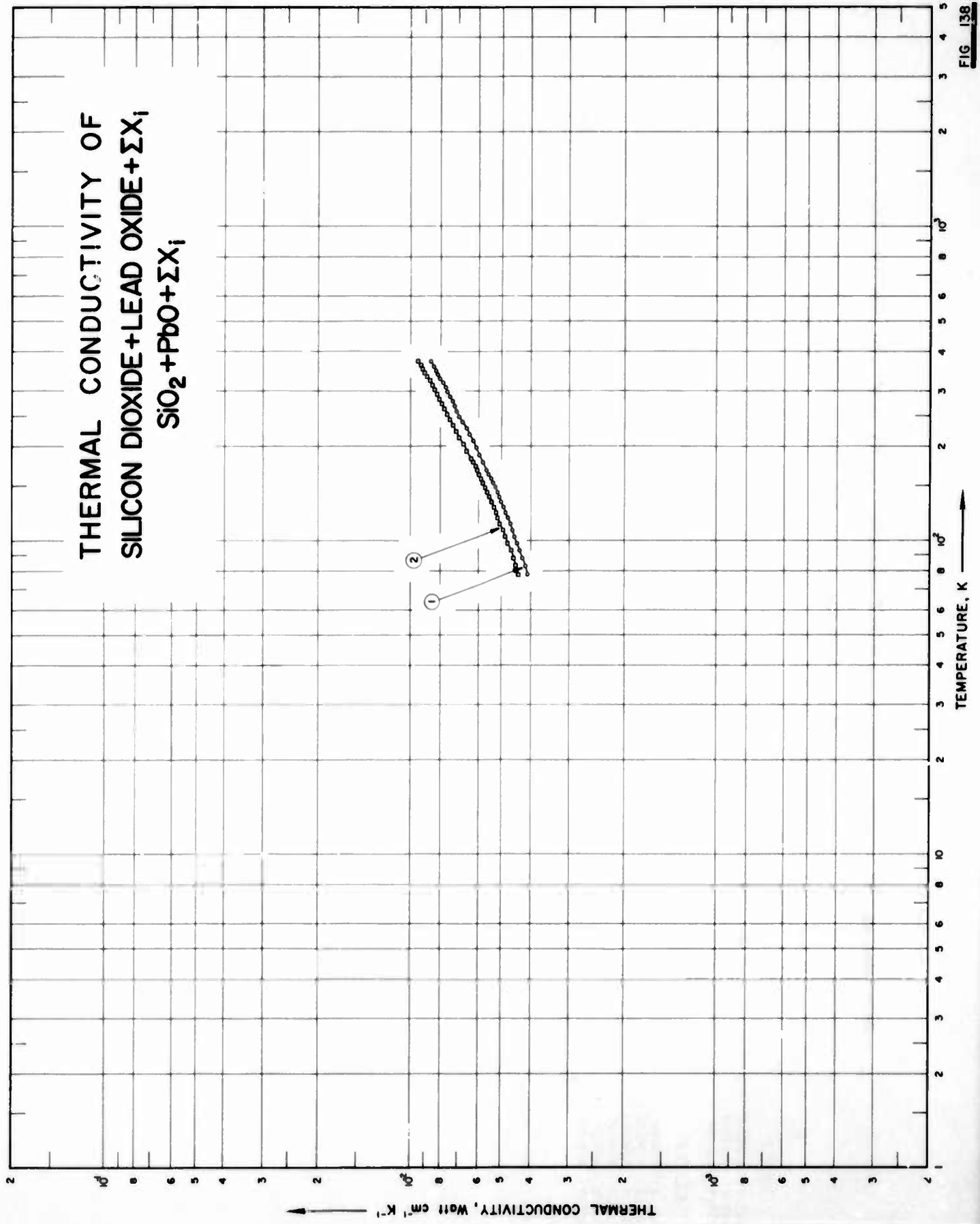


FIG. 138

SPECIFICATION TABLE NO. 138 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + LEAD OXIDE + ΣX_i] $\text{SiO}_2 + \text{PbO} + \Sigma X_i$

[For Data Reported in Figure and Table No. 138]

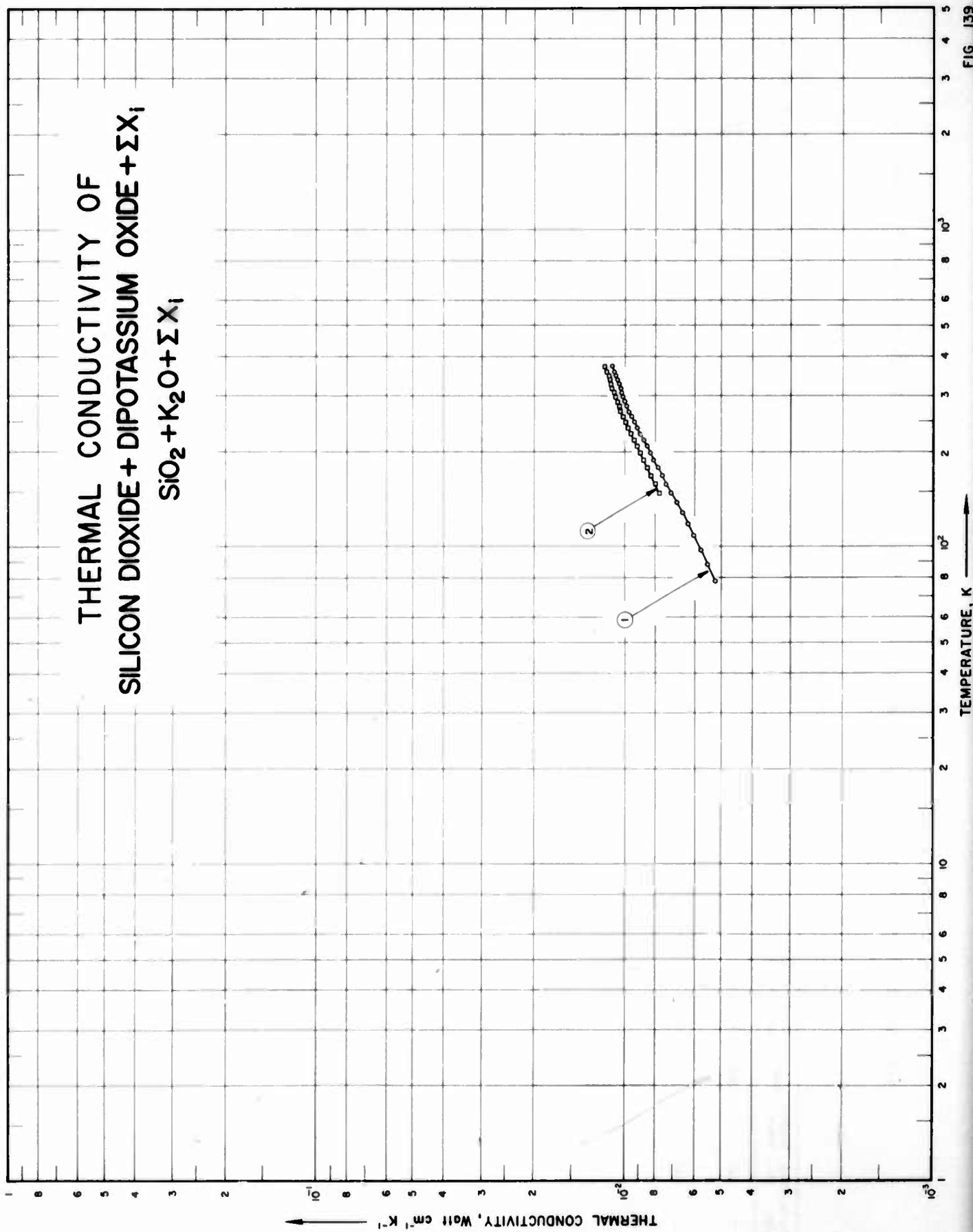
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
							SiO_2	PbO	Al_2O_3	
1	147	L	1960	78-373		Glass; I	46.0	44.8	0.2	3 in. dia x 0.375 in. thick; density 3.55 g cm ⁻³ .
2	147	L	1960	78-373		Glass; G	54.2	34.2	7.1	2.4 Na ₂ O, 2.0 Sb ₂ O ₃ , and 0.2 As ₂ O ₃ , 3 in. dia x 0.375 in. thick; density 3.19 g cm ⁻³ .

DATA TABLE NO. 138 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + LEAD OXIDE + ΣX_i] $\text{SiO}_2 + \text{PbO} + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

CURVE 1			CURVE 1 (cont.)			CURVE 2 (cont.)		
T	k		T	k		T	k	
78.2	0.00410		303.2	0.00766*		213.2	0.00695	
83.2	0.00418		308.2	0.00770		218.2	0.00703*	
88.2	0.00427		313.2	0.00778*		223.2	0.00711	
93.2	0.00435		318.2	0.00787		228.2	0.00715*	
98.2	0.00444		323.2	0.00795*		233.2	0.00728	
103.2	0.00452		328.2	0.00803		238.2	0.00732*	
108.2	0.00460		333.2	0.00812*		243.2	0.00745	
113.2	0.00469		338.2	0.00820		248.2	0.00753*	
118.2	0.00477		343.2	0.00824*		253.0	0.00761	
123.2	0.00485		348.2	0.00828		258.2	0.00770*	
128.2	0.00494		353.2	0.00837*		263.2	0.00778	
133.2	0.00502		358.2	0.00841		268.2	0.00787*	
138.2	0.00510		363.2	0.00845*		273.2	0.00791	
143.2	0.00519		368.2	0.00854*		278.2	0.00799*	
148.2	0.00527		373.2	0.00862		283.2	0.00808	
153.2	0.00536					288.2	0.00816*	
158.2	0.00544					293.2	0.00824	
163.2	0.00556					298.2	0.00833*	
168.2	0.00565		78.2	0.00439		303.2	0.00837	
173.2	0.00573*		83.2	0.00448		308.2	0.00845*	
178.2	0.00582		88.2	0.00456		313.2	0.00854	
183.2	0.00590*		93.2	0.00464		318.2	0.00862*	
188.2	0.00598		98.2	0.00477		323.2	0.00870	
193.2	0.00602*		103.2	0.00485		328.2	0.00879*	
198.2	0.00611		108.2	0.00494		333.2	0.00887	
203.2	0.00619*		113.2	0.00506		338.2	0.00895*	
208.2	0.00628		118.2	0.00515		343.2	0.00904	
213.2	0.00636*		123.2	0.00523		348.2	0.00912*	
218.2	0.00644		128.2	0.00531		353.2	0.00916	
223.2	0.00649*		133.2	0.00544		358.2	0.00925*	
228.2	0.00657		138.2	0.00552		363.2	0.00929	
233.2	0.00665*		143.2	0.00561		368.2	0.00937*	
238.2	0.00678		148.2	0.00573		373.2	0.00946	
243.2	0.00686*		153.2	0.00582				
248.2	0.00695		158.2	0.00590				
253.2	0.00703*		163.2	0.00598				
258.2	0.00707		168.2	0.00607				
263.2	0.00711*		173.2	0.00615				
268.2	0.00720		178.2	0.00628				
273.2	0.00728*		183.2	0.00636				
278.2	0.00732		188.2	0.00644*				
283.2	0.00736*		193.2	0.00657				
288.2	0.00745		198.2	0.00665*				
293.2	0.00753*		203.2	0.00674				
298.2	0.00761		208.2	0.00682*				

* Not shown on plot

THERMAL CONDUCTIVITY OF
 SILICON DIOXIDE + DIPOTASSIUM OXIDE + ΣX_i
 $\text{SiO}_2 + \text{K}_2\text{O} + \Sigma X_i$



SPECIFICATION TABLE NO. 139 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + DIPHOTASSIUM OXIDE + ΣX_1] $SiO_2 + K_2O + \Sigma X_1$

[For Data Reported in Figure and Table No. 139]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks
							SiO ₂	K ₂ O	Na ₂ O	CaO	
1	147	L	1960	78-373		Glass; D	71.2	14.5	7.6	5.5	3.0 ZnO, 2.9 B ₂ O ₃ , 0.8 Sb ₂ O ₃ ; 0.1 Al ₂ O ₃ , and other oxides < 0.1 each; 3 in. dia x 0.375 in. thick; density 2.52 g cm ⁻³ .
2	147	L	1960	148-373		Glass; C	72.7	14.5	4.0		7.7 B ₂ O ₃ , 0.4 Al ₂ O ₃ , 0.4 Sb ₂ O ₃ , 0.4 ZnO, and other oxides < 0.1 each; 3 in. dia x 0.375 in. thick; density 2.45 g cm ⁻³ .

DATA TABLE NO. 139 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + DIPOTASSIUM OXIDE + ΣX_i] SiO₂ + K₂O + ΣX_i

(Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹)

CURVE 1		CURVE 1 (cont.)		CURVE 2 (cont.)	
T	k	T	k	T	k
78.2	0.00519	306.2	0.01025	293.2	0.01067*
83.2	0.00536*	313.2	0.01029*	298.2	0.01075
88.2	0.00548	318.2	0.01033	303.2	0.01084*
93.2	0.00561*	323.2	0.01042*	308.2	0.01088
98.2	0.00573	328.2	0.01050	313.2	0.01096*
103.2	0.00586*	333.2	0.01054*	318.2	0.01105
108.2	0.00602	338.2	0.01063	323.2	0.01109*
113.2	0.00615*	343.2	0.01071*	328.2	0.01113
118.2	0.00628	348.2	0.01075	333.2	0.01121*
123.2	0.00640*	353.2	0.01079*	338.2	0.01125
128.2	0.00653	358.2	0.01084*	343.2	0.01130*
133.2	0.00666*	363.2	0.01088*	348.2	0.01138
138.2	0.00682	368.2	0.01096*	353.2	0.01146*
143.2	0.00699*	373.2	0.01100	358.2	0.01151
149.2	0.00711			363.2	0.01159*
153.2	0.00724*			368.2	0.01163*
158.2	0.00736			373.2	0.01172
163.2	0.00745*	CURVE 2			
168.2	0.00757	146.2	0.00774		
173.2	0.00770*	153.2	0.00787*		
178.2	0.00782	158.2	0.00799		
183.2	0.00795*	163.2	0.00812*		
188.2	0.00808	168.2	0.00824		
193.2	0.00820*	173.2	0.00833*		
198.2	0.00828	178.2	0.00845		
203.2	0.00841*	183.2	0.00858*		
208.2	0.00849	188.2	0.00870		
213.2	0.00862*	193.2	0.00879*		
218.2	0.00874	198.2	0.00891		
223.2	0.00887*	203.2	0.00900*		
228.2	0.00895	208.2	0.00912		
233.2	0.00904*	213.2	0.00920*		
238.2	0.00912	218.2	0.00933		
243.2	0.00925*	223.2	0.00941*		
248.2	0.00933	228.2	0.00954		
253.2	0.00941*	233.2	0.00962*		
258.2	0.00950	238.2	0.00975		
263.2	0.00958*	243.2	0.00983*		
268.2	0.00971	248.2	0.00992		
273.2	0.00979*	253.2	0.01000*		
278.2	0.00987	258.2	0.01013		
283.2	0.00992*	263.2	0.01021*		
288.2	0.01000	268.2	0.01030		
293.2	0.01004*	273.2	0.01038*		
298.2	0.01013	278.2	0.01046		
303.2	0.01017*	283.2	0.01054*		
		288.2	0.01059		

* Not shown on plot

FIGURE SHOWS ONLY 8 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF
SILICON DIOXIDE + DISODIUM OXIDE + ΣX_i
 $SiO_2 + Na_2O + \Sigma X_i$

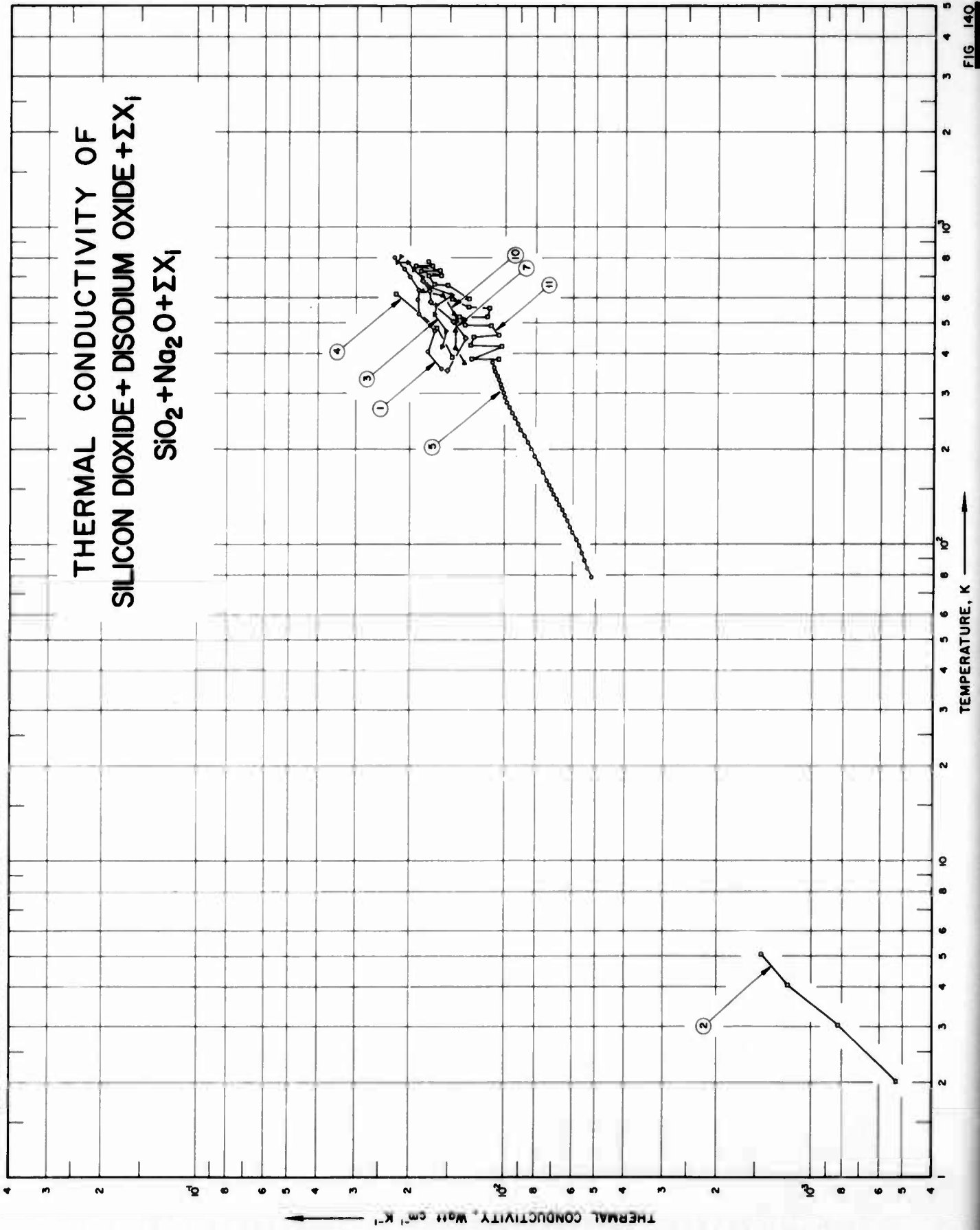


FIG. 140

SPECIFICATION TABLE NO. 140 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + DISODIUM OXIDE + ΣX_i] $\text{SiO}_2 + \text{Na}_2\text{O} + \Sigma X_i$

[For Data Reported in Figure and Table No. 140]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks	
							SiO_2	Na_2O	CaO	Al_2O_3		MgO
1	136	R	1959	355-795	± 10	Silicate glass	69.05	16.38	7.37	3.05	2.80	0.55 Na_2SO_4 , 0.48 K_2O , 0.12 NaCl, 0.09 Fe_2O_3 , 0.015 CoO and 0.015 NiO.
2	142	L	1955	2.0-5.0		Soft glass	70.12	16.82	5.4	2.58	3.6	0.78 B_2O_3 , 0.35 K_2O , and 0.20 SO_3 ; density 2.50 g cm^{-3} .
3	136	R	1959	418-804	± 10	Silicate glass	58.43	13.32	6.0	7.89	3.51	4.25 K_2O , 0.24 Na_2SO_4 , 0.12 NaCl, 0.11 Fe_2O_3 , 0.013 CaO, and 0.013 NiO.
4	34	C	1943	386-611		Soda-lime glass	69.73	20.96	9.05			0.18 B_2O_3 , and trace K_2O .
5	147	L	1960	78-373		Glass E	67.7	14.6	5.4	1.8		4.0 B_2O_3 , 3.3 BaO, 1.8 K_2O , 1.3 Fe_2O_3 , $< 1.0 \text{ As}_2\text{O}_3$, and other oxides < 0.1 each; 3 in. dia x 0.375 in. thick; density 2.42 g cm^{-3} .
6	73,136	R	1954	497-826	± 10	Soda-lime silica glass; 1	71.25	13.35	11.82	0.26	2.44	0.68 Na_2SO_4 , 0.14 Fe_2O_3 , and 0.06 NaCl; prepared by Pittsburgh Plate Glass Company Laboratory; ellipsoidal specimen.
7	73,136	R	1954	350-724	± 10	Soda-lime silica glass; 2	70.84	13.32	11.75	0.22	2.64	0.61 Na_2SO_4 , 0.56 Fe_2O_3 , and 0.06 NaCl; same source and shape as the above specimen.
8	73,136	R	1954	361-798	± 10	Soda-lime silica glass; 3	69.05	16.38	7.37	3.05	2.90	0.55 Na_2O , 0.48 K_2O , 0.12 NaCl, 0.09 Fe_2O_3 , 0.015 NiO, and 0.015 CoO ; same source and shape as the above specimen.
9	73,136	R	1954	421-806	± 10	Soda-lime silica glass; 4	58.43	19.32	6.00	7.89	3.51	4.25 K_2O , 0.24 Na_2SO_4 , 0.12 NaCl, 0.11 Fe_2O_3 , 0.013 NiO, and 0.013 CoO ; same source and shape as the above specimen.
10	72,136	C	1955	368-685	± 10	Soda-lime silica glass; 1	71.25	13.25	11.82	0.26	2.44	Similar to the above specimen 1 (curve no. 6) except in cubic shape; measured with another method.
11	114,136	C	1954	381-773		Soda-lime silica glass; 2	70.84	13.32	11.75	0.22	2.64	Similar to the above specimen 2 (curve no. 7) except in cubic shape; measured with another method.
12	136	R	1959	393-847	± 10	Silica glass, Corning 0080	74.0	16.5	5.0	1.0	3.5	1.0 Al_2O_3 ; ellipsoidal specimen.
13	136	R	1959	433-888	± 10	Silica glass, Corning 0080						Similar to the above specimen.
14	136	R	1959	509-839	± 10	Silica glass, Corning 0080						Similar to the above specimen.

DATA TABLE NO. 140 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + SESQUIOXIDE + ΣX_i] $\text{SiO}_2 + \text{Na}_2\text{O} + \Sigma X_i$

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k	T	k	T	k	T	k	T	k	T	k		
<u>CURVE 1</u>															
355.2	0.0159	108.2	0.00602	333.2	0.01054*	421.2	0.01540	746.7	0.0192	<u>CURVE 11(cont.)</u>					
403.2	0.0176	113.2	0.00615	338.2	0.01063	469.2	0.01510	748.5	0.0170						
468.2	0.0167	118.2	0.00628	343.2	0.01071*	537.2	0.01695	771.2	0.0204*						
525.2	0.0188	123.2	0.00640	348.2	0.01075*	568.2	0.01632	773.2	0.0175						
586.2	0.0189	128.2	0.00653	353.2	0.01079*	593.2	0.01527	<u>CURVE 12*</u>							
629.2	0.0188	133.2	0.00670	358.2	0.01084	633.2	0.01736	393.2	0.0184						
691.2	0.0201	138.2	0.00682	363.2	0.01088*	686.2	0.01820	523.2	0.0169						
732.2	0.0209	143.2	0.00699	368.2	0.01096*	738.2	0.01979	578.2	0.0192						
795.2	0.0226	148.2	0.00711	373.2	0.01100	770.2	0.02042	641.2	0.0190						
<u>CURVE 2</u>															
2	0.00053	153.2	0.00724	<u>CURVE 6*</u>				771.2	0.02192	748.2	0.0207	<u>CURVE 13*</u>			
3	0.00083	158.2	0.00736	497.2	0.01736	<u>CURVE 10</u>				793.2	0.0223				
4	0.00119	163.2	0.00745*	536.2	0.01866	368.2	0.0135	806.2	0.02167	748.2	0.0207				
5	0.00144	168.2	0.00757	570.2	0.01632	413.2	0.0144					847.2	0.0251		
<u>CURVE 3</u>															
418.2	0.0158	173.2	0.00770*	615.2	0.01778	467.2	0.0144								
468.2	0.0154	178.2	0.00782	675.2	0.02038	527.2	0.0146								
528.2	0.0167	183.2	0.00795*	716.2	0.02075	593.2	0.0143								
565.2	0.0165	188.2	0.00808	760.2	0.02163	603.2	0.0157								
609.2	0.0147	193.2	0.00820*	793.2	0.02042	622.2	0.0183								
642.2	0.0173	198.2	0.00828	826.2	0.02159	685.2	0.0180*								
693.2	0.0183	203.2	0.00841*	<u>CURVE 7</u>				<u>CURVE 11</u>							
732.2	0.0195	208.2	0.00849	350.2	0.01527	381.2	0.0105								
770.2	0.0220	213.2	0.00862*	443.2	0.01347	383.2	0.0128								
804.2	0.0214	218.2	0.00874	499.2	0.01467	419.2	0.0102								
<u>CURVE 4</u>															
386.2	0.0147	223.2	0.00887*	579.2	0.01607	423.2	0.0129								
478.2	0.0164	228.2	0.00895	625.2	0.01724	449.2	0.0126								
611.2	0.0223	233.2	0.00904*	672.2	0.01824	454.2	0.0105								
<u>CURVE 5</u>															
78.2	0.00519	238.2	0.00912	724.2	0.01987*	486.2	0.0111								
83.2	0.00536	243.2	0.00925*	<u>CURVE 8*</u>				488.2	0.0134						
88.2	0.00548	248.2	0.00933	361.2	0.01527	519.7	0.0140	793.2	0.0194						
93.2	0.00561	253.2	0.00941*	404.2	0.01707	550.2	0.0112	839.2	0.0209						
103.2	0.00586	258.2	0.00950	471.2	0.01648	559.2	0.0131								
<u>CURVE 5 (cont.)</u>															
263.2	0.00958*	268.2	0.00971	587.2	0.01862	590.2	0.0147								
273.2	0.00980*	273.2	0.00987	638.2	0.01879	654.2	0.0152								
283.2	0.00992*	283.2	0.00992*	688.2	0.02029	655.2	0.0167								
298.2	0.01000	298.2	0.01000	733.2	0.02084	696.2	0.0175								
298.2	0.01004*	298.2	0.01004*	798.2	0.02264	722.7	0.0159								
298.2	0.01013	298.2	0.01013					724.2	0.0161						
303.2	0.01017*	303.2	0.01017*												
308.2	0.01025	308.2	0.01025												
313.2	0.01029*	313.2	0.01029*												
318.2	0.01033	318.2	0.01033												
323.2	0.01042*	323.2	0.01042*												
328.2	0.01050	328.2	0.01050												

* Not shown on plot

SPECIFICATION TABLE NO. 141 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + LITHIUM ALUMINATE + ΣX_1] SrO + Li₂O·Al₂O₃ + ΣX_1

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) SrO Li ₂ O·Al ₂ O ₃ Al ₂ O ₃	Composition (continued), Specifications and Remarks
1	3	L	1953	324-407	253 A-1	65.0 18.3 16.7	Firing temperature 1589 K; density (25 C) 3.12 g cm ⁻³ ; water absorption 0%.

DATA TABLE NO. 141 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + LITHIUM ALUMINATE + ΣX_1] SrO + Li₂O·Al₂O₃ + ΣX_1 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
CURVE 1*	
323.7	0.0277
336.7	0.0274
356.0	0.0275
375.2	0.0269
406.5	0.0210

* No graphical presentation

FIGURE SHOWS ONLY 7 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF
 STRONTIUM OXIDE + LITHIUM ZIRCONIUM SILICATE + ΣX_i
 $SrO + Li_2O \cdot ZrO \cdot SiO_2 + \Sigma X_i$

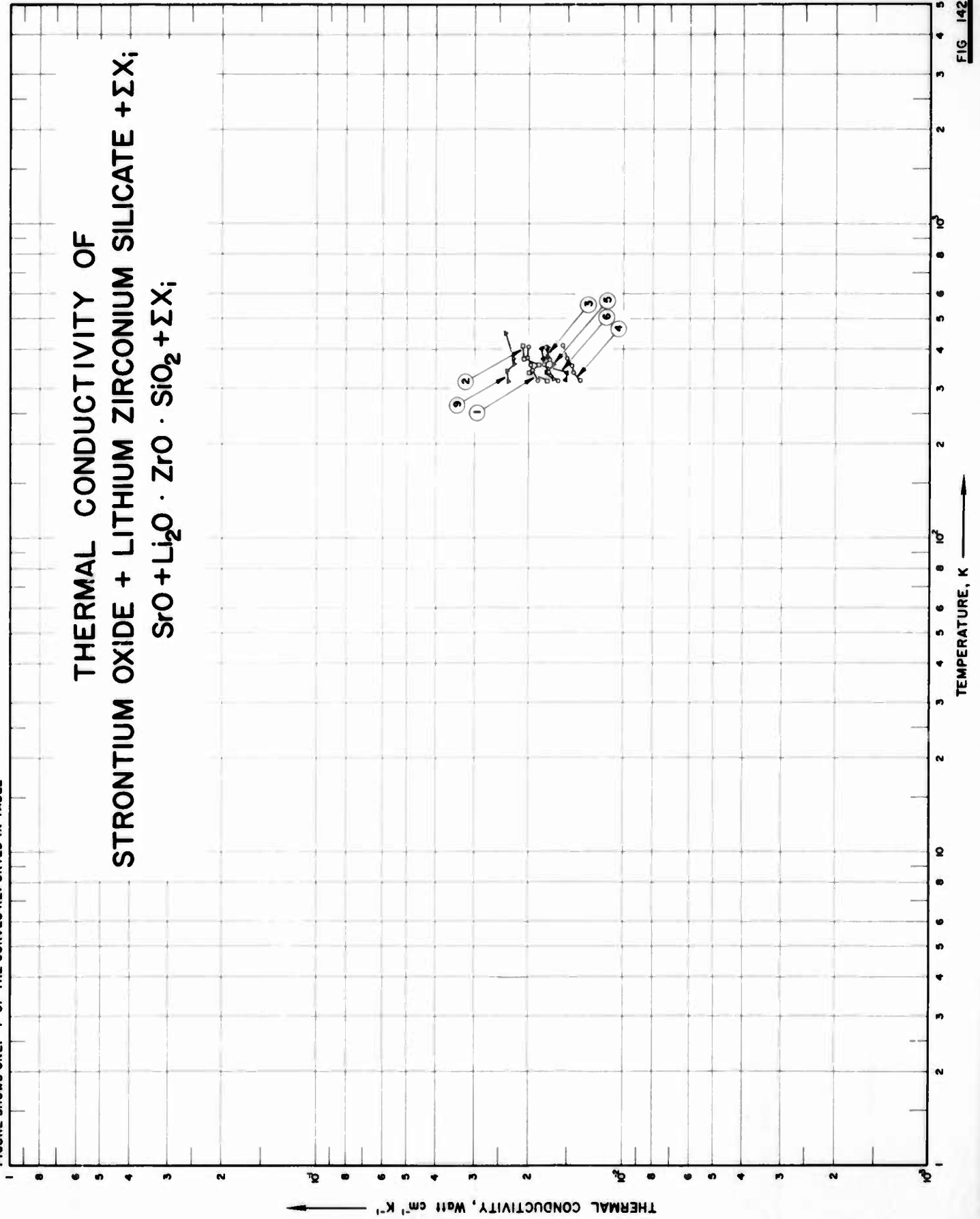


FIG. 142

SPECIFICATION TABLE NO. 142 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + LITHIUM ZIRCONIUM SILICATE + ΣX_1] $\text{SrO} + \text{Li}_2\text{O} \cdot \text{ZrO} \cdot \text{SiO}_2 + \Sigma X_1$

[For Data Reported in Figure and Table No. 142]

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						SrO	$\text{Li}_2\text{O} \cdot \text{ZrO} \cdot \text{SiO}_2$	Al_2O_3	
1	42	L	1953	320-410	232A-1	69.0	14.5	16.5	Density (25 C) 3.21 g cm ⁻³ ; 0.0% water absorption.
2	42	L	1953	319-412	231A-1	65.0	18.5	16.5	Density (25 C) 3.22 g cm ⁻³ ; 0.0% water absorption.
3	42	L	1953	320-408	233A-1	68.0	19.5	12.5	Density (25 C) 3.16 g cm ⁻³ ; 0.0% water absorption.
4	42	L	1953	321-412	234A-1	61.0	26.5	12.5	Density (25 C) 2.49 g cm ⁻³ ; 0.21% water absorption.
5	42	L	1953	322-406	235A-1	55.5	32.0	12.5	Density (25 C) 2.95 g cm ⁻³ ; 0.0% water absorption.
6	42	L	1953	319-404	237A-1	53.0	34.5	12.5	Density (25 C) 3.00 g cm ⁻³ ; 0.0% water absorption.
7	42	L	1953	317-409	238A-1	51.0	36.5	12.5	Density (25 C) 2.75 g cm ⁻³ ; 0.82% water absorption.
8	3	L	1953	321-411	243A-1	55.7	31.8	12.5	12.5 ZnO; density (25 C) 3.27 g cm ⁻³ ; fired at 1027 C; water absorption 0%.
9	3	L	1953	318-452	244A-1	47.6	27.4	12.5	25.0 ZnO; density (25 C) 3.52 g cm ⁻³ ; fired at 1135 C; water absorption 0.071%.

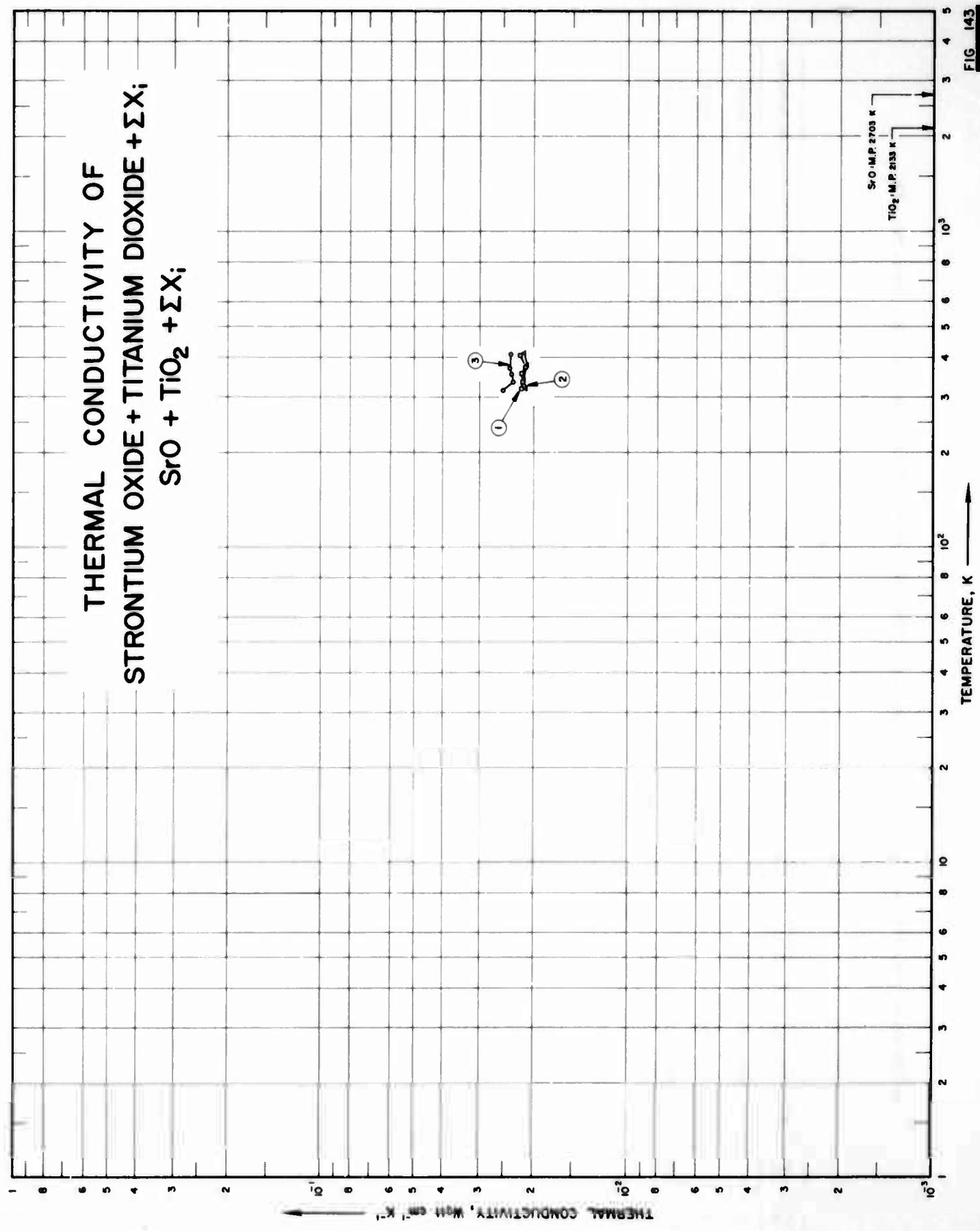
DATA TABLE NO. 142 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + LITHIUM ZIRCONIUM SILICATE + ΣX_i] SrO + Li₂O · ZrO · SiO₂ + ΣX_i
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
320.0	0.0187	316.9	0.0164
343.7	0.0195	336.8	0.0174
357.4	0.0197	355.0	0.0177
377.3	0.0201	374.1	0.0181
409.7	0.0200	408.7	0.0176
<u>CURVE 2</u>			
319.0	0.0175	321.0	0.0183
337.6	0.0199	336.6	0.0191
358.0	0.0186	357.5	0.0197
375.6	0.0207	377.7	0.0197
411.7	0.0208	411.2	0.0201
<u>CURVE 3</u>			
319.9	0.0162	317.5	0.0233
337.3	0.0173	342.5	0.0235
357.3	0.0178	360.0	0.0223
373.3	0.0172	375.9	0.0224
408.3	0.0177	452.3	0.0238
<u>CURVE 4</u>			
320.5	0.0137		
338.3	0.0144		
356.3	0.0146		
376.1	0.0152		
412.3	0.0156		
<u>CURVE 5</u>			
322.1	0.0166		
339.9	0.0171		
359.5	0.0167		
376.7	0.0174		
405.9	0.0175		
<u>CURVE 6</u>			
319.4	0.0153		
336.2	0.0151		
352.8	0.0182		
373.1	0.0181		
403.5	0.0184		

* Not shown on Plot

FIG. 143

THERMAL CONDUCTIVITY OF STRONTIUM OXIDE + TITANIUM DIOXIDE + ΣXi; SrO + TiO₂ + ΣXi;



SPECIFICATION TABLE NO. 143 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + TITANIUM DIOXIDE + ΣX_1] $\text{SrO} + \text{TiO}_2 + \Sigma X_1$

[For Data Reported in Figure and Table No. 143]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						SrO	TiO ₂	Li ₂ O · ZrO ₂ · SiO ₂	
1	3	L	1953	322-409	240A-1	52.5	25.0	22.5	Density (25 C) 2.80 g cm ⁻³ ; fired at 1149 C; water absorption 0.024%.
2	3	L	1953	321-415	241A-1	39.8	37.4	22.8	Density (25 C) 2.88 g cm ⁻³ ; fired at 1149 C; water absorption 0.041%.
3	3	L	1953	317-412	242A-1	43.7	37.5	18.8	Density (25 C) 2.92 g cm ⁻³ ; fired at 1149 C; water absorption 0.0096%.

DATA TABLE NO. 143 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + TITANIUM DIOXIDE + ΣX_i] SrO + TiO₂ + ΣX_i
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
321.5	0.0219
336.8	0.0217
355.7	0.0218
375.5	0.0212
409.4	0.0221
<u>CURVE 2</u>	
320.7	0.0212
339.2	0.0215
358.8	0.0216
379.7	0.0210
414.8	0.0215
<u>CURVE 3</u>	
317.0	0.0251
337.0	0.0233
356.9	0.0236
373.4	0.0239
412.2	0.0237

THERMAL CONDUCTIVITY OF
STRONTIUM OXIDE + ZINC OXIDE + ΣX_i
SrO + ZnO + ΣX_i

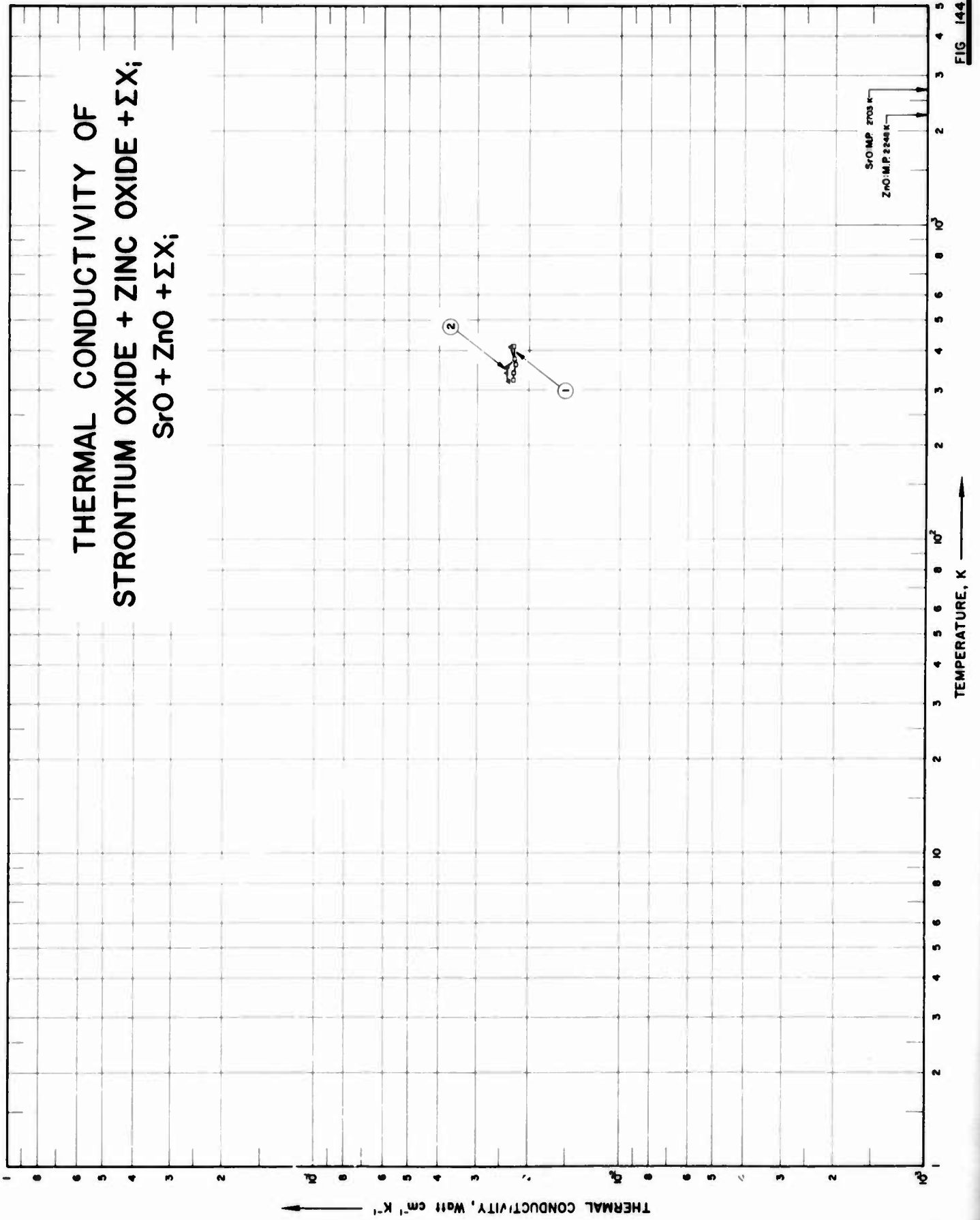


FIG 144

SPECIFICATION TABLE NO. 144 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + ZINC OXIDE + ΣX_1] SrO + ZnO + ΣX_1

[For Data Reported in Figure and Table No. 144]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						SrO	ZnO	$\text{Li}_2\text{O} \cdot \text{ZrO}_2 \cdot \text{SiO}_2$	
1	3	L	1953	321-415	246A-1	52.5	25.0	22.5	Density (25 C) 3.48 g cm ⁻³ , fired at 1232 C; water absorption 0.024%
2	3	L	1953	320-415	247A-1	43.7	37.5	18.8	Density (25 C) 3.12 g cm ⁻³ , fired at 1315 C; water absorption 0%

DATA TABLE NO. 144 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + ZINC OXIDE + ΣX_i] SrO + ZnO + ΣX_i
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
321.0	0.0229
340.2	0.0228
367.3	0.0223
376.3	0.0225
414.9	0.0227
<u>CURVE 2</u>	
319.6	0.0236
339.2	0.0240
356.6	0.0239
375.5	0.0224*
414.6	0.0232

* Not shown on Plot

SPECIFICATION TABLE NO. 145 THERMAL CONDUCTIVITY OF [TIN DIOXIDE + MAGNESIUM OXIDE + ΣX_1] $\text{SnO}_2 + \text{MgO} + \Sigma X_1$

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						SnO_2	MgO	ZnO	
1	12	1953	323-417		215 A-1	42.7	34.2	23.1	$3\text{MgO} + \text{SnO}_2 + \text{ZnO}$ by mole; fired at 1454 C; water absorption 0.362%, density 4.34 g cm^{-3} .

DATA TABLE NO. 145 THERMAL CONDUCTIVITY OF [TIN DIOXIDE + MAGNESIUM OXIDE + ΣX_1] $\text{SnO}_2 + \text{MgO} + \Sigma X_1$ [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

T k

CURVE 1*

322.8	0.0527
340.9	0.0527
358.7	0.0519
378.8	0.0502
416.7	0.0485

THERMAL CONDUCTIVITY OF
TIN DIOXIDE+ZINC OXIDE + ΣX_i
 $SnO_2 + ZnO + \Sigma X_i$

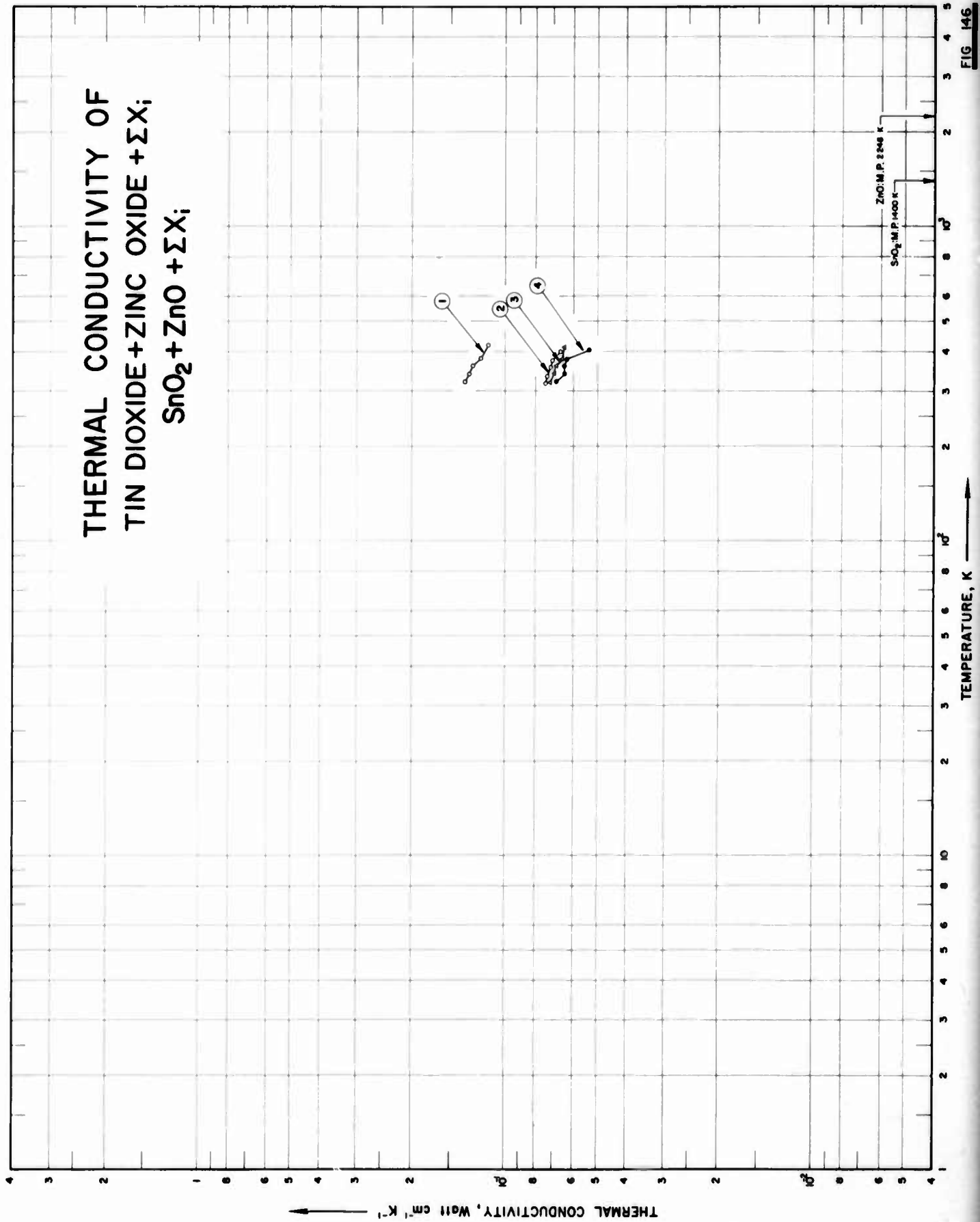


FIG 146

SPECIFICATION TABLE NO. 146 THERMAL CONDUCTIVITY OF [TIN DIOXIDE + ZINC OXIDE + ΣX_i] $\text{SnO}_2 + \text{ZnO} + \Sigma X_i$

[For Data Reported in Figure and Table No. 146]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
							SnO_2	ZnO	MgO	
1	12		1953	321-420		210A-1	78.9	14.2	6.9	$\text{MgO} + 3 \text{SnO}_2 + \text{ZnO}$ by mole; prepared by milling pure oxides in water, calcining at 1093 C after drying, then dry pressing in a 0.50 in. steel die at 15000 psi; fired at 1399 C and soaked for 1.50 hr; water absorption 0.171% and density 5.51 g cm^{-3} .
2	12		1953	317-401		211A-1	59.7	32.3	8.0	$\text{MgO} + 2 \text{SnO}_2 + 2 \text{ZnO}$ by mole; same preparation as that of the above specimen except fired at 1427 C; water absorption 0.014% and density 5.00 g cm^{-3} .
3	12		1953	319-412		212A-1	65.0	17.6	17.4	$2 \text{MgO} + 2 \text{SnO}_2 + \text{ZnO}$ by mole; same preparation as that of the above specimen 210A-1; water absorption 0.097% and density 4.85 g cm^{-3} .
4	12		1953	322-405		216A-1	55.3	29.9	14.8	$\text{MgO} + \text{SnO}_2 + \text{ZnO}$ by mole; same preparation as that of the above specimen except fired at 1482 C; water absorption 0.058% and density 4.50 g cm^{-3} .

DATA TABLE NO. 146 THERMAL CONDUCTIVITY OF [TIN DIOXIDE + ZINC OXIDE + ΣX_i] $\text{SnO}_2 + \text{ZnO} + \Sigma X_i$

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1

320.8 0.136
340.3 0.131
361.5 0.128
380.1 0.120
420.2 0.114

CURVE 2

317.0 0.0744
335.2 0.0732
357.3 0.0715
375.8 0.0703
400.9 0.0665

CURVE 3

319.4 0.0720
341.2 0.0699
360.1 0.0690
378.9 0.0657
411.9 0.0644

CURVE 4

321.8 0.0686
341.8 0.0644
360.3 0.0644
377.2 0.0632
405.0 0.0536

SPECIFICATION TABLE NO. 147 THERMAL CONDUCTIVITY OF [ZINC OXIDE + STRONTIUM OXIDE + ΣX_i] ZnO + SrO + ΣX_i

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks	
						ZnO	SrO		
1	3	L	1953	318-413	245 A-1	50.0	31.8	18.2	Density (25 C) 3.83 g cm ⁻³ ; fired at 1166 C; water absorption 0.03%.

DATA TABLE NO. 147 THERMAL CONDUCTIVITY OF [ZINC OXIDE + STRONTIUM OXIDE + ΣX_i] ZnO + SrO + ΣX_i [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
318.0	0.0377
338.1	0.0351
356.1	0.0351
377.7	0.0348
412.6	0.0337

CURVE 1*

* No graphical presentation

THERMAL CONDUCTIVITY OF
 ZINC OXIDE + TIN DIOXIDE + ΣX_i
 $ZnO + SnO_2 + \Sigma X_i$

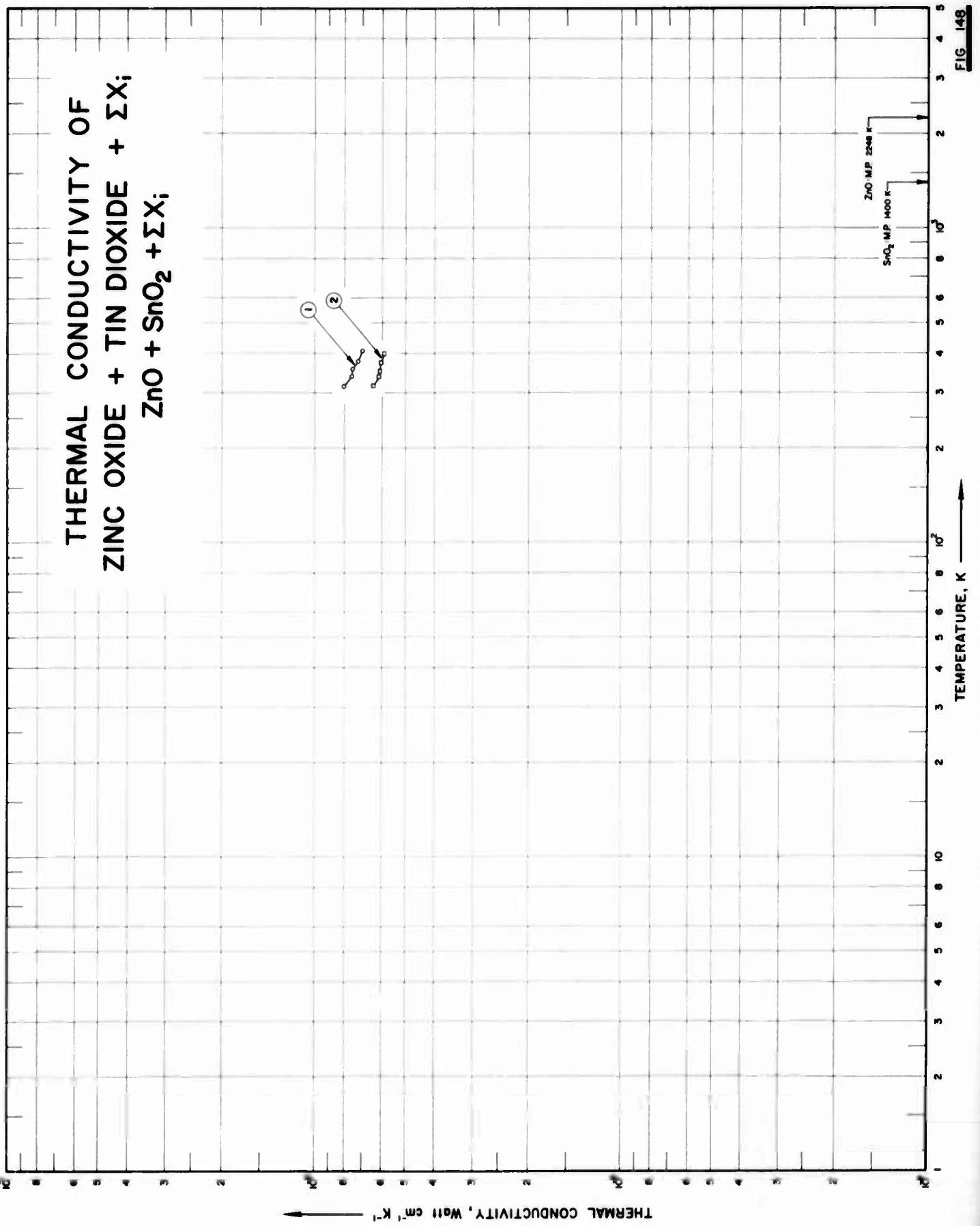


FIG 148

SPECIFICATION TABLE NO. 148 THERMAL CONDUCTIVITY OF [ZINC OXIDE + TIN DIOXIDE + ΣX_i] ZnO + SnO₂ + ΣX_i

[For Data Reported in Figure and Table No. 148]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
							ZnO	SnO ₂	MgO	
1	12		1953	316-410		313A-1	56.1	34.6	9.3	MgO + SnO ₂ + 3 ZnO by mole; prepared by milling pure oxides in water, calcining at 2000 F after drying, then dry pressing in a 0.50 in. steel die at 15000 psi; fired at 2600 F and soaked for 1.50 hr; water absorption 0.082%; density 4.80 g cm ⁻³ .
2	12		1953	316-398		214A-1	41.3	38.2	20.5	2 MgO + SnO ₂ + 2 ZnO by mole; same preparation as that of the above specimen; water absorption 0.006%, density 4.86 g cm ⁻³ .

DATA TABLE NO. 148 THERMAL CONDUCTIVITY OF [ZINC OXIDE + TIN DIOXIDE + ΣX_i] ZnO + SnO₂ + ΣX_i [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
316.4	0.0803
339.1	0.0757
357.5	0.0753
377.7	0.0724
409.8	0.0699
<u>CURVE 2</u>	
316.4	0.0644
337.5	0.0615
351.9	0.0611
374.1	0.0607
398.2	0.0590

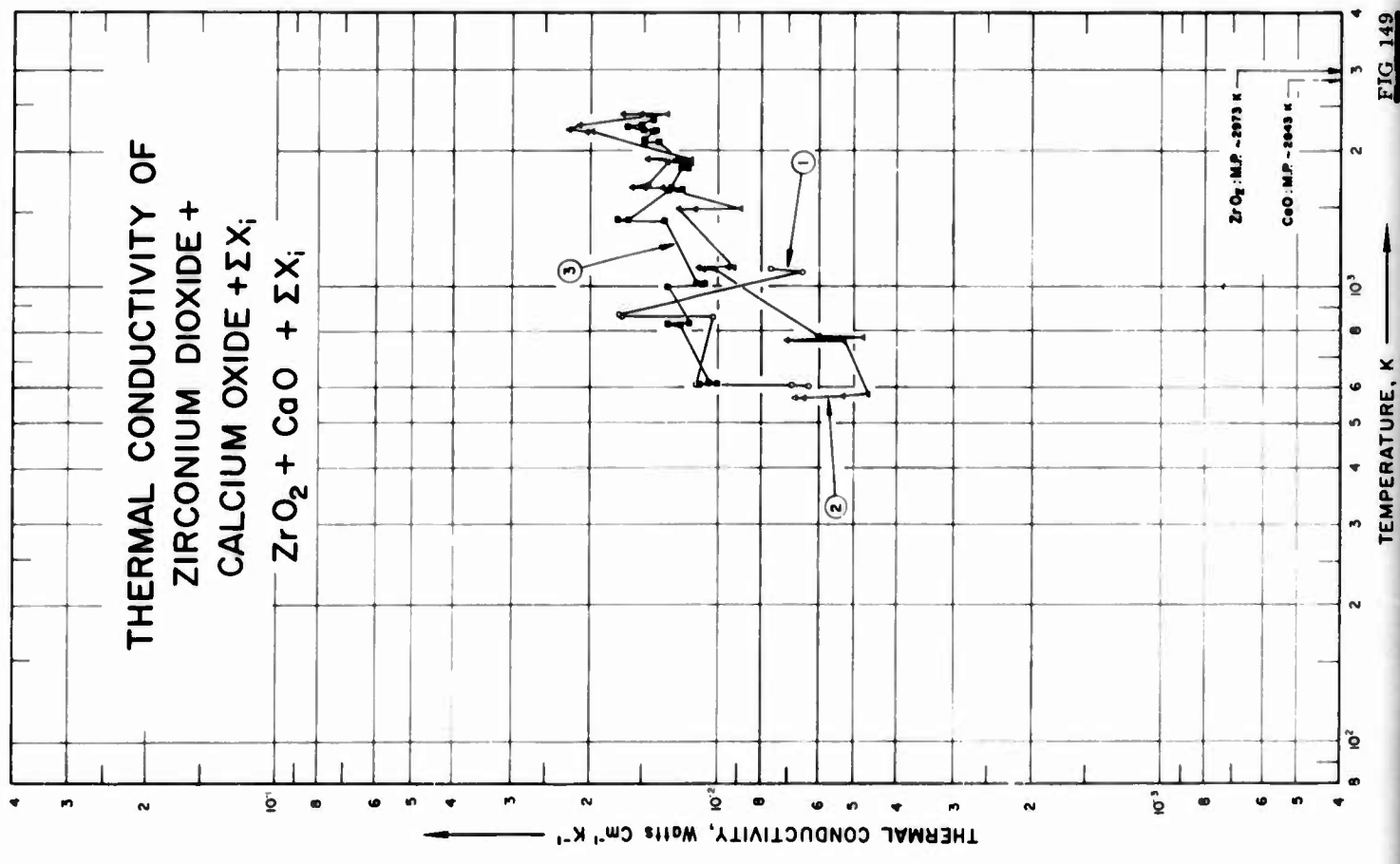


FIG. 149

SPECIFICATION TABLE NO. 14^a THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + CALCIUM OXIDE + ΣX_i] ZrO₂ + CaO + ΣX_i

[For Data Reported in Figure and Table No. 149]

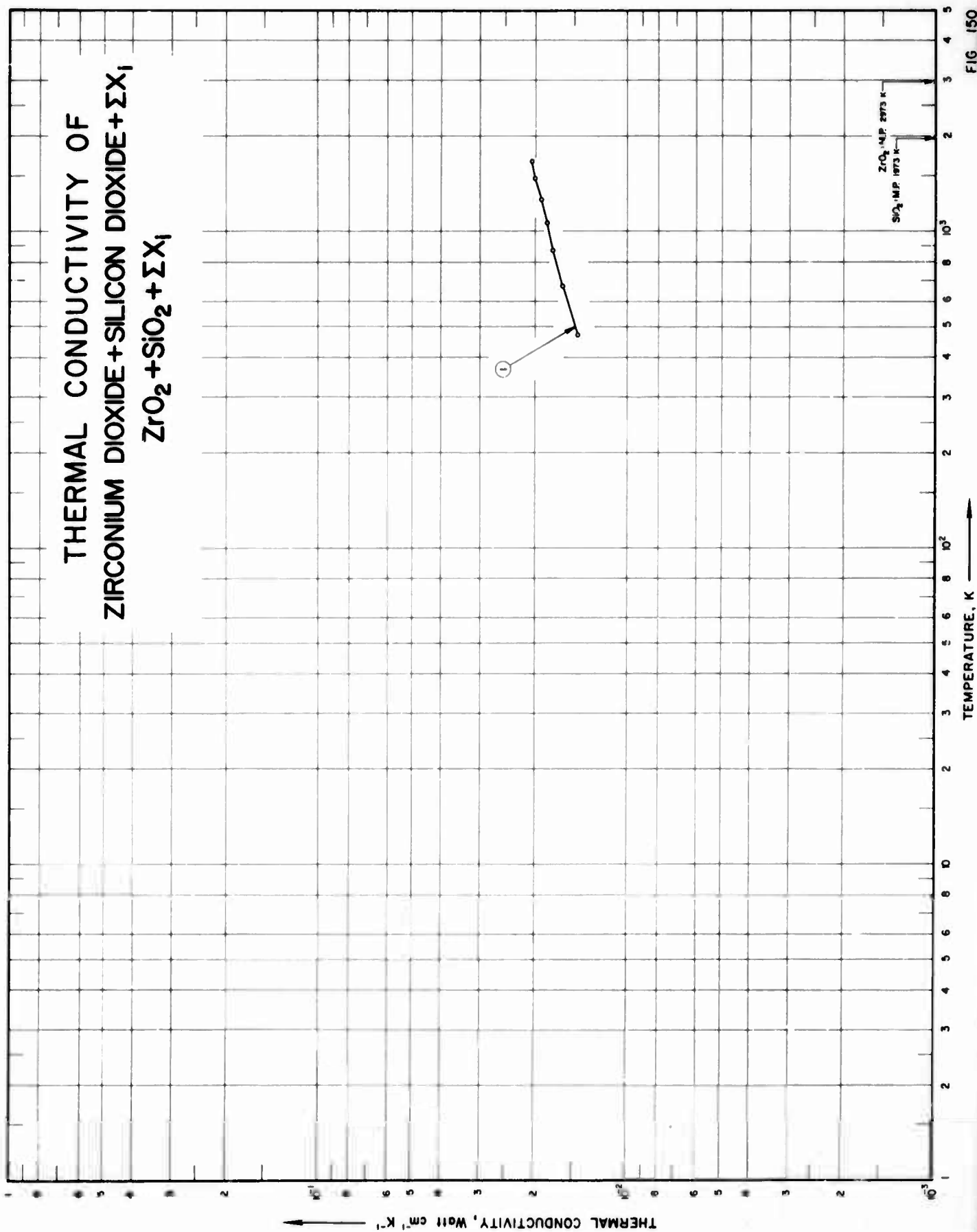
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks	
							ZrO ₂	CaO		
1	82	R	1962	599-1088		Stabilized Zirconia	93.216	2.903	2.67	0.33 SiO ₂ , 0.204 MgO, 0.252 CaSO ₄ , 0.175 other sulfates and 0.22 other oxides; 1 in. dia x 1 in. long; stabilized zirconia with coarse grains; molded; density 4.133 g cm ⁻³ ; porosity 3.0%; melting point 2855 K.
2	82	R	1962	568-2387		Stabilized Zirconia	93.216	2.903	2.67	0.33 SiO ₂ , 0.204 MgO, 0.252 CaSO ₄ , 0.175 other sulfates and 0.22 other oxides; similar to the above specimen.
3	82	R	1962	607-2330		Stabilized Zirconia	93.216	2.903	2.67	0.33 SiO ₂ , 0.204 MgO, 0.252 CaSO ₄ , 0.175 other sulfates and 0.22 other oxides; similar to the above specimen.

DATA TABLE NO. 149 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + CALCIUM OXIDE + ΣX_i] $ZrO_2 + CaO + \Sigma X_i$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
599.3	0.00632	607.1	0.0110
605.4	0.00689	609.3	0.0100
605.4	0.0112	610.4	0.0105
852.6	0.0102	820.4	0.0123
854.3	0.0167	824.8	0.0132
865.4	0.0170	827.1	0.0117
1070.4	0.00653	996.5	0.0132
1088.2	0.00763	1003.2	0.0109
<u>CURVE 2</u>			
568.2	0.00649	1008.2	0.0107
569.3	0.00674	1012.6	0.0113
570.9	0.00528	1394.3	0.0134
579.3	0.00462	1398.7	0.0173
757.1	0.00528	1398.7	0.0163
759.8	0.00704	1627.6	0.0122
769.3	0.00476	1635.4	0.0132
776.5	0.00601	1645.9	0.0130
1080.3	0.0101	1819.8	0.0123
1080.9	0.0109	1819.8	0.0117
1081.5	0.00922	1834.8	0.0119
1082.6	0.00945	2083.2	0.0139
1483.2	0.0124	2083.2	0.0149
1485.4	0.0113	2089.3	0.0149
1485.4	0.00891	2202.6	0.0143
1651.5	0.0136	2206.5	0.0141
1651.5	0.0159	2206.5	0.0150
1651.5	0.0149	2206.5	0.0150*
1682.1	0.0146	2252.6	0.0162
1874.3	0.0133	2274.8	0.0151
1874.3	0.0116	2330.4	0.0143
1896.5	0.0147		
1896.5	0.0116		
2192.1	0.0205		
2192.1	0.0198		
2203.2	0.0224		
2262.1	0.0213		
2387.1	0.0133		
2387.1	0.0151		
2387.1	0.0166		

* Not shown on Plot

THERMAL CONDUCTIVITY OF
ZIRCONIUM DIOXIDE + SILICON DIOXIDE + ΣX_i
 $ZrO_2 + SiO_2 + \Sigma X_i$



SPECIFICATION TABLE NO. 150 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + SILICON DIOXIDE + ΣX_1] ZrO₂ + SiO₂ + ΣX_1

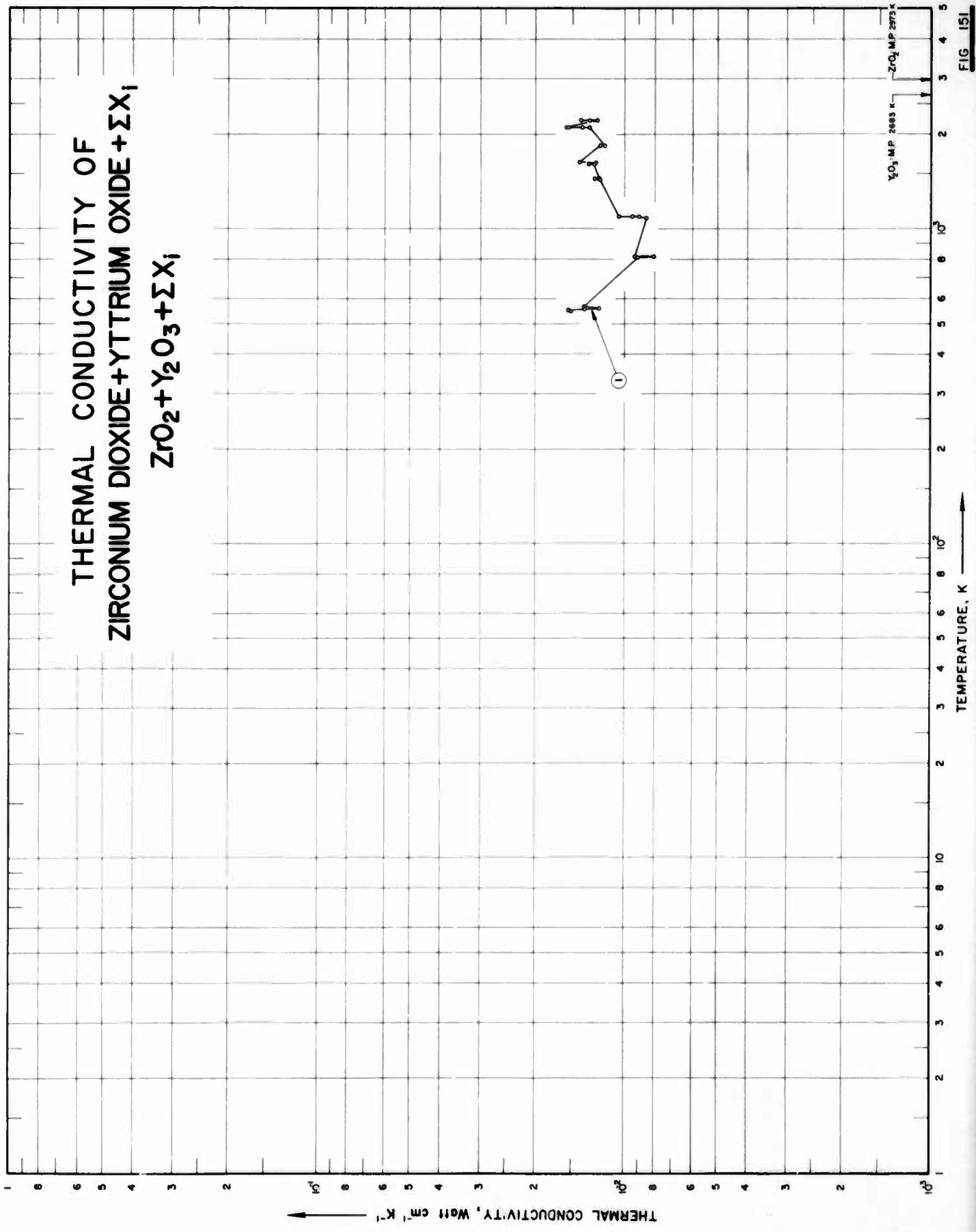
[For Data Reported in Figure and Table No. 150]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
							ZrO ₂	SiO ₂	Al ₂ O ₃	
1	383	L	1927	473-1673	±15	Zirconia brick	60.44	27.26	7.75	1.60 Fe ₂ O ₃ , 0.04 CaO; specimen 10.8 cm in dia and 22.8 cm long; made of South American baddeleyite ore, calcined and crushed into grog, bonded with some fine ground ore, pressed into bricks, fired at 1923 K; apparent density 4.87 g cm ⁻³ ; bulk density 3.43 g cm ⁻³ ; porosity 29.5%.

DATA TABLE NO. 150 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + SILICON DIOXIDE + ΣX_i] $ZrO_2 + SiO_2 + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k
<u>CURVE 1</u>	
473.2	0.0146
673.2	0.0163
873.2	0.0176
1073.2	0.0184
1273.2	0.0192
1473.2	0.0201
1673.2	0.0205

THERMAL CONDUCTIVITY OF
 ZIRCONIUM DIOXIDE+YTTTRIUM OXIDE + ΣX_i
 $ZrO_2 + Y_2O_3 + \Sigma X_i$



SPECIFICATION TABLE NO. 151 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE + ΣX_1] ZrO₂ + Y₂O₃ + ΣX_1

[For Data Reported in Figure and Table No. 151]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks	
							ZrO ₂	Y ₂ O ₃	CeO ₂		CaO
1	82	R	1962	549-2206			88.41	7.09	2.73	0.46	0.25 MgO, 0.25 SiO ₂ , 0.063 CaSO ₄ , 0.045 SO ₃ , and 0.702 minor oxides; prepared from 89.3 of (99 ZrO ₂ , 0.52 CaO, 0.28 MgO, 0.28 SiO ₂ , 0.07 CaSO ₄ , and 0.05 SO ₃), 7.8 of (90.9 Y ₂ O ₃ , 0.80 CeO ₂ , and 4.27 minor oxides), and 2.9 of (92.0 CeO ₂ and 7.6 minor oxides); specimen 1 in. dia x 1 in. long; coarse grain; stabilized; molded; density 4.62 g cm ⁻³ ; porosity 22.5%; melting point 2905 K.

DATA TABLE NO. 151 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE + ΣX_i] $ZrO_2 + Y_2O_3 + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k
548.8	0.0151
550.9	0.0154
555.9	0.0136
558.7	0.0122
566.5	0.0137
810.9	0.00900
813.2	0.00799
814.3	0.00922
1084.3	0.00848
1094.3	0.00891
1096.5	0.00939
1098.2	0.0104
1426.5	0.0121
1435.9	0.0126
1450.9	0.0125*
1450.9	0.0122
1602.6	0.0126
1605.4	0.0132
1605.4	0.0124
1614.3	0.0142
1614.3	0.0138*
1633.2	0.0120
1833.2	0.0116
1833.2	0.0115*
1841.5	0.0117*
2083.2	0.0131
2083.2	0.0138
2083.2	0.0153
2083.2	0.0157
2205.9	0.0131
2205.9	0.0123
2205.9	0.0140

CURVE 1

* Not shown on plot

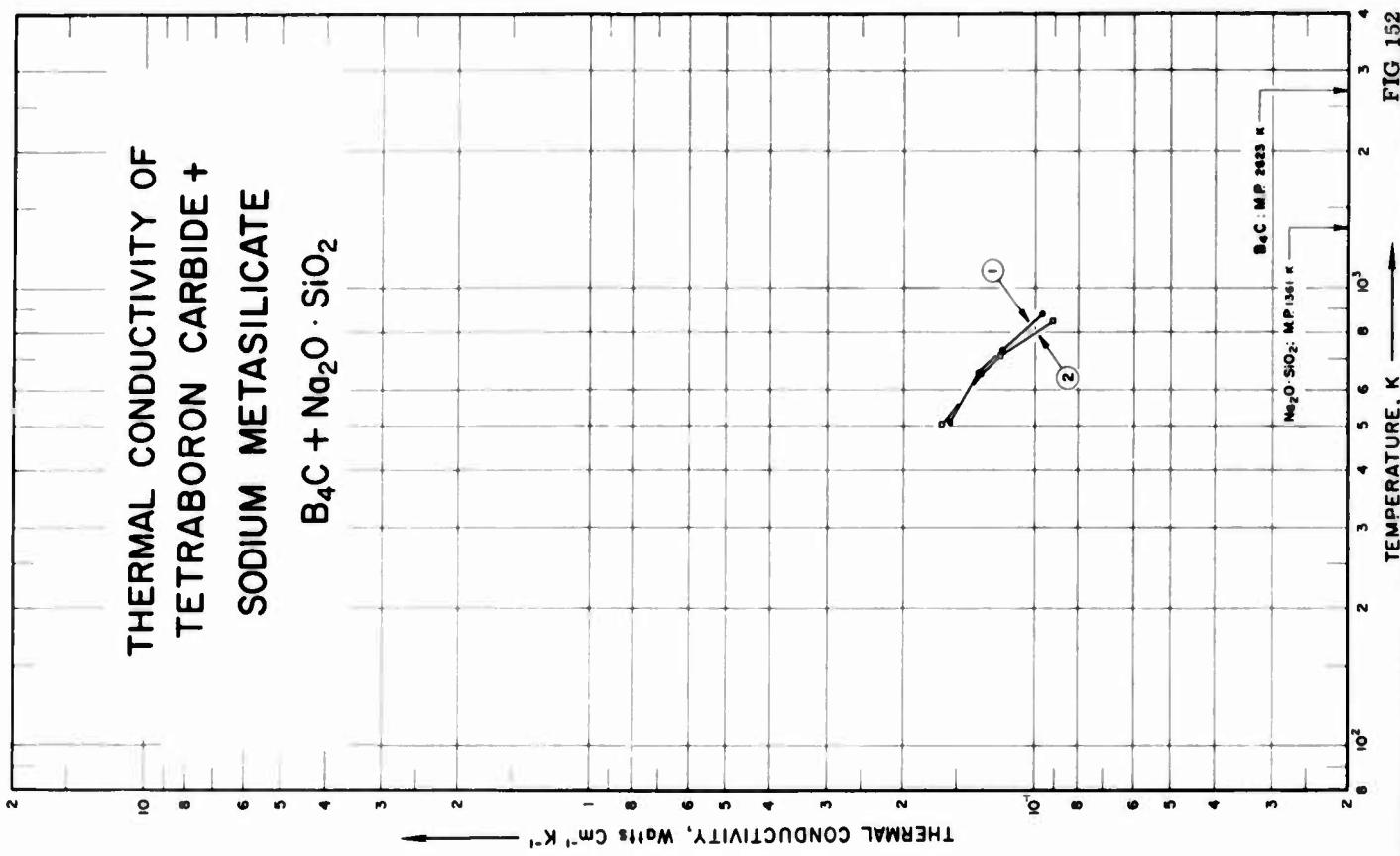


FIG. 152

SPECIFICATION TABLE NO. 152 THERMAL CONDUCTIVITY OF [TETRABORON CARBIDE + SODIUM METASILICATE] $B_4C + Na_2O \cdot SiO_2$

[For Data Reported in Figure and Table No. 152]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) B_4C	Composition (weight percent) $Na_2O \cdot SiO_2$	Composition (continued), Specifications and Remarks
1	C	1952	511-873		No. 18	97.85	2.15	Rammed; density 2.06 g cm^{-3} .
2	C	1952	503-843		No. 19	97.8	2.2	Rammed; density 2.06 g cm^{-3} .

DATA TABLE NO. 152 THERMAL CONDUCTIVITY OF [TETRABORON CARBIDE + SODIUM METASILICATE] $B_4C + Na_2O \cdot SiO_2$

[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k
<u>CURVE 1</u>	
511.2	0.156
653.2	0.134
733.2	0.118
873.2	0.0963
<u>CURVE 2</u>	
503.2	0.163
653.2	0.134
718.2	0.120
843.2	0.0918

THERMAL CONDUCTIVITY OF
GRAPHITE + THORIUM DIOXIDE
C + ThO₂

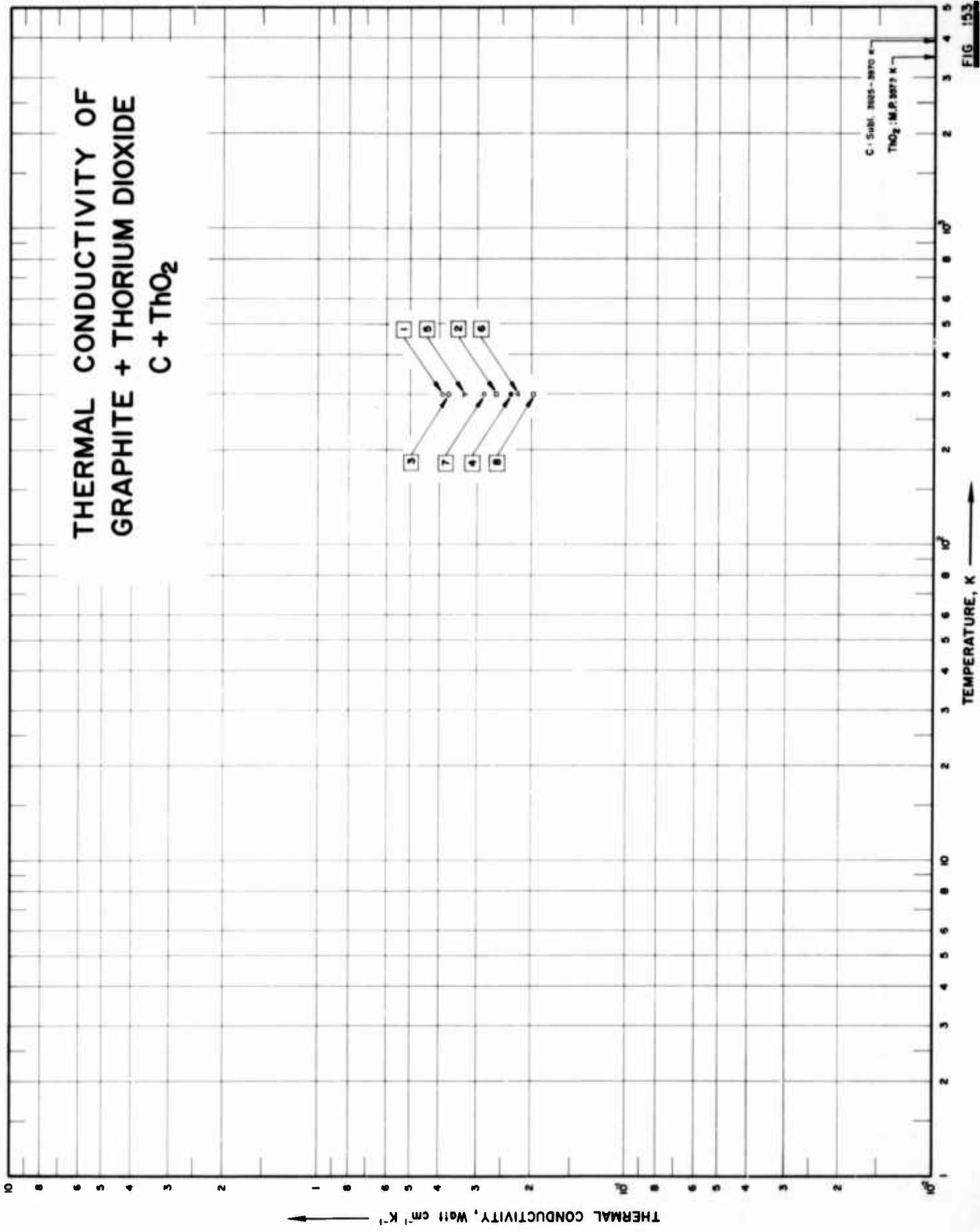


FIG. 153

SPECIFICATION TABLE NO. 153 THERMAL CONDUCTIVITY OF [GRAPHITE + THORIUM DIOXIDE] C + ThO₂

[For Data Reported in Figure and Table No. 153]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) C	Composition (weight percent) ThO ₂	Composition (continued), Specifications and Remarks
1	181		1959	298.2		Fuel-filled Graphite	89.96	10.04	Baked to 1425 C; bulk density 1.927 g cm ⁻³ ; measured with grain.
2	181		1959	298.2		Fuel-filled Graphite	89.96	10.04	The above specimen measured against grain.
3	181		1959	298.2		Fuel-filled Graphite	80.05	19.95	Baked to 1425 C; bulk density 1.971 g cm ⁻³ ; measured with grain.
4	181		1959	298.2		Fuel-filled Graphite	80.05	19.95	The above specimen measured against grain.
5	181		1959	298.2		Fuel-filled Graphite	70.03	29.97	Baked to 1425 C; bulk density 2.149 g cm ⁻³ ; measured with grain.
6	181		1959	298.2		Fuel-filled Graphite	70.03	29.97	The above specimen measured against grain.
7	181		1959	298.2		Fuel-filled Graphite	60.07	39.93	Baked to 1425 C; bulk density 2.369 g cm ⁻³ ; measured with grain.
8	181		1959	298.2		Fuel-filled Graphite	60.07	39.93	The above specimen measured against grain.

DATA TABLE NO. 153 THERMAL CONDUCTIVITY OF [GRAPHITE + THORIUM DIOXIDE] C + ThO₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
298.2	0.391
<u>CURVE 2</u>	
298.2	0.261
<u>CURVE 3</u>	
298.2	0.374
<u>CURVE 4</u>	
298.2	0.234
<u>CURVE 5</u>	
298.2	0.329
<u>CURVE 6</u>	
298.2	0.222
<u>CURVE 7</u>	
298.2	0.286
<u>CURVE 8</u>	
298.2	0.197

FIGURE SHOWS ONLY 8 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF
GRAPHITE + URANIUM DIOXIDE
C(GRAPHITE) + UO₂

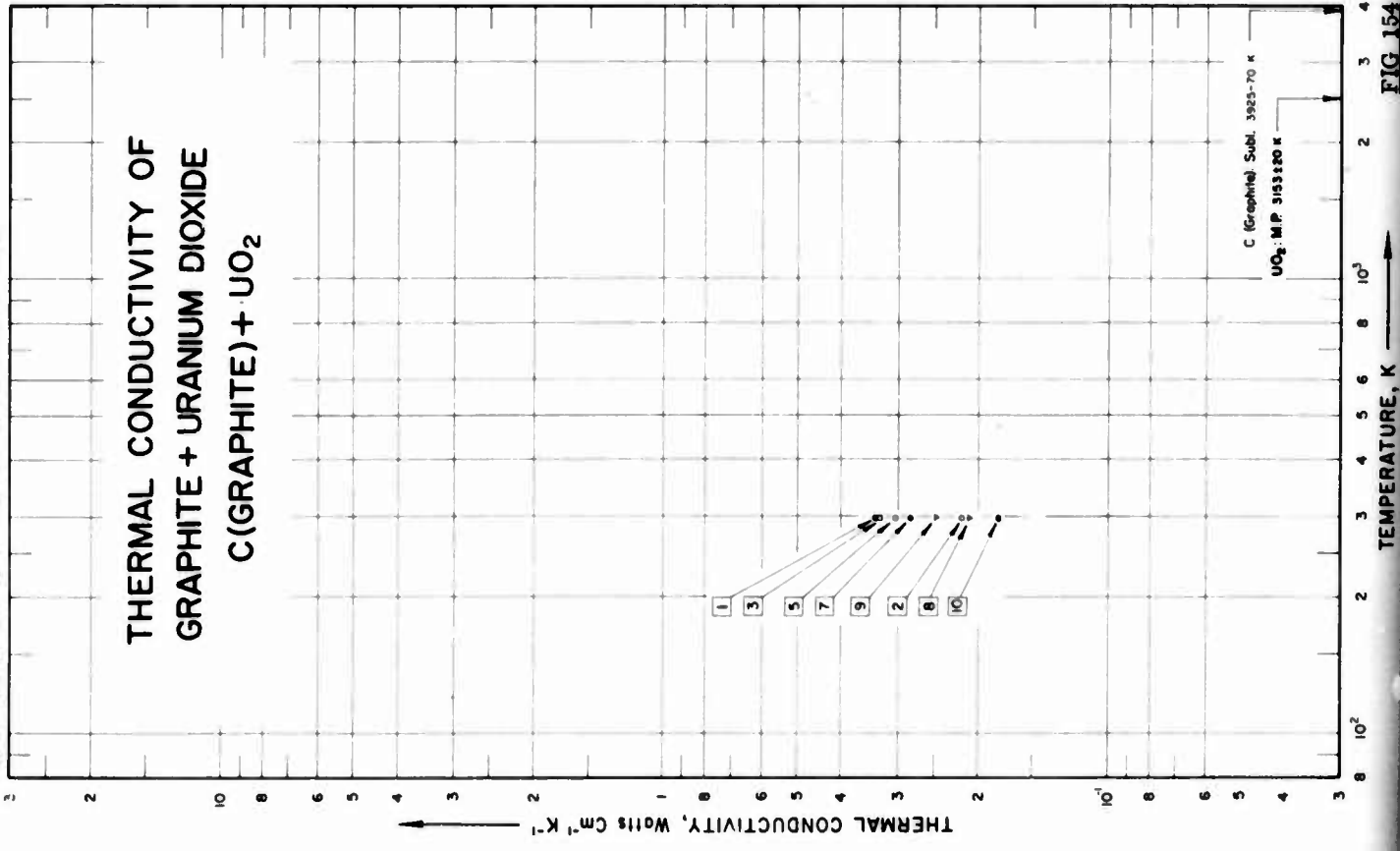


FIG 154

SPECIFICATION TABLE NO. 154 THERMAL CONDUCTIVITY OF [GRAPHITE + URANIUM DIOXIDE] C + UO₂

[For Data Reported in Figure and Table No. 154]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition C	Composition (weight percent) UO ₂	Composition (continued), Specifications and Remarks
1	181		1959	298.2		Fuel-filled graphite	96.69	3.31	Baked to 1425 C; bulk density 1.724 g cm ⁻³ ; measured with grain.
2	181		1959	298.2		Fuel-filled graphite	96.69	3.31	The above specimen measured against grain.
3	181		1959	298.2		Fuel-filled graphite	88.89	11.11	Baked to 1425 C; bulk density 1.832 g cm ⁻³ ; measured with grain.
4	181		1959	298.2		Fuel-filled graphite	88.89	11.11	The above specimen measured against grain.
5	181		1959	298.2		Fuel-filled graphite	78.47	21.53	Baked to 1425 C; bulk density 2.007 g cm ⁻³ ; measured with grain.
6	181		1959	298.2		Fuel-filled graphite	78.47	21.53	The above specimen measured against grain.
7	181		1959	298.2		Fuel-filled graphite	67.05	32.95	Baked to 1425 D; bulk density 2.224 g cm ⁻³ ; measured with grain.
8	181		1959	298.2		Fuel-filled graphite	67.09	32.95	The above specimen measured against grain.
9	181		1959	298.2		Fuel-filled graphite	58.61	41.39	Baked to 1425 C; bulk density 2.441 g cm ⁻³ ; measured with grain.
10	181		1959	298.2		Fuel-filled graphite	58.61	41.39	The above specimen measured against grain.

DATA TABLE NO. 154 THERMAL CONDUCTIVITY OF [GRAPHITE + URANIUM DIOXIDE] C + UO₂

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
	<u>CURVE 1</u>
298.2	0.338
	<u>CURVE 2</u>
298.2	0.218
	<u>CURVE 3</u>
298.2	0.334
	<u>CURVE 4*</u>
298.2	0.222
	<u>CURVE 5</u>
298.2	0.306
	<u>CURVE 6*</u>
298.2	0.218
	<u>CURVE 7</u>
298.2	0.282
	<u>CURVE 8</u>
298.2	0.209
	<u>CURVE 9</u>
298.2	0.249
	<u>CURVE 10</u>
298.2	0.180

* Not shown on plot

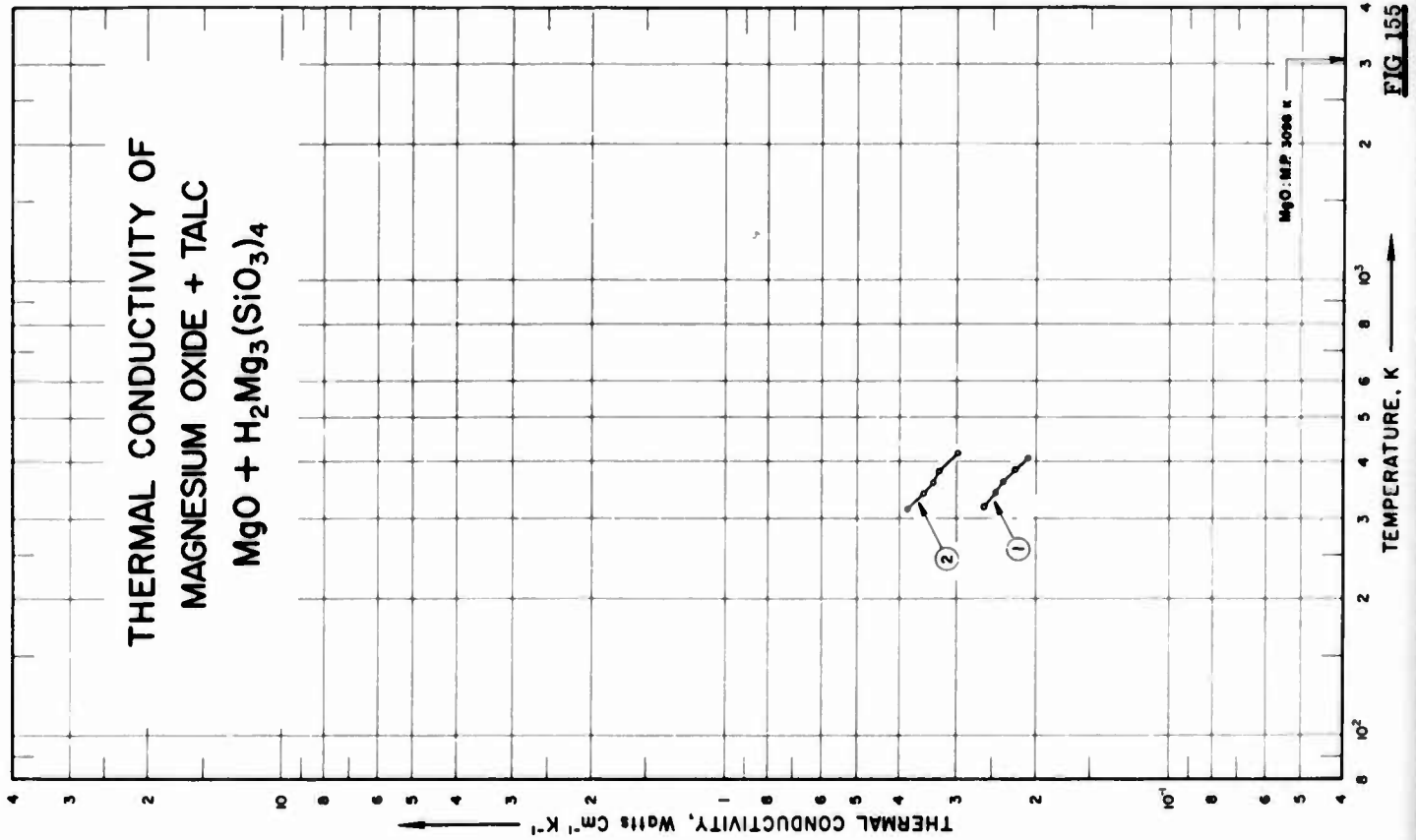


FIG 155

SPECIFICATION TABLE NO. 155 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + TALC] $MgO + H_2Mg_3(SiO_3)_4$

[For Data Reported in Figure and Table No. 155]

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Sp. cimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						MgO	$H_2Mg_3(SiO_3)_4$	
1	23	1952	319-408		179A-1	92.5	7.5	White color; fired at 1811 K and soaked for 2 hrs; water absorption 0.029%; density 3.219 g cm ⁻³ .
2	12	1953	315-418		181A-1	97.5	2.5	Calcined at 1367 K and dry-pressed at 15000 psi; fired at 1811 K and soaked for 1 hr; density 3.45 g cm ⁻³ .

DATA TABLE NO. 155 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + TALC] $\text{MgO} + \text{H}_2\text{Mg}_3(\text{SiO}_3)_4$

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
319.3	0.262
342.7	0.245
360.6	0.236
384.8	0.222
407.7	0.208
<u>CURVE 2</u>	
315.0	0.384
340.8	0.364
360.5	0.346
380.6	0.328
417.6	0.299

SPECIFICATION TABLE NO. 156 THERMAL CONDUCTIVITY OF [SILICON CARBIDE + SILICON DIOXIDE] SiC + SiO₂

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	84	L	1925	1623.2	1.0	9" carborundum No. 1A Wall	91.51 SiC, 8.02 SiO ₂ , 0.26 Al ₂ O ₃ , 0.65 Fe ₂ O ₃ , 0.17 ignition loss; the wall under test was built of standard 2.5 x 4.5 x 9 in. brick laid up with cement of the same composition as the brick; the brick were made of carborundum recrystallized in an electric furnace; apparent density 2.05 g cm ⁻³ ; porosity 34.1% calculated by assuming SiC specific gravity 3.17; the brick was placed so that the temp gradient was through the 9 in. dimension.
2	84	L	1925	1623.2	1.0	4.5" carborundum No. 1B Wall	93.20 SiC, 4.50 SiO ₂ , 1.33 Al ₂ O ₃ , 1.03 Fe ₂ O ₃ ; same as the above specimen except having apparent density 2.07 g cm ⁻³ and porosity 33.5%, the brick was placed so that the temp gradient was through the 4.5 in. dimension.
3	84	L	1925	1623.2	1.0	4.5" carborundum No. 1C Wall	93.20 SiC, 4.50 SiO ₂ , 1.33 Al ₂ O ₃ , 1.03 Fe ₂ O ₃ ; apparent density 2.20 g cm ⁻³ ; porosity 29.5%; the brick was placed so that the temp gradient was through the 4.5 in. dimension.
4	84	L	1925	1623.2	1.0	4.5" carborundum No. 2 Wall	80.10 SiC, 14.72 SiO ₂ , 1.47 Al ₂ O ₃ , 1.33 Fe ₂ O ₃ , 0.88 ignition loss; the wall under test was built of standard 2.5 x 4.5 x 9 in. brick laid up with cement of the same composition as the brick; the brick contained ceramic bonds and were kiln fired at approx 1350 C; apparent density 2.48 g cm ⁻³ ; porosity 18.4% calculated by assuming 3.17 for SiC specific gravity; the brick was placed so that the temp gradient was through the 4.5 in. dimension.

DATA TABLE NO. 156 THERMAL CONDUCTIVITY OF [SILICON CARBIDE + SILICON DIOXIDE] SiC + SiO₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1*</u>			
1623.2	0.169	1623.2	0.227
<u>CURVE 2*</u>			
1623.2	0.180	1623.2	0.160
<u>CURVE 3*</u>			
<u>CURVE 4*</u>			

* No graphical presentation

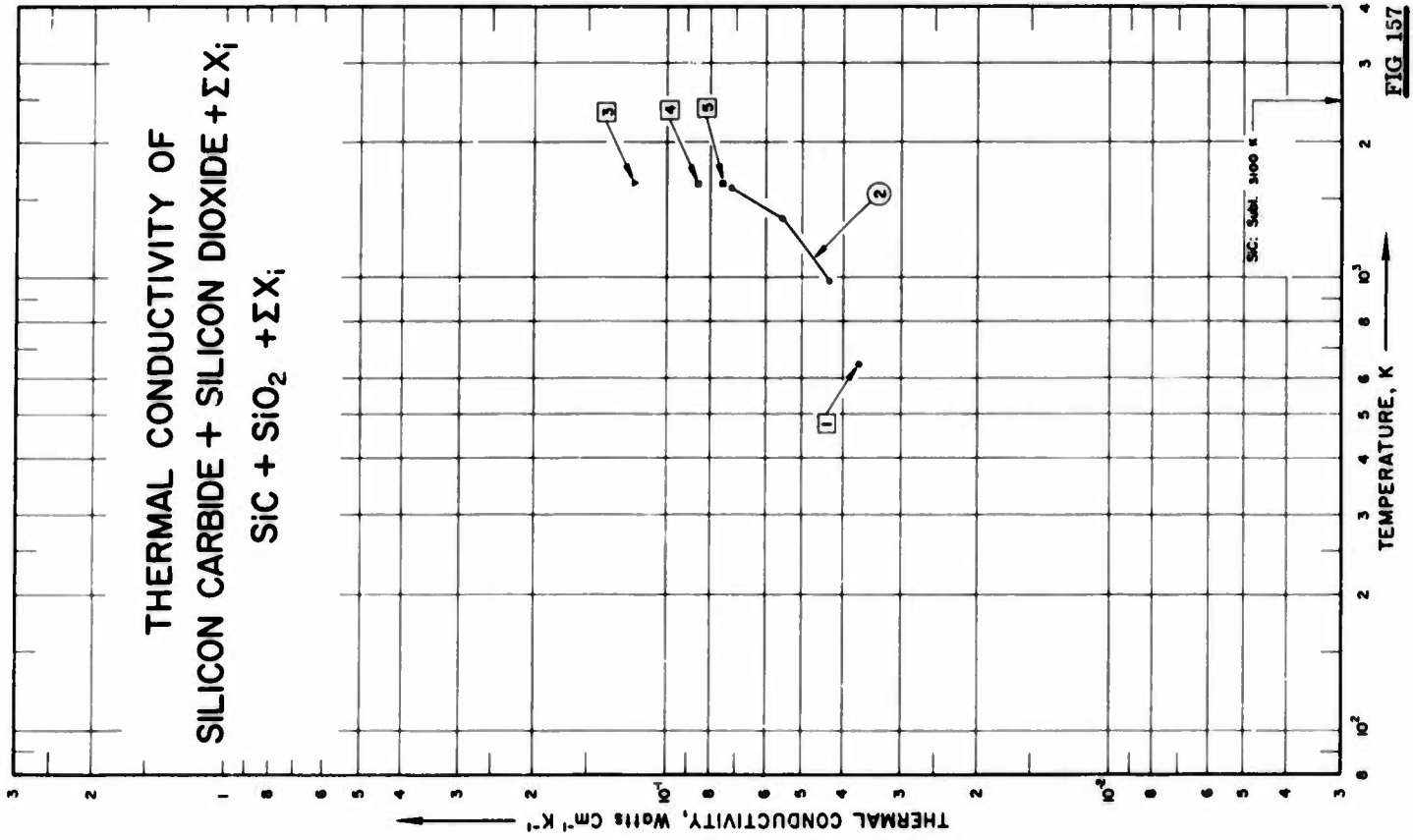


FIG 157

SPECIFICATION TABLE NO. 157 THERMAL CONDUCTIVITY OF [SILICON CARBIDE + SILICON DIOXIDE + ΣX_i] SIC + SiO₂ + ΣX_i

[For Data Reported in Figure and Table No. 157]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	SIC	SiO ₂	Al ₂ O ₃	Composition (continued), Specifications and Remarks
1	80	L	1934	647.1		Silicon carbide brick, Norton	86.7	8.2	4.2	0.3 Fe ₂ O ₃ , 0.2 CaO, 0.2 TiO ₂ and 0.2 Alkali; approximate composition; clay-bonded; bulk density 2.23 g cm ⁻³ and porosity 28.3%
2	80	L	1934	986-1598		Silicon carbide brick, Norton	86.7	8.2	4.2	0.3 Fe ₂ O ₃ , 0.2 CaO, 0.2 TiO ₂ , and 0.2 Alkali; the above specimen measured with insulating brick placed between the calorimeter and the lower surface of the specimen.
3	84	L	1925	1623.2	1.0	4.50 in. carborundum No. 3 wall	68.50	23.31	5.58	1.57 Fe ₂ O ₃ ; made from standard 2.5 x 4.5 x 9 in. brick laid with cement of the same composition; kiln fired at approximately 1350 C; apparent density 2.35 g cm ⁻³ ; 20.7% porosity calculated by assuming specific gravity of SIC as 3.17; ignition loss 0.24%.
4	84	L	1925	1623.2	1.0	4.50 in. carborundum No. 4 wall	52.60	36.80	8.10	1.97 Fe ₂ O ₃ ; same as above but apparent density 2.36 g cm ⁻³ and porosity 17.7%.
5	84	L	1925	1623.2	1.0	4.50 in. carborundum No. 5 wall	48.35	38.76	11.63	1.97 Fe ₂ O ₃ ; same as above but apparent density 2.31 g cm ⁻³ and porosity 18.9%; ignition loss 0.10%.

DATA TABLE NO. 157 THERMAL CONDUCTIVITY OF [SILICON CARBIDE + SILICON DIOXIDE + ΣX_i] SIC + SiO₂ + ΣX_i

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
647.1	0.0369
<u>CURVE 2</u>	
995.9	0.0434
1364.8	0.0552
1597.6	0.0718
<u>CURVE 3</u>	
1623.2	0.118
<u>CURVE 4</u>	
1623.2	0.0854
<u>CURVE 5</u>	
1623.2	0.0745

THERMAL CONDUCTIVITY OF THORIUM DIOXIDE + GRAPHITE

$\text{ThO}_2 + \text{C}$

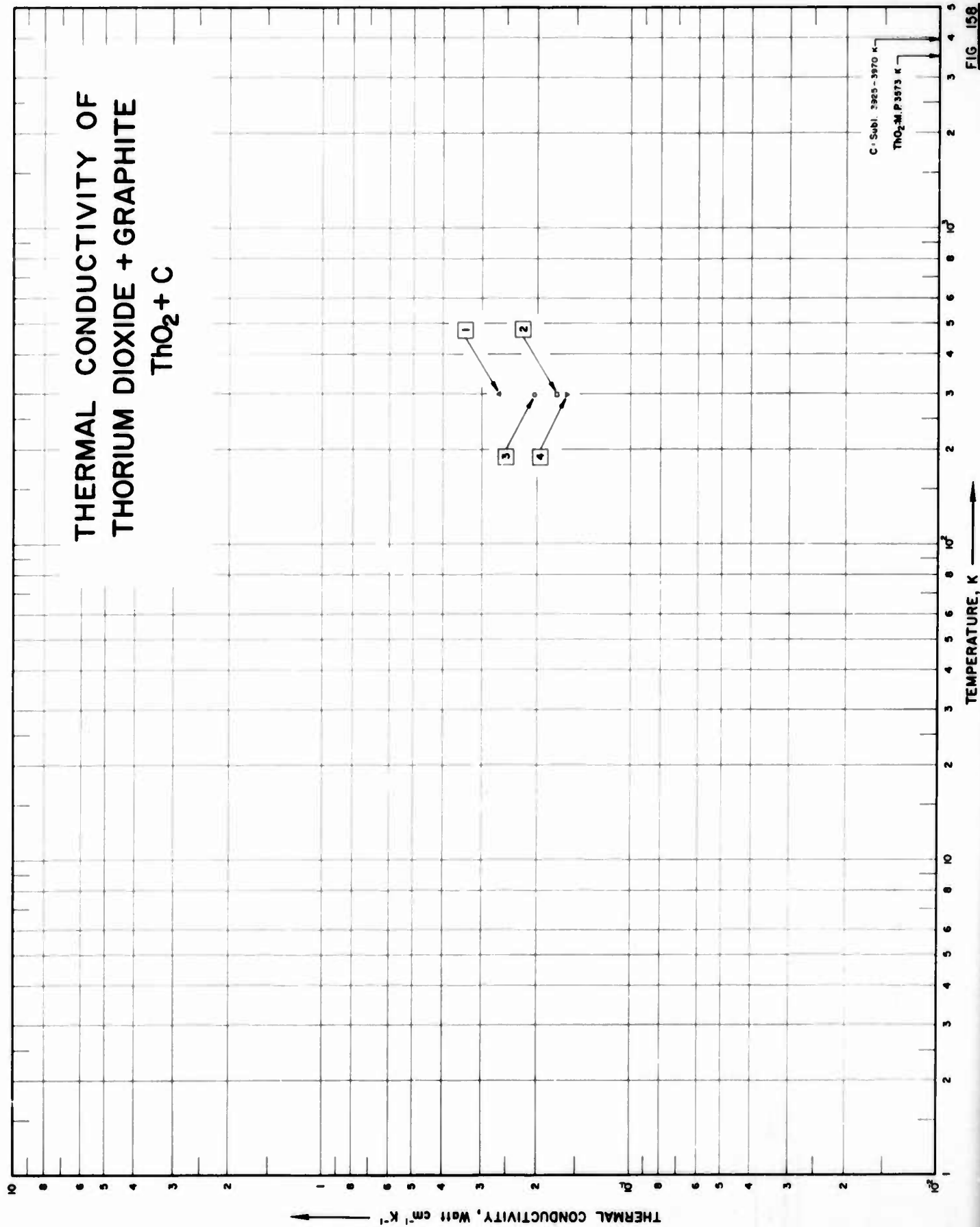


FIG. 158

SPECIFICATION TABLE NO. 158 THERMAL CONDUCTIVITY OF [THORIUM DIOXIDE + GRAPHITE] $\text{ThO}_2 + \text{C}$

[For Data Reported in Figure and Table No. 158]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition ThO_2	Composition (weight percent) C	Composition (continued), Specifications and Remarks
1	181		1959	298.2		Fuel-filled graphite	50.06	49.94	Baked to 1425 C; bulk density 2.624 g cm ⁻³ ; measured with grain.
2	181		1959	298.2		Fuel-filled graphite	50.06	49.94	The above specimen measured against grain.
3	181		1959	298.2		Fuel-filled graphite	60.17	39.83	Baked to 1425 C; bulk density 2.951 g cm ⁻³ ; measured with grain.
4	181		1959	298.2		Fuel-filled graphite	60.17	39.83	The above specimen measured against grain.

DATA TABLE NO. 158 THERMAL CONDUCTIVITY OF [THORIUM DIOXIDE + GRAPHITE] ThO₂ + C[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
298.2	0.265
<u>CURVE 2</u>	
298.2	0.173
<u>CURVE 3</u>	
298.2	0.204
<u>CURVE 4</u>	
298.2	0.161

SPECIFICATION TABLE NO. 159 THERMAL CONDUCTIVITY OF CESIUM IODIDE CsI

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	214	C	1960	227-361			Crystalline specimen supplied by Harshaw Chem. Co. radius 1 cm, thickness 0.5 cm.

DATA TABLE NO. 159 THERMAL CONDUCTIVITY OF CESIUM IODIDE CsI

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
237.0	0.0140
242.6	0.0135
265.0	0.0125
277.8	0.0115
296.0	0.0105
316.3	0.0105
346.2	0.00950
360.7	0.00950

CURVE 1*

* No graphical presentation

SPECIFICATION TABLE NO. 160 THERMAL CONDUCTIVITY OF COPPER IODIDE CuI

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	597, 598	P	1963	290			Density 5.63 g cm ⁻³ ; melting point 605 C.; measured by a transient method.

DATA TABLE NO. 160 THERMAL CONDUCTIVITY OF COPPER IODIDE CuI

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
290	0.017

* No graphical presentation

SPECIFICATION TABLE NO. 161 THERMAL CONDUCTIVITY OF SILVER IODIDE AgI

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	597, 598	P	1963	290			Density 5.67 g cm ⁻³ ; melting point 557 C; measured by a transient method.

DATA TABLE NO. 161 THERMAL CONDUCTIVITY OF SILVER IODIDE AgI

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
290	0.004

* No graphical presentation

SPECIFICATION TABLE NO. 162 THERMAL CONDUCTIVITY OF CESIUM BROMIDE CsBr

Curve No.	Rel. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	71	C	1951	318, 338			Cubic isotropic crystal.
2	214	C	1980	228-368			Crystalline specimen supplied by Harshaw Chem. Corp.; 2 cm in dia and 0.5 cm thick.

DATA TABLE NO. 162 THERMAL CONDUCTIVITY OF CESIUM BROMIDE CsBr

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1 *</u>	
318.2	0.0092
338.2	0.0109
<u>CURVE 2 *</u>	
228.0	0.0118
248.7	0.0100
269.4	0.00924
295.0	0.00878
312.0	0.00823
337.5	0.00800
367.5	0.00776

* No graphical presentation

THERMAL CONDUCTIVITY OF
POTASSIUM BROMIDE
KBr

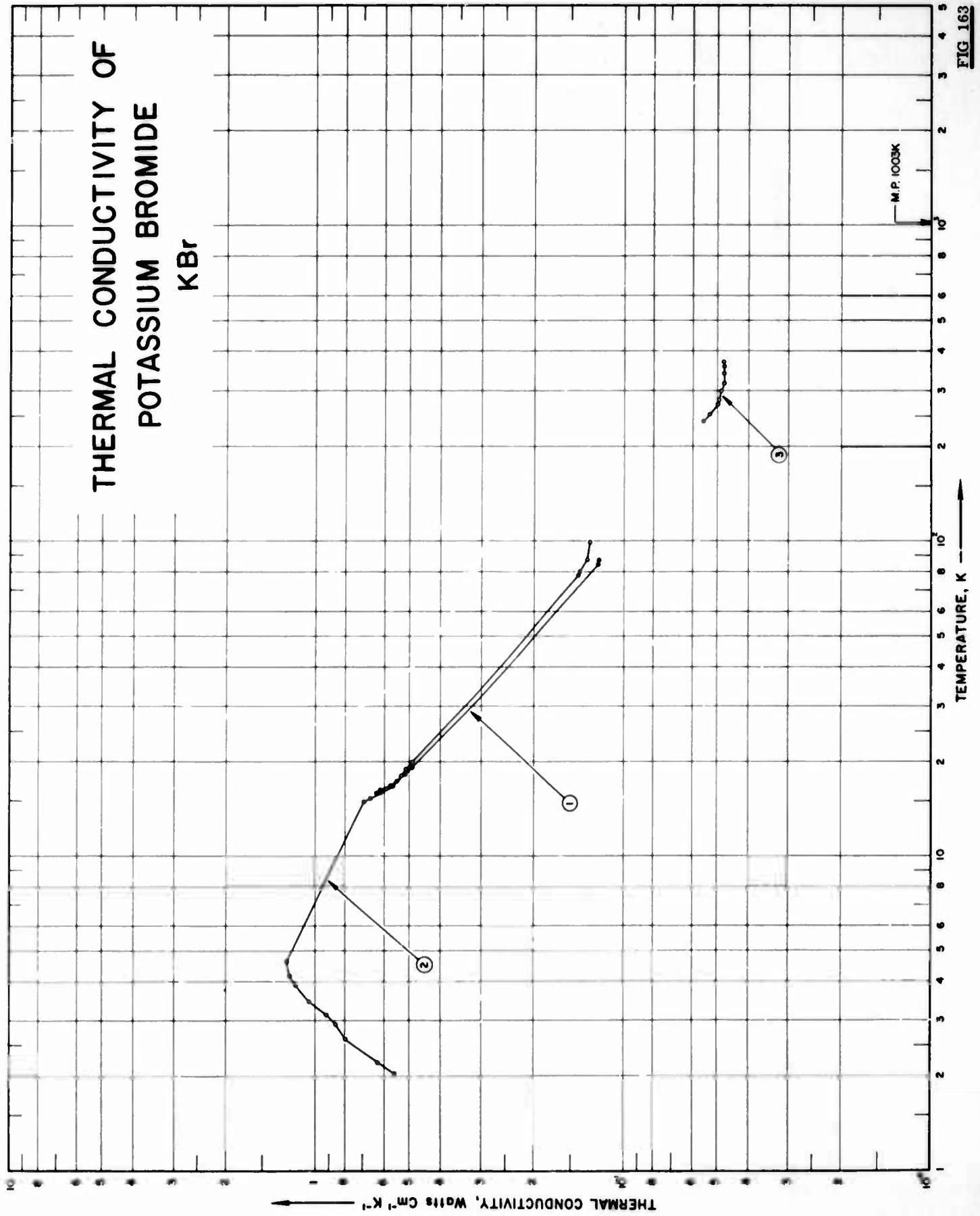


FIG 163

SPECIFICATION TABLE NO. 163 THERMAL CONDUCTIVITY OF POTASSIUM BROMIDE KBr

[For Data Reported in Figure and Table No. 163]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	32	L	1937	16-88		I	1.938 cm long, 0.294 cm dia; measured using soldered contact.
2	32	L	1937	2.0-90		II	2.437 cm long, 0.310 cm dia; measured using amalgam contact.
3	214	C	1960	241-372			Crystalline sample provided by Harshaw Chem. Comp.; radius 1 cm, thickness 0.5 cm.

DATA TABLE NO. 163 THERMAL CONDUCTIVITY OF POTASSIUM BROMIDE KBr

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
15.8	0.633
16.3	0.617
16.8	0.571
17.4	0.546
18.3	0.515
19.10	0.490
84.6	0.122
87.7	0.121
<u>CURVE 2</u>	
2.04	0.556
2.21	0.629
2.63	0.794
2.93	0.855
3.13	0.917
3.46	1.05
3.89	1.16
4.18	1.21
4.65	1.24
15.0	0.693
15.3	0.663
15.9	0.615
16.8	0.564
18.0	0.529
18.9	0.512
20.0	0.489
78.2	0.142
80.3	0.140
87.5	0.133
89.5	0.129
<u>CURVE 3</u>	
241.0	0.0555
253.0	0.0531
275.0	0.0500
282.0	0.0498
301.5	0.0487
318.2	0.0480
342.5	0.0480
360.7	0.0480
372.2	0.0480

SPECIFICATION TABLE NO. 164 THERMAL CONDUCTIVITY OF SILVER BROMIDE AgBr

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	585	P	1953	308-683			Rod specimen 3 mm in dia; cast.
2	71	C	1951	313, 341			Cubic isotropic crystal.

DATA TABLE NO. 164 THERMAL CONDUCTIVITY OF SILVER BROMIDE AgBr

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
308.2	0.00900
353.2	0.00785
413.2	0.00711
473.2	0.00628
485.7	0.00586
545.7	0.00533
580.7	0.00502
615.7	0.00473
630.7	0.00475
648.2	0.00477
673.2	0.00554
683.2	0.00607
<u>CURVE 2*</u>	
313.2	0.0071
341.2	0.0071

* No graphical presentation

SPECIFICATION TABLE NO. 165 THERMAL CONDUCTIVITY OF THALLIUM BROMIDE TlBr

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	71	C	1951	316,343			Cubic isotropic crystals.

DATA TABLE NO. 165 THERMAL CONDUCTIVITY OF THALLIUM BROMIDE TlBr

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
316.2	0.00586
343.2	0.00586

* No graphical presentation

SPECIFICATION TABLE NO. 166 THERMAL CONDUCTIVITY OF DIBERYLLIUM CARBIDE Be₂C

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	255	R	1950	598-1168			Hollow hot-pressed cylinder; 0.986 in. O. D., 0.609 in. I. D. and 3.0 in. long.

DATA TABLE NO. 166 THERMAL CONDUCTIVITY OF DIBERYLLIUM CARBIDE Be₂C[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
CURVE 1*			
CURVE 1 (cont.)*			
598.2	0.0137	923.2	0.0175
653.2	0.0148	923.2	0.0177
696.2	0.0146	933.2	0.0189
713.2	0.0148	963.2	0.0184
723.2	0.0168	978.2	0.0195
740.2	0.0158	980.2	0.0199
743.2	0.0155	1018.2	0.0213
758.2	0.0163	1033.2	0.0211
766.2	0.0173	1046.2	0.0199
793.2	0.0157	1108.2	0.0216
803.2	0.0173	1113.2	0.0218
848.2	0.0165	1168.2	0.0212
875.2	0.0183		
885.2	0.0162		
895.2	0.0191		
	0.0177		

* No graphical presentation

THERMAL CONDUCTIVITY OF TETRABORON CARBIDE B_4C

FIGURE SHOWS ONLY 8 OF THE CURVES REPORTED IN TABLE

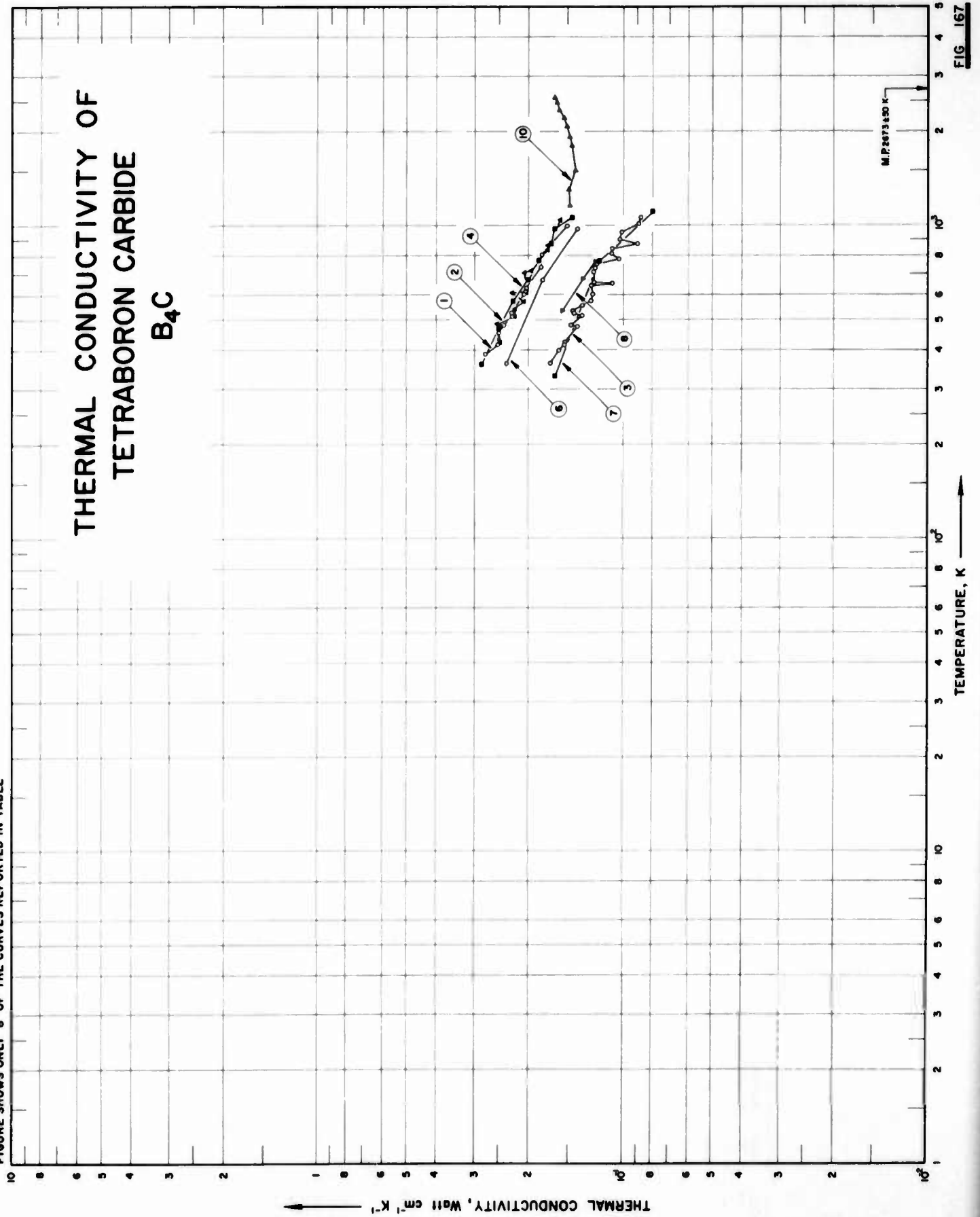


FIG 167

SPECIFICATION TABLE NO. 167 THERMAL CONDUCTIVITY OF TETRABORON CARBIDE B₄C

[For Data Reported in Figure and Table No. 167]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	212	C	1951	390-999		No. 5 (B ₄ C)	77.1 B, 22.2 C chemical composition; specimen 2 cm in dia and 15 cm long; hot-pressed; density 2.5 g cm ⁻³ ; Armco iron used as comparative material.
2	212	C	1951	425-1033		No. 11 (Norton No. D11, 776-2)	Similar to the above specimen except density 2.33 g cm ⁻³ .
3	212	C	1951	364-1066		No. 13 (No. D11, 798-1)	77.1 B, 22.2 C chemical composition; specimen 2 cm in dia and 15 cm long; rammed and sintered; density 1.9 g cm ⁻³ ; Armco iron used as comparative material.
4	76	C	1952	363-1073			Specimen .75 in. in dia and 9 in. long; hot-pressed; density 2.5 g cm ⁻³ ; lead used as comparative material.
5	76	C	1952	363-1073			Similar to the above specimen except density 2.33 g cm ⁻³ .
6	76	C	1952	363-973			Specimen .75 in. in dia and 9 in. long; rammed and sint.-red; density 1.9 g cm ⁻³ ; lead used as comparative material.
7	76	C	1952	333-1103			Similar to the above specimen except density 1.91 g cm ⁻³ .
8	76	C	1952	533-763		No. 17	1.85 Sodium silicate; specimen .75 in. in dia and 9 in. long; rammed; density 2.03 g cm ⁻³ ; lead used as comparative material.
9	583	C	1963	489-1036	± 4.0		75.97 B, 21.18 C, 0.07 B ₂ O ₃ , 0.27 Fe, 0.40 Si and 0.015 Al ₂ O ₃ ; specimen 2 in. in dia and 1 in. thick; density 2.5 g cm ⁻³ ; hot-pressed; measured in helium atmosphere; Armco iron used as comparative material.
10	583	P	1963	1168-2580	± 4.0		The above specimen measured by another method; thermal conductivity values calculated from the measurement of thermal diffusivity, specific heat and density.

DATA TABLE NO. 167 THERMAL CONDUCTIVITY OF TETRABORON CARBIDE B_4C [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k	T	k	T	k
<u>CURVE 1</u>					
390.2	0.278	659.2	0.127	533.2	0.156
418.2	0.252	711.2	0.125	673.2	0.135
454.2	0.251	732.2	0.124	763.2	0.122
480.2	0.240	751.2	0.123	<u>CURVE 9*</u>	
513.2	0.227	785.2	0.103	469.30	0.247
528.2	0.228	814.2	0.110	538.72	0.223
608.2	0.207	842.2	0.108	685.94	0.190
618.2	0.206	876.2	0.090	844.27	0.170
632.2	0.204	909.2	0.103	1035.94	0.156
735.2	0.183	950.2	0.102	<u>CURVE 10</u>	
806.2	0.182	1021.2	0.089	1168.16	0.147
999.2	0.150	1066.2	0.088	1313.72	0.148
<u>CURVE 2</u>					
425.2	0.248	363.2	0.285	1502.60	0.142
484.2	0.253	473.2	0.250	1805.38	0.146
512.2	0.224	573.2	0.225	1924.83	0.147
545.2	0.224	673.2	0.200	2079.27	0.151
574.2	0.207	773.2	0.185	2210.94	0.154
611.2	0.226	873.2	0.170	2347.05	0.159
611.2	0.204	973.2	0.165	2472.05	0.162
708.2	0.206	1073.2	0.145	2580.40	0.165
718.2	0.196	<u>CURVE 5*</u>			
898.2	0.172	363.2	0.287		
858.2	0.172	473.2	0.245		
1033.2	0.158	573.2	0.220		
<u>CURVE 3</u>					
364.2	0.171	673.2	0.195		
400.2	0.161	773.2	0.180		
417.2	0.154	873.2	0.165		
425.2	0.154	973.2	0.155		
478.2	0.140	1073.2	0.145		
484.2	0.147	<u>CURVE 6</u>			
519.2	0.136	363.2	0.235		
529.2	0.143	673.2	0.180		
539.2	0.145	973.2	0.140		
558.2	0.136	<u>CURVE 7</u>			
579.2	0.128	333.2	0.165		
603.2	0.127	773.2	0.120		
644.2	0.128	1103.2	0.080		
654.2	0.109				

* Not shown on plot

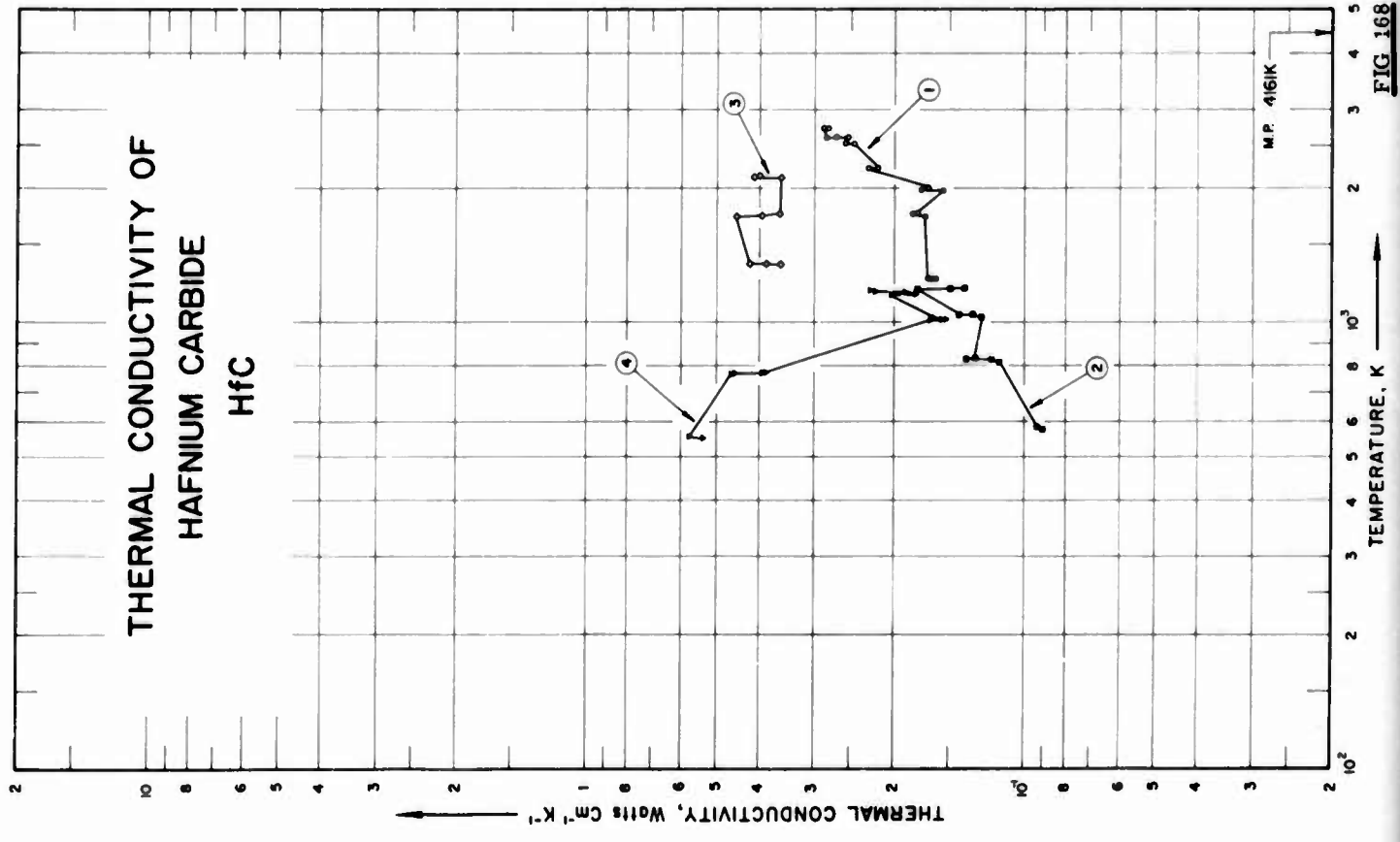


FIG 168

SPECIFICATION TABLE NO. 168 THERMAL CONDUCTIVITY OF HAFNIUM CARBIDE K1C

[For Data Reported in Figure and Table No. 168]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	144	R	1963	1261-2718	5-7	1	Specimen 0.75 in. long, 0.75 in. O.D. and 0.25 in. I.D.; heat-soaked at 2204 C; ground and polished to eliminate all the scratches on specimen surface; specimen found broken on post inspection.
2	243	R	1962	580-1192	2-4		Specimen 0.75 in. O.D., 0.25 in. I.D. and 0.75 in. long; hot-pressed; firing temp near 3593 C and max exposure temp 2882 C; density 10.04 g cm ⁻³ .
3	243	R	1962	1351-2122	2-4		The above specimen measured after heat-soaked.
4	243	R	1962	553-1174	2-4		Specimen 0.75 in. O.D., 0.75 in. I.D. and 0.75 in. long; hot-pressed; firing temp near 3593 C and max exposure temp 2882 C; density 10.04 g cm ⁻³ .

DATA TABLE NO. 168 THERMAL CONDUCTIVITY OF HAFNIUM CARBIDE HfC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

CURVE 1		CURVE 3	
T	k	T	k
1260.9	0.162	1351.0	0.359
1260.9	0.166	1366.5	0.389
1260.9	0.165*	1366.5	0.421*
1262.6	0.169	1366.5	0.424*
1747.1	0.171	1738.7	0.454
1755.4	0.183	1749.8	0.398
1758.2	0.179	1752.6	0.401*
1993.2	0.156	1752.6	0.363
1990.9	0.176	2108.2	0.359
1991.5	0.169	2116.5	0.414
2218.7	0.229	2122.1	0.408*
2218.7	0.219	2122.1	0.401
2220.9	0.217*		
2507.6	0.246	CURVE 4	
2509.8	0.258	552.6	0.539
2514.8	0.259*	555.9	0.578
2589.3	0.255	586.7	0.577*
2595.9	0.270	768.2	0.462
2598.2	0.284	770.9	0.453
2708.2	0.289	772.1	0.395
2708.7	0.281	773.2	0.385
2718.2	0.285*	1012.1	0.166
		1012.6	0.157
		1013.2	0.153
		1014.3	0.164
		1167.6	0.203
		1168.7	0.206*
580.4	0.0909	1169.8	0.179
584.3	0.0937	1173.2	0.190
587.1	0.0923*	1173.7	0.221
820.4	0.115	1173.7	0.221
823.7	0.115*	1174.3	0.226
827.1	0.120		
828.2	0.138		
829.3	0.131		
1029.3	0.127		
1040.9	0.133		
1040.9	0.143		
1040.9	0.144*		
1188.2	0.179		
1192.1	0.151		
1192.1	0.138		

* Not shown on plot

SPECIFICATION TABLE NO. 169 THERMAL CONDUCTIVITY OF TRIIRON CARBIDE Fe_3C

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	372		1940	298.2		Cementite	No details reported.

DATA TABLE NO. 169 THERMAL CONDUCTIVITY OF TRIIRON CARBIDE Fe_3C [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T k
CURVE 1*
 298.2 0.0711

*No graphical presentation

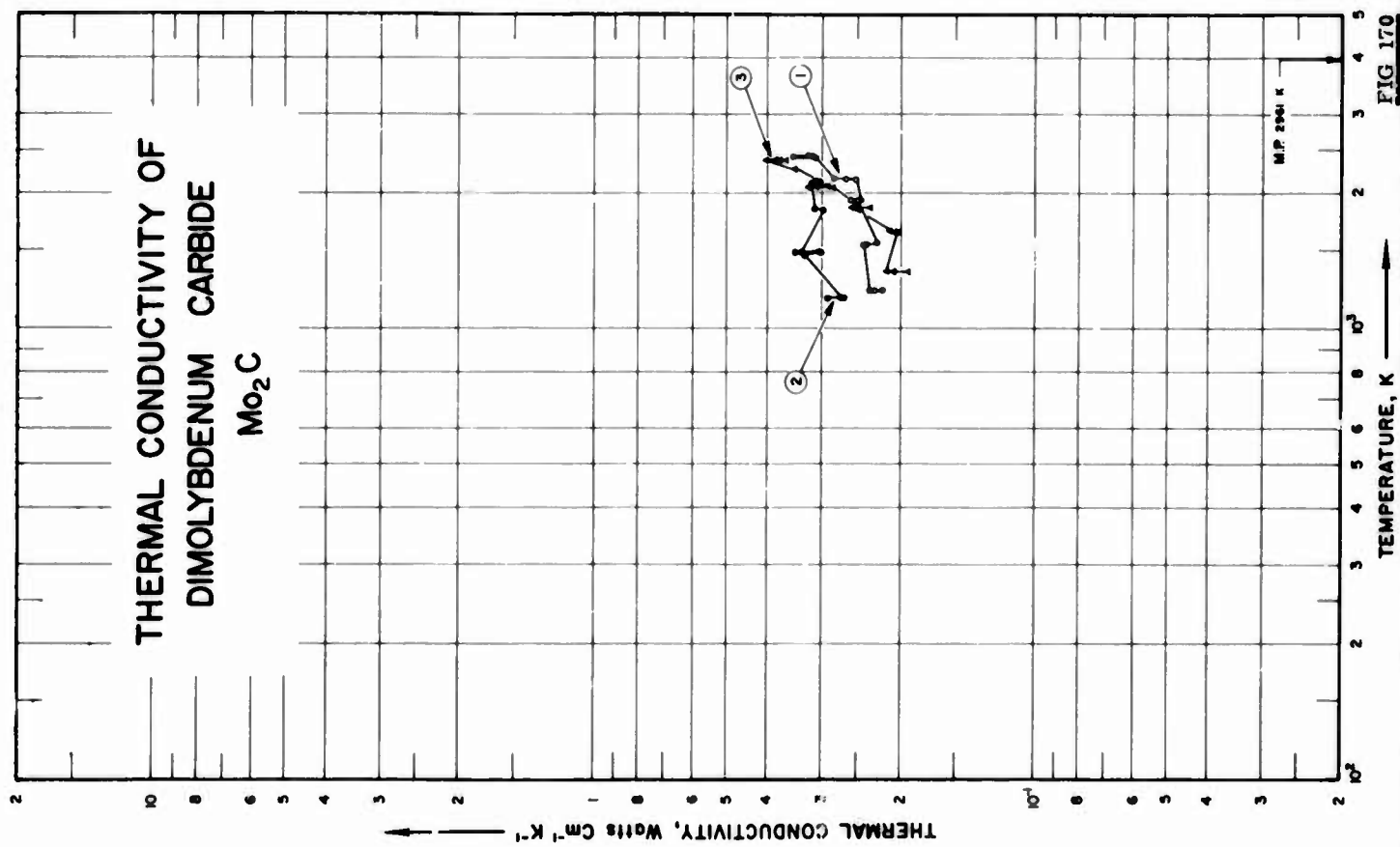


FIG 170

SPECIFICATION TABLE NO. 170 THERMAL CONDUCTIVITY OF DIMOLYBDENUM CARBIDE Mo_2C

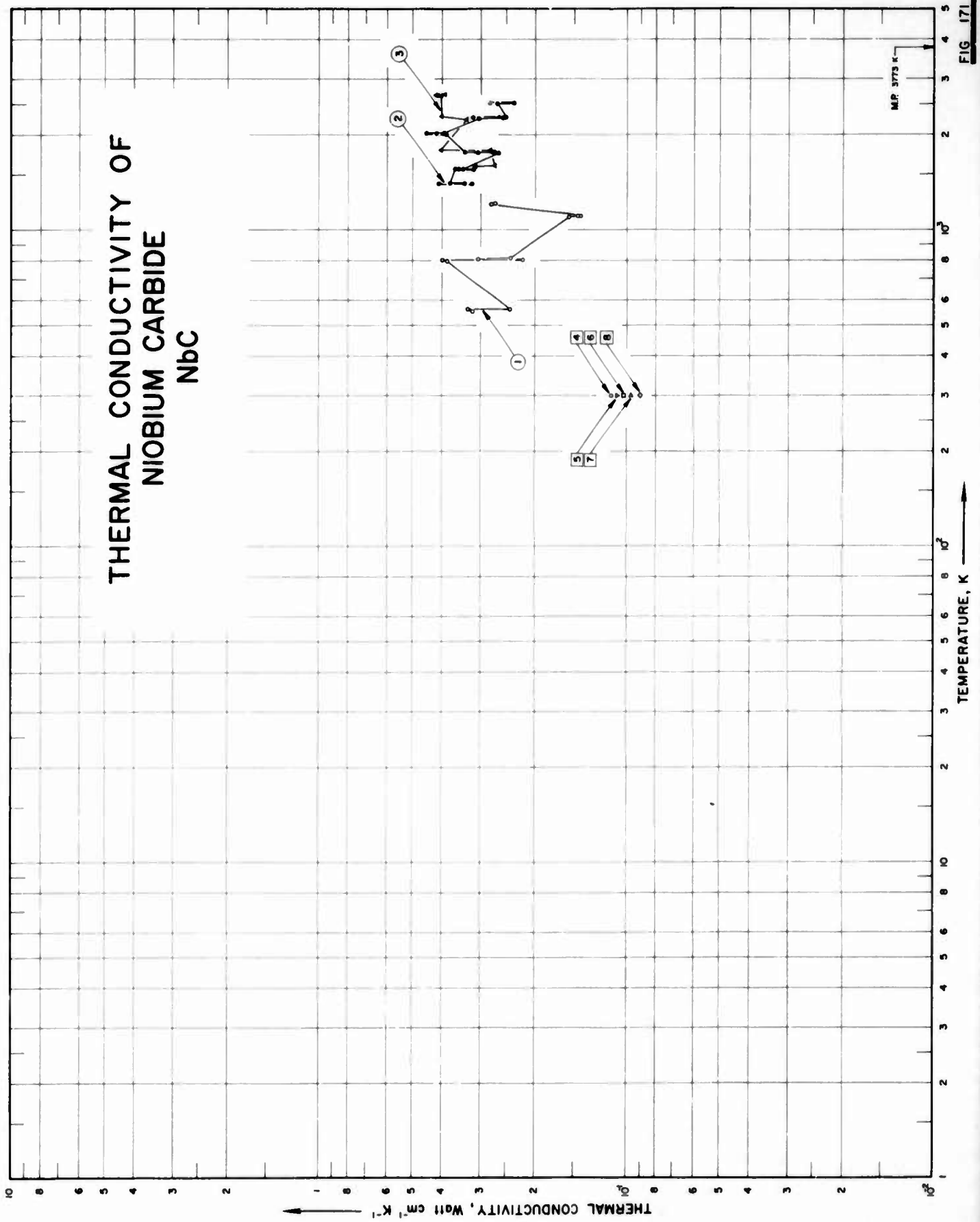
[For Data Reported in Figure and Table No. 170]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	144	R	1963	1222-2414	5-7	1	Specimen 0.75 in. long, 0.75 in. O.D. and 0.25 in. I.D.; ground and polished to eliminate all the scratches on specimen surface; specimen found broken and partially melted on post inspection.
2	144	R	1963	1172-2114	5-7	2	Similar to the above specimen; specimen found broken on post inspection.
3	144	R	1963	1344-2394	5-7	3	Similar to the above specimen except furthermore heat-soaked at 1538 C; specimen found broken on post inspection.

DATA TABLE NO. 170 THERMAL CONDUCTIVITY OF DIMOLYBDENUM CARBIDE Mo_2C [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
1222.1	0.219	1857.1	0.258
1222.1	0.229	1862.6	0.234
1222.1	0.235	1865.4	0.256
1223.7	0.233*	1872.6	0.249
1544.8	0.242	2065.4	0.283
1547.6	0.240	2068.2	0.320
1551.5	0.226	2069.8	0.309
1927.1	0.250	2070.4	0.291
1930.9	0.259	2267.1	0.345
1932.1	0.247	2372.6	0.405
2153.2	0.252	2373.2	0.361
2156.5	0.265	2376.5	0.374
2167.1	0.281	2384.3	0.382
2402.1	0.311		
2413.7	0.348		
2413.7	0.314		
2414.3	0.321		
<u>CURVE 2</u>			
1172.1	0.268		
1172.1	0.291		
1172.1	0.270		
1469.3	0.328		
1472.1	0.301		
1473.2	0.305		
1475.4	0.345		
1475.4	0.334		
1842.6	0.299		
1844.3	0.311		
1847.1	0.310*		
2105.4	0.317		
2106.5	0.304		
2113.7	0.310		
<u>CURVE 3</u>			
1344.3	0.207		
1344.3	0.215		
1344.3	0.192		
1344.3	0.216*		
1642.1	0.204		
1645.9	0.211		
1645.9	0.205		

* Not shown on plot



SPECIFICATION TABLE NO. 171 THERMAL CONDUCTIVITY OF NIOBIUM CARBIDE NbC

[For Data Reported in Figure and Table No. 171]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	243	R	1962	555-1220	2-4		88.43 Nb, 11.3 C, 0.1 Fe, 0.1 W, 0.07 N, <0.01 each Si, Mn, Mg, Cr, Sn, Ti, Zr and Ni; specimen 0.75 in. O.D., 0.25 in. I.D. and 0.75 in. long; hot-pressed; max exposure temp 2616 C; density 7.62 g cm ⁻³ .
2	243	R	1962	1403-2517	2-4		Similar to the above specimen except specimen found cracked and fissured after the measurements.
3	243	R	1962	1586-2694	2-4		Similar to the above specimen.
4	6	L	1965	298.2	± 6.0		99.49 Nb, 10.51 C; specimen prepared by pressing and sintering of powder mixtures close to stoichiometric composition of carbide and appropriate metal; sintering was carried out in a TVV-4 vacuum furnace at 10 ⁻⁴ to 10 ⁻⁵ mm pressure at 2200 to 2400 C; electrical resistivity 89.8 x 10 ⁻⁶ ohm cm at room temp.
5	6	L	1965	298.2	± 6.0		90.044 Nb, 9.956 C; similar to the above specimen except electrical resistivity 135.2 x 10 ⁻⁶ ohm cm at room temp.
6	6	L	1965	298.2	± 6.0		90.54 Nb, 9.46 C; similar to the above specimen except electrical resistivity 151.9 x 10 ⁻⁶ ohm cm at room temp.
7	6	L	1965	298.2	± 6.0		91.065 Nb, 8.935 C; similar to the above specimen except electrical resistivity 150.0 x 10 ⁻⁶ ohm cm at room temp.
8	6	L	1965	298.2	6.0		91.6 Nb, 8.4 C; similar to the above specimen except electrical resistivity 171.7 x 10 ⁻⁶ ohm cm at room temp.

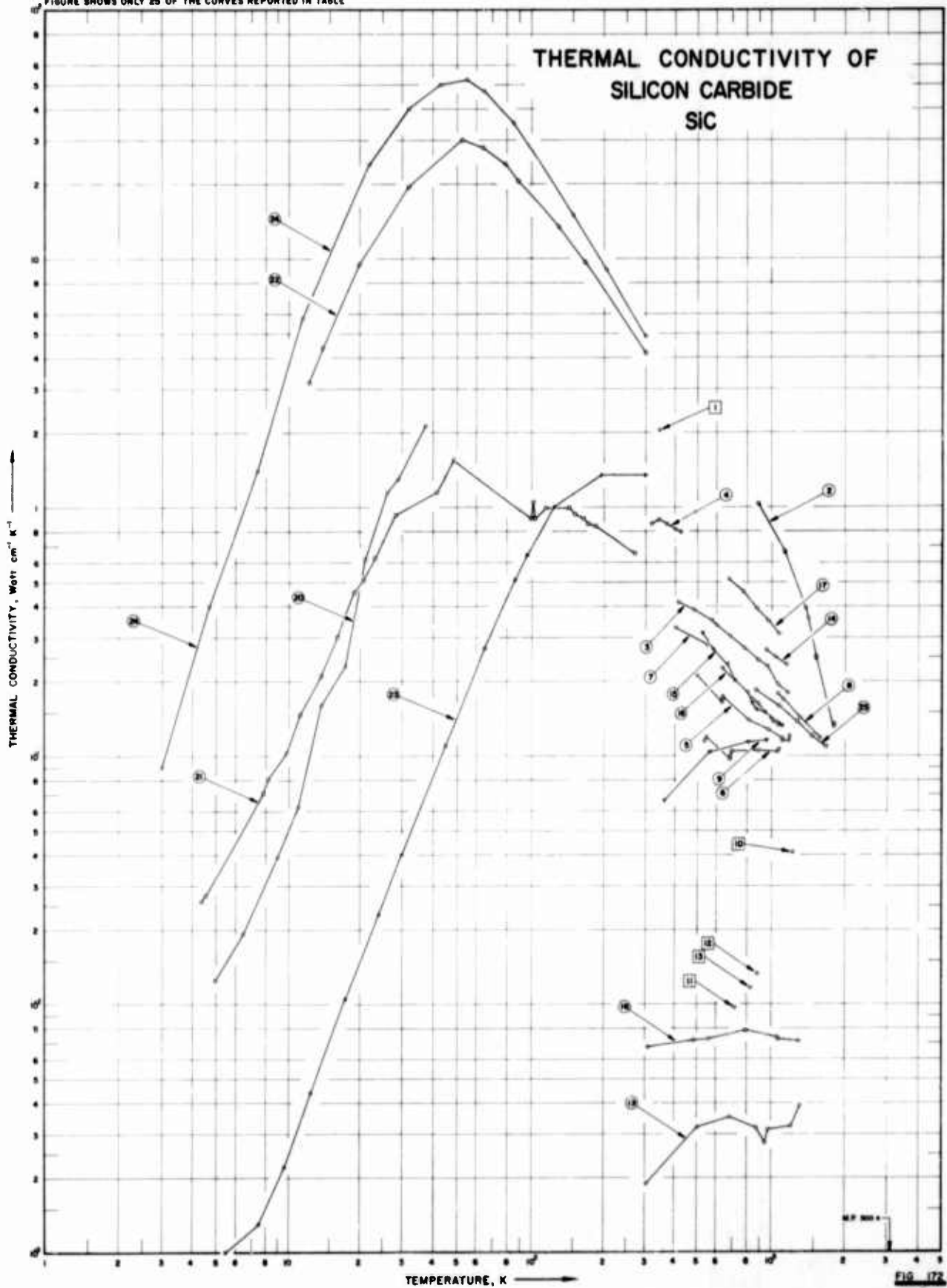
DATA TABLE NO. 171 THERMAL CONDUCTIVITY OF NIOBIUM CARBIDE NBC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
554.8	0.317	2516.5	0.239*
562.1	0.330	2516.5	0.284
563.2	0.244	<u>CURVE 3</u>	
799.3	0.385	1586.0	0.314
803.2	0.398	1594.3	0.273
809.8	0.220	1783.2	0.281
810.9	0.306	1783.2	0.404
812.6	0.242	2236.7	0.332
1104.8	0.157	2277.6	0.404
1105.4	0.147	2666.5	0.407
1108.7	0.144	2672.1	0.382
1209.3	0.280*	2677.6	0.412
1209.3	0.280	2694.3	0.421
1217.1	0.273	<u>CURVE 4</u>	
1218.7	0.273*	298.2	0.112
1220.4	0.271*	<u>CURVE 5</u>	
<u>CURVE 2</u>			
1402.6	0.320	298.2	0.107
1405.4	0.412	<u>CURVE 6</u>	
1405.4	0.399	298.2	0.102
1405.4	0.378	<u>CURVE 7</u>	
1408.2	0.410*	298.2	0.097
1566.5	0.363	<u>CURVE 8</u>	
1566.5	0.352	298.2	0.090
1566.5	0.317	<u>CURVE 9</u>	
1566.5	0.343	<u>CURVE 10</u>	
1752.6	0.265	<u>CURVE 11</u>	
1761.0	0.307	<u>CURVE 12</u>	
1763.7	0.274	<u>CURVE 13</u>	
1763.7	0.278	<u>CURVE 14</u>	
1763.7	0.310*	<u>CURVE 15</u>	
1772.1	0.337	<u>CURVE 16</u>	
2030.4	0.398	<u>CURVE 17</u>	
2036.0	0.453	<u>CURVE 18</u>	
2036.0	0.420	<u>CURVE 19</u>	
2038.7	0.394	<u>CURVE 20</u>	
2258.2	0.306	<u>CURVE 21</u>	
2261.0	0.257	<u>CURVE 22</u>	
2263.7	0.319	<u>CURVE 23</u>	
2266.5	0.350	<u>CURVE 24</u>	
2505.4	0.268	<u>CURVE 25</u>	
2508.2	0.235	<u>CURVE 26</u>	
2513.7	0.232*	<u>CURVE 27</u>	

* Not shown on plot

FIGURE SHOWS ONLY 25 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 172 THERMAL CONDUCTIVITY OF SILICON CARBIDE SIC

[For Data Reported in Figure and Table No. 172]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	13	C	1953	343.2	±3.0		Polycrystal; specimen 1.75 in. long and 0.22 in. in dia; supplied by Carborundum Co.; density 2.8 g cm ⁻³ ; Armco iron used as comparative material.
2	37	L	1958	589-1801	5.0		67.46 Si, 28.56 C, 0.73 Al, 0.58 Fe, 0.48 CaO; density 3.1 g cm ⁻³ .
3	14	C	1953	413-1168			Cubic specimen; cut from ingot; supplied by Norton Co.; total porosity 21.7%; dense sintered alumina used as comparative material.
4	68	C	1954	318-423	±3.0	288A-1	Single crystal of hexagonal crystal system in α phase.
5	232	L	1954	499-1198		Commercial SiC	Frit-bonded.
6	232	L	1954	538-1063		Commercial SiC	Frit-bonded.
7	80	L	1934	404.551		SiC brick, Refrax	96.9 SiC, 1.3 Al ₂ O ₃ , 1.3 Fe ₂ O ₃ and 0.7 SiO ₂ ; approx composition; recrystallized; supplied by Carborundum Co.; bulk density 2.18 g cm ⁻³ ; porosity 34.4%.
8	80	L	1934	1063-1582		SiC brick, Refrax	The above specimen measured with insulating brick placed between the calorimeter and the lower surface of the brick.
9	103	L	1937	363-963			> 85 SiC in finished state, containing no clay bond, lime, magnesia, or silicate of soda; specimen ~1 in. thick.
10	81	L	1924	1232.8		Crystolon SiC	98.0 SiC; specimen 8.5 in. in dia and 3.54 in. thick; made by crushing the electric furnace products to pass a No. 14 screen and bonding with fire clay, containing 10% bond clay (composition 25.41 Al ₂ O ₃ , 59.55 SiO ₂ , 2.31 Fe ₂ O ₃ , 1.33 TiO ₂ , 1.01 K ₂ O + Na ₂ O, 0.46 CaO, 0.33 MgO and 9.10 loss), fired to cone 16; measured at 749.6 mm Hg pressure; porosity 29.14%, calculated from the dry, saturated, and suspended weight.
11	216	R	1951	719.3		No. 8 grain	Specimen measured from the inner half of test annulus.
12	216	R	1951	887.1		No. 8 grain	The above specimen measured from the outer half of the test annulus.
13	216	R	1951	830.4		No. 8 grain	The above specimen measured from the entire annulus.
14	233	R, C	1955	953-1153			Hot-pressed.
15	233	R, C	1955	523-1103		Sample 1	Frit-bonded.
16	233	R, C	1955	633-1063		Sample 2	Frit-bonded.
17	233	R, C	1955	673-1073			Si (~15%) bonded supplied by O. R. N. L.
18	234	R	1959	309-1302			Density 1.59 g cm ⁻³ ; 320 B mesh powder; measured in helium atmosphere.
19	234	R	1959	305-1320			Density 1.59 g cm ⁻³ ; 320 B mesh powder; measured in air.
20	381	L	1961	5-38			Polycrystalline specimen of β -type (cubic crystal); dimensions 1x1x10 mm; made by pyrolysis of chlorosilanes in hydrogen atmosphere.

SPECIFICATION TABLE NO. 172 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
21	381	L	1961	4.4-270			Single crystal of α -SiC (hexagonal type); dimensions 6x6x0.6 mm; prepared by Lely procedure from technical-grade polycrystalline SiC; specimen nitrogen doped (10^{18} N atoms cm^{-3}), other impurities $<10^{17}$ atoms cm^{-3} by spectrochemical analysis.
22	382	L	1964	12.3-300	± 10	R-43	Single crystal; light green 6H polytype; n-type; 0.14 cm in effective dia and 0.70 cm long; major impurity N, Al 1×10^{19} atoms cm^{-3} ; electrical conductivity 4.5×10^{-1} ohm $^{-1}\text{cm}^{-1}$ at 300 K; heat flow perpendicular to c-axis.
23	382	L	1964	4.0-300	± 10	R-52	Single crystal; dark blue and a mixture of 6H and 15R polytypes; p-type; 0.16 cm in effective dia and 0.67 cm long; major impurity AP 4×10^{19} atoms cm^{-3} ; electrical conductivity 1.6 ohm $^{-1}\text{cm}^{-1}$ at 300 K; heat flow perpendicular to c-axis.
24	382	L	1964	3.0-300	± 10	R-66	Single crystal; 6H poly type; colorless; n-type; 0.12 cm in effective dia and 0.35 cm long; major impurity N 1×10^{17} atoms cm^{-3} , electrical conductivity 9×10^{-2} ohm $^{-1}\text{cm}^{-1}$ at 300 K; heat flow perpendicular to c-axis.
25	383	L	1927	873-1673	± 25		Commercial recrystallized silicon carbide; specimen 10.8 cm in dia and 22.8 cm long; apparent density 3.19 g cm^{-3} ; bulk density 2.06 g cm^{-3} ; porosity 35.3%.
26	595	C	1962	589, 882			Foam specimen; Min-k 1301 (Johns Manville Corp.) used as comparative material.
27	472	R	1963	650-1039			Foam specimen contained in a cylindrical annuli of 2.75 in. O. D. and 0.75 in. I. D.; density 0.465 g cm^{-3} .
28	472	R	1963	805-1039			The above specimen measured at decreasing temperatures.

DATA TABLE NO. 172 THERMAL CONDUCTIVITY OF SILICON CARBIDE SiC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k		
<u>CURVE 1</u>		<u>CURVE 5 (cont.)</u>		<u>CURVE 12</u>		<u>CURVE 18 (cont.)</u>		<u>CURVE 21 (cont.)</u>		<u>CURVE 24</u>		<u>CURVE 25</u>		<u>CURVE 26*</u>		<u>CURVE 27*</u>		<u>CURVE 28*</u>	
343.2	2.05	816.2	0.139	887.1	0.0134	791.2	0.00784	48.5	1.55	3.0	0.09	12.3	3.2	588.7	0.00981	649.8	0.00134	805.4	0.00322
889.8	1.03	973.2	0.128	1062.2	0.00737	1062.2	0.00737	100.0	0.895	4.7	0.4	14.0	4.4	882.1	0.0124	760.9	0.00265	922.1	0.00402
1130.0	0.670	1105.2	0.118	1074.2	0.00727	1074.2	0.00727	102.0	1.05	7.4	1.4	20.0	9.5	1073.2	0.159	9.6	0.0022	1039	0.00391
1332.2	0.666	1107.2	0.117	1301.7	0.00710	1301.7	0.00710	104.0	0.897	11.5	5.8	32.0	19.5	1473.2	0.121	12.5	0.0044	1039	0.00462
888.8	1.04	1186.2	0.117	830.4	0.0117	<u>CURVE 19</u>		115.0	0.987	22.0	24.0	145.0	0.987	1673.2	0.109	30.0	0.040	805.4	0.00322
889.8	1.03	1198.2	0.121	<u>CURVE 14</u>		305.1	0.00190	132.0	0.937	32.0	40.0	152.0	0.937	588.7	0.00981	649.8	0.00134	922.1	0.00402
1130.0	0.670	<u>CURVE 6</u>		953.2	0.268	507.2	0.00320	165.0	0.897	43.0	50.0	165.0	0.897	882.1	0.0124	760.9	0.00265	1039	0.00391
1389.6	0.395*	538.2	0.115	1043.2	0.251	687.8	0.00351	173.0	0.857	55.0	52.5	173.0	0.857	1073.2	0.159	9.6	0.0022	944.3	0.00391
1414.6	0.360	543.2	0.119	1153.2	0.234	868.4	0.00319	185.0	0.836	65.0	47.0	185.0	0.836	1473.2	0.121	12.5	0.0044	1039	0.00462
1528.3	0.249	683.2	0.0979	<u>CURVE 15</u>		947.9	0.00277	270.0	0.655	85.0	35.0	270.0	0.655	1673.2	0.109	30.0	0.040	805.4	0.00322
1528.6	0.251	688.2	0.100	523.2	0.314	980.4	0.00313	<u>CURVE 22</u>		150.0	15.0	1204.0	0.00325	588.7	0.00981	649.8	0.00134	922.1	0.00402
1800.0	0.132*	683.2	0.105	583.2	0.268	1204.0	0.00325	12.3	3.2	205.0	9.0	1204.0	0.00325	882.1	0.0124	760.9	0.00265	1039	0.00391
1801.1	0.135	1062.2	0.105	663.2	0.234	1320.1	0.00393	14.0	4.4	300.0	4.9	1320.1	0.00393	1073.2	0.159	9.6	0.0022	944.3	0.00391
<u>CURVE 3</u>		<u>CURVE 7</u>		713.2	0.201	<u>CURVE 20</u>		20.0	9.5	<u>CURVE 23</u>		32.0	19.5	588.7	0.00981	649.8	0.00134	922.1	0.00402
413.2	0.418	404.1	0.329	803.2	0.180	4.97	0.0125	20.0	9.5	4.0	0.0008	32.0	19.5	588.7	0.00981	649.8	0.00134	922.1	0.00402
483.2	0.387	550.9	0.280	843.2	0.163	6.46	0.0193	52.5	30.0	5.5	0.0010	52.5	30.0	882.1	0.0124	760.9	0.00265	1039	0.00391
573.2	0.351	598.2	0.339	873.2	0.155	8.99	0.0390	64.0	28.0	7.5	0.0013	64.0	28.0	1073.2	0.159	9.6	0.0022	944.3	0.00391
598.2	0.339	683.2	0.05	943.2	0.151	11.0	0.0624	79.0	24.0	12.5	0.0105	79.0	24.0	1473.2	0.121	12.5	0.0044	1039	0.00462
683.2	0.05	<u>CURVE 8</u>		1103.2	0.134	13.8	0.160	89.0	20.5	17.5	0.011	89.0	20.5	1673.2	0.109	30.0	0.040	805.4	0.00322
783.2	0.272	1063.2	0.179	<u>CURVE 16</u>		17.5	0.230	130.0	13.5	167.0	9.7	130.0	13.5	588.7	0.00981	649.8	0.00134	922.1	0.00402
883.2	0.243	1120.9	0.170	633.2	0.226	21.2	0.617	167.0	9.7	300.0	4.2	167.0	9.7	882.1	0.0124	760.9	0.00265	1039	0.00391
963.2	0.230	1302.1	0.144	883.2	0.163	26.2	1.15	<u>CURVE 21</u>		4.0	0.0008	300.0	4.2	588.7	0.00981	649.8	0.00134	922.1	0.00402
1063.2	0.195	1582.1	0.118	1003.2	0.138	29.0	1.30	4.4	0.0260	5.5	0.0010	4.0	0.0008	882.1	0.0124	760.9	0.00265	1039	0.00391
1168.2	0.190	<u>CURVE 9</u>		1063.2	0.134	37.5	2.13	4.4	0.0260	7.5	0.0013	4.4	0.0260	1073.2	0.159	9.6	0.0022	944.3	0.00391
317.5	0.862	382.6	0.0664	<u>CURVE 17</u>		4.4	0.0260	4.57	0.0275	9.6	0.0022	4.4	0.0260	588.7	0.00981	649.8	0.00134	922.1	0.00402
341.1	0.858	566.9	0.103	673.2	0.519	4.57	0.0275	7.85	0.0707	9.6	0.0022	4.57	0.0275	1073.2	0.159	9.6	0.0022	944.3	0.00391
370.1	0.858	811.0	0.114	773.2	0.460	7.85	0.0707	8.22	0.0508	12.5	0.0044	7.85	0.0707	1473.2	0.121	12.5	0.0044	1039	0.00462
400.2	0.816	962.7	0.116	873.2	0.393	9.82	0.103	24.0	0.023	17.5	0.0105	9.82	0.103	1673.2	0.109	30.0	0.040	805.4	0.00322
423.0	0.795	<u>CURVE 10</u>		973.2	0.351	11.2	0.147	30.0	0.040	30.0	0.040	11.2	0.147	588.7	0.00981	649.8	0.00134	922.1	0.00402
499.2	0.211	1073.2	0.310	1073.2	0.310	13.8	0.210	45.0	0.11	45.0	0.11	13.8	0.210	882.1	0.0124	760.9	0.00265	1039	0.00391
633.2	0.165	1232.2	0.0411	<u>CURVE 18</u>		16.2	0.301	65.0	0.27	65.0	0.27	16.2	0.301	1073.2	0.159	9.6	0.0022	944.3	0.00391
635.2	0.169	<u>CURVE 11</u>		309.3	0.00675	19.0	0.455	86.0	0.51	86.0	0.51	19.0	0.455	588.7	0.00981	649.8	0.00134	922.1	0.00402
637.2	0.174	719.3	0.00974	485.2	0.00717	20.7	0.510	96.0	0.64	96.0	0.64	20.7	0.510	1073.2	0.159	9.6	0.0022	944.3	0.00391
				561.0	0.00727	23.2	0.625	125.0	1.0	125.0	1.0	23.2	0.625	588.7	0.00981	649.8	0.00134	922.1	0.00402
						28.3	0.930	300.0	1.35	300.0	1.35	28.3	0.930	1073.2	0.159	9.6	0.0022	944.3	0.00391
						41.7	1.15					41.7	1.15	588.7	0.00981	649.8	0.00134	922.1	0.00402

* Not shown on plot

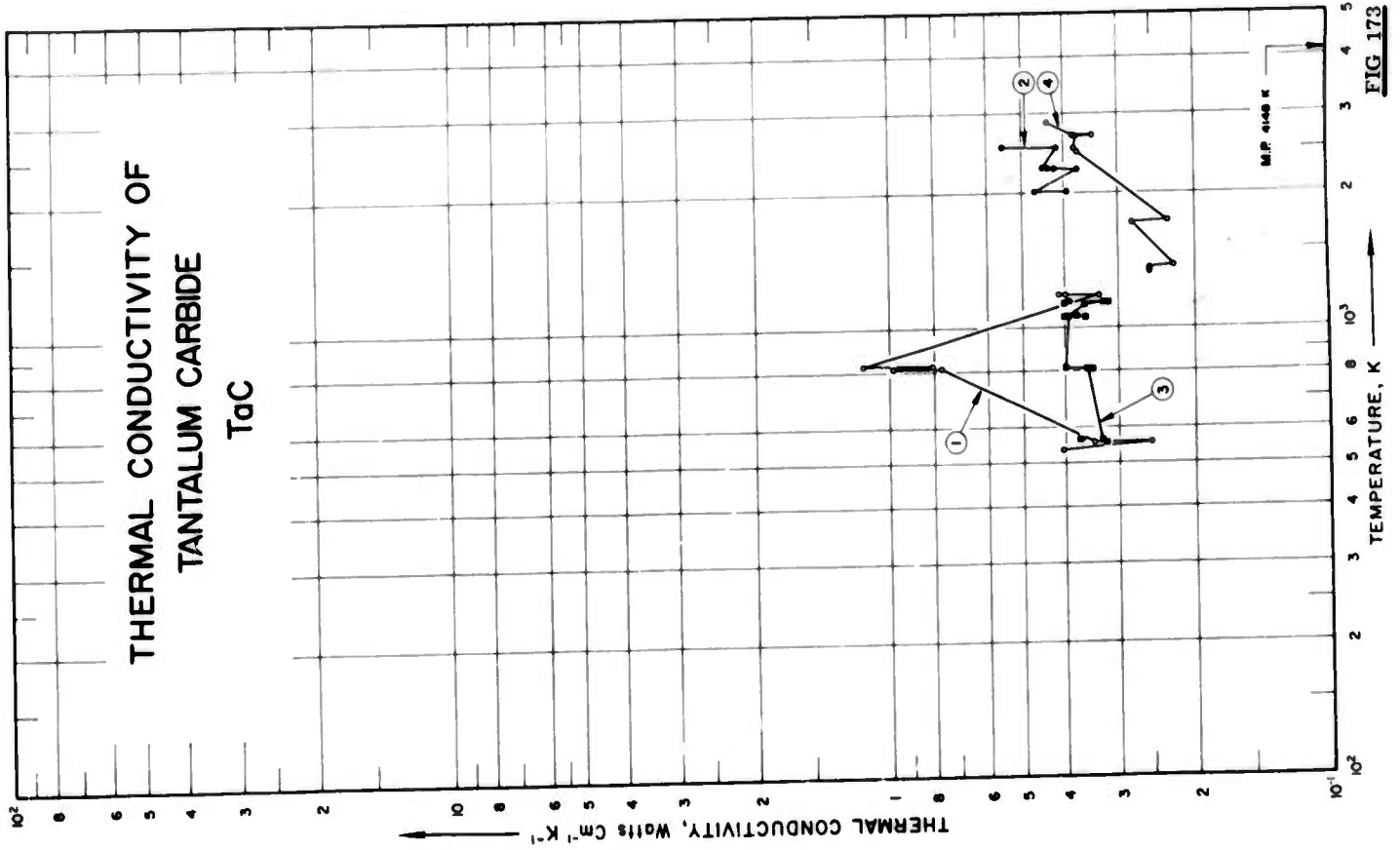


FIG. 173

SPECIFICATION TABLE NO. 173 THERMAL CONDUCTIVITY OF TANTALUM CARBIDE TaC

[For Data Reported in Figure and Table No. 173]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	243	R	1962	537-1194			93.75 Ta, 6.14 C, 0.1 W, <0.01 each Si, Mg, Ca, Al, Ti, Nb, Sn, Zr, Fe, Nb, Mn, Mg and Ni; specimen 0.75 in. O.D., 0.25 in. I.D. and 0.75 in. long; hot-pressed; max exposure temp 2649 C; density 13.87 g cm ⁻³ ; SRI run number C72. Similar to the above but pitting and spalling was found after measurements; SRI run number C83.
2	243	R	1962	2008-2555			
3	243	R	1962	552-1151			93.75 Ta, 6.14 C, 0.1 W, <0.01 each Si, Mg, Ca, Al, Ti, Nb, Sn, Zr, Fe, Nb, Mn, Mg and Ni; specimen 0.75 in. O.D., 0.25 in. I.D. and 0.75 in. long; hot-pressed; max exposure temp 2649 C; density 13.87 g cm ⁻³ ; SRI run number C82.
4	243	R	1962	1342-2855			Similar to the above specimen but heat soaked, pitting and spalling found on specimen after measurements; SRI run number C90.

DATA TABLE NO. 173 THERMAL CONDUCTIVITY OF TANTALUM CARBIDE TaC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
537.1	0.407	1341.5	0.254
556.5	0.251	1355.4	0.254
559.3	0.343	1374.8	0.222
819.3	0.773	1719.3	0.278
819.8	0.984	1742.1	0.239
829.8	0.808	2466.5	0.372
832.6	1.15	2511.0	0.379
1187.1	0.333	2674.8	0.372
1190.4	0.398	2686.0	0.342
1194.3	0.415	2694.3	0.381
		2855.4	0.436
<u>CURVE 2</u>			
2008.2	0.398		
2022.1	0.469		
2258.2	0.372		
2263.7	0.420		
2266.5	0.437		
2266.5	0.416*		
2272.1	0.447		
2272.1	0.400*		
2536.0	0.417		
2555.4	0.551		
<u>CURVE 3</u>			
551.5	0.322		
554.3	0.320*		
558.2	0.342*		
565.4	0.371		
565.4	0.329		
570.9	0.368*		
810.4	0.356		
810.9	0.345		
813.2	0.350*		
813.7	0.398		
1064.3	0.392		
1064.8	0.358		
1067.1	0.400		
1068.2	0.375		
1068.7	0.371*		
1133.7	0.361		
1139.3	0.400		
1147.6	0.325		
1149.8	0.317		
1150.9	0.332		

* Not shown on Plot

SPECIFICATION TABLE NO. 174 THERMAL CONDUCTIVITY OF THORIUM CARBIDE ThC

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	476	C	1962	438-638			Specimen 20 mm in dia and 15 mm long; measured in vacuum of 10^{-5} mm Hg; density 8.5 g cm^{-3} .
2	476	C	1962	443-624			The above specimen, 2nd run.
3	476	C	1962	457-633			The above specimen, 3rd run.

DATA TABLE NO. 174 THERMAL CONDUCTIVITY OF THORIUM CARBIDE ThC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

438.2 0.0807
 478.2 0.0795
 531.2 0.0753
 563.2 0.0774
 638.2 0.0732

CURVE 2*

443.2 0.0879
 433.2 0.0816
 535.2 0.0774
 566.2 0.0753
 624.2 0.0753

CURVE 3*

457.2 0.0837
 523.2 0.0753
 568.2 0.0732
 593.2 0.0753
 633.2 0.0753

* No graphical presentation

SPECIFICATION TABLE NO. 175 THERMAL CONDUCTIVITY OF THORIUM DICARBIDE ThC_2

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	476	C	1962	443-627			Specimen 20 mm in dia and 15 mm long; measured in vacuum of the order of 10^{-5} mm Hg; density 6.6 g cm^{-3} .

DATA TABLE NO. 175 THERMAL CONDUCTIVITY OF THORIUM DICARBIDE ThC_2 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
443.2	0.241
487.2	0.230
519.2	0.222
546.2	0.213
576.2	0.207
603.2	0.207
627.2	0.205

* No graphical presentation

THERMAL CONDUCTIVITY OF TITANIUM CARBIDE TiC

FIGURE SHOWS ONLY 16 OF THE CURVES REPORTED IN TABLE

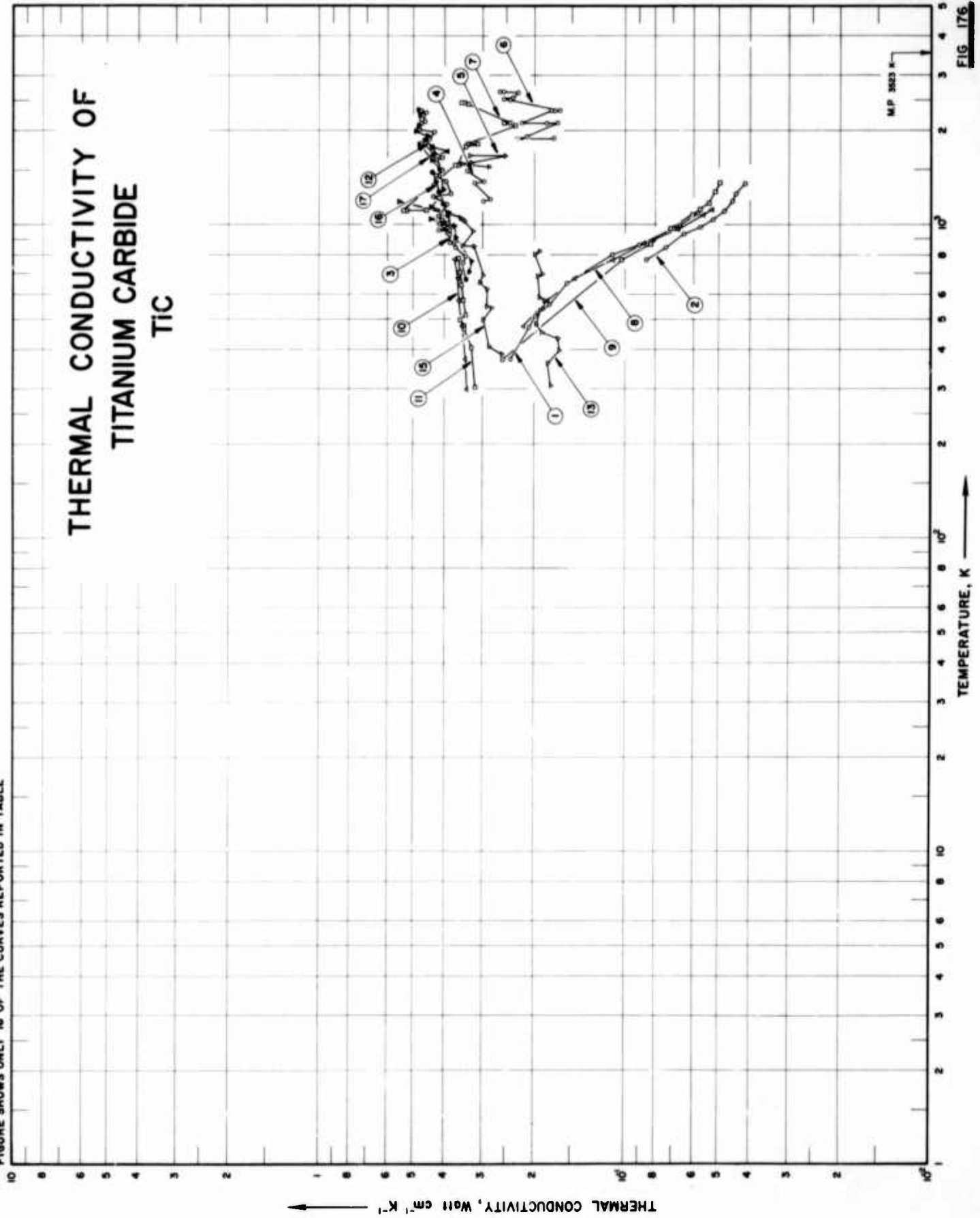


FIG. 176

SPECIFICATION TABLE NO. 176 THERMAL CONDUCTIVITY OF TITANIUM CARBIDE TiC

[For Data Reported in Figure and Table No. 176]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	14	C	1953	373-1093			80.6 Ti, 19.0 C, 0.4 O; 1 in. cubic specimen prepared by hydrostatically pressing and firing to 2000 C; firing shrinkage 15%; total porosity 4.4%; grinding time 100 hrs; dense sintered alumina used as comparative material.
2	14	R	1953	773-1353			80.6 Ti, 19.0 C, 0.4 O; ellipsoidal specimen prepared by casting, hydrostatically pressing and firing to 2000 C; shrinkage in pressing 6%, in firing 5%; grinding time 24 hrs.
3	63	R	1961	758-2313	10.0		<0.3 metallic impurities by chemical analysis; hot-pressed.
4	144	R	1962	1199-1500	5-7	1	Specimen 0.75 in. long, 0.75 in. O.D. and 0.25 in. I.D.; heat soaked at 2050 K; ground and polished to eliminate all the scratches on specimen's surface.
5	144	R	1962	1543-1860	5-7	1	Similar to the above specimen but cracked during measurement.
6	144	R	1962	1892-2668	5-7	2	Similar to the above specimen except heat soaked at 2200 K; and cracked during experiment.
7	144	R	1962	1121-2460	5-7	3	Similar to the above specimen except heat soaked at 2117 K; specimen cracked.
8	170	C	1953	473-1123			Cubic specimen prepared by hydrostatically pressing at 20,000 psi and firing to 2000 C in vacuo; milled with alcohol in steel for 100 hrs; final bulk density 4.63 g cm ⁻³ ; lead used as comparative material.
9	170	R	1953	373-1373			Ellipsoidal specimen prepared by slip casting from water suspension, hydrostatically pressing and firing at 2000 C in vacuo; bulk density 3.9 g cm ⁻³ . No other information reported.
10	270	P	1962	298-773			80.3 ± 0.3 Ti, 19.3 C and <0.2 metallic impurities; single phase; supplied by the Carborundum Co.; density 4.77 g cm ⁻³ ; calculated from flash diffusivity.
11	277	P	1963	303-778			79.2 Ti, 19.5 C and <0.2 metallic impurities; single phase; supplied by Norton Co.; density 4.74 g cm ⁻³ ; calculated from radial diffusivity.
12	277	P	1963	1673-1873			79.6 ± 1.2 Ti, 17.7 C and 1.4 metallic impurities; single phase; MIT cubic specimen; density 4.56 g cm ⁻³ ; calculated from flash diffusivity.
13	277	P	1963	308-823			80.3 ± 0.3 Ti, 19.3 C and <0.2 metallic impurities; single phase; supplied by the Carborundum Co.; density 4.77 g cm ⁻³ ; calculated from radial diffusivity.
14	277	P	1963	1623-1823			79.2 Ti, 20.2 C, 0.02 Fe; specimen in excess of 97% theoretical density; prepared to a tolerance of ± 0.001 in. in the form of a cylinder 1 in. in dia and 1 in. high; fabricated by the Norton Co., supplied by Atomics International; alumina AL-300 as reference standard (thermal conductivity of the standard determined by J. J. Swica, Alfred University).
15	374	C	1965	386-1185	0.5		Specimen 2 in. O.D., 0.5 in. I.D. and 3 in. long.
16	289	R	1961	673-1473			

SPECIFICATION TABLE NO. 176 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
17	413	R	1963	709-2333	± 10	sample 1	80.3 ± 0.3 Ti, 19.3 C, <0.2 metallic impurities; single phase; supplied by Carborundum Co.; specimen 2 in. O.D., 0.5 in. I.D. and 3 in. long; density 4.77 g cm ⁻³ ; electrical resistivity 72.9, 79.3, 83.2, 87.7 and 92.8 μohm cm at 350, 458, 514, 589 and 686 C, respectively.
18	413	R	1963	770-2191	± 10	sample 2	Similar to the above specimen except no electrical resistivity data reported.
19	413	R	1963	760-1075	± 10	sample 3	Similar to the above specimen except electrical resistivity 67.9, 74.2, 77.6, 82.0, 86.6 and 47.4 μohm cm at 350, 458, 514, 589, 686 and 21 C, respectively.
20	414	P	1964	296-771	± 4	Carborundum	80.3 ± 0.3 Ti, 19.3 C, and <0.2 metallic impurities; 0.25 in. dia x 0.10 in. thick; supplied by Carborundum Co.; density 4.77 g cm ⁻³ ; thermal conductivity data calculated from measured thermal diffusivity values (with flash technique) and specific heat data of Naylor, B. F. (J. Am. Ceram. Soc., 68 (3), 370-1, 1946).
21	414	P	1964	311-814	± 4		76.6 ± 1.2 Ti, 17.7 C, and 1.4 metallic impurities; cube specimen obtained from MIT; density 4.56 g cm ⁻³ ; same measuring method as the above specimen.
22	414	P	1964	1655-1800	± 5		79.2 Ti, 20.2 C, and <0.2 metallic impurities; 0.625 in. dia x 1.375 in. long; supplied by Norton; density 4.74 g cm ⁻³ ; same measuring method as the above specimen except thermal diffusivity measured with radial technique.
23	414	P	1964	1620-1871	± 5	Carborundum	80.3 ± 0.3 Ti, 19.3 C, and <0.2 metallic impurities; 0.625 in. dia x 1.375 in. long; supplied by Carborundum Co.; density 4.77 g cm ⁻³ ; same measuring method as the above specimen.

THERMAL CONDUCTIVITY OF TUNGSTEN CARBIDE WC

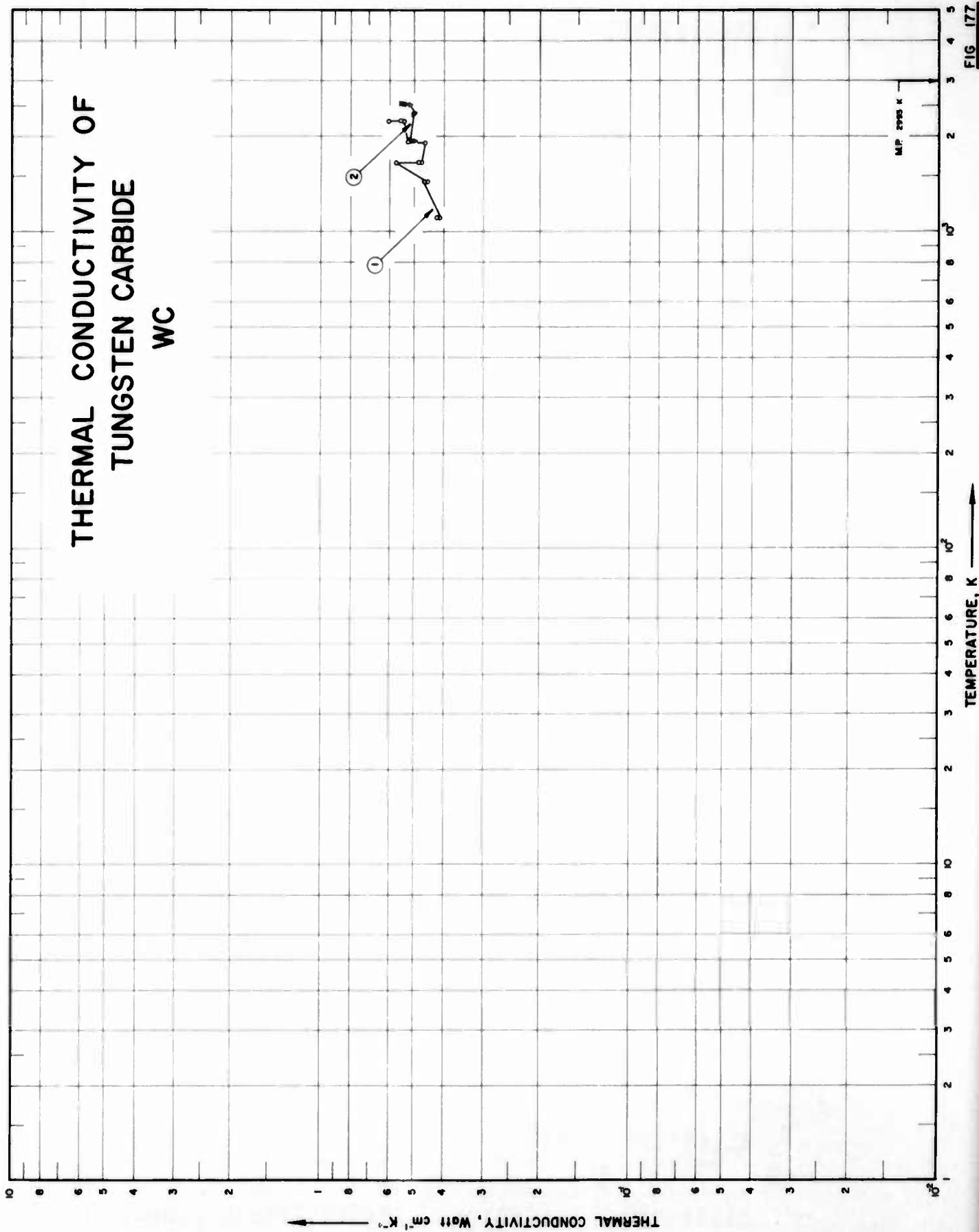


FIG. 177

SPECIFICATION TABLE NO. 177 THERMAL CONDUCTIVITY OF TUNGSTEN CARBIDE WC

[For Data Reported in Figure and Table No. 177]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	144	R	1963	1103-2227	5-7	1	Specimen 0.75 in. long, 0.75 in. O.D. and 0.25 in. I.D.; heat-soaked at 2135 C; ground and polished to eliminate all the scratches on specimen's surface; specimen found cracked on post inspection.
2	144	R	1963	1948-2547	5-7	2	Similar to the above specimen except heat-soaked at 2010-2037 C; specimen found broken on post inspection.

DATA TABLE NO. 177 THERMAL CONDUCTIVITY OF TUNGSTEN CARBIDE WC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1

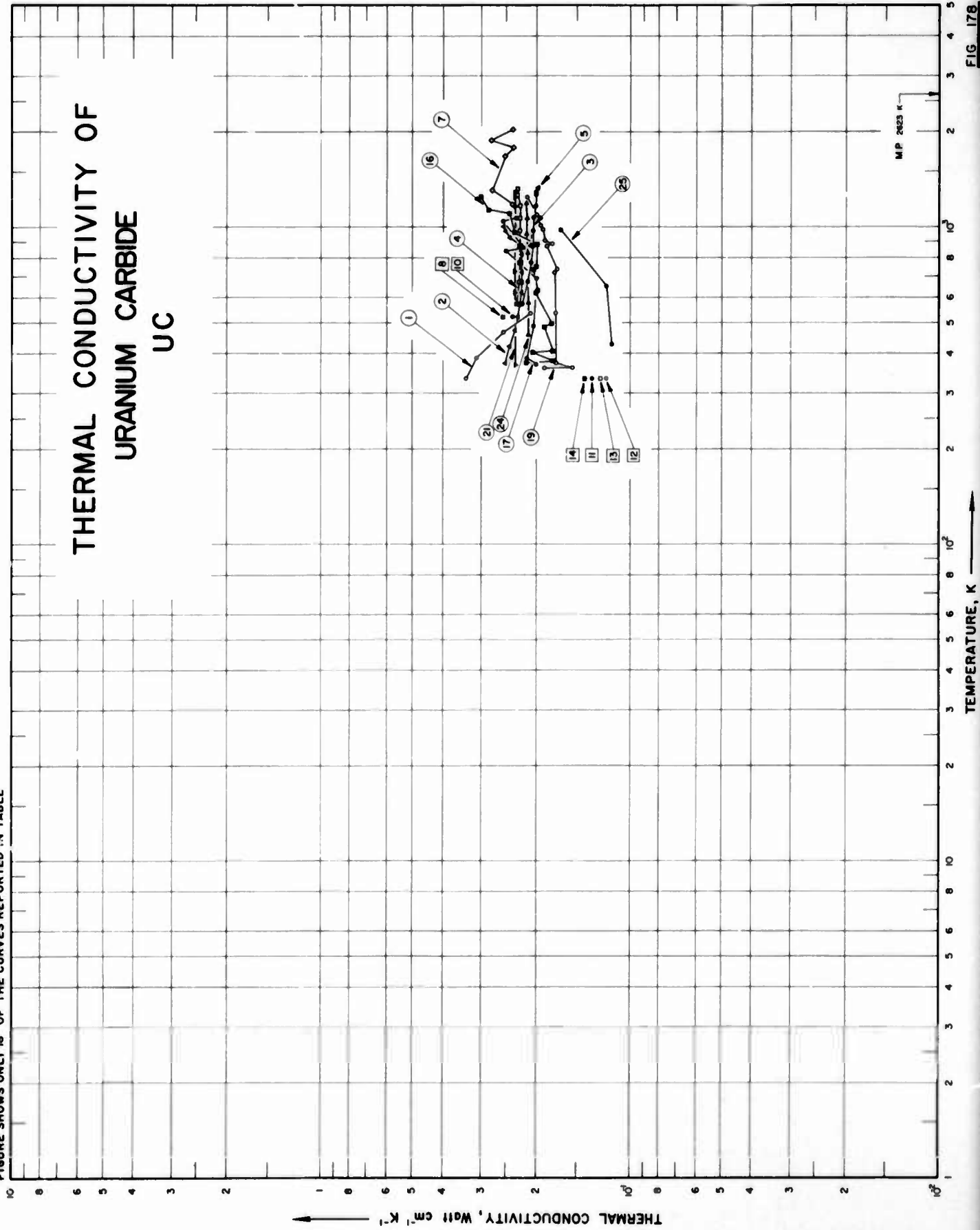
1102.6	0.423
1102.6	0.413
1431.5	0.467
1431.5	0.455
1654.8	0.575
1659.3	0.484
1659.3	0.473
1914.8	0.461
1929.3	0.526
2223.2	0.540
2225.4	0.608
2226.5	0.558

CURVE 2

1947.6	0.497
1948.7	0.510
1953.7	0.518
2337.6	0.504
2375.4	0.498
2376.5	0.497*
2537.1	0.515
2540.4	0.531
2542.1	0.541
2546.5	0.601

* Not shown on Plot

FIGURE SHOWS ONLY 18 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 178 THERMAL CONDUCTIVITY OF URANIUM CARBIDE UC

[For Data Reported in Figure and Table No. 178]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	149	C	1958	333-538	< 6		4.815 ± 0.02 total C (0.054 ± 0.02 free carbon), corresponding to 98 mole% UC, 1 mole %U and 1 mole% C; prepared by sintering UC powder itself; density 10.2 ± 0.02 g cm ⁻³ ; porosity 25%.
2	150	L	1959	373-1008			5.2 total C (0.4 free C); specimen 0.50 in. in dia and 2 in. long; prepared by the drop-casting technique.
3	151	C	1959	473-1293	< 5	specimen 100	5.3 total C (0.5 free C); cast; measured in vacuum of ~2 x 10 ⁻⁵ mm Hg; Armco iron used as comparative material.
4	151	C	1959	473-1323	< 5	specimen 79	4.9 total C (0.1 free C); similar to the above specimen.
5	185		1960	572-1339			4.9 total C (0.1 free C).
6	185		1960	572-1339			5.3 total C (0.5 free C).
7	244	E	1962	1180-2045			100% dense with a composition of 94.7 U, 5.3 total C (determined after measurements) and < 0.02 O; specimen 9 cm long and 0.9 cm in dia; supplied by Battelle Memorial Institute; measured in a vacuum of about 10 ⁻⁴ torr below 1800 K, and with a cover gas of gettered argon at 100 torr introduced to suppress vapor loss of the specimen above 1800 K.
8	477	C	1962	523.2	± 5		4.5 total C; prepared by arc melting discs of uranium metal with chips of nuclear grade graphite on a copper hearth under argon at 30 mm Hg pressure, then by drop casting.
9	477	C	1962	523.2	± 5		4.8 total C (stoichiometric); similar to the above specimen in preparation.
10	477	C	1962	523.2	± 5		5.1 total C (0.3 free C); similar to the above specimen in preparation.
11	478	C	1958	333.2	± 10	1	Specimen 0.50 in. in dia and 0.50 in. long; prepared at Culbeth by cold compacting of elements and reacting at 1100 C; density 10.3 g cm ⁻³ .
12	478	C	1958	333.2	± 10	2	Similar to the above specimen except density 10.14 g cm ⁻³ .
13	478	C	1958	333.2	± 10	3	Similar to the above specimen except density 10.03 g cm ⁻³ .
14	478	C	1958	333.2	± 15	4	Specimen greater than 0.50 in. in dia and 0.50 in. long; prepared by hot-pressing at A. E. R. E.; density 10.52 g cm ⁻³ .
15	478	C	1958	333.2	± 15	5	Similar to the above specimen except density 11.07 g cm ⁻³ .
16	480	C	1964	374-1253	< ± 5		4.4 analyzed carbon; specimen 0.50 in. in dia and 0.75 in. long; cast; density 13.92 g cm ⁻³ (99.8% of theoretical value); stainless steel 347 used as comparative material.
17	480	C	1964	368-1257	< ± 5		4.35 analyzed carbon; specimen 0.50 in. in dia and 0.75 in. long; sintered; density 13.72 g cm ⁻³ (98.1% of theoretical value); stainless steel 347 used as comparative material.

SPECIFICATION TABLE NO. 178 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
18	480	C	1964	379-1259	< ± 5		4.75 analyzed carbon; specimen 0.50 in. in dia and 0.75 in. long; cast; density 13.65 g cm ⁻³ (99.8% of theoretical value); stainless steel 347 used as comparative material.
19	480	C	1964	358-1249	< ± 5		4.62 analyzed carbon; specimen 0.50 in. in dia and 0.75 in. long; sintered; density 12.28 g cm ⁻³ (90.1% of theoretical value); stainless steel 347 used as comparative material.
20	480	C	1964	383-1260	< ± 5		5.23 analyzed carbon; specimen 0.50 in. in dia and 0.75 in. long; cast; density 13.35 g cm ⁻³ (99.0% of theoretical value); stainless steel 347 used as comparative material.
21	481	P	1963	367-1284			4.58 C; polycrystalline disc specimen 0.25 in. in dia and 0.10 in. thick; thermal conductivity data obtained from the smooth curve calculated the measurement of thermal diffusivity, specific heat and density.
22	481	P	1963	362-1286			4.33 C; similar to the above specimen.
23	481	P	1963	369-1185			4.24 C; similar to the above specimen.
24	481	P	1963	458-1184			4.04 C; similar to the above specimen.
25	482, 483		1960	429-978			Prepared from UO ₂ and C by heating the mixture in a beryllium oxide crucible in a vacuum furnace with a graphite heater, then sintered; data corrected to zero porosity.

DATA TABLE NO. 178 THERMAL CONDUCTIVITY OF URANIUM CARBIDE UC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>									
333.2	0.335	1073.2	0.226	1223.2	0.280*	383.2	0.235	369.2	0.206
388.2	0.310	1173.2	0.226	1257.2	0.239*	391.2	0.245	475.2	0.209
468.2	0.255	1273.2	0.230			416.2	0.244	583.2	0.210
538.2	0.209	1323.2	0.230			417.2	0.236	708.2	0.213
<u>CURVE 2</u>									
373.2	0.251	572.1	0.220*	379.2	0.200	514.2	0.214	781.2	0.215
473.2	0.243	872.1	0.208	384.2	0.187	521.2	0.217	872.2	0.216
473.2	0.234	1338.7	0.199	435.2	0.203	642.2	0.208	981.2	0.218
523.2	0.230			440.2	0.186	651.2	0.215	1071.2	0.220
573.2	0.226			448.2	0.184	764.2	0.225	1133.2	0.221
623.2	0.222			457.2	0.181	777.2	0.218	1185.2	0.223
673.2	0.222			457.2	0.183	841.2	0.220		
723.2	0.222			590.2	0.183	861.2	0.225	<u>CURVE 24</u>	
773.2	0.226			602.2	0.183	861.2	0.225	458.2	0.212
823.2	0.230			694.2	0.188	979.2	0.235	579.2	0.212
873.2	0.238			708.2	0.176	1001.2	0.236	708.2	0.213*
923.2	0.243			788.2	0.200	1093.2	0.245	830.2	0.214
1008.2	0.255			868.2	0.200	1117.2	0.249	830.2	0.215
<u>CURVE 3*</u>									
473.2	0.234*	1180	0.239	937.2	0.214	1280.2	0.277	1070.2	0.215
573.2	0.222	1310	0.276	1012.2	0.233			1184.2	0.216
673.2	0.213	1675	0.251	1099.2	0.241				
773.2	0.209	1760	0.236	1127.2	0.245				
873.2	0.205	1870	0.278	1233.2	0.267				
973.2	0.205	2045	0.237	1259.2	0.276				
1073.2	0.205								
1173.2	0.201								
1273.2	0.201								
1293.2	0.201								
<u>CURVE 4</u>									
473.2	0.234*	523.2	0.255	358.2	0.180	367.2	0.233	429.2	0.116
573.2	0.230	523.2	0.238	361.2	0.155	469.2	0.233*	653.2	0.121
673.2	0.226			368.2	0.200*	622.2	0.233	978.2	0.169
773.2	0.226			372.2	0.175	725.2	0.233		
873.2	0.226			537.2	0.175	950.2	0.233*		
973.2	0.226			548.2	0.174*	976.2	0.233*		
1073.2	0.226			548.2	0.175	1072.2	0.233*		
1173.2	0.226			718.2	0.177	1170.2	0.233		
1273.2	0.226			736.2	0.174	1249.2	0.233		
1293.2	0.226			736.2	0.174	1284.2	0.233		
<u>CURVE 5</u>									
473.2	0.234*	523.2	0.238	368.2	0.200				
573.2	0.230			372.2	0.211*				
673.2	0.226			386.2	0.215				
773.2	0.226			391.2	0.212*				
873.2	0.226			488.2	0.204				
973.2	0.226			495.2	0.209*				
1073.2	0.226			495.2	0.215*				
1173.2	0.226			677.2	0.200				
1273.2	0.226			689.2	0.200				
1293.2	0.226			843.2	0.251				
<u>CURVE 6*</u>									
473.2	0.234*	523.2	0.121	1048.2	0.257				
573.2	0.230			1073.2	0.232				
673.2	0.226								
773.2	0.226								
873.2	0.226								
973.2	0.226								
1073.2	0.226								
1173.2	0.226								
1273.2	0.226								
1293.2	0.226								

* Not shown on plot

SPECIFICATION TABLE NO. 179 THERMAL CONDUCTIVITY OF URANIUM DICARBIDE UC₂

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	159	C	1955	323.2	25		Glycerine coated. 8.7 C, 1 Ni and 0.3 O; fairly crystallized with a trace phase of UC present (the last treatment before analysis ended with a rapid cooling from 2150 K); specimen 4.13 cm long and 0.623 cm in dia, with nickel at the cold ends in the grain boundaries while none was observed at the center; hot-pressed in graphite for 15 min at about 1700 C and 6000 psi; a gross measurement of density immediately following fabrication showed 95% of theoretical density; lattice parameter were $a_0 = 3.515 \pm 0.002$ a. u. and $C_0 = 5.976 \pm 0.0002$ a. u.; the specimen was cleaned and polished in a gettered-argon glove box.
2	244	E	1962	1570-2025	20		

DATA TABLE NO. 179 THERMAL CONDUCTIVITY OF URANIUM DICARBIDE UC₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
323.2	0.335
<u>CURVE 2*</u>	
1570	0.105
1600	0.126
1710	0.126
1770	0.126
1780	0.134
1850	0.151
1940	0.155
1955	0.184
2025	0.157

* No graphical presentation

THERMAL CONDUCTIVITY OF
VANADIUM CARBIDE
VC

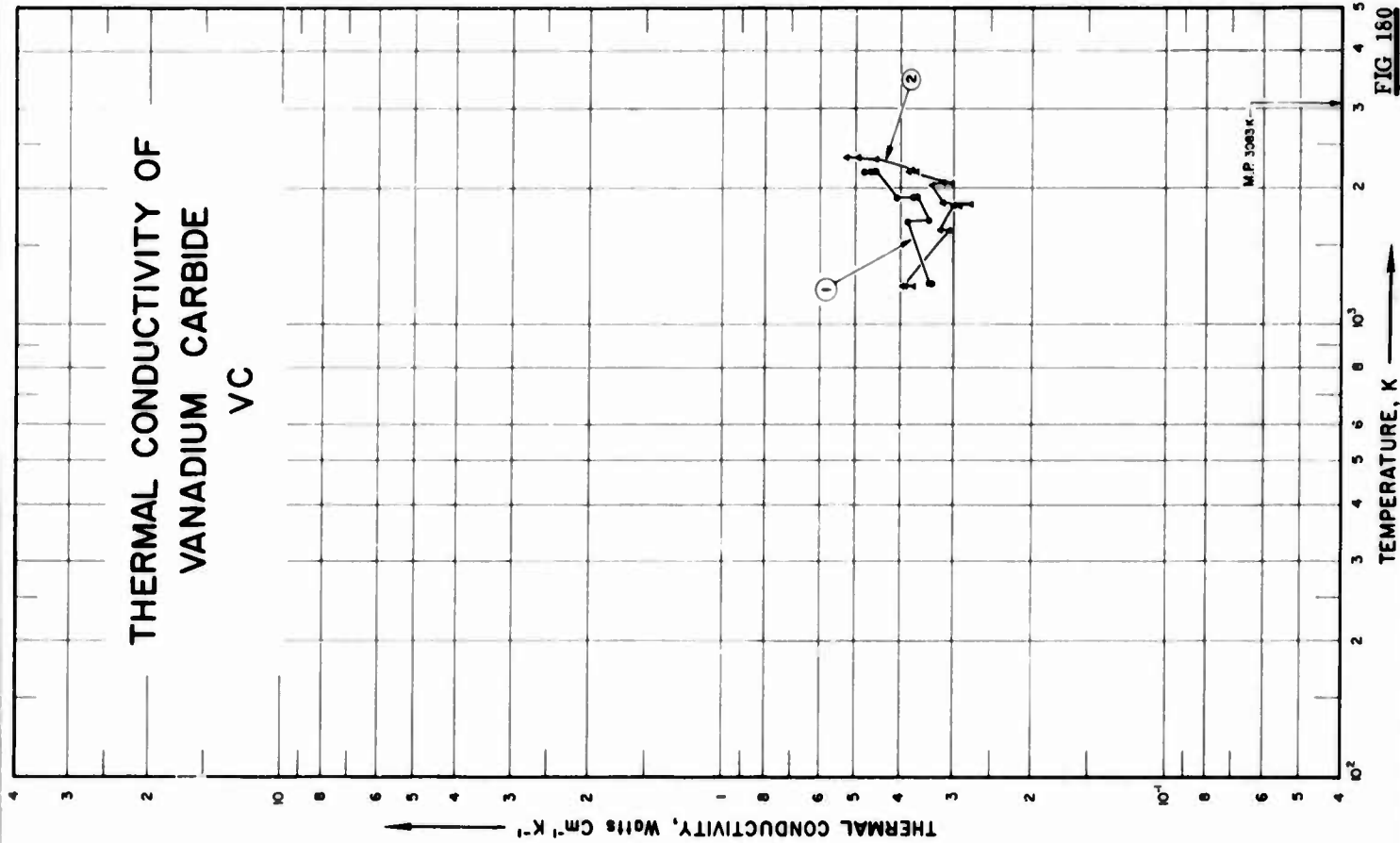


FIG 180

SPECIFICATION TABLE NO. 180 THERMAL CONDUCTIVITY OF VANADIUM CARBIDE VC

[For Data Reported in Figure and Table No. 180]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	144	R	1963	1242-2189	5-7	1	Ground and polished to eliminate completely the scratches on the surface of the specimens and then heat-soaked at 2024 C; specimen 0.75 in. long, 0.75 in. O.D., and 0.25 in. I.D.; specimen found cracked on post inspection. Same as the above specimen except heat-soaked at 1913 C.
2	144	R	1963	1230-2342	5-7	2	

DATA TABLE NO. 180 THERMAL CONDUCTIVITY OF VANADIUM CARBIDE VC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

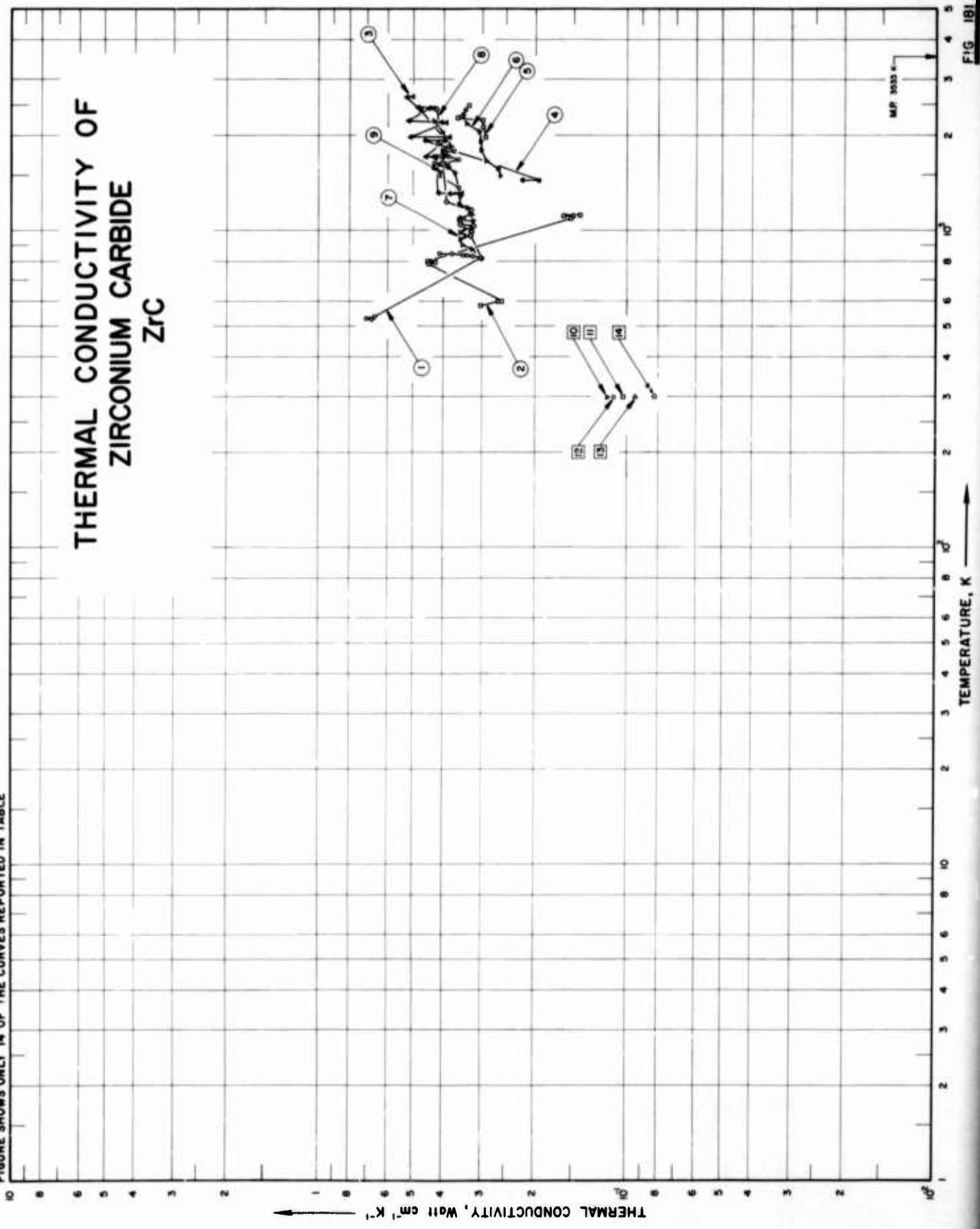
T	k
<u>CURVE 1</u>	
1241.5	0.343
1241.5	0.336
1694.3	0.387
1694.3	0.388*
1694.3	0.343
1905.4	0.365
1908.2	0.374
1913.7	0.410
2188.7	0.457
2188.7	0.482
2188.7	0.466
<u>CURVE 2</u>	
1229.8	0.390
1229.8	0.398
1229.8	0.372
1229.8	0.391*
1620.4	0.307
1620.4	0.321
1621.5	0.321*
1844.3	0.301
1848.7	0.293
1852.1	0.278
1853.2	0.319
2047.1	0.335
2051.5	0.303
2065.9	0.316
2065.9	0.313*
2174.3	0.383
2175.9	0.367
2184.3	0.376
2333.2	0.454
2334.3	0.459*
2340.4	0.497
2341.5	0.528

* Not shown on plot

FIG. 181

THERMAL CONDUCTIVITY OF ZIRCONIUM CARBIDE ZrC

FIGURE SHOWS ONLY 14 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 181 THERMAL CONDUCTIVITY OF ZIRCONIUM CARBIDE ZrC

[For Data Reported in Figure and Table No. 181]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	243	R	1962	528-847	2-4		Specimen 0.75 in. in dia, 0.75 in. O.D. and 0.25 in. I.D.; supplied by General Electric Co.; pressed and sintered; density 5.94 g cm ⁻³ ; SRI run No. C-68.	
2	243	R	1962	581-1111	2-4		Similar to the above specimen; SRI run No. C-75.	
3	243	R	1962	1308-2650	2-4		Similar to the above specimen; SRI run No. C-84.	
4	243	R	1962	1450-2425	2-4		Similar to the above specimen but heat-soaked 2755 K before test; specimen deteriorated at above 2866 K; SRI run No. C-94.	
5	244	E	1962	1965-2470			11.7 C (including 0.18 free carbon), and <0.002 O ₂ ; specimen 0.607 cm in dia and ~4 cm long; supplied by Wah Chang Co.; hot-pressed from 325 mesh high purity powder in graphite dies at 2300 C for 1 hr at 6000 psi pressure; lattice parameter A ₀ 4.699 ± 0.002 Å; polished; annealed to 2400 K for 1 hr 90% theoretical density after fabrication and property measurements.	
6	244	E	1962	1490-2400			Similar to the above specimen except 11.8 C (including 0.3 free carbon).	
7	245, 413, 479, 484	R	1962	813-2208		2	89.8 Zr, 11.0 C and <0.2 metallic impurities; as received; single phase; specimen 2.0 in. O.D., 0.5 in. I.D. and 3.0 in. long; supplied by Carborundum Co.; average grain size 50 μ; hot-pressed; density 6.13 g cm ⁻³ .	
8	245, 413, 479, 484	R	1962	813-2423		3	87.8 Zr, 12.1 C and <0.6 metallic impurities; similar to the above specimen except density 6.17 g cm ⁻³ .	
9	245, 413, 479, 484	R	1962	1368-2338		4	89.8 Zr, 11.0 C and <0.2 metallic impurities; similar to the above specimen except density 6.18 g cm ⁻³ .	
10	6	L	1965	298.2	± 6		89.394 Zr, 10.606 C; specimen prepared by pressing and sintering of powder mixtures close to stoichiometric composition of carbide and appropriate metal; sintering was carried out in a TVV-4 vacuum furnace at 10 ⁻⁴ to 10 ⁻⁵ mm pressure at 2200 to 2400 C; electrical resistivity 100.0 × 10 ⁻⁴ ohm cm at room temp.	
11	6	L	1965	298.2	± 6		90.275 Zr, 9.725 C; similar to the above specimen except electrical resistivity 123.6 × 10 ⁻⁴ ohm cm at room temp.	
12	6	L	1965	298.2	± 6		90.965 Zr, 9.035 C; similar to the above specimen except electrical resistivity 130.2 × 10 ⁻⁴ ohm cm at room temp.	
13	6	L	1965	298.2	± 6		91.361 Zr, 8.639 C; similar to the above specimen except electrical resistivity 130.0 × 10 ⁻⁴ ohm cm at room temp.	
14	6	L	1965	298.2	± 6		92.356 Zr, 7.644 C; similar to the above specimen except electrical resistivity 166.2 × 10 ⁻⁴ ohm cm at room temp.	
15	414	P	1964	1573-1873	± 5		Specimen 0.625 in. dia x 1.375 in. long; thermal conductivity data calculated from measured thermal diffusivity values (with radial diffusivity apparatus) and specific heat value of 0.125 cal g ⁻¹ C ⁻¹ .	

DATA TABLE NO. 181 THERMAL CONDUCTIVITY OF ZIRCONIUM CARBIDE ZrC

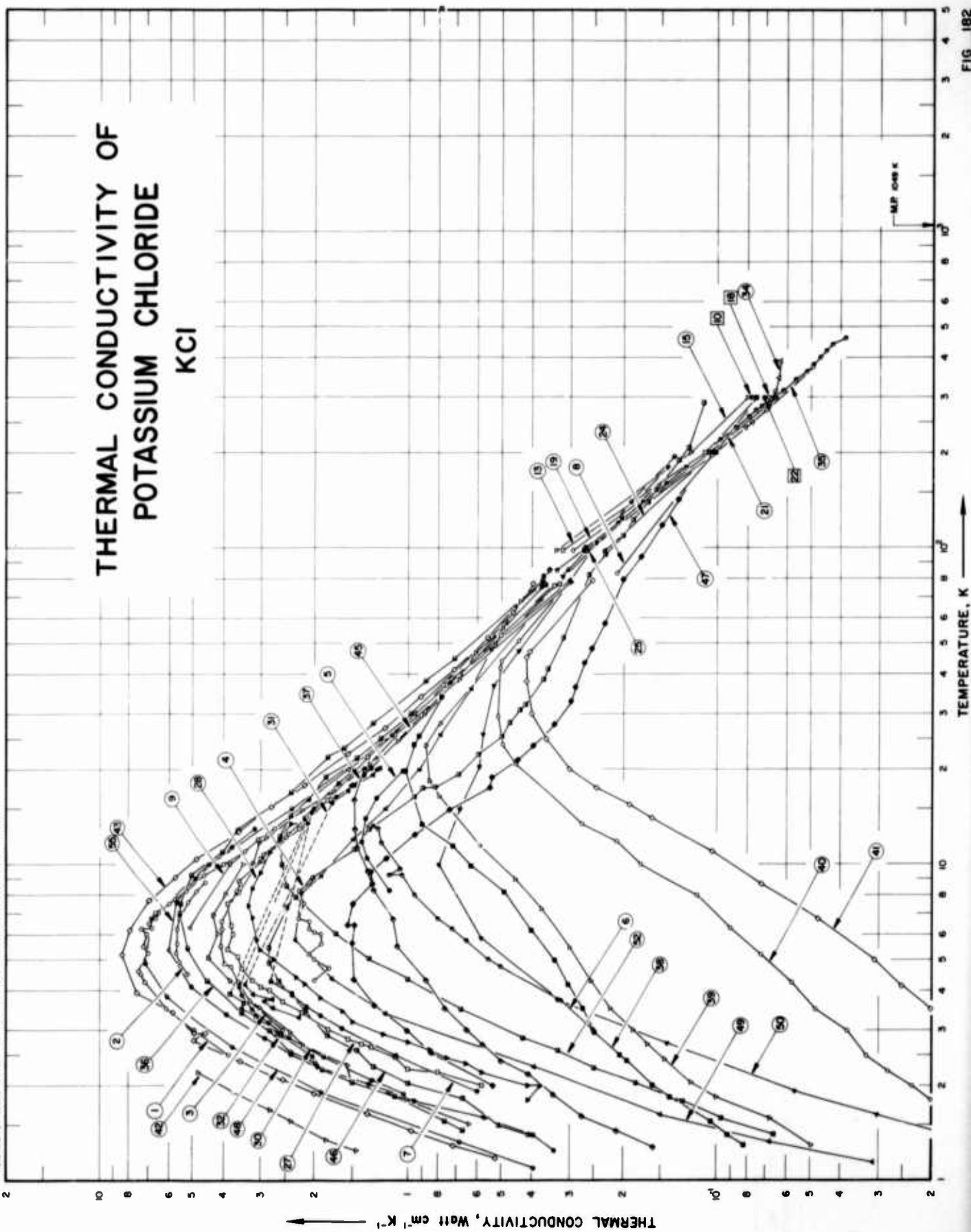
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹·K⁻¹]

T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 3 (cont.)</u>		<u>CURVE 7 (cont.)</u>		<u>CURVE 9 (cont.)</u>			
528.2	0.678	2444.3	0.485	1008.2	0.341	1883.2	0.420		
530.4	0.707	2647.1	0.525	1008.2	0.326	1923.2	0.408*		
531.5	0.714*	2649.8	0.502	1073.2	0.320	1973.2	0.389*		
535.4	0.663	<u>CURVE 4</u>		1083.2	0.356	2088.2	0.420*		
818.2	0.303	1449.8	0.221	1098.2	0.351	2338.2	0.439*		
829.3	0.304*	1449.8	0.196	1118.2	0.324	<u>CURVE 10</u>			
830.4	0.323	1449.8	0.196	1138.2	0.320*	298.2	0.116		
833.2	0.335	1933.2	0.460	1183.2	0.335	<u>CURVE 11</u>			
833.7	0.346	1938.7	0.398	1209.2	0.356	298.2	0.110		
845.4	0.376	2408.2	0.479	1293.2	0.351	<u>CURVE 12</u>			
846.5	0.412	2408.2	0.472*	1523.2	0.368	298.2	0.103		
<u>CURVE 2</u>		2424.8	0.430*	1583.1	0.385	<u>CURVE 13</u>			
580.9	0.303	2424.8	0.434*	1613.2	0.418	298.2	0.094		
595.9	0.265	<u>CURVE 5</u>		1728.2	0.395	<u>CURVE 14</u>			
597.1	0.258	1965	0.293	1793.2	0.402	298.2	0.082		
785.4	0.446	2120	0.443*	1843.2	0.377	<u>CURVE 15</u>			
793.2	0.427	2225	0.299	2053.2	0.404	1573	0.385		
793.2	0.450	2265	0.360	2208.2	0.431	1673	0.406		
1097.1	0.153	2470	0.331	<u>CURVE 8</u>		1773	0.423		
1101.5	0.151	1490	0.262	813.2	0.301	1873	0.439		
1105.4	0.162	1560	0.266	963.2	0.326	<u>CURVE 9</u>			
1107.1	0.143	1795	0.293	993.2	0.326	1368.2	0.358		
1108.2	0.150*	1905	0.303	1038.2	0.320	1493.2	0.416		
1110.9	0.163*	1905	0.305	1048.2	0.351	1608.2	0.389		
<u>CURVE 3</u>		2055	0.308	1053.2	0.347*	1633.2	0.427		
1308.2	0.384	2170	0.338	1063.2	0.326*	1673.2	0.356		
1308.2	0.349	2310	0.346	1238.2	0.393	1703.2	0.385		
1313.7	0.418	2400	0.341	2423.2	0.423	1708.2	0.408		
1702.6	0.425	<u>CURVE 6</u>		<u>CURVE 9</u>		1773.2	0.397		
1702.6	0.430	1490	0.262	1368.2	0.358	1838.2	0.370		
1705.4	0.459	1560	0.266	1493.2	0.416	<u>CURVE 7</u>			
1705.4	0.450*	1655	0.293	1608.2	0.389	1493.2	0.358		
1972.1	0.381	1795	0.303	1633.2	0.427	1493.2	0.358		
1983.2	0.513	1905	0.305	1673.2	0.356	1608.2	0.389		
2191.5	0.392	2055	0.308	1703.2	0.385	1633.2	0.427		
2199.8	0.404	2170	0.338	1703.2	0.385	1673.2	0.356		
2211.0	0.519	2310	0.346	1733.2	0.397	1703.2	0.385		
2436.0	0.447	2400	0.341	1783.2	0.370	1773.2	0.397		
2436.0	0.436	2400	0.341	1838.2	0.387	1838.2	0.387		

* Not shown on plot

THERMAL CONDUCTIVITY OF POTASSIUM CHLORIDE KCl

FIGURE SHOWS ONLY 41 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 182 THERMAL CONDUCTIVITY OF POTASSIUM CHLORIDE

[For Data Reported in Figure and Table No. 182]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, °C	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	46	L	1957	2.5-13	± 10	A	Single crystal; supplied by Harshaw Chemical Co.; 40 cm x 0.45 cm ² ; annealed in air at 700 C for 0.5 hr, cooled to room temperature at a rate of 30 C hr ⁻¹ .
2	46	L	1957	4.5-8.8	± 10	K	Cut from the same crystal as the above specimen; 4.0 cm x 0.44 cm ² ; remelted and grown in a graphite crucible by using a modified Kyropoulos technique at a growth rate of 1.4 cm hr ⁻¹ , cleaved and ground, annealed in air at 700 C for 0.5 hr, cooled to room temperature at a rate of 30 C hr ⁻¹ .
3	46	L	1957	3.0-14	± 10	N	Cut from the same crystal as the above specimen; 4.0 cm x 0.41 cm ² ; same fabrication method as above except calcium chloride added to the melt during growth (concentrations G = 0.6 x 10 ⁻⁴).
4	46	L	1957	4.3-8.9	± 10	Q	Cut from the same crystal as the above specimen; 4.0 cm x 0.43 cm ² ; same fabrication method as above; calcium chloride concentrations G = 1.1 x 10 ⁻⁴ .
5	46	L	1957	8.3-20	± 10	R	Cut from the same crystal as the above specimen; 4.0 cm x 0.43 cm ² ; same fabrication method as above; G = 1.3 x 10 ⁻⁴ .
6	46	L	1957	3.0-13	± 10	S	Cut from the same crystal as the above specimen; 4.0 cm x 0.42 cm ² ; same fabrication method as above; G = 2.1 x 10 ⁻⁴ .
7	32	L	1937	1.9-82			Red specimen with square cross section of length 3.97 cm and thickness 0.252 cm.
8	22	L	1911	83-373			3.00 cm cubic specimen.
9	28	L	1956	6.3-79			< 0.01 Al, < 0.01 Mg, and small concentrations of Fe, Mn, Si, and Na; dielectric crystal supplied by Harshaw Chemical Co.; 5 x 0.5 x 0.5 cm.
10	230	L	1952	298.2		1	Colorless crystal; 20 x 10 x 10 mm; annealed.
11	230	L	1952	298.2		2	Similar to the above specimen.
12	230	L	1952	298.2		3	Similar to the above specimen.
13	230	L	1952	98-298		4	Similar to the above specimen.
14	230	L	1952	298.2		5	Similar to the above specimen.
15	230	L	1952	98-298		8	Similar to the above specimen.
16	230	L	1952	298.2		13	Similar to the above specimen.
17	230	L	1952	298.2		15	Similar to the above specimen.
18	230	L	1952	298.2		10	Similar to the above specimen.
19	230	L	1952	98-298		5	Specimen 5 quenched at 700-710 C; concentration of colored centers n = 0.
20	230	L	1952	298.2		15	Specimen 15 quenched at 700-710 C; n = 0.
21	230	L	1952	98-298		3	Specimen 3 quenched at 700-710 C; n = 0.58 x 10 ¹⁸ cm ⁻³ .
22	230	L	1952	298.2		6	Similar to the above specimen except n = 1.2 x 10 ¹⁸ cm ⁻³ .

SPECIFICATION TABLE NO. 182 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
23	230	L	1952	298.2		14	Similar to the above specimen except $n = 1.7 \times 10^{18} \text{ cm}^{-3}$.
24	230	L	1952	98-298		2	Specimen 2 quenched at 700-710 C; $n = 1.9 \times 10^{18} \text{ cm}^{-3}$.
25	230	L	1952	98-298		9	Similar to the above specimen except $n = 4.8 \times 10^{18} \text{ cm}^{-3}$.
26	230	L	1952	298.2		10	Specimen 10 quenched at 700-710 C; $n = 0.46 \times 10^{18} \text{ cm}^{-3}$.
27	62	L	1960	2.0-77			Single crystal; supplied by Harshaw Chemical Co.; $4.0 \times 4.5 \times 4.0 \text{ mm}$; cleaved and annealed.
28	62	L	1960	1.8-78			The above specimen after the additive coloration n (concentration of colored centers) = $8 \times 10^{17} \text{ cm}^{-3}$.
29	225	L	1938	2.3-20			Pure crystalline; $3 \text{ cm} \times 0.0626 \text{ cm}^2$.
30	231	L	1938	1.9-20		II	Very pure crystalline square rod specimen of length 3.81 cm and thickness 0.511 cm.
31	231	L	1938	3.3-20		IIA	Cut from the same sample as the above specimen; square rod of length 4.01 cm and thickness 0.385 cm.
32	231	L	1938	2.5-19		III	Cut from the same sample as the above specimen; square rod of length 2.98 cm and thickness 0.763 cm.
33	164	L	1956	5.2-15.0			Optical grade crystal obtained from Harshaw Chemical Co.
34	214	C	1960	240-390			Crystal; supplied by Harshaw Chemical Co.; 1 cm dia \times 0.5 cm thick; Z-cut quartz crystal used as comparative material.
35	452, 453	L	1962	85-460	± 3		Single crystal; specimen $8 \times 8 \times 20 \text{ mm}$; grown from the melt by Kyropoulos method; initial material of chemically pure grade; sample cut from a single crystal ingot, annealed in air at 873 K for 6-8 hrs and slowly cooled to room temperature.
36	454	L	1962	1.45-79.0		A	Pure single crystal.
37	454	L	1962	1.27-85.0		B	Single crystal; KNO_3 concentration $9 \times 10^{16} \text{ cm}^{-3}$.
38	454	L	1962	1.29-34.0		C	Single crystal; KNO_3 concentration $4 \times 10^{17} \text{ cm}^{-3}$.
39	454	L	1952	1.29-79.0		D	Single crystal. KNO_3 concentration $5 \times 10^{17} \text{ cm}^{-3}$.
40	454	L	1962	1.48-77.0		E	Single crystal, KNO_3 concentration $1.6 \times 10^{18} \text{ cm}^{-3}$.
41	454	L	1962	1.39-79.0		F	Single crystal, KNO_3 concentration $4 \times 10^{18} \text{ cm}^{-3}$.
42	455		1967	1.3-2.2		L	High purity crystalline; specimen cross section $12.7 \times 13.0 \text{ mm}^2$; zone-refined and seed-pulled.
43	455		1967	1.2-77		2G3	Cut from the above specimen; cross section $6.78 \times 5.63 \text{ mm}^2$.
44	440		1964	1.6-46		A	Pure.
45	440		1964	1.5-87		B	Specimen doped with KI with I^- concentration 1.0×10^{18} molecules cm^{-3} .
46	440		1964	1.4-288		C	Specimen doped with KI, with I^- concentration 1.25×10^{19} molecules cm^{-3} .

SPECIFICATION TABLE NO. 182 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
47	440		1964	2.0-203		D	Specimen doped with KI, with I ⁻ concentration 5×10^{19} molecules cm ⁻³ .
48	440		1964	0.32-195		A	Pure.
49	440		1964	1.1-125		B	Specimen doped with 0.25% in melt of LiCl.
50	440		1964	0.31-181		C	Specimen doped with 1.0% in melt of LiCl.
51	456		1965	1.8-194			Rectangular specimen 5 x 5 x 40 mm; grown at Cornell by Kyropoulos technique using high purity argon gas as protective atmosphere, high purity graphite crucible was used; prepared by cleavage then annealed at 650 C for 12 hrs in an atmosphere of distilled chlorine and slowly cooled to remove mechanical strains.
52	456		1965	1.4-77			Similar to the above specimen except compressed 3% in length; dislocation density 2.0×10^7 dislocations cm ⁻² .
53	456		1965	1.4-129			Recovery thermal conductivity data of the above specimen.
54	456		1965	1.3-78			The above specimen annealed at 400 C for 15 min.
55	456		1965	1.3-13			The above specimen annealed at 650 K for 15 min.

SPECIFICATION TABLE NO. 183 THERMAL CONDUCTIVITY OF SILVER CHLORIDE AgCl

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	214	C	1960	221-373			Crystalline; specimen 2 cm in dia and 0.5 cm thick; drawn from a melt (initially chemically pure silver chloride powder).

DATA TABLE NO. 183 THERMAL CONDUCTIVITY OF SILVER CHLORIDE AgCl

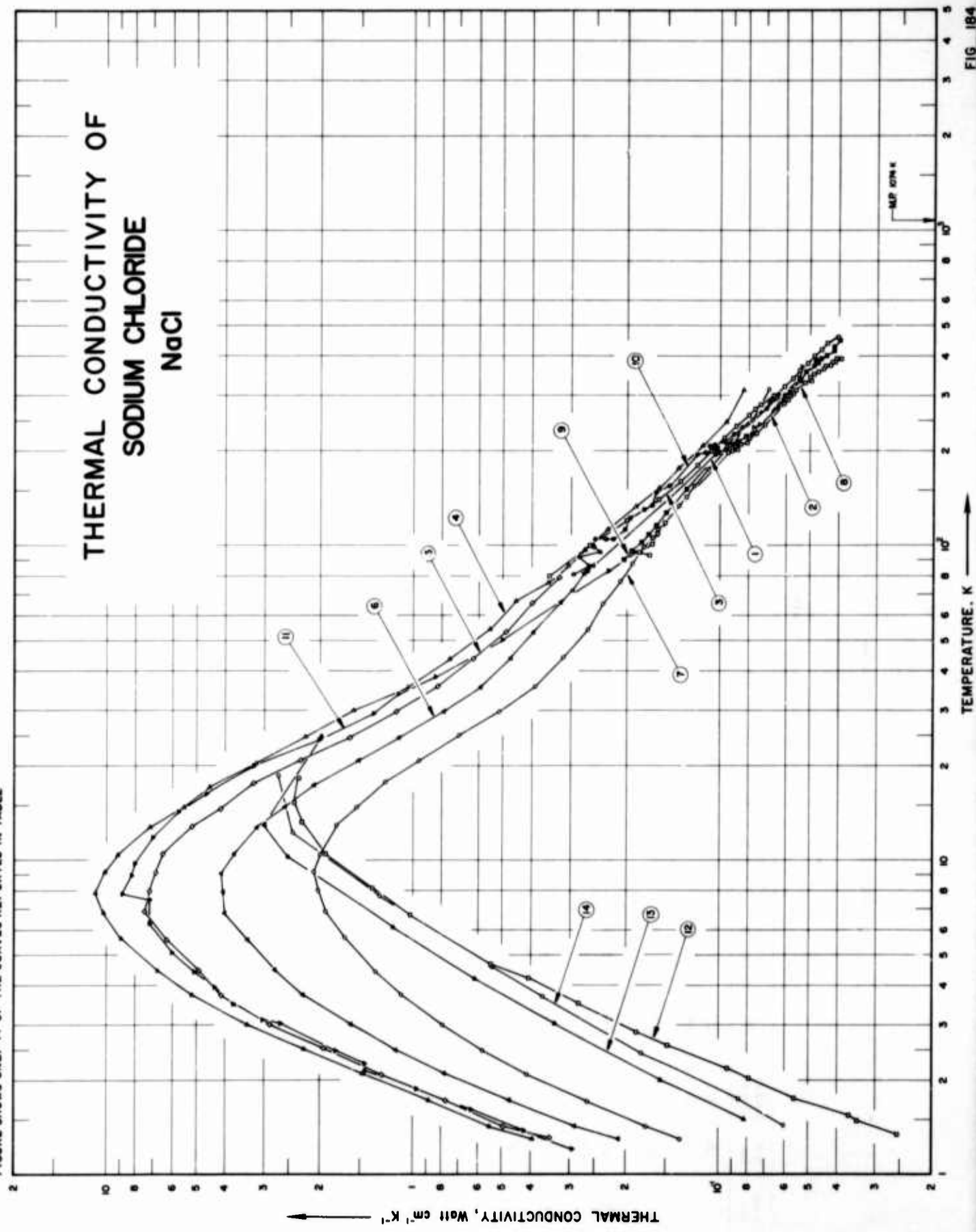
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u> *	
221.3	0.0130
225.0	0.0126
269.8	0.0119
295.0	0.0115
313.0	0.0110
325.0	0.0109
360.4	0.0107
372.5	0.0105

* No graphical presentation

THERMAL CONDUCTIVITY OF SODIUM CHLORIDE NaCl

FIGURE SHOWS ONLY 14 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 184 THERMAL CONDUCTIVITY OF SODIUM CHLORIDE NaCl

[For Data Reported in Figure and Table No. 184]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	22	L	1911	83-373		Rock salt	Crystalline.
2	214	C	1960	237-370			Crystalline; specimen 1 cm in radius and 0.5 cm in thickness, supplied by Harshaw Chemical Company.
3	453	L	1962	80-460	±3		Single crystal grown from the melt by Kyropoulos method; initial material, of chemically pure grade; specimen 5 x 8 x 20 mm cut from a single crystal ingot annealed in air at 873 K for 6-8 hrs and slowly cooled to room temperature.
4	496	L	1966	1.3-313	7-8		Pure; treated by bubbling chlorine through the melt.
5	496	L	1966	1.3-79	7-8		0.000077 NaI; prepared from pure NaCl by bubbling chlorine through the melt, then doped with appropriate amount of NaI.
6	496	L	1966	1.3-87	7-8		0.0049 NaI; prepared from pure NaCl by bubbling chlorine through the melt, then doped with appropriate amount of NaI.
7	496	L	1966	1.3-314	7-8		0.019 NaI; prepared from pure NaCl by bubbling chlorine through the melt, then doped with appropriate amount of NaI.
8	497, 498	C	1962	93-393	±3±5		0.4 mole% Ca; single crystal; grown from the melt by the Kyropoulos method using chemically pure materials; pure single crystals of NaCl or KCl used as comparative material.
9	497, 498	C	1962	90-449	±3±5		Similar to the above specimen except with 0.18 mole% Ca.
10	497, 498	C	1962	81-470	±3±5		Similar to the above specimen except the material was pure.
11	456		1965	1.2-95			Rectangular specimen 5 x 5 x 40 mm; prepared by cleavage; grown at Cornell by Kyropoulos technique using high-purity argon gas as protective atmosphere, sintered alumina crucible was used; specimen was cut from a larger rectangular bar compressed along a [100] direction perpendicular to heat flow; annealed at 650 C for 12 hrs in distilled chlorine atmosphere and slowly cooled.
12	456		1965	1.3-18			Similar to the above specimen except plastically deformed 4% in length; dislocation density 2.5×10^7 dislocations cm^{-2} .
13	456		1965	1.5-25			The above specimen annealed at 355 C for 15 min.
14	456		1965	1.4-19			The above specimen annealed at 400 C for 15 min.
15	456		1965	1.3-16			The above specimen annealed at 450 C for 15 min.

DATA TABLE NO. 184 (continued)

T	k	T	k
<u>CURVE 11 (cont.)</u>			
7.46	7.16	1.43	0.0604
7.82	8.31	1.74	0.0855
8.95	8.19	2.43	0.178
9.75	7.98	3.67	0.367
11.8	6.97	4.56	0.537
14.2	5.73	7.67	1.30
16.2	4.63	12.2	2.43
20.0	3.24	18.6	2.70
24.1	2.00	<u>CURVE 15*</u>	
29.2	1.36	1.33	0.0252
33.8	1.12	1.78	0.0551
38.2	0.836	2.19	0.0923
50.0	0.498	2.89	0.182
66.7	0.322*	4.25	0.403
83.0	0.227	6.78	1.01
95.1	0.168	10.7	1.88
<u>CURVE 12</u>			
1.34	0.0255	15.7	2.37
1.49	0.0342		
1.55	0.0366		
1.75	0.0556		
2.02	0.0787		
2.18	0.0931		
2.58	0.148		
2.85	0.185		
3.51	0.281		
4.24	0.407		
4.68	0.545		
6.70	1.03		
8.15	1.37		
10.5	1.92		
13.2	2.27		
15.2	2.41		
18.3	2.32		
<u>CURVE 13</u>			
1.50	0.0817		
1.99	0.156		
3.00	0.335		
4.20	0.615		
6.14	1.17		
10.3	2.51		
13.0	2.99		
24.7	1.98		

* Not shown on plot

SPECIFICATION TABLE NO. 185 THERMAL CONDUCTIVITY OF THALLIUM CHLORIDE TICI

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	71	C	1951	311, 345			Cubic isotropic crystal.

DATA TABLE NO. 185 THERMAL CONDUCTIVITY OF THALLIUM CHLORIDE TICI

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

311.2 0.0075
345.2 0.0075

* No graphical presentation

SPECIFICATION TABLE NO. 186 THERMAL CONDUCTIVITY OF ZINC DICHLORIDE $ZnCl_2$

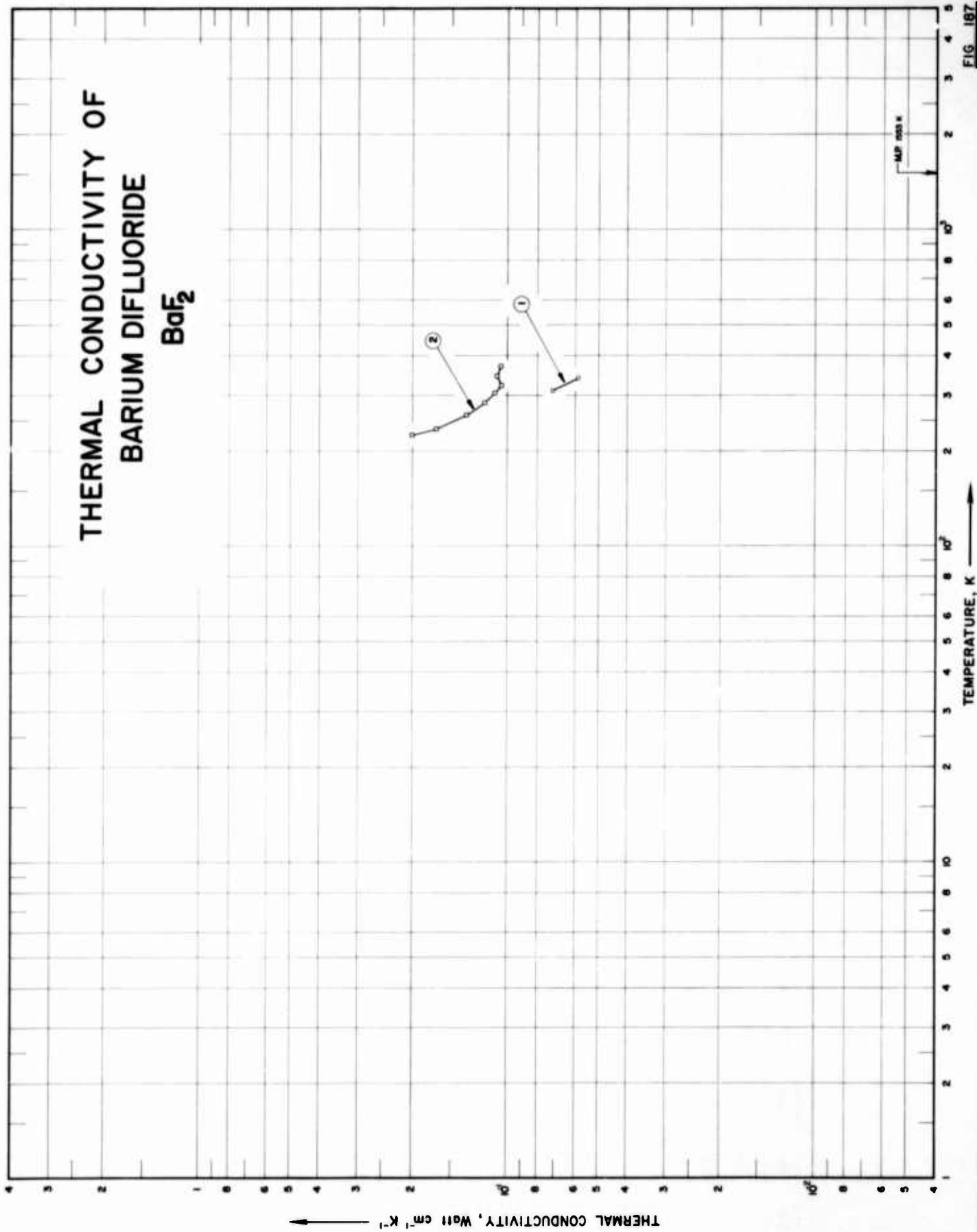
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	242	-	1961	563-641	± 3		Specimen of A. R. purity; each data point is the mean value of 4 or 5 different measurements; measured in molten state. Similar to the above specimen.
2	242	-	1961	591	± 3		

DATA TABLE NO. 186 THERMAL CONDUCTIVITY OF ZINC DICHLORIDE $ZnCl_2$ [Temperature, T, K; Thermal Conductivity, k, $Watt\ cm^{-1}\ K^{-1}$]

T	k
<u>CURVE 1*</u>	
562.9	0.00313
587.1	0.00296
614.0	0.00294
641.3	0.00290
<u>CURVE 2*</u>	
591	0.00301

* No graphical presentation

THERMAL CONDUCTIVITY OF
BARIUM DIFLUORIDE
 BaF_2



SPECIFICATION TABLE NO. 187 THERMAL CONDUCTIVITY OF BARIUM DIFLUORIDE BaF_2

[For Data Reported in Figure and Table No. 187]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	71	C	1951	311, 341			Cubic isotropic crystal; specimen supplied by Optovac Co. of Boston; Z-cut crystalline quartz used as standard.
2	214	C	1960	225-370			Crystalline specimen, 1 cm in radius, 0.5 cm thick; specimen supplied by Optovac Co. Z-cut quartz used as standard.

DATA TABLE NO. 187 THERMAL CONDUCTIVITY OF BARIUM DIFLUORIDE BaF₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
311.2	0.0711
341.2	0.0586
<u>CURVE 2</u>	
225.0	0.290
236.6	0.167
260.0	0.134
284.0	0.117
305.0	0.109
323.0	0.104
346.7	0.107
370.0	0.105

THERMAL CONDUCTIVITY OF CALCIUM DIFLUORIDE CaF₂

FIGURE SHOWS ONLY 10 OF THE CURVES REPORTED IN TABLE

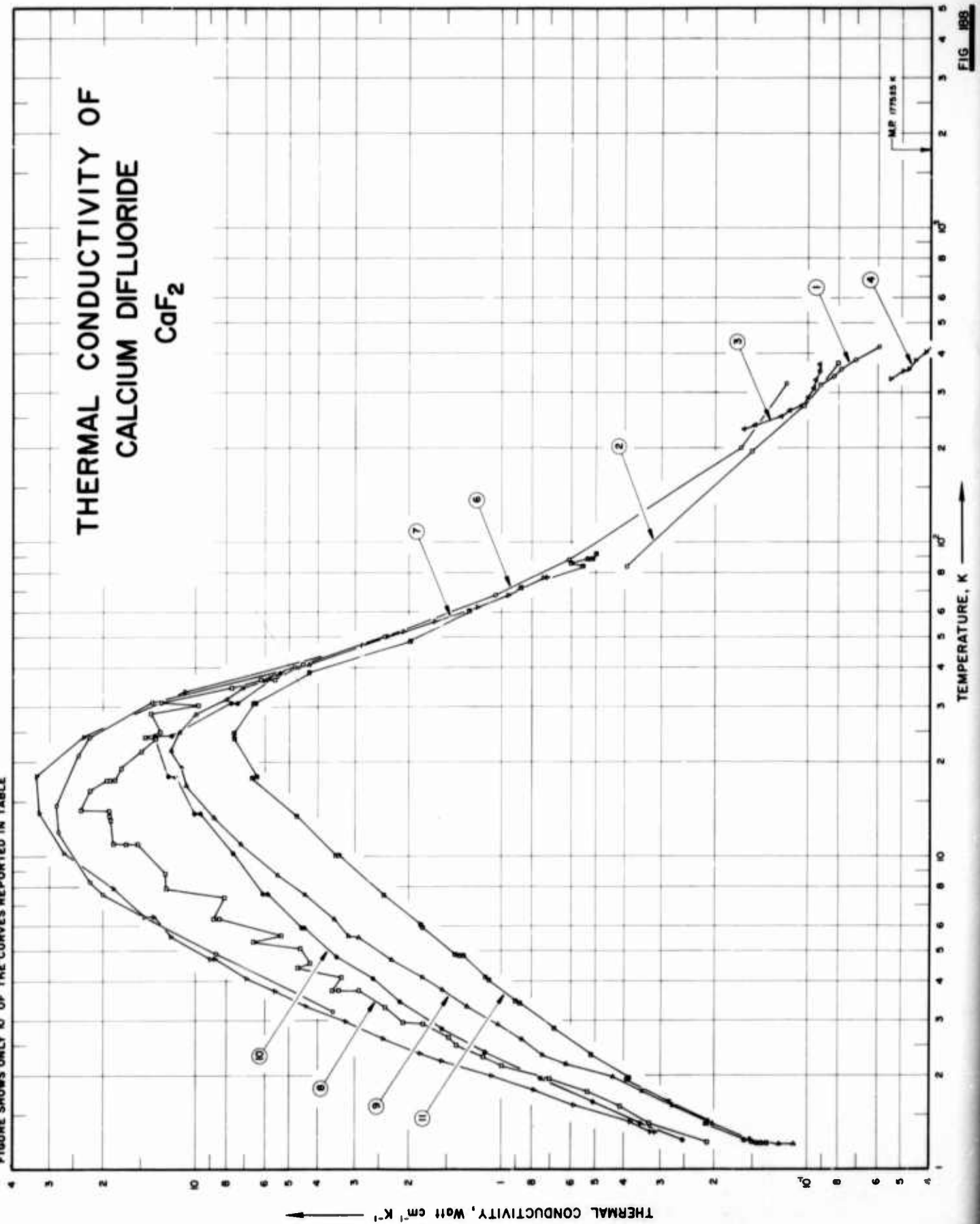


FIG. 10B

SPECIFICATION TABLE NO. 188 THERMAL CONDUCTIVITY OF CALCIUM DIFLUORIDE CaF_2

[For Data Reported in Figure and Table No. 188]

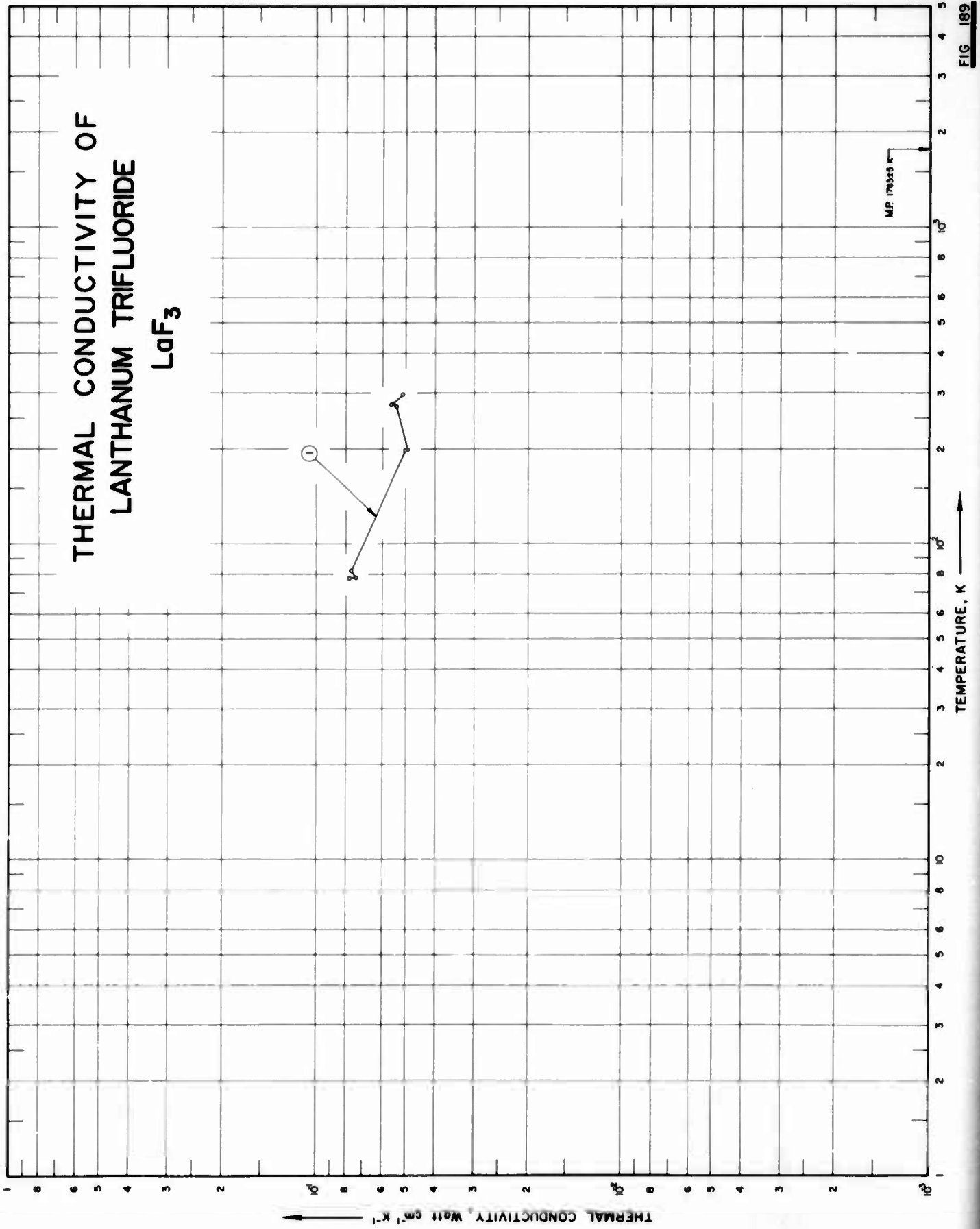
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3	L	1953	319-421		255A-1	Single crystal, grown synthetically by Harshaw Chemical Co.
2	22	L	1911	83-373			Single crystal.
3	214	C	1960	229-369			Crystalline, specimen 1 cm in radius, 0.5 cm thick; provided by Optovac Co., Z-cut quartz crystals used as standard.
4	293	C	1957	331-944	±4		Single crystal of optical quality, specimen cube shaped 0.875 x 0.875 x 0.875 in.; raw material provided by Harshaw Chemical Co.; specimen prepared by hydrostatically pressing the powder dry without a binder, and fired; cubic specimen cut from fired slug with faces ground flat and parallel on a diamond lap; polycrystalline alumina used as standard.
5	293	C	1957	440-1031	±4		Polycrystalline of optical quality, specimen cube shaped 0.875 x 0.875 x 0.875 in.; volume porosity 8.17-10%, average crystal size 2 μ ; polycrystalline alumina used as standard.
6	379	L	1960	3.2-320		Sample 30	Debye temperature ~520 K, 0.85 cm dia.
7	499	L	1965	1.3-77		C	Single crystal blank obtained from Harshaw Chemical Company; rectangular rod specimen cut from bulk material with <110> longitudinal axis.
8	499	L	1965	1.2-61		4P	Remainder of the above blank heated to 270 C within 2 hrs, compressed along [121] axis for 10 min to reach an average deformation of 4.0%, cut a rectangular rod specimen in which edge dislocation was parallel to its longitudinal axis.
9	499	L	1965	1.2-60		4S	Rectangular rod specimen cut from the above blank with edge dislocation perpendicular to the longitudinal axis.
10	499	L	1965	1.2-80		7P	Single crystal blank obtained from Harshaw Chemical Company; heated to 270 C within 2 hrs compressed along [121] axis for 10 min to reach an average deformation of 7.0%, cut a rectangular rod specimen in which edge dislocation parallel to its longitudinal axis.
11	499	L	1965	1.2-92		7S	Rectangular rod specimen cut from the above blank with edge dislocation perpendicular to the longitudinal axis.

DATA TABLE NO. 188 THERMAL CONDUCTIVITY OF CALCIUM DIFLUORIDE CaF_2 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>																			
318.7	0.0912	661.0	0.0288	7.91	18.4	13.1	18.9	8.67	5.45	1.22	0.136	10.9	7.24	10.9	7.24	1.22	0.141	13.2	8.75
338.1	0.0824	810.0	0.0251	10.2	26.8	13.4	19.1	10.9	7.24	1.22	0.145	13.9	13.2	13.2	8.75	1.23	0.151	16.8	10.7
356.7	0.0782	937.0	0.0234	13.8	32.4	13.9	19.1	16.8	10.7	1.25	0.159	14.1	23.6	16.8	10.7	1.41	0.213	19.1	11.1
382.7	0.0707	1031.0	0.0217	18.1	33.1	16.3	22.0	19.1	11.1	1.42	0.210	17.5	19.5	19.1	11.1	1.64	0.281	21.7	12.0
420.6	0.0594	<u>CURVE 6</u>		33.6	10.7	17.5	19.5	21.7	12.0	1.96	0.382	24.9	11.2	24.9	11.2	2.33	0.515	28.2	10.0
<u>CURVE 2</u>		3.2	3.55	47.4	2.83	17.5	18.9	24.9	11.2	3.40	0.571	28.2	10.0	28.2	10.0	3.45	0.500	30.2	1.10
83.2	0.390	4.9	8.6	50.4	2.34	17.5	18.2	28.2	10.0	4.83	1.32	31.6	7.98	31.6	7.98	4.83	1.32	34.4	1.12
195.2	0.151	7.6	20.0	52.2	2.07	19.1	17.4	34.5	7.11	4.83	1.36	31.6	7.98	34.5	7.11	4.83	1.36	36.6	6.19
273.2	0.103	8.3	22.0	62.2	1.19	23.8	13.4	36.3	5.97	5.94	1.80	23.8	13.4	36.3	5.97	5.94	1.80	36.6	6.19
373.2	0.0799	12.0	28.0	68.6	0.951	23.9	14.6	46.1	2.97*	6.05	1.82	24.9	13.0	46.1	2.97*	6.05	1.82	46.1	2.97*
<u>CURVE 3</u>		21.0	24.0	77.3	0.735	28.4	13.9	60.3	1.39*	10.1	3.39	30.2	9.77	60.3	1.39*	10.1	3.39	30.2	9.77
229.1	0.162	24.0	22.1	77.3	0.715	30.2	13.9	60.3	1.39*	10.1	3.39	30.2	9.77	60.3	1.39*	10.1	3.39	30.2	9.77
236.5	0.149	31.0	13.8	<u>CURVE 8</u>		30.9	12.9	30.9	12.9	2.82	1.56	30.9	12.9	30.9	12.9	2.82	1.56	30.9	12.9
253.0	0.123	40.0	4.80	1.23	0.211	34.4	7.69	36.6	6.19	3.44	2.12	34.4	7.69	36.6	6.19	3.44	2.12	34.4	7.69
263.5	0.114	50.0	2.40	1.41	0.327	36.6	6.19	36.6	6.19	4.07	2.61	36.6	6.19	36.6	6.19	4.07	2.61	36.6	6.19
273.0	0.104	68.0	1.05	1.59	0.413	40.7	4.47	40.7	4.47	4.76	3.45	40.7	4.47	40.7	4.47	4.76	3.45	40.7	4.47
289.1	0.0985	88.0	0.61	1.77	0.530	46.1	3.09*	46.1	3.09*	5.92	4.51	46.1	3.09*	46.1	3.09*	5.92	4.51	46.1	3.09*
309.0	0.0960	200.0	0.165	1.95	0.702	60.5	1.31*	60.5	1.31*	7.59	5.86	60.5	1.31*	60.5	1.31*	7.59	5.86	60.5	1.31*
328.6	0.0941	320.0	0.117	2.15	0.995	<u>CURVE 9</u>		2.82	1.56	10.2	6.11	2.82	1.56	10.2	6.11	10.1	3.39	10.1	3.39
350.8	0.0918	1.33	0.312	2.29	1.14	1.21	0.110	2.82	1.56	13.7	9.68	2.82	1.56	13.7	9.68	10.1	3.39	10.1	3.39
369.0	0.0918	1.33	0.322	2.50	1.39	1.21	0.123	3.44	2.12	13.7	9.68	3.44	2.12	13.4	4.74	13.4	4.74	13.4	4.74
<u>CURVE 4</u>		1.42	0.380	2.92	1.79	1.21	0.123	4.07	2.61	17.8	6.61	4.07	2.61	17.8	6.61	17.8	6.61	17.8	6.61
331.0	0.0543	1.61	0.589	2.95	2.07	1.41	0.202	4.76	3.45	17.9	6.37	4.76	3.45	17.9	6.37	17.9	6.37	17.9	6.37
350.0	0.0493	1.80	0.787	3.30	2.38	1.60	0.273	5.92	4.51	23.8	7.55	5.92	4.51	23.8	7.55	23.8	7.55	23.8	7.55
356.0	0.0472	1.99	1.07	3.72	2.90	1.78	0.345	7.59	5.86	24.7	7.55	7.59	5.86	24.7	7.55	24.7	7.55	24.7	7.55
379.0	0.0447	2.22	1.56	3.72	3.40	1.98	0.435	10.2	6.11	30.8	6.43	10.2	6.11	30.8	6.43	30.8	6.43	30.8	6.43
402.0	0.0414	2.36	1.82	4.11	3.58	2.17	0.522	13.7	9.68	38.4	4.27	13.7	9.68	38.4	4.27	38.4	4.27	38.4	4.27
463.0	0.0364*	2.62	2.41	4.43	4.66	2.32	0.738	13.7	9.68	48.5	1.97	13.7	9.68	48.5	1.97	48.5	1.97	48.5	1.97
509.0	0.0322*	2.97	3.21	4.55	4.25	2.61	0.859	13.7	9.68	60.3	1.28	13.7	9.68	60.3	1.28	60.3	1.28	60.3	1.28
651.0	0.0305*	3.33	4.37	5.08	4.59	2.90	1.02	18.0	11.5	83.6	0.550	18.0	11.5	83.6	0.550	83.6	0.550	83.6	0.550
748.0	0.0292*	3.73	5.55	5.35	6.55	3.33	1.29	24.3	13.6	85.1	0.600	24.3	13.6	85.1	0.600	85.1	0.600	85.1	0.600
848.0	0.0284*	4.09	6.89	5.60	5.30	3.75	1.55	30.8	10.9	89.5	0.530	30.8	10.9	89.5	0.530	89.5	0.530	89.5	0.530
944.0	0.0285*	4.72	8.67	6.34	6.34	4.11	1.80	30.8	10.9	91.6	0.499	30.8	10.9	91.6	0.499	91.6	0.499	91.6	0.499
<u>CURVE 5</u>		4.74	8.95	6.34	8.75	4.66	2.27	30.8	10.9										
440.0	0.0372	5.55	11.9	7.38	8.09	5.50	2.90	30.8	10.9										
528.0	0.0334	5.57	11.1*	7.87	12.4	6.31	3.16	30.8	10.9										
		5.60	11.5*	8.79	12.5	6.31	3.53	30.8	10.9										
		6.40	13.6	10.9	15.4	7.52	4.41	30.8	10.9										
		6.40	14.5	10.9	16.8	7.52	4.41	30.8	10.9										
		11.0	18.5	11.0	18.5	7.52	4.41	30.8	10.9										

* Not shown on plot

THERMAL CONDUCTIVITY OF
LANTHANUM TRIFLUORIDE
 LaF_3



SPECIFICATION TABLE NO. 189 THERMAL CONDUCTIVITY OF LANTHANUM TRIFLUORIDE LaF₃

[For Data Reported in Figure and Table No. 189]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	461	L	1967	78-299			Single crystal; supplied by Optovac, Inc.; density reported as 5.981, 5.977, 5.972, 5.973, 5.962, 5.959, 5.952, 5.943, 5.941, and 5.930 g cm ⁻³ at 111, 126, 144, 176, 208, 231, 254, 271, 289, and 335 K, respectively.

DATA TABLE NO. 189 THERMAL CONDUCTIVITY OF LANTHANUM TRIFLUORIDE LaF_3
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
77.7	0.0777
78.0	0.0736
82.4	0.0766
197.1	0.0501
197.5	0.0493
273.8	0.0536
273.8	0.0531*
276.6	0.0562
277.0	0.0553
297.2	0.0512
298.7	0.0508*

CURVE 1

* Not shown on plot

THERMAL CONDUCTIVITY OF LITHIUM FLUORIDE

LiF

FIGURE SHOWS ONLY 23 OF THE CURVES REPORTED IN TABLE

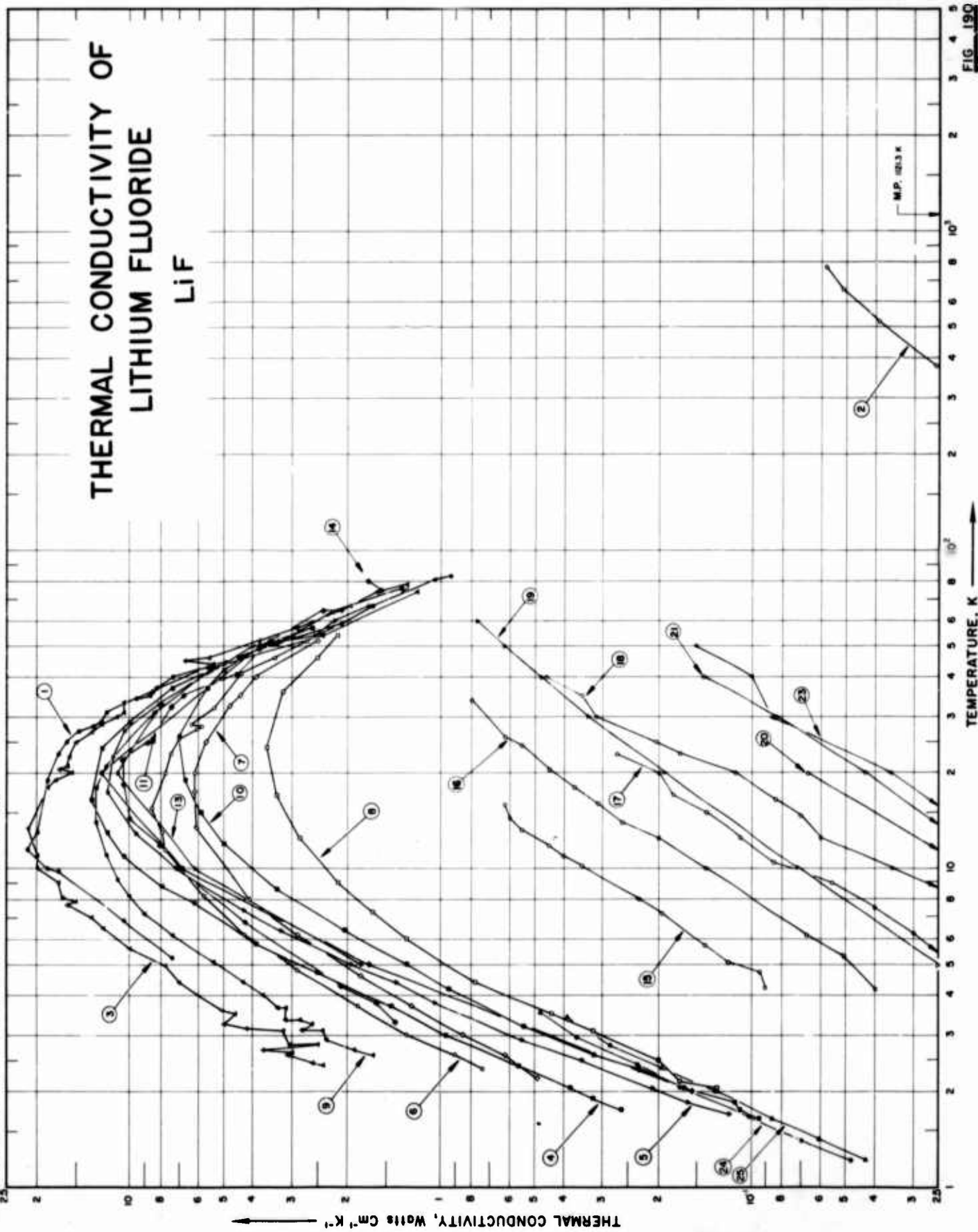


FIG. 190

SPECIFICATION TABLE NO. 190 THERMAL CONDUCTIVITY OF LITHIUM FLUORIDE LiF

[For Data Reported in Figure and Table No. 190]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	28	L	1956	5.3-84			Crystalline, with traces of Mg (main impurity in a concentration of less than 0.001%), Al, Fe, and Si; specimen 5 cm long and of roughly square cross-section of side 5.5 mm, supplied by Harshaw Chemical Co.
2	34	C	1943	378-772			Synthetic, colorless, single crystal, specimen size 1 cm cube; stainless steel rod used as standard.
3	62	L	1960	2.4-78		Harshaw LiF	Single crystal, 6.70 x 7.3 x 40 mm; cleaved specimen; annealed for 3 hrs at 1100°K (40° below the melting point), cooled at the rate of one degree per min to 500°K and then more slowly to room temperature.
4	62	L	1960	1.8-76		Harshaw LiF	Single crystal, 0.74 x 0.79 x 40 mm; same treatment as above.
5	62	L	1960	1.7-67		Harshaw LiF	Single crystal 0.74 x 0.79 x 40 mm; first the same treatment as above then sand-blasted and annealed.
6	62	L	1960	2.4-75		Harshaw LiF	Single crystal 6.7 x 7.3 x 40 mm; after cleaving, annealed 3 hrs at 1100°K (40° below the melting point) and cooled at a rate of one degree per min, to 500°K and then more slowly to room temperature, then irradiated with x-ray at room temperature to produce F centers (an electrode trapped in a halogen vacancy is an F center), density N_F (number of F centers per unit volume) = $4.2 \times 10^{17} \text{ cm}^{-3}$.
7	62	L	1960	2.2-52		Harshaw LiF	The above specimen after successive irradiation of x-rays at room temperature until $N_F = 7.1 \times 10^{17} \text{ cm}^{-3}$.
8	62	L	1960	2.1-54		Harshaw LiF	The above specimen after successive irradiation with x-rays of 1.5 Mev at room temperature until $N_F = 2 \times 10^{18} \text{ cm}^{-3}$.
9	62	L	1960	2.6-74		Harshaw LiF	The above specimen ($N_F = 2 \times 10^{18} \text{ cm}^{-3}$), annealed for 2 hrs at 570°K, E-band partly bleached but a small band remains which peaks at around 2100 Å wavelength.
10	62	L	1960	1.7-57		Harshaw LiF	Single crystal 0.74 x 0.79 x 40 mm, similarly prepared and treated; irradiated with x-rays at 300°K; $N_F = 2.2 \times 10^{17} \text{ cm}^{-3}$.
11	62	L	1960	2.0-50		Harshaw LiF	Single crystal 0.94 x 0.92 x 40 mm, similar to the above but unirradiated.
12	62	L	1960	2-76		Harshaw LiF	The above specimen, irradiated with 60 Kv x-rays at 77°K; measured without warming up after the irradiation.
13	62	L	1960	5-33		Harshaw LiF	The above specimen irradiated with 60Kv x-rays at 77°K; measured after a short warmup to 300°K.
14	229	L	1958	3.3-80			Single crystal, long rod with a cross-section of 0.165 x 0.170 in., grown by Harshaw Chemical Co.; unirradiated.
15	229	L	1958	4.3-16			The above specimen irradiated with a Co^{60} gamma ray dose of 1.936×10^6 Roentgens; specimen wrapped in Aluminum foil and temperature of irradiation ~40°C.

SPECIFICATION TABLE NO. 190 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
16	229	L	1958	4.2-35			The above specimen after successive Co^{60} gamma ray dose of 4.035×10^6 Roentgens accumulated irradiation.
17	229	L	1958	4.5-23			The above specimen after successive Co^{60} gamma ray dose of 7.575×10^6 Roentgens accumulated irradiation.
18	229	L	1958	4.8-40			The above specimen after successive Co^{60} gamma ray dose of 20.885×10^6 Roentgens accumulated irradiation.
19	229	L	1958	5-60			Single crystal, long rod with a cross-section of 0.105×0.105 in., grown by Harshaw Chemical Co., irradiated with a dose of 4.36×10^{15} n cm^{-2} thermal neutrons; the specimen wrapped in 2 S Aluminium foil, and temperature of irradiation -60°C .
20	229	L	1958	7-20			Similar to the above specimen but irradiated at -60°C with a dose of 2.76×10^{16} thermal neutrons cm^{-2} .
21	229	L	1958	8-40			Similar to the above specimen but irradiated with a dose of 5.09×10^{16} thermal neutrons cm^{-2} .
22	229	L	1958	6-14			Similar to the above specimen but irradiated with a dose of 1.069×10^{17} thermal neutrons cm^{-2} .
23	229	L	1958	5-50			Similar to the above specimen but irradiated with a dose of 5.23×10^{17} thermal neutrons cm^{-2} .
24	499	L	1965	1.2-3.5		4.2 P	Single crystal blank deformed at 175°C by compressing along [010] axis, average deformation 4.2%, rectangular rod specimen cut from the deformed blank with edge dislocation parallel to the longitudinal axis.
25	499	L	1965	1.2-3.4		4.2 S	Rectangular rod specimen cut from the above blank with edge dislocation perpendicular to the longitudinal axis.
26	499	L	1965	7.1-80		4.2 S	Similar to the above specimen.
27	456		1965	1.8-36			Cleaved specimen $0.8 \times 1.0 \times 40$ mm supplied by Harshaw Chemical Co.; as-cleaved condition; dislocation density 5.5×10^6 dislocations cm^{-2} .
28	456		1965	1.8-37			Similar to the above specimen except specimen plastically deformed by bending it at room temperature over a rod 8 mm dia (this large piece L.F. was annealed and slowly cooled to room temperature), specimen bent immediately after cleaving; average dislocation density 2×10^7 dislocations cm^{-2} .

DATA TABLE NO. 190 THERMAL CONDUCTIVITY OF LITHIUM FLUORIDE LiF

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k		
<u>CURVE 1</u>															
5.25	7.40	5.6	10.0	11	10.5	13.0	8.0	36.0	3.20	12	5.00	35.0	6.8		
6.90	10.5	13	12.4	15.5	8.6	15.5	8.6	46.0	2.50	15	5.90	41.0	4.5		
9.80	17.0	16.5	13.5	20.0	7.8	20.0	7.8	54.0	2.15	19	6.70	52.0	3.5		
10.0	18.5	24	12.5	23.0	7.5	23.0	7.5	<u>CURVE 2</u>					65.0	2.4	
11.5	21.5	29	10.0	26.0	7.0	26.0	7.0	<u>CURVE 3</u>					65.0	2.1	
13.0	20.0	37	7.40	27.5	6.1	27.5	6.1	<u>CURVE 4</u>					75.0	1.6	
19.0	18.5	54	3.00	28.0	5.9	28.0	5.9	<u>CURVE 5</u>					80.0	1.7	
23.0	17.0	64	2.25	28.5	6.4	28.5	6.4	<u>CURVE 6</u>					<u>CURVE 15</u>		
25.0	16.0	76	1.35	32.0	5.4	32.0	5.4	<u>CURVE 7</u>					<u>CURVE 16</u>		
27.0	14.7	13.5	21.5	41.0	4.4	41.0	4.4	<u>CURVE 8</u>					<u>CURVE 17</u>		
28.0	13.3	18.0	18.5	46.0	3.4	46.0	3.4	<u>CURVE 9</u>					<u>CURVE 14 (cont.)</u>		
29.0	12.5	19.0	17.5	52.0	2.7	52.0	2.7	<u>CURVE 10</u>					<u>CURVE 11</u>		
31.0	12.0	20.0	15.5	75.0	1.3	75.0	1.3	<u>CURVE 11</u>					<u>CURVE 12*</u>		
34.5	9.5	20.0	17.0	<u>CURVE 12</u>				<u>CURVE 13</u>					<u>CURVE 14</u>		
36.0	8.5	21.0	16.0	1.7	0.12	1.7	0.12	<u>CURVE 14</u>					<u>CURVE 15</u>		
40.0	7.35	22.5	15.7	1.9	0.16	1.9	0.16	<u>CURVE 15</u>					<u>CURVE 16</u>		
43.0	5.60	25.0	15	2.5	0.35	2.5	0.35	<u>CURVE 16</u>					<u>CURVE 17</u>		
51.0	3.35	27.0	13.5	2.9	0.55	2.9	0.55	<u>CURVE 17</u>					<u>CURVE 18</u>		
59.0	2.10	28.5	12.5	3.8	1.05	3.8	1.05	<u>CURVE 18</u>					<u>CURVE 19</u>		
67.0	1.65	30.0	11.0	4.4	1.40	4.4	1.40	<u>CURVE 19</u>					<u>CURVE 20</u>		
81.0	1.05	31.0	10.5	5.0	1.95	5.0	1.95	<u>CURVE 20</u>					<u>CURVE 21</u>		
83.5	0.930	33.5	10.5	6.4	3.25	6.4	3.25	<u>CURVE 21</u>					<u>CURVE 22</u>		
<u>CURVE 2</u>															
378.2	0.0256	35.0	8.70	7.4	4.30	7.4	4.30	<u>CURVE 22</u>					<u>CURVE 23</u>		
522.2	0.0390	37.0	8.30	10.0	7.20	10.0	7.20	<u>CURVE 23</u>					<u>CURVE 24</u>		
657.2	0.0510	44.0	5.40	13.0	9.60	13.0	9.60	<u>CURVE 24</u>					<u>CURVE 25</u>		
772.2	0.0577	45.0	6.70	17.5	12.0	17.5	12.0	<u>CURVE 25</u>					<u>CURVE 26</u>		
<u>CURVE 3</u>															
2.4	2.40	46.0	5.60	22.5	11.5	22.5	11.5	<u>CURVE 26</u>					<u>CURVE 27</u>		
2.45	2.60	46.0	5.60	27.0	10.5	27.0	10.5	<u>CURVE 27</u>					<u>CURVE 28</u>		
2.6	3.10	52.0	3.90	33.0	8.20	33.0	8.20	<u>CURVE 28</u>					<u>CURVE 29</u>		
2.7	3.70	57.0	2.90	44.0	5.00	44.0	5.00	<u>CURVE 29</u>					<u>CURVE 30</u>		
2.8	2.50	58.0	2.65	50.0	4.00	50.0	4.00	<u>CURVE 30</u>					<u>CURVE 31</u>		
2.8	3.05	67.0	1.95	52.0	3.20	52.0	3.20	<u>CURVE 31</u>					<u>CURVE 32</u>		
3.1	3.20	74.0	1.60	60.0	2.55	60.0	2.55	<u>CURVE 32</u>					<u>CURVE 33</u>		
3.15	4.20	78.0	1.30	67.0	1.70	67.0	1.70	<u>CURVE 33</u>					<u>CURVE 34</u>		
3.35	5.00	<u>CURVE 4</u>												<u>CURVE 34</u>	
3.5	4.60	1.75	0.26	2.05	0.13	2.05	0.13	<u>CURVE 34</u>					<u>CURVE 35</u>		
3.6	5.10	1.9	0.32	2.15	0.17	2.15	0.17	<u>CURVE 35</u>					<u>CURVE 36</u>		
4.4	7.00	2.5	0.26	2.5	0.20	2.5	0.20	<u>CURVE 36</u>					<u>CURVE 37</u>		
4.95	7.80	2.6	0.38	3.1	0.32	3.1	0.32	<u>CURVE 37</u>					<u>CURVE 38</u>		
<u>CURVE 5</u>															
2.7	3.70	2.8	0.38	3.5	0.44	3.5	0.44	<u>CURVE 38</u>					<u>CURVE 39</u>		
2.7	3.70	3.0	0.56	4.4	0.78	4.4	0.78	<u>CURVE 39</u>					<u>CURVE 40</u>		
3.1	3.20	3.0	0.96	6.0	1.30	6.0	1.30	<u>CURVE 40</u>					<u>CURVE 41</u>		
3.15	4.20	3.7	1.45	7.3	2.9	7.3	2.9	<u>CURVE 41</u>					<u>CURVE 42</u>		
3.35	5.00	4.7	2.50	9.0	2.15	9.0	2.15	<u>CURVE 42</u>					<u>CURVE 43</u>		
3.5	4.60	5.8	3.90	12.5	2.85	12.5	2.85	<u>CURVE 43</u>					<u>CURVE 44</u>		
3.6	5.10	17.0	6.20	17.0	3.35	17.0	3.35	<u>CURVE 44</u>					<u>CURVE 45</u>		
4.4	7.00	8.8	8.00	24.0	3.60	24.0	3.60	<u>CURVE 45</u>					<u>CURVE 46</u>		
4.95	7.80	8.8	8.00	24.0	3.60	24.0	3.60	<u>CURVE 46</u>					<u>CURVE 47</u>		

* Not shown on plot

DATA TABLE NO. 190 (continued)

T	k	T	k	T	k	T	k	T	k
<u>CURVE 17 (cont.)</u>		<u>CURVE 22*</u>		<u>CURVE 26 (cont.)*</u>		<u>CURVE 27*</u>		<u>CURVE 28 (cont.)*</u>	
12.5	0.110	6.0	0.00625	18.2	6.11	1.78	0.159	5.48	1.00
15.0	0.140	10.0	0.0114	18.8	6.83	2.05	0.188	7.05	1.69
17.0	0.180	13.5	0.0167	19.1	8.17	2.43	0.340	7.43	1.72
20.0	0.200	<u>CURVE 23</u>		20.5	6.03	2.88	0.547	8.77	2.48
23.0	0.270	5.0	0.00541*	22.7	7.84	3.57	0.906	9.98	3.54
<u>CURVE 18</u>		10.0	0.0133*	26.9	7.38	4.14	1.33	10.6	3.45
4.75	0.0094*	20.0	0.0357	29.9	10.6	4.57	1.55	12.5	5.06
5.8	0.012*	30.0	0.0854	57.5	3.19	5.48	2.26	13.1	4.84
6.3	0.015*	40.0	0.100	80.2	1.32	7.03	3.49	14.2	5.90
8.5	0.024*	50.0	0.152	<u>CURVE 27*</u>		8.65	5.02	15.2	5.90
10.0	0.035	<u>CURVE 24</u>		10.0	6.59	17.3	6.98	15.7	5.90
12.5	0.06	1.23	0.0479	10.5	6.55	17.3	7.41	17.3	6.98
14.7	0.07	1.41	0.0695	12.4	8.79	18.8	7.10	18.8	7.10
16.5	0.084	1.68	0.102	12.9	7.92	19.7	7.53	19.7	7.53
20.0	0.115	2.08	0.169	14.1	9.29	23.8	7.80	23.8	7.80
23.0	0.17	2.42	0.232	15.4	9.06	29.4	7.62	29.4	7.62
25.0	0.205	2.95	0.363	17.1	9.89	36.9	6.27	36.9	6.27
30.0	0.315	3.52	0.477	17.1	10.4				
35.0	0.35	<u>CURVE 25</u>		18.4	10.1				
40.0	0.46	1.22	0.0429	18.4	10.4				
<u>CURVE 19</u>		10.0	0.0714	10.5	6.55				
5.0	0.0250	1.43	0.0605	10.5	6.55				
10.0	0.0714	1.65	0.0855	12.4	8.79				
20.0	0.192	2.00	0.131	12.9	7.92				
30.0	0.333	2.37	0.196	14.1	9.29				
40.0	0.476	2.78	0.281	15.4	9.06				
50.0	0.625	3.40	0.389	17.1	9.89				
60.0	0.769	<u>CURVE 26*</u>		18.4	10.1				
<u>CURVE 20</u>		7.08	1.89	22.4	10.4				
7.0	0.0119*	7.08	2.13	22.4	10.0				
10.0	0.0200*	8.17	2.37	26.9	9.84				
20.0	0.0667	9.00	2.91	31.1	8.85				
<u>CURVE 21</u>		10.5	3.55	36.1	7.05				
8.0	0.0115*	11.2	4.41	<u>CURVE 28*</u>					
10.0	0.0159*	12.1	4.66	1.81	0.0601				
20.0	0.0435	13.6	5.08	2.07	0.0753				
30.0	0.0833	15.1	6.11	2.47	0.129				
40.0	0.143	15.1	6.22	2.89	0.209				
		16.9	7.08	3.65	0.380				
				4.17	0.560				
				4.65	0.724				

* Not shown on plot

SPECIFICATION TABLE NO. 191 THERMAL CONDUCTIVITY OF [LITHIUM FLUORIDE + POTASSIUM FLUORIDE + ΣX_1] LiF + KF + ΣX_1

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks
						LiF	KF	NaF	UF ₄	
1	257	C	1953	879-973	No. 14	44.5	43.5	10.9	1.1	Armco iron used as comparative material.

DATA TABLE NO. 191 THERMAL CONDUCTIVITY OF [LITHIUM FLUORIDE + POTASSIUM FLUORIDE + ΣX_1] LiF + KF + ΣX_1

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
879.2	0.0398
902.2	0.0398
918.2	0.0433
924.2	0.0433
973.2	0.0346

* No graphical presentation

THERMAL CONDUCTIVITY OF SODIUM FLUORIDE NaF

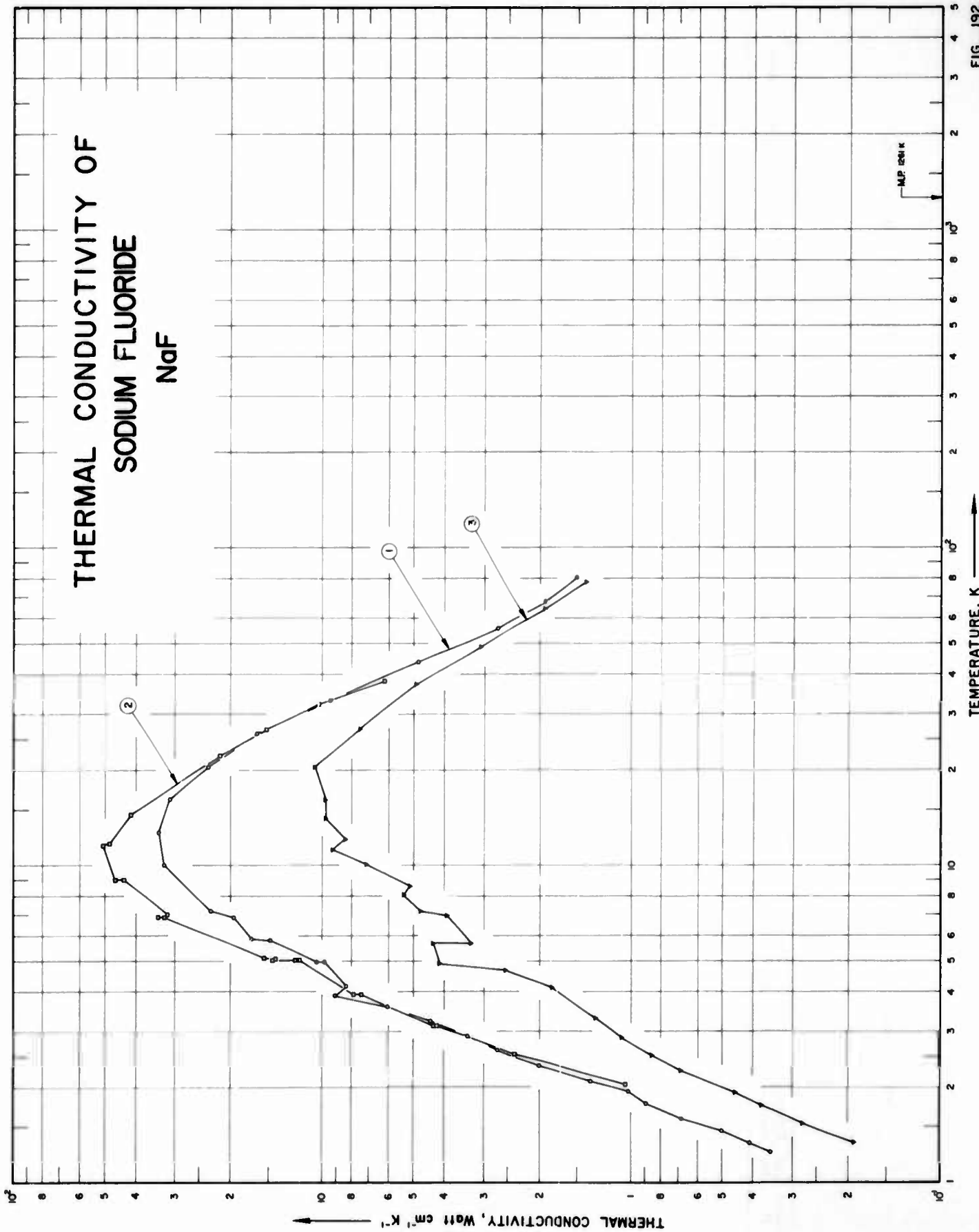


FIG. 192

SPECIFICATION TABLE NO. 192 THERMAL CONDUCTIVITY OF SODIUM FLUORIDE NaF

[For Data Reported in Figure and Table No. 192]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	456		1965	1.3-81			Cleaved specimen supplied by Harshaw Chemical Co.; undeformed crystal; dislocation density 3×10^6 dislocation cm^{-2} .
2	456		1965	2.0-38			Similar to the above specimen except specimen compressed 0.3% in length parallel to the longest dimensions between the jaws of a toolmaker's vice; dislocation density 1.8×10^6 dislocations cm^{-2} .
3	456		1965	1.3-79			Similar to the above specimen except compressed 0.7% and dislocation density 9.3×10^6 dislocation cm^{-2} .

DATA TABLE NO. 192 THERMAL CONDUCTIVITY OF SODIUM FLUORIDE NaF

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
1.25	0.352	7.03	31.7
1.34	0.410	9.00	43.7
1.46	0.502	9.00	46.5
1.59	0.684	11.6	50.5
1.77	0.891	11.7	48.5
1.94	1.02	14.5	41.6
2.09	1.36	22.3	21.6
2.34	2.01	26.8	15.2
2.62	2.71	32.3	10.2
2.90	3.41	38.1	6.2
3.24	4.42	<u>CURVE 2</u>	
3.61	6.05	1.34	0.191
3.90	9.06	1.54	0.277
4.17	8.32	1.76	0.376
4.97	9.82	1.93	0.455
4.97	10.4	2.26	0.689
5.81	14.8	2.52	0.853
5.88	17.0	2.86	1.08
6.87	19.6	3.30	1.31
7.23	23.1	3.30	1.82
10.1	32.6	4.14	1.54
12.7	33.9	4.69	2.54
16.2	31.2	4.91	4.14
20.5	23.3	5.69	4.32
26.1	16.4	5.69	3.30
33.2	9.40	6.95	3.93
43.6	4.83	7.16	4.75
55.6	2.70	8.09	5.38
67.6	1.93	8.63	5.11
80.5	1.51	10.1	7.12
<u>CURVE 2</u>			
2.04	1.05	11.2	9.25
2.54	2.38	12.1	8.36
3.13	4.22	14.1	9.75
3.13	4.32	16.1	9.75
3.92	7.43	20.4	10.6
3.92	7.89	26.9	7.46
5.04	11.9	37.2	4.90
5.04	12.3	48.9	3.07
5.07	14.3	64.1	1.92
5.13	15.5	78.9	1.40
6.89	32.6		

SPECIFICATION TABLE NO. 193 THERMAL CONDUCTIVITY OF [SODIUM FLUORIDE + BERYLLIUM DIFLUORIDE] NaF + BeF₂

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) NaF	Composition (weight percent) BeF ₂	Composition (continued), Specifications and Remarks
1	263	L	1952	799-801		.57	43	No other information reported.

DATA TABLE NO. 193 THERMAL CONDUCTIVITY OF [SODIUM FLUORIDE + BERYLLIUM DIFLUORIDE] NaF + BeF₂

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE I*

799.2 0.0415
800.2 0.0433
801.2 0.0398

* No graphical presentation

SPECIFICATION TABLE NO. 194 THERMAL CONDUCTIVITY OF [SODIUM FLUORIDE + ZIRCONIUM TETRAFLUORIDE + ΣX_i] NaF + ZrF₄ + ΣX_i

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks	
							NaF	ZrF ₄		
1	257	C	1953	787-1049		No. 30	50	46	4	Armco iron used as comparative material.

DATA TABLE NO. 194 THERMAL CONDUCTIVITY OF [SODIUM FLUORIDE + ZIRCONIUM TETRAFLUORIDE + ΣX_i] NaF + ZrF₄ + ΣX_i [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1 *

787.2	0.0294
889.2	0.0242
1049.2	0.0260

* No graphical presentation

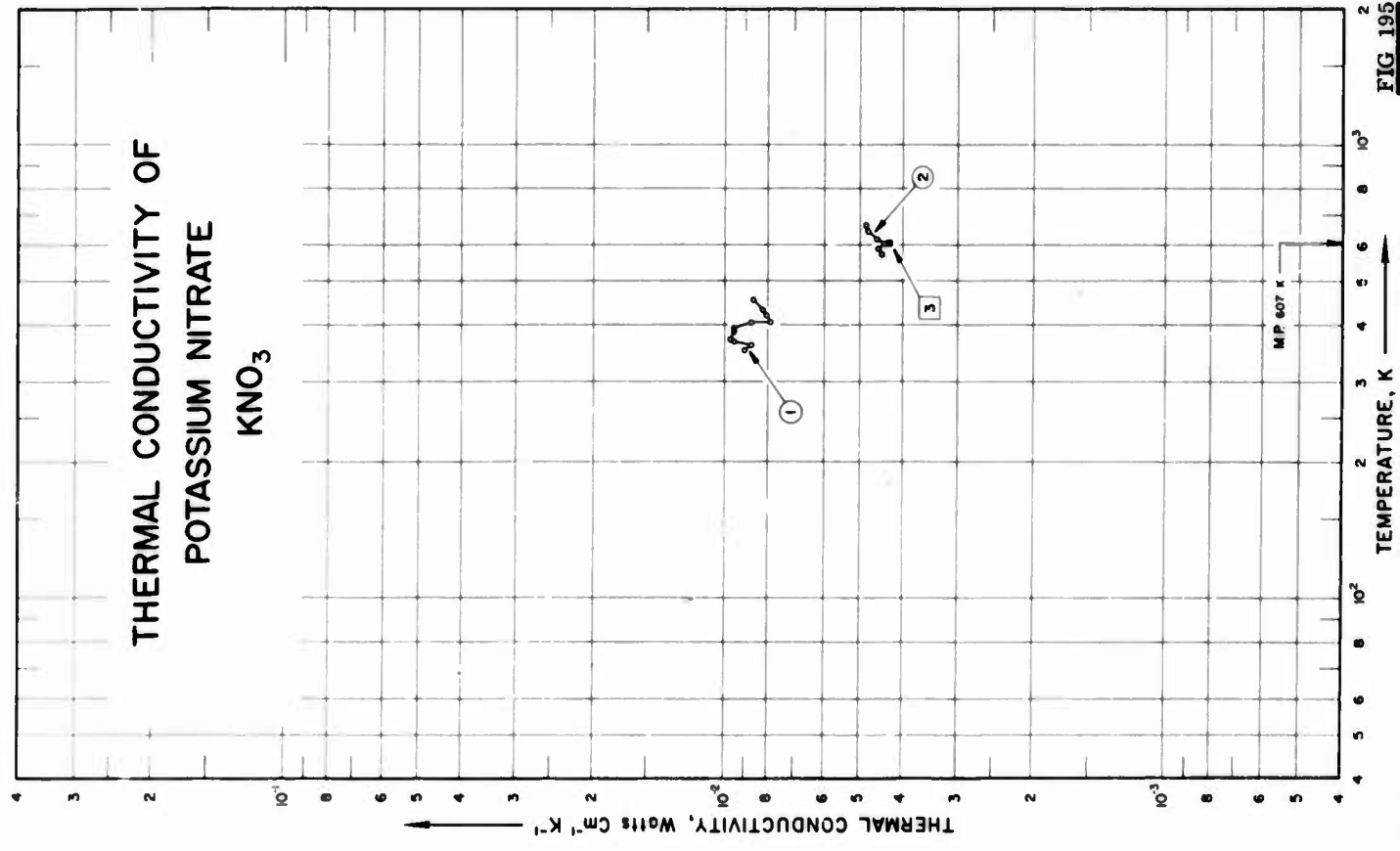


FIG 195

SPECIFICATION TABLE NO. 195 THERMAL CONDUCTIVITY OF POTASSIUM NITRATE KNO_3

[For Data Reported in Figure and Table No. 195]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	241	C	1960	353-455			Polycrystal obtained by slow cooling of the melt of potassium nitrate of special purity grade.
2	242		1961	573-668	3.0		A.R. purity; data reported as mean of 4 or 5 different measurements; measured in molten state.
3	242		1961	606.0	3.0		Same as the above specimen; measured in molten state.

DATA TABLE NO. 195 THERMAL CONDUCTIVITY OF POTASSIUM NITRATE KNO_3 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
353.2	0.0090
363.2	0.0087
368.2	0.0095
373.2	0.0097
386.2	0.0095
394.2	0.0095
403.2	0.0087
407.2	0.0079
421.2	0.0080
433.2	0.0082
455.2	0.0086
<u>CURVE 2</u>	
573.0	0.00448
592.0	0.00456
608.4	0.00439
620.2	0.00460
621.5	0.00464*
646.0	0.00479
667.7	0.00485
<u>CURVE 3</u>	
606.0	0.00431

* Not shown on plot

SPECIFICATION TABLE NO. 196 THERMAL CONDUCTIVITY OF SILVER NITRATE AgNO_3

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	242		1961	469-525	3		Specimen at A. R. purity; each dat. point is the mean value of 4 or 5 different measurements; measured in molten state.
2	242		1961	484	3		Same as the above specimen; measured in molten state.

DATA TABLE NO. 196 THERMAL CONDUCTIVITY OF SILVER NITRATE AgNO_3 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1*

469.3 0.00447
 475.4 0.00462
 481.4 0.00390
 487.6 0.00404
 506.0 0.00426
 525.4 0.00426

CURVE 2*

484 0.00377

* No graphical presentation

SPECIFICATION TABLE NO. 197 THERMAL CONDUCTIVITY OF SODIUM NITRATE NaNO_3

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	242		1961	582	±3		Specimen of A. R. purity; mean value of 4 or 5 different measurements

DATA TABLE NO. 197 THERMAL CONDUCTIVITY OF SODIUM NITRATE NaNO_3

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T k

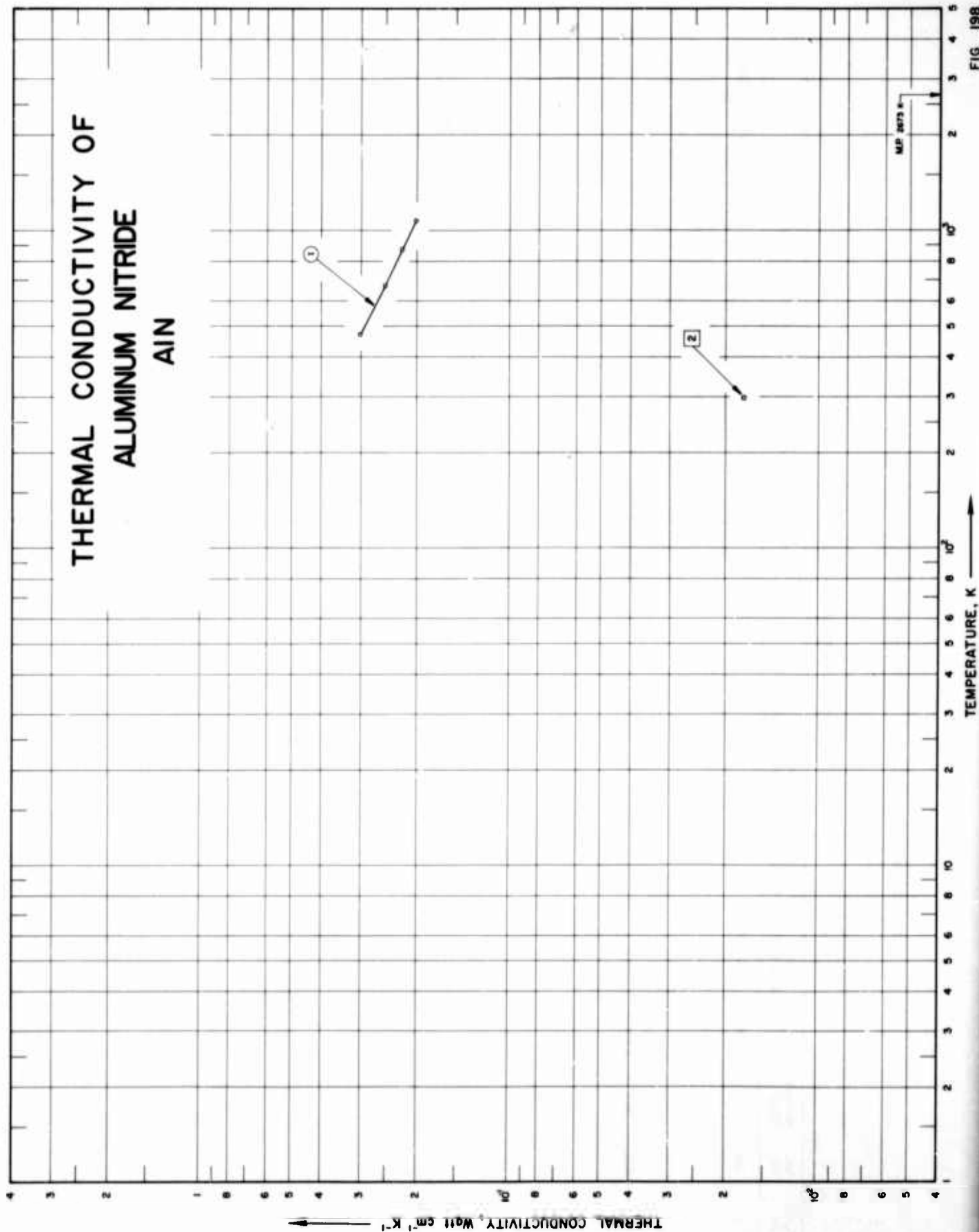
CURVE 1*

582 0.00565

* No graphical presentation

FIG. 198

THERMAL CONDUCTIVITY OF ALUMINUM NITRIDE AlN



SPECIFICATION TABLE NO. 198 THERMAL CONDUCTIVITY OF ALUMINUM NITRIDE AlN

[For Data Reported in Figure and Table No. 198]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	500	C	1960	473-1073			64.8 Al, 32.8 N, 0.2 C, 0.4 Si, 0.1 Fe; fabricated by hot pressing the milled powder at 2273 K in graphite dies, applying pressures of about 5000 psi, test bars 3 x 0.5 x 0.25 in. cut from the hot-pressed pieces with a diamond wheel and ground to produce smooth parallel surfaces; bulk density 3.20 g cm ⁻³ (density of the powder 3.23 g cm ⁻³); particle size 0.5 to 25 μ; heat flow parallel to direction of pressing; measured in stagnant nitrogen atmosphere; Inconel used as comparative material. High purity; highly sintered.
2	501	P	1959	298.2			

DATA TABLE NO. 198 THERMAL CONDUCTIVITY OF ALUMINUM NITRIDE AlN

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
473.2	0.301
673.2	0.251
873.2	0.222
1073.2	0.201
<u>CURVE 2</u>	
298.2	0.0176

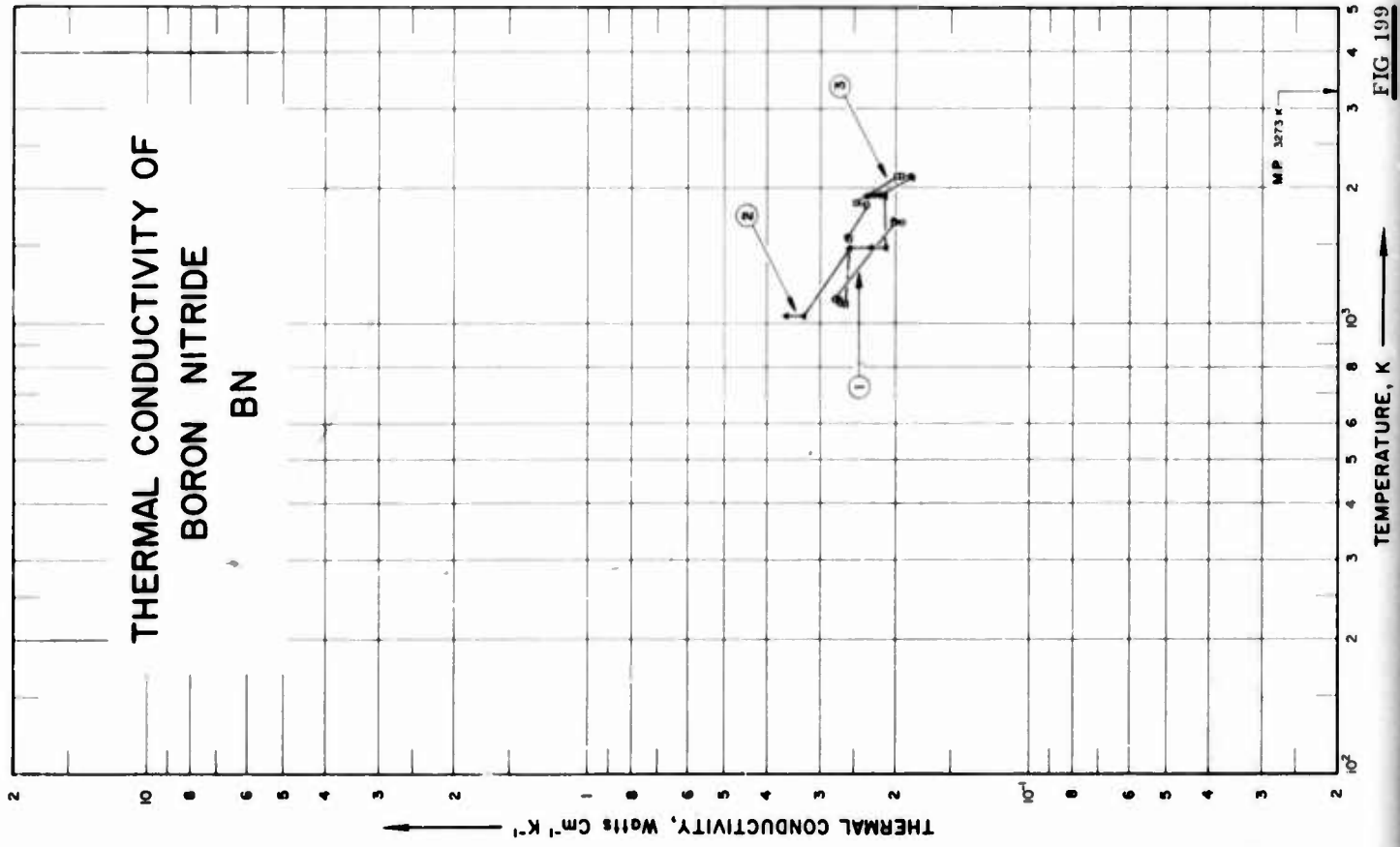


FIG 199

SPECIFICATION TABLE NO. 199 THERMAL CONDUCTIVITY OF BORON NITRIDE BN

[For Data Reported in Figure and Table No. 199]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	144	R	1963	1112-1697		1	Specimen 0.75 in. long, 0.75 in. O.D., and 0.25 in. I.D.; surface scratches eliminated by grinding and polishing.
2	144	R	1963	1047-2114		1	Second of the above specimen.
3	144	R	1963	1103-2129		2	Similar to the above specimen.

DATA TABLE NO. 199 THERMAL CONDUCTIVITY OF BORON NITRIDE BN

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1

1112.1	0.270
1130.4	0.270
1130.4	0.279
1670.9	0.201
1679.3	0.193
1696.5	0.202

CURVE 2

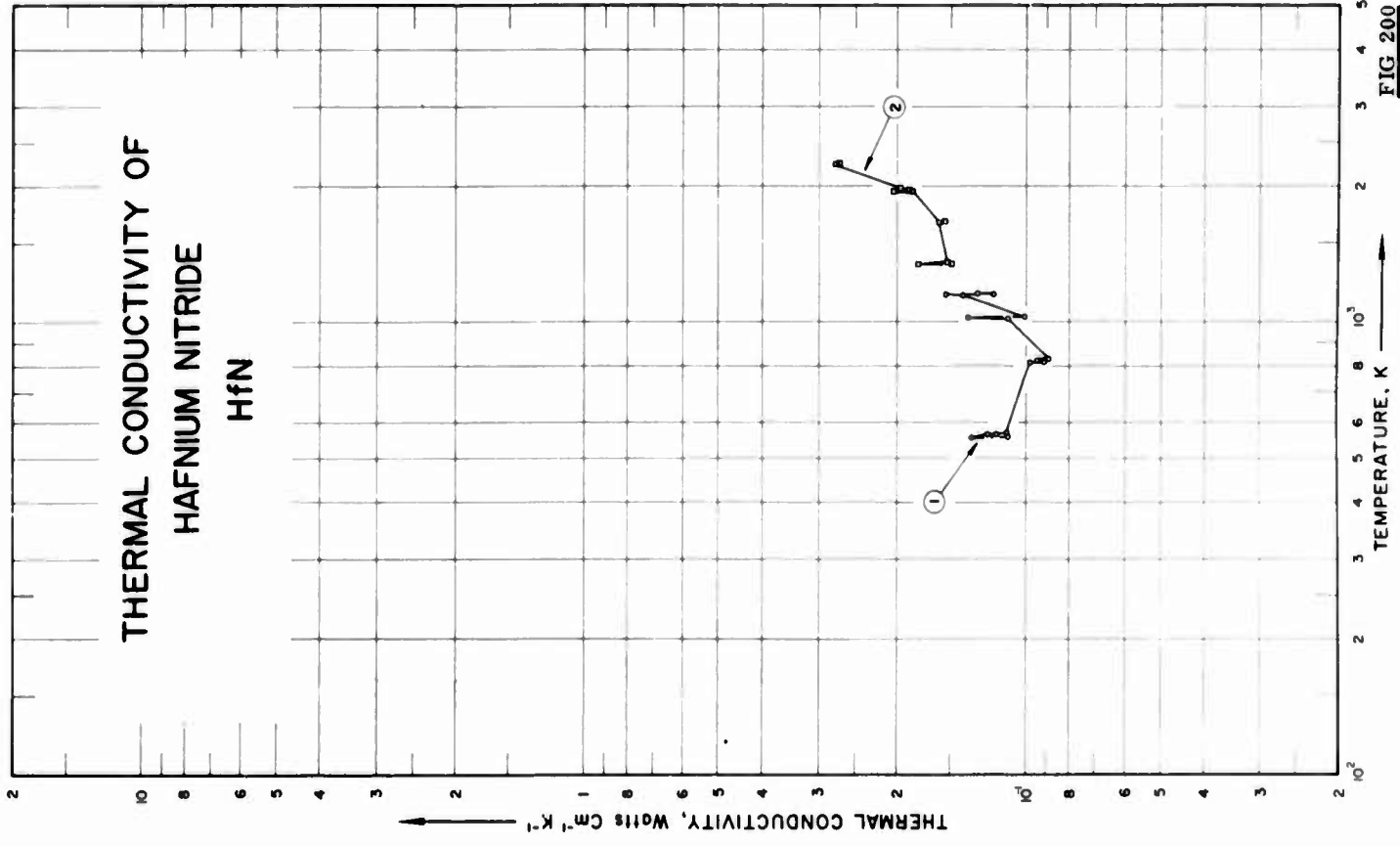
1047.1	0.362
1047.1	0.329
1474.8	0.256
1475.4	0.227
1498.7	0.210
1910.4	0.212
1917.1	0.234
1928.2	0.219
1933.2	0.233*
2108.7	0.183
2110.9	0.185
2112.1	0.184*
2114.3	0.185*

CURVE 3

1102.6	0.262
1102.6	0.260*
1540.4	0.256
1542.6	0.254*
1549.3	0.258
1894.3	0.233
1850.4	0.247
2120.4	0.194
2125.9	0.194*
2129.3	0.198

* Not shown on Plot

FIG 200



SPECIFICATION TABLE NO. 200 THERMAL CONDUCTIVITY OF HAFNIUM NITRIDE HfN

[For Data Reported in Figure and Table No. 200]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	243	R	1962	557-1149	~3		95.4 Hf, 6.61 N ₂ , and 0.9 O ₂ (wet analysis); hot-pressed to 3867 K; supplied by Carborundum Co.; density 10.89 g cm ⁻³ .
2	243	R	1962	1336-2232	~3		Second run of the above specimen; fractured during run.

DATA TABLE NO. 200 THERMAL CONDUCTIVITY OF HAFNIUM NITRIDE HfN

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
557.1	0.111
558.7	0.135
562.6	0.124
562.6	0.118
563.7	0.111
808.7	0.0987
811.5	0.0916
813.2	0.0948
817.1	0.0959
817.1	0.0859*
819.3	0.0920*
821.5	0.0896
1015.4	0.111
1016.5	0.138
1017.1	0.101
1144.8	0.141
1145.4	0.131
1149.3	0.155
1149.3	0.120
<u>CURVE 2</u>	
1335.9	0.150
1349.8	0.180
1349.8	0.153
1661.0	0.160
1661.0	0.156
1666.5	0.160*
1669.3	0.160*
1833.2	0.185
1933.2	0.205
1949.8	0.189
1961.0	0.198
2227.6	0.278
2227.6	0.273
2231.8	0.273*
2231.8	0.273*

* Not shown on Plot

THERMAL CONDUCTIVITY OF TRISILICON TETRANITRIDE Si_3N_4

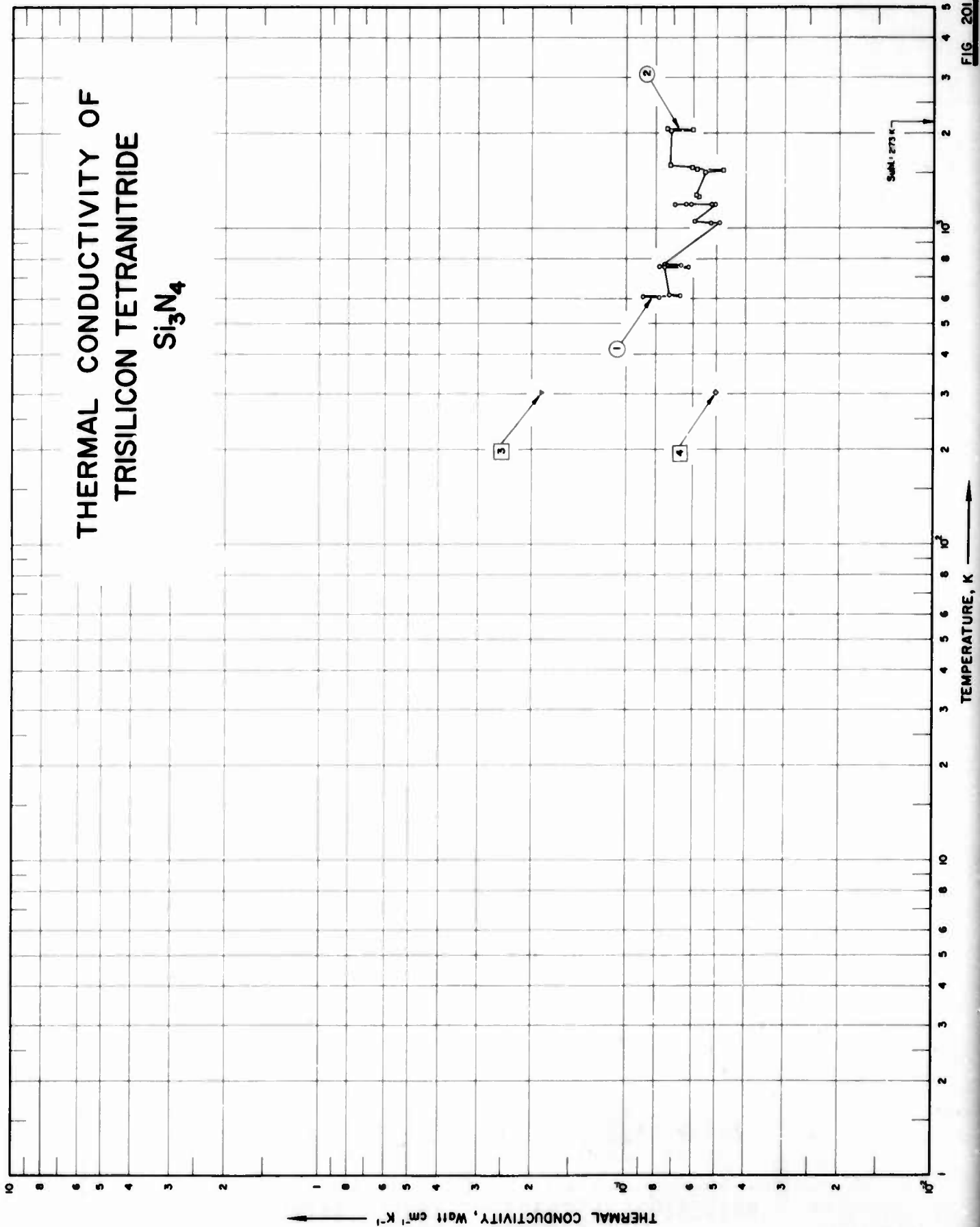


FIG. 201

SPECIFICATION TABLE NO. 201 THERMAL CONDUCTIVITY OF TRISILICON TETRANITRIDE Si_3N_4

[For Data Reported in Figure and Table No. 201.]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	243	R	1962	603-1195	2.5		Impurities 0.05 Ca, 0.01 Cu, 0.01 Mg, 0.3 Al, 1.5 Fe, 0.01 Ti and trace Be, Na, and Mn; cast; specimen 0.75 in. O.D., 0.25 in. I.D., 0.75 in. long; density 2.38 g cm ⁻³ .
2	243	R	1962	1267-2061	2.5		Second run of the above specimen; melted during run.
3	384	C	1962	303			Density 3.16 g cm ⁻³ ; data read from calibration of a direct-reading thermal comparator.
4	384	C	1962	303			Data for specimen of density 2.34 g cm ⁻³ .

DATA TABLE NO. 201 THERMAL CONDUCTIVITY OF TRISILICON TETRANITRIDE Si_3N_4 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
603.2	0.0786
607.1	0.0887
611.5	0.0663
613.2	0.0727
753.2	0.0750
755.4	0.0623
757.1	0.0779
763.7	0.0779*
764.3	0.0661
769.3	0.0750
1045.4	0.0490
1054.3	0.0525
1063.2	0.0596
1064.3	0.0594*
1190.4	0.0503
1192.6	0.0522
1193.7	0.0617
1194.3	0.0636
1194.8	0.0698
<u>CURVE 2</u>	
1266.5	0.0575
1272.1	0.0584
1294.3	0.0591*
1511.0	0.0548
1527.6	0.0476
1547.1	0.0584
1555.4	0.0606
1580.6	0.0721
2044.3	0.0715
2047.1	0.0600
2061.0	0.0734
<u>CURVE 3</u>	
303.0	0.185
<u>CURVE 4</u>	
303.0	0.050

* Not shown on Plot

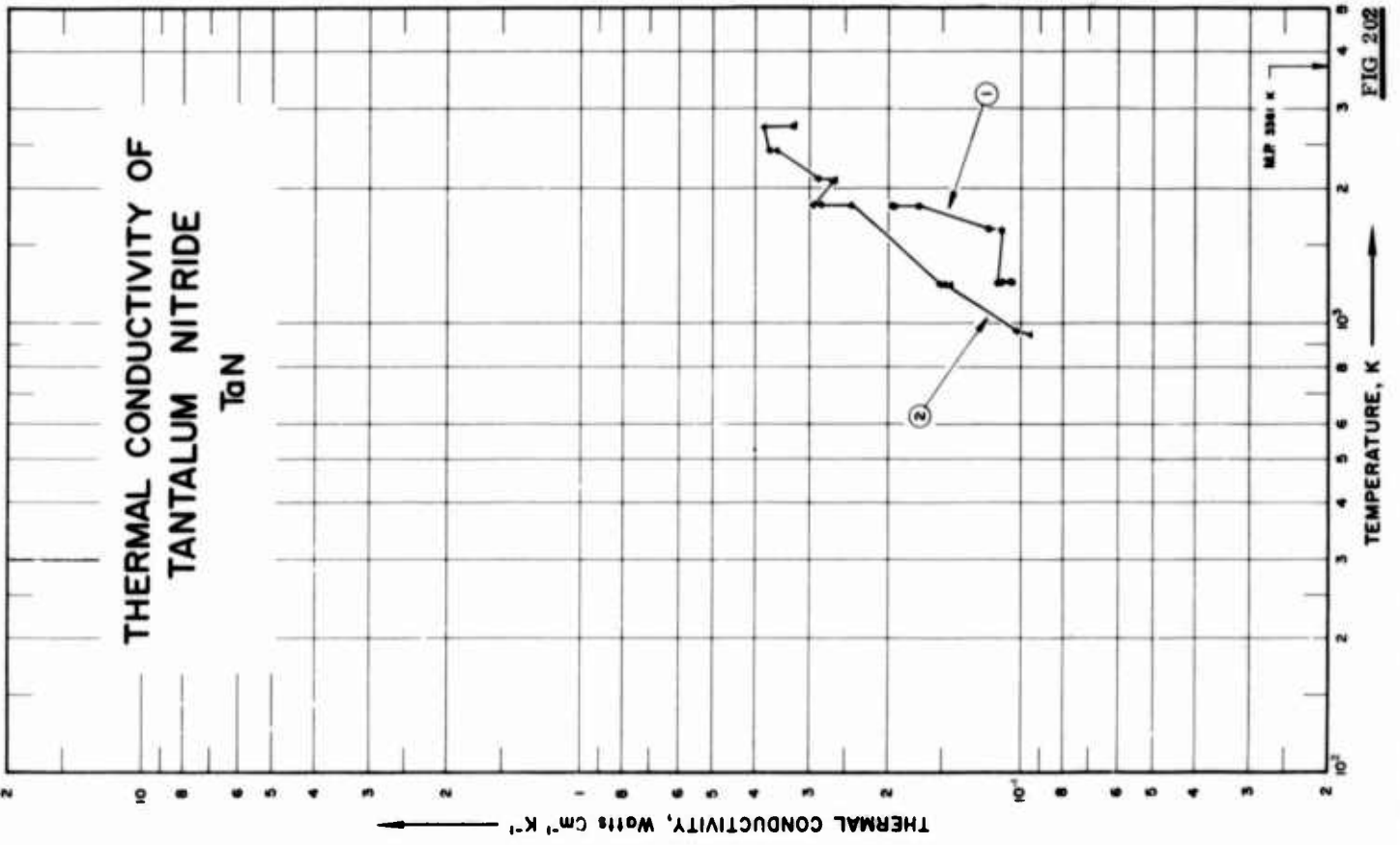


FIG 202

SPECIFICATION TABLE NO. 202 THERMAL CONDUCTIVITY OF TANTALUM NITRIDE TaN

[For Data Reported in Figure and Table No. 202]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	144	R	1963	1237-1836	~6			Specimen 0.75 in. O. D., 0.25 in. I. D., and 0.75 in. long; ground and polished to eliminate surface scratches; heat soaked at 1422 K; broke during run.
2	144	R	1963	948-2765	~6			Similar to the above specimen but not heat soaked; broke during run.

DATA TABLE NO. 202 THERMAL CONDUCTIVITY OF TANTALUM NITRIDE TaN

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
1237.1	0.114
1238.7	0.111
1238.7	0.112*
1238.7	0.107
1238.7	0.106
1610.9	0.111
1610.9	0.111*
1612.6	0.119
1820.9	0.170
1832.1	0.195
1835.9	0.196
<u>CURVE 2</u>	
948.2	0.0956
962.6	0.103
1223.7	0.149
1224.8	0.144
1224.8	0.152
1224.8	0.151*
1837.1	0.243
1842.1	0.285
1843.7	0.286
2077.6	0.266
2083.2	0.265
2089.8	0.287
2404.8	0.356
2408.2	0.356*
2414.3	0.372
2739.3	0.382
2750.9	0.329
2765.3	0.328

* Not shown on Plot

FIGURE SHOWS ONLY 19 OF THE CURVES REPORTED IN TABLE

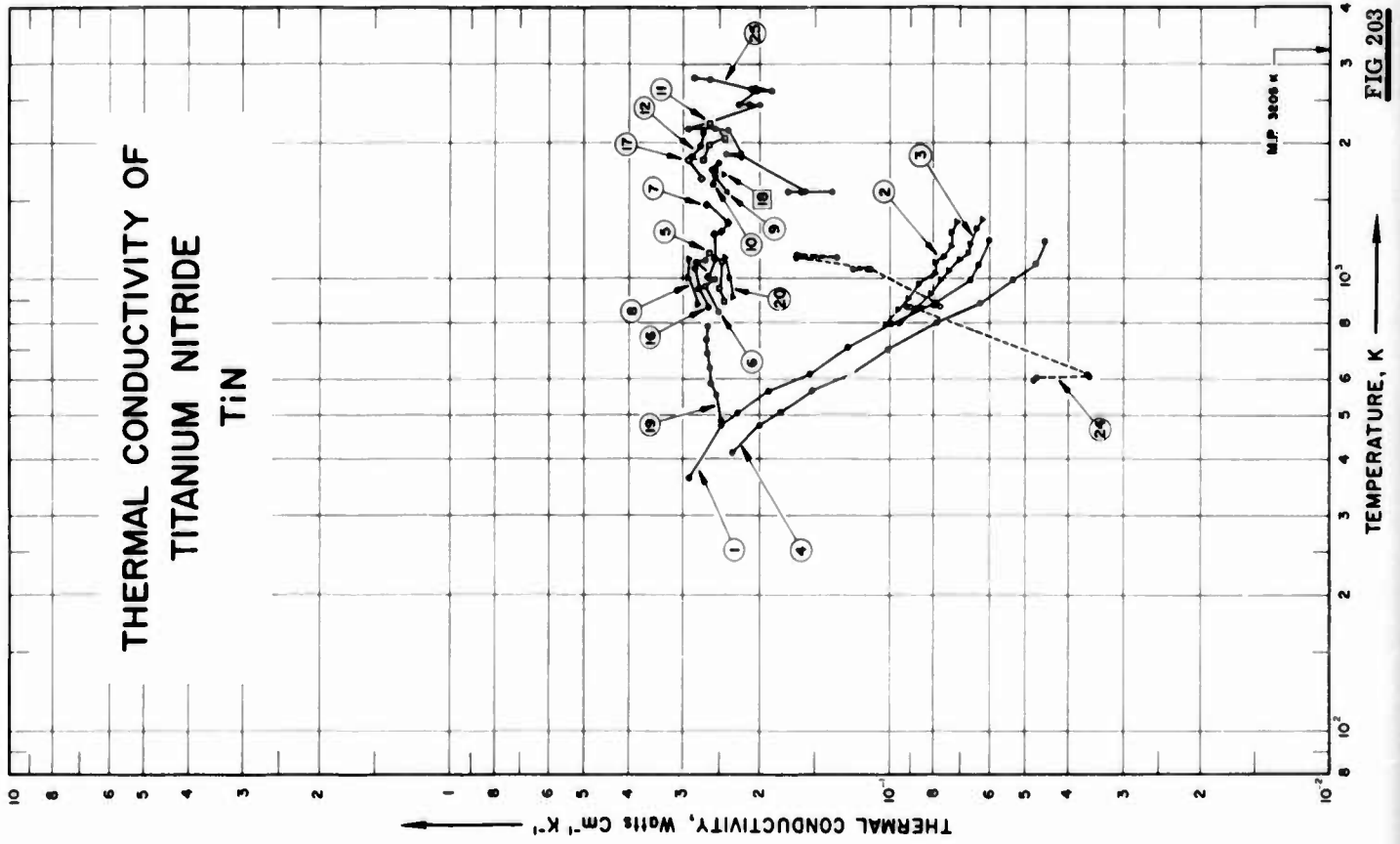


FIG 203

SPECIFICATION TABLE NO. 203 THERMAL CONDUCTIVITY OF TITANIUM NITRIDE TIN

[For Data Reported in Figure and Table No. 203]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	14	C	1953	363-1218			Supplier's analysis: initial composition 77.5 Ti, 18.0 N, 1.0 Ca, 0.2 H, 0.3 C, 0.1 Fe, and 0.1 SiO ₂ ; (after firing) 77.8 Ti, 18.2 N, and 2.6 O; 1 in. cubic specimen, hydrostatically pressed; fired at 2100 C; total porosity 19.0%; firing shrinkage 9%; dense sintered alumina used as comparative material.
2	14	R	1953	793-1343			The above composition; ellipsoidal specimen; slip cast and hydrostatically pressed; fired at 2100 C; total porosity 19.8%; shrinkage; pressing 6%, firing 9%.
3	14	R	1953	798-1353			The second run of the above specimen.
4	45	C	1953	413-1205			Cubic specimen; hydrostatically pressed; fired at 2100 C; measured in vacuo.
5	270, 413, 414	R	1962	884-1193		1	76.5 Ti, 17.7 N, <0.5 other metals and carbon; specimen 2 in. O.D., 0.5 in. I.D. and 1.5 in. long; supplied by General Astrometals Corp.; single phase; average grain size 11 μ ; density 4.91 g cm ⁻³ ; porosity 10%; measured in helium atmosphere.
6	270, 413, 414	R	1962	840-1100		1	Second run of the above specimen.
7	270, 413, 414	R	1962	1010-1455		1	Third run of the above specimen.
8	270, 413, 414	R	1962	878-1107		1	Fourth run of the above specimen.
9	270, 413, 414	R	1962	1558-1732		1	Fifth run of the above specimen.
10	270, 413, 414	R	1962	1611-1800		1	Sixth run of the above specimen.
11	270, 413, 414	R	1962	1833-2205		1	Seventh run of the above specimen.
12	270, 413, 414	R	1962	1723-2107		1	Eighth run of the above specimen.
13	270, 413, 414	R	1962	882-1190		2	77.9 Ti, 17.9 N, <0.9 other metals and carbon; single phase; specimen 2 in. O.D., 0.5 in. I.D. and 1.5 in. long; supplied by General Astrometals Corp; average grain size 11 μ ; density 4.78 g cm ⁻³ ; porosity 12%; measured in helium atmosphere.
14	270, 413, 414	R	1962	1782.2		2	Second run of the above specimen.
15	270, 413, 414	R	1962	964, 1127		2	Third run of the above specimen.
16	270, 413, 414	R	1962	862-1062		2	Fourth run of the above specimen.

SPECIFICATION TABLE NO. 203 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
17	270,413, 414	R	1962	1671-1828		2	Fifth run of the above specimen.
18	270,413, 414	R	1962	1698.2		2	Sixth run of the above specimen.
19	270,413, 414	R	1962	483-783		2	Seventh run of the above specimen.
20	270,413, 414	R	1962	904-1115		3	No details reported.
21	270,413, 414	R	1962	899.2		3	Second run of the above specimen.
22	270,413, 414	R	1962	892-1130		3	Third run of the above specimen.
23	270,413, 414	R	1962	888-1052		3	Fourth run of the above specimen.
24	243	R	1962	594-1119	~3		Specimen 0.75 in. O.D., 0.25 in. I.D., and 0.75 in. long; hot pressed; density 4.08 g cm ⁻³ .
25	243	R	1962	1553-2769	~3		Second run of the above specimen; melted during measurement.
26	258,413	P	1963	473-773		2	77.9 Ti, 17.9 N, <0.9 other metals, remainder probably oxygen tied up as TiO ₂ (composition after measurements); single phase; average grain size 11 μ; specimen 0.250 in. dia, 0.100 in. thick; cut from specimen 2, density 4.78 g cm ⁻³ ; thermal conductivity data calculated from measured diffusivity values (with flash technique) and specific heat data of Naylor, B. F. (J. Am. Ceram. Soc., 68(3), 370-1, 1946)

DATA TABLE NO. 203 THERMAL CONDUCTIVITY OF TITANIUM NITRIDE TiN

[Temperature, T, K; Thermal Conductivity, k, Watts cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k
CURVE 1									
363.2	0.291	613.2	0.124	1611.2	0.259	1698.2	0.243	1052.1	0.113
473.2	0.248	697.2	0.102	1740.2	0.258			1117.6	0.167
503.2	0.227	797.2	0.0791	1800.2	0.251	CURVE 19			
563.2	0.192	881.2	0.0636			CURVE 25			
616.2	0.155	993.2	0.0536	CURVE 11		483.2	0.249	1552.6	0.137
703.2	0.126	1078.8	0.0477	1833.2	0.271	553.2	0.255	1552.6	0.163
796.2	0.100	1205.2	0.0452	1986.2	0.264	583.2	0.262	1552.6	0.175
883.2	0.0795	CURVE 5		2044.2	0.244	633.2	0.264	1552.6	0.160
991.2	0.0669	894.2	0.224	2205.2	0.262	733.2	0.268	1552.6	0.222
1075.2	0.0640	941.2	0.250	CURVE 12		783.2	0.266	1861.0	0.242
1218.2	0.0602	948.2	0.250*	1723.2	0.259*	CURVE 20			
CURVE 2									
793.2	0.103	1090.2	0.246	1860.2	0.289	904.2	0.232	1869.3	0.224
851.2	0.0962	1103.2	0.263	1964.2	0.276	1008.2	0.237	1872.1	0.226*
903.2	0.0912	CURVE 6		1978.2	0.278*	1115.2	0.245	2127.6	0.238
973.2	0.0866	840.2	0.251	2107.2	0.273	CURVE 21*			
1033.2	0.0795	963.2	0.269	CURVE 13*		899.2	0.263	2144.3	0.265
1123.2	0.0761	997.2	0.256	882.2	0.279	CURVE 22*			
1181.2	0.0732	1082.2	0.280	963.2	0.257	892.2	0.242	2149.8	0.294
1273.2	0.0732	1100.2	0.269	1076.2	0.267	1034.2	0.257	2416.5	0.200
1343.2	0.0711	CURVE 7		1190.2	0.273	1130.2	0.253	2427.6	0.212
CURVE 3									
798.2	0.0954	1010.2	0.263	1782.2	0.254	CURVE 23*			
863.2	0.0879	1118.2	0.254	CURVE 14*		898.2	0.233	2597.1	0.202
923.2	0.0816	1251.2	0.256	1782.2	0.254	1009.2	0.247	2613.7	0.186
993.2	0.0778	1270.2	0.248	CURVE 15*		1052.2	0.251	2622.1	0.213
1043.2	0.0741	1337.2	0.238	964.2	0.279	CURVE 24			
1103.2	0.0707	1455.2	0.267	1127.2	0.274	594.3	0.0479	2763.7	0.264
1143.2	0.0674	CURVE 8		CURVE 16		600.4	0.0470	2769.3	0.284
1199.2	0.0669	878.2	0.278	862.2	0.264	604.3	0.0359	473.2	0.249
1291.2	0.0649	1004.2	0.292	945.2	0.276	612.6	0.0366	523.2	0.254
1353.2	0.0628	1107.2	0.291	1062.2	0.283	874.3	0.0923	573.2	0.259
CURVE 4									
413.2	0.234	CURVE 9		1671.2	0.274	874.8	0.0897	623.2	0.262
473.2	0.201	1556.2	0.241	1828.2	0.293	874.8	0.0776	723.2	0.266
505.2	0.181	1654.2	0.255						
565.2	0.154	1732.2	0.255						

*Not shown on plot

THERMAL CONDUCTIVITY OF URANIUM NITRIDE UN

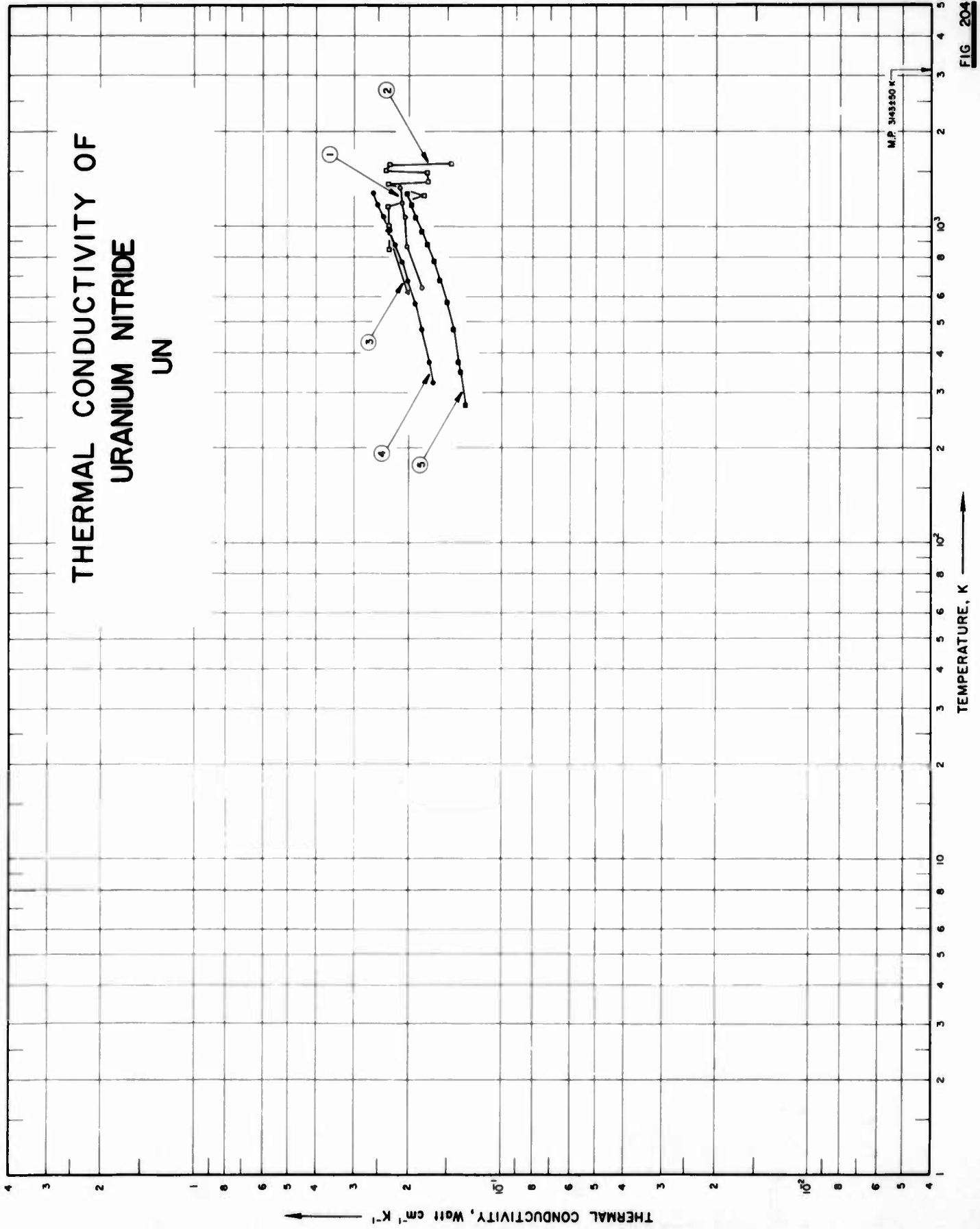


FIG. 204

SPECIFICATION TABLE NO. 204 THERMAL CONDUCTIVITY OF URANIUM NITRIDE UN

[For Data Reported in Figure and Table No. 204]

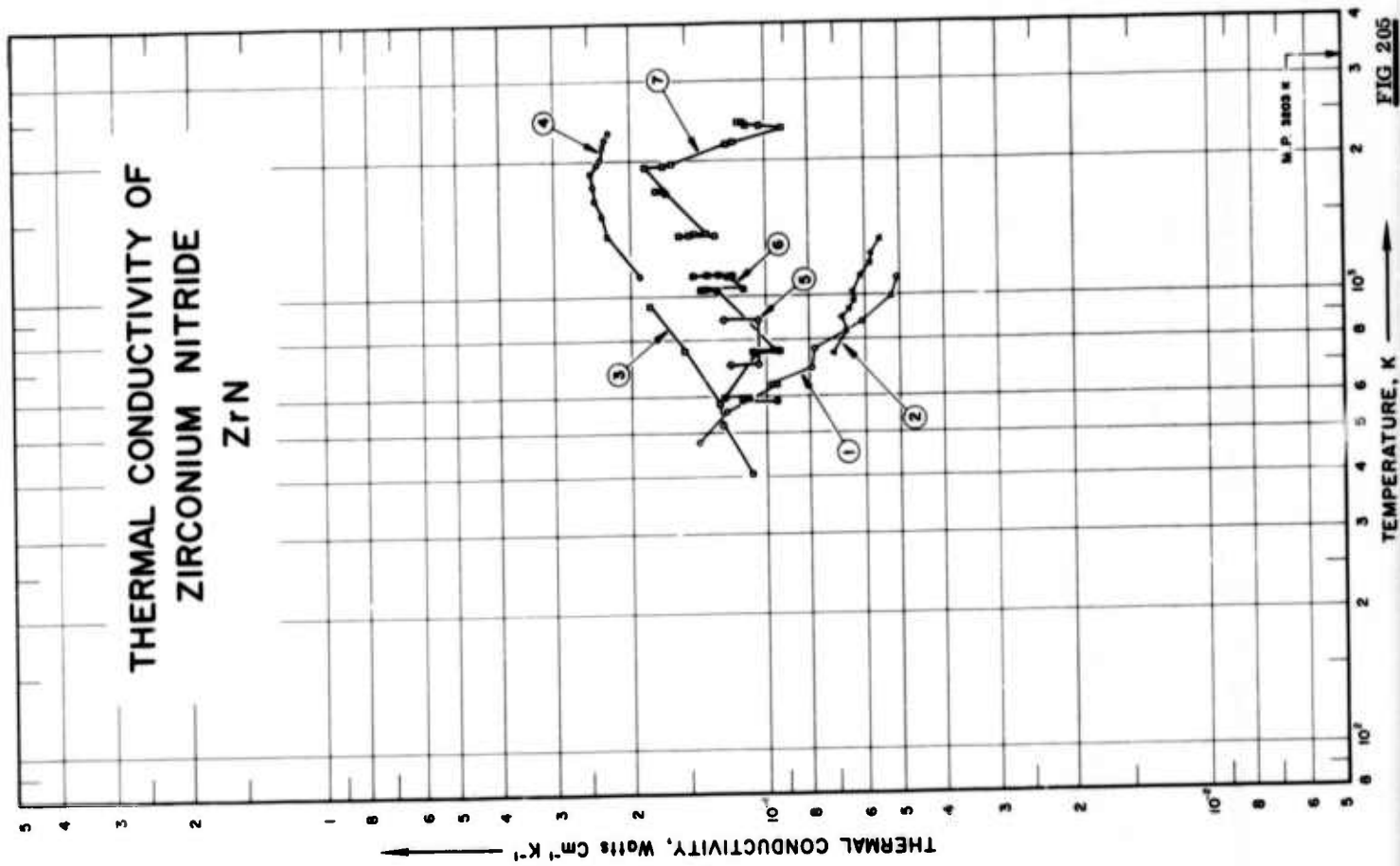
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	502	P	1963	640-1333			95 to 98% dense, prepared by hot pressing.
2	502	P	1963	845-1583			The above specimen, second run.
3	502	P	1963	620, 976			95 to 98% dense, prepared by hot pressing.
4	503	C	1964	323-1273			5.38 N, 0.047 C, 0.0055 O, 0.0025 Si, <0.002 Zn, <0.001 each Al, Fe, and K, <0.006 P, <0.0002 each Ni, Mg, Bi, and Pb, <0.0008 Nb, <0.0005 Sn, Cr, <0.0003 V, Ca, 0.0003 Mo, <0.0001 Mn, 0.0001 each B, Cu, trace Cd and Li; dense, stoichiometric, polycrystalline; prepared by the slow reaction consumable electrode arc-melting method; ground into a 0.5 in. dia cylinder 11/16 in. long and metallographically polished on both ends; measurements made under a vacuum of 4×10^{-4} torr; metallographic structure after the measurements free from cracks and contaminations at grain boundaries; stainless steel used as comparative material.
5	504		1964	273-1273			94.5% dense UN; specimen 1 in. in dia and 0.25 in. thick; the thermal conductivity measured values corrected to theoretical density.

DATA TABLE NO. 204 THERMAL CONDUCTIVITY OF URANIUM NITRIDE UN

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
640.2	0.181	573.2	0.151
663.2	0.203	673.2	0.159
1074.2	0.206	773.2	0.166
1193.2	0.210	873.2	0.174
1333.2	0.214	973.2	0.182
<u>CURVE 2*</u>			
845.2	0.232	1073	0.190
1001.2	0.232	1173	0.196
1165.2	0.234	1273	0.203
1251.2	0.179		
1251.2	0.179		
1369.2	0.233		
1394.2	0.174		
1492.2	0.175		
1510.2	0.237		
1573.2	0.230		
1583.2	0.147		
<u>CURVE 3</u>			
620.2	0.202		
976.2	0.233		
<u>CURVE 4</u>			
323.2	0.167		
373.2	0.172		
473.2	0.182		
573.2	0.191		
673.2	0.201		
773.2	0.211		
873.2	0.221		
973.2	0.231		
1073.2	0.241		
1173.2	0.251		
1273.2	0.260		
<u>CURVE 5</u>			
273.2	0.131		
348.2	0.136		
373.2	0.138		
473.2	0.144		

* Not shown on plot



SPECIFICATION TABLE NO. 205 THERMAL CONDUCTIVITY OF ZIRCONIUM NITRIDE ZrN

[For Data Reported in Figure and Table No. 205]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	14	C	1953	478-1093			Initial composition (supplier's) 9.8 N, 0.12 C, 0.7 SiO ₂ , and 0.03 H; after firing 81.8 Zr, 8.9 N, and 5.2 O; 1 in cubic specimen; hydrostatically pressed; fired at 2000 C; porosity 19.3%; total shrinkage 10%; dense sintered alumina used as comparative material.
2	14	R	1953	748-1341			Initial composition (supplier's) 9.8 N, 0.12 C, 0.7 SiO ₂ , and 0.03 H; after firing 81.8 Zr, 8.9 N, and 5.2 O; ellipsoidal specimen; slip-cast and hydrostatically pressed; fired at 2000 C; porosity 19.6%; linear shrinkage: pressing 5%, firing 19%.
3	251	C	1963	408-955	±4		84.6 Zr, 13.5 N, 0.2 Fe, 0.8 H, 0.4 Si, and 0.5 alkali metal oxides; supplied by Norton Co.; specimen 2 in. dia., 1 in thick; hot-pressed and fired at 2373 K; density 6.50 g cm ⁻³ ; measured in a helium atmosphere; Armco iron used as comparative material.
4	251	P	1963	1117-2308	±4		The above specimen measured by another method; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
5	243	K	1962	704-889	~3		Specimen 0.75 in. O. D., and 0.25 in. I. D., and 0.75 in. long; pressed and sintered; supplied by General Electric Co.; density 6.84 g cm ⁻³ ; deteriorated at 2928 K.
6	243	R	1962	589-1113	~3		Second run of the above specimen.
7	243	R	1962	1561-2405	~3		Third run of the above specimen; fractured during run

DATA TABLE NO. 205 THERMAL CONDUCTIVITY OF ZIRCONIUM NITRIDE ZrN

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k
<u>CURVE 1</u>					
478.2	0.142	703.7	0.121	2399.8	0.111
553.2	0.124	709.8	0.105	2405.4	0.117
638.2	0.0941	888.2	0.105	2405.4	0.114
638.2	0.0979	889.3	0.126		
691.2	0.0795	<u>CURVE 6</u>			
763.2	0.0782	588.7	0.0946		
873.2	0.0615	588.7	0.114		
996.2	0.0523	593.2	0.110		
1093.2	0.0510	594.3	0.125		
		745.4	0.107		
		754.8	0.0932		
		755.4	0.108		
		755.9	0.0963		
		1021.5	0.129		
		1027.1	0.137		
		1035.1	0.140		
		1039.3	0.113		
		1109.8	0.123		
		1111.5	0.120		
		1111.5	0.146		
		1112.1	0.128		
		1112.6	0.135		
		<u>CURVE 7</u>			
		1360.9	0.156		
		1363.7	0.148		
		1363.7	0.130		
		1366.5	0.144		
		1372.1	0.136		
		1699.8	0.166		
		1705.4	0.176		
		1705.4	0.169		
		1936.7	0.186		
		1944.3	0.169		
		1952.6	0.162		
		1955.4	0.163*		
		2161.0	0.123		
		2183.2	0.119		
		2186.0	0.122*		
		2349.8	0.0914		
		2388.7	0.104		
		<u>CURVE 5</u>			
		703.7	0.121		
		709.8	0.105		
		888.2	0.105		
		889.3	0.126		
		<u>CURVE 6</u>			
		588.7	0.0946		
		588.7	0.114		
		593.2	0.110		
		594.3	0.125		
		745.4	0.107		
		754.8	0.0932		
		755.4	0.108		
		755.9	0.0963		
		1021.5	0.129		
		1027.1	0.137		
		1035.1	0.140		
		1039.3	0.113		
		1109.8	0.123		
		1111.5	0.120		
		1111.5	0.146		
		1112.1	0.128		
		1112.6	0.135		
		<u>CURVE 7</u>			
		1360.9	0.156		
		1363.7	0.148		
		1363.7	0.130		
		1366.5	0.144		
		1372.1	0.136		
		1699.8	0.166		
		1705.4	0.176		
		1705.4	0.169		
		1936.7	0.186		
		1944.3	0.169		
		1952.6	0.162		
		1955.4	0.163*		
		2161.0	0.123		
		2183.2	0.119		
		2186.0	0.122*		
		2349.8	0.0914		
		2388.7	0.104		
		<u>CURVE 3</u>			
408.2	0.109				
520.9	0.126				
573.3	0.128				
760.9	0.152				
955.4	0.182				
		<u>CURVE 4</u>			
1116.5	0.192				
1372.1	0.227				
1502.6	0.232				
1636.7	0.242				
1758.2	0.244				
1883.2	0.246				
1966.5	0.239				
2019.3	0.235				
2149.8	0.232				
2236.7	0.228				
2307.6	0.225				

* Not shown on plot

SPECIFICATION TABLE NO. 206 THERMAL CONDUCTIVITY OF AMMONIUM DIHYDROGEN PHOSPHATE $\text{NH}_4\text{H}_2\text{PO}_4$

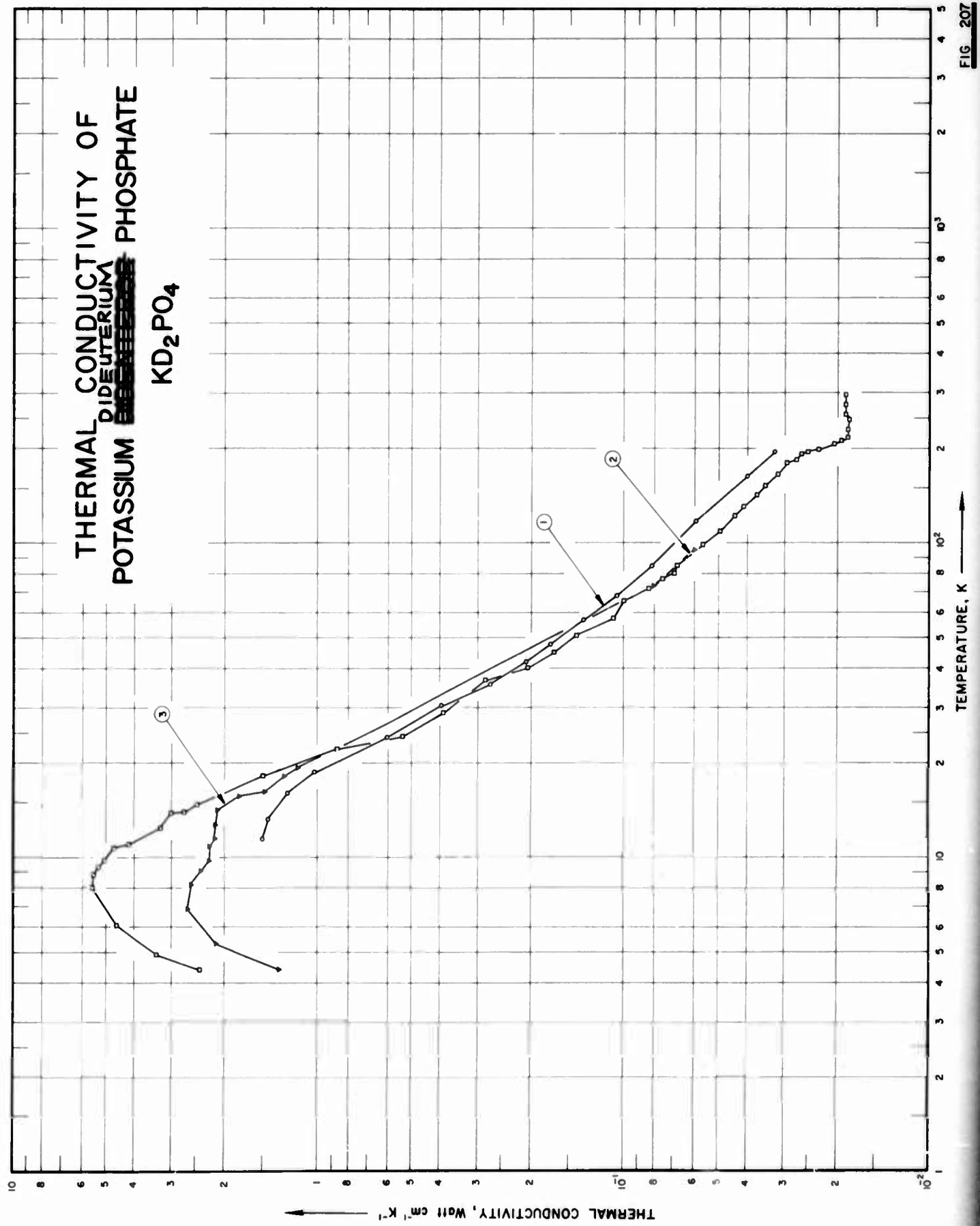
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	71	C	1951	315, 339			Tetragonal crystal; measured with heat flow parallel to the optic axis.
2	71	C	1951	313, 342			As above but heat flow perpendicular to the optic axis.

DATA TABLE NO. 206 THERMAL CONDUCTIVITY OF AMMONIUM DIHYDROGEN PHOSPHATE $\text{NH}_4\text{H}_2\text{PO}_4$

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
315.2	0.00711
339.2	0.00711
<u>CURVE 2*</u>	
313.2	0.0126
342.2	0.0134

* No graphical presentation



DIDEUTERIUM
SPECIFICATION TABLE NO. 207 THERMAL CONDUCTIVITY OF POTASSIUM-DIDEUTERIUM PHOSPHATE KD_2PO_4

[For Data Reported in Figure and Table No. 207]

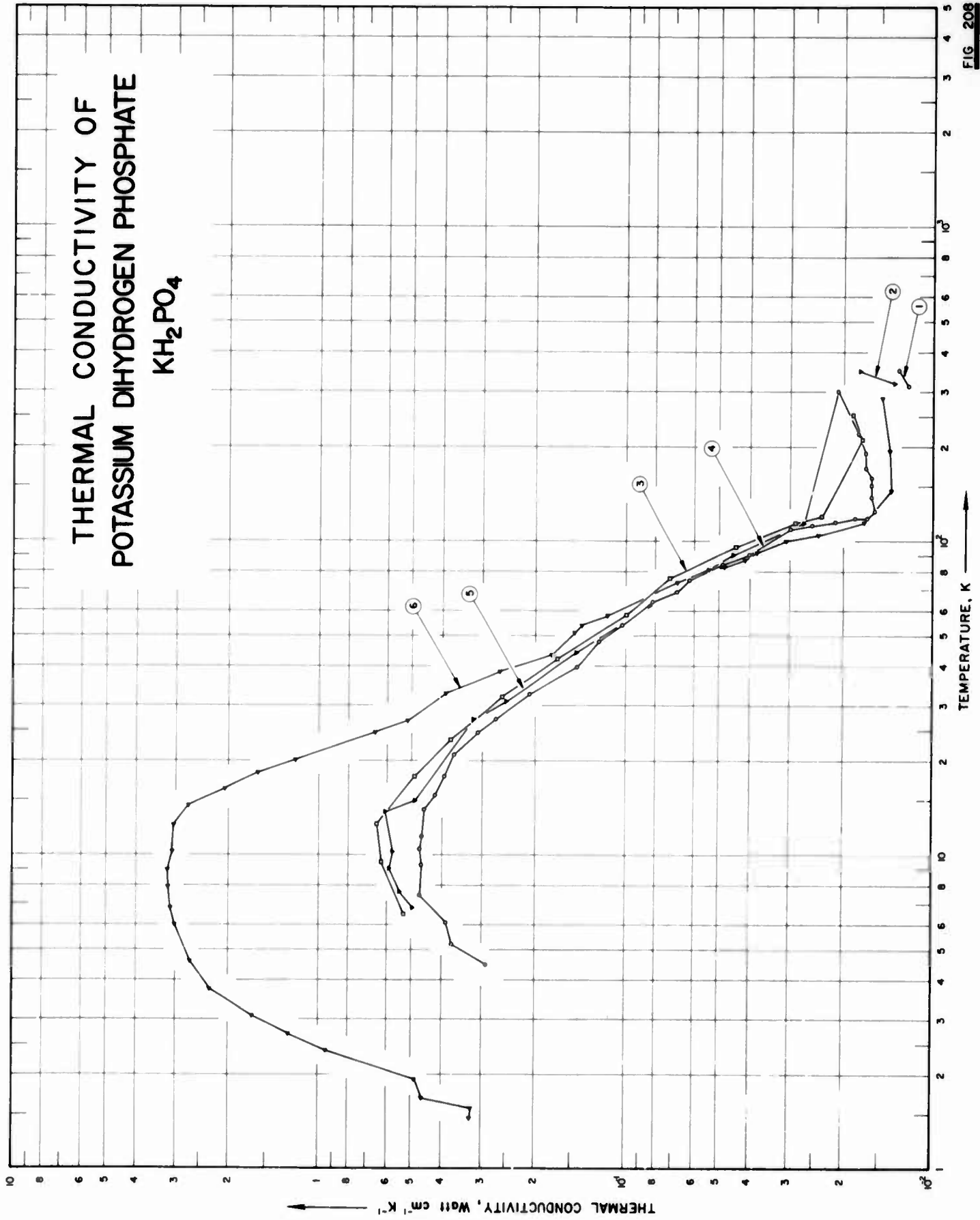
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	514	L	1966	12-196		No. 1a	Single crystal with tetragonal symmetry, nominally 92% - deuterated for hydrogen; specimen 2.4 x 2.4 x 6.3 mm, long dimension parallel to a-axis; supplied by Isomet Corporation; cut and formed into rectangular rod using a wet thread and a polishing paper; Curie temperature 213 K; heat flow along a-axis.
2	514	L	1966	4.4-297		No. 2c	Similar to the above specimen except specimen 2.1 x 2.7 x 11.6 mm, long dimension parallel to c-axis; heat flow along c-axis.
3	514, 515	L	1966	4.4-95		No. 3c	Similar to the above specimen except specimen 2.2 x 2.2 x 11.5 mm, long dimension parallel to c-axis.

DATA TABLE NO. 207 THERMAL CONDUCTIVITY OF POTASSIUM ~~DI~~ **DIDEUTERIUM** PHOSPHATE KD_2PO_4

[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
11.5	1.51	99.3	0.0562
13.3	1.45	109.7	0.0494
16.1	1.25	122.2	0.0440
18.7	1.03	131.9	0.0410
24.3	0.607	143.6	0.0370
30.6	0.398	152.8	0.0348
35.7	0.272	166.4	0.0314
42.2	0.207	180.4	0.0294
47.9	0.172	184.6	0.0273
57.2	0.135	193.7	0.0263
68.1	0.105	196.8	0.0250
84.6	0.0813	199.1	0.0231
118.9	0.0594	208.5	0.0205
164.4	0.0399	213.9	0.0194
196.4	0.0323	217.8	0.0185
<u>CURVE 2</u>			
4.40	2.43	230.2	0.0185
4.93	3.38	247.8	0.0183
6.10	4.61	258.9	0.0188
7.98	5.56	276.8	0.0188
8.79	5.51	297.2	0.0188
9.29	5.33	<u>CURVE 3</u>	
9.90	5.06	4.43	1.32
10.7	4.74	5.35	2.14
11.0	4.18	6.89	2.65
12.4	3.27	8.21	2.58
13.8	3.02	9.06	2.39
13.9	2.73	9.82	2.26
14.7	2.47	10.9	2.25
18.3	1.50	11.6	2.16
22.2	0.867	12.7	2.15
24.4	0.537	14.3	2.13
28.9	0.391	15.7	1.79
36.7	0.283	16.3	1.47
40.2	0.205	18.2	1.28
45.0	0.167	19.4	1.16
50.8	0.143	73.6	0.0796
57.6	0.108	95.1	0.0594
65.9	0.0991		
71.8	0.0828		
77.1	0.0752		
80.2	0.0690		
84.7	0.0678		

THERMAL CONDUCTIVITY OF
POTASSIUM DIHYDROGEN PHOSPHATE
 KH_2PO_4



SPECIFICATION TABLE NO. 208 THERMAL CONDUCTIVITY OF POTASSIUM DIHYDROGEN PHOSPHATE KH_2PO_4

[For Data Reported in Figure and Table No. 208]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	71	C	1951	312-350			Tetragonal crystal; measured with heat flow parallel to the optic axis.
2	71	C	1951	319-347			Above specimen measured with heat flow perpendicular to the optic axis.
3	514, 515	L	1966	6.5-253		No. 1a	Single crystal with tetragonal symmetry; 2.1 x 2.8 x 10.7 mm, long dimension parallel to a-axis; supplied by Gakushuin University; cut and formed into rectangular rod using a wet thread and a polishing paper; Curie temperature 122 K; heat flow along a-axis.
4	514, 515	L	1966	4.5-300		No. 2c	Similar to the above specimen except specimen 2.3 x 2.4 x 11.7 mm, long dimension parallel to c-axis; heat flow along c-axis.
5	515	L	1967	6.8-301		No. 3c	Similar to the above specimen except specimen 2.4 x 2.6 x 11.9 mm, long dimension parallel to c-axis.
6	440		1964	1.5-286			Ferroelectric - paraelectric transition occurred at 116 K.

DATA TABLE NO. 208 THERMAL CONDUCTIVITY OF POTASSIUM DIHYDROGEN PHOSPHATE KH_2PO_4
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k	T	k	T	k
<u>CURVE 1</u>							
312.2	0.0121	69.8	0.0684	6.78	3.13		
350.2	0.0130	75.7	0.0622	7.87	3.18		
<u>CURVE 2</u>							
		84.6	0.0485	8.95	3.17		
		90.8	0.0401	10.2	3.07		
		109.4	0.0299	12.5	3.05		
319.2	0.0134	112.5	0.0254	14.4	2.72		
347.2	0.0176	116.2	0.0213	16.2	2.06		
<u>CURVE 3</u>							
		118.9	0.0182	18.2	1.59		
		118.9	0.0166	20.1	1.19		
		125.1	0.0156	24.6	0.659		
6.50	0.530	138.1	0.0160	26.8	0.519		
9.46	0.628	151.4	0.0160	32.7	0.391		
12.6	0.649	159.6	0.0160	38.6	0.262		
17.8	0.490	171.0	0.0167	43.6	0.176		
23.3	0.378	191.9	0.0167	51.1	0.147		
31.9	0.258	220.9	0.0177	54.2	0.139		
42.4	0.168	300.0	0.0209	58.9	0.114		
58.4	0.0995			74.1	0.0676		
76.4	0.0716			81.1	0.0536		
95.7	0.0443			83.8	0.0481		
114.6	0.0289			87.7	0.0415		
120.8	0.0236			92.9	0.0379		
211.9	0.0173			100.2	0.0308		
253.0	0.0186			104.7	0.0283		
<u>CURVE 4</u>							
4.49	0.291	10.3	0.575	104.7	0.0283		
5.20	0.373	13.7	0.607	115.6	0.0170		
6.08	0.389	14.9	0.486	145.9	0.0138		
7.45	0.272	17.1	0.319	194.1	0.0139		
9.27	0.465	27.1	0.249	286.4	0.0148		
10.5	0.474	30.9	0.145				
11.5	0.465	44.4	0.0450				
14.0	0.488	90.0	0.0450				
15.6	0.423	114.0	0.0270				
17.8	0.395	301.4	0.0209*				
20.9	0.368						
24.6	0.311						
27.1	0.271						
32.6	0.209						
39.7	0.145						
47.8	0.123						
54.0	0.102						
64.1	0.0817						
<u>CURVE 5</u>							
		6.84	0.494				
		7.61	0.545				
		9.02	0.586				
		10.3	0.575				
		13.7	0.607				
		14.9	0.486				
		17.1	0.319				
		27.1	0.249				
		30.9	0.145				
		44.4	0.0450				
		90.0	0.0450				
		114.0	0.0270				
		301.4	0.0209*				
<u>CURVE 6</u>							
		1.45	0.325				
		1.56	0.323				
		1.68	0.462				
		1.92	0.489				
		2.38	0.944				
		2.69	1.26				
		3.08	1.65				
		3.75	2.31				
		4.59	2.68				
		5.96	3.01				

* Not shown on plot

SPECIFICATION TABLE NO. 209 THERMAL CONDUCTIVITY OF AMMONIUM HYDROGEN SULFATE NH_4HSO_4

Curve No.	Rel. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	242	P	1961	413-486	± 3		Specimen of A. R. purity; mean value of 4 or 5 different measurements for each data point; measured in molten state by using a thermal conductivity wire probe. Same as above.
2	242	P	1961	418	± 3		

DATA TABLE NO. 209 THERMAL CONDUCTIVITY OF AMMONIUM HYDROGEN SULFATE NH_4HSO_4 [Temperature, T. K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T k

CURVE 1*

413.2 0.00465
 417.5 0.00436
 436.2 0.00396
 461.2 0.00379
 486.4 0.00362

CURVE 2*

418 0.00389

No graphical presentation

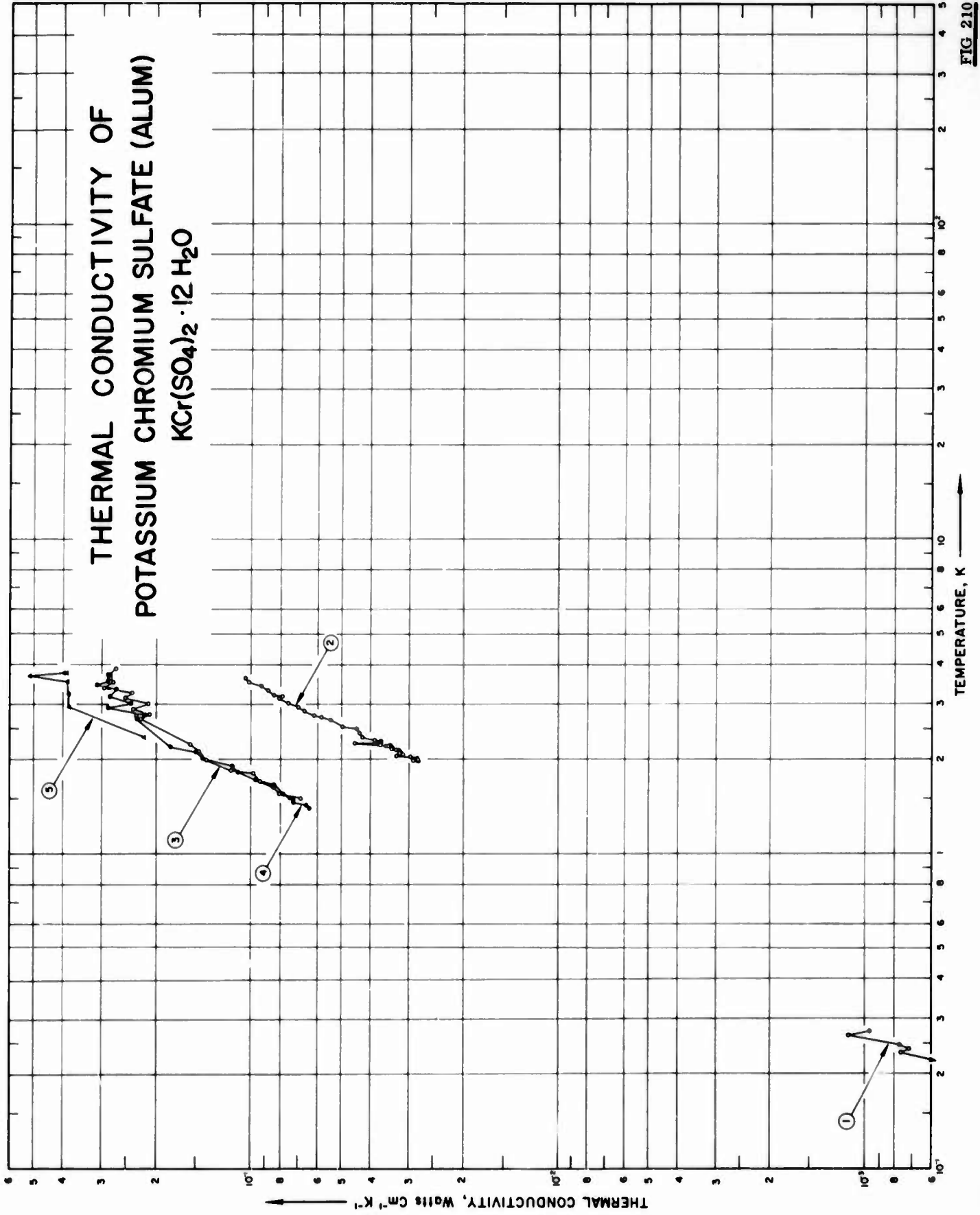


FIG 210

SPECIFICATION TABLE NO. 210 THERMAL CONDUCTIVITY OF POTASSIUM CHROMIUM SULFATE (ALUM) $KCr(SO_4)_2 \cdot 12H_2O$

[For Data Reported in Figure and Table No. 210]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	77	L	1950	0.15-0.27		Potassium chrome alum salt	Single crystal; 65 mm long, octagonal cross section with 15 mm width; cut from a crystal so that the specimen axis coincided with one of the cubic axes of the crystal.
2	78	L	1948	2.0-3.6		Potassium chrome alum salt; 14-XI	10.46 Cr (theoretically 10.43 Cr), 0.007 Fe; not detectable for contamination with Al and Mn; cut from a large octahedral crystal in the direction of any edge; some turbid spots and some small bubbles shown on rod; cooled as quickly as possible by the help of helium gas passing through glass envelope.
3	78	L	1948	1.5-3.9		Potassium chrome alum salt; 13-XII	Same as the above specimen except cooled slowly by evacuating helium gas from the envelope at temperatures from 70 K to 20 K, but helium gas inserted when cooled from 20 K to 4 K.
4	78	L	1948	1.4-3.7		Potassium chrome alum salt; 19-XII	Same as the above specimen.
5	78	L	1948	2.4-3.8		Potassium chrome alum salt	Same as the above specimen except cooled very slowly with envelope evacuated all the time.

DATA TABLE NO. 210 THERMAL CONDUCTIVITY OF POTASSIUM CHROMIUM SULFATE (ALUM) $\text{KCr(SO}_4)_2 \cdot 12\text{H}_2\text{O}$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k	T	k	T	k
<u>CURVE 1</u>							
0.145	0.000158*	3.17	0.0787	2.02	0.143	3.17	0.0787
0.149	0.000186*	3.20	0.0840	2.10	0.148*	3.20	0.0840
0.166	0.000222	3.31	0.0877	2.18	0.180	3.31	0.0877
0.218	0.000552	3.41	0.0926	2.67	0.231	3.41	0.0926
0.235	0.000756	3.51	0.101	2.76	0.219	3.51	0.101
0.240	0.000715	3.61	0.104	2.91	0.286	3.61	0.104
0.248	0.000768	<u>CURVE 3</u>					
0.266	0.00112	1.50	0.0685	3.00	0.241	1.50	0.0685
0.274	0.00096	1.56	0.0906	3.32	0.269	1.56	0.0906
<u>CURVE 2</u>							
1.97	0.0277	1.63	0.0840	3.45	0.313	1.63	0.0840
1.98	0.0290	1.70	0.0935	3.53	0.286	1.70	0.0935
2.00	0.0279	1.84	0.116	3.69	0.285	1.84	0.116
2.01	0.0280	1.99	0.139	<u>CURVE 5</u>			
2.04	0.0296	2.11	0.149	2.35	0.218	2.11	0.149
2.05	0.0329	2.13	0.147	2.92	0.382	2.13	0.147
2.07	0.0313	2.23	0.156	3.22	0.383	2.23	0.156
2.09	0.0321	2.67	0.225	3.54	0.386	2.67	0.225
2.11	0.0319	2.75	0.232	3.67	0.515	2.75	0.232
2.13	0.0322	2.78	0.211	3.74	0.397	2.78	0.211
2.15	0.0330	2.88	0.238	3.76	0.389	2.88	0.238
2.16	0.0341	2.99	0.213	<u>CURVE 4 (cont.)</u>			
2.18	0.0338	3.12	0.252	2.02	0.143	3.12	0.252
2.20	0.0356	3.24	0.240	2.10	0.148*	3.24	0.240
2.20	0.0347	3.37	0.296	2.18	0.180	3.37	0.296
2.20	0.0344	3.50	0.275	2.67	0.231	3.50	0.275
2.22	0.0370	3.62	0.280	2.76	0.219	3.62	0.280
2.25	0.0450	3.75	0.283	2.91	0.286	3.75	0.283
2.25	0.0368	3.87	0.270	3.00	0.241	3.87	0.270
2.28	0.0368	<u>CURVE 5</u>					
2.30	0.0386	1.40	0.0637	3.32	0.269	2.30	0.0386
2.35	0.0424	1.43	0.0654	3.45	0.313	2.35	0.0424
2.42	0.0435	1.46	0.0725	3.53	0.286	2.42	0.0435
2.50	0.0444	1.49	0.0725	3.69	0.285	2.50	0.0444
2.58	0.0495	1.52	0.0741	<u>CURVE 3</u>			
2.66	0.0541	1.55	0.0781	1.50	0.0685	2.66	0.0541
2.72	0.0581	1.66	0.0940	1.56	0.0906	2.72	0.0581
2.75	0.0617	1.73	0.0962	1.63	0.0840	2.75	0.0617
2.84	0.0667	1.81	0.110	1.70	0.0935	2.84	0.0667
2.93	0.0699	1.90	0.115	1.84	0.116	2.93	0.0699
3.02	0.0752	<u>CURVE 4 (cont.)</u>					
3.11	0.0806	2.02	0.143	2.10	0.148*	3.11	0.0806
<u>CURVE 5</u>							
2.35	0.218	2.92	0.382	3.22	0.383	2.35	0.218
3.54	0.386	3.54	0.386	3.67	0.515	3.54	0.386
3.67	0.515	3.74	0.397	3.74	0.397	3.67	0.515
3.74	0.397	3.76	0.389	3.76	0.389	3.74	0.397
3.76	0.389	<u>CURVE 4 (cont.)</u>					

* Not shown on plot

SPECIFICATION TABLE NO. 211 THERMAL CONDUCTIVITY OF POTASSIUM HYDROGEN SULFATE KHSO_4

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	242		1961	444-524	± 3		Specimen of A. R. purity; data point is the mean value of 4 or 5 different measurements; measured in molten state.
2	242		1961	479	± 3		Same as the above specimen; measured in molten state.

DATA TABLE NO. 211 THERMAL CONDUCTIVITY OF POTASSIUM HYDROGEN SULFATE KHSO_4 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1*

443.8	0.06404
456.2	0.00380
471.7	0.00363
485.2	0.00352
498.2	0.00365
524.2	0.00372

CURVE 2*

479	0.00339
-----	---------

* No graphical presentation

SPECIFICATION TABLE NO. 212 THERMAL CONDUCTIVITY OF SODIUM HYDROGEN SULFATE NaHSO_4

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	242		1961	443-518	± 3		Specimen of A. R. purity; data value is the mean value of 4 or 5 different measurements; measured in molten state.
2	242		1961	452	± 3		Same as the above specimen; measured in molten state.

DATA TABLE NO. 212 THERMAL CONDUCTIVITY OF SODIUM HYDROGEN SULFATE NaHSO_4 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
443.0	0.00626
450.0	0.00604
460.3	0.00490
470.2	0.00502
502.2	0.00509
518.3	0.00515
<u>CURVE 2*</u>	
452	0.00460

*No graphical presentation

SPECIFICATION TABLE NO. 213 THERMAL CONDUCTIVITY OF SODIUM THIOSULFATE $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent).	Specifications and Remarks
1	259	R	1932	295.3				The substance was melted and poured into container (5.75 in. x 7 in.) until the depth of liquid was 6 in., when it had solidified and cooled to room temperature the supply to the central heating element was switched on and maintained constant; when temperature conditions had remained steady for two hrs., readings on which the calculations of heat conductivity were based were taken.

DATA TABLE NO. 213 THERMAL CONDUCTIVITY OF SODIUM THIOSULFATE $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k
CURVE 1*
 295.0 0.0136

* No graphical presentation

THERMAL CONDUCTIVITY OF ZINC SULFATE HEPTAHYDRATE $ZnSO_4 \cdot 7H_2O$

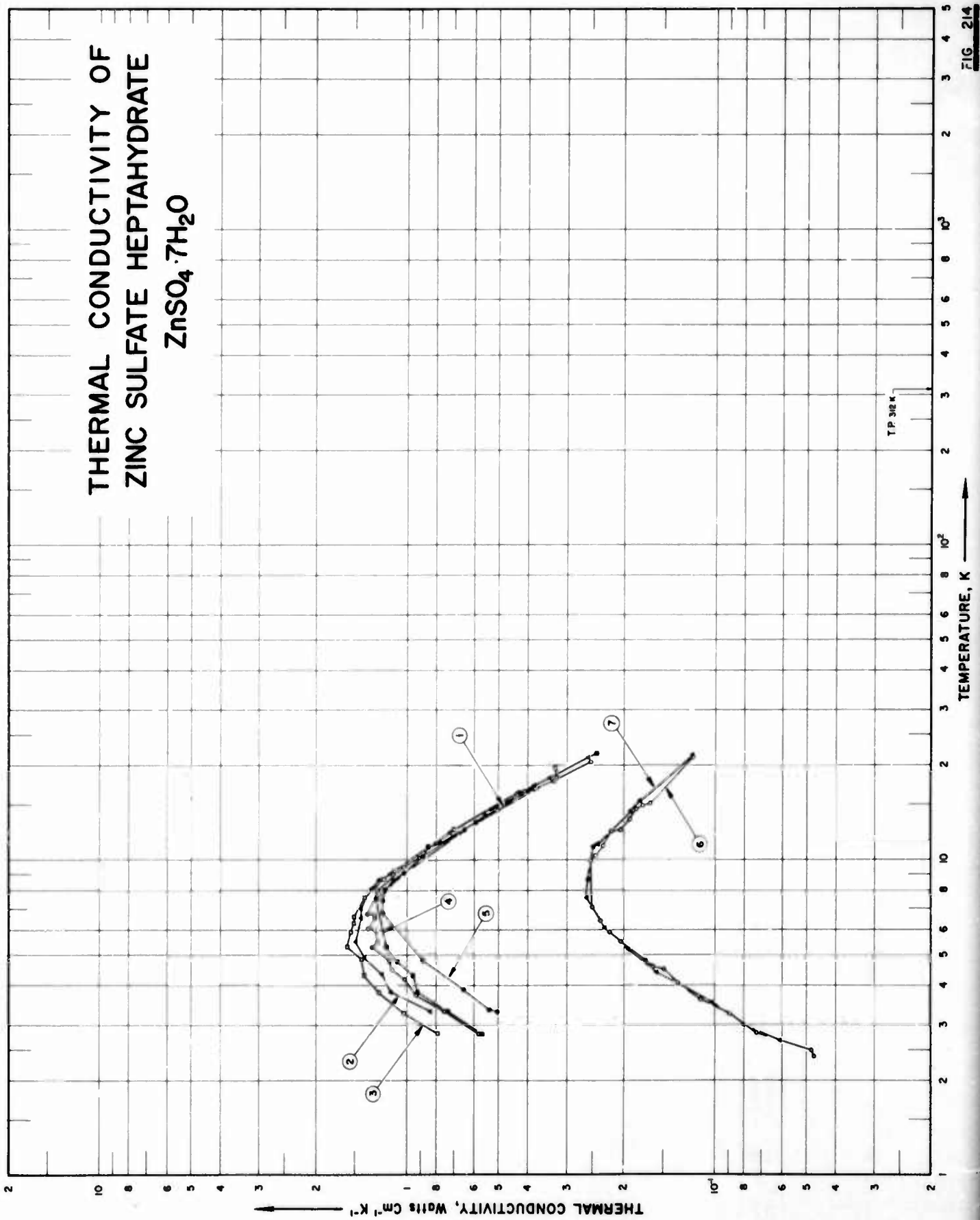


FIG. 214

SPECIFICATION TABLE NO. 214 THERMAL CONDUCTIVITY OF ZINC SULFATE HEPTAHYDRATE $\frac{1}{2}\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$

[For Data Reported in Figure and Table No. 214]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight per cent) and Remarks
1	148		1961	2.8-21		I	0.25 $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$; single crystal; the basic material used was of the "Analar" purity grade (max. impurity 0.006%); specimen cut from larger single crystal along the edges to the size of about 3 cm (length) x 0.4 cm x 0.4 cm; the cooling process was that the atmospheric air surrounding the specimen mounted in the apparatus at room temperature was first pumped out after the apparatus had been cooled down to 90 K, then replaced by helium gas at low pressure to continue the slow cooling down process; measurements began at 20 K until 2 K; precautions were taken to avoid dehydrating the specimen.
2	148		1961	3.3-21		I	The second run of the same specimen I; the apparatus was first warmed up to about 90 K; the atmosphere air was let into specimen space to a pressure slightly below one atmosphere; then the temperature was raised to room temperature and pressure to atmospheric pressure before the cooling process.
3	148		1961	2.8-20		I	The third run of the same specimen I; the apparatus was first warmed up to room temperature; then the specimen was wetted with distilled water and dried quickly with absorbent paper. The specimen chamber was resealed and the cooling process started.
4	148		1961	2.8-22		I	The fourth run of the same specimen I; the apparatus was first warmed up to room temperature; then a small amount of acetone was put in the specimen chamber 5 hrs before the cooling down process.
5	148		1961	3.3-22		I	The fifth run of the same specimen I; the apparatus was first warmed up to 200 K and dry air at atmospheric pressure was then admitted into the specimen chamber (the specimen lost some water of crystallization); then the apparatus was warmed up to room temperature and pressure in specimen chamber maintained at atmospheric pressure. Afterwards, the apparatus was cooled down to 90 K in 4 hrs and kept at 90 K for 48 hrs before further cooling down to measurement temperature.
6	148		1961	2.4-21		II	Same as the specimen I except having $1.0\text{ FeSO}_4 \cdot 7\text{H}_2\text{O}$; process same as that of the first run of the specimen I.
7	148		1961	2.7-22		II	The second run of the same specimen II; the apparatus was first warmed up to and kept at 90 K for about 30 hrs and maintained at high vacuum (order of 10 ⁻⁵ mm Hg) in the specimen chamber; then followed the cooling process.

DATA TABLE NO. 214 THERMAL CONDUCTIVITY OF ZINC SULFATE HEPTAHYDRATE $ZnSO_4 \cdot 7H_2O$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	CURVE 1		CURVE 3		CURVE 5		CURVE 7	
	T	k	T	k	T	k	T	k
2.8	0.560	0.79	3.30	0.503	2.68	0.0610		
3.3	0.750	1.02	3.35	0.535	3.0	0.0800		
3.7	0.931	1.245	3.88	0.645	3.5	0.102		
4.2	1.025	1.39	4.79	0.983	4.4	0.157		
4.5	1.125	1.42	6.80	1.207	5.2	0.194		
4.8	1.150	1.59	7.41	1.211	6.1	0.229		
5.3	1.314	1.55	8.0	1.183	7.6	0.260		
5.5	1.263	1.51	8.6	1.114	8.65	0.259		
6.0	1.268	1.51	9.07	1.025	11.0	0.248		
6.05	1.360	1.39	10.29	0.647	11.2	0.230		
6.55	1.285	1.20	16.3	0.421	14.25	0.190		
6.7	1.286	1.105	16.5	0.400	15.45	0.178		
6.75	1.360	0.700	16.75	0.388	21.5	0.120		
8.0	1.264	0.442	21.8	0.242*				
9.5	1.032	0.330						
10.2	0.910	0.325						
14.4	0.501							
20.5	0.252							
CURVE 2			CURVE 4			CURVE 6		
T	k		T	k		T	k	
3.3	0.835		2.8	0.565		2.37	0.0471	
3.8	1.113		3.3	0.735		2.49	0.0461	
4.35	1.215		3.8	0.921		2.82	0.0728	
4.9	1.390		4.3	0.955		3.25	0.0890	
5.5	1.490		4.8	1.061		3.62	0.112	
6.6	1.435		5.3	1.175		4.50	0.150	
7.0	1.438		7.5	1.278		4.60	0.162	
8.1	1.315		10.2	0.884		5.50	0.205	
8.6	1.242		11.0	0.850		5.90	0.222	
9.1	1.140		11.3	0.770		6.41	0.235	
12.2	0.720		13.2	0.592		7.05	0.250	
16.3	0.430		18.2	0.242		9.95	0.252	
17.2	0.360					10.32	0.245	
18.2	0.340					11.10	0.232	
21.2	0.258					12.35	0.219	
						12.50	0.205	
						13.50	0.192	
						14.50	0.184	
						14.94	0.175	
						15.10	0.166	
						21.2	0.119	

* Not shown on plot

SPECIFICATION TABLE NO. 215 THERMAL CONDUCTIVITY OF CERIUM SULFIDE CeS

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	511	T	1962	973-1573			Electrical conductivity 6.3, 6.1, 5.5 and 4.7 mho cm ⁻¹ at 973, 1203, 1402 and 1573 K, respectively.

DATA TABLE NO. 215 THERMAL CONDUCTIVITY OF CERIUM SULFIDE CeS

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
973	0.020
1103	0.018
1203	0.014
1273	0.019
1402	0.011
1523	0.015
1573	0.015

CURVE 1*

* No graphical presentation

SPECIFICATION TABLE NO. 216 THERMAL CONDUCTIVITY OF DICERUM TRISULFIDE Ce_2S_3

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	505	C	1960	300-1573		A-26	Prepared by resolidifying the molten material; electrical conductivity reported as 8.7, 6.3, 6.37, 6.1, 6.0, 5.5, 5.12, and 4.7 $\text{ohm}^{-1}\text{cm}^{-1}$ at 300, 973, 1103, 1203, 1273, 1402, 1523, and 1573 K, respectively.

DATA TABLE NO. 216 THERMAL CONDUCTIVITY OF DICERUM TRISULFIDE Ce_2S_3 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T	k
	<u>CURVE 1*</u>
300	0.006
973	0.007
1103	0.011
1203	0.010
1273	0.011
1402	0.011
1523	0.012
1573	0.011

* No graphical presentation

SPECIFICATION TABLE NO. 217 THERMAL CONDUCTIVITY OF DICOPPER SULFIDE Cu_2S

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent). Specifications and Remarks
1	256		1955	293.2			Electrical conductivity $3.7 \times 10^2 \text{ ohm}^{-1}\text{cm}^{-1}$ at 20 C.

DATA TABLE NO. 217 THERMAL CONDUCTIVITY OF DICOPPER SULFIDE Cu_2S
 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1*

293.2 0.00418

* No graphical presentation

SPECIFICATION TABLE NO. 218 THERMAL CONDUCTIVITY OF [DICOPPER SULFIDE + IRON SULFIDE + TRINICKEL DISULFIDE] $\text{Cu}_2\text{S} + \text{FeS} + \text{Ni}_3\text{S}_2$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	256		1955	293.2			7.5 mole % FeS.
2	256		1955	293.2			17 mole % FeS.
3	256		1955	293.2			35 mole % FeS.
4	256		1955	293.2			44 mole % FeS.

DATA TABLE NO. 218 THERMAL CONDUCTIVITY OF [DICOPPER SULFIDE + IRON SULFIDE + TRINICKEL DISULFIDE] $\text{Cu}_2\text{S} + \text{FeS} + \text{Ni}_3\text{S}_2$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
293.2	0.100
<u>CURVE 2*</u>	
293.2	0.0544
<u>CURVE 3*</u>	
293.2	0.0335
<u>CURVE 4*</u>	
293.2	0.0251

* No graphical presentation

SPECIFICATION TABLE NO. 219 THERMAL CONDUCTIVITY OF [DICOPPER SULFIDE + TRINICKEL DISULFIDE] $\text{Cu}_2\text{S} + \text{Ni}_3\text{S}_2$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	256		1955	293.2			33 mole % Ni_3S_2 .
2	256		1955	293.2			67 mole % Ni_3S_2 .

DATA TABLE NO. 219 THERMAL CONDUCTIVITY OF [DICOPPER SULFIDE + TRINICKEL DISULFIDE] $\text{Cu}_2\text{S} + \text{Ni}_3\text{S}_2$
[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
293.2	0.0335
<u>CURVE 2*</u>	
293.2	0.0586

* No graphical presentation

THERMAL CONDUCTIVITY OF LANTHANUM SULFIDE LaS

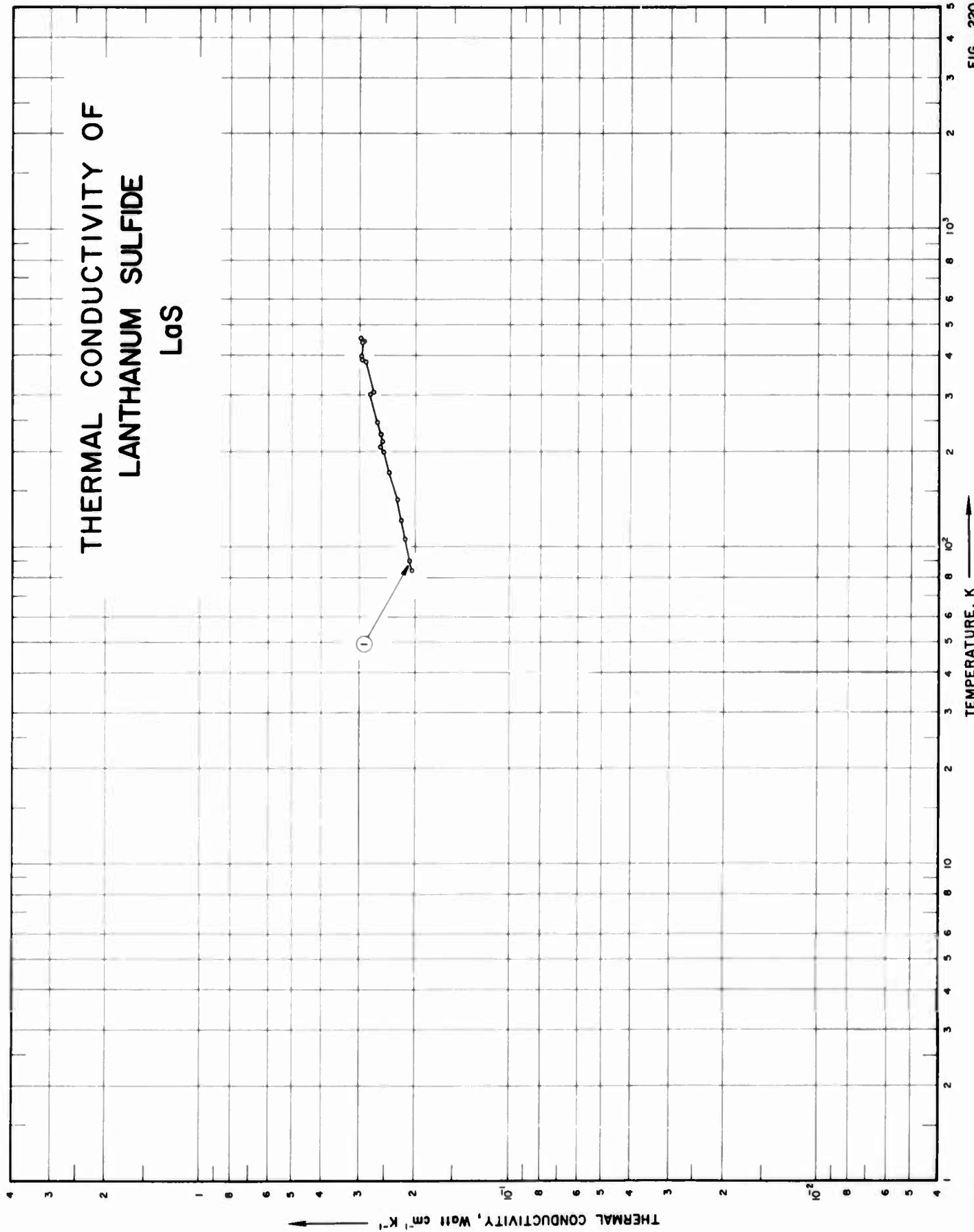


FIG. 220

SPECIFICATION TABLE NO. 220 THERMAL CONDUCTIVITY OF LANTHANUM SULFIDE LaS

[For Data Reported in Figure and Table No. 220]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	506, 507	L	1966	84-453	$\pm 3 \pm 5$		NaCl type compound with ionic-metallic type bonding; prepared by pressing powders of the compound under a pressure of about 8000 kg cm ⁻² , sintering in a vacuum of $\sim 10^{-5}$ Torr for 1 to 2 hrs at 1600 to 1800 C; electrical resistivity reported range from 1.70-5.29 μ ohm cm at 84-463 K respectively; measured in a vacuum of 10^{-4} - 10^{-5} mm Hg.

DATA TABLE NO. 220 THERMAL CONDUCTIVITY OF LANTHANUM SULFIDE LaS
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
84	0.205
90	0.208
106	0.215
122	0.222
141	0.229
172	0.243
199	0.254
206	0.259
215	0.256
227	0.259
246	0.265
303	0.280
307	0.274
381	0.290
389	0.297
398	0.298
441	0.296
446	0.294
453	0.300

SPECIFICATION TABLE NO. 221 THERMAL CONDUCTIVITY OF TRINICKEL DISULFIDE Ni_3S_2

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	256		1955	293.2			

DATA TABLE NO. 221 THERMAL CONDUCTIVITY OF TRINICKEL DISULFIDE Ni_3S_2

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T k
CURVE 1*
 293.2 0.0879

No graphical presentation

SPECIFICATION TABLE NO. 222 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + CHROMIUM] CERMETS $Al_2O_3 + Cr$

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Al_2O_3	Composition (weight percent) Cr	Composition (continued), Specifications and Remarks
1	296	1958	293.2		Type LT-1	70	30	Supplied by Haynes Stellite Co.

DATA TABLE NO. 222 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + CHROMIUM] CERMETS $Al_2O_3 + Cr$

[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T k

CURVE 1*

293.2 0.0962

* No graphical presentation

THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + BERYLLIUM] CERMETS BeO + Be

FIGURE SHOWS ONLY 9 OF THE CURVES REPORTED IN TABLE

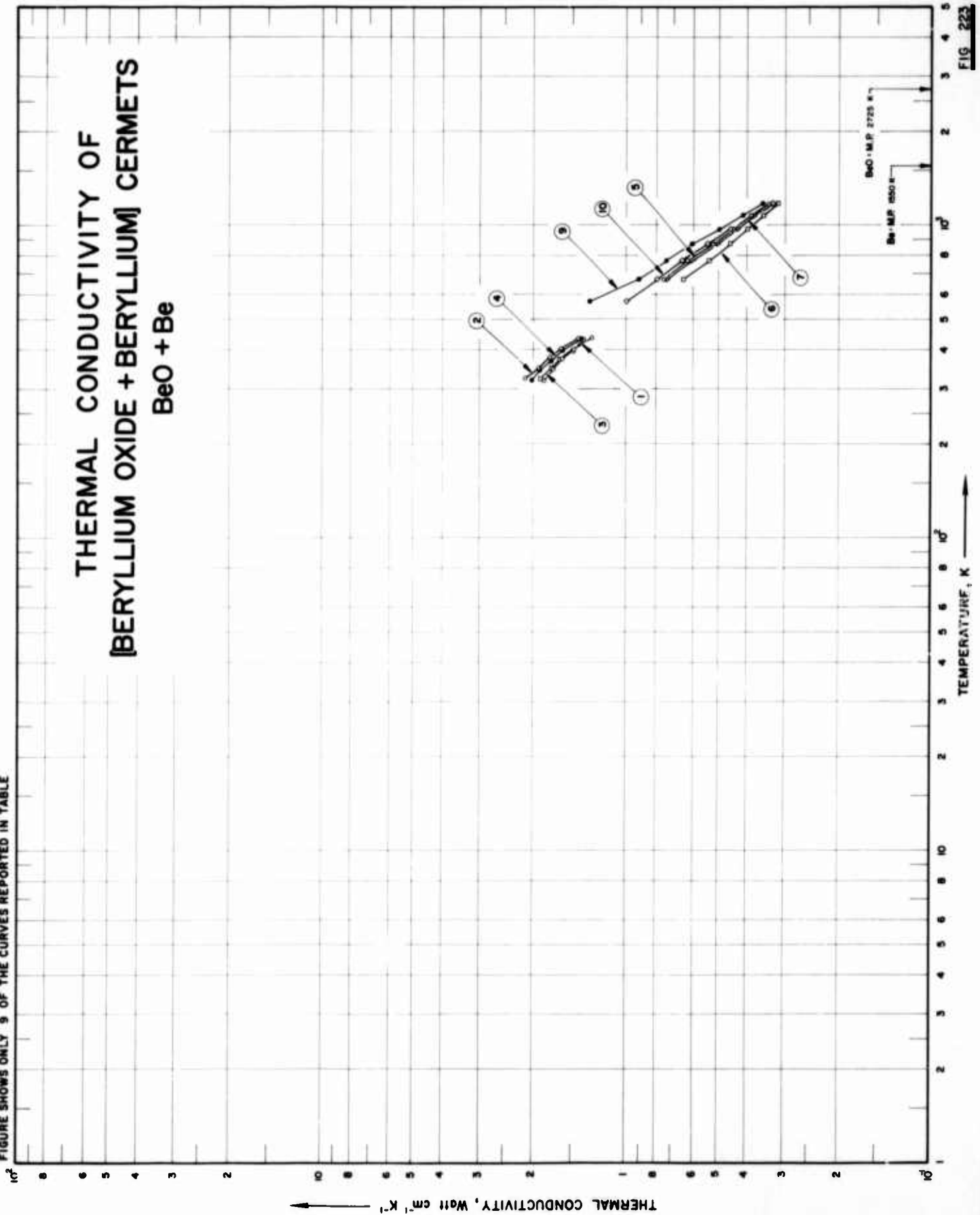


FIG. 223

SPECIFICATION TABLE NO. 223 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + BERYLLIUM] CERMEETS BeO + Be

[For Data Reported in Figure and Table No. 223]

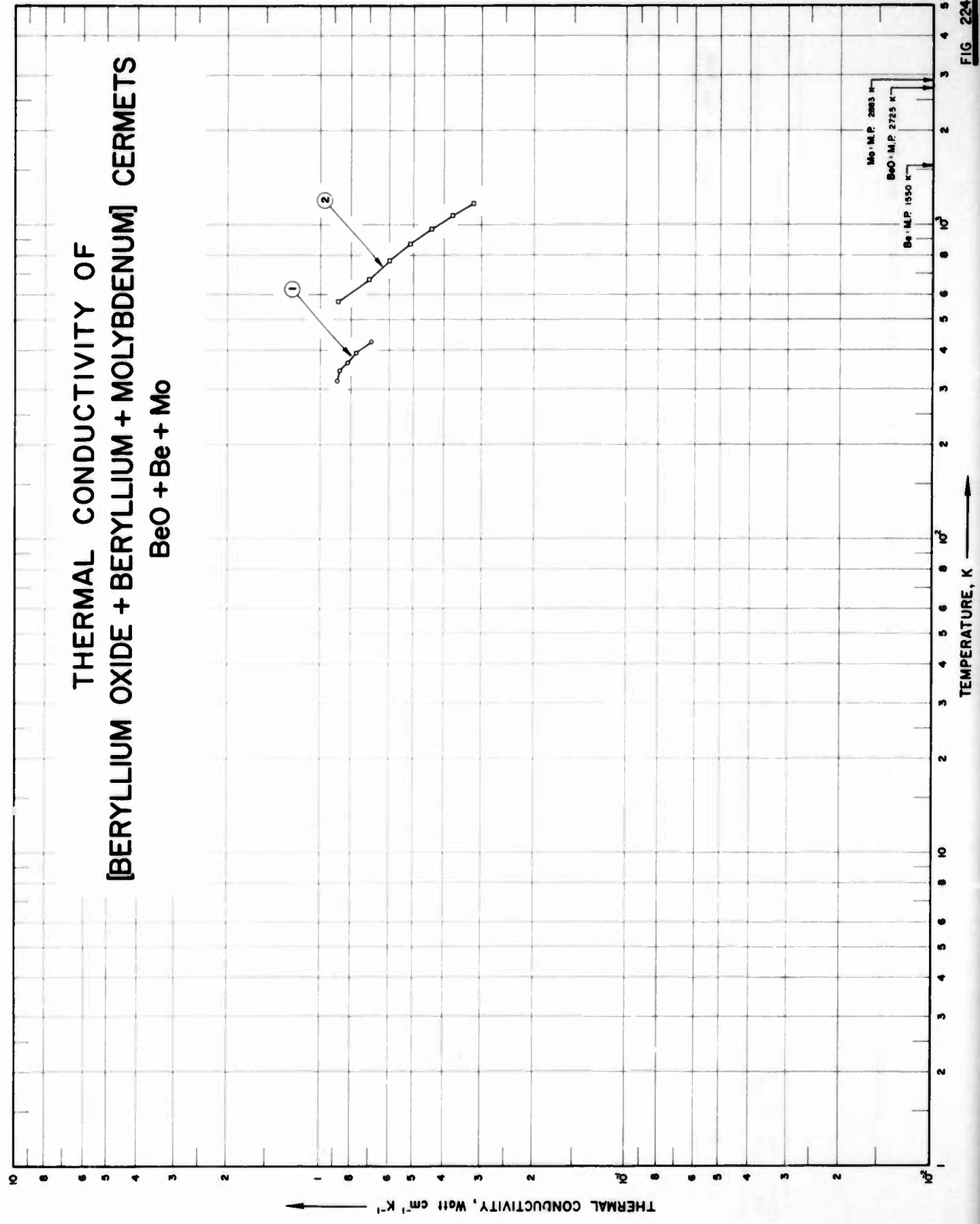
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	12		1953	320-436		267A-1	Metal content 5.24%, metal particle size 2-5 μ ; density 2.81 g cm ⁻³ .
2	12		1953	325-434		268A-1	Metal content 5.65%, metal particle size 2-5 μ ; density 2.87 g cm ⁻³ .
3	12		1953	323-430		269A-1	Metal content 6.06%, metal particle size 15-25 μ ; density 2.86 g cm ⁻³ .
4	12		1953	320-432		270A-1	Metal content 6.06%, metal particle size 15-25 μ ; density 2.86 g cm ⁻³ .
5	378	L	1962	673-1173	$\pm 2 - \pm 4$	3A	97 BeO and 3 Be; cylindrical specimen, 1.625 in. in diameter, 1 in. long; bulk density 2.945 g cm ⁻³ ; > 99% theoretical density; smoothed results; data not corrected to zero porosity.
6	378	L	1962	673-1173	$\pm 2 - \pm 4$	4A	94 BeO and 6 Be; cylindrical specimen, 1.625 in. in diameter, 1 in. long; bulk density 2.905 g cm ⁻³ ; > 99% theoretical density; smoothed results; data not corrected to zero porosity.
7	378	L	1962	673-1173	$\pm 2 - \pm 4$	5A	91 BeO and 9 Be; cylindrical specimen, 1.625 in. in diameter, 1 in. long; bulk density 2.834 g cm ⁻³ ; > 99% theoretical density; smoothed results; data not corrected to zero porosity.
8	378	L	1962	673-1173	$\pm 2 - \pm 4$	6A	88 BeO and 12 Be; cylindrical specimen, 1.625 in. in diameter, 1 in. long; bulk density 2.787 g cm ⁻³ ; > 99% theoretical density; smoothed results; data not corrected to zero porosity.
9	378	L	1962	573-1173	$\pm 2 - \pm 4$	7A	93 BeO and 7 Be; cylindrical specimen, 1.625 in. in diameter, 1 in. long; bulk density 2.842 g cm ⁻³ ; > 98% theoretical density; smoothed results; data not corrected to zero porosity.
10	378	L	1962	573-1173	$\pm 2 - \pm 4$	8A	93 BeO and 7 Be; cylindrical specimen, 1.625 in. in diameter, 1 in. long; bulk density 2.917 g cm ⁻³ ; 100% theoretical density; smoothed results; data not corrected to zero porosity.

DATA TABLE NO. 223 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + BERYLLIUM]CERMETS BeO + Be
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
319.6	1.85	1073.2	0.354
346.1	1.72	1173.2	0.317
373.8	1.62	<u>CURVE 7</u>	
400.8	1.48	673.2	0.734
436.5	1.30	773.2	0.603
<u>CURVE 2</u>			
324.7	2.13	873.2	0.503
349.3	1.92	973.2	0.430
377.8	1.77	1073.2	0.379
402.4	1.63	1173.2	0.337*
434.0	1.44	<u>CURVE 8*</u>	
<u>CURVE 3</u>			
323.1	1.89	673.2	0.735
347.7	1.74	773.2	0.577
372.0	1.63	873.2	0.482
396.7	1.49	973.2	0.413
429.8	1.38	1073.2	0.357
<u>CURVE 4</u>			
319.6	2.01	1173.2	0.303
344.6	1.90	<u>CURVE 9</u>	
367.6	1.75	573.2	1.132
398.4	1.62	673.2	0.911
431.8	1.41	773.2	0.740
<u>CURVE 5</u>			
673.2	0.756	873.2	0.605
773.2	0.627	973.2	0.498
873.2	0.524	1073.2	0.414
973.2	0.448	1173.2	0.356
1073.2	0.388	<u>CURVE 10</u>	
1173.2	0.340	573.2	0.995
<u>CURVE 6</u>			
673.2	0.646	673.2	0.794
773.2	0.538	773.2	0.652
873.2	0.457	873.2	0.542
973.2	0.397	973.2	0.455
		1073.2	0.388*
		1173.2	0.329

* Not shown on plot

THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + BERYLLIUM + MOLYBDENUM] CERMETS BeO + Be + Mo



SPECIFICATION TABLE NO. 224 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + BERYLLIUM + MOLYBDENUM] CERMEITS BeO + Be + Mo

[For Data Reported in Figure and Table No. 224]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	12		1953	320-428		272A	Apparent porosity 6.2%; density 2.75 g cm^{-3} .
2	378	L	1962	573-1173	± 4	9A	86 BeO, 7 Be and 7 Mo; cylindrical specimen 1.625 in. in diameter, 1 in. long; bulk density 2.975 g cm^{-3} ; 98% theoretical density; smoothed data without correction to zero porosity.

DATA TABLE NO. 224 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + BERYLLIUM + MOLYBDENUM] CERMENTS BeO + Be + Mo
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
319.6	0.882
344.2	0.866
366.5	0.816
393.6	0.774
427.6	0.690
<u>CURVE 2</u>	
573.2	0.875
673.2	0.701
773.2	0.597
873.2	0.511
973.2	0.439
1073.2	0.374
1173.2	0.318

THERMAL CONDUCTIVITY OF
[BERYLLIUM OXIDE + BERYLLIUM + SILICON] CERMETS
BeO + Be + Si

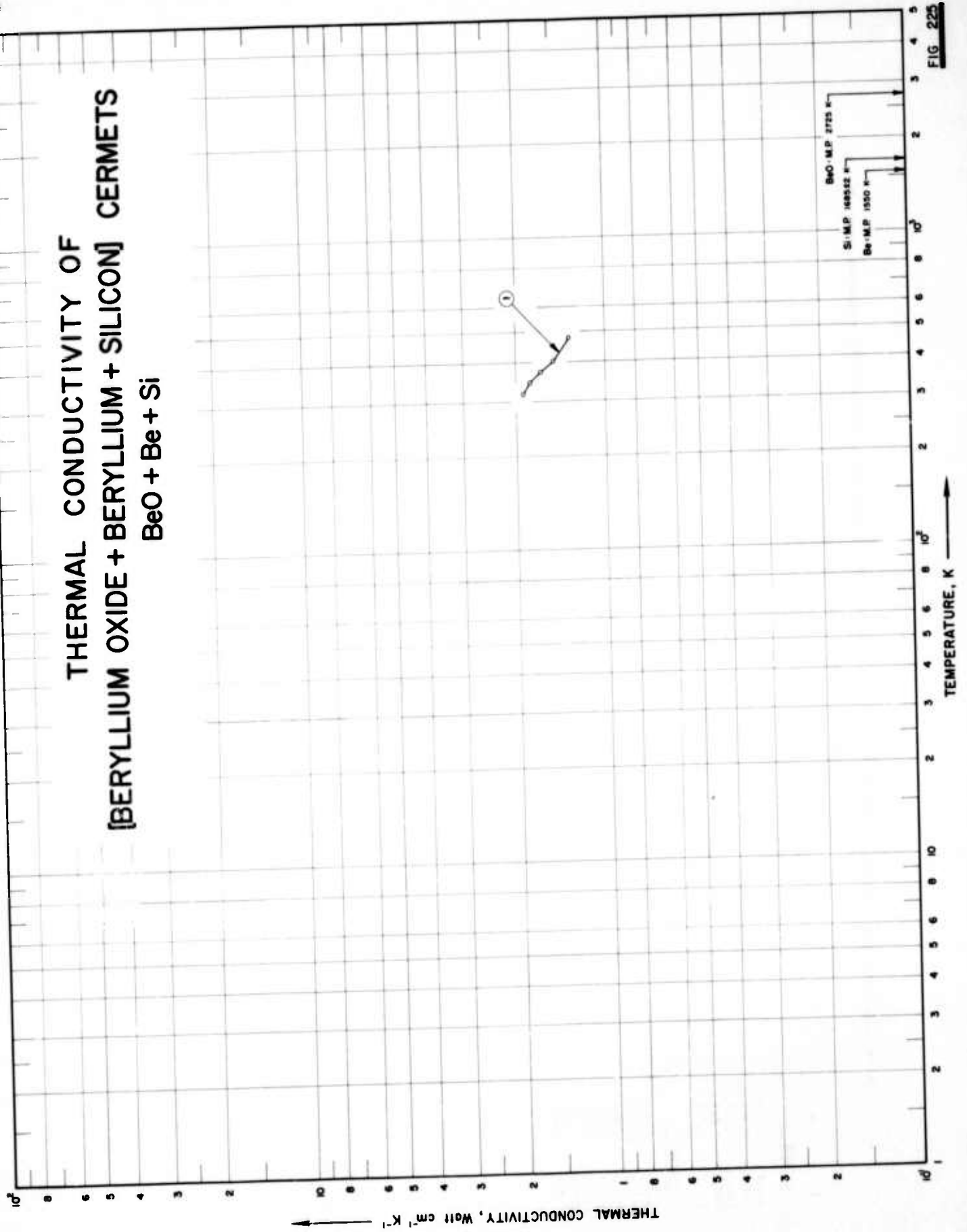


FIG. 225

SPECIFICATION TABLE NO. 225 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + BERYLLIUM + SILICON]CERMETS BeO + Be + Si

[For Data Reported in Figure and Table No. 225]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	12		1953	317-477		272A-1	Density 2.91 g cm ⁻³ .

DATA TABLE NO. 225 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + BERYLLIUM + SILICON]CERMETS BeO + Be + Si
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
317.2	1.89
345.2	1.79
373.9	1.66
403.4	1.50
476.6	1.33

SPECIFICATION TABLE NO. 226 THERMAL CONDUCTIVITY OF [TETRABORON CARBIDE + ALUMINUM] CERMETS $B_4C + Al$

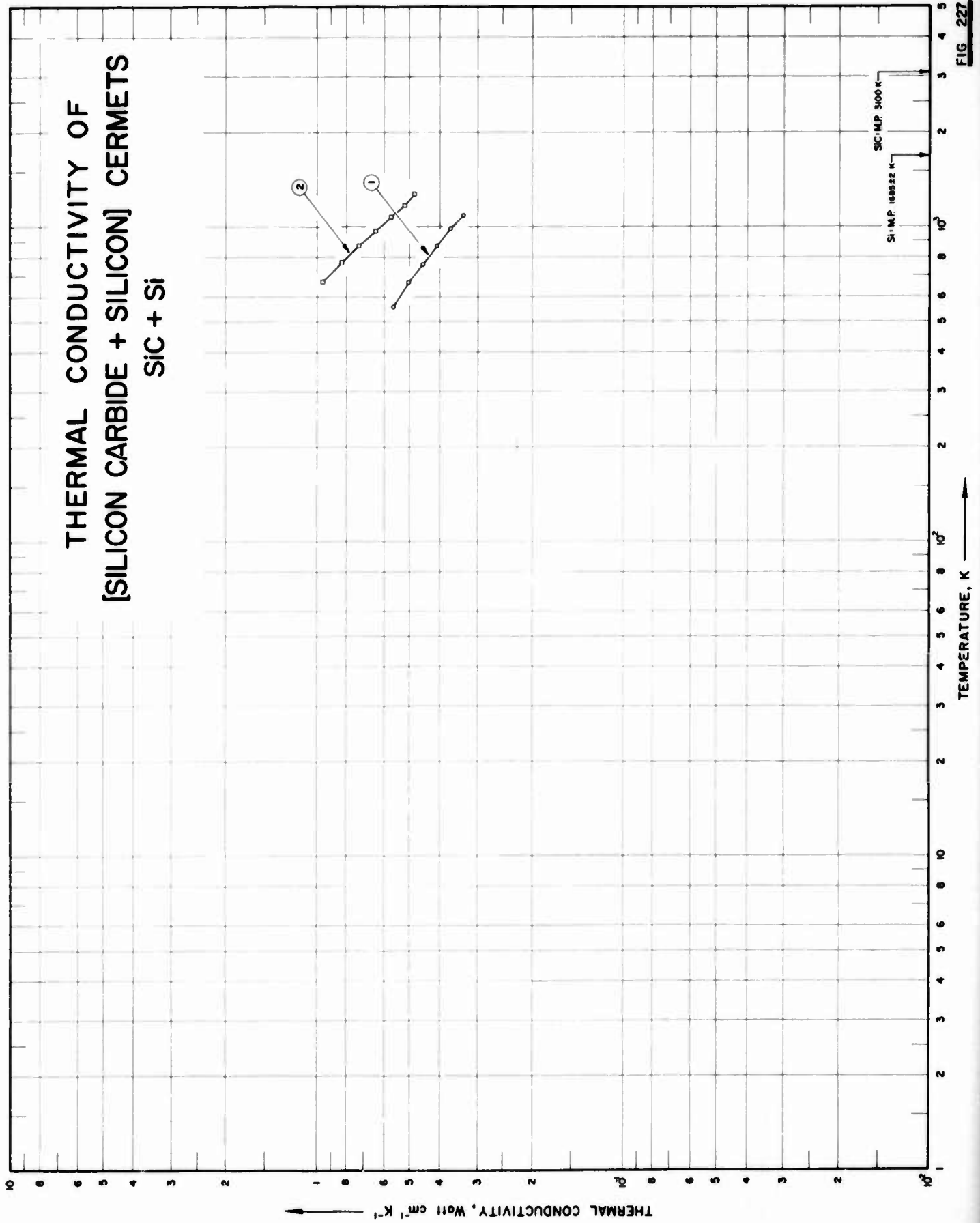
Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						B_4C	Al	
1	473	L	1964	366-533	Boral	50	50	Prepared by adding pre-oxidized B_4C powder (oxidized at 811 C for one hr) to molten Al, mix allowed to stand for 10-15 min, molded, rolled; density 2.53 $g\ cm^{-3}$.

DATA TABLE NO. 226 THERMAL CONDUCTIVITY OF [TETRABORON CARBIDE + ALUMINUM] CERMETS $B_4C + Al$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k
<u>CURVE 1*</u>	
366	0.433
505	0.332
533	0.329

* No graphical presentation

THERMAL CONDUCTIVITY OF
[SILICON CARBIDE + SILICON] CERMETS
SiC + Si



SPECIFICATION TABLE NO. 227 THERMAL CONDUCTIVITY OF [SILICON CARBIDE + SILICON] CERMEETS SiC + Si

[For Data Reported in Figure and Table No. 227]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	136	C	1959	556-1089	± 4		SiC bonded with 30 volume % Si, specimen size 7/8 x 7/8 x 7/8 in. cube, with faces ground flat and parallel on a diamond lap.
2	378	C	1962	673-1273	± 6	10A	96.5 SiC, 2.5 Si, 0.4 C, 0.4 Al, and 0.2 Fe; cylindrical specimen 1.625 in. diameter, 1 in. long; bulk density 3.01 g cm ⁻³ ; 95% theoretical density; Inconel used as reference material; smoothed data without correction to zero porosity.

DATA TABLE NO. 227 THERMAL CONDUCTIVITY OF [SILICON CARBIDE + SILICON] CERMETS SIC + Si
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
556.2	0.562
668.2	0.502
760.2	0.455
871.2	0.410
991.2	0.369
1089.2	0.335
<u>CURVE 2</u>	
673.2	0.960
773.2	0.828
873.2	0.725
973.2	0.640
1073.2	0.570
1173.2	0.518
1273.2	0.483

SPECIFICATION TABLE NO. 228 THERMAL CONDUCTIVITY OF [DISODIUM OXIDE + SODIUM] CERMETS $\text{Na}_2\text{O} + \text{Na}$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	399, 398	L	1965	328	<15		59.1 Na_2O , 40.9 Na.
2	399, 398	L	1965	328	<15		50.6 Na_2O , 49.4 Na.

DATA TABLE NO. 228 THERMAL CONDUCTIVITY OF [DISODIUM OXIDE + SODIUM] CERMETS $\text{Na}_2\text{O} + \text{Na}$
[Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
328	0.554
<u>CURVE 2*</u>	
328	0.578

* No graphical presentation

THERMAL CONDUCTIVITY OF
 [STRONTIUM METATITANATE+
 COBALT] CERMENTS
 $SrTiO_3 + Co$

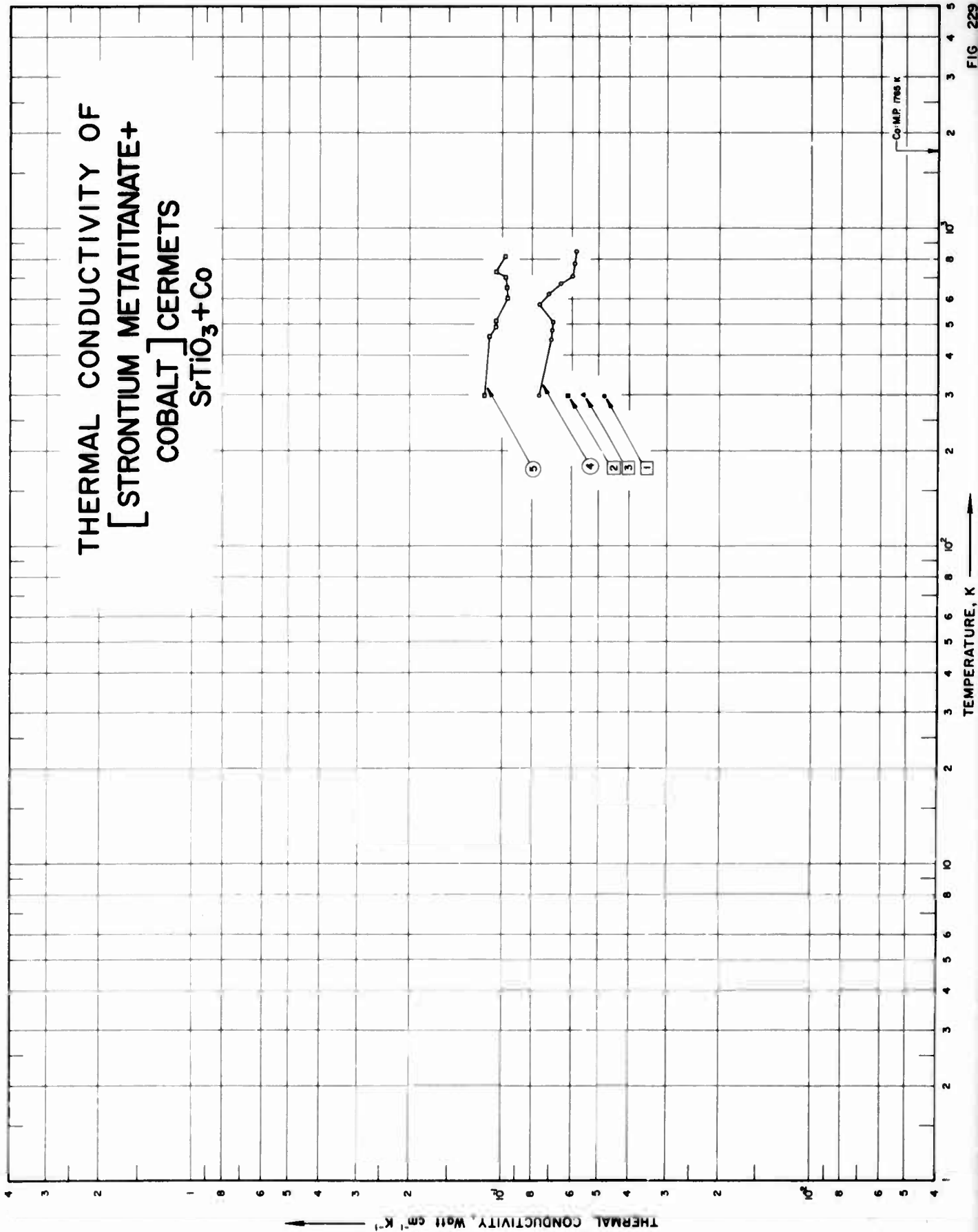


FIG. 229

SPECIFICATION TABLE NO. 229 THERMAL CONDUCTIVITY OF [STRONTIUM METATITANATE + COBALT] CERMETS $\text{SrTiO}_3 + \text{Co}$

[For Data Reported in Figure and Table No. 229]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	283		1959	298.2		Specimen No. 15	10% Co.
2	283		1959	298.2		Specimen No. 4	20% Co.
3	283		1959	298.2		Specimen No. 16	30% Co.
4	283		1959	298-848		Specimen No. 5	30% Co.
5	283		1959	298-818		Specimen No. 12	40% Co.

DATA TABLE NO. 229 THERMAL CONDUCTIVITY OF [STRONTIUM METATITANATE + COBALT] CERMETS $\text{SrTiO}_3 + \text{Co}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
298.2	0.0481
<u>CURVE 2</u>	
298.2	0.0619
<u>CURVE 3</u>	
298.2	0.0552
<u>CURVE 4</u>	
298.2	0.0761
448.2	0.0695
478.2	0.0690
508.2	0.0686
578.2	0.0757
623.2	0.0707
673.2	0.0649
708.2	0.0598
778.2	0.0590
848.2	0.0582
<u>CURVE 5</u>	
298.2	0.114
458.2	0.110
491.2	0.105
513.2	0.105
601.2	0.0962
653.2	0.0967
701.2	0.0975
733.2	0.105
818.2	0.0979

SPECIFICATION TABLE NO. 230 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + COBALT] CERMETs TiC + Co

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						TiC	Co	
1	264	1949	298.2			80	20	Density = 5.42 g cm ⁻³ .

DATA TABLE NO. 230 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + COBALT] CERMETs TiC + Co
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k
CURVE.1*
 298.2 0.356

* No graphical presentation

SPECIFICATION TABLE NO. 231 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + COBALT + NIOBIUM CARBIDE] CERMETS TiC + Co + NbC

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						TiC	Co	NbC	
1	264	1949	298.2			66.3	18.7	15.0	

DATA TABLE NO. 231 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + COBALT + NIOBIUM CARBIDE] CERMETS TiC + Co + NbC
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

298.2 0.314

* No graphical presentation

THERMAL CONDUCTIVITY OF
[TITANIUM CARBIDE+NICKEL+MOLYBDENUM
+NIOBIUM CARBIDE] CERMETS
TiC+Ni+Mo+NbC

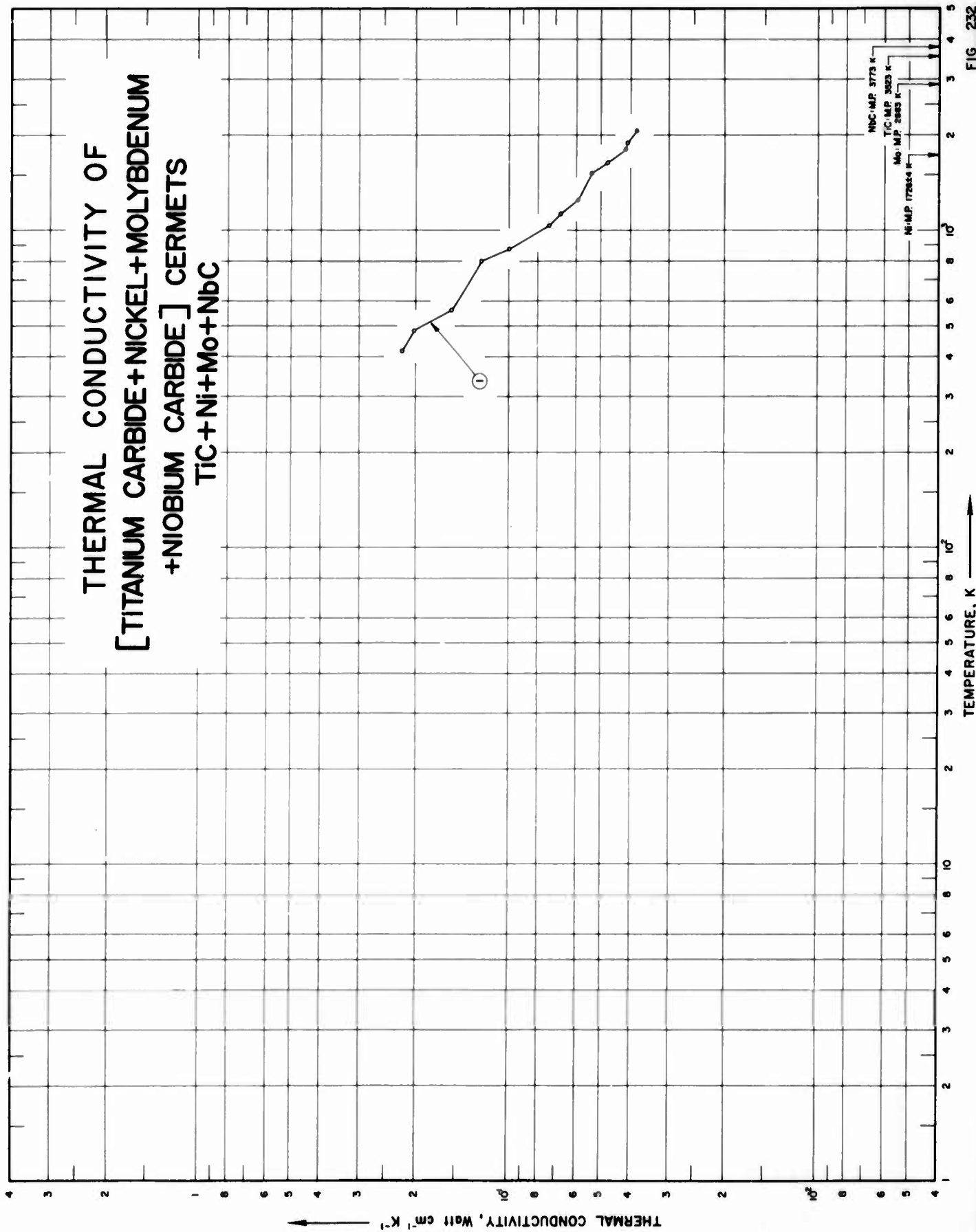


FIG 232

SPECIFICATION TABLE NO. 232 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + NICKEL + MOLYBDENUM + NIOBIUM CARBIDE] CERMETS TiC + Ni + Mo + NbC

[For Data Reported in Figure and Table No. 232]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						TiC	Ni	Mo	
1	298 R	1961	420-2062	<5	Kennametals K161B	72.0	16.7	3.3	6.0 Specimen consisted of 5 one-in. disks.

DATA TABLE NO. 232 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + NICKEL + MOLYBDENUM + NIOBIUM CARBIDE] CERMETS TIC + Ni + Mo + NbC
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
419.8	0.222
485.9	0.203
664.8	0.156
802.1	0.124
875.4	0.100
1032.1	0.0736
1134.8	0.0677
1258.7	0.0595
1505.9	0.0537
1649.3	0.0476
1807.6	0.0415
1899.8	0.0412
2061.5	0.0384

SPECIFICATION TABLE NO. 233 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + NICKEL + NIOBIUM CARBIDE] CERMETS TiC + Ni + NbC

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						TiC	Ni	NbC	
1	296	1958	293.2			70	20	10	Density 5.8 g cm ⁻³ .

DATA TABLE NO. 243 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + NICKEL + NIOBIUM CARBIDE] CERMETS TiC + Ni + NbC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

293.2 0.335

* No graphical presentation

SPECIFICATION TABLE NO. 234 THERMAL CONDUCTIVITY OF [URANIUM CARBIDE + URANIUM] CERMETS UC + U

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						UC	U	
1	482, 483	1960	479-969			80.0	20.0	Prepared by sintering mixture of UC and U in a graphite crucible in a vacuum furnace with a graphite heater; data corrected to zero porosity.

DATA TABLE NO. 234 THERMAL CONDUCTIVITY OF [URANIUM CARBIDE + URANIUM] CERMETS UC + U

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
479.2	0.232
642.2	0.200
969.2	0.239

* No graphical presentation

THERMAL CONDUCTIVITY OF
 [URANIUM DIOXIDE + CHROMIUM] CERMETS
 $UO_2 + Cr$

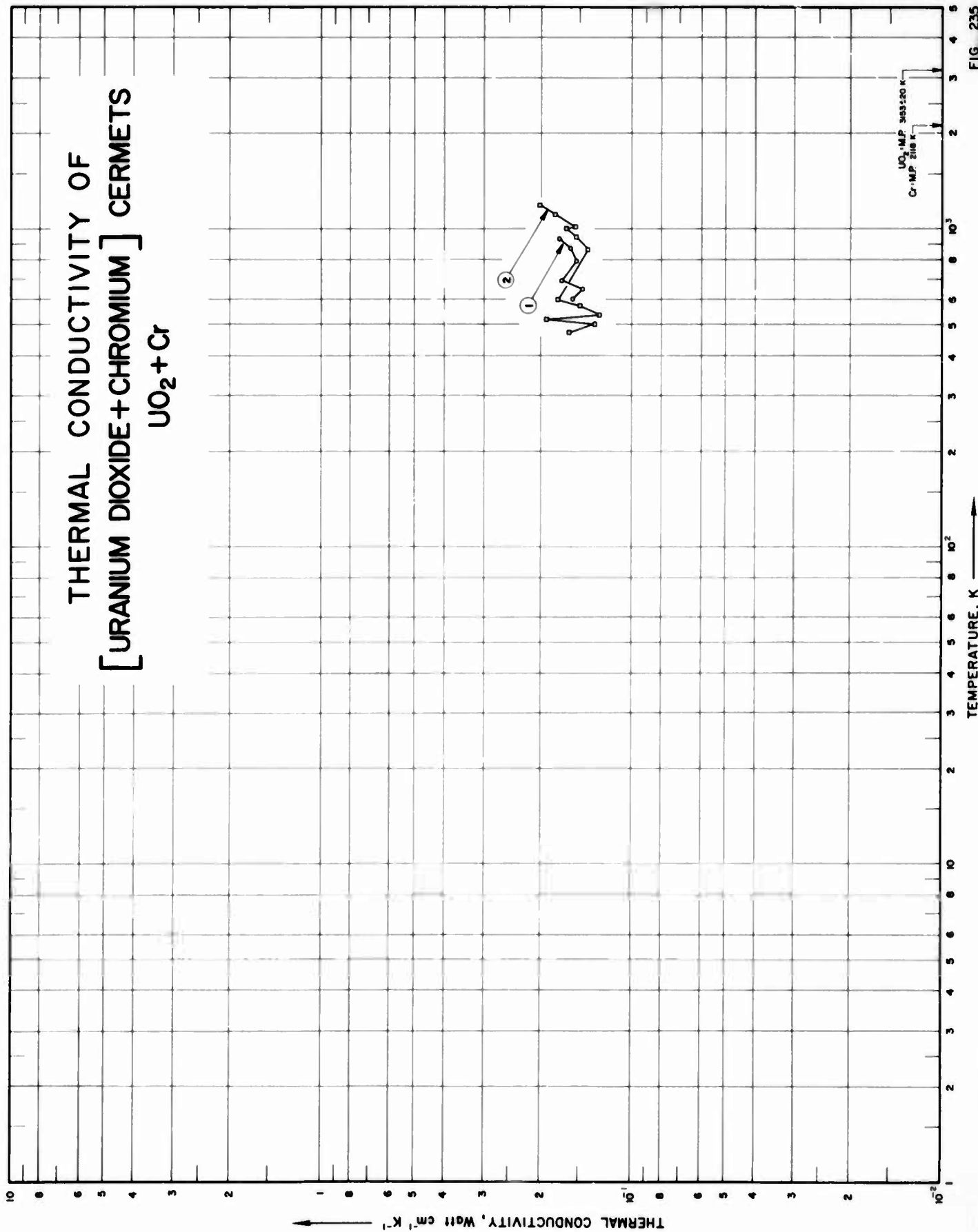


FIG. 235

SPECIFICATION TABLE NO. 235 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + CHROMIUM] CERMETS $UO_2 + Cr$

[For Data Reported in Figure and Table No. 235]

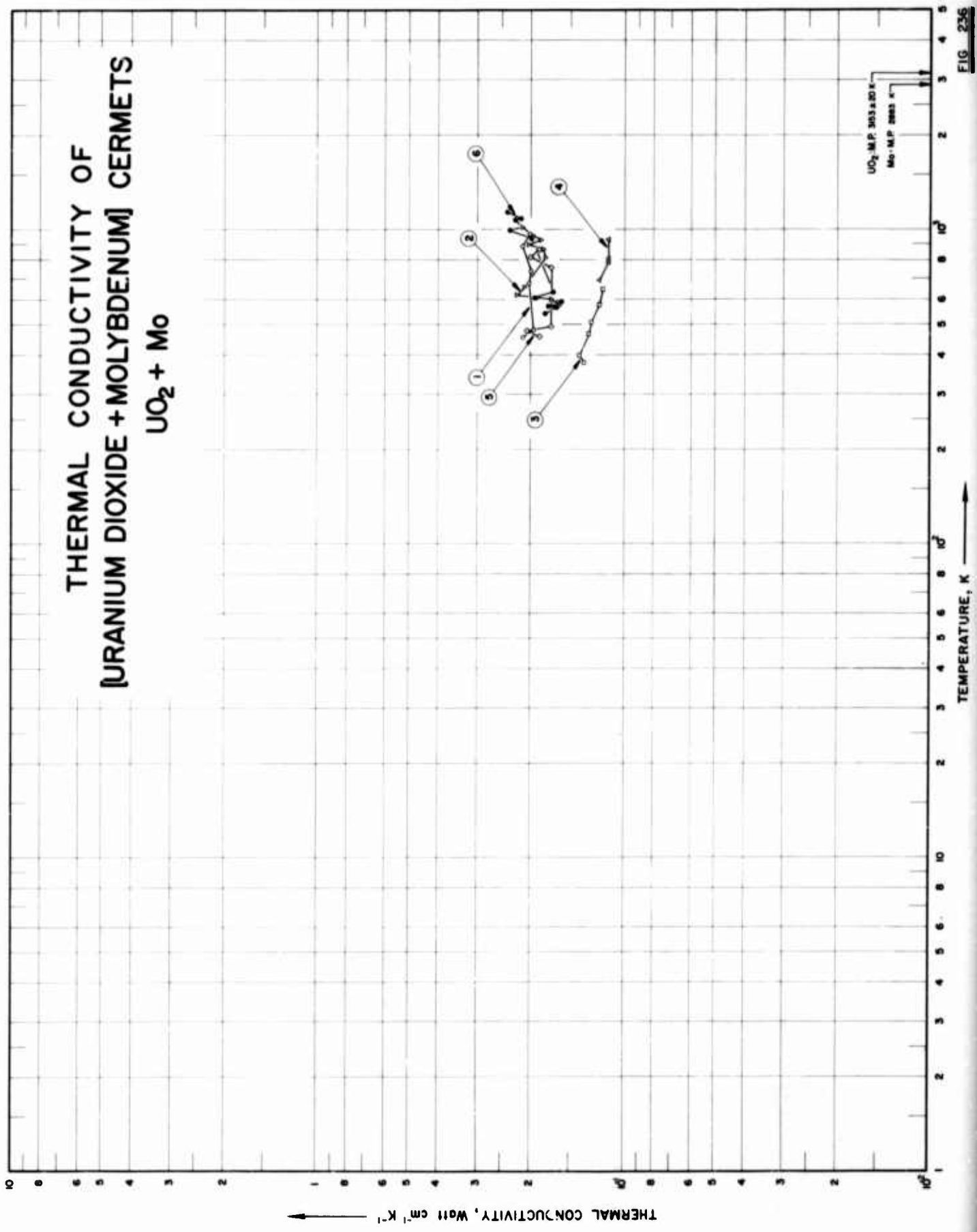
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	385	C	1961	602-927	<±5	TC-104	80 vol% UO_2 ; 97.1 % of theoretical density; using - 100 + 400 mesh spherical UO_2 ; gas-pressure bonded for hrs at 2300 F and 10,000 psi of helium gas pressure.
2	385	C	1961	474-1188	<±5	TC-104	Same specimen as above, 2nd run.

DATA TABLE NO. 235 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + CHROMIUM] CERMETS $\text{UO}_2 + \text{Cr}$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
602.2	0.158
647.2	0.146
686.2	0.172
794.2	0.154
866.2	0.161
927.2	0.175
<u>CURVE 2</u>	
474.2	0.162
500.2	0.133
522.2	0.192
539.2	0.128
573.2	0.149
599.2	0.176
863.2	0.141
940.2	0.154
1005.2	0.166
1017.2	0.155
1113.2	0.181
1186.2	0.202

FIG. 236

THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + MOLYBDENUM] CERMETS UO₂ + Mo



SPECIFICATION TABLE NO. 236 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + MOLYBDENUM] CERMENTS $UO_2 + Mo$

[For Data Reported in Figure and Table No. 236]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	385	C	1961	456-972	< ± 5	Tc - 82	70 volume % UO_2 , 91.7% of theoretical density, using - 100 + 140 mesh hydrothermal UO_2 , specimen prepared in rod form by gas pressure bonding for 3 hours at 1533 K and 10,000 psi of helium gas pressure; Armco iron used as primary standard and Type 347 stainless steel used as secondary standard. The above specimen, second run.
2	385	C	1961	575-1020	< ± 5	Tc - 82	80 volume % UO_2 , 91.1% of theoretical density; using - 100 + 140 mesh hydrothermal UO_2 ; specimen prepared in rod form by gas pressure bonding for 3 hours at 1589 K and 10,000 psi of helium gas pressure; Armco iron used as primary standard and Type 347 stainless steel used as secondary standard. The above specimen, second run.
3	385	C	1961	379-647	< ± 5	Tc - 90	
4	385	C	1961	692-932	< ± 5	Tc - 90	50 volume % UO_2 , 94.4% of theoretical density; using - 100 + 140 mesh spherical UO_2 ; specimen prepared in rod form by gas pressure bonding for 3 hours at 1561 K and 10,000 psi of helium gas pressure; Armco iron used as primary standard and Type 347 stainless steel used as secondary standard. The above specimen, second run.
5	385	C	1961	458-866	< ± 5	Tc - 105	
6	385	C	1961	544-1143	< ± 5	Tc - 105	

DATA TABLE NO. 236 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + MOLYBDENUM] CERMEETS $UO_2 + Mo$
 [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 6</u>	
456.2	0.212	544.2	0.180
483.2	0.196	568.2	0.166
677.2	0.203	574.2	0.176
740.2	0.199	591.2	0.160
886.2	0.213	606.2	0.194
972.2	0.201	635.2	0.170
<u>CURVE 2</u>		944.2	0.199
575.2	0.163	997.2	0.236
604.2	0.173	1019.2	0.212*
623.2	0.222	1076.2	0.225
657.2	0.210	1084.2	0.214
815.2	0.179	1143.2	0.239
866.2	0.183		
898.2	0.203		
927.2	0.185		
956.2	0.197		
1020.2	0.212		
<u>CURVE 3</u>			
379.2	0.136		
398.2	0.140		
468.2	0.130		
507.2	0.127		
579.2	0.120		
647.2	0.117		
<u>CURVE 4</u>			
692.2	0.120		
788.2	0.112		
810.2	0.112		
932.2	0.112		
<u>CURVE 5</u>			
458.2	0.187		
476.2	0.206		
492.2	0.173		
759.2	0.173		
816.2	0.200		
866.2	0.187		

* Not shown on plot

THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE+NIONIUM] CERMETS UO₂ + Nb

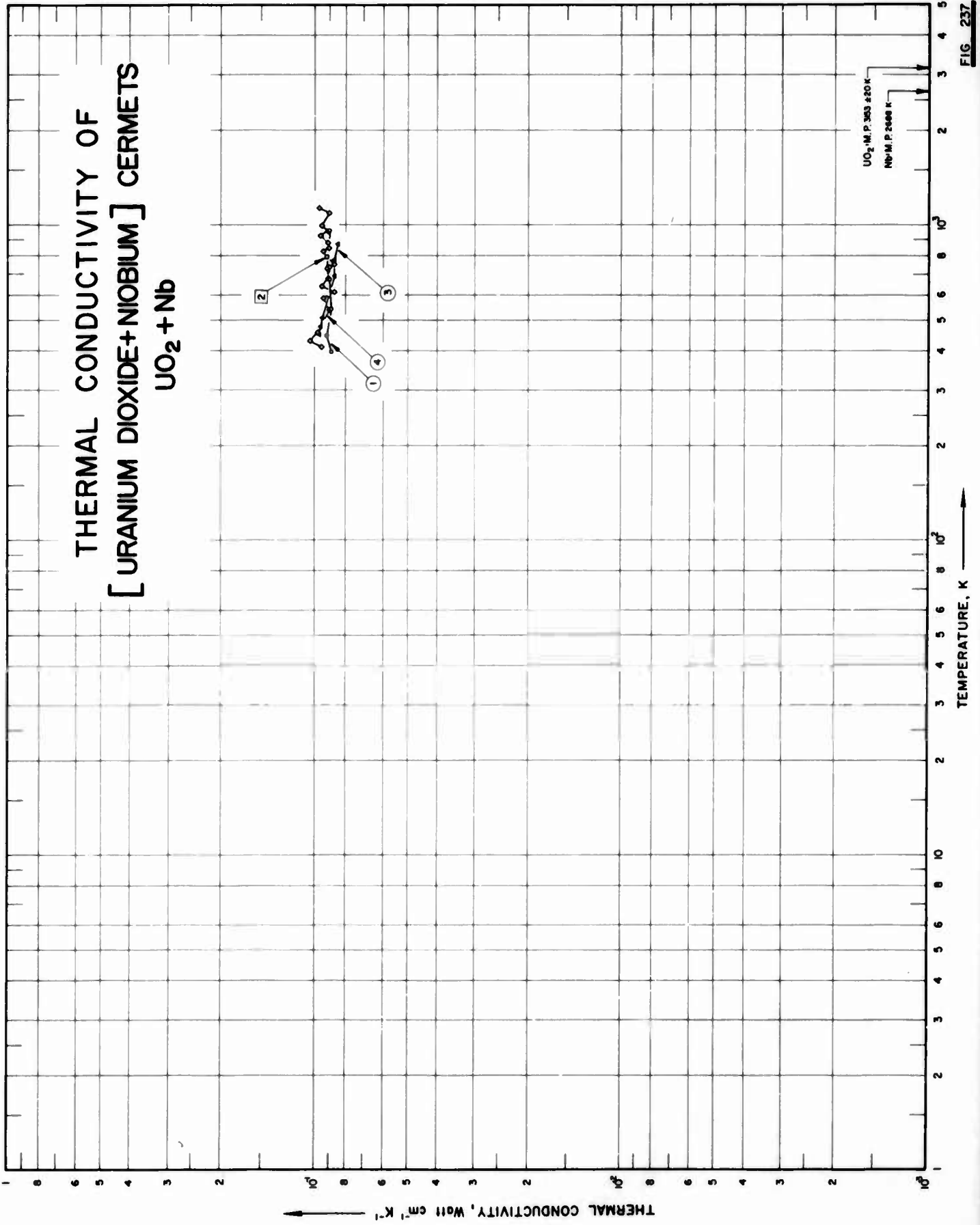


FIG. 237

SPECIFICATION TABLE NO. 237 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE - NIOBIUM] CERMETS $UO_2 + Nb$

[For Data Reported in Figure and Table No. 237]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	385	C	1961	397-966	<±5	TC-115	80 vol % UO_2 ; 85.3 % of theoretical density; niobium coated - 100 + 140 mesh spherical UO_2 ; gas-pressure bonded for 3 hrs at 2100 F and 10,000 psi of helium gas pressure; Armco iron used as primary standard and Type 347 stainless steel used as secondary standard. The above specimen, 2nd run.
2	385	C	1961	795.2	<±5	TC-115	
3	385	C	1961	450-872	<±5	TC-130	80 vol % UO_2 ; 89.5 % of theoretical density; niobium coated - 140 + 200 mesh hydrothermal UO_2 ; gas-pressure bonded 3 hrs at 1561 K and 10,000 psi of helium gas pressure; Armco iron used as primary standard and Type 347 stainless steel used as secondary standard. The above specimen, 2nd run.
4	385	C	1961	413-1131	<±5	TC-130	

DATA TABLE NO. 237 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + NIOBIUM] CERMETS UO₂ + Nb
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
397.2	0.089
447.2	0.092
544.2	0.089
677.2	0.090
730.2	0.092
966.2	0.090
<u>CURVE 2</u>	
795.2	0.092
<u>CURVE 3</u>	
450.2	0.097
478.2	0.096
510.2	0.095
690.2	0.087
775.2	0.087
872.2	0.085
<u>CURVE 4</u>	
413.2	0.095
434.2	0.103
457.2	0.098
540.2	0.090
587.2	0.094
614.2	0.087
641.2	0.095
678.2	0.091
736.2	0.090
751.2	0.087
825.2	0.094
843.2	0.090
876.2	0.091
925.2	0.096
958.2	0.091
986.2	0.095
1090.2	0.090
1131.2	0.097

THERMAL CONDUCTIVITY OF
 URANIUM DIOXIDE + STAINLESS STEEL] CERMENTS
 $UO_2 + Fe$

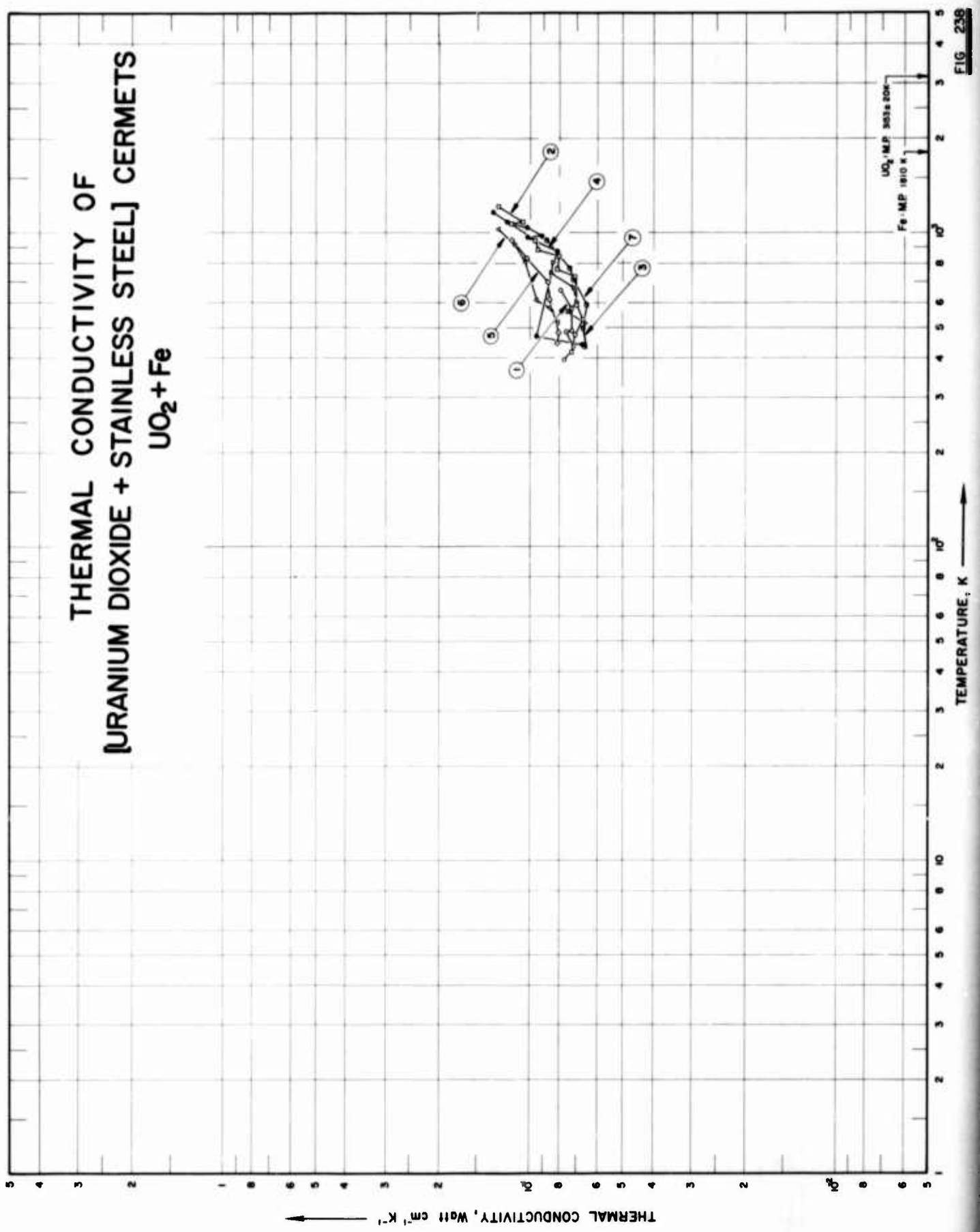


FIG. 238

SPECIFICATION TABLE NO. 238 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + STAINLESS STEEL ΣX_1] CERMENTS $UO_2 + Fe + \Sigma X_1$

[For Data Reported in Figure and Table No. 238]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	385	C	1961	395-656	< ± 5	Tc - 102	80 volume % of UO_2 , 98.4% of theoretical density; using - 100 + 140 mesh hydrothermal UO_2 and Type 302B stainless steel; gas pressure bonded for 3 hours at 1533 K and 10,000 psi of helium gas pressure; Armco iron used as primary standard and Type 347 stainless steel as secondary standard. The above specimen, second run.
2	385	C	1961	418-1213	< ± 5	Tc - 102	
3	385	C	1961	518-804	< ± 5	Tc - 103	80 volume % of UO_2 , 97.2% of theoretical density, using - 100 + 140 spherical UO_2 and Type 302B stainless steel; gas pressure bonded for 3 hours at 1533 K and 10,000 psi of helium gas pressure; Armco iron used as primary standard and Type 347 stainless steel as secondary standard.
4	385	C	1961	442-1169	< ± 5	Tc - 103	The above specimen, second run.
5	385	C	1961	446-947	< ± 5	Tc - 81	70 volume % of UO_2 , 97.0% of theoretical density; using - 100 + 140 mesh hydrothermal UO_2 and Type 302B stainless steel; gas pressure bonded for 3 hours at 1533 K and 10,000 psi of helium gas pressure; Armco iron used as primary standard and Type 347 stainless steel as secondary standard.
6	385	C	1961	521-1031	< ± 5	Tc - 81	The above specimen, second run.
7	385	C	1961	437-945	< ± 5	Tc - 80	80 volume % of UO_2 , 95.5% of theoretical density, using - 100 + 140 mesh hydrothermal UO_2 and Type 302B stainless steel; gas pressure bonded for 3 hours at 1533 K and 10,000 psi of helium gas pressure; Armco iron used as primary standard and Type 347 stainless steel as secondary standard.
8	385	C	1961	415-1012	< ± 5	Tc - 80	The above specimen, second run.

DATA TABLE NO. 238 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + STAINLESS STEEL] CERMEETS $UO_2 + Fe + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
395.0	0.077	446.2	0.081
433.0	0.072	483.2	0.080
484.0	0.076	614.2	0.086
488.0	0.073	696.2	0.087
575.0	0.073	832.2	0.103
656.0	0.079	947.2	0.115
<u>CURVE 2</u>			
418.0	0.073	521.2	0.081
476.0	0.071	578.2	0.086
532.0	0.067	714.2	0.095
590.0	0.070	807.2	0.104
727.0	0.071	915.2	0.113
765.0	0.081	1031.2	0.127
844.0	0.080		
884.0	0.094		
943.0	0.096		
1070.0	0.116		
1084.0	0.106		
1213.0	0.127		
<u>CURVE 3</u>			
518.0	0.066	437.2	0.066
564.0	0.075	499.2	0.067
604.0	0.070	593.2	0.065
674.0	0.072	715.2	0.072
745.0	0.085	773.2	0.074
804.0	0.084	945.2	0.088
<u>CURVE 4</u>			
442.0	0.067	415.2	0.063
470.0	0.095	465.2	0.071
373.0	0.081	828.2	0.080
970.0	0.102	1012.2	0.092
978.0	0.091		
1047.0	0.102		
1088.0	0.119		
1169.0	0.133		
<u>CURVE 5</u>			
<u>CURVE 6</u>			
<u>CURVE 7</u>			
<u>CURVE 8*</u>			

* Not shown on plot

SPECIFICATION TABLE NO. 239 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + URANIUM] CERMENTS UO₂ + U

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							UO ₂	U	
1	430	-	1966	298.2			55.1	44.9	Spherical uranium powder obtained from National Lead Co. containing impurities: 0.05 Fe, 0.01 Mg, 0.008 Mo, 0.005 Si, <0.005 K, <0.005 P, <0.005 Ti, <0.005 Zn, <0.002 Ca, <0.001 As, <0.001 Na, 0.0005 Ni, <0.0005 Al, <0.0005 Co, <0.0005 Sn, 0.0004 Mn, 0.0002 Cu, 0.0001 Pb, traces of Ag, Bi, Cr, Li, Sb, Be, and B; oxidized to desired percentage by spreading over the bottom of a Petri dish and placed in an oven at 150 C; specimen contained in a 0.75 in. dia x 2 in. long stainless steel cylindrical cell; mesh size -70+80; thermal conductivity measured by using the transient line source method, the heat source was a 36-gauge constantan wire contained in a 0.025 in. O.D. hypodermic tube soldered along the axis of the cylindrical cell, data calculated from measured line temperatures at two certain times; measured in nitrogen at 1 atm.
2	430	-	1966	298.2			55.1	44.9	Similar to the above specimen; measured in nitrogen under pressure in the range 9.12×10^{-3} -5.495 x 10 ³ mm Hg.
3	430	-	1966	298.2			90.0	10.0	Similar to the above specimen; measured in nitrogen at 1 atm.
4	430	-	1966	298.2			60.3	39.7	Same impurities, source, and measuring method as the above specimen; mesh size -230+325; measured in nitrogen at 1 atm.
5	430	-	1966	298.2			54.1	45.9	Similar to the above specimen; measured in nitrogen under pressure in the range 4.90×10^{-3} -4.677 x 10 ³ mm Hg.

DATA TABLE NO. 239 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + URANIUM] CERMENTS UO₂ + U
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
298.2	0.06239
p(mm Hg) k	
<u>CURVE 2*</u>	
$\bar{T} = 298.2$	
0.00912	0.0009962
4.27	0.000322
31.3	0.000870
216	0.00146
776	0.00171
1514	0.00181
5495	0.00188
T	k
<u>CURVE 3*</u>	
298.2	0.00254
<u>CURVE 4*</u>	
298.2	0.00205
p(mm Hg) k	
<u>CURVE 5*</u>	
$\bar{T} = 298.2$	
0.00490	0.000130
0.0501	0.000163
0.832	0.000268
14.6	0.000711
135	0.00119
767	0.00157
1738	0.00174
4677	0.00176

* No graphical presentation

THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + ZIRCONIUM] CERMETS $UO_2 + Zr$

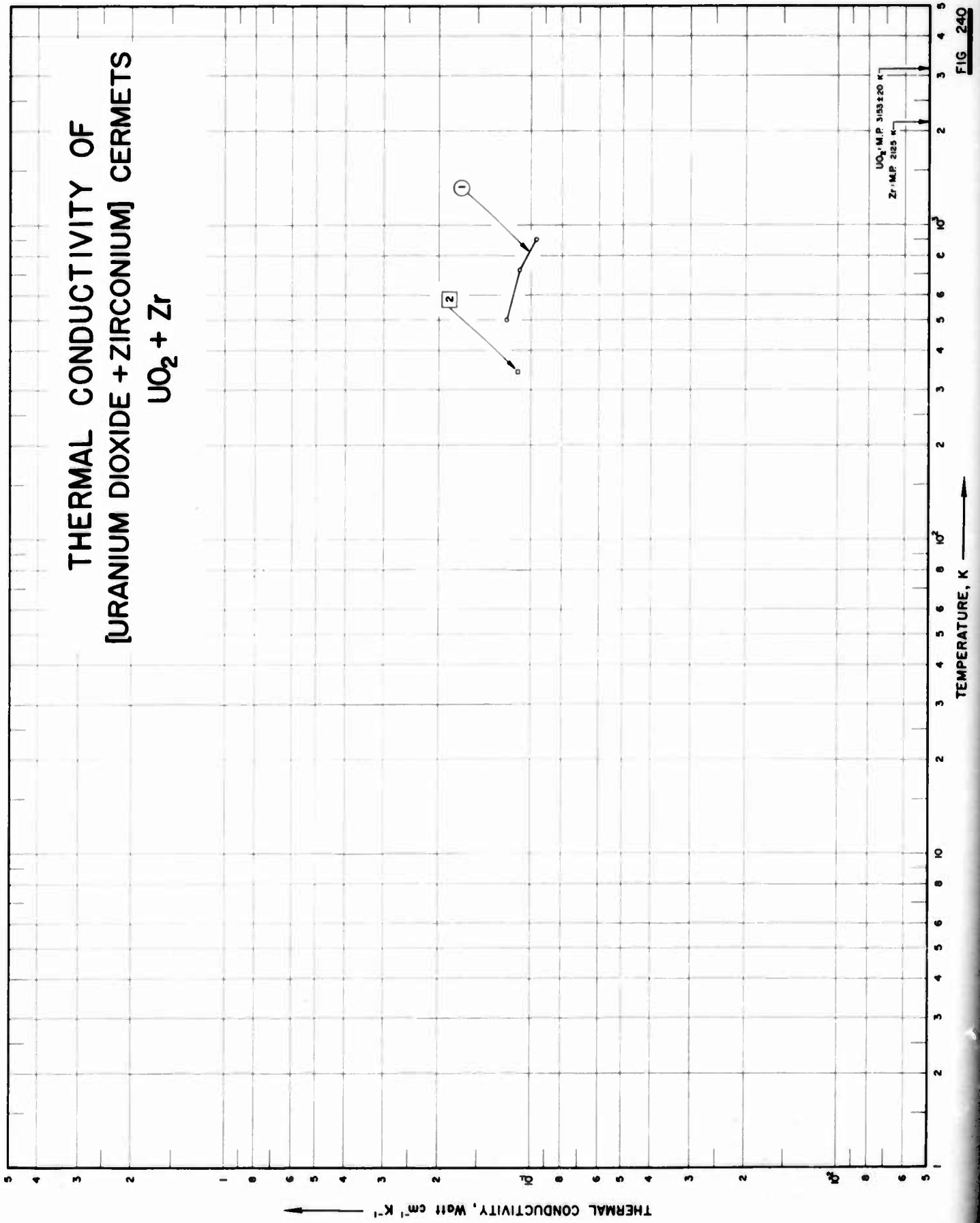


FIG. 240

SPECIFICATION TABLE NO. 240 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + ZIRCONIUM] CERMENTS $UO_2 + Zr$

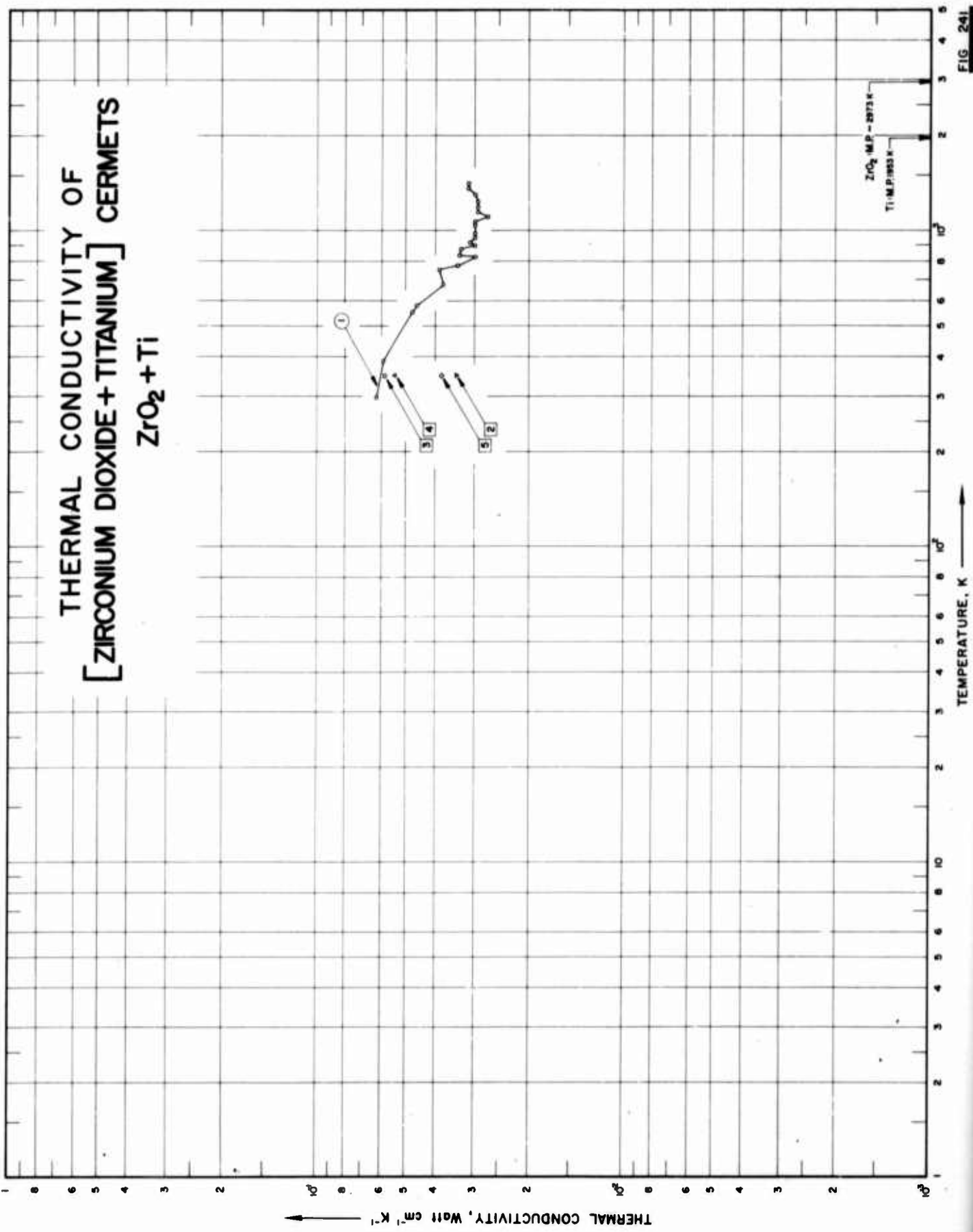
[For Data Reported in Figure and Table No. 240]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	76	C	1952	498-903			43 UO_2 , 57 Zr; 59% of theoretical density.
2	396	C	1954	343			80 UO_2 , 20 Zr; hot pressed in helium atmosphere at 1750 C and 3500 psi for 30 min; density 8.71 g cm ⁻³ .

DATA TABLE NO. 240 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + ZIRCONIUM] CERMEETS $\text{UO}_2 + \text{Zr}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
498.2	0.121
723.2	0.109
903.2	0.096
<u>CURVE 2</u>	
343.0	0.111

THERMAL CONDUCTIVITY OF
 [ZIRCONIUM DIOXIDE + TITANIUM] CERMETS
 $ZrO_2 + Ti$



SPECIFICATION TABLE NO. 241 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + TITANIUM] CERMETs ZrO₂ + Ti

[For Data Reported in Figure and Table No. 241]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							ZrO ₂	Ti	
1	523	R	1964	298-1423			93.59	6.42	The monoclinic zirconia contains 98.8 ZrO ₂ (including HfO ₂), 0.33 Si, 0.10 TiO ₂ and 0.10 CaO, original particle size 0.26 μ; the titanium power contains 98 Ti and 1.1 N, original particle size -325 mesh; specimen was in cylindrical form of 1.375 in. O. D. by 1.000 in. high with a 23/64 in. dia center hole; milled, cold-pressed and then vacuum sintered at 1870 C for 1 hr; density = 5.65 - 5.75 g cm ⁻³ .
2	524	C	1963	348.2			98.0	2.0	ZrO ₂ has a reported purity of 99.87% for the total oxide including 2% HfO ₂ ; the cermet was prepared by mixing in methyl alcohol, drying, pelletizing, then by pressing into wafer-type specimen, and then was fired in a vacuum resistance furnace for 2 hrs at 1800 C and cooled at a rate of approximately 60 C per min. Same fabrication as above.
3	524	C	1963	348.2			93.6	6.4	Same fabrication as above.
4	524	C	1963	348.2			93.6	6.4	Same fabrication as above, except the firing temperature was 200 C.
5	524	C	1963	348.2			85.7	14.3	Same fabrication as above, except the firing temperature was 1800 C.

DATA TABLE NO. 241 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + TITANIUM] CERMETS ZrO₂ + Ti
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
298.2	0.0628
388.2	0.0594
553.2	0.0477
583.2	0.0464
678.2	0.0377
753.2	0.0389
778.2	0.0339
828.2	0.0297
838.2	0.0335
878.2	0.0331
898.2	0.0297
923.2	0.0310
953.2	0.0297
983.2	0.0297
1048.2	0.0297
1073.2	0.0297
1118.2	0.0272
1153.2	0.0293
1193.2	0.0293
1243.2	0.0293
1303.2	0.0297
1373.2	0.0314
1423.2	0.0314
<u>CURVE 2</u>	
348.2	0.0343
<u>CURVE 3</u>	
348.2	0.0586
<u>CURVE 4</u>	
348.2	0.0544
<u>CURVE 5</u>	
348.2	0.0381

SPECIFICATION TABLE NO. 242 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + ZIRCONIUM] CERMETS $ZrO_2 + Zr$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZrO_2	Composition (weight percent) Zr	Composition (continued), Specifications and Remarks
1	430	-	1966	298.2			54.5	45.5	Powder specimen contained in a 0.75 in. dia x 2 in. long stainless steel cylindrical cell; mesh size-70+80; thermal conductivity measured by using the transient line source method, the heat source was a 36-gauge constantan wire contained in a 0.025 in. O.D. hypodermic tube soldered along the axis of the cylindrical cell, data calculated from the measured line temperature at two certain times; measured in nitrogen at 1 atm.
2	430	-	1966	298.2			90.0	10.0	Similar to the above specimen.

DATA TABLE NO. 242 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + ZIRCONIUM] CERMETS $ZrO_2 + Zr$ [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹k⁻¹]

T k

CURVE 1*

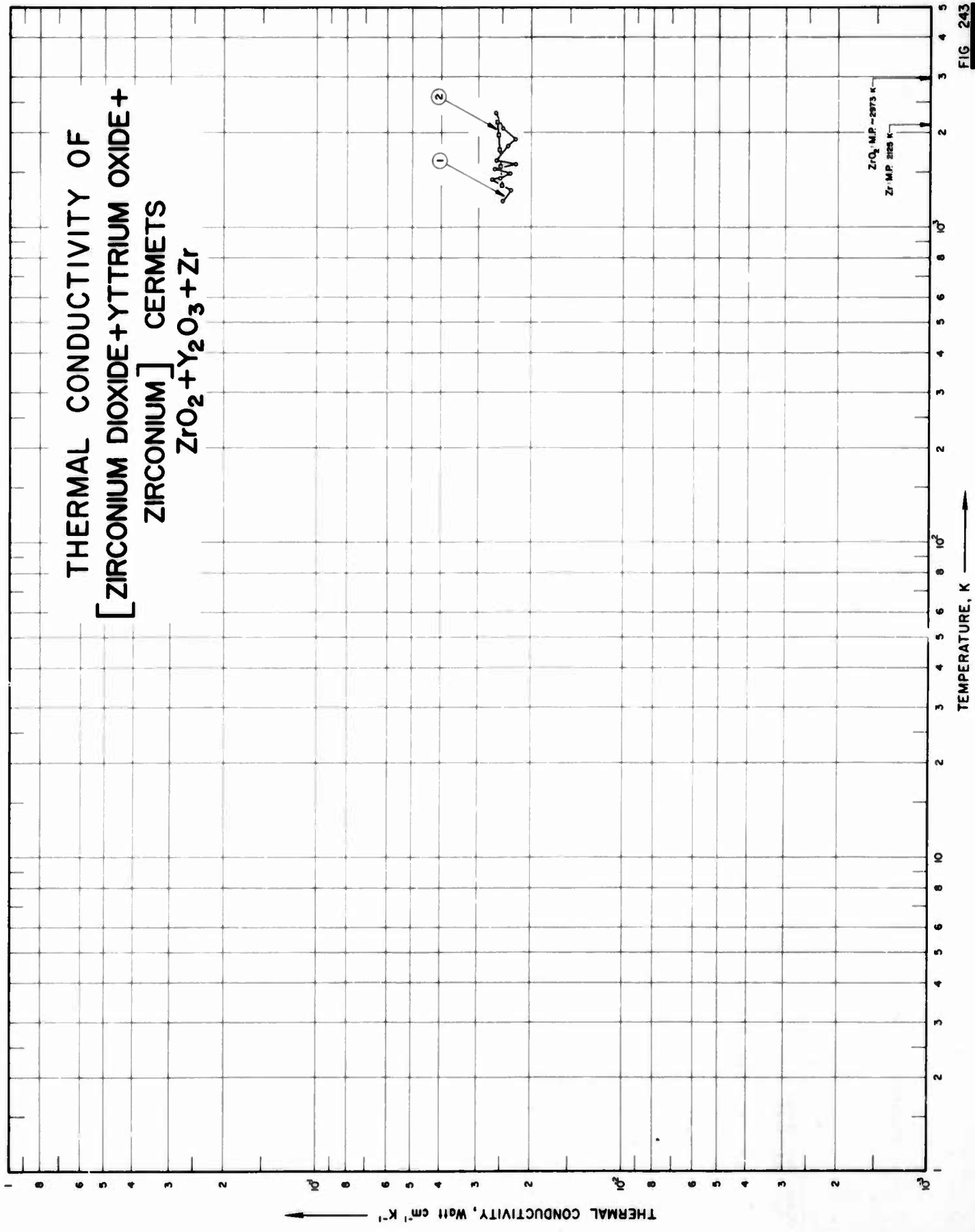
298.2 0.00260

CURVE 2*

298.2 0.00195

* No graphical presentation

THERMAL CONDUCTIVITY OF
 [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE +
 ZIRCONIUM] CERMETS
 $ZrO_2 + Y_2O_3 + Zr$



SPECIFICATION TABLE NO. 243 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE + ZIRCONIUM] CERMETS $ZrO_2 + Y_2O_3 + Zr$

[For Data Reported in Figure and Table No. 243]

Curve No.	Ref. Method No.	Year Used	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						ZrO ₂	Y ₂ O ₃ Zr	
1	291	R	1964	1213-2308		80	12 8	Y ₂ O ₃ stabilized ZrO ₂ with 8% Zr; prepared by hot-pressing the mixed powders at 1900 C and then machined into disc form with 2 in. O. D. and 0.375 in. I. D.; particles of Zr metal uniformly distributed through the material; density was 97% of theoretical value. Same specimen as above; data corrected to 100% theoretical value of density.
2	291	R	1964	1373-2173				

DATA TABLE NO. 243 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE + ZIRCONIUM] CERMETS $ZrO_2 + Y_2O_3 + Zr$
 [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k
<u>CURVE 1</u>	
1213.2	0.0248
1233.2	0.0244*
1318.2	0.0234
1358.2	0.0234*
1423.2	0.027
1433.2	0.0254
1483.2	0.0236
1543.2	0.0266
1588.2	0.0225
1633.2	0.0262
1818.2	0.0239
1833.2	0.0234*
1908.2	0.0226
2073.2	0.0248
2308.2	0.0263
<u>CURVE 2</u>	
1373.2	0.025
1573.2	0.0253
1773.2	0.0255
1973.2	0.0257
2173.2	0.0259

* Not shown on plot

SPECIFICATION TABLE NO. 244 THERMAL CONDUCTIVITY OF AMMONIUM PERCHLORATE NH_4ClO_4

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	509	P	1964	323-513	± 5	Reagent grade		Specimen consists of two identical discs 1.125 in. in dia, compressed from powder; particle size range from 43 to 61 μ ; density 1.9 g cm^{-3} ; porosity 2.3%.

DATA TABLE NO. 244 THERMAL CONDUCTIVITY OF AMMONIUM PERCHLORATE NH_4ClO_4 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
323.2	0.00469
373.2	0.00452
423.2	0.00427
473.2	0.00402
513.2	0.00377

* No graphical presentation

SPECIFICATION TABLE NO. 245 THERMAL CONDUCTIVITY OF CADMIUM GERMANIUM PHOSPHIDE CdGeP₂

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	510	L	1966	298.2		CdGeP ₂ ; 6		Stoichiometric n-type polycrystalline; specimen 12 x 4 x 4 mm; prepared from 99.9999 pure Cd, p-type Ge (~50 ohm cm), and 99.9999 pure red phosphorus, materials loaded into a high-purity graphite crucible which was carefully fitted in a sealed quartz tube, heated at 10 C hr ⁻¹ to 580 C, annealed for 12 hrs under an external argon pressure of 60 atm, heated at 10 C hr ⁻¹ to 980 C, after a period of 30 min, cooled down to 830 C, rotated and vibrated for 30 min, then the Bridgman process performed at a lower rate of 10 mm hr ⁻¹ till room temperature reached; melting point 800 C; electrical resistivity 4.8 x 10 ³ ohm cm at room temperature.

DATA TABLE NO. 245 THERMAL CONDUCTIVITY OF CADMIUM GERMANIUM PHOSPHIDE CdGeP₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k
 CURVE 1*
 298.2 0.11

* No graphical presentation

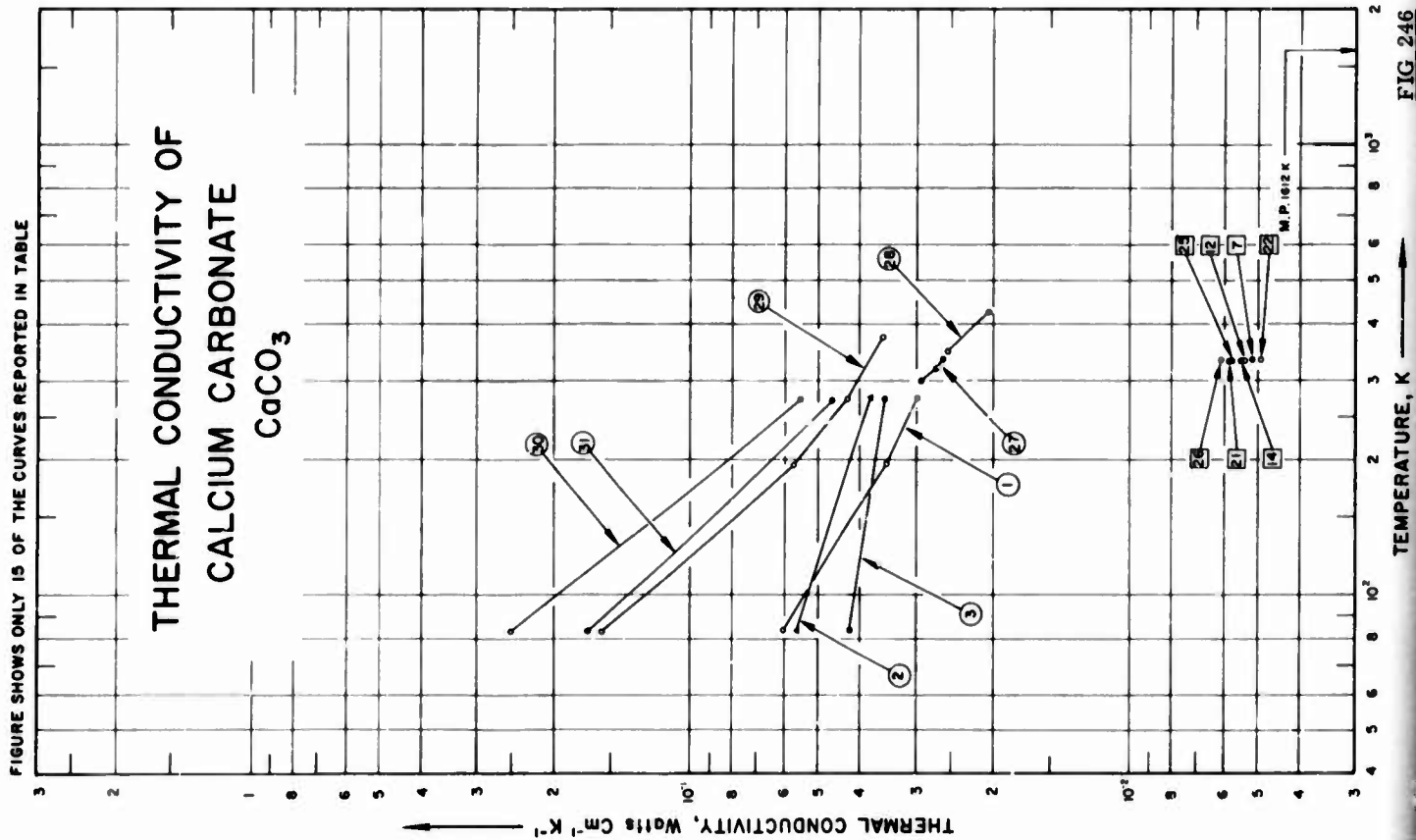


FIG 246

SPECIFICATION TABLE NO. 246 THERMAL CONDUCTIVITY OF CALCIUM CARBONATE CaCO_3

[For Data Reported in Figure and Table No. 246]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	22	L	1911	83-273		Marble	Large grain; 103 crystal interruptions per cm.
2	119	C	1925	83, 273		Marble	Fine grain; 138 crystal interruptions per cm.
3	119	C	1925	83, 273		Marble	Marble stone powder; apparent density 1.12 g cm^{-3} ; porosity 59.3%; particle size -115 + 150 Tyler mesh.
4	120	L	1953	331.1		Marble powder	Marble stone powder; apparent density 1.12 g cm^{-3} ; porosity 59.3%; particle size -200 + 325 Tyler mesh.
5	120	L	1953	331.2		Marble powder	Marble stone powder; apparent density 1.13 g cm^{-3} ; porosity 58.9%; particle size -150 + 200 Tyler mesh.
6	120	L	1953	330.2		Marble powder	Marble stone powder; apparent density 1.15 g cm^{-3} ; porosity 58.2%; particle size -48 + 65 Tyler mesh.
7	120	L	1953	333.2		Marble powder	Marble stone powder; apparent density 1.15 g cm^{-3} ; porosity 58.2%; particle size -65 + 100 Tyler mesh.
8	120	L	1953	332.2		Marble powder	Marble stone powder; apparent density 1.18 g cm^{-3} ; porosity 57.1%; particle size -28 + 48 Tyler mesh.
9	120	L	1953	334.5		Marble powder	Marble stone powder; apparent density 1.18 g cm^{-3} ; porosity 57.1%; particle size -115 + 150 Tyler mesh.
10	120	L	1953	330.3		Marble powder	Marble stone powder; apparent density 1.19 g cm^{-3} ; porosity 56.7%; particle size -200 + 325 Tyler mesh.
11	120	L	1953	330.4		Marble powder	Marble stone powder; apparent density 1.22 g cm^{-3} ; porosity 55.6%; particle size -48 + 65 Tyler mesh.
12	120	L	1953	330.5		Marble powder	Marble stone powder; apparent density 1.22 g cm^{-3} ; porosity 55.6%; particle size -65 + 100 Tyler mesh.
13	120	L	1953	331.2		Marble powder	Marble stone powder; apparent density 1.26 g cm^{-3} ; porosity 54.2%; particle size -28 + 48 Tyler mesh.
14	120	L	1953	331.1		Marble powder	Marble stone powder; apparent density 1.26 g cm^{-3} ; porosity 54.2%; particle size -115 + 150 Tyler mesh.
15	120	L	1953	330.8		Marble powder	Marble stone powder; apparent density 1.27 g cm^{-3} ; porosity 53.8%; particle size -150 + 200 Tyler mesh.
16	120	L	1953	330.7		Marble powder	Marble stone powder; apparent density 1.32 g cm^{-3} ; porosity 52.0%; particle size -150 + 200 Tyler mesh.
17	120	L	1953	328.8		Marble powder	Marble stone powder; apparent density 1.32 g cm^{-3} ; porosity 52.0%; particle size -200 + 325 Tyler mesh.
18	120	L	1953	330.8		Marble powder	Marble stone powder; apparent density 1.32 g cm^{-3} ; porosity 52.0%; particle size -200 + 325 Tyler mesh.

SPECIFICATION TABLE NO. 246 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
19	120	L	1953	333.3		Marble powder	Marble stone powder; apparent density 1.32 g cm ⁻³ ; porosity 52.0%; mixed particle sizes: 22% (-28 + 48) Tyler mesh, 20% (-48 + 65) Tyler mesh, 11% (-65 + 100) Tyler mesh, 5% (-115 + 150) Tyler mesh, 20% (-130 + 200) Tyler mesh, and 22% (-200 + 325) Tyler mesh.
20	120	L	1953	332.1		Marble powder	Marble stone powder; apparent density 1.40 g cm ⁻³ ; porosity 49.1%; mixed particle sizes as above.
21	120	L	1953	329.5		Marble powder	Marble stone powder; apparent density 1.40 g cm ⁻³ ; porosity 49.1%; particle size -200 + 325 Tyler mesh.
22	120	L	1953	332.2		Marble powder	Marble stone powder; apparent density 1.07 g cm ⁻³ ; porosity 61.1%.
23	120	L	1953	331.2		Marble powder	Marble stone powder; apparent density 1.25 g cm ⁻³ ; porosity 54.6%.
24	120	L	1953	334.0		Marble powder	Marble stone powder; apparent density 1.29 g cm ⁻³ ; porosity 53.1%.
25	120	L	1953	330.6		Marble powder	Marble stone powder; apparent density 1.36 g cm ⁻³ ; porosity 50.5%.
26	120	L	1953	332.3		Marble powder	Marble stone powder; apparent density 1.47 g cm ⁻³ ; porosity 46.5%.
27	117	L	1955	298-337	1.0-2.0	Marble	Specimen thickness 15.2 mm; density 2.68 g cm ⁻³ .
28	121	R	1921	348, 423		White Alabama marble	Composed principally of calcium carbonate and a small amount of magnesium carbonate; dried by heating in an oven for 4 hrs at 130 C.
29	22	L	1911	83-374		Calcite	Single crystal; measured perpendicular to the principal axis.
30	119	C	1925	83, 273		Calcite	Single crystal; measured parallel to the principal axis.
31	119	C	1925	83, 273		Calcite	Single crystal; measured perpendicular to the principal axis.
32	508	L	1940	390-633		Brown Marble	98 CaCO ₃ and organic matter such as oils; specimen 1 in. thick and 8 in. in dia; specimen obtained from St. Marc des Carriers, Que.; density 2.659 g cm ⁻³ ; coarse-grained.
33	508	L	1940	398-615		White Marble	Specimen 1 in. thick and 8 in. in dia; density 2.755 g cm ⁻³ ; obtained from Phillipsburg, Que.
34	508	L	1940	443.7		White Marble	Similar to the above specimen; measurements done after exposure to high temperature test.
35	508	L	1940	398-608		Black Marble	96 CaCO ₃ and some organic matter; specimen 1 in. thick and 8 in. in dia; density 2.803 g cm ⁻³ ; obtained from St. Albert, Ont.
36	508	L	1940	390.4		Black Marble	Similar to the above specimen; measurements done after exposure to high temperature test.

DATA TABLE NO. 246 THERMAL CONDUCTIVITY OF CALCIUM CARBONATE CaCO₃[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k
<u>CURVE 1</u>							
83.2	0.0605	<u>CURVE 11*</u>		<u>CURVE 22</u>		<u>CURVE 31</u>	
195.2	0.0352	330.4	0.00526	332.2	0.00493	83.0	0.170
273.2	0.0299	<u>CURVE 12</u>		<u>CURVE 23*</u>		273.2	0.0466
<u>CURVE 2</u>							
<u>CURVE 13*</u>		330.45	0.00537	331.2	0.00545	<u>CURVE 32*</u>	
83.0	0.0564	<u>CURVE 14</u>		<u>CURVE 24*</u>		390.4	0.0167
273.2	0.0390	331.15	0.00538	334.0	0.00556	469.3	0.0151
<u>CURVE 3</u>							
<u>CURVE 15*</u>		<u>CURVE 16*</u>		<u>CURVE 25</u>		518.7	0.0138
83.0	0.0425	331.1	0.00550	330.6	0.00578	633.2	0.0114
273.2	0.0352	<u>CURVE 17*</u>		<u>CURVE 26</u>		<u>CURVE 33*</u>	
<u>CURVE 4*</u>							
331.1	0.00502	330.8	0.00543	332.3	0.00614	398.2	0.0144
<u>CURVE 5*</u>							
<u>CURVE 18*</u>		<u>CURVE 19*</u>		<u>CURVE 27</u>		443.2	0.0144
331.2	0.00505	330.7	0.00550	298.2	0.0294	511.5	0.0150
<u>CURVE 6*</u>							
<u>CURVE 19*</u>		<u>CURVE 20*</u>		<u>CURVE 28</u>		615.4	0.0138
330.15	0.00502	330.8	0.00562	348.2	0.0257	<u>CURVE 34*</u>	
<u>CURVE 7</u>							
333.2	0.00519	<u>CURVE 21</u>		423.2	0.0206	443.7	0.0131
<u>CURVE 8*</u>							
<u>CURVE 20*</u>		<u>CURVE 29</u>		<u>CURVE 35*</u>		<u>CURVE 35*</u>	
332.2	0.00519	333.3	0.00562	83.2	0.158	397.6	0.0156
<u>CURVE 9*</u>							
<u>CURVE 21</u>		<u>CURVE 30</u>		195.2	0.0576	483.7	0.0151
334.45	0.00526	332.05	0.00587	273.2	0.0429	607.6	0.0137
<u>CURVE 10*</u>							
330.3	0.00526	329.45	0.00587	374.2	0.0356	<u>CURVE 36*</u>	
<u>CURVE 10*</u>							
<u>CURVE 21</u>		<u>CURVE 30</u>		83.0	0.251	<u>CURVE 36*</u>	
330.3	0.00526	329.45	0.00587	273.2	0.0551	<u>CURVE 36*</u>	

* Not shown on plot

SPECIFICATION TABLE NO. 247 THERMAL CONDUCTIVITY OF [CALCIUM PHOSPHATE + LITHIUM CARBONATE + MAGNESIUM CARBONATE] $\text{Ca}_3(\text{PO}_4)_2 + \text{Li}_2\text{CO}_3 + \text{MgCO}_3$

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						$\text{Ca}_3(\text{PO}_4)_2$	Li_2CO_3	MgCO_3	
1	23	1952	312-391		164A	33.33	33.33	33.33	Fired at 1200 K for 1.5 hrs; density (after firing) 2.49 g cm ⁻³ ; water absorption 0.007%.

DATA TABLE NO. 247 THERMAL CONDUCTIVITY OF [CALCIUM PHOSPHATE + LITHIUM CARBONATE + MAGNESIUM CARBONATE] $\text{Ca}_3(\text{PO}_4)_2 + \text{Li}_2\text{CO}_3 + \text{MgCO}_3$
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

311.7 0.0439
 331.2 0.0423
 352.2 0.0423
 370.2 0.0410
 390.7 0.0397

* No graphical presentation

SPECIFICATION TABLE NO. 248 THERMAL CONDUCTIVITY OF [CARBON + OXYGEN] C + O

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						C	O	
1	P	1960	1273-3273		Channel Carbon Black	94.59	4.79	0.68 H, and 0.09 ash, heat treated from 1000 to 3000 C in nitrogen atmosphere for a duration of 10 - 30 min; particle dia < 1 μ ; degree of graphitization 9% at the max. exposed temperature; thermal conductivity data calculated from measurements of diffusivity, bulk weight, and specific heat data; measured in a nitrogen argon atmosphere.

DATA TABLE NO. 248 THERMAL CONDUCTIVITY OF [CARBON + OXYGEN] C + O

[Temperature, T, K, Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

1273.2 0.000256
 1573.2 0.000511
 1773.2 0.000604
 2073.2 0.000814
 2273.2 0.000814
 2623.2 0.000814
 2973.2 0.000814
 3273.2 0.000395

* No graphical presentation

SPECIFICATION TABLE NO. 249 THERMAL CONDUCTIVITY OF [CARBON + VOLATILE MATERIALS] C + Volatile Materials

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation.	Composition (weight percent)	Composition (continued), Specifications and Remarks
1	161 P	1960	1273-3073		Petroleum Coke	C Bal	0.08 ash; heat treated 10-30 min before each measurement; particle dia ~0.5 mm; density 1.405 g cm ⁻³ ; measured in nitrogen + argon atmosphere; thermal conductivity data calculated from measured values of thermal diffusivity and specific heat.
						Volatiles Materials 5.13	

DATA TABLE NO. 249 THERMAL CONDUCTIVITY OF [CARBON + VOLATILE MATERIALS] C + Volatile Materials

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
	<u>CURVE 1*</u>
1273.2	0.00214
1673.2	0.00242
2053.2	0.00279
2273.2	0.00316
3073.2	0.00335

* No graphical presentation

SPECIFICATION TABLE NO. 250 THERMAL CONDUCTIVITY OF GALLIUM PHOSPHIDE GaP

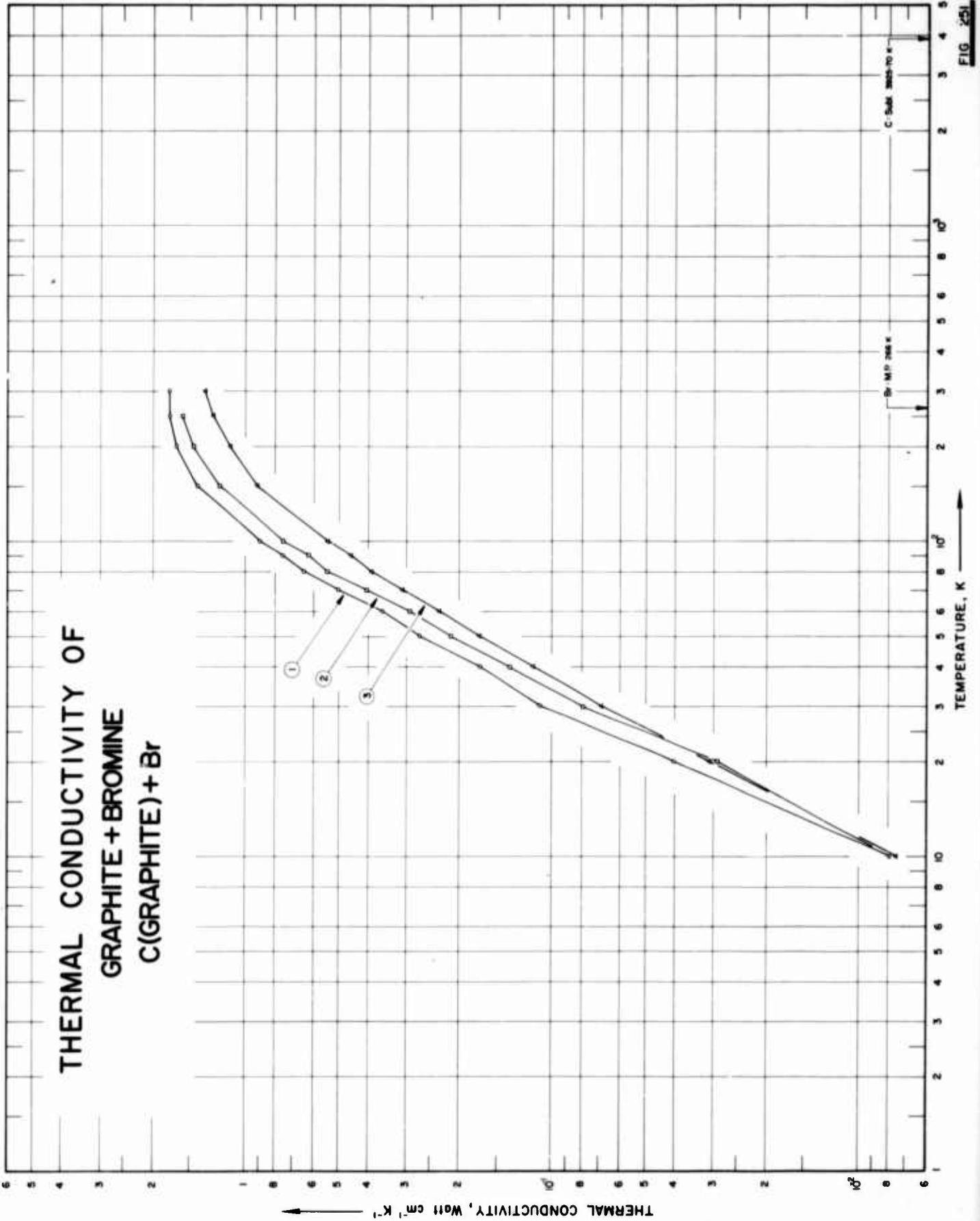
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	597, 598	P	1963	290			Melting point ~ 1350 C; measured by a transient method.

DATA TABLE NO. 250 THERMAL CONDUCTIVITY OF GALLIUM PHOSPHIDE GaP

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k
CURVE 1*
 290 1.09

* No graphical presentation



THERMAL CONDUCTIVITY OF
GRAPHITE + BROMINE
C(GRAPHITE) + Br

THERMAL CONDUCTIVITY, Watt cm⁻¹ K⁻¹

TEMPERATURE, K

SPECIFICATION TABLE NO. 251 THERMAL CONDUCTIVITY OF [GRAPHITE + BROMIDE] C + Br

[For Data Reported in Figure and Table No. 251]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						C	Br	
1	E	1956	10-300	±5	Brom-Graphite	97.97	2.03	Calculated composition; brominated AGOT-KC graphite.
2	E	1956	10-250	±5	Brom-Graphite	94.43	5.57	Calculated composition; brominated AGOT-KC graphite.
3	E	1956	10-300	±5	Brom-Graphite	92.76	7.24	Calculated composition; brominated AGOT-KC graphite.

DATA TABLE NO. 251 THERMAL CONDUCTIVITY OF [GRAPHITE + BROMINE] C + Br
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
10	0.00795
20	0.0402
30	0.109
40	0.172
50	0.272
60	0.360
70	0.502
80	0.649
90	0.753
100	0.899
150	1.42
200	1.67
250	1.76
300	1.76
<u>CURVE 2</u>	
10	0.00795*
20	0.0293
30	0.0795
40	0.136
50	0.213
60	0.293
70	0.406
80	0.544
90	0.628
100	0.753
150	1.21
200	1.46
250	1.59
<u>CURVE 3</u>	
10	0.00753
20	0.031
30	0.069
40	0.115
50	0.172
60	0.234
70	0.310
80	0.393
90	0.460
100	0.544
150	0.92
200	1.13
250	1.28
300	1.36

* Not shown on plot

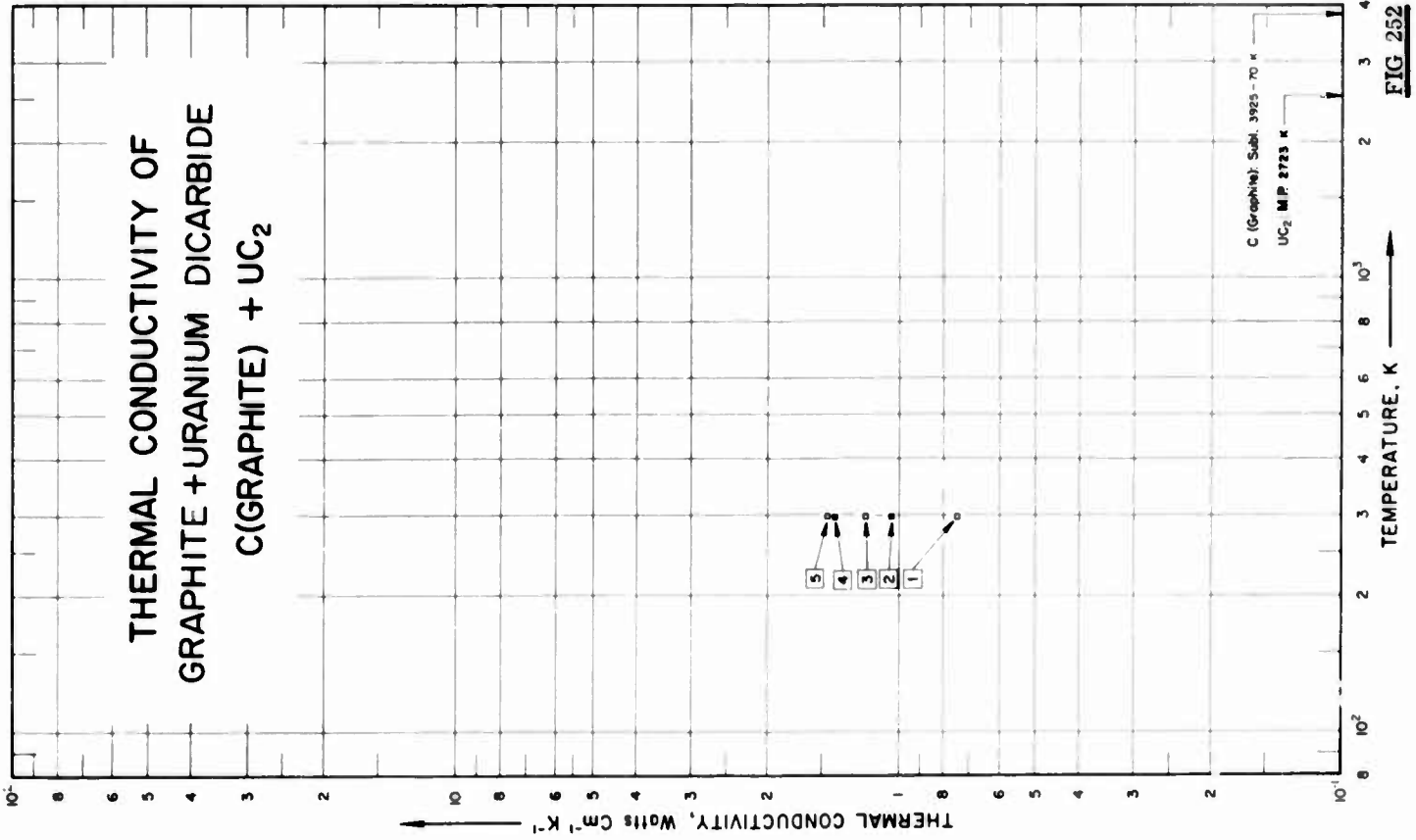


FIG 252

SPECIFICATION TABLE NO. 252 THERMAL CONDUCTIVITY OF [GRAPHITE + URANIUM DICARBIDE] C + UC₂

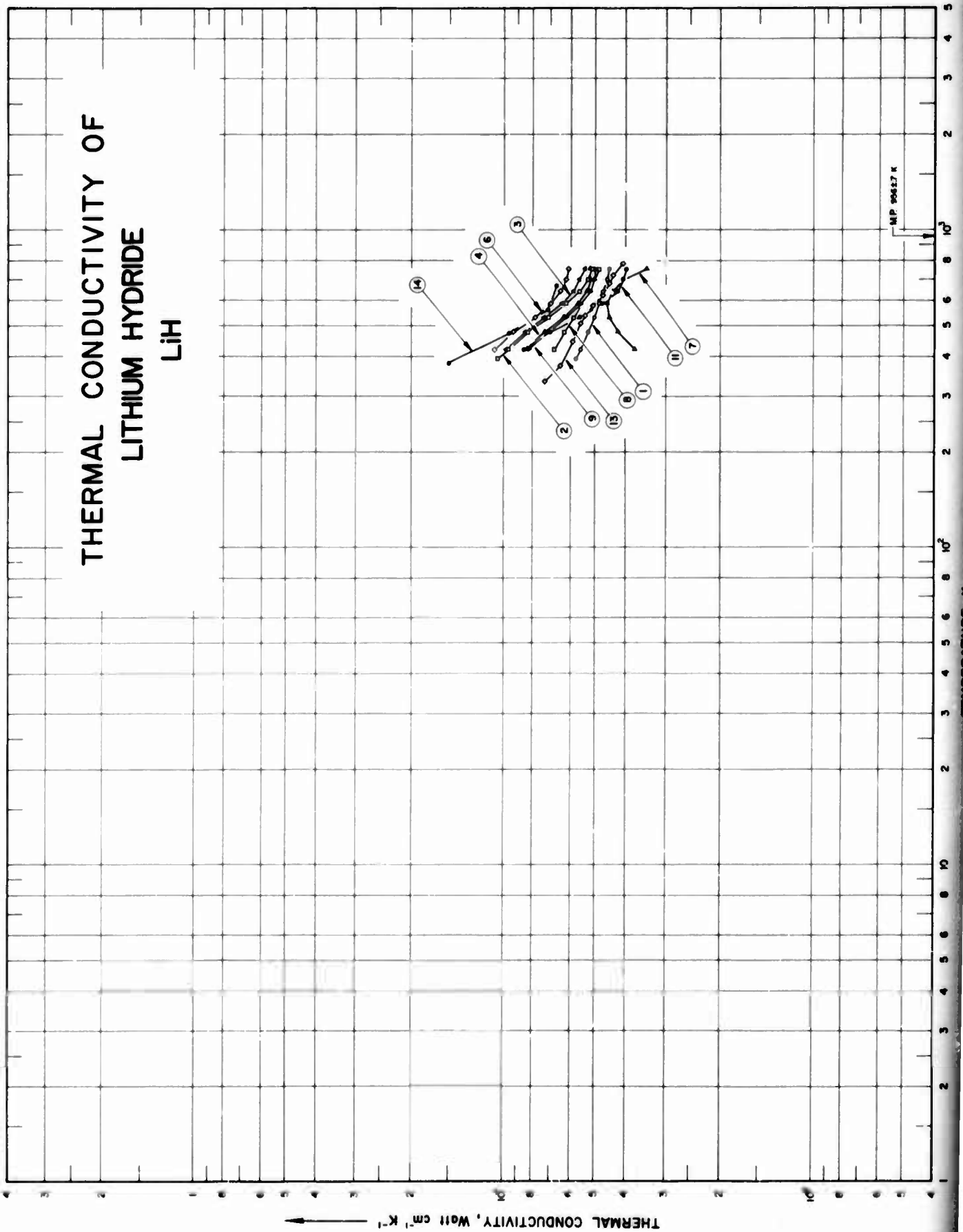
[For Data Reported in Figure and Table No. 252]

Curve No.	Ref. No. Used	Method	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							C	UC ₂	
1	181		1959	298.2			88.96	11.04	Baked to 2800 C; bulk density 1.866 g cm ⁻³ .
2	181		1959	298.2			78.07	21.93	As above but bulk density 1.986 g cm ⁻³ .
3	181		1959	298.2			72.52	27.48	As above but bulk density 2.067 g cm ⁻³ .
4	181		1959	298.2			65.92	34.08	As above but bulk density 2.157 g cm ⁻³ .
5	181		1959	298.2			56.13	43.87	As above but bulk density 2.333 g cm ⁻³ .

DATA TABLE NO. 252 THERMAL CONDUCTIVITY OF [GRAPHITE + URANIUM DICARBIDE] C + UC₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
298.2	0.744
<u>CURVE 2</u>	
298.2	1.04
<u>CURVE 3</u>	
298.2	1.18
<u>CURVE 4</u>	
298.2	1.39
<u>CURVE 5</u>	
298.2	1.45

FIGURE SHOWS ONLY 11 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 253 THERMAL CONDUCTIVITY OF LITHIUM HYDRIDE LiH

[For Data Reported in Figure and Table No. 253]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	512	R	1962	394-755			Cylindrical specimen 36 in. long and 6 in. dia with 0.03 in. stainless steel walls and a centrally located finned coolant tube, the fin was of a spiral configuration, 1.50 in. in dia, with three spirals per in. of tube, lithium hydride was cast inside the cylinder; thermal conductivity was measured from inside the coolant tube to the outside of the can; vacuum in the voids of the lithium hydride.
2	512	R	1962	394-755			The above specimen measured from inside the coolant tube to the outside of the can; with helium filling the voids in the lithium hydride.
3	512	R	1962	422-755			The above specimen measured from inside the coolant tube to the outside of the can; with hydrogen filling the voids in the lithium hydride.
4	512	R	1962	422-755			The above specimen with vacuum in the voids of the lithium hydride; the fine effective conductivity was measured from inside the finned coolant tube to an intermediate point (radius = 1.25 in.) in the lithium hydride outside the fin area.
5	512	R	1962	422-755			The above specimen with helium in the voids of the lithium hydride; the fin effective conductivity was measured.
6	512	R	1962	422-755			The above specimen with hydrogen in the voids of the lithium hydride; the fin effective conductivity was measured.
7	512	R	1962	422-755			The above specimen with vacuum in the voids of the lithium hydride; the salt (lithium hydride) to the can effective conductivity was measured from the intermediate point (radius = 1.25 in.) to the outside of the can.
3	512	R	1962	422-755			The above specimen with helium in the voids of the lithium hydride; the salt to the can effective conductivity was measured.
9	512	R	1962	422-755			The above specimen with hydrogen in the voids of the lithium hydride; the salt to the can effective conductivity was measured.
10	512	R	1962	422-755			The above specimen with vacuum in the voids of the lithium hydride; the salt effective conductivity was measured between two points in the salt (radius = 1.25 in., 1.70 in.)
11	512	R	1962	422-755			The above specimen with helium in the voids of the lithium hydride; the salt effective conductivity was measured.
12	512	R	1962	422-755			The above specimen with hydrogen in the voids of the lithium hydride; the salt effective conductivity was measured.
13	132	R	1958	335-786			Cold pressed; reinforced with perforated honeycomb oriented with the axis of the cells normal to the direction of heat flow.
14	513		1961	380-670			

DATA TABLE NO. 253 THERMAL CONDUCTIVITY OF LITHIUM HYDRIDE LHM
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k
<u>CURVE 1</u>							
394.3	0.0576	588.8	0.0682	422.1	0.0909	<u>CURVE 10*</u>	
422.1	0.0557	644.3	0.0649	477.6	0.0770	422.1	0.0857
477.6	0.0528	699.9	0.0632	533.2	0.0640	477.6	0.0696
533.2	0.0502	755.4	0.0623	588.8	0.0545	533.2	0.0562
588.8	0.0485	<u>CURVE 6</u>		644.3	0.0476	588.8	0.0476
644.3	0.0472	422.1	0.108	699.9	0.0433	644.3	0.0424
699.9	0.0459	477.6	0.0926	755.4	0.0398	699.9	0.0407
755.4	0.0450	533.2	0.0787	<u>CURVE 11</u>		755.4	0.0398
<u>CURVE 2</u>							
394.3	0.105	588.8	0.0696	422.1	0.0857	<u>CURVE 12*</u>	
422.1	0.0969	644.3	0.0646	477.6	0.0696	422.1	0.0813
477.6	0.0830	699.9	0.0623	533.2	0.0562	477.6	0.0718
533.2	0.0710	755.4	0.0614	588.8	0.0476	533.2	0.0640
588.8	0.0623	<u>CURVE 7</u>		588.8	0.0573	588.8	0.0573
644.3	0.0562	422.1	0.0376	699.9	0.0502	644.3	0.0533
699.9	0.0528	477.6	0.0424	755.4	0.0481	699.9	0.0502
755.4	0.0511	533.2	0.0450	<u>CURVE 13</u>		755.4	0.0481
<u>CURVE 3</u>							
422.1	0.0961	588.8	0.0459	334.8	0.0730	<u>CURVE 14</u>	
477.6	0.0848	644.3	0.0441	374.3	0.0649	390.2	0.151
533.2	0.0736	699.9	0.0402*	445.4	0.0592	475.2	0.0962
588.8	0.0644	755.4	0.0346	508.7	0.0556	563.2	0.0711
644.3	0.0588	<u>CURVE 8</u>		538.7	0.0537	670.2	0.0669
699.9	0.0562	422.1	0.0684	577.1	0.0507		
755.4	0.0540	477.6	0.0632	625.4	0.0472		
<u>CURVE 4</u>							
422.1	0.0839	533.2	0.0588	680.9	0.0450		
477.6	0.0727	588.8	0.0554*	722.1	0.0436		
533.2	0.0632	644.3	0.0528*	785.9	0.0408		
598.8	0.0566	699.9	0.0502*	<u>CURVE 9</u>			
644.3	0.0533	755.4	0.0485	422.1	0.0822		
699.9	0.0519	422.1	0.0710*	477.6	0.0710*		
755.4	0.0519	477.6	0.0623	533.2	0.0623		
<u>CURVE 5*</u>							
422.1	0.101	588.8	0.0562	588.8	0.0562		
477.6	0.0865	644.3	0.0519	644.3	0.0519		
533.2	0.0762	699.9	0.0502	699.9	0.0502		
		755.4	0.0497	755.4	0.0497		

* Not shown on Plot

THERMAL CONDUCTIVITY OF
MAGNESIUM CARBONATE
MgCO₃

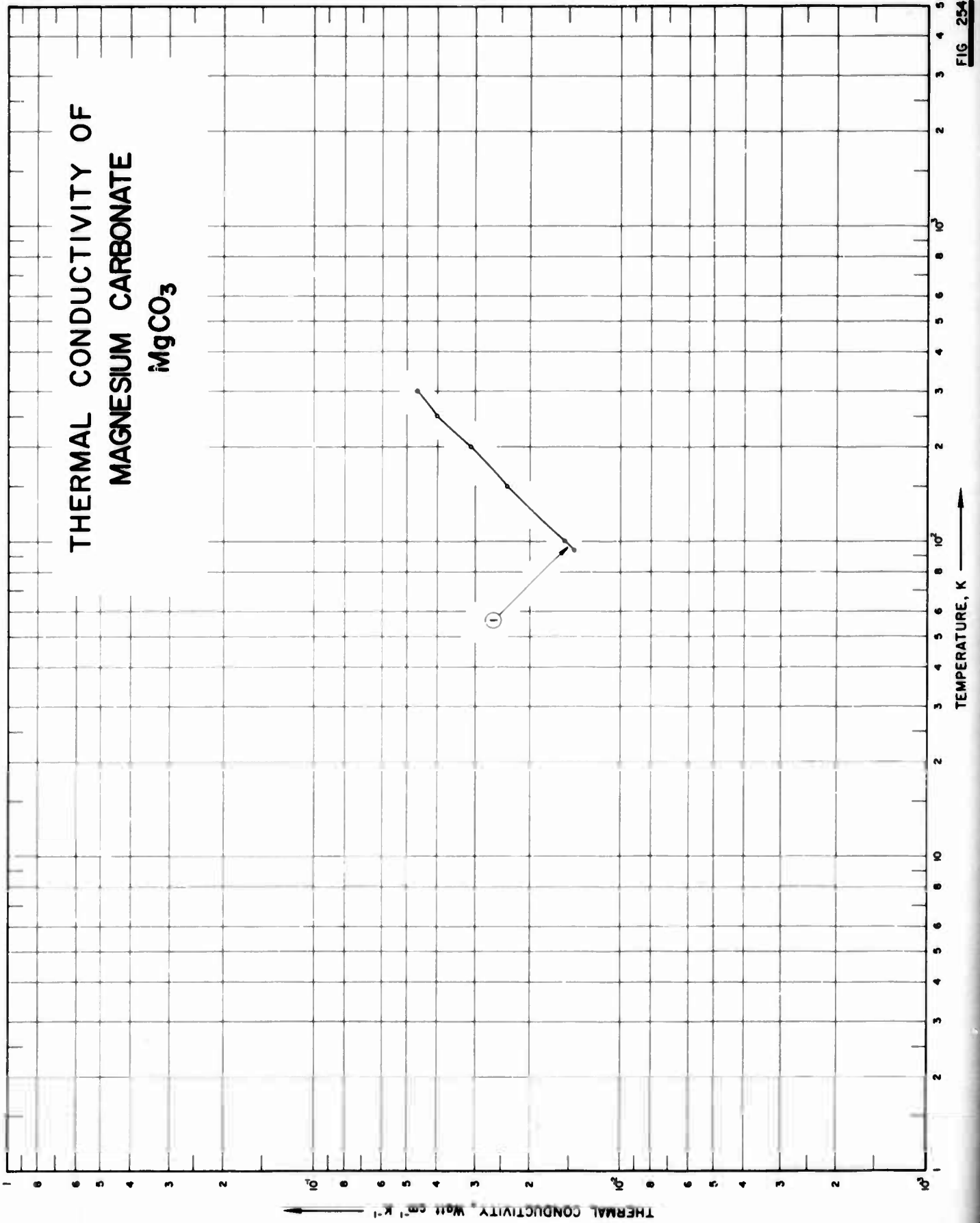


FIG. 254

SPECIFICATION TABLE NO. 254 THERMAL CONDUCTIVITY OF MAGNESIUM CARBONATE $MgCO_3$

[For Data Reported in Figure and Table No. 254]

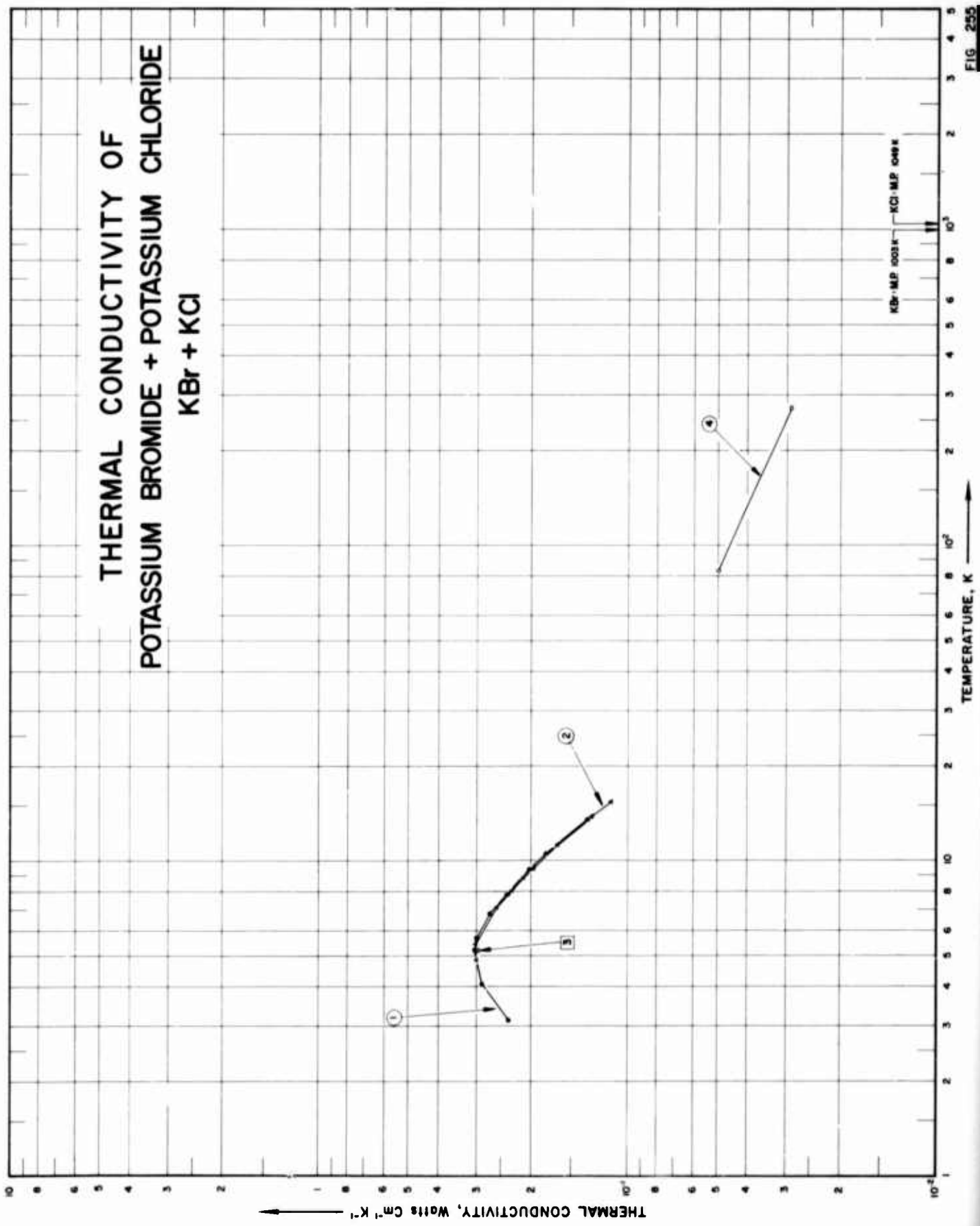
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	139	R	1950	93-300			Powdered; density 0.22 g cm^{-3} .

DATA TABLE NO. 254 THERMAL CONDUCTIVITY OF MAGNESIUM CARBONATE MgCO_3 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

T	k
33.2	0.0145
100	0.0155
150	0.0240
200	0.0310
250	0.0400
300	0.0465

FIG. 255

**THERMAL CONDUCTIVITY OF
POTASSIUM BROMIDE + POTASSIUM CHLORIDE
KBr + KCl**



SPECIFICATION TABLE NO. 255 THERMAL CONDUCTIVITY OF [POTASSIUM BROMIDE + POTASSIUM CHLORIDE] KBr + KCl

[For Data Reported in Figure and Table No. 255]

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						KBr	KCl	
1	164 L	1956	3.1-14			60.53	39.47	49.0 mole % KBr and 51.0 mole % KCl; single KBr-KCl mixed crystal; specimen obtained in the form of optical grade crystals from Harshaw Chemical Co.; fragments of these melted and single mixed-crystal pulled from the melt; annealed at 75 C below the melting point; helium bath maintained at 2.2 K.
2	164 L	1956	4.9-16			60.53	39.47	As above but the helium bath maintained at 4.2 K.
3	164 L	1956	5.2			61.0	39.0	49.5 mole % KBr and 50.5 mole % KCl; single mixed-crystal.
4	380 L	1956	83,273			96.15	3.85	90 mole % KBr and 10 mole % KCl; mixed crystals pressed.

DATA TABLE NO. 155 THERMAL CONDUCTIVITY OF [POTASSIUM BROMIDE + POTASSIUM CHLORIDE] KBr + KCl
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
3.12	0.236
4.05	0.288
5.21	0.305
5.71	0.300
6.82	0.272
7.82	0.240
9.40	0.201
10.63	0.179
13.61	0.133
<u>CURVE 2</u>	
4.88	0.300
5.46	0.301
7.13	0.258
7.90	0.236
8.03	0.232
8.90	0.211
9.51	0.196
11.35	0.165
13.97	0.129
15.50	0.113
<u>CURVE 3</u>	
5.2	0.302
<u>CURVE 4</u>	
83	0.0496
273	0.0291

**THERMAL CONDUCTIVITY OF
POTASSIUM CHLORIDE + POTASSIUM BROMIDE
KCl+KBr**

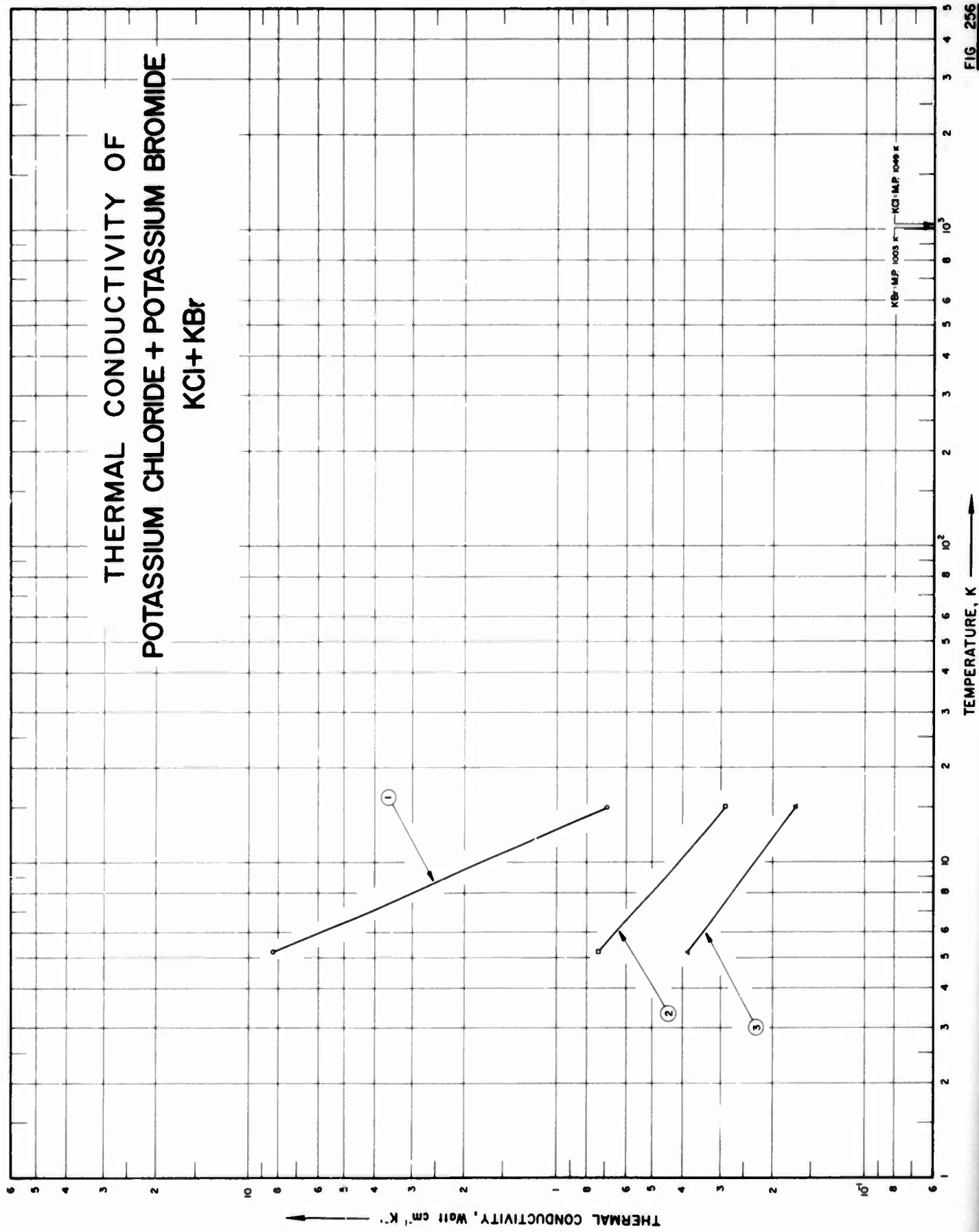


FIG. 256

SPECIFICATION TABLE NO. 256 THERMAL CONDUCTIVITY OF [POTASSIUM CHLORIDE + POTASSIUM BROMIDE] KCl + KBr

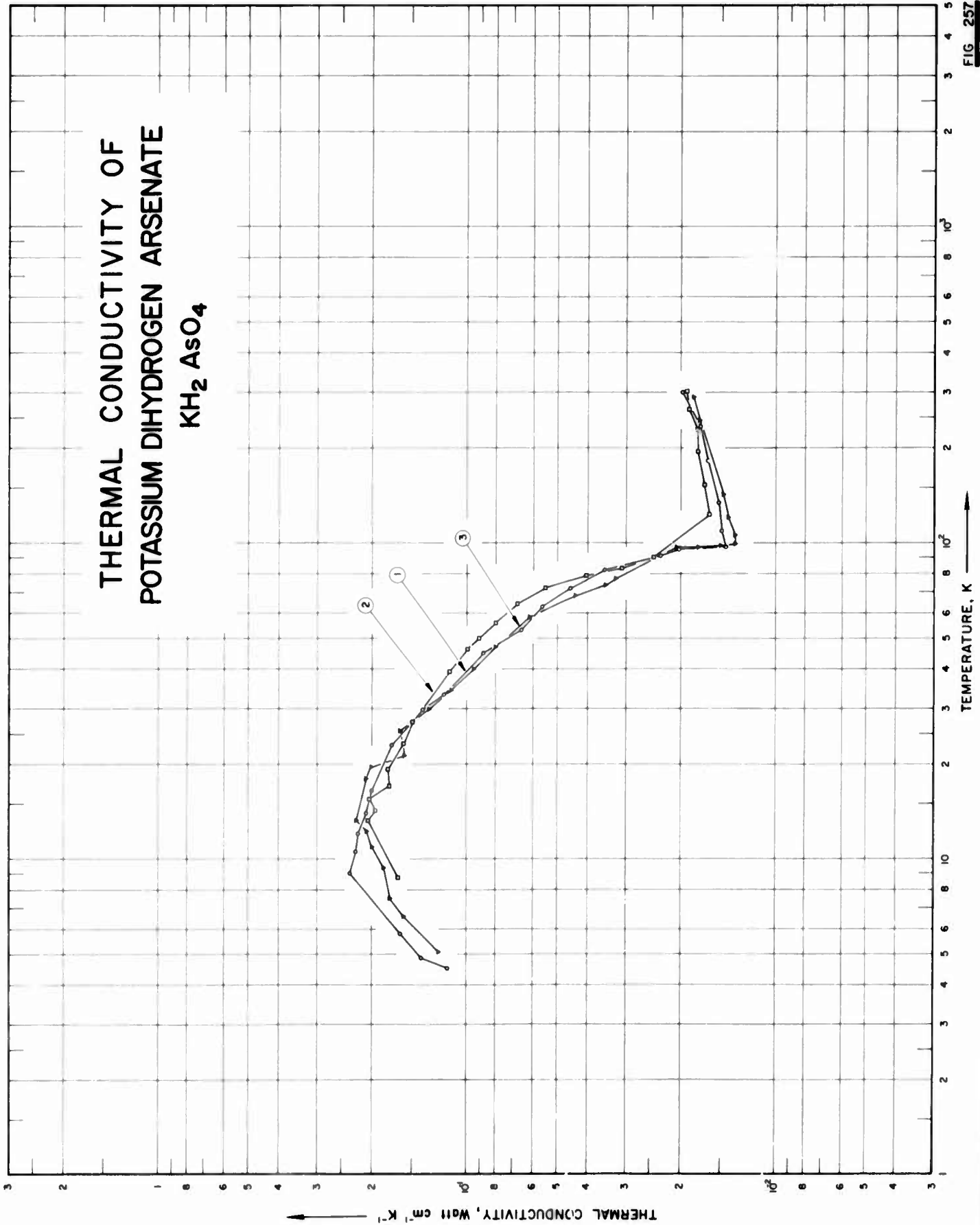
[For Data Reported in Figure and Table No. 256]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							KCl	KBr	
1	164	L	1956	5.2, 15			97.63	2.37	98.5 mole % KCl, 1.5 mole % KBr; single mixed crystal.
2	164	L	1956	5.2, 15		Single KCl-KBr mixed crystal	85.22	14.78	90.2 mole % KCl, 9.8 mole % KBr; single mixed crystal.
3	164	L	1956	5.2, 15		Single KCl-KBr mixed crystal	61.11	38.89	71.5 mole % KCl, 28.5 mole % KBr; single mixed crystal.

DATA TABLE NO. 256 THERMAL CONDUCTIVITY OF [POTASSIUM CHLORIDE + POTASSIUM BROMIDE] KCl + KBr
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
5.2	1.835
15.0	0.690
<u>CURVE 2</u>	
5.2	0.735
15.0	0.290
<u>CURVE 3</u>	
5.2	0.385
15.0	0.168

THERMAL CONDUCTIVITY OF
POTASSIUM DIHYDROGEN ARSENATE
 KH_2AsO_4



SPECIFICATION TABLE NO. 257 THERMAL CONDUCTIVITY OF POTASSIUM DIHYDROGEN ARSENATE KH_2AsO_4

[For Data Reported in Figure and Table No. 257]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	514,515	L	1966	4.5-300		No. 1c	Single crystal with tetragonal symmetry; specimen 1.9 x 2.2 x 11.0 mm, long dimension parallel to c-axis; prepared by usual recrystallization technique, cut and formed into rectangular rod using a wet thread and a polishing paper; Curie temperature 96 K; heat flow along c-axis.
2	515	L	1967	8.8-302		No. 2c	Similar to the above specimen except specimen 1.9 x 2.2 x 11.5 mm, long dimension parallel to c-axis.
3	515	L	1967	5.1-289		No. 3a	Similar to the above specimen except specimen 1.4 x 2.0 x 6.0 mm, long dimension parallel to a-axis; heat flow along a-axis.

DATA TABLE NO. 257 THERMAL CONDUCTIVITY OF POTASSIUM DIHYDROGEN ARSENATE KH_2AsO_4 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
4.52	0.116	153.8	0.0169
4.88	0.140	196.9	0.0177
5.81	0.162	229.7	0.0177
9.02	0.235	265.0	0.0188
10.6	0.224	302.1	0.0191
12.1	0.221		
14.0	0.208	<u>CURVE 3</u>	
16.5	0.200	5.06	0.123
23.0	0.172	6.58	0.158
29.7	0.139	7.50	0.175
33.3	0.119	9.40	0.182
44.8	0.0881	10.9	0.199
53.1	0.0656	12.2	0.207
62.8	0.0562	13.2	0.223
71.6	0.0455	18.0	0.207
82.3	0.0352	19.6	0.200
91.4	0.0233	21.2	0.158
95.3	0.0203	25.5	0.163
97.1	0.0145	29.7	0.133
109.9	0.0149	34.3	0.113
134.0	0.0152	39.9	0.0948
182.0	0.0165	46.9	0.0802
234.0	0.0174	58.4	0.0617
300.0	0.0198	68.1	0.0439
		73.5	0.0350
		77.3	0.0325
		96.6	0.0206
		97.7	0.0176
		99.3	0.0136
		106.2	0.0136
		121.1	0.0142
		142.6	0.0147
		245.0	0.0175
		289.2	0.0182
<u>CURVE 2</u>			
8.75	0.165		
13.2	0.205		
14.2	0.194		
15.5	0.202		
17.0	0.176		
19.3	0.177		
23.1	0.159		
27.1	0.149		
39.2	0.114		
46.1	0.0993		
49.8	0.0912		
55.7	0.0796		
64.1	0.0679		
72.3	0.0548		
78.9	0.0405		
83.4	0.0310		
90.0	0.0244		
122.2	0.0162		

SPECIFICATION TABLE NO. 258 THERMAL CONDUCTIVITY OF POTASSIUM THIOCYANATE KSCN

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	242		1961	423-486	±3		Specimen of A. R. purity; each data point is the mean value of 4 or 5 different measurements; measured in molten state. Same as the above specimen; measured in molten state.
2	242		1961	448	±3		

DATA TABLE NO. 258 THERMAL CONDUCTIVITY OF POTASSIUM THIOCYANATE KSCN

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

423.2 0.00327
 440.2 0.00312
 454.0 0.00281
 465.0 0.00295
 486.4 0.00292

CURVE 2*

448 0.00272

*No graphical presentation

SPECIFICATION TABLE NO. 259 THERMAL CONDUCTIVITY OF [SILICON CARBIDE + GRAPHITE] SIC + C

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	216	R	1951	839.3			Mixture of granulated silicon carbide and graphite powder; measured from the inner half of the test annulus.
2	216	R	1951	969.8			Same as the above specimen except measured from the entire annulus.

DATA TABLE NO. 259 THERMAL CONDUCTIVITY OF [SILICON CARBIDE + GRAPHITE] SIC + C
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
839.3	0.0134
<u>CURVE 2*</u>	
969.8	0.0159

*No graphical presentation

SPECIFICATION TABLE NO. 260 THERMAL CONDUCTIVITY OF SODIUM HYDROXIDE NaOH

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	242		1961	592	±3		Specimen of A. R. purity; mean value of 4 or 5 different measurements; measured in molten state.

DATA TABLE NO. 260 THERMAL CONDUCTIVITY OF SODIUM HYDROXIDE Na OH

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

592 0.00920

* No graphical presentation

SPECIFICATION TABLE NO. 261 THERMAL CONDUCTIVITY OF [STRONTIUM DIFLUORIDE + ΣX_i] SrF₂ + ΣX_i

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	470	P	1959	298.2			92% theoretical density.

DATA TABLE NO. 261 THERMAL CONDUCTIVITY OF [STRONTIUM DIFLUORIDE + ΣX_i] SrF₂ + ΣX_i

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

298.2 0.0142

* No graphical presentation

SPECIFICATION TABLE NO. 262 THERMAL CONDUCTIVITY OF ZINC GERMANIUM PHOSPHIDE ZnGeP₂

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	510	L	1966	298.2		ZnGeP ₂ ; 11	Stoichiometric p-type polycrystalline; 12 x 4 x 4 mm; prepared from 99.9998 pure Zn, p-type Ge (~50 ohm cm), and 99.9999 pure red phosphorus, materials loaded into a high-purity graphite crucible which was closely fitted in a sealed quartz tube, heated to 500 C in one hr, then heated to 800 C at 10 C hr ⁻¹ , then to 1060 C at 20 C hr ⁻¹ ; during the heating process, the tube was subjected to external argon pressure of 7, 13, 45, 80, 100, 125, and 150 atm, respectively in the temperature ranges of room temperature to 400 C, 400-500 C, 500-590 C, 580-630 C, 630-680 C, 680-880 C, and 880-1060 C, rotated and vibrated for 30 min, after another 30 min, the Bridgman process was performed at a lowering rate 10 mm hr ⁻¹ till reached room temperature; melting point 1025 C.

DATA TABLE NO. 262 THERMAL CONDUCTIVITY OF ZINC GERMANIUM PHOSPHIDE ZnGeP₂[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k
 CURVE 1*
 298.2 0.18

* No graphical presentation

THERMAL CONDUCTIVITY OF
ZIRCONIUM HYDRIDE
 ZrH_x

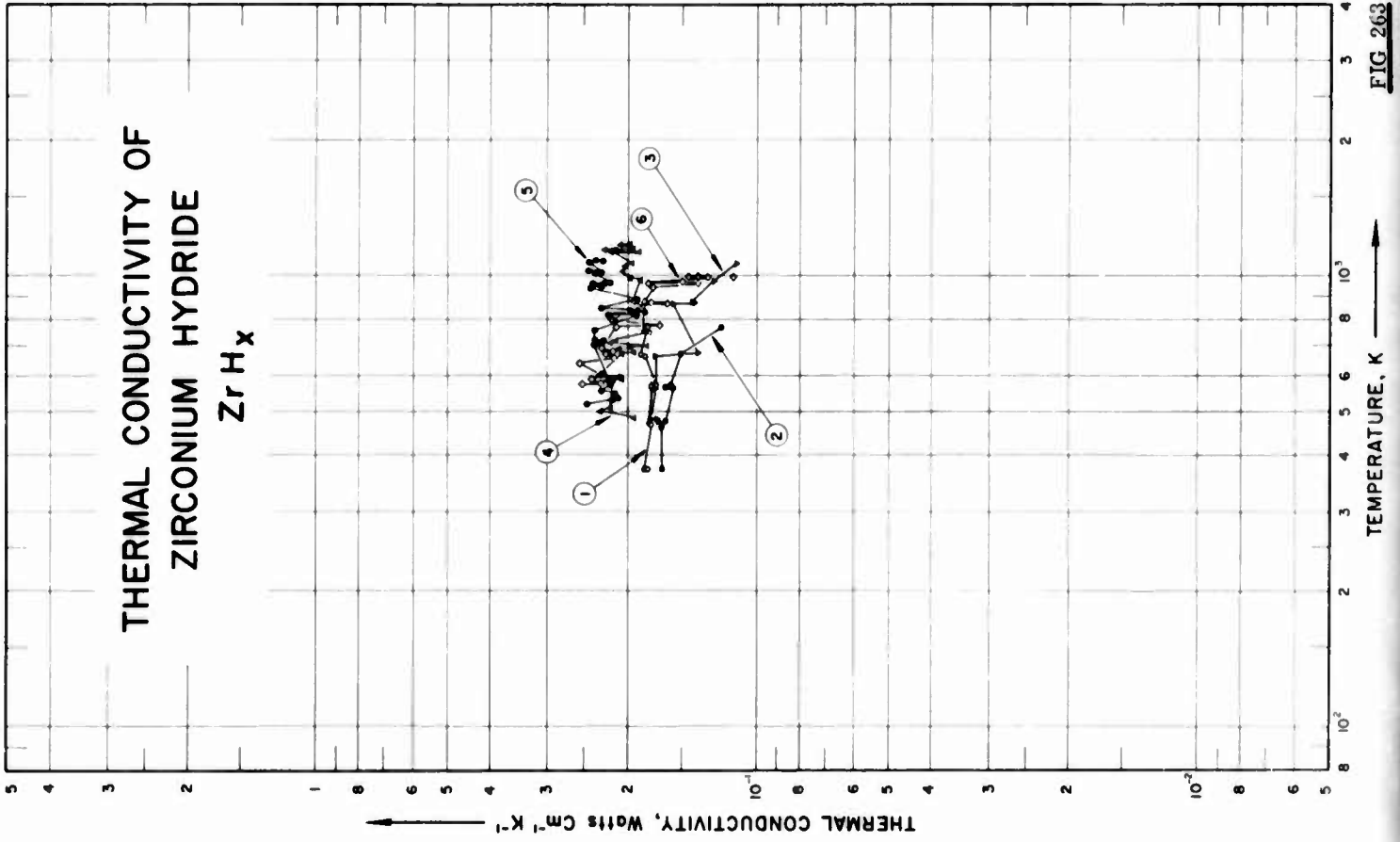


FIG 263

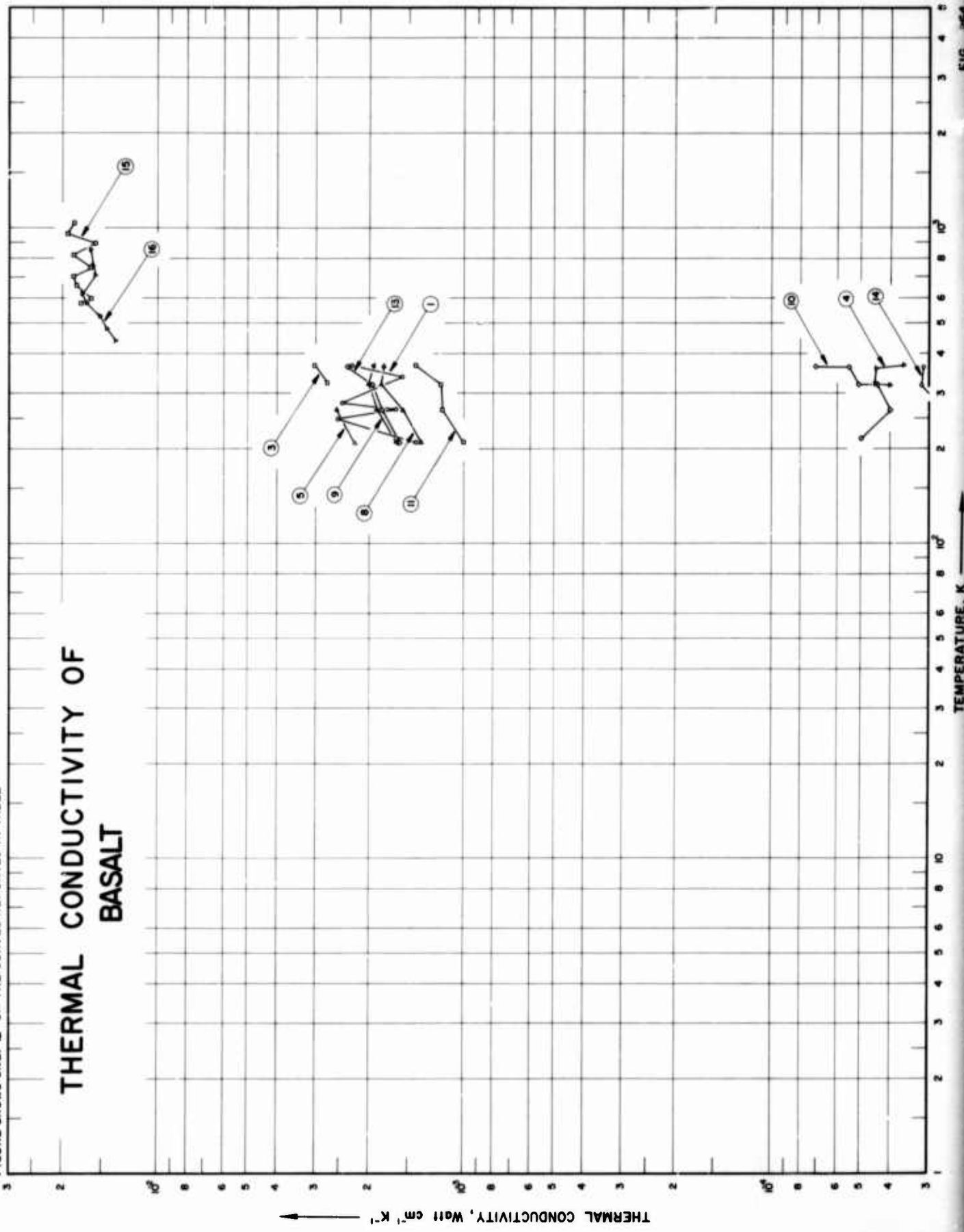
SPECIFICATION TABLE NO. 263 THERMAL CONDUCTIVITY OF ZIRCONIUM HYDRIDE ZrH_x

[For Data Reported in Figure and Table No. 263]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	36		1956	373-774		ZrH _{1.58} Sample 1	0.59 H (NH = 2.16×10^{23} hydrogen atoms cm^{-3}); specimen 0.5 in. in dia., 4 in. long; density 6.29 $g\ cm^{-3}$.
2	36		1956	373-770		ZrH _{1.58} Sample 2-1	As above but heated to 700 C and cooled in a furnace at an undetermined rate; heater being improved to minimize uncertainties of heat transfer in the specimen; 1st run.
3	36		1956	477-1066		ZrH _{1.58} Sample 2-2	2nd run of the above specimen.
4	235	C	1962	490-1181		ZrH _{1.5}	45.3 at. % H; prepared in a furnace at 900 C by flowing hydrogen at 1 atm over clean zirconium (the zirconium preheated to 950-1000 C under vacuum); homogenized and slowly cooled; specimen 0.60 in. in dia and 1.55 in. long of delta (fcc) crystal; molybdenum used as comparative material.
5	235	C	1962	526-1101		ZrH _{1.5}	Specimen similarly prepared as above with 56.6 at. % H.
6	235	C	1962	561-1001		ZrH _{1.5}	Specimen similarly prepared as above with 60 at. % H.

FIGURE SHOWS ONLY 12 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF BASALT



THERMAL CONDUCTIVITY, WATT CM⁻¹ K⁻¹

TEMPERATURE, K

SPECIFICATION TABLE NO. 264 THERMAL CONDUCTIVITY OF BASALT

[For Data Reported in Figure and Table No. 264]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	539	P	1962	209-367		Olivine basalt	Collected from Pisgah Crater, San Bernardino, Calif.; passed through Gates jaw crusher and a stainless steel hammer mill-type pulverizer to reduce to -35 mesh material; density 1.49 g cm ⁻³ .
2	539	P	1962	265-363		Olivine basalt	The above specimen measured in a vacuum of 5 x 10 ⁻⁴ mm Hg.
3	539	P	1962	325, 368		Olivine basalt	Same source and production method as the above specimen; density 1.65 g cm ⁻³ .
4	539	P	1962	319-367		Olivine basalt	The above specimen measured in a vacuum of 5 x 10 ⁻⁴ mm Hg.
5	539	P	1962	208, 266		Olivine basalt	Same source and production method as the above specimen; density 1.95 g cm ⁻³ .
6	539	P	1962	242.1		Olivine basalt	Same source and production method as the above specimen; density 1.75 g cm ⁻³ ; measured in a vacuum of 5 x 10 ⁻⁴ mm Hg.
7	539	P	1962	218, 267		Olivine basalt	Same source, production method, and measuring condition as the above specimen; density 1.57 g cm ⁻³ .
8	539	P	1962	210-367		Olivine basalt	Collected from Pisgah Crater, San Bernardino, Calif.; passed through Gates jaw crusher and a stainless steel hammer mill-type pulverizer to reduce to -35 mesh material, then screened into nominal mesh size -35+48; density 1.36 g cm ⁻³ .
9	539	P	1962	210-367		Olivine basalt	Same source and production method as the above specimen; density 1.56 g cm ⁻³ .
10	539	P	1962	216-365		Olivine basalt	The above specimen measured in a vacuum of 5 x 10 ⁻⁴ mm Hg.
11	539	P	1962	210-367		Olivine basalt	Collected from Pisgah Crater, San Bernardino, Calif.; passed through Gates jaw crusher and a stainless steel hammer mill-type pulverizer to reduce to -35 mesh material then screened into nominal-150 mesh; density 1.14 g cm ⁻³ .
12	539	P	1962	319, 363		Olivine basalt	The above specimen measured in a vacuum of 5 x 10 ⁻⁴ mm Hg.
13	539	P	1962	209-365		Olivine basalt	Same source and production method as the above specimen; density 1.57 g cm ⁻³ .
14	539	P	1962	213-362		Olivine basalt	The above specimen measured in a vacuum of 5 x 10 ⁻⁴ mm Hg.
15	578	R	1963	576-1048	±5	NTS Basalt No. 1	(Composition in vol percent); 66 plagioclase, 26 iron minerals (mainly hematite), 8 olivine; fine-grained appearance; specimen 3.5 in. O. D., 0.875 in. I. D. and 18 in. long; obtained from shot No. 12, hole DB-C-4 and shot No. 13, DB-4 of project Buck, Board; density 2.68 g cm ⁻³ ; specimen does not necessarily represent bulk average properties of its formation.
16	578	R	1963	442-858	±5	NTS Basalt No. 2	Similar to the above specimen.

DATA TABLE NO. 264 THERMAL CONDUCTIVITY OF BASALT
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k
<u>CURVE 1</u>					
209.3	0.00142	209.9	0.00164	704	0.0184
249.9	0.00254	265.4	0.00189	748	0.0163
267.1	0.00165	319.3	0.00201	822	0.0184
279.9	0.00246	366.5	0.00194	895	0.0158
338.2	0.00157	<u>CURVE 10</u>		964	0.0192
367.1	0.00228	216.0	0.000497	1048	0.0184
<u>CURVE 2*</u>					
265.4	0.0000172	319.3	0.000400	<u>CURVE 16</u>	
319.9	0.000241	319.9	0.000509	442	0.0136
362.6	0.0000294	362.6	0.000547	483	0.0145
<u>CURVE 3</u>					
324.9	0.00275	364.9	0.0000710	529	0.0153
367.6	0.00303	<u>CURVE 11</u>		564	0.0167
<u>CURVE 4</u>					
318.8	0.0000400	210.4	0.00100	623	0.0172
321.5	0.0000447	266.0	0.00117	711	0.0157
359.9	0.0000445	319.9	0.00118	762	0.0160
367.1	0.0000363	367.1	0.00143	858	0.0153
<u>CURVE 5</u>					
207.6	0.00223	<u>CURVE 12*</u>		<u>CURVE 13</u>	
266.0	0.00256	319.3	0.0000154	208.8	0.00161
<u>CURVE 6*</u>					
242.1	0.0000177	363.2	0.0000163	266.0	0.00183
<u>CURVE 7*</u>					
217.6	0.0000157	<u>CURVE 14</u>		318.8	0.00196
266.5	0.0000182	213.2	0.0000273*	364.9	0.00235
<u>CURVE 8</u>					
209.9	0.00137	263.8	0.0000265*	<u>CURVE 15</u>	
265.4	0.00157	318.2	0.0000317	209.9	0.00137
319.3	0.00162	362.1	0.0000313	265.4	0.00157
366.5	0.00180	576	0.0176	319.3	0.00162
		658	0.0180	366.5	0.00180

* Not shown on plot

THERMAL CONDUCTIVITY OF BERYL

FIGURE SHOWS ONLY 7 OF THE CURVES REPORTED IN TABLE

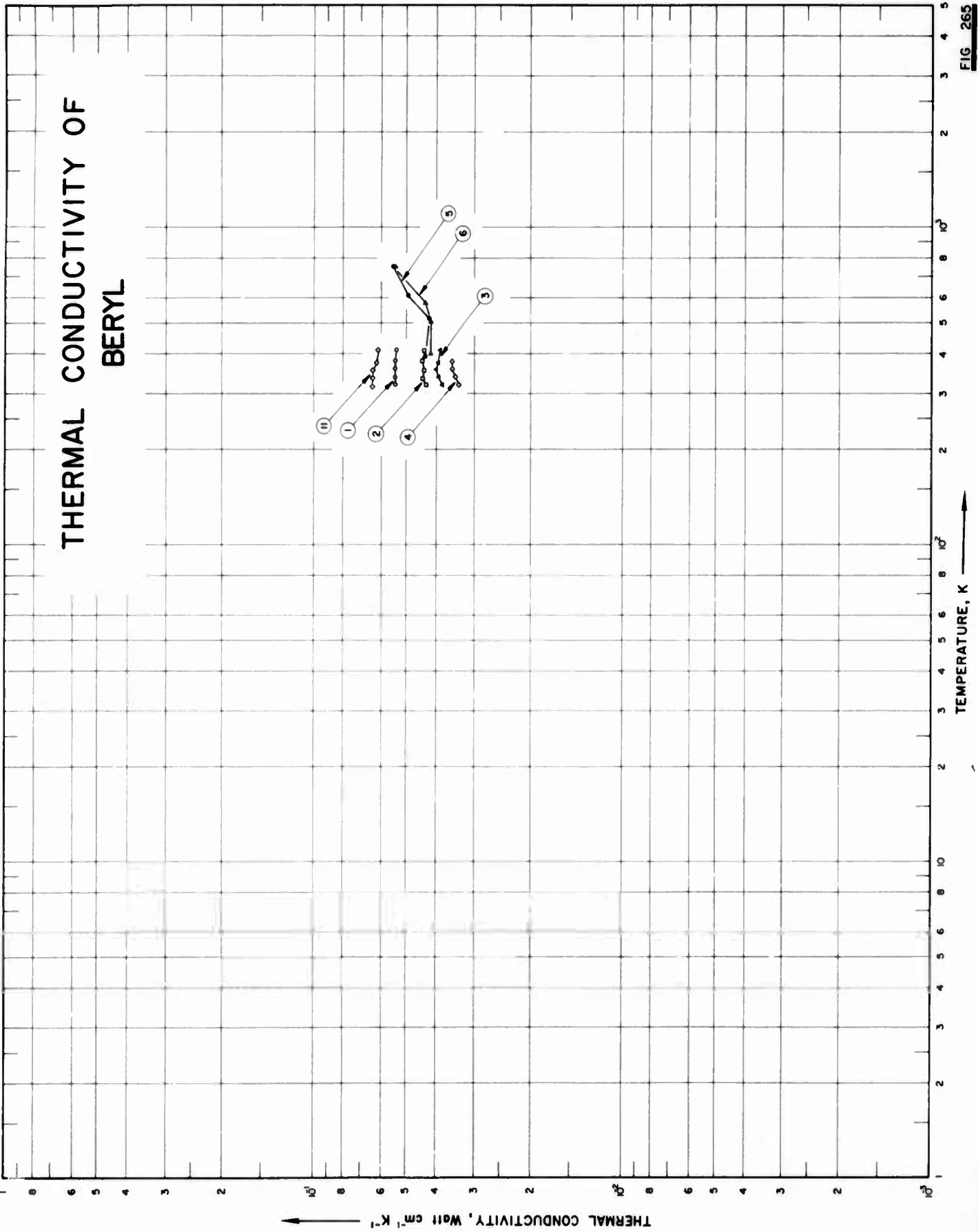


FIG. 265

TEMPERATURE, K

THERMAL CONDUCTIVITY, Watt $\text{cm}^{-1} \text{K}^{-1}$

SPECIFICATION TABLE NO. 265 THERMAL CONDUCTIVITY OF BERYL

[For Data Reported in Figure and Table No. 265]

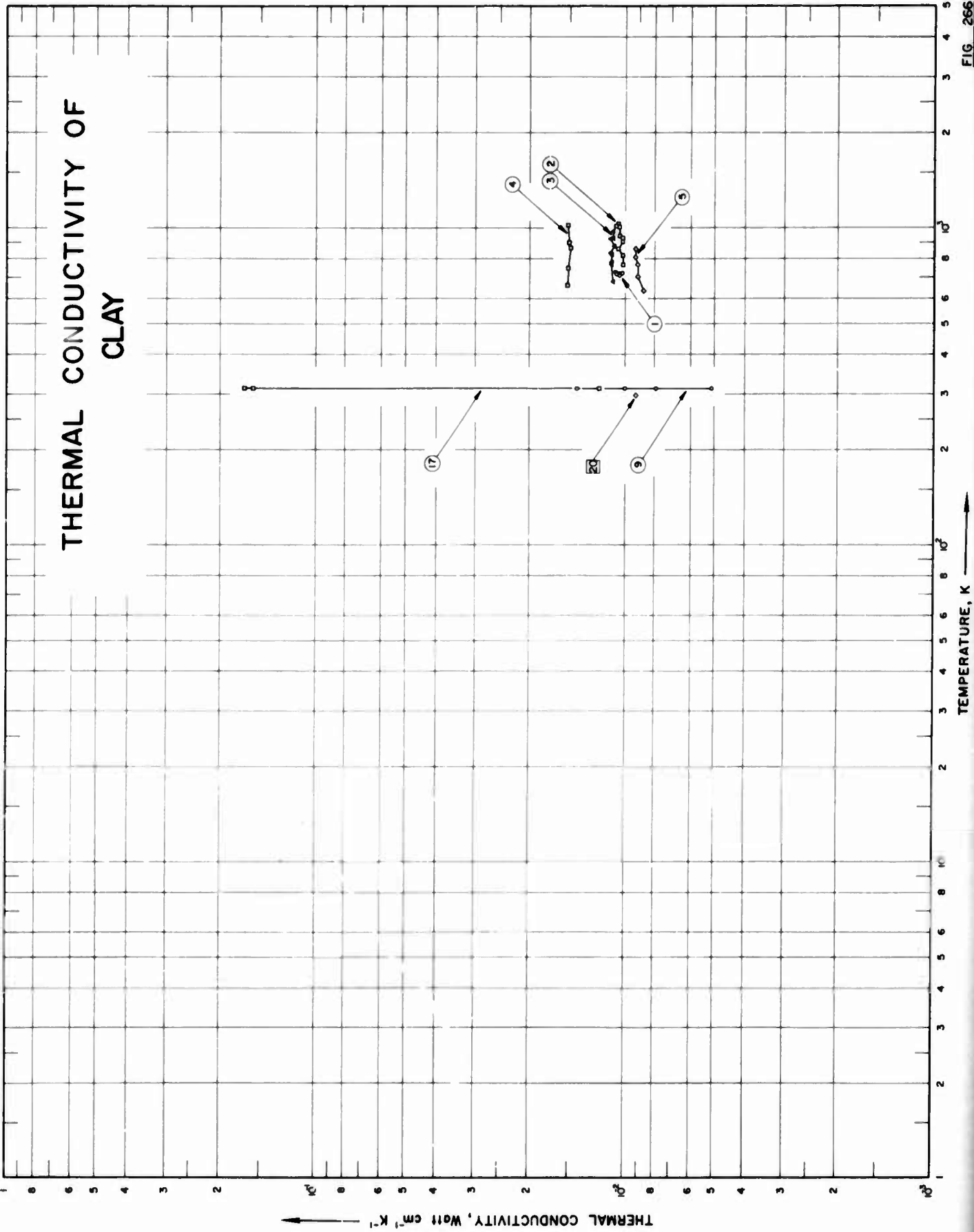
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3	L	1953	320-415		256A-1	Single crystal; variation of aquamarine; c-axis parallel to direction of heat flow.
2	3	L	1953	319-408		256B-1	Single crystal; variation of aquamarine; c-axis perpendicular to direction of heat flow.
3	3	L	1953	319-411		257A-1	Single crystal; golden beryl; c-axis parallel to the direction of heat flow.
4	3	L	1953	319-378		257B-1	Single crystal; golden beryl; c-axis perpendicular to the direction of heat flow.
5	34	C	1943	393-754		Brazil $3\text{BeO} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$	Green single crystal; specimen 1 x 1 x 1 cm ; measured parallel to the c-axis; 18-8 stainless steel used as comparative material.
6	34	C	1943	399-756		Brazil $3\text{BeO} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$	The above specimen measured normal to the c-axis; 18-8 stainless steel used as comparative material.
7	69	C	1954	316-380	± 3	256C-1, Brazil	Aqua single crystal of hexagonal crystal system; specimen 0.25 in. in dia and 0.25 in. high; measured in the direction of c-axis, and in new "vacuum" (comparative) apparatus.
8	68	C	1954	317-409	± 3	256B-2, Brazil	The above specimen measured in the a-axis direction and same apparatus.
9	68	C	1954	316-408	± 3	257C-1, Brazil	Golden single crystal of hexagonal crystal system; specimen 0.25 in. in dia and 0.25 in. high; measured in the direction of c-axis; and in new "vacuum" (comparative) apparatus.
10	68	C	1954	314-408	± 3	257B-2, Brazil	The above specimen measured in a-axis direction and same apparatus.
11	68	C	1954	315-413	± 3	250A-1, India	Aqua single crystal of hexagonal crystal system; specimen 0.25 in. in dia and 0.25 in. high; measured in the direction of c-axis and in new "vacuum" (comparative) apparatus.

DATA TABLE NO. 265 THERMAL CONDUCTIVITY OF BERYL
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
320.4	0.0544	315.7	0.0552
333.5	0.0544	336.8	0.0548
359.1	0.0544	359.2	0.0548
380.5	0.0544	379.7	0.0548
414.9	0.0536		
<u>CURVE 2</u>			
318.6	0.0431	316.5	0.0464
334.1	0.0444	334.6	0.0435
354.5	0.0439	359.5	0.0444
379.8	0.0444	378.5	0.0439
407.6	0.0439	409.4	0.0439
<u>CURVE 3</u>			
319.0	0.0384	316.4	0.0389
338.2	0.0395	338.3	0.0388
357.7	0.0401	357.5	0.0401
376.6	0.0396	376.0	0.0403
411.1	0.0390	407.5	0.0403
<u>CURVE 4</u>			
319.4	0.0337	314.1	0.0346
338.8	0.0346	332.7	0.0354
358.1	0.0354	353.5	0.0361
378.0	0.0354	376.0	0.0360
378.1	0.0351*	407.5	0.0363
<u>CURVE 5</u>			
393.2	0.0435	315.3	0.0640
516.2	0.0423	335.1	0.0640
613.2	0.0494	354.2	0.0640
754.2	0.0552	375.3	0.0623
		413.0	0.0615
<u>CURVE 6</u>			
399.2	0.0417		
505.2	0.0418		
577.2	0.0435		
756.2	0.0552		

Not shown on plot

FIGURE SHOWS ONLY 8 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 266 THERMAL CONDUCTIVITY OF CLAY

[For Data Reported in Figure and Table No. 266]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	91	C	1947	713-730		Fire clay; Chamotte	Cylindrical specimen; iron used as comparative material.
2	551	R	1909	769-1030		Fire clay; A	Dark reddish-brown fire clay, containing no gravel, structure similar to sandstone; specimen supplied by the Laclede Christy Clay Products Co., St. Louis, Missouri.
3	551	R	1909	679-978		Fire clay; 3	Almost white, very coarse fire clay, containing a large amount of gravel, specimen supplied by the above-mentioned company.
4	551	R	1909	661-1030		Fire clay; 1	Brown, coarse fire clay, containing very small amount of gravel; specimen supplied by the above-mentioned company.
5	551	R	1909	635-860		Fire clay; B	Reddish-brown fire clay of medium coarse structure, containing very small pieces of white gravel; specimen supplied by the above-mentioned company.
6	556, 557	L	1952	343-393		Kuchin	Specimens 180-190 mm in dia and 25-30 mm thick; measurements done on 5 different specimens with porosities ranging from 14.4 to 21% and different degrees of evacuation (0 to 740 mm Hg).
7	556, 557	L	1952	343-393		Beskudnikov	Similar to the above specimens except porosity range 13.8 to 17%.
8	556, 557	L	1952	343-393		Ashkhabad	Similar to the above specimens except porosity range 15.7 to 26.6%.
9	556, 557	P	1952	313.2		Beskudnikov	Specimen 70 mm in dia and 100 mm long; volumetric weight 1230 Kg cm ⁻³ ; measured over a moisture content range of 1.2 to 26.4% at 0 mm Hg vacuum.
10	556, 557	P	1952	313.2		Beskudnikov	Similar to the above specimen except moisture content range 1.1 to 26.2%; measured at 300 mm Hg vacuum.
11	556, 557	P	1952	313.2		Beskudnikov	Similar to the above specimen except moisture content range 1.1 to 26.4%; measured at 500 mm Hg vacuum.
12	556, 557	P	1952	313.2		Beskudnikov	Similar to the above specimen except measured at 740 mm Hg vacuum.
13	556, 557	P	1952	313.2		Kuchin	Specimen 70 mm in dia and 100 mm long; volumetric weight 1150 Kg cm ⁻³ ; measured over a moisture content range of 1.2 to 26.8% at 0 mm Hg vacuum.
14	556, 557	P	1952	313.2		Kuchin	Similar to the above specimen except measured at 300 mm Hg vacuum.
15	556, 557	P	1952	313.2		Kuchin	Similar to the above specimen except moisture content range 0.8 to 27.2%; measured at 740 mm Hg vacuum.
16	556, 557	P	1952	313.2		Ashkhabad	Specimen 70 mm in dia and 100 mm long; volumetric weight 1200 Kg cm ⁻³ ; measured over a moisture content range of 1.2 to 19.8% at 0 mm Hg vacuum.

SPECIFICATION TABLE NO. 266 (continued)

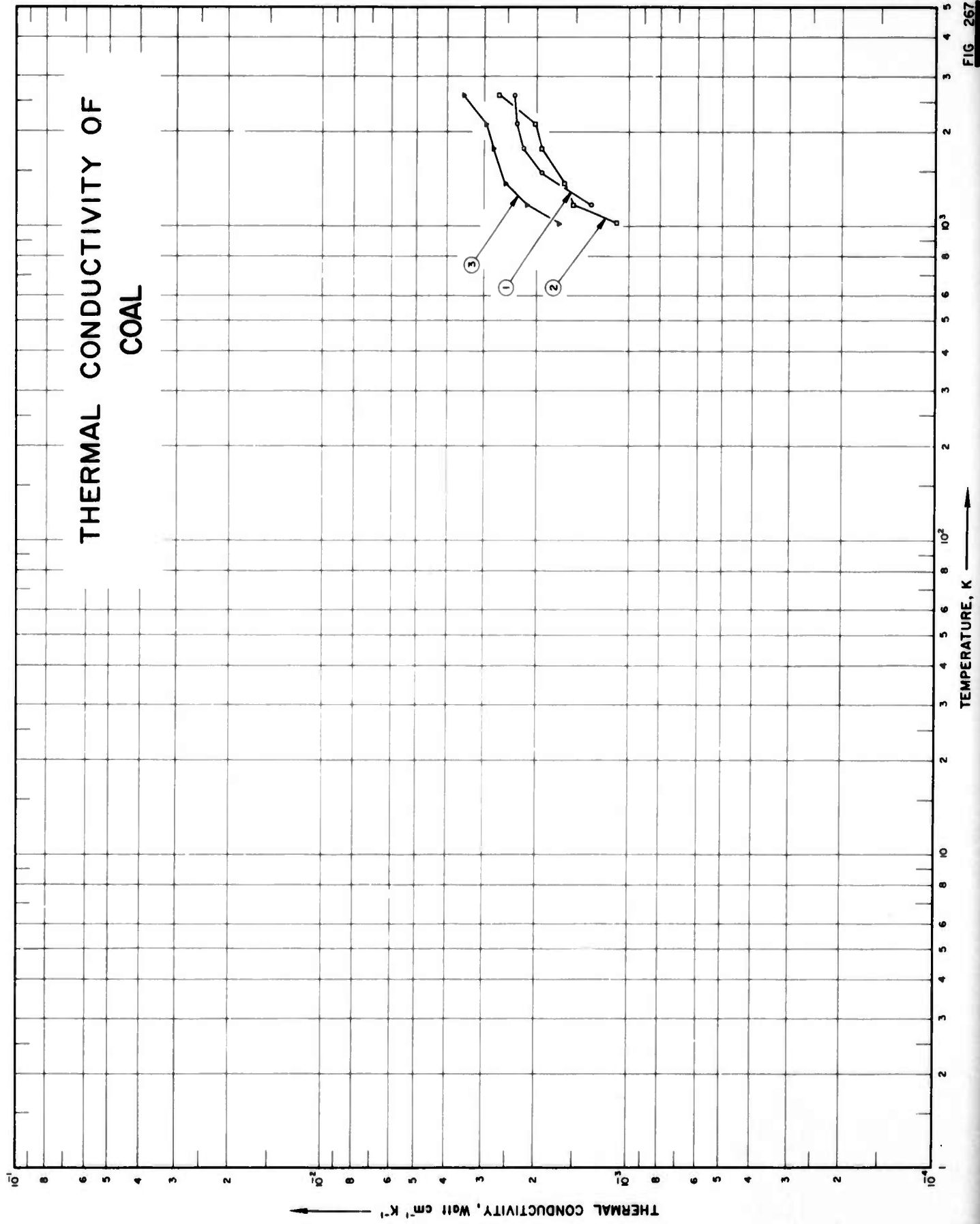
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
17	556, 557	P	1952	313.2		Ashkhabad	Similar to the above specimen except moisture content range 0.8 to 20%; measured at 300 mm Hg vacuum.
18	556, 557	P	1952	313.2		Ashkhabad	Similar to the above specimen except moisture content range 1.2 to 19.2%; measured at 500 mm Hg vacuum.
19	556, 557	P	1952	313.2		Ashkhabad	Similar to the above specimen except moisture content range 1 to 19.3%; measured at 740 mm Hg vacuum.
20	546	P	1924	297.2		Sandy clay	Moisture content 15%; density 1.78 g cm ⁻³

DATA TABLE NO. 266 THERMAL CONDUCTIVITY OF CLAY
 (Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹)

T	k	T	k	Moisture content (%)	k	Moisture content (%)	k
<u>CURVE 1</u>							
713.2	0.0105	767.4	0.00908	<u>CURVE 10*</u> (T = 313.2 K)			
715.2	0.0105*	811.0	0.00925	1.1	0.00523	11.9	0.0121
718.2	0.0107	859.8	0.00925	7.2	0.00860	27.2	0.0142
723.2	0.0103*	Total		13	0.0105	<u>CURVE 16*</u> (T = 313.2 K)	
724.2	0.0103	porosity (%)	k	26.2	0.0151	1.2	0.00465
730.2	0.0108					8	0.0116
<u>CURVE 2</u>							
769.4	0.0103	<u>CURVE 6*</u> (T = 343.2-393.2 K)		<u>CURVE 11*</u> (T = 313.2 K)			
824.8	0.0103	14.4	0.00437	1.1	0.00535	14	0.0139
864.9	0.0106	15.1	0.00432	7.2	0.00941	19.8	0.0139
906.2	0.0103	17.5	0.00404	13.6	0.0121	<u>CURVE 17</u> (T = 313.2 K)	
935.3	0.0103	19.4	0.00397	26.4	0.0132	0.8	0.00511*
937.9	0.0105*	21	0.00381			7.4	0.0121
945.8	0.0105	<u>CURVE 7*</u> (T = 343.2-393.2 K)		<u>CURVE 12*</u> (T = 313.2 K)			
1011.2	0.0105	13.8	0.00472	1.1	0.00604	13.6	0.158
1015.8	0.0108	14.7	0.00465	7.8	0.0119	20	0.167
1030.4	0.0106	15.8	0.00446	14	0.0144	<u>CURVE 18*</u> (T = 313.2 K)	
<u>CURVE 3</u>							
679.7	0.0110	16.5	0.00432	26.4	0.0172	1.2	0.00604
766.4	0.0111	17	0.00430			8	0.0139
770.9	0.0111	<u>CURVE 8*</u> (T = 343.2-393.2 K)		<u>CURVE 13*</u> (T = 313.2 K)			
830.7	0.0111	15.7	0.00549	6	0.00814	12.8	0.0174
838.5	0.0113	16.5	0.00535	11.4	0.00930	19.2	0.0168
878.9	0.0109	18.8	0.00504	26.8	0.0121	<u>CURVE 19*</u> (T = 313.2 K)	
928.4	0.0112	22.6	0.00471			1	0.00651
930.3	0.0110	26.6	0.00465			7.6	0.0142
977.8	0.0110	<u>CURVE 4</u>		<u>CURVE 14*</u> (T = 313.2 K)			
661.4	0.0153	Moisture content (%)	k	1.2	0.00465	13	0.0186
747.2	0.0152	6.8	0.00790	6.2	0.00883	19.3	0.0205
869.9	0.0149	13.6	0.0100	11.9	0.00976	<u>CURVE 20</u>	
900.6	0.0150	26.4	0.0142	26.8	0.0130	297.2	0.00920
1029.7	0.0151	<u>CURVE 9</u> (T = 313.2 K)		<u>CURVE 15*</u> (T = 313.2 K)			
<u>CURVE 5</u>							
635.6	0.00874	1.2	0.00511	6.8	0.00790	0.8	0.00477
703.8	0.00908	6.8	0.0100	13.6	0.0100	6	0.0100
		26.4	0.0142	26.8	0.0130		

* Not shown on plot

THERMAL CONDUCTIVITY OF COAL



SPECIFICATION TABLE NO. 267 THERMAL CONDUCTIVITY OF COAL

[For Data Reported in Figure and Table No. 267]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	587	P	1960	1173-2623		Angren brown coal	Noncaking Angren brown coal heated to 1100 C at a rate of 5 c min ⁻¹ and kept at this temperature for 3 hrs; the high-temperature treatment of the specimen carried out in an atmosphere of nitrogen in a furnace with graphite heater, temperature controlled by means of a stepped transformer; total time of heating 45 min; material studied consisting chiefly of carbon (heating to 1100 yields a coke product containing up to 95% carbon, relative to the dry ashless mass); the specimen ground to a particle size of less than 0.5 mm; volume weight between 0.550 and 0.650 g cm ⁻³ .
2	587	P	1960	1023-2623		Donets gas coal	Noncaking Donets gas coal; same heat treatment and size as the above specimen.
3	587	P	1960	1023-2623		Donets anthracite	Noncaking Donets anthracite coal; same heat treatment and size as the above specimen.

DATA TABLE NO. 267 THERMAL CONDUCTIVITY OF COAL
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
1173.2	0.00134
1493.2	0.00192
1773.2	0.00221
2123.2	0.00232
2623.2	0.00238
<u>CURVE 2</u>	
1023.2	0.00110
1173.2	0.00153
1373.2	0.00163
1773.2	0.00192
2123.2	0.00203
2623.2	0.00267
<u>CURVE 3</u>	
1023.2	0.00169
1173.2	0.00215
1373.2	0.00256
1773.2	0.00279
2123.2	0.00296
2623.2	0.00349

THERMAL CONDUCTIVITY OF DOLOMITE

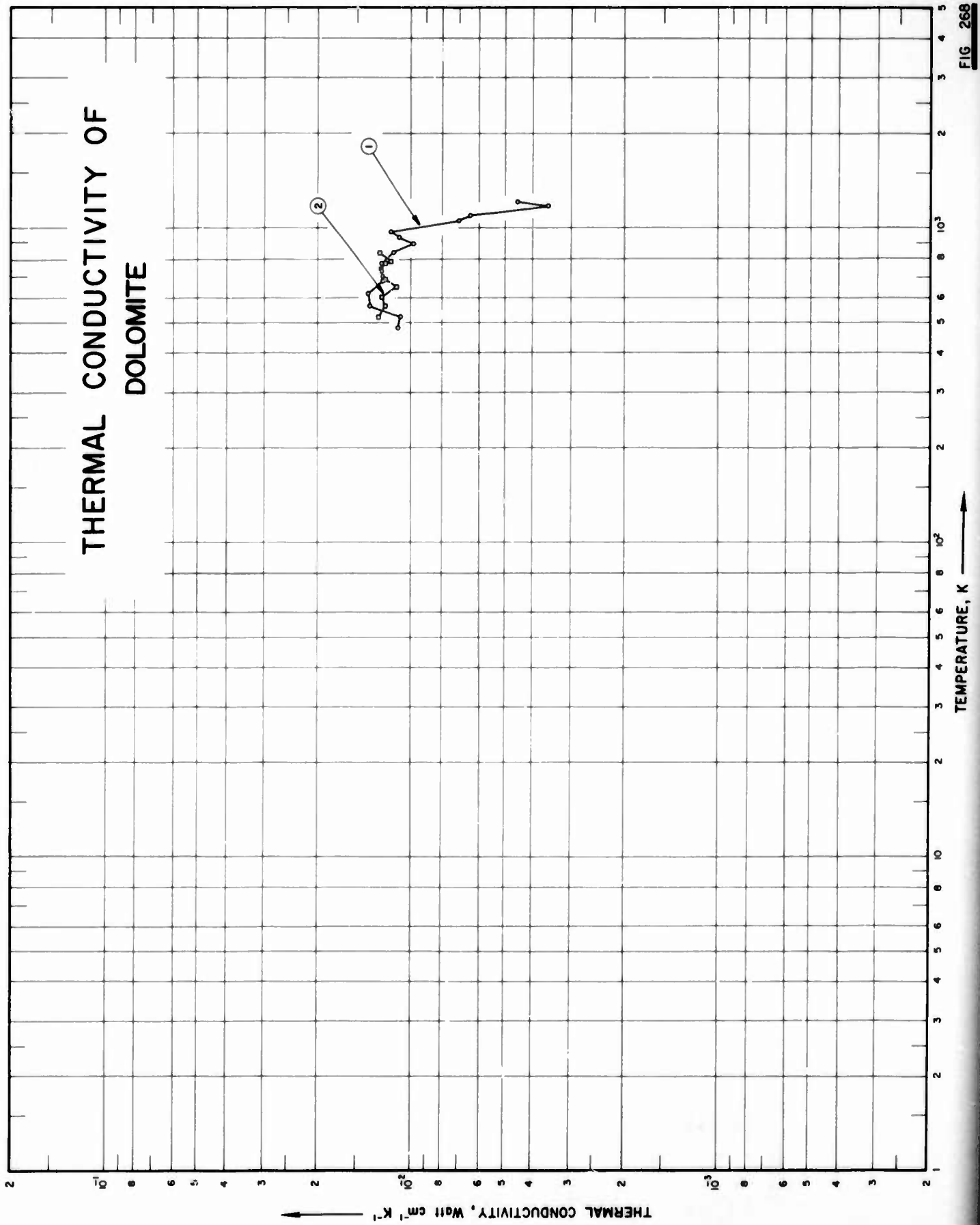


FIG 268

SPECIFICATION TABLE NO. 268 THERMAL CONDUCTIVITY OF DOLOMITE

[For Data Reported in Figure and Table No. 268]

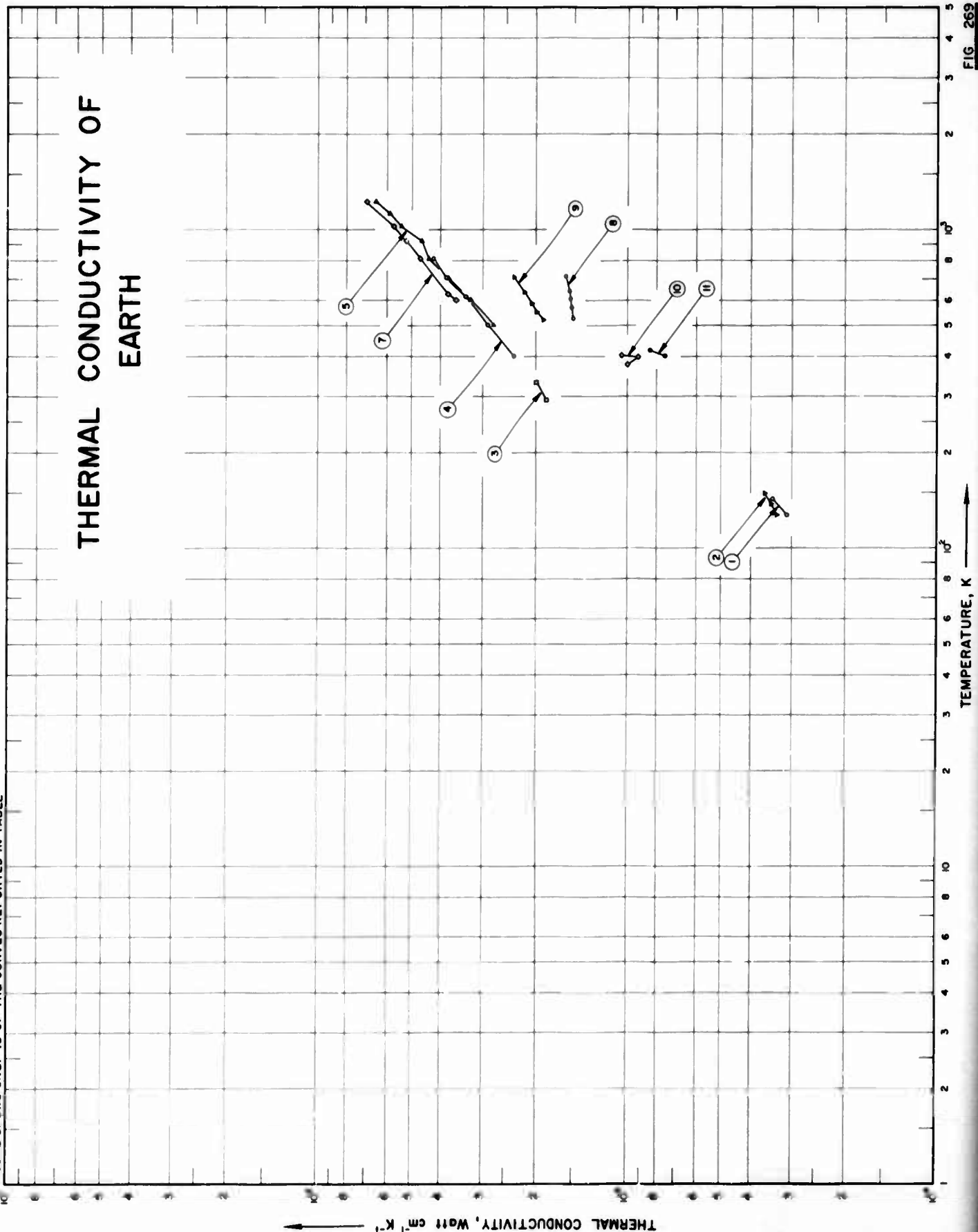
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	578	R	1963	484-1208	± 5	NTS dolomite No. 1	(Composition in vol percent); 99 dolomite, 1 others (primarily quartz and muscovite), fine-grained appearance; specimen 2.25 in. O.D., 0.375 in. I.D. and 12 in. long; obtained from exploratory dolomite hole No. 1, dolomite hill at level of 200 ft; density 2.80 g cm ⁻³ ; specimen does not necessarily represent bulk averages of its formation; data values above 1000 K are in the region of decomposition of the carbonates and are of qualitative value only, due to formation of microcracks and some large fusion in the specimen; other types of carbonate rocks show thermal conductivity values higher by a factor of 2, according to literature.
2	578	R	1963	523-833	± 5	NTS dolomite No. 2	Similar to the above specimen.

DATA TABLE NO. 268 THERMAL CONDUCTIVITY OF DOLOMITE
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
484	0.0110
521	0.0108
565	0.0135
619	0.0137
678	0.0124
229	0.0125
773	0.0125
835	0.0114
888	0.00983
932	0.0109
970	0.0116
1051	0.00699
1098	0.00640
1173	0.00356
1208	0.00452
<u>CURVE 2</u>	
523	0.0127
565	0.0121
603	0.0124
654	0.0111
687	0.0121
744	0.0125
772	0.0121
774	0.0116
833	0.0126

FIGURE SHOWS ONLY 10 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF EARTH



SPECIFICATION TABLE NO. 269 THERMAL CONDUCTIVITY OF EARTH

[For Data Reported in Figure and Table No. 269]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	43	L	1954	128, 144		Diatomaceous Earth	Density 14.0 lb ft ⁻³ .
2	43	L	1954	128-150		Diatomaceous Earth	Density 17.0 lb ft ⁻³ .
3	273	L	1963	293, 333			Density 0.15 g cm ⁻³ ; apparatus: NBS guarded hot plate.
4	273	R	1963	403-813	<3.0		Density 0.15 g cm ⁻³ ; apparatus without end guarding.
5	273	R	1963	503-1223	<3.0		Density 0.15 g cm ⁻³ ; apparatus with ends guarded.
6	273	R	1963	603-1228	<3.0		Density 0.15 g cm ⁻³ ; sintered and then pulverized.
7	273	R	1963	603-1228	<3.0		Density 0.51 g cm ⁻³ ; sintered.
8	100	L	1957	529-716		Kieselguhr (1)	Insulating powders; bulk density 0.388 g cm ⁻³ .
9	100	L	1957	523-714		Kieselguhr (2)	Insulating powders; bulk density 0.628 g cm ⁻³ .
10	240	R	1919	378-403		Ordinary kieselguhr	Specimen 12.2 mm I. D., 19 mm O. D., and 8 cm long.
11	240	R	1919	401, 419		Ignited kieselguhr	Specimen 12.2 mm I. D., 19 mm O. D., and 8 cm long.

DATA TABLE NO. 269 THERMAL CONDUCTIVITY OF EARTH
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
127.6	0.000310	813.2	0.00469
144.3	0.000342	923.2	0.00523
<u>CURVE 2</u>			
127.6	0.000332	1023.2	0.00573
138.2	0.000346	1228.2	0.00690
149.8	0.000361	<u>CURVE 8</u>	
<u>CURVE 3</u>			
293.2	0.00186	528.7	0.00151
333.2	0.00199	572.6	0.00153
<u>CURVE 4</u>			
403.2	0.00234	606.5	0.00154
503.2	0.00289	643.2	0.00156
618.2	0.00337	715.9	0.00160
708.2	0.00383	<u>CURVE 9</u>	
813.2	0.00423	523.2	0.00190
<u>CURVE 5</u>			
503.2	0.00276	552.6	0.00198
603.2	0.00326	587.1	0.00205
708.2	0.00377	637.6	0.00216
813.2	0.00437	713.7	0.00234
923.2	0.00462	<u>CURVE 10</u>	
1023.2	0.00544	377.8	0.00100
1123.2	0.00588	398.8	0.000920
1223.2	0.00649	403.2	0.00105
<u>CURVE 6*</u>			
603.2	0.00347	<u>CURVE 11</u>	
833.2	0.00444	401.2	0.000753
1023.2	0.00536	419.0	0.000837
1228.2	0.00640	<u>CURVE 7</u>	
<u>CURVE 7 (cont.)</u>			
603.2	0.00358		
628.2	0.00377		

Not shown on plot

SPECIFICATION TABLE NO. 270 THERMAL CONDUCTIVITY OF GABBERO

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	586	L	1933	309, 323	1	Gabbro	Specimen 5 cm in dia and 2 cm long; from Sligachan Skye; density 3.10 g cm^{-3} .

DATA TABLE NO. 270 THERMAL CONDUCTIVITY OF GABBERO

[Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

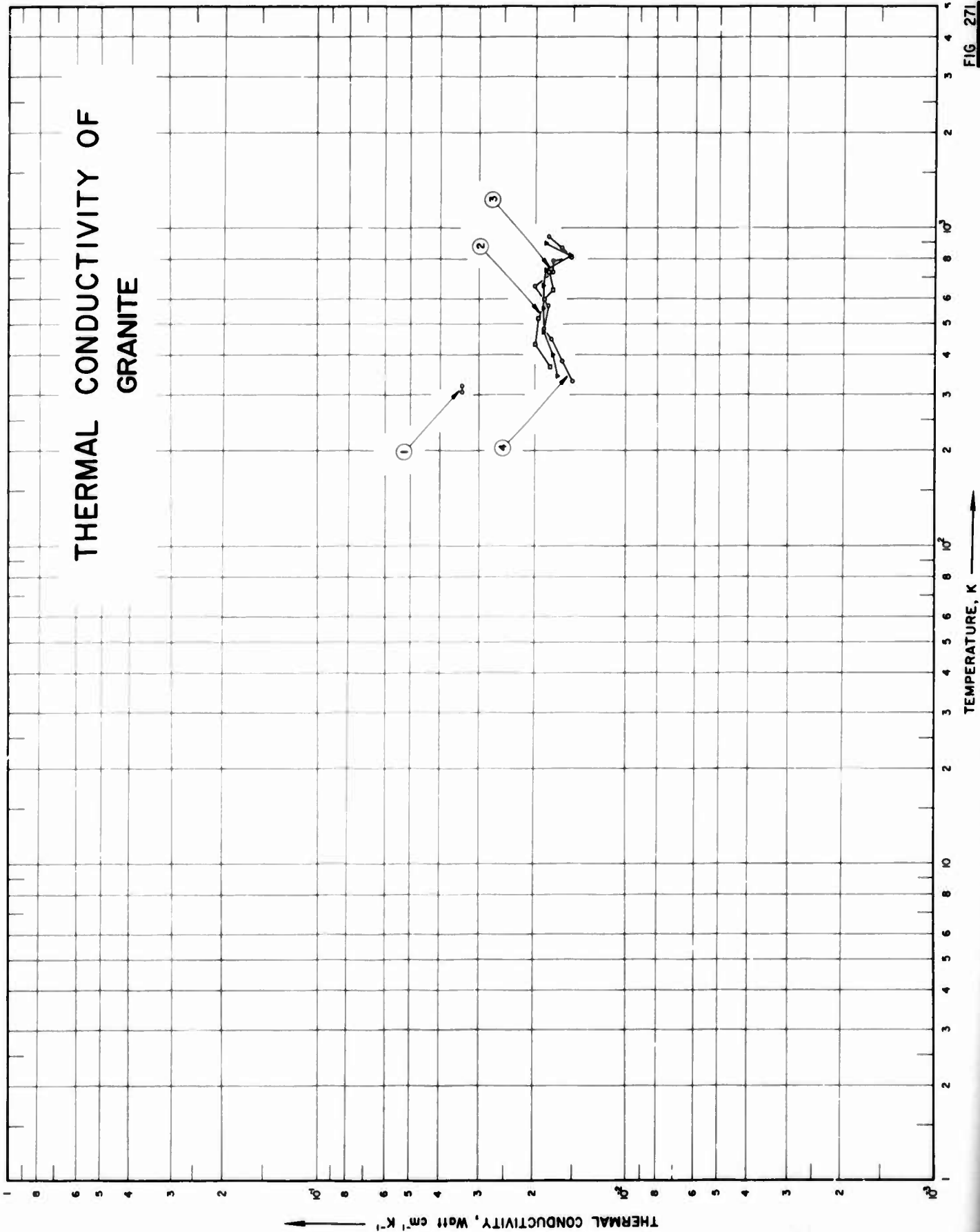
T k

CURVE 1*

309.4	0.0255
323.1	0.0247

* No graphical presentation

THERMAL CONDUCTIVITY OF GRANITE



SPECIFICATION TABLE NO. 271 THERMAL CONDUCTIVITY OF GRANITE

[For Data Reported in Figure and Table No. 271]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	586	L	1933	307-320	1	Granite	Specimen 5 cm in dia and 2 cm long; from New May Quarry, Aberdeenshire; density 2.58 g cm ⁻³ .
2	578	R	1963	368-773	± 5	NTS Granite No. 1	(Composition in vol percent): 34 plagioclase, 28 orthoclase, 27 quartz, 9 biotite, 2 others, coarse grained appearance; specimen 3.5 in. O. D., 0.875 in. I. D. and 18 in. long; obtained from U15b exploratory hole area 15, at 1000 ft level; density 2.67 g cm ⁻³ ; specimen does not necessarily represent bulk average properties of its formation.
3	578	R	1963	343-896	± 5	NTS Granite No. 2	Similar to the above specimen.
4	578	R	1963	330-943	± 5	NTS Granite No. 3	Similar to the above specimen.

DATA TABLE NO. 271 THERMAL CONDUCTIVITY OF GRANITE
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
306.9	0.0339
320.2	0.0339
<u>CURVE 2</u>	
368	0.0178
433	0.0200
523	0.0195
600	0.0186
643	0.0174
733	0.0180
<u>CURVE 3</u>	
343	0.0168
400	0.0174
473	0.0197
556	0.0187
662	0.0187
738	0.0184
823	0.0152
896	0.0184
<u>CURVE 4</u>	
330	0.0151
383	0.0163
448	0.0176
483	0.0187
573	0.0176
658	0.0201
728	0.0174
793	0.0174
811	0.0152
873	0.0164
943	0.0180

THERMAL CONDUCTIVITY OF LIMESTONE

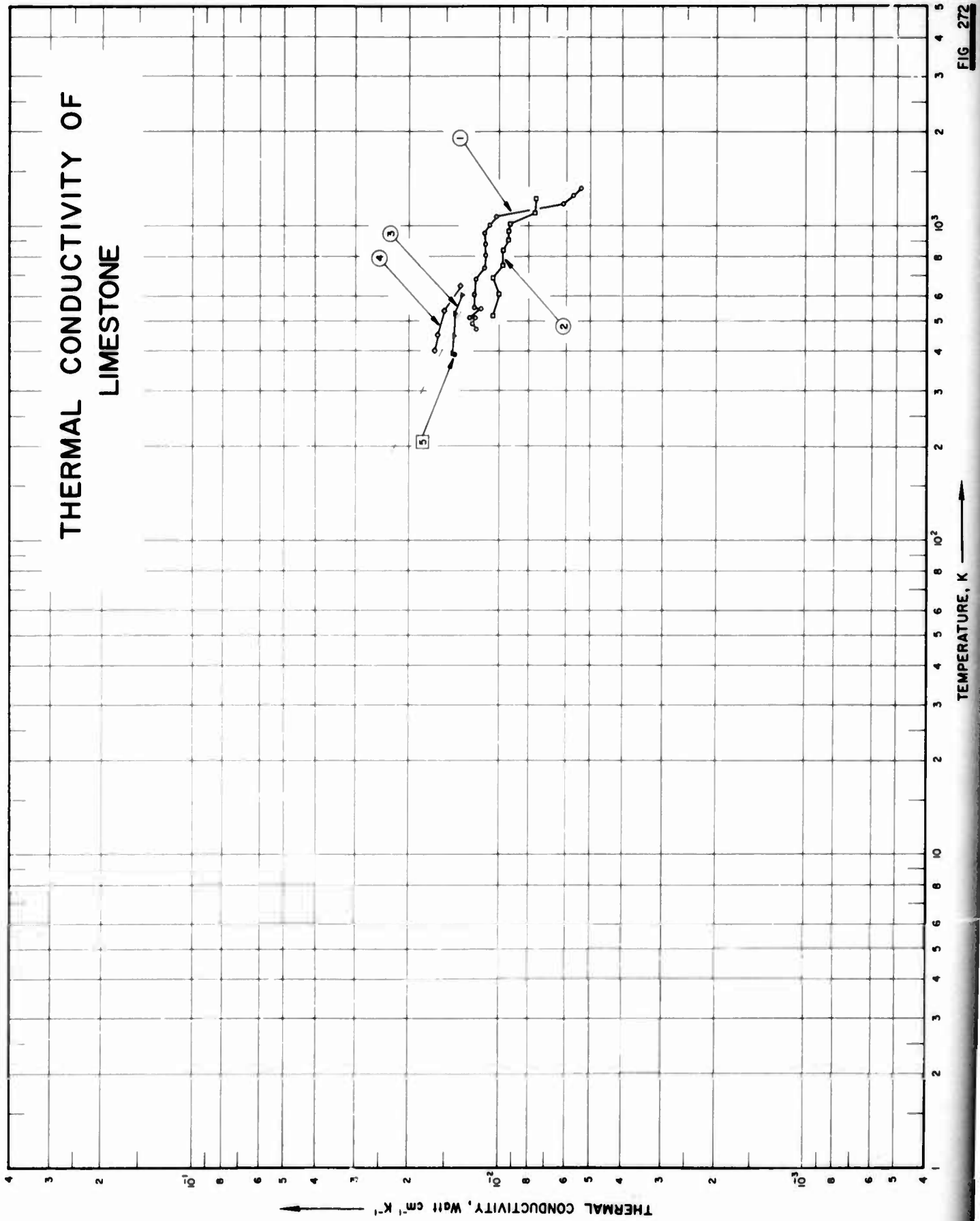


FIG. 272

SPECIFICATION TABLE NO. 272 THERMAL CONDUCTIVITY OF LIMESTONE

[For Data Reported in Figure and Table No. 272]

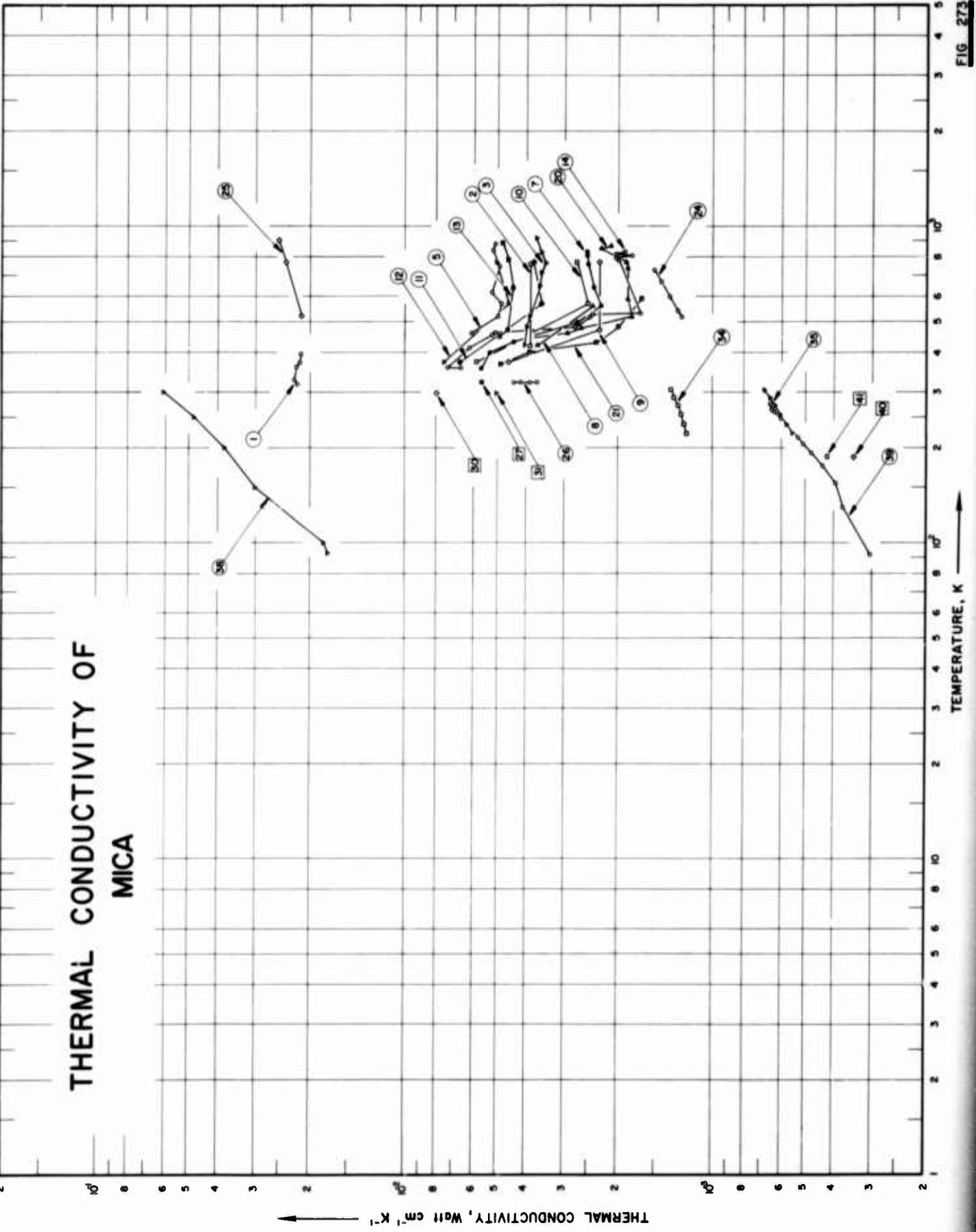
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	578	R	1963	472-1324	± 6	Indiana Limestone No. 2	(Composition in vol percent): 98.4 calcite, 1.0 quartz, 0.6 hematite; fine grained in appearance; specimen 3.5 in. O. D., 0.875 in. I. D. and 18 in. long; exact origin of specimen unknown; density 2.30 g cm ⁻³ ; specimen does not necessarily represent the bulk average properties of its formation; data above 1100 K indicate region of decomposition of the carbonates and the thermal conductivity values are qualitative only due to the formation of microcracks and some large fusions in the specimen; other types of carbonate rocks show thermal conductivity values higher by a factor of 2 according to the literature.
2	578	R	1963	520-1228	± 6	Indiana Limestone No. 2	Similar to the above specimen.
3	508	L	1940	396-605		Queenstone grey	Specimen 8 in. in dia and 1 in. thick; a mixture of dolomite and calcite containing 22% MgCO ₃ ; density 2.675 g cm ⁻³ ; obtained from Queenston, Ont.
4	508	L	1940	403-650		Rama	Specimen 8 in. in dia and 1 in. thick; a mixture of dolomite and calcite containing 30% of MgCO ₃ ; density 2.563 g cm ⁻³ ; obtained from Langford Mills, Ont.
5	508	L	1940	392.1		Rama	Similar to the above specimen; measurements done after exposure to high temperature test.

DATA TABLE NO. 272 THERMAL CONDUCTIVITY OF LIMESTONE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
472	0.0119	<u>CURVE 5</u>	
493	0.0123	392.1	0.0141
512	0.0120		
513	0.0126		
546	0.0115		
553	0.0121		
610	0.0121		
683	0.0119		
736	0.0112		
813	0.0111		
878	0.0111		
952	0.0112		
1013	0.0107		
1075	0.0103		
1181	0.00619		
1253	0.00573		
1324	0.00540		
<u>CURVE 2</u>			
520	0.0105		
613	0.0100		
688	0.0105		
754	0.00971		
840	0.00967		
901	0.00933		
965	0.00933		
1028	0.00921		
1101	0.00766		
1228	0.00762		
<u>CURVE 3</u>			
395.9	0.0143		
450.4	0.0141		
527.6	0.0140		
605.4	0.0133		
<u>CURVE 4</u>			
403.2	0.0164		
454.3	0.0160		
540.4	0.0153		
650.4	0.0134		

FIGURE SHOWS ONLY 26 OF THE CURVES REPORTED IN TABLE



THERMAL CONDUCTIVITY, $\text{W m}^{-1} \text{K}^{-1}$ ←

TEMPERATURE, K →

SPECIFICATION TABLE NO. 273 THERMAL CONDUCTIVITY OF MICA

[For Data Reported in Figure and Table No. 273]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	407	L	1949	317-397			Glass bonded.
2	577	L	1937	420, 761.2		Madagascan phlogopites; 1	Amber light; measured under 74 psi loading.
3	577	L	1937	424-916		Madagascan phlogopites; 1	The above specimen measured under 176 psi loading; density when loaded 2.66 g cm ⁻³ .
4	577	L	1937	426-809		Madagascan phlogopites; 1	The above specimen measured when cooled from 643 C.
5	577	L	1937	460-880		Madagascan phlogopites; 2	Amber dark; measured under 176 psi loading; loaded density 2.90 g cm ⁻³ .
6	577	L	1937	496.2		Madagascan phlogopites; 2	The above specimen measured when cooled from 607 C.
7	577	L	1937	357-833		Madagascan phlogopites; 3	Amber dark; measured under 176 psi loading; loaded density 2.87 g cm ⁻³ .
8	577	L	1937	423, 2,560.2		Madagascan phlogopites; 3	The above specimen measured when cooled from 560 C.
9	577	L	1937	373-773		Madagascan phlogopites; 3-2	Similar to the above specimen 3 but measured under 23 psi loading.
10	577	L	1937	373-773		Madagascan phlogopites; 3-2	The above specimen measured under 48 psi loading.
11	577	L	1937	373-773		Madagascan phlogopites; 3-2	The above specimen measured under 178 psi loading.
12	577	L	1937	373-773		Madagascan phlogopites; 3-2	The above specimen measured under 330 psi loading.
13	577	L	1937	448-891		Canadian phlogopites; 4	Dark; measured under 176 psi loading; loaded density 2.98 g cm ⁻³ .
14	577	L	1937	357-833		Canadian phlogopites; 5	Medium; 0.094 cm thickness; measured under 176 psi loading; loaded density 2.85 g cm ⁻³ .
15	577	L	1937	364-506		Canadian phlogopites; 5	The above specimen measured when cooled from 250 C.
16	577	L	1937	349-883		Canadian phlogopites; 5	Medium; 0.051 cm thickness; measured under 176 psi loading; loaded density 2.95 g cm ⁻³ .
17	577	L	1937	353-541		Canadian phlogopites; 5	The above specimen measured when cooled from 610 C.
18	577	L	1937	346-912		Canadian phlogopites; 6	Medium; measured under 176 psi loading; loaded density 2.82 g cm ⁻³ .
19	577	L	1937	419, 2,516.2		Canadian phlogopites; 6	The above specimen measured when cooled from 639 C.

SPECIFICATION TABLE NO. 273 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
20	577	L	1937	388-865		Canadian phlogopites; 7	Light; measured under 176 psi loading; loaded density 2.84 g cm ⁻³ .
21	577	L	1937	368-593		Canadian phlogopites; 7	The above specimen measured when cooled from 592 C.
22	577	L	1937	383-918		Canadian phlogopites; 8	Light; measured under 176 psi loading; loaded density 2.95 g cm ⁻³ .
23	577	L	1937	374.2, 413.2		Canadian phlogopites; 8	The above specimen measured when cooled from 645 C.
24	100	L	1957	518-729			Powders; bulk density 0.332 g cm ⁻³ .
25	76	C	1952	523-903		Synthetic Mica	98% of theoretical density.
26	125	L	1923	323.2	1		Sample consisting of two large sheets of mica each about 0.7 mm in thickness; measured with increasing pressure.
27	125	L	1923	323.2	1		Specimen 0.013 cm thick.
28	125	L	1923	323.2	1		Specimen 0.013 cm thick.
29	125	L	1923	323.2	1		Various specimens with different thickness from 0.01 cm to 0.025 cm; pressure 120 psi.
30	152	L	1956	298.2		Mica	Unirradiated.
31	152	L	1956	298.2		Mica	The above specimen exposed with 4 x 10 ¹⁸ epithermal neutrons per cm ² for 480 Mwd in the MTR.
32	330	C	1957	298.2		Bonded Mica	Thermal comparator loaded with 100 gram weight applied on the plane lapped surface of the specimen.
33	330	C	1957	299.2		Bonded Mica	Thermal comparator applied to a 3 in. dia and 0.187 in. thick lapped disk specimen.
34	109	L	1947	222-306			Board vermiculite; specimen 1 in. thick; density 0.303 g cm ⁻³ ; as received.
35	109	L	1947	222-306			Fill vermiculite; expanded; specimen 1 in. thick; density 0.13 g cm ⁻³ as received.
36	79	L	1942	565.7			Coarse granules; density 0.152 g cm ⁻³ .
37	100	L	1957	532-720			Powder; bulk density 0.268 g cm ⁻³ .
38	139	R	1950	93-300			Powdered; density 0.090 g cm ⁻³ .
39	561	R	1948	92-275		Granulated vermiculite 2A	Grain size 10-14 mesh; bulk density 0.2163 g cm ⁻³ .
40	561	R	1948	187.2		Granulated vermiculite 2B	Grain size 4-10 mesh; bulk density 0.144 g cm ⁻³ .
41	561	R	1948	187.2		Granulated vermiculite 2C	Mixed grain size; 7.9% 3-4 mesh, 26.5% 4-10 mesh, and 65.6% 10-14 mesh; bulk density 0.157 g cm ⁻³ .

SPECIFICATION TABLE NO. 274 THERMAL CONDUCTIVITY OF PERLITE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	567	L	1966	171-283			Expanded perlite powder; density 0.048 g cm ⁻³ .

DATA TABLE NO. 274 THERMAL CONDUCTIVITY OF PERLITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
CURVE 1*	
170.7	0.000250
228.2	0.000325
283.2	0.000395

* No graphical presentation

THERMAL CONDUCTIVITY OF ROCK

FIGURE SHOWS ONLY 16 OF THE CURVES REPORTED IN TABLE

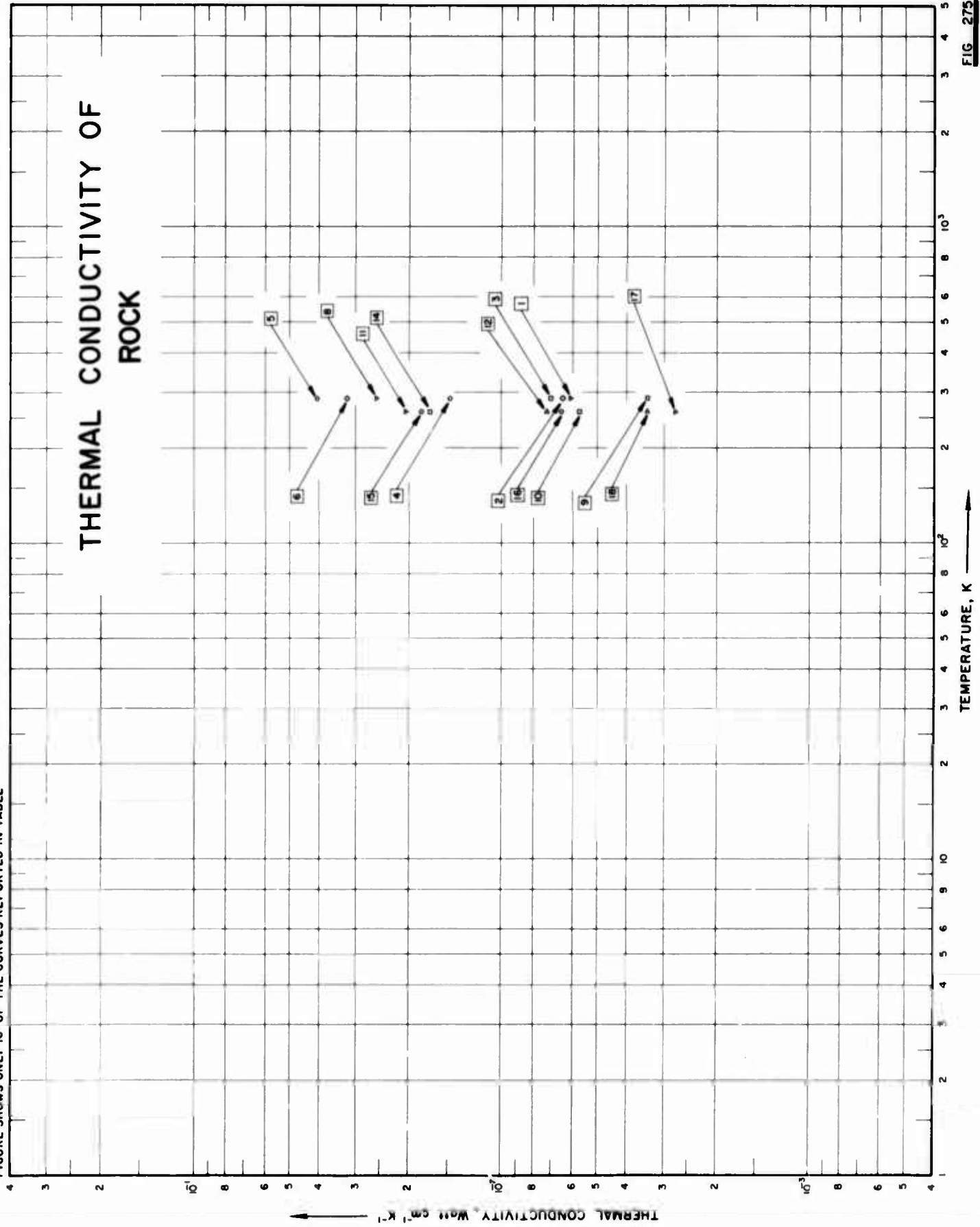


FIG. 275

SPECIFICATION TABLE NO. 275 THERMAL CONDUCTIVITY OF ROCK

[For Data Reported in Figure and Table No. 275]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	545	P	1947	287.3		Winchester crushed trap rock; 3E-1	Consisting of a fine-grained quartz diorite (0.75 in. max size) obtained from quarry at Winchester, Mass.; specimen 5.36 in. in dia and 10.68 in. high. Material placed in approximately five equal layers and compacted using an increasing number of blows on each layer to obtain a uniform unit weight through the specimen; unfrozen; immersed in a water bath and brought to a constant temperature of approximately 24 C and removed from this bath and immediately immersed in a second water bath at a temperature of approximately 4.5 C; specific gravity 2.91, unit weight 1.62 g cm ⁻³ ; unit dry weight 1.59 g cm ⁻³ ; water content 1.9% dry weight.
2	545	P	1947	287.3		Winchester crushed trap rock; 3E-2	Similar to the above specimen except unit weight 1.636 g cm ⁻³ ; unit dry weight 1.602 g cm ⁻³ ; water content 2.1% dry weight.
3	545	P	1947	287.3		Winchester crushed trap rock; 3E-3	Similar to the above specimen except unit weight 1.647 g cm ⁻³ ; unit dry weight 1.578 g cm ⁻³ ; water content 4.4% dry weight.
4	545	P	1947	287.3		Winchester crushed trap rock; 3E-4	Similar to the above specimen except unit weight 2.014 g cm ⁻³ ; unit dry weight 1.578 g cm ⁻³ ; water content 27.2% dry weight.
5	545	P	1947	287.3		Winchester crushed trap rock; 3E-5	Similar to the above specimen except unit weight 2.04 g cm ⁻³ ; unit dry weight 1.59 g cm ⁻³ ; water content 28.4% dry weight; test results are not consistent with results of other tests and time curves are not erratic.
6	545	P	1947	287.3		Winchester crushed trap rock; 3E-6a	Similar to the above specimen except unit weight 2.05 g cm ⁻³ ; unit dry weight 1.602 g cm ⁻³ ; water content 27.7% dry weight.
7	545	P	1947	287.3		Winchester crushed trap rock; 3E-7	Similar to specimen 3E-1 except unit weight 1.957 g cm ⁻³ ; unit dry weight 1.619 g cm ⁻³ ; water content 20.9% dry weight.
8	545	P	1947	287.3		Winchester crushed trap rock; 3E-8	Similar to the above specimen except unit weight 2.07 g cm ⁻³ ; unit dry weight 1.63 g cm ⁻³ ; water content 26.7% dry weight.
9	545	P	1947	287.3		Winchester crushed trap rock; 3E-21	Similar to the above specimen except unit weight 1.504 g cm ⁻³ ; unit dry weight 1.801 g cm ⁻³ ; water content 0.2% dry weight.
10	545	P	1947	261.8		Winchester crushed trap rock; 3E-9	Consisting of a fine-grained quartz diorite (0.75 in. max size) obtained from quarry at Winchester, Mass.; specimen 5.36 in. in dia and 10.68 in. high; material placed in approximately five equal layers and compacted using an increasing number of blows on each layer to obtain a uniform unit weight through the specimen; frozen; subjected to a constant freezing temperature of approximately -20 C inside the freezing cabinet until temperature equilibrium is reached, then immersed in a brine bath at a temperature of approximately -2.7 C; specific gravity 2.91; unit weight 1.67 g cm ⁻³ ; unit dry weight 1.65 g cm ⁻³ ; water content 1.5% dry weight.

SPECIFICATION TABLE NO. 275 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
11	545	P	1947	261.8		Winchester crushed trap rock; 3E-10	Similar to the above specimen except unit weight 2.07 g cm^{-3} ; unit dry weight 1.65 g cm^{-3} ; water content 25.8% dry weight; cover lifted off cylinder due to heaving during test; results slightly affected by leaking of brine into specimen.
12	545	P	1947	261.8		Winchester crushed trap rock; 3E-11	Similar to specimen 3E-9 except unit weight 1.74 g cm^{-3} ; unit dry weight 1.071 g cm^{-3} ; water content 2.2% dry weight.
13	545	P	1947	261.8		Winchester crushed trap rock; 3E-12	Similar to the above specimen except unit weight 1.68 g cm^{-3} ; unit dry weight 1.66 g cm^{-3} ; water content 1.2%.
14	545	P	1947	261.8		Winchester crushed trap rock; 3E-13	Similar to the above specimen except unit weight 2.08 g cm^{-3} ; unit dry weight 1.071 g cm^{-3} ; water content 22.1%, slight leaking.
15	545	P	1947	261.8		Winchester crushed trap rock; 3E-14	Similar to the above specimen except unit weight 2.07 g cm^{-3} ; unit dry weight 1.66 g cm^{-3} ; water content 25.0%.
16	545	P	1947	261.8		Winchester crushed trap rock; 3E-15	Similar to the above specimen except unit weight 1.71 g cm^{-3} ; unit dry weight 1.68 g cm^{-3} ; water content 2.0%.
17	545	P	1947	261.8		Winchester crushed trap rock; 3E-17	Similar to the above specimen except unit weight 1.65 g cm^{-3} ; unit dry weight 1.63 g cm^{-3} ; water content 0.21% dry weight.
18	545	P	1947	261.8		Winchester crushed trap rock; 3E-18	Similar to the above specimen except unit weight 1.785 g cm^{-3} ; unit dry weight 1.78 g cm^{-3} ; water content 0.12% dry weight.

DATA TABLE NO. 275 THERMAL CONDUCTIVITY OF ROCK
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
	<u>CURVE 1</u>	<u>CURVE 13*</u>	
287.3	0.00606	261.8	0.00578
	<u>CURVE 2</u>	<u>CURVE 14</u>	
287.3	0.00642	261.8	0.0171
	<u>CURVE 3</u>	<u>CURVE 15</u>	
287.3	0.00697	261.8	0.0183
	<u>CURVE 4</u>	<u>CURVE 16</u>	
287.3	0.0147	261.8	0.00649
	<u>CURVE 5</u>	<u>CURVE 17</u>	
287.3	0.0402	261.8	0.00272
	<u>CURVE 6</u>	<u>CURVE 18</u>	
287.3	0.0320	261.8	0.00339
	<u>CURVE 7*</u>		
287.3	0.00642		
	<u>CURVE 8</u>		
287.3	0.0256		
	<u>CURVE 9</u>		
287.3	0.00339		
	<u>CURVE 10</u>		
261.8	0.00568		
	<u>CURVE 11</u>		
261.8	0.0204		
	<u>CURVE 12</u>		
261.8	0.00722		

* Not shown on plot

SPECIFICATION TABLE NO. 276 THERMAL CONDUCTIVITY OF SALT

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	578	R	1963	332-464	±7	Goome Salt No. 1	Composition (in vol %) 95 NaCl, 3 SiH and clay, 2 polyhalite; grainy in appearance; translucent to red-brown with brown streaks; specimen 3.5 in. O.D., 0.875 in. I.D. and 18 in. long; specimen cored from massive blocks from the Goome event ground zero room (1200 ft level); density 2.147 g cm ⁻³ ; the temp dependence of the thermal conductivity for this salt is qualitatively similar to that of the literature values.
2	578	R	1963	370-600	±7	Goome Salt No. 2	Similar to the above specimen.

DATA TABLE NO. 276 THERMAL CONDUCTIVITY OF SALT

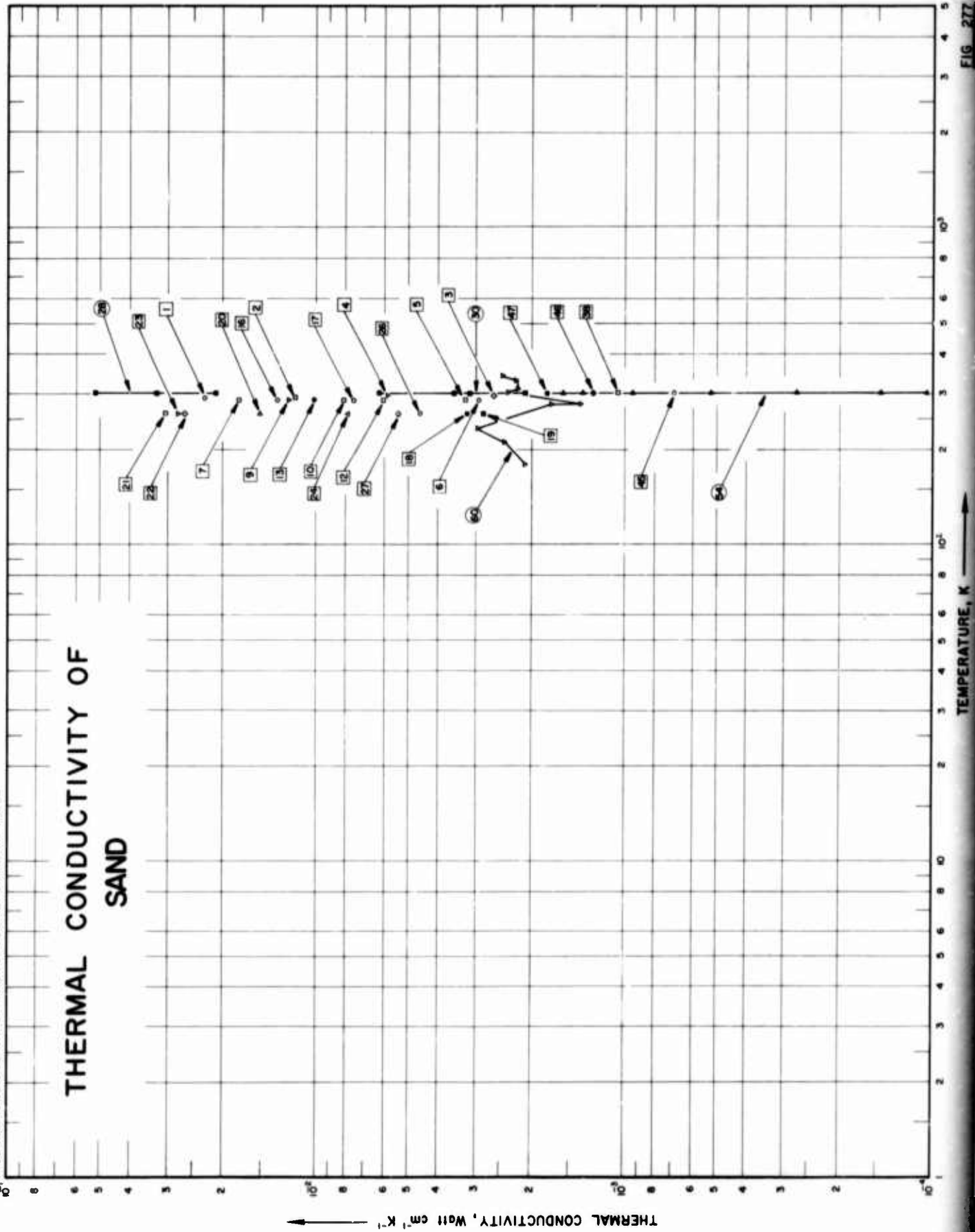
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
332	0.0291
375	0.0283
439	0.0289
464	0.0278
<u>CURVE 2*</u>	
370	0.0377
426	0.0300
496	0.0260
532	0.0265
600	0.0251

* No graphical presentation

FIGURE SHOWS ONLY 30 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF SAND



SPECIFICATION TABLE NO. 277 THERMAL CONDUCTIVITY OF SAND

[For Data Reported in Figure and Table No. 277]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	589	F	1958	293.2			Leighton Buzzard sand; particle sizes 0.060-0.085 cm; dry density 1.54 g cm ⁻³ ; average moisture content 22%.
2	589	F	1958	293.2			Similar to the above specimen except average moisture content 2.3%.
3	546	P	1924	297.2		Quartz sand	Medium fine; dry; density 1.65 g cm ⁻³ .
4	546	P	1924	297.2		Quartz sand	Medium fine; density 1.75 g cm ⁻³ ; moisture content 8.3%.
5	545	P	1947	287.3		Lowell Sand No. 3A-4	Specimen 5.36 in. in dia and 10.68 in. in height; consisting of cohesiveness siliceous sand from a glacial outwash deposit at South Lowell, Mass.; the material placed in approx five equal layers and compacted, using an increasing number of blows on each layer to obtain a uniform unit weight throughout the specimen; unfrozen; immersed in a water bath and brought to a constant temp of approx 24 C and then immersed in a second water bath at a temp of approx 4.5 C; specific gravity 2.66; unit dry weight 1.68 g cm ⁻³ ; water content 0.2% dry weight.
6	545	P	1947	287.3		Lowell Sand No. 3A-5	Similar to the above specimen except specific gravity 2.66; unit weight 1.62 g cm ⁻³ ; unit dry weight 1.6 g cm ⁻³ ; specimen not properly sealed letting some water in during test.
7	545	P	1947	287.3		Lowell Sand No. 3A-6	Similar to the above specimen except water content 16.4% dry weight, unit weight 1.987 g cm ⁻³ ; unit dry weight 1.71 g cm ⁻³ ; specimen not properly sealed letting some water in during test.
8	545	P	1947	287.3		Lowell Sand No. 3A-7	Similar to the above specimen except unit weight 1.96 g cm ⁻³ ; unit dry weight 1.62 g cm ⁻³ ; water content 20.9% dry weight.
9	545	P	1947	287.3		Lowell Sand No. 3A-8	Similar to the above specimen except unit weight 1.72 g cm ⁻³ ; unit dry weight 1.65 g cm ⁻³ ; water content 4.5% dry weight.
10	545	P	1947	287.3		Lowell Sand No. 3A-9	Similar to the above specimen except unit weight 1.4 g cm ⁻³ ; unit dry weight 1.34 g cm ⁻³ ; water content 4.9% dry weight.
11	545	P	1947	287.3		Lowell Sand No. 3A-10	Similar to the above specimen except unit weight 1.38 g cm ⁻³ ; unit dry weight 1.35 g cm ⁻³ ; water content 2.3% dry weight.
12	545	P	1947	287.3		Lowell Sand No. 3A-11	Similar to the above specimen except unit weight 1.49 g cm ⁻³ ; unit dry weight 1.46 g cm ⁻³ ; water content 1.9% dry weight.
13	545	P	1947	287.3		Lowell Sand No. 3A-12	Similar to the above specimen except unit weight 1.785 g cm ⁻³ ; unit dry weight 1.75 g cm ⁻³ ; water content 2.2% dry weight.
14	545	P	1947	287.3		Lowell Sand No. 3A-13	Similar to the above specimen except unit weight 1.69 g cm ⁻³ ; unit dry weight 1.65 g cm ⁻³ ; water content 2.0% dry weight.
15	545	P	1947	287.3		Lowell Sand No. 3A-15	Similar to the above specimen except unit weight 1.46 g cm ⁻³ ; unit dry weight 1.43 g cm ⁻³ ; water content 2.1% dry weight.

SPECIFICATION TABLE NO. 277 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
16	545	P	1947	287.3		Lowell Sand No. 3A-16	Similar to the above specimen except unit weight 1.76 g cm^{-3} ; unit dry weight 1.68 g cm^{-3} ; water content 5.1% dry weight.
17	545	P	1947	287.3		Lowell Sand No. 3A-17	Similar to the above specimen except unit weight 1.48 g cm^{-3} ; unit dry weight 1.45 g cm^{-3} ; water content 2.1% dry weight.
18	54f	P	1947	261.8		Lowell Sand No. 3A-18	Specimen 5.36 in. in dia and 10.68 in. in height; consisting of a cohesionless, siliceous sand from a glacial outwash deposit at South Lowell, Mass.; the material placed in approximately five equal layers and compacted, using an increasing number of blows on each layer to obtain a uniform unit weight throughout the specimen; frozen; subjected to a constant freezing temperature of approximately -20 C inside the freezing cabinet until temperature equilibrium is reached and then immersed in a brine bath at a temperature of approximately -2.77 C ; specific gravity 2.66; unit weight 1.70 g cm^{-3} ; unit dry weight 1.70 g cm^{-3} ; water content 0.17% dry weight.
19	545	P	1947	261.8		Lowell Sand No. 3A-19	Similar to the above specimen except unit weight 1.65 g cm^{-3} ; unit dry weight 1.65 g cm^{-3} .
20	545	P	1947	261.8		Lowell Sand No. 3A-20	Similar to the above specimen except unit weight 1.73 g cm^{-3} ; unit dry weight 1.65 g cm^{-3} ; water content 5.4% dry weight.
21	545	P	1947	261.8		Lowell Sand No. 3A-21	Similar to the above specimen except unit weight 1.98 g cm^{-3} ; unit dry weight 1.7 g cm^{-3} ; water content 16.5% dry weight.
22	545	P	1947	261.8		Lowell Sand No. 3A-22	Similar to the above specimen except unit weight 1.95 g cm^{-3} ; unit dry weight 1.65 g cm^{-3} ; water content 18.5% dry weight.
23	545	P	1947	261.8		Lowell Sand No. 3A-23	Similar to the above specimen except unit weight 1.98 g cm^{-3} ; unit dry weight 1.65 g cm^{-3} ; water content 20.5% dry weight.
24	545	P	1947	261.8		Lowell Sand No. 3A-24	Similar to the above specimen except unit weight 1.71 g cm^{-3} ; unit dry weight 1.68 g cm^{-3} ; water content 2.2% dry weight.
25	545	P	1947	261.8		Lowell Sand No. 3A-25	Similar to the above specimen except unit weight 1.76 g cm^{-3} ; unit dry weight 1.69 g cm^{-3} ; water content 4.2% dry weight.
26	545	P	1947	261.8		Lowell Sand No. 3A-26	Similar to the above specimen except unit weight 1.79 g cm^{-3} ; unit dry weight 1.79 g cm^{-3} ; water content 0.66% dry weight.
27	545	P	1947	261.8		Lowell Sand No. 3A-27	Similar to the above specimen except unit weight 1.8 g cm^{-3} ; unit dry weight 1.78 g cm^{-3} ; water content 0.95% dry weight.
28	590	P	1961	303.2		Quartz sand	Unconsolidated sand; specimen 5 in. in dia and 7 in long; measured with water saturated (at 1 atm) and various porosities.
29	590	P	1961	303.2		Quartz sand	Unconsolidated sand; specimen 5 in. in dia and 7 in. long; measured with saturated oil (i.e. n-heptane, at 1 atm) and various porosities.

SPECIFICATION TABLE NO. 277 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
30	590	P	1961	303.2		Quartz sand	Unconsolidated sand; 5 in. in dia and 7 in. long; measured with saturated air (at 1 atm) and various porosities.
31	590	P	1961	303.2		Quartz sand	Unconsolidated sand; 20/30 mesh Ottawa sand and 140/200 Wassau sand; specimen 5 in. in dia and 7 in. long; measured with saturated Freon-12; porosity = 19.4%; K_f is saturant thermal conductivity.
32	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated argon.
33	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated air.
34	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated n-heptane.
35	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated helium.
36	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated hydrogen.
37	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated water.
38	590	P	1961	303.2		Quartz sand	Unconsolidated sand; 20/30 mesh Ottawa sand; specimen 5 in. in dia and 7 in. long; measured with saturated Freon-12; porosity 36.1%; K_f is saturant thermal conductivity.
39	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated argon.
40	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated air.
41	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated n-heptane.
42	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated helium.
43	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated hydrogen.
44	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated water.
45	590	P	1961	303.2		Quartz sand	Unconsolidated sand; 40/200 mesh Wassau sand; specimen 5 in. in dia and 7 in. long; measured with saturated Freon-12; porosity 59%; K_f is saturant thermal conductivity.
46	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated argon.
47	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated air.
48	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated n-heptane.
49	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated helium.
50	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated hydrogen.
51	590	P	1961	303.2		Quartz sand	Similar to the above specimen except with saturated water.
52	590	P	1961	303.2		Quartz sand	Unconsolidated sand; 20/30 mesh Ottawa and 140/200 mesh Wassau sand; specimen 5 in. in dia and 7 in. long; porosity = 18%; measured with various air pressure. (interstitial air pressure).

SPECIFICATION TABLE NO. 277 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
53	590	P	1961	303.2		Quartz sand	Unconsolidated sand; 20/30 mesh Ottawa sand; specimen 5 in. in dia and 7 in. long; porosity 33%, measured with various interstitial air pressure.
54	590	P	1961	303.2		Quartz sand	Unconsolidated sand; 140/200 mesh Wausau sand; specimen 5 in. in dia and 7 in. long; porosity 39%; measured with various interstitial air pressure.
55	590	P	1961	303.2		Quartz sand	Unconsolidated quartz sand; specimen 5 in. in dia and 7 in. long; porosity = 15%; measured with various interstitial hydrogen gas pressure.
56	590	P	1961	303.2		Quartz sand	Similar to the above specimen except measured with various interstitial helium gas pressure.
57	590	P	1961	303.2		Quartz sand	Similar to the above specimen except measured with various interstitial air pressure.
58	590	P	1961	303.2		Quartz sand	Similar to the above specimen except measured with various interstitial argon gas pressure.
59	590	P	1961	303.2		Quartz sand	Similar to the above specimen except measured with various interstitial Freon-12 pressure.
60	539	P	1962	180-343		Silica sand	99 silica, 76 mesh commercial grade foundry sand; moisture content <0.03; density 1.60 g cm ⁻³ ; specific heat data obtained from Goldsmith, A., Waterman, T. E., and Hirschhorn, H. J., "Handbook of Thermophysical Properties of Solid Materials", and from Smithsonian Institute Physical Tables.
61	539	P	1962	319-368		Silica sand	The above specimen measured in a vacuum of 5×10^{-6} mm Hg.

DATA TABLE NO. 277 (continued)

Pair (mm Hg)	k
<u>CURVE 57*</u> ($\bar{T} = 303.2 \text{ K}$)	
10	0.00188
52.5	0.00418
200	0.00565
750	0.00649
1600	0.00669
<u>CURVE 58*</u> ($\bar{T} = 303.2 \text{ K}$)	
15	0.00126
110	0.00314
400	0.00397
700	0.00418
850	0.00418
<u>CURVE 59*</u> ($\bar{T} = 303.2 \text{ K}$)	
110	0.00209
750	0.00209
1700	0.00230
T	k
<u>CURVE 60</u>	
180.4	0.00209
212.6	0.00243
235.4	0.00296
279.3	0.00172
279.9	0.00138
303.8	0.00236
312.1	0.00220
332.1	0.00222
342.6	0.00246
<u>CURVE 61*</u>	
319.3	0.0000369
320.4	0.0000396
329.9	0.0000438
344.3	0.0000417
366.0	0.0000500
368.2	0.0000346

* Not shown on plot

THERMAL CONDUCTIVITY OF SANDSTONE

FIGURE SHOWS ONLY 20 OF THE CURVES REPORTED IN TABLE

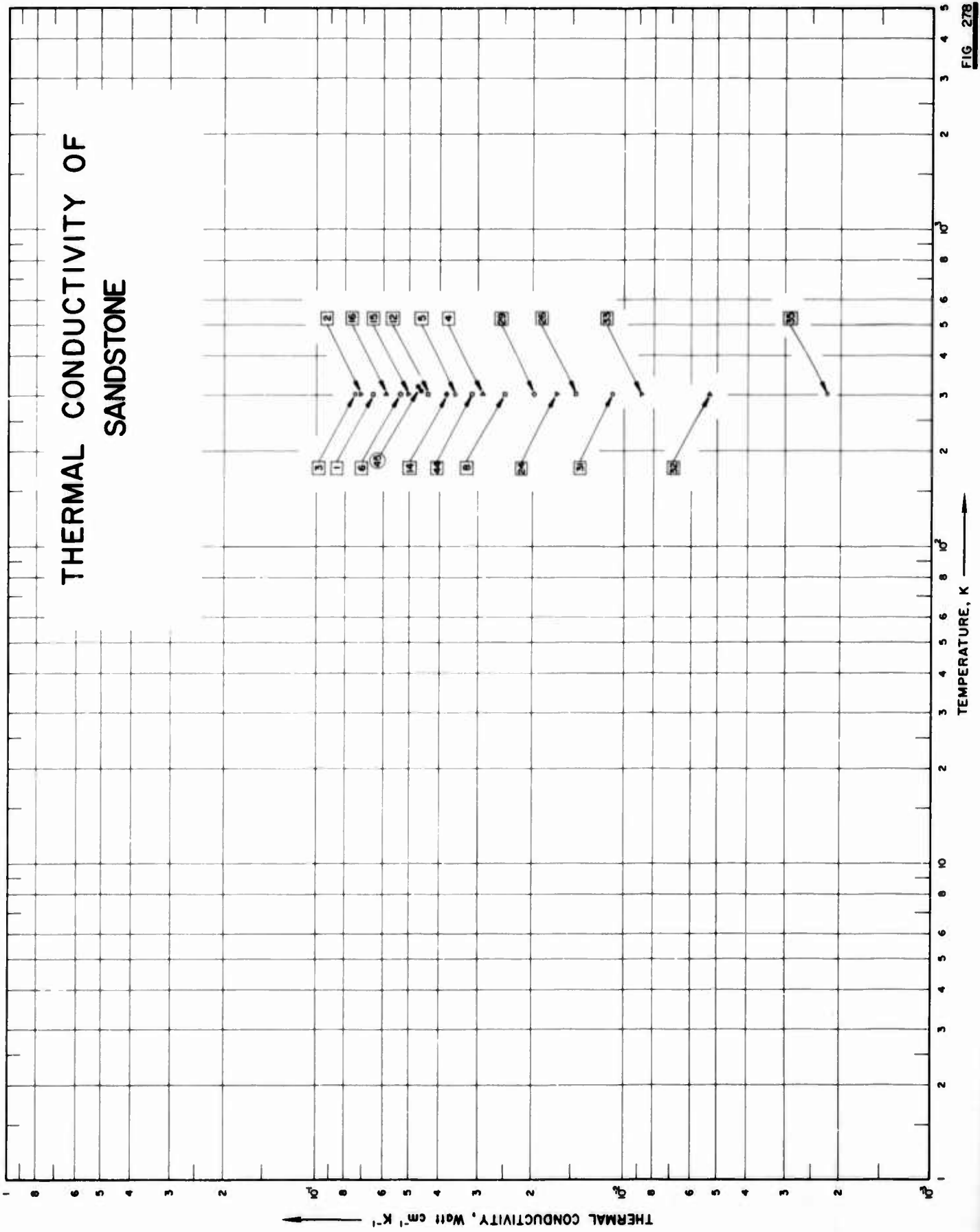


FIG. 278

SPECIFICATION TABLE NO. 278 THERMAL CONDUCTIVITY OF SANDSTONE

[For Data Reported in Figure and Table No. 278]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	591	P	1961	303.2		Berkeley	Consolidated sandstone; (98-99 quartz, 1-2 kaolinite); with saturant (air) at atmospheric pressure; specimen 3 in. in dia and 6.5 in. long; porosity 3.0%; permeability < 0.1 md; K_f is saturant conductivity.
2	591	P	1961	303.2		Berkeley	The above specimen with n-heptane saturated at atmospheric pressure.
3	591	P	1961	303.2		Berkeley	The above specimen with water saturated at atmospheric pressure.
4	591	P	1961	303.2		Berkeley	The above specimen with vacuo.
5	591	P	1961	303.2		St. Peters	Consolidated sandstone; (98-99 quartz, 1-2 kaolinite); with saturant (air) at atmospheric pressure; specimen 3 in. in dia and 6.5 in. long; porosity 11%; permeability 3.4 md; K_f is saturant conductivity.
6	591	P	1961	303.2		St. Peters	The above specimen with n-heptane saturated at atmospheric pressure.
7	591	P	1961	303.2		St. Peters	The above specimen with water saturated at atmospheric pressure.
8	591	P	1961	303.2		St. Peters	The above specimen with vacuo.
9	591	P	1961	303.2		Tensleep	Consolidated sandstone; (90-95 quartz, 5-10 amorphous silica); with saturant (freon) at atmospheric pressure; specimen 3 in. in dia and 6.5 in. long; porosity 15.5%; permeability 220 md; K_f is saturant conductivity.
10	591	P	1961	303.2		Tensleep	The above specimen with saturated argon at atmospheric pressure.
11	591	P	1961	303.2		Tensleep	The above specimen with saturated air at atmospheric pressure.
12	591	P	1961	303.2		Tensleep	The above specimen with saturated n-heptane at atmospheric pressure.
13	591	P	1961	303.2		Tensleep	The above specimen with saturated helium at atmospheric pressure.
14	591	P	1961	303.2		Tensleep	The above specimen with saturated hydrogen at atmospheric pressure.
15	591	P	1961	303.2		Tensleep	The above specimen with saturated 60% ethanol at atmospheric pressure.
16	591	P	1961	303.2		Tensleep	The above specimen with saturated water at atmospheric pressure.
17	591	P	1961	303.2		Tensleep	The above specimen with vacuo.
18	591	P	1961	303.2		Berea	Consolidated sandstone; (88-89 quartz, 9-10 kaolinite, 2 illite); with saturant (N_2O) at atmospheric pressure; specimen 3 in. in dia and 6.5 in. long; porosity 22%; permeability 480 md; K_f is saturant conductivity.
19	591	P	1961	303.2		Berea	The above specimen with saturated air at atmospheric pressure.
20	591	P	1961	303.2		Berea	The above specimen with saturated n-heptane at atmospheric pressure.
21	591	P	1961	303.2		Berea	The above specimen with saturated helium at atmospheric pressure.
22	591	P	1961	303.2		Berea	The above specimen with saturated hydrogen at atmospheric pressure.
23	591	P	1961	303.2		Berea	The above specimen with saturated water at atmospheric pressure.

SPECIFICATION TABLE NO. 278 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, °C	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
24	591	P	1961	303.2		Berea	The above specimen with vacuo.
25	591	P	1961	303.2		Teapot	Consolidated sandstone; (68 quartz, 7 kaolinite, 5 illite); with saturant (freon) at atmospheric pressure; specimen 3 in. in dia and 6.5 in. long; porosity 29%; permeability 1960 md; K_f is saturant conductivity.
26	591	P	1961	303.2		Teapot	The above specimen with saturated argon at atmospheric pressure.
27	591	P	1961	303.2		Teapot	The above specimen with saturated air at atmospheric pressure.
28	591	P	1961	303.2		Teapot	The above specimen with saturated n-heptane at atmospheric pressure.
29	591	P	1961	303.2		Teapot	The above specimen with saturated helium at atmospheric pressure.
30	591	P	1961	303.2		Teapot	The above specimen with saturated water at atmospheric pressure.
31	591	P	1961	303.2		Teapot	The above specimen with vacuo.
32	591	P	1961	303.2		Tripolite	Consolidated sandstone; (85-90 quartz, 10-15 amorphous silica); with saturant (air) at atmospheric pressure; specimen 3 in. in dia and 6.5 in. long; porosity 59%; permeability 650 md; K_f is saturant conductivity.
33	591	P	1961	303.2		Tripolite	The above specimen with saturated n-heptane at atmospheric pressure.
34	591	P	1961	303.2		Tripolite	The above specimen with saturated water at atmospheric pressure.
35	591	P	1961	303.2		Tripolite	The above specimen with vacuo.
36	591	P	1961	303.2		Berkeley	Similar to the above Berkeley specimen with various air pressures (dry air values).
37	591	P	1961	303.2		Berkeley	Similar to the above Berkeley specimen with various air pressures (60% RH values).
38	591	P	1961	303.2		Tensleep	Similar to the above Tensleep specimen with various air pressures (dry air values).
39	591	P	1961	303.2		Berea	Similar to the above Berea specimen with various internal nitrogen gas pressures and zero net overburden pressure.
40	591	P	1961	303.2		Berea	Similar to the above Berea specimen with various internal nitrogen gas pressures and 4000 psi net overburden pressure.
41	591	P	1961	303.2		Berea	Similar to the above Berea specimen (except evacuated) measured with increasing overburden pressure P_{ob} .
42	591	P	1961	303.2		Berea	Similar to the above Berea specimen (except evacuated) measured with decreasing overburden pressure P_{ob} .
43	591	P	1961	303.2		Berea	Similar to the above Berea specimen (air saturated) measured with increasing overburden pressure P_{ob} .
44	591	P	1961	303.2		Berea	Similar to the above Berea specimen (air saturated) measured with increasing overburden pressure P_{ob} .

SPECIFICATION TABLE NO. 278 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
45	586	L	1933	310, 320	1		Recrystallized; specimen 5 cm in dia and 2 cm long; density 2.40 g cm^{-3} ; obtained from Lower Permian. The Old Quarry, Penrith, Cumberland.

DATA TABLE NO. 278 THERMAL CONDUCTIVITY OF SANDSTONE
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

$K_f(W/cmK)$ k	$K_f(W/cmK)$ k	$K_f(W/cmK)$ k	$K_f(W/cmK)$ k	$K_f(W/cmK)$ k	$P(mm\ Hg)$ k	$P(mm\ Hg)$ k	$P_{ob}(psi)$ k	k
$\frac{CURVE\ 1}{(T = 303.2\ K)}$	$\frac{CURVE\ 10^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 19^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 28^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 36^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 39\ (cont.)^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 43^*}{(T = 303.2\ K)}$		
0.000264 0.0649	0.000177 0.0287	0.000264 0.0239	0.00128 0.0265	0.011 0.0290	14 0.0236	0 0.0235		
$\frac{CURVE\ 2}{(T = 303.2\ K)}$	$\frac{CURVE\ 11^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 20^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 29}{(T = 303.2\ K)}$	0.019 0.0299	77 0.0243	410 0.0269		
0.00128 0.0711	0.000264 0.0304	0.00128 0.0374	0.035 0.0325	0.3 0.0405	150 0.0262	999 0.0286		
$\frac{CURVE\ 3}{(T = 303.2\ K)}$	$\frac{CURVE\ 12}{(T = 303.2\ K)}$	$\frac{CURVE\ 21^*}{(T = 303.2\ K)}$	0.00147 0.0198	0.7 0.0418	300 0.0274	1575 0.0298		
0.00628 0.0741	0.00128 0.0437	0.00128 0.0304	4 0.0433	8.5 0.0452	550 0.0276	2125 0.0307		
$\frac{CURVE\ 4}{(T = 303.2\ K)}$	$\frac{CURVE\ 13^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 22^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 30^*}{(T = 303.2\ K)}$	105 0.0519	1000 0.0282	2780 0.0314		
0.00 0.0290	0.00147 0.0345	0.00179 0.0300	750 0.0649	750 0.0649	1200 0.0282	3600 0.0320		
$\frac{CURVE\ 5}{(T = 303.2\ K)}$	$\frac{CURVE\ 14}{(T = 303.2\ K)}$	$\frac{CURVE\ 23^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 31}{(T = 303.2\ K)}$	$\frac{CURVE\ 37^*}{(T = 303.2\ K)}$	2100 0.0301			
0.000264 0.0356	0.00179 0.0379	0.00628 0.0448	0.06 0.0364	0.045 0.0324	$\frac{CURVE\ 40^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 44}{(T = 303.2\ K)}$		
$\frac{CURVE\ 6}{(T = 303.2\ K)}$	$\frac{CURVE\ 15}{(T = 303.2\ K)}$	$\frac{CURVE\ 24}{(T = 303.2\ K)}$	0.33 0.0450	0.33 0.0450	(T = 303.2 K)	2000 0.0312		
0.00128 0.0534	0.00305 0.0502	0.00 0.0168	750 0.0680	750 0.0680	0.34 0.0337	T k		
$\frac{CURVE\ 7^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 16}{(T = 303.2\ K)}$	$\frac{CURVE\ 25^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 32}{(T = 303.2\ K)}$	$\frac{CURVE\ 38^*}{(T = 303.2\ K)}$	6 0.0337	$\frac{CURVE\ 45}{(T = 303.2\ K)}$		
0.06628 0.0636	0.00628 0.0586	0.000979 0.0146	0.00264 0.00527	15 0.0339	6 0.0337	309.7 0.0460		
$\frac{CURVE\ 8}{(T = 303.2\ K)}$	$\frac{CURVE\ 17^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 26}{(T = 303.2\ K)}$	$\frac{CURVE\ 33}{(T = 303.2\ K)}$	57.5 0.0345	15 0.0339	319.8 0.0470		
0.00 0.0249	0.00 0.0262	0.000177 0.0142	0.05 0.0264	100 0.0356	57.5 0.0345			
$\frac{CURVE\ 9^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 18^*}{(T = 303.2\ K)}$	$\frac{CURVE\ 27^*}{(T = 303.2\ K)}$	0.6 0.0264	170 0.0351	100 0.0356			
0.0000979 0.0300	0.000167 0.0241	0.000264 0.0154	10.05 0.0270	300 0.0349	170 0.0351			
			55 0.0274	550 0.0348	300 0.0349			
			190 0.0282	1300 0.0358	550 0.0348			
			300 0.0285	1800 0.0354	1300 0.0358			
			750 0.0301	2300 0.0356	1800 0.0354			
			1600 0.0324		2300 0.0356			
			$P_{N_2}(PSIA)$ k	$P_{ob}(psi)$ k				
			525 0.0234					
			1140 0.0262					
			1830 0.028					
			2430 0.0296					
			3190 0.0304					
			3965 0.0305					
			$\frac{CURVE\ 41^*}{(T = 303.2\ K)}$					
			525 0.0234					
			1140 0.0262					
			1830 0.028					
			2430 0.0296					
			3190 0.0304					
			3965 0.0305					
			$\frac{CURVE\ 42^*}{(T = 303.2\ K)}$					
			0 0.0173					
			225 0.0213					
			2000 0.0330					

* Not shown on plot

SPECIFICATION TABLE NO. 279 THERMAL CONDUCTIVITY OF SILLIMANITE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3		1953	333.2			Max water absorption 0.05%; flexural strength 18,500 psi; coefficient of expansion 4.4×10^{-6} at 25 to 700 C.

DATA TABLE NO. 279 THERMAL CONDUCTIVITY OF SILLIMANITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k
CURVE 1*
 333.2 0.0260

* No graphical presentation

SPECIFICATION TABLE NO. 280 THERMAL CONDUCTIVITY OF SLATE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	508	L	1940	393-578		Slate	Specimen 8 in. in dia and 1 in. thick; density 2.947 g cm ⁻³ ; obtained from Madoc, Ont.
2	508	L	1940	395-577		Slate	Similar to the above specimen; measurements done after exposure to high temp test.

DATA TABLE NO. 280 THERMAL CONDUCTIVITY OF SLATE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

393.2 0.0153
 461.5 0.0164
 577.6 0.0146

CURVE 2*

394.8 0.0149
 483.2 0.0147
 576.5 0.0143

* No graphical presentation

SPECIFICATION TABLE NO. 281 THERMAL CONDUCTIVITY OF SOIL

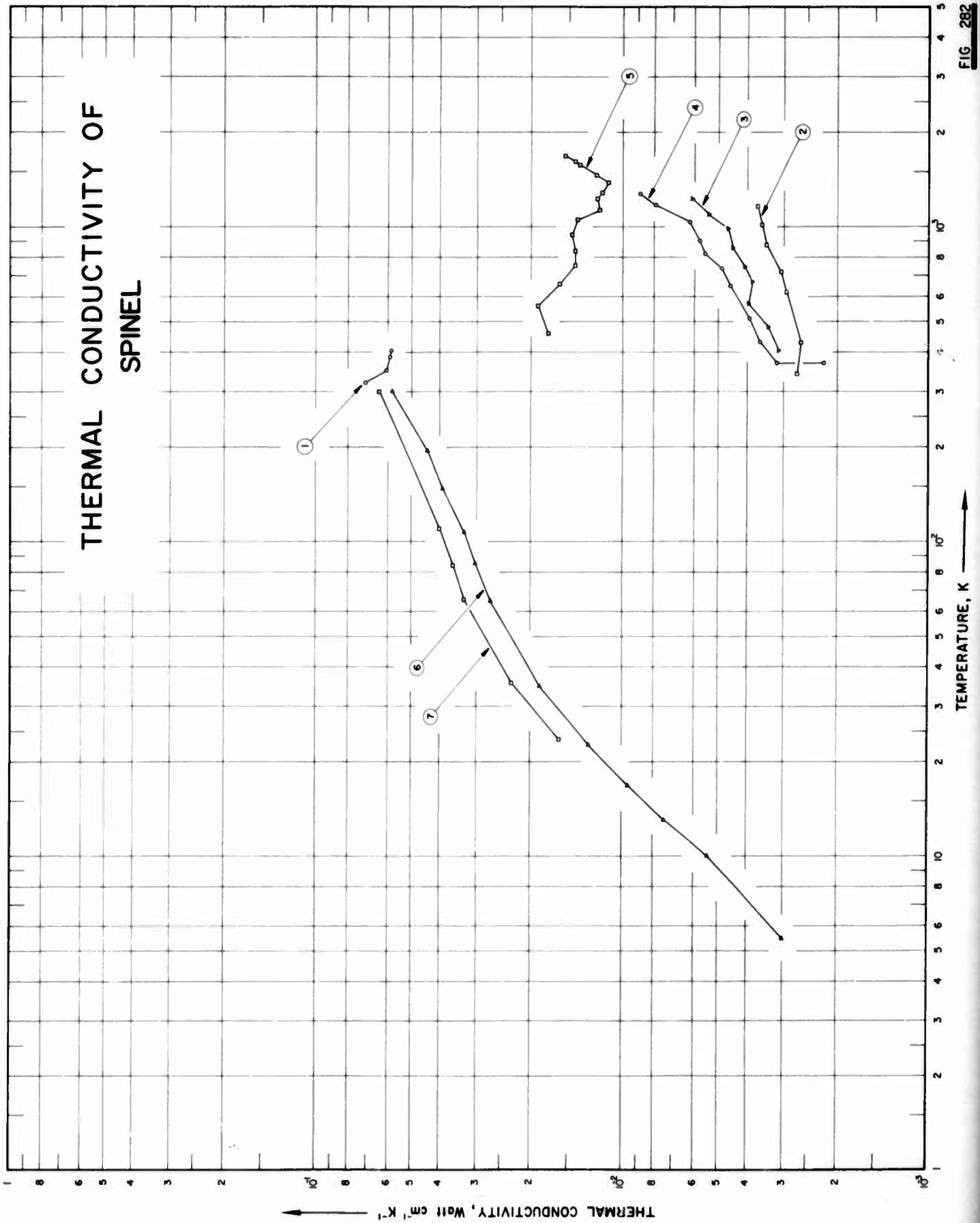
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	31	R	1958	293.2			Mineral; density 2.65 g cm ⁻³ .
2	31	R	1958	293.2			Organic; density 1.3 g cm ⁻³ .
3	31	R	1958	293.2			Mineral; dry; density 1.5 g cm ⁻³ .
4	31	R	1958	293.2			Mineral; saturated; density 1.93 g cm ⁻³ .
5	31	R	1958	293.2			Organic; dry; density 0.13 g cm ⁻³ .
6	31	R	1958	293.2			Organic; saturated; density 1.03 g cm ⁻³ .

DATA TABLE NO. 281 THERMAL CONDUCTIVITY OF SOIL

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1*</u>			
293.2	0.0293	293.2	0.00502
<u>CURVE 2*</u>			
293.2	0.0251		
<u>CURVE 3*</u>			
293.2	0.0109		
<u>CURVE 4*</u>			
293.2	0.0209		
<u>CURVE 5*</u>			
293.2	0.000335		

* No graphical presentation



SPECIFICATION TABLE NO. 282 THERMAL CONDUCTIVITY OF SPINEL.

[For Data Reported in Figure and Table No. 282]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	407	L	1949	322-406			No details reported.
2	463	R	1961	341-1169			Powder specimen contained in a hollow cylinder of 91 mm internal dia and 203 mm long; grain size < 0.2 mm; bulk density 1.51 g cm ⁻³ .
3	463	R	1961	405-1232			Similar to the above specimen except grain size 0.2~1 mm and bulk density 1.2 g cm ⁻³ .
4	463	R	1961	369-1273			Similar to the above specimen except grain size 2~5 mm and bulk density 0.92 g cm ⁻³ .
5	463	R	1961	459-1670			Prepared from the powder of grain size 0.2~1 mm by pressing and firing at 1650 C; bulk density 1.79 g cm ⁻³ .
6	300	L	1962	5.5 300		R-56 (M _{56.73} Fe _{0.41} Al _{1.85} O ₄)	Single natural crystal of pleonaste spinel from Queensland; chemical analysis indicated a formula of (Ti _{0.02} Mg _{0.75} Fe _{0.41} Al _{1.85})O ₄ ; other impurities low Cr, Mn, Ni, V, Zn, and trace Si; not detected for Be, Ca, K, Li, Na and Zr; free of second phase inclusions; specimen 0.34 cm average dia and 1.12 cm long; opaque and water worn; lattice constant 8.128 Å.
7	300	L	1962	24-300		R-62 (M _{56.13} Fe _{0.33} Al _{1.93} O ₄)	Similar to the above specimen except chemical analysis indicated a formula of (Ti _{0.01} Mg _{0.73} Fe _{0.33} Al _{1.93})O ₄ ; specimen 0.24 cm average dia and 1.00 cm long; lattice constant 8.117 Å.

DATA TABLE NO. 282 THERMAL CONDUCTIVITY OF SPINEL
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
321.5	0.0707	459.2	0.0175
351.2	0.0607	561.2	0.0189
388.7	0.0594	656.2	0.0160
405.6	0.0586	751.2	0.0142
<u>CURVE 2</u>			
341.2	0.00270	942.2	0.0146
430.2	0.00263	1058	0.0140
621.2	0.00293	1138	0.0118
717.2	0.00306	1233	0.0120
875.2	0.00342	1287	0.0116
1017	0.00356	1391	0.0111
1169	0.00368	1462	0.0121
		1577	0.0138
		1609	0.0142
		1670	0.0154
<u>CURVE 3</u>			
405.2	0.00311	<u>CURVE 6</u>	
482.2	0.00337	5.47	0.0030
573.2	0.00396	10.06	0.0054
673.2	0.00384	13.09	0.0074
749.2	0.00407	16.86	0.0096
856.2	0.00449	22.65	0.0128
987.2	0.00465	34.75	0.0186
1100	0.00538	64.78	0.027
1232	0.00608	85.19	0.0303
<u>CURVE 4</u>			
369.2	0.00221	107.52	0.033
369.2	0.00316	147.8	0.039
430.2	0.00360	195.8	0.044
511.2	0.00392	300	0.053
651.2	0.00456	<u>CURVE 7</u>	
736.2	0.00487	23.6	0.016
823.2	0.00554	35.6	0.023
903.2	0.00576	65.5	0.033
1041	0.00622	84.1	0.036
1177	0.00794	110.0	0.040
1273	0.00884	300.0	0.064

SPECIFICATION TABLE NO. 283 THERMAL CONDUCTIVITY OF SPODUMENE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	282	R	1955	398-1133			<p>β-Spodumene; 17.7 chemically pure Li_2CO_3, 24.5 Al_2O_3 and AlO, 57.8 pottery flint; corresponding to the compound $\text{LiO} \cdot \text{Al}_2\text{O}_3 \cdot 4 \text{SiO}_2$ (there is a discrepancy between the LiO_2 term of this formula and the above-mentioned composition of Li_2CO_3); specimen made up of eleven rings of 0.524 cm O.D., 2.74 cm I.D., and 0.5 in. thick each, stacked to form a cylinder 5.5 in. high but measured only over the centrally-placed rings; 7% binder (500 g carbowax, 10 g methocel and 1000 cc water) added; hydraulically pressed at 4400 psi; set on aluminum and fired at a rate of 120 C per hr and held at a peak of 1345 C for 5 hrs; specific gravity 2.13; apparent porosity 10.0% and shrinkage 7.2%.</p>

DATA TABLE NO. 283 THERMAL CONDUCTIVITY OF SPODUMENE

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
CURVE 1*	
398.2	0.0108
511.2	0.0113
623.2	0.0120
708.2	0.0119
783.2	0.0130
856.2	0.0134
923.2	0.0138
978.2	0.0138
1028.2	0.0138
1078.2	0.0140
1133.2	0.0141

* No graphical presentation

THERMAL CONDUCTIVITY OF STEATITE

FIGURE SHOWS ONLY 6 OF THE CURVES REPORTED IN TABLE

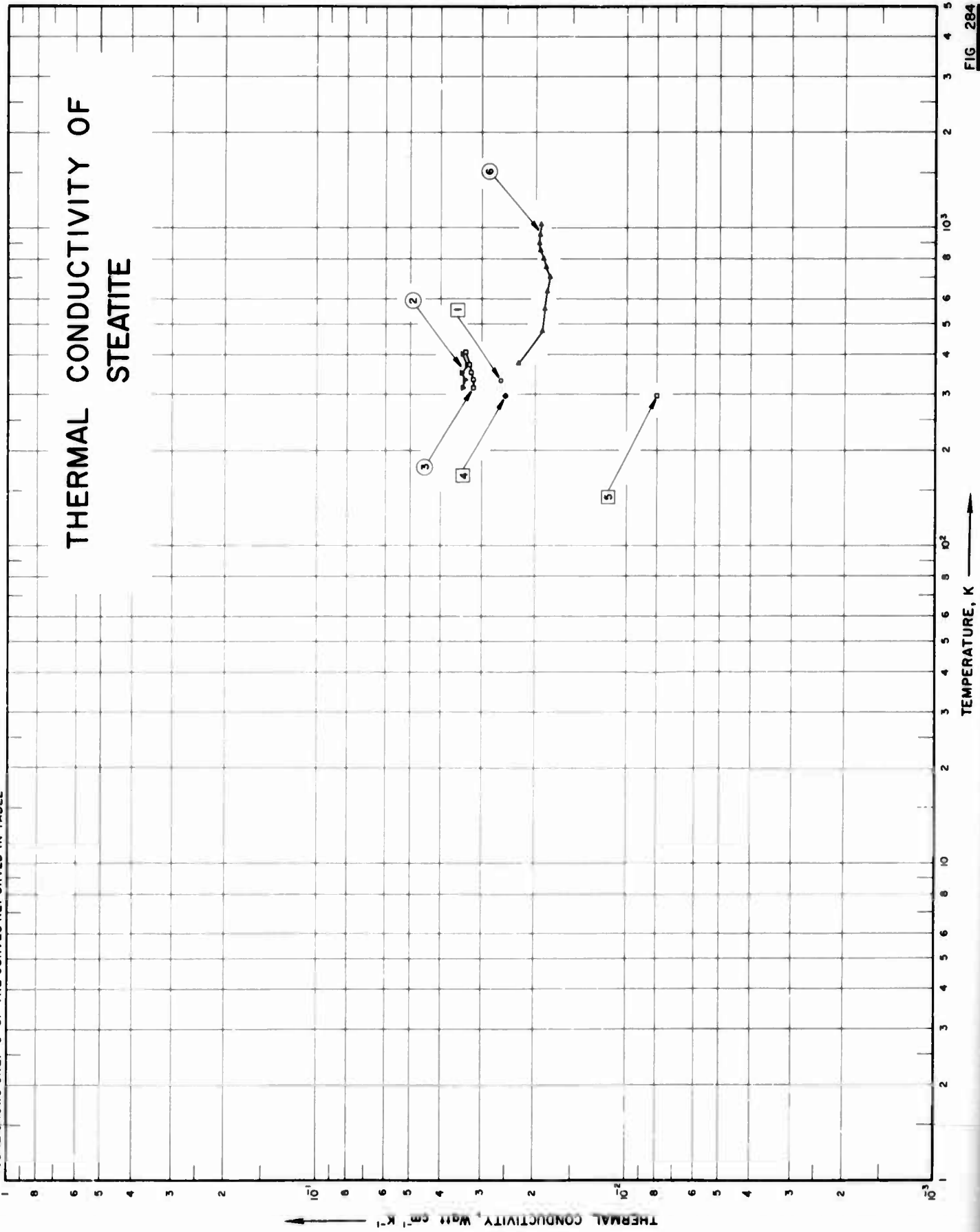


FIG. 284

SPECIFICATION TABLE NO. 284 THERMAL CONDUCTIVITY OF STEATITE

[For Data Reported in Figure and Table No. 284]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3		1953	333.2			Maximum water absorption 0.05%; flexural strength 15,000 psi; coefficient of expansion (25-700 C) 8.3×10^{-4} .
2	68		1954	317-404	± 3.0	10B2	
3	68	C	1954	316-409	± 3.0	12C2	Commercial steatite.
4	152	L	1956	298.2		Steatite 228	Specimen in form of wafers 0.75 in. in dia and 29 mils thick.
5	152	L	1956	298.2		Steatite 228	The above specimen exposed with 7×10^{19} epithermal neutrons per cm^2 for 480 Mwd in the MTR.
6	282	R	1955	378-1030			82.0 mancharian talc, 8.0 Main feldspar, and 10.0 Tennessee ball clay; specimen made up of eleven rings 5.31 cm O.D., 2.79 cm I.D. and 0.5 in. thick each, stacked to form a cylinder 5.5 in. high, but measured only over the centrally-placed rings; milled in distilled water for five hrs; 10% binder (500 g carbowax, 10 g methocel, and 1000 cc water) added; fired on pottery flint to 1350 C at a rate of 60 C per hr; sp gr 2.56; mod. rupture 8,890 psi; apparent porosity 0.2%; shrinkage 8.4%; coefficient of expansion (25-1000 C) 82.0×10^{-4} .
7	108	L	1920	368.2		Soapstone	Specimen 9 in. in dia and 0.715 in. thick; specific gravity 2.87.

DATA TABLE NO. 284 THERMAL CONDUCTIVITY OF STEATITE
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
333.2	0.0260
<u>CURVE 2</u>	
316.8	0.0342
335.0	0.0338
353.8	0.0346
372.8	0.0333
404.1	0.0344
<u>CURVE 3</u>	
316.3	0.0319
335.6	0.0320
352.8	0.0325
374.4	0.0327
408.6	0.0337
<u>CURVE 4</u>	
298.2	0.0251
<u>CURVE 5</u>	
298.2	0.00795
<u>CURVE 6</u>	
376.2	0.0228
478.2	0.0189
560.2	0.0186
635.2	0.0181
701.2	0.0178
758.2	0.0184
805.2	0.0187
853.2	0.0191
898.2	0.0194
958.2	0.0192
1030.2	0.0191
<u>CURVE 7*</u>	
363.2	0.0335

* Not shown on plot

SPECIFICATION TABLE NO. 285 THERMAL CONDUCTIVITY OF TOURMALINE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	34	C	1943	398-723		Brazil		Green; specimen 1 x 1 x 1 cm; cut from a single crystal with its c- (principle) axis normal to the two opposite surfaces and parallel to other surfaces; heat flow parallel to c-axis; 18-8 stainless steel used as comparative material.
2	34	C	1943	398-729		Brazil		The above specimen measured with heat flow perpendicular to c-axis; 18-8 stainless steel used as comparative material.

DATA TABLE NO. 285 THERMAL CONDUCTIVITY OF TOURMALINE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

398.2 0.0291
 540.2 0.0320
 613.2 0.0322
 723.2 0.0351

CURVE 2*

393.2 0.0296
 492.2 0.0346
 591.2 0.0383
 729.2 0.0417

* No graphical presentation

THERMAL CONDUCTIVITY OF TUFF

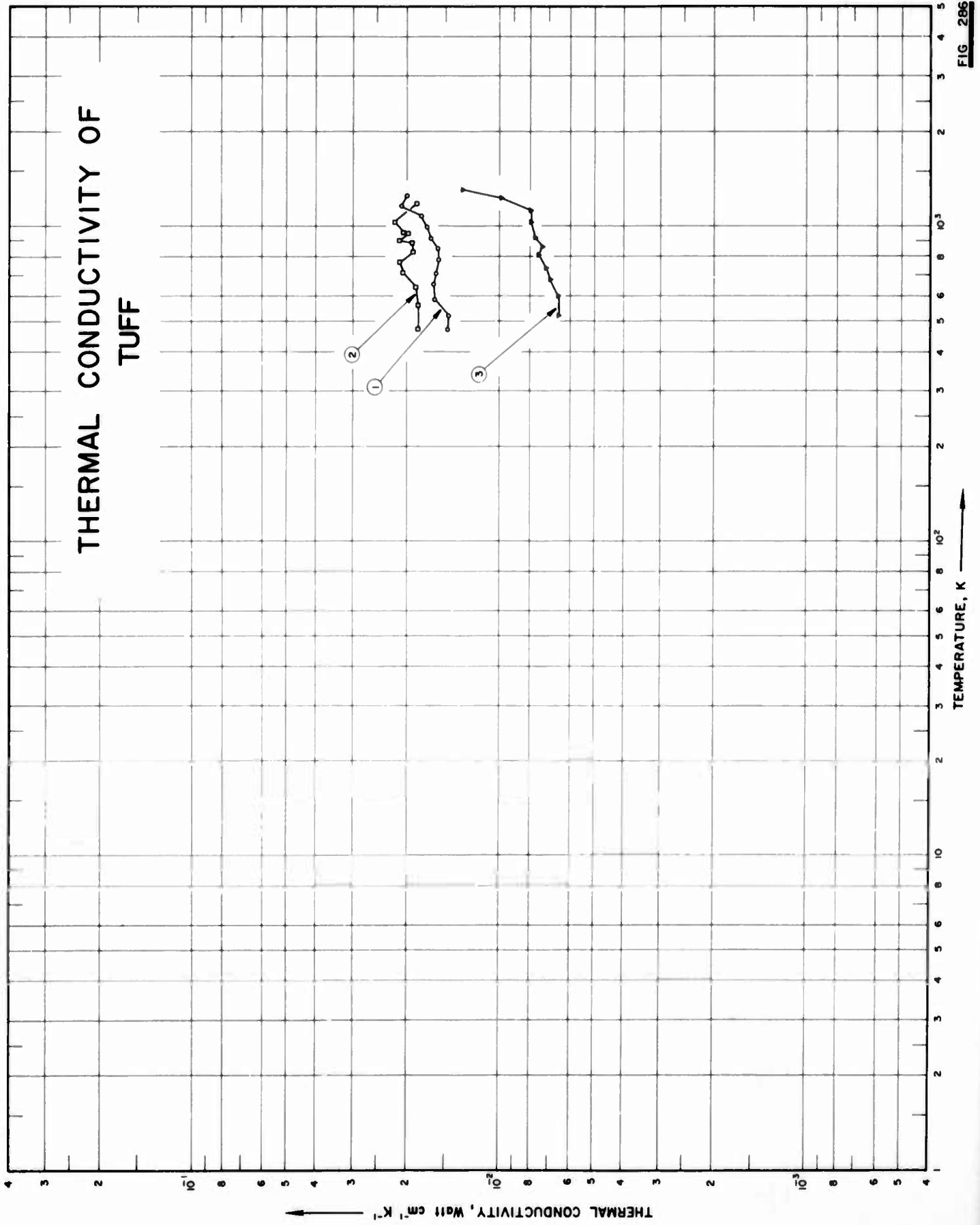


FIG. 285

SPECIFICATION TABLE NO. 286 THERMAL CONDUCTIVITY OF TUFF

[For Data Reported in Figure and Table No. 286]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	578	R	1963	471-1253	+9	TOS-4	(Composition in vol percent) 72 matrix (clay, chalcidony, zeolite, etc.), 14 chalcidony segregations, 5 quartz phenocrysts, 6 feldspar phenocrysts; moderately grained appearance; specimen 3.5 in. O. D., 0.875 in. I. D. and 18 in long; obtained from U12607 at a drill depth of 75-78 ft; density 2.24 g cm ⁻³ (dry); specimen fairly representative of most of the coherent NTS Tuffs (TOS-1 to 5, and basal part of 7). Similar to the above specimen.
2	578	R	1963	471-1173	+9	TOS-4	(Composition in vol percent) 86 glassy matrix, 12 quartz phenocrysts, 1 feldspar phenocrysts, 1 rock fragments; grainy friable in appearance; specimen 3.5 in. O. D., 0.875 in. I. D. and 18 in. long; extraction location unknown; sintered above 1173 K; density 1.27 g cm ⁻³ ; specimen representative of friable materials.
3	578	R	1963	523-1307	+9	TOS-7	

DATA TABLE NO. 286 THERMAL CONDUCTIVITY OF TUFF
 [Temperature, T. K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
471	0.0147
523	0.0146
588	0.0163
658	0.0164
711	0.0161
785	0.0158
850	0.0159
918	0.0167
998	0.0172
1083	0.0180
1165	0.0207
1253	0.0199
<u>CURVE 2</u>	
471	0.0184
563	0.0184
643	0.0187
715	0.0205
771	0.0210
831	0.0191
893	0.0192
903	0.0210
951	0.0198
959	0.0204
1033	0.0217
1173	0.0186
<u>CURVE 3</u>	
523	0.00653
601	0.00653
680	0.00690
744	0.00711
813	0.00749
863	0.00728
923	0.00766
1031	0.00791
1134	0.00791
1240	0.00983
1307	0.0132

SPECIFICATION TABLE NO. 287 THERMAL CONDUCTIVITY OF WOLLASTONITE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3		1953	333.2			Max water absorption 0.05%; flexural strength 22,000 psi; coefficient of expansion 5.9×10^{-6} at 25-700 C.
2	23		1952	317-397		W-34	60 wollastonite, 30 Kentucky Old Mine No. 4 ball clay, 5 barium carbonate, 5 litharge.

DATA TABLE NO. 287 THERMAL CONDUCTIVITY OF WOLLASTONITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

333.2 0.0260

CURVE 2*

317.2 0.0271
 334.2 0.0268
 354.7 0.0272
 373.2 0.0259
 397.2 0.0262

* No graphical presentation

SPECIFICATION TABLE NO. 288 THERMAL CONDUCTIVITY OF CEMENT

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	328.2	1		Portland burnt cement; thickness = 0.42 cm; pressure = 21 lb in. ⁻² .
2	580	L	1955	307.3		Portland cement	100% under binding; dry density 2.010 g cm ⁻³ .
3	580	L	1955	311.5		Slag-Portland cement	Dry density 1.730 g cm ⁻³ .
4	580	L	1955	311.0		Slag cement	12-15% under binding; dry density 1.760 g cm ⁻³ .

DATA TABLE NO. 288 THERMAL CONDUCTIVITY OF CEMENT

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

328.2 0.0126

CURVE 2*

307.3 0.00675

CURVE 3*

311.5 0.00530

CURVE 4*

311.0 0.00416

* No graphical presentation

FIGURE SHOWS ONLY 62 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF CONCRETES

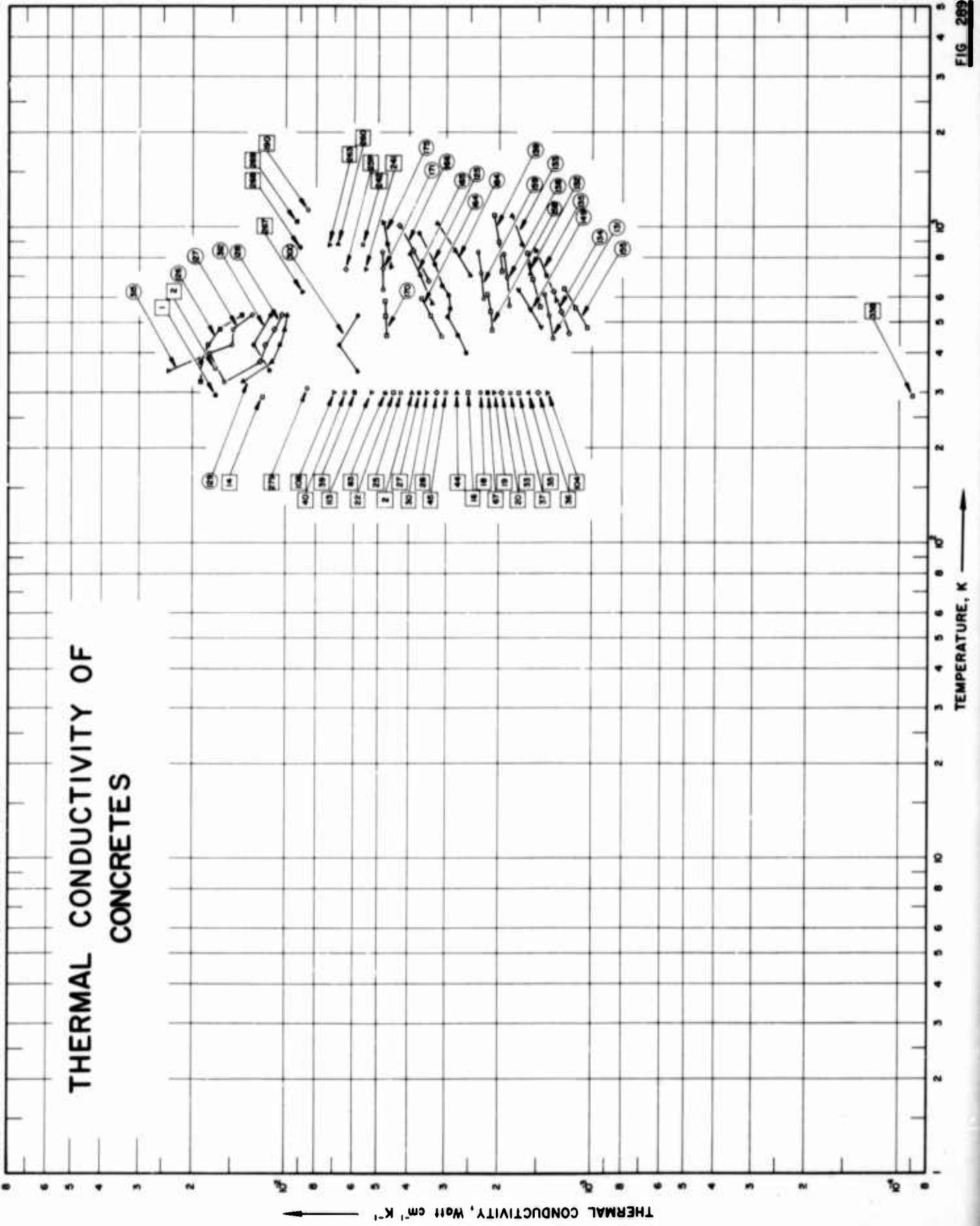


FIG. 269

SPECIFICATION TABLE NO. 289 THERMAL CONDUCTIVITY OF CONCRETES

[For Data Reported in Figure and Table No. 289]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	88	L	1926	292.8	1.0	Bitumin concrete	Bitumin used as conglomerant; density 2.25 g cm ⁻³ .
2	88	L	1926	356.1	1.0	Bitumin concrete	Similar to the above specimen.
3	88	L	1926	356.2	1.0	Bitumin concrete	Similar to the above specimen.
4	88	L	1926	292.8	1.0	Bitumin concrete	Similar to the above specimen.
5	88	L	1926	376.5	1.0	Bitumin concrete	Similar to the above specimen.
6	88	L	1926	376.6	1.0	Bitumin concrete	Similar to the above specimen.
7	88	L	1926	292.8	1.0	Paraffin concrete	Paraffin used as conglomerant; density 2.25 g cm ⁻³ .
8	88	L	1926	292.9	1.0	Paraffin concrete	Similar to the above specimen.
9	88	L	1926	292.7	1.0	Paraffin concrete	Similar to the above specimen.
10	88	L	1926	293.3	1.0	Paraffin concrete	Similar to the above specimen.
11	88	L	1926	293.0	1.0	Paraffin concrete	Similar to the above specimen.
12	88	L	1926	293.6	1.0	Paraffin concrete	Similar to the above specimen.
13	545	P	1947	287.3		Blended bituminous concrete aggregate; 3G-1	Prepared from locally processed aggregates of sand and partially crushed gravel obtained from bins at plant; specimen contained in brass hollow cylinder of 5.36 in. I.D. and 10.68 in. long; materials compacted by placing into the cylinder in 5 approx equal layers, applying increasing number of blows on each layer; density 2.14 g cm ⁻³ ; water content zero; thermal conductivity values calculated from measured transient surface temp change and specific heat data.
14	545	P	1947	287.3		Asphaltic bituminous concrete; 3F-1	Prepared from the blended bituminous concrete aggregate and 4.5% bitumin; same dimensions, compacting procedure, and measuring method as the above specimen; density 2.40 g cm ⁻³ .
15	545	P	1947	287.3		Asphaltic bituminous concrete; 3F-2	Similar to the above specimen.
16	552	L	1960	298.2		Metallurgical pumice concrete	20 x 20 x 4 cm; mixed by hand, filled into prescribed form and tamped, prestored for 24 hrs, submitted to heat treatment for about 2 hrs at 60 C and for 4 hrs at 85 C; grain size 0-7 mm; density 1.23 g cm ⁻³ .
17	552	L	1960	298.2		Metallurgical pumice concrete	Similar to the above specimen except density 1.17 g cm ⁻³ .
18	552	L	1960	298.2		Metallurgical pumice concrete	Similar to the above specimen except density 1.13 g cm ⁻³ .
19	552	L	1960	298.2		Metallurgical pumice concrete	Similar to the above specimen.

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
20	552	L	1960	298.2		Metallurgical pumice concrete	Similar to the above specimen except density 1.08 g cm ⁻³ .
21	552	L	1960	298.2		Direct process slag concrete	Same dimensions and fabrication method as the above specimen; grain size 0-7 mm; density 1.57 g cm ⁻³ .
22	552	L	1960	298.2		Direct process slag concrete	Similar to the above specimen.
23	552	L	1960	298.2		Direct process slag concrete	Similar to the above specimen except density 1.52 g cm ⁻³ .
24	552	L	1960	298.2		Direct process slag concrete	Similar to the above specimen.
25	552	L	1960	298.2		Direct process slag concrete	Similar to the above specimen except density 1.51 g cm ⁻³ .
26	552	L	1960	298.2		Direct process slag concrete	Similar to the above specimen except density 1.48 g cm ⁻³ .
27	552	L	1960	298.2		Leuna slag concrete	Same dimensions and fabrication method as the above specimen; density 1.50 g cm ⁻³ ; grain size 0-15 mm.
28	552	L	1960	298.2		Leuna slag concrete	Similar to the above specimen except density 1.73 g cm ⁻³ .
29	552	L	1960	298.2		Leuna slag concrete	Similar to the above specimen except density 1.69 g cm ⁻³ .
30	552	L	1960	298.2		Leuna slag concrete	Similar to the above specimen except density 1.71 g cm ⁻³ .
31	552	L	1960	298.2		Leuna slag concrete	Similar to the above specimen except density 1.63 g cm ⁻³ .
32	552	L	1960	298.2		Leuna slag concrete	Similar to the above specimen except density 1.61 g cm ⁻³ .
33	552	L	1960	298.2		Slag concrete	Same dimensions and fabrication method as the above specimen; density 0.87 g cm ⁻³ ; grain size 0-15 mm.
34	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 0.85 g cm ⁻³ .
35	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 0.86 g cm ⁻³ .
36	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 0.83 g cm ⁻³ .
37	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 0.81 g cm ⁻³ .
38	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 0.80 g cm ⁻³ .
39	552	L	1960	298.2		Limestone gravel concrete	Same dimensions and fabrication method as the above specimen; density 1.89 g cm ⁻³ ; grain size 0-15 mm.
40	552	L	1960	298.2		Limestone gravel concrete	Similar to the above specimen except density 1.87 g cm ⁻³ .

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
41	552	L	1960	298.2		Limestone gravel concrete	Similar to the above specimen.
42	552	L	1960	298.2		Limestone gravel concrete	Similar to the above specimen except density 1.82 g cm ⁻³ .
43	552	L	1960	298.2		Limestone gravel concrete	Similar to the above specimen except density 1.81 g cm ⁻³ .
44	552	L	1960	298.2		K 1	100% blast furnace slag; cement content in concrete 280 K gm ⁻³ ; 20 x 20 x 4 cm; mixed by hand, filled in prescribed forms and tamped, prestored for 24 hrs, submitted to a heat treatment for about 2 hrs at 60 C and 4 hrs at 85 C; grain size 0-7 mm; density (dry) 1.66 g cm ⁻³ .
45	552	L	1960	298.2		K 2	80% blast furnace slag (grain size 0-7 mm) and 20% metallurgical pumice (grain size 3-15 mm); cement content in concrete 283 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.57 g cm ⁻³ .
46	552	L	1960	298.2		K 4	60% blast furnace slag (grain size 0-7 mm) and 40% metallurgical pumice (grain size 3-15 mm); cement content in concrete 264 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.61 g cm ⁻³ .
47	552	L	1960	298.2		K 6	40% blast furnace slag (grain size 0-7 mm) and 60% metallurgical pumice (grain size 3-15 mm); cement content in concrete 272 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.46 g cm ⁻³ .
48	552	L	1960	298.2		K 3	80% blast furnace slag (grain size 0-7 mm) and 20% hirschfelder slag (grain size 0-15 mm); cement content in concrete 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.46 g cm ⁻³ .
49	552	L	1960	298.2		K 5	60% blast furnace slag (grain size 0-7 mm) and 40% hirschfelder slag (grain size 0-15 mm); cement content in concrete 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.37 g cm ⁻³ .
50	552	L	1960	298.2		K 7	40% blast furnace slag (grain size 0-7 mm) and 60% hirschfelder slag (grain size 0-15 mm); cement content in concrete 273 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.25 g cm ⁻³ .
51	552	L	1960	298.2		K 22	40% blast furnace slag and 60% Calbe blast furnace slag (grain size 0-7 mm); cement content in concrete 275 K gm ⁻³ ; compression strength 42.7 K cm ⁻² ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.69 g cm ⁻³ .
52	552	L	1960	298.2		K 28	40% blast furnace slag (grain size 0-7 mm) and 60% Lenna coal slag (grain size 0-15 mm); cement content in concrete 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.72 g cm ⁻³ .
53	552	L	1960	298.2		K 17	100% Calbe blast furnace slag; grain size 0-7 mm; cement content in concrete 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.73 g cm ⁻³ .

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
54	552	L	1960	298.2		K 18	50% Calbe blast furnace slag (grain size 0~7 mm) and 20% metallurgical pumice (grain size 3~15 mm); cement content in concrete 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.68 g cm ⁻³ .
55	552	L	1960	298.2		K 20	60% Calbe blast furnace slag (grain size 0~7 mm) and 40% metallurgical pumice (grain size 3~15 mm); cement content in concrete 275 K gm ⁻³ ; compression strength 61.5 K cm ⁻² ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.60 g cm ⁻³ .
56	552	L	1960	298.2		K 19	80% Calbe blast furnace slag (grain size 0~7 mm) and 20% hirschfelder slag (grain size 0~15 mm); cement content in concrete 283 K gm ⁻³ ; compression strength 41.1 Kp cm ⁻² ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.53 g cm ⁻³ .
57	552	L	1960	298.2		K 21	60% Calbe blast furnace slag (grain size 0~7 mm) and 40% hirschfelder slag (grain size 0~15 mm); cement content in concrete 275 K gm ⁻³ ; compression strength 37.1 Kp cm ⁻² ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.33 g cm ⁻³ .
58	552	L	1960	298.2		K 46	80% Stalinstadt blast furnace slag (grain size 0~7 mm) and 20% sand (grain size 0~7 mm); cement content in concrete not measured; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.79 g cm ⁻³ .
59	552	L	1960	298.2		K 34	100% Stalinstadt dump slag; cement content in concrete 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; grain size 0~15 mm; density (dry) 1.22 g cm ⁻³ .
60	552	L	1960	298.2		K 38	80% Stalinstadt dump slag (grain size 0~15 mm) and 20% metallurgical pumice (grain size 3~15 mm); cement content in concrete 277 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.24 g cm ⁻³ .
61	552	L	1960	298.2		K 39	60% Stalinstadt dump slag (grain size 0~15 mm) and 40% metallurgical pumice (grain size 0~15 mm); cement content in concrete 277 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.25 g cm ⁻³ .
62	552	L	1960	298.2		K 40	40% Stalinstadt dump slag (grain size 0~15 mm) and 60% metallurgical pumice (grain size 3~15 mm); cement content in concrete 286 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.38 g cm ⁻³ .
63	552	L	1960	298.2		K 41	80% Stalinstadt dump slag (grain size 0~15 mm) and 20% Unterwellenborn direct process slag (grain size 0~7 mm); cement content in concrete 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.25 g cm ⁻³ .
64	552	L	1960	298.2		K 42	60% Stalinstadt dump slag (grain size 0~15 mm) and 40% Unterwellenborn direct process slag (grain size 0~7 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.35 g cm ⁻³ .
65	552	L	1960	298.2		K 43	40% Stalinstadt dump slag (grain size 0~15 mm) and 60% Unterwellenborn direct process slag (grain size 0~7 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.42 g cm ⁻³ .

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
66	552	L	1960	298.2		K 35	80% Stalinstadt dump slag (grain size 0-15 mm) and 20% blast furnace slag (gray) (grain size 0-7 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.30 g cm ⁻³ .
67	552	L	1960	298.2		K 36	60% Stalinstadt dump slag (grain size 0-15 mm) and 40% blast furnace slag (gray) (grain size 0-7 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.45 g cm ⁻³ .
68	552	L	1960	298.2		K 37	40% Stalinstadt dump slag (grain size 0-15 mm) and 60% blast furnace slag (gray) (grain size 0-7 mm); cement content 274 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.47 g cm ⁻³ .
69	552	L	1960	298.2		K 44	60% Stalinstadt dump slag (grain size 0-15 mm) and 40% limestone gravel (grain size 0-7 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.36 g cm ⁻³ .
70	552	L	1960	298.2		K 45	40% Stalinstadt dump slag (grain size 0-7 mm); cement content 280 K gm ⁻³ ; compression strength 30.0 Kp cm ⁻² ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.43 g cm ⁻³ .
71	552	L	1960	298.2		K 10	100% Stalinstadt metallurgical pumice (grain size 0-7 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.23 g cm ⁻³ .
72	552	L	1960	298.2		K 8	80% Stalinstadt metallurgical pumice (grain size 0-7 mm) and 20% sand (grain size 0-3 mm); cement content 273 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.35 g cm ⁻³ .
73	552	L	1960	298.2		K 12	100% Unterwellenborn direct process slag (grain size 0-7 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.56 g cm ⁻³ .
74	552	L	1960	298.2		K 13	80% Unterwellenborn direct process slag (grain size 0-7 mm) and 20% metallurgical pumice (grain size 0-15 mm); cement content 275 K gm ⁻³ ; compression strength 66.8 Kp cm ⁻² ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.49 g cm ⁻³ .
75	552	L	1960	298.2		K 15	60% Unterwellenborn direct process slag (grain size 0-7 mm) and 40% metallurgical pumice (grain size 0-15 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.48 g cm ⁻³ .
76	552	L	1960	298.2		K 14	80% Unterwellenborn direct process slag (grain size 0-7 mm) and 20% hirschefelder slag (grain size 0-15 mm); cement content 27 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.42 g cm ⁻³ .
77	552	L	1960	298.2		K 16	60% Unterwellenborn direct process slag (grain size 0-7 mm) and 40% hirschefelder slag (grain size 0-15 mm); cement content 272 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.27 g cm ⁻³ .
78	552	L	1960	298.2		K 23	100% Leuna coal slag (grain size 0-15 mm) cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.74 g cm ⁻³ .

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
79	552	L	1960	298.2		K 24	80% Leuna coal slag (grain size 0-15 mm) and 20% metallurgical pumice (grain size 3-15 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.64 g cm ⁻³ .
80	552	L	1960	298.2		K 27	60% Leuna coal slag (grain size 0-15 mm) and 40% metallurgical pumice (grain size 3-15 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.63 g cm ⁻³ .
81	552	L	1960	298.2		K 25	80% Leuna coal slag (grain size 0-15 mm) and 20% hirschfelder slag (grain size 0-7 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density 1.51 g cm ⁻³ .
82	552	L	1960	298.2		K 26	60% Leuna coal slag (grain size 0-15 mm) and 40% hirschfelder slag (grain size 0-7 mm); cement content 272 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.33 g cm ⁻³ .
83	552	L	1960	298.2		K 29	100% Limestone gravel; grain size 0-15 mm; cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.63 g cm ⁻³ .
84	552	L	1960	298.2		K 30	80% Limestone gravel (grain size 0-15 mm) and 20% metallurgical pumice (grain size 3-15 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.58 g cm ⁻³ .
85	552	L	1960	298.2		K 31	60% Limestone gravel (grain size 0-15 mm) and 40% metallurgical pumice (grain size 3-15 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.40 g cm ⁻³ .
86	552	L	1960	298.2		K 32	80% Limestone gravel (grain size 0-15 mm) and 20% hirschfelder slag (grain size 0-15 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.47 g cm ⁻³ .
87	552	L	1960	298.2		K 33	60% Limestone gravel (grain size 0-15 mm) and 40% hirschfelder slag (grain size 0-15 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.27 g cm ⁻³ .
88	552	L	1960	298.2		K 11	100% hirschfelder slag [from coal (liquid) slag]; grain size 0-15 mm; cement content 277 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.90 g cm ⁻³ .
89	552	L	1960	298.2		K 9	80% hirschfelder slag [from coal (liquid) slag] (grain size 0-15 mm) and 20% sand (grain size 0-3 mm); cement content 275 K gm ⁻³ ; size 20 x 20 x 4 cm; same treatment as the above specimen; density (dry) 1.13 g cm ⁻³ .
90	553	L	1937	297.1		Sand and gravel aggregate; 1	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 2.00, and coarse aggregate No. 4 to 0.5 in. 2.75; 24 x 24 x 2 in.; density 2.406 g cm ⁻³ .

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
91	553	L	1937	297.1		Sand and gravel aggregate; 2	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 2.75, coarse aggregate No. 4 to 0.5 in. 4.50; 24 x 24 x 2 in.; density 2.404 g cm ⁻³ .
92	553	L	1937	297.1		Sand and gravel aggregate; 3	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 3.50, and coarse aggregate No. 4 to 0.5 in. 5.50; 24 x 24 x 2 in.; density 2.372 g cm ⁻³ .
93	553	L	1937	297.1		Sand and gravel aggregate; 4	Similar to specimen 1 but with density 2.374 g cm ⁻³ and slump inches 5.
94	553	L	1937	297.1		Sand and gravel aggregate; 4	2nd run of the above specimen.
95	553	L	1937	297.1		Sand and gravel aggregate; 5	Similar to specimen 2 but with density 2.345 g cm ⁻³ and slump inches 5.
96	553	L	1937	297.1		Sand and gravel aggregate; 5	2nd run of the above specimen.
97	553	L	1937	297.1		Sand and gravel aggregate; 6	Similar to specimen 3 but with density 2.318 g cm ⁻³ and slump inches 5.
98	553	L	1937	297.1		Sand and gravel aggregate; 6	2nd run of the above specimen.
99	553	L	1937	297.1		Limestone aggregate; 1	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 2.00, and coarse aggregate No. 4 to 0.5 in. 2.75; 24 x 24 x 2 in.; density 2.259 g cm ⁻³ .
100	553	L	1937	297.1		Limestone aggregate; 2	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 2.75, and coarse aggregate No. 4 to 0.5 in. 4.50; 24 x 24 x 2 in.; density 2.295 g cm ⁻³ .
101	553	L	1937	297.1		Limestone aggregate; 3	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 3.50, and coarse aggregate No. 4 to 0.5 in. 5.50; 24 x 24 x 2 in.; density 2.270 g cm ⁻³ .
102	553	L	1937	297.1		Limestone aggregate; 4	Similar to the specimen 1 but with density 2.183 g cm ⁻³ and slump inches = 3.
103	553	L	1937	297.1		Limestone aggregate; 5	Similar to the specimen 2 but with density 2.124 g cm ⁻³ and slump inches = 3.
104	553	L	1937	297.1		Limestone aggregate; 6	Similar to the specimen 3 but with density 2.135 g cm ⁻³ and slump inches = 3.
105	553	L	1937	297.1		Cinders aggregate; 1	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 2.00, and coarse aggregate No. 4 to 0.5 in. 2.75; 24 x 24 x 2 in.; density 1.762 g cm ⁻³ .
106	553	L	1937	297.1		Cinders aggregate; 2	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 2.75, and coarse aggregate No. 4 to 0.5 in. 4.50; 24 x 24 x 2 in.; density 1.664 g cm ⁻³ .
107	553	L	1937	297.1		Cinders aggregate; 3	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 3.50, and coarse aggregate No. 4 to 0.5 in. 5.50; 24 x 24 x 2 in.; density 1.554 g cm ⁻³ .

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
108	553	L	1937	297.1		Cinders aggregate; 4	Similar to the specimen 1 but with slump inches = 3.
109	553	L	1937	297.1		Cinders aggregate; 5	Similar to the specimen 2 but with density 1.632 g cm ⁻³ and slump inches = 3.
110	553	L	1937	297.1		Cinders aggregate; 6	Similar to the specimen 3 but with density 1.626 g cm ⁻³ and slump inches = 3.
111	553	L	1937	297.1		Haydite aggregate; 1	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 2.00, and coarse aggregate No. 4 to 0.5 in. 2.75; 24 x 24 x 2 in.; density 1.405 g cm ⁻³ .
112	553	L	1937	297.1		Haydite aggregate; 2	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 2.75, and coarse aggregate No. 4 to 0.5 in. 4.50; 24 x 24 x 2 in.; density 1.301 g cm ⁻³ .
113	553	L	1937	297.1		Haydite aggregate; 3	Mix proportions (by volume): cement 1, fine aggregate 0 to No. 4 3.50, and coarse aggregate No. 4 to 0.5 in. 5.50; 24 x 24 x 2 in.; density 1.198 g cm ⁻³ .
114	553	L	1937	297.1		Haydite aggregate; 4	Similar to specimen 1 but with density 1.424 g cm ⁻³ and slump inches = 4.
115	553	L	1937	297.1		Haydite aggregate; 5	Similar to specimen 2 but with density 1.293 g cm ⁻³ and slump inches = 4.
116	553	L	1937	297.1		Haydite aggregate; 5	2nd run of above specimen.
117	553	L	1937	297.1		Haydite aggregate; 6	Similar to specimen 3 but with density 1.286 g cm ⁻³ and slump inches = 4.
118	553	L	1937	297.1		Haydite aggregate; 7	Mix proportions (by volume): cement 1 and fine aggregate 0 to No. 4 8.50; 24 x 24 x 2 in.; density 1.129 g cm ⁻³ .
119	553	L	1937	297.1		Haydite aggregate; 7	2nd run of above specimen.
120	553	L	1937	297.1		Expanded burned clay aggregate	Mix proportions (by volume): cement 1 and fine aggregate 0 to No. 4 8.00; 24 x 24 x 2 in.; density 0.960 g cm ⁻³ .
121	553	L	1937	297.1		Treated limestone slag aggregate	Mix proportions (by volume): cement 1 and fine aggregate 0 to No. 4 7.00; 24 x 24 x 2 in.; density 1.241 g cm ⁻³ .
122	553	L	1937	297.1			By-product of manufacturing phosphate used as aggregate; mix proportions (by volume): cement 1 and fine aggregate 0 to No. 4 8.00; 24 x 24 x 2 in.; density 1.426 g cm ⁻³ .
123	553	L	1937	297.1			Similar to the above specimen but with density 1.496 g cm ⁻³ .
124	553	L	1937	297.1			Similar to the above specimen but with density 1.108 g cm ⁻³ and pumice as the aggregate.
125	186	L	1928	395-946		Sil-o-cel C-3 concrete	Cured in moist air for 28 days, oven dried at 394 K and fired slowly to 700 K; density 0.923 g cm ⁻³ ; porosity 65.2%.

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
126	583	R	1953	324-525		Barytes concrete	45.15 sweetwater barytes (1 in.), 39.23 sweetwater barytes (3/8 in.), 9.37 Portland cement (type I or II) and 6.25 water; density (25 C) 3.5 g cm ⁻³ .
127	583	R	1953	324-525		Barytes concrete	5.7% water; density (25 C) 3.5 g cm ⁻³ .
128	583	R	1953	324-525		Barytes concrete	1.4% water; density (25 C) 3.5 g cm ⁻³ .
129	583	R	1953	324-525		Barytes concrete	9.75% water; density (25 C) 3.5 g cm ⁻³ .
130	583	R	1953	366.2		Portland cement concrete	Density (25 C) 2.3 g cm ⁻³ .
131	582		1953	443-607		Lummitte cement concrete	1 lummitte to 4 vermiculite by dry loose volume; 13.5 x 9.0 x 2.5 in.; prefired at 1366 K on one side for 24 hrs; fired density 0.614 g cm ⁻³ ; measured at 755 K furnace temp.
132	582		1953	556-824		Lummitte cement concrete	The above specimen measured at 1033 K furnace temp.
133	582		1953	707-1088		Lummitte cement concrete	The above specimen measured at 1366 K furnace temp.
134	582		1953	456-624		Lummitte cement concrete	Same composition and dimensions as the above specimen; fired at 1366 K on all sides for 24 hrs; fired density 0.629 g cm ⁻³ ; measured at 755 K furnace temp.
135	582		1953	583-844		Lummitte cement concrete	The above specimen measured at 1033 K furnace temp.
136	582		1953	750-1121		Lummitte cement concrete	The above specimen measured at 1366 K furnace temp.
137	582		1953	447-602		Commercial castable	13.5 x 9.0 x 2.5 in.; prefired at 1255 K on one side for 24 hrs; fired density 1.016 g cm ⁻³ ; measured at 755 K furnace temp.
138	582		1953	563-818		Commercial castable	The above specimen measured at 1033 K furnace temp.
139	582		1953	719-1082		Commercial castable	The above specimen measured at 1366 K furnace temp.
140	582		1953	461-612		Commercial castable	Same dimensions as the above specimen; prefired at 1255 K on all sides for 24 hrs; fired density 1.016 g cm ⁻³ ; measured at 755 K furnace temp.
141	582		1953	586-832		Commercial castable	The above specimen measured at 1033 K furnace temp.
142	582		1953	743-1100		Commercial castable	The above specimen measured at 1366 K furnace temp.
143	582		1953	463-615		Commercial castable	1 lummitte to 4 vermiculite by dry loose volume; 9.0 x 4.5 x 2.5 in.; cast on end in steel mold so as to obtain smooth faces, cured for 24 hrs in the molds in a moist cabinet or in laboratory air, dried for 18 to 24 hrs at 378 K after removing molds, then prefired for 24 to 72 hrs at 1144 to 1366 K on all sides; dried density 0.708 g cm ⁻³ ; measured at 755 K furnace temp.
144	582		1953	591-835		Commercial castable	The above specimen measured at 1033 K furnace temp.
145	582		1953	743-1099		Commercial castable	The above specimen measured at 1366 K furnace temp.
146	582		1953	454-627		Commercial castable	1 lummitte to 6 vermiculite by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 0.586 g cm ⁻³ and fired density 0.517 g cm ⁻³ ; measured at 755 K furnace temp.
147	582		1953	568-848		Commercial castable	The above specimen measured at 1033 K furnace temp.

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
148	582		1953	711-1094			The above specimen measured at 1366 K furnace temp.
149	582		1953	480-626			1 luminite to 4 perlite by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 0.726 g cm ⁻³ and fired density 0.673 g cm ⁻³ ; measured at 755 K furnace temp.
150	582		1953	616-851			The above specimen measured at 1633 K furnace temp.
151	582		1953	728-1035			The above specimen measured at 1255 K furnace temp.
152	582		1953	464-624			1 luminite to 6 perlite by dry loose volume; same preparation procedures and dimensions as the above specimen; fired density 0.583 g cm ⁻³ ; measured at 755 K furnace temp.
153	582		1953	590-846			The above specimen measured at 1633 K furnace temp.
154	582		1953	691-1027			The above specimen measured at 1255 K furnace temp.
155	582		1953	478-636			1 luminite to 8 perlite by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 0.394 g cm ⁻³ and fired density 0.372 g cm ⁻³ ; measured at 755 K furnace temp.
156	582		1953	615-866			The above specimen measured at 1633 K furnace temp.
157	582		1953	730-1057			The above specimen measured at 1255 K furnace temp.
158	582		1953	467-608			1 luminite to 4 calcined diatomaceous earth by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 0.916 g cm ⁻³ and fired density 0.847 g cm ⁻³ ; measured at 755 K furnace temp.
159	582		1953	594-827			The above specimen measured at 1633 K furnace temp.
160	582		1953	699-1006			The above specimen measured at 1255 K furnace temp.
161	582		1953	455-610			1 luminite to 6 calcined diatomaceous earth by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 0.795 g cm ⁻³ and fired density 0.753 g cm ⁻³ ; measured at 755 K furnace temp.
162	582		1953	572-828			The above specimen measured at 1633 K furnace temp.
163	582		1953	680-1016			The above specimen measured at 1255 K furnace temp.
164	582		1953	447-595			1 luminite to 4 pumice by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 1.245 g cm ⁻³ and fired density 1.141 g cm ⁻³ ; measured at 755 K furnace temp.
165	582		1953	575-819			The above specimen measured at 1633 K furnace temp.
166	582		1953	673-1002			The above specimen measured at 1255 K furnace temp.
167	582		1953	419-588			1 luminite to 6 pumice by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 1.147 g cm ⁻³ and fired density 1.105 g cm ⁻³ ; measured at 755 K furnace temp.

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
168	582		1953	533-810			The above specimen measured at 1033 K furnace temp.
169	582		1953	607-980			The above specimen measured at 1255 K furnace temp.
170	582		1953	453-580			1 lumite to 4 haydite by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 1.555 g cm ⁻³ and fired density 1.463 g cm ⁻³ ; measured at 755 K furnace temp.
171	582		1953	633-833			The above specimen measured at 1033 K furnace temp.
172	582		1953	751-1018			The above specimen measured at 1255 K furnace temp.
173	582		1953	464-597			1 lumite to 6 haydite by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 1.440 g cm ⁻³ and fired density 1.381 g cm ⁻³ ; measured at 755 K furnace temp.
174	582		1953	633-846			The above specimen measured at 1033 K furnace temp.
175	582		1953	745-1032			The above specimen measured at 1255 K furnace temp.
176	582		1953	463-596			1 lumite to 1 vermiculite to 5 haydite by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 1.376 g cm ⁻³ and fired density 1.314 g cm ⁻³ ; measured at 755 K furnace temp.
177	582		1953	614-839			The above specimen measured at 1033 K furnace temp.
178	582		1953	712-1014			The above specimen measured at 1255 K furnace temp.
179	582		1953	462-601			1 lumite to 2 vermiculite to 4 haydite by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 1.256 g cm ⁻³ and fired density 1.203 g cm ⁻³ ; measured at 755 K furnace temp.
180	582		1953	604-835			The above specimen measured at 1033 K furnace temp.
181	582		1953	708-1018			The above specimen measured at 1255 K furnace temp.
182	582		1953	461-609			1 lumite to 3 vermiculite to 3 haydite by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 1.044 g cm ⁻³ and fired density 0.995 g cm ⁻³ ; measured at 755 K furnace temp.
183	582		1953	600-841			The above specimen measured at 1033 K furnace temp.
184	582		1953	700-1023			The above specimen measured at 1255 K furnace temp.
185	582		1953	459-610			1 lumite to 4 vermiculite to 2 haydite by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 0.935 g cm ⁻³ and fired density 0.883 g cm ⁻³ ; measured at 755 K furnace temp.
186	582		1953	591-841			The above specimen measured at 1033 K furnace temp.
187	582		1953	694-1024			The above specimen measured at 1255 K furnace temp.

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
188	582		1953	621.0			1 lumnite to 4 crushed firebrick by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 1.911 g cm ⁻³ and fired density 1.834 g cm ⁻³ ; measured at 755 K furnace temp.
189	582		1953	659.3			The above specimen measured at 1033 K furnace temp.
190	582		1953	1139.7			The above specimen measured at 1366 K furnace temp.
191	582		1953	624.9			1 lumnite to 6 crushed firebrick by dry loose volume; same preparation procedures and dimensions as the above specimen; dried density 1.876 g cm ⁻³ and fired density 1.804 g cm ⁻³ ; measured at 755 K furnace temp.
192	582		1953	860.5			The above specimen measured at 1033 K furnace temp.
193	582		1953	1140.7			The above specimen measured at 1366 K furnace temp.
194	195	L	1958	327-422			Contained 50 crushed insulating firebrick and 50 aluminous cement; cut from cement-gunned slabs of a cast-and-heat-at-811 K cement having a fired density 1.04 to 1.11 g cm ⁻³ , cured at 297 K for 24 hrs with a timed intermittent water spray on the exposed surface during the last 18 hrs, followed by drying in air for a day and 18 hrs at 378 K, then heated for 18 hrs at 533 K; measured in air at 1 atm.
195	195	L	1958	328-427			The above specimen measured in helium at 1 atm.
196	195	L	1958	328-422			The above specimen measured in helium at 200 psi g.
197	195	L	1958	367, 644			The above specimen measured in pure helium.
198	564	L	1944	297-325			Thickness of the specimen 2 in.; density 1.679 g cm ⁻³ .
199	564	L	1944	297-325			Thickness of the specimen 2 in.; density 1.922 g cm ⁻³ .
200	79	L	1942	428-803		Diatomaceous aggregate concrete	5 parts of diatomaceous aggregate to one part of Portland cement; soaked with water and rammed.
201	79	L	1942	503-753		Sand cement concrete	One part of ordinary sand to three parts of cement.
202	100	L	1957	513-682		Light weight concrete	Bulk density 0.870 g cm ⁻³ .
203	100	L	1957	514-682		Light weight concrete	Bulk density 1.012 g cm ⁻³ .
204	581		1955	525.5			1 lumnite to 6 vermiculite by dry loose volume; 9.0 x 4.5 x 2.0 in.; placed with a dry gun; cured for 24 hrs in the molds in a moist cabinet or in laboratory air, dried for 18 to 24 hrs at 378 K after removing molds, and then pre-fired for 24 to 72 hrs at 1144 to 1366 K on all sides; dried density 0.684 g cm ⁻³ and fired density 0.605 g cm ⁻³ ; measured at 755 K furnace temp.
205	581		1958	689.3			The above specimen measured at 1033 K furnace temp.
206	581		1958	820.9			The above specimen measured at 1255 K furnace temp.

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
207	581		1958	540.5				1 lamnite to 4 vermiculite by dry loose volume; placed with dry gun; same preparation procedures and dimensions as the above specimen; dried density 0.843 g cm ⁻³ and fired density 0.715 g cm ⁻³ ; measured at 755 K furnace temp.
208	581		1958	709.4				The above specimen measured at 1033 K furnace temp.
209	581		1958	847.2				The above specimen measured at 1255 K furnace temp.
210	581		1958	527.5		Commercial castable		Specimen cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; fired density 0.750 g cm ⁻³ ; measured at 755 K furnace temp.
211	581		1958	693.8		Commercial castable		The above specimen measured at 1033 K furnace temp.
212	581		1958	823.5		Commercial castable		The above specimen measured at 1255 K furnace temp.
213	581		1958	528.0				1 lamnite to 6 perlite by dry loose volume; cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; dried density 0.865 g cm ⁻³ and fired density 0.823 g cm ⁻³ ; measured at 755 K furnace temp.
214	581		1958	699.3				The above specimen measured at 1033 K furnace temp.
215	581		1958	838.0				The above specimen measured at 1255 K furnace temp.
216	581		1958	542.9				The specimen was placed with dry gun; same preparation procedures and dimensions as the above specimen; dried density 1.005 g cm ⁻³ and fired density 0.879 g cm ⁻³ ; measured at 755 K furnace temp.
217	581		1958	717.7				The above specimen measured at 1033 K furnace temp.
218	581		1958	857.0				The above specimen measured at 1255 K furnace temp.
219	581		1958	538.9				1 lamnite to 4 perlite by dry loose volume; cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; dried density 0.980 g cm ⁻³ ; fired density 0.907 g cm ⁻³ ; measured at 755 K furnace temp.
220	581		1958	718.5				The above specimen measured at 1033 K furnace temp.
221	581		1958	865.7				The above specimen measured at 1255 K furnace temp.
222	581		1958	538.7				The specimen was cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimens; fired density 1.012 g cm ⁻³ ; measured at 755 K furnace temp.
223	581		1958	712.2				The above specimen measured at 1033 K furnace temp.
224	581		1958	845.6				The above specimen measured at 1255 K furnace temp.

SPECIFICATION TABLE NO. 2-9 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
225	581		1958	604.0			1 lumnite to 1 topaz to 1 CFB to 4 calcined diatomaceous earth by weight; cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; fired density 1.177 g cm ⁻³ ; measured at 755 K furnace temp.
226	581		1958	824.9			The above specimen measured at 1033 K furnace temp.
227	581		1958	1082.1			The above specimen measured at 1255 K furnace temp.
228	581		1958	543.3			Acrated 1 lumnite to 4 expanded shale; cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; dried density 1.265 g cm ⁻³ and fired density 1.201 g cm ⁻³ ; measured at 755 K furnace temp.
229	581		1958	733.7			The above specimen measured at 1033 K furnace temp.
230	581		1958	872.9			The above specimen measured at 1255 K furnace temp.
231	581		1958	551.4		Commercial castable	Specimen placed with dry gun; same preparation procedures and dimensions as the above specimen; dried density 1.309 g cm ⁻³ and fired density 1.224 g cm ⁻³ ; measured at 755 K furnace temp.
232	581		1958	739.2		Commercial castable	The above specimen measured at 1033 K furnace temp.
233	581		1958	878.8		Commercial castable	The above specimen measured at 1255 K furnace temp.
234	581		1958	541.2			1 lumnite to 3 vermiculite to 2 expanded shale; placed with wet gun; same preparation procedures and dimensions as the above specimen; dried density 1.322 g cm ⁻³ and fired density 1.233 g cm ⁻³ ; measured at 755 K furnace temp.
235	581		1958	723.2			The above specimen measured at 1033 K furnace temp.
236	581		1958	862.9			The above specimen measured at 1255 K furnace temp.
237	581		1958	548.7			1 lumnite to 4 expanded shale (-8 M to Dust); cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; fired density 1.374 g cm ⁻³ ; measured at 755 K furnace temp.
238	581		1958	744.4			The above specimen measured at 1033 K furnace temp.
239	581		1958	889.9			The above specimen measured at 1255 K furnace temp.
240	581		1958	535.9			1 lumnite to 2.4 "A" expanded shale to 3.0 "C" expanded shale; same preparation procedures and dimensions as the above specimen; fired density 1.480 g cm ⁻³ ; measured at 755 K furnace temp.
241	581		1958	732.6			The above specimen measured at 1033 K furnace temp.
242	581		1958	975.8			The above specimen measured at 1255 K furnace temp.
243	581		1958	535.7			Acrated 1 lumnite to 4 CFB; same preparation procedures and dimensions as the above specimen; dried density 1.567 g cm ⁻³ and fired density 1.509 g cm ⁻³ ; measured at 755 K furnace temp.
244	581		1958	723.0			The above specimen measured at 1033 K furnace temp.

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
245	581		1958	876.8			The above specimen measured at 1255 K furnace temp.
246	581		1958	555.1			1 lumnite to 4 expanded shale; placed with dry gun; same preparation procedures and dimensions as the above specimen; dried density 1.591 g cm ⁻³ and fired density 1.525 g cm ⁻³ ; measured at 755 K furnace temp.
247	581		1958	741.4			The above specimen measured at 1033 K furnace temp.
248	581		1958	883.8			The above specimen measured at 1255 K furnace temp.
249	581		1958	618.1			1 lumnite to 3 expanded shale; placed with dry gun; same preparation procedures and dimensions as the above specimen; fired density 1.535 g cm ⁻³ ; measured at 755 K furnace temp.
250	581		1958	822.4			The above specimen measured at 1033 K furnace temp.
251	581		1958	1013.1			The above specimen measured at 1255 K furnace temp.
252	581		1958	533.0			1 lumnite to 1 CFB to 3 expanded shale; cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; fired density 1.569 g cm ⁻³ ; measured at 755 K furnace temp.
253	581		1958	728.9			The above specimen measured at 1033 K furnace temp.
254	581		1958	871.9			The above specimen measured at 1255 K furnace temp.
255	581		1958	538.6			Vibrated 1 lumnite to 4 expanded shale; cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; dried density 1.655 g cm ⁻³ ; fired density 1.570 g cm ⁻³ ; measured at 755 K furnace temp.
256	581		1958	741.9			The above specimen measured at 1033 K furnace temp.
257	581		1958	888.5			The above specimen measured at 1255 K furnace temp.
258	581		1958	537.3			1 lumnite to 2 CFB to 2 expanded shale; cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; fired density 1.656 g cm ⁻³ ; measured at 755 K furnace temp.
259	581		1958	731.9			The above specimen measured at 1033 K furnace temp.
260	581		1958	878.4			The above specimen measured at 1255 K furnace temp.
261	581		1958	531.1			1 lumnite to 3 CFB to 1 expanded shale; cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; fired density 1.762 g cm ⁻³ ; measured at 755 K furnace temp.
262	581		1958	725.1			The above specimen measured at 1033 K furnace temp.
263	581		1958	871.1			The above specimen measured at 1255 K furnace temp.
264	581		1958	635.5		Commercial castable	The specimen was cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; fired density 1.788 g cm ⁻³ ; measured at 755 K furnace temperature.

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
265	581		1958	868.6		Commercial castable	The above specimen measured at 1633 K furnace temp.
266	581		1958	1143.2		Commercial castable	The above specimen measured at 1255 K furnace temp.
267	581		1958	623.5			1 lumnite to 4 CFB (stiff mud); cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; dried density 2.002 g cm ⁻³ ; fired density 1.922 g cm ⁻³ ; measured at 755 K furnace temp.
268	581		1958	860.2			The above specimen measured at 1633 K furnace temp.
269	581		1958	1145.6			The above specimen measured at 1255 K furnace temp.
270	581		1958	630.0			Vibrated 1 lumnite to 4 CFB (stiff mud); cast on end in steel mold so as to obtain homogeneous surface; same preparation procedures and dimensions as the above specimen; dried density 2.046 g cm ⁻³ ; fired density 1.972 g cm ⁻³ ; measured at 755 K furnace temp.
271	581		1958	862.9			The above specimen measured at 1633 K furnace temp.
272	581		1958	1146.7			The above specimen measured at 1255 K furnace temp.
273	580		1955	296.5			Made from granulated blast furnace slag and slag cement; dry density 1.750 g cm ⁻³ .
274	580		1955	303.9			Made from granulated blast furnace slag and Portland cement; water binding ratio 55%; dry density 1.840 g cm ⁻³ .
275	580		1955	311.7			Similar to the above specimen except water binding ratio 63%; dry density 1.920 g cm ⁻³ .
276	580		1955	310.0			Made from boiler slag and slag cement; dry density 1.720 g cm ⁻³ .
277	580		1955	312.4			Slag concrete from clay coagulation binding; dry density 1.850 g cm ⁻³ .
278	580		1955	309.1			Slag concrete from tripolite clay binding; dry density 1.850 g cm ⁻³ .
279	580		1955	308.2			Activated blast-furnace slag mixed with crushed granite; density 2.270 g cm ⁻³ .
280	580		1955	303.313			Activated blast-furnace slag mixed with crushed chips from solid waste of blast-furnace slag; density from 2.170-2.360 g cm ⁻³ .
281	580		1955	308.2			Activated blast-furnace slag mixed with powdered rubble from blast-furnace slag; density 1.820 g cm ⁻³ .
282	580		1955	305.2			Similar to the above specimen except density 1.520 g cm ⁻³ .
283	579		1958	298.2		Expanded slag concrete; A	0.375 in. to 0 aggregate and 4.08 sacks · yd ⁻³ cement factor; moist-cured for 28 days, oven-dried and ground both sides, then re-dried in the oven prior to test; air content 19.5%; oven dry weight 1.394 g cm ⁻³ .
284	579		1958	298.2		Expanded slag concrete; A	0.375 in. to 0 aggregate and 5.51 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 23.0%; oven dry weight 1.408 g cm ⁻³ .

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
285	579		1958	298.2		Expanded slag concrete, A	0.5 in. aggregate and 7.14 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 13.1%; oven dry weight 1.575 g cm ⁻³ .
286	579		1958	298.2		Expanded slag concrete, A	0.75 in. aggregate and 7.36 sacks · yd ⁻³ cement factor; same curing and drying process and the above specimen; air content 15.8%; oven dry weight 1.525 g cm ⁻³ .
287	579		1958	298.2		Expanded slag concrete, A	0.375 in. to 0 aggregate and 7.41 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 14.3%; oven dry weight 1.543 g cm ⁻³ .
288	579		1958	298.2		Expanded slag concrete, A	0.375 in. to 0 aggregate and 8.69 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 8.7%; oven dry weight 1.656 g cm ⁻³ .
289	579		1958	298.2		Expanded slag concrete, B	0.375 in. to 0 aggregate and 7.01 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 14.5%; oven dry weight 1.373 g cm ⁻³ .
290	579		1958	298.2		Expanded slag concrete, B	0.375 in. to 0 aggregate and 7.00 sacks · yd ⁻³ cement factor; 10% natural sand by dry loose volume of fine aggregate; same curing and drying process as the above specimen; air content 13.5%; oven dry weight 1.410 g cm ⁻³ .
291	579		1958	298.2		Expanded slag concrete, B	0.375 in. to 0 aggregate and 7.22 sacks · yd ⁻³ cement factor; 20% natural sand by dry loose volume of fine aggregate; same curing and drying process as the above specimen; air content 7.4%; oven dry weight 1.538 g cm ⁻³ .
292	579		1958	298.2		Expanded slag concrete, B	0.375 in. to 0 aggregate and 7.15 sacks · yd ⁻³ cement factor; 30% natural sand by dry loose volume of fine aggregate; same curing and drying process as the above specimen; air content 8.7%; oven dry weight 1.583 g cm ⁻³ .
293	579		1958	298.2		Expanded slag concrete, C	0.375 in. to 0 aggregate and 3.92 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 25.8%; oven dry weight 0.961 g cm ⁻³ .
294	579		1958	298.2		Expanded slag concrete, C	0.375 in. to 0 aggregate and 5.43 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 21.4%; oven dry weight 1.089 g cm ⁻³ .
295	579		1958	298.2		Expanded slag concrete, C	0.375 in. to 0 aggregate and 7.10 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 10.5%; oven dry weight 1.278 g cm ⁻³ .
296	579		1958	298.2		Expanded slag concrete, C	0.375 in. to 0 aggregate and 8.41 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 16.4%; oven dry weight 1.171 g cm ⁻³ .
297	579		1958	298.2		Expanded slag concrete, D	0.375 in. to 0 aggregate and 5.86 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 26.4%; oven dry weight 1.280 g cm ⁻³ .
298	579		1958	298.2		Expanded slag concrete, D	0.375 in. to 0 aggregate and 7.50 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 25%; oven dry weight 1.378 g cm ⁻³ .
299	579		1958	298.2		Expanded slag concrete, D	0.375 in. to 0 aggregate and 8.85 sacks · yd ⁻³ cement factor; same curing and drying process as the above specimen; air content 18.0%; oven dry weight 1.563 g cm ⁻³ .

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
300	121	R	1921	348-523			Made with 1 ft ³ "Universal" Portland cement and 0.384 ft ³ of water; the concrete was set for 24 hrs, stored in damp sand for two weeks and then thoroughly dried in a dry room.
301	121	R	1921	348-523			Ratio of Portland cement; sand; gravel = 1:1.2:1.1 (in vol); 100% water content (normal); same preparation procedures as above.
302	121	R	1921	348-523			Similar to the above specimen except 110% water content.
303	121	R	1921	373, 473			Similar to the above specimen except 120% water content.
304	121	R	1921	348-523			Ratio of cement; sand; gravel = 1:1.9:1.7; 100% water content; same preparation procedures as above.
305	121	R	1921	348, 423			Similar to the above specimen except 110% water content.
306	121	R	1921	348-523			Similar to the above specimen except 120% water content.
307	121	R	1921	373, 473			Ratio of cement; sand; gravel = 1:2.4:2.3; 100% water content; same preparation procedures as above.
308	121	R	1921	348-523			Similar to the above specimen except 110% water content.
309	121	R	1921	348, 423			Similar to the above specimen except 120% water content.
310	121	R	1921	373, 473			Ratio of cement; sand; gravel = 1:3.1:3.0; 100% water content; same preparation procedures as above.
311	121	R	1921	348-523			Similar to the above specimen except 110% water content.
312	121	R	1921	348-523			Similar to the above specimen except 120% water content.
313	121	R	1921	348, 423			Ratio of cement; sand; gravel = 1:4.3:4.0; 110% water content; same preparation procedures as above.
314	121	R	1921	373, 473			Similar to the above specimen except 120% water content.
315	121	R	1921	348, 423			Ratio of cement; sand; gravel = 1:5.6:5.1; 110% water content; same preparation procedures as above.
316	121	R	1921	373, 473			Similar to the above specimen except 120% water content.
317	552	L	1960	298, 2		Slag concrete	20 x 20 x 4 cm; mixed by hand, filled in prescribed form, tamped, then normal heated with seven days of damp storage and subsequent air storage.
318	552	L	1960	298, 2		Slag concrete	Similar to the above specimen except density 1.49 g cm ⁻³ .
319	552	L	1960	298, 2		Slag concrete	Similar to the above specimen except density 1.52 g cm ⁻³ .
320	552	L	1960	298, 2		Slag concrete	Similar to the above specimen except density 1.70 g cm ⁻³ .
321	552	L	1960	298, 2		Slag concrete	Similar to the above specimen except density 1.79 g cm ⁻³ .

SPECIFICATION TABLE NO. 289 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
322	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 2.02 g cm ⁻³ .
323	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.58 g cm ⁻³ .
324	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.59 g cm ⁻³ .
325	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.68 g cm ⁻³ .
326	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.80 g cm ⁻³ .
327	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.66 g cm ⁻³ .
328	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.73 g cm ⁻³ .
329	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.30 g cm ⁻³ .
330	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.22 g cm ⁻³ .
331	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 2.00 g cm ⁻³ .
332	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.83 g cm ⁻³ .
333	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.80 g cm ⁻³ .
334	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.77 g cm ⁻³ .
335	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.70 g cm ⁻³ .
336	552	L	1960	298.2		Slag concrete	Similar to the above specimen except density 1.70 g cm ⁻³ .
337	529	P	1956	291.5		Foamed lightweight concrete	12 in. cube; water content 12.0%; density 0.384 g cm ⁻³ ; thermal conductivity value calculated from measured transient temp change.
3.9	529	P	1956	291.5		Foamed lightweight concrete	The above specimen dried; density 0.336 g cm ⁻³ .

DATA TABLE NO. 289 THERMAL CONDUCTIVITY OF CONCRETE
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

<u>CURVE 1</u>	<u>CURVE 12*</u>	<u>CURVE 23*</u>	<u>CURVE 34*</u>	<u>CURVE 45</u>	<u>CURVE 56*</u>	<u>CURVE 67</u>	<u>CURVE 78*</u>
292.8 0.0171	293.6 0.0175	298.2 0.00395	298.2 0.00186	298.2 0.00302	298.2 0.00256	298.2 0.00221	298.2 0.00267
<u>CURVE 2</u>	<u>CURVE 13*</u>	<u>CURVE 24*</u>	<u>CURVE 35</u>	<u>CURVE 46*</u>	<u>CURVE 57*</u>	<u>CURVE 68*</u>	<u>CURVE 79*</u>
356.1 0.0171	287.3 0.00542	298.2 0.00407	298.2 0.00163	298.2 0.00325	298.2 0.00209	298.2 0.00291	298.2 0.00267
<u>CURVE 3*</u>	<u>CURVE 14</u>	<u>CURVE 25</u>	<u>CURVE 36</u>	<u>CURVE 47*</u>	<u>CURVE 58*</u>	<u>CURVE 69*</u>	<u>CURVE 80*</u>
356.2 0.0171	287.3 0.0120	298.2 0.00430	298.2 0.00151	298.2 0.00256	298.2 0.00314	298.2 0.00267	298.2 0.00337
<u>CURVE 4*</u>	<u>CURVE 15*</u>	<u>CURVE 26*</u>	<u>CURVE 37</u>	<u>CURVE 48*</u>	<u>CURVE 59*</u>	<u>CURVE 70*</u>	<u>CURVE 81*</u>
292.8 0.0172	287.3 0.0119	298.2 0.00395	298.2 0.00174	298.2 0.00244	298.2 0.00232	298.2 0.00349	298.2 0.00256
<u>CURVE 5*</u>	<u>CURVE 16</u>	<u>CURVE 27</u>	<u>CURVE 38*</u>	<u>CURVE 49*</u>	<u>CURVE 60*</u>	<u>CURVE 71*</u>	<u>CURVE 82*</u>
376.5 0.0173	298.2 0.00256	298.2 0.00372	298.2 0.00174	298.2 0.00232	298.2 0.00209	298.2 0.00291	298.2 0.00209
<u>CURVE 6*</u>	<u>CURVE 17*</u>	<u>CURVE 28</u>	<u>CURVE 39</u>	<u>CURVE 50*</u>	<u>CURVE 61*</u>	<u>CURVE 72*</u>	<u>CURVE 83</u>
376.6 0.0174	298.2 0.00244	298.2 0.00325	298.2 0.00604	298.2 0.00267	298.2 0.00232	298.2 0.00279	298.2 0.00477
<u>CURVE 7*</u>	<u>CURVE 18</u>	<u>CURVE 29*</u>	<u>CURVE 40</u>	<u>CURVE 51*</u>	<u>CURVE 62*</u>	<u>CURVE 73*</u>	<u>CURVE 84*</u>
292.8 0.0175	298.2 0.00232	298.2 0.00325	298.2 0.00651	298.2 0.00325	298.2 0.00314	298.2 0.00430	298.2 0.00395
<u>CURVE 8*</u>	<u>CURVE 19</u>	<u>CURVE 30</u>	<u>CURVE 41*</u>	<u>CURVE 52*</u>	<u>CURVE 63*</u>	<u>CURVE 74*</u>	<u>CURVE 85*</u>
292.9 0.0173	298.2 0.00209	298.2 0.00349	298.2 0.00581	298.2 0.00256	298.2 0.00198	298.2 0.00407	298.2 0.00407
<u>CURVE 9*</u>	<u>CURVE 20</u>	<u>CURVE 31*</u>	<u>CURVE 42*</u>	<u>CURVE 53*</u>	<u>CURVE 64*</u>	<u>CURVE 75*</u>	<u>CURVE 86*</u>
292.7 0.0174	298.2 0.00198	298.2 0.00267	298.2 0.00616	298.2 0.00291	298.2 0.00291	298.2 0.00349	298.2 0.00395
<u>CURVE 10*</u>	<u>CURVE 21*</u>	<u>CURVE 32*</u>	<u>CURVE 43*</u>	<u>CURVE 54*</u>	<u>CURVE 65*</u>	<u>CURVE 76*</u>	<u>CURVE 87*</u>
293.3 0.0174	298.2 0.00395	298.2 0.00267	298.2 0.00593	298.2 0.00349	298.2 0.00232	298.2 0.00349	298.2 0.00325
<u>CURVE 11*</u>	<u>CURVE 22</u>	<u>CURVE 33</u>	<u>CURVE 44</u>	<u>CURVE 55*</u>	<u>CURVE 66*</u>	<u>CURVE 77*</u>	<u>CURVE 88*</u>
293.0 0.0175	298.2 0.00453	298.2 0.00186	298.2 0.00279	298.2 0.00314	298.2 0.00232	298.2 0.00314	298.2 0.00198

* Not shown on plot

DATA TABLE NO. 289 (continued)

298.2	0.00244	297.1	0.0166	297.1	0.00529	395	0.00260	442.5	0.00136	718.7	0.00197	568.2	0.00122	477.5	0.00105
	<u>CURVE 90*</u>	<u>CURVE 101*</u>	<u>CURVE 102*</u>	<u>CURVE 113</u>	<u>CURVE 125</u>	451	0.00278	521.8	0.00140	594.2	0.00203	694.7	0.00134	552.6	0.00115
						456	0.00277*	607.1	0.00145	1081.5	0.00210	847.6	0.00148	635.6	0.00126
297.1	0.0189	297.1	0.0151	297.1	0.00632	515	0.00299								
	<u>CURVE 91*</u>	<u>CURVE 103*</u>	<u>CURVE 105*</u>	<u>CURVE 115*</u>	<u>CURVE 126</u>	547	0.00294								
						605	0.00297								
297.1	0.0186	297.1	0.0144	297.1	0.00561	648	0.00313	555.7	0.00149	460.6	0.00166	711.0	0.00137	615.1	0.00127
	<u>CURVE 92*</u>	<u>CURVE 104</u>	<u>CURVE 116*</u>	<u>CURVE 127</u>	<u>CURVE 133</u>	758	0.00330	683.3	0.00157	532.2	0.00175	871.2	0.00160	729.9	0.00144
						946	0.00372	823.7	0.00164	612.1	0.00185	1094.3	0.00192	866.2	0.00167
297.1	0.0190	297.1	0.0141	297.1	0.00557	323.6	0.0190								
	<u>CURVE 93*</u>	<u>CURVE 105*</u>	<u>CURVE 117*</u>	<u>CURVE 128</u>	<u>CURVE 134</u>	373.2	0.0189	706.6	0.00160	585.9	0.00177	480.4	0.00148	730.2	0.00145
						424.4	0.0180	883.4	0.00171	702.3	0.00186	545.4	0.00160	873.0	0.00170
297.1	0.0175	297.1	0.00668	297.1	0.00577	474.8	0.0164	1087.7	0.00184	832.1	0.00197	626.0	0.00176	1056.5	0.00202
	<u>CURVE 94*</u>	<u>CURVE 106*</u>	<u>CURVE 118*</u>	<u>CURVE 129</u>	<u>CURVE 135</u>	525.2	0.0140								
						323.6	0.0160	456.0	0.00121	742.5	0.00187	616.1	0.00163	467.4	0.00212
297.1	0.0179	297.1	0.00620	297.1	0.00417	373.2	0.0173*	535.0	0.00128	909.3	0.00199	719.2	0.00179	537.1	0.00216
	<u>CURVE 95*</u>	<u>CURVE 107*</u>	<u>CURVE 119*</u>	<u>CURVE 130*</u>	<u>CURVE 136*</u>	399.2	0.0177	623.6	0.00136	1100.3	0.00214	850.5	0.00199	607.5	0.00221
						424.4	0.0151								
297.1	0.0179	297.1	0.00538	297.1	0.00407	474.8	0.0150								
	<u>CURVE 96*</u>	<u>CURVE 108</u>	<u>CURVE 120*</u>	<u>CURVE 131</u>	<u>CURVE 137*</u>	525.2	0.0129	583.1	0.00133	462.5	0.00137	728.3	0.00175	593.9	0.00228
								704.0	0.00142	531.5	0.00152	860.8	0.00195	710.1	0.00232
297.1	0.0175	297.1	0.00705	297.1	0.00329			844.2	0.00154	614.5	0.00168	1035.0	0.00221	827.0	0.00237
	<u>CURVE 97*</u>	<u>CURVE 109*</u>	<u>CURVE 121*</u>	<u>CURVE 132*</u>	<u>CURVE 138</u>	323.6	0.0160*								
						373.2	0.0123								
297.1	0.0185	297.1	0.00632	297.1	0.00327	424.4	0.0118	750.4	0.00147	590.6	0.00152	463.8	0.00131	698.8	0.00234
	<u>CURVE 98*</u>	<u>CURVE 110*</u>	<u>CURVE 122*</u>	<u>CURVE 133*</u>	<u>CURVE 139</u>	474.8	0.0110	919.1	0.00160	702.8	0.00168	539.4	0.00142	849.3	0.00242
						525.2	0.0104	1120.9	0.00176	835.4	0.00184	624.0	0.00154	1095.6	0.00250
297.1	0.0180	297.1	0.00612	297.1	0.00460										
	<u>CURVE 99*</u>	<u>CURVE 111*</u>	<u>CURVE 123*</u>	<u>CURVE 140*</u>	<u>CURVE 146*</u>	323.6	0.0139	446.9	0.00175	742.8	0.00173	589.6	0.00147	454.6	0.00188
						373.2	0.0112	522.7	0.00179	904.6	0.00189	707.9	0.00162	527.7	0.00196
297.1	0.0162	297.1	0.00599	297.1	0.00493	424.4	0.0106	601.8	0.00183	1099.1	0.00210	846.2	0.00180	610.3	0.00207
	<u>CURVE 100*</u>	<u>CURVE 112*</u>	<u>CURVE 124*</u>	<u>CURVE 141*</u>	<u>CURVE 150*</u>	474.8	0.0102								
						525.2	0.0100								
297.1	0.0173	297.1	0.00545	297.1	0.00349										
	<u>CURVE 101*</u>	<u>CURVE 113*</u>	<u>CURVE 125*</u>	<u>CURVE 142*</u>	<u>CURVE 151*</u>	366.2	0.01731	563.1	0.00187	453.7	0.00112	691.3	0.00157	571.5	0.00202
								687.5	0.00191	531.9	0.00123	841.8	0.00178	692.5	0.00211
								817.6	0.00196	626.8	0.00135	1027.1	0.00203	828.3	0.00220

* Not shown on plot

DATA TABLE NO. 289 (continued)

<u>CURVE 165^o</u>	T	k	T	k	T	k	T	k	T	k	T	k	T	k
679.6	0.00211	0.00487	462.0	0.00294	694.3	0.00213	366.5	0.00483	689.3	0.00159	717.7	0.00239	733.7	0.00368
837.1	0.00222	0.00489	530.2	0.00301	841.7	0.00237	644.3	0.00620	<u>CURVE 205^o</u>	<u>CURVE 217^o</u>	<u>CURVE 229^o</u>			
1016.1	0.00233	0.00492	601.3	0.00307	1023.8	0.00268	<u>CURVE 198^o</u>		<u>CURVE 206^o</u>	<u>CURVE 218^o</u>	<u>CURVE 230^o</u>			
							297.3	0.00541	820.9	0.00167	857.0	0.00258	872.9	0.00388
<u>CURVE 164</u>	T	k	T	k	T	k	T	k	<u>CURVE 207^o</u>	<u>CURVE 219^o</u>	<u>CURVE 231^o</u>			
447.1	0.00314	0.00491	603.6	0.00305	621.0	0.00788	311.3	0.00550	540.5	0.00175	538.9	0.00265	551.4	0.00385
524.3	0.00341	0.00502	713.4	0.00321	<u>CURVE 189^o</u>		324.8	0.00547	<u>CURVE 208^o</u>	<u>CURVE 220^o</u>	<u>CURVE 232^o</u>			
584.6	0.00365	0.00512	835.1	0.00338	859.3	0.00824	<u>CURVE 199^o</u>		709.4	0.00180	718.5	0.00299	739.2	0.00392
							297.3	0.00702	<u>CURVE 209^o</u>	<u>CURVE 221^o</u>	<u>CURVE 233^o</u>			
<u>CURVE 163</u>	T	k	T	k	T	k	T	k	847.2	0.00190	865.7	0.00323	878.8	0.00412
574.9	0.00338	0.00437	708.3	0.00316	<u>CURVE 190</u>		311.4	0.00711	<u>CURVE 210^o</u>	<u>CURVE 222^o</u>	<u>CURVE 234^o</u>			
701.3	0.00371	0.00442	852.2	0.00337	1139.7	0.00856	311.7	0.00711	527.5	0.00167	538.7	0.00228	541.2	0.00327
819.3	0.00402	0.00449	1017.9	0.00363	<u>CURVE 191^o</u>		325.0	0.00711	<u>CURVE 211^o</u>	<u>CURVE 223^o</u>	<u>CURVE 235^o</u>			
							<u>CURVE 200^o</u>		693.8	0.00186	712.2	0.00255	723.2	0.00333
<u>CURVE 162</u>	T	k	T	k	T	k	T	k	<u>CURVE 212^o</u>	<u>CURVE 224^o</u>	<u>CURVE 236^o</u>			
672.9	0.00348	0.00451	461.4	0.00225	624.9	0.00783	428.2	0.00188	823.5	0.00200	845.6	0.00262	862.9	0.00339
839.2	0.00392	0.00458	528.8	0.00247	<u>CURVE 192^o</u>		553.2	0.00201	<u>CURVE 213^o</u>	<u>CURVE 225^o</u>	<u>CURVE 237^o</u>			
1002.0	0.00435	0.00464	609.1	0.00275	860.5	0.00821	678.2	0.00213	699.3	0.00262	824.9	0.00418	744.4	0.00412
							803.2	0.00242	528	0.00238	604.0	0.00394	548.7	0.00391
<u>CURVE 161</u>	T	k	T	k	T	k	T	k	<u>CURVE 214^o</u>	<u>CURVE 226^o</u>	<u>CURVE 238^o</u>			
419.3	0.00283	0.00460	599.5	0.00244	<u>CURVE 193^o</u>		503.2	0.00105	699.3	0.00262	824.9	0.00418	744.4	0.00412
529.2	0.00304	0.00475	705.4	0.00272	1140.7	0.00859	753.2	0.00130	<u>CURVE 215^o</u>	<u>CURVE 227^o</u>	<u>CURVE 239^o</u>			
588.0	0.00316	0.00489	840.7	0.00306	<u>CURVE 194^o</u>		682.1	0.00208	838.0	0.00284	1082.1	0.00453	889.9	0.00427
							<u>CURVE 201^o</u>		<u>CURVE 216^o</u>	<u>CURVE 228^o</u>	<u>CURVE 240^o</u>			
<u>CURVE 160</u>	T	k	T	k	T	k	T	k	823.5	0.00200	845.6	0.00262	862.9	0.00339
532.8	0.00307	0.00377	699.9	0.00253	326.5	0.00277	512.6	0.00199	<u>CURVE 217^o</u>	<u>CURVE 229^o</u>	<u>CURVE 241^o</u>			
711.0	0.00338	0.00397	839.6	0.00284	363.7	0.00280	558.2	0.00202	699.3	0.00262	824.9	0.00418	744.4	0.00412
809.5	0.00355	0.00420	1023.3	0.00326	422.1	0.00326	609.3	0.00205	<u>CURVE 218^o</u>	<u>CURVE 230^o</u>	<u>CURVE 242^o</u>			
							682.1	0.00208	528	0.00238	604.0	0.00394	548.7	0.00391
<u>CURVE 159</u>	T	k	T	k	T	k	T	k	<u>CURVE 219^o</u>	<u>CURVE 231^o</u>	<u>CURVE 243^o</u>			
606.9	0.00322	0.00384	458.7	0.00192	327.6	0.00396	<u>CURVE 202^o</u>		<u>CURVE 214^o</u>	<u>CURVE 232^o</u>	<u>CURVE 244^o</u>			
841.4	0.00368	0.00411	528.6	0.00209	370.4	0.00320	514.3	0.00218	699.3	0.00262	824.9	0.00418	744.4	0.00412
979.7	0.00395	0.00441	610.4	0.00229	427.1	0.00326	568.7	0.00219	<u>CURVE 215^o</u>	<u>CURVE 227^o</u>	<u>CURVE 245^o</u>			
							624.3	0.00221	838.0	0.00284	1082.1	0.00453	889.9	0.00427
<u>CURVE 158</u>	T	k	T	k	T	k	T	k	<u>CURVE 220^o</u>	<u>CURVE 233^o</u>	<u>CURVE 246^o</u>			
452.9	0.00477	0.00402	591.4	0.00204	327.6	0.00453	<u>CURVE 203^o</u>		699.3	0.00262	824.9	0.00418	744.4	0.00412
518.8	0.00479	0.00427	704.8	0.00224	370.4	0.00506	514.3	0.00218	<u>CURVE 221^o</u>	<u>CURVE 234^o</u>	<u>CURVE 247^o</u>			
580.1	0.00481	0.00456	840.8	0.00250	422.1	0.00513	568.7	0.00219	838.0	0.00284	1082.1	0.00453	889.9	0.00427
							682.1	0.00222	542.9	0.00224	543.3	0.00349	535.9	0.00531

* Not shown on plot

DATA TABLE NO. 289 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
	<u>CURVE 241</u>		<u>CURVE 253*</u>		<u>CURVE 265*</u>		<u>CURVE 277*</u>		<u>CURVE 289*</u>		<u>CURVE 301*</u>		<u>CURVE 310*</u>		<u>CURVE 320*</u>		<u>CURVE 330*</u>
732.6	0.00552	728.9	0.00574	868.6	0.00806	312.4	0.00616	298.2	0.00346	348.2	0.0153	373.2	0.0148	298.2	0.00267		
	<u>CURVE 242</u>		<u>CURVE 254*</u>		<u>CURVE 266*</u>		<u>CURVE 278*</u>		<u>CURVE 290*</u>		<u>CURVE 302*</u>		<u>CURVE 311*</u>		<u>CURVE 321*</u>		<u>CURVE 331*</u>
875.8	0.00564	871.9	0.00584	1143.2	0.00845	309.1	0.00477	298.2	0.00376	423.2	0.0135	348.2	0.0159	298.2	0.00314		
	<u>CURVE 243*</u>		<u>CURVE 255*</u>		<u>CURVE 267</u>		<u>CURVE 279</u>		<u>CURVE 291*</u>		<u>CURVE 303*</u>		<u>CURVE 312</u>		<u>CURVE 322*</u>		<u>CURVE 332*</u>
535.7	0.00529	538.6	0.00573	623.5	0.00890	308.2	0.00860	298.2	0.00444	423.2	0.0139	348.2	0.0159	298.2	0.00407		
	<u>CURVE 244*</u>		<u>CURVE 256*</u>		<u>CURVE 268</u>		<u>CURVE 280*</u>		<u>CURVE 292*</u>		<u>CURVE 304*</u>		<u>CURVE 313*</u>		<u>CURVE 323*</u>		<u>CURVE 333*</u>
723.0	0.00551	741.9	0.00571	860.2	0.00907	303.2	0.00721	298.2	0.00436	348.2	0.0145	373.2	0.0126	298.2	0.00232		
	<u>CURVE 245*</u>		<u>CURVE 257*</u>		<u>CURVE 269</u>		<u>CURVE 281*</u>		<u>CURVE 293*</u>		<u>CURVE 305*</u>		<u>CURVE 314*</u>		<u>CURVE 324*</u>		<u>CURVE 334*</u>
876.8	0.00570	888.5	0.00580	1145.6	0.00933	313.2	0.00686	298.2	0.00216	423.2	0.0153	348.2	0.0168	298.2	0.00232		
	<u>CURVE 246*</u>		<u>CURVE 258*</u>		<u>CURVE 270*</u>		<u>CURVE 282*</u>		<u>CURVE 294*</u>		<u>CURVE 306*</u>		<u>CURVE 315</u>		<u>CURVE 325*</u>		<u>CURVE 335*</u>
555.1	0.00531	537.3	0.00633	630.0	0.00909	305.2	0.00546	298.2	0.00251	423.2	0.0144	348.2	0.0126	298.2	0.00279		
	<u>CURVE 247*</u>		<u>CURVE 259</u>		<u>CURVE 271*</u>		<u>CURVE 283*</u>		<u>CURVE 295*</u>		<u>CURVE 307*</u>		<u>CURVE 316*</u>		<u>CURVE 326*</u>		<u>CURVE 336*</u>
741.4	0.00548	731.9	0.00648	862.9	0.00929	298.2	0.00342	298.2	0.00325	348.2	0.0148	373.2	0.0126	298.2	0.00279		
	<u>CURVE 248*</u>		<u>CURVE 260</u>		<u>CURVE 272*</u>		<u>CURVE 284*</u>		<u>CURVE 296*</u>		<u>CURVE 308*</u>		<u>CURVE 317*</u>		<u>CURVE 327*</u>		<u>CURVE 337*</u>
883.8	0.00555	878.4	0.00668	1146.7	0.00955	298.2	0.00348	298.2	0.00313	423.2	0.0144	348.2	0.0240	298.2	0.00279		
	<u>CURVE 249*</u>		<u>CURVE 261*</u>		<u>CURVE 273*</u>		<u>CURVE 285*</u>		<u>CURVE 297*</u>		<u>CURVE 309*</u>		<u>CURVE 318*</u>		<u>CURVE 328*</u>		<u>CURVE 338*</u>
618.1	0.00453	531.1	0.00679	296.5	0.00442	298.2	0.00420	298.2	0.00306	423.2	0.0130	373.2	0.0114	298.2	0.00291		
	<u>CURVE 250*</u>		<u>CURVE 262*</u>		<u>CURVE 274*</u>		<u>CURVE 286*</u>		<u>CURVE 298*</u>		<u>CURVE 310*</u>		<u>CURVE 319*</u>		<u>CURVE 329*</u>		<u>CURVE 339*</u>
822.4	0.00467	725.1	0.00708	303.9	0.00581	298.2	0.00408	298.2	0.00352	348.2	0.0149	373.2	0.0114	298.2	0.00232		
	<u>CURVE 251*</u>		<u>CURVE 263</u>		<u>CURVE 275*</u>		<u>CURVE 287*</u>		<u>CURVE 299*</u>		<u>CURVE 311*</u>		<u>CURVE 320*</u>		<u>CURVE 330*</u>		<u>CURVE 340*</u>
1013.1	0.00482	971.1	0.00734	311.7	0.00477	298.2	0.00395	298.2	0.00408	348.2	0.0174	348.2	0.0174	298.2	0.00232		
	<u>CURVE 252*</u>		<u>CURVE 264*</u>		<u>CURVE 276*</u>		<u>CURVE 288*</u>		<u>CURVE 300</u>		<u>CURVE 312*</u>		<u>CURVE 321*</u>		<u>CURVE 331*</u>		<u>CURVE 341*</u>
533.0	0.00557	635.5	0.00787	310.0	0.00674	298.2	0.00460	348.2	0.00586	423.2	0.0156	348.2	0.0156	298.2	0.00384		
	<u>CURVE 253*</u>		<u>CURVE 265*</u>		<u>CURVE 277*</u>		<u>CURVE 289*</u>		<u>CURVE 301*</u>		<u>CURVE 313*</u>		<u>CURVE 322*</u>		<u>CURVE 332*</u>		<u>CURVE 342*</u>

* Not shown on plot

DATA TABLE NO. 289 (continued)

T	k
<u>CURVE 332*</u>	
298.2	0.00325
<u>CURVE 333*</u>	
298.2	0.00372
<u>CURVE 334*</u>	
298.2	0.00325
<u>CURVE 335*</u>	
298.2	0.00349
<u>CURVE 336*</u>	
298.2	0.00325
<u>CURVE 337*</u>	
291.5	0.00175
<u>CURVE 338</u>	
291.5	0.000909

* Not shown on plot

SPECIFICATION TABLE NO. 290 THERMAL CONDUCTIVITY OF PLASTER

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	576		1957	298.2		Plaster of Paris	In powdered form; density (25 C) = 1.13 g cm ⁻³ .

DATA TABLE NO. 290 THERMAL CONDUCTIVITY OF PLASTER

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

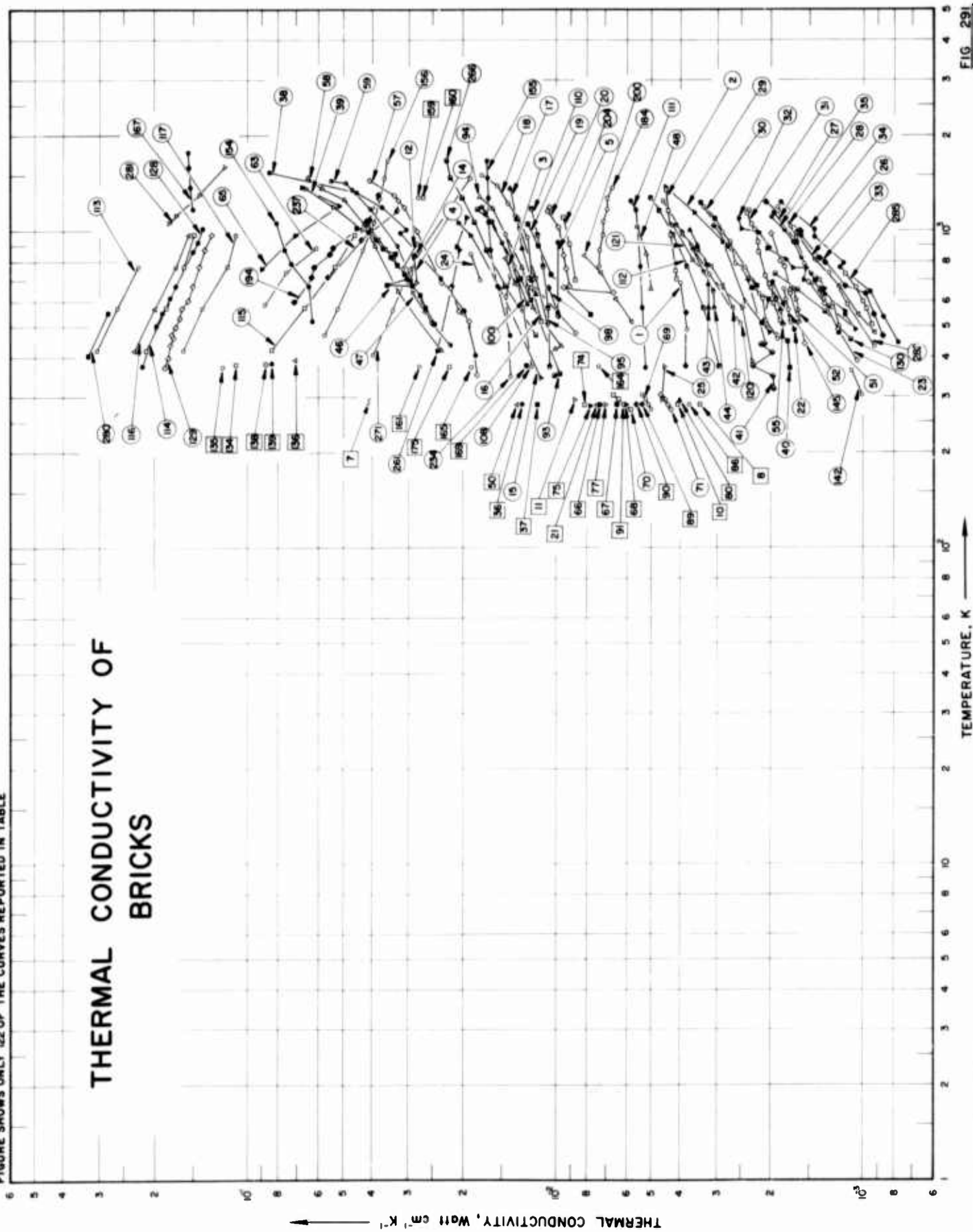
CURVE 1*

298.2 0.00134

* No graphical presentation

FIGURE SHOWS ONLY 122 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF BRICKS



THERMAL CONDUCTIVITY, Watt cm⁻¹ K⁻¹ ↑

TEMPERATURE, K →

SPECIFICATION TABLE NO. 291 THERMAL CONDUCTIVITY OF BRICKS

[For Data Reported in Figure and Table No. 291]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	90	L	1943	489, 685	<1.5	B & W No. 80 Kaolin 9-in. straight	8.93 in. length, 4.48 in. width, 2.44 in. thickness; bulk density 2.21 g cm ⁻³ ; condition of brick stability obtained by repeated heating.
2	90	L	1943	706-1358	<1.5	B & W No. 80 Kaolin 9-in. straight	Same as above but measured with the backing-up of 0.50 in. of group 20 insulating fire brick.
3	91	C	1947	681, 824	1.7	Chamotte	20% carborundum; cylindrical specimen; iron used as comparative material.
4	91	C	1947	688, 830		Chamotte	60% carborundum; cylindrical specimen; iron used as comparative material.
5	92	PF	1950	553, 923		Chamotte (fire brick)	Normal; density 1.85 g cm ⁻³ .
6	92	PF	1950	373, 553		Chamotte (fire brick)	Porous; density 1.23 g cm ⁻³ .
7	93		1957	293, 2		Carbon brick (plenia)	Density 1.5 g cm ⁻³ ; porosity 30%.
8	94	L	1942	283, 2		Cement porous brick	Measured at wall; density 0.725 g cm ⁻³ ; moisture content 5.0 vol. %.
9	94	L	1942	283, 2		Cement porous brick	Measured at laboratory; density 0.720 g cm ⁻³ ; moisture content 4.1 vol. %.
10	94	L	1942	283, 2		Cement porous brick	Measured at wall; density 0.722 g cm ⁻³ ; moisture content 6.1 vol. %.
11	93		1957	293, 2		Ceramic brick K60	Specimen prepared by factory Hognas-Billesholm AB, Hognas; density 2.1 g cm ⁻³ ; porosity 17%.
12	91	C	1947	763, 912		Chrome magnesite brick	Cylindrical specimens from batches of different compositions; iron used as comparative material.
13	91	C	1947	743, 893		Chrome magnesite brick	Similar to the above specimens.
14	91	C	1947	696, 846		Chrome magnesite brick	Similar to the above specimens.
15	95	L	1935	347-1070	10.0	Mexko; dense fire clay brick	0.989 in. in thickness and 3.97 in. in dia; density 2.34 g cm ⁻³ .
16	90	L	1943	516, 662	<1.5	Mexko; superduty fire-clay 9-in. straight	9.00 in. in length, 4.42 in. in width, 2.48 in. in thickness; bulk density 2.27 g cm ⁻³ ; condition of brick stability obtained by repeated heating.
17	90	L	1943	632-1369	<1.5	Mexko; superduty fire-clay 9-in. straight	Same as the above specimen; measured with 0.50 in. of group 29 backing-up insulation.
18	96	L	1934	478-1505		Mexko; fire brick	Specimen consisted of 8 standard-size bricks forming a section 18 x 18 x 2.5 in. in size.
19	96	L	1934	544-1055		Mexko; fire brick	Similar to the above specimen but measured by using a different apparatus.
20	97	C	1958	638-1183	±6.0	Superduty fire-clay brick	From "Ordzhonikidze" factory; 55 mm dia x 56 mm long; porosity 20.2%; carborundum used as comparative material.
21	94	L	1942	283, 2		Diatomaceous	Measured at wall; density 1.67 g cm ⁻³ ; moisture content 1.55 vol. %.
22	79	L	1942	488-688		Diatomaceous	Main constituents: hydrated amorphous silica and diatomaceous earth; crushing strength 850 lb in. ⁻² and density 0.72 g cm ⁻³ .

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
23	79	L	1942	388-688		Diatomaceous	Same as the above specimen but with a crushing strength 250 lb in. ⁻² and density 0.42 g cm. ⁻³ .
24	91	C	1947	700, 848		Dinas	Specimen prepared by "Firey Ural Dinas" factory; iron used as comparative material.
25	44	F	1934	293, 373		Fire brick	Density 1.73 g cm. ⁻³ .
26	98	L	1942	478-1005		Fire brick; A	Density 0.316 g cm. ⁻³ .
27	98	L	1942	478-1144		Fire brick; B	Density 0.442 g cm. ⁻³ .
28	98	L	1942	478-1189		Fire brick; C	Density 0.493 g cm. ⁻³ .
29	98	L	1942	478-1367		Fire brick; D	Density 0.639 g cm. ⁻³ .
30	98	L	1942	455-1194		Fire brick; E	Density 0.638 g cm. ⁻³ .
31	98	L	1942	522-1167		Fire brick; F	Density 0.606 g cm. ⁻³ .
32	98	L	1942	489-1100		Fire brick; A	With coarse pores; 1.04 lb per 9-in. straight; density 0.285 g cm. ⁻³ .
33	98	L	1942	467-1233		Fire brick; B	Intermediate pores, 1.01 lb per 9-in. straight; density 0.277 g cm. ⁻³ .
34	98	L	1942	444-1233		Fire brick; C	Fine pores, 1.01 lb per 9-in. straight; density 0.277 g cm. ⁻³ .
35	99	L	1952	489-1122		Fire brick	No details reported.
36	94	L	1942	283, 2		Hand-burned face brick	Measured at wall; density 1.885 g cm. ⁻³ ; moisture content 1.7 vol. %.
37	94	L	1942	283, 2		Hand-burned face brick	Measured in the laboratory; density 1.952 g cm. ⁻³ ; moisture content 1.4 vol. %.
38	96	L	1934	405-1533		High temp. insulating brick; 2	Specimen consisted of 5 standard-size bricks forming a section 18 x 18 x 2.5 in. in size.
39	96	L	1934	1009-1378		High temp. insulating brick; 2	The above specimen with cracks opening on the hot surface.
40	95	L	1935	369-1225	2.0	Lightweight brick; A	1.021 in. thick and 3.98 in. in dia; measured in direct contact with heater; density 0.509 g cm. ⁻³ .
41	95	L	1935	318-1048	2.0	Lightweight brick; B	1.013 in. thick and 4.0 in. in dia; measured by placing the specimen between heater and the specimen A; density 0.513 g cm. ⁻³ .
42	4	R	1951	573-973	5	B & W K-28 insulating fire brick	No details reported.
43	7	R	1949	571-1014		B & W K-28 insulating fire brick	Weight 2.5 lb per standard brick; supplied by Babcock and Wilcox Co.
44	1		1950	573-1046		B & W K-28 insulating fire brick	Specimen supplied by Babcock and Wilcox Co.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
45	1		1950	576-1082		B & W K-28 insulating brick	Specimen supplied by Babcock and Wilcox Co.
46	2	R	1951	510-1021		B & W K-28 insulating brick	Specimen supplied by Babcock and Wilcox Co.
47	2	R	1951	553-1040		B & W K-28 insulating brick	2nd run of the above specimen.
48	85	L	1949	655-1038	5.0-7.0	Lightweight brick; 7	Specimen prepared by "Borovichak" factory; density 1.90 g cm ⁻³ ; open porosity 61.2%; additional shrinkage 0.8% when exposed at 1350 C for 2 hrs.
49	94	L	1942	283.2		Lime sand brick	Measured at wall; density 1.760 g cm ⁻³ ; moisture content 8.3 vol. %.
50	94	L	1942	283.2		Lime sand brick	Measured in the laboratory; density 1.884 g cm ⁻³ ; moisture content 4.9 vol. %.
51	100	L	1957	515-659		Mica brick	White; bulk density 0.703 g cm ⁻³ .
52	100	L	1957	512-656		Mica brick	Red; bulk density 0.705 g cm ⁻³ .
53	100	L	1957	523-644		Mica brick	White; fired at 800 C; bulk density 0.684 g cm ⁻³ .
54	100	L	1957	531-684		Mica brick	White; fired at 900 C; bulk density 0.660 g cm ⁻³ .
55	100	L	1957	505-673		Mica brick	White; fired at 1000 C; bulk density 0.666 g cm ⁻³ .
56	100	L	1957	507-653		Mica brick	White; fired at 1100 C; bulk density 0.666 g cm ⁻³ .
57	96	L	1934	353-1450		Refractory insulating brick	Specimen consisted of 8 standard-size bricks forming a section 18 x 18 x 2.5 in. in size.
58	96	L	1934	422-1478		Refractory insulating brick	Similar to the above specimen.
59	96	L	1934	439-1450		Refractory insulating brick	Similar to the above specimen.
60	96	L	1934	561-1339		Refractory insulating brick Johns-Manville C-22	Similar to the above specimen.
61	86	C	1948	841.2	3	Refractory insulating com- mon chamotte brick	Specimen prepared by "Semiluksk" factory; density 1.98 g cm ⁻³ ; iron used as comparative material.
62	86	L	1948	738.2		Refractory insulating chamotte brick	Similar to the above specimen but measured in a different apparatus.
63	91	C	1947	587-883		Magnesite brick	Specimen prepared by "Magnezit" factory; iron used as comparative material.
64	92	C P	1950	813-1023		Magnesite brick	No details reported.
65	97	C	1952	763-1373	±6.0	Magnesite brick	Porosity 22.5%; carborundum used as comparative material.
66	94	L	1942	284.1		Metallurgical brick; HS150	Measured at wall; density 1.910 g cm ⁻³ ; moisture content 3.99 vol. %; aged for 83 days.
67	94	L	1942	284.3		Metallurgical brick; HS150	Measured at wall; density 1.910 g cm ⁻³ ; moisture content 2.91 vol. %; aged for 198 days.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
68	94	L	1942	284.1		Metallurgical brick; HS150	Measured at wall; density 1.910 g cm ⁻³ ; moisture content 2.32 vol. %; aged for 402 days.
69	94	L	1942	273-303		Metallurgical brick; HS150	Measured in the laboratory; density 2.115 g cm ⁻³ ; moisture content 2.8 vol. %.
70	94	L	1942	273-303		Metallurgical brick; HS100	Measured in the laboratory; density 1.786 g cm ⁻³ ; moisture content 15.5 vol. %.
71	94	L	1942	273-303		Metallurgical brick; HS100	Measured in the laboratory; density 1.786 g cm ⁻³ ; moisture content 1.7 vol. %.
72	94	L	1942	285.4		Metallurgical brick; HS150	Measured at wall; density 2.030 g cm ⁻³ ; moisture content 4.3 vol. % (brick), 4.8 vol. % (wall).
73	94	L	1942	284.1		Metallurgical brick; HS150	Laboratory measurement; density 1.910 g cm ⁻³ ; moisture content 2.2 vol. % (brick), 2.3 vol. % (wall).
74	94	L	1942	282.0		Metallurgical brick; HS150	Measured at wall; density 1.975 g cm ⁻³ ; moisture content 17.2 vol. % (brick), 13.1 vol. % (wall).
75	94	L	1942	280.7		Metallurgical brick; HS100	Measured at wall; density 1.570 g cm ⁻³ ; moisture content 18.1 vol. % (brick), 14.2 vol. % (wall).
76	94	L	1942	282.4		Metallurgical brick; HS100	Measured at wall; density 1.620 g cm ⁻³ ; moisture content 15.1 vol. % (brick), 11.5 vol. % (wall).
77	94	L	1942	283.8		Metallurgical brick; HS100	Measured at wall; density 1.740 g cm ⁻³ ; moisture content 16.2 vol. % (brick), 12.2 vol. % (wall).
78	94	L	1942	287.3		Metallurgical brick; HS100	Measured at wall; density 1.690 g cm ⁻³ ; moisture content 14.8 vol. % (brick), 10.4 vol. % (wall).
79	94	L	1942	283.0		Metallurgical brick; HS100	Measured at wall; density 1.900 g cm ⁻³ ; moisture content 15.8 vol. % (brick), 11.1 vol. % (wall).
80	94	L	1942	292.1		Metallurgical porous brick	Measured at wall; density 0.955 g cm ⁻³ ; moisture content 6.8 vol. % (brick), 5.3 vol. % (wall).
81	94	L	1942	288.2		Metallurgical porous brick	Measured at wall; density 1.035 g cm ⁻³ ; moisture content 7.0 vol. % (brick), 5.2 vol. % (wall).
82	94	L	1942	294.9		Metallurgical porous brick	Measured at wall; density 1.000 g cm ⁻³ ; moisture content 10.9 vol. % (brick), 10.1 vol. % (wall).
83	94	L	1942	283.6		Metallurgical porous brick	Measured at wall; density 0.950 g cm ⁻³ ; moisture content 15.6 vol. % (brick), 13.6 vol. % (wall).
84	94	L	1942	300.3		Metallurgical porous brick	Measured at wall; density 0.955 g cm ⁻³ ; moisture content 6.6 vol. % (brick), 5.5 vol. % (wall).
85	94	L	1942	283.2		Metallurgical porous brick	Measured at wall; density 0.985 g cm ⁻³ ; moisture content 8.5 vol. %.
86	94	L	1942	283.2		Metallurgical porous brick (special)	Measured at wall; density 0.955 g cm ⁻³ ; moisture content 5.5 vol. %.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
87	94	L	1942	283.2		Porous brick	Measured at wall; density 1.230 g cm ⁻³ ; moisture content 1.1 vol %.
88	94	L	1942	283.2		Porous brick	Measured in laboratory; density 1.279 g cm ⁻³ ; moisture content 1.0 vol %.
89	94	L	1942	283.2		Porous concrete brick	Measured at wall; density 1.010 g cm ⁻³ ; moisture content 7.5 vol %.
90	94	L	1942	283.2		Slag brick	Measured at wall; density 1.147 g cm ⁻³ ; moisture content 4.6 vol %.
91	94	L	1942	283.2		Slag brick	Measured at wall; density 1.315 g cm ⁻³ ; moisture content 6.0 vol %.
92	94	L	1942	283.2		Slag brick	Laboratory measurement; density 1.357 g cm ⁻³ ; moisture content 3.3 vol %.
93	95	L	1935	350-1172	10.0	Silica fire brick (Star brand); I	1.009 in. thick and 4.02 in. in dia; measured with specimen II (the following specimen) in between the heater and this specimen; density 1.69 g cm ⁻³ .
94	95	L	1935	425-1277	10.0	Silica fire brick (Star brand); II	0.990 in. thick and 4.02 in. in dia; measured in direct contact with the heater and with the above specimen I on top; density 1.69 g cm ⁻³ .
95	95	L	1935	503-1121	10.0	Silica fire brick (Star brand); I	Same as the above specimen I except measured in direct contact with the heater and with the above specimen II on top.
96	95	L	1935	457-1030	10.0	Silica fire brick (Star brand); II	Same as the above specimen II except measured in contact with the above specimen I which is in direct contact with the heater.
97	95	L	1935	482-1078	10.0	Silica fire brick (Star brand); II	Same as the above specimen II except measured alone.
98	90	L	1943	544, 663	< 1.5	Commercial 9 in. straight silica brick (Star)	8.99 in. in length, 4.49 in. in width, 2.47 in. in thickness; bulk density 1.68 g cm ⁻³ ; condition of brick stability obtained by repeated heating.
99	90	L	1943	731-1367	< 1.5	Commercial 9 in. straight silica brick (Star)	Same as above but measured with 0.50 in. of group 29 insulating fire brick backing-up.
100	101	L	1935	589-1190	± 5.0	Silica brick; 1	Supplied by Wilkes, G. B.
101	101	L	1935	506-1190	± 5.0	Silica brick; 2	Same supplier as above; used as a guard brick in the measurement of the above specimen.
102	101	L	1935	456-1190	± 5.0	Silica brick; 1	Second run of specimen 1, after the brick and the thermocouples removed and then restored.
103	101	L	1935	489-1190	± 5.0	Silica brick; 3	Supplied by Birch, R. E. of Harbison-Walker Refractories Co.
104	101	L	1935	556-1190	± 5.0	Silica brick; 3	Second run of the above specimen, after the brick and the thermocouples removed and then restored.
105	101	L	1935	500-1123	± 5.0	Silica brick	Porosity 32%; specimen thickness 2.5 in.
106	100	L	1957	520-659		Vermiculite brick	Bulk density 0.484 g cm ⁻³ .
107	92	†P	1950	413, 733		Tripolite (tripoli earth) brick	No details reported.
108	102	L	1957	373-1173		Shamotte	Obtained from Harbison-Walker Refractories Co.; 30 mm dia x 20 mm high.
109	102	L	1957	373-1173		Silica	Obtained from General Refractories Co.; 30 mm dia x 20 mm high.

SPECIFICATION TABLE NO. 251 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
110	102	L	1957	373-1173		Zirconia	Obtained from Norton Co.; 30 mm dia x 30 mm long; dense; stabilized.
111	102	L	1957	373-1248		Zirconia insulating	Obtained from Norton Co.; 30 mm dia x 30 mm long.
112	102	L	1957	373-1273		Fire-brick HW28	Obtained from Harbison-Walker Refractories Co.; 30 mm dia x 30 mm long.
113	102	L	1957	423-773		Carsiat carborundum	Obtained from Didier Co.; 50 x 22 x 22 mm.
114	102	L	1957	423-973		Carbofrax carborundum	50 x 22 x 22 mm.
115	102	L	1957	423-973		Magnesite brick	30 mm dia x 20 mm high.
116	102	L	1957	423-973		SiC brick; 1	Manufactured in Japan; 30 mm dia x 30 mm long.
117	102	L	1957	423-973		SiC brick; 2	Similar to the above specimen.
118	103	L	1937	393, 855	<10	Silica-fire brick	Flat circular disk specimen.
119	103	L	1937	534, 692	<10	Silica-fire brick	Same sample as above but measured in different apparatus.
120	103	L	1937	513-1244	<10	Kaolin insulating refractory brick; I	0.958 in. in thickness, 4.44 in. in dia; density 0.641 g cm ⁻³ ; specimen in direct contact with center heater.
121	103	L	1937	386-1046	<10	Kaolin insulating refractory brick; II	0.959 in. in thickness, 4.50 in. in dia; density 0.639 g cm ⁻³ ; in measurement this specimen placed on top of the above specimen I.
122	103	L	1937	606-1215	<10	Kaolin insulating refractory brick; II	The above specimen II placed in direct contact with center heater.
123	103	L	1937	491-1033	<10	Kaolin insulating refractory brick; I	Specimen I placed on top of the above specimen II.
124	103	L	1937	424-1321	<10	Kaolin insulating refractory brick; I	The above specimen I in direct contact with center heater in a different apparatus.
125	103	L	1937	362-1173	<10	Kaolin insulating refractory brick; II	Specimen II placed on top of the above specimen I.
126	103	L	1937	485-1420	<10	Kaolin insulating refractory brick; II	Specimen II in direct contact with center heater in the 2nd apparatus.
127	103	L	1937	420-1250	<10	Kaolin insulating refractory brick; I	Specimen I placed on top of the above specimen II.
128	104	L	1956	376-1023		Carbofrax	Produced by U. S. Carborundum Co.; SiC 89%; specimen 20 mm in dia and 30 mm long; porosity 16.52%; clay guard ring is used.
129	104	L	1956	373-973		SiC brick; domestic (Japan)	Specimen 22 x 22 x 50 mm; porosity 15.34%; clay guard ring is used in measurement.
130	105	R	1958	454-732		Porous fire-brick (Italy)	Density 0.520 g cm ⁻³ .
131	105	R	1958	382-567		Porous fire-brick (Italy)	Different run of the above specimen.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
132	81	L	1924	1223.2	<2.0	Star silica brick; 2	8.5 in. dia x 3 in. thick; porosity 27.7%.
133	81	L	1924	1223.2	<2.0	Star silica brick; 3	8.5 in. dia x 3 in. thick; porosity 27.7%.
134	106	C	1956	377.7	3	Carbon brick; A1	80 mm dia x 125 mm long; apparent density 1.594 g cm ⁻³ ; electrical resistivity 0.00433 ohm cm; used for lining of Al electrolysis; copper used as comparative material.
135	106	C	1956	372.2	3	Carbon brick; A2	80 mm dia x 125 mm long; apparent density 1.586 g cm ⁻³ ; electrical resistivity 0.00446 ohm cm; used for lining of Al electrolysis; same comparative material as above.
136	106	C	1956	392.7	3	Carbon brick; B1	80 mm dia x 125 mm long; apparent density 1.548 g cm ⁻³ ; electrical resistivity 0.00505 ohm cm; used for lining of Al electrolysis; same comparative material as above.
137	106	C	1956	388.2	3	Carbon brick; B2	80 mm dia x 125 mm long; apparent density 1.556 g cm ⁻³ ; electrical resistivity 0.00477 ohm cm; used for lining of Al electrolysis; same comparative material as above.
138	106	C	1956	381.2	3	Carbon brick; C1	80 mm dia x 125 mm long; apparent density 1.654 g cm ⁻³ ; electrical resistivity 0.00418 ohm cm; used for lining of Al electrolysis; same comparative material as above.
139	106	C	1956	383.2	3	Carbon brick; C2	80 mm dia x 125 mm long; apparent density 1.674 g cm ⁻³ ; electrical resistivity 0.00412 ohm cm; used for lining of Al electrolysis; same comparative material as above.
140	107	L	1924	413-498		Hytex hydraulic pressed building brick	12 in. x 12 in. x 2 in. thick; heat flow approximately perpendicular to surface of the brick.
141	107	L	1924	518-1183		Georgia fire brick (G-3)	Same as the above specimen.
142	108	L	1920	303,363		Sil-O-Cel	Specimen 9 in. in dia, 0.977 in. thick; density 0.495; heat flow in transverse direction.
143	186	L	1928	547-1093	±2.5	Sil-O-Cel, No. 2	Density 0.641 g cm ⁻³ ; porosity 75%.
144	186	L	1928	573-1081	±2.5	Sil-O-Cel C-22, No. 3	Density 0.577 g cm ⁻³ ; porosity 75.7%.
145	186	L	1928	443-979	±2.5	Special Sil-O-Cel, No. 4	Density 0.541 g cm ⁻³ ; porosity 76.7%.
146	186	L	1928	492-1025	±2.5	Sil-O-Cel super, No. 5	Density 0.703 g cm ⁻³ ; porosity 72.6%.
147	186	L	1928	600-1120	±2.5	Sil-O-Cel super, No. 6	Density 0.652 g cm ⁻³ ; porosity 76.7%.
148	186	L	1928	472-1043	±2.5	Sil-O-Cel calcined, No. 8	Density 0.450 g cm ⁻³ ; porosity 83.9%.
149	186	L	1928	426-961	±2.5	Sil-O-Cel calcined, No. 9	Density 0.509 g cm ⁻³ ; porosity 84.0%.
150	186	L	1928	412-903	±2.5	Sil-O-Cel natural, No. 10	Density 0.437 g cm ⁻³ ; porosity 82.0%.
151	186	L	1928	410-977	±2.5	Sil-O-Cel natural, No. 11	Density 0.450 g cm ⁻³ ; porosity 85.6%.
152	186	L	1928	598-1220	±2.5	Fire-clay brick, 1st quality Missouri	Density 1.93 g cm ⁻³ ; porosity 26.5%.
153	186	L	1928	623-1187	±2.5	Red brick, hard burned	Density 2.10 g cm ⁻³ ; porosity 23.7%.
154	186	L	1928	522-1069	±2.5	Red brick, soft burned	Density 1.75 g cm ⁻³ ; porosity 38.3%.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
155	383	L	1927	473-1673	±15	Alumina fused brick	Commercial brick; specimen 10.8 cm dia x 22.8 cm long; apparent density 3.67 g cm ⁻³ ; bulk density 2.90 g cm ⁻³ ; porosity 27.3%; made of fused alumina grog and bonded with fire clay.
156	383	L	1927	473-1673	±20	Magnesite fire brick	Commercial brick; 10.8 cm dia x 22.8 cm long.
157	383	L	1927	473-1673	±15	Chrome fire brick	Commercial brick; 10.8 cm dia x 22.8 cm long; apparent density 3.94 g cm ⁻³ ; bulk density 2.74 g cm ⁻³ ; porosity 30.5%.
158	457	C	1954	293.2			Cork used as comparative material.
159	81	L	1924	1223	< 2.0	Magnesia brick; 1	92.0-95.0 MgO; electrically sintered, fired to cone 16; 0.5 in. dia x 1.983 in. thick; prepared by crushing the electric furnace products to pass a No. 14 screen and bonding with fire clay; specimen contains 3% bond clay of 25.41 Al ₂ O ₃ , 59.55 SiO ₂ , 2.31 Fe ₂ O ₃ , 1.33 TiO ₂ , 1.01 (K ₂ O + Na ₂ O), 0.46 CaO, 0.33 MgO, and 9.10 loss; measured at 744.0 mm Hg pressure; porosity 23.4% calculated from the dry saturated suspended weight.
160	81	L	1924	1223	< 2.0	Magnesia brick; 2	Same as the above specimen except measured at 741.3 mm Hg pressure.
161	458	R	1921	373.2		Magnesia brick	53.27 MgO (original composition from author was 53.27 MnO that could be mistyped), 32.46 SiO ₂ , 14.78 Al ₂ O ₃ , 4.91 CaO, 2.5 Fe ₂ O ₃ ; specimen 10 cm in dia and 45 mm in height; density reported as 2.295, 2.294, 2.291, 2.285, 2.275, and 2.266 g cm ⁻³ at 20, 50, 100, 200, 300, and 400 C, respectively.
162	458	P	1921	373.2		Magnesia brick	Similar to the above specimen except measured with different method, thermal conductivity data calculated from diffusibility, specific heat and specific gravity.
163	458	R	1921	373.2		Common brick	76.52 SiO ₂ , 13.67 Al ₂ O ₃ , 6.77 Fe ₂ O ₃ , 1.77 CaO, 0.42 MgO, and 0.27 MnO; 10 cm dia x 4.5 cm thick.
164	458	P	1921	373.2		Common brick	Similar to the above specimen; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
165	458	R	1921	373.2		Chrome	31.89 Cr ₂ O ₃ , 24.86 Al ₂ O ₃ , 16.48 MgO, 16.91 Fe ₂ O ₃ , 8.30 SiO ₂ , 0.26 CaO; specimen 10 cm in dia and 45 mm in height; density reported as 2.982, 2.981, 2.978, and 2.970 g cm ⁻³ at 20, 50, 100, and 200 C, respectively.
166	458	P	1921	373.2		Chrome	Similar to the above specimen except measured in different method; thermal conductivity data calculated from the measurement of diffusibility, specific heat and specific gravity.
167	84	L	1925	1173-1773		Carbofrax	Test wall built of standard 9 x 4.5 x 2.5 in. bricks laid up with cement of the same composition as the bricks; heat flow through the 4.5 in. dimension; measured at decreasing temperatures.
168	458	R	1921	373.2		Silica brick	94.98 SiO ₂ , 3.06 CaO, 1.18 Al ₂ O ₃ , and 1.13 Fe ₂ O ₃ ; 10 cm dia x 4.5 cm thick; density reported as 1.840, 1.836, 1.829, 1.814, and 1.804 g cm ⁻³ at 20, 50, 100, 200, and 300 C, respectively.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
169	458	P	1921	373.2		Silica brick	Similar to the above specimen; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
170	458	R	1921	373.2		Shamotte brick	69.78 SiO ₂ , 33.95 Al ₂ O ₃ , 4.37 Fe ₂ O ₃ , 0.79 CaO, traces of MgO and MnO; 10 cm dia x 4.5 cm thick; density reported as 1.917, 1.916, 1.913, 1.905, 1.901, 1.896, and 1.892 g cm ⁻³ at 20, 50, 100, 200, 300, 400, and 500 C, respectively.
171	458	P	1921	373.2		Shamotte brick	Similar to the above specimen; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
172	458	R	1921	373.2		Slag brick	43.27 CaO, 26.75 SiO ₂ , 15.21 Al ₂ O ₃ , 12.69 Cr ₂ O ₃ , 6.75 Fe ₂ O ₃ , and 2.29 MnO; 10 cm dia x 4.5 cm thick.
173	458	P	1921	373.2		Slag brick	Similar to the above specimen; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
174	458	P	1921	373.2		Chrome brick	36.42 Cr ₂ O ₃ , 19.51 Al ₂ O ₃ , 14.56 MgO, 1.85 SiO ₂ , 1.843 Fe ₂ O ₃ , and 0.94 CaO; 4 cm dia x 8 cm long; density 3.028 g cm ⁻³ ; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
175	458	P	1921	373.2		Magnesia brick	76.43 MgO, 18.26 SiO ₂ , 2.56 Al ₂ O ₃ , 0.80 Fe ₂ O ₃ , 0.21 MnO, and trace of CaO; 4 cm dia x 8 cm long; supplied by Imperial Steel Works; density 2.370 g cm ⁻³ ; same measuring method as above.
176	458	P	1921	373.2		Silica brick	51.29 SiO ₂ , 4.01 Fe ₂ O ₃ , 2.80 CaO, 1.27 Al ₂ O ₃ , and 0.46 MnO; 4 cm dia x 8 cm long; prepared by Imperial Steel Works; density 1.891 g cm ⁻³ ; same measuring method as above.
177	458	P	1921	373.2		Red brick	76.32 SiO ₂ , 21.96 Al ₂ O ₃ , 1.88 Fe ₂ O ₃ , traces of CaO and MgO; commercial brick; 4 cm dia x 8 cm long; density 1.795 g cm ⁻³ ; same measuring method as above.
178	458	P	1921	373.2		Red brick	76.45 SiO ₂ , 21.13 Al ₂ O ₃ , 2.02 Fe ₂ O ₃ , traces of CaO and MgO; same source, dimensions, and measuring method as the above specimen; density 1.782 g cm ⁻³ .
179	458	P	1921	373.2		Shamotte brick	79.98 SiO ₂ , 19.48 Al ₂ O ₃ , 0.40 Fe ₂ O ₃ , traces of CaO and MgO; 4 cm dia x 8 cm long; supplied by Imperial Steel Works; density 1.565 g cm ⁻³ ; same measuring method as above.
180	458	P	1921	373.2		Shamotte brick	71.74 SiO ₂ , 25.56 Al ₂ O ₃ , 1.02 Fe ₂ O ₃ , 0.82 CaO, and 0.53 MgO; 4 cm dia x 8 cm long; supplied by Imperial Steel Works; density 1.784 g cm ⁻³ ; same measuring method as above.
181	458	P	1921	373.2		Slag brick	40.39 CaO, 26.34 SiO ₂ , 12.90 Al ₂ O ₃ , 1.71 MnO, 0.34 MgO, and 0.26 Fe ₂ O ₃ ; 4 cm dia x 8 cm long; density 1.572 g cm ⁻³ ; same measuring method as above.
182	458	P	1921	373.2		Slag brick	41.32 CaO, 25.64 SiO ₂ , 13.72 Al ₂ O ₃ , 2.09 MnO, 0.4 MgO, and 0.28 Fe ₂ O ₃ ; 4 cm dia x 8 cm long; density 1.585 g cm ⁻³ ; same measuring method as above.

SPECIFICATION TABLE NO. 281 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
183	238	P	1921	773-1373		Magnesite brick	81.79 MgO, 5.24 CaO, and 1.87 Fe ₂ O ₃ ; very close texture; 9 x 4.5 x 2.5 in.; apparent density 2.63 g cm ⁻³ , true density 3.29 g cm ⁻³ , porosity 20.0%; heat flow along the length of the specimen.
184	238	P	1921	773-1373		Magnesite brick	87.88 MgO, 4.68 CaO, and 2.56 Fe ₂ O ₃ ; texture not so close; apparent density 2.56 g cm ⁻³ , true density 3.28 g cm ⁻³ , porosity 24.5%.
185	247	L	1932	379-794	1.0	Chromite brick	40.09 Cr ₂ O ₃ , 22.68 MgO, 13.16 Fe ₂ O ₃ , 10.48 Al ₂ O ₃ , 10.53 SiO ₂ , 2.32 Mn ₂ O ₄ , 0.68 CaO, and trace of TiO ₂ ; density 3.988 g cm ⁻³ , porosity 27.3%.
186	143	L	1955	683-1263		Magnezit; 4	49.46 MgO, 20.48 Cr ₂ O ₃ , 12.59 Al ₂ O ₃ , 9.15 Fe ₂ O ₃ , 5.24 SiO ₂ , 1.90 FeO, 1.26 CaO, 0.09 total Ca, Mg, Fe, and Mn; chromomagnesite refractory brick; density 2.95 g cm ⁻³ , apparent porosity 22.8%; gas permeability 0.455 m ³ x cm m ⁻² hr ⁻¹ (mm H ₂ O) ⁻¹ .
187	143	L	1955	673-1253		Magnezit; 5	Similar to the above specimen.
188	143	L	1955	643-1168		Magnezit; 6	Similar to the above specimen.
189	143	L	1955	658-1245		K Marksa; 11	42.31 MgO, 24.35 Cr ₂ O ₃ , 12.34 Al ₂ O ₃ , 11.94 Fe ₂ O ₃ , 6.14 SiO ₂ , 1.71 FeO, 1.65 CaO, 0.13 total Ca, Mg, Fe, and Mn; chromomagnesite refractory brick; density 3.03 g cm ⁻³ , apparent porosity 21.5%; gas permeability 0.303 m ³ x cm m ⁻² hr ⁻¹ (mm H ₂ O) ⁻¹ .
190	143	L	1955	698-1258		Magnezit; 7	64.85 MgO, 12.28 Cr ₂ O ₃ , 8.51 Al ₂ O ₃ , 5.80 Fe ₂ O ₃ , 4.28 SiO ₂ , 1.67 FeO, 1.44 CaO, 0.21 total Ca, Mg, Fe, and Mn; chromomagnesite heat resistant refractory brick; density 3.04 g cm ⁻³ , apparent porosity 19.1%; gas permeability 0.450 m ³ x cm m ⁻² hr ⁻¹ (mm H ₂ O) ⁻¹ .
191	143	L	1955	708-1263		Magnezit; 8	Similar to the above specimen.
192	143	L	1955	653-1233		Magnezit; 9	Similar to the above specimen.
193	143	L	1955	683-1228		Ordzhonikidze; 10	42.87 MgO, 22.34 Cr ₂ O ₃ , 13.04 Fe ₂ O ₃ , 11.46 Al ₂ O ₃ , 5.42 SiO ₂ , 2.88 FeO, 1.76 CaO, trace total Ca, Mg, Fe, and Mn; chromomagnesite heat resistant refractory brick; density 2.95 g cm ⁻³ , apparent porosity 25.6%; gas permeability 0.598 m ³ x cm m ⁻² hr ⁻¹ (mm H ₂ O) ⁻¹ .
194	462	L	1915	598-1303		Magnesia brick	92.1 MgO, 5.0 SiO ₂ , 1.7 CaO, 1.6 Fe ₂ O ₃ , and 0.4 Al ₂ O ₃ ; commercial brand; 2.5 in. thick; fine grained; apparent density 2.40 g cm ⁻³ .
195	85	L	1949	636-1036	5-7	High temp insulating blast furnace brick	56.42 SiO ₂ , 1.42 Fe ₂ O ₃ , 40.18 total Al ₂ O ₃ and TiO ₂ , 0.88 CaO, and 0.36 MgO; semi-dry pressed; from Semiluk factory; density 2.16 g cm ⁻³ and open porosity 17.8%; no additional shrinkage when exposed at 1350 C for 2 hrs.
196	85	L	1949	623-993	5-7	Light weight brick	66.08 SiO ₂ , 1.04 Fe ₂ O ₃ , 30.48 total Al ₂ O ₃ and TiO ₂ , 0.92 CaO, and 0.52 MgO; from Shchekinsk factory; density 1.30 g cm ⁻³ and open porosity 49.9%; 0.1% additional shrinkage when exposed at 1350 C for 2 hrs.
197	85	L	1949	636-1003	5-7	Light weight brick	70.98 SiO ₂ , 1.38 Fe ₂ O ₃ , 25.08 total Al ₂ O ₃ and TiO ₂ , 0.96 CaO, and 0.25 MgO; from Saitirevsk factory; density 1.17 g cm ⁻³ and open porosity 56.6%; 2.0% additional shrinkage when exposed at 1350 C for 2 hrs.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
198	86	C	1948	503-798	3	II	65.72 SiO ₂ , 1.93 Fe ₂ O ₃ , 29.02 total TiO ₂ and Al ₂ O ₃ , 1.08 CaO, and 0.62 MgO; open porosity 0.86%; water absorption 81.0%; gas permeability 211 ml m ⁻² hr ⁻¹ ; refractoriness 1630-1650 C; light gray color; pore size up to 1.5 mm in dia; pore distribution even.
199	86	C	1948	505-797	3	III	66.38 SiO ₂ , 1.63 Fe ₂ O ₃ , 29.05 total TiO ₂ and Al ₂ O ₃ , 1.12 CaO, and 0.51 MgO; density 0.86 g cm ⁻³ ; open porosity 66.3%; water absorption 75.4%; gas permeability 280 ml m ⁻² hr ⁻¹ ; refractoriness 1630-1650 C; yellowish red color; pores heterogeneous, a small number of pores of 3-5 mm side by side with pores of 1.5 mm.
200	86	C	1948	518-834	3	IV	67.89 SiO ₂ , 1.93 Fe ₂ O ₃ , 27.81 total TiO ₂ and Al ₂ O ₃ , 0.64 CaO, and 0.52 MgO; density 0.98 g cm ⁻³ ; open porosity 63%; water absorption 62.6%; gas permeability 46 ml m ⁻² hr ⁻¹ ; refractoriness 1630-1650 C; white color; large number of pores with diameters 6-7 mm.
201	86	L	1948	783-1028		IV	67.89 SiO ₂ , 27.81 total TiO ₂ and Al ₂ O ₃ , 1.93 Fe ₂ O ₃ , 0.64 CaO, and 0.52 MgO; same as the above specimen.
202	86	L	1948	758-973		II	65.72 SiO ₂ , 29.02 total TiO ₂ and Al ₂ O ₃ , 1.93 Fe ₂ O ₃ , 1.08 CaO, and 0.52 MgO; same as the above specimen.
203	85	L	1949	666-1064	5-7	Normal brick; 2	63.06 SiO ₂ , 33.91 total Al ₂ O ₃ + TiO ₂ , 1.21 Fe ₂ O ₃ , 1.00 CaO, and 0.67 MgO; semidry pressed; from Semiluk's factory; density 1.86 g cm ⁻³ ; open porosity 29.1%; no additional shrinkage when exposed at 1350 C for 2 hrs.
204	85	L	1949	698-1101	5-7	Normal brick; 5	56.32 SiO ₂ , 40.72 Al ₂ O ₃ and TiO ₂ , 1.02 CaO, 0.92 Fe ₂ O ₃ , and 0.48 MgO; semidry pressed; from Borovitchsk factory; density 1.92 g cm ⁻³ ; open porosity 28.1%; 0.5% additional shrinkage when exposed at 1350 C for 2 hrs.
205	238	P	1921	873-1373		Silica brick C	93.36 SiO ₂ , 2.97 Al ₂ O ₃ , and 2.20 CaO; specimen 9 x 4.5 x 2.5 in.; open texture with large number of fissures of appreciable size; bonding of coarse (angular rock fragments of 0.25 in. and downward) and fine fairly good except fine material easily detached; porosity 20.7%; heat flow in lengthwise direction.
206	79	L	1942	696-880		No. 3, aluminous fire clay	52.0 SiO ₂ , 41.3 Al ₂ O ₃ , 2.7 TiO ₂ , and 2.5 Fe ₂ O ₃ ; fired at the temperature of refractory standard cone 33; 18 in. x 18 in. dimensions.
207	79	C	1942	1062, 1254		No. 3, aluminous fire clay	Similar to the above specimen except in disc form; steel used as comparative material.
208	85	L	1949	661-1048	5-7	Light weight brick	54.56 SiO ₂ , 40.73 Al ₂ O ₃ + TiO ₂ , 2.59 Fe ₂ O ₃ , 0.92 CaO, and 0.45 MgO; from Borovitchsk factory; density 1.24 g cm ⁻³ ; open porosity 53.0%; 0.5% additional shrinkage when exposed at 1350 C for 2 hrs.
209	86	C	1948	513-827			68.12 SiO ₂ , 27.38 Al ₂ O ₃ + TiO ₂ , 2.04 Fe ₂ O ₃ , 0.88 CaO, and 0.59 MgO; density 0.91 g cm ⁻³ ; open porosity 65.1%; water absorption 64.5%; gas permeability 216 ml m ⁻² hr ⁻¹ ; and refractoriness 1630 C; light yellow color; numerous pores with size up to 1.5 mm in dia and small number of pores with dia up to 5-6 mm; distribution of pores even.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
210	86	L	1948	753-993			68.12 SiO ₂ , 27.38 Al ₂ O ₃ + TiO ₂ , 2.04 Fe ₂ O ₃ , 0.88 CaO, and 0.59 MgO; other descriptions same as the above.
211	85	L	1949	668-1053	5-7	Normal brick; 3	75.70 SiO ₂ , 20.41 Al ₂ O ₃ + TiO ₂ , 2.59 Fe ₂ O ₃ , 0.68 CaO, and 0.53 MgO; semi-acid; of sheet form from Latsensk factory; density 1.85 g cm ⁻³ ; open porosity 30.4%; 0.1% additional shrinkage when exposed at 1350 C for 2 hrs.
212	85	L	1949	668-1053	5-7	Normal brick; 4	48.40 SiO ₂ , 37.36 Al ₂ O ₃ + TiO ₂ , 2.24 Fe ₂ O ₃ , 0.62 CaO, and 0.59 MgO; in sheet form from Borovitchak factory; density 1.919 g cm ⁻³ ; open porosity 29.0%; 0.3% additional shrinkage when exposed at 1350 C for 2 hrs.
213	247	L	1932	399-851	1	Bauxite brick; 21	73.04 Al ₂ O ₃ , 19.60 SiO ₂ , 2.86 TiO ₂ , 2.30 Fe ₂ O ₃ , 1.42 CaO, and 0.65 MgO; density 3.310 g cm ⁻³ ; porosity 27.2%; gas permeability 0.013 m ² -cm per m ² -hr-mm Hg.
214	79	L	1942	688-857	1	Fire clay brick; 1	56.46 SiO ₂ , 36.79 Al ₂ O ₃ , 2.58 Fe ₂ O ₃ , 1.84 TiO ₂ , 1.24 alkali oxides, 0.60 MgO, and 0.38 CaO; fired at the temp of the refractory test cone 31; in slab form 18 in. x 18 in.
215	79	C	1942	1066, 1301		Fire clay brick; 1	Similar to the above specimen except in disk form of 8 in. in dia and 1 in. in thickness; steel used as comparative material.
216	79	L	1942	615-784		Fire clay brick; 2	Similar to the above specimen except in slab form 18 in. x 18 in.
217	79	C	1942	1009, 1242		Fire clay brick; 2	Similar to the above specimen except in disk form 8 in. in dia and 1 in. in thickness; steel used as comparative material.
218	83	C	1956	531-833		Egyptian fire clay brick; A	64.5 SiO ₂ , 26.0 Al ₂ O ₃ , 7.0 Fe ₂ O ₃ , 1.1 CaO, and 1.0 MgO; bulk density 1.01 g cm ⁻³ ; apparent porosity 72.7%.
219	83	L	1956	593-881		Egyptian fire clay brick; B	65.3 SiO ₂ , 29.5 Al ₂ O ₃ , 3.5 Fe ₂ O ₃ , 0.9 MgO, and 0.8 CaO; bulk density 1.09 g cm ⁻³ ; apparent porosity 60.0%.
220	83	L	1956	606-858		Egyptian fire clay brick; C	71.0 SiO ₂ , 24.0 Al ₂ O ₃ , 2.5 Fe ₂ O ₃ , 0.8 CaO, and 0.7 MgO; bulk density 0.780 g cm ⁻³ ; apparent porosity 68.5%.
221	84	L	1925	1623	1	Fire clay wall; 26	58.50 SiO ₂ , 34.48 Al ₂ O ₃ , 3.52 Fe ₂ O ₃ , 1.80 TiO ₂ , 0.62 MgO, 0.29 CaO, and 0.31 ignition loss; original coarse, fairly open, first quality fire clay; apparent density 2.05 g cm ⁻³ ; porosity 26.8% calculated by assuming specific gravity 2.60 for fire clay; the wall under test was built with standard 2.5 x 4.5 x 9 in. bricks laid up with cement of the same composition as the brick.
222	462	L	1915	816-1268		Fire clay brick (Farnley)	66 SiO ₂ , 31 Al ₂ O ₃ , 1.2 TiO ₂ , 1.0 alkalis, 0.9 MgO, 0.3 CaO; commercial brand; specimen 1.5 in. thick; apparent density 1.95 g cm ⁻³ ; hard fired to Seger Cone 10-11.
223	462	L	1915	1033-1203		Fire clay brick (Farnley)	Similar to the above specimen.
224	462	L	1915	1278-1293		Fire clay brick (Farnley)	Similar to the above specimen except apparent density 1.90 g cm ⁻³ ; soft fired to Seger Cone 8-9.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
225	462	L	1915	1078		Silicious brick (Farnley)	82.5 SiO ₂ , 16.1 Al ₂ O ₃ , 1.2 TiO ₂ , 1.3 alkalis, trace CaO and MgO; specimen 3 in. thick; apparent density 1.82 g cm ⁻³ , with many silica grains.
226	462	L	1915	1113		Silica brick (Gregory)	95.3 SiO ₂ , 2.0 Al ₂ O ₃ , 2.0 TiO ₂ , 1.5 CaO; specimen 2.5 in. thick; coarse grain; apparent density 1.75 g cm ⁻³ .
227	462	L	1915	918-1191		Silica brick (Gregory)	Similar to the above specimen except apparent density 1.74 g cm ⁻³ .
228	238	P	1921	773-1373		Fire brick; D	63.38 SiO ₂ , 26.12 Al ₂ O ₃ , and 2.50 Fe ₂ O ₃ ; close structure; not much clay frog, but large proportion of angular quartz grains; adherence very good; very few fissures; quartz grains very evenly graded; faces of brick not good; very fine black cores; appearance of many pinholes; brick size 9 x 4.5 x 2.5 in.; porosity 17.3%; heat flow along the length of the specimen.
229	247	L	1932	394-817	1	Silica brick; S	92.14 SiO ₂ , 2.59 CaO, 2.21 Al ₂ O ₃ , 1.11 Fe ₂ O ₃ , 0.34 TiO ₂ , and 0.23 MgO; density 2.328 g cm ⁻³ ; porosity 28.1%; gas permeability 2.354 m ³ cm ⁻¹ hr ⁻¹ (mm of H ₂ O) ⁻¹ .
230	238	P	1921	873-1373		Silica brick; B	94.02 SiO ₂ , 2.64 CaO, and 1.78 Al ₂ O ₃ ; exceptionally fine-grained, close, and uniform texture throughout the brick; major portion of material of sand size, with very few fragments of rock of appreciable size; porosity 38.2%, with pores of even size; friable; brick size: 9 x 4.5 x 2.5 in.; heat flow in the lengthwise direction of the brick.
231	79	L	1942	640-1088		Sillimanite refractory brick; 4	58.08 Al ₂ O ₃ , 39.6 SiO ₂ , 1.49 TiO ₂ , 0.53 Fe ₂ O ₃ , 0.39 CaO, 0.15 MgO, and 0.25 alkali oxides; specimen in the form of a slab measuring 18 in. x 18 in.; prepared from well calcined and graded sillimanite bonded with highly refractory plastic clays; fired at 1410 to 1420 C for 60 hrs; fired material showing considerable mullite development; porosity 23.16%; weight lost on ignition 0.08%.
232	79	C	1942	1029, 1253		Sillimanite refractory brick; 4	Similar to the above specimen but in disc form 8 in. in dia and 1 in. thick; steel used as comparative material.
233	247	L	1932	403-749	1	Bauxite brick 20	59.89 Al ₂ O ₃ , 36.62 SiO ₂ , 1.12 CaO, 0.87 Fe ₂ O ₃ , 0.66 MgO, and 0.62 TiO ₂ ; density 3.029 g cm ⁻³ ; porosity 35.9%; gas permeability 0.010 m ³ -cm per m ² -hr-mm H ₂ O.
234	247	L	1932	348-723	1	Sillimanite brick E	59.70 Al ₂ O ₃ , 36.88 SiO ₂ , 1.44 TiO ₂ , 1.01 Fe ₂ O ₃ , 0.50 CaO, 0.07 MgO, and 0.06 Mn ₂ O ₄ ; density 2.989 g cm ⁻³ ; porosity 20.7%; gas permeability 0.100 m ³ -cm per m ² -hr-mm H ₂ O.
235	247	L	1932	346-744	1	Sillimanite brick G	59.47 Al ₂ O ₃ , 37.00 SiO ₂ , 1.54 TiO ₂ , 0.91 Fe ₂ O ₃ , 0.44 CaO, 0.09 MgO, and 0.06 Mn ₂ O ₄ ; density 3.053 g cm ⁻³ ; porosity 20.6%; gas permeability 0.073 m ³ -cm per m ² -mm H ₂ O.
236	143	L	1955	723-1313		Magnezit; 1	93.88 MgO, 2.08 SiO ₂ , 0.83 (0.05 TiO ₂) Al ₂ O ₃ , 1.63 Fe ₂ O ₃ , 1.24 CaO, and 0.20 total Ca, Mg, Fe, and Mn; magnesite basic refractory brick; density 2.81 g cm ⁻³ ; apparent porosity 22.0%; gas permeability 1.34 ml m ⁻² hr ⁻¹ per mm H ₂ O.
237	143	L	1955	713-1303		Magnezit; 2	Similar to the above specimen.
238	143	L	1955	773-1348		Magnezit; 3	Similar to the above specimen.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
239	247	L	1932	399-740	1	Fire clay brick 17	53.56 SiO ₂ , 42.23 Al ₂ O ₃ , 1.59 Fe ₂ O ₃ , 1.01 CaO, 0.83 MgO, and 0.62 TiO ₂ ; density 2.710 g cm ⁻³ , porosity 31.5%; gas permeability 3.00 m ³ cm per m ² -hr-mm H ₂ O.
240	247	L	1932	598-804	1	Fire clay brick 725	<60 SiO ₂ , >40 Al ₂ O ₃ ; porosity 21.0%.
241	79	L	1942	709-902		Sillimanite refractory brick; 6	58.29 SiO ₂ , 9.24 Al ₂ O ₃ , 0.89 TiO ₂ , 0.63 Fe ₂ O ₃ , 0.38 CaO, 0.10 MgO, and 0.29 alkali oxides; specimen in the form of a slab measuring 18 in. x 18 in.; made from natural quartzitic silica sands bonded with clays; fired at 1360 C for 14 hrs; after being fired specimen is of fine texture, containing finely divided cristobalite and considerable residual free quartz in a clayey matrix; porosity 21.36%; weight lost on ignition 0.14%.
242	79	C	1942	1025, 1225		Sillimanite refractory brick; 6	Similar to the above specimen but in disc form 8 in. in dia and 1 in. in thickness; steel used as comparative material.
243	79	L	1942	679-822		Sillimanite refractory brick; 7	59.11 SiO ₂ , 9.04 Al ₂ O ₃ , 0.75 TiO ₂ , 0.53 Fe ₂ O ₃ , 0.13 MgO, 0.10 CaO, and 0.17 alkali oxides; specimen in the form of a slab measuring 18 in. x 18 in.; similar raw material to the above specimen No. 6; fired at 1360 C for 14 hrs; mineralogical constitution of the fired product similar to the above specimen No. 6; porosity 24.10%; weight lost on ignition 0.12%.
244	79	C	1942	1006, 1252		Sillimanite refractory brick; 7	Similar to the above specimen but in disc form 8 in. in dia and 1 in. in thickness; steel used as comparative material.
245	80	L	1934	382, 877		Dense fire clay brick (Mexko-brand)	52.5 SiO ₂ , 42.07 Al ₂ O ₃ , 2.0 TiO ₂ , 1.6 Fe ₂ O ₃ , 0.5 CaO, trace MgO, and 0.6 alkali; approx composition, bulk density 143 lb ft ⁻³ , porosity 15.2%.
246	80	L	1934	733-1527		Dense fire clay brick (Mexko-brand)	The above specimen measured with insulating brick placed between the calorimeter and the lower surfaces of the brick.
247	238	P	1921	873-1373		Fire brick E	57.9 SiO ₂ , 32.96 Al ₂ O ₃ ; very close structure; abundance of fine grained rounded grog and a little larger grained grog; exceptionally good adherence; marked by a fair number of black cores, generally with cavities; faces smooth and edges sharp; brick size 9 x 4.5 x 2.5 in.; porosity 15.9%; heat flow in the length-wise direction.
248	238	P	1921	773-1373		Fire brick F	67.49 SiO ₂ , 27.15 Al ₂ O ₃ ; very open texture; abundance of rounded clay grog of uneven grading, some grains approximating to pebbles; unweathered pellets detected; adherence poor - in fact, material is very friable; highly fissured; brick size 9 x 4.5 x 2.5 in.; porosity 24.6%; heat flow in the direction of the length of the brick.
249	238	P	1921	773-1373		Retort material G	67.1 SiO ₂ , 27.17 Al ₂ O ₃ ; very open texture; very heavily grogged with medium to fine rounded material of uneven grading; abundance of small fissures; adherence of grog very poor; matrix appears to have contracted away from the grog; brick size 9 x 4.5 x 2.5 in.; porosity 24%; heat flow in the direction of the length of the brick.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
250	238	P	1921	773-1373		Retort material H	65.7 SiO ₂ , 28.47 Al ₂ O ₃ ; somewhat closer in texture than G; heavily grogged with rounded material of slightly more even grading than G; adherence as a whole fairly good, although some are easily detached; some fissures; very white color with well-defined skin; brick size 9 x 4.5 x 2.5 in.; porosity 28.2%; heat flow in the direction of the length of the brick.
251	238	P	1921	773-1373		Retort material I	72.46 SiO ₂ , 21.65 Al ₂ O ₃ ; very close in texture; abundant grog which, tending to be rounded, is evenly graded, possibly some quartz fragments; black cores present, but scarce; tendency toward layering; fissures, present but scarce, are parallel to outside faces; superficial skin; signs of possible reduction toward end of fire; brick size 9 x 4.5 x 2.5 in.; porosity 24.7%; heat flow in the direction of the length of the brick.
252	383	L	1927	473-1623	±15	Kaolin firebrick	52.02 SiO ₂ , 45.92 Al ₂ O ₃ , 1.51 Fe ₂ O ₃ , 0.35 TiO ₂ , and traces of alkalis; specimen 10.8 cm in dia and 22.8 cm long; apparent density 2.66 g cm ⁻³ , bulk density 2.36 g cm ⁻³ ; porosity 10.8%; made of sedimentary kaolin by mixing 65% of 20-mesh pre-fired grog and 35% of raw clay, and firing to 1575 C for 4 hrs.
253	383	L	1927	473-1773	±15	Kaolin firebrick	52.02 SiO ₂ , 45.92 Al ₂ O ₃ , 1.51 Fe ₂ O ₃ , 0.35 TiO ₂ , and traces of alkalis; specimen 10.8 cm in dia and 22.8 cm long; apparent density 2.65 g cm ⁻³ , bulk density 2.19 g cm ⁻³ ; porosity 23.2%; made of sedimentary kaolin by mixing 65% of 4-mesh pre-fired grog and 35% of raw clay, and firing to 1575 C for 4 hrs.
254	383	L	1927	473-1673	±15	Kaolin firebrick	52.02 SiO ₂ , 45.92 Al ₂ O ₃ , 1.51 Fe ₂ O ₃ , 0.35 TiO ₂ , and traces of alkalis; specimen 10.8 cm in dia and 22.8 cm long; apparent density 2.50 g cm ⁻³ , bulk density 1.27 g cm ⁻³ ; porosity 49.1%.
255	247	L	1932	423-808	1	Silica brick 1	95.12 SiO ₂ , 2.37 CaO, 0.55 Al ₂ O ₃ , 0.69 Fe ₂ O ₃ , 0.19 MgO, and 0.72 TiO ₂ ; density 2.342 g cm ⁻³ ; porosity 19.0%; gas permeability 0.184 m ³ -cm per m ² -hr-mm H ₂ O.
256	247	L	1932	377-798	1	Silica brick 8	94.02 SiO ₂ , 2.98 CaO, 0.91 Al ₂ O ₃ , 0.79 Fe ₂ O ₃ , 0.22 MgO, and 0.50 TiO ₂ ; density 2.327 g cm ⁻³ ; porosity 23.1%; gas permeability 0.582 m ³ -cm per m ² -hr-mm H ₂ O.
257	247	L	1932	377-744	1	Silica brick 9	92.28 SiO ₂ , 3.26 CaO, 1.84 Al ₂ O ₃ , 0.55 Fe ₂ O ₃ , 0.23 MgO, and 0.41 TiO ₂ ; density 2.350 g cm ⁻³ ; porosity 27.6%; gas permeability 1.750 m ³ -cm per m ² -hr-mm H ₂ O.
258	210		1952	644-1366		Dense brick; A	4.5/5.0 CaO, <2.0 HfO ₂ , 0.2-0.5 Fe ₂ O ₃ , 0.5-1.0 SiO ₂ , 0.4-1.0 TiO ₂ , and balance of ZrO ₂ ; stabilized; density (25 C) 4.0 g cm ⁻³ ; 28 vol % pores.
259	210		1952	644-1366		Insulating brick; B	4.5/5.0 CaO, <2.0 HfO ₂ , 0.2-0.5 Fe ₂ O ₃ , 0.5-1.0 SiO ₂ , 0.4-1.0 TiO ₂ , and balance of ZrO ₂ ; stabilized; density (25 C) 2.72 g cm ⁻³ and 50 vol % pores.
260	210		1952	644-1366		Insulating brick; C	4.5/5.0 CaO, <2.0 HfO ₂ , 0.2-0.5 Fe ₂ O ₃ , 0.5-1.0 SiO ₂ , 0.4-1.0 TiO ₂ , and balance of ZrO ₂ ; stabilized; density (25 C) 1.81 g cm ⁻³ and 65 vol % pores.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
261	374	C	1965	420-1106	0-±2		Type C, lime-stabilized zirconia, 93.7 ZrO ₂ , 3.35 CaO, 1.38 HfO ₂ , 0.30 SiO ₂ , 1.07 Al ₂ O ₃ , 0.17 Fe ₂ O ₃ , and 0.03 TiO ₂ ; composed of polygonal grains of anisotropic material with most grains in the range 0.10 to 0.15 mm; prepared to a tolerance of ±0.001 in. in the form of a cylinder 1 in. in dia and 1 in. high; fabricated by the Zirconium Corp. of America; bulk density 5.4 g cm ⁻³ ; true density 5.7 g cm ⁻³ ; true porosity 5% of the total volume; pyroceram 9606 as comparative material; unknown and standard used for the first time.
262	374	C	1965	661-1126	0-±3		Similar to the above specimen; unknown used first time, standard used several times up to 1273 K.
263	374	C	1965	417-1116	0-±4		Similar to the above specimen; unknown used several times up to 1373 K, standard used for the first time.
264	374	C	1965	1313, 1373		Corundum brick	Similar to the above specimen except alumina Al ₂ O ₃ as reference standard.
265	247	L	1932	356-840	1.0	Corundum brick	78.82 Al ₂ O ₃ , 14.72 SiO ₂ , 2.85 TiO ₂ , 1.35 Fe ₂ O ₃ , 0.66 MgO, 0.39 CaO, and 0.06 Mn ₂ O ₄ ; density 3.472 g cm ⁻³ ; porosity 35.3%; gas permeability 0.065 m ² m ⁻² hr ⁻¹ (mm H ₂ O) ⁻¹ .
266	383	L	1927	473-1673	±15	Silica firebrick	97 SiO ₂ ; 10.8 cm dia x 22.8 cm long; apparent density 2.34 g cm ⁻³ ; bulk density 1.64 g cm ⁻³ ; porosity 30.4%.
267	383	L	1927	473-1673	±15	Penn. firebrick	54.16 SiO ₂ , 36.84 Al ₂ O ₃ , 2.72 TiO ₂ , 2.70 Fe ₂ O ₃ , 1.14 MgO, 0.29 sulphates and 0.10 CaO; 10.8 cm dia x 22.8 cm long; apparent density 2.59 g cm ⁻³ ; bulk density 1.90 g cm ⁻³ ; porosity 26.7%.
268	383	L	1927	473-1673	±15	Missouri firebrick	53.12 SiO ₂ , 43.3 Al ₂ O ₃ , 2.48 Fe ₂ O ₃ , 0.64 CaO, 0.46 MgO, and 0.15 alkalis; 10.8 cm dia x 22.8 cm long; apparent density 2.64 g cm ⁻³ ; bulk density 2.15 g cm ⁻³ ; porosity 18.4%.
269	383	L	1927	473-1673	±15	Zirconia brick	69.44 ZrO ₂ , 27.26 SiO ₂ , 7.75 Al ₂ O ₃ , 1.60 Fe ₂ O ₃ , and 0.04 CaO; 10.8 cm dia x 22.8 cm long; made of South American baddeleyite ore, calcined and crushed into grog, bonded with some fine ground ore, pressed into brick, fired at 1923 K; apparent density 4.87 g cm ⁻³ ; bulk density 3.43 g cm ⁻³ ; porosity 29.5%.
270	383	L	1927	473-1673	±15	Spinel firebrick	65 Al ₂ O ₃ and 26 MgO; specimen 10.8 cm in dia and 22.8 cm long; made up by grinding together Grecian magnesite and Dutch Guiana bauxite heated to 2048 K until the mixture became a dense spinel biscuit, then crushed into grog and bonded together with raw magnesite and bauxite in the same proportions to form a brick, then fired to 2023 K; apparent density 3.51 g cm ⁻³ ; bulk density 2.23 g cm ⁻³ ; porosity 36.3%.
271	282	L	1933	409-1561		Magnesite brick	86.8 MgO, 6.3 Fe ₂ O ₃ , 3.0 CaO, 2.6 SiO ₂ , and 0.8 Al ₂ O ₃ ; bulk density 2.54 g cm ⁻³ ; true density 3.59 g cm ⁻³ ; porosity 26-29%.

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
272	79	L	1942	382-752		Silica refractory brick; No. 5	95.16 SiO ₂ , 1.96 CaO, 1.57 TiO ₂ , 1.46 Al ₂ O ₃ , 0.85 Fe ₂ O ₃ , 0.05 MgO, and 0.21 alkali oxides; slab specimen 1.5 in. x 1.8 in.; prepared from ganister-type quartzite rocks; fired at 1410-1420 C for 60 hrs; density 1.81 g cm ⁻³ ; porosity 22.77%; weight lost on ignition 0.14%.	
273	79	C	1942	1091, 1223		Silica refractory		Similar to the above specimen but in disc form of dimensions 8 in. dia x 1 in. thick; steel used as comparative material.
274	80	L	1934	393-1101		Star-brand brick	95.9 SiO ₂ , 2.0 CaO, 1.0 Al ₂ O ₃ , 1.0 Fe ₂ O ₃ , 0.1 MgO, and 0.1 alkalis; supplied by Harbison-Walker Refractories Co.; bulk density 1.52 g cm ⁻³ ; porosity 28.0%.	
275	80	L	1934	1569		Star-brand brick		The above specimen measured with insulating brick placed between the calorimeter and the lower surface of the specimen.
276	238	P	1921	974-1256		Silica brick; 1A ₁	95.4 SiO ₂ , 1.68 CaO, and 0.90 Al ₂ O ₃ ; 9 x 4.5 x 2.5 in.; texture very open and many large and sub-angular rock fragments; bonding of coarse and fine fairly good, although adherence of some of the grains is only fair; abundant large fissures; apparent density 1.75 g cm ⁻³ ; porosity 24.0%; heat flow in the direction of the length of brick with thermocouple at a distance of 4.0 cm from the hot face; thermal conductivity values calculated from author's measured thermal diffusivity data and the specific heat data of Bradshaw and Emery (Trans., 19, 84, 1919).	
277	238	P	1921	940-1208		Silica brick; 1A ₂		The above specimen measured with thermocouple at a distance of 5.4 cm from the hot face.
278	238	P	1921	968-1229		Silica brick; 2A ₃		Similar to the above specimen except apparent density 1.80 g cm ⁻³ and porosity 22.3%; heat flow in the direction of the length of the brick with thermocouple at a distance of 4.3 cm from the hot face.
279	238	P	1921	830-1159		Silica brick; 2A ₄		The above specimen measured with thermocouple at a distance of 6.4 cm from the hot face.
280	80	L	1934	404, 551		SiC brick, refrax	96.9 SiC, 1.3 Al ₂ O ₃ , 1.3 Fe ₂ O ₃ , and 0.7 SiO ₂ ; recrystallized; supplied by Carborundum Co.; bulk density 2.18 g cm ⁻³ ; porosity 34.4%.	
281	80	L	1934	1063-1582		SiC brick, refrax		The above specimen measured with insulating brick placed between the calorimeter and the lower surface of the brick.
282	547	L	1938	434-739		Diatomaceous insulating brick	9 x 9 x 3 in.	
283	547	L	1938	433-751		Diatomaceous insulating brick	5 x 3 x 3 in.	
284	547	L	1938	446-754		Diatomaceous insulating brick	2 in. dia x 6.8 cm thick	

SPECIFICATION TABLE NO. 291 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
285	547	L	1938	505-732		Diatomaceous insulating brick	2 in. dia x 6.8 cm thick.
286	547	L	1938	527-732	3.2	Diatomaceous insulating brick	9 x 9 x 3 in.
287	547	L	1938	396-705	3.2	Diatomaceous insulating brick	9 x 9 x 3 in.
288	547	L	1938	468-723	3.2	Diatomaceous insulating brick	9 x 9 x 3 in.
289	547	L	1938	501-719	3.2	Diatomaceous insulating brick	9 x 9 x 3 in.
290	547	L	1938	413-702	3.2	Diatomaceous insulating brick	9 x 9 x 3 in.
291	547	L	1938	462-722	3.2	Diatomaceous insulating brick	9 x 9 x 3 in.

DATA TABLE NO. 251 THERMAL CONDUCTIVITY OF BRICKS

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>													
488.8	0.00379	477.6	0.00865	700.2	0.0177	455.4	0.00190	466.5	0.000865	405.4	0.0193	<u>CURVE 32</u>	
684.9	0.00400	710.9	0.0123	847.7	0.0189	522.1	0.00208	544.3	0.000923	560.9	0.0198	<u>CURVE 33</u>	
<u>CURVE 2</u>													
706.0	0.00414	724.8	0.0120	<u>CURVE 25</u>		610.9	0.00213	633.2	0.000981	633.2	0.0235	<u>CURVE 34</u>	
747.1	0.00415	955.4	0.0124	293.2	0.00460	766.5	0.00242	794.3	0.00133	710.9	0.0235	<u>CURVE 35</u>	
971.0	0.00434	1099.8	0.0134	373.2	0.00452	788.7	0.00260	816.5	0.00138	988.7	0.0322	<u>CURVE 36</u>	
973.2	0.00434*	1394.3	0.0156	<u>CURVE 26</u>		922.1	0.00271	966.5	0.00162	1016.5	0.0307	<u>CURVE 37</u>	
1169.4	0.00440	1505.4	0.0175	477.6	0.00923	988.7	0.00288	999.8	0.00162	1183.2	0.0371	<u>CURVE 38</u>	
1358.3	0.00449	<u>CURVE 19</u>		1194.3	0.00335	1194.3	0.00335	1233.2	0.00208	1533.2	0.0855	<u>CURVE 39</u>	
<u>CURVE 3</u>													
681.2	0.0136	544.3	0.00779	544.3	0.00104	477.6	0.00923	477.6	0.00208	1009.3	0.0433	<u>CURVE 40</u>	
824.2	0.0146	727.3	0.0104	666.5	0.00121	522.1	0.00186	444.3	0.000779	1199.8	0.0537	<u>CURVE 41</u>	
<u>CURVE 4</u>													
688.2	0.0281	810.9	0.0114	898.7	0.00167	660.9	0.00199	533.2	0.000865	1377.6	0.0655	<u>CURVE 42</u>	
830.2	0.0289	1055.3	0.0123	1005.4	0.00164	677.6	0.00202*	644.3	0.000952				
<u>CURVE 5</u>													
553.2	0.00988	<u>CURVE 20</u>		699.8	0.00203*	699.8	0.00203*	766.5	0.00120	368.7	0.00174	<u>CURVE 43</u>	
923.2	0.00988	638.2	0.00662	<u>CURVE 27</u>		722.1	0.00208	794.3	0.00117	449.7	0.00177	<u>CURVE 44</u>	
<u>CURVE 6*</u>													
347.3	0.0112	663.2	0.00947	477.6	0.00121	855.4	0.00219	955.4	0.00144	510.2	0.00214	<u>CURVE 45</u>	
657.5	0.0152	668.2	0.00907	699.8	0.00144	922.1	0.00221	1010.9	0.00144	609.5	0.00204	<u>CURVE 46</u>	
974.3	0.0188	763.2	0.00933	922.1	0.00167	1055.4	0.00226	1233.2	0.00187	664.1	0.00230	<u>CURVE 47</u>	
1070.2	0.0206	838.2	0.00947*	1144.3	0.00196	1144.3	0.00239	<u>CURVE 35</u>		673.5	0.00222	<u>CURVE 48</u>	
<u>CURVE 7</u>													
293.2	0.0407	888.2	0.00970*	<u>CURVE 28</u>		1166.5	0.00237	499.7	0.00120	1098.5	0.00305	<u>CURVE 49</u>	
553.2	0.00383	1026.2	0.00982	477.6	0.00121*	477.6	0.00121*	577.6	0.00130	1225.3	0.00342	<u>CURVE 50</u>	
553.2	0.00383	1158.2	0.0107	489.8	0.00121	489.8	0.00121	649.8	0.00138				
<u>CURVE 8</u>													
293.2	0.0407	1183.2	0.0105	588.7	0.00127	488.7	0.00107	733.2	0.00148	317.8	0.00195	<u>CURVE 51</u>	
553.2	0.00383	<u>CURVE 21</u>		598.7	0.00138	544.3	0.00115	822.1	0.00159	347.5	0.00196	<u>CURVE 52</u>	
923.2	0.00988	283.2	0.00744	699.8	0.00138	555.4	0.00115	916.5	0.00169	375.8	0.00229	<u>CURVE 53</u>	
<u>CURVE 9*</u>													
293.2	0.0407	788.7	0.00156	788.7	0.00156	633.2	0.00133	1005.4	0.00182	414.2	0.00197	<u>CURVE 54</u>	
553.2	0.00383	844.3	0.00167	944.3	0.00167	655.4	0.00133	1122.1	0.00199	438.6	0.00215	<u>CURVE 55</u>	
923.2	0.00988	1033.2	0.00173	1033.2	0.00173	699.8	0.00156	<u>CURVE 36</u>		441.9	0.00209	<u>CURVE 56</u>	
1388.8	0.0142	1188.7	0.00190	1188.7	0.00190	766.5	0.00153	283.2	0.0129	785.0	0.00236	<u>CURVE 57</u>	
<u>CURVE 10</u>													
283.2	0.00409	<u>CURVE 22</u>		<u>CURVE 22</u>		810.9	0.00170	810.9	0.00170	898.9	0.00277	<u>CURVE 58</u>	
684.9	0.00400	488.2	0.00168	477.6	0.00202	877.6	0.00205	988.7	0.00202	1047.6	0.00308	<u>CURVE 59</u>	
<u>CURVE 11</u>													
293.2	0.00872	699.8	0.00242	922.1	0.00286	1010.9	0.00248	1099.8	0.00254				
706.0	0.00414	888.2	0.00182	1144.3	0.00358	1366.5	0.00448						
747.1	0.00415	699.8	0.00197										
973.2	0.00434*	888.2	0.00197										
1169.4	0.00440	388.2	0.00105										
1358.3	0.00449	488.2	0.00122										
<u>CURVE 12</u>													
763.2	0.0315	588.2	0.00134										
912.2	0.0281	688.2	0.00151										
<u>CURVE 13*</u>													
544.3	0.00779												
727.3	0.0104												
810.9	0.0114												
898.7	0.0123												
<u>CURVE 14</u>													
696.2	0.0296												
846.2	0.0286												
<u>CURVE 15</u>													
347.3	0.0112												
657.5	0.0152												
974.3	0.0188												
1070.2	0.0206												
<u>CURVE 16</u>													
516.0	0.0112												
662.1	0.0120												
<u>CURVE 17</u>													
632.1	0.0116												
697.1	0.0120												
862.1	0.0129												
1097.1	0.0135												
1388.8	0.0142												
<u>CURVE 18</u>													
293.2	0.0407												
<u>CURVE 19</u>													
283.2	0.00344												
<u>CURVE 20</u>													
283.2	0.00341												

* Not shown on plot

DATA TABLE NO. 291 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 42</u>													
573.2	0.00266	553.2	0.0264	684.3	0.00179	1422.1	0.0493	284.1	0.00604	287.3	0.00662	283.2	0.00558
673.2	0.00287	636.2	0.0290	<u>CURVE 55</u>		1449.8	0.0548	<u>CURVE 65</u>		<u>CURVE 78*</u>		<u>CURVE 90</u>	
773.2	0.00315	729.2	0.0306*	<u>CURVE 56*</u>		<u>CURVE 60*</u>		<u>CURVE 69</u>		<u>CURVE 79*</u>		<u>CURVE 91</u>	
873.2	0.00351	810.2	0.0339	505.4	0.00183	560.9	0.0226	273.2	0.00500	283.0	0.00639	283.2	0.00616
973.2	0.00394	877.2	0.0361	560.9	0.00187	616.5	0.0242	283.2	0.00511	<u>CURVE 80</u>		<u>CURVE 92*</u>	
<u>CURVE 43</u>													
571.2	0.00322	1008.2	0.0403	611.5	0.00193	727.6	0.0248	293.2	0.00523	<u>CURVE 81*</u>		<u>CURVE 93</u>	
678.2	0.00322	1040.2	0.0414	673.2	0.00199*	838.7	0.0267	303.2	0.00535	292.1	0.00401	283.2	0.00633
783.2	0.00326	<u>CURVE 48</u>		<u>CURVE 56*</u>		1116.5	0.0293	<u>CURVE 70</u>		<u>CURVE 81*</u>		<u>CURVE 93</u>	
896.2	0.00351	655.2	0.00500	506.5	0.00190	1299.8	0.0342	273.2	0.00581	288.2	0.00430	349.9	0.0102
1014.2	0.00372	843.2	0.00523	586.5	0.00193	1338.7	0.0355	283.2	0.00604*	294.9	0.00386	354.8	0.00972
<u>CURVE 44</u>													
573.2	0.00307	1038.2	0.00558	600.4	0.00196	841.2	0.0184	293.2	0.00639	283.6	0.00401	512.8	0.0112*
648.2	0.00310	<u>CURVE 49*</u>		652.6	0.00198	<u>CURVE 57</u>		303.2	0.00662	294.9	0.00386	605.8	0.0121
749.2	0.00333	283.2	0.0116	<u>CURVE 50</u>		352.6	0.0180	<u>CURVE 71</u>		300.3	0.00389	708.7	0.0131
873.2	0.00362	<u>CURVE 50</u>		519.3	0.0192	738.2	0.0124	273.2	0.00430	<u>CURVE 82*</u>		836.3	0.0141*
986.2	0.00395	283.2	0.0134	558.2	0.0206	<u>CURVE 63</u>		283.2	0.00442	<u>CURVE 83*</u>		1072.8	0.0163
1046.2	0.00415	<u>CURVE 51</u>		660.9	0.0219	688.7	0.0234	293.2	0.00453	283.6	0.00401	1172.8	0.0181
<u>CURVE 45*</u>													
576.2	0.00302	347.1	0.0262*	688.7	0.0234	841.2	0.0184	303.2	0.00465	<u>CURVE 84*</u>		<u>CURVE 94</u>	
648.2	0.00312	999.8	0.0281	741.7	0.0753	841.2	0.0184	273.2	0.00430	300.3	0.00389	425.3	0.0102
741.2	0.00333	1193.2	0.0312	883.2	0.0607	<u>CURVE 62*</u>		285.4	0.00604	<u>CURVE 85*</u>		434.6	0.00966
970.2	0.00366	1235.9	0.0327	937.1	0.0627*	738.2	0.0124	283.2	0.00442	<u>CURVE 86*</u>		575.6	0.0118
982.2	0.00395	1294.3	0.0335	999.8	0.0281	<u>CURVE 64*</u>		293.2	0.00453	283.2	0.00397	665.8	0.0124
1042.2	0.00415	1433.2	0.0405*	1023.2	0.0251	813.2	0.0251	303.2	0.00465	283.2	0.00397	766.9	0.0129
1082.2	0.00432	1449.8	0.0410	1023.2	0.0251	1023.2	0.0251	284.1	0.00604	<u>CURVE 86*</u>		916.6	0.0137*
<u>CURVE 46</u>													
510.2	0.0246	512.1	0.00173	<u>CURVE 58</u>		1449.8	0.0410	<u>CURVE 74</u>		283.2	0.00374	1277.1	0.0178
574.2	0.0263	564.8	0.00176	422.1	0.0234	<u>CURVE 65</u>		282.0	0.00814	<u>CURVE 87*</u>		<u>CURVE 95</u>	
626.2	0.0273	605.9	0.00179	649.8	0.0327	422.1	0.0234	<u>CURVE 75</u>		283.2	0.00511	502.8	0.0107
674.2	0.0292	655.9	0.00182	899.8	0.0392	763.2	0.0898	280.7	0.00779	<u>CURVE 88*</u>		709.1	0.0117
677.2	0.0357	<u>CURVE 53*</u>		1055.4	0.0427	973.2	0.0703	<u>CURVE 76*</u>		283.2	0.00511	1120.7	0.0136
705.2	0.0303	523.2	0.00162	1260.9	0.0498	1373.2	0.0668	<u>CURVE 77</u>		<u>CURVE 89</u>		<u>CURVE 98*</u>	
731.2	0.0311	568.2	0.00163	1372.1	0.0587	<u>CURVE 56</u>		282.4	0.00779	283.2	0.00511	457.1	0.00988
783.2	0.0328	644.3	0.00166	1477.6	0.0648	284.1	0.00726	<u>CURVE 78</u>		<u>CURVE 90</u>		648.5	0.0123
830.2	0.0346	<u>CURVE 54*</u>		438.7	0.0219	284.1	0.00726	283.2	0.00697	<u>CURVE 91</u>		1029.7	0.0142
848.2	0.0333	513.7	0.0252	513.7	0.0252	<u>CURVE 67</u>		<u>CURVE 79</u>		<u>CURVE 92*</u>		<u>CURVE 93</u>	
883.2	0.0369	649.8	0.0284*	649.8	0.0284*	284.3	0.00649	283.2	0.00535	<u>CURVE 93</u>		<u>CURVE 94</u>	
941.2	0.0388	899.8	0.0329	899.8	0.0329	<u>CURVE 68</u>		<u>CURVE 80</u>		<u>CURVE 94</u>		<u>CURVE 95</u>	
996.2	0.0414	1177.6	0.0408	1177.6	0.0408	<u>CURVE 69</u>		<u>CURVE 81*</u>		<u>CURVE 95</u>		<u>CURVE 96</u>	
1021.2	0.0454	1355.4	0.0470	1355.4	0.0470	<u>CURVE 70</u>		<u>CURVE 82*</u>		<u>CURVE 96</u>		<u>CURVE 97</u>	

* Not shown on plot

DATA TABLE NO. 291 (continued)

<u>CURVE 97*</u>		<u>CURVE 102(cont.)*</u>		<u>CURVE 108</u>		<u>CURVE 114</u>		<u>CURVE 121(cont.)</u>		<u>CURVE 127*</u>		<u>CURVE 131(cont.)*</u>	
T	k	T	k	T	k	T	k	T	k	T	k	T	k
481.8	0.0110	1145.2	0.0164	373.2	0.0120	423.2	0.212	1046.1	0.00425	420.1	0.00254	506.7	0.001237
749.2	0.0142	1189.7	0.0168	573.2	0.0128	573.2	0.184	<u>CURVE 122*</u>		546.8	0.00270	566.8	0.001404
774.1	0.0137	<u>CURVE 103*</u>		773.2	0.0137	773.2	0.161			751.6	0.00317	<u>CURVE 132*</u>	
803.5	0.0143	489.1	0.0105	973.2	0.0146*	973.2	0.149	605.7	0.00297	851.2	0.00337	1223.2	0.00372
1078.2	0.0159	1173.2	0.0160*	1173.2	0.0160*	<u>CURVE 115</u>		1092.4	0.00423	1174.9	0.00443	<u>CURVE 133*</u>	
<u>CURVE 98</u>		589.2	0.0117	<u>CURVE 109*</u>		423.2	0.0637	1024.6	0.00358	1249.8	0.00462		
543.8	0.00984	700.4	0.0127	373.2	0.0100	573.2	0.0661	1215.1	0.00417	<u>CURVE 128</u>			
663.2	0.0107	811.6	0.0138	573.2	0.0116	773.2	0.0531	<u>CURVE 123*</u>		376.2	0.218	<u>CURVE 134</u>	
<u>CURVE 99*</u>		922.8	0.0147	773.2	0.0130	773.2	0.0460	491.4	0.00264	428.2	0.209*		
731.0	0.0119	1034.0	0.0157	973.2	0.0146	973.2	0.0460	709.2	0.00320	503.2	0.197		
862.7	0.0123	1145.2	0.0167	973.2	0.0153	<u>CURVE 116</u>		866.4	0.00384	553.2	0.188		
1053.3	0.0138	1189.7	0.0177	1173.2	0.0153	423.2	0.231	1032.9	0.00404	618.2	0.178		
1367.2	0.0155	<u>CURVE 104*</u>		<u>CURVE 110</u>		573.2	0.199	<u>CURVE 124*</u>		673.2	0.172	<u>CURVE 135</u>	
<u>CURVE 100</u>		555.8	0.0112	373.2	0.0105	773.2	0.171	423.7	0.00216	773.2	0.159*	372.2	0.121
589.2	0.0123	589.2	0.0115	573.2	0.0107	973.2	0.156	617.4	0.00291	863.2	0.151	<u>CURVE 136</u>	
700.4	0.0132	700.4	0.0125	773.2	0.0110	<u>CURVE 117</u>		864.4	0.00313	923.2	0.146	392.7	0.0711
811.6	0.0141*	811.6	0.0134	973.2	0.0115	423.2	0.162	1015.7	0.00339	1023.2	0.140		
922.8	0.0150	1034.0	0.0144	1173.2	0.0121	573.2	0.141	1098.7	0.00389	<u>CURVE 129</u>			
1034.0	0.0160*	1145.2	0.0153	<u>CURVE 111</u>		773.2	0.119	1236.8	0.00430	373.2	0.186	<u>CURVE 137*</u>	
1145.2	0.0170	1189.7	0.0168	373.2	0.00523	973.2	0.109	1320.9	0.00482	398.2	0.182		
1189.7	0.0175	<u>CURVE 105*</u>		573.2	0.00536	<u>CURVE 118*</u>		<u>CURVE 125*</u>		438.2	0.178		
<u>CURVE 101*</u>		500.2	0.0110	773.2	0.00544*	393.3	0.0089	361.9	0.00218	463.2	0.174	<u>CURVE 138</u>	
505.7	0.0112	567.0	0.0113	1173.2	0.00565	855.2	0.0127	509.4	0.00290	498.2	0.172		
700.4	0.0120	605.9	0.0116	1248.2	0.00586	<u>CURVE 119*</u>		717.4	0.00303	533.2	0.167	<u>CURVE 139</u>	
811.6	0.0141	711.5	0.0123	<u>CURVE 112</u>		423.2	0.162	810.3	0.00323	573.2	0.163		
883.9	0.0135	800.5	0.0130	373.2	0.00297	573.2	0.141	898.6	0.00366	603.2	0.157	<u>CURVE 140*</u>	
1034.0	0.0150	922.8	0.0146	573.2	0.00335	573.2	0.105	978.6	0.00418	673.2	0.151		
1034.0	0.0160	1123.0	0.0152	773.2	0.00381	692.3	0.0118	1103.6	0.00418	773.2	0.144		
1145.2	0.0170	<u>CURVE 106*</u>		973.2	0.00427	<u>CURVE 120</u>		1173.2	0.00462	873.2	0.138		
1189.7	0.0175	520.4	0.00172	1173.2	0.00473	512.5	0.00251	<u>CURVE 126*</u>		973.2	0.132		
<u>CURVE 102*</u>		567.6	0.00176	1273.2	0.00502	726.2	0.00320	484.6	0.00271	<u>CURVE 130</u>			
455.8	0.00959	617.1	0.00182	<u>CURVE 113</u>		976.1	0.00392*	662.9	0.00297	454.2	0.001103		
478.0	0.00981	659.3	0.00186	423.2	0.307	1243.8	0.00459	905.9	0.00349	555.2	0.001334		
589.2	0.0112	573.2	0.262	573.2	0.262	<u>CURVE 121</u>		1033.3	0.00372	651.2	0.001647		
700.4	0.0123	773.2	0.224	773.2	0.224	385.8	0.00229	1249.7	0.00446	732.2	0.001932		
811.6	0.0133	<u>CURVE 107*</u>		<u>CURVE 114</u>		573.2	0.00297	1420.4	0.00470	<u>CURVE 131*</u>			
922.8	0.0144	413.2	0.00198	395.8	0.00229	806.6	0.00363	<u>CURVE 122</u>		381.8	0.001013		
1034.0	0.0153	733.2	0.00198	806.6	0.00363	<u>CURVE 115</u>		1420.4	0.00525	444.9	0.001106		

* Not shown on plot

DATA TABLE NO. 291 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 143*</u>															
547.1	0.00249	472.1	0.000995	598.2	0.00988	473.2	0.0259	1773	0.156	373.2	0.00523	673.2	0.0192	903.2	0.0180
688.2	0.00267	583.7	0.00107	688.7	0.0102	673.2	0.0310	1573	0.155	1573	0.155	1123	0.0184	1123	0.0184
690.9	0.00267	605.9	0.00107	786.5	0.0103	873.2	0.0343	1373	0.153	1173	0.151	1253	0.0171	1253	0.0171
812.1	0.00288	767.1	0.00116	888.2	0.0111	1073	0.0372	1173	0.151	373.2	0.00661				
875.4	0.00287	790.9	0.00116	992.1	0.0111	1273	0.0397			<u>CURVE 168*</u>					
1092.6	0.00310	1043.2	0.00127	1062.6	0.0119	1473	0.0423			<u>CURVE 181*</u>					
				1135.9	0.0117	1673	0.0439	373.2	0.0121	373.2	0.00364	643.2	0.0175	843.2	0.0173
<u>CURVE 144*</u>															
573.2	0.00234	425.9	0.00105			<u>CURVE 158*</u>		<u>CURVE 169</u>		<u>CURVE 182*</u>		1033	0.0160	1168	0.0157
687.1	0.00245	488.7	0.00108			293.2	0.0050	373.2	0.0124	373.2	0.00435				
695.4	0.00255	520.9	0.00115	623.2	0.0109			<u>CURVE 170*</u>							
852.6	0.00283	567.6	0.00113	741.5	0.0116	<u>CURVE 159</u>		373.2	0.00950	<u>CURVE 183*</u>		658.2	0.0185	903.2	0.0173
861.5	0.00267	618.2	0.00119	903.7	0.0139			<u>CURVE 171*</u>		773.2	0.0121	1113	0.0179	1248	0.0166
1080.9	0.00291	630.9	0.00126	1186.5	0.0165			<u>CURVE 172*</u>		873.2	0.0119	1248	0.0166		
		739.8	0.00128			<u>CURVE 160</u>		1073	0.0115	<u>CURVE 190*</u>		698.2	0.0277	913.2	0.0238
		775.9	0.00134					1273	0.0113	1173	0.0109	1123	0.0211	1258	0.0201
		960.9	0.00148			<u>CURVE 154</u>		373.2	0.00448	<u>CURVE 184</u>					
<u>CURVE 145</u>															
442.6	0.00156			522.1	0.0626			<u>CURVE 173*</u>		773.2	0.00732				
523.7	0.00162			670.4	0.0642			373.2	0.00435	873.2	0.00732				
529.8	0.00163			789.8	0.0727	<u>CURVE 161</u>		973.2	0.00711	973.2	0.00711				
607.1	0.00166	411.5	0.000940	872.6	0.0762			<u>CURVE 174*</u>		1073	0.00711				
632.6	0.00173	485.9	0.000949	1068.7	0.0809			373.2	0.0164	1173	0.00690				
647.6	0.00173	506.5	0.00101			<u>CURVE 162*</u>		373.2	0.0164	1273	0.00690				
771.0	0.00182	534.8	0.000966					<u>CURVE 175</u>		1373	0.00669				
800.4	0.00187	615.9	0.00108			<u>CURVE 155</u>		<u>CURVE 176*</u>							
978.7	0.00199	623.2	0.00105	473.2	0.0142			373.2	0.0221	<u>CURVE 185*</u>		653.2	0.0238	898.2	0.0206
		698.7	0.00104	673.2	0.0155			373.2	0.0221	379.4	0.0232	918.2	0.0217	1088	0.0189
		790.9	0.00118	873.2	0.0163	<u>CURVE 163*</u>		<u>CURVE 177*</u>		490.5	0.0217	1233	0.0177	1233	0.0177
		902.6	0.00122	1073.2	0.0167			373.2	0.0101	793.9	0.0163				
				1273	0.0167			<u>CURVE 178*</u>							
				1473	0.0168*			373.2	0.0182	<u>CURVE 186*</u>		683.2	0.0231	893.2	0.0222
				1673	0.0168			373.2	0.00674	<u>CURVE 191*</u>		1143	0.0188	1083	0.0198
						<u>CURVE 156</u>		373.2	0.00569	<u>CURVE 192*</u>		1263	0.0169	1228	0.0189
								<u>CURVE 164</u>							
						373.2	0.00732	<u>CURVE 165</u>							
								<u>CURVE 166*</u>							
						473.2	0.0573	<u>CURVE 167*</u>							
						673.2	0.0523	373.2	0.0101	<u>CURVE 186*</u>		683.2	0.0182	893.2	0.0222
						873.2	0.0431	373.2	0.0101	<u>CURVE 193*</u>		1143	0.0188	1083	0.0198
						1073	0.0397	<u>CURVE 168*</u>				1263	0.0169	1228	0.0189
						1273	0.0377	373.2	0.0188						
						1473	0.0364	<u>CURVE 169*</u>							
						1673	0.0356	373.2	0.0182						

* Not shown on plot

DATA TABLE NO. 291 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 243*</u>		<u>CURVE 249 (cont.)*</u>		<u>CURVE 254*</u>		<u>CURVE 260*</u>		<u>CURVE 265 (cont.)*</u>		<u>CURVE 270 (cont.)*</u>		<u>CURVE 277*</u>	
79.2	0.0121	1273	0.00586	473.2	0.00460	644.2	0.00209	586.5	0.01147	873.2	0.0176	940.2	0.00377
745.2	0.0126	1373	0.00732	673.2	0.00624	699.2	0.00209	840.3	0.01146	1073	0.0188	1020	0.00402
822.2	0.0130			873.2	0.00753	811.2	0.00216			1273	0.0197	1114	0.06448
<u>CURVE 244*</u>		<u>CURVE 250*</u>		<u>CURVE 255*</u>		<u>CURVE 261</u>		<u>CURVE 266</u>		<u>CURVE 271</u>		<u>CURVE 278*</u>	
		773.2	0.00397	1073	0.00586	420.2	0.0240	473.2	0.0117	409.3	0.0398	967.7	0.00368
1006	0.0134	873.2	0.00460	422.9	0.00927	665.2	0.0216	673.2	0.0146	565.4	0.0342	1045	0.00444
1252	0.0142	973.2	0.00502	520.9	0.0103	665.2	0.0216	873.2	0.0167	755.4	0.0298	1134	0.00481
<u>CURVE 245*</u>		<u>CURVE 251*</u>		<u>CURVE 256*</u>		<u>CURVE 262*</u>		<u>CURVE 267*</u>		<u>CURVE 272*</u>		<u>CURVE 279*</u>	
381.5	0.0111	773.2	0.00523	377.1	0.0115	661.2	0.0229	473.2	0.0100	582.2	0.0151	829.7	0.00393
876.5	0.0142	873.2	0.00607	504.3	0.0126	662.2	0.0216	673.2	0.0113	683.2	0.0163	996.7	0.00460
<u>CURVE 246*</u>		<u>CURVE 252*</u>		<u>CURVE 257*</u>		<u>CURVE 263*</u>		<u>CURVE 268*</u>		<u>CURVE 273*</u>		<u>CURVE 280</u>	
732.6	0.0123	1073	0.00711	798.0	0.0149	763.2	0.0221	473.2	0.0100	1091	0.0172	404.1	0.329
1145	0.0156	1073	0.00816	372.4	0.00564	854.2	0.0203	673.2	0.0126	1223	0.0184	550.9	0.280
1527	0.0173	1173	0.00879	501.6	0.00787	859.2	0.0224	873.2	0.0146				
<u>CURVE 247*</u>		<u>CURVE 253*</u>		<u>CURVE 258*</u>		<u>CURVE 264*</u>		<u>CURVE 269*</u>		<u>CURVE 274*</u>		<u>CURVE 281</u>	
873.2	0.00418	473.2	0.0197	644.2	0.00764	417.2	0.0230	473.2	0.0100	393.0	0.00796	1063	0.179
973.2	0.00502	673.2	0.0218	699.2	0.00764	646.2	0.0215	673.2	0.0126	610.4	0.0117	1121	0.170
1073	0.00586	873.2	0.0234	811.2	0.00764	828.2	0.0210	873.2	0.0146	742.1	0.0133	1302	0.144
1173	0.00669	1073	0.0251	921.2	0.00764	1033	0.00793	1073	0.0155	939.3	0.0155	1582	0.118
1273	0.00816	1273	0.0268	1144	0.00822	1078	0.0188	1273	0.0163	1101	0.0176		
1373	0.0100	1373	0.0280	1366	0.00894	1116	0.0184	1473	0.0172				
<u>CURVE 248*</u>		<u>CURVE 254*</u>		<u>CURVE 259*</u>		<u>CURVE 265*</u>		<u>CURVE 270*</u>		<u>CURVE 275*</u>		<u>CURVE 282</u>	
773.2	0.00418	473.2	0.0142	644.2	0.00469	355.6	0.01012	473.2	0.0146	1569	0.0223	434.2	0.000920
873.2	0.00460	673.2	0.0159	699.2	0.00469	419.4	0.01051	673.2	0.0163			586.2	0.00113
973.2	0.00502	873.2	0.0172	811.2	0.00476			873.2	0.0176			739.2	0.00130
1073	0.00565	1073	0.0180	921.2	0.00490			1073	0.0184				
1173	0.00628	1273	0.0188	1033	0.00534			1273	0.0192				
1273	0.00732	1373	0.0201	1144	0.00570			1473	0.0201				
1373	0.00879			1366	0.00649			1673	0.0205				
<u>CURVE 249*</u>		<u>CURVE 255*</u>		<u>CURVE 260*</u>		<u>CURVE 266*</u>		<u>CURVE 271*</u>		<u>CURVE 276*</u>		<u>CURVE 283*</u>	
773.2	0.00335	473.2	0.0159	644.2	0.00469	355.6	0.01012	473.2	0.0146	974.2	0.00360	1061	0.00406
873.2	0.00377	673.2	0.0172	699.2	0.00469	419.4	0.01051	673.2	0.0163	1061	0.00406	1156	0.00448
973.2	0.00439	873.2	0.0180	811.2	0.00476			873.2	0.0176	1156	0.00448	1256	0.00515
1073	0.00502	1073	0.0188	921.2	0.00490			1073	0.0184				
1173	0.00565	1273	0.0197	1033	0.00534			1273	0.0192				
1273	0.00732	1373	0.0201	1144	0.00570			1473	0.0201				
1373	0.00879			1366	0.00649			1673	0.0205				

* Not shown on plot

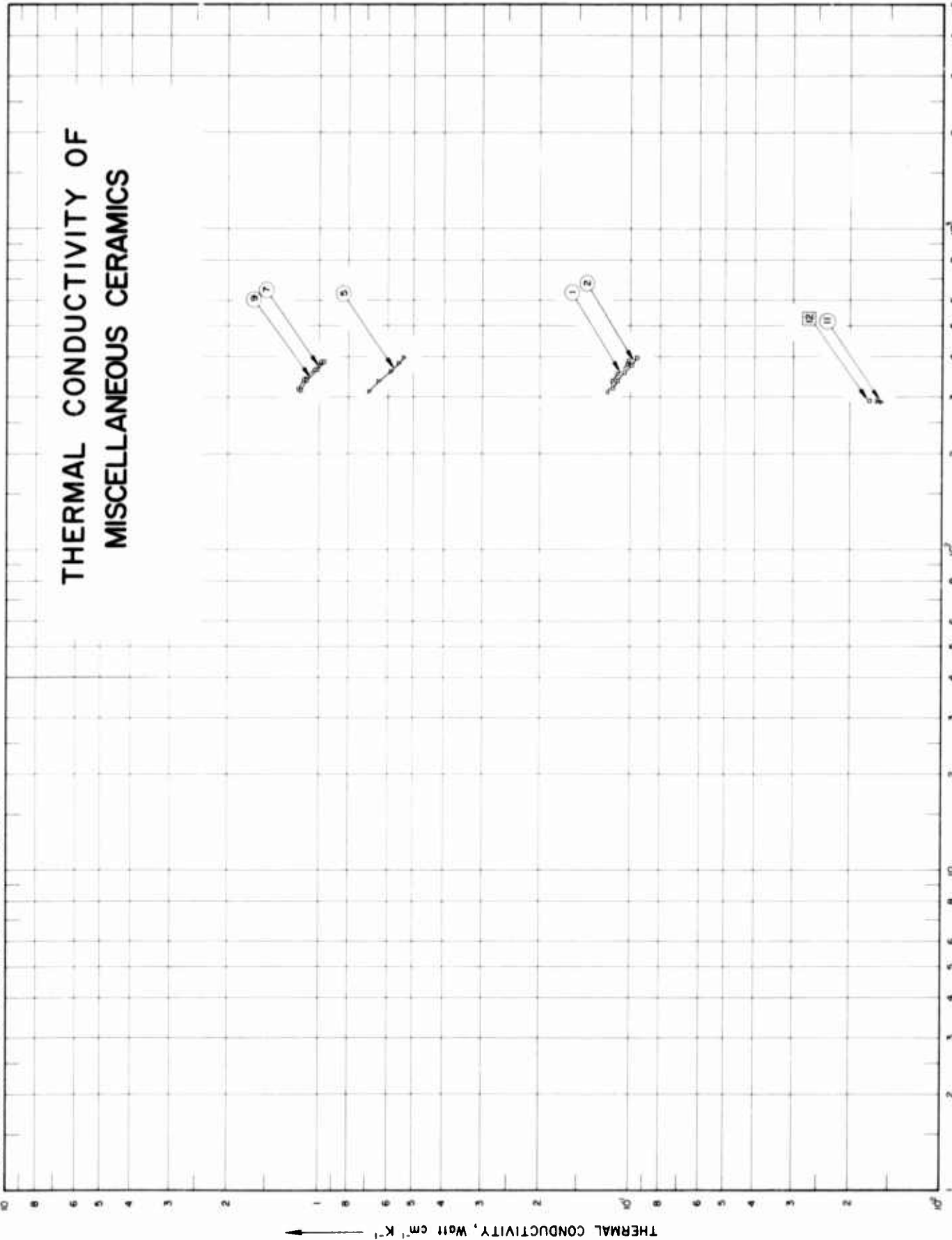
DATA TABLE NO. 291 (continued)

T	k
<u>CURVE 284 (cont.)*</u>	
614.2	0.00110
754.2	0.00123
<u>CURVE 285</u>	
505.2	0.000937
568.2	0.00979
596.2	0.00100
564.2	0.00107
732.2	0.00115
<u>CURVE 286*</u>	
527.2	0.00111
598.2	0.00121
732.2	0.00132
<u>CURVE 287*</u>	
396.2	0.000996
619.2	0.00121
705.2	0.00128
<u>CURVE 288*</u>	
468.2	0.00104
618.2	0.00120
723.2	0.00128
<u>CURVE 289*</u>	
501.2	0.00112
606.2	0.00120
719.2	0.00132
<u>CURVE 290*</u>	
413.2	0.00100
599.2	0.00115
702.2	0.00126
<u>CURVE 291*</u>	
462.2	0.00104
604.2	0.00118
722.2	0.00129

* Not shown on plot

THERMAL CONDUCTIVITY OF MISCELLANEOUS CERAMICS

FIGURE SHOWS ONLY 7 OF THE CURVES REPORTED IN TABLE



THERMAL CONDUCTIVITY, Watt cm⁻¹ K⁻¹

TEMPERATURE, K

SPECIFICATION TABLE NO. 292 THERMAL CONDUCTIVITY OF MISCELLANEOUS CERAMICS

[For Data Reported In Figure and Table No. 292]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	87	C	1954	311-389	± 3.0	98 A-1	0.500 in. dia x 0.500 in. long; measured in a vacuum of $< 1 \mu$; copper used as comparative material.
2	87	C	1954	320-397	± 3.0	98 A-2	Second run of the above specimen.
3	87	C	1954	318-414	± 3.0	139 A-1	Similar to the above specimen.
4	87	C	1954	316-408	± 3.0	149 A-1	Similar to the above specimen.
5	87	C	1954	312-399	± 3.0	140 B-1	Similar to the above specimen.
6	87	C	1954	315-444	± 3.0	14 C-1	Similar to the above specimen.
7	87	C	1954	318-386	± 3.0	78 A-1	Similar to the above specimen.
8	87	C	1954	317-395	± 3.0	78 A-2	Second run of the above specimen.
9	87	C	1954	316-389	± 3.0	78 B-1	Similar to the above specimen.
10	88	L	1926	292.0, 292.4			Specimen thickness 12.6 mm; density 2.26 g cm ⁻³ .
11	88	L	1926	290.6, 290.7			Specimen thickness 4.7 mm; density 2.26 g cm ⁻³ .
12	88	L	1926	293.6	1.0		Specimen dia 100 mm, thickness 14 mm; density 2.25 g cm ⁻³ .

DATA TABLE NO. 292 THERMAL CONDUCTIVITY OF MISCELLANEOUS CERAMICS

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
311.3	0.120	318.3	1.180
337.8	0.116	340.8	1.134
355.3	0.111	366.4	1.042
379.6	0.103	386.1	0.987
389.2	0.102		
<u>CURVE 2</u>			
320.3	0.115	316.5	1.180
338.2	0.111	338.0	1.138
358.5	0.105	362.4	1.038
378.8	0.0992	395.0	0.962
397.4	0.0954		
<u>CURVE 3*</u>			
317.6	0.120	316.4	1.167
344.3	0.112	339.6	1.117
359.6	0.106	366.9	1.029
376.8	0.103	388.8	0.967
414.2	0.0941		
<u>CURVE 4*</u>			
316.2	0.121	292.0	0.0165
335.8	0.115	292.4	0.0164
357.6	0.106		
376.8	0.102		
407.7	0.0941		
<u>CURVE 5</u>			
312.3	0.696	293.64	0.0175
335.1	0.644		
361.9	0.590		
382.4	0.556		
399.1	0.536		
<u>CURVE 6*</u>			
315.2	0.657		
338.1	0.649		
365.1	0.598		
384.9	0.565		
443.6	0.540		
<u>CURVE 7</u>			
<u>CURVE 8</u>			
<u>CURVE 9*</u>			
<u>CURVE 10*</u>			
<u>CURVE 11</u>			
<u>CURVE 12</u>			

* Not shown on plot

THERMAL CONDUCTIVITY OF CORDIERITE

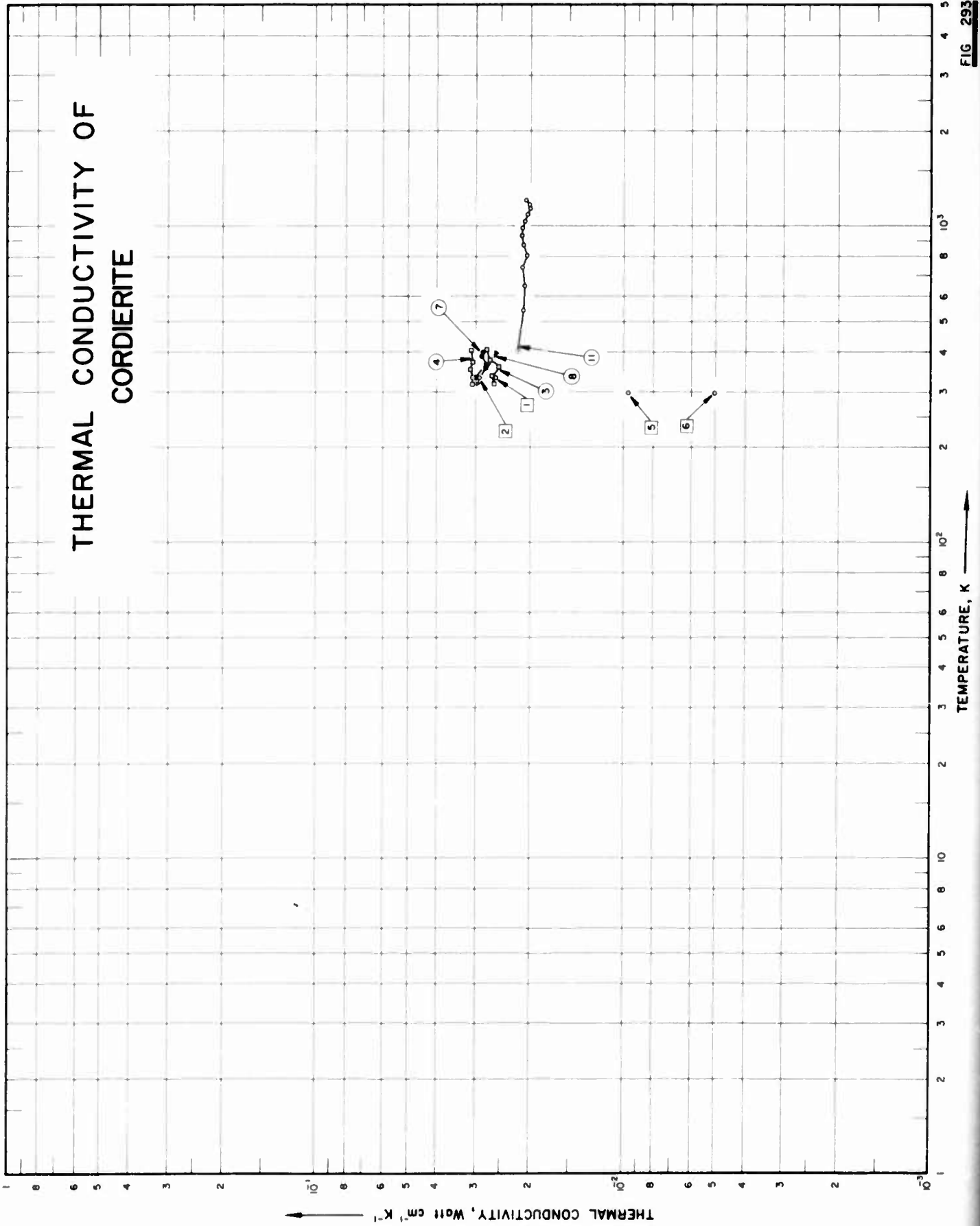


FIG. 293

SPECIFICATION TABLE NO. 29. THERMAL CONDUCTIVITY OF CORDIERITE $4\text{Mg} \cdot \text{Fe}(\text{O} \cdot 4\text{Al}_2\text{O}_3 \cdot 10\text{SiO}_2 \cdot \text{H}_2\text{O})$

For Data Reported in Figure and Table No. 293.

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3		1953	333.2			Max. water absorption 0.95%; flexural strength 11,200 psi; coefficient of expansion (25-700 C) 2.9×10^{-6} .
2	3		1953	333.2		Rutgers	Max. water absorption 0.95%; flexural strength 15,000 psi; coefficient of expansion (25-700 C) 2.3×10^{-6} .
3	65	C	1954	320-409		274A-1; G-10-N	35.95 calcine 23 D 27.1 hi-grade talc, 20.05 magnesium oxide, 44.9 Edgar plastic kaolin, 7.59 N. Carolina Kaolin (sparks), and 14.92 $\text{Ba}_2\text{P}_2\text{O}_7$ (Monsanto), 10.0 old mine No. 4, 29.57 Edgar Plastic Kaolin, and 29.57 N. Carolina Kaolin; fabricated by using 0.5 in. extrusion die; measured in vacuum; copper used as comparative standard.
4	65	C	1954	317-406		43A2; G-10-A	35.95 calcine 23 D (same as above), 10.0 old mine No. 4, and 59.15 Edgar Plastic Kaolin; similar to the above specimen.
5	152	L	1956	298.2		Cordierite 202	Preirradiated with 6×10^{13} epithermal neutrons per cm^2 for 480 Mwd in the MTR; weight change -0.6%; specimen 20 mils thick and 0.75 in. in dia.
6	152	L	1956	298.2		Cordierite 202	The above specimen postirradiated with 6×10^{13} epithermal neutrons per cm^2 for 480 Mwd in The MTR; weight change -0.6%.
7	465	L	1950	336-399		G-10A	No details reported.
8	465, 407	L	1950	321-398		M-244-A	Commercial cordierite.
9	465, 407	L	1950	328-392		Commercial steatite	No details reported.
10	465, 407	L	1950	320-383		Steatite	No details reported.
11	282	R	1955	403-120*			93% cordierite (composition: 52.1 Florida kaolin [EPK], 34.6 Champion and Challenger ball clay, 7.3 MgO Westvaco FN-722, 6.0 Sierra talc) was mixed in a ball mill with distilled water and flint pebbles, and after drying, 7% binder (composition: 500 g carbowax, 10 g methocel and 1000 cc water) was added; specimens (ring type) were set on alumina powder, fired at a rate of 120° per hr, and held at 1400 C for 5 hrs; specimen 5.08 cm O.D., 2.67 cm I.D. and 0.5 in. thickness; eleven rings are stacked to form a cylinder 5.5 in. high but measured only over the centrally-placed rings; density 2.12 g cm^{-3} ; 5,000 (estimated) psi mod. rupture; 0.3% apparent porosity; 11.2% shrinkage; 26.2×10^{-7} coeff. of exp. (25 - 1000 C).

DATA TABLE NO. 293 THERMAL CONDUCTIVITY OF CORDIERITE $4(\text{Mg}, \text{Fe})\text{O} \cdot 4\text{Al}_2\text{O}_3 \cdot 10\text{SiO}_2 \cdot \text{H}_2\text{O}$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>			
333.2	0.0260	327.7	0.0311
		348.2	0.0309
<u>CURVE 2</u>			
333.2	0.0294	369.4	0.0306
		391.7	0.0294
<u>CURVE 3</u>			
320.0	0.0263	319.9	0.0245
337.9	0.0266	337.4	0.0266
360.6	0.0254	366.7	0.0278
378.1	0.0269	383.1	0.0263
408.4	0.0277	<u>CURVE 11</u>	
<u>CURVE 4</u>			
317.0	0.0309	403.2	0.0220
335.2	0.0308	543.2	0.0212
354.7	0.0315	648.2	0.0209
372.7	0.0308	743.2	0.0213
406.3	0.0312	808.2	0.0206
<u>CURVE 5</u>			
298.2	0.00972	873.2	0.0211
		938.2	0.0214
<u>CURVE 6</u>			
298.2	0.00502	988.2	0.0213
		1038.2	0.0209
		1088.2	0.0205
<u>CURVE 7</u>			
336.4	0.0304	1138.2	0.0201
365.2	0.0279	1173.2	0.0202
387.1	0.0287	1208.2	0.0207
399.0	0.0285	<u>CURVE 8</u>	
<u>CURVE 8</u>			
320.8	0.0297		
355.2	0.0280		
398.1	0.0259		

* Not shown on plot

SPECIFICATION TABLE NO. 294 THERMAL CONDUCTIVITY OF ENAMEL

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	575	R	1953	293.2		Silicon enamel; Heyden L28	From the company VVB (Z) Alcid Chemische Fabrick von Heyden, Radebeul-Dresden; heated at 400 C for about 4 min.

DATA TABLE NO. 294 THERMAL CONDUCTIVITY OF ENAMEL

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

293.2 0.00470

* No graphical presentation

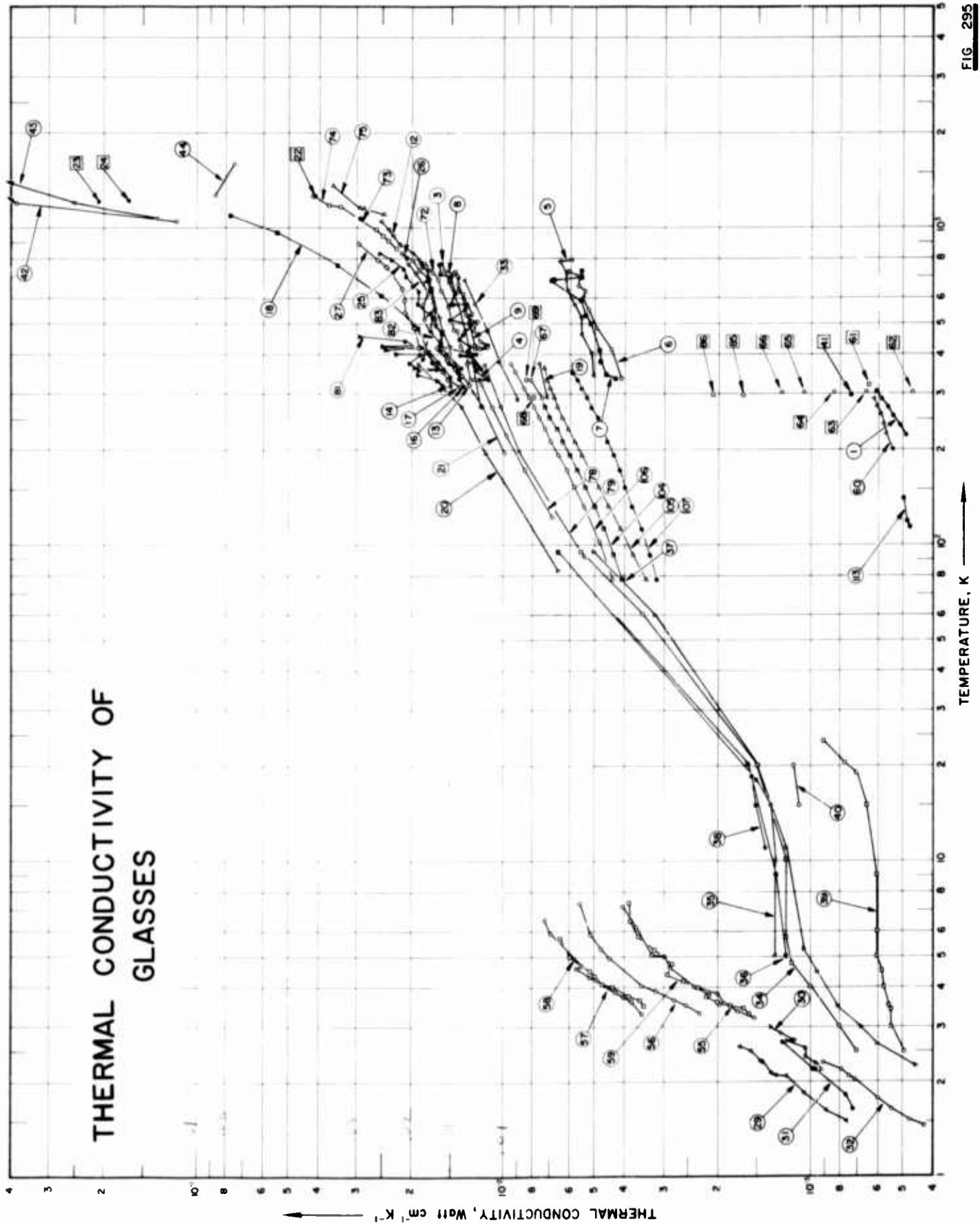


FIG. 295

SPECIFICATION TABLE NO. 295 THERMAL CONDUCTIVITY OF GLASSES

[For Data Reported in Figure and Table No. 295]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-305		Cellular Glass	Cellular glass block; density 0.165 g cm ⁻³ ; 1 in. in thickness; as received.
2	110	R	1945	1.3		Thuringian glass	Two tubes of O. D. 0.95 cm, thickness 0.091 cm, and different lengths viz. 5, 8 and 2 cm.
3	330	C	1957	298.2		Borosilicate glass	3 in. dia x 0.20 in. thick lapped disk specimen; measured under 100 g load; thermal comparator No. 4 used.
4	111	L	1952	331-768		Pyrex glass 774	Clear chemical glass supplied by Cincinnati Gasket and Packing Co.; density reported as 2.2213 and 2.2205 g cm ⁻³ at 0 and 50 C, respectively.
5	112	L	1958	344-800		Aluminate silicate glass 723	14 x 14 x 0.250 in.; supplied by Corning Glass Works.
6	112	L	1958	335-733		Borosilicate glass 3235	14 x 14 x 0.250 in.; supplied by Pittsburgh Plate Glass Co.
7	112	L	1958	337-736		Soda-lime silica plate glass 9330	14 x 14 x 0.250 in.; supplied by Libbey-Owen-Ford Glass Co.
8	33	C	1954	419-736		White plate glass	
9	33	C	1954	426-728		White plate glass	Disk specimen; supplied by Pittsburgh Plate Glass Co.; measured under a load of ~23 psi; Armco iron used as comparative material.
10	33	C	1954	413-714		Solex 2808 plate glass	The above specimen measured with aluminum foil of 0.00025 in. thick adjacent to specimen surface; same comparative material.
11	33	C	1954	421-731		Solex "S" plate glass	Similar to above but without the aluminum foil.
12	33	C	1954	442-1059		Window glass; 248 Al-1	Similar to above
13	9	L	1953	319-420	±1	Borosilicate glass; 249 Al-1	Similar to above but supplied by Corning Glass Works.
14	9	L	1953	319-410	±1	Lead glass; 250 Al-1	0.497 in. in length, 0.410 in. in dia; density 2.42 g cm ⁻³ .
15	9	L	1953	317-407	±1	Plate glass; 251 Al-1	0.496 in. in length, 0.411 in. in dia; density 2.35 g cm ⁻³ .
16	9	L	1953	316-411	±1	Pyrex glass; 252 Al-1	0.494 in. in length, 0.409 in. in dia; density 3.04 g cm ⁻³ .
17	9	L	1953	316-412	±1	Silica glass	0.496 in. in length, 0.410 in. in dia; density 2.50 g cm ⁻³ .
18	34	C	1943	377-1092		Soda glass	0.497 in. in length, 0.410 in. in dia; density 2.22 g cm ⁻³ .
19	44	F	1914	293, 373		Quartz glass	Pure; fused; 1 cm cubic specimen; 18-8 stainless steel used as comparative material.
20	22	L	1911	83-373		Borosilicate crown glass	0.332 cm dia x 6.0 cm long; density 2.59 g cm ⁻³ .
21	22	L	1911	195-373		Green glass	No details reported.
22	113	L	1954	1268.2			No details reported.

0.6 Fe₂O₃

SPECIFICATION TABLE NO. 295 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
23	113	L	1954	1206.2		Colorless glass	0.1 Fe ₂ O ₃ .
24	113	L	1954	1216.2		Amber glass	0.2 Fe ₂ O ₃ .
25	45	R	1953	387-840		Soda-lime silica glass; 0080	Ellipsoidal specimen supplied by Corning Glass Works.
26	45	R	1953	517-834		Soda-lime silica glass; 0080	Similar to the above specimen.
27	45	R	1953	422-892		Soda-lime silica glass; 0080	Similar to the above specimen.
28	114		1954	489-858		Pyrex glass	No details reported.
29	78	L	1948	1.5-2.6		Jena Gerate 20	Cylindrical specimen of dia 0.78 cm.
30	78	L	1948	2.2-3.0		Jena Gerate 16	Similar to the above specimen.
31	78	L	1948	1.6-2.7		Thuringian glass	Similar to the above specimen.
32	78	L	1948	1.5-2.3		Monax	Similar to the above specimen.
33	302	P	1962	289-685		Pyrex glass 7740	Approx composition: 80.4 SiO ₂ , 13.3 B ₂ O ₃ , 4.4 Na ₂ O and 2.0 Al ₂ O ₃ ; thermal conductivity values calculated from measured thermal diffusivity data and literature data of specific heat and density.
34	69	L	1951	2.5-95		Quartz glass	Specimen dia 6.1 mm, length 2.3 cm.
35	69	L	1951	5.0-95		Quartz glass	Specimen dia 7.7 mm, length 2.25 cm.
36	69	L	1951	5.0-95		Quartz glass	Specimen dia 7.4 mm, length 4.6 cm.
37	69	L	1951	2.3-95		Phoenix glass	A borosilicate glass; specimen dia 6.0 mm, length 2.15 cm.
38	69	L	1951	11-20		Phoenix glass	A borosilicate glass; specimen dia 9.4 mm, length 3.05 cm.
39	330	C	1957	298.2		Borosilicate glass	3 in. dia x 0.25 in. thick lapped disk specimen; thermal comparator No. 4 used.
40	116	L	1949	15, 20		Phoenix glass	A borosilicate glass; specimen dia 6.1 mm, length 27 mm.
41	117	P	1955	297.2		Foamglass	Specimen thickness 14.8 mm; density 0.15 g cm ⁻³ ; thermal conductivity values calculated from measured transient temp changes.
42	118	-	1952	1050-1800		Window glass	Thermal conductivity values calculated from measured data of spectral absorption constant of the specimen.
43	118	-	1952	1973-1540		Commercial glass	Similar to above.
44	118	-	1952	1273, 1600		X-ray protection glass	Similar to above.
45	152	L	1956	298.2		Plate glass	Wafer specimen 0.75 in. dia x 0.020 in. thick.

SPECIFICATION TABLE NO. 295 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
46	152	L	1956	298.2		Plate glass	The above specimen exposed in 3×10^{19} epithermal neutrons per cm^2 for 480 MWD in the MTR.
47	152	L	1956	298.2		Silica glass	No details reported.
48	152	L	1956	298.2		Silica glass	The above specimen exposed in 7×10^{19} epithermal neutrons per cm^2 for 480 MWD in the MTR.
49	39	C	1960	367-700		White plate glass	Specimen 3 in. in dia and 0.25 in. in thickness prepared by Pittsburgh Plate Glass Co.; density 2.52 g cm^{-3} ; Armco iron used as comparative material.
50	39	C	1960	367-700		Pyrex glass 774	Specimen 3 in. in dia and 0.25 in. in thickness; prepared by Cincinnati Gasket and Packing Co.; density 2.22 g cm^{-3} at 273 K; same comparative material as above.
51	39	C	1960	273-573		Pyrex glass 774	Same as the above specimen.
52	39	C	1960	367-700		Solex 280EX	Specimen 3 in. in dia and 0.25 in. in thickness; prepared by Pittsburgh Plate Glass Co.; density 2.53 g cm^{-3} at 273 K; same comparative material as above.
53	39	C	1960	367-700		Solex "S"	Similar to the above specimen except density 2.52 g cm^{-3} at 273 K.
54	39	C	1960	423-1073		Fused silica	Specimen 3 in. in dia and 0.25 in. in thickness; density 2.20 g cm^{-3} at 273 K; same comparative material as above.
55	188	L	1958	3.2-7.2		Silica glass	High purity fused silica square rod of 19.9 mm ² cross-section supplied by Corning Glass Works; density 2.2002 g cm^{-3} .
56	188	L	1958	3.3-7.4		Silica glass	The above specimen irradiated with 1.71×10^{19} neutrons cm^{-2} ; density 2.24 g cm^{-3} .
57	188	L	1958	3.3-6.5		Silica glass	The above specimen again irradiated with 4.13×10^{19} neutrons (total irradiation $5.84 \times 10^{19} \text{ n cm}^{-2}$); density 2.26 g cm^{-3} .
58	188	L	1958	3.5-5.7		Silica glass	The above specimen again irradiated with $3.5 \times 10^{19} \text{ n cm}^{-2}$; density 2.26 g cm^{-3} .
59	188	L	1958	3.3-7.4		Silica glass	The above specimen annealed at 925 C for 9 hrs; density 2.2045 g cm^{-3} .
60	189		1950	200-288		Foam glass	Density $0.160-0.176 \text{ g cm}^{-3}$; negligible water absorption (in vol % per 24 hrs).
61	100	L	1957	310.9		Foam glass	Bulk density 0.171 g cm^{-3} .
62	190		1954	303.2		Foam glass	Density 0.1 g cm^{-3} .
63	190		1954	303.2		Foam glass	Density 0.2 g cm^{-3} .
64	190		1954	303.2		Foam glass	Density 0.3 g cm^{-3} .
65	190		1954	303.2		Foam glass	Density 0.4 g cm^{-3} .
66	190		1954	303.2		Foam glass	Density 0.5 g cm^{-3} .
67	108	L	1920	293, 333		Plate glass	Dia 9 in., thickness 0.252 in.; specific gravity 2.49; transverse heat flow.
68	108	L	1920	293.2		Plate glass	Dia 9 in., thickness 0.289 in.; specific gravity 2.60; transverse heat flow.

SPECIFICATION TABLE NO. 295 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
69	108	L	1920	333-2		Plate glass	Dia 9 in., thickness 0.289 in.; transverse heat flow.
70	34	C	1943	388-751		Pyrex glass	80.5 SiO ₂ , 12.9 B ₂ O ₃ , 3.8 Na ₂ O, 2.2 Al ₂ O ₃ , and 0.4 PbO; 1 x 1 x 1 cm; ground; 18-8 stainless steel used as comparative material.
71	34	C	1943	386-611		Soda-lime glass	69.73 SiO ₂ , 20.96 Na ₂ O, 9.05 CaO, 0.18 B ₂ O ₃ , and trace of K ₂ O; 1 x 1 x 1 cm; 18-8 stainless steel used as comparative material.
72	303	L	1940	333-773		Pyrex glass 774	Disk specimen obtained from Corning Glass Works; density 2.229 g cm ⁻³ .
73	295	C	1960	513-1083		Vycor-brand glass, V-1	Obtained in the leached condition, then heat treated, cut, and polished; sintered; density 2.18 g cm ⁻³ ; zero porosity; polycrystalline Al ₂ O ₃ and ZrO ₂ used as comparative material.
74	295	C	1960	493-1273		Vycor-brand glass, V-2	Obtained in the leached condition, then heat treated, cut, and polished; sintered; density 1.62 g cm ⁻³ ; porosity 2.57%, pore size 0.005 μ; polycrystalline Al ₂ O ₃ and ZrO ₂ used as comparative material.
75	295	C	1960	553-1363		Vycor-brand glass, V-2	Obtained in the leached condition, then heat treated, cut, and polished; sintered; density 2.12 g cm ⁻³ ; microscopic porosity 4.1%; gravimetric porosity 2.6%; pore size 14-20 μ; polycrystalline Al ₂ O ₃ and ZrO ₂ used as comparative material.
76	301	L	1963	273-573		Pyrex glass 7740	Density 2.2258 g cm ⁻³ at 24.3 C; refractive index 1.47257 ± 0.00003 at 23 C for the D lines of sodium (5893 Å); specimen was somewhat strained; after the thermal conductivity measurement the glass was annealed and the index of refraction decreased to 1.47211 ± 0.00003; data reported are the deduced probable values.
77	136	C	1959	343-869	±4	Pyrex glass 7740	Approx composition: 81.0 SiO ₂ , 12.5 B ₂ O ₃ , 4.5 Na ₂ O, and 2.0 Al ₂ O ₃ .
78	147	L	1960	123-373		A	Approx composition: 80.8 SiO ₂ , 12.8 B ₂ O ₃ , 4.2 Na ₂ O, and 2.2 Al ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 2.22 g cm ⁻³ .
79	187	R	1932	92-523			80.5 SiO ₂ , 12.5 B ₂ O ₃ , 4.0 Na ₂ O, and 2.0 Al ₂ O ₃ ; density 2.233 g cm ⁻³ at 21 C.
80	304	L	1961	273-773		Pyrex glass 7740	Cylindrical specimen of dia 2.540 cm; tentative data.
81	321	P	1961	297-458	±5	Pyrex glass 7740	Tubing; resistance 8.5-21.7 ohm; value of (ρ ck) measured by platinum film gage deposited parallel to axis of the tube; value of specific heat C taken from calculated data by Kelly, K. K., U. S. Dept. of the Interior, Bur. of Mines Bull. No. 476, 1949.
82	321	P	1961	294-544		Soda-lime plate glass	Tubing; resistance 12.3 ohm; value of (ρ ck) measured by platinum film gage deposited parallel to axis of the tube; value of specific heat C taken from calculated data by Kelly, K. K., U. S. Dept. of the Interior, Bur. of Mines Bull. No. 476, 1949.
83	303	L	1940	323-773		Silica glass	1.509 in. dia and 0.250 in. thick; obtained from Thermal Syndicate, Ltd.; density 2.199 g cm ⁻³ .

SPECIFICATION TABLE NO. 295 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
84	430	P	1966	298.2		Pyrex	Spherical beads supplied by Minnesota Mining and Mfg. Co.; specimen contained in a 0.75 in. dia x 2 in. long cylindrical cell; mesh size -140 + 200; thermal conductivity measured by using the transient line source method; the heat source was a .36-gauge constantan wire contained in a 0.025 in. O. D. hypodermic tube soldered along the axis of the cylindrical cell; data calculated from measured line temp at two certain times; measured in Freon-12 under a pressure of ~100 psig.
85	430	P	1966	298.2		Pyrex	Similar to the above specimen; measured in argon under a pressure of ~100 psig.
86	430	P	1966	298.2		Pyrex	Similar to the above specimen; measured in nitrogen under a pressure of ~100 psig.
87	430	P	1966	298.2		Pyrex	Similar to the above specimen; measured in methane under a pressure of ~100 psig.
88	430	P	1966	298.2		Pyrex	Similar to the above specimen; measured in helium under a pressure of ~100 psig.
89	430	P	1966	298.2		Pyrex	Similar to the above specimen; measured in hydrogen under a pressure of ~100 psig.
90	430	P	1966	298.2		Pyrex	Similar to the above specimen with water filled in the container.
91	147	L	1960	78-373		E	67.7 SiO ₂ , 14.6 Na ₂ O, 5.4 CaO, 4.0 B ₂ O ₃ , 3.0 R ₂ O, 1.8 Al ₂ O ₃ , 1.8 K ₂ O, 1.3 Fe ₂ O ₃ , and <1.0 As ₂ O ₃ , 3 in. dia x 9.375 in. thick; density 2.42 g cm ⁻³ .
92	147	L	1960	83-363		F	57.9 SiO ₂ , 11.1 Al ₂ O ₃ , 9.7 ZnO, 9.4 Na ₂ O, 4.9 CaO, 3.0 ZnO, 2.9 B ₂ O ₃ , 0.8 Sb ₂ O ₃ , and 0.1 Al ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 2.52 g cm ⁻³ .
93	147	L	1960	78-373		D	71.2 SiO ₂ , 14.5 K ₂ O, 7.6 Na ₂ O, 5.5 CaO, 3.0 ZnO, 2.9 B ₂ O ₃ , 0.8 Sb ₂ O ₃ , and 0.1 Al ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 2.52 g cm ⁻³ .
94	147	L	1960	148-373		C	72.7 SiO ₂ , 14.5 K ₂ O, 7.7 B ₂ O ₃ , 4.0 Na ₂ O, 0.4 Al ₂ O ₃ , 0.4 Sb ₂ O ₃ , and 0.4 ZnO; 3 in. dia x 0.375 in. thick; density 2.45 g cm ⁻³ .
95	73, 136	R	1954	497-826	±10	Soda-lime silica glass; 1	71.25 SiO ₂ , 13.35 Na ₂ O, 11.82 CaO, 244 MgO, 0.68 Na ₂ SO ₄ , 0.26 Al ₂ O ₃ , 0.14 Fe ₂ O ₃ , and 0.06 NaCl; prepared by Pittsburgh Plate Glass Co. Lab.; ellipsoidal specimen.
96	73, 136	R	1954	350-724	±10	Soda-lime silica glass; 2	70.84 SiO ₂ , 13.32 Na ₂ O, 11.75 CaO, 2.64 MgO, 0.61 Na ₂ SO ₄ , 0.56 Fe ₂ O ₃ , 0.22 Al ₂ O ₃ , and 0.06 CaCl; same source and shape as the above specimen.
97	73, 136	R	1954	361-798	±10	Soda-lime silica glass; 3	69.05 SiO ₂ , 16.38 Na ₂ O, 7.37 CaO, 3.05 Al ₂ O ₃ , 2.80 MgO, 0.55 Na ₂ SO ₄ , 0.48 K ₂ O, 0.12 NaCl, 0.09 Fe ₂ O ₃ , 0.015 NiO, and 0.015 CoO; same source and shape as the above specimen.
98	73, 136	R	1954	421-806	±10	Soda-lime silica glass; 4	58.43 SiO ₂ , 19.32 Na ₂ O, 7.89 Al ₂ O ₃ , 6.00 CaO, 4.25 K ₂ O, 3.51 MgO, 0.24 Na ₂ SO ₄ , 0.12 CaCl, 0.11 Fe ₂ O ₃ , 0.013 NiO, and 0.013 CoO; same source and shape as the above specimen.
99	72, 136	C	1955	368-685	±10	Soda-lime silica glass; 1	Similar to the above specimen 1 except in cubic shape; measured with another method.
100	114, 72, 136	C	1954	381-773	±10	Soda-lime silica glass; 2	Similar to the above specimen 2 except in cubic shape; measured with another method.

SPECIFICATION TABLE NO. 295 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
101	136	R	1959	393-847		Silicate glass, Corning 0080	74.0 SiO ₂ , 16.5 Na ₂ O, 5.0 CaO, 3.5 MgO, and 1.0 Al ₂ O ₃ ; ellipsoidal specimen.
102	136	R	1959	433-888		Silicate glass, Corning 0080	Similar to the above specimen.
103	136	R	1959	509-839		Silicate glass, Corning 0080	Similar to the above specimen.
104	147	L	1960	78-373		I	46.0 SiO ₂ , 44.8 PbO, 9.2 K ₂ O, and 0.1 Al ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 3.55 g cm ⁻³ .
105	147	L	1960	78-363		K	59.7 PbO, 35.6 SiO ₂ , 4.4 K ₂ O, and 0.2 Al ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 4.29 g cm ⁻³ .
106	147	L	1960	79-373		G	54.2 SiO ₂ , 34.2 PbO, 7.1 K ₂ O, 2.4 Na ₂ O, 2.0 Sb ₂ O ₃ , and 0.2 As ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 3.19 g cm ⁻³ .
107	147	L	1960	78-353		L	80.0 PbO and 20.0 SiO ₂ ; 3 in. dia x 0.375 in. thick; density 6.10 g cm ⁻³ .
108	147	L	1960	78-373		J	42.9 BaO, 40.5 SiO ₂ , 7.7 ZnO, 6.5 B ₂ O ₃ , 1.8 Al ₂ O ₃ , 0.3 Sb ₂ O ₃ , and 0.2 As ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 3.56 g cm ⁻³ .
109	147	L	1960	78-373		H	49.8 SiO ₂ , 24.2 BaO, 8.5 K ₂ O, 7.8 ZnO, 5.9 PbO, 2.9 Na ₂ O, 0.7 Sb ₂ O ₃ , and 0.2 As ₂ O ₃ ; 3 in. dia x 0.375 in. thick; density 3.18 g cm ⁻³ .
110	128	L	1946	325.4			2.05 in. thick; expanded; density 0.170 g cm ⁻³ .
111	128	L	1946	194,243			Similar to above except 1.07 in. thick.
112	563	L	1945	222-305			Cellular block; thickness of sample 1 in.; density (25 C) 0.165 g cm ⁻³ .
113	43	L	1954	115-141			Cellular block; density 0.147 g cm ⁻³ .

DATA TABLE No. 295 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
CURVE 35															
5.0	0.00130	1050	0.116	273.2	0.0119	3.3	0.0023	4.75	0.00245	293.2	0.00797	493.2	0.0162*	768.2	0.01975
10.0	0.00130	1200	0.384	373.2	0.0124	3.5	0.00255	5.25	0.00335	365.2	0.0173*	635.2	0.0173*	869.2	0.02343
15.0	0.00135	1400	0.480*	473.2	0.0137	3.65	0.0028	5.8	0.00365	433.2	0.0202*	733.2	0.0202*		
18.0	0.00150	1600	0.465*	573.2	0.0144	3.9	0.0032	6.5	0.00385	533.2	0.0218*	833.2	0.0218*		
95.0	0.00650	1800	0.436*			4.05	0.00355	7.4	0.0039	333.2	0.0226	863.2	0.0226		
CURVE 36															
5.0	0.00120	1073	0.136	366.5	0.0123	5.3	0.0048			366.5	0.0123	913.2	0.0239	123.2	0.0069
9.0	0.00130	1200	0.252	477.6	0.0126	5.9	0.0052			477.6	0.0126	948.2	0.0249	173.2	0.0085
20.25	0.00160	1540	0.558*	588.8	0.0130	7.4	0.0056			588.8	0.0130	993.2	0.0260	223.2	0.0098
95.0	0.00650			699.8	0.0132					699.8	0.0132	1173.2	0.0339	273.2	0.0109
CURVE 37															
2.25	0.00045	1273	0.0872	366.5	0.0118	3.3	0.00355	272.1	0.000606	272.1	0.00331	443.2	0.0415*	373.2	0.0127*
2.65	0.00060	1600	0.0755	477.6	0.0126	3.5	0.00405	284.1	0.000620	284.1	0.00331	553.2	0.0174*		
3.0	0.00068			588.8	0.0133	3.75	0.0043			386.2	0.0147	613.2	0.0179*	92	0.0054
3.5	0.00091			699.8	0.0138	4.3	0.0052			478.2	0.0164	703.2	0.0188*	198	0.0089
4.5	0.00095	298.2	0.0126			4.6	0.00575	310.9	0.000649	611.2	0.0223	705.2	0.0188*	275	0.0103
5.25	0.00105					4.7	0.0055					791.2	0.0192*	372	0.0116
11.0	0.00120					5.9	0.0070					813.2	0.0213*	423	0.0121*
20.25	0.00150*					6.5	0.0073					903.2	0.0222*	482	0.0126*
60.0	0.0032											933.2	0.0251*	523	0.0131*
95.0	0.0050											1103.2	0.0247		
CURVE 38															
11.0	0.00140	298.2	0.0146	423.2	0.0149	3.5	0.0035	303.2	0.000465	363.2	0.0126	563.2	0.0111	273.2	0.0106
15.0	0.00150			573.2	0.0201	3.65	0.0036			373.2	0.0134	633.2	0.0116	373.2	0.0119
18.5	0.00155			673.2	0.0213	3.75	0.0039			378.2	0.0133	683.2	0.0122	473.2	0.0133
20.25	0.00160*			873.2	0.0230	4.0	0.0044			405.2	0.0136*	723.2	0.0127	573.2	0.0146
				973.2	0.0239	4.1	0.00475			423.2	0.0140	773.2	0.0133	673.2	0.0160
				1073.2	0.0247	4.35	0.0050			478.2	0.0146				
CURVE 39*															
298.2	0.0117			3.2	0.00115	4.5	0.0052	303.2	0.000848	568.2	0.0153	473.2	0.0138	297	0.0135*
				3.35	0.00175	5.0	0.0060			633.2	0.0161	523.2	0.0138	300	0.0134*
				3.55	0.00193	5.7	0.0065			683.2	0.0165	573.2	0.0143	306	0.0139*
				4.0	0.0024					723.2	0.0172			319	0.0142*
				4.6	0.0029					773.2	0.0182			322	0.0159
				5.0	0.003									322	0.0145*
				5.05	0.0033									329	0.0143*
				6.2	0.0037									330	0.0156*
				7.2	0.00408									332	0.0166
														336	0.0166*
														345	0.0191
														356	0.0190
														360	0.0167
CURVE 40															
298.2	0.0117	366.5	0.0114	3.3	0.00167	3.3	0.00167	303.2	0.00126	513.2	0.0165*	343.2	0.01088		
		477.6	0.0126	3.8	0.00202	3.45	0.00186			533.2	0.0167*	433.2	0.0127		
		588.8	0.0135	4.0	0.0024	3.55	0.00198			565.2	0.0172*	493.2	0.0172*		
		699.8	0.0144	4.6	0.0029	3.6	0.00203			585.2	0.0172*	553.2	0.01339		
				5.05	0.0033	3.75	0.0022			686.2	0.0184*	613.2	0.01473		
				6.2	0.0037	3.8	0.00215			776.2	0.0201*	671.2	0.01653		
				7.2	0.00408	4.0	0.00235			803.2	0.0209	718.2	0.01795		
						4.2	0.0026			1083.2	0.0293				
						4.4	0.00295								
CURVE 41															
497.2	0.000731														

* Not shown on plot

DATA TABLE NO. 295 (continued)

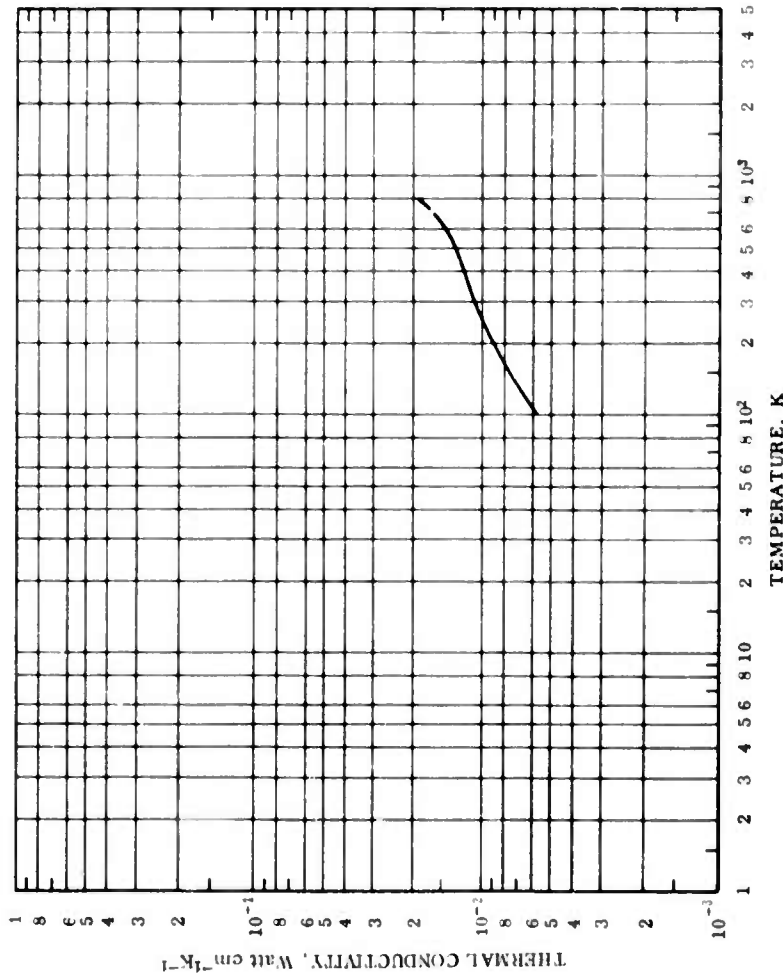
T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 81 (cont.)</u>																					
362	0.0159*	298.2	0.00167	133.2	0.00824	497.2	0.01736	368.2	0.0135	433.2	0.0155	213.2	0.00582	78.2	0.00460						
366	0.0195	<u>CURVE 86</u>		153.2	0.00883	536.2	0.01866	413.2	0.0144	488.2	0.0154	233.2	0.00611	93.2	0.00485						
373	0.0164*	298.2	0.00209	173.2	0.00929	570.2	0.01632	467.2	0.0144	546.2	0.0167	253.2	0.00636	113.2	0.00519						
374	0.0201*	298.2	0.00209	193.2	0.00975	615.2	0.01778	503.2	0.0143	593.2	0.0168	273.2	0.00661	133.2	0.00552						
374	0.0162*	298.2	0.00209	213.2	0.01013	675.2	0.02038	527.2	0.0146	656.2	0.0168	293.2	0.00678	153.2	0.00582						
376	0.0204	298.2	0.00209	233.2	0.01046	716.2	0.02075	603.2	0.0159	768.2	0.0205	313.2	0.00699	173.2	0.00611						
394	0.0212*	298.2	0.00209	253.2	0.01079	760.2	0.02163	622.2	0.0183	888.2	0.0251	333.2	0.00715	193.2	0.00640						
395	0.0214*	298.2	0.00209	273.2	0.01105	793.2	0.02342	645.2	0.0180	<u>CURVE 101*</u>											
400	0.0187	298.2	0.00293	293.2	0.01130	826.2	0.02159	685.2	0.0180	<u>CURVE 102*</u>											
401	0.0226	<u>CURVE 88*</u>		313.2	0.01151	<u>CURVE 96*</u>						<u>CURVE 103*</u>									
402	0.0182*	298.2	0.00439	333.2	0.01172	350.2	0.01527	381.2	0.0105	509.2	0.0180	<u>CURVE 106</u>									
414	0.0246	298.2	0.00439	353.2	0.01192	443.2	0.01347	419.2	0.0102	624.2	0.0177	78.2	0.00439	78.2	0.00778						
416	0.0219*	298.2	0.00439	363.2	0.01201	499.2	0.01469	423.2	0.0129	699.2	0.0177	103.2	0.00485	103.2	0.00778						
422	0.0186	<u>CURVE 89*</u>		<u>CURVE 93*</u>						<u>CURVE 104</u>						<u>CURVE 109*</u>					
424	0.0186	298.2	0.00565	78.2	0.00519	93.2	0.00561	672.2	0.01824	488.2	0.0134	253.2	0.00695	253.2	0.00728						
427	0.0192	298.2	0.00565	93.2	0.00561	113.2	0.00615	724.2	0.01987	488.2	0.0134	273.2	0.00728	273.2	0.00728						
441	0.0211*	298.2	0.00565	113.2	0.00615	133.2	0.00669	519.2	0.0140	519.2	0.0140	293.2	0.00728	293.2	0.00728						
458	0.0293	298.2	0.00628	153.2	0.00724	173.2	0.00770	519.7	0.0114	519.7	0.0114	273.2	0.00791	273.2	0.00791						
294	0.0120*	<u>CURVE 91*</u>		193.2	0.00820	361.2	0.01527	550.2	0.0112	550.2	0.0112	293.2	0.00824	113.2	0.00506						
315	0.0149*	78.2	0.00519	213.2	0.00862	404.2	0.01707	590.2	0.0147	113.2	0.00469	313.2	0.00854	113.2	0.00531						
362	0.0138	78.2	0.00519	233.2	0.00904	471.2	0.01648	590.2	0.0131	133.2	0.00502	333.2	0.00887	153.2	0.00561						
400	0.0156	93.2	0.00561	253.2	0.00941	545.2	0.01833	654.2	0.0152	153.2	0.00536	353.2	0.00916	173.2	0.00586						
431	0.0162	113.2	0.00615	273.2	0.00979	587.2	0.01862	655.2	0.0167	173.2	0.00573	373.2	0.00946	193.2	0.00615						
476	0.0174	133.2	0.00670	293.2	0.01004	638.2	0.01879	696.2	0.0175	193.2	0.00602	213.2	0.00946	213.2	0.00640						
518	0.0185*	153.2	0.00724	313.2	0.01029	688.2	0.02029	697.2	0.0159	213.2	0.00636	233.2	0.00946	233.2	0.00661						
544	0.0174	173.2	0.00770	333.2	0.01054	733.2	0.02084	722.7	0.0185	233.2	0.00665	253.2	0.00946	253.2	0.00695						
<u>CURVE 83</u>																					
323.2	0.0143*	213.2	0.00862	353.2	0.01079	798.2	0.02264	724.2	0.0175	253.2	0.00703	78.2	0.00318	78.2	0.00460						
383.2	0.0149*	233.2	0.00904	421.2	0.01540	469.2	0.01510	746.7	0.0161	273.2	0.00728	93.2	0.00335	93.2	0.00481						
423.2	0.0152	253.2	0.00941	469.2	0.01540	537.2	0.01695	746.7	0.0161	273.2	0.00728	113.2	0.00356	113.2	0.00506						
473.2	0.0159	273.2	0.00980	568.2	0.01632	568.2	0.01632	748.5	0.0170	293.2	0.00753*	133.2	0.00381	133.2	0.00531						
523.2	0.0163	293.2	0.01029	593.2	0.01632	633.2	0.01736	771.2	0.0204	313.2	0.00778*	153.2	0.00402	153.2	0.00561						
573.2	0.0172*	313.2	0.01054	666.2	0.01632	666.2	0.01736	771.2	0.0204	333.2	0.00812*	173.2	0.00418	173.2	0.00586						
623.2	0.0176*	353.2	0.01079	738.2	0.01632	738.2	0.01736	773.2	0.0175	353.2	0.00837*	193.2	0.00435	193.2	0.00615						
673.2	0.0184	373.2	0.01100	806.2	0.01632	806.2	0.01736	773.2	0.0175	373.2	0.00862*	213.2	0.00456*	213.2	0.00640						
723.2	0.0194	<u>CURVE 94*</u>						<u>CURVE 105</u>						<u>CURVE 110</u>							
773.2	0.0207	148.2	0.00774	421.2	0.01510	469.2	0.01510	746.7	0.0161	253.2	0.00703	78.2	0.00318	78.2	0.00460						
823.2	0.0163	173.2	0.00833	469.2	0.01510	537.2	0.01695	746.7	0.0161	273.2	0.00728	93.2	0.00335	93.2	0.00481						
873.2	0.0172*	193.2	0.00879	568.2	0.01632	568.2	0.01632	748.5	0.0170	293.2	0.00753*	113.2	0.00356	113.2	0.00506						
923.2	0.0176*	213.2	0.00920	593.2	0.01632	633.2	0.01736	771.2	0.0204	313.2	0.00778*	133.2	0.00381	133.2	0.00531						
973.2	0.0184	233.2	0.01009	666.2	0.01632	666.2	0.01736	771.2	0.0204	333.2	0.00812*	153.2	0.00402	153.2	0.00561						
1023.2	0.0194	253.2	0.01079	738.2	0.01632	738.2	0.01736	773.2	0.0175	353.2	0.00837*	173.2	0.00418	173.2	0.00586						
1073.2	0.0207	273.2	0.01100	806.2	0.01632	806.2	0.01736	773.2	0.0175	373.2	0.00862*	193.2	0.00435	193.2	0.00615						
<u>CURVE 84*</u>																					
83.2	0.00653	298.2	0.00669	83.2	0.00653	83.2	0.00653	83.2	0.00653	83.2	0.00653	83.2	0.00653	83.2	0.00653						
113.2	0.00766	298.2	0.00766	113.2	0.00766	113.2	0.00766	113.2	0.00766	113.2	0.00766	113.2	0.00766	113.2	0.00766						
194.3	0.000131	298.2	0.000131	194.3	0.000131	194.3	0.000131	194.3	0.000131	194.3	0.000131	194.3	0.000131	194.3	0.000131						
243.2	0.000141	298.2	0.000141	243.2	0.000141	243.2	0.000141	243.2	0.000141	243.2	0.000141	243.2	0.000141	243.2	0.000141						

* Not shown on plot

DATA TABLE NO. 295 (continued)

T	k
<u>CURVE 112</u>	
222.2	0.000383
239.2	0.000509
255.5	0.000539
272.1	0.000558
288.8	0.000583
305.3	0.000609
<u>CURVE 113</u>	
115	0.000476
120	0.000483
141	0.000498

FIGURE AND TABLE NO. 295R RECOMMENDED THERMAL CONDUCTIVITY OF CORNING CODE 7740 GLASS



RECOMMENDED VALUES*

(Approximate composition: 80.6% SiO₂, 13% B₂O₃, 4.3% Na₂O, and 2.1% Al₂O₃)

T ₁	k ₁	k ₂	T ₂
100	0.0058	0.335	-279.7
150	0.0076	0.439	-189.7
200	0.0090	0.520	-99.7
250	0.0101	0.584	-9.7
273.2	0.0106	0.612	32.0
300	0.0110	0.636	80.3
350	0.0117	0.676	170.3
400	0.0124	0.716	260.3
500	0.0136	0.786	440.3
600	0.0149	0.861	620.3
700	0.0165	0.953	800.3
500	0.0189) ‡	(1.09)	980.3

REMARKS

The recommended values are thought to be accurate to within 5% of the true values near room temperature and 5 to 10% at other temperatures.

* T₁ in K, k₁ in Watt cm⁻¹K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹ft⁻¹F⁻¹. ‡ Values in parentheses are extrapolated.

SPECIFICATION TABLE NO. 296 THERMAL CONDUCTIVITY OF MULLITE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	407	L	1949	327-446		C-1	No details reported.

DATA TABLE NO. 296 THERMAL CONDUCTIVITY OF MULLITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
326.6	0.0323
362.3	0.0301
445.6	0.0287

CURVE 1*

* No graphical presentation

SPECIFICATION TABLE NO. 297 THERMAL CONDUCTIVITY OF PETALITE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	468	L	1950	325-392			No details reported.

DATA TABLE NO. 297 THERMAL CONDUCTIVITY OF PETALITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

328.6	0.0266
357.8	0.0268
391.5	0.0277

* No graphical presentation

THERMAL CONDUCTIVITY OF PORCELAINS

FIGURE SHOWS ONLY 15 OF THE CURVES REPORTED IN TABLE

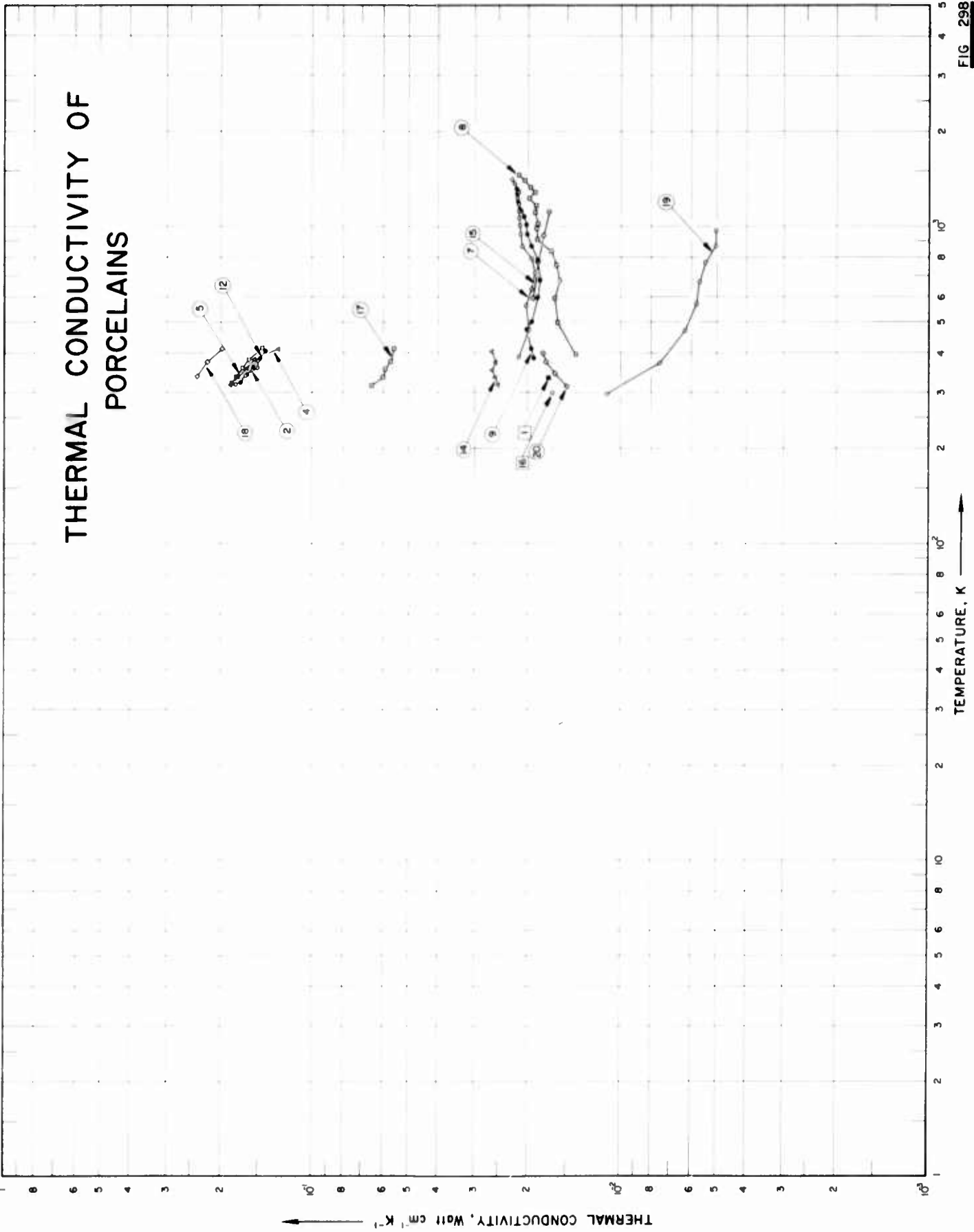


FIG 298

SPECIFICATION TABLE NO. 295 THERMAL CONDUCTIVITY OF PORCELAINS

[For Data Reported in Figure and Table No. 298]

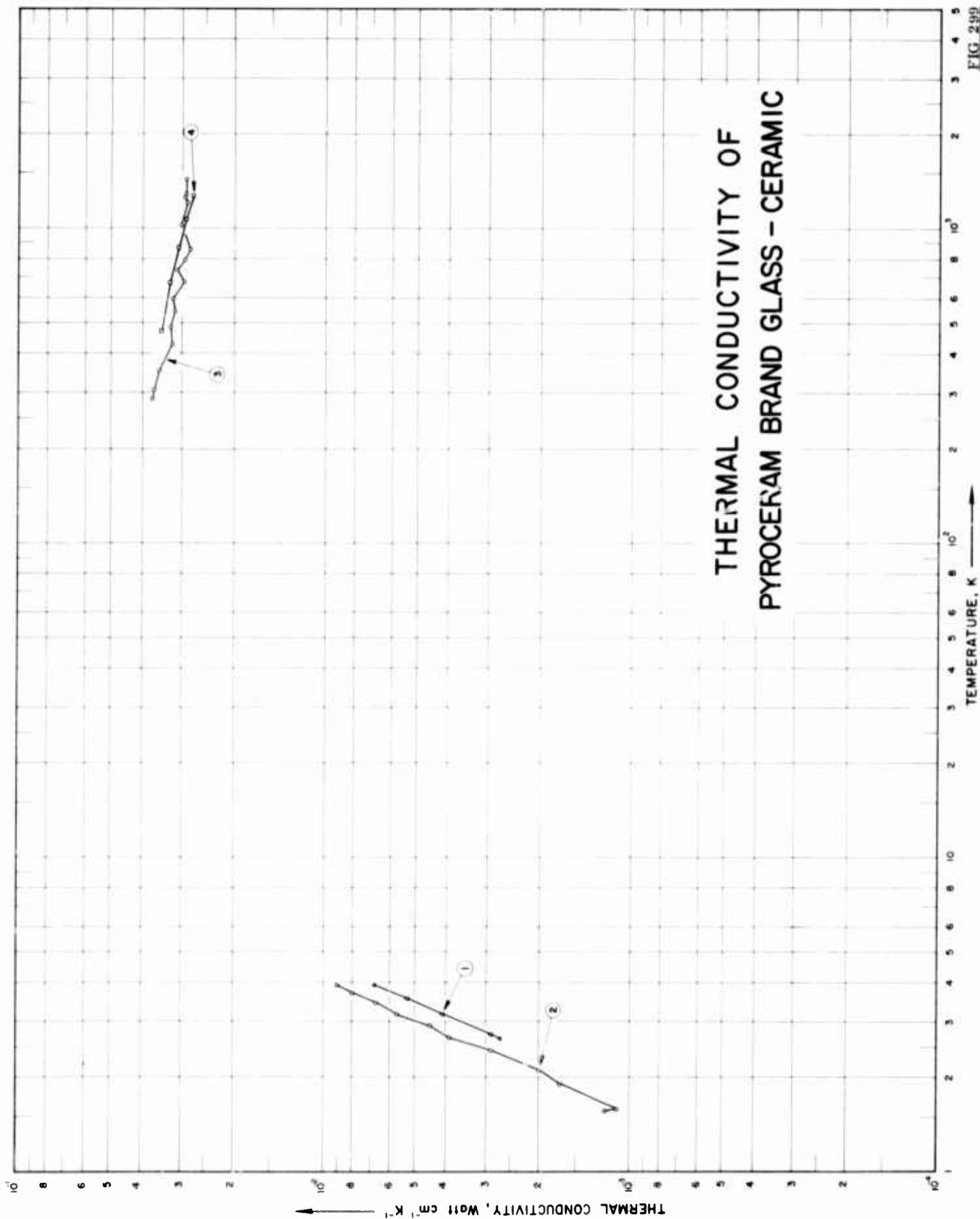
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	3		1953	333-2			Maximum water absorption 0.05%.	
2	42	L	1953	319-377	±3	6 M-1	High Al ₂ O ₃ ; 0.349 in. in dia and 0.500 in. in length.	
3	42	L	1953	316-410	±3	6 P-1	High Al ₂ O ₃ ; 0.450 in. in dia and 0.496 in. in length.	
4	42	L	1953	318-412	±3	6 J-1	High Al ₂ O ₃ ; 0.250 in. in dia and 0.250 in. in length.	
5	42	L	1953	320-416	±3	6 K-1	High Al ₂ O ₃ ; 0.249 in. in dia and 0.500 in. in length.	
6	42	L	1953	313-387	±3	6 L-1	High Al ₂ O ₃ ; 0.300 in. in dia and 0.501 in. in length.	
7	89	R	1952	388-1418		Electrical porcelain; A	Starting material consisting of 19.0 flint, 37.0 feldspar, 7.0 Edgar plastic kaolin, 22.0 Edgar Nocarb clay, and 15.0 Kentucky old mine No. 4 ball clay, ball-milled for 15 hrs, slip-cast, and fired to 1250 C; 0.25% open pores; bulk density 2.5 g cm ⁻³ .	
8	89	R	1952	395-1456		Electrical porcelain; B	Same as the above specimen.	
9	89	R	1952	385-1396		Electrical porcelain; 3	Same as the above specimen.	
10	42, 87	C	1953	322-425	±3	6 R-1	High Al ₂ O ₃ ; 0.500 in. in dia and 0.497 in. in length; copper used as comparative material.	
11	42, 87	C	1953	382-410	±3	6 R-2	Second run of the above specimen.	
12	42, 87	C	1953	323-406	±3	6 Q-1	High Al ₂ O ₃ ; 0.501 in. in dia and 0.500 in. in length.	
13	42, 87	C	1953	319-384	±3	6 N-1	High Al ₂ O ₃ ; 0.410 in. in dia and 0.500 in. in length.	
14	68	C	1954	317-404	±3	Wet process; 7A2	Copper used as comparative material.	
15	76	C	1952	593-1113		MgTiO ₃ porcelain	0.75 in. dia x 9 in. long; density 2.87 g cm ⁻³ .	
16	182	L	1956	298.2		Porcelain 576	Exposed with 6 x 10 ¹⁹ epithermal neutrons per cm ² for 480 MWD in the MTR.	
17	9	C	1953	315-411		High Zircon; 283A-1	62.5 zircon G, 25.0 calcium zirconium silicate, and 12.5 old mine No. 4 ball clay; bulk density 3.91 g cm ⁻³ ; water absorption 0.03%.	
18	136	C	1959	336-413	±4	Alumina porcelain	91 vol % α-alumina bonded with a continuous glassy matrix.	
19	550	P	1963	298-973		Coors; type AB-2	High alumina; cylindrical specimen from Coors Porcelain Co.; density 3.42 g cm ⁻³ ; thermal conductivity values calculated from measured data of thermal diffusivity and specific heat.	
20	468	L	1950	314-400		Wet process	No details reported.	

DATA TABLE NO. 298 THERMAL CONDUCTIVITY OF PORCELAINS

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 7</u>		<u>CURVE 9 (cont.)</u>		<u>CURVE 14 (cont.)</u>		<u>CURVE 20</u>			
333.2	0.0173	388.2	0.0215	784.2	0.0186	372.0	0.0256	314.0	0.0150		
<u>CURVE 2</u>		473.2	0.0199	866.2	0.0195	404.1	0.0264	345.5	0.0164		
318.7	0.179	567.2	0.0203	943.2	0.0201	<u>CURVE 15</u>		375.6	0.0176		
339.7	0.166	636.2	0.0195	1016.2	0.0203	593.2	0.0193	399.5	0.0179		
358.0	0.151	715.2	0.0190	1076.2	0.0207	773.2	0.0186				
377.3	0.151	793.2	0.0195	1128.2	0.0211	933.2	0.0179				
<u>CURVE 3*</u>		868.2	0.0209	1198.2	0.0216	1113.2	0.0172				
315.5	0.178	943.2	0.0211	1273.2	0.0218	<u>CURVE 16</u>					
334.1	0.172	1006.2	0.0213	1323.2	0.0219	298.2	0.0167				
358.1	0.156	1066.2	0.0215	1396.2	0.0224	<u>CURVE 17</u>					
374.2	0.149	1123.2	0.0215	<u>CURVE 10*</u>		314.7	0.0653				
409.6	0.138	1178.2	0.0215	321.5	0.169	334.1	0.0598				
<u>CURVE 4</u>		1238.2	0.0218	341.2	0.162	355.5	0.0594				
317.7	0.187	1288.2	0.0215	362.2	0.154	375.7	0.0573				
335.6	0.176	1368.2	0.0222	424.9	0.146	411.0	0.0556				
358.2	0.164	1418.2	0.0227	<u>CURVE 11*</u>		<u>CURVE 18</u>					
381.4	0.155	<u>CURVE 8</u>		381.7	0.162	336.2	0.237				
411.8	0.129	395.2	0.0140	404.1	0.141	373.2	0.220				
<u>CURVE 5</u>		466.2	0.0161	410.1	0.135	413.2	0.198				
320.0	0.185	576.2	0.0159	<u>CURVE 12</u>		<u>CURVE 19</u>					
337.3	0.178	756.2	0.0163	322.5	0.173	298.2	0.0111				
356.0	0.170	836.2	0.0169	342.5	0.164	373.2	0.00753				
378.1	0.161	910.2	0.0187	360.5	0.157	473.2	0.00628				
416.2	0.146	988.2	0.0188	383.6	0.148	573.2	0.00577				
<u>CURVE 6*</u>		1046.2	0.0186	405.5	0.143	673.2	0.00565				
312.8	0.177	1106.2	0.0190	<u>CURVE 13*</u>		773.2	0.00544				
332.0	0.176	1166.2	0.0188	318.5	0.182	873.2	0.00502				
353.4	0.161	1230.2	0.0199	338.5	0.166	973.2	0.00502				
396.7	0.150	1280.2	0.0190	359.4	0.160						
		1330.2	0.0197	383.6	0.150	<u>CURVE 14</u>					
		1400.2	0.0205	<u>CURVE 14</u>		316.8	0.0251				
		1456.2	0.0215	334.4	0.0257	353.7	0.0262				
		<u>CURVE 9</u>		385.2	0.0191						
		412.2	0.0195	412.2	0.0202						
		473.2	0.0202	500.2	0.0195						
		596.2	0.0187	678.2	0.0184						

* Not shown on plot



SPECIFICATION TABLE NO. 299 THERMAL CONDUCTIVITY OF PYROCERAM BRAND GLASS-CERAMIC

[For Data Reported in Figure and Table No. 299]

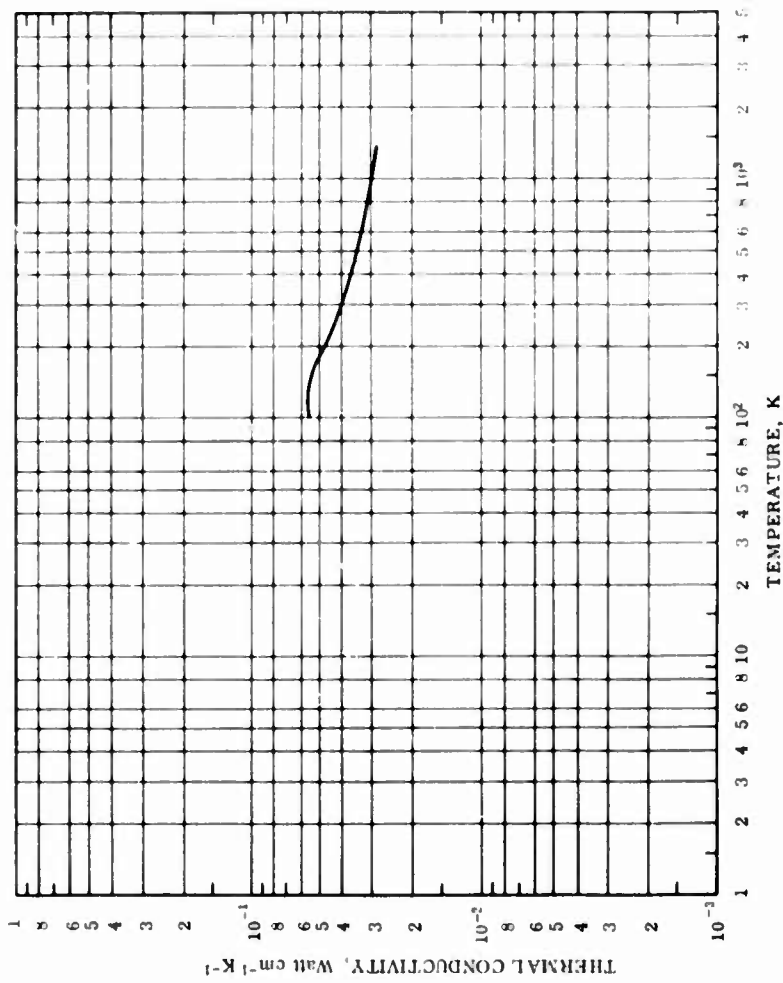
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	306	L	1962	2.7-3.9		Pyroceram 9606 (a)	From Corning Glass Works; specimen cross section 0.334 cm x 1.666 cm.
2	306	L	1962	1.6-3.9		Pyroceram 9606 (b)	From Corning Glass Works; specimen cross section 0.130 cm x 1.607 cm.
3	275	P	1963	288-1433		Pyroceram 9606	From Corning Glass Works; calculated from thermal diffusivity data.
4	305	L	1962	473-1273		Pyroceram 9606	Pyroceram 9606; (a microcrystalline glass), product of Corning Glass Works; specimen 2.540 cm in dia and 1.269 cm in length; density 2.601 g cm ⁻³ ; data obtained before and after the specimen held at 1000 C for about 275 hrs agree with each other.

DATA TABLE NO. 299 THERMAL CONDUCTIVITY OF PYROCERAM BRAND GLASS-CERAMIC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
2.65	0.0027	473.2	0.0350
2.74	0.0029	673.2	0.0327
3.16	0.0041	873.2	0.0308
3.56	0.0053	1073.2	0.0290
3.94	0.0068	1273.2	0.0275
<u>CURVE 2</u>			
1.56	0.0012		
1.59	0.0011		
1.90	0.0017		
2.10	0.0020		
2.43	0.0029		
2.67	0.0039		
2.91	0.0045		
3.18	0.0057		
3.45	0.0067		
3.70	0.0080		
3.91	0.0090		
<u>CURVE 3</u>			
288.2	0.0372		
308.2	0.0368		
353.2	0.0354		
428.2	0.0324		
483.2	0.0328		
543.2	0.0317		
598.2	0.0321		
673.2	0.0295		
735.2	0.0312		
791.2	0.0294		
858.2	0.0281		
1021.2	0.0301		
1201.2	0.0289		
1253.2	0.0294		
1263.2	0.0290		
1433.2	0.029		
<u>CURVE 4</u>			

FIGURE AND TABLE NO. 299R RECOMMENDED THERMAL CONDUCTIVITY OF PYROCERAM BRAND GLASS-CERAMIC CODE #606



RECOMMENDED VALUES*

T ₁	k ₁	k ₂	T ₂
100	0.0542	3.13	-279.7
150	0.0550	3.18	-189.7
200	0.0474	2.74	-99.7
250	0.0428	2.47	-9.7
273.2	0.0413	2.39	32.0
300	0.0399	2.31	80.3
350	0.0379	2.19	170.3
400	0.0365	2.11	260.3
500	0.0345	1.99	440.3
600	0.0331	1.91	620.3
700	0.0319	1.84	800.3
800	0.0310	1.79	980.3
900	0.0303	1.75	1160
1000	0.0297	1.72	1340
1100	0.0291	1.69	1520
1200	0.0287	1.66	1700
1300	0.0284	1.64	1880
1400	0.0282	1.63	2060

REMARKS

The recommended values are thought to be accurate to within 5% of the true values near room temperature and 5 to 10% at other temperatures.

* T₁ in K, k₁ in Watt cm⁻¹K⁻¹, T₂ in F, and k₂ in Btu hr⁻¹F⁻¹.

SPECIFICATION TABLE NO. 300 THERMAL CONDUCTIVITY OF COPOLYCHLOROETHYLENE-VINYL ACETATE)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	388	L	1960	289-375		PVC III	Degree of polymerization: 1500.
2	388	L	1960	289-365		PVC IV	Degree of polymerization: 800.

DATA TABLE NO. 300 THERMAL CONDUCTIVITY OF COPOLYCHLOROETHYLENE-VINYL ACETATE)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

289 0.00126
 292 0.00134
 298 0.00138
 312 0.00138
 325 0.00146
 347 0.00146
 361 0.00172
 375 0.00218

CURVE 2*

289 0.000921
 298 0.00100
 308 0.000921
 313 0.00100
 322 0.00109
 332 0.00126
 345 0.00134
 354 0.00151
 365 0.00159

* No graphical presentation

SPECIFICATION TABLE NO. 301 THERMAL CONDUCTIVITY OF COPOLY(FORMALDEHYDE-UREA), MIPORA

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	525		1951	293.2			Foamed; density 0.018-0.022 g cm ⁻³ ; porosity 97-98%.
2	525		1951	178.2			The above specimen measured at one atm.
3	525		1951	178.2			The above specimen measured at 0.01 mm Hg.
4	525		1951	178.2			The above specimen measured by filling H ₂ in the apparatus and then evacuating by forepump.

DATA TABLE NO. 301 THERMAL CONDUCTIVITY OF COPOLY(FORMALDEHYDE-UREA), MIPORA

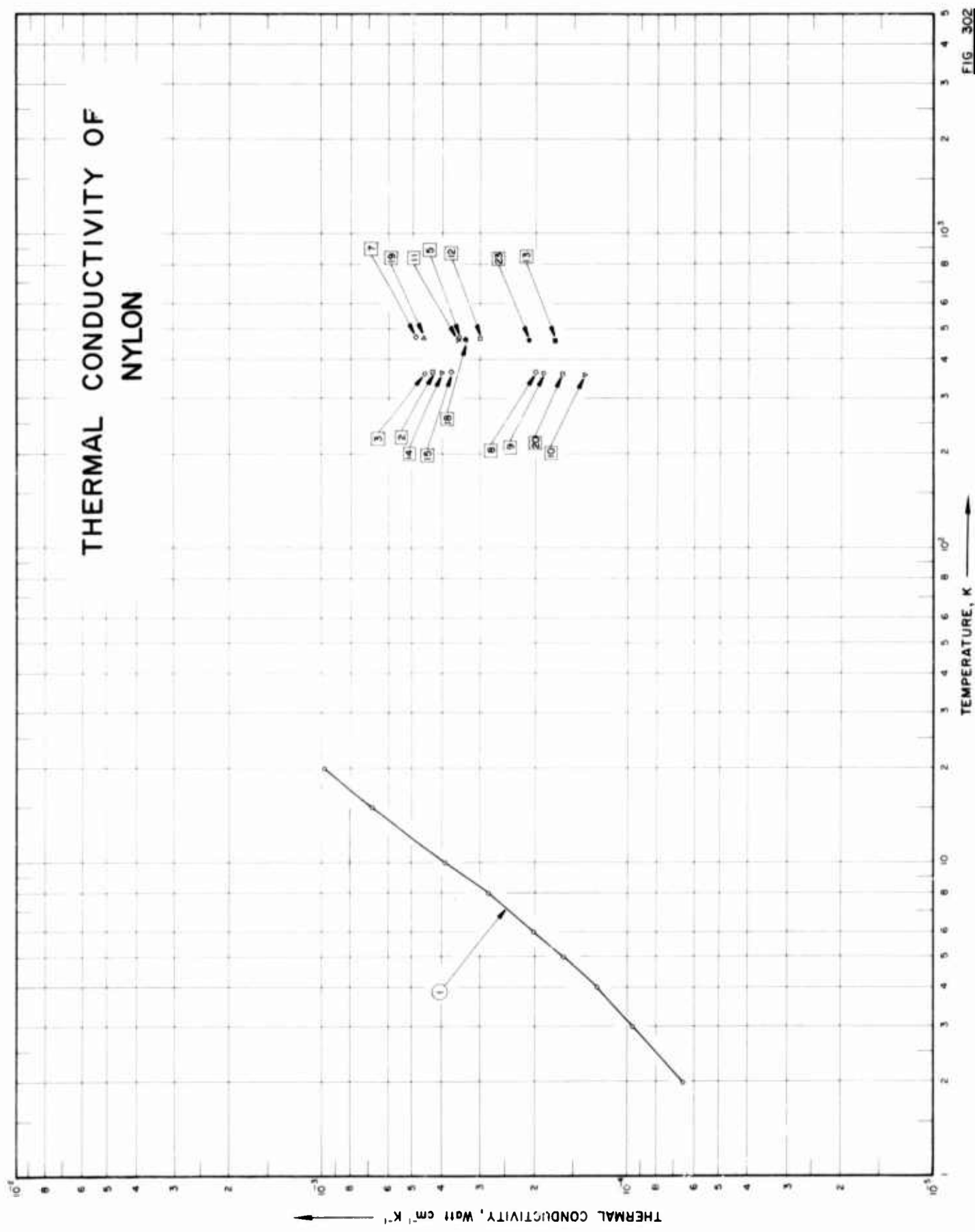
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
293.2	0.000430
<u>CURVE 2*</u>	
178.2	0.000256
<u>CURVE 3*</u>	
178.2	0.0000291
<u>CURVE 4*</u>	
178.2	0.0000360

* No graphical presentation

FIG. 302

THERMAL CONDUCTIVITY OF NYLON



SPECIFICATION TABLE NO. 302 THERMAL CONDUCTIVITY OF NYLON

[For Data Reported in Figure and Table No. 302]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	142	L	1955	2.0-20			A drawn monofilament, 2 mm in dia; supplied by Imperial Chemical Industries, Ltd.
2	526	P	1962	366.4	+7	IN	Plain weave, 64 ends in. ⁻¹ , 68 picks in. ⁻¹ nylon; 2.10 oz yd ⁻² ; average thickness 0.00531 in.; thickness under load 0.00458 in.; measured under 16.7 psi pressure, 35.6 ppi tensile stress; and 11.8 psi compressive stress.
3	526	P	1962	361.6	+7	IN	Similar to the above specimen except under 13.3 psi pressure.
4	526	P	1962	363.7	+7	IN	Similar to the above specimen except under 16.3 psi pressure, 39.9 ppi tensile stress and 13.6 compressive stress.
5	526	P	1962	469.8	+7	IN	Similar to the above specimen except under 18.2 psi pressure, 45.6 ppi tensile stress and 11.8 compressive stress.
6	526	P	1962	469.5	+7	IN	Similar to the above specimen except under 17.2 psi pressure.
7	526	P	1962	471.2	+7	IN	Similar to the above specimen except under 18.2 psi pressure, 38.9 ppi tensile stress and 13.0 compressive stress.
8	526	P	1962	364.8	+7	IN	Similar to the above specimen except in 12.7 mm Hg vacuum, under 35.6 ppi tensile stress and 11.8 psi compressive stress.
9	526	P	1962	362.1	+7	IN	Similar to the above specimen except in 12.7 mm Hg vacuum.
10	526	P	1962	357.9	+7	IN	Similar to the above specimen except in 1.0 mm Hg vacuum, under 41.0 ppi tensile stress and 13.7 psi compressive stress.
11	526	P	1962	466.0	+7	IN	Similar to the above specimen except in 38.0 mm Hg vacuum, under 35.6 ppi tensile stress and 11.8 psi compressive stress.
12	526	P	1962	467.1	+7	IN	Similar to the above specimen except in 25.4 mm Hg vacuum, under 35.6 ppi tensile stress and 12.3 psi compressive stress.
13	526	P	1962	459.0	+7	IN	Similar to the above specimen except in 2.0 mm Hg vacuum, under 35.6 ppi tensile stress and 12.9 psi compressive stress.
14	526	P	1962	362.6	+7	IIN	Twill (2 x 1) type; 64 ends in. ⁻¹ , 68 picks in. ⁻¹ nylon; 2.06 oz yd ⁻² ; average thickness 0.00656 in.; thickness under load 0.00573 in.; measured under 15.7 psi pressure, 35.6 ppi tensile stress and 11.8 psi compressive stress.
15	526	P	1962	365.2	+7	IIN	Similar to the above specimen except 0.00573 in. thickness under load, 16.1 psi pressure, 35.6 ppi tensile stress and 11.8 psi compressive stress.
16	526	P	1962	364.1	+7	IIN	Similar to the above specimen except 0.00570 in. thickness under load, 16.3 psi pressure, 39.5 ppi tensile stress and 13.2 psi compressive stress.
17	526	F	1962	464.5	+7	IIN	Similar to the above specimen except 0.00573 in. thickness under load, 20.2 psi pressure, 35.6 ppi tensile stress and 11.9 psi compressive stress.
18	526	P	1962	462.0	+7	IIN	Similar to the above specimen except 17.5 psi pressure, 35.6 ppi tensile stress and 11.8 psi compressive stress.

SPECIFICATION TABLE NO. 302 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
19	526	P	1962	467.7	±7	IIN	Similar to the above specimen except 0.00571 in. thickness under load, 16.0 psi pressure, 38.4 ppi tensile stress and 12.8 psi compressive stress.
20	526	P	1962	359.0	±7	IIN	Similar to the above specimen except 0.00572 in. thickness under load, 12.7 mm Hg vacuum, 35.6 ppi tensile stress and 12.3 psi compressive stress.
21	526	P	1962	357.6	±7	IIN	Similar to the above specimen except 0.00573 in. thickness under load, 12.7 mm Hg vacuum, 35.6 ppi tensile stress and 11.8 psi compressive stress.
22	526	P	1962	359.0	±7	IIN	Similar to the above specimen except 0.00570 in. thickness under load, 0.4 mm Hg vacuum, 39.9 ppi tensile stress and 13.3 psi compressive stress.
23	526	P	1962	462.6	±7	IIN	Similar to the above specimen except 0.00573 in. thickness under load, 12.7 mm Hg vacuum, 35.6 ppi tensile stress and 11.8 psi compressive stress.
24	526	P	1962	460.4	±7	IIN	Similar to the above specimen except 12.7 mm Hg vacuum, 35.6 ppi tensile stress and 11.8 psi compressive stress.
25	526	P	1962	458.9	±7	IIN	Similar to the above specimen except 0.00571 in. thickness under load, 2.0 mm Hg vacuum, 37.8 ppi tensile stress and 12.6 psi compressive stress.

DATA TABLE NO. 302 THERMAL CONDUCTIVITY OF NYLON
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k
<u>CURVE 1</u>					
2	0.000065	357.9	0.000138	357.6	0.000168
3	0.000095	<u>CURVE 10</u>			
4	0.000125	<u>CURVE 11</u>			
5	0.000160	466.0	0.000358	359.0	0.000137
6	0.000200	<u>CURVE 12</u>			
8	0.000280	467.1	0.000301	462.6	0.000209
10	0.000390	<u>CURVE 13</u>			
15	0.000680	459.0	0.000173	460.4	0.000208
20	0.000980	<u>CURVE 14</u>			
<u>CURVE 2</u>					
366.4	0.000431	362.6	0.000403	458.9	0.000171
<u>CURVE 3</u>					
361.6	0.000457	<u>CURVE 15</u>			
<u>CURVE 4*</u>					
363.7	0.000436	365.2	0.000376		
<u>CURVE 5</u>					
469.8	0.000355	364.1	0.000412		
<u>CURVE 6*</u>					
469.5	0.000358	464.5	0.000294		
<u>CURVE 7</u>					
471.2	0.000488	462.0	0.000337		
<u>CURVE 8</u>					
364.8	0.000199	467.7	0.000460		
<u>CURVE 9</u>					
362.1	0.000187	359.0	0.000163		

* Not shown on plot

SPECIFICATION TABLE NO. 303 THERMAL CONDUCTIVITY OF PHENOLIC RESIN

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	527	L	1956	293.5	1.2		0.1 amino acid; cured.
2	527	L	1956	310.4	1.2		0.2 amino acid; cured.
3	527	L	1956	310.2	1.2		0.3 amino acid; cured.
4	527	L	1956	296.6	1.2		Cured.

DATA TABLE NO. 303 THERMAL CONDUCTIVITY OF PHENOLIC RESIN

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

293.5 0.0032

CURVE 2*

310.4 0.00323

CURVE 3*

310.2 0.00294

CURVE 4*

296.6 0.00455

* No graphical presentation

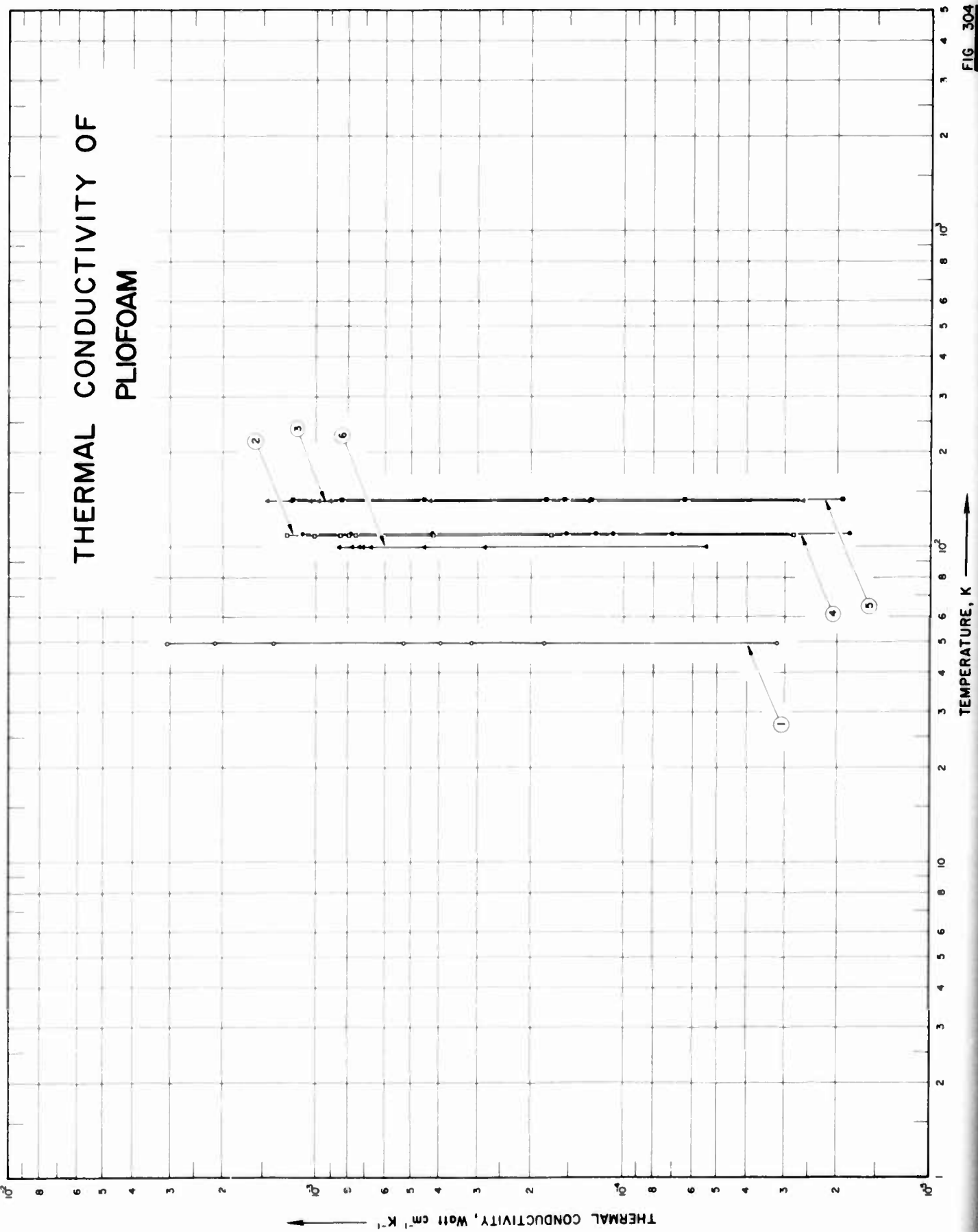


FIG. 304

SPECIFICATION TABLE NO. 304 THERMAL CONDUCTIVITY OF PU FOAM

[For Data Reported in Figure and Table No. 304]

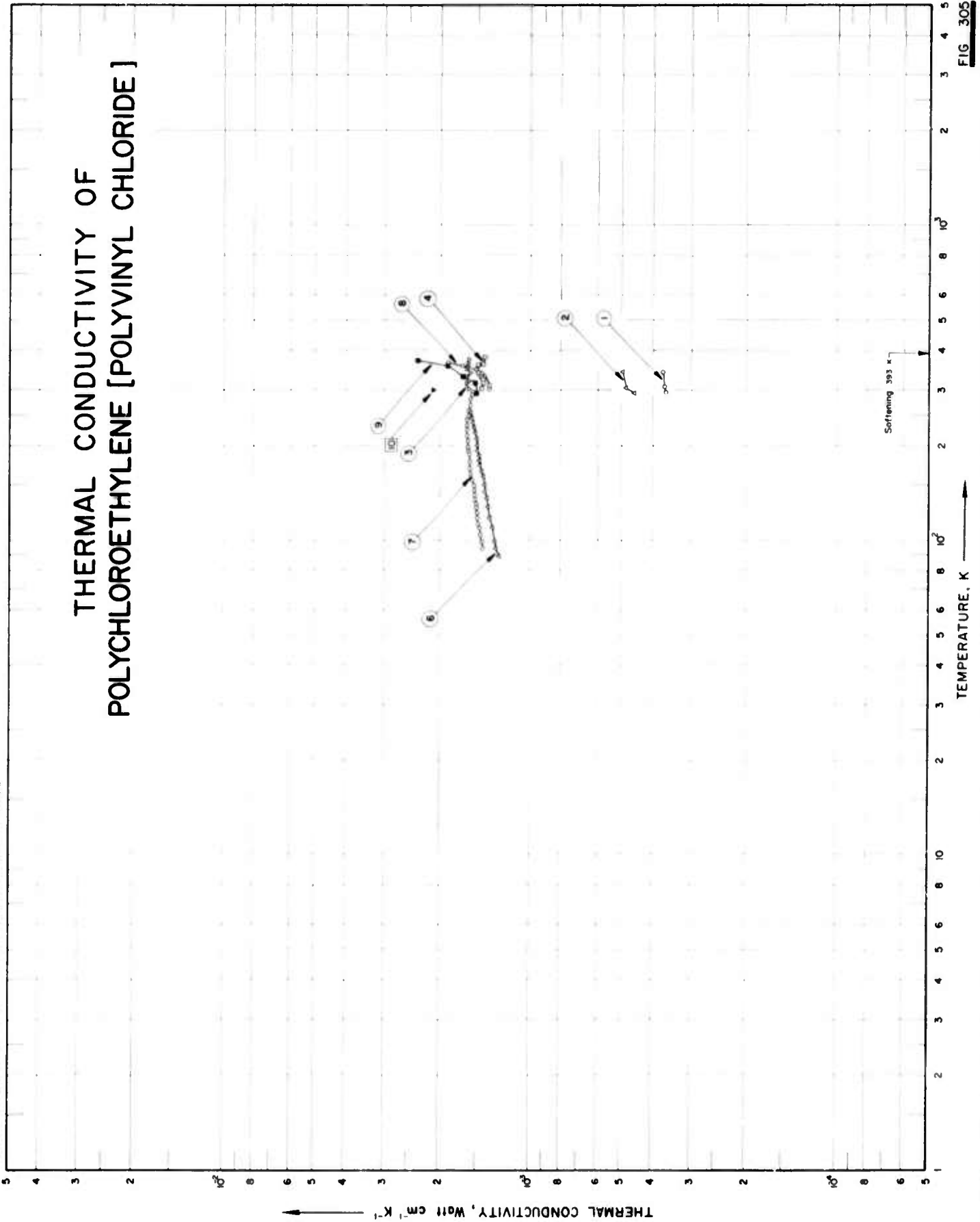
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	122	R	1953	49.4			Foam specimen supplied by Goodyear Co.; packing density 0.014 g cm^{-3} ; filled with hydrogen; measured at various hydrogen pressures ranging from 0.0059 to 595 mm Hg.
2	122	R	1953	109.5			Similar to the above specimen; measured at various hydrogen pressures ranging from 0.0050 to 607.5 mm Hg.
3	122	R	1953	140.9			Similar to the above specimen; measured at various hydrogen pressures ranging from 0.0049 to 601.0 mm Hg.
4	122	R	1953	110.1			Similar to the above specimen but filled with nitrogen; measured at various nitrogen pressures ranging from 0.0055 to 591.5 mm Hg.
5	122	R	1953	141.0			Similar to the above specimen; measured at various pressures nitrogen ranging from 0.0056 to 585.5 mm Hg.
6	122	R	1953	98.5			Foam specimen supplied by U. S. Rubber Co.; packing density 0.024 g cm^{-3} ; filled with hydrogen; measured at various hydrogen pressures ranging from 0.0221 to 625.3 mm Hg.

DATA TABLE NO. 304 THERMAL CONDUCTIVITY OF PLIO-OAM
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

p(mm Hg)	k	p(mm Hg)	k
CURVE 1 T = 49.4K			
0.0059	0.0000318	390.0	0.000782
0.181	0.000181	591.5	0.00111
1.17	0.000315	CURVE 5 T = 141 K	
16.0	0.000395	0.0056	0.0000193
50.0	0.000528	0.108	0.0000643
224.0	0.00139	0.122	0.000128
405.0	0.00214	15.0	0.000156
595.0	0.00307	48.0	0.000179
CURVE 2 T = 109.8K			
0.005	0.0000281	196.5	0.000456
0.112	0.000173	384.5	0.000833
0.946	0.000420	585.5	0.00120
17.0	0.000757	CURVE 6 T = 98.5K	
50.5	0.000792	0.0221	0.0000542
209.0	0.000847	0.507	0.000285
406.5	0.00102	1.77	0.000452
607.5	0.00126	15.5	0.000571
CURVE 3 T = 140.9K			
0.0049	0.0000262	69.9	0.000719
0.103	0.000131	230.2	0.000738
0.956	0.000433	441.3	0.000778
17.0	0.000910	625.3	0.000853
54.5	0.000987	CURVE 4 (cont.)	
205.0	0.00105	0.0059	0.0000318
417.5	0.00123	0.181	0.000181
601.0	0.00146	1.17	0.000315
CURVE 4 T = 110.1K			
0.0055	0.0000183	16.0	0.000395
0.181	0.0000706	50.0	0.000528
1.37	0.000109	224.0	0.00139
15.5	0.000124	405.0	0.00214
50.5	0.000154	595.0	0.00307
195.5	0.00025		

FIGURE SHOWS ONLY 9 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF POLYCHLOROETHYLENE [POLYVINYL CHLORIDE]



SPECIFICATION TABLE NO. 305 THERMAL CONDUCTIVITY OF POLYCHLOROETHYLENE (POLYVINYL CHLORIDE)

[For Data Reported in Figure and Table No. 305]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	58	L	1953	296-343		No. 1	Specimen from Gen. Tire and Rubber Co.
2	58	L	1953	295-342		No. 2	Similar to the above specimen.
3	59	L	1953	303-377			Low plasticizer content; approx 0.05 in. thick placed under a pressure of about 2 psi.
4	59	L	1953	303-390			As above but with high plasticizer content.
5	60	P	1960	323.2			Specimen 20 mm in dia, 150 mm long; the rod was initially cooled to 0 C and put in boiling water; thermal conductivity values calculated from measured transient temperature changes.
6	387	P	1962	89-363	±4		10% plasticizer content.
7	387	P	1962	94-362	±4		40% plasticizer content.
8	388	L	1960	302-368		PVC - I	Molecular weight 1000.
9	398	L	1960	293-373		PVC - II	Molecular weight 1300.
10	330	C	1957	298.2		Plasticized PVC	Specimen .25 in. thick and 3 in. dia lapped disk; measured by thermal comparator No. 4.

DATA TABLE NO. 305 THERMAL CONDUCTIVITY OF POLYCHLOROETHYLENE (POLYVINYL CHLORIDE)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>									
296.3	0.000366	103.4	0.00134*	255.5	0.00137	118.6	0.00150	266.6	0.00159*
308.8	0.000369	109.1	0.00135	257.9	0.00158*	123.2	0.00150	268.8	0.00158
342.7	0.000374	113.7	0.00136*	260.1	0.00157*	127.3	0.00151	271.5	0.00157*
<u>CURVE 2</u>									
294.8	0.000459	118.6	0.00137	263.4	0.00158*	131.8	0.00151	272.5	0.00158*
305.8	0.000435	123.2	0.00138*	265.6	0.00158*	136.1	0.00153	276.4	0.00157*
342.1	0.000498	127.0	0.00139*	273.1	0.00159*	139.6	0.00153	278.7	0.00157*
<u>CURVE 3</u>									
303.2	0.00159	131.3	0.00140*	276.2	0.00159*	144.2	0.00154	281.7	0.00157
316.2	0.00163	136.1	0.00140	283.3	0.00160*	148.1	0.00154	283.9	0.00156*
320.2	0.00159	139.4	0.00141*	286.7	0.00160*	151.5	0.00155*	286.6	0.00156*
331.2	0.00163	143.1	0.00142*	287.7	0.00159*	156.3	0.00156	289.1	0.00156
340.2	0.00157	146.7	0.00142*	291.8	0.00160*	158.9	0.00156*	291.3	0.00155*
351.2	0.00163	150.8	0.00143	295.7	0.00160*	162.6	0.00157	294.2	0.00155*
355.7	0.00161	154.4	0.00144*	303.4	0.00161*	166.6	0.00157*	296.5	0.00155
364.2	0.00161	159.0	0.00144	308.0	0.00161*	169.6	0.00158	298.8	0.00155*
374.2	0.00160*	161.8	0.00145*	311.1	0.00161*	173.2	0.00158*	301.4	0.00155*
376.7	0.00159	166.2	0.00146	313.2	0.00161*	177.0	0.00158	304.2	0.00154*
<u>CURVE 4</u>									
303.2	0.00146	170.1	0.00146*	317.3	0.00161*	181.0	0.00158*	306.1	0.00158*
315.2	0.00144	173.1	0.00147	319.5	0.00160*	183.6	0.00159*	308.4	0.00154*
325.2	0.00144	176.0	0.00148*	322.2	0.00160*	188.0	0.00159	310.7	0.00153*
331.2	0.00146	179.9	0.00148	324.1	0.00160*	190.7	0.00159	312.7	0.00153*
339.2	0.00149	183.3	0.00149*	326.3	0.00160*	193.7	0.00160	316.7	0.00153*
341.2	0.00149*	186.9	0.00148	329.1	0.00160*	197.5	0.00161	317.3	0.00153*
360.2	0.00144	190.3	0.00149*	331.3	0.00161*	201.2	0.00161*	320.7	0.00152*
380.2	0.00142	193.2	0.00150	333.8	0.00160*	203.7	0.00161*	322.7	0.00151*
<u>CURVE 5*</u>									
303.2	0.00146	196.7	0.00149*	336.3	0.00161*	207.2	0.00161	324.8	0.00152*
315.2	0.00144	200.1	0.00150	338.8	0.00160*	209.8	0.00161*	326.8	0.00151*
325.2	0.00144	203.2	0.00151*	341.8	0.00160*	213.4	0.00162*	329.2	0.00151*
331.2	0.00146	206.0	0.00151*	344.2	0.00159*	216.3	0.00162*	332.7	0.00151*
339.2	0.00149	209.3	0.00151	348.7	0.00159*	219.4	0.00162*	335.1	0.00150*
341.2	0.00149*	212.1	0.00152*	350.3	0.00160*	223.1	0.00162*	336.8	0.00151*
360.2	0.00144	215.5	0.00152*	352.6	0.00160*	225.6	0.00162*	339.4	0.00150*
380.2	0.00142	219.5	0.00153	354.6	0.00159*	228.7	0.00162*	341.7	0.00150*
<u>CURVE 6</u>									
323.2	0.00164	221.9	0.00153*	356.2	0.00159*	231.2	0.00162*	345.1	0.00150*
<u>CURVE 7</u>									
227.6	0.00154	224.5	0.00153*	359.1	0.00158*	233.4	0.00162	349.1	0.00150*
229.9	0.00154*	227.6	0.00154	362.6	0.00158*	236.9	0.00162*	350.6	0.00149*
232.7	0.00155*	229.9	0.00154*	362.6	0.00158*	239.9	0.00161*	352.7	0.00149*
236.5	0.00155	232.7	0.00155*	362.6	0.00158*	242.7	0.00162	354.5	0.00149*
239.1	0.00155*	236.5	0.00155	362.6	0.00158*	245.3	0.00161*	356.7	0.00149*
241.4	0.00156*	239.1	0.00155*	362.6	0.00158*	247.9	0.00160	359.4	0.00149*
244.2	0.00156	241.4	0.00156*	362.6	0.00158*	252.5	0.00160*	362.1	0.00148*
246.6	0.00156*	244.2	0.00156	362.6	0.00158*	255.7	0.00160*		
250.3	0.00156*	246.6	0.00156*	362.6	0.00158*	258.8	0.00160		
252.9	0.00157*	250.3	0.00156*	362.6	0.00158*	260.9	0.00159*		
		252.9	0.00157*	362.6	0.00158*	263.7	0.00159*		
<u>CURVE 8</u>									
89.1	0.00128	94.3	0.00144	94.3	0.00144	94.3	0.00144	94.3	0.00144
94.6	0.00131	99.5	0.00145	99.5	0.00145	99.5	0.00145	99.5	0.00145
99.0	0.00133	104.2	0.00147	104.2	0.00147	104.2	0.00147	104.2	0.00147
		109.1	0.00147	109.1	0.00147	109.1	0.00147	109.1	0.00147
		113.4	0.00149	113.4	0.00149	113.4	0.00149	113.4	0.00149
<u>CURVE 9</u>									
293	0.00151	293	0.00151	293	0.00151	293	0.00151	293	0.00151
316	0.00153	316	0.00153	316	0.00153	316	0.00153	316	0.00153
331	0.00167	331	0.00167	331	0.00167	331	0.00167	331	0.00167
339	0.00163*	339	0.00163*	339	0.00163*	339	0.00163*	339	0.00163*
345	0.00159*	345	0.00159*	345	0.00159*	345	0.00159*	345	0.00159*
359	0.00188	359	0.00188	359	0.00188	359	0.00188	359	0.00188
373	0.00234	373	0.00234	373	0.00234	373	0.00234	373	0.00234
<u>CURVE 10</u>									
298.2	0.0021	298.2	0.0021	298.2	0.0021	298.2	0.0021	298.2	0.0021

* Not shown on Plot

THERMAL CONDUCTIVITY OF POLYETHYLENE (CH₂CH₂)_n

FIGURE SHOWS ONLY 5 OF THE CURVES REPORTED IN TABLE

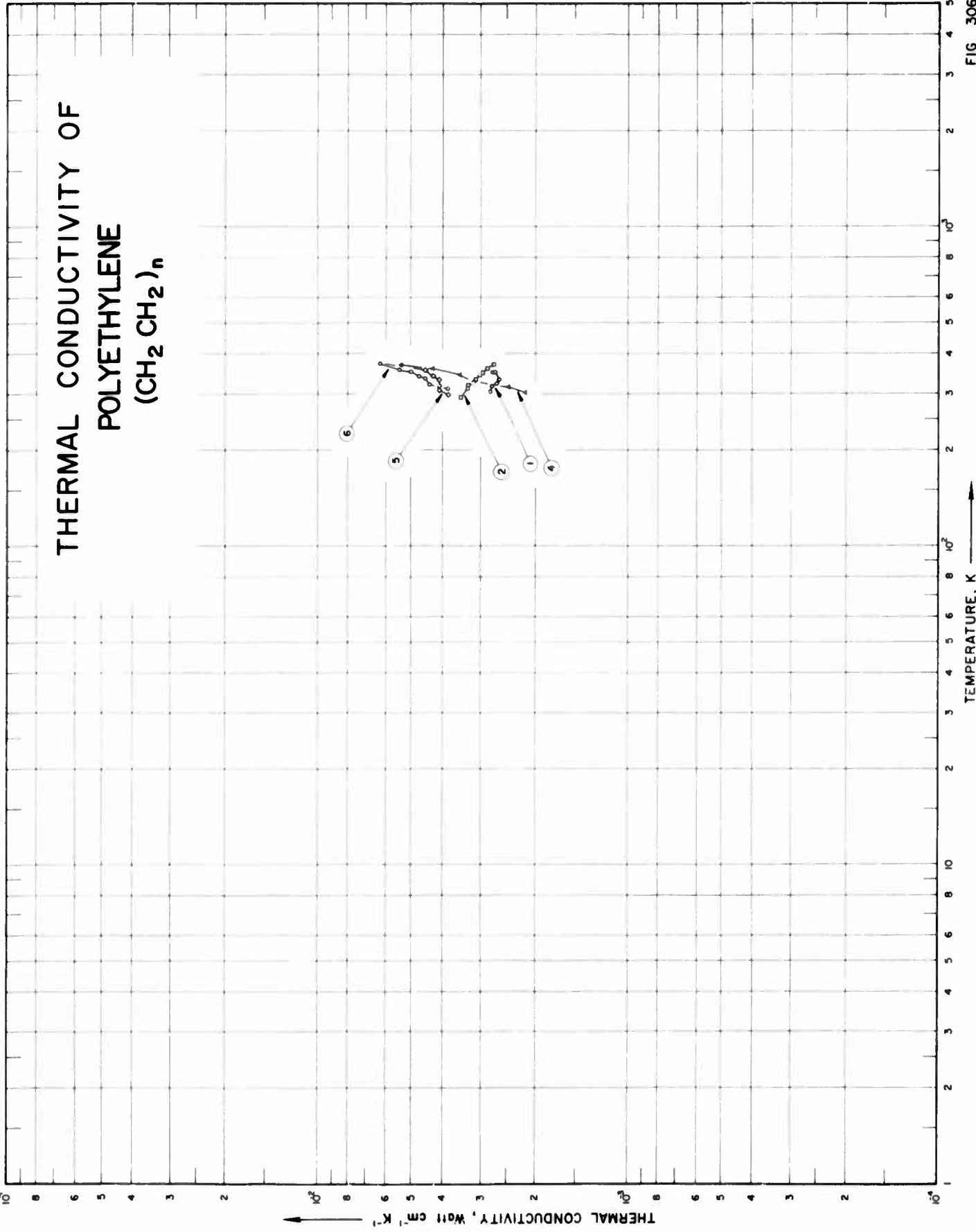


FIG. 306

SPECIFICATION TABLE NO. 306 THERMAL CONDUCTIVITY OF POLYETHYLENE $(\text{CH}_2\text{CH}_2)_n$

[For Data Reported in Figure and Table No. 306]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	59	L	1953	305-353			Dry surface; approximately 0.05 in. thick placed under a slight pressure estimated at 2 lb in. ⁻²
2	59	L	1953	293-371			Glycerine on surface; approximately 0.05 in. thick placed under a slight pressure estimated at 2 lb in. ⁻²
3	330	C	1957	298.2			0.2188 in. thick and 3 in. dia lapped disk specimen; thermal comparator No. 4 used.
4	388	L	1960	302-369		PE I	M.W. 21,000.
5	388	L	1960	297-372		PE II	M.W. 70,000-80,000.
6	388	L	1960	311-373		PE III	M.W. 70,000-80,000.
7	388	L	1960	308-393		PE IV	M.W. 70,000-80,000.

M.W. = Molecular Weight

DATA TABLE NO. 306 THERMAL CONDUCTIVITY OF POLYETHYLENE (CH₂CH₂)_nTemperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹

T	k	T	k
<u>CURVE 1</u>			
305.2	0.00280	356	0.00452
317.2	0.00275	372	0.00636*
322.2	0.00265		
333.7	0.00264	<u>CURVE 6</u>	
333.7	0.00258*	311	0.00385
352.7	0.00270	321	0.00439
352.7	0.00274	335	0.00452
		340	0.00473
		352	0.00498
		357	0.00544
		373	0.00628
<u>CURVE 2</u>			
293.2	0.00349		
313.2	0.00331	<u>CURVE 7*</u>	
319.2	0.00320	305	0.00335
326.2	0.00316	319	0.00385
328.2	0.00314*	324	0.00300
328.7	0.00316*	335	0.00402
333.2	0.00310	348	0.00402
344.7	0.00301	374	0.00494
347.2	0.00295*	393	0.00561
349.7	0.00295		
360.2	0.00285		
371.2	0.00272		
<u>CURVE 3*</u>			
298.2	0.00335		
<u>CURVE 4</u>			
302	0.00218		
314	0.00247		
327	0.00318*		
344	0.00352		
359	0.00431		
369	0.00536		
<u>CURVE 5</u>			
297	0.00385		
308	0.00410		
316	0.00410		
331	0.00410		
340	0.00427		

* Not shown on plot

SPECIFICATION TABLE NO. 307 THERMAL CONDUCTIVITY OF POLYHEXAHYDRO-2H-AZEPIN-2-ONE, SILON

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	538	L	1955	333, 373			Rod 44.71 x 210 mm; density 1.15 g cm ³ .

DATA TABLE NO. 307 THERMAL CONDUCTIVITY OF POLYHEXAHYDRO-2H-AZEPIN-2-ONE, SILON

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
	<u>CURVE 1^o</u>
333.2	0.00259
373.2	0.00267

No graphical presentation

THERMAL CONDUCTIVITY OF POLY(METHYL METHACRYLATE) [PLEXIGLAS]

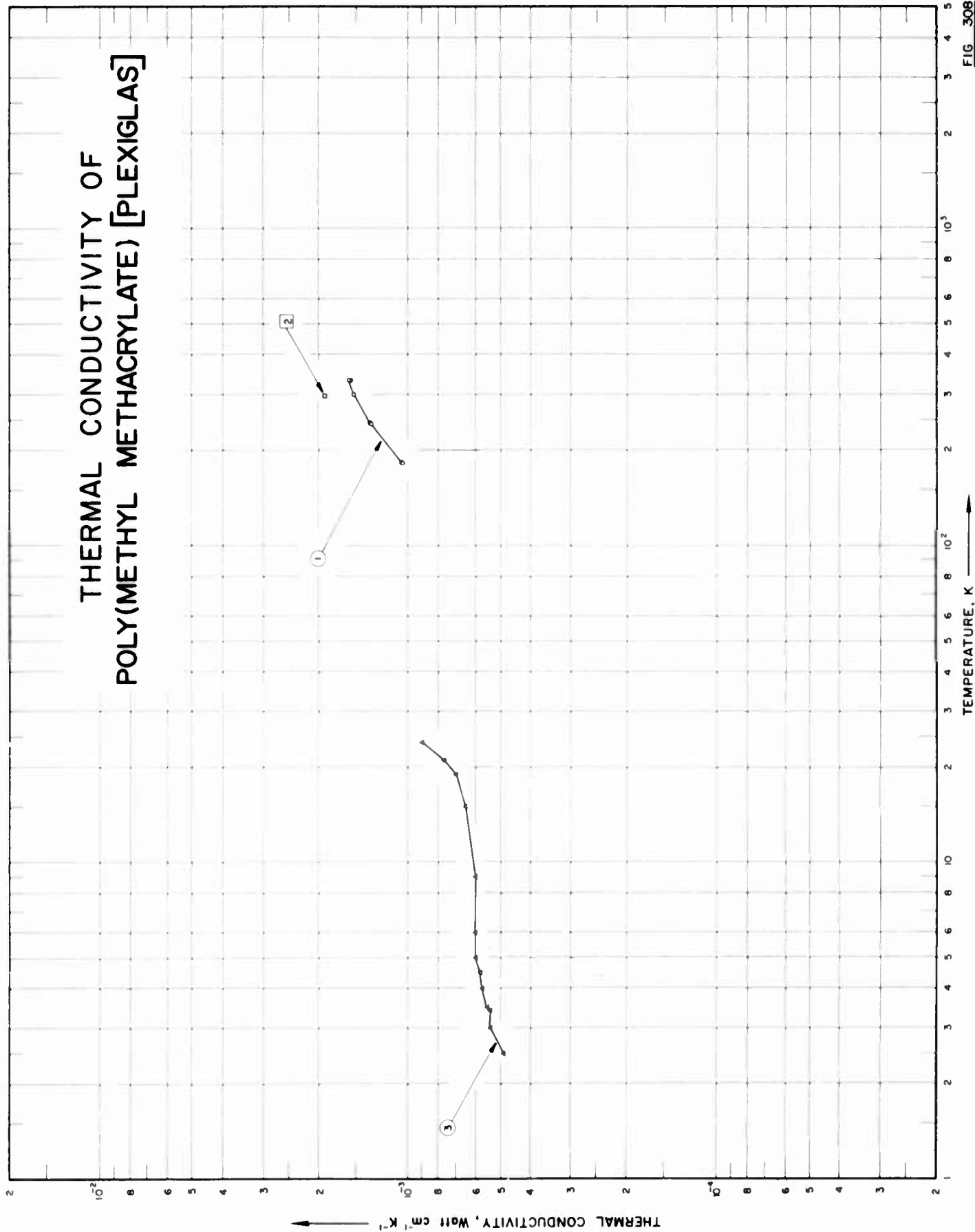


FIG. 308

SPECIFICATION TABLE NO. 308 THERMAL CONDUCTIVITY OF POLY(METHYL METHACRYLATE) [PLEXIGLAS] $(CH_2CCH_3COOCH_3)_n$

[For Data Reported in Figure and Table No. 308]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	111	L	1952	183-332		AN-P-44A	Aircraft quality; supplied by Rohm and Haas Chemical Co.
2	117	P	1955	298.2	1-2		Specimen thickness 10.0 mm; density 1.18 g cm ⁻³ .
3	69	L	1951	2.5-24		Perspex	1.27 cm dia x 3.05 cm long.

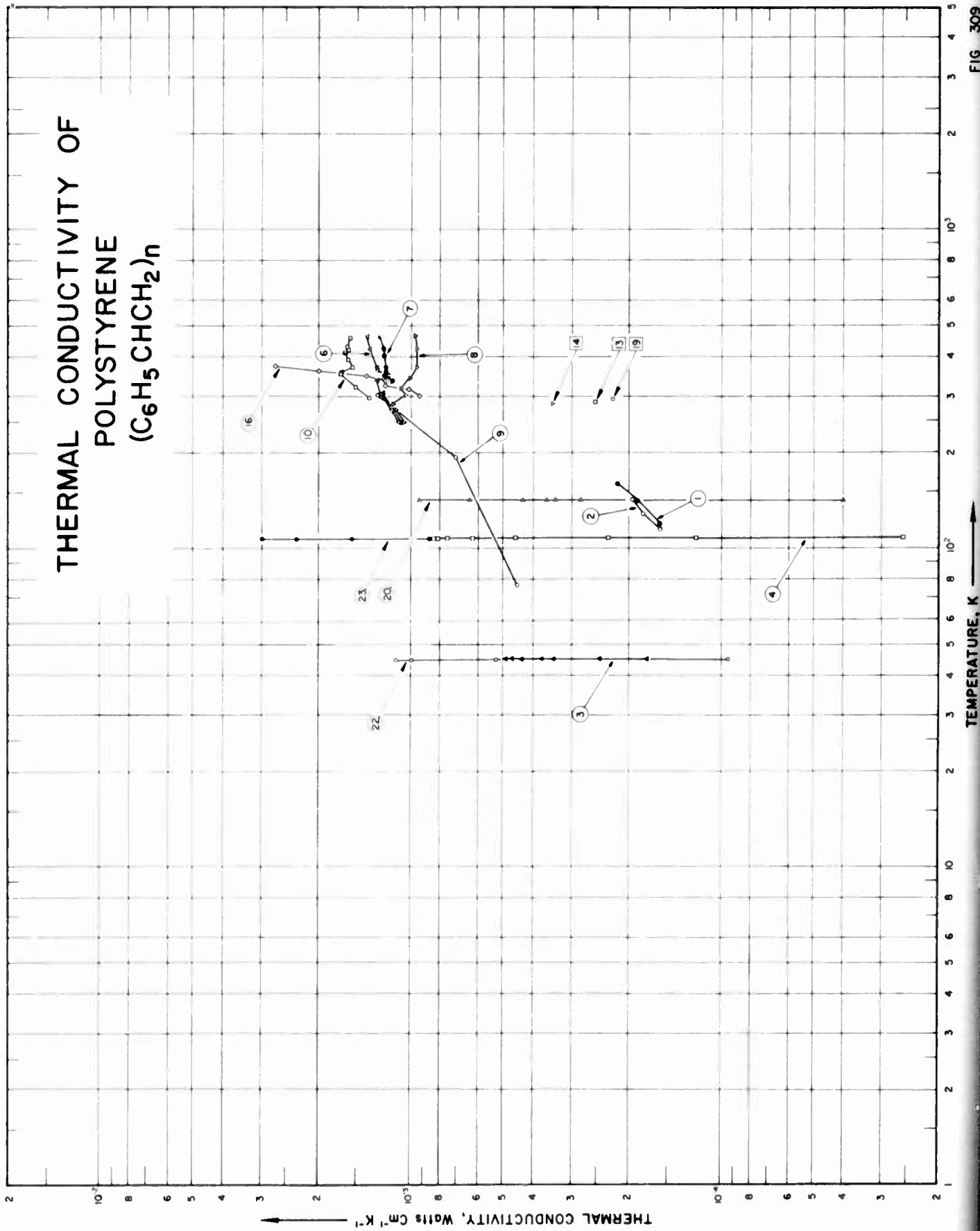
DATA TABLE NO. 308 THERMAL CONDUCTIVITY OF POLY(METHYL METHACRYLATE) [PLEXIGLAS]

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
183.3	0.00105
184.4	0.00106
244.8	0.00134
245.6	0.00135
300.3	0.00154
332.1	0.00158
332.2	0.00157*
<u>CURVE 2</u>	
298.2	0.00192
<u>CURVE 3</u>	
2.5	0.00049
3.0	0.00054
3.4	0.00054
3.5	0.00055
4.0	0.00057
4.5	0.00058
5.0	0.00060
6.0	0.00060
9.0	0.00060
15.0	0.00065
19.0	0.00070
21.0	0.00077
24.0	0.00090

* Not shown on plot

FIGURE SHOWS ONLY 16 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 309 THERMAL CONDUCTIVITY OF POLYSTYRENE (C₆H₅CHCH₂)_n

[For Data: Reported in Figure and Table No. 309]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	43	L	1954	120-160			Expanded board specimen; density 0.6240 g cm ⁻³
2	43	L	1954	115-143			Expanded board specimen; flameproofed; density 0.6288 g cm ⁻³
3	122	R	1953	45.1			Colloidal aggregate; packing density 0.282 g cm ⁻³ ; filled with hydrogen; measured at various hydrogen pressures ranging from 0.495 to 821.6 mm Hg.
4	122	R	1953	108.8			Similar to the above specimen; measured at various hydrogen pressures ranging from 0.0251 to 632.6 mm Hg.
5	122	R	1953	109.1			Similar to the above specimen but filled with nitrogen; measured at various nitrogen pressures ranging from 0.0241 to 590.5 mm Hg.
6	123	P	1953	249-466			Molecular weight 3650; density reported as 1.099, 1.096, 1.097, 1.099, 1.097, 1.045, 1.024, and 0.9775 g cm ⁻³ at -20, -10, 0, 10, 20, 50, 100, and 185 C, respectively; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
7	123	P	1953	249-466			Molecular weight 2300; density reported as 1.095, 1.093, 1.091, 1.088, 1.052, 1.045, 1.023, and 0.907 g cm ⁻³ at -20, -10, 0, 10, 20, 50, 100, and 180 C, respectively; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
8	123	P	1953	249-466			Molecular weight 960; density reported as 1.071, 1.068, 1.065, 1.095, 1.095, 1.044, 1.014, and 0.6694 g cm ⁻³ at -20, -10, 0, 10, 20, 50, 100, and 185 C, respectively; thermal conductivity values calculated from measured data of thermal diffusivity, specific heat, and density.
9	124	L	1960	78-305	2		Density 1.03 g cm ⁻³ .
10	528	P	1953	298-460			Prepared by polymerizing monostyrene with 5 mole % of very pure p-divinylbenzene at 200 C without a catalyst; thermal conductivity values calculated from measured data of thermal diffusivity and specific heat.
11	528	P	1953	301-455			Similar to the above specimen except prepared with 9 mole % of very pure p-divinylbenzene.
12	528	P	1953	302-458			Similar to the above specimen except prepared with 15 mole % of very pure p-divinylbenzene.
13	529	-	1956	289.8			Expanded; density 0.0441 g cm ⁻³ ; thermal conductivity data calculated from measured transient rise of the specimen temperature.
14	529	-	1956	286.5			Similar to the above specimen except density 0.0641 g cm ⁻³ .
15	388	L	1960	298-368		PS-II	Degree of polymerization: M.W. 1000.
16	388	L	1960	303-375		PS-I	Degree of polymerization: M.W. 700.

SPECIFICATION TABLE NO. 309 (continued)

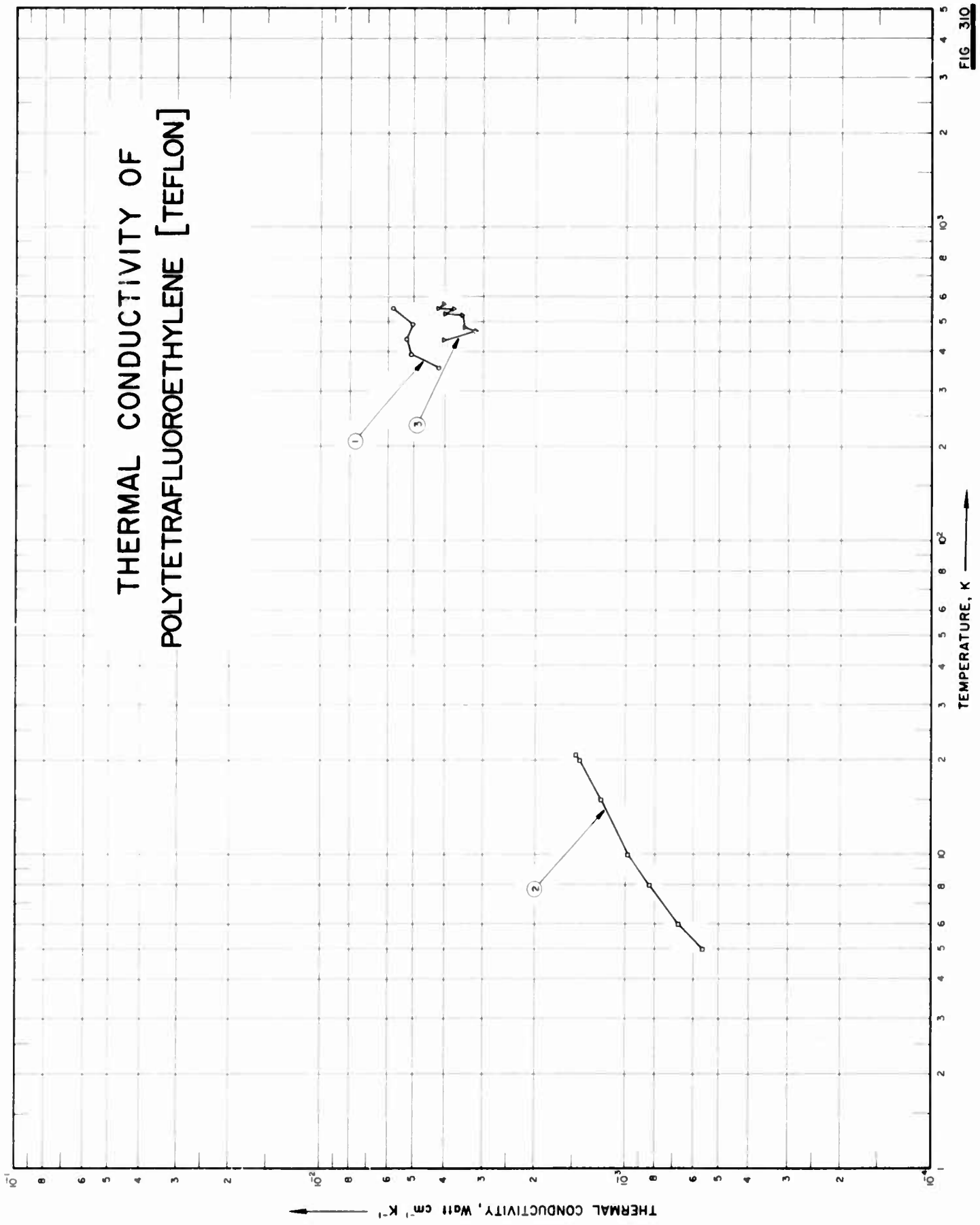
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
17	530	L	1956	296.6			Foam specimen; 20 cm dia x 2.5 cm thick; density 0.030 g cm ⁻³ ; measured in air.
18	530	L	1956	297.8			The above specimen measured in carbon dioxide.
19	530	L	1956	296.7			The above specimen measured in chloromethane.
20	122	R	1953	142.0		Styrofoam	Cellular specimen, filled with hydrogen; packing density 0.025 ⁸ g cm ⁻³ ; measured at various hydrogen pressures ranging from 0.0061 to 602.0 mm Hg.
21	122	R	1953	109.0		Styrofoam	Finely ground specimen filled with nitrogen; packing density: 0.031 to 0.05 ⁸⁶ g cm ⁻³ ; measured at various nitrogen pressures ranging from 0.032 to 603.9 mm Hg.
22	122	R	1953	45.2		Styrofoam	Similar to the above specimen but filled with hydrogen; measured at various hydrogen pressures ranging from 0.0194 to 645.4 mm Hg.
23	122	R	1953	109.2		Styrofoam	Similar to the above specimen; measured at various hydrogen pressures ranging from 0.056 to 601.5 mm Hg.
24	520	L	1964	288-3 ⁸⁶	+2		Specimen 0.5 in. thick; unoriented.
25	520	L	1964	301-361	+2		Specimen 0.5 in. thick; biaxially oriented; provided by the Plax Company; perfectly clear and bubble free.
26	554	R	1949	45.1		Colloidal aggregate	Packing density 0.282 g cm ⁻³ ; measured in the presence of hydrogen gas with liquid hydrogen in the cryostat, hydrogen pressure ranged from 0.495 to 621.6 mm Hg.
27	554	R	1949	109.1			Same as above except measured with liquid nitrogen in the cryostat, nitrogen pressure ranged from 0.0241 to 590.5 mm Hg.
28	555	R	1949	109.2			Same as above except measured with liquid hydrogen in the cryostat, hydrogen pressure ranged from 0.025 to 632.6 mm Hg.

DATA TABLE NO. 309 THERMAL CONDUCTIVITY OF POLYSTYRENE (C₈H₈ClCH₂)_n[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	p (mm Hg)	T	k	T	k	p (mm Hg)	T	k	T	k	Pressure of hydrogen (mm Hg)
CURVE 1												
120	0.000159	396.3	0.000276	77.6	0.00045	289.8	0.000252	CURVE 20				
141	0.000187	590.5	0.000284	194.3	0.00071	305.4	0.00128	T = 142 K				
160	0.000216							0.0061	0.0000397	287.7	0.00153	CURVE 26*
CURVE 2												
115	0.000159	CURVE 6		298.2	0.00136	CURVE 13		T = 45.00 K				
129	0.000180	249.2	0.00109	323.2	0.00151	CURVE 14		0.175	0.000194*	299.1	0.00155	0.495
143	0.000195	273.2	0.00116	355.2	0.00169	CURVE 15*		1.78	0.000279	313.4	0.00157	1.732
CURVE 3												
T = 45.1 K												
0.495	0.000174	466.2	0.00139	460.2	0.00157	368	0.00243	50.0	0.000360	339.4	0.00161	18.95
1.73	0.000243	339.2	0.00129	373.2	0.00155	315	0.00117	204.5	0.000429	347.6	0.00162	49.3
18.9	0.000343	306.2	0.00126	361.2	0.00167	308	0.00113	398.0	0.000635	349.5	0.00162	203.65
49.3	0.000376	339.2	0.00118	394.2	0.00159	326	0.00121	602.0	0.000927	352.7	0.00163	421.45
203.6	0.000432	363.2	0.00128	413.2	0.00163	333	0.00130	CURVE 21*				
421.4	0.000465	373.2	0.00129	423.2	0.00160	353	0.00134	T = 109 K				
621.6	0.000489	423.2	0.00136	423.2	0.00160	358	0.00176	0.032	0.0000843	361.4	0.00162	Pressure of nitrogen (mm Hg)
CURVE 4												
T = 108.8 K												
0.0251	0.0000256	349.2	0.00121	373.2	0.00158	338	0.00121	2.43	0.000111	364.8	0.00164	CURVE 27*
0.264	0.000121	403.2	0.00123	406.2	0.00156	363	0.00197	14.1	0.000170	366.5	0.00165	T = 109.09 K
0.778	0.000230	423.2	0.00123	419.2	0.00162	375	0.00268	52.8	0.000348	368.9	0.00165	0.0241
7.68	0.000455	466.2	0.00126	458.2	0.00159	375	0.00268	196.6	0.000749	369.6	0.00162	0.264
CURVE 5*												
T = 109.1 K												
60.5	0.000622	249.2	0.00106	302.2	0.00132	303	0.000921	395.8	0.00114	371.4	0.00163	1.23
242.6	0.000753	273.2	0.00113	307.2	0.00134	317	0.00100	603.9	0.00146	375.8	0.00164	17.9
452.9	0.000807	285.2	0.00115	313.2	0.00137	324	0.00121	CURVE 22				
632.6	0.000836	303.2	0.00103	323.2	0.00141	338	0.00138	T = 45.2 K				
CURVE 5*												
T = 109.16 K												
0.0241	0.0000157	319.2	0.00107	332.2	0.00146	350	0.00159	0.0194	0.0000944	301.3	0.00149	Pressure of hydrogen (mm Hg)
0.264	0.0000652	343.2	0.00100	347.2	0.00148	353	0.00167*	0.238	0.000271	311.1	0.00148	0.0251
1.23	0.000126	373.2	0.00095	367.2	0.00149	363	0.00156	2.65	0.000351	312.0	0.00151	0.264
17.9	0.000208	423.2	0.00095	389.2	0.00151	375	0.00162	17.7	0.000368	320.9	0.00153	0.000126
62.8	0.000237	466.2	0.00096	392.2	0.00157	375	0.00162	61.3	0.000380	331.7	0.00155	17.9
191.0	0.000257	249.2	0.00106	302.2	0.00132	303	0.000921	197.8	0.000523	340.4	0.00157	62.8
CURVE 6*												
T = 109.2 K												
60.5	0.000622	273.2	0.00113	307.2	0.00134	317	0.00100	416.9	0.000983	345.9	0.00157	191.0
242.6	0.000753	285.2	0.00115	313.2	0.00137	324	0.00121	645.4	0.00111	350.6	0.00158	590.5
452.9	0.000807	303.2	0.00103	323.2	0.00141	338	0.00138	CURVE 23				
632.6	0.000836	319.2	0.00107	332.2	0.00146	350	0.00159	T = 109.2 K				
CURVE 7*												
T = 109.2 K												
0.0241	0.0000157	343.2	0.00100	347.2	0.00148	353	0.00167*	0.056	0.000174*	360.6	0.00161	0.0251
0.264	0.0000652	373.2	0.00095	367.2	0.00149	363	0.00156	0.265	0.000557*	0.264	0.000121	0.264
1.23	0.000126	423.2	0.00095	389.2	0.00151	375	0.00162	2.33	0.000717*	0.778	0.000230	0.778
17.9	0.000208	466.2	0.00096	392.2	0.00157	375	0.00162	15.4	0.000829*	7.68	0.000455	7.68
62.8	0.000237	249.2	0.00106	302.2	0.00132	303	0.000921	52.5	0.000857	60.5	0.000622	60.5
191.0	0.000257	273.2	0.00113	307.2	0.00134	317	0.00100	195.8	0.00155	242.6	0.000822	242.6
CURVE 8*												
T = 109.2 K												
60.5	0.000622	273.2	0.00113	307.2	0.00134	317	0.00100	394.8	0.00231	452.9	0.000807	452.9
242.6	0.000753	285.2	0.00115	313.2	0.00137	324	0.00121	601.5	0.00294	632.6	0.000833	632.6

* Not shown on plot

THERMAL CONDUCTIVITY OF
POLYTETRAFLUOROETHYLENE [TEFLON]



SPECIFICATION TABLE NO. 310 THERMAL CONDUCTIVITY OF POLYTETRAFLUOROETHYLENE (TEFLON)

[For Data Reported in Figure and Table No. 310]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	531	C	1958	359-554	±5	Duroid 5600	Fiber reinforced; annealed and heat treated at 583 K for 4 hrs; density 1.99 g cm^{-3} ; alumina used as comparative material.
2	532	L	1957	5.0-21	10		2.54 cm dia x 20.5 cm long; extruded; density 2.218 g cm^{-3} .
3	531	C	1958	439-572	±5		Crystalline; annealed and heat treated at 583 K for 4 hrs, cooled; density 2.17 g cm^{-3} ; melting point 600 K, alumina used as comparative material.

DATA TABLE NO. 310 THERMAL CONDUCTIVITY OF POLYTETRAFLUOROETHYLENE (TEFLON)

Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹

T k

CURVE 1

358.7	0.00426
394.3	0.00511
442.1	0.00529
494.3	0.00505
553.7	0.00584

CURVE 2

5	0.00056
6	0.00067
8	0.00083
10	0.00098
15	0.0012
20	0.00142
20.8	0.00146

CURVE 3

439.3	0.00401
470.9	0.00317
481.5	0.00346
485.4	0.00346*
527.6	0.00352
532.1	0.00397
553.2	0.00375
553.2	0.00420
572.1	0.00404

* Not shown on plot

SPECIFICATION TABLE NO. 311 THERMAL CONDUCTIVITY OF POLYTRIFLUOROCHLOROETHYLENE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	531	C	1958	318-465	< 5	Kel-F		Annealed and heat treated at 472 K for 24 hrs, cooled slowly; density 2.15 g cm ⁻³ ; alumina used as comparative material.

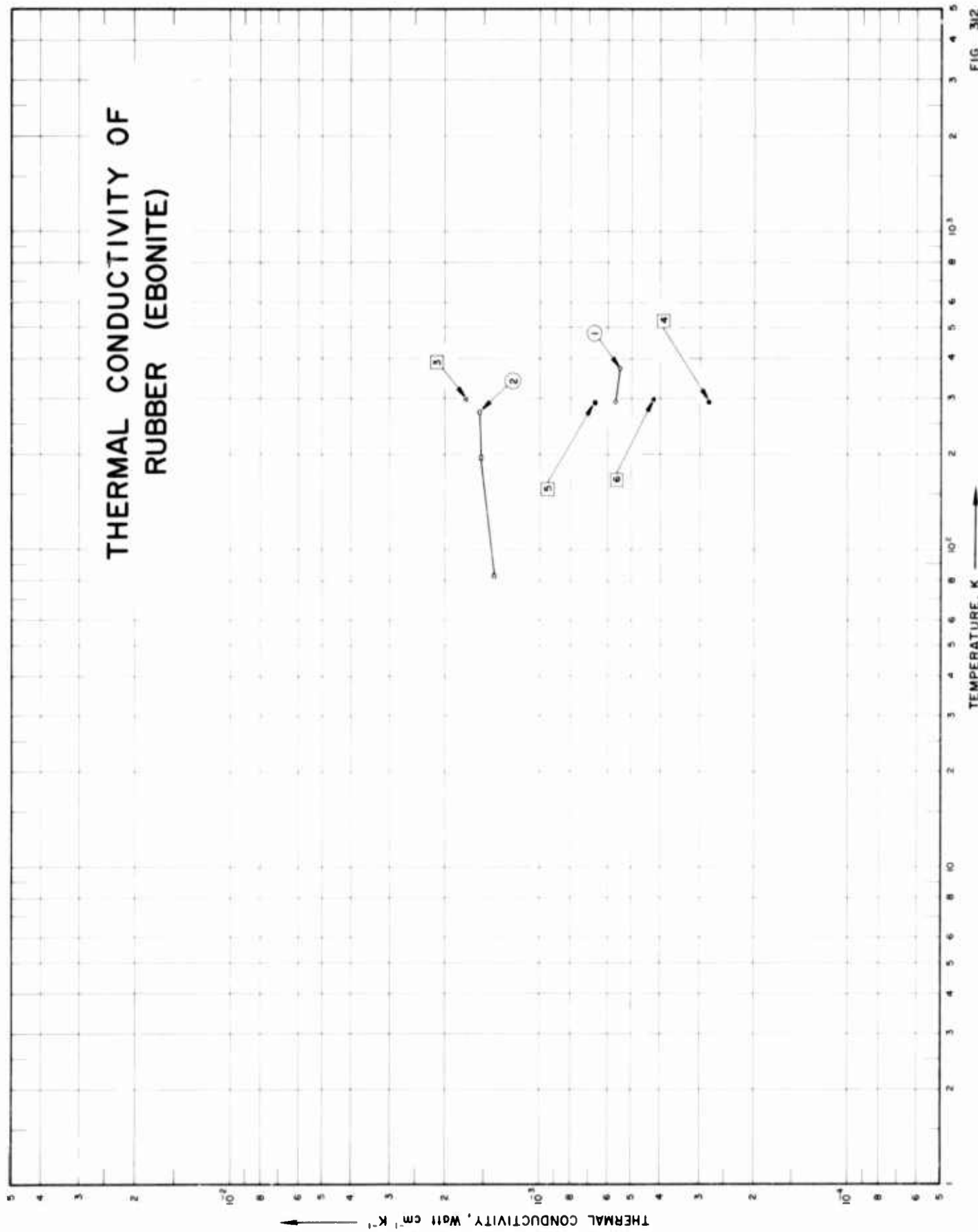
DATA TABLE NO. 311 THERMAL CONDUCTIVITY OF POLYTRIFLUOROCHLOROETHYLENE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
317.6	0.00146
350.7	0.00185
370.9	0.00211
383.2	0.00245
390.9	0.00232
402.6	0.00237
408.2	0.00249
435.9	0.00235
437.6	0.00251
460.9	0.00267
464.6	0.00248

* No graphical presentation

THERMAL CONDUCTIVITY OF RUBBER (EBONITE)



SPECIFICATION TABLE NO. 312 THERMAL CONDUCTIVITY OF RUBBER (EBONITE)

[For Data Reported in Figure and Table No. 312]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	44	F	1914	293.373		Hard Rubber	Radius 0.327 cm, length 6.3 cm; density 1.19 g cm ⁻³ .
2	22	L	1911	83-273		Hard Rubber	No details reported.
3	125	L	1923	298.2	1	Hard Rubber	Average value of measurements for various specimens with different thicknesses ranging from 0.035 cm to 0.15 cm; measured under pressure 21 lb in. ²
4	529	P	1956	290.4		Hard Rubber	New sample; expanded; density 0.969 g cm ⁻³ ; thermal conductivity values calculated from measured transient temperature changes.
5	529	P	1956	290.4		Hard Rubber	Old weathered sample, expanded; same measuring method as above.
6	330	C	1957	295.2		Hard Rubber	Expanded; 0.3125 in. thick and 3 in. dia lapped disk specimen; thermal comparator No. 4 used.

FIGURE SHOWS ONLY 17 OF THE CURVES REPORTED IN TABLE

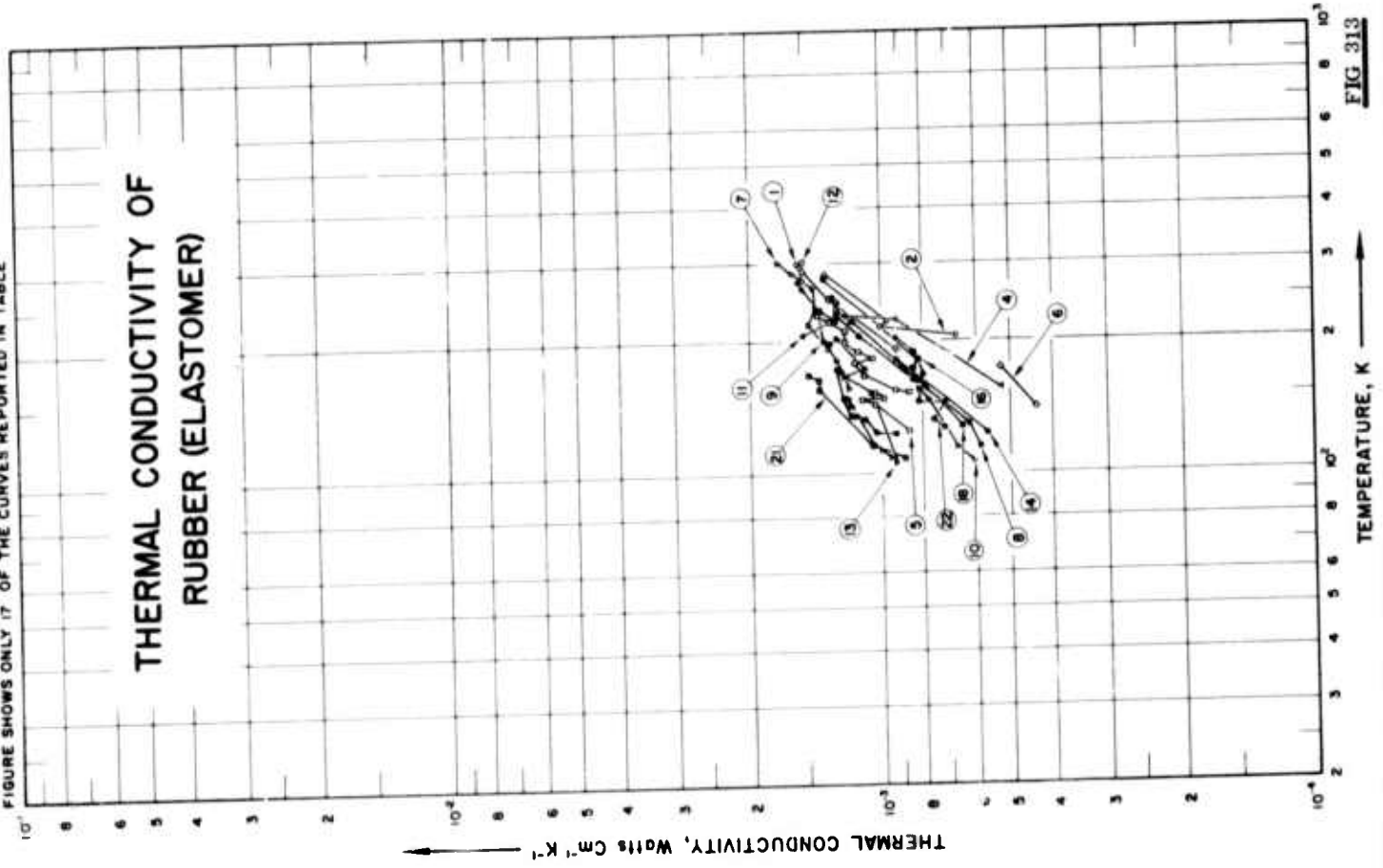


FIG 313

DATA TABLE NO. 312 THERMAL CONDUCTIVITY OF RUBBER (ERONITE)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
293.2	0.000569
373.2	0.000548
<u>CURVE 2</u>	
83.2	0.00138
195.2	0.00153
273.2	0.00155
<u>CURVE 3</u>	
298.2	0.00172
<u>CURVE 4</u>	
290.4	0.000281
<u>CURVE 5</u>	
290.4	0.000663
<u>CURVE 6</u>	
298.2	0.00042

SPECIFICATION TABLE NO. 313 THERMAL CONDUCTIVITY OF RUBBER (ELASTOMER)

[For Data Reported in Figure and Table No. 313]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	191	L	1950	275-301	4.0	Run No. 1	87.64 pure latex, 2.61 zinc oxide, 2.4 Sulphur, 0.79 captax, 3.5 stearic acid, 1.75 pine tar, 1.31 antioxidant, cured 120 min at 274 F; no stretch; measured with increasing temperature.
2	191	L	1950	205-285	4.0	Run No. 1	The above specimen measured with decreasing temperature.
3	191	L	1950	151-253	4.0	Run No. 2	Same as the above specimen; no stretch; measured with increasing temperature.
4	191	L	1950	157-229	4.0	Run No. 2	The above specimen measured with decreasing temperature.
5	191	L	1950	125-229	4.0	Run No. 3	Same as the above specimen; no stretch; measured with increasing temperature.
6	191	L	1950	141, 173	4.0	Run No. 3	The above specimen measured with decreasing temperature.
7	191	L	1950	109-301	4.0	Run No. 4	Same as the above specimen; 50% stretch; measured with increasing temperature.
8	191	L	1950	115-251	4.0	Run No. 4	The above specimen measured with decreasing temperature.
9	191	L	1950	123-227	4.0	Run No. 5	Same as the above specimen; 50% stretch; measured with increasing temperature.
10	191	L	1950	107-155	4.0	Run No. 5	The above specimen measured with decreasing temperature.
11	191	L	1950	203-273	4.0	Run No. 6	Same as the above specimen; 100% stretch; measured with increasing temperature.
12	191	L	1950	191-301	4.0	Run No. 6	The above specimen measured with decreasing temperature.
13	191	L	1950	107-203	4.0	Run No. 7	Same as the above specimen; 100% stretch; measured with increasing temperature.
14	191	L	1950	123, 181	4.0	Run No. 7	The above specimen; measured with decreasing temperature.
15	191	L	1950	183-257	4.0	Run No. 8	Same as the above specimen; 100% stretch; measured with increasing temperature.
16	191	L	1950	163-278	4.0	Run No. 8	The above specimen measured with decreasing temperature.
17	191	L	1950	118-204	4.0	Run No. 9	Same as the above specimen; 100% stretch; measured with increasing temperature.
18	191	L	1950	128-246	4.0	Run No. 9	The above specimen measured with decreasing temperature.
19	191	L	1950	169-268	4.0	Run No. 10	Same as the above specimen; 50% stretch; measured with increasing temperature.
20	191	L	1950	195, 209	4.0	Run No. 10	The above specimen measured with decreasing temperature.
21	191	L	1950	108-268	4.0	Run No. 11	Same as the above specimen; no stretch measured with increasing temperature.
22	191	L	1950	127-273	4.0	Run No. 11	The above specimen measured with decreasing temperature.

DATA TABLE NO. 313 THERMAL CONDUCTIVITY OF RUBBER (ELASTOMER)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	CURVE 1	CURVE 6	CURVE 10 (cont.)	CURVE 16	CURVE 21
275.2	0.00151		141.2	0.000439	147.2	0.000774
301.2	0.00155		173.2	0.000525	155.2	0.000816
		CURVE 2	CURVE 7	CURVE 11		
205.2	0.000669		109.2	0.000941	203.2	0.00134 *
216.2	0.00100		113.2	0.00100	207.2	0.00151
221.2	0.000962		117.2	0.00105	211.2	0.00151 *
285.2	0.00134		143.2	0.00117	222.2	0.00126
		CURVE 3 *	149.2	0.00119	226.2	0.00134 *
151.2	0.00117		156.2	0.00118	235.2	0.00138
163.2	0.00105		157.2	0.00118 *	237.2	0.00140 *
163.2	0.00111		171.2	0.00123	261.2	0.00151
193.2	0.00119		181.2	0.00126	273.2	0.00155
195.2	0.00128		193.2	0.00130		
205.2	0.00117		217.2	0.00146		
243.2	0.00138		239.2	0.00140		
253.2	0.00138		263.2	0.00142		
		CURVE 4	285.2	0.00159		
157.2	0.000523		301.2	0.00172		
223.2	0.000920					
229.2	0.00121					
		CURVE 5				
125.2	0.000858					
143.2	0.00103					
147.2	0.00111					
153.2	0.00103					
153.2	0.000858					
155.2	0.000920					
163.2	0.00107					
167.2	0.00109					
179.2	0.00115					
183.2	0.00105					
189.2	0.00113					
199.2	0.00121					
211.2	0.00121					
221.2	0.00130					
229.2	0.00138					
		CURVE 8				
115.2	0.000586					
129.2	0.000628					
205.2	0.00113					
229.2	0.00126					
251.2	0.00128					
		CURVE 9				
123.2	0.000920					
123.2	0.00103					
133.2	0.00109					
136.2	0.00115					
136.2	0.000858					
155.2	0.000920					
163.2	0.00107					
167.2	0.00109					
179.2	0.00115					
183.2	0.00105					
189.2	0.00113					
199.2	0.00121					
211.2	0.00121					
221.2	0.00130					
229.2	0.00138					
		CURVE 12				
191.2	0.000920					
249.2	0.00130					
288.2	0.00151					
301.2	0.00151					
		CURVE 13				
107.2	0.000920					
153.2	0.00105					
165.2	0.00121					
173.2	0.00109					
203.2	0.00126					
		CURVE 14				
123.2	0.000565					
181.2	0.000920					
		CURVE 15 *				
183.2	0.00126					
213.2	0.00130					
227.2	0.00146					
243.2	0.00142					
257.2	0.00146					
		CURVE 17 *				
118.2	0.00105					
129.2	0.00100					
141.2	0.00109					
143.2	0.00107					
146.2	0.000816					
168.2	0.000795					
188.2	0.000837					
193.2	0.00119					
204.2	0.00121					
		CURVE 18				
128.2	0.000649					
163.2	0.000816					
223.2	0.00117					
235.2	0.00126					
246.2	0.00126					
		CURVE 19 *				
169.2	0.00113					
187.2	0.00124					
203.2	0.00142					
207.2	0.00136					
223.2	0.00140					
223.2	0.00144					
233.2	0.00132					
233.2	0.00136					
235.2	0.00132					
245.2	0.00140					
245.2	0.00140					
249.2	0.00138					
258.2	0.00142					
268.2	0.00151					
268.2	0.00142					
		CURVE 20 *				
195.2	0.00100					
209.2	0.00111					

* Not shown on plot

FIGURE SHOWS ONLY 13 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF RUBBER (GR-S)

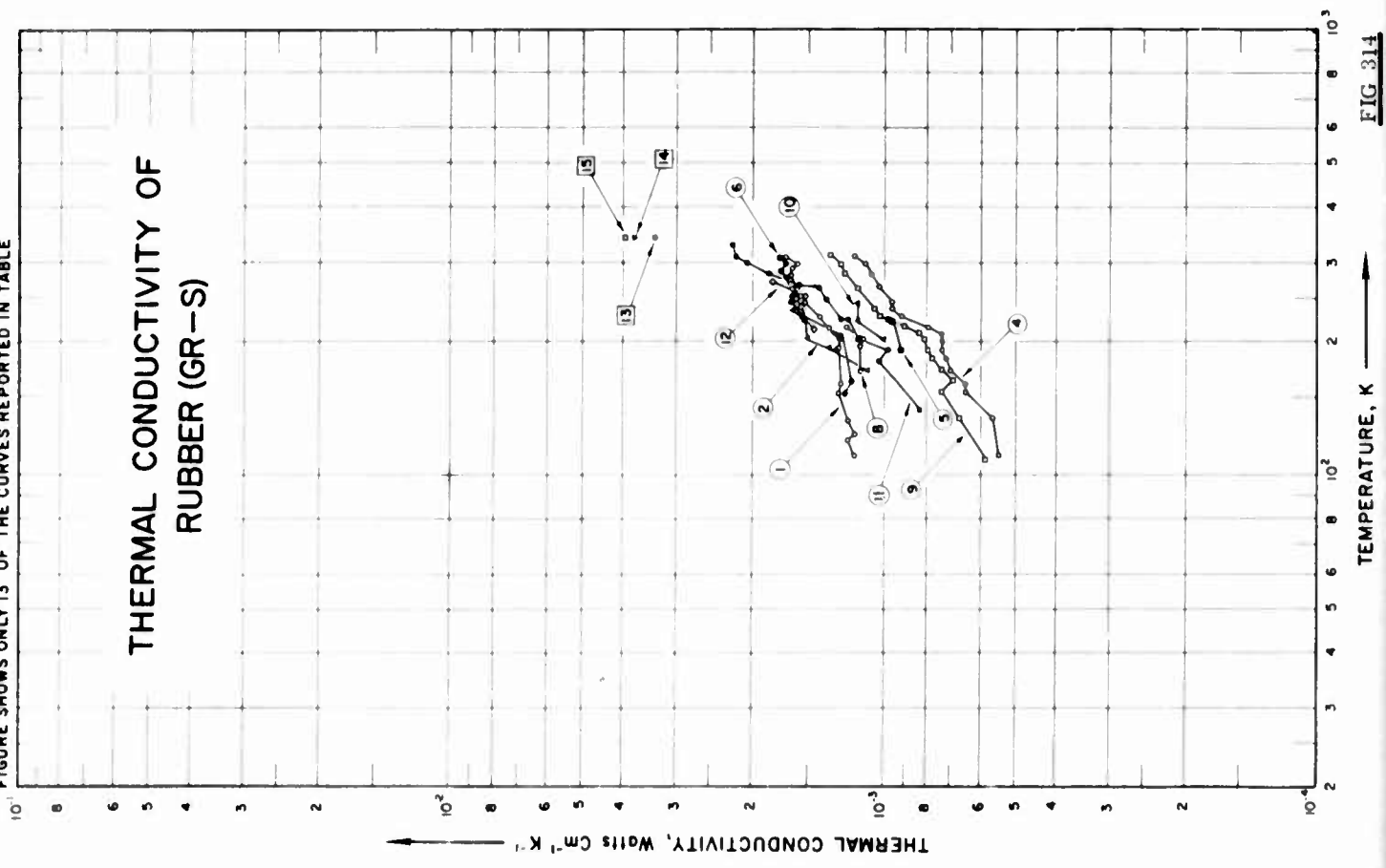


FIG 314

SPECIFICATION TABLE NO. 314 THERMAL CONDUCTIVITY OF RUBBER (GOVERNMENT RUBBER-STYRENE)

For Data Reported in Figure and Table No. 314

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	191	L	1950	110-309	± 8.5	GR-S	88.1 GR-S, 4.4 zinc oxide, 1.8 sulphur, 1.3 captax, 4.4 hardol B; optimum-cured 60 min at 421 K; specific gravity 0.99; no stretch; measured at increasing temperatures.	
2	191	L	1950	173-236	± 8.5	GR-S	The above specimen measured at decreasing temperatures.	
3	191	L	1950	173-215	± 8.5	GR-S	Similar to the above specimen except measured at increasing temperatures.	
4	191	L	1950	111-311	± 8.5	GR-S	Similar to the above specimen except 100% stretched and measured at increasing temperatures.	
5	191	L	1950	191-225	± 8.5	GR-S	The above specimen measured at decreasing temperatures.	
6	191	L	1950	153-309	± 8.5	GR-S	Same chemical composition and specific gravity as the above specimen; over-cured 120 min at 421 K; unstretched; measured at increasing temperatures.	
7	191	L	1950	191-233	± 8.5	GR-S	The above specimen measured at decreasing temperatures.	
8	191	L	1950	173-215	± 8.5	GR-S	The above specimen measured at increasing temperatures.	
9	191	L	1950	109-313	± 8.5	GR-S	Similar to the above specimen except 100% stretched and measured at increasing temperatures.	
10	191	L	1950	203-245	± 8.5	GR-S	The above specimen measured at decreasing temperatures.	
11	191	L	1950	141-329	± 8.5	GR-S	Kept for two years at room temperature, constantly exposed to air and light.	
12	191	L	1950	203-274	± 8.5	GR-S	The above specimen measured at decreasing temperatures.	
13	192	L	1945	343.2	1.3	GR-S tread type	5.5 carbon black (by weight base on 100 parts of GR-S).	
14	192	L	1945	343.2	1.3	GR-S tread type	2.5 aluminum powder, 3.3 carbon black (by weight based on 100 parts of GR-S).	
15	192	L	1945	343.2	1.3	GR-S tread type	5.0 aluminum powder, 5.5 carbon black (by weight based on 100 parts of GR-S).	

THERMAL CONDUCTIVITY OF RUBBER (MISCELLANEOUS)

FIGURE SHOWS ONLY 29 OF THE CURVES REPORTED IN TABLE

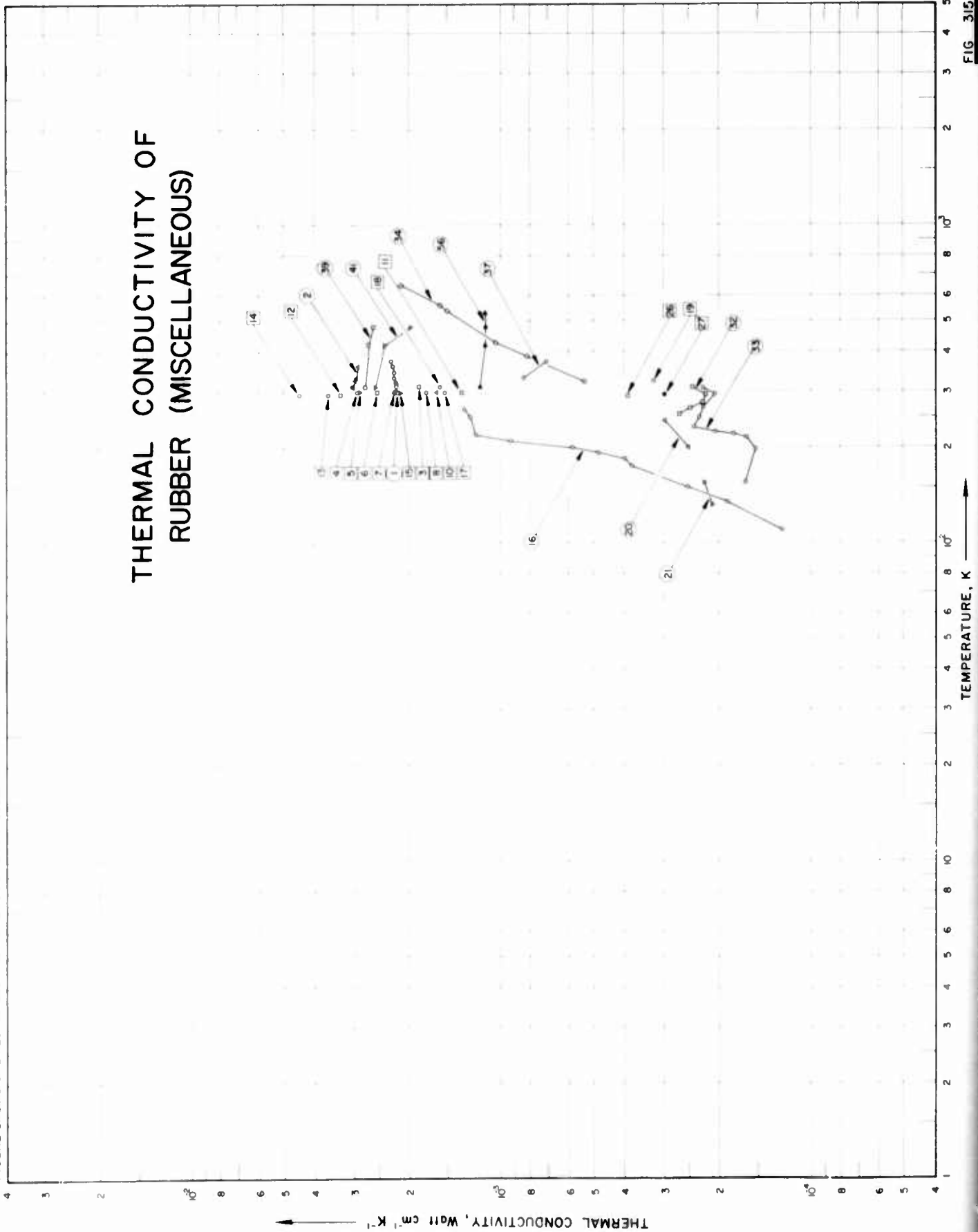


FIG. 315

SPECIFICATION TABLE NO. 315 THERMAL CONDUCTIVITY OF RUBBER (Miscellaneous)

[For Data Reported in Figure and Table No. 315]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent).	Specifications and Remarks
1	59	L	1953	299-375				Typical dielectric mix; approximately 0.05 in. thick placed under a slight pressure estimated at 2 lb in. ⁻² .
2	59	L	1953	303-360				Designed for high conductivity; approximately 0.05 in. thick placed under a slight pressure estimated at 2 lb in. ⁻² .
3	125	L	1923	311.2	1	Commercial rubber		Cross-sectional area 15.59 cm ⁻² ; thickness 0.286 cm; under pressure 8 lb in. ⁻² .
4	125	L	1923	298.2	1	Commercial rubber		Vulcanized; 38% rubber; thickness 0.385 cm; under pressure 8.4 lb in. ⁻² .
5	125	L	1923	298.2	1	Commercial rubber		Vulcanized; 40% rubber; thickness 0.381 cm; under pressure 8.4 lb in. ⁻² .
6	125	L	1923	298.2	1	Commercial rubber		Vulcanized; 44% rubber; thickness 0.287 cm; under pressure 8.4 lb in. ⁻² .
7	125	L	1923	298.2	1	Commercial rubber		Vulcanized; 50% rubber; thickness 0.387 cm; under pressure 8.4 lb in. ⁻² .
8	125	L	1923	298.2	1	Commercial rubber		Vulcanized; 67% rubber; thickness 0.286 cm; under pressure 8.4 lb in. ⁻² .
9	125	L	1923	298.2	1	Commercial rubber		Vulcanized; 83% rubber; thickness 0.412 cm; under pressure 8.4 lb in. ⁻² .
10	125	L	192	298.2	1	Commercial rubber		Vulcanized; 92% rubber; thickness 0.324 cm; under pressure 8.4 lb in. ⁻² .
11	125	L	1923	298.2	1	Commercial rubber		Vulcanized; 100% rubber; plantation rubber crepe; thickness 0.103 cm; under pressure 34 lb in. ⁻³ .
12	125	L	1923	293.2	1	X-ray protective rubber		Lead equivalent = 0.35%; thickness 0.173 cm; under pressure 2.5 lb in. ⁻² .
13	125	L	1923	293.2	1	X-ray protective rubber		Lead equivalent = 0.41%; thickness 0.260 cm; under pressure 2.5 lb in. ⁻² .
14	125	L	1923	293.2	1	X-ray protective rubber		Lead equivalent = 0.43%; thickness 0.463 cm; under pressure 2.5 lb in. ⁻² .
15	117	L	1955	295.2	1.0-2.0			Thickness 15.1 mm; density 1.08 g cm ⁻³ ; thermal conductivity values calculated from measured data of thermal diffusivity and specific heat.
16	126	L	1941	110-265				Vulcanized flat ring specimen of 30 mm O. D. and 10 mm I. D.
17	127	F	1950	298.2				Thickness 1.025 cm; density 1.10 g cm ⁻³ ; thermal conductivity values calculated from measured transient temperature changes.
18	108	L	1920	310.7		Hard rubber		9 in. in dia. 0.380 in. thick; specific gravity 1.19; heat flow in transverse direction.
19	128	L	1946	323.7				Expanded rubber board 2.01 in. in thickness; density 0.078 g cm ⁻³ .
20	128	L	1946	200, 243				Expanded rubber board 1.00 in. in thickness; density 0.078 g cm ⁻³ .
21	43	L	1954	132, 155				Expanded rubber board density 0.072 g cm ⁻³ .
22	536	P	1953	301.2				10 x 10 x 0.42 cm; density 1.60 g cm ⁻³ .
23	536	P	1953	315.2				5 mm thick plate; 13 x 15 cm ² surface; density 1.96 g cm ⁻³ .
24	189		1950	200-289		Rubatec		Density 0.13-0.14 g cm ⁻³ ; water absorption (24 hrs) 0.2 vol %.
25	533	L	1962	300-334		Rubatec R203-H		Buna-N foam rubber; specimen size 0.25 in. x 12 in. x 12 in.

SPECIFICATION TABLE NO. 315 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
26	534	L	1961	291.8		Adiprene rubber	Flexible polyurethane foam rubber; 8 x 5 x 0.469 in.; density 0.0320 g cm ⁻³ .
27	535	L	1962	294.3		Adiprene rubber; 2	Polyurethane foam rubber; crushed and re-expanded with CCl ₄ F in pure air, aged at 333 K for 25 days; density 0.0481 g cm ⁻³ .
28	535	L	1962	294.3		Adiprene rubber; 2	The cells of the above specimen crushed and then re-expanded with CCl ₄ F in pure air the second time, aged at 333 K for 30 days.
29	535	L	1962	294.3		Adiprene rubber; 2	The cells of the above specimen crushed and then re-expanded with CCl ₄ F in pure air the third time, aged at 333 K for 33 days.
30	535	L	1962	294.3		Adiprene rubber; 2	The cells of the above specimen crushed and then re-expanded with CCl ₄ F in pure air the fourth time, aged at 333 K for 36 days.
31	535	L	1962	294.3		Adiprene rubber; 3	Cut from the same sample as the above specimen; aged at 333 K continuously.
32	535	L	1962	255-310		Adiprene rubber; A	Rigid polyurethane foam rubber; prepared by using CCl ₄ F as captive blowing agent.
33	535	L	1962	157-309		Adiprene rubber; B	Similar to the above specimen.
34	498, 499	L	1961	323-647		SRI 3	Resin type R-7002 silicone foam rubber; 30 x 12 x 0.5 in.; average thickness 0.688 in.; manufactured by Dow Corning Corp.; fabricated by heating at 472 K for 1 hr, 497 K for 1 hr, and 522 K for 24-48 hrs, cooled at 497 K for 1 hr, 472 K for 1 hr, and at 339 K for 1 hr; density 0.186 g cm ⁻³ .
35	192	L	1945	333, 373			Rubber sponge; initially uncured.
36	192	L	1945	333, 373			Rubber sponge; cured, undried.
37	192	L	1945	333, 373			Rubber sponge; cured, dried.
38	537	L	1960	311, 422		Acrylate Rubber	83.7 Vyram N 5400, 11.6 MgO, 2.9 PbO ₂ , and 1.8 CH ₃ (CH ₂) ₁₆ COOH (stearic acid); 6 x 6 x 0.250 in.; optimum-cured at 439 K for 60 min.
39	537	L	1960	311-478		Carboxy Nitrile	66.9 Hycar 1072, 26.8 FEF black, 3.3 ZnO, 2.3 Tuad, and 1.7 CH ₃ (CH ₂) ₁₆ COOH; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 428 K for 30 min.
40	537	L	1960	311-478		Acrylic Rubber	64.4 Acrylon EA-5, 32.2 HAF black, 1.3 Tetrone A, 1.3 triethylene tetramine peroxide, and 0.8 CH ₃ (CH ₂) ₁₆ COOH; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 428 K for 20 min.
41	537	L	1960	311-478		Carboxy Rubber	Firestone proprietary compound butaprene T; 6 x 6 x 0.250 in.; vulcanized.
42	537	L	1960	311-478		Nitrile Rubber	68.3 Butaprene NL, 20.5 HAF black, 6.8 dibutyl phthalate, 2.0 ZnO, 1.7 S, and 0.7 altax; 6 x 6 x 0.250 in.; vulcanized.
43	537	L	1960	310.9		Thiokol ST	63.3 Thiokol ST, 31.7 HAF black, 2.8 GMF (30%), 1.9 CH ₃ (CH ₂) ₁₆ COOH, and 0.3 ZnO; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 435 K for 40 min.
44	537	L	1960	311, 422		Butaprene E	Firestone proprietary compound; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 411 K for 20 min.

SPECIFICATION TABLE NO. 315 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
45	537	L	1960	311-478		Hevea	61.2 smoked sheet, 30.6 HAF black, 1.8 pine tar, 1.8 CH ₃ (CH ₂) ₁₆ COOH, 1.8 ZnO, 1.5 S, 0.7 BLE, 0.31 santo cure, and 0.2 ajone LX; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 411 K for 60 min.
46	537	L	1960	311-422		Hypalon S2	65.2 Hypalon S2, 19.5 MgO, 13.0 HAF black, 1.6 staybelite resin, and 0.7 Tetrone A; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 411 K for 45 min.
47	537	L	1960	311-533		Chloroprene Rubber	61.6 Neoprene GRT, 30.8 MPC black, 3.1 ZnO, 2.5 MgO, 1.2 agerite stellite, 0.5 altex, and 0.3 CH ₃ (CH ₂) ₁₆ COOH; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 411 K for 45 min.
48	537	L	1960	311-533		Viton Rubber	72.6 Viton A, 14.5 MT black, 10.9 MgO, 1.3 copper inhibitor 65, and 0.7 HMDAC; 6 x 6 x 0.250 in.; vulcanized optimum-cured at 422 K for 60 min; post-cured at 373, 394, 422, and 450 K for 1 hr each, and at 478 K for 8 hrs.
49	537	L	1960	311, 422		LTP	60.0 FR-S 1500, 30.0 HAF black, 4.8 med. proc. oil, 1.8 ZnO, 1.2 CH ₃ (CH ₂) ₁₆ COOH, 1.2 S, 0.7 santo cure, and 0.3 PBNA; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 411 K for 60 min.
50	537	L	1960	311, 422		Methacrylate Rubber	45.2 butadiene, 19.35 methyl methacrylate, 19.35 HAF black, 9.7 Ba(OH) ₂ , 8 H ₂ O, 3.2 pine tar, 1.9 Di cup 40 C, and 1.3 Monsanto 4010 antioxidant; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 433 K for 45 min.
51	537	L	1960	311-533		Resin-cured Butyl	53.5 Enjay butyl 325, 32.8 HAF black, 6.6 amberol ST-137, 6.6 brominated butyl, and 0.5 CH ₃ (CH ₂) ₁₆ COOH; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 433 K for 90 min.
52	537	L	1960	311-533		Poly(ethyl acrylate)	64.8 Poly(ethyl acrylate), 19.4 HAF black, 6.5 Ca(OH) ₂ , 3.2 CH ₃ OCH ₂ CH ₂ OH (ethylene glycol), 3.2 pine tar, 1.3 PBNA, 1.3 CH ₃ (CH ₂) ₁₆ COOH, and 0.3 copper inhibitor 65; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 433 K for 90 min.
53	537	L	1960	311-533		Silicone Rubber	96.1 silastic 916 U, 3.4 silastic S-2094 (20% di-t-butyl peroxide), and 0.5 CH ₃ (CH ₂) ₁₆ COOH; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 433 K for 20 min; post-cured at 422 and 450 K for 1 hr each, at 478 K for 4 hrs, and at 505 and 522 K for 8 hrs each.
54	537	L	1960	311-478		Tellurac-cured Butyl	52.5 Enjay butyl 325, 26.2 MPC black, 13.1 ZnO, 2.6 PbO ₂ , 2.6 vistanex B-80, 1.6 ethyl tellurac, 1.1 S, and 0.3 polyac; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 433 K for 30 min.
55	537	L	1960	311-478		Dibenzo GMF-cured Butyl	51.4 Enjay butyl 325, 25.7 MPC black, 10.3 ZnO, 5.1 Pb ₂ O ₃ , 3.3 dibenzo GMF, 2.6 vistanex B-80, 1.0 S, 0.3 polyac, and 0.3 CH ₃ (CH ₂) ₁₆ COOH; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 433 K for 30 min.
56	537	L	1960	311-533		Kel-F 3700	82.4 Kel-F 3700, 8.2 dypbos, 8.2 ZnO, and 1.2 benzoyl peroxide; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 394 K for 30 min, post-cured at 394 K for 1 hr and at 422 K for 16 hrs.

SPECIFICATION TABLE NO. 316 THERMAL CONDUCTIVITY OF ANTHRACENE $C_{14}H_{10}$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	67	P	1950	298-361			Specimen in long cylindrical form; distilled and recrystallized; melting point 490 K; mean error $\pm 0.5 \times 10^{-3}$ cal $cm^{-1}sec^{-1}C^{-1}$.

DATA TABLE NO. 316 THERMAL CONDUCTIVITY OF ANTHRACENE $C_{14}H_{10}$ [Temperature, T. K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k
	<u>CURVE 1*</u>
297.9	0.00339
313.6	0.00337
333.2	0.00335
343.2	0.00333
352.8	0.00331
360.6	0.00328

* No graphical presentation

SPECIFICATION TABLE NO. 317 THERMAL CONDUCTIVITY OF BENZENE, P-DIBROMO $C_6H_4Br_2$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	67	P	1950	293-357			Specimen in long cylindrical form; distilled and recrystallized; melting point 360 K; mean error = $\pm 0.5 \times 10^{-3} \text{ cal cm}^{-1} \text{ sec}^{-1} \text{ C}^{-1}$.

DATA TABLE NO. 317 THERMAL CONDUCTIVITY OF BENZENE, P-DIBROMO $C_6H_4Br_2$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
293.0	0.00215
309.6	0.00218
324.0	0.00220
338.4	0.00218
357.1	0.00209

* No graphical presentation

SPECIFICATION TABLE NO. 318 THERMAL CONDUCTIVITY OF BENZENE, P-DICHLORO $C_6H_4Cl_2$

Curve No.	Re. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	67	P	1950	293-323				Specimen in long cylindrical form; distilled and recrystallized; melting point 326 K; mean error = 0.5×10^{-3} cal cm ⁻¹ sec ⁻¹ C ⁻¹ .

DATA TABLE NO. 318 THERMAL CONDUCTIVITY OF BENZENE, P-DICHLORO $C_6H_4Cl_2$

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
293.4	0.00247
299.9	0.00228
306.4	0.00231
313.0	0.00176
322.7	0.00134

* No graphical presentation

SPECIFICATION TABLE NO. 319 THERMAL CONDUCTIVITY OF BENZENE, P-DIODO $C_6H_4I_2$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	67	P	1950	293-324			Specimen in long cylindrical form; distilled and recrystallized; melting point 402 K; mean error 0.5×10^{-3} cal $cm^{-1}sec^{-1}C^{-1}$.

DATA TABLE NO. 319 THERMAL CONDUCTIVITY OF BENZENE, P-DIODO $C_6H_4I_2$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T k

CURVE 1*

293.1	0.00184
305.5	0.00184
323.8	0.00180

* No graphical presentation

SPECIFICATION TABLE NO. 320 THERMAL CONDUCTIVITY OF DIPHENYL $C_6H_5C_6H_5$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	67	P	1950	292-331			Specimen in long cylindrical form; distilled and recrystallized; mean error = $\pm 0.5 \times 10^{-3}$ (cal cm ⁻¹ sec ⁻¹ C ⁻¹).
2	260	R	1961	365-582	1.5		Supply from Hopkin and Williams Ltd. with crystallizing point 68.7 C min and distillation range 2.5 C max; measured in liquid state.

DATA TABLE NO. 320 THERMAL CONDUCTIVITY OF DIPHENYL $C_6H_5C_6H_5$

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

291.6 0.00251
301.8 0.00297
315.6 0.00301
331.3 0.00301

CURVE 2*

365.2 0.00136
402.0 0.00131
437.5 0.00124
472.7 0.00119
484.4 0.00117
517.4 0.00113
578.9 0.00105
581.6 0.00105

* No graphical presentation

SPECIFICATION TABLE NO. 321 THERMAL CONDUCTIVITY OF DIPHENYL OXIDE (C₁₂H₁₀O)

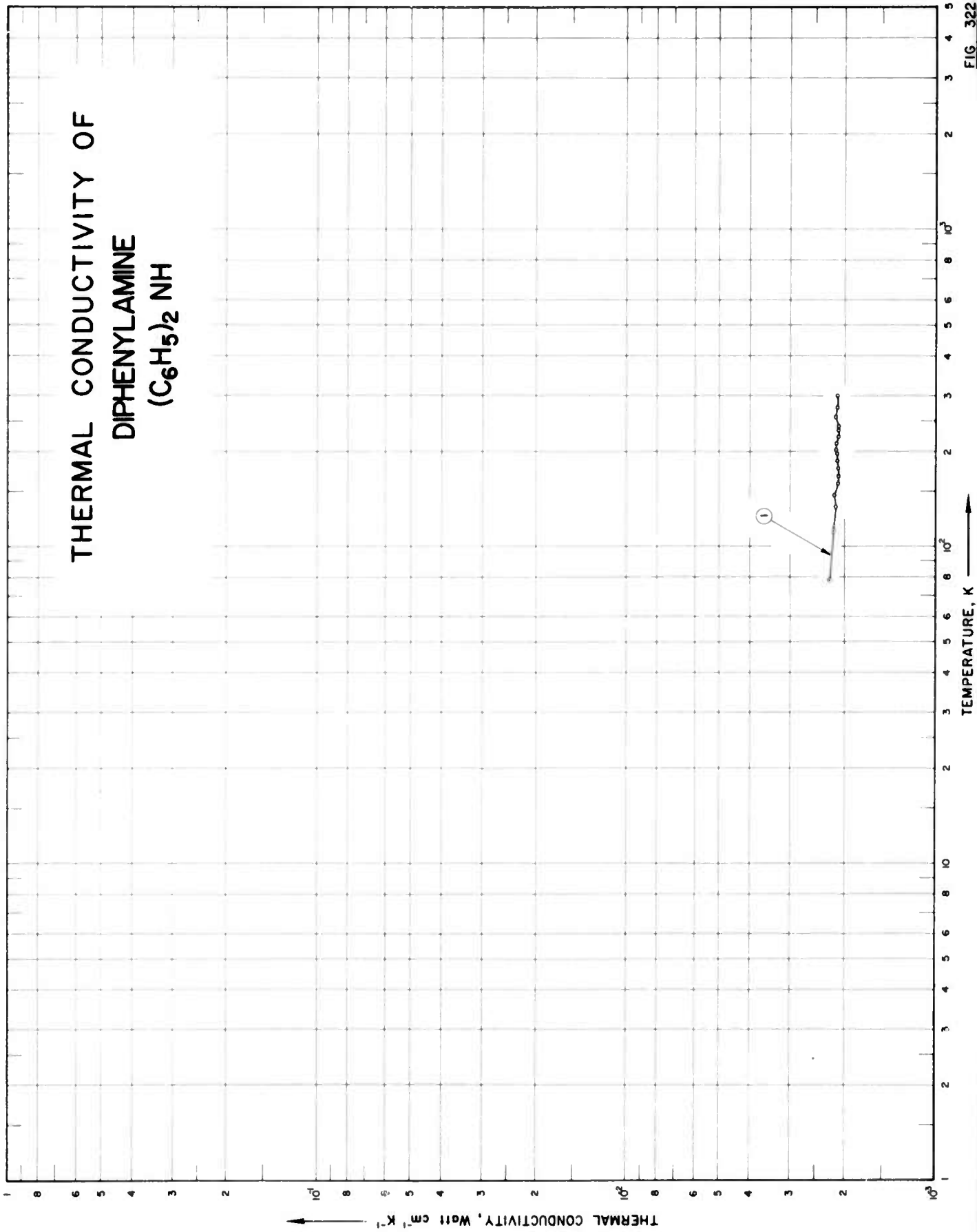
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	260	R	1961	330-511	1.5		B. D. H. Laboratory reagent; M. P. / F. P. 26-27 C; very slightly tinted crystalline solid; in liquid state.

DATA TABLE NO. 321 THERMAL CONDUCTIVITY OF DIPHENYL OXIDE (C₁₂H₁₀O)[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
329.9	0.00138
352.2	0.00136
402.6	0.00128
461.7	0.00118
493.0	0.00114
511.2	0.00111

* No graphical presentation

THERMAL CONDUCTIVITY OF
DIPHENYLAMINE
(C₆H₅)₂NH



SPECIFICATION TABLE NO. 322 THERMAL CONDUCTIVITY OF DIPHENYLAMINE (C₆H₅)₂NH

[For Data Reported in Figure and Table No. 322]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	66	R	1905	75-299			Melted over a water bath and frozen slowly from beneath.

DATA TABLE NO. 322 THERMAL CONDUCTIVITY OF DIPHENYLAMINE (C₆H₅)₂NH
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
78.2	0.00225
112.2	0.00218
134.2	0.00215
146.2	0.00217
158.2	0.00211
167.2	0.00211
177.2	0.00211
187.2	0.00213
197.2	0.00213
202.2	0.00215
212.2	0.00214*
215.2	0.00211*
223.2	0.00210
228.5	0.00210*
234.2	0.00210
240.2	0.00210
245.2	0.00213*
250.2	0.00214*
256.2	0.00215
266.2	0.00213*
275.2	0.00212
299.2	0.00212

* Not shown on plot

SPECIFICATION TABLE NO. 323 THERMAL CONDUCTIVITY OF [DIPHENYLMETHANE + NAPHTHALENE] $(C_{10}H_8)_2CH_2 + C_{10}H_8$

Curve No.	Ref. Method No.	Year Used	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) $(C_{10}H_8)_2CH_2$	Composition (continued), Specifications and Remarks $C_{10}H_8$
1	261	E	1955	293.2	± 0.5	Bal	2.6

DATA TABLE NO. 323 THERMAL CONDUCTIVITY OF [DIPHENYLMETHANE + NAPHTHALENE] $(C_{10}H_8)_2CH_2 + C_{10}H_8$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

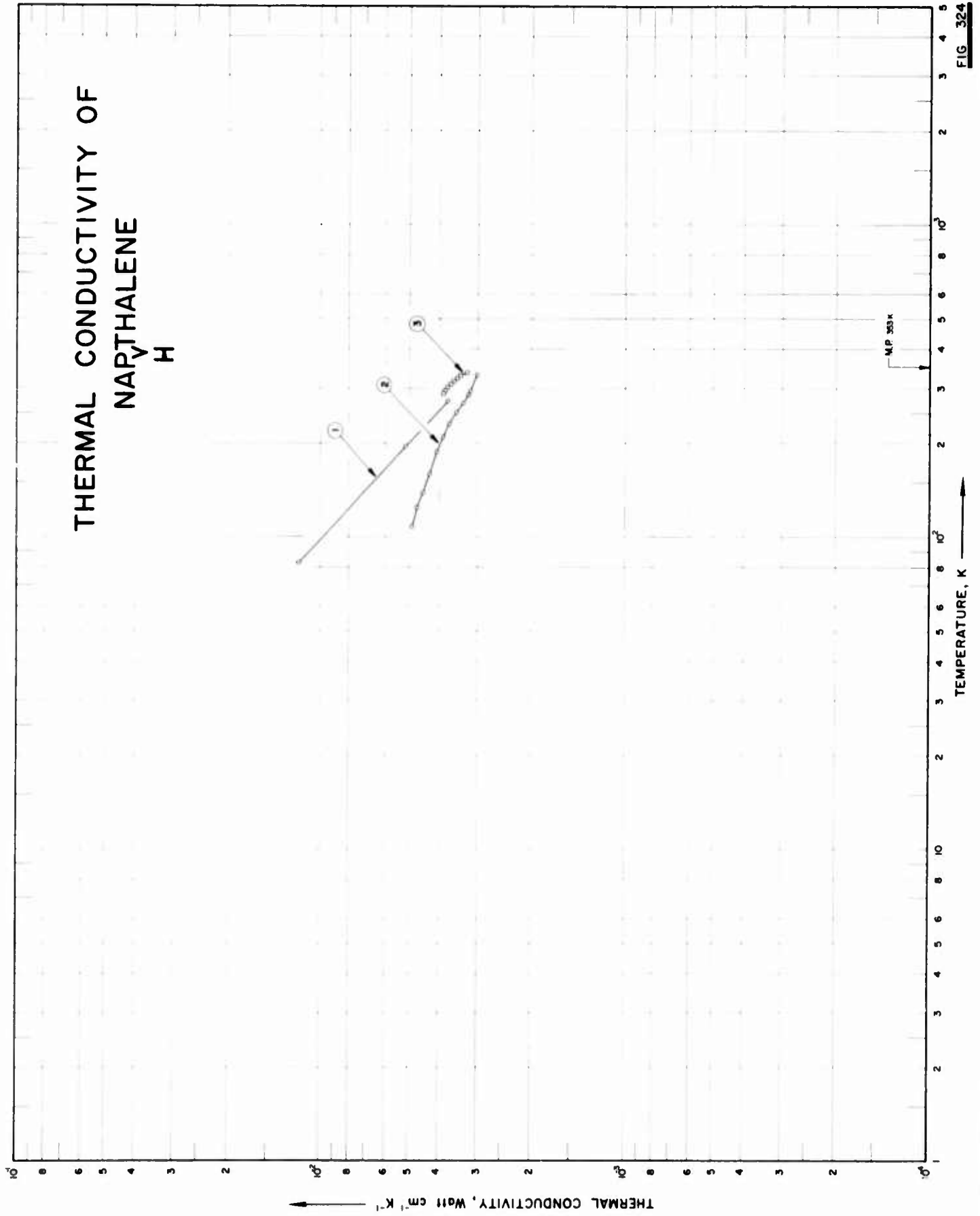
T k

CURVE 1*

293.2 0.00349

*No graphical presentation

THERMAL CONDUCTIVITY OF NAPHTHALENE H



SPECIFICATION TABLE NO. 324 THERMAL CONDUCTIVITY OF NAPHTHALENE $C_{10}H_8$

[For Data Reported in Figure and Table No. 324]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	22	L	1911	83-273			No other details reported.
2	66	R	1905	108-332			Melting point 79 C.
3	67	P	1950	290-339			Purified by distillation and recrystallization; melting point 353 K; data mean error $\pm 0.5 \times 10^{-3}$ cal $cm^{-1} sec^{-1} C^{-1}$.

DATA TABLE NO. 324 THERMAL CONDUCTIVITY OF NAPHTHALENE $C_{10}H_8$
 [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k
<u>CURVE 1</u>	
83.2	0.0118
195.2	0.00512
273.2	0.00377
<u>CURVE 2</u>	
108.2	0.00490
125.2	0.00473
139.2	0.00452
160.2	0.00431
187.2	0.00410
210.2	0.00390
231.2	0.00374
251.2	0.00354
269.2	0.00336
286.2	0.00323
295.2	0.00318
332.2	0.00302
<u>CURVE 3</u>	
289.5	0.00387
296.5	0.00383
303.5	0.00377
310.6	0.00368
317.7	0.00360
324.8	0.00351
331.8	0.00343
338.9	0.00326

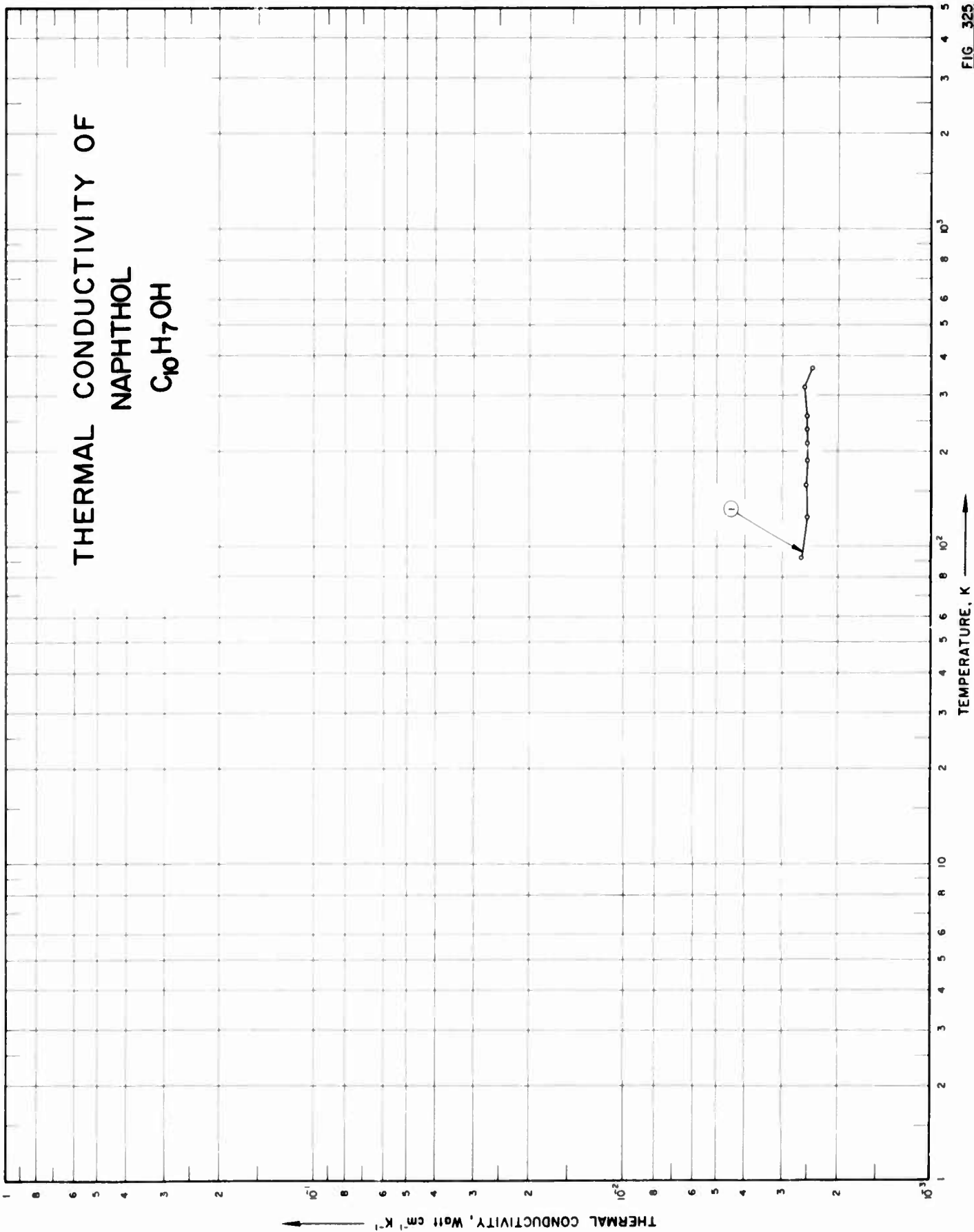


FIG. 325

SPECIFICATION TABLE NO. 325 THERMAL CONDUCTIVITY OF NAPHTHOL $C_{10}H_8O$

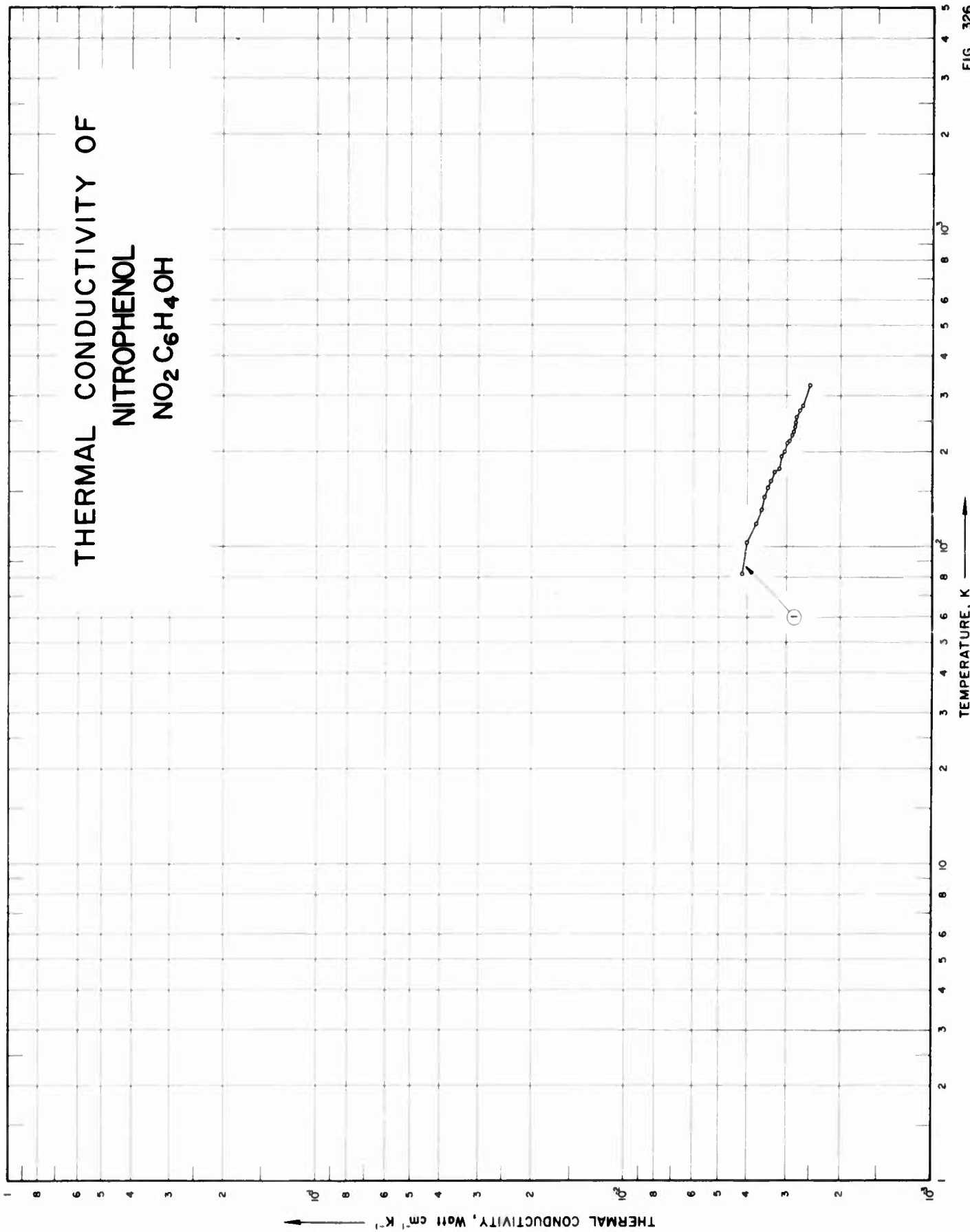
[For Data Reported in Figure and Table No. 325]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	66	R	1905	92-365			Heated in an oil bath and cooled slowly underneath.

DATA TABLE NO. 325 THERMAL CONDUCTIVITY OF NAPHTHOL $C_{10}H_7OH$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1} K^{-1}$]

T	k
92.2	0.00261
123.2	0.00250
156.2	0.00253
187.2	0.00251
212.2	0.00250
235.2	0.00251
258.2	0.00251
318.2	0.00256
365.2	0.00242

THERMAL CONDUCTIVITY OF
NITROPHENOL
 $\text{NO}_2\text{C}_6\text{H}_4\text{OH}$



SPECIFICATION TABLE NO. 326 THERMAL CONDUCTIVITY OF NITROPHENOL $\text{NO}_2\text{C}_6\text{H}_4\text{OH}$

[For Data Reported in Figure and Table No. 326]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	66	R	1905	82-323			Pure; heated in an oil bath and cooled slowly beneath.

DATA TABLE NO. 326 THERMAL CONDUCTIVITY OF NITROPHENOL $\text{NO}_2\text{C}_6\text{H}_4\text{OH}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
82.2	0.00418
103.2	0.00401
118.2	0.00377
131.2	0.00363
143.2	0.00356
153.2	0.00347
161.2	0.00338
172.2	0.00330
177.2	0.00318
194.2	0.00312
200.2	0.00305
213.2	0.00298
216.2	0.00293
226.2	0.00287
231.2	0.00284
239.2	0.00280
247.2	0.00278
257.2	0.00277
263.2	0.00272*
269.2	0.00269
273.2	0.00266*
279.2	0.00264*
280.2	0.00264*
320.2	0.00251*
323.2	0.00250

CURVE 1

* Not shown on plot

SPECIFICATION TABLE NO. 327 THERMAL CONDUCTIVITY OF PHENANTHRENE $C_{14}H_{10}$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	67	P	1950	291-325			Specimen in long cylindrical form; distilled and recrystallized; mean error = $\pm 0.5 \times 10^{-3}$ cal $cm^{-1}sec^{-1}C^{-1}$.

DATA TABLE NO. 327 THERMAL CONDUCTIVITY OF PHENANTHRENE $C_{14}H_{10}$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k
290.9	0.00205
305.9	0.00203
313.3	0.00201
324.5	0.00192

CURVE 1*

No graphical presentation

SPECIFICATION TABLE NO. 328 THERMAL CONDUCTIVITY OF SANTOWAX R

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	260	R	1961	429-665	1.5		52 meta-terphenyl, 39 para-terphenyl, 8 ortho-terphenyl, 1 diphenyl, and higher polyphenyls; in liquid state.

DATA TABLE NO. 328 THERMAL CONDUCTIVITY OF SANTOWAX R

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
428.6	0.00132
428.8	0.00132
462.2	0.00130
481.8	0.00127
508.6	0.00126
546.8	0.00120
549.2	0.00120
570.3	0.00119
615.0	0.00115
618.4	0.00114
664.7	0.00110

* No graphical presentation

SPECIFICATION TABLE NO. 329 THERMAL CONDUCTIVITY OF SODIUM ACETATE $\text{NaC}_2\text{H}_3\text{O}_2 \cdot 3\text{H}_2\text{O}$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	259	R	1932	29 s. s			The substance was melted and poured into container (5.75 in. dia x 7 in.) until the depth of liquid was 6 in., when it had solidified and cooled to room temperature the supply to the central heating element was switched on and maintained constant; when temperature conditions had remained steady for two hrs., readings on which the calculations of heat conductivity were based were taken.

DATA TABLE NO. 329 THERMAL CONDUCTIVITY OF SODIUM ACETATE $\text{NaC}_2\text{H}_3\text{O}_2 \cdot 3\text{H}_2\text{O}$ [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1

29 s. s 0.00115

SPECIFICATION TABLE NO. 330 THERMAL CONDUCTIVITY OF TRINITROTOLUENE $\text{CH}_2\text{C}_6\text{H}_2(\text{NO}_2)_3$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	521	R	194*	293-393			Grade I; contained almost entirely of 2:4:6-trinitrotoluene; of setting-point 80.4 C.

DATA TABLE NO. 330 THERMAL CONDUCTIVITY OF TRINITROTOLUENE $\text{CH}_2\text{C}_6\text{H}_2(\text{NO}_2)_3$

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k
CURVE 1*			
CURVE 1 (cont.)*			
293.2	0.00151	383.7	0.000586
307.8	0.00147	393.2	0.000552
317.5	0.00145	393.2	0.000628
338.0	0.00140		
342.0	0.00139		
344.2	0.00139		
346.2	0.00131		
348.2	0.00136		
350.2	0.000732		
352.0	0.000142		
353.2	0.000360		
355.0	0.000251		
356.8	0.000283		
357.2	0.000473		
357.9	0.000418		
360.7	0.000506		
362.6	0.000490		
363.2	0.000439		
368.9	0.000506		
372.7	0.000515		
373.7	0.000607		
377.2	0.000556		
382.9	0.000552		

* No graphical presentation

SPECIFICATION TABLE NO. 331 THERMAL CONDUCTIVITY OF APPLIED COATINGS (NONMETALLIC)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base	Coating	Composition (continued), Specifications and Remarks
1	485	L	1963	323-374		No. 9	Glass laminate	Paint	7 sheets of 184 Volan (glass cloth with a Volan finish) impregnated with 37-9X phenyl silane resin, plus one coat of plastic primer and two coats of SAF paint (alkyd resin base); specimen 7 x 7 x 0.172 in.; pressed at 100 psi at 450 K for 1 hr, post-cured at 450 K for 16 hrs; density 1.925 g cm ⁻³ .
2	485	L	1963	337-351		No. 10	Glass laminate	Paint	Similar to the above specimen but applied two coats of TIC paint (water base) instead of SAF paint.

DATA TABLE NO. 331 THERMAL CONDUCTIVITY OF APPLIED COATINGS (NONMETALLIC)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
323.2	0.00177
343.2	0.00160
348.7	0.00226
356.5	0.00192
374.3	0.00190
<u>CURVE 2*</u>	
336.5	0.00182
338.7	0.00156
350.9	0.00180

* No graphical presentation

THERMAL CONDUCTIVITY OF HONEYCOMB STRUCTURES (NONMETALLIC)

FIGURE SHOWS ONLY 14 OF THE CURVES REPORTED IN TABLE

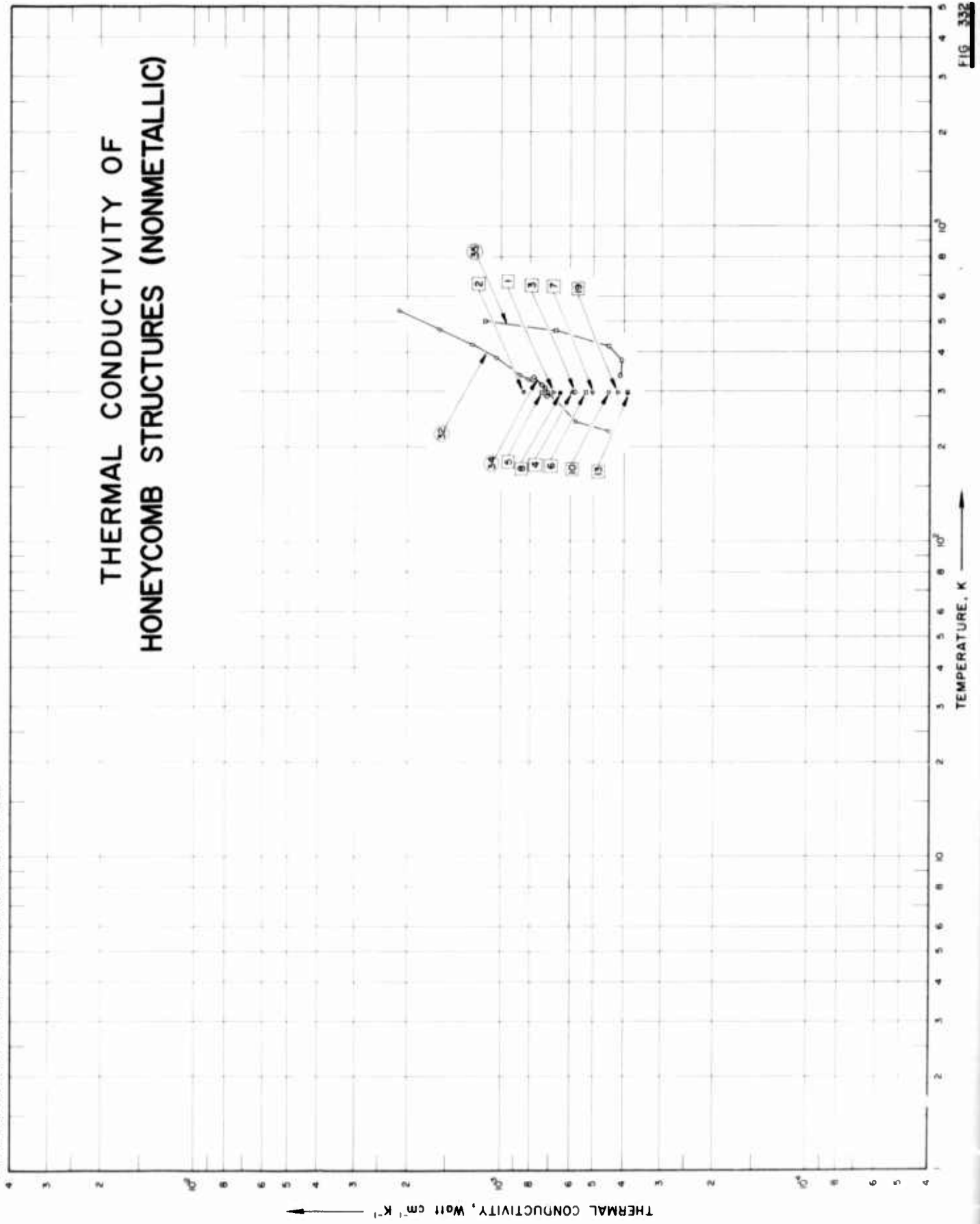


FIG. 332

SPECIFICATION TABLE NO. 332 THERMAL CONDUCTIVITY OF HONEYCOMB STRUCTURES (NONMETALLIC)

[For Data Reported in Figure and Table No. 332]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Core	Composition	Facing	Composition (continued), Specifications and Remarks
1	205	L	1953	297.2		Paper	Paper	Air		Paper honeycomb with hexagonal cell section; core description: corrugated sheets laid perpendicular to the faces and parallel to each other; weight of paper 50 lb per 3000 ft ² and density of core 0.0471 g cm ⁻³ .
2	205	L	1953	298.7		Paper	Paper	Air		Similar to the above specimen except core density 0.0557 g cm ⁻³ .
3	205	L	1953	298.2		Paper	Foamed Resin A			Similar to the above specimen except space filled with foamed resin A and core weight 0.0854 g cm ⁻³ .
4	205	L	1953	298.9		Paper	Foamed Resin B			Similar to the above specimen except space filled with foamed resin B and core weight 0.139 g cm ⁻³ .
5	205	L	1953	298.8		Paper	Foamed Resin C			Similar to the above specimen except space filled with foamed resin C and core weight 0.169 g cm ⁻³ .
6	205	L	1953	298.4		Paper	Urea Foam			Similar to the above specimen except space filled with shredded urea foam and core weight 0.0756 g cm ⁻³ .
7	205	L	1953	298.5		Paper	Silica Aerogel			Similar to the above specimen except space filled with silica aerogel and core weight 0.103 g cm ⁻³ .
8	205	L	1953	298.8		Paper	Siliceous Rock			Similar to the above specimen except space filled with puffed siliceous rock; core weight 0.171 g cm ⁻³ .
9	205	L	1953	298.3		Paper	Air			Paper honeycomb with core description: corrugated paper laid perpendicular to the faces and parallel to each other with treated flat paper insertion; weight of paper 50 lb per 3000 ft ² and weight of core 0.0879 g cm ⁻³ .
10	205	L	1953	297.4		Paper	Air			Paper honeycomb with core description: corrugated paper laid parallel to the faces and parallel to each other with treated flat paper insertions; weight of paper 50 lb per 3000 ft ² and weight of core 0.0681 g cm ⁻³ .
11	205	L	1953	298.1		Paper	Air			Paper honeycomb with core description: corrugated sheets laid perpendicular to the faces and parallel to each other with treated flat paper insertion; weight of paper 30 lb per 3000 ft ² and weight of core 0.0537 g cm ⁻³ .
12	205	L	1953	297.1		Paper	Air			Paper honeycomb with core description: corrugated sheets were laid parallel to the faces and parallel to each other with treated flat paper insertion; weight of paper 50 lb per 3000 ft ² and weight of core 0.0750 g cm ⁻³ .
13	205	L	1953	298.5		Paper	Silica Aerogel			Similar to the above specimen except space filled with silica aerogel and core weight 0.136 g cm ⁻³ .
14	205	L	1953	299.1		Paper	Air			Paper honeycomb with core description: the flutes of adjacent corrugated sheets, which were perpendicular to the faces, were at right angles; paper weight 50 lb per 3000 ft ² and core weight 0.0441 g cm ⁻³ .

SPECIFICATION TABLE NO. 332 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Core	Composition	Facing	Composition (continued), Specifications and Remarks
15	205	L	1953	297.1			Paper	Air		Paper honeycomb with core description: the flutes of adjacent corrugated sheets, which were laid parallel to the faces, were at right angles; paper weight 50 lb per 3000 ft ² and core weight 0.0441 g cm ⁻³ .
16	205	L	1953	298.1			Paper	Air		Paper honeycomb with core description: the flutes of adjacent corrugated sheets, which were laid perpendicular to the faces, were at right angles and inclining 45° to the faces; paper weight 50 lb per 3000 ft ² and core weight 0.0431 g cm ⁻³ .
17	205	L	1953	297.8			Paper	Urea Foam		Paper honeycomb with core description: the flutes of adjacent corrugated sheets, which were laid perpendicular to the faces, were at right angles; space filled with shredded urea foam; paper weight 50 lb per 3000 ft ² and core weight 0.0654 g cm ⁻³ .
18	205	L	1953	297.8			Paper	Air		Paper honeycomb with core description: the flutes of adjacent corrugated sheets, which were laid perpendicular to the faces, were at right angles with flat sheets laid in between; paper weight 50 lb per 3000 ft ² and core weight 0.0849 g cm ⁻³ .
19	205	L	1953	297.4			Paper	Air		Paper honeycomb with core description: the flutes of adjacent corrugated sheets, which were laid parallel to the faces, were at right angles with flat sheets laid in between; paper weight 50 lb per 3000 ft ² and core weight 0.0750 g cm ⁻³ .
20	205	L	1953	297.7			Paper	Air		Paper honeycomb with circular cell sections; paper weight 50 lb per 3000 ft ² and core weight 0.0463 g cm ⁻³ .
21	205	L	1953	298.5			Paper	Foamed Resin A		Paper honeycomb with space filled with foamed resin A; paper weight 50 lb per 3000 ft ² and core weight 0.0881 g cm ⁻³ .
22	205	L	1953	298.6			Paper	Foamed Resin A		Paper honeycomb of circular cell sections with space filled with foamed resin A; large loops 1.25 in. in dia and made with 20 lb kraft paper; core weight 0.0301 g cm ⁻³ .
23	206	L	1956	298.2			Paper	Air		Paper honeycomb with 15% water-soluble phenolic resin treated paper; core made of corrugated sheets assembled with principal flute directions of adjacent sheet at right angles; paper weight 50 lb per 3000 ft ² ; core weight 0.0441 g cm ⁻³ and thickness 1 in.
24	206	L	1956	298.2			Paper	Air		Paper honeycomb with resin treated paper; core made of corrugated sheets assembled parallel to each other and bonded at the crest; paper weight 30 lb per 3000 ft ² ; core weight 0.0471 g cm ⁻³ and thickness 1 in.
25	206	L	1956	298.2			Paper	Air		Similar to the above specimen except with core weight 0.0876 g cm ⁻³ .

SPECIFICATION TABLE NO. 332 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Core	Composition	Facing	Composition (continued), Specifications and Remarks
26	206	L	1956	298.2			Paper	Air		Paper honeycomb with resin treated paper; core made of corrugated sheets of paper assembled parallel to each other and separated by a single treated and uncorrugated sheet; paper weight 30 lb per 3000 ft ² ; core weight 0.0537 g cm ⁻³ and thickness 1 in.
27	206	L	1956	298.2			Paper	Air		Similar to the above specimen except with core weight 1.0881 g cm ⁻³ .
28	206	L	1956	298.2			Paper	Air		Paper honeycomb with resin treated paper; core consisted of sheets of paper looped and bonded to form circular cells; core weight 0.0463 g cm ⁻³ and thickness 1 in.
29	206	L	1956	298.2			Paper	Air		Paper honeycomb with resin treated paper; core filled with foamed resin and consisted of corrugated sheets assembled parallel to each other and bonded at crest; paper weight 30 lb per 3000 ft ² ; core weight 0.0859 g cm ⁻³ and thickness 1 in.
30	206	L	1956	298.2			Paper	Insulation		Similar to the above specimen except core weight 0.0756 g cm ⁻³ and filled with insulation in the core.
31	206	L	1956	298.2			Paper	Air		Paper honeycomb with resin treated paper; core consisted of sheets of paper looped and bonded to form circular cells; core weight 0.0301 g cm ⁻³ and thickness 1 in.
32	193	L	1957	225-545		BBCL	Polyester	Air	Polyester	Polyester honeycomb panel (0.25 in. cell size, 0.144 g cm ⁻³ density) with polyester glass fabric faces (181 volan A); face resin No.: P-43; face catalyst: 2% A. T. C.; core 0.625 in. thick.
33	208	L	1957	289-339		A	Phenol	Air	Glass	0.034 in. thick skins made of combinations of 181 and 112 glass fabric with Garan finish, impregnated with polyester resin (BRS 142); 0.0641 g cm ⁻³ nylon phenolic honeycomb core 0.309 in. thick; cell size honeycomb 0.25 in.; core bonded to the skins with epoxy resin.
34	208	L	1957	240-333		B	Phenol	Air		0.034 in. thick skins made of combination of 181 and 112 glass fabric with Garan finish, impregnated with polyester resin (BRS 142); 0.0961 g cm ⁻³ CTL (glass fabric) phenolic honeycomb core 0.311 in. thick; cell size honeycomb 0.25 in.; core bonded to the skins with epoxy resin.
35	196	L	1955	337-504						Heat-resistant sandwich panel supplied by Goodyear Co.; 0.362 in. thick; fabricated using a phenolic-honeycomb core and laminate faces of 181 glass fabric and TAC-polyester resin 135; density 0.159 g cm ⁻³ .

DATA TABLE NO. 332 THERMAL CONDUCTIVITY OF HONEYCOMB STRUCTURES (NONMETALLIC)

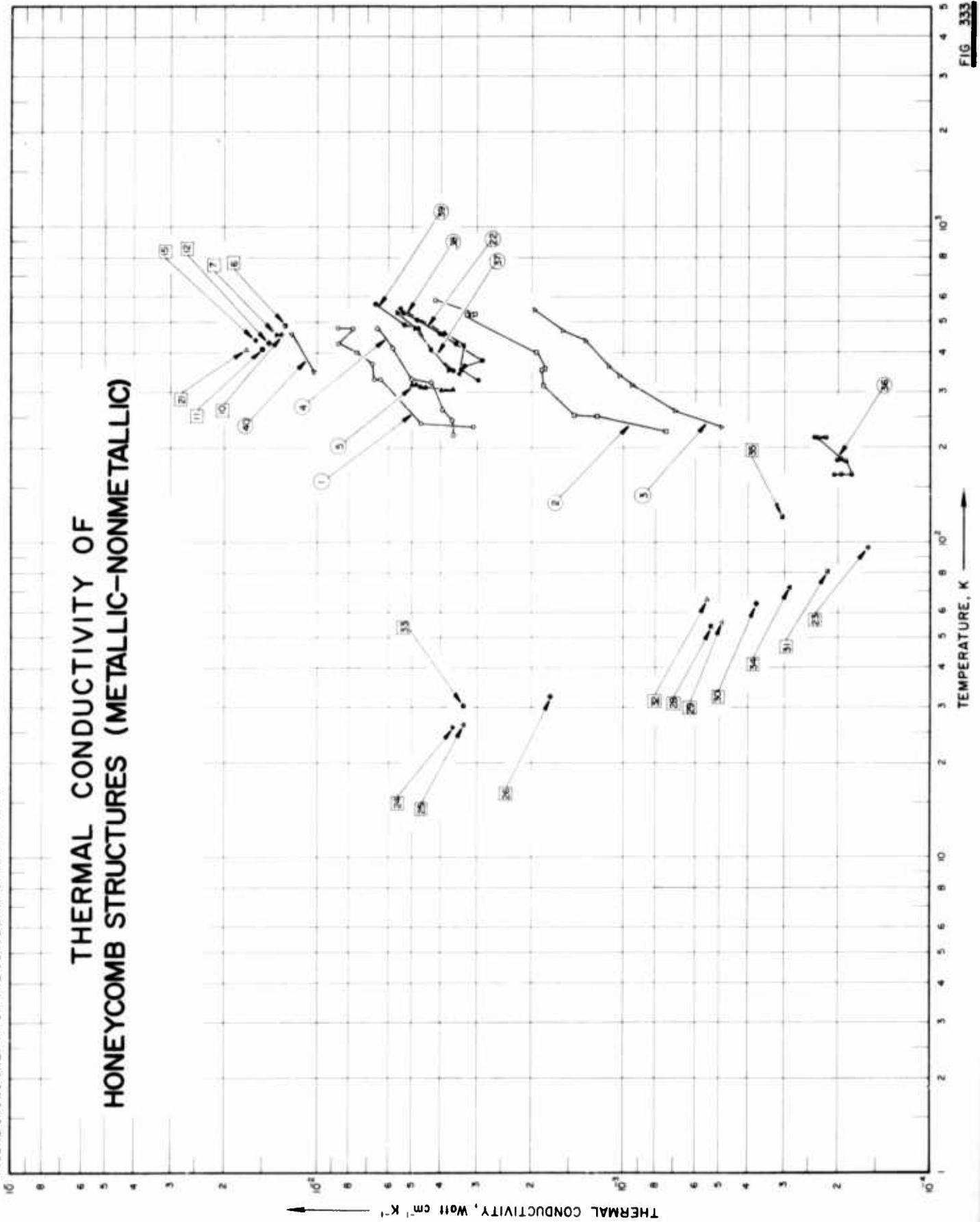
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k
	<u>CURVE 1</u>	<u>CURVE 12*</u>	<u>CURVE 23*</u>	<u>CURVE 32 (cont.)</u>			
297.2	0.000678	297.1	0.000447	298.2	0.000649	424.6	0.00124
	<u>CURVE 2</u>	<u>CURVE 13</u>	<u>CURVE 24*</u>	474.7	0.00157		
298.7	0.000837	298.5	0.000389	544.5	0.00213		
	<u>CURVE 3</u>	<u>CURVE 14*</u>	<u>CURVE 25*</u>	<u>CURVE 33*</u>			
298.2	0.000577	299.1	0.000649	289.3	0.000669		
	<u>CURVE 4</u>	<u>CURVE 15*</u>	<u>CURVE 26*</u>	318.8	0.000701		
298.9	0.000591	297.1	0.000515	338.8	0.000734		
	<u>CURVE 5</u>	<u>CURVE 16*</u>	<u>CURVE 27*</u>	<u>CURVE 34</u>			
298.8	0.000736	298.1	0.000692	290.4	0.000711		
	<u>CURVE 6</u>	<u>CURVE 17*</u>	<u>CURVE 28*</u>	314.9	0.000738		
298.4	0.000534	297.8	0.000505	333.2	0.000776		
	<u>CURVE 7</u>	<u>CURVE 18*</u>	<u>CURVE 29*</u>	<u>CURVE 35</u>			
298.5	0.000505	297.8	0.000736	337.1	0.000411		
	<u>CURVE 8</u>	<u>CURVE 19</u>	<u>CURVE 30*</u>	377.4	0.000409		
298.8	0.000649	297.4	0.000418	419.8	0.000446		
	<u>CURVE 9*</u>	<u>CURVE 20*</u>	<u>CURVE 31*</u>	468.5	0.000668		
298.3	0.000851	297.7	0.000764	503.9	0.00112		
	<u>CURVE 10</u>	<u>CURVE 21*</u>	<u>CURVE 32*</u>				
297.4	0.000447	298.5	0.000548	225.2	0.000447		
	<u>CURVE 11*</u>	<u>CURVE 22*</u>		241.6	0.000577		
298.1	0.000678	298.6	0.000447	299.3	0.000707		
				307.2	0.000721		
				327.6	0.000908		
				338.8	0.000865		
				382.9	0.00104		

* Not shown on plot

FIGURE SHOWS ONLY 30 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF HONEYCOMB STRUCTURES (METALLIC-NONMETALLIC)



SPECIFICATION TABLE NO. 333 THERMAL CONDUCTIVITY OF HONEYCOMB STRUCTURES (METALLIC-NONMETALLIC)

[For Data Reported in Figure and Table No. 333]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition		Facing	Composition (continued), Specifications and Remarks
							Core	Air		
1	193	L	1957	232-480		BBC3	Aluminum Alloy	Air	Aluminum Alloy	Aluminum alloy honeycomb panel (0.25 in. cell size, 0.0689 g cm ⁻³ density) with 0.02 in. thick aluminum alloy (2024-T3) faces; core resin 0.002 in. thick and core 0.625 in. thick.
2	193	L	1957	224-587		GLM9	Stainless Steel	Air	Stainless Steel	Stainless steel honeycomb panel (0.375 in. cell size, 0.0015 in. thick foil) with stainless steel faces (0.032 in. thick); core and face of 17-7 PH alloys; face brazed to core; core 0.625 in. thick.
3	193	L	1957	232-546		BBC4	Phenol	Air	Alumina Alloy	Phenolic honeycomb panel (0.25 in. cell size, 0.144 g cm ⁻³ density) with 0.02 in. thick aluminum alloy (2024-T3) faces (catalyst: agent A) core 0.625 in. thick.
4	193	L	1957	219-489		BBC5	Aluminum Alloy	Air	Polyester	Aluminum alloy honeycomb panel (0.25 in. cell size, 0.0659 g cm ⁻³ density) with polyester glass fabric faces (181 volan A); face resin No. 1; P-43 and face catalyst 2% A. T. C.; core resin 0.002 in. aluminum alloy 2024-T3; core 0.625 in. thick.
5	207	L	1956	304-318			Aluminum	Air	Aluminum	Two 0.008 in. thick 34ST aluminum face sheets bonded with elastomer-resin adhesive to a 0.25 in. cellular aluminum core of 0.003 in.; 3S-H19 aluminum core density 0.9689 g cm ⁻³ .
6	209	L	1962	490.4			Stainless Steel	Air	Stainless Steel	A 12 in. x 12 in. x 0.532 in. brazed PH15-7Mo stainless steel honeycomb panel with nominal 0.016 in. PH15-7Mo stainless steel faces; honeycomb foil 0.0015 in. nominal thickness and 0.1875 in. cell spacing; brazing foil a 72% silver, 7.3% copper, and 0.2% lithium alloy with thickness 0.002 in. prior to brazing; hot surface temp controlled by ignition temp controller; run No. 1.
7	209	L	1962	457.0			Stainless Steel	Air	Stainless Steel	Run No. 2 of the above specimen.
8	209	L	1962	490.4			Stainless Steel	Air	Stainless Steel	Run No. 3 of the above specimen.
9	209	L	1962	490.4			Stainless Steel	Air	Stainless Steel	Run No. 4 of the above specimen.
10	209	L	1962	457.0			Stainless Steel	Air	Stainless Steel	Run No. 5 of the above specimen.
11	209	L	1962	414.3			Stainless Steel	Air	Stainless Steel	Run No. 6 of the above specimen.
12	209	L	1962	431.5			Stainless Steel	Air	Stainless Steel	Run No. 7 of the above specimen.
13	209	L	1962	414.3			Stainless Steel	Air	Stainless Steel	Run No. 8 of the above specimen.

SPECIFICATION TABLE NO. 333 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Core	Composition	Facing	Composition (continued), Specifications and Remarks
14	209	L	1962	478.1			Stainless Steel	Air	Stainless Steel	The above specimen, hot surface temperature controlled by multichannel recorder; run No. 1.
15	209	L	1962	444.3			Stainless Steel	Air	Stainless Steel	Run No. 2 of the above specimen.
16	209	L	1962	476.5			Stainless Steel	Air	Stainless Steel	Run No. 3 of the above specimen.
17	209	L	1962	476.5			Stainless Steel	Air	Stainless Steel	Run No. 4 of the above specimen.
18	209	L	1962	451.5			Stainless Steel	Air	Stainless Steel	Run No. 5 of the above specimen.
19	209	L	1962	411.5			Stainless Steel	Air	Stainless Steel	Run No. 6 of the above specimen.
20	209	L	1962	424.3			Stainless Steel	Air	Stainless Steel	Run No. 7 of the above specimen.
21	209	L	1962	409.3			Stainless Steel	Air	Stainless Steel	Run No. 8 of the above specimen.
22	279	L	1959	329-537			Stainless Steel	Air	Stainless Steel	17-7 PH stainless steel panel with shell adhesive No. 422 as bonding agent; overall height 0.622 in. with 0.052 in. face thickness; solidity of core 0.0136 in. and cell 0.25 in. square; core density 0.104 g cm ⁻³ .
23	280	C	1962	96.5			Glass + Phenolic	Vacuum	CRES Metal	3 in. thick flat glass fiber/phenolic honeycomb bonded between 0.010 thick CRES skins and closed with 0.030 thick CRES channels of the same depth as the honeycomb core at the panel edges to form gas-tight boxes; sine wave glass-fiber/phenolic core with numerous 0.125 in dia drilled holes; cell size 1.125 in.; core density 0.0160 g cm ⁻³ , bonded to CRES skins with Bloomingdale Rubber Co.'s HT424 adhesives, and filled by 0.0320 g cm ⁻³ density polyurethane foam which was bonded with Hexcel's No. 1252 adhesives; core manufactured by the Narmco Materials Div.; measured with vacuum of 5 - 10 x 10 ⁻⁴ cm Hg in the core; Stafoam 604 used as comparative material.
24	280	C	1962	25.9			Glass + Phenolic	Helium	CRES Metal	Same description as the above specimen except HRP (heat resistant phenolic)/glass-fiber 0.0352 g cm ⁻³ density core with cell size 0.375 in., manufactured by Hexcel Products Inc.; measured with helium filled core at 1 atm pressure.

SPECIFICATION TABLE NO. 333 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Core	Composition	Facing	Composition (continued), Specifications and Remarks
25	280	C	1962	26.5			Glass + Phenolic	Helium	CRES Metal	The above specimen measured with helium in the core at 0.50 atm pressure.
26	280	C	1962	32.6			Glass + Phenolic	Helium	CRES Metal	The above specimen measured with helium in the core at 0.20 atm pressure.
27	280	C	1962	25.9			Glass + Phenolic	Hydrogen	CRES Metal	The above specimen measured with hydrogen in the core at 1 atm pressure.
28	280	C	1962	54.3			Glass + Phenolic	Hydrogen	CRES Metal	The above specimen measured with hydrogen in the core at 35×10^{-4} cm Hg pressure.
29	280	C	1962	55.9			Glass + Phenolic	Hydrogen	CRES Metal	The above specimen measured with hydrogen in the core at 10×10^{-4} cm Hg pressure.
30	280	C	1962	64.3			Glass + Phenolic	Hydrogen	CRES Metal	The above specimen measured with hydrogen in the core at 2×10^{-4} cm Hg pressure.
31	280	C	1962	80.9			Glass + Phenolic	Helium	CRES Metal	The above specimen measured with helium (probably) in the core at 10^{-4} cm Hg pressure.
32	280	C	1962	65.9			Glass + Phenolic	Helium	CRES Metal	Similar to the above specimen except 5 in. in thickness; measured with helium in the core at 40×10^{-4} cm Hg.
33	280	C	1962	30.4			Glass + Phenolic	Helium	CRES Metal	The above specimen measured with helium in the core at 1 atm.
34	280	C	1962	72.0			Glass + Phenolic	Vacuum	CRES Metal	Same descriptions as the above specimen except HRP (heat resistant phenolic)/glass-fiber 0.0381 g cm ⁻³ density core, manufactured by Hexcel Products Inc.; measured at a pressure of 11×10^{-4} cm Hg self cryopumped.
35	280	C	1962	121.5			Glass + Phenolic	Vacuum	CRES Metal	The above specimen measured at a pressure of 5×10^{-4} cm Hg (pump on).
36	281	L	1963	165-217			Glass	Air	CRES Metal	Glass fiber with syntactic foam; specimen dia 100 in. and mean thickness 0.68 in.
37	486	L	1961	353-539			Steel	Air	Steel	Core made from 0.002 in. thick 17-7 PH steel; face sheets PH 15-7 Mo steel 0.020 in. thick, brazed to core with Cu 1700 (75.0 Cu and 25.0 Mn); specimen 9 in. in dia; core section 0.5 in. thick manufactured by Tool Research Co.; prepared by brazing at 1228 K, austenite conditioning in argon 1228 ± 14 K for 15 min, air cooling to room temp, transforming at 200 ± 6 K for 8 hrs., and aging at 783 ± 6 K for 1 hr.; a pressure of 80 psi applied to the specimen during testing.

SPECIFICATION TABLE NO. 333 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Core	Composition	Facing	Composition (continued), Specifications and Remarks
38	486	L	1961	344-553		Steel	Steel	Air	Steel	Similar to the above specimen except brazing alloy Lithobraz 501 (50.0 Ni, 46.4 Ag, 3.5 Cu, and 0.1 Li).
39	486	L	1961	350-572		Steel	Steel	Air	Steel	Similar to the above specimen except brazing alloy Silvalloy T-50 (62.4 Ag, 32.07 Cu, and 4.43 Ni), and austenite conditioning at 1172 K for 15 min.
40	486	L	1961	350, 458		Steel	Steel	Air	Steel	Similar to the above specimen except brazing alloy Lithobraz 925 (92.8 Ag, 7.0 Cu, and 0.2 Li), and heat treatment was austenite conditioning in argon at 1033 ± 14 K for 90 min; air cooling to 289 K, and aged at 839 ± 14 K for 90 min.

DATA TABLE NO. 333 THERMAL CONDUCTIVITY OF HONEYCOMB STRUCTURES (METALLIC-NONMETALLIC)

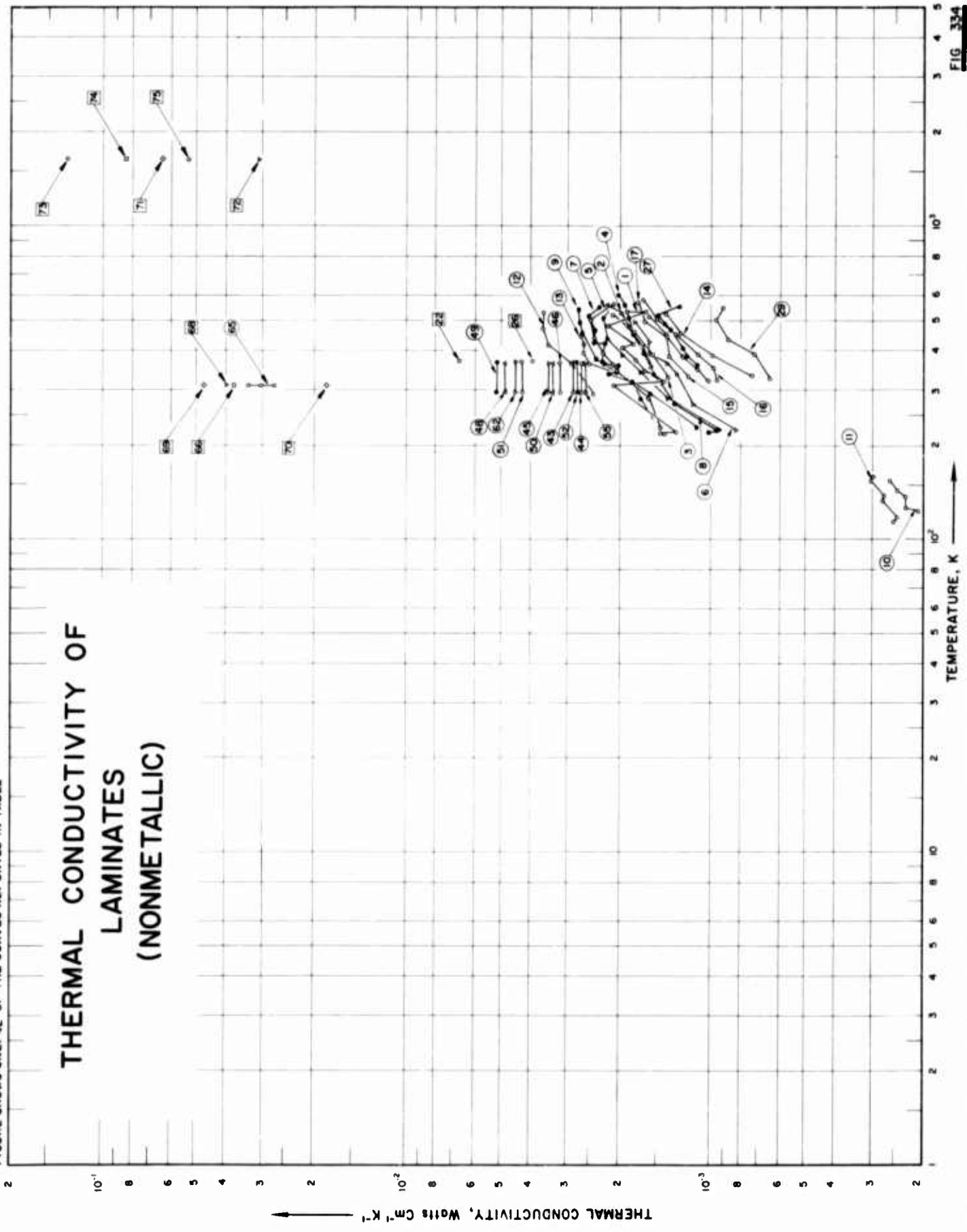
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>													
232.1	0.00309	331.3	0.00502	478.1	0.0133	96.5	0.000159	72.0	0.000288	349.8	0.0103		
239.6	0.00469	415.5	0.00581	<u>CURVE 14*</u>									
330.2	0.00637	479.8	0.00653	<u>CURVE 23</u>									
330.2	0.00668	<u>CURVE 15</u>											
369.0	0.00678	<u>CURVE 24</u>											
403.9	0.00757	<u>CURVE 35</u>											
430.7	0.00868	<u>CURVE 5</u>											
478.4	0.00776	304.3	0.00398	<u>CURVE 25</u>									
479.1	0.00767*	305.4	0.00363	<u>CURVE 36</u>									
479.6	0.00762*	311.9	0.0045	26.5	0.00332	164.8	0.000194	164.8	0.000204	164.8	0.000197*	164.8	0.000190
480.1	0.00865	313.9	0.00467	<u>CURVE 26</u>									
<u>CURVE 2</u>													
224.2	0.000736	318.3	0.00485	476.5	0.0138	32.6	0.00173	181.5	0.000187	182.0	0.000200	183.2	0.000194
251.2	0.00121	<u>CURVE 18*</u>											
252.1	0.00144	490.4	0.0127	<u>CURVE 27*</u>									
315.4	0.00183	<u>CURVE 19*</u>											
353.5	0.00185	<u>CURVE 29</u>											
403.8	0.00193	457.0	0.0135	54.3	0.000534	<u>CURVE 37</u>							
526.8	0.00325	<u>CURVE 8*</u>											
528.8	0.00313	<u>CURVE 20*</u>											
529.0	0.00306	490.4	0.0133	55.9	0.000490	352.6	0.00375	483.2	0.00490	538.7	0.00562	<u>CURVE 39</u>	
587.3	0.00418	<u>CURVE 9*</u>											
<u>CURVE 3</u>													
232.4	0.000490	490.4	0.0129	<u>CURVE 30</u>									
261.6	0.000692	<u>CURVE 10</u>											
316.3	0.000937	409.3	0.0169	64.3	0.000375	344.3	0.00346	422.1	0.00332	<u>CURVE 39</u>			
338.8	0.00102	457.0	0.0130	<u>CURVE 31</u>									
363.5	0.00111	<u>CURVE 22</u>											
438.6	0.00133	328.7	0.00298	80.9	0.000216	349.8	0.00361	463.7	0.00389	552.6	0.00548	<u>CURVE 39</u>	
470.7	0.00157	355.4	0.00339	<u>CURVE 32</u>									
546.3	0.00196	365.2	0.00331	<u>CURVE 33</u>									
<u>CURVE 4</u>													
219.1	0.00361	414.3	0.0150	65.9	0.000548	410.9	0.00433	477.6	0.00476	494.3	0.00534	572.1	0.00663
244.3	0.00365	<u>CURVE 12</u>											
265.6	0.00394	431.5	0.0142	30.4	0.00332	<u>CURVE 39</u>							
323.7	0.00431	<u>CURVE 13*</u>											
<u>CURVE 13*</u>													
414.3	0.0152	<u>CURVE 33</u>											

* Not shown on plot

FIGURE SHOWS ONLY 42 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF LAMINATES (NONMETALLIC)



THERMAL CONDUCTIVITY, Watts $\text{cm}^{-1} \text{K}^{-1}$

TEMPERATURE, K

SPECIFICATION TABLE NO. 334 THERMAL CONDUCTIVITY OF LAMINATES (NONMETALLIC)

For Data Reported in Figure and Table No. 334

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
1	389	L	1957	219-535		BBC-10	Glass Fabric (No. 181)	Epon-828 Resin	Specimen 12 x 12 in. cut from laminate of Epon-828 resin with glass fabric (class No. 181 with Volan A finish); manufactured by Brunswick-Balke Collender Co.
2	389	L	1957	359-566		DC-1	Glass Fabric (No. 181)	Silicone (Dow Corning 2104)	Similar to the above.
3	389	L	1957	331-523		DC-2	Glass Fabric (No. 181)	Silicone (Dow Corning 2106)	Similar to the above.
4	194	L	1958	222-609		Asbestos-Phenolic 9526D	Raybestos (Manhattan 9526D)	Phenolic Resin	Specimen of 0.225 in. nominal thickness; 3 plies; cured at 300 F for 0.50 hr at 400 psi, post cured at 300 F for 4 hrs and 350 F for 3 hrs; laminate density 78 lb ft ⁻³ (1.25 g cm ⁻³); fabricated by Brunswick-Balke Collender Co.
5	194	L	1958	229-565		Shell X-131	Glass Fabric (No. 181)	Epoxy (Shell X-131) Resin	0.50 in. nominal thickness; 12 plies; glass fabric of Volan A finish and the catalyst consisted of 13 parts (by weight) pyromellitic dianhydride and 19 parts maleic anhydride; the laminate cured at 200 F for 2 hrs at 25 psi and 300 F for 4 hrs; density 117 lb ft ⁻³ (1.87 g cm ⁻³).
6	194	L	1958	225-611		CTL 37-9X	Glass Fabric (No. 181)	Phenolic (CTL 37-9X) Resin	0.225 in. nominal thickness; 12 plies; modified phenolic and glass fabric of A-1100 finish; laminate cured at 280 F for 0.50 hr at 17.5 psi, post cured at 250 F for 24 hrs, 300 F for 24 hrs, 350 F for 24 hrs and 400 F for 24 hrs; calculated density 102 lb ft ⁻³ (1.65 g cm ⁻³).
7	194	L	1958	227-560		X-1068	Glass Fabric (No. 181)	Tac-Polyester (Vibron X-1068) Resin	0.225 in. nominal thickness; 13 plies; glass fabric of Garan Finish and the catalyst composed of 1.5% Benzoyl Peroxide; laminate cured at 200 F for 12 hrs, 250 F for 3 hrs in vacuum, post cured at 300 F for 1 hr, 350 F for 5 hrs and 400 F for 1 hr; density 112 lb ft ⁻³ (1.79 g cm ⁻³).
8	194	L	1958	227-569		Selectron 5016 Fluted Core	Glass Fabric (No. 181)	Polyester (Selectron 5016) Resin	Fluted core sandwich, flute size: 0.143 in. thick, 0.375 in. wide and 0.0075 in. wall thickness; 15 plies on both sides of the sandwich; glass fabric of Volan A finish, 2% Benzoyl Peroxide used as catalyst; cured at 250 F for 5 hrs; density 105 lb ft ⁻³ (1.68 g cm ⁻³).

SPECIFICATION TABLE NO. 334 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
9	194	L	1958	230-547		Shell X-131 Fluted Core	Glass Fabric (No. 181)	Epoxy Resin (Shell X-131)	Fluted core sandwich, fluted size; 0.300 in. wide, 0.350 in. thick and 0.0075 in. wall thickness, 15 plies on one side and 11 plies on the other side of the sandwich; glass fabric of Volan A finish; 13 parts by weight of maleic anhydride used as catalyst; cured at 200 F for 2 hrs under vacuum and post cured at 300 F for 4 hrs; density 124 lb ft ⁻³ (1.99 g cm ⁻³).
10	43	L	1954	124-155		Resin-bonded mineral wool board	Mineral Wool	Resin	Resin-bonded mineral wool board; density 16.4 lb ft ⁻³ (0.26 g cm ⁻³).
11	43	L	1954	115-160		Asphalt-bonded mineral wool board	Mineral Wool	Asphalt Resin	Asphalt-bonded mineral wool board; density 16.6 lb ft ⁻³ (0.27 g cm ⁻³).
12	390	C	1961	294-533			Asbestos	Phenolic Resin	Laminate 0.225 in thick; Transite used as comparative material.
13	390	C	1961	339-450		Lamicaid No. 6045	Glass Fabric (No. 181)	Phenolic Resin (BY 17085)	Transite used as comparative material. Laminate 0.119 in. thick; 14 plies; manufactured by Bakelite Co.; resin content 39.3% by weight; Hexasol used as catalyst.
14	196	L	1955	336-527		B-1	Glass Fabric (No. 181)	Phenolic Resin (Copolon 506)	Laminate 0.115 in. thick; 12 plies; manufactured by Narmco Inc.; glass fabric of Volan A finish; resin content 33% by weight; no catalyst.
15	196	L	1955	334-519		N-1	Glass Fabric (No. 181)	Silicone Resin (Dow Corning 2106)	Laminate 0.105 in. thick; 12 plies; manufactured by Dow Corning Corp.; glass fabric of No. 112 finish; XY-15 used as catalyst.
16	196	L	1955	325-585		DC-2	Glass Fabric (No. 181)	Tac-Polyester Resin (Vibrin 135)	Laminate 0.143 in. thick; glass fabric of No. 301 finish; resin content 39.3% by weight; Benzoyl Peroxide used as catalyst; manufactured by Naugatuck Chem. Co.
17	196	L	1955	324-575		NK-1	Glass Fabric (No. 181)	Phenolic Resin	Specific gravity ~1.35; measured in the x-direction (perpendicular to lamination).
18	197	P	1952	373.2		Insurok (XXX-T-640)	Paper	Phenolic Resin	The above specimen measured in the y-direction (parallel to lamination).
19	197	P	1952	373.2		Insurok (XXX-T-640)	Paper	Phenolic Resin	The above specimen measured in the z-direction (parallel to lamination).
20	197	P	1952	373.2		Insurok (XXX-T-640)	Paper	Phenolic Resin	Laminate of 1 in. nominal thickness; specific gravity ~1.34; measured in the x-direction.
21	197	P	1952	373.2		Insurok (C-T-601)	Cloth	Phenolic Resin	

SPECIFICATION TABLE NO. 334 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
22	197	P	1952	373.2		Insurok (C-T-601)	Cloth	Phenolic Resin	The above specimen measured in the y-direction.
23	197	P	1952	373.2		Insurok (C-T-601)	Cloth	Phenolic Resin	The above specimen measured in the z-direction.
24	197	P	1952	373.2		Lamicaid (C-6030)	Cloth	Phenolic Resin	Laminate 0.50 in. thick; specific gravity 1.31; measured in the x-direction.
25	197	P	1952	373.2		Lamicaid (C-6030)	Cloth	Phenolic Resin	The above specimen measured in the y-direction.
26	197	P	1952	373.2		Lamicaid (C-6030)	Cloth	Phenolic Resin	The above specimen measured in the z-direction.
27	198	L	1955	361-555		GY-F	Glass Fabric (No. 181)	Selectron 5003 Resin	Laminate of 11-12 plies; glass fabric of Volan A finish; resin content 37.5% by weight; manufactured by Goodyear Co.; density 114.3 lb ft ⁻³ (1.83 g cm ⁻³); laminate placed in a cabinet of constant temp at 73 F and 50% RH for at least 1 week prior to test.
28	198	L	1955	332-552		GY-G	Glass Fabric (No. 181)	Selectron 5003 Resin	Laminate of 12 plies with 42.5% resin content; similarly treated as above; density 113.51 lb ft ⁻³ (1.82 g cm ⁻³).
29	198	L	1955	327-550		GY-H	Glass Fabric (No. 181)	Selectron 5003 Resin	4 plies; 24.5% resin content; similarly treated as above; density 118.99 lb ft ⁻³ (1.90 g cm ⁻³)
30	198	L	1955	328-560		GY-I	Glass Fabric (No. 181)	Selectron 5003 Resin	11 plies; 34.1% resin content; similarly treated as above; density 191.15 lb ft ⁻³ (1.62 g cm ⁻³).
31	198	L	1955	362-564		CTL-A	Glass Fabric (No. 181)	Phenolic Resin (CTL-91-LD)	14 plies; 28.3% resin content; manufactured by Cincinnati Testing and Research Lab; similarly treated as above; density 119.18 lb ft ⁻³ (1.75 g cm ⁻³).
32	198	L	1955	336-584		CTL-B	Glass Fabric (No. 181)	Phenolic Resin (CTL-91-LD)	Similarly treated as above; density 94.22 lb ft ⁻³ (1.51 g cm ⁻³).
33	198	L	1955	366-552		CTL-C	Glass Fabric (No. 181)	Phenolic Resin (CTL-91-LD)	Similarly treated as above; density 102.34 lb ft ⁻³ (1.64 g cm ⁻³).
34	193	L	1955	314-507		S	Glass Fabric (No. 181)	33 E pon + 67 Plyophen (1001/5023)	24.5% resin content; density 108.58 lb ft ⁻³ (1.74 g cm ⁻³); laminate from Shell Co.
35	198	L	1955	361-613		GY-F	Glass Fabric (No. 181)	Selectron 5003 Resin	Another run of the specimen in curve No. 27.

SPECIFICATION TABLE NO. 334 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
36	198	L	1955	330-557		GY-A	Glass Fabric (No. 116)	Selectron 5003 Resin	Laminates of 30-32 plies; 39.5% resin content, glass fabric of Garan finish; laminate placed in a cabinet of constant temp at 73 F and 50% RH for at least 1 week prior to test; density 119.12 lb ft ⁻³ (1.76 g cm ⁻³); specimen from Goodyear Co.
37	198	L	1955	375-553		GY-C	Glass Fabric (No. 181)	Selectron 5003 Resin	12 ply-laminate with glass fabric of Volan A finish and 40.8% resin content; similarly treated as above; density 114.07 lb ft ⁻³ (1.82 g cm ⁻³).
38	198	L	1955	331-523		GY-D	Glass Fabric (No. 143)	Selectron 5003 Resin	11 ply-laminate; 43.5% resin content; similarly treated as above; density 107.05 lb ft ⁻³ (1.61 g cm ⁻³).
39	199	L	1954	344-556		DC-1	Glass Fabric (No. 181)	Silicone (No. 2104) Resin	14 ply-laminate; glass fabric of OC 112 finish, 32-35% resin content; laminated by Dow Corning Co.; specimen 0.1415 in. thick and 64 in. ² ; density 101.00 lb ft ⁻³ (1.62 g cm ⁻³); similarly treated before test.
40	199	L	1954	335-551		GY-E-1	Glass Fabric (No. 181)	Selectron 5003 Resin	11 ply-laminate; glass fabric of Volan A finish, 29.2% resin content; laminated by Goodyear Co.; specimen 0.1055 in. thick, 64 in. ² area; similarly treated as above before test; density 119.75 lb ft ⁻³ (1.92 g cm ⁻³).
41	199	L	1954	340-537		GY-E-1	Glass Fabric (No. 128)	Selectron 5003 Resin	18 ply-laminate; glass fabric of Volan A finish, 39.2% resin content; laminated by Goodyear Co.; specimen 0.113 in. thick and 64 in. ² area; similarly treated as above before test; density 115.32 lb ft ⁻³ (1.85 g cm ⁻³).
42	199	L	1954	320-575		AC-3 & 4	Glass Fabric (No. 181)	Laminac (PDL-7-669) Resin	12 ply-laminate; glass fabric of OC 136 finish, 33.9% resin content; LaperCo ATC-1% used as catalyst; laminated by American Cyanamid Co.; specimen 0.1165 in. thick, 64 in. ² area; similarly treated before test; density 116.38 lb ft ⁻³ (1.86 g cm ⁻³).
43	200	P	1951	297.367		PBE-A	Paper	Phenolic Resin	Specimen 5 x 5 x 0.50 in.; resin content 50%; density 53.6 lb ft ⁻³ (1.34 g cm ⁻³).

SPECIFICATION TABLE NO. 334 (continued)

Curve Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
44	P	1951	297,367		PBE-B	Paper	Phenolic Resin	As above but resin content 57.5%, density 57.5 lb ft ⁻³ (0.92 g cm ⁻³).
45	P	1951	297,367		FBG-A	Cotton Fabric	Phenolic Resin	As above but resin content 50%, density 82.9 lb ft ⁻³ (1.33 g cm ⁻³).
46	P	1951	297,367		FBG-B	Cotton Fabric	Phenolic Resin	As above but resin content 57.5%, density 82.1 lb ft ⁻³ (1.31 g cm ⁻³).
47	P	1951	297,367		GBE-B	Glass mat	Phenol Aniline Resin	As above but resin content 59.5%, density 92.8 lb ft ⁻³ (1.49 g cm ⁻³).
48	P	1951	297,367		GMG-A	Fiberglass	Melamine Resin	As above but resin content 40%, density 117.5 lb ft ⁻³ (1.88 g cm ⁻³).
49	P	1951	297,367		GMG-C	Fiberglass	Melamine Resin	As above but resin content 45%, density 118.9 lb ft ⁻³ (1.90 g cm ⁻³).
50	P	1951	297,367		Poly-D	Fiberglass	Polyester (low-pressure)	As above but resin content 31%, density 112.2 lb ft ⁻³ (1.80 g cm ⁻³).
51	P	1951	297,367		LPP-D	Fiberglass	Phenolic (low-pressure)	As above but resin content 28.4%, density 115.9 lb ft ⁻³ (1.86 g cm ⁻³).
52	P	1951	297,367		GSG-E	Glass	Silicone Resin	As above but resin content 52%, density 101.6 lb ft ⁻³ (1.63 g cm ⁻³).
53	P	1951	297,367		GSG-F	Glass	Silicone Resin	As above but resin content 40%, density 106.2 lb ft ⁻³ (1.70 g cm ⁻³).
54	P	1951	297,367		PBE-A	Paper	Phenolic Resin	Specimen 5 x 5 x 0.225 in.; resin content 50%, density 86.9 lb ft ⁻³ (1.38 g cm ⁻³).
55	P	1951	297,367		PBE-B	Paper	Phenolic Resin	Specimen 5 x 5 x 0.225 in.; resin content 57.5%, density 82.5 lb ft ⁻³ (1.32 g cm ⁻³).
56	P	1951	297,367		FBG-A	Cotton Fabric	Phenolic Resin	Specimen 5 x 5 x 0.225 in.; resin content 50%, density 81.8 lb ft ⁻³ (1.31 g cm ⁻³).
57	P	1951	297,367		FBG-B	Cotton Fabric	Phenolic Resin	Specimen 5 x 5 x 0.225 in.; resin content 57.5%, density 81.5 lb ft ⁻³ (1.31 g cm ⁻³).
58	P	1951	297,367		GBE-B	Glass mat	Phenol Aniline Resin	Specimen 5 x 5 x 0.225 in.; resin content 59.5%, density 91.1 lb ft ⁻³ (1.46 g cm ⁻³).
59	P	1951	297,367		GMG-B	Fiberglass	Melamine Resin	Specimen 5 x 5 x 0.225 in.; resin content 40%, density 118.2 lb ft ⁻³ (1.89 g cm ⁻³).
60	P	1951	297,367		GMG-C	Fiberglass	Melamine Resin	Specimen 5 x 5 x 0.225 in.; resin content 45%, density 118.5 lb ft ⁻³ (1.90 g cm ⁻³).

SPECIFICATION TABLE NO. 334 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, %	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
61	200	P	1951	297, 367		Poly-D	Fiberglass	Polyester (low pressure)	Specimen 5 x 5 x 0.225 in.; resin content 31.0%, density 113.1 lb ft ⁻³ (1.61 g cm ⁻³).
62	200	P	1951	297, 367		LPP-D	Fiberglass	Phenolic (low pressure)	Specimen 5 x 5 x 0.225 in.; resin content 28.4%, density 124.8 lb ft ⁻³ (2.00 g cm ⁻³).
63	200	P	1951	297, 367		GSG-E	Glass	Silicone Resin	Specimen 5 x 5 x 0.225 in.; resin content 52%, density 106.4 lb ft ⁻³ (1.61 g cm ⁻³).
64	200	P	1951	297, 367		GSG-F	Glass	Silicone Resin	Specimen 5 x 5 x 0.225 in.; resin content 40%, density 106.4 lb ft ⁻³ (1.70 g cm ⁻³).
65	487	L	1957	308, 2			Glass	Polyester Resin	Thermal conductivities were measured on pairs of discs 3 in. in dia each about 0.25 in. thick; bulk density range from 1.7 to 1.84 g cm ⁻³ (105.9 to 115.0 lb ft ⁻³).
66	487	L	1957	308, 2			Glass	Phenolic Resin	Similar to the above specimen except bulk density 1.86 g cm ⁻³ (116.1 lb ft ⁻³).
67	487	L	1957	308, 2			Glass	Silicone Resin	Similar to the above specimen except bulk density 1.90 g cm ⁻³ (118.9 lb ft ⁻³).
68	487	L	1957	308, 2			Glass	Epoxy-phenolic Resin	Similar to the above specimen except bulk density 1.89 g cm ⁻³ (115.0 lb ft ⁻³).
69	487	L	1957	308, 2			Glass	Melamine Resin	Similar to the above specimen except bulk density 1.97 g cm ⁻³ (124.0 lb ft ⁻³).
70	487	L	1957	308, 2			Glass	Unfilled polyester Resin	Similar to the above specimen except bulk density 1.21 g cm ⁻³ (75.5 lb ft ⁻³).
71	84	L	1925	1623			Brick	Fire clay	9 in. carborundum No. 1A wall was insulated with 4.5 in. fire-clay No. 26 brick wall with a thin layer of fire clay in between; the wall under test was built of standard 2.5 x 4.5 x 9 in. bricks laid up with cement of the same composition as the brick; carborundum No. 1A was made of carborundum recrystallized in an electric furnace containing 91.51 SiC, 8.02 SiO ₂ , 0.20 Al ₂ O ₃ , and 0.65 Fe ₂ O ₃ (0.17 ignition loss) with apparent density 2.05 g cm ⁻³ and 34.1% porosity calculated by assuming specific gravity 3.17 for SiC; fire clay No. 26 was coarse, fairly open, first quality fire clay containing 58.90 SiO ₂ , 34.48 Al ₂ O ₃ , 3.52 Fe ₂ O ₃ , 1.80 TiO ₂ , 0.29 CaO, and 0.62 MgO (0.31 ignition loss) with apparent density 2.05 g cm ⁻³ and 26.8% porosity calculated by assuming specific gravity 2.60 for fire clay; the bricks were placed so that the temp gradient was through the 4.5 in. dimension.

SPECIFICATION TABLE NO. 334 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
72	84	L	1925	1623			Brick	Fire clay	Similar to the above specimen except the 9 in. carborundum No. 1A wall was insulated with 4.5 in. fire clay No. 75 brick wall; fire clay No. 75 containing 56.90 SiO ₂ , 37.70 Al ₂ O ₃ , 2.37 Fe ₂ O ₃ , 1.74 TiO ₂ , 0.82 CaO, and 0.20 MgO with 0.67 g cm ⁻³ apparent density, and 74.2% porosity calculated by assuming 2.60 specific gravity for fire clay, were fired at 1350 C.
73	84	L	1925	1623			Brick	Fire clay	Similar to the above specimen except 4.5 in. carborundum No. 1C wall was insulated with 4.5 in. fire clay No. 26 brick wall; the carborundum No. 1C brick containing 80.20 SiC, 4.50 SiO ₂ , 1.33 Al ₂ O ₃ , and 1.03 Fe ₂ O ₃ with 2.29 g cm ⁻³ apparent density, and 29.5% porosity calculated with 3.17 specific gravity for SiC were made of carborundum recrystallized in an electric furnace.
74	84	L	1925	1623			Brick	Fire clay	Similar to the above specimen except 4.5 in. carborundum No. 2 wall was insulated with 4.5 in. fire clay No. 26 brick wall; the carborundum No. 2 brick containing 80.10 SiC, 14.72 SiO ₂ , 1.47 Al ₂ O ₃ , and 1.33 Fe ₂ O ₃ (0.88 ignition loss) with 2.48 g cm ⁻³ apparent density and 18.4% porosity calculated by assuming 3.17 specific gravity for SiC, contained ceramic bonds and were kiln fired at approx. 1350 C.
75	84	L	1925	1623			Brick	Fire clay	Similar to the above specimen except 4.5 in. carborundum No. 2 wall was insulated with 4.5 in. fire clay No. 75 brick wall; see above specimen for composition, specifications and remarks about carborundum No. 2 brick.
76	84	L	1925	1623			Brick	Fire clay	Similar to the above specimen except 4.5 in. carborundum No. 3 wall was insulated with 4.5 in. fire clay No. 26 brick wall; the carborundum No. 3 brick containing 5.58 Al ₂ O ₃ , 68.50 SiC, 23.31 SiO ₂ , and 1.57 Fe ₂ O ₃ (0.24 ignition loss) with 2.35 g cm ⁻³ apparent density and 20.7% porosity calculated by assuming 3.17 for SiC specific gravity, contained ceramic bonds and were kiln fired at approx 1350 C.

SPECIFICATION TABLE NO. 334 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
77	84	L	1925	1623			Brick	Fire clay	Similar to the above specimen except 4.5 in. carborundum No. 4 wall was insulated with 4.5 in. fire clay No. 26 brick wall; the carborundum No. 4 brick containing 8.10 Al ₂ O ₃ , 52.60 SiC, 36.80 SiO ₂ , and 1.97 Fe ₂ O ₃ (0.02 ignition loss) with 2.36 g cm ⁻³ apparent density and 17.7% porosity calculated by assuming 3.17 for SiC specific gravity, contained ceramic bonds and were kiln fired at approx 1350 C.
78	84	L	1925	1623			Brick	Fire clay	Similar to the above specimen except 4.5 in. carborundum No. 5 wall was insulated with 4.5 in. fire clay No. 26 brick wall; carborundum No. 5 containing 11.63 Al ₂ O ₃ , 48.35 SiC, 38.76 SiO ₂ , and 1.97 Fe ₂ O ₃ (0.10 ignition loss) with 2.31 g cm ⁻³ apparent density, and 18.9% porosity calculated by assuming 3.17 for SiC specific gravity contained ceramic bonds and were kiln fired at approx 1350 C.
79	488, 489	L	1961	225-548		Scotchply; SRI 1-1	Plastic	3MXP-175 Epoxy Resin	30 ± 1.5 resin; 60 N roving reinforcing; unidirectional laminate; specimen 18 x 12 x 0.125 in.; average thickness 0.125 in.; manufactured by Minnesota Mining and Mfg. Co.; pressed at 408-411 K under 90-95 psi for 40 min; post-cured at 380 K for 16 hrs; 20 plies; density 1.841 g cm ⁻³ .
80	488, 489	L	1961	230-548		Scotchply; SRI 1-2	Plastic	3MXP-175 Epoxy Resin	30 ± 1.5 resin; 60 N roving reinforcing; isotropic laminate; specimen 18 x 12 x 0.125 in.; average thickness 0.122 in.; manufactured by Minnesota Mining and Mfg. Co.; pressed at 403-405 K under 90 psi for 40 min; post-cured at 380 K for 16 hrs; 21 plies; density 1.841 g cm ⁻³ .
81	488, 489	L	1961	443, 548		Scotchply; SRI 1-2	Plastic	3MXP-175 Epoxy Resin	The above specimen measured at decreasing temp.
82	488, 489	L	1961	222-661		Astrolite; SRI 7-1	Plastic	Phenolic resin SC-1008	30-35 resin; refrasil 184 weave reinforcing; parallel layup; specimen 18 x 18 x 0.125 in.; average thickness 0.126 in.; manufactured by H. I. Thompson Fiber Glass Co.; curing at 422 K for 2 hrs; 6 plies; density 1.442 g cm ⁻³ .
83	488, 489	L	1961	514-661		Astrolite; SRI 7-1			The above specimen measured at decreasing temp.

SPECIFICATION TABLE NO. 334 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
84	488, 489	L	1961	219-623		Astrolite; SRI 7-2	Plastic	Phenolic resin SC-1008	30-35 resin; reffrasil 184 weave reinforcing; specimen 12 x 8 x 0.125 in.; edgewise layup with thickness in warp direction; average thickness 0.125 in.; manufactured by H. I. Thompson Fiber Glass Co.; cured at 366 K for 1 hr. at 394 K for 1 hr, and at 422 K for 2 hrs; ∞ plies per in.; density 1.442 g cm ⁻³ . The above specimen measured at decreasing temp.
85	488, 489	L	1961	514-623		Astrolite; SRI 7-2			
86	488, 489	L	1961	224-661		SRI 8-1	Plastic	CTL 37-9X resin	25.7 resin; 181 "E" glass fabric reinforcing; parallel layup; specimen 18 x 18 x 0.125 in.; average thickness 0.132 in.; manufactured by Cincinnati Testing and Research Lab.; molded with part pressure 100 psi, cured at 411-416 K for 0.5 hr, post-cured at 394 K for 4 days; 14 plies; density 1.866 g cm ⁻³ . The above specimen measured at decreasing temp.
87	488, 489	L	1961	515-661		SRI 8-1			
88	488, 489	L	1961	220-645		SRI 8-2	Plastic	CTL 37-9X resin	31.272 resin; 181 "E" glass fabric reinforcing; specimen 7 x 4.75 x 0.7 in.; edgewise layup with thickness in warp direction; average thickness 0.699 in.; manufactured by Cincinnati Testing and Research Lab.; molded with part pressure 100 psi, cured at 411-416 K for 4 hrs, post-cured at 394 K for 4 days; 91 plies per in.; density 1.778 g cm ⁻³ . The above specimen measured at decreasing temp.
89	488, 489	L	1961	465-645		SRI 8-2			
90	488, 489	L	1961	223-645		SRI 8-3	Plastic	CTL 37-9X resin	24.312 resin; 181 "E" glass fabric reinforcing; specimen 10 x 10 x 0.7 in.; edgewise layup with thickness at 45° of warp direction; average thickness 0.708 in.; manufactured by Cincinnati Testing and Research Lab.; augmented bag molded with part pressure 100 psi, cured at 411-416 K for 4 hrs; post-cured at 394 K for 4 days; density 1.789 g cm ⁻³ . The above specimen measured at decreasing temp.
91	488, 489	L	1961	475-645		SRI 8-3			

SPECIFICATION TABLE NO. 334 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
92	488, 489	L	1961	218-662		YN 25; SRI 9	Plastic	CTL-91 LD Phenolic resin	42 resin; heat set and scoured SN-19 nylon reinforcing; chopped fabric construction; specimen 6 in. dia x 0.25 in. thick; average thickness 0.265 in.; manufactured by U.S. Polymetric Chemicals, Inc; molded at 408 K for 1 hr; density 1.153 g cm ⁻³ . The above specimen measured at decreasing temp.
93	488, 489	L	1961	457-662		YN 25; SRI 9			
94	488, 489	L	1961	219-656		SRI 10	Plastic	DC-2106 Silicon resin	40 RPD asbestos reinforcing; specimen 12 x 12 x 0.125 in.; average thickness 0.121 in.; manufactured by U.S. Polymetric Chemicals, Inc; fabricated by loading at 439 K, applying full pressure and bumping after 20 sec. cured at 439 K and 850 psi for 1.5 hrs, removed hot from press; 37 plies; density 1.820 g cm ⁻³ . The above specimen measured at decreasing temp.
95	488, 489	L	1961	444-656		SRI 10			
96	488, 489	L	1961	234-561		SRI 11	Plastic	CTL 91-LD Phenolic resin	31 resin; 38-40 resin in prepreg. prior to molding; glass type YM-31A weave style 181 reinforcing; specimen 18 x 18 x 0.125 in.; average thickness 0.116 in.; manufactured by Wright Air Development Div, USAF; pressed at 345 psi; cured at 422 K for 20 min, post-cured at 422 K for 24 hrs, at 450 K for 24 hrs, and at 478 K for 24 hrs; density 2.098 g cm ⁻³ . The above specimen measured at decreasing temp.
97	488, 489	L	1961	461-661		SRI 11			
98	488, 489	L	1961	227-588		SRI 12	Plastic	Epon 1031 Epoxy resin	22 resin; 38-40 resin in prepreg. prior to molding; glass type YM-31A weave style 181 reinforcing; specimen 18 x 18 x 0.125 in.; average thickness 0.110 in.; manufactured by Wright Air Development Div, USAF; pressed at 245 psi, cured at 444 K for 30 min, post-cured at 422 K for 24 hrs; density 2.203 g cm ⁻³ . The above specimen measured at decreasing temp.
99	488, 489	L	1961	463-558		SRI 12			
100	488, 489	L	1961	227-648		SRI 13	Plastic	R/M High heat resistant phenolic resin	25-30 resin; R/M style 42 RPD asbestos reinforcing; specimen 18 x 18 x 0.125 in.; average thickness 0.147 in.; manufactured by Raybestos-Manhattan, Inc; 40 plies; density 1.874 g cm ⁻³ .

SPECIFICATION TABLE NO. 334 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
101	488, 489	L	1961	481-648		SRI 13	Graphite	101 Phenolic Resin	The above specimen measured at decreasing temp. 6 sheets of graphite mat impregnated with 101 phenolic resin; specimen 7 x 7 x 0.141 in.; materials supplied by U.S. Polymeric Chemicals Co., Inc; pressed at 100 psi at 450 K for 1 hr; post-cured at 450 K for 16 hrs; density 1.064 g cm ⁻³ at 60 C.
102	485	L	1963	315-434		No. 1	Graphite	101 Phenolic Resin	13 sheets of WC-001 graphite cloth impregnated with 101 phenolic resin; specimen 7 x 7 x 0.163 in.; pressed at 100 lb in. ⁻² at 450 K for 1 hr, removed from the press, and post-cured for 16 hrs at 450 K; density (60 C) 1.275 g cm ⁻³ .
103	485	L	1963	312-409		No. 2	Graphite	101 Phenolic Resin	7 sheets of 184 Volan (glass cloth with a Volan finish) impregnated with 37-9X phenyl silane resin; specimen 7 x 7 x 0.168 in.; pressed at 100 lb in. ⁻² at 450 K for 1 hr, removed from the press, and post-cured for 16 hrs at 450 K; density (60 C) 1.938 g cm ⁻³ .
104	485	L	1963	330-428		No. 3	Glass	37-9X Phenyl silane resin	Similar to the above specimen except specimen thickness 0.170 in.
105	485	L	1963	336-432		No. 5	Glass	37-9X Phenyl silane resin	Refrasil cloth impregnated with 91 LD phenolic resin; specimen 7 x 7 x 0.170 in.; pressed at 100 lb in. ⁻² at 450 K for 1 hr, removed from the press, and post-cured for 16 hrs at 450 K; density (60 C) 1.554 g cm ⁻³ .
106	485	L	1963	337-407		No. 8	Refrasil	91 LD Phenolic Resin	Glass cloth impregnated with silicone resin; 6 in. square plate specimen; supplied by Cadillac Plastic Co.; foam glass used as comparative material.
107	588	C	1956	302-697		G-7	Glass	Silicone resin	Glass cloth impregnated with teflon resin; 6 in. square plate specimen; supplied by E. I. DuPont deNemours and Co.; same comparative material as above.
108	588	C	1956	301-728		Armalon 410L	Glass	Teflon resin	Glass fiber molding compound impregnated with silicone resin; 6 in. square plate specimen; supplied by Dow Corning Corp; same comparative material as above.
109	588	C	1956	318-775		DC 301	Glass	Silicone resin	

DATA TABLE NO. 334 THERMAL CONDUCTIVITY OF LAMINATES (NONMETALLIC)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>											
218.1	0.00143	229.3	0.00147	242.1	0.00349	255.4	0.00251*	273.2	0.00230	286.5	0.00139
219.7	0.00147	294.5	0.00160	477.6	0.00363	555.4	0.00234	373.2	0.00230	376.6	0.00153
220.7	0.00131	347.1	0.00205	533.2	0.00362	559.8	0.00231*	CURVE 19*		419.8	0.00163
313.2	0.00209	347.6	0.00203*	CURVE 13		CURVE 8		373.2	0.0148	465.4	0.00175
320.3	0.00143	364.8	0.00211	338.7	0.00206*	395.9	0.00226	CURVE 20*		519.1	0.00184
345.8	0.00166	395.9	0.00226	226.5	0.000937	422.1	0.00251*	373.2	0.0148	552.1	0.00151
377.4	0.00177	398.6	0.00228*	294.3	0.00137	366.5	0.00251	CURVE 29		CURVE 28*	
409.8	0.00195	443.7	0.00244	346.5	0.00170	394.3	0.00263	373.2	0.0148	326.8	0.000646
423.3	0.00179	502.1	0.00251	389.2	0.00195	422.1	0.00263	CURVE 21*		391.1	0.000723
485.4	0.00218	565.4	0.00209	441.5	0.00219	449.8	0.00269	CURVE 22		436.3	0.000875
533.1	0.00163	CURVE 6		516.5	0.00228	CURVE 14		373.2	0.00330	501.8	0.000961
534.8	0.00189	224.8	0.000829	569.3	0.00209*	CURVE 9		CURVE 30*		550.0	0.000912
CURVE 2		272.2	0.00114	CURVE 5		336.1	0.000737	CURVE 31*		CURVE 35*	
358.4	0.00157	338.7	0.00130	522.1	0.00251*	389.3	0.000981	CURVE 32*		361.1	0.00155
413.9	0.00169	367.1	0.00140	555.4	0.00234	460.6	0.00127	CURVE 25*		393.9	0.00170
480.2	0.00186	391.5	0.00162*	559.8	0.00231*	526.8	0.00151	373.2	0.00674	475.9	0.00170
529.9	0.00196	393.7	0.00160*	CURVE 8		CURVE 15		CURVE 23*		367.0	0.00128
565.6	0.00219	430.4	0.00160	226.5	0.000937	334.3	0.00119	373.2	0.00674	407.7	0.00134
CURVE 3		495.9	0.00177	294.3	0.00137	385.6	0.00138	CURVE 24*		467.9	0.00140
330.9	0.00138	552.6	0.00195*	441.5	0.00219	453.2	0.00142	CURVE 25*		531.5	0.00153
390.4	0.00156	610.9	0.00205*	516.5	0.00228	518.5	0.00162	CURVE 26		559.5	0.00119
463.2	0.00180	CURVE 7		CURVE 10		CURVE 16		CURVE 27		CURVE 36*	
523.0	0.00211	227.1	0.00150*	124	0.000209	CURVE 17		373.2	0.00395	329.9	0.00109
CURVE 4		258.7	0.00151*	127	0.000231	CURVE 18*		CURVE 32*		368.3	0.00131
222.1	0.00102	283.2	0.00169	138	0.000231	CURVE 19*		CURVE 33*		426.8	0.00146
223.7	0.000959	320.4	0.00182	143	0.000245	CURVE 20*		CURVE 34*		510.1	0.00153
273.2	0.00133	339.3	0.00218	155	0.000260	CURVE 21*		CURVE 35*		557.1	0.00140
334.8	0.00154	340.4	0.00219*	CURVE 11		CURVE 22		CURVE 36*		CURVE 37*	
395.4	0.00167	343.2	0.00203*	115	0.000252	325.2	0.000952	CURVE 32*		374.8	0.00175
450.9	0.00179	346.5	0.00206*	118	0.000245	353.7	0.000979	CURVE 27		445.2	0.00182
507.1	0.00196	361.5	0.00203	134	0.000275	388.9	0.00110	360.5	0.00112	507.5	0.00187
563.2	0.00193	367.1	0.00225	138	0.000274	454.4	0.00131	385.3	0.00120	553.1	0.00119
564.3	0.00193*	374.8	0.00229	155	0.000301	507.0	0.00151	408.9	0.00124	CURVE 38*	
608.7	0.00202	426.5	0.00224	160	0.000296	585.3	0.00167	469.9	0.00136	331.0	0.00126
		426.5	0.00224*	428.2	0.00244	CURVE 12		489.6	0.00143	376.4	0.00146
		429.3	0.00237*	488.2	0.00140	294.3	0.00243	519.4	0.00151	426.2	0.00155
		467.1	0.00242	574.8	0.00174	366.5	0.00290	554.5	0.00127	469.8	0.00160
		519.8	0.00254							509.3	0.00155
										523.2	0.00137

* Not shown on plot

DATA TABLE NO. 334 (continued)

T	k	T	k	T	k	T	k
<u>CURVE 101*</u>							
480.9	0.00249	337.1	0.00185	557.9	0.00156		
558.7	0.00260	360.4	0.00193	558.7	0.00157		
647.6	0.00281	384.3	0.00173	610.5	0.00150		
<u>CURVE 102*</u>							
389.8	0.00176	389.8	0.00176	611.5	0.00151		
399.8	0.00169	399.8	0.00169	657.7	0.00151		
407.1	0.00185	407.1	0.00185	661.1	0.00122		
315.4	0.00179	<u>CURVE 107*</u>					
332.6	0.00172	302.0	0.00120	661.2	0.00142		
367.6	0.00180	302.5	0.00144	662.3	0.00119		
380.4	0.00208	315.9	0.00132	723.9	0.00132		
394.3	0.00229	316.3	0.00133	728.1	0.00126		
411.5	0.00262	340.0	0.00140	<u>CURVE 109*</u>			
418.2	0.00238	340.0	0.00139	317.6	0.00186		
434.	0.00274	364.2	0.00151	317.9	0.00212		
<u>CURVE 103*</u>							
311.5	0.00469	364.3	0.00155	362.3	0.00219		
324.	0.00459	393.6	0.00155	362.9	0.00218		
345.4	0.00427	394.4	0.00156	429.8	0.00234		
357.6	0.00394	424.8	0.00160	429.9	0.00229		
382.6	0.00430	424.5	0.00161	494.1	0.00247		
408.7	0.00415	458.9	0.00164	494.4	0.00243		
<u>CURVE 104*</u>							
329.8	0.000952	464.8	0.00164	563.6	0.00251		
340.4	0.00192	533.6	0.00170	564.7	0.00253		
344.8	0.00190	533.6	0.00171	647.5	0.00268		
358.7	0.00157	566.1	0.00177	647.8	0.00266		
385.9	0.00146	568.1	0.00179	726.7	0.00309		
397.1	0.00163	606.5	0.00184	730.2	0.00310		
420.9	0.00164	606.8	0.00187	769.6	0.00363		
427.6	0.00185	640.9	0.00199	774.9	0.00363		
<u>CURVE 108*</u>							
300.9	0.00128	696.8	0.00197				
306.2	0.00126	<u>CURVE 105*</u>					
329.6	0.00153	300.9	0.00128				
329.6	0.00152	306.2	0.00126				
358.7	0.00150	329.6	0.00128				
377.6	0.00141	367.7	0.00155				
404.3	0.00146	368.0	0.00156				
431.5	0.00153	410.2	0.00156				
<u>CURVE 106*</u>							
459.2	0.00160	411.8	0.00156				
459.8	0.00160	459.2	0.00160				
508.8	0.00161	459.8	0.00160				
509.7	0.00159	508.8	0.00161				
509.7	0.00159	509.7	0.00159				

* Not shown on plot

THERMAL CONDUCTIVITY OF LAMINATES (METALLIC - NONMETALLIC)

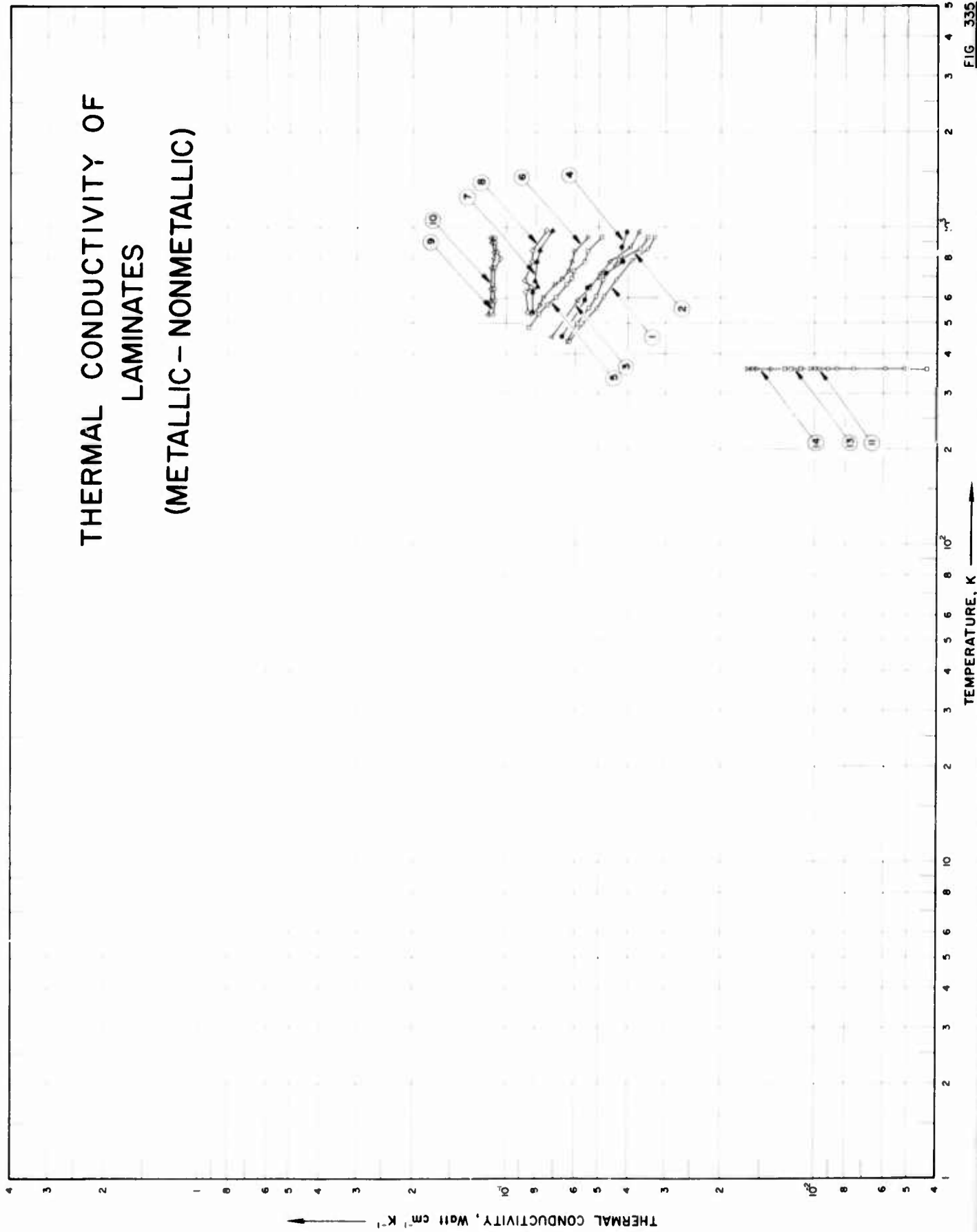


FIG. 335

SPECIFICATION TABLE NO. 335 THERMAL CONDUCTIVITY OF LAMINATES (METALLIC-NONMETALLIC)

[For Data Reported in Figure and Table No. 335]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Designation of Specimen	Composition			Composition (continued), Specifications and Remarks
							Composite Materials	Binder	Steel	
1	65	C	1958	438-933	±2	Forsterite	Steel	Cu-Ag alloy	85% forsterite, 15% stainless steel (430); the ceramic and the metal brazed together by braze alloy (72 Cu, 18 Ag., M. P. 780 C); measured perpendicular to lamination using alumina (97.6 Al ₂ O ₃ , designated as Body Al -300) from Western Gold and Platinum Co. as standard.	
2	65	C	1958	438-933	±2	Forsterite	Steel	Cu-Ag alloy	Data of the above specimen obtained by comparing to another alumina standard.	
3	65	C	1958	454-966	±2	Forsterite	Steel	Cu-Ag alloy	67% forsterite, 33% stainless steel (430); similarly prepared and tested as above.	
4	65	C	1958	454-966	±2	Forsterite	Steel	Cu-Ag alloy	Data of the above specimen obtained by comparing to another alumina standard.	
5	65	C	1958	485-933	±2	Forsterite	Steel	Cu-Ag alloy	50% forsterite, 50% stainless steel (430); similarly prepared and tested as above.	
6	65	C	1958	485-933	±2	Forsterite	Steel	Cu-Ag alloy	Data of the above specimen obtained by comparing to another alumina standard.	
7	65	C	1958	543-983	±2	Forsterite	Steel	Cu-Ag alloy	85% forsterite, 15% stainless steel (430); thermal conductivity parallel to lamination; temp gradient from thermocouples inserted below the ceramic.	
8	65	C	1958	543-983	±2	Forsterite	Steel	Cu-Ag alloy	Data of the above specimen from thermocouples below the metal.	
9	65	C	1958	533-926	±2	Forsterite	Steel	Cu-Ag alloy	67% forsterite, 33% stainless steel (430); thermal conductivity parallel to lamination; temp gradient from thermocouples inserted below the ceramic.	
10	65	C	1958	533-926	±2	Forsterite	Steel	Cu-Ag alloy	Data of the above specimen from thermocouples below the metal.	
11	490	L	1920	358.2		Steel	Air		30 varnished silicon steel foils each of thickness 0.014 in.; density 7.36 g cm ⁻³ ; measured under pressures in the range 0 to 132 psi.	
12	490	L	1920	358.2		Steel	Air		30 oxide coated silicon steel foils each of thickness 0.014 in.; density 7.54 g cm ⁻³ ; measured under pressures in the range 0 to 136 psi.	
13	490	L	1920	358.2		Steel	Air		30 varnished silicon steel foils each of thickness 0.0172 in.; density 7.51 g cm ⁻³ ; measured under pressures in the range 0 to 128 psi.	

SPECIFICATION TABLE NO. 335 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition		Composition (continued), Specifications and Remarks
							Composite Materials	Binder	
14	490	L	1920	358.2		Steel	Air	30 silicon steel foils each of thickness 0.0172 in.; density 7.79 g cm ⁻³ ; measured under pressures in the range 0 to 125 psi.	

DATA TABLE NO. 335 THERMAL CONDUCTIVITY OF LAMINATES (METALLIC-NONMETALLIC)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
CURVE 1																			
438.2	0.0628	570.2	0.0736	533.2	0.111	533.2	0.003337	125	0.0165	CURVE 12* (T = 358.2K)									
499.2	0.0569	602.2	0.0690	589.2	0.109	589.2	0	100	0.0159	CURVE 14 (cont.)									
559.2	0.0506	633.2	0.0640	641.2	0.110	641.2	20	80	0.0154										
608.2	0.0481	687.2	0.0615	746.2	0.109	746.2	40	40	0.00689										
685.2	0.0439	729.2	0.0607	796.2	0.105	796.2	60	60	0.00748										
789.2	0.0399	776.2	0.0556	838.2	0.107	838.2	80	80	0.00827										
855.2	0.0343	843.2	0.0544	898.2	0.109	898.2	100	100	0.00866										
933.2	0.0326	933.2	0.0490	926.2	0.109	926.2	120	120	0.00906										
CURVE 2																			
438.2	0.0636	CURVE 5 (cont.)		CURVE 6		CURVE 9		CURVE 10		CURVE 11 (T = 358.2K)		CURVE 12*		CURVE 13 (T = 358.2K)		CURVE 14		CURVE 14 (cont.)	
499.2	0.0594	485.2	0.0841*	533.2	0.115	533.2	0.115	533.2	0.115	533.2	0.00886	533.2	0.00945	533.2	0.00433	533.2	0.00807*	533.2	0.0165
559.2	0.0540	535.2	0.0824	589.2	0.113	589.2	0.113	589.2	0.113	589.2	60	589.2	0.00925	589.2	0.00807*	589.2	0.00965*	589.2	0.0159
608.2	0.0510	570.2	0.0778	641.2	0.113	641.2	0.113	641.2	0.113	641.2	40	641.2	100	641.2	0.0104*	641.2	0.0104*	641.2	0.0154
685.2	0.0485	602.2	0.0757	746.2	0.113	746.2	0.113	746.2	0.113	746.2	20	746.2	80	746.2	0.0110	746.2	0.0110	746.2	0.0138
789.2	0.0431	663.2	0.0695	796.2	0.111	796.2	0.111	796.2	0.111	796.2	0	796.2	100	796.2	0.0118	796.2	0.0118	796.2	0.0138
855.2	0.0364	687.2	0.0661	838.2	0.110	838.2	0.110	838.2	0.110	838.2	80	838.2	120	838.2	0.0122*	838.2	0.0122*	838.2	0.0114*
933.2	0.0343	729.2	0.0632	898.2	0.112	898.2	0.112	898.2	0.112	898.2	100	898.2	100	898.2	0.0118*	898.2	0.0118*	898.2	0.00709*
CURVE 3																			
454.2	0.0715	776.2	0.0615	926.2	0.113	926.2	0.113	926.2	0.113	926.2	120	926.2	120	926.2	0.0114*	926.2	0.0114*	926.2	0.00709*
591.2	0.0590	843.2	0.0604	843.2	0.0604	843.2	0.0604	843.2	0.0604	843.2	80	843.2	80	843.2	0.00925*	843.2	0.00925*	843.2	0.00709*
645.2	0.0536	933.2	0.0544	933.2	0.0544	933.2	0.0544	933.2	0.0544	933.2	100	933.2	100	933.2	0.00965*	933.2	0.00965*	933.2	0.00709*
716.2	0.0494	CURVE 7		CURVE 11 (T = 358.2K)		CURVE 12*		CURVE 13 (T = 358.2K)		CURVE 14		CURVE 14 (cont.)		CURVE 14		CURVE 14 (cont.)		CURVE 14 (cont.)	
783.2	0.0460	543.2	0.0820	629.2	0.0820	629.2	0.0820	629.2	0.0820	629.2	0	629.2	0	629.2	0.00512	629.2	0.00512	629.2	0.0165
868.2	0.0393	629.2	0.0791	653.2	0.0791	653.2	0.0791	653.2	0.0791	653.2	20	653.2	20	653.2	0.00748	653.2	0.00748	653.2	0.0159
966.2	0.0368	681.2	0.0803	681.2	0.0803	681.2	0.0803	681.2	0.0803	681.2	40	681.2	40	681.2	0.00846	681.2	0.00846	681.2	0.0154
CURVE 4																			
454.2	0.0661	783.2	0.0795	783.2	0.0795	783.2	0.0795	783.2	0.0795	783.2	60	783.2	60	783.2	0.00906	783.2	0.00906	783.2	0.0138
591.2	0.0556	848.2	0.0778	848.2	0.0778	848.2	0.0778	848.2	0.0778	848.2	80	848.2	80	848.2	0.00925*	848.2	0.00925*	848.2	0.0114*
645.2	0.0544	983.2	0.0711	983.2	0.0711	983.2	0.0711	983.2	0.0711	983.2	100	983.2	100	983.2	0.00965	983.2	0.00965	983.2	0.0114*
716.2	0.0473	CURVE 8		CURVE 9		CURVE 10		CURVE 11 (T = 358.2K)		CURVE 12*		CURVE 13 (T = 358.2K)		CURVE 14		CURVE 14 (cont.)		CURVE 14 (cont.)	
783.2	0.0418	543.2	0.0849	629.2	0.0862	629.2	0.0862	629.2	0.0862	629.2	0	629.2	0	629.2	0.00944*	629.2	0.00944*	629.2	0.0165
868.2	0.0423	629.2	0.0828	653.2	0.0828	653.2	0.0828	653.2	0.0828	653.2	20	653.2	20	653.2	0.00945*	653.2	0.00945*	653.2	0.0159
966.2	0.0402	681.2	0.0870	681.2	0.0870	681.2	0.0870	681.2	0.0870	681.2	40	681.2	40	681.2	0.00906*	681.2	0.00906*	681.2	0.0154
CURVE 5																			
485.2	0.0841	783.2	0.0824	783.2	0.0824	783.2	0.0824	783.2	0.0824	783.2	20	783.2	20	783.2	0.00846*	783.2	0.00846*	783.2	0.0165
535.2	0.0782	848.2	0.0820	848.2	0.0820	848.2	0.0820	848.2	0.0820	848.2	0	848.2	0	848.2	0.00591	848.2	0.00591	848.2	0.0159
591.2	0.0715	983.2	0.0741	983.2	0.0741	983.2	0.0741	983.2	0.0741	983.2	100	983.2	100	983.2	0.00496*	983.2	0.00496*	983.2	0.0138

* Not shown on plot

FIGURE SHOWS ONLY 2 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF POWDERS (NONMETALLIC)

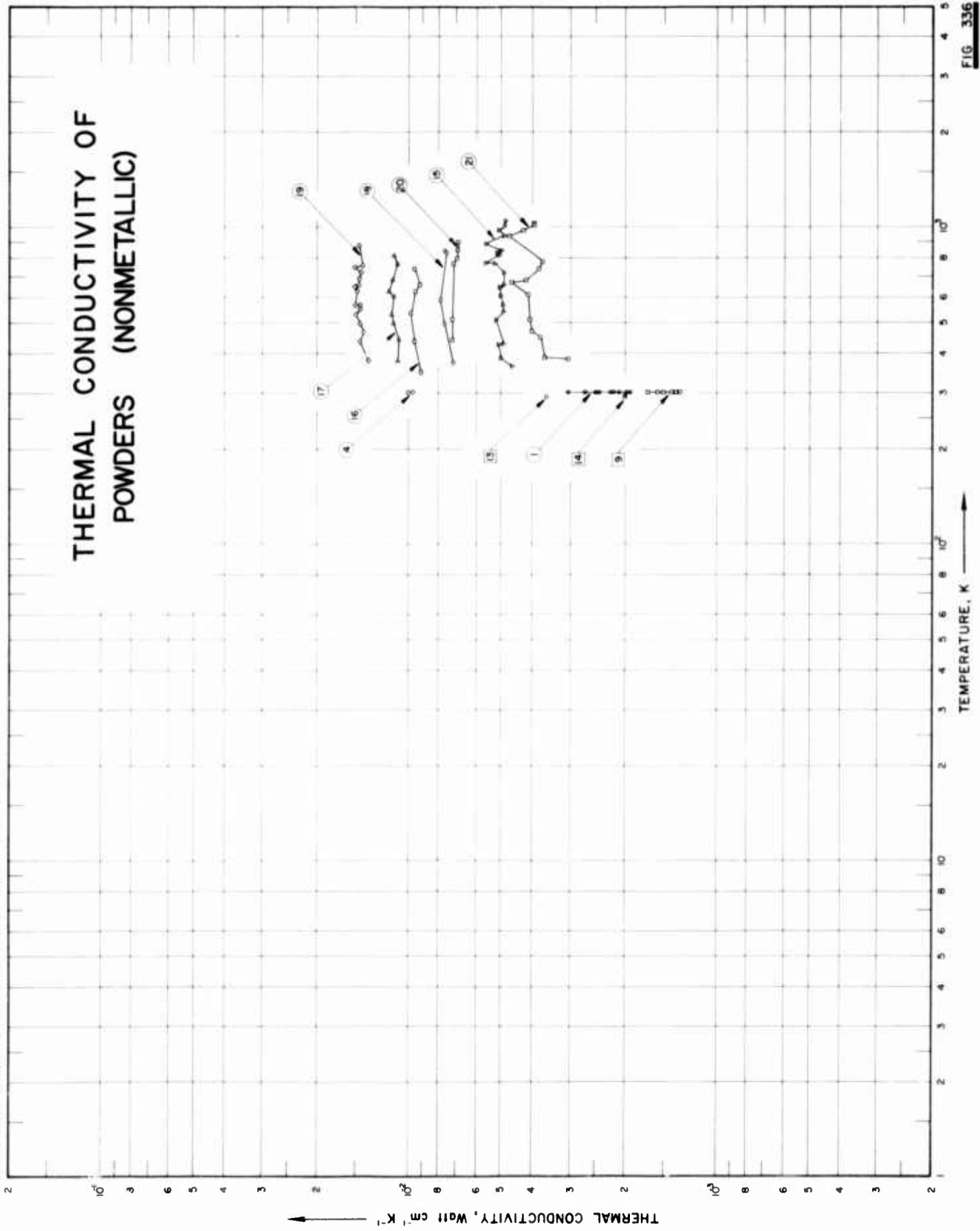


FIG. 336

SPECIFICATION TABLE NO. 336 THERMAL CONDUCTIVITY OF POWDERS (NONMETALLIC)

[For Data Reported in Figure and Table No. 336]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition		Composition (continued), Specifications and Remarks
							Solid Particles	Environment	
1	471	R	1951	303.2		Aluminum Oxide	Carbon Dioxide	Alumina grains supplied by Norton Co. contained in a cylindrical cell of 2.210 cm O. D., 0.9476 cm I. D., and total volume 110.06 cm ³ ; carbon dioxide filled the cell; alumina grain size 1.6-8 mm; measured as CO ₂ pressure varied from 1.4 to 63.3 atm.	
2	471	R	1951	303.2		Aluminum Oxide	Nitrogen	Similar to the above specimen except nitrogen filled the cell; measured as N ₂ pressure varied from 1.5 to 84.1 atm.	
3	471	R	1951	303.2		Aluminum Oxide	Helium	Similar to the above specimen except helium filled the cell; measured as He ₂ pressure varied from 2.5 to 83.6 atm.	
4	471	R	1951	303.2		Aluminum Oxide	Hydrogen	Similar to the above specimen except hydrogen filled the cell; measured as H ₂ pressure varied from 3.8 to 83.0 atm.	
5	471	R	1951	303.2		Aluminum Oxide	Carbon Dioxide	Similar to the above specimen except alumina grain size 0.4797 mm and carbon dioxide filled the cell; measured as CO ₂ pressure varied from 1.4 to 64.5 atm.	
6	471	R	1951	303.2		Aluminum Oxide	Nitrogen	Similar to the above specimen except nitrogen filled the cell; measured as N ₂ pressure varied from 1.6 to 83.7 atm.	
7	471	R	1951	303.2		Aluminum Oxide	Helium	Similar to the above specimen except helium filled the cell; measured as He ₂ pressure varied from 3.2 to 82.8 atm.	
8	471	R	1951	303.2		Aluminum Oxide	Hydrogen	Similar to the above specimen except hydrogen filled the cell; measured as H ₂ pressure varied from 1.6 to 84.3 atm.	
9	471	R	1951	303.2		Borosilicate	Carbon Dioxide	Borosilicate glass grains contained in a cylindrical cell of 2.210 cm O. D., 0.9476 cm I. D., and total volume 110.06 cm ³ ; carbon dioxide filled the cell; average glass grain size 0.5404 mm; measured as CO ₂ pressure varied from 1.3 to 62.5 atm.	
10	471	R	1951	303.2		Borosilicate	Nitrogen	Similar to the above specimen except nitrogen filled the cell; measured as N ₂ pressure varied from 1.2 to 80.0 atm.	
11	471	R	1951	303.2		Borosilicate	Helium	Similar to the above specimen except helium filled the cell; measured as He ₂ pressure varied from 1.0 to 80.2 atm.	
12	471	R	1951	303.2		Borosilicate	Hydrogen	Similar to the above specimen except hydrogen filled the cell; measured as H ₂ pressure varied from 1.2 to 83.8 atm.	

SPECIFICATION TABLE NO. 336 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Solid Particles	Composition Environment	Composition (continued), Specifications and Remarks
13	491	R	1958	292.7			Charcoal	Helium	Sutcliffe Speakman 208 C. 8-14 mesh charcoal obtained from I. C. I. contained in a cylindrical cell of I. D. 1.5 cm, O. D. 3.9 cm, and length 5 cm; measured in helium.
14	491	R	1958	293.3			Charcoal	Helium	
15	492	R	1954	365-1059			Uranium Dioxide	Argon	Similar to the above specimen but measured in air.
16	492	R	1954	349-631			Uranium Dioxide	Argon & Helium	Cylindrical cell of 0.375 in. I. D., 1.75 in. O. D., and 16.5 in. long filled with UO ₂ powder, -100 + 150 mesh size 59% by weight; -325 mesh size 41% by weight packed to 58% of theoretical density of UO ₂ , void volume of 42% filled with argon gas; UO ₂ powder supplied by KAPL, General Electric Co.
17	492	R	1954	380-819			Uranium Dioxide	Argon & Helium	Similar to the above specimen but the 42% void volume filled with 51.2 vol % argon and 48.8 vol % helium.
18	492	R	1954	375-845			Uranium Dioxide	Argon & Helium	Similar to the above specimen but the 42% void volume filled with 35 vol % argon and 65 vol % helium.
19	492	R	1954	381-880			Uranium Dioxide	Argon & Helium	Similar to the above specimen but the 42% void volume filled with 75 vol % argon and 25 vol % helium.
20	492	R	1954	444-900			Uranium Dioxide	Helium	Similar to the above specimen but the 42% void volume filled with helium.
21	492	R	1954	386-1033			Uranium Dioxide	Nitrogen	Similar to the above specimen but the 42% void volume filled with nitrogen.
							Uranium Dioxide	Xenon & Krypton	Similar to the above specimen but the 42% void volume filled with mixture of xenon and krypton with Xe to Kr ratio = 4.898.

DATA TABLE NO. 336 THERMAL CONDUCTIVITY OF POWDERS (NONMETALLIC)

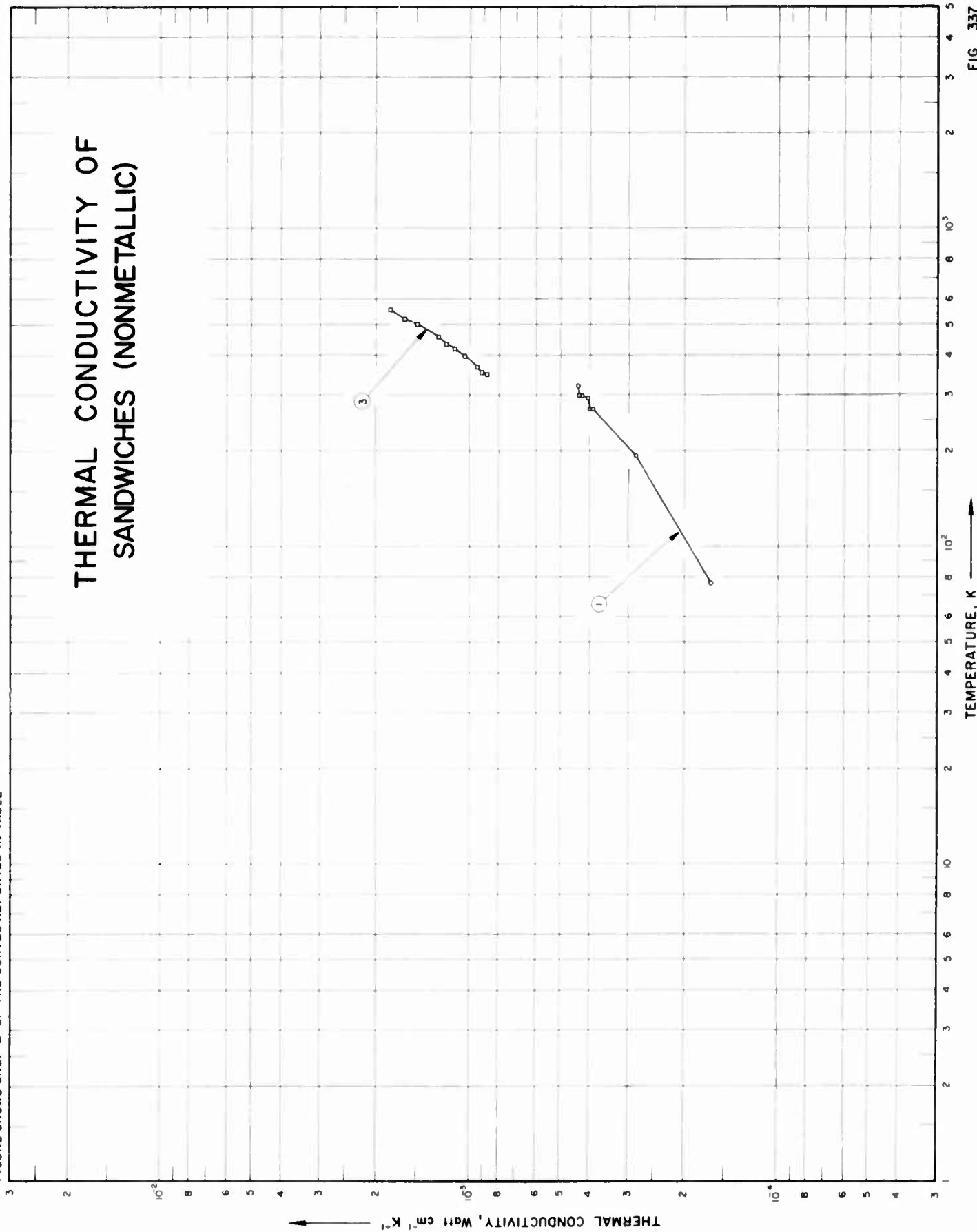
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

CURVE 1 (T = 303.2 K)		CURVE 4 (T = 303.2 K)		CURVE 6 (cont.)* (T = 303.2 K)		CURVE 10* (T = 303.2 K)		CURVE 15		CURVE 18		CURVE 21 (cont.)					
p(atm)	k	p(atm)	k	p(atm)	k	p(atm)	k	T	k	T	k	T	k				
1.4	0.001928	3.8	0.00969	76.4	0.002908	1.2	0.001849	365.4	0.00460	374.8	0.00715	615.4	0.00412				
4.6	0.001974	5.9	0.00975*	83.7	0.002916	10.5	0.001858	387.1	0.00497	496.5	0.00763	674.8	0.00464				
11.1	0.002008*	7.5	0.00980*	CURVE 7* (T = 303.2 K)				428.7	0.00509	534.3	0.00789	683.2	0.00417				
14.7	0.002016*	21.0	0.00980*	17.6	0.001866	29.4	0.001863	430.4	0.00490	534.3	0.00753	742.6	0.00381				
20.5	0.002038*	40.0	0.00982*	59.0	0.001825	59.0	0.001925	513.7	0.00517	845.4	0.00763	783.7	0.00369				
27.9	0.002096	41.5	0.00987*	80.0	0.001958	80.0	0.001958	544.3	0.00490	CURVE 19							
38.0	0.002190	51.6	0.00996*	CURVE 11* (T = 303.2 K)				610.9	0.00500	380.9	0.0136	979.8	0.00471				
42.4	0.002230	67.0	0.00998*	18.0	0.00874	18.0	0.00874	649.3	0.00504	385.4	0.0135*	1019.8	0.00395				
49.5	0.002418	80.7	0.01003*	20.0	0.00875	20.0	0.00875	652.6	0.00497*	438.7	0.0145	1033.2	0.00395				
52.6	0.002494	83.0	0.01004	41.7	0.00878	41.7	0.00878	659.8	0.00490	468.2	0.0141						
57.4	0.002690	CURVE 5* (T = 303.2 K)				48.3	0.00879	724.8	0.00488	472.1	0.0140*						
63.3	0.003059	1.4	0.001757	55.4	0.00882	55.4	0.00882	770.4	0.00523	497.1	0.0145						
		4.8	0.001799	66.9	0.00884	66.9	0.00884	819.3	0.00504	532.2	0.0150						
		8.3	0.001812	82.8	0.00886	82.8	0.00886	833.2	0.00498*	552.6	0.0145						
		14.8	0.001874	CURVE 8* (T = 303.2 K)				54.4	0.004012	572.1	0.0145						
		21.7	0.001954	1.0	0.00916	1.0	0.00916	833.7	0.00511	572.1	0.0145						
		36.3	0.002054	7.3	0.00967	7.3	0.00967	845.4	0.00495	572.6	0.0151						
		38.7	0.002096	11.3	0.00967	11.3	0.00967	891.5	0.00557	578.7	0.0150*						
		45.7	0.002209	17.5	0.00970	17.5	0.00970	941.5	0.00486	632.1	0.0148						
		52.4	0.002356	27.1	0.00972	27.1	0.00972	1008.2	0.00507	652.1	0.0151						
		56.3	0.002464	47.9	0.00975	47.9	0.00975	1058.2	0.00486	664.8	0.0146						
		60.8	0.002644	56.6	0.00982	56.6	0.00982	941.5	0.00483	691.5	0.0146						
		64.5	0.002816	69.2	0.00982	69.2	0.00982	994.2	0.00507	713.2	0.0147*						
		CURVE 6* (T = 303.2 K)				84.3	0.00992	84.3	0.00992	723.7	0.0144						
		1.6	0.002548	CURVE 9 (T = 303.2 K)				1.1	0.004217	443.7	0.00720						
		3.2	0.002615	1.3	0.001331	1.3	0.001331	349.3	0.00914	514.3	0.00720						
		6.6	0.002628	6.7	0.001351*	6.7	0.001351*	437.6	0.00954	769.3	0.00711						
		9.3	0.002661	15.1	0.001372	15.1	0.001372	537.6	0.00981	798.7	0.00694						
		12.1	0.002678	22.6	0.001389*	22.6	0.001389*	663.2	0.00917	847.6	0.00692						
		15.2	0.002686	28.6	0.001418	28.6	0.001418	741.5	0.00954	900.4	0.00691						
		27.1	0.002699	35.5	0.001448*	35.5	0.001448*	631.5	0.00947	CURVE 20							
		35.3	0.002707	42.2	0.001498	42.2	0.001498	443.7	0.00720	443.7	0.00720						
		41.4	0.002725	47.6	0.001561	47.6	0.001561	514.3	0.00720	514.3	0.00720						
		49.2	0.002724	51.4	0.001611*	51.4	0.001611*	769.3	0.00711	769.3	0.00711						
		62.0	0.002766	55.0	0.001695	55.0	0.001695	798.7	0.00694	798.7	0.00694						
		71.8	0.002795	62.5	0.001996*	62.5	0.001996*	847.6	0.00692	847.6	0.00692						
		81.7	0.002876	83.8	0.004335	83.8	0.004335	900.4	0.00691	900.4	0.00691						
		83.6	0.002876	CURVE 13				CURVE 16				CURVE 21					
		CURVE 14				CURVE 17				CURVE 19				CURVE 20			
		CURVE 15				CURVE 18				CURVE 21				CURVE 22			
		CURVE 16				CURVE 19				CURVE 20				CURVE 21			
		CURVE 20				CURVE 21				CURVE 22				CURVE 23			
		CURVE 21				CURVE 22				CURVE 23				CURVE 24			
		CURVE 22				CURVE 23				CURVE 24				CURVE 25			
		CURVE 23				CURVE 24				CURVE 25				CURVE 26			
		CURVE 24				CURVE 25				CURVE 26				CURVE 27			
		CURVE 25				CURVE 26				CURVE 27				CURVE 28			
		CURVE 26				CURVE 27				CURVE 28				CURVE 29			
		CURVE 27				CURVE 28				CURVE 29				CURVE 30			
		CURVE 28				CURVE 29				CURVE 30				CURVE 31			
		CURVE 29				CURVE 30				CURVE 31				CURVE 32			
		CURVE 30				CURVE 31				CURVE 32				CURVE 33			
		CURVE 31				CURVE 32				CURVE 33				CURVE 34			
		CURVE 32				CURVE 33				CURVE 34				CURVE 35			
		CURVE 33				CURVE 34				CURVE 35				CURVE 36			
		CURVE 34				CURVE 35				CURVE 36				CURVE 37			
		CURVE 35				CURVE 36				CURVE 37				CURVE 38			
		CURVE 36				CURVE 37				CURVE 38				CURVE 39			
		CURVE 37				CURVE 38				CURVE 39				CURVE 40			
		CURVE 38				CURVE 39				CURVE 40				CURVE 41			
		CURVE 39				CURVE 40				CURVE 41				CURVE 42			
		CURVE 40				CURVE 41				CURVE 42				CURVE 43			
		CURVE 41				CURVE 42				CURVE 43				CURVE 44			
		CURVE 42				CURVE 43				CURVE 44				CURVE 45			
		CURVE 43				CURVE 44				CURVE 45				CURVE 46			
		CURVE 44				CURVE 45				CURVE 46				CURVE 47			
		CURVE 45				CURVE 46				CURVE 47				CURVE 48			
		CURVE 46				CURVE 47				CURVE 48				CURVE 49			
		CURVE 47				CURVE 48				CURVE 49				CURVE 50			
		CURVE 48				CURVE 49				CURVE 50				CURVE 51			
		CURVE 49				CURVE 50				CURVE 51				CURVE 52			
		CURVE 50				CURVE 51				CURVE 52				CURVE 53			
		CURVE 51				CURVE 52				CURVE 53				CURVE 54			
		CURVE 52				CURVE 53				CURVE 54				CURVE 55			
		CURVE 53				CURVE 54				CURVE 55				CURVE 56			
		CURVE 54				CURVE 55				CURVE 56				CURVE 57			
		CURVE 55				CURVE 56				CURVE 57				CURVE 58			
		CURVE 56				CURVE 57				CURVE 58				CURVE 59			
		CURVE 57				CURVE 58				CURVE 59				CURVE 60			
		CURVE 58				CURVE 59				CURVE 60				CURVE 61			
		CURVE 59				CURVE 60				CURVE 61				CURVE 62			
		CURVE 60				CURVE 61				CURVE 62				CURVE 63			
		CURVE 61				CURVE 62				CURVE 63				CURVE 64			
		CURVE 62				CURVE 63				CURVE 64				CURVE 65			
		CURVE 63				CURVE 64				CURVE 65				CURVE 66			
		CURVE 64				CURVE 65				CURVE 66				CURVE 67			
		CURVE 65				CURVE 66				CURVE 67				CURVE 68			
		CURVE 66				CURVE 67				CURVE 68				CURVE 69			
		CURVE 67				CURVE 68				CURVE 69				CURVE 70			
		CURVE 68				CURVE 69				CURVE 70				CURVE 71			
		CURVE 69				CURVE 70				CURVE 71				CURVE 72			
		CURVE 70				CURVE 71				CURVE 72				CURVE 73			
		CURVE 71				CURVE 72				CURVE 73				CURVE 74			
		CURVE 72				CURVE 73				CURVE 74				CURVE 75			
		CURVE 73				CURVE 74				CURVE 75				CURVE 76			
		CURVE 74				CURVE 75				CURVE 76				CURVE 77			
		CURVE 75				CURVE 76				CURVE 77				CURVE 78			
		CURVE 76				CURVE 77				CURVE 78				CURVE 79			
		CURVE 77				CURVE 78				CURVE 79				CURVE 80			
		CURVE 78				CURVE 79				CURVE 80				CURVE 81			
		CURVE 79				CURVE 80				CURVE 81				CURVE 82			
		CURVE 80				CURVE 81				CURVE 82				CURVE 83			
		CURVE 81				CURVE 82				CURVE 83				CURVE 84			
		CURVE 82				CURVE 83				CURVE 84				CURVE 85			
		CURVE 83				CURVE 84				CURVE 85				CURVE 86			
		CURVE 84				CURVE 85				CURVE 86				CURVE 87			
		CURVE 85				CURVE 86				CURVE 87				CURVE 88			
		CURVE 86				CURVE 87				CURVE 88				CURVE 89			
		CURVE 87				CURVE 88				CURVE 89				CURVE 90			
		CURVE 88				CURVE 89				CURVE 90				CURVE 91			
		CURVE 89				CURVE 90				CURVE 91				CURVE 92			
		CURVE 90				CURVE 91				CURVE 92				CURVE 93			
		CURVE 91				CURVE 92				CURVE 93				CURVE 94			
		CURVE 92				CURVE 93				CURVE 94				CURVE 95			
		CURVE 93				CURVE 94				CURVE 95				CURVE 96			
		CURVE 94				CURVE 95				CURVE 96				CURVE 97			
		CURVE 95				CURVE 96				CURVE 97				CURVE 98			
		CURVE 96				CURVE 97				CURVE 98				CURVE 99			
		CURVE 97				CURVE 98				CURVE 99				CURVE 100			

* Not shown on plot

THERMAL CONDUCTIVITY OF SANDWICHES (NONMETALLIC)

FIGURE SHOWS ONLY 2 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 337 THERMAL CONDUCTIVITY OF SANDWICHES (NONMETALLIC)

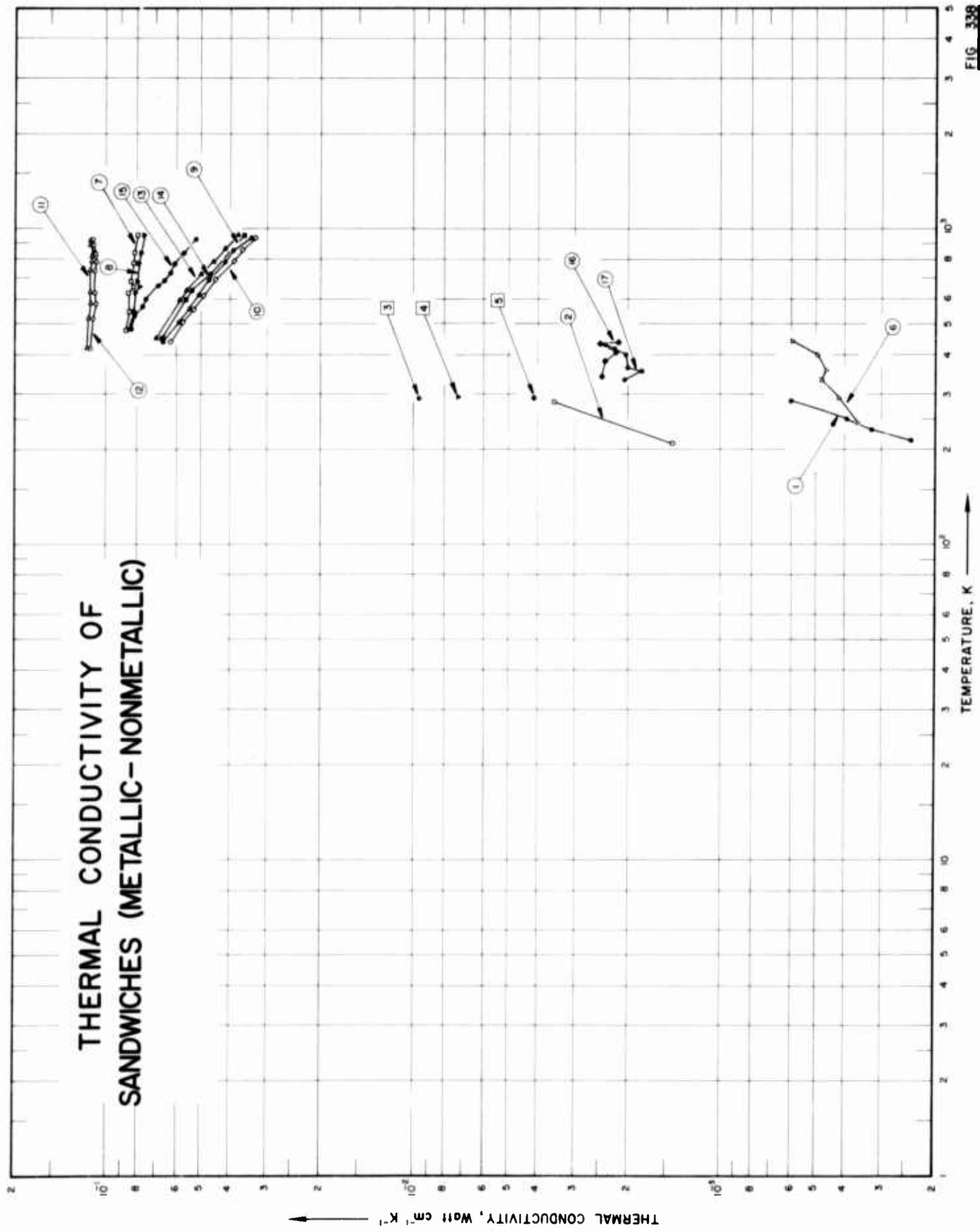
[For Data Reported in Figure and Table No. 337]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composite Materials		Binder	Composition (continued), Specifications and Remarks
							Composite Materials	Composition		
1	124	L	1960	77-322	< 2		Cork	Rubber		Specimen 0.249 in. in thickness; density 0.168 g cm ⁻³ .
2	124	L	1960	297.6	< 2		Cork	Rubber		Specimen 0.141 in. in thickness; density 0.168 g cm ⁻³ .
3	196	L	1955	349-559		SRI GP-2	Plastic	Glass	Polyester Resin	One foamed-in-place sandwich panel; 1/3 in. thick; fabricated using alkyl-isocyanate plastic core and laminate faces of 181 glass fabric and TAC-polyester resin.

DATA TABLE NO. 337 THERMAL CONDUCTIVITY OF SANDWICHES (NONMETALLIC)
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
77.1	0.000166
194.3	0.000284
273.2	0.000391
273.2	0.000398
294.3	0.000405
299.8	0.000424
300.4	0.000434
322.1	0.000438
<u>CURVE 2*</u>	
297.6	0.000421
<u>CURVE 3</u>	
349.2	0.000873
356.8	0.000906
369.9	0.000943
398.2	0.00104
423.3	0.00112
436.6	0.00120
457.8	0.00127
461.3	0.00127*
502.9	0.00149
524.1	0.00162
558.9	0.00180

* Not shown on plot



THERMAL CONDUCTIVITY, Watt cm⁻¹ K⁻¹

TEMPERATURE, K

SPECIFICATION TABLE NO. 338 THERMAL CONDUCTIVITY OF SANDWICHES (METALLIC-NONMETALLIC)

[For Data Reported in Figure and Table No. 338]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition		Composition (continued), Specifications and Remarks
							Composite Materials	Binder	
1	493	R	1949	215-286		Aluminum foil	Asbestos strips + Air	46 mm dia x 305 mm long; consisted of 3 sheets of 0.2 mm thick aluminum foil lapped in three layers about a 12 mm dia cylindrical heater, asbestos strips of about 4 mm thick and 4 mm wide used as separators between successive metal sheet layers, with air of 1 atm filling the vacant spaces.	
2	493	R	1949	210, 285		Aluminum foil	Asbestos strips + Helium	Similar to the above specimen, but with helium of 1 atm filling the vacant spaces between the metal layers.	
3	491	R	1958	293.2		Charcoal + Helium	Copper gauze	Sutcliffe Speakman 208 C. 8-14 mesh charcoal obtained from I. C. I. contained in a cylindrical cell of I. D. 1.5 cm, O. D. 3.9 cm, and length 5 cm, eleven copper gauze disk made from 28 gauge wire 20 holes in. ¹ placed parallel to heat flow in the charcoal bed spaced at ~0.5 cm intervals; measured in helium.	
4	491	R	1958	295.1		Charcoal + Helium	Copper gauze	Similar to the above specimen except six gauze discs placed in the bed at ~1.0 cm intervals.	
5	491	R	1958	293.4		Charcoal + Air	Copper gauze	Similar to the above specimen but measured in air.	
6	389	L	1957	244-445		Foam	Aluminum alloy	Specimen consisted of core of foam with alkyl isocyanate resin manufactured by Brunswick-Balke Collender Co., and faces of aluminum alloy; core thickness 0.625 in., face thickness 0.25 in.; foam density 0.160 g cm ⁻³ .	
7	494	C	1960	483-963	±6	Forsterite	Stainless steel	85 vol % forsterite, 15 vol % stainless steel 430; 1 in. cube specimen fabricated using 4 layers of forsterite and 3 layers of stainless steel; heat flow parallel to the laminae; MIT alumina standard used as comparative material. Second run of the above specimen.	
8	494	C	1960	483-963	±6			Similar to the above specimen except heat flow perpendicular to the laminae.	
9	494	C	1960	441-936	±3			Second run of the above specimen.	
10	494	C	1960	440-936	±3			67 vol % forsterite, 15 vol % stainless steel 430; 1 in. cube specimen fabricated using 2 layers of forsterite and 1 layer of stainless steel; heat flow parallel to the laminae; same comparative material as above.	
11	494	C	1960	420-924	±6	Forsterite	Steel	Second run of the above specimen.	
12	494	C	1960	420-928	±6			Second run of the above specimen.	

SPECIFICATION TABLE NO. 338 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composite Materials		Binder	Composition (continued), Specifications and Remarks
							Composite Materials	Composition		
13	494	C	1960	453-956	±3					Similar to the above specimen except heat flow perpendicular to the laminas.
14	494	C	1960	451-958	±3					Second run of the above specimen.
15	494	C	1960	485-931			Forsterite	Stainless steel		50 vol % forsterite, 50 vol % stainless steel 430; 1 in. cube specimen fabricated using 2 layers of forsterite and 1 layer of stainless steel; heat flow perpendicular to the laminas; MIT standard alumina used as comparative material.
16	485	L	1963	343-438			Asbestos	Silver	91 LD Phenolic resin	Asbestos cloth with one sheet of silver foil in center impregnated with 91 LD phenolic resin; 0.254 in. x 0.34 ft ² ; materials supplied by U. S. Polymeric Chemicals Co., Inc.; pressed at 100 psi at 450 K for 1 hr, post-cured at 450 K for 16 hrs; density 1.810 g cm ⁻³ at 60 C.
17	485	L	1963	334-433			Asbestos	Aluminum	91 LD Phenolic resin	Asbestos cloth with one sheet of aluminum foil in center impregnated with 91 LD phenolic resin; 0.281 in. x 0.34 ft ² ; same supplier and fabrication method as the above specimen; density 1.727 g cm ⁻³ at 60 C.

DATA TABLE NO. 35 THERMAL CONDUCTIVITY OF SANDWICHES (METALLIC-NONMETALLIC)

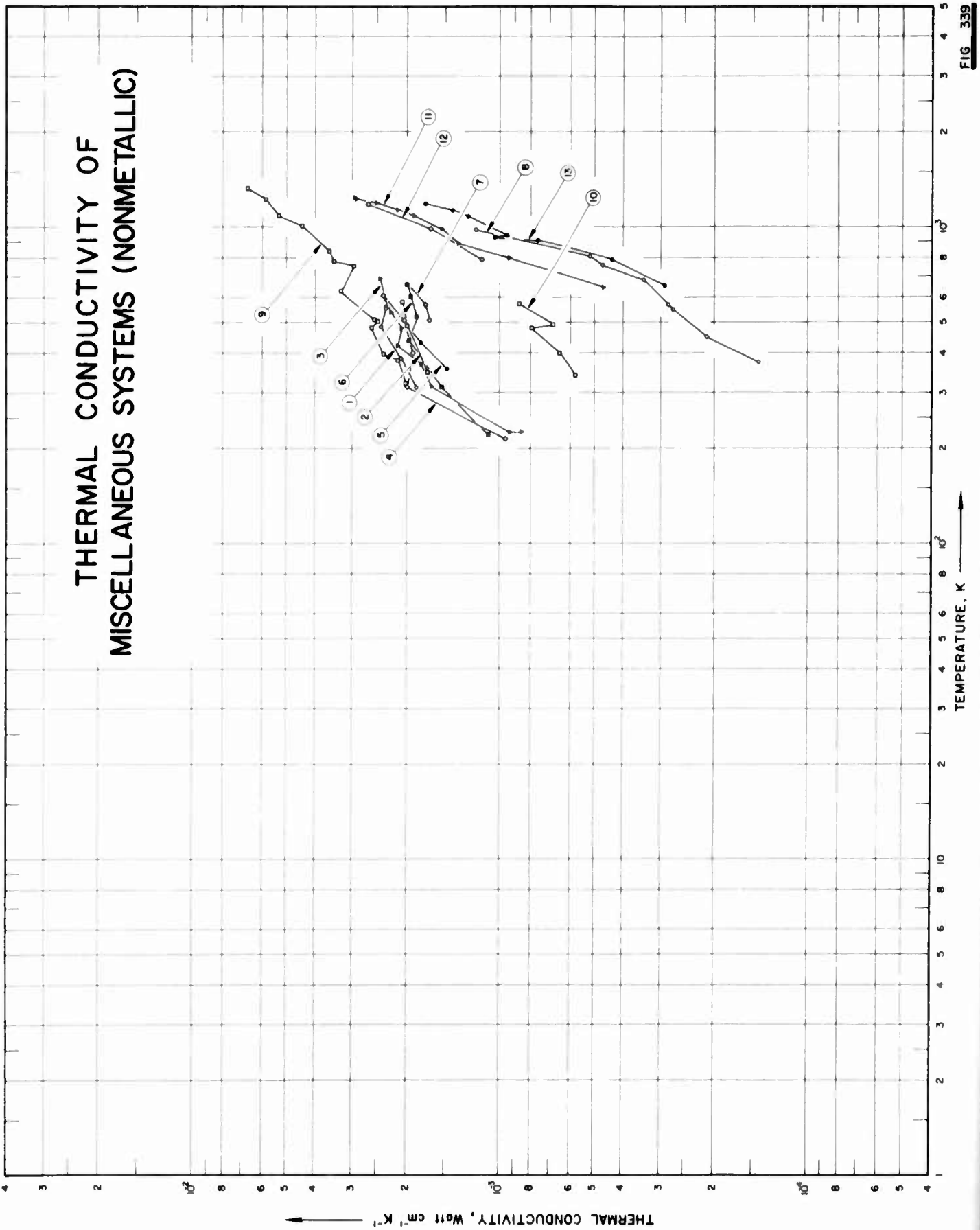
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>									
214.7	0.000238	483.2	0.0847	420.2	0.113	242.6	0.00244		
232.7	0.000323	548.2	0.0824	523.2	0.110	383.7	0.00238		
251.7	0.000391	632.2	0.0812	583.2	0.108	409.8	0.00219		
286.2	0.000598	659.2	0.0787	632.2	0.109	435.9	0.00247		
<u>CURVE 2</u>									
		783.2	0.0791	794.2	0.107	438.2	0.00215		
210.2	0.00143	843.2	0.0778	820.2	0.108	<u>CURVE 17</u>			
284.7	0.00351	963.2	0.0761	841.2	0.108	334.3	0.00205		
<u>CURVE 3</u>									
		<u>CURVE 9</u>				356.5	0.00179		
293.2	0.0056	441.2	0.0665	453.2	0.0698	401.5	0.00203		
<u>CURVE 4</u>									
		506.2	0.0592	595.2	0.0590	417.7	0.00221		
295.1	0.0072	563.2	0.0548	644.7	0.0561	432.6	0.00237		
<u>CURVE 5</u>									
		620.2	0.0511	723.2	0.0500				
293.4	0.0041	693.2	0.0471	789.2	0.0455				
<u>CURVE 6</u>									
		786.2	0.0418	868.2	0.0418				
244.3	0.000361	856.2	0.0390	956.2	0.0376				
283.6	0.000418	936.2	0.0339	<u>CURVE 10</u>					
332.9	0.000476	<u>CURVE 14</u>							
357.0	0.000462	440.2	0.0630	451.2	0.0667				
358.4	0.000462*	509.2	0.0579	598.2	0.0561				
444.6	0.000591	559.2	0.0531	644.0	0.0536				
<u>CURVE 7</u>									
		615.2	0.0492	722.2	0.0467				
483.2	0.0968	595.2	0.0448	790.2	0.0418*				
548.2	0.0849	791.2	0.0387	868.2	0.0389*				
632.2	0.0851	861.2	0.0364	958.2	0.0357				
659.2	0.0824	936.2	0.0328	<u>CURVE 15</u>					
685.2	0.0837	<u>CURVE 11</u>							
783.2	0.0823	420.2	0.115	485.2	0.0837				
845.2	0.0816	524.2	0.114	535.2	0.0816				
963.2	0.0795	583.2	0.113	571.5	0.0769				
<u>CURVE 8</u>									
		631.2	0.113	603.2	0.0750				
		742.7	0.113	665.2	0.0686				
		793.2	0.111	689.2	0.0657				
		817.2	0.111	728.5	0.0630				
		897.2	0.110	778.2	0.0613				
		893.2	0.112	843.2	0.0573				
		924.2	0.113	931.2	0.0523				

* Not shown on plot

FIGURE SHOWS ONLY 13 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF MISCELLANEOUS SYSTEMS (NONMETALLIC)



SPECIFICATION TABLE NO. 339 THERMAL CONDUCTIVITY OF MISCELLANEOUS SYSTEMS (NONMETALLIC)

[For Data Reported in Figure and Table No. 339]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition			Binder	Composition (continued), Specifications and Remarks
							Plastic	Composite Materials	Glass		
1	488, 489	L	1961	312-563		SRI 2	Plastic	Glass	CTL-91 LD Phenolic resin	35% ±5% resin; 181 chopped glass reinforcing; 8 x 8 x 0.25 in.; average thickness 0.281 in.; manufactured by Reihold Engineering and Plastics Co.; molded at 408 K for 1 hr, post-cured at 408 K for 24 hrs; density 1.829 g cm ⁻³ .	
2	488, 489	L	1961	348-585		SRI 2				The above specimen measured at decreasing temp.	
3	488, 489	L	1961	225-689		Fiberite 4030-190; SRI 4	Plastic	Glass	Phenolic resin R181	48-53 resin; glass roving No. F846 reinforcing; 8 x 8 x 0.25 in.; average thickness 0.230 in.; prepared by curing hydraulic press at 2000 psi, cured at 433 K for 20 min; density 1.728 g cm ⁻³ .	
4	488, 489	L	1961	215-607		Coast F130R; SRI 5	Plastic	Glass	Silicone resin 4P020, F130R DC-2106	35% ±3% resin; chopped glass 1B603 reinforcing; 10 x 6.5 x 0.25 in.; average thickness 0.273 in.; manufactured by Coast Manufacturing and Supply Co.; heated at 366 K for 16 hrs, at 400 K for 2 hrs, at 422 K for 2 hrs, at 450 K for 2 hrs, at 478 K for 2 hrs, at 500 K for 2 hrs, and at 523 K for 12 hrs, then cooled to 366 K before removing from oven; density 1.698 to 1.757 g cm ⁻³ .	
5	488, 489	L	1961	357-607		Coast F130R; SRI 5				The above specimen measured at decreasing temp.	
6	488, 489	L	1961	222-658		Astrolite; SRI 6	Plastic	Cloth	Phenolic resin SC-1008	30-35 resin; 0.5 x 0.5 in. squares of 1201 V cloth reinforcing; 16 x 6 x 0.125 in.; manufactured by H. I. Thompson Fiber Glass Co.; average thickness 0.132 in.; molded, cured at 422 K for 2 hrs; density 1.442 g cm ⁻³ .	
7	488, 489	L	1961	508-658		Astrolite; SRI 6				The above specimen measured at decreasing temp.	
8	495	R	1964	375-981			Carbon	Vacuum		Type VDF carbon felt supplied by National Carbon Co.; specimen prepared by wrapping carbon felt on a 0.875 in. dia iron tube; specimen 1.25 in. in O. D. and 10 in. in length; density of carbon felt 0.083 g cm ⁻³ , measured in a vacuum of about 200 μ.	
9	495	R	1964	319-1332			Carbon	Helium		Similar to the above specimen but measured in helium at 1 atm.	
10	495	R	1964	340-571			Carbon	Air		Similar to the above specimen but measured in air at 1 atm.	

SPECIFICATION TABLE NO. 339 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition		Binder	Composition (continued), Specifications and Remarks
							Composite Materials	Materials		
11	472	R	1963	650-1250	8		Aluminum Oxide	Graphite		Density of Al_2O_3 foam 0.474 g cm^{-3} ; graphite fibers 0.087 g cm^{-3} ; solid section of Al_2O_3 (foam brick) were formed into cylinders, which filled the annulus between the measuring apparatus and a tantalum shield 2 in. in dia, two layers of graphite fiber (14μ average dia, type WDF) mats were placed in the annulus between 2 in. tantalum shield and outer container; measured in a vacuum of 4×10^{-4} to 2×10^{-4} mm Hg.
12	472	R	1963	794-1189	7		Aluminum Oxide	Graphite		The above specimen measured at decreasing temp.
13	472	R	1963	655-1189			Aluminum Oxide	Graphite		Density of graphite fibers 0.082 g cm^{-3} , alumina 1.957 g cm^{-3} , alumina bubbles ($250\text{-}350 \mu$ dia) placed in annulus formed by tantalum shield (2 in. dia) and the measuring apparatus (0.75 in. dia); graphite fibers (14μ average dia, 2 layers of matting) in annulus formed by 2 in. dia shield and outer tantalum container (2.75 in. dia); measured in a vacuum of 0.7×10^{-4} to 1.2×10^{-4} mm Hg.
14	472	R	1963	911-1144	7		Aluminum Oxide	Graphite		The above specimen measured at decreasing temp.

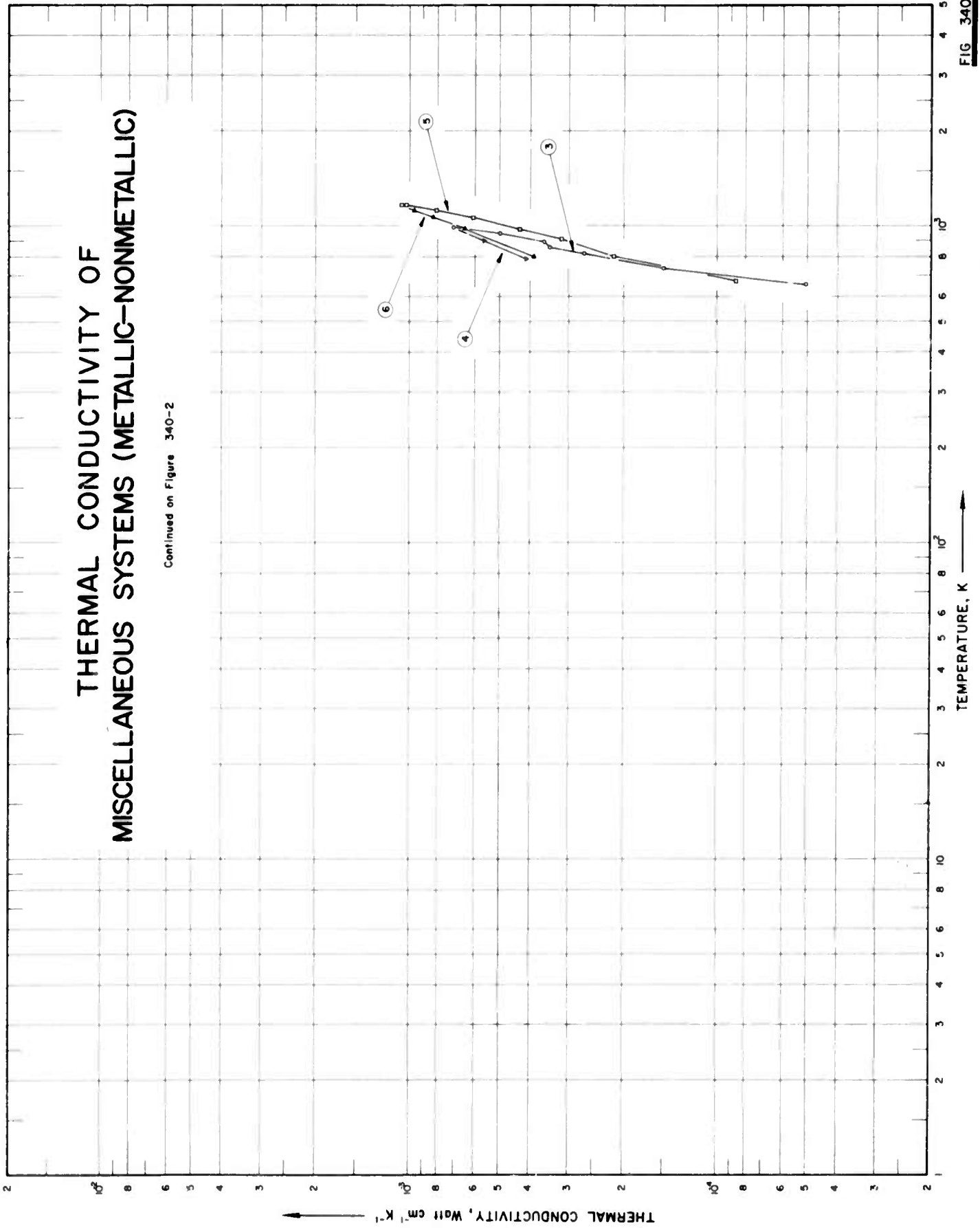
DATA TABLE NO. 339 THERMAL CONDUCTIVITY OF MISCELLANEOUS SYSTEMS (NONMETALLIC)
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k
<u>CURVE 1</u>							
311.5	0.00185	440.4	0.00195	340	0.000571		
384.3	0.00207	522.6	0.00184	400	0.000645		
485.4	0.00240	603.7	0.00192	480	0.000786		
555.9	0.00231	658.2	0.00197	491	0.000677		
563.2	0.00231			571	0.000860		
<u>CURVE 2</u>							
348.2	0.00169	507.6	0.00168	<u>CURVE 11</u>			
489.3	0.00198	565.2	0.00172	649.8	0.000462		
584.8	0.00205	658.2	0.00197*	799.8	0.000923		
<u>CURVE 3</u>							
225.4	0.000844	375	0.000142	894.3	0.00134		
225.4	0.000917	447	0.000209	988.7	0.00153		
314.8	0.00164	550	0.000270	1088.7	0.00187		
369.8	0.00178	569	0.000280	1133.2	0.00211*		
374.3	0.00178*	681	0.000337	1141.5	0.00211		
423.7	0.00211	753	0.000465	1194.3	0.00247		
481.5	0.00206	808	0.000513	1238.7	0.00288		
539.8	0.00223	981	0.00118	1249.8	0.00291		
595.9	0.00233	<u>CURVE 12</u>					
688.7	0.00241	319	0.00199*	794.3	0.00112		
<u>CURVE 4</u>							
214.8	0.000948	321	0.00200	988.7	0.00166		
313.2	0.00198	397	0.00236	1188.7	0.00264		
400.9	0.00189	481	0.00258	<u>CURVE 13</u>			
507.6	0.00202	505	0.00246	655.4	0.000288		
607.1	0.00236	511	0.00253	794.3	0.000433		
<u>CURVE 5</u>							
357.1	0.00147	755	0.00294	910.9	0.000750		
433.2	0.00179	782	0.00350*	933.2	0.00102		
607.1	0.00236*	783	0.00343	944.3	0.000937		
<u>CURVE 6 (cont.)</u>							
357.1	0.00147	1008	0.00440	1088.7	0.00125		
433.2	0.00179	1092	0.00527	1133.2	0.00141		
607.1	0.00236*	379	0.00211	1188.7	0.00173		
<u>CURVE 7</u>							
221.5	0.00107	844	0.00356	<u>CURVE 14*</u>			
313.7	0.00153	1232	0.00580	910.9	0.000721		
370.5	0.00176*	1332	0.00662	1099.8	0.00118		
		626	0.00324	1144.3	0.00151		

* Not shown on plot

THERMAL CONDUCTIVITY OF MISCELLANEOUS SYSTEMS (METALLIC-NONMETALLIC)

Continued on Figure 340-2



THERMAL CONDUCTIVITY OF MISCELLANEOUS SYSTEMS (METALLIC-NONMETALLIC)

CONTINUED FROM FIGURE 340-1

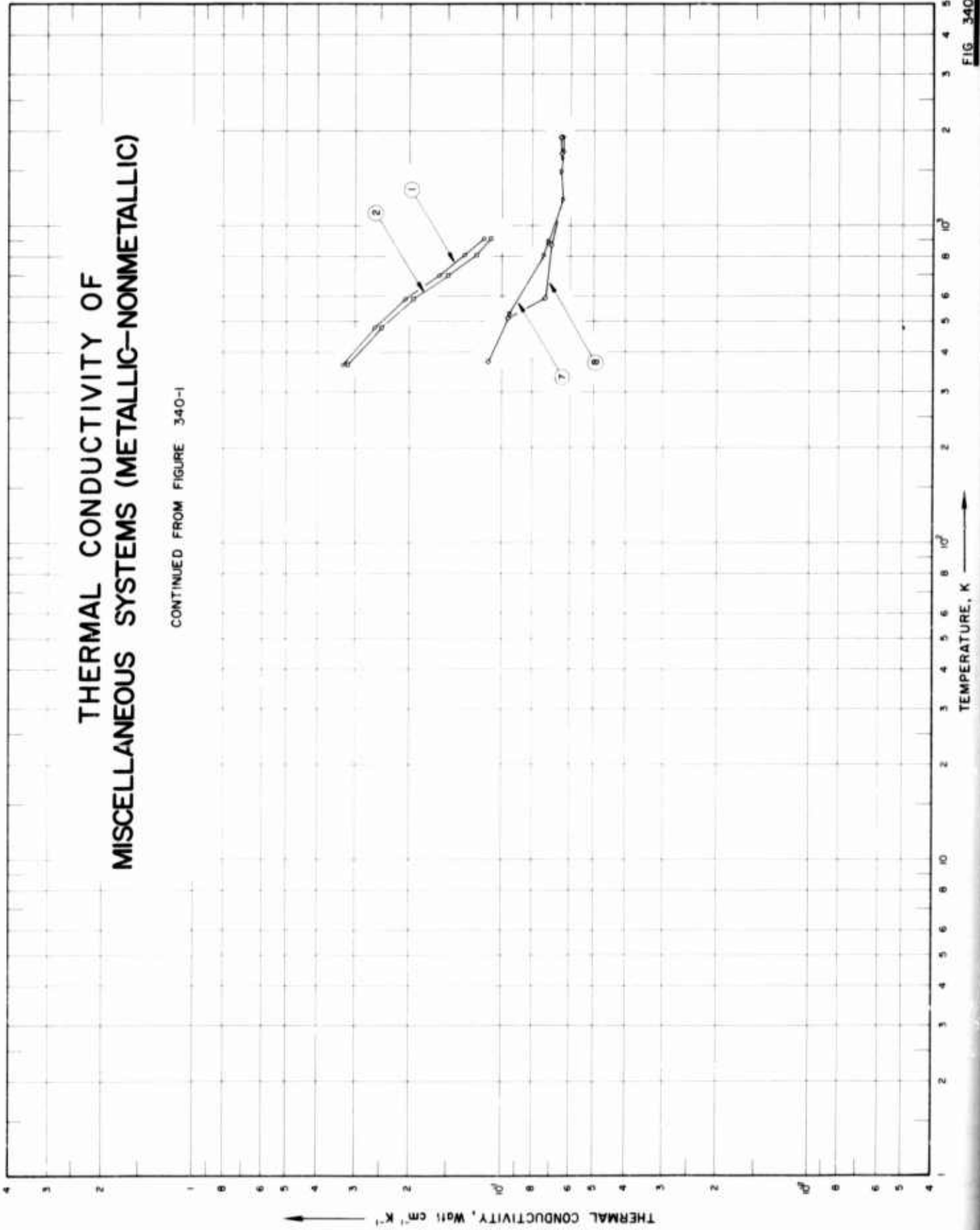


FIG. 340-2

SPECIFICATION TABLE NO. 340 THERMAL CONDUCTIVITY OF MISCELLANEOUS SYSTEMS (METALLIC-NONMETALLIC)

[For Data Reported in Figure and Table No. 340]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composite Materials		Binder	Composition (continued), Specifications and Remarks
							Aluminum Oxide	Molybdenum		
1	286	C	1958	367-914			Aluminum Oxide	Molybdenum		90.0 Al ₂ O ₃ and 10.0 Mo; 1 x 1 x 1 in.; prepared from Norton 38-900 alumina of grain size 5-9 μ , and from 0.002 in. dia unannealed molybdenum wire obtained from Fansteel Metallurgical Corp and cut to 0.125 in. long by Rayon Processing Co.; batches thoroughly mixed, charged into a graphite mold, hot pressed at 1650 C under 3000 psi, cooled to room temp in about 4 hrs; heat flow parallel to the Mo fiber orientation; alumina used as comparative material.
2	286	C	1958	367-911			Aluminum Oxide	Molybdenum		Similar to the above specimen but heat flow perpendicular to the Mo fiber orientation.
3	472	R	1963	655-994	6-9	Test 11	Paper, Aluminum, Stainless Steel, Graphite			Multifoil insulation formed by wrapping Dexiglas paper and 0.002 in. aluminum foil alternately around the measuring apparatus, the foil was slit to reduce conduction, thirteen layers of paper and ten layers of foil were used, the insulation was surrounded by a 1.25 in. dia Type 304 stainless steel tube, four layers of graphite fiber (14 μ average dia, type WDF) mats filled the annulus between the stainless steel tube and the outer tantalum container; total heating time 91 hrs; pressure range 1.4 x 10 ⁻⁷ to 2.0 x 10 ⁻⁵ mm Hg; density of graphite fiber 0.088 g cm ⁻³ ; measured in increasing temp.
4	472	R	1963	789-994	6-9					The above specimen measured at decreasing temp.
5	472	R	1963	672-1161	6-9		Paper, Tantalum, Graphite			Multifoil insulation of alternate layers of "Fiberfrax" paper and tantalum foil (0.0005 in.) was formed around the measuring apparatus, there were ten layers of paper, nine foil layers, foils were slit to reduce conduction, an outer layer of tantalum (0.005 in.) was used for the last foil, three layers of graphite fibers (10 μ average dia, type WDF) were wrapped around the multifoil insulation, tantalum foils were also used to separate the graphite layers, the entire insulation was enclosed by a tantalum cylinder (2.75 in. dia); total heating time 122 hrs; pressure range 1 x 10 ⁻⁶ to 6 x 10 ⁻⁴ mm Hg; density of graphite 0.083 g cm ⁻³ ; measured in increasing temp.
6	472	R	1963	800-1161	6-9					The above specimen measured at decreasing temp.
7	204	R	1957	529-1913			Thorium Dioxide, Molybdenum			10 Mo; 0.5 CaF ₂ ; reinforcing Mo fibers 0.002 in. in dia and 0.125 in. in nominal length; specimen made up of two 1 in. thick discs of 0.50 in. I.D. and 2.5 in. O.D.; hot pressed at 1500 \pm 50 C and at pressure of 100 psi for 30 min; average bulk density 9.26 g cm ⁻³ .
8	236	R	1962	373-1903			Thorium Dioxide, Molybdenum			10 Mo; reinforcing Mo fibers 0.005 cm in dia and 0.5 cm in length.

DATA TABLE NO. 340 THERMAL CONDUCTIVITY OF MISCELLANEOUS (METALLIC-NONMETALLIC)
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
366.5	0.331	799.8	0.000389
477.6	0.262	933.2	0.000649
588.7	0.207	1069.3	0.000829
699.8	0.161	1119.3	0.000966
810.9	0.132	1160.9	0.00106*
913.7	0.115		
<u>CURVE 2</u>			
366.5	0.318	529.3	0.0950
477.6	0.249	802.4	0.0736
588.7	0.195	892.7	0.0715
699.8	0.151	1209.9	0.0640
810.9	0.121	1490.2	0.0649
910.9	0.109	1705.9	0.0636
		1912.8	0.0644
<u>CURVE 3</u>			
655.4	0.0000505	373.2	0.111
738.7	0.000151	513.2	0.0962
816.5	0.000267	593.2	0.0732
855.4	0.000346	873.2	0.0699
894.3	0.000361	1203.2	0.0644*
949.8	0.000498	1483.2	0.0644*
994.3	0.000707	1698.2	0.0644
		1903.2	0.0649
<u>CURVE 4</u>			
788.7	0.000411		
899.8	0.000562		
994.3	0.000707*		
<u>CURVE 5</u>			
672.1	0.0000865		
802.6	0.000216		
910.9	0.000317		
977.6	0.000433		
1066.5	0.000606		
1124.8	0.000808		
1160.9	0.00103		
1160.9	0.00106		

* Not shown on plot

SPECIFICATION TABLE NO. 341 THERMAL CONDUCTIVITY OF ASH

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	293,298	1	3	3.63 cm dia x 0.091 cm thick; sp. gravity = 0.74; moisture content 14.3%; heat flow parallel to the grain, measured under a load of 21 psi.
2	125	L	1923	293,298	1	1	3.63 cm dia x 0.100 cm thick; sp. gravity = 0.74; moisture content 15.5%; heat flow perpendicular to the grain, radial to annual rings; measured under a load of 21 psi.
3	125	L	1923	293,298	1	2	3.63 cm dia x 0.102 cm thick; sp. gravity = 0.74; moisture content 15%; heat flow perpendicular to the grain, tangential to annual rings; measured under a load of 21 psi.
4	125	L	1923	293,298	1	6	3.63 cm dia x 0.081 cm thick; sp. gravity = 0.74; moisture content 14.9%; same measuring conditions as the above specimen 3.
5	125	L	1923	293,298	1	4	3.63 cm dia x 0.100 cm thick; sp. gravity = 0.74; moisture content 16.0%; same measuring conditions as the above specimen 1.
6	125	L	1923	293,298	1	5	3.63 cm dia x 0.100 cm thick; sp. gravity = 0.74; moisture content 16.6%; same measuring conditions as the above specimen 2.

DATA TABLE NO. 341 THERMAL CONDUCTIVITY OF ASH

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k
<u>CURVE 1*</u>					
293.2	0.00299	293.2	0.00154	293.2	0.00194
298.2	0.00303	298.2	0.00155	298.2	0.00196
<u>CURVE 2*</u>					
<u>CURVE 3*</u>					
<u>CURVE 4*</u>					
<u>CURVE 5*</u>					
<u>CURVE 6*</u>					
293.2	0.00153	293.2	0.00315	293.2	0.00174
298.2	0.00159	298.2	0.00323	298.2	0.00176

* No graphical presentation

SPECIFICATION TABLE NO. 342 THERMAL CONDUCTIVITY OF BALSA

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	293.2	1		Sp. gravity 0.1; moisture content 1.3%; heat flow perpendicular to grain and tangential to annual rings; measured under a load of 21 psi.
2	125	L	1923	293.2	1	Waterproofed balsa	Sp. gravity 0.1; moisture content 1.3%; heat flow perpendicular to grain and tangential to annual rings; measured under a load of 21 psi.
3	125	L	1923	293.2	1	Pseudo balsa	Sp. gravity 0.25; moisture content 1.3%; heat flow parallel to grain; measured under a load of 21 psi.
4	125	L	1923	293.2	1	Pseudo balsa	Sp. gravity 0.25; moisture content 1.3%; heat flow perpendicular to grain; measured under a load of 21 psi.

DATA TABLE NO. 342 THERMAL CONDUCTIVITY OF BALSA

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

293.2 0.000460

CURVE 2*

293.2 0.000544

CURVE 3*

293.2 0.00121

CURVE 4*

293.2 0.000669

*No graphical presentation

SPECIFICATION TABLE NO. 343 THERMAL CONDUCTIVITY OF BOXWOOD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	44	F	1914	293,373			0.654 cm dia x 5.7 cm long; density 0.901 g cm ⁻³ .

DATA TABLE NO. 343 THERMAL CONDUCTIVITY OF BOXWOOD

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1

293.2 0.00149
373.2 0.00173

* No graphical presentation

SPECIFICATION TABLE NO. 344 THERMAL CONDUCTIVITY OF CEDAR

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	293.2	1		0.230 in. thick; specific gravity 0.49, moisture content 13.4%; measured under a load of 21 psi; heat flow perpendicular to grain and tangent to the annual rings.
2	125	L	1923	293.2	1		Similar to above but 0.200 in. thick, specific gravity 0.48, and moisture content 12.7%.
3	125	L	1923	293.2	1		Similar to above but 0.197 in. thick, moisture content 10.6%.

DATA TABLE NO. 344 THERMAL CONDUCTIVITY OF CEDAR

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

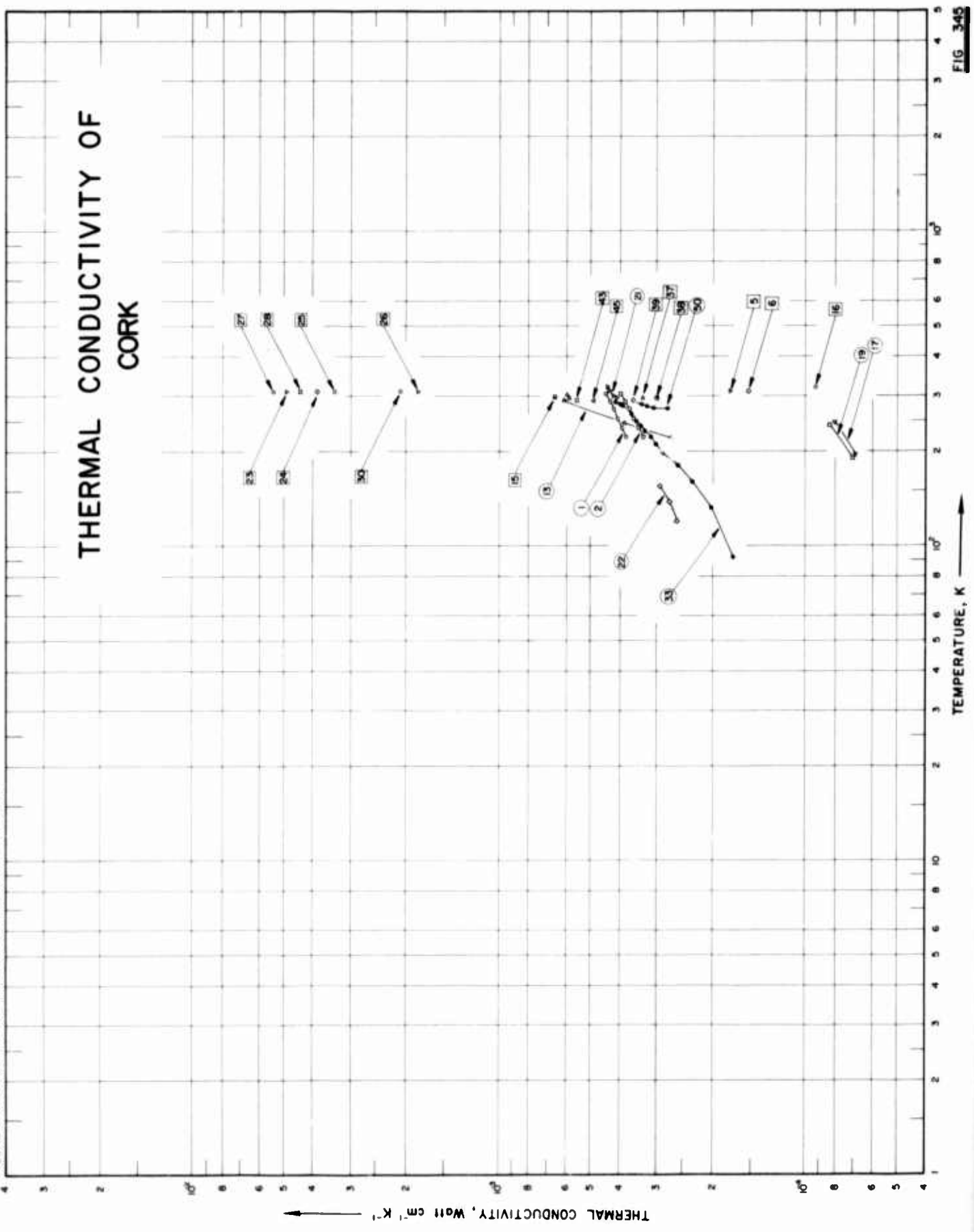
T k
CURVE 1*
 293.2 0.00121
CURVE 2*
 293.2 0.00105
CURVE 3*
 293.2 0.00116

* No graphical presentation

FIG. 3-45

THERMAL CONDUCTIVITY OF CORK

FIGURE SHOWS ONLY 25 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 345 THERMAL CONDUCTIVITY OF CORK

[For Data Reported in Figure and Table No. 345]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	109	L	1947	222-306				Thickness of specimen 1 in.; oven dried; density 0.195 g cm ⁻³ .
2	109	L	1947	222-306				Thickness of specimen 1 in.; oven dried; density 0.128 g cm ⁻³ .
3	109	L	1947	222-306				Thickness of specimen 1 in.; oven dried; density 0.104 g cm ⁻³ .
4	558	L	1951	310.9				Thickness of specimen 1 in.; density 0.107 g cm ⁻³ at 25 C.
5	558	L	1951	310.9				Thickness of specimen 1 in.; density 0.107 g cm ⁻³ at 25 C; measured in a vacuum of 0.08 μ Hg.
6	558	L	1951	310.9				Thickness of specimen 1 in.; density 0.107 g cm ⁻³ at 25 C; measured in a vacuum of 0.06 μ Hg.
7	558	L	1951	310.9				Thickness of specimen 1 in.; density 0.199 g cm ⁻³ at 25 C.
8	558	L	1951	310.9				Thickness of specimen 1 in.; density 0.199 g cm ⁻³ at 25 C; measured in a vacuum of 0.13 μ Hg.
9	558	L	1951	222-305				Thickness of specimen 1 in.; density 0.195 g cm ⁻³ at 25 C.
10	558	L	1951	222-305				Thickness of specimen 1 in.; density 0.128 g cm ⁻³ at 25 C.
11	558	L	1951	222-305				Thickness of specimen 1 in.; density 0.104 g cm ⁻³ at 25 C.
12	189		1950	200-289				Density 0.120-0.160 g cm ⁻³ ; water absorption (24 hrs submerged) 5.2 vol %.
13	493	R	1949	222-302		A		Uniformly carbonized; bulk density 0.208 g cm ⁻³ .
14	493	C	1949	220, 296		B		20 x 20 x 8 cm; uniformly carbonized; bulk density 0.208 g cm ⁻³ ; cork board A used as comparative material.
15	493	C	1949	295.2		B		20 x 20 x 8 cm; over-carbonized; bulk density 0.138 g cm ⁻³ ; same comparative material as above.
16	128	L	1946	319.3		A		2.02 in. thick; dry; density 0.113 g cm ⁻³ .
17	128	L	1946	195, 248		A		Similar to above except 1.12 in. thick.
18	128	L	1946	322.6		B		1.99 in. thick; dry; density 0.107 g cm ⁻³ .
19	128	L	1946	192, 244		B		Similar to above except 1.04 in. thick.
20	559	L	1957	289-313				Density 0.123 g cm ⁻³ .
21	559	L	1957	296-320				Density 0.138 g cm ⁻³ .
22	43	L	1954	120-155				Density 0.151 g cm ⁻³ .
23	560	L	1954	310.9				Specimen 1 in. thick; density 0.107 g cm ⁻³ ; measured in air.
24	560	L	1954	310.9				The above specimen measured in CO ₂ .
25	560	L	1954	310.9				The above specimen measured in F-12.

SPECIFICATION TABLE NO. 345 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
26	560	L	1954	310.9			The above specimen measured in vacuum.
27	560	L	1954	310.9			Specimen 1 in. thick; density 0.199 g cm ⁻³ ; measured in air.
28	560	L	1954	310.9			The above specimen measured in CO ₂ .
29	560	L	1954	310.9			The above specimen measured in F-12.
30	560	L	1954	310.9			The above specimen measured in vacuum.
31	100	L	1957	323.332			Bulk density 0.284 g cm ⁻³ .
32	534	L	1961	271.5			9 x 9 x 1 in.; density 0.128 g cm ⁻³ .
33	561	R	1948	92-288		1A	Granulated slab specimen packed into a hollow cylinder of 2 in. I.D. and 10 in. O.D.; baked; grain size 49.5% 10-20 mesh and 50.5% through 20 mesh; bulk density 0.101-0.103 g cm ⁻³ .
34	561	R	1948	190.5		1A	The above specimen repacked; bulk density 0.103 g cm ⁻³ .
35	561	R	1948	189.8		1B	Similar to the above specimen but grain size 4-10 mesh and bulk density 0.0865 g cm ⁻³ .
36	530	L	1956	297.1			Expanded; 20 cm dia x 2.5 cm long; density 0.160 g cm ⁻³ ; measured in air.
37	530	L	1956	296.6			The above specimen measured in CO ₂ .
38	530	L	1956	296.2			The above specimen measured in CH ₃ Cl.
39	529	P	1956	290.4			Moisture content 3.0%; thermal conductivity data calculated from measured transient temp change.
40	529	P	1956	290.4			Similar to the above specimen but moisture content 10.0%.
41	529	P	1956	290.4			Density 0.208 g cm ⁻³ ; same measuring method as above.
42	529	P	1956	290.4			Density 0.112 g cm ⁻³ ; moisture content 2.5%; same measuring method as above.
43	529	P	1956	290.9			Density 0.336 g cm ⁻³ ; moisture content 2.0%; same measuring method as above.
44	529	P	1956	290.9			Density 0.128 g cm ⁻³ ; moisture content 3.0%; same measuring method as above.
45	529	P	1956	290.9			Similar to the above specimen but moisture content 8.0%.
46	529	P	1956	290.4			Granulated; baked; grain size 2-3 mesh; density 0.0961 g cm ⁻³ ; moisture content 8.0%; same measuring method as above.
47	529	P	1956	290.4			The above specimen dried for 36 hrs.
48	529	P	1956	290.4			Granulated, baked; grain size 4-6 mesh; water content 3.0%; density 0.144 g cm ⁻³ ; same measuring method as above.

SPECIFICATION TABLE NO. 345 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
49	529	P	1956	290.4			The above specimen dried for 36 hrs.
50	529	P	1956	274-290			Slab cork 3 in. x 3 in. x 6 in.; wrapped in "polythene"; density 0.128 g cm ⁻³ ; moisture content 2.3%; same measuring method as above.
51	529	P	1956	278-290			The above specimen after drying out for 48 hrs and cooling for 72 hrs.

DATA TABLE NO. 345 THERMAL CONDUCTIVITY OF CORK

(Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹)

T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 1</u>													
222.0	0.000381	222.2	0.000381	295.2	0.000661	120	0.000260	92.2	0.000171	290.4	0.000462	278.2	0.000309
238.7	0.000394	239.2	0.000394	<u>CURVE 16</u>		138	0.000274	132.2	0.000202	<u>CURVE 41*</u>		280.4	0.000312
255.4	0.000407	255.5	0.000407	155	0.000293	<u>CURVE 23</u>		160.2	0.000234	<u>CURVE 42*</u>		283.2	0.000309
272.2	0.000421	272.1	0.000421	319.3	0.000924	<u>CURVE 24</u>		181.7	0.000258	<u>CURVE 43</u>		287.1	0.000352
288.9	0.000433	288.8	0.000433	<u>CURVE 17</u>		310.9	0.00490	198.2	0.000287	<u>CURVE 44*</u>		288.7	0.000372
305.5	0.000446	305.3	0.000446	<u>CURVE 18*</u>		310.9	0.00384	211.2	0.000301	<u>CURVE 45</u>		289.8	0.000387
<u>CURVE 2</u>													
222.0	0.000333	222.2	0.000331	195.4	0.0000693	<u>CURVE 25</u>		232.4	0.000327	<u>CURVE 46*</u>			
238.7	0.000346	239.2	0.000346	247.6	0.0000803	<u>CURVE 26</u>		241.2	0.000339	<u>CURVE 47*</u>			
255.4	0.000359	255.5	0.000359	<u>CURVE 19*</u>		310.9	0.00337	248.9	0.000351	<u>CURVE 48*</u>			
272.2	0.000372	272.1	0.000372	322.6	0.0000910	<u>CURVE 27</u>		256.0	0.000357*	<u>CURVE 49*</u>			
288.9	0.000385	288.8	0.000385	<u>CURVE 20*</u>		310.9	0.00443	262.4	0.000365	<u>CURVE 50</u>			
305.5	0.000398	305.3	0.000398	289.1	0.000397	<u>CURVE 28</u>		268.4	0.000372*	<u>CURVE 51*</u>			
<u>CURVE 3*</u>													
222.0	0.000320	222.2	0.000320	289.3	0.000395	<u>CURVE 29*</u>		273.9	0.000377*	<u>CURVE 52</u>			
238.7	0.000336	239.2	0.000336	290	0.000396	<u>CURVE 30</u>		279.0	0.000393	<u>CURVE 53</u>			
255.4	0.000352	255.5	0.000352	289.6	0.000397	<u>CURVE 31*</u>		283.5	0.000398	<u>CURVE 54</u>			
272.2	0.000368	272.1	0.000368	290	0.000396	<u>CURVE 32*</u>		287.7	0.000417	<u>CURVE 55</u>			
288.9	0.000384	288.8	0.000384	291.1	0.000398	<u>CURVE 33</u>		<u>CURVE 34*</u>		<u>CURVE 56*</u>			
305.5	0.000400	305.3	0.000400	289.1	0.000399	<u>CURVE 34*</u>		190.5	0.000280	<u>CURVE 57*</u>			
<u>CURVE 4*</u>													
310.9	0.000408	200.0	0.000317	289.6	0.000395	<u>CURVE 35*</u>		189.8	0.000291	<u>CURVE 58*</u>			
<u>CURVE 5</u>													
310.9	0.000175	222.2	0.000332	290	0.000396	<u>CURVE 36*</u>		297.1	0.000415	<u>CURVE 59*</u>			
<u>CURVE 6</u>													
310.9	0.000153	239.2	0.000346	290	0.000396	<u>CURVE 37</u>		290.4	0.000430	<u>CURVE 60*</u>			
<u>CURVE 7*</u>													
310.9	0.000453	255.5	0.000361	290	0.000396	<u>CURVE 38</u>		296.6	0.000334	<u>CURVE 61*</u>			
<u>CURVE 8*</u>													
310.9	0.000173	272.1	0.000375	311.1	0.000419	<u>CURVE 39</u>		290.4	0.000361	<u>CURVE 62*</u>			
<u>CURVE 9*</u>													
310.9	0.000153	288.8	0.000389	311.1	0.000420	<u>CURVE 40*</u>		287.1	0.000368*	<u>CURVE 63*</u>			
<u>CURVE 10*</u>													
221.7	0.000271	221.7	0.000271	312.9	0.000419	<u>CURVE 41*</u>		290.4	0.000447	<u>CURVE 64*</u>			
246.7	0.000389	246.7	0.000389	<u>CURVE 21*</u>		310.9	0.00208	294.2	0.000348	<u>CURVE 65</u>			
290.2	0.000615	290.2	0.000615	296.2	0.000300	<u>CURVE 31*</u>		274.2	0.000277	<u>CURVE 66*</u>			
294.2	0.000586	294.2	0.000586	322.6	0.000433	<u>CURVE 32*</u>		275.9	0.000307	<u>CURVE 67*</u>			
302.2	0.000598	302.2	0.000598	331.5	0.000476	<u>CURVE 33*</u>		277.6	0.000313*	<u>CURVE 68*</u>			
<u>CURVE 11*</u>													
219.7	0.000258	219.7	0.000258	290.4	0.000361	<u>CURVE 34*</u>		282.6	0.000337	<u>CURVE 69*</u>			
295.7	0.000594	295.7	0.000594	310.2	0.000435*	<u>CURVE 35*</u>		284.8	0.000346*	<u>CURVE 70*</u>			
<u>CURVE 12*</u>													
319.0	0.000443*	319.0	0.000443*	312.2	0.000435	<u>CURVE 36*</u>		287.1	0.000368*	<u>CURVE 71*</u>			
320.2	0.000443	320.2	0.000443	271.5	0.000490	<u>CURVE 37*</u>		287.1	0.000368*	<u>CURVE 72*</u>			
<u>CURVE 13</u>													
221.7	0.000271	221.7	0.000271	290.4	0.000361	<u>CURVE 38</u>		287.1	0.000368*	<u>CURVE 73*</u>			
246.7	0.000389	246.7	0.000389	310.2	0.000435*	<u>CURVE 39</u>		287.1	0.000368*	<u>CURVE 74*</u>			
290.2	0.000615	290.2	0.000615	312.2	0.000435	<u>CURVE 40*</u>		287.1	0.000368*	<u>CURVE 75*</u>			
294.2	0.000586	294.2	0.000586	320.2	0.000443	<u>CURVE 41*</u>		287.1	0.000368*	<u>CURVE 76*</u>			
302.2	0.000598	302.2	0.000598	290.4	0.000361	<u>CURVE 42*</u>		287.1	0.000368*	<u>CURVE 77*</u>			
<u>CURVE 14*</u>													
219.7	0.000258	219.7	0.000258	290.4	0.000361	<u>CURVE 43*</u>		287.1	0.000368*	<u>CURVE 78*</u>			
295.7	0.000594	295.7	0.000594	310.2	0.000435*	<u>CURVE 44*</u>		287.1	0.000368*	<u>CURVE 79*</u>			
<u>CURVE 15*</u>													
319.0	0.000443*	319.0	0.000443*	290.4	0.000361	<u>CURVE 45*</u>		287.1	0.000368*	<u>CURVE 80*</u>			
320.2	0.000443	320.2	0.000443	310.2	0.000435*	<u>CURVE 46*</u>		287.1	0.000368*	<u>CURVE 81*</u>			

* Not shown on plot

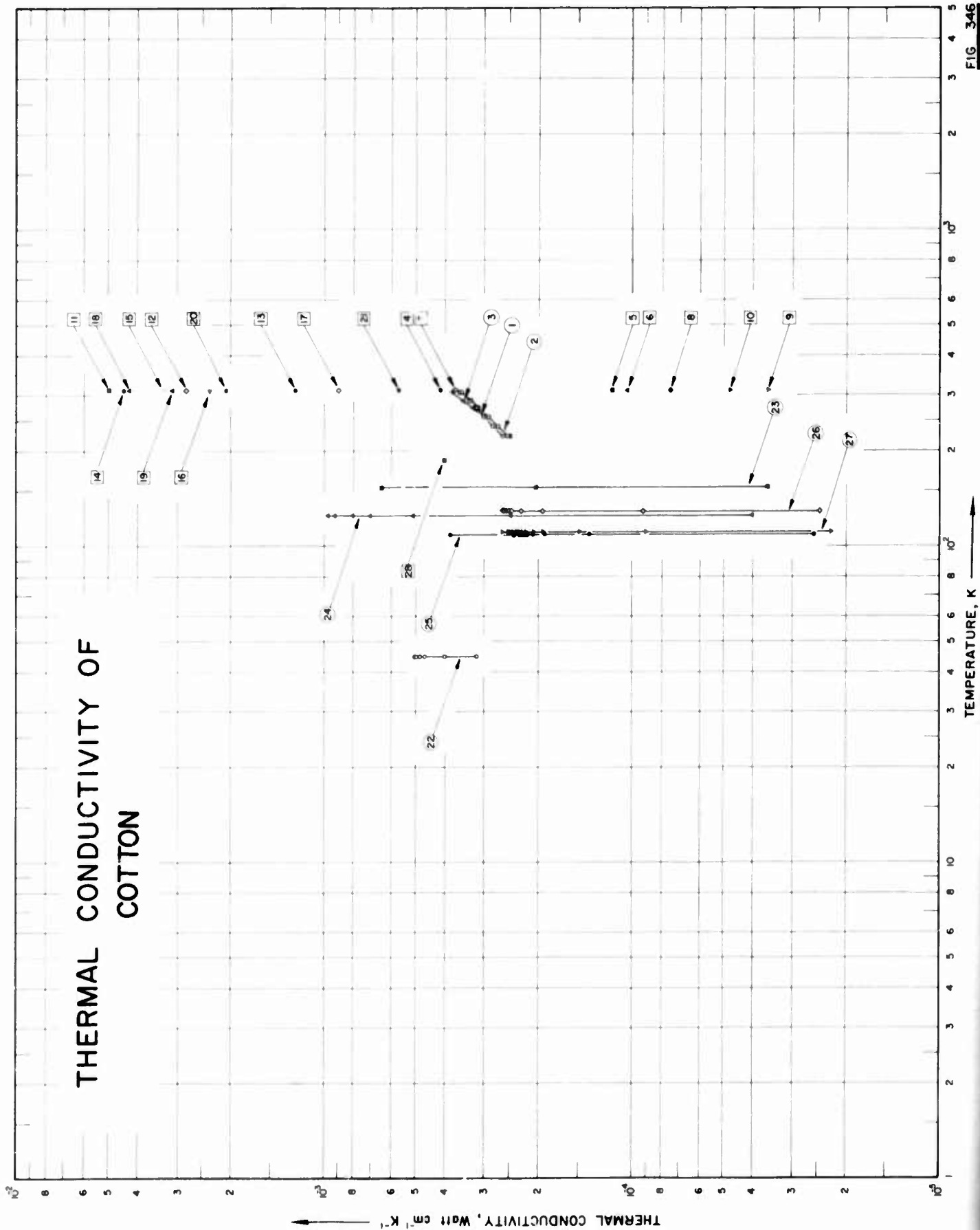


FIG. 345

SPECIFICATION TABLE NO. 346 THERMAL CONDUCTIVITY OF COTTON

[For Data Reported in Figure and Table No. 346]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-305			Specimen 1 in. thick; density 0.0424 g cm ⁻³ , as received.
2	109	L	1947	222-305			Specimen 1 in. thick; density 0.0245 g cm ⁻³ , as received.
3	109	L	1947	222-305			Specimen 1 in. thick; density 0.0152 g cm ⁻³ , as received.
4	558	L	1951	310.9			8 x 8 x 1 in.; density 0.0125 g cm ⁻³ at 25 C.
5	558	L	1951	310.9			The above specimen measured in a vacuum of 0.11 μ Hg.
6	558	L	1951	310.9			The above specimen measured in a vacuum of 0.07 μ Hg.
7	558	L	1951	310.9			8 x 8 x 1 in.; density 0.0245 g cm ⁻³ at 25 C.
8	558	L	1951	310.9			The above specimen measured in a vacuum of 0.12 μ Hg.
9	558	L	1951	310.9			8 x 8 x 1 in.; density 0.0420 g cm ⁻³ at 25 C.
10	558	L	1951	310.9			The above specimen measured in a vacuum of 0.14 μ Hg.
11	560	L	1954	310.9			Specimen 1 in. thick; density 0.0125 g cm ⁻³ , measured in F-12.
12	560	L	1954	310.9			Specimen 1 in. thick; density 0.0245 g cm ⁻³ , measured in CO ₂ .
13	560	L	1954	310.9			The above specimen measured in F-12.
14	560	L	1954	310.9			Specimen 1 in. thick; density 0.0420 g cm ⁻³ , measured in CO ₂ .
15	560	L	1954	310.9			The above specimen measured in F-12.
16	122	R	1953	49.4		Medical cotton	Filled with hydrogen; measured under various hydrogen pressures ranging from 0.322 to 322.0 mm Hg.
17	122	R	1953	154.8		Medical cotton	Filled with hydrogen; measured under various hydrogen pressures ranging from 0.0089 to 0.791 mm Hg.
18	122	R	1953	125.1		Medical cotton	Filled with hydrogen; measured under various hydrogen pressures ranging from 0.0104 to 501.4 mm Hg.
19	122	R	1953	109.2		Medical cotton	Filled with nitrogen; measured under various nitrogen pressures ranging from 0.0090 to 831.8 mm Hg.
20	122	R	1953	128.5		Medical cotton	Filled with nitrogen; measured under various nitrogen pressures ranging from 0.0084 to 800.0 mm Hg.
21	122	R	1953	111.0		Medical cotton	Measured in air under various atmospheric pressures ranging from 0.0080 to 708.0 mm Hg.
22	122	R	1953	49.4		Medical cotton	Specimen contained between a solid copper ball and a concentric spherical shell of dia 2 in. and 5 in., respectively; measured in hydrogen at pressures ranging from 0.322 to 322.0 mm Hg.

SPECIFICATION TABLE NO. 346 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
23	122	R	1953	154.8		Medical cotton	Similar to above except measured in hydrogen at pressures ranging from 0.0089 to 0.791 mm Hg.
24	122	R	1953	125.1		Medical cotton	Similar to above except measured in hydrogen at pressures ranging from 0.0104 to 501.4 mm Hg.
25	122	R	1953	109.2		Medical cotton	Similar to above except measured in nitrogen at pressures ranging from 0.0090 to 831.8 mm Hg.
26	122	R	1953	128.5		Medical cotton	Similar to above except measured in nitrogen at pressures ranging from 0.0084 to 800.0 mm Hg.
27	122	R	1953	111.0		Medical cotton	Similar to above except measured in air at pressures ranging from 0.0080 to 986.3 mm Hg.
28	561	R	1948	186.5		Cotton waste	Tangled thread form; packed in a hollow cylinder of 2 in. I. D. and 10 in. O. D.; bulk density 0.131 g cm ⁻³ .

DATA TABLE NO. 346 THERMAL CONDUCTIVITY OF COTTON

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k
<u>CURVE 1</u>							
222.0	0.000264	310.9	0.000358	310.9	0.000571	398.0	0.000229*
238.7	0.000281	<u>CURVE 10</u>		p(mm Hg) k		603.6	0.000233
255.4	0.000300	310.9	0.000476	<u>CURVE 22</u>		798.0	0.000243
272.2	0.000319	<u>CURVE 11</u>		T = 49.4 K		831.8	0.000388
288.9	0.000336	310.9	0.000498	0.322	0.000318	<u>CURVE 26</u>	
305.5	0.000355	310.9	0.00498	1.03	0.000401	T = 128.5 K	
<u>CURVE 2</u>							
222.0	0.000254	<u>CURVE 12</u>		7.00	0.000469	0.0084	0.0000246
238.7	0.000271	310.9	0.00284	28.0	0.000486	0.0837	0.0000927
255.4	0.000291	<u>CURVE 13</u>		62.9	0.000491*	0.838	0.000195
272.2	0.000312	310.9	0.00125	195.9	0.000495*	4.00	0.000230
288.9	0.000332	<u>CURVE 14</u>		396.3	0.000500	20.0	0.000248
305.5	0.000356	310.9	0.00125	322.0	0.000506	50.0	0.000252
<u>CURVE 3</u>							
222.0	0.000250	<u>CURVE 15</u>		<u>CURVE 23</u>		402.7	0.000256*
238.7	0.000275	310.9	0.00445	T = 154.8 K		602.7	0.000262
255.4	0.000300*	<u>CURVE 16</u>		0.0089	0.000360	800.0	0.000264
272.2	0.000327	310.9	0.00332	0.0847	0.000205	<u>CURVE 27</u>	
288.9	0.000353	<u>CURVE 17</u>		0.791	0.000653	T = 111 K	
305.5	0.000384	310.9	0.00332	<u>CURVE 24</u>		0.0080	0.0000225
<u>CURVE 4</u>							
310.9	0.000415	<u>CURVE 18</u>		T = 125.1 K		0.0721	0.0000903
<u>CURVE 5</u>							
310.9	0.000116	310.9	0.00236	0.0104	0.0000405	0.330	0.000149
<u>CURVE 6</u>							
310.9	0.000104	310.9	0.00429	0.243	0.000250	1.61	0.000194
<u>CURVE 7</u>							
310.9	0.00371	310.9	0.00312	0.625	0.000515	4.00	0.000208
<u>CURVE 8</u>							
310.9	0.0000750	310.9	0.00220	2.01	0.000711	20.0	0.000222
		310.9	0.00208	4.00	0.000812	50.0	0.000225
				35.0	0.000933	200.9	0.000229*
				303.4	0.000983	394.5	0.000231*
				501.4	0.000987	597.0	0.000235
				<u>CURVE 25</u>		625.2	0.000235*
				T = 109.2 K		746.4	0.000239
				0.0090	0.0000258	918.2	0.000249
				0.266	0.000138	201.8	0.000229*
				1.48	0.000192	400.9	0.000230*
				5.00	0.000210	602.6	0.000235*
				20.0	0.000220	743.0	0.000239*
				50.0	0.000224	986.3	0.000264
				200.0	0.000227	760.3	0.000252
						708.0	0.000242

* Not shown on plot

SPECIFICATION TABLE NO. 347 THERMAL CONDUCTIVITY OF FAT

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	562	R	1954	293.333		Beef fat	No details reported.
2	562	R	1954	293.2		Bone fat	No details reported.
3	562	R	1954	293.2		Pig fat	No details reported.

DATA TABLE NO. 347 THERMAL CONDUCTIVITY OF FAT
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*293.2 0.00354
333.2 0.00175CURVE 2*

293.2 0.00186

CURVE 3*

293.2 0.00238

* No graphical presentation

SPECIFICATION TABLE NO. 348 THERMAL CONDUCTIVITY OF FIR

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	293.2			Specific gravity 0.6; moisture content 15%; measured under a load of 21 psi; heat flow perpendicular to the grain.

DATA TABLE NO. 348 THERMAL CONDUCTIVITY OF FIR

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1

293.2 0.00117

* No graphical presentation

SPECIFICATION TABLE NO. 349 THERMAL CONDUCTIVITY OF GREENHEART

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	44	F	1914	293, 373			0.668 cm dia x 7.5 cm long; density 1.08 g cm ⁻³ .

DATA TABLE NO. 349 THERMAL CONDUCTIVITY OF GREENHEART

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*293.2 0.00469
373.2 0.00460

* No graphical presentation

SPECIFICATION TABLE NO. 350 THERMAL CONDUCTIVITY OF HARDWOOD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	596	L	1951	292-325			No details reported.
2	596	C	1951	328.8			3 in. dia x 0.25 in. thick; Armco iron used as comparative material.

DATA TABLE NO. 350 THERMAL CONDUCTIVITY OF HARDWOOD

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
292.4	0.00154
316.3	0.00155
317.8	0.00154
324.7	0.00154
<u>CURVE 2</u>	
328.8	0.00152

* No graphical presentation

SPECIFICATION TABLE NO. 351 THERMAL CONDUCTIVITY OF IVORY

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	353.2	1	African ivory	Measured under a load of 113 psi; heat flow perpendicular to the axis.
2	125	L	1923	353.2	1	African ivory	Similar to the above specimen.
3	125	L	1923	353.2	1	African ivory	Similar to the above specimen except thickness 0.174 cm; heat flow parallel to the axis.

DATA TABLE NO. 351 THERMAL CONDUCTIVITY OF IVORY

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
353.2	0.00452
<u>CURVE 2*</u>	
353.2	0.00523
<u>CURVE 3*</u>	
353.2	0.00573

* No graphical presentation

SPECIFICATION TABLE NO. 352 THERMAL CONDUCTIVITY OF KAPOK

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	558	L	1951	310.9			1 in. thick; density 0.00416 g cm ⁻³ at 25 C; measured in air at various air pressures ranging from 12.7 to 743.0 mm Hg.
2	559		1951	310.9			1 in. thick; density 0.0159 g cm ⁻³ at 25 C; measured in air at 1 atm.
3	558	L	1951	310.9			The above specimen measured in a vacuum of 0.1 μ Hg.
4	558	L	1951	310.9			1 in. thick; density 0.0634 g cm ⁻³ at 25 C; measured in air at 1 atm.
5	558	L	1951	310.9			The above specimen measured in a vacuum of 0.12 μ Hg.
6	560	L	1954	310.9			1 in. thick; density 0.00416 g cm ⁻³ ; measured in air.
7	560	L	1954	310.9			The above specimen measured in CO ₂ .
8	560	L	1954	310.9			The above specimen measured in F-12.
9	560	L	1954	310.9			The above specimen measured in vacuum.
10	560	L	1954	310.9			1 in. thick; density 0.0159 g cm ⁻³ ; measured in CO ₂ .
11	560	L	1954	310.9			The above specimen measured in F-12.
12	560	L	1954	310.9			1 in. thick; density 0.0634 g cm ⁻³ ; measured in CO ₂ .
13	560	L	1954	310.9			The above specimen measured in F-12.
14	560	L	1954	310.9			1 in. thick; density 0.00416 g cm ⁻³ ; measured in air with various % content of CO ₂ .
15	560	L	1954	310.9			The above specimen measured in air with various % content of F-12.

DATA TABLE NO. 352 THERMAL CONDUCTIVITY OF KAPOK
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

ρ (mm Hg)	k	T	k
	<u>CURVE 1*</u> (\bar{T} = 310.9K)	<u>CURVE 11*</u>	
12.7	0.000513	310.9	0.00214
236.2	0.000516		<u>CURVE 12*</u>
490.2	0.000516	310.9	0.00292
743.0	0.000516		<u>CURVE 13*</u>
T	k		
	<u>CURVE 2*</u>	310.9	0.00199
310.9	0.000353	% of CO ₂	k
	<u>CURVE 3*</u>	in air	
310.9	0.0000541		<u>CURVE 14*</u> (\bar{T} = 310.9K)
	<u>CURVE 4*</u>	0	0.00625
310.9	0.000352	25	0.00599
	<u>CURVE 5*</u>	50	0.00561
310.9	0.0000252	75	0.00535
	<u>CURVE 6*</u>	100	0.00505
		% of F-12	k
		in air	
			<u>CURVE 15*</u> (\bar{T} = 310.9K)
			0
			6.00625
			25
			0.00531
			50
			0.00467
			75
			0.00427
			100
			0.00395
			<u>CURVE 7*</u>
			310.9
			0.00509
			<u>CURVE 8*</u>
			310.9
			0.00403
			<u>CURVE 9*</u>
			310.9
			0.00157
			<u>CURVE 10*</u>
			310.9
			0.00395

* No graphical presentation

SPECIFICATION TABLE NO. 353 THERMAL CONDUCTIVITY OF LIGNUM VITAE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	44	F	1914	293, 373			0.668 cm dia x 6.8 cm long; density 1.16 g cm ⁻³ .

DATA TABLE NO. 353 THERMAL CONDUCTIVITY OF LIGNUM VITAE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
293.2	0.00253
373.2	0.00300

CURVE T*

* No graphical presentation

SPECIFICATION TABLE NO. 354 THERMAL CONDUCTIVITY OF MAHOAGANY

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	44	F	1914	293.373			0.65 cm dia x 5.5 cm long; density 0.55 g cm ⁻³ .
2	125	L	1923	293.2	1		Sp. gravity 0.70; moisture content 15%; heat flow parallel to grain.
3	125	L	1923	293.2	1		Sp. gravity 0.70; moisture content 15%; heat flow perpendicular to grain, radial to annual rings.
4	125	L	1923	293.2	1		Sp. gravity 0.70; moisture content 15%; heat flow perpendicular to grain, tangential to annual rings.

DATA TABLE NO. 354 THERMAL CONDUCTIVITY OF MAHOAGANY

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
293.2	0.00213
373.2	0.00253
<u>CURVE 2*</u>	
293.2	0.00310
<u>CURVE 3*</u>	
293.2	0.00167
<u>CURVE 4*</u>	
293.2	0.00155

* No graphical presentation

SPECIFICATION TABLE NO. 355 THERMAL CONDUCTIVITY OF MAPLE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1920	293, 323			9 in. dia x 0.733 in. thick; specific gravity 0.72; heat flow along grain.
2	108	L	1920	323.2			Similar to the above specimen except thickness 0.508 in.

DATA TABLE NO. 355 THERMAL CONDUCTIVITY OF MAPLE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*293.2 0.00425
323.2 0.00434CURVE 2*

323.2 0.00192

* No graphical presentation

SPECIFICATION TABLE NO. 356 THERMAL CONDUCTIVITY OF OAK

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	108	L	1920	323.2		White oak	9 in. dia x 0.516 in. thick; specific gravity 0.60; heat flow across grain.
2	108	L	1920	328.2		White oak	Similar to the above specimen but thickness 0.754 in.
3	44	F	1914	293, 373		0.65 in. dia x 6.3 cm long; density 0.65 g cm ⁻³ .	
4	125	L	1923	293.2	1		Specific gravity 0.60; moisture content 14%; heat flow perpendicular to grain and tangent to annual rings.

DATA TABLE NO. 356 THERMAL CONDUCTIVITY OF OAK

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
323.2	0.00190
<u>CURVE 2*</u>	
328.2	0.00395
<u>CURVE 3*</u>	
293.2	0.00244
373.2	0.00254
<u>CURVE 4*</u>	
293.2	0.00117

* No graphical presentation

SPECIFICATION TABLE NO. 357 THERMAL CONDUCTIVITY OF PINES

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	108	L	1920	343.2		White pine	9 in. dia by 0.519 in. thick; specific gravity 0.45; heat flow in longitudinal direction.
2	108	L	1920	328.2		White pine	Similar to the above specimen but thickness 0.732 in.
3	125	L	1923	293.2		Pitch pine	Moisture content 15%; measured under a load of 21 psi.
4	109	L	1947	222-306			1.25 in. thick, density 0.396 g cm ⁻³ ; as received.

DATA TABLE NO. 357 THERMAL CONDUCTIVITY OF PINES

[Temperature, T, K, Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

343.2 0.00107

CURVE 2*

328.2 0.00256

CURVE 3*

293.2 0.00138

CURVE 4*

222.0 0.000886
 238.7 0.000913
 255.4 0.000939
 272.2 0.000966
 288.9 0.000994
 305.5 0.00102

* No graphical presentation

SPECIFICATION TABLE NO. 358 THERMAL CONDUCTIVITY OF REDWOOD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	563	L	1945	222-305		Redwood bark	Thickness of specimen 1 in.; density 0.0641 g cm ⁻³ ; as received.
2	128	L	1946	318.7		Redwood bark	Shredded bark; 2.00 in. thick; density 0.0625 g cm ⁻³ .
3	128	L	1946	189.242		Redwood bark	Shredded bark; 1.00 in. thick; density 0.0641 g cm ⁻³ .

DATA TABLE NO. 358 THERMAL CONDUCTIVITY OF REDWOOD

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

222.2 0.000286
 239.2 0.000307
 255.5 0.000330
 272.1 0.000356
 288.8 0.000379
 305.3 0.000407

CURVE 2*

318.7 0.000107

CURVE 3*

189.3 0.0000593
 241.5 0.0000717

* No graphical presentation

SPECIFICATION TABLE NO. 359 THERMAL CONDUCTIVITY OF SAWDUST

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	529	P	1956	290.4			Dry mixed timbers; density 0.128 g cm^{-3} ; thermal conductivity data calculated from measured transient temperature changes.
2	529	P	1956	290.4			Similar to the above specimen except density 0.224 g cm^{-3} .

DATA TABLE NO. 359 THERMAL CONDUCTIVITY OF SAWDUST

[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1*

290.4 0.000505

CURVE 2*

290.4 0.000699

* No graphical presentation

SPECIFICATION TABLE NO. 360 THERMAL CONDUCTIVITY OF SPRUCE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	373.2	1		Specimen gradually dried out in an electric oven maintained at 100 C; measurements taken with various reducing moisture contents; heat flow across the grain and radial to the annual rings.
2	125	L	1923	293.2	1		Specific gravity 0.41; moisture content 16%; heat flow along grain.
3	125	L	1923	293.2	1		Similar to the above specimen except heat flow perpendicular to the grain and radial to the annual rings.
4	125	L	1923	293.2	1		Similar to the above specimen except heat flow perpendicular to the grain and tangent to the annual rings.

DATA TABLE NO. 360 THERMAL CONDUCTIVITY OF SPRUCE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

Moisture content(%)	k	T	k
<u>CURVE 1*</u>			
(T = 373.2K)			
3.40	0.00122	293.2	<u>CURVE 3*</u>
5.80	0.00126		
7.70	0.00129	293.2	<u>CURVE 4*</u>
9.95	0.00133		
17.00	0.00142		
T	k		
<u>CURVE 2*</u>			
293.2	0.00222		

* No graphical presentation

SPECIFICATION TABLE NO. 361 THERMAL CONDUCTIVITY OF TEAK

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	293.2	1		Specific gravity 0.72; moisture content 10%; measured under a load of 21 psi; heat flow perpendicular to grain and tangent to annual rings.

DATA TABLE NO. 361 THERMAL CONDUCTIVITY OF TEAK

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

293.2 0.00138

* No graphical presentation

SPECIFICATION TABLE NO. 362 THERMAL CONDUCTIVITY OF VULCANIZED FIBER

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	323.2	1		Measured under a load of 21 psi.
2	125	L	1923	323.2	1		Similar to above.

DATA TABLE NO. 362 THERMAL CONDUCTIVITY OF VULCANIZED FIBER

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u> *	
323.2	0.00209
<u>CURVE 2</u> *	
323.2	0.00335

* No graphical presentation

SPECIFICATION TABLE NO. 363 THERMAL CONDUCTIVITY OF WALNUT

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	44	F	1914	293.373		Satin walnut	Density 0.5 g cm ⁻³ , measured along grain.
2	44	F	1914	293.373		Satin walnut	Similar to the above specimen.
3	125	L	1923	293.2	1		Heat flow across the grain and tangent to the annual rings; measured under various load ranging from 33.2 to 61.1 psi.
4	125	L	1923	293.2	1		The above specimen measured at decreasing loads ranging from 61.1 to 23.2 psi.
5	125	L	1923	293.8	1		0.0593 cm thick; measured under a load of 21 psi.
6	125	L	1923	294.4	1		Similar to above except thickness 0.0913 cm.
7	125	L	1923	291.4	1		Similar to above except thickness 0.1503 cm.
8	125	L	1923	293.2	1		Specific gravity 0.65; moisture content 11.8%; measured under a load of 21 psi; heat flow along grain.
9	125	L	1923	293.2	1		Specific gravity 0.65; moisture content 12.1%; measured under a load of 21 psi; heat flow perpendicular to grain and radial to annual rings.
10	125	L	1923	293.2	1		Specific gravity 0.65; moisture content 11.3%; measured under a load of 21 psi; heat flow perpendicular to grain and tangent to annual rings.

DATA TABLE NO. 363 THERMAL CONDUCTIVITY OF WALNUT

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	p (psi)	k	T	k	T	k	T	k
<u>CURVE 1*</u>		<u>CURVE 3*</u>		<u>CURVE 4*</u>		<u>CURVE 5*</u>		<u>CURVE 7*</u>	
293.2	0.00182			(T = 293.2K)					
373.2	0.00227	33.2	0.00137	293.8	0.00136	291.4	0.00136	293.2	0.00145
		46.1	0.00138						
		61.1	0.00137						
<u>CURVE 2*</u>		<u>CURVE 6*</u>		<u>CURVE 8*</u>		<u>CURVE 9*</u>		<u>CURVE 10*</u>	
293.2	0.000669	46.1	0.00138	294.4	0.00137	293.2	0.00332	293.2	0.00136
373.2	0.00104	61.1	0.00137						

* No graphical presentation

SPECIFICATION TABLE NO. 364 THERMAL CONDUCTIVITY OF WHITE WOOD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	44	F	1914	293, 373		American white wood	0.65 cm dia x 6.5 cm long; density 0.575 g cm ⁻³ .

DATA TABLE NO. 364 THERMAL CONDUCTIVITY OF WHITE WOOD

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
	<u>CURVE 1*</u>
293.2	0.00170
373.2	0.00187

* No graphical presentation

SPECIFICATION TABLE NO. 365 THERMAL CONDUCTIVITY OF WOOD FIBERS

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	558	L	1951	310.9			Fiber; 1 in. thick; density 0.056 g cm ⁻³ at 25 C; measured in air.
2	558	L	1951	310.9			The above specimen measured in a vacuum of 0.08 μ Hg.
3	558	L	1951	310.9			Fiber; 1 in. thick; density 0.111 g cm ⁻³ at 25 C; measured in air.
4	558	L	1951	310.9			The above specimen measured in a vacuum of 0.09 μ Hg.
5	44	F	1914	293.373		Red fiber	Fiber; density 2.59 g cm ⁻³ .
6	564	L	1944	297-325			Fiber; 1 in. thick; density 0.0641 g cm ⁻³ .
7	564	L	1944	297-325			1 in. thick; density 0.128 g cm ⁻³ .
8	564	L	1944	296-325			1 in. thick; density 0.0961 g cm ⁻³ .
9	560	L	1954	310.9			1 in. thick; density 0.056 g cm ⁻³ ; measured in F-12.
10	560	L	1954	310.9			1 in. thick; density 0.111 g cm ⁻³ ; measured in CO ₂ .
11	560	L	1954	310.9			The above specimen measured in F-12.

DATA TABLE NO. 365 THERMAL CONDUCTIVITY OF WOOD FIBERS

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k
<u>CURVE 1*</u>		<u>CURVE 4*</u>		<u>CURVE 6*</u>		<u>CURVE 10*</u>	
310.9	0.000392	310.9	0.0000476	297.1	0.000387	310.9	0.00350
				311	0.000410	311	0.000411
<u>CURVE 2*</u>		<u>CURVE 5*</u>		<u>CURVE 7*</u>		<u>CURVE 11*</u>	
310.9	0.0000750	293.2	0.00469	324.6	0.000436	310.9	0.00246
		373.2	0.00498				
<u>CURVE 3*</u>				297.1	0.000404	310.9	0.00247
310.9	0.000400			310.7	0.000418		
				324.8	0.000441		

* No graphical presentation

SPECIFICATION TABLE NO. 366 THERMAL CONDUCTIVITY OF WOOL

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	565	L	1950	293.2		Angora wool	Density 0.19 g cm ⁻³ .
2	565	L	1950	293.2		Sheep wool	Density 0.13 g cm ⁻³ .
3	565	L	1950	293.2		Sheep wool	Density 0.16 g cm ⁻³ .

DATA TABLE NO. 366 THERMAL CONDUCTIVITY OF WOOL

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

293.2 0.000464

CURVE 2*

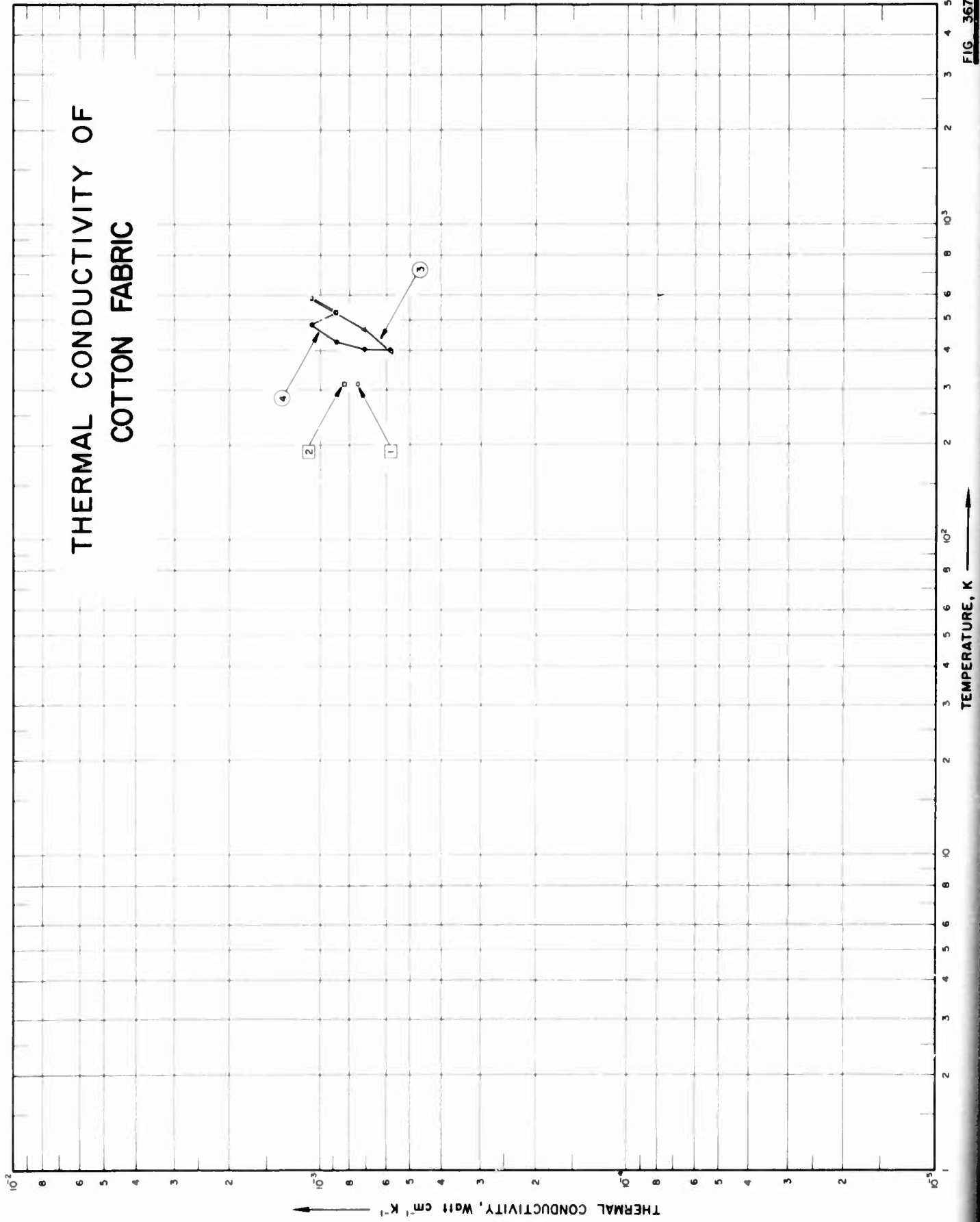
293.2 0.000477

CURVE 3*

293.2 0.000565

* No graphical presentation

THERMAL CONDUCTIVITY OF COTTON FABRIC



SPECIFICATION TABLE NO. 367 THERMAL CONDUCTIVITY OF COTTON FABRICS

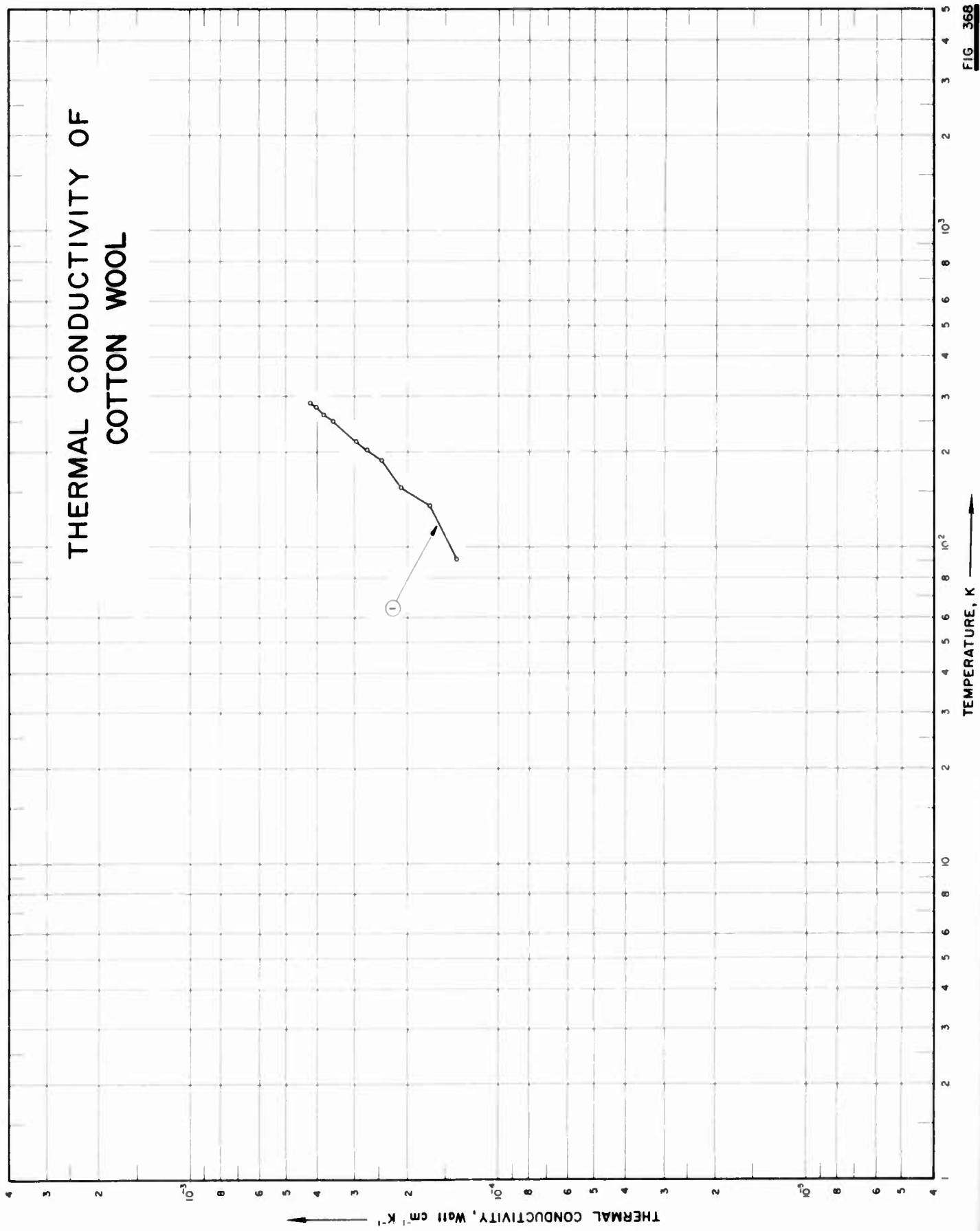
[For Data Reported in Figure and Table No. 367]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	313.2	1	Cotton fabric	3.63 cm dia disk specimen; measured under a load of 21 psi.
2	125	L	1923	313.2	1	Cotton fabric	Another run of the above specimen.
3	105	R	1958	398-584		Cotton silicate felt	Density 0.185 g cm ⁻³ .
4	105	R	1958	401-582		Cotton silicate felt	Second run of the above specimen.

DATA TABLE NO. 367 THERMAL CONDUCTIVITY OF COTTON FABRIC
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
313.2	0.000753
<u>CURVE 2</u>	
313.2	0.000837
<u>CURVE 3</u>	
398.2	0.000580
467.2	0.000717
528.7	0.000890
583.9	0.001080
<u>CURVE 4</u>	
400.9	0.000582
402.7	0.000715
527.2	0.000885
582.2	0.001074

THERMAL CONDUCTIVITY OF COTTON WOOL



SPECIFICATION TABLE NO. 36^s THERMAL CONDUCTIVITY OF COTTON WOOL

[For Data Reported in Figure and Table No. 36^s]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	561	R	1948	92-286			Wadding specimen packed in a hollow cylinder of 2 in. I.D. and 10 in. O.D.; cruded, bulk density 0.0416 g cm ⁻³ .

DATA TABLE NO. 368 THERMAL CONDUCTIVITY OF COTTON WOOL

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
92.2	0.000138
136.0	0.000170
155.9	0.000211
188.0	0.000246
204.4	0.000275
217.2	0.000298
251.2	0.000360
263.5	0.000384
278.0	0.000406
286.2	0.000422

CURVE 1

SPECIFICATION TABLE NO. 369 THERMAL CONDUCTIVITY OF HAIR FELT

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-306			Thickness 0.75 in.; density 0.175 g cm ⁻³ , as received.
2	558	L	1951	310.9			Thickness 0.75 in.; density 0.178 g cm ⁻³ at 25 C.
3	558	L	1951	310.9			The above specimen measured in a vacuum of 0.1 μ Hg.
4	560	L	1954	310.9			0.75 in. thick; density 0.178 g cm ⁻³ , measured in air.
5	560	L	1954	310.9			The above specimen measured in CO ₂ .
6	560	L	1954	310.9			The above specimen measured in F-12.
7	560	L	1954	310.9			The above specimen measured in vacuum.

DATA TABLE NO. 369 THERMAL CONDUCTIVITY OF HAIR FELT

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1*</u>			
222.0	0.000287		
238.7	0.000303		
255.4	0.000322		
272.2	0.000340		
288.9	0.000361		
305.5	0.000382		
<u>CURVE 2*</u>			
310.9	0.000375		
<u>CURVE 3*</u>			
310.9	0.000447		
<u>CURVE 4*</u>			
310.9	0.00450		
<u>CURVE 5*</u>			
310.9	0.00320		
<u>CURVE 6*</u>			
310.9	0.00215		
<u>CURVE 7*</u>			
310.9	0.000537		

* No graphical presentation

SPECIFICATION TABLE NO. 370 THERMAL CONDUCTIVITY OF PLUTON CLOTH

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	526	P	1962	455.8	± 7		Manufactured by Mimm. Mining & Mfg. Co.; plain weave type with 26 yarns in. ¹ and 25 yarns in. ² filling; 8.0 oz yd ² ; 0.01304 in. ave thickness; 0.01056 in. thickness under load; measured under 16.2 psia pressure, 11.9 ppi tensile stress, and 3.9 psi compressive stress; thermal conductivity calculated from measured transient temperature changes.
2	526	P	1962	459.1	± 7		Similar to the above specimen except with 0.01069 in. thickness under load; measured under 16.5 psia pressure, 9.6 ppi tensile stress, and 3.2 psi compressive stress.
3	526	P	1962	456.3	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured under 16.5 psia pressure, 8.4 ppi tensile stress, and 2.9 psi compressive stress.
4	526	P	1962	565.5	± 7		Similar to the above specimen except with 0.01056 in. thickness under load; measured under 16.9 psia pressure, 11.9 ppi tensile stress, and 3.9 psi compressive stress.
5	526	P	1962	563.6	± 7		Similar to the above specimen except with 0.01069 in. thickness under load; measured under 17.7 psia pressure, 9.6 ppi tensile stress, and 3.2 psi compressive stress.
6	526	P	1962	565.5	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured under 17.3 psia pressure, 8.4 ppi tensile stress, and 2.9 psi compressive stress.
7	526	P	1962	674.1	± 7		Similar to the above specimen except with 0.01069 in. thickness under load; measured under 17.1 psia pressure, 9.6 ppi tensile stress, and 3.2 psi compressive stress.
8	526	P	1962	674.9	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured under 16.4 psia pressure, 8.4 ppi tensile stress, and 2.9 psi compressive stress.
9	526	P	1962	682.6	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured under 16.2 psia pressure, 8.3 ppi tensile stress, and 2.9 psi compressive stress.
10	526	P	1962	449.4	± 7		Similar to the above specimen except with 0.01069 in. thickness under load; measured in 1.5 mm Hg vacuum under 9.6 ppi tensile stress and 3.2 psi compressive stress.
11	526	P	1962	447.6	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured in 2.0 mm Hg vacuum under 8.4 ppi tensile stress and 2.9 psi compressive stress.
12	526	P	1962	445.3	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured in 1.0 mm Hg vacuum under 8.3 ppi tensile stress and 2.9 psi compressive stress.

SPECIFICATION TABLE NO. 370 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
13	526	P	1962	551.8	± 7		Similar to the above specimen except with 0.01069 in. thickness under load; measured in 1.5 mm Hg vacuum under 9.6 ppi tensile stress and 3.2 psi compressive stress.
14	526	P	1962	551.2	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured in 1.5 mm Hg vacuum under 8.4 ppi tensile stress and 2.9 psi compressive stress.
15	526	P	1962	550.9	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured in 1.2 mm Hg vacuum under 8.3 ppi tensile stress and 2.9 psi compressive stress.
16	526	P	1962	663.3	± 7		Similar to the above specimen except with 0.01069 in. thickness under load; measured in 5.0 mm Hg vacuum under 9.6 ppi tensile stress and 3.2 psi compressive stress.
17	526	P	1962	665.1	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured in 1.5 mm Hg vacuum under 8.4 ppi tensile stress and 2.9 psi compressive stress.
18	526	P	1962	666.7	± 7		Similar to the above specimen except with 0.01077 in. thickness under load; measured in 2.5 mm Hg vacuum under 8.3 ppi tensile stress and 2.9 psi compressive stress.

DATA TABLE NO. 370 THERMAL CONDUCTIVITY OF PLUTON CLOTH

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k	T	k
<u>CURVE 1*</u>	<u>CURVE 4*</u>	<u>CURVE 7*</u>	<u>CURVE 10*</u>	<u>CURVE 13*</u>	<u>CURVE 16*</u>				
455.8 0.000450	565.5 0.000523	674.1 0.000666	449.4 0.00143	551.8 0.000291	663.3 0.000320				
<u>CURVE 2*</u>	<u>CURVE 5*</u>	<u>CURVE 8*</u>	<u>CURVE 11*</u>	<u>CURVE 14*</u>	<u>CURVE 17*</u>				
459.1 0.000424	563.6 0.000507	674.9 0.000659	447.6 0.000208	551.2 0.000244	665.1 0.000346				
<u>CURVE 3*</u>	<u>CURVE 6*</u>	<u>CURVE 9*</u>	<u>CURVE 12*</u>	<u>CURVE 15*</u>	<u>CURVE 18*</u>				
456.3 0.000424	565.5 0.000493	682.6 0.000651	445.3 0.000162	550.9 0.000260	666.7 0.000263				

* No graphical presentation

SPECIFICATION TABLE NO. 371 THERMAL CONDUCTIVITY OF RENE 41 CLOTH

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	526	P	1962	445.9	±7		Plain type weave; avg thickness 0.00591 in.; manufactured by Avco Everett Res. Lab; 0.002779 in. thickness under load; measured under 17.5 psia pressure, 6.1 ppi tensile stress, and 15.6 psi compressive stress; thermal conductivity value calculated from measured transient temp changes.
2	526	P	1962	434.4	±7		Similar to the above specimen except with 5.3 ppi tensile stress.
3	526	P	1962	425.7	±7		Similar to the above specimen except with 5.7 ppi tensile stress.
4	526	P	1962	674.4	±7		Similar to the above specimen except with 18.0 psia pressure and 6.1 ppi tensile stress.
5	526	P	1962	607.3	±7		Similar to the above specimen except with 17.5 psia pressure and 5.7 ppi tensile stress.
6	526	P	1962	677.6	±7		Similar to the above specimen except with 0.00357 in. thickness under load; measured under 17.5 psia pressure, 6.1 ppi tensile stress, and 1.9 psi compressive stress.
7	526	P	1962	870.4	±7		Similar to the above specimen except with 0.002779 in. thickness under load; measured under 17.5 psia pressure, 6.1 ppi tensile stress, and 15.6 psi compressive stress.
8	526	P	1962	746.5	±7		Similar to the above specimen except with 17.6 psia pressure, 5.7 ppi tensile stress, and 15.6 psi compressive stress.
9	526	P	1962	891.5	±7		Similar to the above specimen except with 17.7 psia pressure, 6.2 ppi tensile stress, and 1.9 psi compressive stress.
10	526	P	1962	1065.5	±7		Similar to the above specimen except measured under 0.002779 in. thickness under load; 17.5 psia pressure, 5.0 ppi tensile stress, and 15.6 psi compressive stress.
11	526	P	1962	916.5	±7		Similar to the above specimen except with 18.3 psia pressure; 4.7 ppi tensile stress and 15.6 psi compressive stress.
12	526	P	1962	1042.1	±7		Similar to the above specimen except with 0.003570 in. thickness under load; measured under 17.7 psia pressure and 4.8 ppi tensile stress.
13	526	P	1962	459.8	±7		Similar to the above specimen except with 0.002779 in. thickness under load; measured in 18 mm Hg vacuum under 6.1 ppi tensile stress and 13.5 psi compressive stress.
14	526	P	1962	443.8	±7		Similar to the above specimen except with 11 mm Hg vacuum, 5.3 ppi tensile stress, and 13.5 psi compressive stress.
15	526	P	1962	433.3	±7		Similar to the above specimen except with 6 mm Hg vacuum, 5.7 ppi tensile stress, and 13.5 psi compressive stress.
16	526	P	1962	678.4	±7		Similar to the above specimen except with 24 mm Hg vacuum, 6.1 ppi tensile stress, and 13.5 psi compressive stress.
17	526	P	1962	607.2	±7		Similar to the above specimen except with 16 mm Hg vacuum, 5.7 ppi tensile stress, and 13.5 psi compressive stress.

SPECIFICATION TABLE NO. 371 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
18	526	P	1962	679.1	±7		Similar to the above specimen except with 0.063524 in. thickness under load; measured in 17 mm Hg vacuum under 6.2 ppi tensile stress.
19	526	P	1962	892.6	±7		Similar to the above specimen except with 0.002779 in. thickness under load; measured in 24 mm Hg vacuum under 6.1 ppi tensile stress and 3.3, 5 psi compressive stress.
20	526	P	1962	749.2	±7		Similar to the above specimen except with 20 mm Hg vacuum. 5.7 ppi tensile stress, and 13.5 psi compressive stress.
21	526	P	1962	868.2	±7		Similar to the above specimen except with 0.00352 in. thickness under load; measured in 8 mm Hg vacuum under 5.2 ppi tensile stress and 2.0 psi compressive stress.
22	526	P	1962	1070.4	±7		Similar to the above specimen except with 0.002779 in. thickness under load; measured in 67 mm Hg vacuum under 5.0 ppi tensile stress and 13.5 psi compressive stress.
23	526	P	1962	889.8	±7		Similar to the above specimen except with 27 mm Hg vacuum. 1.0 ppi tensile stress, and 13.5 psi compressive stress.
24	526	P	1962	432.9	±7		Plain type weave; CS-105 (Goodyear Acft. Co.) coating; 0.00877 in. avg thickness; manufactured by the Avco Everett Res. Lab; 0.004087 in. thickness under load; measured under 17.5 psia pressure, 5.3 ppi tensile stress, and 8.8 psi compressive stress.
25	526	P	1962	425.5	±7		Similar to the above specimen except with 17.4 psia pressure and 3.2 ppi tensile stress.
26	526	P	1962	427.1	±7		Similar to the above specimen except with 17.5 psia pressure and 4.0 ppi tensile stress.
27	526	P	1962	606.3	±7		Similar to the above specimen except with 17.5 psia pressure and 5.3 ppi tensile stress.
28	526	P	1962	594.3	±7		Similar to the above specimen except with 17.4 psia pressure and 3.2 ppi tensile stress.
29	526	P	1962	784.6	±7		Similar to the above specimen except with 18.4 psia pressure and 5.3 ppi tensile stress.
30	526	P	1962	784.5	±7		Similar to the above specimen except with 17.9 psia pressure and 3.2 ppi tensile stress.
31	526	P	1962	912.1	±7		Similar to the above specimen except with 18.4 psia pressure and 2.2 ppi tensile stress.
32	526	P	1962	916.5	±7		Similar to the above specimen except with 18.4 psia pressure, and 2.6 ppi tensile stress.
33	526	P	1962	430.5	±7		Similar to the above specimen except with 0.00412 in. thickness under load; measured in 24 mm Hg vacuum under 5.0 ppi tensile stress, and 7.6 psi compressive stress.
34	526	P	1962	435.4	±7		Similar to the above specimen except with 21 mm Hg vacuum and 3.2 ppi tensile stress.
35	526	P	1962	434.8	±7		Similar to the above specimen except with 9 mm Hg vacuum and 4.0 ppi tensile stress.
36	526	P	1962	601.5	±7		Similar to the above specimen except with 7 mm Hg vacuum and 5.3 ppi tensile stress.
37	526	P	1962	605.9	±7		Similar to the above specimen except with 30 mm Hg vacuum and 3.2 ppi tensile stress.
38	526	P	1962	785.2	±7		Similar to the above specimen except with 10 mm Hg vacuum and 4.6 ppi tensile stress.
39	526	P	1962	785.4	±7		Similar to the above specimen except with 40 mm Hg vacuum and 3.2 ppi tensile stress.
40	526	P	1962	904.8	±7		Similar to the above specimen except with 20 mm Hg vacuum and 2.2 ppi tensile stress.

DATA TABLE NO. 371 THERMAL CONDUCTIVITY OF RENE 41 CLOTH

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k	T	k	T	k
<u>CURVE 1*</u>	<u>CURVE 12*</u>	<u>CURVE 23*</u>	<u>CURVE 34*</u>				
445.9	0.000159	1042.1	0.000317	889.8	0.000194	435.4	0.000346
<u>CURVE 2*</u>	<u>CURVE 13*</u>	<u>CURVE 24*</u>	<u>CURVE 35*</u>				
434.4	0.000173	459.8	0.000128	432.9	0.000519	434.8	0.000247
<u>CURVE 3*</u>	<u>CURVE 14*</u>	<u>CURVE 25*</u>	<u>CURVE 36*</u>				
425.7	0.000144	443.8	0.000267	425.4	0.000978	601.5	0.000223
<u>CURVE 4*</u>	<u>CURVE 15*</u>	<u>CURVE 26*</u>	<u>CURVE 37*</u>				
674.4	0.000292	433.3	0.000260	427.1	0.000661	605.9	0.0000917
<u>CURVE 5*</u>	<u>CURVE 16*</u>	<u>CURVE 27*</u>	<u>CURVE 38*</u>				
607.3	0.000320	678.4	0.000239	606.3	0.000789	785.2	0.000254
<u>CURVE 6*</u>	<u>CURVE 17*</u>	<u>CURVE 28*</u>	<u>CURVE 39*</u>				
677.6	0.000339	607.2	0.000204	594.3	0.000710	785.4	0.000943
<u>CURVE 7*</u>	<u>CURVE 18*</u>	<u>CURVE 29*</u>	<u>CURVE 40*</u>				
870.4	0.000348	679.1	0.000216	784.6	0.00101	904.8	0.000431
<u>CURVE 8*</u>	<u>CURVE 19*</u>	<u>CURVE 30*</u>					
746.5	0.000502	892.6	0.000339	784.5	0.000933		
<u>CURVE 9*</u>	<u>CURVE 20*</u>	<u>CURVE 31*</u>					
891.5	0.000400	749.2	0.000379	912.1	0.000824		
<u>CURVE 10*</u>	<u>CURVE 21*</u>	<u>CURVE 32*</u>					
1065.5	0.000755	868.2	0.000166	916.5	0.000457		
<u>CURVE 11*</u>	<u>CURVE 22*</u>	<u>CURVE 33*</u>					
916.5	0.000999	1070.4	0.000817	430.5	0.000161		

* No graphical presentation

SPECIFICATION TABLE NO. 372 THERMAL CONDUCTIVITY OF SILK FABRIC

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	313.2	1		Measured under a load of 21 psi.
2	125	L	1923	313.2	1		Second run of the above specimen.
3	125	L	1923	294.2	1		Waterproofed; 0.012 cm thick; measured under a load of 21 psi.
4	125	L	1923	294.2	1		Waterproofed; two layers; 0.025 cm thick; measured under a load of 21 psi.
5	125	L	1923	294.2	1		Waterproofed; six layers; 0.075 cm thick; measured under a load of 21 psi.
6	125	L	1923	294.2	1		Waterproofed; nine layers; 0.111 cm thick; measured under a load of 21 psi.

DATA TABLE NO. 372 THERMAL CONDUCTIVITY OF SILK FABRIC

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1*</u>	<u>CURVE 5*</u>		
313.2 0.000418	294.2 0.00174		
<u>CURVE 2*</u>	<u>CURVE 6*</u>		
313.2 0.000502	294.2 0.00184		
<u>CURVE 3*</u>			
294.2 0.00142			
<u>CURVE 4*</u>			
294.2 0.00150			

* No graphical presentation

SPECIFICATION TABLE NO. 373 THERMAL CONDUCTIVITY OF ASBESTOS CEMENT BOARD (TRANSITE)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	390	P	1961	339-589		Transite	Density 0.193-0.1918 g cm ⁻³ between 339-589 K; thermal conductivity values calculated from thermal diffusivity, density, and specific heat of the specimen.

DATA TABLE NO. 373 THERMAL CONDUCTIVITY OF ASBESTOS CEMENT BOARD (TRANSITE)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
338.7	0.00770
366.5	0.00757
394.3	0.00749
422.1	0.00742
449.8	0.00739
477.6	0.00736
505.4	0.00736
533.2	0.00736
560.9	0.00733
588.7	0.00731

* No graphical presentation

SPECIFICATION TABLE NO. 374 THERMAL CONDUCTIVITY OF ASPHALT - GLASS WOOL PAD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-306			Thickness of specimen 1 in.; density 0.284 g cm ⁻³ ; as received.

DATA TABLE NO. 374 THERMAL CONDUCTIVITY OF ASPHALT - GLASS WOOL PAD

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
222.0	0.000304
238.7	0.000326
255.4	0.000348
272.2	0.000369
288.9	0.000394
305.5	0.000414

CURVE 1*

* No graphical presentation

SPECIFICATION TABLE NO. 375 THERMAL CONDUCTIVITY OF CARDBOARD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	323.2	1		3.63 cm dia disk; measured under a load of 21 psi.
2	125	L	1923	323.2	1		Another run of the above specimen.
3	88	L	1926	273, 293			Density 0.79 g cm ⁻³ .

DATA TABLE NO. 375 THERMAL CONDUCTIVITY OF CARDBOARD

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

323.2 0.00167

CURVE 2*

323.2 0.00335

CURVE 3*293.2 0.00143
273.2 0.00138

* No graphical presentation

SPECIFICATION TABLE NO. 376 THERMAL CONDUCTIVITY OF CELLULOSE FIBERBOARD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-306			Lignin-impregnated fiberboard; 1.25 in. thick; density 1.37 g cm ⁻³ ; as received.

DATA TABLE NO. 376 THERMAL CONDUCTIVITY OF CELLULOSE FIBERBOARD

[Temperature T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
CURVE 1*	
222.0	0.00241
238.7	0.00247
255.4	0.00251
272.2	0.00255
288.9	0.00261
305.5	0.00265

* No graphical presentation

SPECIFICATION TABLE NO. 377 THERMAL CONDUCTIVITY OF CORNSTALK WALLBOARD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	566	L	1929	322.8		No. 1	Made from cornstalks.
2	566	L	1929	322.8		No. 1	Second run of the above specimen.
3	566	L	1929	322.8		No. 2	Made from cornstalks.
4	566	L	1929	322.8		No. 2	Second run of the above specimen.
5	566	L	1929	322.8		No. 3	Made from cornstalks.
6	566	L	1929	322.8		No. 3	Second run of the above specimen.
7	566	L	1929	322.8		No. 4	Made from cornstalks.
8	566	L	1929	322.8		No. 4	Second run of the above specimen.
9	566	L	1929	322.8		No. 5	Made from cornstalks.
10	566	L	1929	322.8		No. 6	Made from cornstalks.

DATA TABLE NO. 377 THERMAL CONDUCTIVITY OF CORNSTALK WALLBOARD

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	Γ	k	T	k	T	k
<u>CURVE 1*</u>							
322.8	0.000563		<u>CURVE 4*</u>		<u>CURVE 7*</u>		<u>CURVE 10*</u>
		322.8	0.000573	322.8	0.000544	322.8	0.000404
<u>CURVE 2*</u>							
322.8	0.000610		<u>CURVE 5*</u>		<u>CURVE 8*</u>		
		322.8	0.000513	322.8	0.000551		
<u>CURVE 3*</u>							
322.8	0.000554		<u>CURVE 6*</u>		<u>CURVE 9*</u>		
		322.8	0.000512	322.8	0.000624		

* No graphical presentation

SPECIFICATION TABLE NO. 378 THERMAL CONDUCTIVITY OF DIATOMITE AGGREGATE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	186	L	1928	478-958	2.5	Sil-o-cel coarse grade; A	Granular specimen packed in a ring of 7.9 in. I.D. and 1.4 in. thick; oven dried thoroughly at 250 F.; packing density 0.288 g cm ⁻³ . Similar to the above specimen except packing density 0.352 g cm ⁻³ .
2	186	L	1928	467-958	2.5	Sil-o-cel coarse grade; B	

DATA TABLE NO. 378 THERMAL CONDUCTIVITY OF DIATOMITE AGGREGATE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
477.6	0.000759
549.3	0.000838
597.6	0.000887
710.9	0.00101
772.1	0.00107
958.2	0.00127
<u>CURVE 2*</u>	
467.1	0.000837
549.8	0.000890
595.4	0.000935
718.7	0.00104
799.8	0.00107
957.6	0.00124

* No graphical presentation

SPECIFICATION TABLE NO. 379 THERMAL CONDUCTIVITY OF EXCELSIOR

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-306			Thickness of specimen 1 in.; density 0.0295 g cm ⁻³ ; as received.
2	564	L	1944	297-325			Thickness of specimen 1 in.; density 0.0300 g cm ⁻³ .

DATA TABLE NO. 379 THERMAL CONDUCTIVITY OF EXCELSIOR

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

222.0 0.000307
 238.7 0.000342
 255.4 0.000376
 272.2 0.000412
 288.9 0.000451
 305.5 0.000495

CURVE 2*

297.1 0.000462
 311 0.000498
 324.8 0.000534

* No graphical presentation

SPECIFICATION TABLE NO. 380 THERMAL CONDUCTIVITY OF FIR PLYWOOD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-306			Thickness 0.75 in.; density 0.532 g cm ⁻³ , as received.

DATA TABLE NO. 380 THERMAL CONDUCTIVITY OF FIR PLYWOOD

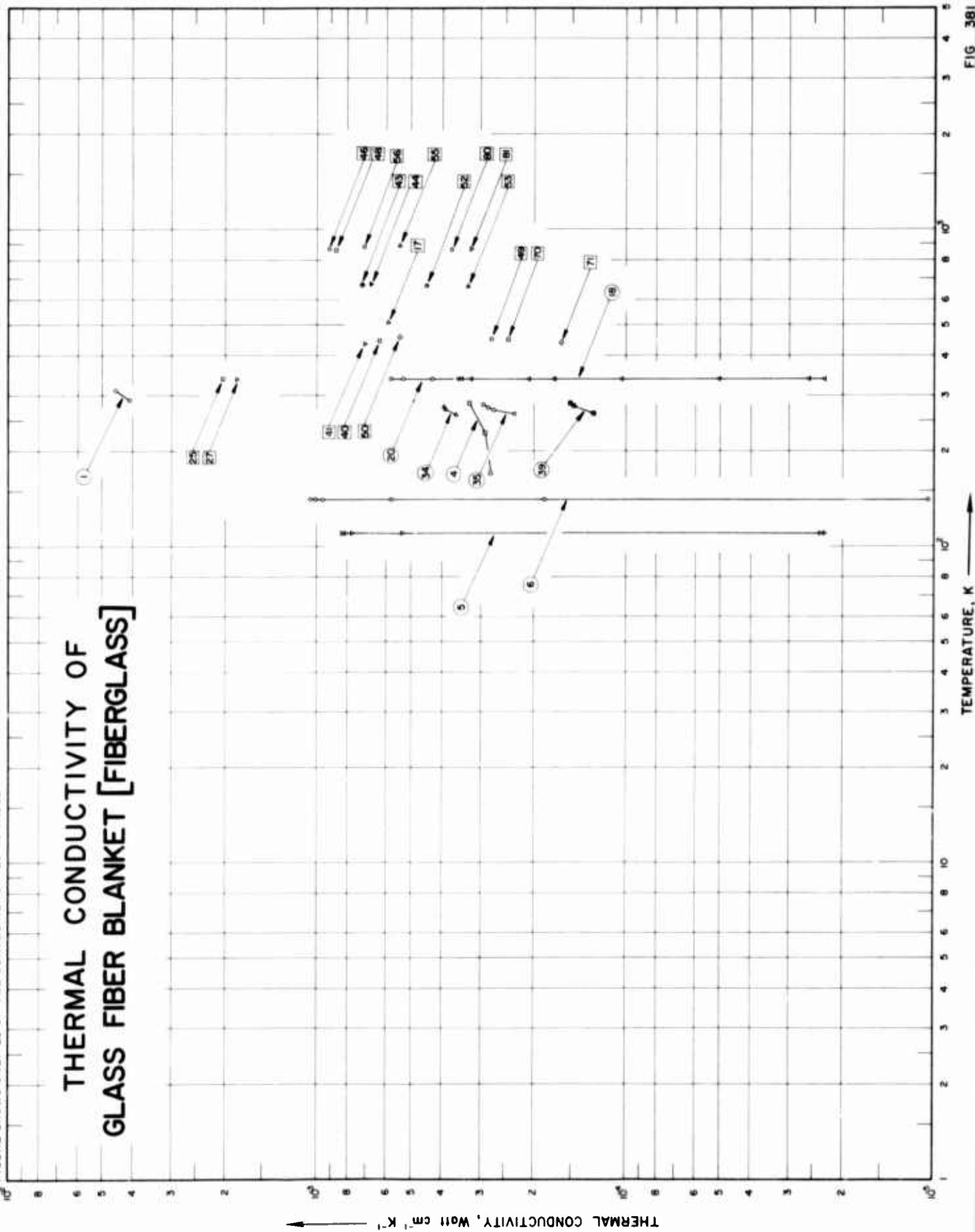
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
	<u>CURVE 1*</u>
222.0	0.00101
238.7	0.00104
255.4	0.00107
272.2	0.00111
288.9	0.00114
305.5	0.00117

* No graphical presentation

FIGURE SHOWS ONLY 28 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF GLASS FIBER BLANKET [FIBERGLASS]



TEMPERATURE, K

SPECIFICATION TABLE NO. 381 THERMAL CONDUCTIVITY OF GLASS FIBER BLANKETS (FIBERGLASS)

[For Data Reported in Figure and Table No. 381]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	559	L	1957	291.312			Density 0.0096 g cm ⁻³ .
2	559	L	1957	290.311			Density 0.0681 g cm ⁻³ .
3	559	L	1957	291.311			Density 0.0157 g cm ⁻³ .
4	567	L	1955	171-283			Fine glass fibre blanket - resin bonded; density 0.016 g cm ⁻³ .
5	122	R	1953	110.0		Superfine PF	Blanket type bonded by an organic agent; about 0.5 in. thick; manufactured by Owens-Corning Fiberglas Corp; packing density 0.046 g cm ⁻³ ; filled with hydrogen; measured at various hydrogen pressures ranging from 0.0095 to 594 mm Hg.
6	122	R	1953	141.0		Superfine PF	Similar to the above specimen; filled with hydrogen; measured at various hydrogen pressures ranging from 0.0052 to 606 mm Hg.
7	122	R	1953	109.3		Superfine PF	Similar to the above specimen; filled with nitrogen; measured at various nitrogen pressures ranging from 0.0075 to 599 mm Hg.
8	122	R	1953	140.8		Superfine PF	Similar to the above specimen; filled with nitrogen; measured at various nitrogen pressures ranging from 0.0068 to 586 mm Hg.
9	122	R	1953	109.7		Superfine E	White wool type; supplied in bulk by Owen-Corning Fiberglas Corp; packing density 0.077 g cm ⁻³ ; filled with hydrogen; measured at various hydrogen pressures ranging from 0.0063 to 602.5 mm Hg.
10	122	R	1953	140.8		Superfine E	Similar to the above specimen; filled with hydrogen; measured at various hydrogen pressures ranging from 0.0060 to 595.5 mm Hg.
11	122	R	1953	109.6		Superfine E	Similar to the above specimen; filled with nitrogen; measured at various nitrogen pressures ranging from 0.0080 to 599.0 mm Hg.
12	122	R	1953	140.6		Superfine E	Similar to the above specimen; filled with nitrogen; measured at various nitrogen pressures ranging from 0.0071 to 595.0 mm Hg.
13	122	R	1953	109.8		Superfine AA	Supplied by Owen-Corning Fiberglas Corp; fiber dia about 0.0005 in.; packing density 0.1629 g cm ⁻³ ; filled with hydrogen; measured at various hydrogen pressures ranging from 0.0064 to 593.0 mm Hg.
14	122	R	1953	141.3		Superfine AA	Similar to the above specimen; filled with hydrogen; measured at various hydrogen pressures ranging from 0.0054 to 600.0 mm Hg.
15	122	R	1953	109.2		Superfine AA	Similar to the above specimen; filled with nitrogen; measured at various nitrogen pressures ranging from 0.0055 to 788.0 mm Hg.
16	122	R	1953	140.5		Superfine AA	Similar to the above specimen; filled with nitrogen; measured at various nitrogen pressures ranging from 0.0052 to 577.0 mm Hg.
17	100	L	1957	508.7			Resin bonded; bulk density 0.0681 g cm ⁻³ .

SPECIFICATION TABLE NO. 381 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
18	568	L	1952	338.7		Insulation A3	Specimen thickness 1 in.; sp. gr. 2.01; avg fiber dia 2.58 μ ; insulation density 0.0742 g cm ⁻³ ; vol fraction of fiber 0.9369; effective pore size 54.8 μ ; filled with air; measured at various air pressures ranging from 0.00085 to 760 mm Hg.
19	568	L	1952	338.7		Insulation A2	Specimen thickness 1 in.; sp. gr. 2.01; avg fiber dia 2.58 μ ; insulation density 0.024 g cm ⁻³ ; vol fraction of fiber 0.0120; effective pore size 169 μ ; filled with air; measured at various air pressures ranging from 0.0003 to 760 mm Hg.
20	568	L	1952	338.7		Insulation A1	Specimen thickness 1 in.; sp. gr. 2.01; avg fiber dia 2.58 μ ; insulation density 0.00375 g cm ⁻³ ; vol fraction of fiber 0.00436; effective pore size 465 μ ; filled with air; measured at various air pressures ranging from 0.0013 to 760 mm Hg.
21	568	L	1952	338.7		Insulation A4	Specimen thickness 1 in.; sp. gr. 2.01; avg fiber dia 2.58 μ ; insulation density 0.134 g cm ⁻³ ; vol fraction of fiber 0.00665; effective pore size 30.4 μ ; filled with air; measured at various air pressures ranging from 0.00025 to 760 mm Hg.
22	568	L	1952	422.1		Insulation A4	Similar to the above specimen except measured with air at various pressures ranging from 0.0012 to 760 mm Hg.
23	568	L	1952	338.7		Insulation B	Thickness of specimen 1 in.; sp. gr. 2.5; avg fiber dia 1.51 μ ; insulation density 0.119 g cm ⁻³ ; vol fraction of fiber 0.0474; effective pore size 25.0 μ ; filled with air; measured at 760 mm Hg.
24	568	L	1952	422.1		Insulation B	Similar to the above specimen except measured at various air pressures ranging from 0.002 to 760 mm Hg.
25	568	L	1952	338.7		Insulation A1	Similar to the Insulation A1 except measured in helium at 760 mm Hg.
26	568	L	1952	338.7		Insulation A2	Similar to the Insulation A2 except measured in helium at 76 and 760 mm Hg.
27	568	L	1952	338.7		Insulation A3	Similar to the Insulation A3 except measured in helium at 760 mm Hg.
28	568	L	1952	338.7		Insulation A1	Similar to the Insulation A1 except measured in carbon dioxide at 760 mm Hg.
29	568	L	1952	338.7		Insulation A2	Similar to the Insulation A2 except measured in carbon dioxide at 76 and 760 mm Hg.
30	568	L	1952	338.7		Insulation A3	Similar to the Insulation A3 except measured in carbon dioxide at 760 mm Hg.
31	568	L	1952	338.7		Insulation A1	Similar to the Insulation A1 except measured in Freon-12 at 760 mm Hg.
32	568	L	1952	338.7		Insulation A2	Similar to the Insulation A2 except measured in Freon-12 at 76 and 760 mm Hg.
33	568	L	1952	338.7		Insulation A3	Similar to the Insulation A3 except measured in Freon-12 at 760 mm Hg.
34	569	L	1956	261-276		PI 152	Thickness 5 cm; density 0.033 g cm ⁻³ ; fiber size about 12 μ ; measured in air.
35	569	L	1956	263-280		PI 152	The above specimen measured in CO ₂ .
36	569	L	1956	263-281		PI 452	Thickness 5 cm; density 0.120 g cm ⁻³ ; fiber size about 12 μ ; measured in air.
37	569	L	1956	261-286		PI 352	Thickness 5 cm; density 0.088 g cm ⁻³ ; fiber size about 12 μ ; measured in air.

SPECIFICATION TABLE NO. 381 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
38	569	L	1956	263-286		Pi 352	The above specimen measured in CO ₂ .
39	569	L	1956	262-283		Pi 352	The above specimen measured in CF ₂ Cl ₂ .
40	526	P	1962	445.3	±7		Fiber glass cloth; 8 harness satin type, 57 ends in. ⁻¹ , 54 picks in. ⁻¹ , 8.9 oz yd ⁻² ; avg thickness 0.01660 in.; 0.01270 in. thickness under load; measured under 17.5 psia pressure; 28.8 ppi tensile stress, and 9.5 psi compressive stress; thermal conductivity value calculated from measured transient temp changes.
41	526	P	1962	437.9	±7		Similar to the above specimen except with 0.01341 in. thickness under load; measured under 16.9 psia pressure, 18.4 ppi tensile stress, and 5.9 psi compressive stress.
42	526	P	1962	463.8	±7		Similar to the above specimen except with 0.01321 in. thickness under load; measured under 17.2 psia pressure, 5.7 ppi tensile stress, and 6.8 psi compressive stress.
43	526	P	1962	667.4	±7		Similar to the above specimen except with 0.0134 in. thickness under load; measured under 17.6 psia pressure, 18.4 ppi tensile stress, and 5.9 psi compressive stress.
44	526	P	1962	670.3	±7		Similar to the above specimen except with 0.0134 in. thickness under load; measured under 17.6 psia pressure, 15.8 ppi tensile stress, and 5.9 psi compressive stress.
45	526	P	1962	671.6	±7		Similar to the above specimen except with 0.0132 in. thickness under load; measured under 17.7 psia pressure, 5.7 ppi tensile stress, and 6.8 psi compressive stress.
46	526	P	1962	868.3	±7		Similar to the above specimen except with 0.01270 in. thickness under load; measured under 18.0 psia pressure, 28.8 ppi tensile stress, and 9.5 psi compressive stress.
47	526	P	1962	872.2	±7		Similar to the above specimen except with 0.01341 in. thickness under load; measured under 17.3 psia pressure, 15.8 ppi tensile stress, and 5.9 psi compressive stress.
48	526	P	1962	864.7	±7		Similar to the above specimen except with 0.01321 in. thickness under load; measured under 17.3 psia pressure, 5.7 ppi tensile stress, and 6.8 psi compressive stress.
49	526	P	1962	454.8	±7		Similar to the above specimen except with 0.01270 in. thickness under load; measured in a vacuum of 7.0 mm Hg under 28.8 ppi tensile stress and 9.5 psi compressive stress.
50	526	P	1962	458.1	±7		Similar to the above specimen except with 0.01341 in. thickness under load; measured in a vacuum of 12.0 mm Hg under 13.4 ppi tensile stress and 5.9 psi compressive stress.
51	526	P	1962	453.1	±7		Similar to the above specimen except with 0.01202 in. thickness under load; measured in a vacuum of 3.0 mm Hg under 5.7 ppi tensile stress and 13.5 psi compressive stress.
52	526	P	1962	665.4	±7		Similar to the above specimen except with 0.01270 in. thickness under load; measured in a vacuum of 14.0 mm Hg under 28.8 ppi tensile stress and 9.5 psi compressive stress.

SPECIFICATION TABLE NO. 381 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
53	526	P	1962	664.7	±7		Similar to the above specimen except with 0. 01341 in. thickness under load; measured in a vacuum of 8. 0 mm Hg under 15. 8 ppi tensile stress and 5. 9 psi compressive stress.
54	526	P	1962	664. 8	±7		Similar to the above specimen except with 0. 01202 in. thickness under load; measured in a vacuum of 7. 0 mm Hg under 5. 7 ppi tensile stress and 13. 5 psi compressive stress.
55	526	P	1962	887. 5	±7		Similar to the above specimen except with 0. 01341 in. thickness under load; measured in a vacuum of 22. 0 mm Hg under 18. 4 ppi tensile stress and 5. 9 psi compressive stress.
56	526	P	1962	894. 4	±7		Similar to the above specimen except with 0. 01341 in. thickness under load; measured in a vacuum of 17. 0 mm Hg under 15. 8 ppi tensile stress and 5. 9 psi compressive stress.
57	526	P	1962	881. 4	±7		Similar to the above specimen except with 0. 01202 in. thickness under load; measured in a vacuum of 15. 0 mm Hg under 5. 7 ppi tensile stress and 13. 5 psi compressive stress.
58	526	P	1962	443. 1	±7		Aluminized fiberglass; plain weave; avg thickness 0. 01021 in.; 0. 00854 in. thickness under load; measured under 16. 9 psia pressure, 26. 0 ppi tensile stress, and 8. 6 psi compressive stress.
59	526	P	1962	455. 0	±7		Similar to the above specimen except with 0. 00845 in. thickness under load; measured under 17. 4 psia pressure, 28. 5 ppi tensile stress, and 9. 4 psi compressive stress.
60	526	P	1962	448. 9	±7		Similar to the above specimen except with 0. 00855 in. thickness under load; measured under 17. 3 psia pressure, 26. 0 ppi tensile stress, and 8. 5 psi compressive stress.
61	526	P	1962	601. 8	±7		Similar to the above specimen except with 0. 00845 in. thickness under load; measured under 17. 2 psia pressure, 28. 8 ppi tensile stress, and 9. 4 psi compressive stress.
62	526	P	1962	609. 0	±7		Similar to the above specimen except with 0. 00845 in. thickness under load; measured under 17. 5 psia pressure, 28. 5 ppi tensile stress, and 9. 4 psi compressive stress.
63	526	P	1962	616. 3	±7		Similar to the above specimen except with 0. 00855 in. thickness under load; measured under 17. 4 psia pressure, 26. 0 ppi tensile stress, and 8. 5 psi compressive stress.
64	526	P	1962	773. 6	±7		Similar to the above specimen except with 0. 00845 in. thickness under load; measured under 17. 7 psia pressure, 28. 8 ppi tensile stress, and 9. 4 psi compressive stress.
65	526	P	1962	765. 2	±7		Similar to the above specimen except with 0. 00845 in. thickness under load; measured under 17. 5 psia pressure, 28. 5 ppi tensile stress, and 9. 4 psi compressive stress.
66	526	P	1962	768. 0	±7		Similar to the above specimen except with 0. 00855 in. thickness under load; measured under 17. 1 psia pressure, 26. 0 ppi tensile stress, and 8. 5 psi compressive stress.
67	526	P	1962	877. 3	±7		Similar to the above specimen except with 0. 00845 in. thickness under load; measured under 17. 6 psia pressure, 28. 8 ppi tensile stress, and 9. 4 psi compressive stress.

SPECIFICATION TABLE NO. 381 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
68	526	P	1962	876.7	±7		Similar to the above specimen except with 0.00845 in. thickness under load; measured under 17.3 psia pressure, 28.5 ppi tensile stress, and 9.4 psi compressive stress.
69	526	P	1962	875.1	±7		Similar to the above specimen except with 0.00855 in. thickness under load; measured under 17.5 psia pressure, 26.0 ppi tensile stress, and 8.5 psi compressive stress.
70	526	P	1962	448.3	±7		Similar to the above specimen except with 0.00844 in. thickness under load; measured in a vacuum of 6.0 mm Hg under 28.8 ppi tensile stress and 9.5 psi compressive stress.
71	526	P	1962	436.6	±7		Similar to the above specimen except with 0.00844 in. thickness under load; measured in a vacuum of 3.0 mm Hg under 28.5 ppi tensile stress and 9.5 psi compressive stress.
72	526	P	1962	415.4	±7		Similar to the above specimen except with 0.00845 in. thickness under load; measured in a vacuum of 2.7 mm Hg under 28.8 ppi tensile stress and 9.4 psi compressive stress.
73	526	P	1962	590.5	±7		Similar to the above specimen except with 0.00844 in. thickness under load; measured in a vacuum of 8.0 mm Hg under 28.8 ppi tensile stress and 9.5 psi compressive stress.
74	526	P	1962	560.9	±7		Similar to the above specimen except with 0.00844 in. thickness under load; measured in a vacuum of 5.0 mm Hg under 28.5 ppi tensile stress and 9.5 psi compressive stress.
75	526	P	1962	589.8	±7		Similar to the above specimen except with 0.00854 in. thickness under load; measured in a vacuum of 3.0 mm Hg under 26.0 ppi tensile stress and 8.6 psi compressive stress.
76	526	P	1962	760.7	±7		Similar to the above specimen except with 0.00844 in. thickness under load; measured in a vacuum of 15.0 mm Hg under 28.8 ppi tensile stress and 9.5 psi compressive stress.
77	526	P	1962	745.1	±7		Similar to the above specimen except with 0.00844 in. thickness under load; measured in a vacuum of 6.0 mm Hg under 28.5 ppi tensile stress and 9.5 psi compressive stress.
78	526	P	1962	755.2	±7		Similar to the above specimen except with 0.00854 in. thickness under load; measured in a vacuum of 7.0 mm Hg under 26.0 ppi tensile stress and 8.6 psi compressive stress.
79	526	P	1962	878.7	±7		Similar to the above specimen except with 0.00844 in. thickness under load; measured in a vacuum of 15.0 mm Hg under 28.8 ppi tensile stress and 9.5 psi compressive stress.
80	526	P	1962	964.1	±7		Similar to the above specimen except with 0.00844 in. thickness under load; measured in a vacuum of 10.0 mm Hg under 28.5 ppi tensile stress and 9.5 psi compressive stress.

SPECIFICATION TABLE NO. 381 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
81	526	P	1962	866.6	±7		Similar to the above specimen except with 0.00855 in. thickness under load; measured in a vacuum of 9.0 mm Hg under 26.0 psi tensile stress and 8.6 psi compressive stress.
82	529	P	1956	290.4			Density 0.0641 g cm ⁻³ ; thermal conductivity value calculated from measured thermal diffusivity data.
83	529	P	1956	290.4			Similar to the above specimen.

DATA TABLE NO. 381 THERMAL CONDUCTIVITY OF GLASS FIBER BLANKET [FIBERGLASS]

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	p(mm)	k	p(mm)	k	p(mm)	k	p(mm)	k	p(mm)	k
CURVE 1											
T = 109.5K											
290.7	0.00407		0.0075		0.0080		0.0058		0.0000793		0.0003
311.7	0.00453		0.118		0.098		0.228		0.0000793		0.0011
CURVE 2*											
T = 422.1K											
290.1	0.00412		1.08		0.927		1.19		0.0000865		0.003
310.8	0.00452		13.5		13.0		13.0		0.000865		0.01
CURVE 3*											
T = 140.8K											
290.8	0.00402		51.5		54.5		51.0		0.0000995		0.027
311.2	0.00446		200		205.0		220.5		0.000144		0.095
CURVE 4											
T = 140.8K											
170.7	0.000279		400		397.0		418.5		0.000157		0.2
228.2	0.000291		599		599.0		602.5		0.000252		0.5
283.2	0.000326						788.0		0.000322		1
CURVE 5											
T = 110K											
0.0095	0.0000230								0.000398		5
0.207	0.000237								0.000418		20
1.16	0.000534								0.000423		76
15.5	0.000774								0.000424		200
52.5	0.000807								0.000425		760
207	0.000823*										
398	0.000828										
594	0.000831*										
CURVE 6											
T = 141K											
0.0052	0.0000105										
0.128	0.000185										
1.11	0.000579										
52.5	0.000955										
207.5	0.00104*										
400	0.00105										
606	0.00105*										
CURVE 7*											
T = 109.5K											
0.0063	0.0000243										
0.123	0.000232										
0.886	0.000558										
15.0	0.000792										
51.5	0.000822										
202.0	0.000846										
367.0	0.000853										
602.5	0.000858										
CURVE 8*											
T = 140.8K											
0.0668	0.0000130										
0.118	0.0000649										
0.968	0.000128										
12.0	0.000162										
50.0	0.000168										
200.5	0.000171										
395.0	0.000173										
586.0	0.000177										
CURVE 9*											
T = 109.7K											
0.0063	0.0000243										
0.123	0.000232										
0.886	0.000558										
15.0	0.000792										
51.5	0.000822										
202.0	0.000846										
367.0	0.000853										
602.5	0.000858										
CURVE 10*											
T = 140.8K											
0.0060	0.0000213										
0.151	0.000272										
1.17	0.000682										
12.0	0.000986										
52.5	0.00104										
210.5	0.00107										
402.0	0.00108										
598.5	0.00109										
CURVE 11*											
T = 109.5K											
0.0071	0.0000180										
0.113	0.0000883										
1.43	0.000163										
11.5	0.000186										
53.5	0.000191										
195.5	0.000194										
398.0	0.000196										
598.0	0.000204										
CURVE 12*											
T = 140.8K											
0.0071	0.0000180										
0.113	0.0000883										
1.43	0.000163										
11.5	0.000186										
53.5	0.000191										
195.5	0.000194										
398.0	0.000196										
598.0	0.000204										
CURVE 13*											
T = 109.8K											
0.0064	0.0000113										
0.123	0.000109										
0.88	0.000345										
17.0	0.000752										
53.5	0.000807										
201.5	0.000840										
409.5	0.000851										
593.0	0.000859										
CURVE 14*											
T = 141.5K											
0.0054	0.0000130										
0.089	0.0000891										
1.06	0.000409										
15.0	0.000904										
56.0	0.00101										
212.0	0.00105										
399.5	0.00107										
600.0	0.00108										
CURVE 15*											
T = 109.2K											
0.0058	0.0000753										
0.228	0.0000657										
1.19	0.000110										
13.0	0.000144										
51.0	0.000151										
220.5	0.000156										
418.5	0.000157										
602.5	0.000158										
788.0	0.000159										
CURVE 16*											
T = 140.5K											
0.0052	0.0000100										
0.175	0.0000644										
0.971	0.000119										
12.0	0.000178										
55.0	0.000189										
220.5	0.000194										
494.0	0.000196										
577.0	0.000197										
CURVE 17											
T = 109.8K											
508.7	0.000591										
CURVE 18											
T = 338.7K											
0.0085	0.0000231										
0.00175	0.0000231*										
0.0065	0.0000260										
0.015	0.0000505										
0.10	0.000104										
0.35	0.000173										
4.5	0.000209										
17.5	0.000324										
65	0.000346										
200	0.000355*										
760	0.000356*										
CURVE 19*											
T = 338.7K											
0.0003	0.0000793										
0.0011	0.0000793										
0.003	0.0000808										
0.01	0.0000865										
0.027	0.0000995										
0.095	0.000144										
0.2	0.000187										
0.5	0.000252										
1	0.000322										
5	0.000398										
20	0.000418										
76	0.000423										
200	0.000424										
760	0.000425										
CURVE 20											
T = 338.7K											
0.0013	0.000180*										

DATA TABLE NO. 381 (continued)

p(mm.)	k	T	k	T	k	T	k	T	k
<u>CURVE 31*</u>									
<u>T = 338.7K</u>									
760	0.000376	263.2	0.000203	454.8	0.000277	601.8	0.000531	590.5	0.000353
		273.2	0.000215						
		278.7	0.000221						
		286.2	0.000227						
<u>CURVE 32*</u>									
<u>T = 338.7K</u>									
76	0.000234								
760	0.000234	262.2	0.000128	453.1	0.000590	616.3	0.000613	589.8	0.000247
		279.2	0.000149						
		283.2	0.000152						
<u>CURVE 33*</u>									
<u>T = 338.7K</u>									
760	0.000167	445.3	0.000633	665.4	0.000448	773.6	0.000749	760.7	0.000422
<u>CURVE 34</u>									
T	k								
260.7	0.000360	437.9	0.000703	664.7	0.000329	765.2	0.000720	745.1	0.000324
270.2	0.000389								
275.7	0.000395								
<u>CURVE 35</u>									
263.2	0.000232								
269.2	0.000273								
274.7	0.000285								
280.2	0.000296								
<u>CURVE 36*</u>									
263.2	0.000291								
270.7	0.000300								
275.2	0.000307								
281.2	0.000314								
<u>CURVE 37*</u>									
260.7	0.000291								
271.7	0.000325								
277.2	0.000316								
281.6	0.000322								
286.2	0.000331								
<u>CURVE 38*</u>									
<u>T = 338.7K</u>									
458.1	0.000543	609.0	0.000637	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 39</u>									
453.1	0.000590	616.3	0.000613	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 40</u>									
443.1	0.000687	448.3	0.000244	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 41</u>									
455.0	0.000587	436.5	0.000163	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 42*</u>									
448.9	0.000737	415.4	0.000166	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 43</u>									
864.7	0.000869								
<u>CURVE 44</u>									
864.7	0.000869								
<u>CURVE 45*</u>									
864.7	0.000869								
<u>CURVE 46</u>									
864.7	0.000869								
<u>CURVE 47*</u>									
864.7	0.000869								
<u>CURVE 48</u>									
864.7	0.000869								
<u>CURVE 49</u>									
454.8	0.000277	601.8	0.000531	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 50</u>									
458.1	0.000543	609.0	0.000637	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 51*</u>									
453.1	0.000590	616.3	0.000613	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 52</u>									
443.1	0.000687	448.3	0.000244	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 53</u>									
455.0	0.000587	436.5	0.000163	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 54*</u>									
448.9	0.000737	415.4	0.000166	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 55</u>									
864.7	0.000869								
<u>CURVE 56</u>									
864.7	0.000869								
<u>CURVE 57*</u>									
864.7	0.000869								
<u>CURVE 58*</u>									
864.7	0.000869								
<u>CURVE 59*</u>									
864.7	0.000869								
<u>CURVE 60*</u>									
864.7	0.000869								
<u>CURVE 61*</u>									
454.8	0.000277	601.8	0.000531	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 62*</u>									
458.1	0.000543	609.0	0.000637	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 63*</u>									
453.1	0.000590	616.3	0.000613	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 64*</u>									
443.1	0.000687	448.3	0.000244	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 65*</u>									
455.0	0.000587	436.5	0.000163	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 66*</u>									
448.9	0.000737	415.4	0.000166	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 67*</u>									
864.7	0.000869								
<u>CURVE 68*</u>									
864.7	0.000869								
<u>CURVE 69*</u>									
864.7	0.000869								
<u>CURVE 70</u>									
454.8	0.000277	601.8	0.000531	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 71</u>									
458.1	0.000543	609.0	0.000637	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 72*</u>									
453.1	0.000590	616.3	0.000613	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 73*</u>									
443.1	0.000687	448.3	0.000244	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 74*</u>									
455.0	0.000587	436.5	0.000163	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 75*</u>									
448.9	0.000737	415.4	0.000166	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 76*</u>									
864.7	0.000869								
<u>CURVE 77*</u>									
864.7	0.000869								
<u>CURVE 78*</u>									
864.7	0.000869								
<u>CURVE 79*</u>									
864.7	0.000869								
<u>CURVE 80</u>									
454.8	0.000277	601.8	0.000531	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 81</u>									
458.1	0.000543	609.0	0.000637	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 82*</u>									
453.1	0.000590	616.3	0.000613	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 83*</u>									
443.1	0.000687	448.3	0.000244	876.7	0.000737	864.1	0.000372	290.4	0.000317
<u>CURVE 84*</u>									
455.0	0.000587	436.5	0.000163	877.3	0.000798	878.7	0.000479	866.6	0.000320
<u>CURVE 85*</u>									
448.9	0.000737	415.4	0.000166	876.7	0.000737	864.1	0.000372	290.4	0.000317

* Not shown on plot

SPECIFICATION TABLE NO. 382 THERMAL CONDUCTIVITY OF GLASS FIBER BOARD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	128	L	1946	321.5			2.02 in. thick; density 0.176 g cm ⁻³ .
2	128	L	1946	194-247			Similar to above except 1.00 in. thick.
3	559	L	1957	289-316			Density 0.215 g cm ⁻³ .

DATA TABLE NO. 382 THERMAL CONDUCTIVITY OF GLASS FIBER BOARD

[Temperature, T K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
321.5	0.0000972
<u>CURVE 2*</u>	
193.7	0.0000579
246.5	0.0000734
<u>CURVE 3*</u>	
289.1	0.000499
289.7	0.000495
290.1	0.000494
311.2	0.000524
311.6	0.000524
311.7	0.000519
315.7	0.000533
315.7	0.000530

* No graphical presentation

SPECIFICATION TABLE NO. 383 THERMAL CONDUCTIVITY OF KOLDBOARD

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	189		1950	200-288			Supplied by Baldwin-Hill Co., density 0.256-0.272 g cm ⁻³ ; water absorption (24 hrs) 14.1 vol %.

DATA TABLE NO. 383 THERMAL CONDUCTIVITY OF KOLDBOARD

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
200.0	0.000361
222.2	0.000389
239.2	0.000404
255.5	0.000433
272.1	0.000447
288.1	0.000476

CURVE 1*

* No graphical presentation

SPECIFICATION TABLE NO. 394 THERMAL CONDUCTIVITY OF MONOLITHIC WALL

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	553	L	1937	297.1		30a	39.3 sand, 60.7 crushed limestone concrete, plastic mix; 4.32 in. in thickness; density of concrete in wall 2.247 g cm ⁻³ .
2	553	L	1937	297.1		31a	36.5 sand, 63.5 coarse gravel concrete, plastic mix; 4.168 in. in thickness; density of concrete in wall 2.295 g cm ⁻³ .
3	553	L	1937	297.1		32a	36.5 sand, 63.5 coarse gravel concrete, dry tamp mix; 4.05 in. in thickness; density of concrete in wall 2.384 g cm ⁻³ .
4	553	L	1937	297.1		33a	39.8 fine cinders, 60.2 coarse cinders, concrete plastic mix; 3.902 in. in thickness; density of concrete in wall 1.512 g cm ⁻³ .
5	553	L	1937	297.1		34a	42.6 fine Haydite, 57.4 coarse Haydite plastic mix; 3.960 in. in thickness; density of concrete in wall 1.245 g cm ⁻³ .
6	553	L	1937	297.1		35a	52.6 sand, 47.4 coarse cinders, dry tamp mix; 3.958 in. in thickness; density of concrete in wall 1.901 g cm ⁻³ .

DATA TABLE NO. 394 THERMAL CONDUCTIVITY OF MONOLITHIC WALL

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1*</u>	<u>CURVE 1*</u>	<u>CURVE 4*</u>	<u>CURVE 4*</u>
297.1	0.0175	297.1	0.00929
<u>CURVE 2*</u>	<u>CURVE 2*</u>	<u>CURVE 5*</u>	<u>CURVE 5*</u>
297.1	0.0179	297.1	0.00538
<u>CURVE 3*</u>	<u>CURVE 3*</u>	<u>CURVE 6*</u>	<u>CURVE 6*</u>
297.1	0.0189	297.1	0.0123

* No graphical presentation

SPECIFICATION TABLE NO. 385 THERMAL CONDUCTIVITY OF PAPER

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	59	L	1953	295-385			Oil impregnated paper; approx 0.05 in. thick; measured under a load of about 2 psi.
2	125	L	1923	313.2			Rice paper; thickness 0.003 cm; measured under a load of 21 psi.

DATA TABLE NO. 385 THERMAL CONDUCTIVITY OF PAPER

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
294.7	0.00180
297.2	0.00180
310.2	0.00184
321.2	0.00184
335.2	0.00186
339.2	0.00180
353.2	0.00186
359.2	0.00182
360.2	0.00184
361.7	0.00186
365.2	0.00184
385.2	0.00180
<u>CURVE 2*</u>	
313.2	0.000460

* No graphical presentation

SPECIFICATION TABLE NO. 386 THERMAL CONDUCTIVITY OF SEA-WEED PRODUCT

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	561	R	1948	92-270			Powder form; contained in a hollow cylinder of 2 in. I. D. and 10 in. O. D.; bulk density 0.130 g cm ⁻³ .
2	561	R	1948	190			50.0 block, 49.5 powder; bulk density 0.117 g cm ⁻³ .

DATA TABLE NO. 386 THERMAL CONDUCTIVITY OF SEA-WEED PRODUCT

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
92.2	0.000147
135.5	0.000197
162.7	0.000234
183.2	0.000258
200.2	0.000277
213.2	0.000293
223.7	0.000305
234.2	0.000315
243.0	0.000327
250.2	0.000337
256.7	0.000346
263.7	0.000350
269.7	0.000358

<u>CURVE 2*</u>	
190.0	0.000348

* No graphical presentation

SPECIFICATION TABLE NO. 387 THERMAL CONDUCTIVITY OF VEGETABLE FIBERBOARDS, MISCELLANEOUS

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-306			0.75 in. thick; density 0.251 g cm ⁻³ ; moisture content 24.1%.
2	109	L	1947	222-306			Similar to the above specimen but moisture content 3.1%.
3	109	L	1947	222-306			Similar to the above specimen but zero moisture content.
4	558	L	1951	310, 9			0.75 in. thick; density 0.245 g cm ⁻³ at 25 C; measured in air.
5	558	L	1951	310, 9			The above specimen measured in a vacuum of 0.05 μ Hg.
6	563	L	1945	222-305			0.75 in. thick; density 0.245 g cm ⁻³ .
7	564	L	1944	297-325			0.75 in. thick; density 0.251 g cm ⁻³ .
8	560	L	1954	230-311			0.75 in. thick; density 0.245 g cm ⁻³ ; measured in air.
9	560	L	1954	230-311			The above specimen measured in CO ₂ .
10	560	L	1954	283, 311			The above specimen measured in F-12.
11	560	L	1954	230-311			The above specimen measured in vacuum.
12	128	L	1946	316, 5			1.97 thick; densit. 0.231 g cm ⁻³ .
13	128	L	1946	194, 242			Similar to the above specimen except 1.02 in. thick.

DATA TABLE NO. 387 THERMAL CONDUCTIVITY OF VEGETABLE FIBERBOARDS, MISCELLANEOUS

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1*</u>			
222.0	0.000495	297.1	0.000492
238.7	0.000516	311.3	0.000509
255.4	0.000542	324.8	0.000524
272.2	0.000565	<u>CURVE 5*</u>	
288.9	0.000588	310.9	0.00613
305.5	0.000611	283.2	0.00578
<u>CURVE 2*</u>			
222.0	0.000424	255.4	0.00540
238.7	0.000441	230.4	0.00507
255.4	0.000460	<u>CURVE 9*</u>	
272.2	0.000477	310.9	0.00483
288.9	0.000495	283.2	0.00448
305.5	0.000513	255.4	0.00410
<u>CURVE 3*</u>			
222.0	0.000411	230.4	0.00377
238.7	0.000430	<u>CURVE 10*</u>	
255.4	0.000447	310.9	0.00367
272.2	0.000466	283.2	0.00339
288.9	0.000483	<u>CURVE 11*</u>	
305.5	0.000502	310.9	0.00126
<u>CURVE 4*</u>			
310.9	0.000509	283.2	0.00118
<u>CURVE 5*</u>			
310.9	0.000108	255.4	0.00107
<u>CURVE 6*</u>			
316.5	0.000117	230.4	0.00100
<u>CURVE 12*</u>			
222.2	0.000411	316.5	0.000117
239.2	0.000428	<u>CURVE 13*</u>	
255.5	0.000447	194.3	0.0000855
272.1	0.000466	242.1	0.0000979
288.8	0.000483		
305.3	0.000502		

* No graphical presentation

SPECIFICATION TABLE NO. 388 THERMAL CONDUCTIVITY OF WALLBOARD, MISCELLANEOUS

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	566	L	1929	322.8		No. 7	Commercial wallboard.
2	566	L	1929	322.8		No. 8	Commercial wallboard.
3	566	L	1929	322.8		No. 8	Second run of the above specimen.
4	566	L	1929	322.8		No. 9	Commercial wallboard.
5	566	L	1929	322.8		No. 9	Second run of the above specimen.

DATA TABLE NO. 388 THERMAL CONDUCTIVITY OF WALLBOARD, MISCELLANEOUS

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u> *	
322.8	0.000640
<u>CURVE 2</u> *	
322.8	0.000581
<u>CURVE 3</u> *	
322.8	0.000594
<u>CURVE 4</u> *	
322.8	0.000633
<u>CURVE 5</u> *	
322.8	0.000587

* No graphical presentation

SPECIFICATION TABLE NO. 389 THERMAL CONDUCTIVITY OF WOOD PRODUCTS, MISCELLANEOUS

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-306			Wood fiber blanket; 1 in. thick; density 0.056 g cm ⁻³ ; as received.
2	109	L	1947	222-306			Wood fiber mat; 1 in. thick; aerated; density 0.027 g cm ⁻³ ; as received.

DATA TABLE NO. 389 THERMAL CONDUCTIVITY OF WOOD PRODUCTS, MISCELLANEOUS

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

222.0 0.000286
 238.7 0.000304
 255.4 0.000322
 272.2 0.000340
 288.9 0.000361
 305.5 0.000384

CURVE 2*

222.0 0.000270
 238.7 0.000293
 255.4 0.000316
 272.2 0.000340
 288.9 0.000363
 305.5 0.000392

* No graphical presentation

SPECIFICATION TABLE NO. 390 THERMAL CONDUCTIVITY OF WOOL FELT

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	108	L	1920	313, 343			9 in. dia x 0.96 in. thick; specific gravity 0.15.

DATA TABLE NO. 390 THERMAL CONDUCTIVITY OF WOOL FELT

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
	<u>CURVE 1</u> *
313.2	0.000623
343.2	0.000732

* No graphical presentation

SPECIFICATION TABLE NO. 391 THERMAL CONDUCTIVITY OF ASBESTOS FIBER

[For Data Reported in Figure and Table No. 391;]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	240	R	1919	435.8-436.1			Fiber specimen packed in a hollow cylinder of size 12.2 mm I.D., 19 mm O.D., and 8 cm long.
2	570	L	1930	297-328		Asbestos fibre III	Average thickness 0.0805 m; density 0.151 g cm ⁻³ .
3	570	L	1930	297-318		Asbestos fibre II	Average thickness 0.0434 m; density 0.202 g cm ⁻³ .
4	108	L	1920	324.2			Dia 9 in., thickness 0.344 in. cut from 1 in. sheet; sp. gr. 0.894; transverse heat flow.
5	108	L	1920	293.2			Dia 9 in., thickness 0.306 in.; made from 0.025 in. paper; sp. gr. 0.98; transverse heat flow.
6	108	L	1920	293-333			Similar to the above specimen but with thickness 0.356 in. and made from 0.035 in. paper.
7	108	L	1920	293.328			Dia 9 in., thickness 0.507 in.; sp. gr. 1.93; transverse heat flow.

DATA TABLE NO. 391 THERMAL CONDUCTIVITY OF ASBESTOS FIBER

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u>	
435.8	0.00142
436.1	0.00151
<u>CURVE 2</u>	
297.2	0.581
314.7	0.628
328.2	0.674
<u>CURVE 3</u>	
296.7	0.674
306.7	0.709
318.2	0.732
<u>CURVE 4</u>	
324.2	0.00165
<u>CURVE 5</u>	
293.2	0.00144
<u>CURVE 6</u>	
293.2	0.00279
323.2	0.00282
333.2	0.00157
<u>CURVE 7</u>	
293.2	0.00745
328.2	0.00816

SPECIFICATION TABLE NO. 392 THERMAL CONDUCTIVITY OF MICANITE

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	303.2	1	Commercial	Measured under a load of 21 psi.
2	125	L	1923	303.2	1	Commercial	Similar to above specimen.

DATA TABLE NO. 392 THERMAL CONDUCTIVITY OF MICANITE

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

303.2 0.00209

CURVE 2*

303.2 0.00418

* No graphical presentation

SPECIFICATION TABLE NO. 393 THERMAL CONDUCTIVITY OF MINERAL FIBER

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	564	L	1944	297-325		B	1 in. thick; packing density 0.0264 g cm ⁻³ .
2	564	L	1944	297-325		A	1 in. thick; packing density 0.0561 g cm ⁻³ .
3	564	L	1944	297-325		B	1 in. thick; packing density 0.0396 g cm ⁻³ .
4	564	L	1944	297-325		B	1 in. thick; packing density 0.0529 g cm ⁻³ .
5	564	L	1944	297-325		A	1 in. thick; packing density 0.0681 g cm ⁻³ .
6	564	L	1944	297-325		A	1 in. thick; packing density 0.112 g cm ⁻³ .

DATA TABLE NO. 393 THERMAL CONDUCTIVITY OF MINERAL FIBER

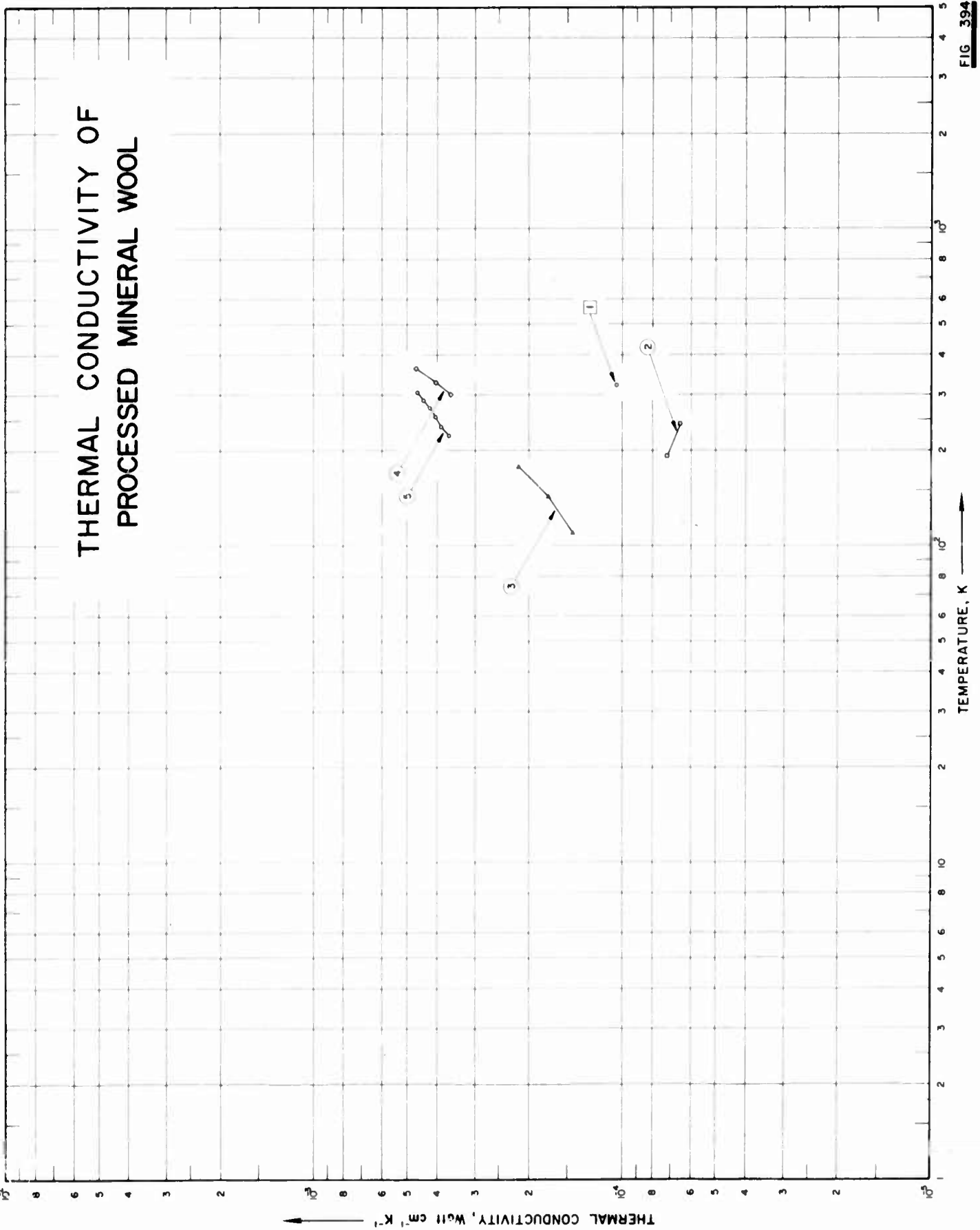
[Temperature, T. K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
<u>CURVE 1*</u>			
297.1	0.000420	297.1	0.000361
311	0.000453	311	0.000389
324.8	0.000493	324.8	0.000416
<u>CURVE 2*</u>			
297.1	0.000398	297.1	0.000378
311	0.000428	310.9	0.000401
325.1	0.000463	324.8	0.000433
<u>CURVE 3*</u>			
297.0	0.000375	297.1	0.000362
311	0.000404	311	0.000388
324.8	0.000438	324.8	0.000412

* No graphical presentation

FIGURE SHOWS ONLY 5 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF PROCESSED MINERAL WOOL



SPECIFICATION TABLE NO. 394 THERMAL CONDUCTIVITY OF MINERAL WOOL, PROCESSED

[For Data Reported in Figure and Table No. 394]

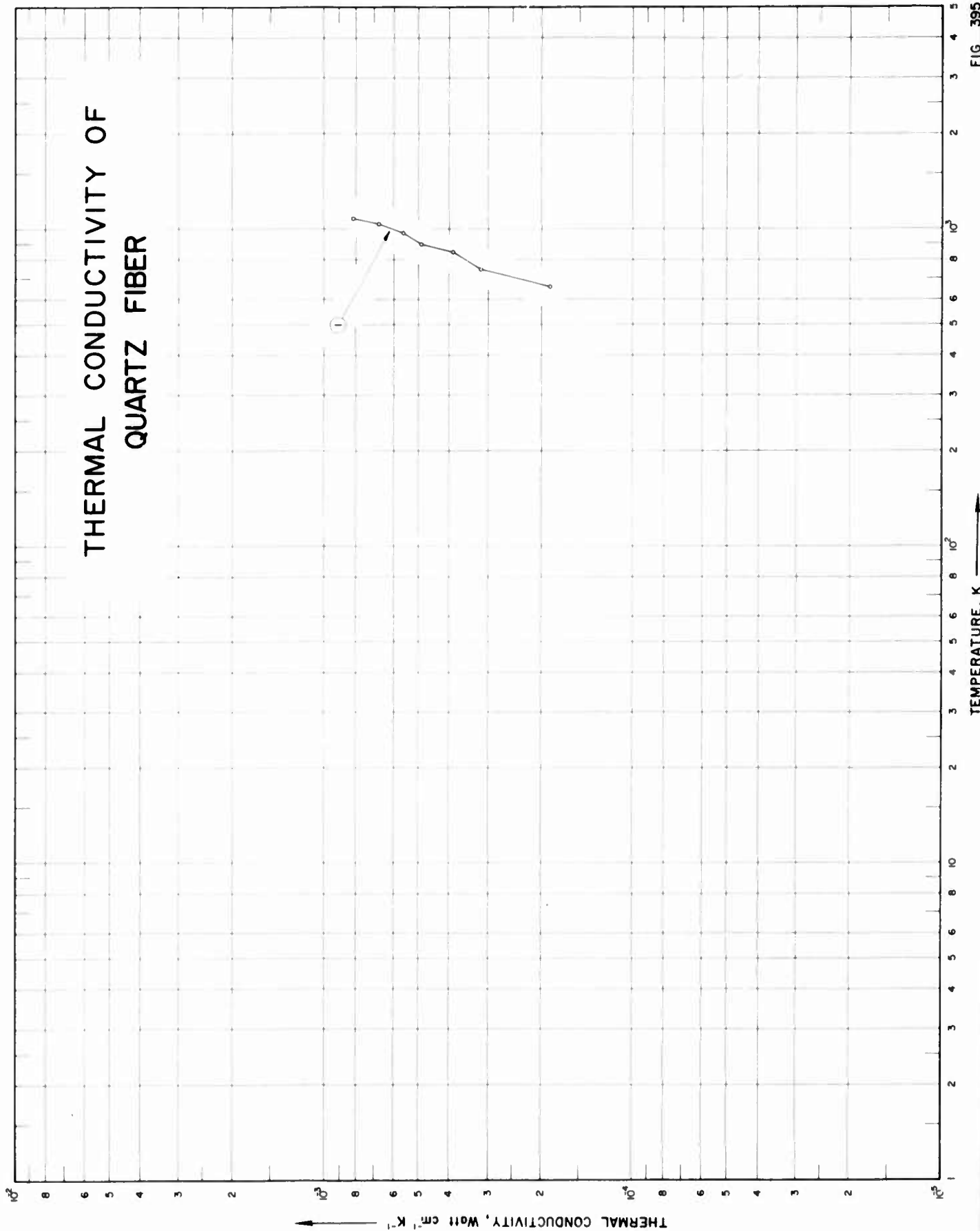
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	128	L	1946	323.7		Mineral wool board	2.02 in. thick; density 0.229 g cm ⁻³ .
2	128	L	1946	193-244		Mineral wool board	Similar to the above specimen except 0.99 in. thick.
3	43	L	1954	110-177		Mineral wool felt	Density 0.064-0.128 g cm ⁻³ .
4	43	L	1954	300-362		Mineral wool felt	Density 0.070-0.128 g cm ⁻³ .
5	109	L	1947	222-306		Mineral wool board	1 in. thick; density 0.252 g cm ⁻³ ; as received.
6	189		1950	200-289		Mineral wool board	Density 0.232-0.264 g cm ⁻³ ; water absorption (24 hrs) 3.3 vol %.

DATA TABLE NO. 394 THERMAL CONDUCTIVITY OF PROCESSED MINERAL WOOL
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
<u>CURVE 1</u>	
323.7	0.000104
<u>CURVE 2</u>	
193.2	0.0000717
243.7	0.0000651
<u>CURVE 3</u>	
110	0.000144
143	0.000173
177	0.000216
<u>CURVE 4</u>	
300	0.000361
328	0.000404
362	0.000468
<u>CURVE 5</u>	
222.0	0.000366
238.7	0.000387
255.4	0.000405
272.2	0.000424
288.9	0.000444
305.5	0.000464
<u>CURVE 6*</u>	
200.0	0.000346
222.2	0.000361
239.2	0.000389
255.5	0.000404
272.1	0.000418
288.8	0.000447

* Not shown on plot

THERMAL CONDUCTIVITY OF QUARTZ FIBER



SPECIFICATION TABLE NO. 395 THERMAL CONDUCTIVITY OF QUARTZ FIBER

[For Data Reported in Figure and Table No. 395]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	472	R	1963	661-1083		Dyna-quartz fiber	Specimen packed in a hollow cylinder of O. D. 2.75 in. and I. D. 0.75 in.; density 0.107 g cm^{-3} ; supplied by Johns-Manville; measured in a vacuum of 5×10^{-4} to 1×10^{-4} mm Hg.

DATA TABLE NO. 395 THERMAL CONDUCTIVITY OF QUARTZ FIBERS
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
660.9	0.000187
747.1	0.000317
844.3	0.000389
894.3	0.000490
972.1	0.000555
1033.2	0.000678
1083.2	0.000815

CURVE 1

SPECIFICATION TABLE NO. 396 THERMAL CONDUCTIVITY OF ROCK CORK

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	189		1950	200-288			Density range 0.22 ~ 0.26 g cm ⁻³ ; water absorption (24 hrs) 1.4 - 2.3 vol %.

DATA TABLE NO. 396 THERMAL CONDUCTIVITY OF ROCK CORK

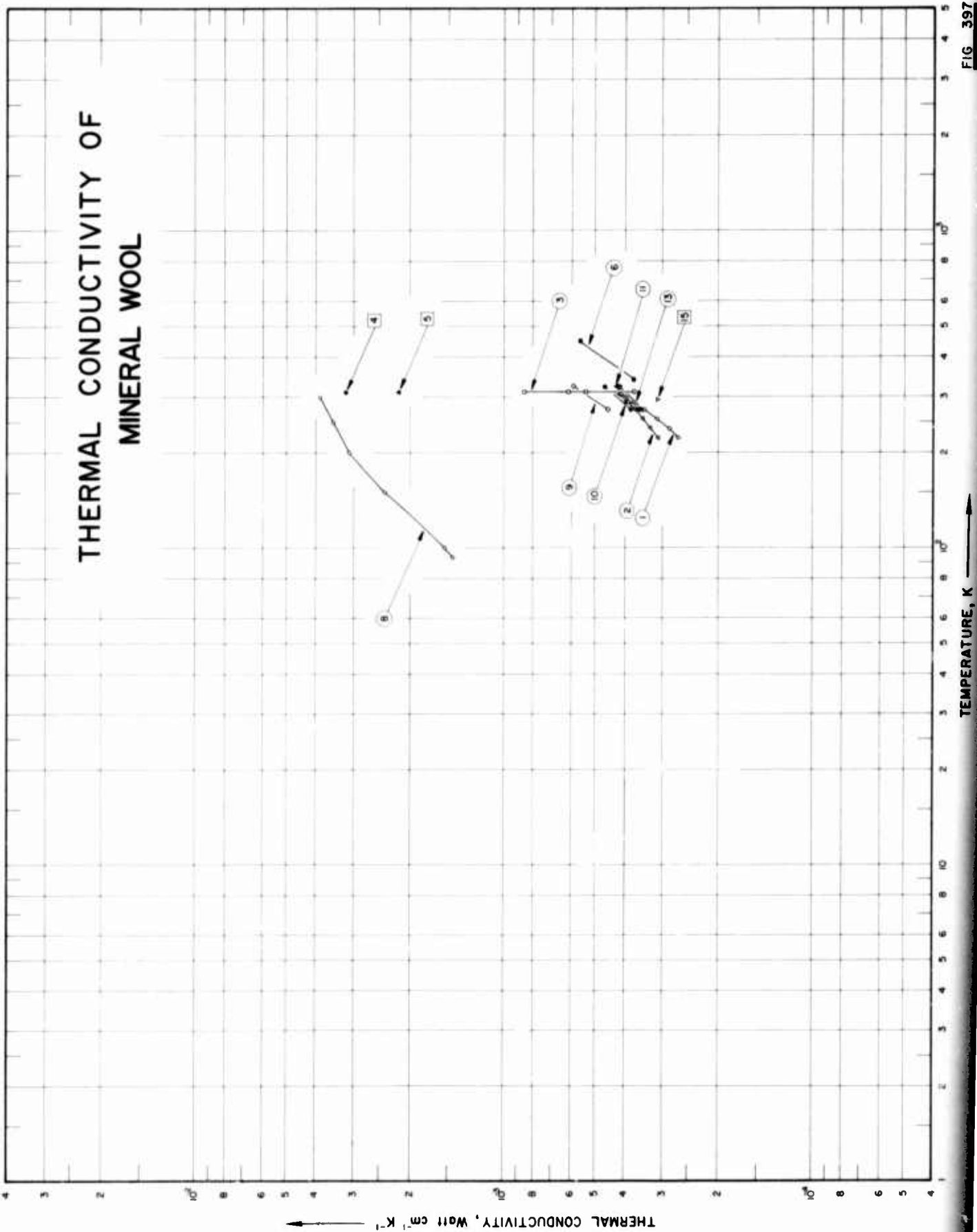
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
200.0	0.000346
222.2	0.000375
239.2	0.000389
255.5	0.000411
272.1	0.000433
288.1	0.000462

* No graphical presentation

THERMAL CONDUCTIVITY OF MINERAL WOOL

FIGURE SHOWS ONLY 12 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 397 THERMAL CONDUCTIVITY OF MINERAL WOOL

[For Data Reported in Figure and Table No. 397]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	109	L	1947	222-306			1 in. thick; density 0.056 g cm ⁻³ ; as received.
2	109	L	1947	222-306			Notulated; 1.5 in. thick; density 0.16 g cm ⁻³ ; as received.
3	558	L	1951	310.9			1 in. thick; density 0.123 g cm ⁻³ ; measured in air under various air pressures ranging from 0.02 μ Hg to 1 atm.
4	560	L	1954	310.9			1 in. thick; density 0.123 g cm ⁻³ ; measured in CO ₂ .
5	560	L	1954	310.9			The above specimen measured in F-12.
6	573	L	1954	339.450			No details reported.
7	563	L	1945	222-305			Thickness of specimen 1 in.; density 0.056 g cm ⁻³ at 25 C.
8	139	R	1950	53-300		Rock wool	Density 0.250 g cm ⁻³ .
9	571		1950	273.323		Rock wool	Density 0.030 g cm ⁻³ .
10	571		1950	273.323		Rock wool	Density 0.060 g cm ⁻³ .
11	571		1950	273.323		Rock wool	Density 0.090 g cm ⁻³ .
12	571		1950	273.323		Rock wool	Density 0.120 g cm ⁻³ .
13	571		1950	273.323		Rock wool	Density 0.145 g cm ⁻³ .
14	571		1950	273.323		Rock wool	Density 0.165 g cm ⁻³ .
15	457	C	1954	293.2		Rock wool	Cork used as comparative material.

DATA TABLE NO. 397 THERMAL CONDUCTIVITY OF MINERAL WOOL

Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

CURVE 1		CURVE 7		CURVE 14*	
T	k	T	k	T	k
222.0	0.000268	222.2	0.000268	273.2	0.000372
238.7	0.000286	239.2	0.000286	323.2	0.000430
255.4	0.000312	255.5	0.000312		
272.2	0.000343	272.1	0.000343	CURVE 15	
288.9	0.000391	288.8	0.000376	293.2	0.00031
305.5	0.000414	305.3	0.000414		
CURVE 2		CURVE 8			
222.0	0.000307	93.2	0.0145		
238.7	0.000328	100	0.0155		
255.4	0.000349	150	0.0240		
272.2	0.000369	200	0.0310		
288.9	0.000392	250	0.0350		
305.5	0.000417	300	0.0390		
CURVE 3		CURVE 9			
P(mm Hg) k		273.2	0.000453		
T = 310.9K		323.2	0.000593		
CURVE 4		CURVE 10			
atm.	0.000372	273.2	0.000384		
9.0	0.0000851	323.2	0.000465		
3.0	0.0000613				
0.02	0.0000534	CURVE 11			
CURVE 5		273.2	0.000360		
310.9	0.00318	323.2	0.000430		
CURVE 6		CURVE 12*			
310.9	0.00218	273.2	0.000360		
		323.2	0.000430		
CURVE 13		273.0	0.000375		
339.0	0.000375	450.2	0.000562		
450.2	0.000562				

* Not shown on plot

SPECIFICATION TABLE NO. 398 THERMAL CONDUCTIVITY OF MYSTIC SLAG

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	545	P	1947	287.3		3D-1	Specimen consisted of basic residue from blast furnace located at Everett, Mass.; packed in a hollow cylinder of 5.36 in. dia and 10.68 in. long; material placed in container in five approximately equal layers and compacted; using increasing number of blows on each layer to obtain a uniform density through the specimen; specific gravity 2.45; density 1.382 g cm ⁻³ ; moisture content 9.1% of dry weight; thermal conductivity value calculated from measured transient temperature change.
2	545	P	1947	287.3		3D-2	Similar to the above specimen except density 1.736 g cm ⁻³ ; moisture content 33.5% of dry weight.
3	545	P	1947	287.3		3D-6	Similar to the above specimen except density 1.488 g cm ⁻³ ; moisture content 0.6% of dry weight.
4	545	P	1947	261.8		3D-3	Similar to the above specimen except density 1.471 g cm ⁻³ ; moisture content 5.5% of dry weight.
5	545	P	1947	261.8		3D-4	Similar to the above specimen except density 1.784 g cm ⁻³ ; moisture content 27.7% of dry weight.
6	545	P	1947	261.8		3D-5	Similar to the above specimen except density 1.434 g cm ⁻³ ; moisture content 0.21% of dry weight.

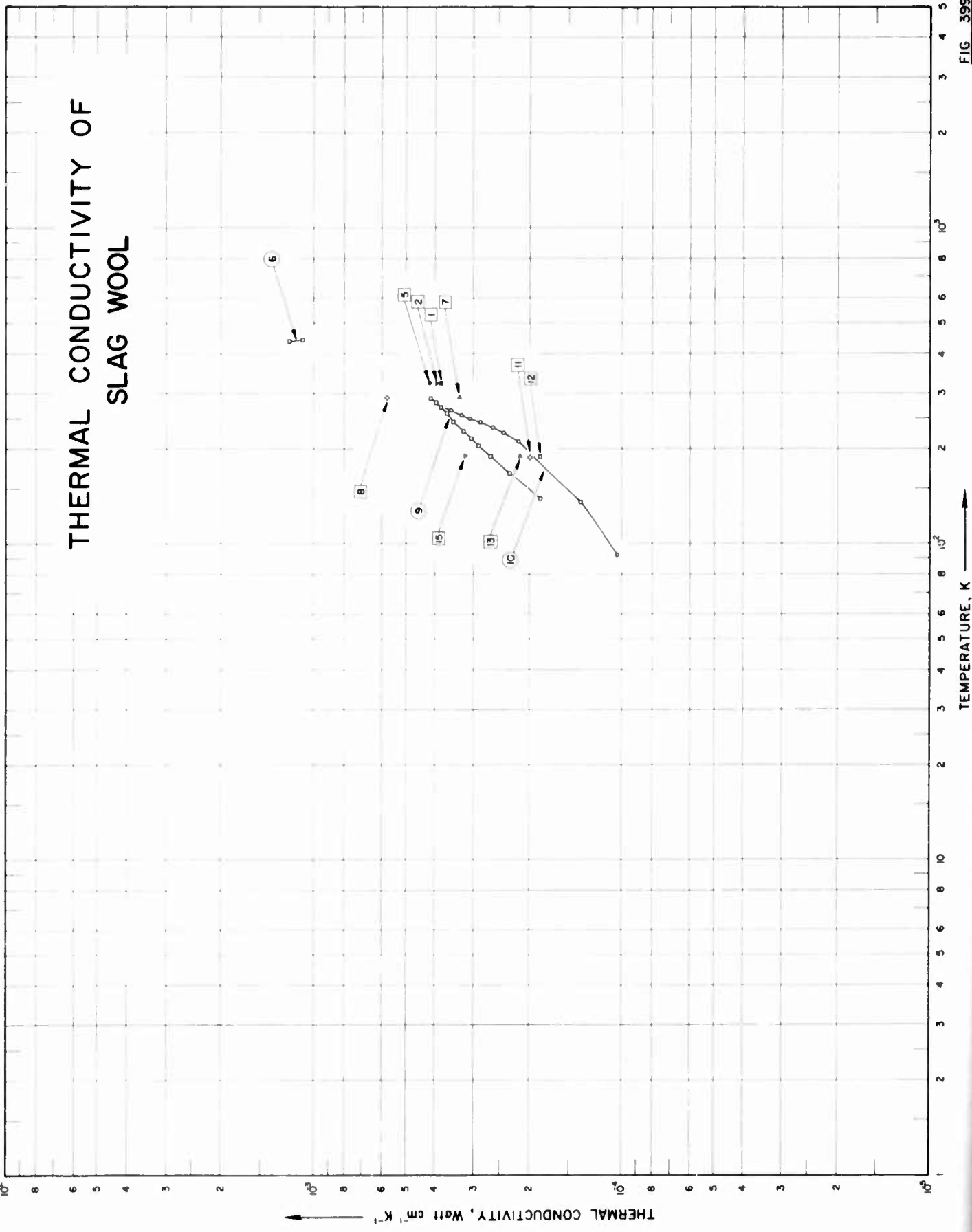
DATA TABLE NO. 398 THERMAL CONDUCTIVITY OF MYSTIC SLAG

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k
<u>CURVE 1*</u>	<u>CURVE 3*</u>	<u>CURVE 5*</u>			
287.3	0.00325	287.3	0.00253	261.8	0.0116
<u>CURVE 2*</u>	<u>CURVE 4*</u>	<u>CURVE 6*</u>			
287.3	0.00957	261.8	0.00424	261.8	0.00211

* No graphical presentation

FIGURE SHOWS ONLY 12 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 399 THERMAL CONDUCTIVITY OF SLAG WOOL

[For Data Reported in Figure and Table No. 399]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	571		1950	323.2			Specimen consisted mainly of SiO ₂ , CaO and oxides of Al, Fe, and Mn; density 0.080 g cm ⁻³ .
2	571		1950	323.2			Similar to the above specimen except density 0.100 g cm ⁻³ .
3	571		1950	323.2			Similar to the above specimen except density 0.125 g cm ⁻³ .
4	571		1950	323.2			Similar to the above specimen except density 0.150 g cm ⁻³ .
5	571		1950	323.2			Similar to the above specimen except density 0.175 g cm ⁻³ .
6	240	R	1919	438.444			Specimen packed in a hollow cylinder of 12.2 mm I. D., 19 mm O. D., and 8 cm long.
7	529	P	1956	290.4			Density 0.128 g cm ⁻³ ; thermal conductivity value calculated from measured transient temp changes.
8	529	P	1956	290.4			Similar to the above specimen except density 0.320 g cm ⁻³ .
9	561	R	1948	139-289		6A	Packed in a hollow cylinder of 2 in. I. D. and 10 in. O. D.; bulk density 0.197 g cm ⁻³ .
10	561	R	1948	92-284		6B	Similar to the above specimen but bulk density 0.112 g cm ⁻³ .
11	561	R	1948	187.3		6C	Similar to the above specimen but bulk density 0.147 g cm ⁻³ .
12	561	R	1948	188.3		6D	Similar to the above specimen but bulk density 0.130 g cm ⁻³ .
13	561	R	1948	189.3		6E	Similar to the above specimen but bulk density 0.095 g cm ⁻³ .
14	561	R	1948	190.2		6F	Similar to the above specimen but bulk density 0.080 g cm ⁻³ .
15	561	R	1948	190.2		6G	Similar to the above specimen but bulk density 0.059 g cm ⁻³ .

DATA TABLE NO. 399 THERMAL CONDUCTIVITY OF SLAG WOOL
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
<u>CURVE 1</u>			
323.2	0.000384	92.2	0.000104
		136.5	0.000138
		211.2	0.000218
<u>CURVE 2</u>			
323.2	0.000395	224.5	0.000242
		234.2	0.000261
<u>CURVE 3*</u>			
		243.2	0.000286
		249.6	0.000307
		256.2	0.000328
		265.2	0.000355
		274.2	0.000384*
		279.7	0.000405*
		284.2	0.000426*
323.2	0.000407		
<u>CURVE 5</u>			
323.2	0.000418	187.3	0.000199
<u>CURVE 6</u>			
438.1	0.00121	188.3	0.000185
443.8	0.00109		
<u>CURVE 7</u>			
290.4	0.000332	189.3	0.000216
<u>CURVE 8</u>			
290.4	0.000577	190.2	0.000232
<u>CURVE 9</u>			
139.2	0.000184	190.2	0.000317
167.8	0.000233		
189.2	0.000265		
204.2	0.000289		
216.0	0.000305		
227.4	0.000322		
243.7	0.000348		
259.7	0.000365		
270.7	0.000382		
280.4	0.000397		
288.7	0.000415		

* Not shown on plot

SPECIFICATION TABLE NO. 400 THERMAL CONDUCTIVITY OF BITUMEN

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight per cent), Specifications and Remarks
1	88	L	1926	292,356		I	Specimen thickness 5.5 mm; mean density 1.05 g cm ⁻³ .
2	88	L	1926	294,349		II	Specimen thickness 5.0 mm; mean density 1.05 g cm ⁻³ .

DATA TABLE NO. 400 THERMAL CONDUCTIVITY OF BITUMEN

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1</u> *	
292.1	0.00166
355.9	0.00173
<u>CURVE 2</u> *	
294.1	0.00169
349.2	0.00171

* No graphical presentation

SPECIFICATION TABLE NO. 401 THERMAL CONDUCTIVITY OF BONE CHAR

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	549	L	1953	337.7			Bulk density 0.700 g cm ⁻³ at 25 C; moisture content 2-4%.
2	549	L	1953	337.7			Similar to the above specimen except bulk density 0.791 g cm ⁻³ at 25 C.
3	549	L	1953	337.7			Similar to the above specimen except bulk density 0.857 g cm ⁻³ at 25 C.
4	549	L	1953	337.7			Similar to the above specimen except bulk density 0.823 g cm ⁻³ at 25 C.

DATA TABLE NO. 401 THERMAL CONDUCTIVITY OF BONE CHAR

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
<u>CURVE 1*</u>	
337.7	0.00178
<u>CURVE 2*</u>	
337.7	0.00167
<u>CURVE 3*</u>	
337.7	0.00181
<u>CURVE 4*</u>	
337.7	0.00169

* No graphical presentation

SPECIFICATION TABLE NO. 402 THERMAL CONDUCTIVITY OF CHARCOAL

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	491	L	1958	293			Sutcliffe Speakman 208 C charcoal bed contained in a cylindrical annular space of 1.5 cm I.D., 3.9 cm O.D., and 5 cm long; filled with helium.
2	491	L	1958	293			Similar to the above specimen except filled with air.

DATA TABLE NO. 402 THERMAL CONDUCTIVITY OF CHARCOAL

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
	<u>CURVE 1*</u>
293	0.0036
	<u>CURVE 2*</u>
293	0.0020

* No graphical presentation

SPECIFICATION TABLE NO. 403 THERMAL CONDUCTIVITY OF COAL TAR FRACTIONS

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	572	F	1953	393-603	<1		4.52% free carbon and 1.6% humidity; from Kizelovski coal (USSR); sp weight (20 C) = 1.1673.
2	572	F	1953	453-613	<1		2.85% free carbon and 3.7% humidity; from Kuznetski coal (USSR); sp weight (20 C) = 1.1859.
3	572	F	1953	423-533	<1		9.95% free carbon and 3.9% humidity; from a mixture of Kuznetski and Karagandunski coals; sp weight (20 C) = 1.2195.

DATA TABLE NO. 403 THERMAL CONDUCTIVITY OF COAL TAR FRACTIONS

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	CURVE 1*		CURVE 3*	
	k	T	k	T
393.2	0.00139	423.2	0.00130	
468.2	0.00128	478.2	0.00119	
488.2	0.00119	488.2	0.00115	
528.2	0.00116	533.2	0.00105	
553.2	0.00103			
598.2	0.00105			
603.2	0.00103			
CURVE 2*				
453.2	0.00129			
483.2	0.00123			
498.2	0.00114			
553.2	0.00102			
613.2	0.00096			

* No graphical presentation

REFERENCES TO DATA SOURCES

- | Ref.
No. | TPRC
No. | |
|-------------|-------------|---|
| 1 | 16816 | Norton, F. H., Fellows, D. M., Adams, M., and McQuarrie, M., USAEC Rept. NYO-594, 1-22, 1950. |
| 2 | 16821 | Norton, F. H., Kingery W. D., Fellows, D. M., Adams, M., McQuarrie, M. C., Coble, R. L., Francl, J., Vasilos, T., and Anderson, H. H., USAEC Rept. NYO-597, 1-15, 1951. |
| 3 | 9404 | Koenig, J. H., Rutgers Univ. N.J. Ceram. Research Sta. Progr. Rept. 2, 1-117, 1953. [AD 131 54] |
| 4 | 16818 | Norton, F. H., USAEC Rept. NYO-598, 1-10, 1951. |
| 5 | 2441 | Kingery, W. D., J. Am. Ceram. Soc., <u>37</u> , 88-90, 1954. |
| 6 | 35859 | Neshpor, V. S., Ordanyan, S. S., Avgustinik, A. I., and Khusidman, M. B., NASA TTF-9350, 1-15, 1965. |
| 7 | 16826 | Norton, F. H., Fellows, D. M., Adams, M., McQuarrie, M., and Fullerton, C. P., USAEC NYOO-96, Progr. Rept. 2, 1-43, 1949. |
| 8 | 10013 | Sutton, W. H., J. Am. Ceram. Soc., <u>43</u> (2), 81-6, 1960. |
| 9 | 7102 | Koenig, J. H. (Director), Rutgers Univ., N.J. Ceram. Research Sta., Progr. Rept. 4, 1-35, 1953. [AD 293 35] |
| 10 | 9316 | Norton, F. H., Kingery, W. D., et al., USAEC Rept. NYO-602, 1-40, 1952. |
| 11 | 7690 | Powers, R. W., Schwartz, D., and Johnson, H. L., Cryogenic Lab., OSU, USAF TR264-5, 1-19, 1951. |
| 12 | 7067 | Koenig, J. H. (Director), Rutgers Univ. N.J. Ceram. Research Sta. Progr. Rept. 3, 1-25, 1953. [AD 198 33] |
| 13 | 6200 | Weeks, J. L. and Seifert, R. L., Rev. Sci. Instr., <u>24</u> , 1054-7, 1953. |
| 14 | 24366 | Vasilos, T., Kingery, W. D., and Norton, F. H., USAEC Rept. NYO-3649, 1-33, 1953. |
| 15 | 6364 | Jamieson, C. P. and Mrozowski, S., Proc. Conf. on Carbon, Univ. Buffalo, 155-66, 1956. |
| 16 | 9857 | Worthing, A. G., Phys. Rev., <u>4</u> , 535-43, 1914. |
| 17 | 6739 | Burr, A. C., Canad. J. Technol., <u>29</u> , 451-7, 1951. |
| 18 | 6225 | Powell, R. W. and Schofield, F. H., Proc. Phys. Soc. (London), <u>51</u> (1), 153-72, 1939. |
| 19 | 43 | Brown, A. R. G., Watt, W., Powell, R. W., and Tye, R. P., Brit. J. Appl. Phys., <u>7</u> , 73-6, 1956. |
| 20 | 3556 | Buerschaper, R. A., J. Appl. Phys., <u>15</u> , 452-4, 1944. |
| 21 | 9914 | Kaye, G. W. C. and Higgins, W. F., Proc. Roy. Soc. (London), <u>A122</u> , 633-46, 1929. |
| 22 | 6708 | Eucken, A., Ann. Physik, <u>34</u> (2), 185-221, 1911. |
| 23 | 9410 | Koenig, J. H., Rutgers Univ. N.J. Ceram. Research Sta. Progr. Rept. 6, 1-98, 1952. [ATI 163 519] |
| 24 | 8195 | Ploetz, G. L., Muccigrosso, A. T., and Krystyniak, C. W., USAEC Rept. KAPL-1918, 1-24, 1958. |
| 25 | 266 | Berman, R., Simon, F. E., and Ziman, J. M., Proc. Roy. Soc. (London), <u>A220</u> , 171-83, 1953. |
| 26 | 179 | Ioffe, A. V. and Ioffe, A. F., Doklady Akad. Nauk USSR, <u>97</u> (5), 821-2, 1954. |
| 27 | 7200 | Berman, R., Simon, F. E., and Wilks, J., Nature, <u>168</u> , 277-80, 1951. |
| 28 | 1161 | Berman, R., Foster, E. L., and Ziman, J. M., Proc. Roy. Soc. (London), <u>A237</u> , 344-54, 1956. |
| 29 | 6944 | Hedge, J. C. and Fieldhouse, I. B., AECU-3381, 1-10, 1956. |
| 30 | 15942 | Paprocki, S. J. (Editor), Keller, D. L., Hodge, E. S., Boyer, C. B., Fox, J. B., Kizer, D. E., and Porembka, S. W., USAEC Rept. BMI-1475, 1-92, 1960. |
| 31 | 6478 | de Vries, D. A. and Peck, A. J., Australian J. Phys., <u>11</u> (2), 255-71, 1958. |
| 32 | 9289 | de Haas, W. J. and Biermasz, Th., Physica, <u>4</u> (8), 752-6, 1937. |
| 33 | 6565 | Lucks, C. F., Matolich, J., and Van Velzor, J. A., USAF TR 6145, Pt. III, 1-71, 1954. [AD 954 06] |
| 34 | 1287 | Knapp, W. J., J. Am. Ceram. Soc., <u>26</u> , 48-55, 1943. |
| 35 | 107 | Colosky, B. P., Am. Ceram. Soc. Bull., <u>31</u> (1), 465-6, 1952. |
| 36 | 6544 | NBS, NBS Rept. 4761, Progr. Rept. 1, 1-6, 1956. [AD 101 080] |

Ref. No.	TPRC No.	
37	6970	Fieldhouse, I. B., Hedge, J. C., Lang, J. I., and Waterman, T. E., WADC TR 57-487, 1-88, 1958. [AD 150 954] [PB 131 718]
38	22625	Yoshida, I., J. Phys. Soc. Japan, <u>15</u> (12), 2211-9, 1960.
39	10947	Lucks, C. F., Deem, H. W., and Woods, W. D., Am. Ceram. Soc. Bull., <u>39</u> (6), 313-9, 1960.
40	16415	Ward, F. A., Phil. Mag., <u>48</u> , 971-7, 1924.
41	8370	Johnston, H. L., Ohio State Univ. Research Foundation, USAF Proj. MX-588, Rept. 20, 1-10, 1948. [ATI 45 490]
42	7036	Koenig, J. H. (Director), Rutgers Univ. N. J. Ceram. Res. Sta. Progr. Rept. 1, 1-33, 1953. [AD 5 552]
43	6325	Verschoor, J. D., Refrig. Eng., <u>62</u> (9), 35-7 and 98, 1954.
44	16313	Barratt, T., Proc. Phys. Soc. (London), <u>27</u> , 81-93, 1914.
45	10164	Norton, F. H., Kingery, W. D., et al., USAEC Rept. NYO-3646, 1-8, 1953. [AD 16 492]
46	163	Slack, G. A., Phys. Rev., <u>105</u> , 832-42, 1957.
47	9972	Raeth, C. H., USAEC Rept. CP-2332, 1-25, 1944.
48	6502	Fieldhouse, I. B., Hedge, J. C., Lang, J. L., Takata, A. N., and Waterman, T. E., WADC TR 55-495, Pt. 1, 20-48, 1956. [AD 110 404]
49	258	Tyler, W. W. and Wilson, A. C., Jr., Phys. Rev., <u>89</u> (4), 870-5, 1953.
50	820	Smith, A. W. and Rasor, N. S., USAEC Rept. NAA-SR-1590, 1-25, 1956.
51	734	Deegan, G. E., USAEC Rept. NAA-SR-1716, 1077, 1956.
52	166	Euler, J., Ann. Physik, <u>6</u> , <u>18</u> , 345-69, 1956.
53	7130	Rasor, N. S., USAEC Rept. NAA-SR-1061, 1-23, 1955. [AD 50 086]
54	190	Euler, J., Naturwissenschaften, <u>39</u> , 568-9, 1952.
55	6560	Lucks, C. F. and Deem, H. W., WADC TR 55-496, 1-65, 1956. [AD 97 185]
56	8104	Fletcher, J. F. and Snyder, W. A., Am. Ceram. Soc. Bull., <u>36</u> (3), 101-4, 1957.
57	16820	Norton, F. H., Kingery, W. D., Fellows, D. M., Adams, M., McQuarrie, M. C., and Coble, R. L., USAEC Rept. NYO-596, 1-9, 1950.
58	6431	Doolittle, J. S., N. Carolina State College Quarterly Rept. 3, 1-4, 1953. [AD 122 141]
59	6210	Marshall, T. A., Brit. J. Appl. Phys., <u>4</u> , 112-4, 1953.
60	23906	Tautz, H., Exp. Tech. der Physik, <u>8</u> (1), 34-7, 1960.
61	13785	Jaffee, R. I. and Maykuth, D. J., Aero-Space Eng., <u>19</u> , 39-44, 1960.
62	23952	Pohl, R. O., Phys. Rev., <u>118</u> (6), 1499-508, 1960.
63	18030	Taylor, R. E., J. Am. Ceram. Soc., <u>44</u> (10), 525, 1961.
64	9880	Slack, G. A. and Newman, R., Phys. Rev. Letters, <u>1</u> (10), 359-60, 1958.
65	10682	Francis, R. K., Brown, R., McNamara, E. P., and Tinklepaugh, J. R., Wright Air Development Center, WADC TR 58-600, PB-151664, 1-69, 1958. [AD 205 549]
66	9287	Lees, C. H., Phil. Trans. Roy. Soc. (London), <u>A204</u> , 433-66, 1905.
67	1172	Ueberreiter, K. and Orthmann, H. J., Z. Naturforsch., <u>A5</u> , 101-8, 1950.
68	7104	Koenig, J. H. (Director), Rutgers Univ. N. J. Ceram. Res. Sta. Progr. Rept. 5, 1-24, 1954.
69	1411	Berman, R., Proc. Roy. Soc. (London), <u>A208</u> , 90-108, 1951.
70	1108	Berman, R., Foster, E. L., and Ziman, J. M., Proc. Roy. Soc. (London), <u>A231</u> , 130-44, 1955.
71	25435	McCarthy, K. A. and Ballard, S. S., J. Opt. Soc. Am., <u>41</u> , 1062-3, 1951.
72	10101	Kingery, W. D. and Norton, F. H., USAEC Rept. NYO-6447, 1-14, 1955. [AD 55 595]
73	10192	Norton, F. H. and Kingery, W. D., USAEC Rept. NYO-6441, 1-7, 1954. [AD 27 184]
74	25427	Quirk, J. and Harman, C. G., J. Am. Ceram. Soc., <u>37</u> , 24-6, 1954.
75	1639	Pengelly, A. E., Brit. J. Appl. Phys., <u>6</u> , 18-20, 1955.
76	6991	McCreight, L. R., USAEC Rept. TID-10062, 1-19, 1952.
77	1425	Garrett, C. G. B., Phil. Mag., <u>41</u> , 621-30, 1950.
78	26	Bijl, D., Physica, <u>14</u> , 684-93, 1948.
79	5258	Griffiths, E., Powell, R. W., and Hickman, M. J., J. Inst. Fuel, <u>15</u> , 107-20, 1942.
80	7180	Wilkes, G. B., J. Am. Ceram. Soc., <u>17</u> , 173-7, 1934.

- | Ref.
No. | TPRC
No. | |
|-------------|-------------|--|
| 81 | 20589 | Buckner, O.S., J. Am. Ceram. Soc., <u>7</u> , 19-28, 1924. |
| 82 | 26012 | Lowrance, D.T., Chance Vought Corp., CVC Rept. 2-53420/2R375, 1-95, 1962. [AD 273 802] |
| 83 | 9247 | Sheriff, I.I. and Bakr, M.Y., Silicates Ind., <u>21</u> (6-7), 287-9, 1956. |
| 84 | 20757 | Hartmann, M.L. and Westmont, O.B., J. Am. Ceram. Soc., <u>8</u> , 92-95, 1925. |
| 85 | 801 | Kolechkova, A.F. and Goncharov, V.V., Ogneupory, <u>14</u> , 445-53, 1949. |
| 86 | 4492 | Kolechkova, A.F. and Goncharov, V.V., Ogneupory, <u>13</u> , 401-7, 1948. |
| 87 | 110 | Ruh, E., J. Am. Ceram. Soc., <u>37</u> (5), 224-9, 1954. |
| 88 | 21109 | Jakob, M., Z. tech. Physik, <u>7</u> , 475-81, 1926. |
| 89 | 10851 | Norton, F.H. and Kingery, W.D., USAEC Rept. NYO-601, 1-52, 1952. |
| 90 | 3610 | Patton, T.C. and Norton, C.L., Jr., J. Am. Ceram. Soc., <u>26</u> , 350-8, 1943. |
| 91 | 617 | Dudavskii, I.E., Zavodskaya Lab., <u>13</u> , 710-5, 1947. |
| 92 | 838 | Plotnikov, L.A., Zavodskaya Lab., <u>16</u> , 1136-9, 1950. |
| 93 | 74 | Wester, A. and Aggeryd, B., Das Papier, <u>11</u> (5-6), 98-104, 1957. |
| 94 | 1070 | Cammerer, J.S., Stahl und Eisen, <u>62</u> , 503-10, 1942. |
| 95 | 7182 | Finck, J.L., J. Am. Ceram. Soc., <u>18</u> , 6-12, 1935. |
| 96 | 7181 | Weinland, C.E., J. Am. Ceram. Soc., <u>17</u> , 194-202, 1934. |
| 97 | 8552 | Shakhtin, D.M., UKAEA Rept. IGRL-T/C-67, 1-4, 1958. |
| 98 | 3671 | Norton, C.L., Jr., J. Am. Ceram. Soc., <u>25</u> (15), 451-9, 1942. |
| 99 | 1967 | Duplin, V.J., Jr., and Fitzsimmons, E.S., J. Am. Ceram. Soc., <u>35</u> , 226-9, 1952. |
| 100 | 10271 | Bishui, B.M. and Prasad, J., Central Glass and Ceram. Research Inst. Bull. (India), <u>4</u> , 144-9, 1957. |
| 101 | 7185 | Austin, J.B. and Pierce, R.H.H., Jr., J. Am. Ceram. Soc., <u>18</u> , 48-54, 1935. |
| 102 | 220 | Suzuki, H., Kuwayama, N., and Yamauchi, T., Yogyo Kyokai Shi, <u>65</u> , 206-11, 1957. |
| 103 | 13367 | Finck, J.L., J. Am. Ceram. Soc., <u>20</u> , 378-82, 1937. |
| 104 | 1991 | Suzuki, H., Kuwayama, N., and Yamauchi, T., Yogyo Kyokai Shi, <u>64</u> (726), 161-6, 1956. |
| 105 | 23960 | Nuvoli, A., Ricerca Scientifica, <u>28</u> (10), 2095-101, 1958. |
| 106 | 40 | Noguchi, T. and Miyazaki, Y., Tanso, <u>5</u> , 36-9, 1956. |
| 107 | 21969 | Hersey, M.D. and Butzler, E.W., J. Washington Acad. Sci., <u>14</u> , 147-51, 1924. |
| 108 | 22166 | Taylor, T.S., Mech. Eng., <u>42</u> , 8-10, 1920. |
| 109 | 6359 | Rowley, F.B., Jordan, R.C., and Lander, R.M., Refrigeration Engineering, <u>53</u> , 35-9, 1947. |
| 110 | 5402 | Keesom, P.H., Physica, <u>11</u> (4), 339-42, 1945. |
| 111 | 6567 | Lucks, C.F., Bing, G.F., Matolich, J., Deem, H.W., and Thompson, H.B., USAF TR 6145, 1-39, 1952. [AD 95 239] |
| 112 | 7695 | Melonas, J.V., Covington, P.C., and Pears, C.D., Southern Res. Inst., WADC TR 58-129, 1-15, 1958. [AD 155 816] |
| 113 | 206 | Kunugi, M., Tanaka, S., Shimizu, S., and Kitamura, K., J. Ceram. Assoc. (Japan), <u>62</u> (703), 780-4, 1954. |
| 114 | 10100 | Kingery, W.D. and Norton, F.H., USAEC Rept. NYO-6446, 1-6, 1954. [AD 53 808] |
| 115 | 56 | Berman, R., Phys. Rev., <u>76</u> , 315-6, 1949. |
| 116 | 7477 | Wilkinson, K.R. and Wilks, J., J. Sci. Instr., <u>26</u> , 19-20, 1949. |
| 117 | 1125 | Krischer, O. and Esdorn, H., VDI Forschungsheft 450 Suppl. to Forsch. Gebiete Ingenieurw., B, (21), 28-39, 1955. |
| 118 | 145 | Geffcken, I.W., Glastechn. Ber., <u>25</u> , 392-6, 1952. |
| 119 | 7028 | Eucken, A., Z. Tech. Physik, <u>6</u> , 689-94, 1925. |
| 120 | 768 | Marathe, M.N. and Tendolkar, G.S., Trans. Indian Inst. Chem. Engrs., <u>6</u> , 90-104, 1953. |
| 121 | 21495 | Carman, A.P. and Nelson, R.A., Univ. Illinois Exp. Sta. Bull. 122, 1-32, 1921. |
| 122 | 7099 | Powers, R.W., Johnston, H.L., Hansen, R.H., and Ziegler, J.B., Ohio State Univ. Cryogenic Lab. USAF TR-264-16, 1-29, 1953. [AD 27 569] |
| 123 | 88 | Ueberreiter, K. and Otto-Laupenmuhlen, E., Z. Naturforsch, II, <u>8A</u> , 664-73, 1953. |
| 124 | 17269 | Hager, N.E., Jr., Rev. Sci. Instr., <u>31</u> (2), 177-85, 1960. |

- | Ref. No. | TPRC No. | |
|----------|----------|--|
| 125 | 7648 | Griffiths, E. and Kaye, G.W.C., Proc. Roy. Soc. (London), <u>A104</u> , 71-98, 1923. |
| 126 | 3265 | Schallamach, A., Proc. Phys. Soc. (London), <u>53</u> , 214-8, 1941. |
| 127 | 20037 | Clarke, L. N. and Kingston, R. S. T., Australian J. Appl. Sci., <u>1</u> (2), 172-87, 1950. |
| 128 | 6321 | Wilkes, G. B., Refrig. Eng., <u>52</u> , 37-42, 1946. |
| 129 | 21022 | Hansen, C. A., Trans. Am. Electrochem. Soc., <u>16</u> , 329-62, 1909. |
| 130 | 2438 | McQuarrie, M., J. Am. Ceram. Soc., <u>37</u> (2), 84-8, 1954. |
| 131 | 2434 | Francel, J. and Kingery, W. D., J. Am. Ceram. Soc., <u>37</u> , 80-4, 1954. |
| 132 | 7689 | Fieldhouse, I. B., Hedge, J. C., and Lang, J. I., WADC TR 58-274, 1-79, 1958. [AD 206 892] |
| 133 | 2429 | Francel, J. and Kingery, W. D., J. Am. Ceram. Soc., <u>37</u> , 99-107, 1954. |
| 134 | 1115 | Shul'man, A. R., Fedorov, V. N., and Shepsenvol, M. A., Zhur. tekhn. Fiz., <u>22</u> , 1271-80, 1952. |
| 135 | 7095 | Shakhtin, D. M. and Vishnevskii, I. I., Zavodskaya Lab., <u>23</u> , 927-9, 1957. |
| 136 | 10052 | Kingery, W. D., J. Am. Ceram. Soc., <u>42</u> (12), 617-27, 1959. |
| 137 | 6941 | Soxman, E. J., Study of Heat Transfer of Ceramic Materials, Alfred Univ., ONR, I, 1-36, 1955. |
| 138 | 1166 | Ditmars, D. A. and Ginnings, D. C., J. Research NBS, <u>59</u> (2), 93-9, 1957. |
| 139 | 76 | Codegone, C., La Ricerca Sci., <u>20</u> , 68-70, 1950. |
| 140 | 22427 | Kaye, G.W.C. and Higgins, W. F., Proc. Roy. Soc. (London), <u>A113</u> , 335-51, 1926. |
| 141 | 1180 | Scholes, W. A., J. Am. Ceram. Soc., <u>33</u> (4), 111-7, 1950. |
| 142 | 9398 | Berman, R., Foster, E. L., and Rosenberg, H. M., Brit. J. Appl. Phys., <u>6</u> (5), 181-2, 1955. |
| 143 | 757 | Kolechkova, A. F. and Goncharov, V. V., Ogneupory, <u>20</u> , 39-44, 1955. |
| 144 | 26008 | Pears, C. D. (Project director), Southern Res. Inst. Tech. Documentary Rept. ASD-TDR-62-765, 20-402, 1963. [AD 298 061] |
| 145 | 10110 | Kingery, W. D. and Norton, F. H., USAEC Rept. NYO-6450, 1-16, 1955. [AD 73 173] |
| 146 | 10045 | Kingery, W. D. and Norton, F. H., USAEC Rept. NYO-6451, 1-16, 1955. [AD 80 699] |
| 147 | 15618 | Ratcliffe, E. H., Phys. and Chem. of Glasses, <u>1</u> (3), 103-4, 1960. |
| 148 | 24174 | Sujak, B., ACTA Physica Polonica, <u>20</u> (2), 167-74, 1961. |
| 149 | 19423 | Boettcher, A. and Schneider, G., Proc. of 2nd U. N. Conference on Peaceful Uses of Atomic Energy, <u>6</u> , 561-3, 1958. |
| 150 | 26079 | Secrest, A. C., Jr., Foster, E. L., and Dickerson, R. F., USAEC Rept. BMI-1309, 1-16, 1959. |
| 151 | 26078 | Noe, A., Eldridge, E. A., and Deem, H. W., USAEC Rept. BMI-1377, 74-6, 1959. |
| 152 | 25109 | Bopp, C. D., Towns, R. L., and Sisman, O., USAEC Rept. ORNL-1945, 35-6, 1956. |
| 153 | 10857 | Norton, F. H., Kingery, W. D., et al., USAEC Rept. NYO-600, 1-20, 1951. |
| 154 | 6249 | Powell, R. W., Phil. Mag., <u>7</u> , <u>27</u> (185), 677-86, 1939. |
| 155 | 22782 | Mannchen, W., Z. Metallk., <u>23</u> , 193-6, 1931. |
| 156 | 8330 | Grard, C. and Villey, J., Compt. Rend., <u>185</u> , 856-8, 1927. |
| 157 | 124 | de Nobel, J., Bull. Inst. Intern. Froid, Annexe 1956-2, 97-109, 1956. |
| 158 | 824 | Berman, R., Proc. Phys. Soc. (London), <u>A65</u> , 1029-40, 1952. |
| 159 | 16782 | Snyder, T. M. and Kamm, R. L., USAEC Rept. C-192, A-230, 1-56, 1955. |
| 160 | 10690 | Mrozowski, S., Andrew, J. F., Repetski, J., Strauss, H. E., and Wobschall, D. C., WADC TR-58-360, Pt. I, 1-59, 1958. [AD 206 664] |
| 161 | 25359 | Kasatochkin, V. I., Zamoluev, V. K., Kaverov, A. T., and Usenbaev, K., Proc. Acad. Sci. USSR Phys. Chem. Sect., <u>135</u> (1), 1009-12, 1960. |
| 162 | 16829 | Tyler, W. W. and Wilson, A. C., Jr., USAEC Rept. KAPL-789, 1-54, 1952. |
| 163 | 10087 | Rasor, N. S. and Smith, A. W., USAEC Rept. NAA-SR-862, 1-37, 1954. [AD 85 006] |
| 164 | 204 | Williams, W. S., Bull. Inst. Intern. Froid, Annexe 1956-2, 119-24, 1956. |
| 165 | 29663 | Ross, A. M., USAEC Rept. CRFD-817, 1-55, 1960. |
| 166 | 9319 | Eian, C. S. and Deissler, R. G., NACA RM E53G03, 1-18, 1953. |
| 167 | 6968 | Boegli, J. S. and Deissler, R. G., NACA RM E54L10, 1-20, 1955. [AD 56 099] |
| 168 | 24212 | Bethoux, O., Thomas, P., and Weil, L., Compt. Rend., <u>253</u> (19), 2043-5, 1961. |
| 169 | 21298 | Cohen, I., Lustman, B., and Eichenberg, J. D., J. Nuclear Materials, <u>3</u> (3), 331-53, 1961. |

Ref. No.	TPRC No.	
170	10030	Norton, F.H. and Kingery, W.D., USAEC Rept. NYO-3644, 1-18, 1953. [AD 11 816]
171	10063	Scott, R., UKAEA Rept. AERE M/R 2526, 1-11, 1958. [AD 209 258 L]
172	14147	Howard, V.C. and Gulvin, T.F., UKAEA IG Rept. 51 (RD/C), 1-23, 1961.
173	27838	Daniel, J.L., Matolich, J., Jr., and Deem, H.W., USAEC Rept. HW-69945, 1-42, 1962.
174	14833	Reiswig, R.D., J. Am. Ceram. Soc., <u>44</u> (1), 48-9, 1961.
175	6298	Powell, R.W., Proc. Phys. Soc. (London), <u>49</u> (4), 419-25, 1937.
176	6978	Fieldhouse, I.B., Hedge, J.C., and Waterman, T.E., WADC TR 55-495, Pt. III, 1956. [AD 110 526]
177	6980	Rasor, N.S. and McClelland, J.D., WADC TR 56-400, I, 1-53, 1957. [AD 118 144]
178	10846	Rasor, N.S., North American Aviation, NAA-SR-43, 1-36, 1950.
179	20403	Icole, M., Ann de Chimie et de Physique, <u>25</u> , 134-44, 1912.
180	20777	Mrozowski, S., Andrew, J.F., Juul, N., Strauss, H.E., and Wobschall, D.C., WADC TR 58-360, Pt. III, 1-54, 1961. [AD 258 531]
181	26075	National Carbon Co., USAEC ORO-240, 1, P1-2, 1959.
182	22833	Van Sant, J.H., USAEC Rept. GAMD-2089, 1-21, 1961.
183	25348	Gumenyuk, V.S. and Lebedev, V.V., Phys. Metals and Metallog, USSR, <u>11</u> (1), 30-5, 1961. [AD 262 622]
184	25074	Childers, H.M. and Cerceo, J.M., WADD TR 60-190, 1-66, 1961. [AD 272 691]
185	15792	Atomic International Div., North American Aviation, Inc., NAA-SR-5350, Progr. Repts., 1960.
186	20652	Hartmann, M.L., Westmont, O.B., and Weinland, C.E., Proc. ASTM, <u>28</u> (2), 820-47, 1928.
187	16179	Stephens, R.W.B., Phil. Mag., <u>14</u> , 897-914, 1932.
188	27955	Crawford, J.H., Jr., and Cohen, A.F., USAEC Rept. ORNL-2614, 43-6, 1958. [TID-4500]
189	1097	Stone, J.F., Petroleum Engr., <u>22</u> (1), C11-C16, 1950.
190	1630	Hubscher, M., Silikattech, <u>5</u> , 243-7, 1954.
191	777	Dauphinee, T.M., Ivey, D.G., and Smith, H.D., Can. J. Res., <u>A28</u> , 596-615, 1950.
192	1737	Hall, G.L. and Prettyman, I.B., India Rubber World, <u>113</u> , 222-35, 1945.
193	9149	Eldred, V.W. and Curtis, G.C., Nature, <u>179</u> , 910, 1957.
194	7681	Melonas, J.V., Covington, P.C., and Pears, C.D., Southern Res. Inst. WADC Tech. Rept. 58-179, 1-54, 1958. [AD 204 795]
195	8136	Wygant, J.F. and Crowley, M.S., J. Am. Ceram. Soc., <u>41</u> (5), 183-8, 1958.
196	8113	O'Brien, F.R. and Oglesby, S., Jr., WADC TR-54-306, Pt. 2, 16-22, 67-9, 1955. [AD 91 221]
197	1422	Freiling, J., Eckert, R.E., and Westwater, J.W., Ind. Eng. Chem., <u>44</u> , 906-10, 1952.
198	6617	O'Brien, F.R. and Oglesby, S., Jr., Southern Res. Inst., WADC TR-54-306, Pt. 1, 1-133, 1955. [AD 81 159]
199	10146	O'Brien, F.R., Covington, P.C., Harlan, W.J., and Oglesby, S., Jr., Southern Res. Inst. Rept. 1864-523-IV, 1-40, 1954. [AD 65 211]
200	20020	Schoenborn, E.M., Armstrong, A.A., Jr., and Beatty, K.O., Jr., Bull. Am. Soc. Testing Mat'ls., No. 174, 54-9, 1951.
201	1629	Nomura, S., Rept. Inst. Sci. and Technol., Univ. Tokyo, <u>6</u> , 117-9, 1952.
202	25307	Kodzhespirov, F.F., Soviet Phys. -Solid state, <u>3</u> (3), 567-70, 1961.
203	18522	Yoshida, I., Nomura, S., and Sawada, S., J. Phys. Soc. Japan, <u>13</u> , 1550-1, 1958.
204	6945	Armour Research Foundation, ARF Project No. G-025, Final Rept. for Oct. 1956 to Sept. 1957, 19-28, 1957.
205	1632	Fahey, D.J., Dunlap, M.E., and Seidl, R.J., Southern Pulp Paper Manufacturer, <u>16</u> (9), 40-50, 1953.
206	22803	Seidl, R.J., Forest Products Lab. Rept. 1918, 1-27, 1956. [AD 110 961]
207	6520	Urey, H.B., Jr., Master thesis Oklahoma A & M College, 1-40, 1956. [AD 108 261]
208	399	Mark, M., Modern Plastics, <u>34</u> (9), 168, 247, 1957.
209	28922	Peterson, J.J., CVC Rept. 2-53420/2R374, 1-77, 1962. [AD 273 801]
210	1458	Whittemore, O.J., Jr. and Marshall, D.W., J. Am. Ceram. Soc., <u>35</u> (4), 85-9, 1952.
211	10481	Norton, F.H. and Kingery, W.D., USAEC Rept. NYO-6442, 1-8, 1954. [AD 40 872]
212	7005	Deem, H.W. and Lucks, C.F., BMI-713, 1-8, 1954.

- | Ref.
No. | TPRC
No. | |
|-------------|-------------|---|
| 213 | 59 | Tanaka, M., Tsubaki, T., Ueshima, T., and Kamiike, O., <i>J. Ceram. Assoc. Japan</i> , <u>64</u> , 83-9, 1956. |
| 214 | 15620 | McCarthy, K.A. and Ballard, S.S., <i>J. Appl. Phys.</i> , <u>31</u> (8), 1410-2, 1960. |
| 215 | 16756 | Berman, R., Foster, E.L., Schneidmesser, B., and Tirmizi, S.M.A., <i>J. Appl. Phys.</i> , <u>31</u> (12), 2156-9, 1960. |
| 216 | 16767 | Salmon, D.F. and Bailey, J.F., USAEC Rept. ANP-71 (Del.) 1-15, 1951. |
| 217 | 16036 | Truesdale, R.S., Swica, J.J., and Tinklepaugh, J.R., College of Ceramics, State Univ. of N.Y. at Alfred Univ., Progr. Rept. 11, Nov. 1, 1959 to Apr. 30, 1960, 1-67, 1960. [AD 240 278] |
| 218 | 16022 | Taylor, R.E., USAEC Rept. NAA-SR-4905, 1-19, 1960. |
| 219 | 26077 | Schofield, H.Z., Duckworth, W.H., and Long, R.E., USAEC BMI-T 13, 1-24, 1949. |
| 220 | 26076 | Nelson, H.R., AEC Res. and Dev. Rept. BMI-HRN-Memo No. 10, 4-5, 1947. |
| 221 | 12256 | Birtwistle, S. and Shaw, R.A., UKAEA Industrial Group R &DB (S)-TN-2134, 1-15, 1959. |
| 222 | 7013 | Ratcliffe, E.H., <i>Brit. J. Appl. Phys.</i> , <u>10</u> , 22-5, 1959. |
| 223 | 9861 | Seemann, H.E., <i>Phys. Rev.</i> , <u>31</u> , 119-29, 1928. |
| 224 | 9294 | de Haas, W.J. and Biermasz, T., <i>Physica</i> , <u>5</u> (7), 619-24, 1938. |
| 225 | 19203 | de Haas, W.J. and Biermasz, T., <i>Physica</i> , <u>5</u> (4), 320-4, 1938. |
| 226 | 25453 | Berman, R., Klemens, P.G., Simon, F.E., and Fry, T.M., <i>Nature (London)</i> , <u>166</u> , 864-6, 1950. |
| 227 | 8245 | de Haas, W.J. and Biermasz, T., Comm. K. Onnes Lab. Univ. Leiden, Suppt. No. 82 to Nos. 241-252, 1-13, 1936. |
| 228 | 15248 | Cutler, M., Snodgrass, H.R., Cheney, G.T., Appel, J., Mallon, C.E., and Meyer, C.H., Jr., USAEC Rept. GA-1939, 1-99, 1961. |
| 229 | 27954 | Cohen, A.F., USAEC ORNL-2614, 39-42, 1958. [TID-4500] |
| 230 | 784 | Devyatkov, E.D. and Stilbans, L.S., <i>Zhur. Tekh. Fiz.</i> , <u>22</u> , 968-72, 1952. |
| 231 | 11913 | de Haas, W.J. and Biermasz, T., <i>Physica</i> , <u>5</u> , 47-53, 1938. |
| 232 | 10483 | Norton, F.H. and Kingery, W.D., USAEC Rept. NYO-6445, 1-8, 1954. [AD 40 874] |
| 233 | 16823 | Norton, F.H. and Kingery, W.D., M.I.T., USAEC Rept. NYO-6449, 1-16, 1955. |
| 234 | 16029 | Armour Res. Foundation, APEX-516, 1-6, 1959. |
| 235 | 26006 | Beck, R.L., <i>Trans. ASM</i> , <u>55</u> (3), 556-64, 1962. |
| 236 | 26080 | Baskin, Y. and Handwerk, J.H., USAEC ANL 6529, 1-29, 1962. |
| 237 | 14955 | Wray, K.L. and Connolly, T.J., <i>J. Appl. Phys.</i> , <u>30</u> (11), 1702-5, 1959. |
| 238 | 20009 | Green, A.T., <i>Trans. Brit. Ceram. Soc.</i> , <u>21</u> , 394-414, 1921. |
| 239 | 9142 | Deissler, R.G. and Eian, C.S., NACA RM E52 CO5, 1-44, 1952. |
| 240 | 21929 | Thomas, R., <i>J. Soc. Chem. Ind.</i> , <u>38</u> , 357T-360T, 1919. |
| 241 | 24061 | Yoshida, I. and Sawada, S., <i>J. Phys. Soc. Japan</i> , <u>15</u> (1), 199-200, 1960. |
| 242 | 11743 | Turnbull, A.G., <i>Australian J. of Appl. Sci.</i> , <u>12</u> (3), 324-9, 1961. |
| 243 | 26074 | Neel, D.S., Pears, C.D., and Oglesby, S., Jr., WADD TR 60-924, Southern Res. Inst., 58-201, 1962. [AD 275 360] |
| 244 | 26949 | Grossman, L.N., Hoyt, E.W., Ingold, J.H., Kaznoff, A.I., and Sanderson, M.J., USAEC Rept. No. GEST-2009, 1-208, 1962. [AD 296 577] |
| 245 | 23829 | Taylor, R.E. and Nakata, M.M., WADD-TR-60-581, Pt. III, 1-21, 1962. [AD 285 236] |
| 246 | 20113 | Kamilov, I.K., <i>Soviet Phys. -Solid State</i> , <u>4</u> (9), 1693-7, 1963. |
| 247 | 16913 | Kanz, A., <i>Mitt. Forsch. Inst.</i> , <u>2</u> (10), 223-34, 1932. |
| 248 | 25063 | Ewing, C.T., Spann, J.R., and Miller, R.R., NRL Memo Rept. 909, 1-10, 1959. |
| 249 | 192 | Mikashima, H. and Nakao, Y., <i>Tetsu-To-Hagane</i> , <u>39</u> , 1229-33, 1953. |
| 250 | 7140 | Bidwell, C.C., <i>Phys. Rev.</i> , <u>2</u> , <u>10</u> (6), 756-66, 1917. |
| 251 | 25961 | Hedge, J.C., Kopec, J.W., Kostenko, C., and Lang, J.I., ASD-TDR-63-597, Wright-Patterson Air Force Base, Ohio, 1-128, 1963. [AD 424 375] |
| 252 | 14416 | Wilkes, G.B., <i>J. Am. Ceram. Soc.</i> , <u>16</u> (3), 125-30, 1933. |
| 253 | 15658 | Flieger, H.W., Jr., and Ginnings, D.C., NBS Rept. 5642, 1-26, 1957. |
| 254 | 790 | Skanavi, G.I. and Kashtanova, A.M., <i>Zhur. Tekh. Fiz.</i> , <u>25</u> , 1883-92, 1955. |
| 255 | 189 | Neely, J.J., Teeter, C.E., Jr., and Trice, J.B., <i>J. Am. Ceram. Soc.</i> , <u>33</u> , 363-4, 1950. |

Ref. No.	TPRC No.	
256	786	Chizhikov, D. M., Gulyanitskaya, Z. F., and Bogovarova, N. N., <i>Izvest. Akad. Nauk SSSR, Otdel. Tekh. Nauk</i> No. 6, 109-13, 1955.
257	22824	Claiborne, S. J., ORNL Central Files No. CF 53-1-233, 1-2, 1953.
258	26439	Taylor, R. E. and Nakata, M. M., <i>Atomics International, 2nd ARPA Quarterly Progr. Rept.</i> , 1-16, 1963. [AD 297 874]
259	21939	Sturley, K. R., <i>J. Soc. Chem. Ind.</i> , <u>51</u> (1), 271T-273T, 1932.
260	14083	Burton, J. T. A. and Ziebland, H., <i>Ministry of Aviation (British) Explosives Res. and Dev. Establishment Rept. 17/R/60</i> , 1-17, 1961. [AD 251 642]
261	1128	Gillam, D. G., Romben, L., Nissen, H. E., and Lamm, O., <i>Acta Chemica Scand.</i> , <u>9</u> , 641-56, 1955.
262	20657	Codegone, C., <i>Ricerca Scientifica e Ricostruzione</i> , <u>10</u> , 701-6, 1939.
263	22822	Claiborne, S. J., ORNL CF-52-11-72, 1-2, 1952.
264	7531	Redmond, J. C. and Smith, E. N., <i>Trans., AIME</i> , <u>185</u> , 987-93, 1949.
265	16037	Mrozowski, S., Andrew, J. F., Juul, N., Okada, J., Strauss, H. E., and Wobschall, D. C., <i>WADC Tech. Rept. 58-360, II</i> , 1960. [AD 236 663]
266	27009	Juul, N., Sato, S., and Strauss, H. E., <i>Progr. Rept.</i> , State Univ. of N. Y. at Buffalo, No. 17, 1-11, 1963. [AD 405 540]
267	26684	Hartunian, R. A. and Varwig, R. L., <i>Phys. Fluids</i> , <u>5</u> (2), 169-74, 1962.
268	21703	Codegone, C., <i>Ricerca Scientifica e Ricostruzione</i> , <u>16</u> (3-4), 286-9, 1946.
269	16893	Flinta, J. E., <i>USAEC Rept. TID-7546, (Book 2)</i> , 516-25, 1958.
270	29600	Taylor, R. E. and Nakata, M. M., <i>AI-8058</i> , 8-12, 1962. [AD 293 802]
271	16849	Johnson, J. R., Doney, L. M., Fulkerson, S. D., Taylor, A. J., Warde, J. M., and White, G. D., <i>ORNL-2011</i> , 7, 1956.
272	32169	Mischke, R. A. and Smith, J. M., <i>Ind. Eng. Chem. Fundamentals</i> , <u>1</u> (4), 288-92, 1962.
273	29585	Flynn, D. R., <i>J. of Research of NBS</i> , <u>67C</u> (2), 129-37, 1963.
274	10083	Norton, F. H., Kingery, W. D., and others, MIT, <i>USAEC Rept. NYO-3643</i> , 1-124, 1953. [AD 13 940]
275	24384	Rudkin, R. L., <i>ASD-TDR-62-24, II</i> , 1-16, 1963. [AD 413 005]
276	24810	Booker, J., Paine, R. M., and Stonehouse, A. J., <i>WADD TR 60-889</i> , 1-133, 1961. [AD 265 625]
277	26405	Taylor, R. E. and Nakata, M. M., <i>Atomic Intern.</i> , 8494, 1-11, 1963. [AD 406 098]
278	30599	Burk, M., <i>Mater. Res. Std.</i> , <u>3</u> (1), 25-8, 1963.
279	10022	Swann, R. T., <i>NASA-TN-D-171</i> , 1-24, 1959.
280	23153	Haskins, J. F., Jones, H., and Percy, J. L., <i>MRG-323</i> , 1-18, 1962. [AD 291 518]
281	29558	Minges, M. L. and Meiselman, J. M., <i>Tech. Memo ASRCE TM 63-7</i> , Wright-Patterson Air Force Base, Ohio, 1-13, 1963.
282	28067	Thielke, N. R., Penn. State Univ., Univ. Park, <i>WADC TR 54-467</i> , 1-88, 1955. [AD 88 128]
283	16094	Martin Co., Nuclear Div., Baltimore, <i>USAEC Rept. MND-SR-1674</i> , 1-72, 1959.
284	31786	Francis, R. K., McNamara, E. P., and Tinklepaugh, J. R., <i>State Univ. of N. Y., College of Ceram. at Alfred Univ., Aeronautical Res. Lab.</i> , WADC, 1958. [AD 154 72]
285	25901	Makarounis, O. and Jenkins, R. J., <i>USNRDL-TR-599</i> , 1-16, 1962. [AD 295 887]
286	31788	Truesdale, R. S., Swica, J. J., and Tinklepaugh, J. R., <i>State Univ. of N. Y., College of Ceram. at Alfred Univ.</i> , <i>WADC TR 58-452</i> , 1-36, 1958. [AD 207 079]
287	32520	Nishijima, T., Kawada, T., and Ishihata, A., <i>J. Am. Ceram. Soc.</i> , <u>48</u> (1), 31-4, 1965.
288	33776	Gen. Elec. Co., Lamp Glass Dept., Circle No. 600, Lucalox, 1-11, 1963.
289	28655	Glower, D. D. and Wallace, D. C., <i>Sandia Corp., USAEC Rept. TID-16906, SCDC-2886</i> , 1-16, 1962.
290	20313	Burk, M., <i>J. Am. Ceram. Soc.</i> , <u>46</u> (3), 150-1, 1963.
291	26233	Feith, A. D., Gen. Elec. Co., Adv. Tech. Service, <i>USAEC Rept. GEMP-296</i> , 1-25, 1964.
292	29231	Fitzsimmons, E. S., Gen. Elec. Co., Aircraft Nuclear Propulsion Dept., <i>DC-61-6-4</i> , 1-9, 1961.
293	209	Charvat, F. R. and Kingery, W. D., <i>J. Am. Ceram. Soc.</i> , <u>40</u> (9), 306-15, 1957.
294	25618	Laubitz, M. J., <i>Canadian, J. Phys.</i> , <u>41</u> (10), 1663-78, 1963.
295	18644	Lee, D. W. and Kingery, W. D., <i>J. Am. Ceram. Soc.</i> , <u>43</u> (11), 594-607, 1960.
296	28870	Sibley, L. B., Allen, C. M., Zielenbach, W. J., Peterson, C. L., and Goldthwaite, W. H., <i>WADC TR 58-299</i> , 1-52, 1958. [AD 203 787]
297	103	Powell, R. W., <i>Trans. Brit. Ceram. Soc.</i> , <u>53</u> (7), 389-97, 1954.

- | Ref.
No. | TPRC
No. | |
|-------------|-------------|--|
| 298 | 24812 | Fieldhouse, I. B. and Lang, J. I., WADD TR 60-904, 1-119, 1961. [AD 268 304] |
| 299 | 8133 | Karpinski, J. M., Hasselman, D. P. H., Tervo, R., and Fetterley, G. H., Am. Ceram. Soc. Bull., <u>37</u> (7), 329-33, 1958. |
| 300 | 10615 | Slack, G. A., Phys. Rev., <u>126</u> (2), 427-41, 1962. |
| 301 | 32772 | Flynn, D. R., NBS Rept. 7836, 1-22, 1963. [AD 407 802] |
| 302 | 27922 | Plummer, W. A., Campbell, D. E., and Comstock, A. A., J. Am. Ceram. Soc., <u>45</u> (7), 310-6, 1962. |
| 303 | 20780 | Birch, F. and Clark, H., Am. J. Sci., <u>238</u> (8), 529-58, 1940. |
| 304 | 29152 | Flynn, D. R. and Robinson, H. E., NBS Rept. No. 7135, 1-36, 1961. [AD 277 034] |
| 305 | 24315 | Flynn, D. R., NBS Rept. 7740, 1962. [AD 411 157] |
| 306 | 26836 | Chang, G. K. and Jones, R. E., Phys. Rev., <u>126</u> (6), 2055-8, 1962. |
| 307 | 32611 | Adams, M., J. Am. Ceram. Soc., <u>37</u> (2), 74-9, 1954. |
| 308 | 9293 | de Haas, W. J. and Biermasz, T., Physica, <u>2</u> , 673-82, 1935. |
| 309 | 26060 | Devyatkova, E. D., Petrov, A. V., Smirnov, I. A., and Moizhes, B. Ya., Soviet Phys. -Solid State, <u>2</u> (4), 681-8, 1960. |
| 310 | 35072 | Thurber, W. R. and Mante, A. J. H., Phys. Rev., <u>139</u> (5A), 1655-65, 1965. |
| 311 | 10809 | Mason, C. R., Walton, J. D., Bowen, M. D., and Teague, W. T., Summary Rept. No. 3, Proj. No. A-212, Eng. Expt. Sta., Georgia Inst. Tech., Atlanta, 1-120, 1959. [AD 230 200] |
| 312 | 10432 | Ballard, S. S., McCarthy, K. A., and Davis, W. C., Rev. Sci. Instr., <u>21</u> (11), 905-7, 1950. |
| 313 | 25602 | Mason, C. R., Walton, J. D., Bowen, M. D., and Teague, W. T., Quarterly Rept. No. 14, Proj. No. A-212, Eng. Expt. Sta., Georgia Inst. Tech., Atlanta, 1-28, 1959. [AD 216 618] |
| 314 | 10898 | Charlesworth, D. H., AECL No. 828, 1-24, 1959. [AD 218 621] |
| 315 | 12708 | Nonken, G. C., Steel Processing, <u>34</u> , 377-81, 1948. |
| 316 | 18353 | Norton, F. H. and Kingery, W. D., USAEC NYO-599, 1-31, 1951. |
| 317 | 28929 | JPL Research Summary No. 36-5, Pasadena, Calif., <u>II</u> , 12-5, 1960. |
| 318 | 18625 | McClelland, J. D. and Zehms, E. H., J. Am. Ceram. Soc., <u>43</u> (1), 54, 1960. |
| 319 | 29130 | General Electric Co., GEMP-16A, 1-33, 1962. |
| 320 | 24817 | General Electric Co., GEMP-9A, 1-71, 1962. |
| 321 | 27117 | Hartunian, R. A. and Varwig, R. L., USAF TDR-594 (1217-01) TN-2, 1-46, 1961. [AD 606 036] |
| 322 | 17008 | Cohen, A. F., USAEC ORNL-2413, 70-1, 1957. |
| 323 | 22544 | Gallo, C., Thermoelectricity Quarterly Rept. No. 4, 1-7, 1961. [AD 277 122] |
| 324 | 28778 | Tuchschmid, A., Ann. Phys. Chem., Beiblatter, <u>8</u> , 490-2, 1884. |
| 325 | 16421 | Lees, C. H., Phil. Trans. Roy. Soc. (London), <u>183</u> , 481-509, 1892. |
| 326 | 21255 | Kozak, M. I., Zhur. Tekh. Fiz., <u>22</u> (1), 73-6, 1952. |
| 327 | 9254 | Sinel'nikov, N. N. and Filipovich, V. N., Soviet Phys. Tech. Phys., <u>3</u> , 193-6, 1958. |
| 328 | 9238 | Gafner, G., Brit. J. Appl. Phys., <u>8</u> (10), 393-7, 1957. |
| 329 | 7082 | Norton, F. H., Kingery, W. D., Loeb, A. L., Francl, J., Coble, R. L., and Vasilos, T., USAEC NYO-3647, 1-61, 1953. [AD 23 561] |
| 330 | 7288 | Powell, R. W., J. Sci. Instr., <u>34</u> (12), 485-92, 1957. |
| 331 | 31783 | Pears, C. D., Proc. 3rd Thermal Conductivity Conference, 453-79, 1963. |
| 332 | 30255 | Buessem, W. R. and Bush, E. A., J. Am. Ceram. Soc., <u>38</u> (1), 27-32, 1955. |
| 333 | 35983 | Sugawara, A., J. Appl. Phys., <u>36</u> (8), 2375-7, 1965. |
| 334 | 28106 | Juul, N., Sato, S., and Strauss, H. E., USAEC NP-12878, 1-11, 1963. [AD 416 276] |
| 335 | 27395 | Pike, J. N., Research Rept. No. C-16, Parma Research Lab., Union Carbide Corp., Parma, Ohio, 1-27, 1963. [AD 404 453] |
| 336 | 38399 | Powell, R. W., Tye, R. P., and Metcalf, S. C., 3rd Symposium on Thermophysical Properties, March 22-5, 1965, 289-95. |
| 337 | 7663 | Barratt, T., Proc. Phys. Soc. (London), <u>26</u> , 347-71, 1914. |
| 338 | 34428 | National Carbon Co. (Carbon Products Div.), Union Carbide Corp., Industrial Graphite Engineering Handbook, published in a series of revised editions. |
| 339 | 5 | Zavaritskii, N. V. and Zeldovich, A. C., Zhur. Tekh. Fiz., <u>26</u> , 2032-6, 1956. |
| 340 | 29509 | Hoch, M. and Vardi, J., Tech. Doc. Rept. No. ASD-TDR-62-608, Part I, Wright-Patterson Air Force Base, Ohio, 1-19, 1962. |

- | Ref. No. | TPRC No. | |
|----------|------------|--|
| 341 | 8196 | Wagner, P., Driesner, A.R., and Kmetko, E.A., Second Intern. Conf. on the Peaceful Uses of Atomic Energy, Geneva, <u>7</u> , 379-88, 1958. |
| 342 | 16422 | Crary, A.P., <i>Physics</i> , <u>4</u> , 332-3, 1933. |
| 343 | 10953 | Union Carbide Corp. Thermoelectric Materials, Bi-Monthly Prog. Rept. No. 4, 1-33, 1959. [AD 231 650] |
| 344 | 28899 | Mrozowski, S., Andrew, J.F., Juul, N., Strauss, H.E., Tsuzuku, T., and Wobschall, D.C., WADC-TR-58-360, IV, 1-45, 1962. |
| 345 | 15598 | Bowman, J.C., Krumhansl, J.A., and Meers, J.T., Proc. 1957 Industrial Carbon and Graphite Conf. Soc. Chem. Ind. (London), 52-9, 1958. |
| 346 | 10906 | Durand, R.E. and Klein, D.J., U.S. At. Energy Comm. NAA-SR-1520, 1-33, 1956. |
| 347 | 37379 | Dull, R.B., WADD TR 61-72, Vol. XXVI, 1-448, 1964. [AD 602 607] |
| 348 | 16590 | Fieldhouse, I.B., Land, J.I., and Blau, H.H., Jr., WADC TR-59-744, <u>4</u> , 1960. |
| 349 | 33847 | Holland, M.G., Klein, C.A., and Straub, W.D., <i>J. Phys. Chem. Solids</i> , <u>27</u> (5), 903-6, 1966. |
| 350 | 36698 | Taylor, R., <i>Brit. J. Appl. Phys.</i> , <u>16</u> (4), 509-15, 1965. |
| 351 | 36697 | Mills, J.J., Morant, R.A., and Wright, D.A., <i>Brit. J. Appl. Phys.</i> , <u>16</u> (4), 479-85, 1965. |
| 352 | 26843 | Slack, G.A., <i>Phys. Rev.</i> , <u>127</u> (3), 694-701, 1962. |
| 353 | 38041 | Klein, C.A. and Holland, M.G., <i>Phys. Rev.</i> , <u>136</u> (2A), A575-90, 1964. |
| 354 | 26574 | Mason, I.B. and Knibbs, R.H., AERE-R 3973 (Gt. Brit.), 1-22, 1962. |
| 355 | 36699 | Goldsmid, H.J. and Lacklison, D.E., <i>Brit. J. Appl. Phys.</i> , <u>16</u> , 573-5, 1965. |
| 356 | 17773 | Snyder, T.M. and Kamm, R.L., USAEC Rept. No. C-96, 1, 1942. |
| 357 | 21500 | Thielke, N.R. (compiler), Thermoelectric Materials Bi-monthly Prog. Rept. No. 1 Nat. Carbon Co., 1-29, 1959. |
| 358 | <u>113</u> | Smith, A.W., <i>Phys. Rev.</i> , <u>95</u> (2), 1095-6, 1954. |
| 359 | 16775 | Garth, R.C. and Sailor, V.L., USAEC Rept. BNL-69, 1949. |
| 360 | 33806 | de Combarieu, A., <i>Bull. Inst. Intern. Froid, Annexe</i> 1965-2, 63-72, 1965. |
| 361 | 22948 | Pappis, J. and Blum, S.L., <i>J. Am. Ceram. Soc.</i> , <u>44</u> (12), 592-7, 1961. |
| 362 | 36175 | Hooker, C.N., Ubbelohde, A.R., and Young, D.A., <i>Proc. Roy. Soc. (London)</i> , <u>284</u> (1396), 17-31, 1965. |
| 363 | 28174 | Wheeler, M.J., <i>Brit. J. Appl. Phys.</i> , <u>16</u> (3), 365-76, 1965. |
| 364 | 2428 | Kingery, W.D., Francl, J., Coble, R.L., and Vasilos, T., <i>J. Am. Ceram. Soc.</i> , <u>2</u> , <u>37</u> (2), 107-10, 1954. |
| 365 | 31160 | Johnson, W. and Watt, W., <i>Spec. Ceram., Proc. Symp. Brit. Ceram. Res. Assoc. 1962 (England)</i> , 237-59, 1963. |
| 366 | 25034 | Breckenridge, R.G. (compiler), Union Carbide Corp., 1-20, 1960. [AD 246 217] |
| 367 | 22836 | Mrozowski, S., Andrew, J.F., Juul, N., Sato, S., Strauss, H.E., and Tsuzuku, T., WADC TR 58-360, Part V, 1-68, 1963. |
| 368 | 25973 | Jain, S.C. and Krishnan, K.S., F.R.S., <i>Proc. Roy. Soc. (London)</i> , Part II-IV, <u>225A</u> , 1-32, 1954. |
| 369 | 34346 | Taylor, R., <i>Phil. Mag.</i> , <u>8</u> , <u>13</u> (121), 157-66, 1966. |
| 370 | 31576 | Kraemer, H. and Schmeiser, K., <i>Z. Physik. Chem.</i> , <u>35</u> , 1-9, 1962. |
| 371 | 35243 | Slack, G.A., <i>Phys. Rev.</i> , <u>A139</u> (2), 507-15, 1965. |
| 372 | 8345 | Donaldson, J.W., <i>Foundary Trade J.</i> , <u>63</u> , 141-4, 1940. |
| 373 | 12215 | Laubitz, M.J., <i>Can. J. Phys.</i> , <u>37</u> , 798-808, 1959. |
| 374 | 35041 | Mirkovich, V.V., <i>J. Am. Ceram. Soc.</i> , <u>48</u> (8), 387-91, 1965. |
| 375 | 28172 | Truesdale, R.S., M.S. Thesis, Alfred Univ., 1-91, 1960. |
| 376 | 17449 | McGill, R.C. and Smith, J.A.G., <i>At. Energy Research Estab. (Gt. Brit.)</i> , R-3019, 1-2, 1959. |
| 377 | 35248 | Pryor, A.W., Tainsh, R.J., and White, G.K., <i>J. Nuclear Materials</i> , <u>14</u> , 208-19, 1964. |
| 378 | 27252 | Ewing, C.T., Walker, B.E., Jr., Spann, J.R., Steinkuller, E.W., and Miller, R.R., <i>J. Chem. Eng. Data</i> , <u>7</u> , 251-6, 1962. |
| 379 | 25113 | Slack, G.A., <i>Proc. Intern. Conf. Semiconductor Phys.</i> , 630-3, 1961. |
| 380 | 15610 | Eucken, A. and Huhn, G., <i>Z. Physik. Chem.</i> , <u>134</u> , 193-219, 1928. |
| 381 | 26750 | Bosch, G., <i>Philips Research Repts.</i> , <u>16</u> , 455-61, 1961. |

- | Ref. No. | TPRC No. | |
|----------|----------|---|
| 382 | 38217 | Slack, G.A., J. Appl. Phys., <u>35</u> (12), 3460-6, 1964. |
| 383 | 20929 | Norton, F.H., J. Am. Ceram. Soc., <u>10</u> , 30-52, 1927. |
| 384 | 25061 | Powell, R.W. and Tye, R.P., Special Ceramics, Proc. Symp. Brit. Ceram. Res. Assoc., 261-80, 1963. |
| 385 | 26694 | Cunningham, G.W., Kizer, D.E., and Paprocki, S.J., Plansee Proc. 4th Seminar, 483-509, 1962. |
| 386 | 8486 | Rauch, W.G., USAEC ANL-5268, 1-13, 1954. |
| 387 | 27403 | Eiermann, K. and Hellwege, K.H., J. Polymer Sci., <u>57</u> , 97-104, 1962. |
| 388 | 24016 | Hattori, M., Bull. Univ. Osaka Prefecture, <u>A9</u> (1), 51-8, 1960. |
| 389 | 6973 | Covington, P.C. and Oglesby, S., Jr., WADC TR 57-10, 1-62, 1957. [AD 131 032] |
| 390 | 16222 | Smith, W.K., NOTS TP2624, 1-10, 1961. [AD 263 771] |
| 391 | 33250 | Bocquet, M. and Micaud, G., Bull. Inform. Sci. Tech. (Paris), <u>79</u> , 83-96, 1964. |
| 392 | 29272 | Schweitzer, D. and Singer, R., BNL 696 (S-59), 56-8, 1962. |
| 393 | 43747 | Meyer, R.A. and Koyama, K., USAEC GA-4621, 1-12, 1963. |
| 394 | 35533 | Digesu, F.L. and Pears, C.D., AFML-TR-65-142, 1-279, 1965. [AD 471 337] |
| 395 | 30973 | Hooker, C.N., Ubbelohde, A.R., and Young, D.A., Proc. Roy. Soc., <u>276</u> (1364), 83-95, 1963. |
| 396 | 42488 | Kaspar, J., SSD-TR-67-56, 1-43, 1967. [AD 813 821] |
| 397 | 42736 | Bortz, S.A. and Connors, C.L., IIT Res. Inst., 1-67, 1966. [AD 804 035] |
| 398 | 44182 | Kozlov, F.A. and Antonov, I.N., Soviet J. Atomic Energy, <u>19</u> (4), 1333-4, 1965. |
| 399 | 42392 | Kozlov, F.A. and Antonov, I.N., Atomnaya Energiya, <u>19</u> (4), 391-2, 1965. |
| 400 | 34483 | Godbee, H.W. and Ziegler, W.T., J. Appl. Phys., <u>37</u> (1), 40-55, 1966. |
| 401 | 43505 | Kelly, P.N., Masters Thesis, Univ. of Idaho, 1-40, 1960. |
| 402 | 21046 | Kelly, P.N., USAEC IDO-14592, 1-25, 1962. |
| 403 | 41346 | Zadworny, F., Compt. Rend., <u>B264</u> (8), 569-72, 1967. |
| 404 | 33179 | Perelotov, I.I., TRC-Tras. 1068, 1-12, 1962. |
| 405 | 33178 | Perelotov, I.I., Teploenergetika, <u>7</u> (2), 77-80, 1960. |
| 406 | 38834 | Brodie, D.E. and Mate, C.F., Can. J. Phys., <u>43</u> (12), 2344-60, 1965. |
| 407 | 30225 | Snyder, N.H., Smoke, E.J., Wisely, H.R., and Ruh, E., 1-89, 1949. [AD 89 089] |
| 408 | 28916 | Powers, D.J., BLR61-15(M), 1-21, 1962. [AD 276 983] |
| 409 | 33807 | DeGöer, A.M., Bull. Inst. Intern. Froid, Annexe, <u>2</u> 73-82, 1965. |
| 410 | 42732 | Collins, C.G., USAEC GEMP-61, 157-169, 1966. |
| 411 | 43749 | Wood, W.D., Lucks, C.F., and Deem, H.W. (Dayton, R.W. and Tipton, C.R., editors), BMI-1448, 31-4, 1960. |
| 412 | 31430 | Emanuelson, R.C., Pratt and Whitney Aircraft, APR1048 (Suppl. 1), 1-8, 1963. |
| 413 | 33540 | Taylor, R.E. and Nakata, M.M., WADD-TR-60-581 (Pt. 4), 1-109, 1963. [AD 428 669] [AD 441 079] |
| 414 | 32247 | Taylor, R.E. and Morreale, J., J. Am. Ceram. Soc., <u>47</u> (2), 69-73, 1964. |
| 415 | 32912 | Milnes, M.V., North American Aviation Inc., SDL408, 1-14, 1963. |
| 416 | 33662 | Bowen, M.D., M.S. Thesis, Georgia Inst. Technology, 1-32, 1959. |
| 417 | 33440 | Godfrey, T.G., Fulkerson, W., Kollie, T.G., Moore, J.P., and McElroy, D.L., USAEC ORNL-3556, 1-67, 1964. |
| 418 | 33506 | Amelinckx, S., Blank, H., DeConinck, R., Denayer, M., Devreese, J., Knaepen, F., Nagels, P., Penninckx, R., Strumane, R., and Van Lierde, W., EURAEC-524, 1-24, 1963. |
| 419 | 31246 | Lyons, M.F., Straley, R.L., Coplin, D.H., Weidenbaum, B., and Pashos, T.J., Trans. Am. Nucl. Soc., <u>6</u> , 152, 1963. |
| 420 | 37438 | Daniel, R.C. and Cohen, I., USAEC WAPD-246, 1-151, 1964. |
| 421 | 33408 | Chernock, W.P., Burdg, C.E., Vell, E.I., and Zuromisky, G., USAEC CEND-204, 1-32, 1964. |
| 422 | 33975 | Bates, J.L., BNWL-150, 1.8-1.20, 1965. |
| 423 | 28443 | Daniel, J.L. and Bates, J.L., USAEC HW-76303, 2.19-.21, 1963. |
| 424 | 31479 | Deem, H.W. and Lucks, C.F., BMI 1324, 7-8, 1959. |
| 425 | 31963 | Deem, H.W. and Matolich, J., Jr., BMI-1644 (Del), J1-4, 1963. |

- | Ref. No. | TPRC No. | |
|----------|----------|---|
| 426 | 10850 | Eichenberg, J.D., USAEC WAPD-200, 1-9, 1958. |
| 427 | 35825 | Feith, A.D., USAEC TID-21668 GE-TM63-9-5, 1-25, 1963. |
| 428 | 41063 | Christensen, J.A., USAEC HW-76302, 2.13-.15, 1963. |
| 429 | 19982 | Brenden, B.B. and Newkirk, H.W., USAEC HW-59574, 1-45, 1959. |
| 430 | 39869 | Swift, D.L., <i>Interr. J. Heat Mass Transfer</i> , <u>9</u> (10), 1061-74, 1966. |
| 431 | 40368 | Lyons, M.F., Coplin, D.H., Hausner, H., Weidenbaum, B., and Pashos, T.J., USAEC GEAP-51000-1, 1-76, 1966. |
| 432 | 29388 | Godfrey, T.G. and McElroy, D.L. (Manly, W.D., Program Director), USAEC ORNL-3254, 264-6, 1962. |
| 433 | 21545 | Godfrey, T.G. and McElroy, D.L. (Manly, W.D., Program Director), USAEC ORNL-3210, 175-6, 1962. |
| 434 | 29390 | Godfrey, T.G. and McElroy, D.L. (Manly, W.D., Program Director), USAEC ORNL-3372, 294-6, 1962. |
| 435 | 26868 | Berg, K., Flinta, J.E., and Seltorp, L., <i>Proc. U.N. 2nd Intern. Conf. Peaceful Uses Atomic Energy</i> , 691-6, 1958. |
| 436 | 23979 | Bogatevskii, M., Caillat, R., Delmas, R., Janvier, J.C., and Robertson, J.A.L., <i>New Nucl. Mater. Including Non-Metal. Fuels, Proc. Conf.</i> , 307-22, 1963. |
| 437 | 26424 | Dean, R.A., USAEC CVNA-127, 1-34, 1962. |
| 438 | 19992 | Shapiro, H. and Powers, R.M., USAEC SCNC-294, 1-43, 1959. |
| 439 | 25775 | Bemden, V. et al., EURAEC-491, 1-42, 1962. |
| 440 | 38108 | Sievers, A.J. and Pohl, R.O., CFSTI NYO-2391-5, CONF-764-4, 1-12, 1964. |
| 441 | 43420 | Porneuf, A., USAEC CEND-153, <u>2</u> , 131-4, 1962. |
| 442 | 33090 | Yoshizawa, Y., Sugawara, A., and Yamada, E., <i>J. Appl. Phys.</i> , <u>35</u> (4), 1354-5, 1964. |
| 443 | 9285 | Lees, C.H., <i>Phil. Trans. Roy. Soc. (London)</i> , <u>A191</u> , 399-440, 1898. |
| 444 | 36241 | Mogilevskii, B.M. and Chudnovskii, A.F., <i>Inzh.-Fiz. Zh., Akad. Nauk Belorus. SSR</i> , <u>7</u> (12), 23-31, 1964. |
| 445 | 39345 | Mogilevskii, B.M. and Chudnovskii, A.F., <i>J. Engineering Physics</i> , <u>7</u> (12), 1-15, 1966. |
| 446 | 35222 | Green, S.E., <i>Proc. Phys. Soc. (London)</i> , <u>44</u> (243), Pt. 3, 295-313, 1932. |
| 447 | 39890 | Turnbull, A.G., Ph.D. Thesis, Imperial College of Science and Technology, (London), 1-146, 1959. |
| 448 | 28731 | Hecht, H., <i>Ann. Physik</i> , <u>14</u> , 1008-30, 1904. |
| 449 | 31397 | Niven, C. and Geddes, A.E.M., <i>Proc. Roy. Soc. (London)</i> , <u>A87</u> , 535-9, 1912. |
| 450 | 36865 | Pochettino, A. and Fulcheris, G., <i>Atti Accad. Sci. Torino, Pt. I Classe Sci. Fis. Mat. E. Nat.</i> , <u>58</u> (14), 311-20, 1923. |
| 451 | 21254 | Ioffe, A.V. and Ioffe, A.F., <i>Zh. Tekh. Fiz.</i> , <u>22</u> (12), 2005-13, 1952. |
| 452 | 26529 | Devyatkova, E.D. and Smirnov, I.A., <i>Fiz. Tverdogo Tela</i> , <u>4</u> (7), 1972-5, 1962. |
| 453 | 26528 | Devyatkova, E.D. and Smirnov, I.A., <i>Soviet Phys.-Solid State</i> , <u>4</u> (7), 1445-6, 1963. [AD 270 841] |
| 454 | 26819 | Pohl, R.O., <i>Phys. Rev. Letters</i> , <u>8</u> (12), 481-3, 1962. |
| 455 | 43438 | Peech, J.M., Bower, D.A., and Pohl, R.O., <i>J. Appl. Phys.</i> , <u>38</u> (5), 2166-71, 1967. |
| 456 | 36978 | Taylor, A., Albers, H.R., and Pohl, R.O., <i>J. Appl. Phys.</i> , <u>36</u> (7), 2270-8, 1965. |
| 457 | 16072 | Codegone, C., <i>Ricerca Sci.</i> , <u>24</u> (12), 2623-7, 1954. |
| 458 | 22633 | Tadokoro, Y., <i>Science Repts. Tohoku Imp. Univ.</i> , <u>10</u> , 339-410, 1921. |
| 459 | 33125 | Fritts, R.W., Ph.D. Thesis, Northwestern Univ., 1-68, 1950. |
| 460 | 43681 | Klein, P.H., <i>J. Appl. Phys.</i> , <u>38</u> (4), 1598-603, 1967. |
| 461 | 43682 | Klein, P.H. and Croft, W.J., <i>J. Appl. Phys.</i> , <u>38</u> (4), 1603-7, 1967. |
| 462 | 31865 | Dougill, G., Hodsman, H.J., and Cobb, J.W., <i>J. Soc. Chem. Ind. (London)</i> , <u>34</u> (9), 465-70, 1915. |
| 463 | 26561 | Pustovalov, V.V., <i>Steklo i Keram.</i> , <u>18</u> (12), 17-9, 1961. |
| 464 | 27771 | Pustovalov, V.V., <i>Glass and Ceramics (Moscow)</i> , <u>18</u> (12), 618-20, 1961. |
| 465 | 36785 | Suemune, Y., <i>J. Phys. Soc. (Japan)</i> , <u>20</u> (1), 174-5, 1965. |
| 466 | 17426 | Douthett, D. and Friedberg, S.A., <i>Phys. Rev.</i> , <u>121</u> (6), 1662-7, 1961. |
| 467 | 40937 | Mante, A.J. H. and Volger, J., <i>Phys. Letters</i> , <u>A24</u> (3), 139-40, 1967. |
| 468 | 31535 | Snyder, N.H., Smole, E.J., Wisely, H.R., and Ruh, E., ATI 86345, 1-90, 1950. |

Ref. No.	TPRC No.	
469	34386	Shanks, H.R. and Redin, R.D., <i>J. Phys. Chem. Solids</i> , <u>27</u> (1), 75-8, 1966.
470	16093	Martin Co., USAEC MND-SR-1673, 1-85, 1959.
471	812	Weininger, J.L. and Schneider, W.G., <i>Indust. Engng. Chem.</i> , <u>43</u> (5), 1229-33, 1951.
472	25157	Wechsler, A.E. and Glaser, P.E., ASD-TDR-63-574, 1-171, 1963. [AD 420 193]
473	23316	Kitzes, A.S. and Hullings, W.Q., AECD 3625, 25-41, 1954.
474	22191	Tiller, W.A., Johansen, H.A., and Holstein, T., 1-97, 1958. [AD 215964] [PB 160 748-8]
475	8097	Griffiths, E. and Challoner, A.R., <i>Trans. Brit. Ceram. Soc.</i> , <u>40</u> , 40-53, 1941.
476	23408	Marchal, M. and Trouve, J., AEC-TR-5174, -131, 1962.
477	27176	Brown, D.J. and Stobo, J.J., <i>Plansee Proceedings</i> , 4th Seminar, 279-93, 1962.
478	28261	Howard, V.C., UKAEA IGR-TM/C-0164, 1-5, 1958.
479	28880	Taylor, R.E. and Nakata, M.M., <i>Atomics International</i> , AI-7034, 1-14, 1962. [AD 270 841]
480	31184	Crane, J. and Gordon, E., USAEC UNC-5080, 1-67, 1964.
481	31996	Carniglia, S.C., NAA-SR-MEMO-9015 Conf-206-5, 1-41, 1963.
482	33116	Meerson, G.A., Kotel'nikov, R.B., and Bashlykov, S.N., <i>Atomnaya Energiya (USSR)</i> , <u>9</u> (5), 387-91, 1960.
483	30998	Meerson, G.A., Kotel'nikov, R.B., and Bashlykov, S.N., <i>At. Energy (USSR)</i> , <u>9</u> (5), 927-31, 1961.
484	27924	Taylor, R.E., <i>J. Am. Ceram. Soc.</i> , <u>45</u> (7), 353-4, 1962.
485	27379	Sedillo, L., Castonguay, T.T., and Donaldson, W.E., NAVWEPS Rept. 7918 (Pt. 2) NOTS TP2938, 1-28, 1963. [AD 407 515]
486	24980	Smallen, H., Bondesen, A.J., and Romaine, R.P., NOR-60-45, 1-25, 1961. [AD 270 421]
487	31889	Ratcliffe, E.H., <i>Plastics (London)</i> , <u>22</u> (55), 233, 1957.
488	18235	Howse, P.T., Jr., Pears, C.D., and Oglesby, S., Jr., WADD TR60-657, 1-137, 1961. [AD 260 065]
489	23836	Howse, P.T., Jr., and Pears, C.D., <i>Modern Plastics</i> , <u>39</u> (1), 140-53, 246-8, 1961.
490	23490	Taylor, T.S., <i>Elec. World</i> , <u>76</u> (24), 1159-62, 1920.
491	10860	Gluekauf, E. and Watts, R.E., UKAEA AERE C/M337, 1-3, 1958. [AD 158 977L]
492	16831	Shackelford, M.H., USAEC KAPL-M-MHS-23, 1-11, 1954.
493	6256	Fukuroi, T., <i>Sci. Rept. Research Inst. Tohoku Univ.</i> , <u>A1</u> (2), 107-10, 1949.
494	14136	Francis, R.K. and Tinklepaugh, J.R., <i>J. Am. Ceram. Soc.</i> , <u>43</u> (11), 560-3, 1960.
495	36797	Engel, N.N. and McElroy, D.L., USAEC 2797 Conf-764-9, 1-11, 1964.
496	39765	Klein, M.V. and Caldwell, R.F., <i>Rev. Sci. Instr.</i> , <u>37</u> (10), 1291-7, 1966.
497	24394	Lemanov, V.V. and Smirnov, I.A., <i>Fiz. Tverd. Tela</i> , <u>4</u> (9), 2611-3, 1962.
498	28177	Lemanov, V.V. and Smirnov, I.A., <i>Soviet Phys.-Solid State</i> , <u>4</u> (9), 1914-6, 1963.
499	35940	Moss, M., <i>J. Appl. Phys.</i> , <u>36</u> (10), 3308-19, 1965.
500	18374	Taylor, K.M., and Lente, C., <i>J. Electrochem. Soc.</i> , <u>107</u> (4), 308-14, 1960.
501	20321	Long, G. and Foster, L.M., <i>J. Am. Ceram. Soc.</i> , <u>42</u> (2), 53-9, 1959.
502	28259	Keller, D.L., BMI-X-10027 EURAEC 10027, 1-10, 1963.
503	35040	Endebrook, R.W., Foster, E.L., and Keller, D., USAEC BMI-1690, 1-22, 1964.
504	30353	Kollie, T.G. and Moore, J.P., USAEC ORNL-3670, 142-3, 1964.
505	16624	Kurnick, S.W., Appel, J.C., and Cutler, M., GAMD-1529, 1-25, 1960. [AD 245 978]
506	39991	Golubkov, A.V., Devyatkova, E.D., Zhuze, V.P., Sergeeva, V.M., and Smirnov, I.A., <i>Fiz. Tverd. Tela</i> , <u>8</u> (6), 1761-71, 1966.
507	39992	Golubkov, A.V., Devyatkova, E.D., Zhuze, V.P., Sergeeva, V.M., and Smirnov, I.A., <i>Soviet Phys.-Solid State</i> , <u>8</u> (6), 1403-10, 1966.
508	27917	Niven, C.D., <i>Can. J. Research</i> , <u>A18</u> , 132-7, 1940.
509	35542	Rosser, W.A., Inami, S.H., and Wise, H., 1-16, 1964. [AD 614 081] [AD 464 840]
510	41597	Masumoto, K., Isomura, S., and Goto, W., <i>J. Phys. Chem. Solids</i> , <u>27</u> (11/12), 1939-47, 1966.
511	33076	Cutler, M., <i>Advanced Energy Conversion</i> , <u>2</u> , 29-43, 1962.
512	21241	McKee, D.J., USAEC DC-61-1-22, 1-8, 1961.
513	16138	Hamill, C.W., Waldrop, F.B., and Kite, H.T., USAEC Y-1366, 1-15, 1961.
514	33785	Suemune, Y., <i>J. Phys. Soc. (Japan)</i> , <u>21</u> (4), 802, 1966.

- | Ref. No. | TPRC No. | |
|----------|----------|---|
| 515 | 41265 | Suemune, Y., <i>J. Phys. Soc. (Japan)</i> , <u>22</u> (3), 735-43, 1967. |
| 516 | 28919 | Feigelson, R.S., <i>ASTIA WAL-TR 853/1</i> , 1-39, 1962. [AD 277 686] |
| 517 | 26783 | Luthi, B., <i>Phys. Chem. Solids</i> , <u>23</u> , 35-8, 1962. |
| 518 | 20510 | Powers, R.M., Cavallaro, Y., and Mathern, J.P., <i>USAEC SCNC-317</i> , 1-128, 1960. |
| 519 | 31964 | Wright, T.R., Fackelmann, J.M., Kizer, D.E., and Keller, D.L., <i>USAEC BMI-1644 (Del)</i> , U1-3, 1963. |
| 520 | 32812 | Pasquino, A.D. and Pilsworth, M.N., Jr., <i>J. Polymer Sci.</i> , <u>B2</u> (3), 253-5, 1964. |
| 521 | 577 | Read, J.H. and Lloyd, D.M.G., <i>Trans. Faraday Soc.</i> , <u>44</u> , 721-9, 1948. |
| 522 | 31136 | Burdick, R.B. and Hoskyns, W.R., <i>USAF ARL 63-170</i> , 1-72, 1963. [AD 420 569] |
| 523 | 33351 | Arias, A., <i>NASA TN-D-2464</i> , 1-72, 1964. |
| 524 | 23107 | Ruh, R., <i>J. Am. Ceram. Soc.</i> , <u>46</u> (7), 301-7, 1963. |
| 525 | 856 | Fradkov, A.B., <i>Doklady Akad. Nauk SSSR</i> , <u>81</u> , 549-51, 1951. |
| 526 | 27214 | Engholm, G., Lis, S.J., and Baschiere, R.J., <i>ASD-TDR-62-810</i> , 1-157, 1962. [AD 407 663] |
| 527 | 29 | Cămpan, T.I., Anghelache, D., and Belous, V., <i>Bull. Inst. Politeh. Iasi.</i> , <u>2</u> (6), 321-30, 1956. |
| 528 | 91 | Ueberreiter, K. and Otto-Laupenmühlen, E., <i>Kolloid-Z.</i> , <u>133</u> (1), 26-32, 1953. |
| 529 | 6324 | Mann, G. and Forsyth, F.G.E., <i>Mod. Refrign.</i> , <u>59</u> , 188-91, 1956. |
| 530 | 24969 | Myncke, H., Van Itterbeek, A., and deGreve, L., <i>Bull. Inst. Intern. Froid, Annexe</i> , <u>2</u> , 241-9, 1956. |
| 531 | 16507 | Schultz, A.W. and Wong, A.K., <i>ASTIA WAL TR 397/10</i> , 1-22, 1958. [AD 154 351] |
| 532 | 6680 | Powell, R.L., Rogers, W.M., and Coffin, D.O., <i>J. Res. Natl. Bur. Std.</i> , <u>59</u> (5), 349-55, 1957. |
| 533 | 29514 | Chandler, H.H., <i>USAF FTDM-2210</i> , 1-3, 1962. [AD 285 365] |
| 534 | 22621 | Stops, D.W., <i>J. Sci. Instr.</i> , <u>38</u> (5), 221, 1961. |
| 535 | 20374 | Patten, G.A. and Skochdopole, R.E., <i>Modern Plastics</i> , <u>39</u> (11), 149-52, 191, 1962. |
| 536 | 20940 | Wolkenstein, W.S., <i>Technik</i> , <u>8</u> (9), 593-6, 1953. |
| 537 | 16038 | Hayes, R.A., Smith, F.M., Kidder, G.A., Henning, J.C., Rigby, J.D., and Hall, G.L., <i>WADC TR 56-331 (Pt. 4)</i> , 1-157, 1960. [AD 240 212] |
| 538 | 1102 | Urbancová, L., <i>Chem. Prumysl</i> , <u>5</u> , 338-40, 1955. |
| 539 | 29491 | Bernett, E.C., Wood, H.L., Jaffe, L.D., and Martens, H.E., <i>NASA JPL-TR-32-368</i> , 1-19, 1962. |
| 540 | 20999 | Breckenridge, R.G., 1-20, 1960. [AD 245 092] |
| 541 | 29118 | Pandorf, R.C., Chen, C.Y., and Daunt, J.G., 1-7, 1962. [AD 275 287] |
| 542 | 42558 | Rafalowicz, J., <i>Acta Phys. Polon.</i> , <u>30</u> (8), (Pt. 2), 205-22, 1966. |
| 543 | 1913 | Franck, E.U., <i>Z. Elektrochem.</i> , <u>55</u> (7), 636-43, 1951. |
| 544 | 38106 | Turnbull, A.G., <i>Z. Physik. Chem.</i> , <u>42</u> (3-4), 243-6, 1964. |
| 545 | 25437 | Shannon, W.L. and Wells, W.A., <i>Proc. Am. Soc. Testing Mater.</i> , <u>47</u> , 1044-55, 1947. |
| 546 | 25145 | Ingersoll, L.R. and Koepf, O.A., <i>Phys. Rev.</i> , <u>24</u> (Pt. 2), 92-3, 1924. |
| 547 | 14860 | Oliver, H., <i>Trans. Ceram. Soc.</i> , <u>37</u> , 49-59, 1938. |
| 548 | 6990 | Weeks, J.L. and Seifert, R.L., <i>USAEC ANL-4938</i> , 1-14, 1952. [AD 1929] |
| 549 | 257 | Barrett, E.P., Jonnard, A., and Missmer, J.H., <i>Ind. Eng. Chem.</i> , <u>45</u> (7), 1524-6, 1953. |
| 550 | 23121 | Hasselman, D.P.H. and Crandall, W.B., <i>J. Am. Ceram. Soc.</i> , <u>46</u> (9), 434-7, 1963. |
| 551 | 20765 | Clement, J.K. and Egy, W.L., <i>Univ. Ill. Eng. Expt. Sta. Bull. No. 36</i> , 1-31, 1909. |
| 552 | 24268 | Reinsdorf, S., <i>Silikattech.</i> , <u>11</u> (7), 312-8, 1960. |
| 553 | 14744 | Rowley, F.B. and Algren, A.B., <i>Univ. Minn. Eng. Expt. Sta. Bull. No. 12</i> , 1-134, 1937. |
| 554 | 9412 | Powers, R.W. and Hansen, R.H. (Johnston, H.L., Editor), <i>ATI 58926, (PR-24)</i> , 1-16, 1949. |
| 555 | 9413 | Powers, R.W. and Hansen, R.H. (Johnston, H.L., Editor), <i>ATI 58926, (PR-25)</i> , 1-12, 1949. |
| 556 | 268 | Budnikov, P.P. and Al'perovich, I.A., <i>J. Appl. Chem. (USSR)</i> , <u>25</u> , 665-73, 1952. |
| 557 | 785 | Budnikov, P.P. and Al'perovich, I.A., <i>Zhur. Priklad. Khim.</i> , <u>25</u> , 582-91, 1952. |
| 558 | 6357 | Rowley, F.B., Jordan, R.C., Lund, C.E., and Lander, R.M., <i>Heating, Piping and Air Conditioning</i> , <u>23</u> (12), 103-9, 1951. |
| 559 | 6936 | Zabawsky, Z., <i>ASTM Spec. Tech. Publ. 217</i> , 3-16, 1957. |

- | Ref.
No. | TPRC
No. | |
|-------------|-------------|---|
| 560 | 7020 | Lander, R.M., Heating, Piping and Air Conditioning, <u>26</u> (12), 121-6, 1954. |
| 561 | 19642 | Chow, C.S., Proc. Phys. Soc. (London), <u>61</u> , 206-16, 1948. |
| 562 | 98 | Lapshin, A., Myasnaya Ind. SSSR, <u>25</u> (2), 55-6, 1954. |
| 563 | 6308 | Rowley, F.B., Jordan, R.C. and Lander, R.M., Refrig. Eng., <u>50</u> , 541-4, 1945. |
| 564 | 7018 | Lander, R.M., Univ. Minn. Inst. Technol. Eng. Exp. Sta. Tech. Paper 49, 1-34, 1944. |
| 565 | 24258 | Bettini, T.M., Ric. Sci., <u>20</u> (4), 464-6, 1950. |
| 566 | 8326 | Stiles, H., Chem. Met. Eng., <u>36</u> , 625-6, 1929. |
| 567 | 7333 | Hickman, M.J. and Ratcliffe, E.H., 9th Intern. Congr. Refrign., Ag-S, 1955. |
| 568 | 1939 | Verschoor, J.D. and Greebler, P., Trans. Am. Soc. Mech. Engrs., <u>74</u> , 961-8, 1952. |
| 569 | 24968 | Bartoli, R. and Laine, P., Bull. Inst. Intern. Froid, Annexe, 233-40, 1956. |
| 570 | 21748 | Codegone, C., Industria (Milan), <u>44</u> (15), 401-3, 1930. |
| 571 | 1628 | Braun, G., Bauwirtschaft, No. 47, 3-10, 1950. |
| 572 | 850 | Liplavk, I.L., Zhur. Priklad. Khim., <u>26</u> , 178-84, 1953. |
| 573 | 25445 | Verschoor, J.D. and Wilber, A., Heating, Piping and Air Conditioning, <u>26</u> (7), 125-30, 1954. |
| 574 | 29516 | Chandler, H.H. and Hancock, F.E., USAF TDM-2435, 1-9, 1962. [AD 285 153] |
| 575 | 193 | Bock, H., Chem. Tech. (Berlin), <u>5</u> (7), 387-90, 1953. |
| 576 | 31 | Brown, W.G., Nature, <u>179</u> , 1187, 1957. |
| 577 | 13404 | Powell, R.W. and Griffiths, E., Proc. Roy. Soc. (London), <u>A163</u> (913), 189-98, 1937. |
| 578 | 28116 | Stephens, D.R., USAEC UCRL-7605, 1-19, 1963. |
| 579 | 25431 | Lewis, D.W., J. Am. Concrete Inst., <u>30</u> (5), 619-33, 1958. |
| 580 | 787 | Epshtein, A.S., Stroitel. Prom., <u>33</u> (9), 33-5, 1955. |
| 581 | 8134 | Hansen, W.C. and Livovich, A.F., Am. Ceram. Soc. Bull., <u>37</u> (7), 322-8, 1958. |
| 582 | 104 | Hansen, W.C. and Livevich, A.F., J. Am. Ceram. Soc., <u>36</u> (11), 356-62, 1953. |
| 583 | 174 | Gallaher, R.B. and Kitzes, A.S., USAEC ORNL 1414, 1-30, 1953. |
| 584 | 33346 | LaMarre, D.A. Simpson G.R., and Thorburn, M.R., USAF, 1-41, 1962. [AD 437 864] |
| 585 | 456 | Pochapsky, T.E., J. Chem. Phys., <u>21</u> (9), 1539-40, 1953. |
| 586 | 16320 | Nancarrow, H.A., Proc. Phys. Soc. (London), <u>45</u> , 447-61, 1933. |
| 587 | 25356 | Zamoluev, V.K., Mukhanova, L.N., and Taitis, E.M., Proc. Acad. Sci. USSR. Chemical Techn. Sect., <u>133</u> (5), 127-9, 1960. |
| 588 | 29617 | Dietz, J.L. and Hangen, W.J., ASTIA MT-M23, 1-38, 1956. [AD 289 592] |
| 589 | 9266 | deVries, D.A. and Peck, A.J., Australian J. Phys., <u>11</u> (3), 409-23, 1958. |
| 590 | 20264 | Woodside, W. and Messmer, J.H., J. Appl. Phys., <u>32</u> (9), 1688-99, 1961. |
| 591 | 20265 | Woodside, W. and Messmer, J.H., J. Appl. Phys., <u>32</u> (9), 1699-706, 1961. |
| 592 | 9416 | Powers, R.W. and Hansen, R.H., (Johnston, H.L., Editor), ATI 52496, 1-61, 1949. |
| 593 | 6919 | Woodside, W., Heating, Piping and Air Conditioning, <u>30</u> (9), 163-70, 1958. |
| 594 | 1553 | Howling, D.H., Mendoza, E., and Zimmerman, J.E., Proc. Roy. Soc. (London), <u>A229</u> , 86-109, 1955. |
| 595 | 24809 | Powers, D.J., USAF BLR61-20(M), 1-14, 1962. [AD 284 355] |
| 596 | 6940 | Lucks, C.F., Thompson, H.B., Smith, A.R., Curry, F.P., Deem, H.W., and Bing, G.F., AFTR6145 Pt. 1, ATI 117 715, 1-127, 1951. |
| 597 | 32441 | Ioffe, A.V., Fiz. Tverd. Tela, <u>5</u> (11), 3336-8, 1963. |
| 598 | 25014 | Ioffe, A.V., Soviet Physics - Solid State, <u>5</u> (11), 2446-7, 1964. |

Material Index

MATERIAL INDEX TO THERMAL CONDUCTIVITY COMPANION VOLUMES 1, 2, AND 3

Material Name	Vol.	Page	Material Name	Vol.	Page
"A" nickel	1	239, 241, 1029, 1039	AISI 304	1	1161, 1165, 1168
Acetone [(CH ₃) ₂ CO]	3	129	AISI 310	1	1167, 1168
Acetone - benzene system	3	440	AISI 316	1	1165, 1166
Acetylene (CHCH)	3	133	AISI 347	1	1165, 1166, 1168
Acetylene - air system	3	381			
Acid potassium sulfate (KHSO ₄) (see potassium hydrogen sulfate)			AISI 403	1	1149
Acheson graphite	2	73	AISI 410	1	1150
Acrylate rubber	2	982	AISI 420	1	1162
Acrylic rubber	2	982	AISI 430	1	1154
Adiprene rubber	2	982	AISI 440 C	1	1154
ADP (see ammonium dihydrogen orthophosphate)			AISI 446	1	1155, 1156
Advance	1	54, 970	AISI 1010	1	1185
African ivory	2	1076	AISI 1095 (see SAE 1095)		
AgCu	1	1338	AISI 2515	1	1198, 1199, 1200
Ag _{0.25} Cu _{0.75} InTe ₂	1	1406			
Aggregate concrete (see under modifiers)			AISI 4130 (see SAE 4130)		
Ag ₆ Sb ₆ PbSe ₁₃	1	1379	AISI 4140 (see SAE 4140)		
AgSbTe ₂	1	1335	AISI 4340	1	1213, 1214
AgSbTe ₂ + SnTe	1	1410			
AgSbTe ₂ · SnTe	1	1411	AISI C 1010 (see SAE 1010)		
Ag ₂ Se	1	1339	AISI C 1015	1	1186
Ag _{2-x} Te	1	1342	AISI C 1020 (see SAE 1020)		
Ag ₂ Te	1	1342	Alloy steel	1	1214
Air	3	512	Alloy steel, high	1	1214
Air - carbon monoxide system	3	353	Alpax	1	481
Air - methane system	3	385	Alpax gamma	1	918
AISI 301	1	1165	Alum	2	688
AISI 302	1	1161	Alumel	1	1015, 1039
AISI 303	1	1165, 1168	Alumina (see aluminum oxide)		

Material Name	Vol.	Page	Material Name	Vol.	Page
Alumina + Mullite	2	322	Aluminum alloys (specific types) (continued)		
Alumina fused brick	2	897	2014 (same as aluminum alloy 14S)	1	901
Alumina porcelain	2	937	2024 (same as aluminum alloy 24S)	1	898, 901
Aluminate silicate 723 glass	2	923	2358	1	481
Aluminum	1	1	3003 (same as aluminum alloy 3S)	1	912
Aluminum + Antimony	1	469	3004 (same as aluminum alloy 4S)	1	912
Aluminum + Copper	1	470	5052 (same as aluminum alloy 52S)	1	478, 909
Aluminum + Copper + ΣX_i	1	895	5083 (same as aluminum alloy LK183)	1	909
Aluminum + Iron	1	474	5086 (same as aluminum alloy K186)	1	909
Aluminum + Iron + ΣX_i	1	905	5154 (same as aluminum alloy A54S)	1	478, 909
Aluminum + Magnesium	1	477	5456	1	909
Aluminum + Magnesium + ΣX_i	1	908	6063 (same as aluminum alloy 63S)	1	909
Aluminum + Manganese + ΣX_i	1	911	7075 (same as aluminum alloy 75S)	1	923
Aluminum + Nickel + ΣX_i	1	914	A54S (see aluminum alloy 5154)		
Aluminum + Silicon	1	480	Alpax	1	481
Aluminum + Silicon + ΣX_i	1	917	Alpax gamma	1	918
Aluminum + Tin	1	483	Alusil	1	481
Aluminum + Uranium	1	484	British 2L-11	1	900
Aluminum + Zinc	1	487	British L-5	1	923
Aluminum + Zinc + ΣX_i	1	922	British L-8	1	899
Aluminum + ΣX_i	1	925	British Y-1	1	900
Aluminum alloys (specific types)			British Y-2	1	900
2S (see aluminum alloy 1100)			Cond-Al	1	906
3S (see aluminum alloy 3003)			D (zeppelin)	1	900
4S (see aluminum alloy 3004)			DIN 712	1	475
12	1	897, 899, 900	Duralumin	1	896
14S (see aluminum alloy 2014)			German Y alloy	1	896, 898
24S (see aluminum alloy 2024)			J51	1	906
52S (see aluminum alloy 5052)			Japanese 2E-8	1	899
63S (see aluminum alloy 6063)			Japanese M-1	1	899
75S (see aluminum alloy 7075)			K186 (see aluminum alloy 5086)		
132 (see aluminum alloy Lo-Ex)			K-S alloy 245	1	920
1100 (same as aluminum alloy 2S)	1	906, 920	K-S alloy 280	1	920

Material Name	Vol.	Page	Material Name	Vol.	Page
Aluminum alloys (specific types) (continued)			Aluminum oxide (Al_2O_3) (continued)		
K-S alloy special	1	902	E98	2	101
LK183 (see aluminum alloy 5083)			Gulton HS, B	2	103
Lo-Ex (same as aluminum alloy 132)	1	919	Hi alumina	2	99
Magnalium	1	478	Ignited alumina	2	106
Nelson-Kebbenleg 10	1	896	Linde synthetic sapphire	2	94
RAE 40 C	1	915	Lucalox	2	106
RAE 47 B	1	915	Norton 38-900	2	103, 104
RAE 47 D	1	915	Sapphire	2	93
RAE 55	1	915	Synthetic sapphire	2	94
RR 50	1	918, 919, 920	TC 352	2	107
RR 53	1	901	Wesgo Al-300	2	101, 107, 108
RR 53 C	1	918	Aluminum oxide + Aluminum silicate	2	321
RR 59	1	898	Aluminum oxide + (di)Chromium trioxide	2	324
RR 77	1	923	Aluminum oxide + (di)Manganese trioxide	2	327
RR 131 D	1	909	Aluminum oxide + Silicon dioxide	2	328
SA 1	1	918, 919	Aluminum oxide + Silicon dioxide + ΣX_1	2	453
SA 44	1	918, 919	Aluminum oxide + Titanium dioxide + ΣX_1	2	456
Silumin, sodium modified	1	920	Aluminum oxide + Zirconium dioxide	2	331
γ -Silumin, modified	1	920	Aluminum oxide - chromium cermets	2	707
Y-alloy	1	896, 898	Aluminum silicate ($3Al_2O_3 \cdot 2SiO_2$)	2	254
Aluminum borosilicate complex, natural (see tourmaline)			Aluminum silicate + Aluminum oxide	2	334
Aluminum bronze	1	531, 532, 953	Alundum	2	459
Aluminum fluosilicate ($2AlFO \cdot SiO_2$)	2	251	Alusil	1	481
Brazil topaz	2	252	Amalgam	1	216
Aluminum nitride (AlN)	2	653	Amber glass	2	924
Aluminum oxide (Al_2O_3)	2	98	American white wood	2	1090
AP-30	2	99	Ammonia (NH_3)	3	95
AV-30	2	102	Ammonia - air system	3	442
B45F	2	101	Ammonia - carbon monoxide system	3	444
Corundum	2	94, 99	Ammonia - ethylene system	3	446
			Ammonia - hydrogen system	3	448
			Ammonia - nitrogen system	3	451
			Ammonium acid phosphate [$NH_4H_2PO_4$] (see ammonium dihydrogen phosphate)		

Material Name	Vol.	Page	Material Name	Vol.	Page
Ammonium perchlorate (NH_4ClO_4), reagent grade	2	757	Argon - carbon dioxide system	3	297
Ammonium dihydrogen phosphate ($\text{NH}_4\text{H}_2\text{PO}_4$)	2	679	Argon - deuterium system	3	299
Ammonium dihydrogen orthophosphate [$\text{NH}_4\text{H}_2\text{PO}_4$] (see ammonium dihydrogen phosphate)			Argon - helium system	3	251
Ammonium hydrogen sulfate (NH_4HSO_4)	2	687	Argon - hydrogen system	3	301
Ammonium phosphate, monobasic [$\text{NH}_4\text{H}_2\text{PO}_4$] (see ammonium dihydrogen phosphate)			Argon - hydrogen - deuterium - nitrogen system	3	507
Ammonium biphosphate [$\text{NH}_4\text{H}_2\text{PO}_4$] (see ammonium dihydrogen phosphate)			Argon - hydrogen - nitrogen system	3	493
Ammonium bisulfate [NH_4HSO_4] (see ammonium hydrogen sulfate)			Argon - hydrogen - nitrogen - oxygen system	3	508
AMS 4908 A (see Ti-8Mn)			Argon - krypton system	3	263
AMS 4925 A (see titanium alloy C-130 AM, or titanium alloy RC-130S)			Argon - krypton - deuterium system	3	488
AMS 4926 (see titanium alloy A-110A [?])			Argon - krypton - hydrogen system	3	496
AMS 4928 (see Ti-6Al-4V)			Argon - krypton - xenon system	3	483
AMS 4929 (see Ti-155A)			Argon - krypton - xenon - deuterium system	3	506
AMS 4969 (see Ti-155A)			Argon - krypton - xenon - hydrogen system	3	505
AMS 5385 C (see Haynes stellite alloy 21)			Argon - methane system	3	304
Angora wool	2	1092	Argon - neon system	3	258
Angren brown coal	2	808	Argon - nitrogen system	3	306
Anthracene [$\text{C}_6\text{H}_4(\text{CH})_2\text{C}_6\text{H}_4$]	2	985	Argon - oxygen system	3	311
Anthracin [$\text{C}_6\text{H}_4(\text{CH})_2\text{C}_6\text{H}_4$] (see anthracene)			Argon - oxygen - methane system	3	485
Antimony	1	10	Argon - propane system	3	316
Antimony + Aluminum	1	488	Argon - propane - ethanol ^{dimethyl ether} system	3	499
Antimony + Beryllium + ΣX_1	1	926	Argon - xenon system	3	267
Antimony + Bismuth	1	489	Argon - xenon - hydrogen - deuterium system	3	510
Antimony + Cadmium	1	492	Armalon lamintes (nonmetallic)	2	1032
Antimony + Copper	1	495	Armco iron	1	157, 158, 159, 160, 161, 163
Antimony + Lead	1	496	Arsenic	1	15
Antimony - tellurium intermetallic compound Sb_2Te_3	1	1241	Arsenic - tellurium intermetallic compound As_2Te_3	1	1244
Antimony + Tin	1	497	Arsenic telluride [As_2Te_3] (see arsenic - tellurium intermetallic compound)		
Antimony telluride [Sb_2Te_3] (see antimony - tellurium intermetallic compound)			Asbestos cement board	2	1107
Argentum (see silver)			Asbestos fiber	2	1135
Argon	3	1	Ash	2	1059
Argon - benzene system	3	295			

Material Name	Vol.	Page	Material Name	Vol.	Page
Ashkhabad clay	2	804, 805	Barytes concrete	2	871
Asphalt-glass wood pad	2	1108	Basalt	2	797
Asphaltic bituminous concrete	2	863	NTS basalt	2	798
As ₂ Te ₃	1	1244	Olivine basalt	2	798
ASTM B 265-58T, grade 6 (see titanium alloy A-110AT)			Ba ₂ Sn	1	1246
ASTM B 265-58T, grade 7 (see Ti-8Mn)			Bauxite brick	2	901, 902
Astrolite	2	1029, 1030, 1052	Beef fat	2	1072
Aurum (see gold)			Be ₁₂ Nb	1	1248
Austenitic stainless steel	1	1165, 1183	Be ₁₇ Nb ₂	1	1248
Balsa	2	1060	Benzene (C ₆ H ₆)	3	135
Pseudo	2	1060	Benzene, p-dibromo (C ₆ H ₄ Br ₂)	2	986
Waterproofed	2	1060	Benzene, p-dichloro (C ₆ H ₄ Cl ₂)	2	987
Ba ₂ Pb	1	1245	Benzene, p-diiodo (C ₆ H ₄ I ₂)	2	988
Barium-lead intermetallic compound Ba ₂ Pb	1	1245	Benzene - hexane system	3	387
Barium-tin intermetallic compound Ba ₂ Sn	1	1246	Beryl	2	800
Barium difluoride (BaF ₂)	2	627	Brazil	2	801
Barium oxide (BaO)	2	120	India	2	801
Barium oxide + Silicon dioxide + ΣX ₁	2	457	Beryllia (see beryllium oxide)		
Barium oxide + Strontium oxide	2	337	Beryllium	1	18
Barium oxide + Strontium oxide + ΣX ₁	2	460	Beryllium + Aluminum	1	498
Barium stannide [Ba ₂ Sn] (see barium - tin intermetallic compound)			Beryllium + Beryllium oxide	1	1416
Barium titanates			Beryllium + Fluorine + ΣX ₁	1	929
BaTiO ₃	2	257	Beryllium + Magnesium	1	499
BaO · 2TiO ₃	2	260	Beryllium + Magnesium + ΣX ₁	1	932
Barium metatitanate (BaTiO ₃)	2	257	Beryllium - niobium intermetallic compounds		
Barium metatitanate + Calcium metatitanate	2	340	Be _x Nb _y	1	1247
Ca _{0.994} Ba _{0.996} TiO ₃	2	341	Be ₁₂ Nb	1	1248
Ca _{0.099} Ba _{0.901} TiO ₃	2	341	Be ₁₇ Nb ₂	1	1248
Ca _{0.19} Ba _{0.81} TiO ₃	2	341	Beryllium - tantalum intermetallic compounds		
Barium metatitanate + Magnesium zirconate	2	343	Be _x Ta _y	1	1250
Barium metatitanate + Manganese niobate	2	344	TaBe ₁₂	1	1251
Barium dititanate (BaTi ₂ O ₆)	2	260	Ta ₂ Be ₁₇	1	1251
			Beryllium - uranium intermetallic compounds		
			Be _x U _y	1	1253

Material Name	Vol.	Page	Material Name	Vol.	Page
Beryllium - uranium intermetallic compounds			Biphenyl [$C_6H_5C_6H_5$] (see diphenyl)		
UBe_{13}	1	1254	Biphenyl + o-, m-, p-Terphenyl + Higher phenyls (see santowax R)		
Beryllium - zirconium intermetallic compounds $Be_{13}Zr$	1	1256	$BiSbTe_{3,13}$	1	1390
Beryllium bronze	1	539	$Bi_{1,33}Sb_{0,67}Te_{3,13}$	1	1389
(di)Beryllium carbide (Be_2C)	2	571	$Bi_{1,5}Sb_{0,5}Te_{3,13}$	1	1389
Beryllium copper	1	539	$Bi_{1,75}Sb_{0,25}Te_{3,1}$	1	1390
Beryllium oxide (BeO)	2	123	$Bi_{1,75}Sb_{0,25}Te_{3,13}$	1	1389
3008 (refractory grade)	2	125	$Bi_{1,75}Sb_{0,25}Te_{3,19}$	1	1390
4811 BeO porcelain	2	124	$Bi_{1,75}Sb_{0,25}Te_{3,26}$	1	1390
AOX grade	2	127, 129	Bismuth	1	25
BD-98	2	125	Bismuth + Antimony	1	502
Brush SP grade	2	125	Bismuth + Cadmium	1	505
Clifton metal grade	2	127	Bismuth + Cadmium + ΣX_1	1	935
Grade I	2	128	Bismuth + Lead	1	508
Grade II	2	128	Bismuth + Lead + ΣX_1	1	938
Porcelain	2	124	Bismuth - lead eutectic	1	509
Triangle beryllia	2	126	Bismuth - tellurium intermetallic compound Bi_2Te_3	1	1257
UOX grade	2	124, 127, 128, 129	Bismuth + Tin	1	511
Beryllium oxide + Aluminum oxide + ΣX_1	2	461	Bismuth alloys (specific types)		
Beryllium oxide + Magnesium oxide + ΣX_1	2	464	Hutchin's alloy	1	512
Beryllium oxide + Thorium dioxide + ΣX_1	2	467	Lipowitz alloy	1	939
Beryllium oxide + Uranium dioxide	2	347	Rose metal	1	939
Beryllium oxide + Zirconium dioxide + ΣX_1	2	470	Wood's metal	1	939
Beryllium oxide - beryllium cermets	2	708	Bismuth stannate [$Bi_2(SnO_3)_3$]	2	261
Beryllium oxide - beryllium - molybdenum cermets	2	711	Bismuth tristannate [$Bi_2(SnO_3)_3$] (see bismuth stannate)		
Beryllium oxide - beryllium - silicon cermets	2	714	Bismuth telluride [Bi_2Te_3] (see bismuth - tellurium intermetallic compound)		
Beskhudnikov clay	2	804	Bi_2Te_3	1	1257
$Be_{12}Ta$	1	1251	$Bi_2Te_3 + Bi_2Se_3$	1	1393
$Be_{17}Ta_2$	1	1251	$Bi_2Te_3 + Sb_2Te_3$	1	1388
$Be_{13}U$	1	1254	$Bi_2Te_3 + Sb_2Te_3 + Sb_2Se_3$	1	1392
$Be_{13}Zr$	1	1256	$Bi_2Te_3 + Te$	1	1415
			$Bi_2Te_{3,19}$	1	1415
			$Bi_2Te_{3,26}$	1	1415

Material Name	Vol.	Page	Material Name	Vol.	Page
Bitter spar (see dolomite)			Brass (specific types) (continued)		
Bitumen	2	1155	Cast	1	980
Bitumin concrete	2	863	High (see yellow brass)		
Bituminous concrete aggregate, blended	2	863	High tensile	1	980
Black temper cast iron	1	1137	Leaded free cutting	1	981
Bone char	2	1156	MS 58	1	980
Bone fat	2	1072	MS 76/22/2	1	980
Boralloy (see boron nitride)			Red	1	591
Boric anhydride [B_2O_3] (see boron oxide)			Red, German	1	981
Boric oxide [B_2O_3] (see boron oxide)			Rolled	1	980
Boron	1	41	Yellow	1	981, 982
Boron - silicon intermetallic compounds	2	1	Brazil beryl	2	801
SiB ₄	1	1262	Brazil topaz	2	252
SiB ₆	1	1262	Brazil tourmaline	2	855
(tetra)Boron carbide (B ₄ C)	2	572	Bricks	2	889
(tetra)Boron carbide + Sodium metasilicate	2	541	Alumina fused	2	897
(tetra)Boron carbide - aluminum cermets	2	717	Aluminous fire clay	2	900
Boron trifluoride (BF ₃)	3	99	Bauxite	2	329, 901, 902
Boron nitride (BN)	2	656	Carbofrax	2	897
Boron oxide (B ₂ O ₃)	2	138	Carbofrax carborundum	2	895
Boron sesquioxide [B_2O_3] (see boron oxide)			Carbon	2	890, 896
(di)Boron trioxide [B_2O_3] (see boron oxide)			Carsiat carborundum	2	895
Boron silicides (see boron - silicon intermetallic compounds)			Cement porous	2	890
Boronated graphite	2	61	Ceramic	2	890
Borosilicate glass	2	923, 924	Chamotte	2	890
Borosilicate 3235 glass	2	923	Chrome	2	454, 897, 898
Borosilicate crown glass	2	923	Chrome fire brick	2	897
Boxwood	2	1061	Chrome magnesite	2	890
Brass	1	591, 592, 980, 981, 982	Chronite	2	473, 899
Brass (specific types)			Chromomagnesite	2	481
70/30	1	590	Common	2	492, 897
B. S. 249	1	981			

Material Name	Vol.	Page	Material Name	Vol.	Page
Bricks (continued)			Bricks (continued)		
Corundum	2	454, 905	Magnesia	2	485, 897, 898, 899
Dense	2	443, 904	Magnesite	2	478, 483, 892, 895, 905
Dense fireclay	2	403	Magnesite fire	2	897
Diatomaceous	2	890, 891	Magnezit	2	899, 902
Diatomaceous insulating	2	906, 907	Marksa	2	899
Dinas	2	891	Metallurgical	2	892, 893
Egyptian fire clay	2	491, 901	Metallurgical porous	2	893
Fire	2	491, 891, 895, 902, 903	Mica	2	892
Fireclay	2	403, 404, 490, 491, 896, 901, 903	Missouri fire	2	492, 905
Fire clay, dense	2	903	Normal	2	488, 489, 900, 901
Fire clay, superduty	2	890	Ordzhonikidze	2	899
Georgia fire	2	896	Penn. fire	2	905
Hand-burned face	2	891	Porous	2	894
High temp. insulating	2	891	Porous concrete	2	894
High temp. insulating blast furnace	2	488, 899	Porous fire (Italy)	2	895
Hytex hydraulic pressed building	2	896	Red	2	405, 492, 898
Insulating	2	443, 891, 904	Red, hard burned	2	896
Insulating fire	2	891	Red, soft burned	2	896
Kaolin fire	2	404, 405, 904	Red shamotte	2	405
Kaolin insulating refractory	2	895	Refractory insulating	2	892
Light weight	2	488, 489, 892, 899, 900	Refractory insulating common chamotte	2	892
Lime sand	2	892	Shamotte	2	492, 894, 898
			Shamotte, white	2	405
			Silica	2	408, 489, 492, 502, 894, 896,

Material Name	Vol.	Page	Material Name	Vol.	Page
Bricks (continued)			British Y-1	1	900
Silica (continued)	2	897, 898, 900, 902, 904, 906	British Y-2	1	900
			British steel	1	1114, 1118, 1187
Silica fire	2	894, 895, 905	Brom-graphite	2	768
Silica refractory	2	185	Bromine	3	13
Silicon carbide	2	555, 586, 895	Bromyride (see silver bromide)		
Silicon carbide, refrax	2	586, 906	Bronze	1	585, 586, 976, 980
Silicious	2	492, 902	Bronze, aluminum	1	531, 532, 953
Sillimanite	2	329, 902	Bronze, beryllium	1	539
Sillimanite refractory	2	329, 403, 902, 903	Bronze, phosphor	1	585, 586, 976
Sil-O-Cel	2	896	Bronze, silicon	1	973
Sil-O-Cel, calcined	2	896	Bronze, silver	1	579, 980
Sil-O-Cel, natural	2	896	B ₄ Si	1	1262
Sil-O-Cel, special	2	896	B ₆ Si	1	1262
Sil-O-Cel, super	2	896	Butane, i-(i-C ₄ H ₁₀)	3	139
Slag	2	898	Butane, n-(n-C ₄ H ₁₀)	3	141
Spinel fire	2	905	Butaprene E rubber	2	982
Star-brand	2	185	Butter of zinc (see zinc dichloride)		
Tripolite	2	894	Cadmium	1	45
Vermiculite	2	894	Cadmium + Antimony	1	514
Zirconia	2	535, 895, 905	Cadmium - antimony intermetallic compound CdSb	1	1264
Brimstone (see sulfur)			Cadmium + Bismuth	1	517
British 2L-11	1	900	Cadmium + Bismuth + ΣX _i	1	941
British C-32	1	948	Cadmium - tellurium intermetallic compound CdTe	1	2167
British carbon steel	1	1186	Cadmium + Thallium	1	520
British L-5	1	923	Cadmium + Tin	1	521
British L-8	1	899	Cadmium + Zinc	1	524
			Cadmium antimonide [CdSb] (see cadmium - antimony intermetallic compound)		

Material Name	Vol.	Page	Material Name	Vol.	Page
Cadmium germanium phosphide (CdGeP ₂)	2	758	Ca _{2.02} Pb	1	1271
Cadmium telluride [CdTe] (see cadmium - tellurium intermetallic compound)			Ca _{2.10} Pb	1	1271
Calcia (see calcium oxide)			Ca _{2.18} Pb	1	1271
Calcite	2	761	Carbofrax brick	2	897
Calcium - lead intermetallic compounds			Carbofrax carborundum brick	2	895
Ca _x Pb _y	1	1270	Carbon	2	5
Ca ₂ Pb	2	1271	Diamond	2	9
Ca _{2.02} Pb	1	1271	Graphite (see each individual graphite)		
Ca _{2.10} Pb	1	1271	Lampblack	2	6
Ca _{2.18} Pb	1	1271	Petroleum coke	2	6
Calcium - tin intermetallic compound			Carbon + Oxygen	2	764
Ca ₂ Sn	1	1273	Carbon + Volatile materials	2	765
Calcium carbonate (CaCO ₃)	2	759	Carbon brick	2	890, 896
Calcium carbonate (CaCO ₃)			Carbon tetrachloride (CCl ₄)	3	156
Black marble	2	761	Carbon monoxide (CO)	3	151
Brown marble	2	761	Carbon monoxide - hydrogen system	3	405
Calcite	2	761	Carbon dioxide (CO ₂)	3	145
Marble	2	760, 761	Carbon dioxide and ethylene system	3	389
Marble powder	2	760, 761	Carbon dioxide - hydrogen system	3	391
Natural (see limestone)			Carbon dioxide - nitrogen system	3	396
White marble	2	761	Carbon dioxide - oxygen system	3	401
White Alabama marble	2	761	Carbon dioxide - propane system	3	403
Calcium difluoride (CaF ₂)	2	630	Carbon steel	1	1118, 1119, 1126, 1180, 1185
Calcium oxide (CaO)	2	141	Carbon steel, British	1	1186
Calcium phosphate + Lithium carbonate + Magnesium carbonate	2	763	Carbon steel, Japanese	1	1185
Calcium stannate (CaSnO ₃)	2	264	Carborundum	2	553, 555, 596
Calcium stannide [Ca ₂ Sn] (see calcium - tin intermetallic compound)			Carboxy nitrile rubber	2	982
Calcium metatitanate (CaTiO ₃)	2	267	Cardboard	2	1109
Calcium tungstate (CaWO ₄)	2	270	Carsiat carborundum brick	2	895
Calcium wolframate [CaWO ₄] (see calcium tungstate)			Cartridge brass 70% (see brass 70/30)		
Canadian natural graphite	2	54	Ca ₂ Sn	1	1273
Ca ₂ Pb	1	1271			

Material Name	Vol.	Page	Material Name	Vol.	Page
Cassiopeium (see lutetium)			Cellular glass	2	923
Cast iron	1	1129, 1130, 1133, 1134, 1136, 1137, 1205, 1222	Cellulose fiberboard	1	1110
			Celtium (see hafnium)		
Cast irons (specific types)			Cement		
Black temper	1	1137	Hydraulic (see Portland cement)	2	861
Gray	1	1130, 1135	Portland	2	861
Heat resistant	1	1146	Slag	2	861
High duty	1	1133, 1135	Slag - Portland	2	861
Hot mold, gray	1	1135	Cement porous brick	2	890
Nickel-resist	1	1204	Ceramic brick	2	890
Nr 1510, spherical	1	1222	Ceramics, miscellaneous	2	915
Nr 1520, pearlitic matrix	1	1222	Cerium	1	50
Soft, gray	1	1135	Cerium dioxide (CeO ₂)	2	144
White	1	1130, 1135	Cerium dioxide + Magnesium oxide	2	350
White temper	1	1137	Cerium dioxide + Uranium dioxide	2	353
Cd ₃ As ₂ + Zn ₃ As ₂	1	1396	Cerium sulfides		
Cd _{0.04} Hg _{0.96} Te	1	1408	CeS	2	697
Cd _{0.07} Hg _{0.93} Te	1	1408	Ce ₂ S ₃	2	698
CdSb	1	1264	Cermets (see each individual cermet)		
CdSb + ZnSb	1	1397	Cesium	1	54
CdSb · ZnSb	1	1398	Cesium bromide (CsBr)	2	565
2CdSb · 3ZnSb	1	1413	Cesium iodide (CsI)	2	561
3CdSb · 2ZnSb	1	1398	Chamotte brick	2	890
3CdSb · 7ZnSb	1	1413	Chamotte clay	2	804
7CdSb · 3ZnSb	1	1398	Channel carbon black	2	764
CdTe	1	1267	Charcoal	2	1157
Cd _{1.6} Zn _{1.4} As ₂	1	1396	Chlorine	3	17
Cd ₂ ZnAs ₂	1	1396	Chlorodifluoromethane [C ₂ HF ₂] (see Freon 22)		
Cd _{2.8} Zn _{0.5} As ₂	1	1396	Chloroform (CHCl ₃)	3	161
Cedar	2	1062	Chloroform - ethyl ether system	3	470
Ceiba (see kapok)			Chloromethane [CH ₃ Cl] (see methyl chloride)		
			Chloroprene rubber	2	983
			Chlorotrifluoromethane [C ₂ CF ₃] (see Freon 13)		

Material Name	Vol.	Page	Material Name	Vol.	Page
Chroman	1	1018	Cobalt	1	64
Chrome brick	2	454, 897, 898	Cobalt + Carbon	1	526
Chrome fire brick	2	897	Cobalt + Chromium	1	527
Chrome magnesite brick	2	890	Cobalt + Chromium + ΣX_1	1	947
Chromel 502	1	1210	Cobalt + Iron + ΣX_1	1	950
Chromel A	1	698	Cobalt + Nickel	1	528
Chromel C	1	1036	Cobalt + Nickel + ΣX_1	1	951
Chromel P	1	698	Cobalt - silicon intermetallic compound		
Chromite brick	2	473, 899	CoSi	1	1274
Chromium	1	60	Cobalt alloys (specific types)		
Chromium + Aluminum oxide	1	1419	British C-32	1	948
Chromium + Iron + ΣX_1	1	944	Haynes stellite 21	1	948
Chromium + Nickel	1	525	Haynes stellite 23	1	948
Chromium alloy, ferrochromium	1	945	S 816	1	948
(di)Chromium trioxide + Magnesium oxide + ΣX_1	2	473	WI 52	1	948
Cinder aggregate concrete	2	869, 870	X-40	1	948
Clays	2	803	(tri)Cobalt strontium metatitanate (Co_3SrTiO_3)	2	271
Ashkhabad	2	804, 805	Cobalt zinc ferrate [$Co(Zn)Fe_2O_4$]	2	272
Beskudnikov	2	804	Coke, petroleum	2	765
Chamotte	2	804	Colloidal aggregate polystyrene	2	965
Fire clay	2	804	Colorless glass	2	924
Kuchin	2	804	Columbium (see niobium)		
Sandy clay	2	805	Columbium alloys (see niobium alloys)		
Clay aggregate concrete, expanded burned	2	870	Commercial castable concrete	2	871, 875, 876, 877, 878
Climax	1	1198, 1213	Common brick	2	492, 897
Coal	2	807	Concretes	2	862
Angren brown coal	2	808	Asphaltic bituminous	2	863
Donets anthracite	2	808	Barytes	2	871
Donets gas coal	2	808	Bitumin	2	863
Coal tar fractions	2	1158	Bituminous aggregate, blended	2	863
Coatings, applied (nonmetallic)	2	1009	Cinder aggregate	2	869, 870
			Clay aggregate, expanded burned	2	870

Material Name	Vol.	Page	Material Name	Vol.	Page
Concretes (continued)			Copper, electrolytic tough pitch	1	70, 72
Commercial castable	2	871, 875, 876, 877, 878	Copper, free-cutting	1	582
Diatomaceous aggregate	2	874	Copper, oxygen-free high-conducting	1	69, 74
Haydite aggregate	2	870	Copper, phosphorus deoxidized	1	72
Leuna slag	2	864	Copper-126, leaded	1	555
Light weight	2	874	Copper + Aluminum	1	530
Light weight, foamed	2	881	Copper + Aluminum + ΣX_1	1	952
Limestone aggregate	2	869	Copper + Antimony	1	534
Limestone gravel	2	864, 865	Copper - antimony - selenium intermetallic compound $CuSbSe_2$	1	1275
Lummite cement	2	871	Copper + Arsenic	1	535
Metallurgical pumice	2	863, 864	Copper + Beryllium	1	538
Paraffin	2	863	Copper + Beryllium + ΣX_1	1	955
Portland cement	2	871	Copper + Cadmium	1	541
Sand cement	2	874	Copper + Cadmium + ΣX_1	1	956
Sand and gravel aggregate	2	868, 869	Copper + Chromium	1	542
Slag	2	864, 880, 881	Copper + Cobalt	1	545
Slag, direct process	2	864	Copper + Cobalt + ΣX_1	1	957
Slag, expanded	2	878, 879	Copper + Gold	1	548
Slag aggregate, limestone treated	2	870	Copper + Iron	1	551
Cond-Al	1	906	Copper + Iron + ΣX_1	1	960
Constantan	1	564	Copper + Lead	1	554
Contracid	1	1036	Copper + Lead + ΣX_1	1	961
Contracid B 7 M	1	1036	Copper + Manganese	1	557
Copoly(chloroethylene-vinyl-acetate)	2	943	Copper + Manganese + ΣX_1	1	964
Copoly-[1,1-difluoro-ethylene-hexafluoro propene], Viton A rubber (see Viton rubber)			Copper + Nickel	1	561
Copoly(formaldehyde-urea)	2	944	Copper + Nickel + ΣX_1	1	969
Copper	1	68	Copper + Palladium	1	568
Copper, coalesced	1	69, 72	Copper + Phosphorus	1	571
Copper, electrolytic	1	72, 73	Copper + Platinum	1	574
			Copper - selenium intermetallic compound Cu_3Se_2	1	1276
			Copper + Silicon	1	575
			Copper + Silicon + ΣX_1	1	972
			Copper + Silver	1	578

Material Name	Vol.	Page	Material Name	Vol.	Page
Copper + Tellurium	1	581	Copper alloys (specific types) (continued)		
Copper + Tin	1	584	Cupralloy type 5, Russian	1	543
Copper + Tin + ΣX_1	1	975	Cupro nickel	1	970
Copper + Zinc	1	588	Cupro nickel, NM-81, Russian	1	562
Copper + Zinc + ΣX_1	1	979	Eureka	1	563
Copper + Zirconium + ΣX_1	1	985	German silver	1	980, 981
Copper alloys (specific types)			Gun-metal, admiralty	1	976
Advance	1	970	Gun-metal, ordinary	1	976
ASTM B301-58T	1	582	Lohm	1	564
Beryllium copper	1	539	Manganin	1	965
Brass	1	591, 592, 980, 981, 982	Manganin NM Mts	1	965
Brass 70/30	1	570	Navy M	1	977
Brass B.S. 249	1	981	Nickel silver	1	981
Brass, cast	1	980	SAE bearing alloy 40	1	976
Brass, high tensile	1	980	SAE bearing alloy 62	1	976
Brass, leaded free cutting	1	981	SAE bearing alloy 64	1	976
Brass MS 58	1	980	SAE bearing alloy 66	1	962
Brass MS 76/22/2	1	980	Copper glance [see (di)copper sulfide]		
Brass, red, German	1	591, 981	Copper iodide (CuI)	2	562
Brass, rolled	1	980	Copper hemioxide (Cu_2O) [see (di)copper oxide]		
Brass, yellow	1	981, 982	(di)Copper oxide (Cu_2O)	2	147
Bronze	1	585, 586, 976, 980	Copper protoxide (Cu_2O) [see (di)copper oxide]		
Bronze, aluminum	1	531, 532, 953	Copper selenide [Cu_3Se_2] (see copper - selenium intermetallic compound)		
Bronze, beryllium	1	539	(di)Copper sulfide (Cu_2S)	2	699
Bronze, phosphor	1	585, 586, 976	(di)Copper sulfide + Iron sulfide + (tri)Nickel disulfide	2	700
Bronze, silicon	1	973	(di)Copper sulfide + (tri)Nickel disulfide	2	701
Bronze, silver	1	579, 980	Copperous oxide (Cu_2O) [see (di)copper oxide]		
Constantan	1	564	Copperous sulfide (Cu_2S) [see (di)copper sulfide]		
			Cordierite	2	918
			Cordierite 202	2	919
			Rutgers	2	919
			Steatite	2	919

Material Name	Vol.	Page	Material Name	Vol.	Page
Cork	2	1063	$(\text{CuSbSe}_2)_{0.8}(\text{Cu}_3\text{Se}_2)_{0.2}$	1	1400
Corning 0080 glass	2	511, 928	$(\text{CuSbSe}_2)_{0.9}(\text{Cu}_3\text{Se}_2)_{0.1}$	1	1400
Corning 7740 glass	2	933	Cu_3Se_2	1	1276
Cornstalk wallboard	2	1111	$\text{Cu}_3\text{Se}_2 + \text{CuSbSe}_2$	1	1401
Corronil	1	1032	"D" nickel	1	1039
Corundum	2	94, 99	Decane, n-($\text{C}_{10}\text{H}_{22}$)	3	164
Corundum brick	2	454, 905	Dense brick	2	443, 904
Cotton	2	1068	Deuterium	3	21
Waste	2	1070	Deuterium - hydrogen system	3	407
Medical	2	1069, 1070	Deuterium - nitrogen system	3	410
Cotton fabric	2	1093	Diamond	2	9
Cotton silicate felt fabric	2	1094	Type I	2	10
Cotton wool	2	1096	Type II	2	10
Crucible HNM	1	1168	Diatomaceous aggregate concrete	2	874
Crucible steel, Japanese	1	1204	Diatomaceous brick	2	890, 891
Cu + BeCo	1	1420	Diatomaceous earth	2	814
CuAu	1	1281	Diatomaceous insulating brick	2	906, 907
Cu_3Au	1	1281	Diatomite (see diatomaceous earth)		
Cupralloy, Russian, type 5	1	543	Diatomite aggregate	2	1112
Cupronickel	1	970	Sil-O-Cel coarse grade	2	1112
Cupronickel, Russian, NM-81	1	562	Dichlorodifluoromethane [Cl_2CF_2] (see Freon 12)		
Cuprum (see copper)			Dichlorofluoromethane [Cl_2CHF] (see Freon 21)		
CuSbSe_2	1	1275	1, 2-Dichloro-1, 1, 2, 2-tetrafluoroethane [$\text{CClF}_2\text{CClF}_2$] (see Freon 114)		
$\text{CuSbSe}_2 + \text{Cu}_3\text{Se}_2$	1	1400	Diethylamine - ethyl ether system	3	472
$(\text{CuSbSe}_2)_{0.1}(\text{Cu}_3\text{Se}_2)_{0.9}$	1	1401	Dimethyl ketone [$(\text{CH}_3)_2\text{CO}$] (see acetone)		
$(\text{CuSbSe}_2)_{0.2}(\text{Cu}_3\text{Se}_2)_{0.8}$	1	1401	Dimethyl methane [C_3H_8] (see propane)		
$(\text{CuSbSe}_2)_{0.25}(\text{Cu}_3\text{Se}_2)_{0.75}$	1	1401	Dinas brick	2	891
$(\text{CuSbSe}_2)_{0.3}(\text{Cu}_3\text{Se}_2)_{0.7}$	1	1401	Diphenyl ($\text{C}_6\text{H}_5\text{C}_6\text{H}_5$)	2	989
$(\text{CuSbSe}_2)_{0.33}(\text{Cu}_3\text{Se}_2)_{0.67}$	1	1401	Diphenylamine [$(\text{C}_6\text{H}_5)_2\text{NH}$] (see acetone)	2	991
$(\text{CuSbSe}_2)_{0.4}(\text{Cu}_3\text{Se}_2)_{0.6}$	1	1401	Diphenylmethane + Naphthalene	2	994
$(\text{CuSbSe}_2)_{0.5}(\text{Cu}_3\text{Se}_2)_{0.5}$	1	1401	Diphenyl oxide [$(\text{C}_6\text{H}_5)_2\text{O}$] (see acetone)	2	990
$(\text{CuSbSe}_2)_{0.6}(\text{Cu}_3\text{Se}_2)_{0.4}$	1	1400	Dolomite	2	810
$(\text{CuSbSe}_2)_{0.7}(\text{Cu}_3\text{Se}_2)_{0.3}$	1	1400			

Material Name	Vol.	Page	Material Name	Vol.	Page
Dolomite (continued)			Enamel (continued)		
NTS dolomite	2	811	Silicon	2	921
Domestic graphite, Japan	2	56	Erbium	1	86
Donets anthracite coal	2	808	Ethane (C ₂ H ₆)	3	167
Donets gas coal	2	808	Ethanol [C ₂ H ₅ OH] (see ethyl alcohol)		
Dow metal	1	999	Dimethyl ether - argon system	3	454
Duralumin	1	896	Dimethyl ether - methyl formate system	3	474
Duranickel	1	1015	Dimethyl ether - propane system	3	456
Duranickel alloy 301 (see duranickel)			Ethyl alcohol (C ₂ H ₅ OH)	3	169
Duroid 5600	2	968	Ethyl ether [(C ₂ H ₅) ₂ O]	3	179
Dyna quartz fiber	2	1144	Ethylene (CH ₂ CH ₂)	3	173
Dysprosium	1	82	Ethylene - hydrogen system	3	413
Earth	2	813	Ethylene - methane system	3	415
Diatomaceous	2	814	Ethylene - nitrogen system	3	417
Kieselguhr	2	814	Ethylene glycol (CH ₂ OHCH ₂ OH)	3	177
Kieselguhr, ignited	2	814	Eureka	1	563
Kieselguhr, ordinary	2	814	Europium	1	90
Easy-Flo silver solder silver alloy	1	1059	Encelsior	2	1113
Ebonite rubber	2	971	Fat	2	1072
Egyptian fire clay brick	2	491, 901	Beef	2	1072
EI-257, Russian	1	1166, 1214	Bone	2	1073
EI-435, Russian	1	1022	Pig	2	1073
EI-572, Russian	1	1167	Ferrocobalt, Russian	1	1081
EI-606, Russian	1	1167	Ferrocromium, Russian	1	945
EI-607, Russian	1	1019, 1020, 1021	Ferromanganese, Russian	1	684, 1010
EI-802, Russian	1	1156, 1157	Ferromanganese, low carbon, Russian	1	1010
EI-855, Russian	1	1214	Ferromanganese, normal, Russian	1	1010
Elastomer rubber	2	974	Ferromolybdenum, Russian	1	690, 1013
Elekton 2	1	999	Ferrosilicon, Russian	1	765
Electrical porcelain	2	937	Ferrosilicon 45%, Russian	1	1218
Electrolytic iron	1	157, 159	Ferrotitanium, Russian	1	1225
Enamel	2	921	Ferrotungsten, Russian	1	1090
			Ferrovandium, Russian	1	875
			Ferrum (see iron)		

Material Name	Vol.	Page	Material Name	Vol.	Page
Fiberglass	2	1115	Fused quartz [see silicon dioxide (fused)]		
Fiberite	2	1052	GaAs	1	1277
Fir	2	1073	GaAs + GaP	1	1423
Fir plywood	2	1114	GaAs _{0.5} P _{0.5}	1	1424
Fire brick	2	491, 891, 895, 902, 903	GaAs _{0.65} P _{0.35}	1	1424
			GaAs _{0.67} P _{0.33}	1	1424
			GaAs _{0.8} P _{0.2}	1	1424
Fire clay	2	804	GaAs _{0.9} P _{0.1}	1	1424
Fire clay, Aluminous	2	489	Gabbro	2	816
Fire clay, light weight	2	403, 404	Gadolinium	1	93
			Gadolinium oxide + Samarium oxide	2	356
Fire clay, pressed	2	403	Gallium	1	97
Fire clay brick	2	403, 404, 490, 491, 896, 901, 903	Gallium - arsenic intermetallic compound GaAs	1	1277
			Gallium arsenide [GaAs] (see gallium - arsenic intermetallic compound)		
Fire clay brick, aluminous	2	900	Garnet [M ₃ ^{II} M ₂ ^{III} (SiO ₄) ₃]	2	278
Fire clay brick, dense	2	903	Genetron 11 [Cl ₃ CF] (see Freon 11)		
Fire clay brick, superduty	2	890	Genetron 12 [Cl ₂ CF ₂] (see Freon 12)		
Fissium alloy	1	1095	Genetron 13 [ClCF ₃] (see Freon 13)		
Flowers of tin (see tin dioxide)			Genetron 22 [ClCHF ₂] (see Freon 22)		
Fluorine	3	26	Genetron 113 [CCl ₂ FCClF ₂] (see Freon 113)		
Foam glass	2	924, 925	Genetron 114 [CClF ₂ CClF ₂] (see Freon 114)		
Forsterite (Mg ₂ SiO ₄)	2	275	Georgia fire brick	2	896
Freon 10 [CCl ₄] (see carbon tetrachloride)			German chromin	1	1018
Freon 11 (Cl ₃ CF)	3	183	German silver	1	980, 981
Freon 12 (Cl ₂ CF ₂)	3	187	German steel	1	1118
Freon 13 (ClCF ₃)	3	191	German Y alloy	1	896, 898
Freon 20 [CHCl ₃] (see chloroform)			Germanium	1	108
Freon 21 (Cl ₂ CHF)	3	193	Germanium + Silicon	1	597
Freon 22 (ClCHF ₂)	3	197	Germanium - tellurium intermetallic compound GeTe	1	1280
Freon 113 (CCl ₂ FCClF ₂)	3	201	Germanium 74, enriched	1	112
Freon 114 (CClF ₂ CClF ₂)	3	205	Germanium telluride [GeTe] (see germanium- tellurium intermetallic compound)		
Fuel-filled graphite	2	545, 548, 558	GeTe	1	1280

Material Name	Vol.	Page	Material Name	Vol.	Page
Glasses	2	922	Glasses (continued)		
Aluminate silicate 723	2	923	Soda-lime silica	2	511, 924, 927
Amber	2	924	Soda-lime silica plate 9330	2	923
Borosilicate	2	923, 924	Soft	2	511
Borosilicate 3235	2	923	Solex 2808 plate	2	923
Borosilicate crown	2	923	Solex 2808 X	2	925
Cellular	2	923	Solex "S"	2	925
Colorless	2	924	Soldex "S" plate	2	923
Corning 0080	2	511, 928	Thuringian	2	923, 924
Foam	2	924, 925	Vycor-brand	2	926
Golden plate (see amber glass)			White plate	2	923, 925
Green	2	923	Window	2	923, 924
Jena Geräte	2	924	X-ray protection	2	924
Lead	2	923	Glass fiber blankets (same as fiberglass)	2	1115
Monax	2	924	Insulation	2	1117
Phoenix	2	924	Superfine	2	1116
Plate	2	923, 924, 925, 926	Glass fiber board	2	1124
Pyrex	2	499, 923, 924, 926, 927	Glucinum (see beryllium)		
Pyrex 7740	2	499, 923, 924, 925, 926	Glycerol (C ₃ H ₇ OHCHOHCH ₂ OH)	3	209
Quartz	2	923, 924	Gnome salt	2	832
Silica	2	923, 925, 926	Gold	1	132
Silica, fused	2	925	Gold + Cadmium	1	600
Silicate	2	511	Gold + Chromium	1	603
Soda	2	923	Gold + Cobalt	1	606
Soda-lime	2	926	Gold + Copper	1	609
Soda-lime plate	2	926	Gold - copper intermetallic compounds		
			Au _x Cu _y	1	1281
			CuAu	1	1282
			Cu ₃ Au	1	1282
			Gold + Palladium	1	614
			Gold + Platinum	1	617
			Gold + Silver	1	620

Material Name	Vol.	Page	Material Name	Vol.	Page
Gold + Zinc	1	623	Graphite (continued)		
Golden plate glass (see amber glass)			Grade CEQ	2	63, 65
Government rubber-styrene rubber	2	977	Grade CFW	2	67
Granite	2	817	Grade CFZ	2	67, 71, 72
NTS granite	2	818	Grade CS	2	54, 55, 56, 64
Graphite	2	53	Grade CS-112	2	63
Acheson	2	73	Grade CS-312	2	63
Boronated	2	61	Grade CSF	2	55
British reactor grade A	2	69	Grade CSF-MTR	2	63
British reactor grade carbon	2	69, 70	Grade EY 9	2	69, 70, 71
Brom-graphite	2	768	Grade EY 9A	2	70
Brookhaven	2	26	Grade G-5	2	60, 61
Canadian natural graphite	2	54	Grade G-9	2	60, 61
Carbon resistor	2	73	Grade GBE	2	54, 55
Deposited carbon	2	32	Grade GBH	2	55
Domestic, Japan	2	56	Grade H4LM	2	61
Fuel-filled	2	545, 548, 558	Grade JTA	2	70, 72
Grade 875 S	2	45	Grade L-117	2	63
Grade 890 S	2	49	Grade MH4LM	2	70
Grade AGA	2	64	Grade P1	2	35
Grade AGHT	2	57	Grade R-0008	2	60
Grade AGOT	2	13	Grade R0025	2	71
Grade AGOT-KC	2	17	Grade RT-0003	2	54
Grade AGOT-CSF-MTR	2	17	Grade RVA	2	66, 67
Grade AGSR	2	57, 58, 63, 64	Grade RVD	2	67
Grade AGSX	2	64	Grade SA-25	2	42
Grade ATJ	2	20	Grade TS-148	2	59
Grade ATL	2	64	Grade TS-160	2	59
Grade ATL-82	2	71			
Grade AUC	2	63, 64, 65			
Grade AWG	2	24			
Grade CDG	2	65			

Material Name	Vol.	Page	Material Name	Vol.	Page
Graphite (continued)			Greenheart	2	1074
Nuclear grade TSP	2	60	Gulton HS. B aluminum oxide	2	103
Grade ZT	2	60, 61, 71	Gun metal, admiralty	1	976
Grade ZTA	2	65, 66, 70	Gun metal ^{metal} , ordinary	1	976
Grade ZTB	2	66	"H" Monel	1	1032
Grade ZTC	2	66	Hafnia (see hafnium oxide)		
Grade ZTD	2	66	Hafnium	1	138
Grade ZTE	2	66	Hafnium - boron intermetallic compound HfB ₂	1	1284
Grade ZTF	2	66	Hafnium + Zirconium	1	624
Graphitized carbon black	2	60	Hafnium carbide (HfC)	2	575
Karbate	2	59	Hafnium nitride (HfN)	2	659
Korite	2	55	Hafnium oxide (HfO ₂)	2	150
Moderator graphite	2	70	Hair felt	2	1099
Natural Ceylon block	2	55	Hand-burned face brick	2	891
Ohmite	2	73	Hardwood	2	1075
Pencil lead graphite	2	65	Hastelloy A	1	1036
Porous-40	2	63	Hastelloy B	1	1042
Porous-60	2	63	Hastelloy C	1	1018
Pyrolytic	2	32	Hastelloy R-235	1	1019
Pyrolytic graphite filament	2	32	Haydite aggregate concrete	2	870
Reactor grade carbon stock	2	73	Haynes alloy N-155	1	1177
Spektral Kohle 1	2	54	Haynes alloy Nb-752	1	1056
Supertemp pyrolytic	2	72	Haynes stellite alloy 21	1	948
U. B. carbon	2	62	Haynes stellite alloy 23	1	948
U. B. graphite	2	62	Haynes stellite alloy 27	1	1029
Graphite + Bromine	2	767	Haynes stellite alloy 31 (same as cobalt alloy X40)	1	948
Graphite + Thorium dioxide	2	544	Heavy hydrogen (see deuterium, or tritium)		
Graphite + Uranium dicarbide	2	770	Helium	3	29
Graphite + Uranium dioxide	2	547	Helium - air system	3	318
Gray cast iron	1	1130, 1135	Helium - argon - krypton system	3	481
Gray cast iron, hot mold	1	1135	Helium - argon - nitrogen system	3	486
Green glass	2	923	Helium - argon - xenon system	3	479
			Helium - n-butane system	3	320
			Helium - carbon dioxide system	3	322

Material Name	Vol.	Page	Material Name	Vol.	Page
Helium - cyclopropane system	3	325	Hydrargyrum (see mercury)		
Helium - deuterium system	3	327	Hydriodic acid [HI] (see hydrogen iodide)		
Helium - ethane system	3	329	Hydrochloric acid [HCl] (see hydrogen chloride)		
Helium - ethylene system	3	331	Hydrogen	3	41
Helium - hydrogen system	3	333	Hydrogen - oxygen system	3	429
Helium - krypton system	3	276	Hydrogen - nitrogen system	3	419
Helium - krypton - xenon system	3	480	Hydrogen - nitrogen - ammonia system	3	500
Helium - methane system	3	338	Hydrogen - nitrogen - oxygen system	3	498
Helium - neon system	3	271	Hydrogen - nitrous oxide system	3	427
Helium - neon - deuterium system	3	489	Hydrogen chloride (HCl)	3	101
Helium - neon - xenon system	3	482	Hydrogen iodide (HI)	3	103
Helium - nitrogen system	3	340	Hydrogen sulfide (H ₂ S)	3	104
Helium - nitrogen - methane system	3	487	Hypalon S2 rubber	2	983
Helium - oxygen system	3	343	Hypo (see sodium thiosulfate)		
Helium - oxygen - methane system	3	484	Hytex hydraulic pressed building brick	2	896
Helium - propane system	3	345	Ignited alumina	2	106
Helium - propylene system	3	347	Illinium (see promethium)		
Helium - xenon system	3	280	InAs	1	1292
Heptane, n-(C ₇ H ₁₆)	3	211	InAs + InP	1	1426
Hevea rubber	2	983	InAs _{0.6} P _{0.4}	1	1427
Hexane, n-(C ₆ H ₁₄)	3	214	InAs _{0.8} P _{0.2}	1	1427
HfB ₂	1	1284	InAs _{0.9} P _{0.1}	1	1427
HgSe	1	1320	InAs _{0.96} P _{0.06}	1	1427
HgTe	1	1321	Inco "713 C"	1	1022
HgTe + CdTe	1	1407	Inconel	1	1018, 1019, 1021
Hi alumina	2	99	Inconel alloy 600 (see inconel)		
High carbon steel, Japanese	1	1119	Inconel alloy 702	1	1022
High-perm-49	1	1199	Inconel alloy 713 (see Inco "713 C")		
High temp. insulating brick	2	891	Inconel alloy X-750 (see inconel X)		
High temp. insulating blast furnace brick	2	899	Inconel X	1	1018
High zircon porcelain	2	937	India beryl	2	801
Holmium	1	142	Indiana limestone	2	821
Honeycomb structures (metallic - nonmetallic)	2	1015	Indium	1	146
Honeycomb structures (nonmetallic)	2	1010			
Hutchins alloy	1	512			

Material Name	Vol.	Page	Material Name	Vol.	Page
Indium - antimony intermetallic compound InSb	1	1287	Iron	1	156
Indium - arsenic intermetallic compound InAs	1	1292	Iron + Aluminum + ΣX_1 (I)	1	1142
Indium + Lead	1	627	Iron + Aluminum + ΣX_1 (II)	1	1145
Indium - selenium intermetallic compound In ₂ Se ₃	1	1295	Iron + Carbon + ΣX_1 (I) (C ≤ 2.00%)	1	1113
Indium - tellurium intermetallic compound In ₂ Te ₃	1	1298	Iron + Carbon + ΣX_1 (II) (C ≤ 2.00%)	1	1124
Indium + Thallium	1	630	Iron + Carbon + ΣX_1 (I) (C > 2.00%)	1	1128
Indium + Tin	1	634	Iron + Carbon + ΣX_1 (II) (C > 2.00%)	1	1132
Indium antimonide [InSb] (see indium - antimony intermetallic compound)			Iron + Chromium + ΣX_1 (I)	1	1148
Indium arsenide [InAs] (see indium - arsenic intermetallic compound)			Iron + Chromium + ΣX_1 (II)	1	1152
Indium oxide (InO)	2	153	Iron + Chromium + Nickel + ΣX_1 (I)	1	1160
Indium selenide [In ₂ Se ₃] (see indium - selenium intermetallic compound)			Iron + Chromium + Nickel + ΣX_1 (II)	1	1164
Indium telluride [In ₂ Te ₃] (see indium - tellurium intermetallic compound)			Iron + Cobalt + ΣX_1 (II)	1	1176
Ingot iron	1	1134	Iron + Copper + ΣX_1 (I)	1	1179
InSb	1	1287	Iron + Manganese + ΣX_1 (I)	1	1182
InSb + In ₂ Te ₃	1	1403	Iron + Manganese + ΣX_1 (II)	1	1191
In ₂ Se ₃	1	1295	Iron + Molybdenum + ΣX_1 (II)	1	1194
Insulating brick	2	443, 891, 904	Iron + Nickel + ΣX_1 (I)	1	1197
Insulating fire brick	2	891	Iron + Nickel + ΣX_1 (II)	1	1202
Insulation fiberglass	2	1117	Iron + Nickel + Chromium + ΣX_1 (I)	1	1209
Insurok	2	1023, 1024	Iron + Nickel + Chromium + ΣX_1 (II)	1	1212
In ₂ Te ₃	1	1298	Iron + Phosphor + ΣX_1 (I)	1	1216
In ₂ Te ₃ + Cu ₂ Te + Ag ₂ Te	1	1406	Iron + Silicon + ΣX_1 (I)	1	1217
Intermetallic compounds (see each individual intermetallic compound)			Iron + Silicon + ΣX_1 (II)	1	1221
Invar	1	1199	Iron + Titanium + ΣX_1 (I)	1	1225
Invar, free cut	1	1205	Iron + Tungsten + ΣX_1 (I)	1	1226
Iodine	2	83	Iron + Tungsten + ΣX_1 (II)	1	1229
Iodyride [AgI] (see silver iodide)			Iron, Armco	1	157, 158, 159, 160, 161, 163
Ionium (see thorium)			Iron, electrolytic	1	157, 159
Iridium	1	152	Iron, nodular	1	1222
			Iron, silai	1	1222, 1223
			Iron, Swedish	1	158

Material Name	Vol.	Page	Material Name	Vol.	Page
Iron, wrought	1	1185, 1219	Kieselguhr earth	2	814
(tri)Iron carbide (Fe_3C)	2	578	Kieselguhr earth, ignited	2	814
(tri)Iron tetraoxide (Fe_3O_4)	2	154	Kieselguhr earth, ordinary	2	814
Iron oxide, magnetic [Fe_3O_4] (see (tri)iron tetraoxide)			Knaptic	1	327
Isotron 11 (see Freon 11)			Koldboard	2	1125
Isotron 12 (see Freon 12)			Korite graphite	2	55
Isotron 13 (see Freon 13)			Kovar	1	1203
Isotron 22 (see Freon 22)			Krupp steel	1	1115, 1184
Isotron 113 (see Freon 113)			Krypton	3	50
isotron 114 (see Freon 114)			Krypton - deuterium system	3	349
Ivory	2	1076	Krypton - hydrogen system	3	351
African	2	1076	Krypton - neon system	3	284
Japanese 2E-8	1	899	Krypton - nitrogen system	3	354
Japanese fish-plate	1	1119	Krypton - oxygen system	3	356
Japanese M-1	1	899	Krypton - xenon system	3	288
Japanese steel	1	1195, 1210	Kuehin clay	2	804
Jena Geräte glass	2	924	"L" nickel	1	238, 239
Jodium (see iodine)			Lamicoid	2	1023, 1024
"K" Monel	1	1032	Laminates (metallic - nonmetallic)	2	1036
K. S. alloy 245	1	920	Laminates (nonmetallic)	2	1021
K. S. alloy 280	1	920	Armalon	2	1032
K. S. alloy special	1	902	Astrolite	2	1029, 1030
K. S. magnet steel	1	1177	Insurok	2	1023, 1024
Kalium (see potassium)			Lamicoid	2	1023, 1024
Kaolin fire brick	2	404, 405, 904	Scotchply	2	1029
Kaolin insulating refractory brick	2	895	Laminate, epoxy resin (see scotch ply laminate)		
Kapok	2	1077	Lampblack	2	6
Karbate graphite	2	59	Lanthanum	1	171
Kel-F	2	970	Lanthanum + Neodymium + ΣX_1	1	988
Kel-F 3700	2	983	Lanthanum - selenium intermetallic compound		
Kennametals K161B	2	728	LaSe	1	1301
Ketopropane [$(CH_3)_2CO$] (see acetone)					
Kh80 T, Russian	1	1019			

Material Name	Vol.	Page	Material Name	Vol.	Page
Lanthanum - tellurium intermetallic compound			Lignum Vitae	2	1079
LaTe	1	1304	Lime sand brick	2	892
Lanthanum trifluoride (LaF ₃)	2	633	Limestone	2	820
Lanthanum selenide [LaSe] (see lanthanum - selenium intermetallic compound)			Indiana	2	821
Lanthanum sulfide (LaS)	2	702	Queenstone grey	2	821
Lanthanum telluride [LaTe] (see lanthanum - tellurium intermetallic compound)			Rama	2	821
LaSe	1	1301	Limestone aggregate concrete	2	869
LaTe	1	1304	Limestone gravel concrete	2	864, 865
Laughing gas (see nitrous oxide)			Lipowitz alloy	1	939
Lead	1	175	Lithia (see lithium oxide)		
Lead, pyrometric standard	1	183, 184	Lithium	1	192
Lead + Antimony	1	637	Lithium + Boron + ΣX_1	1	992
Lead + Antimony + ΣX_1	1	991	Lithium + Sodium	1	655
Lead + Bismuth	1	640	Lithium + Sodium + ΣX_1	1	995
Lead + Indium	1	643	Lithium fluoride (LiF)	2	636
Lead + Silver	1	646	Lithium fluoride + Potassium fluoride + ΣX_1	2	641
Lead - tellurium intermetallic compound			Lithium hydride (LiH)	2	773
PbTe	1	1307	Lithium oxide (Li ₂ O)	2	157
Lead + Thallium	1	649	Lohm	1	564
Lead + Tin	1	652	Low alloy steel	1	1213
Lead alloy, SAE bearing alloy 12	1	991	Low-exp-42	1	1205
Lead glass	2	923	Lowell sand	2	834, 835
Lead oxide + Silicon dioxide	2	359	Lucalox	2	106
Lead oxide + Silicon dioxide + ΣX_1	2	474	Lummite cement concrete	2	871
Lead telluride [PbTe] (see lead - tellurium intermetallic compound)			Lutetium	1	198
Lead metatitanate (PbTiO ₃)	2	279	Macloy G steel	1	1213
Lead zirconate (PbZrO ₃)	2	282	Magnalium	1	478
Light weight brick	2	488, 489, 892, 899, 900	Magnesia (see magnesium oxide)		
Light weight concrete	2	874	Magnesia brick	2	485, 897, 898, 899
Light weight concrete, foamed	2	881	Magnesite brick	2	478, 483, 892, 895, 905

Material Name	Vol.	Page	Material Name	Vol.	Page
Magnesite fire brick	2	897	Magnesium aluminates (continued)		
Magnesium	1	202	Natural ruby spinel	2	284
Magnesium + Aluminum	1	658	Spinel	2	284
Magnesium + Aluminum + ΣX_1	1	998	Synthetic spinel	2	287
Magnesium - antimony intermetallic compound			Magnesium aluminate + Magnesium oxide	2	362
Mg_3Sb_2	1	1310	Magnesium aluminate + Silicon dioxide	2	365
Magnesium + Cadmium	1	661	Magnesium aluminate + (di)Sodium oxide	2	368
Magnesium + Calcium	1	662	Magnesium metaaluminate [$MgAl_2O_4$] (see magnesium aluminate)		
Magnesium + Cerium	1	663	Magnesium antimonide [Mg_3Sb_2] (see magnesium - antimony intermetallic compound)		
Magnesium + Cerium + ΣX_1	1	1001	Magnesium carbonate ($MgCO_3$)	2	776
Magnesium + Cobalt + ΣX_1	1	1004	Magnesium oxide (MgO)	2	158
Magnesium + Copper	1	666	Magnesium oxide + Beryllium oxide	2	371
Magnesium + Copper + ΣX_1	1	1005	Magnesium oxide + Calcium oxide + ΣX_1	2	477
Magnesium - germanium intermetallic compound			Magnesium oxide + (di)Chromium trioxide + ΣX_1	2	480
Mg_2Ge	1	1311	Magnesium oxide + Clay	2	374
Magnesium + Manganese	1	669	Magnesium oxide + (di)Iron trioxide + ΣX_1	2	483
Magnesium + Nickel	1	672	Magnesium oxide + Magnesium aluminate	2	375
Magnesium + Nickel + ΣX_1	1	1008	Magnesium oxide + Magnesium orthosilicate	2	378
Magnesium + Silicon	1	675	Magnesium oxide + Nickel oxide	2	381
Magnesium - silicon intermetallic compound			Magnesium oxide + Silicon dioxide	2	384
Mg_2Si	1	1314	Magnesium oxide + Silicon dioxide + ΣX_1	2	484
Magnesium + Silver	1	678	Magnesium oxide + Talc	2	550
Magnesium + Tin	1	679	Magnesium oxide + Tin dioxide	2	387
Magnesium - tin intermetallic compound			Magnesium oxide + Uranium dioxide	2	390
Mg_2Sn	1	1317	Magnesium oxide + Zinc oxide	2	391
Magnesium + Zinc	1	680	Magnesium silicate (see Forsterite)		
Magnesium alloys (specific types)			Magnesium orthosilicate + Magnesium oxide	2	394
AN-M-29	1	999	Magnesium silicide [Mg_2Si] (see magnesium - silicon intermetallic compound)		
AZ 31 A (see magnesium alloy, AN-M-29)			Magnesium stannate ($MgSnO_3$)	2	289
Dow metal	1	999	Magnesium stannide [Mg_2Sn] (see magnesium - tin intermetallic compound)		
Elekton 2	1	999	Magnesium titanate porcelain	2	937
Magnesium aluminates			Magnezit	2	385, 481
$MgO \cdot Al_2O_3$	2	283			
$MgO \cdot 3.5Al_2O_3$	2	286			

Material Name	Vol.	Page	Material Name	Vol.	Page
Magnezit brick	2	899, 902	Marsh gas (see methane)		
Mahogany	2	1080	Marksa brick	2	899
Manganese	1	208	Medical cotton	2	1069, 1070
Manganese + Copper	1	683	Mercury	1	212
Manganese + Iron	1	684	Mercury - selenium intermetallic compound		
Manganese + Iron + ΣX_i	1	1009	HgSe	1	1320
Manganese + Nickel	1	685	Mercury + Sodium	1	686
Manganese + Silicon + ΣX_i	1	1012	Mercury - tellurium intermetallic compound		
Manganese alloys (specific types)			HgTe	1	1321
Ferromanganese, Russian	1	684, 1010	Mercury selenide [HgSe] (see mercury - selenium intermetallic compound)		
Silicomanganese, Russian	1	1010, 1012	Mercury telluride [HgTe] (see mercury - tellurium intermetallic compound)		
Manganese ferrate ($MnFe_2O_4$)	2	292	Metallurgical brick	2	892, 893
Manganese oxides			Metallurgical porous brick	2	893
MnO	2	168	Metallurgical pumice concrete	2	863, 864
Mn_2O_4	2	170	Methacrylate rubber	2	983
Manganese monoxide [MnO] (see manganese oxides)			Methane (CH_4)	3	218
(di)Manganese trioxide + Aluminum oxide	2	397	Methane - propane system	3	432
(di)Manganese trioxide + Magnesium oxide	2	398	Methanol [CH_3OH] (see methyl alcohol)		
(di)Manganese trioxide + Silicon dioxide	2	399	Methanol - argon system	3	458
(tri)Manganese tetraoxide [Mn_2O_4] (see manganese oxides)	2	170	Methanol - hexane system	3	460
Manganese zinc ferrate [$Mn(Zn)Fe_2O_4$]	2	295	Methyl alcohol (CH_3OH)	3	223
Manganin	1	965	Methyl chloride (CH_3Cl)	3	227
Manganin NM Mts, Russian	1	965	Methyl formate - propane system	3	462
Manganomanganic oxide [Mn_2O_4] (see (tri)manganese tetraoxide)			Mg_2Ge	1	1311
Maple	2	1081	Mg_3Sb_2	1	1310
Marbles			Mg_2Si	1	1314
Black	2	761	Mg_2Sn	1	1317
Brown	2	761	Mica	2	823, 892
Powder	2	760, 761	Canadian phlogopites	2	824, 825
White	2	761	Granulated vermiculite	2	825
White Alabama	2	761	Madagascan phlogopites	2	824

Material Name	Vol.	Page	Material Name	Vol.	Page
Mica (continued)			Monel alloy 505 (see "S" monel)		
Synthetic	2	825	Monel alloy 506 (see "H" monel)		
Mica, bonded	2	825	Monel alloy K-500 (see "K" monel)		
Micanite	2	1138	Monel alloy R-405 (see "R" monel)		
Mild steel	1	1186	Monolithic wall	2	1126
Mineral cotton (see mineral wool)			MoSi ₂	1	1324
Mineral fiber	2	1139	MSM-4Al-4Mn (see titanium alloy C-130 AM or titanium alloy RC-1308)		
Mineral wool	2	1147	MSM-6Al-4V (see Ti-6Al-4V)		
Mineral wood, processed	2	1140	MST-6Al-4V (see Ti-6Al-4V)		
Board	2	1141	MST-8Mn (see Ti-8Mn)		
Felt	2	1141	Mullite	2	254, 934
Mipora	2	944	Mullite + Alumina	2	335
Missouri firebrick	2	905	Multimet N-155	1	1165
Moderator graphite	2	70	Mystic slag	2	1150
Molybdenum	1	222	N. S. nickel	1	708
Molybdenum + Iron	1	690	Naphthalene (C ₁₀ H ₈)	2	995
Molybdenum + Iron + ΣX ₁	1	1013	Naphthalin [C ₁₀ H ₈] (see naphthalene)		
Molybdenum - silicon intermetallic compound			Naphthol (C ₁₀ H ₇ OH)	2	998
MoSi ₂	1	1324	Natrium (see sodium)		
Molybdenum + Thorium dioxide	1	1429	Natural Ceylon graphite	2	55
Molybdenum + Titanium	1	691	Navy M	1	977
Molybdenum + Tungsten	1	694	Nelson - Kebbenleg 10	1	896
Molybdenum alloy, ferromolybdenum, Russian	1	690, 1013	Neodymium	1	230
(di)Molybdenum carbide (Mo ₂ C)	2	579	Neon	3	56
Molybdenum disilicide [MoSi ₂] (see molyb- denum - silicon intermetallic compound)			Neon - argon - deuterium system	3	490
			Neon - argon - hydrogen - nitrogen system	3	509
Monax glass	2	924	Neon - argon - krypton system	3	478
Monel	1	1032	Neon - argon - krypton - xenon system	3	504
Monel, cast	1	1032	Neon - carbon dioxide system	3	358
Monel, "H"	1	1032	Neon - deuterium system	3	360
Monel, "K"	1	1032	Neon - hydrogen system	3	362
Monel, "R"	1	1032	Neon - hydrogen - nitrogen system	3	494
Monel, "S"	1	1032	Neon - hydrogen - oxygen system	3	492
Monel alloy 400 (see monel)			Neon - krypton - deuterium system	3	491

Material Name	Vol.	Page	Material Name	Vol.	Page
Neon - nitrogen system	3	365	Nickel + Iron	1	707
Neon - nitrogen - oxygen system	3	495	Nickel + Iron + ΣX_1	1	1035
Neon - oxygen system	3	368	Nickel + Manganese	1	710
Neon - xenon system	3	291	Nickel + Manganese + ΣX_1	1	1038
Neptunium	1	234	Nickel + Molybdenum + ΣX_1	1	1041
80 Ni-20 Cr (see chromel A)			Nickel + ΣX_1	1	1044
Ni-Cr steel	1	1167, 1168, 1210, 1213	Nickel alloys (specific types)		
			"A" nickel	1	711
Nickrom (see chromel A)			Alumel	1	1015, 1039
Nichrome	1	1018, 1019, 1021, 1036	Chroman	1	1018
			Chromel A	1	698
Nichrome N	1	698	Chromel C	1	1036
Nichrome V (see chromel A)			Chromel P	1	698
Nickel	1	237	Contracid	1	1036
Nickel, "A"	1	239, 241, 1029, 1039	Contracid B7M	1	1036
			Corronil	1	1032
Nickel, "D"	1	1039	"D" nickel	1	1039
Nickel, electrolytic	1	238, 239, 240	Duranickel	1	1015
			EI-435, Russian	1	1022
Nickel, "L"	1	238, 239	EI-607, Russian	1	1019, 1020, 1021
Nickel, "O"	1	239	German chromin	1	1018
Nickel, "Z" (see duranickel)			Grade A	1	711, 1044
Nickel 200 (see nickel, A)			H monel	1	1032
Nickel 211 (see nickel, D)			Hastelloy A	1	1036
Nickel + Aluminum + ΣX_1	1	1014	Hastelloy B	1	1042
Nickel - antimony intermetallic compound			Hastelloy C	1	1018
NiSb	1	1327	Hastelloy R-235	1	1019
Nickel + Chromium	1	697	Haynes stellite 27	1	1029
Nickel + Chromium + ΣX_1	1	1017	HyMn-80	1	1036
Nickel + Cobalt	1	700	INCO "713 C"	1	1022
Nickel + Cobalt + ΣX_1	1	1028	Inconel	1	1018, 1019, 1021
Nickel + Copper	1	703			
Nickel + Copper + ΣX_1	1	1031	Inconel 702	1	1022

Material Name	Vol.	Page	Material Name	Vol.	Page
Nickel alloys (specific types) (continued)			Nickel alloys (specific types) (continued)		
Inconel alloy 713 (see Inco "713C")			Refralloy 26	1	1029
Inconel X	1	1018	Rene 41	1	1022
Inconel X-750 (see Inconel X)			"S" monel	1	1032
INOR-8	1	1042	Silicon monel	1	1032
K monel	1	1032	"Z" nickel (see duranickel)		
Kh80T, Russian	1	1019	Nickel antimonide [NiSb] (see nickel - antimony intermetallic compound)		
"L" nickel	1	238, 239	Nickel bronze	1	1032
M 252	1	1022	Nickel oxide (NiO)	2	171
Monel	1	1032	Nickel silver	1	981
Monel, cast	1	1032	Nickel silver 12% (see german silver)		
Monel alloy 400 (see monel)			(tri)Nickel disulfide (Ni ₃ S ₂)	2	705
Monel alloy 505 (see "S" monel)			Nickel zinc ferrate [Ni(Zn)Fe ₂ O ₄]	2	298
Monel alloy K-500 (see "K" monel)			Nicrosilal, British	1	1204
80Ni-20Cr	1	1019	Nigrine (see rutile)		
Nichrome	1	1018, 1019, 1021, 1036	Nil alba (see zinc oxide)		
Nichrome N	1	698	Nimocast 713 C	1	1022
Nickel bronze	1	1032	Nimonic 75	1	1019
Nimocast 713 C	1	1022	Nimonic 75, French	1	1019
Nimonic 75	1	1019	Nimonic 80	1	1018
Nimonic 75, French	1	1019	Nimonic 80/80 A, French	1	1019
Nimonic 80	1	1018, 1019	Nimonic 90	1	1019
Nimonic 80/80A, French	1	1019	Nimonic 95	1	1019
Nimonic 90	1	1019	Nimonic 100	1	1029
Nimonic 95	1	1019	Nimonic 105	1	1029
Nimonic 100	1	1029	Nimonic 115	1	1029
Nimonic 105	1	1029	Nimonic DS, French	1	1213
Nimonic 115	1	1029	Nimonic PE 7	1	1206
N. S. nickel	1	708	Niobium	1	245
"O" nickel	1	239	Niobium + Molybdenum + ΣX ₁	1	1046
OKh 20N 60B	1	1022	Niobium + Tantalum + ΣX ₁	1	1049
"R" monel	1	1032	Niobium + Titanium + ΣX ₁	1	1052
			Niobium + Tungsten + ΣX ₁	1	1055
			Niobium + Uranium	1	713

Material Name	Vol.	Page	Material Name	Vol.	Page
Niobium + Zirconium	1	716	Nylon	2	945
Niobium alloys (specific types)			Nylon 6 (see polyhexahydro-2H-azepin-2-one)		
D-36 (see niobium alloy Nb-10W-5Zr)			"O" nickel	1	239
Haynes alloy Nb-752	1	1056	Oak	2	1082
Nb-5Mo-5V-1Zr	1	1047	White	2	1082
Nb-27Ta-12W-0.2Zr	1	1050	Octane, n-(C ₈ H ₁₈)	3	233
Nb-10Ti-5Zr	1	1053	Ohmite graphite	2	73
Nb-15W-5Mo-1Zr-0.05C	1	1056	OKh20 N60 B, Russian	1	1022
Nb-10W-1Zr-0.1C	1	1056	Olivine (see forsterite)		
Nb-10W-5Zr	1	1056	Olivine basalt	2	798
Nb-0.5Zr	1	717	Ordzhonikidze brick	2	899
Niobium carbide (NbC)	2	582	Osmium	1	254
NiSb	1	1327	Oxygen	3	76
Niton (see radon)			Palladium	1	258
Nitric oxide (NO)	3	106	Palladium + Copper	1	720
Nitrile rubber	2	982	Palladium + Gold	1	723
Nitrogen	3	64	Palladium + Platinum	1	726
Nitrogen - oxygen system	3	434	Palladium + Silver	1	727
Nitrogen - oxygen - carbon dioxide system	3	497	Paper	2	1127
Nitrogen - propane system	3	438	Paraffin concrete	2	863
Nitrogen dioxide [NO ₂] (see nitrogen peroxide)			PbTe	1	1307
Nitrogen peroxide (NO ₂)	3	108	Pearlitic matrix cast iron, Nr. 1520	1	1222
Nitrogen monoxide [N ₂ O] (see nitrous oxide)			Pearlitic pig iron, Russian	1	1137
Nitrophenol (NO ₂ C ₆ H ₄ OH)	2	1001	Pencil lead graphite	2	65
Nitrous oxide (N ₂ O)	3	114	Penn. fire brick	2	905
Nivac	1	238	Pentane, n-(C ₅ H ₁₂)	3	236
Nodular iron	1	1137, 1222	Periclase	2	160
Nonane, n-(C ₉ H ₂₀)	3	230	Perlite	2	827
Normal brick	2	488, 489, 900, 901	Petalite	2	935
NTS basalt	2	798	Petroleum coke	2	765
NTS dolomite	2	811	Phenanthrene (C ₁₄ H ₁₀)	2	1004
NTS granite	2	818	Phenanthrin [C ₁₄ H ₁₀] (see phenanthrene)		
			Phenyl ether [(C ₆ H ₅) ₂ O] (see diphenyl oxide)		
			Phoenix glass	2	924

Material Name	Vol.	Page	Material Name	Vol.	Page
Phosphor bronze	1	585, 586, 976	Polyethylene	2	956
Phosphorus	2	86	Polyethylene, chlorosulfonated (see rubber, hypalon)		
Pig fat	2	1073	Polyhexahydro-2H-azepin-2-one, silon	2	959
Pines	2	1083	Poly(methyl methacrylate) [same as plexiglas]	2	960
Pitch	2	1083	AN-P-44A	2	961
White	2	1083	Perspex	2	961
Pitch pines	2	1083	Polystyrene	2	963
Pladuram	1	416	Colloidal aggregate	2	965
Plaster	2	887	Styrofoam	2	965
Plate glass	2	923, 924, 925, 926	Polysulfide rubber (see rubber, Thiokol)		
Platinoid	1	981	Polytetrafluoroethylene (same as Teflon)	2	967
Platinum	1	262	Polytrifluorochloroethylene	2	970
Platinum + Copper	1	730	Polyurethane (see rubber, Adiprene)		
Platinum + Gold	1	733	Polyvinyl chloride	2	953
Platinum + Iridium	1	734	Porcelains	2	936
Platinum + Palladium	1	737	Alumina	2	937
Platinum + Rhodium	1	738	Electrical	2	937
Platinum + Ruthenium	1	743	High zircon	2	937
Platinum + Silver	1	745	MgTiO ₃ porcelain	2	937
Plexiglas	2	960	Porcelain 576	2	937
Plexiglas AN-P-44A	2	961	Wet process	2	937
Pliofoam	2	950	Porous brick	2	894
Pluton cloth	2	1100	Porous concrete brick	2	894
Plutonium	1	270	Porous fire brick (Italy)	2	895
Plutonium, α-	1	271	Portland cement	2	861
Plutonium + Aluminum	1	746	Portland cement concrete	2	871
Plutonium + Iron	1	747	Potassium	1	274
Plutonium alloy, delta-stabilized	1	746	Potassium + Sodium	1	748
Polychloroethylene (polyvinyl chloride)	2	953	Potassium acid phosphate [KH ₂ PO ₄] (see potassium dihydrogen phosphate)		
Polychloroethylene (polyvinyl chloride), plasticized	2	954	Potassium bromide (KBr)	2	566
Polychlorotrifluoroethylene (see polytrifluorochloroethylene)			Potassium bromide + Potassium chloride	2	779
			Potassium chloride (KCl)	2	613
			Potassium chloride + Potassium bromide	2	782

Material Name	Vol.	Page	Material Name	Vol.	Page
Potassium chrome alum salt	2	689	Quartz fiber	2	1143
Potassium chromium sulfate [$KCr(SO_4)_2 \cdot 12H_2O$]	2	688	Dyna	2	1144
Potassium diduterium ^{dideuterium} phosphate (KD_2PO_4)	2	680	Quartz glass	2	187, 188, 923, 924
Potassium dihydrogen arsenate (KH_2AsO_4)	2	785	Quartz sand	2	834, 835, 836, 837
Potassium dihydrogen phosphate (KH_2PO_4)	2	684	Queenstone grey limestone	2	821
Potassium hydrogen sulfate ($KHSO_4$)	2	691	Quick silver (see mercury)		
Potassium nitrate (KNO_3)	2	647	"R" monel	1	1032
Potassium phosphate, monobasic [KH_2PO_4] (see potassium dihydrogen phosphate)			Radon	3	84
Potassium biphosphate [KH_2PO_4] (see potassium dihydrogen phosphate)			Rama limestone	2	821
Potassium diphosphate [KH_2PO_4] (see potassium dihydrogen phosphate)			RCA N91	1	701
Potassium rhodanide [$KSCN$] (see potassium thiocyanate)			RCA N97	1	701
Potassium sulfocyanate [$KSCN$] (see potassium thiocyanate)			Re_3As_7	1	1330
Potassium sulfocyanide [$KSCN$] (see potassium thiocyanide)			Red brass	1	591
Potassium thiocyanate ($KSCN$)	2	788	Red brass, German	1	981
Powders (nonmetallic)	2	1040	Red brick	2	405, 492, 898
Praseodymium	1	281	Red brick, hard burned	2	896
Promethium	1	285	Red brick, soft burned	2	896
Propane (C_3H_8)	3	240	Redwood	2	1084
2-Propanone [$(CH_3)_2CO$] (see acetone)			Bark	2	1084
Pseudo balsa	2	1060	Red wood fiber	2	1091
Pyrex	2	499, 923, 924, 926, 927	Refractory insulating brick	2	892
Pyrex 7740	2	499, 923, 924, 925, 926	Refractory insulating common chamotte brick	2	892
Pyroacetic acid (see acetone)			Refralloy 26	1	1029
Pyrocera 9606	2	940	Refrax	2	586
Pyrocera brand glass-ceramic	2	939	ReGe	1	1331
Pyrolytic graphite	2	30	ReGe ₂	1	1331
Quartz [see silicon dioxide (crystalline)]			Rene 41	1	1022
			Rene 41 cloth	2	1102
			ReSe ₂	1	1332
			Rex 78	1	1213

Material Name	Vol.	Page	Material Name	Vol.	Page
Rhenium	1	288	Rubbers (continued)		
Rhenium - arsenic intermetallic compound			Nitrile	2	982
Re_3As_7	1	1330	Poly(ethyl acrylate)	2	983
Rhenium - germanium intermetallic compounds			Polysulfide (see rubber, Thiokol)		
ReGe	1	1331	Resin-cured butyl	2	983
$ReGe_2$	1	1331	Rubatex	2	981
Rhenium - selenium intermetallic compound			Rubatex R203-H (same as Buna-N foam)	2	981
$ReSe_2$	1	1332	Silicone	2	983
Rhenium selenide [$ReSe_2$] (see rhenium selenium intermetallic compound)			Tellurace-cured butyl	2	983
Rhodium	1	292	Thiokol ST	2	982
Rock	2	828	Viton	2	983
Rock cork	2	1146	X-ray protective	2	981
Rock wool	2	1148	Rubidium	1	296
Rose metal	1	939	Rubidium + Cesium	1	751
Rubatex rubber	2	981	Russian alloy	1	1192, 1218, 1222
Rubatex R203-H rubber	2	981	Russian cupralloy, type 5	1	543
Rubbers	2	980	Russian cupro nickel, NM-81	1	562
Acrylate	2	982	Russian stainless steel (see stainless steel)		
Acrylic	2	982	Russian steel	1	1118
Adiprene	2	982	Rutgers cordierite	2	919
Buna-N foam (see rubber, Rubatex R203-H)			Ruthenium	1	300
Butaprene E	2	982	Rutile	2	203
Carboxy nitrile	2	982	"S" monel	1	1032
Chloroprene	2	983	SAE 1010	1	1183
Dibenzo GMF-cured butyl	2	983	SAE 1015 (see AISI C 1015)		
Ebonite	2	971	SAE 1020	1	1183
Elastomer	2	974	SAE 1095	1	1114
Government rubber-styrene	2	977	SAE 4130	1	1153
Hard	2	972, 981	SAE 4140	1	1155
Hevea	2	983	SAE 4340 (see AISI 4340)		
Hypalon S2	2	983	SAE bearing alloy 10	1	1070
Kel-F 3700	2	983	SAE bearing alloy 11	1	1070
Methacrylate	2	983	SAE bearing alloy 12	1	991
			SAE bearing alloy 40	1	976

Material Name	Vol.	Page	Material Name	Vol.	Page
SAE bearing alloy 62	1	976	$Sb_{1.4}Bi_{0.6}Te_{3.13}$	1	1381
SAE bearing alloy 64	1	976	$Sb_{1.4}Bi_{0.6}Te_{3.19}$	1	1383
SAE bearing alloy 66	1	962	$Sb_{1.4}Bi_{0.6}Te_{3.26}$	1	1384
Salt, gnome	2	832	$Sb_{1.5}Bi_{0.5}Te_3$	1	1381
Samarium	1	305	$Sb_{1.5}Bi_{0.5}Te_{3.06}$	1	1384
Sand	2	833	$Sb_{1.5}Bi_{0.5}Te_{3.13}$	1	1382
Lowell	2	834, 835	$Sb_{1.5}Bi_{0.5}Te_{3.19}$	1	1384
Quartz	2	834, 835, 836, 837	$Sb_{1.5}Bi_{0.5}Te_{3.26}$	1	1384
Silica	2	441, 837	$Sb_{1.6}Bi_{0.4}Te_3$	1	1381
Sand cement concrete	2	874	$Sb_{1.6}Bi_{0.4}Te_{3.13}$	1	1383
Sand and gravel aggregate concrete	2	868, 869	$Sb_{1.6}Bi_{0.4}Te_{3.19}$	1	1384
Sandstone	2	840	$Sb_{1.6}Bi_{0.4}Te_{3.26}$	1	1384
Berea	2	841, 842	$Sb_{1.7}Bi_{0.3}Te_3$	1	1381
Berkeley	2	841, 842	$Sb_{1.8}Bi_{0.2}Te_3$	1	1381
St. Peters	2	841	$Sb_2Se_3 + Ag_2Se + PbSe$	1	1379
Teapot	2	842	Sb_2Te_3	1	1241
Tensleep	2	841, 842	$Sb_2Te_3 + Bi_2Te_3$	1	1380
Tripolite	2	842	$Sb_2Te_3 + In_2Te_3$	1	1386
Sandwiches (nonmetallic)	2	1044	Scandium	1	309
Sandwiches (metallic - nonmetallic)	2	1047	Scotchply laminate (nonmetallic)	2	1029
Sandy clay	2	805	Sea-weed product	2	1128
Santowax R	2	1005	Selenium	1	313
Sapphire	2	93	Selenium + Bromine	1	754
Sapphire, synthetic	2	95	Selenium + Cadmium	1	755
Sapphire, Linde synthetic	2	94	Selenium + Chlorine	1	756
Satin walnut	2	1089	Selenium + Iodine	1	757
Sawdust	2	1085	Selenium + Thallium	1	758
$Sb_{1.2}Bi_{0.8}Te_{3.13}$	1	1381	Shamotte brick	2	894, 898
$Sb_{1.33}Bi_{0.67}Te_{3.13}$	1	1381	Sheep wool	2	1092
$Sb_{1.4}Bi_{0.6}Te_{3.06}$	1	1383	Silat iron	1	1222, 1223
			Silica (see silicon dioxide)		

Material Name	Vol.	Page	Material Name	Vol.	Page
Silica brick	2	408,	Silicon dioxide (SiO ₂)	2	174
		489,	Crystalline		
		492,	Domestic (USA)		
		502,	Foamed fused silica		
		894,	Fused		
		896,	Linde silica		
		897,	Slip 10		
		898,	Slip 18		
		900,	Quartz glass		
		902,	Silica gel		
Silica fire brick	2	904,	Silica refractory brick	2	185
		906	Slip cast fused silica		
			Star-brand brick		
Silica glass	2	923,	Vitreous	2	184, 185, 187
		925,			
		926			
Silica glass, fused	2	925	Silicon dioxide + Aluminum oxide	2	402
Silica sand	2	837	Silicon dioxide + Aluminum oxide + ΣX_1	2	487
Silicate glass	2	511	Silicon dioxide + Barium oxide + ΣX_1	2	495
Silicious brick	2	492,	Silicon dioxide + Boron oxide + ΣX_1	2	498
		902	Silicon dioxide + Calcium oxide		
Silicomanganese, Russian	1	1010,	Silicon dioxide + Calcium oxide + ΣX_1	2	501
		1012	Silicon dioxide + (di)Iron trioxide	2	410
Silicon	1	326	Silicon dioxide + Lead oxide + ΣX_1	2	504
Silicon + Germanium	1	761	Silicon dioxide + (di)Potassium oxide + ΣX_1	2	507
Silicon + Iron	1	764	Silicon dioxide + (di)Sodium oxide + ΣX_1	2	510
Silicon alloy, ferrosilicon, Russian	1	765	Silicone rubber	2	983
Silicon bronze	1	973	Silk fabric	2	1105
Silicon carbide (SiC)	2	585	Sillimanite	2	454, 845
		Crystolon SiC	Sillimanite brick		
		SiC brick, refrax	Sillimanite refractory brick		
Silicon carbide, refractory (see refrax)			Sil-O-Cel brick	2	896
Silicon carbide + Graphite	2	789	Sil-O-Cel brick, calcined	2	896
Silicon carbide - silicon cermets	2	718	Sil-O-Cel brick, natural	2	896
Silicon carbide + Silicon dioxide	2	553			
Silicon carbide + Silicon dioxide + ΣX_1	2	554			
Silicon carbide brick	2	895			
Silicon carbide brick, refrax	2	586,			
		906			
Silicon enamel	2	921			
Silicon monel	1	1032			
(tri)Silicon tetranitride (Si ₃ N ₄)	2	662			

Material Name	Vol.	Page	Material Name	Vol.	Page
Sil-O-Cel brick, special	2	896	Silver chloride (AgCl)	2	620
Sil-O-Cel brick, super	2	896	Silver iodide (AgI)	2	563
Sil-O-Cel coarse grade diatomite aggregate	2	1112	Silver nitrate (AgNO ₃)	2	650
Silon	2	959	Silver selenide [Ag ₂ Se] (see silver - selenium intermetallic compound)		
Silumin, sodium modified	2	920	Silver solder, Easy-Flo	1	1059
γ-Silumin, modified	1	920	Silver steel	1	1114
Silver	1	340	Silver telluride [Ag ₂ Te] (see silver - tellurium intermetallic compound)		
Silver + Antimony	1	767	Slag aggregate concrete, limestone treated	2	870
Silver - antimony - tellurium intermetallic compound			Slag brick	2	898
AgSbTe ₂	1	1335	Slag cement	2	861
Silver + Cadmium	1	770	Slag concrete	2	864, 880, 881
Silver + Cadmium + ΣX ₁	1	1058	Slag concrete, direct process	2	864
Silver + Copper	1	773	Slag concrete, expanded	2	878, 879
Silver - copper intermetallic compound			Slag concrete, Leuna	2	864
AgCu	1	1338	Slag-Portland cement	2	861
Silver + Gold	1	774	Slag wool (same as mineral wool)	2	1151
Silver + Indium	1	777	Slate	2	846
Silver + Lead	1	780	SnSe ₂	1	1352
Silver + Manganese	1	783	SnTe	1	1355
Silver + Palladium	1	786	SnTe + AgSbTe ₂	1	1411
Silver + Platinum	1	790	Soapstone	2	853
Silver - selenium intermetallic compound			Soda glass	2	923
Ag ₂ Se	1	1339	Soda-lime glass	2	926
Silver - tellurium intermetallic compounds			Soda-lime plate glass	2	926
Ag _{2-x} Te	1	1342	Soda-lime silica glass	2	511, 924, 927
Ag ₂ Te	1	1342	Soda-lime silica plate glass, 9330	2	923
Silver + Tin	1	791	Sodium	1	349
Silver + Zinc	1	792	Sodium + Mercury	1	795
Silver + ΣX ₁	1	1061	Sodium + Potassium	1	798
Silver alloy, silver solder, Easy-Flo	1	1059	Sodium + (di)Sodium oxide	1	1432
Silver antimony telluride [AgSbTe ₂] (see silver - antimony - tellurium intermetallic compound)			Sodium acetate (NaC ₂ H ₃ O ₂ · 3H ₂ O)	2	1006
Silver bromide (AgBr)	2	569			
Silver bronze	1	579, 980			

Material Name	Vol.	Page	Material Name	Vol.	Page
Sodium chloride (NaCl)	2	621	Stainless steels (specific types)		
Sodium fluoride (NaF)	2	642	1 Kh 18 N9T (Russian)	1	1168
Sodium fluoride + Beryllium difluoride	2	645	15 Kh 12 VMF, Russian (see steel EI 802, Russian)		
Sodium fluoride + Zirconium tetrafluoride + ΣX_1	2	646	17-4 PH	1	1168
Sodium hydrate [NaOH] (see sodium hydroxide)			17-7	1	1165
Sodium hydrogen sulfate (NaHSO ₄)	2	692	17-7 PH	1	1166
Sodium hydroxide (NaOH)	2	790	18-8	1	1161, 1162, 1167, 1168
Sodium nitrate (NaNO ₃)	2	651	416	1	1168
(di)Sodium oxide - sodium cermets	2	721	3754	1	1161
Sodium hyposulfite [Na ₂ S ₂ O ₃ · 5H ₂ O] (see sodium thiosulfate)			AISI 301	1	1165
Sodium thiosulfate (Na ₂ S ₂ O ₃ · 5H ₂ O)	2	693	AISI 302	1	1161
Sodium tungsten bronze (Na _x WO ₃)	2	301	AISI 303	1	1165, 1168
Sodium tungsten oxide [Na _x WO ₃] (see sodium tungsten bronze)			AISI 304	1	1161, 1165, 1168
Soft cast iron, gray	1	1135			
Soft glass	2	511	AISI 310	1	1168
Soft steel	1	1126	AISI 316	1	1165, 1166, 1169, 1170
Soil	2	847			
Solder, soft	1	840	AISI 347	1	1165, 1166, 1168
Solex 2808 plate glass	2	923			
Solex 2808 X glass	2	925	AISI 403	1	1149
Solex "S" glass	2	925	AISI 410	1	1150
Solex "S" plate glass	2	923	AISI 420	1	1162
Spektral Kohle 1	2	54	AISI 430	1	1150, 1154
Spherical cast iron, Nr 1510	1	1222			
Spinel	2	284, 369, 848	AISI 440 C	1	1154
			AISI 446	1	1149, 1150, 1155, 1156
Spinel, natural ruby	2	284			
Spinel firebrick	2	905	AM 355 (Russian)	1	1168
Spodumene	2	851	AS 21	1	1161
Spruce	2	1086	Austenitic	1	1165, 1183
Sr ₂ Si	1	1343			
Sr ₂ Sn	1	1344	Crucible HNM	1	1168
			EI 572, Russian (same as stainless steel 18-8)	1	1168

Material Name	Vol.	Page	Material Name	Vol.	Page
Stainless steel (specific types) (continued)			Steels (specific types) (continued)		
EY a 1 T (see stainless steel 1 Kh 18 N9 T)			AISI C 1010 (see steel SAE 1010)		
F. H. (British)	1	1161	AISI C 1015 (same as steel SAE 1015)	1	1186
Russian	1	1150, 1161	AISI C 1020 (same as steel SAE 1020)		
SF 11, British (see stainless steel AISI 403)			Alloy steel	1	1214
Staybrite	1	1161	Alloy steel, high	1	1214
Stannic anhydride [SnO ₂] (see tin dioxide)			AMS 2713	1	1210
Stannic selenide [SnSe ₂] (see tin - selenium intermetallic compound)			AMS 2714	1	1213
Stannous telluride [SnTe] (see tin - tellurium intermetallic compound)			Haynes alloy N-155	1	1177
Stannum (see tin)			High carbon, Japanese	1	1119
Staybrite steel, British	1	1161	High-perm-49	1	1199
Steam - air system	3	464	High speed	1	1230, 1231, 1232, 1234
steam - carbon dioxide system	3	466	High speed, 18	1	1233
steam - nitrogen system	3	468	High speed, 18-4-1	1	1233
Steam bronze (see navy M)			High speed, M1	1	1195
Steatite	2	852	High speed, M2	1	1233
10 B 2	2	853	High speed, M10	1	1195
12 C 2	2	853	High speed, T1	1	1233
228	2	853	Invar	1	1199
Soapstone	2	853	Invar, fine cut	1	1205
Steatite cordierite	2	919	Japanese	1	1195, 1210
Steels (specific types)			Jessop G 17, British	1	1213
1 Kh 14 N 14 V2M (see steel EI 257)			Kh Zn (Russian)	1	1210
5 ZA 2, Russian	1	1213	Kovar	1	1203
12 MKH, Russian	1	1192	Krupp	1	1115, 1184
AISI 1010	1	1185	K. S. magnet	1	1177
AISI 1095 (see steel SAE 1095)			Low alloy	1	1213
AISI 2515	1	1198, 1199, 1200	Low-exp-42	1	1205
AISI 4130 (see steel SAE 4130)			Low Mn	1	1183
AISI 4140 (see steel SAE 4140)			Macloy G	1	1213
AISI 4340	1	1213, 1214	Mild steel	1	1186
			Ni-Cr steel	1	1167, 1168,

Material Name	Vol.	Page	Material Name	Vol.	Page
Steels (specific types) (continued)			Steels (specific types) (continued)		
Ni-Cr steel (continued)	1	1210, 1213	Crucible	1	1204, 1213
NI-Spa-C	1	1214	EI-257 (Russian)	1	1166, 1214
Nichrom	1	1210, 1213	EI-606 (Russian)	1	1168
Nicrosilal, British	1	1204	EI-802 (Russian)	1	1156
Nimonic DS, French	1	1213	EI-855 (Russian)	1	1214
Nimonic PE7	1	1206	En8 (CMK), British	1	1184, 1186
Oil-hardening non-deforming	1	1125	En 19 (British)	1	1153
R7 (Russian)	1	1236	En 31 (British)	1	1153, 1154
R10 (Russian)	1	1236	En 32 A (BGKI), British	1	1192
R12 (Russian)	1	1236	Era ATV (British)	1	1213
R15 (Russian)	1	1235	EYA-2	1	1166
R18 (Russian)	1	1236	Ferrosilicon 45%, Russian	1	1218
R15 Kh 3 (Russian)	1	1235	Ferrotitanium, Russian	1	1225
R15 Kh 3 K 5 (Russian)	1	1235	Fish-plate, Japanese	1	1119
R15 Kh 3 K 10 (Russian)	1	1235	FNCT	1	1213
R15 Kh 3 K 12 (Russian)	1	1235, 1236	G 18B, British	1	1165, 1213
R15 Kh 4 (Russian)	1	1236	German	1	1118
R20, British	1	1165	H. 20, British	1	1154
Rex 75	1	1213	H. 27, British	1	1154
Russian	1	1118, 1166	H. 46, British	1	1154
Russian alloy	1	1192, 1218, 1222	SAE 1020	1	1183
SAE 1010	1	1183	SAE 1095	1	1114
SAE 1015 (see steel AISI C 1015)			SAE 4130	1	1153
British	1	1114, 1118, 1187	SAE 4140	1	1155
Carbon	1	1118, 1119, 1126, 1180, 1185	SAE 4340 (see steel AISI 4340)		
Carbon, British	1	1186	Silver steel	1	1114
Carbon, Japanese	1	1185	Soft	1	1126
Chromel 502	1	1210	St 42. 11 (German)	1	1186, 1218
Climax	1	1198, 1213	Stainless steels (see separate entries under stainless steels)		
			Tool steel	1	1115

Material Name	Vol.	Page	Material Name	Vol.	Page
Steels (specific types) (continued)			TaBe ₁₂ (see beryllium - tantalum interm. comp.)		
Vacromin F	1	1213	Ta ₂ Be ₁₇ (see beryllium - tantalum interm. comp.)		
WF 100 (Russian)	1	1166	TaGe ₂	1	1345
Sibium (see antimony)			Tantalum	1	355
Strontia (see strontium oxide)			Tantalum - boron intermetallic compound		
Strontium - silicon intermetallic compound			TaB ₂	1	1345
Sr ₂ Si	1	1343	Tantalum - germanium intermetallic compound		
Strontium - tin intermetallic compound			TaGe ₂	1	1348
Sr ₂ Sn	1	1344	Tantalum + Niobium	1	801
Strontium difluoride + ΣX_1	2	791	Tantalum + Niobium + ΣX_1	1	1062
Strontium oxide (SrO)	2	194	Tantalum + Tungsten	1	802
Strontium oxide + Lithium aluminate + ΣX_1	2	513	Tantalum + Tungsten + ΣX_1	1	1065
Strontium oxide + Lithium zirconium silicate + ΣX_1	2	514	Tantalum alloys (specific types)		
Strontium oxide + Titanium dioxide + ΣX_1	2	517	T 222	1	1066
Strontium oxide + Zinc oxide + ΣX_1	2	520	Ta-30Nb-7.5V	1	1063
Strontium silicide [Sr ₂ Si] (see strontium - silicon intermetallic compound)			Ta-8W-2Hf	1	1066
Strontium stannide [Sr ₂ Sn] (see strontium - tin intermetallic compound)			Tantalum boride [TaB ₂] (see tantalum - boron intermetallic compound)		
Strontium metatitanate (SrTiO ₃)	2	304	Tantalum carbide (TaC)	2	589
Strontium metatitanate - cobalt cermets	2	722	Tantalum nitride (TaN)	2	665
Strontium zirconate (SrZrO ₃)	2	307	Teak	2	1087
Styrofoam polystyrene	2	965	Technetium	1	363
Sulfathiorine [Na ₂ S ₂ O ₃ · 5H ₂ O] (see sodium thiosulfate)			Teflon	2	967
Sulfur	2	89	Teflon, Duroid 5600	2	968
Sulfur dioxide (SO ₂)	3	116	Tellurium	1	366
Sulfurous acid anhydride [SO ₂] (see sulfur dioxide)			Tellurium + Arsenic + ΣX_1	1	1068
Supertemp pyrolytic graphite	2	72	Tellurium + Selenium	1	805
Swedish iron	1	158	Tellurium + Thallium	1	808
Systems, miscellaneous (metallic - non-metallic)	2	1055	Terbium	1	372
Systems, miscellaneous (nonmetallic)	2	1051	Thallium	1	376
Ta-30Nb-7.5V	1	1063	Thallium + Cadmium	1	811
Ta-8W-2Hf	1	1066	Thallium + Indium	1	812
TaB ₂	1	1345	Thallium + Lead	1	815

Material Name	Vol.	Page	Material Name	Vol.	Page
Thallium - lead intermetallic compound			TiB ₂	1	1358
Tl ₂ Pb	1	1349	Tin	1	389
Thallium + Tellurium	1	818	Tin + Aluminum	1	823
Thallium + Tin	1	821	Tin + Antimony	1	824
Thallium bromide (TlBr)	2	570	Tin + Antimony + ΣX_1	1	1069
Thallium carbide (TlC)	2	625	Tin + Bismuth	1	827
Thiokol ST rubber	2	982	Tin + Cadmium	1	830
Thoria (see thorium dioxide)			Tin + Copper	1	833
Thorium	1	381	Tin + Copper + ΣX_1	1	1072
Thorium + Uranium	1	822	Tin + Indium	1	834
Thorium carbides			Tin + Lead	1	839
ThC	2	592	Tin + Mercury	1	842
ThC ₂	2	593	Tin - selenium intermetallic compound		
Thorium dioxide (ThO ₂)	2	195	SnSe ₂	1	1352
Thorium dioxide + Graphite	2	557	Tin + Silver	1	845
Thorium dioxide + Uranium dioxide	2	413	Tin - tellurium intermetallic compound		
Thoron (see radon)			SnTe	1	1355
Thulium	1	385	Tin + Thallium	1	846
Thuringian glass	2	923, 924	Tin + Zinc	1	847
Ti-130 A	1	850	Tin alloys (specific types)		
Ti-140 A	1	1081	SAE bearing alloy 10	1	1070
Ti-150 A	1	1078, 1089	SAE bearing alloy 11	1	1070
Ti-155 A	1	1074	Soft solder	1	840
Ti-2.5 Al-16V	1	1087	White bearing metal	1	1070
Ti-3Al-11Cr-13V	1	1087	Tin anhydride [SnO ₂] (see tin dioxide)		
Ti-4Al-4Mn (see titanium alloy C-130 AM, or titanium alloy RC-1308)			Tin ash [SnO ₂] (see tin dioxide)		
Ti-4Al-3Mo-1V	1	1074, 1075	Tin dioxide (SnO ₂)	2	199
Ti-5Al-1.4Cr-1.5Fe-1.2Mo (see Ti-155 A)			Tin dioxide + Magnesium oxide	2	416
Ti-5Al-2.5Sn (see titanium alloy A-110 AT)			Tin dioxide + Magnesium oxide + ΣX_1	2	523
Ti-6Al-4V	1	1074	Tin dioxide + Zinc oxide	2	419
Ti-2Cr-2Fe-2Mo (see Ti-140 A)			Tin dioxide + Zinc oxide + ΣX_1	2	524
Ti-8Mn	1	850	Tin peroxide [SnO ₂] (see tin dioxide)		
Ti-13V-11Cr-3Al	1	1087	TiNi	1	1361
			TiNi + Cu	1	1433
			TiNi + Ni	1	1436

Material Name	Vol.	Page	Material Name	Vol.	Page
Titania (see titanium oxide)			Titanium alloys (specific types) (continued)		
Titanic acid anhydride [TiO ₂] (see titanium dioxide)			C-130 AM	1	1074
Titanic anhydride [TiO ₂] (see titanium dioxide)			C-110 M (see Ti-8Mn)		
Titanic oxide [TiO ₂] (see titanium dioxide)			MSM-4Al-4Mn (see titanium alloy C-130 AM, or titanium alloy RC-1308)		
Titanium	1	410	MSM-6Al-4V (see titanium alloy Ti-6Al-4V)		
Titanium, iodide	1	411	MST-6Al-4V (see titanium alloy Ti-6Al-4V)		
Titanium + Aluminum	1	848	MST-8Mn (see titanium alloy Ti-8Mn)		
Titanium + Aluminum + ΣX_1	1	1073	RC-1308	1	1084
Titanium - boron intermetallic compound			Ti-130 A	1	850
TiB ₂	1	1358	Ti-140 A	1	1081
Titanium + Chromium + ΣX_1	1	1077	Ti-150 A	1	1078, 1089
Titanium + Iron + ΣX_1	1	1080	Ti-155 A	1	1074
Titanium + Manganese	1	849	Ti-2.5Al-16V	1	1087
Titanium + Manganese + ΣX_1	1	1083	Ti-3Al-11Cr-13V	1	1087
Titanium - nickel intermetallic compound			Ti-4Al-4Mn (see titanium alloy C-130 AM, or titanium alloy RC-1308)		
TiNi	1	1361	Ti-4Al-3Mo-1V	1	1074, 1075
Titanium + Oxygen	1	852	Ti-5Al-1.4Cr-1.5Fe-1.2Mo (see titanium alloy Ti-155 A)		
Titanium + Vanadium + ΣX_1	1	1086	Ti-5Al-2.5Sn (see titanium alloy A-110 AT)		
Titanium + ΣX_1	1	1089	Ti-6Al-4V	1	1074
Titanium alloys (specific types)			Ti-2Cr-2Fe-2Mo (see titanium alloy Ti-140 A)		
120 VCA	1	1087	Ti-8Mn	1	850
A-110 AT	1	1074	Ti-13V-11Cr-3Al	1	1087
AMS 4908 (see titanium alloys Ti-8Mn)			Titanium boride [TiB ₂] (see titanium - boron intermetallic compound)		
AMS 4925 A (see titanium alloys C-130 AM, or titanium alloys RC-1308)			Titanium carbide (TiC)	2	594
AMS 4926 (see titanium alloys A-110 AT)			Titanium carbide - cobalt cermets	2	725
AMS 4928 (see titanium alloys Ti-6Al-4V)			Titanium carbide - cobalt - niobium carbide cermets	2	726
AMS 4929 (see titanium alloys Ti-155 A)			Titanium carbide - nickel - molybdenum - niobium carbide cermets	2	727
AMS 4969 (see titanium alloys Ti-155 A)			Titanium carbide - nickel - niobium carbide cermets	2	730
ASTM B 265-58 T, grade 6 (see titanium alloy A-110 AT)					
ASTM 265-58 T, grade 7 (see titanium alloy Ti-8Mn)					

Material Name	Vol.	Page	Material Name	Vol.	Page
Titanium nitride (TiN)	2	668	Tungsten - selenium intermetallic compound		
Titanium dioxide (TiO ₂)	2	202	WSe ₂	1	1368
Dense titania	2	204	Tungsten - silicon intermetallic compound		
Rutile	2	203	WSi ₂	1	1369
Tl ₂ Pb	1	1349	Tungsten - tellurium intermetallic compound		
Toluene (C ₆ H ₅ CH ₃)	3	242	WTe ₂	1	1370
Tool steel	1	1115, 1233	Tungsten + Thorium dioxide	1	1439
Tool steel, M1 high-speed	1	1195	Tungsten alloy, ferrotungsten (Russian)	1	1090
Tool steel, M10 high-speed	1	1195	Tungsten boride [WB] (see tungsten - boron intermetallic compound)		
Topaz	2	251	Tungsten carbide (WC)	2	598
Tourmaline	2	855	Tungsten trioxide (WO ₃)	2	209
Tourmaline, Brazil	2	855	Tungsten trioxide + Zinc oxide	2	422
Transite	2	1107	Tungsten diselenide [WSe ₂] (see tungsten - selenium intermetallic compound)		
Triangle beryllia	2	126	Tungsten disilicide [WSi ₂] (see tungsten - silicon intermetallic compound)		
Trichlorofluoromethane [Cl ₃ CF] (see Freon 11)			Tungsten ditelluride [WTe ₂] (see tungsten - tellurium intermetallic compound)		
Trichloromethane [CHCl ₃] (see chloroform)			Tungstic acid anhydride [WO ₃] (see tungsten trioxide)		
Trichlorotrifluoroethane [CCl ₂ FCClF ₂] (see Freon 113)			Tungstic anhydride [WO ₃] (see tungsten trioxide)		
Trifluoroborane [BF ₃] (see boron trifluoride)			Tungstic oxide [WO ₃] (see tungsten trioxide)		
Trifluorotrichloroethane [CCl ₂ FCClF ₂] (see Freon 113)			UBe ₁₃ (see beryllium - uranium intermetallic compound)		
Trinitrotoluene [CH ₂ C ₆ H ₂ (NO ₂) ₃]	2	1007	Uranic oxide [UO ₂] (see uranium dioxide)		
Tripolite brick	2	894	Uranium	1	429
Tritium	3	87	Uranium + Aluminum	1	858
Tuballoy (same as uranium)	1	429	Uranium + Chromium	1	859
Tuff	2	856	Uranium + Iron	1	862
Tungsten	1	415	Uranium + Magnesium	1	863
Tungsten - arsenic intermetallic compound			Uranium + Molybdenum	1	864
W ₃ As ₇	1	1364	Uranium + Molybdenum + ΣX ₁	1	1094
Tungsten - boron intermetallic compound			Uranium + Niobium	1	867
WB	1	1365	Uranium + Silicon	1	868
Tungsten + Iron + ΣX ₁	1	1090	Uranium + Uranium dioxide	1	1442
Tungsten + Nickel + ΣX ₁	1	1091	Uranium + Zirconium	1	871
Tungsten + Rhenium	1	855			

Material Name	Vol.	Page	Material Name	Vol.	Page
Uranium + Zirconium + ΣX_1	1	1097	Vermiculite brick	2	894
Uranium carbides			Vermiculite mica, granulated	2	825
UC	2	601	Vitallium type alloy (see Haynes stellite alloy 21)		
UC ₂	2	605	Viton rubber	2	983
Uranium carbide - uranium cermets	2	731	Vitreous silica	2	184, 185, 187
Uranium - 3% fissium alloy	1	1095	Volcanic ash (see tuff)		
Uranium - 5% fissium alloy	1	1095, 1097	Vulcanized fiber	2	1088
Uranium - 8% fissium alloy	1	1095	Vycor-brand glass	2	926
Uranium - 10% fissium alloy	1	1095	W-2 chromalloy (see molybdenum - silicon intermetallic compound)		
Uranium nitride (UN)	2	672	Wallboard	2	1131
Uranium oxides			Walnut	2	1089
UO ₂	2	210	W ₃ As ₇	1	1364
U ₃ O ₈	2	237	Water (H ₂ O)	3	120
Uranium dioxide (UO ₂)	2	210	WB	1	1365
Uranium dioxide + Beryllium oxide	2	423	White bearing metal	1	1070
Uranium dioxide + Calcium oxide	2	426	White cast iron	1	1130, 1135
Uranium dioxide - chromium cermets	2	732	White oak	2	1082
Uranium dioxide - molybdenum cermets	2	735	White pines	2	1083
Uranium dioxide - niobium cermets	2	738	White plate glass	2	923, 925
Uranium dioxide + (di)Niobium pentoxide	2	427	White temper cast iron	1	1137
Uranium dioxide - stainless steel cermets	2	741	White wood	2	1090
Uranium dioxide - uranium cermets	2	744	Winchester crushed trap rock	2	829, 830
Uranium dioxide + Yttrium oxide	2	428	Window glass	2	923, 924
Uranium dioxide - zirconium cermets	2	746	Wolfram (see tungsten)		
Uranium dioxide + Zirconium dioxide	2	429	Wolfamic acid, anhydrous [WO ₃] (see tungsten trioxide)		
(tri)uranium octoxide (U ₃ O ₈)	2	237	Wolframite [WO ₃] (see tungsten trioxide)		
Uranous uranic oxide [U ₃ O ₈] (see (tri)uranium octoxide)			Wollastonite	2	859
Vacromin F	1	1213	Wood felt	2	1133
Valve bronze (see navy M)			Wood fibers	2	1091
Vanadium	1	441	Wood's metal	1	939
Vanadium + Iron	1	874	Wood products	2	1132
Vanadium + Yttrium	1	877			
Vanadium alloy, ferrovanadium (Russian)	1	875			
Vanadium carbide (VC)	2	606			
Vegetable fiberboards	2	1129			

Material Name	Vol.	Page	Material Name	Vol.	Page
Wool	2	1092	Zinc - silicon - arsenic intermetallic compound		
Angora	2	1092	ZnSiAs ₂	1	1374
Sheep	2	1092	Zinc alloys (specific types)		
Wrought iron	1	1185, 1219	Zamak Nr 400	1	880
WSe ₂	1	1368	Zamak Nr 410	1	1098
WSi ₂	1	1369	Zamak Nr 430	1	1098
WTe ₂	1	1370	Zinc dichloride (ZnCl ₂)	2	626
X-metal (see uranium)			Zinc ferrate (ZnFe ₂ O ₄)	2	314
X-ray protection glass	2	924	Zinc germanium phosphide (ZnGeP ₂)	2	792
Xenon	3	88	Zinc oxide (ZnO)	2	243
Xenon - deuterium system	3	371	Zinc oxide + Magnesium oxide	2	435
Xenon - hydrogen system	3	374	Zinc oxide + Strontium oxide + ΣX ₁	2	527
Xenon - nitrogen system	3	377	Zinc oxide + Tin dioxide	2	438
Xenon - oxygen system	3	379	Zinc oxide + Tin dioxide + ΣX ₁	2	528
Yellow brass	1	981, 982	Zinc selenide [ZnSe] (see zinc - selenium intermetallic compound)		
Ytterbium	1	446	Zinc selenium arsenide [ZnSiAs ₂] (see zinc - selenium - arsenic intermetallic compound)		
Yttria (see yttrium oxide)			Zinc sulfate heptahydrate (ZnSO ₄ · 7H ₂ O)	2	694
Yttrium	1	449	Zircaloy-2	1	888
Yttrium aluminate (Y ₃ Al ₅ O ₁₂)	2	308	Zircaloy-4	1	888
Yttrium ferrate [Y ₃ Fe ₂ (FeO ₄) ₃]	2	311	Zircon, Brazil	2	318
Yttrium iron garnet (see yttrium ferrate)			Zircon 475	2	318
Yttrium oxide (Y ₂ O ₃)	2	240	Zirconia (see zirconium dioxide)		
Yttrium oxide + Uranium dioxide	2	432	Zirconia, stabilized	2	522
"Z" nickel (see duranickel)			Zirconia brick	2	335, 895, 905
Zamak Nr 400	1	880	Zirconium	1	461
Zamak Nr 410	1	1098	Zirconium, iodide	1	462, 463
Zamak Nr 430	1	1098	Zirconium + Aluminum	1	882
Zinc	1	453	Zirconium + Aluminum + ΣX ₁	1	1100
Zinc + Aluminum	1	880	Zirconium - boron intermetallic compound		
Zinc + Aluminum + ΣX ₁	1	1098	ZrB	1	1375
Zinc + Cadmium	1	881	Zirconium + Hafnium	1	883
Zinc + Lead + ΣX ₁	1	1099			
Zinc - selenium intermetallic compound					
ZnSe	1	1371			

Material Name	Vol.	Page	Material Name	Vol.	Page
Zirconium + Hafnium + ΣX_1	1	1101	Zirconium orthosilicate ($ZrSiO_4$) (continued)		
Zirconium + Molybdenum + ΣX_1	1	1104	Zircon	2	318
Zirconium + Niobium	1	886	Zircon tam	2	318
Zirconium + Tantalum + ΣX_1	1	1105	ZnSb + CdSb	1	1412
Zirconium + Tin	1	887	ZnSe	1	1371
Zirconium + Tin + ΣX_1	1	1108	ZnSiAs ₂	1	1374
Zirconium + Titanium	1	890	ZrB	1	1375
Zirconium + Uranium	1	891			
Zirconium + Uranium + ΣX_1	1	1111			
Zirconium + Zirconium dioxide	1	1444			
Zirconium + ΣX_1	1	1112			
Zirconium alloys (specific types)					
Zircaloy-2	1	888			
Zircaloy-4	1	888			
Zirconium boride [ZrB] (see zirconium - boron intermetallic compound)					
Zirconium carbide (ZrC)	2	609			
Zirconium hydride (ZrH)	2	793			
Zirconium nitride (ZrN)	2	675			
Zirconium dioxide (ZrO ₂)	2	246			
Zirconium dioxide + Aluminum oxide	2	441			
Zirconium dioxide + Calcium oxide	2	442			
Zirconium dioxide + Calcium oxide + ΣX_1	2	531			
Zirconium dioxide + Magnesium oxide	2	446			
Zirconium dioxide + Silicon dioxide + ΣX_1	2	534			
Zirconium dioxide - titanium cermets	2	749			
Zirconium dioxide + Yttrium oxide	2	449			
Zirconium dioxide + Yttrium oxide + ΣX_1	2	537			
Zirconium dioxide - yttrium oxide - zirconium cermets	2	753			
Zirconium dioxide - zirconium cermets	2	752			
Zirconium silicate [ZrSiO ₄] (see zirconium orthosilicate)					
Zirconium silicate, natural (see zircon)					
Zirconium orthosilicate ($ZrSiO_4$)	2	317			
Brazil zircon	2	318			