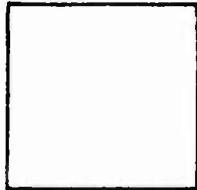


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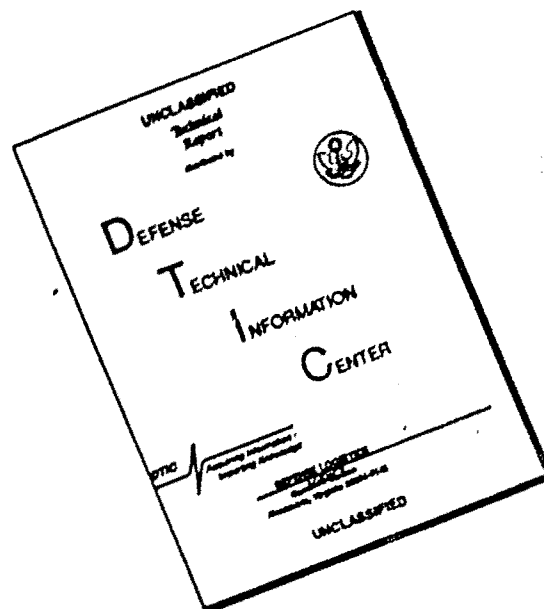
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The TPRC Data Series
VOLUME 2

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Nonmetallic Solids

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 silicides--clay--coal--coatings--composites--diamond--diatomite--soil--
 rubber compounds--fibers--fiberboard--fiberglass--wood--firebrick--glass--
 borosilicate glass--corning glasses--silica glass--line 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

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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

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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.

THERMAL CONDUCTIVITY

Nonmetallic Solids

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"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) non-metallic 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

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GROUPING OF MATERIALS AND LIST OF FIGURES AND TABLES

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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 (Sapphure)	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	$[\text{M}_2^{II}\text{M}_2^{III}(\text{SiO}_4)_3]$	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.

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

Figure and/or Table No.	Name		Page No.
70	Aluminum Oxide + Aluminum Silicate	$\text{Al}_2\text{O}_3 + 3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	321
71	Aluminum Oxide + (di)Chromium Trioxide	$\text{Al}_2\text{O}_3 + \text{Cr}_2\text{O}_3$	324
72	Aluminum Oxide + (di)Manganese Trioxide	$\text{Al}_2\text{O}_3 + \text{Mn}_2\text{O}_3$	327
73	Aluminum Oxide + Silicon Dioxide	$\text{Al}_2\text{O}_3 + \text{SiO}_2$	328
74	Aluminum Oxide + Zirconium Dioxide	$\text{Al}_2\text{O}_3 + \text{ZrO}_2$	331
75	Aluminum Silicate + Aluminum Oxide	$3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 + \text{Al}_2\text{O}_3$	334
76	Barium Oxide + Strontium Oxide	$\text{BaO} + \text{SrO}$	337
77	Barium Metatitanate + Calcium Metatitanate	$\text{BaTiO}_3 + \text{CaTiO}_3$	340
78	Barium Metatitanate + Magnesium Zirconate	$\text{BaTiO}_3 + \text{MgZrO}_3$	343
79	Barium Metatitanate + Manganese Niobate	$\text{BaTiO}_3 + \text{Mn}_2\text{Nb}_2\text{O}_7$	344
80	Beryllium Oxide + Uranium Dioxide	$\text{BeO} + \text{UO}_2$	347
81	Cerium Dioxide + Magnesium Oxide	$\text{CeO}_2 + \text{MgO}$	350
82	Cerium Dioxide + Uranium Dioxide	$\text{CeO}_2 + \text{UO}_2$	353
83	Gadolinium Oxide + Samarium Oxide	$\text{Gd}_2\text{O}_3 + \text{Sm}_2\text{O}_3$	356
84	Lead Oxide + Silicon Dioxide	$\text{PbO} + \text{SiO}_2$	359
85	Magnesium Aluminate + Magnesium Oxide	$\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{MgO}$	362
86	Magnesium Aluminate + Silicon Dioxide	$\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{SiO}_2$	365
87	Magnesium Aluminate + (di)Sodium Oxide	$\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{Na}_2\text{O}$	368
88	Magnesium Oxide + Beryllium Oxide	$\text{MgO} + \text{BeO}$	371
89	Magnesium Oxide + Clay	$\text{MgO} + \text{Clay}$	374
90	Magnesium Oxide + Magnesium Aluminate	$\text{MgO} + \text{MgO} \cdot \text{Al}_2\text{O}_3$	375
91	Magnesium Oxide + Magnesium Orthosilicate	$\text{MgO} + 2\text{MgO} \cdot \text{SiO}_2$	378
92	Magnesium Oxide + Nickel Oxide	$\text{MgO} + \text{NiO}$	381
93	Magnesium Oxide + Silicon Dioxide	$\text{MgO} + \text{SiO}_2$	384
94	Magnesium Oxide + Tin Dioxide	$\text{MgO} + \text{SnO}_2$	387
95	Magnesium Oxide + Uranium Dioxide	$\text{MgO} + \text{UO}_2$	390
96	Magnesium Oxide + Zinc Oxide	$\text{MgO} + \text{ZnO}$	391
97	Magnesium Orthosilicate + Magnesium Oxide	$2\text{MgO} \cdot \text{SiO}_2 + \text{MgO}$	394
98	(di)Manganese Trioxide + Aluminum Oxide	$\text{Mn}_2\text{O}_3 + \text{Al}_2\text{O}_3$	397
99	(di)Manganese Trioxide + Magnesium Oxide	$\text{Mn}_2\text{O}_3 + \text{MgO}$	398
100	(di)Manganese Trioxide + Silicon Dioxide	$\text{Mn}_2\text{O}_3 + \text{SiO}_2$	399
101	Silicon Dioxide + Aluminum Oxide	$\text{SiO}_2 + \text{Al}_2\text{O}_3$	402
102	Silicon Dioxide + Calcium Oxide	$\text{SiO}_2 + \text{CaO}$	407
103	Silicon Dioxide + (di)Iron Trioxide	$\text{SiO}_2 + \text{Fe}_2\text{O}_3$	410
104	Thorium Dioxide + Uranium Dioxide	$\text{ThO}_2 + \text{UO}_2$	413
105	Tin Dioxide + Magnesium Oxide	$\text{SnO}_2 + \text{MgO}$	416
106	Tin Dioxide + Zinc Oxide	$\text{SnO}_2 + \text{ZnO}$	419
107	Tungsten Trioxide + Zinc Oxide	$\text{WO}_3 + \text{ZnO}$	422
108	Uranium Dioxide + Beryllium Oxide	$\text{UO}_2 + \text{BeO}$	423
109	Uranium Dioxide + Calcium Oxide	$\text{UO}_2 + \text{CaO}$	426
110	Uranium Dioxide + (di)Niobium Pentoxide	$\text{UO}_2 + \text{Nb}_2\text{O}_5$	427
111	Uranium Dioxide + Yttrium Oxide	$\text{UO}_2 + \text{Y}_2\text{O}_3$	428
112	Uranium Dioxide + Zirconium Dioxide	$\text{UO}_2 + \text{ZrO}_2$	429
113	Yttrium Oxide + Uranium Dioxide	$\text{Y}_2\text{O}_3 + \text{UO}_2$	432
114	Zinc Oxide + Magnesium Oxide	$\text{ZnO} + \text{MgO}$	435
115	Zinc Oxide + Tin Dioxide	$\text{ZnO} + \text{SnO}_2$	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 Dicarbid	ThC_2	593
176	Titanium Carbide	TiC	594
177	Tungsten Carbide	WC	598
178	Uranium Carbide	UC	601
179	Uranium Dicarbid	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 Di hydrogen Phosphate	KD ₂ HPO 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 Dicarbid	$\text{C} + \text{UC}_2$	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
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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.,

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

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

$$k_t = \frac{1}{3} C_t v l_t \quad (3)$$

where C_t 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

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

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.,

$$\frac{1}{k_\ell} = W_\ell = \sum_{(\alpha)} W_{(\alpha)} \quad (7)$$

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

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

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, $k_\ell(T)$ 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 $\gamma \approx 2$). 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_r . 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

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

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_λ 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]

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

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 Joule 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 Hérinckx 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.

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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 non-oxides, 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, etc., *transition temperatures, 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
		—	≥99.5	>0.2
	B. Multiple	—	<99.5	≥0.2
		—	<99.5	>0.2
		≤99.5	—	<0.2
3. Compounds	>95.0	—	<2.0	<2.0
4. Mixtures (or solutions) of compounds	A. Binary	—	≥95.0	≥2.0
		—	≥95.0	>2.0
	B. Multiple	—	<95.0	≥2.0
		—	<95.0	>2.0
		≤95.0	—	<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:

- a. Author(s)—The names and initials of all authors are given. The last name is written first, followed by initials.
- b. 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*.
- c. Journal title—The abbreviated title of the journal as used in *Chemical Abstracts* is given.
- d. 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.
- e. Pages—The inclusive page numbers of the article.
- f. Year—The year of publication.

Report:

- a. Author(s)
- b. 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*.
- c. Name of the responsible organization.
- d. Report, or bulletin, circular, technical note, etc.
- e. Number
- f. Part
- g. Pages
- h. Year
- i. 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	$\text{Btu}_{\text{IT}} \text{hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$	$\text{Btu}_{\text{IT}} \text{in.} \text{hr}^{-1} \text{in.}^{-1} \text{F}^{-1}$	$\text{Btu}_{\text{th}} \text{hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$	$\text{Btu}_{\text{th}} \text{in.} \text{hr}^{-1} \text{in.}^{-1} \text{F}^{-1}$	$\text{cal}_{\text{IT}} \text{sec}^{-1} \text{cm}^{-1} \text{C}^{-1}$	$\text{cal}_{\text{th}} \text{sec}^{-1} \text{cm}^{-1} \text{C}^{-1}$	$\text{kcal}_{\text{th}} \text{hr}^{-1} \text{m}^{-1} \text{C}^{-1}$	$\text{J sec}^{-1} \text{cm}^{-1} \text{K}^{-1}$	$\text{W cm}^{-1} \text{K}^{-1}$	$\text{W m}^{-1} \text{K}^{-1}$	$\text{mW cm}^{-1} \text{K}^{-1}$
$\text{Btu}_{\text{IT}} \text{hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$	1	12	1.00067	12.0000	4.18179×10^{-4}	4.18656×10^{-4}	1.48516	1.70073×10^{-2}	1.70073×10^{-2}	1.70073	17.3073
$\text{Btu}_{\text{IT}} \text{in.} \text{hr}^{-1} \text{in.}^{-1} \text{F}^{-1}$	8.33333×10^{-2}	1	8.43851×10^{-2}	1.00067	3.44482×10^{-4}	3.44713×10^{-4}	0.124057	1.44228×10^{-3}	1.44228×10^{-3}	0.144228	1.44228
$\text{Btu}_{\text{th}} \text{hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$	0.999331	11.9920	1	12	4.18102×10^{-4}	4.18179×10^{-4}	1.48816	1.72958×10^{-2}	1.72958×10^{-2}	1.72958	17.2958
$\text{Btu}_{\text{th}} \text{in.} \text{hr}^{-1} \text{in.}^{-1} \text{F}^{-1}$	8.32776×10^{-2}	0.999331	8.33333×10^{-2}	1	3.44252×10^{-4}	3.44482×10^{-4}	0.124018	1.44131×10^{-3}	1.44131×10^{-3}	0.144131	1.44131
$\text{cal}_{\text{IT}} \text{sec}^{-1} \text{cm}^{-1} \text{C}^{-1}$	2.41509×10^2	2.90250×10^3	2.42071×10^2	2.90485×10^3	1	1.00067	3.60241×10^2	4.1865	4.1865	4.1865×10^2	4.1865×10^3
$\text{cal}_{\text{th}} \text{sec}^{-1} \text{cm}^{-1} \text{C}^{-1}$	2.41747×10^2	2.90096×10^3	2.41909×10^2	2.90291×10^3	0.999331	1	3.6×10^2	4.184	4.184	4.184×10^2	4.184×10^3
$\text{kcal}_{\text{th}} \text{hr}^{-1} \text{m}^{-1} \text{C}^{-1}$	0.671520	8.03824	0.671509	8.06161	2.77592×10^{-2}	2.77778×10^{-2}	1	1.16222×10^{-2}	1.16222×10^{-2}	1.16222	11.6222
$\text{J sec}^{-1} \text{cm}^{-1} \text{K}^{-1}$	57.7749	6.93147×10^2	57.8176	6.93811×10^2	0.238846	0.239006	86.0421	1	1	1×10^2	1×10^3
$\text{W cm}^{-1} \text{K}^{-1}$	57.7749	6.93147×10^2	57.8176	6.93811×10^2	0.238846	0.239006	86.0421	1	1	1×10^2	1×10^3
$\text{W m}^{-1} \text{K}^{-1}$	0.577749	6.93147	0.578176	6.93811	2.38846×10^{-2}	2.39006×10^{-2}	0.860421	1×10^{-2}	1×10^{-2}	1	10
$\text{mW cm}^{-1} \text{K}^{-1}$	5.77749	6.93147	5.78176	6.93811	2.38846×10^{-4}	2.39006×10^{-4}	8.60421×10^{-2}	1×10^{-4}	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	Boiling Point, K	Melting Point, K	Critical Temp., K
Actinium	89	(227)	10.07 ¹⁰	f.c.c. ²					124 ³	3200 ± 300 ⁶	1323 ⁵	
Aluminum	13	26.9815	2.702 ⁵	f.c.c. ⁷		1.196 ⁵ 1.17 ⁸ 1.18 ⁹			423 ± 5 ³	2723 ²⁰	933.2 ^{3,16}	11 ¹¹ 8650 ¹⁰⁰ 7740 ¹⁰⁰
Americium	95	(243)	11.7 ⁵	Double c.p.h. ²							1473 ²⁰	
Antimony	51	121.75	6.684 ²⁰	r. ² (γ) ? (γ) ? (γ)	367.8 (γ-γ) ¹³ 690 ¹³ (γ-γ) high-pressure modification	2.6 ⁸ (Sb II)			150 ³	1907 ± 10 ³	903.7 ¹³ 903.65 ²³	15 ¹⁵ 2969
Argon	18	39.948	0.0017824 ²⁰ (at 273.2 K and 1 atm)	f.c.c. ¹⁶					90 ⁴ (at ~45 K)	87.29 ²⁰	83.8 ¹⁷	15 ¹⁵ 151
Arsenic	33	74.9216	5.73 (gray, at 287.2 K) ²¹ 4.7 (black) ²⁰ 2.0 (yellow) ²⁰	r. ⁷ (gray) c. ⁵ (yellow)					236 ³	1090 ¹³ (35.8 atm) (35.8 atm) subl. 896		
Astatine	85	(210)									573.2 ¹⁹	
Barium	56	137.34	3.5 ²⁰	b.c.c. (α) ² ? (β) ²³	648 ^{13,21} (α-β)				110.5 ± 1.8 ²²	1910 ³	998.2 ⁵	15 ¹⁵ 3663 ¹⁰⁰ 3920 ¹⁰⁰
Berkelium	97	(249)										
Beryllium	4	9.0122	1.85 ²⁰	c.p.h. ² (α) b.c.c. (β) ²	1533 ²⁴ (α-β) ~6 ¹⁰⁰ ~8.4 ¹⁰⁰				1160 ¹⁵	3142 ± 100 ³	1550 ²⁴	15 ¹⁵ 6153
Bismuth	83	208.980	9.78 ²⁰	r. ²		3.9 (Bi II, at 25 kbar) ⁸ 7.2 (Bi III, at 27 kbar) ⁸			119 ± 2 ³	1824 ± 8 ³	544.525 ^{3,111}	27 ²⁷ 4620
Boron	5	10.811	2.50 ⁴²	Simple r. ² (α) r. ² (β) ²	1473 (α-β)				1315 ¹⁵	4050 ± 100 ²⁶	2573 ⁵	
Bromine	35	79.909	3.119 ²⁰	orthorh. ²						331.93 ²⁰	266.0 ¹⁷	15 ¹⁵ 584

^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 ^a	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
Cadmium	48	112.40	8.65 ²⁹	c.p.h. ² b.c.c. ¹ (γ)		0.56 ⁵ 0.52 ⁹			252 ± 48 ³	594.18 ² 170 (b.c.c. Subl. at ~85 K) 594.1 ¹⁰ (at 0.11 mm Hg)	1038 ² 1765 ¹³	1903 ¹⁰⁰ 3560 ¹⁰⁰
Calcium	20	40.08	1.55 ²⁹	f.c.c. ¹ (α) b.c.c. ² (β)	737 (α-β) ⁶²				234 ± 5 ³	1123 ¹⁰ Subl. 1123 ¹³ (at 0.35 mm Hg)	1765 ¹³	3267 ¹⁸
Californium	98	(251)										
Carbon (amorphous)	6	12.01115	1.8~2.1 ²⁹							Subl. 4473 ⁵ 3925-3970		
Carbon (diamond)	6	12.01115	3.51 ²⁹	d. ¹⁸					2240 ± 5 ¹¹	1874 ³	5100 ⁵	
Carbon (graphite)	6	12.01115	2.26 (α) ²⁹	h. ¹ (α) r. ² (β)					402 ± 11 ³	1550 ³	Subl. 4473 ⁵ 3925-3970	
Cerium	58	140.12	6.90 ²⁹	f.c.c. ¹ (α) ²² Double c.p.h. ² (β) f.c.c. ¹ (γ) ²² b.c.c. ² (δ) ²² b.c.c. ²	103 ± 5 (α-β) ¹³ 263 ± 5 (β-γ) ²² 1003 (γ-δ) ²²				138 ²⁴	1077 ²⁸	3972 ³	10400 ¹⁰⁰
Cesium	55	132.905	1.873 ²⁹	b.c.c. ²					40 ± 5 ³	301.9 ²⁸ Subl. 301.9 ¹³ (at 1.2 μHg)	939 ³⁸	2060 ¹⁰⁰ 1900 ¹⁰⁰
Chlorine	17	35.453	0.003214 (at 273.2 K) ²⁹	t. ¹⁶						115 ^{4,28} 172.2 ²⁸ (at ~58 K)	239.10 ¹³	417 ¹⁸
Chromium	24	51.996	7.16 ⁴²	c.p.h. ¹ (α) ¹⁷ b.c.c. ¹ (β)	~299 (α-β) ^d			311 ³⁷	598 ± 32 ³	2118 ³⁸	2918 ± 35 ³	
Cobalt	27	58.9332	8.862 ⁴²	c.p.h. ¹ (α) ¹⁷ f.c.c. ¹ (β)	690 (α-β) ¹⁷		1400 ⁴⁰		452 ± 17 ³	1765 ^{3,10}	3229 ³	
Copper	29	63.54	8.933 ²⁹	f.c.c. ²					342 ± 2 ³	1356 ^{3,10}	2811 ± 20 ⁴¹	8500 ¹¹ 8290 ¹⁰⁰
Curium	96	(247)	7 ⁴²	Double c.p.h. ⁸								
Dysprosium	66	162.50	8.556 ⁴²	c.p.h. ¹ (α) ² b.c.c. ¹ (β)	Near m.p. (γ-β) ²			174 ⁴³ 83.5 ⁴³ (ferro-antiferromag.)	172 ± 35 ³	1773 ¹²	3911 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	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	1770 ³⁸	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)										
Cadmium	64	157.25	7.87 ⁴³	c.p.h. (α) b.c.c. (β)	1535 (α-β)		292 ⁴⁰		39 ³ 170 ³	300.2 ¹⁹ 1579 ¹⁹	879 ¹⁰⁴ 3540 ³	8670 ¹⁰⁹
Caesium	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 ¹² (Ga II, high-pressure modification)			317 ³ 125 ⁴	302.93 ⁵ 275.6 ¹²	2510 ³	7620 ²⁷
Germanium	32	72.59	5.36 ²⁹	d. ⁷		5.5 ⁴⁷ (at ~118 kbar)			378 ± 22 ³	1210.6 ⁵	3100 ³	5642 ¹⁸
Gold	79	196.967	19.3 ⁴²	f.c.c. ⁷					165 ± 1 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 0.35 ¹⁰⁴			256 ± 5 ³	2495 ¹⁹	4375 ± 150 ⁴⁹	
Helium	2	4.0026	0.001785 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 ¹⁵
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	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 ~50 K)	20.39 ¹³ 20.37 ²³		33.3 ¹⁵
Indium	49	114.82	7.3 ²⁹	f.c.c. ⁷		3.4035 ⁵			106.8 ± 0.3 ³	429.76 ³ 2279 ± 6 ³		4377 ¹⁸ 7050 ¹⁰⁹
Iodine	53	126.9044	4.93 ²⁹	orthorh. ¹⁸					105 ⁴ (at ~53 K)	386.2 ²⁹ 457.50 ²⁹		785 ¹⁵
Iridium	77	192.2	22.5 ⁴²	f.c.c. ⁷		0.14 ^{5,9}			425 ± 5 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 (α) 1183 ¹³ (β-γ) b.c.c.-paramag. (β) 1673 (γ-δ) f.c.c. (γ) b.c.c. (δ) f.c.c.	1043 ⁴⁰				457 ± 12 ³	1810 ¹⁹	3160 ²⁹	6750 ¹²³ 9400 ¹⁰⁹
Krypton	36	83.80	0.003708 ²⁹ (at 273.2 K and 1 atm)	f.c.c. (γ) b.c.c. (δ) f.c.c.					60 ⁴ (at -30 K)	116.6 ⁵	119.93 ¹³	209.4 ¹⁵
Lanthanum	57	138.91	6.18 ⁴²	Double c.p.h. (α) f.c.c. (β) b.c.c. (γ)	583 ³¹ (α-β) 1141 ³¹ (β-γ)	4.9 (α) 6.3 (β)			142 ± 3 ²²	1193 ⁵	3713 ± 70 ³	10500 ¹⁰⁹
Lawrencium	103	(257)										
Lead	82	207.19	11.34 ²⁹	f.c.c.		7.193 ⁵			102 ± 5 ³	600.576 ^{3,111}	2022 ± 10 ⁴¹	5400 ¹⁰⁹ 4760 ¹⁰⁹
Lithium	3	6.939	0.534 ²⁹	b.c.c.	Martensitic transformation at low temp. ⁵⁴				352 ± 17 ³	448 ³	1599 ¹³	4150 ¹⁰⁹ 3720 ¹⁰⁹
Lutetium	71	174.97	9.85 ²⁹	c.p.h. (α) b.c.c. (β)	Near m.p. (α-β) ⁵⁴				210 ¹⁴	116 ³	1923 ¹⁹	4140 ³
Magnesium	12	24.312	1.74 ²⁹	c.p.h.					396 ± 54 ³	330 ³	1385 ³	3530 ¹⁰⁹
Manganese	25	54.9380	7.43(α) ²⁸ 7.29(β) ²⁸ 7.18(γ) ²⁸	b.c.c. (α) b.c.c. (β) b.c.c. (γ) f.c.c. (δ) 1000 ¹³ (α-β) 1374 ¹³ (β-γ) f.c.c. (δ) 10410 ¹³ (γ-δ) b.c.c. (δ)					418 ± 32 ³	363 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)	r. (α) b.c.t.-pressure induced structure (β)	Martensitic transformation at low temp. ⁵⁴	4.153 ⁵ (α) 3.949 ⁵ (β)			~ 75 ⁵⁵	92 ± 8 ³	234.28 ^{3,16}	629.73 ^{3,10} 1733 ¹⁰⁹ 1705 ¹⁰⁹
Molybdenum	42	95.94	10.24 ⁴²	b.c.c.		0.92 ^{5,9}			459 ± 11 ³	377 ³	2883 ¹³	5785 ± 175 ³ 17000 ¹⁰⁹ 17800 ¹⁰⁹ 7900 ¹⁰⁹
Neodymium	60	144.24	7.007 ²⁹	Double c.p.h. (α) b.c.c. (β)	1135 (α-β) ²⁹				159 ³	148 ± 8 ³	1292 ¹⁹	2956 ⁴⁸ 7900 ¹⁰⁹
Neon	10	20.183	0.0009002 ²⁹ (at 273.2 K and 1 atm)	f.c.c.					60 ⁴ (at -30 K)	24.48 ⁵	27.23 ⁵	44.5 ¹⁵ 27.06 ²⁸

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
Neptunium	93	(237)	20.46 ⁴²	orthorh. ² (α) t. ² (β) b. c. c. ² (γ)	551 ¹ (α-β) 813 ² (β-γ)				121 ³	913.2 ⁵	4150 ³	
Nickel	28	58.71	8.90 ⁴²	b. c. c. ¹			631 ⁴⁰		427 ± 14 ⁴	1726 ^{3,16} 1726 ± 4 ⁶¹	3055 ⁶³	6294 ¹⁵ 11750 ¹⁰⁰
Niobium	41	92.906	6.57 ⁴²	b. c. c. ¹		9.13 ⁷ 9.09 ⁸ 9.1 ⁹			241 ± 13 ³	2741 ± 27 ³ 2688 ⁶⁵	4813 ⁶⁴	19000 ¹⁰⁰
Nitrogen	7	14.0067	0.0012506 ²⁸	c. _{nv} ¹¹ (α) h. _{nv} ¹² (β)	35.62 ¹³ (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 ²⁹	c. p. h. ²		0.655 ⁵ 0.65 ⁸			500 ⁶⁷	3283 ± 10 ⁶⁸	5300 ± 100 ⁷⁰	
Oxygen	8	15.9994	0.001429 ²⁸ (at 273.2 K and 1 atm)	b. c. orthorh. ¹ (α) r. ¹ (β) c. ¹ (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 ¹³ 90.18 ²³	154.8 ¹⁵
Palladium	46	106.4	12.02 ²⁸	f. c. c. ²					283 ± 16 ³	1825 ^{3,16}	3200 ³	
Phosphorus	15	30.9738	1.82 ²⁸ (β) 2.22 ²⁸ (γ) 2.69 ²⁸ (δ)	h. ⁷ (α) b. c. c. ¹ (β) c. ¹ (γ)	196 ¹¹ (α-β) 298.16 ¹³ (β-γ) 298.16 ¹³ (β-δ)				193 ¹ (white) 576 ¹ (white) 553 ¹³ 325 ¹ (red) 800 ¹ (red) 1300 ¹ (black)		993.8 ¹⁵	
Platinum	78	195.09	21.45 ²⁸	f. c. c. ²					234 ± 1 ³	225 ± 5 ³	4100 ³	8280 ¹⁵
Plutonium	94	(242)	19.737 ²⁹ (at 296, 2 K)	Simple monoc. ¹ (α) b. c. monoc. ² (β) f. c. orthorh. ² (γ) f. c. c. ² (δ) b. c. t. ² (δ') b. c. c. ² (ε)	396.7 ¹¹ (α-β) 475 ¹¹ (β-γ) 591.4 ¹¹ (γ-δ) 729 ¹¹ (δ, δ') 757 ± 3 ¹² (δ' - ε)				171 ¹⁴	176 ¹⁴	912.7 ⁵	3727 ¹⁵
Polonium	84	(210)	9.3 ²⁹ (α) 9.5 ²⁹ (β)	Simple c. ¹ (α) r. ¹ (β)	327 ± 1.5 ¹¹ (α-β)				81 ³	527.2 ⁵	1235 ²⁰	2281 ¹⁵
Potassium	19	39.102	0.86 ²⁸	b. c. c. ¹					89.4 ± 0.5 ³	336.8 ⁵	1027 ²⁵	2450 ¹¹ 2140 ¹⁰⁰
Praseodymium	59	140.907	6.769 ²⁸	Double c. p. h. ⁶ (α) b. c. c. ¹ (β)	1071 ²² (α-β)				85 ± 1 ⁶⁵	1192 ± 2 ⁷⁰	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	Melting Point, ^h K	Boiling Point, ⁱ K	Critical Temp., ^j K
Promethium	61	(145)		b. (α) ¹⁰ b. c. t. ²	1185 ¹⁰ (α-β)	1.4 ⁹		6 ^{10a}		1353 ± 10 ³ 1503 ⁵	2730 ³ 4680 ³	
Protactinium	91	(231)	15.37 ^a	b. c. t. ²					159 ³	262 ³		
Radium	88	(226)	5 ²⁹						89 ³	973.2 ⁵ 1960 ³		
Radon	86	(222)	0.00973 ²⁹ (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 ^a	c. p. h. ²		1.698 ²⁸			429 ± 22 ³ 275 ²³	3453 ⁵ 6035 ± 135 ³	2000 ¹¹	
Rhodium	45	102.905	12.45 ^a	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 ³⁶	2100 ¹⁰⁰ 2030 ¹⁰⁰	
Ruthenium	44	101.07	12.2 ²⁹	c. p. h. (α) ¹ γ (β) γ (γ) γ (δ)	1308 ^{11,11} (α-β) 1473 ^{11,11} (β-γ) 1773 ^{11,11} (γ-δ)	0.49 ^{5,9}	14 ⁹	106 ⁹	600 ⁶⁷ 415 ³	2523 ± 10 ⁶⁹ 4325 ± 25 ³		5400 ¹⁰⁰
Samarium	62	150.35	7.54 ²⁹	r. (α) ²² b. c. c. (β)	1190 ²² (α-β)				116 ⁴⁵ 184 ± 4 ³	1345.2 ¹⁸ 2140 ³		
Scandium	21	44.956	3.00 ^a	c. p. h. (α) ² b. c. c. (β)	1607 ² (α-β)				470 ± 80 ⁵¹ 476 ³	1812 ⁵ 3537 ± 30 ³		
Selenium	34	78.96	4.50 ^(α) 4.80 ^(β)	monocl. (α) ¹ h. (β)	304 ¹¹⁷ 398 ¹¹ (vit.-β)	7.3 ⁸⁵ (at ~118 kbar)			151.7 ± 0.4 ⁸⁹ (at ~45 K) 150 ⁴ (at ~75 K)	490.2 ⁵ 1009 ¹¹ (Se) 958.0 ¹² (Se ₄ , 37) 1027 ¹³ (Se ₂)	1757 ¹⁵	
Silicon	14	28.086	2.33 ^a	d. ¹		7.5 ⁸⁷ (at 118-128 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 ²⁵ 1154 ³⁵	2800 ¹¹ 2400 ¹⁰⁰	
Strontium	38	87.62	2.60 ²⁹	f. c. c. (α) ¹⁰ c. p. h. (β) b. c. c. (γ)	488 ¹⁰ (α-β) 878 ¹⁰ (β-γ)				147 ± 1 ²² 148 ²³	1042 ⁵ 1645 ³	3059 ¹⁵ 3810 ¹⁰⁰	
Sulfur	16	32.064	2.07 ^(α) 1.96 ^(β)	r. (α) ¹ monocl. (β)	368.6 ¹³ (α-β)				200 ³ 527 ¹⁸ (α) 250 ¹⁰⁰ (β) at 40 K Subl. 368.6 ¹² (at 0.0047 mm Hg)	386.0 ⁵ (α) 717.75 ^{3,10} 1313 ¹⁵ 392.2 ¹ (β) 5760 ± 60 ³	2200 ¹¹	
Tantalum	73	180.948	16.6 ^a	b. c. c. ²		4.483 ⁵ 4.48 ⁹			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	Curie Temp., K	Neel Temp., K	Debye Temperature at 0 K, K	Debye 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 (α) 6.00 ⁵ (amorph.)	h. ¹ (α) 7 ¹ (β) amorph. ⁵	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 b.c.c. ² (β)	Near m.p. ² (α-β)		219 ³⁶	230 ³⁶	150 ³¹	158 ⁴⁴	1629 ¹⁹	3810 ³	
Thallium	81	204.37	11.85 ²⁹	c.p.h. ² ₁ 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 ⁵²	3219 ¹⁵
Thorium	90	232.038	11.7 ²⁹	f.c.c. ² ₁ b.c.c. ² (β)	1673 ± 25 ³⁸ (α-β)	1.368 ⁵ 1.37 ⁹			170 ³⁴	100 ¹⁴	2023 ¹⁹	4500 ²⁶	14550 ¹⁰⁰
Thulium	69	168.934	9.32 ²⁹	c.p.h. ² ₁ b.c.c. ² (β)	Near m.p. ³⁸ (α-β)		22 ³⁶ (ferro.-antiferro.)	53 ³⁶	127 ± 1 ⁴⁵	167 ⁴⁴	1818 ⁵	2260 ³⁷	6430 ¹⁰⁹
Tin	50	118.69	5.750 ²⁹ (α) 7.31 ²⁹ (β)	f.c.c. ² ₁ b.c.t. ² (β) r. ² (γ)	286.2 ± 3 ³⁸ (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	8000 ¹¹ 9300 ¹⁰⁰	
Titanium	22	47.90	4.5 ²⁹	c.p.h. ² ₁ b.c.c. ² (β)	1155 ¹³ (α-β)	0.29 ^{5,9}			426 ± 5 ³	390 ¹⁴	1953 ¹⁰⁰	3586 ¹⁰⁰	
Tungsten	74	183.85	19.3 ²⁹	b.c.c. ²		0.011 ¹²			388 ± 17 ³	312 ± 3 ³	3653 ^{3,10,13}	6000 ± 200 ³	23000 ¹¹
Uranium	92	238.03	19.07 ²⁹	orthorh. ⁷ t. ⁷ (β) b.c.c. ² (γ)	37 ± 21 ¹⁸ (α-γ) 939 ¹⁹ (α-β) 1040 ¹⁸ (β-γ)	0.68 ⁵ (α) 1.80 ⁵ (γ)			200 ³⁴	300 ³	1405.6 ± 0.6 ¹⁸¹	2950 ± 250 ¹⁸²	12500 ²⁷ 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. ¹⁸							161.2 ²⁵	165.1 ¹³	289.75 ¹⁵
Ytterbium	70	173.04	7.02 ²⁹	f.c.c. ²² ₁ b.c.c. ²² (β)	1071 ^{2,1} (α-β)				118 ¹⁰⁰	1097 ¹²	1970 ³	4420 ¹⁰⁰	
Yttrium	39	88.905	4.47 ²⁹	c.p.h. ²² ₁ b.c.c. ²² (β)	1753 ¹¹⁹ (α-β)				268 ± 32 ³	214 ¹⁰⁴	1799 ¹¹⁹	3670 ¹⁰⁵	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	3119 ¹⁰⁴	2159 ¹⁵ 2910 ¹⁰⁰
Zirconium	40	91.22	6.57 ²⁹	c.p.h. ² ₁ b.c.c. ² (β)	1135 ¹³ (α-β)	0.546 ⁵ 0.55 ⁹			289 ± 24 ³	250 ¹⁴	2125 ¹⁸	4650 ²⁶	12300 ¹⁰⁰

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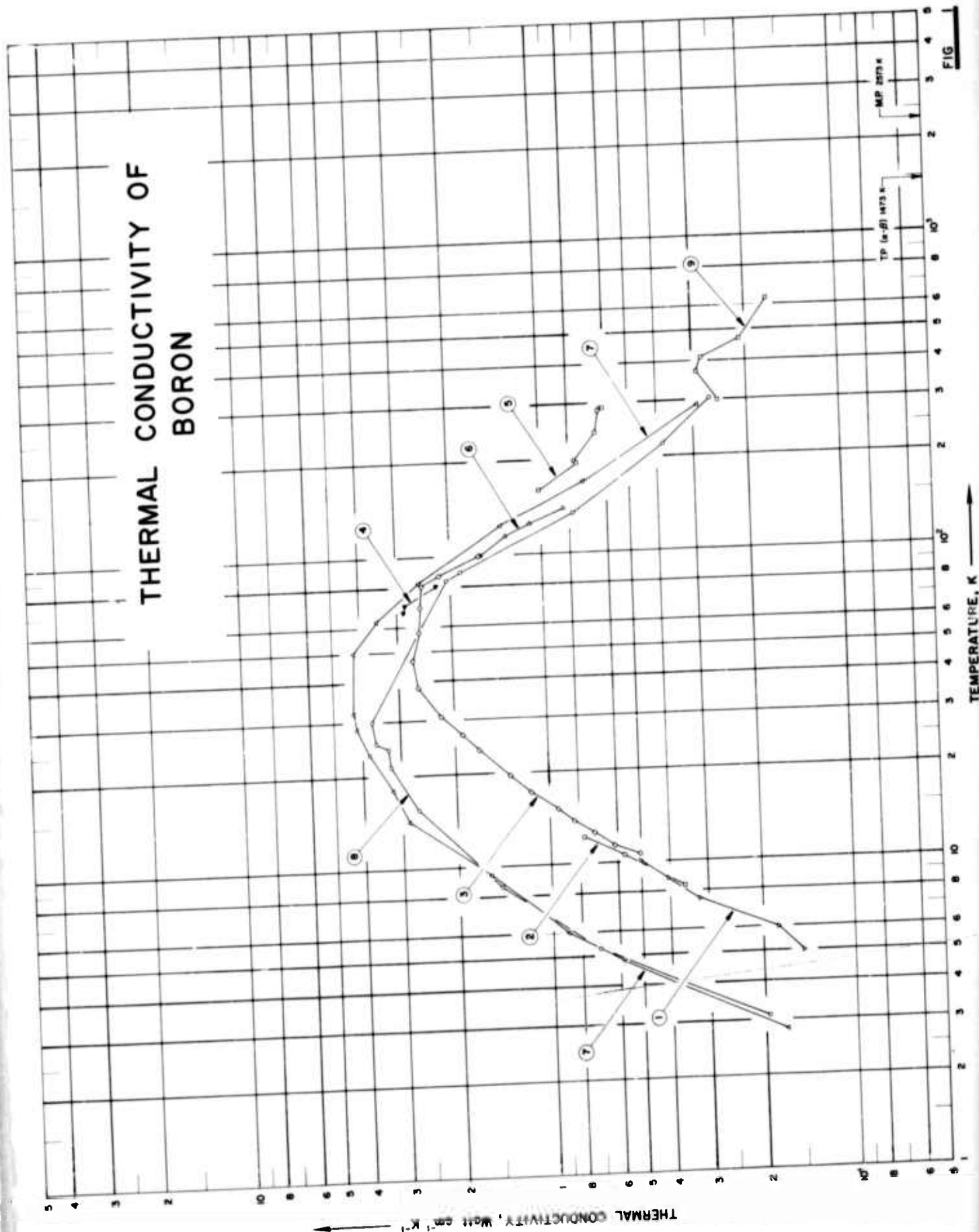
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THERMAL CONDUCTIVITY OF BORON



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	10-109				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.

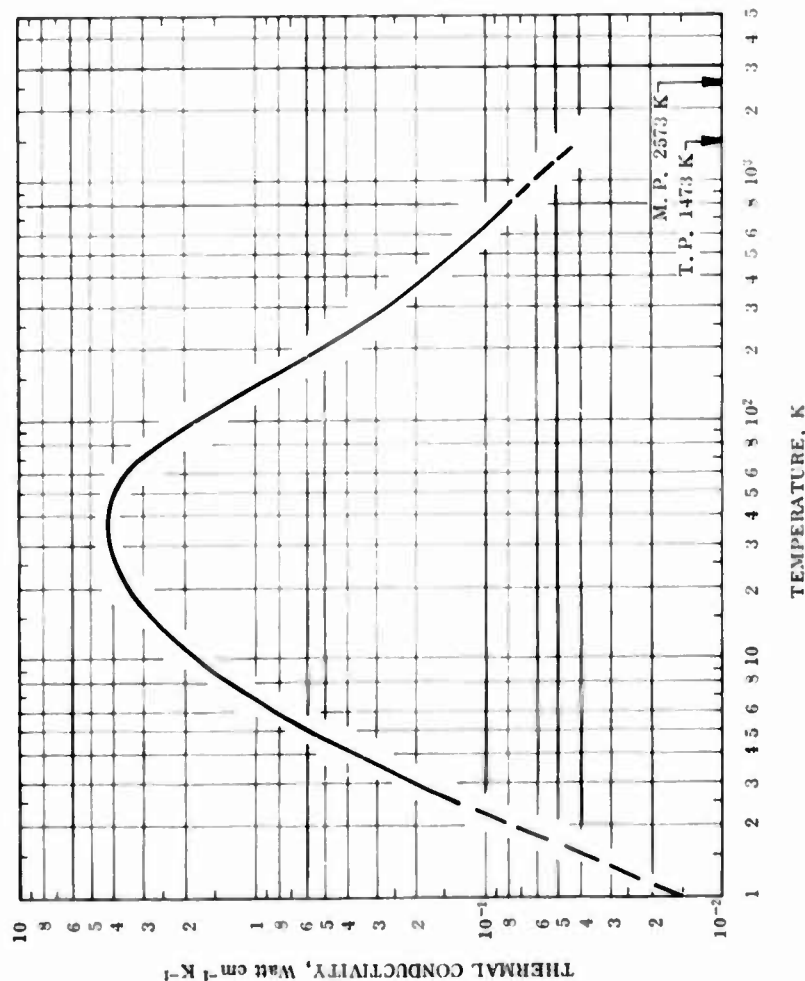
DATA TABLE NO. 1 THERMAL CONDUCTIVITY OF BORON

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

T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 5 (cont.)</u>		<u>CURVE 8 (cont.)</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
<u>CURVE 2</u>		290.1	0.616	<u>CURVE 9</u>	
8.31	0.357	<u>CURVE 6</u>		300	0.25
10.54	0.570	100.6	1.595	370	0.29
12.21	0.773	116.2	1.304	410	0.28
<u>CURVE 3</u>		126.9	1.095	470	0.21
10.61	0.502	140.9	0.840	630	0.17
11.44	0.613	<u>CURVE 7</u>		<u>CURVE 10*</u>	
12.60	0.712	2.8	0.17	293	0.0126
13.82	0.834	4.8	0.58	353	0.0126
15.07	0.936	6.0	0.89		
17.23	1.115	9.4	1.57		
19.57	1.335	14.2	2.85		
23.95	1.674	18.0	3.21		
26.88	1.893	23.5	3.80		
30.75	2.205	26.5	4.15		
38.06	2.595	32.0	4.25		
46.92	2.688	50.0	4.20		
57.53	2.546	63.0	3.50		
79.23	2.515	83.0	2.52		
80.86	2.476	125.0	1.35		
86.86	2.157	170.0	0.715		
99.74	1.612	291.0	0.29		
<u>CURVE 4</u>		<u>CURVE 8</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		
<u>CURVE 5</u>		15.5	2.65		
161.8	1.019	21.5	3.25		
194.4	0.747	24.5	3.30		
		25.5	3.60		
		30.0	3.70		

* 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 Watt cm⁻¹ K⁻¹, T_2 in F, and k_2 in Btu hr⁻¹ ft⁻¹ F⁻¹.

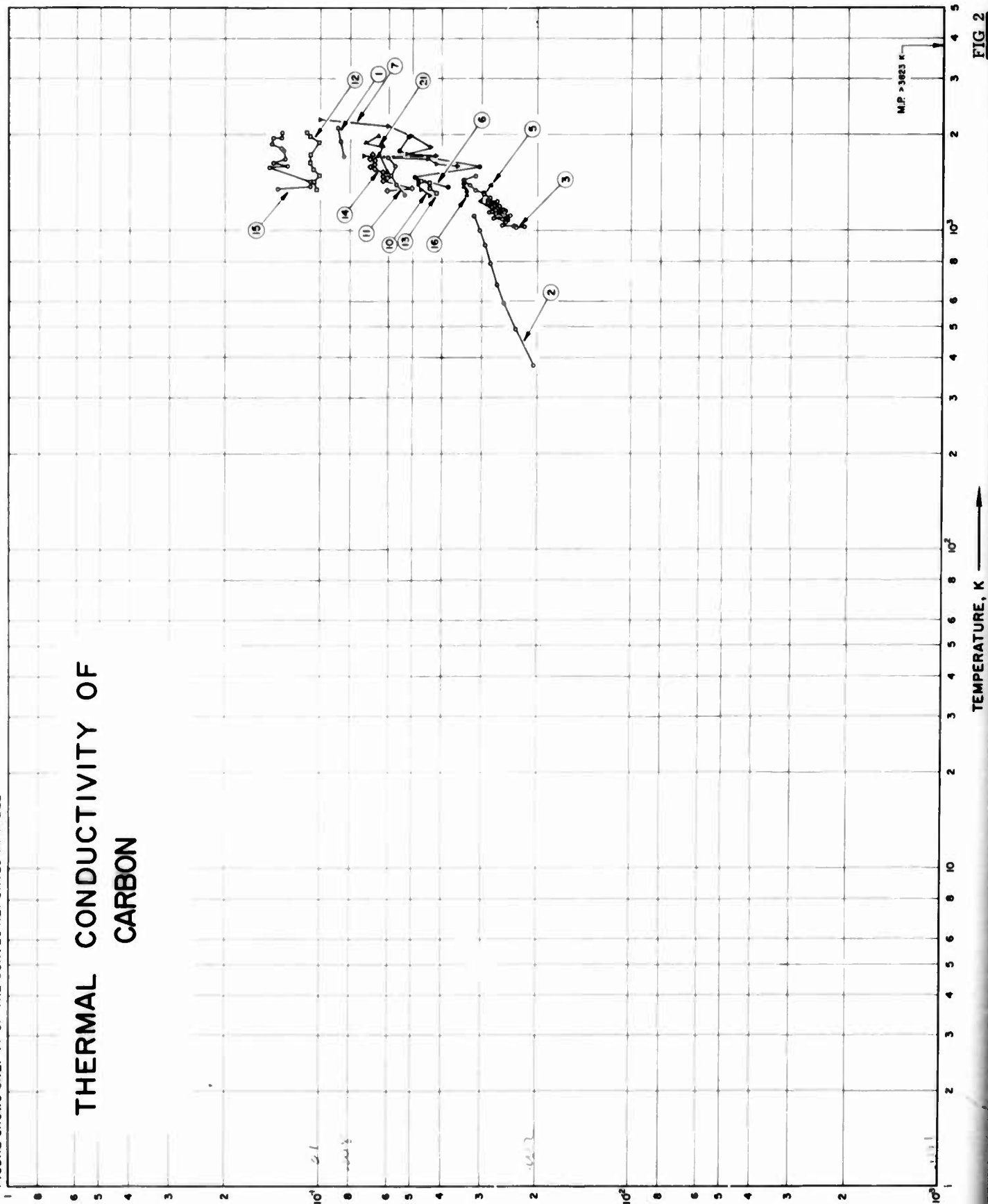
† Values in parentheses are extrapolated.

RECOMMENDED VALUES* (For Polycrystalline)						
T_1	k_1	k_2	T_2	T_1	k_1	T_2
0	0	0	-459.7	500	0.141	8.15
1	(0.0150)†	(0.867)	-457.9	600	0.113	6.53
2	(0.0781)	(4.51)	-456.1	700	(0.0941)	(5.44)
3	0.198	11.4	-454.3	800	(0.0809)	(4.67)
4	0.375	21.7	-452.5	900	(0.0708)	(4.09)
5	0.588	34.0	-450.7	1000	(0.0629)	(3.63)
6	0.826	47.7	-448.9	1100	(0.0569)	(3.29)
7	1.07	61.8	-447.1	1200	(0.0518)	(2.99)
8	1.31	75.7	-445.3	1300	(0.0472)	(2.73)
9	1.54	89.0	-443.5	1400	(0.0437)	(2.52)
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

THERMAL CONDUCTIVITY, $\text{Watt cm}^{-1} \text{K}^{-1}$



TEMPERATURE, K

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	Similar to the above specimen.
8	159	L	1955	373.2		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.
9	108	L	1920	313.368		Lampblack	Specimen 0.476 in. thick; specific gravity 0.165; prepared from Eagle brand German-town lampblack.
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; density 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.

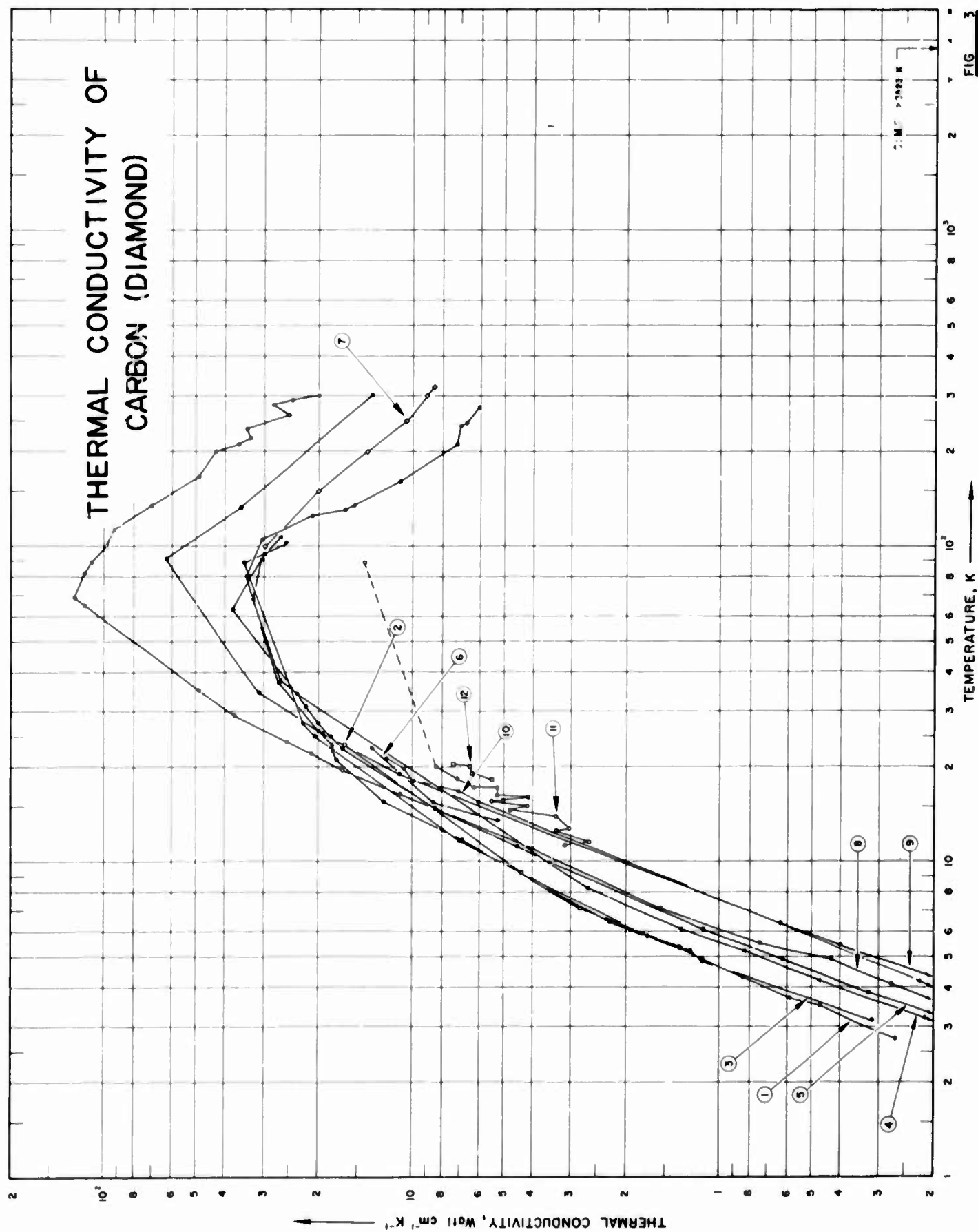
SPECIFICATION TABLE NO. 2 (continued)

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.

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

[illegible]

Not shown on plot

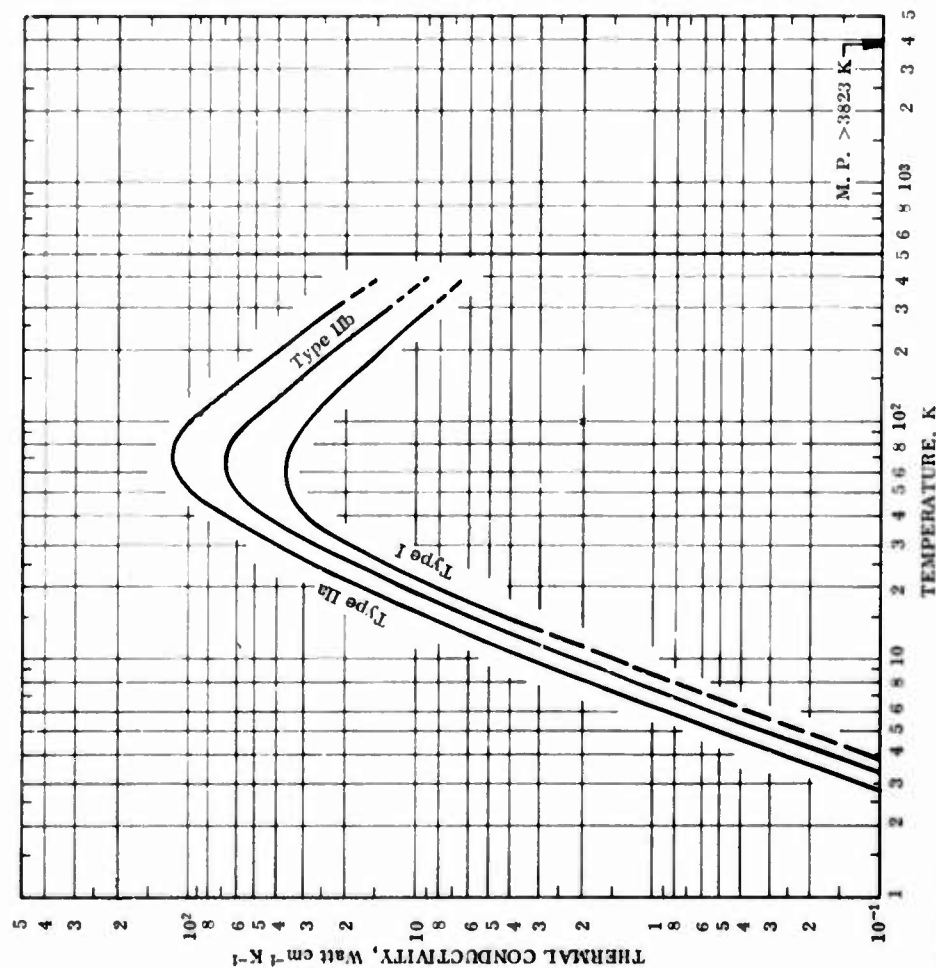


SPECIFICATION TABLE NO. 3 THERMAL CONDUCTIVITY OF CARBON (DIAMOND)

(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>ad</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 II ^a stone; approx. 0.7 x 1.25 x 10 mm, an electrical insulator.
9	28	L	1956	3.0-300		Type IIb	Type II ^b 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.

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



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.

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

T ₁	Type I		Type IIa		Type IIb	
	k ₁	k ₂	k ₁	k ₂	k ₁	k ₂
0	0	0	0	0	0	0
1	(0.00182)*	(0.105)	0	0	0	0
2	(0.0142)	(0.820)	(0.00437)	(0.252)	0.00263	0.152
3	(0.0471)	(2.72)	(0.0341)	(1.97)	0.0206	1.19
4	(0.111)	(6.41)	0.115	6.64	0.0692	4.00
5	(0.211)	(12.2)	0.266	15.4	0.164	9.48
6	(0.351)	(20.3)	0.502	29.0	0.313	18.1
7	(0.540)	(31.2)	0.836	48.3	0.521	30.1
8	(0.770)	(44.5)	1.27	73.4	0.795	45.9
9	(1.08)	(62.4)	1.90	104	1.14	65.9
10	(1.42)	(82.0)	2.46	142	1.57	90.7
11	(1.82)	(105)	3.24	187	2.07	120
12	(2.28)	(132)	4.09	236	2.63	152
13	(2.81)	(162)	5.10	295	3.29	190
14	3.39	196	6.20	358	4.02	232
15	4.03	233	7.45	430	4.87	281
16	4.72	273	8.77	507	5.77	333
18	6.27	362	10.2	589	6.75	390
20	8.00	462	13.5	780	8.90	514
25	13.1	757	17.1	988	11.4	659
30	19.0	1100	27.4	1590	18.5	1070
35	24.9	1440	39.5	2280	26.9	1550
40	29.7	1720	52.5	3030	35.6	2060
45	33.2	1920	66.7	3850	44.6	2580
50	35.6	2060	80.2	4630	53.0	3060
60	37.5	2170	93.0	5370	59.6	3440
70	37.1	2140	113	6530	68.0	3930
80	35.3	2040	120	6930	69.1	3990
90	32.8	1900	117	6760	65.9	3810
100	30.1	1740	110	6360	60.3	3480
150	19.5	1130	100	5790	54.5	3150
200	14.2	820	60.5	3500	32.6	1880
250	11.1	641	40.4	2330	22.6	1310
273.2	10.0	578	29.7	1720	17.1	988
300	9.00	520	26.3	1520	15.3	894
350	(7.58)	(438)	23.1	1330	13.5	780
400	(6.52)	(377)	(18.6)	(1070)	(11.2)	(647)
			(15.5)	(896)	(9.36)	(541)
						260.3

* 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 31 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF AGOT GRAPHITE

Continued on Figure 4-2

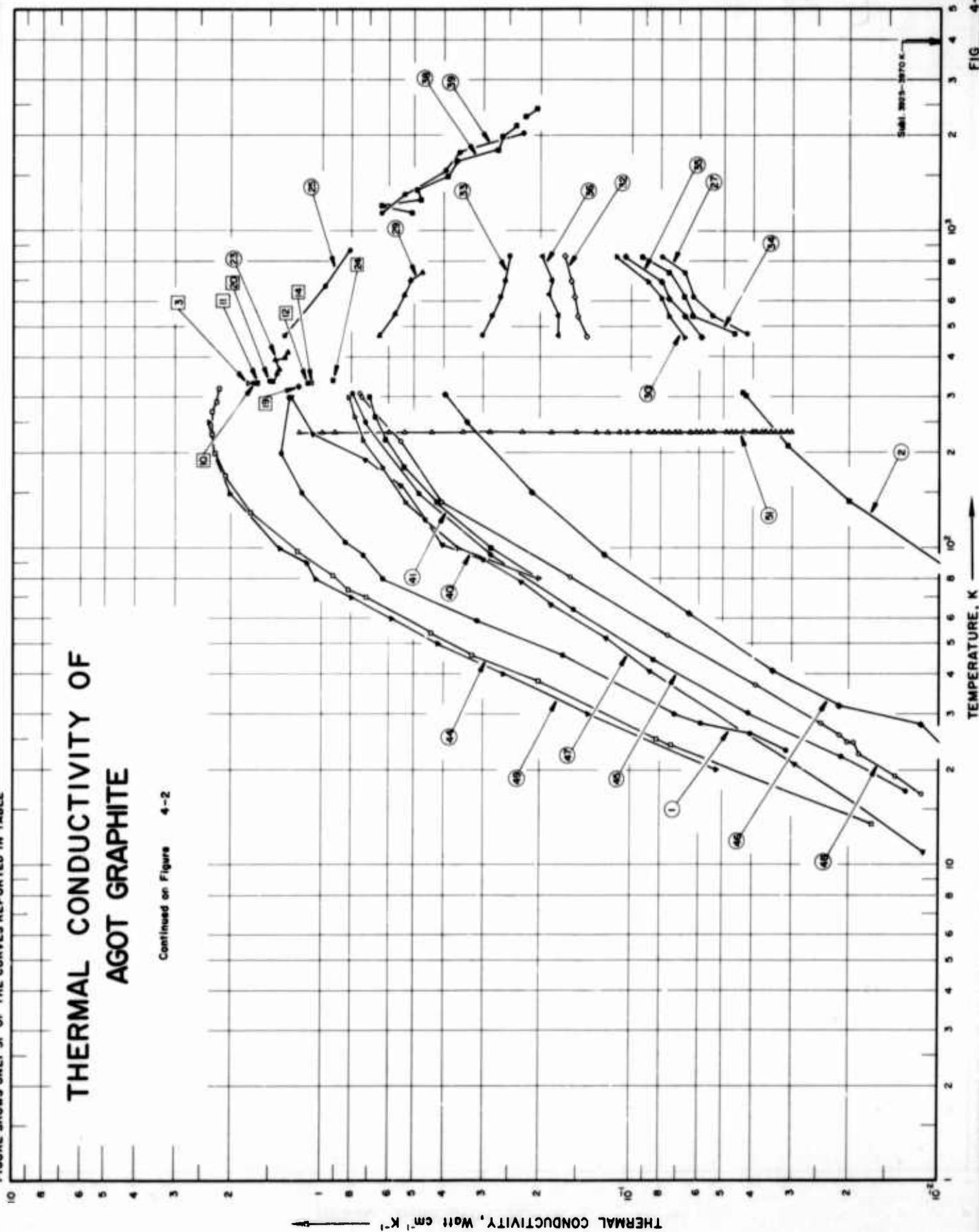
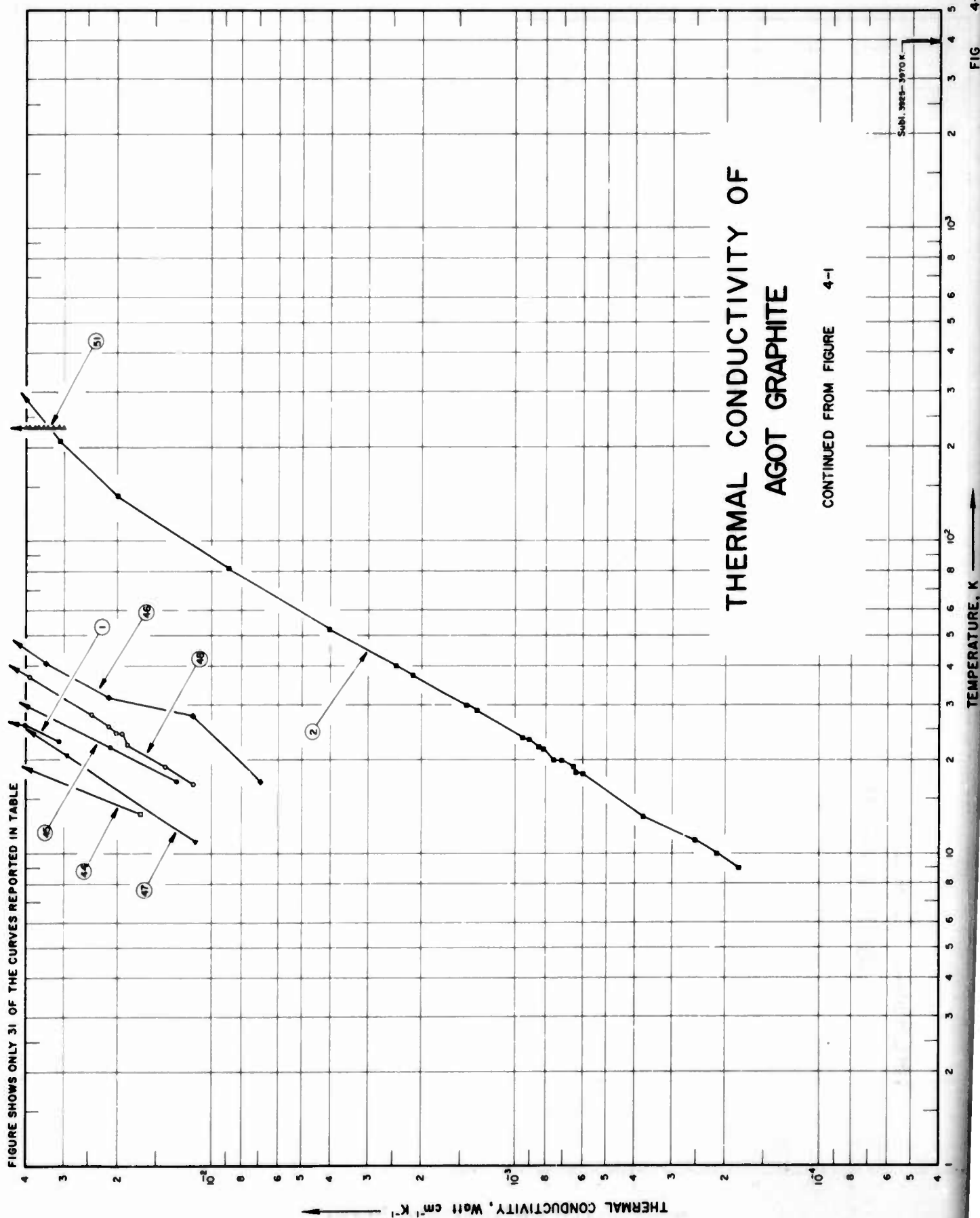


FIGURE SHOWS ONLY 31 OF THE CURVES REPORTED IN TABLE



THERMAL CONDUCTIVITY OF AGOT GRAPHITE

CONTINUED FROM FIGURE 4-1

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 $\sim 1.70 \text{ g cm}^{-3}$; 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 $+ 1.3 \mu\text{volt K}^{-1}$, Hall coefficient -0.21 emu , magneto resistivity $-0.01 \times 10^{-10} \text{ emu}$, electrical resistivity 65.3 milliohm cm , total magnetic susceptibility $-3.08 \times 10^{-4} \text{ cgs unit}$, orientation factor $(\rho_{\text{max}}/\rho_{\text{min}}) = 1.8$.
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 $> 0.032 \text{ in.}$
26	392		1961	473-737		AK-2	Obtained from Brookhaven pile; density 1.73 g cm^{-3} ; grain size $> 0.032 \text{ in.}$
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 1685 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 $> 0.032 \text{ in.}$; 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 $> 0.032 \text{ in.}$; 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 ($\phi_{\text{max}}/\phi_{\text{min}}$) = 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.

[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
CURVE 1													
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 24											
28	0.0586	CURVE 25											
30	0.0711	CURVE 26											
46	0.167	331.2	1.72	331.2	1.64	466.2	1.34	829.2	0.113	697.2	0.188	220	0.732
59	0.314	CURVE 31											
80	0.628	333.2	1.71	331.2	1.65	674.2	0.983	475.2	0.0418	834.2	0.197	300	0.816
95	0.732	CURVE 32											
105	0.837	333.2	1.75	331.2	1.66	868.2	0.812	541.2	0.0544	CURVE 41			
150	1.17	CURVE 33											
200	1.35	333.2	1.75	331.2	1.66	473.2	1.35	621.2	0.0628	324.2	1.67	80	0.201
300	1.30	CURVE 34											
CURVE 2													
9.0	0.000179	333.2	1.75	324.2	1.21	475.2	0.0418	620.2	0.151	1069.2	0.695	300	0.696
10.0	0.000213	CURVE 35											
11.1	0.000251	CURVE 36											
13.2	0.000372	CURVE 37											
18.1	0.000598	CURVE 38											
18.2	0.000634	CURVE 39											
19.0	0.000644	CURVE 40 (cont.)											
19.9	0.000703	CURVE 42											
20.0	0.000749	CURVE 43											
21.7	0.000812	CURVE 44											
22.0	0.000840	CURVE 45											
23.3	0.000895	CURVE 46											
23.6	0.000941	CURVE 47											
28.8	0.00132	CURVE 48											
30.0	0.00143	CURVE 49											
37.4	0.00213	CURVE 50											
40.0	0.00243	CURVE 51											
52.5	0.00402	CURVE 52											
82.0	0.00879	CURVE 53											
140	0.0199	CURVE 54											
210	0.0308	CURVE 55											
302	0.0420	CURVE 56											
309	0.0431	CURVE 57											
CURVE 3													
333.2	1.76	CURVE 58											

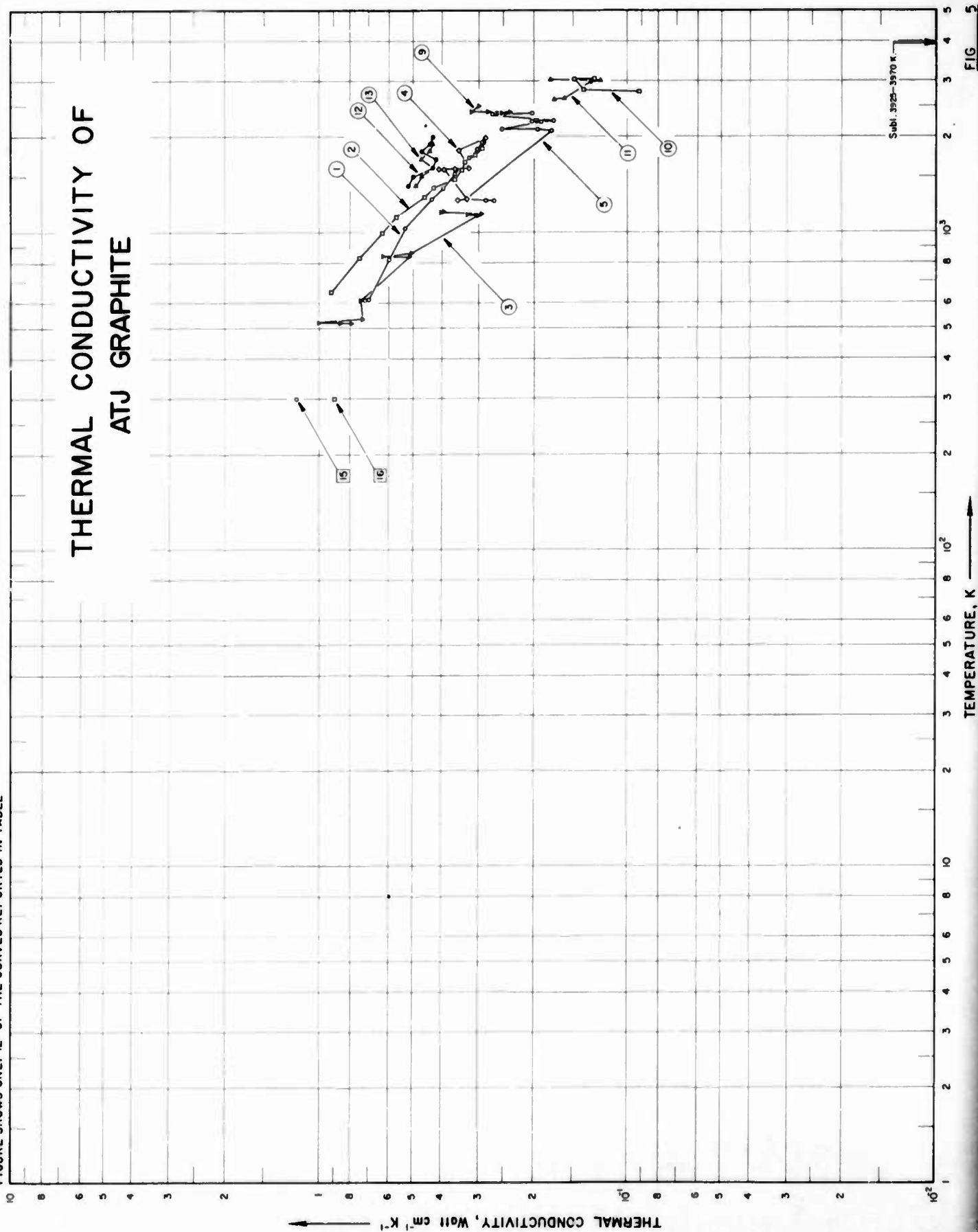
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DATA TABLE NO. 4 (continued)

CURVE 44 (cont.)			CURVE 47 (cont.)			CURVE 50 (cont.)			CURVE 51 (cont.)			CURVE 52 (cont.)			CURVE 53*			CURVE 53 (cont.)*		
T	k		T	k		T	k		T _A	k		T _A	k		T _A	k		T _A	k	
CURVE 44			CURVE 47			CURVE 50			CURVE 51			CURVE 52			CURVE 53			CURVE 53 (cont.)		
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	1.080		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		CURVE 49			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		CURVE 51			1573.2	0.287		973.2	0.277		523.2	0.0268				
17.1	0.0129		24.5	0.0201		CURVE 50			1598.2	0.349		998.2	0.287		548.2	0.0274				
22.0	0.0210		25.7	0.0213		CURVE 51			1623.2	0.439		1023.2	0.299		573.2	0.0282				
30.2	0.0411		28.0	0.0243		CURVE 52			1648.2	0.536		1048.2	0.303		598.2	0.0288				
44.4	0.0837		37.0	0.0389		CURVE 53			1673.2	0.598		1073.2	0.310		623.2	0.0294				
64.4	0.155		53.3	0.0753		CURVE 54			1698.2	0.644*		1098.2	0.327		648.2	0.0301				
95.4	0.285		81.0	0.159		CURVE 55			1723.2	0.699*		1123.2	0.335		673.2	0.0308				
148.5	0.481		140.4	0.406		CURVE 56			1748.2	0.908		1148.2	0.349		698.2	0.0314				
250	0.724		218.0	0.550		CURVE 57			1773.2	0.891*		1173.2	0.364		723.2	0.0320				
308	0.795		300.0	0.741		CURVE 58			1798.2	0.929*		1198.2	0.380		748.2	0.0327				
CURVE 46			308.0	0.753		CURVE 59			1823.2	0.996		1223.2	0.391		773.2	0.0333				
17.1	0.00690		CURVE 49			CURVE 60			1848.2	1.05*		1248.2	0.406		798.2	0.0339				
27.7	0.0115		20	0.0523		CURVE 61			1873.2	1.05*		1273.2	0.431		823.2	0.0343				
31.8	0.0213		30	0.138		CURVE 62			1898.2	1.10*		1323.2	0.452		848.2	0.0354				
41.0	0.0344		40	0.259		CURVE 63			1935.2	1.20		1348.2	0.477		873.2	0.0364				
62.2	0.0640		50	0.418		CURVE 64			CURVE 52			1373.2	0.485		898.2	0.0375				
95	0.122		60	0.586		CURVE 65			CURVE 53			1398.2	0.536		923.2	0.0382				
150	0.211		70	0.795		CURVE 66			CURVE 54			1423.2	0.590		948.2	0.0392				
250	0.339		80	1.05		CURVE 67			CURVE 55			1473.2	0.653		973.2	0.0402				
305	0.397		90	1.13		CURVE 68			CURVE 56			1498.2	0.695		998.2	0.0412				
CURVE 47			100	1.38		CURVE 69			CURVE 57			1523.2	0.720		1023.2	0.0427				
10.9	0.0113		150	2.01		CURVE 70			CURVE 58			1548.2	0.732		1048.2	0.0435				
20.8	0.0293		200	2.26*		CURVE 71			CURVE 59			1573.2	0.749		1073.2	0.0448				
40.8	0.0866		250	2.34		CURVE 72			CURVE 60			1598.2	0.761		1098.2	0.0464				
52.0	0.121		CURVE 50*			CURVE 73			CURVE 61			1623.2	0.837		1123.2	0.0481				
66.5	0.184		10	0.00837		CURVE 74			CURVE 62			1648.2	0.870		1148.2	0.0502				
78.0	0.227		20	0.0460		CURVE 75			CURVE 63			1673.2	0.908		1173.2	0.0519				
92.0	0.299		30	0.121		CURVE 76			CURVE 64			1698.2	0.929		1198.2	0.0540				
103.0	0.404		40	0.230		CURVE 77			CURVE 65			1723.2	0.950		1223.2	0.0565				
124.6	0.460		50	0.368		CURVE 78			CURVE 66			1748.2	0.908		1248.2	0.0590				
158.4	0.551		60	0.502		CURVE 79			CURVE 67			1773.2	0.891		1273.2	0.0615				
			70	0.690		CURVE 80			CURVE 68			1798.2	0.929		1298.2	0.0649				
			80	0.920		CURVE 81			CURVE 69			1823.2	0.996		1323.2	0.0682				
						CURVE 82			CURVE 70			1848.2	1.05		1348.2	0.0724				
						CURVE 83			CURVE 71			1873.2	1.05		1373.2	0.0787				
						CURVE 84			CURVE 72			1898.2	1.10		1398.2	0.0862				
						CURVE 85			CURVE 73			1935.2	1.20							

* Not shown on plot

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 8*</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					1700	0.331
1371.5	0.396	1594.3	0.326	<u>CURVE 9</u>		<u>CURVE 10</u>		1800	0.322
1540.9	0.363	1602.6	0.346*	2383.2	0.253	2783.1	0.0923	1900	0.330
1710.9	0.325	1811.0	0.352	2391.5	0.238	<u>CURVE 15</u>			
1833.2	0.305	1813.7	0.345*	2394.3	0.281	2811.0	0.139	298.2	1.18
1922.1	0.294	1813.7	0.353*	2397.1	0.219	3036.0	0.149	<u>CURVE 16</u>	
		1991.5	0.286	2505.4	0.201	3049.8	0.128	298.2	0.895
<u>CURVE 2</u>		<u>CURVE 5</u>		<u>CURVE 11</u>		<u>CURVE 12</u>			
649.8	0.917	1258.2	0.267	2622.0	0.172	1400	0.520		
830.9	0.748	1263.7	0.286	2641.5	0.160	1500	0.500		
991.5	0.633	1266.5	0.332*	2811.0	0.133	1600	0.430		
1113.7	0.568	2091.5	0.176	2972.1	0.123	1700	0.420		
1297.1	0.459	2102.6	0.195	3002.6	0.123	1800	0.470		
1378.2	0.426	2108.2	0.252	3022.1	0.177	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>		1400	0.489		
1655.4	0.336	2244.3	0.172	1500	0.468	1500	0.468		
1680.9	0.332*	2247.0	0.203*						
1753.7	0.310	2358.2	0.271						
1842.1	0.294	2369.3	0.203						
1929.3	0.292								
<u>CURVE 3</u>		<u>CURVE 6*</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								
614.3	0.728*	<u>CURVE 7*</u>							
836.5	0.513	831.5	0.490						
840.4	0.629	833.2	0.577						
856.5	0.505	836.5	0.646						
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

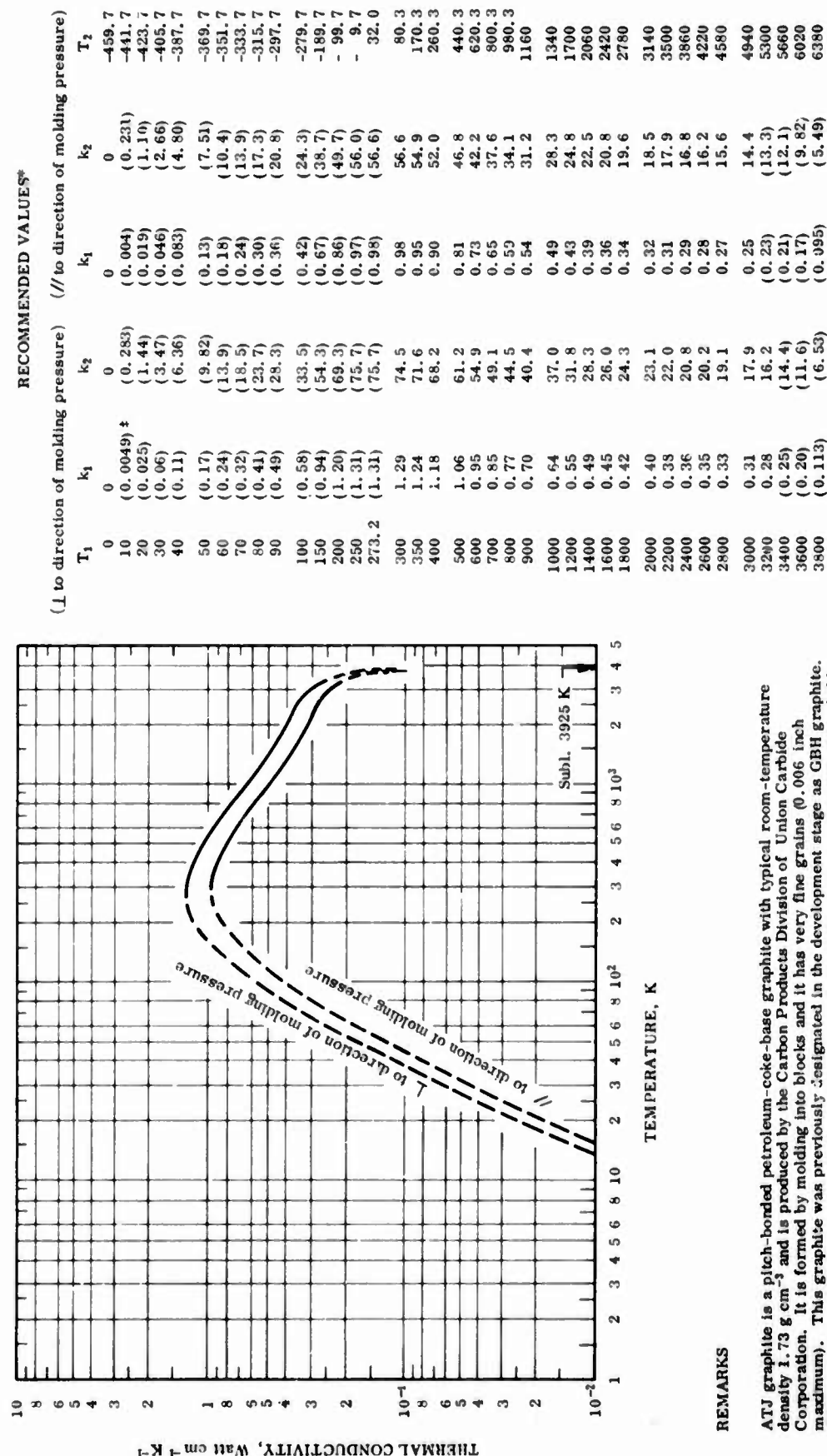
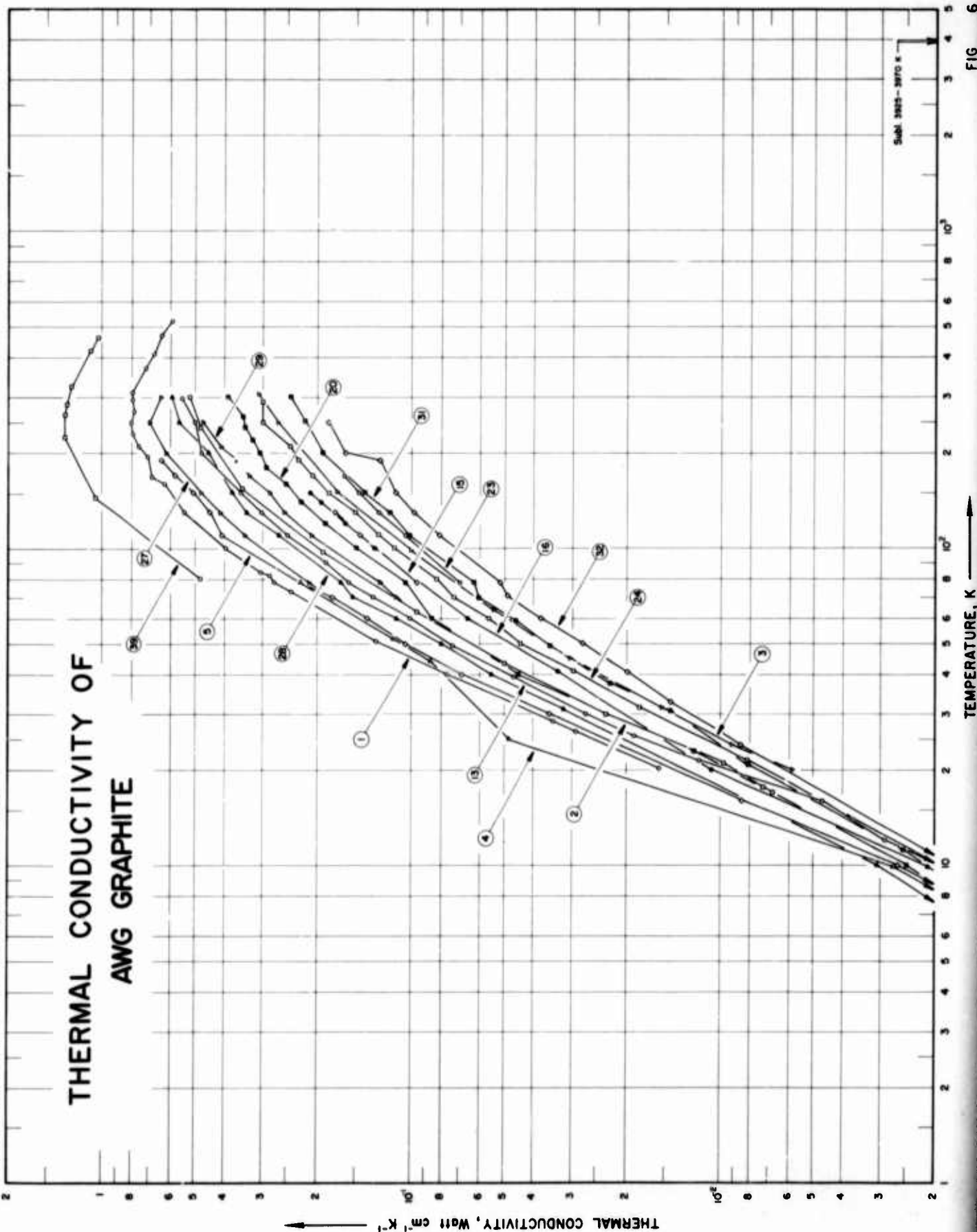


FIGURE SHOWS ONLY 17 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF AWG GRAPHITE



TEMPERATURE, K

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 μ Volt 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 ⁻⁶ cgs unit; orientation factor ($\rho_{\text{max}}/\rho_{\text{min}}$) = 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 μ h 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 μ h 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 μ h 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)

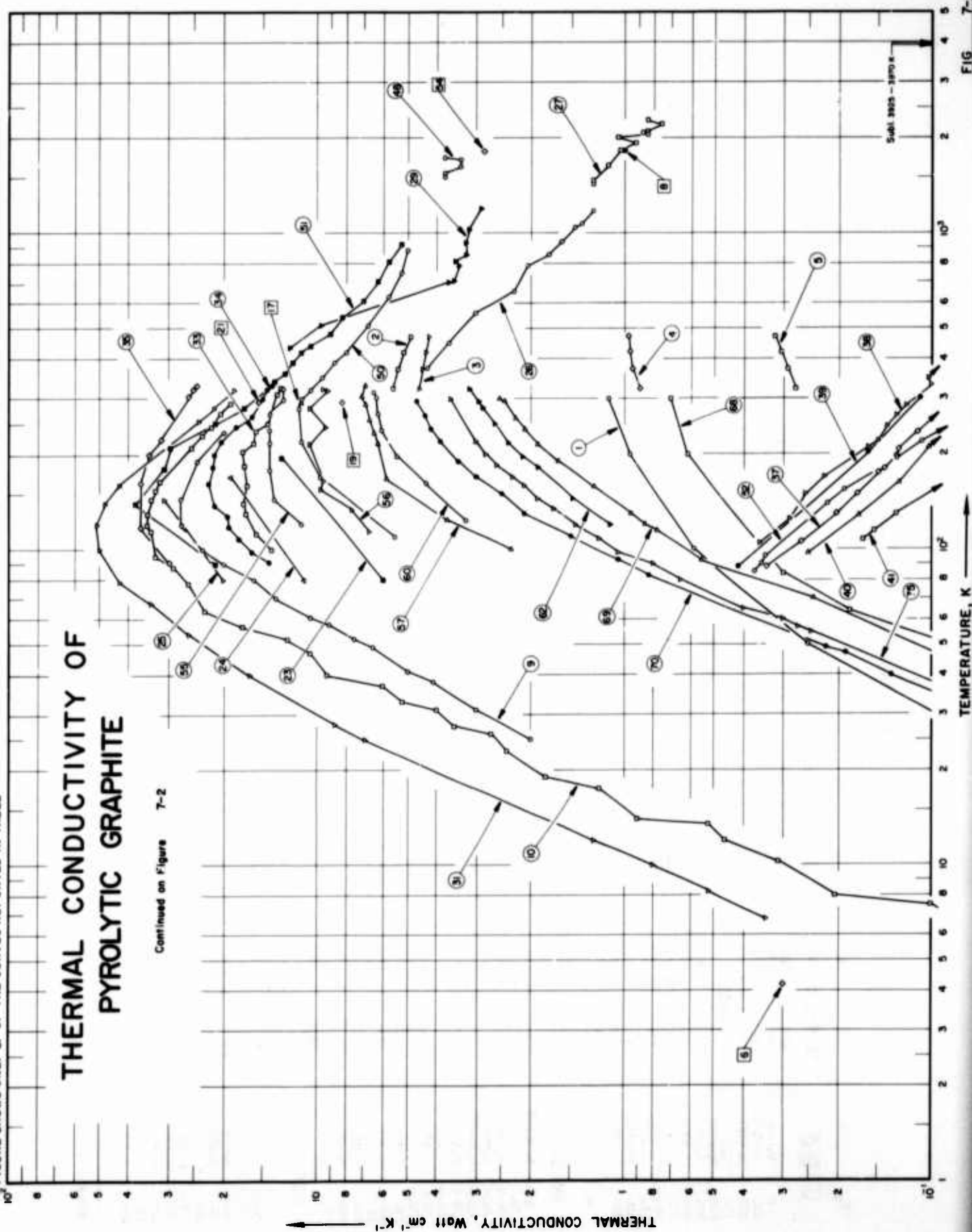
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
33	51	E	1956	7.6-300	<2	C-381, No. 1	Similar to the above specimen but being irradiated at 423 K with an exposure of $0.95 \mu\text{h cm}^{-2}$; 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 $(\rho_{\text{max}}/\rho_{\text{min}}) = 1.9$; measured perpendicular

to the direction of the molding pressure.

FIGURE SHOWS ONLY 61 OF THE CURVES REPORTED IN TABLE

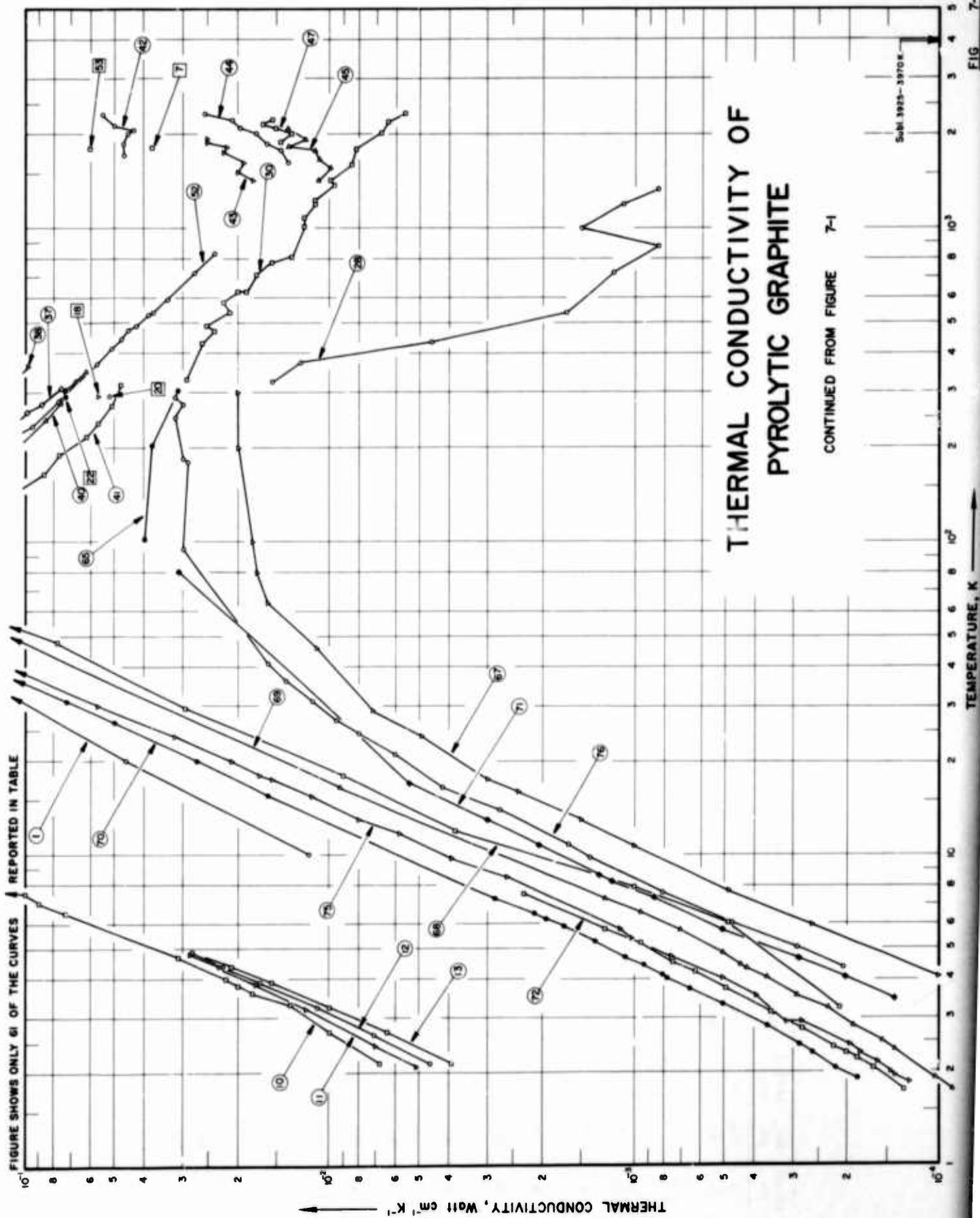
THERMAL CONDUCTIVITY OF PYROLYTIC GRAPHITE

Continued on Figure 7-2



TEMPERATURE, K

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 ⁴ 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_z 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 1800 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, Schlatter and Debrunner 1924, Jacobs and Deem 1956, Wagner et al. 1945, and Roesini et al. 1963.
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. 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. k_x determined simultaneously with the above curve.
53	340	-	1962	1808	large	P1	
54	340	-	1962	1808	large	P1	
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 4×10^{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 285 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.

* Not shown on plot

DATA TABLE NO. 7 (continued)

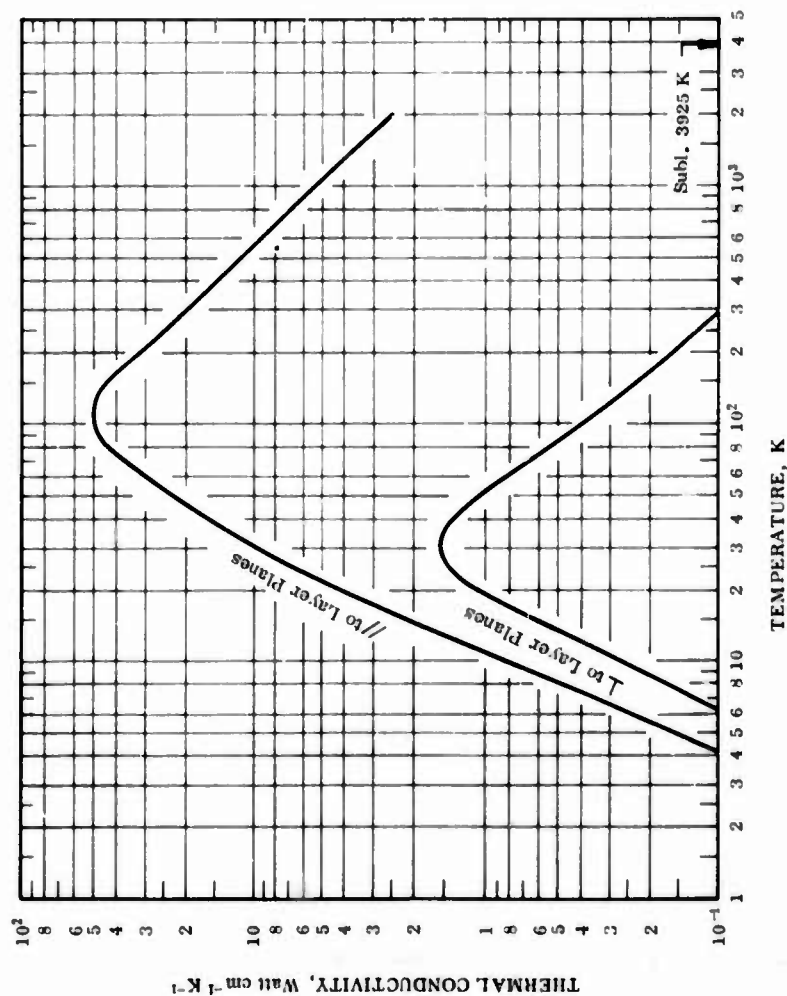
T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 57</u>		<u>CURVE 61*</u>		<u>CURVE 64 (cont.)*</u>		<u>CURVE 68 (cont.)</u>		<u>CURVE 70 (cont.)</u>		<u>CURVE 72 (cont.)</u>		<u>CURVE 75 (cont.)</u>	
100	2.33	114.8	16.66	245.5	18.51	84	0.30	4.7	0.00108	2.75	0.00028	2.90	0.00028
124.5	3.70	136.5	20.83	266.1	18.51	200	0.62	5.3	0.00135	3.1	0.00035	2.90	0.00031
167.9	5.88	158.5	21.27	288.4	17.85	300	0.70	5.9	0.00170	3.7	0.00049	3.50	0.00039
216.3	6.25	186.2	21.27	309.0	15.38			6.25	0.00195	4.2	0.00062	4.0	0.00050
234.4	6.45	206.5	20.83	331.1	14.28	<u>CURVE 69</u>		6.50	0.00213	4.5	0.00074	4.7	0.00075
257.0	6.67	213.8	20.40			1.75	0.00009	7.25	0.00285	5.2	0.00095	5.4	0.00103
288.4	6.90	231.7	19.60	<u>CURVE 65</u>		1.90	0.000102	15.5	0.016	5.8	0.00125	5.8	0.0011
305.5	7.14	248.3	19.23	103.5	0.04	2.35	0.00014	20.0	0.027	7.5	0.00230	8.5	0.0026
331.1	6.90	288.4	18.51	204.2	0.0377	2.50	0.000155	26.5	0.050	<u>CURVE 73*</u>		9.75	0.0039
<u>CURVE 58*</u>		309.0	16.00	305.5	0.0312	2.80	0.00019	31.0	0.0725	2.0	0.000175	11.75	0.0058
		327.3	15.15			3.20	0.00023	40.0	0.135	2.45	0.00026	13.0	0.0080
<u>CURVE 62</u>				<u>CURVE 66*</u>		4.00	0.00029	47.0	0.19	2.0	0.000175	15.5	0.0115
116.1	18.52	120.2	1.11	89.1	0.455	3.50	0.00029	49.0	0.22	2.45	0.00026	17.5	0.0155
134.9	22.22	162.2	23.26	204.2	0.154	4.00	0.00036	82.5	0.825	2.70	0.00032	18.0	0.0170
162.2	23.81	182.0	1.89	302.0	0.100	4.30	0.00042	92.5	1.05	3.80	0.00060	20.0	0.021
211.3	23.81	197.2	2.13			4.4	0.00044	110.0	1.50	4.40	0.000775	24.0	0.032
245.5	22.73	218.8	2.38	<u>CURVE 67</u>		4.8	0.0005	130	2.1	4.60	0.00085	30.0	0.057
266.1	21.74	251.2	2.63	4.0	0.00010	5.7	0.0007	150	2.5	5.0	0.0010	55.0	0.245
309.0	19.61	281.8	2.86	7.25	0.00125	6.5	0.00095	170	3.0	6.0	0.00153	57.0	0.27
335.0	17.86	295.1	2.94	16.5	0.0025	7.00	0.24	190	3.4	6.75	0.0019	60.0	0.30
<u>CURVE 59*</u>		323.6	3.13	70.0	0.55	7.6	0.00048	220	3.9	<u>CURVE 74*</u>		65.0	0.40
				92.5	0.755	10.7	0.0010	240	4.2	3.1	0.000105	80.0	0.65
<u>CURVE 63*</u>				115.0	0.850	10.7	0.0015	265	4.4	3.7	0.000165	90.0	0.80
114.8	17.24	110.9	2.701	120	0.950	13.0	0.0024	295	4.7	4.5	0.000250	98	1.05
136.5	20.83	128.8	3.33	130	1.25	16.0	0.0030	<u>CURVE 71</u>		5.25	0.000350	108	1.2
158.5	21.28	144.5	4.00	158	1.65	17.5	0.0049	3.4	0.00014	5.7	0.000440	120	1.45
184.1	21.28	164.1	4.55	190	1.90	24	0.0072	4.0	0.0002	6.5	0.000620	135	1.7
204.2	20.83	192.8	5.41	215	2.10	29	0.011	4.6	0.000285	9.3	0.00150	145	1.9
213.8	20.41	216.3	5.71	240	2.25	46	0.016	5.7	0.0005	11.5	0.00240	160	2.1
229.1	20.00	239.9	6.06	64	0.0175	64	0.018	7.25	0.00085	12.5	0.00270	170	2.3
245.5	19.23	251.2	6.41	80	0.020	80	0.020	8.25	0.00118	15.5	0.00440	185	2.6
263.0	18.52	260.0	6.45	100	0.020	100	0.020	10.8	0.00205	18.5	0.0060	200	2.8
288.4	18.52	309.0	6.90	200	0.020	200	0.020	13.0	0.003	21.0	0.0075	220	3.0
309.0	16.00			300	0.020	300	0.020	17.0	0.0054	300	0.0290	300	3.6
327.3	14.81					<u>CURVE 70</u>		80.0	0.031	<u>CURVE 76</u>			
<u>CURVE 60</u>						1.9	0.000185			4.3	0.000205		
						2.05	0.000218			5.0	0.00029		
						2.3	0.00026			6.0	0.00047		
						2.45	0.000286			7.5	0.00080		
<u>CURVE 64*</u>				3.2	0.00021	2.80	0.00036			1.85	0.000125		
124.7	3.23	117.5	15.38	7.8	0.0010	3.3	0.00050			1.95	0.000140		
162.2	4.35	141.3	16.66	12.0	0.0038	3.7	0.00065			2.0	0.000145		
198.6	5.41	182.0	20.00	18.0	0.0090	4.0	0.00075			2.15	0.00016		
239.9	6.06	211.3	19.23	29.5	0.0295	4.1	0.00080			2.30	0.00018		
269.2	6.25	216.3	19.60	48	0.078	4.4	0.000925			2.45	0.000195		
302.0	6.33	231.7	18.86	64	0.184								

* Not shown on plot

DATA TABLE NO. 7 (continued)

T	k
<u>CURVE 76 (cont.)</u>	
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

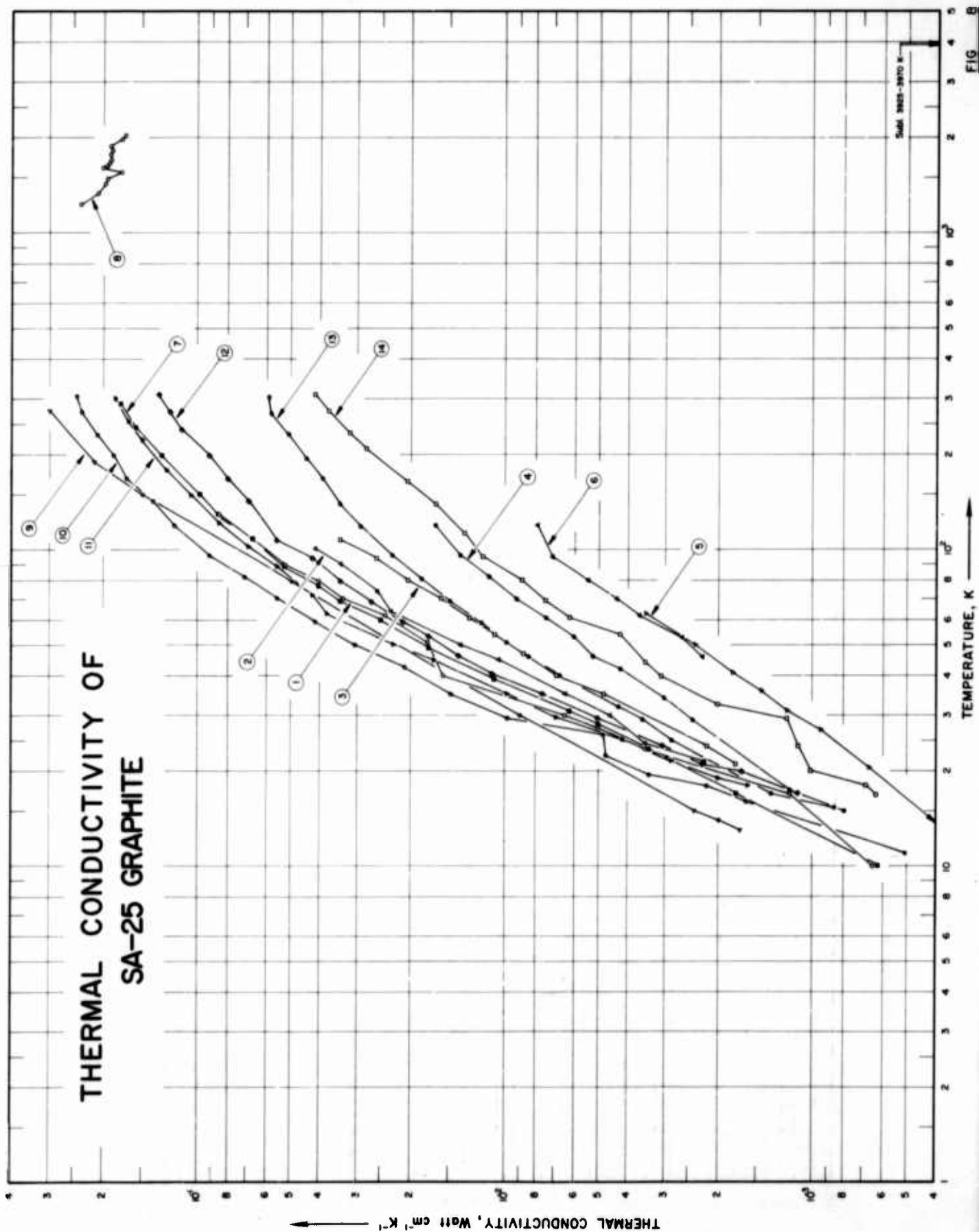


REMARKS

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.

RECOMMENDED VALUES*			
(// to Layer Planes)		(⊥ to Layer Planes)	
T_1	k_1	k_2	T_2
0	0	0	-459.7
10	0.81	46.8	-441.7
20	4.2	243	-423.7
30	9.9	572	-405.7
40	16.3	942	-387.7
50	23.0	1330	-369.7
60	29.8	1720	-351.7
70	36.5	2110	-333.7
80	42.9	2480	-315.7
90	47.3	2730	-297.7
100	49.8	2890	-279.7
150	45.3	2620	-189.7
200	32.5	1880	-99.7
250	24.5	1420	-9.7
273.2	22.3	1290	32.0
300	20.0	1160	80.3
350	16.9	976	170.3
400	14.6	844	260.3
500	11.3	653	440.3
600	9.3	537	620.3
700	7.9	456	800.3
800	6.8	393	980.3
900	6.0	347	1160
1000	5.3	306	1340
1100	4.8	277	1520
1200	4.4	254	1700
1300	4.0	231	1880
1400	3.7	214	2060
1500	3.4	196	2240
1600	3.2	185	2420
1700	3.0	173	2600
1800	2.8	162	2780
1900	2.6	150	2960
2000	2.5	144	3140

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



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 0.2×10^{-10} emu, electrical resistivity 43 milliohm cm, total magnetic susceptibility -21.02×10^{-4} cgs unit, orientation factor ($\rho_{\max}/\rho_{\min}$) = 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 0.2×10^{-10} emu; electrical resistivity 65.3×10^{-3} ohm cm; total susceptibility -21.02×10^{-4} cgs unit, and orientation factor ($\rho_{\max}/\rho_{\min}$) = 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.

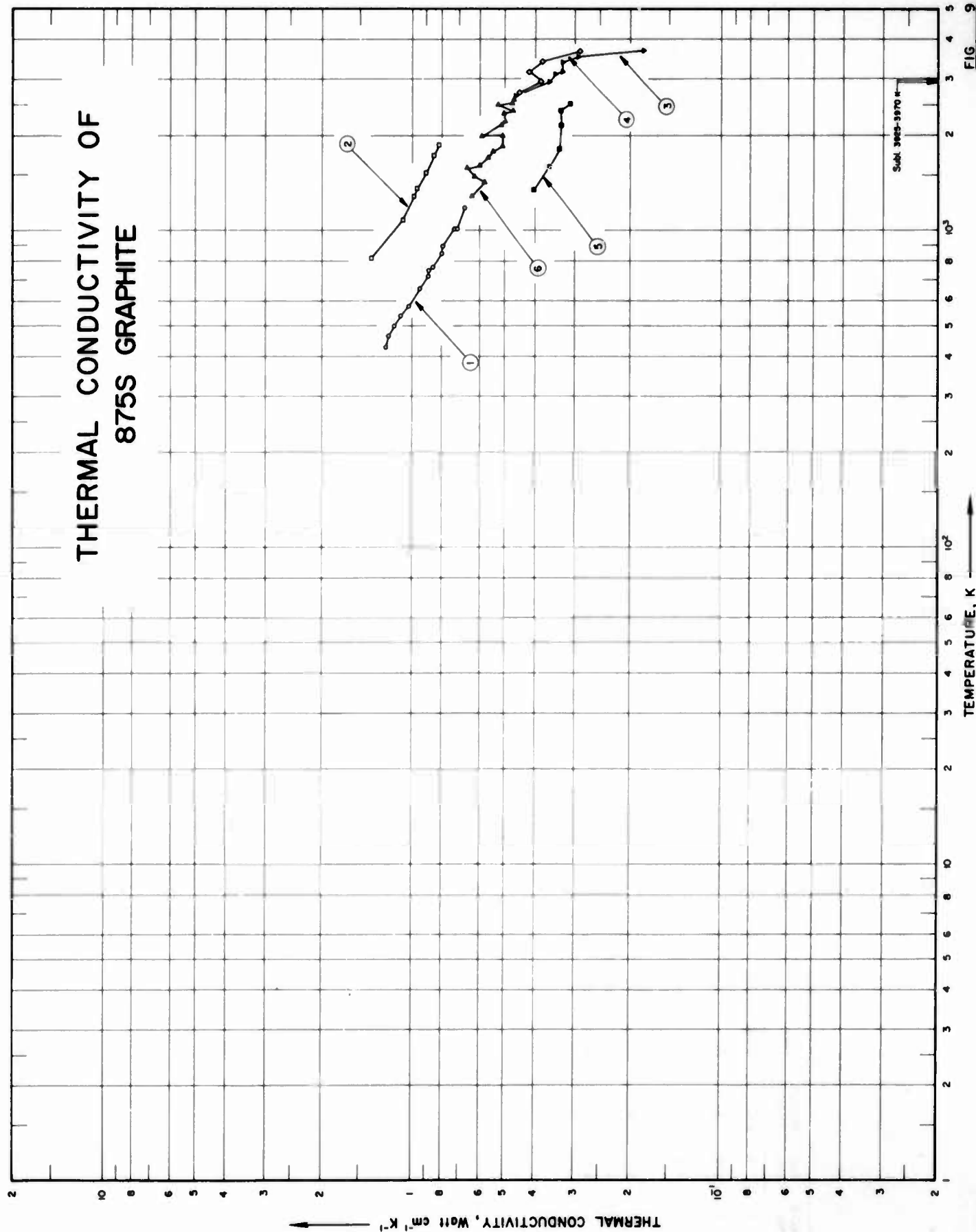
DATA TABLE NO. 8 THERMAL CONDUCTIVITY OF SA-25 GRAPHITE

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

CURVE 1			CURVE 4			CURVE 7 (cont.)			CURVE 10 (cont.)			CURVE 12			CURVE 14		
T	k		T	k		T	k		T	k		T	k		T	k	
10	0.00649		15	0.00795		60	0.0251		17.9	0.00217		17.0	0.00113*		16.8	0.00636	
17	0.00172		17.5	0.00117		69	0.0343		19.4	0.00339		19.9	0.00167		18.0	0.000682	
23.5	0.00335		29	0.00243		77	0.0406		22.3	0.00475		20.9	0.00226*		20.0	0.00102	
27.5	0.00502		34	0.00301		89	0.0523		26.1	0.00482		23.9	0.00305*		24.0	0.00111	
30	0.00649		42	0.00427		108	0.0669		29.4	0.00981		29.3	0.00502		29.3	0.00121	
40	0.0107		46	0.00523		130	0.0858		35.0	0.0147		35.0	0.00761		32.5	0.00251	
51	0.0176		53	0.00607		150	0.0983		42.5	0.0209		40.5	0.0110*		39.6	0.00318	
62	0.0243		61	0.00732		200	0.130		50.8	0.0306		46.5	0.0140		44.1	0.00349	
70	0.0335		70	0.00920		245	0.157		59.0	0.0418		53.1	0.0176		54.0	0.00423*	
80	0.0402		82	0.0113		290	0.176		82.4	0.0715		68.7	0.0269		61.0	0.00628	
90	0.0523		96	0.0138		CURVE 8			96.2	0.0916		79.9	0.0343		80.0	0.00733	
130	0.0858		120	0.0167		CURVE 5			119	0.117		94.0	0.0427		95.0	0.0117	
205	0.128*		CURVE 2			1246	0.237		142	0.138		114	0.0554		113.6	0.0134	
			12.5	0.000356*		1335	0.209		168	0.167		142	0.0686		139	0.0166	
21.5	0.00222		20.5	0.000669		1420	0.198		198	0.186		167	0.0803		164	0.0205	
24.5	0.00335		27	0.006941		1485	0.195		230	0.209		198	0.0920		208	0.0281	
30	0.00460		31	0.00121		1555	0.175		273	0.236		240	0.112		233	0.0318	
35	0.00649		36	0.00146		1605	0.202		306	0.245		273	0.123		275	0.0374	
45	0.0105		41	0.00180		1620	0.196		CURVE 11			310	0.132		309	0.0418*	
50	0.0138		50	0.00238		1665	0.193		18.0	0.00160		CURVE 13					
64	0.0234		63	0.00343		1710	0.190		15.2	0.00201		15.4	0.000858*				
74	0.0259		CURVE 6			1770	0.191		21.5	0.00285		17.0	0.00136				
90	0.0343		46	0.00226		1835	0.187*		25.0	0.00419		25.0	0.00285				
101	0.0418		53	0.00264		1880	0.190		29.5	0.00690		29.0	0.00358				
CURVE 3			62	0.00368		1985	0.175*		35.0	0.00987		31.9	0.00460				
21	0.00176		CURVE 9			2045	0.170*		44.7	0.0167		40.0	0.00679*				
24	0.00218		13	0.00170		CURVE 7			50.2	0.0227		46.0	0.00837*				
35	0.00481		70	0.00439		14	0.00200		63.0	0.0379		51.0	0.00991*				
40	0.00690		80	0.00544		15	0.00240		72.4	0.0427		58.9	0.0118				
47	0.00879		95	0.00711		30	0.00900		89.0	0.0556		68.9	0.0149				
54	0.0107		112	0.00795		80	0.0500		103	0.0690		81.0	0.0185				
61	0.0129		CURVE 7			150	0.150		122	0.0854		96.0	0.0231				
70	0.0159		10	0.000628		190	0.215		149	0.105		118	0.0289				
80	0.0205		17	0.00176		275	0.300		179	0.126		140	0.0343				
94	0.0259		23.5	0.00339		CURVE 10			223	0.149		168	0.0393				
115	0.0343		28	0.00502		10.1	0.000506		256	0.166		195	0.0448				
			31	0.00628		16.0	0.00163		302	0.185		232	0.0510				
			39	0.0107								270	0.0582				
			49	0.0176								305	0.0594				

* Not shown on plot

THERMAL CONDUCTIVITY OF 875S GRAPHITE



SPECIFICATION TABLE NO. 9 THERMAL CONDUCTIVITY OF 87SS 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.

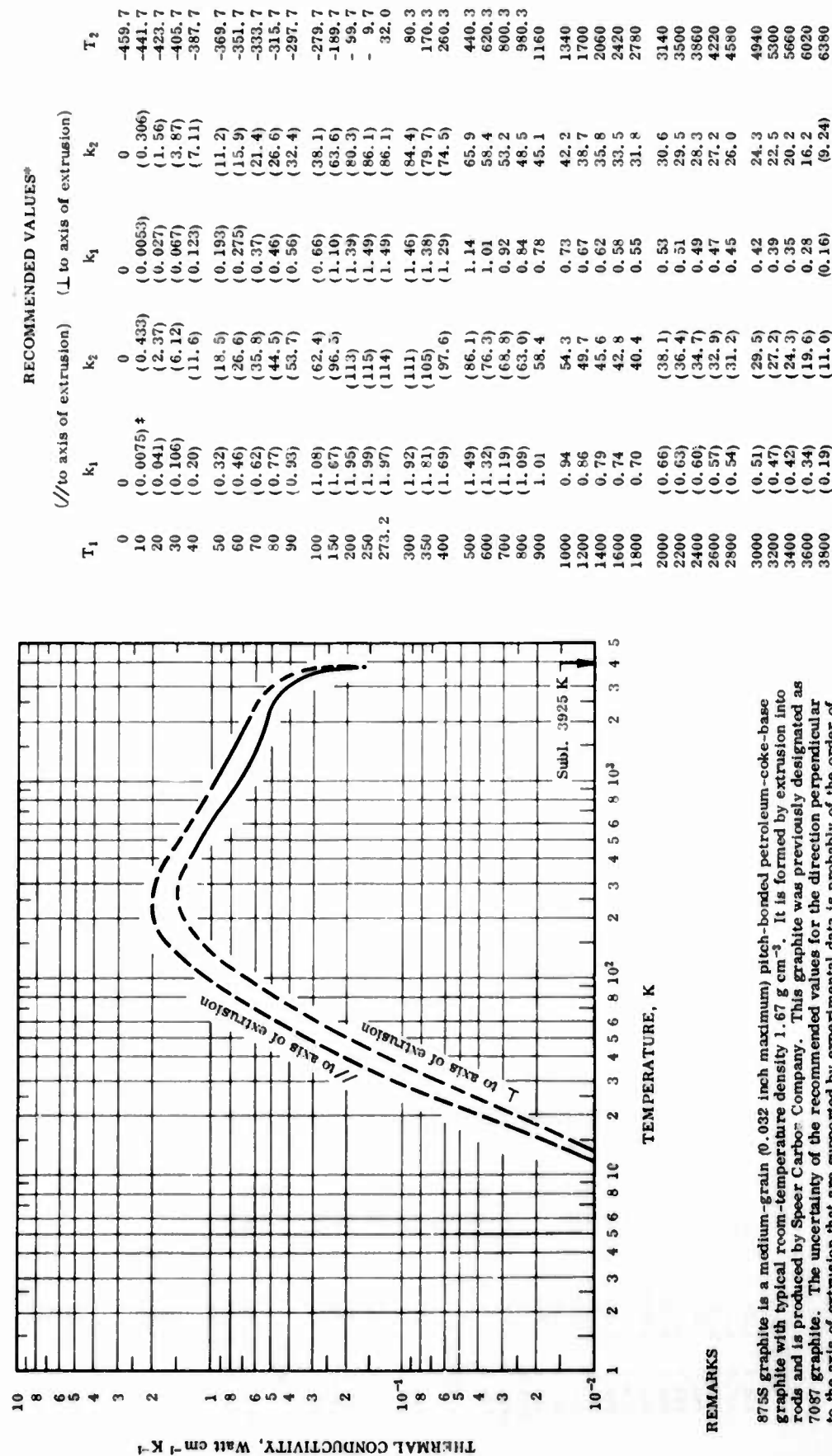
DATA TABLE NO. 9 THERMAL CONDUCTIVITY OF 875S GRAPHITE

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

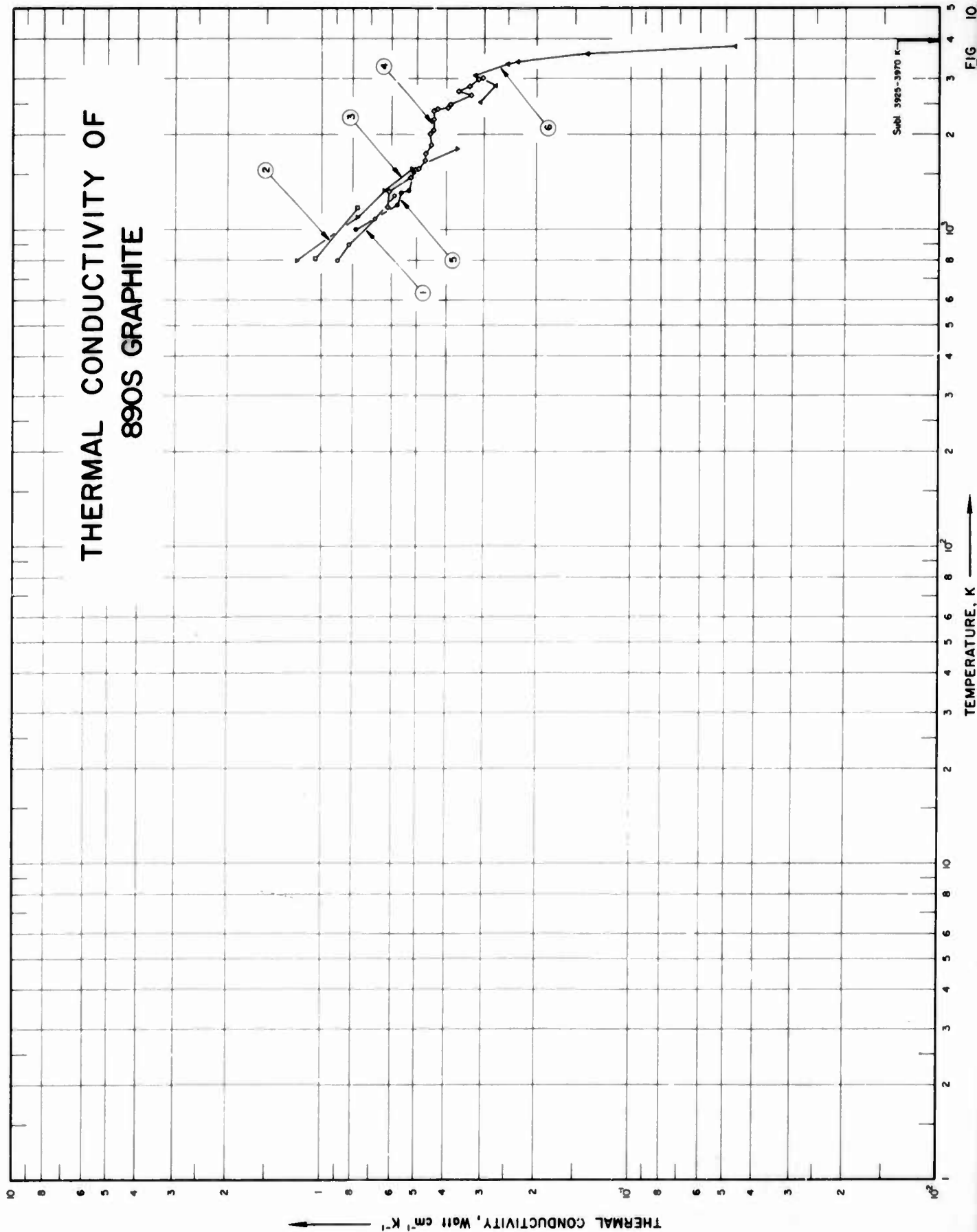
T	k	T	k
<u>CURVE 1</u>		<u>CURVE 4 (cont.)</u>	
433.2	1.23	3422.1	0.379
467.6	1.20	3694.3	0.289
503.2	1.15		
540.9	1.09	<u>CURVE 5</u>	
578.7	1.03	1351.0	0.403
658.7	0.943	1594.8	0.360
662.1	0.950*	1818.2	0.336
723.7	0.883	2158.7	0.331
754.8	0.884	2395.4	0.332
772.6	0.852	2527.1	0.310
849.8	0.796		
863.2	0.798*	<u>CURVE 6</u>	
895.4	0.794	1288.7	0.639
1015.9	0.725	1427.6	0.582
1015.9	0.710	1483.2	0.625
1182.1	0.673	1588.7	0.663
		1610.9	0.604
<u>CURVE 2</u>		1705.4	0.568
820.1	1.37	1783.2	0.545
1084.0	1.08	1855.4	0.509
1287.9	0.985	1998.5	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
1864.7	0.817	2355.4	0.504
		2394.3	0.470
<u>CURVE 3</u>		2505.4	0.528
2861.0	0.459	2533.2	0.474
2953.2	0.360	2599.8	0.466
3137.1	0.346		
3181.0	0.329		
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



THERMAL CONDUCTIVITY OF 890S GRAPHITE



SPECIFICATION TABLE NO. 10 THERMAL CONDUCTIVITY OF 890S GRAPHITE

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

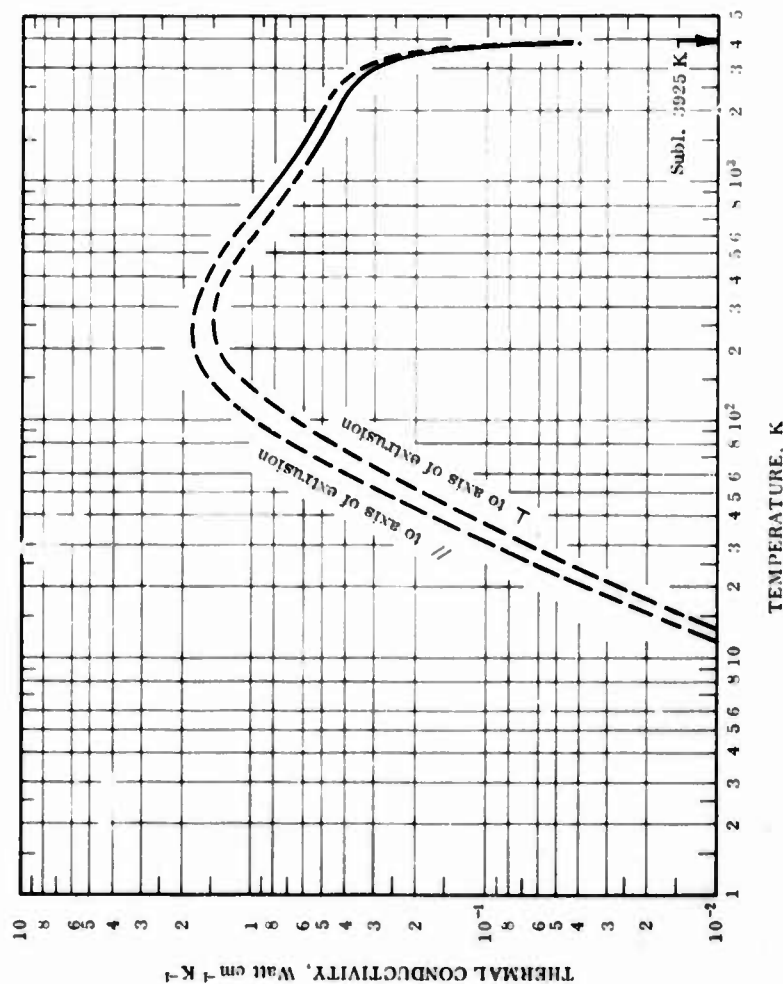
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	48	L	1956	832-1284	±5	1	7 in. dia x 1.5 in. thick; density 1.612 g cm ⁻³ ; measured with unidirectional heat flow through the disk.
2	48	L	1956	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>		<u>CURVE 5</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>		<u>CURVE 6</u>	
812.6	1.05	2539.9	0.310
1172.1	0.772	2853.2	0.275
<u>CURVE 3</u>		3075.1	0.322
797.6	1.20	3348.7	0.251
1099.8	0.774	3396.0	0.232
1330.4	0.633	3598.2	0.139
1553.2	0.516	3786.0	0.0467
1808.7	0.367		
<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		
2069.3	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



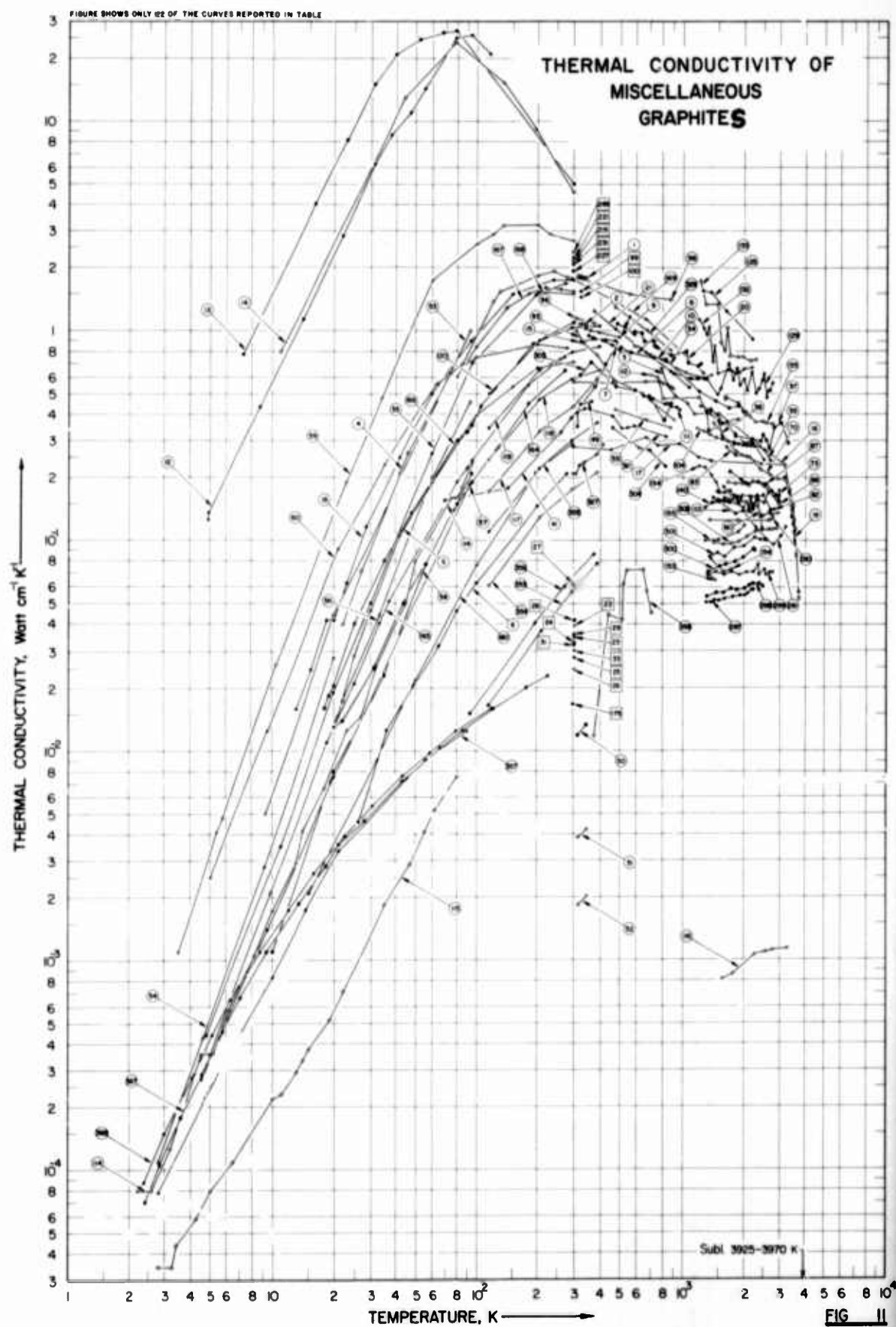
REMARKS

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 $\pm 20\%$, 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.

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

* 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 graphite; (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	612-1394	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	1952	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	1952	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 3100 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 $1557 \mu\text{ohm cm}$; measured with grain.
91	181		1959	298.2		TS-148	Similar to the above specimen but electrical resistivity $2594 \mu\text{ohm cm}$; 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 $2122 \mu\text{ohm cm}$; measured with grain.
93	181		1959	298.2		TS-160	Similar to the above specimen but measured against grain; electrical resistivity $3006 \mu\text{ohm cm}$.
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 $1942 \mu\text{ohm cm}$; 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^{-6} 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	553-963		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_z 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_T 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	1383-2583			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	1513-2046			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	293-1273			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; 3 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 an across 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 μ ohm cm; with grain orientation.
182	338		1962	298.2		AGSR	Similar to the above but electrical resistivity 1500 μ ohm 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 μ ohm 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 μ ohm cm; with grain orientation.
186	338		1962	298.2		AGSR	Similar to the above but electrical resistivity 1110 μ ohm 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 μ ohm cm; with grain orientation.
188	338		1962	298.2		AGSR	Similar to the above but electrical resistivity 1130 μ ohm 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 μ ohm cm; with grain orientation.
190	338		1962	298.2		AGA	Similar to the above but electrical resistivity 1090 μ ohm 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 μ ohm cm; with grain orientation.
192	338		1962	298.2		AGSX	Similar to the above but electrical resistivity 1330 μ ohm 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 μ ohm cm; with grain orientation.
194	338		1962	298.2		AGSX	Similar to the above but electrical resistivity 1390 μ ohm 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 μ ohm cm; with grain orientation.
196	338		1962	298.2		AGSX	Similar to the above but electrical resistivity 1010 μ ohm 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 μ ohm cm; with grain orientation.
198	338		1962	298.2		CS	Similar to the above but electrical resistivity 1310 μ ohm 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 μ ohm cm; with grain orientation.
200	338		1962	298.2		CS	Similar to the above but electrical resistivity 1100 μ ohm 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 μ ohm cm; with grain orientation.
202	338		1962	298.2		ATL	Similar to the above but electrical resistivity 1070 μ ohm 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 μ ohm cm; with grain orientation.
204	338		1962	298.2		ATL	Similar to the above but electrical resistivity 1180 μ ohm cm; across grain orientation.
205	338		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 μ ohm cm; with grain orientation.
206	338		1962	298.2		AUC	Similar to the above but electrical resistivity 1230 μ ohm 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 μ ohm 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 1072 $\mu\text{ohm cm}$; 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		CDG	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 'Kohinoor' 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 21.48 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	1593-3199			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. 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.
286	265	R	1960	1403-3273		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.
287	265	R	1960	1418-3188		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 3100 C.
288	265	R	1960	1503-3073		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.
289	265	R	1960	1363-3183		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.
290	265	R	1960	1373-2773		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).
291	367	R	1963	1343-2313			The above specimen heat treated at 2400 C for 10 min.
292	367	R	1963	1303-2603			The above specimen heat treated at 2800 C for 10 min.
293	367	R	1963	1303-2948			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).
294	367	R	1963	1353-2303			The above specimen heated at 2400 C for 10 min.
295	367	R	1963	1363-2583			The above specimen heated at 2800 C for 10 min.
296	367	R	1963	1373-2973			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 0.50 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).
297	367	R	1963	1318-2233			

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, 600, 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 Morgan 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 3.5×10^{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, 0.0968, 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	1088-3030		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. Vacuum wax 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			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		
<u>CURVE 129 (cont.)</u>				<u>CURVE 132 (cont.)</u>				<u>CURVE 135 (cont.)</u>				<u>CURVE 139*</u>				<u>CURVE 143*</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			1973.2	0.193	1893.2	0.206						
2760	0.565	2180	0.67	2263.2	0.369	1600	0.163	<u>CURVE 144*</u>		2093.2	0.207	2263.2	0.192						
<u>CURVE 130*</u>				2473.2	0.370	1700	0.189	1653.2	0.175	<u>CURVE 152*</u>		2503.2	0.184						
1180	0.50	1220	1.73	2568.2	0.366	1800	0.175	2061.2	0.162	1643.2	0.186	2803.2	0.180	20	0.0130				
1310	0.30	1300	1.34	2608.2	0.365*	1900	0.182	2393.2	0.0887	1803.2	0.187	2933.2	0.190	22	0.0140				
1425	0.245	1490	1.35	2713.2	0.360*	2000	0.172			1983.2	0.193	<u>CURVE 159*</u>		31	0.0250				
1525	0.225	1540	0.88	2773.2	0.360	2100	0.159	<u>CURVE 145*</u>		2083.2	0.192	1293.2	0.163	44	0.0500				
1590	0.21	1610	0.8	<u>CURVE 136*</u>		2200	0.165	1833.2	0.167	2123.2	0.203	1533.2	0.169	80	0.150				
1680	0.23	1670	1.04	1593.2	0.249	<u>CURVE 140</u>		2158.2	0.163	<u>CURVE 153</u>		1743.2	0.169	95	0.190				
1740	0.20	1700	0.76	1733.2	0.249	1300	0.143	2323.2	0.171	<u>CURVE 154</u>		2033.2	0.170	180	0.450				
1880	0.20	1890	0.75	1893.2	0.212	1400	0.152	2543.2	0.142	<u>CURVE 160*</u>		2443.2	0.168	273	0.650				
2150	0.185	1970	0.75	1993.2	0.230	1500	0.156	2773.2	0.146	1363.2	0.0686	2783.2	0.167						
2290	0.195	2150	0.72	2093.2	0.238	1600	0.155	2983.2	0.127	1453.2	0.0649	2998.2	0.166	18.5	0.011				
2400	0.195	2280	0.73	2163.2	0.218	1700	0.153	3037.2	0.120	<u>CURVE 155</u>		3093.2	0.180	25	0.021				
<u>CURVE 131*</u>				2323.2	0.230	1800	0.156*	3268.2	0.109	<u>CURVE 161*</u>									
1180	0.345	1220	0.227	2473.2	0.217	1900	0.151*	<u>CURVE 146*</u>		1293.2	0.100								
1240	0.365	1290	0.224	2509.2	0.198	2000	0.150*	1833.2	0.134	1593.2	0.0711								
1340	0.31	1380	0.205	2663.2	0.202	2100	0.153*	1733.2	0.0732	<u>CURVE 156*</u>									
1420	0.27	1460	0.19	2823.2	0.192	2200	0.142	2478.2	0.121	1393.2	0.0816								
1480	0.24	1510	0.17	<u>CURVE 137*</u>		2300	0.164	2743.2	0.114	1533.2	0.101								
1570	0.205	1620	0.17	1623.2	0.220	2465	0.114	<u>CURVE 147*</u>		1858.2	0.111								
1700	0.205	1700	0.173	1773.2	0.205	<u>CURVE 141*</u>		1683.2	0.146	2013.2	0.119								
1800	0.19	1770	0.164	1853.2	0.206	1300	0.145	1963.2	0.142	<u>CURVE 157*</u>									
1870	0.185	1860	0.15	2023.2	0.190	1400	0.143	<u>CURVE 148*</u>		1393.2	0.131								
2070	0.19	1900	0.155*	2253.2	0.184	1500	0.141	1643.2	0.184	1563.2	0.155								
2140	0.175	1980	0.143	2323.2	0.180	1600	0.150	1703.2	0.205	1813.2	0.176								
2240	0.2	2080	0.153*	2578.2	0.180	1700	0.141	<u>CURVE 149*</u>		2073.2	0.186								
2350	0.18	2240	0.15	2773.2	0.178	1800	0.137	1643.2	0.201	2333.2	0.174								
<u>CURVE 132</u>				2823.2	0.170	1900	0.138	2013.2	0.222	<u>CURVE 158*</u>									
1200	1.14	2510	0.152	<u>CURVE 138*</u>		2100	0.146	1643.2	0.201	<u>CURVE 162*</u>									
1260	1.025	2630	0.169	1653.2	0.205	2200	0.160	2013.2	0.222	1393.2	0.207								
1326	0.95	<u>CURVE 135</u>		1943.2	0.180	<u>CURVE 142*</u>		1653.2	0.218	1513.2	0.176								
1350	1.05	1823.2	0.476	2093.2	0.181	1513.2	0.197	1753.2	0.213	1653.2	0.207								
1420	0.71	1823.2	0.486	2423.2	0.175	1833.2	0.174	2043.2	0.209	1813.2	0.176								
1440	0.845	1863.2	0.455	2493.2	0.170	2048.2	0.159	2253.2	0.223	2158.2	0.180								
1490	0.625	1973.2	0.420	2823.2	0.170	<u>CURVE 150*</u>		2453.2	0.172	2525.2	0.174								
1670	0.655	1993.2	0.415	<u>CURVE 139*</u>		2823.2	0.159	2603.2	0.174	2603.2	0.174								
1740	0.645	2008.2	0.404	1653.2	0.205	<u>CURVE 143*</u>		1393.2	0.207	1513.2	0.176								

* 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 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	0.992	298.2	1.21	298.2	0.987	298.2	0.946	298.2	1.32		
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	298.2	1.84		
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	298.2	0.929		
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	1.51	1353.2	0.347	298.2	1.25	298.2	1.46	298.2	0.849	298.2	2.15	298.2	1.96	298.2	2.39		
<u>CURVE 169</u>		1503.2	0.339	<u>CURVE 190*</u>		<u>CURVE 202*</u>		<u>CURVE 214*</u>		<u>CURVE 226*</u>		<u>CURVE 238*</u>		<u>CURVE 250*</u>			
293.2	1.782	1873.2	0.318	298.2	1.19	298.2	1.21	290.2	0.155	298.2	0.828	298.2	0.736	298.2	1.78		
673.2	1.130	2303.2	0.301	<u>CURVE 191*</u>		<u>CURVE 203*</u>		373.2	0.159	<u>CURVE 227</u>		<u>CURVE 239*</u>		<u>CURVE 251*</u>			
1273.2	0.628	<u>CURVE 180</u>		298.2	1.62	298.2	1.15	<u>CURVE 215</u>		298.2	1.94	298.2	1.95	298.2	1.47		
<u>CURVE 170*</u>		15.2	0.00209	<u>CURVE 192*</u>		<u>CURVE 204*</u>		298.2	2.16	<u>CURVE 228*</u>		<u>CURVE 240*</u>		<u>CURVE 252*</u>			
1273.2	0.492	50.2	0.0218	298.2	0.975	298.2	1.10	<u>CURVE 216*</u>		298.2	1.04	298.2	0.741	298.2	0.812		
1873.2	0.452	100.2	0.0762	<u>CURVE 193*</u>		<u>CURVE 205*</u>		298.2	0.870	<u>CURVE 229*</u>		<u>CURVE 241*</u>		<u>CURVE 253*</u>			
<u>CURVE 171*</u>		195.2	0.211	298.2	1.58	298.2	1.64	<u>CURVE 217*</u>		298.2	2.01	298.2	1.98	298.2	1.56		
296.2	0.291	<u>CURVE 194*</u>		<u>CURVE 206*</u>		<u>CURVE 218*</u>		298.2	1.87	<u>CURVE 230*</u>		<u>CURVE 242*</u>		<u>CURVE 254*</u>			
<u>CURVE 172*</u>		298.2	0.866	298.2	0.933	298.2	1.05	<u>CURVE 219*</u>		298.2	0.980	298.2	0.732	298.2	0.339		
1273.2	0.431	<u>CURVE 195*</u>		<u>CURVE 207*</u>		<u>CURVE 220*</u>		298.2	0.833	<u>CURVE 231</u>		<u>CURVE 243*</u>		<u>CURVE 255*</u>			
1873.2	0.310	298.2	1.49	298.2	1.58	298.2	1.69	<u>CURVE 221</u>		298.2	2.09	298.2	2.03	298.2	1.56		
<u>CURVE 173*</u>		<u>CURVE 196*</u>		<u>CURVE 208*</u>		<u>CURVE 232*</u>		298.2	2.19	<u>CURVE 244*</u>		<u>CURVE 256*</u>		<u>CURVE 256*</u>			
1273.2	0.624	298.2	1.02	298.2	1.28	298.2	1.33	<u>CURVE 222*</u>		298.2	1.33	298.2	0.912	298.2	0.339		
1873.2	0.419	<u>CURVE 197*</u>		<u>CURVE 209*</u>		<u>CURVE 233*</u>		298.2	0.770	<u>CURVE 245*</u>		<u>CURVE 257*</u>		<u>CURVE 257*</u>			
<u>CURVE 174*</u>		298.2	1.47	298.2	1.58	298.2	0.259	<u>CURVE 223</u>		298.2	1.78	298.2	2.23	298.2	1.10		
1273.2	0.272	<u>CURVE 198*</u>		<u>CURVE 210*</u>		<u>CURVE 225*</u>		<u>CURVE 234*</u>		<u>CURVE 246*</u>		<u>CURVE 258*</u>		<u>CURVE 260*</u>			
1873.2	0.226	298.2	1.58	298.2	1.58	298.2	0.259	298.2	2.25	<u>CURVE 235*</u>		<u>CURVE 247*</u>		<u>CURVE 259*</u>			
<u>CURVE 175</u>		<u>CURVE 199*</u>		<u>CURVE 211*</u>		<u>CURVE 226*</u>		<u>CURVE 235*</u>		<u>CURVE 247*</u>		<u>CURVE 259*</u>		<u>CURVE 261*</u>			

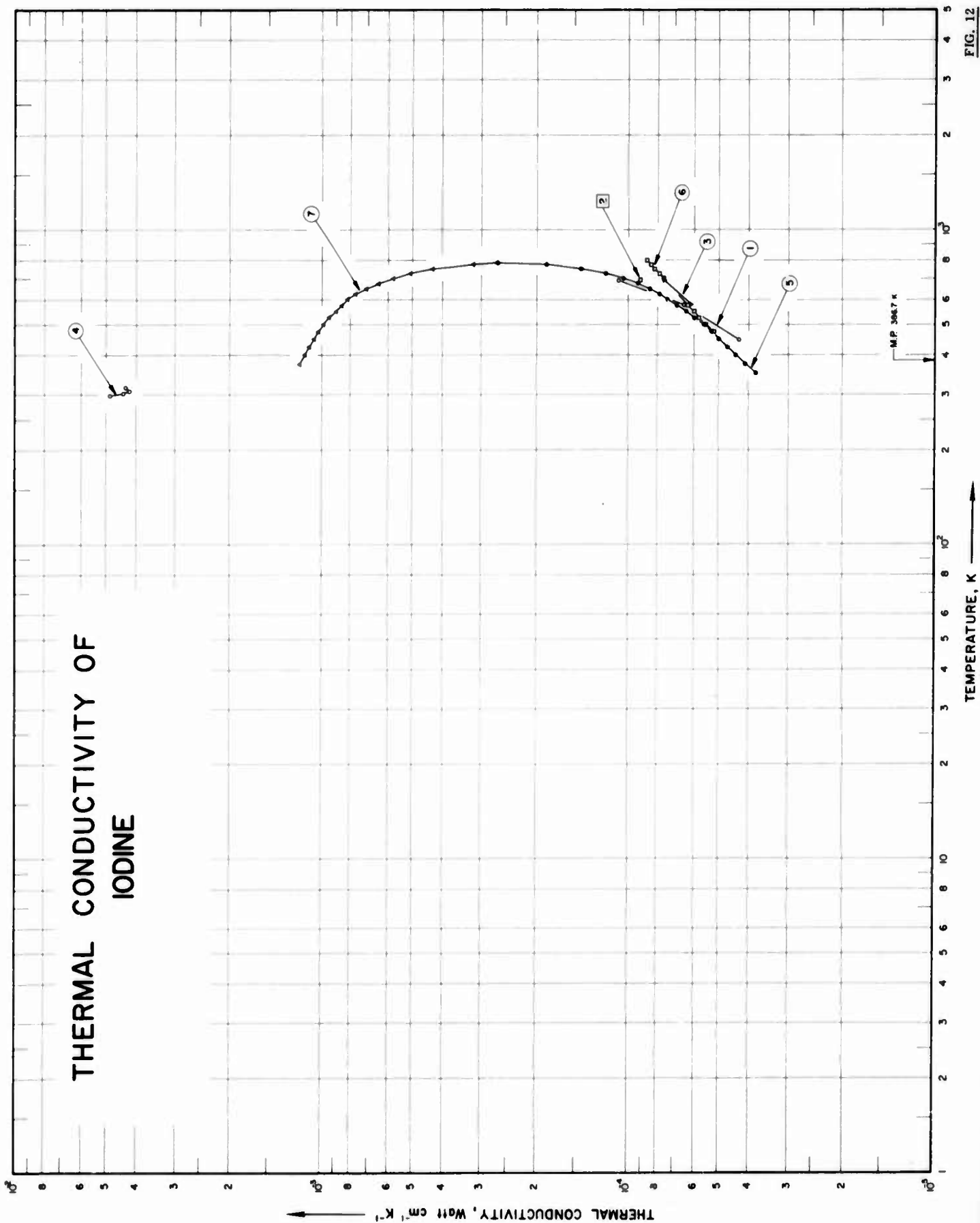
* Not shown on plot

* 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
<u>CURVE 350*</u>		<u>CURVE 354</u>		<u>CURVE 360*</u>		<u>CURVE 366*</u>		<u>CURVE 368 (cont.)</u>		<u>CURVE 373*</u>		<u>CURVE 377 (cont.)*</u>		<u>CURVE 381 (cont.)*</u>					
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	<u>CURVE 361*</u>		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				
<u>CURVE 355</u>		<u>CURVE 362*</u>		463.2	0.00276	463.2	0.00276	<u>CURVE 369*</u>		1886	0.202	1048	0.753	2000	0.400				
115	0.110	473.2	1.64	493.2	0.00276	493.2	0.00276	318.2	1.16	2233	0.151	1113	0.711	<u>CURVE 382*</u>					
205	0.220	573.2	1.44	523.2	0.00276	523.2	0.00276	323.2	1.18	<u>CURVE 374*</u>		<u>CURVE 378*</u>		1200	0.660				
295	0.302	773.2	1.20	643.2	0.00282	643.2	0.00282	338.2	1.16	93.2	2.49	323.2	1.58	1320	0.580				
385	0.365	873.2	1.13	703.2	0.00287	703.2	0.00287	353.2	1.07	193.2	2.05	353.2	1.53	1450	0.520				
<u>CURVE 356</u>		<u>CURVE 363*</u>		763.2	0.00289	763.2	0.00289	435.2	1.02	273.2	1.75	408.2	1.42						
371.5	1.25	311.2	0.0544	873.2	0.00301	873.2	0.00301	543.2	0.900	373.2	1.46	423.2	1.41						
<u>CURVE 357</u>		<u>CURVE 364*</u>		<u>CURVE 367</u>		<u>CURVE 370*</u>		<u>CURVE 375*</u>		<u>CURVE 379*</u>									
374.8	1.24	311.2	0.0795	2.41	0.000703	2.41	0.000703	93.2	1.75	313.2	1.61								
492.6	1.16	341.2	0.0879	2.85	0.000107	2.85	0.000107	193.2	1.40	320.7	1.60								
494.8	1.18	456.2	0.0879	4.54	0.000287	4.54	0.000287	273.2	1.15	338.2	1.57								
752.1	0.957	582.2	0.0879	5.78	0.000459	5.78	0.000459	1048	0.513	358.2	1.52								
760.4	0.945	676.2	0.0711	7.05	0.000667	7.05	0.000667	1083	0.464	398.2	1.46								
1015	0.874	753.2	0.0711	9.38	0.00109	9.38	0.00109	1342	0.293	440.7	1.38								
1017	0.886	853.2	0.0669	13.4	0.00187	13.4	0.00187	1363	0.345	505.7	1.26								
1325	0.770	<u>CURVE 363*</u>		18.3	0.00284	18.3	0.00284	<u>CURVE 371*</u>		613.2	1.07	123.2	1.78						
1633	0.762	310.2	0.167	22.1	0.00359	22.1	0.00359	673.2	1.00	233.2	1.76	313.2	1.72						
1942	0.711	329.2	0.184	27.9	0.00465	27.9	0.00465	710.7	0.946	353.2	1.70	413.2	1.71						
2205	0.710	345.2	0.201	43.5	0.00718	43.5	0.00718	798.2	0.904	453.2	1.67	503.2	1.63						
<u>CURVE 352*</u>		465.2	0.192	66.4	0.0104	66.4	0.0104	818.2	0.870	543.2	1.59	628.2	1.46						
2.8	0.000078	470.2	0.201	86.3	0.0127	86.3	0.0127	898.2	0.837	628.2	1.46	763.2	1.28						
4.7	0.00022	601.2	0.167	122.2	0.0161	122.2	0.0161	943.2	0.778	853.2	1.12	973.2	0.962						
10.0	0.00083	609.2	0.176	177.8	0.0201	177.8	0.0201	953.2	0.745	1018	0.728	<u>CURVE 381*</u>							
14.5	0.00175	643.2	0.167	227.0	0.0228	227.0	0.0228	1076	0.669	1128	0.628	<u>CURVE 382*</u>							
21	0.0033	<u>CURVE 368</u>		<u>CURVE 372*</u>		<u>CURVE 377*</u>		<u>CURVE 383*</u>		<u>CURVE 387*</u>									
56	0.0091	2.38	0.0000875	2.38	0.0000875	2.38	0.0000875	1798	0.241	483.2	1.26								
90	0.0125	4.06	0.00277	4.06	0.00277	4.06	0.00277	1848	0.146	555.7	1.15								
<u>CURVE 358</u>		5.12	0.000443	5.12	0.000443	5.12	0.000443	1907	0.130	585.7	1.11								
373.2	0.0646	6.32	0.000652	6.32	0.000652	6.32	0.000652	2013	0.176	633.2	1.08								
438.2	0.0717	706.2	0.146	8.75	0.00110	8.75	0.00110	2548	0.131	748.2	0.946								
515.2	0.0465	788.2	0.138	11.8	0.00175	11.8	0.00175	2798	0.117	<u>CURVE 379*</u>									
523.2	0.0670	804.2	0.142	15.9	0.00262	15.9	0.00262	3048	0.142	<u>CURVE 380*</u>									
543.2	0.0728	<u>CURVE 364*</u>		<u>CURVE 367</u>		<u>CURVE 370*</u>		<u>CURVE 375*</u>		<u>CURVE 379*</u>									
655.2	0.0488	336.7	1.09	336.7	1.09	336.7	1.09	483.2	1.26	<u>CURVE 382*</u>									
676.2	0.0512	<u>CURVE 365*</u>		<u>CURVE 368</u>		<u>CURVE 372*</u>		<u>CURVE 377*</u>		<u>CURVE 381*</u>									
713.2	0.0520	343.2	0.154	343.2	0.154	343.2	0.154	555.7	1.15	<u>CURVE 383*</u>									
<u>CURVE 359*</u>		295	0.0571	295	0.0571	295	0.0571	633.2	1.05	<u>CURVE 384*</u>									
385	0.0775	385	0.0775	385	0.0775	385	0.0775	723.2	0.962	<u>CURVE 385*</u>									
<u>CURVE 360*</u>		<u>CURVE 364*</u>		<u>CURVE 368</u>		<u>CURVE 372*</u>		<u>CURVE 377*</u>		<u>CURVE 381*</u>									
115	0.061	343.2	0.253	343.2	0.253	343.2	0.253	483.2	1.26	<u>CURVE 382*</u>									
205	0.128	<u>CURVE 361*</u>		<u>CURVE 365*</u>		<u>CURVE 369*</u>		<u>CURVE 374*</u>		<u>CURVE 378*</u>									
295	0.176	388.2	0.00274	388.2	0.00274	388.2	0.00274	555.7	1.15	<u>CURVE 383*</u>									
385	0.212	448.2	0.00276	448.2	0.00276	448.2	0.00276	748.2	0.946	<u>CURVE 384*</u>									
<u>CURVE 355</u>		<u>CURVE 362*</u>		<u>CURVE 366*</u>		<u>CURVE 370*</u>		<u>CURVE 375*</u>		<u>CURVE 379*</u>									
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	<u>CURVE 361*</u>		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				
<u>CURVE 355</u>		<u>CURVE 362*</u>		463.2	0.00276	463.2	0.00276	<u>CURVE 369*</u>		1886	0.202	1048	0.753	2000	0.400				
115	0.110	473.2	1.64	493.2	0.00276	493.2	0.00276	318.2	1.16	2233	0.151	1113	0.711	<u>CURVE 382*</u>					
205	0.220	573.2	1.44	523.2	0.00276	523.2	0.00276	323.2	1.18	<u>CURVE 374*</u>		<u>CURVE 378*</u>		1200	0.660				
295	0.302	773.2	1.20	643.2	0.00282	643.2	0.00282	338.2	1.16	93.2	2.49	323.2	1.58	1320	0.580				
385	0.365	873.2	1.13	703.2	0.00287	703.2	0.00287	353.2	1.07	193.2	2.05	353.2	1.53	1450	0.520				
<u>CURVE 356</u>		<u>CURVE 363*</u>		763.2	0.00289	763.2	0.00289	435.2	1.02	273.2	1.75	408.2	1.42						
371.5	1.25	311.2	0.0544	873.2	0.00301	873.2	0.00301	543.2	0.900	373.2	1.46	423.2	1.41						
<u>CURVE 357</u>		<u>CURVE 364*</u>		<u>CURVE 367</u>		<u>CURVE 370*</u>		<u>CURVE 375*</u>		<u>CURVE 379*</u>									
374.8	1.24	311.2	0.0795	2.41	0.000703	2.41	0.000703	93.2	1.75	313.2	1.61								
492.6	1.16	341.2	0.0879	2.85	0.000107	2.85	0.000107	193.2	1.40	320.7	1.60								
494.8	1.18	456.2	0.0879	4.54	0.000287	4.54	0.000287	273.2	1.15	338.2	1.57								
752.1	0.957	582.2	0.0879	5.78	0.000459	5.78	0.000459	1048	0.513	358.2	1.52								
760.4	0.945	676.2	0.0711	7.05	0.000667	7.05	0.000667	1083	0.464	398.2	1.46								
1015	0.874	753.2	0.0711	9.38	0.00109	9.38	0.00109	1342	0.293	440.7	1.38								
1017	0.886	853.2	0.0669	13.4	0.00187	13.4	0.00187	1363	0.345	505.7	1.26								
1325	0.770	<u>CURVE 363*</u>		18.3	0.00284	18.3	0.00284	<u>CURVE 371*</u>		613.2	1.07	123.2	1.78						
1633	0.762	310.2	0.167	22.1	0.00359	22.1	0.00359	673.2	1.00	233.2	1.76	313.2	1.72						
1942	0.711	329.2	0.184	27.9	0.00465	27.9	0.00465	710.7	0.946	353.2	1.70	413.2	1.71						
2205	0.710	345.2	0.201	43.5	0.00718	43.5	0.00718	798.2	0.904	453.2	1.67	503.2	1.63						
<u>CURVE 352*</u>		465.2	0.192	66.4	0.0104	66.4	0.0104	818.2	0.870	543.2	1.59	628.2	1.46						
2.8	0.000078	470.2	0.201	86.3	0.0127	86.3	0.0127	898.2	0.837	628.2	1.46	763.2	1.28						
4.7	0.00022	601.2	0.167	122.2	0.0161	122.2	0.0161	943.2	0.778	853.2	1.12	973.2	0.962						
10.0	0.00083	609.2	0.176	177.8	0.0201	177.8	0.0201	953.2	0.745	1018	0.728	<u>CURVE 381*</u>							
14.5	0.00175	643.2	0.167	227.0	0.0228	227.0	0.0228	1076	0.669	1128	0.628	<u>CURVE 382*</u>							
21	0.0033	<u>CURVE 368</u>		<u>CURVE 372*</u>		<u>CURVE 377*</u>		<u>CURVE 383*</u>		<u>CURVE 387*</u>									
56	0.0091	2.38	0.0000875	2.38	0.0000875	2.38	0.0000875	1798	0.241	483.2	1.26								
90	0.0125	4.06	0.00277	4.06	0.00277	4.06	0.00277	1848	0.146	555.7	1.15								
<u>CURVE 358</u>		5.12	0.000443	5.12	0.000443	5.12	0.000443	1907	0.130	585.7	1.11								
373.2	0.0646	6.32	0.000652	6.32	0.000652	6.32	0.000652	2013	0.176	633.2	1.08								
438.2	0.0717	706.2	0.146	8.75	0.00110	8.75	0.00110	2548	0.131	748.2	0.946								
515.2	0.0465	788.2	0.138	11.8	0.00175	11.8	0.00175	2798	0.117	<u>CURVE 379*</u>									
523.2	0.0670	804.2	0.142	15.9	0.00262	15.9	0.00262	3048	0.142	<u>CURVE 380*</u>									
543.2	0.0728	<u>CURVE 364*</u>		<u>CURVE 367</u>		<u>CURVE 370*</u>		<u>CURVE 375*</u>		<u>CURVE 379*</u> </									

* Not shown on plot



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				Similar to above, except measured at a pressure of 175 mm Hg.
4	450	C	1923	298-316	±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.
5	*			350-785				Saturated vapor; recommended values based on the correlation of Schaefer and Thodos (A.I.Ch.E. Journal, 5, 367-72, 1959).
6	*			350-800				Gas at 1 atm; recommended values based on the correlation of Schaefer and Thodos. (A.I.Ch.E. Journal, 5, 367-72, 1959).
7	*			375-795				Saturated liquid; recommended values based on the correlation of Schaefer and Thodos (A.I.Ch.E. Journal, 5, 367-72, 1959).

DATA TABLE NO. 12 THERMAL CONDUCTIVITY OF IODINE

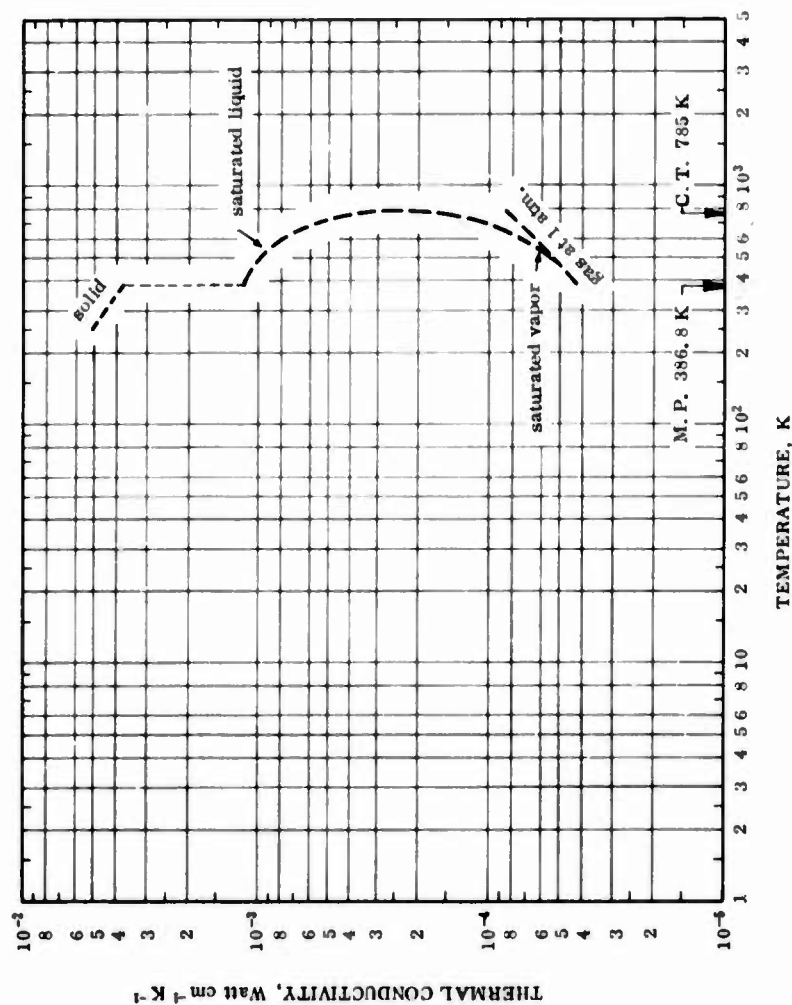
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	CURVE 1		T	k	CURVE 4		T	k	CURVE 5 (cont.)		T	k	CURVE 6		T	k	CURVE 5 (cont.)		T	k	CURVE 6 (cont.)		T	k	CURVE 7		T	k	CURVE 7 (cont.)	
		447	578			575	600			475	500			525	575			525	550			525	550			525	550			525	550
447	0.0000431	297.6	0.00487							0.000053	0.000196			0.000058	0.000058			0.000058	0.000058			0.000058	0.000058			0.000058	0.000058			0.000058	0.000058
578	0.0000653	302.7	0.00441							0.000056	0.000265			0.000060	0.000060			0.000060	0.000060			0.000060	0.000060			0.000060	0.000060			0.000060	0.000060
693	0.000108	308.6	0.00421							0.000060	0.000060			0.000060	0.000060			0.000060	0.000060			0.000060	0.000060			0.000060	0.000060			0.000060	0.000060
		316.1	0.00434							0.000064	0.000064			0.000064	0.000064			0.000064	0.000064			0.000064	0.000064			0.000064	0.000064			0.000064	0.000064
										0.000069	0.000069			0.000069	0.000069			0.000069	0.000069			0.000069	0.000069			0.000069	0.000069			0.000069	0.000069
										0.000075	0.000075			0.000075	0.000075			0.000075	0.000075			0.000075	0.000075			0.000075	0.000075			0.000075	0.000075
693	0.0000912	350	0.000038							0.000079	0.000079			0.000079	0.000079			0.000079	0.000079			0.000079	0.000079			0.000079	0.000079			0.000079	0.000079
		375	0.000041							0.000085	0.000085			0.000085	0.000085			0.000085	0.000085			0.000085	0.000085			0.000085	0.000085			0.000085	0.000085
		400	0.000044							0.000093	0.000093			0.000093	0.000093			0.000093	0.000093			0.000093	0.000093			0.000093	0.000093			0.000093	0.000093
579	0.0000619	425	0.000047							0.000104	0.000104			0.000104	0.000104			0.000104	0.000104			0.000104	0.000104			0.000104	0.000104			0.000104	0.000104
693	0.0000761	450	0.000050							0.000119	0.000119			0.000119	0.000119			0.000119	0.000119			0.000119	0.000119			0.000119	0.000119			0.000119	0.000119
										0.000143	0.000143			0.000143	0.000143			0.000143	0.000143			0.000143	0.000143			0.000143	0.000143			0.000143	0.000143

* 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)

T_2

- 9.7

32.0

80.3

170.3

236.5

236.5

260.3

440.3

620.3

800.3

953.3

236.5

260.3

440.3

620.3

800.3

953.3

236.5

260.3

440.3

620.3

800.3

953.3

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

† Values in parentheses are estimated.

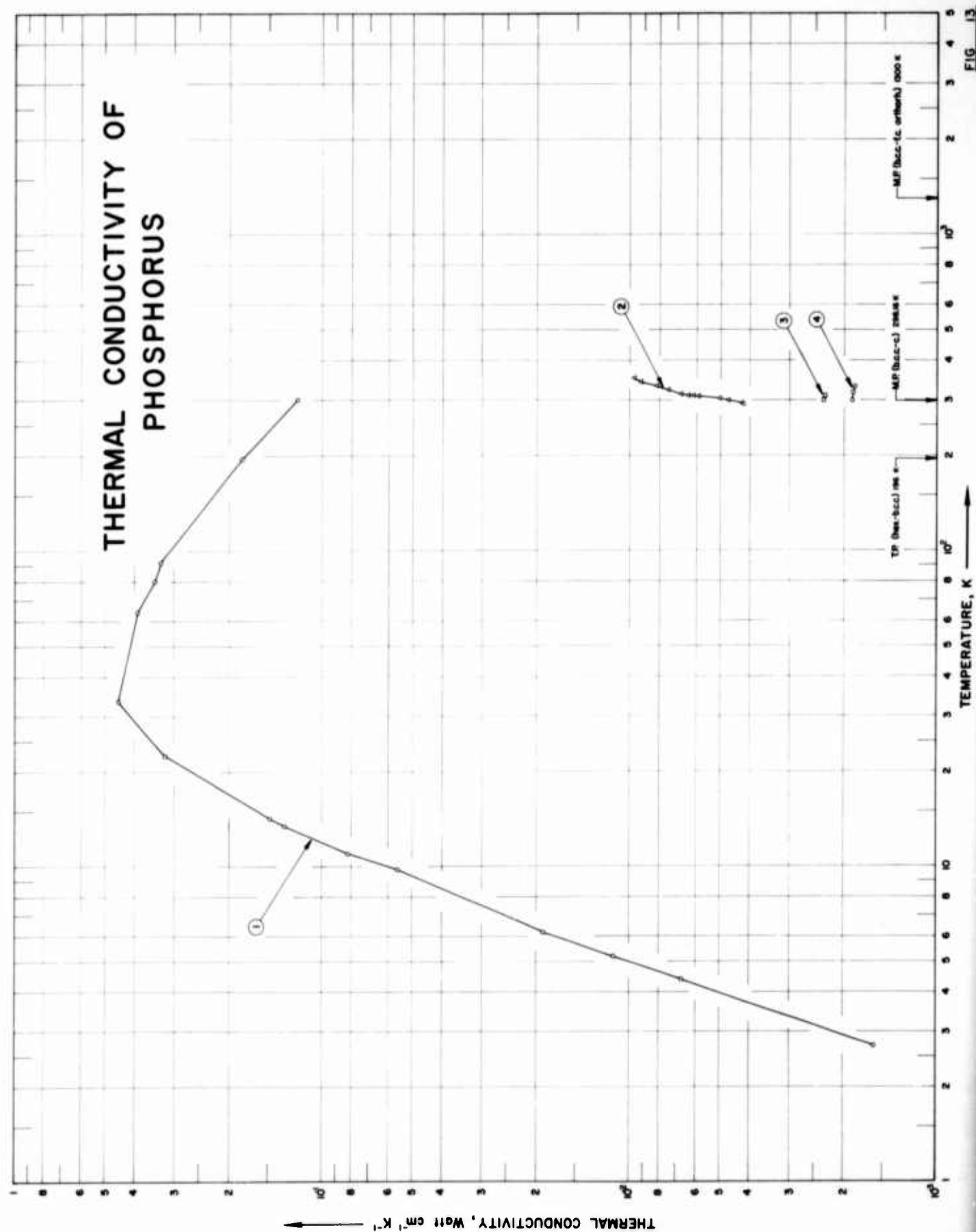


FIG. 13

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 $\sim 200 \mu$; orthorhombic (black) phosphorus rod of dimensions $1.2 \times 0.35 \times 0.35$ 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 $44.0 \pm 0.1 \text{ C}$.
4	544	P	1964	301-331	± 2		Similar to the above specimen except in liquid state (the first data point for super-cooled liquid).

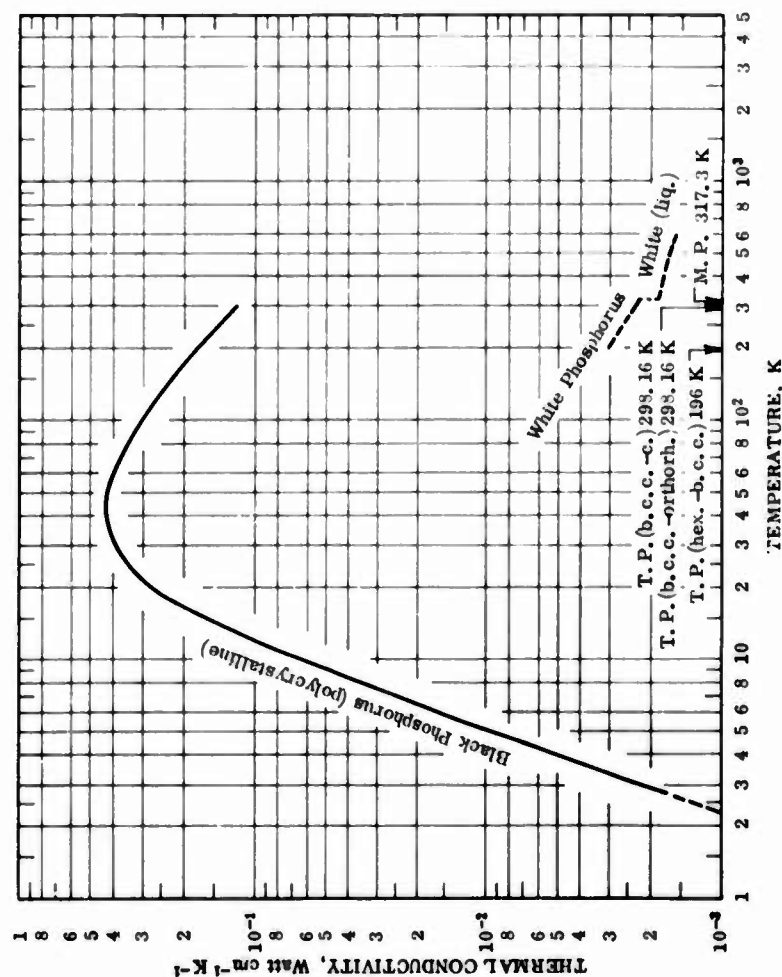
DATA TABLE NO. 13 THERMAL CONDUCTIVITY OF PHOSPHORUS

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

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



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.

RECOMMENDED VALUES*

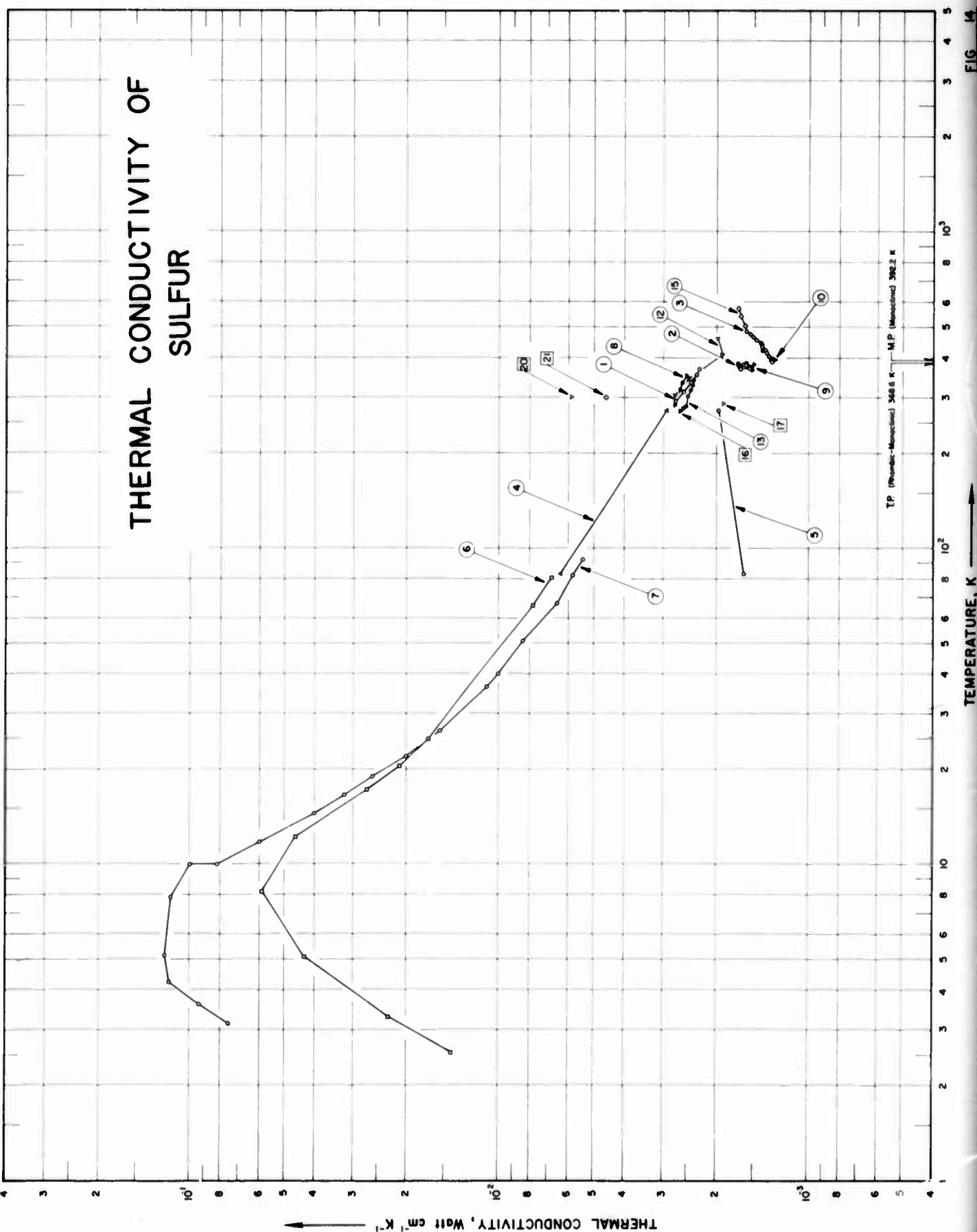
Polycrystalline Black Phosphorus				White Phosphorus			
T_1	k_1	k_2	T_2	T_1	k_1	k_2	T_2
0	0	0	-459.7	0	0	0	-459.7
1	(0.0000796)†	(0.00456)	-457.9	200	(0.00308)	(0.178)	-99.7
2	(0.000645)	(0.0373)	-456.1	250	(0.00265)	(0.153)	-9.7
3	0.00220	0.127	-454.3	273.2	(0.00250)	(0.144)	32.0
4	0.00511	0.295	-452.5	300	0.00235	0.136	80.3
5	0.00598	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	317.3	0.00187	0.108	111.4
13	0.122	7.05	-436.3	350	(0.00183)	(0.106)	170.3
14	0.144	8.32	-434.5	400	(0.00178)	(0.103)	260.3
15	0.165	9.53	-432.7	500	(0.00167)	(0.0965)	440.3
16	0.187	10.8	-430.9	600	(0.00157)	(0.0907)	620.3
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

* T_1 in K, k_1 in Watt cm⁻¹K⁻¹, T_2 in F, and k_2 in Btu hr⁻¹ft⁻¹F⁻¹.

†Values in parentheses are extrapolated.

FIGURE SHOWS ONLY 14 OF THE CURVES REPORTED IN TABLE



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	99.98 pure; α (rhombic) sulfur; polycrystalline; crown glass plate used as comparative material, the thermal conductivity of which is given as $k = 0.803 \pm 0.00054$ t with k in kcal m ⁻¹ hr ⁻¹ C ⁻¹ and t in C.
8	442, 333	C	1964, 1965	285-354	± 1		99.98 pure; β (monoclinic) sulfur; polycrystalline; same comparative material used as above.
9	333	C	1965	370-389	± 1		99.98 pure; liquid sulfur; same comparative material used as above.
10	333	C	1965	395-428	± 1		4 cm dia x 0.193 cm thick.
11	443	L	1898	306, 334			Data cover both solid and liquid states.
12	444, 445	P	1964	305-460			
13	446	R	1932	277-353			Rhombic crystal; spherical shell specimen with O. D. 10.200 cm and I. D. 5.314 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	$< \pm 3$		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.

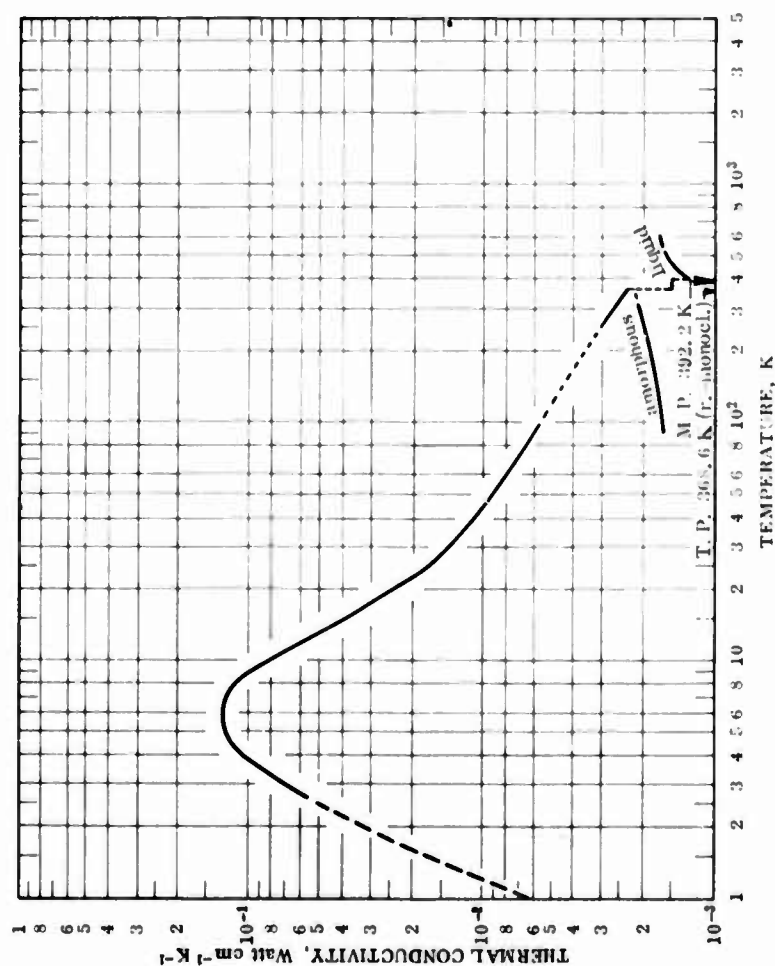
DATA TABLE NO. 14 THERMAL CONDUCTIVITY OF SULFUR

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

T	k	T	k	T	k	T	k	T	k	T	k	T	k	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*	273.2	0.00264
313.2	0.00286	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		
368.2	0.00166	463.2	0.00151	25.0	0.0168	67.0	0.0065	384.16	0.00148	460.2	0.00199	303.3	0.00255	276.73	0.00258
369.2	0.00155	473.2	0.00154	66.0	0.0078	82.0	0.0058	384.75	0.00156	<u>CURVE 13</u>					
373.2	0.00167	483.2	0.00158	81.0	0.0068	92.0	0.0054	385.38	0.00150	318.9	0.00252	307.8	0.00254		
375.2	0.00155							386.92	0.00159	327.8	0.00247	<u>CURVE 15*</u>			
377.2	0.00169							388.11	0.00148	338.3	0.00243	300	0.00209		
379.2	0.00163	<u>CURVE 4</u>				<u>CURVE 7</u>				277.2	0.00259	358.0	0.00238		
381.2	0.00170	83.2	0.00637	3.15	0.075	285.03	0.00275			281.5	0.00253	<u>CURVE 20</u>			
383.2	0.00159	273.2	0.00293	3.60	0.093	292.61	0.00274	<u>CURVE 10*</u>							
				4.25	0.116	306.38	0.00268	303.7	0.00249	303.3	0.00247*	<u>CURVE 15</u>			
				5.15	0.120	316.76	0.00265	304.0	0.00247*	304.0	0.00247*	460.1	0.00149*		
				7.90	0.115	322.26	0.00263	395.21	0.00129	316.6	0.00244	501.2	0.00161		
				10.00	0.099	332.26	0.00260	400.65	0.00132	328.0	0.00244*	537.3	0.00166		
				10.00	0.082	337.27	0.00258	405.29	0.00130	328.5	0.00241*	574.3	0.00169		
				11.80	0.060	347.23	0.00254	410.71	0.00132	328.8	0.00241				
				14.50	0.040	354.80	0.00251	420.57	0.00136	340.6	0.00239				
388.2	0.00131							427.71	0.00139						
393.2	0.00132														

* Not shown on plot

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



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.

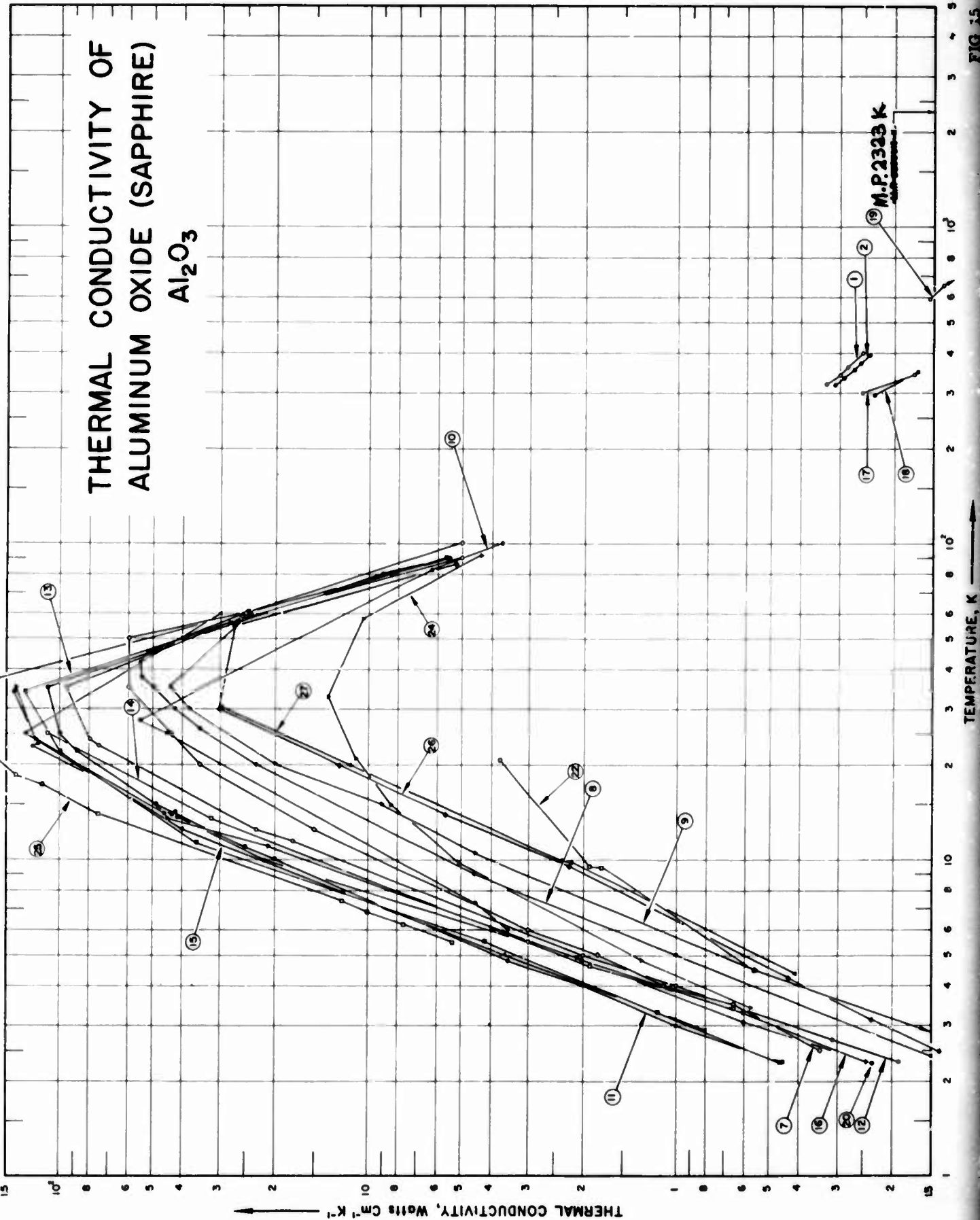
RECOMMENDED VALUES*

T ₁	k ₁	k ₂	T ₂	T ₁	k ₁	k ₂	T ₂
Polycrystalline							
1	(0.00662) ± (0.383)		-457.9				
2	(0.0320)	(1.85)	-456.1	90	0.00163	0.0942	-297.7
3	0.0694	4.01	-454.3	100	0.00165	0.0953	-279.7
4	0.106	6.12	-452.5	150	0.00175	0.101	-189.7
5	0.124	7.16	-450.7	200	0.00185	0.107	-99.7
6	0.128	7.40	-448.9	250	0.00195	0.113	-9.7
7	0.123	7.11	-447.1	273.2	0.00200	0.116	32.0
8	0.112	6.47	-445.3	300	0.00206	0.119	80.3
9	0.0970	5.60	-443.5	350	(0.00216)	(0.125)	170.3
10	0.0817	4.72	-441.7	In Liquid State			
11	0.0688	3.98	-439.9				
12	0.0581	3.36	-438.1				
13	0.0499	2.88	-436.3				
14	0.0435	2.51	-434.5				
15	0.0384	2.22	-432.7	392.2	0.00129	0.0745	246.3
16	0.0343	1.98	-430.9	400	0.00132	0.0763	260.3
18	0.0280	1.62	-427.3	500	0.00160	0.0924	440.3
20	0.0235	1.36	-423.7	600	(0.00170)	(0.0982)	620.3
25	0.0169	0.976	-414.7				
30	0.0140	0.809	-405.7				
35	0.0122	0.705	-396.7				
40	0.0109	0.630	-387.7				
45	0.00993	0.574	-378.7				
50	0.00917	0.530	-369.7				
60	0.00799	0.462	-351.7				
70	0.00717	0.414	-333.7				
80	0.00654	0.378	-315.7				
90	0.00602	0.348	-297.7				
100	(0.00562)	(0.325)	-279.7				
150	(0.00430)	(0.248)	-189.7				
200	(0.00355)	(0.205)	-99.7				
250	(0.00305)	(0.176)	-9.7				
273.2	0.00287	0.166	32.0				
300	0.00269	0.155	80.3				
350	0.00242	0.140	170.3				
368.6	0.00233	0.135	203.8				
368.6	0.00154	0.0890	203.8				
392.2	0.00150	0.0867	246.3				

* 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.

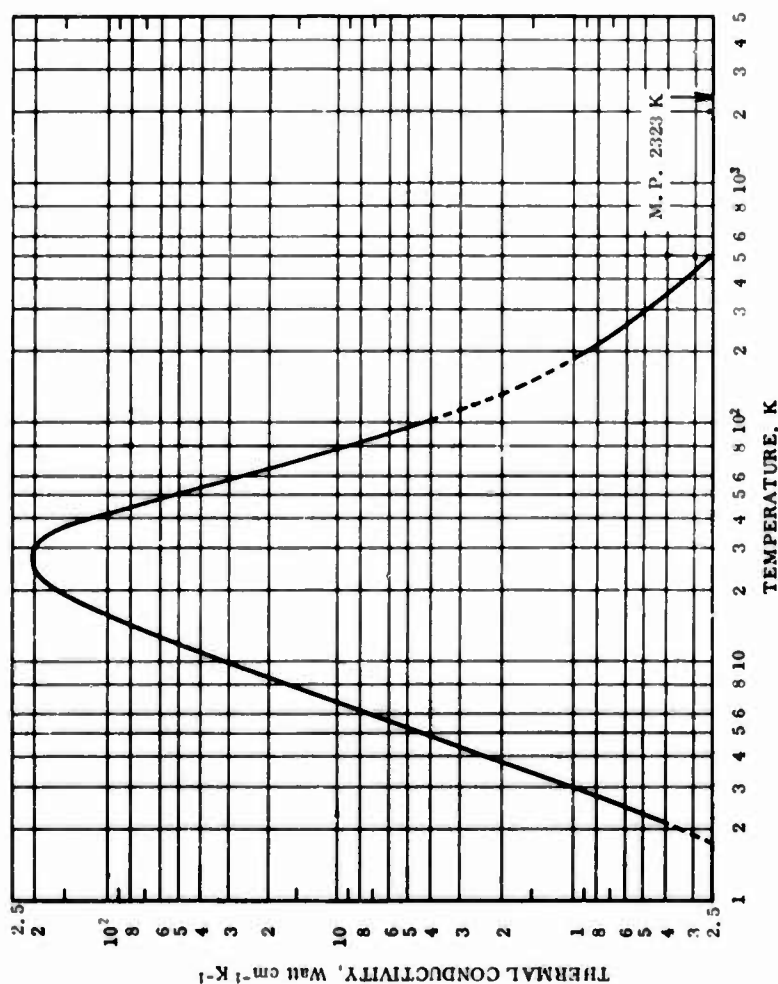
SPECIFICATION TABLE NO. 15 (continued)

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.

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

[illegible]

Not shown on plot

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

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.

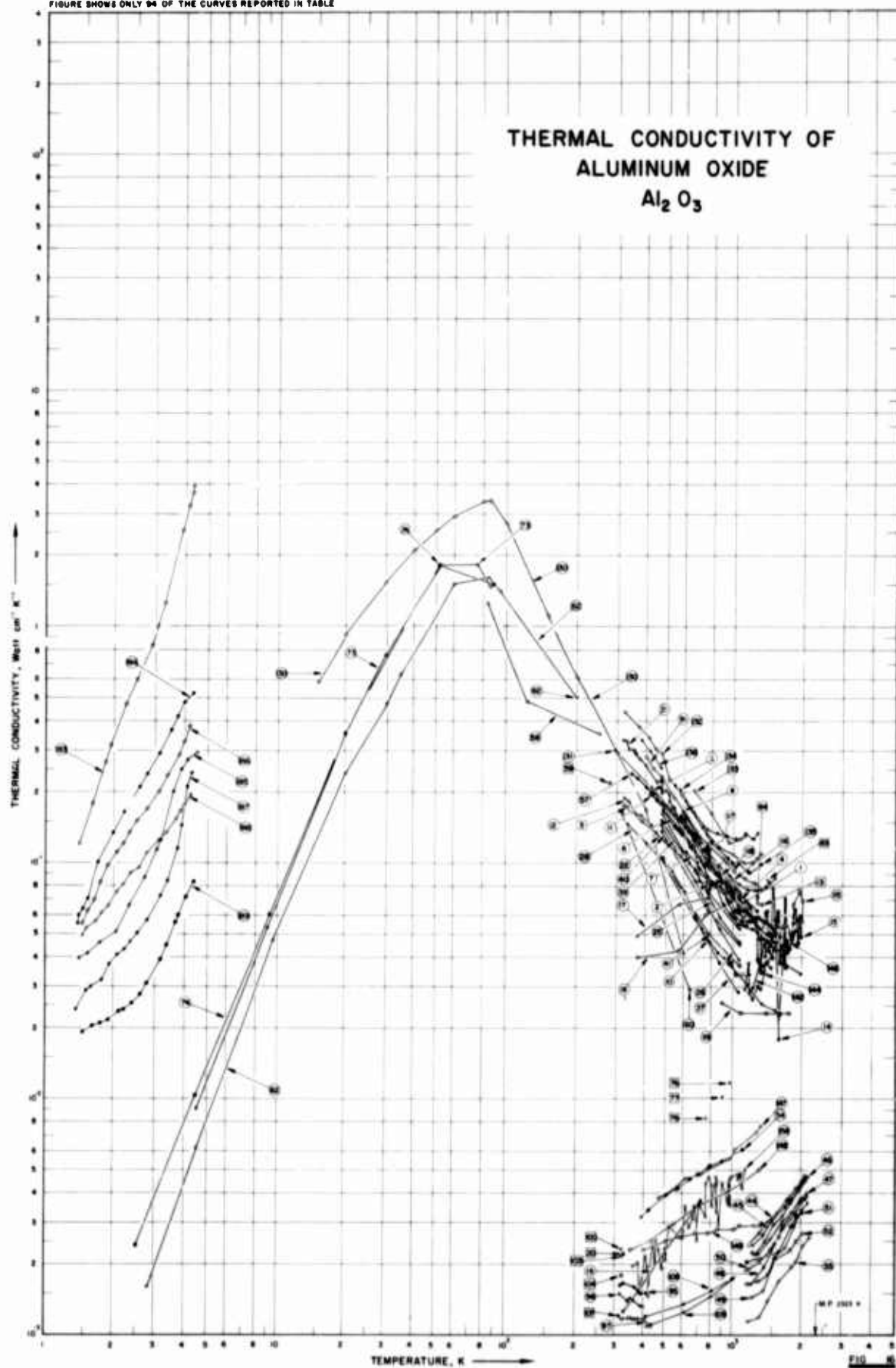
RECOMMENDED VALUES*
(High-purity synthetic sapphire single crystal)

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)	(30.6)	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

* 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 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_2O_3 ; supplied by McDanel Refractory Porcelain Co.; porosity 25.65; 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			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 1.9%.
14	89	R	1952	1397-1973	5-7	M-2	Prepared by slip casting and firing.
15	89	R	1952	1273-1983	5-7	M-4	Similar to the above specimen.
16	89	R	1952	1336-2028	5-7	M-5	Similar to the above specimen.
17	34	C	1943	373-769		Corundum (African)	Red; single crystal; measured parallel to c-axis; 18-8 stainless steel used as comparative material.
18	34	C	1943	372-985		Corundum (African)	Red; single crystal; measured normal to c-axis; 18-8 stainless steel used as comparative material.
19	79	L	1942	328, 728			Porous; measured in the presence of air atmosphere; density 0.77 g cm^{-3} .
20	79	L	1942	328.2			Same as the above specimen but measured in the presence of hydrogen atmosphere.
21	131	C	1954	318-900	<3		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 cataphoretically on a tungsten wire and then heated to 1600-1700 C.
45	134	R	1952	1248-2083			Porous layer coated cataphoretically on a tungsten wire and then heated to 1600-1700 C.
46	134	R	1952	1268-2143			Porous layer coated cataphoretically on a tungsten wire and then heated to 1600-1700 C.
47	134	R	1952	1243-2143			Porous layer coated cataphoretically on a tungsten wire and then heated to 1600-1700 C.
48	134	R	1952	1223-2093			Porous layer coated cataphoretically on a tungsten wire and then heated to 1600-1700 C.
49	134	R	1952	1233-2143			Porous layer coated cataphoretically on a tungsten wire and then heated to 1600-1700 C.
50	134	R	1952	1193-2123			Porous layer coated cataphoretically on a tungsten wire and then heated to 1600-1700 C.
51	134	R	1952	1173-2043			Porous layer coated cataphoretically on a tungsten wire and then heated to 1600-1700 C.
52	134	R	1952	1173-2043			Porous layer coated cataphoretically on a tungsten wire and then heated to 1600-1700 C.
53	134	R	1952	1193-2193			Porous layer coated cataphoretically 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_2O_3 ; total porosity 19.8%.
58	137	P	1957	84-249		AV30	96.0 Al_2O_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 Na ₂ O, 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. Alundum	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. Alundum	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 SiO ₂ , 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 (bohmite) 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_2O_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% theoretical density; average crystal size about 2μ , with some crystals as large as 70μ .
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_2O_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_2O_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_2O_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 13μ ; 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	383-1403		A-5	Polycrystalline specimen fabricated by pressing hydrostatically and sintering; grain size 28μ ; 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 19μ ; 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	N	1960	1238-1473		TC 352	99.3 pure; supplied by Gladding McBean; sintered; bulk density 3.8 g cm ⁻³ (97% 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 confocal; 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	R	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-350	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 Al-300	Specimen obtained from Western Gold and Platinum Co.; alumina cubes used as reference standard obtained from W. D. Kingery, 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		AlI-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		AlI-2	Similar to the above specimen.
161	401, 402	R	1960	975-1255		AlI-3	Similar to the above specimen.
162	401, 402	R	1960	789, 889		AlI-4	Similar to the above specimen.
163	401, 402	R	1960	821, 1064		AlI-5	Similar to the above specimen.
164	401, 402	R	1960	1001-1229		AlI-6	Similar to the above specimen.
165	401, 402	R	1960	923-1145		AlI-7	Similar to the above specimen.
166	401, 402	R	1960	980-1198		AlI-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			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 ⁻⁴ ~ 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 ⁻⁴ ~ 2.95 x 10 ⁻⁴ 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	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>			
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												
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												
1152.2	0.0623	1053.2	0.0638	1203.2	0.0565	524.2	0.164	1393.2	0.0410*	1508.2	0.0460	400.2	0.259	773.2	0.114												
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												
1574.2	0.0536	1153.2	0.0607			661.2	0.124	1413.2	0.0460*	1753.2	0.0490	418.2	0.247*	786.2	0.103												
1674.2	0.0527	1228.2	0.0586	<u>CURVE 8</u>				743.2	0.105	0.0623	1778.2	0.0410	426.2	0.244*	813.2	0.0962*											
1737.2	0.0540	1293.2	0.0586	593.2	0.165	839.2	0.0904	1428.2	0.0423	1826.2	0.0418	426.2	0.241*	818.2	0.0900*												
		1353.2	0.0565	683.2	0.132	964.2	0.0803	1448.2	0.0439*	1943.2	0.0556	430.2	0.236*	833.2	0.0933*												
		1453.2	0.0552	763.2	0.0983	1067.2	0.0715	1483.2	0.0473*	1963.2	0.0632	443.2	0.229*	836.2	0.0891*												
		1523.2	0.0502	853.2	0.0900			1498.2	0.0397	2023.2	0.0464	450.2	0.220*	853.2	0.0891*												
		1553.2	0.0502	933.2	0.0782	<u>CURVE 12</u>				1504.2	0.0490*	2028.2	0.0577	863.2	0.0920*												
				1013.2	0.0711	322.4	0.188	1508.2	0.0435	2028.2	0.0577	470.2	0.223	873.2	0.0866*												
				1083.2	0.0628			1553.2	0.0561	<u>CURVE 17</u>				473.2	0.220*	900.2	0.0816*										
				1113.2	0.0628	339.2	0.182	1573.2	0.0619	473.2	0.210*	473.2	0.215*	<u>CURVE 22</u>													
				1193.2	0.0607	360.9	0.162	1573.2	0.0368*	373.2	0.0490	473.2	0.210*														
				1253.2	0.0586	382.4	0.159	1573.2	0.0485	575.2	0.0669	473.2	0.204														
						425.2	0.145	1607.2	0.0485	769.2	0.0707	473.2	0.197	323.0	0.175												
				<u>CURVE 9</u>				1608.2	0.0377	496.2	0.203			385.8	0.150												
				293.2	0.251	1333.2	0.0669	1618.2	0.0444	508.2	0.198*	498.2	0.197*	449.0	0.123												
				323.2	0.213			1666.2	0.0406*	516.2	0.195	585.7	0.197*	490.0	0.123												
				373.2	0.169	<u>CURVE 14</u>				1703.2	0.0469*	572.2	0.0423	789.8	0.0820												
				423.2	0.142	1387.2	0.0402	1723.2	0.0473*	985.2	0.0682	543.2	0.170	1007.3	0.0675*												
				473.2	0.121	1392.2	0.0469	1723.2	0.0510*			548.2	0.164	1160.0	0.0613*												
				523.2	0.109	1447.2	0.0502	1735.2	0.0469	<u>CURVE 19</u>				550.2	0.169*												
				573.2	0.0962	1463.2	0.0456	1738.2	0.0540*	328.2	0.00126	578.2	0.158*	1512.0	0.0550*												
				673.2	0.0820	1487.2	0.0732	1743.2	0.0414	728.2	0.00372	583.2	0.156*	1589.8	0.0549*												
				773.2	0.0732*	1523.2	0.0573	1753.2	0.0427*			596.2	0.155*	1694.4	0.0550*												
				873.2	0.0669*	1595.2	0.0178	1773.2	0.0431	<u>CURVE 20</u>				600.2	0.154												
				973.2	0.0607*	1598.2	0.0226	1808.2	0.0481	328.2	0.00222	633.2	0.139*	1773.2	0.0556*												
				1073.2	0.0586*	1641.2	0.0531*	1813.2	0.0477*	328.2	0.00222	636.2	0.135*	1875.8	0.0556*												
				1173.2	0.0586*	1663.2	0.0402	1818.2	0.0498*			646.2	0.132*														
				1263.2	0.0569*	1681.2	0.0707	1848.2	0.0506*	<u>CURVE 21</u>				657.2	0.135												
						1690.2	0.0372	1848.2	0.0569	318.2	0.330	696.2	0.128	473.2	0.213												
				<u>CURVE 10</u>				1973.2	0.0339	330.2	0.327	708.2	0.120*	673.2	0.121												
				769.2	0.0473			1853.2	0.0552*	338.2	0.304	720.2	0.115*	873.2	0.0837												
				964.2	0.0372	<u>CURVE 15</u>				1908.2	0.0632	743.2	0.111*	1073.2	0.0693												
				1155.2	0.0305	1273.2	0.0515*	1918.2	0.0582*			756.2	0.113	1152.0	0.0549*												
				1347.2	0.0251	1275.2	0.0531	1930.2	0.0577*			783.2	0.105	1273.2	0.0537												
				1535.2	0.0238	1298.2	0.0389	1943.2	0.0456			833.2	0.094	1473.2	0.0535												
				1631.2	0.0230	1298.2	0.0389	1953.2	0.0594			883.2	0.090	1473.2	0.0535												
						1333.2	0.0343	1983.2	0.0594			943.2	0.0837	1473.2	0.0535												
						1398.2	0.0343	1983.2	0.0594			943.2	0.0837	1473.2	0.0535												
						1553.2	0.0460					943.2	0.0837	1473.2	0.0535												

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*(cont.)</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	1173.2	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
17.75	0.117	14.66	0.0970	<u>CURVE 77</u>		551.2	0.153	<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	611.2	0.135	379.2	0.241	1125.2	0.0858	1241.2	0.0816	355.4	0.000692
<u>CURVE 65*</u> (T = 773.2 K)		<u>CURVE 71*</u> (T = 1073.2 K)		<u>CURVE 78*</u>		672.2	0.120	389.2	0.227	1241.2	0.0816	317.6	0.00163	366.5	0.000675
7.25	0.0818	4.7	0.0600	<u>CURVE 79*</u>		741.2	0.106	465.2	0.196	<u>CURVE 92*</u>		328.7	0.00166	377.6	0.000640
11.75	0.0701	9.6	0.0529	901.5	0.0102	819.2	0.0929	503.2	0.180	371.2	0.296	380.9	0.00154	<u>CURVE 100</u>	
17.8	0.0565	14.67	0.0449	<u>CURVE 78*</u>		925.2	0.0791	542.2	0.164	423.2	0.249	394.3	0.00151	322.1	0.00232
22.1	0.0471	19.7	0.0372	1318.0	0.0567	962.2	0.0753	628.2	0.136	474.2	0.216	416.5	0.00152	<u>CURVE 101*</u>	
<u>CURVE 66*</u> (T = 1073.2 K)		<u>CURVE 72*</u> (T = 1073.2 K)		<u>CURVE 79*</u>		1032.2	0.0690	633.2	0.132	562.2	0.164	<u>CURVE 96</u>		322.1	0.00208
7.5	0.0546	4.7	0.0656	<u>CURVE 80*</u>		712.2	0.117	802.2	0.100	667.2	0.129	315.4	0.00149	322.1	0.00216
12.0	0.0474	9.7	0.0620	1333.5	0.0482	1171.2	0.0602	839.2	0.0916	751.2	0.109	340.9	0.00140	<u>CURVE 102*</u>	
17.75	0.0387	14.75	0.0588	<u>CURVE 81*</u>		<u>CURVE 87*</u>		893.2	0.0862	810.2	0.0983	349.8	0.00144	322.1	0.00166
22.15	0.0320	19.7	0.0557	1284.0	0.0583	403.2	0.259	946.2	0.0812	955.2	0.0795	362.6	0.00140	<u>CURVE 103</u>	
<u>CURVE 67*</u> (T = 473.2 K)		<u>CURVE 73</u>		<u>CURVE 82*</u>		466.2	0.232	1019.2	0.0736	1029.2	0.0741	388.9	0.00133	322.1	0.00166
4.6	0.184	4.5	0.0091	<u>CURVE 83</u>		406.2	0.215	1036.2	0.0724	1029.2	0.0741	388.9	0.00133	<u>CURVE 104</u>	
9.65	0.155	9.01	0.0532	1289.5	0.0547	466.2	0.215	1138.2	0.0661	1120.2	0.0686	399.8	0.00132	<u>CURVE 105*</u>	
13.4	0.136	20.0	0.35	<u>CURVE 84</u>		507.2	0.194	1234.2	0.0619	1243.2	0.0640	<u>CURVE 97</u>		322.1	0.00216
19.6	0.104	30.3	0.76	<u>CURVE 85*</u>		571.2	0.159	<u>CURVE 90*</u>		<u>CURVE 93*</u>		321.5	0.00117	<u>CURVE 106*</u>	
<u>CURVE 68*</u> (T = 473.2 K)		<u>CURVE 74</u>		<u>CURVE 86*</u>		625.2	0.138	376.2	0.249	373.2	0.295	346.5	0.00118	322.1	0.00178
4.5	0.200	2.52	0.0024	<u>CURVE 87*</u>		680.2	0.120	451.2	0.220	473.2	0.234	363.2	0.00117	<u>CURVE 107</u>	
9.7	0.189	4.45	0.0103	<u>CURVE 88*</u>		746.2	0.107	489.2	0.196	573.2	0.182	377.6	0.00118	<u>CURVE 108</u>	
13.5	0.182	9.2	0.0608	<u>CURVE 89*</u>		800.2	0.100	526.2	0.170	673.2	0.143	405.4	0.00118	<u>CURVE 109</u>	
19.7	0.168	19.9	0.351	<u>CURVE 90*</u>		1036.2	0.0728	593.2	0.155	773.2	0.118	433.2	0.00109	322.1	0.00163
<u>CURVE 69*</u> (T = 773.2 K)		<u>CURVE 75</u>		<u>CURVE 91</u>		1123.2	0.0644	660.2	0.136	873.2	0.102	436.5	0.00111	<u>CURVE 110</u>	
4.25	0.0885	39.0	1.50	<u>CURVE 92*</u>		1213.2	0.0640	792.2	0.107	973.2	0.0887	<u>CURVE 98*</u>		293.2	0.000987
9.64	0.0749	1173.2	0.0643	<u>CURVE 93*</u>		<u>CURVE 98*</u>		911.2	0.0891	1073.2	0.0795	318.2	0.000987	293.2	0.000970
14.75	0.0628	1473.2	0.0536	<u>CURVE 94*</u>		423.2	0.258	1073.2	0.0782	1173.2	0.0703	337.6	0.000987	313.2	0.00100
19.75	0.0502	<u>CURVE 95*</u>		<u>CURVE 96*</u>		458.2	0.225	1154.2	0.0674	1273.2	0.0632	350.9	0.000987	<u>CURVE 111</u>	
<u>CURVE 70*</u> (T = 1073.2 K)		<u>CURVE 76</u>		<u>CURVE 97</u>		486.2	0.195	1243.2	0.0628	<u>CURVE 94*</u>		365.4	0.00104	<u>CURVE 112</u>	
2.52	0.0024	<u>CURVE 77</u>		<u>CURVE 98*</u>		524.2	0.187	<u>CURVE 91</u>		373.2	0.272	384.3	0.000935	313.2	0.00121
4.45	0.0103	<u>CURVE 78*</u>		<u>CURVE 99*</u>		549.2	0.167	403.2	0.282	473.2	0.218	403.2	0.000969	<u>CURVE 113</u>	
9.2	0.0608	19.9	0.351	<u>CURVE 80*</u>		583.2	0.157	429.2	0.251	573.2	0.169	430.9	0.000935	<u>CURVE 114</u>	
52.2	1.80	<u>CURVE 81*</u>		<u>CURVE 82*</u>		629.2	0.135	468.2	0.232	673.2	0.134	435.4	0.000935	<u>CURVE 115</u>	
89.0	1.50	<u>CURVE 83*</u>		<u>CURVE 84*</u>		666.2	0.127	537.2	0.189	773.2	0.111	444.3	0.000935	<u>CURVE 116</u>	
4.25	0.0885	<u>CURVE 85*</u>		<u>CURVE 86*</u>		798.2	0.0992	602.2	0.161	873.2	0.0962	<u>CURVE 99*</u>		413.2	0.00120
9.64	0.0749	<u>CURVE 87*</u>		<u>CURVE 88*</u>		917.2	0.0849	674.2	0.139	973.2	0.0845	613.2	0.00136	613.2	0.00136
14.75	0.0628	<u>CURVE 89*</u>		<u>CURVE 90*</u>		1010.2	0.0749	762.2	0.119	1073.2	0.0757	913.2	0.00154	913.2	0.00154
19.75	0.0502	<u>CURVE 91*</u>		<u>CURVE 92*</u>		1100.2	0.0678	<u>CURVE 93*</u>		<u>CURVE 94*</u>		<u>CURVE 100</u>		<u>CURVE 101</u>	
<u>CURVE 71*</u> (T = 1073.2 K)		<u>CURVE 77</u>		<u>CURVE 93*</u>		<u>CURVE 98*</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>	
7.25	0.0818	<u>CURVE 78*</u>		<u>CURVE 94*</u>		<u>CURVE 100</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>	
11.75	0.0701	<u>CURVE 79*</u>		<u>CURVE 95*</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
17.8	0.0565	<u>CURVE 80*</u>		<u>CURVE 96*</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
22.1	0.0471	<u>CURVE 81*</u>		<u>CURVE 97*</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
<u>CURVE 72*</u> (T = 1073.2 K)		<u>CURVE 78</u>		<u>CURVE 98*</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
7.5	0.0546	<u>CURVE 79</u>		<u>CURVE 99*</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
12.0	0.0474	<u>CURVE 80</u>		<u>CURVE 100</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
17.75	0.0387	<u>CURVE 81</u>		<u>CURVE 101</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
22.15	0.0320	<u>CURVE 82</u>		<u>CURVE 102</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
<u>CURVE 73</u>		<u>CURVE 83</u>		<u>CURVE 103</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
4.6	0.184	<u>CURVE 84</u>		<u>CURVE 104</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
9.65	0.155	<u>CURVE 85</u>		<u>CURVE 105</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
13.4	0.136	<u>CURVE 86</u>		<u>CURVE 106</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
19.6	0.104	<u>CURVE 87</u>		<u>CURVE 107</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
<u>CURVE 74</u>		<u>CURVE 88</u>		<u>CURVE 108</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
4.5	0.200	<u>CURVE 89</u>		<u>CURVE 109</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
9.7	0.189	<u>CURVE 90</u>		<u>CURVE 110</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
13.5	0.182	<u>CURVE 91</u>		<u>CURVE 111</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
19.7	0.168	<u>CURVE 92</u>		<u>CURVE 112</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
<u>CURVE 75</u>		<u>CURVE 93</u>		<u>CURVE 113</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
7.5	0.168	<u>CURVE 94</u>		<u>CURVE 114</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
11.8	0.147	<u>CURVE 95</u>		<u>CURVE 115</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
17.75	0.117	<u>CURVE 96</u>		<u>CURVE 116</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
22.25	0.0943	<u>CURVE 97</u>		<u>CURVE 117</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
<u>CURVE 76</u>		<u>CURVE 98</u>		<u>CURVE 118</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
763.7	0.00829	<u>CURVE 99</u>		<u>CURVE 119</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
<u>CURVE 77</u>		<u>CURVE 100</u>		<u>CURVE 120</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
977.6	0.0117	<u>CURVE 101</u>		<u>CURVE 121</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
<u>CURVE 78</u>		<u>CURVE 102</u>		<u>CURVE 122</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
901.5	0.0102	<u>CURVE 103</u>		<u>CURVE 123</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
<u>CURVE 79</u>		<u>CURVE 104</u>		<u>CURVE 124</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
977.6	0.0117	<u>CURVE 105</u>		<u>CURVE 125</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
<u>CURVE 80</u>		<u>CURVE 106</u>		<u>CURVE 126</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
354.2	0.234	<u>CURVE 107</u>		<u>CURVE 127</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
410.2	0.209	<u>CURVE 108</u>		<u>CURVE 128</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
493.2	0.175	<u>CURVE 109</u>		<u>CURVE 129</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
551.2	0.153	<u>CURVE 110</u>		<u>CURVE 130</u>		<u>CURVE 101*</u>		<u>CURVE 102*</u>		<u>CURVE 103</u>		<u>CURVE 104</u>		<u>CURVE 105*</u>	
611.2															

DATA TABLE NO. 16 (continued)

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			1061.5	0.00403
1377.2	0.00500			673.2	0.121	872.1	0.00291	1228.7	0.00742	<u>CURVE 171</u>		1186.5	0.00429
<u>CURVE 149</u>		<u>CURVE 153</u>		773.2	0.101	903.7	0.00438			<u>CURVE 172</u>		1334.8	0.00402
405.2	0.00230	833.2	0.0916	873.2	0.0862	961.5	0.00358	<u>CURVE 165</u>		557.6	0.00227	<u>CURVE 177</u>	
513.2	0.00250	983.2	0.0766	973.2	0.0757	966.5	0.00441	922.6	0.00453	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	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	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 173</u>		1620.9	0.00391
873.2	0.00280	1433.2	0.0561	<u>CURVE 158</u>		1063.7	0.00478	<u>CURVE 166</u>		478.7	0.00199	1124.8	0.00396
1033.2	0.00280	1498.2	0.0544	359.8	0.00196	1068.7	0.00457	<u>CURVE 167</u>		598.7	0.00292	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		
1253.2	0.00290	813.2	0.0941	386.5	0.00151	1102.1	0.00419	1087.1	0.00452	819.8	0.00351	<u>CURVE 178</u>	
1328.2	0.00290	983.2	0.0778	409.8	0.00216	1139.3	0.00500	1197.6	0.00452	1022.6	0.00465	795.9	0.00374
<u>CURVE 150</u>		1083.2	0.0665	417.1	0.00194	<u>CURVE 159</u>		<u>CURVE 168</u>		<u>CURVE 174</u>		914.8	0.00358
813.2	0.0883	1328.2	0.0586	424.8	0.00145	699.8	0.00234	457.6	0.00222	1015.4	0.00441	1278.7	0.00363
993.2	0.0703	1343.2	0.0573	437.6	0.00251	767.6	0.00324	563.2	0.00241	462.6	0.00251	1642.1	0.00443
1143.2	0.0623	1423.2	0.0573	443.2	0.00232	<u>CURVE 160</u>		649.8	0.00277	519.8	0.00267	1830.4	0.00576
1283.2	0.0531	1498.2	0.0536	454.3	0.00199	837.6	0.00362	738.2	0.00315	698.2	0.00296	<u>CURVE 180</u>	
1368.2	0.0544	<u>CURVE 155</u>		455.4	0.00228	1037.6	0.00476	<u>CURVE 169</u>		868.2	0.00341	944.8	0.00408
1433.2	0.0527	422.2	0.169	471.5	0.00228	<u>CURVE 161</u>		909.8	0.00393	959.3	0.00365	1333.7	0.00426
1503.2	0.0515	462.2	0.156	488.2	0.00190	<u>CURVE 162</u>		1123.7	0.00460	<u>CURVE 175</u>		1614.3	0.00466
<u>CURVE 151</u>		454.2	0.155	503.2	0.00232	<u>CURVE 163</u>		1442.6	0.00479	604.3	0.00313	<u>CURVE 181</u>	
853.2	0.0828	651.2	0.109	505.4	0.00206	820.9	0.00350	1498.7	0.00519	728.7	0.00331	751.5	0.00388
993.2	0.0715	789.2	0.092	506.5	0.00279	936.5	0.00350	<u>CURVE 170</u>		818.2	0.00333	1352.6	0.00415
1113.2	0.0619	862.2	0.091	525.9	0.00287	989.3	0.00389	1039.8	0.00450	820.9	0.00350	1707.6	0.00448
1223.2	0.0590	917.2	0.081	529.8	0.00258	820.9	0.00350	1235.9	0.00509	936.5	0.00391		
1443.2	0.0552	924.2	0.081	600.4	0.00256	992.1	0.00514	1474.8	0.00538				
1473.2	0.0544	938.2	0.079	604.3	0.00273	1064.3	0.00583						
<u>CURVE 152</u>		<u>CURVE 156</u>		620.4	0.00350	<u>CURVE 164</u>							
813.2	0.0879	442.2	0.1610	644.3	0.00284	<u>CURVE 165</u>							
958.2	0.0736	679.2	0.1049	671.5	0.00310	820.9	0.00350						
1083.2	0.0669	764.8	0.0748	677.6	0.00350	936.5	0.00391						
1213.2	0.0615	1004.2	0.0735	698.7	0.00303	992.1	0.00514						
		1225.2	0.0624	709.8	0.00358	1064.3	0.00583						
				764.8	0.00317								
				793.2	0.00436								
				812.1	0.00427								
				814.8	0.00350								

* 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		T	k		T	k		T	k		p(mm Hg)	k x 10 ⁶		p(mm Hg)	k x 10 ⁶	
342.1	0.00149		1.41	0.0394		3.70	0.115		333.0	0.00144		0.00000224	0.437		0.684	240	
355.4	0.00151		1.53	0.0414		3.85	0.143		363.9	0.00167		0.00000944	0.543		1.97	327	
382.6	0.00152		1.74	0.0458		4.06	0.209		402.5	0.00168		0.0000269	0.684		5.31	432	
404.8	0.00156		2.03	0.0506		4.27	0.240		445.7	0.00165		0.000197	1.35		67.6	617	
422.6	0.00163		2.32	0.0661					506.9	0.00162							
446.5	0.00173		2.69	0.0867		CURVE 188			526.0	0.00174					Stress(Kg cm ⁻²)		
469.3	0.00178		3.03	0.113					575.4	0.00189		0.00767	8.61				
492.1	0.00187		3.16	0.125		1.45	0.0492		627.3	0.00191		0.0513	26.6		CURVE 198*		
519.3	0.00199		3.56	0.200		1.52	0.0531		666.6	0.00181		0.133	48.4		(T = 4.2 K)		
542.1	0.00211		3.83	0.250		1.66	0.0566		672.0	0.00196		0.692	94.4				
594.8	0.00222		4.06	0.273		1.76	0.0614		733.1	0.00205		1.97	133		0.288	0.0380	
			4.47	0.294		1.88	0.0656		832.3	0.00207		12.9	184		0.395	0.0490	
CURVE 183						2.05	0.0750		CURVE 191*			63.1	209		1.14	0.124	
1.41	0.120		CURVE 186			2.19	0.0807								2.28	0.234	
1.60	0.178		1.45	0.0551		2.35	0.0902		4.2	0.125 x 10 ⁻⁴					5.01	0.427	
1.83	0.267		1.53	0.0625		2.55	0.0951								8.47	0.637	
1.92	0.313		1.63	0.0695		2.76	0.110								5.78	0.568	
2.23	0.470		1.74	0.0828		3.10	0.125								2.95	0.365	
2.48	0.596		1.87	0.0975		3.33	0.134								1.17	0.195	
2.87	0.830		2.05	0.111		3.66	0.153								0.389	0.0964	
3.04	0.938		2.18	0.121		3.81	0.166										
3.27	1.36		2.32	0.134		3.96	0.177										
3.88	2.53		2.49	0.150		4.24	0.194										
4.14	3.25		2.76	0.169		CURVE 189											
4.29	3.72		3.11	0.200		1.46	0.0192										
4.31	3.99		3.37	0.234		1.61	0.0203										
CURVE 184			3.77	0.288		1.75	0.0209										
1.38	0.0551		3.95	0.327		1.89	0.0216										
1.39	0.0598		4.17	0.381		2.10	0.0235										
1.46	0.0738		CURVE 187			2.21	0.0239										
1.53	0.0802		1.37	0.0239		2.39	0.0254										
1.70	0.100		1.52	0.0286		2.58	0.0277										
1.97	0.133		1.63	0.0299		2.76	0.0308										
2.21	0.164		1.77	0.0319		3.15	0.0388										
2.57	0.208		1.91	0.0372		3.33	0.0449										
2.77	0.238		2.06	0.0409		3.64	0.0560										
3.11	0.290		2.20	0.0431		3.74	0.0598										
3.47	0.366		2.35	0.0463		4.02	0.0718										
3.72	0.419		2.51	0.0501		4.35	0.0834										
3.96	0.478		2.77	0.0569													
4.32	0.524		3.14	0.0719													
			3.37	0.0836													

* Not shown on plot

DATA TABLE NO. 16 (continued)

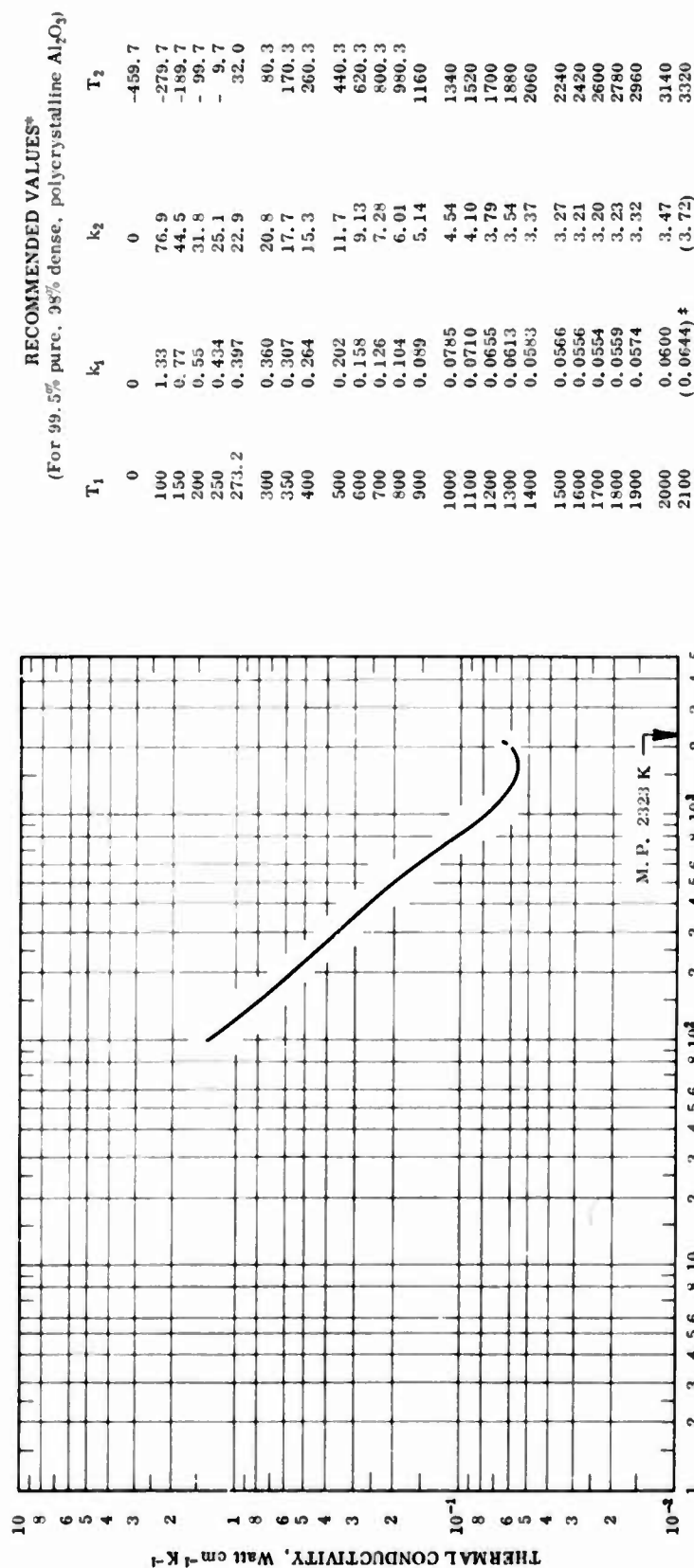
T	k x 10 ⁴	T	k
<u>CURVE 202*</u>			
2.00	5.42	316.9	0.0548
2.57	5.60	354.3	0.0540
3.09	6.70	394.6	0.0515
3.76	6.55	421.1	0.0485
4.16	7.02		
<u>CURVE 203*</u>			
2.77	0.589	664	0.00303
3.58	1.06	750	0.00303
4.24	1.41	830	0.00317
4.79	2.25	1011	0.00375
		1208	0.00346

<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		

<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 

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

‡ Values in parentheses are extrapolated.

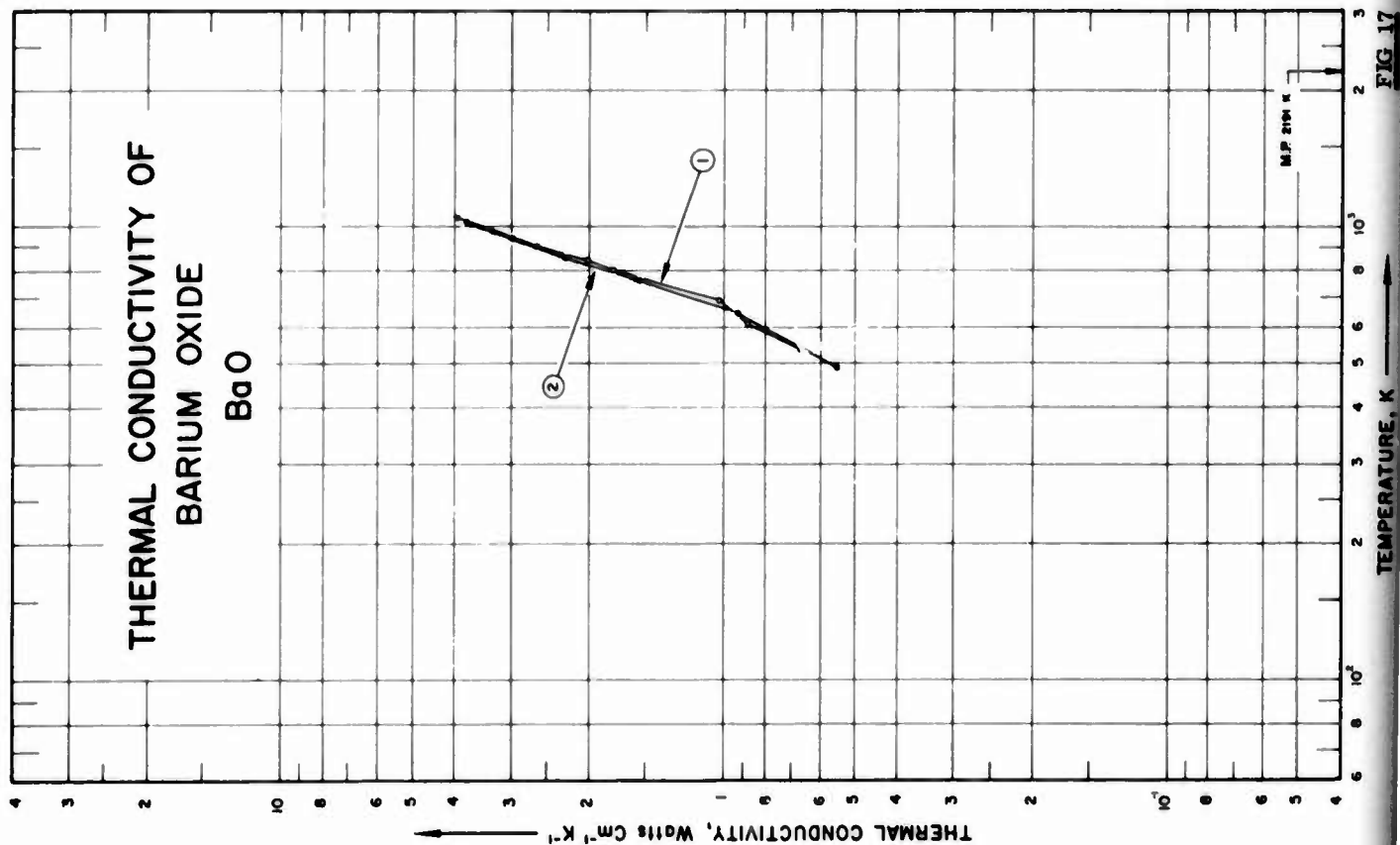


FIG 17

SPECIFICATION TABLE NO. 17 THERMAL CONDUCTIVITY OF BARIUM OXIDE BaO

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

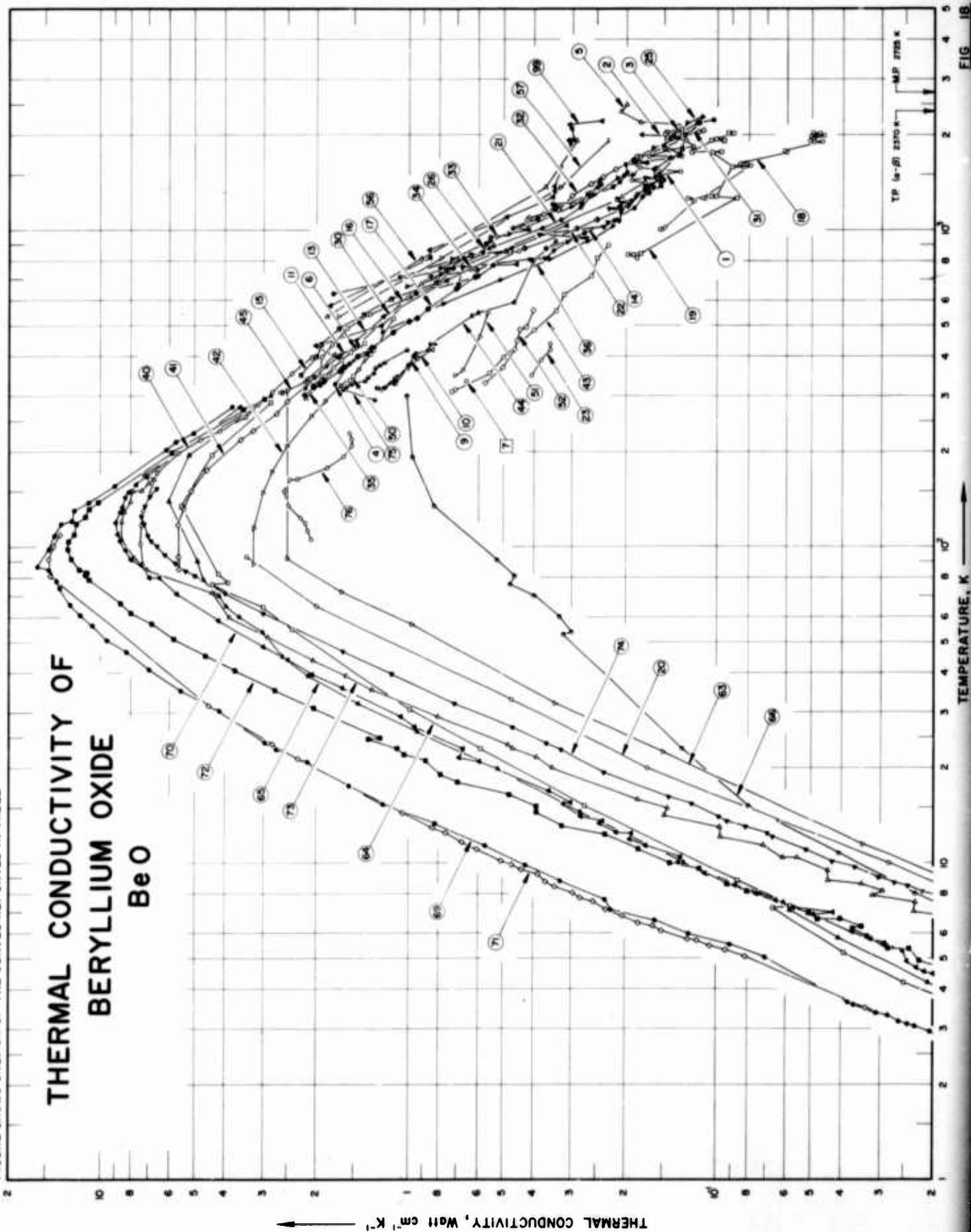
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent). Specifications and Remarks
1	75	L	1955	538-1033	~ 10	Tube No. 3	Pure; polycrystalline; apparent thermal conductivity (effects due to radiation at high temperatures not considered).
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: 97.5% 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) = 8.4×10^{-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) = 8.2×10^{-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 Zirco-nium 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			No details reported.
24	220		1947	573-1173		Commercial	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		3008-13-3	Brush SP grade of 0.27 metallic impurities; obtained from ORNL; specimen 3 in. long, 2 in. O.D. and 0.5 in. I.D.; hot-pressed; average grain size 50 μ; density 2.59 g cm ⁻³ .
26	218	R	1960	630-2242		ORN-1	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	0.97 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. 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 9.5% 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 x 10 ¹⁸ neutrons cm ⁻² .
51	319	C	1962	348-548		AOX-BeO(329)	Similar to the above specimen but irradiated by 2.0 x 10 ²⁰ neutrons cm ⁻² .
52	319	C	1962	328-560		AOX-BeO(329)	Similar to the above specimen but irradiated by 3.7 x 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			Powder.
60	376	C	1959	361-759	5-10		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 x 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	$\leq \pm 2$	12 μ No. 2176	Similar to the above specimen except the grain size was 12 μ
65	377	L	1964	2.25-300	$\leq \pm 2$	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} ; 96% 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 $10^{18} \sim 2 \times 10^{18} \text{ n} > 1 \text{ MeV/cm}^2$; 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 $2 \times 10^{18} \text{ n} > 1 \text{ MeV/cm}^2$.
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 5% 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 800 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} (~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. 1^a THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE BeO[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

CURVE 1		CURVE 5		CURVE 10 (cont.)		CURVE 15 (cont.)		CURVE 18		CURVE 19 (cont.)		CURVE 24 (cont.) [*]	
T	k	T	k	T	k	T	k	T	k	T	k	T	k
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*			853.2	0.490	1022.6	0.151			1173.2	0.19
1532.2	0.1328	1443.2	0.150*	CURVE 11				1247.1	0.120	CURVE 20		CURVE 25	
1573.2	0.1803	1443.2	0.210*	317.3	2.19	CURVE 16		1255.4	0.126	2.6	0.00095*		
1633.2	0.1946	1653.2	0.190*	343.6	2.05	348.2	1.996	1255.4	0.111	4.5	0.0040*	665	1.020
1703.2	0.1318	1763.2	0.170*	371.2	1.87	398.2	1.925	1255.4	0.112	10.0	0.028	721	0.789
1708.2	0.1690	1823.2	0.135*	401.6	1.68	435.2	1.787	1607.6	0.0795	20.0	0.17	810	0.729
1793.2	0.1464	1973.2	0.130*	436.1	1.47	488.2	1.577	1610.4	0.0822	33.0	0.47	922	0.557
1833.2	0.1203	2043.2	0.130*	CURVE 12*		540.2	1.326	1612.1	0.0837	65.0	2.0	971	0.481
1913.2	0.1276	2173.2	0.140*	343.2	1.82	608.2	1.046	1762.1	0.0600	93.0	3.4	1180	0.303
1963.2	0.1402	2193.2	0.180			633.2	0.929*	1785.4	0.0613			1300	0.258
2020.7	0.1245	2363.2	0.210			688.2	0.803	1786.5	0.0617*	CURVE 21		1470	0.216
2040.7	0.1402	2493.2	0.200			748.2	0.753	1909.8	0.0466	710.2	1.071	1493	0.181
CURVE 2		CURVE 6		CURVE 13		833.2	0.594	1912.6	0.0493	742.2	0.770*	1695	0.177*
1303.2	0.1695	321.7	2.06	370.2	1.62	853.2	0.448	1920.9	0.0508	875.2	0.556	1732	0.158*
1373.2	0.1548	345.6	1.88	398.2	1.71			1925.9	0.0499	1016.2	0.377	1823	0.162
1463.2	0.1621	368.6	1.76	433.2	2.02	CURVE 17		1995.9	0.0462	1087.2	0.328	1950	0.136
1553.2	0.1642	388.3	1.66	498.2	1.23	301.4	2.19	1997.1	0.0503	1180.2	0.281	2008	0.131*
1563.7	0.1611	410.0	1.54	633.2	0.954	319.4	2.04	2001.5	0.0475	1283.2	0.267	2075	0.130*
1688.2	0.1443	439.4	1.39	713.2	0.607	325.8	1.94	2009.3	0.0496	1431.2	0.246	2160	0.127
1743.2	0.1333			776.2	0.544	332.9	1.879					2290	0.112
1847.2	0.1506	CURVE 7		780.2	0.456	359.0	1.674	CURVE 19		CURVE 22		CURVE 26	
1947.2	0.1448	333.2	0.658			359.4	1.679*	817.6	0.185	713.2	0.858	630	1.722
1973.2	0.1391	CURVE 14				360.1	1.668*	832.1	0.188	743.2	0.615	756	0.721
1998.2	0.1778	873.2	0.368	CURVE 8*		360.5	1.672*	834.3	0.198	871.2	0.435	850	0.583
CURVE 3		973.2	0.274	360.5	1.662*	367.6	1.647	842.6	0.179	1015.2	0.292	905	0.571
1813.2	0.1496	1073.2	0.220	367.6	1.647	397.0	1.454	1287.1	0.0871	1092.2	0.251	1080	0.391
1998.2	0.1496	1173.2	0.188	426.2	1.316	426.2	1.316	1288.7	0.106	1183.2	0.199	1182	0.343
2030.7	0.1475	1273.2	0.176	426.6	1.311*	475.2	1.131	1288.7	0.101	1290.2	0.177*	1270	0.261*
2073.2	0.1318	1373.2	0.172	475.2	1.131	475.2	1.131	1589.8	0.0903	1431.2	0.151	1360	0.223
CURVE 4		CURVE 15		514.7	0.995	514.7	0.995	1590.4	0.0838			1405	0.212
326.2	1.745	317.7	1.20	514.6	0.989*	514.6	0.989*	1591.5	0.0803*	CURVE 23		1490	0.205
378.2	1.561	334.0	1.12	524.6	0.942	524.6	0.942	1596.5	0.0909*	347.2	0.409	1503	0.200
407.2	1.372	373.0	1.01	560.5	0.872	560.5	0.872	1762.6	0.104	387.9	0.360	1610	0.202
CURVE 10		439.4	0.824	560.9	0.872*	560.9	0.872*	1770.4	0.0971	419.8	0.357	1631	0.171
314.5	1.23	CURVE 9		652.7	0.704	652.7	0.704	1771.5	0.122	435.9	0.357	1648	0.190
342.6	1.11	317.7	1.20	712.4	0.614	712.4	0.614	1771.5	0.103			1888	0.146*
366.6	1.02	334.0	1.12					1783.2	0.119	CURVE 24*		2046	0.132*
		373.0	1.01					1914.3	0.105	573.2	0.42	2060	0.130*
		399.4	0.967					1917.6	0.0953	723.2	0.35	2144	0.116
		439.4	0.824					1923.2	0.102			2242	0.103
								2002.6	0.0891				
								2005.9	0.0932				

^a Not shown on plot

DATA TABLE NO. 18 (continued)

CURVE 27*			CURVE 29 (cont.)*			CURVE 33			CURVE 34 (cont.)			CURVE 37*			CURVE 40 (cont.)			CURVE 43 (cont.)		
T	k		T	k		T	k		T	k		T	k		T	k		T	k	
CURVE 27*			CURVE 29 (cont.)*			CURVE 33			CURVE 34 (cont.)			CURVE 37*			CURVE 40 (cont.)			CURVE 43 (cont.)		
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				
989	0.384		1920	0.159		1006	0.419		1063.2	0.232		699.8	0.485		308.2	2.82		CURVE 44		
1156	0.317		1920	0.167		1010	0.470		1071.2	0.213		810.9	0.339		353.2	2.41		318.2	1.27	
1229	0.251		1985	0.158		1162	0.346*		1140.2	0.209		922.1	0.265		398.2	2.09		328.2	1.11	
1365	0.237		2065	0.149		1168	0.321*		1169.2	0.209		1033.2	0.218					338.2	1.10*	
1516	0.211		2134	0.148		1181	0.342		1170.2	0.229		1144.3	0.192		CURVE 41			408.2	0.95	
1530	0.190		2242	0.151		1210	0.352		1177.2	0.211		1255.4	0.177		85.2	5.54		418.2	0.87	
1636	0.176		2293	0.156		1217	0.281		1210.2	0.197		1366.5	0.171		93.2	5.65		438.2	0.85	
1669	0.171					1301	0.268		1230.2	0.210		1477.6	0.168		119.2	5.65		538.2	0.63	
CURVE 28*			CURVE 30			1368	0.249		1244.2	0.192					133.2	5.44		548.2	0.60	
			449.8	1.48		1383	0.243		1281.2	0.186		CURVE 38*			151.2	5.13		588.2	0.46	
970	0.517		533.2	1.21		1393	0.254*		1300.2	0.184		366.5	1.78		175.2	4.60		793.2	0.40	
1125	0.373		694.3	0.762		1440	0.242*		1333.2	0.174		477.6	1.24		218.2	3.56		913.2	0.34	
1141	0.342		877.6	0.476		1490	0.219*		1362.2	0.163		588.7	0.807		233.2	3.24		CURVE 45		
1164	0.327		1038.7	0.315		1501	0.203*		1368.2	0.174		699.8	0.518		263.2	2.72		313.2	2.65	
1219	0.344					1549	0.213*		1389.2	0.165		810.9	0.360		288.2	2.51		313.2	2.61	
1371	0.250		CURVE 31			1550	0.194*		1425.2	0.175*		922.1	0.277		363.2	1.88*		343.2	2.19	
1410	0.236		1249.8	0.216		1564	0.190*		1440.2	0.155		1033.2	0.228		408.2	1.67*		348.2	2.15	
1430	0.239		1505.4	0.157		1605	0.202*		1455.2	0.174		1144.3	0.204					403.2	1.75	
1470	0.242		1794.3	0.132		1709	0.184*		1463.2	0.155		1255.4	0.190		CURVE 42			533.2	1.17*	
1557	0.199		2199.8	0.116		1742	0.176*		1487.2	0.155*		1366.5	0.185		88.2	3.24		668.2	0.88*	
1559	0.204		CURVE 32			1770	0.185*		CURVE 35			1699.8	0.173		115.2	3.24		688.2	0.82*	
1575	0.202					1775	0.181*		293.2	2.176					148.2	3.03		778.2	0.67*	
1587	0.196					1779	0.176*		673.2	0.920		CURVE 39*			173.2	2.82				
1739	0.162					1880	0.169*		1273.2	0.209		699.8	0.709		208.2	2.51				
1745	0.171					1920	0.168*					810.9	0.554		258.2	2.09		CURVE 46*		
1833	0.176					1930	0.174*		CURVE 36			922.1	0.450		288.2	1.88		318.2	2.22	
1882	0.158		1073.2	0.420		1943	0.173*		366.5	1.71*		1033.2	0.363		323.2	1.67		323.2	2.17	
1921	0.153		1083.2	0.418		1979	0.172*		477.6	1.21		1144.3	0.312		338.2	1.46		338.2	2.05	
1938	0.160		1118.2	0.374		2000	0.173*		588.7	0.788		1255.4	0.260		403.2	1.65		403.2	1.65	
2070	0.144		1153.2	0.335		2050	0.171*		699.8	0.511		1366.5	0.225		458.2	1.36		458.2	1.36	
2120	0.142		1283.2	0.305		2080	0.171*		810.9	0.357		1477.6	0.208		543.2	1.09		543.2	1.09	
2195	0.154		1473.2	0.239		2116	0.184*		922.1	0.268		1588.7	0.173		638.2	0.89		638.2	0.89	
2256	0.160		1553.2	0.218		2131	0.184*		1033.2	0.222		1699.8	0.173		713.2	0.74		713.2	0.74	
CURVE 29*			CURVE 31			CURVE 34			CURVE 40			CURVE 47*			CURVE 43			CURVE 44		
			1698.2	0.180		673.2	0.695		88.2	7.32		308.2	0.73		313.2	0.71		318.2	1.27	
1175	0.337		1843.2	0.158*		768.2	0.680		103.2	7.45		323.2	0.64*		323.2	0.64*		328.2	1.11	
1369	0.249		1953.2	0.131*		810.2	0.413		1255.4	0.192*		353.2	0.58		353.2	0.58		338.2	1.10*	
1442	0.260		2033.2	0.127*		815.2	0.369		1366.5	0.185*		398.2	0.50		398.2	0.50		408.2	0.95	
1490	0.216		2053.2	0.116		860.2	0.347		1477.6	0.177*		483.2	0.40		483.2	0.40		418.2	0.87	
1522	0.207					916.2	0.313					553.2	0.34		553.2	0.34		548.2	0.85	
1600	0.209											628.2	0.32		628.2	0.32		588.2	0.63	

* 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 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>		<u>CURVE 68*</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	673.2	0.726
748.2	0.66	560.2	0.402	703.2	0.685	488.2	1.15	7.2	0.0105*	32.0	1.45	773.2	0.595
<u>CURVE 48*</u>		<u>CURVE 53*</u>		793.2	0.418	497.2	1.11	11.5	0.0340	39.1	2.13	873.2	0.498
303.2	2.26	1118.2	0.0092	795.2	0.372	497.2	1.07	22.5	0.149	45.0	2.60	973.2	0.427
343.2	2.05	1343.2	0.0100	843.2	0.356	509.2	1.11	32.0	0.340	54.5	3.03	1073.2	0.370
383.2	1.81	1443.2	0.0105	893.2	0.318	514.2	1.05	57.0	0.975	60.0	3.59	1173.2	0.321
408.2	1.78	1558.2	0.0109	923.2	0.276	514.2	1.03	72.0	1.65	65.8	3.95		
443.2	1.55	1663.2	0.0134	949.2	0.389	515.2	1.08	92.0	2.49	70.8	4.20		
538.2	1.20	1738.2	0.0184	1003.2	0.247	527.2	1.06	310	2.51	79.0	4.70		
628.2	0.98	1773.2	0.0192	1037.2	0.243	646.2	0.753	<u>CURVE 64</u>		90.0	4.90		
<u>CURVE 49*</u>		<u>CURVE 54*</u>		1053.2	0.222	659.2	0.745	2.2	0.00500*	139	6.00	1.36	0.00238*
339.2	1.799	1133.2	0.0130	1123.2	0.211	707.2	0.619	2.8	0.00890*	195	5.20	1.40	0.00258*
360.7	1.707	1363.2	0.0138	1152.2	0.209	723.2	0.607	3.5	0.0154*	300	2.85	1.66	0.00414*
415.7	1.485	1473.2	0.0138	1153.2	0.234	730.2	0.594	2.2	0.00500*			1.72	0.00462*
425.7	1.414	1578.2	0.0147	1193.2	0.201	759.2	0.577	3.5	0.0154*	<u>CURVE 66</u>		2.01	0.00719*
470.2	1.356	1683.2	0.0147	1213.2	0.210	<u>CURVE 61*</u>		4.2	0.0250	3.0	0.00240*	2.32	0.0110*
482.2	1.309	1831.2	0.0173	1263.2	0.188	368.2	1.67	5.2	0.0392	3.0	0.00240*	2.39	0.0117*
537.2	1.213	1831.2	0.0173	1281.2	0.190	488.2	1.34	7.3	0.0580	3.5	0.00353*	2.51	0.0141*
568.2	1.171	<u>CURVE 55*</u>		1313.2	0.176	482.2	1.30	7.2	0.0660	4.25	0.00490*	2.58	0.0148*
<u>CURVE 50</u>		1118.2	0.00556	1349.2	0.167	518.2	1.17	8.8	0.0860	4.8	0.00730*	2.72	0.0173*
334.7	1.552	1348.2	0.00736	1373.2	0.167	501.2	0.954	15.2	0.271	8.0	0.0230	2.83	0.0190*
345.7	1.523	1453.2	0.00757	1403.2	0.163	431.2	0.661	23.0	0.590	10.7	0.0409	2.95	0.0205
405.7	1.339	1563.2	0.00908	1405.2	0.176	<u>CURVE 62</u>		30.6	0.990	15.2	0.0800	3.06	0.0229
420.7	1.318	1673.2	0.00996	1443.2	0.163	401.2	1.50	54.7	2.40	23.1	0.130	3.10	0.0243
482.2	0.108	411.2	1.38	405.2	1.48	401.2	1.45	64.5	3.01	53.0	0.300	3.16	0.0260
1748.2	0.0108	418.2	1.41	411.2	1.38	401.2	1.45	76.0	4.40	53.0	0.320	3.30	0.0284
1798.2	0.0113	423.2	1.31	418.2	1.41	405.2	1.48	77.0	3.88	60.5	0.330	3.37	0.0308
<u>CURVE 51</u>		323.2	0.0100	441.2	1.37	405.2	1.48	82.0	4.20	70.2	0.399	3.57	0.0365
348.2	0.711	483.2	0.0105	483.2	1.23	411.2	1.38	135	5.46	76.5	0.475	3.64	0.0378
361.2	0.674	658.2	0.0100	493.2	1.26	418.2	1.41	195	4.40	81.0	0.460	5.04	0.0703
460.2	0.598	<u>CURVE 60*</u>		501.2	1.13	423.2	1.31	285	2.85	91.0	0.525	5.53	0.0908
548.2	0.565	361.2	1.87	505.2	1.27	441.2	1.37	<u>CURVE 65</u>		135	0.830	5.98	0.123
<u>CURVE 52</u>		374.2	1.79	518.2	1.10	483.2	1.23	193	0.975	193	0.975	6.59	0.159
328.2	0.573	<u>CURVE 57</u>		530.2	1.10	493.2	1.26	300	1.02	300	1.02	7.16	0.223
368.2	0.502	533	1.70	605.2	0.900	501.2	1.13	2.25	0.00425*			7.66	0.234
420.5	0.460	811	0.79	613.2	0.874	505.2	1.27	2.89	0.00835*			7.76	0.234
448.2	0.452	1366	0.33	633.2	0.879	518.2	1.10	3.5	0.0137*	<u>CURVE 67*</u>		8.79	0.277
486.2	0.444	1922	0.23	689.2	0.774	530.2	1.10	3.6	0.0153*	673.2	0.777	9.84	0.423
				701.2	0.749	605.2	0.900	4.2	0.0208	773.2	0.631	11.4	0.570
				782.2	0.594	613.2	0.874	5.8	0.0408	873.2	0.526	13.4	0.820
				801.2	0.594	633.2	0.879	7.1	0.0580	973.2	0.449	15.4	1.22
				803.2	0.602	689.2	0.774	7.5	0.0610	1073.2	0.390	17.6	1.56
						699.2	0.774	8.0	0.0730	1173.2	0.338	20.9	2.15
						701.2	0.749	10.0	0.128			22.9	2.72
						782.2	0.594	14.5	0.280			24.0	2.99
						801.2	0.594	19.95	0.523			35.2	5.53
						803.2	0.602					41.2	6.97
												46.6	8.30

* Not shown on plot

DATA TABLE NO. 18 (continued)

CURVE 69 (cont.)			CURVE 70 (cont.)			CURVE 71			CURVE 72 (cont.)			CURVE 73 (cont.)			CURVE 73 (cont.)			CURVE 74		
T	k		T	k		T	k		T	k		T	k		T	k		T	k	
50.8	9.57		6.97	0.0426		1.56	0.00335*		2.38	0.00297*		2.97	0.00177*		59.6	3.86		1.83	0.000308*	
56.5	10.7		7.21	0.0569		1.88	0.00598*		2.62	0.00380*		3.24	0.00239*		71.5	5.41		1.83	0.000333*	
61.1	11.7		7.62	0.0646		2.47	0.0126*		2.70	0.00413*		3.30	0.00250*		84.7	7.03		1.92	0.000421*	
65.8	12.5		8.00	0.0753		2.69	0.0162*		2.84	0.00455*		3.36	0.00258*		92.0	7.83		1.98	0.000447*	
74.1	13.5		8.53	0.0877		3.48	0.0334		2.90	0.00499*		3.43	0.00275*		106.7	8.65		2.08	0.000560*	
78.3	13.8		9.25	0.108		5.02	0.0813		2.94	0.00522*		3.49	0.00275*		121.1	8.59		2.17	0.000565*	
84.7	14.7		10.0	0.133		5.31	0.0935		3.15	0.00555*		3.79	0.00342*		129.4	8.41		2.25	0.000655*	
86.5	16.0		10.4	0.131		5.45	0.104		3.24	0.00622*		3.79	0.00356*		138.4	8.04		2.38	0.000702*	
98.2	14.7		11.3	0.171		5.69	0.116		3.30	0.00686*		4.05	0.00439*		150.7	7.94		2.58	0.000982*	
108.6	14.0		11.8	0.183		5.75	0.124		3.38	0.00757*		4.17	0.00462*		158.1	7.00		2.74	0.00106*	
118.0	13.3		12.4	0.191		6.11	0.152		3.44	0.00804*		4.40	0.00552*		164.1	6.71		2.83	0.00114*	
120.8	12.3		12.5	0.215		6.31	0.162		3.54	0.00861*		4.40	0.00647*		168.7	7.24		2.83	0.00126*	
130.3	12.2		13.4	0.243		6.49	0.180		3.64	0.00940*		4.56	0.00670*		280.5	3.16		2.99	0.00130*	
138.0	10.9		13.6	0.239		6.82	0.204		3.72	0.0100*		4.65	0.00569*					3.23	0.00161*	
157.0	9.00		14.0	0.279		7.11	0.232		3.82	0.0106*		4.89	0.00780*					3.39	0.00177*	
203.2	6.15		15.3	0.321		7.55	0.255		3.86	0.0114*		5.18	0.00950*					3.42	0.00199*	
215.8	5.72		15.5	0.301		7.78	0.280		3.95	0.0116*		5.51	0.0111*					3.49	0.00188*	
228.6	5.05		16.9	0.357		8.02	0.297		3.95	0.0119*		6.04	0.0124*					3.62	0.00215*	
277.3	3.78		20.9	0.598		8.43	0.343		4.01	0.0129*		6.34	0.0138*					3.92	0.00255*	
			21.5	0.690		8.73	0.367		4.16	0.0140*		6.68	0.0150*					4.06	0.00281*	
			22.9	0.671		9.20	0.387		4.35	0.0152*		7.02	0.0232					4.19	0.00311*	
			26.8	0.955		9.53	0.437		4.50	0.0163*		7.50	0.0229					4.25	0.00327*	
			29.0	1.07		9.86	0.468		4.58	0.0179*		8.83	0.0443					4.53	0.00372*	
			35.7	1.63		10.2	0.506		4.72	0.0192*		9.46	0.0443					4.66	0.00399*	
			39.5	2.06		11.1	0.605		4.93	0.0222		10.4	0.0553					4.73	0.00421*	
			44.0	2.50		11.7	0.675		5.38	0.0239		11.4	0.0617							
			48.3	3.01		12.5	0.759		5.38	0.0284		12.2	0.0716							
			58.5	4.21		12.9	0.843		5.85	0.0328		13.0	0.075							
			71.1	5.70		14.4	1.05		6.22	0.0367		14.2	0.0975							
			79.6	6.53		21.4	2.30		6.32	0.0341		14.9	0.148							
			79.6	6.95		23.7	2.82		6.67	0.0402		15.9	0.182							
			87.1	7.46		31.5	4.54		6.97	0.0476		20.0	0.348							
			91.2	8.07		81.1	14.4		7.52	0.0575*		21.6	0.391							
			97.3	8.38		91.0	14.6		7.66	0.0644*		23.1	0.466							
			104.0	8.71		100.2	14.2		8.05	0.0769*		23.7	0.483							
			109.4	8.85		109.9	13.4		8.59	0.0800		29.2	1.59							
			119.7	8.97					8.59	0.0923		39.2	2.05							
			128.5	8.71					8.59	0.0923		43.9	2.92							
			133.7	8.61					8.59	0.0923		52.0	2.92							
			143.2	8.38					10.1	0.142										
			148.3	8.15					10.1	0.142										
			157.4	7.75					11.2	0.181										
			166.7	7.11					12.3	0.234										
			277.3	3.57					13.2	0.324										
									14.5	0.391										
									15.2	0.391										

* Not shown on plot

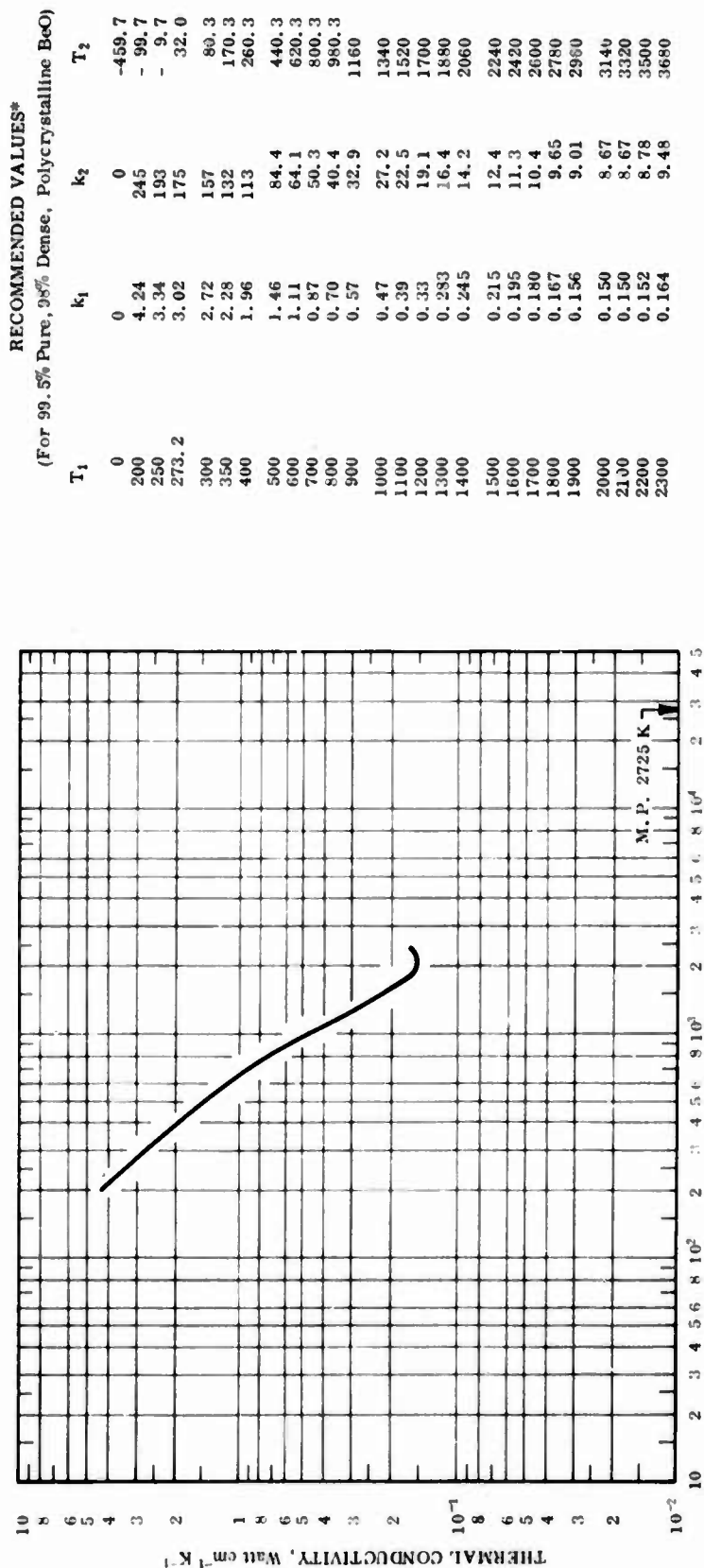
DATA TABLE NO. 15 (continued)

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	0.708	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
1283.2	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
2088.2	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	768.2	0.760	578.2	1.85
833.2	0.668	808.2	0.749	802.2	0.813
833.2	0.645	846.2	0.764	836.2	0.813
1067.2	0.381	1101.2	0.496	836.2	0.800
1075.2	0.395	1113.2	0.479	864.2	0.816
1075.2	0.363	1136.2	0.485	1061.2	0.418
1087.2	0.384	1287.2	0.389	1106.2	0.395
1263.2	0.274	1312.2	0.378	1106.2	0.431
1284.2	0.255	1328.2	0.401	1294.2	0.325
1312.2	0.273	1360.2	0.352	1319.2	0.309
1821.2	0.257	1747.2	0.303	1326.2	0.322
1844.2	0.226	1771.2	0.326	1670.2	0.248
1851.2	0.267	1793.2	0.307	1683.2	0.232
1874.2	0.255	1972.2	0.261	1717.2	0.247
2087.2	0.176	2007.2	0.262	1950.2	0.244
2083.2	0.187	2048.2	0.268	2002.2	0.244
2088.2	0.188	2093.2	0.219	2053.2	0.244
2122.2	0.190	2110.2	0.222	2163.2	0.190
2269.2	0.183				

* Not shown on plot

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



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.

* 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.

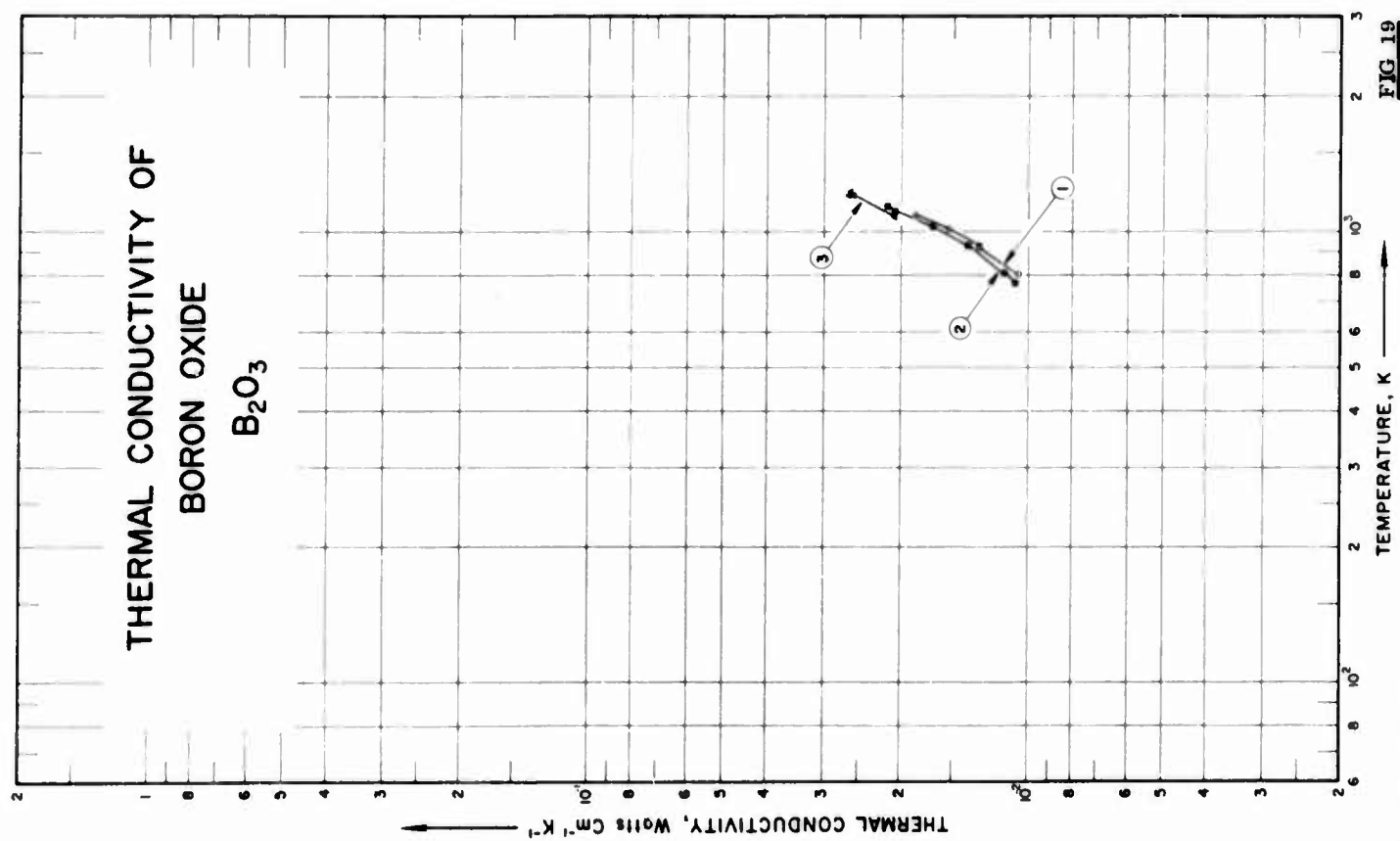


FIG 19

SPECIFICATION TABLE NO. 19 THERMAL CONDUCTIVITY OF BORON OXIDE B_2O_3

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

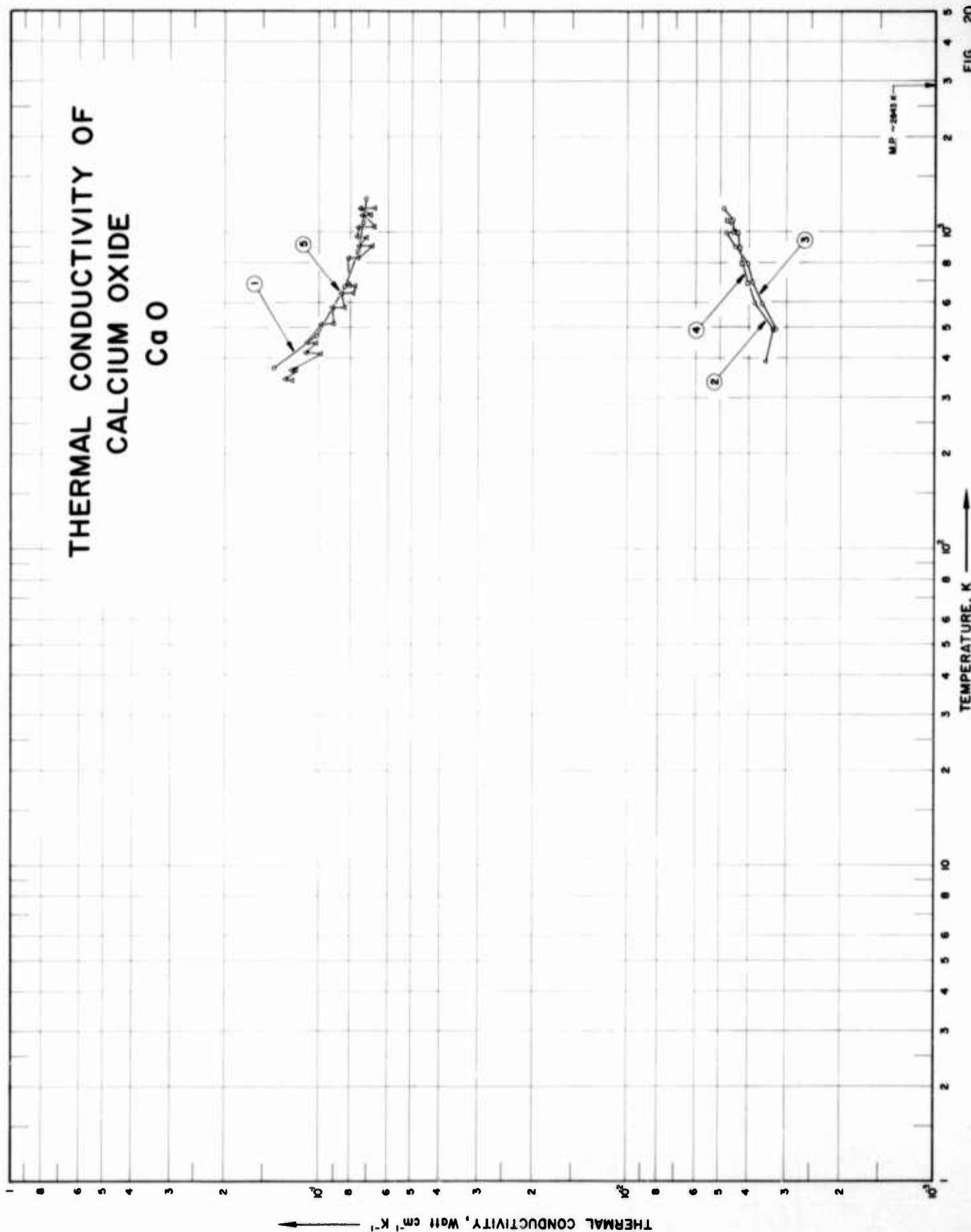
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	248	R	1959	809-1098			In liquid state; contained in the annulus of two concentric stainless steel tubes (1.22 cm radius difference), with a very 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 $^{-1}K^{-1}$]

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			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%.
2	221	R	1959	390-897	5.9		Packed powdered CaO; 90% of the particles in 0.3-6.6 micron range; density 1.86 g cm ⁻³ .
3	221	R	1959	494-1199	5.9		Similar to the above specimen except 1.57 g cm ⁻³ density.
4	221	R	1959	693-1197	5.9		Second run of the above specimen.
5	45	C	1953	341-1196			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).

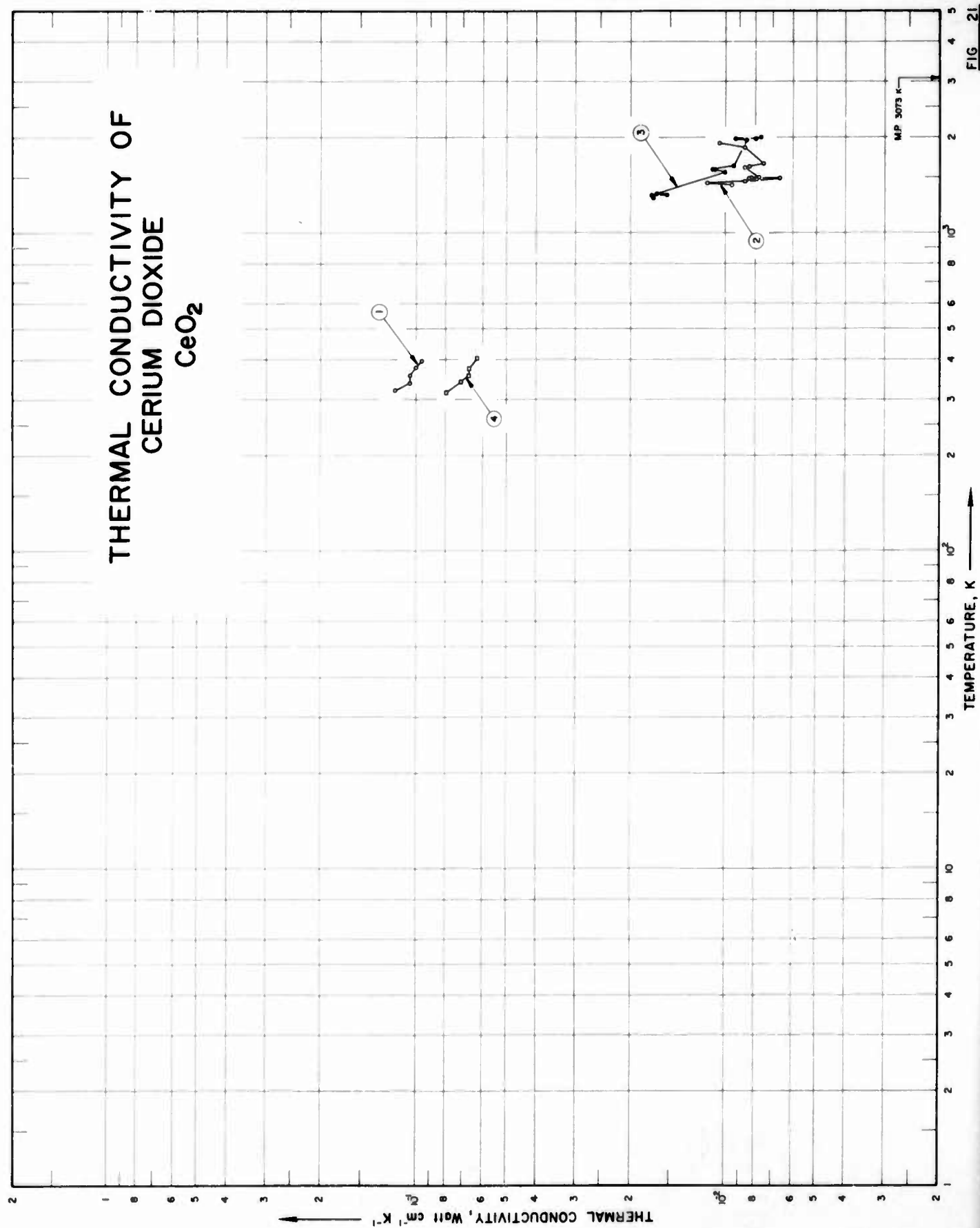
DATA TABLE NO. 20 THERMAL CONDUCTIVITY OF CALCIUM OXIDE CaO

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

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 5</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>		448.2	0.103
390.0	0.00353	448.2	0.109
492.2	0.00330	512.2	0.0983
593.3	0.00382	517.2	0.0900
896.8	0.00439*	580.2	0.0908
<u>CURVE 3</u>		580.2	0.0837
493.8	0.00326	644.2	0.0858
593.2	0.00361	644.2	0.0787
693.2	0.00390	678.2	0.0874
796.4	0.00405	681.2	0.0808
896.8	0.00445	833.2	0.0812
996.6	0.00480	833.2	0.0757
997.2	0.00451	908.2	0.0749
1099.2	0.00454	908.2	0.0678
1199.2	0.00489	968.2	0.0703
<u>CURVE 4</u>		972.2	0.0761
692.5	0.00402	1042	0.0753
692.8	0.00403*	1043	0.0665
790.6	0.00421	1138	0.0736
892.2	0.00432	1141	0.0686
995.2	0.00437	1196	0.0741
1095.3	0.00475	1196	0.0661
1097.2	0.00450*		
1197.2	0.00488*		

* Not shown on plot

THERMAL CONDUCTIVITY OF CERUM DIOXIDE CeO_2



SPECIFICATION TABLE NO. 21 THERMAL CONDUCTIVITY OF CERIUM DIOXIDE CeO_2

[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 CeO_2 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

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
1519.4	0.00865
1627.1	0.00837
1652.6	0.00750
1859.8	0.00865
1914.8	0.0105

CURVE 3

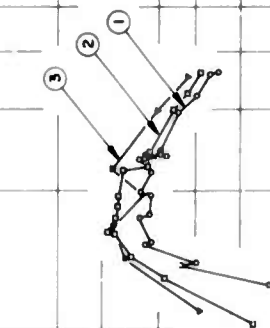
1292.1	0.0170
1313.7	0.0172
1322.1	0.0154
1327.1	0.0166
1555.9	0.0100
1555.4	0.0108
1588.2	0.0111
1628.2	0.00938
1969.2	0.00851
1977.1	0.00923
1978.2	0.00793
2005.9	0.00765

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

THERMAL CONDUCTIVITY, $\text{Watt cm}^{-1} \text{K}^{-1}$ $\uparrow$



MP 1500 K

TEMPERATURE, K $\rightarrow$

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, 3.32, 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
CURVE 1		CURVE 3 (cont.)	
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		
CURVE 2		CURVE 3	
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		
CURVE 3		109.6	0.0489
		143.9	0.0709
		168.0	0.0755
		196.9	0.0648
		222.8	0.0756

* Not shown on plot

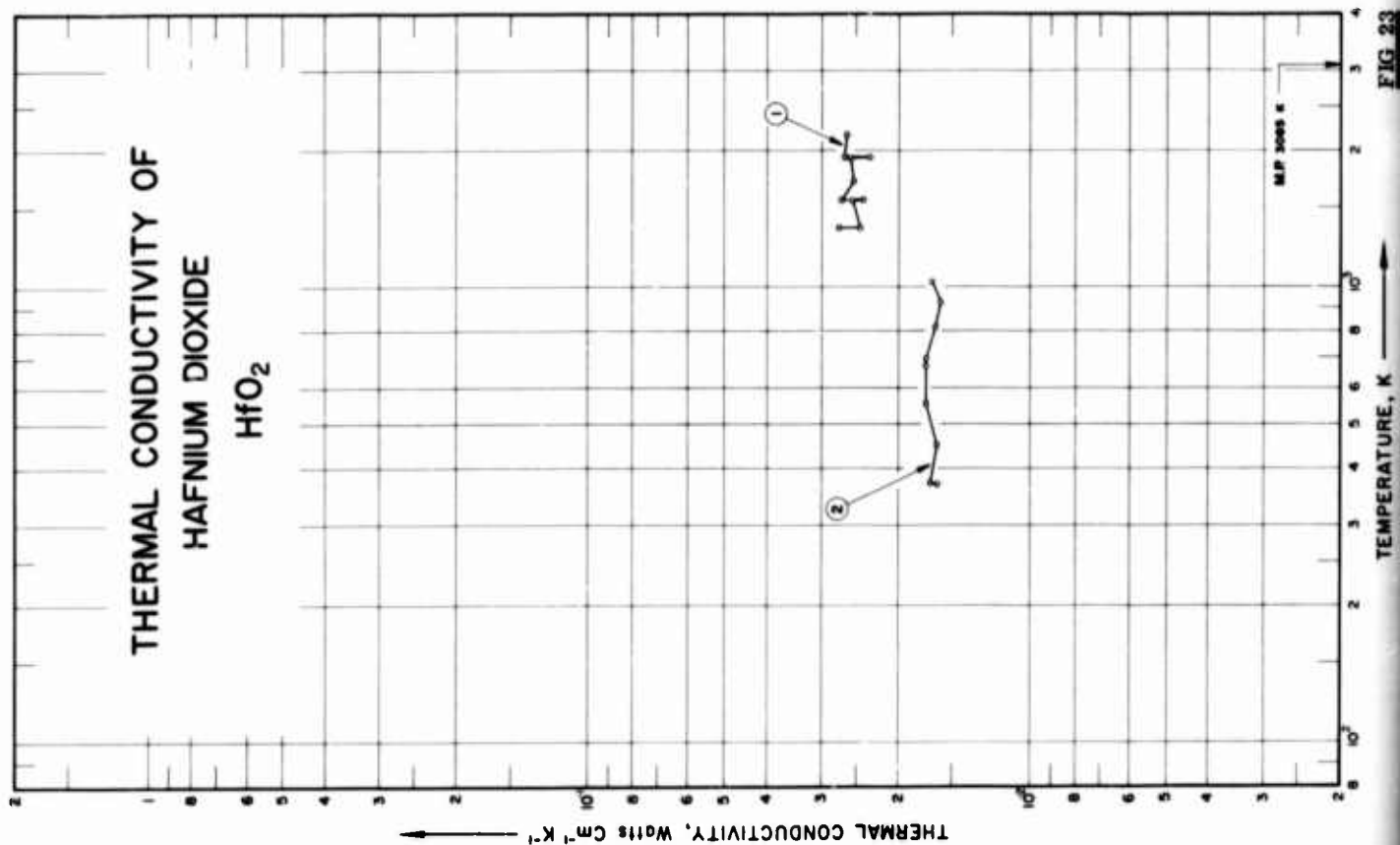


FIG 23

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 4.4 9.55 g cm^{-3} at 25 C; specimen found blistered and partially melted on post inspection.
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

CURVE 1

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

CURVE 2

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

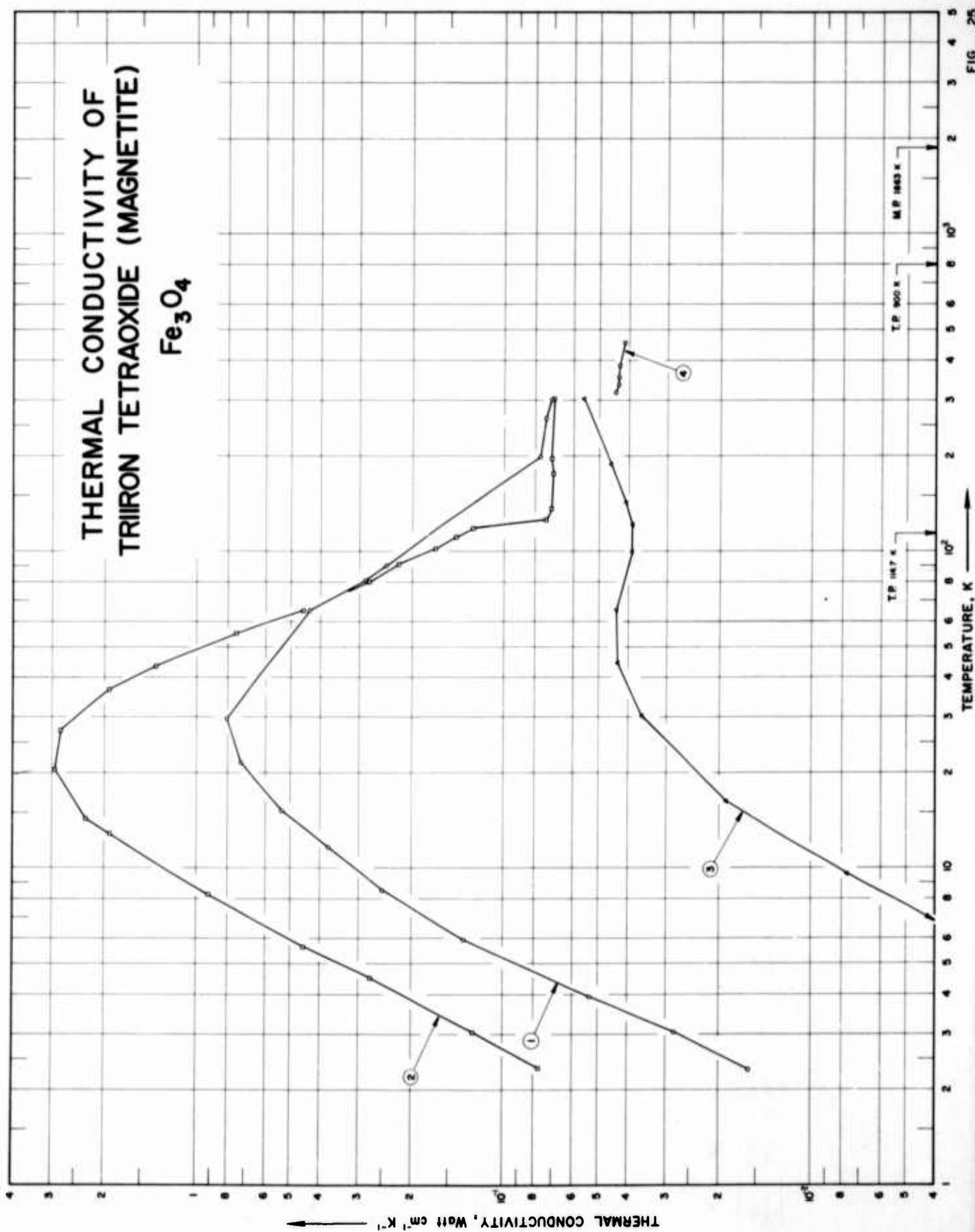
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	363	P	1965	1204-1722			Density 6.3 g cm ⁻³ ; thermal conductivity values calculated from measured thermal diffusivity data and the assumed constant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



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} atom cm^{-3} Al, $<10^{18}$ atom cm^{-3} Be, $<10^{18}$ atom cm^{-3} Ca, 10^{18} atom cm^{-3} Cr, $<10^{18}$ atom cm^{-3} K, $<10^{18}$ atom cm^{-3} Li, 10^{18} atom cm^{-3} Mg, 10^{18} atom cm^{-3} Mn, 10^{18} atom cm^{-3} Na, 10^{18} atom cm^{-3} Ni, $<10^{18}$ atom cm^{-3} Si, $<10^{18}$ atom cm^{-3} Ti, $<10^{18}$ atom cm^{-3} V, $<10^{18}$ atom cm^{-3} Zn, and $<10^{18}$ 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 $2.6 \times 10^{20} \text{ cm}^{-3}$. A section of the above specimen (1.23 cm long, 0.2 cm av. dia) annealed at 1500 K in a CO: 20 CO ₂ atmosphere; lattice constant 8.398 Å; vacancy concentration $2 \times 10^{20} \text{ cm}^{-3}$.
2	300	L	1962	2.3-304		R-57	
3	300	L	1962	3.0-302		R-63 (Co _{0.97} Fe _{2.03} 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 $8 \times 10^{19} \text{ cm}^{-3}$ 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	CURVE 1		T	k	CURVE 3	
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						
CURVE 2				CURVE 4			
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						

* 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		1953	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, $\text{Watt cm}^{-1} \text{K}^{-1}$]

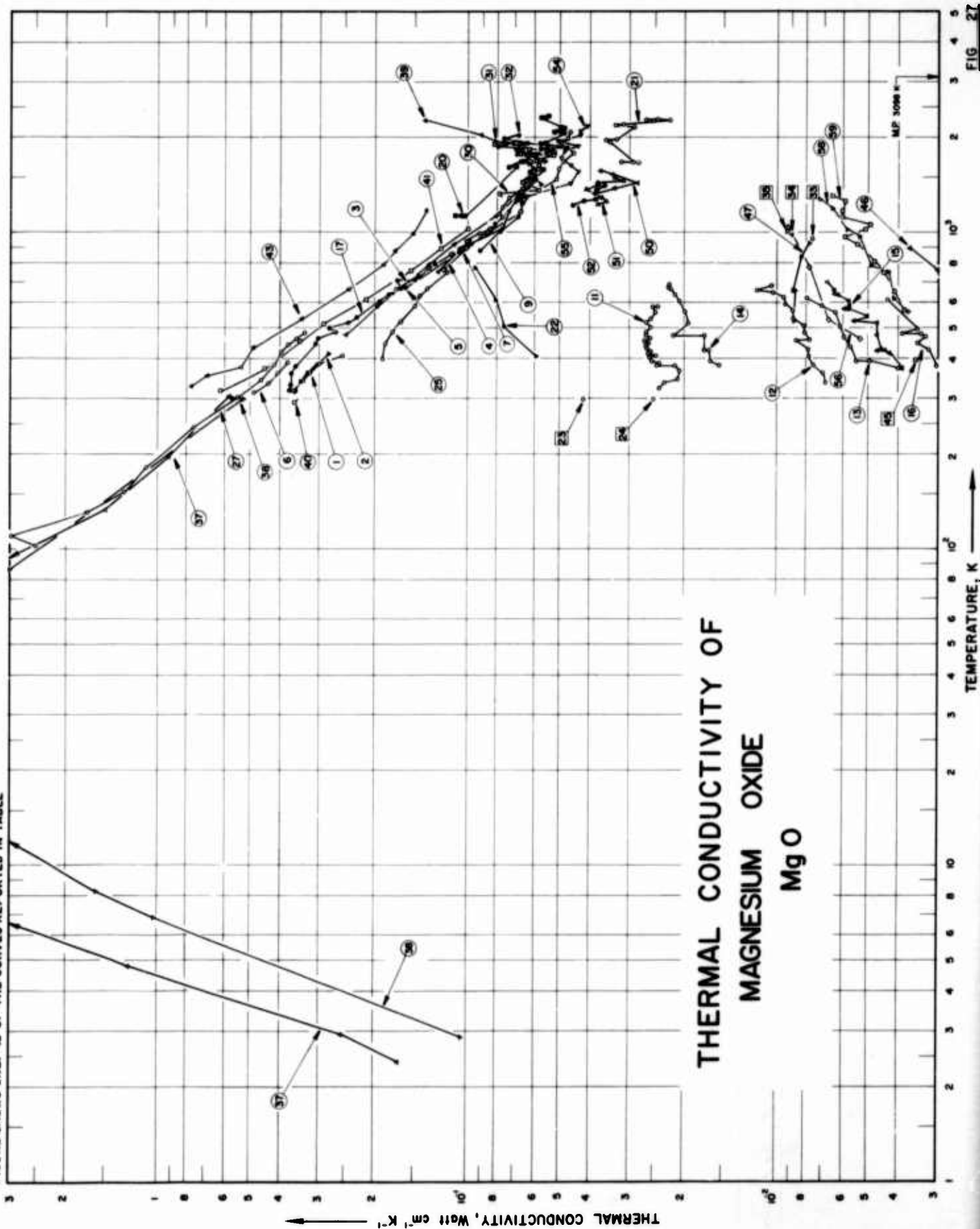
T k

CURVE 1*

333.2 0.0173

* No graphical presentation

FIGURE SHOWS ONLY 45 OF THE CURVES REPORTED IN TABLE



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 = 0.85%.
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			Sintered.
6	23	C	1952	312-388		83A-1		Single crystal.
7	57	R	1950	764-1611		A		Sintered; open pores 0.49%, closed pores 8.44%, total porosity 8.93% 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; 0.58 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	Single crystal.
27	285	P	1962	103-483	± 5	Run 1	Fired to total porosity of 8.10-8.95% to a bulk density of 3.25-3.29 g cm^{-3} .
28	274	R	1953	653-1513	< 5	Run 2	Same material as the above; separate run.
29	274	R	1953	748-1523	< 5	M-10	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%.
30	274	R	1953	1283-1908	< 10.7	M-11	Same material as the above, separate run.
31	274	R	1953	1423-1953	< 10.7	M-12	Same material as the above; separate run.
32	274	R	1953	1573-2023	< 10.7	Periclase	Compressed granular specimen; porosity 23.5%.
33	299	R	1958	951.7	± 10	Periclase	Compressed granular specimen; porosity 15.2%.
34	299	R	1958	980.7	± 10	Periclase	Compressed granular specimen; porosity 13.7%.
35	299	R	1958	1000.7	± 10		Density 3.30 g cm^{-3} .
36	302	P	1962	313-1263		R-38	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 (ppm in atms cm^{-2}) given in $\log_{10} \text{ppm}$ = 18.4 Al, 18.4 Be, 18.7 Ca, 17.6 Cr; 17.6 Fe, 18.4 K, 17.5 Li, 17.3 Mn, 18.7 Na, 17.2 Ni, 17.9 Si, 17.6 Ti, 17.3 V, 17.8 Zn, 17.7 Zr.
37	300	L	1962	2.4-305			Similar to above specimen except 1.24 cm long and 0.41 cm average dia; impurity (ppm in atms cm^{-2}) given in $\log_{10} \text{ppm}$ = 18.4 Al, 18.4 Be, 18.3 Ca, 17.6 Cr, 17.6 Fe, 18.4 K, 17.5 Li, 17.3 Mn, 18.7 Na, 17.2 Ni, 18.7 Si, 17.6 Ti, 17.3 V, 17.8 Zn, 18.1 Zr.
38	300	L	1962	2.9-300		R-14	99% MgO , 0.5% Si , 0.3% Mn ; specimen composed of 5 one-in. disks; density 2.98 g cm^{-3} .
39	298	R	1961	478-2264			Sintered; 97% of theoretical density; with an average grain size of about 15 microns.
40	296		1958	293-1273		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.
41	293	C	1957	319-1036	± 4		

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	MgO FPM-1	Data from 6 runs with 3 specimens.
50	317	R	1960	1332-1565			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 8.35%, 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 268μ ; 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 369μ 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 268μ 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	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						
712.2	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>								<u>CURVE 39</u>											
933.2	0.0920	943.2	0.0996	1698.2	0.0556	1073.2	0.109	477.6	0.247	533.2	0.342	873.2	0.0912						
1023.2	0.0845	1743.2	0.0598	1743.2	0.0598	1173.2	0.0962	589.8	0.196	663.2	0.242	892.2	0.101						
1113.2	0.0770	1768.2	0.0682	1768.2	0.0682	1263.2	0.0870	798.2	0.188	798.2	0.188	894.2	0.106						
1143.2	0.0795	1793.2	0.0556	1793.2	0.0556	<u>CURVE 37</u>		873.2	0.172			912.2	0.0925						
1183.2	0.0770	1843.2	0.0661	1843.2	0.0661	2.40	0.167	703.2	0.154*			942.2	0.0987						
1283.2	0.0732	1858.2	0.0669	1858.2	0.0669	2.93	0.255	795.4	0.134			946.2	0.100						
1373.2	0.0661	1898.2	0.0795	1898.2	0.0795	4.81	1.25	920.4	0.111			956.2	0.102						
1458.2	0.0640	1903.2	0.0736	1903.2	0.0736	6.59	3.05	1145.9	0.0801			994.2	0.0916						
1513.2	0.0619	1923.2	0.0745	1923.2	0.0745	8.83	7.70	1361.5	0.0668*			1013.2	0.0774						
<u>CURVE 25</u>						10.39	12.52	1593.7	0.0562			1023.2	0.0833						
400.2	0.189	1948.2	0.0707	1948.2	0.0707	13.17	19.61	2042.6	0.0902			1038.2	0.0837						
448.2	0.185	1953.2	0.0816	1953.2	0.0816	15.47	24.23	2263.7	0.139			1043.2	0.0761						
486.7	0.175	<u>CURVE 29*</u>		<u>CURVE 32</u>		17.17	32.37					1055.2	0.0987						
521.2	0.165	748.2	0.121	1573.2	0.0628*	21.40	28.76					1101.2	0.0690						
539.2	0.148	893.2	0.107	1733.2	0.0544*	27.17	32.37					1121.2	0.0674						
632.2	0.144	1033.2	0.0770	1813.2	0.0527	34.02	28.46					1143.2	0.0795						
668.2	0.136	1163.2	0.0732	1843.2	0.0577	47.02	13.48					1153.2	0.0787						
756.2	0.116	1273.2	0.0703	1863.2	0.0473	49.72	14.96					1175.2	0.0720						
<u>CURVE 26*</u>						63.63	8.27					1196.2	0.0636						
573.2	0.203	1373.2	0.0649	1883.2	0.0544	78.19	4.79					1201.2	0.0761						
873.2	0.115	1473.2	0.0611	1903.2	0.0636	88.10	3.46					1223.2	0.0745						
1173.2	0.0757	1523.2	0.0598	1988.2	0.0753	133.34	1.50					1263.2	0.0657						
1473.2	0.0611	<u>CURVE 30</u>		<u>CURVE 33</u>		196.93	0.922					1270.2	0.0590						
<u>CURVE 27</u>						304.75	0.584					1281.2	0.0644						
103.2	2.49	1283.2	0.0686*	951.7	0.00761	<u>CURVE 38</u>						1293.2	0.0715						
111.2	2.97	1328.2	0.0787	<u>CURVE 34</u>		2.88	0.104					1301.2	0.0682						
133.2	1.70	1353.2	0.0586			6.85	1.03					1356.2	0.0548						
153.2	1.28	1448.2	0.0653	<u>CURVE 35</u>		9.39	1.60					1358.2	0.0602						
183.2	1.09	1553.2	0.0602			15.02	4.48					1368.2	0.0640						
243.2	0.753	1578.2	0.0586			15.36	5.23					1369.2	0.0653						
303.2	0.544	1643.2	0.0586			23.44	8.80					1383.2	0.0653						
343.2	0.460	1698.2	0.0527			24.28	8.91					1394.2	0.0640						
383.2	0.418	1773.2	0.0669			24.92	9.29					1426.2	0.0615						
423.2	0.397	1798.2	0.0523			37.70	10.39					1443.2	0.0523						
443.2	0.377	1848.2	0.0628			52.65	7.81					1455.2	0.0635						
463.2	0.356	1873.2	0.0657			63.75	6.29					1456.2	0.0619						
483.2	0.335	1898.2	0.0669			65.10	5.67					1467.2	0.0632						
		1903.2	0.0816			83.09	3.40					1473.2	0.0606						
		1908.2	0.0787																

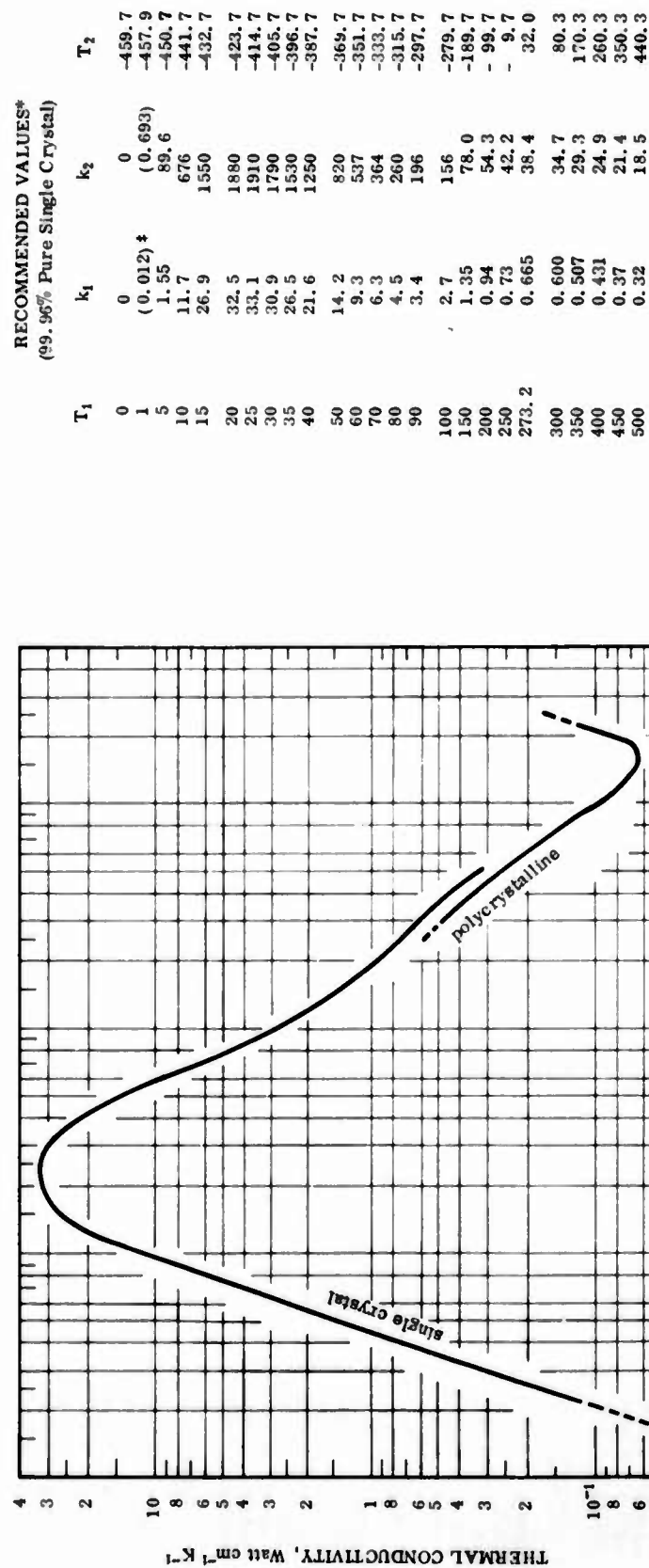
* Not shown on plot

DATA TABLE NO. 27 (continued)

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<u>CURVE 49 (cont.)*</u>		<u>CURVE 53*</u>		<u>CURVE 57 (cont.)*</u>		<u>CURVE 61*</u>		<u>CURVE 65*</u>		<u>CURVE 68 (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	563.2	0.00370	1273.2	0.0690	693.2	0.00766	1095.2	0.00915				
1537.2	0.0577	1603.2	0.0301	623.2	0.00414	1373.2	0.0642	798.2	0.00828						
1539.2	0.0556	1638.2	0.0314	753.2	0.00430	1463.2	0.0607	894.2	0.00874	<u>CURVE 69*</u>					
1547.2	0.0573	<u>CURVE 54</u>		788.2	0.00486	1506.2	0.0598	993.2	0.00884	378.2	0.00418				
1555.2	0.0510	1301.2	0.0635	973.2	0.00530	<u>CURVE 62*</u>		1099.2	0.00942	415.2	0.00428				
1570.2	0.0577	1438.2	0.0464	1023.2	0.00580	375.1	0.00433	<u>CURVE 66*</u>		507.2	0.00528				
1599.2	0.0586	1558.2	0.0439	1198.2	0.00650	502.6	0.00502	366.2	0.00671	605.2	0.00569				
1615.2	0.0586	1638.2	0.0464	1273.2	0.00715	572.3	0.00552	431.2	0.00708	707.2	0.00628				
1618.2	0.0598	1713.2	0.0498	<u>CURVE 59</u>		643.6	0.00604	568.2	0.00859	807.2	0.00696				
1624.2	0.0510	1813.2	0.0485	473.2	0.00330*	724.0	0.00661	622.2	0.00921	918.2	0.00730				
1639.2	0.0561	1873.2	0.0439	573.2	0.00382	801.6	0.00689	716.2	0.01021	1022.2	0.00781				
1673.2	0.0586	1948.2	0.0510	653.2	0.00410	809.5	0.00666	814.2	0.01060	<u>CURVE 70*</u>					
<u>CURVE 50</u>		2023.2	0.0431	748.2	0.00444	<u>CURVE 63*</u>		915.2	0.01108	718.2	0.00657				
1332.2	0.0389	2163.2	0.0410	811.2	0.00475	373.2	0.00635	1012.2	0.01163	719.2	0.00665				
1383.2	0.0337	<u>CURVE 55</u>		918.2	0.00588	443.7	0.00717	1113.2	0.01158	721.2	0.00648				
1443.2	0.0285	1358.2	0.0582*	973.2	0.00590	503.2	0.00786	<u>CURVE 67*</u>		820.2	0.00680				
1528.2	0.0343	1473.2	0.0515	1023.2	0.00508	682.9	0.00981	368.2	0.00720	918.2	0.00742				
1565.2	0.0372	1593.2	0.0502	1063.2	0.00490	756.0	0.01005	498.2	0.00892	1015.2	0.00771				
<u>CURVE 51</u>		1678.2	0.0490	1123.2	0.00600	842.4	0.01018	596.2	0.00997	1098.2	0.00813				
1221.2	0.0379	1773.2	0.0452	1173.2	0.00600	<u>CURVE 64*</u>		797.2	0.01086	1099.2	0.00802				
1251.2	0.0356	1903.2	0.0498	1263.2	0.00589	380.2	0.00420	892.2	0.01176						
1293.2	0.0368	2063.2	0.0473	1308.2	0.00650	413.2	0.00431	1094.2	0.01269						
1369.2	0.0412	<u>CURVE 56</u>		<u>CURVE 60*</u>		509.2	0.00529	<u>CURVE 68*</u>							
1407.2	0.0377	463.2	0.00530	460.2	0.171	603.2	0.00567	371.2	0.00482						
1443.2	0.0350	633.2	0.00666	769.2	0.135	702.2	0.00632	433.2	0.00533						
1451.2	0.0316	783.2	0.00780	883.2	0.114	718.2	0.00658	528.2	0.00624						
1492.2	0.0337	1043.2	0.00917	943.2	0.102	719.2	0.00643	628.2	0.00699						
<u>CURVE 52</u>		1258.2	0.0101	991.2	0.0929	818.2	0.00673	699.2	0.00750						
1219.2	0.0454	<u>CURVE 57*</u>		1033.2	0.0854	821.2	0.00698	724.2	0.00756						
1252.2	0.0420	573.2	0.00582	1143.2	0.0795	1016.2	0.00769	799.2	0.00788						
1273.2	0.0396	698.2	0.00634	1193.2	0.0770	1094.2	0.00801	897.2	0.00837						
1288.2	0.0370*			1283.2	0.0728	1101.2	0.00801	898.2	0.00854						
1320.2	0.0368*			1373.2	0.0661			998.2	0.00868						
1352.2	0.0379*			1453.2	0.0636										
1357.2	0.0383			1511.2	0.0619										
1409.2	0.0360														

* Not shown on plot

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



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.

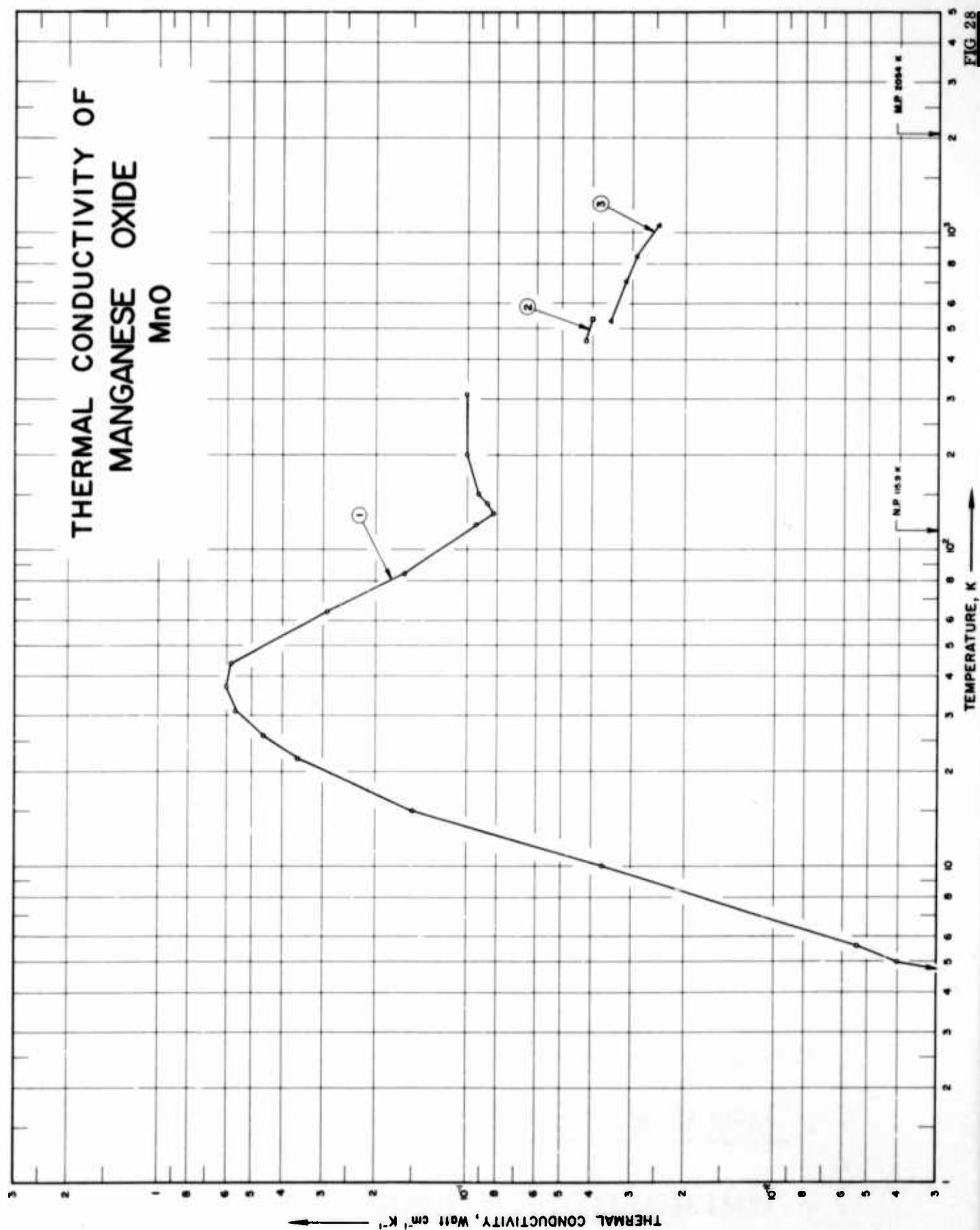
TABLE NO. 27R (continued)

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.



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 ₁ ; 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		CURVE 2	
4.0	0.0011*	458.2	0.0420
5.0	0.0040	538.2	0.0400
5.6	0.0054		
10.0	0.037	CURVE 3	
15.0	0.15	526.2	0.0350
22.0	0.36	703.2	0.0315
26.0	0.46	843.2	0.0290
31.0	0.56	1053.2	0.0245
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

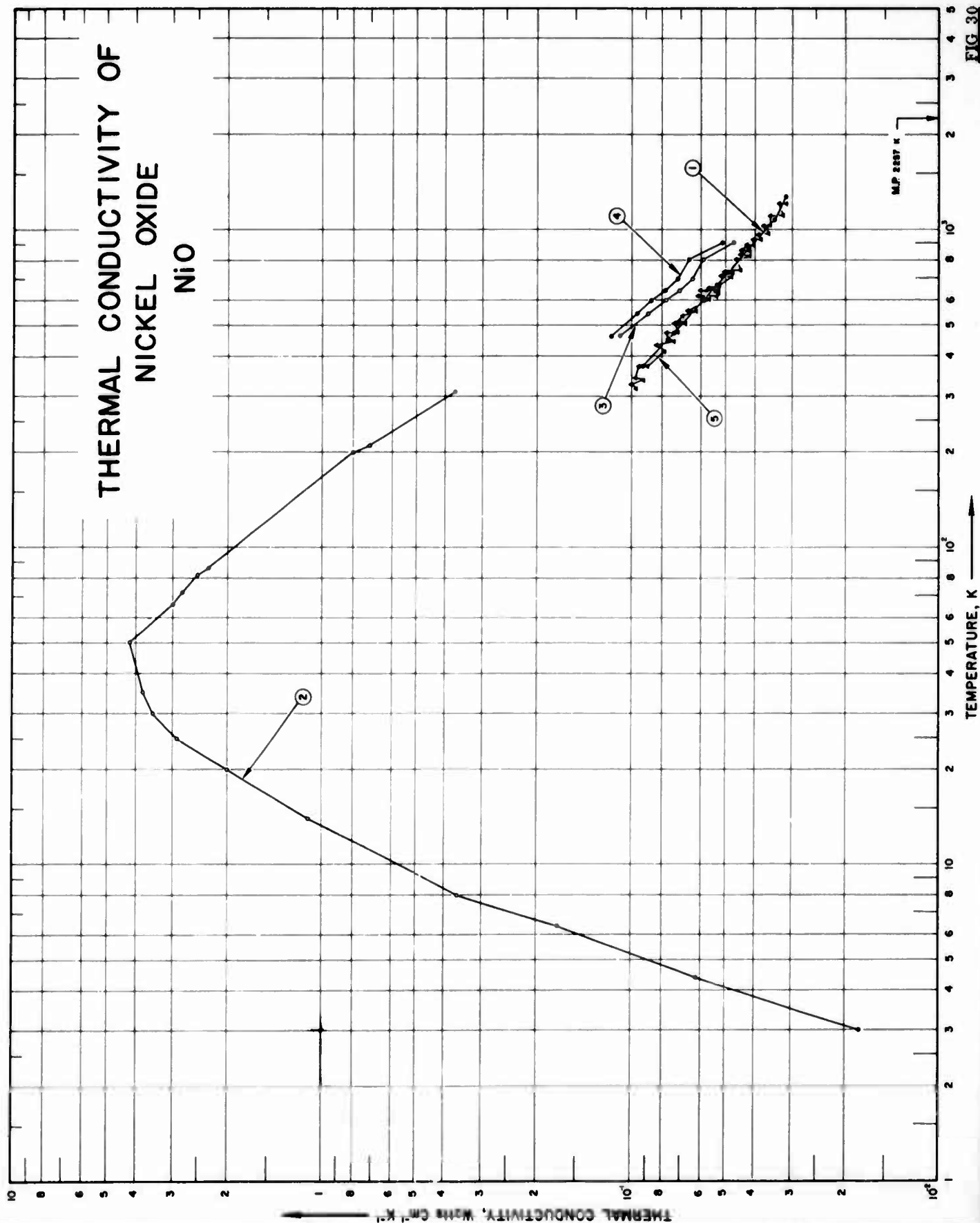
SPECIFICATION TABLE NO. 29 THERMAL CONDUCTIVITY OF TRIMANGANESE TETRAOXIDE Mn_2O_4

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⁻¹ K⁻¹]

T	k
CURVE 1*	
317.6	0.0343
341.2	0.0351
360.0	0.0356
381.3	0.0356
399.7	0.0347

* No graphical presentation



SPECIFICATION TABLE NO. 30 THERMAL CONDUCTIVITY OF NICKEL OXIDE NiO

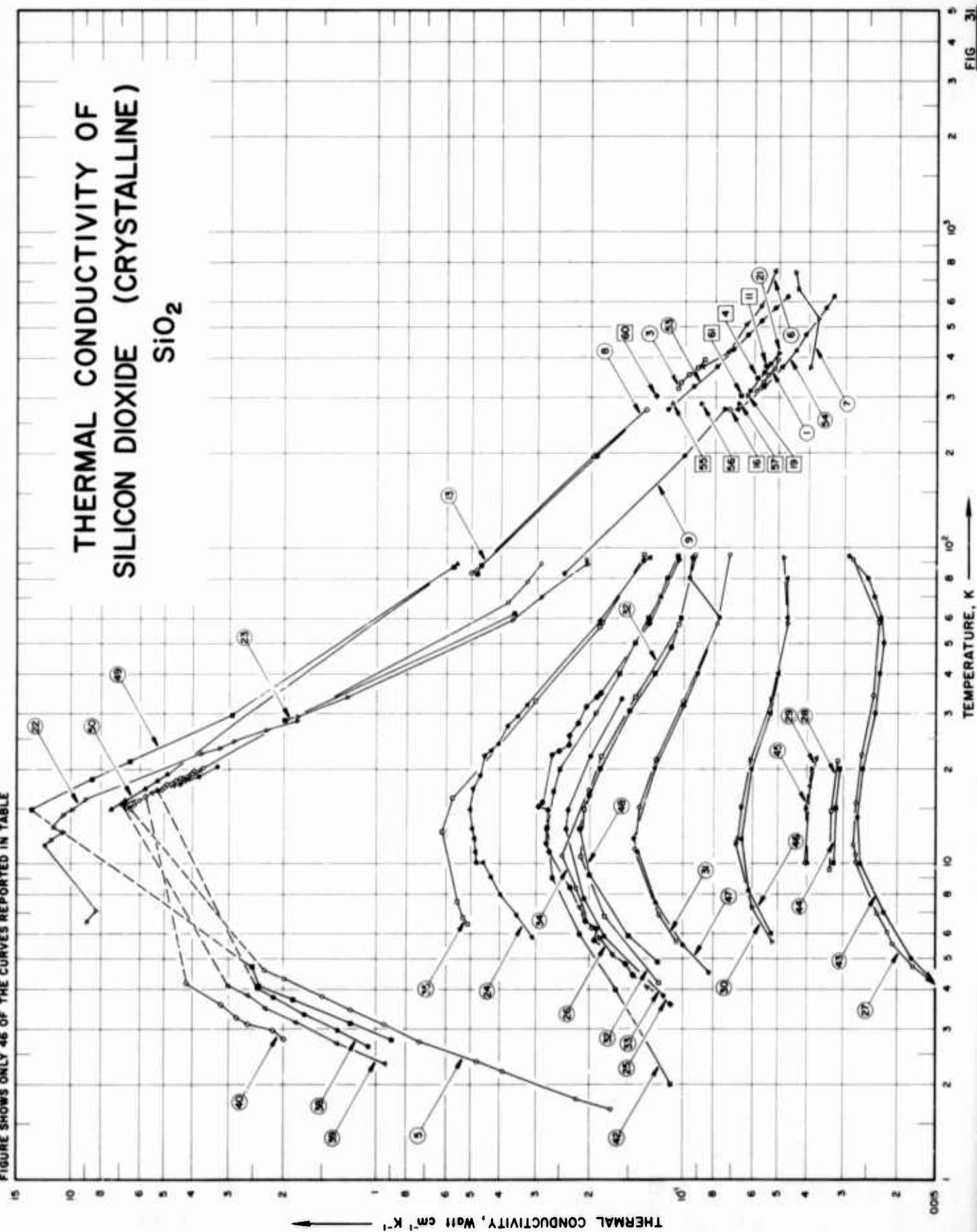
[For Data Reported in Figure and Table No. 30]

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		

FIGURE SHOWS ONLY 46 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 31 THERMAL CONDUCTIVITY OF SILICON DIOXIDE (CRYSTALLINE) SiO_2

[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	$\pm 2 \sim \pm 5$		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	28, 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	3.8-34			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 3.023 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 1.005 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 5×10^{-4} 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.

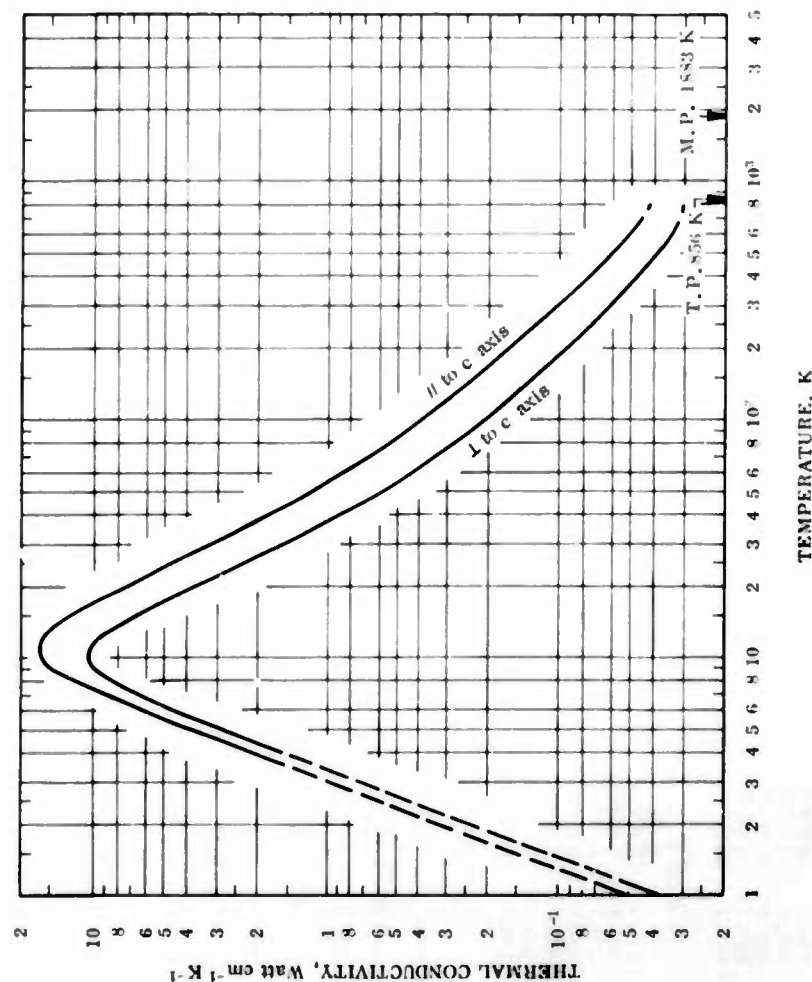
[illegible]

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) SiO_2 

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.

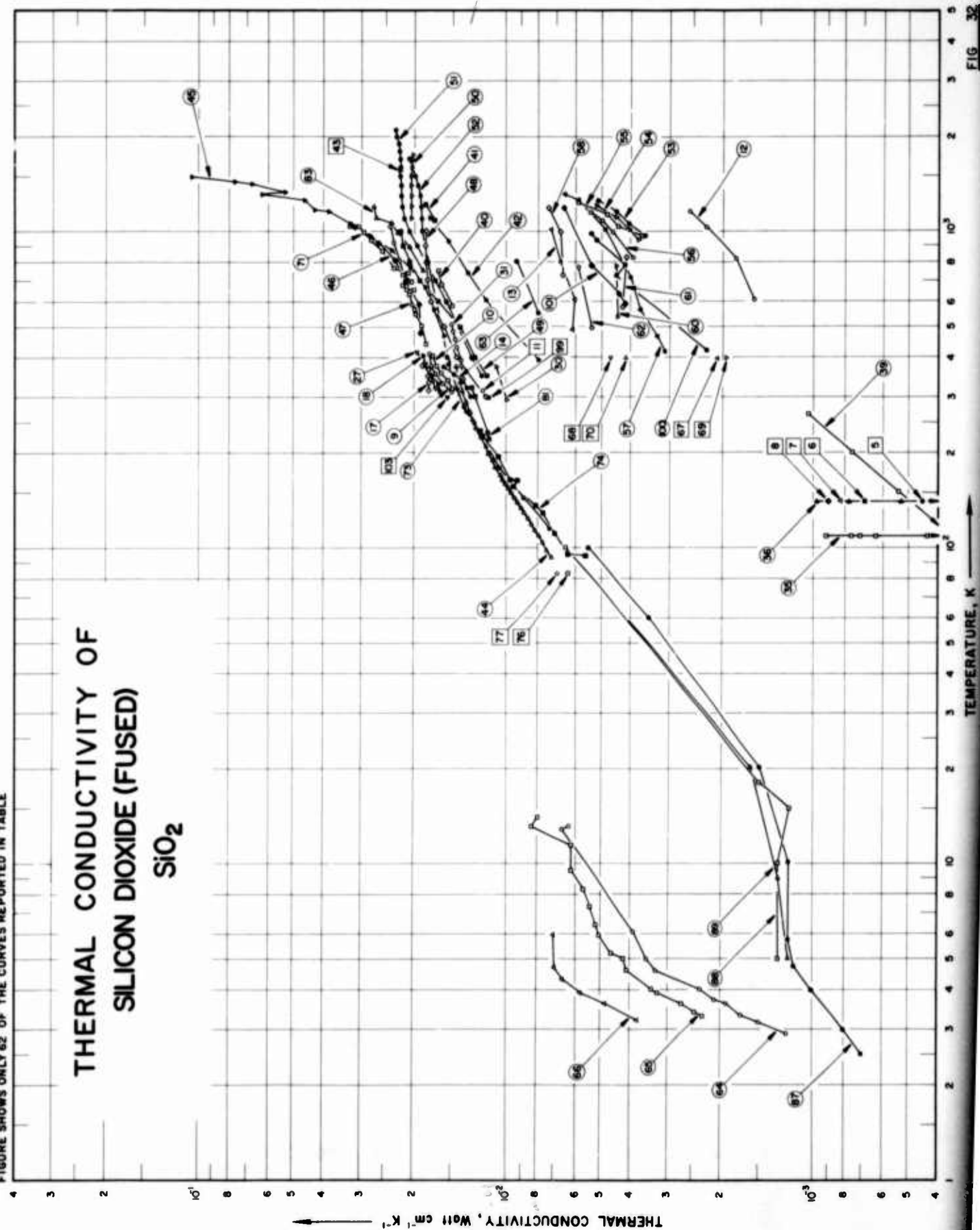
RECOMMENDED VALUES*
Quartz Single Crystal

T_1	($\parallel$ to c-axis)			($\perp$ to c-axis)			T_2
	k_1	k_2	k_3	k_1	k_2	k_3	
0	0	0	0	0	0	0	-459.7
1	(0.05) [‡]	(2.80)	(0.036)	(0.036)	(2.08)	(2.08)	-457.9
5	4.0	231	3.0	3.0	173	173	-450.7
7	9.0	520	6.6	6.6	381	381	-447.1
8	12.1	699	8.6	8.6	497	497	-445.3
9	15.0	867	10.0	10.0	578	578	-443.5
10	16.5	953	10.4	10.4	601	601	-441.7
11	16.8	971	10.3	10.3	595	595	-439.9
12	16.3	942	9.7	9.7	561	561	-438.1
13	15.2	878	8.7	8.7	503	503	-436.3
15	12.5	722	6.7	6.7	387	387	-432.7
20	7.2	416	3.7	3.7	214	214	-423.7
25	4.6	266	2.35	2.35	136	136	-414.7
30	3.18	184	1.61	1.61	93.0	93.0	-405.7
35	2.33	135	1.18	1.18	68.2	68.2	-396.7
40	1.79	103	0.89	0.89	51.4	51.4	-387.7
45	1.43	82.6	0.71	0.71	41.0	41.0	-378.7
50	1.18	68.2	0.585	0.585	33.8	33.8	-369.7
60	0.85	49.1	0.429	0.429	24.8	24.8	-351.7
70	0.66	38.1	0.337	0.337	19.5	19.5	-333.7
80	0.54	31.2	0.279	0.279	16.1	16.1	-315.7
90	0.45	26.0	0.239	0.239	13.9	13.9	-297.7
100	0.39	22.5	0.208	0.208	12.0	12.0	-279.7
150	0.231	13.3	0.130	0.130	7.51	7.51	-189.7
200	0.164	9.48	0.095	0.095	5.49	5.49	-99.7
250	0.127	7.34	0.075	0.075	4.33	4.33	-9.7
273	0.116	6.70	0.0684	0.0684	3.95	3.95	32
300	0.104	6.01	0.0621	0.0621	3.59	3.59	80.3
350	0.088	5.08	0.0530	0.0530	3.06	3.06	170.3
400	0.076	4.39	0.0470	0.0470	2.72	2.72	260.3
450	0.067	3.87	0.0423	0.0423	2.44	2.44	350.3
500	0.060	3.47	0.0388	0.0388	2.24	2.24	440.3
600	0.050	2.89	0.0340	0.0340	1.96	1.96	620.3
700	0.0447	2.58	0.0314	0.0314	1.81	1.81	800.3
800	(0.0420)	(2.43)	(0.0306)	(0.0306)	(1.77)	(1.77)	980.3

* T_1 in K, k_1 in $\text{Watt cm}^{-1} \text{K}^{-1}$, T_2 in $^{\circ}\text{F}$, and k_2 in $\text{Btu hr}^{-1} \text{ft}^{-1} \text{F}^{-1}$.[‡] Values in parentheses are extrapolated.

FIGURE SHOWS ONLY 62 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF SILICON DIOXIDE (FUSED) SiO_2



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 (0.107 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 . Similar to the above specimen except with 1.503 mm thickness and 2.294 g cm ⁻³ density.
32	140	C	1926	344-510			Similar to the above specimen except with 2.002 mm thickness and 2.293 g cm ⁻³ density.
33	140	C	1926	345-509			Similar to the above specimen except with glycerine films on the surfaces and 2.204 g cm ⁻³ density.
34	140	C	1926	348.3			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.
35	122	R	1953	109.4			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.
36	122	R	1953	140.8			Similar to the above specimen except measured at constant temperature 109.4 K and at various nitrogen pressures ranging from 0.0022 to 554 mm Hg.
37	122	R	1953	109.2			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.
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 1.8 in. x 1.8 in., prepared from gunister-type quartzite rocks; fired at 1410 to 1420°C for 60 hrs; density 1.81 g cm ⁻³ (112 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	95.3 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, 84, 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 ₁ 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		Float 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	$\epsilon/s = 0.4$ (ϵ , 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	$\epsilon/s = 0.4$, $\Delta T = 2-4$ C.
75	246	L	1963	96-305	1-3	Fused quartz	$\epsilon/s = 0.2$, $\Delta T = 4-6$ 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	$\pm 4-5$		Fused quartz; five specimens of dimensions $1 \times 1 \times 1 \text{ cm}^3$ 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 2.406 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 1.0×10^{-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 $1.85-1.95 \text{ g cm}^{-3}$; 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	5, 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.

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

T	k	T	k	T	k	T	k	p (mm Hg)	k	T	k	T	k
<u>CURVE 1*</u>		<u>CURVE 11</u>		<u>CURVE 18</u>		<u>CURVE 24*</u>		<u>CURVE 30</u>		<u>CURVE 35</u> (T = 109.4K)		<u>CURVE 44 (cont.)</u>	
140.05	0.000013	14.2	0.0118	314.0	0.0165	313.5	0.0159	293.2	0.00992	0.0053	0.0000544*	93.2	0.00030*
<u>CURVE 2*</u>		<u>CURVE 12</u>		330.9	0.0166	334.2	0.0159	373.2	0.0107	0.207	0.0000406*	100	0.000333*
		351.9	0.0175	353.4	0.0172	353.4	0.0172	373.2	0.0107	0.913	0.0000916*	150	0.0106*
140.27	0.000031	410.9	0.00156	369.1	0.0180*	372.9	0.0169	<u>CURVE 31</u>		13.5	0.000277	200	0.000760
<u>CURVE 3*</u>		406.0	0.0057	397.9	0.0174	397.9	0.0174	341.9	0.0138	53.5	0.000435	265	0.00104
		120.4	0.00180	<u>CURVE 19*</u>		<u>CURVE 25*</u>		376.1	0.0141	211.5	0.000635	198.2	0.0111
140.30	0.000150	1633.2	0.00227	319.1	0.0159	317.7	0.0151	392.3	0.0141	399.0	0.000718	193.2	0.0113*
<u>CURVE 4*</u>		164.8	0.00256	335.4	0.0159	335.2	0.0155	403.6	0.0144*	596.5	0.000762	198.2	0.0114
		353.0	0.0167	353.0	0.0167	430.7	0.0145	430.7	0.0145	582.2	0.0151	203.2	0.0116*
140.38	0.000333	488.7	0.00616	352.7	0.0164	459.6	0.0147	459.6	0.0147	683.2	0.0163	208.2	0.0117
		508.7	0.00606	369.3	0.0173	485.5	0.0149	485.5	0.0149	752.2	0.0167	213.2	0.0118*
<u>CURVE 5</u>		797.1	0.00675	394.3	0.0181	510.2	0.0150	<u>CURVE 32*</u>		<u>CURVE 41</u>		218.2	0.00120*
		1902.1	0.00727	<u>CURVE 20*</u>		<u>CURVE 26*</u>		343.6	0.0140	0.057	0.0000209*	223.2	0.0121
140.56	0.000452	<u>CURVE 14</u>		318.0	0.0151	320.4	0.0154	343.6	0.0140	1.204	0.000166*	228.2	0.0122*
		333.5	0.0159	333.8	0.0160	378.6	0.0141	378.6	0.0141	16.0	0.000371*	233.2	0.0123*
<u>CURVE 6</u>		350.2	0.0165	351.5	0.0165	398.3	0.0146	398.3	0.0146	53.5	0.000528	238.2	0.0125
140.52	0.000692	336.7	0.0138	370.3	0.0176	376.0	0.0165	404.4	0.0144	202.5	0.000780	243.2	0.0126*
		353.2	0.0148	396.7	0.0179	392.9	0.0172	431.7	0.0145	398.5	0.000908*	248.2	0.0127*
<u>CURVE 7</u>		374.7	0.0160	<u>CURVE 21*</u>		<u>CURVE 27</u>		459.6	0.0149	603.0	0.000977	253.2	0.0128
		319.1	0.0159	319.1	0.0170	431.7	0.0145	459.6	0.0149	393.0	0.00796	258.2	0.0129*
140.61	0.000826	335.4	0.0160	338.6	0.0173	360.1	0.0177*	485.1	0.0153	610.4	0.0117	263.2	0.0130*
<u>CURVE 8</u>		334.5	0.0161	353.0	0.0167	360.1	0.0177*	510.4	0.0153	742.1	0.0133	268.2	0.0131
		353.8	0.0171	369.3	0.0173	381.1	0.0183	<u>CURVE 33*</u>		939.3	0.0132*	273.2	0.0132*
140.58	0.000900	371.0	0.0174	393.6	0.0175	416.7	0.0197	345.4	0.0141	1100.9	0.0175	278.2	0.0134*
<u>CURVE 9</u>		408.1	0.0175	<u>CURVE 22*</u>		<u>CURVE 28*</u>		396.6	0.0144	0.0022	0.00000460	284.2	0.0134*
		318.0	0.0151	318.0	0.0151	316.2	0.0165	405.0	0.0144	0.175	0.0000205	288.2	0.0135
310.8	0.0151	332.0	0.0161	333.5	0.0159	335.8	0.0172	432.2	0.0145	1.391	0.0000385	293.2	0.0136*
335.9	0.0170	337.7	0.0162	350.2	0.0167	351.6	0.0179	460.8	0.0149	12.0	0.0000678	298.2	0.0137*
376.4	0.0175	352.2	0.0172	370.3	0.0176	375.8	0.0185	508.5	0.0151	44.0	0.000101	303.2	0.0138*
412.2	0.0177	373.4	0.0170	396.7	0.0179	406.8	0.0201	405.0	0.0144	182.0	0.000148	308.2	0.0139*
<u>CURVE 10</u>		<u>CURVE 17</u>		<u>CURVE 23*</u>		<u>CURVE 29*</u>		584.0	0.000174	379.0	0.000174	313.2	0.0139
		313.8	0.0179	316.1	0.0153	316.2	0.0165	432.2	0.0145	584.0	0.000191	318.2	0.0140*
317.1	0.0151	338.6	0.0179	333.7	0.0156	335.8	0.0172	460.8	0.0149	93.2	0.00721	323.2	0.0140*
335.4	0.0163	349.7	0.0180	353.1	0.0165	351.6	0.0179	485.6	0.0150	98.2	0.00749	328.2	0.0136*
375.6	0.0169	376.8	0.0179	371.1	0.0167	375.8	0.0185	508.5	0.0151	103.2	0.00774	328.2	0.0141*
405.6	0.0174	375.3	0.0189	397.1	0.0178	406.8	0.0201	<u>CURVE 34*</u>		108.2	0.00795	333.2	0.0141
								348.3	0.0138	113.2	0.00820	338.2	0.0142*
										118.2	0.00841	343.2	0.0143*
										123.2	0.00862	348.2	0.0144*
										128.2	0.00887	353.2	0.0144*
										133.2	0.00908	358.2	0.01450*
										138.2	0.00925	363.2	0.0146*
										143.2	0.00946	368.2	0.0146*
										148.2	0.00967	373.2	0.0146
										153.2	0.00987		
										158.2	0.01008		

* Not shown on plot

DATA TABLE NO. 32 (continued)

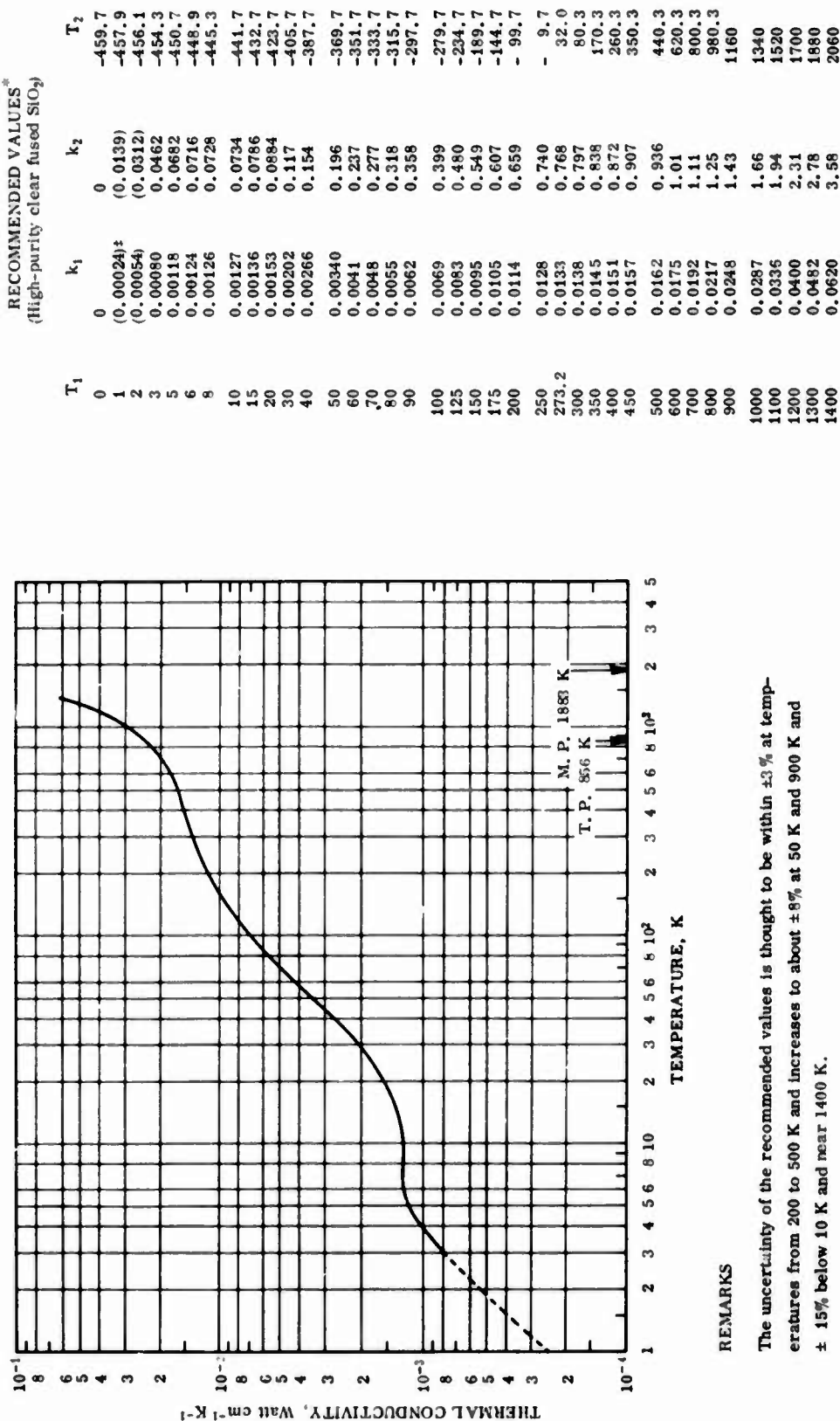
CURVE 45		CURVE 49		CURVE 52 (cont.)		CURVE 57 (cont.)		CURVE 64 (cont.)		CURVE 71		CURVE 72 (cont.)*		CURVE 74 (cont.)							
T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k						
368.2	0.0151*	350	0.0116	600	0.0171*	906.5	0.00457*	6.10	0.00390	441.2	0.0183	754.2	0.0213	304	0.0137*						
468.2	0.0159	400	0.0127	700	0.0174*	1014.8	0.00488	12.8	0.00660	502.2	0.0190	825.2	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	851.2	0.0213	344	0.0146*						
668.2	0.0184	600	0.0167	900	0.0187*	1258.7	0.00590			554.2	0.0200*	851.2	0.0226	354	0.0148*						
773.2	0.0206	700	0.0192	1000	0.0188	1316.5	0.00658	CURVE 65		568.2	0.0200	917.2	0.0233	361	0.0149*						
871.2	0.0238	800	0.0209	1100	0.0189			CURVE 58		588.2	0.0202*	937.2	0.0237	370	0.0150*						
968.2	0.0280	900	0.0219	1200	0.0190			3.30	0.00230	631.2	0.0209	1003.2	0.0243	378	0.0151*						
1069.2	0.0327	1000	0.0224	1300	0.0192			3.40	0.00245	654.2	0.0201	1065.2	0.0251	384	0.0151*						
CURVE 50		1400	0.0195	1400	0.0195	730.9	0.00661	3.60	0.00270	657.2	0.0214	CURVE 73				384	0.0151*				
1173.2	0.0428	1500	0.0199	1500	0.0199	996.5	0.00675	3.90	0.00325	659.2	0.0213*	430	0.0153*	392	0.0152*						
1265.2	0.0464	1600	0.0203*	1600	0.0203*	1182.1	0.00742	4.00	0.00340	677.2	0.0214*	446	0.0159*	430	0.0153*						
1313.2	0.0628	1700	0.0208			CURVE 59*		4.60	0.00410	679.2	0.0220	446	0.0159*	446	0.0159*						
1339.2	0.0534			CURVE 53		393.2	0.00318	5.00	0.00420	693.2	0.0205	463	0.0162*	463	0.0162*						
1412.2	0.0674	1200	0.0205			1282.1	0.00602	5.20	0.00460	714.2	0.0209*	CURVE 75*				179	0.0105				
1441.2	0.0766	1300	0.0205	974.2	0.00360			5.92	0.00505	714.2	0.0218*	179	0.0105	CURVE 75*				179	0.0105		
1481.2	0.105	1400	0.0205	1061.2	0.00406	CURVE 60		6.40	0.00520	728.2	0.0210	249	0.0127	96	0.00594	96	0.00594				
CURVE 46		1500	0.0205	1156.2	0.00448	537.1	0.00443	7.30	0.00540	737.2	0.0210	270	0.0134	108	0.00674	108	0.00674				
366.5	0.0182	1600	0.0204	1255.7	0.00515	778.2	0.00447	8.30	0.00570	765.2	0.0235	279	0.0136	130	0.00803	130	0.00803				
477.6	0.0192	1700	0.0204			CURVE 54		9.50	0.00620	796.2	0.0237*	319	0.0144	164	0.00954	164	0.00954				
588.7	0.0193	1750	0.0203			537.1	0.00443	11.50	0.00620	864.2	0.0256	357	0.0146*	226	0.0121	226	0.0121				
CURVE 51				CURVE 54		778.2	0.00447	13.2	0.00840	902.2	0.0258*	373	0.0148*	294	0.0138	294	0.0138				
350	0.0119			940.2	0.00377	CURVE 61		14.0	0.00798	907.2	0.0265*	381	0.0153	305	0.0140	305	0.0140				
400	0.0128	350	0.0119	1019.7	0.00402	578.2	0.00426	CURVE 66		935.2	0.0274*	402	0.0156*	CURVE 76				402	0.0156*		
500	0.0142*	400	0.0128	1114.2	0.00448	828.7	0.00415	3.20	0.00380	938.2	0.0280	418	0.0156*	83.2	0.00636	83.2	0.00636				
600	0.0157	500	0.0142*	1208.2	0.00519			3.60	0.00480	959.2	0.0282*	453	0.0158*	CURVE 76				453	0.0158*		
700	0.0170	600	0.0157			CURVE 62		3.91	0.00580	991.2	0.0296	454	0.0162*	CURVE 77				454	0.0162*		
800	0.0181*	700	0.0170			499.3	0.00535	4.30	0.00660	991.2	0.0296	474	0.0164*	CURVE 77				474	0.0164*		
900	0.0196	800	0.0181*	967.7	0.00368	774.8	0.00588	4.70	0.00696	1025.2	0.0308	CURVE 74				CURVE 74				1025.2	0.0308
1000	0.0208	900	0.0196	1044.7	0.00444	CURVE 63		5.95	0.00700	1037.2	0.0329	94	0.00561	83.2	0.00686	83.2	0.00686				
1100	0.0217	1000	0.0208	1134.2	0.00481	552.6	0.00798	CURVE 67		CURVE 72*				95	0.00636	CURVE 78				95	0.00636
1200	0.0220	1100	0.0217	1229.2	0.00590	804.8	0.00928	395.4	0.00209	445.2	0.0187	112	0.00703	128	0.00770	128	0.00770				
1300	0.0222	1200	0.0220			CURVE 56		CURVE 68		494.2	0.0197	136	0.00812	157	0.00950	157	0.00950				
1400	0.0222	1300	0.0222	829.7	0.00393	CURVE 64		397.0	0.00469	511.2	0.0195	163	0.00929	163	0.00929	163	0.00929				
1500	0.0223	1400	0.0222	996.7	0.00460	2.90	0.00122	CURVE 69		548.2	0.0206	195	0.0107	195	0.0107	195	0.0107				
1600	0.0223	1500	0.0223	1079.7	0.00498	3.15	0.00150	CURVE 70		560.2	0.0200	200	0.0113*	200	0.0113*	200	0.0113*				
1700	0.0223	1600	0.0223	1159.2	0.00540	3.32	0.00170	398.7	0.00194	576.2	0.0206	220	0.0118*	220	0.0118*	220	0.0118*				
1800	0.0225	1700	0.0223			3.60	0.00190	CURVE 71		602.2	0.0206	225	0.0119	225	0.0119	225	0.0119				
1900	0.0226	1800	0.0225	417.1	0.00310	3.70	0.00210	CURVE 72		613.2	0.0213	230	0.0121*	230	0.0121*	230	0.0121*				
2000	0.0231	1900	0.0226	465.9	0.00331	4.00	0.00235	CURVE 73		643.2	0.0210	235	0.0122	235	0.0122	235	0.0122				
2100	0.0232	2000	0.0231	568.7	0.00374	4.60	0.00330	399.8	0.00417	660.2	0.0213	283	0.0137*	283	0.0137*	283	0.0137*				
CURVE 52		500	0.0163*	715.9	0.00400	5.00	0.00354	CURVE 74		714.2	0.0214	302	0.0142*	302	0.0142*	302	0.0142*				
300	0.0117			CURVE 57				CURVE 75		735.2	0.0216	CURVE 79*				CURVE 79*				735.2	0.0216
400	0.0146	300	0.0131*	417.1	0.00310	2.90	0.00122	CURVE 65		445.2	0.0187	94	0.00561	83.2	0.00686	83.2	0.00686				
500	0.0160	400	0.0156	465.9	0.00331	3.15	0.00150	395.4	0.00209	494.2	0.0197	95	0.00636	128	0.00770	128	0.00770				
600	0.0177	500	0.0163*	568.7	0.00374	3.32	0.00170	397.0	0.00469	511.2	0.0195	112	0.00703	136	0.00812	136	0.00812				
700	0.0182	600	0.0177	715.9	0.00400	3.60	0.00190	CURVE 66		548.2	0.0206	128	0.00770	157	0.00950	157	0.00950				
800	0.0184	700	0.0182			3.70	0.00210	CURVE 67		560.2	0.0200	136	0.00812	163	0.00929	163	0.00929				
900	0.0184	800	0.0184			4.00	0.00235	CURVE 68		576.2	0.0206	157	0.00950	195	0.0107	195	0.0107				
900	0.0185	900	0.0184			4.60	0.00330	CURVE 69		602.2	0.0206	163	0.00929	200	0.0113*	200	0.0113*				
1000	0.0184	1000	0.0184			5.00	0.00354	CURVE 70		613.2	0.0213	205	0.0114*	220	0.0118*	220	0.0118*				
								CURVE 71		643.2	0.0210	220	0.0118*	225	0.0119	225	0.0119				
								CURVE 72		660.2	0.0213	230	0.0121*	230	0.0121*	230	0.0121*				
								CURVE 73		673.2	0.0204	235	0.0122	235	0.0122	235	0.0122				
								CURVE 74		714.2	0.0214	283	0.0137*	283	0.0137*	283	0.0137*				
								CURVE 75		735.2	0.0216	302	0.0142*	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	T	k
<u>CURVE 80*</u>		<u>CURVE 84 (cont.)*</u>		<u>CURVE 87 (cont.)</u>		<u>CURVE 91*</u>		<u>CURVE 97*</u>					
123.2	0.00887	861.2	0.0341	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 98*</u>					
173.2	0.0107	1013.2	0.0297	20.25	0.00150	378.2	0.0169						
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	0.0136	1160.2	0.0393	<u>CURVE 88</u>		503.2	0.0163						
303.2	0.0137	1215.2	0.0423	5.0	0.00130	503.2	0.0175	<u>CURVE 100</u>					
323.2	0.0141	1253.2	0.0448	10.0	0.00130	505.2	0.0155						
<u>CURVE 81</u>		<u>CURVE 85*</u>		15.0	0.00120	624.2	0.0203						
220	0.0113	343.2	0.0155	18.0	0.00150	723.2	0.0179						
236	0.0114	423.2	0.0162	100.0	0.00650	723.2	0.0204						
300	0.0126	461.2	0.0156	<u>CURVE 89</u>		815.5	0.0192						
320	0.0130	479.2	0.0167	5.0	0.00120	817.2	0.0213						
360	0.0134*	517.2	0.0167	9.0	0.00130	890.2	0.0247						
<u>CURVE 82*</u>		583.2	0.0176	20.25	0.00160	890.2	0.0234						
490	0.0142	624.2	0.0188	100.0	0.00650*	949.2	0.0278	<u>CURVE 101</u>					
550	0.0146	673.2	0.0187	5.0	0.00120	949.2	0.0273						
560	0.0159	726.2	0.0205	100	0.00343	592.60	0.00417						
700	0.0176	813.2	0.0215	100	0.00665	646.49	0.00438						
<u>CURVE 83</u>		873.2	0.0228	150	0.00925	782.60	0.00538						
500	0.0151*	883.2	0.0240	200	0.0112	1195.94	0.00658						
575	0.0155*	963.2	0.0268	250	0.0127	<u>CURVE 102*</u>							
750	0.0188	1035.2	0.0302	300	0.0138	298.2	0.0138						
890	0.0209	1091.2	0.0314	350	0.0146	<u>CURVE 103</u>							
990	0.0228	1113.2	0.0335	400	0.0153								
1060	0.0238	1183.2	0.0377	450	0.0159								
1100	0.0270	1243.2	0.0418	500	0.0164								
1220	0.0276	1273.2	0.0450	550	0.0168								
<u>CURVE 84*</u>		297	0.0145	600	0.0172								
418.2	0.0155	325	0.0147	650	0.0177								
451.2	0.0153	362	0.0157	700	0.0184								
478.2	0.0159	372	0.0163	750	0.0193								
505.2	0.0159	400	0.0168	800	0.0205								
571.2	0.0167	413	0.0184	850	0.0218								
609.2	0.0184	422	0.0182	900	0.0236								
668.2	0.0188	<u>CURVE 87</u>		950	0.0259								
705.2	0.0199	2.5	0.00070	1000	0.0291								
785.2	0.0218	3.0	0.00080	1050	0.0335								
		4.0	0.00100	1100	0.0397								
		4.75	0.00115										

* Not shown on plot

FIGURE AND TABLE NO. 32R RECOMMENDED THERMAL CONDUCTIVITY OF SILICON DIOXIDE (FUSED) SiO_2 

REMARKS

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

* 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.

SPECIFICATION TABLE NO. 33 THERMAL CONDUCTIVITY OF STRONTIUM OXIDE SrO

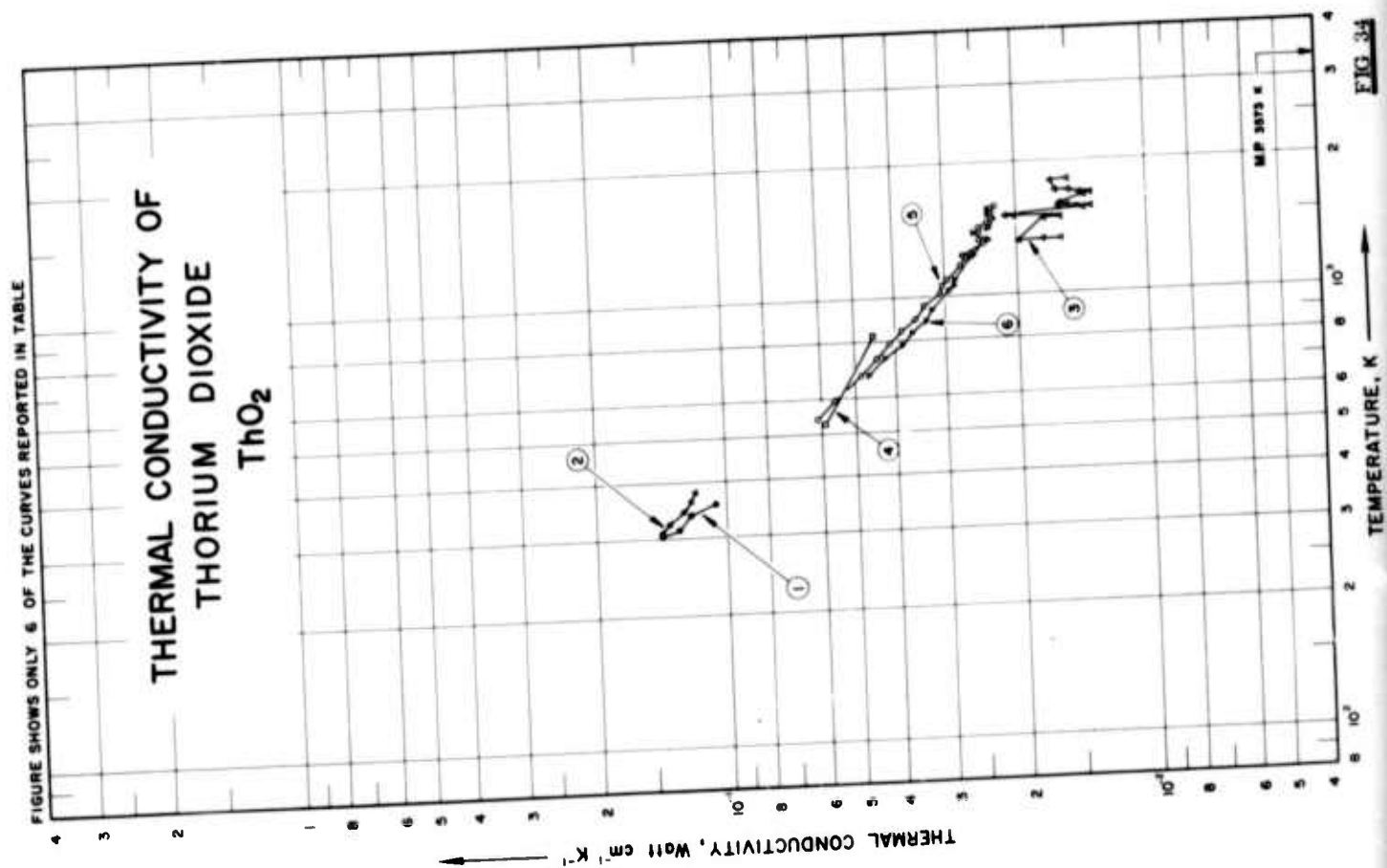
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	75	L	1955	493-1003	< 10	Tube No. 2	Polycrystalline; prepared from SrCO ₃ ; measured under vacuum 10 ⁻⁶ mm Hg; apparent thermal conductivity (effects 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
CURVE 1 *	
493.2	0.50
676.2	0.80
798.2	1.25
893.2	1.76
1003.2	2.30

* No graphical presentation



SPECIFICATION TABLE NO. 34 THERMAL CONDUCTIVITY OF THORIUM DIOXIDE ThO_2

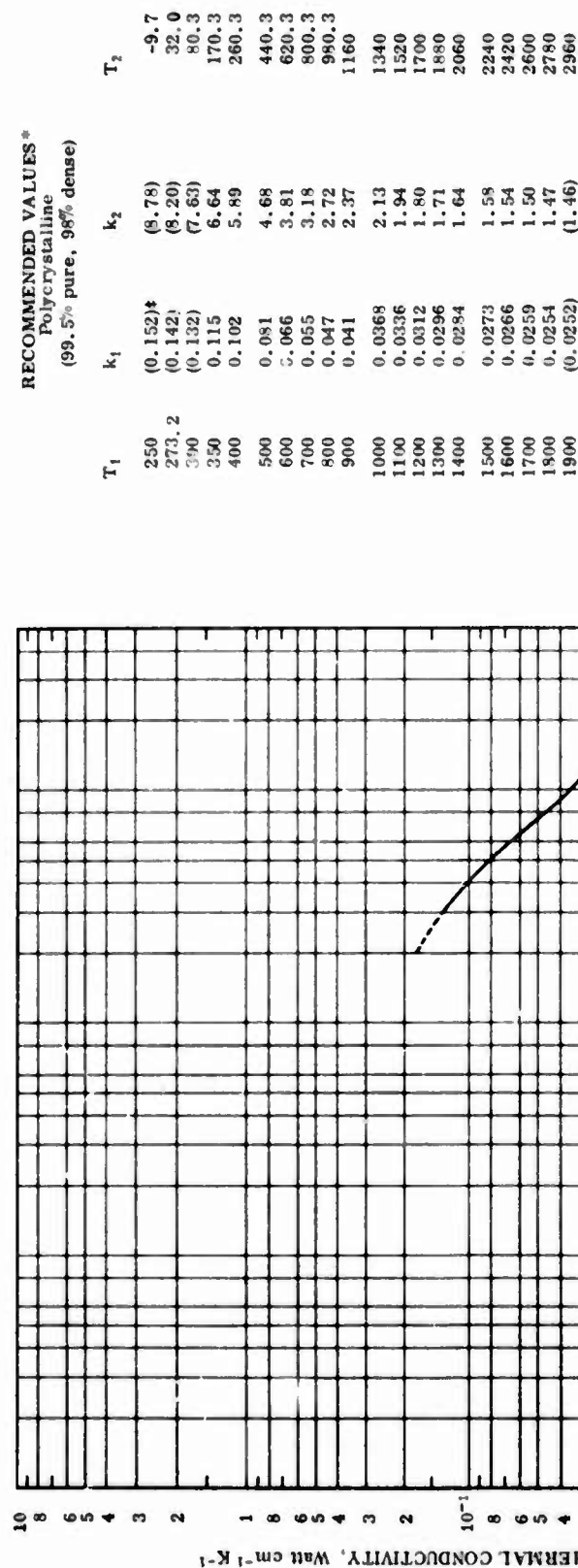
[For Data Reported in Figure and Table No. 34]

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 $\pm$ 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				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>		<u>CURVE 5 (cont.)</u>		<u>CURVE 6 (cont.)</u>		<u>CURVE 10*</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	<u>CURVE 7*</u>		1752	0.000649		
<u>CURVE 2</u>		893.2	0.0351			1816	0.000702		
		953.2	0.0335						
		1013.2	0.0305	1219	0.000456				
306.0	0.141	1063.2	0.0301	1300	0.000533				
322.0	0.136	1093.2	0.0293	1400	0.000618				
342.1	0.126	1173.2	0.0276	1500	0.000698				
361.4	0.122	1223.2	0.0264	1600	0.000784				
379.0	0.118	1243.2	0.0268	1701	0.000889				
<u>CURVE 3</u>		1303.2	0.0238	1800	0.001006				
		1348.2	0.0243	1893	0.00115				
		1393.2	0.0243	1942	0.00128				
1330.9	0.0156	1423.2	0.0243	1989	0.00135				
1330.9	0.0172	1453.2	0.0234	2009	0.00144				
1330.9	0.0195	1493.2	0.0226	<u>CURVE 8*</u>					
1490.9	0.0170	1533.2	0.0226	1301	0.00105				
1498.2	0.0156	1563.2	0.0226	1400	0.00111				
1522.1	0.0209	1593.2	0.0222	1500	0.00117				
1509.3	0.0198	<u>CURVE 5</u>		1600	0.00123				
1576.5	0.0138	538.2	0.062	1700	0.00129				
1590.9	0.0133	593.2	0.054	1800	0.00134				
1581.5	0.0157	673.2	0.046	1902	0.00139				
1587.6	0.0149	733.2	0.042	2009	0.00144				
1597.6	0.0156	783.2	0.038	<u>CURVE 9*</u>					
1673.7	0.0137	833.2	0.036	1225	0.000466				
1687.6	0.0133	883.2	0.033	1301	0.000539				
1691.5	0.0141	933.2	0.032	1400	0.000630				
1705.9	0.0149	1003.2	0.029	1500	0.000708				
1708.7	0.0160	1053.2	0.028	1555	0.000746				
1801.5	0.0164	1093.2	0.028	1600	0.000766				
1820.9	0.0149	1173.2	0.027	1653	0.000782				
<u>CURVE 4</u>		1223.2	0.0255	1700	0.000783				
526.8	0.0586	1243.2	0.0251	1760	0.000761				
824.1	0.0448	1303.2	0.0243*	1799	0.000725				
<u>CURVE 5</u>		1348.2	0.023	1816	0.000702				
		1423.2	0.025						
543.2	0.061	1453.2	0.0225*						
593.2	0.0552	1493.2	0.0225						

* Not shown on plot

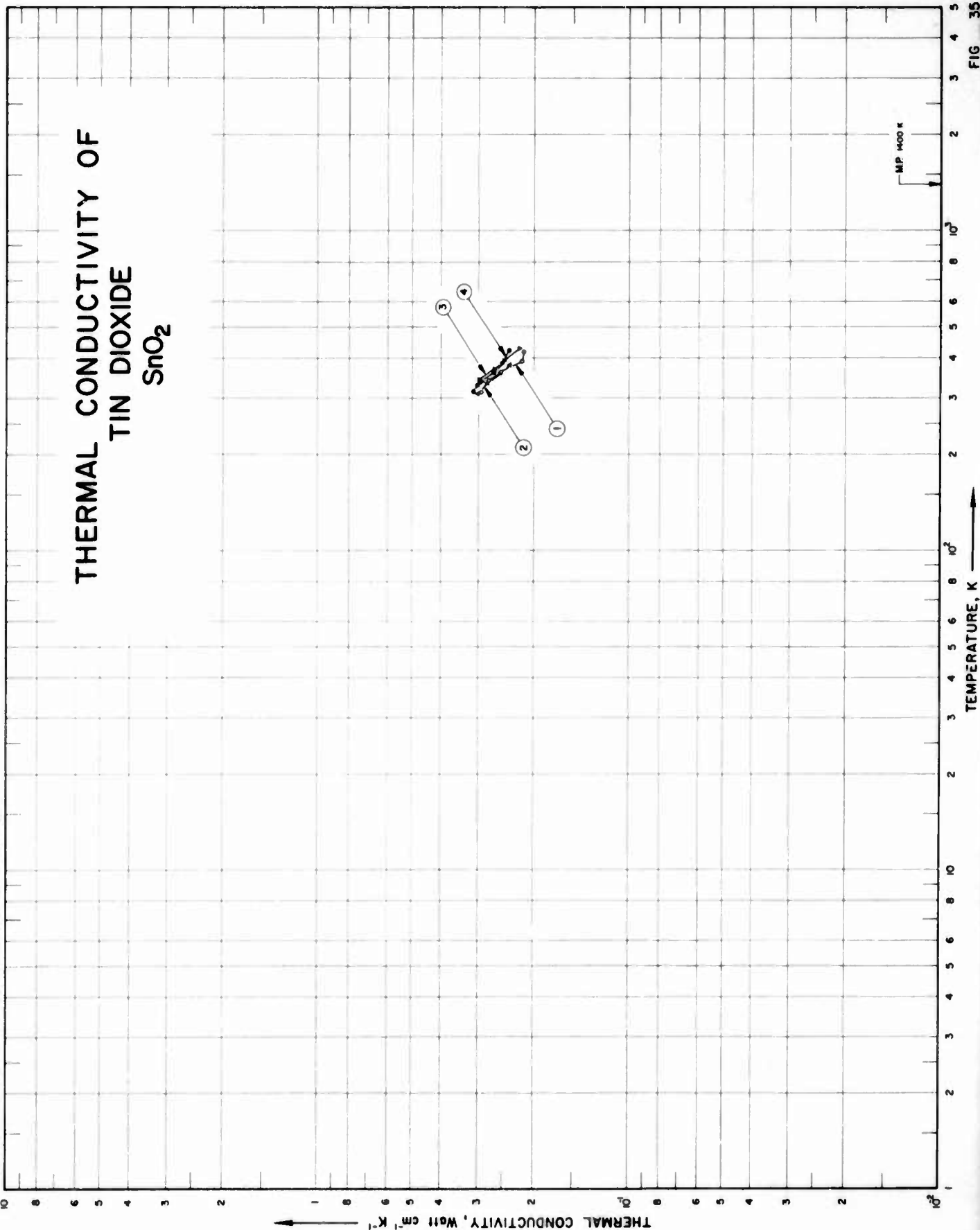
FIGURE AND TABLE NO. 34R RECOMMENDED THERMAL CONDUCTIVITY OF THORIUM DIOXIDE ThO_2 

REMARKS

The recommended values are for 99.5% pure, 98% dense, polycrystalline ThO_2 . 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.

* 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.

FIGURE SHOWS ONLY 4 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 35 THERMAL CONDUCTIVITY OF TIN DIOXIDE SnO_2

[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 1952 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 SnO_2
 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

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

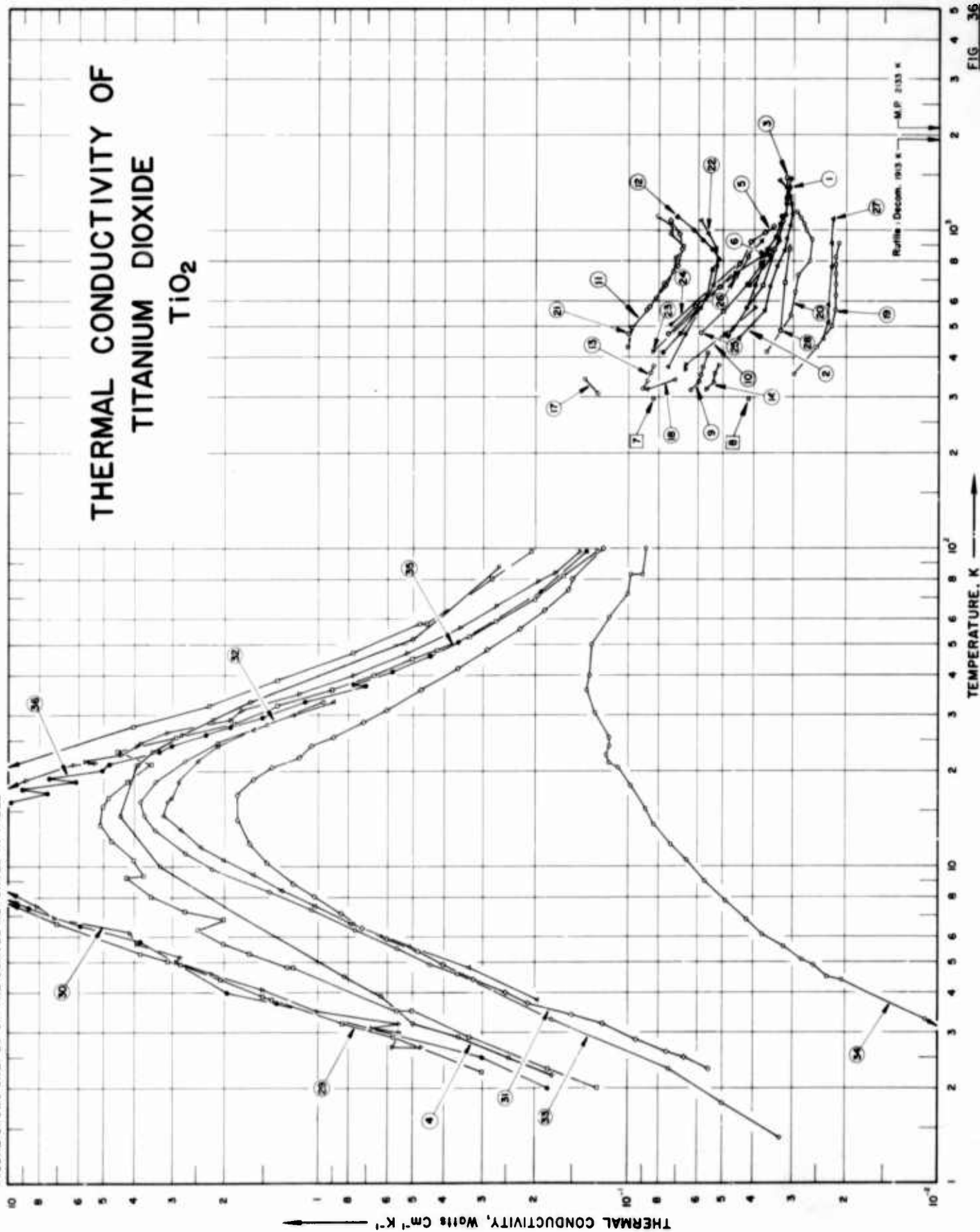
CURVE 5*

313.2 0.293

Not shown on plot

THERMAL CONDUCTIVITY OF TITANIUM DIOXIDE TiO_2

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	2,2-38		Rutile	Single crystal; specimen 2 mm in dia and 60 mm long; supplied by Linde Air Products.
5	146		1955	473-1035		I	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		II	Polycrystal with crystal size 28 microns; pressed hydrostatically and sintered for 2 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 Lindo 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		1cO	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.

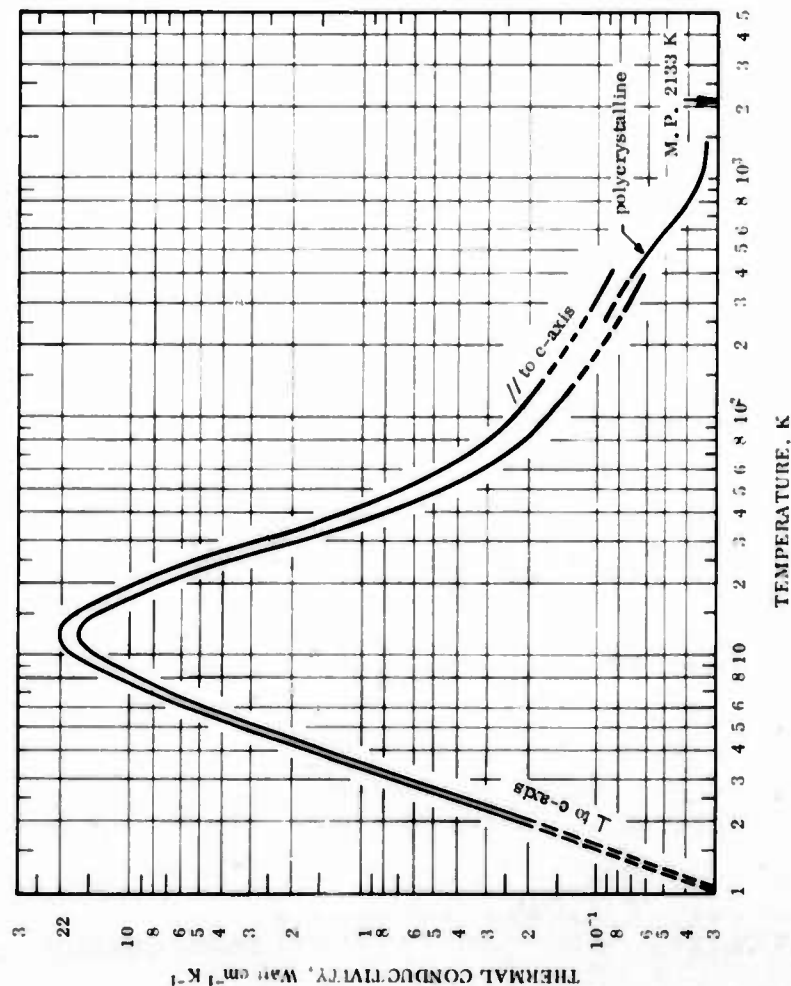
SPECIFICATION TABLE NO. 36 (continued)

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 $1 \times 4 \times 17$ 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 $1 \times 4 \times 19$ mm; defect concentration $1 \times 10^{15} \text{ cm}^{-2}$; 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 $1 \times 4 \times 19$ mm; 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		2aOHRO	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 $1 \times 3.5 \times 14$ mm; supplied by the National Lead Co.; niobium concentration $1.6 \times 10^{19} \text{ atoms cm}^{-2}$; 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 $\times$ 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	T	k	T	k	T	k
CURVE 1		CURVE 4 (cont.)		CURVE 10		CURVE 15*		CURVE 21		CURVE 25 (cont.)		CURVE 29 (cont.)		CURVE 30		CURVE 27		CURVE 28	
468.2	0.0487	3.9	0.630	363.2	0.066	338.2	0.0883	473.2	0.100	783.2	0.038	11.1	18.0*	2.7	0.47	458.2	0.024	488.2	0.033
571.2	0.0425	4.5	0.825	378.2	0.066			573.2	0.0866	853.2	0.036	15.0	17.5*	2.7	0.58	513.2	0.023	683.2	0.032
673.2	0.0399	10.0	3.30	473.2	0.049	CURVE 16*		673.2	0.077	963.2	0.034*	16.2	16.0*	3.0	0.67	593.2	0.023	878.2	0.031*
783.2	0.0377	14.5	4.45	573.2	0.040	CURVE 17		773.2	0.070	1073.2	0.033	18.0	12.5*	3.2	0.55	768.2	0.0225	1023.2	0.0309*
873.2	0.0366	21.0	3.90	CURVE 11		338.2	0.0537	873.2	0.069			20.0	11.0*	4.1	1.5	1068.2	0.022		
951.2	0.0343	23.0	3.50	432.2	0.102			973.2	0.069	CURVE 26		27.5	4.0	4.6	2.2				
1055.7	0.0333	26.0	2.80	496.2	0.0983	CURVE 18		1073.2	0.074	508.2	0.069*	32.0	2.25	4.75	2.55				
1133.2	0.0320	29.0	2.20	565.5	0.0883	309.2	0.126			563.2	0.062	38.5	1.35	5.0	2.9				
1218.2	0.0318	33.0	1.65	616.2	0.0824	341.2	0.138	CURVE 22		623.2	0.055*	47.0	0.77	5.2	2.8				
1293.2	0.0316	52.5	0.500	681.8	0.0774			373.2	0.075	713.2	0.046	58.0	0.475	5.7	3.9				
1373.2	0.0310	88.0	0.265	743.0	0.0725	CURVE 19		573.2	0.059	823.2	0.042	80.0	0.28	5.9	0.45				
1463.2	0.0308	CURVE 5		820.4	0.0710	317.2	0.0879	673.2	0.054	908.2	0.038*	98.0	0.205	6.2	5.1				
		473.2	0.0751	892.2	0.0672	340.2	0.0711	773.2	0.0527	1015.2	0.034*			6.9	7.1				
CURVE 2		580.7	0.0619	975.2	0.0737			873.2	0.053					7.5	8.1				
566.2	0.0448	688.2	0.0519	1044.9	0.0732	CURVE 12		1973.2	0.056	CURVE 29				8.6	10.5*				
670.7	0.0358	784.7	0.0445			419.2	0.0782			458.2	0.024	2.7	0.47	9.2	12.8*				
871.2	0.0340	923.2	0.0410	474.6	0.0690	533.2	0.0299	CURVE 23		513.2	0.023	2.7	0.58	10.0	14.3*				
943.2	0.0318	1034.5	0.0348	559.2	0.0615	430.2	0.0251	473.2	0.075*	593.2	0.023	3.0	0.67	10.2	13.0*				
		CURVE 6		628.2	0.0565	500.2	0.0224	573.2	0.062*	768.2	0.0225	3.1	0.67	11.1	13.2*				
1048.2	0.0310	674.2	0.0418	733.2	0.0547	565.2	0.0218	663.2	0.052*	903.2	0.0225	3.2	0.55	11.6	12.7*				
1128.2	0.0305	820.7	0.0357	816.8	0.0523	626.2	0.0217	733.2	0.046	1068.2	0.022	4.1	1.5	13.0	15.0*				
1213.2	0.0308	943.2	0.0337	874.2	0.0544	679.2	0.0218	923.2	0.038			4.6	2.2	15.0	14.0*				
1283.2	0.0310	1123.2	0.0330	933.2	0.0586	730.2	0.0217	1043.2	0.037*	CURVE 27		5.2	2.8	15.5	12.0*				
1365.7	0.0318			1018.2	0.0628	825.2	0.0217	1173.2	0.034*	458.2	0.024	5.7	3.9	16.2	13.0*				
1448.2	0.0335	CURVE 7		1102.2	0.0706	910.2	0.0213			593.2	0.023	6.2	5.1	17.7	13.0*				
		298.2	0.0837			CURVE 13				768.2	0.0225	6.9	7.1	21.0	6.2				
CURVE 3		CURVE 8		CURVE 14		481.2	0.0367	CURVE 24		1068.2	0.022	7.5	8.1	21.2	5.3				
473.2	0.0481	298.2	0.0418	318.7	0.0904	543.2	0.0307	503.2	0.074	CURVE 28		8.6	10.5*						
673.2	0.0377			338.4	0.0874	640.2	0.0298	583.2	0.062*	488.2	0.033	8.6	10.5*						
873.2	0.0347			358.5	0.0858	798.2	0.0266	668.2	0.052*	683.2	0.032	9.2	12.8*						
1073.2	0.0326			375.9	0.0837	873.2	0.0260	788.2	0.044*	878.2	0.031*	10.0	14.3*						
1273.2	0.0318			CURVE 14		938.2	0.0263	923.2	0.038	1023.2	0.0309*	10.2	13.0*						
1473.2	0.0318			317.0	0.0569	998.2	0.0274					11.1	13.2*						
		316.7	0.0636	335.3	0.0540	1053.2	0.0278	CURVE 25				11.6	12.7*						
		336.2	0.0598	356.9	0.0536	1101.2	0.0286	478.2	0.059	CURVE 29		13.0	15.0*						
		377.5	0.0586	377.0	0.0519	1145.2	0.0295	553.2	0.050	2.25	0.30	15.0	14.0*						
		414.0	0.0561					673.2	0.042	2.90	0.30	15.5	12.0*						
										3.2	0.83	15.7	13.0*						
										3.8	1.40	18.7	8.8						
										4.4	2.05	21.0	6.2						
										4.9	2.80	21.2	5.3						
										5.0	3.10								
										5.3	3.80								
										5.6	7.0								
										8.0	11.0*								

* Not shown on plot

FIGURE AND TABLE NO. 36R RECOMMENDED THERMAL CONDUCTIVITY OF TITANIUM DIOXIDE TiO_2 

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)	(1.33)			-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)	(9.71)	(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)	(0.093)	(5.37)	-
273.2	(0.111)	(6.41)	(0.078)	(4.51)	(0.089)	(5.14)	32.0
300	0.104	6.01	0.074	4.28	(0.084)	(4.85)	80.3
350	0.094	5.43	0.066	3.81	(0.0767)	(4.43)	170.3
400	0.085	4.91	0.060	3.47	0.0701	4.05	260.3
500					0.0588	3.40	440.3
600					0.0502	2.90	620.3
700					0.0439	2.54	800.3
800					0.0394	2.28	980.3
900					0.0365	2.11	1160
1000					0.0346	2.00	1340
1100					0.0335	1.94	1520
1200					0.0328	1.90	1700
1300					0.0323	1.87	1880
1400					0.0321	1.85	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 TiO_2 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.

* 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 or interpolated.

SPECIFICATION TABLE NO. 37 THERMAL CONDUCTIVITY OF TUNGSTEN TRIOXIDE WO₃

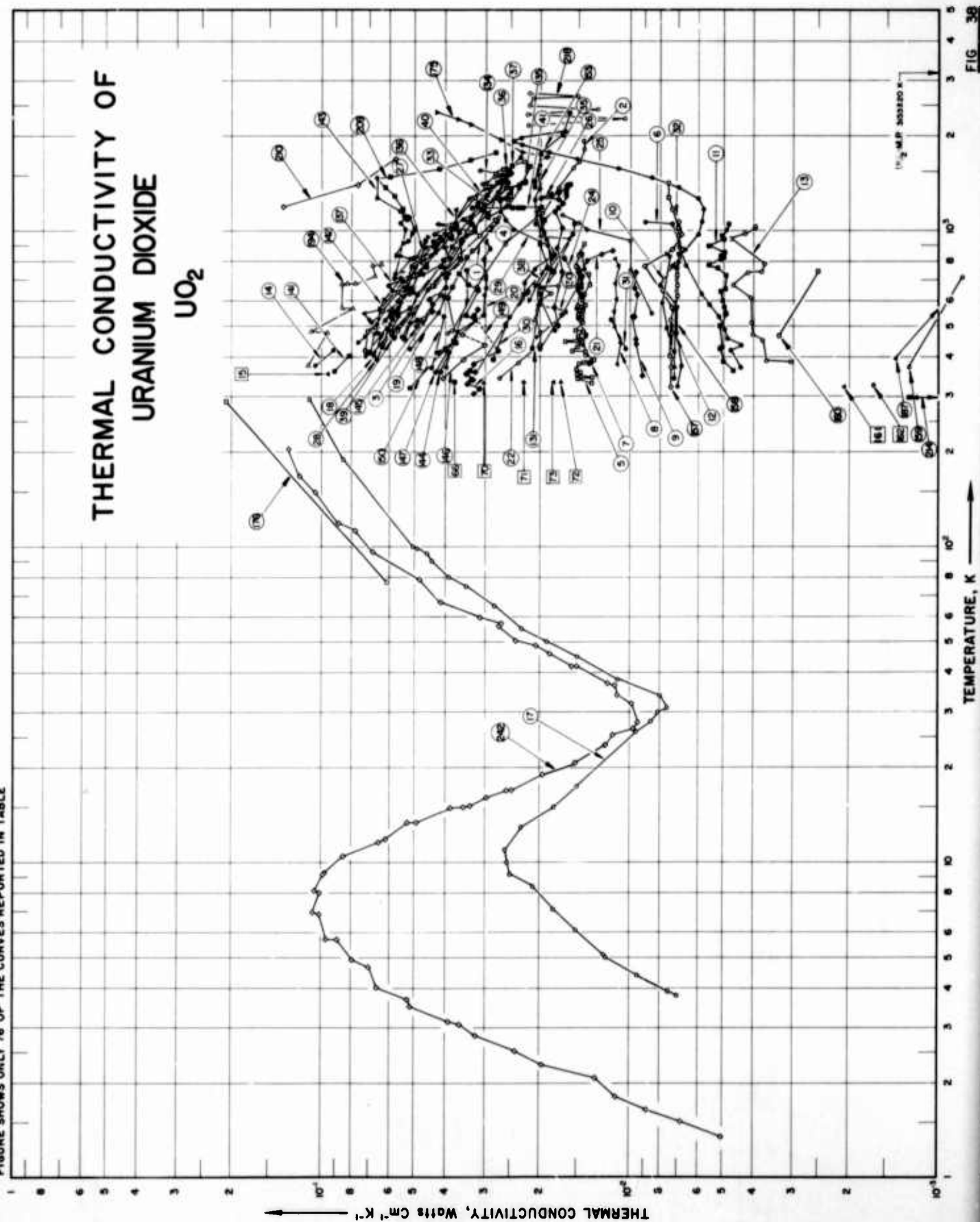
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	254	E	1955	396-568	3		0.28 ZnO; coarse crystalline structure; prepared by firing H ₂ WO ₃ and ZnO; considerable porosity.

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

FIGURE SHOWS ONLY 76 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 38 THERMAL CONDUCTIVITY OF URANIUM DIOXIDE UO_2

[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	$\pm 5 (T < 673)$ $\pm 10 (T > 673)$	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 centerless 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 ²¹ 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 $0.67 \times 10^{19} \text{ nvt}$ and total burn-up $5.3 \times 10^{18} \text{ fiss. cm}^{-2}$.
23	169	R	1961	623, 663		WAPD 22-9	Same supplier, fabrication method, and measuring condition as the above specimen; density 10.28 g cm^{-3} (93.8% theoretical density); diametral clearance 0.020 cm; irradiated for one day at estimated total exposure $0.46 \times 10^{19} \text{ nvt}$ and total burn-up $3.8 \times 10^{18} \text{ fiss. cm}^{-2}$.
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 $0.19 \times 10^{19} \text{ nvt}$ and total burn-up $1.6 \times 10^{18} \text{ fiss. cm}^{-2}$.
25	169	R	1961	548-1133		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 $0.19 \times 10^{19} \text{ nvt}$ and total burn-up $1.5 \times 10^{18} \text{ fiss. cm}^{-2}$, 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 10% 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 $3.6 \times 10^{19} \text{ fiss. cm}^{-2}$; 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 $1.6 \times 10^{19} \text{ fiss. cm}^{-2}$.

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 diameter clearance; irradiated for 15 days with an estimated total exposure of $0.19 \times 10^{21} \text{ nvt}$ and total burn-up $1.5 \times 10^{18} \text{ fiss. cm}^{-2}$.
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 $1.14 \times 10^{18} \text{ nvt}$; 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 1.28 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_2 .
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 $0 \leq x \leq 0.13$.
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 4×10^{-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 4.5×10^{-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 10.4×10^{-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 9.10×10^{-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 17.5×10^{-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 2.4×10^{-4} cm and coefficient of variation 25%; 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 3.8×10^{-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 4.8×10^{-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 8.3×10^{-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 13%; 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 04, 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 07, A	The above specimen re-oxidized and re-measured in the same way.
65	165	C	1960	333.2	±2	UO_2 08, A	The above specimen re-oxidized and re-measured in the same way.
66	165	C	1960	333.2	±2	UO_2 08, 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 TiO_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 08, 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 21, 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 21, G	Similar to the above specimen.
77	165	C	1960	333.2	±2	UO ₂ 21, 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^{18} 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^{18} 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^{18} 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^{19} 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^{19} 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 $8.9 \times 10^{14} \text{ n cm}^{-2}$; 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 $2.3 \times 10^{15} \text{ n cm}^{-2}$; 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 $7.4 \times 10^{14} \text{ n cm}^{-2}$.
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 $8.15 \times 10^{14} \text{ n cm}^{-2}$; 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 $2.25 \times 10^{15} \text{ n cm}^{-2}$; 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 $6.8 \times 10^{14} \text{ n cm}^{-2}$; 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 $1.0 \times 10^{15} \text{ n cm}^{-2}$; 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 _{4b}	Total impurity < 0.004, prepared by cold-pressing hydrogen-sintering method.
103	165	C	1960	333.2	±2	A _{4c}	The above specimen annealed in vacuum for one hr at $400 \pm 5^\circ \text{C}$.
104	165	C	1960	333.2	±2	A _{4b}	Similar to specimen A _{4b} .
105	165	C	1960	333.2	±2	A _{2c}	The above specimen annealed in vacuum for one hr at $900 \pm 5^\circ \text{C}$.
106	165	C	1960	333.2	±2	B _{4b}	Similar to specimen A _{4b} .
107	165	C	1960	333.2	±2	B _{4c}	The above specimen annealed in vacuum for one hr at $600 \pm 5^\circ \text{C}$.
108	165	C	1960	333.2	±2	B _{4b}	Similar to specimen A _{4b} .
109	165	C	1960	333.2	±2	B _{2c}	The above specimen annealed in vacuum for one hr at $700 \pm 5^\circ \text{C}$.

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 _{1a}	Similar to specimen S ₅ ; measured before being irradiated.
111	165	C	1960	333.2	±2	S _{1b}	The above specimen annealed in vacuum for one hr at 600 ± 5 C.
112	165	C	1960	333.2	±2	I _{1a}	Similar to specimen I ₄ ; measured before being irradiated.
113	165	C	1960	333.2	±2	I _{1b}	The above specimen annealed in vacuum for one hr at 1000 ± 5 C.
114	165	C	1960	333.2	±2	S _{1a}	Similar to specimen S ₅ ; measured before being irradiated.
115	165	C	1960	333.2	±2	S _{1b}	The above specimen annealed in vacuum for one hr at 700 ± 5 C.
116	165	C	1960	333.2	±2	I _{1a}	Similar to specimen I ₄ ; measured before being irradiated.
117	165	C	1960	333.2	±2	I _{1b}	The above specimen annealed in vacuum for one hr at 900 ± 5 C.
118	165	C	1960	333.2	±2	I _{2a}	Similar to specimen I ₅ ; measured before being irradiated.
119	165	C	1960	333.2	±2	I _{2b}	The above specimen annealed in vacuum for one hr at 800 ± 5 C.
120	165	C	1960	333.2	±2	S _{1a}	Similar to specimen S ₅ ; measured before being irradiated.
121	165	C	1960	333.2	±2	S _{1b}	The above specimen annealed in vacuum for one hr at 600 ± 5 C.
122	165	C	1960	333.2	±2	I _{1a}	Similar to specimen I ₄ ; measured before being irradiated.
123	165	C	1960	333.2	±2	I _{1b}	The above specimen annealed in vacuum for one hr at 500 ± 5 C.
124	165	C	1960	333.2	±2	S _{1a}	Similar to specimen S ₅ ; measured before being irradiated.
125	165	C	1960	333.2	±2	S _{1b}	The above specimen annealed in vacuum for one hr at 600 ± 5 C.
126	165	C	1960	333.2	±2	S _{1c}	The above specimen annealed again in vacuum for 30 min at 700 C.
127	165	C	1960	333.2	±2	S _{1d}	The above specimen annealed again in vacuum for one hr at 1000 C.
128	165	C	1960	333.2	±2	L _{1a}	Similar to specimen L ₁₁ ; measured before being irradiated.
129	165	C	1960	333.2	±2	L _{1b}	The above specimen annealed in vacuum for one hr at 800 ± 5 C.
130	173	C	1962	461-1161	±5	UO ₂ 99.9 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 99.9 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	364-892	±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 fissions 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	498-886	±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 fissions 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 fissions 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 2.003; 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 U ; 51.0×10^{20} atoms cm^{-3} U^{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 $0.040 \times 10^{20} - 0.35 \times 10^{20}$ nvt; total burn-up 0.4×10^{20} fission, cm^{-2} ; first start-up.
180	420	R	1964	649-948		Bett 69-4	The above specimen; total thermal exposure $0.39 \times 10^{20} - 0.56 \times 10^{20}$ nvt; total burn-up 0.9×10^{20} 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 $0.57 \times 10^{20} - 0.84 \times 10^{20}$ nvt; total burn-up 1.6×10^{20} 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 $0.85 \times 10^{20} - 1.1 \times 10^{20}$ nvt; total burn-up 2.4×10^{20} 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 $1.2 \times 10^{20} - 1.7 \times 10^{20}$ nvt; total burn-up 3.5×10^{20} 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 $1.7 \times 10^{20} - 2.2 \times 10^{20}$ nvt; total burn-up 5.2×10^{20} 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 $2.2 \times 10^{20} - 2.6 \times 10^{20}$ nvt; total burn-up 6.6×10^{20} 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 $15.6 \times 10^{20} - 15.9 \times 10^{20}$ nvt; total burn-up 25×10^{20} 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		Powder; pressed; mean temperature value taken.
188	356		1942	362.2	5-10	Bett 69-4	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.
189	411	L	1960	323-1073		65	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.
190	411	L	1960	323-1073		68	

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 Ω 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 ⁻⁴ 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 ceg 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 ²² 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			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 $\pm$ 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 $\pm$ 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, 0.005 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 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 $\sim 70 + 80$; 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} to 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^{-3} to 5.188×10^3 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_3 , 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 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 ($\mu_{235}^{\text{U}}/\mu_{\text{total}}$); 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% "carbawax 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 ₃ 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 psi 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 ³ 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 + 6 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 SeO_2 , 0.00495 Eu_2O_3 , 0.0018 SnO_2 , 0.00135 Sb_2O_3 , 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} .

* Not shown on plot

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

*Not shown on plot

DATA TABLE NO. 38 (continued)

CURVE 134 (cont.)		CURVE 137		CURVE 139*		CURVE 142 (cont.)		CURVE 146		CURVE 150 (cont.)		CURVE 154 (cont.)*	
T	k	T	k	T	k	T	k	T	k	T	k	T	k
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	0.0597
661.2	0.0516	646.2	0.0591	528.2	0.0597	813.2	0.0517	436.2	0.0301	806.2	0.0371*	873.2	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	CURVE 147		879.2	0.0349*	1006.2	0.0613
1022.2	0.0386	843.2	0.0434	821.2	0.0374	924.2	0.0527					1073.2	0.0610
1271.2	0.0337	905.2	0.0423	882.2	0.0366	980.2	0.0514					1173.2	0.0360
1393.2	0.0284	910.2	0.0430*			1003.2	0.0505	357.2	0.0430	CURVE 151*			
1407.2	0.0306	945.2	0.0386	CURVE 140*		1112.2	0.0520	450.2	0.0378				
1506.2	0.0264	979.2	0.0438			1118.2	0.0529	602.2	0.0342				
1552.2	0.0314	986.2	0.0400*					752.2	0.0346				
		1037.2	0.0383*	378.2	0.0779	CURVE 143							
CURVE 135		1095.2	0.0354	431.2	0.0718			CURVE 148					
		1210.2	0.0304	463.2	0.0640	680.2	0.061*						
747.2	0.0403*	1228.2	0.0320	604.2	0.0538	729.2	0.058	368.2	0.0442				
803.2	0.0397*	1337.2	0.0292*	661.2	0.0474	1019.2	0.054	538.2	0.0404				
1011.2	0.0292*	1359.2	0.0282*	747.2	0.0397	1087.2	0.056	752.2	0.0346*				
1103.2	0.0297	1385.2	0.0291*	881.2	0.0376	1112.2	0.054						
1220.2	0.0258	1439.2	0.0268*	1031.2	0.0302	1186.2	0.056	CURVE 149					
1371.2	0.0256*	1449.2	0.0286*			1284.2	0.067						
1392.2	0.0236	1623.2	0.0251*	CURVE 141		1489.2	0.067	332.2	0.0345*				
1424.2	0.0236*	1705.2	0.0233					344.2	0.0339*				
1614.2	0.0218			361.2	0.0906	CURVE 144		359.2	0.0336				
				402.2	0.0811			377.2	0.0327				
CURVE 136				460.2	0.0686*	330.2	0.0452*	417.2	0.0275				
				555.2	0.0601*	358.2	0.0415	440.2	0.0306*				
526.2	0.0706	363.2	0.0767	691.2	0.0505*	413.2	0.0389	540.2	0.0327				
542.2	0.0579*	440.2	0.0679	799.2	0.0479*	448.2	0.0428	565.2	0.0317				
548.2	0.0733	494.2	0.0622			614.2	0.0398						
565.2	0.0632*	531.2	0.0619	CURVE 142		637.2	0.0383	CURVE 150					
692.2	0.0549	572.2	0.0527			817.2	0.0345	319.2	0.0519				
733.2	0.0472	631.2	0.0505	416.2	0.0739*	886.2	0.0341*	331.2	0.0509*				
821.2	0.0389	711.2	0.0390	442.2	0.0714*			427.2	0.0397				
897.2	0.0405	828.2	0.0357	443.2	0.0766			430.2	0.0393*				
997.2	0.0325	914.2	0.0368	461.2	0.0724	CURVE 145		521.2	0.0325				
1052.2	0.0426	1007.2	0.0312	476.2	0.0655			541.2	0.0346				
1052.2	0.0374			501.2	0.0672	498.2	0.0493	651.2	0.0318				
1172.2	0.0373			563.2	0.0648	627.2	0.0416	673.2	0.0342				
1172.2	0.0295*			606.2	0.0630	886.2	0.0341*	736.2	0.0363				
1317.2	0.0296*			633.2	0.0581*			755.2	0.0388*				

* Not shown on plot

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k														
<u>CURVE 183(cont.)*</u>				<u>CURVE 185*</u>				<u>CURVE 189*</u>				<u>CURVE 193(cont.)*</u>				<u>CURVE 195(cont.)*</u>				<u>CURVE 199*</u>				<u>CURVE 204*</u>				<u>CURVE 209</u>			
761.2	0.025	396.2	0.020	323.2	0.0865	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	373.2	0.0769	2060.2	0.0198	574.2	0.0577	473.2	0.069	540.2	0.0550	1173.2	0.0550																
857.2	0.023	556.2	0.024	473.2	0.0630	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	573.2	0.0533	2106.2	0.0210	774.2	0.0491	873.2	0.054	738.2	0.0179	1373.2	0.0654																
880.2	0.024	720.2	0.025	673.2	0.0462	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	773.2	0.0408			973.2	0.0409	1273.2	0.059			1473.2	0.0598																
903.2	0.023	842.2	0.025	873.2	0.0365	<u>CURVE 194</u>				<u>CURVE 205*</u>				<u>CURVE 205*</u>				<u>CURVE 205*</u>													
909.2	0.025	874.2	0.025	973.2	0.0336	373.2	0.112	371.2	0.0997	<u>CURVE 196*</u>				<u>CURVE 206*</u>				<u>CURVE 206*</u>													
913.2	0.027	911.2	0.025	1073.2	0.0301	472.2	0.0960	452.2	0.0832	<u>CURVE 200*</u>				<u>CURVE 207*</u>				<u>CURVE 207*</u>													
913.2	0.025	913.2	0.024			565.2	0.0795	532.2	0.0722	<u>CURVE 201*</u>				<u>CURVE 208*</u>				<u>CURVE 208*</u>													
914.2	0.024	915.2	0.025	<u>CURVE 190*</u>				<u>CURVE 202*</u>				<u>CURVE 209*</u>				<u>CURVE 209*</u>															
918.2	0.023	915.2	0.025	323.2	0.0865	1009.2	0.0415*	473.2	0.058	<u>CURVE 203*</u>				<u>CURVE 210</u>				<u>CURVE 210</u>													
919.2	0.024	928.2	0.025	373.2	0.0769	1020.2	0.0282	473.2	0.044	<u>CURVE 204*</u>				<u>CURVE 211*</u>				<u>CURVE 211*</u>													
925.2	0.025	929.2	0.025	473.2	0.0630	1071.2	0.0416*	473.2	0.040	<u>CURVE 205*</u>				<u>CURVE 212*</u>				<u>CURVE 212*</u>													
934.2	0.025	934.2	0.026	573.2	0.0533	1075.2	0.0433*	471.2	0.0294	<u>CURVE 206*</u>				<u>CURVE 213*</u>				<u>CURVE 213*</u>													
934.2	0.025	934.2	0.026	673.2	0.0462	1076.2	0.0448*	501.2	0.0299	<u>CURVE 207*</u>				<u>CURVE 214*</u>				<u>CURVE 214*</u>													
954.2	0.025	954.2	0.025	773.2	0.0408	1077.2	0.0448*	513.2	0.0306	<u>CURVE 208*</u>				<u>CURVE 215*</u>				<u>CURVE 215*</u>													
957.2	0.025	960.2	0.024	873.2	0.0365	1170.2	0.0399*	513.2	0.0306	<u>CURVE 209*</u>				<u>CURVE 216*</u>				<u>CURVE 216*</u>													
960.2	0.024	936.2	0.025	1173.2	0.0462	1170.2	0.0399*	421.2	0.0321	<u>CURVE 210*</u>				<u>CURVE 217*</u>				<u>CURVE 217*</u>													
963.2	0.026	938.2	0.025	1192.2	0.0330	1192.2	0.0330*	431.2	0.0335	<u>CURVE 211*</u>				<u>CURVE 218*</u>				<u>CURVE 218*</u>													
966.2	0.023	941.2	0.025	1271.2	0.0301	1271.2	0.0386*	442.2	0.0339	<u>CURVE 212*</u>				<u>CURVE 219*</u>				<u>CURVE 219*</u>													
				1272.2	0.0343*	1272.2	0.0343*	473.2	0.0328	<u>CURVE 213*</u>				<u>CURVE 220*</u>				<u>CURVE 220*</u>													
				1273.2	0.0421*	1273.2	0.0421*	573.2	0.0328	<u>CURVE 214*</u>				<u>CURVE 221*</u>				<u>CURVE 221*</u>													
				1303.2	0.0356*	1303.2	0.0356*	617.2	0.0310	<u>CURVE 215*</u>				<u>CURVE 222*</u>				<u>CURVE 222*</u>													
				1371.2	0.0305*	1371.2	0.0305*			<u>CURVE 198*</u>				<u>CURVE 223*</u>				<u>CURVE 223*</u>													
				1376.2	0.0363*			373.2	0.071	<u>CURVE 199*</u>				<u>CURVE 224*</u>				<u>CURVE 224*</u>													
						473.2	0.057	473.2	0.057	<u>CURVE 200*</u>				<u>CURVE 225*</u>				<u>CURVE 225*</u>													
						573.2	0.048	573.2	0.048	<u>CURVE 201*</u>				<u>CURVE 226*</u>				<u>CURVE 226*</u>													
						673.2	0.042	673.2	0.042	<u>CURVE 202*</u>				<u>CURVE 227*</u>				<u>CURVE 227*</u>													
						773.2	0.0331	773.2	0.0331	<u>CURVE 203*</u>				<u>CURVE 228*</u>				<u>CURVE 228*</u>													
						873.2	0.023	873.2	0.023	<u>CURVE 204*</u>				<u>CURVE 229*</u>				<u>CURVE 229*</u>													
						973.2	0.0167	973.2	0.0167	<u>CURVE 205*</u>				<u>CURVE 230*</u>				<u>CURVE 230*</u>													
						1065.2	0.0253	1065.2	0.0253	<u>CURVE 206*</u>				<u>CURVE 231*</u>				<u>CURVE 231*</u>													
						1165.2	0.0310	1165.2	0.0310	<u>CURVE 207*</u>				<u>CURVE 232*</u>				<u>CURVE 232*</u>													
						1253	0.05598	1253	0.05598	<u>CURVE 208*</u>				<u>CURVE 233*</u>				<u>CURVE 233*</u>													
						1395	0.03516	1395	0.03516	<u>CURVE 209*</u>				<u>CURVE 234*</u>				<u>CURVE 234*</u>													
										<u>CURVE 210*</u>				<u>CURVE 235*</u>				<u>CURVE 235*</u>													
										<u>CURVE 211*</u>				<u>CURVE 236*</u>				<u>CURVE 236*</u>													
										<u>CURVE 212*</u>				<u>CURVE 237*</u>				<u>CURVE 237*</u>													
										<u>CURVE 213*</u>				<u>CURVE 238*</u>				<u>CURVE 238*</u>													
										<u>CURVE 214*</u>				<u>CURVE 239*</u>				<u>CURVE 239*</u>													
										<u>CURVE 215*</u>				<u>CURVE 240*</u>				<u>CURVE 240*</u>													
										<u>CURVE 216*</u>				<u>CURVE 241*</u>				<u>CURVE 241*</u>													
										<u>CURVE 217*</u>				<u>CURVE 242*</u>				<u>CURVE 242*</u>													
										<u>CURVE 218*</u>				<u>CURVE 243*</u>				<u>CURVE 243*</u>													
										<u>CURVE 219*</u>				<u>CURVE 244*</u>				<u>CURVE 244*</u>													
										<u>CURVE 220*</u>				<u>CURVE 245*</u>				<u>CURVE 245*</u>													
										<u>CURVE 221*</u>				<u>CURVE 246*</u>				<u>CURVE 246*</u>													
										<u>CURVE 222*</u>				<u>CURVE 247*</u>				<u>CURVE 247*</u>													
										<u>CURVE 223*</u>				<u>CURVE 248*</u>				<u>CURVE 248*</u>													
										<u>CURVE 224*</u>				<u>CURVE 249*</u>				<u>CURVE 249*</u>													
										<u>CURVE 225*</u>				<u>CURVE 250*</u>				<u>CURVE 250*</u>													
										<u>CURVE 226*</u>				<u>CURVE 251*</u>				<u>CURVE 251*</u>													
										<u>CURVE 227*</u>				<u>CURVE 252*</u>				<u>CURVE 252*</u>													
										<u>CURVE 228*</u>				<u>CURVE 253*</u>				<u>CURVE 253*</u>													
										<u>CURVE 229*</u>				<u>CURVE 254*</u>				<u>CURVE 254*</u>													
										<u>CURVE 230*</u>				<u>CURVE 255*</u>				<u>CURVE 255*</u>													
										<u>CURVE 231*</u>				<u>CURVE 256*</u>				<u>CURVE 256*</u>													
										<u>CURVE 232*</u>				<u>CURVE 257*</u>				<u>CURVE 257*</u>													
										<u>CURVE 233*</u>				<u>CURVE 258*</u>				<u>CURVE 258*</u>													
										<u>CURVE 234*</u>				<u>CURVE 259*</u>				<u>CURVE 259*</u>													
										<u>CURVE 235*</u>				<u>CURVE 260*</u>				<u>CURVE 260*</u>													
										<u>CURVE 236*</u>				<u>CURVE 261*</u>				<u>CURVE 261*</u>													
										<u>CURVE 237*</u>				<u>CURVE 262*</u>				<u>CURVE 262*</u>													
										<u>CURVE 238*</u>				<u>CURVE 263*</u>				<u>CURVE 263*</u>													
										<u>CURVE 239*</u>				<u>CURVE 264*</u>				<u>CURVE 264*</u>													
										<u>CURVE 240*</u>				<u>CURVE 265*</u>				<u>CURVE 265*</u>													
										<u>CURVE 241*</u>				<u>CURVE 266*</u>				<u>CURVE 266*</u>													
										<u>CURVE 242*</u>				<u>CURVE 267*</u>				<u>CURVE 267*</u>													
										<u>CURVE 243*</u>				<u>CURVE 268*</u>				<u>CURVE 268*</u>													
										<u>CURVE 244*</u>				<u>CURVE 269*</u>				<u>CURVE 269*</u>													
										<u>CURVE 245*</u>				<u>CURVE 270*</u>				<u>CURVE 270*</u>													
										<u>CURVE 246*</u>				<u>CURVE 271*</u>				<u>CURVE 271*</u>													
										<u>CURVE 247*</u>				<u>CURVE 272*</u>				<u>CURVE 272*</u>													
										<u>CURVE 248*</u>				<u>CURVE 273*</u>				<u>CURVE 273*</u>													
										<u>CURVE 249*</u>				<u>CURVE 274*</u>				<u>CURVE 274*</u>													
										<u>CURVE 250*</u>				<u>CURVE 275*</u>				<u>CURVE 275*</u>													
										<u>CURVE 251*</u>				<u>CURVE 276*</u>				<u>CURVE 276*</u>													
										<u>CURVE 252*</u>				<u>CURVE 277*</u>				<u>CURVE 277*</u>													
										<u>CURVE 253*</u>				<u>CURVE 278*</u>				<u>CURVE 278*</u>													
										<u>CURVE 254*</u>				<u>CURVE 279*</u>				<u>CURVE 279*</u>													
										<u>CURVE 255*</u>				<u>CURVE 280*</u>				<u>CURVE 280*</u>													
										<u>CURVE 256*</u>				<u>CURVE 281*</u>				<u>CURVE 281*</u>													
										<u>CURVE 257*</u>				<u>CURVE 282*</u>				<u>CURVE 282*</u>													
										<u>CURVE 258*</u>				<u>CURVE 283*</u>				<u>CURVE 283*</u>													
										<u>CURVE 259*</u>				<u>CURVE 284*</u>				<u>CURVE 284*</u>													
										<u>CURVE 260*</u>				<u>CURVE 285*</u>				<u>CURVE 285*</u>													
										<u>CURVE 261*</u>				<u>CURVE 286*</u>				<u>CURVE 286*</u>													
										<u>CURVE 262*</u>				<u>CURVE 287*</u>				<u>CURVE 287*</u>													
										<u>CURVE 263*</u>				<u>CURVE 288*</u>				<u>CURVE 288*</u>													
										<u>CURVE 264*</u>				<u>CURVE 289*</u>				<u>CURVE 289*</u>													
										<u>CURVE 265*</u>				<u>CURVE 290*</u>				<u>CURVE 290*</u>													
										<u>CURVE 266*</u>				<u>CURVE 291*</u>				<u>CURVE 291*</u>													
										<u>CURVE 267*</u>				<u>CURVE 292*</u>				<u>CURVE 292*</u>													
										<u>CURVE 268*</u>				<u>CURVE 293*</u>				<u>CURVE 293*</u>													
										<u>CURVE 269*</u>				<u>CURVE 294*</u>				<u>CURVE 294*</u>													
										<u>CURVE 270*</u>				<u>CURVE 295*</u>				<u>CURVE 295*</u>													
										<u>CURVE 271*</u>				<u>CURVE 296*</u>				<u>CURVE 296*</u>													
										<u>CURVE 272*</u>				<u>CURVE 297*</u>				<u>CURVE 297*</u>													
										<u>CURVE 273*</u>				<u>CURVE 298*</u>				<u>CURVE 298*</u>													
										<u>CURVE 274*</u>				<u>CURVE 299*</u>				<u>CURVE 299*</u>													
										<u>CURVE 275*</u>				<u>CURVE 300*</u>				<u>CURVE 300*</u>													
										<u>CURVE 276*</u>				<u>CURVE 301*</u>				<u>CURVE 301*</u>													
										<u>CURVE 277*</u>				<u>CURVE 302*</u>				<u>CURVE 302*</u>													
										<u>CURVE 278*</u>				<u>CURVE 303*</u>				<u>CURVE 303*</u>													
										<u>CURVE 279*</u>				<u>CURVE 304*</</u>																	

* Not shown on plot

DATA TABLE NO. 38 (continued)

CURVE 215*		CURVE 217(cont.)*		CURVE 219(cont.)*		CURVE 223*		CURVE 226*		CURVE 233(cont.)*		CURVE 236(cont.)*		CURVE 241*	
T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
298.2	0.00175	581.2	0.0509	833.2	0.03980	352.2	0.0346	472.2	0.0711	1513	0.02594	1004	0.0266	623.2	0.0190
p(mm Hg)	k	647.2	0.0542	857.2	0.03910	461.2	0.0158	667.2	0.0691	1547	0.02535	1024	0.0292	1008.2	0.0140
		647.2	0.0466	862.2	0.03850	652.2	0.0163	859.2	0.0569	1561	0.02576	1024	0.0246	1383.2	0.0116
		785.2	0.0436			739.2	0.0146	859.2	0.0426	1594	0.02576	1032	0.0251	1523.2	0.0119
CURVE 214		815.2	0.0387			890.2	0.0218	1064.2	0.0324	1618	0.02455	1035	0.0278	1598.2	0.0118
(T = 298.2K)		878.2	0.0428			989.2	0.0215	1273.2	0.0262	1625	0.02495	1093	0.0282	1648.2	0.0123
		900.2	0.0390			1056.2	0.0290			1638	0.02576	1093	0.0258		
0.0055	0.0000573	1052.2	0.0366			1342.2	0.0261			1649	0.02576				
1.01	0.000167*	1148.2	0.0284			1352.2	0.0283			1667	0.02489				
24.3	0.000556*	1283.2	0.0311			1376.2	0.0324			1697	0.02576				
135	0.000925*	1314.2	0.0287			1398.2	0.0302								
794	0.00118	1387.2	0.0269												
3055	0.00124	1486.2	0.0259												
6310	0.00126	1597.2	0.0256												
		1685.2	0.0191												
T	k	1751.2	0.0227												
		1822.2	0.0186												
		1930.2	0.0182												
		2390.2	0.0179												
CURVE 215*		CURVE 217(cont.)*		CURVE 219(cont.)*		CURVE 223*		CURVE 226*		CURVE 233(cont.)*		CURVE 236(cont.)*		CURVE 241*	
298.2	0.00120	2154.2	0.0221	373.2	0.07198	329.2	0.0071	470.2	0.0661	338.2	0.0689	455.2	0.0567	1.36	0.00501
p(mm Hg)	k	2263.2	0.0105	475.2	0.06323	565.2	0.0072	660.2	0.0633	338.2	0.0678	456.2	0.0629	1.52	0.00679
		2338.2	0.0222	675.2	0.04948	775.2	0.0070	867.2	0.0521	338.7	0.0646	456.2	0.0537	1.82	0.0110
		2413.2	0.0129	869.9	0.04120	1071.2	0.0059	1053.2	0.0360	339.8	0.0737	839.2	0.0418	2.08	0.0128
CURVE 216*		2494.2	0.0219	970.7	0.04079	1224.2	0.0055	1273.2	0.0366	339.8	0.0737	842.2	0.0457	2.29	0.0195
(T = 298.2K)		2623.2	0.0212	1071.7	0.03752	1395.2	0.0063			465.4	0.0537	1498	0.0392	2.53	0.0239
0.0108	0.0000962	1173.2	0.03208	1164.9	0.03428	1486.2	0.0095			465.4	0.0490	1498	0.0441	2.84	0.0320
0.0501	0.0000920	1279.2	0.02994	1173.2	0.03219	1575.2	0.0095			465.4	0.0517	3.07	0.0441	3.07	0.0359
1.82	0.000126	1279.2	0.02994	1279.2	0.02994	1723.2	0.0158			465.4	0.0517	3.14	0.0441	3.14	0.0388
24.8	0.000414	1282.7	0.02974	1282.7	0.02974	1846.2	0.0220			465.4	0.0517	3.51	0.0441	3.51	0.0515
162	0.000837	1372.2	0.02846	1372.2	0.02846	1957.2	0.0241			465.4	0.0517	3.68	0.0441	3.68	0.0522
759	0.00108	1465.2	0.02712	1465.2	0.02712	2068.2	0.0192			465.4	0.0517	4.02	0.0441	4.02	0.0658
2818	0.00113					2101.2	0.0155			465.4	0.0517	4.69	0.0441	4.69	0.0697
5198	0.00114									465.4	0.0517	4.92	0.0441	4.92	0.0794
										465.4	0.0517	5.73	0.0441	5.73	0.0885
										465.4	0.0517	5.73	0.0441	5.73	0.0962
										465.4	0.0517	6.86	0.0441	6.86	0.101
										465.4	0.0517	6.95	0.0441	6.95	0.107
										465.4	0.0517	8.00	0.0441	8.00	0.101
										465.4	0.0517	8.15	0.0441	8.15	0.105
										465.4	0.0517	9.16	0.0441	9.16	0.0982
										465.4	0.0517	9.27	0.0441	9.27	0.0968
										465.4	0.0517	10.5	0.0441	10.5	0.0847
										465.4	0.0517	11.7	0.0441	11.7	0.0650
										465.4	0.0517	11.9	0.0441	11.9	0.0617
										465.4	0.0517	13.4	0.0441	13.4	0.0492
										465.4	0.0517	14.9	0.0441	14.9	0.0383
										465.4	0.0517	15.0	0.0441	15.0	0.0350
										465.4	0.0517	15.2	0.0441	15.2	0.0334
										465.4	0.0517	16.1	0.0441	16.1	0.0296
										465.4	0.0517	16.9	0.0441	16.9	0.0255
										465.4	0.0517	17.0	0.0441	17.0	0.0247
										465.4	0.0517	19.0	0.0441	19.0	0.0195
										465.4	0.0517	20.8	0.0441	20.8	0.0153
										465.4	0.0517	22.9	0.0441	22.9	0.0134

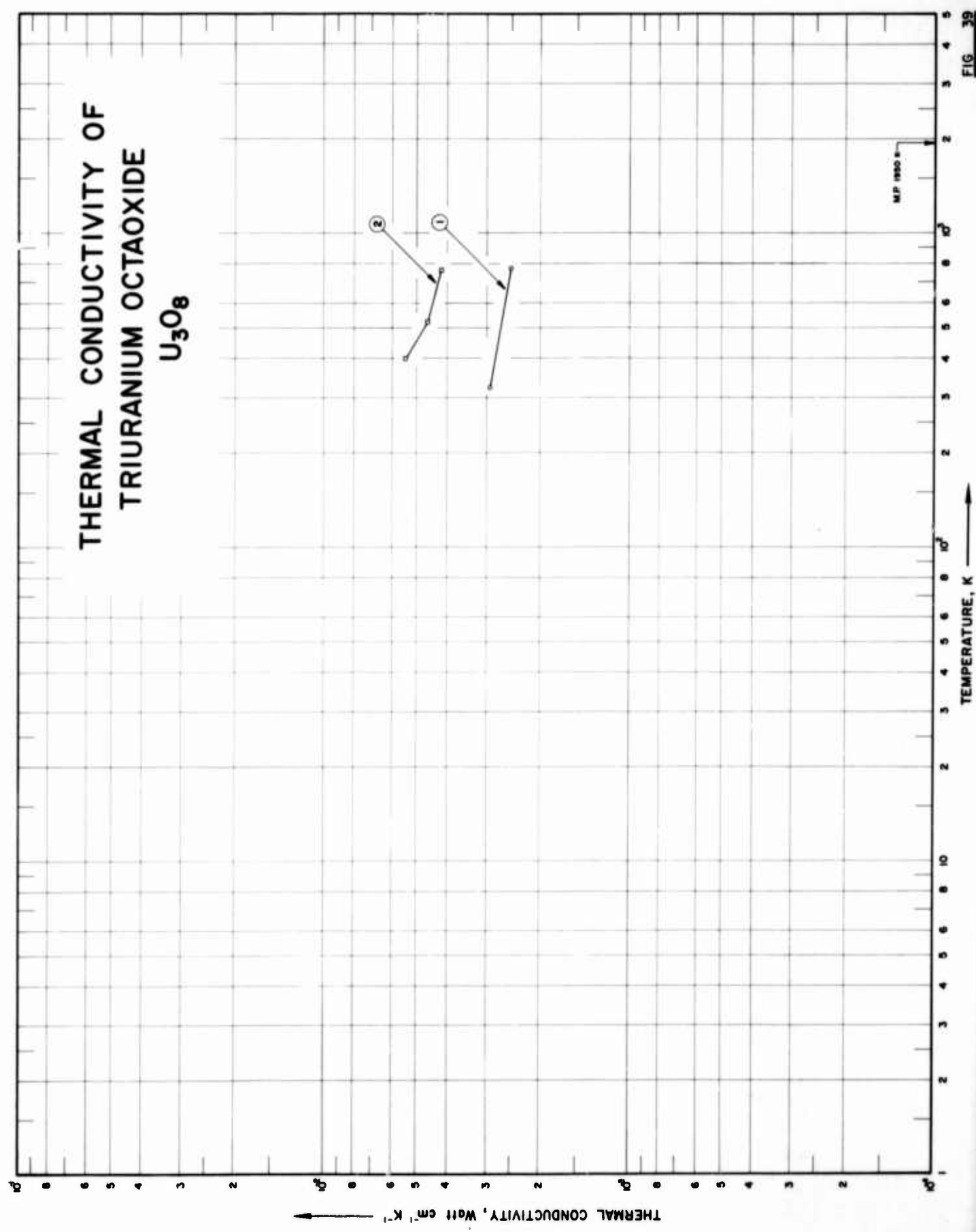
* Not shown on plot

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
<u>CURVE 243*</u>	
523.2	0.0699
<u>CURVE 244*</u>	
523.2	0.0678

* Not shown on plot

THERMAL CONDUCTIVITY OF TRIURANIUM OCTAOXIDE U_3O_8



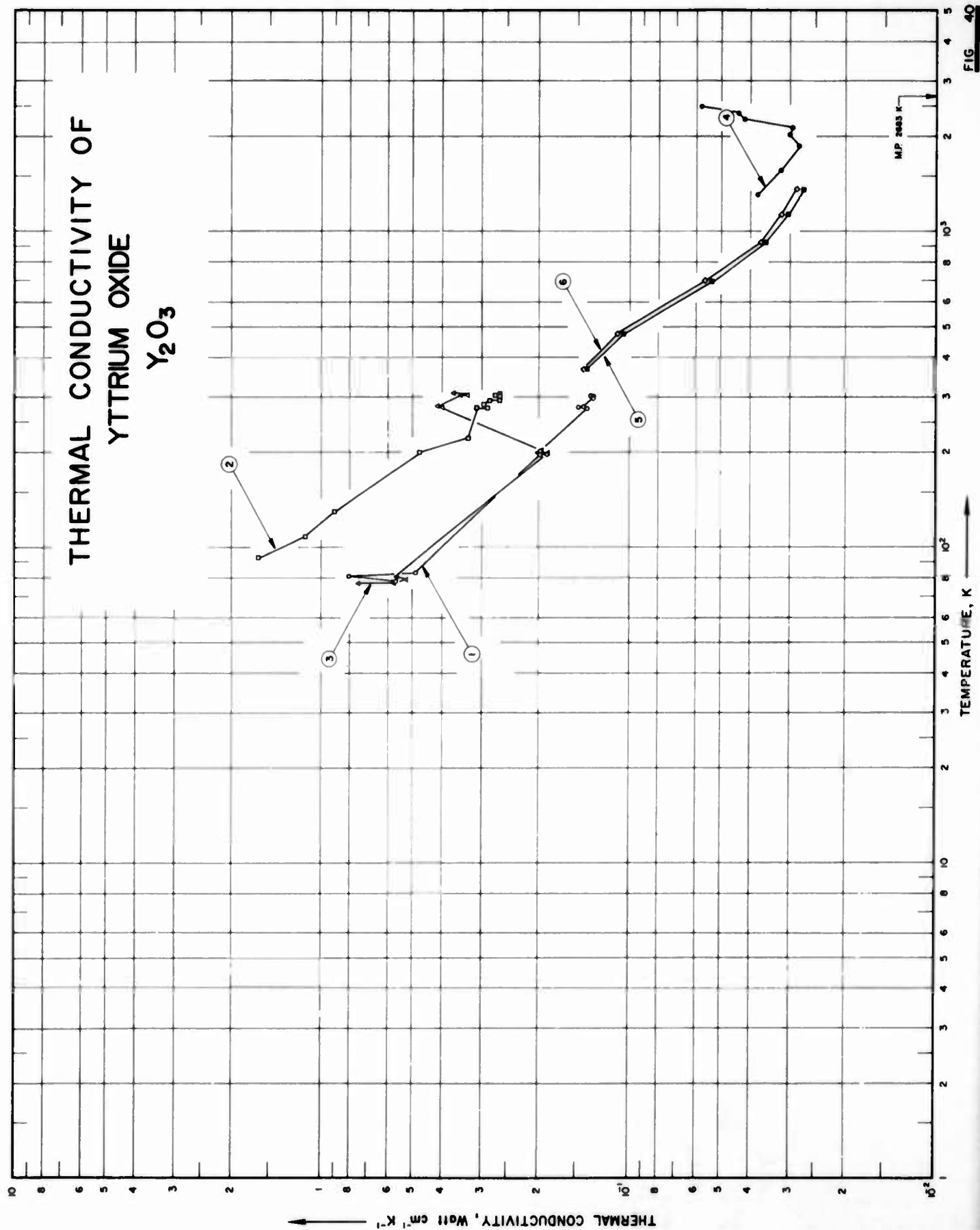
SPECIFICATION TABLE NO. 39 THERMAL CONDUCTIVITY OF (tri)URANIUM OCTOXIDE U_3O_8

[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			Powder; measured under 100 lb in. ⁻² pressure.
2	159	L	1955	398-763			Specimen 3 in. long, 3 in. dia; pressed in 150 ton press.

DATA TABLE NO. 35 THERMAL CONDUCTIVITY OF (t-r)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



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, 5.051, 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 2.7×10^{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>		<u>CURVE 4</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	<u>CURVE 5</u>	
302	0.133	366.5	0.138
304	0.135	477.6	0.105
		699.8	0.0537
<u>CURVE 2</u>		922.1	0.0357
93	1.64	1144.3	0.0305
108	1.14	1366.5	0.0272
130	0.909		
200	0.478	<u>CURVE 6</u>	
222	0.332	366.5	0.143
276	0.313	477.6	0.110
276	0.289	699.8	0.0561
284	0.299	922.1	0.0374
292	0.285	1144.3	0.0318
292	0.265	1366.5	0.0286
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		

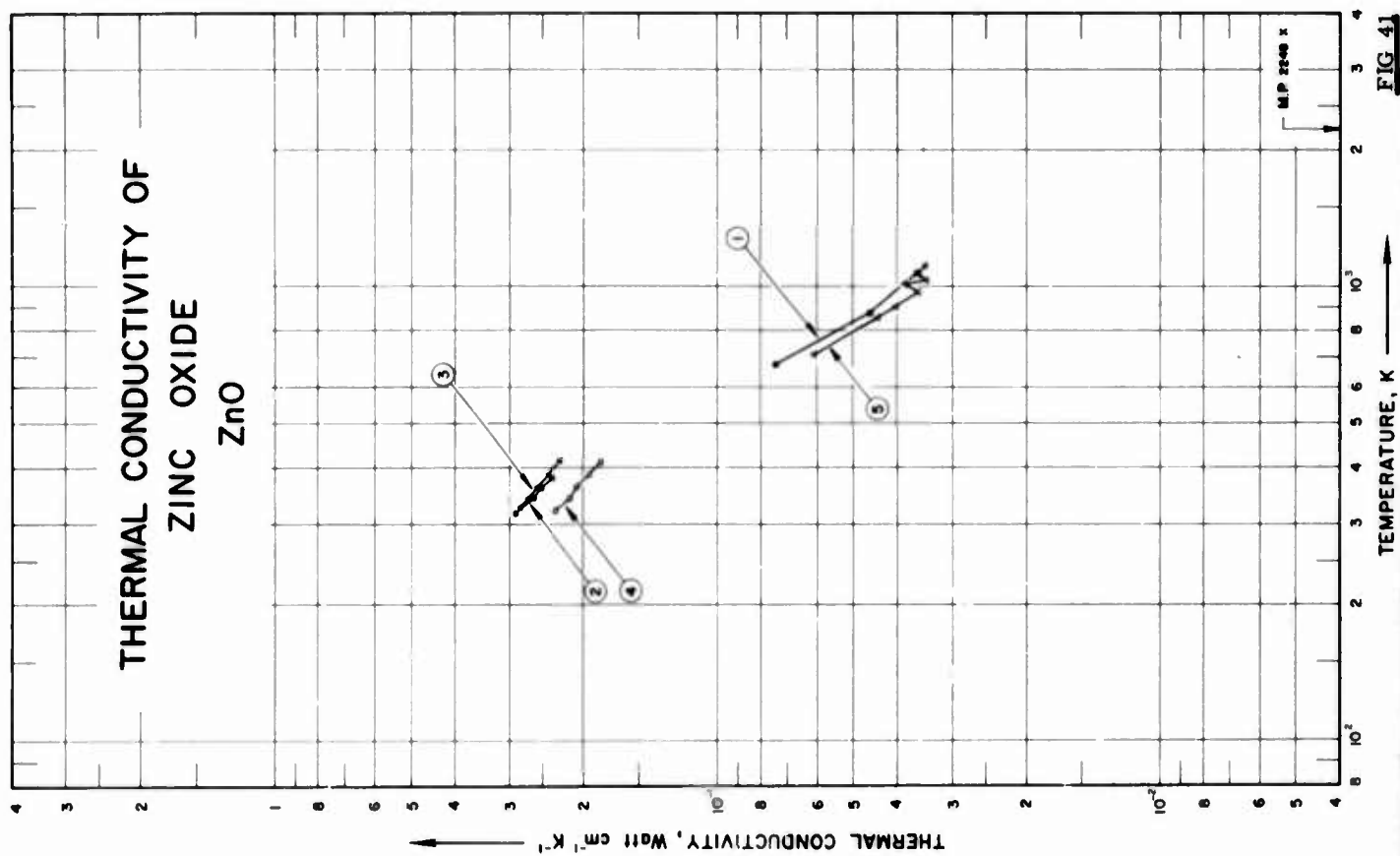


FIG 41

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

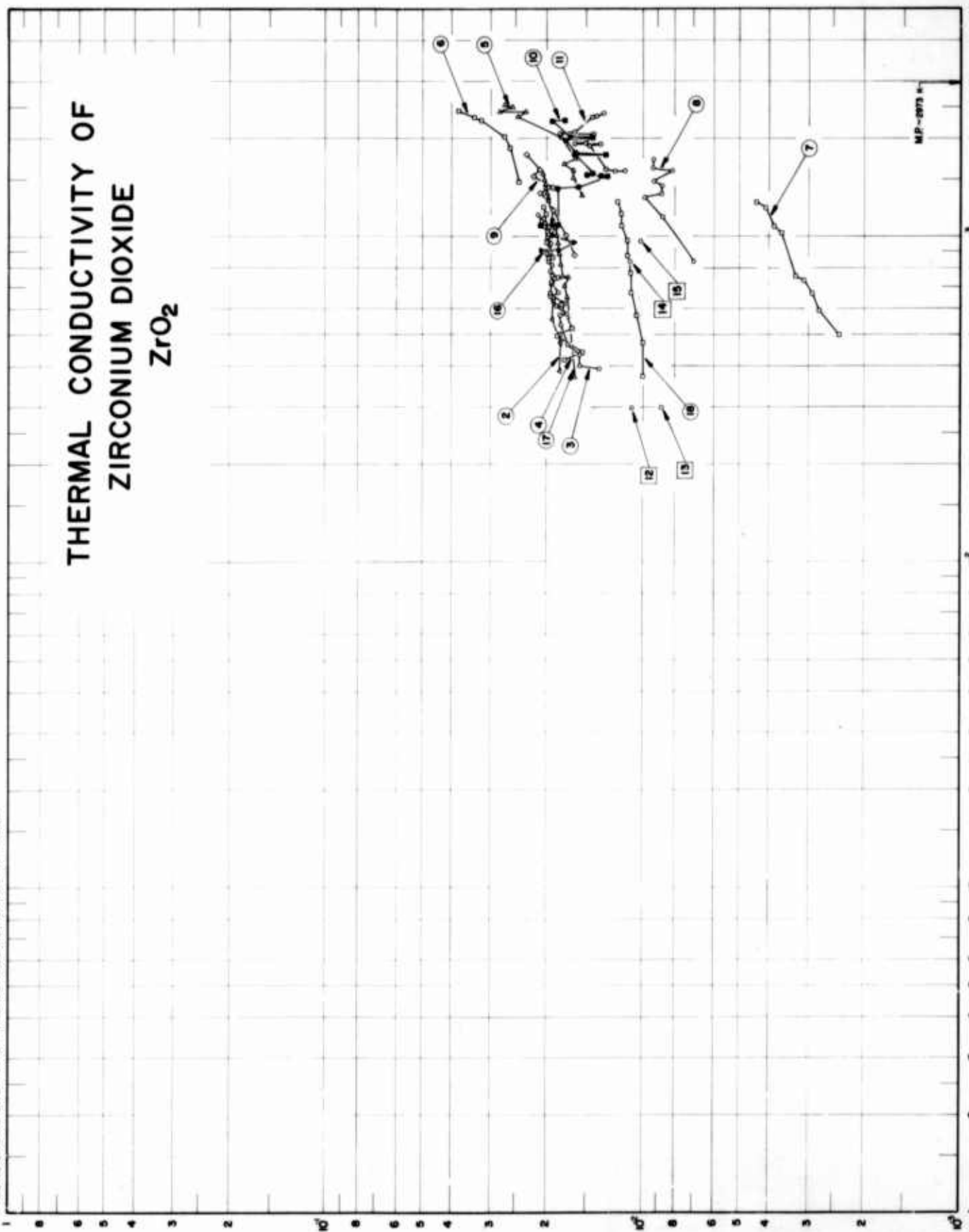
FIGURE SHOWS ONLY 17 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF ZIRCONIUM DIOXIDE ZrO_2

THERMAL CONDUCTIVITY, $Watt\ cm^{-1}\ K^{-1}$

TEMPERATURE, K

MP-2973 K



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 $<0.2 \text{ mm}$; bulk density 2.53 g cm^{-3} .
22	463	R	1961	654-1274			Similar to the above specimen except grain size $0.2 \sim 1 \text{ mm}$ and bulk density 2.30 g cm^{-3} .
23	463	R	1961	473-1273			Similar to the above specimen except grain size $2 \sim 5 \text{ mm}$ and bulk density 1.62 g cm^{-3} .

DATA TABLE NO. 42 THERMAL CONDUCTIVITY OF ZIRCONIUM DIOXIDE ZrO_2

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

Not shown on plot

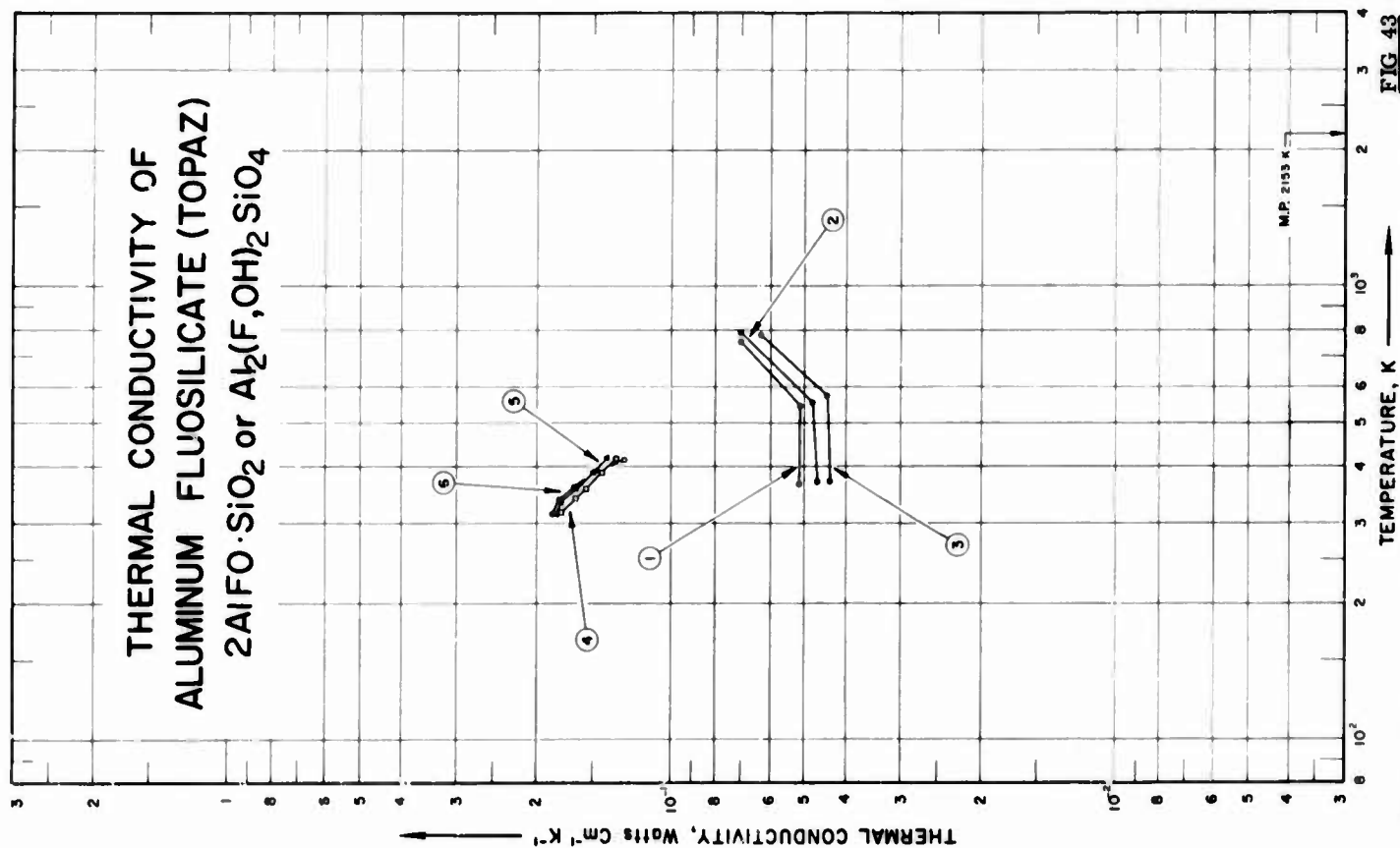


FIG 43

SPECIFICATION TABLE NO. 43 THERMAL CONDUCTIVITY OF ALUMINUM FLUOSILICATE (TOPAZ) $Al_2(F, OH)_2SiO_2$ or $2AlFO \cdot SiO_2$

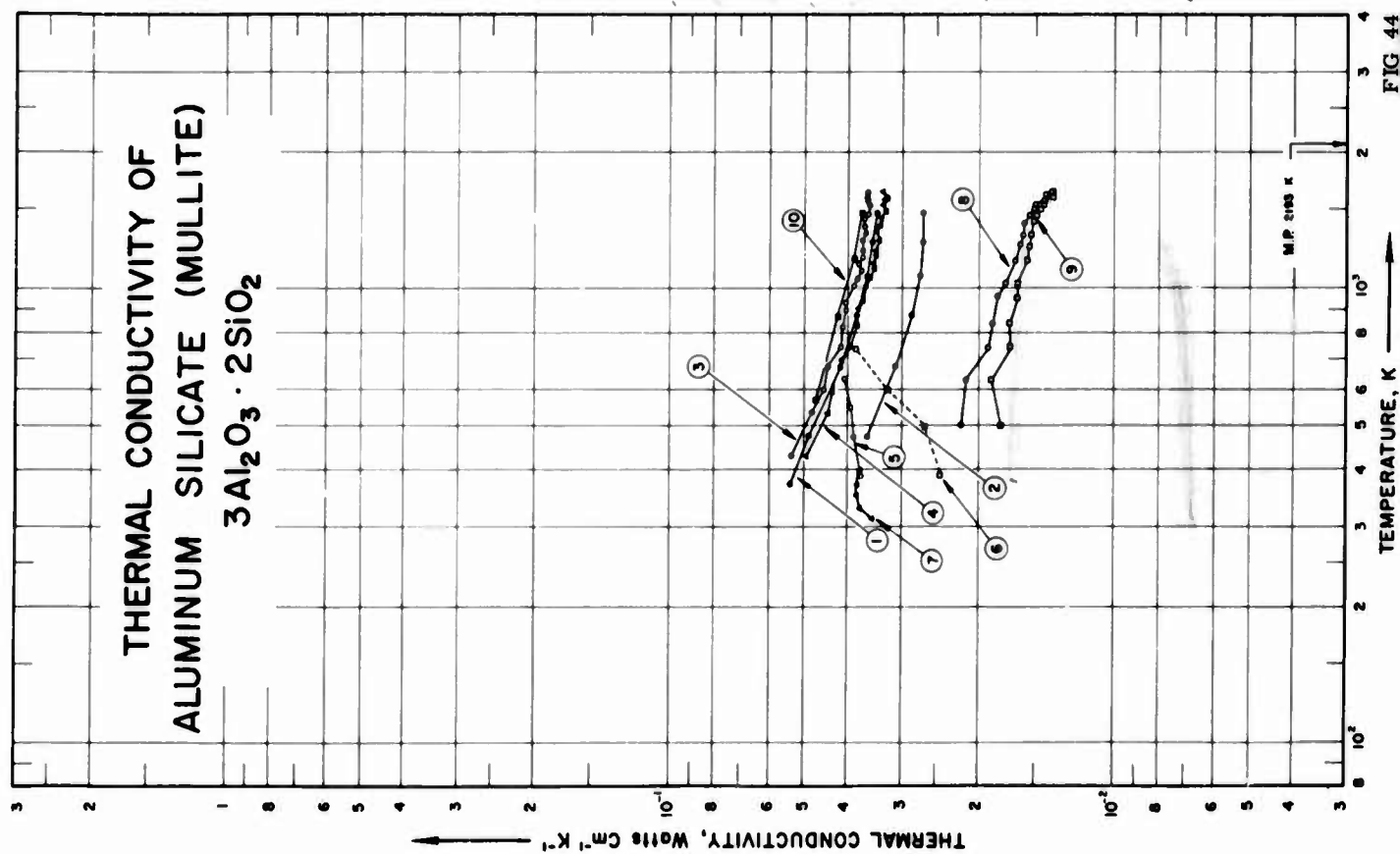
[For Data Reported in Figure and Table No. 43]

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) $\text{Al}_2(\text{F, OH})_2\text{SiO}_2$ or $2\text{AlFO} \cdot \text{SiO}_2$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
367.2	0.0315
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) $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$

[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_2O_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.

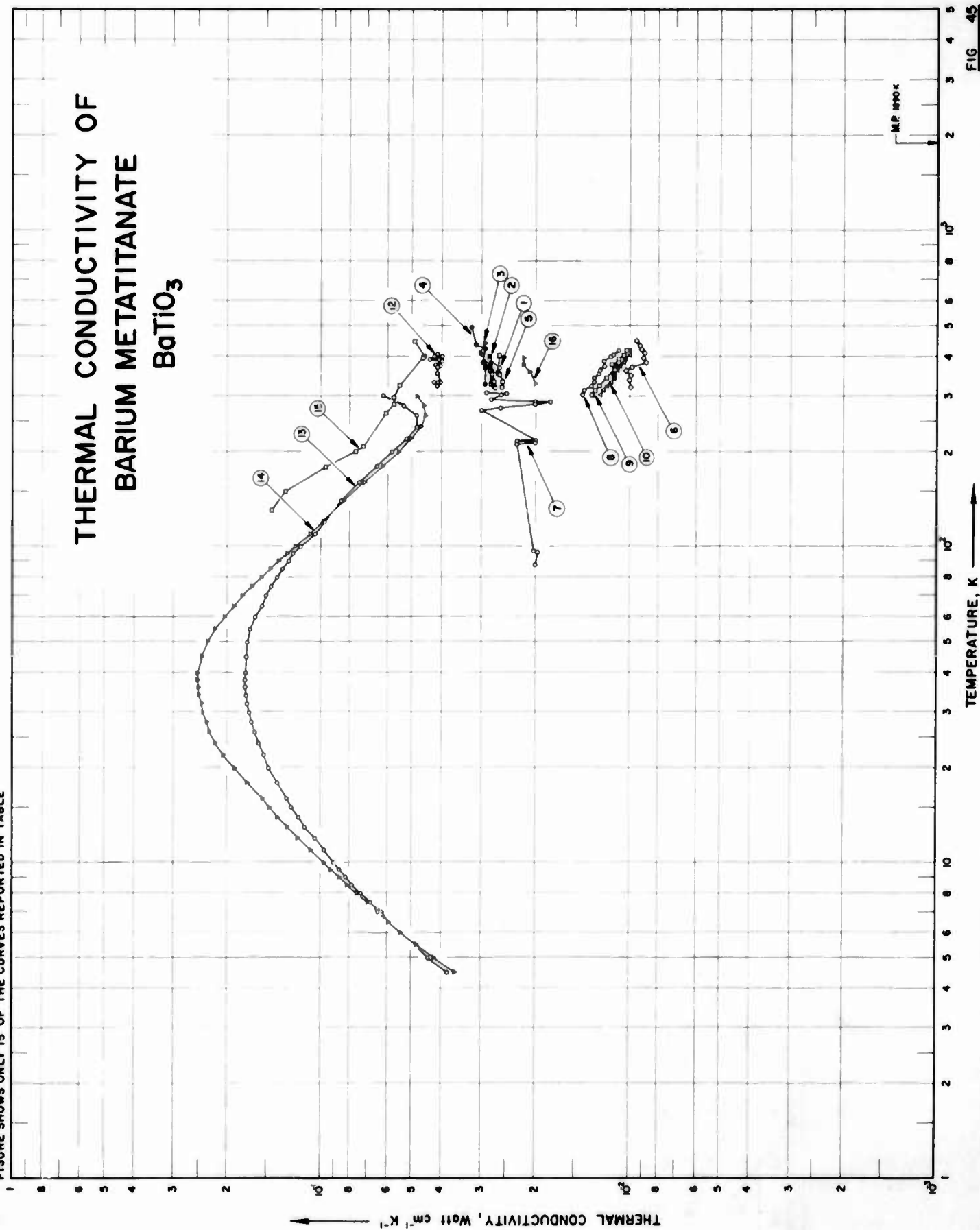
DATA TABLE NO. 44 THERMAL CONDUCTIVITY OF ALUMINUM SILICATE (MULLITE) $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 4 (cont.)</u>		<u>CURVE 8 (cont.)</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	1018.2	0.0364	1260.2	0.0162
1473.2	0.0343	1053.2	0.0356	1335.2	0.0159
<u>CURVE 2</u>		1108.2	0.0347	1409.2	0.0158
473.2	0.0360	1136.2	0.0349	1478.2	0.0154
673.2	0.0310	1185.7	0.0345	1515.2	0.0150
873.2	0.0285	1218.2	0.0345	1552.2	0.0149
1073.2	0.0272	1278.2	0.0339	1594.2	0.0142
1273.2	0.0268	1335.7	0.0345	1634.2	0.0141
1473.2	0.0268	1378.2	0.0337	1652.2	0.0138
<u>CURVE 3</u>		1438.2	0.0335	<u>CURVE 9</u>	
430.7	0.0536	1473.2	0.0326	502.2	0.0179
535.7	0.0481	1535.7	0.0331	634.2	0.0187
598.2	0.0452	1573.2	0.0328	746.2	0.0171
673.2	0.0446	1583.2	0.0324	846.2	0.0172
745.7	0.0414	1635.7	0.0331	961.2	0.0165
<u>CURVE 5</u>		392.2	0.0372	1048.2	0.0164
825.7	0.0412	477.2	0.0387	1169.2	0.0157
898.2	0.0406	563.2	0.0395	1254.2	0.0155
935.7	0.0406	740.2	0.0502	1329.2	0.0153
1018.2	0.0387	<u>CURVE 6</u>		1402.2	0.0151
1053.2	0.0381	392.2	0.0243	1468.2	0.0149
1098.2	0.0372	500.2	0.0264	1501.2	0.0146
1133.2	0.0377	608.2	0.0321	1543.2	0.0143
1175.7	0.0370	744.2	0.0382	1579.2	0.0142 *
1218.2	0.0370	<u>CURVE 7</u>		1613.2	0.0136
1273.2	0.0370	315.2	0.0349	1629.2	0.0136 *
1328.2	0.0364	333.6	0.0375	<u>CURVE 10</u>	
1372.2	0.0366	354.5	0.0377	573.2	0.0470
1463.2	0.0360	373.8	0.0378	873.2	0.0418
1533.2	0.0356	401.7	0.0372	1173.2	0.0383
1565.7	0.0360	<u>CURVE 8</u>		1473.2	0.0366
1583.2	0.0360	502.2	0.0218		
1633.2	0.0360	634.2	0.0214		
<u>CURVE 4</u>					
428.2	0.0496				
533.2	0.0446				
583.2	0.0435				

* 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 BaTiO_3

[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 siliconite furnace; the product crushed, well pulverized and meshed, then pressed ($1.3 \text{ tons. cm}^{-2}$) 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; $0.14 \text{ cal g}^{-1} \text{ deg}^{-1}$; velocity of sound in specimen $4.5 \times 10^5 \text{ cm sec}^{-1}$, mean free path $16.2 \text{ \AA}$.
9	202	F	1961	303-418			Similar to above except impurity 0.5 mol % of $\text{Mn}_2\text{Nb}_2\text{O}_7$.
10	202	F	1961	303-418			Similar to above except impurity 1.0 mol % $\text{Mn}_2\text{Nb}_2\text{O}_7$.
11	203	C	1958	323-458			Specimen sintered from BaCO_3 and TiO_2 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_2O_3 major impurity; single crystal; specimen $\sim 1 \times 1 \times 7 \text{ mm}$; 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		Poly-crystalline; specimen $1 \times 1 \times 7 \text{ mm}$; 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.

SPECIFICATION TABLE NO. 46 THERMAL CONDUCTIVITY OF BARIUM DITITANATE $\text{BaO} \cdot 2\text{TiO}_2$

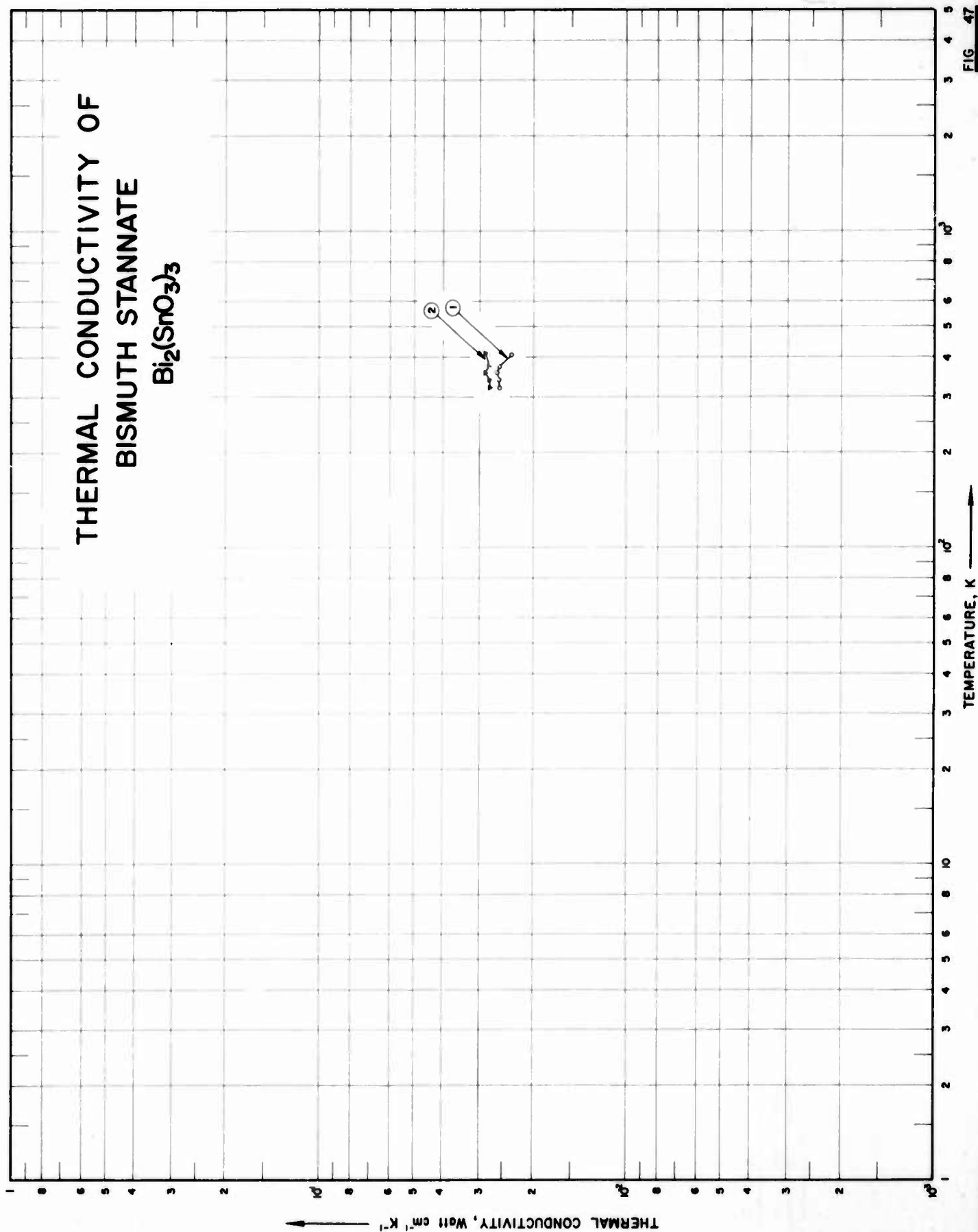
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	468	L	1950	328-394		38A	Specimen 0.492 in. dia x 0.491 in. long.

DATA TABLE NO. 46 THERMAL CONDUCTIVITY OF BARIUM DITITANATE $\text{BaO} \cdot 2\text{TiO}_2$ [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

T	k
CURVE 1*	
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 cm⁻¹ 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

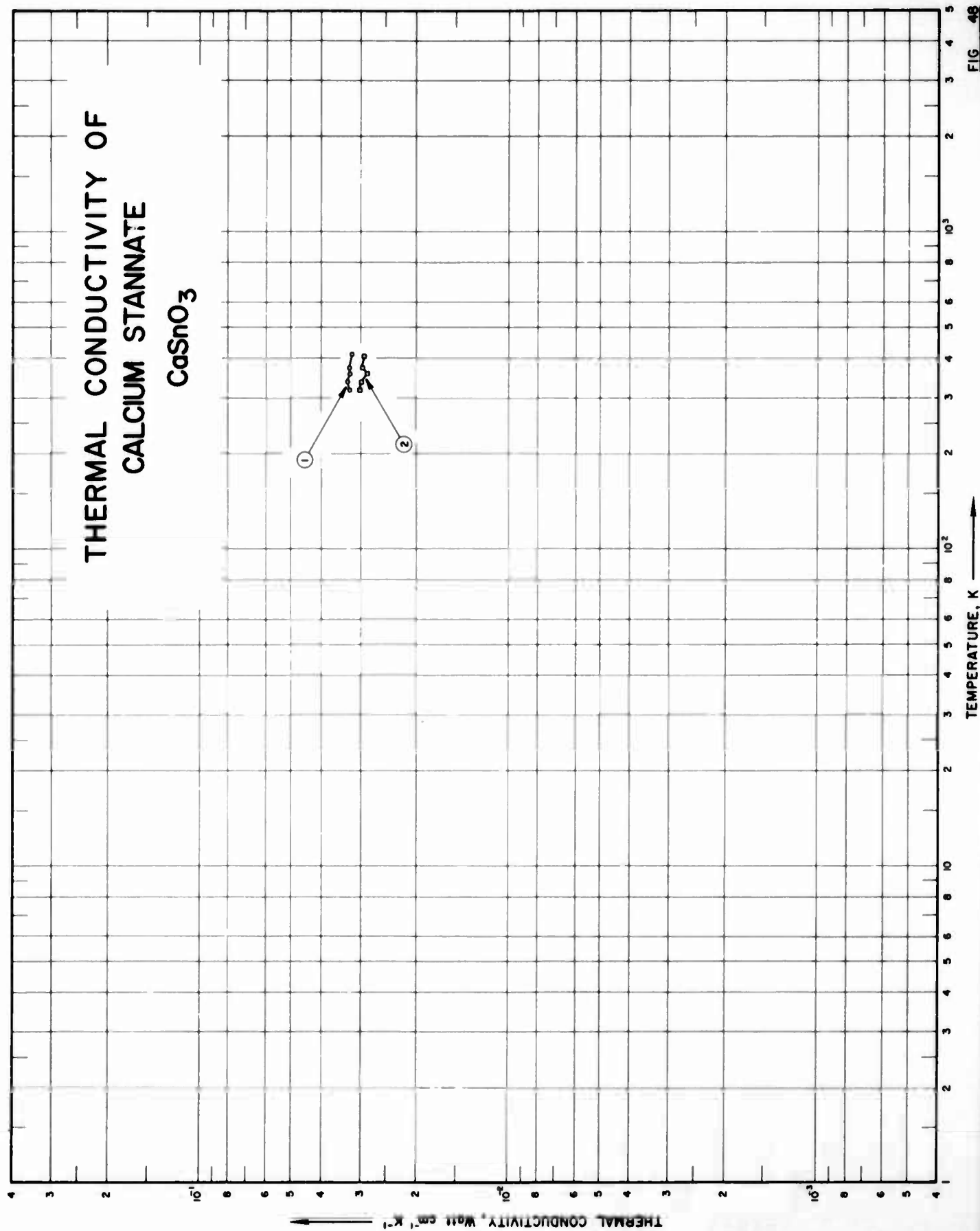


FIG. 48

SPECIFICATION TABLE NO. 48 THERMAL CONDUCTIVITY OF CALCIUM STANNATE CaSnO_3

[For Data Reported in Figure and Table No. 48]

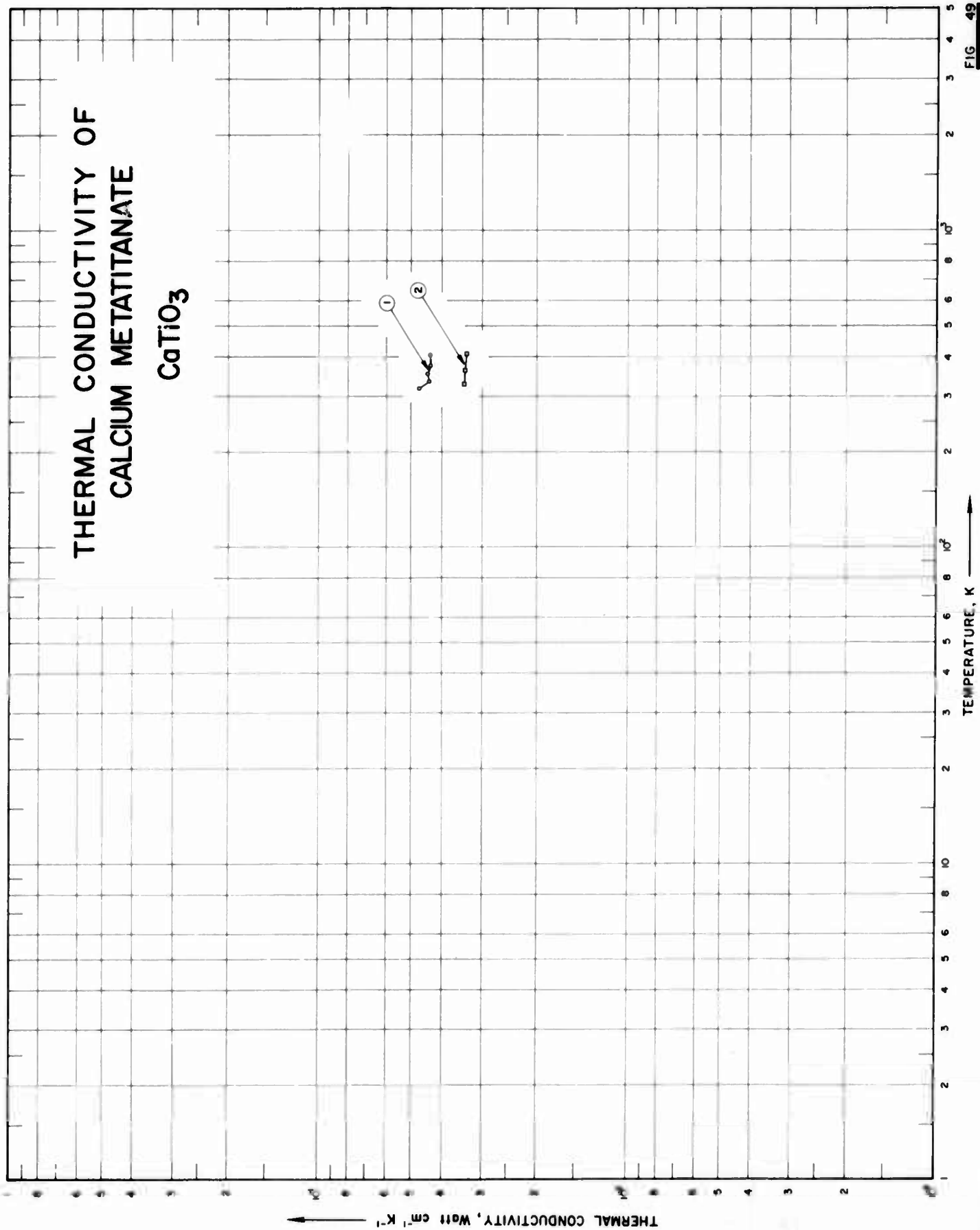
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3	L	1953	319-411		167B-1	Density (25 C) 5.08 g cm^{-3} ; water absorption 0.57%.
2	3	L	1953	318-407		167B-2	Separate run of the above specimen.

DATA TABLE NO. 48 THERMAL CONDUCTIVITY OF CALCIUM STANNATE CaSnO_3

[Temperature, T, K; Thermal Conductivity, k, Watt cm $^{-1}$ 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 CaTiO_3



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. 0.417 in. dia x 0.513 in. long.
2	468	L	1950	327-407		42B	

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 CaWO_4

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 CaWO_4

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

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
<u>CURVE 1 *</u>	
298.2	0.0724

* No graphical presentation

THERMAL CONDUCTIVITY OF
COBALT ZINC FERRATE
 $\text{Co}(\text{Zn})\text{Fe}_2\text{O}_4$

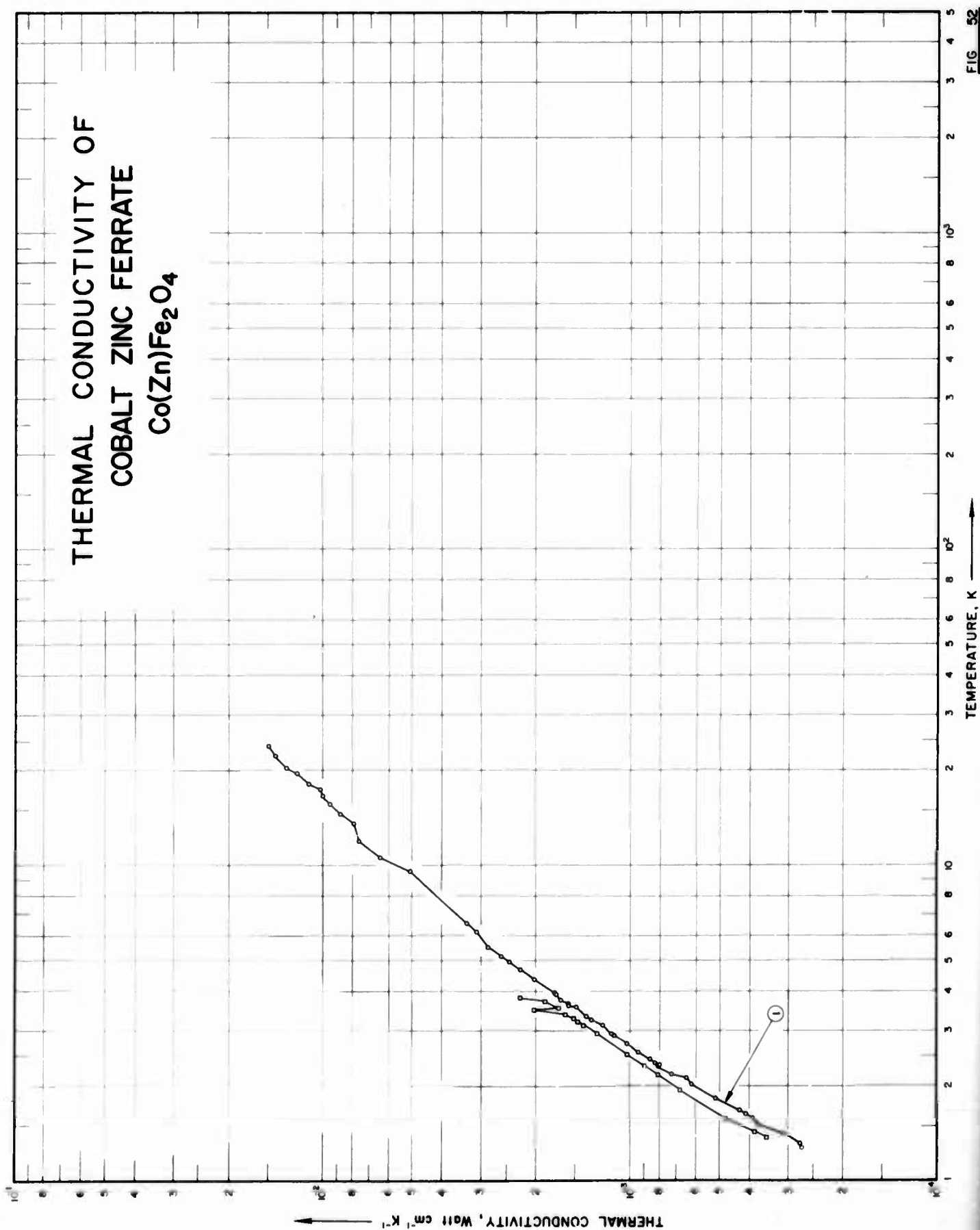


FIG. 52

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]

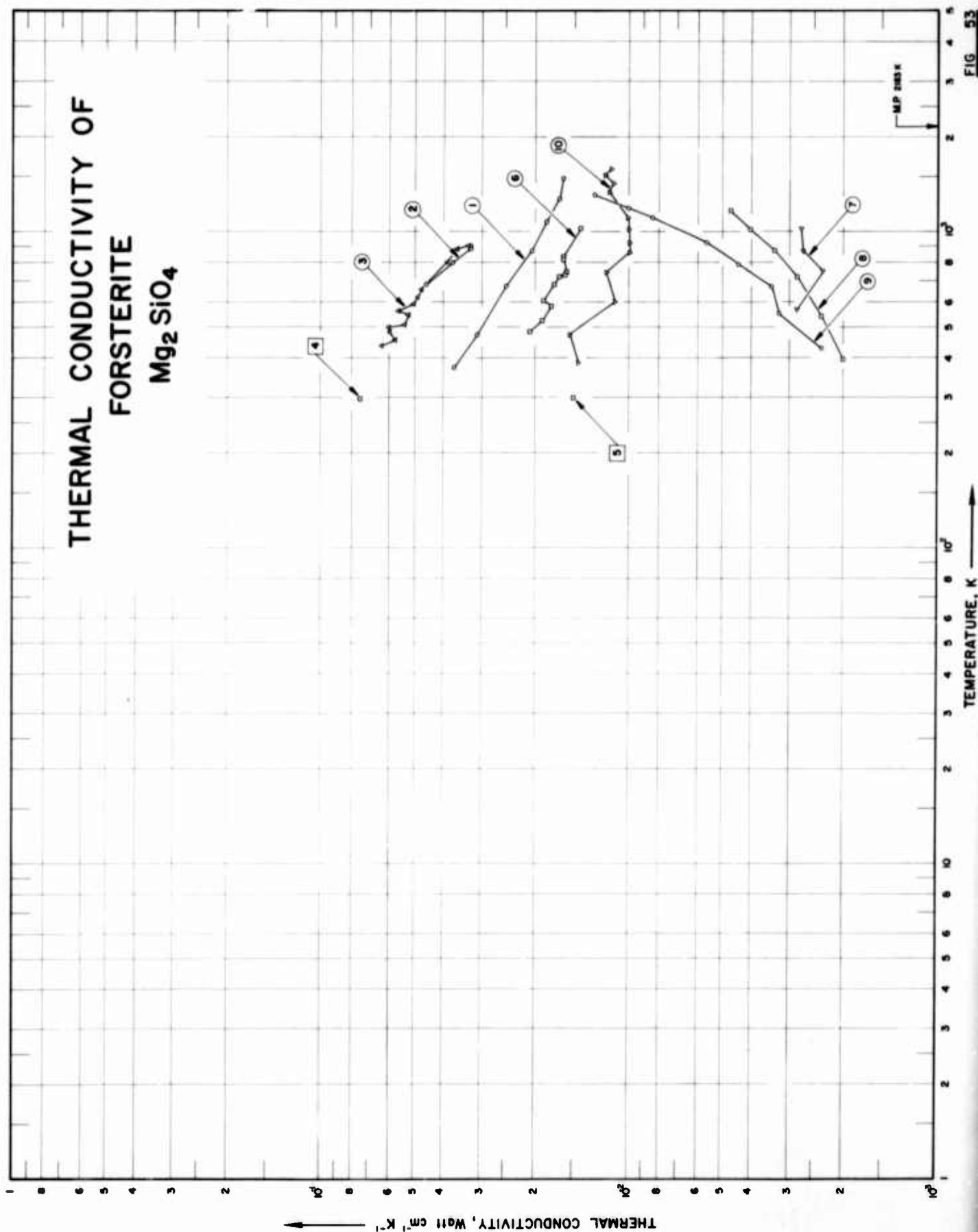
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	466	L	1961	1.3-24			Major metallic components: 55.8 Fe, 11.6 Co, and 6.46 Zn; specimen 4.37 cm in length and 0.329 cm ² in cross section; single 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	CURVE 1		T	k	CURVE 1 (cont.)	
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	0.000515						
2.02	0.000620						
2.12	0.000645						
2.18	0.000725						
2.31	0.000810						
2.33	0.000800						
2.36	0.000830						
2.43	0.000860						
2.56	0.000940						
2.74	0.00103						
2.90	0.00113						
2.93	0.00115						
3.11	0.00123						
3.25	0.00133						
3.33	0.00138						
3.56	0.00149						
3.60	0.00157						
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						

CURVE 2

1.36	0.000360
1.43	0.000385
1.57	0.000475
1.67	0.000535
1.95	0.000680
2.18	0.000810
2.32	0.000895
2.53	0.00103
2.92	0.00128
3.12	0.00142
3.20	0.00147
3.29	0.00153
3.39	0.00161
3.46	0.00204
3.51	0.00170
3.72	0.00186
3.76	0.00226



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 Mg_2SiO_4
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

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>			
653.2	0.0460				
798.2	0.0372	568.2	0.00282		
883.2	0.0326	753.2	0.00232		
901.2	0.0326	871.2	0.00270		
		1029	0.00275		
<u>CURVE 3</u>		<u>CURVE 8</u>			
437.2	0.0636				
456.2	0.0577	396.2	0.00199		
481.2	0.0598	541.2	0.00235		
499.2	0.0602	723.2	0.00282		
509.2	0.0540	873.2	0.00335		
548.2	0.0523	1019	0.00401		
563.2	0.0561	1167	0.00470		
591.2	0.0506				
621.2	0.0490	<u>CURVE 9</u>			
658.2	0.0477				
683.2	0.0460*	428.2	0.00235		
798.2	0.0389	552.2	0.00324		
883.2	0.0360	673.2	0.00343		
901.2	0.0331	787.2	0.00442		
		925.2	0.00561		
<u>CURVE 4</u>		1108	0.00837		
298.2	0.0753	1192	0.0100		
		1319	0.0129		
<u>CURVE 5</u>		<u>CURVE 10</u>			
298.2	0.0151				
		384.2	0.0145		
<u>CURVE 6</u>		473.2	0.0154		
483.2	0.0208	596.2	0.0111		
525.2	0.0189	742.2	0.0118		
583.2	0.0178	857.2	0.00988		
		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		1964	315-377	± 3	Garnet [$M_2^{II} M_2^{III} (SiO_4)_3$]	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⁻¹ K⁻¹]

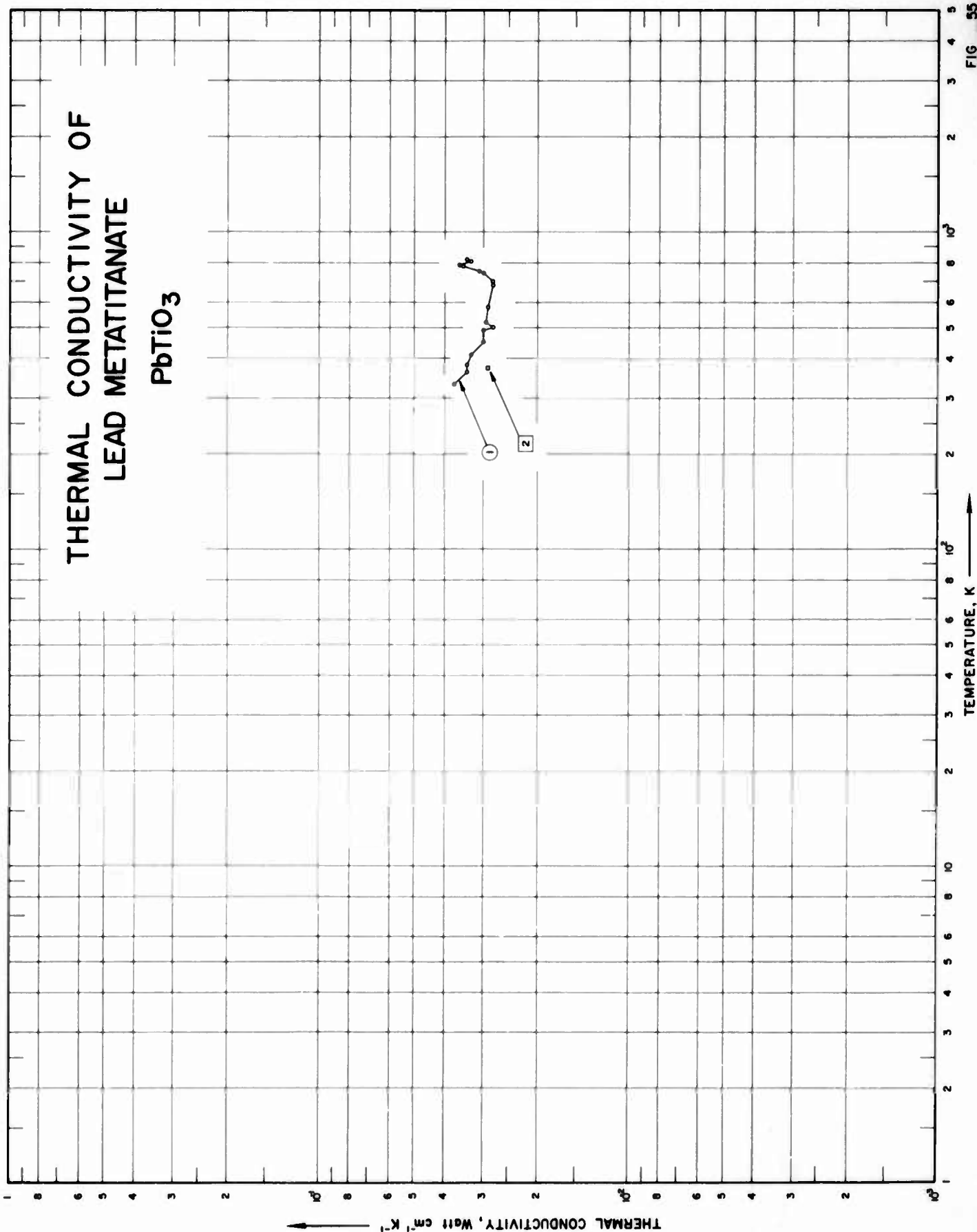
T k

CURVE 1*

315.0	0.0358
324.6	0.0361
357.9	0.0354
376.8	0.0356

* 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 siliconit furnace; the product was crashed, well pulverized and measured (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 $\text{cm}^{-1}\text{K}^{-1}$]

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

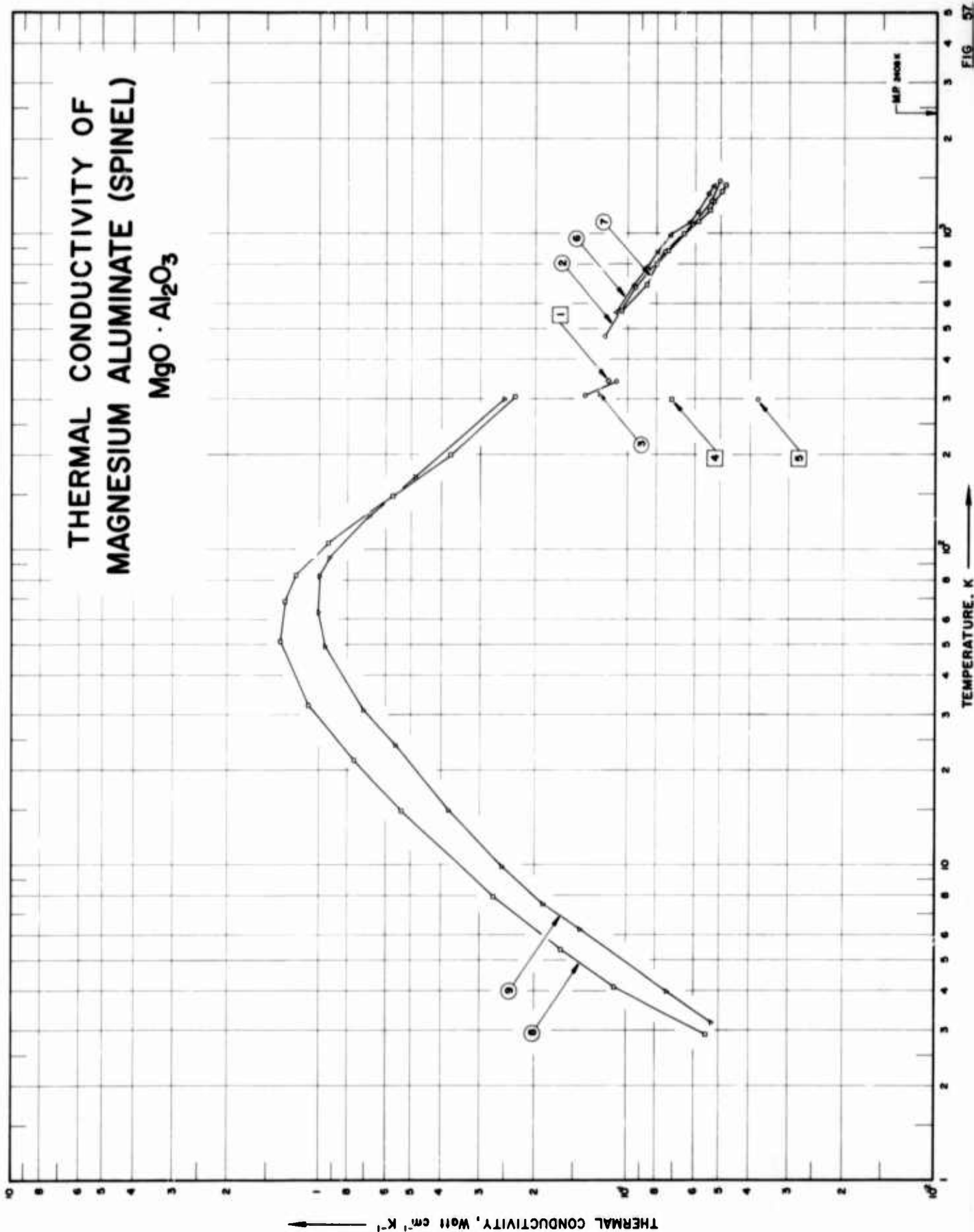
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	38	C	1960	345-530			Powdered raw materials of special grade PbO and chemically pure grade ZrO_2 mixed together with water, pressed into a disc 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
CURVE 1*	
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)
 $\text{MgO} \cdot \text{Al}_2\text{O}_3$



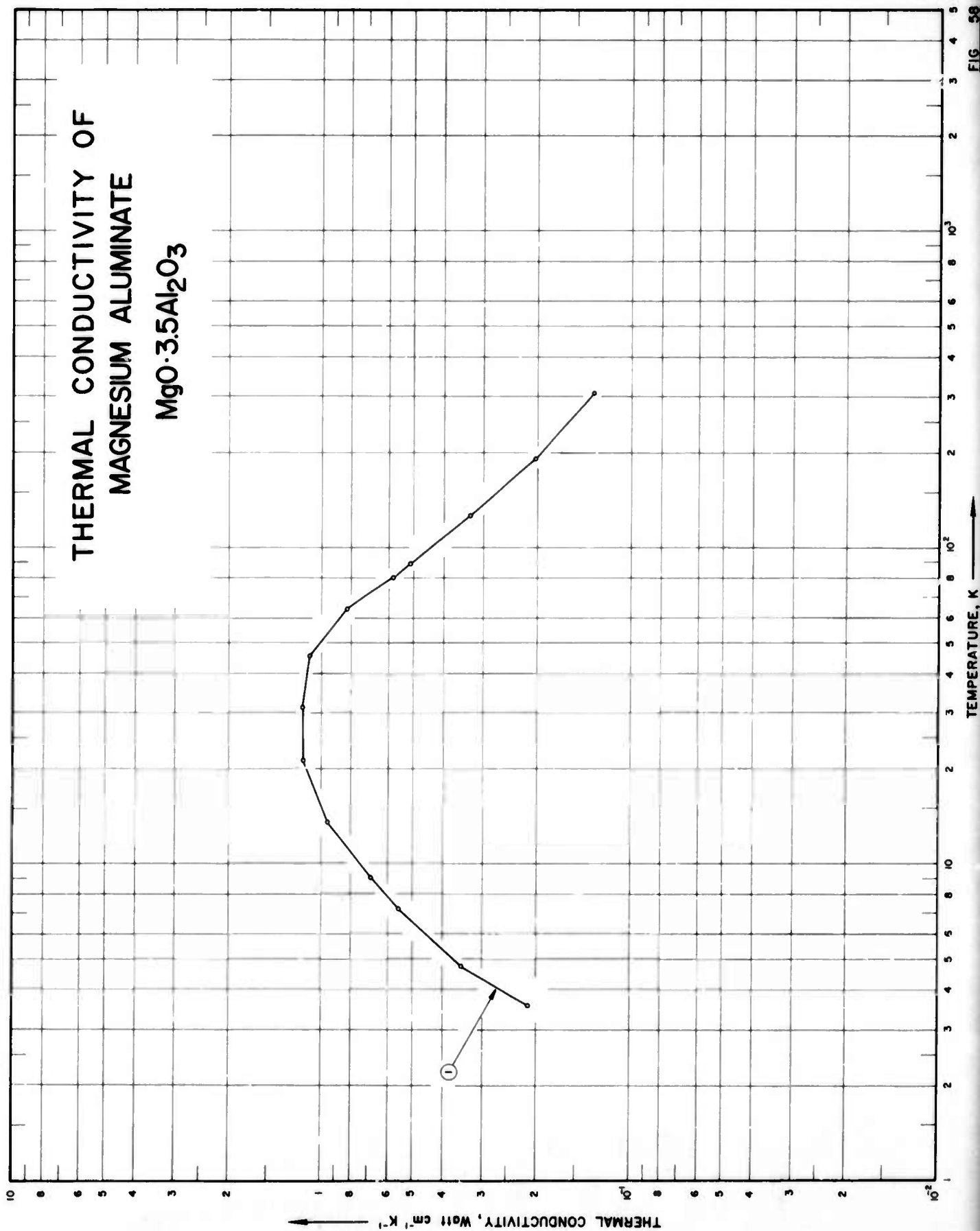
SPECIFICATION TABLE NO. 57 THERMAL CONDUCTIVITY OF MAGNESIUM ALUMINATE $MgO \cdot Al_2O_3$

[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 Al_2O_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^{18} 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		R-42;	2nd run of the above specimen.
8	300	L	1962	2.9-305		Natural Ruby Spinel	Single natural crystal; impurity (epi in atom cm^{-3}) given in log ₁₀ epi: $<18.1 \text{ Be}$, $<17.7 \text{ Ca}$, 19.2 Cr , 18.9 Fe , 17.7 K , 18.2 Li , 18.1 Mn , 18.3 Na , $<17.6 \text{ Ni}$, 18.3 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 $8.0866 \text{ \AA}$.
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: $<18.1 \text{ Be}$, $<17.7 \text{ Ca}$, 19.3 Cr , 19.2 Fe , 18.3 K , 18.2 Li , 17.9 Mn , 18.3 Na , $<17.6 \text{ Ni}$, 18.2 Si , 18.3 Ti , 19.4 V , 19.5 Zn and $<17.4 \text{ Zr}$; specimen 0.45 cm long and 0.25 in. avg. dia; lattice constant $8.0866 \text{ \AA}$.

DATA TABLE NO. 57 THERMAL CONDUCTIVITY OF MAGNESIUM ALUMINATE $\text{MgO} \cdot \text{Al}_2\text{O}_3$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 7 (cont.)</u>	
343.2	0.117	1183.2	0.0540
<u>CURVE 2</u>		1268.2	0.0528
473.2	0.119	1356.2	0.0494
673.2	0.0941	1423.2	0.0481
873.2	0.0749	<u>CURVE 8</u>	
1073.2	0.0615	2.91	0.055
1273.2	0.0536	4.11	0.110
473.2	0.0502	5.39	0.165
<u>CURVE 3</u>		7.94	0.271
308.2	0.138	14.85	0.538
341.2	0.109	21.50	0.758
<u>CURVE 4</u>		32.04	1.08
298.2	0.0711	51.11	1.35
<u>CURVE 5</u>		68.56	1.30
298.2	0.0377	82.62	1.19
<u>CURVE 6</u>		105.8	0.927
563.2	0.109	147.51	0.572
683.2	0.0952	199.76	0.375
783.2	0.0858	305.35	0.233
875.2	0.0791	<u>CURVE 9</u>	
980.2	0.0720	3.18	0.053
1080.2	0.0624	3.97	0.073
1173.2	0.0590	6.25	0.143
1348.2	0.0544	7.53	0.188
1418.2	0.0528	9.92	0.254
<u>CURVE 7</u>		14.91	0.379
568.2	0.105	24.03	0.560
688.2	0.0864	31.15	0.705
798.2	0.0799	49.42	0.950
883.2	0.0732	63.41	1.00
998.2	0.0653	82.96	0.992
1091.2	0.0589	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 $\text{MgO} \cdot 3.5 \text{ Al}_2\text{O}_3$

[For Data Reported in Figure and Table No. 58]

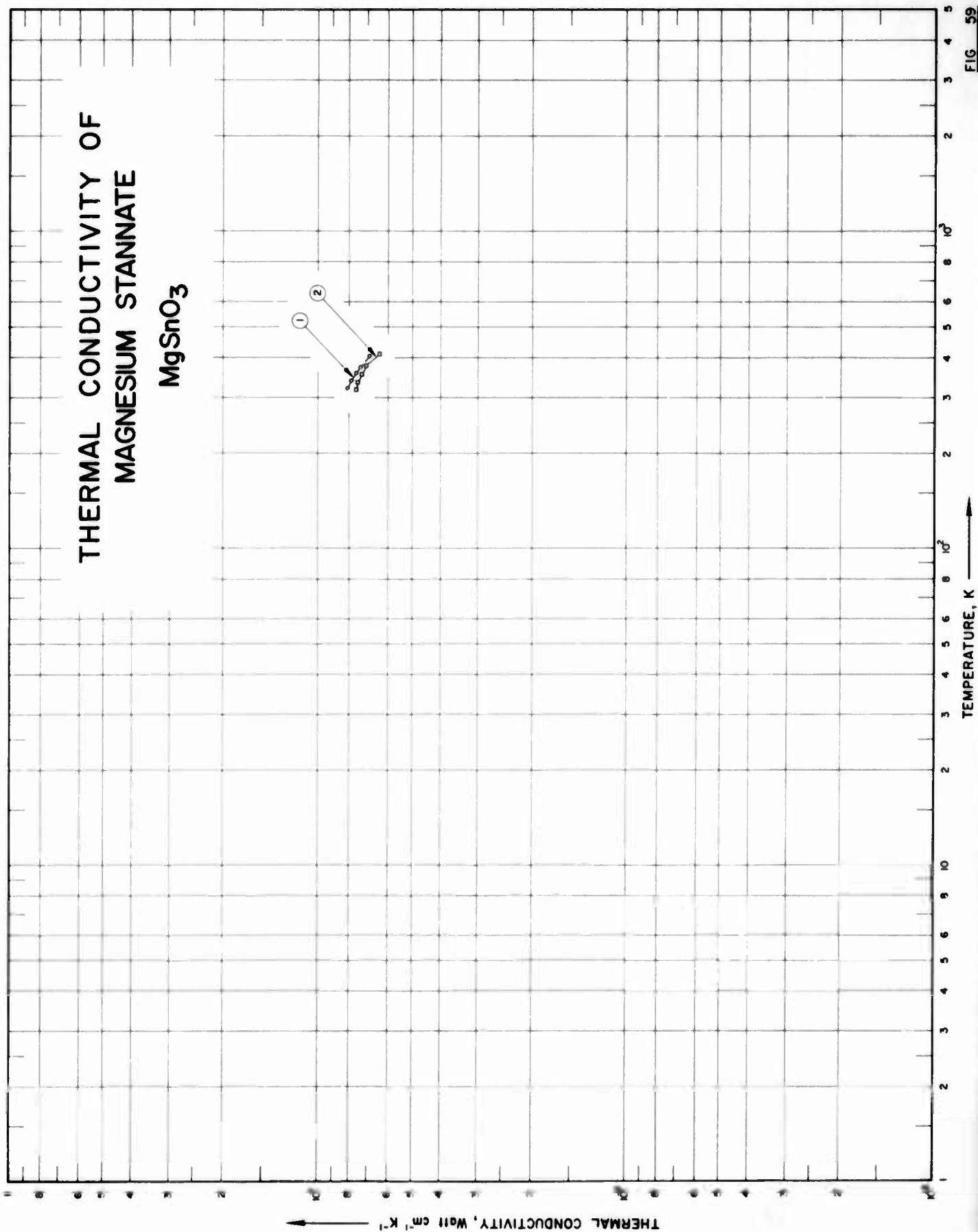
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	300	L	1962	3.6-301		Synthetic Spinel R-53	Single synthetic crystal; made with the Verneuil process by Linde Air Products Co. N. Y.; impurity (epi 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 7.979Å.

DATA TABLE NO. 58 THERMAL CONDUCTIVITY OF MAGNESIUM ALUMINATE $\text{MgO} \cdot 3.5 \text{Al}_2\text{O}_3$

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

T	k
<u>CURVE 1</u>	
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

THERMAL CONDUCTIVITY OF MAGNESIUM STANNATE MgSnO_3



SPECIFICATION TABLE NO. 59 THERMAL CONDUCTIVITY OF MAGNESIUM STANNATE MgSnO_3

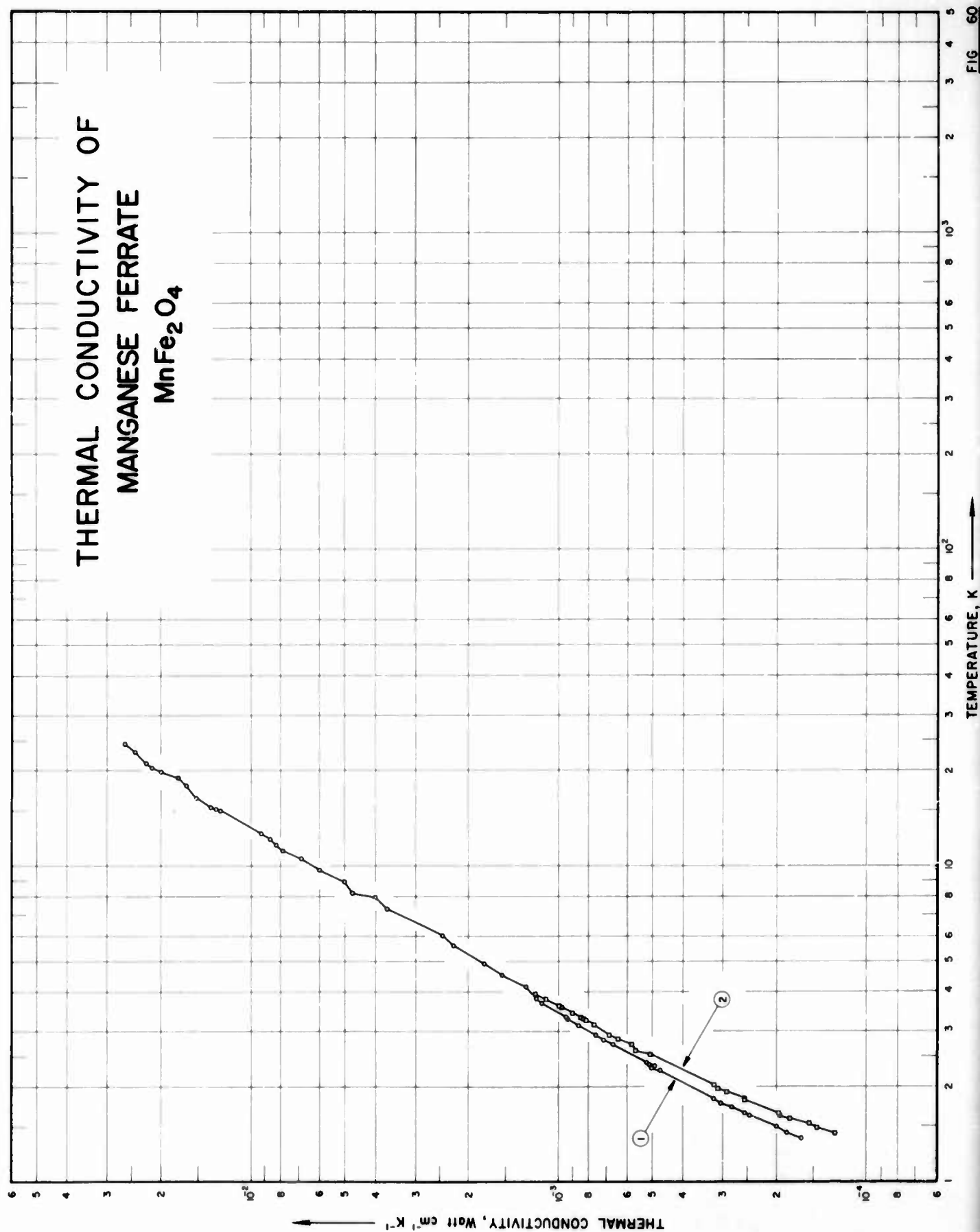
[For Data Reported in Figure and Table No. 59]

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	0.0808
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

THERMAL CONDUCTIVITY OF
MANGANESE FERRATE
 MnFe_2O_4



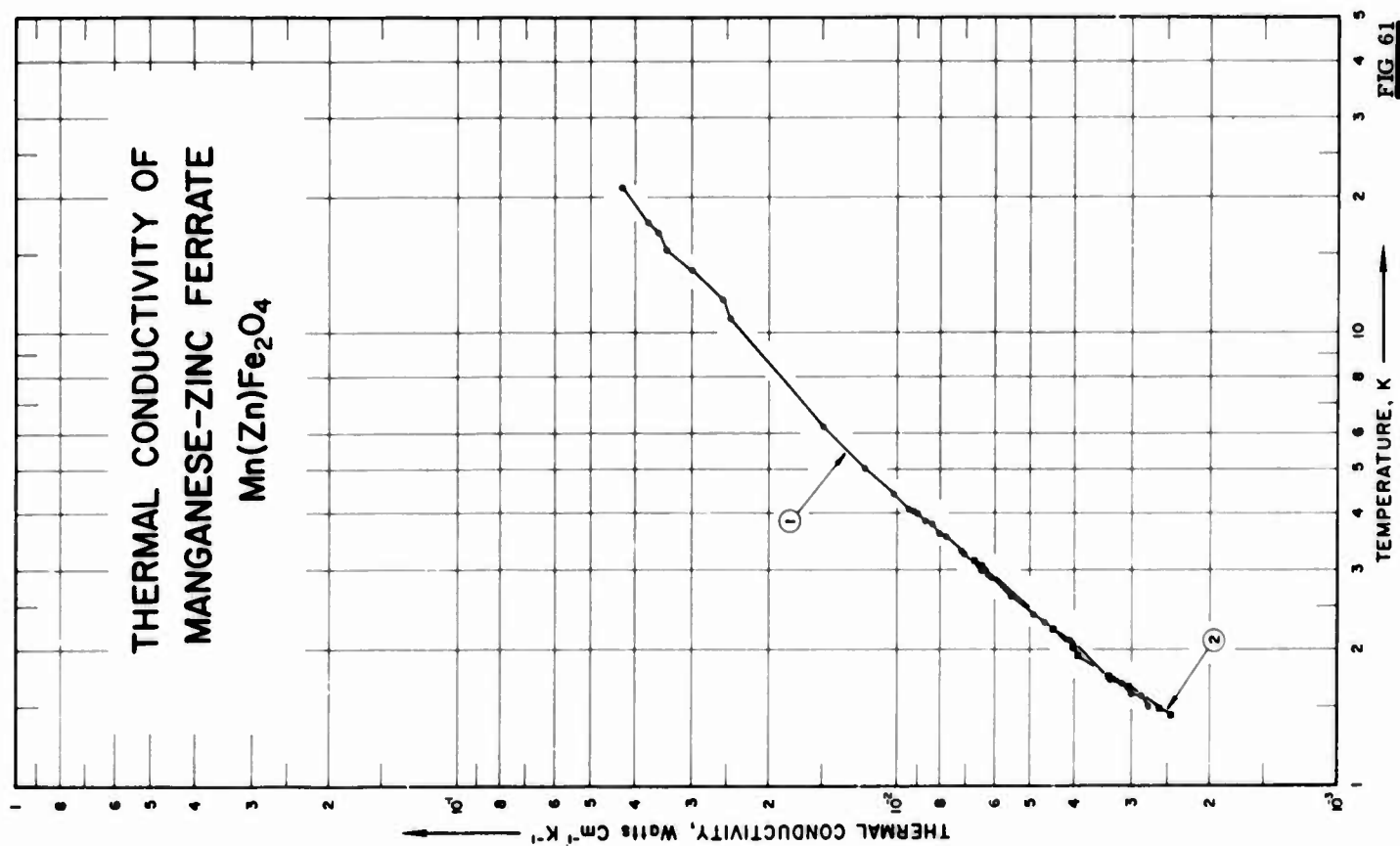
SPECIFICATION TABLE NO. 60 THERMAL CONDUCTIVITY OF MANGANESE FERRATE MnFe_2O_4

[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 , $\sim 10^3$, and $\geq 10^2$ 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 $\text{cm}^{-1} \text{K}^{-1}$]

T	k	CURVE 1		T	k	CURVE 1 (cont.)	
		CURVE 1	CURVE 2			CURVE 1	CURVE 2
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						
13.0	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						



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, $\pm 7 \times 10^8$ 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 $\text{Mn}(\text{Zn})\text{Fe}_2\text{O}_4$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	CURVE 2 (cont.)	
		T	k
1.50	0.00275	2.56	0.00535*
1.57	0.00285	2.65	0.00550
1.60	0.00300	2.79	0.00585*
1.69	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		

CURVE 2

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

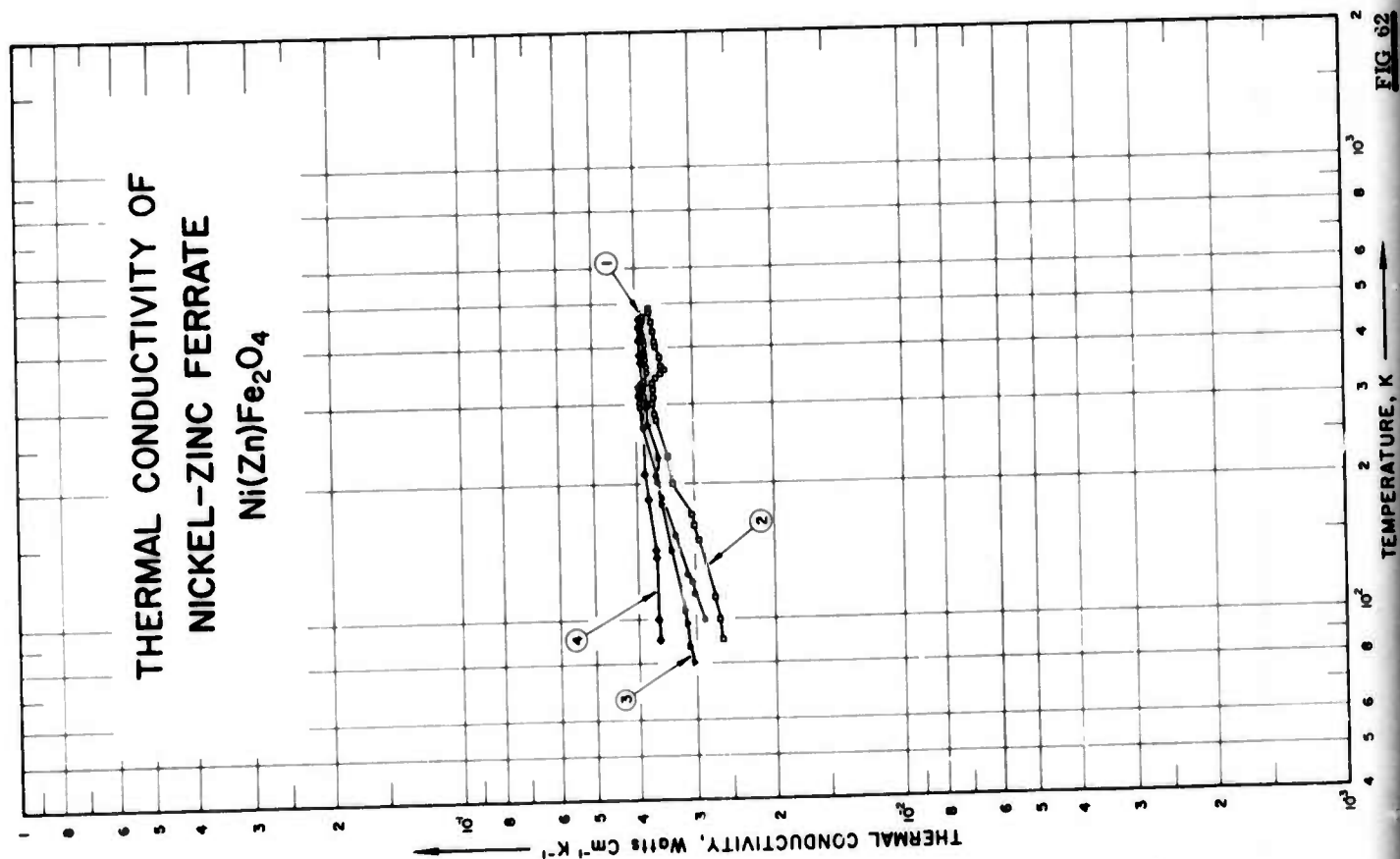


FIG 62

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]

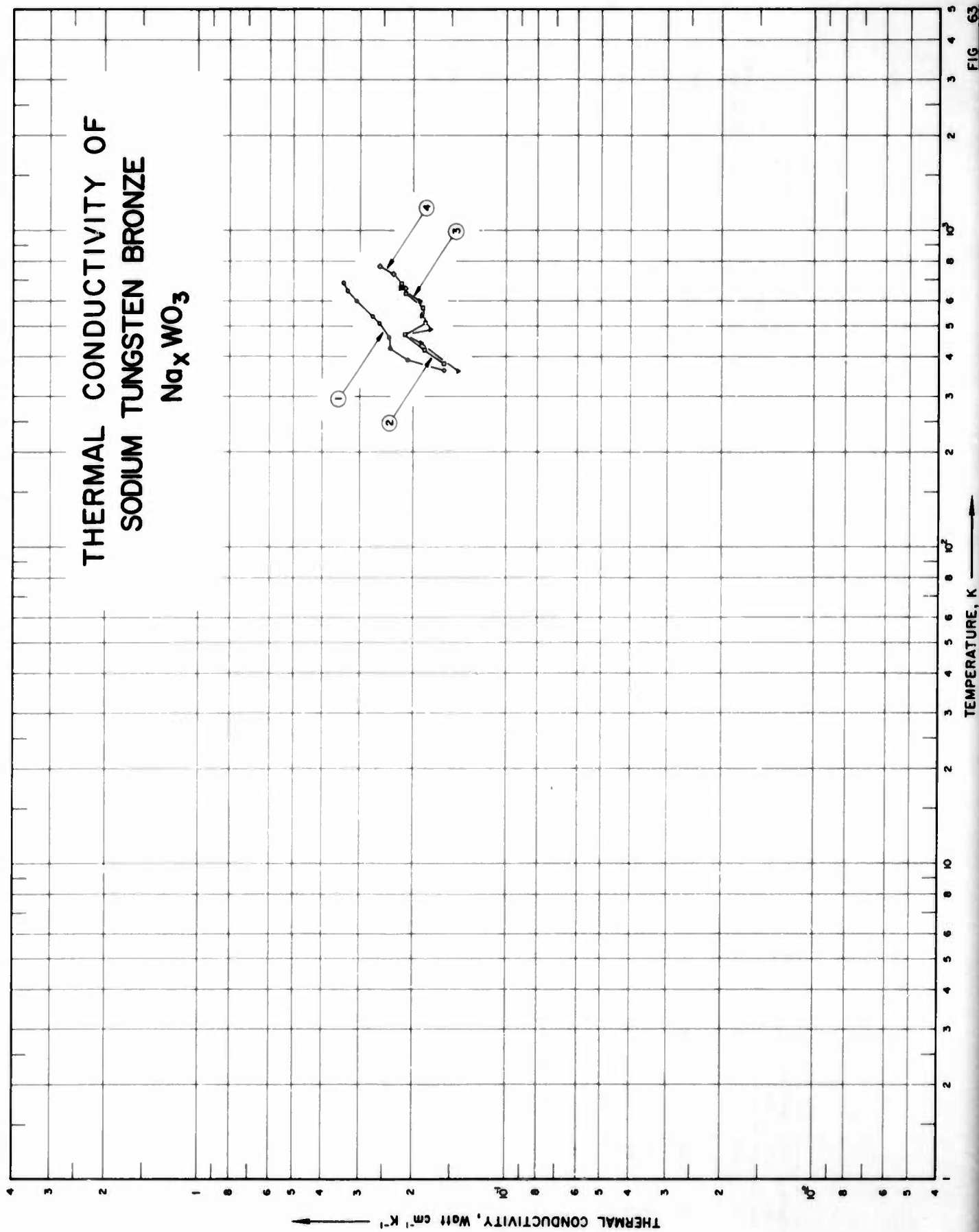
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)	Specifications and Remarks
1	246	L	1963	100-468	1-3	$\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$ No. 3	Initial composition: 66.80 Fe_2O_3 , 9.37 NiO and 23.83 ZnO; 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	$\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$ 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	$\text{Ni}_{0.25}\text{Zn}_{0.75}\text{Fe}_2\text{O}_4$ 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	$\text{Ni}_{0.1}\text{Zn}_{0.9}\text{Fe}_2\text{O}_4$ No. 9	Initial composition: 66.42 Fe_2O_3 , 3.11 NiO and 30.47 ZnO; similar to the above specimen.	

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

T	k	T	k	T	k	T	k	T	k
CURVE 1		CURVE 2 (cont.)		CURVE 3		CURVE 4 (cont.)		CURVE 4 (cont.)	
100	0.0287	332	0.0368	80	0.0303	210	0.0385	210	0.0385
114	0.0301	342	0.0363	87	0.0310	260	0.0395*	260	0.0395*
121	0.0305	350	0.0351	98	0.0314	270	0.0385*	270	0.0385*
126	0.0312	355	0.0347	105	0.0316	290	0.0385*	290	0.0385*
153	0.0331	362	0.0331	142	0.0337	294	0.0385*	294	0.0385*
201	0.0360	380	0.0354	180	0.0351	297	0.0385*	297	0.0385*
209	0.0364	400	0.0360	210	0.0362*	300	0.0397*	300	0.0397*
266	0.0387	412	0.0362	220	0.0366	310	0.0387	310	0.0387
296	0.0391	432	0.0366	320	0.0366	320	0.0387	320	0.0387
302	0.0393	451	0.0368	350	0.0368	350	0.0389*	350	0.0389*
313	0.0395	477	0.0374	408	0.0382	370	0.0389	370	0.0389
328	0.0395	487	0.0374	416	0.0383	385	0.0389	385	0.0389
332	0.0399			424	0.0385	415	0.0391	415	0.0391
338	0.0393			458	0.0385	442	0.0391	442	0.0391
351	0.0379			468	0.0385	463	0.0391	463	0.0391
364	0.0379								
376	0.0379								
385	0.0380								
392	0.0381								
402	0.0381								
408	0.0382*								
416	0.0383								
424	0.0385								
458	0.0385								
468	0.0385								
CURVE 2		CURVE 4							
90	0.0264	300	0.0379*	80	0.0303	210	0.0385	210	0.0385
100	0.0266	330	0.0381*	87	0.0310	260	0.0395*	260	0.0395*
112	0.0272	340	0.0381*	98	0.0314	270	0.0385*	270	0.0385*
150	0.0295	372	0.0383*	105	0.0316	290	0.0385*	290	0.0385*
161	0.0300	427	0.0383*	142	0.0337	294	0.0385*	294	0.0385*
171	0.0304	470	0.0383*	180	0.0351	297	0.0385*	297	0.0385*
172	0.0308*	487	0.0387*	210	0.0362*	300	0.0397*	300	0.0397*
200	0.0324			220	0.0366	310	0.0387	310	0.0387
230	0.0341			320	0.0366	320	0.0387	320	0.0387
276	0.0360			350	0.0368	350	0.0389*	350	0.0389*
285	0.0364			408	0.0382	370	0.0389	370	0.0389
300	0.0366			416	0.0383	385	0.0389	385	0.0389
310	0.0366			424	0.0385	415	0.0391	415	0.0391
322	0.0366			458	0.0385	442	0.0391	442	0.0391
				468	0.0385	463	0.0391	463	0.0391

* 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

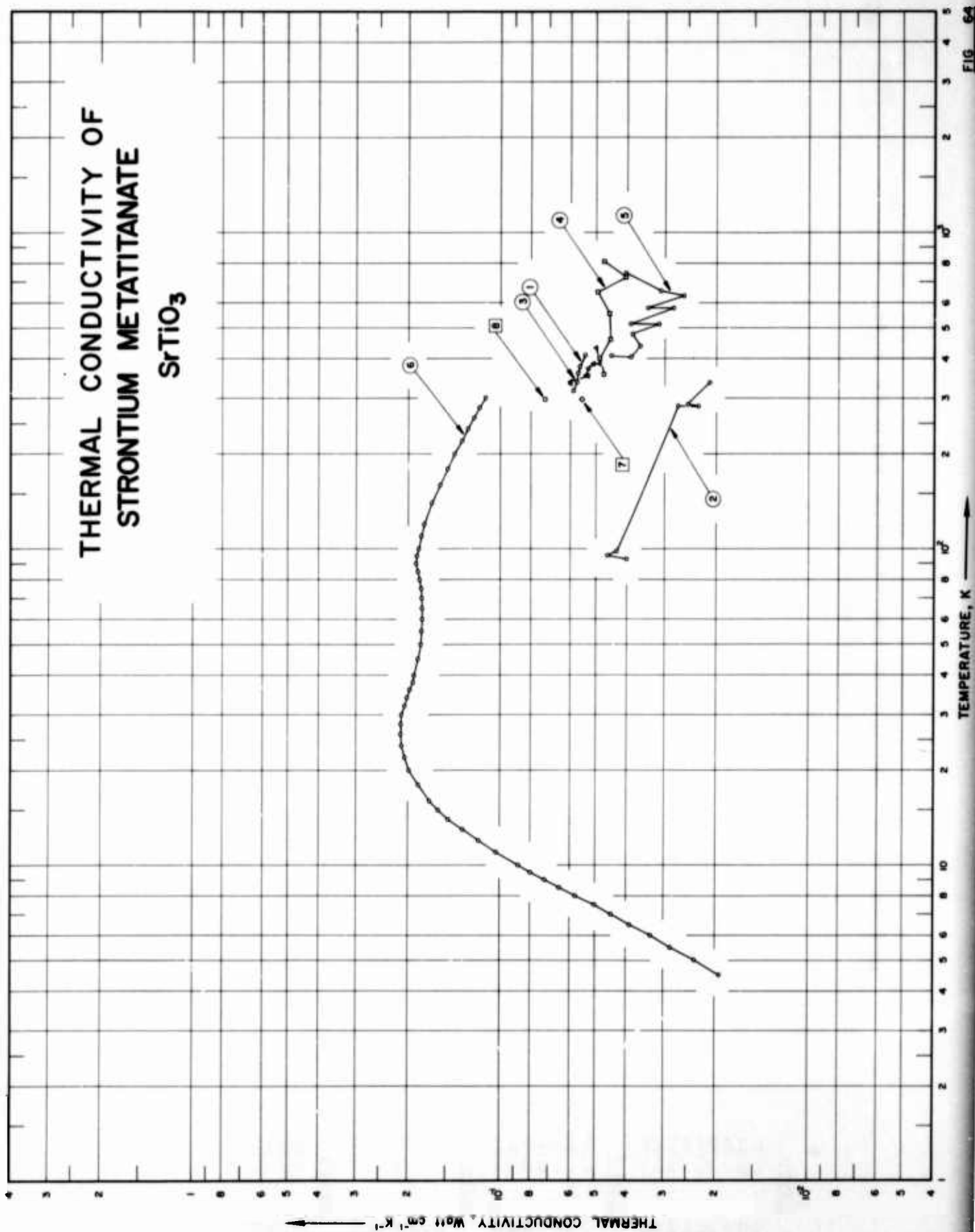
[For Data Reported in Figure and Table No. 63]

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		$\text{Na}_{0.513}\text{WO}_3$	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



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 Silconit 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	1958	333-433			Pure; 1st run.
4	283		1959	358-808			2nd run of the above specimen.
5	283		1959	403-743			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.
6	465	L	1965	4.5-300			88.8% theoretical density.
7	470	L	1959	298.2			94% theoretical density.
8	470	L	1959	298.2			

DATA TABLE NO. 64 THERMAL CONDUCTIVITY OF STRONTIUM METATITANATE SrTiO_3 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 5 (cont.)</u>		<u>CURVE 6 (cont.)</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	578.2	0.0343	80	0.184
377.6	0.0561	633.2	0.0259	85	0.186
410.3	0.0540	653.2	0.0310	90	0.188
		743.2	0.0406	95	0.187
<u>CURVE 2</u>				100	0.185
93.2	0.040	<u>CURVE 6</u>		110	0.181
95.2	0.046	4.5	0.0194	120	0.177
98.2	0.043	5.0	0.0236	140	0.168
283.2	0.027	5.5	0.0284	160	0.158
283.2	0.023	6.0	0.0333	180	0.149
286.2	0.025	6.5	0.0390	200	0.141
337.2	0.021	7.0	0.0447	220	0.134
<u>CURVE 3</u>		7.5	0.0504	240	0.128
333.2	0.060	8.0	0.0576	260	0.122
338.2	0.060	8.5	0.0648	280	0.117
353.2	0.053	9.0	0.0721	300	0.112
354.2	0.054	9.5	0.0798		
373.2	0.053	10	0.0875	<u>CURVE 7</u>	
385.2	0.051	11	0.103	298.2	0.0552
385.2	0.049	12	0.118	<u>CURVE 8</u>	
433.2	0.050	13	0.132	298.2	0.0724
<u>CURVE 4</u>		14	0.147		
358.2	0.0473	15	0.159		
398.2	0.0490	16	0.170		
458.2	0.0452	18	0.185		
553.2	0.0456	20	0.198		
648.2	0.0494	22	0.205		
723.2	0.0406	24	0.210		
808.2	0.0473	26	0.211		
<u>CURVE 5</u>		28	0.211		
403.2	0.0389	30	0.210		
408.2	0.0448	32	0.205		
438.2	0.0364	34	0.201		
478.2	0.0385	36	0.197		
513.2	0.0389	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

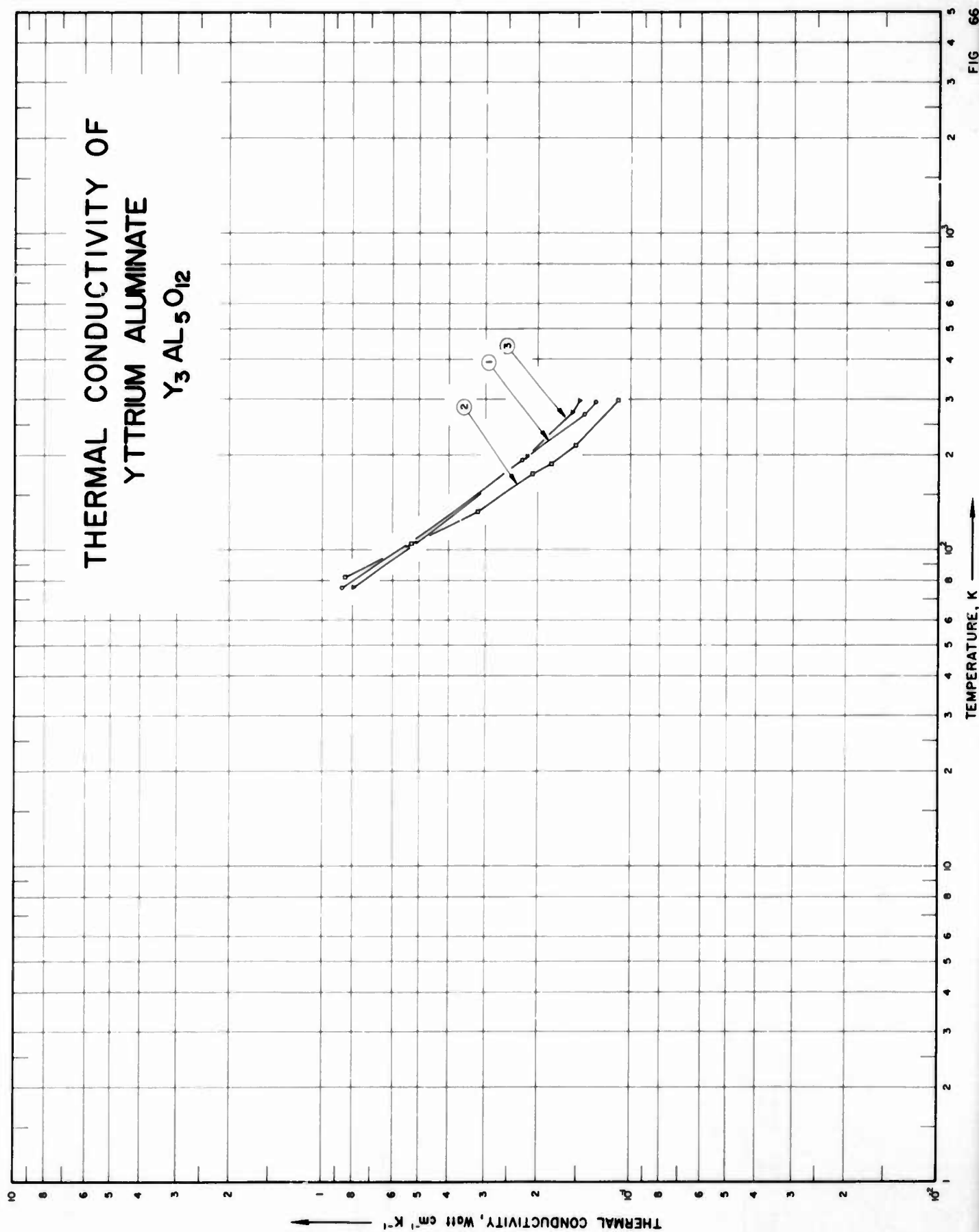


FIG. 66

SPECIFICATION TABLE NO. 66 THERMAL CONDUCTIVITY OF YTTRIUM ALUMINATE $Y_3Al_5O_{12}$

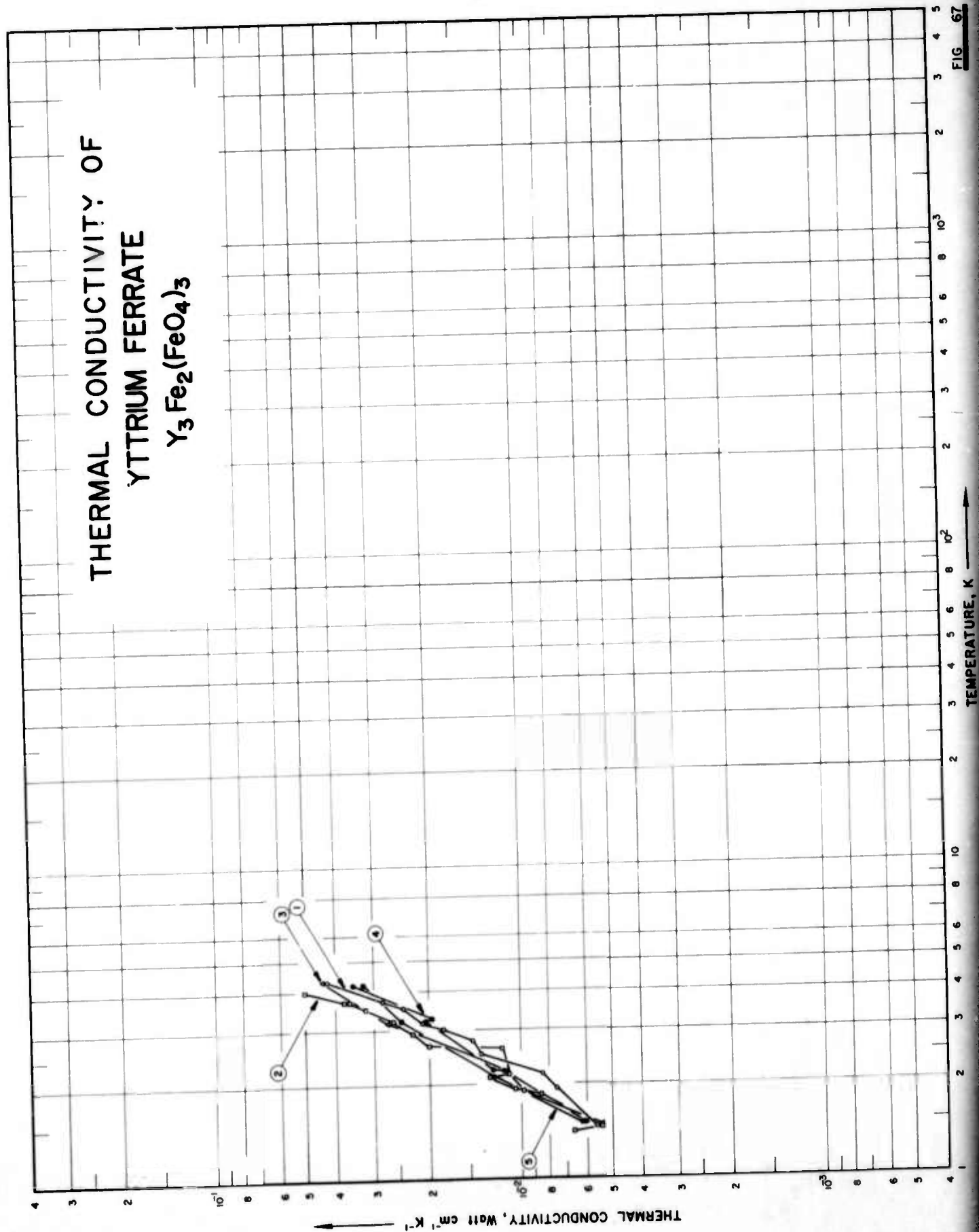
[For Data Reported in Figure and Table No. 66]

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 ¹⁸ 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 ¹⁸ 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 $Y_2Al_2O_7$
 [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
CURVE 1		CURVE 5	
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		

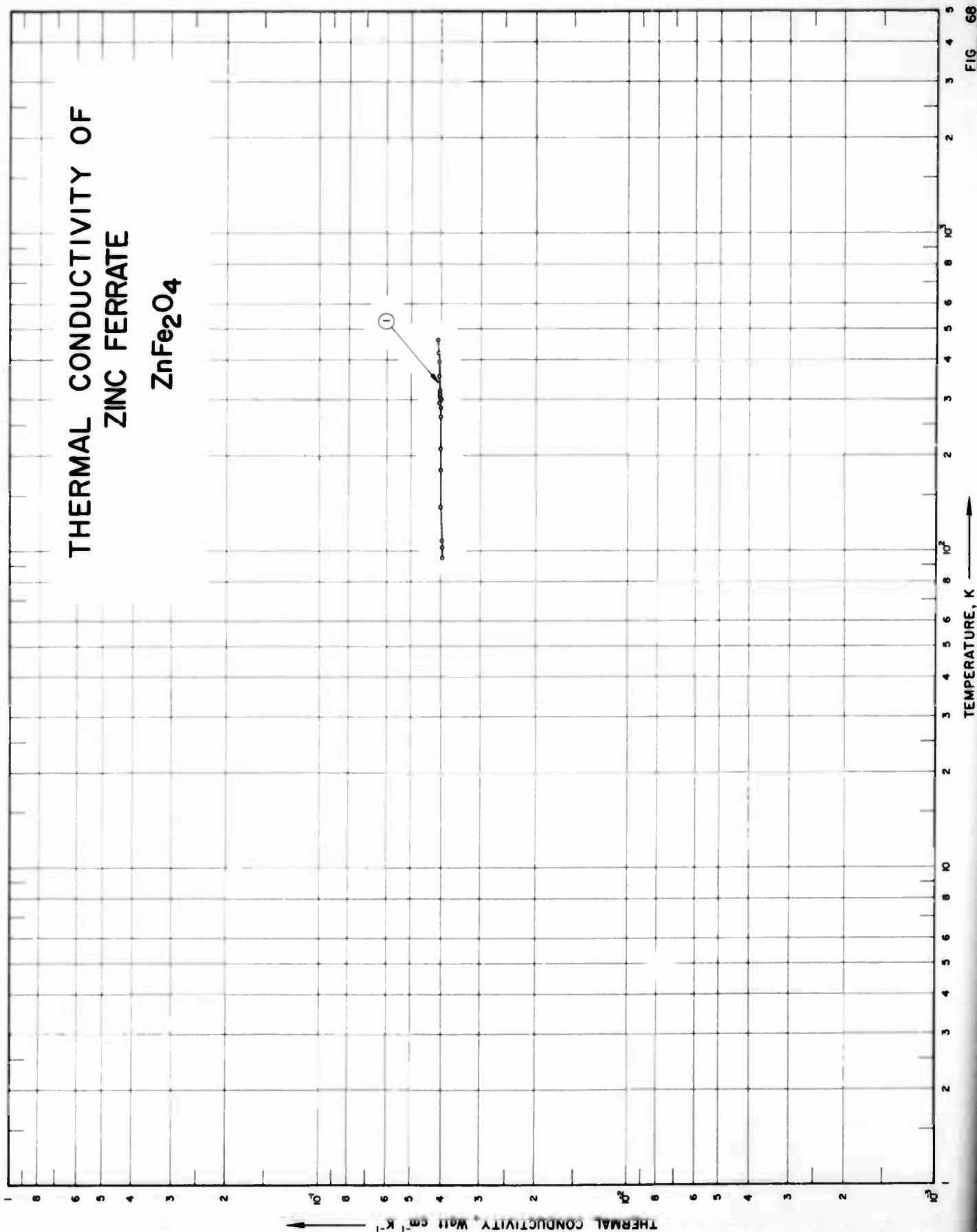
CURVE 2	
1.4	0.0066
1.45	0.0054
1.85	0.0085
1.90	0.0098
1.93	0.0105
2.1	0.0128
2.15	0.011
2.6	0.016
2.65	0.020
2.9	0.0225
3.2	0.026
3.5	0.032
3.7	0.036
3.7	0.0375
4.2	0.05

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]

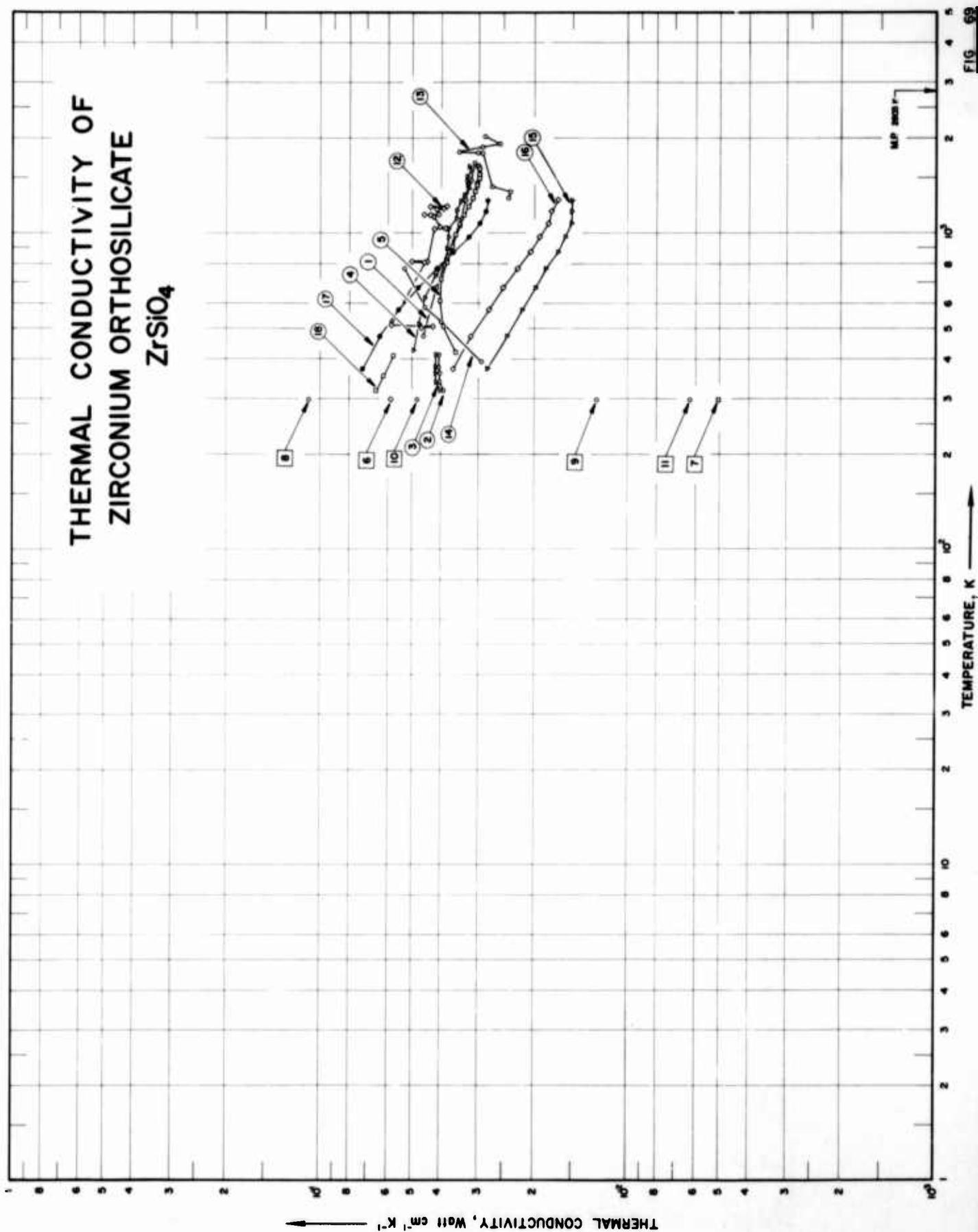
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent),	Specifications and Remarks
1	246	L	1963	95-463	1-3	No. 3		Mixture of ground 66.24 analytically pure Fe_2O_3 (CHDA) and 33.76 ZnO ; prepared by mixing for 3 days by wet method 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 $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
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 ZrSiO_4

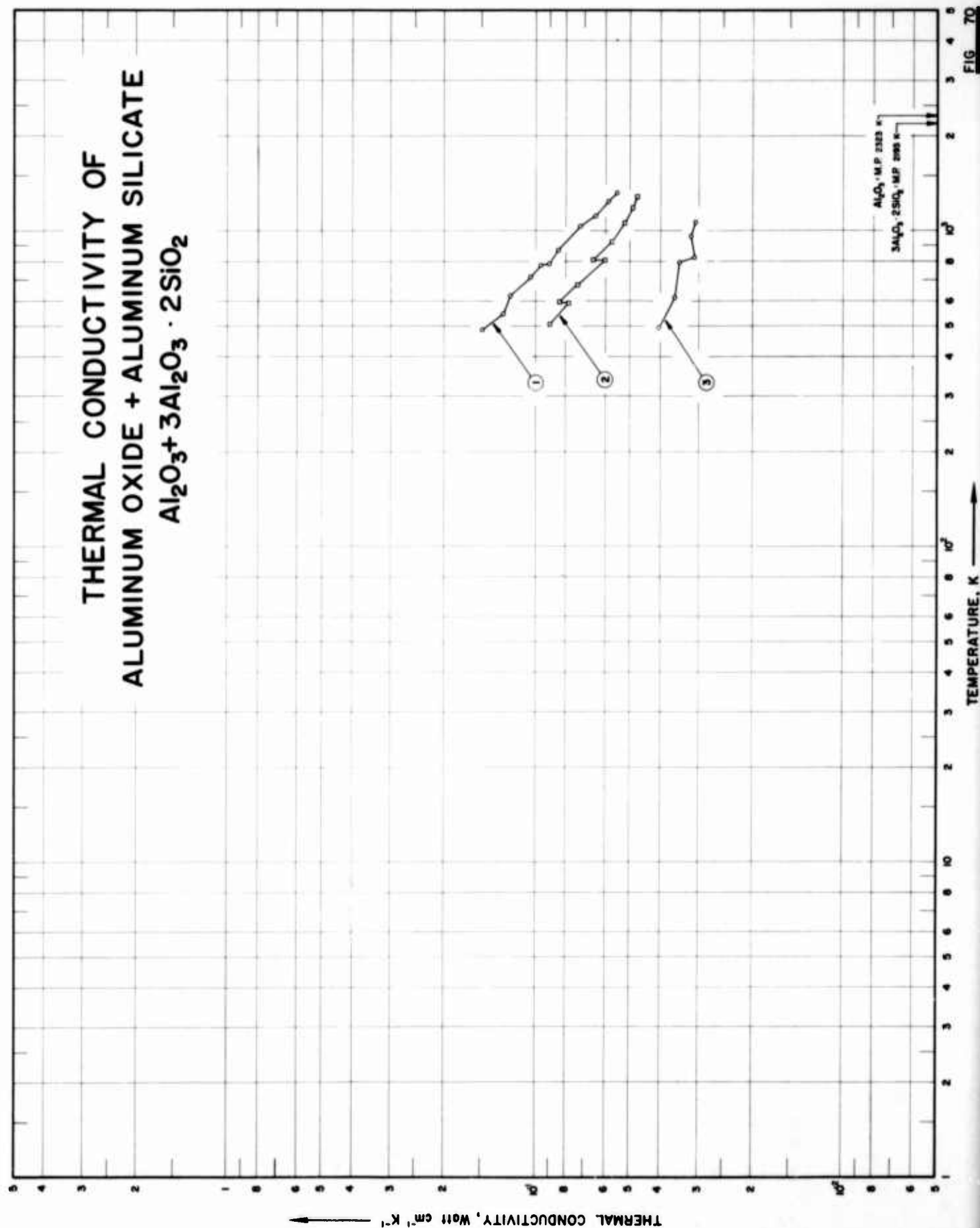


SPECIFICATION TABLE NO. 69 THERMAL CONDUCTIVITY OF ZIRCONIUM ORTHOSILICATE $ZrSiO_4$

[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 epithermal 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.

THERMAL CONDUCTIVITY OF
ALUMINUM OXIDE + ALUMINUM SILICATE
 $\text{Al}_2\text{O}_3 + 3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$



SPECIFICATION TABLE NO. 70 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + ALUMINUM SILICATE] $\text{Al}_2\text{O}_3 + 3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$

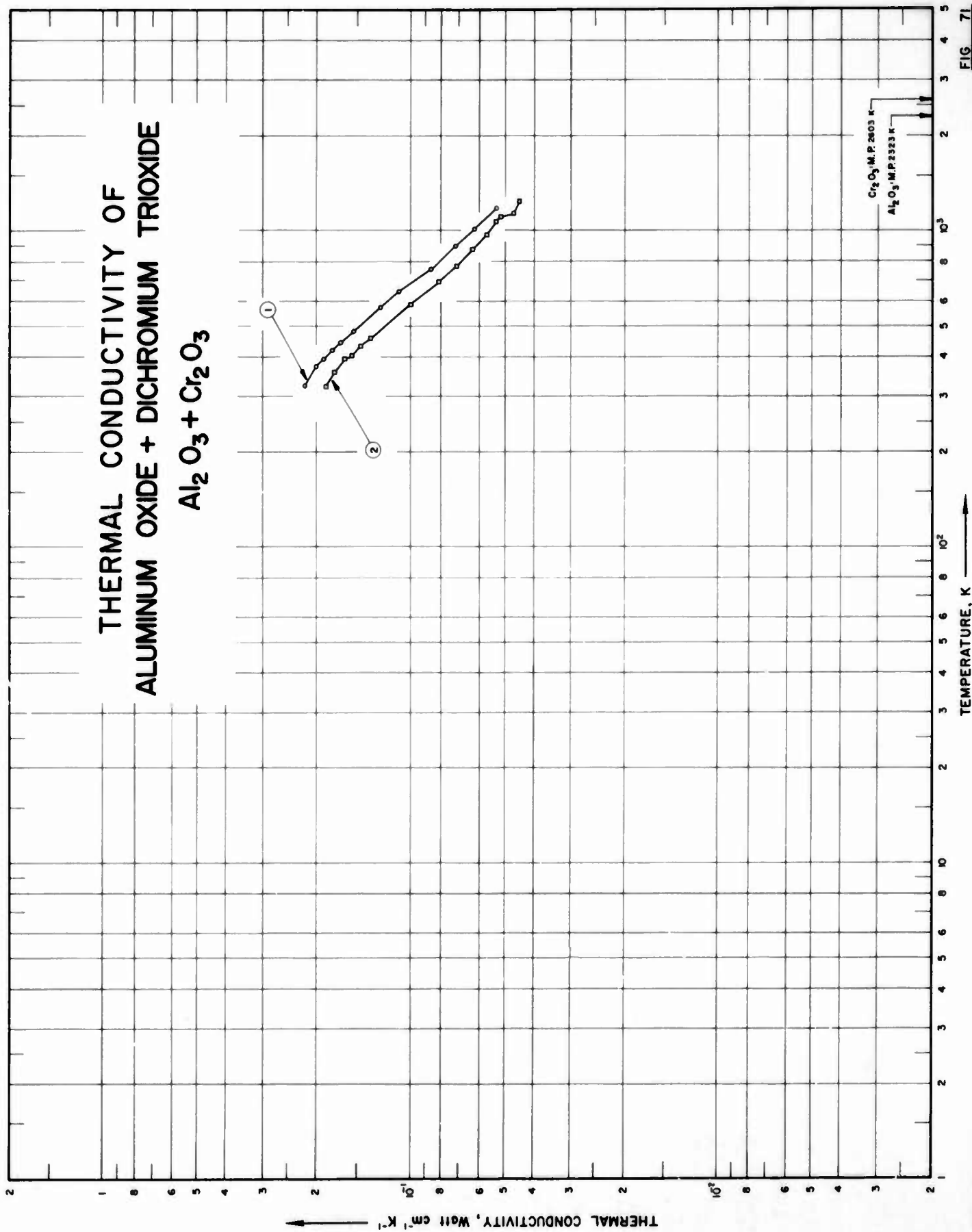
[For Data Reported in Figure and Table No. 70]

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 SILICATE] $\text{Al}_2\text{O}_3 + 3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1</u>	
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
<u>CURVE 2</u>	
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
<u>CURVE 3</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

THERMAL CONDUCTIVITY OF ALUMINUM OXIDE + DICHROMIUM TRIOXIDE $\text{Al}_2\text{O}_3 + \text{Cr}_2\text{O}_3$



SPECIFICATION TABLE NO. 71 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + DICHROMIUM TRIOXIDE] $\text{Al}_2\text{O}_3 + \text{Cr}_2\text{O}_3$

[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	CURVE 1	
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		
1193.2	0.0531		

T	k	CURVE 2	
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] $\text{Al}_2\text{O}_3 + \text{Mn}_2\text{O}_3$

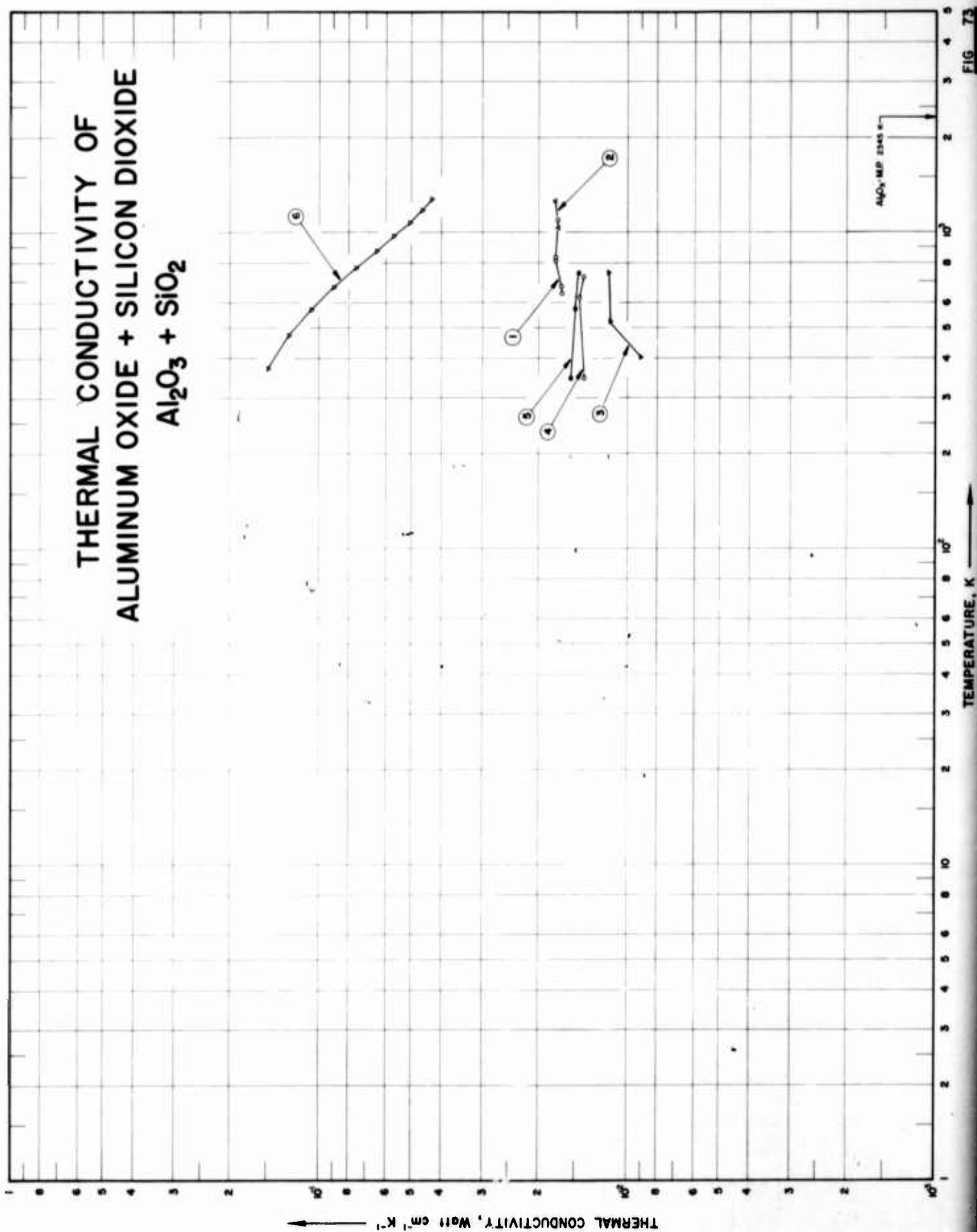
Curve No.	Ref. Method No.	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Al_2O_3	Composition (continued), Specifications and Remarks Mn_2O_3
1	23	1952	313-401		157A	72.1	Mn_2O_3 : 4 Al_2O_3 ; firing temperature 1811 K; water absorption 0.007%; density 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, Watt cm⁻¹K⁻¹]

T	k
CURVE 1*	
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 $\text{Al}_2\text{O}_3 + \text{SiO}_2$



SPECIFICATION TABLE NO. 73 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + SILICON DIOXIDE] $\text{Al}_2\text{O}_3 + \text{SiO}_2$

[For Data Reported in Figure and Table No. 73]

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Al_2O_3	SiO_2	Composition (continued), Specifications and Remarks
1	79,475 L	1942	640-1088		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 0.04%.
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 $\text{m}^3 - \text{cm per m}^2 - \text{hr} - \text{mm H}_2\text{O}$.
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 $\text{m}^3 - \text{cm per m}^2 - \text{hr} - \text{mm H}_2\text{O}$.
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 $\text{m}^3 - \text{cm per m}^2 - \text{mm H}_2\text{O}$.
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

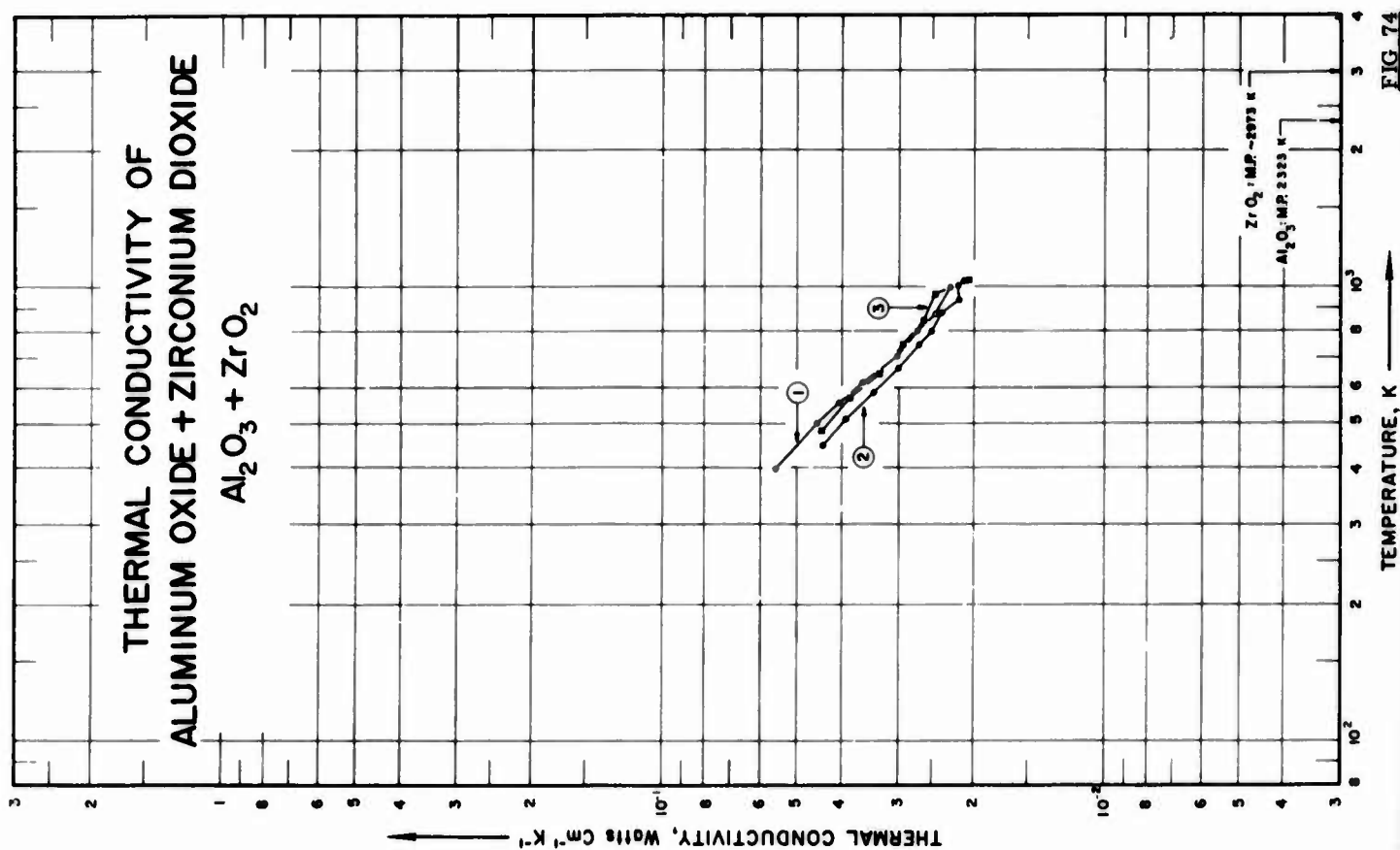


FIG 74

SPECIFICATION TABLE NO. 74 THERMAL CONDUCTIVITY OF [ALUMINUM OXIDE + ZIRCONIUM DIOXIDE] $\text{Al}_2\text{O}_3 + \text{ZrO}_2$

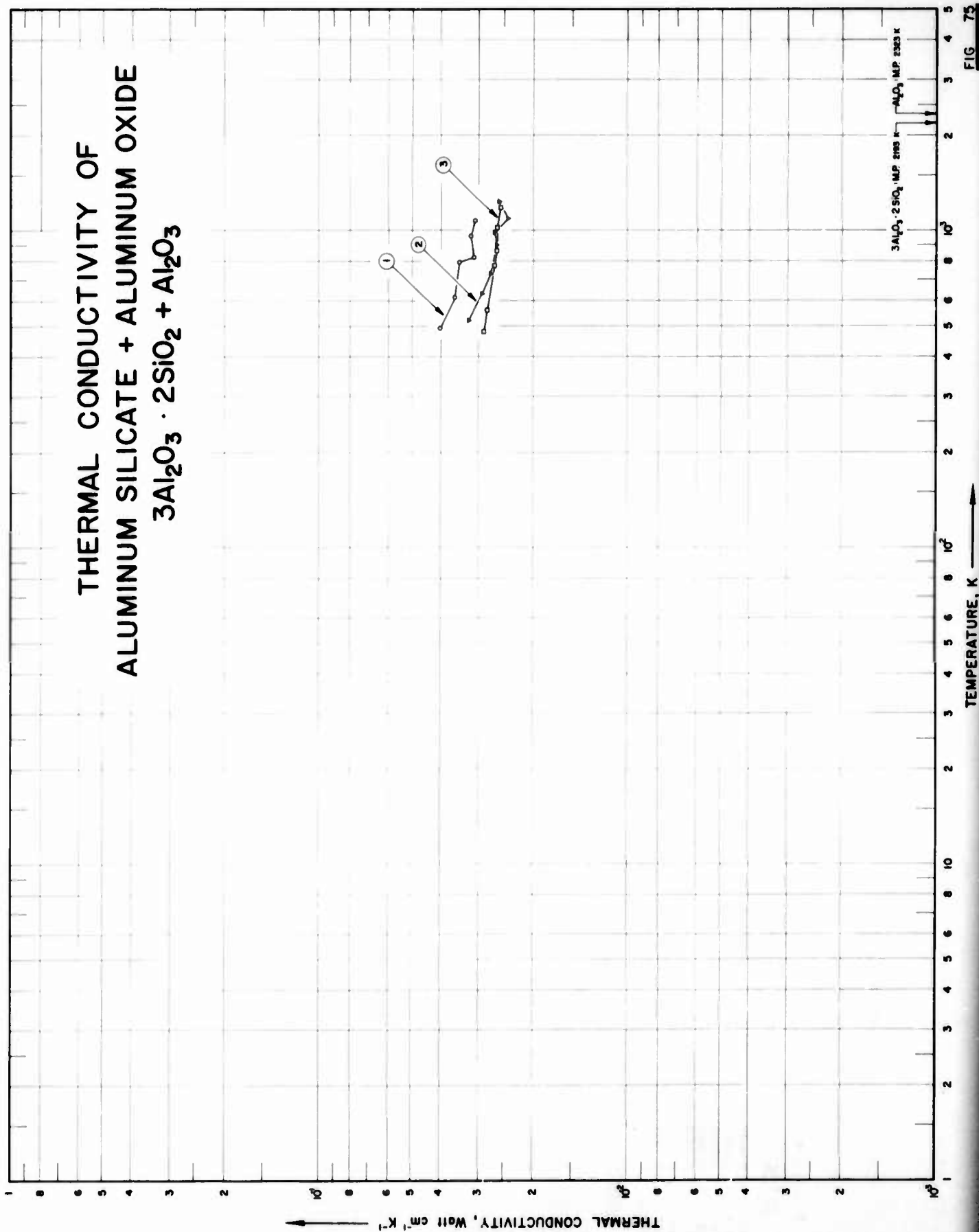
[For Data Reported in Figure and Table No. 74]

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
938.2	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] $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 + \text{Al}_2\text{O}_3$

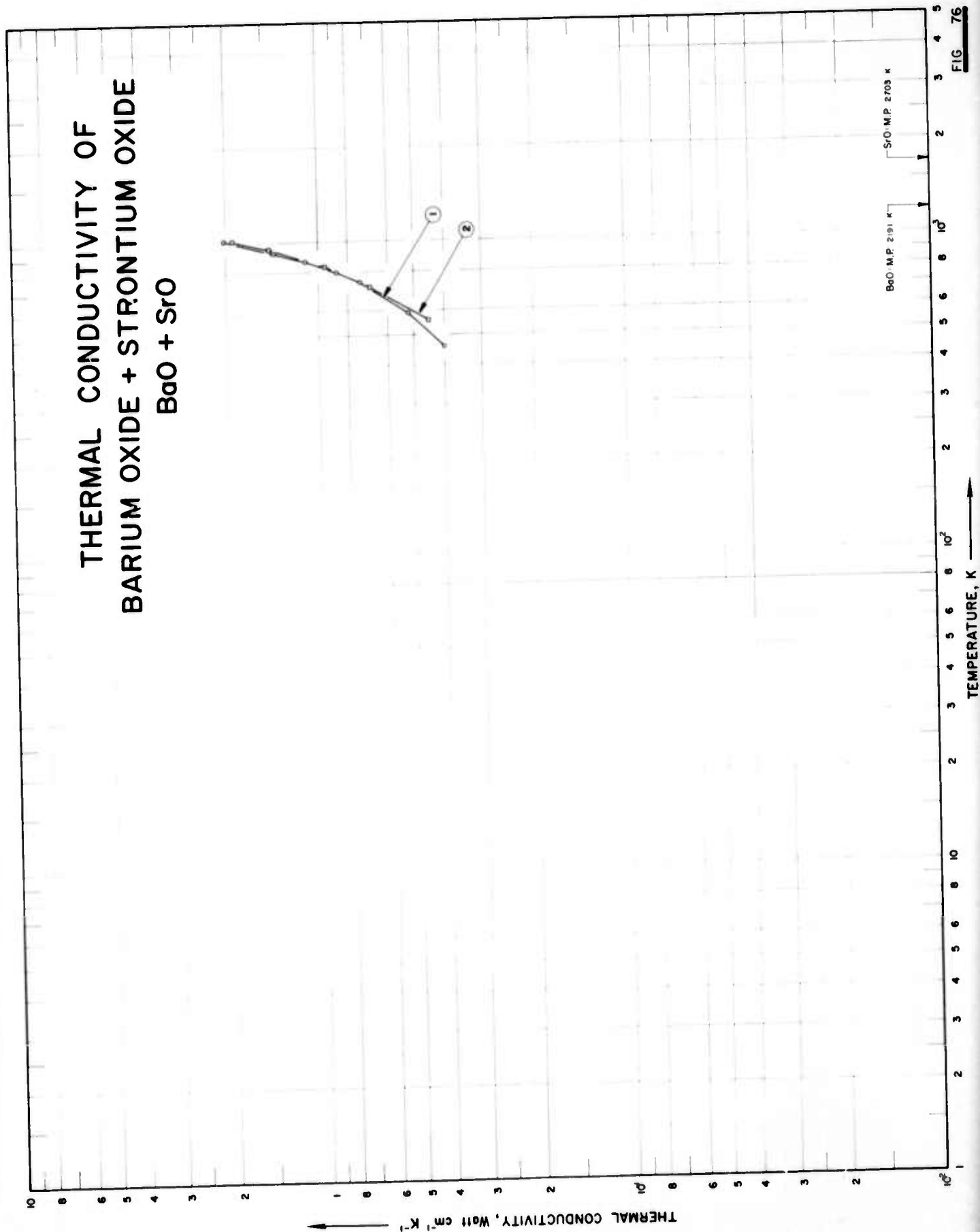
[For Data Reported in Figure and Table No. 75]

Curve No.	Ref. No.	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	136	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	136	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	136	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

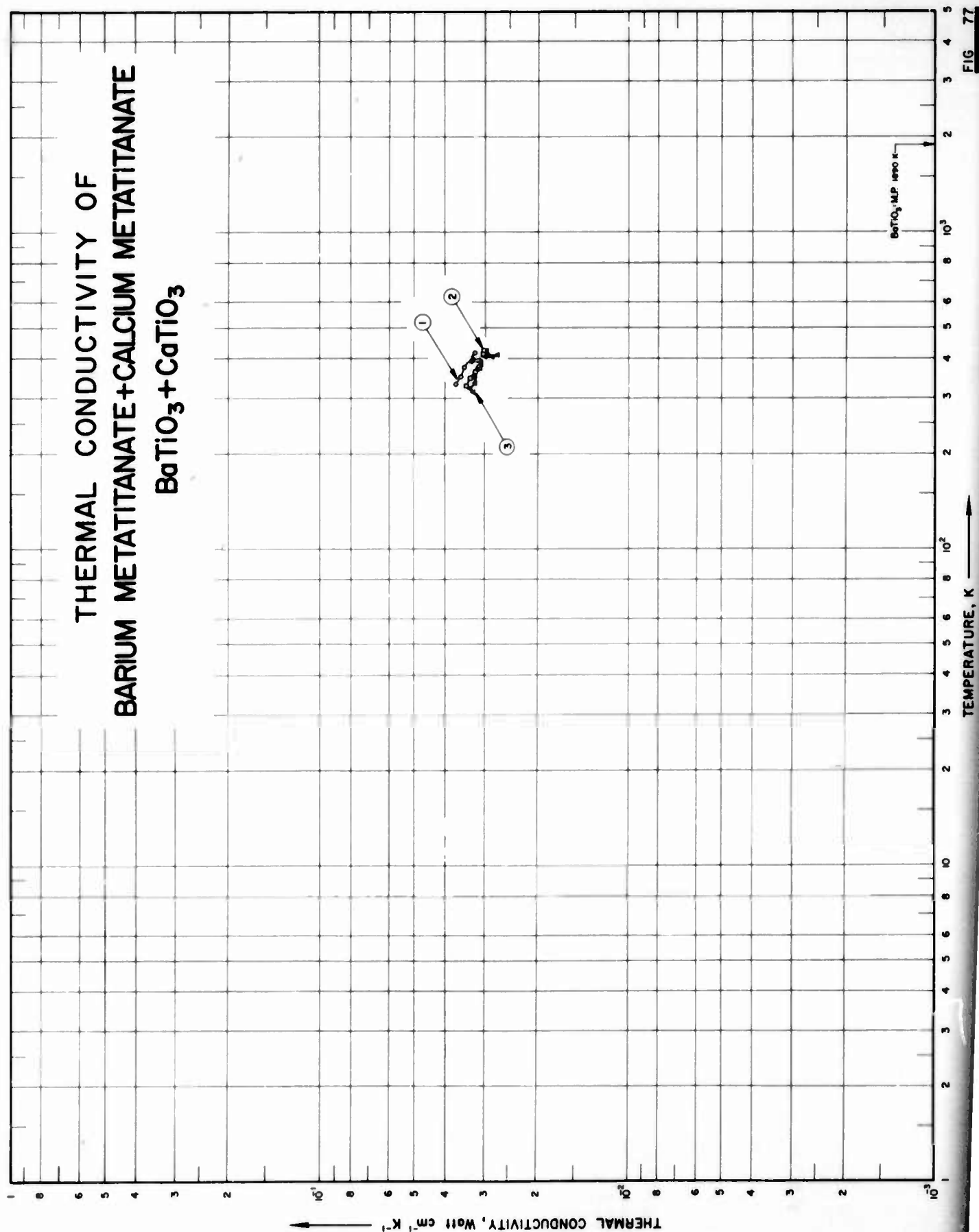
[For Data Reported in Figure and Table No. 76]

Curve No.	Ref. No.	Method Used	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

THERMAL CONDUCTIVITY OF
BARIUM METATITANATE+CALCIUM METATITANATE
 $\text{BaTiO}_3 + \text{CaTiO}_3$



TEMPERATURE, K →

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	$\text{Ca}_{0.039}\text{Ba}_{0.961}\text{TiO}_3$	93.98	6.02	Similar to the above specimen except density 5.6 g cm^{-3} .
3	289	C	1962	314-422	<10	$\text{Ca}_{0.113}\text{Ba}_{0.887}\text{TiO}_3$	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
CURVE 1	
333.2	0.037
350.7	0.036
375.7	0.035
416.2	0.0325
CURVE 2	
328.2	0.0345
347.7	0.0335
362.7	0.0325
413.2	0.0307
422.7	0.0305
CURVE 3	
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] $\text{BaTiO}_3 + \text{MgZrO}_3$

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] $\text{BaTiO}_3 + \text{MgZrO}_3$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
CURVE 1*	
330.6	0.0435
363.9	0.0456
388.1	0.0444
412.5	0.0439

* No graphical presentation

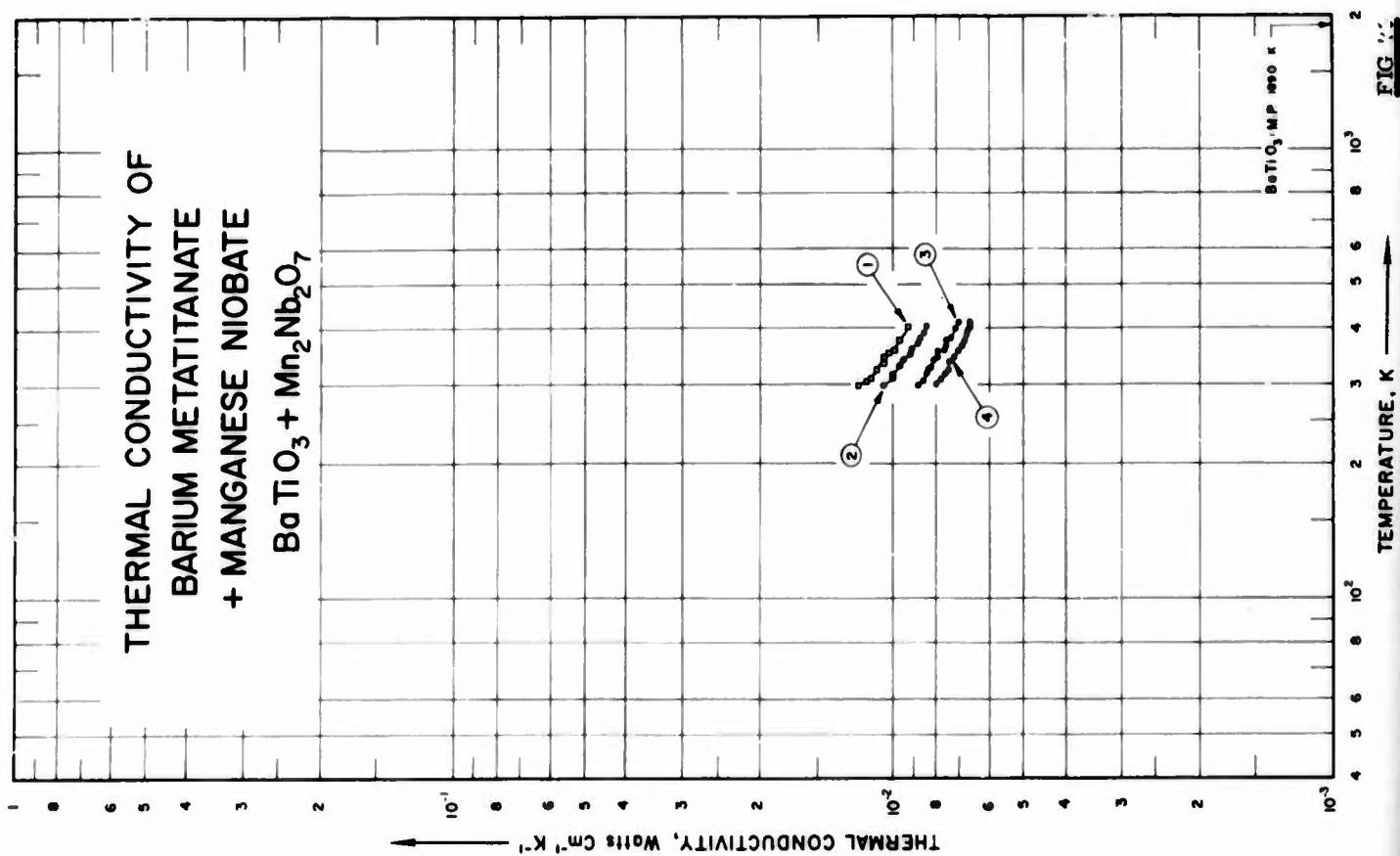


FIG. 12

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] $\text{BaTiO}_3 + \text{Mn}_2\text{Nb}_2\text{O}_7$
 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 4</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

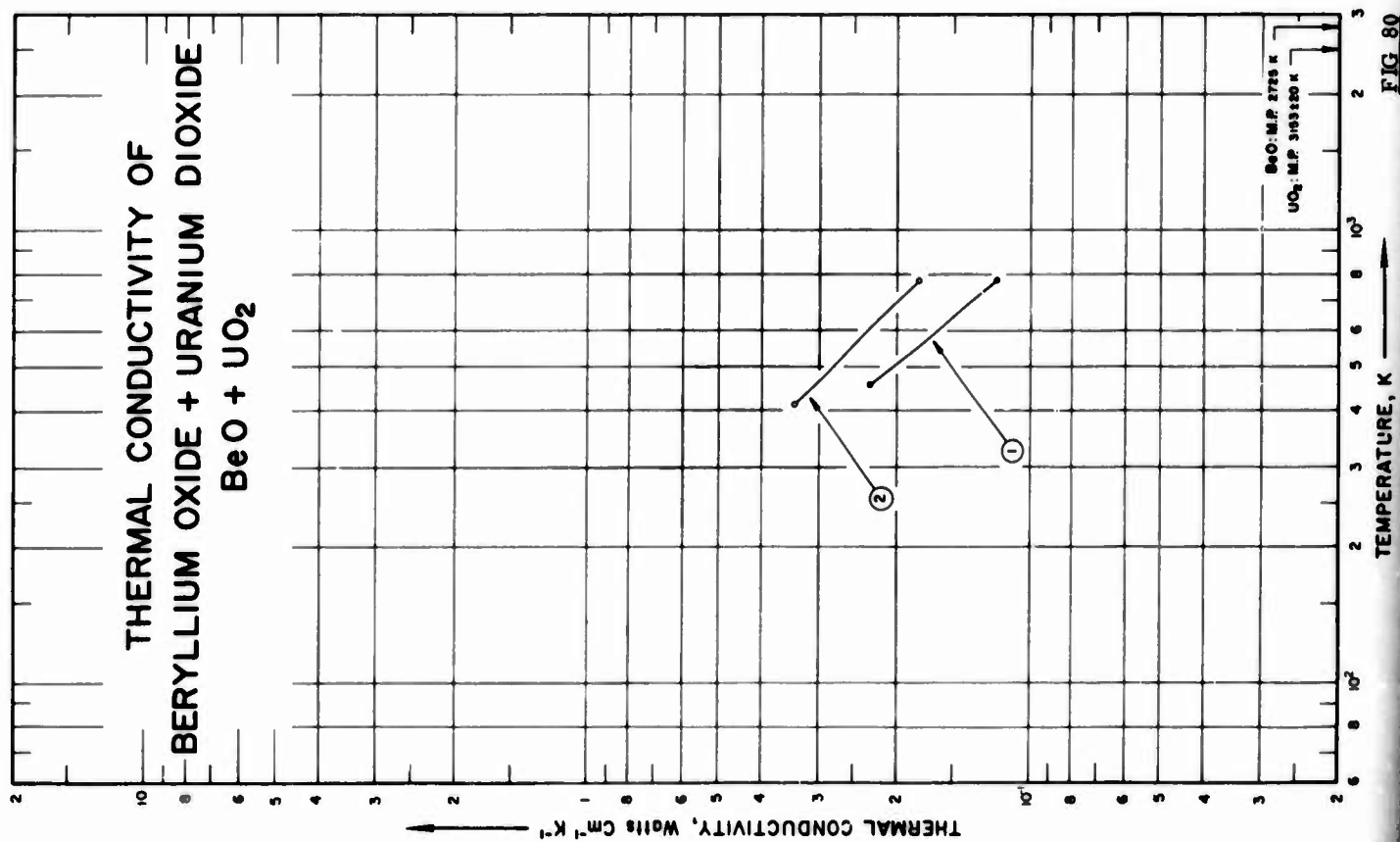


FIG 80

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
CERIUM DIOXIDE + MAGNESIUM OXIDE
 $\text{CeO}_2 + \text{MgO}$

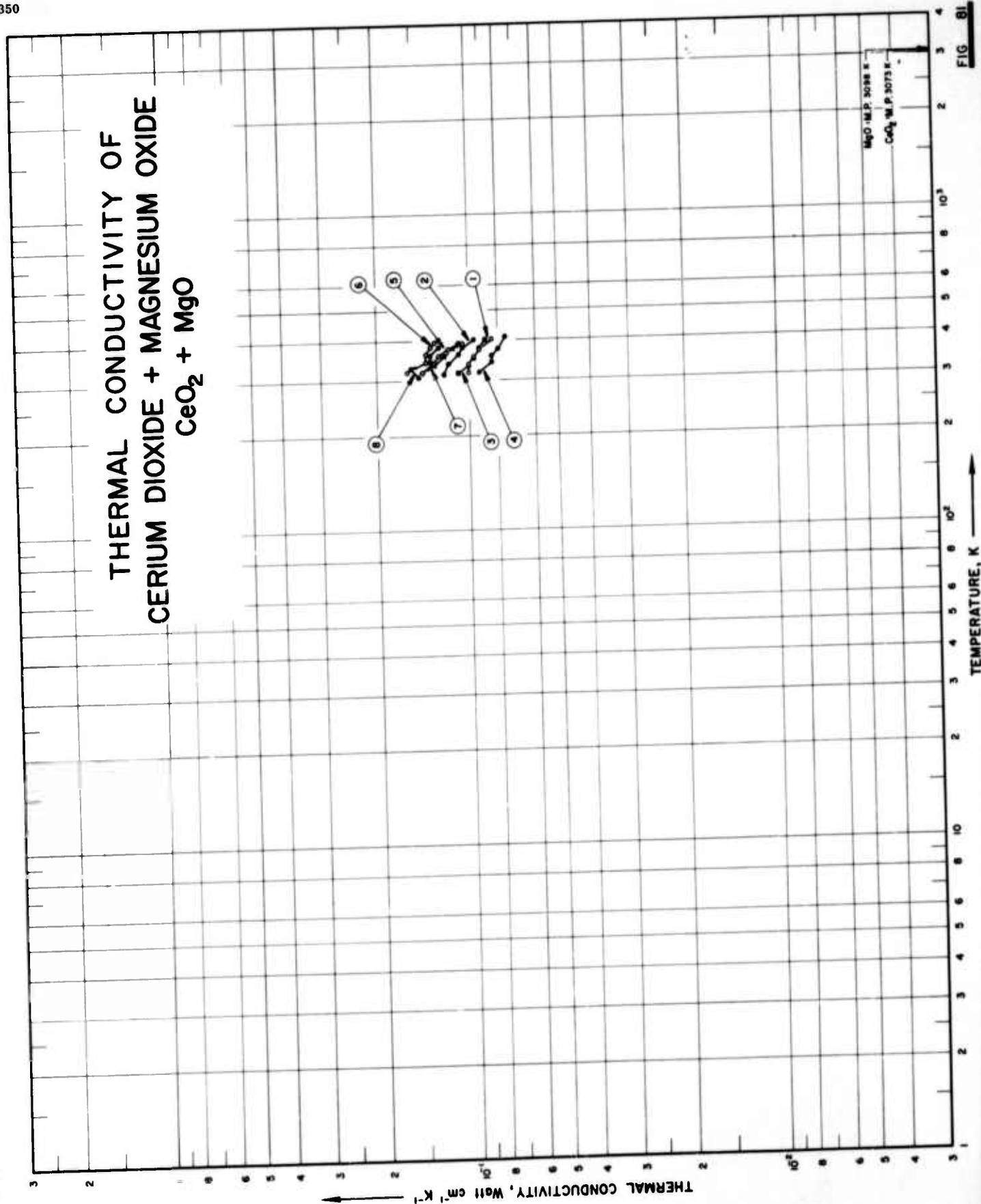


FIG. 81

SPECIFICATION TABLE NO. 81 THERMAL CONDUCTIVITY OF [CERUM DIOXIDE + MAGNESIUM OXIDE] $\text{CeO}_2 + \text{MgO}$

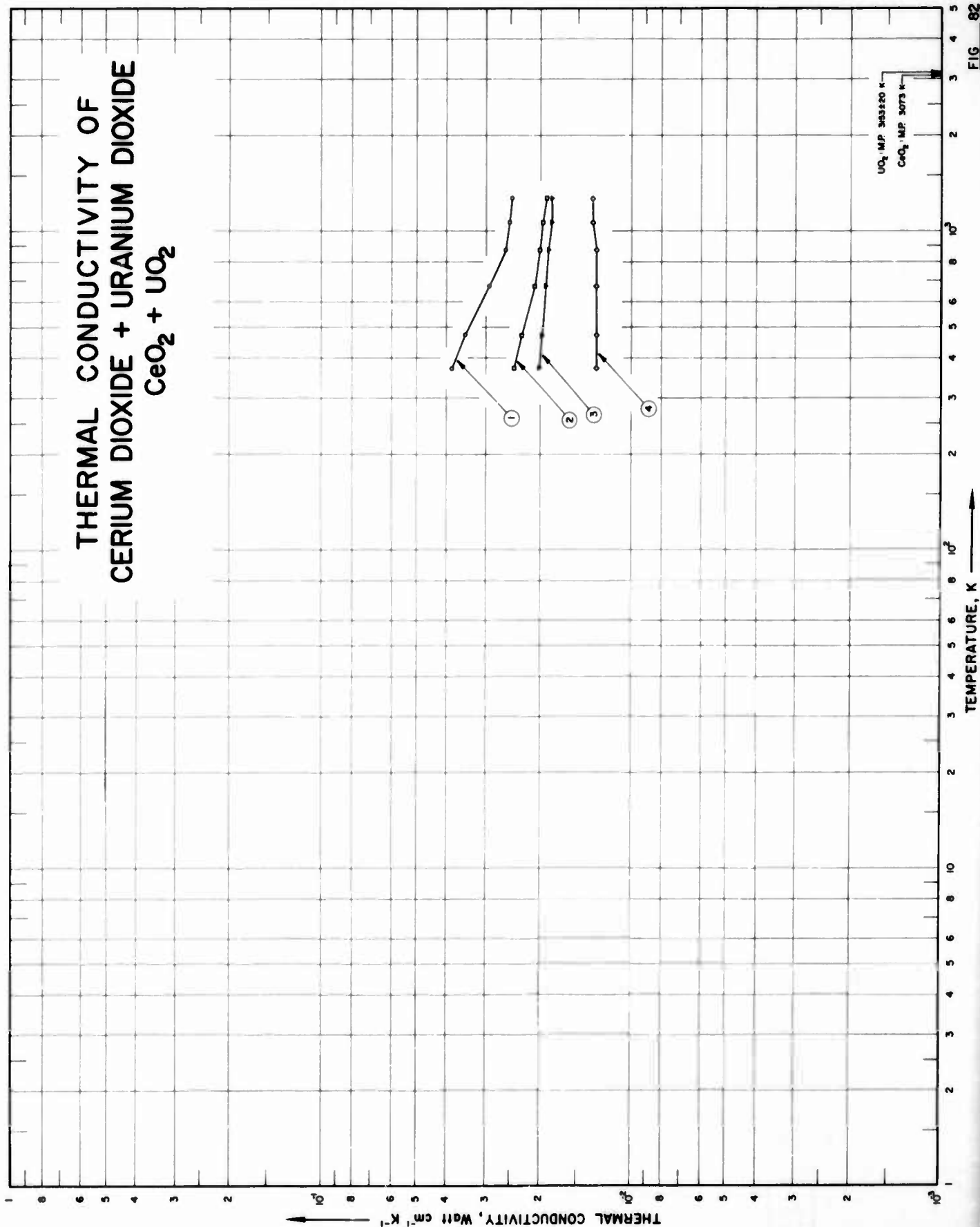
[For Data Reported in Figure and Table No. 81]

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] $\text{CeO}_2 + \text{MgO}$ [Temperature, T, K; Thermal Conductivity, k, Watts $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 7</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	380.7	0.113
403.5	0.0837	394.9	0.109
<u>CURVE 2</u>		<u>CURVE 8</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 $\text{CeO}_2 + \text{UO}_2$



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 (weight percent) 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 $\text{U}_2\text{O}_3 - \text{CeO}_2$, fired in hydrogen atmosphere to 1600°C for 1 hr, and machined to final size; not oxidized; densified 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 $\text{U}_2\text{O}_3 - \text{CeO}_2$, 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

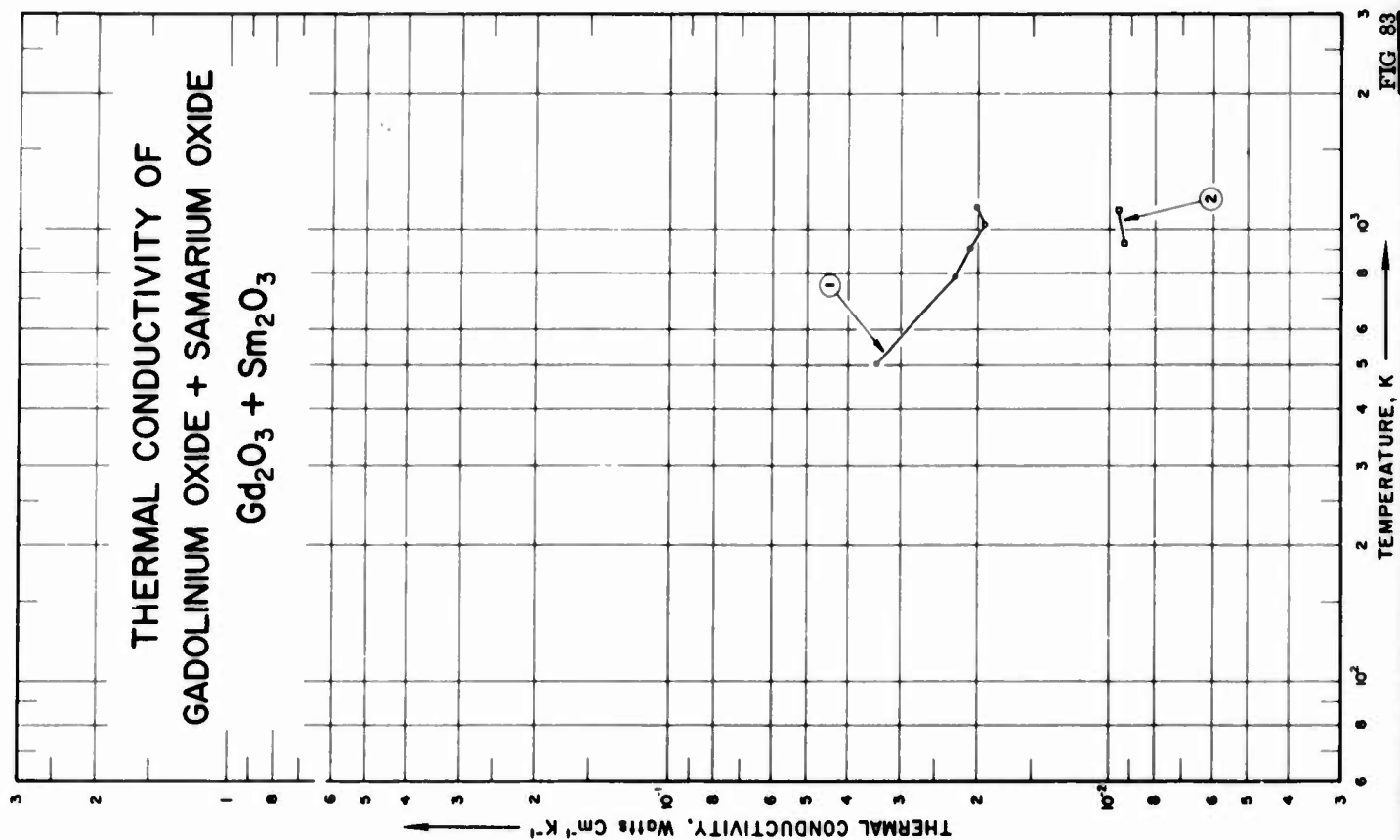


FIG 83

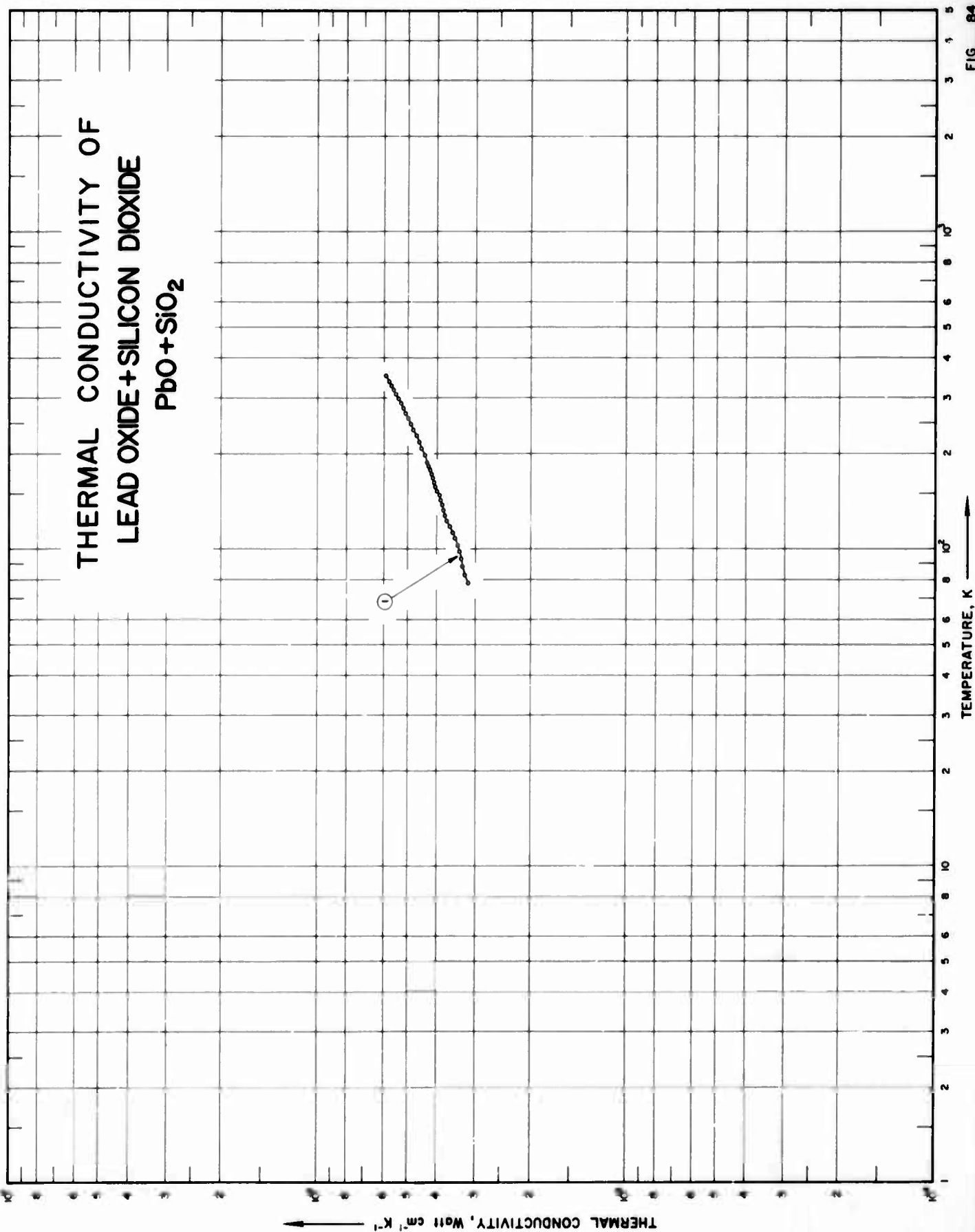
SPECIFICATION TABLE NO. 83 THERMAL CONDUCTIVITY OF [GADOLINIUM OXIDE + SAMARIUM OXIDE] $Gd_2O_3 + Sm_2O_3$

[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] $\text{Gd}_2\text{O}_3 + \text{Sm}_2\text{O}_3$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

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



SPECIFICATION TABLE NO. 84 THERMAL CONDUCTIVITY OF [LEAD OXIDE + SILICON DIOXIDE] $PbO + SiO_2$

[For Data Reported in Figure a.d Table No. 84]

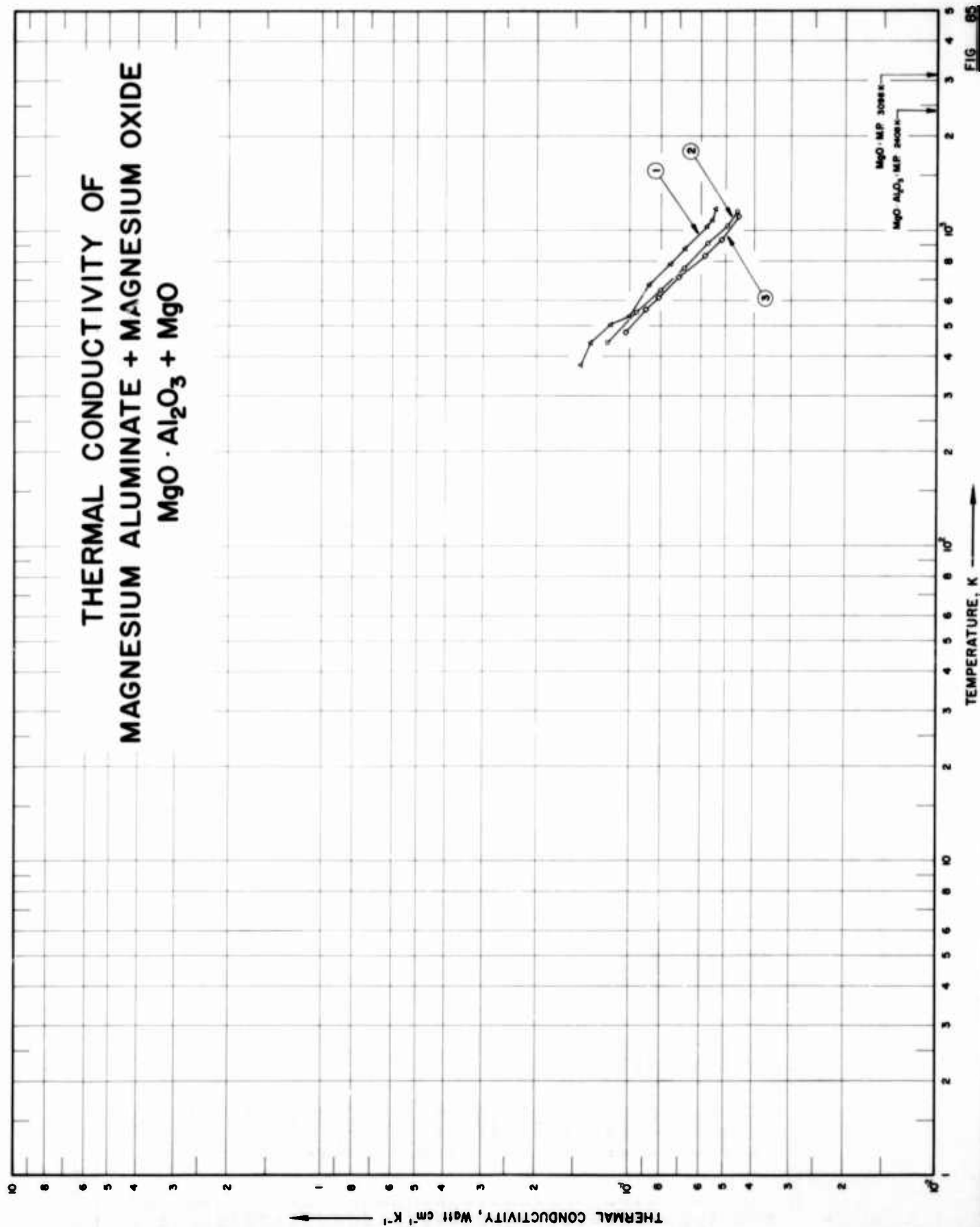
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) PbO	SiO_2	Composition (continued), Specifications and Remarks
1	147	L	1960	78-353		L	80.0	20.0	Specimen 3 in. in dia and 0.375 in. thick; density 6.10 $g\ cm^{-3}$.

DATA TABLE NO. 84 THERMAL CONDUCTIVITY OF [LEAD OXIDE + SILICON DIOXIDE] $\text{PbO} + \text{SiO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	CURVE 1	
		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
 $\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{MgO}$



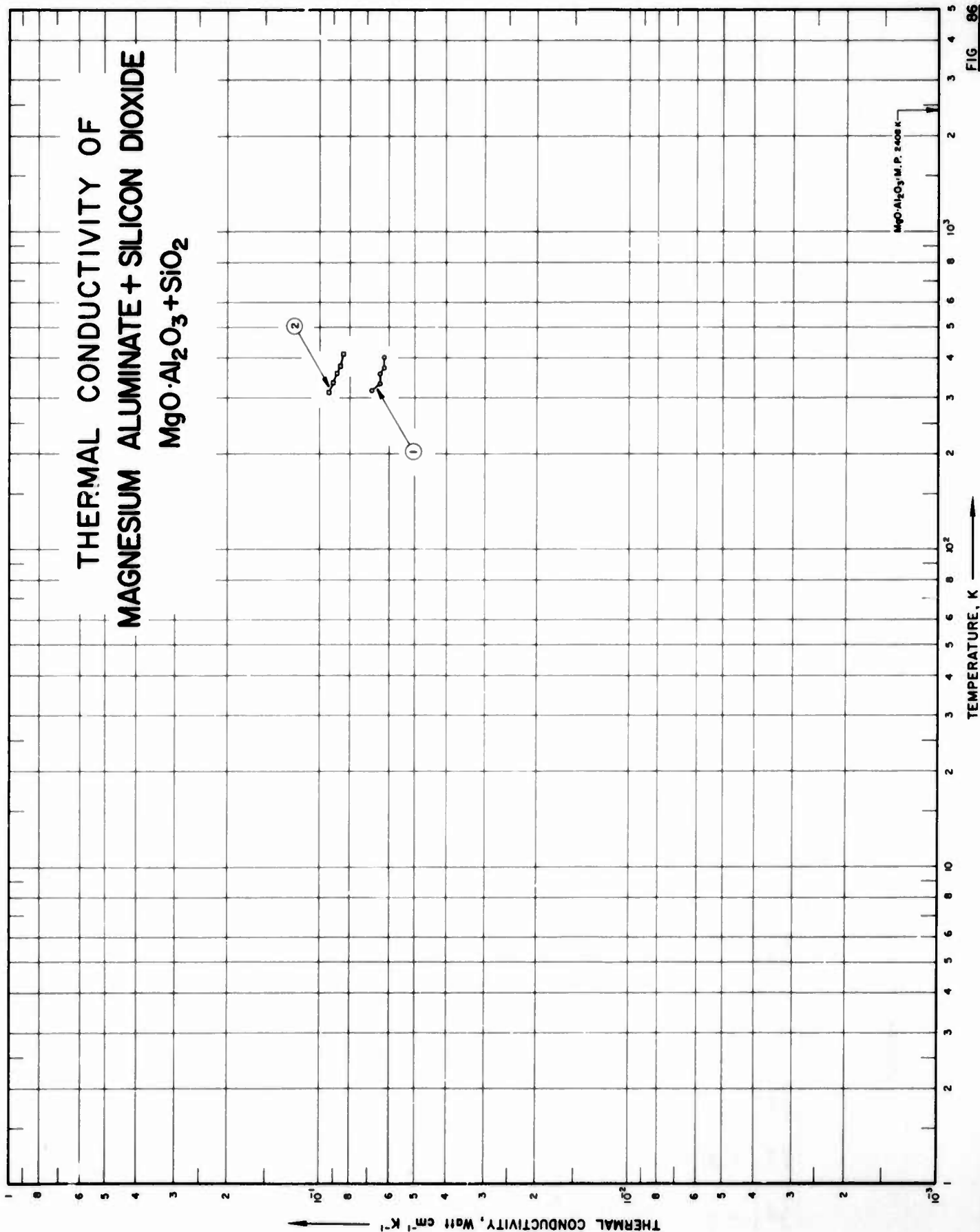
SPECIFICATION TABLE NO. 85 THERMAL CONDUCTIVITY OF [MAGNESIUM ALUMINATE + MAGNESIUM OXIDE] $\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{MgO}$

[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 · Al ₂ O 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	0.123
503.2	0.116
537.2	0.100
673.2	0.0872
787.2	0.0749
890.2	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



SPECIFICATION TABLE NO. 86 THERMAL CONDUCTIVITY OF [MAGNESIUM ALUMINATE + SILICON DIOXIDE] $\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{SiO}_2$

[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
CURVE 1	
317.0	0.0682
333.9	0.0644
356.1	0.0644
373.6	0.0628
400.8	0.0628
CURVE 2	
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
 $\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{Na}_2\text{O}$

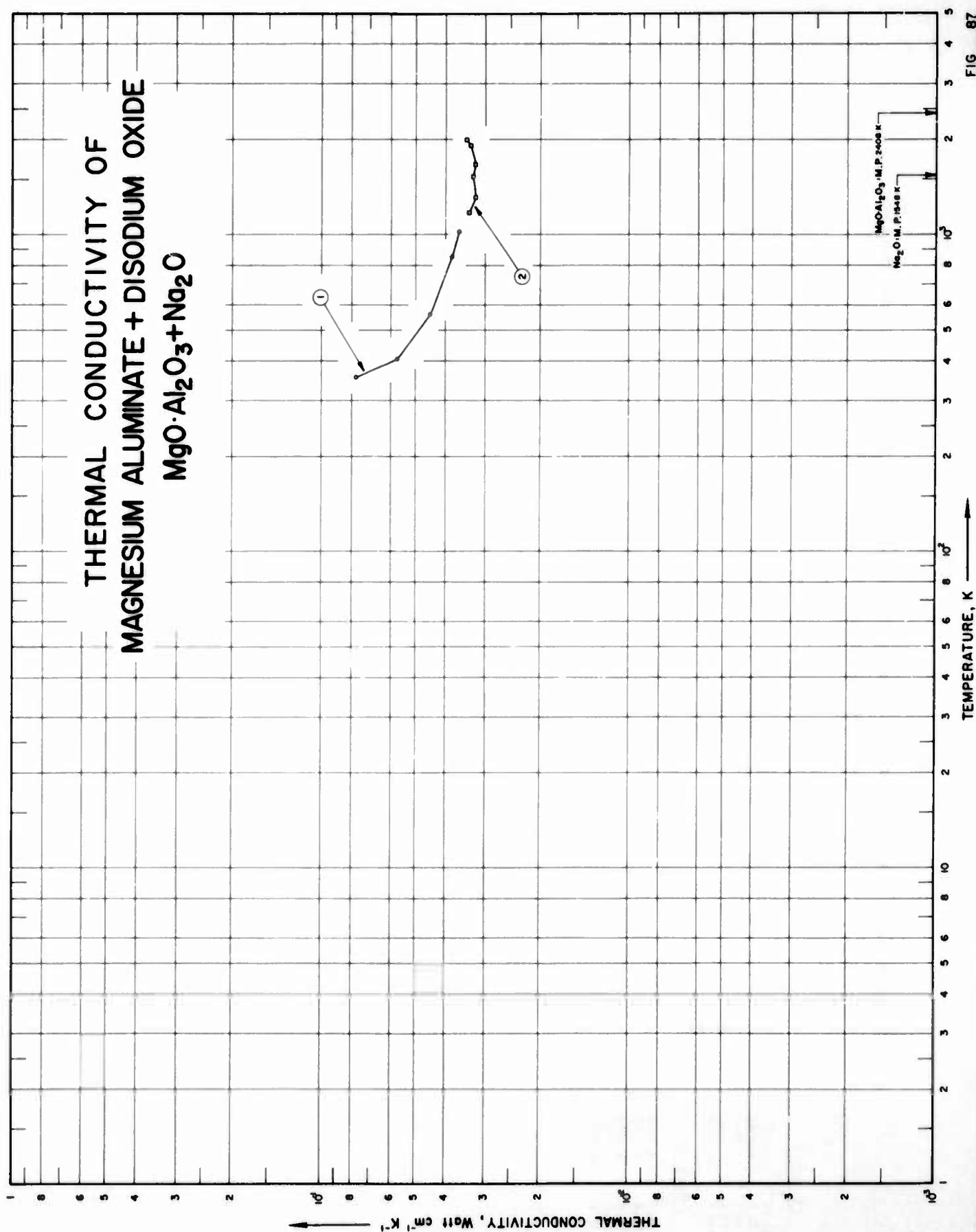


FIG. 87

SPECIFICATION TABLE NO. 87 THERMAL CONDUCTIVITY OF [MAGNESIUM ALUMINATE + DISODIUM OXIDE] $\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{Na}_2\text{O}$

[For Data Reported in Figure and Table No. 87]

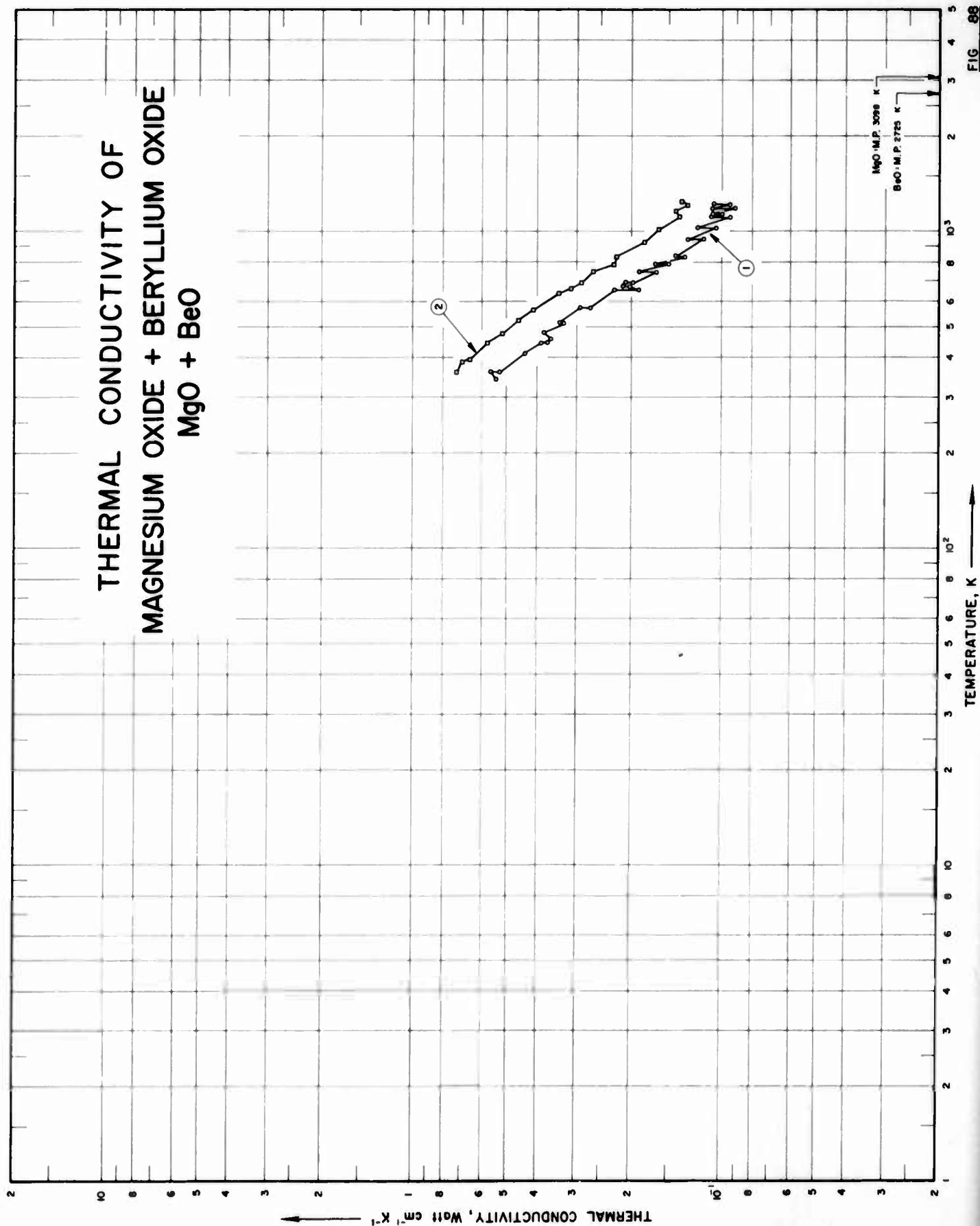
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	251	C	1963	355-1022	± 4.0	Spinel	68.26 Al_2O_3 , 26.74 MgO , 3.17 Na_2O , 0.33 SiO_2 , 0.026 Fe_2O_3 , and 1.20 B; specimen 2 in. in dia and 1 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] $\text{MgO} \cdot \text{Al}_2\text{O}_3 + \text{Na}_2\text{O}$ [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

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.

SPECIFICATION TABLE NO. 89 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + CLAY] MgO + Clay

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	Composition (weight percent) Clay	Composition (continued), Specifications and Remarks
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⁻¹ K⁻¹]

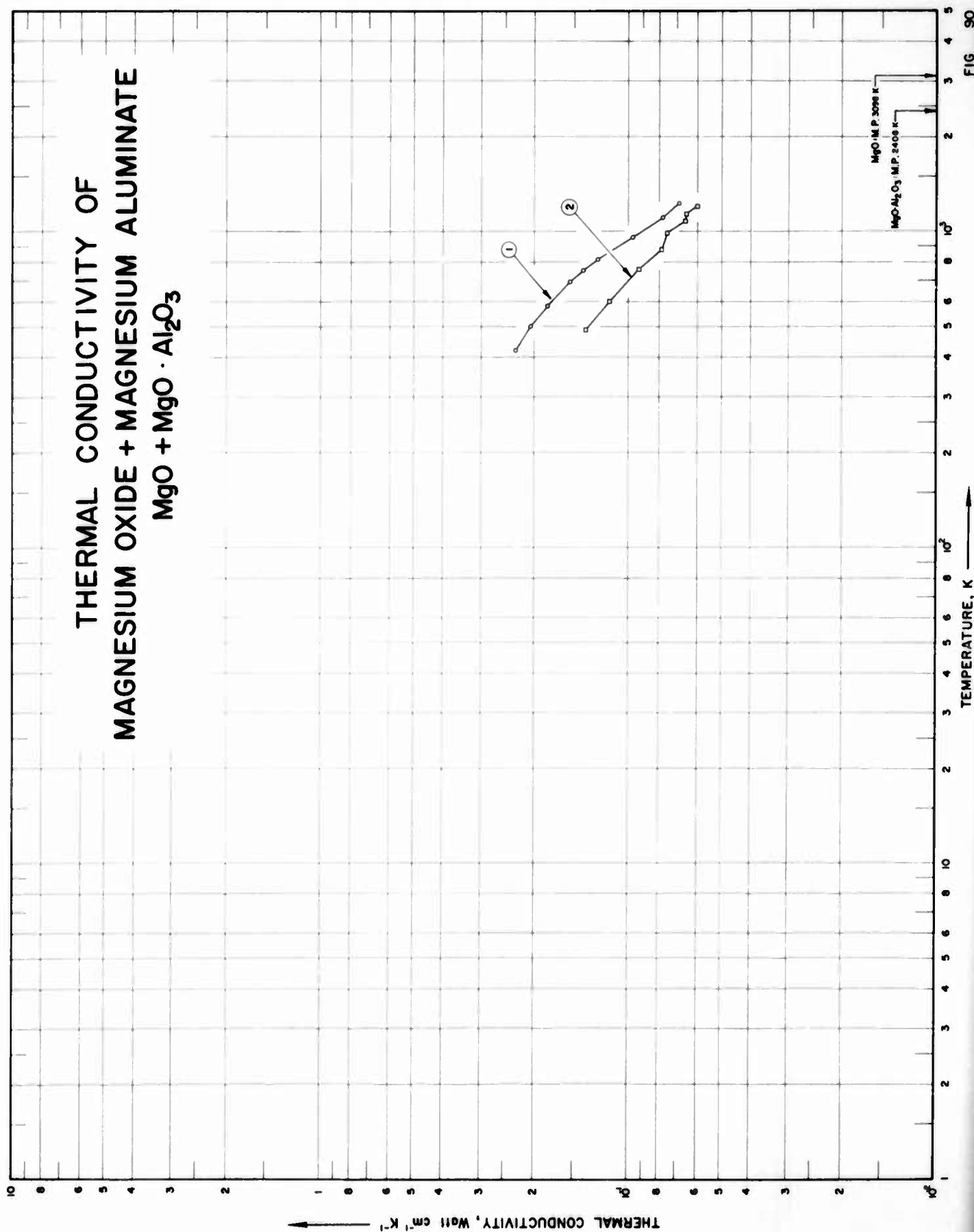
T k

CURVE 1*

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
 $\text{MgO} + \text{MgO} \cdot \text{Al}_2\text{O}_3$



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]

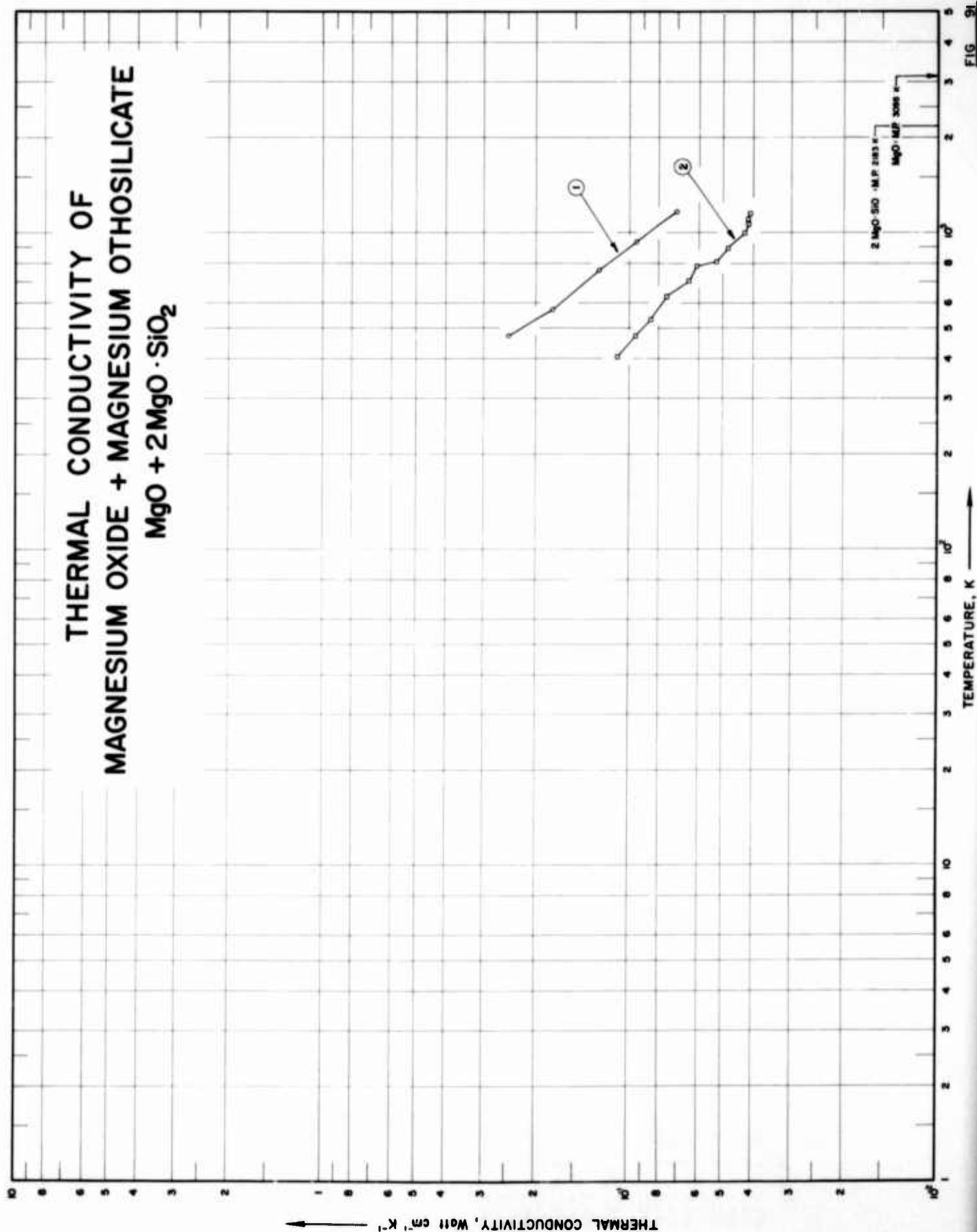
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO · Al ₂ O ₃		Composition (continued), Specifications and Remarks
1	136	C	1959	423-1239	±4		84.2	15.8	Corresponding to 14.4 vol % magnesium aluminate; fired at 1800 C; bulk density 3.25 g cm ⁻³ ; porosity 10.7 vol %; data corrected for porosity; calculated composition.
2	136	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] $\text{MgO} + \text{MgO} \cdot \text{Al}_2\text{O}_3$

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

T	k
<u>CURVE 1</u>	
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
 $\text{MgO} + 2\text{MgO} \cdot \text{SiO}_2$



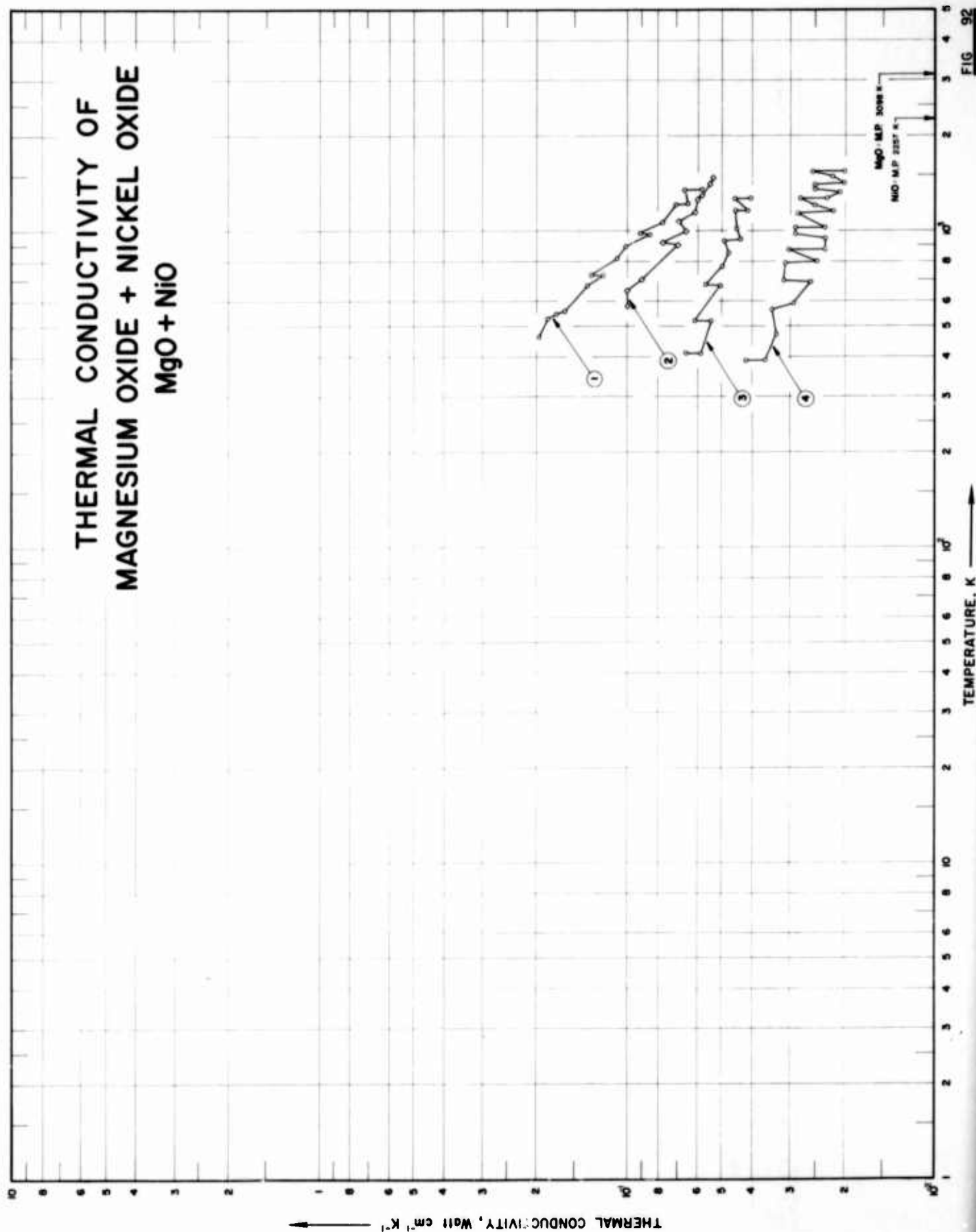
SPECIFICATION TABLE NO. 91 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + MAGNESIUM ORTHOSILICATE] $\text{MgO} + 2\text{MgO} \cdot \text{SiO}_2$

[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	0.0527
895.2	0.0491
988.2	0.0427
1070.2	0.0416
1111.2	0.0418
1153.2	0.0410



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>		<u>CURVE 3 (cont.)</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		
730.2	0.132	<u>CURVE 4</u>	
823.2	0.108	389.2	0.0418
895.2	0.102	391.2	0.0364
978.2	0.0845	472.2	0.0335
989.2	0.0908	565.2	0.0347
1073.2	0.0774	591.2	0.0293
1213.2	0.0699	690.2	0.0259
1215.2	0.0644	697.2	0.0318
1356.2	0.0657	792.2	0.0314
1361.2	0.0582	807.2	0.0247
		875.2	0.0305
<u>CURVE 2</u>		878.2	0.0234
579.2	0.0996	948.2	0.0234
648.2	0.101	973.2	0.0289
704.2	0.0895	1035.2	0.0289
903.2	0.0689	1038.2	0.0234
920.2	0.0774	1149.2	0.0285
1013.2	0.0657	1153.2	0.0222
1078.2	0.0690	1218.2	0.0251
1152.2	0.0615	1278.2	0.0276
1268.2	0.0602	1278.2	0.0230
1300.2	0.0586	1332.2	0.0209
1421.2	0.0544	1362.2	0.0251
1468.2	0.0536	1417.2	0.0251
		1426.2	0.0201
<u>CURVE 3</u>		1492.2	0.0222
413.2	0.0657	1546.2	0.0255
413.2	0.0586	1548.2	0.0201
521.2	0.0544		
523.2	0.0615		
676.2	0.0502		
676.2	0.0565		
773.2	0.0498		
858.2	0.0477		
933.2	0.0490		
943.2	0.0435		

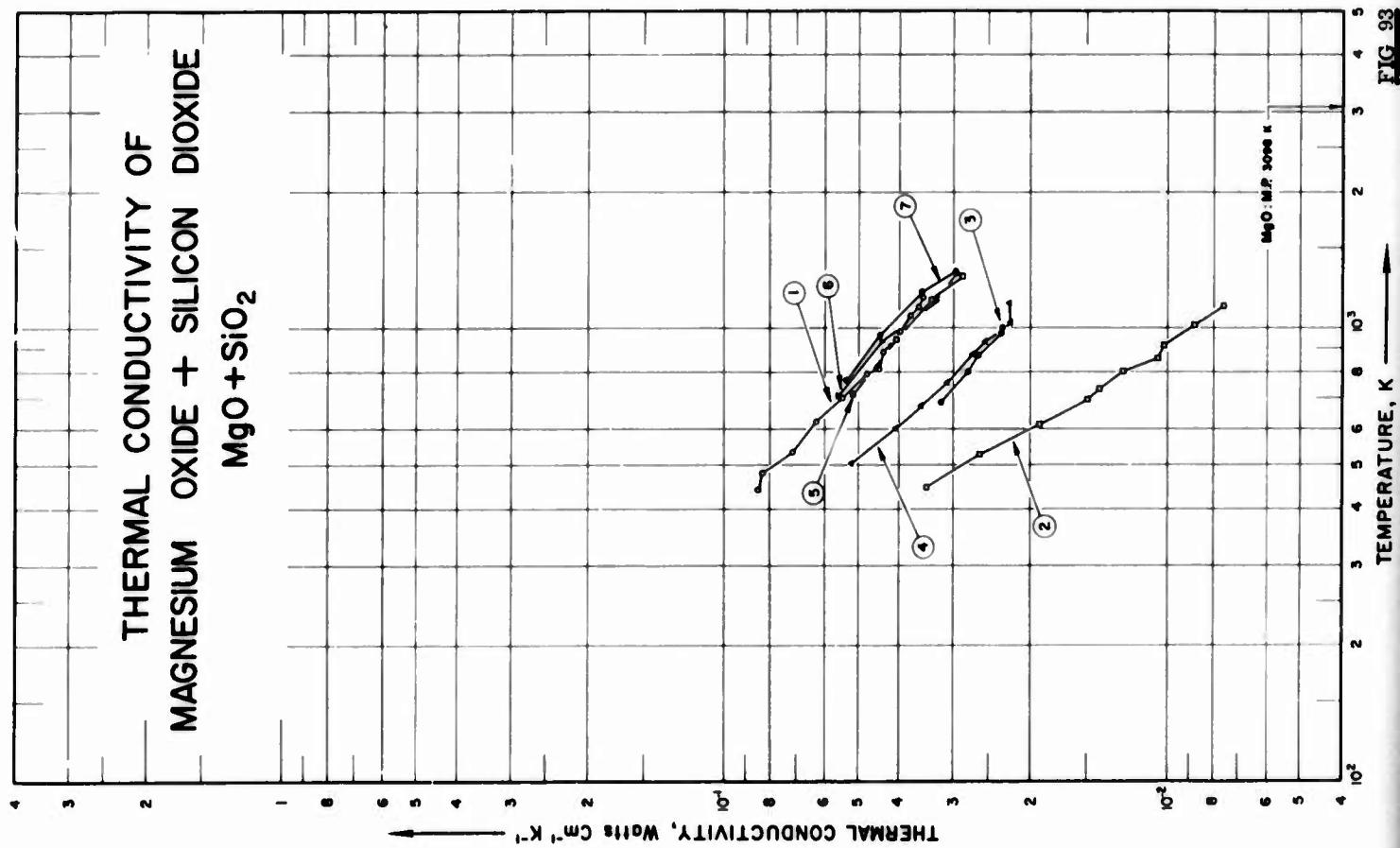


FIG 93

SPECIFICATION TABLE NO. 93 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + SILICON DIOXIDE] $\text{MgO} + \text{SiO}_2$

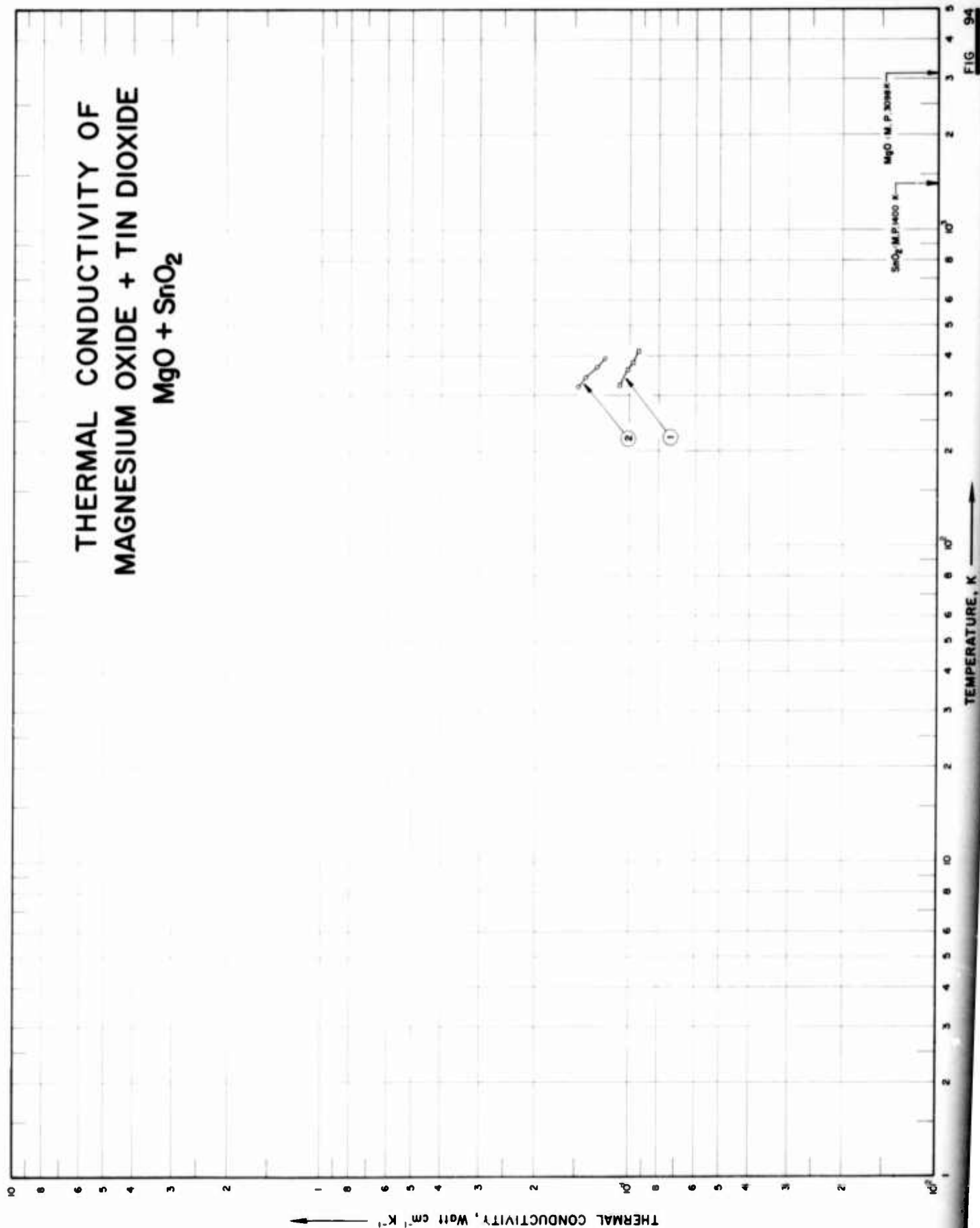
[For Data Reported in Figure and Table No. 93]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							MgO	SiO_2	
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_2O_3 , 1.63 Fe_2O_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 $\text{ml m}^{-2} \text{hr}^{-1}$ per mm H_2O .
									Similar to the above specimen.
6	143	L	1955	713-1303		Magnezit; 2			
7	143	L	1955	773-1348		Magnezit; 3			Similar to the above specimen.

DATA TABLE NO. 93 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + SILICON DIOXIDE] $\text{MgO} + \text{SiO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watts $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 5</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		
793.2	0.0478	<u>CURVE 6</u>	
812.6	0.0447	713.2	0.0558
883.2	0.0435	943.2	0.0437
982.2	0.0397	1163.2	0.0330
1069.2	0.0376	1303.2	0.0293
1115.5	0.0360		
1170.2	0.0351	<u>CURVE 7</u>	
<u>CURVE 2</u>		773.2	0.0535
447.2	0.0346	973.2	0.0442
528.4	0.0262	1203.2	0.0354
617.2	0.0192	1348.2	0.0294
697.2	0.0149		
735.5	0.0140		
800.7	0.0125		
858.2	0.0105		
918.2	0.0102		
1012.2	0.00879		
1125.2	0.00757		
<u>CURVE 3</u>			
688.2	0.0318		
801.2	0.0277		
871.2	0.0262		
974.2	0.0233		
1001.7	0.0232		
<u>CURVE 4</u>			
503.2	0.0520		
601.2	0.0404		
676.2	0.0356		
759.2	0.0309		
878.2	0.0270		
934.2	0.0254		
1027.2	0.0202		
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 3.94 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

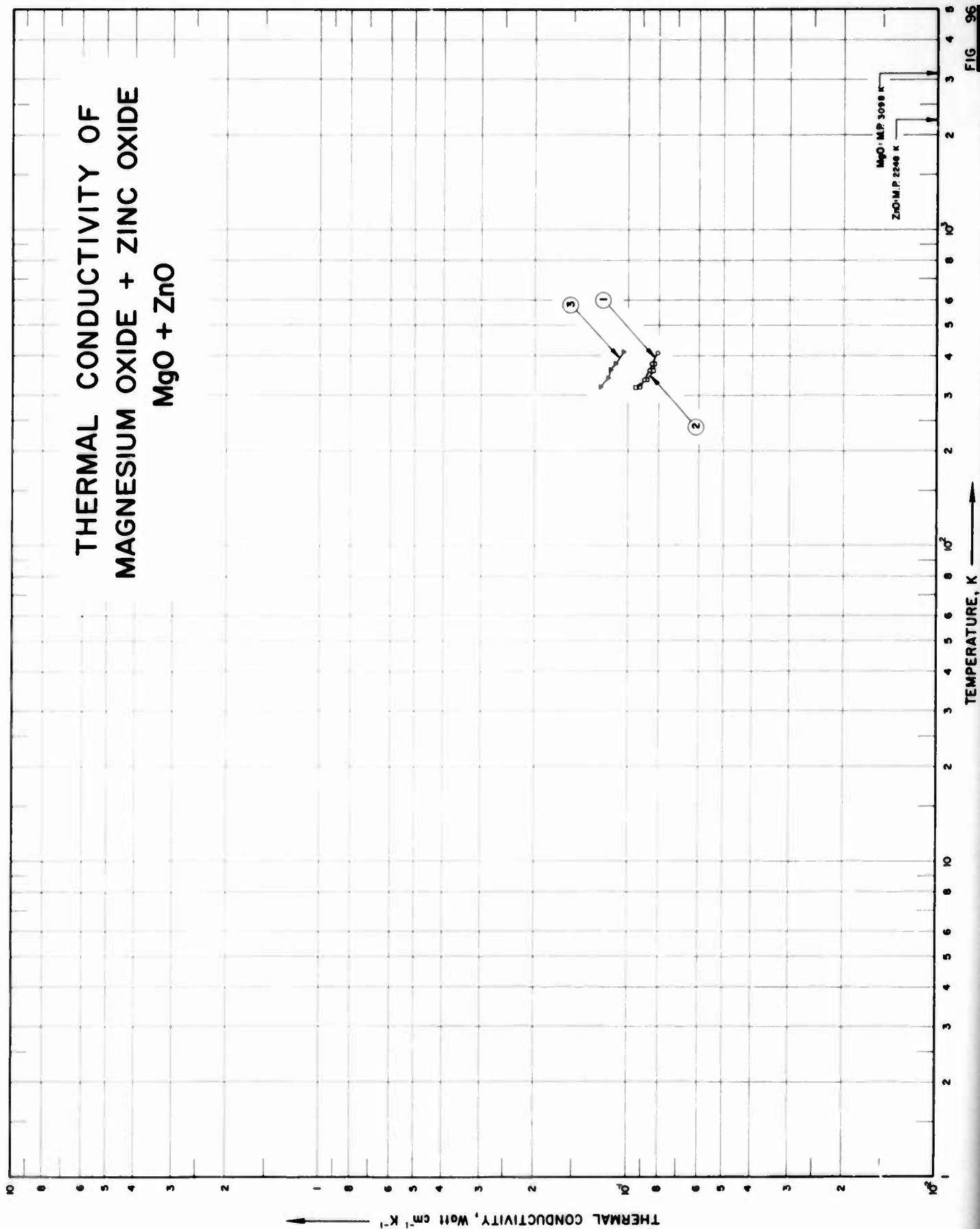
Curve No.	R. Method No.	Year Used	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	Composition (weight percent) UO ₂	Composition (continued), Specifications and Remarks
1	76	L	1952	383-793		53	47	87% theoretical density.

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
CURVE 1 *	
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]

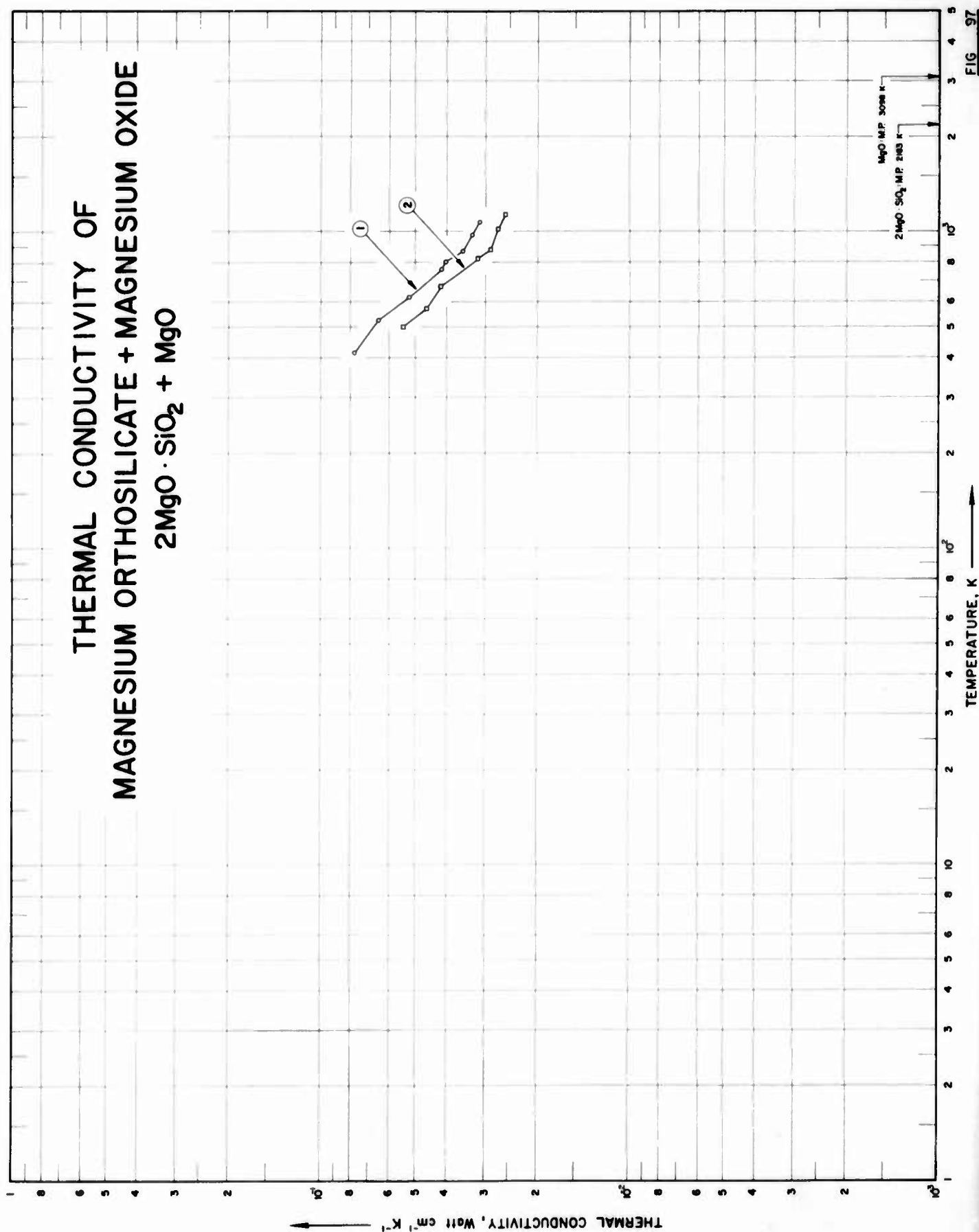
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							MgO	ZnO	
1	12		1953	319-410		264A-1	53.6	46.4	7 MgO + 3 ZnO by mole; prepared from pure oxides, milled in water, 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
 $2\text{MgO} \cdot \text{SiO}_2 + \text{MgO}$



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) $2\text{MgO} \cdot \text{SiO}_2$	Composition (weight percent) 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] $\text{Mn}_2\text{O}_3 + \text{Al}_2\text{O}_3$

Curve No.	Ref. Method No. 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	$3\text{Mn}_2\text{O}_3$; $2\text{Al}_2\text{O}_3$; 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] $\text{Mn}_2\text{O}_3 + \text{Al}_2\text{O}_3$ [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

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] $\text{Mn}_2\text{O}_3 + \text{MgO}$

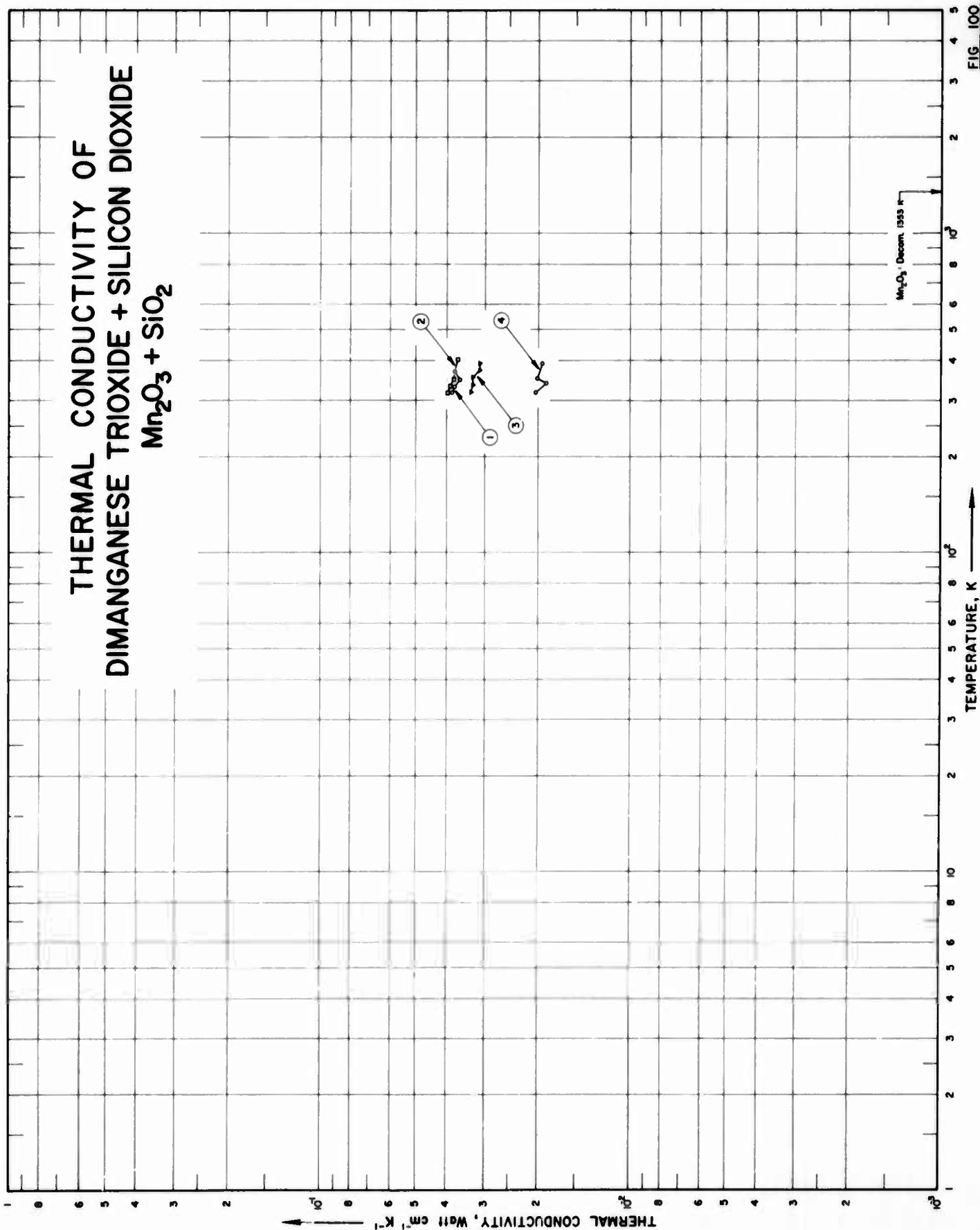
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Mn_2O_3	Composition (weight percent) MgO	Composition (continued), Specifications and Remarks
1	23		1952	319-408		177 A	94	6	$4\text{Mn}_2\text{O}_3$; MgO ; fired at 1644 K; density 4.11 g cm^{-3} ; water absorption 0.45%.

DATA TABLE NO. 99 THERMAL CONDUCTIVITY OF [DIMANGANESE TRIOXIDE + MAGNESIUM OXIDE] $\text{Mn}_2\text{O}_3 + \text{MgO}$ [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 $\text{Mn}_2\text{O}_3 + \text{SiO}_2$



SPECIFICATION TABLE NO. 100 THERMAL CONDUCTIVITY OF [MANGANESE TRIOXIDE + SILICON DIOXIDE] $\text{Mn}_2\text{O}_3 + \text{SiO}_2$

[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 (weight percent) Mn_2O_3	Composition (weight percent) SiO_2	Composition (continued), Specifications and Remarks
1	23	1952	319-371		172A	91.18	8.82	Composition $4\text{Mn}_2\text{O}_3 : \text{SiO}_2$; 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 $4\text{Mn}_2\text{O}_3 : \text{SiO}_2$; 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 $3\text{Mn}_2\text{O}_3 : 2\text{SiO}_2$; firing temperature 1533 K; water absorption none; density 3.71 g cm^{-3} .
4	23	1952	317-394		174A	63.27	36.73	Composition $2\text{Mn}_2\text{O}_3 : 3\text{SiO}_2$; 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

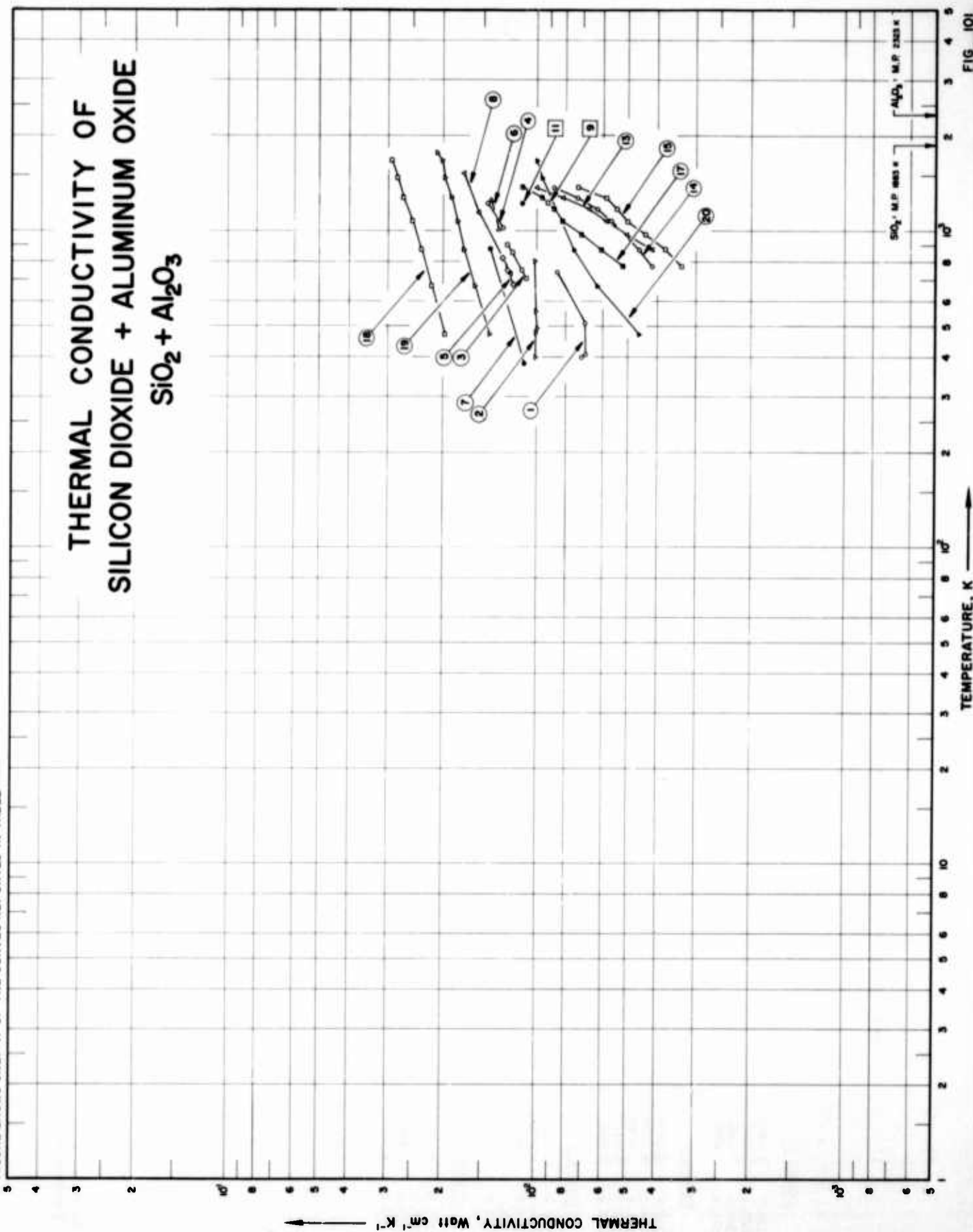


FIG. 101

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.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) SiO_2 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	>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 0.13%.
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 grog); 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 but in disc form 8 in. in dia and 1 in. in thickness; steel used as comparative material.
10	81	L	1924	1223.2		Pressed fireclay; 3		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%.
11	81	L	1924	1223.2		Light weight fireclay	66.77 28.94	The above specimen measured with insulating brick placed between the calorimeter and the lower surface of the brick.

Similar to the above specimen except measured at 745.8 mm Hg pressure.

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 grog, and 10% 16 F grog) 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.

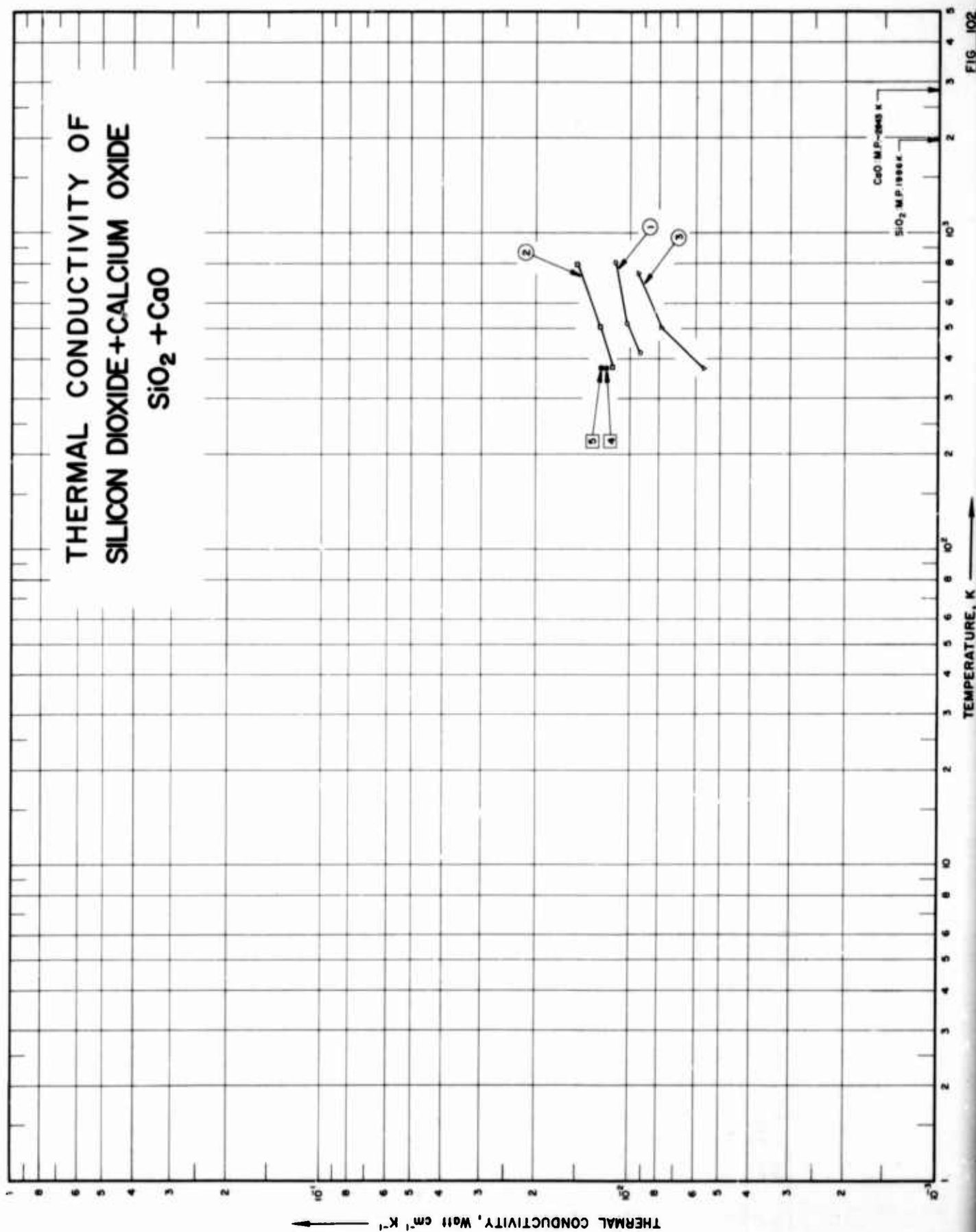
SPECIFICATION TABLE NO. 101 (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) SiO_2	Composition (weight percent) Al_2O_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_2O_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. No.	Method Used	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
19	383	L	1927	473-1773	± 15	Kaolin firebrick	52.02	45.92	1.51 Fe_2O_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 sedimentary kaolin by mixing 85% of 4-mesh prefired 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_2O_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 28.5%.
22	458	P	1921	373.2		Red brick	76.32	21.96	1.88 Fe_2O_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_2O_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_2O_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.

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. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							SiO ₂	CaO	
1	247	L	1932	423-808	1.0	Silica brick 1	95.12	2.37	0.55 Al ₂ O ₃ , 0.69 Fe ₂ O ₃ , 0.19 MgO, 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.
2	247	L	1932	377-798	1.0	Silica brick 8	94.02	2.98	0.91 Al ₂ O ₃ , 0.79 Fe ₂ O ₃ , 0.22 MgO, 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.
3	247	L	1932	372-744	1.0	Silica brick 9	92.26	3.26	1.84 Al ₂ O ₃ , 0.55 Fe ₂ O ₃ , 0.23 MgO, 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.
4	458	R	1921	373.2		Silica brick	94.98	3.06	1.18 Al ₂ O ₃ , and 1.13 Fe ₂ O 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, $\text{Watt cm}^{-1} \text{K}^{-1}$]

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

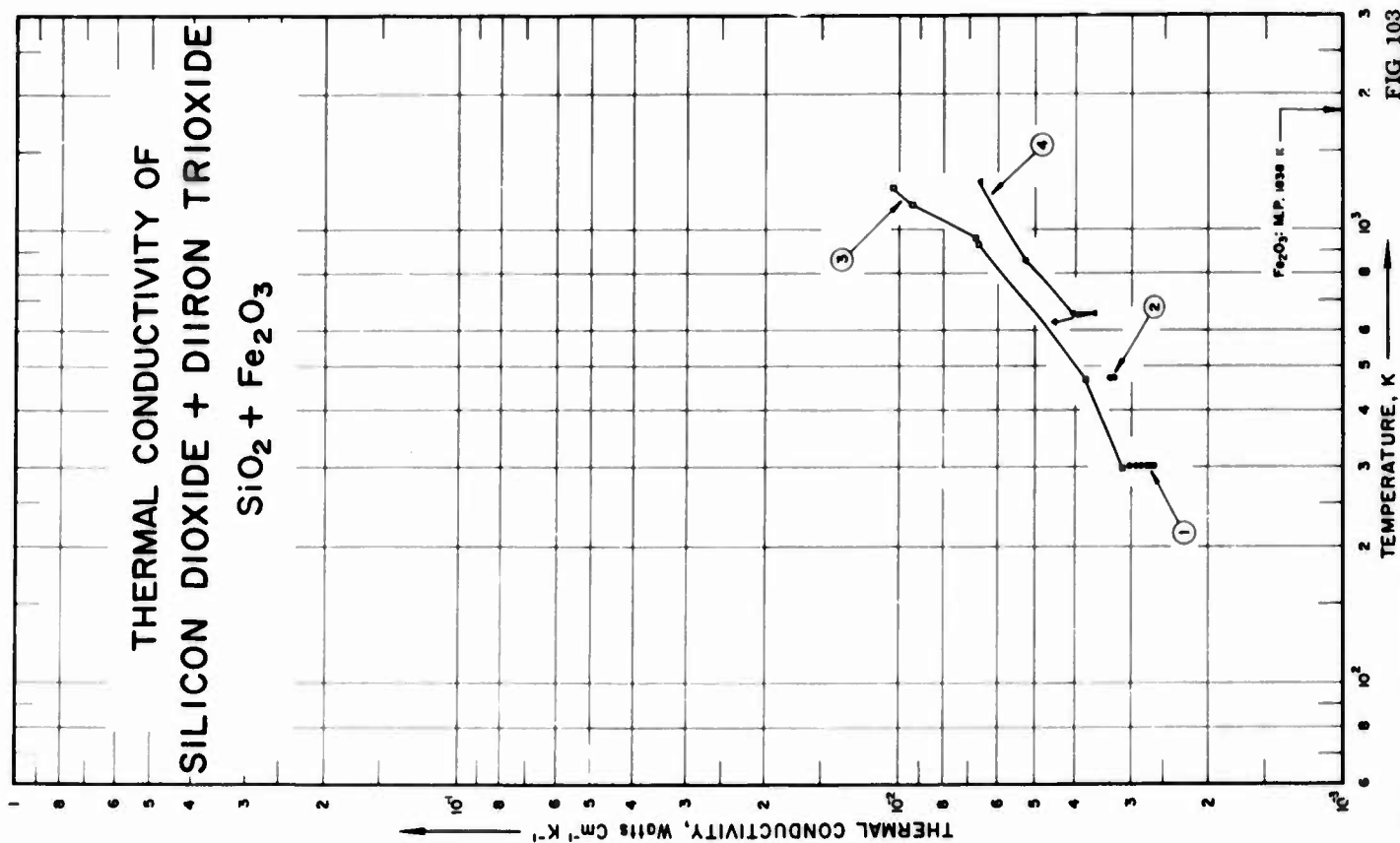


FIG 103

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 (weight percent) SiO_2	Composition (weight percent) Fe_2O_3	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.

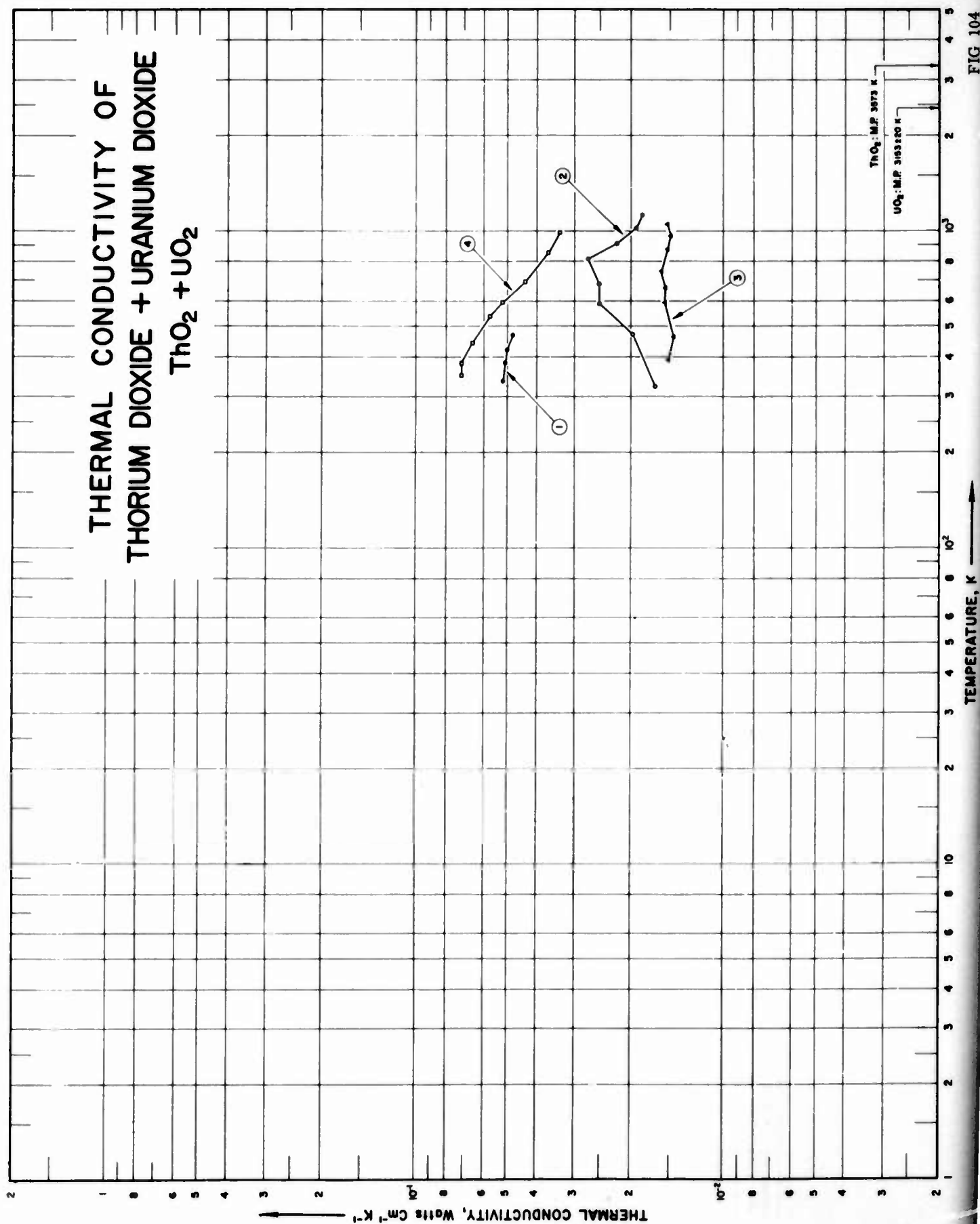
DATA TABLE NO. 103 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + BIRON TRIOXIDE] $\text{SiO}_2 + \text{Fe}_2\text{O}_3$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

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	$\pm 4\%$	$\text{Th}_{0.734}\text{U}_{0.266}\text{O}_2$	73.2	26.8	Corresponding to 26.4 mole % UO_2 , 73.6 mole % ThO_2 ; solid solution.
2	136	C	1959	324-1123	$\pm 4\%$	$\text{Th}_{0.734}\text{U}_{0.266}\text{O}_{2+x}$	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	$\pm 4\%$	$\text{Th}_{0.60}\text{U}_{0.40}\text{O}_{2+x}$	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	$\pm 4\%$	$\text{Th}_{0.9}\text{U}_{0.1}\text{O}_{2+x}$	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] $\text{ThO}_2 + \text{UO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

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 $\text{SnO}_2 + \text{MgO}$

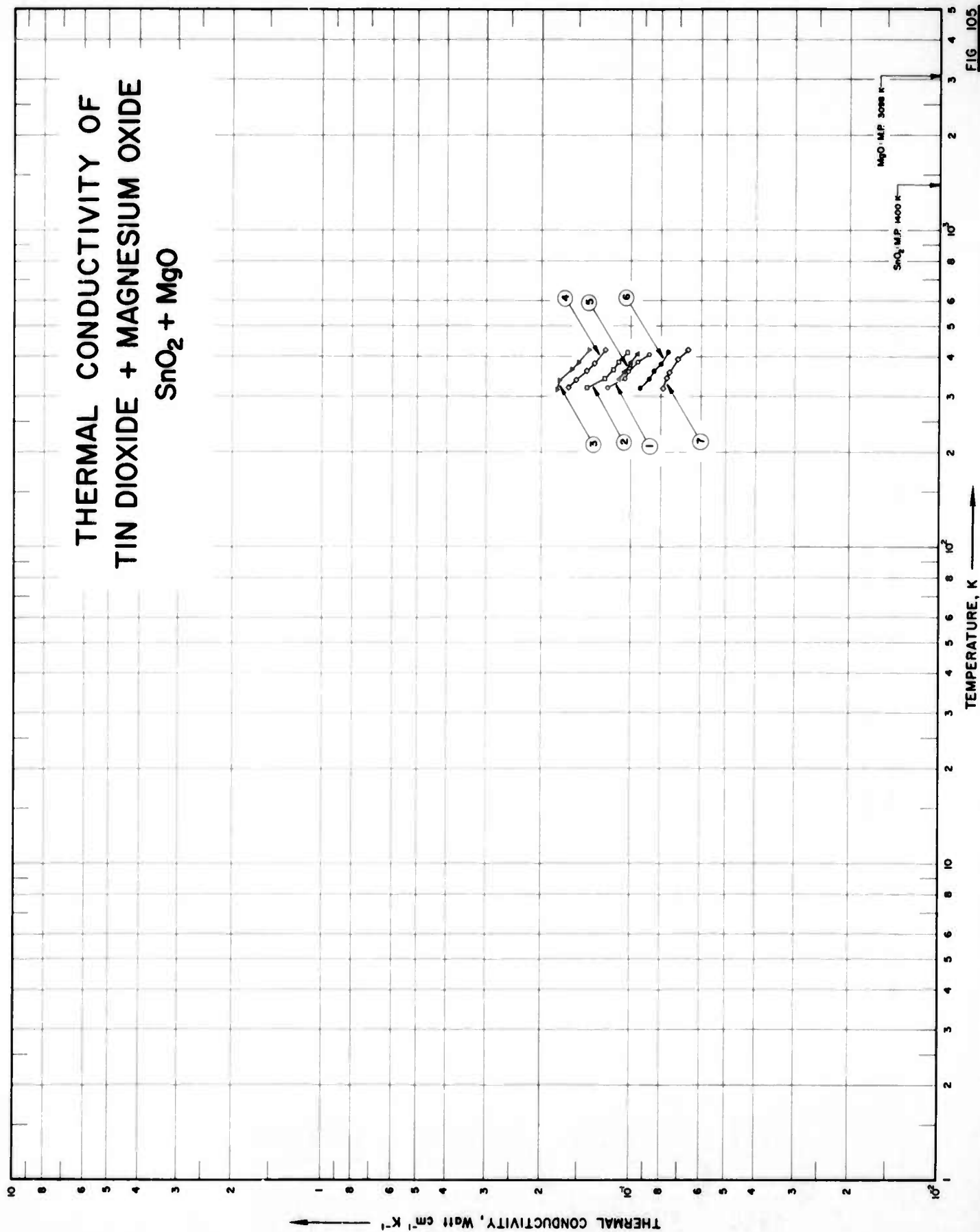


FIG 105

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]

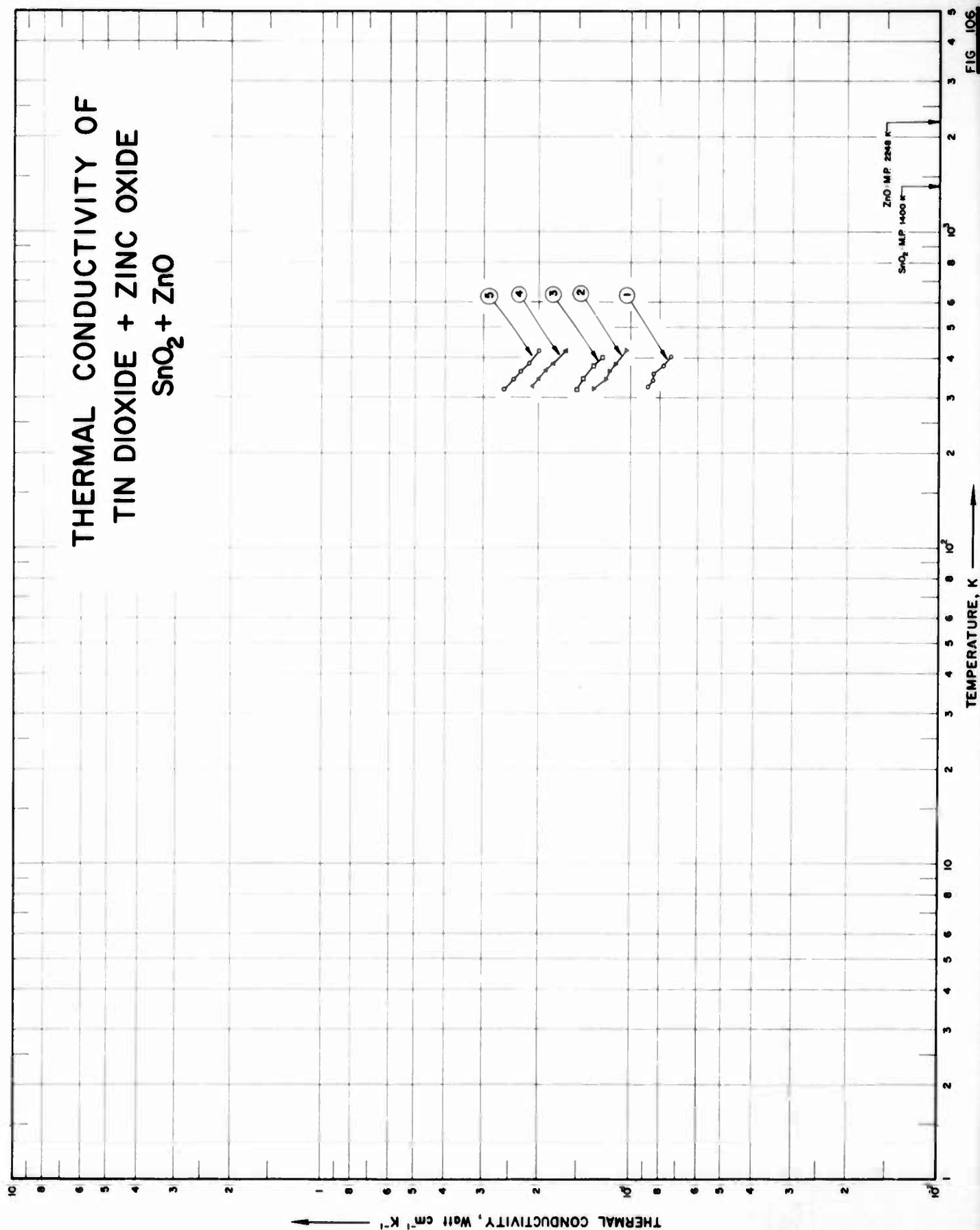
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) SnO_2	Composition (weight percent) MgO	Composition (continued), Specifications and Remarks
1	12		1953	321-408		218A-1	97.1	2.9	1 $\text{MgO} + 9 \text{SnO}_2$ by mole; prepared 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 0.095%; 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] $\text{SnO}_2 + \text{MgO}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 6 (cont.)</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>		356.5	0.0753
320.9	0.141	393.8	0.0707
341.0	0.123	421.9	0.0657
364.5	0.115	<u>CURVE 3</u>	
384.0	0.110	315.9	0.177
413.9	0.103	337.4	0.174
<u>CURVE 3</u>		365.0	0.158
315.9	0.177	385.8	0.150
337.4	0.174	421.4	0.138
365.0	0.158	<u>CURVE 4</u>	
385.8	0.150	320.4	0.162
421.4	0.138	338.8	0.153
<u>CURVE 4</u>		362.7	0.141
320.4	0.162	382.8	0.133
338.8	0.153	420.6	0.122
362.7	0.141	<u>CURVE 5</u>	
382.8	0.133	319.2	0.119*
420.6	0.122	339.2	0.110
<u>CURVE 5</u>		358.2	0.106
319.2	0.119*	376.5	0.101
339.2	0.110	382.0	0.100
358.2	0.106	408.6	0.0950
376.5	0.101	<u>CURVE 6</u>	
382.0	0.100	317.2	0.0933
408.6	0.0950	340.2	0.0874
<u>CURVE 6</u>		361.8	0.0841
317.2	0.0933		
340.2	0.0874		
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.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) SnO_2	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, $\text{Watt cm}^{-1} \text{K}^{-1}$]

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

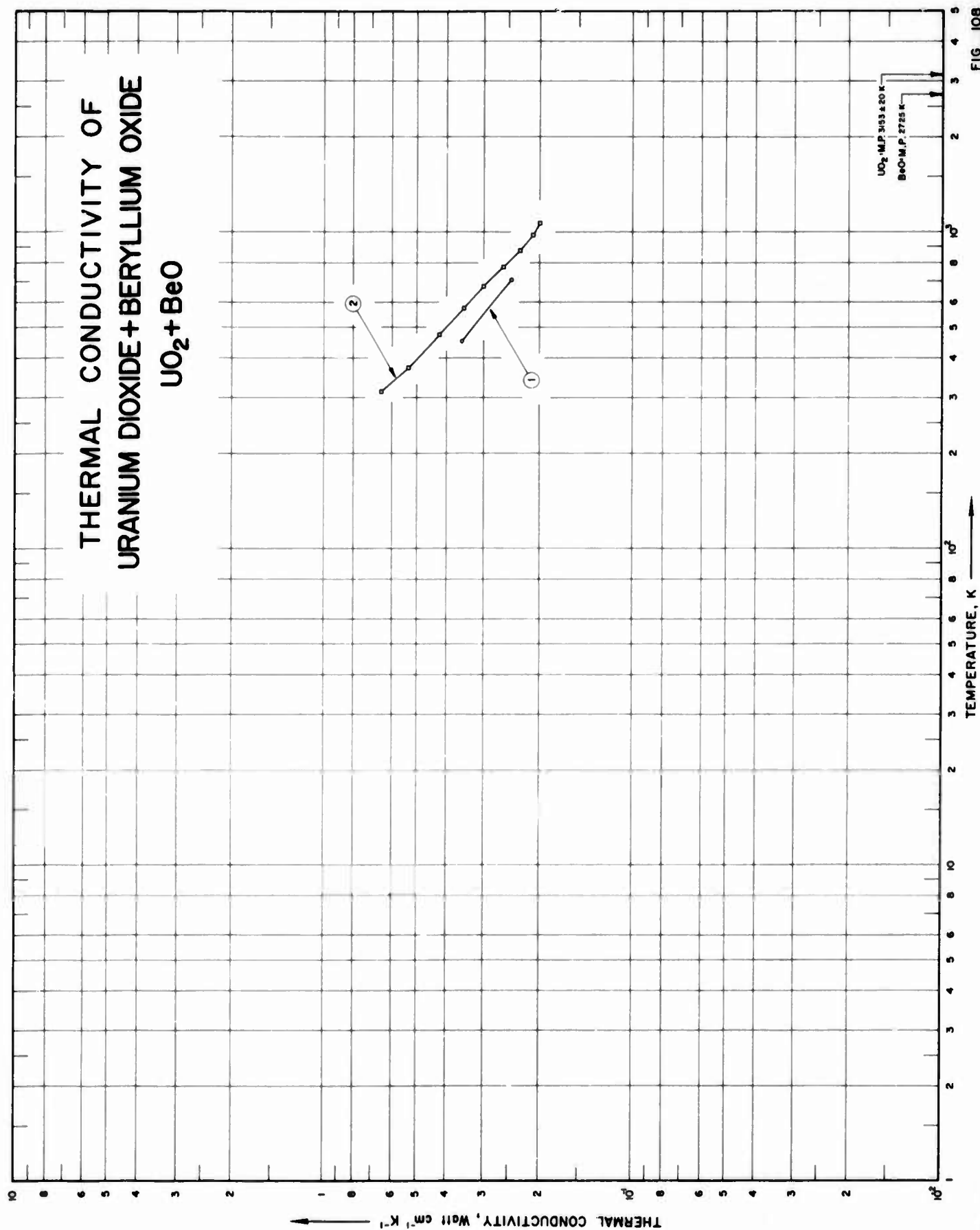
SPECIFICATION TABLE NO. 107 THERMAL CONDUCTIVITY OF [TUNGSTEN TRIOXIDE + ZINC OXIDE] $\text{WO}_3 + \text{ZnO}$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) WO_3	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] $\text{WO}_3 + \text{ZnO}$ [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

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



SPECIFICATION TABLE NO. 108 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + BERYLLIUM OXIDE] $\text{UO}_2 + \text{BeO}$

[For Data Reported in Figure and Table No. 108]

Curve No.	Ref. No.	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] $\text{UO}_2 + \text{CaO}$

Curve No.	Ref. Method No.	Year Used	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 for 90% H_2 at 1300 C; initial oxygen to uranium ratio 2.58, final oxygen to uranium ratio 1.98; electrical resistivity 58 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] $\text{UO}_2 + \text{CaO}$
[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
CURVE 1 *	
1054.2	0.0326
1079.2	0.0227

* No graphical presentation

SPECIFICATION TABLE NO. 110 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + DINIOBIUM PENTOXIDE] $\text{UO}_2 + \text{Nb}_2\text{O}_5$

Curve No.	Ref. Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) UO_2	Composition (weight percent) Nb_2O_5	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 + DINIOBIUM PENTOXIDE] $\text{UO}_2 + \text{Nb}_2\text{O}_5$ [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
CURVE 1*	
933.2	0.0364
956.2	0.0355

* No graphical presentation

SPECIFICATION TABLE NO. 111 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + YTTRIUM OXIDE] $\text{UO}_2 + \text{Y}_2\text{O}_3$

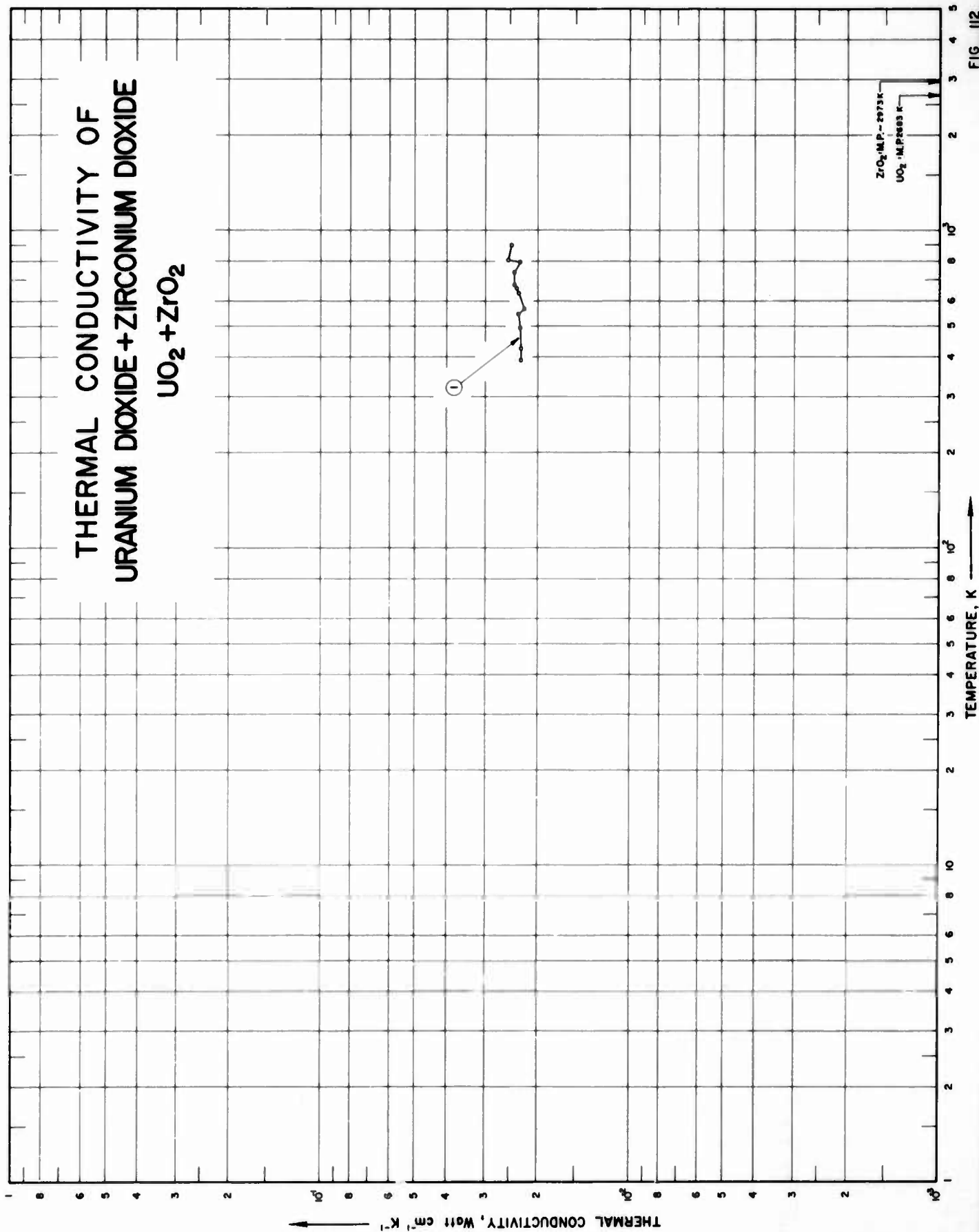
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) UO_2	Composition (weight percent) Y_2O_3	Composition (continued), Specifications and Remarks
1	438	C	1959	928-1137			96.63	3.37	Specimen 0.856 $\pm$ 0.001 in. in dia and 1.00 $\pm$ 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 as 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 $\text{Y}(\text{NO}_3)_3$; 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] $\text{UO}_2 + \text{Y}_2\text{O}_3$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

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				
1095.2	0.0471	771.2	0.0372		
		869.2	0.0355		

* No graphical presentation

THERMAL CONDUCTIVITY OF URANIUM DIOXIDE + ZIRCONIUM DIOXIDE $\text{UO}_2 + \text{ZrO}_2$



SPECIFICATION TABLE NO. 112 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + ZIRCONIUM DIOXIDE] $\text{UO}_2 + \text{ZrO}_2$

[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 $\text{UO}_2 + 1 \text{ZrO}_2$ by mole; pressed at 50 tsi and homogenized by sintering for 20 hrs at 1700 C; measured in a vacuum of approximately 2×10^{-6} 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, $\text{Watt cm}^{-1} \text{K}^{-1}$]

T	k
CURVE 1	
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

THERMAL CONDUCTIVITY OF
YTTRIUM OXIDE + URANIUM DIOXIDE
 $Y_2O_3 + UO_2$

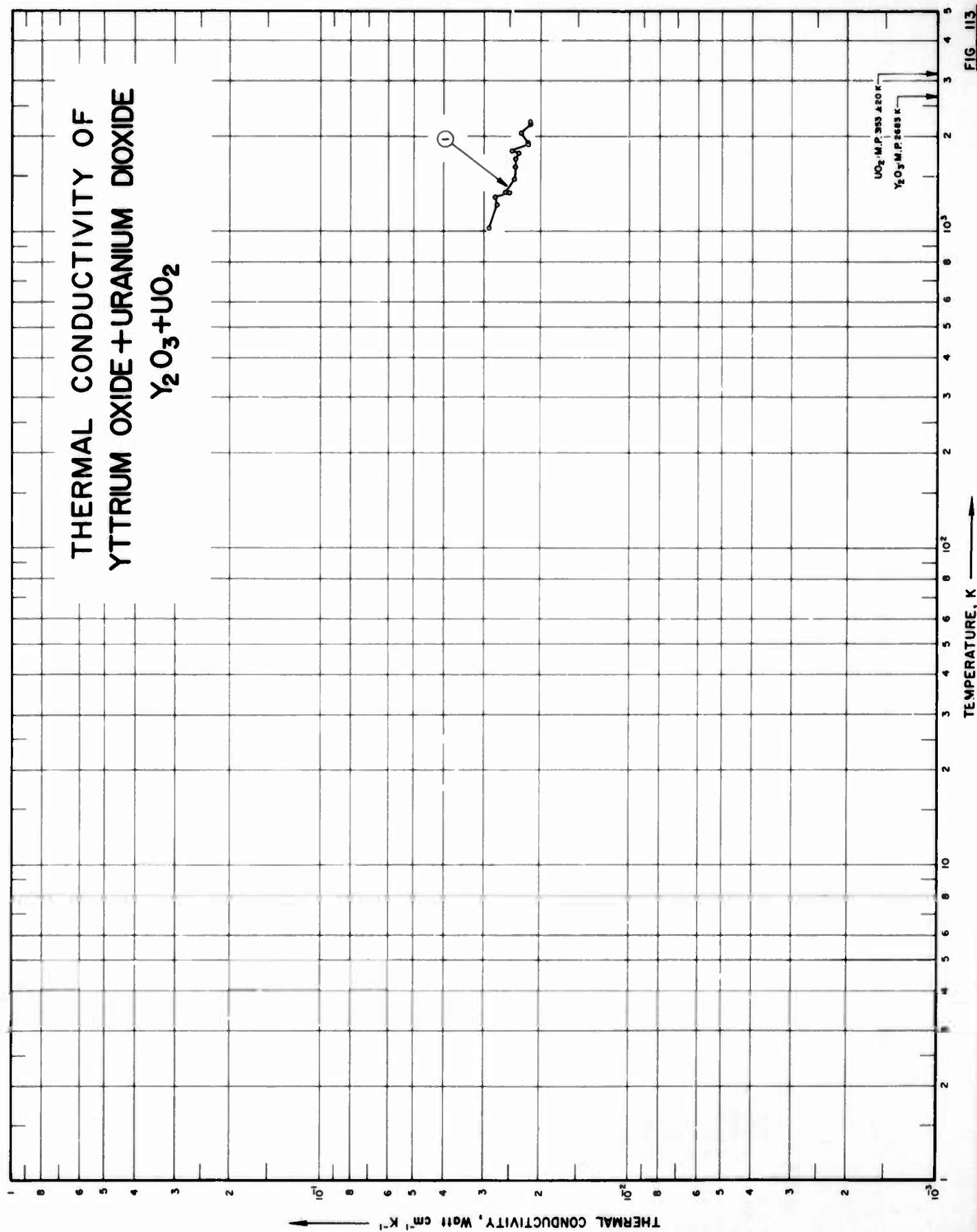


FIG. 113

SPECIFICATION TABLE NO. 113 THERMAL CONDUCTIVITY OF [YTTRIUM OXIDE + URANIUM DIOXIDE] $Y_2O_3 + UO_2$

[For Data Reported in Figure and Table No. 113]

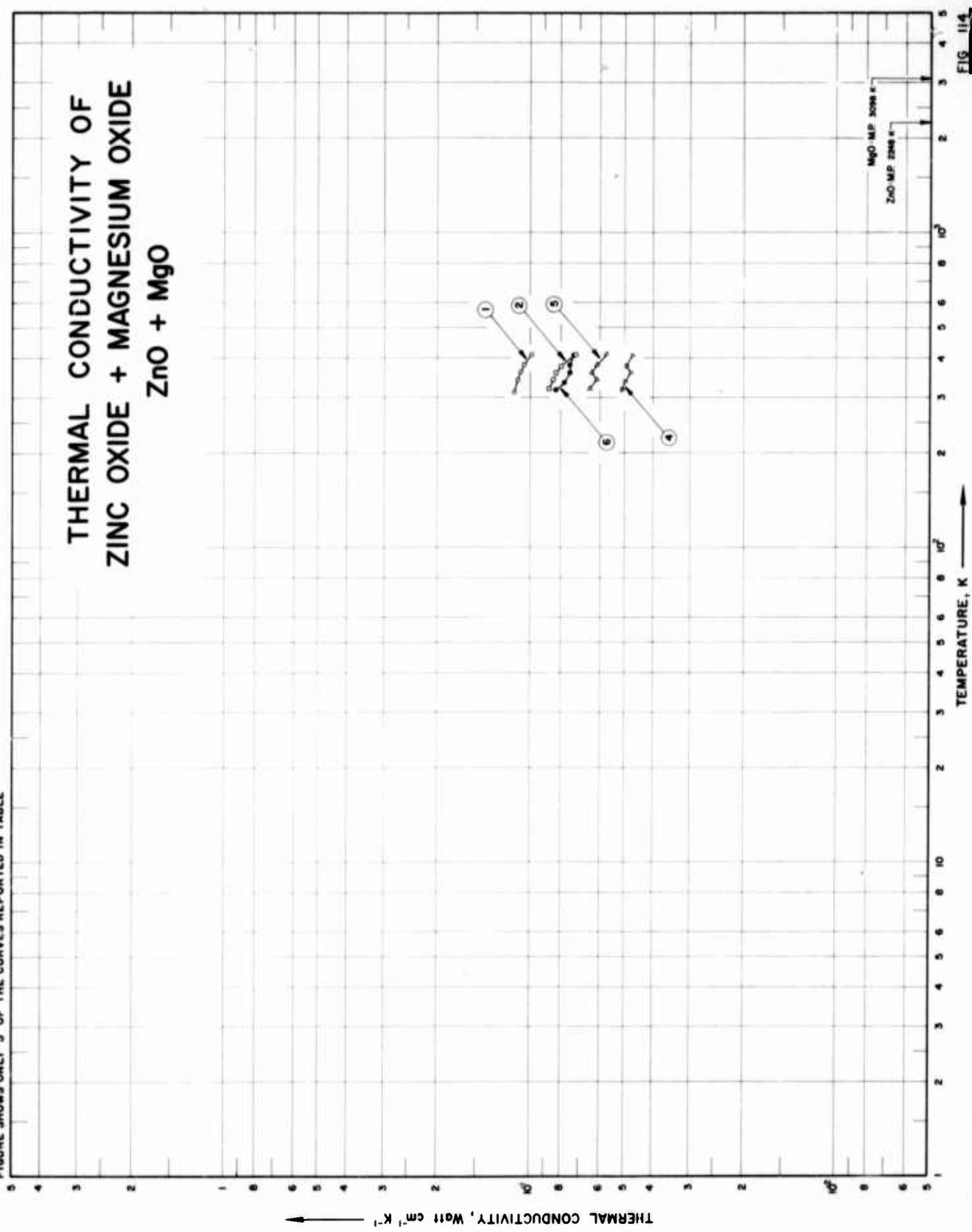
Curve No.	Ref. Method No.	Year Used	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						Y_2O_3	UO_2	
1	291	R	1964	1038-2233	$3Y_2O_3 + UO_{2.2}$	71.5	28.5	Specimen in disc form of 2 in. O. D. and 0.375 in. I. D. ; 99% of theoretical density.

DATA TABLE NO. 113 THERMAL CONDUCTIVITY OF [YTTRIUM OXIDE + URANIUM DIOXIDE] $\text{Y}_2\text{O}_3 + \text{UO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
CURVE 1	
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

THERMAL CONDUCTIVITY OF ZINC OXIDE + MAGNESIUM OXIDE ZnO + MgO

FIGURE SHOWS ONLY 5 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 114 THERMAL CONDUCTIVITY OF [ZINC OXIDE + MAGNESIUM OXIDE] ZnO + MgO

[For Data Reported in Figure and Table No. 114]

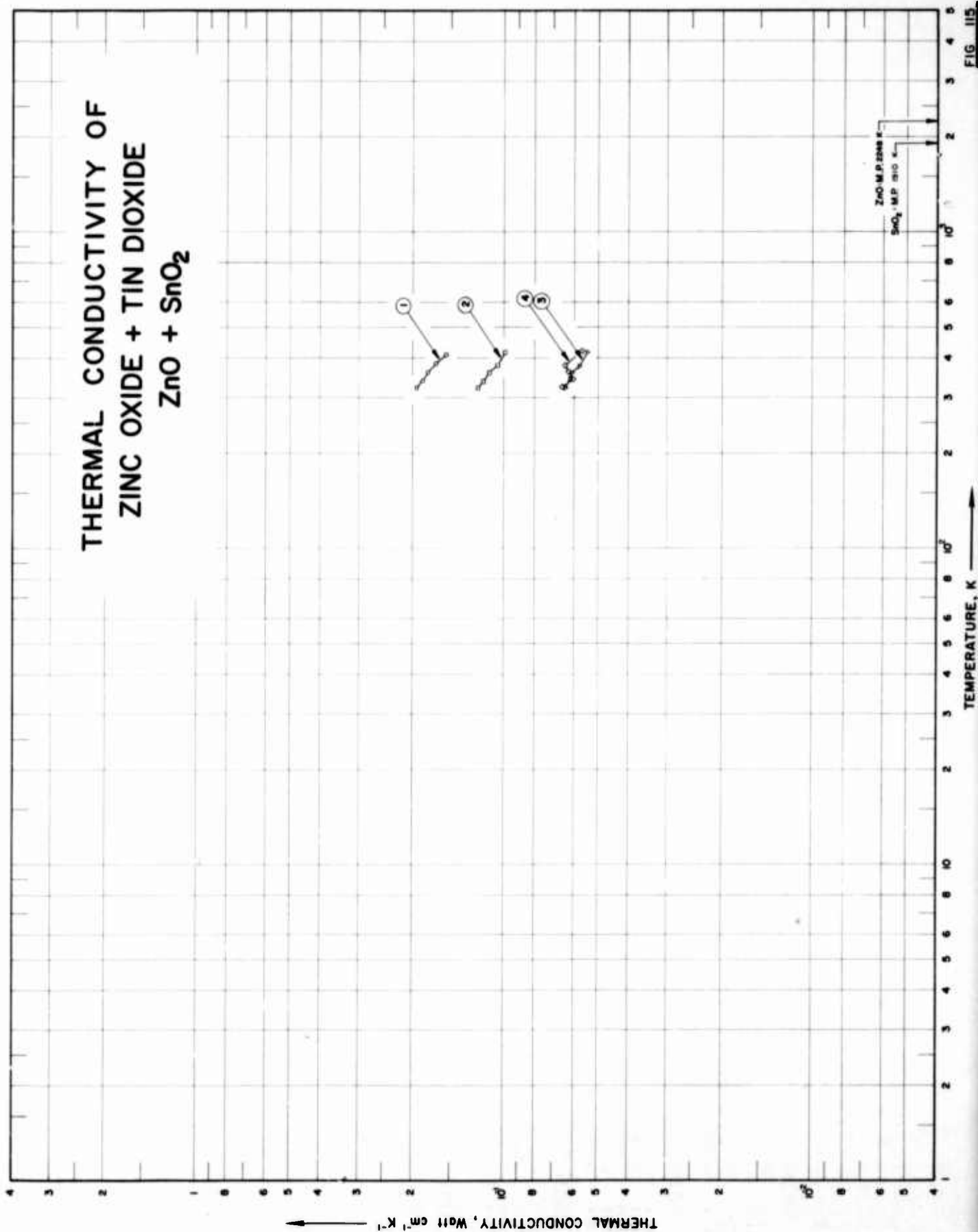
Curve No.	Ref. No.	Method Used	Year	Temp. Range, °K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZnO	MgO	Composition (continued), Specifications and Remarks
1	12		1953	313-411		258A-1	94.8	5.2	9ZnO + MgO by mole; prepared from pure oxides, milled in water, dried, calcined 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
 $\text{ZnO} + \text{SnO}_2$



SPECIFICATION TABLE NO. 115 THERMAL CONDUCTIVITY OF [ZINC OXIDE + TIN DIOXIDE] $\text{ZnO} + \text{SnO}_2$

[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 $\text{ZnO} + 1 \text{SnO}_2$ 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 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 $\text{ZnO} + 1 \text{SnO}_2$ 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 $\text{ZnO} + 3 \text{SnO}_2$ 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] $\text{ZnO} + \text{SnO}_2$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

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
379.9	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] $\text{ZrO}_2 + \text{Al}_2\text{O}_3$

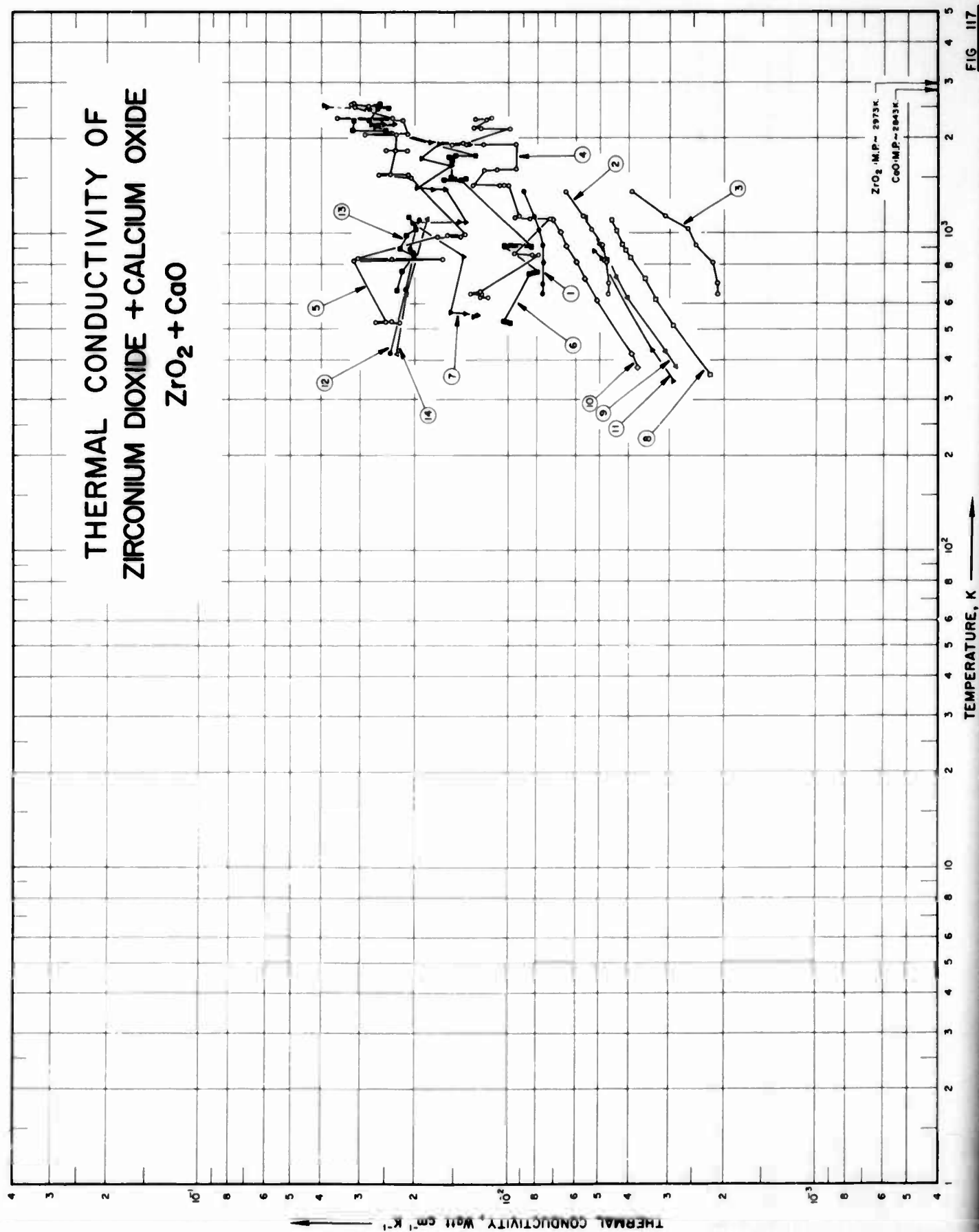
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZrO_2	Composition (weight percent) Al_2O_3	Composition (continued), Specifications and Remarks
1	522	P	1963	373-823	± 4		91.6	8.4	As received; density 5.13 g cm^{-3} (92.5% 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] $\text{ZrO}_2 + \text{Al}_2\text{O}_3$ [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 $\text{ZrO}_2 + \text{CaO}$



SPECIFICATION TABLE NO. 117 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + CALCIUM OXIDE] $\text{ZrO}_2 + \text{CaO}$

[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 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_2O_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_2O_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_2O_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	390-1123	± 10	H30F			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_2O_3 , 0.17 Fe_2O_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 ± 0.001 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 used as comparative material; unknown and standard used for the first time.

SPECIFICATION TABLE NO. 117 (continued)

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
13	374	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	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.
15	374	C	1965	1313, 1373					Similar to the above specimen except alumina AL-300 used as comparative material.

THERMAL CONDUCTIVITY OF
ZIRCONIUM DIOXIDE + MAGNESIUM OXIDE
 $\text{ZrO}_2 + \text{MgO}$

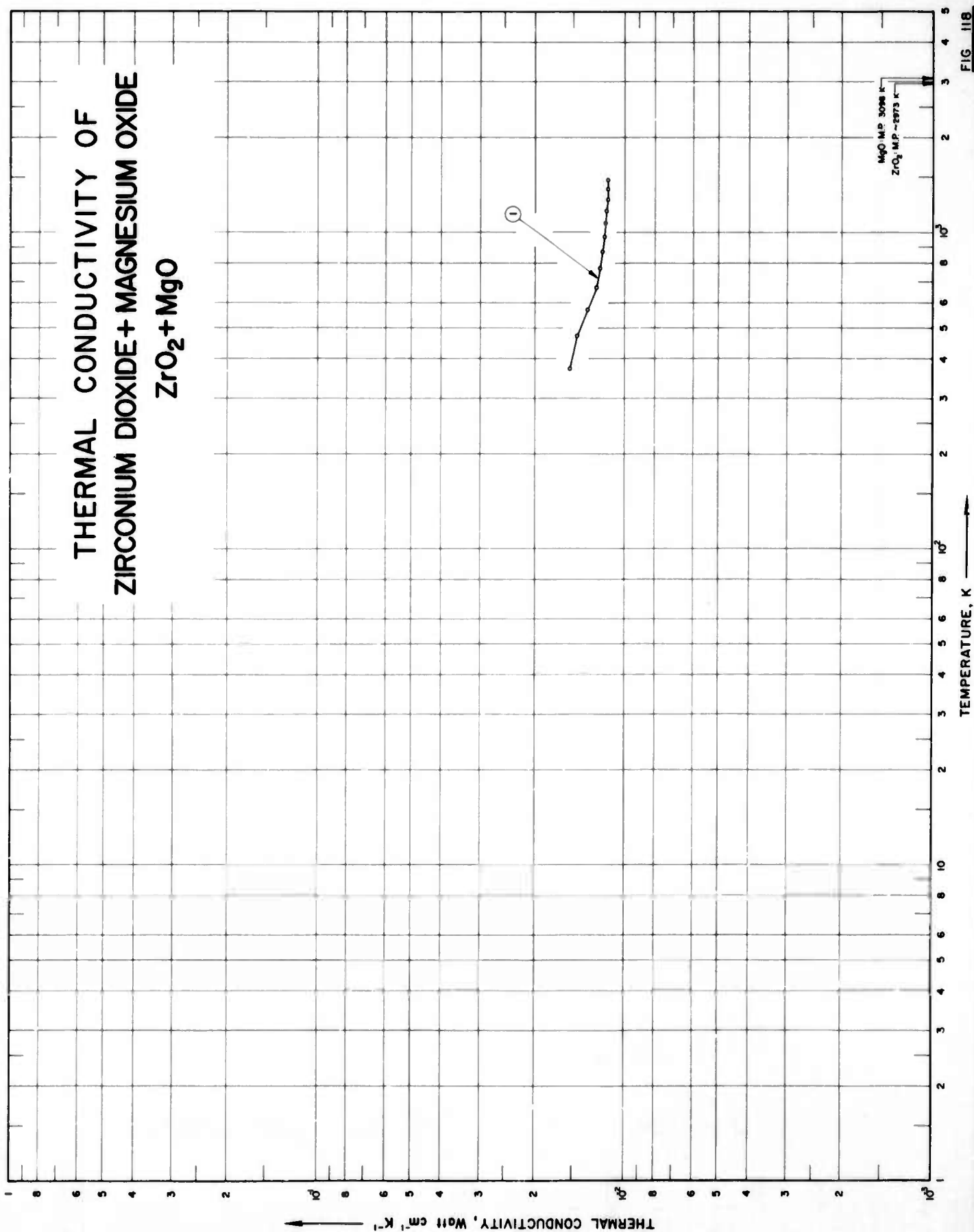


FIG. 118

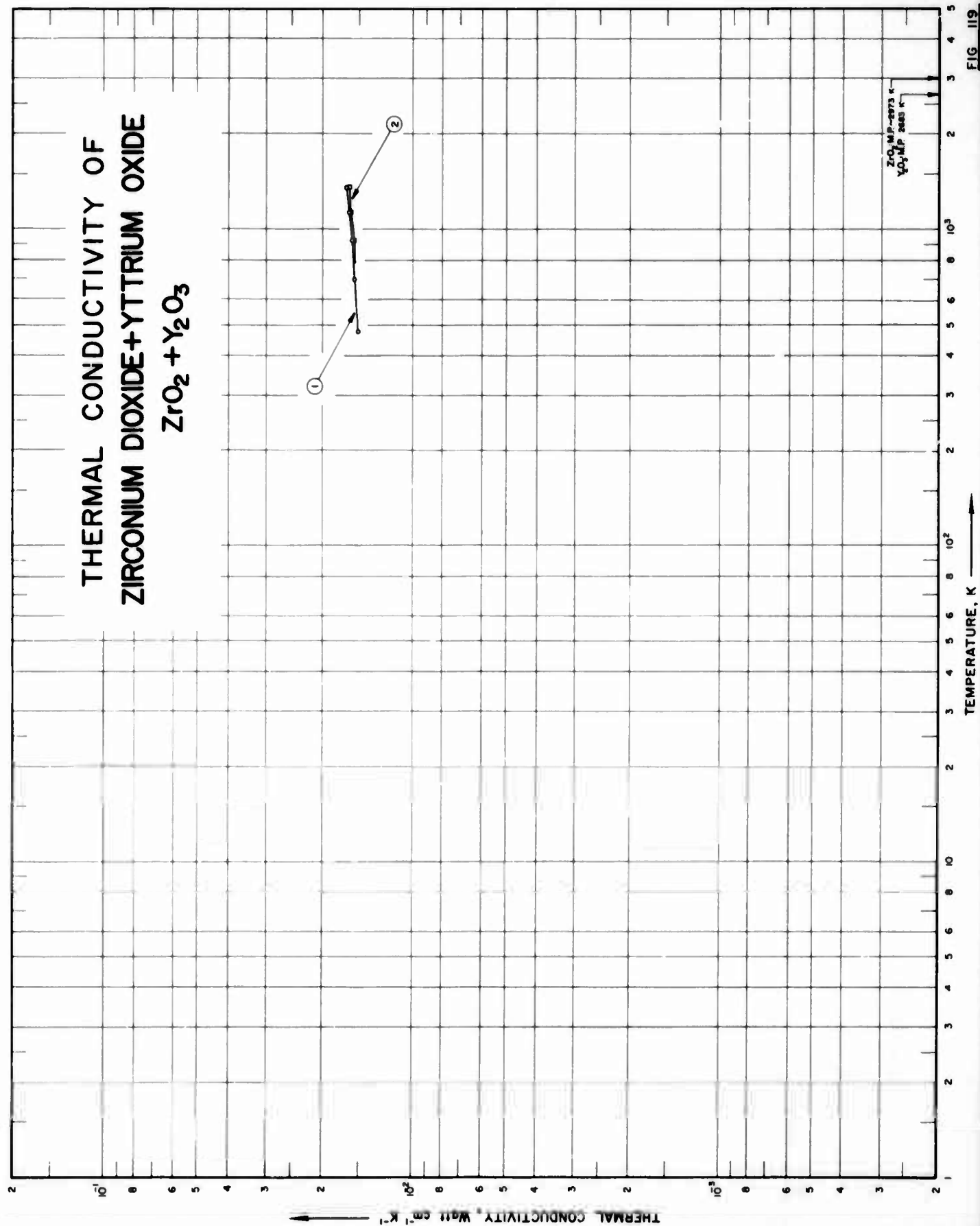
SPECIFICATION TABLE NO. 118 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + MAGNESIUM OXIDE] $\text{ZrO}_2 + \text{MgO}$

[For Data Reported in Figure and Table No. 118]

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	MgO	
1	253	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_2O_3 , 0.001-0.01 Fe_2O_3 , < 0.005 Na_2O , < 0.005 K_2O , < 0.005 Li_2O , < 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
CURVE 1	
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



SPECIFICATION TABLE NO. 119 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE] $\text{ZrO}_2 + \text{Y}_2\text{O}_3$

[For Data Reported in Figure and Table No. 119]

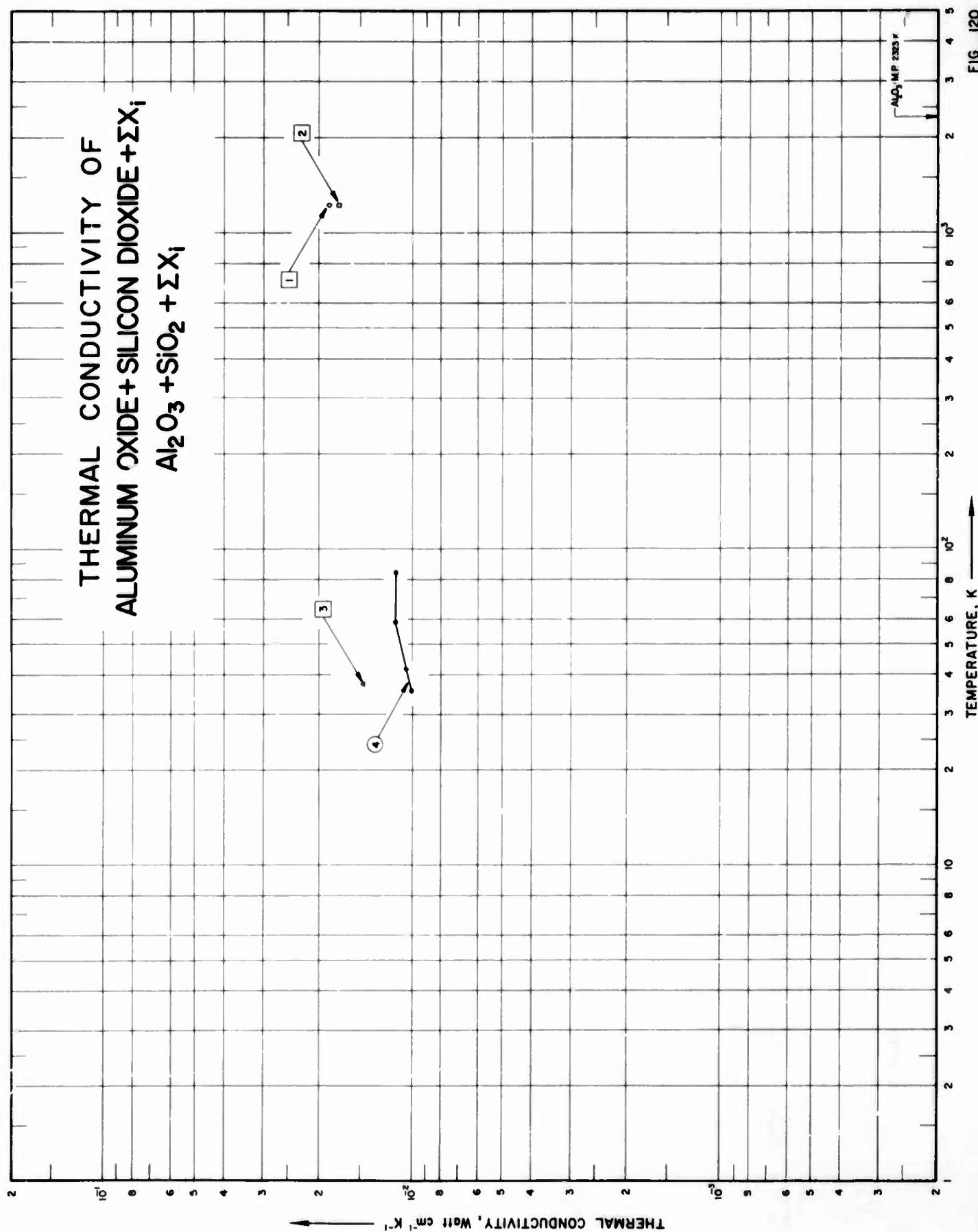
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZrO_2	Y_2O_3	Composition (continued), Specifications and Remarks
1	292	C	1961	478-1367		No. 1	85.0	15.0	Specimen 0.5 x 0.5 x 0.875 in.; prepared from Columbia-National, ZrO_2 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
CURVE 1	
477.6	0.0152
699.8	0.0156
922.1	0.0159
1144.2	0.0163
1366.5	0.0166
CURVE 2	
477.6	0.0152*
699.8	0.0156*
922.1	0.0157
1144.3	0.0161
1366.5	0.0163

* Not shown on plot

THERMAL CONDUCTIVITY OF
ALUMINUM OXIDE + SILICON DIOXIDE + ΣX_i
 $Al_2O_3 + SiO_2 + \Sigma X_i$



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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	1	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_i] $\text{Al}_2\text{O}_3 + \text{SiO}_2 + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

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] $Al_2O_3 + TiO_2 + \Sigma X_i$

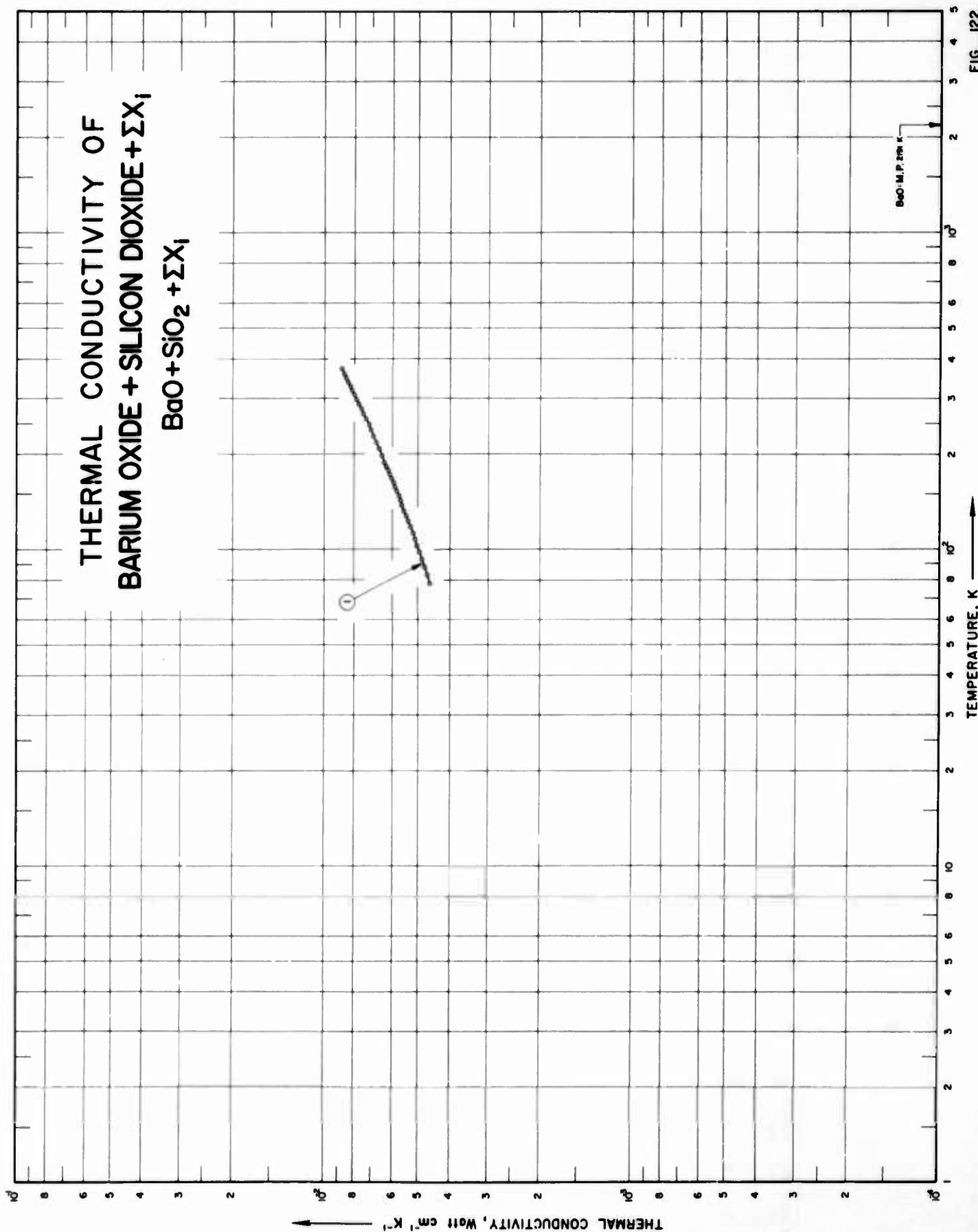
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) Al_2O_3 TiO_2 SiO_2	Composition (continued), Specifications and Remarks
1	81	L	1924	1223.2		Fused Alumina No. 1	92-96 1.5-4.0 1.0-2.5	0.25-1.0 Fe_2O_3 , 0-1.25 ZrO_2 ; traces 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 Alumina 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
CURVE 1*	
1223.2	0.0365
CURVE 2*	
1223.2	0.0332

* No graphical presentation

THERMAL CONDUCTIVITY OF
BARIUM OXIDE + SILICON DIOXIDE + ΣX_i
 $\text{BaO} + \text{SiO}_2 + \Sigma X_i$



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	147	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	CURVE 1	
		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*

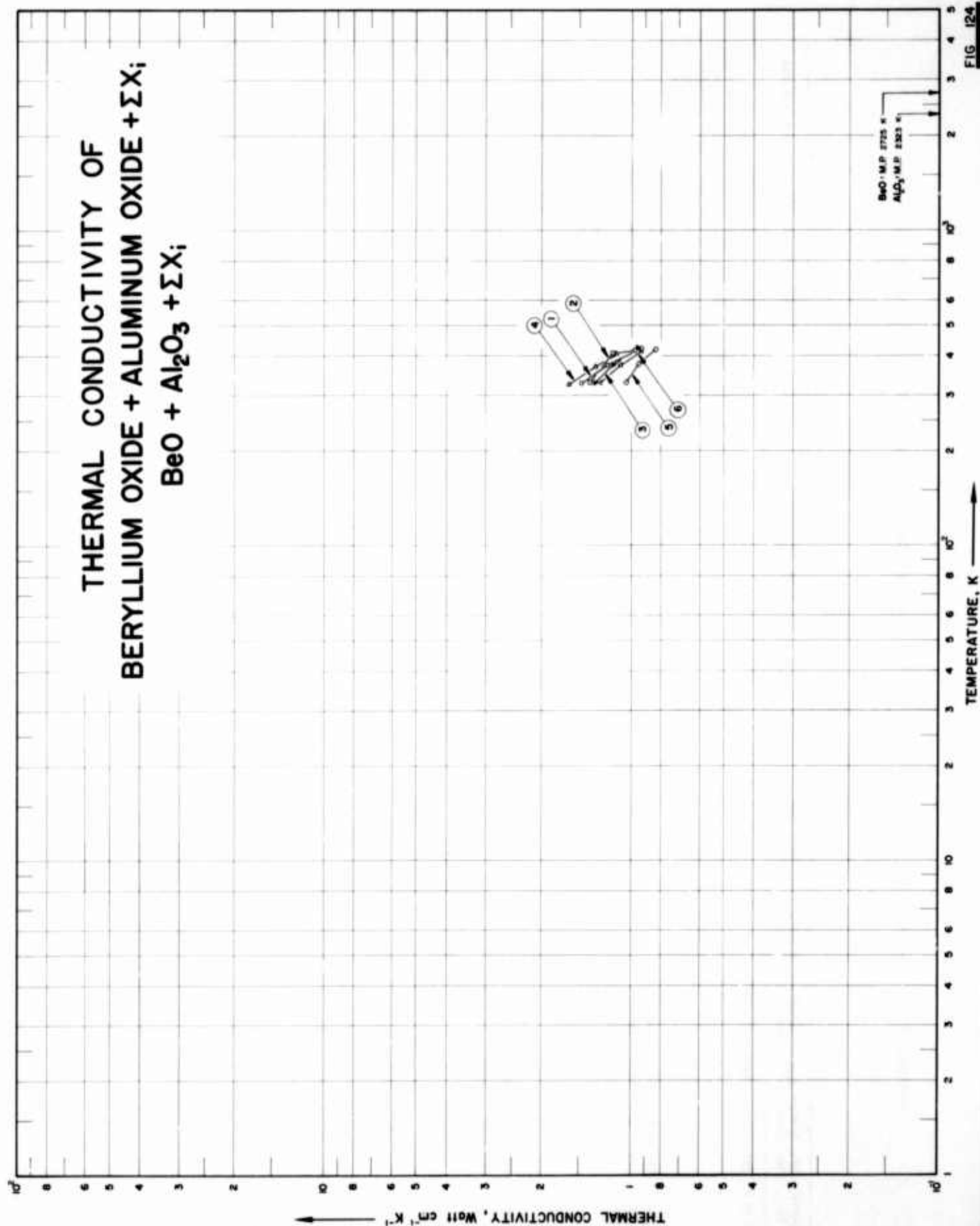
458.2 0.000033
 583.2 0.000040
 663.2 0.000048
 773.2 0.000068
 813.2 0.000070
 853.2 0.000091

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
 $\text{BeO} + \text{Al}_2\text{O}_3 + \Sigma X_i$



DATA TABLE NO. 124 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + ALUMINUM OXIDE + ΣX_i] B=O + Al_2O_3 + ΣX_i
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

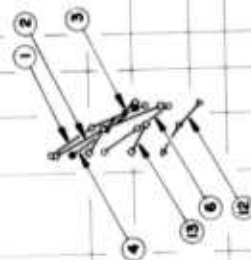
T	k
<u>CURVE 1</u>	
329.2	1.477
377.2	1.201
423.2	0.925
<u>CURVE 2</u>	
330.2	1.339
410.2	1.167
415.2	0.975
<u>CURVE 3</u>	
330.2	1.339
379.2	1.163
426.2	0.956
<u>CURVE 4</u>	
326.2	1.62
370.2	1.33
408.2	1.13
<u>CURVE 5</u>	
330.2	1.05
378.2	0.946
420.2	0.833
<u>CURVE 6</u>	
329.2	1.27
375.2	1.09
418.2	0.928

FIGURE SHOWS ONLY 7 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF
BERYLLIUM OXIDE + MAGNESIUM OXIDE + ΣX_i
 $\text{BeO} + \text{MgO} + \Sigma X_i$

THERMAL CONDUCTIVITY, $\text{Watt cm}^{-1} \text{K}^{-1}$

TEMPERATURE, K



SPECIFICATION TABLE NO. 125 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + MAGNESIUM OXIDE + ZrO_2] BeO + MgO + ZrO_2

[For Data Reported in Figure and Table No. 125]

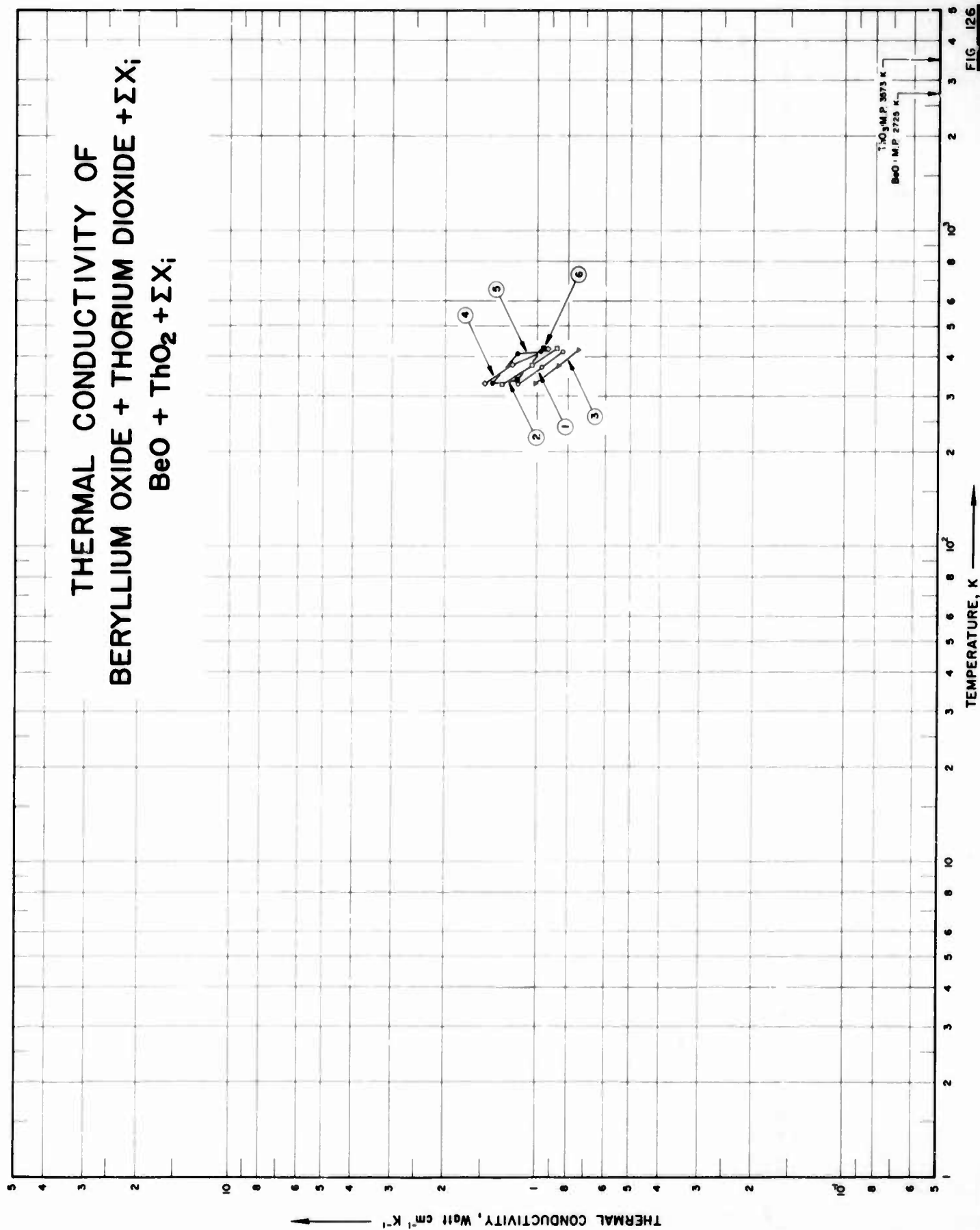
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			ThO ₂	Composition (continued), Specifications and Remarks	
							BeO	MgO	Al ₂ O ₃			
1	141	L	1950	329-419		A 4	91.2	4.0	2.4	2.4	2.4	Fluorescent grade BeO; special acid-washed 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	2.3	Same description as the above specimen.
3	141	L	1950	331-425		A 15	80.8	15.0	2.1	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	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	4.25	Same description as the above specimen.
6	141	L	1950	328-417		C 15	68.0	15.0	8.5	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 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 ZrO ₂ ; same description as the above specimen.
9	141	L	1950	325-409		N 15	80.8	15.0	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 ZrO ₂ ; same description as specimen N 4.
11	141	L	1950	328-415		O 15	76.5	15.0	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 ZrO ₂ ; same description as the specimen above.
13	141	L	1950	332-420		Y 8	77.5	8.0	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>		<u>CURVE 9*</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>		<u>CURVE 10*</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>		<u>CURVE 11*</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>		<u>CURVE 12</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>		<u>CURVE 13</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
 $\text{BeO} + \text{ThO}_2 + \Sigma X_i$



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		Similar to the above specimen.
6	141	L	1950	330-426		C	80.0	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
 $\text{BeO} + \text{ZrO}_2 + \Sigma X_i$

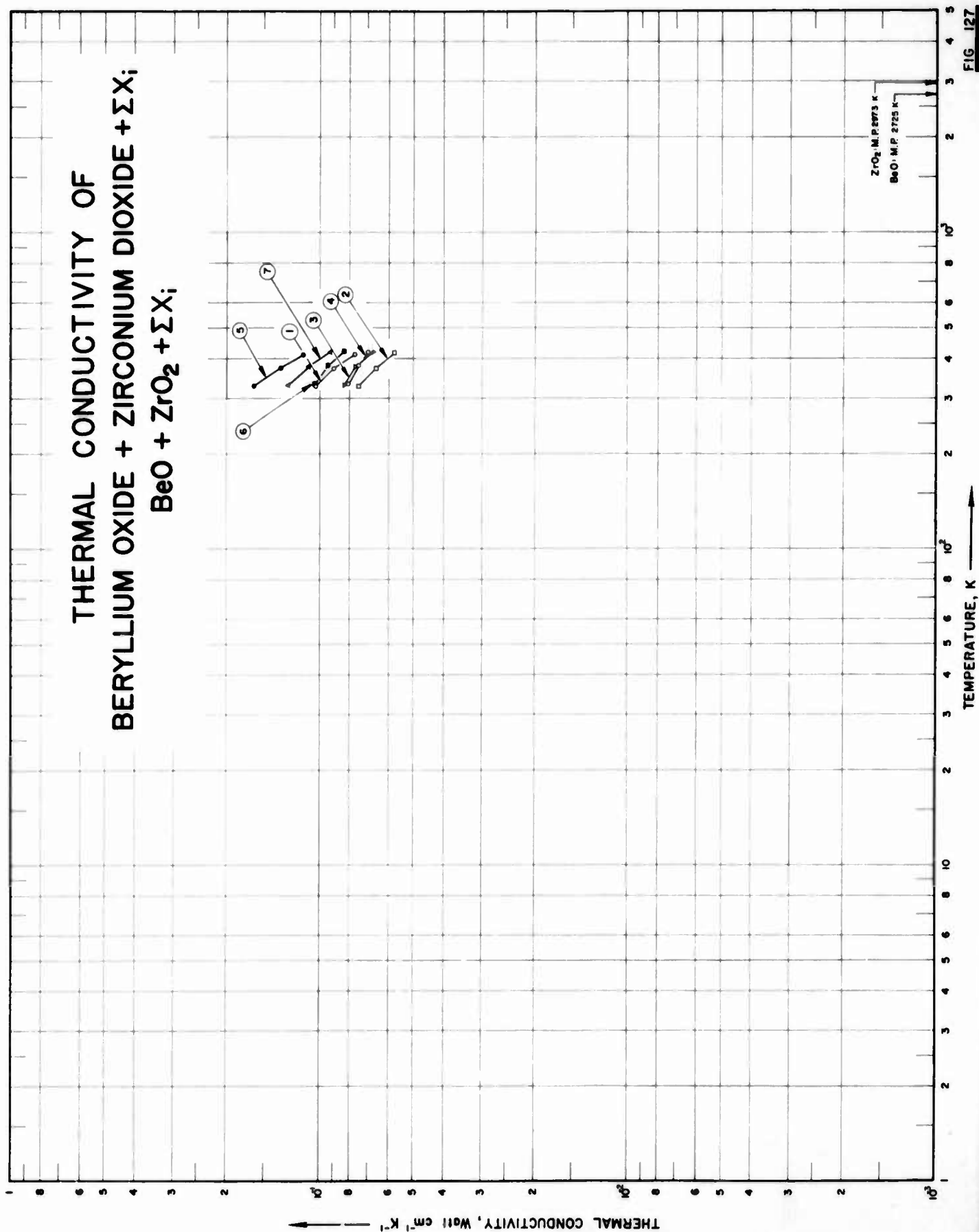


FIG. 127

SPECIFICATION TABLE NO. 127 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + ZIRCONIUM DIOXIDE + EX₁] BeO + ZrO₂ + EX₁

[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	9.6	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	1.65
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] $Cr_2O_3 + MgO + \Sigma X_i$

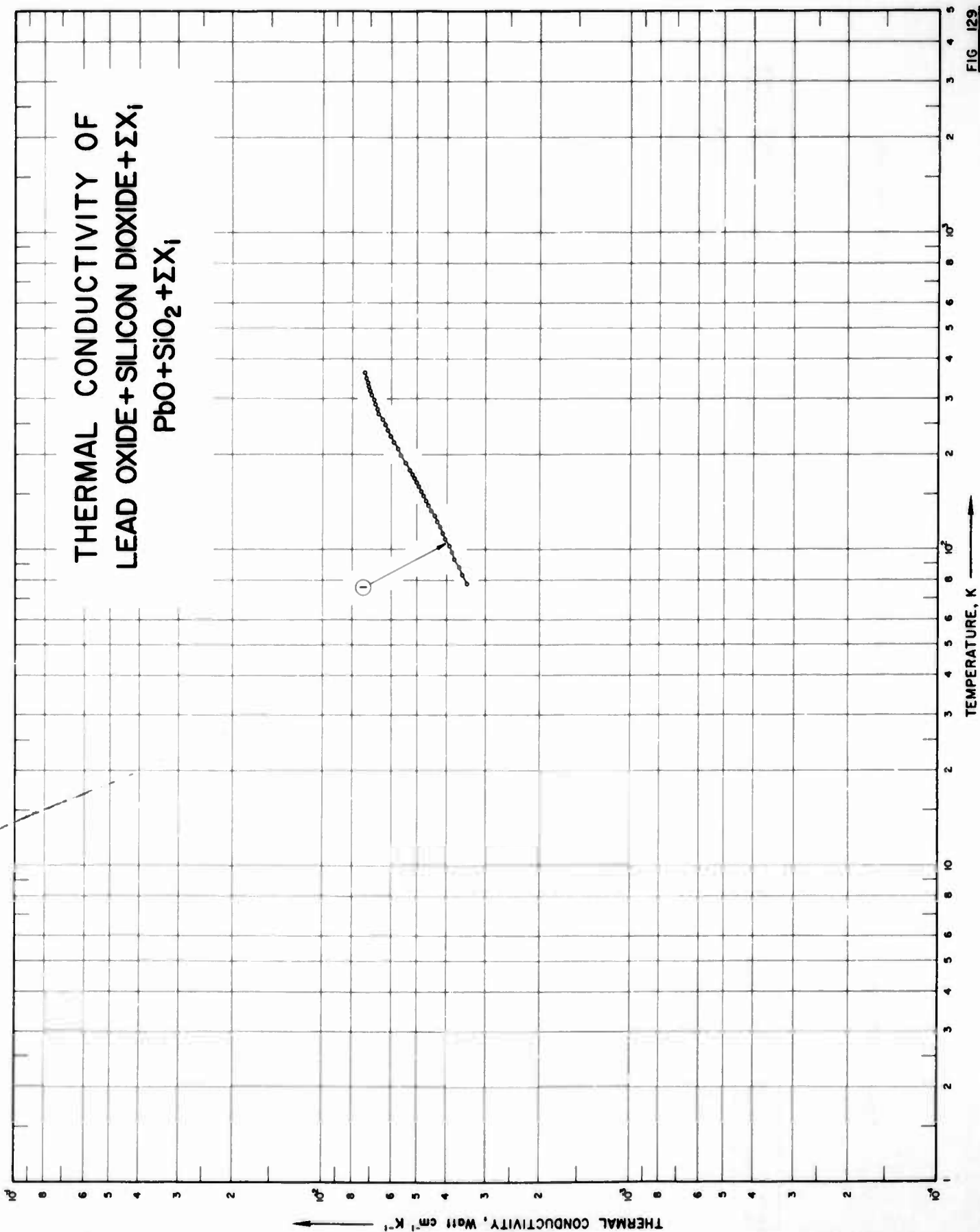
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)						Composition (continued), Specifications and Remarks
							Cr ₂ O ₃	MgO	Fe ₂ O ₃	Al ₂ O ₃	SiO ₂	Mn ₂ O ₄	
1	247	L	1932	379-794	1.0	Chromite Brick 23	40.09	22.68	13.16	10.48	10.53	2.32	0.68 CaO, trace TiO ₂ ; density 3.988 g cm ⁻³ ; porosity 27.3%; gas permeability 0.555 m ³ -cm per m ² hr per mm of H ₂ O.

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
CURVE 1*	
379.4	0.0232
490.5	0.0217
793.9	0.0163

* No graphical presentation

THERMAL CONDUCTIVITY OF
LEAD OXIDE + SILICON DIOXIDE + ΣX_i
 $PbO + SiO_2 + \Sigma X_i$



SPECIFICATION TABLE NO. 129 THERMAL CONDUCTIVITY OF [LEAD OXIDE + SILICON DIOXIDE + ΣX_i] PbO + SiO₂ + ΣX_i

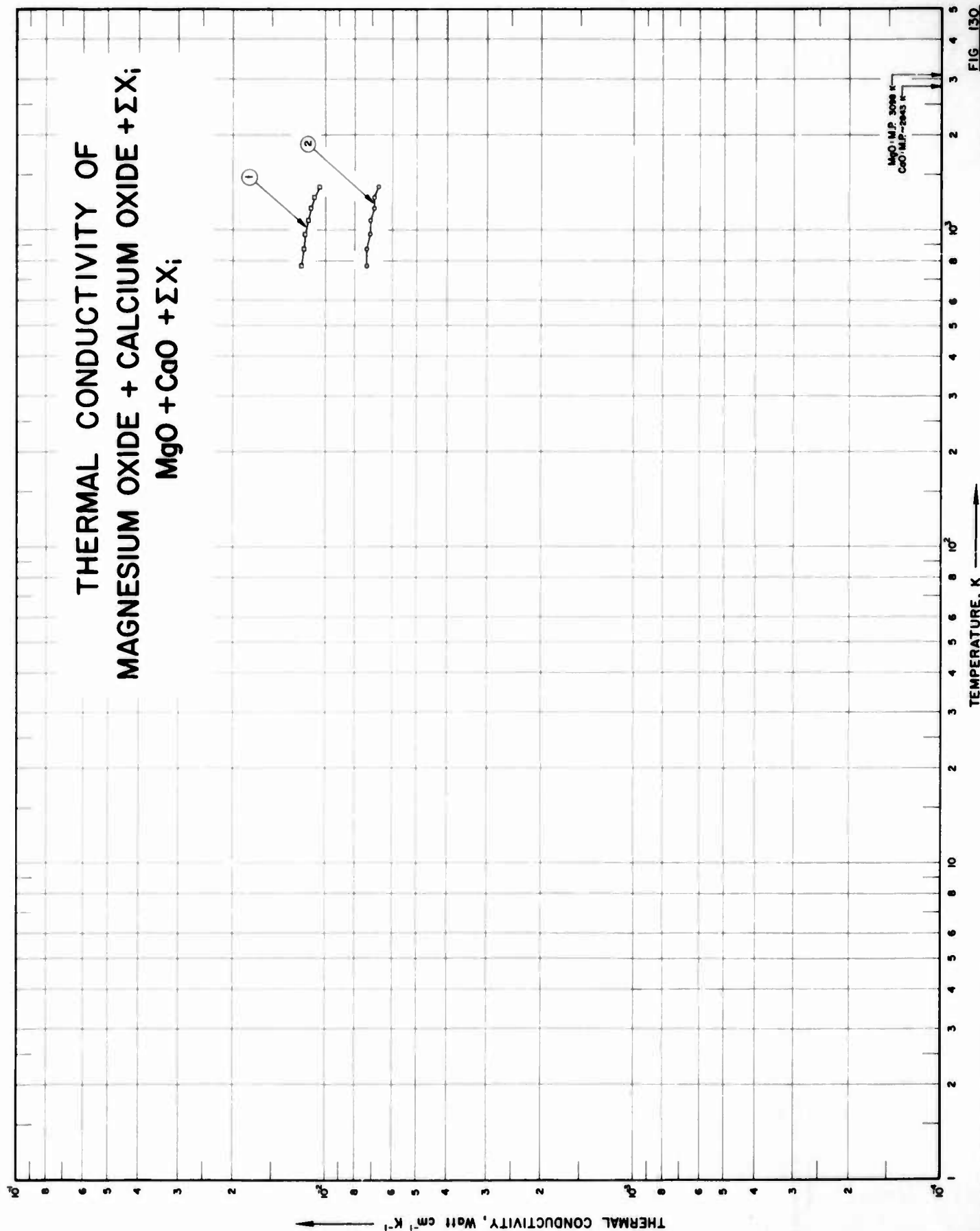
[For Data Reported in Figure and Table No. 129]

Curve No.	Ref. Method No. 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_i] PbO + SiO₂ + ΣX_i
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k	T	k
CURVE 1		CURVE 1 (cont.)	
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



SPECIFICATION TABLE NO. 130 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + CALCIUM OXIDE + ΣX_i] MgO + CaO + ΣX_i

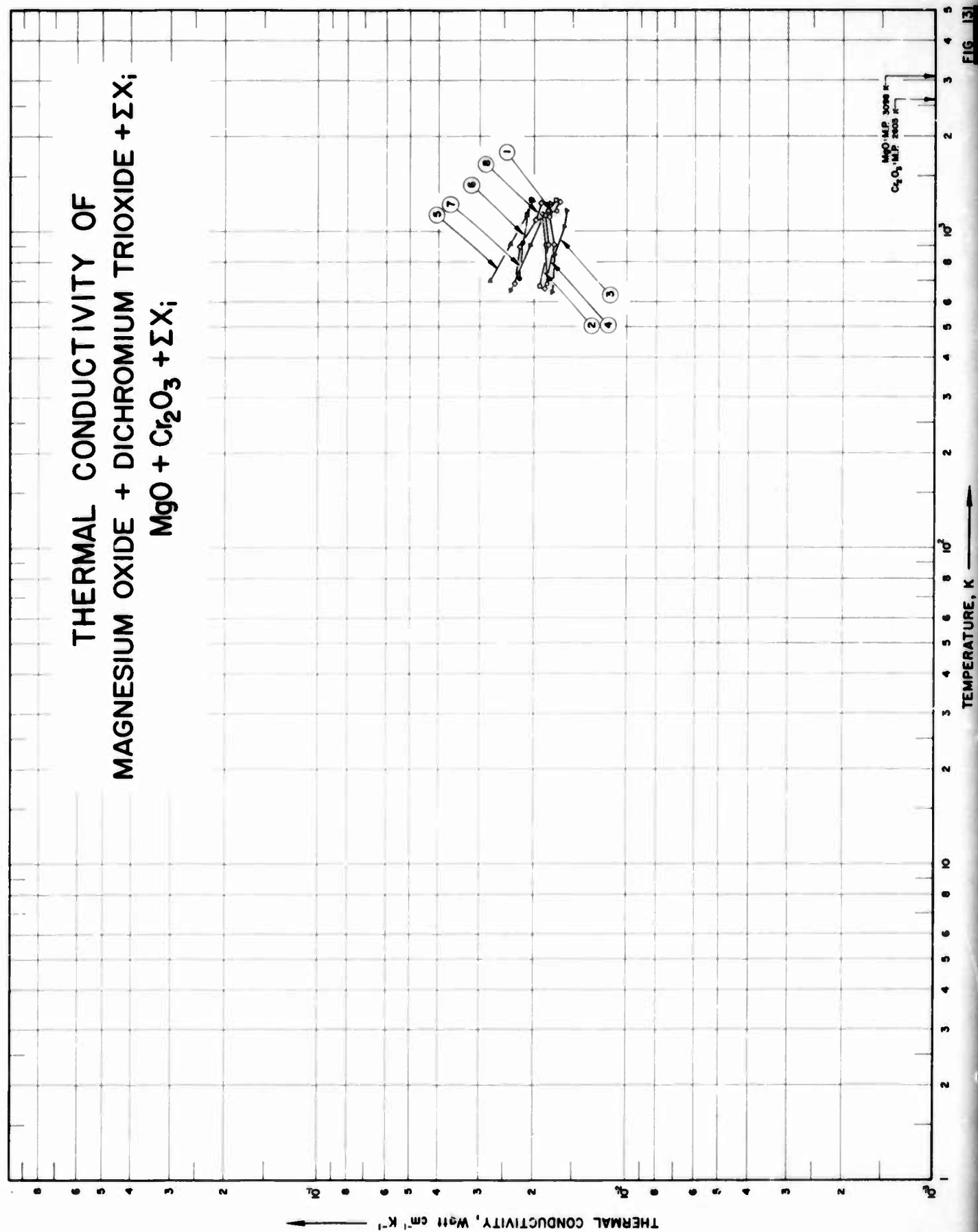
[For Data Reported in Figure and Table No. 130]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) MgO	CaO	Fe ₂ O ₃	Composition (continued), Specifications and Remarks
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
<u>CURVE 1</u>	
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
<u>CURVE 2</u>	
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] $MgO + Cr_2O_3 + \Sigma X_i$

[For Data Reported in Figure and Table No. 131]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, °K	Reported Error, %	Name and Specimen Designation	Al_2O_3	Cr_2O_3	Composition (weight percent)	MgO	SiO_2	Composition (continued), Specifications and Remarks
1	143	L	1955	693-1263		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	143	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	143	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	143	L	1955	658-1248		K Marks; 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	143	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	143	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	143	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	143	L	1955	683-1228		Ordzhonikidze; 10	11.46	22.34	13.04	42.87	5.42	2.88 FeO, 1.76 CaO, trace total Cu, 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] $\text{MgO} + \text{Cr}_2\text{O}_3 + \Sigma X_i$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 7</u>	
683.2	0.0182	653.2	0.0238
903.2	0.0184	898.2	0.0206
1143.2	0.0188	1088.2	0.0189
1263.2	0.0169	1233.2	0.0177
<u>CURVE 2</u>		<u>CURVE 8</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 No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	MgO	Fe ₂ O ₃	CaO	SiO ₂	Al ₂ O ₃	Composition (weight percent)	Composition (continued), Specifications and Remarks
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
<u>CURVE 1*</u>	
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
 $\text{MgO} + \text{SiO}_2 + \Sigma X_i$

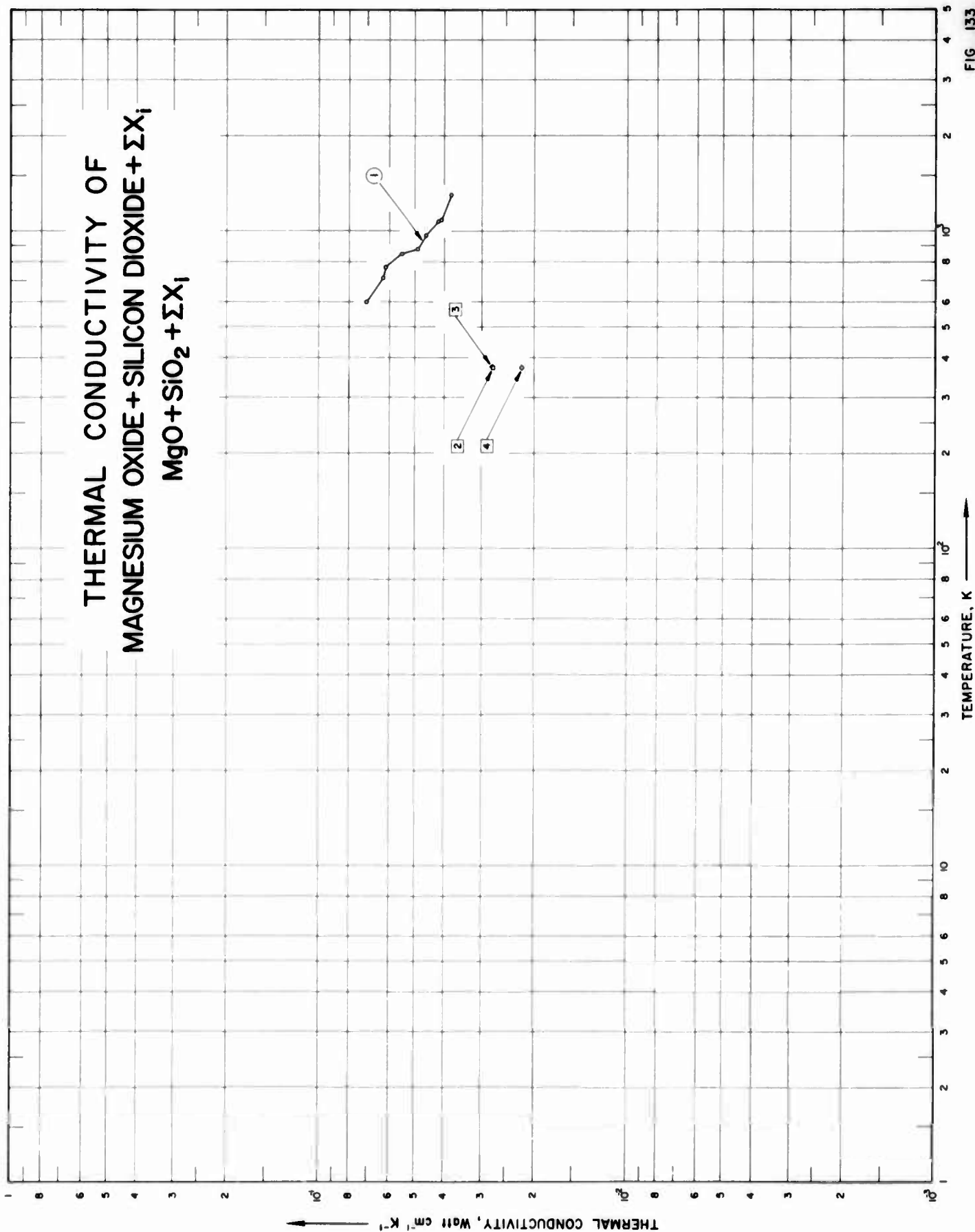


FIG 133

SPECIFICATION TABLE NO. 133 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + SILICON OXIDE + ΣX_i] $\text{MgO} + \text{SiO}_2 + \Sigma X_i$

[For Data Reported in Figure and Table No. 133]

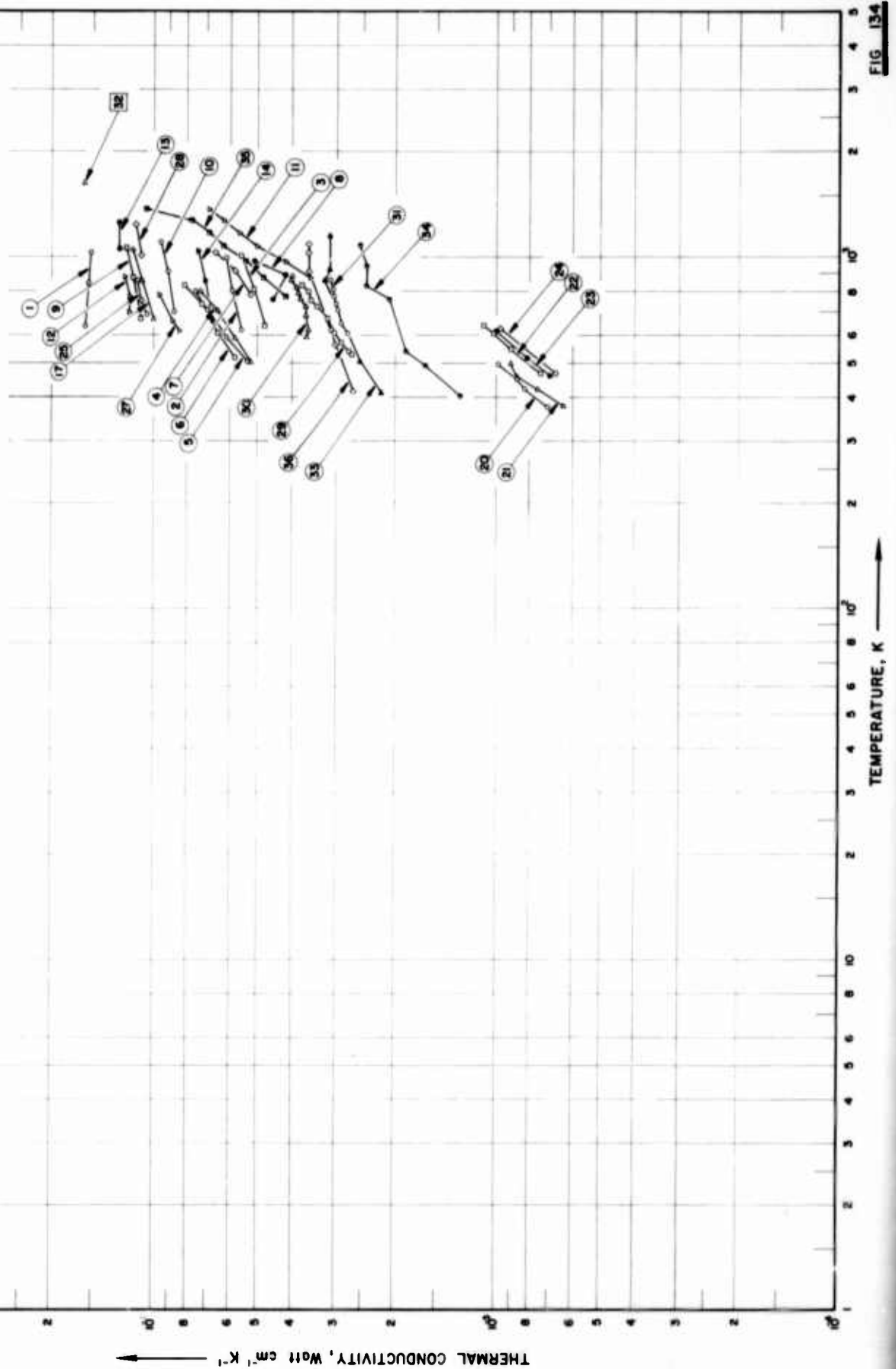
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks
							MgO	SiO ₂	Fe ₂ O ₃	CaO	
1	462	L	1915	598-1303		Magnesia brick (Mabor)	92.1	5.0	1.6	1.7	0.4 Al ₂ O ₃ ; commercial 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. 133 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + SILICON DIOXIDE + ΣX_i] MgO + SiO₂ + ΣX_i
 [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 + ΣX_i
 $\text{SiO}_2 + \text{Al}_2\text{O}_3 + \Sigma X_i$



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. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) SiO_2 Al_2O_3 Fe_2O_3 TiO_2	Composition (continued), Specifications and Remarks
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 Semiluksk 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 58.6%; 2.0% additional shrinkage when exposed at 1350 C for 2 hrs.
4	86	C	1948	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 ml $\text{m}^{-2}\text{hr}^{-1}$; 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 280 ml $\text{m}^{-2}\text{hr}^{-1}$; 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.
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 ml $\text{m}^{-2}\text{hr}^{-1}$; 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 Semiluksk 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. 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
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 Borovichsk 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
13	79	C	1942	1062, 1254		No. 3, aluminous fire clay	52.0	41.3	2.5	2.7
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 Borovichsk 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 Borovichsk factory; density 1.919 g cm ⁻³ ; open porosity 29.0%; 0.3% 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)

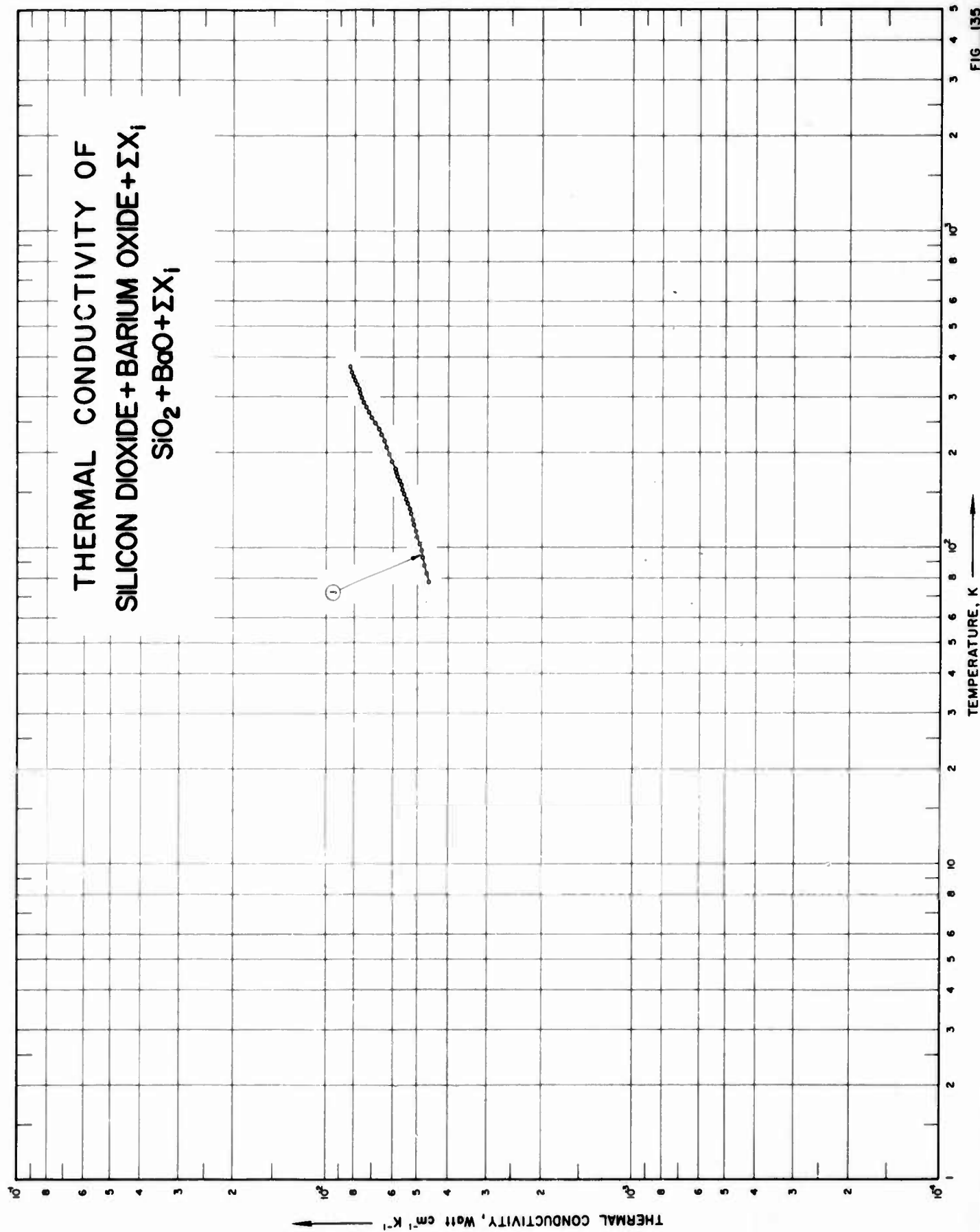
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
							SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂
20	213	C	1956	376-496		Expanded Vermiculite	35.76	18.7	18.3	
							7.82 MgO, 3.61 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. 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 (weight percent)	Composition (continued), Specifications and Remarks
27	79	L	1942	618-784		Fire clay brick; 2	56.46	36.79	2.58	1.34		1.24 alkali oxides 0.50 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		Fire clay brick; 2	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		Egyptian fire clay brick; A	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	593-881		Egyptian fire clay brick; B	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		Egyptian fire clay brick; C	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	1.0	Fire clay wall; 26	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		α	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		γ	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		Fire-brick D	68.38	26.12	2.50			Close structure; not much clay grog, 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 17.5%; 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		Fire clay brick (Farnley)	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		Fire clay brick (Farnley)	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 1.90 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, 0.30 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 .



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	147	L	1960	78-373	Glass; H	49.8	24.2	8.5 7.8	5.9 PbO , 2.9 Na_2O , 0.7 Sb_2O_3 , and 0.2 As_2O_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	CURVE 1		T	CURVE 1 (cont.)	
	k			k	
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
 $\text{SiO}_2 + \text{B}_2\text{O}_3 + \Sigma X_i$

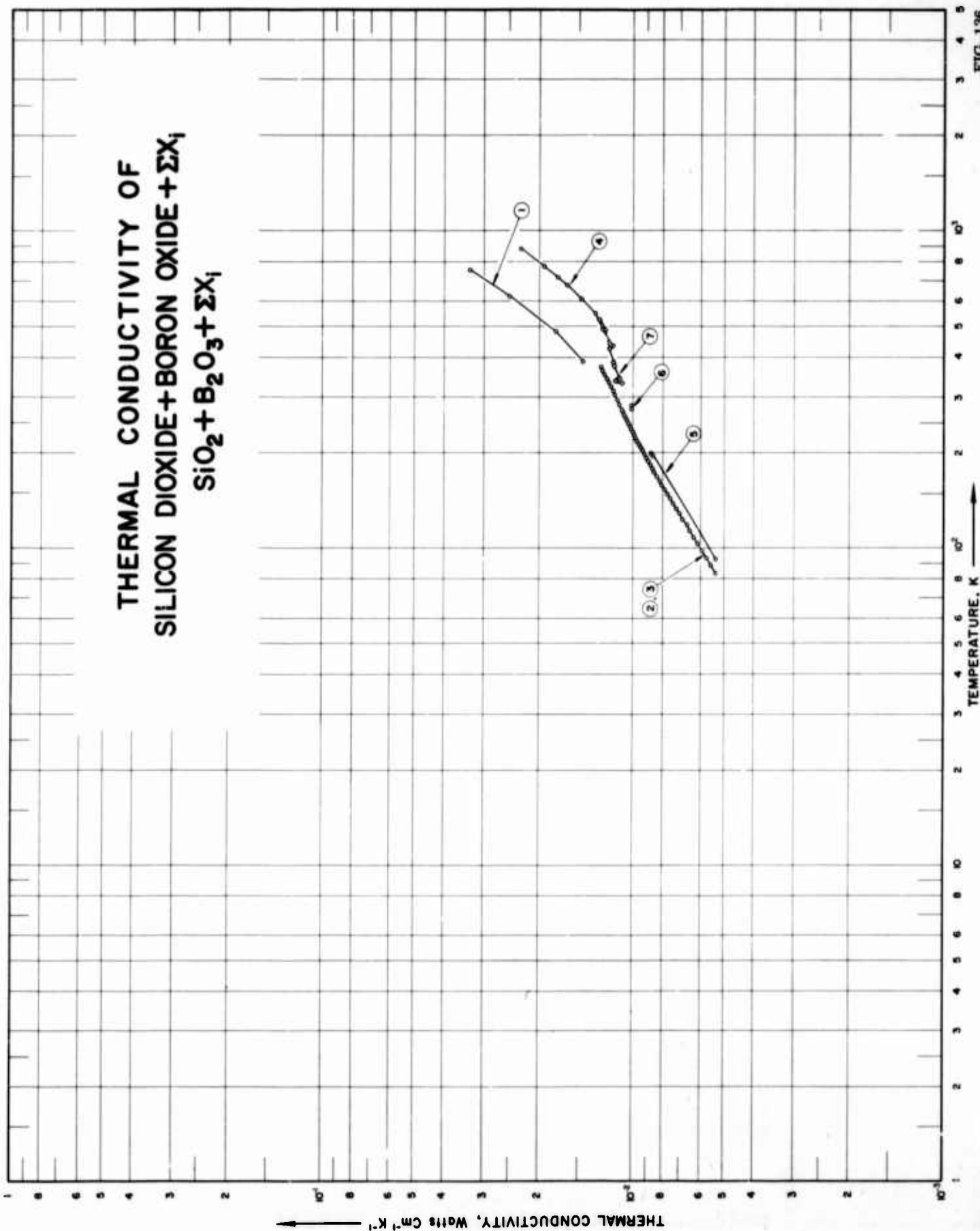


FIG. 136

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. No.	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	±10.0	Pyrex 7740	12.5	81.0	4.0	2.0
5	187	R	1932	92-198		Pyrex glass	12.5	80.5	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.
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>		<u>CURVE 2 (cont.)</u>		<u>CURVE 3 (cont.)</u>		<u>CURVE 4 (cont.)</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>		288.2	0.0112*	198.2	0.00920	715.2	0.0178
83.2	0.00536	293.2	0.0113	203.2	0.00933	768.2	0.0197
88.2	0.00552	298.2	0.0114*	208.2	0.00946	811.2	0.0197
93.2	0.00573	303.2	0.0115	213.2	0.00958	871.2	0.0234
98.2	0.00594	308.2	0.0116*	218.2	0.00971	<u>CURVE 5</u>	
103.2	0.00615	313.2	0.0116	223.2	0.00983	92.2	0.00540
108.2	0.00632	318.2	0.0117*	228.2	0.00992	195.5	0.00879
113.2	0.00653	323.2	0.0118	233.2	0.0100	198.3	0.00891
118.2	0.00669	328.2	0.0119*	238.2	0.0102	<u>CURVE 6</u>	
123.2	0.00690	333.2	0.0120	243.2	0.0103	275.0	0.0103
128.2	0.00707	338.2	0.0121*	248.2	0.0104	279.2	0.0103
133.2	0.00724	343.2	0.0122	253.2	0.0105	<u>CURVE 7</u>	
138.2	0.00741	348.2	0.0123*	258.2	0.0106	328.2	0.0110
143.2	0.00757	353.2	0.0124	263.2	0.0107	332.7	0.0110*
148.2	0.00774	358.2	0.0125*	268.2	0.0108	338.8	0.0113
153.2	0.00791	363.2	0.0126	273.2	0.0109	343.7	0.0112
158.2	0.00808*	368.2	0.0125*	278.2	0.0111	372.2	0.0116
163.2	0.00820	373.2	0.0127	283.2	0.0112	378.4	0.0116*
168.2	0.00837*	<u>CURVE 3*</u>		288.2	0.0112	385.2	0.0117
173.2	0.00854	83.2	0.00536	293.2	0.0113	423.2	0.0121
178.2	0.00866*	88.2	0.00552	298.2	0.0114	428.2	0.0121*
183.2	0.00879	93.2	0.00573	303.2	0.0115	482.2	0.0126
188.2	0.00895*	98.2	0.00594	308.2	0.0116	488.6	0.0127*
193.2	0.00908	103.2	0.00615	313.2	0.0116	523.2	0.0131
198.2	0.00920*	108.2	0.00632	318.2	0.0117	<u>CURVE 4</u>	
203.2	0.00933	113.2	0.00653	323.2	0.0118	430.2	0.0118
208.2	0.00946*	118.2	0.00669	328.2	0.0119	<u>CURVE 5</u>	
213.2	0.00958	123.2	0.00690	333.2	0.0120	248.2	0.0104*
218.2	0.00971*	128.2	0.00707	338.2	0.0121	253.2	0.0105
223.2	0.00983	133.2	0.00724	343.2	0.0122	258.2	0.0106*
228.2	0.00992*	138.2	0.00741	348.2	0.0123	263.2	0.0107
233.2	0.0100	143.2	0.00757	353.2	0.0124	<u>CURVE 6</u>	
238.2	0.0102*	148.2	0.00774	358.2	0.0125	430.2	0.0118
243.2	0.0103	153.2	0.00791	363.2	0.0126	<u>CURVE 7</u>	
248.2	0.0104*	158.2	0.00808	368.2	0.0127	248.2	0.0104*
253.2	0.0105	163.2	0.00820	<u>CURVE 4</u>		253.2	0.0105
258.2	0.0106*	168.2	0.00837	430.2	0.0118	258.2	0.0106*
263.2	0.0107	173.2	0.00854	<u>CURVE 5</u>		263.2	0.0107

* Not shown on plot

THERMAL CONDUCTIVITY OF
SILICON DIOXIDE + CALCIUM OXIDE + ΣX_i
 $\text{SiO}_2 + \text{CaO} + \Sigma X_i$

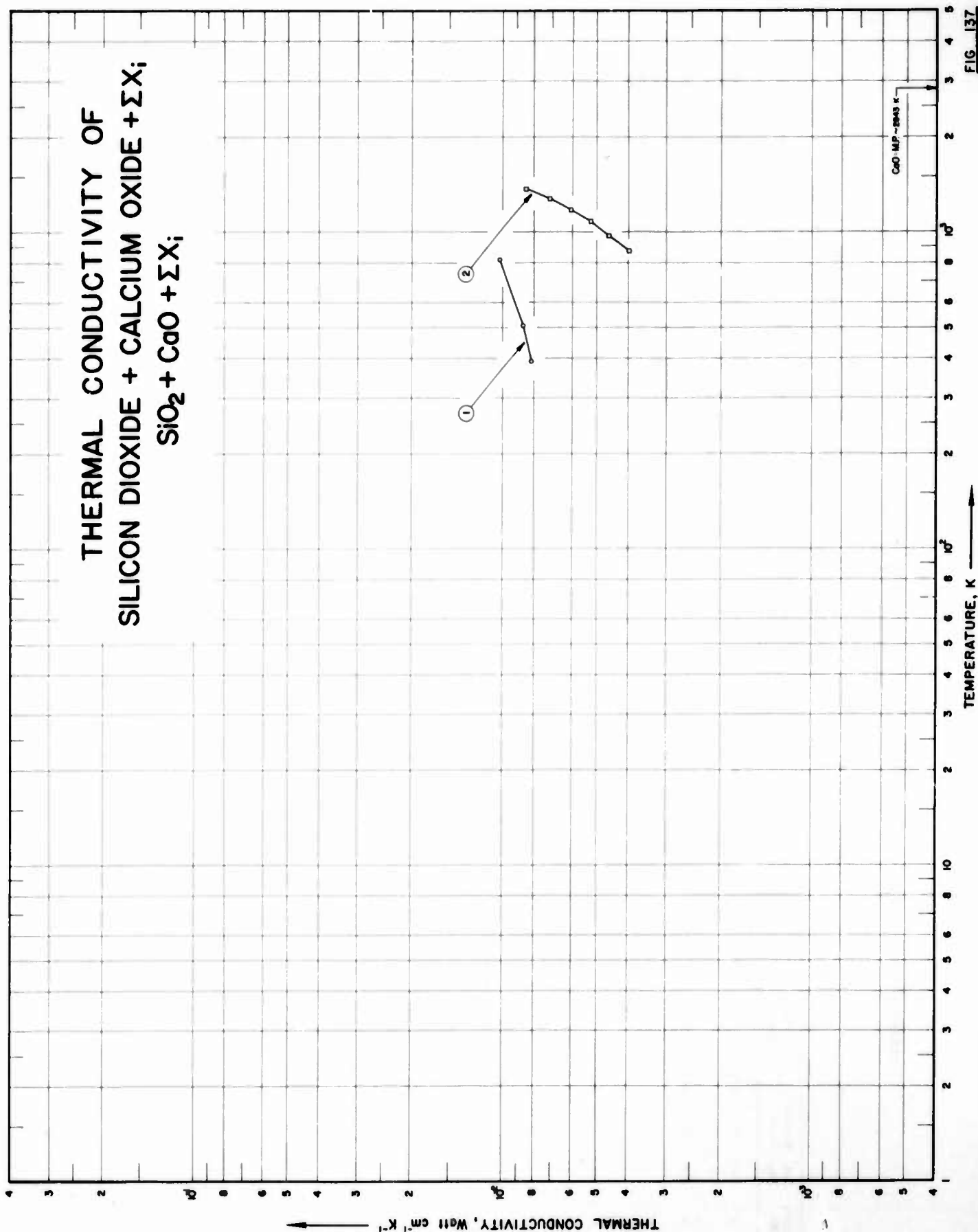


FIG 137

SPECIFICATION TABLE NO. 137 THERMAL CONDUCTIVITY OF [SILICON DIOXIDE + CALCIUM OXIDE + ΣX_i] $\text{SiO}_2 + \text{CaO} + \Sigma X_i$

[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: $9 \times 4.5 \times 2.5 \text{ in.}$; heat 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, Watt $\text{cm}^{-1}\text{K}^{-1}$]

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

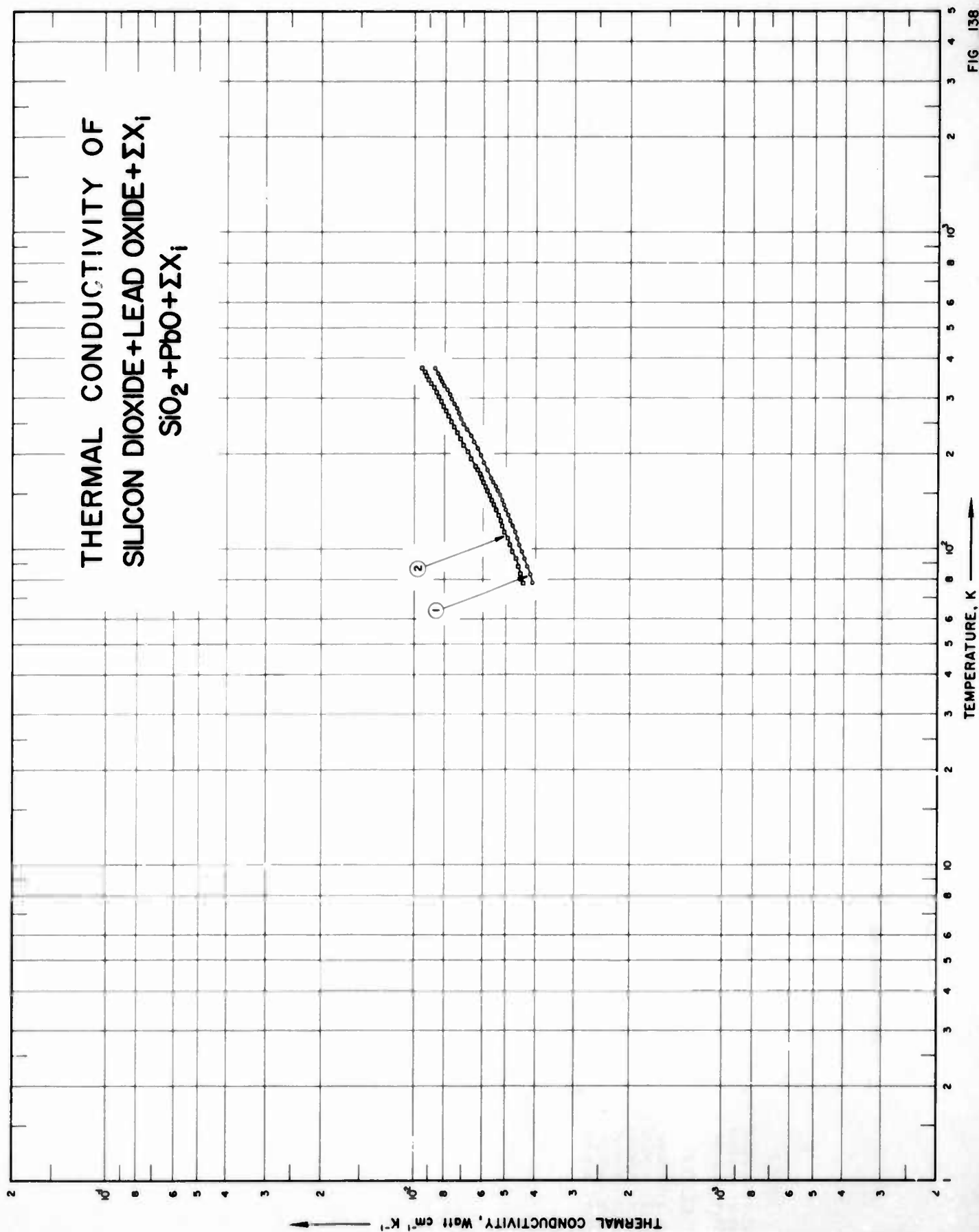


FIG 138

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]

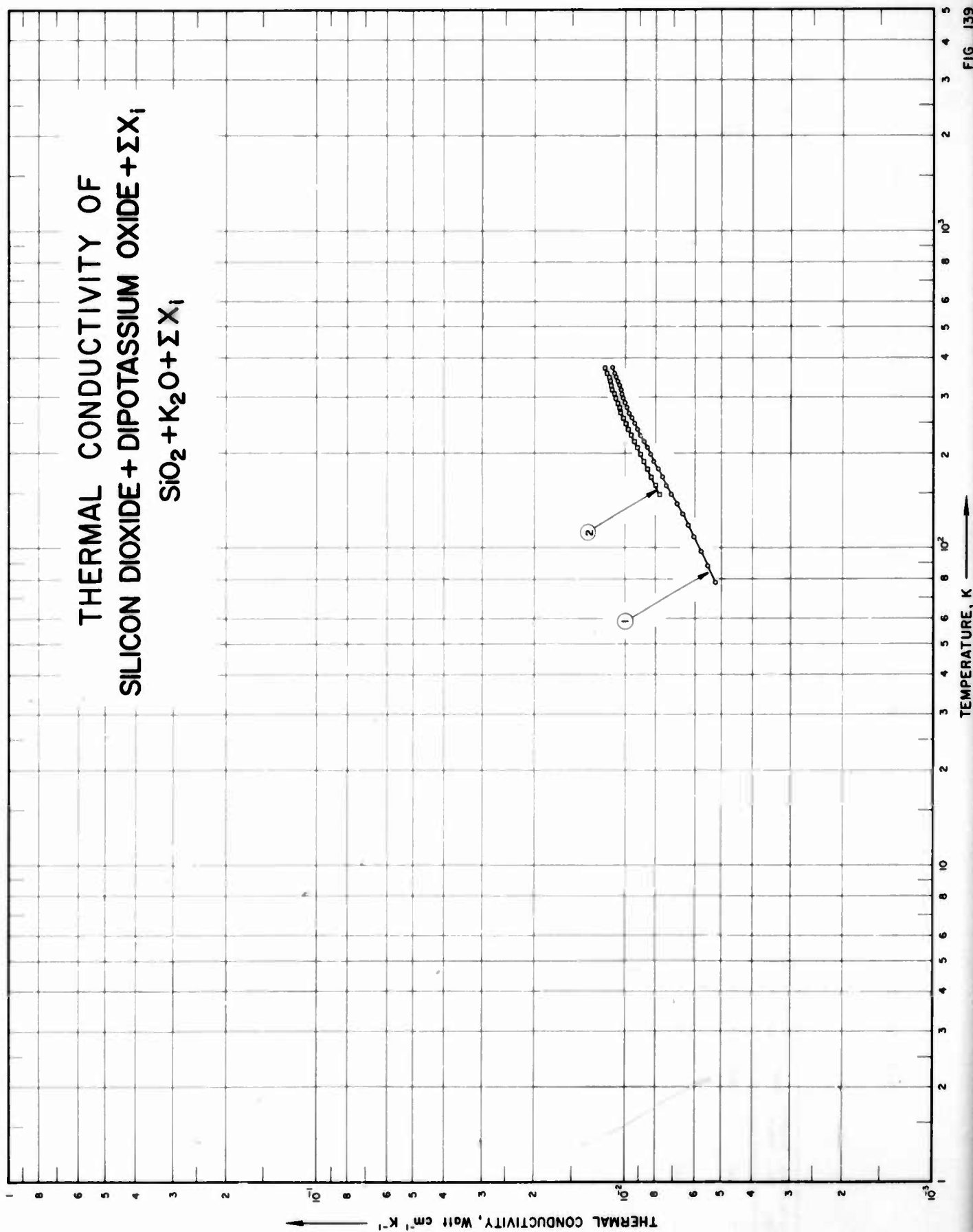
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks
							SiO ₂	PbO	K ₂ O	Al ₂ O ₃	
1	147	L	1960	78-373		Glass; I	46.0	44.8	9.2	0.2	3 in. dia x 0.375 in. thick; density 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					303.2	0.00837	
173.2	0.00573*		78.2	0.00439		308.2	0.00845*	
178.2	0.00582		83.2	0.00448		313.2	0.00854	
183.2	0.00590*		88.2	0.00456		318.2	0.00862*	
188.2	0.00598		93.2	0.00464		323.2	0.00870	
193.2	0.00602*		98.2	0.00477		328.2	0.00879*	
198.2	0.00611		103.2	0.00485		333.2	0.00887	
203.2	0.00619*		108.2	0.00494		338.2	0.00895*	
208.2	0.00628		113.2	0.00506		343.2	0.00904	
213.2	0.00636*		118.2	0.00515		348.2	0.00912*	
218.2	0.00644		123.2	0.00523		353.2	0.00916	
223.2	0.00649*		128.2	0.00531		358.2	0.00925*	
228.2	0.00657		133.2	0.00544		363.2	0.00929	
233.2	0.00665*		138.2	0.00552		368.2	0.00937*	
238.2	0.00678		143.2	0.00561		373.2	0.00946	
243.2	0.00686*		148.2	0.00573				
248.2	0.00695		153.2	0.00582				
253.2	0.00703*		158.2	0.00590				
258.2	0.00707		163.2	0.00598				
263.2	0.00711*		168.2	0.00607				
268.2	0.00720		173.2	0.00615				
273.2	0.00728*		178.2	0.00628				
278.2	0.00732		183.2	0.00636				
283.2	0.00736*		188.2	0.00644*				
288.2	0.00745		193.2	0.00657				
293.2	0.00753*		198.2	0.00665*				
298.2	0.00761		203.2	0.00674				
			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 + DIPOPOTASSIUM OXIDE + ΣX_1] $\text{SiO}_2 + \text{K}_2\text{O} + \Sigma X_1$

[For Data Reported in Figure and Table No. 139]

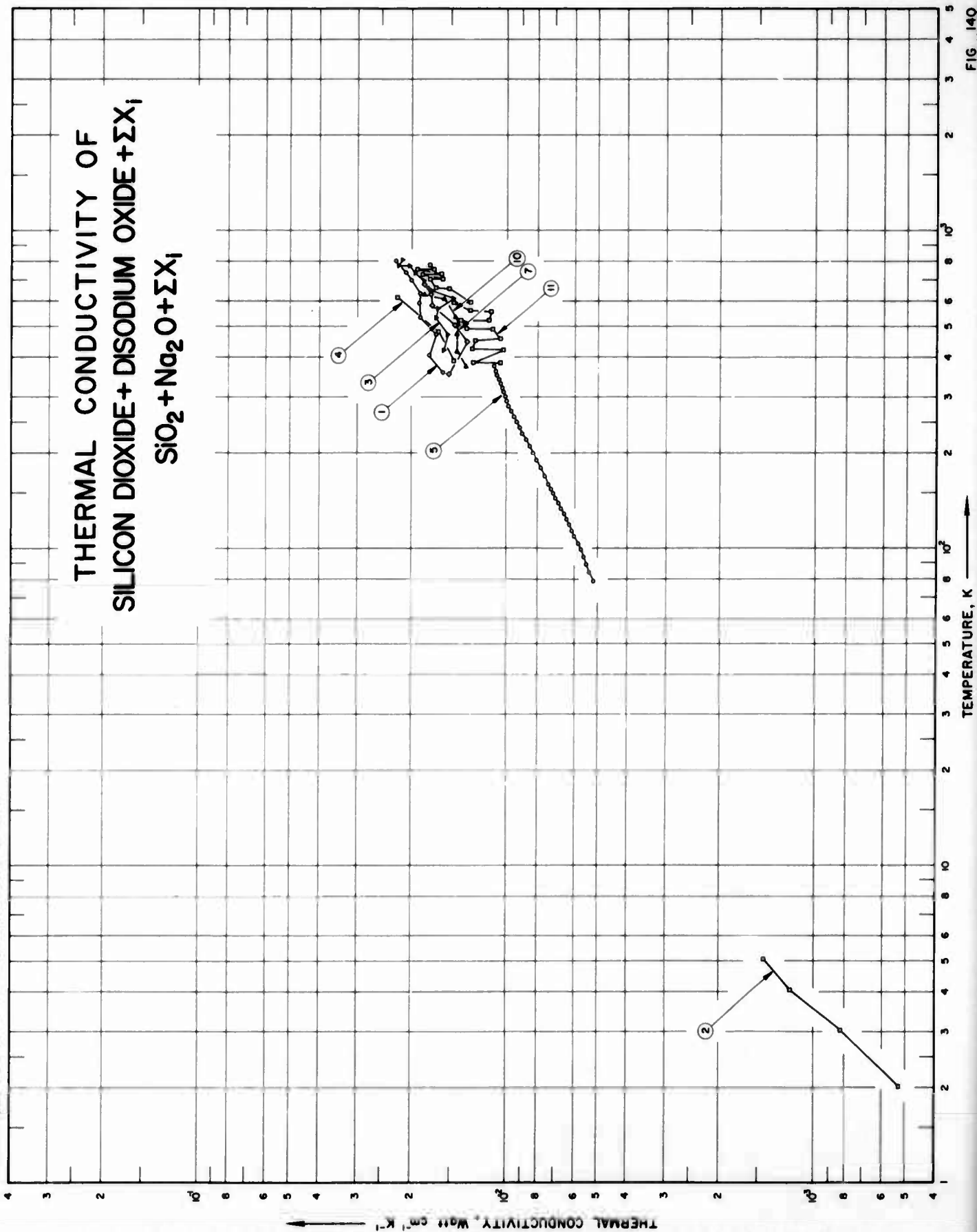
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)				Composition (continued), Specifications and Remarks
							SiO_2	K_2O	Na_2O	CaO	
1	147	L	1960	78-373		Glass; D	71.2	14.5	7.6	5.5	3.0 ZnO , 2.9 B_2O_3 , 0.8 Sb_2O_3 , 0.1 Al_2O_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_2O_3 , 0.4 Al_2O_3 , 0.4 Sb_2O_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] $\text{SiO}_2 + \text{K}_2\text{O} + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	CURVE 1		T	k	CURVE 1 (cont.)		T	k	CURVE 2 (cont.)	
		T	k			T	k			T	k
78.2	0.00519	306.2	0.01025	306.2	0.01067*	293.2	0.01067*	293.2	0.01067*	293.2	0.01067*
83.2	0.00536*	313.2	0.01029*	313.2	0.01075	298.2	0.01075	298.2	0.01075	298.2	0.01075
88.2	0.00548	318.2	0.01033	318.2	0.01084*	303.2	0.01084*	303.2	0.01084*	303.2	0.01084*
93.2	0.00561*	323.2	0.01042*	323.2	0.01088	308.2	0.01088	308.2	0.01088	308.2	0.01088
98.2	0.00573	328.2	0.01050	328.2	0.01096*	313.2	0.01096*	313.2	0.01096*	313.2	0.01096*
103.2	0.00586*	333.2	0.01054*	333.2	0.01105	318.2	0.01105	318.2	0.01105	318.2	0.01105
108.2	0.00602	338.2	0.01063	338.2	0.01109*	323.2	0.01109*	323.2	0.01109*	323.2	0.01109*
113.2	0.00615*	343.2	0.01071*	343.2	0.01113	328.2	0.01113	328.2	0.01113	328.2	0.01113
118.2	0.00628	348.2	0.01075	348.2	0.01121*	333.2	0.01121*	333.2	0.01121*	333.2	0.01121*
123.2	0.00640*	353.2	0.01079*	353.2	0.01125	338.2	0.01125	338.2	0.01125	338.2	0.01125
128.2	0.00653	358.2	0.01084*	358.2	0.01130*	343.2	0.01130*	343.2	0.01130*	343.2	0.01130*
133.2	0.00669*	363.2	0.01088*	363.2	0.01138	348.2	0.01138	348.2	0.01138	348.2	0.01138
138.2	0.00682	368.2	0.01096*	368.2	0.01146*	353.2	0.01146*	353.2	0.01146*	353.2	0.01146*
143.2	0.00699*	373.2	0.01100	373.2	0.01151	358.2	0.01151	358.2	0.01151	358.2	0.01151
148.2	0.00711				0.01159*	363.2	0.01159*	363.2	0.01159*	363.2	0.01159*
153.2	0.00724*				0.01163*	368.2	0.01163*	368.2	0.01163*	368.2	0.01163*
158.2	0.00736				0.01172	373.2	0.01172	373.2	0.01172	373.2	0.01172
163.2	0.00745*										
168.2	0.00757										
173.2	0.00770*										
178.2	0.00782										
183.2	0.00795*										
188.2	0.00808										
193.2	0.00820*										
198.2	0.00828										
203.2	0.00841*										
208.2	0.00849										
213.2	0.00862*										
218.2	0.00874										
223.2	0.00887*										
228.2	0.00895										
233.2	0.00904*										
238.2	0.00912										
243.2	0.00925*										
248.2	0.00933										
253.2	0.00941*										
258.2	0.00950										
263.2	0.00958*										
268.2	0.00971										
273.2	0.00979*										
278.2	0.00987										
283.2	0.00992*										
288.2	0.01000										
293.2	0.01004*										
298.2	0.01013										
303.2	0.01017*										

* Not shown on plot

FIGURE SHOWS ONLY 8 OF THE CURVES REPORTED IN TABLE



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	SiO ₂	Na ₂ O	CaO	Al ₂ O ₃	MgO	Composition (continued), Specifications and Remarks
1	136	R	1959	355-795	±10	Silicate glass	69.05	16.38	7.37	3.05	2.80	0.55 Na ₂ SO ₄ , 0.48 K ₂ O, 0.12 NaCl, 0.09 Fe ₂ O 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 ₂ O ₃ , 0.35 K ₂ O, 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 ₂ O, 0.24 Na ₂ SO ₄ , 0.12 NaCl, 0.11 Fe ₂ O ₃ , 0.013 CaO, and 0.013 NiO.
4	34	C	1943	386-611		Soda-lime glass	69.73	20.96	9.05			0.18B ₂ O ₃ , and trace K ₂ O.
5	147	L	1960	78-373		Glass E	67.7	14.6	5.4	1.8		4.0 B ₂ O ₃ , 3.3 BaO, 1.8 K ₂ O, 1.3 Fe ₂ O ₃ , <1.0 As ₂ 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 ₂ SO ₄ , 0.14 Fe ₂ O 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 ₂ SO ₄ , 0.56 Fe ₂ O 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	2.80	0.55 Na ₂ O ₃ , 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.
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 ₂ O, 0.24 Na ₂ SO ₄ , 0.12 NaCl, 0.11 Fe ₂ O 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 ₂ O 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 + SODIUM OXIDE + ΣX_i] $\text{SiO}_2 + \text{Na}_2\text{O} + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

CURVE 1			CURVE 5 (cont.)			CURVE 5 (cont.)			CURVE 9*			CURVE 11 (cont.)		
T	k		T	k		T	k		T	k		T	k	
355.2	0.0159		108.2	0.00602		333.2	0.01054*		421.2	0.01540		746.7	0.0192	
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				
629.2	0.0188		133.2	0.00670		358.2	0.01084		633.2	0.01736				
691.2	0.0201		138.2	0.00682		363.2	0.01088*		686.2	0.01820				
732.2	0.0209		143.2	0.00699		368.2	0.01096*		738.2	0.01979				
795.2	0.0226		148.2	0.00711		373.2	0.01100		770.2	0.02042				
			153.2	0.00724					771.2	0.02192				
			158.2	0.00736					806.2	0.02167				
			163.2	0.00745*										
			168.2	0.00757										
2	0.00053		173.2	0.00770*		497.2	0.01736							
3	0.00083		178.2	0.00782		536.2	0.01866							
4	0.00119		183.2	0.00795*		570.2	0.01632							
5	0.00144		188.2	0.00808		615.2	0.01778							
			193.2	0.00820*		675.2	0.02038							
			198.2	0.00828		716.2	0.02075							
			203.2	0.00841*		760.2	0.02163							
			208.2	0.00849		793.2	0.02042							
			213.2	0.00862*		826.2	0.02159							
			218.2	0.00874										
			223.2	0.00887*										
			228.2	0.00895										
			233.2	0.00904*										
			238.2	0.00912										
			243.2	0.00925*										
			248.2	0.00933										
			253.2	0.00941*										
			258.2	0.00950										
			263.2	0.00958*										
			268.2	0.00971										
			273.2	0.00980*										
			278.2	0.00987										
			283.2	0.00992*										
			288.2	0.01000										
			293.2	0.01004*										
			298.2	0.01013										
			303.2	0.01017*										
			308.2	0.01025										
			313.2	0.01029*										
			318.2	0.01033										
			323.2	0.01042*										
			328.2	0.01050										

CURVE 2			CURVE 6*			CURVE 10			CURVE 13*		
T	k		T	k		T	k		T	k	
418.2	0.0158		497.2	0.01736		368.2	0.0135		433.2	0.0155	
468.2	0.0154		536.2	0.01866		413.2	0.0144		488.2	0.0154	
528.2	0.0167		570.2	0.01632		467.2	0.0144		546.2	0.0167	
565.2	0.0165		615.2	0.01778		503.2	0.0143		593.2	0.0168	
609.2	0.0147		675.2	0.02038		527.2	0.0146		656.2	0.0168	
642.2	0.0173		716.2	0.02075		603.2	0.0157		768.2	0.0205	
693.2	0.0183		760.2	0.02163		622.2	0.0183		888.2	0.0251	
732.2	0.0195		793.2	0.02042		685.2	0.0180*				
769.2	0.0203		826.2	0.02159							
770.2	0.0220										
804.2	0.0214										

CURVE 3			CURVE 7			CURVE 11			CURVE 14*		
T	k		T	k		T	k		T	k	
418.2	0.0158		350.2	0.01527		381.2	0.0105		509.2	0.0180	
468.2	0.0154		443.2	0.01347		383.2	0.0128		568.2	0.0182	
528.2	0.0167		499.2	0.01467		419.2	0.0102		624.2	0.0177	
565.2	0.0165		579.2	0.01607		423.2	0.0129		699.2	0.0177	
609.2	0.0147		625.2	0.01724		449.2	0.0126		753.2	0.0188	
642.2	0.0173		672.2	0.01824		454.2	0.0105		793.2	0.0194	
693.2	0.0183		724.2	0.01987*		486.2	0.0111		839.2	0.0209	
732.2	0.0195					488.2	0.0134				
769.2	0.0203					519.2	0.0140				
770.2	0.0220					519.7	0.0114				
804.2	0.0214					550.2	0.0112				

CURVE 4			CURVE 8*			CURVE 12*		
T	k		T	k		T	k	
386.2	0.0147		361.2	0.01527		393.2	0.0184	
478.2	0.0164		404.2	0.01707		523.2	0.0169	
611.2	0.0223		471.2	0.01648		578.2	0.0192	
			545.2	0.01833		641.2	0.0190	
			559.2	0.01831		701.2	0.0203	
			590.2	0.0147		748.2	0.0207	
			590.2	0.0131		793.2	0.0223	
			654.2	0.0152		847.2	0.0251	
			655.2	0.0167				
			696.2	0.0175				
			697.2	0.0159				
			722.7	0.0185				
			724.2	0.0161				

CURVE 5*			CURVE 13*		
T	k		T	k	
78.2	0.00519		433.2	0.0155	
83.2	0.00536		488.2	0.0154	
88.2	0.00548		546.2	0.0167	
93.2	0.00561		593.2	0.0168	
98.2	0.00573		656.2	0.0168	
103.2	0.00586		768.2	0.0205	

* Not shown on plot

SPECIFICATION TABLE NO. 141 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + LITHIUM ALUMINATE + ΣX_1] $\text{SrO} + \text{Li}_2\text{O} \cdot \text{Al}_2\text{O}_3 + \Sigma X_1$

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
							SrO	Li ₂ O·Al ₂ O ₃	Al ₂ O ₃	
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] $\text{SrO} + \text{Li}_2\text{O} \cdot \text{Al}_2\text{O}_3 + \Sigma X_1$ [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
 $\text{SrO} + \text{Li}_2\text{O} \cdot \text{ZrO} \cdot \text{SiO}_2 + \Sigma X_i$

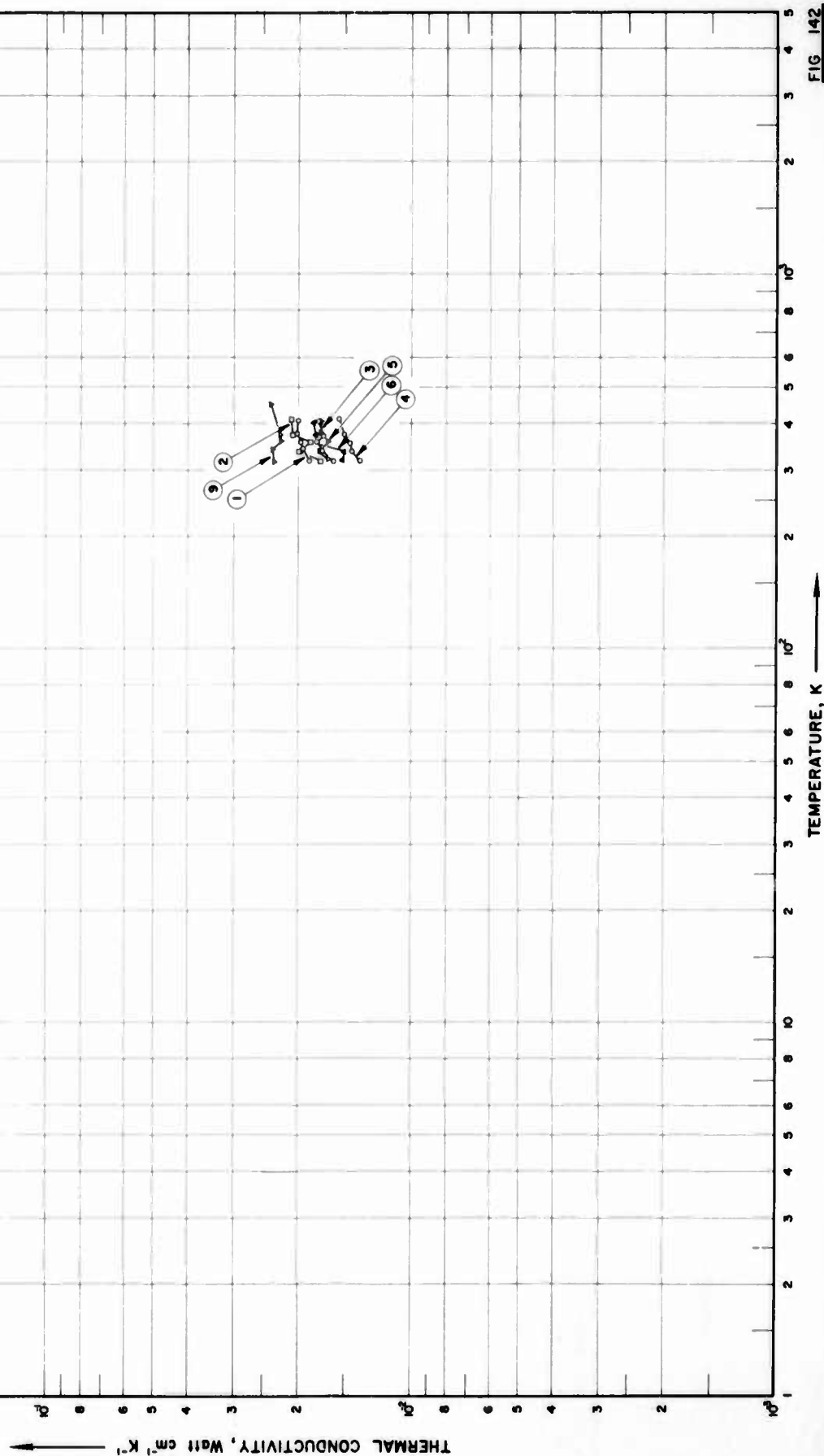


FIG. 142

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]

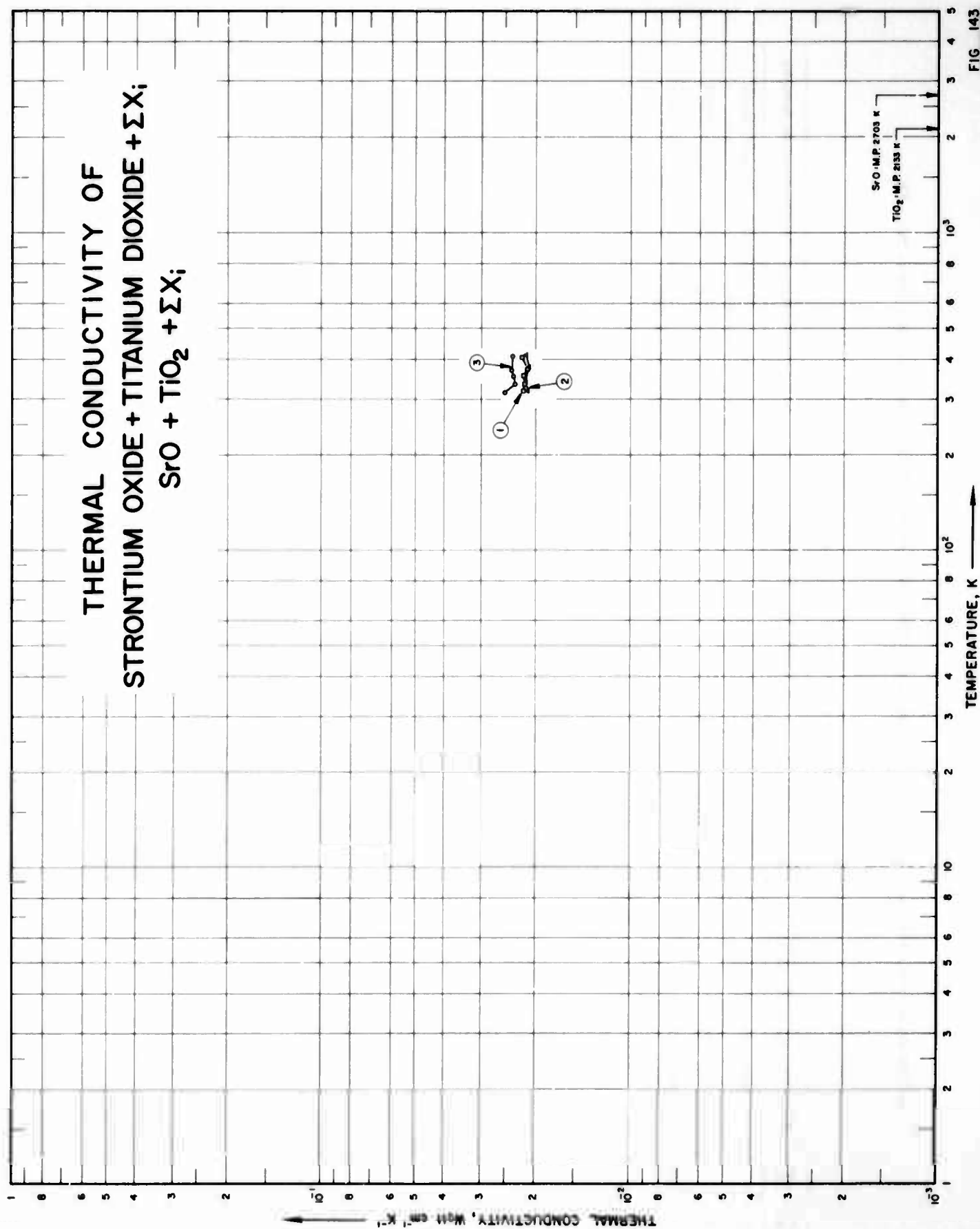
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
							SrO	$\text{Li}_2\text{O} \cdot \text{ZrO} \cdot \text{SiO}_2$	Al_2O_3	
1	42	L	1953	320-410		232A-1	69.0	14.5	16.5	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 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		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] $\text{SrO} + \text{Li}_2\text{O} \cdot \text{ZrO} \cdot \text{SiO}_2 + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	T	k
CURVE 1		CURVE 7*	
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
CURVE 2		CURVE 8*	
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
CURVE 3		CURVE 9	
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
CURVE 4			
320.5	0.0137		
338.3	0.0144		
356.3	0.0146		
376.1	0.0152		
412.3	0.0156		
CURVE 5			
322.1	0.0166		
339.9	0.0171		
359.5	0.0167		
376.7	0.0174		
405.9	0.0175		
CURVE 6			
319.4	0.0153		
336.2	0.0151		
352.8	0.0182*		
373.1	0.0181		
403.5	0.0184		

* Not shown on Plot

THERMAL CONDUCTIVITY OF
STRONTIUM OXIDE + TITANIUM DIOXIDE + ΣX_i
 $SrO + TiO_2 + \Sigma X_i$



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 No. 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
 $\text{SrO} + \text{ZnO} + \Sigma X_i$

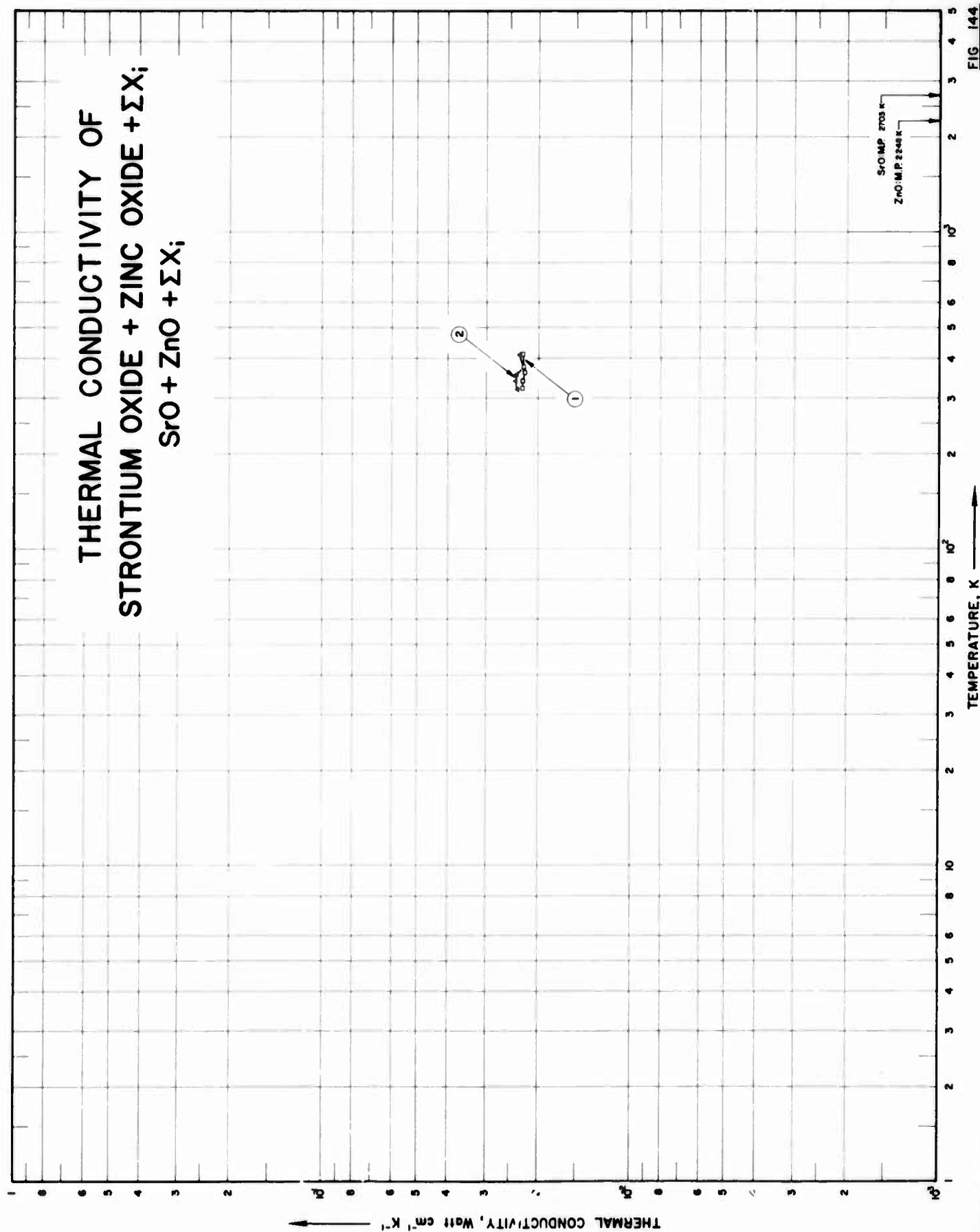


FIG. 144

SPECIFICATION TABLE NO. 144 THERMAL CONDUCTIVITY OF [STRONTIUM OXIDE + ZINC OXIDE + ΣX_1] $\text{SrO} + \text{ZnO} + \Sigma X_1$

[For Data Reported in Figure and Table No. 144]

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	ZnO	$\text{Li}_2\text{O} \cdot \text{ZrO}_2 \cdot \text{SiO}_2$	
1	3	L	1953		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		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
CURVE 1	
321.0	0.0229
340.2	0.0228
367.3	0.0223
376.3	0.0225
414.9	0.0227
CURVE 2	
319.6	0.0236
339.2	0.0240
356.6	0.0239
375.5	0.0224*
414.6	0.0232

* Not shown on Plot

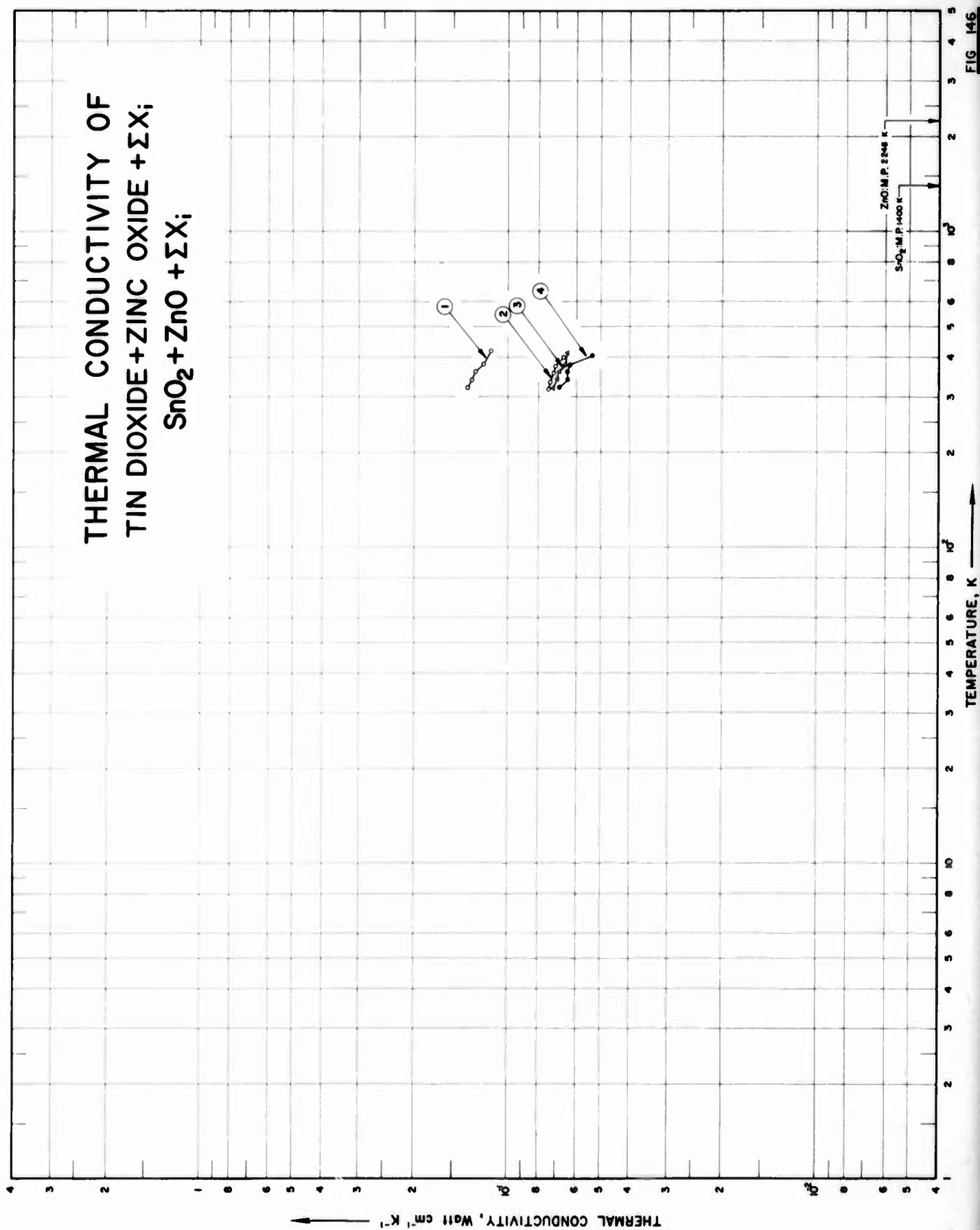
SPECIFICATION TABLE NO. 145 THERMAL CONDUCTIVITY OF [TIN DIOXIDE + MAGNESIUM OXIDE + ΣX_i] $\text{SnO}_2 + \text{MgO} + \Sigma X_i$

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
3MgO + SnO ₂ + 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_i] $\text{SnO}_2 + \text{MgO} + \Sigma X_i$ [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ 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
 $\text{SnO}_2 + \text{ZnO} + \Sigma X_i$



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) SnO_2 ZnO MgO	Composition (continued), Specifications and Remarks
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. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZnO SrO Li_2O ZrO_2 SiO_2	Composition (continued), Specifications and Remarks
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, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T	k
CURVE 1*	
318.0	0.0377
338.1	0.0351
356.1	0.0351
377.7	0.0348
412.6	0.0337

* No graphical presentation

THERMAL CONDUCTIVITY OF
ZINC OXIDE + TIN DIOXIDE + ΣX_i
 $ZnO + SnO_2 + \Sigma X_i$

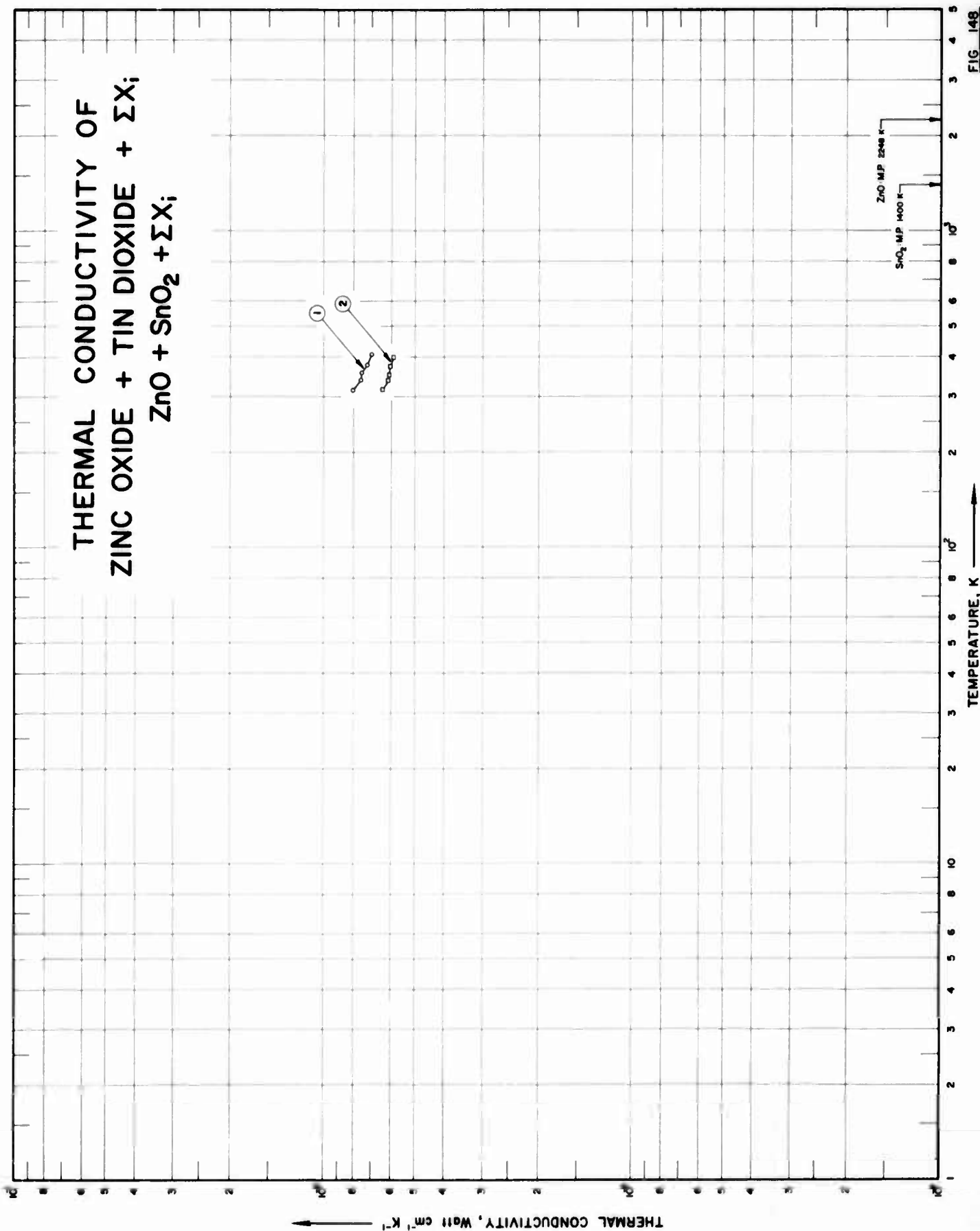


FIG 148

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

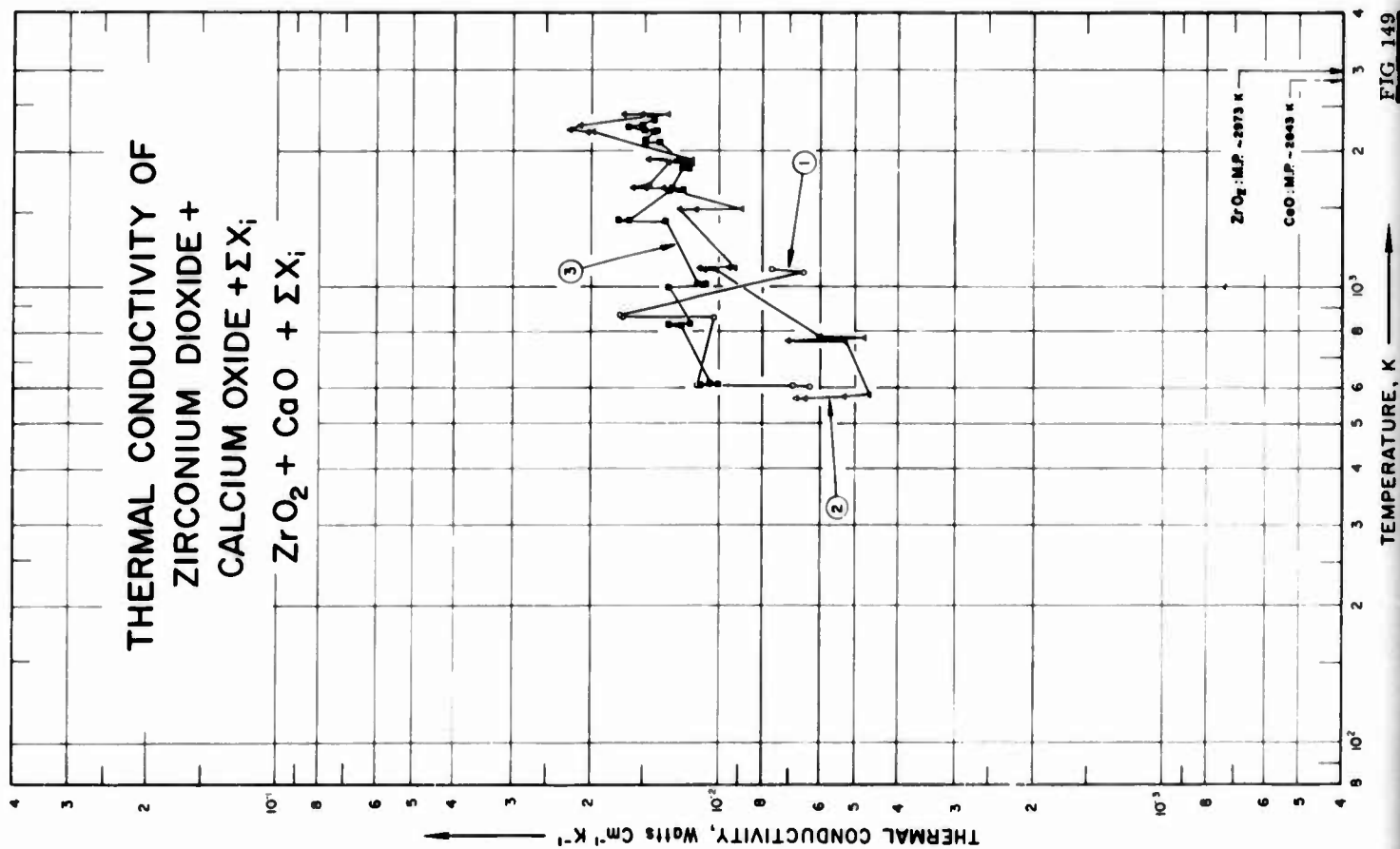


FIG 149

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	CeO ₂	
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 4.153 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.

THERMAL CONDUCTIVITY OF
ZIRCONIUM DIOXIDE + SILICON DIOXIDE + ΣX_i
 $ZrO_2 + SiO_2 + \Sigma X_i$

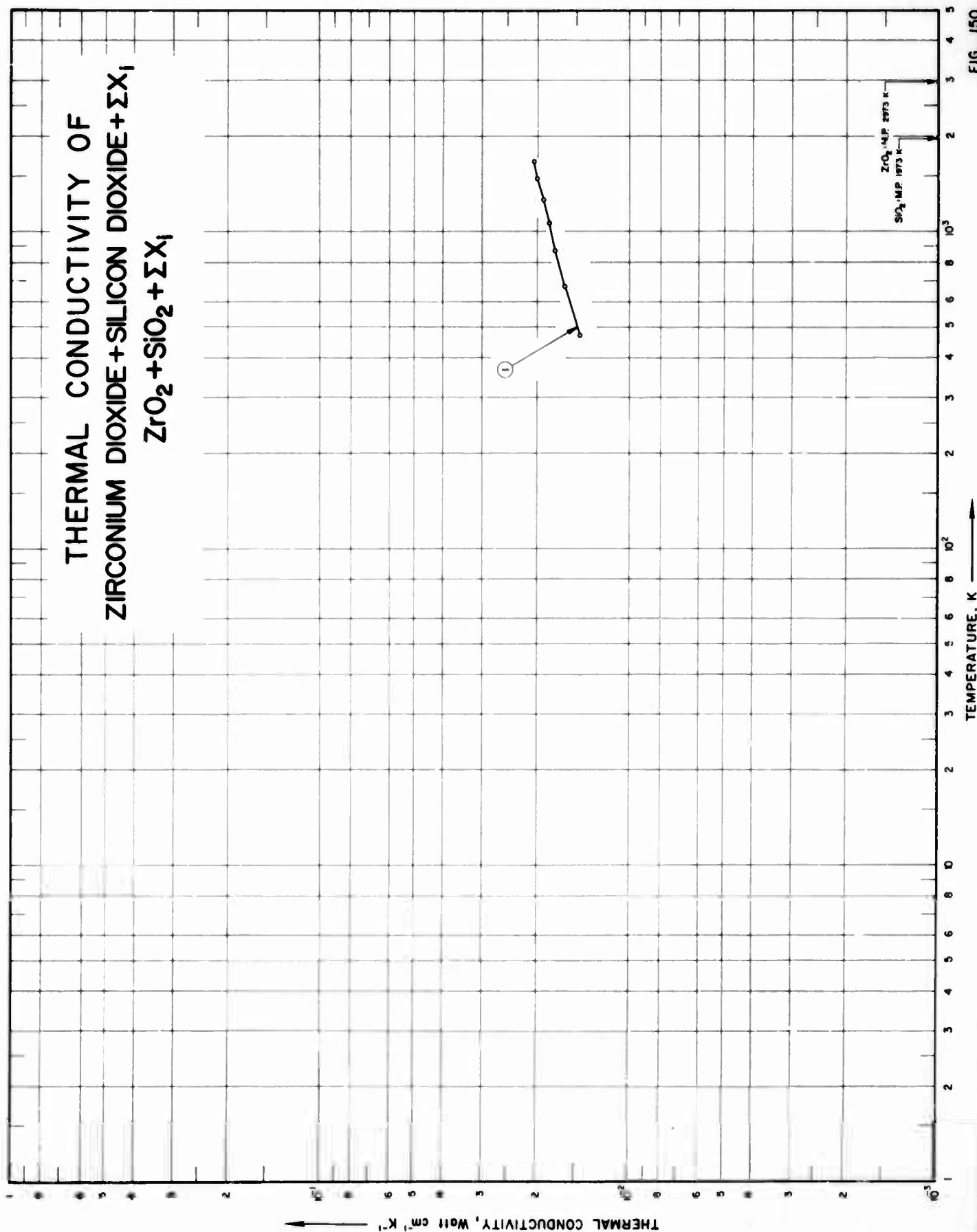


FIG. 150

SPECIFICATION TABLE NO. 150 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + SILICON DIOXIDE + ΣX_i] $ZrO_2 + SiO_2 + \Sigma X_i$

[For Data Reported in Figure and Table No. 150]

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
						ZrO_2	SiO_2	Al_2O_3	
1	383 L	1927	473-1673	± 15	Zirconia brick	60.44	27.26	7.75	1.60 Fe_2O_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] $\text{ZrO}_2 + \text{SiO}_2 + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
CURVE 1	
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
 $ZrO_2+Y_2O_3+\Sigma X_i$

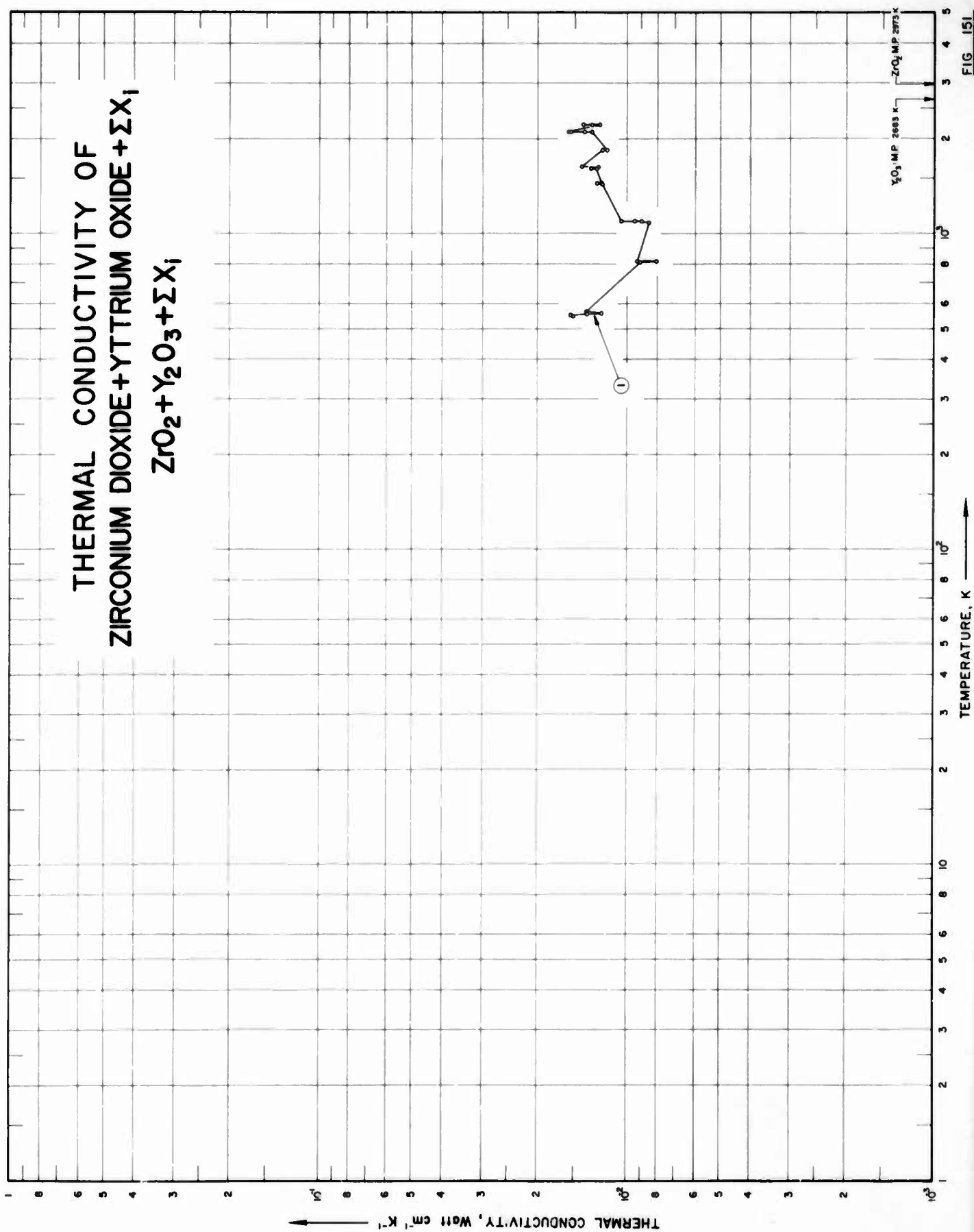


FIG 151

SPECIFICATION TABLE NO. 151 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE + ΣX_1] $ZrO_2 + Y_2O_3 + \Sigma X_1$

[For Data Reported in Figure and Table No. 151]

Curve No.	Ref. No.	Method Used	Temp. Range, K	Year	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZrO_2 Y_2O_3 CeO_2 CaO	Composition (continued), Specifications and Remarks
1	82	R	549-2206	1962			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 (99.9 Y_2O_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] $\text{ZrO}_2 + \text{Y}_2\text{O}_3 + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
CURVE 1	
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

* Not shown on plot

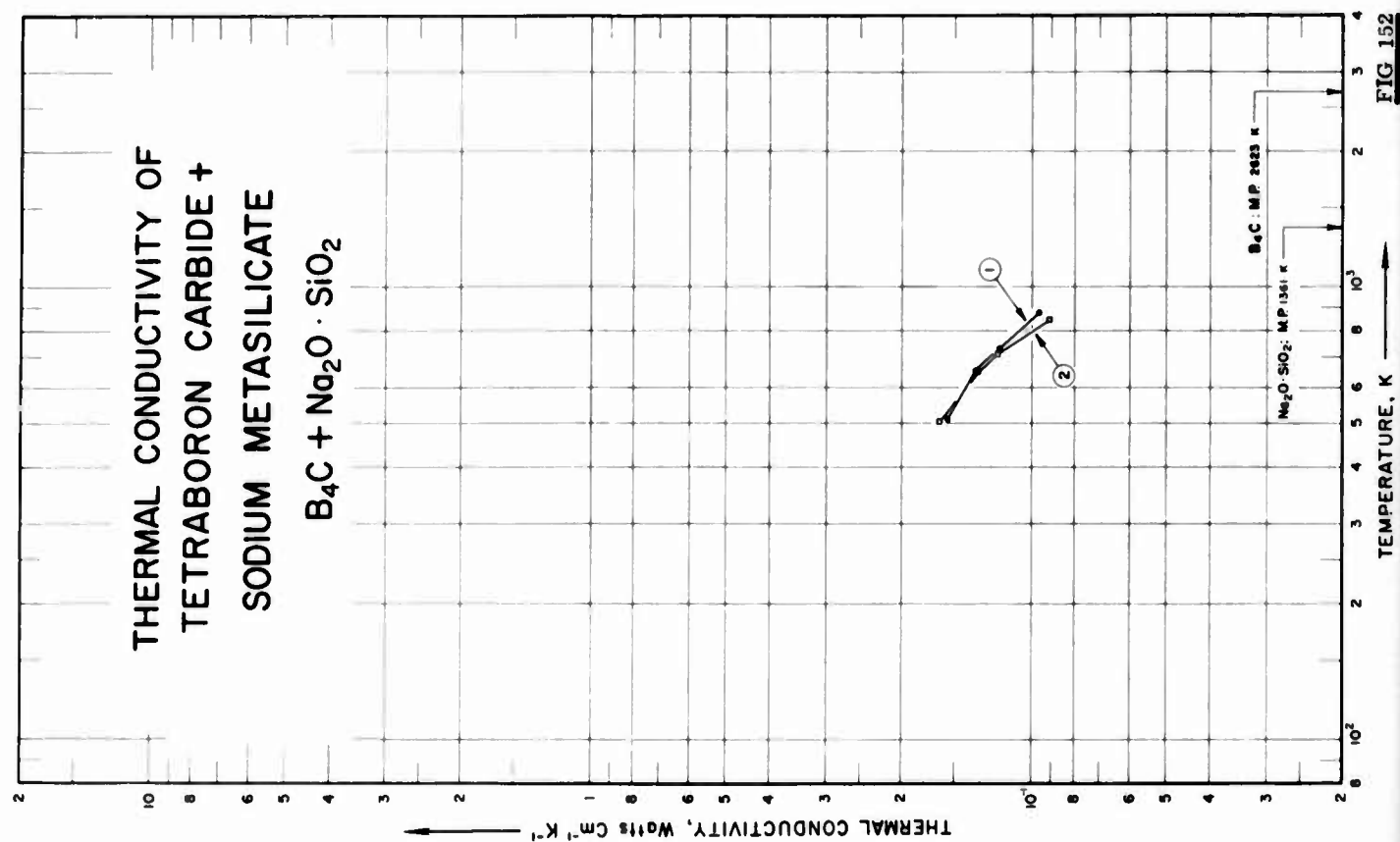


FIG. 152

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. No.	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	76	C	1952	511-873		No. 18	97.85	2.15	Rammed; density 2.06 g cm^{-3} .
2	76	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

CURVE 1

511.2	0.156
653.2	0.134
733.2	0.118
873.2	0.0963

CURVE 2

503.2	0.163
653.2	0.134
718.2	0.120
843.2	0.0918

THERMAL CONDUCTIVITY OF GRAPHITE + THORIUM DIOXIDE C + ThO₂

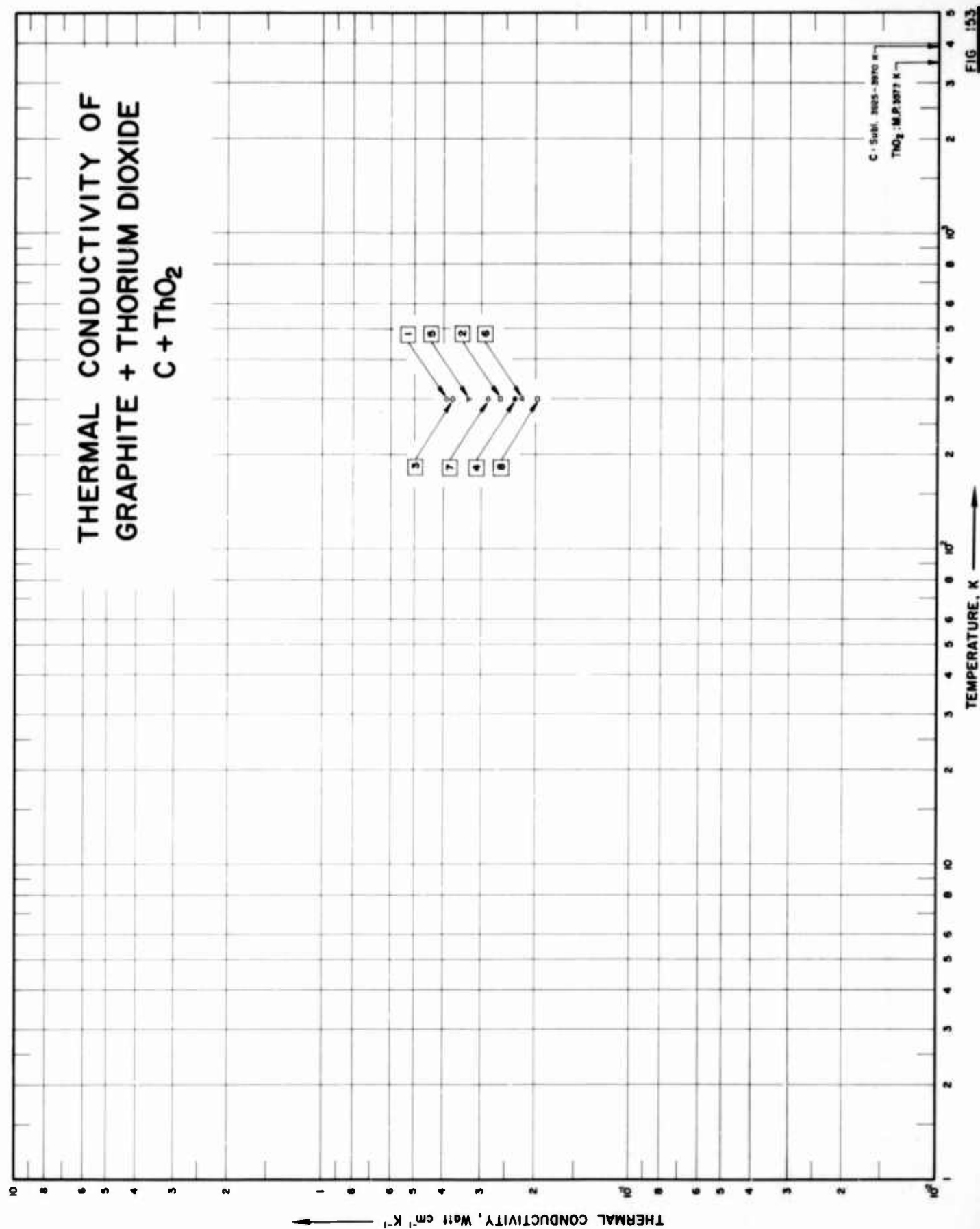


FIG. 153

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

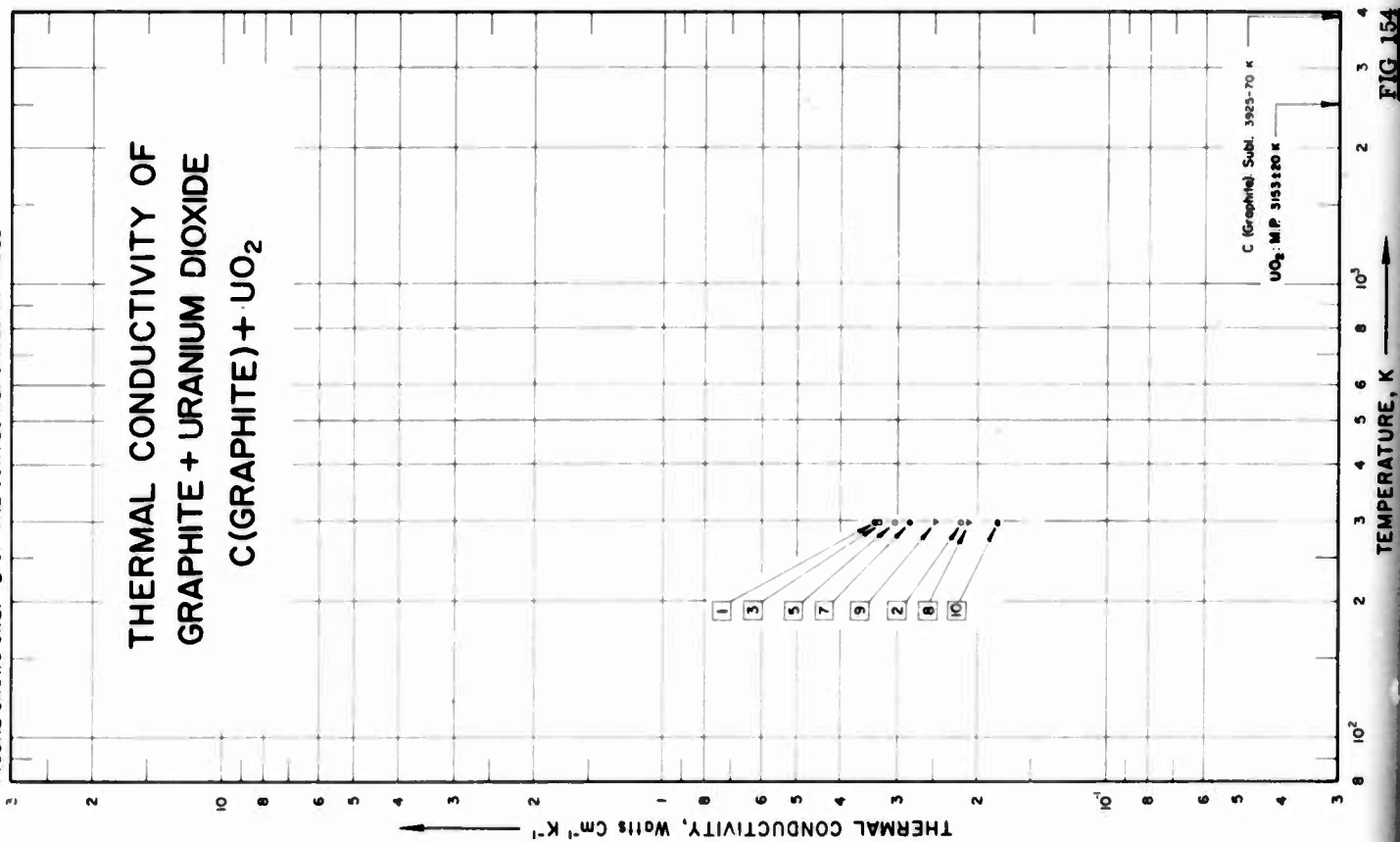


FIG 154

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 (weight percent) 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	67.05	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

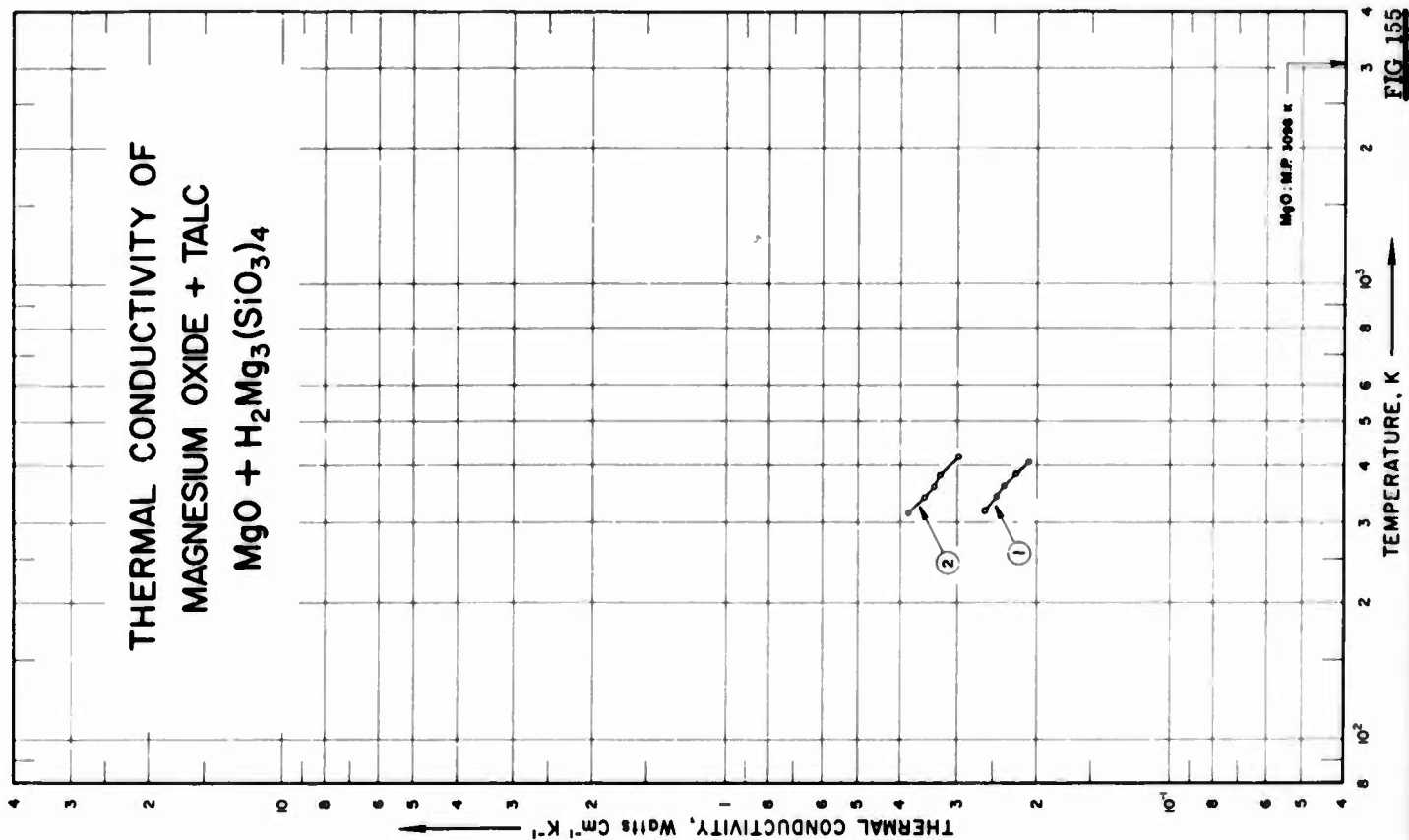


FIG 155

SPECIFICATION TABLE NO. 155 THERMAL CONDUCTIVITY OF [MAGNESIUM OXIDE + TALC] $\text{MgO} + \text{H}_2\text{Mg}_2(\text{SiO}_3)_4$

[For Data Reported in Figure and Table No. 155]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Sp. cimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							MgO	$\text{H}_2\text{Mg}_2(\text{SiO}_3)_4$	
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 3.48 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
CURVE 1*		CURVE 3*	
1623.2	0.169	1623.2	0.227
CURVE 2*		CURVE 4*	
1623.2	0.180	1623.2	0.160

* No graphical presentation

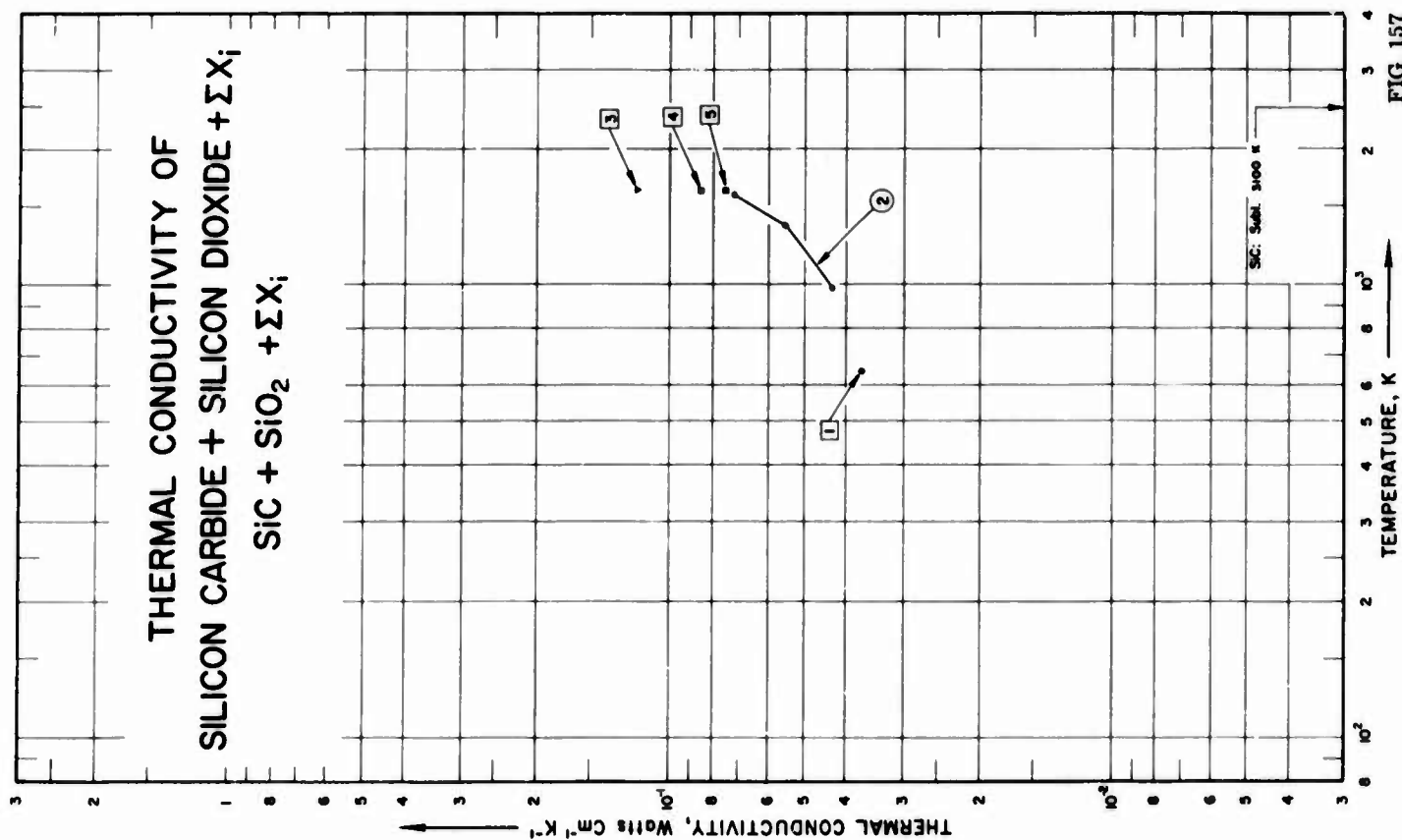


FIG 157

SPECIFICATION TABLE NO. 157 THERMAL CONDUCTIVITY OF [SILICON CARBIDE + SILICON DIOXIDE + ΣX_i] SIC + SiO₂ + ΣX_i

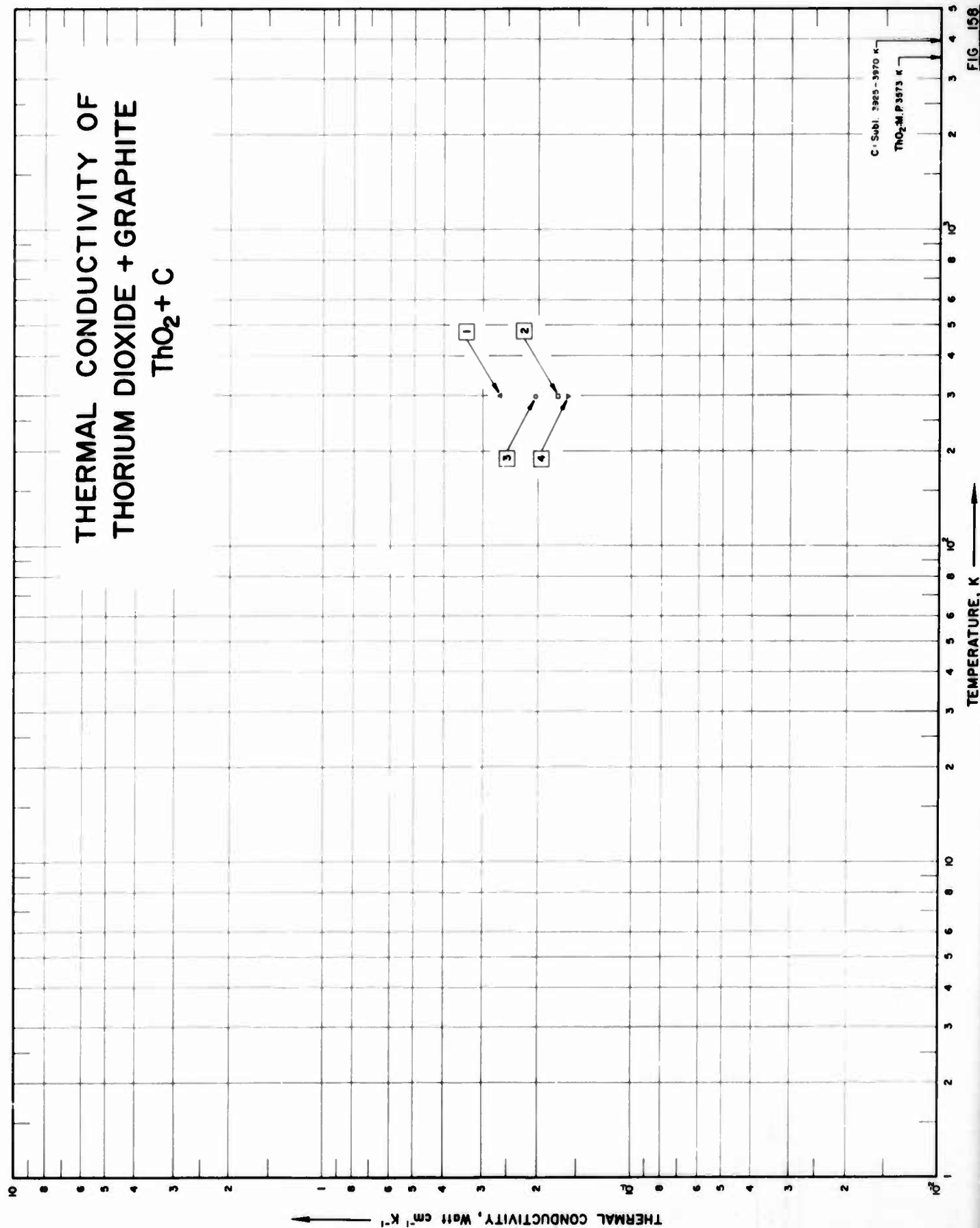
[For Data Reported in Figure and Table No. 157]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)			Composition (continued), Specifications and Remarks
							SIC	SiO ₂	Al ₂ O ₃	
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 3.24%.
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



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] $\text{ThO}_2 + \text{C}$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

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 Csl

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 Csl

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

T	k
CURVE 1*	
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

* 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	0.617

* 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⁻¹ K⁻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

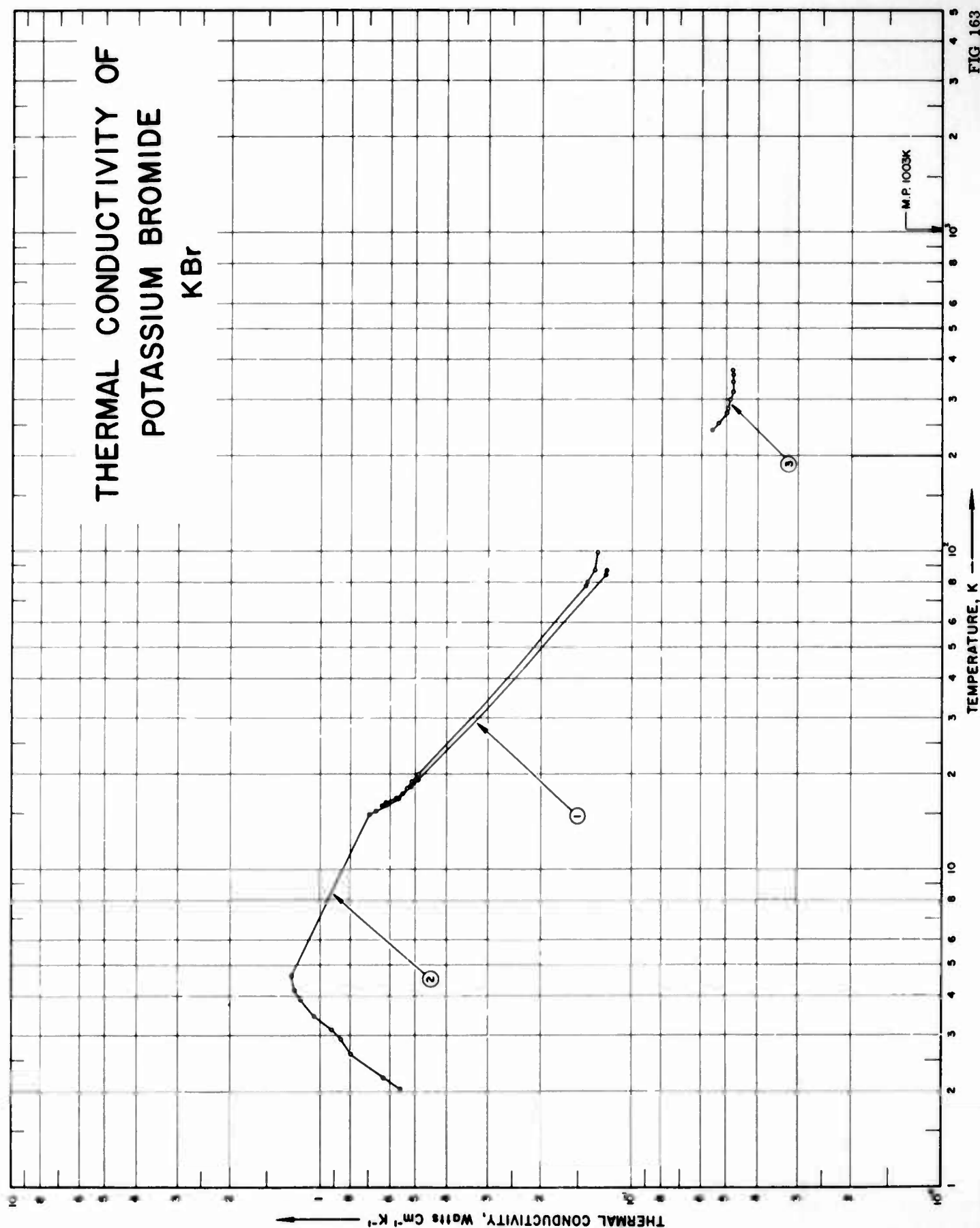


FIG 163

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	0.0490
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
CURVE 1*	
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
CURVE 2*	
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
CURVE 1*	
316.2	0.00586
343.2	0.00586

* No graphical presentation

SPECIFICATION TABLE NO. 166 THERMAL CONDUCTIVITY OF DIBERYLLIUM CARBIDE Be₂C

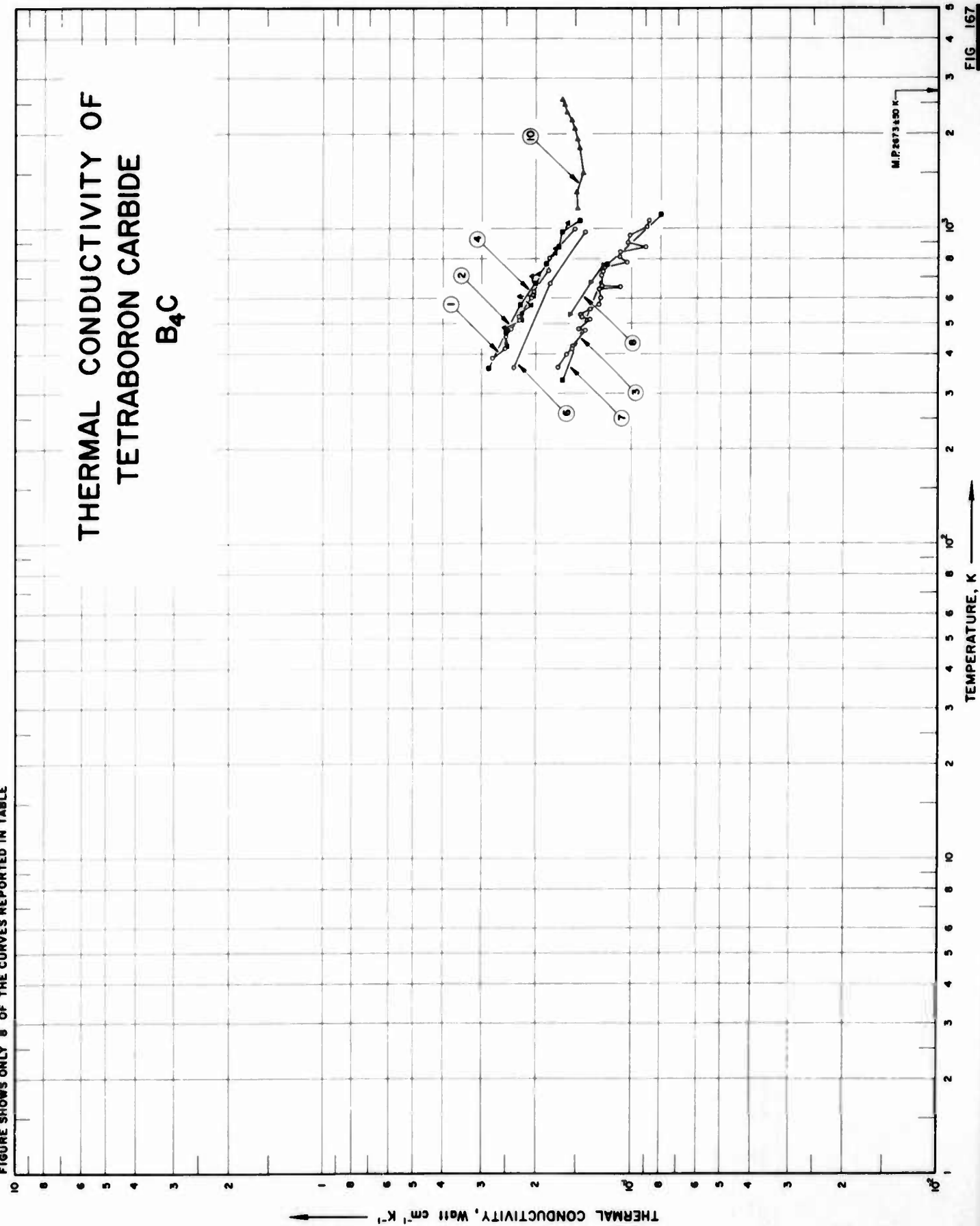
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	255	R	1950	598-1168			Hollow hot-pressed cylinder; 0.986 in. O.D., 0.609 in. I.D. and 3.0 in. long.

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
833.2	0.0165	1168.2	0.0212
848.2	0.0183		
875.2	0.0162		
885.2	0.0191		
895.2	0.0177		

* No graphical presentation

FIGURE SHOWS ONLY 8 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 167 THERMAL CONDUCTIVITY OF TETRABORON CARBIDE B_4C

[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), Sr	Specifications and Remarks
1	212	C	1951	390-999		No. 5 ($B_{2.85}C$)	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 sintered; 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_2O_3 , 0.27 Fe, 0.40 Si and 0.015 Al_2O_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>		<u>CURVE 3 (cont.)</u>		<u>CURVE 8</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		
513.2	0.227	785.2	0.103	<u>CURVE 9*</u>	
528.2	0.228	814.2	0.110	469.30	0.247
608.2	0.207	842.2	0.108	538.72	0.223
618.2	0.206	876.2	0.090	685.94	0.190
632.2	0.204	909.2	0.103	844.27	0.170
735.2	0.183	950.2	0.102	1035.94	0.156
806.2	0.182	1021.2	0.089		
999.2	0.150	1066.2	0.088	<u>CURVE 10</u>	
<u>CURVE 2</u>		<u>CURVE 4</u>		1168.16	0.147
425.2	0.248	363.2	0.285	1313.72	0.148
484.2	0.253	473.2	0.250	1502.60	0.142
512.2	0.224	573.2	0.225	1805.38	0.146
545.2	0.224	673.2	0.200	1924.83	0.147
574.2	0.207	773.2	0.185	2079.27	0.151
611.2	0.226	873.2	0.170	2210.94	0.154
611.2	0.204	973.2	0.165	2347.05	0.159
708.2	0.206	1073.2	0.145	2472.05	0.162
718.2	0.196			2580.40	0.165
838.2	0.172	<u>CURVE 5*</u>			
858.2	0.172	363.2	0.287		
1033.2	0.158	473.2	0.245		
<u>CURVE 3</u>		573.2	0.220		
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				
579.2	0.128	<u>CURVE 7</u>			
603.2	0.127	333.2	0.165		
644.2	0.128	773.2	0.120		
654.2	0.109	1103.2	0.080		

* Not shown on plot

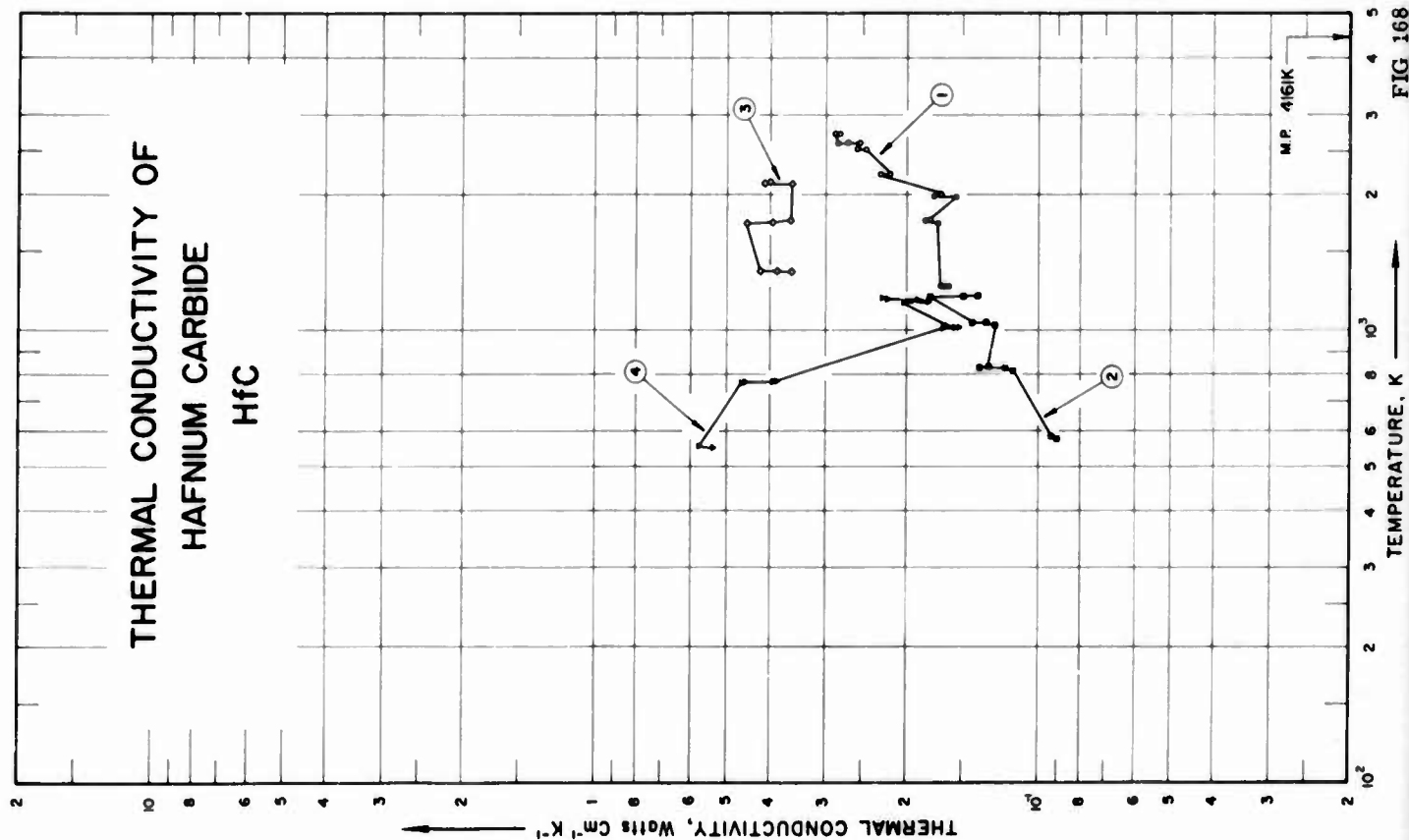


FIG 168

SPECIFICATION TABLE NO. 168 THERMAL CONDUCTIVITY OF HAFNIUM CARBIDE KIC

[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 .

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.

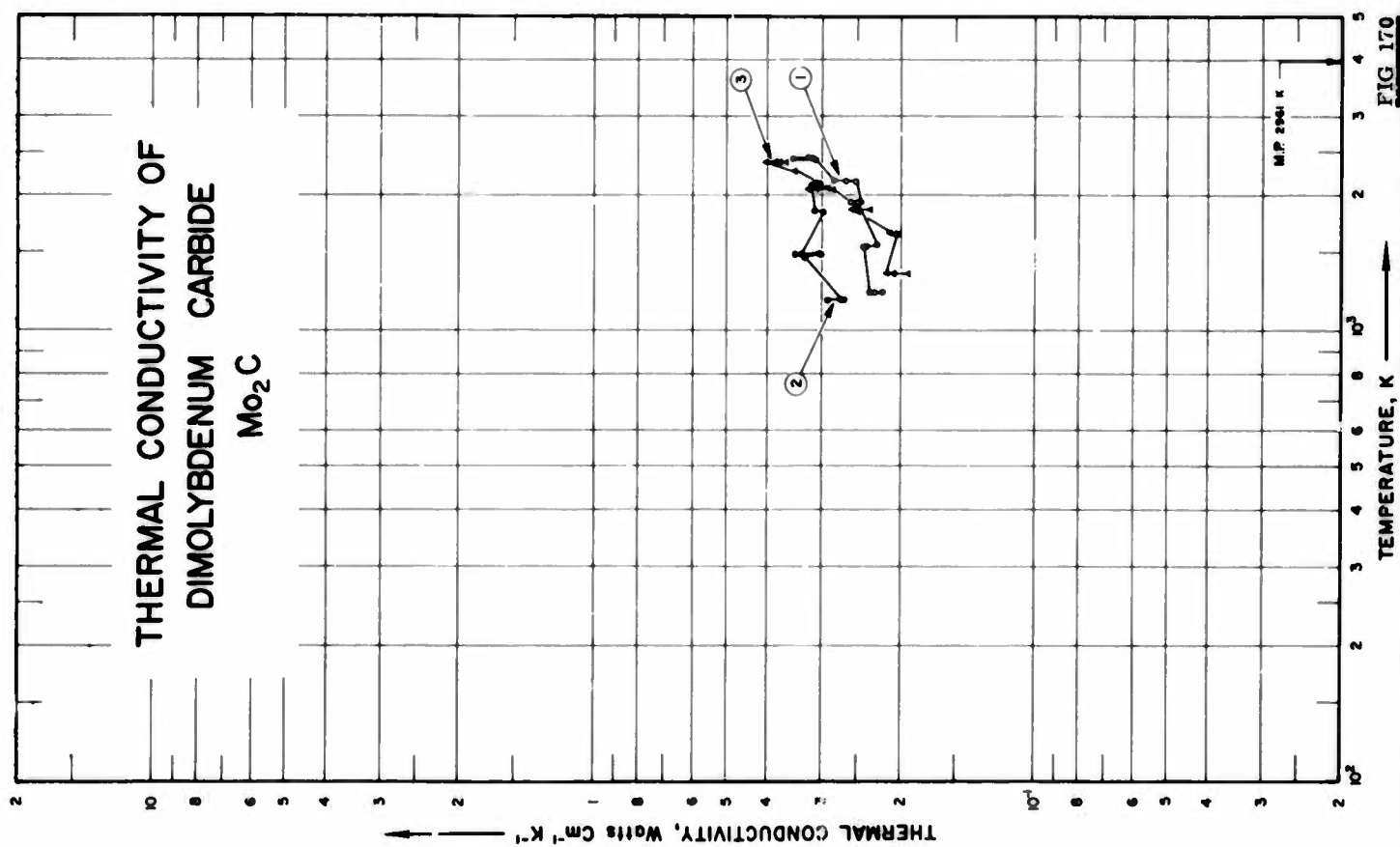
DATA TABLE NO. 169 THERMAL CONDUCTIVITY OF TRIIRON CARBIDE Fe_3C [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1*

298.2 0.0711

*No graphical presentation



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	CURVE 3 (cont.)	
		T	k
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		

CURVE 2	
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

CURVE 3	
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

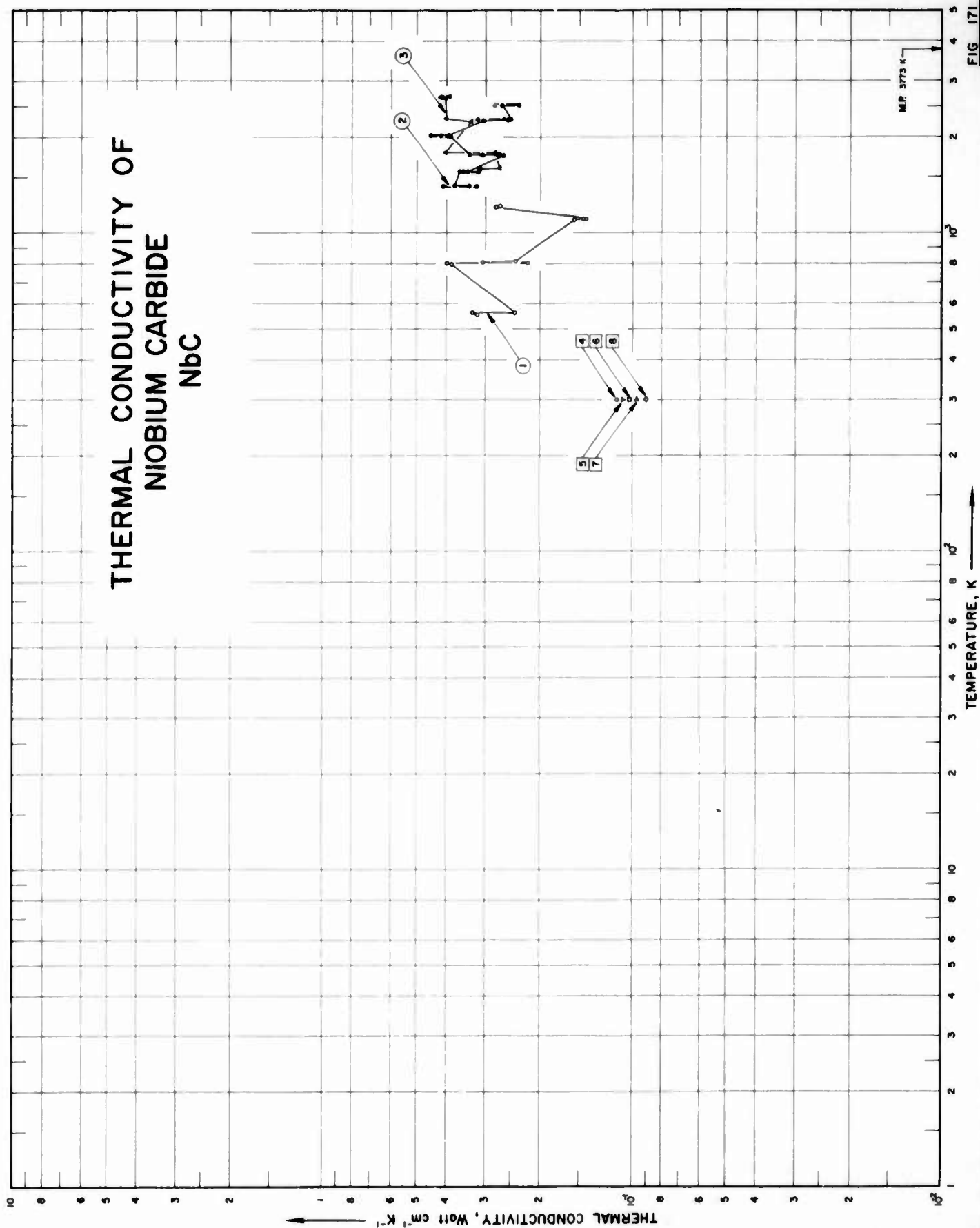


FIG. 171

SPECIFICATION TABLE NO. 171 THERMAL CONDUCTIVITY OF NIOBIUM CARBIDE NbC

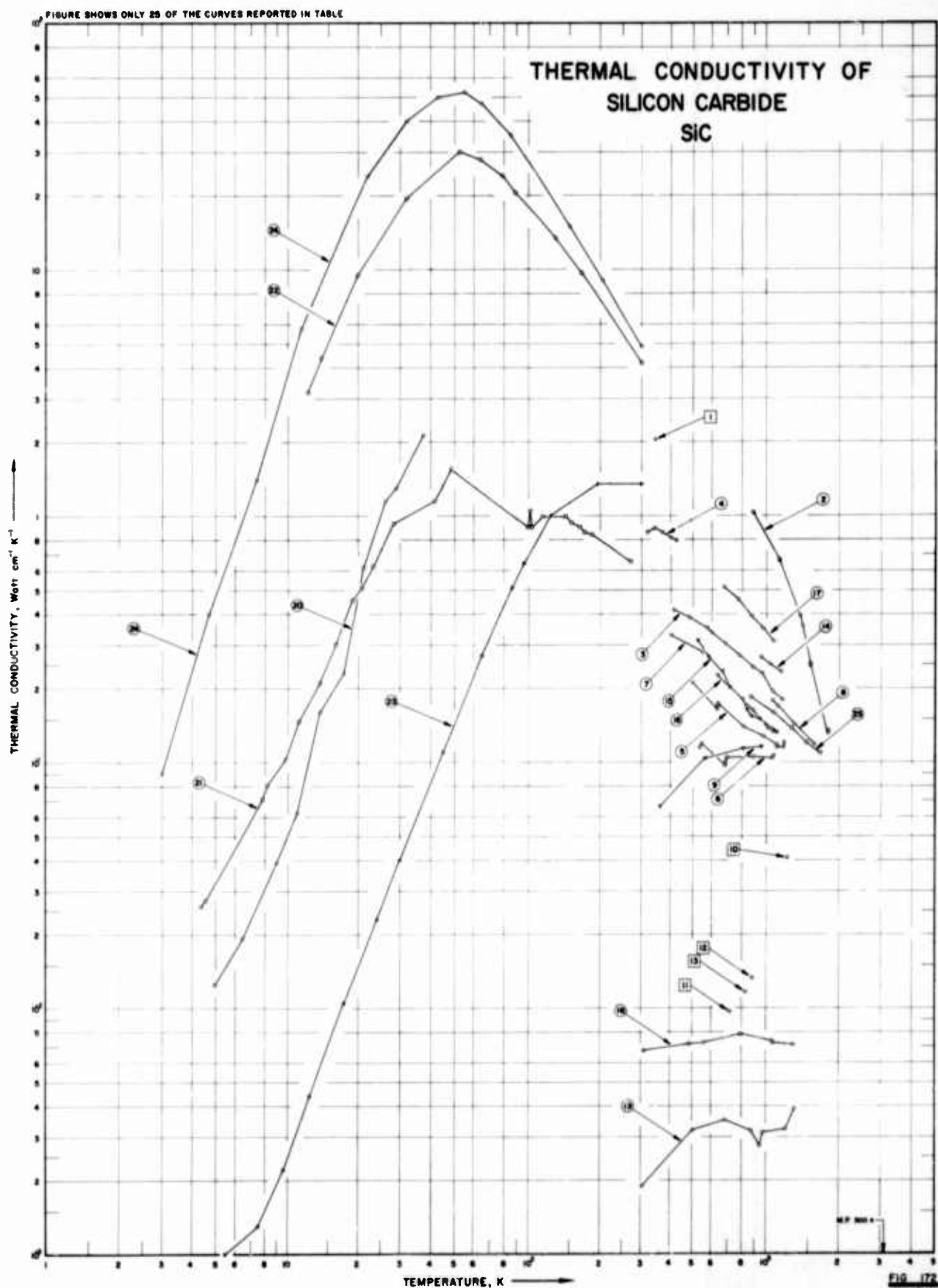
[For Data Reported in Figure and Table No. 171]

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>		<u>CURVE 2 (cont.)</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>		298.2	0.107
1402.6	0.320	<u>CURVE 6</u>	
1405.4	0.412	298.2	0.102
1405.4	0.399	<u>CURVE 7</u>	
1405.4	0.378	298.2	0.097
1408.2	0.410*	<u>CURVE 8</u>	
1566.5	0.363	298.2	0.090
1566.5	0.352		
1566.5	0.317		
1566.5	0.343		
1752.6	0.265		
1761.0	0.307		
1763.7	0.274		
1763.7	0.278		
1763.7	0.310*		
1772.1	0.337		
2030.4	0.398		
2036.0	0.453		
2036.0	0.420		
2038.7	0.394		
2258.2	0.306		
2261.0	0.257		
2263.7	0.319		
2266.5	0.350		
2505.4	0.268		
2508.2	0.235		
2513.7	0.232*		

* Not shown on plot



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 2.5 g cm ⁻³ ; Armco iron used as comparative material.
2	37	L	1958	889-1801	5.0		67.46 Si, 28.58 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, magnesite, 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 6x5x0.6 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 Al 4×10^{18} atoms cm^{-3} ; electrical conductivity $1.6 \text{ ohm}^{-1}\text{cm}^{-1}$ 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	573-1673	± 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.

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

[illegible]

* Not shown on plot

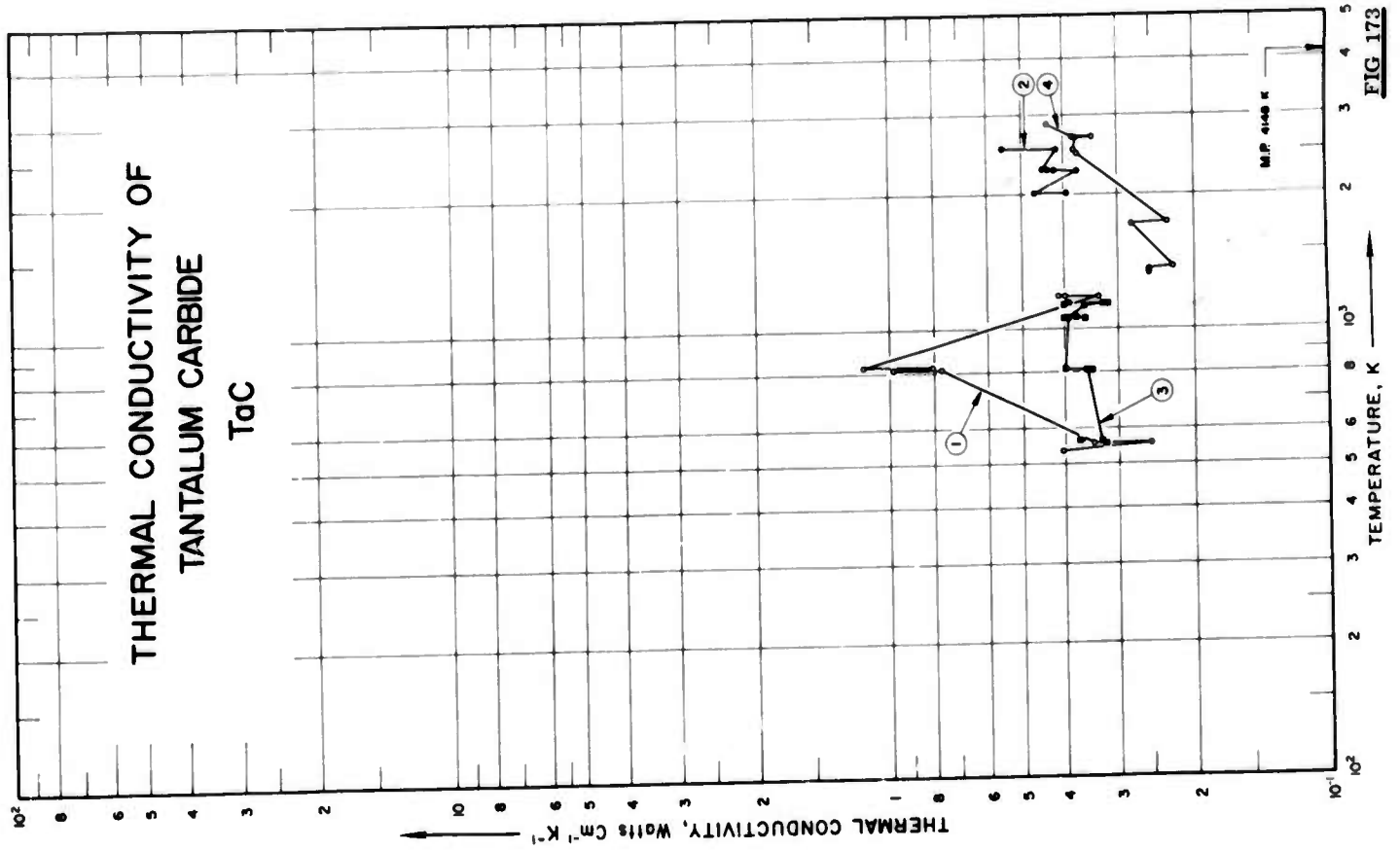


FIG 173

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, Na, 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.	
2	243	R	1962	2008-2555			Similar to the above but pitting and spalling was found after measurements; SRI run number C83.	
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, Na, 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
CURVE 1		CURVE 4	
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
CURVE 2			
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		
CURVE 3			
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	0.392		

* 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^{-3} 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 $^{\circ}\text{K}^{-1}$]

T k

CURVE 1*

438.2 0.0837
 478.2 0.0795
 531.2 0.0753
 563.2 0.0774
 638.2 0.0732

CURVE 2*

443.2 0.0879
 483.2 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 cm $^{-1}\text{K}^{-1}$]

T	k
CURVE 1*	
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

FIGURE SHOWS ONLY 16 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF TITANIUM CARBIDE TiC

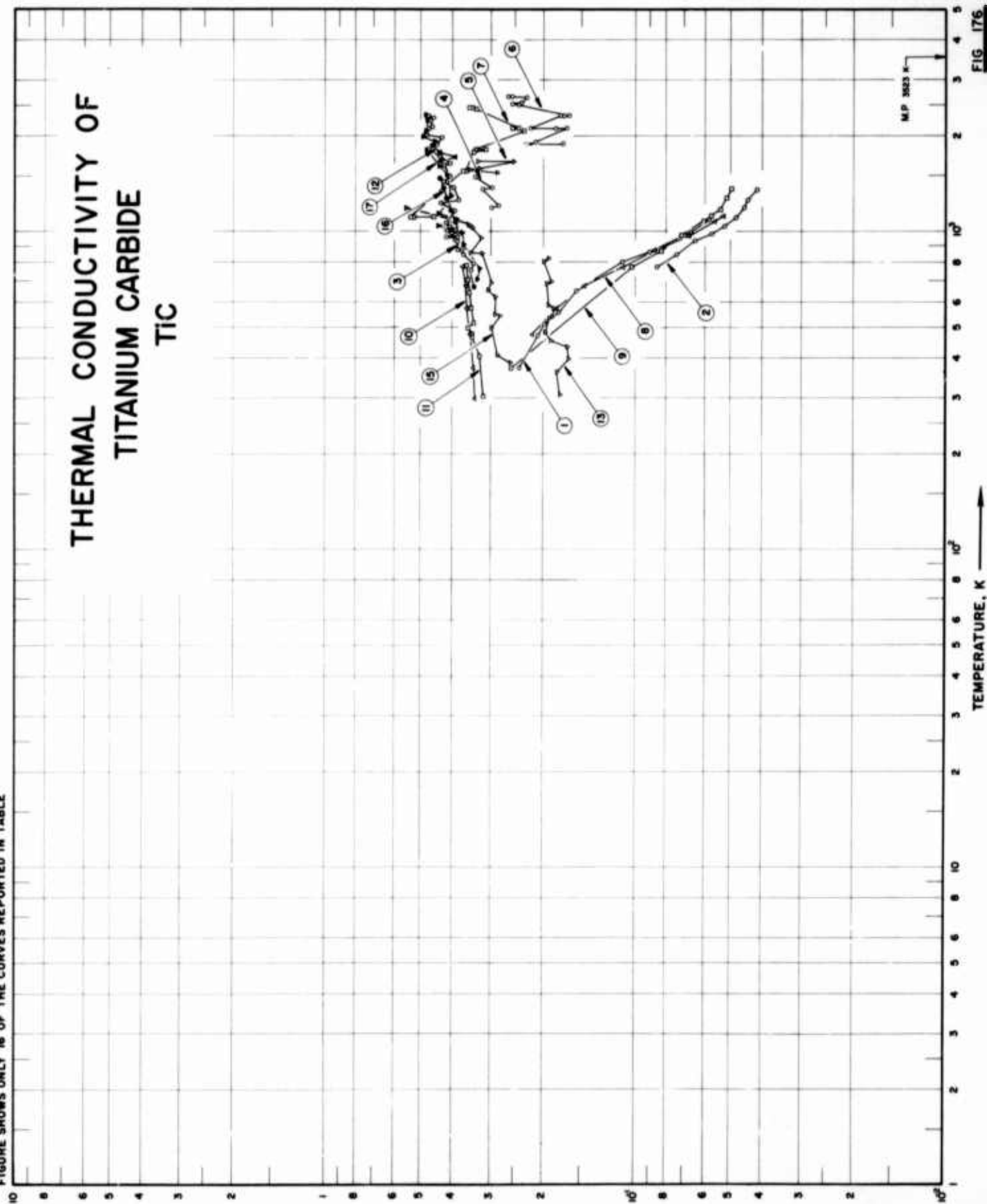
THERMAL CONDUCTIVITY, $\text{Watt cm}^{-1} \text{K}^{-1}$ ←

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 .
10	270	P	1962	298-773			No other information reported.
11	277	P	1963	303-778			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.
12	277	P	1963	1673-1873			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.
13	277	P	1963	308-823			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.
14	277	P	1963	1623-1823			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.
15	374	C	1965	386-1185	0.5		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).
16	289	R	1961	673-1473			Specimen 2 in. O.D., 0.5 in. I.D. and 3 in. long.

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

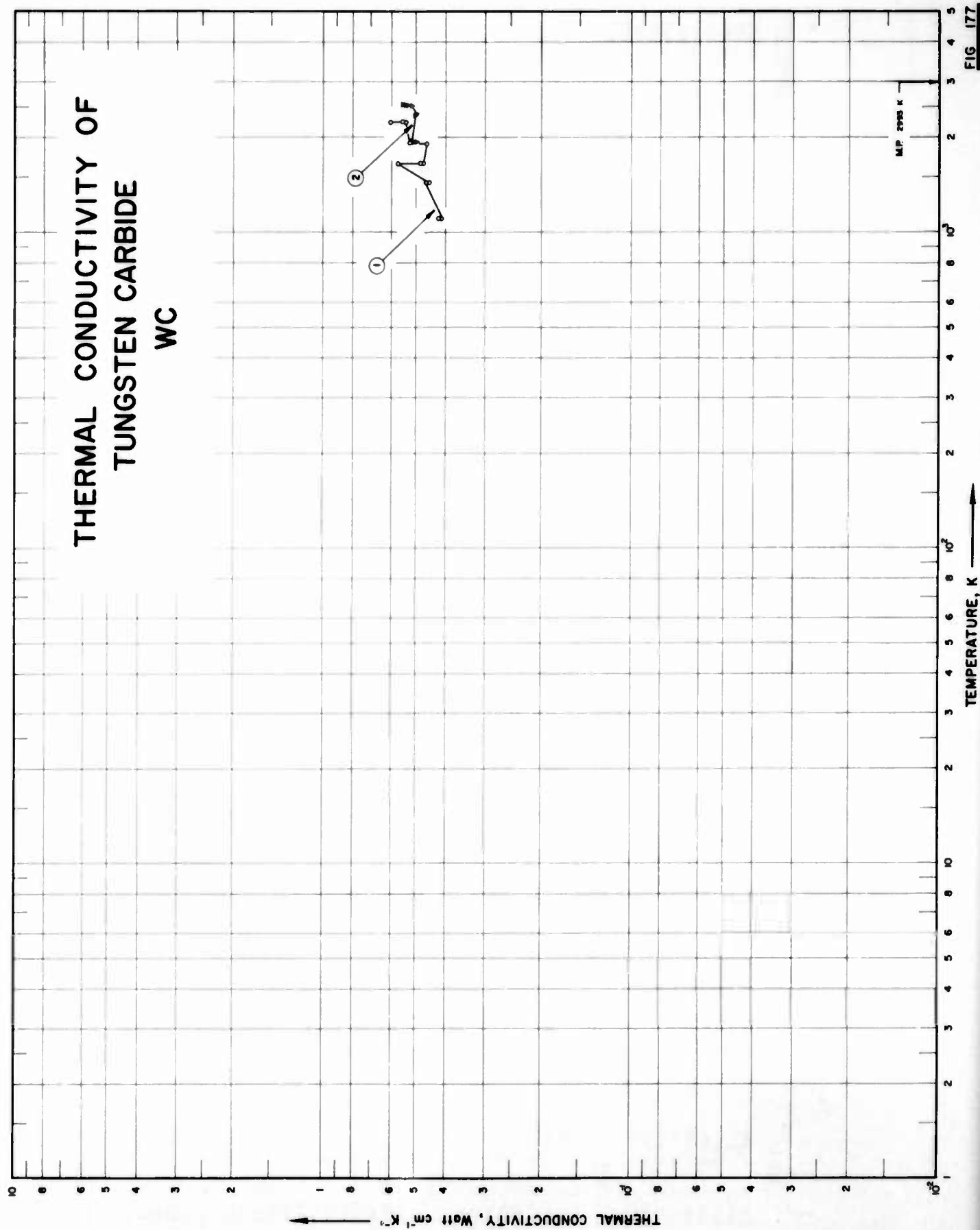


FIG 177

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

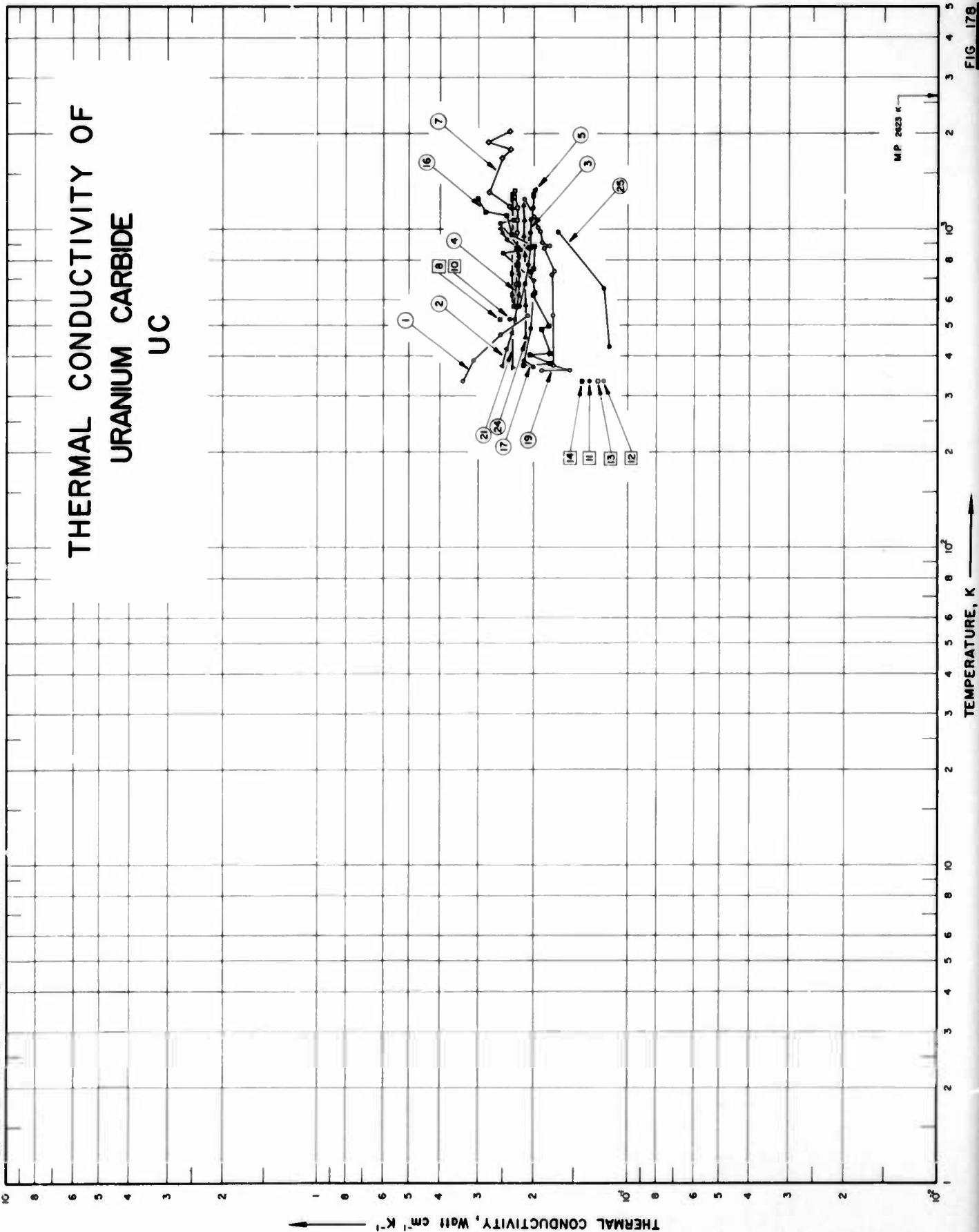
1102.6	0.423
1102.6	0.413
1431.5	0.467
1431.5	0.455
1654.8	0.575
1659.3	0.484
1659.3	0.473
1914.8	0.461
1929.3	0.526
2223.2	0.540
2225.4	0.608
2226.5	0.558

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 $\pm$ 0.02 total C (0.054 $\pm$ 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 $\pm$ 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 $\sim 2 \times 10^{-5}$ 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	$< \pm 5$		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	$< \pm 5$		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	$< \pm 5$		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.

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

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
1830	0.151
1940	0.155
1955	0.184
2025	0.157

*No graphical presentation

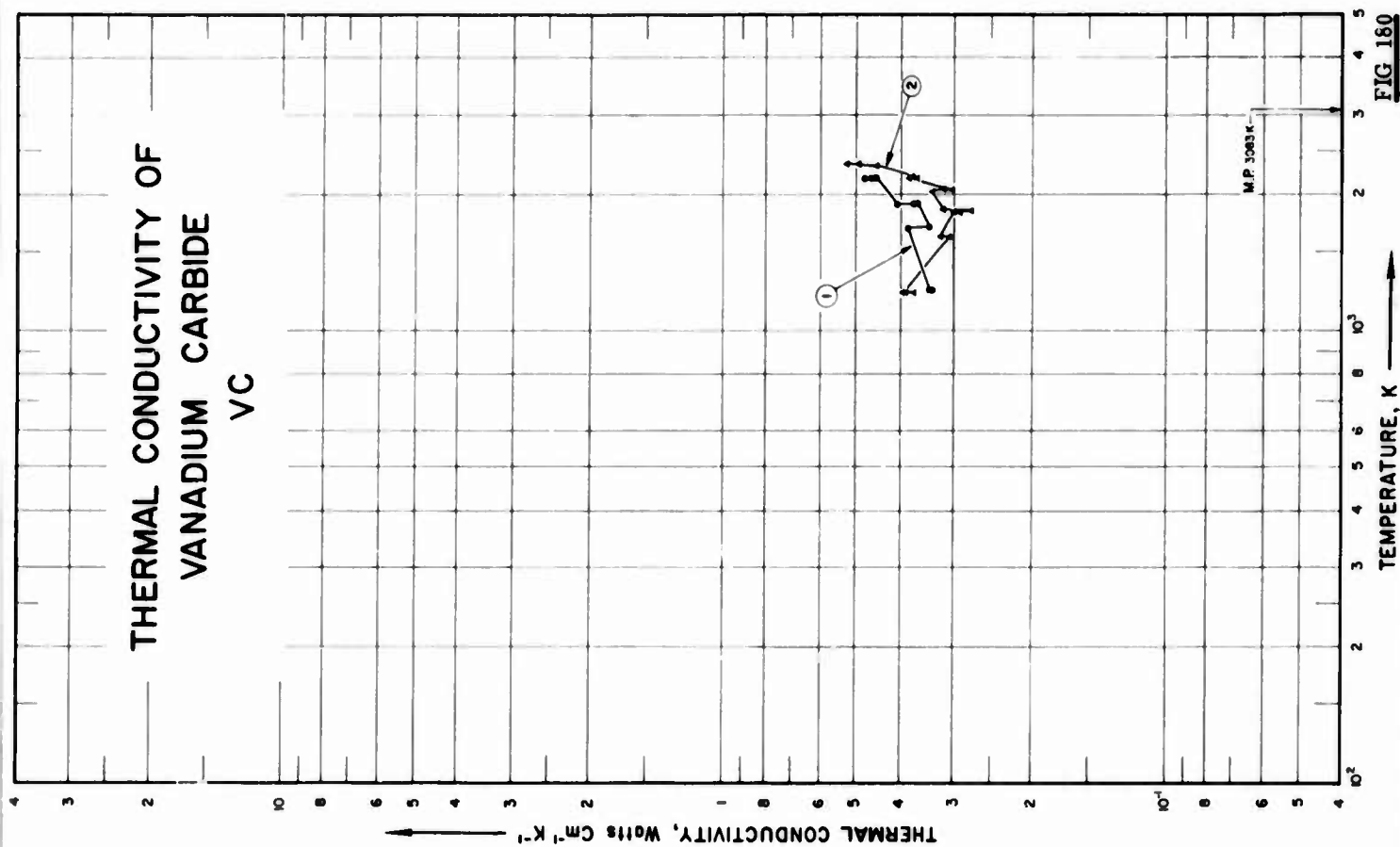


FIG 180

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 specimen 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.
2	144	R	1963	1230-2342	5-7	2	Same as the above specimen except heat-soaked at 1913 C.

DATA TABLE NO. 180 THERMAL CONDUCTIVITY OF VANADIUM CARBIDE VC

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

T k

CURVE 1

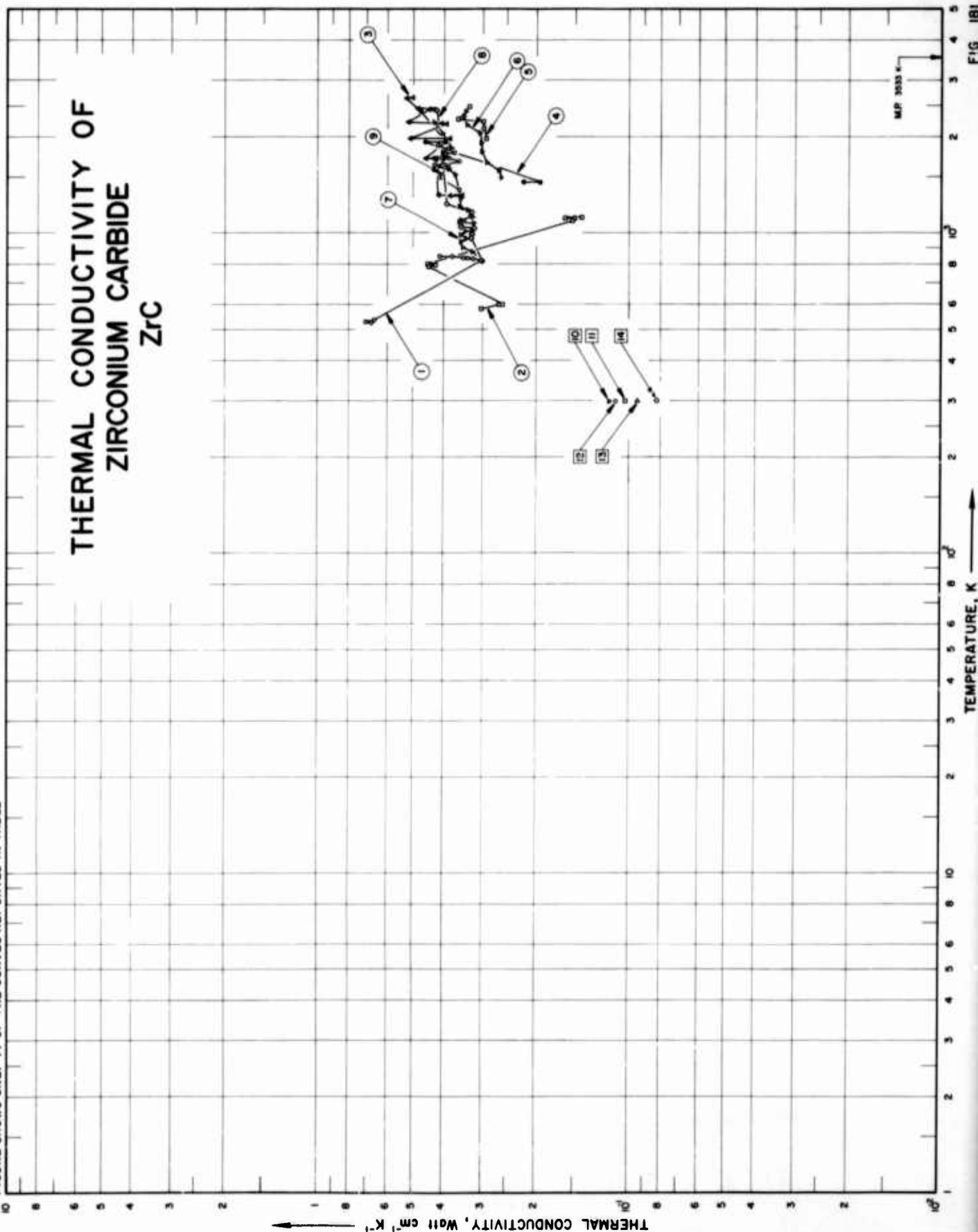
1241.5	0.343
1241.5	0.336
1694.3	0.387
1694.3	0.388*
1694.3	0.343
1905.4	0.365
1908.2	0.374
1913.7	0.410
2188.7	0.457
2188.7	0.482
2188.7	0.466

CURVE 2

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

FIGURE SHOWS ONLY 14 OF THE CURVES REPORTED IN TABLE

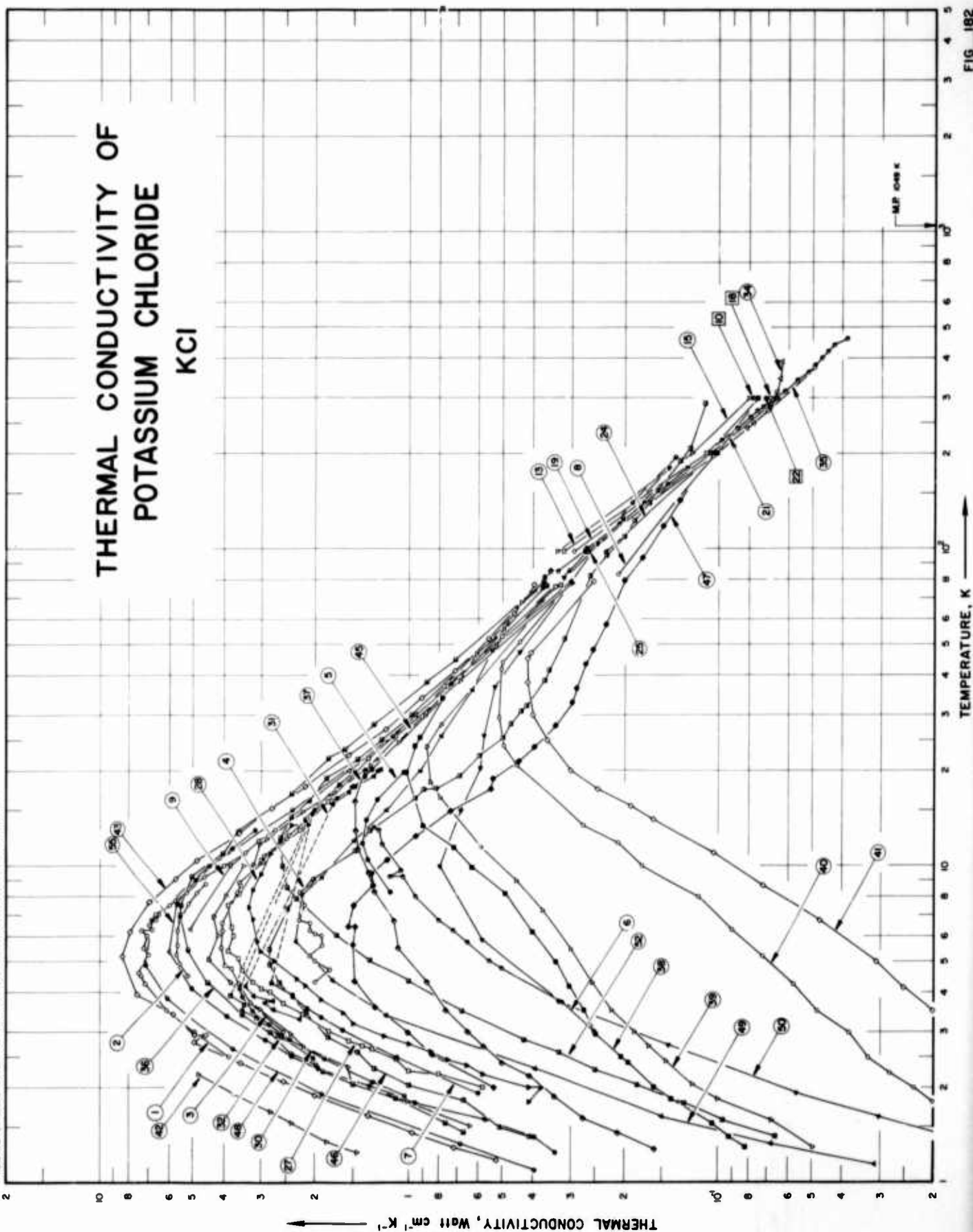


SPECIFICATION TABLE NO. 181 THERMAL CONDUCTIVITY OF ZIRCONIUM CARBIDE ZrC

[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 .	

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 Kyrpoulas 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	296.2		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	296.2		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; $3.3 \text{ cm} \times 0.0626 \text{ cm}^2$.
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 0.383 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	1.5-57		B	Specimen doped with KI with I^- concentration $1.0 \times 10^{18} \text{ molecules cm}^{-3}$.
46	440		1964	1.4-288		C	Specimen doped with KI, with I^- concentration $1.25 \times 10^{19} \text{ molecules cm}^{-3}$.

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^{18} molecules cm^{-3} . Pure. Specimen doped with 0.25% in melt of LiCl. Specimen doped with 1.0% in melt of LiCl. Rectangular specimen $5 \times 5 \times 40$ 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 chloroform and slowly cooled to remove mechanical strains. Similar to the above specimen except compressed 3% in length; dislocation density 2.0×10^7 dislocations cm^{-2} .
48	440		1964	0.32-195		A	
49	440		1964	1.1-125		B	
50	440		1964	0.31-181		C	
51	456		1965	1.8-194			
52	456		1965	1.4-77			Recovery thermal conductivity data of the above specimen.
53	456		1965	1.4-129			The above specimen annealed at 400 C for 15 min.
54	456		1965	1.3-78			The above specimen annealed at 650 K for 15 min.
55	456		1965	1.3-13			

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

* Not shown on plot

[illegible]

* Not shown on plot

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).

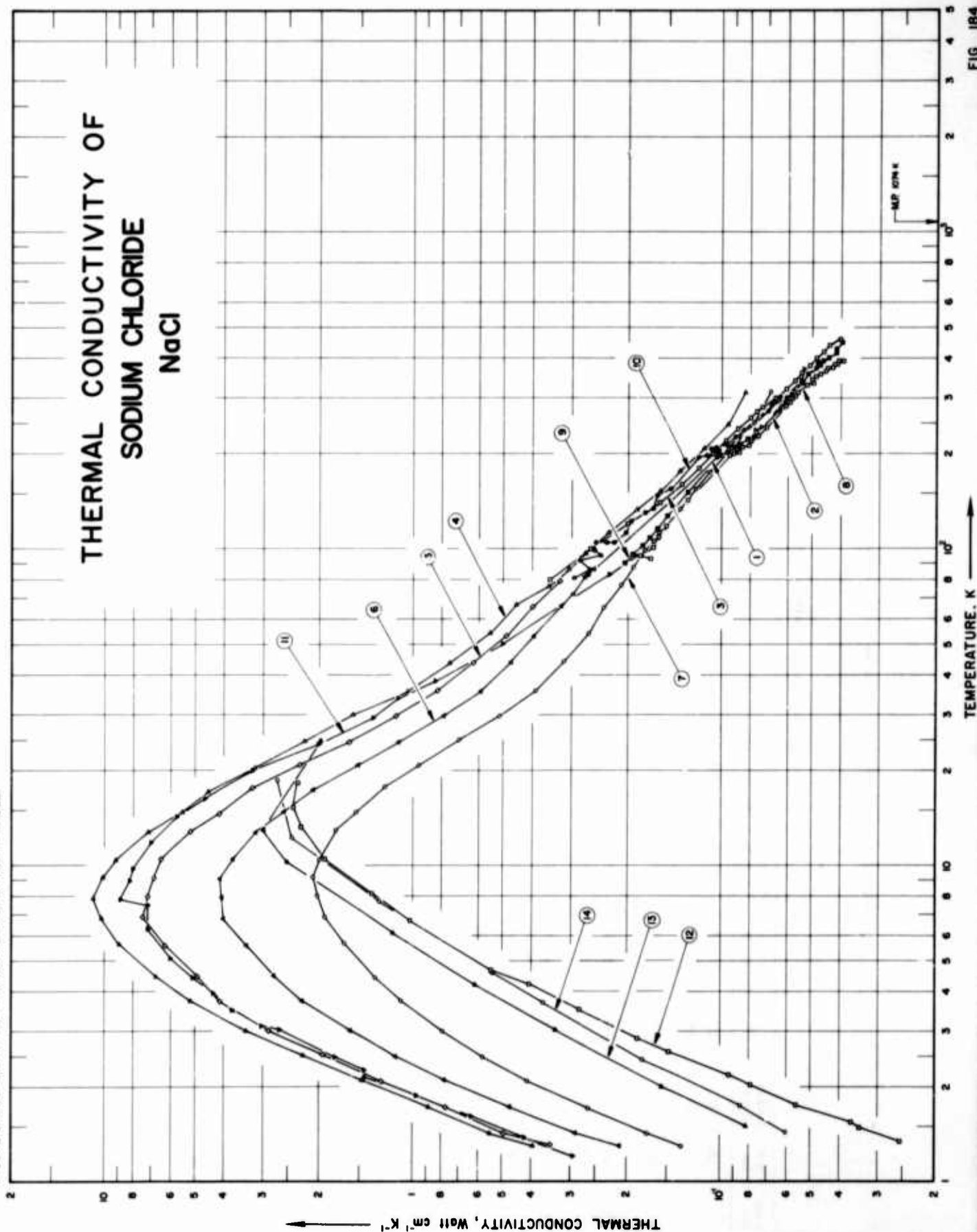
DATA TABLE NO. 183 THERMAL CONDUCTIVITY OF SILVER CHLORIDE AgCl

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

T	k
CURVE 1*	
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

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 8 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	$\pm 3 \pm 5$		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	$\pm 3 \pm 5$		Similar to the above specimen except with 0.18 mole% Ca.
10	497, 498	C	1962	81-470	$\pm 3 \pm 5$		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)

CURVE 11 (cont.)		CURVE 14	
T	k	T	k
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		
29.2	1.36	CURVE 15*	
33.8	1.12	1.33	0.0252
38.2	0.836	1.78	0.0551
50.0	0.498	2.19	0.0923
66.7	0.322*	2.89	0.182
83.0	0.227	4.25	0.403
95.1	0.188	6.78	1.01
		10.7	1.88
		15.7	2.37
CURVE 12			
1.34	0.0255		
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		
CURVE 13			
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

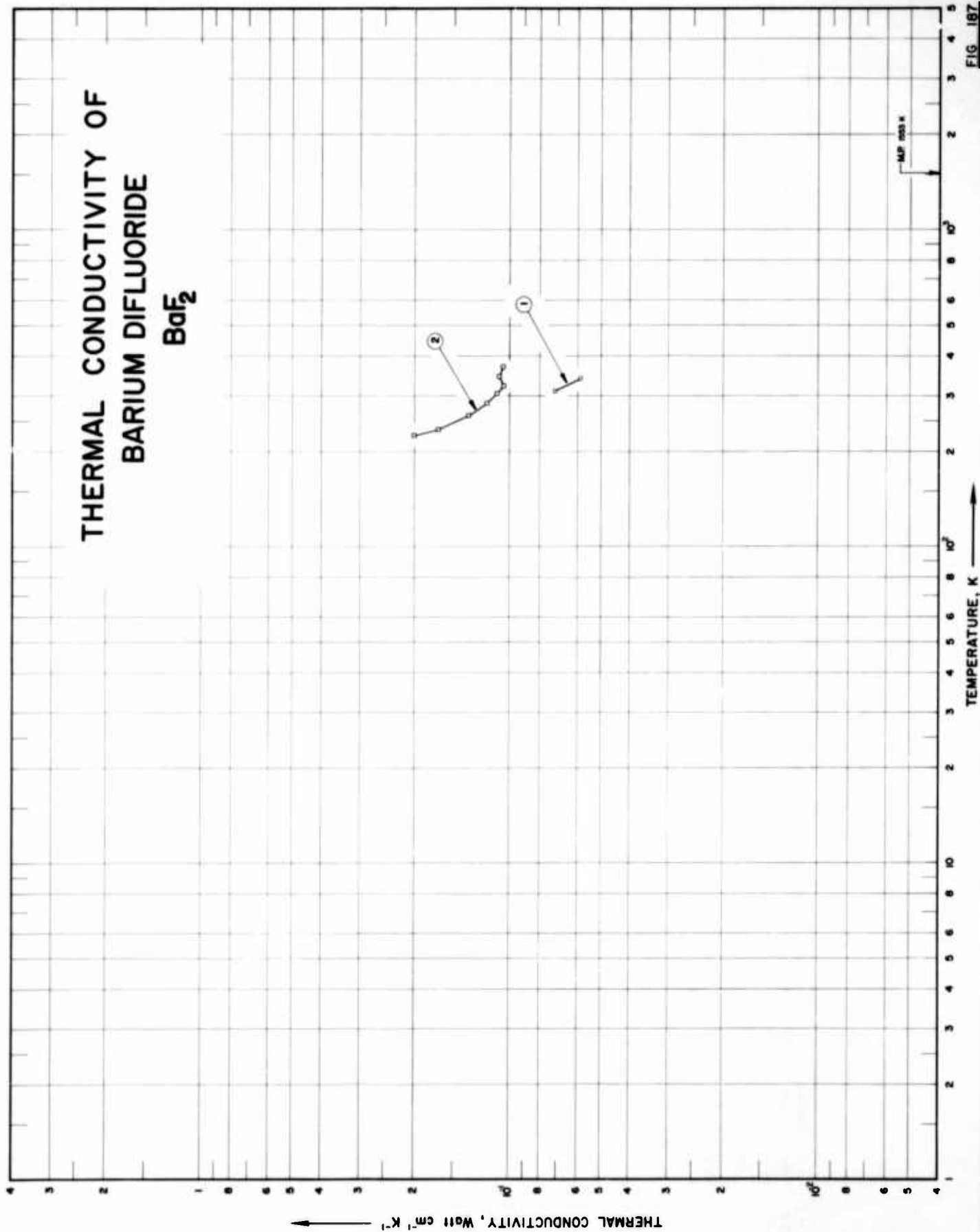
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	242	-	1961	563-641	± 3		Specimen of A. R. purity; each data point is the mean value of 4 or 5 different measurements; measured in molten state.
2	242	-	1961	591	± 3		Similar to the above specimen.

DATA TABLE NO. 186 THERMAL CONDUCTIVITY OF ZINC DICHLORIDE ZnCl_2 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

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

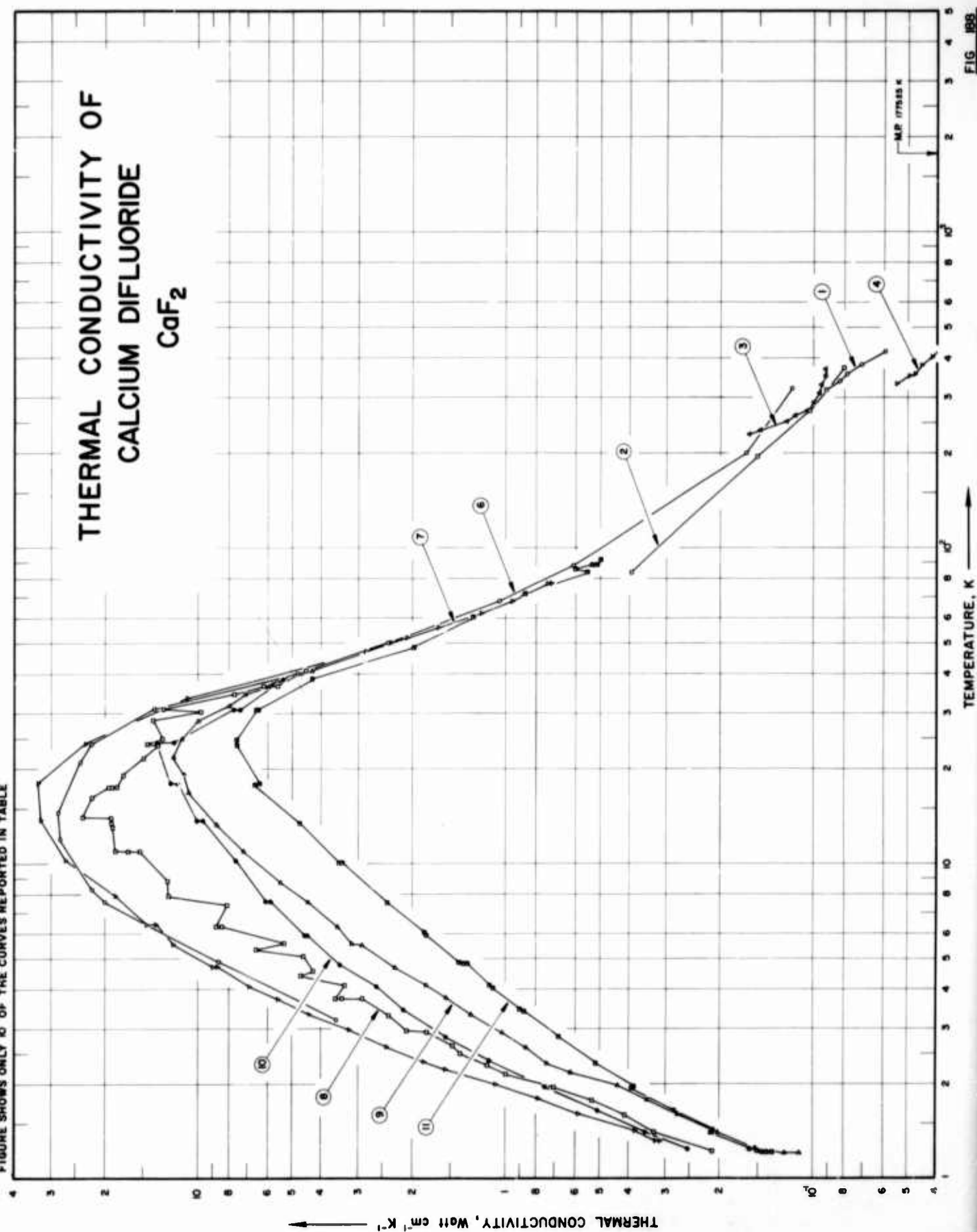
[For Data Reported in Figure and Table No. 187]

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 BaF_2 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

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

FIGURE SHOWS ONLY 10 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 188 THERMAL CONDUCTIVITY OF CALCIUM DIFLUORIDE CaF_2

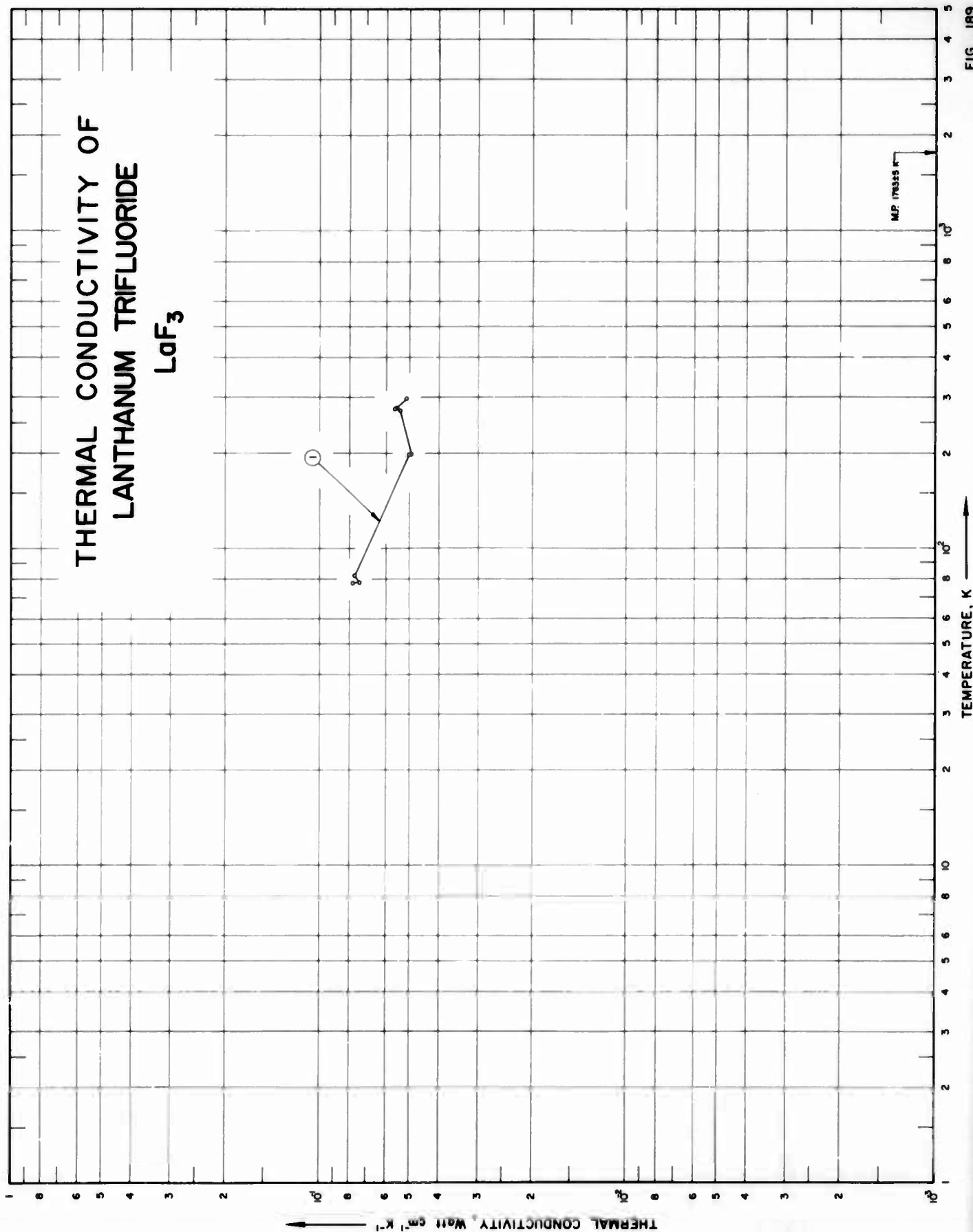
[For Data Reported in Figure and Table No. 188]

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 2.8 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 $\langle 110 \rangle$ 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.

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

* Not shown on plot

THERMAL CONDUCTIVITY OF LANTHANUM TRIFLUORIDE LaF_3



SPECIFICATION TABLE NO. 189 THERMAL CONDUCTIVITY OF LANTHANUM TRIFLUORIDE LaF_3

[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, 299, 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
<u>CURVE 1</u>	
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*

* Not shown on plot

FIGURE SHOWS ONLY 23 OF THE CURVES REPORTED IN TABLE

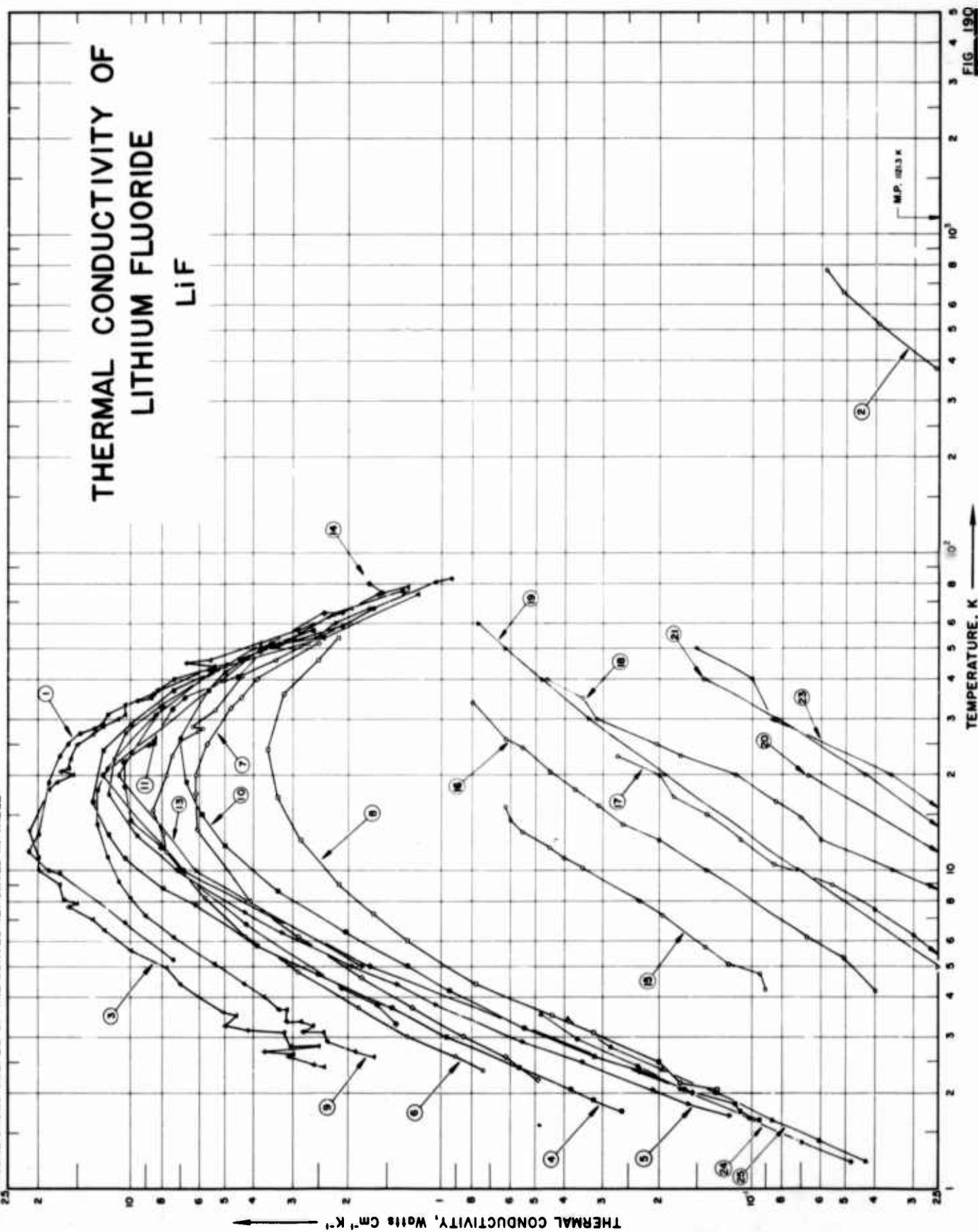


FIG. 190

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 4.935×10^5 Roentgens accumulated irradiation.
17	229	L	1958	4.5-23			The above specimen after successive Co^{60} gamma ray dose of 7.575×10^5 Roentgens accumulated irradiation.
18	229	L	1958	4.8-40			The above specimen after successive Co^{60} gamma ray dose of 20.885×10^5 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 Aluminum 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 5.5×10^5 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 2×10^5 dislocations cm^{-2} .

DATA TABLE NO. 190 (continued)

T	k	T	k	T	k	T	k	T	k
CURVE 17 (cont.)		CURVE 22*		CURVE 26 (cont.)*		CURVE 28 (cont.)*			
12.5	0.110	6.0	0.00625	18.2	6.11	5.48	1.00		
15.0	0.140	10.0	0.0114	18.8	6.83	7.05	1.69		
17.0	0.180	13.5	0.0167	19.1	8.17	7.43	1.72		
20.0	0.200	CURVE 23		20.5	6.03	8.77	2.48		
23.0	0.270	5.0	0.00541*	22.7	7.84	9.98	3.54		
CURVE 18		19.0	0.0133*	26.9	7.38	10.6	3.45		
4.75	0.0094*	20.0	0.0357	29.9	10.6	12.5	5.06		
5.8	0.012*	30.0	0.0854	57.5	3.19	13.1	4.84		
6.3	0.015*	40.0	0.100	80.2	1.32	14.2	5.90		
8.5	0.024*	50.0	0.152	CURVE 27*		15.2	5.90		
10.0	0.035	CURVE 24		1.78	0.159	15.7	5.90		
12.5	0.06	1.23	0.0479	17.3	7.41	17.3	6.98		
14.7	0.07	1.41	0.0695	2.05	0.188	18.8	7.10		
16.5	0.084	1.68	0.102	2.43	0.340	19.7	7.53		
20.0	0.115	2.08	0.169	2.88	0.547	23.8	7.80		
23.0	0.17	2.42	0.232	3.57	0.906	29.4	7.62		
25.0	0.205	2.95	0.363	4.14	1.33	36.9	6.27		
30.0	0.315	3.52	0.477	4.57	1.55				
35.0	0.35	CURVE 25		5.48	2.26				
40.0	0.46	1.22	0.0429	7.03	3.49				
CURVE 19		10.0	6.59	8.65	5.02				
5.0	0.0250	10.5	6.55	10.0	6.59				
10.0	0.0714	12.4	8.79	10.5	6.55				
20.0	0.192	12.9	7.92	12.4	8.79				
30.0	0.333	14.1	9.29	12.9	7.92				
40.0	0.476	15.4	9.06	14.1	9.29				
50.0	0.625	17.1	9.89	15.4	9.06				
60.0	0.769	18.4	10.1	17.1	9.89				
CURVE 20		22.4	10.4	18.4	10.1				
7.0	0.0119*	22.4	10.4	22.4	10.4				
10.0	0.0200*	26.9	9.84	22.4	10.4				
20.0	0.0667	31.1	8.85	26.9	9.84				
CURVE 21		36.1	7.05	31.1	8.85				
		CURVE 28*		36.1	7.05				
8.0	0.0115*	1.81	0.0601						
10.0	0.0159*	2.07	0.0753						
20.0	0.0435	2.47	0.129						
30.0	0.0833	2.89	0.209						
40.0	0.143	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_i] LiF + KF + ΣX_i

Curve No.	Ref. Method No.	Year Used	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_i] LiF + KF + ΣX_i [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T	k
CURVE 1*	
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

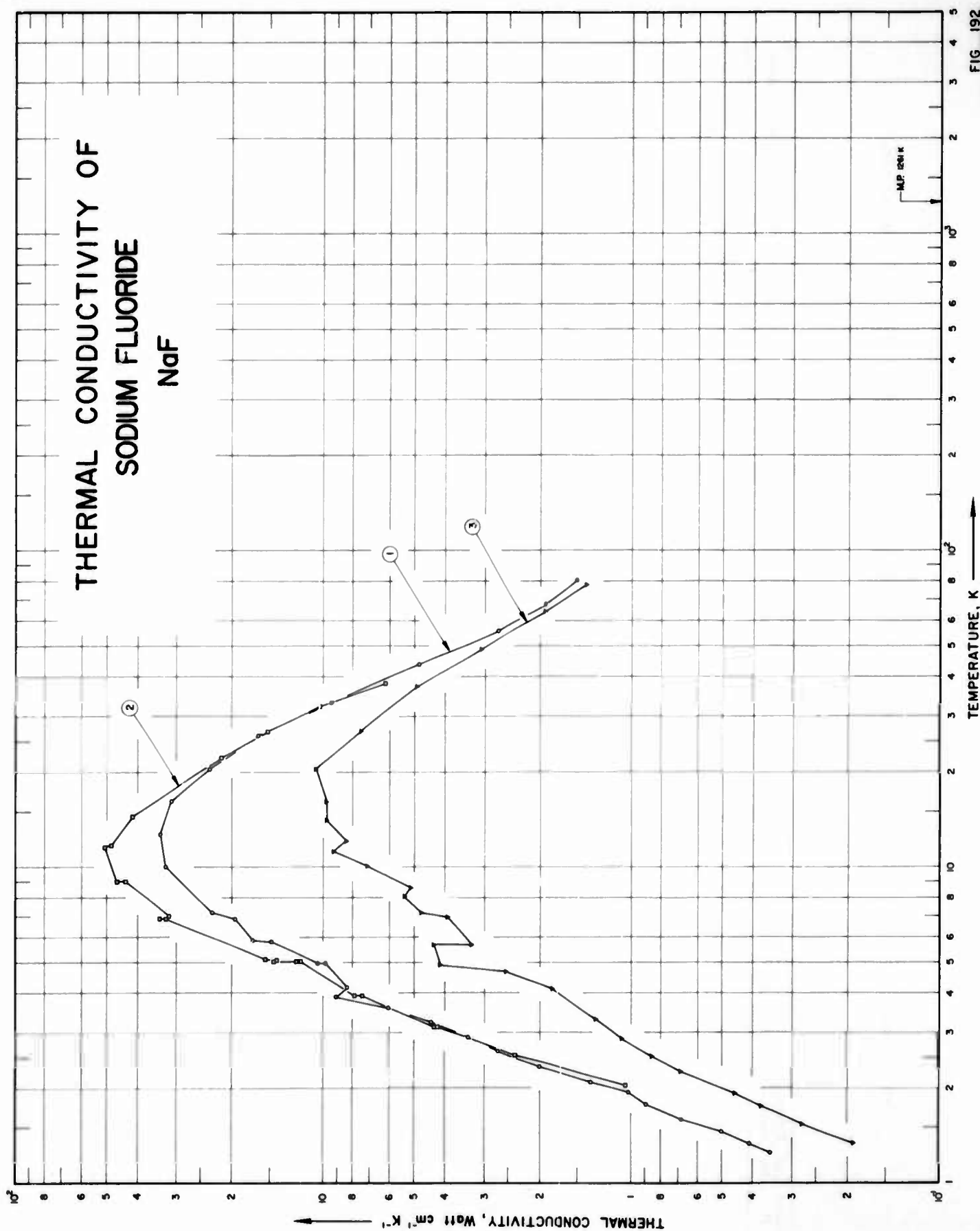


FIG. 192

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 $3 \times 10^5 \text{ cm}^{-2}$.
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 $1.8 \times 10^6 \text{ cm}^{-2}$.
3	456		1965	1.3-79			Similar to the above specimen except compressed 0.7 % and dislocation density $9.3 \times 10^6 \text{ cm}^{-2}$.

SPECIFICATION TABLE NO. 193 THERMAL CONDUCTIVITY OF [SODIUM FLUORIDE + BERYLLIUM DIFLUORIDE] NaF + BeF₂

Curve No.	Ref. Method No.	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 1*	
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) NaF ZrF ₄ UF ₄	Composition (continued), Specifications and Remarks
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

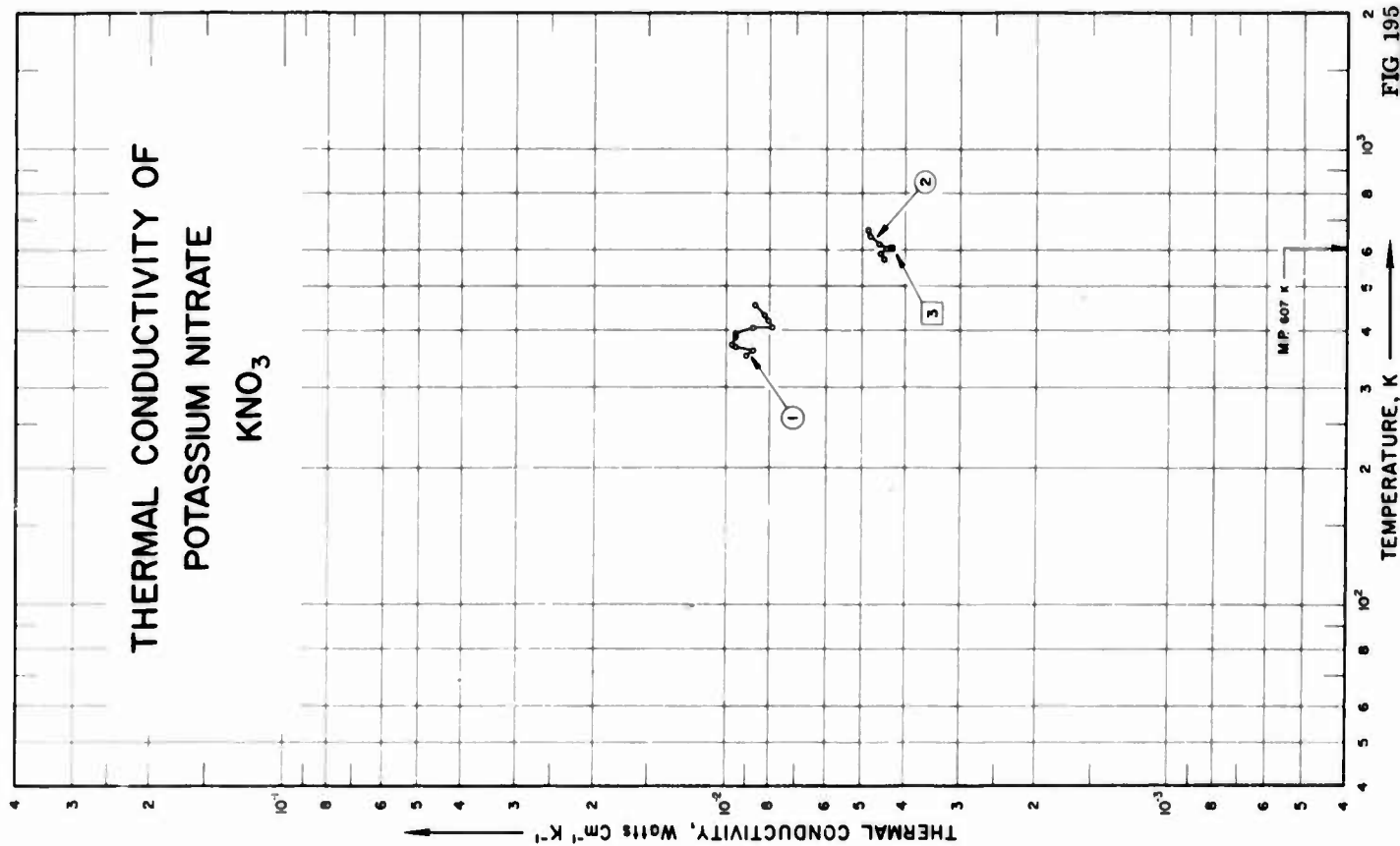


FIG 195

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, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
469.3	0.00447
475.4	0.00462
481.4	0.00390
487.6	0.00404
506.0	0.00426
525.4	0.00426
<u>CURVE 2*</u>	
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

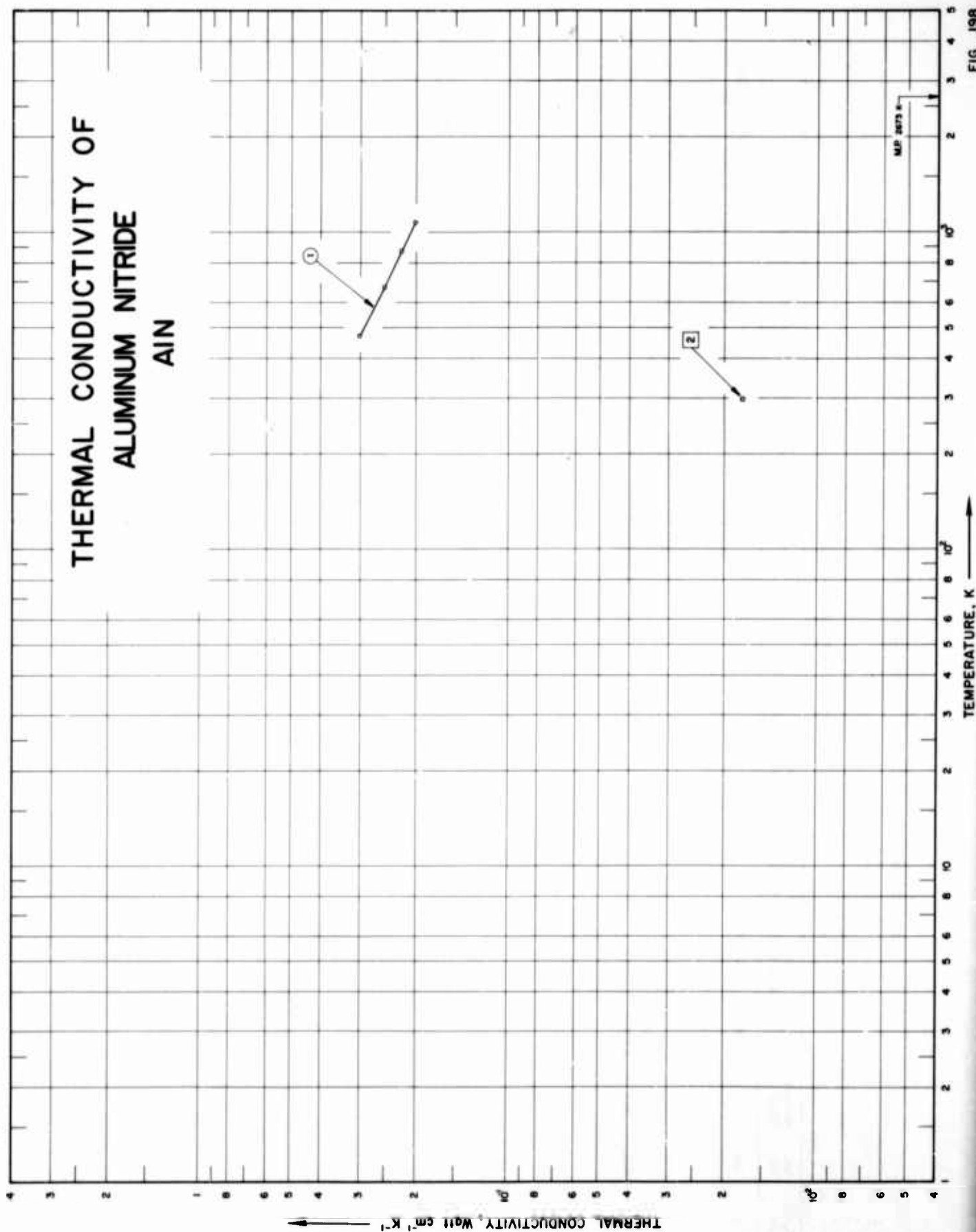
DATA TABLE NO. 197 THERMAL CONDUCTIVITY OF SODIUM NITRATE NaNO_3 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1*

582 0.00565

* No graphical presentation



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. out 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

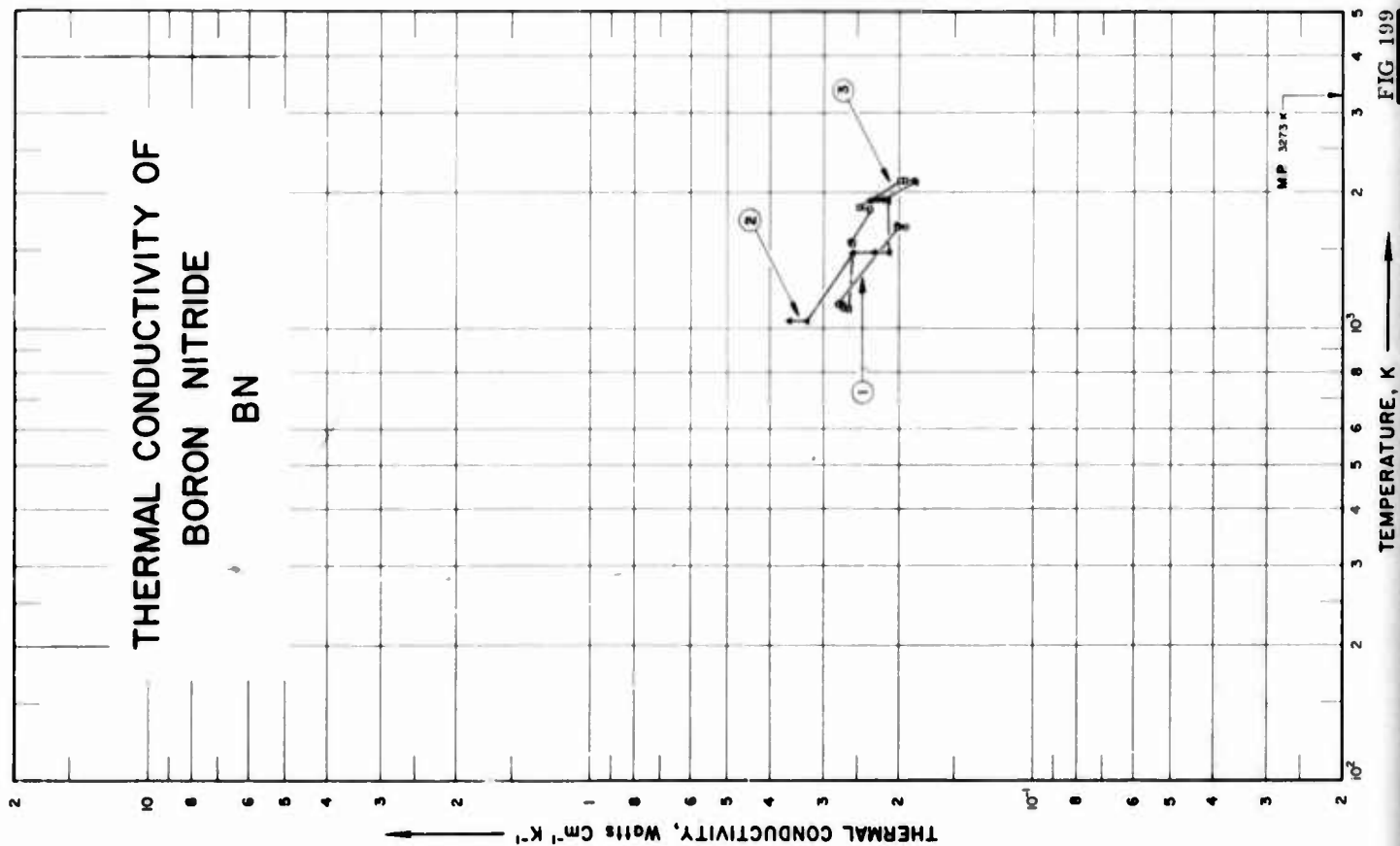


FIG 199

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
1488.7	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

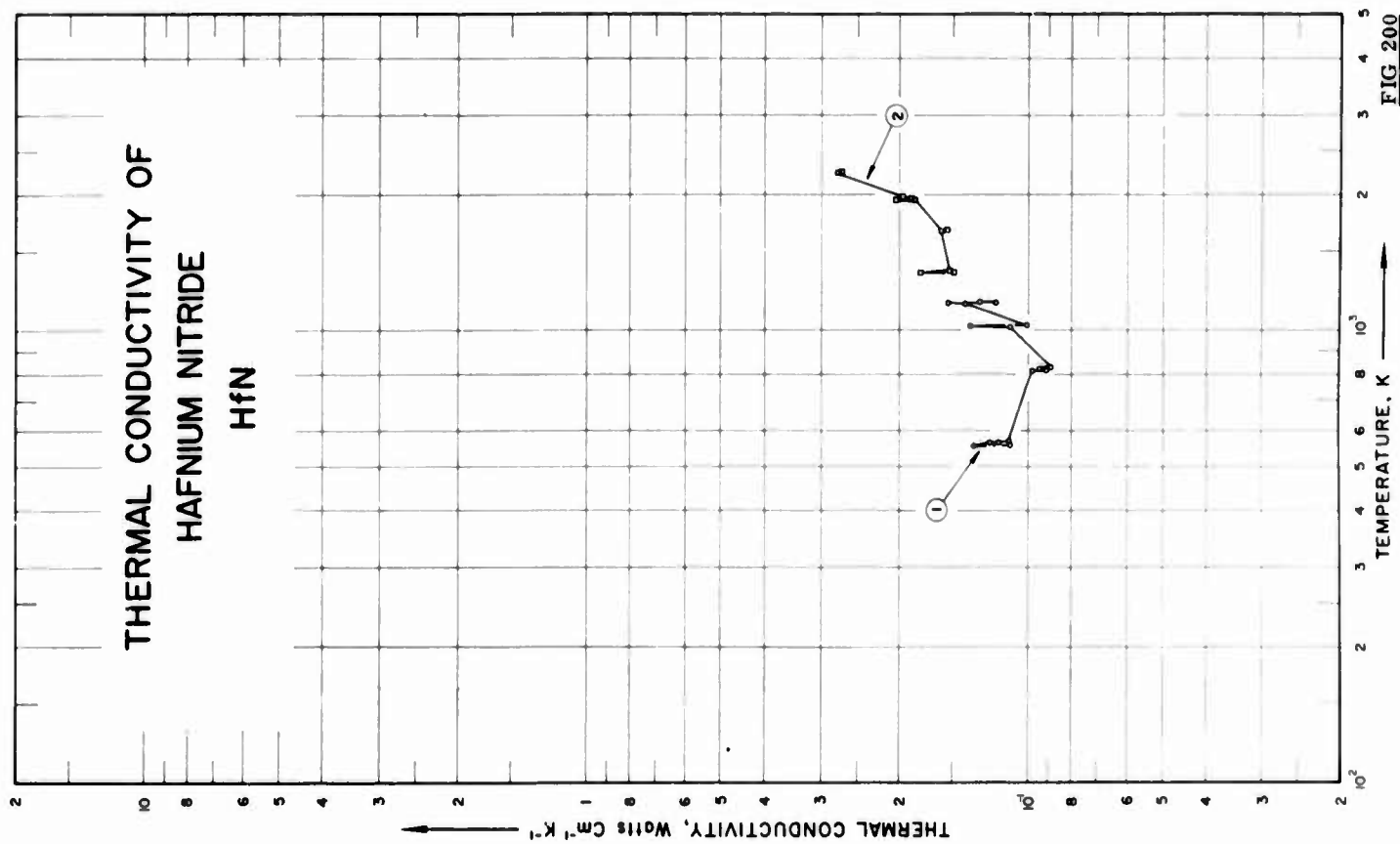


FIG 200

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

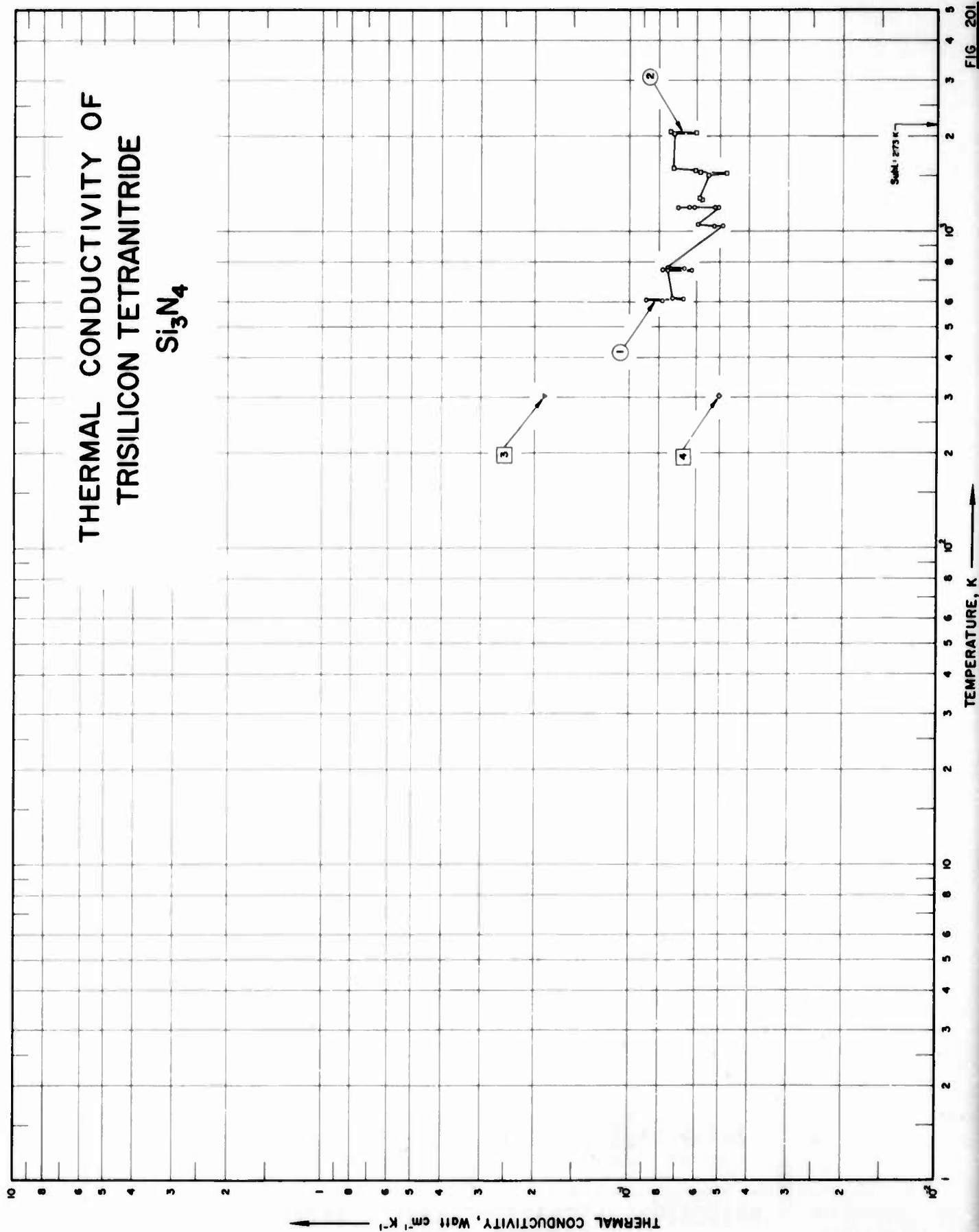
CURVE 1

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	0.0959*
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

CURVE 2

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*
1933.2	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



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

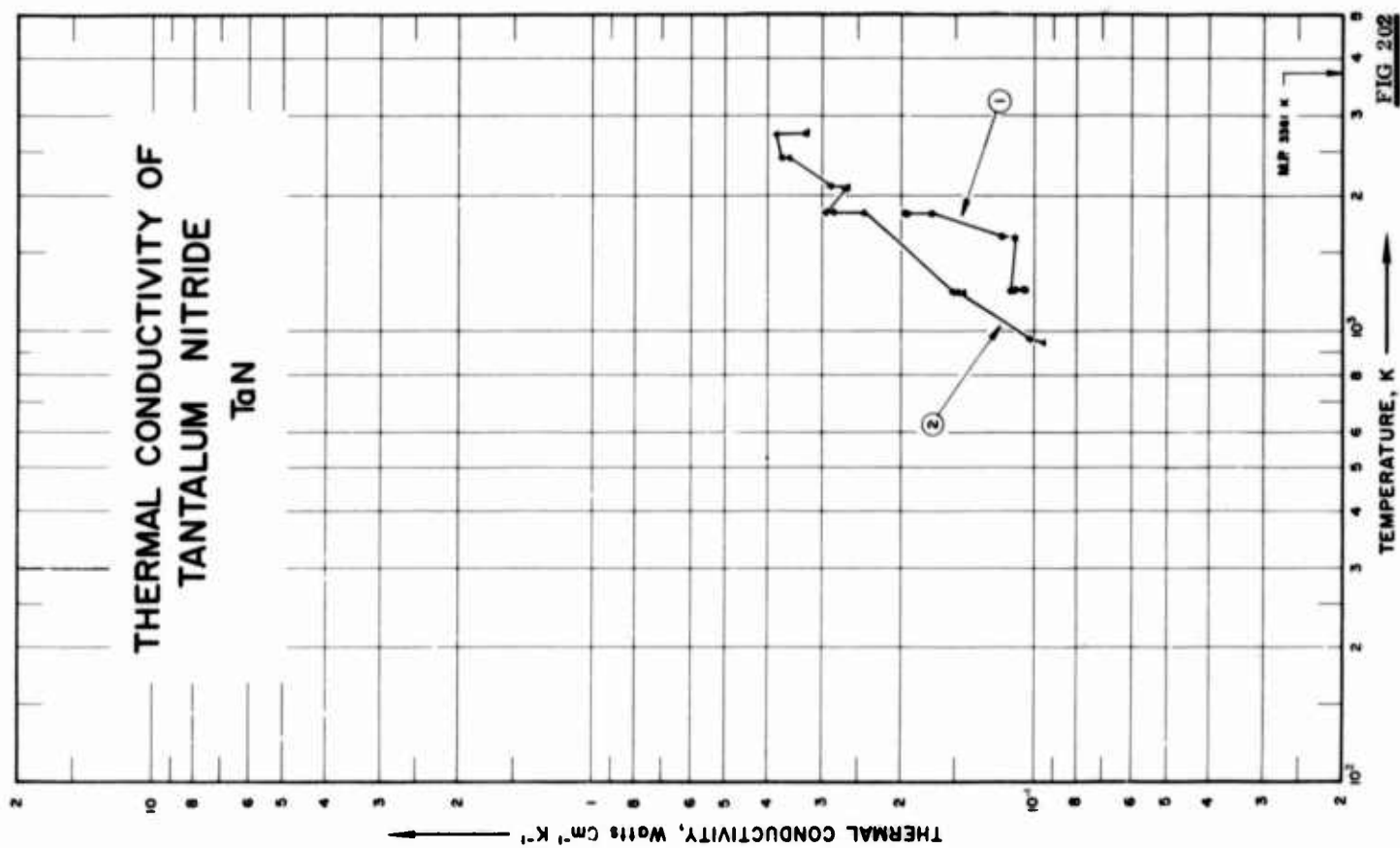


FIG 202

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

CURVE 1

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

CURVE 2

948.2	0.0956
962.6	0.103
1223.7	0.149
1224.8	0.144
1224.8	0.132
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

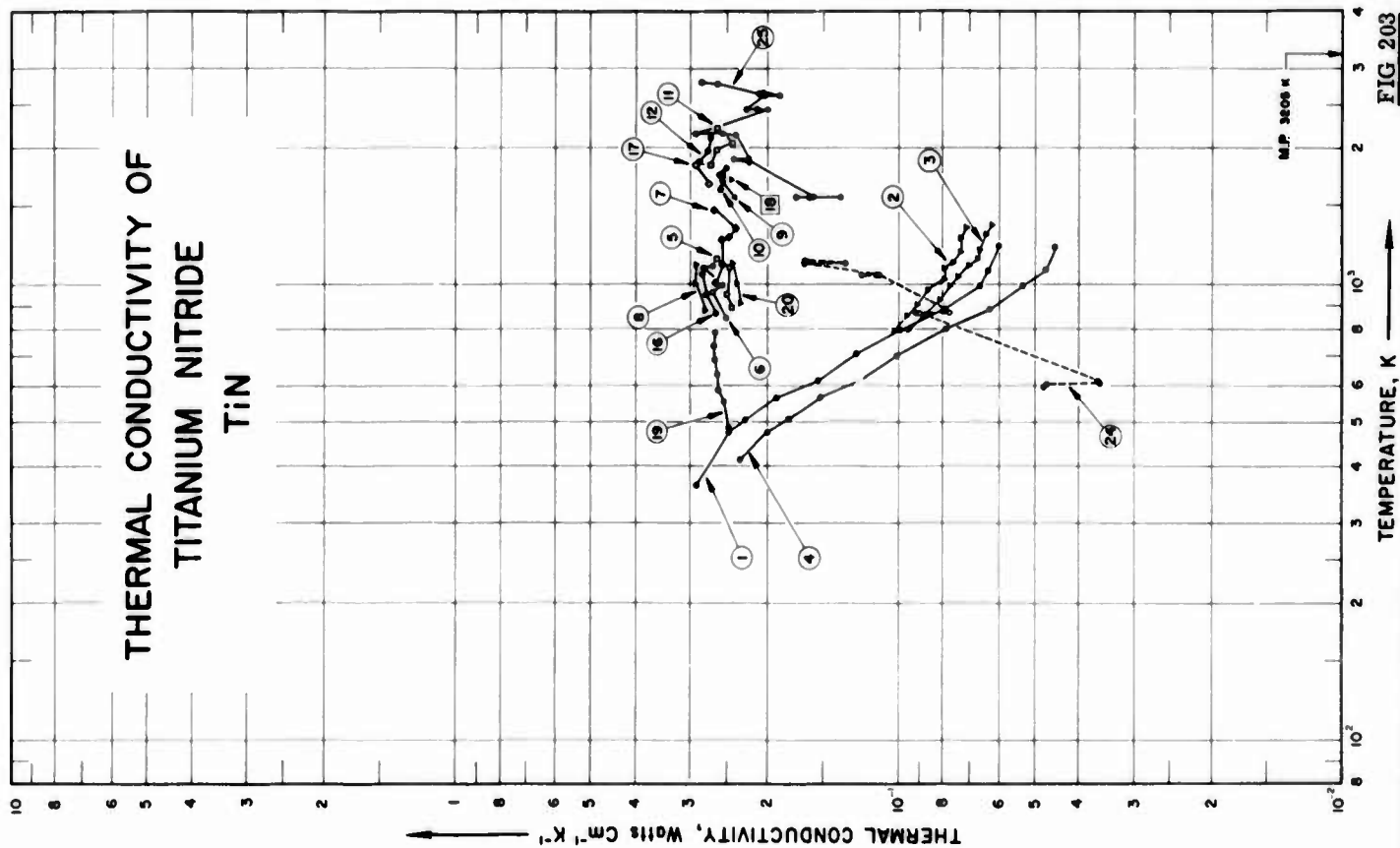


FIG 203

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	493-783		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., 69(3), 370-1, 1946)

THERMAL CONDUCTIVITY OF URANIUM NITRIDE UN

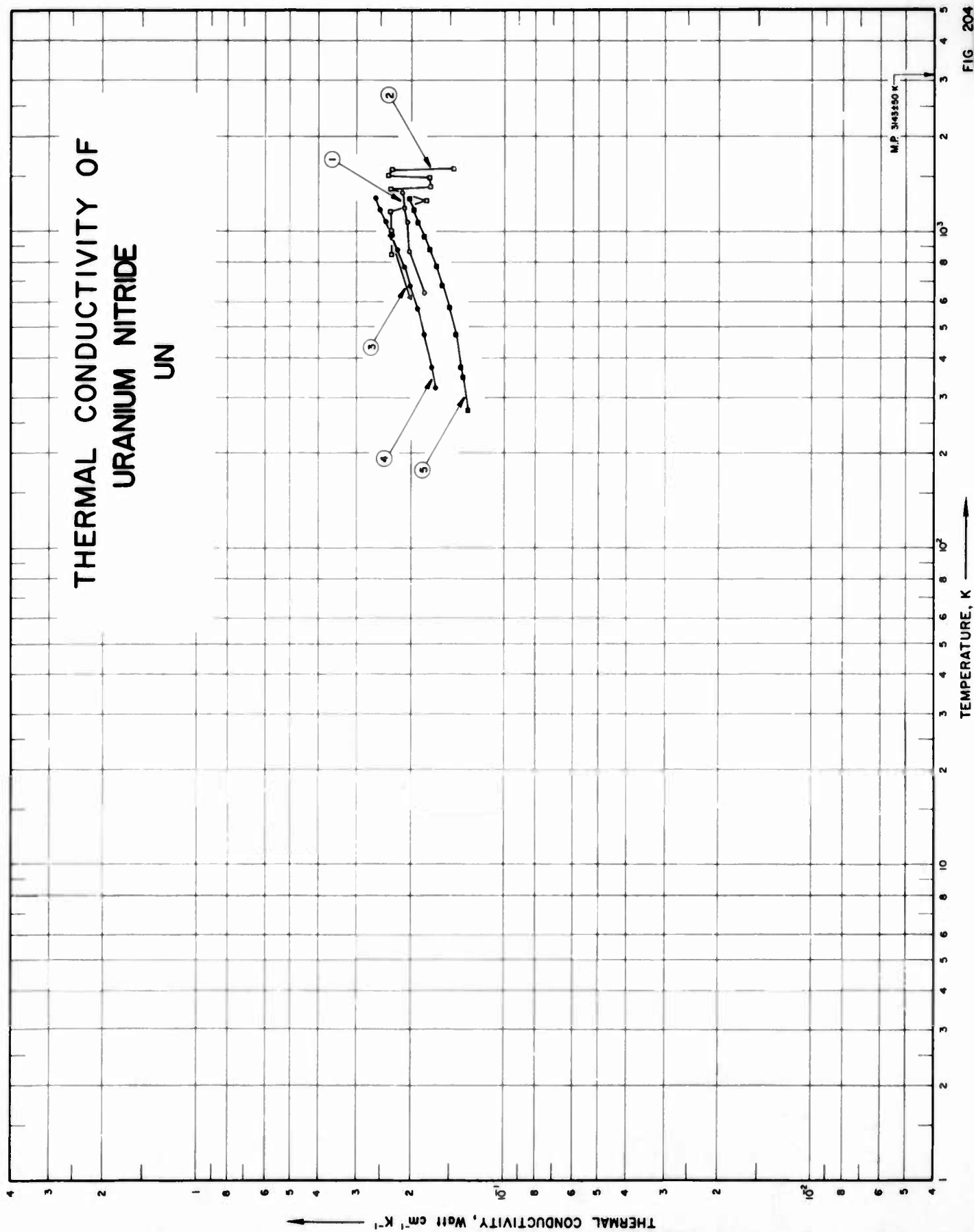


FIG. 204

SPECIFICATION TABLE NO. 204 THERMAL CONDUCTIVITY OF URANIUM NITRIDE UN

[For Data Reported in Figure and Table No. 204]

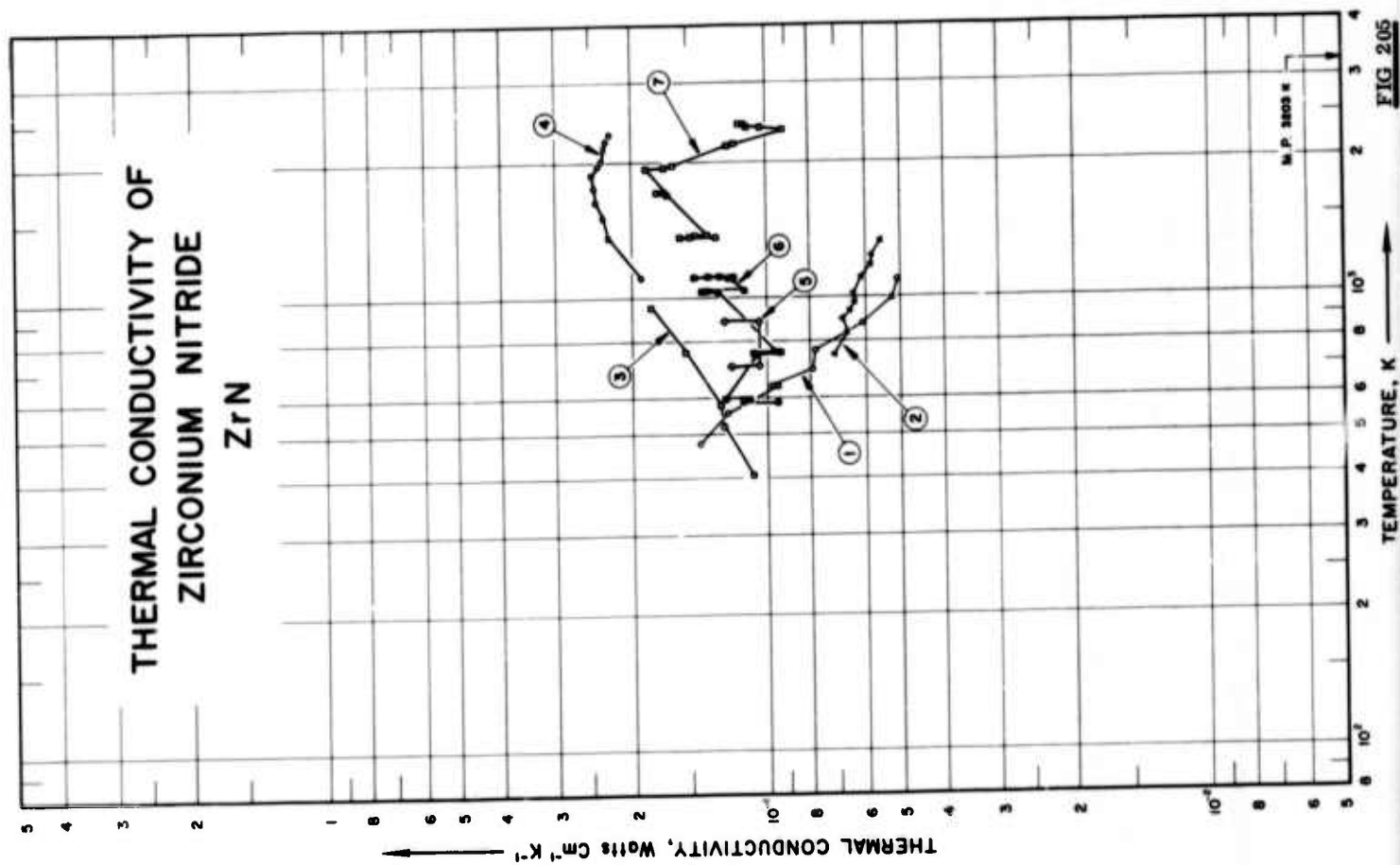
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	502	P	1963	640-1333			95 to 98% dense, prepared by hot pressing.
2	502	P	1963	845-1583			The above specimen, second run.
3	502	P	1963	620, 976			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
CURVE 1		CURVE 5 (cont.)	
640.2	0.181	573.2	0.151
863.2	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
		1073	0.190
		1173	0.196
		1273	0.203
CURVE 2*			
845.2	0.232		
1001.2	0.232		
1165.2	0.234		
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		
CURVE 3			
620.2	0.202		
976.2	0.233		
CURVE 4			
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		
CURVE 5			
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 10%.
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>		<u>CURVE 5</u>		<u>CURVE 7 (cont.)</u>	
478.2	0.142	703.7	0.121	2399.8	0.111
558.2	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				
763.2	0.0782	<u>CURVE 6</u>			
873.2	0.0615	588.7	0.0946		
996.2	0.0523	588.7	0.114		
1093.2	0.0510	593.2	0.110		
		594.3	0.125		
<u>CURVE 2</u>		745.4	0.107		
748.2	0.0711	754.8	0.0932		
838.2	0.0669	755.4	0.108		
893.2	0.0682	755.9	0.0963		
933.2	0.0657	1021.5	0.129		
973.2	0.0640	1027.1	0.137		
1023.2	0.0644	1035.1	0.140		
1110.2	0.0619	1039.3	0.113		
1183.2	0.0586	1109.8	0.123		
1243.2	0.0582	1111.5	0.120		
1341.2	0.0552	1111.5	0.146		
<u>CURVE 3</u>		1112.1	0.128		
408.2	0.109	1112.6	0.135		
520.9	0.126	<u>CURVE 7</u>			
573.3	0.128	1360.9	0.156		
760.9	0.152	1363.7	0.148		
955.4	0.182	1363.7	0.130		
<u>CURVE 4</u>		1366.5	0.144		
1116.5	0.192	1372.1	0.136		
1372.1	0.227	1699.8	0.166		
1502.6	0.232	1705.4	0.176		
1638.7	0.242	1705.4	0.169		
1758.2	0.244	1938.7	0.186		
1883.2	0.246	1944.3	0.169		
1966.5	0.239	1952.6	0.162		
2019.3	0.235	1955.4	0.163*		
2149.8	0.232	2161.0	0.123		
2238.7	0.228	2183.2	0.119		
2307.6	0.225	2186.0	0.122*		
		2349.8	0.0914		
		2388.7	0.104		

* 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

CURVE 1*

315.2 0.00711
 339.2 0.00711

CURVE 2*

313.2 0.0126
 342.2 0.0134

* No graphical presentation

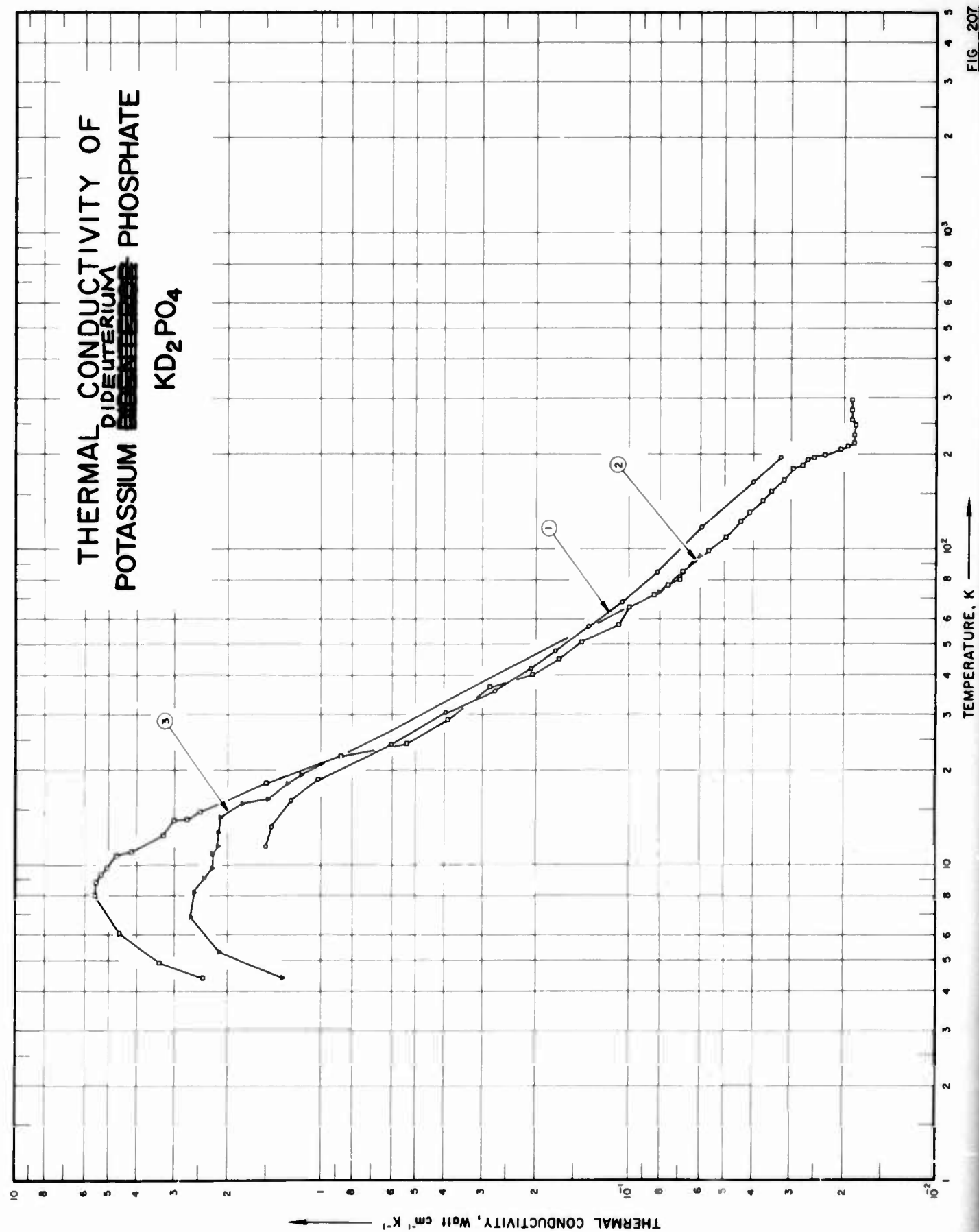


FIG. 207

SPECIFICATION TABLE NO. 207 **DIDEUTERIUM** THERMAL CONDUCTIVITY OF POTASSIUM ~~DEUTERIUM~~ 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~~UTERMIN PHOSPHATE KD_2PO_4
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k	CURVE 2 (cont.)	
		T	k
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	165.4	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
		230.2	0.0185
		247.8	0.0183
		258.9	0.0188
		276.8	0.0188
		297.2	0.0188
CURVE 2		CURVE 3	
4.40	2.43	4.43	1.32
4.93	3.38	5.35	2.14
6.10	4.61	6.89	2.65
7.98	5.56	8.21	2.58
8.79	5.51	9.06	2.39
9.29	5.33	9.82	2.26
9.90	5.06	10.9	2.25
10.7	4.74	11.6	2.16
11.0	4.18	12.7	2.15
12.4	3.27	14.3	2.13
13.8	3.02	15.7	1.79
13.9	2.73	16.3	1.47
14.7	2.47	18.2	1.28
18.3	1.50	19.4	1.16
22.2	0.867	73.6	0.0796
24.4	0.537	95.1	0.0594
28.9	0.391		
36.7	0.283		
40.2	0.205		
45.0	0.167		
50.8	0.143		
57.6	0.108		
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.	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	71	1951	312-350			Tetragonal crystal; measured with heat flow parallel to the optic axis.
2	71	1951	319-347			Above specimen measured with heat flow perpendicular to the optic axis.
3	514, 515	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	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	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
<u>CURVE 1</u>		<u>CURVE 4 (cont.)</u>		<u>CURVE 6 (cont.)</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
		84.6	0.0485	8.95	3.17
<u>CURVE 2</u>		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		<u>CURVE 5</u>	81.1	0.0536
95.7	0.0443			83.8	0.0481
114.6	0.0289	6.84	0.494	87.7	0.0415
120.8	0.0236	7.61	0.545	92.9	0.0379
211.9	0.0173	9.02	0.586	100.2	0.0308
253.0	0.0186	10.3	0.575	104.7	0.0243
		13.7	0.507	115.6	0.0170
		14.9	0.486	145.9	0.0138
		27.1	0.319	194.1	0.0139
		30.9	0.249	286.4	0.0148
		44.4	0.145		
		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		

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.
2	242	P	1961	418	± 3		Same as above.

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

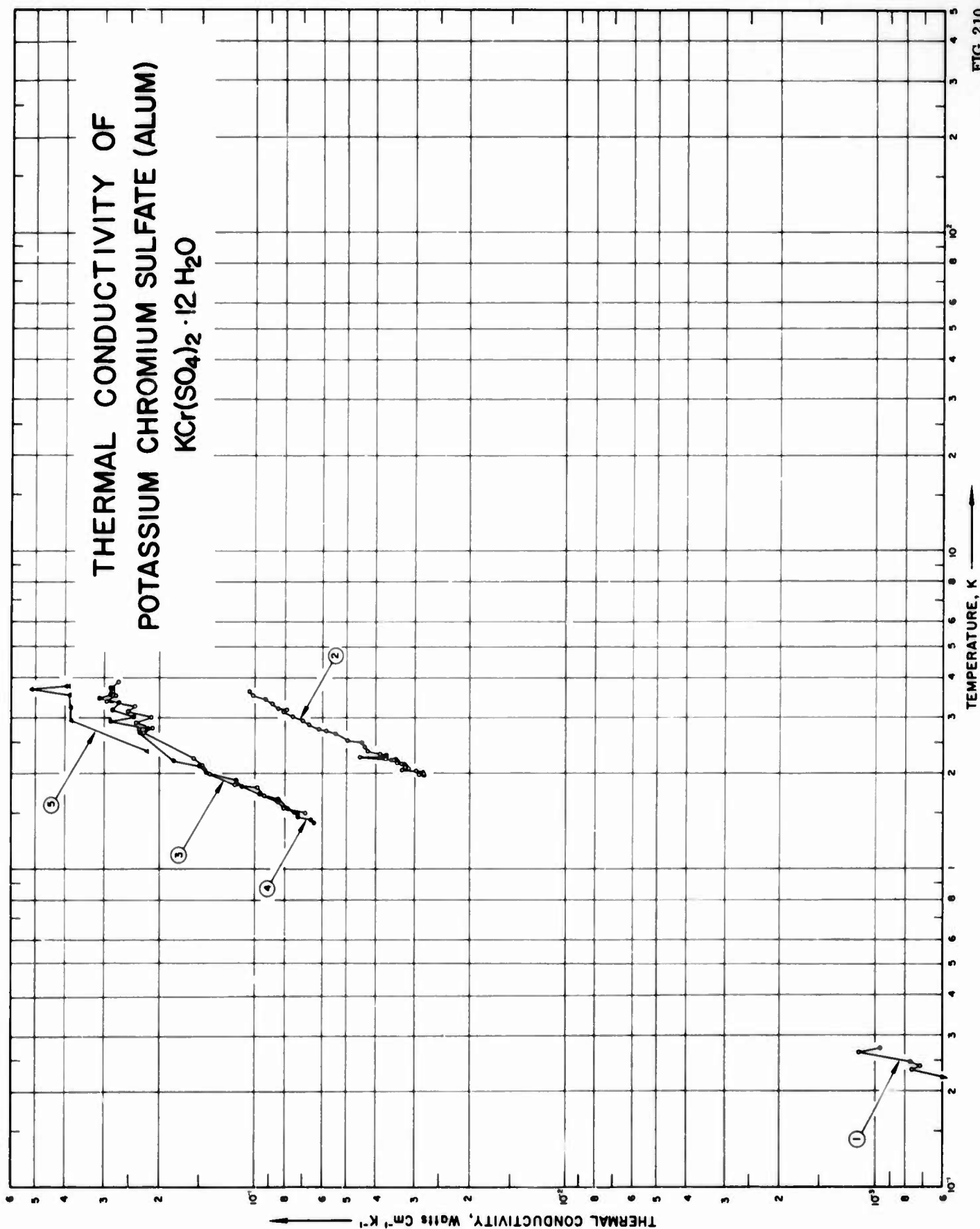


FIG 210

SPECIFICATION TABLE NO. 210 THERMAL CONDUCTIVITY OF POTASSIUM CHROMIUM SULFATE (ALUM) $\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$

[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) $\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 2 (cont.)</u>		<u>CURVE 4 (cont.)</u>	
0.145	0.000158*	3.17	0.0787	2.02	0.143
0.149	0.000186*	3.20	0.0840	2.10	0.148*
0.166	0.000222	3.31	0.0877	2.18	0.180
0.218	0.000552	3.41	0.0926	2.67	0.231
0.235	0.000756	3.51	0.101	2.76	0.219
0.240	0.000715	3.61	0.104	2.91	0.286
0.248	0.000768	<u>CURVE 3</u>		3.00	0.241
0.266	0.00112	1.50	0.0685	3.16	0.282
0.274	0.00096	1.56	0.0906	3.32	0.269
<u>CURVE 2</u>		1.63	0.0840	3.45	0.313
1.97	0.0277	1.70	0.0935	3.53	0.286
1.98	0.0290	1.80	0.0980	3.69	0.285
2.00	0.0279	1.84	0.116	<u>CURVE 5</u>	
2.01	0.0280	1.99	0.139	2.35	0.218
2.04	0.0296	2.11	0.149	2.92	0.382
2.05	0.0329	2.13	0.147	3.22	0.383
2.07	0.0313	2.23	0.156	3.54	0.386
2.09	0.0321	2.67	0.225	3.67	0.515
2.11	0.0319	2.75	0.232	3.74	0.397
2.13	0.0322	2.78	0.211	3.76	0.389
2.15	0.0330	2.88	0.238		
2.16	0.0341	2.99	0.213		
2.18	0.0338	3.12	0.252		
2.20	0.0356	3.24	0.240		
2.20	0.0347	3.37	0.296		
2.20	0.0344	3.50	0.275		
2.22	0.0370	3.62	0.280		
2.25	0.0450	3.75	0.283		
2.25	0.0368	3.87	0.270		
2.28	0.0368	<u>CURVE 5</u>			
2.30	0.0386	1.40	0.0637		
2.35	0.0424	1.43	0.0654		
2.42	0.0435	1.46	0.0725		
2.50	0.0444	1.49	0.0725		
2.58	0.0495	1.52	0.0741		
2.66	0.0541	1.55	0.0781		
2.72	0.0581	1.66	0.0840		
2.75	0.0617	1.73	0.0962		
2.84	0.0667	1.81	0.110		
2.93	0.0699	1.90	0.115		
3.02	0.0752				
3.11	0.0806				

* 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, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1*

443.8 0.00404
 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
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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]

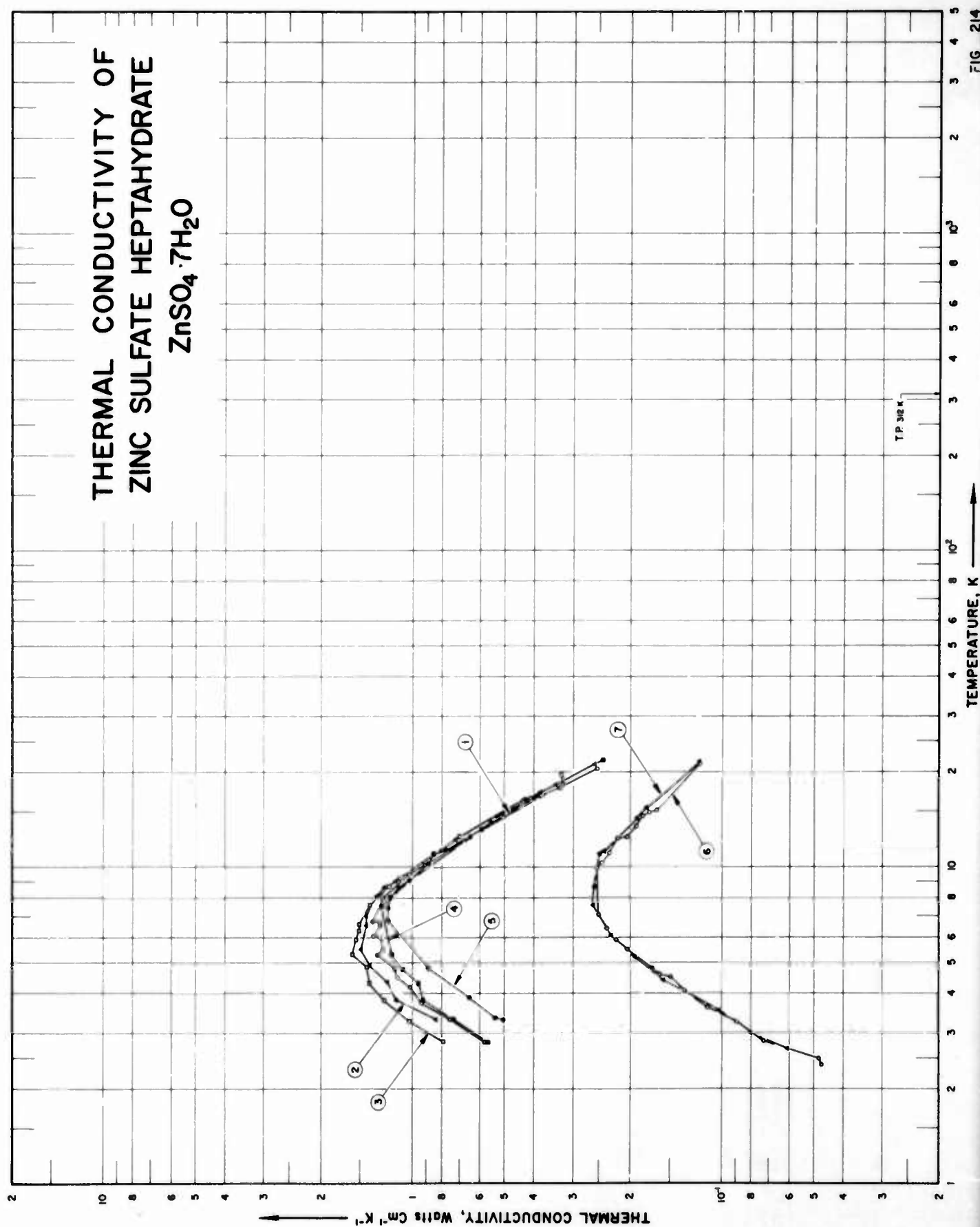
T k

CURVE 1*

295.0 0.0136

* No graphical presentation

THERMAL CONDUCTIVITY OF
ZINC SULFATE HEPTAHYDRATE
 $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$



SPECIFICATION TABLE NO. 214 THERMAL CONDUCTIVITY OF ZINC SULFATE HEPTAHYDRATE $\text{ZnSO}_4 \cdot 7 \text{H}_2\text{O}$

[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 $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1}\text{K}^{-1}$]

CURVE 1		CURVE 3		CURVE 5		CURVE 7	
T	k	T	k	T	k	T	k
2.8	0.580	2.81	0.79	3.30	0.503	2.68	0.0610
3.3	0.750	3.27	1.02	3.35	0.535	3.0	0.0800
3.7	0.931	3.8	1.245	3.88	0.645	3.5	0.102
4.2	1.025	4.3	1.39	4.79	0.883	4.4	0.157
4.5	1.125	4.85	1.42	6.80	1.207	5.2	0.194
4.8	1.150	5.3	1.59	7.41	1.211	6.1	0.229
5.3	1.314	5.9	1.55	8.0	1.183	7.6	0.260
5.5	1.263	6.3	1.51	8.6	1.114	8.65	0.259
6.0	1.268	6.6	1.51	9.07	1.025	11.0	0.248
6.05	1.360	7.6	1.39	10.29	0.647	11.2	0.230
6.55	1.285	8.7	1.20	16.3	0.421	14.25	0.190
6.7	1.286	9.2	1.105	16.5	0.400	15.45	0.178
6.75	1.360	12.5	0.700	16.75	0.388*	21.5	0.120
8.0	1.264	15.7	0.442	21.8	0.242*		
9.5	1.032	17.8	0.330				
10.2	0.910	18.3	0.325	CURVE 6			
14.4	0.501	19.6	0.280	2.37	0.0471		
20.5	0.252			2.49	0.0481		
CURVE 2		CURVE 4		2.82	0.0728		
3.3	0.835	2.8	0.565	3.25	0.0890		
3.8	1.113	3.3	0.735	3.62	0.112		
4.35	1.215	3.8	0.921	4.05	0.135		
4.9	1.390	4.3	0.955	4.50	0.150		
5.5	1.490	4.8	1.081	4.60	0.162		
6.6	1.435	5.3	1.175	4.80	0.172		
7.0	1.438	7.5	1.278	5.50	0.205		
8.1	1.315	10.2	0.884	5.90	0.222		
8.6	1.242	11.0	0.850	6.41	0.235		
9.1	1.140	11.3	0.770	7.05	0.250		
12.2	0.720	13.2	0.592	9.95	0.252		
16.3	0.430	13.8	0.550	10.32	0.245		
17.2	0.380	21.8	0.242	11.10	0.232		
18.2	0.340			12.35	0.219		
21.2	0.258			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
<u>CURVE 1*</u>	
973	0.020
1103	0.018
1203	0.014
1273	0.019
1402	0.011
1523	0.015
1573	0.015

* 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
CURVE 1*	
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, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T k

CURVE 1*

293.2 0.0335

CURVE 2*

293.2 0.0586

* No graphical presentation

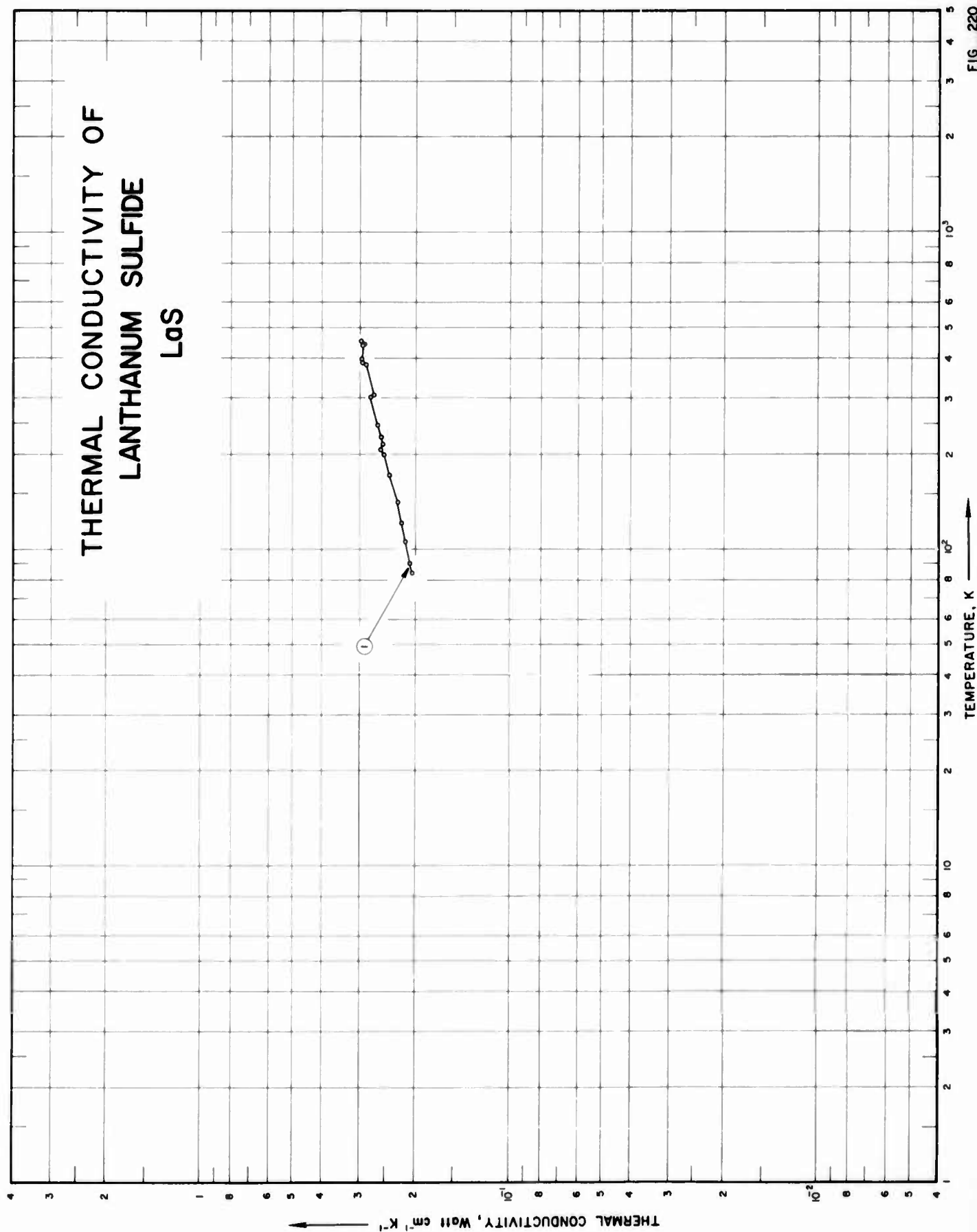


FIG. 220

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 1900 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
CURVE 1	
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 $\text{Al}_2\text{O}_3 + \text{Cr}$

Curve No.	Ref. Method No.	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 $\text{Al}_2\text{O}_3 + \text{Cr}$ [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1} \text{K}^{-1}$]

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

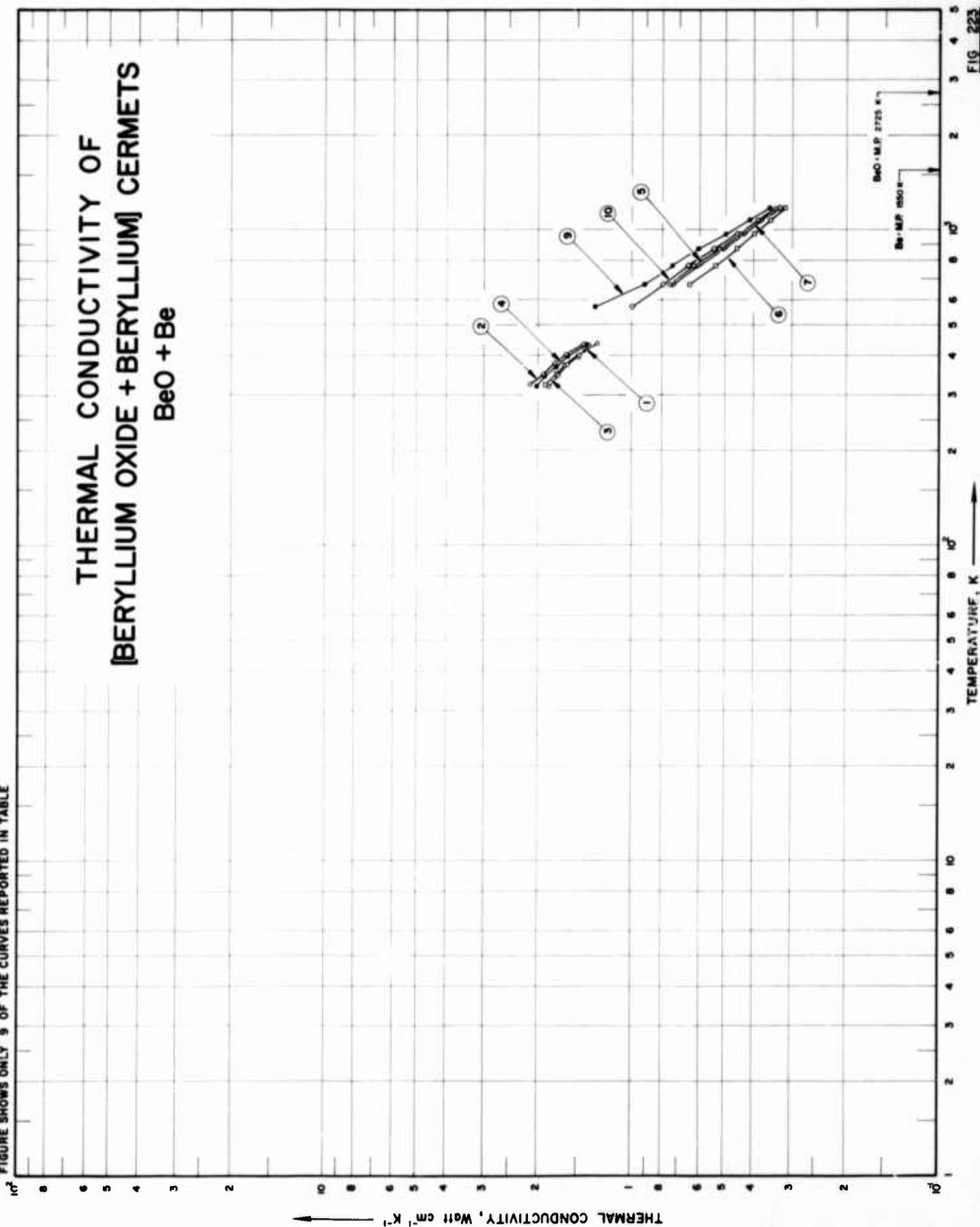


FIG 223

SPECIFICATION TABLE NO. 223 THERMAL CONDUCTIVITY OF [BERYLLIUM OXIDE + BERYLLIUM] CERMETS BeO + Be

[For Data Reported in Figure and Table No. 223]

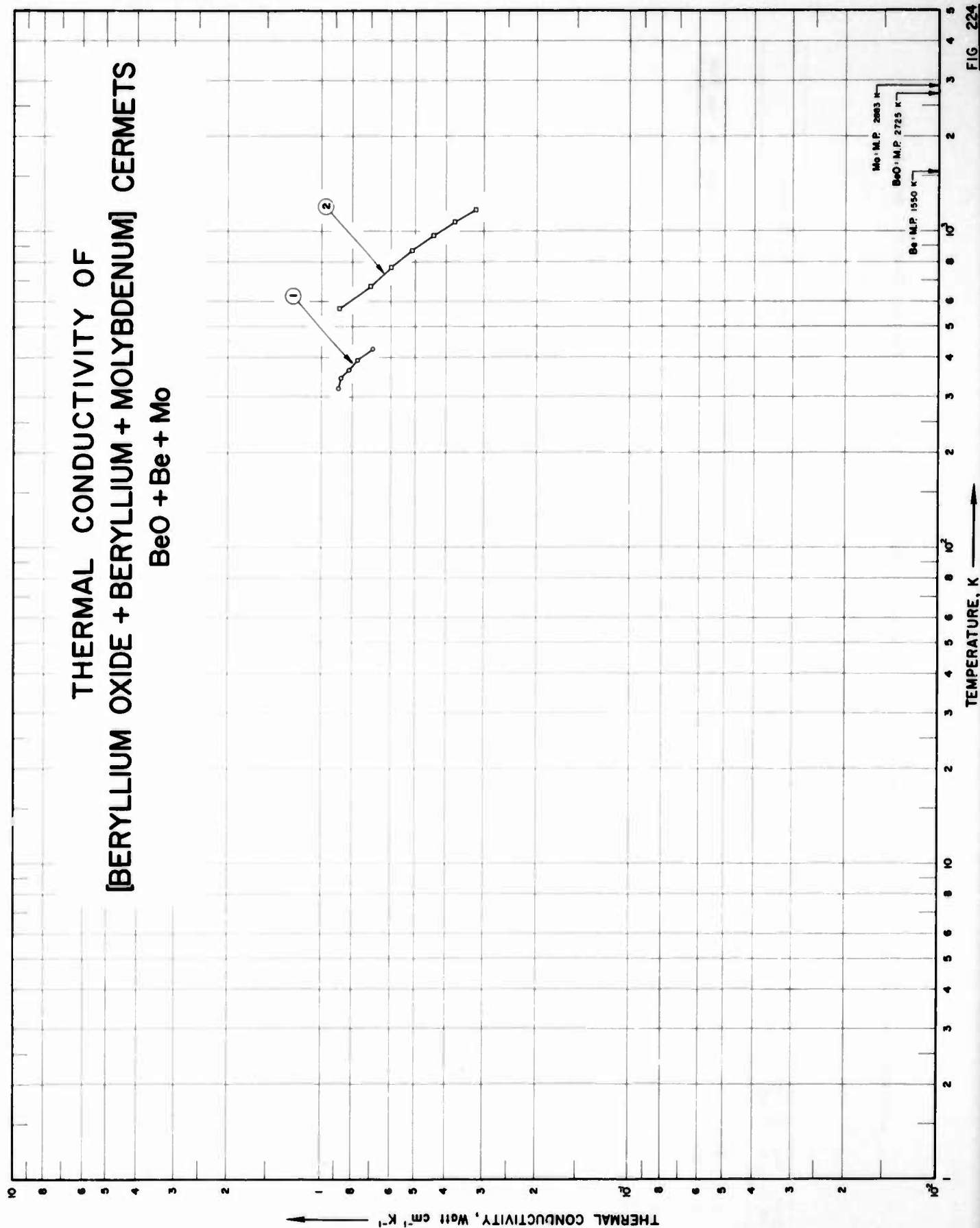
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	12		1953	320-436		267A-1	Metal content 5.24%, metal particle size 2-5 μ ; density 2.81 g cm ⁻³ .
2	12		1953	325-434		268A-1	Metal content 5.65%, 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 15-35 μ ; density 2.86 g cm ⁻³ .
4	12		1953	320-432		270A-1	Metal content 6.06%, metal particle size 15-35 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>		<u>CURVE 6 (cont.)</u>	
319.6	1.85	1073.2	0.354
346.1	1.72	1173.2	0.317
373.8	1.62		
400.8	1.48	<u>CURVE 7</u>	
436.5	1.30	673.2	0.734
<u>CURVE 2</u>		773.2	0.603
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 3</u>		<u>CURVE 8*</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>		1173.2	0.303
319.6	2.01		
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>		873.2	0.605
673.2	0.756	973.2	0.498
773.2	0.627	1073.2	0.414
873.2	0.524	1173.2	0.356
973.2	0.448		
1073.2	0.388	<u>CURVE 10</u>	
1173.2	0.340	573.2	0.995
<u>CURVE 6</u>		673.2	0.794
673.2	0.646	773.2	0.652
773.2	0.538	873.2	0.542
873.2	0.457	973.2	0.455
973.2	0.397	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] CERMETS 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] CERMETS BeO + Be + Mo
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
CURVE 1	
319.6	0.882
344.2	0.866
366.5	0.816
393.6	0.774
427.6	0.690
CURVE 2	
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

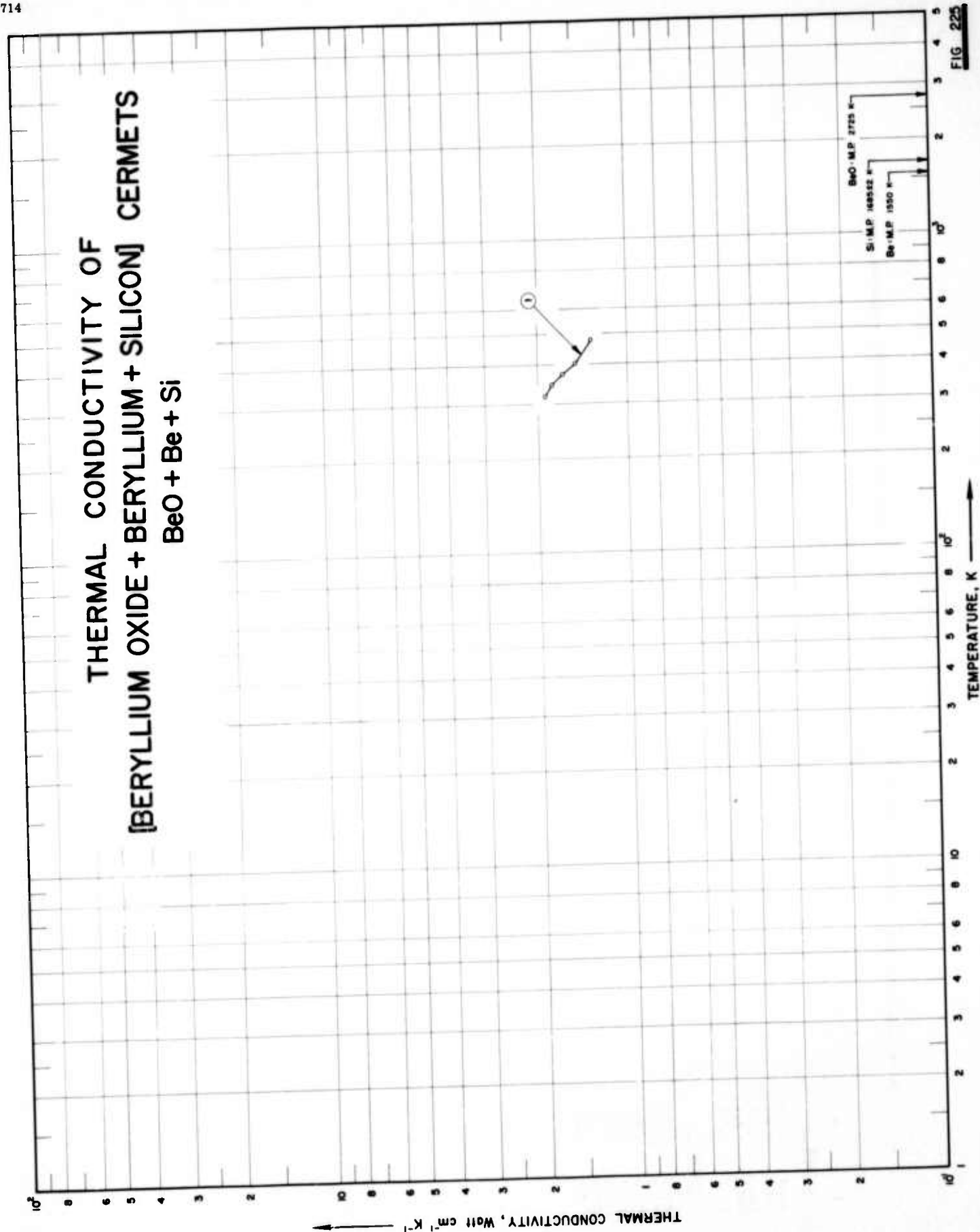


FIG. 225

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
<u>CURVE 1</u>	
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 $B_4C + Al$

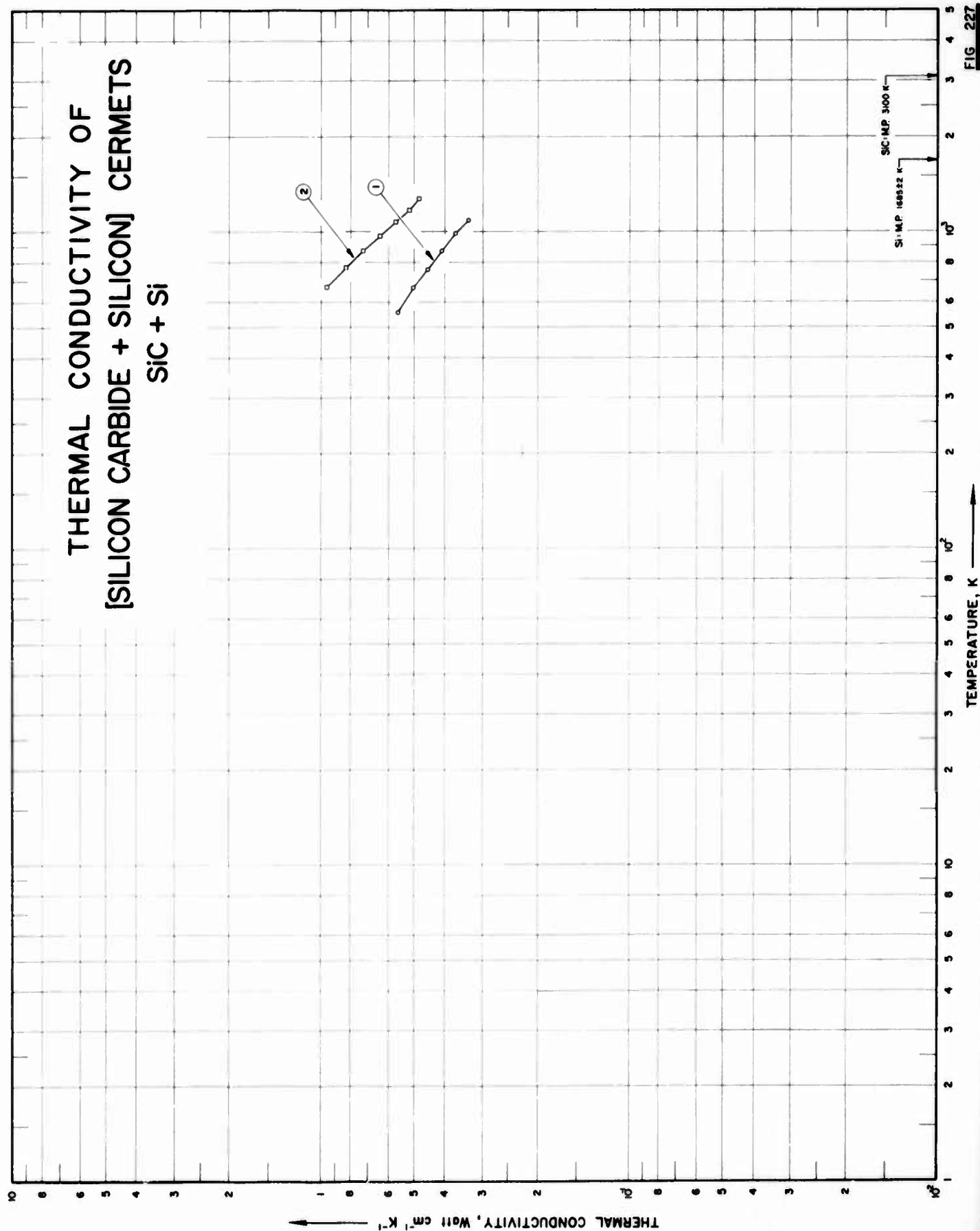
Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
						B_4C	Al	
1	473	L	1964	366-533	Boral	50	50	Prepared by adding pre-oxidized B_4C powder (oxidized at 811 C for one hr) 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⁻¹K⁻¹]

T	k
CURVE 1*	
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] CERMETS 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. 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.
2	378	C	1962	673-1273	± 6	10A	

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
CURVE 1	
556.2	0.562
668.2	0.502
760.2	0.455
871.2	0.410
991.2	0.369
1089.2	0.335
CURVE 2	
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

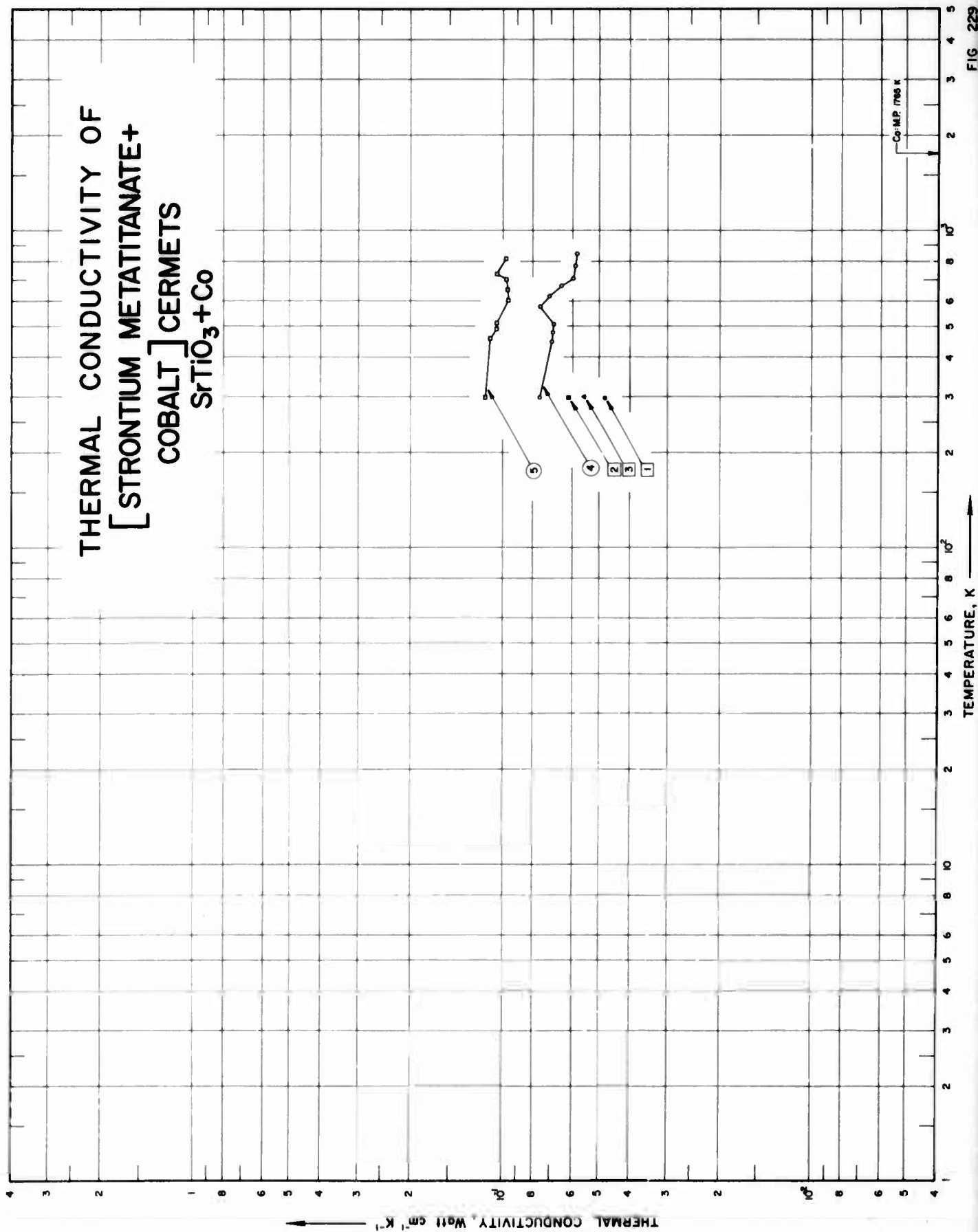
CURVE 1*

328 0.554

CURVE 2*

328 0.578

* No graphical presentation



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 No.	Year Used	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) TiC Co NbC	Composition (continued), Specifications and Remarks
1	264	1949	298.2			66.3 18.7 15.0	

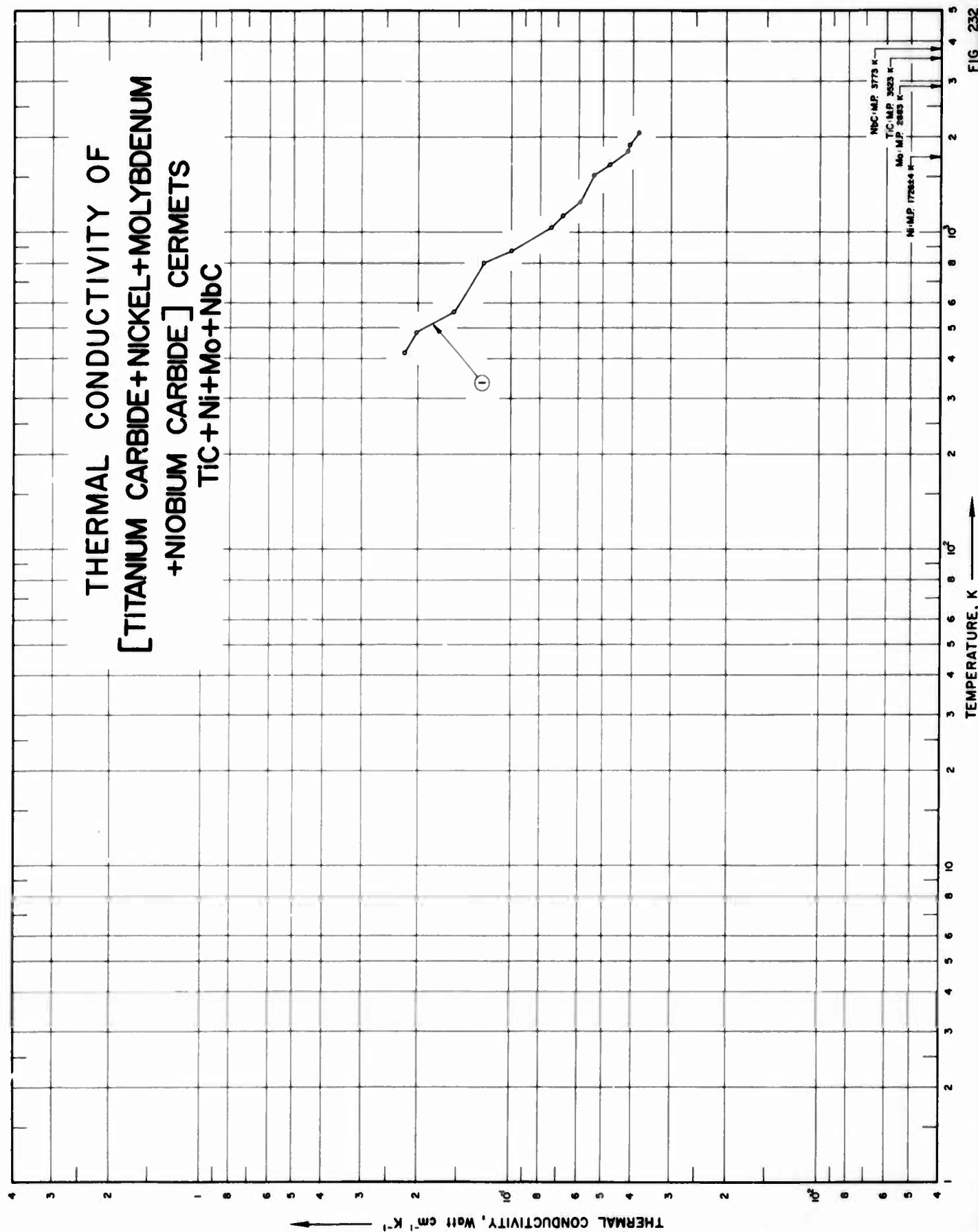
DATA TABLE NO. 231 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + COBALT + NIOBIUM CARBIDE] CERMETS TiC + Co + NbC
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

298.2 0.314

* No graphical presentation



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. No.	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
<u>CURVE 1</u>	
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 No.	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. 233 THERMAL CONDUCTIVITY OF [TITANIUM CARBIDE + NICKEL + NIOBIUM CARBIDE] CERMETS TiC + Ni + NbC

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

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.	Year Used	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.

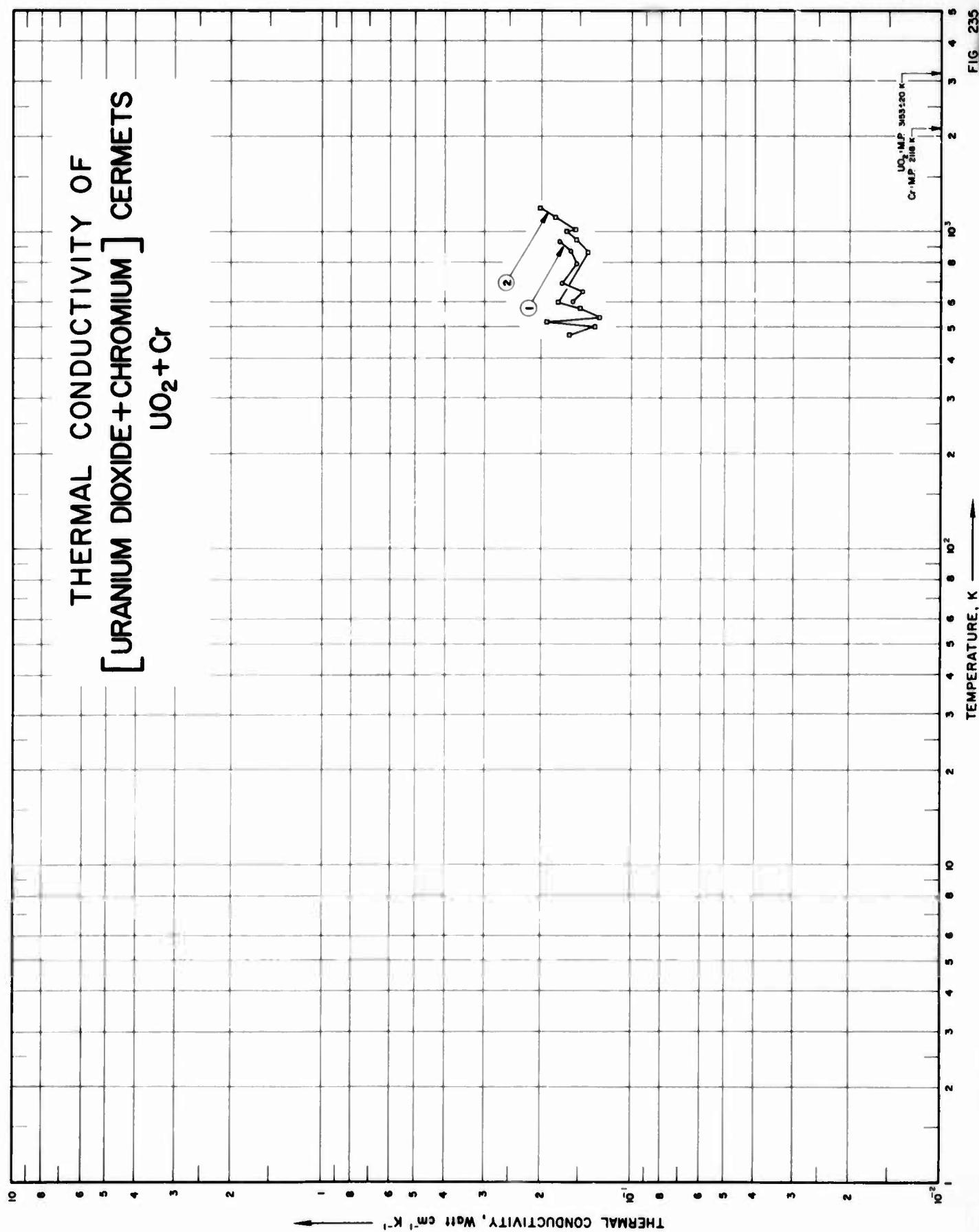
DATA TABLE NO. 234 THERMAL CONDUCTIVITY OF [URANIUM CARBIDE + URANIUM] CERMETS UC + U

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

T	k
CURVE 1*	
479.2	0.232
642.2	0.200
969.2	0.239

* No graphical presentation

THERMAL CONDUCTIVITY OF
[URANIUM DIOXIDE+CHROMIUM] CERMETS
 $\text{UO}_2 + \text{Cr}$



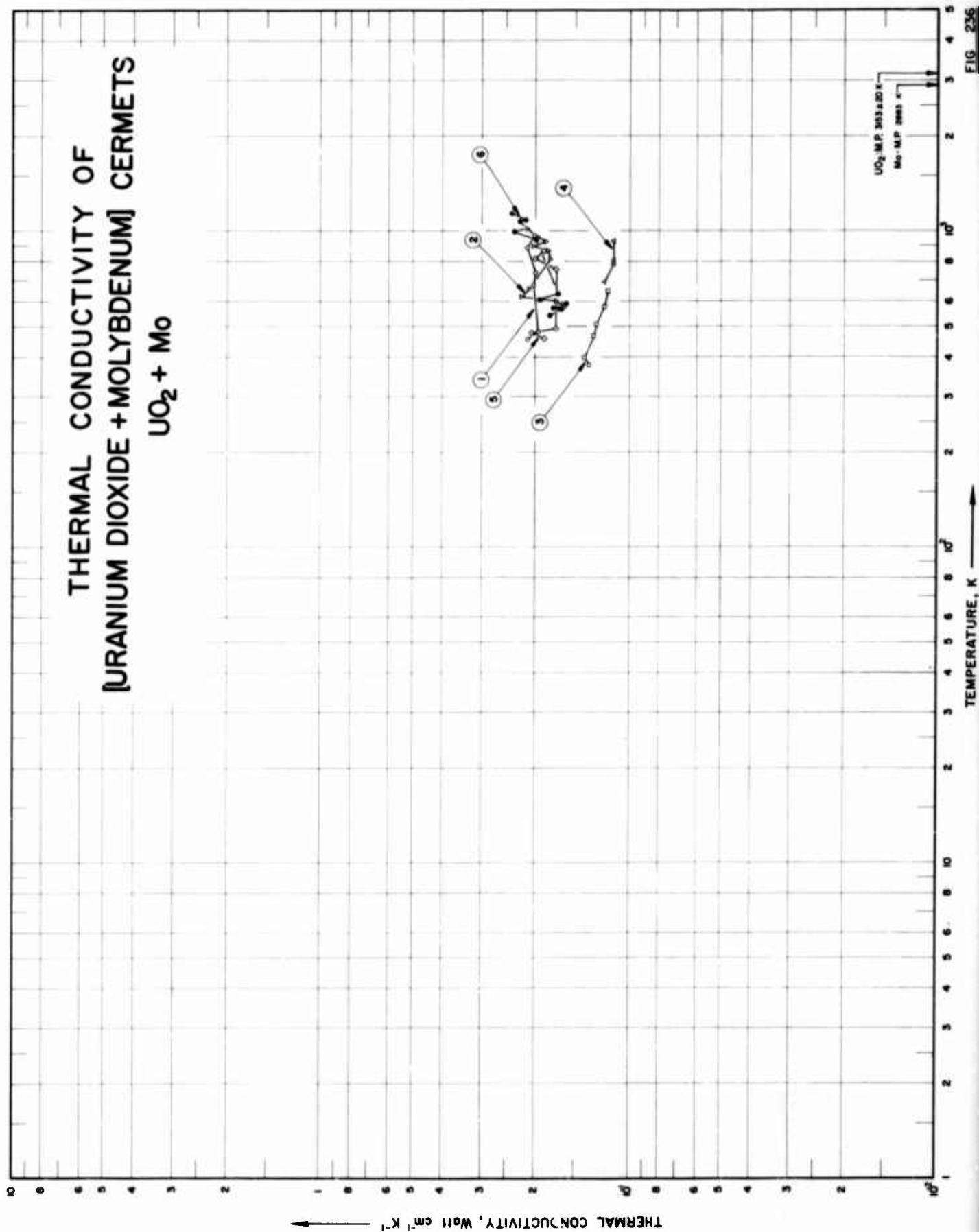
SPECIFICATION TABLE NO. 235 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + CHROMIUM] CERMETS $\text{UO}_2 + \text{Cr}$

[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	$< \pm 5$	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	$< \pm 5$	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, $\text{Watt cm}^{-1} \text{K}^{-1}$]

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
598.2	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



SPECIFICATION TABLE NO. 236 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + MOLYBDENUM] CERMETS $UO_2 + Mo$

[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	$< \pm 5$	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	$< \pm 5$	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	$< \pm 5$	Tc - 90	
4	385	C	1961	692-932	$< \pm 5$	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	$< \pm 5$	Tc - 105	
6	385	C	1961	544-1143	$< \pm 5$	Tc - 105	

DATA TABLE NO. 236 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + MOLYBDENUM] CERMETS $\text{UO}_2 + \text{Mo}$
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
CURVE 1		CURVE 6	
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
CURVE 2		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		
CURVE 3		CURVE 4	
379.2	0.136	692.2	0.120
398.2	0.140	788.2	0.112
468.2	0.130	810.2	0.112
507.2	0.127	932.2	0.112
579.2	0.120		
647.2	0.117		
CURVE 5		CURVE 6	
458.2	0.187	544.2	0.180
476.2	0.206	568.2	0.166
492.2	0.173	574.2	0.176
759.2	0.173	591.2	0.160
816.2	0.200	606.2	0.194
866.2	0.187	635.2	0.170

* Not shown on plot

THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE+NIBIUM] CERMETS $\text{UO}_2 + \text{Nb}$

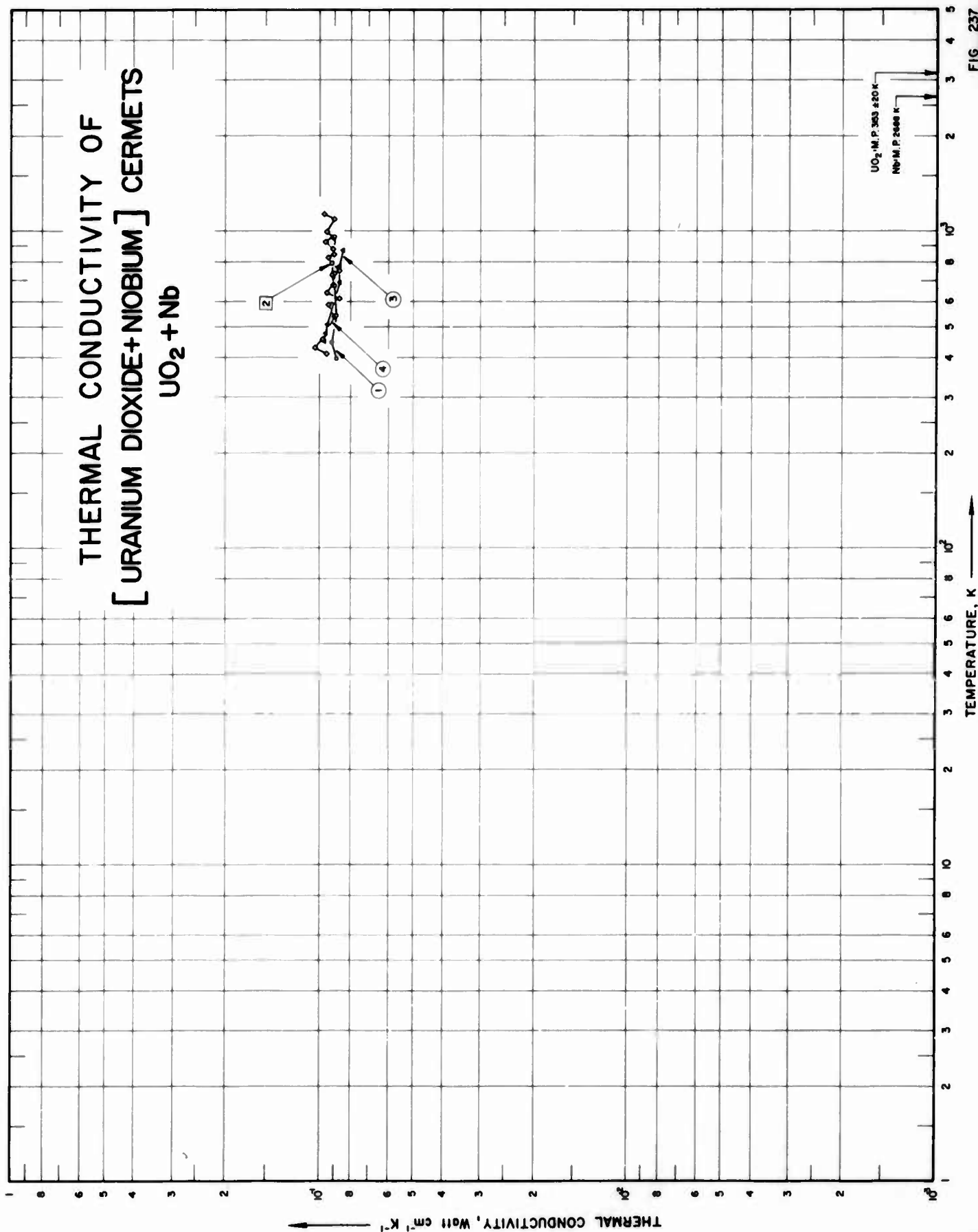


FIG. 237

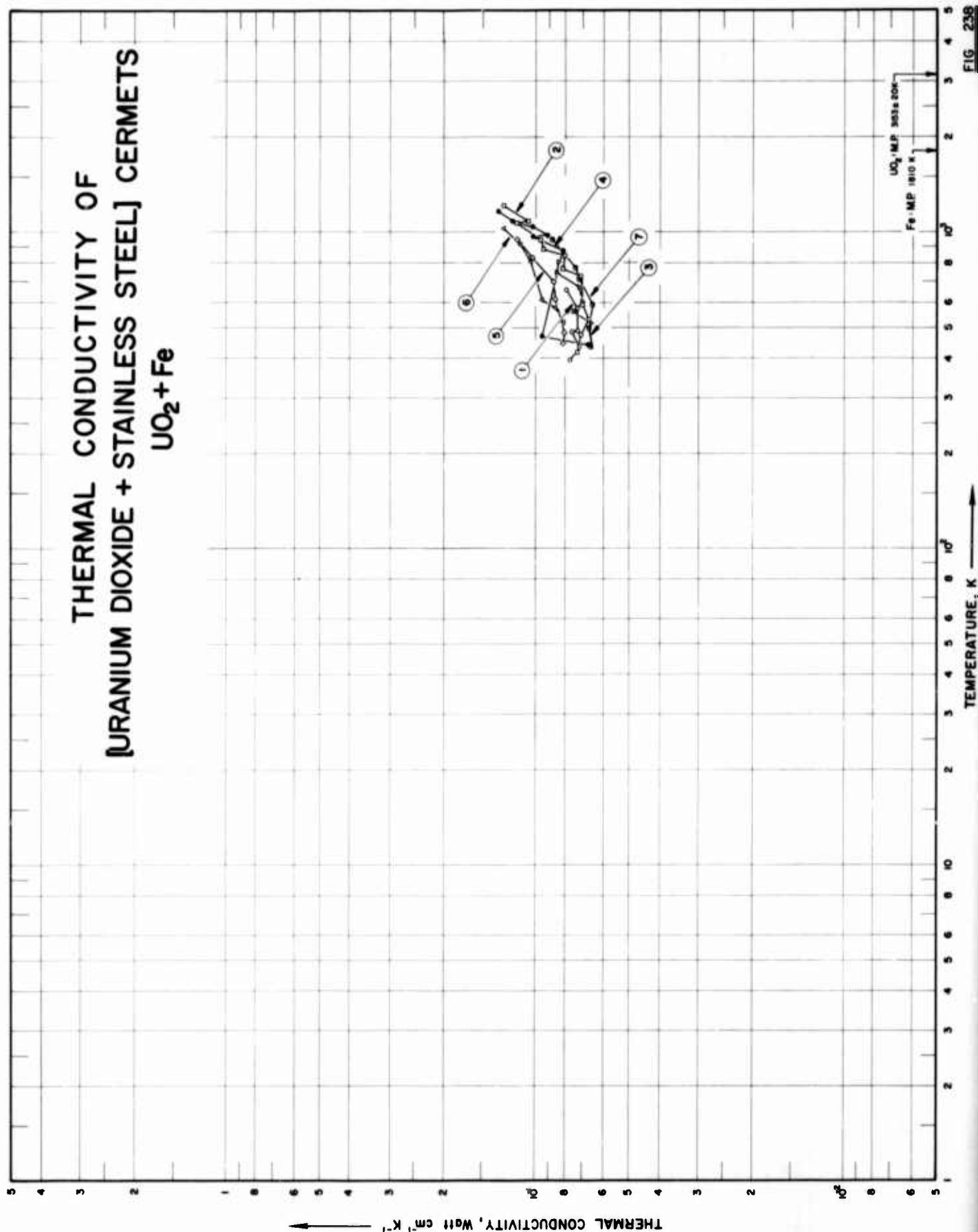
SPECIFICATION TABLE NO. 237 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE - NIOBIUM] CERMETS $UO_2 + Nb$

[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	$< \pm 5$	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	$< \pm 5$	TC-115	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.
3	385	C	1961	450-872	$< \pm 5$	TC-130	
4	385	C	1961	413-1131	$< \pm 5$	TC-130	

DATA TABLE NO. 237 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + NIOBIUM] CERMETS $\text{UO}_2 + \text{Nb}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

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



SPECIFICATION TABLE NO. 238 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + STAINLESS STEEL EX₁] CERMENTS UO₂ + Fe + ΣX₁

[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	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. The above specimen, second run.
3	385	C	1961	518-804	< ± 5	Tc - 103	
4	385	C	1961	442-1169	< ± 5	Tc - 103	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. The above specimen, second run.
5	385	C	1961	446-947	< ± 5	Tc - 81	
6	385	C	1961	521-1031	< ± 5	Tc - 81	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. The above specimen, second run.
7	385	C	1961	437-945	< ± 5	Tc - 80	
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] CERME TS $UO_2 + Fe + \Sigma X_i$
 [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k
CURVE 1		CURVE 5	
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
CURVE 2		CURVE 6	
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	CURVE 7	
884.0	0.094	437.2	0.066
943.0	0.096	499.2	0.067
1070.0	0.116	593.2	0.065
1084.0	0.106	715.2	0.072
1213.0	0.127	773.2	0.074
CURVE 3		945.2	0.088
518.0	0.066	CURVE 8*	
564.0	0.075	415.2	0.063
604.0	0.070	465.2	0.071
674.0	0.072	828.2	0.080
745.0	0.085	1012.2	0.092
804.0	0.084	CURVE 4	
CURVE 4		442.0	0.067
442.0	0.067	470.0	0.095
470.0	0.095	373.0	0.081
373.0	0.081	970.0	0.102
970.0	0.102	978.0	0.091
978.0	0.091	1047.0	0.102
1047.0	0.102	1088.0	0.119
1088.0	0.119	1169.0	0.133

* Not shown on plot

SPECIFICATION TABLE NO. 239 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + URANIUM] CERMETS $UO_2 + U$

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	-	1965	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} to 5.495×10^3 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} to 4.677×10^3 mm Hg.

DATA TABLE NO. 239 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + URANIUM] CERMETS $\text{UO}_2 + \text{U}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
<u>CURVE 1*</u>	
298.2	0.06239
p(mm Hg)	k
<u>CURVE 2*</u>	
$\bar{T} = 298.2$	
0.00912	0.0009562
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 $\text{UO}_2 + \text{Zr}$

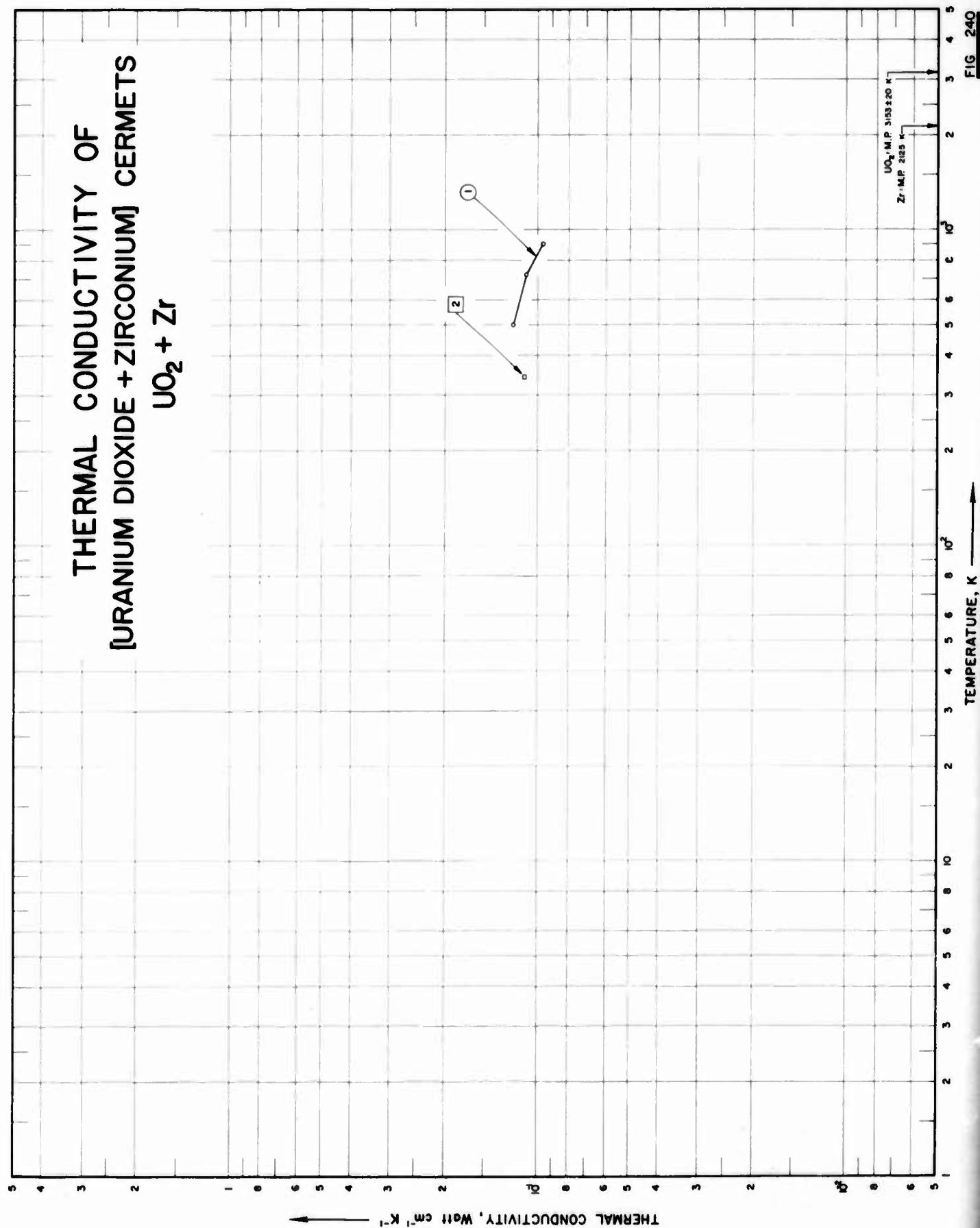


FIG. 240

SPECIFICATION TABLE NO. 240 THERMAL CONDUCTIVITY OF [URANIUM DIOXIDE + ZIRCONIUM] CERMETS $UO_2 + Zr$

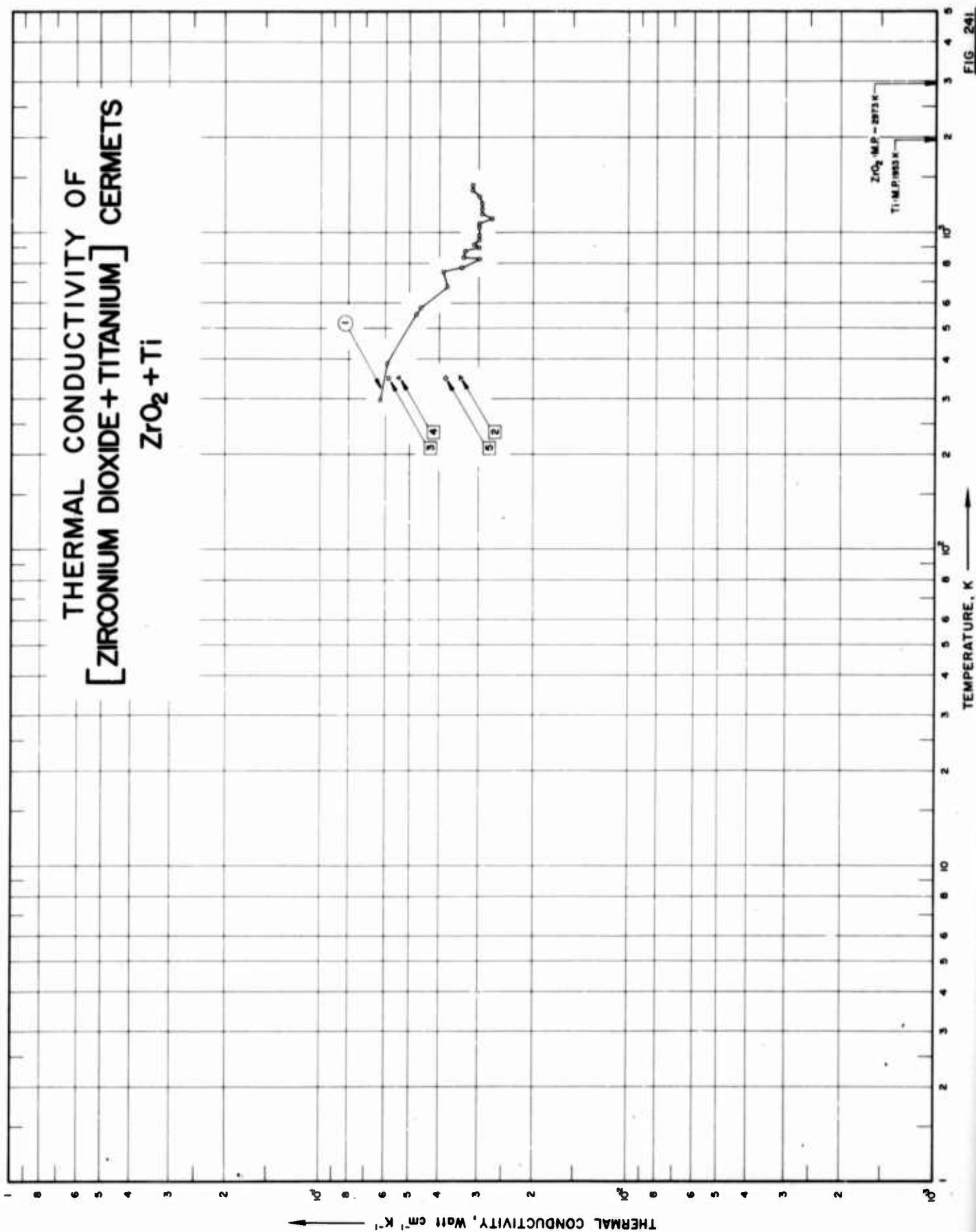
[For Data Reported in Figure and Table No. 240]

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] CERMETS $\text{UO}_2 + \text{Zr}$
 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

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 $ZrO_2 + Ti$

[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			93.58	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.
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 $ZrO_2 + Zr$

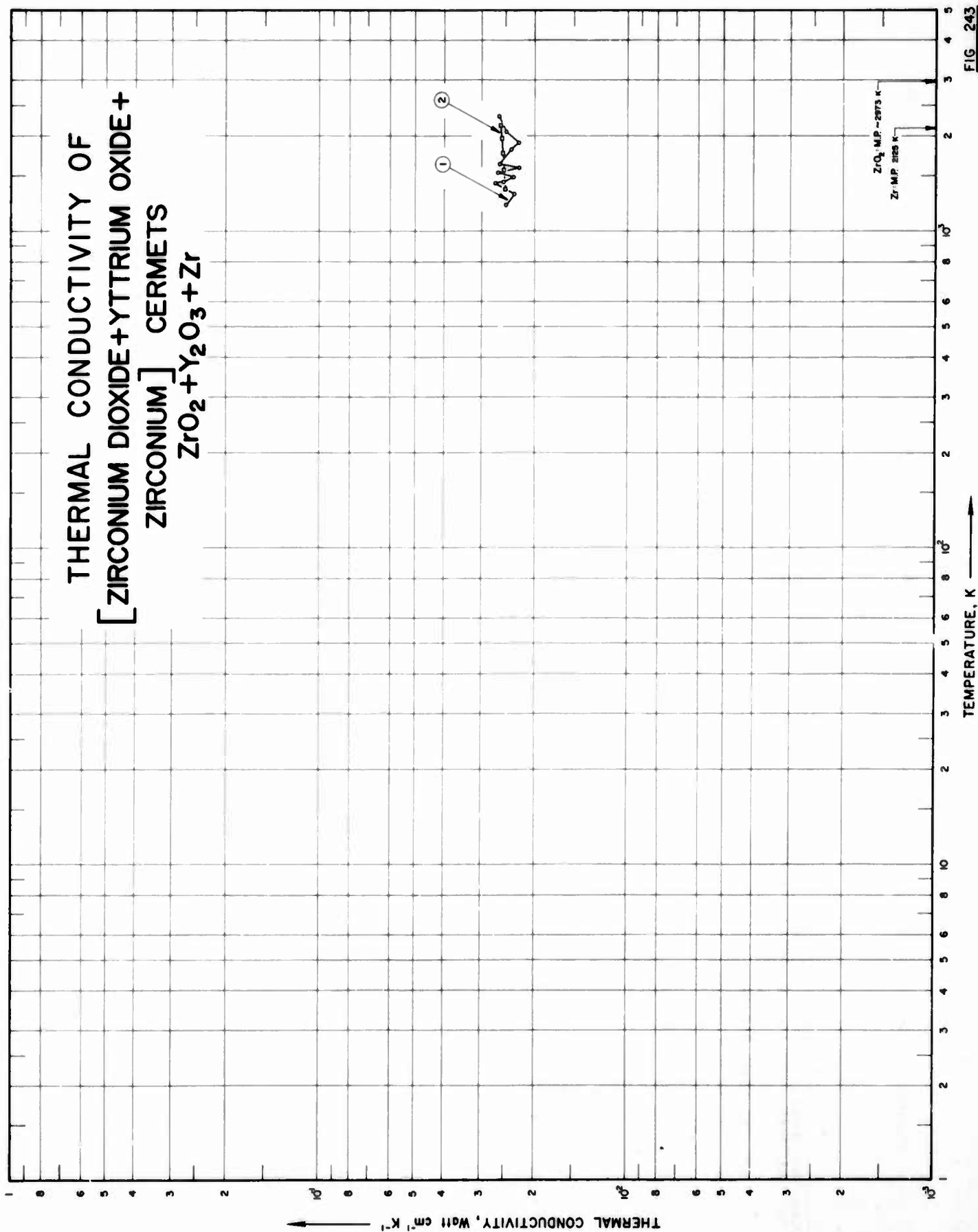
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) ZrO_2	Composition (weight percent) Zr	Composition (continued), Specifications and Remarks
1	430	-	1966	298.2			54.5	45.5	Powder specimen contained in a 0.75 in. dia x 2 in. 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 $cm^{-1}K^{-1}$]

T	k
<u>CURVE 1*</u>	
298.2	0.00260
<u>CURVE 2*</u>	
298.2	0.00195

* No graphical presentation

THERMAL CONDUCTIVITY OF
[ZIRCONIUM DIOXIDE+YTTTRIUM OXIDE+
ZIRCONIUM] CERMETS
 $\text{ZrO}_2 + \text{Y}_2\text{O}_3 + \text{Zr}$



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. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Zr	Composition (continued), Specifications and Remarks
							ZrO ₂	Y ₂ O ₃		
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.
2	291	R	1964	1373-2173						Same specimen as above; data corrected to 100% theoretical value of density.

DATA TABLE NO. 243 THERMAL CONDUCTIVITY OF [ZIRCONIUM DIOXIDE + YTTRIUM OXIDE + ZIRCONIUM] CERMETS $\text{ZrO}_2 + \text{Y}_2\text{O}_3 + \text{Zr}$
 [Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
CURVE 1	
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
CURVE 2	
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

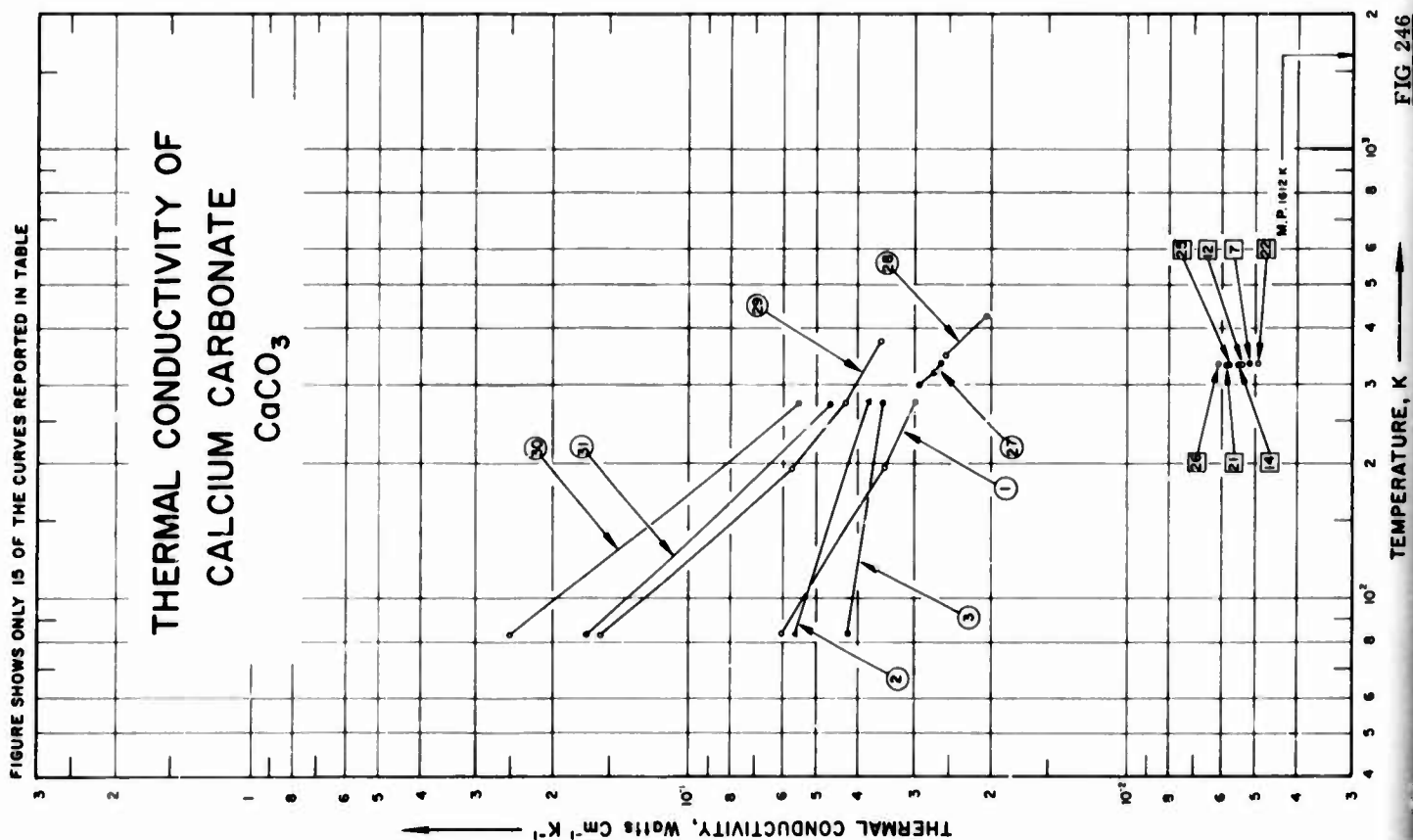
SPECIFICATION TABLE NO. 245 THERMAL CONDUCTIVITY OF CADMIUM GERMANIUM PHOSPHIDE CdGeP_2

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 $12 \times 4 \times 4$ mm; prepared from 99.9999 pure Cd, p-type Ge (~ 50 ohm cm), and 99.9999 pure red phosphorus, materials leaded into a high-purity graphite crucible which was carefully fitted in a sealed quartz tube, heated at $10^\circ \text{C hr}^{-1}$ to 590°C , annealed for 12 hrs under an external argon pressure of 60 atm, heated at $10^\circ \text{C hr}^{-1}$ 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 4.8×10^4 ohm cm at room temperature.

DATA TABLE NO. 245 THERMAL CONDUCTIVITY OF CADMIUM GERMANIUM PHOSPHIDE CdGeP_2 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T k
 CURVE 1*
 298.2 0.11

*No graphical presentation



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	

SPECIFICATION TABLE NO. 246 (continued)

Curve No.	Ref. No.	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
19	120	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% (-150 + 200) Tyler mesh, and 22% (-200 + 325) Tyler mesh.
20	120	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	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	1953	332.2		Marble powder	Marble stone powder; apparent density 1.07 g cm ⁻³ ; porosity 61.1%.
23	120	1953	331.2		Marble powder	Marble stone powder; apparent density 1.25 g cm ⁻³ ; porosity 54.6%.
24	120	1953	334.0		Marble powder	Marble stone powder; apparent density 1.29 g cm ⁻³ ; porosity 53.1%.
25	120	1953	330.6		Marble powder	Marble stone powder; apparent density 1.36 g cm ⁻³ ; porosity 50.5%.
26	120	1953	332.3		Marble powder	Marble stone powder; apparent density 1.47 g cm ⁻³ ; porosity 46.5%.
27	117	1955	298-337	1.0-2.0	Marble	Specimen thickness 15.2 mm; density 2.68 g cm ⁻³ .
28	121	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	1911	83-374		Calcite	Single crystal; measured perpendicular to the principal axis.
30	119	1925	83, 273		Calcite	Single crystal; measured parallel to the principal axis.
31	119	1925	83, 273		Calcite	Single crystal; measured perpendicular to the principal axis.
32	508	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	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	1940	443.7		White Marble	Similar to the above specimen; measurements done after exposure to high temperature test.
35	508	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	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 CaCO_3 [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>		<u>CURVE 11*</u>		<u>CURVE 22</u>		<u>CURVE 31</u>	
83.2	0.0608	330.4	0.00526	332.2	0.00493	83.0	0.170
195.2	0.0352	<u>CURVE 12</u>		<u>CURVE 23*</u>		273.2	0.0466
273.2	0.0299	330.45	0.00537	331.2	0.00545	<u>CURVE 32*</u>	
<u>CURVE 2</u>		<u>CURVE 13*</u>		<u>CURVE 24*</u>		390.4	0.0167
83.0	0.0564	331.15	0.00538	334.0	0.00556	469.3	0.0151
273.2	0.0390	<u>CURVE 14</u>		<u>CURVE 25</u>		518.7	0.0139
<u>CURVE 3</u>		331.1	0.00550	330.6	0.00578	633.2	0.0114
83.0	0.0425	<u>CURVE 15*</u>		<u>CURVE 26</u>		<u>CURVE 33*</u>	
273.2	0.0352	330.8	0.00543	332.3	0.00614	398.2	0.0144
<u>CURVE 4*</u>		<u>CURVE 16*</u>		<u>CURVE 27</u>		443.2	0.0144
331.1	0.00502	330.7	0.00550	298.2	0.0294	511.5	0.0150
<u>CURVE 5*</u>		<u>CURVE 17*</u>		318.2	0.0271	615.4	0.0139
331.2	0.00505	328.75	0.00561	337.2	0.0261	<u>CURVE 34*</u>	
<u>CURVE 6*</u>		<u>CURVE 18*</u>		<u>CURVE 28</u>		443.7	0.0131
330.15	0.00502	330.8	0.00562	348.2	0.0257	<u>CURVE 35*</u>	
<u>CURVE 7</u>		<u>CURVE 19*</u>		423.2	0.0206	397.6	0.0156
333.2	0.00519	333.3	0.00562	<u>CURVE 29</u>		483.7	0.0151
<u>CURVE 8*</u>		83.2	0.158	83.2	0.158	607.6	0.0137
332.2	0.00519	195.2	0.0576	195.2	0.0576	<u>CURVE 36*</u>	
<u>CURVE 9*</u>		273.2	0.0429	273.2	0.0429	390.4	0.0131
334.45	0.00526	374.2	0.0356	374.2	0.0356	<u>CURVE 30</u>	
<u>CURVE 10*</u>		<u>CURVE 21</u>		<u>CURVE 30</u>		83.0	0.251
330.3	0.00526	332.05	0.00587	83.0	0.251	273.2	0.0551
		329.45	0.00587	273.2	0.0551		

* 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 No.	Year Used	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. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							C	O	
1	161	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 < 1μ; 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. No.	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.

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
CURVE I*	
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

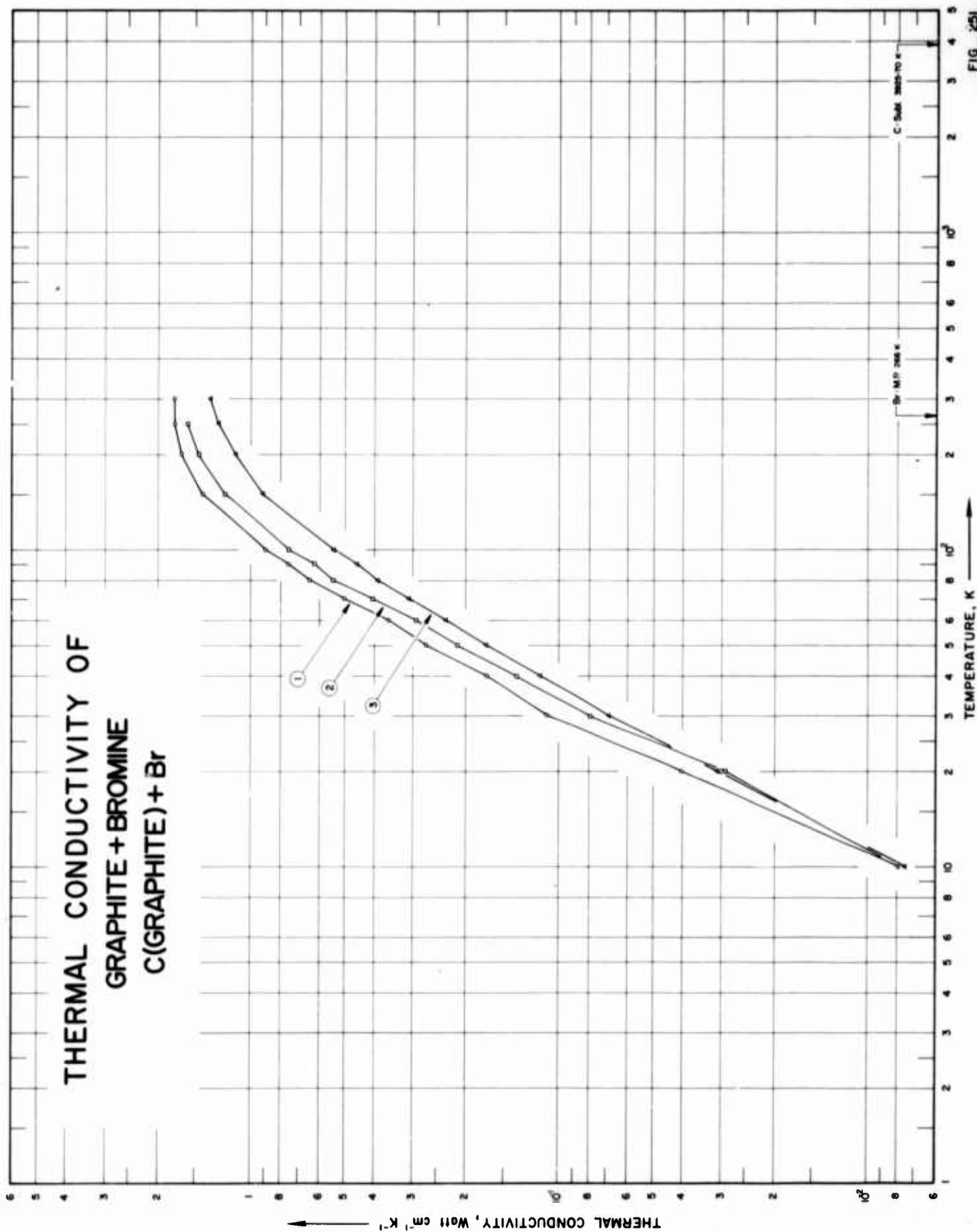
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	597, 598	P	1963	290			Melting point ~ 1350 C; measured by a transient method.

DATA TABLE NO. 250 THERMAL CONDUCTIVITY OF GALLIUM PHOSPHIDE GaP

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

T	k
<u>CURVE 1*</u>	
290	1.09

* No graphical presentation



SPECIFICATION TABLE NO. 251 THERMAL CONDUCTIVITY OF [GRAPHITE + BROMIDE] C + Br

[For Data Reported in Figure and Table No. 251]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent)		Composition (continued), Specifications and Remarks
							C	Br	
1	50	E	1956	10-300	±5	Brom-Graphite	97.97	2.03	Calculated composition; brominated AGOT-KC graphite.
2	50	E	1956	10-250	±5	Brom-Graphite	94.43	5.57	Calculated composition; brominated AGOT-KC graphite.
3	50	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
CURVE 1	
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
CURVE 2	
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
CURVE 3	
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

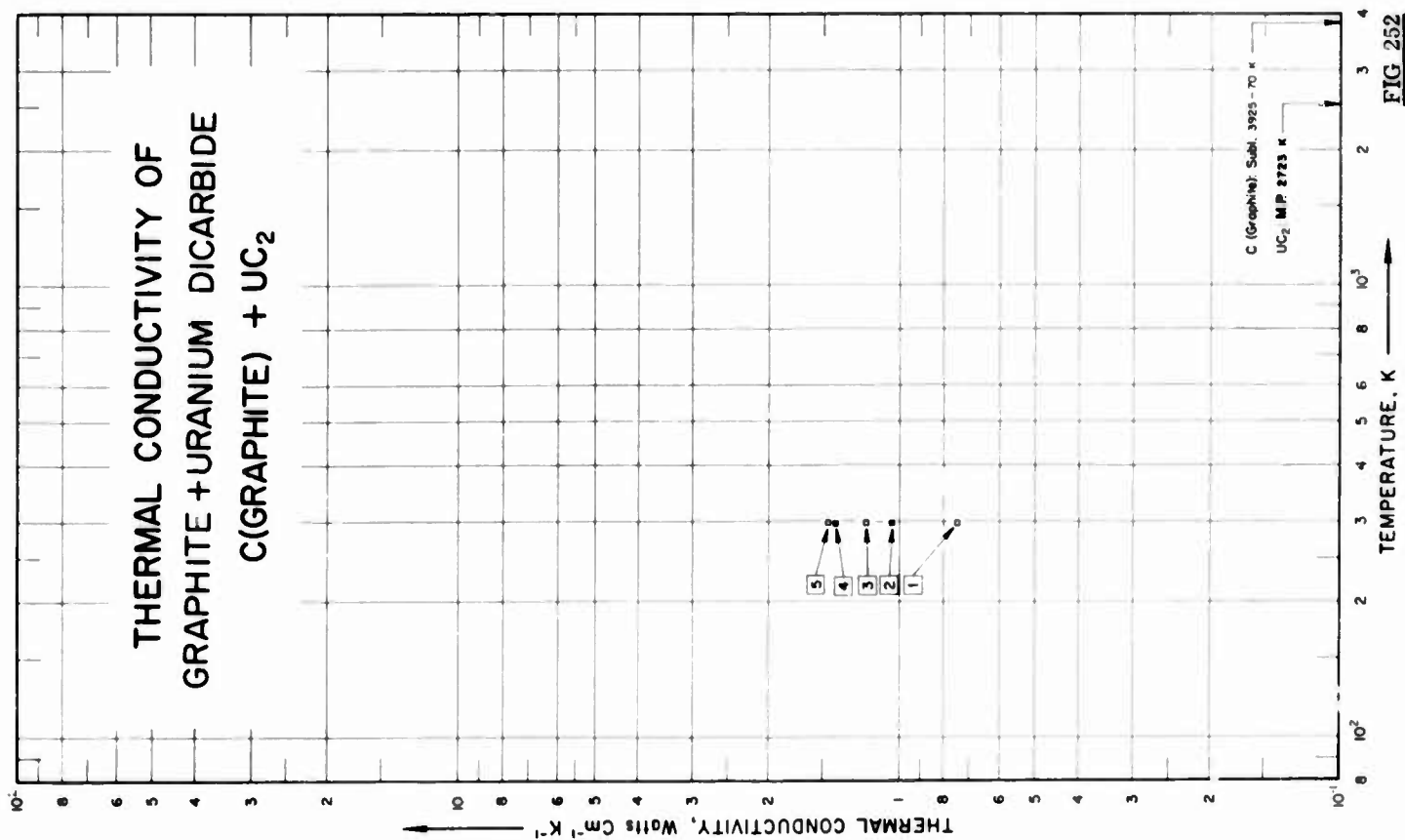


FIG 252

SPECIFICATION TABLE NO. 252 THERMAL CONDUCTIVITY OF [GRAPHITE + URANIUM DICARBIDE] C + UC₂

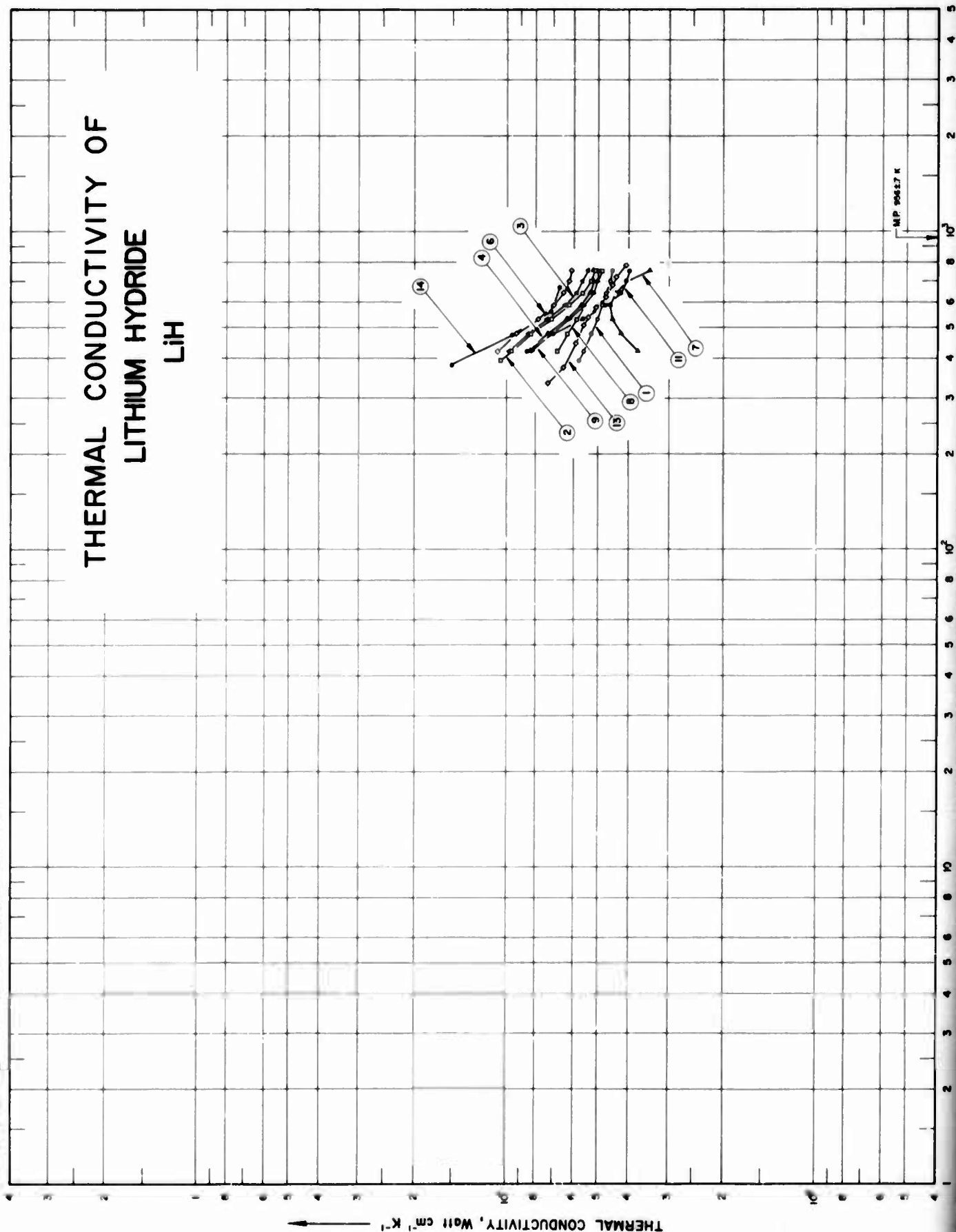
[For Data Reported in Figure and Table No. 252]

Curve No.	Ref. No.	Method Used	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

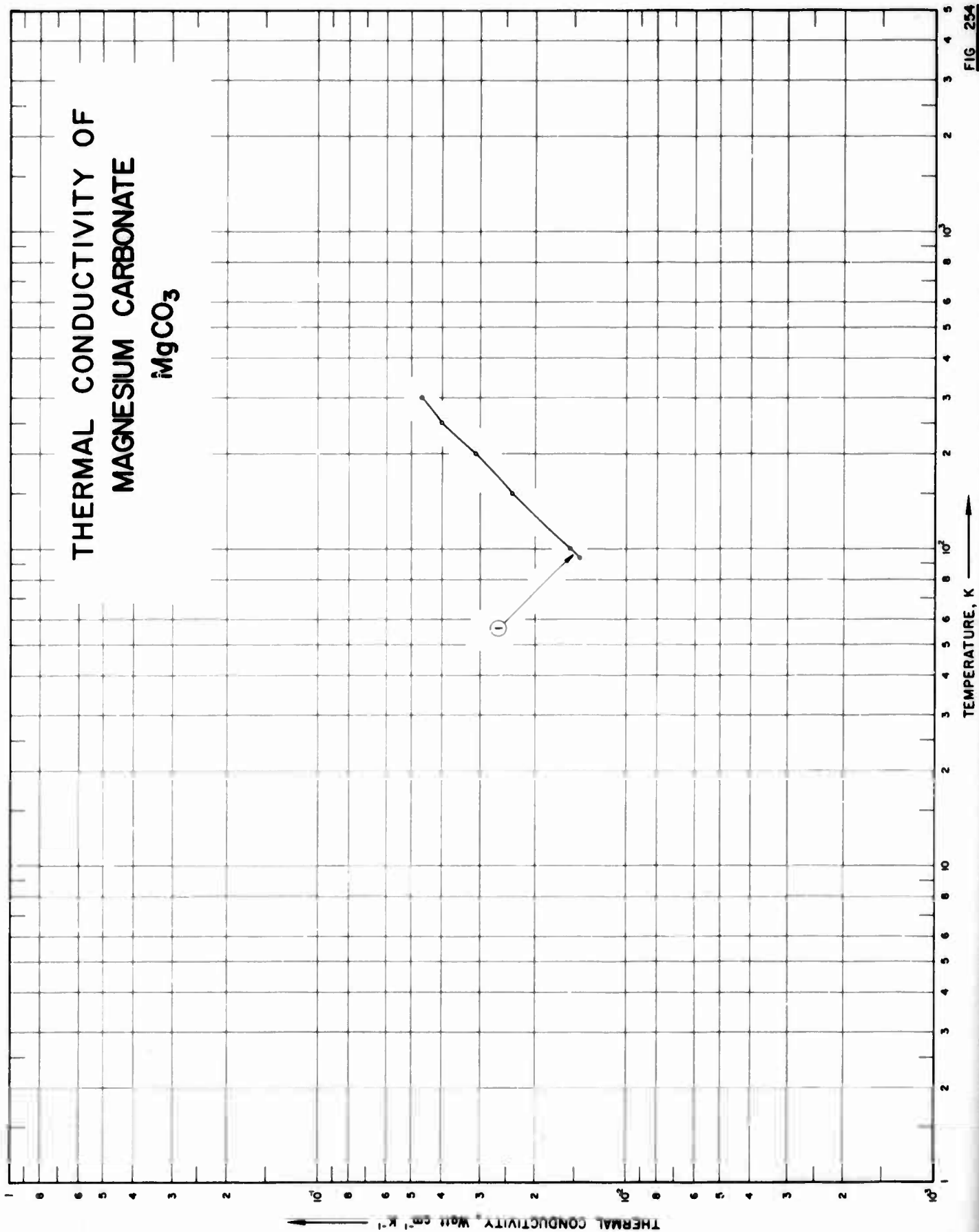
[For Data Reported in Figure and Table No. 253]

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

CURVE 1		CURVE 5 (cont.)*		CURVE 10*	
T	k	T	k	T	k
394.3	0.0576	588.8	0.0682	422.1	0.0909
422.1	0.0557	644.3	0.0649	477.6	0.0770
477.6	0.0528	699.9	0.0632	533.2	0.0640
533.2	0.0502	755.4	0.0623	588.8	0.0545
588.8	0.0485			644.3	0.0476
644.3	0.0472			699.9	0.0433
699.9	0.0459			755.4	0.0398
755.4	0.0450				
CURVE 2		CURVE 6		CURVE 11	
T	k	T	k	T	k
394.3	0.105	422.1	0.108	422.1	0.0857
422.1	0.0969	477.6	0.0926	477.6	0.0696
477.6	0.0830	533.2	0.0787	533.2	0.0562
533.2	0.0710	588.8	0.0696	588.8	0.0476
588.8	0.0623	644.3	0.0646	644.3	0.0424
644.3	0.0562	699.9	0.0623	699.9	0.0407
699.9	0.0528	755.4	0.0614	755.4	0.0398
755.4	0.0511				
CURVE 3		CURVE 7		CURVE 12*	
T	k	T	k	T	k
422.1	0.0981	422.1	0.0376	422.1	0.0813
477.6	0.0848	477.6	0.0424	477.6	0.0718
533.2	0.0736	533.2	0.0450	533.2	0.0640
588.8	0.0644	588.8	0.0459	588.8	0.0573
644.3	0.0588	644.3	0.0441	644.3	0.0533
699.9	0.0562	699.9	0.0402*	699.9	0.0502
755.4	0.0540	755.4	0.0346	755.4	0.0481
CURVE 4		CURVE 8		CURVE 13	
T	k	T	k	T	k
422.1	0.0839	422.1	0.0684	334.8	0.0730
477.6	0.0727	477.6	0.0632	374.3	0.0649
533.2	0.0632	533.2	0.0588	445.4	0.0592
588.8	0.0566	588.8	0.0554*	508.7	0.0556
644.3	0.0533	644.3	0.0528*	538.7	0.0537
699.9	0.0519	699.9	0.0502*	577.1	0.0507
755.4	0.0519	755.4	0.0485	625.4	0.0472
CURVE 5*		CURVE 9		CURVE 14	
T	k	T	k	T	k
422.1	0.101	422.1	0.0822	380.2	0.151
477.6	0.0865	477.6	0.0710*	475.2	0.0962
533.2	0.0762	533.2	0.0623	563.2	0.0711
		588.8	0.0562	670.2	0.0669
		644.3	0.0519		
		699.9	0.0502		
		755.4	0.0497		

* Not shown on plot



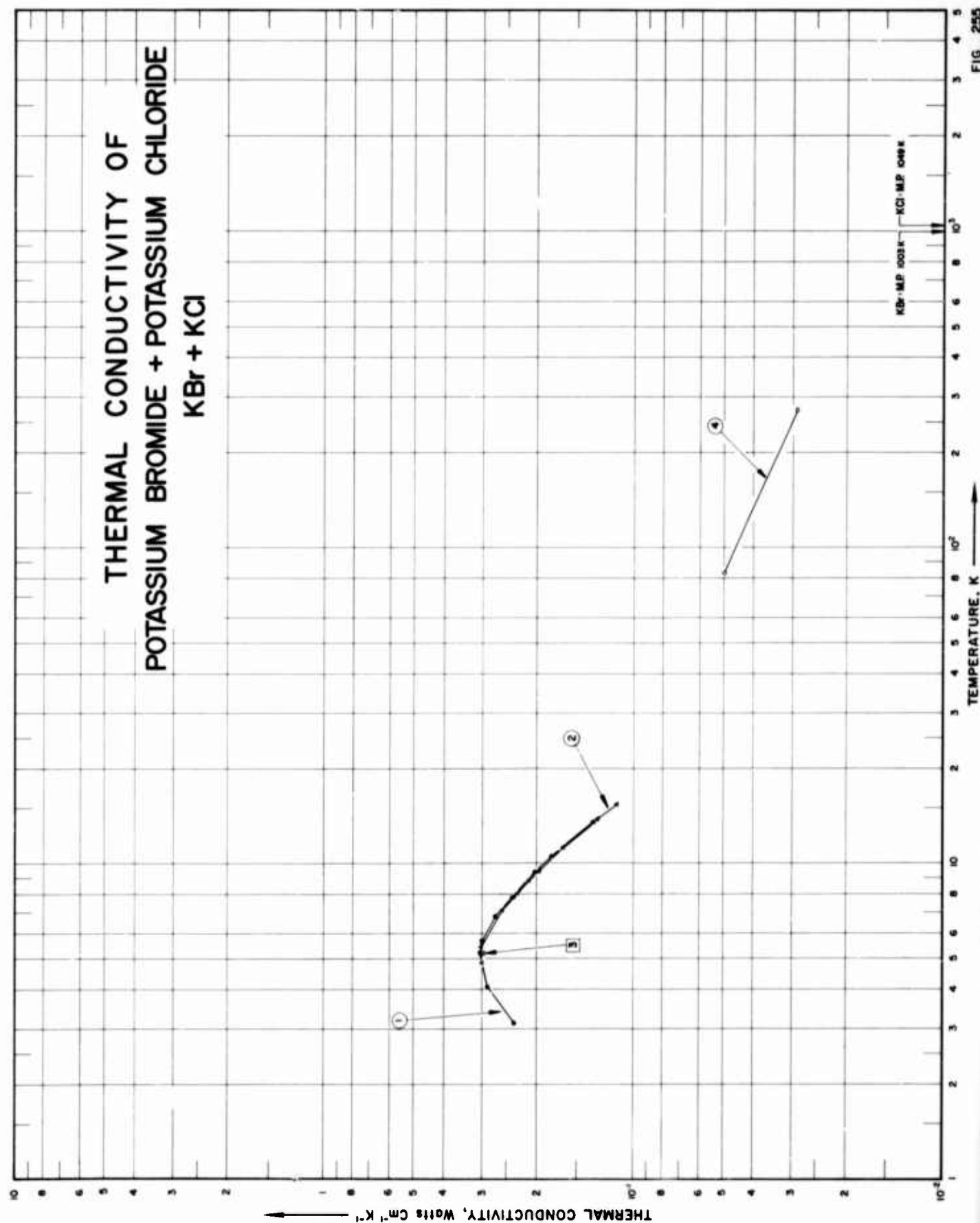
SPECIFICATION TABLE NO. 254 THERMAL CONDUCTIVITY OF MAGNESIUM CARBONATE MgCO_3

[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
<u>CURVE 1</u>	
93.2	0.0145
100	0.0155
150	0.0240
200	0.0310
250	0.0400
300	0.0465



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. No.	Method 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. 255 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

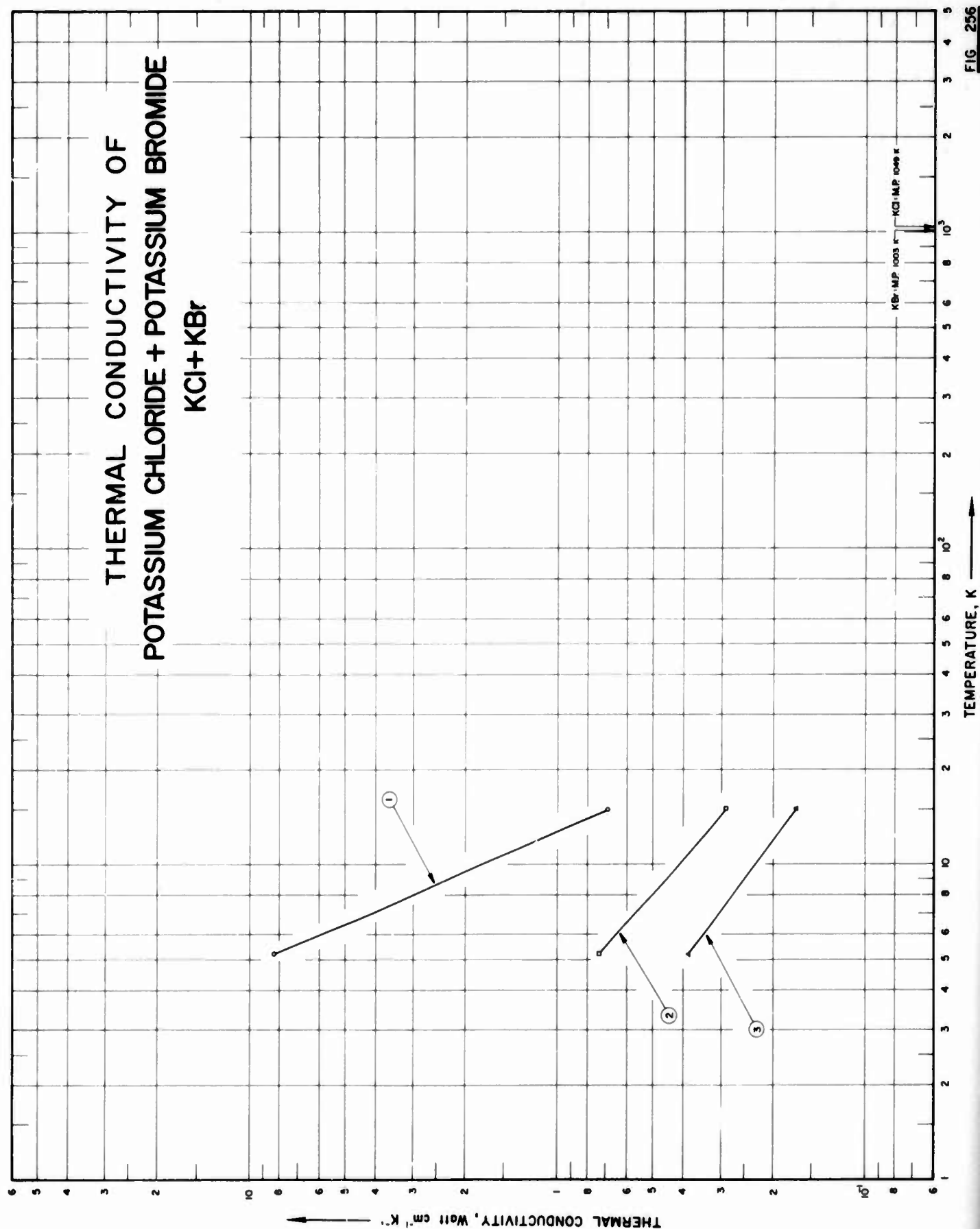


FIG. 256

SPECIFICATION TABLE NO. 256 THERMAL CONDUCTIVITY OF [POTASSIUM CHLORIDE + POTASSIUM BROMIDE] KCl + KBr

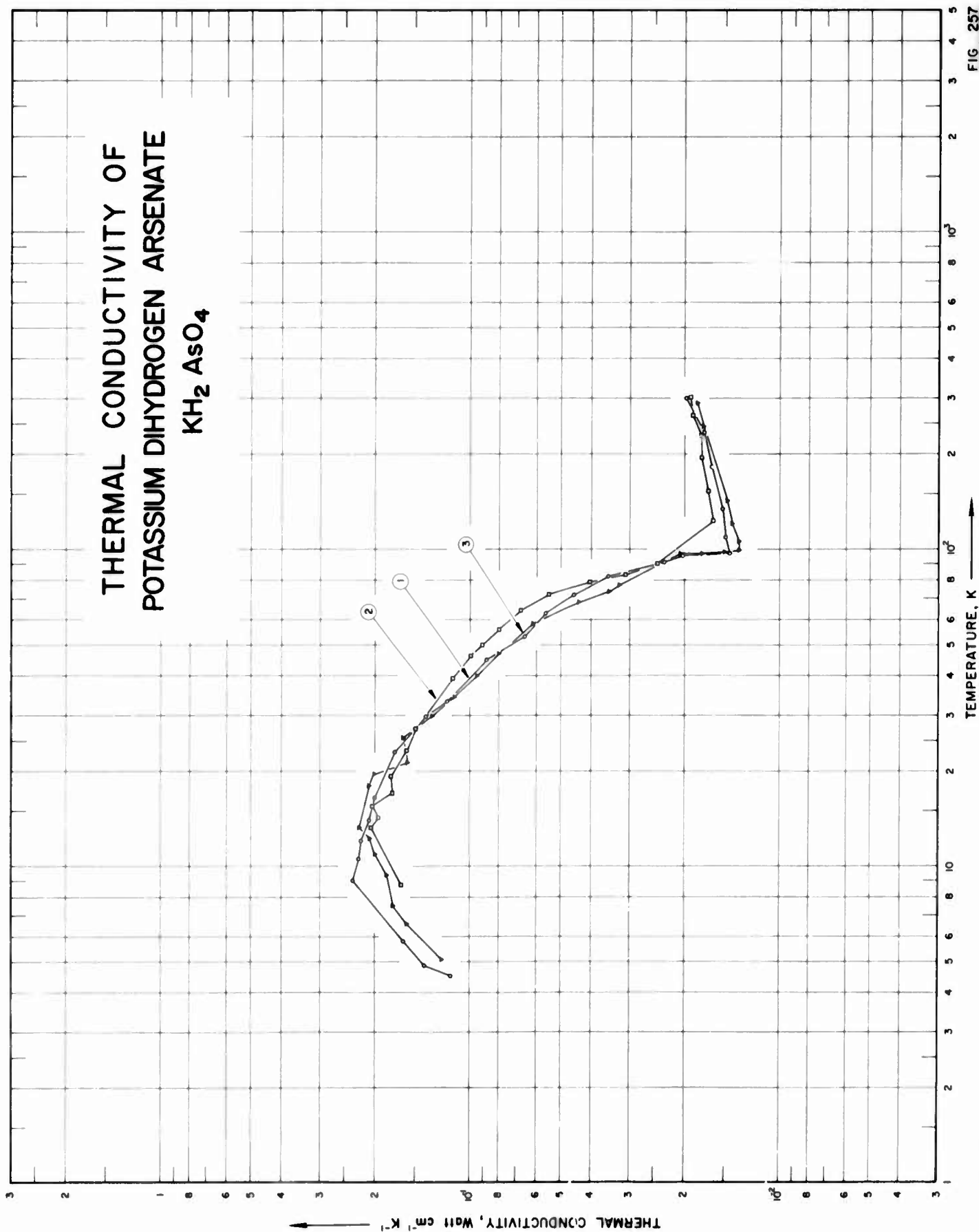
[For Data Reported in Figure and Table No. 256]

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		Single KCl-KBr mixed crystal	97.63	2.37	98.5 mole % KCl, 1.5 mole % KBr; single mixed crystal.
2	164	L	1956	5.2, 15			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.

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.
2	242		1961	448	±3		Same as the above specimen; measured in molten state.

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

CURVE 1*

839.3 0.0134

CURVE 2*

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 NaOH

[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] $SrF_2 + \Sigma X_i$

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] $SrF_2 + \Sigma X_i$
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T k

CURVE 1*

298.2 0.0142

* No graphical presentation

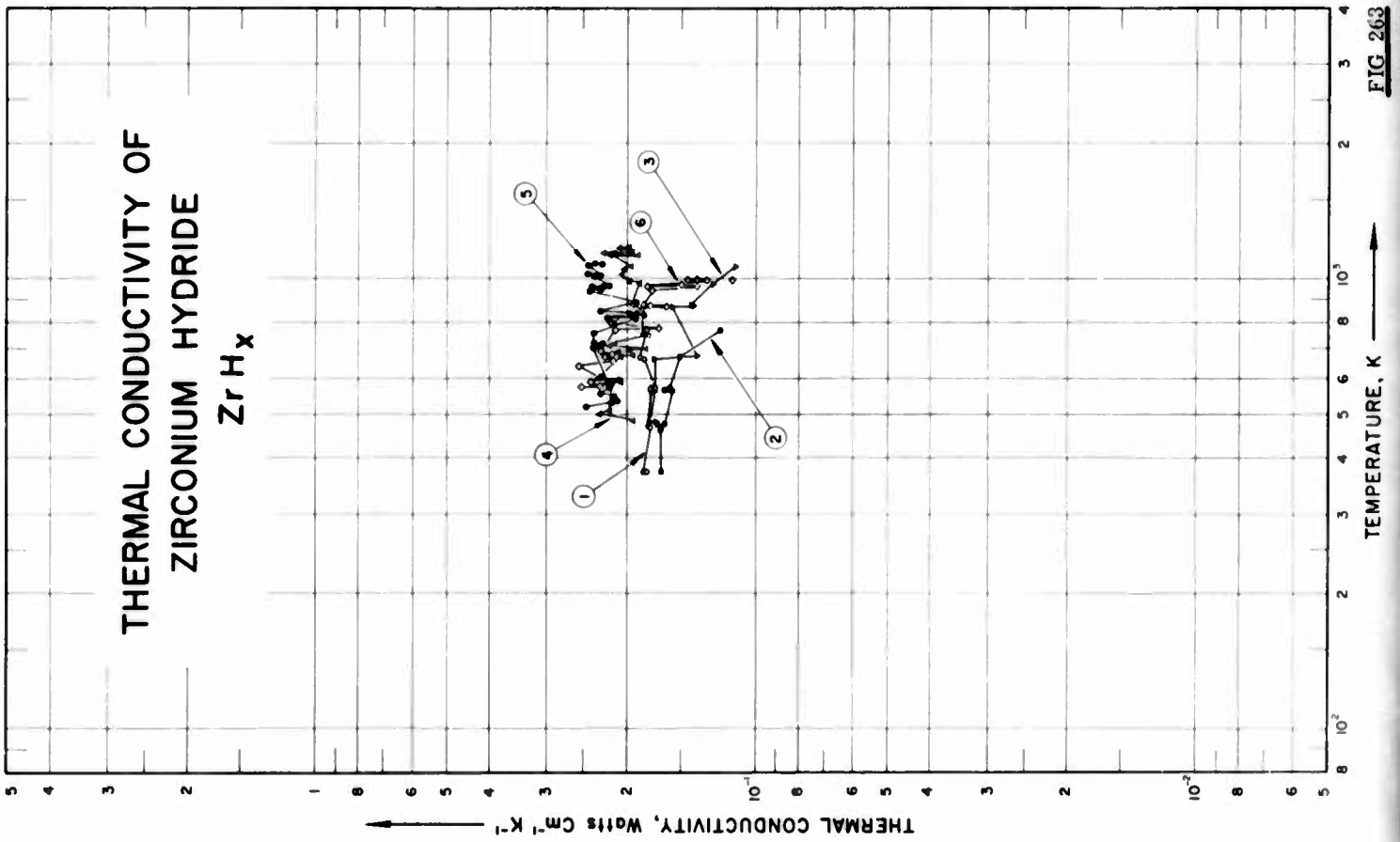
SPECIFICATION TABLE NO. 262 THERMAL CONDUCTIVITY OF ZINC GERMANIUM PHOSPHIDE ZnGeP_2

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; $12 \times 4 \times 4$ 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, 500-580 C, 580-630 C, 630-650 C, 650-880 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 ZnGeP_2 [Temperature, T, K; Thermal Conductivity, k, $\text{Watt cm}^{-1}\text{K}^{-1}$]

T k
 CURVE 1*
 298.2 0.18

* No graphical presentation



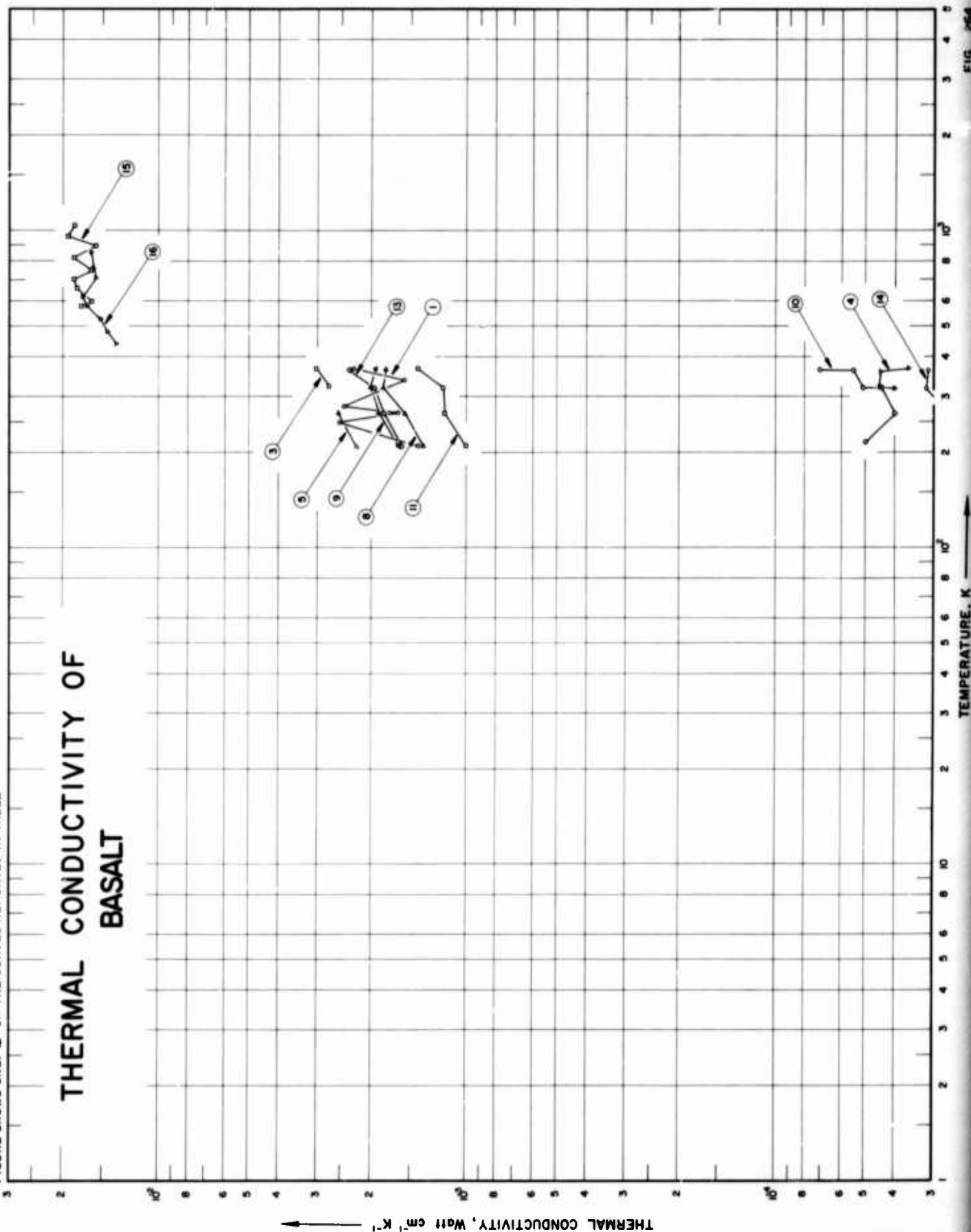
SPECIFICATION TABLE NO. 263 THERMAL CONDUCTIVITY OF ZIRCONIUM HYDRIDE ZrH_x

[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		$ZrH_{1.58}$	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	581-1001		$ZrH_{1.5}$	Specimen similarly prepared as above with 60 at. % H.

FIGURE SHOWS ONLY 12 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF BASALT



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 . The above specimen measured in a vacuum of 5 x 10 ⁻⁴ mm Hg.
2	539	P	1962	265-363		Olivine basalt	Same source and production method as the above specimen; density 1.65 g cm ⁻³ .
3	539	P	1962	325, 368		Olivine basalt	The above specimen measured in a vacuum of 5 x 10 ⁻⁴ mm Hg.
4	539	P	1962	319-367		Olivine basalt	Same source and production method as the above specimen; density 1.95 g cm ⁻³ .
5	539	P	1962	208, 266		Olivine basalt	Same source and production method as the above specimen; density 1.75 g cm ⁻³ .
6	539	P	1962	242.1		Olivine basalt	Same source and production method as the above specimen; density 1.57 g cm ⁻³ .
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>		<u>CURVE 9</u>		<u>CURVE 15 (cont.)</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>		266.5	0.000400	<u>CURVE 16</u>	
265.4	0.0000172	319.3	0.000443	442	0.0136
319.9	0.000241	319.9	0.000509	483	0.0145
362.6	0.000294	362.6	0.000547	529	0.0153
<u>CURVE 3</u>		364.9	0.000710	584	0.0167
324.9	0.00275	<u>CURVE 11</u>		623	0.0172
367.6	0.00303	210.4	0.00100	711	0.0157
<u>CURVE 4</u>		266.0	0.00117	762	0.0160
318.8	0.0000400	319.9	0.00118	858	0.0183
321.5	0.0000447	367.1	0.00143	<u>CURVE 12*</u>	
359.9	0.0000445	<u>CURVE 12*</u>		319.3	0.0000154
367.1	0.0000363	363.2	0.000163	<u>CURVE 13</u>	
<u>CURVE 5</u>		208.8	0.00161	266.0	0.00183
207.6	0.00223	266.0	0.00183	318.8	0.00196
266.0	0.00256	364.9	0.00235	<u>CURVE 14</u>	
<u>CURVE 6*</u>		<u>CURVE 14</u>		213.2	0.0000273*
242.1	0.0000177	263.8	0.000265*	263.8	0.000265*
<u>CURVE 7*</u>		318.2	0.000317	318.2	0.000317
217.6	0.0000157	362.1	0.000313	362.1	0.000313
266.5	0.0000182	<u>CURVE 15</u>		<u>CURVE 8</u>	
<u>CURVE 8</u>		209.9	0.00137	209.9	0.00137
265.4	0.00157	265.4	0.00157	265.4	0.00157
319.3	0.00182	319.3	0.00182	319.3	0.00182
366.5	0.00180	366.5	0.00180	366.5	0.00180

* Not shown on plot

FIGURE SHOWS ONLY 7 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF BERYL

THERMAL CONDUCTIVITY, $\text{Watt cm}^{-1} \text{K}^{-1}$ 

TEMPERATURE, K


 10^2
 10^3

FIG. 265

SPECIFICATION TABLE NO. 265 THERMAL CONDUCTIVITY OF BERYL

[For Data Reported in Figure and Table No. 265]

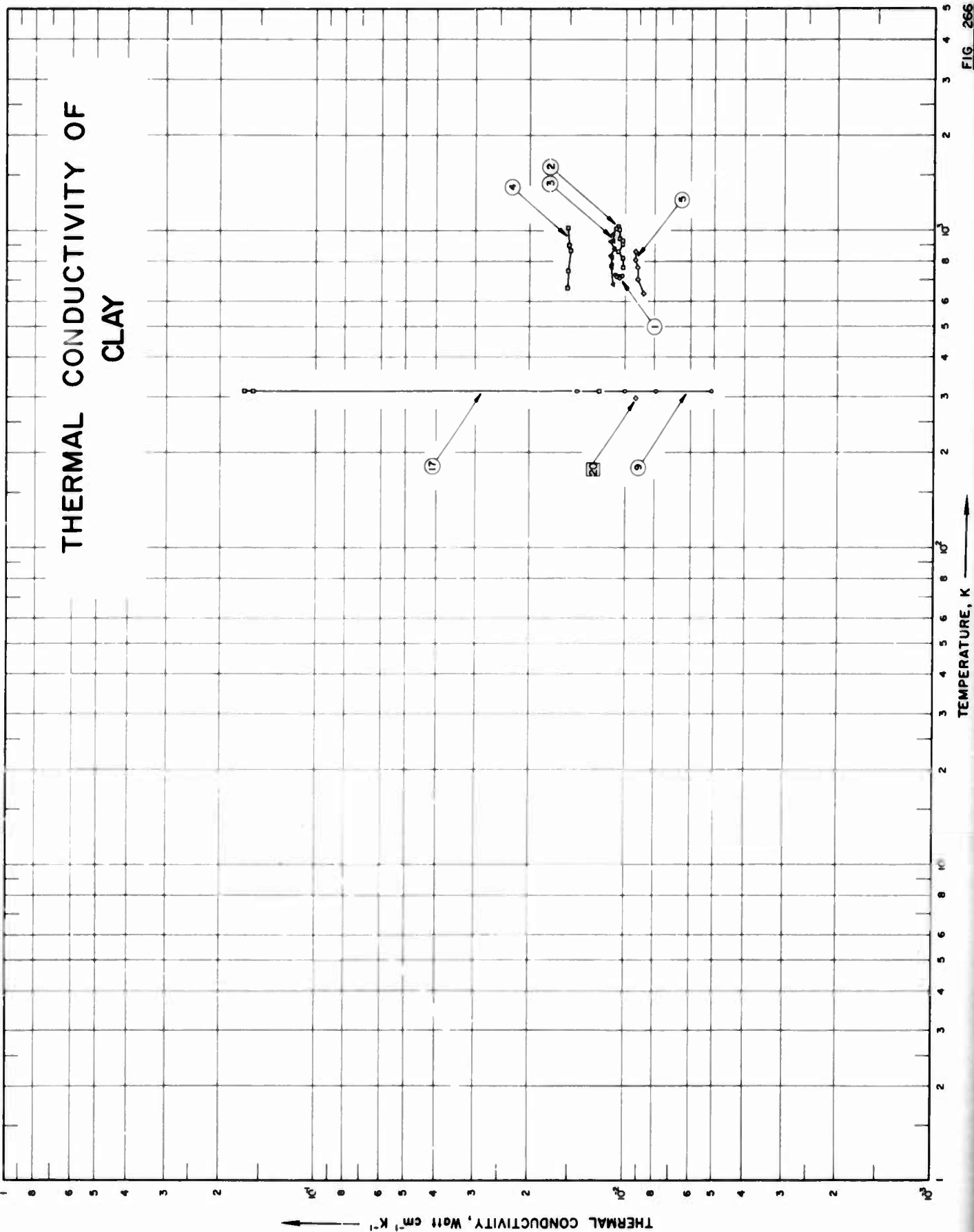
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	3	L	1953	320-415		256A-1	Single crystal; variation of aquamarine; c-axis parallel to direction of heat flow.
2	3	L	1953	319-408		256B-1	Single 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 $1 \times 1 \times 1$ 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>		<u>CURVE 7*</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>		<u>CURVE 8*</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>		<u>CURVE 9*</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>		<u>CURVE 10*</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>		<u>CURVE 11</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		Beskhudnikov	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 26.5%.
9	556, 557	P	1952	313.2		Beskhudnikov	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		Beskhudnikov	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		Beskhudnikov	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		Beskhudnikov	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)

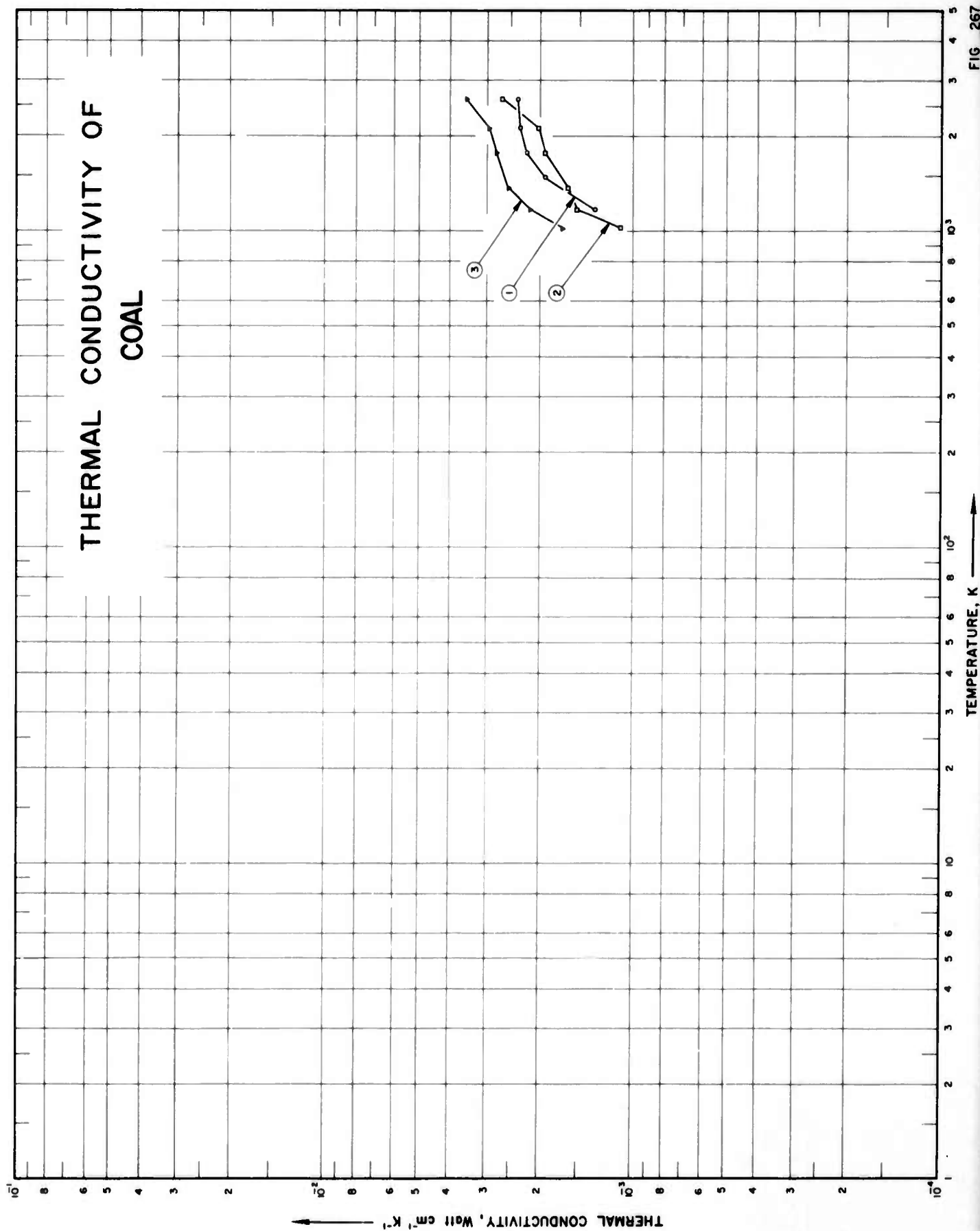
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
17	556, 557	P	1952	313.2		Ashkhabad	Similar to the above specimen except moisture content range 0.8 to 20%; measured at 300 mm Hg vacuum.
18	556, 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
CURVE 1		CURVE 5 (cont.)		CURVE 10*		CURVE 15 (cont.)*	
713.2	0.0105	767.4	0.00908	(T = 313.2 K)		(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	CURVE 16*	
724.2	0.0103	porosity (%)	k	26.2	0.0151	(T = 313.2 K)	
730.2	0.0108						
CURVE 2		CURVE 6*		CURVE 11*		CURVE 17	
769.4	0.0103	(T = 343.2-393.2 K)		(T = 313.2 K)		(T = 313.2 K)	
824.8	0.0103	14.4	0.00437	1.1	0.00535	1.2	0.00465
864.9	0.0106	15.1	0.00432	7.2	0.00941	8	0.0116
906.2	0.0103	17.5	0.00404	13.6	0.0121	14	0.0139
935.3	0.0103	19.4	0.00397	26.4	0.0132	19.8	0.0139
937.9	0.0105*	21	0.00381			CURVE 18*	
945.8	0.0105	CURVE 7*		CURVE 12*		(T = 313.2 K)	
1011.2	0.0105	(T = 343.2-393.2 K)		(T = 313.2 K)		0.8	0.00511*
1015.8	0.0108	13.8	0.00472	1.1	0.00604	7.4	0.0121
1030.4	0.0106	14.7	0.00465	7.8	0.0119	13.6	0.0158
CURVE 3		15.8	0.00446	14	0.0144	20	0.167
679.7	0.0110	16.5	0.00432	26.4	0.0172	CURVE 19*	
766.4	0.0111	17	0.00430			(T = 313.2 K)	
770.9	0.0111	CURVE 8*		CURVE 13*		1.2	0.00604
830.7	0.0111	(T = 343.2-393.2 K)		(T = 313.2 K)		8	0.0139
838.6	0.0113	15.7	0.00549	1.2	0.00442	12.8	0.0174
878.9	0.0109	6	0.00814	6	0.00930	19.2	0.0168
928.4	0.0112	11.4	0.00930	26.8	0.0121	CURVE 20	
930.3	0.0110	18.8	0.00504			(T = 313.2 K)	
977.8	0.0110	22.6	0.00471	CURVE 14*		1	0.00651
CURVE 4		26.6	0.00465	(T = 313.2 K)		7.6	0.0142
661.4	0.0153	Moisture content (%)				13	0.0186
747.2	0.0152			1.2	0.00465	19.3	0.0205
869.9	0.0149			6.2	0.00883	T	k
900.6	0.0150			11.9	0.00976	CURVE 20	
1029.7	0.0151			26.8	0.0130	(T = 313.2 K)	
CURVE 5				(T = 313.2 K)		297.2	0.00920
635.6	0.00874	1.2	0.00511				
703.8	0.00908	6.8	0.00790				
		13.6	0.0100	0.8	0.00477		
		26.4	0.0142	6	0.0100		

* 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

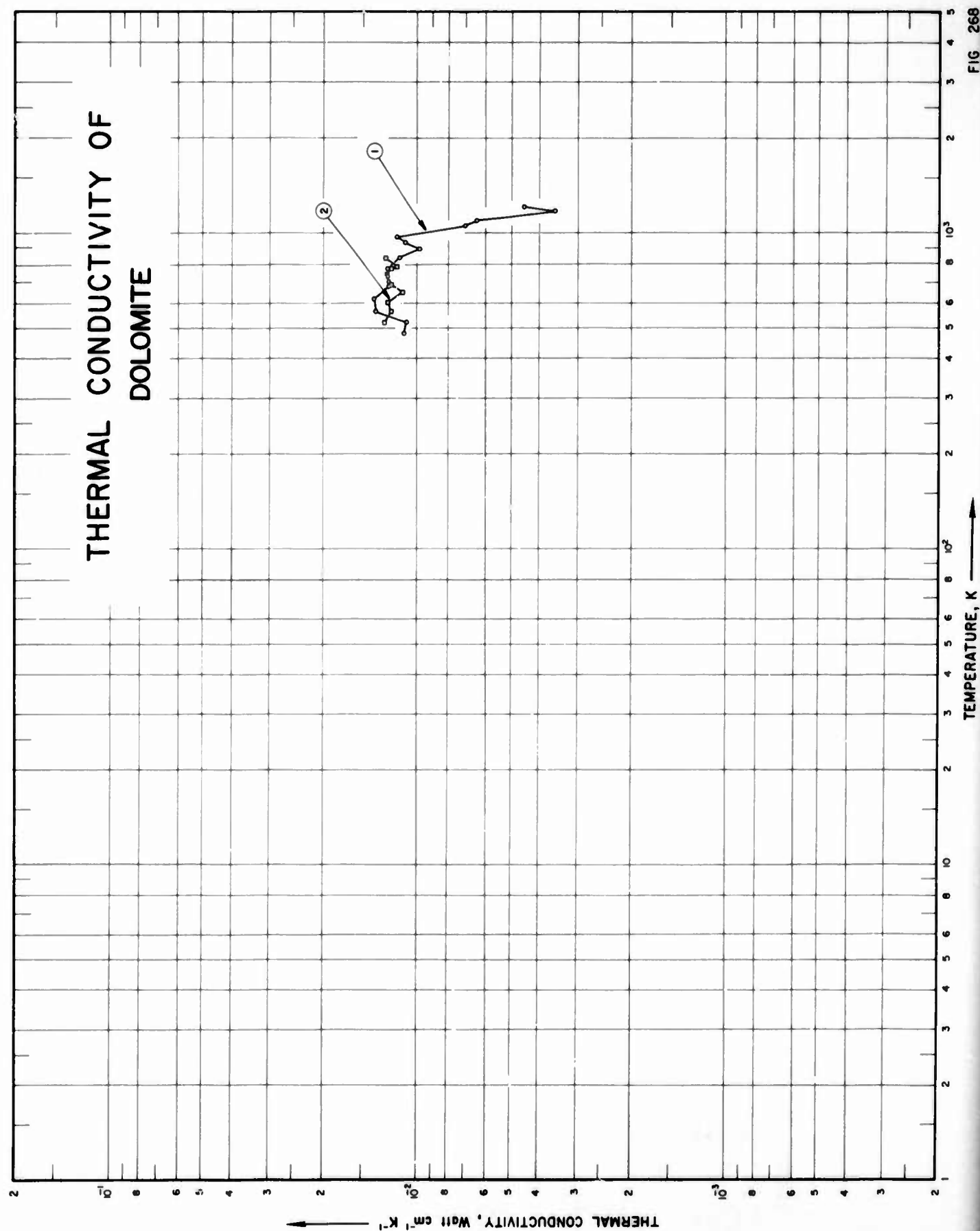


FIG 268

SPECIFICATION TABLE NO. 268 THERMAL CONDUCTIVITY OF DOLOMITE

[For Data Reported in Figure and Table No. 268]

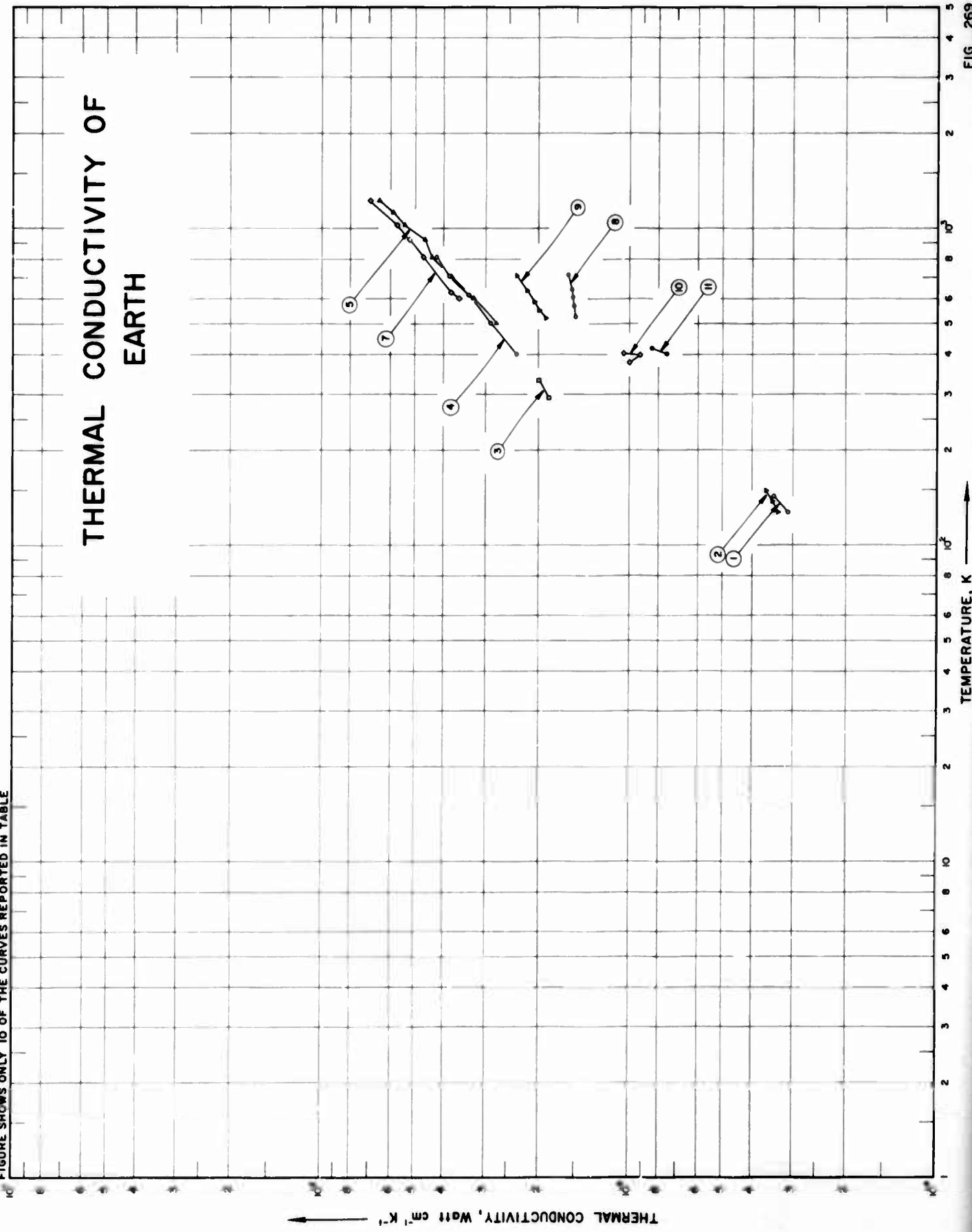
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	578	R	1963	484-1208	± 5	NTS dolomite No. 1	(Composition in vol percent): 99 dolomite, 1 others (primarily quartz and muscovite), fine-grained appearance; 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	0.0136
619	0.0137
678	0.0124
729	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 0.398 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>		<u>CURVE 7 (cont.)</u>	
127.6	0.000310	813.2	0.00469
144.3	0.000342	923.2	0.00523
		1023.2	0.00573
<u>CURVE 2</u>		1228.2	0.00690
127.6	0.000332	<u>CURVE 8</u>	
138.2	0.000346	528.7	0.00151
149.8	0.000361	572.6	0.00153
<u>CURVE 3</u>		606.5	0.00154
293.2	0.00186	643.2	0.00156
333.2	0.00199	715.9	0.00160
<u>CURVE 4</u>		<u>CURVE 9</u>	
403.2	0.00234	523.2	0.00190
503.2	0.00289	552.6	0.00198
618.2	0.00337	587.1	0.00205
708.2	0.00383	637.6	0.00216
813.2	0.00423	713.7	0.00234
<u>CURVE 5</u>		<u>CURVE 10</u>	
503.2	0.00276	377.8	0.00100
603.2	0.00326	398.8	0.000920
708.2	0.00377	403.2	0.00105
813.2	0.00437	<u>CURVE 11</u>	
923.2	0.00462	401.2	0.000753
1023.2	0.00544	419.9	0.000837
1123.2	0.00588		
1223.2	0.00649		
<u>CURVE 6*</u>			
603.2	0.00347		
833.2	0.00444		
1023.2	0.00536		
1228.2	0.00640		
<u>CURVE 7</u>			
603.2	0.00358		
628.2	0.00377		

Not shown on plot

SPECIFICATION TABLE NO. 270 THERMAL CONDUCTIVITY OF GABBRO

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 GABBRO

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

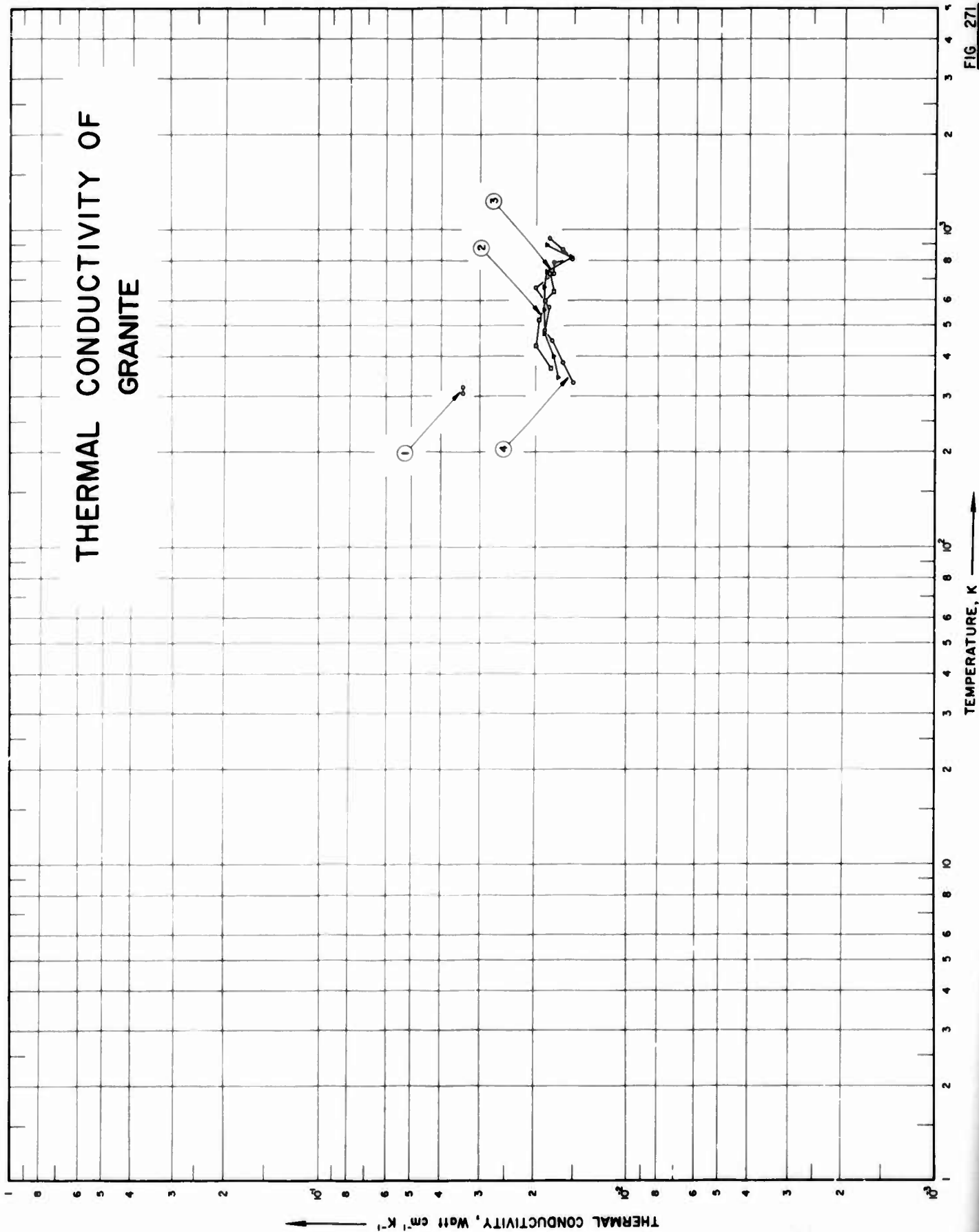
T k

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

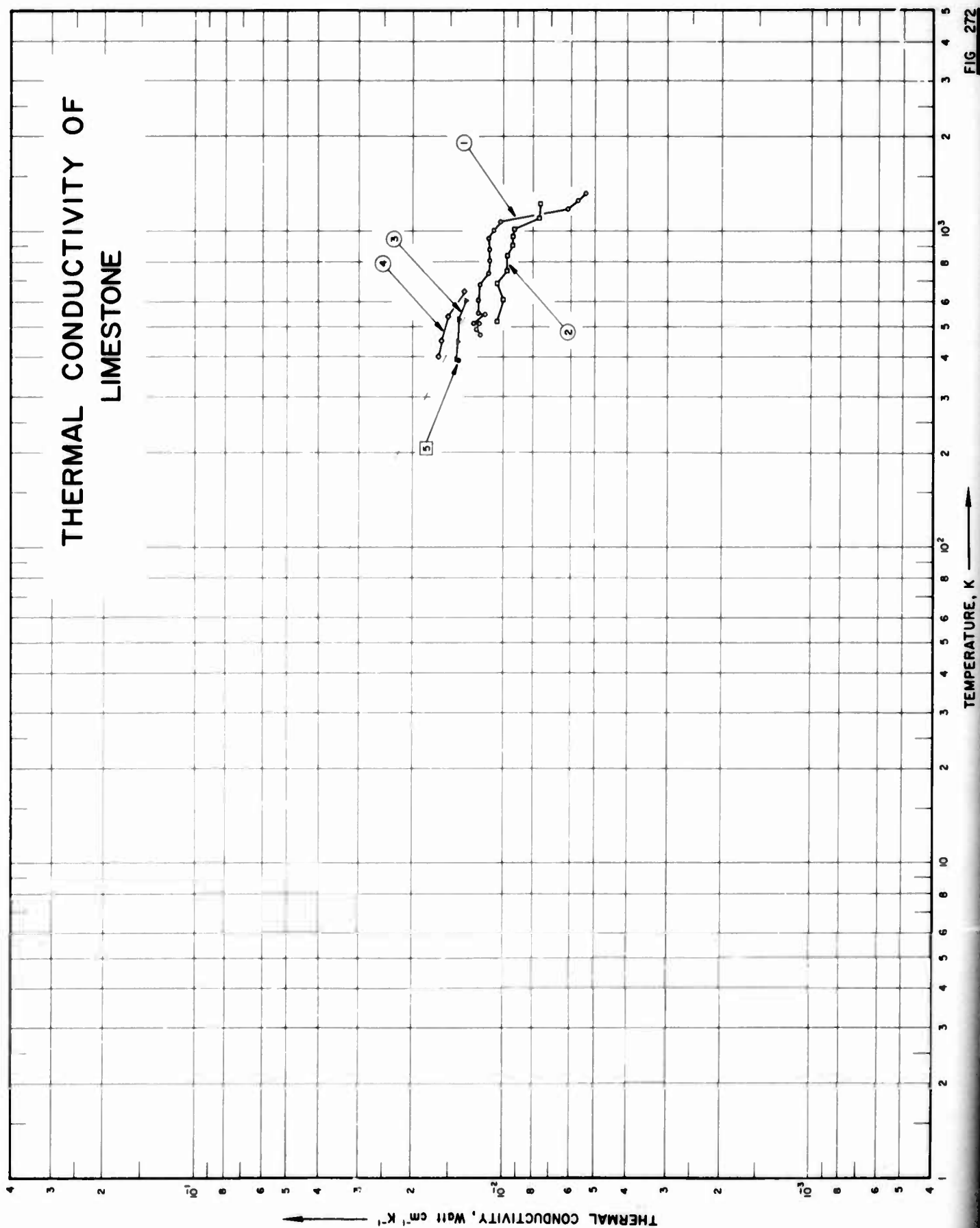


FIG. 272

SPECIFICATION TABLE NO. 272 THERMAL CONDUCTIVITY OF LIMESTONE

[For Data Reported in Figure and Table No. 272]

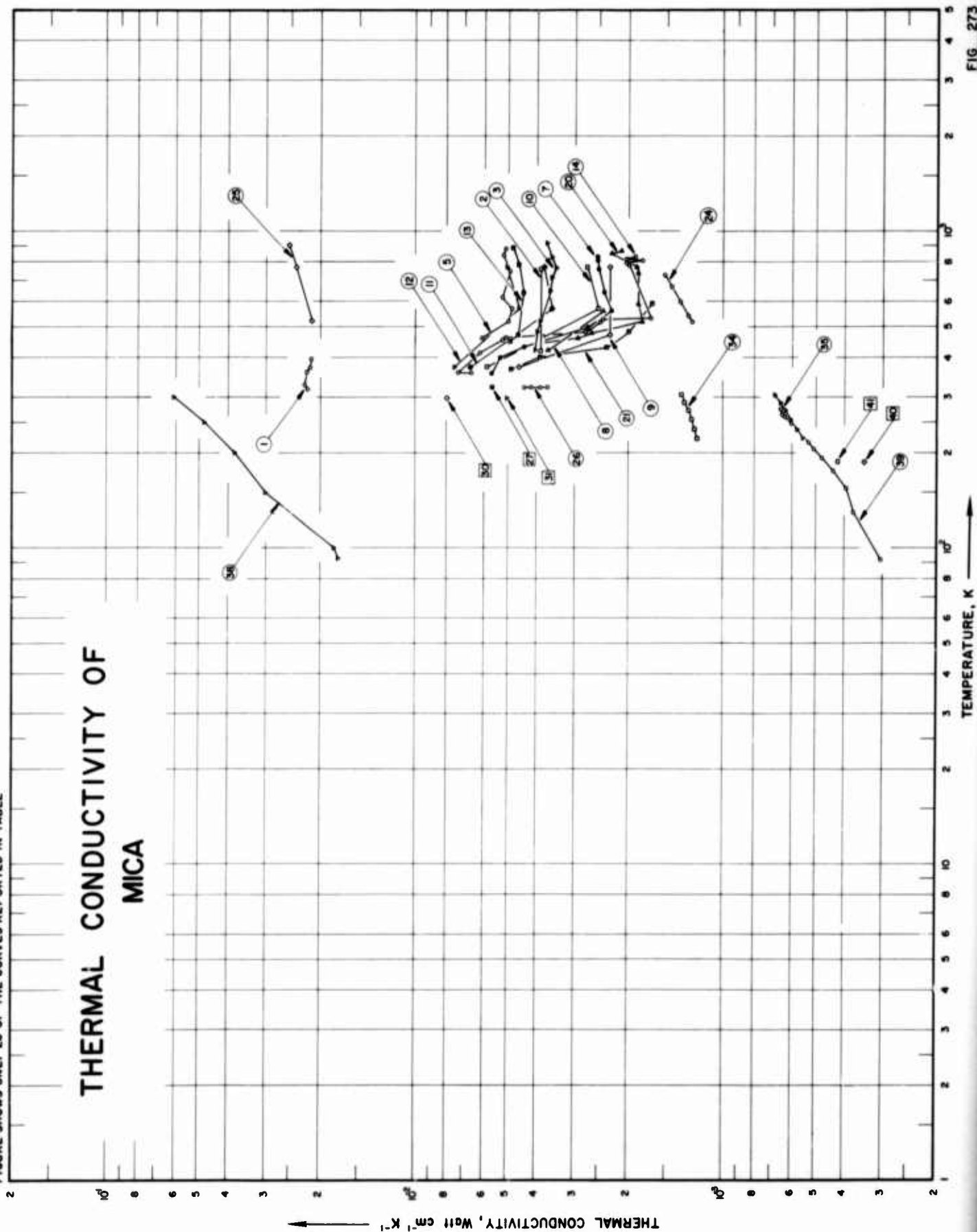
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	578	R	1963	472-1324	± 6	Indiana Limestone No. 2	(Composition in vol percent): 98.4 calcite, 1.0 quartz, 0.6 hematite; fine grained in appearance; 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>		<u>CURVE 5</u>	
472	0.0119	392.1	0.0141
493	0.0123		
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 OF MICA



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 2.85 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 4×10^{19} 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	298.2		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} .

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	T	k										
<u>CURVE 1</u>				<u>CURVE 7</u>				<u>CURVE 13 (cont.)</u>				<u>CURVE 16 (cont.)</u>				<u>CURVE 21</u>				<u>CURVE 26</u> (T = 323.2 K)				<u>CURVE 35</u>				<u>CURVE 40</u>			
317.0	0.0220	357.2	0.00569	785.2	0.00460	848.2	0.00199	368.2	0.00490	375.2	0.00661	848.2	0.00199	368.2	0.00490	375.2	0.00368	222.0	0.000552	187.2	0.000344										
328.7	0.0225	400.2	0.00531	891.2	0.00481	848.2	0.00188	403.2	0.00389	848.2	0.00188	403.2	0.00389	403.2	0.00389	403.2	0.00389	238.7	0.000578												
360.2	0.0221	434.2	0.00444			856.2	0.00209	430.2	0.00236	856.2	0.00209	430.2	0.00236	430.2	0.00236	430.2	0.00236	255.4	0.000606												
371.8	0.0216	496.2	0.00274	<u>CURVE 14</u>				879.2	0.00207	483.2	0.00199	879.2	0.00207	483.2	0.00199	483.2	0.00199	272.2	0.000632												
396.6	0.0214	564.2	0.00228	357.2	0.00661	883.2	0.00192	593.2	0.00167	357.2	0.00661	883.2	0.00192	593.2	0.00167	593.2	0.00167	305.5	0.000659	187.5	0.000422										
<u>CURVE 2</u>				<u>CURVE 8</u>				<u>CURVE 17*</u>				<u>CURVE 22*</u>				<u>CURVE 27</u>				<u>CURVE 36*</u>				<u>CURVE 41</u>							
420.2	0.00387	764.2	0.00251	358.2	0.00732	848.2	0.00199	368.2	0.00490	358.2	0.00732	848.2	0.00199	368.2	0.00490	375.2	0.00368	222.0	0.000552												
761.2	0.00387	809.2	0.00253	415.2	0.00623	891.2	0.00481	403.2	0.00389	415.2	0.00623	891.2	0.00481	403.2	0.00389	415.2	0.00544	565.7	0.00130												
833.2	0.00253			455.2	0.00523			441.2	0.00469	455.2	0.00523			441.2	0.00469	441.2	0.00469	323.2	0.000565												
<u>CURVE 3</u>				<u>CURVE 9</u>				<u>CURVE 18*</u>				<u>CURVE 23*</u>				<u>CURVE 28*</u>				<u>CURVE 37*</u>				<u>CURVE 42</u>							
423.2	0.00368	423.2	0.00368	527.2	0.00243	783.2	0.00199	379.2	0.00577	527.2	0.00243	783.2	0.00199	379.2	0.00577	527.2	0.00377	532.1	0.00130												
560.2	0.00243	560.2	0.00243	532.2	0.00169	806.2	0.00180	463.2	0.00519	532.2	0.00169	806.2	0.00180	463.2	0.00519	532.2	0.00345	548.7	0.00131												
<u>CURVE 4*</u>				<u>CURVE 10</u>				<u>CURVE 19*</u>				<u>CURVE 24</u>				<u>CURVE 29*</u>				<u>CURVE 38*</u>				<u>CURVE 43</u>							
426.2	0.00418	373.2	0.00586	364.2	0.00590	452.2	0.00408	419.2	0.00510	364.2	0.00590	452.2	0.00408	419.2	0.00510	452.2	0.00408	93.2	0.0175												
586.2	0.00381	773.2	0.00272	461.2	0.00410	461.2	0.00410	517.6	0.00124	461.2	0.00410	461.2	0.00410	517.6	0.00124	517.6	0.00124	100	0.0180												
719.2	0.00391	773.2	0.00272	462.2	0.00448	462.2	0.00448	541.5	0.00127	462.2	0.00448	462.2	0.00448	541.5	0.00127	541.5	0.00127	150	0.0300												
809.2	0.00391	773.2	0.00272	473.2	0.00272	473.2	0.00272	599.8	0.00136	473.2	0.00272	473.2	0.00272	599.8	0.00136	599.8	0.00136	200	0.0380												
<u>CURVE 5</u>				<u>CURVE 11</u>				<u>CURVE 20</u>				<u>CURVE 25</u>				<u>CURVE 30</u>				<u>CURVE 31</u>				<u>CURVE 39</u>							
460.2	0.00611	373.2	0.00356	364.2	0.00590	452.2	0.00408	419.2	0.00510	364.2	0.00590	452.2	0.00408	419.2	0.00510	452.2	0.00408	298.2	0.00795												
520.2	0.00498	773.2	0.00377	461.2	0.00410	461.2	0.00410	517.6	0.00124	461.2	0.00410	461.2	0.00410	517.6	0.00124	517.6	0.00124	100	0.0180												
573.2	0.00485			462.2	0.00448	462.2	0.00448	541.5	0.00127	462.2	0.00448	462.2	0.00448	541.5	0.00127	541.5	0.00127	150	0.0300												
616.2	0.00523			487.2	0.00234	487.2	0.00234	519.2	0.00180	487.2	0.00234	487.2	0.00234	519.2	0.00180	519.2	0.00180	200	0.0380												
747.2	0.00494	373.2	0.00460	494.2	0.00234	494.2	0.00234	519.2	0.00180	494.2	0.00234	494.2	0.00234	519.2	0.00180	519.2	0.00180	250	0.0480												
842.2	0.00519	573.2	0.00460	557.2	0.00188	557.2	0.00188	591.2	0.00186	557.2	0.00188	557.2	0.00188	591.2	0.00186	591.2	0.00186	300	0.0610												
880.2	0.00510	773.2	0.00502	583.2	0.00167	583.2	0.00167	737.2	0.00186	583.2	0.00167	583.2	0.00167	737.2	0.00186	737.2	0.00186	206.2	0.000509												
<u>CURVE 6*</u>				<u>CURVE 13</u>				<u>CURVE 16*</u>				<u>CURVE 20</u>				<u>CURVE 25</u>				<u>CURVE 32*</u>				<u>CURVE 34</u>							
496.2	0.00481	448.2	0.00494	603.2	0.00192	603.2	0.00192	773.2	0.00188	603.2	0.00192	603.2	0.00192	773.2	0.00188	773.2	0.00188	225.2	0.000554*												
473.2	0.00464	473.2	0.00464	615.2	0.00169	615.2	0.00169	851.2	0.00228	615.2	0.00169	615.2	0.00169	851.2	0.00228	851.2	0.00228	234.2	0.000571*												
636.2	0.00444	636.2	0.00444	633.2	0.00176	633.2	0.00176	865.2	0.00211	633.2	0.00176	633.2	0.00176	865.2	0.00211	865.2	0.00211	248.2	0.000602												
				653.2	0.00192	653.2	0.00192			653.2	0.00192	653.2	0.00192			653.2	0.00192	260.2	0.000635												
				734.2	0.00169	734.2	0.00169			734.2	0.00169	734.2	0.00169			734.2	0.00169	265.2	0.000647												
																		275.2	0.000656												

* Not shown on plot

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	1955	171-283			Expanded perlite powder; density 0.048 g cm ⁻³ .

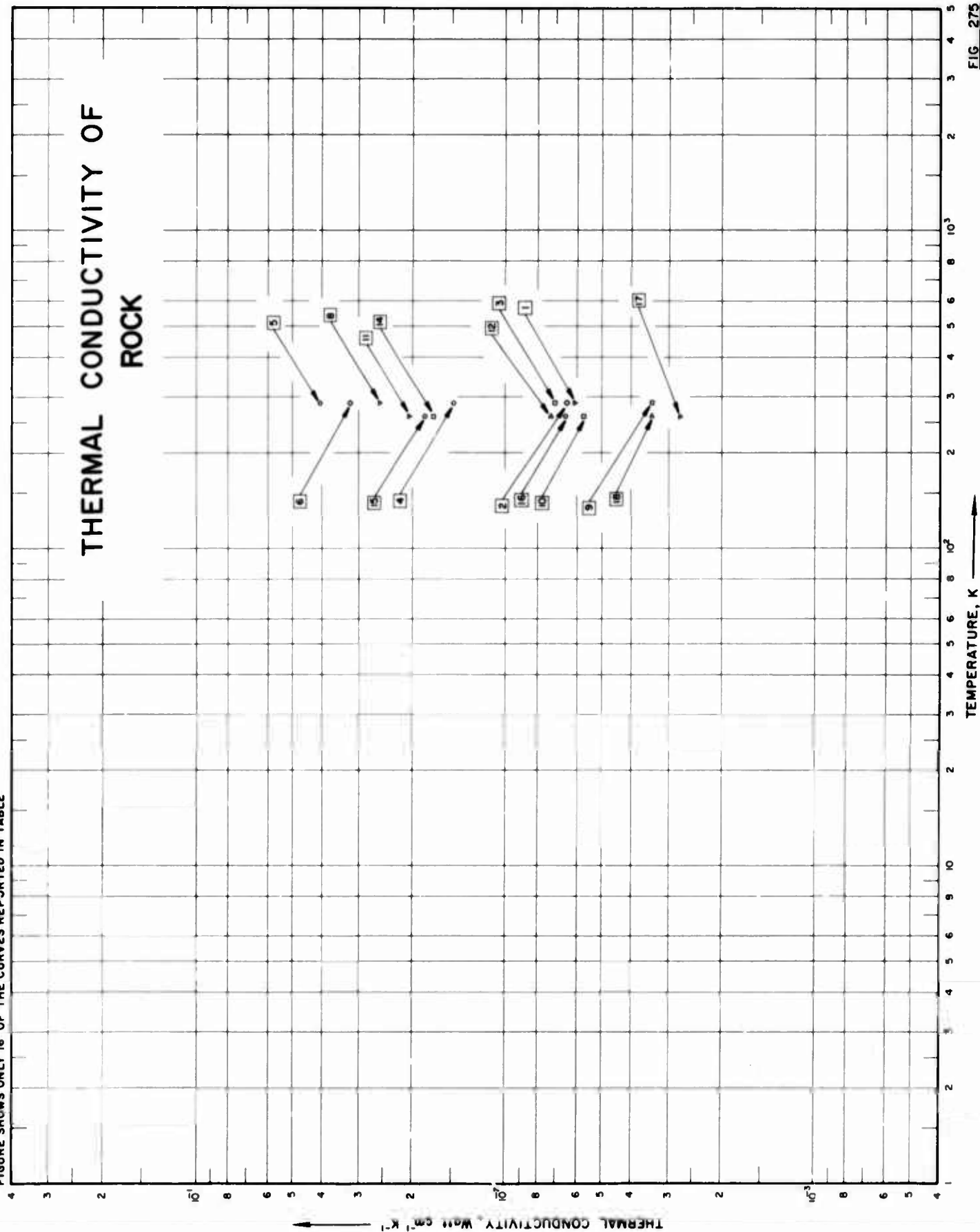
DATA TABLE NO. 274 THERMAL CONDUCTIVITY OF PERLITE

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

T	k
<u>CURVE 1*</u>	
170.7	0.000250
228.2	0.000325
283.2	0.000395

* No graphical presentation

FIGURE SHOWS ONLY 16 OF THE CURVES REPORTED IN TABLE



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 1.804 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>			
287.3	0.00606	261.8	0.00578
<u>CURVE 2</u>			
287.3	0.00642	261.8	0.0171
<u>CURVE 3</u>			
287.3	0.00697	261.8	0.0183
<u>CURVE 4</u>			
287.3	0.0147	261.8	0.00649
<u>CURVE 5</u>			
287.3	0.0402	261.8	0.00272
<u>CURVE 6</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

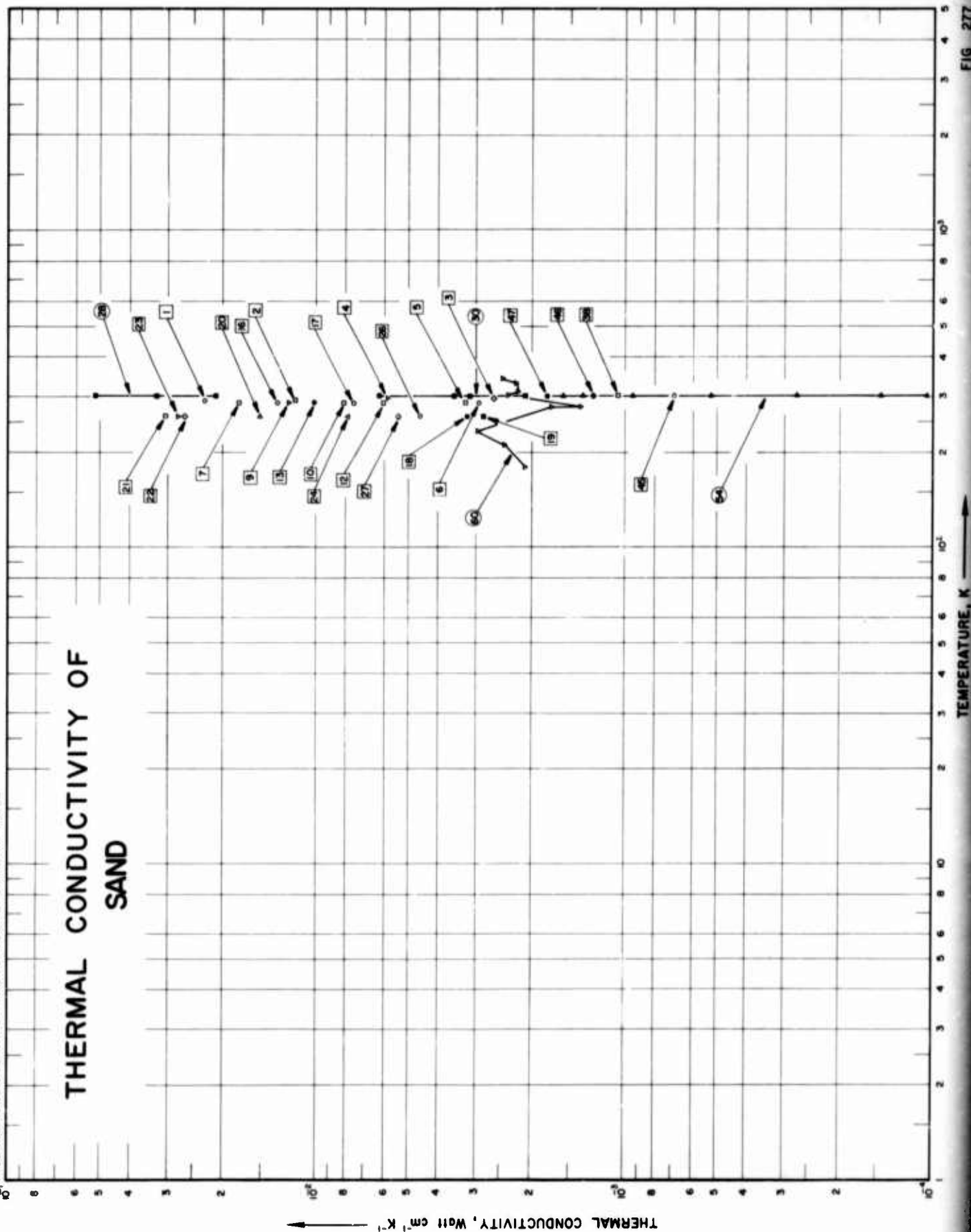
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

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 mm; 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 cohesionless 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	545	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 Wausau 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 Wausau 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 Wausau 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 59%; 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, 70 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.

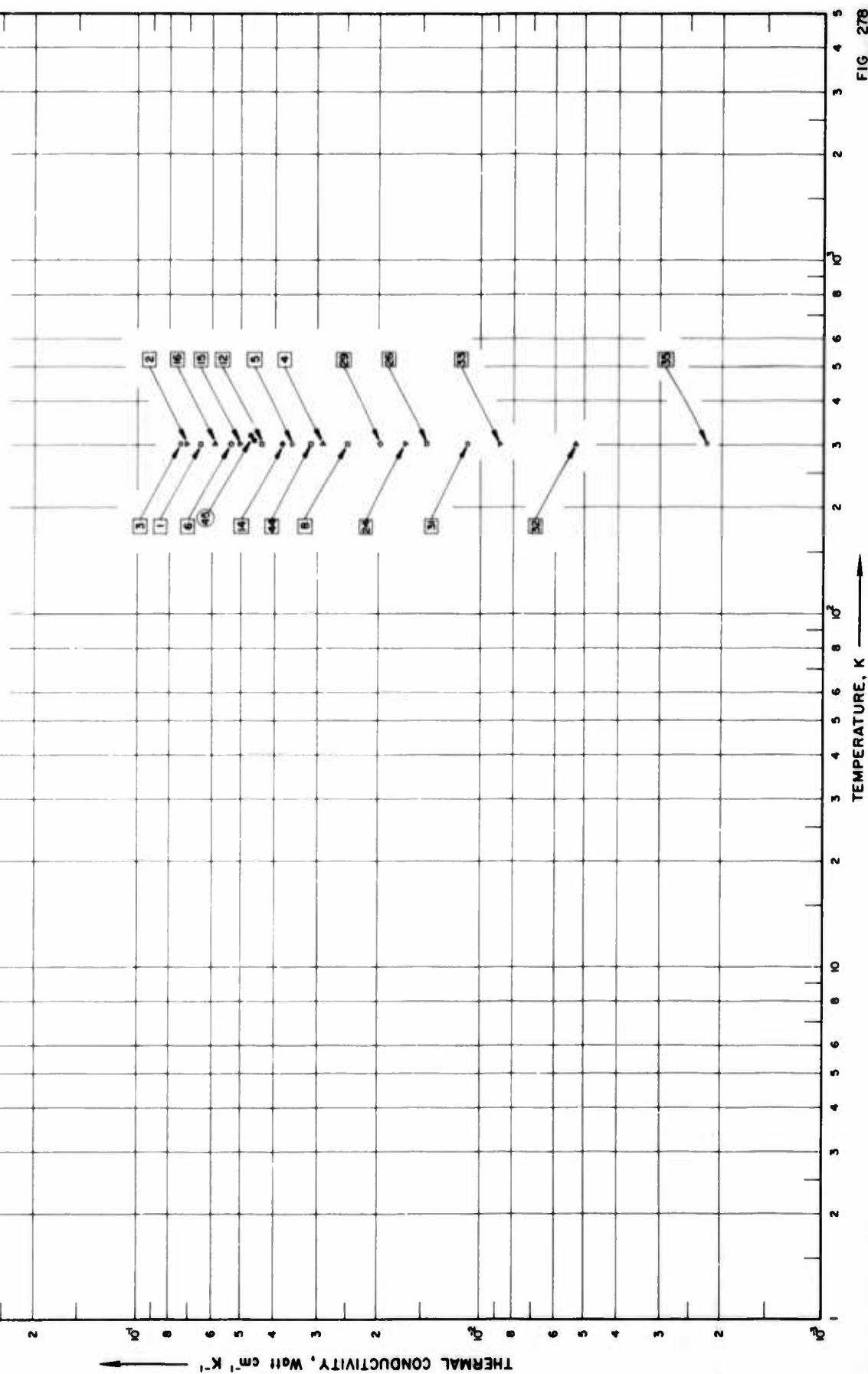
DATA TABLE NO. 277 (continued)

Pair (mm Hg)	k
CURVE 57*	
(T = 303.2 K)	
10	0.00188
52.5	0.00418
200	0.00565
750	0.00849
1600	0.00669
CURVE 58*	
(T = 303.2 K)	
15	0.00126
110	0.00314
400	0.00397
700	0.00418
850	0.00418
CURVE 59*	
(T = 303.2 K)	
110	0.00209
750	0.00209
1700	0.00230
T	k
CURVE 60	
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
CURVE 61*	
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

FIGURE SHOWS ONLY 20 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF SANDSTONE



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, °F	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; (88 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.

[illegible]

* Not shown on plot

SPECIFICATION TABLE NO. 279 THERMAL CONDUCTIVITY OF SILLMANITE

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 SILLMANITE

[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

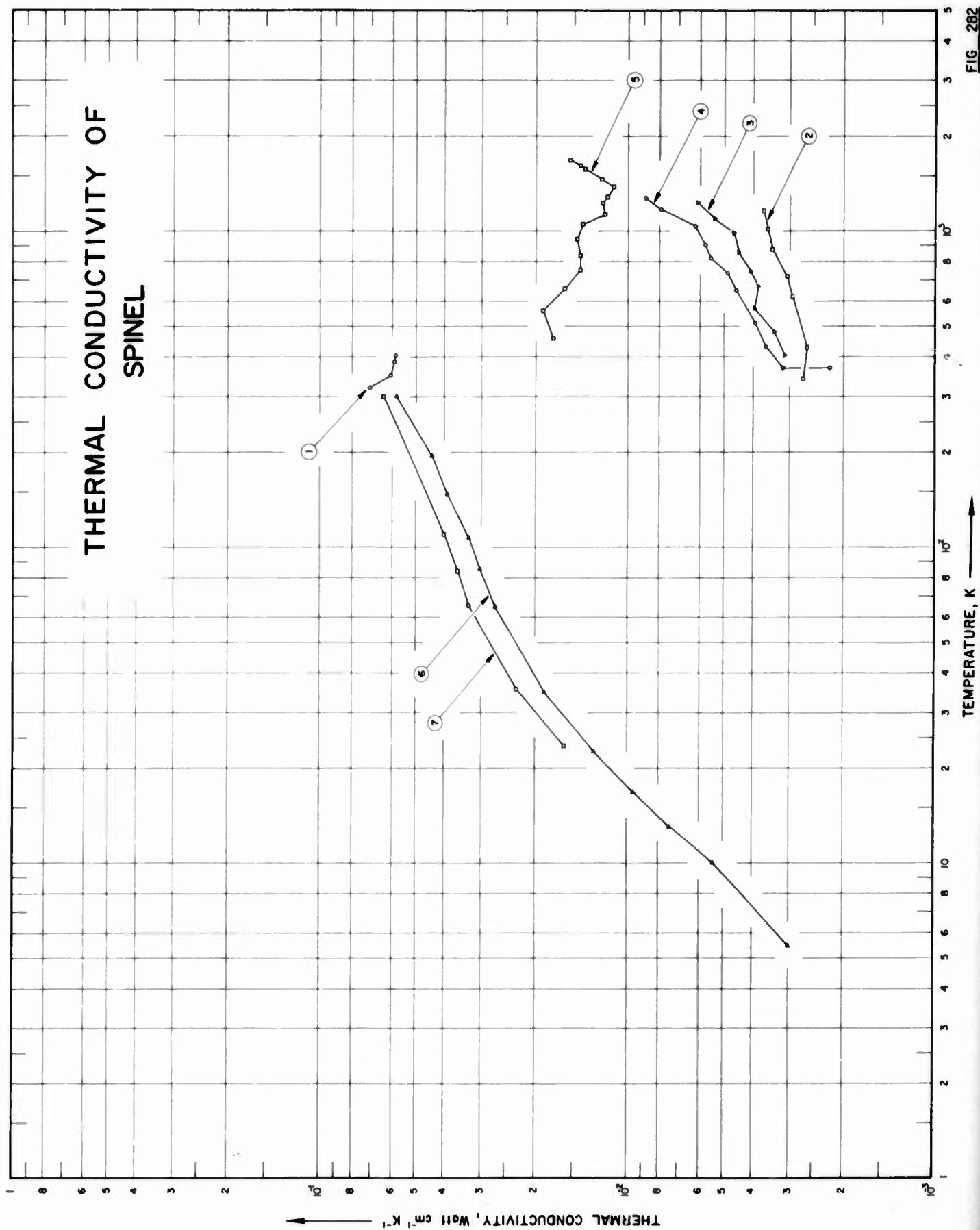
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	31	R	1958	293.2			Mineral; density 2.65 g cm ⁻³ .
2	31	R	1958	293.2			Organic; density 1.3 g cm ⁻³ .
3	31	R	1958	293.2			Mineral; dry; density 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	<u>CURVE 6*</u>	
		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

THERMAL CONDUCTIVITY OF SPINEL



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 ($\text{Mg}_{0.75}\text{Fe}_{0.41}\text{Al}_{1.85}\text{O}_4$)	Single natural crystal of pleonaste spinel from Queensland; chemical analysis indicated a formula of ($\text{Ti}_{0.02}\text{Mg}_{0.75}\text{Fe}_{0.41}\text{Al}_{1.85}\text{O}_4$; 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 $8.128 \text{ \AA}$.
7	300	L	1962	24-300		R-62 ($\text{Mg}_{0.13}\text{Fe}_{0.33}\text{Al}_{1.93}\text{O}_4$)	Similar to the above specimen except chemical analysis indicated a formula of ($\text{Ti}_{0.01}\text{Mg}_{0.13}\text{Fe}_{0.33}\text{Al}_{1.93}\text{O}_4$; specimen 0.24 cm average dia and 1.00 cm long; lattice constant $8.117 \text{ \AA}$.

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>		<u>CURVE 5</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>		839.2	0.0142
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
<u>CURVE 3</u>		1577	0.0138
405.2	0.00311	1609	0.0142
482.2	0.00337	1670	0.0154
573.2	0.00396	<u>CURVE 6</u>	
673.2	0.00384	5.47	0.0030
749.2	0.00407	10.06	0.0054
856.2	0.00449	13.09	0.0074
987.2	0.00465	16.86	0.0096
1100	0.00538	22.65	0.0128
1232	0.00608	34.75	0.0186
<u>CURVE 4</u>		64.78	0.027
369.2	0.00221	85.19	0.0303
369.2	0.00316	107.52	0.033
430.2	0.00360	147.8	0.039
511.2	0.00392	195.8	0.044
651.2	0.00456	300	0.053
736.2	0.00487	<u>CURVE 7</u>	
823.2	0.00554	23.6	0.016
903.2	0.00576	35.6	0.023
1041	0.00622	65.5	0.033
1177	0.00794	84.1	0.036
1273	0.00884	110.0	0.040
		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			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%.	

DATA TABLE NO. 283 THERMAL CONDUCTIVITY OF SPODUMENE

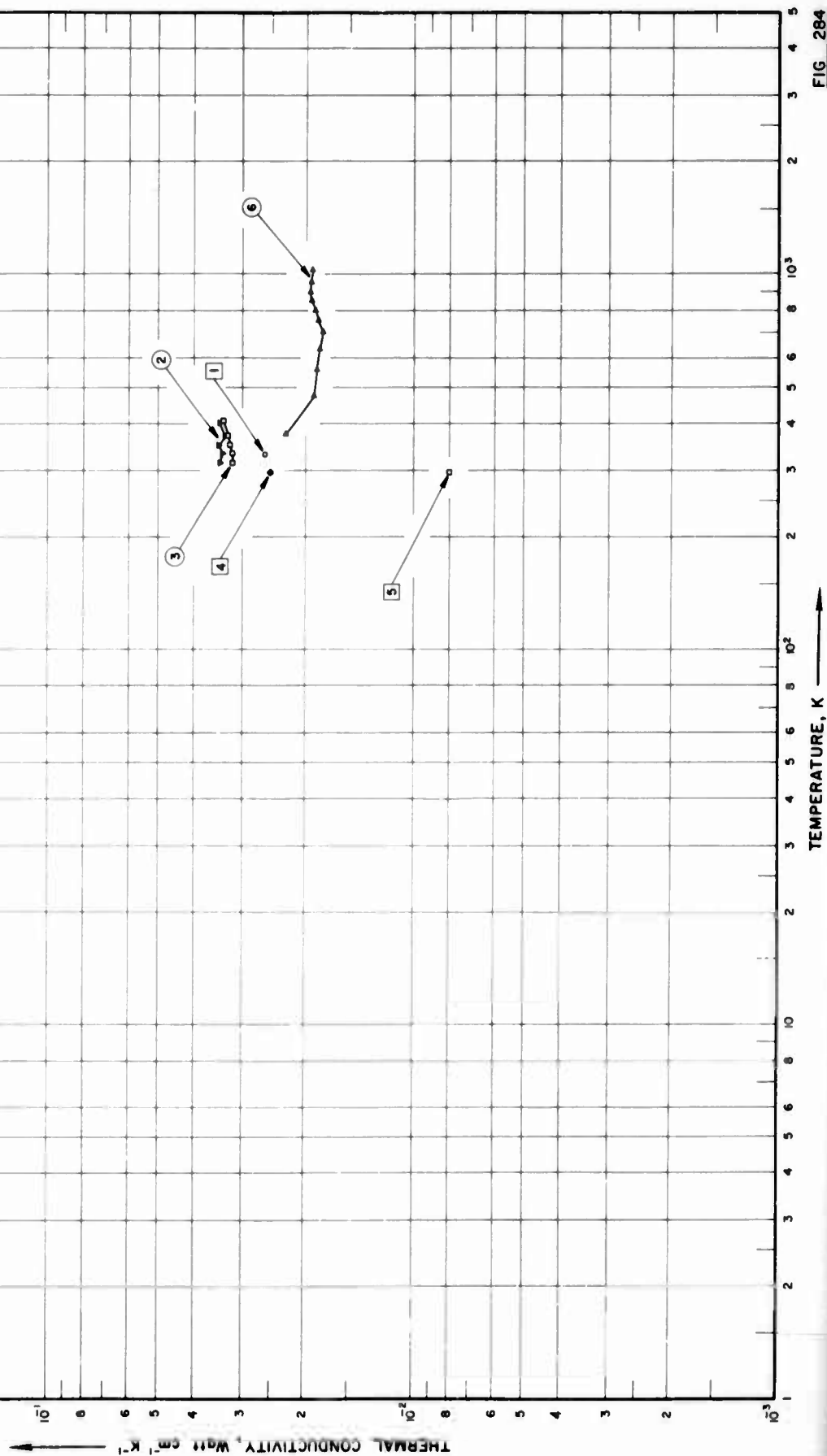
[Temperature, T, K; Thermal Conductivity, k, Watt $\text{cm}^{-1} \text{K}^{-1}$]

T	k
CURVE I*	
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

FIGURE SHOWS ONLY 6 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF STEATITE



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 20 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 NTR.
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>	
378.2	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>	
368.2	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
<u>CURVE 1*</u>	
398.2	0.0291
540.2	0.0320
613.2	0.0322
723.2	0.0351
<u>CURVE 2*</u>	
393.2	0.0296
492.2	0.0346
591.2	0.0383
729.2	0.0417

* No graphical presentation

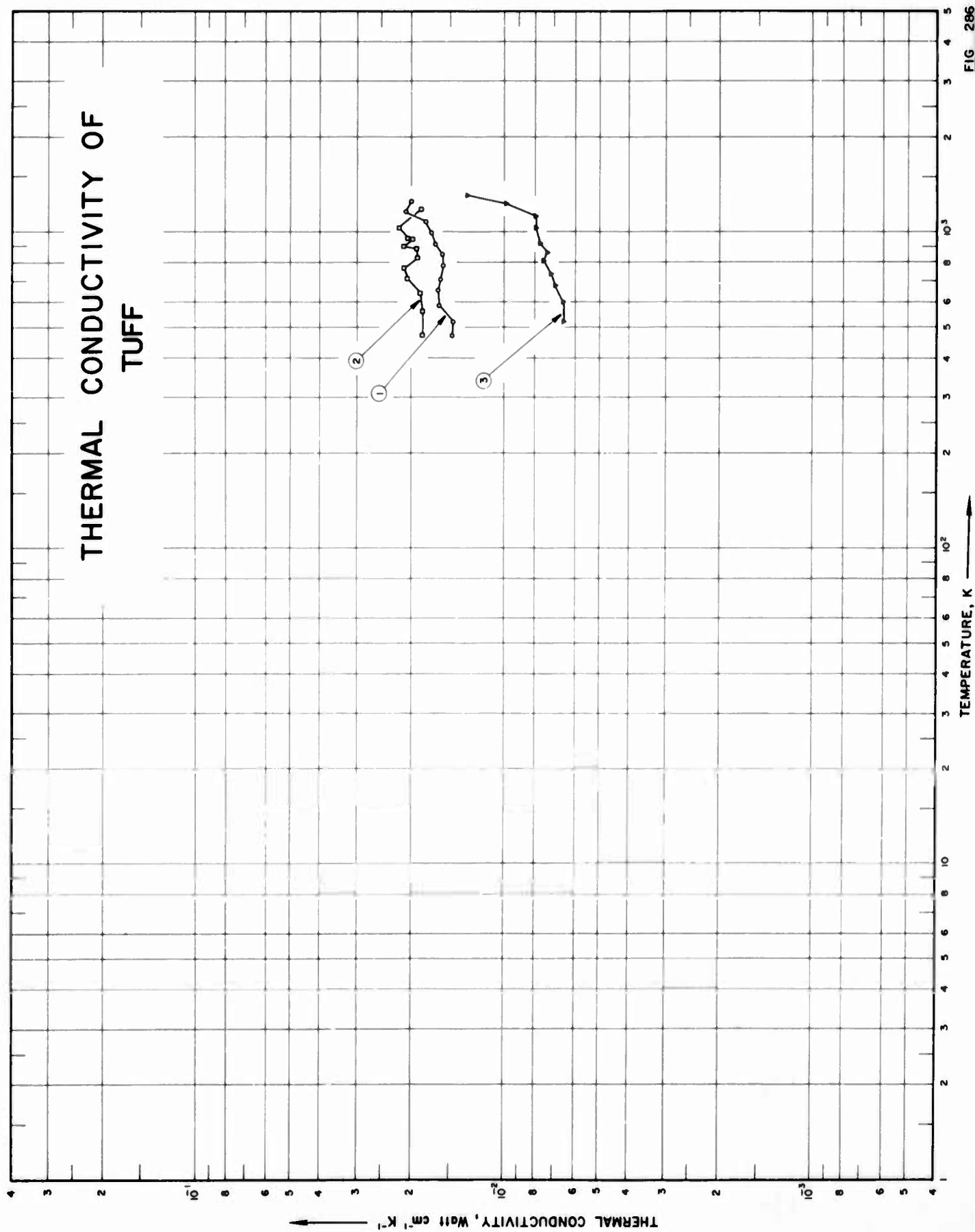


FIG. 285

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, chalcedony, zeolite, etc.), 14 chalcedony segregations, 8 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 cement	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

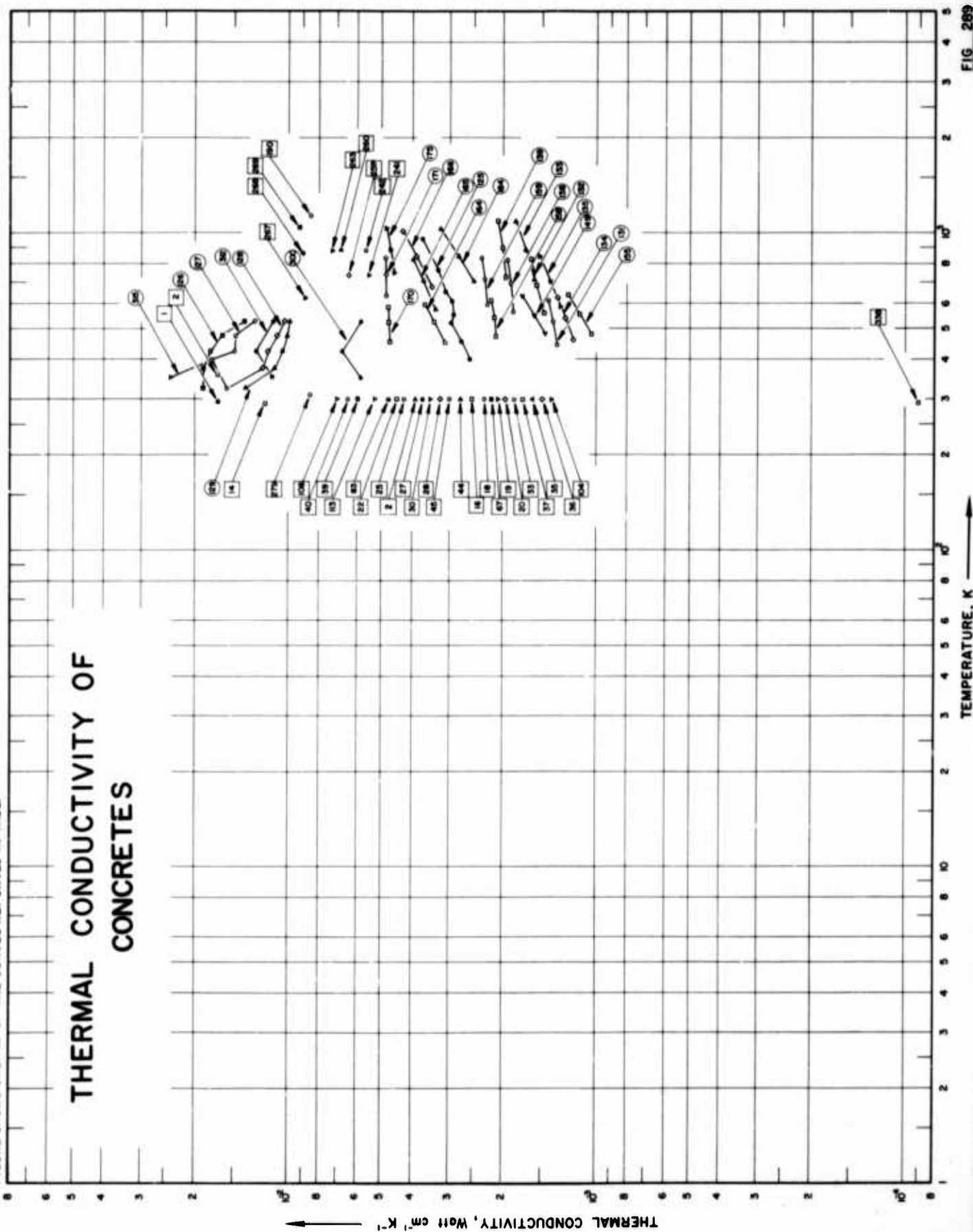
CURVE 4*

311.0 0.00416

* No graphical presentation

FIGURE SHOWS ONLY 62 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF CONCRETES



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	80% 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% hirschfelder 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% hirschfelder 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) 1.00 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		Luminate cement concrete	1 luminate 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		Luminate cement concrete	The above specimen measured at 1033 K furnace temp.
133	582		1953	707-1088		Luminate cement concrete	The above specimen measured at 1366 K furnace temp.
134	582		1953	456-624		Luminate 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		Luminate cement concrete	The above specimen measured at 1033 K furnace temp.
136	582		1953	750-1121		Luminate 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			1 luminate 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			The above specimen measured at 1033 K furnace temp.
145	582		1953	743-1099			The above specimen measured at 1366 K furnace temp.
146	582		1953	454-627			1 luminate 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			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 luminite 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	859.3			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 luminite 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		1958	525.5			1 luminite 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 prefired 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. 249 (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 luminite 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			Aerated 1 luminite 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 luminite 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 luminite 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 luminite 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			Aerated 1 luminite 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			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.

Commercial castable

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 1033 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 1033 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 1033 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 as 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.
339	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]

T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k
<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)

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

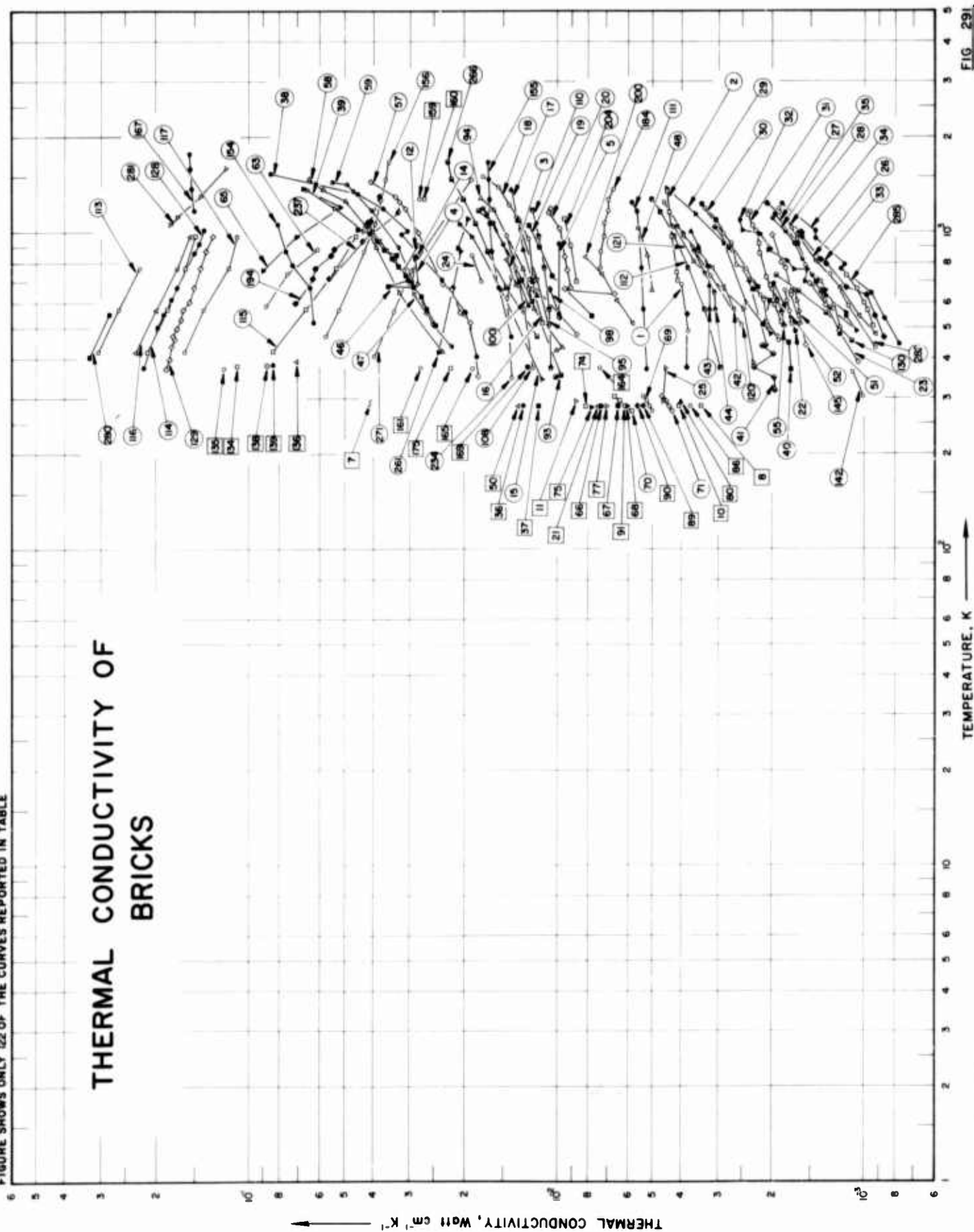
CURVE 1*

298.2 0.00134

* No graphical presentation

FIGURE SHOWS ONLY 22 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF BRICKS



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	PP	1950	553, 923		Chamotte (fire brick)	Normal; density 1.85 g cm ⁻³ .
6	92	PP	1950	373, 553		Chamotte (fire brick)	Porous; density 1.23 g cm ⁻³ .
7	93		1957	293, 2		Carbon brick (plena)	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 Hoganas-Billesholm AB, Hoganas; 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			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	1914	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 common 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	P	1950	813-1023		Magnesite brick	No details reported.
65	97	C	1953	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; HSI50	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; HSI50	Measured in the laboratory; density 2.115 g cm ⁻³ ; moisture content 2.8 vol. %.
70	94	L	1942	273-303		Metallurgical brick; HSI100	Measured in the laboratory; density 1.786 g cm ⁻³ ; moisture content 15.5 vol. %.
71	94	L	1942	273-303		Metallurgical brick; HSI100	Measured in the laboratory; density 1.786 g cm ⁻³ ; moisture content 1.7 vol. %.
72	94	L	1942	285.4		Metallurgical brick; HSI50	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; HSI50	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; HSI50	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; HSI100	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; HSI100	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; HSI100	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; HSI100	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; HSI100	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	350-1173	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. 291 (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; I	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 , 16.45 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, 1.828, 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	60.78 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, 26.78 SiO ₂ , 15.21 Al ₂ O ₃ , 12.60 Cr ₂ O ₃ , 6.75 Fe ₂ O ₃ , and 2.20 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	30.42 Cr ₂ O ₃ , 19.51 Al ₂ O ₃ , 14.56 MgO, 1.88 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	91.20 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 , 22.65 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		Magnetite; 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, 0.05 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		Magnetite; 5	Similar to the above specimen.
188	143	L	1955	643-1168		Magnetite; 6	Similar to the above specimen.
189	143	L	1955	658-1248		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		Magnetite; 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		Magnetite; 8	Similar to the above specimen.
192	143	L	1955	653-1233		Magnetite; 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 49.5%; 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 Sngirevsk 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 Semiluksk 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 0.48 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.
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 Latnensk 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 H ₂ .
214	79	L	1942	688-857		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	619-784		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	64.38 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 0.06%.
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 ⁻¹ 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 ⁻¹ 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 ⁻¹ 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 31.9%; 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 , 0.35 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	1020, 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 , 23.65 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 10.5%; made of sedimentary kaolin by mixing 65% of 20-mesh prefired 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 2.10 g cm ⁻³ , porosity 23.2%; made of sedimentary kaolin by mixing 65% of 4-mesh prefired 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	92.26 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 H ₂ O, 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 H ₂ O, 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 H ₂ O, 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 68 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			Similar to the above specimen except alumina AL-300 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	60.44 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 badeleyite 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	252	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 , 0.08 MgO, and 0.21 alkali oxides; slab specimen 18 in. x 18 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.

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

* 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>				<u>CURVE 47</u>				<u>CURVE 54(cont.)*</u>				<u>CURVE 59(cont.)</u>			
573.2	0.00266	553.2	0.0264	684.3	0.00179	1422.1	0.0493	284.1	0.00604	273.2	0.00500	283.0	0.00639		
673.2	0.00287	636.2	0.0290	<u>CURVE 55</u>				1449.8	0.0548	283.2	0.00511	287.3	0.00662		
773.2	0.00315	729.2	0.0306*	<u>CURVE 56*</u>				<u>CURVE 60*</u>				283.2	0.00662		
873.2	0.00351	810.2	0.0339	505.4	0.00183	560.9	0.0226	560.9	0.0226	283.2	0.00523	283.0	0.00639		
973.2	0.00394	877.2	0.0361	560.9	0.00187	616.5	0.0242	616.5	0.0242	283.2	0.00535	283.0	0.00639		
<u>CURVE 43</u>				611.5	0.00193	727.6	0.0248	727.6	0.0248	283.2	0.00535	283.0	0.00639		
571.2	0.00322	942.2	0.0382	673.2	0.00199*	838.7	0.0267	838.7	0.0267	283.2	0.00535	283.0	0.00639		
678.2	0.00322	1008.2	0.0403	<u>CURVE 56*</u>				1116.5	0.0293	283.2	0.00535	283.0	0.00639		
783.2	0.00326	1040.2	0.0414	505.4	0.00183	1116.5	0.0293	1116.5	0.0293	283.2	0.00535	283.0	0.00639		
896.2	0.00351	<u>CURVE 48</u>				1299.8	0.0342	1299.8	0.0342	283.2	0.00535	283.0	0.00639		
1014.2	0.00372	655.2	0.00500	505.4	0.00183	1338.7	0.0355	1338.7	0.0355	283.2	0.00535	283.0	0.00639		
<u>CURVE 44</u>				560.9	0.00187	1299.8	0.0342	1299.8	0.0342	283.2	0.00535	283.0	0.00639		
573.2	0.00307	843.2	0.00523	600.4	0.00196	1338.7	0.0355	1338.7	0.0355	283.2	0.00535	283.0	0.00639		
648.2	0.00310	1038.2	0.00558	652.6	0.00198	841.2	0.0184	841.2	0.0184	283.2	0.00535	283.0	0.00639		
749.2	0.00333	<u>CURVE 49*</u>				<u>CURVE 61*</u>				283.2	0.00535	283.0	0.00639		
873.2	0.00362	283.2	0.0116	352.6	0.0180	<u>CURVE 62*</u>				283.2	0.00535	283.0	0.00639		
986.2	0.00395	<u>CURVE 50</u>				519.3	0.0192	738.2	0.0124	283.2	0.00535	283.0	0.00639		
1046.2	0.00415	283.2	0.0134	558.2	0.0206	560.9	0.0219	560.9	0.0219	283.2	0.00535	283.0	0.00639		
<u>CURVE 45*</u>				688.7	0.0234	688.7	0.0234	688.7	0.0234	283.2	0.00535	283.0	0.00639		
576.2	0.00302	<u>CURVE 51</u>				347.1	0.0262*	347.1	0.0262*	283.2	0.00535	283.0	0.00639		
648.2	0.00312	515.4	0.00162	999.8	0.0281	999.8	0.0281	999.8	0.0281	283.2	0.00535	283.0	0.00639		
741.2	0.00333	562.1	0.00163	1183.2	0.0312	1183.2	0.0312	1183.2	0.0312	283.2	0.00535	283.0	0.00639		
970.2	0.00366	609.3	0.00166	1235.9	0.0327	1235.9	0.0327	1235.9	0.0327	283.2	0.00535	283.0	0.00639		
982.2	0.00395	638.7	0.00169	1294.3	0.0335	1294.3	0.0335	1294.3	0.0335	283.2	0.00535	283.0	0.00639		
1042.2	0.00415	<u>CURVE 52</u>				1433.2	0.0405*	1433.2	0.0405*	283.2	0.00535	283.0	0.00639		
1082.2	0.00432	512.1	0.00173	1449.8	0.0410	1449.8	0.0410	1449.8	0.0410	283.2	0.00535	283.0	0.00639		
<u>CURVE 46</u>				<u>CURVE 59</u>				<u>CURVE 65</u>				<u>CURVE 72*</u>			
510.2	0.0246	564.8	0.00176	422.1	0.0234	422.1	0.0234	422.1	0.0234	283.2	0.00535	283.0	0.00639		
574.2	0.0263	605.9	0.00179	649.8	0.0327	649.8	0.0327	649.8	0.0327	283.2	0.00535	283.0	0.00639		
626.2	0.0273	655.9	0.00182	899.8	0.0392	899.8	0.0392	899.8	0.0392	283.2	0.00535	283.0	0.00639		
674.2	0.0292	<u>CURVE 53*</u>				1055.4	0.0427	1055.4	0.0427	283.2	0.00535	283.0	0.00639		
677.2	0.0357	523.2	0.00162	1260.9	0.0498	1260.9	0.0498	1260.9	0.0498	283.2	0.00535	283.0	0.00639		
705.2	0.0303	568.2	0.00163	1372.1	0.0587	1372.1	0.0587	1372.1	0.0587	283.2	0.00535	283.0	0.00639		
731.2	0.0311	598.7	0.00164	1477.6	0.0648	1477.6	0.0648	1477.6	0.0648	283.2	0.00535	283.0	0.00639		
783.2	0.0328	644.3	0.00166	<u>CURVE 59</u>				<u>CURVE 75</u>				<u>CURVE 82*</u>			
830.2	0.0346	438.7	0.0219	438.7	0.0219	438.7	0.0219	438.7	0.0219	283.2	0.00535	283.0	0.00639		
848.2	0.0333	513.7	0.0252	513.7	0.0252	513.7	0.0252	513.7	0.0252	283.2	0.00535	283.0	0.00639		
883.2	0.0369	649.8	0.0284*	649.8	0.0284*	649.8	0.0284*	649.8	0.0284*	283.2	0.00535	283.0	0.00639		
941.2	0.0388	899.8	0.0329	899.8	0.0329	899.8	0.0329	899.8	0.0329	283.2	0.00535	283.0	0.00639		
996.2	0.0414	1177.6	0.0408	1177.6	0.0408	1177.6	0.0408	1177.6	0.0408	283.2	0.00535	283.0	0.00639		
1021.2	0.0454	1355.4	0.0470	1355.4	0.0470	1355.4	0.0470	1355.4	0.0470	283.2	0.00535	283.0	0.00639		

* Not shown on plot

DATA TABLE NO. 291 (continued)

CURVE 97*		CURVE 102(cont.)*		CURVE 108		CURVE 114		CURVE 121(cont.)		CURVE 127*		CURVE 131(cont.)*	
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	0.0169	573.2	0.0128	573.2	0.184			546.8	0.00270	566.8	0.001404
774.1	0.0137	CURVE 103*		773.2	0.0137	773.2	0.161	CURVE 122*		751.6	0.00317	CURVE 132*	
803.5	0.0143			973.2	0.0146*	973.2	0.149	605.7	0.00297	851.2	0.00337	CURVE 133*	
1078.2	0.0159			1173.2	0.0160*			852.9	0.00358	1092.4	0.00423	1223.2	0.00372
CURVE 98				CURVE 109*		CURVE 115		1024.6	0.00417	1174.9	0.00443	CURVE 134	
543.8	0.00984	489.1	0.0105	373.2	0.0100	423.2	0.0837	1215.1	0.00443	1249.8	0.00462	CURVE 135	
683.2	0.0107	589.2	0.0117	573.2	0.0116	773.2	0.0661	CURVE 123*		CURVE 128		CURVE 136	
CURVE 99*		811.6	0.0138	773.2	0.0130	773.2	0.0531	491.4	0.00264	376.2	0.218	CURVE 137*	
731.0	0.0119	922.8	0.0147	973.2	0.0146	973.2	0.0460	709.2	0.00320	428.2	0.209*	CURVE 138	
862.7	0.0123	1034.0	0.0157	973.2	0.0153	CURVE 116		866.4	0.00384	503.2	0.197	CURVE 139	
1053.3	0.0138	1145.2	0.0167	1173.2	0.0153	423.2	0.231	1032.9	0.00404	553.2	0.188	CURVE 140*	
1387.2	0.0155	1189.7	0.0177	CURVE 110		573.2	0.199	CURVE 124*		618.2	0.178	CURVE 141*	
CURVE 100		CURVE 104*		373.2	0.0105	773.2	0.171	423.7	0.00216	673.2	0.172	CURVE 142	
589.2	0.0123	555.8	0.0112	573.2	0.0107	973.2	0.156	617.4	0.00291	773.2	0.159*	CURVE 143*	
700.4	0.0132	589.2	0.0115	973.2	0.0110	CURVE 117		864.4	0.00313	863.2	0.151	CURVE 144	
811.6	0.0141*	811.6	0.0134	1173.2	0.0121	423.2	0.162	1015.7	0.00339	923.2	0.146	CURVE 145	
922.8	0.0150	922.8	0.0144	CURVE 111		573.2	0.141	1098.7	0.00389	1023.2	0.140	CURVE 146	
1034.0	0.0160*	1145.2	0.0164	373.2	0.00523	773.2	0.109	1236.8	0.00430	CURVE 129		CURVE 147*	
1145.2	0.0170	1189.7	0.0169	573.2	0.00536	CURVE 118*		1320.9	0.00482	373.2	0.186	CURVE 148	
1189.7	0.0175	CURVE 105*		773.2	0.00544*	393.3	0.0089	CURVE 125*		398.2	0.182	CURVE 149	
CURVE 101*		500.2	0.0110	1173.2	0.00565	855.2	0.0127	361.9	0.00218	438.2	0.178	CURVE 150*	
505.7	0.0112	605.9	0.0116	1248.2	0.00586	CURVE 119*		509.4	0.00290	463.2	0.174	CURVE 151*	
589.2	0.0120	711.5	0.0123	CURVE 112		533.7	0.0105	717.4	0.00303	473.2	0.176	CURVE 152*	
700.4	0.0130	728.2	0.0123	373.2	0.00297	692.3	0.0118	810.3	0.00323	498.2	0.172	CURVE 153	
811.6	0.0141	800.5	0.0130	573.2	0.00335	CURVE 120		978.6	0.00366	533.2	0.167	CURVE 154	
883.9	0.0135	883.9	0.0135	773.2	0.00381	512.5	0.00251	1033.3	0.00372	573.2	0.163	CURVE 155	
1034.0	0.0150	1034.0	0.0146	973.2	0.00427	726.2	0.00320	1243.8	0.00459	603.2	0.157	CURVE 156	
1145.2	0.0170	1123.0	0.0152	1173.2	0.00473	1243.8	0.00459	1249.7	0.00446	673.2	0.151	CURVE 157*	
1189.7	0.0175	CURVE 106*		1273.2	0.00502	CURVE 121		1324.4	0.00470	773.2	0.138	CURVE 158	
CURVE 102*		520.4	0.00172	1273.2	0.00502	CURVE 122		1420.4	0.00525	973.2	0.132	CURVE 159	
455.8	0.00959	567.6	0.00176	CURVE 113		385.8	0.00229	484.6	0.00271	CURVE 130		CURVE 160*	
478.0	0.00981	617.1	0.00182	423.2	0.307	571.9	0.00297	662.9	0.00297	454.2	0.001103	CURVE 161*	
589.2	0.0112	659.3	0.00186	573.2	0.262	806.6	0.00363	905.9	0.00349	555.2	0.001334	CURVE 162*	
700.4	0.0123	CURVE 107*		773.2	0.224			1033.3	0.00372	651.2	0.001647	CURVE 163	
811.6	0.0133	413.2	0.00198					1249.7	0.00446	732.2	0.001932	CURVE 164	
922.8	0.0144	733.2	0.00198					1324.4	0.00470	518.2	0.00916	CURVE 165	
1034.0	0.0153							1420.4	0.00525	643.2	0.00900	CURVE 166	
										1183.2	0.0129	CURVE 167	
										381.8	0.001013	CURVE 168	
										444.9	0.001106	CURVE 169	
										303.2	0.00101	CURVE 170	
										363.2	0.00110	CURVE 171	

* 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 194</u>		<u>CURVE 200 (cont.)</u>		<u>CURVE 208*</u>		<u>CURVE 216*</u>		<u>CURVE 221*</u>		<u>CURVE 229*</u>		<u>CURVE 236*</u>	
598	0.071	735.2	0.00721	661.2	0.00674	618.2	0.00837	1623	0.0159	393.5	0.00811	723.2	0.0516
715.7	0.063	834.2	0.00914	858.2	0.00709	660.2	0.00879	507.3	0.00860	507.3	0.00860	953.2	0.0407
773	0.062	<u>CURVE 201*</u>		1048	0.00744	784.2	0.00962	<u>CURVE 222*</u>		817.3	0.0102	1163.2	0.0337
848	0.055	783.2	0.00523	<u>CURVE 209*</u>		<u>CURVE 217*</u>		815.7	0.012	<u>CURVE 230*</u>		1313.2	0.0284
883	0.049	913.2	0.00581	513.2	0.00558	1009	0.0109	908	0.012	873.2	0.00356	<u>CURVE 237</u>	
973	0.046*	1028	0.00662	603.2	0.00628	1242	0.0113	978	0.015	973.2	0.00418	713.2	0.0558
1076	0.042	<u>CURVE 202*</u>		729.2	0.00709	<u>CURVE 218*</u>		1268	0.017	1073	0.00502	943.2	0.0437
1088	0.041	758.2	0.00779	827.2	0.00779	530.7	0.00269	<u>CURVE 223*</u>		1173	0.00565	1163	0.0330
1303	0.038	<u>CURVE 210*</u>		540.7	0.00276	573.2	0.00290	1033	0.014	1273	0.00628	1303	0.0293*
<u>CURVE 195*</u>		973.2	0.00511	753.2	0.00488	610.2	0.00305	1203	0.016	1373	0.00690	<u>CURVE 238*</u>	
636.2	0.0158	<u>CURVE 203*</u>		885.2	0.00558	620.2	0.00309	<u>CURVE 224*</u>		640.2	0.0167	773.2	0.0535
843.2	0.0155	666.2	0.0109	993.2	0.00616	670.2	0.00319	1278	0.0066	675.2	0.0167	973.2	0.0442
1036	0.0153	871.2	0.0115	<u>CURVE 211*</u>		723.2	0.00343	1293	0.0050	811.2	0.0176	1203	0.0354
<u>CURVE 196*</u>		1064	0.0120	668.2	0.0100	753.2	0.00355	<u>CURVE 225*</u>		823.2	0.0176	1348	0.0294
623.2	0.00558	<u>CURVE 204</u>		858.2	0.0108	798.2	0.00361	1088	0.0172	<u>CURVE 239*</u>		<u>CURVE 240*</u>	
803.2	0.00593	698.2	0.00872	<u>CURVE 212*</u>		593.2	0.00366	1078	0.0104	398.9	0.00709	598.2	0.0101
993.2	0.00616	907.2	0.00907	668.2	0.0102	620.2	0.00361	<u>CURVE 226*</u>		408.6	0.00687	477.9	0.0101
<u>CURVE 197*</u>		1101	0.00953	863.2	0.0109	681.2	0.00368	1113	0.016	511.6	0.00688	402.0	0.00996
636.2	0.00477	<u>CURVE 205*</u>		1053	0.0113	725.2	0.00368	<u>CURVE 227*</u>		740.0	0.00853	559.6	0.0101
813.2	0.00511	873.2	0.00351	<u>CURVE 213*</u>		759.2	0.00379	918	0.013	403.4	0.00907	804.0	0.0102
1003	0.00558	973.2	0.00418	399.2	0.0156	788.2	0.00384	1063	0.015	523.0	0.0115	<u>CURVE 241*</u>	
<u>CURVE 198*</u>		1073	0.00502	507.5	0.0149	818.2	0.00389	1191	0.018	749.4	0.0117	709.2	0.0109
503.2	0.00523	1173	0.00565	851.3	0.0132	860.2	0.00401	<u>CURVE 228*</u>		346.1	0.0156	754.2	0.0113
589.2	0.00581	1273	0.00628	<u>CURVE 214*</u>		881.2	0.00398	1273	0.00774	573.2	0.0151	853.2	0.0121
701.2	0.00651	1373	0.00690	<u>CURVE 215*</u>		896.2	0.00307	1373	0.0105	744.2	0.0147	902.2	0.0126
798.2	0.00732	<u>CURVE 206*</u>		606.2	0.00278	<u>CURVE 219*</u>		<u>CURVE 229*</u>		<u>CURVE 242*</u>		<u>CURVE 243*</u>	
<u>CURVE 199*</u>		696.2	0.0117	649.2	0.00290	593.2	0.00366	773.2	0.00418	1023	0.0130	<u>CURVE 244*</u>	
709.2	0.00697	772.2	0.0117	753.2	0.0105	620.2	0.00361	873.2	0.00481	1225	0.0146	<u>CURVE 245*</u>	
797.2	0.00755	880.2	0.0121	857.2	0.0113	681.2	0.00368	973.2	0.00544	<u>CURVE 235*</u>		<u>CURVE 246*</u>	
<u>CURVE 200</u>		<u>CURVE 207*</u>		1066.	0.0121	725.2	0.00368	1073	0.00628	<u>CURVE 236*</u>		<u>CURVE 247*</u>	
518.2	0.00681	1062	0.0126	1301	0.0126	759.2	0.00379	1173	0.00690	<u>CURVE 237*</u>		<u>CURVE 248*</u>	
608.2	0.00651	1254	0.0126	<u>CURVE 216*</u>		788.2	0.00384	1273	0.00774	<u>CURVE 238*</u>		<u>CURVE 249*</u>	

* 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 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>			
679.2	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		
743.2	0.0126	1373	0.00732	673.2	0.00628	699.2	0.00209	840.3	0.01146	1073	0.0188	1020	0.00402		
822.2	0.0130	<u>CURVE 250*</u>		873.2	0.00753	811.2	0.00216	<u>CURVE 266</u>		1273	0.0197	1114	0.06448		
<u>CURVE 244*</u>		1073	0.00837	1073	0.00920	921.2	0.00245	1033	0.00260	1473	0.0205	1208	0.00519		
1006	0.0134	1273	0.00397	1473	0.00962	1144	0.00310	473.2	0.0117	1673	0.0213	<u>CURVE 278*</u>			
1252	0.0142	1673	0.0100	1366	0.00392	1366	0.00392	673.2	0.0146	<u>CURVE 271</u>		967.7	0.00368		
<u>CURVE 245*</u>		<u>CURVE 255*</u>		<u>CURVE 261</u>		<u>CURVE 267*</u>		873.2	0.0167	409.3	0.0398	1045	0.00444		
1073	0.00586	<u>CURVE 256*</u>		<u>CURVE 262*</u>		1073	0.0184	1273	0.0184	565.4	0.0342	1134	0.00481		
1173	0.00669	422.9	0.00927	420.2	0.0240	1473	0.0218	1473	0.0218	755.4	0.0298	1229	0.00590		
1273	0.00732	520.9	0.0103	665.2	0.0216	1673	0.0226	1673	0.0226	883.2	0.0272	<u>CURVE 279*</u>			
1373	0.00879	807.7	0.0112	873.2	0.0204	1106	0.0195	<u>CURVE 267*</u>		1150	0.0213*	829.7	0.00393		
<u>CURVE 246*</u>		<u>CURVE 251*</u>		<u>CURVE 256*</u>		<u>CURVE 262*</u>		1167	0.0220*	1467	0.0190	996.7	0.00460		
732.6	0.0123	773.2	0.00523	377.1	0.0115	661.2	0.0229	473.2	0.0100	1561	0.0193*	1080	0.00498		
11145	0.0156	873.2	0.00607	504.3	0.0126	662.2	0.0216	673.2	0.0113	<u>CURVE 272*</u>		1159	0.00540		
1527	0.0173	973.2	0.00711	798.0	0.0149	763.2	0.0221	873.2	0.0126	<u>CURVE 280</u>		<u>CURVE 281</u>			
<u>CURVE 247*</u>		1073	0.00816	<u>CURVE 257*</u>		854.2	0.0203	1073	0.0134	582.2	0.0151	404.1	0.329		
873.2	0.00418	1173	0.00879	372.4	0.00564	665.1	0.0216	1273	0.0142	683.2	0.0163	550.9	0.280		
973.2	0.00502	1273	0.00962	501.6	0.00787	763.2	0.0221	1473	0.0151	752.2	0.0167	<u>CURVE 282</u>			
1073	0.00586	1373	0.0113	743.5	0.00939	889.2	0.0224	1673	0.0155	<u>CURVE 283*</u>		434.2	0.000920		
11173	0.00669	<u>CURVE 252*</u>		<u>CURVE 258*</u>		895.2	0.0225	<u>CURVE 265*</u>		393.0	0.00796	586.2	0.00113		
1273	0.00816	473.2	0.0197	644.2	0.00764	1035	0.0200	473.2	0.0100	610.4	0.0117	739.2	0.00130		
1373	0.0100	673.2	0.0218	699.2	0.00764	1126	0.0210	673.2	0.0126	742.1	0.0133	<u>CURVE 284*</u>			
<u>CURVE 248*</u>		873.2	0.0234	811.2	0.00764	<u>CURVE 263*</u>		873.2	0.0146	939.3	0.0155	<u>CURVE 285*</u>			
773.2	0.00418	1073	0.0251	921.2	0.00764	417.2	0.0230	1073	0.0155	1101	0.0176	432.2	0.00109		
873.2	0.00460	1273	0.0268	1033	0.00793	646.2	0.0215	1273	0.0172	<u>CURVE 275*</u>		586.2	0.00120		
973.2	0.00502	1473	0.0280	1144	0.00822	828.2	0.0210	1473	0.0176	<u>CURVE 276*</u>		751.2	0.00132		
1073	0.00565	1673	0.0293	1366	0.00894	1078	0.0188	1673	0.0205	974.2	0.00360	<u>CURVE 284*</u>			
1173	0.00628	<u>CURVE 253*</u>		<u>CURVE 259*</u>		1116	0.0184	<u>CURVE 270*</u>		1061	0.00406	446.2	0.00920		
1273	0.00732	473.2	0.0142	<u>CURVE 264*</u>		1313	0.0180	473.2	0.0146	1156	0.00448	530.2	0.00103		
1373	0.00879	673.2	0.0159	1313	0.0180	1373	0.016	673.2	0.0163	1256	0.00515	<u>CURVE 286*</u>			
<u>CURVE 249*</u>		873.2	0.0172	1373	0.0188	<u>CURVE 265*</u>		873.2	0.0176	1569	0.0223	<u>CURVE 287*</u>			
773.2	0.00335	1073	0.0180	644.2	0.00469	420.2	0.0240	1073	0.0184	974.2	0.00360	<u>CURVE 288*</u>			
873.2	0.00377	1273	0.0197	699.2	0.00469	420.2	0.0240	1273	0.0184	1061	0.00406	<u>CURVE 289*</u>			
973.2	0.00439	1473	0.0197	811.2	0.00476	420.2	0.0240	1473	0.0192	1156	0.00448	<u>CURVE 290*</u>			
1073	0.00502	1673	0.0201	921.2	0.00490	420.2	0.0240	1673	0.0205	1256	0.00515	<u>CURVE 291*</u>			
1173	0.00565	1773	0.0209	1033	0.00534	355.6	0.01012	<u>CURVE 270*</u>		473.2	0.0151	<u>CURVE 292*</u>			
1273	0.00628	<u>CURVE 254*</u>		1144	0.00570	419.4	0.01051	473.2	0.0151	673.2	0.0167	<u>CURVE 293*</u>			
1373	0.00879	1366	0.00649	1366	0.00649	<u>CURVE 265*</u>		673.2	0.0167	<u>CURVE 294*</u>		<u>CURVE 295*</u>			

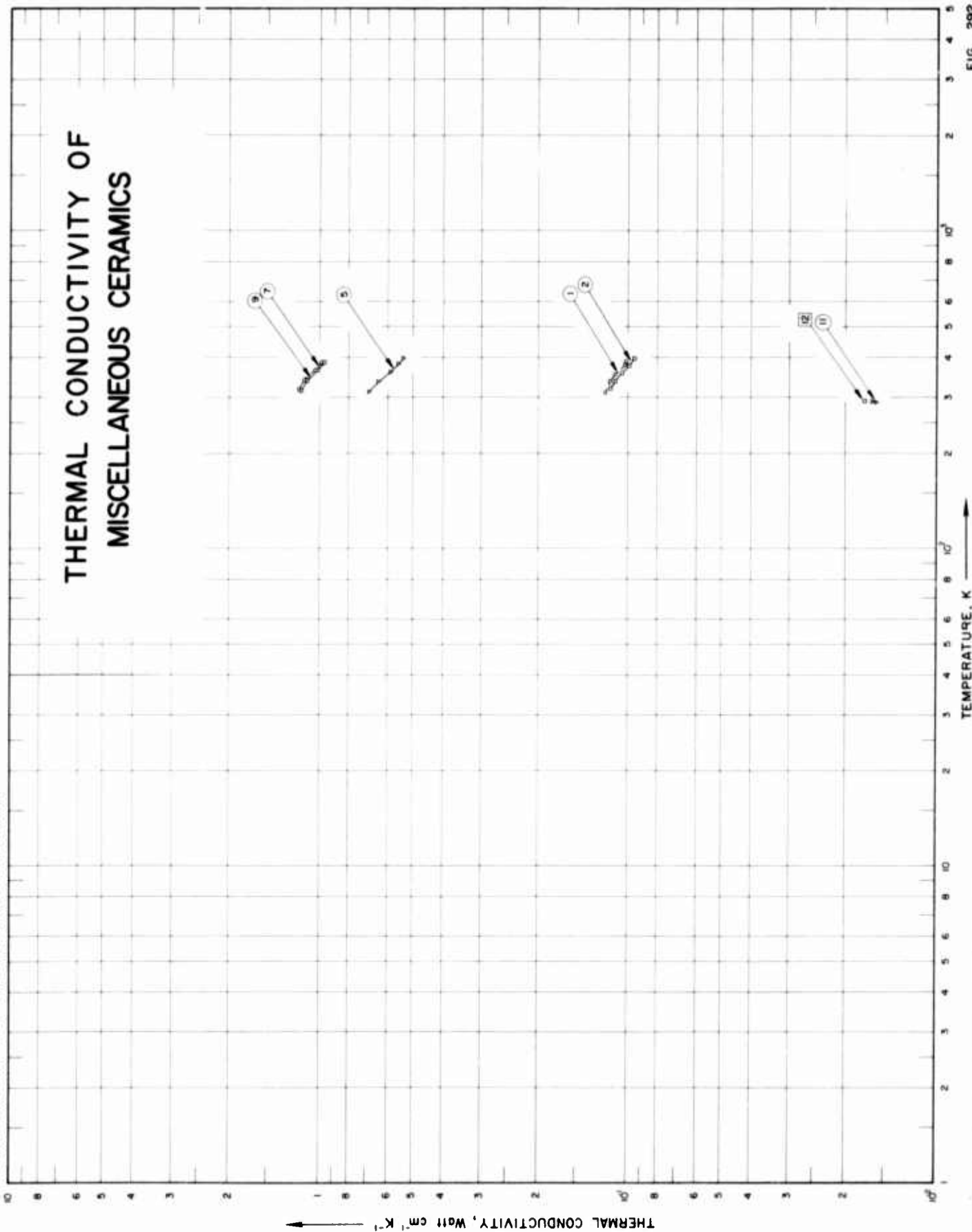
* Not shown on plot

DATA TABLE NO. 291 (continued)

T	k	CURVE 284 (cont.) [*]
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

FIGURE SHOWS ONLY 7 OF THE CURVES REPORTED IN TABLE



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	313-444	± 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} .

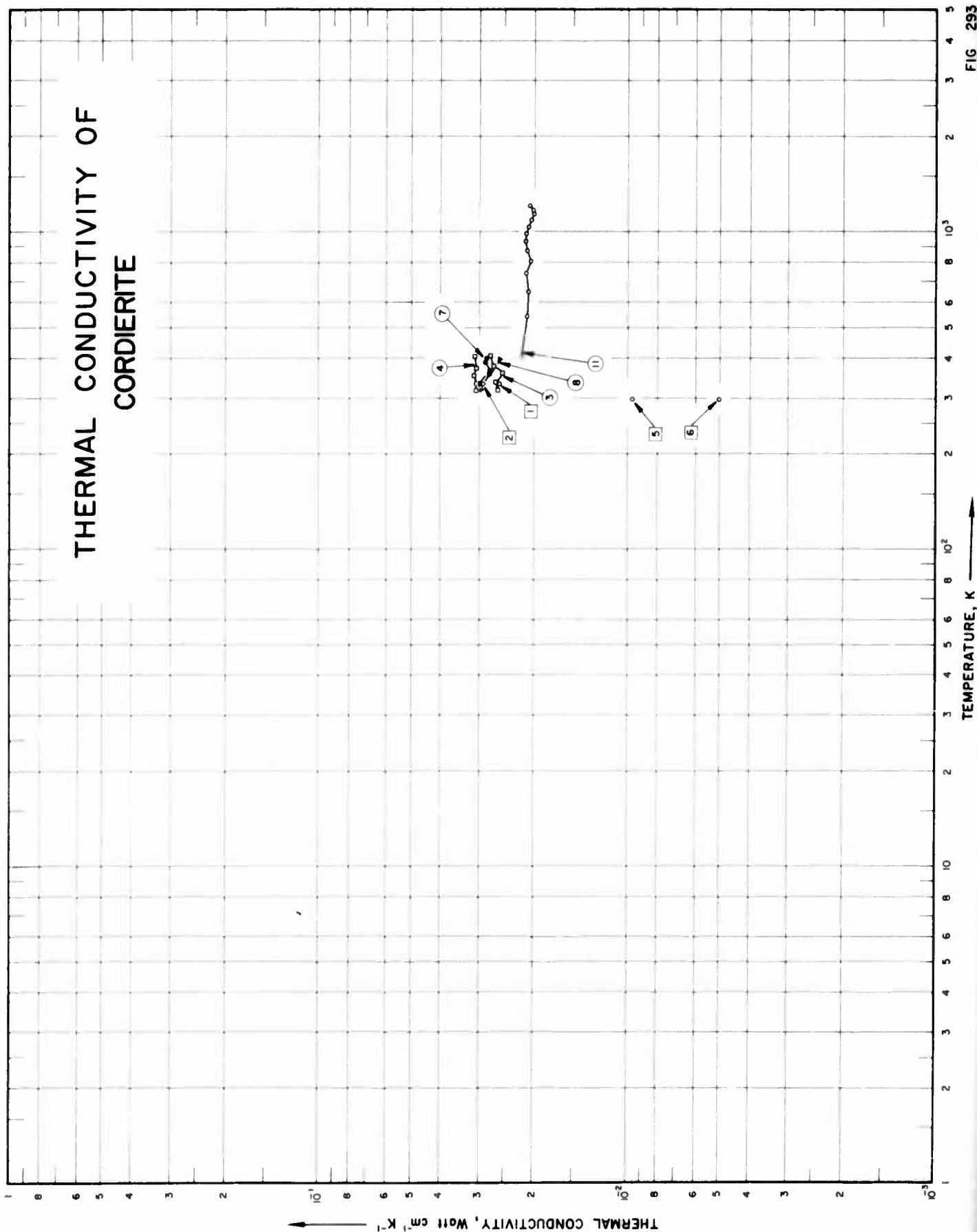
DATA TABLE NO. 292 THERMAL CONDUCTIVITY OF MISCELLANEOUS CERAMICS

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

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 7</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>		<u>CURVE 9*</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>		<u>CURVE 9</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>		<u>CURVE 10*</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	<u>CURVE 11</u>	
407.7	0.0941	290.6	0.0161
		290.7	0.0165
<u>CURVE 5</u>		<u>CURVE 12</u>	
312.3	0.686	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		

* Not shown on plot

THERMAL CONDUCTIVITY OF CORDIERITE



SPECIFICATION TABLE NO. 29. THERMAL CONDUCTIVITY OF CORDIERITE $4\text{Mg} \cdot \text{FeO} \cdot 4\text{Al}_2\text{O}_3 \cdot 10\text{SiO}_2 \cdot \text{H}_2\text{O}$

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 0.05%; flexural strength 11,200 psi; coefficient of expansion (25-700 C) 2.9×10^{-6} .
2	3		1953	333.2		Rutgers	Max. water absorption 0.05%; flexural strength 15,000 psi; coefficient of expansion (25-700 C) 2.3×10^{-6} .
3	68	C	1954	320-408		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	68	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	468	L	1950	336-399		G-10A	No details reported.
8	468, 407	L	1950	321-398		M-244-A	Commercial cordierite.
9	468, 407	L	1950	328-392		Commercial steatite	No details reported.
10	468, 407	L	1950	320-383		Steatite	No details reported.
11	282	R	1955	403-1208			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>		<u>CURVE 9*</u>	
333.2	0.0260	327.7	0.0311
		348.2	0.0309
<u>CURVE 2</u>		369.4	0.0306
		391.7	0.0294
333.2	0.0294	<u>CURVE 10*</u>	
<u>CURVE 3</u>		319.9	0.0245
320.0	0.0263	337.4	0.0266
337.9	0.0266	366.7	0.0278
360.6	0.0254	383.1	0.0263
378.1	0.0269	<u>CURVE 11</u>	
408.4	0.0277	403.2	0.0220
<u>CURVE 4</u>		543.2	0.0212
317.0	0.0309	648.2	0.0209
335.2	0.0308	743.2	0.0213
354.7	0.0315	808.2	0.0206
372.7	0.0308	873.2	0.0211
406.3	0.0312	938.2	0.0214
<u>CURVE 5</u>		988.2	0.0213
298.2	0.00972	1038.2	0.0209
<u>CURVE 6</u>		1088.2	0.0205
298.2	0.00502	1138.2	0.0201
<u>CURVE 7</u>		1173.2	0.0202
		1208.2	0.0207
<u>CURVE 8</u>			
336.4	0.0304		
365.2	0.0279		
387.1	0.0287		
399.0	0.0285		
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 LZ8	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

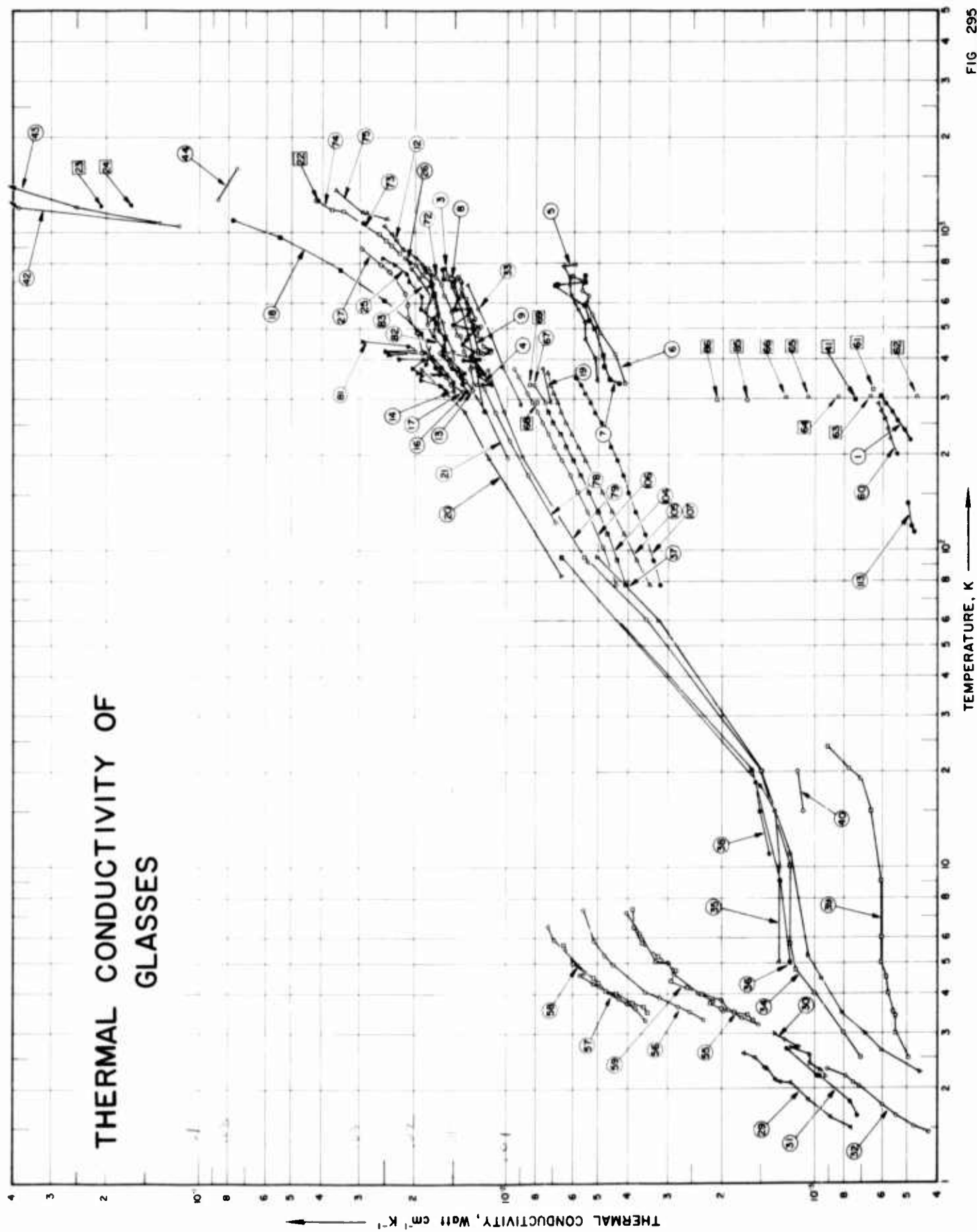
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻¹]

T k

CURVE 1*

293.2 0.00470

* No graphical presentation



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		Disk specimen; supplied by Pittsburgh Plate Glass Co.; measured under a load of ~23 psi; Armco iron used as comparative material.
9	33	C	1954	426-728		White plate glass		The above specimen measured with aluminum foil of 0.00025 in. thick adjacent to specimen surface; same comparative material.
10	33	C	1954	413-714		Solex 2808 plate glass		Similar to above but without the aluminum foil.
11	33	C	1954	421-731		Solex "S" plate glass		Similar to above.
12	33	C	1954	442-1059		Window glass; 248 Al-1		Similar to above but supplied by Corning Glass Works.
13	9	L	1953	319-420	±1	Borosilicate glass; 249 Al-1		0.497 in. in length, 0.410 in. in dia; density 2.42 g cm ⁻³ .
14	9	L	1953	319-410	±1	Lead glass; 250 Al-1		0.496 in. in length, 0.411 in. in dia; density 2.35 g cm ⁻³ .
15	9	L	1953	317-407	±1	Plate glass; 251 Al-1		0.494 in. in length, 0.409 in. in dia; density 3.04 g cm ⁻³ .
16	9	L	1953	316-411	±1	Pyrex glass; 252 Al-1		0.496 in. in length, 0.410 in. in dia; density 2.50 g cm ⁻³ .
17	9	L	1953	316-412	±1	Silica glass		0.497 in. in length, 0.410 in. in dia; density 2.22 g cm ⁻³ .
18	34	C	1943	377-1092		Soda glass		Pure; fused; 1 cm cubic specimen; 18-8 stainless steel used as comparative material.
19	44	F	1914	293, 373		Quartz glass		0.332 cm dia x 6.0 cm long; density 2.59 g cm ⁻³ .
20	22	L	1911	83-373		Borosilicate crown glass		No details reported.
21	22	L	1911	195-373		Green glass		No details reported.
22	113	L	1954	1268.2				0.6 Fe ₂ O 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
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 19.8 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 $0.160\text{--}0.176 \text{ g cm}^{-3}$; 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 $\pm$ 0.00003 at 23 C for the D lines of sodium (5893 $\text{\AA}$); specimen was somewhat strained; after the thermal conductivity measurement the glass was annealed and the index of refraction decreased to 1.47211 $\pm$ 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	1.500 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	78-373		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
<u>CURVE 35</u>		<u>CURVE 42</u>		<u>CURVE 51*</u>		<u>CURVE 56</u>		<u>CURVE 59 (cont.)</u>		<u>CURVE 68</u>		<u>CURVE 74</u>		<u>CURVE 77 (cont.)*</u>	
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	0.00325	386.2	0.0147	613.2	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	478.2	0.0164	703.2	0.0200*		
18.0	0.00150	1600	0.465*	573.2	0.0144	3.9	0.0032	6.5	0.00385	573.2	0.0226	833.2	0.0218*		
95.0	0.00650	1800	0.436*			4.05	0.00355	7.4	0.0039	333.2	0.00843	863.2	0.0218*		
<u>CURVE 36</u>		<u>CURVE 43</u>		<u>CURVE 52*</u>		<u>CURVE 57</u>		<u>CURVE 60</u>		<u>CURVE 70*</u>		<u>CURVE 75</u>		<u>CURVE 79</u>	
5.0	0.00120	1073	0.136	366.5	0.0123	5.3	0.0048	200.0	0.000548	388.2	0.0153	553.2	0.0239	123.2	0.0069
9.0	0.00130	1200	0.252	477.6	0.0126	5.9	0.0052	222.2	0.000562	482.2	0.0177	613.2	0.0249	173.2	0.0085
20.25	0.00160	1540	0.558*	588.8	0.0130	7.4	0.0056	239.2	0.000577	625.2	0.0250	791.2	0.0339	223.2	0.0094
95.0	0.00650			699.8	0.0132			255.5	0.000591	751.2	0.0331	843.2	0.0372	273.2	0.0109
<u>CURVE 37</u>		<u>CURVE 44</u>		<u>CURVE 53*</u>		<u>CURVE 58</u>		<u>CURVE 61</u>		<u>CURVE 71*</u>		<u>CURVE 76*</u>		<u>CURVE 80*</u>	
2.25	0.00045	1273	0.0872	366.5	0.0118	3.6	0.0038	272.1	0.000606	386.2	0.0147	553.2	0.0226*	92	0.0054
2.65	0.00060	1600	0.0755	477.6	0.0126	3.75	0.00405	288.1	0.000620	478.2	0.0164	613.2	0.0251*	198	0.0089
3.0	0.00068			588.8	0.0133	4.3	0.0052	310.9	0.000649	573.2	0.0223	703.2	0.0284	275	0.0103
3.5	0.00081			699.8	0.0138	4.6	0.0055			611.2	0.0223	791.2	0.0292	372	0.0116
4.5	0.00095	298.2	0.0126			4.7	0.0055	<u>CURVE 62</u>	<u>CURVE 72</u>			843.2	0.0360	423	0.0121*
4.5	0.00095					5.9	0.0070	303.2	0.000465	386.2	0.0126	903.2	0.0482	482	0.0126*
5.25	0.00105			423.2	0.0149	6.5	0.0073			478.2	0.0144	933.2	0.0523	523	0.0131*
11.0	0.00120			473.2	0.0192			<u>CURVE 63</u>	<u>CURVE 73</u>			1103.2	0.0616		
20.25	0.00150*			573.2	0.0201	3.5	0.0035	303.2	0.000651	373.2	0.0134	1153.2	0.0616		
60.0	0.0032	298.2	0.0126	673.2	0.0213	3.65	0.0036			378.2	0.0133	1163.2	0.0616		
95.0	0.0050			773.2	0.0222	3.75	0.0039	303.2	0.000651	405.2	0.0136*				
<u>CURVE 38</u>		<u>CURVE 47*</u>		873.2	0.0230	4.0	0.0044	<u>CURVE 64</u>	<u>CURVE 74</u>	473.2	0.0144				
11.0	0.00140	298.2	0.0146	973.2	0.0239	4.1	0.00475			478.2	0.0146				
15.0	0.00150			1073.2	0.0247	4.35	0.0050	303.2	0.000848	568.2	0.0153				
18.5	0.00155					4.5	0.0052	<u>CURVE 65</u>	<u>CURVE 75</u>	633.2	0.0161				
20.25	0.00160*					5.0	0.0060			683.2	0.0165				
<u>CURVE 39*</u>		<u>CURVE 48*</u>				5.7	0.0065	303.2	0.00106	723.2	0.0172				
298.2	0.0117	298.2	0.0146			3.2	0.00115	<u>CURVE 66</u>	<u>CURVE 76*</u>	773.2	0.0182				
<u>CURVE 40</u>		<u>CURVE 49*</u>		3.35	0.00175	3.35	0.00175								
298.2	0.0117	366.5	0.0114	3.55	0.00193	3.55	0.00193	303.2	0.00126	513.2	0.0165*				
<u>CURVE 41</u>		477.6	0.0126	3.8	0.00202	3.8	0.00202	<u>CURVE 67</u>	<u>CURVE 77*</u>	533.2	0.0167*				
15.0	0.00109	588.8	0.0135	4.0	0.0024	4.0	0.0024			565.2	0.0172*				
20.0	0.00113	699.8	0.0144	4.6	0.0029	4.6	0.0029	293.2	0.00747	585.2	0.0172*				
<u>CURVE 42</u>				5.0	0.003	5.0	0.003	333.2	0.00814	686.2	0.0184*				
15.0	0.00109			5.05	0.0033	3.55	0.00198			776.2	0.0201*				
20.0	0.00113			6.2	0.0037	3.6	0.00203			803.2	0.0209				
<u>CURVE 43</u>				7.2	0.00408	3.75	0.00215			1083.2	0.0293				
366.5	0.0125	366.5	0.0125	3.8	0.00215	3.8	0.00215								
477.6	0.0135	477.6	0.0135	4.0	0.00235	4.0	0.00235								
588.8	0.0145	588.8	0.0145	4.2	0.0026	4.2	0.0026								
699.8	0.0157	699.8	0.0157	4.4	0.00295	4.4	0.00295								

* Not shown on plot

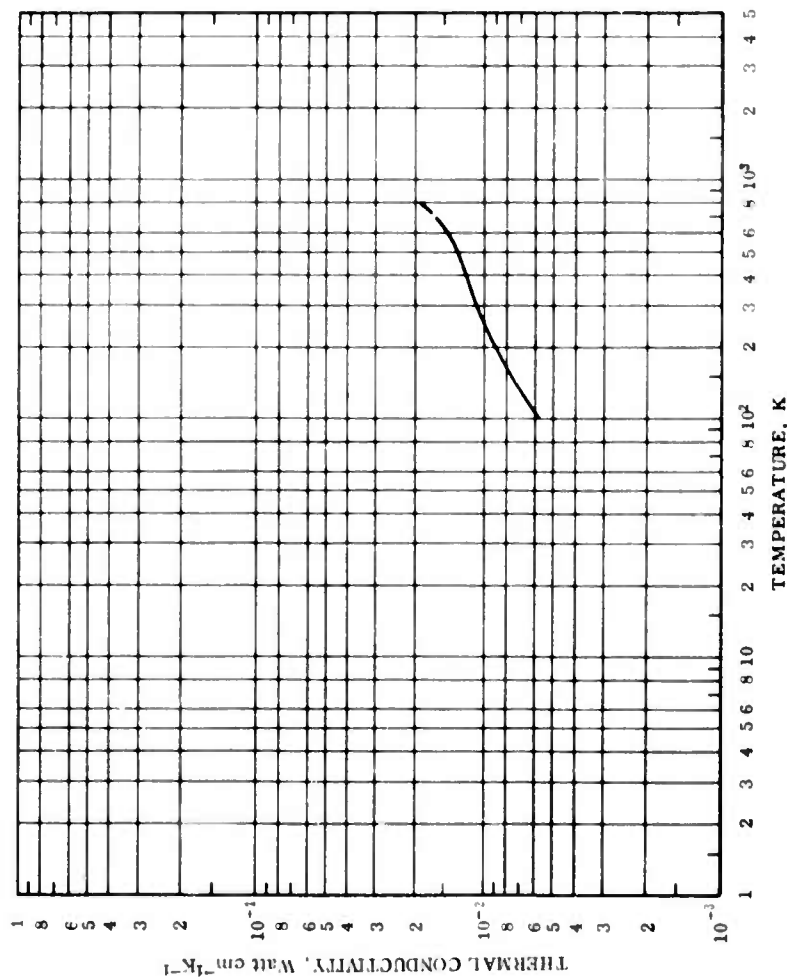
DATA TABLE NO. 295 (continued)

CURVE 81 (cont.)				CURVE 85				CURVE 92 (cont.)				CURVE 95				CURVE 99				CURVE 102				CURVE 105 (cont.)				CURVE 108																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k	T	k																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
362	0.0159*	298.2	0.00167	133.2	0.00828	497.2	0.01736	368.2	0.0135	433.2	0.0155	213.2	0.00582	78.2	0.00460	366	0.0195	153.2	0.00833	536.2	0.01866	413.2	0.0144	233.2	0.00611	93.2	0.00485	373	0.0164*	173.2	0.00929	570.2	0.01632	467.2	0.0144	253.2	0.00636	113.2	0.00519	374	0.0201*	193.2	0.00975	615.2	0.01778	503.2	0.0143	273.2	0.00661	133.2	0.00552	376	0.0162*	298.2	0.00209	213.2	0.01013	675.2	0.02038	527.2	0.0146	293.2	0.00678	153.2	0.00582	394	0.0204*	233.2	0.01046	716.2	0.02075	603.2	0.0159	788.2	0.0205	313.2	0.00699	173.2	0.00611	395	0.0214*	253.2	0.01079	760.2	0.02163	622.2	0.0153	848.2	0.0251	333.2	0.00715	193.2	0.00649	400	0.0187	298.2	0.00293	293.2	0.01130	826.2	0.02159	645.2	0.0180	363.2	0.00732	213.2	0.00669	401	0.0226	313.2	0.01151	848.2	0.02159	645.2	0.0180	363.2	0.00732	213.2	0.00669	402	0.0182*	333.2	0.01172	848.2	0.02159	645.2	0.0180	363.2	0.00732	213.2	0.00669	403	0.0246	353.2	0.01192	848.2	0.02159	645.2	0.0180	363.2	0.00732	213.2	0.00669	404	0.0219*	363.2	0.01201	848.2	0.02159	645.2	0.0180	363.2	0.00732	213.2	0.00669	405	0.0186	78.2	0.00519	93.2	0.00561	672.2	0.01824	486.2	0.0111	509.2	0.0180	568.2	0.0182	78.2	0.00439	406	0.0196	113.2	0.00615	724.2	0.01987	488.2	0.0134	519.2	0.00728	233.2	0.00761	78.2	0.00460	407	0.0192	133.2	0.00669	724.2	0.01987	488.2	0.0134	519.2	0.00728	233.2	0.00761	78.2	0.00460	408	0.0211*	153.2	0.00724	724.2	0.01987	488.2	0.0134	519.2	0.00728	233.2	0.00761	78.2	0.00460	409	0.0293	173.2	0.00770	724.2	0.01987	488.2	0.0134	519.2	0.00728	233.2	0.00761	78.2	0.00460																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
CURVE 82				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				CURVE 101				CURVE 102				CURVE 103				CURVE 104				CURVE 105				CURVE 106				CURVE 107				CURVE 108				CURVE 109				CURVE 110				CURVE 111				CURVE 112				CURVE 113				CURVE 114				CURVE 115				CURVE 116				CURVE 117				CURVE 118				CURVE 119				CURVE 120				CURVE 121				CURVE 122				CURVE 123				CURVE 124				CURVE 125				CURVE 126				CURVE 127				CURVE 128				CURVE 129				CURVE 130				CURVE 131				CURVE 132				CURVE 133				CURVE 134				CURVE 135				CURVE 136				CURVE 137				CURVE 138				CURVE 139				CURVE 140				CURVE 141				CURVE 142				CURVE 143				CURVE 144				CURVE 145				CURVE 146				CURVE 147				CURVE 148				CURVE 149				CURVE 150				CURVE 151				CURVE 152				CURVE 153				CURVE 154				CURVE 155				CURVE 156				CURVE 157				CURVE 158				CURVE 159				CURVE 160				CURVE 161				CURVE 162				CURVE 163				CURVE 164				CURVE 165				CURVE 166				CURVE 167				CURVE 168				CURVE 169				CURVE 170				CURVE 171				CURVE 172				CURVE 173				CURVE 174				CURVE 175				CURVE 176				CURVE 177				CURVE 178				CURVE 179				CURVE 180				CURVE 181				CURVE 182				CURVE 183				CURVE 184				CURVE 185				CURVE 186				CURVE 187				CURVE 188				CURVE 189				CURVE 190				CURVE 191				CURVE 192				CURVE 193				CURVE 194				CURVE 195				CURVE 196				CURVE 197				CURVE 198				CURVE 199				CURVE 200				CURVE 201				CURVE 202				CURVE 203				CURVE 204				CURVE 205				CURVE 206				CURVE 207				CURVE 208				CURVE 209				CURVE 210				CURVE 211				CURVE 212				CURVE 213				CURVE 214				CURVE 215				CURVE 216				CURVE 217				CURVE 218				CURVE 219				CURVE 220				CURVE 221				CURVE 222				CURVE 223				CURVE 224				CURVE 225				CURVE 226				CURVE 227				CURVE 228				CURVE 229				CURVE 230				CURVE 231				CURVE 232				CURVE 233				CURVE 234				CURVE 235				CURVE 236				CURVE 237				CURVE 238				CURVE 239				CURVE 240				CURVE 241				CURVE 242				CURVE 243				CURVE 244				CURVE 245				CURVE 246				CURVE 247				CURVE 248				CURVE 249				CURVE 250				CURVE 251				CURVE 252				CURVE 253				CURVE 254				CURVE 255				CURVE 256				CURVE 257				CURVE 258				CURVE 259				CURVE 260				CURVE 261				CURVE 262				CURVE 263				CURVE 264				CURVE 265				CURVE 266				CURVE 267				CURVE 268				CURVE 269				CURVE 270				CURVE 271				CURVE 272				CURVE 273				CURVE 274				CURVE 275				CURVE 276				CURVE 277				CURVE 278				CURVE 279				CURVE 280				CURVE 281				CURVE 282				CURVE 283				CURVE 284				CURVE 285				CURVE 286				CURVE 287				CURVE 288				CURVE 289				CURVE 290				CURVE 291			

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



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.

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
800	(0.0189) ‡	(1.09)	980.3

* 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
<u>CURVE 1*</u>	
326.6	0.0323
362.3	0.0301
445.6	0.0287

* 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]

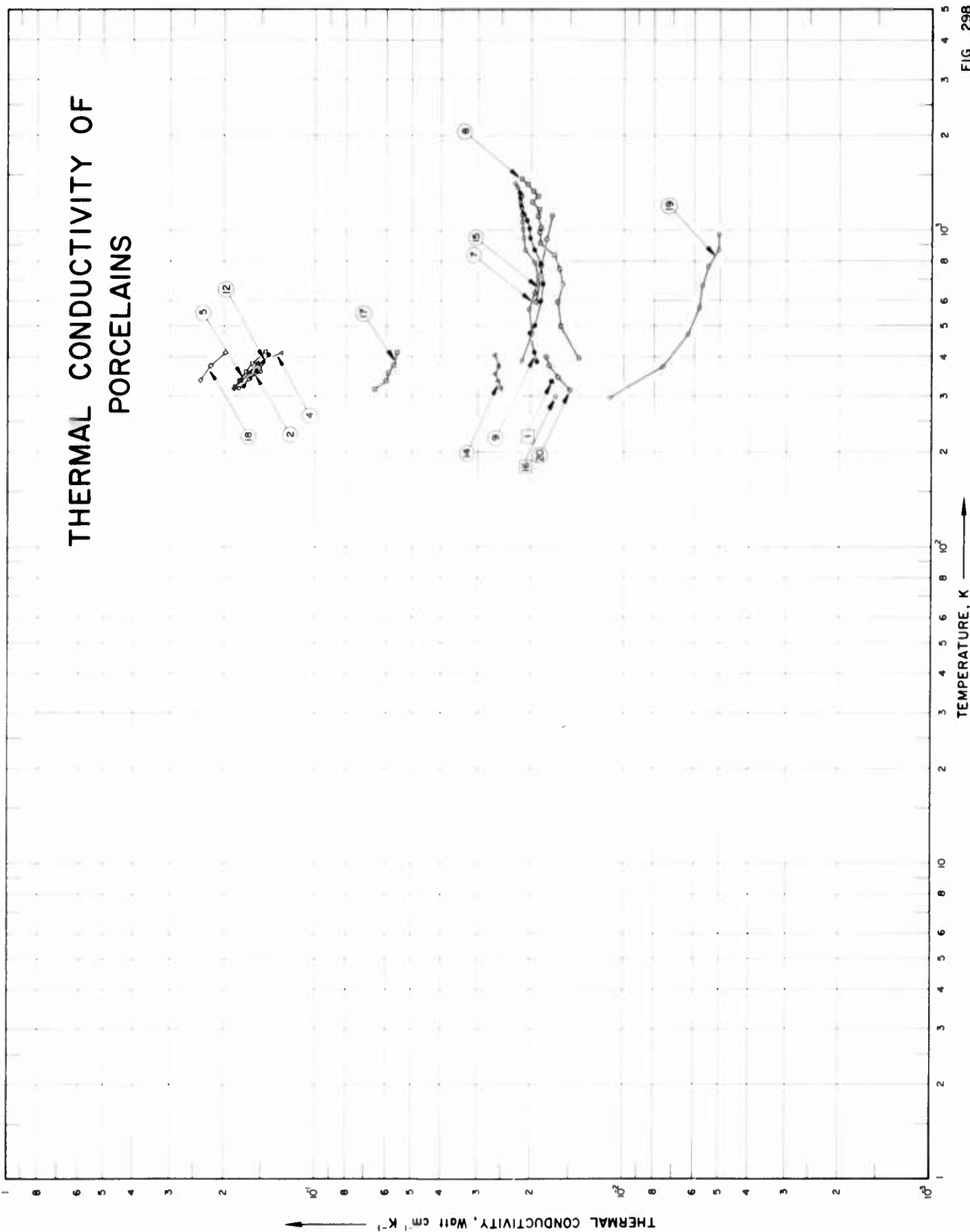
T k

CURVE 1*

328.6	0.0266
357.8	0.0268
391.5	0.0277

* No graphical presentation

FIGURE SHOWS ONLY 15 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 295 THERMAL CONDUCTIVITY OF PORCELAINS

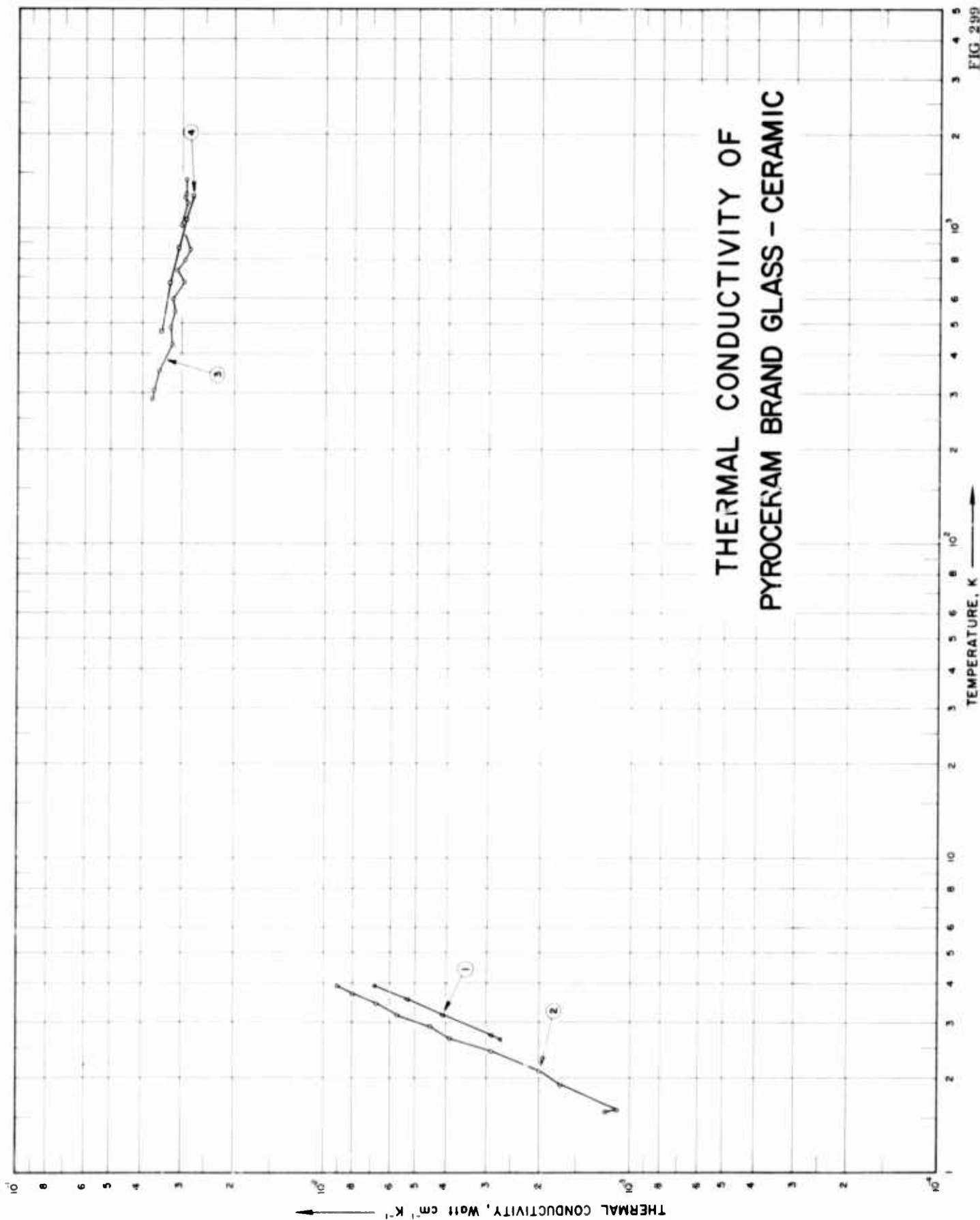
[For Data Reported in Figure and Table No. 298]

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	323-2			Maximum water absorption 0.05%.
2	42	L	1953	319-377	±3	6 M-1	High Al_2O_3 ; 0.349 in. in dia and 0.500 in. in length.
3	42	L	1953	316-410	±3	6 P-1	High Al_2O_3 ; 0.450 in. in dia and 0.496 in. in length.
4	42	L	1953	318-412	±3	6 J-1	High Al_2O_3 ; 0.250 in. in dia and 0.250 in. in length.
5	42	L	1953	320-416	±3	6 K-1	High Al_2O_3 ; 0.249 in. in dia and 0.500 in. in length.
6	42	L	1953	313-387	±3	6 L-1	High Al_2O_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 Nocar 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_2O_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_2O_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_2O_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	152	L	1956	298-2		Porcelain 576	Exposed with 6 x 10 ¹⁰ 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.

[illegible]

* Not shown on plot

THERMAL CONDUCTIVITY OF PYROCEKAM BRAND GLASS - CERAMIC



SPECIFICATION TABLE NO. 299 THERMAL CONDUCTIVITY OF PYROCERAM BRAND GLASS-CERAMIC

[For Data Reported in Figure and Table No. 299]

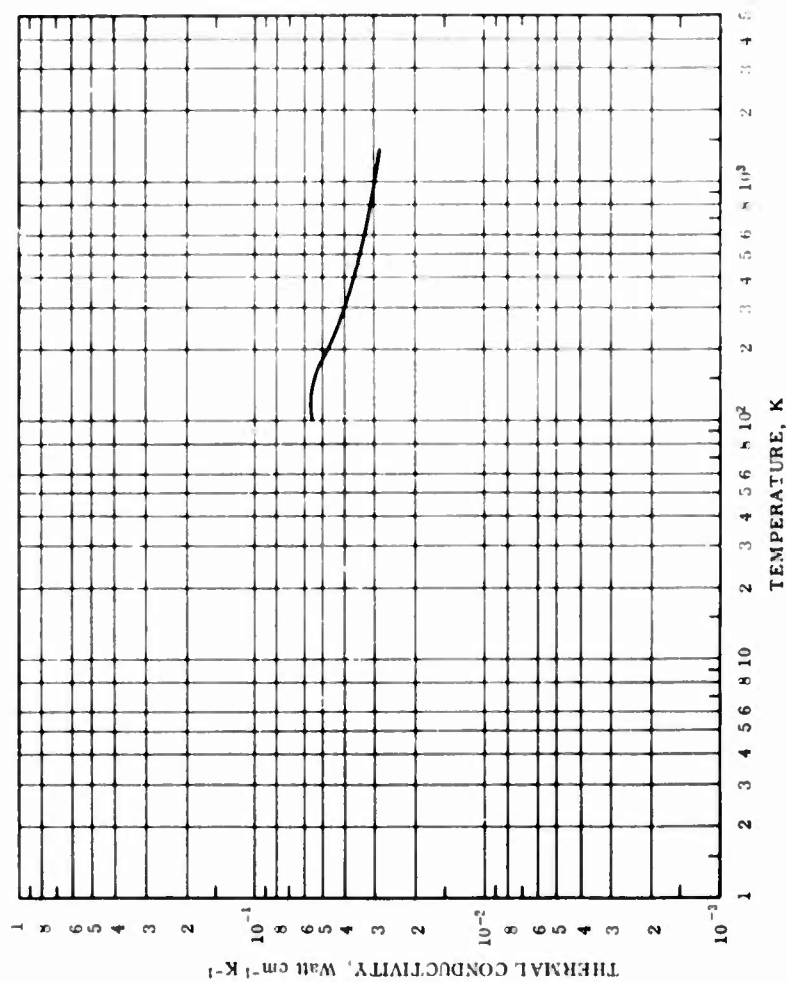
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	306	L	1962	2.7-3.9		Pyroceram 9606 (a)	From Corning Glass Works; specimen cross section 0.334 cm x 1.666 cm.
2	306	L	1962	1.6-3.9		Pyroceram 9606 (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
CURVE 1		CURVE 4	
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
CURVE 2			
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		
CURVE 3			
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		

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.

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

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

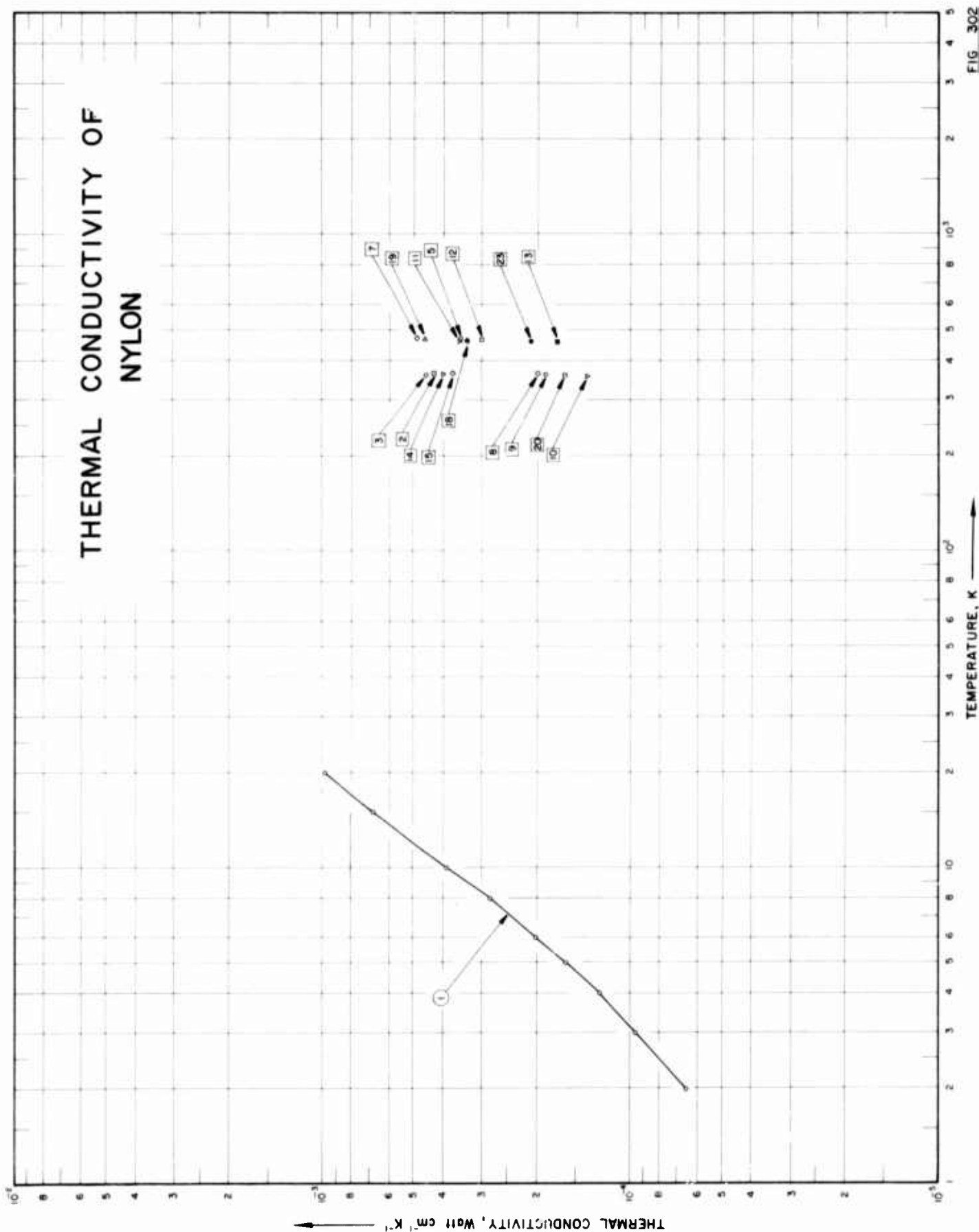
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	525		1951	293.2			Foamed; density 0.018-0.022 g cm ⁻³ ; porosity 97-98%.
2	525		1951	178.2			The above specimen measured at one atm.
3	525		1951	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



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 psi 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 psi 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 psi 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 psi 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 psi 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 psi 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 psi 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 psi 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 38.6 psi 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 0.00456 in.; thickness under load 0.00573 in.; measured under 15.7 psi pressure, 35.6 psi 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 psi 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 psi 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 psi 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 psi 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⁻¹ K⁻¹]

T	k	T	k	T	k		
<u>CURVE 1</u>		<u>CURVE 10</u>		<u>CURVE 21*</u>			
2	0.000065	357.9	0.000138	357.6	0.000168		
3	0.000095	<u>CURVE 11</u>		<u>CURVE 22*</u>			
4	0.000125	466.0	0.000358	359.0	0.000137		
5	0.000160	<u>CURVE 12</u>		<u>CURVE 23</u>			
6	0.000200	467.1	0.000301	462.6	0.000209		
8	0.000280	<u>CURVE 13</u>		<u>CURVE 24*</u>			
10	0.000390	459.0	0.000173	460.4	0.000208		
15	0.000680	<u>CURVE 14</u>		<u>CURVE 25*</u>			
20	0.000980	362.6	0.000403	458.9	0.000171		
<u>CURVE 2</u>		<u>CURVE 15</u>					
366.4	0.000431	365.2	0.000376				
<u>CURVE 3</u>		<u>CURVE 16*</u>					
361.6	0.000457	364.1	0.000412				
<u>CURVE 4*</u>		<u>CURVE 17*</u>					
363.7	0.000436	464.5	0.000294				
<u>CURVE 5</u>		<u>CURVE 18</u>					
469.8	0.000355	462.0	0.000337				
<u>CURVE 6*</u>		<u>CURVE 19</u>					
469.5	0.000358	467.7	0.000460				
<u>CURVE 7</u>		<u>CURVE 20</u>					
471.2	0.000488	359.0	0.000163				
<u>CURVE 8</u>							
364.8	0.000199						
<u>CURVE 9</u>							
362.1	0.000187						

* 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
<u>CURVE 1*</u>	
293.5	0.0032
<u>CURVE 2*</u>	
310.4	0.00323
<u>CURVE 3*</u>	
310.2	0.00294
<u>CURVE 4*</u>	
296.6	0.00455

* No graphical presentation

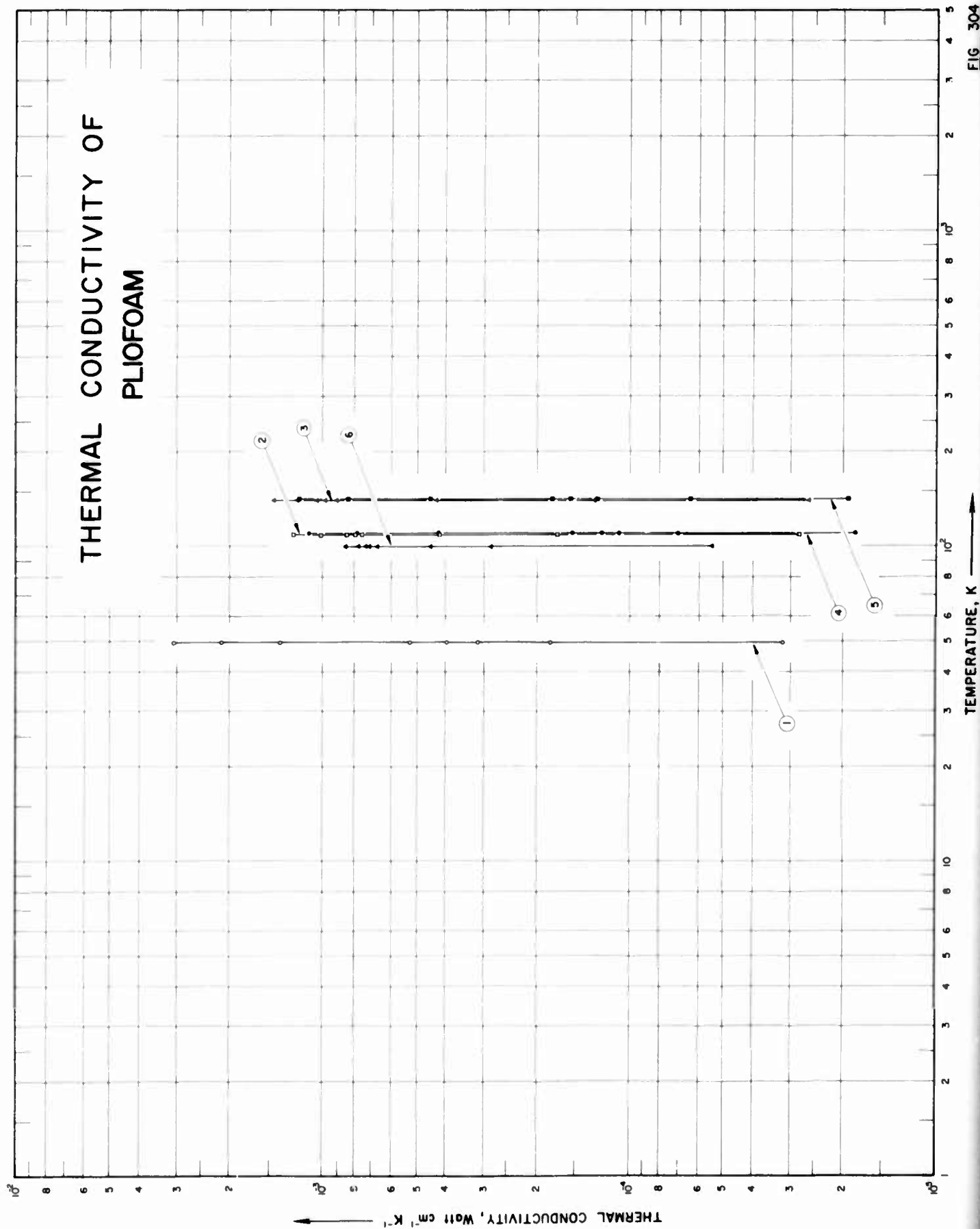


FIG 304

SPECIFICATION TABLE NO. 304 THERMAL CONDUCTIVITY OF PIKFOAM

[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	109.8			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.

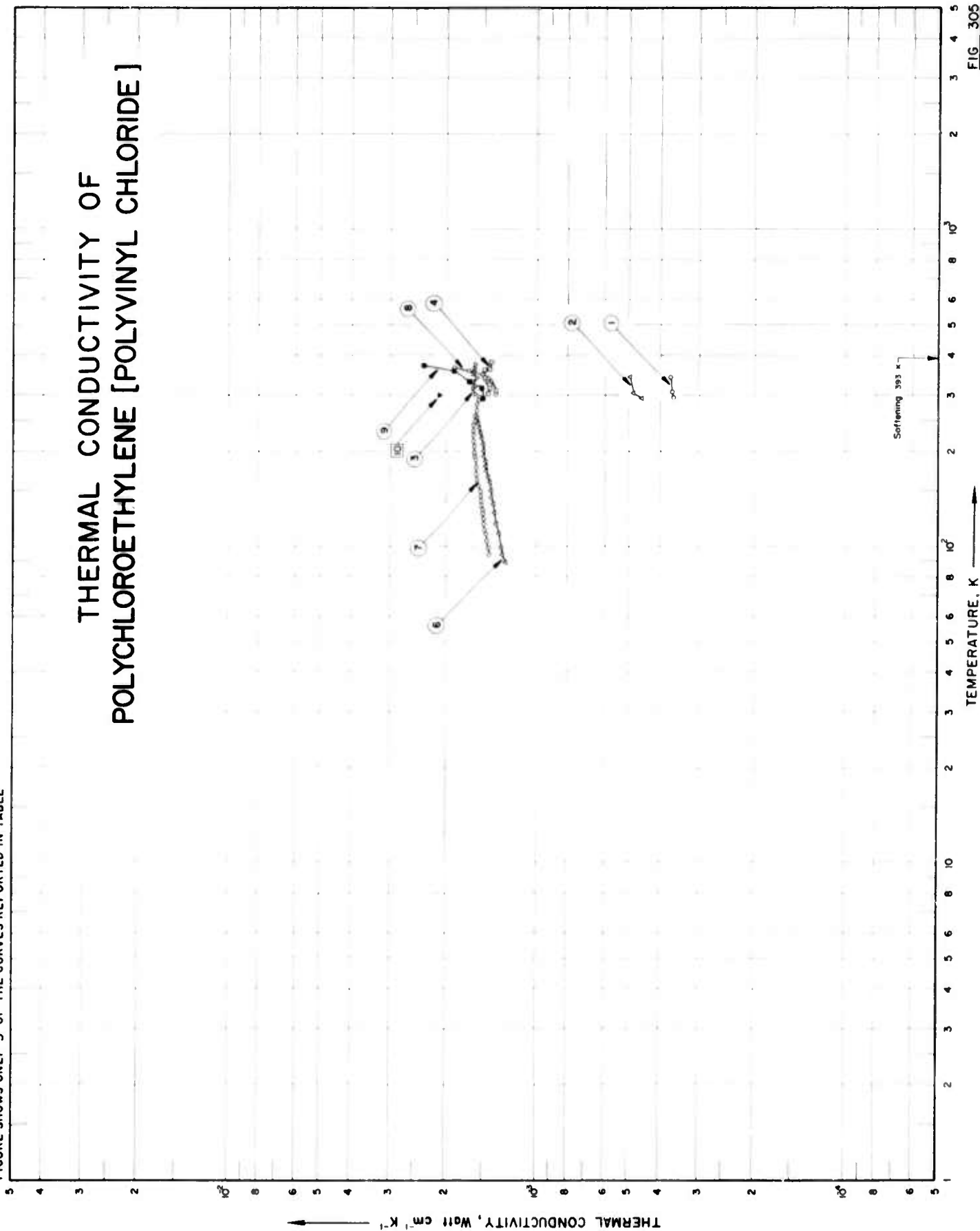
DATA TABLE NO. 304 THERMAL CONDUCTIVITY OF PLIO' OAM

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

p(mm Hg)	k	p(mm Hg)	k
CURVE 1 T = 49.4K		CURVE 4 (cont.)	
0.0059	0.0000318	390.0	0.000782
0.181	0.000181	591.5	0.00111
1.17	0.000315	CURVE 5	
16.0	0.000395	T = 141 K	
50.0	0.000528	0.0056	0.0000193
224.0	0.00139	0.108	0.0000643
405.0	0.00214	0.122	0.000128
595.0	0.00307	15.0	0.000156
CURVE 2		48.0	0.000179
T = 109.8K		196.5	0.000456
0.005	0.0000281	384.5	0.000833
0.112	0.000173	585.5	0.00120
0.946	0.000420	CURVE 6	
17.0	0.000757	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		69.9	0.000719
T = 140.9K		230.2	0.000738
0.0049	0.0000262	441.3	0.000778
0.103	0.000131	625.3	0.000853
0.956	0.000433	CURVE 4	
17.0	0.000910	T = 110.1K	
54.5	0.000987	0.0055	0.0000183
205.0	0.00105	0.181	0.0000706
417.5	0.00123	1.37	0.000109
601.0	0.00146	15.5	0.000124
CURVE 4		50.5	0.000154
T = 110.1K		195.5	0.000425

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	303-380			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	362-368		PVC - I	Molecular weight 1000.
9	388	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.

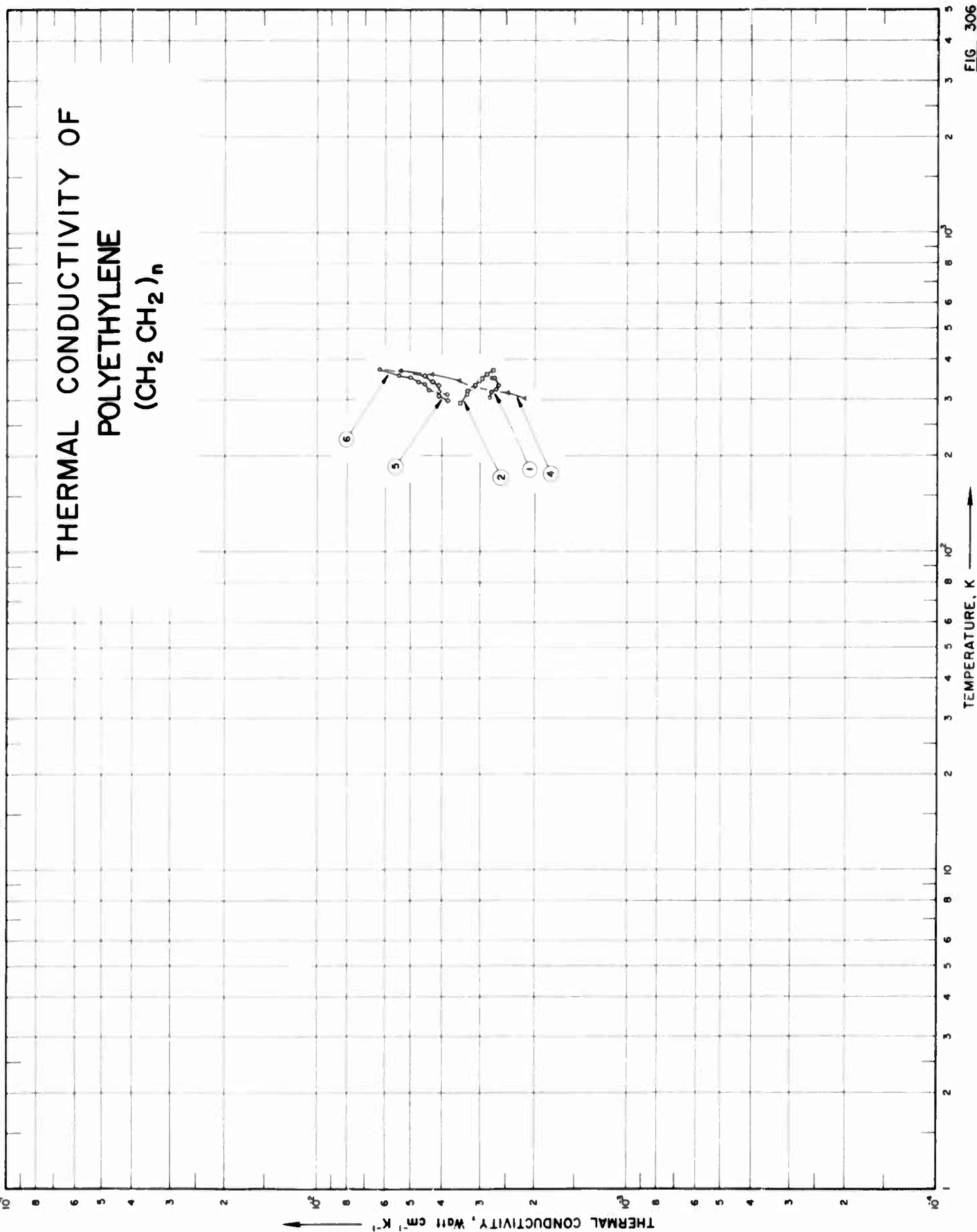
DATA TABLE NO. 305 THERMAL CONDUCTIVITY OF POLYCHLOROETHYLENE (POLYVINYL CHLORIDE)

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

T	k	CURVE 1	T	k	CURVE 6 (cont.)	T	k	CURVE 6 (cont.)	T	k	CURVE 7 (cont.)	T	k	CURVE 7 (cont.)	T	k	CURVE 8
296.3	0.000366		103.4	0.00134*	255.5	0.00157	118.6	0.00150	266.6	0.00158*	303	0.00138					
308.8	0.000369		109.1	0.00135	257.9	0.00158*	123.2	0.00150	268.8	0.00158	310	0.00138					
342.7	0.000374		113.7	0.00136*	260.1	0.00157*	127.3	0.00151	271.5	0.00157*	315	0.00138*					
			118.6	0.00137	263.4	0.00158*	131.8	0.00153	272.5	0.00158*	328	0.00143*					
			123.2	0.00138*	265.6	0.00158*	136.1	0.00153	276.4	0.00157*	333	0.00142					
			127.0	0.00139	273.1	0.00159*	139.6	0.00153	278.7	0.00157*	339	0.00146					
294.8	0.000459		131.3	0.00140*	276.2	0.00159*	144.2	0.00154	281.7	0.00157	349	0.00151					
305.8	0.000485		136.1	0.00140	283.3	0.00160*	148.1	0.00154	283.9	0.00156*	357	0.00167					
342.1	0.000498		139.4	0.00141*	286.7	0.00160*	151.5	0.00155*	286.6	0.00156*	368	0.00185					
			143.1	0.00142	287.7	0.00159*	156.3	0.00156	289.1	0.00156	368	0.00185					
			146.7	0.00142*	291.8	0.00160*	158.9	0.00156*	291.3	0.00155*							
			150.8	0.00143	295.7	0.00160*	162.6	0.00157	294.2	0.00155*							
			154.4	0.00144*	303.4	0.00161*	166.6	0.00157*	296.5	0.00155*							
303.2	0.00159		159.0	0.00144	308.0	0.00161*	169.6	0.00158	298.8	0.00155*							
316.2	0.00163		161.8	0.00145*	311.1	0.00161*	173.2	0.00158*	301.4	0.00155*							
320.2	0.00159		166.2	0.00146	313.2	0.00161*	177.0	0.00158	304.2	0.00154*							
331.2	0.00163		170.1	0.00146*	317.3	0.00161*	181.0	0.00158*	306.1	0.00154*							
340.2	0.00157		173.1	0.00147	319.5	0.00160*	183.6	0.00159*	308.4	0.00154*							
351.2	0.00163		179.0	0.00148*	322.2	0.00160*	188.0	0.00159	310.7	0.00153*							
355.7	0.00161		183.3	0.00149*	324.1	0.00160*	190.7	0.00159	312.7	0.00153*							
364.2	0.00161		186.9	0.00148	326.3	0.00160*	193.7	0.00160	316.7	0.00153*							
374.2	0.00160*		190.3	0.00149*	329.1	0.00160*	197.5	0.00161	317.3	0.00153*							
376.7	0.00159		193.2	0.00150	331.3	0.00161*	201.2	0.00161*	320.7	0.00152*							
			196.7	0.00150	333.8	0.00160*	203.7	0.00161	322.7	0.00151*							
			200.1	0.00150	336.3	0.00161*	207.2	0.00161	324.8	0.00152*							
303.2	0.00146		203.2	0.00151*	338.8	0.00160*	209.8	0.00161*	326.8	0.00151*							
315.2	0.00144		206.0	0.00151*	341.8	0.00160*	213.4	0.00162*	329.2	0.00151*							
325.2	0.00144		209.3	0.00151*	344.2	0.00159*	216.3	0.00162*	332.7	0.00151*							
331.2	0.00146		212.1	0.00152*	348.7	0.00159*	219.4	0.00162*	335.1	0.00150*							
339.2	0.00149		215.5	0.00152*	350.3	0.00160*	223.1	0.00162*	336.8	0.00151*							
341.2	0.00149*		218.9	0.00153	352.6	0.00160*	225.6	0.00162	339.4	0.00150*							
360.2	0.00149		221.9	0.00153	354.6	0.00159*	228.7	0.00162*	341.7	0.00150*							
362.2	0.00144		224.5	0.00153*	356.2	0.00159*	231.2	0.00162*	345.1	0.00150*							
380.2	0.00142		227.6	0.00154	359.1	0.00158*	233.4	0.00162	349.1	0.00150*							
			229.9	0.00154*	362.6	0.00158*	236.9	0.00162*	350.6	0.00149*							
			232.7	0.00155*			239.9	0.00161*	352.7	0.00149*							
			236.5	0.00155			242.7	0.00162	354.5	0.00149*							
			239.1	0.00155*			245.3	0.00161*	356.7	0.00149*							
			241.4	0.00156*			247.9	0.00160	359.4	0.00148*							
			244.2	0.00156			252.8	0.00160*	362.1	0.00148*							
			246.6	0.00156*			255.7	0.00160*									
89.1	0.00128		250.3	0.00156*			258.8	0.00160									
94.6	0.00131		252.9	0.00157*			260.9	0.00159*									
99.0	0.00133						263.7	0.00159*									

* Not shown on Plot

FIGURE SHOWS ONLY 5 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 306 THERMAL CONDUCTIVITY OF POLYETHYLENE $(CH_2CH_2)_n$

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

T	k	T	k
<u>CURVE 1</u>		<u>CURVE 5 (cont.)</u>	
305.2	0.00280	356	0.00452
317.2	0.00278	372	0.00636 [*]
322.2	0.00268		
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>		<u>CURVE 7[*]</u>	
293.2	0.00349	308	0.00335
313.2	0.00331	319	0.00385
319.2	0.00320	324	0.00300
326.2	0.00316	335	0.00402
328.2	0.00314 [*]	348	0.00402
328.7	0.00316 [*]	374	0.00494
333.2	0.00310	393	0.00561
344.7	0.00301		
347.2	0.00295 [*]		
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	323, 373			Rod 44.71 x 240 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⁻¹ K⁻¹]

T	k
CURVE 1*	
323.2	0.00259
373.2	0.00267

No graphical presentation

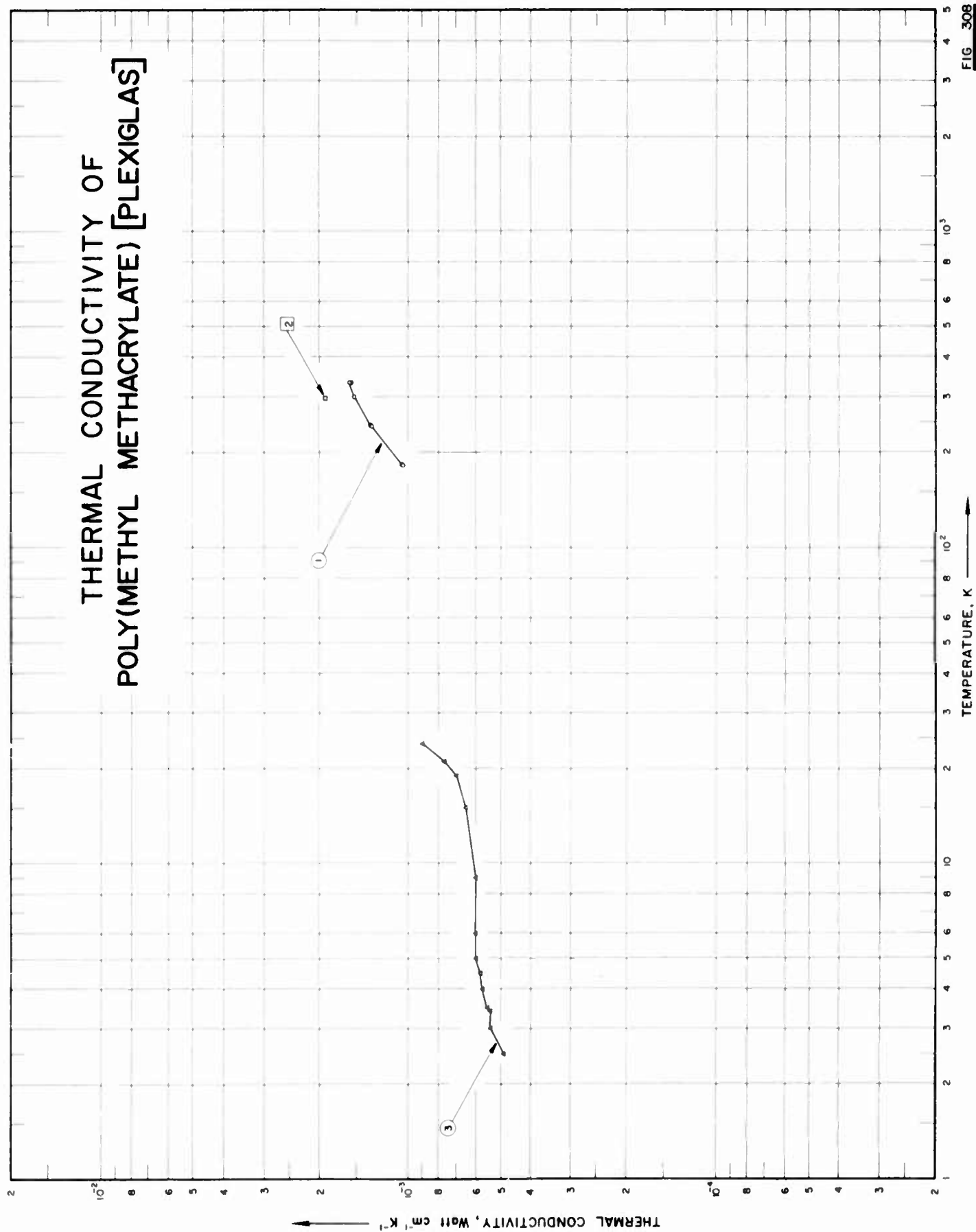


FIG. 308

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]

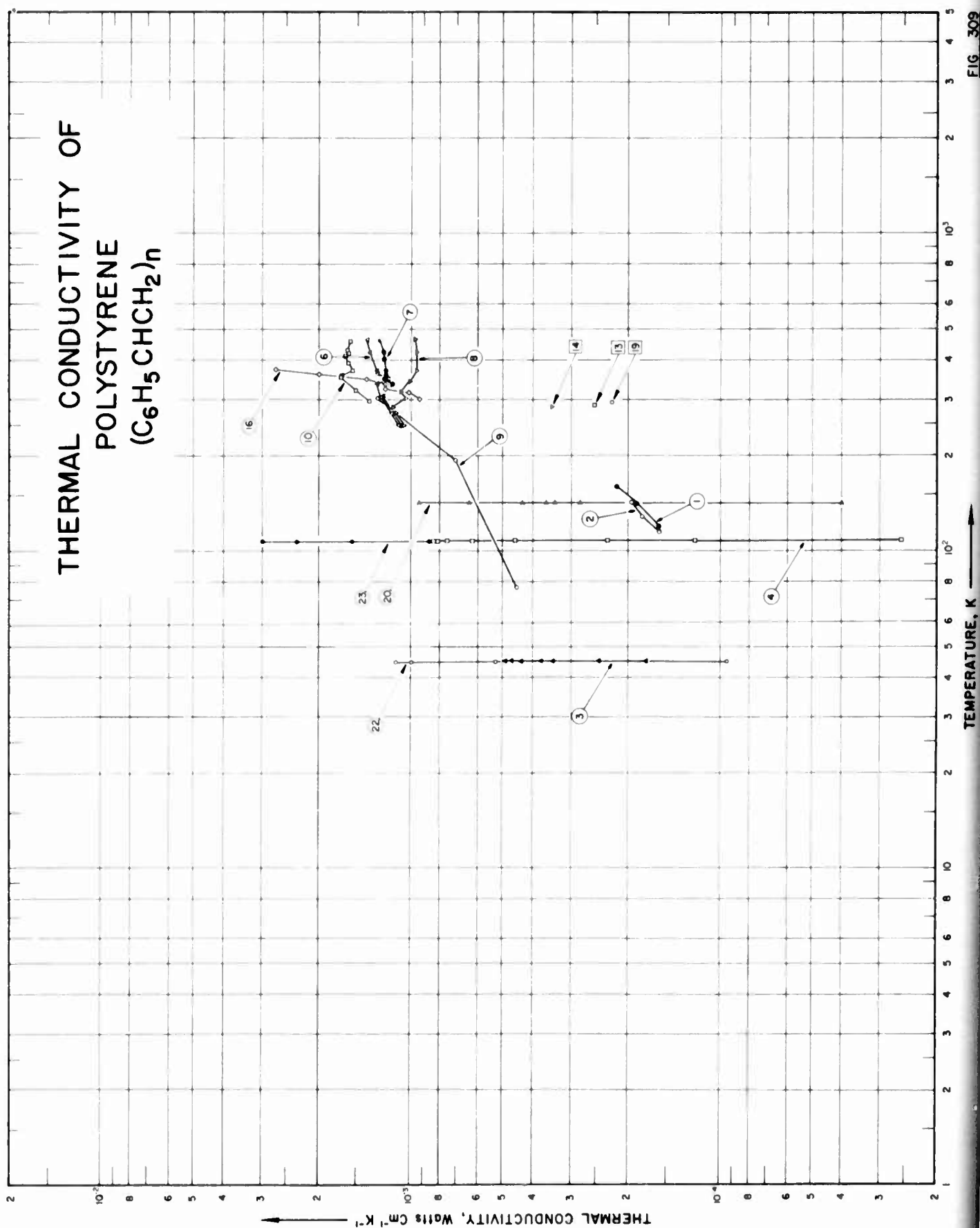
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	111	L	1952	183-332		AN-P-44A	Aircraft quality; supplied by Rohm and Haas Chemical Co.
2	117	P	1955	298.2	1-2		Specimen thickness 10.0 mm; density 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 ($C_6H_5CHCH_2$)_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 0.0240 g cm ⁻³
2	43	L	1954	115-143			Expanded board specimen; flameproofed; density 0.0288 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 521.6 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 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 0.9807 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 560; density reported as 1.071, 1.068, 1.065, 1.095, 1.095, 1.044, 1.014, and 0.0694 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.

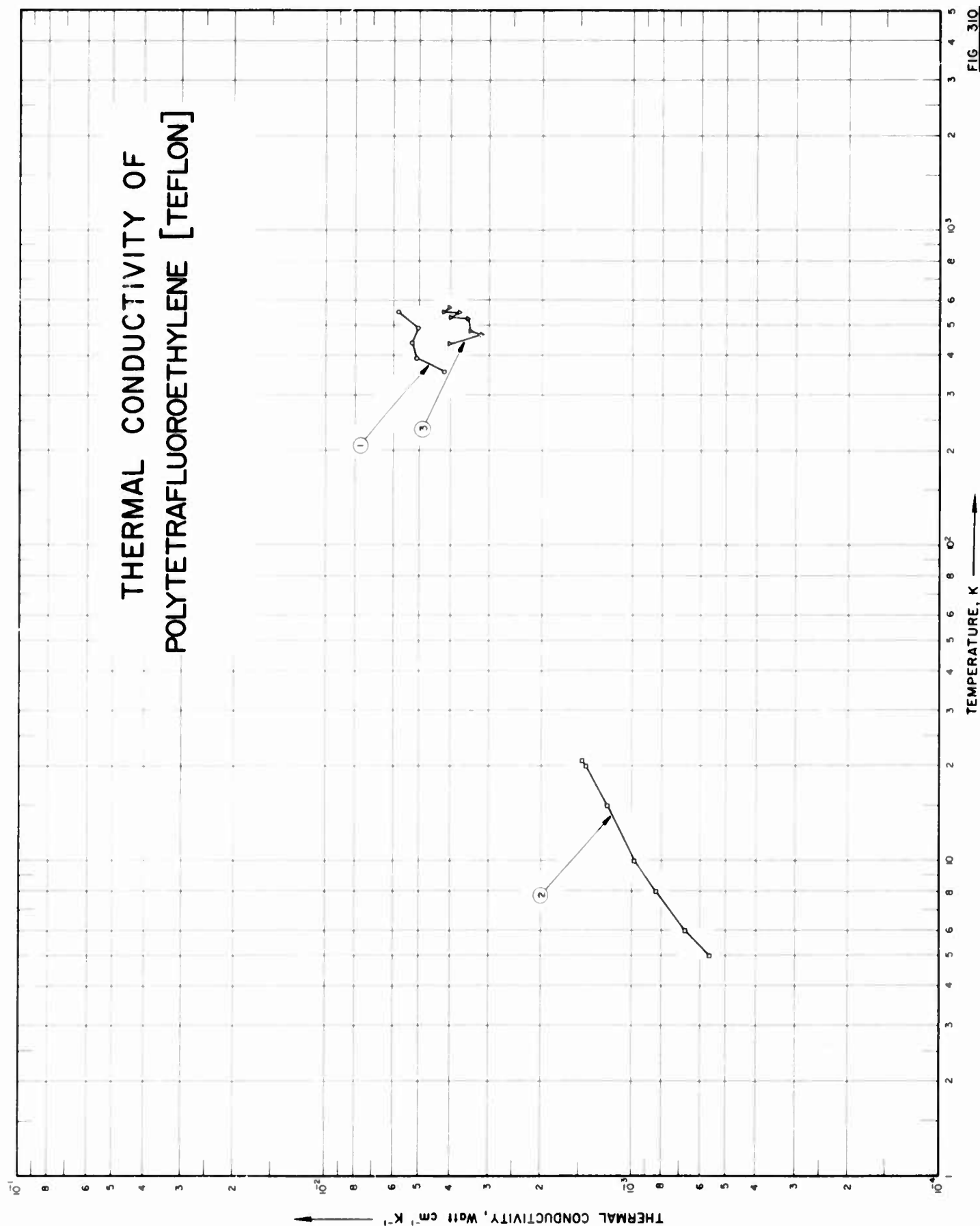
SPECIFICATION TABLE NO. 309 (continued)

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 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 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	288-386	+ 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 ($C_6H_5CHCH_2$)_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	259.8	0.000252	287.7	0.00153	CURVE 26*		
141	0.000187	590.5	0.000284	194.3	0.00071			299.1	0.00155	T = 45.09 K		
160	0.000216			305.4	0.00128	CURVE 14			0.00157	0.495	0.000190	
CURVE 2												
115	0.000159			298.2	0.00136	CURVE 15*			0.00158	1.732	0.000243	
129	0.000190	249.2	0.00109	323.2	0.00151			313.4	0.00157	18.95	0.000343	
143	0.000195	273.2	0.00116	355.2	0.00169	CURVE 16			0.00158	49.3	0.000376	
CURVE 3												
p (mm Hg)	k	306.2	0.00126	361.2	0.00167	298	0.000921	327.7	0.00161	203.65	0.000432	
		339.2	0.00129	373.2	0.00155	315	0.00113	347.6	0.00162	421.45	0.000465	
		350.2	0.00118	394.2	0.00159	326	0.00121	352.7	0.00163	621.8	0.000489	
		363.2	0.00128	413.2	0.00163	333	0.00130	CURVE 21*				
		373.2	0.00129	423.2	0.00159	348	0.00134	T = 109 K				
		423.2	0.00136	433.2	0.00160	353	0.00134	0.032	0.000843	Pressure of nitrogen (mm Hg)		
		466.2	0.00139	460.2	0.00157	358	0.00176	0.322	0.00104	CURVE 27*		
CURVE 4												
0.495	0.000174					368	0.00243	2.43	0.00111	T = 109.09 K		
1.73	0.000243	CURVE 7			CURVE 11*			14.1	0.00170	0.0241	0.0000157	
18.9	0.000343	249.2	0.00108	301.2	0.00135	CURVE 16			52.8	0.00163	0.0000652	
49.3	0.000376	273.2	0.00115	323.2	0.00146	303	0.000921	196.6	0.000749	1.23	0.000126	
203.6	0.000432	323.2	0.00126	342.2	0.00155	317	0.00100	395.8	0.00114	17.9	0.000208	
421.4	0.000465	339.2	0.00115	352.2	0.00157	324	0.00121	603.9	0.00146	62.8	0.000236	
621.6	0.000489	349.2	0.00121	373.2	0.00158	338	0.00121	CURVE 22				
CURVE 5												
0.0251	0.0000256	358.2	0.00120	378.2	0.00159	350	0.00138	0.0194	0.0000944	0.0149	0.000157	
0.264	0.000121	403.2	0.00123	398.2	0.00161	353	0.00167*	0.238	0.000271	0.0148	0.000151	
0.778	0.000230	423.2	0.00123	419.2	0.00156	363	0.00197	2.65	0.000351	0.0153	0.000153	
7.68	0.000455	466.2	0.00126	458.2	0.00159	375	0.00268	17.7	0.000368	0.0158	0.000158	
CURVE 6												
60.5	0.000622					CURVE 17*			61.3	0.000380	0.0155	0.000155
242.6	0.000753	249.2	0.00106	302.2	0.00132	296.6	0.000337	197.8	0.000523	0.0157	0.000157	
452.9	0.000807	273.2	0.00113	307.2	0.00134	CURVE 18*			416.9	0.000983	350.6	0.00158
632.6	0.000836	285.2	0.00115	313.2	0.00137	CURVE 19			645.4	0.00111	356.3	0.00160
CURVE 5*												
		303.2	0.00103	323.2	0.00141	297.8	0.000268	CURVE 23				
		319.2	0.00107	332.2	0.00146	T = 109.2 K			0.056	0.000174*	0.0251	0.0000256
		343.2	0.00100	347.2	0.00148			0.265	0.000557*	0.264	0.000121	
		373.2	0.00095	367.2	0.00149	CURVE 19			2.33	0.000717*	0.778	0.000230
		423.2	0.00095	381.2	0.00156	296.7	0.000223	15.4	0.000829*	7.68	0.000455	
		466.2		389.2	0.00151			52.5	0.000857	60.5	0.000622	
				393.2	0.00157			195.8	0.00155	242.6	0.000753	
				415.2	0.00156			394.8	0.00231	452.9	0.000807	
				423.2	0.00156			601.5	0.00294	632.6	0.000833	
				458.2	0.00159							

* Not shown on plot



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
<u>CURVE 1</u>	
358.7	0.00426
394.3	0.00511
442.1	0.00529
494.3	0.00505
553.7	0.00584
<u>CURVE 2</u>	
5	0.00056
6	0.00067
8	0.00083
10	0.00098
15	0.0012
20	0.00142
20.8	0.00146
<u>CURVE 3</u>	
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.

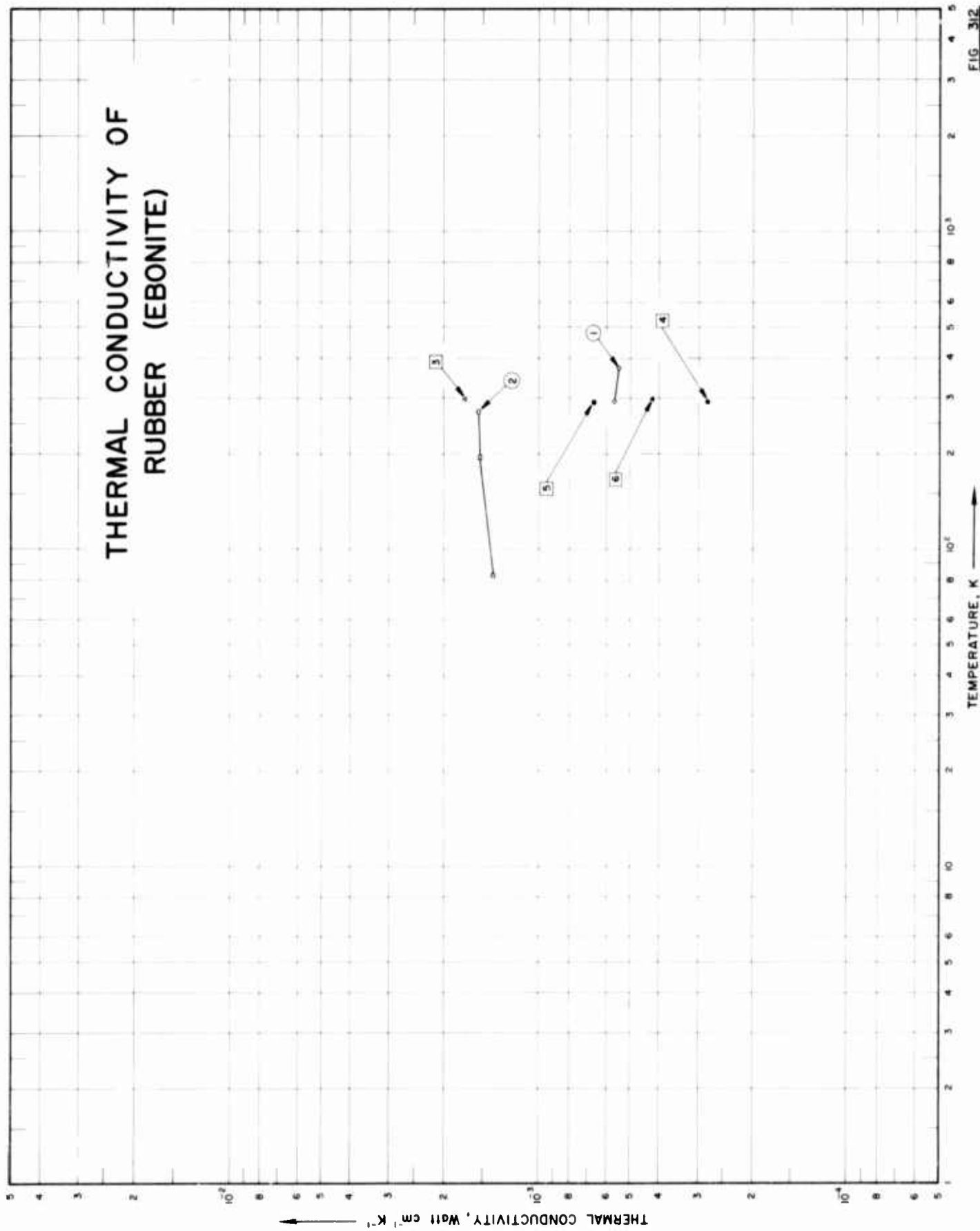
DATA TABLE NO. 311 THERMAL CONDUCTIVITY OF POLYTRIFLUOROCHLOROETHYLENE

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

T	k
CURVE 1*	
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

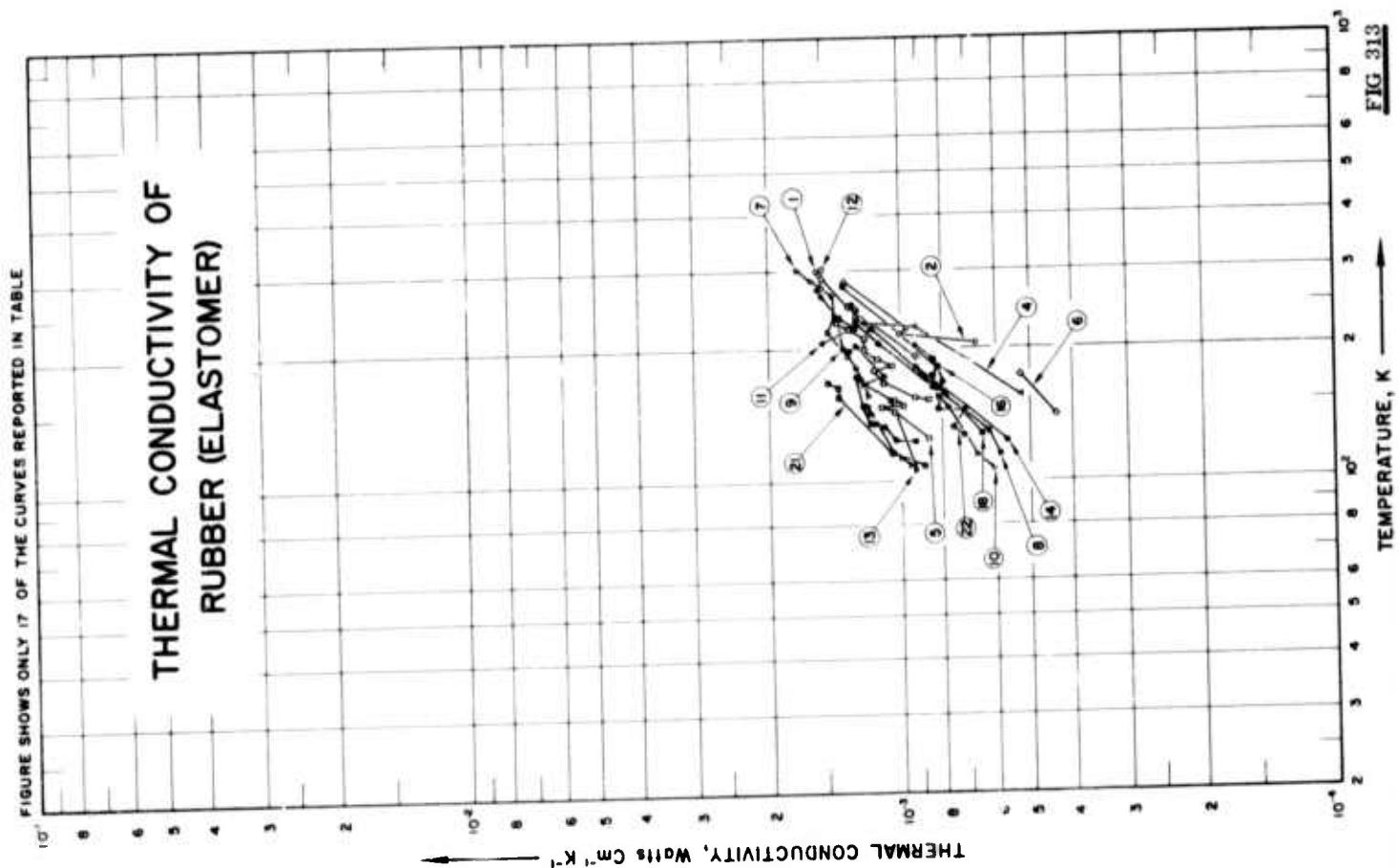
THERMAL CONDUCTIVITY OF RUBBER (EBONITE)



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 0.317 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.



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
193.2	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.

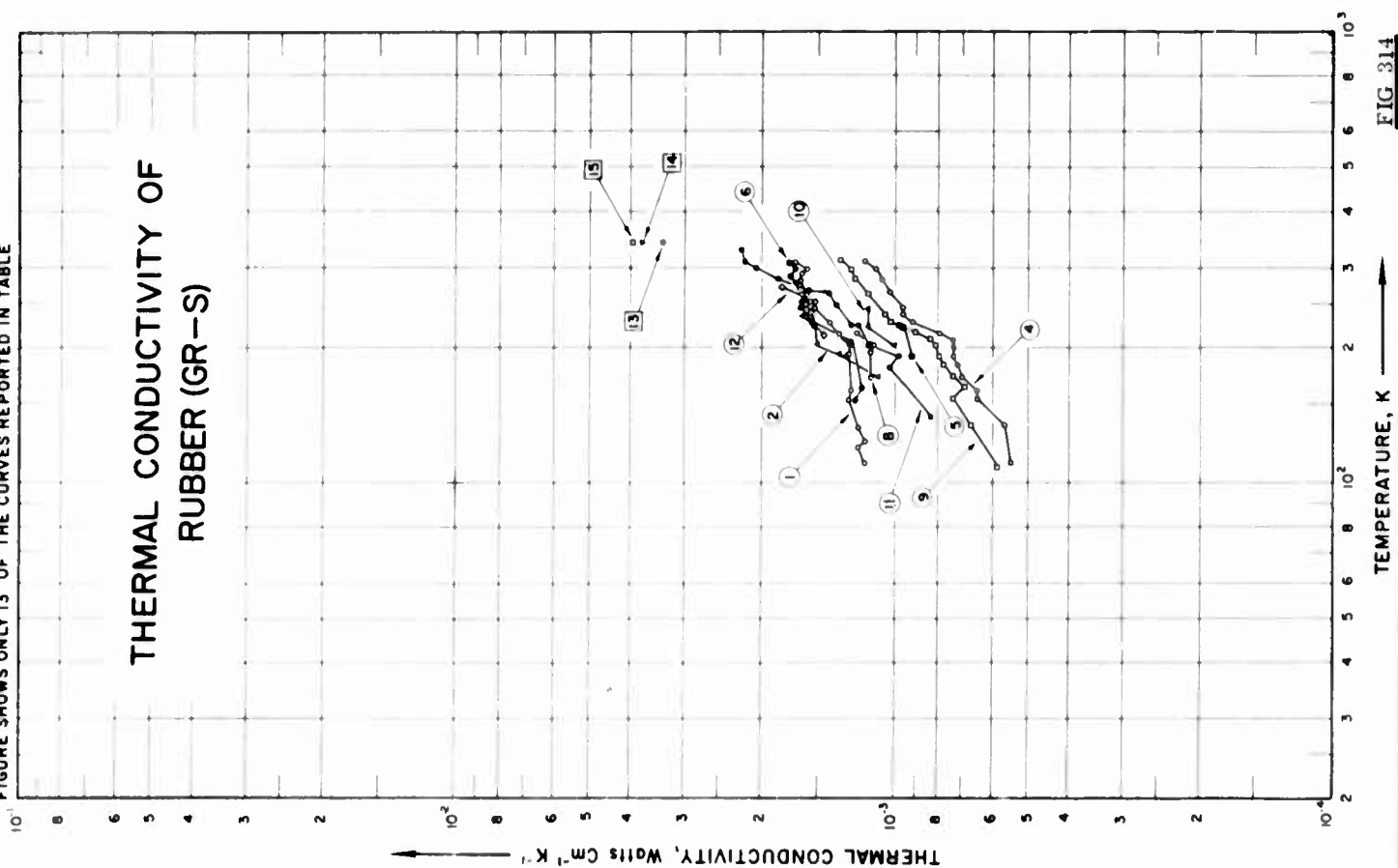
DATA TABLE NO. 313 THERMAL CONDUCTIVITY OF RUBBER (ELASTOMER)

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻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	163.2	0.000837	108.2	0.000879
301.2	0.00155			173.2	0.000523	155.2	0.000816	173.2	0.000837	118.2	0.00105 *
		CURVE 2		CURVE 7		CURVE 11					
205.2	0.000669			109.2	0.000941	203.2	0.00134 *	CURVE 17 *		CURVE 22	
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	CURVE 12					
205.2	0.00117			217.2	0.00146	191.2	0.000920				
243.2	0.00138			239.2	0.00140	249.2	0.00130	CURVE 18			
253.2	0.00138			263.2	0.00142	289.2	0.00151				
		CURVE 4		285.2	0.00159	301.2	0.00151				
157.2	0.000523			301.2	0.00172	CURVE 13					
223.2	0.000920			CURVE 8							
229.2	0.00121			115.2	0.000586						
		CURVE 5		129.2	0.000628						
125.2	0.000858			205.2	0.00113						
143.2	0.00103			229.2	0.00126						
147.2	0.00111			251.2	0.00128						
153.2	0.00103			CURVE 9							
153.2	0.000858			123.2	0.000920						
163.2	0.00107			123.2	0.00103						
167.2	0.00109			133.2	0.00109						
179.2	0.00115			136.2	0.00115						
183.2	0.00105			136.2	0.00117						
189.2	0.00113			155.2	0.000920						
199.2	0.00121			148.2	0.00121						
211.2	0.00121			173.2	0.00126						
221.2	0.00130			197.2	0.00130						
229.2	0.00138			200.2	0.00134						
		CURVE 10		227.2	0.00138 *						
107.2	0.000607			CURVE 14							
115.2	0.000669			123.2	0.000920						
		CURVE 15 *		123.2	0.00103						
				133.2	0.00109						
				136.2	0.00115						
				136.2	0.00117						
				155.2	0.000920						
				148.2	0.00121						
				173.2	0.00126						
				197.2	0.00130						
				200.2	0.00134						
				227.2	0.00138 *						
				CURVE 16							
				107.2	0.000607						
				115.2	0.000669						

* Not shown on plot

FIGURE SHOWS ONLY 13 OF THE CURVES REPORTED IN TABLE



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; measure 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	58 carbon black (by weight base on 100 parts of GR-S).
14	192	L	1945	343.2	1.3	GR-S tread type	25 aluminum powder, 33 carbon black (by weight based on 100 parts of GR-S).
15	192	L	1945	343.2	1.3	GR-S tread type	50 aluminum powder, 8 carbon black (by weight based on 100 parts of GR-S).

DATA TABLE NO. 314 THERMAL CONDUCTIVITY OF RUBBER (GOVERNMENT RUBBER-STYRENE)

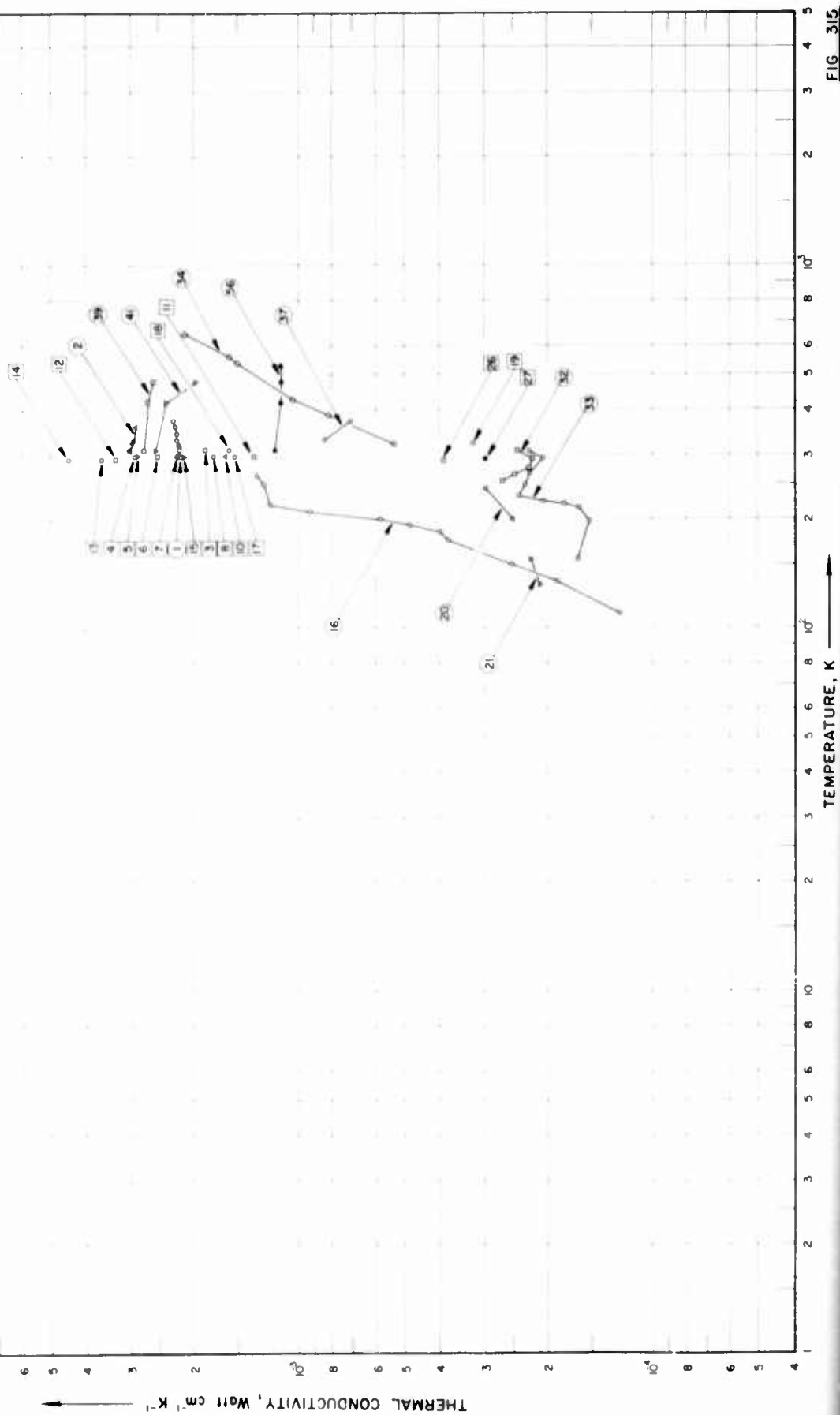
[Temperature, T, K. Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

CURVE 1		CURVE 4 (cont.)		CURVE 8		CURVE 11 (cont.)	
110.2	0.00117	183.2	0.000720	173.2	0.00113	300.2	0.00205
120.2	0.00121	191.2	0.000732	195.2	0.00113	310.2	0.00215
124.2	0.00117	201.2	0.000732	203.2	0.00111	329.2	0.00222
134.2	0.00121*	209.2	0.000736	215.2	0.00123		
134.2	0.00120	215.2	0.000735			CURVE 12	
153.2	0.00126	227.2	0.000920			203.2	0.00115*
161.2	0.00126	237.2	0.000962	109.2	0.000586	213.2	0.00146
193.2	0.00126	245.2	0.000962	135.2	0.000669	229.2	0.00157*
203.2	0.00127	265.2	0.00103	155.2	0.000732	241.2	0.00155
215.2	0.00134	283.2	0.00107	163.2	0.000690	251.2	0.00161
227.2	0.00140	299.2	0.00111	173.2	0.000732	253.2	0.00153
245.2	0.00153	311.2	0.00117	183.2	0.000774	274.2	0.00150
253.2	0.00157			191.2	0.000735		
263.2	0.00163	CURVE 5		201.2	0.000816	CURVE 13	
263.2	0.00159	191.2	0.000920	209.2	0.000837	343.2	0.00339
283.2	0.00165	223.2	0.000962	216.2	0.000900		
291.2	0.00163	225.2	0.000983	227.2	0.00103	CURVE 14	
295.2	0.00159*			237.2	0.00105	345.2	0.00377
299.2	0.00159	CURVE 6		263.2	0.00115		
309.2	0.00189	153.2	0.00123	283.2	0.00123	CURVE 15	
		163.2	0.00119	299.2	0.00126	343.2	0.00397
		205.2	0.00126	313.2	0.00134		
		217.2	0.00134*				
		217.2	0.00135*	CURVE 10			
		227.2	0.00155	203.2	0.00100		
		245.2	0.00165	223.2	0.00115		
		253.2	0.00163	225.2	0.00115*		
		265.2	0.00165*	245.2	0.00115		
		279.2	0.00167			CURVE 11	
		289.2	0.00174	141.2	0.000837		
		299.2	0.00167	151.2	0.00103		
		309.2	0.00174	191.2	0.000983		
				203.2	0.00115		
		CURVE 7*		225.2	0.00121		
		191.2	0.00128	225.2	0.00126		
		193.2	0.00126	226.2	0.00128*		
		193.2	0.00130	249.2	0.00136		
		205.2	0.00149	265.2	0.00142		
		205.2	0.00159	267.2	0.00159		
		223.2	0.00163	285.2	0.00154		
		233.2	0.00165	286.2	0.00150*		
				287.2	0.00156*		
		CURVE 3*					
		173.2	0.00109				
		197.2	0.00117				
		204.2	0.00117				
		215.2	0.00126				
		CURVE 4					
		111.2	0.000544				
		135.2	0.000565				
		155.2	0.000649				
		161.2	0.000649				
		173.2	0.000699				

* Not shown on plot

FIGURE SHOWS ONLY 29 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF RUBBER (MISCELLANEOUS)



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 0.357 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 0.269 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		Rubatex		Density 0.13-0.14 g cm ⁻³ ; water absorption (24 hrs) 0.2 vol %.
25	533	L	1962	300-334		Rubatex 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 8 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 ₃ 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 ₃ 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 ₃ 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 ₃ 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 ₃ 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) ₁₈ 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) ₁₈ 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) ₁₈ 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) ₁₈ COOH, and 0.3 ZnO; 6 x 6 x 0.250 in.; vulcanized; optimum-cured at 433 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 $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$, 1.8 ZnO , 1.6 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 altax, and 0.3 $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$; 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 $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$, 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 $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$, 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 $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$; 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 $\text{Ca}(\text{OH})_2$, 3.2 $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OH}$ (ethylene glycol), 3.2 pine tar, 1.3 PBNA, 1.3 $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$, 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 $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$; 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_2O_3 , 3.3 dibenzo GMF, 2.6 vistanex B-80, 1.0 S, 0.3 polyac, and 0.3 $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$; 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.

[illegible]

* Not shown on plot

SPECIFICATION TABLE NO. 316 THERMAL CONDUCTIVITY OF ANTHRACENE $C_6H_4(CH)_2C_6H_4$

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 $C_6H_4(CH)_2C_6H_4$ [Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻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
CURVE 1*	
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
CURVE 1*	
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⁻¹K⁻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 ($C_6H_5)_2O$

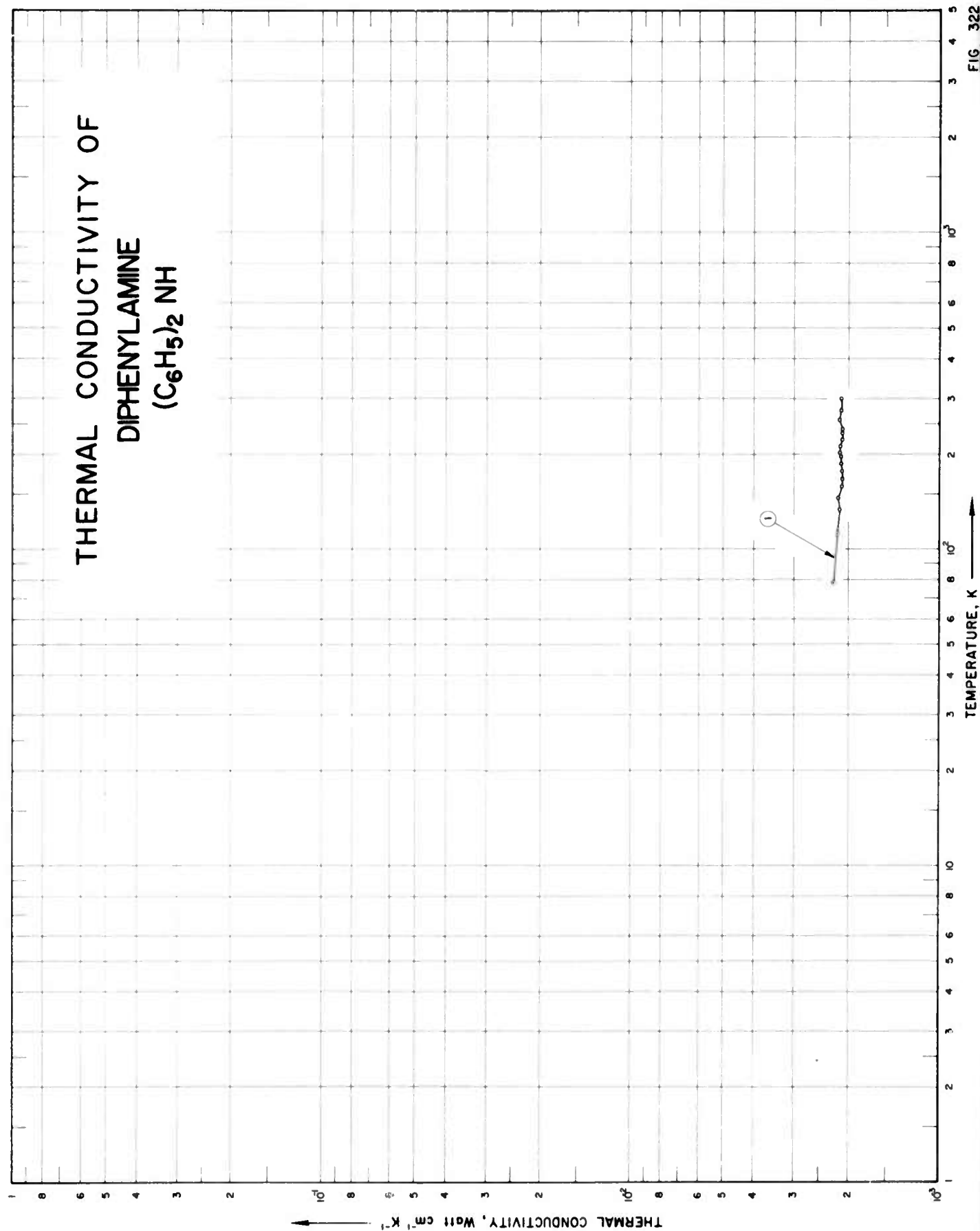
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	260	R	1961	330-511	1.5		B. D. H. Laboratory reagent; M. P. / F. P. 26-27 C; very slightly tinted crystalline solid; in liquid state.

DATA TABLE NO. 321 THERMAL CONDUCTIVITY OF DIPHENYL OXIDE ($C_6H_5)_2O$ [Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

T	k
CURVE 1*	
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
 $(C_6H_5)_2NH$



SPECIFICATION TABLE NO. 322 THERMAL CONDUCTIVITY OF DIPHENYLAMINE $(C_6H_5)_2NH$

[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	78-299			Melted over a water bath and frozen slowly from beneath.

DATA TABLE NO. 322 THERMAL CONDUCTIVITY OF DIPHENYLAMINE $(C_6H_5)_2NH$
 [Temperature, T, K; Thermal Conductivity, k , Watt $cm^{-1} K^{-1}$]

T	k
CURVE 1	
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] $(C_6H_5)_2CH_2 + C_{10}H_8$

Curve No.	Ref. Method No. Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent) $(C_6H_5)_2CH_2$	$C_{10}H_8$	Composition (continued), Specifications and Remarks
1	261	E	1955	293.2	± 0.5	Bal	2.6	

DATA TABLE NO. 323 THERMAL CONDUCTIVITY OF [DIPHENYLMETHANE + NAPHTHALENE] $(C_6H_5)_2CH_2 + C_{10}H_8$
[Temperature, T, K; Thermal Conductivity, k, Watt $cm^{-1}K^{-1}$]

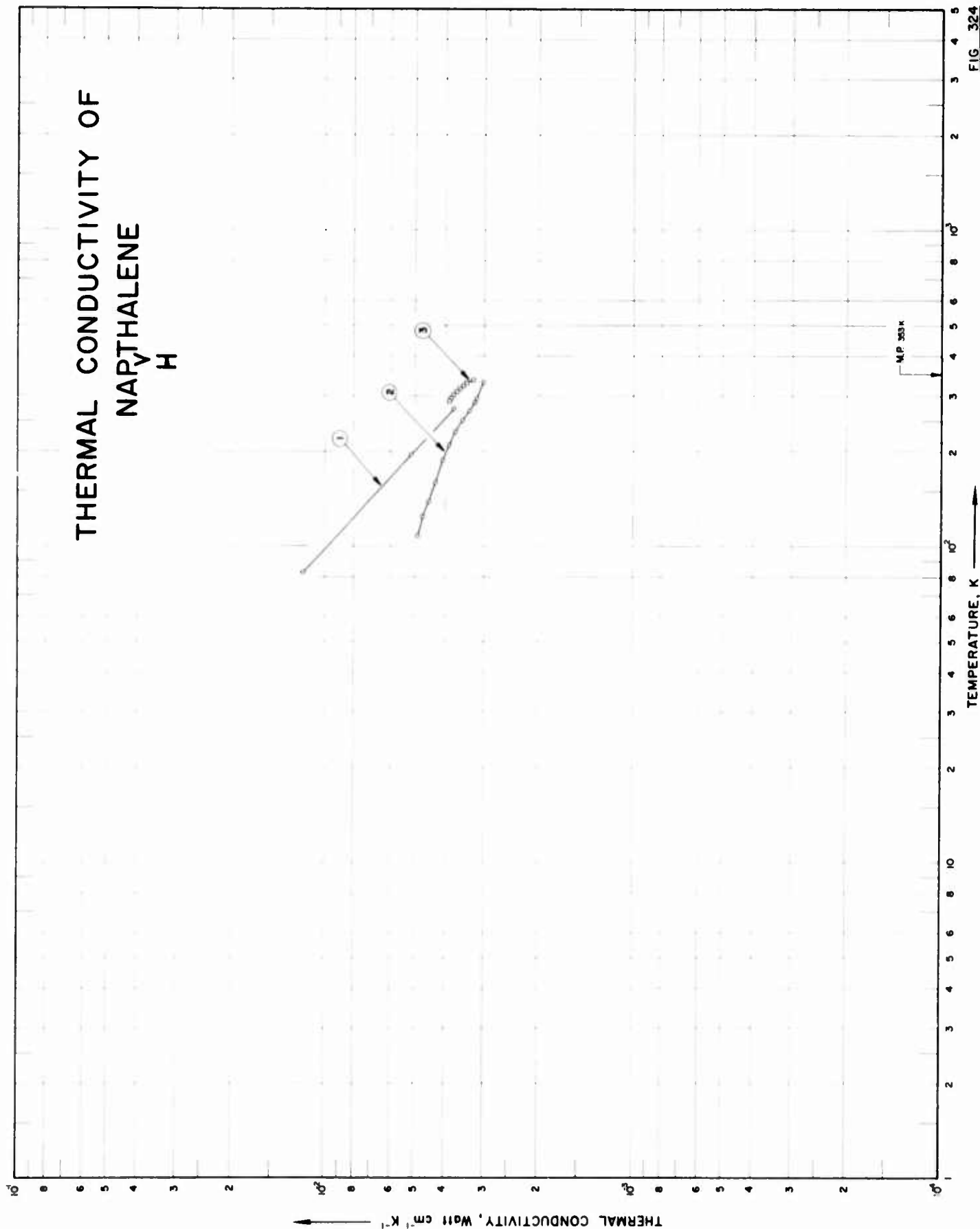
T k

CURVE 1*

293.2 0.00349

*No graphical presentation

THERMAL CONDUCTIVITY OF NAPHTHALENE H



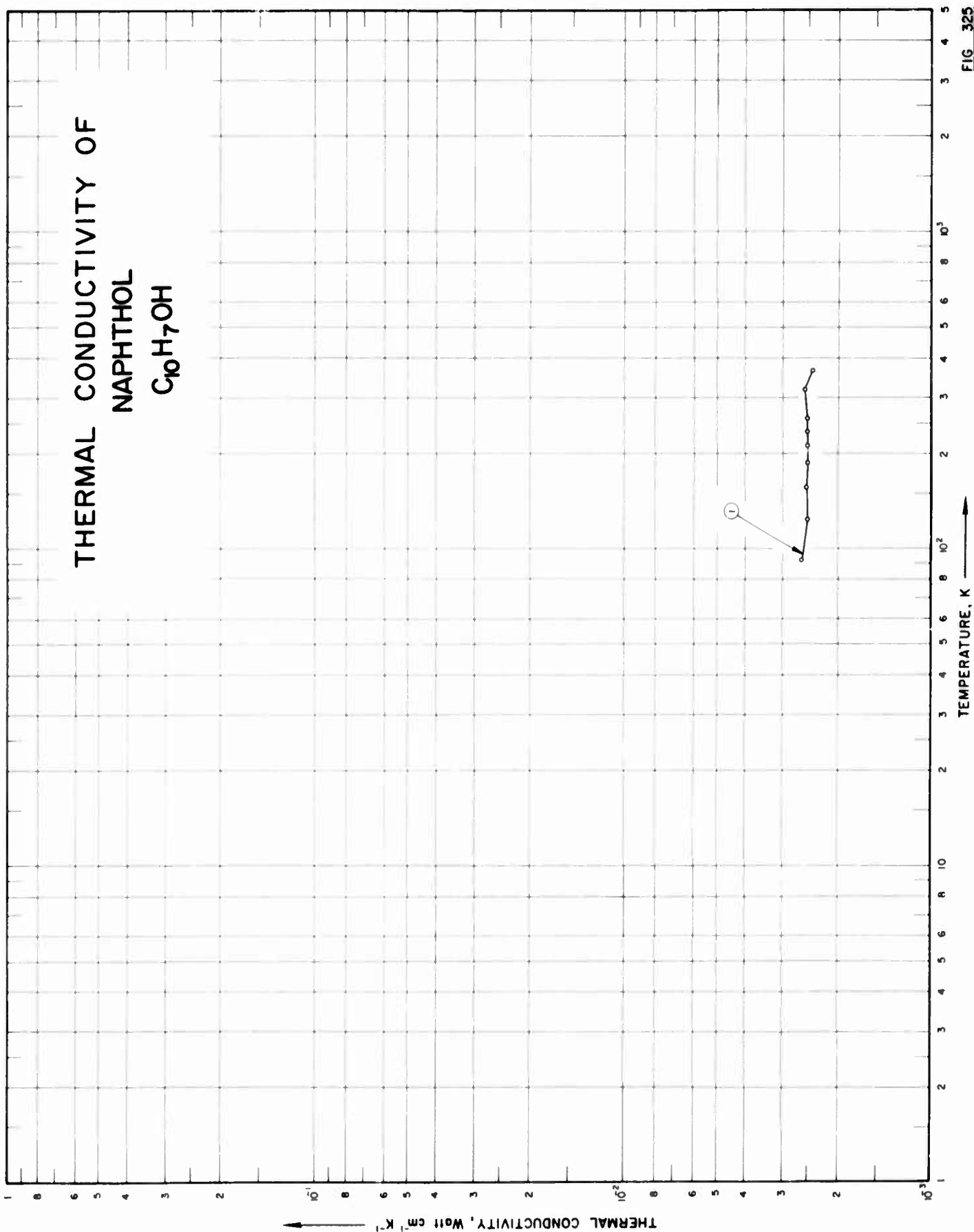
SPECIFICATION TABLE NO. 324 THERMAL CONDUCTIVITY OF NAPHTHALENE $C_{10}H_8$

[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



SPECIFICATION TABLE NO. 325 THERMAL CONDUCTIVITY OF NAPHTHOL $C_{10}H_8OH$

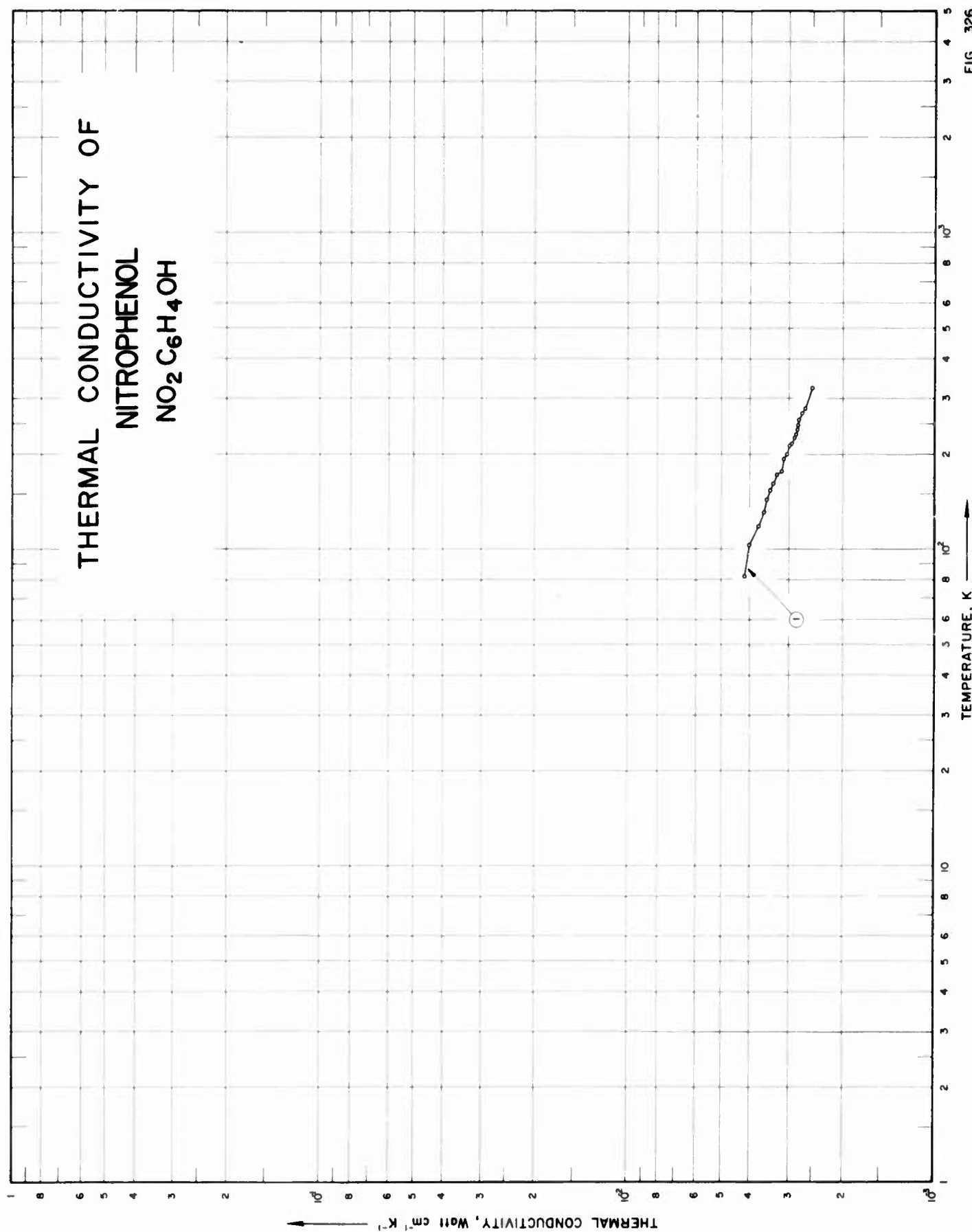
[For Data Reported in Figure and Table No. 325]

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
CURVE 1	
92.2	0.00261
123.2	0.00259
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
 $\text{NO}_2\text{C}_6\text{H}_4\text{OH}$**



TEMPERATURE, K —————→

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
CURVE 1	
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

* 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⁻¹K⁻¹]

T	k
<u>CURVE 1 *</u>	
290.9	0.00205
305.9	0.00203
313.3	0.00201
324.5	0.00192

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

CURVE 1*

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

No graphical presentation

SPECIFICATION TABLE NO. 330 THERMAL CONDUCTIVITY OF TRINITROTOLUENE $\text{CH}_3\text{C}_6\text{H}_2(\text{NO}_2)_3$

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 $\text{CH}_3\text{C}_6\text{H}_2(\text{NO}_2)_3$

[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	0.000293		
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	Composition 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

FIGURE SHOWS ONLY 14 OF THE CURVES REPORTED IN TABLE

THERMAL CONDUCTIVITY OF HONEYCOMB STRUCTURES (NONMETALLIC)

THERMAL CONDUCTIVITY, $\text{Watt cm}^{-1} \text{K}^{-1}$ ———→

TEMPERATURE, K ———→

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	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	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 0.0881 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)

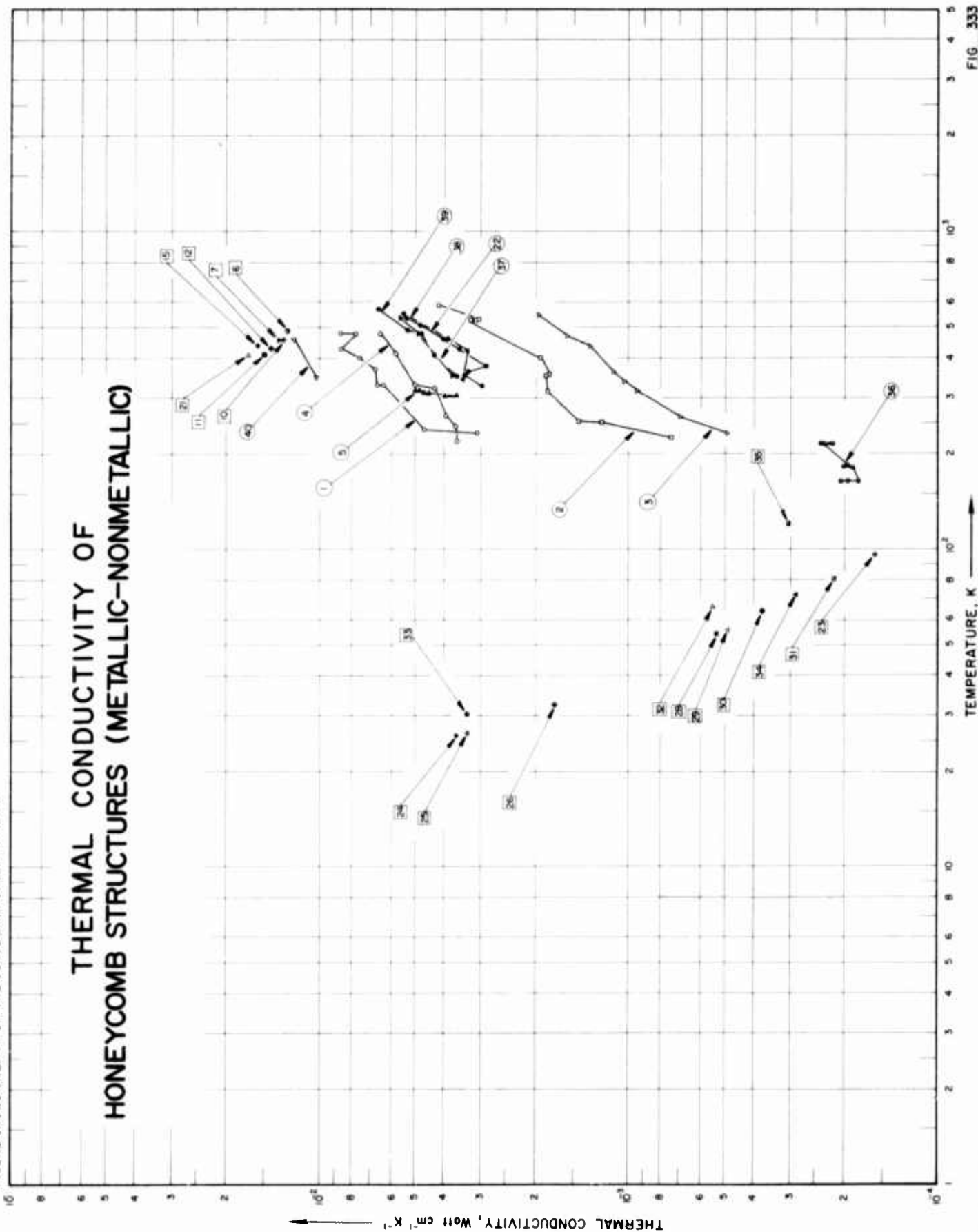
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

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	298.2	0.000663	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	298.2	0.000837	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	298.2	0.000678	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	298.2	0.000851	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	298.2	0.000764	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	298.2	0.000577	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	298.2	0.000447	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	298.2	0.000534	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	Core		
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, 0.0689 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 0.0689 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		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		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 $\pm$ 14 K for 15 min, air cooling to room temp, transforming at 200 $\pm$ 6 K for 8 hrs, and aging at 783 $\pm$ 6 K for 1 hr; a pressure of 80 psi applied to the specimen during testing.

SPECIFICATION TABLE NO. 333 (continued)

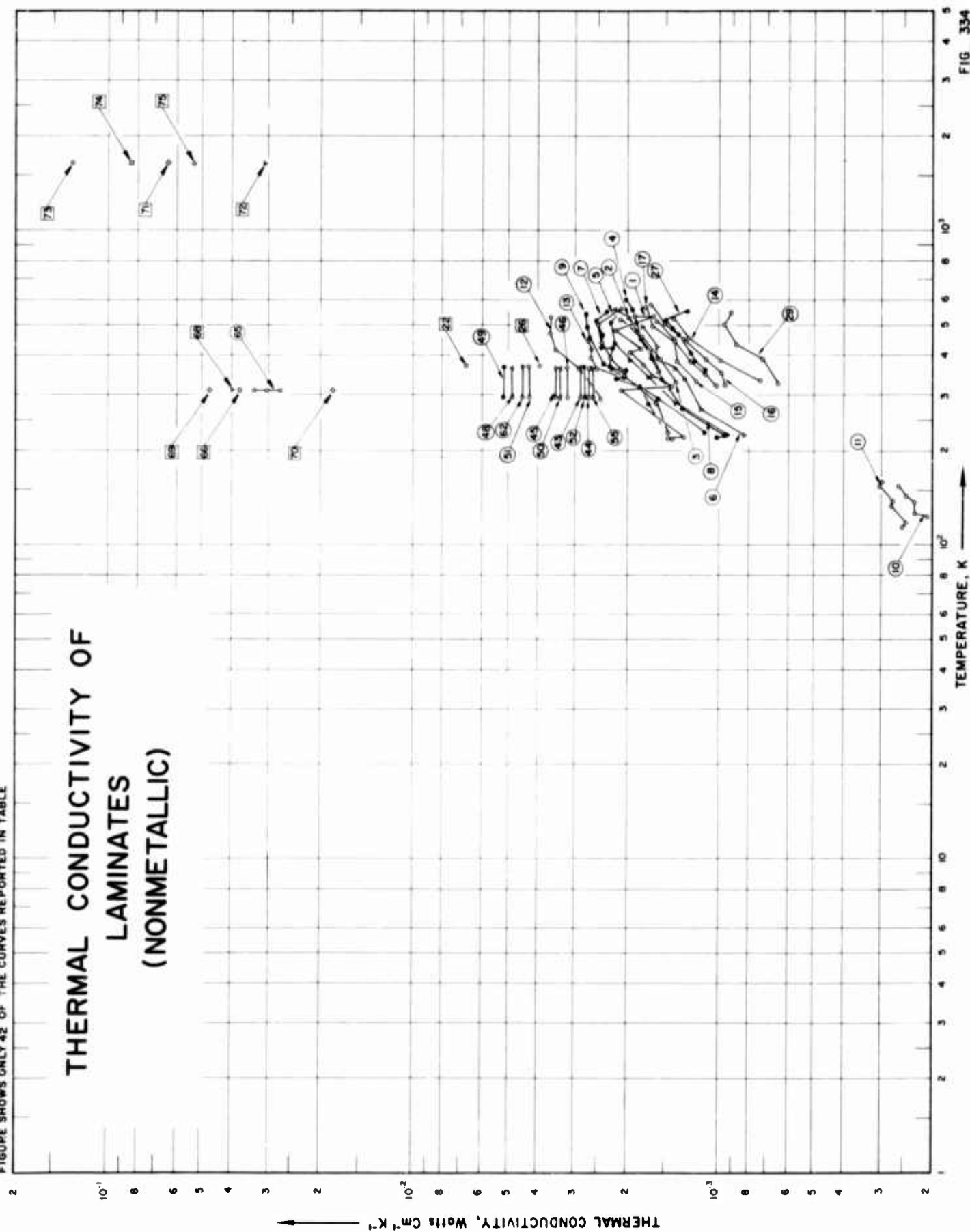
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Core	Composition	Facing	Composition (continued), Specifications and Remarks
38	486	L	1961	344-553			Steel	Air	Steel	Similar to the above specimen except brazing alloy Lithobraz 501 (50.0 Ni, 46.4 Ag, 3.5 Cu, and 0.1 Li).
39	486	L	1961	350-572			Steel	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	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 $\pm$ 14 K for 90 min; air cooling to 289 K, and aged at 839 $\pm$ 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]

[illegible]

*** Not shown on plot**

FIGURE SHOWS ONLY 42 OF THE CURVES REPORTED IN TABLE



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	353-566		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 175 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 103 lb ft ⁻³ (1.65 g cm ⁻³).
7	194	L	1958	227-560		X-1068	Glass Fabric (No. 181)	Tac-Polyester (Vibrin 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 (Shell X-131) Resin	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		Laminate No. 6045	Asbestos	Phenolic Resin	Laminate 0.225 in thick; Transite used as comparative material.
13	390	C	1961	339-450		B-1	Glass Fabric (No. 181)	Phenolic (BV 17085) Resin	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		N-1	Glass Fabric (No. 181)	Phenolic (Conolon 506) Resin	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		DC-2	Glass Fabric (No. 181)	Silicone (Dow Corning 2106) Resin	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		NK-1	Glass Fabric (No. 181)	Tac-Polyester (Vibrin 135) Resin	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					
18	197	P	1952	373.2		Insurok (XXX-T-640)	Paper	Phenolic Resin	Specific gravity ~1.35; measured in the x-direction (perpendicular to lamination).
19	197	P	1952	373.2		Insurok (XXX-T-640)	Paper	Phenolic Resin	The above specimen measured in the y-direction (parallel to lamination).
20	197	P	1952	373.2		Insurok (XXX-T-640)	Paper	Phenolic Resin	The above specimen measured in the z-direction (parallel to lamination).
21	197	P	1952	373.2		Insurok (C-T-601)	Cloth	Phenolic Resin	Laminate of 1 in. nominal thickness; specific gravity ~1.34; measured in the x-direction.

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 (CTL-91-LD) Resin	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 (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 (CTL-91-LD)	Similarly treated as above; density 102.34 lb ft ⁻³ (1.64 g cm ⁻³).
34	198	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 110.12 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 33.6 lb ft ⁻³ (1.34 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
44	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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	200	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, °F	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 100.4 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 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_2O_3 , 52.60 SiC , 36.80 SiO_2 , and 1.97 Fe_2O_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_2O_3 , 48.35 SiC , 38.76 SiO_2 , and 1.97 Fe_2O_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 $\pm$ 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 $\pm$ 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 layout; 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; refrasil 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; 80 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 1.366 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. 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. Polymeric 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			40 RPD asbestos reinforcing; specimen 12 x 12 x 0.125 in.; average thickness 0.121 in.; manufactured by U.S. Polymeric 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.
94 488, 489	L	1961	219-656		SRI 10	Plastic	DC-2106 Silicon resin	
95 488, 489	L	1961	444-656		SRI 10			
96 488, 489	L	1961	234-581		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	461-581		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)

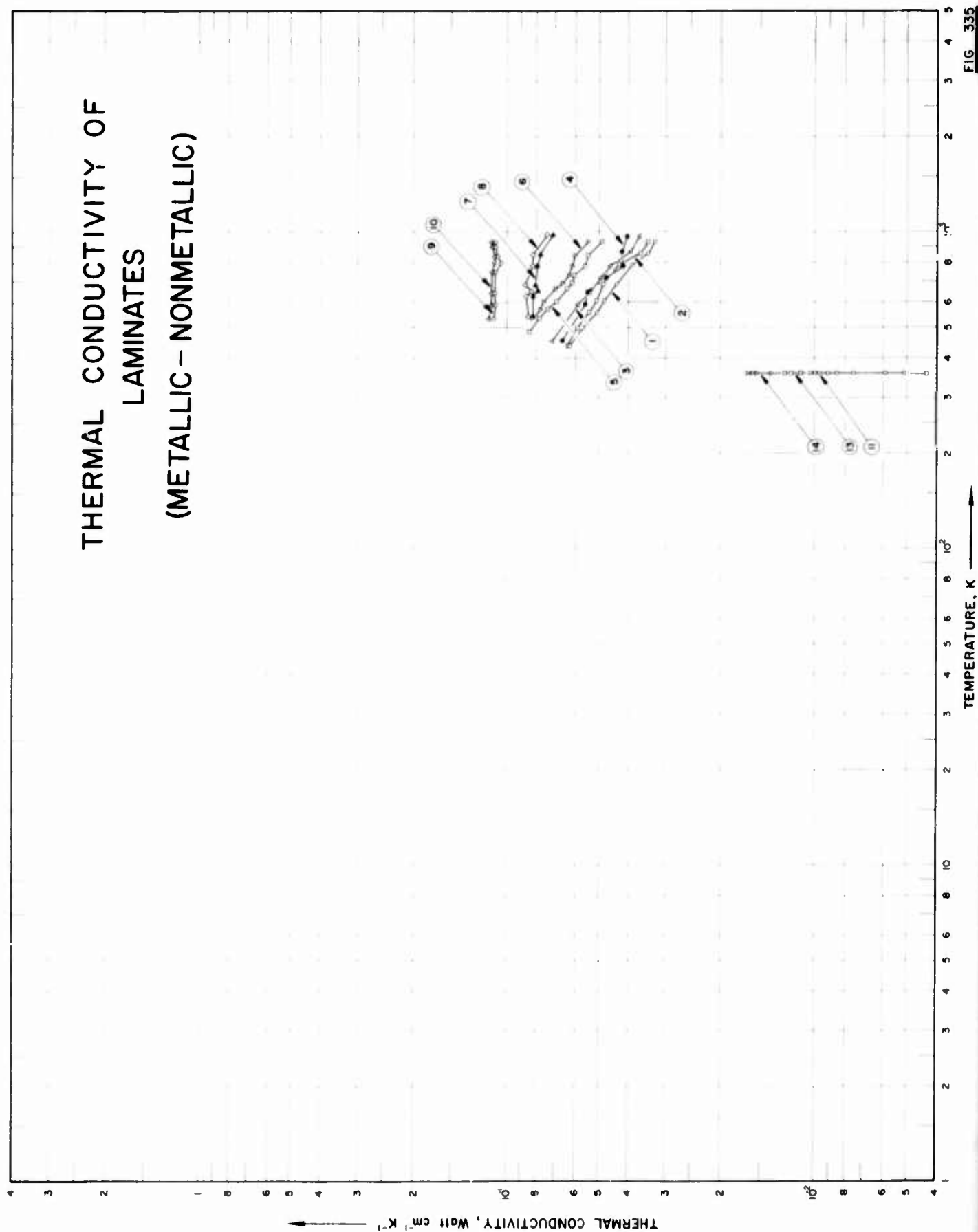
Curve Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Base Material	Binder	Specifications and Remarks
101 488, 489	L	1961	481-648		SRI 13	Graphite	101 Phenolic Resin	The above specimen measured at decreasing temp. 6 sheets of graphite mat impregnated with 101 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. 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 . 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 . Similar to the above specimen except specimen thickness 0.170 in. 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 . Glass cloth impregnated with silicone resin; 6 in. square plate specimen; supplied by Cadillac Plastic Co.; foam glass used as comparative material. Glass cloth impregnated with teflon resin; 6 in. square plate specimen; supplied by E. I. DuPont de Nemours and Co.; same comparative material as above. Glass fiber molding compound impregnated with silicone resin; 6 in. square plate specimen; supplied by Dow Corning Corp; same comparative material as above.
102 485	L	1963	315-434		No. 1			
103 485	L	1963	312-409		No. 2	Graphite	101 Phenolic Resin	
104 485	L	1963	330-428		No. 3	Glass	37-9X Phenyl silane resin	
105 485	L	1963	336-432		No. 5	Glass	37-9X Phenyl silane resin	
106 485	L	1963	337-407		No. 8	Refrasil	91 LD Phenolic Resin	
107 588	C	1956	302-697		G-7	Glass	Silicone resin	
108 588	C	1956	301-728		Armalon 410L	Glass	Teflon resin	
109 588	C	1956	318-775		DC 301	Glass	Silicone resin	

DATA TABLE NO. 334 (continued)

T	k	T	k	Density (g cm ⁻³)	T	k	T	k	T	k	T	k				
<u>CURVE 39*</u>				T = 308.2 1.70 0.0303 1.79 0.0335 1.84 0.0296*	<u>CURVE 65</u>				<u>CURVE 75</u>							
344.2	0.00137	297.1	0.00348		<u>CURVE 55</u>				<u>CURVE 83*</u>							
384.6	0.00158	366.5	0.00348		<u>CURVE 56*</u>				<u>CURVE 89*</u>							
424.5	0.00172	<u>CURVE 46</u>							<u>CURVE 95*</u>							
474.2	0.00182	297.1	0.00320		<u>CURVE 57*</u>				<u>CURVE 96*</u>							
533.3	0.00196	366.5	0.00320	<u>CURVE 47*</u>					<u>CURVE 97*</u>							
555.5	0.00204	297.1	0.00312	<u>CURVE 48</u>					<u>CURVE 98*</u>							
<u>CURVE 40*</u>				<u>CURVE 49</u>				<u>CURVE 99*</u>								
335.2	0.00170	297.1	0.00486	<u>CURVE 50</u>				<u>CURVE 100*</u>								
378.3	0.00182	366.5	0.00486	<u>CURVE 51</u>				<u>CURVE 94*</u>								
424.5	0.00196	297.1	0.00312	<u>CURVE 52</u>				<u>CURVE 95*</u>								
458.4	0.00203	366.5	0.00312	<u>CURVE 53*</u>				<u>CURVE 96*</u>								
501.7	0.00207	297.1	0.00507	<u>CURVE 54*</u>				<u>CURVE 97*</u>								
540.4	0.00167	366.5	0.00507	<u>CURVE 55*</u>				<u>CURVE 98*</u>								
550.6	0.00139	297.1	0.00486	<u>CURVE 56*</u>				<u>CURVE 99*</u>								
<u>CURVE 41*</u>				<u>CURVE 57*</u>				<u>CURVE 100*</u>								
339.6	0.00130	297.1	0.00240	<u>CURVE 58</u>				<u>CURVE 94*</u>								
388.4	0.00151	366.5	0.00240	<u>CURVE 59*</u>				<u>CURVE 95*</u>								
438.9	0.00161	297.1	0.00495	<u>CURVE 60*</u>				<u>CURVE 96*</u>								
499.6	0.00163	366.5	0.00495	<u>CURVE 61*</u>				<u>CURVE 97*</u>								
536.7	0.00133	297.1	0.00339	<u>CURVE 62</u>				<u>CURVE 98*</u>								
<u>CURVE 42*</u>				<u>CURVE 63*</u>				<u>CURVE 99*</u>								
319.5	0.00161	297.1	0.00427	<u>CURVE 64*</u>				<u>CURVE 100*</u>								
353.0	0.00166	366.5	0.00427	<u>CURVE 65*</u>				<u>CURVE 94*</u>								
399.8	0.00179	297.1	0.00348	<u>CURVE 66*</u>				<u>CURVE 95*</u>								
458.0	0.00193	366.5	0.00348	<u>CURVE 67*</u>				<u>CURVE 96*</u>								
490.0	0.00206	297.1	0.00447	<u>CURVE 68</u>				<u>CURVE 97*</u>								
541.6	0.00216	366.5	0.00447	<u>CURVE 69</u>				<u>CURVE 98*</u>								
575.0	0.00202	297.1	0.00279	<u>CURVE 70</u>				<u>CURVE 99*</u>								
<u>CURVE 43</u>				<u>CURVE 71</u>				<u>CURVE 100*</u>								
297.1	0.00287	366.5	0.00279	<u>CURVE 72</u>				<u>CURVE 94*</u>								
<u>CURVE 44</u>				<u>CURVE 73</u>				<u>CURVE 95*</u>								
297.1	0.00268	297.1	0.00294	<u>CURVE 74</u>				<u>CURVE 96*</u>								
366.5	0.00268	366.5	0.00294	<u>CURVE 75</u>				<u>CURVE 97*</u>								
<u>CURVE 45*</u>				<u>CURVE 76*</u>				<u>CURVE 98*</u>								
297.1	0.00289	297.1	0.00289	<u>CURVE 77*</u>				<u>CURVE 99*</u>								
366.5	0.00289	366.5	0.00289	<u>CURVE 78*</u>				<u>CURVE 100*</u>								

* Not shown on plot

THERMAL CONDUCTIVITY OF LAMINATES (METALLIC - NONMETALLIC)



SPECIFICATION TABLE NO. 335 THERMAL CONDUCTIVITY OF LAMINATES (METALLIC-NONMETALLIC)

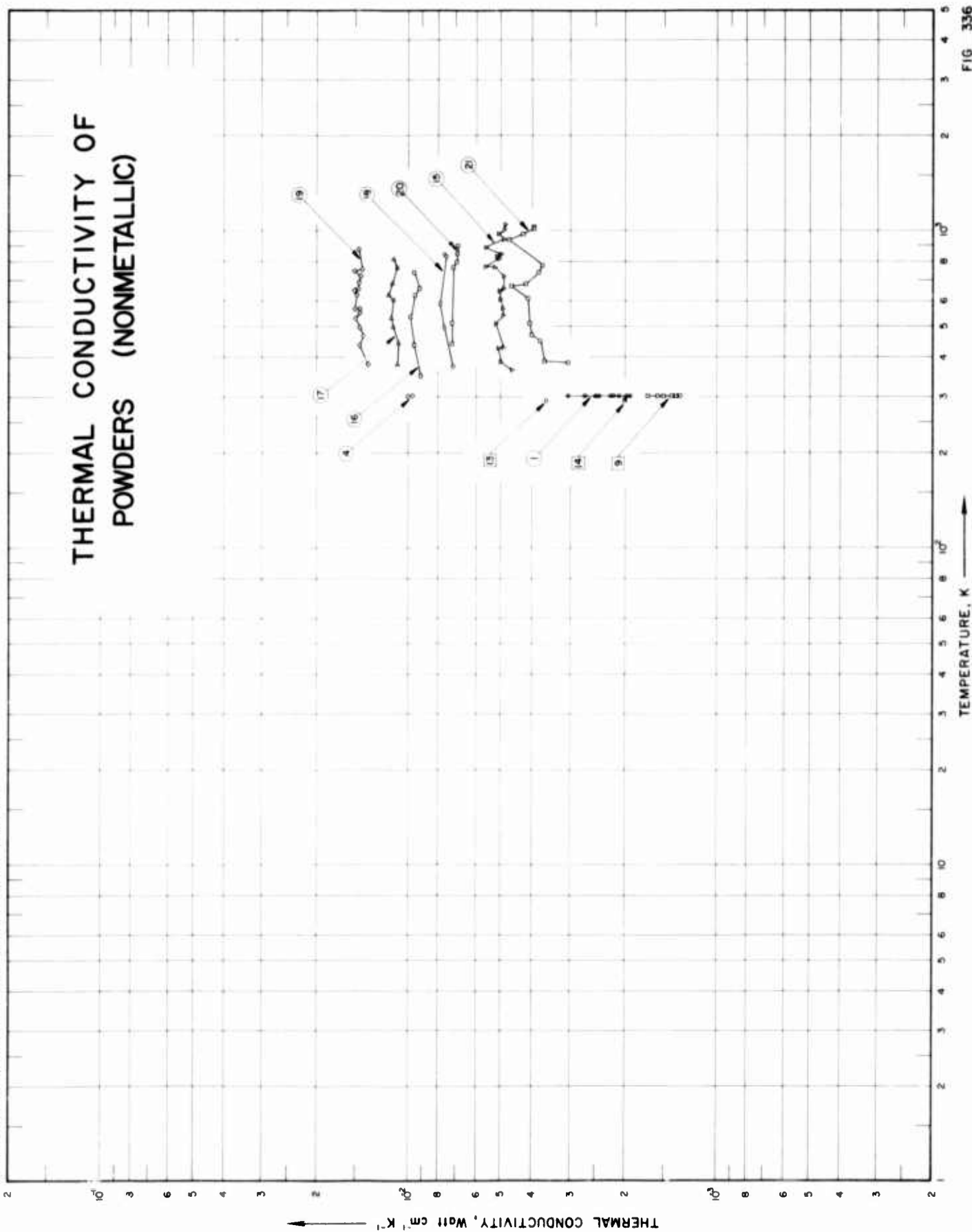
[For Data Reported in Figure and Table No. 335]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition		Binder	Composition (continued), Specifications and Remarks
							Composite Materials	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.

FIGURE SHOWS ONLY 12 OF THE CURVES REPORTED IN TABLE



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)

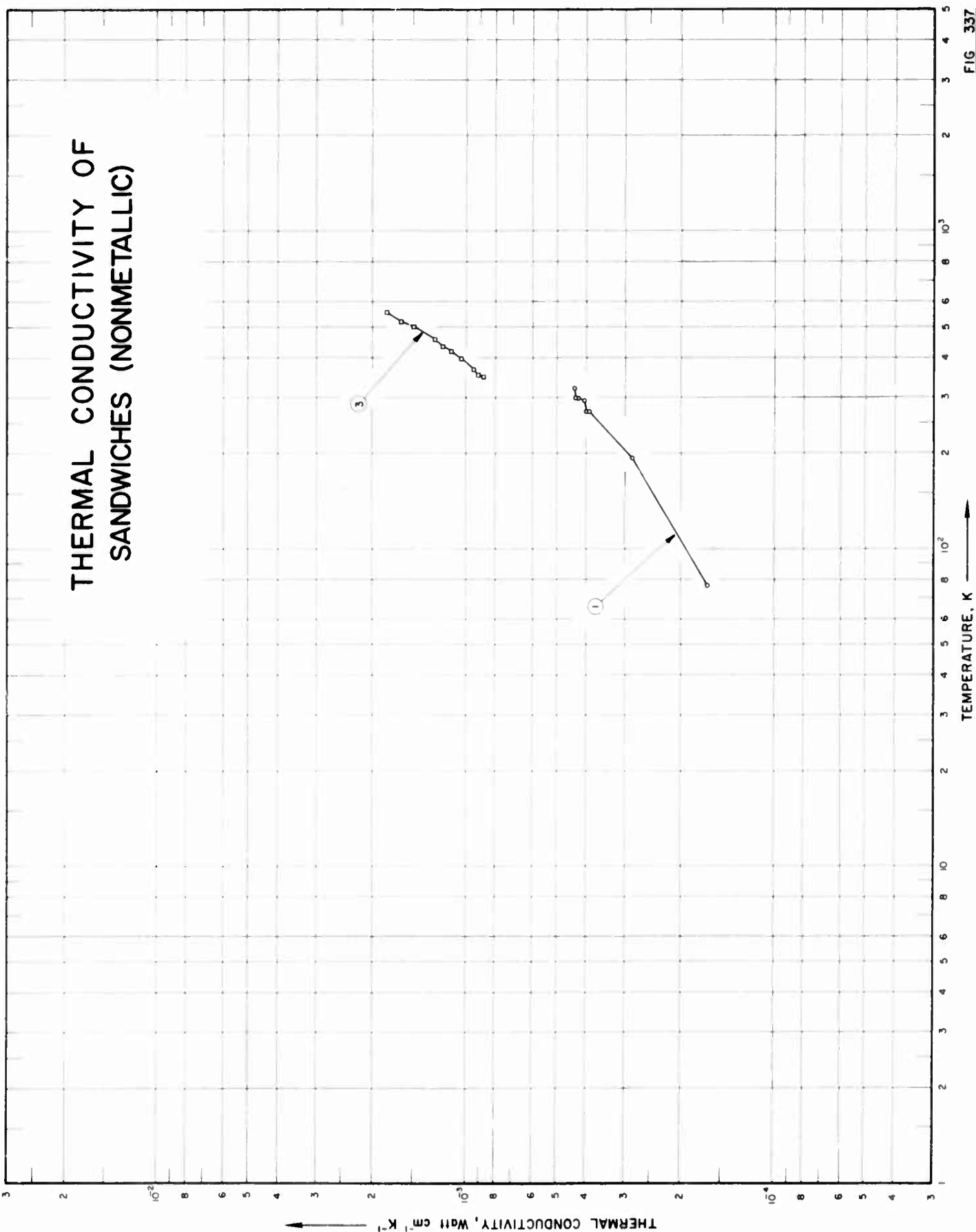
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition		Composition (continued), Specifications and Remarks
							Solid Particles	Environment	
13	491	R	1958	292.7			Charcoal	Helium	Sutcliffe Speakman 208 C. 8-14 mesh charcoal obtained from I. C. 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	Similar to the above specimen but measured in air.
15	492	R	1954	365-1059		Uranium Dioxide		Argon	
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		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		Nitrogen	Similar to the above specimen but the 42% void volume filled with helium.
21	492	R	1954	386-1033		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]

[illegible]

* Not shown on plot

FIGURE SHOWS ONLY 2 OF THE CURVES REPORTED IN TABLE



SPECIFICATION TABLE NO. 337 THERMAL CONDUCTIVITY OF SANDWICHES (NONMETALLIC)

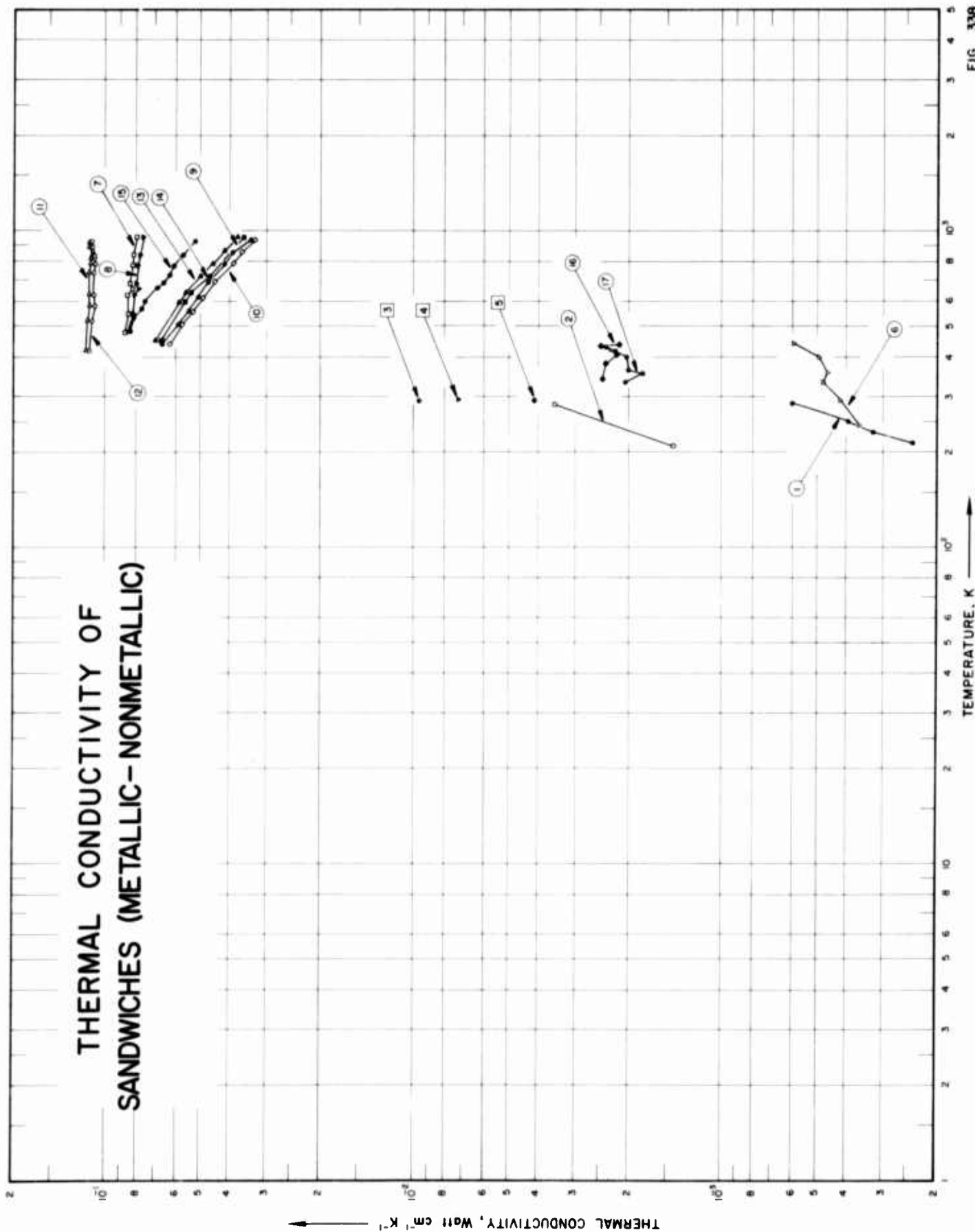
[For Data Reported in Figure and Table No. 337]

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition			Binder	Composition (continued), Specifications and Remarks
							Composite Materials				
1	124	L	1960	77-322	< 2		Cork	Rubber	Rubber		Specimen 0.249 in. in thickness; density 0.168 g cm ⁻³ .
2	124	L	1960	297.6	< 2		Cork	Rubber	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



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		BBC 2	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 laminas; MIT alumina standard used as comparative material.
8	494	C	1960	483-963	±6				Second run of the above specimen.
9	494	C	1960	441-936	±3				Similar to the above specimen except heat flow perpendicular to the laminas.
10	494	C	1960	440-936	±3				Second run of the above specimen.
11	494	C	1960	420-924	±6	Forsterite Steel			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 laminas; same comparative material as above.
12	494	C	1960	420-928	±6				Second run of the above specimen.

SPECIFICATION TABLE NO. 33* (continued)

Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composite Materials	Composition	Binder	Composition (continued), Specifications and Remarks
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.

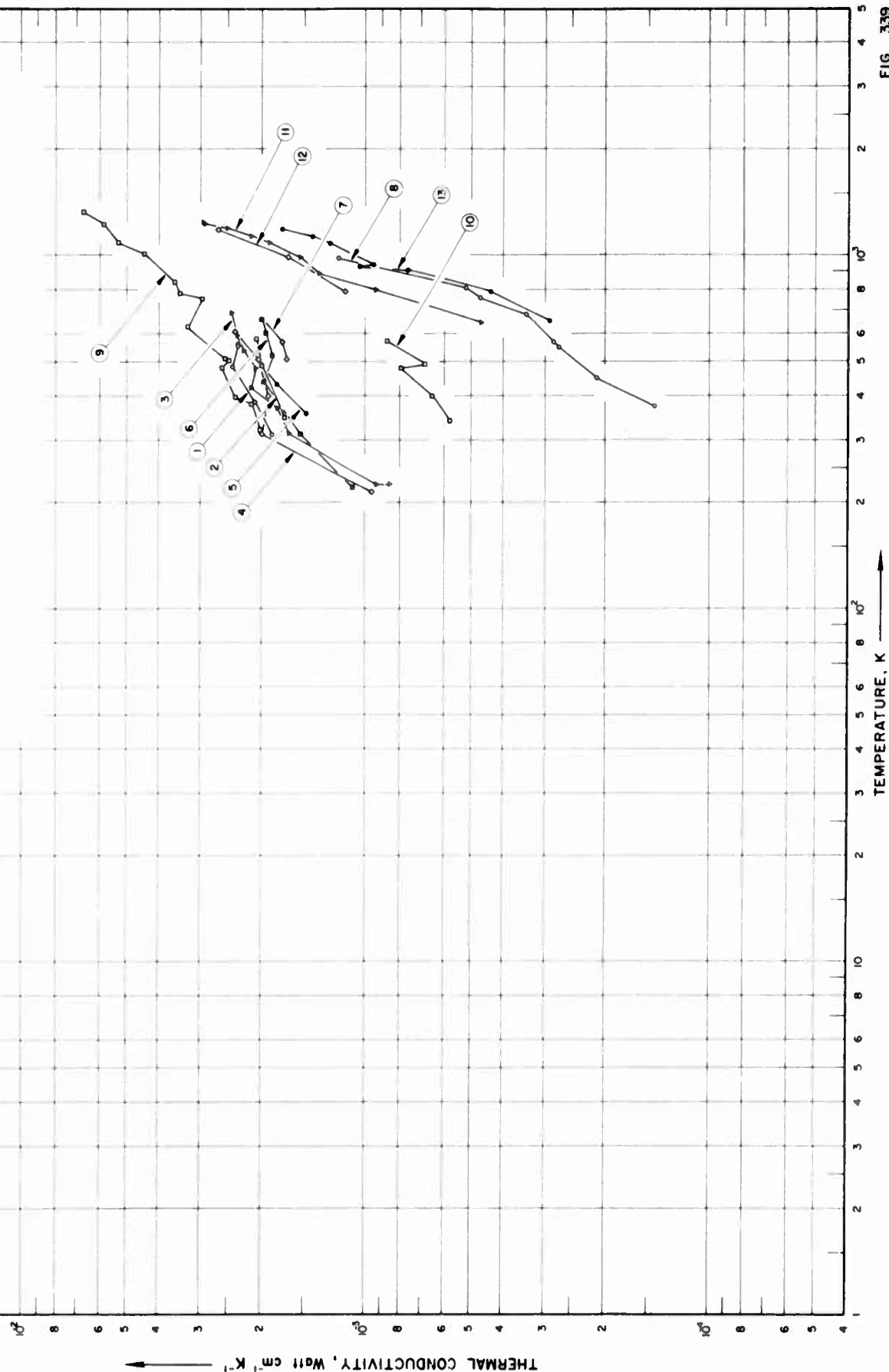
DATA TABLE NO. 38 THERMAL CONDUCTIVITY OF SANDWICHES (METALLIC-NONMETALLIC)
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 8</u>		<u>CURVE 12</u>		<u>CURVE 16</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>		685.2	0.0796	743.2	0.109	438.2	0.00215
		783.2	0.0791	794.2	0.107	<u>CURVE 17</u>	
		843.2	0.0778	820.2	0.108	334.3	0.00205
210.2	0.00143	963.2	0.0761	841.2	0.108	336.5	0.00179
284.7	0.00351	<u>CURVE 9</u>		893.2	0.110	365.4	0.00200
<u>CURVE 3</u>		441.2	0.0665	928.2	0.110	401.5	0.00203
		506.2	0.0592	<u>CURVE 13</u>		417.7	0.00221
293.2	0.0056	563.2	0.0548	453.2	0.0698	432.6	0.00237
<u>CURVE 4</u>		620.2	0.0511	595.2	0.0590		
		693.2	0.0471	644.7	0.0561		
295.1	0.0072	786.2	0.0418	723.2	0.0500		
<u>CURVE 5</u>		856.2	0.0390	789.2	0.0455		
		936.2	0.0339	868.2	0.0418		
		<u>CURVE 10</u>		956.2	0.0376		
293.4	0.0041			<u>CURVE 14</u>			
<u>CURVE 6</u>		440.2	0.0630	451.2	0.0667		
		509.2	0.0579	598.2	0.0561		
244.3	0.000361	559.2	0.0531	644.0	0.0536		
283.6	0.000418	615.2	0.0492	722.2	0.0467		
332.9	0.000476	595.2	0.0448	790.2	0.0418*		
357.0	0.000462	791.2	0.0387	868.2	0.0389*		
358.4	0.000462*	861.2	0.0364	958.2	0.0357		
400.6	0.000490	936.2	0.0328	<u>CURVE 15</u>			
444.6	0.000591	<u>CURVE 11</u>		485.2	0.0837		
<u>CURVE 7</u>		420.2	0.115	535.2	0.0816		
		524.2	0.114	571.5	0.0769		
483.2	0.0868	583.2	0.113	603.2	0.0750		
548.2	0.0849	742.7	0.113	665.2	0.0686		
632.2	0.0851	793.2	0.111	689.2	0.0657		
659.2	0.0824	817.2	0.111	728.5	0.0630		
685.2	0.0837	897.2	0.110	778.2	0.0613		
783.2	0.0823	893.2	0.112	843.2	0.0573		
845.2	0.0816	924.2	0.113	931.2	0.0523		
963.2	0.0795						

* 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	Composite Materials	Composition	Binder	Composition (continued), Specifications and Remarks
1	488, 489	L	1961	312-563		SRI 2	Plastic	Glass	CTL-91 LD Phenolic resin	35% $\pm$ 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 . The above specimen measured at decreasing temp.
2	488, 489	L	1961	348-585		SRI 2				
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 0.220 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% $\pm$ 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 . The above specimen measured at decreasing temp.
5	488, 489	L	1961	357-607		Coast F130R; SRI 5				
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 . The above specimen measured at decreasing temp.
7	488, 489	L	1961	508-658		Astrolite; SRI 6				
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 . Similar to the above specimen but measured in helium at 1 atm.
9	495	R	1964	319-1332			Carbon	Helium		
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	Graphite		
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. The above specimen measured at decreasing temp.
12	472	R	1963	794-1189	7		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.
13	472	R	1963	655-1189			Aluminum Oxide	Graphite		The above specimen measured at decreasing temp.
14	472	R	1963	911-1144	7		Aluminum Oxide	Graphite		

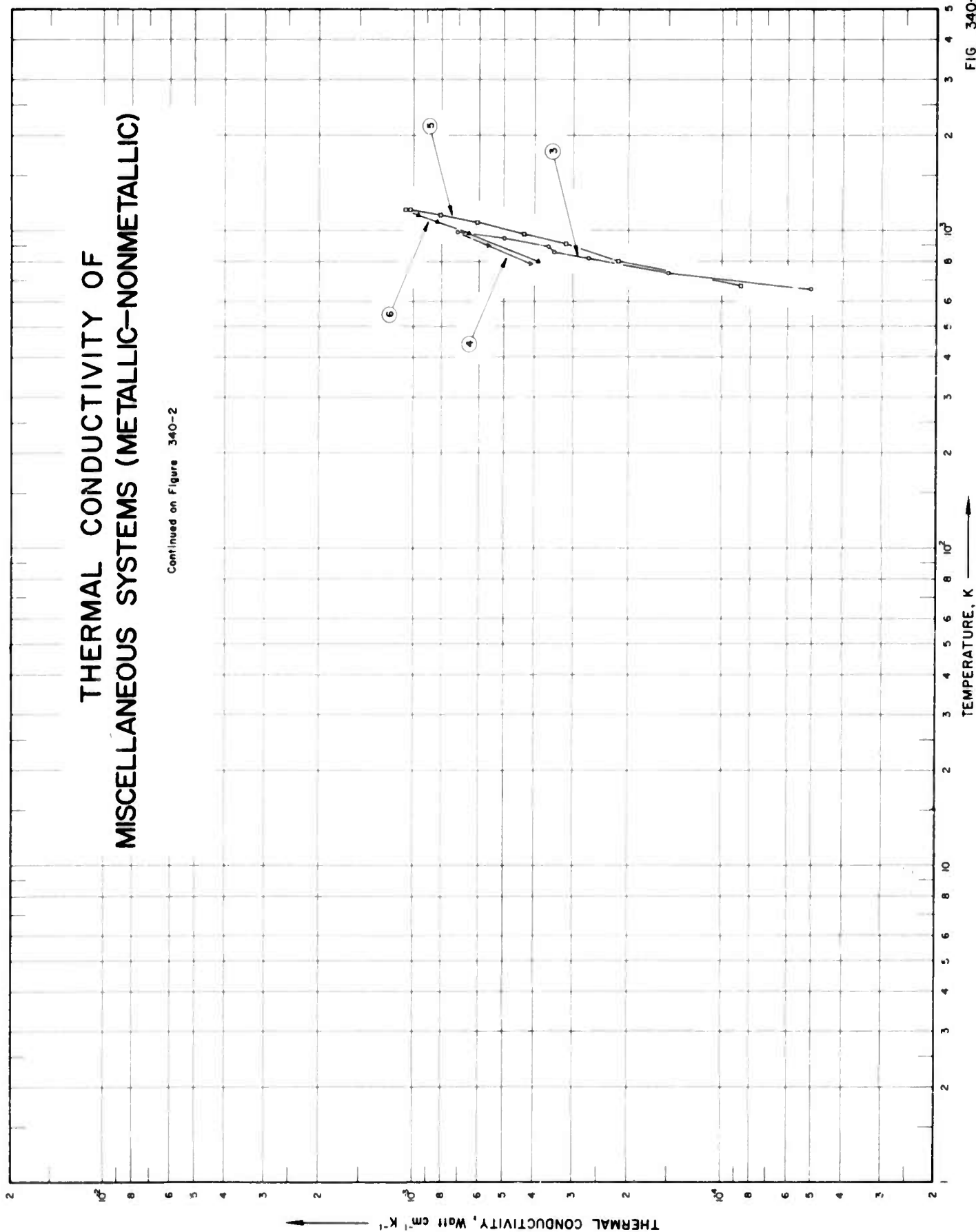
DATA TABLE NO. 339 THERMAL CONDUCTIVITY OF MISCELLANEOUS SYSTEMS (NONMETALLIC)
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k
<u>CURVE 1</u>		<u>CURVE 6 (cont.)</u>		<u>CURVE 10</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>		<u>CURVE 7</u>		<u>CURVE 11</u>	
348.2	0.00169	507.6	0.00168	649.8	0.000462
489.3	0.00198	568.2	0.00172	799.8	0.000923
584.8	0.00205	658.2	0.00197*	894.3	0.00134
<u>CURVE 3</u>		<u>CURVE 8</u>		988.7	0.00153
225.4	0.000844	375	0.000142	1088.7	0.00187
225.4	0.000917	447	0.000209	1133.2	0.00211*
314.8	0.00164	550	0.000270	1141.5	0.00211
369.8	0.00178	569	0.000280	1194.3	0.00247
374.3	0.00178*	681	0.000337	1238.7	0.00288
423.7	0.00211	753	0.000465	1249.8	0.00291
481.5	0.00206	808	0.000513	<u>CURVE 12</u>	
539.8	0.00223	981	0.00118	794.3	0.00112
595.9	0.00233	<u>CURVE 9</u>		988.7	0.00166
688.7	0.00241	319	0.00199*	1188.7	0.00264
<u>CURVE 4</u>		321	0.00200	<u>CURVE 13</u>	
214.8	0.000948	397	0.00236	655.4	0.000288
313.2	0.00198	481	0.00258	794.3	0.000433
400.9	0.00189	505	0.00246	910.9	0.000750
507.6	0.00202	511	0.00253	933.2	0.00102
607.1	0.00236	755	0.00294	944.3	0.000937
<u>CURVE 5</u>		782	0.00350*	1088.7	0.00125
357.1	0.00147	783	0.00343	1133.2	0.00141
433.2	0.00179	1008	0.00440	1188.7	0.00173
607.1	0.00236*	1092	0.00527	<u>CURVE 14*</u>	
<u>CURVE 6</u>		379	0.00211	910.9	0.000721
221.5	0.00107	844	0.00356	1099.8	0.00118
313.7	0.00153	1232	0.00580	1144.3	0.00151
370.5	0.00176*	1332	0.00662		
		626	0.00324		

* Not shown on plot

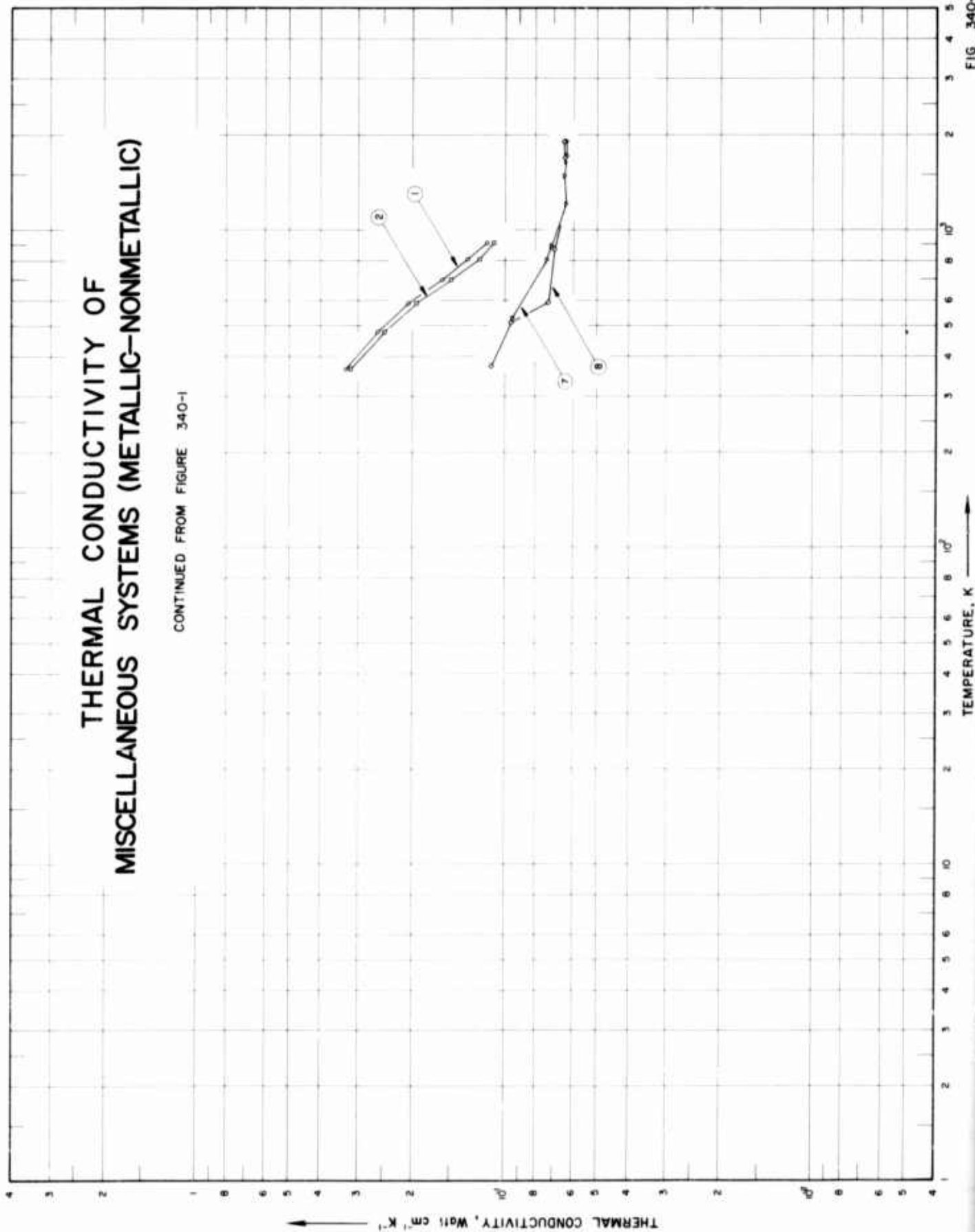
THERMAL CONDUCTIVITY OF MISCELLANEOUS SYSTEMS (METALLIC-NONMETALLIC)

Continued on Figure 340-2



THERMAL CONDUCTIVITY OF MISCELLANEOUS SYSTEMS (METALLIC-NONMETALLIC)

CONTINUED FROM FIGURE 340-1



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	Composition		Binder	Composition (continued), Specifications and Remarks
							Composite Materials	Aluminum Oxide		
1	246	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 II	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 ⁻⁶ mm Hg; density of graphite fiber 0.088 g cm ⁻³ , measured in increasing temp.
4	472	R	1963	789-994	6-9		Paper, Tantalum, Graphite			The above specimen measured at decreasing temp.
5	472	R	1963	672-1161	6-9					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>		<u>CURVE 6</u>	
366.5	0.331	799.8	0.000389
477.6	0.262	983.2	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>		<u>CURVE 7</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>		<u>CURVE 8</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>		<u>CURVE 3*</u>		<u>CURVE 5*</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 4*</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 13%; 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 13%; 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 13%; 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 13%; 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
<u>CURVE 1*</u>	
293.2	0.000460
<u>CURVE 2*</u>	
293.2	0.000544
<u>CURVE 3*</u>	
293.2	0.00121
<u>CURVE 4*</u>	
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%.

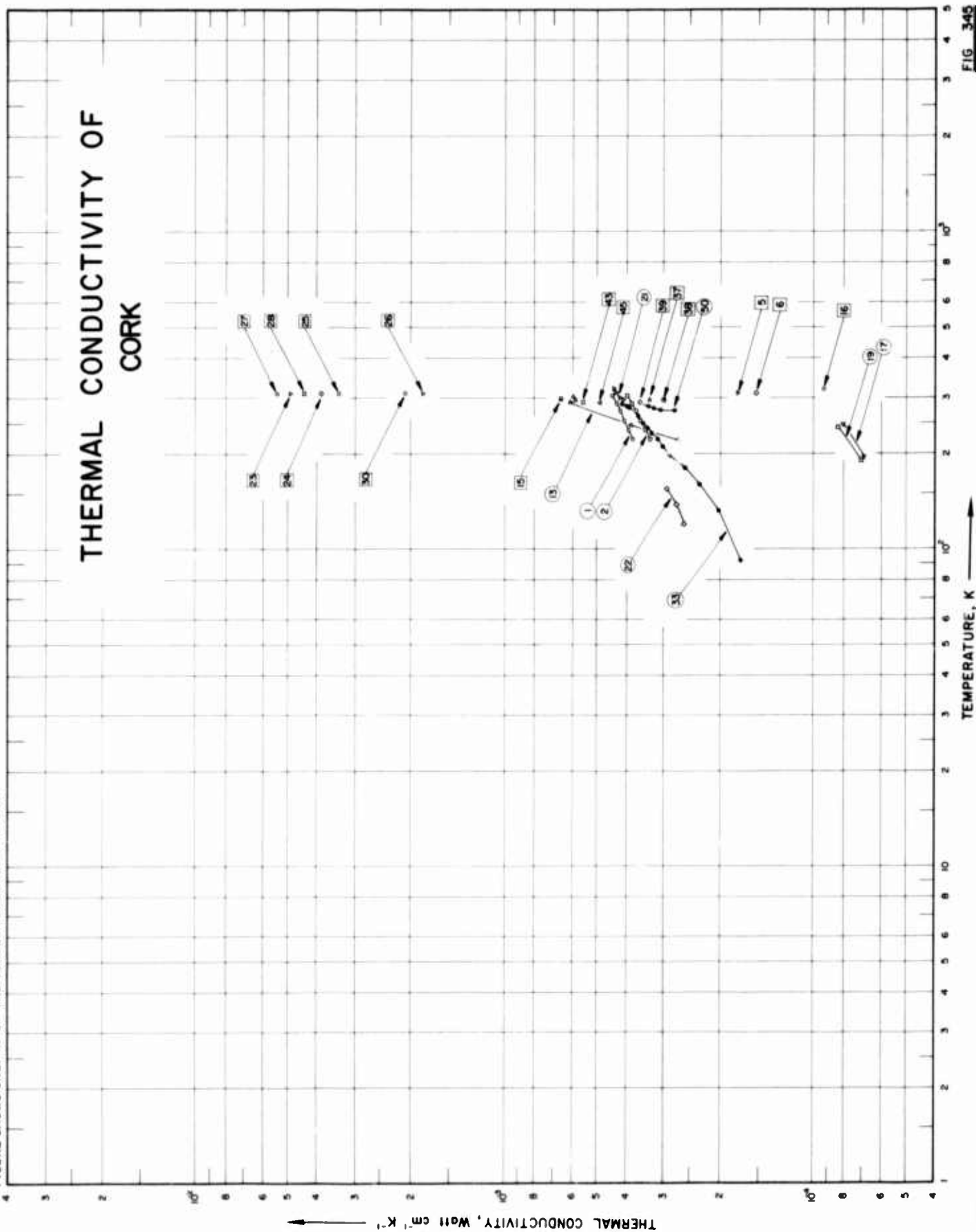
DATA TABLE NO. 344 THERMAL CONDUCTIVITY OF CEDAR

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

T	k
<u>CURVE 1*</u>	
293.2	0.00121
<u>CURVE 2*</u>	
293.2	0.00105
<u>CURVE 3*</u>	
293.2	0.00116

* No graphical presentation

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 0.195 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.

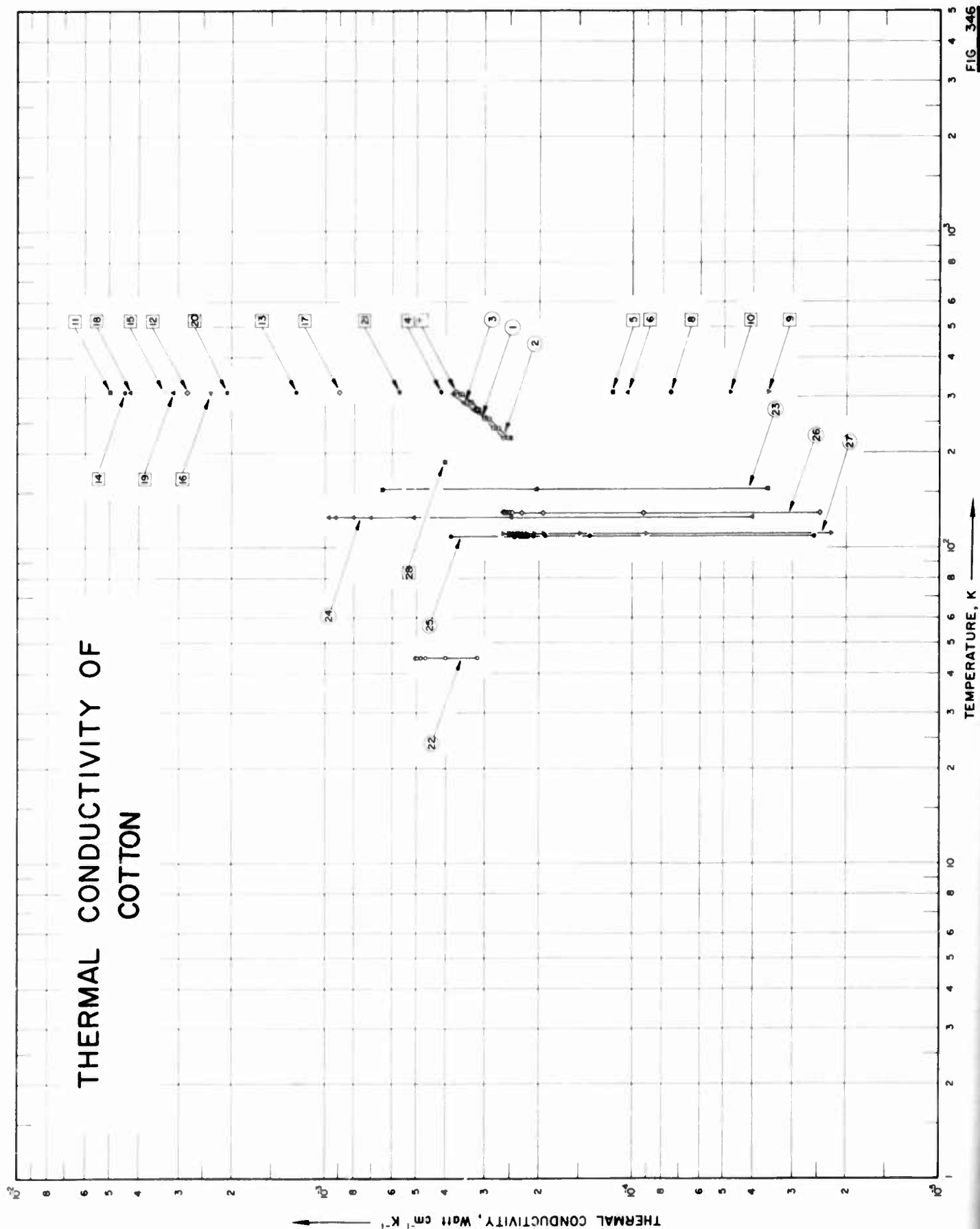
SPECIFICATION TABLE NO. 345 (continued)

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]

<u>CURVE 1</u>		<u>CURVE 9*</u>		<u>CURVE 15</u>		<u>CURVE 22</u>		<u>CURVE 33</u>		<u>CURVE 41*</u>		<u>CURVE 51*</u>	
T	k	T	k	T	k	T	k	T	k	T	k	T	k
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			138	0.000274	132.2	0.000202			280.4	0.000312
255.4	0.000407	255.5	0.000407	<u>CURVE 16</u>		155	0.000293	160.2	0.000234	<u>CURVE 42*</u>		283.2	0.000309
272.2	0.000421	272.1	0.000421					181.7	0.000258			287.1	0.000352
288.9	0.000433	288.8	0.000433	319.3	0.0000924	<u>CURVE 23</u>		198.2	0.000287	290.4	0.000340	288.7	0.000372
305.5	0.000446	305.3	0.000446	<u>CURVE 17</u>				211.2	0.000301			289.8	0.000387
<u>CURVE 2</u>		<u>CURVE 10*</u>				310.9	0.00490	222.6	0.000312	<u>CURVE 43</u>			
222.0	0.000333	222.2	0.000331	195.4	0.0000693	<u>CURVE 24</u>		232.4	0.000327				
238.7	0.000346	239.2	0.000346	247.6	0.0000803			241.2	0.000339	290.9	0.000554		
255.4	0.000359	255.5	0.000359	<u>CURVE 18*</u>		310.9	0.00384	248.9	0.000351				
272.2	0.000372	272.1	0.000372					256.0	0.000357*	<u>CURVE 44*</u>			
288.9	0.000385	288.8	0.000385	<u>CURVE 19</u>		<u>CURVE 25</u>		262.4	0.000365				
305.5	0.000398	305.3	0.000398	322.6	0.0000910			268.4	0.000372*	290.9	0.000397		
<u>CURVE 3*</u>		<u>CURVE 11*</u>				310.9	0.00337	273.9	0.000377*				
222.0	0.000320	222.2	0.000320	<u>CURVE 19</u>				279.0	0.000393	<u>CURVE 45</u>			
238.7	0.000336	239.2	0.000336	191.5	0.0000703	<u>CURVE 26</u>		283.5	0.000398				
255.4	0.000352	255.5	0.000352	243.7	0.0000834	310.9	0.00183	287.7	0.000417	290.9	0.000490		
272.2	0.000368	272.1	0.000368	<u>CURVE 20*</u>				<u>CURVE 34*</u>		<u>CURVE 46*</u>			
288.9	0.000384	288.8	0.000384			<u>CURVE 27</u>		190.5	0.000280	290.4	0.000325		
305.5	0.000400	305.3	0.000400	288.8	0.000397	310.9	0.00543	<u>CURVE 35*</u>		<u>CURVE 47*</u>			
<u>CURVE 4*</u>		<u>CURVE 12*</u>		289.1	0.000399	<u>CURVE 28</u>		189.8	0.000291	290.4	0.000313		
310.9	0.000408	200.0	0.000317	289.3	0.000395			<u>CURVE 36*</u>		<u>CURVE 48*</u>			
<u>CURVE 5</u>		222.2	0.000332	289.6	0.000396	310.9	0.00443	<u>CURVE 37</u>		290.4	0.000430		
310.9	0.000175	239.2	0.000346	290.0	0.000398			297.1	0.000415	<u>CURVE 49*</u>			
<u>CURVE 6</u>		255.5	0.000361	309.9	0.000418	310.9	0.00377	<u>CURVE 38</u>		290.4	0.000348		
310.9	0.000175	272.1	0.000375	310.6	0.000415	<u>CURVE 30</u>		296.6	0.000334	<u>CURVE 50</u>			
310.9	0.000153	288.8	0.000389	311.1	0.000418			<u>CURVE 39</u>		274.2	0.000277		
<u>CURVE 7*</u>		311.1	0.000420	312.9	0.000419	310.9	0.00208	296.2	0.000300	275.9	0.000307		
310.9	0.000153	221.7	0.000271	<u>CURVE 21*</u>				<u>CURVE 40*</u>		277.6	0.000313*		
<u>CURVE 8*</u>		246.7	0.000384	296	0.000407	322.6	0.000433	290.4	0.000361	282.6	0.000337		
310.9	0.000453	290.2	0.000615	298.8	0.000421*	331.5	0.000476	<u>CURVE 32*</u>		284.8	0.000346*		
<u>CURVE 9*</u>		294.2	0.000586	299.1	0.000421			287.1	0.000368*	287.1	0.000397*		
310.9	0.000173	302.2	0.000598	310.2	0.000435*			289.8	0.000415*	290.4	0.000433*		
<u>CURVE 10*</u>		312.2	0.000435	312.2	0.000435	271.5	0.000490						
310.9	0.000173	319.0	0.000443*	319.0	0.000443*								
<u>CURVE 11*</u>		320.2	0.000443										
310.9	0.000173	219.7	0.000258										
<u>CURVE 12*</u>		295.7	0.000594										



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 0.0059 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 μ m 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	T	k
<u>CURVE 1</u>		<u>CURVE 9</u>		<u>CURVE 17</u>		<u>CURVE 25 (cont.)</u>		<u>CURVE 28</u>	
222.0	0.000264	310.9	0.0000358	310.9	0.000571	398.0	0.000229*	186.5	0.000402
238.7	0.000281	<u>CURVE 10</u>		p(mm Hg) k		603.6	0.000233		
255.4	0.000300	310.9	0.0000476	<u>CURVE 22</u>		798.0	0.000243		
272.2	0.000319	<u>CURVE 11</u>		<u>T = 49.4 K</u>		831.9	0.000388		
288.9	0.000336	310.9	0.000116	<u>CURVE 26</u>					
305.5	0.000355	<u>CURVE 12</u>		<u>T = 128.5 K</u>					
<u>CURVE 2</u>		310.9	0.00498	0.322 0.000315					
222.0	0.000254	<u>CURVE 13</u>		1.03 0.000401					
238.7	0.000271	310.9	0.00125	7.00 0.000469					
255.4	0.000291	<u>CURVE 14</u>		28.0 0.000486					
272.2	0.000312	310.9	0.00445	62.9 0.000491*					
288.9	0.000332	<u>CURVE 15</u>		195.9 0.000495*					
305.5	0.000356	310.9	0.00332	396.3 0.000500					
<u>CURVE 3</u>		<u>CURVE 16</u>		322.0 0.000506					
222.0	0.000250	310.9	0.00250	<u>CURVE 23</u>					
238.7	0.000275	<u>CURVE 17</u>		<u>T = 154.8 K</u>					
255.4	0.000300*	310.9	0.00415	0.0089 0.000360					
272.2	0.000327	<u>CURVE 18</u>		0.0847 0.000205					
288.9	0.000353	310.9	0.00332	0.791 0.000653					
305.5	0.000384	<u>CURVE 19</u>		<u>CURVE 24</u>					
<u>CURVE 4</u>		310.9	0.00116	<u>T = 125.1 K</u>					
222.0	0.000250	<u>CURVE 20</u>		0.0104 0.0000405					
238.7	0.000275	310.9	0.000750	0.243 0.000250					
255.4	0.000300*	<u>CURVE 21</u>		0.625 0.000515					
272.2	0.000327	310.9	0.00415	2.01 0.000711					
288.9	0.000353	<u>CURVE 22</u>		4.00 0.000812					
305.5	0.000384	310.9	0.00332	35.0 0.000933					
<u>CURVE 5</u>		<u>CURVE 23</u>		303.4 0.000983					
222.0	0.000250	310.9	0.00116	501.4 0.000987					
238.7	0.000275	<u>CURVE 24</u>		<u>CURVE 25</u>					
255.4	0.000300*	310.9	0.00415	<u>T = 109.2 K</u>					
272.2	0.000327	<u>CURVE 25</u>		0.0090 0.0000258					
288.9	0.000353	310.9	0.00332	0.266 0.000138					
305.5	0.000384	<u>CURVE 26</u>		1.48 0.000192					
<u>CURVE 6</u>		310.9	0.00116	5.00 0.000210					
222.0	0.000250	<u>CURVE 27</u>		20.0 0.000220					
238.7	0.000275	310.9	0.00415	50.0 0.000224					
255.4	0.000300*	<u>CURVE 28</u>		200.0 0.000227					
272.2	0.000327	310.9	0.00332						
288.9	0.000353	<u>CURVE 29</u>							
305.5	0.000384	310.9	0.00116						

* 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	325-328			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

CURVE 1

292.4 0.00158
 316.3 0.00155
 317.8 0.00154
 324.7 0.00154

CURVE 2

329.8 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		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> ($\bar{T}=310.9\text{K}$)			
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	310.9	0.00199
<u>CURVE 2*</u>			
310.9	0.000353	% of CO ₂	k
<u>CURVE 3*</u>			
310.9	0.0000541	<u>CURVE 14*</u> ($\bar{T}=310.9\text{K}$)	
<u>CURVE 4*</u>			
310.9	0.000352	0	0.00625
<u>CURVE 5*</u>			
310.9	0.0000252	25	0.00599
<u>CURVE 6*</u>			
310.9	0.00633	50	0.00561
<u>CURVE 7*</u>			
310.9	0.00509	75	0.00535
<u>CURVE 8*</u>			
310.9	0.00403	100	0.00505
<u>CURVE 9*</u>			
310.9	0.00157	% of F-12	k
<u>CURVE 10*</u>			
310.9	0.00395	in air	
<u>CURVE 15*</u> ($\bar{T}=310.9\text{K}$)			
<u>CURVE 1*</u>			
		0	0.00625
		25	0.00531
		50	0.00467
		75	0.00427
		100	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			0.66% 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
<u>CURVE 1*</u>	
293.2	0.00253
373.2	0.00300

* 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

CURVE 1*

293.2 0.00213
373.2 0.00253

CURVE 2*

293.2 0.00310

CURVE 3*

293.2 0.00167

CURVE 4*

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 0.00434

CURVE 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 1.4%; 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	106	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 0.386 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
CURVE 1* (T = 373.2K)			
3.40	0.00122	293.2	0.00121
5.80	0.00126		
7.70	0.00129	293.2	0.00105
9.95	0.00133		
17.00	0.00142		
T	k		
CURVE 2*			
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

CURVE 1*

323.2 0.00209

CURVE 2*

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 11.5%; 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)		(T = 293.2K)					
373.2	0.00227	33.2	0.00137	23.2	0.00138	293.8	0.00136	291.4	0.00136
		46.1	0.00138	33.2	0.00136				
		61.1	0.00137	37.7	0.00137	<u>CURVE 6*</u>		<u>CURVE 8*</u>	
<u>CURVE 2*</u>				46.1	0.00138	294.4	0.00137	293.2	0.00332
293.2	0.000669			52.0	0.00137				
373.2	0.00104			61.1	0.00137			293.2	0.00136
						<u>CURVE 9*</u>		<u>CURVE 10*</u>	

* 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

CURVE 1*

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	296.2	0.000389
				311	0.000410	311	0.000411
<u>CURVE 2*</u>		<u>CURVE 5*</u>		324.6	0.000436	324.6	0.000436
310.9	0.0000750	293.2	0.00469	<u>CURVE 7*</u>		<u>CURVE 9*</u>	
		373.2	0.00498	297.1	0.000404	310.9	0.00247
<u>CURVE 3*</u>				310.7	0.000418		
310.9	0.000400			324.8	0.000441	310.9	0.00246

*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*

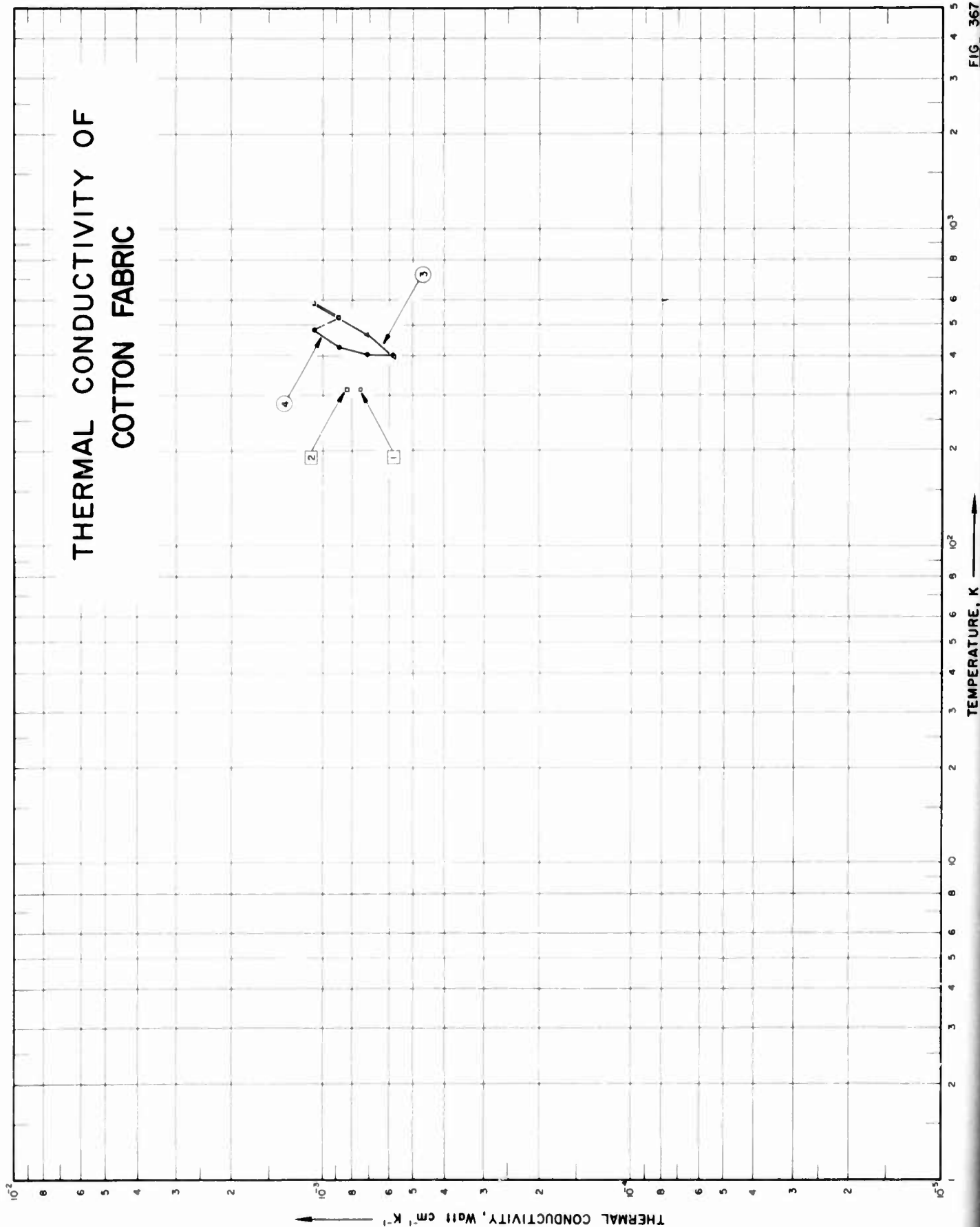
293.2 0.000477

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]

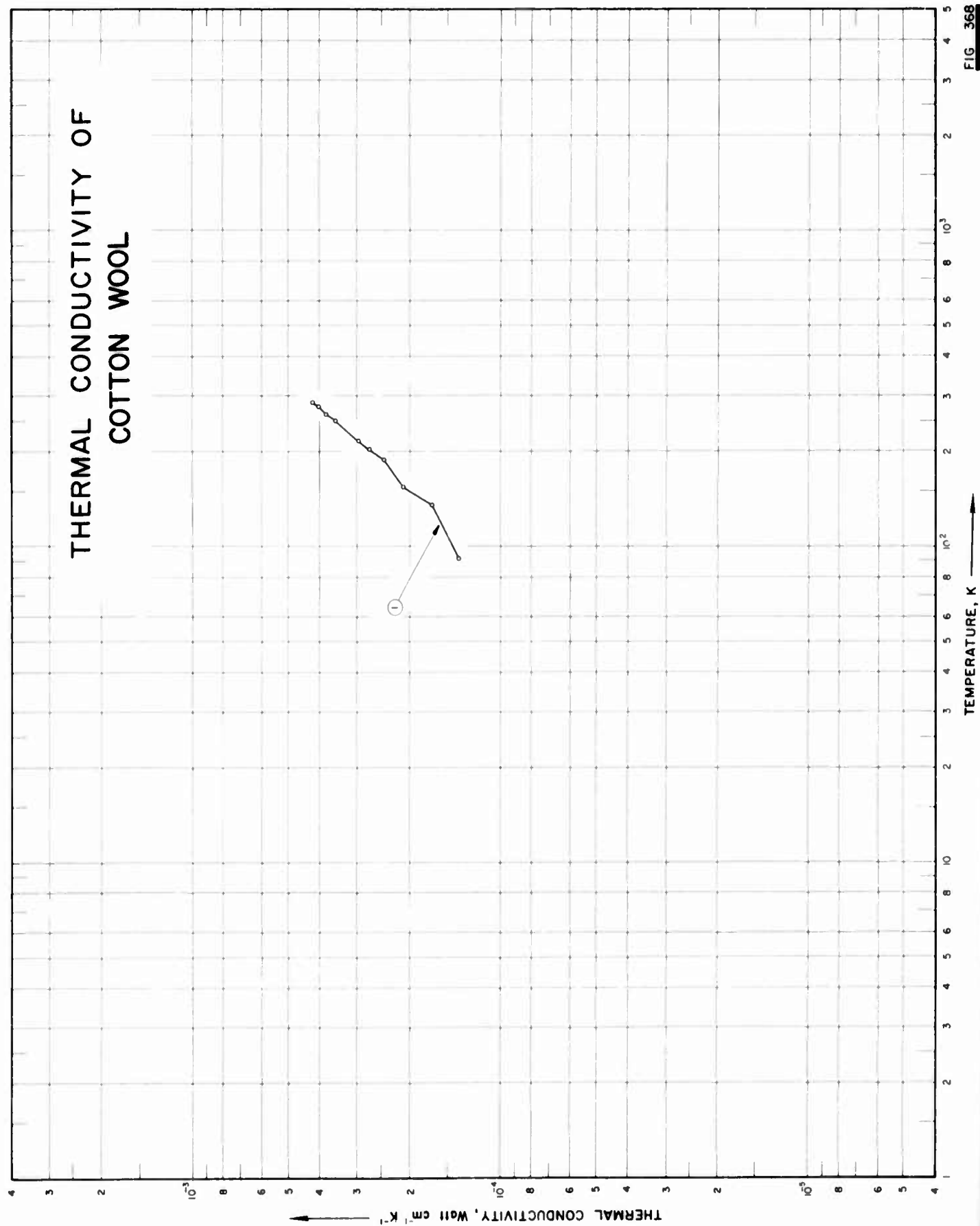
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	125	L	1923	313.2	1	Cotton fabric	3.63 cm dia disk specimen; measured under a load of 21 psi.
2	125	L	1923	313.2	1	Cotton fabric	Another run of 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% THERMAL CONDUCTIVITY OF COTTON WOOL

[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	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
<u>CURVE 1</u>	
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

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
CURVE 1*		CURVE 4*	
222.0	0.000287	310.9	0.00450
238.7	0.000303	CURVE 5*	
255.4	0.000322	310.9	0.00320
272.2	0.000340	CURVE 6*	
288.9	0.000361	310.9	0.00215
305.5	0.000382	CURVE 7*	
CURVE 2*		310.9	0.000537
310.9	0.000375	CURVE 3*	
CURVE 3*		310.9	0.000447

* 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 psi 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 psi 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 psi 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 psi 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 psi 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 psi 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>	
455.8	0.000450	565.5	0.000523	674.1	0.000666	449.4	0.00143	551.8	0.000291
<u>CURVE 2*</u>		<u>CURVE 5*</u>		<u>CURVE 8*</u>		<u>CURVE 11*</u>		<u>CURVE 14*</u>	
459.1	0.000424	563.6	0.000507	674.9	0.000659	447.6	0.000208	551.2	0.000244
<u>CURVE 3*</u>		<u>CURVE 6*</u>		<u>CURVE 9*</u>		<u>CURVE 12*</u>		<u>CURVE 15*</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
								<u>CURVE 16*</u>	
								663.3	0.000320
								<u>CURVE 17*</u>	
								665.1	0.000346
								<u>CURVE 18*</u>	

* 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 0.003524 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 13.5 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 21 mm Hg vacuum and 3.2 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 0.000917	
<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
CURVE 1*	
222.0	0.000304
238.7	0.000326
255.4	0.000348
272.2	0.000369
288.9	0.000394
305.5	0.000414

* 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
<u>CURVE 1*</u>	
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	T	k	T	k
<u>CURVE 1*</u>		<u>CURVE 4*</u>		<u>CURVE 7*</u>	
322.8	0.000563	322.8	0.000573	322.8	0.000544
<u>CURVE 2*</u>		<u>CURVE 5*</u>		<u>CURVE 8*</u>	
322.8	0.000610	322.8	0.000513	322.8	0.000551
<u>CURVE 3*</u>		<u>CURVE 6*</u>		<u>CURVE 9*</u>	
322.8	0.000554	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 .
2	186	L	1928	467-958	2.5	Sil-o-cel coarse grade; B	Similar to the above specimen except packing density 0.352 g cm ⁻³ .

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

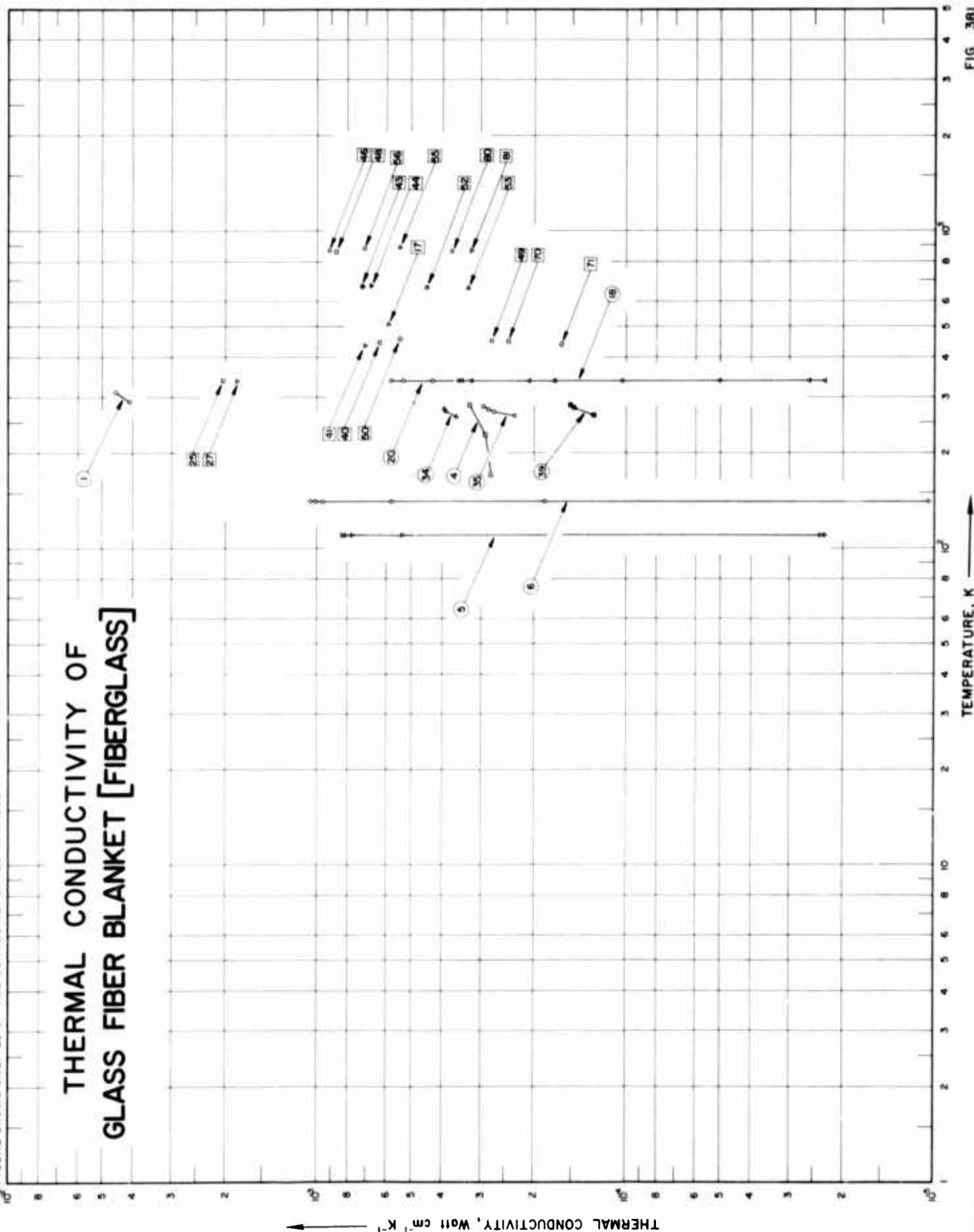
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k
CURVE I*	
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]



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 0.0651 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 0.0058 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 0.0651 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 0.00035 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 ₃ 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 18.4 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	884.4	±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, 28.5 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, 28.5 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, 28.5 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.

T	k	p(mm)	k	p(mm)	k	p(mm)	k	p(mm)	k
CURVE 1 T = 109.3K									
230.7	0.00407	0.0075	0.0000130	0.0080	0.0000201	0.0058	0.00000753	0.0003	0.0000793
331.7	0.00453	0.118	0.0000611	0.098	0.0000783	0.228	0.0000657	0.0011	0.0000793
CURVE 2*									
		1.08	0.000111	0.927	0.000133	1.19	0.000110	0.003	0.0000808
		13.5	0.000132	13.0	0.000153	13.0	0.000144	0.01	0.0000865
230.1	0.00412	51.5	0.000134	54.5	0.000156	51.0	0.000151	0.027	0.0000995
330.8	0.00452	200	0.000136	205.0	0.000158	220.5	0.000156	0.095	0.000144
CURVE 3*									
		400	0.000140	397.0	0.000161	418.5	0.000157	0.2	0.000187
		599	0.000146	599.0	0.000171	602.5	0.000158	0.5	0.000252
230.8	0.00402					788.0	0.000159	1	0.000322
331.2	0.00446							5	0.000398
CURVE 4 T = 140.5K									
		0.0668	0.0000130	0.0071	0.0000180	0.0052	0.0000100	20	0.000418
		0.118	0.0000649	0.113	0.0000883	0.175	0.0000644	76	0.000423
170.7	0.000279	0.968	0.000128	1.43	0.000163	0.971	0.000119	200	0.000424
228.2	0.000291	12.0	0.000162	11.5	0.000186	12.0	0.000178	760	0.000425
283.2	0.000326	50.0	0.000168	53.5	0.000191	55.0	0.000189	CURVE 20 T = 338.7K	
	k	200.5	0.000171	195.5	0.000194	220.5	0.000194	0.0013	0.000180*
		395.0	0.000173	395.0	0.000196	494.0	0.000196	0.003	0.000187*
CURVE 5 T = 110K									
		586.0	0.000177	598.0	0.000204	577.0	0.000197	0.01	0.000202*
0.0095	0.0000230	CURVE 9*		CURVE 13*		T		0.027	0.000231*
0.207	0.000237	T = 109.7K		T = 109.8K		k		0.1	0.000322*
1.16	0.000534	0.0063	0.0000243	0.0064	0.0000113			0.35	0.000433
15.5	0.000774	0.123	0.000232	0.123	0.000109			1	0.000526
52.5	0.000807	0.886	0.000558	0.88	0.000345			3.5	0.000577
207	0.000823*	15.0	0.000792	17.0	0.000752			13	0.000581*
207	0.000828	51.5	0.000822	53.5	0.000807			65	0.000583*
398		202.0	0.000846	201.5	0.000840			200	0.000584*
594	0.000831*	367.0	0.000853	409.5	0.000851			760	0.000584*
		602.5	0.000858	593.0	0.000859			CURVE 21* T = 338.7K	
CURVE 6 T = 141K									
		CURVE 10*		CURVE 14*		CURVE 18		CURVE 22*	
		T = 140.8K		T = 141.3K		T = 338.7K		T = 422.1K	
0.0052	0.0000105	0.0060	0.0000213	0.0054	0.0000130	0.0085	0.0000231	0.00025	0.0000101
0.128	0.000185	0.151	0.000272	0.089	0.0000891	0.00175	0.0000231*	76	0.000326
1.11	0.000579	1.17	0.000682	1.06	0.000409	0.0065	0.0000231*	760	0.000340
14.0	0.000955	12.0	0.000986	15.0	0.000904	0.015	0.000260	CURVE 29* T = 338.7K	
52.5	0.00101	52.5	0.00104	56.0	0.00101	0.10	0.0000505	CURVE 29*	
207.5	0.00104*	210.5	0.00107	212.0	0.00105	0.35	0.000104	T = 338.7K	
400	0.00105	402.0	0.00108	399.5	0.00107	4.5	0.000209	0.0012	0.0000346
606	0.00105*	598.5	0.00109	600.0	0.00108	17.5	0.000346	760	0.000421
						200	0.000355		
						760	0.000356*		

* Not shown on plot

DATA TABLE NO. 381 (continued)

p(mm.)	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
		273.2	0.000215				
<u>CURVE 32*</u>							
<u>T = 338.7K</u>							
760	0.000234	262.2	0.000128	453.1	0.000590	616.3	0.000613
		279.2	0.000149				
<u>CURVE 33*</u>							
<u>T = 338.7K</u>							
760	0.000167	283.2	0.000152	458.1	0.000543	609.0	0.000637
<u>CURVE 34</u>							
<u>T = 338.7K</u>							
760	0.000167	445.3	0.000633	665.4	0.000448	773.6	0.000749
<u>CURVE 35</u>							
<u>T = 338.7K</u>							
260.7	0.000360	437.9	0.000703	664.7	0.000329	765.2	0.000720
270.2	0.000389						
275.7	0.000395						
		463.8	0.000620	664.8	0.000343	768.0	0.000642
<u>CURVE 36*</u>							
<u>T = 338.7K</u>							
263.2	0.000232						
269.2	0.000273						
274.7	0.000285						
280.2	0.000296						
		670.3	0.000670	884.4	0.000708	876.7	0.000737
<u>CURVE 37*</u>							
<u>T = 338.7K</u>							
263.2	0.000291						
270.7	0.000300						
275.2	0.000307						
281.2	0.000314						
		863.3	0.000907	443.1	0.000687	448.3	0.000244
<u>CURVE 38*</u>							
<u>T = 338.7K</u>							
260.7	0.000291						
271.7	0.000325						
277.2	0.000316						
281.6	0.000322						
286.2	0.000331						
		864.7	0.000869	448.9	0.000737	415.4	0.000166

* 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	0.000972
<u>CURVE 2*</u>	
193.7	0.000579
246.5	0.000734
<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
<u>CURVE 1*</u>	
200.0	0.000361
222.2	0.000389
239.2	0.000404
255.5	0.000433
272.1	0.000447
288.1	0.000476

* No graphical presentation

SPECIFICATION TABLE NO. 384 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. 384 THERMAL CONDUCTIVITY OF MONOLITHIC WALL

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

T	k	T	k
CURVE 1*		CURVE 4*	
297.1	0.0175	297.1	0.00829
CURVE 2*		CURVE 5*	
297.1	0.0179	297.1	0.00538
CURVE 3*		CURVE 6*	
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⁻¹ K⁻¹]

T k

CURVE 1*

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

CURVE 2*

190.0 0.000348

* No graphical presentation

SPECIFICATION TABLE NO. 397 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 0.248 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 0.248 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 0.248 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; density 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>		<u>CURVE 7*</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 8*</u>	
288.9	0.000588	310.9	0.00613
305.5	0.000611	283.2	0.00578
<u>CURVE 2*</u>		255.4	0.00540
222.0	0.000424	230.4	0.00507
238.7	0.000441	<u>CURVE 9*</u>	
255.4	0.000460	310.9	0.00483
272.2	0.000477	283.2	0.00448
288.9	0.000495	255.4	0.00410
305.5	0.000513	230.4	0.00377
<u>CURVE 3*</u>		<u>CURVE 10*</u>	
222.0	0.000411	310.9	0.00367
238.7	0.000430	283.2	0.00339
255.4	0.000447	<u>CURVE 11*</u>	
272.2	0.000466	310.9	0.00126
288.9	0.000483	283.2	0.00118
305.5	0.000502	255.4	0.00107
<u>CURVE 4*</u>		230.4	0.00100
310.9	0.000509	<u>CURVE 12*</u>	
<u>CURVE 5*</u>		316.5	0.000117
310.9	0.000108	<u>CURVE 13*</u>	
<u>CURVE 6*</u>		194.3	0.0000855
222.2	0.000411	242.1	0.0000979
239.2	0.000428	<u>CURVE 14*</u>	
255.5	0.000447	194.3	0.0000855
272.1	0.000466	242.1	0.0000979
288.8	0.000483	<u>CURVE 15*</u>	
305.3	0.000502	194.3	0.0000855
<u>CURVE 16*</u>		242.1	0.0000979

* 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⁻¹ K⁻¹]

T	k
<u>CURVE 1*</u>	
222.0	0.000286
238.7	0.000304
255.4	0.000322
272.2	0.000340
288.9	0.000361
305.5	0.000384
<u>CURVE 2*</u>	
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

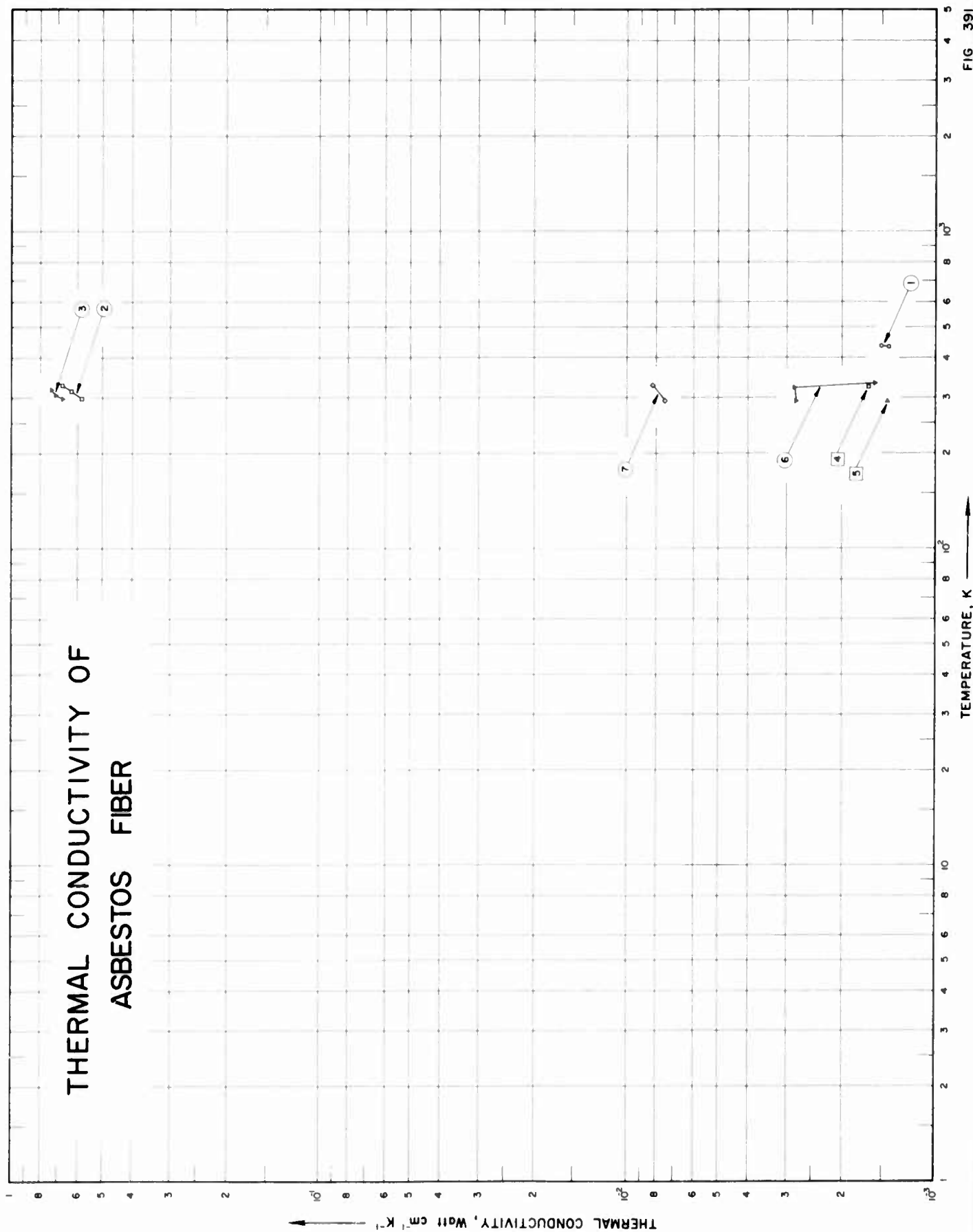
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	108	L	1920	313, 343			9 in. dia x 0.96 in. thick; specific gravity 0.15.

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 .

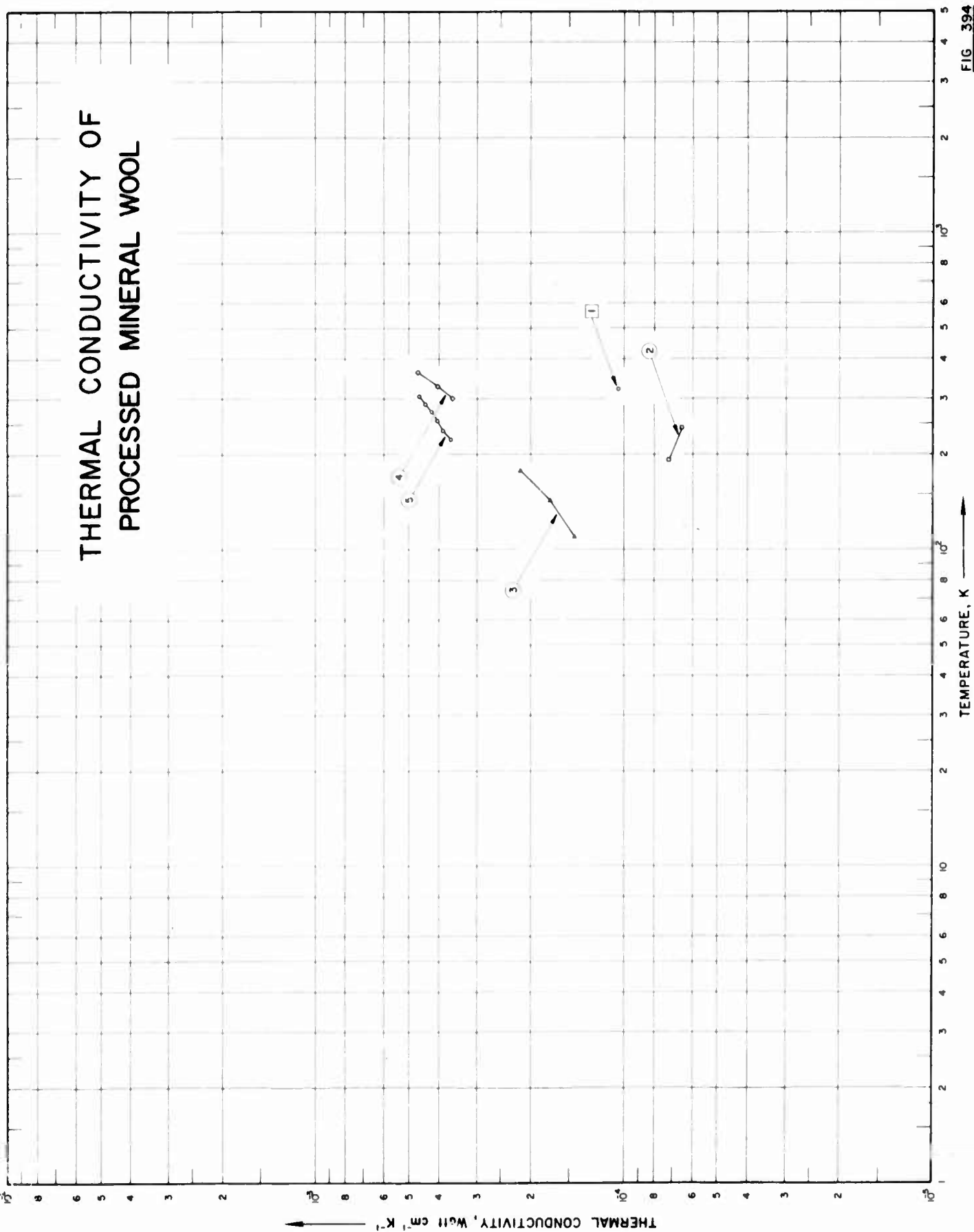
DATA TABLE NO. 393 THERMAL CONDUCTIVITY OF MINERAL FIBER

[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹ K⁻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	0.000418
<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



SPECIFICATION TABLE NO. 394 THERMAL CONDUCTIVITY OF MINERAL WOOL, PROCESSED

[For Data Reported in Figure and Table No. 394]

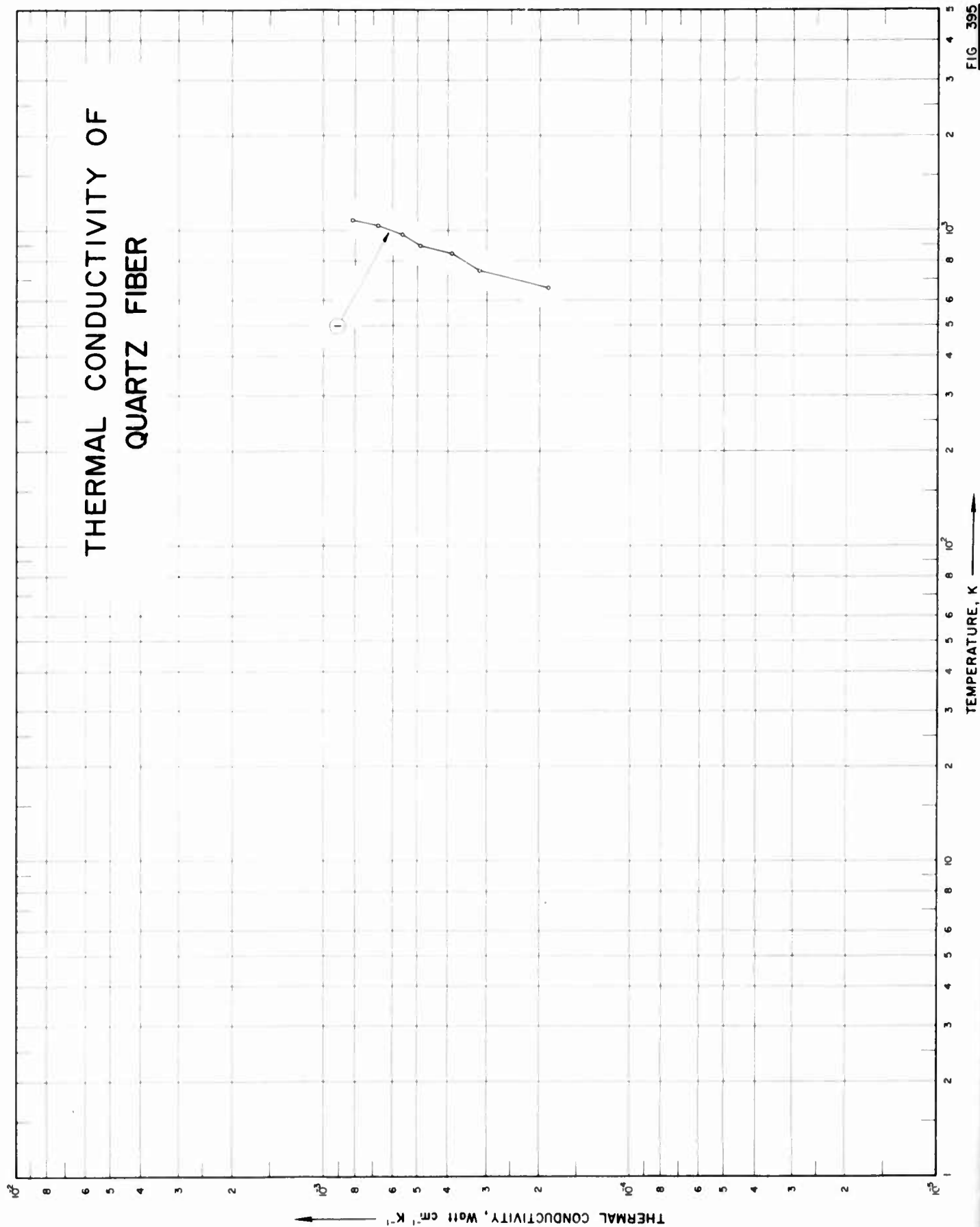
Curve No.	Ref. No.	Method Used	Year	Temp. Range, K	Reported Error, %	Name and Specimen Designation	Composition (weight percent), Specifications and Remarks
1	128	L	1946	323-7		Mineral wool board	2.02 in. thick; density 0.229 g cm ⁻³ .
2	128	L	1946	193-244		Mineral wool board	Similar to the above specimen 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
<u>CURVE 1</u>	
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

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 %.

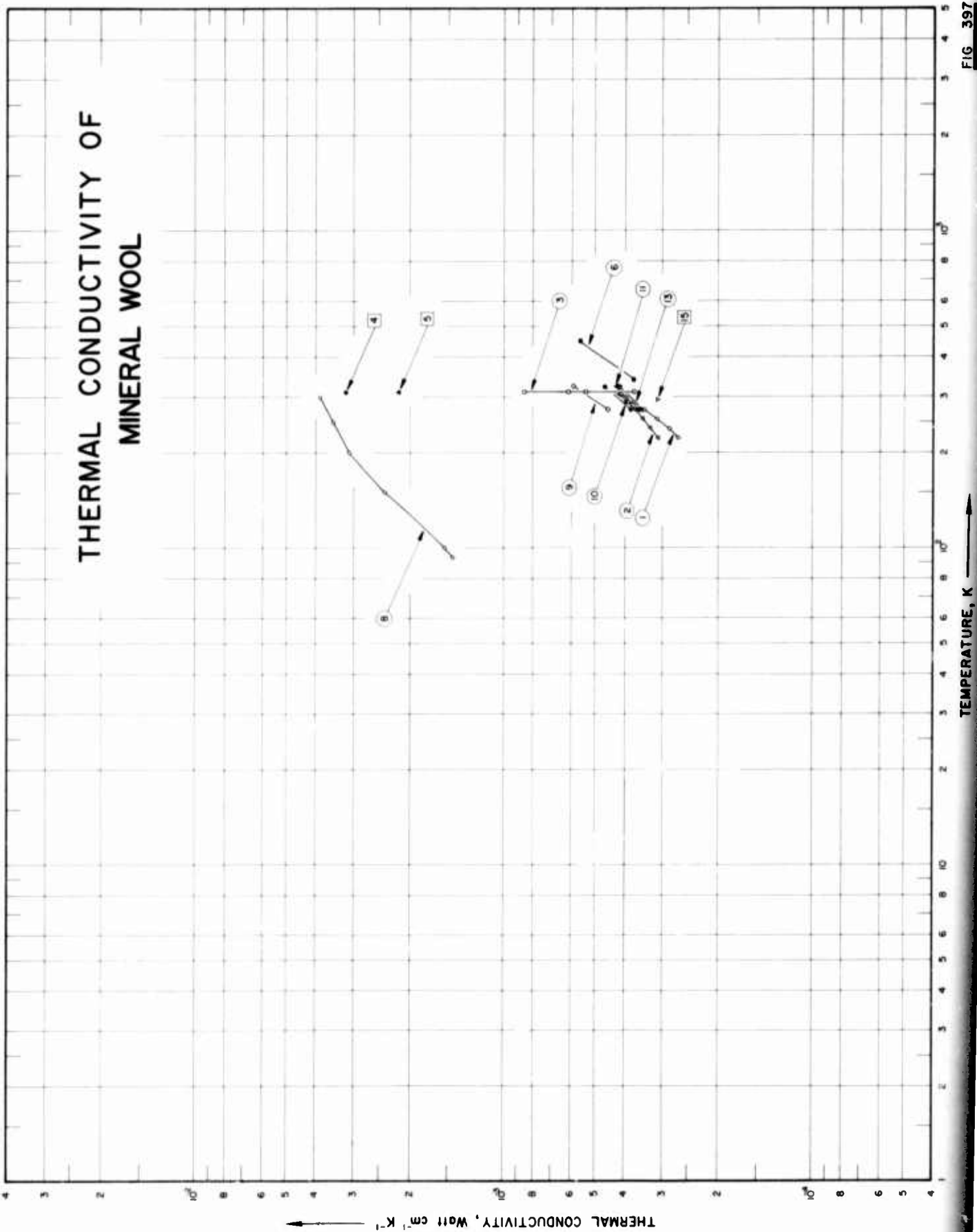
DATA TABLE NO. 396 THERMAL CONDUCTIVITY OF ROCK CORK

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

T	k
CURVE 1*	
200.0	9.000346
222.2	0.000375
239.2	0.000389
255.5	0.000411
272.1	0.000433
288.1	0.000462

* No graphical presentation

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			Modulated; 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		
305.5	0.000414	305.3	0.000414	293.2	0.00031
CURVE 2		CURVE 8			
T	k	T	k		
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			
T	k	T	k		
T = 310.9K		273.2	0.000453		
		323.2	0.000593		
CURVE 10					
atm.	k				
9.0	0.0000851	273.2	0.000384		
3.0	0.0000613	323.2	0.000465		
0.02	0.0000534				
CURVE 11					
T	k				
CURVE 4		273.2	0.000360		
310.9	0.00318	323.2	0.000430		
CURVE 5					
T	k				
CURVE 12*		273.2	0.000360		
310.9	0.00218	323.2	0.000430		
CURVE 6					
T	k				
339.0	0.000375	273.2	0.000349		
450.2	0.000562	323.2	0.000418		

* 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.

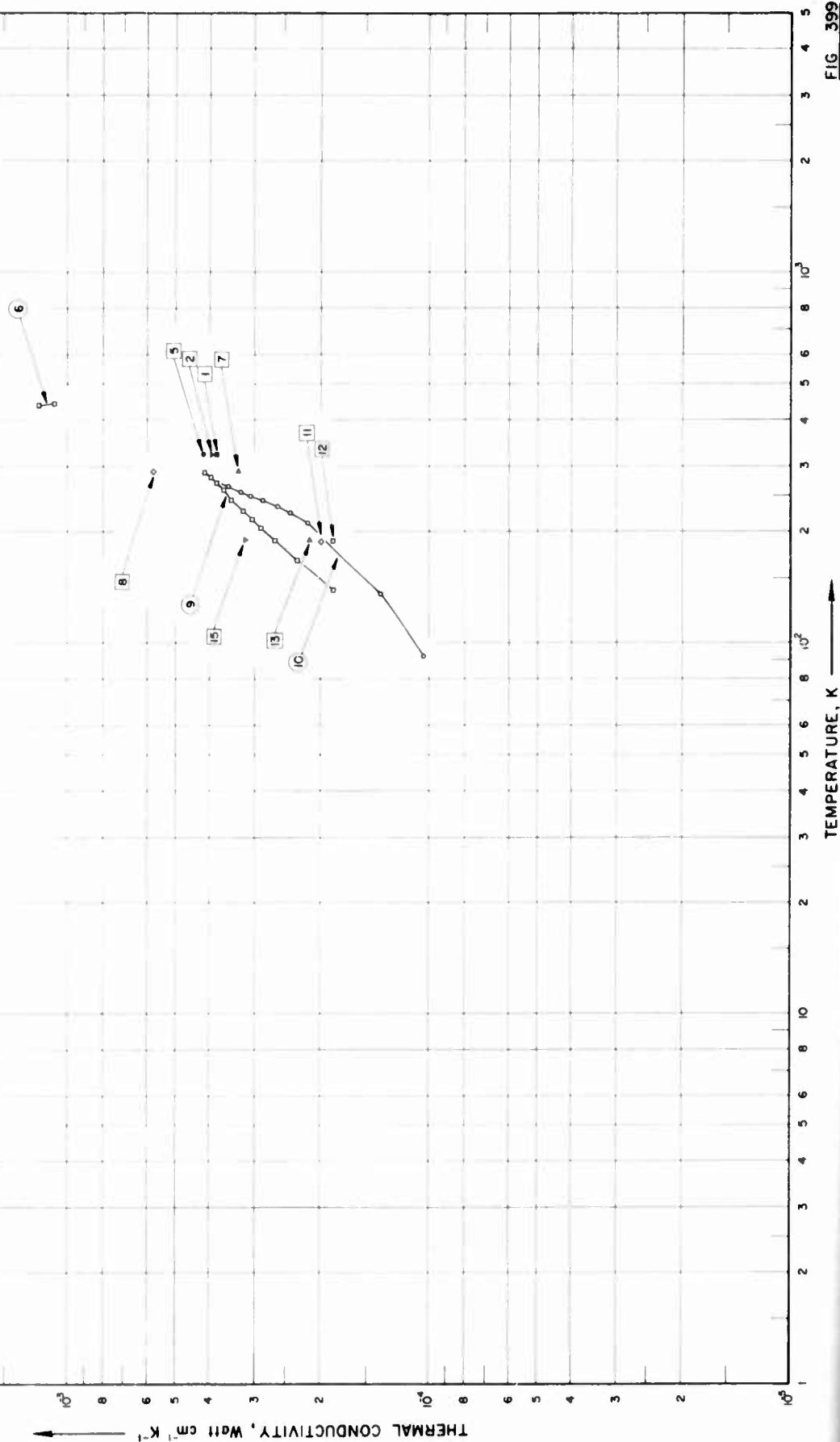
DATA TABLE NO. 398 THERMAL CONDUCTIVITY OF MYSTIC SLAG
[Temperature, T, K; Thermal Conductivity, k, Watt cm⁻¹K⁻¹]

T	k	T	k	T	k
CURVE 1*		CURVE 3*		CURVE 5*	
287.3	0.00325	287.3	0.00253	261.8	0.0116
CURVE 2*		CURVE 4*		CURVE 6*	
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

THERMAL CONDUCTIVITY OF SLAG WOOL



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>		<u>CURVE 10</u>	
323.2	0.000384	92.2	0.000104
		136.5	0.000138
<u>CURVE 2</u>		211.2	0.000218
323.2	0.000395	224.5	0.000242
		234.2	0.000261
<u>CURVE 3*</u>		243.2	0.000286
323.2	0.000395	249.6	0.000307
		256.2	0.000328
<u>CURVE 4*</u>		265.2	0.000355
323.2	0.000407	274.2	0.000384*
		279.7	0.000405*
		284.2	0.000426*
<u>CURVE 5</u>		<u>CURVE 11</u>	
323.2	0.000418	187.3	0.000199
<u>CURVE 6</u>		<u>CURVE 12</u>	
438.1	0.00121	188.3	0.000185
443.8	0.00109	<u>CURVE 13</u>	
<u>CURVE 7</u>		189.3	0.000216
290.4	0.000332	<u>CURVE 14*</u>	
<u>CURVE 8</u>		190.2	0.000232
290.4	0.000577	<u>CURVE 15</u>	
<u>CURVE 9</u>		190.2	0.000317
139.2	0.000184		
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	0.0029

* 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		4.54% 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	k	T	k
CURVE 1*		CURVE 3*	
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		
583.2	0.00102		
613.2	0.00096		

* No graphical presentation

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Aluminum alloys (specific types) (continued)			Aluminum oxide (Al_2O_3) (continued)		
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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 ($3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$)	2	254
Aluminum borosilicate complex, natural (see tourmaline)			Aluminum silicate + Aluminum oxide	2	334
Aluminum bronze	1	531, 532, 953	Alundum	2	456
Aluminum fluosilicate ($2\text{AlFO} \cdot \text{SiO}_2$)	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 [$\text{NH}_4\text{H}_2\text{PO}_4$] (see ammonium dihydrogen phosphate)		

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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 ⁷)			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			

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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 _i	2	457	Beryllia (see beryllium oxide)		
Barium oxide + Strontium oxide	2	337	Beryllium	1	18
Barium oxide + Strontium oxide + ΣX _i	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 _i	1	929
BaTiO ₃	2	257	Beryllium + Magnesium	1	499
BaO · 2TiO ₃	2	260	Beryllium + Magnesium + ΣX _i	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 _{0.999} Ba _{0.991} 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

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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	$Bi_{1,75}Sb_{0,25}Te_{3,13}$	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_i	1	935
Grade I	2	128	Bismuth + Lead	1	508
Grade II	2	128	Bismuth + Lead + ΣX_i	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_i	2	461	Bismuth alloys (specific types)		
Beryllium oxide + Magnesium oxide + ΣX_i	2	464	Hutchin's alloy	1	512
Beryllium oxide + Thorium dioxide + ΣX_i	2	467	Lipowitz alloy	1	939
Beryllium oxide + Uranium dioxide	2	347	Rose metal	1	939
Beryllium oxide + Zirconium dioxide + ΣX_i	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

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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_4C)	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_2O_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 inter-metallic 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			

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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,

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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)		

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Cadmium germanium phosphide (CdGeP_2)	2	758	$\text{Ca}_{2.02}\text{Pb}$	1	1271
Cadmium telluride [CdTe] (see cadmium - tellurium intermetallic compound)			$\text{Ca}_{2.10}\text{Pb}$	1	1271
Calcia (see calcium oxide)			$\text{Ca}_{2.18}\text{Pb}$	1	1271
Calcite	2	761	Carbofrax brick	2	897
Calcium - lead intermetallic compounds			Carbofrax carborundum brick	2	895
Ca_xPb_y	1	1270	Carbon	2	5
Ca_2Pb	2	1271	Diamond	2	9
$\text{Ca}_{2.02}\text{Pb}$	1	1271	Graphite (see each individual graphite)		
$\text{Ca}_{2.10}\text{Pb}$	1	1271	Lampblack	2	6
$\text{Ca}_{2.18}\text{Pb}$	1	1271	Petroleum coke	2	6
Calcium - tin intermetallic compound			Carbon + Oxygen	2	764
Ca_2Sn	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_2Sn] (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_2Sn	1	1273
Ca_2Pb	1	1271			

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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)		
			Cement		
			Hydraulic (see Portland cement)	2	861
			Portland	2	861
			Slag	2	861
			Slag - Portland	2	861
Cast irons (specific types)			Cement porous brick	2	890
Black temper	1	1137	Ceramic brick	2	890
Gray	1	1130, 1135	Ceramics, miscellaneous	2	915
Heat resistant	1	1146	Cerium	1	50
High duty	1	1133, 1135	Cerium dioxide (CeO ₂)	2	144
Hot mold, gray	1	1135	Cerium dioxide + Magnesium oxide	2	350
Nickel-resist	1	1204	Cerium dioxide + Uranium dioxide	2	353
Nr 1510, spherical	1	1222	Cerium sulfides		
Nr 1520, pearlitic matrix	1	1222	CeS	2	697
Soft, gray	1	1135	Ce ₂ S ₃	2	698
White	1	1130, 1135	Cermets (see each individual cermet)		
White temper	1	1137	Cesium	1	54
Cd ₃ As ₂ + Zn ₃ As ₂	1	1396	Cesium bromide (CsBr)	2	565
Cd _{0.04} Hg _{0.96} Te	1	1408	Cesium iodide (CsI)	2	561
Cd _{0.07} Hg _{0.93} Te	1	1408	Chamotte brick	2	890
CdSb	1	1264	Chamotte clay	2	804
CdSb + ZnSb	1	1397	Channel carbon black	2	764
CdSb • ZnSb	1	1398	Charcoal	2	1157
2CdSb • 3ZnSb	1	1413	Chlorine	3	17
3CdSb • 2ZnSb	1	1398	Chlorodifluoromethane [ClCHF ₂] (see Freon 22)		
3CdSb • 7ZnSb	1	1413	Chloroform (CHCl ₃)	3	161
7CdSb • 3ZnSb	1	1398	Chloroform - ethyl ether system	3	470
CdTe	1	1267	Chloromethane [CH ₃ Cl] (see methyl chloride)		
Cd _{1.6} Zn _{1.4} As ₂	1	1396	Chloroprene rubber	2	983
Cd ₂ ZnAs ₂	1	1396	Chlorotrifluoromethane [ClCF ₃] (see Freon 13)		
Cd _{2.8} Zn _{0.5} As ₂	1	1396			
Cedar	2	1062			
Ceiba (see kapok)					

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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_i	1	947
Chromel 502	1	1210	Cobalt + Iron + ΣX_i	1	950
Chromel A	1	698	Cobalt + Nickel	1	528
Chromel C	1	1036	Cobalt + Nickel + ΣX_i	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_i	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_i	2	473	WI 52	1	948
Cinder aggregate concrete	2	869, 870	X-40	1	948
Clays	2	803	(tri)Cobalt strontium metatitanate ($\text{Co}_3\text{SrTiO}_3$)	2	271
Ashkhabad	2	804, 805	Cobalt zinc ferrate [$\text{Co}(\text{Zn})\text{Fe}_2\text{O}_4$]	2	272
Beskhudnikov	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_i	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_i	1	955
Portland cement	2	871	Copper + Cadmium	1	541
Sand cement	2	874	Copper + Cadmium + ΣX_i	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_i	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_i	1	960
Constantan	1	564	Copper + Lead	1	554
Contracid	1	1036	Copper + Lead + ΣX_i	1	961
Contracid B 7 M	1	1036	Copper + Manganese	1	557
Copoly(chloroethylene-vinyl-acetate)	2	943	Copper + Manganese + ΣX_i	1	964
Copoly-[1,1-difluoro-ethylene-hexafluoropropene], Viton A rubber (see Viton rubber)			Copper + Nickel	1	561
Copoly(formaldehyde-urea)	2	944	Copper + Nickel + ΣX_i	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_i	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	Cuppralloy type 5, Russian	1	543
Copper + Tin + ΣX_i	1	975	Cupro nickel	1	970
Copper + Zinc	1	588	Cupro nickel, NM-81, Russian	1	562
Copper + Zinc + ΣX_i	1	979	Eureka	1	563
Copper + Zirconium + ΣX_i	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 $[\text{Cl}_2\text{CF}_2]$ (see Freon 12)		
Cuprum (see copper)			Dichlorofluoromethane $[\text{Cl}_2\text{CHF}]$ (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 $[\text{C}_3\text{H}_8]$ (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 $[(\text{C}_6\text{H}_5)_2\text{NH}]$	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 $[(\text{C}_6\text{H}_5)_2\text{O}]$	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	Ethanol - argon system Dimethyl ether	3	454
Duralumin	1	896	Ethanol - methyl formate system Dimethyl ether	3	474
Duranickel	1	1015	Ethanol - propane system Dimethyl ether	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	Excelsior	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	Ferrochromium, 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
			Ferrovanadium, 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 ($\text{CH}_2\text{OHCHOHCH}_2\text{OH}$)	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_xCu_y	1	1281
			CuAu	1	1282
			Cu_3Au	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			
Graphite	2	53	Grade CS	2	54, 55, 56, 64
Acheson	2	73			
Boronated	2	61	Grade CS-112	2	63
British reactor grade A	2	69	Grade CS-312	2	63
British reactor grade carbon	2	69, 70	Grade CSF	2	55
Brom-graphite	2	768	Grade CSF-MTR	2	63
Brookhaven	2	26	Grade EY 9	2	69, 70, 71
Canadian natural graphite	2	54			
Carbon resistor	2	73	Grade EY 9A	2	70
Deposited carbon	2	32	Grade G-5	2	60, 61
Domestic, Japan	2	56			
Fuel-filled	2	545, 548, 558	Grade G-9	2	60, 61
Grade 875 S	2	45	Grade GBE	2	54, 55
Grade 890 S	2	49	Grade GBH	2	55
Grade AGA	2	64	Grade H4LM	2	61
Grade AGHT	2	57	Grade JTA	2	70, 72
Grade AGOT	2	13			
Grade AGOT-KC	2	17	Grade L-117	2	63
Grade AGOT-CSF-MTR	2	17	Grade MH4LM	2	70
Grade AGSR	2	57, 58, 63, 64	Grade P1	2	35
Grade AGSX	2	64	Grade R-0008	2	60
Grade ATJ	2	20	Grade R0025	2	71
Grade ATL	2	64	Grade RT-0003	2	54
Grade ATL-82	2	71	Grade RVA	2	66, 67
Grade AUC	2	63, 64, 65	Grade RVD	2	67
Grade AWG	2	24	Grade SA-25	2	42
Grade CDG	2	65	Grade TS-148	2	59
			Grade TS-160	2	59

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_2Se_3	1	1295	Iron + Carbon + ΣX_1 (I) (C $\leq$ 2.00%)	1	1113
Indium - tellurium intermetallic compound In_2Te_3	1	1298	Iron + Carbon + ΣX_1 (II) (C $\leq$ 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_2Se_3] (see indium - selenium intermetallic compound)			Iron + Chromium + Nickel + ΣX_1 (II)	1	1164
Indium telluride [In_2Te_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_2Te_3	1	1403	Iron + Manganese + ΣX_1 (II)	1	1191
In_2Se_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_2Te_3	1	1298	Iron + Phosphor + ΣX_1 (I)	1	1216
In_2Te_3 + Cu_2Te + Ag_2Te	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

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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)			Knapic	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	Kuchin 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 250	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 [$(\text{CH}_3)_2\text{CO}$] (see acetone)					
Kh80 T, Russian	1	1019			

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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_i	1	992
Lead + Antimony + ΣX_i	1	991	Lithium + Sodium	1	655
Lead + Bismuth	1	640	Lithium + Sodium + ΣX_i	1	995
Lead + Indium	1	643	Lithium fluoride (LiF)	2	636
Lead + Silver	1	646	Lithium fluoride + Potassium fluoride + ΣX_i	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_i	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

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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_i	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_i	1	1001	Magnesium carbonate ($MgCO_3$)	2	776
Magnesium + Cobalt + ΣX_i	1	1004	Magnesium oxide (MgO)	2	158
Magnesium + Copper	1	666	Magnesium oxide + Beryllium oxide	2	371
Magnesium + Copper + ΣX_i	1	1005	Magnesium oxide + Calcium oxide + ΣX_i	2	477
Magnesium - germanium intermetallic compound			Magnesium oxide + (di)Chromium trioxide + ΣX_i	2	480
Mg_2Ge	1	1311	Magnesium oxide + Clay	2	374
Magnesium + Manganese	1	669	Magnesium oxide + (di)Iron trioxide + ΣX_i	2	483
Magnesium + Nickel	1	672	Magnesium oxide + Magnesium aluminate	2	375
Magnesium + Nickel + ΣX_i	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_i	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			

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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

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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_i	1	1013	Naphthalin [C ₁₀ H ₈] (see naphthalene)		
Molybdenum - silicon intermetallic com- pound			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

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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

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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 + EX ₁	1	1046
OKh 20N 60B	1	1022	Niobium + Tantalum + EX ₁	1	1049
"R" monel	1	1032	Niobium + Titanium + EX ₁	1	1052
			Niobium + Tungsten + EX ₁	1	1055
			Niobium + Uranium	1	713

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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 diphenyloxide)		
			Phoenix glass	2	924

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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 [$\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$]	2	688	Dyna	2	1144
Potassium dideuterium phosphate (KD_2PO_4)	2	680	Quartz glass	2	187, 188, 923, 924
Potassium dihydrogen arsenate (KH_2AsO_4)	2	785			
Potassium dihydrogen phosphate (KH_2PO_4)	2	684	Quartz sand	2	834, 835, 836, 837
Potassium hydrogen sulfate (KHSO_4)	2	691			
Potassium nitrate (KNO_3)	2	647	Queenstone grey limestone	2	821
Potassium phosphate, monobasic [KH_2PO_4] (see potassium dihydrogen phosphate)			Quick silver (see mercury)		
Potassium biphosphate [KH_2PO_4] (see potassium dihydrogen phosphate)			"R" monel	1	1032
Potassium diphosphate [KH_2PO_4] (see potassium dihydrogen phosphate)			Radon	3	84
Potassium rhodanide [KSCN] (see potassium thiocyanate)			Rama limestone	2	821
Potassium sulfocyanate [KSCN] (see potassium thiocyanate)			RCA N91	1	701
Potassium sulfocyanide [KSCN] (see potassium thiocyanide)			RCA N97	1	701
Potassium thiocyanate (KSCN)	2	788	Re_3As_7	1	1330
Powders (nonmetallic)	2	1040	Red brass	1	591
Praseodymium	1	281	Red brass, German	1	981
Promethium	1	285	Red brick	2	405, 492, 898
Propane (C_3H_8)	3	240	Red brick, hard burned	2	896
2-Propanone [$(\text{CH}_3)_2\text{CO}$] (see acetone)			Red brick, soft burned	2	896
Pseudo balsa	2	1060	Redwood	2	1084
Pyrex	2	499, 923, 924, 926, 927	Bark	2	1084
			Red wood fiber	2	1091
Pyrex 7740	2	499, 923, 924, 925, 926	Refractory insulating brick	2	892
			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

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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	Rubutex	2	981
Rhenium - selenium intermetallic compound			Rubutex 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
Rubutex rubber	2	981	Russian alloy	1	1192, 1218, 1222
Rubutex 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, Rubutex 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

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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	$Sb_{1.6}Bi_{0.5}Te_3$	1	1381
Samarium	1	305	$Sb_{1.6}Bi_{0.6}Te_{3.06}$	1	1384
Sand	2	833	$Sb_{1.6}Bi_{0.5}Te_{3.13}$	1	1382
Lowell	2	834, 835	$Sb_{1.6}Bi_{0.5}Te_{3.19}$	1	1384
Quartz	2	834, 835, 836, 837	$Sb_{1.6}Bi_{0.5}Te_{3.26}$	1	1384
Silica	2	441, 837	$Sb_{1.6}Bi_{0.4}Te_3$	1	1381
Sand cement concrete	2	874	$Sb_{1.6}Bi_{0.4}Te_{3.06}$	1	1384
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	$Sb_{1.8}Bi_{0.2}Te_{3.13}$	1	1383
Teapot	2	842	$Sb_2Se_3 + Ag_2Se + PbSe$	1	1379
Tensleep	2	841, 842	Sb_2Te_3	1	1241
Tripolite	2	842	$Sb_2Te_3 + Bi_2Te_3$	1	1380
Sandwiches (nonmetallic)	2	1044	$Sb_2Te_3 + In_2Te_3$	1	1386
Sandwiches (metallic - nonmetallic)	2	1047	Scandium	1	309
Sandy clay	2	805	Scotchply laminate (nonmetallic)	2	1029
Santowax R	2	1005	Sea-weed product	2	1128
Sapphire	2	93	Selenium	1	313
Sapphire, synthetic	2	95	Selenium + Bromine	1	754
Sapphire, Linde synthetic	2	94	Selenium + Cadmium	1	755
Satin walnut	2	1089	Selenium + Chlorine	1	756
Sawdust	2	1085	Selenium + Iodine	1	757
$Sb_{1.2}Bi_{0.8}Ti_{3.13}$	1	1381	Selenium + Thallium	1	758
$Sb_{1.33}Bi_{0.67}Te_{3.13}$	1	1381	Shamotte brick	2	894, 898
$Sb_{1.4}Bi_{0.6}Te_{3.06}$	1	1383	Sheep wool	2	1092
			Silat iron	1	1222, 1223
			Silica (see silicon dioxide)		

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			Crystalline	2	174
			Domestic (USA)	2	175
			Foamed fused silica	2	184
			Fused	2	183
			Linde silica	2	184
			Slip 10	2	189
Silica fire brick	2	894, 895, 905	Slip 18	2	188
			Quartz glass	2	187, 188
Silica glass	2	923, 925, 926	Silica gel	2	185
Silica glass, fused	2	925	Silica refractory brick	2	185
Silica sand	2	837	Slip cast fused silica	2	184
Silicate glass	2	511	Star-brand brick	2	185
Silicious brick	2	492, 902	Vitreous	2	184, 185, 187
Silicomanganese, Russian	1	1010, 1012	Silicon dioxide + Aluminum oxide	2	402
Silicon	1	326	Silicon dioxide + Aluminum oxide + ΣX_i	2	487
Silicon + Germanium	1	761	Silicon dioxide + Barium oxide + ΣX_i	2	495
Silicon + Iron	1	764	Silicon dioxide + Boron oxide + ΣX_i	2	498
Silicon alloy, ferrosilicon, Russian	1	765	Silicon dioxide + Calcium oxide	2	407
Silicon bronze	1	973	Silicon dioxide + Calcium oxide + ΣX_i	2	501
Silicon carbide (SiC)	2	585	Silicon dioxide + (di)Iron trioxide	2	410
Crystolon SiC	2	586	Silicon dioxide + Lead oxide + ΣX_i	2	504
SiC brick, refrax	2	586	Silicon dioxide + (di)Potassium oxide + ΣX_i	2	507
Silicon carbide, refractory (see refrax)			Silicon dioxide + (di)Sodium oxide + ΣX_i	2	510
Silicon carbide + Graphite	2	789	Silicone rubber	2	983
Silicon carbide - silicon cermets	2	718	Silk fabric	2	1105
Silicon carbide + Silicon dioxide	2	553	Sillimanite	2	454, 845
Silicon carbide + Silicon dioxide + ΣX_i	2	554	Sillimanite brick	2	902
Silicon carbide brick	2	895	Sillimanite refractory brick	2	902, 903
Silicon carbide brick, refrax	2	586, 906	Sil-O-Cel brick	2	896
Silicon enamel	2	921	Sil-O-Cel brick, calcined	2	896
Silicon monel	1	1032	Sil-O-Cel brick, natural	2	896
(tri)Silicon tetranitride (Si ₃ N ₄)	2	662			

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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			

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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	AISI 310	1	1168
Soft glass	2	511	AISI 316	1	1165, 1166, 1169, 1170
Soft steel	1	1126	AISI 347	1	1165, 1166, 1168
Soil	2	847			
Solder, soft	1	840	AISI 403	1	1149
Solex 2808 plate glass	2	923	AISI 410	1	1150
Solex 2808 X glass	2	925	AISI 420	1	1162
Solex "S" glass	2	925	AISI 430	1	1150, 1154
Solex "S" plate glass	2	923	AISI 440 C	1	1154
Spektral Kohle 1	2	54	AISI 446	1	1149, 1150, 1155, 1156
Spherical cast iron, Nr 1510	1	1222	AM 355 (Russian)	1	1168
Spinel	2	284, 369, 848	AS 21	1	1161
Spinel, natural ruby	2	284	Austenitic	1	1165, 1183
Spinel firebrick	2	905	Crucible HNM	1	1168
Spodumene	2	851	EI 572, Russian (same as stainless steel 18-8)	1	1168
Spruce	2	1086			
Sr ₂ Si	1	1343			
Sr ₂ Sn	1	1344			

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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, free 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,

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Ni-Cr steel (continued)	1	1210, 1213	Crucible	1	1204, 1213
Ni-Span-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

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Vacromin F	1	1213	Ta ₂ Be ₁₇ (see beryllium - tantalum interm. comp.)		
WF 100 (Russian)	1	1166	TaGe ₂	1	1345
Stibium (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_i	2	791	Tantalum + Niobium + ΣX_i	1	1062
Strontium oxide (SrO)	2	194	Tantalum + Tungsten	1	802
Strontium oxide + Lithium aluminate + ΣX_i	2	513	Tantalum + Tungsten + ΣX_i	1	1065
Strontium oxide + Lithium zirconium silicate + ΣX_i	2	514	Tantalum alloys (specific types)		
Strontium oxide + Titanium dioxide + ΣX_i	2	517	T 222	1	1066
Strontium oxide + Zinc oxide + ΣX_i	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
Sulfothiorine [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_i	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

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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)		
Trifluorotrifluoroethane [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 _i	1	1094
Tungsten - boron intermetallic compound			Uranium + Niobium	1	867
WB	1	1365	Uranium + Silicon	1	868
Tungsten + Iron + ΣX _i	1	1090	Uranium + Uranium dioxide	1	1442
Tungsten + Nickel + ΣX _i	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_i	2	527
Xenon - nitrogen system	3	377	Zinc oxide + Tin dioxide	2	438
Xenon - oxygen system	3	379	Zinc oxide + Tin dioxide + ΣX_i	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	535, 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_i	1	1100
Zinc + Aluminum	1	880	Zirconium - boron intermetallic compound		
Zinc + Aluminum + ΣX_i	1	1098	ZrB	1	1375
Zinc + Cadmium	1	881	Zirconium + Hafnium	1	883
Zinc + Lead + ΣX_i	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			