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Thermophysical Properties of High Temperature Solid Materials

VOLUME 2a: NONFERROUS ALLOYS

Part 2: Nonferrous Binary Alloys

Thermophysical Properties
Research Center, Purdue University
Y. S. TOULOUKIAN, Editor

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Thermophysical Properties of High Temperature Solid Materials

CONTRIBUTORS

G. C. Y. Wang, PROJECT COORDINATOR

E. H. Buyco	*Specific Heat*
R. S. Hernicz and R. L. Feng	*Thermal Linear Expansion*
J. J. G. Hsia and G. C. Y. Wang	*Thermal Conductivity*
C. K. Hsieh, I. M. Yeyinmen, J. J. G. Hsia, and I. Keskin	*Thermal Radiative Properties*
I. Keskin and C. Y. Lee	*Melting Point*
C. Y. Lee	*Vapor Pressure, Density, and Heats of Transformation*
G. C. Y. Wang	*Thermal Diffusivity*
G. C. Y. Wang and C. Y. Lee	*Electrical Resistivity*

Thermophysical Properties of High Temperature Solid Materials

VOLUME 2: NONFERROUS ALLOYS

Part I: Nonferrous Binary Alloys

Thermophysical Properties Research Center
PURDUE UNIVERSITY

Y. S. Touloukian, EDITOR

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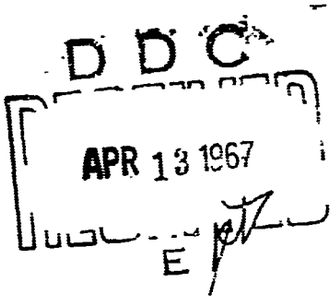

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PREFACE

The phenomenal growth of science and technology since the early forties has brought about a universal appreciation of the fact that present limitations in many technical developments are often a direct result of the paucity of knowledge on the properties of materials. Engineering developments in the years ahead will be closely linked to the research that is done today to contribute to a better understanding of the properties of matter, of which thermophysical properties constitute a major segment.

With a realization of the seriousness of this situation, a great deal of research effort has been made in recent years on the thermophysical properties of materials with the result that the volume of research literature has increased many fold. In spite of this fact, it is generally agreed that the present level of research on thermophysical properties still falls substantially short of existing needs and anticipated future demands. However, what is even more disturbing is the fact that engineering groups across the nation are using no more than a fraction of the information already available, either because it is in a form not directly useful to them or, often, because its existence is not generally known.

To partially remedy this situation concerning the thermophysical properties of high temperature materials, the Materials Laboratory of the U.S. Air Force at Wright-Patterson Air Force Base sponsored a project in 1957 to bring together a large portion of the then available data in a single work for easy reference. From this compilation, performed by the Armour Research Foundation, a four-volume work entitled *Handbook of Thermophysical Properties of Solid Materials* emerged. It was first published in 1960 as WADC TR58-476; in 1961 it was issued as a hard-bound set by The Macmillan Company.

Because of the favorable reception given to this original work, the Materials Laboratory of the U.S. Air Force requested the Thermophysical Properties Research Center (TPRC), in 1964, to update and revise this reference work in order to increase its usefulness and to put it on a more current basis. The present six-volume work, entitled *Thermophysical Properties of High Temperature Solid Materials*, consists of nine books totaling more than 8,500 pages. It is the result of a two-year project by TPRC. This new encyclopedic reference work cannot be called a revised edition of the earlier publication since nearly every page has been changed through major additions, corrections, and re-evaluation. An effort was made to adhere to the basic format of the earlier work. However, the organization of the material and the index to materials have been completely redesigned for greater ease in locating the information desired.

Inevitably, not all of the properties covered have received the same degree of attention. The material on thermal radiative properties, thermal diffusivity, and specific heat has been totally revised and rewritten. Materials on the coefficient of thermal expansion and thermal conductivity have received major revisions, and those on electrical resistivity, density, and melting point have had moderate revisions. Finally, lesser revisions were made to data concerning vapor pressure and heats of transformation. The new information incorporated into the work covered research conducted primarily during the years 1957 to 1964, although some major references are included from 1965 and some from as far back as 1910.

In processing the large amount of new and old data incorporated in these volumes, it was necessary that some degree of selectivity be exercised both from the standpoint of the references cited and the data extracted from them. It is hoped, however, that no major source of information has been omitted. Whenever possible, an effort was made to suggest recommended values of the properties. In the plots, recommended values are indicated by curves. It should be clear, however, that the designation of "recommended values" in no way implies that a critical analysis has been performed in all cases, nor does it suggest that they repre-

sent definitive values. Because most of the materials covered are not well-defined engineering materials, and because there is often a great paucity of information, any critical evaluation of these data is most difficult—if not impossible.

With a full appreciation of these inherent difficulties it is nevertheless hoped that the present compendia will prove to be of great usefulness to engineers seeking information on thermophysical properties. In spite of the extreme care exercised in processing the data and proofing the manuscript, it is possible that some errors might have been inadvertently overlooked. Should any instance of such oversight be uncovered, the Editor would be most indebted if it is brought to his attention.

The fact that such an enormous undertaking could be accomplished in such a short time is attributable primarily to TPRC's unique resources in the area of thermophysical properties information. Grateful acknowledgment is made to the Electronic Properties Information Center for assistance in providing bibliographic searches on electrical resistivity and to the Air Force Materials Laboratory for general assistance in bibliographic information. Extensive personal inquiries were made to the authors of research papers and reports requesting clarification and original data. The enthusiastic response to these inquiries (in the majority of the cases) is also gratefully acknowledged. The Editor and the contributing staff wish to give a special note of thanks in acknowledging the valuable assistance and cooperation they received individually and collectively from TPRC's Scientific Documentation Division personnel and the supporting staff of graphics and technical typists without whose painstaking and skillful contributions this work would not have been possible.

This work was performed under Contract No. AF33(615)1642, sponsored by the Air Force Materials Laboratory, Research and Technology Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. The personnel directly affiliated with this program were Mr. D. A. Shinn, Chief, Materials Information Branch; Mr. E. Dugger, Technical Manager, Information Processing; and Mr. J. H. Charlesworth, engineer in charge of this project. Their understanding cooperation has contributed much to the success of the program.

It is sincerely hoped that *Thermophysical Properties of High Temperature Solid Materials* will constitute an even more valuable contribution to technology than its predecessor. This work should prove to be an invaluable source of information on an important group of properties of materials to every engineer, providing him with reliable information of a scope that would be impossible for any one individual to master. If we have been able to approach these goals, the results will be highly gratifying.

June 1966

Y. S. TOULOUKIAN, Director
Thermophysical Properties Research Center
Purdue University
2595 Yeager Road
West Lafayette, Indiana 47906

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EXPLANATORY TEXT

I. SCOPE OF COVERAGE

Thermophysical Properties of High Temperature Solid Materials comprises six volumes. Volumes 2, 4, and 6 each consist of two parts because of the large amount of material covered. The general contents of the respective volumes are as follows:

Volume 1—Elements
Volume 2—Nonferrous Alloys
  Part I—Nonferrous Binary Alloys
  Part II—Nonferrous Multiple Alloys
Volume 3—Ferrous Alloys
Volume 4—Oxides and Their Solutions and Mixtures
  Part I—Simple Oxygen Compounds and Their Mixtures
  Part II—Solutions and Their Mixtures of Simple Oxygen Compounds, Including Glasses and Ceramic Materials
Volume 5—Nonoxides and Their Solutions and Mixtures, Including Miscellaneous Ceramic Materials
Volume 6—Intermetallics, Cermets, Polymers, and Composite Systems
  Part I—Intermetallics
  Part II—Cermets, Polymers, and Composite Systems

The specific properties covered in each volume are:

1. Density (ρ)
2. Melting Point (M. P.)
3. Heat of Fusion (Δh_f)
4. Heat of Vaporization (Δh_v)
5. Heat of Sublimation (Δh_s)
6. Electrical Resistivity (r)
7. Specific Heat at Constant Pressure (c_p)
8. Thermal Conductivity (k)
9. Thermal Diffusivity (α)
10. Thermal Linear Expansion ($\Delta L/L$)
11. Thermal Radiative Properties:
    Absorptance (α), Emittance (ε), Reflectance (ρ), and Transmittance (τ)
12. Vapor Pressure (p)

Generally, only materials with melting points above 800°K (approximately 1000°F) are included, except for materials within the categories of polymers, plastics, and composites. A detailed discussion of the material classification procedure is presented in the following sections. A Material Index for the entire work is included at the end of each volume.

II. TPRC CLASSIFICATION OF MATERIALS

Materials are classified into the eight categories listed below. Whenever applicable, the compositions are reported in weight percent of the constitutents. For purposes of material classification TPRC considers the following elements as nonmetallic: H, He, C, N, O, F, Ne, P, S, Cl, A, Br, Kr, I, Xe, At, and Rn.

1. *Elements*: For the purpose of classification an element is specified as follows:
   A. For metallic elements, the limit of impurities is <0.20 percent for each foreign constituent and <0.50 percent total impurities.
   B. For nonmetallic elements (i.e., carbon including graphite and diamond), the limit of impurities is ≤ 2.0 percent for each foreign constituent and ≤ 5.0 percent total impurities.
2. *Nonferrous Alloys*: This category is for alloys in which the major constituent is other than iron. For the purpose of classification, nonferrous alloys are specified as follows:
   A. Nonferrous Binary Alloys: The sum of the binary constituents is ≥ 99.50 percent and other constituents ≤ 0.20 percent each.
   B. Nonferrous Multiple Alloys: The sum of the first two constituents is <99.50 percent and/or any other constituent >0.20 percent. Alternatively, the major constituent is ≤ 99.50 percent and each of the other constituents <0.20 percent (or not given).
3. *Ferrous Alloys*: This category is for alloys in which iron is greater than or equal to any other constituent. For the purpose of classification, ferrous alloys are specified as follows:
   A. Carbon Steels: Carbon ≤ 2.0 percent and carbon $\geq$ any other alloying constituent.
      a. Group I: Every other alloying constituent is ≤ 0.20 percent except for Mn, P, S, Si, which may be ≤ 0.60 percent each.
      b. Group II: At least one other alloying constituent >0.20 percent and/or any of Mn, P, S, Si >0.60 percent.
   B. Cast Irons: Carbon >2.0 percent and carbon $\geq$ any other alloying constituent.
      a. Group I: Every other alloying constituent ≤ 0.20 percent except for Mn, P, S, Si, which may be ≤ 0.60 percent each.
      b. Group II: At least one other alloying constituent >0.20 percent and/or any of Mn, P, S, Si >0.60 percent.
   C. Alloy Steels (including alloy cast iron): The major alloying constituent is other than carbon.
      a. Group I: Every other alloying constituent ≤ 0.20 percent except for Mn, P, S, Si, which may be ≤ 0.60 percent each, and C ≤ 2.0 percent.*
      b. Group II: At least one other alloying constituent >0.20 percent and/or any of Mn, P, S, Si >0.60 percent.*
4. *Nonmetallic Compounds and Their Mixtures and Solutions*: Ceramic materials such as oxides, bromides, carbides, carbonates, nitrides, silicates, etc., are included in this category. For the purpose of classification, they are specified as follows:
   A. For simple compounds and their solutions, the limit of impurities is ≤ 2.0 percent for each foreign constituent and ≤ 5.0 percent total impurities.

---

* Exception is made when Mn, P, S, or Si is the major alloying constituent. For instance, in the case of Fe + Mn + ΣX_i alloys the specifications corresponding to Groups I and II would be as follows:
  a. Group I: Every other alloying constituent ≤ 0.20 percent except for P, S, Si, which may be ≤ 0.60 percent each, and C ≤ 2.0 percent.
  b. Group II: At least one other alloying constituent >0.20 percent and/ any of P, S, Si >0.60 percent.
  In the above example, Mn has a higher weight percentage than any of P, S, or Si but does not necessarily have a weight percentage higher than 0.60 percent. Thus, the limits of Mn percentage may be written:
  $$\text{Fe} \geq \text{Mn} > \text{P, S, Si and any other alloying constituent and Mn} \geq 0.20.$$
  The same guideline is applied to ferrous alloys containing P, S, or Si as major alloying constituents.

B. For mixtures of simple compounds and their solutions, the major constituent is <95.0 percent, or any other constituent is >2.0 percent.

5. *Intermetallics*: An intermetallic is a metal-metal compound formed by metallic elements in a fixed simple atomic ratio. For the purpose of classification, specifications are the same as those for Class 4.
6. *Cermets*: Cermets are ceramic materials such as carbides, oxides, etc., fused with or bonded by one or more pure metals. However, there are also metal-metal cermets, metal-intermetallic cermets, etc., which are also included in this category.
7. *Polymers*: Polymers are chemical compounds or mixtures of compounds formed by polymerization and consisting essentially of repeating molecular structural units.
8. *Composite Systems*: A composite system may consist of materials in combination, with clearly defined boundaries existing between components of the system, or a homogeneous material having a distinct configuration.

For the reader's convenience, the classification scheme for Classes 1 through 4, described above, is summarized in the following table.

SUMMARY TABLE OF TPRC CLASSIFICATION OF MATERIALS

Classification				Limits of Composition (weight percent)			
				X_1	$X_1 + X_2$	X_2	X_3
1. ELEMENTS	A. METALLIC			>99.50	--	<0.20	<0.20
	B. NONMETALLIC			≥95.0	--	≤2.0	≤2.0
2. NONFERROUS ALLOYS (X_1 > Fe)	A. BINARY ALLOYS			--	≥99.50	≥0.20	≤0.20
	B. MULTIPLE ALLOYS			--	≥99.50	>0.20	>0.20
				--	<99.50	≥0.20	≤0.20
				--	<99.50	>0.20	>0.20
				≤99.50	--	<0.20	<0.20
				X_1	X_2	X_3	Mn, P Sor Si
3. FERROUS ALLOYS (X_1 = Fe ≥ X_2)	A. CARBON STEELS	GROUP I		Fe	C ≤2.0	≤0.20	≤0.60
		GROUP II		Fe	C ≤2.0	≤0.20	>0.60
				Fe	C ≤2.0	>0.20	≤0.60
				Fe	C ≤2.0	>0.20	>0.60
	B. CAST IRONS	GROUP I		Fe	C >2.0	≤0.20	≤0.60
		GROUP II		Fe	C >2.0	≤0.20	>0.60
				Fe	C >2.0	>0.20	≤0.60
				Fe	C >2.0	>0.20	>0.60
	C. ALLOYS* STEELS	GROUP I		Fe	≠ C	≤0.20 and C ≤2.0	≤0.50
		GROUP II		Fe	≠ C	≤0.20	>0.60
				Fe	≠ C	>0.20	≤0.60
				Fe	≠ C	>0.20	>0.60

4. NONMETALLIC COMPOUNDS AND THEIR MIXTURES AND SOLUTIONS

	X_1	X_2
A. SIMPLE COMPOUNDS AND THEIR SOLUTIONS	≥95.0	≤2.0
B. MIXTURES OF SIMPLE COMPOUNDS AND THEIR SOLUTIONS	<95.0	≤2.0
	≥95.0	>2.0
	<95.0	>2.0

NOMENCLATURE:

X_1 = Major Constituent

X_2 = Second Highest Constituent

X_3 = Third Highest Constituent

Where: $X_1 \geq X_2 \geq X_3 \geq X_4 \geq \cdots\cdots$

*In case Mn, P, S, or Si represents X_2 this particular element is dropped from the last column.

III. PRESENTATION OF DATA

Each of the six volumes consists of seven sections arranged in the following order:

1. Preface
2. Table of Contents
3. Explanatory Text
4. Conversion Factors
5. Body of Data
6. References
7. Material Index.

In the following paragraphs a detailed description of Sections 5, 6, and 7 is given. The contents of the first four sections are self-explanatory.

BODY OF DATA

Data on each material are presented in graphical or tabular form for selected sets of measurements, and are accompanied by a Reference Information Table with corresponding specifications and remarks. The first five properties listed in Section I of this Explanatory Text are considered as *point values* and are grouped together in a single table in the same manner as the graphs for the other remaining properties. Furthermore, for a given material group, where several properties are reported, data are arranged in accordance with the order of the property list given in Section I of this text.

Graphic Presentation

Data extracted from various references on a given material and property are shown on a single graph by means of distinct plotting symbols, which are identified in the Reference Information Table on the page following the graph. Each set of symbols indicates the data of a given investigator, but does not necessarily imply actual measured points. In numerous instances authors present only smoothed values, either in graphical or tabular form, and it is frequently impossible to distinguish interpolated or smoothed values from actual observed data.

In reporting data on thermal linear expansion, investigators sometimes give a single average value of this property for a considerable temperature range. In such instances it is assumed that a linear relationship is implied. All data on thermal linear expansion were reduced to a datum of 293°K (20°C); i.e., $(\Delta L/L) = 0$ at 293°K (20°C). This point is identified by a cross (+) on each graph.

The definition of $(\Delta L/L)$ used in this work is

$$(\Delta L/L) = \frac{L_T - L_{293}}{L_{293}} \times 100$$

where L_T = length of specimen at temperature T.

L_{293} = length of specimen at 293°K (20°C).

To compute the "coefficient" of thermal linear expansion β from 293°K to any temperature T, the following relation may be used.*

$$\beta = \frac{1}{100\,(T - 293)} \frac{\Delta L}{L}, \text{ in } K^{-1}$$

* It is necessary to divide the right-hand side of this equation by 100 because the graphical presentation of $(\Delta L/L)$ is in percent expansion from 293°K.

In some instances the coefficient of thermal linear expansion is reported in tabular form.

Curves drawn through the plotted points are the "most probable" curves based on the data shown. As additional information becomes available in the future, these recommendations may well be modified.

Point Value Table

Data extracted from various references are identified by distinct symbols in the same manner as data points on a graph. "Most probable" values are given either at the top of the table or are indicated in a footnote. These selections are usually made solely on the basis of the data presented. Sometimes these point values are also reported as a function of temperature or composition, in which case they are shown in graphical form and placed immediately following the tabular values.

Reference Information Table

A table giving the reference information associated with each set of data obtained in the graph immediately follows the graph. The table contains the following information:

1. Symbol The plotting symbols are identical with and correspond to those used in the graph.
2. Reference. References are identified by hyphenated numbers which serve to locate the bibliographic citation in the section of References at the end of each volume. The initial two digits indicate the year of publication and the last digits identify the specific reference within the given year. In those instances where a reference does not carry a date, the letter symbol ND is used in place of the year of publication. Undated references are listed at the end of the list of References.
3. Temperature Range. Range covered by the data in a given paper or report.
4. Reported Error. The author's estimated accuracy (or precision).
5. Sample Specification. This column contains all pertinent available information about the test sample. This information consists of the following:
   a. Commercial trade name, chemical formula, etc., followed by manufacturer's name, if it is necessary for correct identification.
   b. Composition of the sample, expressed in weight percent. Unless otherwise stated, the percent sign is omitted.
   c. Physical characteristics of the material, such as a single crystal, polycrystalline, density, crystal structures, etc.
   d. Specimen designation by the author is given in brackets at the end of the citation.
6. Remarks. This column contains information on:
   a. Special process used in fabrication of the sample, such as being sintered, chill-cast, etc.
   b. Sample history, such as cold-worked, hot-pressed, annealed, etc.
   c. Conditions under which the specimen was investigated, environment, etc.
   d. Other pertinent remarks.

REFERENCES

The section on Reference gives complete bibliographic citations for all the references from which data were extracted. They are arranged chronologically by year of publication, and in arbitary sequence within any given year.

For the preparation of the references, the following order and convention is used.

Periodicals

1. Author(s) name: Last name first, followed by initials.
2. Journal name: Standard TPRC journal name abbreviations are used.
3. Series, volume, and number.

a. If the series is represented by a letter, it is underlined together with the volume number.
b. If the series is represented by a number, then only the numeral representing the volume is underlined.
c. The numeral for the issue number is shown in parentheses.

4. Pages: Indicate the beginning and ending pages.

Reports

1. Author(s) name is given in the same form as for periodicals.
2. The name of the responsible organization, if any.
3. The name of sponsor.
4. Report, bulletin, or circular designation.
5. Number.
6. Part.
7. Pages (same as for periodicals).
8. AD and PB numbers or equivalents.

Books

The bibliographic citation for books lists: author(s), title, volume, edition, publisher, and page(s).

In general, private communications are not listed as references. However, if TPRC did obtain additional substantive information from an author through private communication, and if this information was used, the remark "additional data obtained from author(s)" is added at the end of the reference citation.

MATERIAL INDEX

The Material Index lists all the materials included in this work by their proper trade or commercial names arranged in alphabetical order and, for materials designated by number codes, the listing is in increasing numerical order. Location of information on a particular property for a particular material is specified by the volume number and page numbers indicated within the appropriate property column of the index. The page number always indicates the starting page of the graphs or point value tables. Chemical formulas are given in parentheses following the proper names of materials which can be chemically identified. However, for materials within a general group, e.g., different oxides of cerium, the entries are only by chemical formulas listed under the material group designation, such as "cerium oxides." Whenever applicable, an effort is made to list commercial materials under their several accepted names. In the case of broad classes of materials, such as steels, glasses, etc., the materials are listed under their common names as well as under the heading of their general class when the designation is merely a letter and number code.

Simpler inorganic compounds (e.g., aluminum oxide, tantalum boride) are named according to the convention given in the *Handbook of Chemistry and Physics* (The Chemical Rubber Co., 45th edition, 1964, and—if not available there—the 43rd edition, 1962). Other inorganic compounds are generally named in accordance with the convention given in the *Chemical Abstracts* by giving the more electropositive part of the name first and the more electronegative part second. For nonferrous and ferrous alloys, only the first two components are listed and ΣX_i is added to designate multiple alloys. An exception is made, however, for chromium-nickel and nickel-chromium ferrous alloys, in which cases, all three major constituents are listed. For other organic compounds and their mixtures and solutions, all components with weight percent greater than . percent are listed. Finally, for cermets, the name of the ceramic part is given first and the metal part second, each in their respective alphabetical order regardless of their weight percentages, with the exception of beryllium cermet (e.g., Beryllium YB-9052), in which case the name of the metal part is given first.

CONVERSION FACTORS

NOTE: In preparing the conversion factors, the following basic definitions were used:

1 in. = 2.54 cm*

1 lb. = 453.59237 g*

1 cal_{Th} = 4.184 (exactly) Joule*

1 cal_{IT} = 4.1868 (exactly) Joule*

1 $Btu_{IT} lb^{-1} F^{-1}$ = 1 $cal_{IT} g^{-1} C^{-1}$‡

The subscripts "Th" and "IT" denote "Thermochemical" and "International Steam Table" units, respectively.

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* *NBS Technical News Bulletin*, 47(10), 1963.

‡ Mueller, E. F., and Rossini, F. D., *Am. J. Physics*, 12(1), 4, 1944.

CONVERSION FACTORS FOR UNITS OF DENSITY

MULTIPLY by appropriate factor to OBTAIN →	g cm^{-3}	g in.$^{-3}$	kg m^{-3}	kg ft^{-3}	lb in.$^{-3}$	lb ft^{-3}
g cm^{-3}	1	1.63872 x 10	1.0 x 10^{3}	2.83170 x 10	3.61275 x 10^{-2}	6.24283 x 10
g in.$^{-3}$	6.10234 x 10^{-2}	1	6.10234 x 10	1.72800	2.20462 x 10^{-3}	3.80959
kg m^{-3}	1.0 x 10^{3}	1.63872 x 10^{-2}	1	2.83170 x 10^{-2}	3.61275 x 10^{-5}	6.24283 x 10^{-2}
kg ft^{-3}	3.51446 x 10^{-2}	5.78704 x 10^{-1}	3.53145 x 10	1	1.27582 x 10^{-3}	2.20462
lb in.$^{-3}$	2.76797 x 10	4.53592 x 10^{2}	2.76797 x 10^{4}	7.83808 x 10^{2}	1	1.72800 x 10^{3}
lb ft^{-3}	1.60184 x 10^{-2}	2.62496 x 10^{-1}	1.60184 x 10	4.53592 x 10^{-1}	5.78704 x 10^{-4}	1

CONVERSION FACTORS FOR UNITS OF LATENT HEAT

MULTIPLY by appropriate factor to OBTAIN →	$cal_{Th}g^{-1}$	$cal_{IT}g^{-1}$	W sec g^{-1}	$J_{Int}g^{-1}$	$Btu_{Th}lb^{-2}$	$Btu_{IT}lb^{-1}$
$cal_{Th}g^{-1}$	1	9.99331×10^{-1}	4.184	4.18331	1.8	1.79880
$cal_{IT}g^{-1}$	1.00067	1	4.1868	4.18611	1.80120	1.8
W sec g^{-1}	2.39006×10^{-1}	2.38846×10^{-1}	1	9.99835×10^{-1}	4.30210×10^{-1}	4.29923×10^{-1}
$J_{Int}g^{-1}$	2.39045×10^{-1}	2.38885×10^{-1}	1.00017	1	4.30281×10^{-1}	4.29994×10^{-1}
$Btu_{Th}lb^{-1}$	5.55556×10^{-1}	5.55184×10^{-1}	2.32444	2.32406	1	9.99331×10^{-1}
$Btu_{IT}lb^{-1}$	5.55927×10^{-1}	5.55556×10^{-1}	2.326	2.32562	1.00067	1

CONVERSION FACTORS FOR UNITS OF SPECIFIC HEAT

MULTIPLY by appropriate factor to OBTAIN →	$cal_{Th}g^{-1}C^{-1}$	$cal_{IT}g^{-1}C^{-1}$	W sec $g^{-1}K^{-1}$	$J_{int}g^{-1}K^{-1}$	$Btu_{Th}lb^{-1}F^{-1}$	$Btu_{IT}lb^{-1}F^{-1}$
$cal_{Th}g^{-1}C^{-1}$	1	9.99331×10^{-1}	4.184	4.18331	1	9.99331×10^{-1}
$cal_{IT}g^{-1}C^{-1}$	1.00067	1	4.1868	4.18611	1.00067	1
W sec $g^{-1}K^{-1}$	2.390006×10^{-1}	2.38846×10^{-1}	1	9.99835×10^{-1}	2.39000×10^{-1}	2.38846×10^{-1}
$J_{Int}g^{-1}K^{-1}$	2.39045×10^{-1}	2.38886×10^{-1}	1.00017	1	2.39045×10^{-1}	2.38885×10^{-1}
$Btu_{Th}lb^{-1}F^{-1}$	1	9.99331×10^{-1}	4.184	4.18331	1	9.99331×10^{-1}
$Btu_{IT}lb^{-1}F^{-1}$	1.00067	1	4.1868	4.18611	1.00067	1

Note: To convert quantities per "gram" to "mol" basis multiply conversion factor by the molecular weight M.

CONVERSION FACTORS FOR UNITS OF THERMAL CONDUCTIVITY

MULTIPLY by appropriate factor to OBTAIN →	$Btu_{IT}hr^{-1}ft^{-1}F^{-1}$	$Btu_{IT}in.hr^{-1}ft^{-2}F^{-1}$	$cal_{IT}sec^{-1}cm^{-1}C^{-1}$	$cal_{Th}sec^{-1}cm^{-1}C^{-1}$	$kcal_{Th}hr^{-1}m^{-1}C^{-1}$	$W\ cm^{-1}K^{-1}$
$Btu_{IT}hr^{-1}ft^{-1}F^{-1}$	1	1.2×10	4.13379×10^{-3}	4.13656×10^{-3}	1.48916	1.73073×10^{-2}
$Btu_{IT}in.hr^{-1}ft^{-2}F^{-1}$	8.33333×10^{-2}	1	3.44482×10^{-4}	3.44713×10^{-4}	1.24097×10^{-1}	1.44228×10^{-3}
$cal_{IT}sec^{-1}cm^{-1}C^{-1}$	2.41909×10^{2}	2.90201×10^{3}	1	1.00067	3.60241×10^{2}	4.1868
$cal_{Th}sec^{-1}cm^{-1}C^{-1}$	2.41747×10^{2}	2.90096×10^{3}	9.99331×10^{-1}	1	3.6×10^{2}	4.184
$kcal_{Th}hr^{-1}m^{-1}C^{-1}$	0.71620×10^{-1}	8.05824	2.77592×10^{-3}	2.77778×10^{-3}	1	1.16223×10^{-2}
$W\ cm^{-1}K^{-1}$	5.77789×10	6.93347×10^{2}	2.38846	2.39000	8.60421×10	1

CONVERSION FACTORS FOR UNITS OF THERMAL DIFFUSIVITY

MULTIPLY ↓ by appropriate factor to OBTAIN →	cm^2sec^{-1}	cm^2hr^{-1}	m^2hr^{-1}	$in.^2sec^{-1}$	ft^2sec^{-1}	ft^2hr^{-1}
cm^2sec^{-1}	1	3.60×10^3	3.60×10^{-4}	1.550×10^{-1}	1.07639×10^{-3}	3.87501
cm^2hr^{-1}	2.77778×10^{-4}	1	1.0×10^{-4}	4.30555×10^{-2}	2.98998×10^{-7}	1.07639×10^{-3}
m^2hr^{-1}	2.77778	1.0×10^4	1	4.30555	2.98998×10^{-3}	1.07639×10
$in.^2sec^{-1}$	6.45160	2.32258×10^4	2.32259	1	6.94444×10^{-3}	2.50×10
ft^2sec^{-1}	9.29030×10^2	3.34451×10^6	3.34451×10^{-2}	1.440×10^2	1	3.60×10^3
ft^2hr^{-1}	2.58064×10^{-4}	9.29030×10^2	9.29030×10^{-8}	4.0×10^{-4}	2.77778×10^{-4}	1

CONVERSION FACTORS FOR UNITS OF VAPOR PRESSURE

MULTIPLY ↓ by appropriate factor to OBTAIN →	dyne cm^{-2}	atm	kg cm^{-2}	mm Hg	in. Hg	lb $in.^{-2}$
dyne cm^{-2}	1	9.8690×10^{-7}	1.01970×10^{-6}	7.5010×10^{-4}	2.9530×10^{-5}	1.45040×10^{-5}
atm	1.01339×10^{6}	1	1.03320	7.60×10^{2}	2.9920×10	1.46960×10
kg cm^{-2}	9.8070×10^{5}	9.6780×10^{-1}	1	7.3560×10^{2}	2.8960×10	1.42230×10
mm Hg	1.33320×10^{3}	1.31580×10^{-3}	1.35950×10^{-3}	1	3.9370×10^{-2}	1.93370×10^{-2}
in. Hg	3.3860×10^{4}	3.3420×10^{-2}	3.4530×10^{-2}	2.540×10	1	4.9120×10^{-1}
lb $in.^{-2}$	6.89470×10^{4}	6.80460×10^{-2}	7.0310×10^{-2}	5.1710×10	2.0360	1

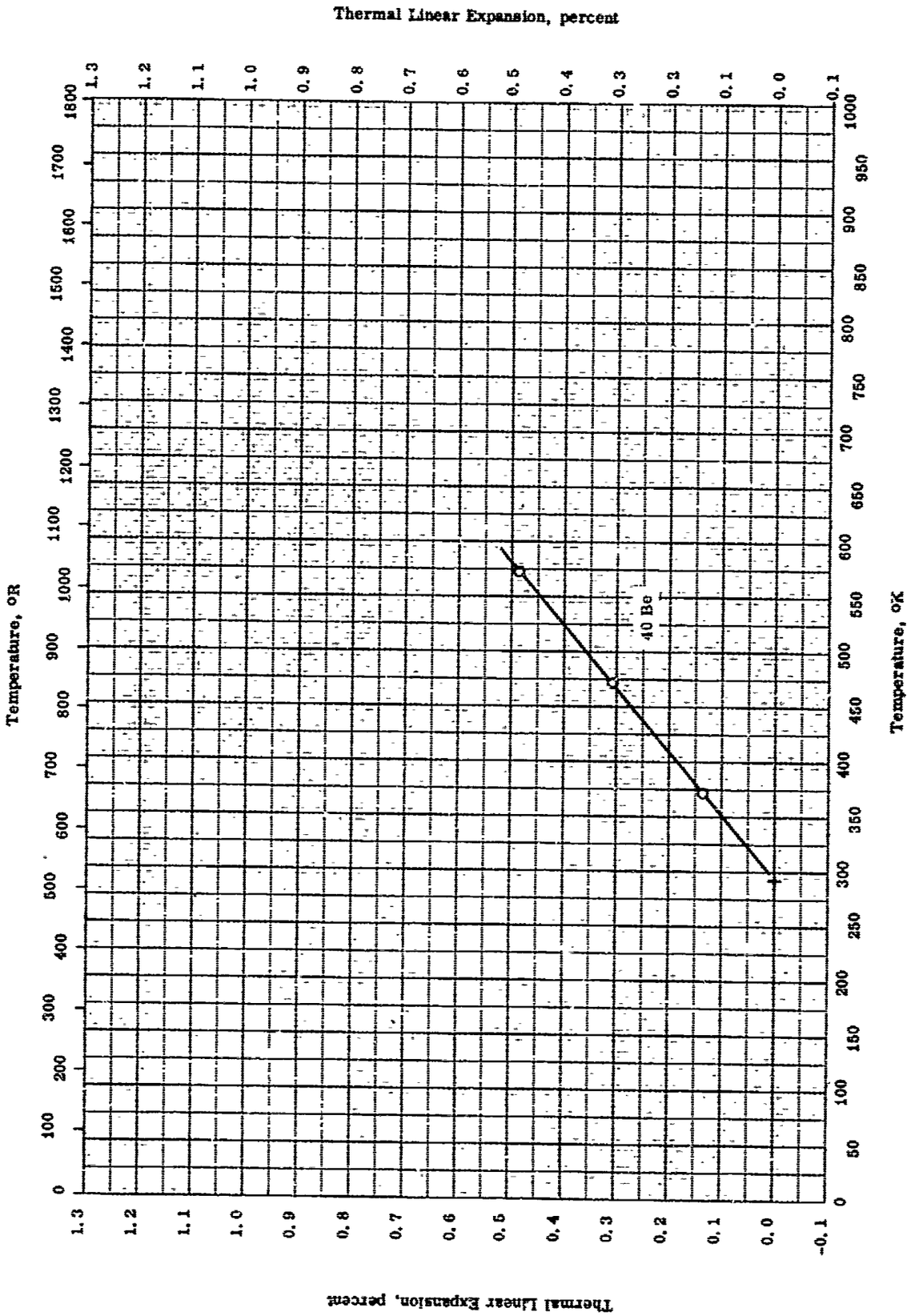
BODY OF DATA

NONFERROUS ALLOYS

PART I

NONFERROUS BINARY ALLOYS

(Sum of the binary constituents ≥ 99.50 percent
and other constituents ≤ 0.20 percent each)



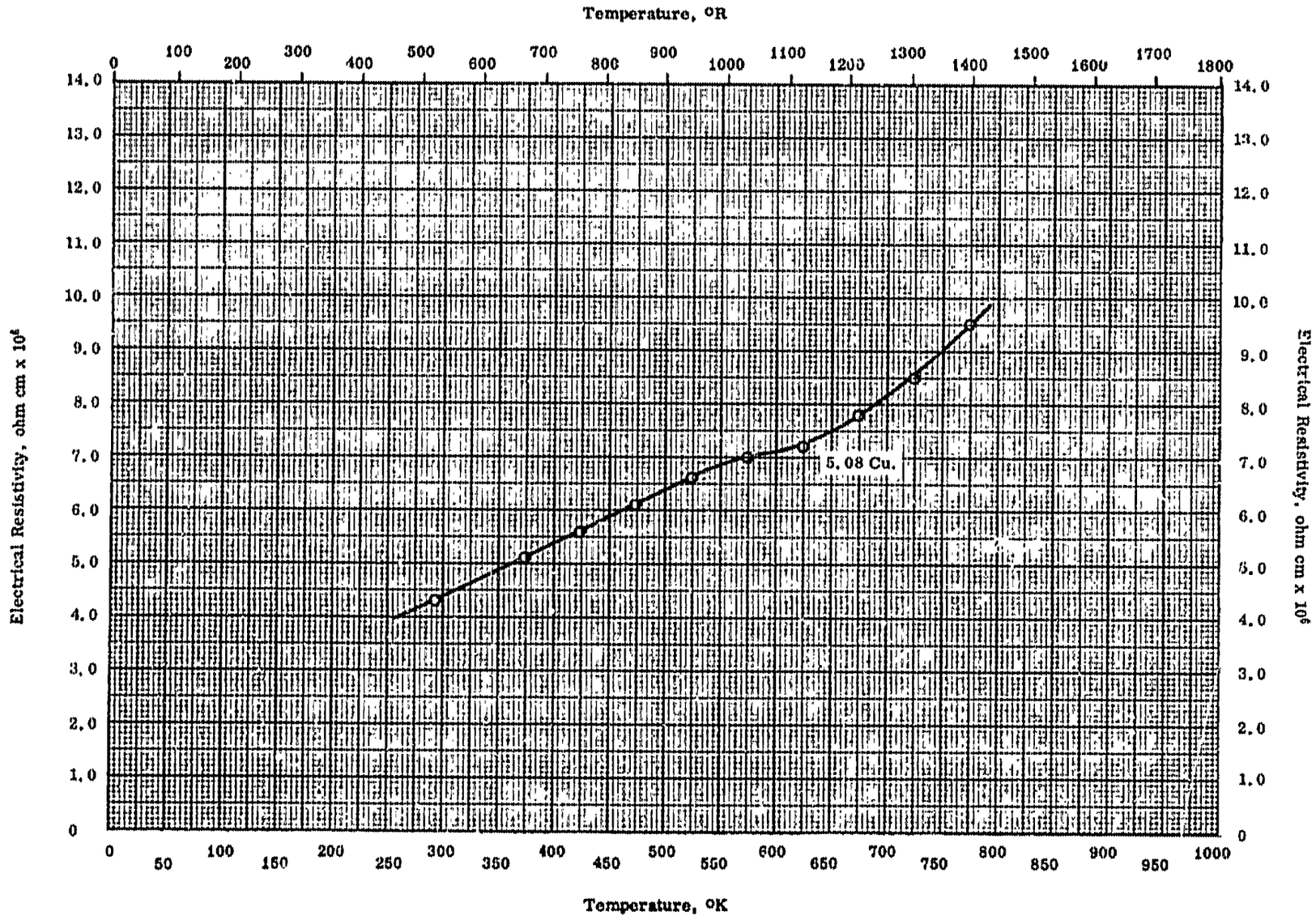
THERMAL LINEAR EXPANSION — ALUMINUM + BERYLLIUM

TPRC

THERMAL LINEAR EXPANSION -- ALUMINUM + BERYLLIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-19	293-573		60 Al, 40 Be, and trace Ag.	Cast at 2300 F, heat treated at 1025 F for 24 hrs, hot forged annealed at 1025 F for 4 hrs, water quenched, and cold worked from 3/4 in. to 5/8 in. dia.



ELECTRICAL RESISTIVITY -- ALUMINUM + COPPER

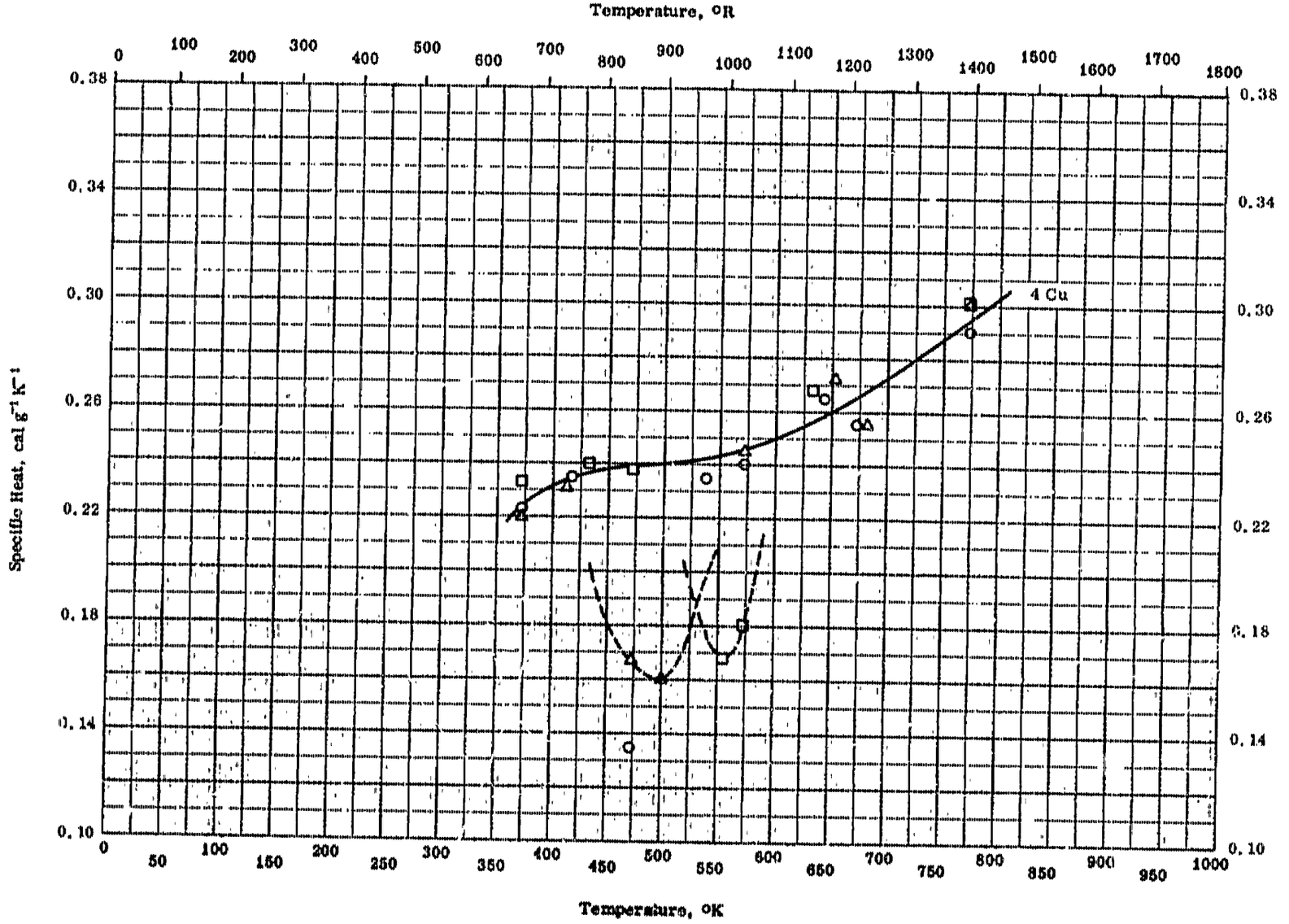
TPRC

ELECTRICAL RESISTIVITY -- ALUMINUM +COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	48-1	293-1073		5.08 Cu, 0.15 Fe, 0.05 each Si and Zn, 0.02 Ti, and traces of Mg, Mn.	Cast; heated 6 hrs at 970 F and water quenched.

TPRC



SPECIFIC HEAT -- ALUMINUM + COPPER

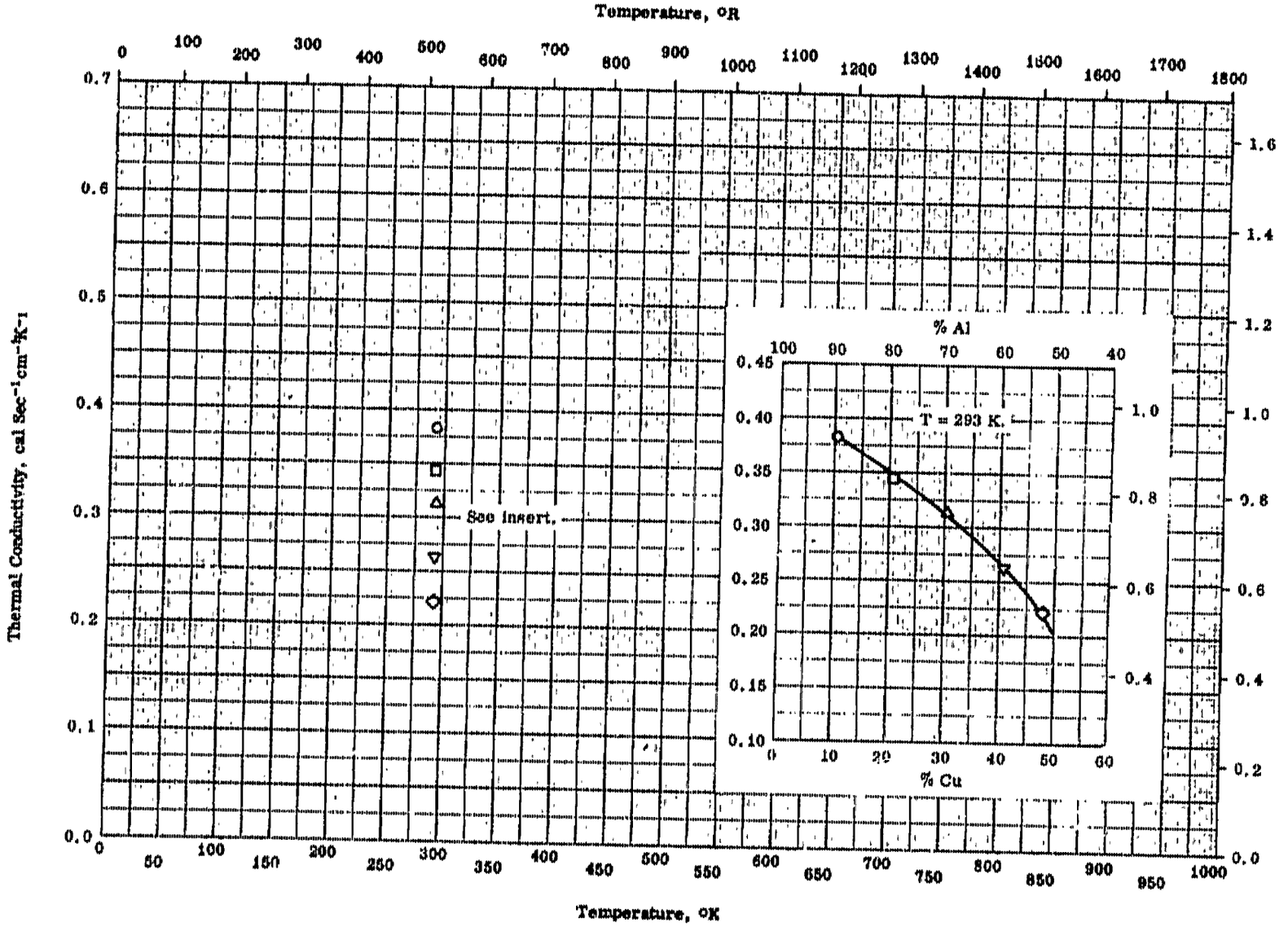
TPRC

SPECIFIC HEAT -- ALUMINUM + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	55-11	373-773		4 Cu. and 0.05 Sn.	Forged, solution treated at 530 C, and quenched.
□	55-11	373-773		4 Cu	Same as above.
△	55-11	373-773		4 Cu and 0.02 Sn.	Same as above.

TPRC



THERMAL CONDUCTIVITY — ALUMINUM + COPPER

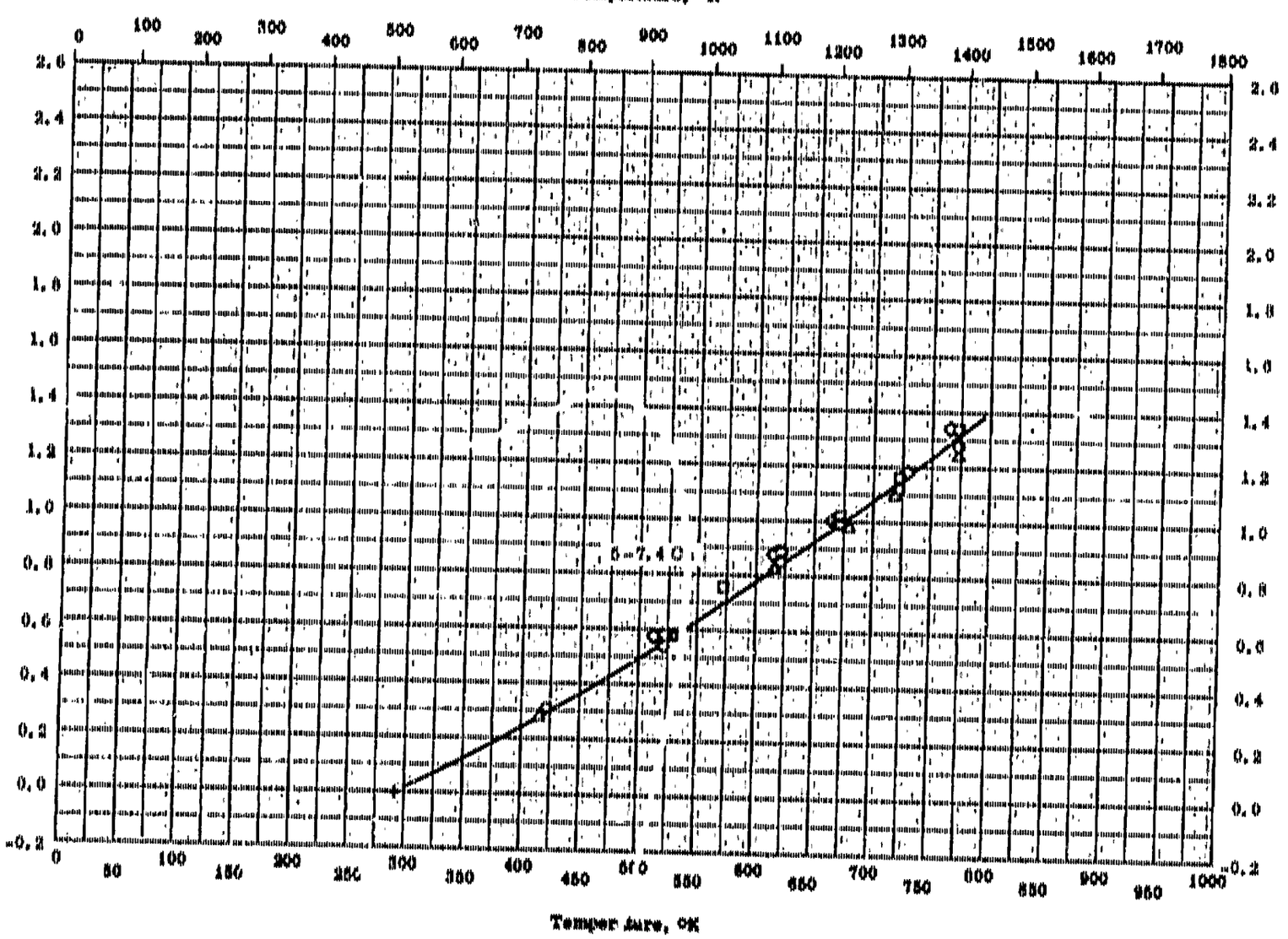
TPRC

THERMAL CONDUCTIVITY -- ALUMINUM + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	60-4	293		10.24 Cu.	Annealed 5 hrs at temperature near M. P. and furnace cooled.
□	60-4	293		20.78 Cu.	Same as above.
△	60-4	293		30.32 Cu.	Same as above.
▽	60-4	293		40.82 Cu.	Same as above.
◇	60-4	293		48.00 Cu.	Same as above.

TPRC

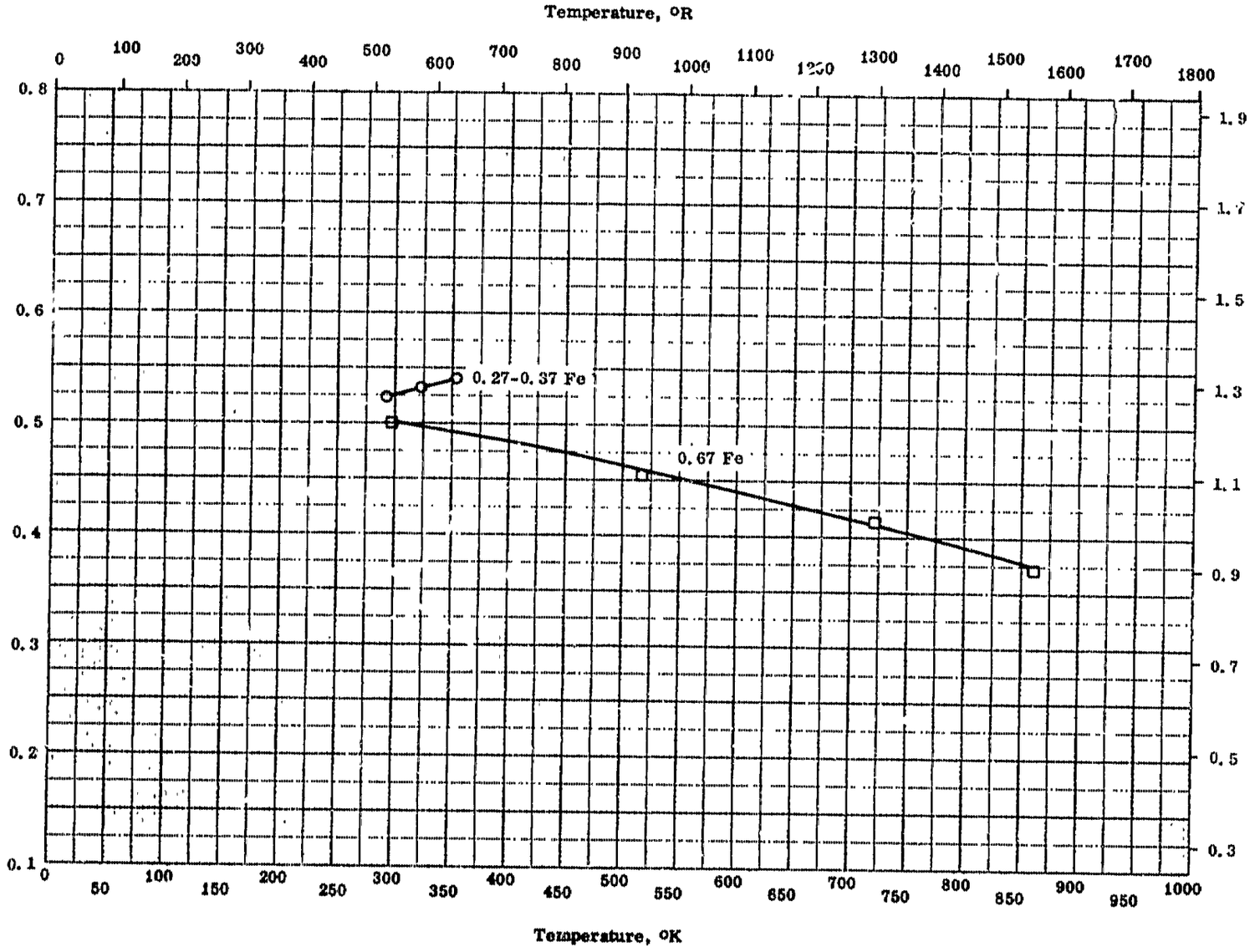


THERMAL LINEAR EXPANSION -- ALUMINUM + COPPER

THERMAL LINEAR EXPANSION — ALUMINUM + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	48-1	293-773		5.08 Cu, 0.15 Fe, 0.05 Si, Zn each, 0.02 Ti, and trace of Mg and Mn.	Cast, heated 6 hrs at 520 C, and water quenched; initial test.
□	48-1	293-773		Same as above	Second heating.
△	48-1	293-773		7.36 Cu, 0.15 Fe, 0.05 Si, Zn each, 0.02 Ti, and traces of Mg and Mn.	Cast, heated 6 hrs at 520 C, and water quenched; initial test.
◇	48-1	293-773		Same as above.	Second heating.



Thermal Conductivity, cal Sec^{-1} cm^{-1} K^{-1}

Thermal Conductivity, Btu hr^{-1} ft^{-1} R^{-1} x 10^{-2}

TPRC

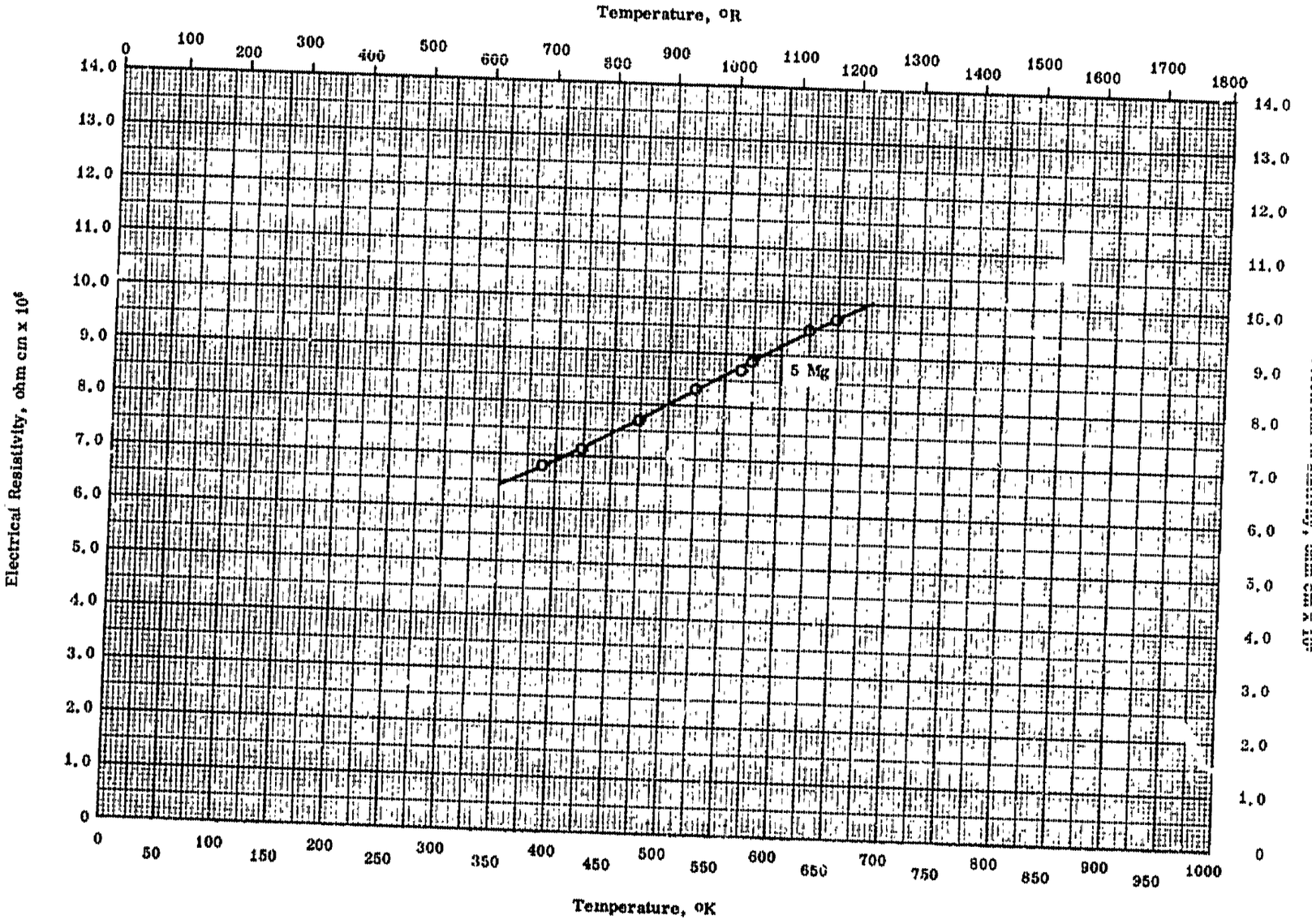
THERMAL CONDUCTIVITY -- ALUMINUM + IRON

THERMAL CONDUCTIVITY -- ALUMINUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	47-1	298-923		99.2 Al, 0.67 Fe, 0.10 Si, 0.01 Cu, and 0.01 >Mn and Mg.	
○	58-3	293-353		0.27 - 0.37 Fe, 0.19 Mg, 0.16 Si, 0.034 Zn, 0.021 Mn, and 0.019 Cu.	

TPRC

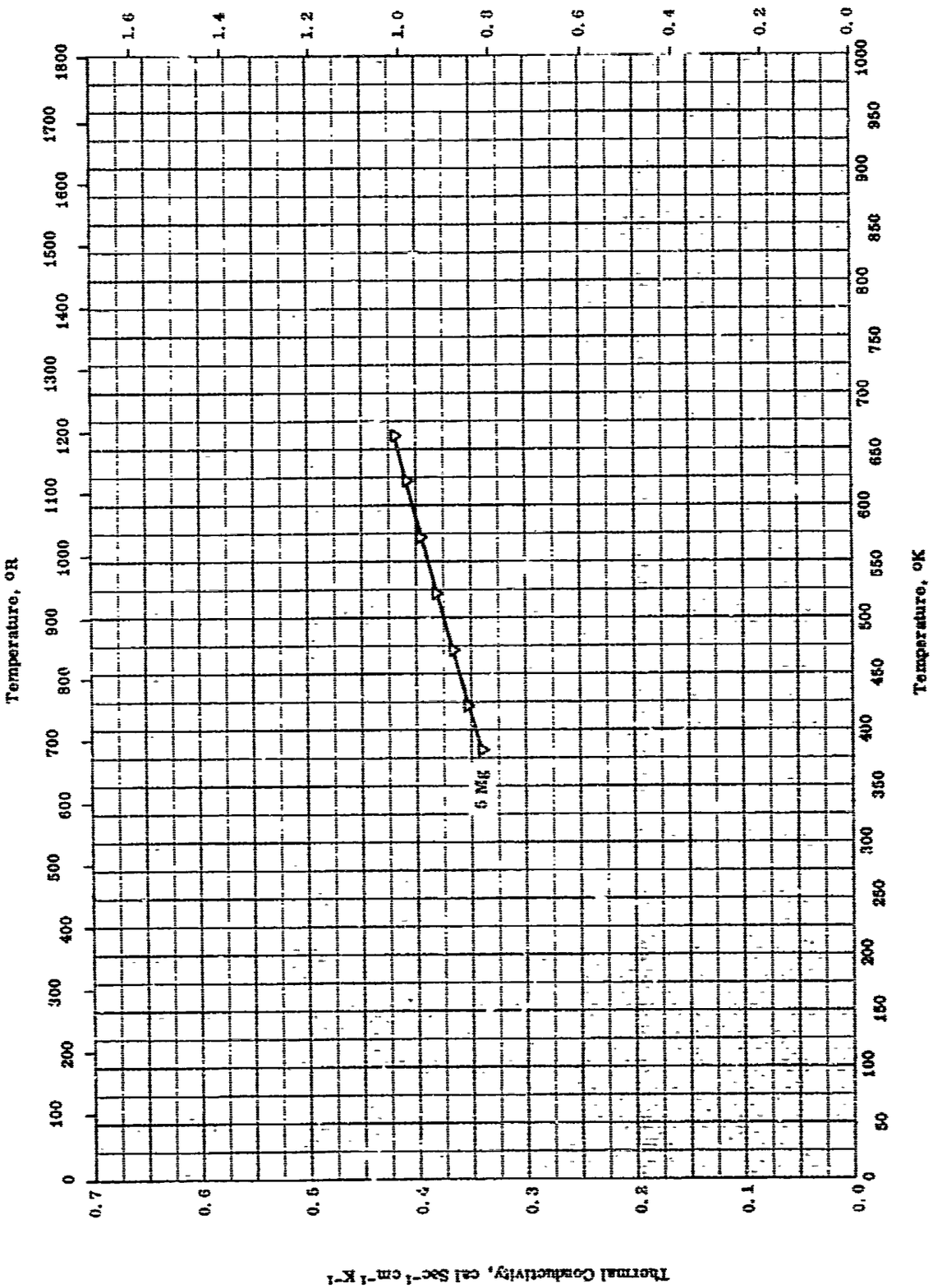


ELECTRICAL RESISTIVITY — ALUMINUM + MAGNESIUM

ELECTRICAL RESISTIVITY — ALUMINUM + MAGNESIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	40-1	388-649		Hydronalium 5 (German design.) 95 Al and 5 Mg; nominal composition.	Cast at 700 C into molds at 200 C; rolled and drawn, and then turned into rods.



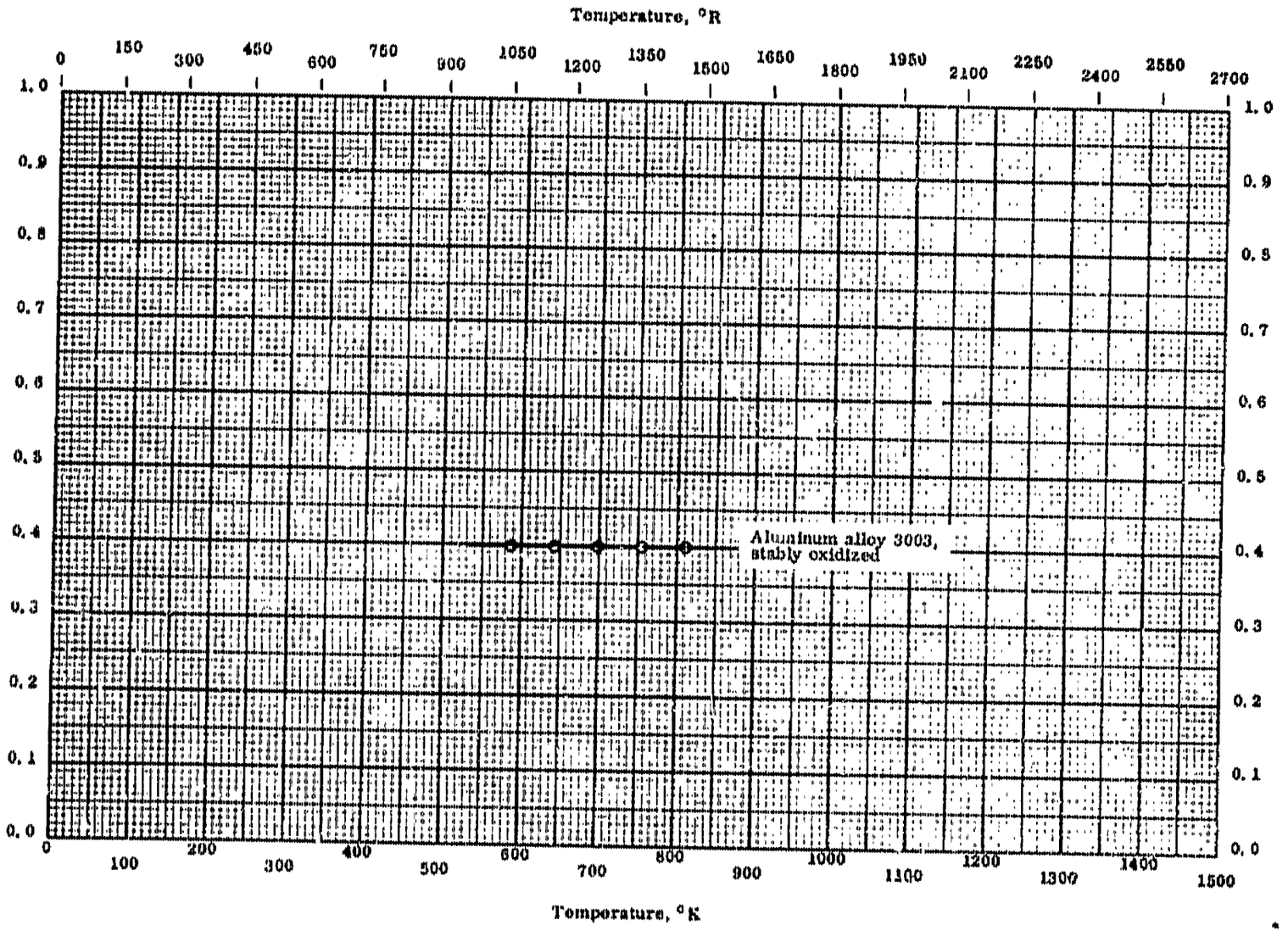
THERMAL CONDUCTIVITY -- ALUMINUM + MAGNESIUM

THERMAL CONDUCTIVITY -- ALUMINUM + MAGNESIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
▽	40-1	372-661		Hydronalium 5 (German design.); 95 Al and 5 Mg; nominal composition.	Cast at 700 C into molds at 200 C; rolled and drawn, then turned into rods; radiation loss less than 5%.

TPRC



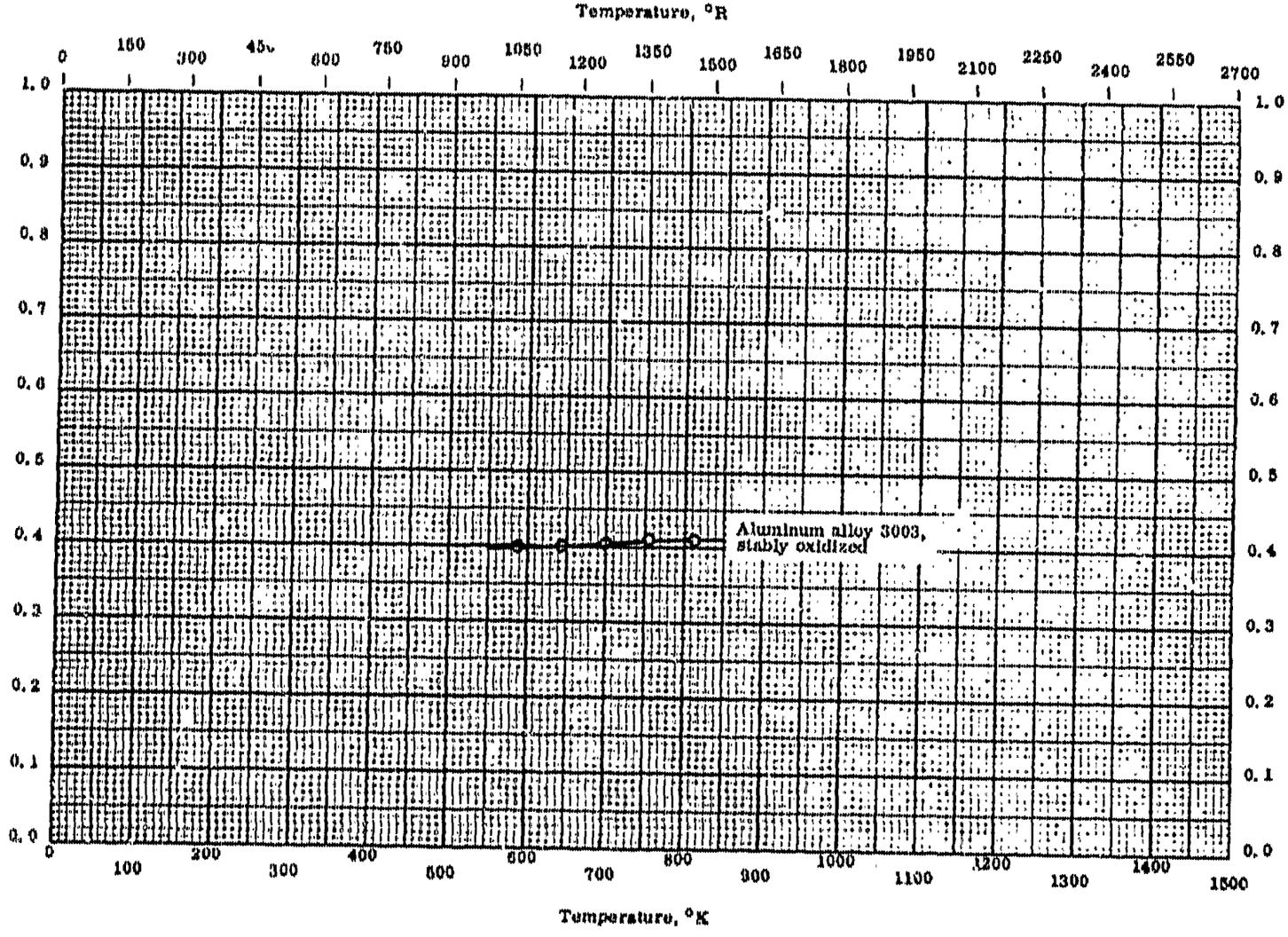
HEMISPHERICAL TOTAL EMITTANCE -- ALUMINUM + MANGANESE

TPRC

HEMISPHERICAL TOTAL EMITTANCE -- ALUMINUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	58-24	589-811	> 2	Aluminum alloy 3003; 1.2 Mn.	Stably oxidized in quiescent air at 811 K.



TPRC

NORMAL TOTAL EMITTANCE -- ALUMINUM + MANGANESE

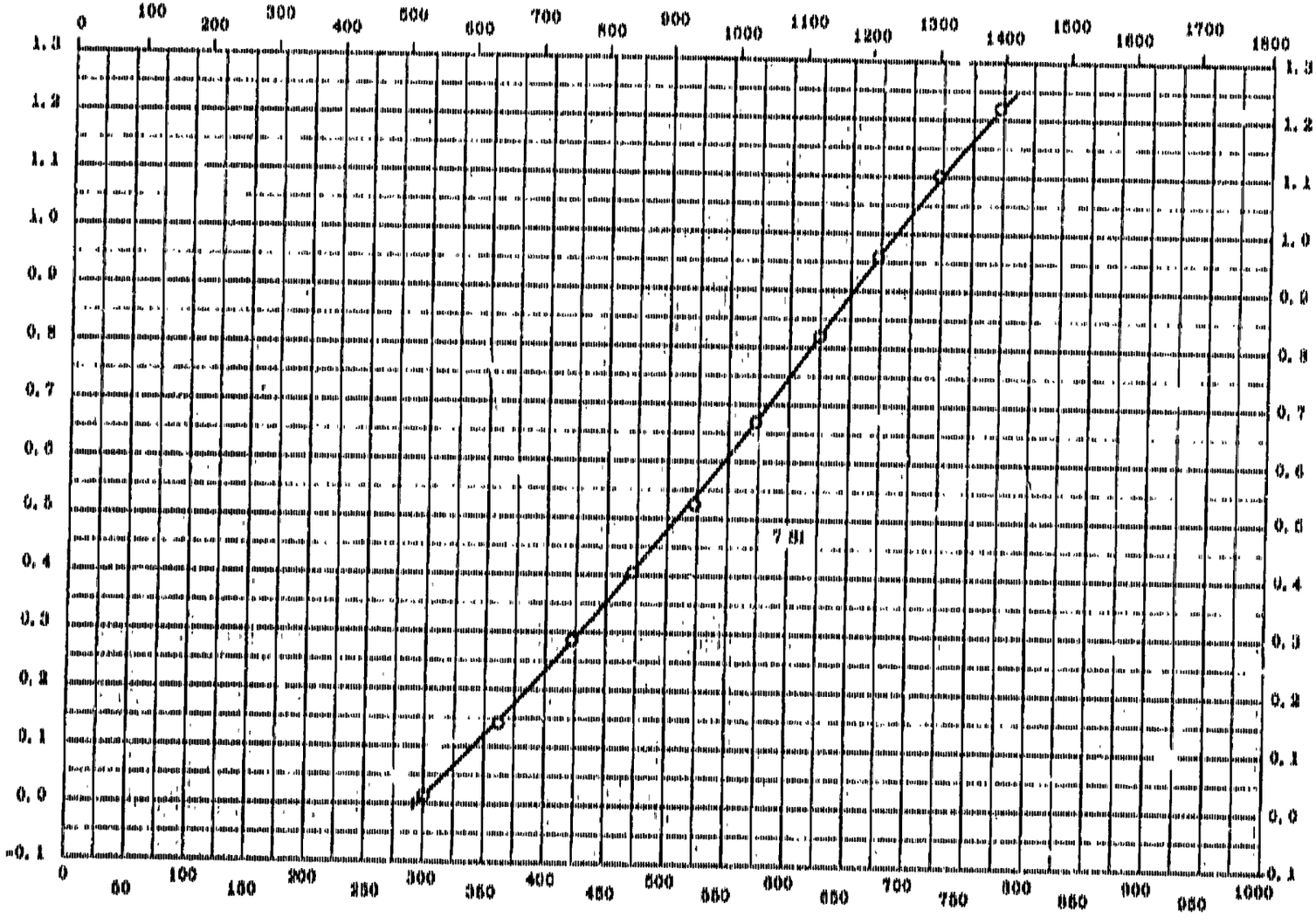
NORMAL TOTAL EMITTANCE -- ALUMINUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	58-34	589-611	>2	Aluminum alloy 3003; 1.2 Mn.	Stably oxidized at 611 K.

TPRC

Temperature, °F



Thermal Linear Expansion, percent

Thermal Linear Expansion, mm/mm

Temperature, °K

THERMAL LINEAR EXPANSION — ALUMINUM + SILICON

THERMAL LINEAR EXPANSION -- ALUMINUM + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	48-1	293-773		7.10 Si, 0.15 Fe, 0.05 Zn, 0.02 Ti, 0.01 Cu, and trace of Mg, Mn.	Cast, held 6 hrs at 520 C, and checked in water.

TPRC

PROPERTIES OF ALUMINUM + SILVER

REPORTED VALUES

	Density:	g cm^{-3}	lb ft^{-3}
○	10.02 Ag	2.90	181
▽	30.21 Ag	3.45	215

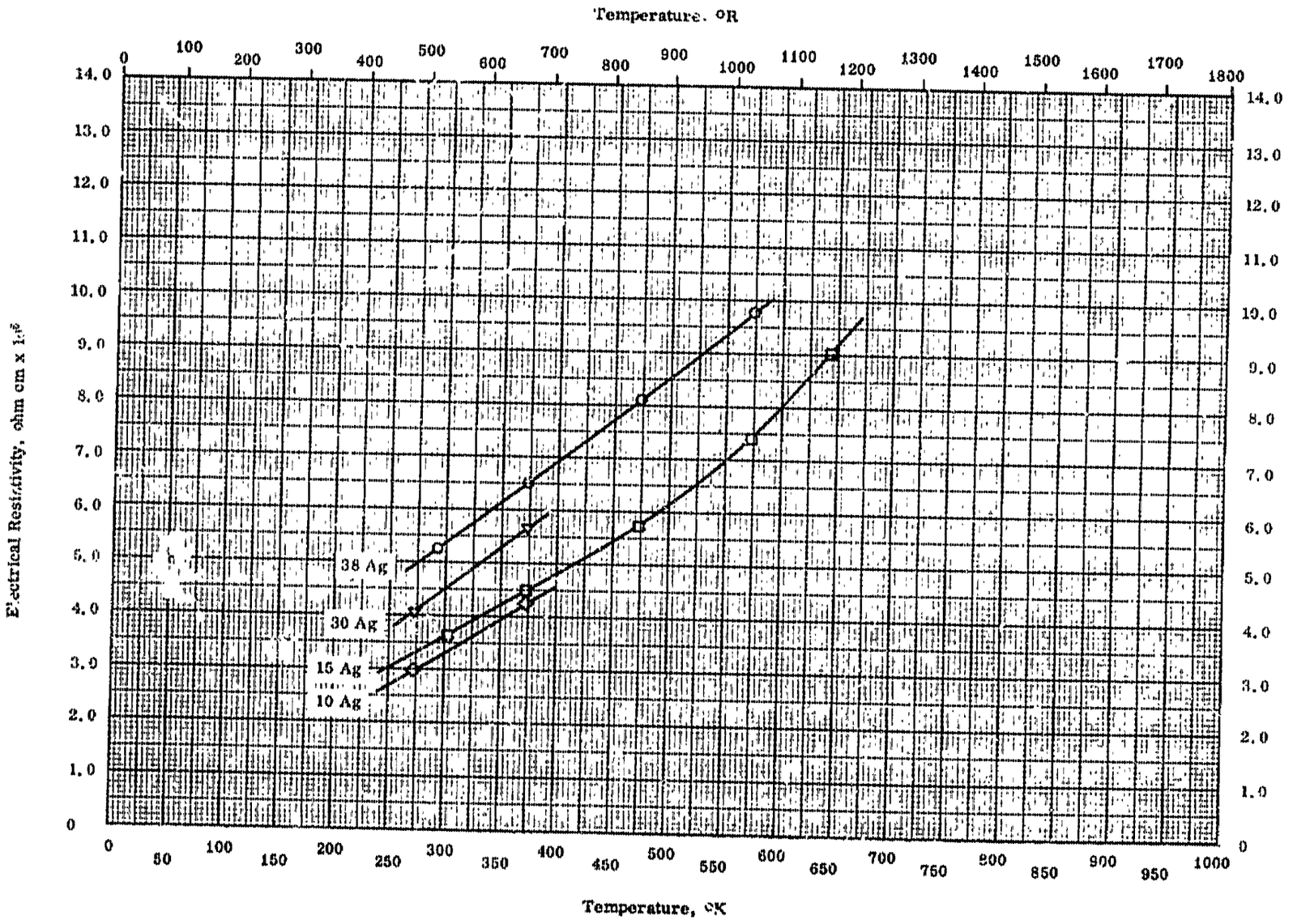
	Heat of Sublimation:	cal g^{-1}	Btu lb^{-1}
□	9.6 Ag	$1884_{808\,K}$	$3401_{1455\,R}$
△	16.5 Ag	1863_{836K}	$3553_{1505\,R}$

PROPERTIES OF ALUMINUM + SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	43-1	298		10.02 Ag; prepared from pure Ag and 99.99 pure Al.	Density by weight in air and in water.
▽	43-1	298		30.12 Ag; same as above.	Same as above.
□	54-21	808		9.6 Ag; nominal.	
△	54-21	836		16.5 Ag; nominal.	

TPRC



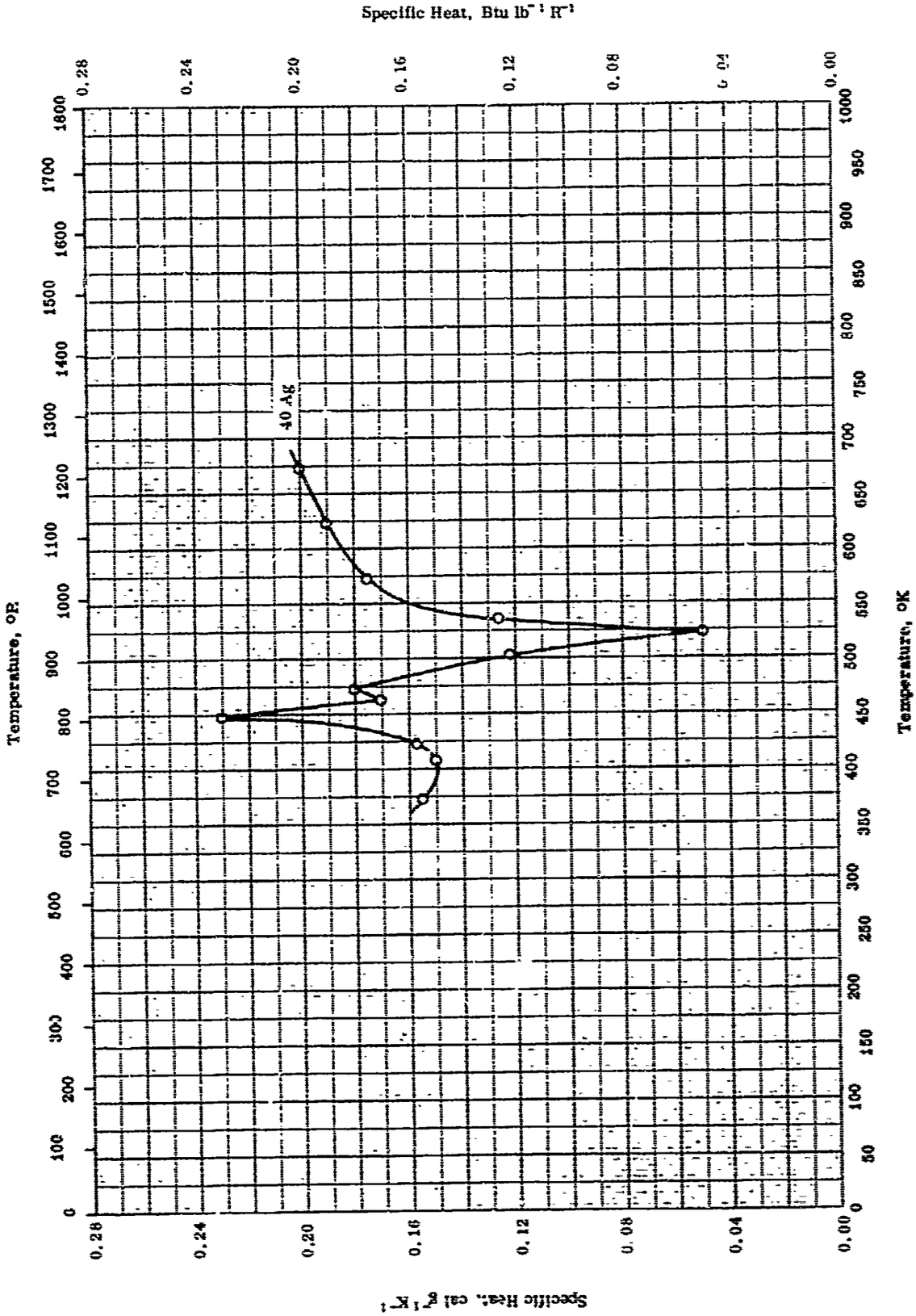
ELECTRICAL RESISTIVITY — ALUMINUM + SILVER

ELECTRICAL RESISTIVITY -- ALUMINUM + SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-25	293-573		38 Ag.	Furnace cooled 4 days from 550 C homogenizing temperature.
□	55-25	303-718		15 Ag.	Same as above.
◇	43-1	273-373		89.98 Al and 10.02 Ag.	
▽	43-1	273-373		69.79 Al and 30.21 Ag.	

TPRC



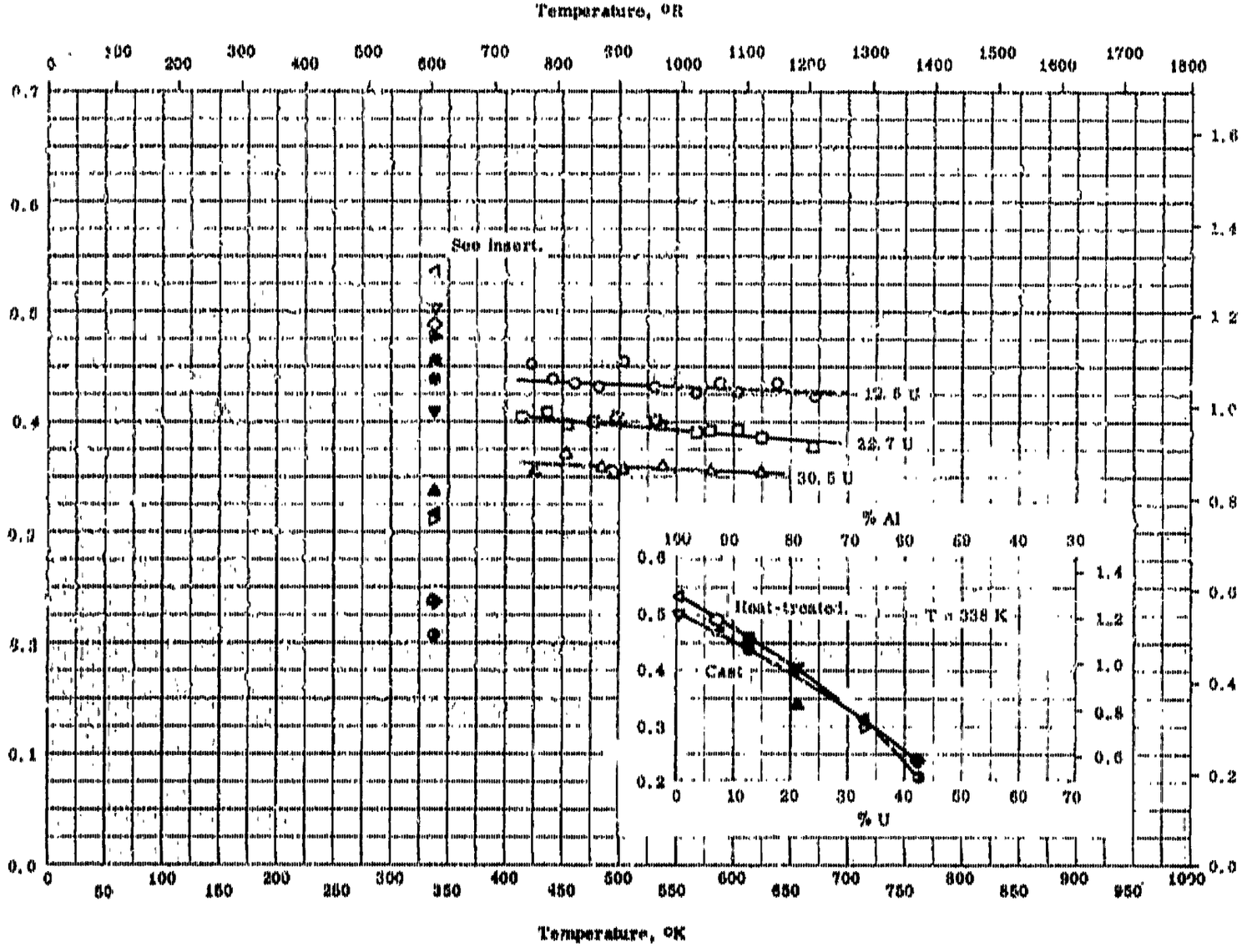
SPECIFIC HEAT — ALUMINUM + SILVER

SPECIFIC HEAT -- ALUMINUM + SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	41-3	373-673		60 Al and 40 Ag.	Quenched from 550 C and aged 7 days at room temperature.

TPRC



THERMAL CONDUCTIVITY -- ALUMINUM + URANIUM

TPRC

THERMAL CONDUCTIVITY — ALUMINUM + URANIUM

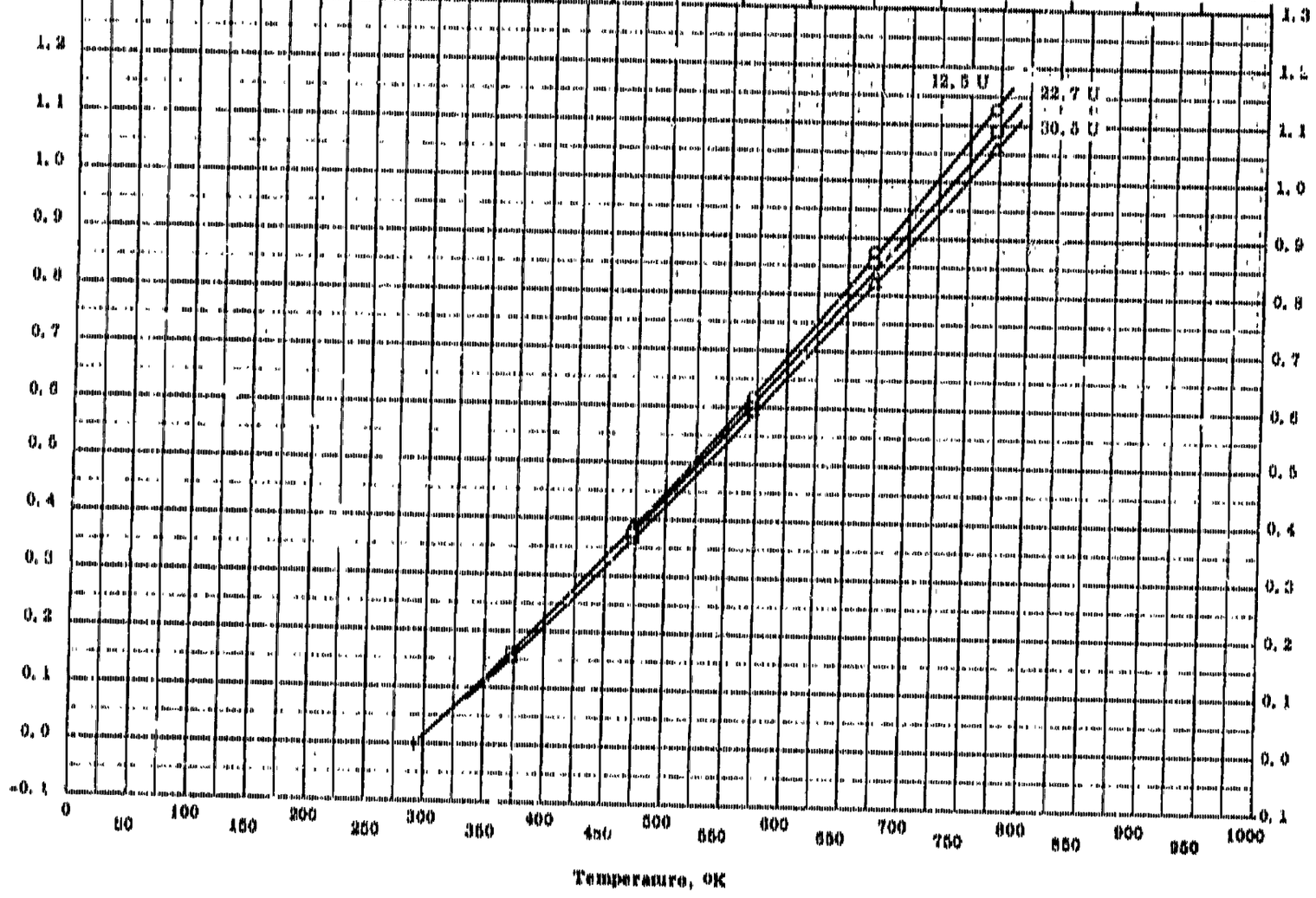
REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	55-2	423-671		12.5 U.	Annealed 1/2 hr at 370 C.
□	55-2	416-671		32.7 U.	Same as above.
△	55-2	436-626		30.3 U.	Same as above.
▽	63-4	338	<1.6	0.5 U, 0.10 > Fe, 0.07 > Si, 0.04 > Ca, and 0.02 > B; prepared from >99.5 reactor-grade U and 99.99 Al.	Cast after dissolving uranium in aluminum at approx. 100 C above the liquidus temperature of the alloy.
◁	63-4	338	<4.0	Same as above.	The above sample except heat-treated at 620 C for 5 days.
▷	63-4	338	<1.6	0.97 U, 0.10 > Fe, 0.07 > Si, 0.04 > Ca, and 0.02 > B; same raw materials as the above sample.	Cast after dissolving uranium in aluminum at approx. 100 C above the liquidus temperature of alloys.
◇	63-4	338	<4.0	Same as above.	Same as the above sample except heat-treated at 620 C for 5 days.
●	63-4	338	<1.6	12.01 U, 0.10 > Fe, 0.07 > Si, 0.04 > Ca, and 0.02 > B; same raw materials as the above sample.	Cast after dissolving uranium in aluminum at approx. 100 C above the liquidus temperature of alloys.
■	63-4	338	<4.0	Same as above.	Same as above except heat-treated at 620 C for 5 days.
▲	63-4	338	<1.6	21.43 U, 0.10 Fe, 0.07 Si, 0.04 Ca, and 0.02 > B; same raw materials as the above sample.	Cast after dissolving uranium in aluminum at approx. 100 C above the liquidus temperature of alloy.

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
▼	63-4	338	<4.0	Same as above.	Same as above except heat-treated at 620 C for 5 days.
◀	63-4	338	<1.6	32.94 U, 0.10 Fe, 0.07 Si, 0.04 Ca, and 0.02+ B; same raw materials as the above sample.	Cast after dissolving uranium in aluminum at appros. 100 C above the liquidus temperature of alloy.
▷	63-4	338	<4.0	Same as above.	Same as above except heat-treated at 620 C for 5 days.
◆	63-4	338	<1.6	42.49 U, 0.10 Fe, 0.07 Si, 0.04 Ca, and 0.02+ B; same raw materials as the above sample.	Cast after dissolving uranium in aluminum at approx. 100 C above the liquidus temperature of alloy.
●	63-4	338	<4.0	Same as above.	Same as above except heat-treated at 620 C for 5 days.

TPRC



CRU-1

THERMAL LINEAR EXPANSION — ALUMINUM + URANIUM

THERMAL LINEAR EXPANSION — ALUMINUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	57-54	293-773		13.6 U) 0.5 in. dia. by 3.30 in. long specimen.	Prepared from forged alloys.
□	57-54	293-773		23.7 U same as above.	Same as above.
△	57-54	293-773		30.5 U same as above.	Same as above.

PROPERTIES OF BARIUM + STRONTIUM

REPORTED VALUES

Melting Point:		**K**	**R**
O	0.4 Sr	983	1770
Heat of Fusion:		**cal g^{-1}**	**Btu lb^{-1}**
□	0.4 Sr	13.3 ± 0.6	24.0 ± 1

PROPERTIES OF BARIUM +STRONTIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	50-10	950-983		0.4 Sr, 0.1 Ca, 0.02 Fe, 0.01 each Mg, Cu, and Mn, and traces of Si.	
□	50-10	---		Same as above.	Δhf from steps in enthalpy and temperature curve.

TPRC

PROPERTIES OF BERYLLIUM + ALUMINUM

REPORTED VALUES

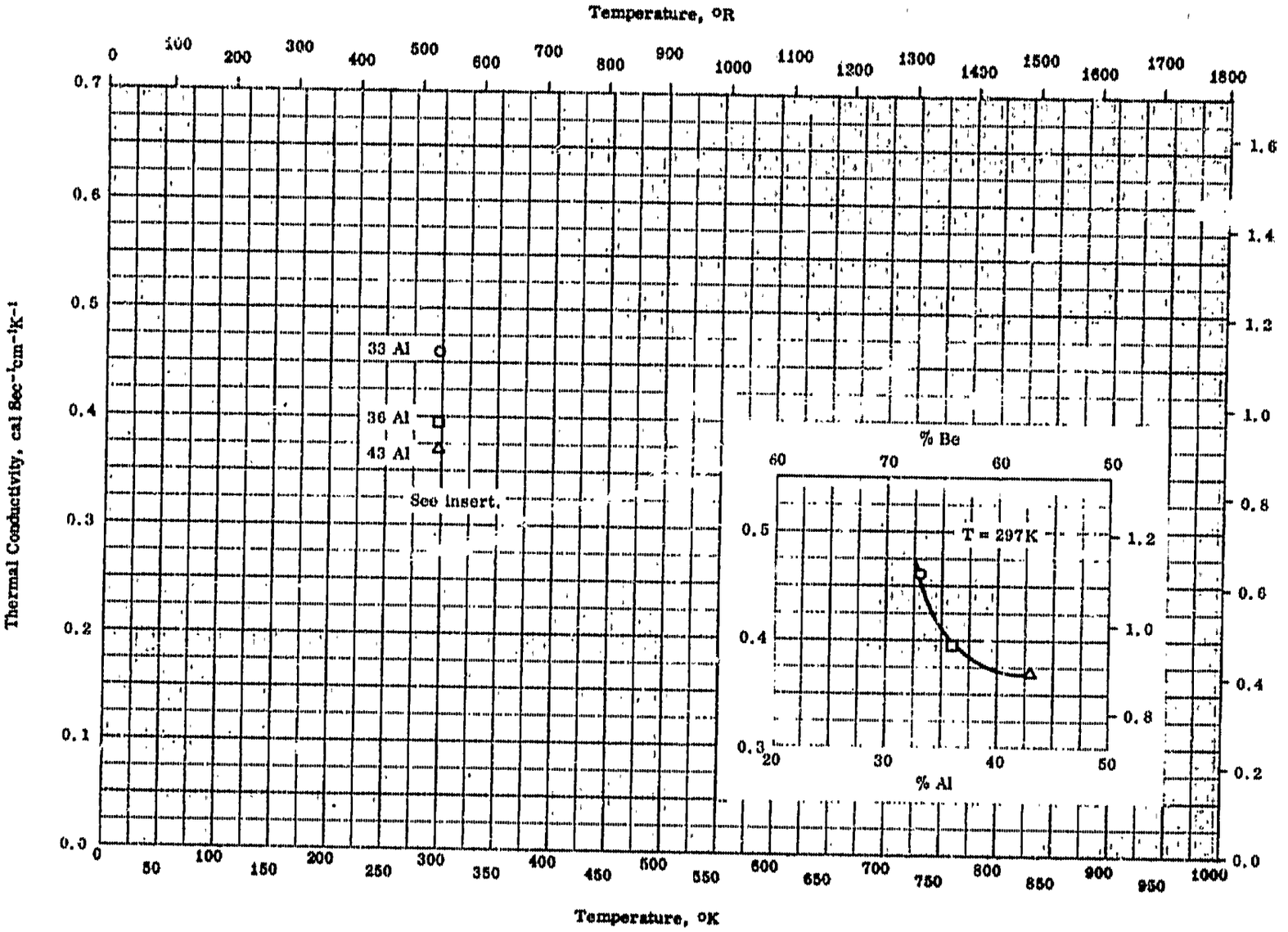
Density:	g cm^{-3}	lb ft^{-3}
○ 0.21 Al	1.73	108
□ 0.21 Al	1.80	112

PROPERTIES OF BERYLLIUM + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	49-10	298		98.54 Be, 0.21 Al, 0.19 Mg, 0.164 Fe, 0.084 Si, 0.036 Ca, 0.016 Cr, 0.013 Cu, 0.011 Mn, 0.008 Ni, 0.006 Pb, 0.0006 Sn, 0.005 B, and 0.00003 Cd.	Max. density by compacting at 116,000 psi, 3 hrs at 1200 C in vacuum.
□	49-10	298		Same as above.	Max. density by sintering 30 min. 1230 C in A atm.

TPRC



THERMAL CONDUCTIVITY -- BERYLLIUM + ALUMINUM

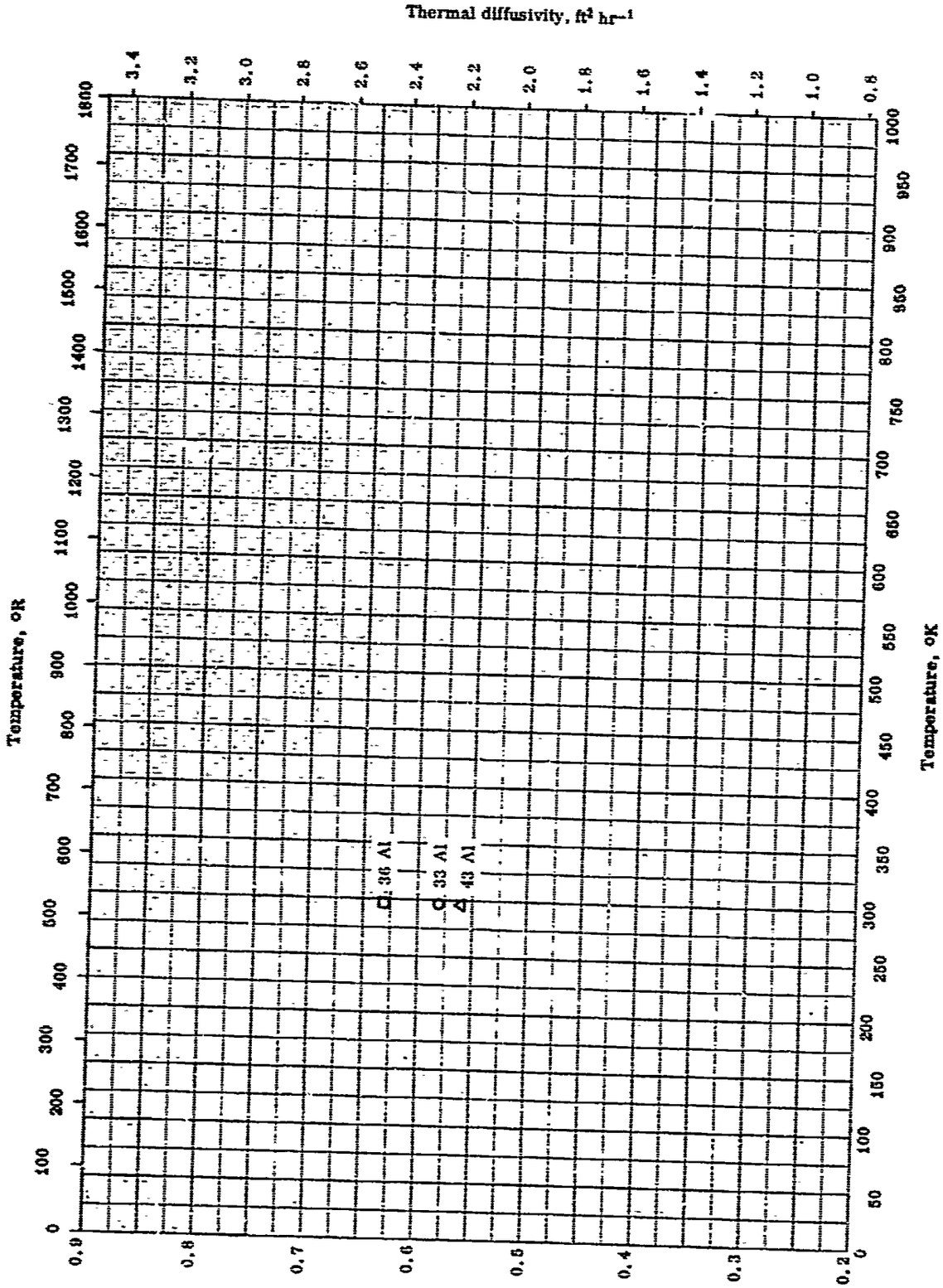
TPRC

TPRC

THERMAL CONDUCTIVITY -- BERYLLIUM + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	64-1	297		33 Al; density 2.00 g cm^{-3}.	
□	64-1	297		76 Al; density 2.07 g cm^{-3}.	
△	64-1	297		43 Al; density 2.14 g cm^{-3}.	

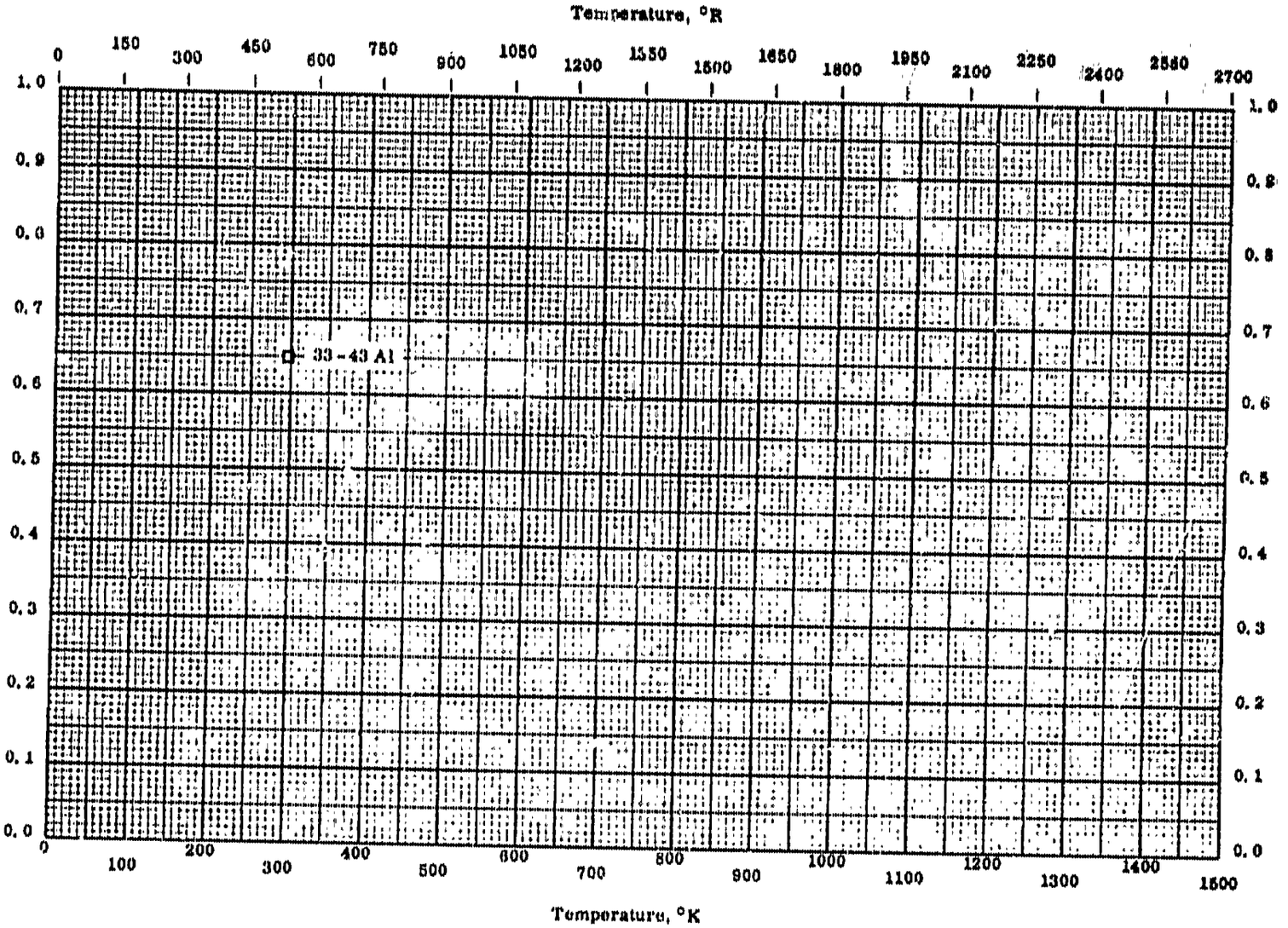


THERMAL DIFFUSIVITY -- BERYLLIUM + ALUMINUM

THERMAL DIFFUSIVITY — BERYLLIUM + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	64-1	297		67 Be and 33 Al; density 2.05 g cm^{-3}.	
□	64-1	297		64 Be and 36 Al; density 2.07 g cm^{-3}.	
△	64-1	297		57 Be and 43 Al; density 2.14 g cm^{-3}.	



NORMAL TOTAL EMITTANCE -- BERYLLIUM + ALUMINUM

NORMAL TOTAL EMITTANCE -- BERYLLIUM + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	04-1	297		Three samples: (1) 33 Al; density 2.05 gm cm^{-3} (2) 36 Al; density 2.07 gm cm^{-3} (3) 43 Al; density 2.14 gm cm^{-3}.	Same value for all three samples.

TPRC

PROPERTIES OF BORON + IRON

REPORTED VALUES

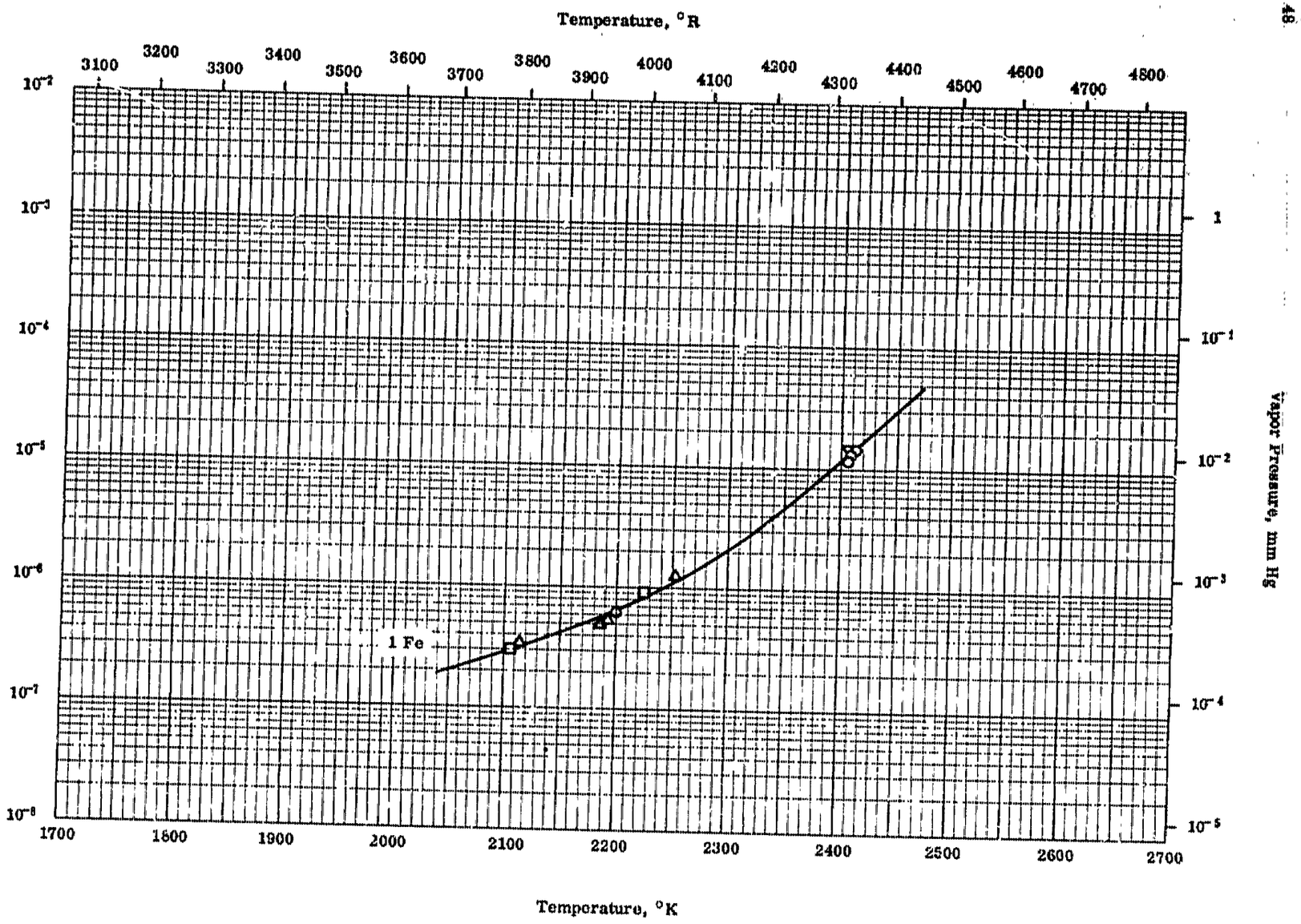
Heat of Sublimation:	cal g^{-1}	Btu lb^{-1}
△ 1.0 Fe	13020 ± 180	23440 ± 330
◇ 1.0 Fe	12800 ± 400*	23100 ± 800*

*Most probable value for alloys of this composition.

PROPERTIES OF BORON + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
△	53-21	298		1 Fe and 0.13 C.	Δh_s from vapor pressure.
◇	57-13	298		Same as above.	Same as above.



VAPOR PRESSURE -- BORON + IRON

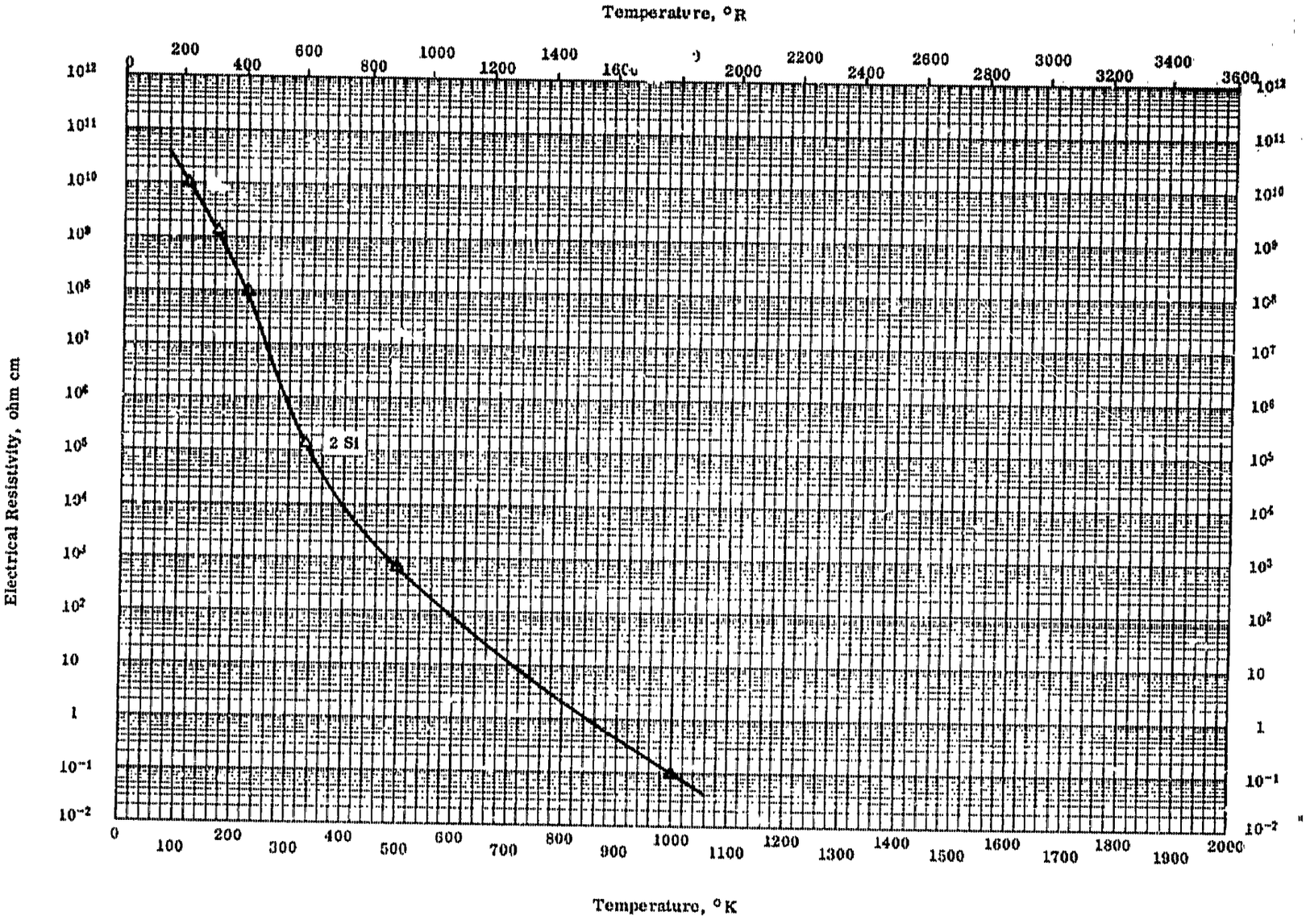
IPRC

VAPOR PRESSURE -- BORON + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
△	57-13			1 Fe, 0.13 C.	Carbon crucibles.
▽	57-13			1 Fe, 0.13 C.	Tantalum crucibles.
○	57-13			1 Fe, 0.13 C.	ZrB_2 crucibles.
□	57-13			1 Fe, 0.13 C.	Early 1953 data.

TPRC



ELECTRICAL RESISTIVITY -- BORON + SILICON

TPRC

ELECTRICAL RESISTIVITY -- BORON + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
Δ	57-27	111-1000		2 Si and 0.03 > others.	Prepared by reduction of B Cl_3 with H_2 on heated tungsten at 1530 C.

TPRC

PROPERTIES OF CADMIUM + SILVER

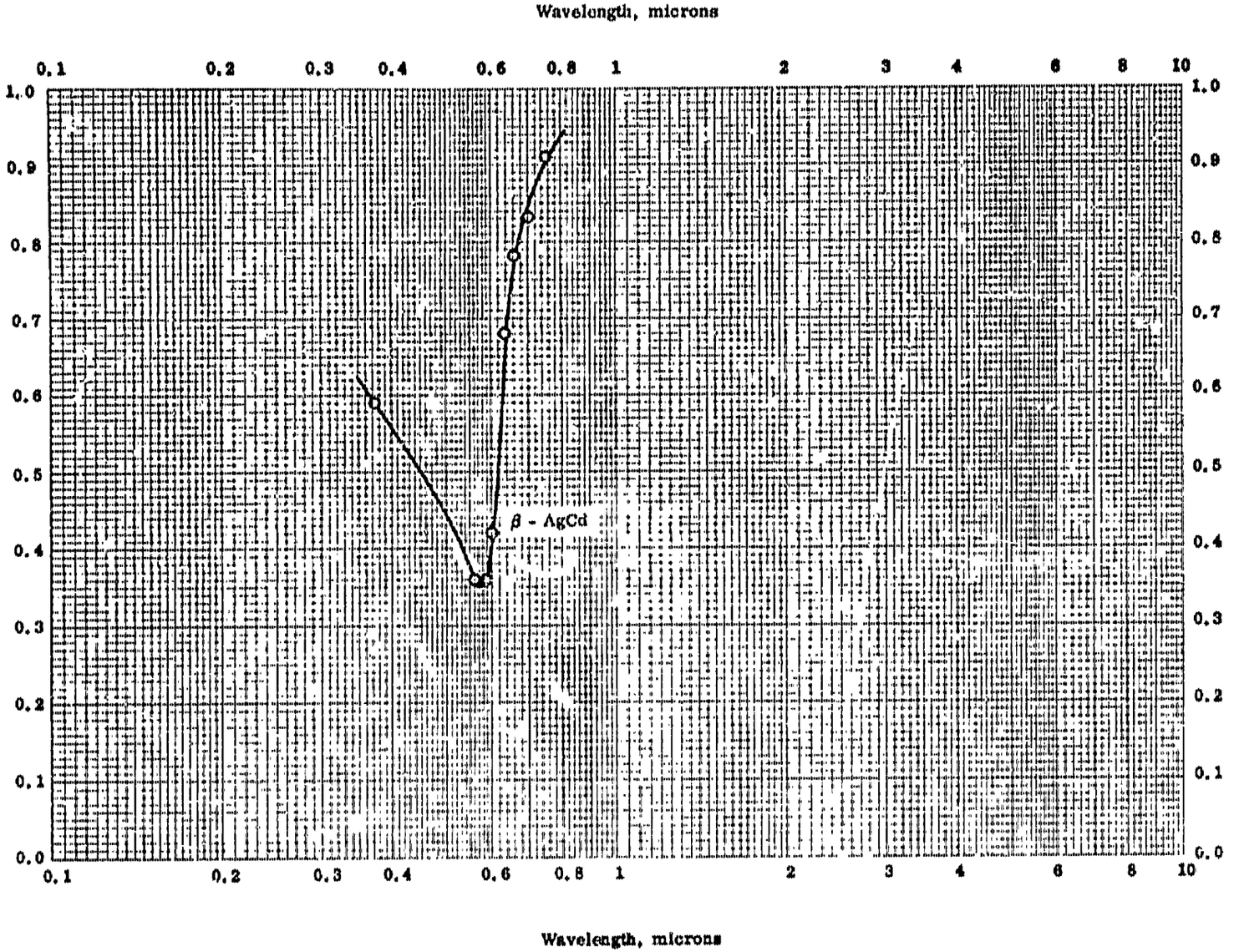
REPORTED VALUES

Melting Point:		K	R
○	31.6 Ag	865	1558
Heat of Fusion:		$cal\ g^{-1}$	$Btu\ lb^{-1}$
□	31.6 Ag	18.2 ± 1	32.8 ± 1.6

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	43-4	866		68.4 Cd; ϵ- phase	
□	43-4	866	± 2.3	Same as above.	From enthalpy data by drop method copper block calorimeter.

TPRC



ANGULAR SPECTRAL REFLECTANCE -- CADMIUM + SILVER

TPRC

ANGULAR SPECTRAL REFLECTANCE -- CADMIUM + SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. °K	Wavelength Range, μ	Rept. Error%	Sample Specifications	Remarks
O	61-24	298	0.375-0.75		β - AgCd; 2000 Å film.	Vacuum evaporated on glass; 45 degree illumination and 45 degree viewing; data extracted from smooth curve.

PROPERTIES OF CALCIUM + MAGNESIUM

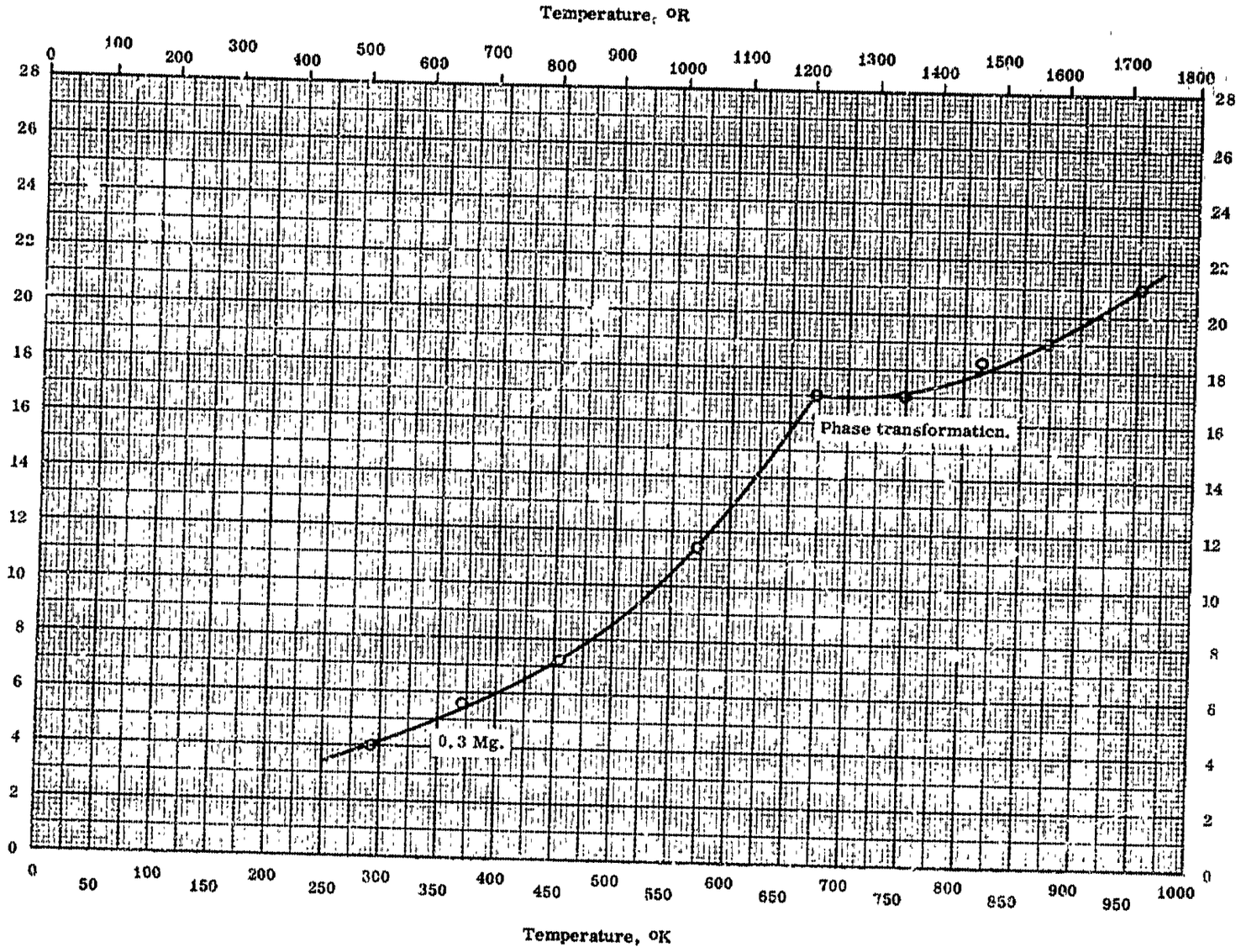
REPORTED VALUES

Melting Point:	K	R
□ 0.3 Mg	1122	2020

REFERENCE INFORMATION

Symbol	Ref.	Temp, Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-28	2020		99.66 Ca, 0.3 Mg, 0.0225 N, 0.006 Fe, 0.004 Mn, and 0.001 Al.	Triple distilled.

TPRC



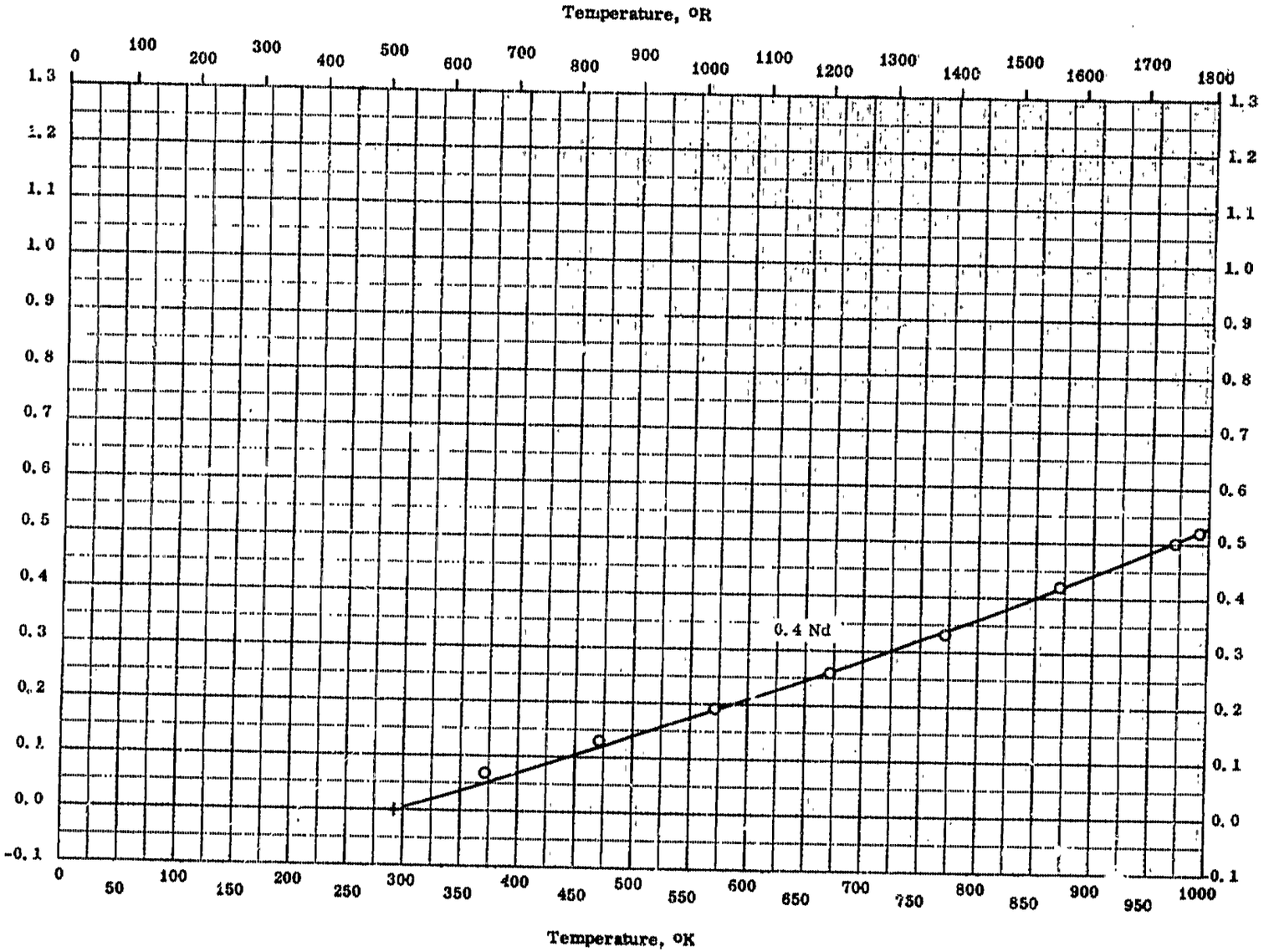
ELECTRICAL RESISTIVITY -- CALCIUM + MAGNESIUM

TPRC

ELECTRICAL RESISTIVITY -- CALCIUM + MAGNESIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-28	293-973		99.66 Ca, 0.3 Mg, 0.025 N, 0 006 Fe, 0.004 Mn, and 0.001 Al.	Triple distilled.



THERMAL LINEAR EXPANSION -- CERIUM + NEODYMIUM

Thermal Linear Expansion, percent

THERMAL LINEAR EXPANSION -- CERIUM + NEODYMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	57-51	293-995		0.4 Nd, 0.05 Pr and La each, 0.04 Fe, N_2, Ca each, 0.03 Si, and 0.02 C.	Data obtained during heating; cooling data not shown because sample softened.

TPRC

PROPERTIES OF CHROMIUM + IRON

REPORTED VALUES

Melting Point:		**K**	**R**
O	0.3 Fe	2176	3917

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	52-15	2160-2186		Electrolytic; 0.3 Fe, 0.08 O, 0.03 Si, 0.004 S, 0.002 N, 0.09% Mo, and negligible C.	Annealed in purified H_2 for 100 hrs at 1375 C; melted in stabilized zirconia crucible under purified A atm.

TPRC

Electrical Resistivity, ohm cm x 10^6

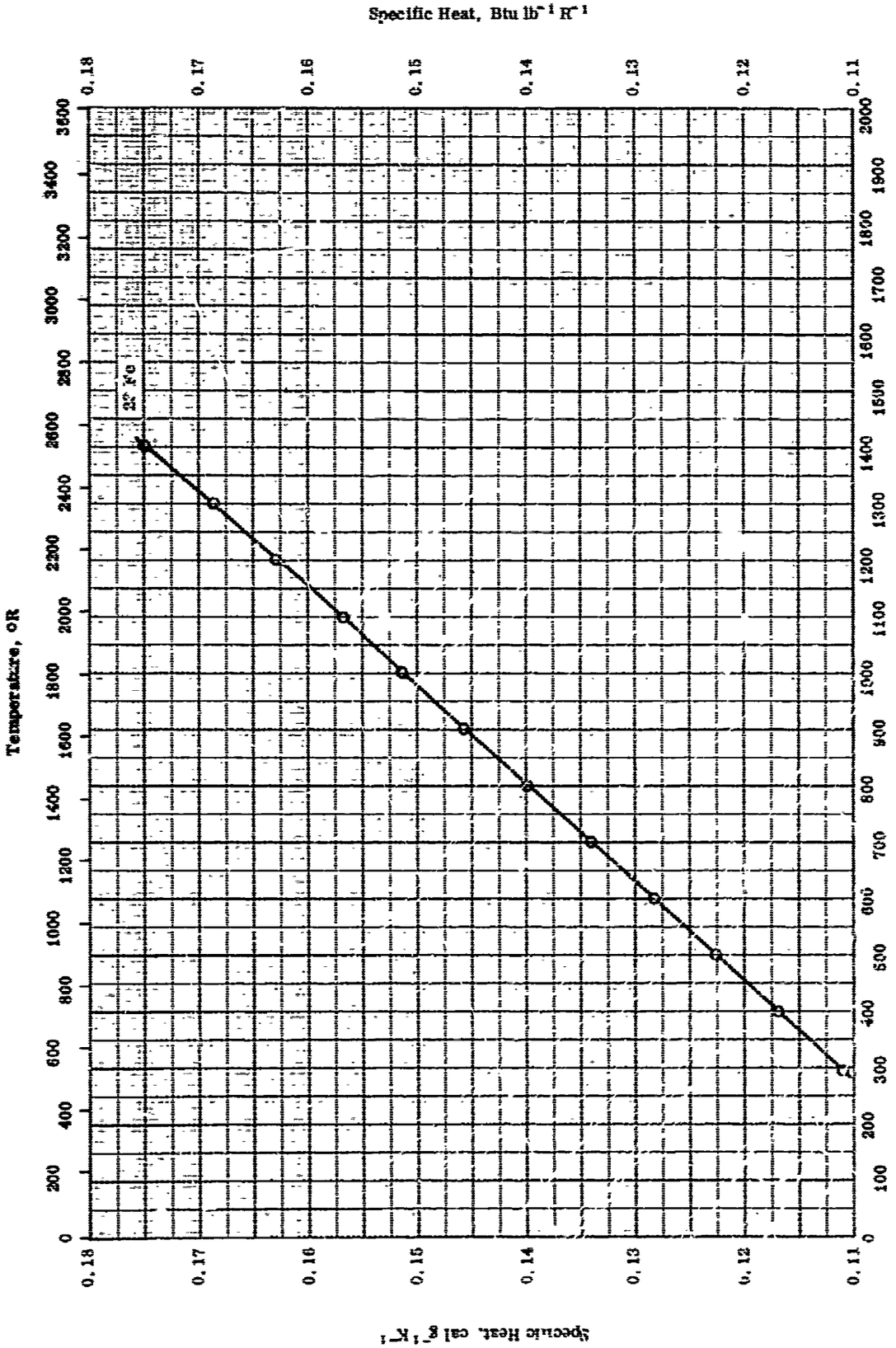
ELECTRICAL RESISTIVITY -- CHROMIUM + IRON

Electrical Resistivity, ohm cm x 10^6

ELECTRICAL RESISTIVITY -- CHROMIUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
▽	53-17	293-848		0.54 Fe, 0.14 Si, and 0.014 S.	Made by decomposing Cr hydride; annealed 40 hrs at 700 C; auth. reported γ/γ_{20C}; γ_{20C} not given.
○	53-17	198-373		Same as above.	Same as the above; O_2 and N_2 content reduced by sintering in H_2 atoms.

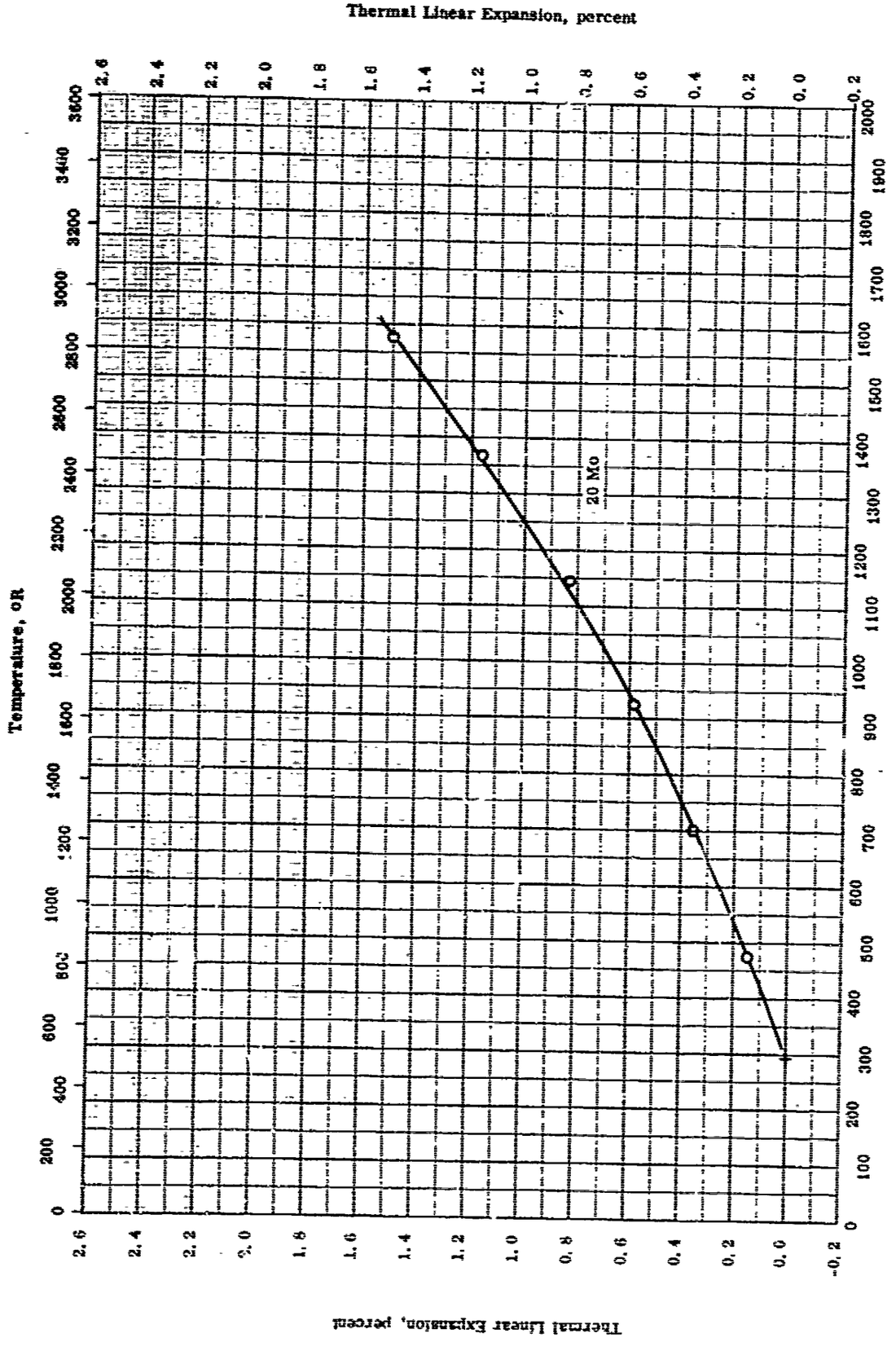


SPECIFIC HEAT — CHROMIUM + IRON

SPECIFIC HEAT -- CHROMIUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	59-11	298-1400	± 0.5	Sample No. 80 Cr; 77.2 Cr and 22.8 Fe.	Homogenized for 4 days at 1350 C under helium; air cooled to room temperature.



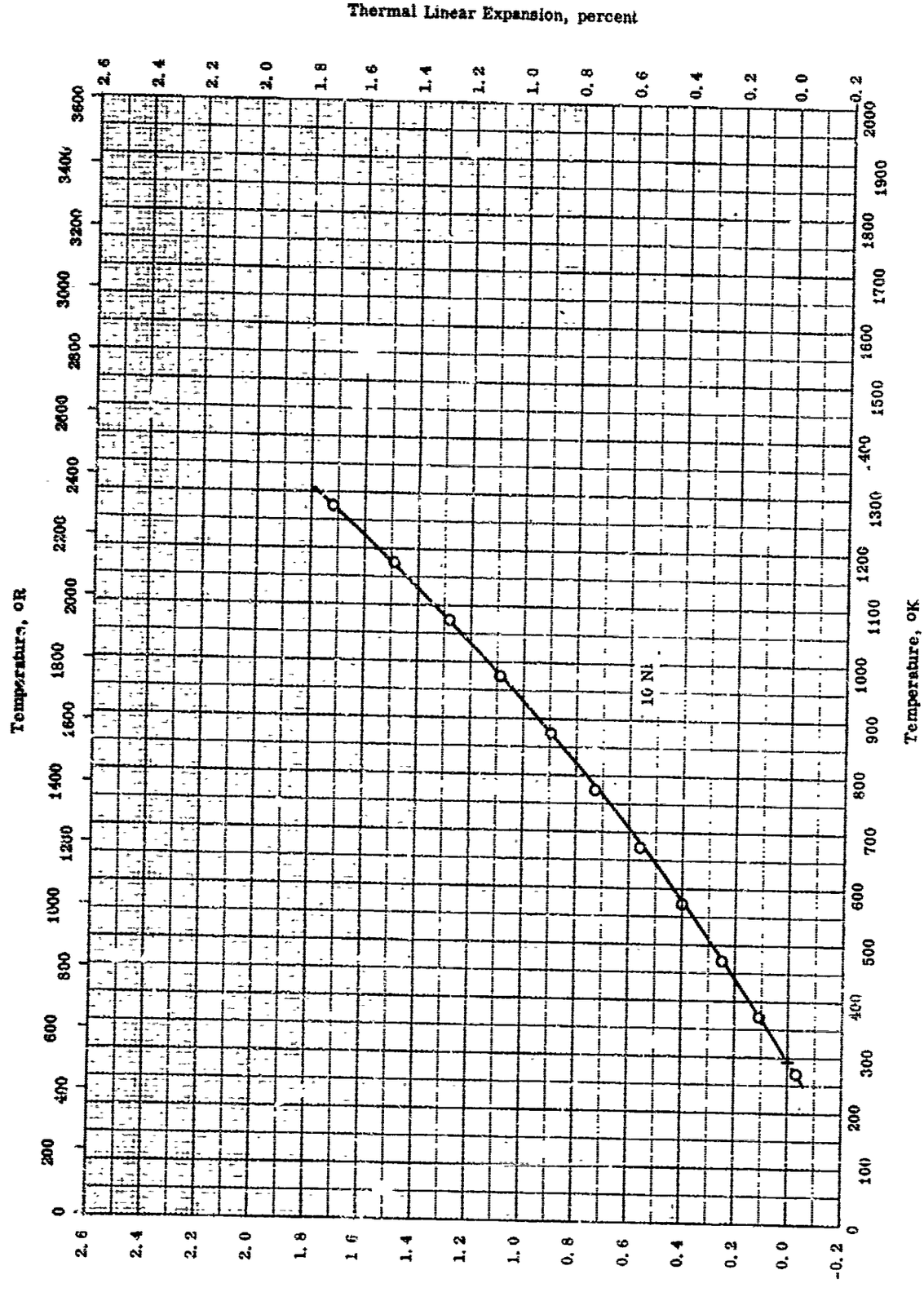
THERMAL LINEAR EXPANSION — CHROMIUM + MOLYBDENUM

THERMAL LINEAR EXPANSION -- CHROMIUM + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	34-28 also 55-40	293-1573		80 Cr and 20 Mo, prepared from 99 + pure Cr and 99.75 + pure Mo.	Initial run discarded as bends in sight wires came out during heating; results given from cooling curve plus later runs.

TPRC



THERMAL LINEAR EXPANSION -- CHROMIUM + NICKEL

Thermal Linear Expansion, percent

THERMAL LINEAR EXPANSION -- CHROMIUM + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	41-5	273-1273		Chronin; approx. analysis: 90 Cr, 10 Ni, and trace Fe.	

PROPERTIES OF CHROMIUM + SILICON

REPORTED VALUES

Density:	g cm^{-3}	lb ft^{-3}
○ 0.29 Si	7.07	441
□ 0.53 Si	6.86	428

PROPERTIES OF CHROMIUM + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	41-4	298		99.2 Cr, 0.29 Si, and 0.05 Mn.	Hot-swaged.
□	41-4	298		96.7 Cr, 0.53 Si, 0.09 C, 0.065 N, 0.02 Fe, and 0.02 Mn.	Hot-swaged.

TPRC

PROPERTIES OF CHROMIUM + TUNGSTEN

REPORTED VALUES

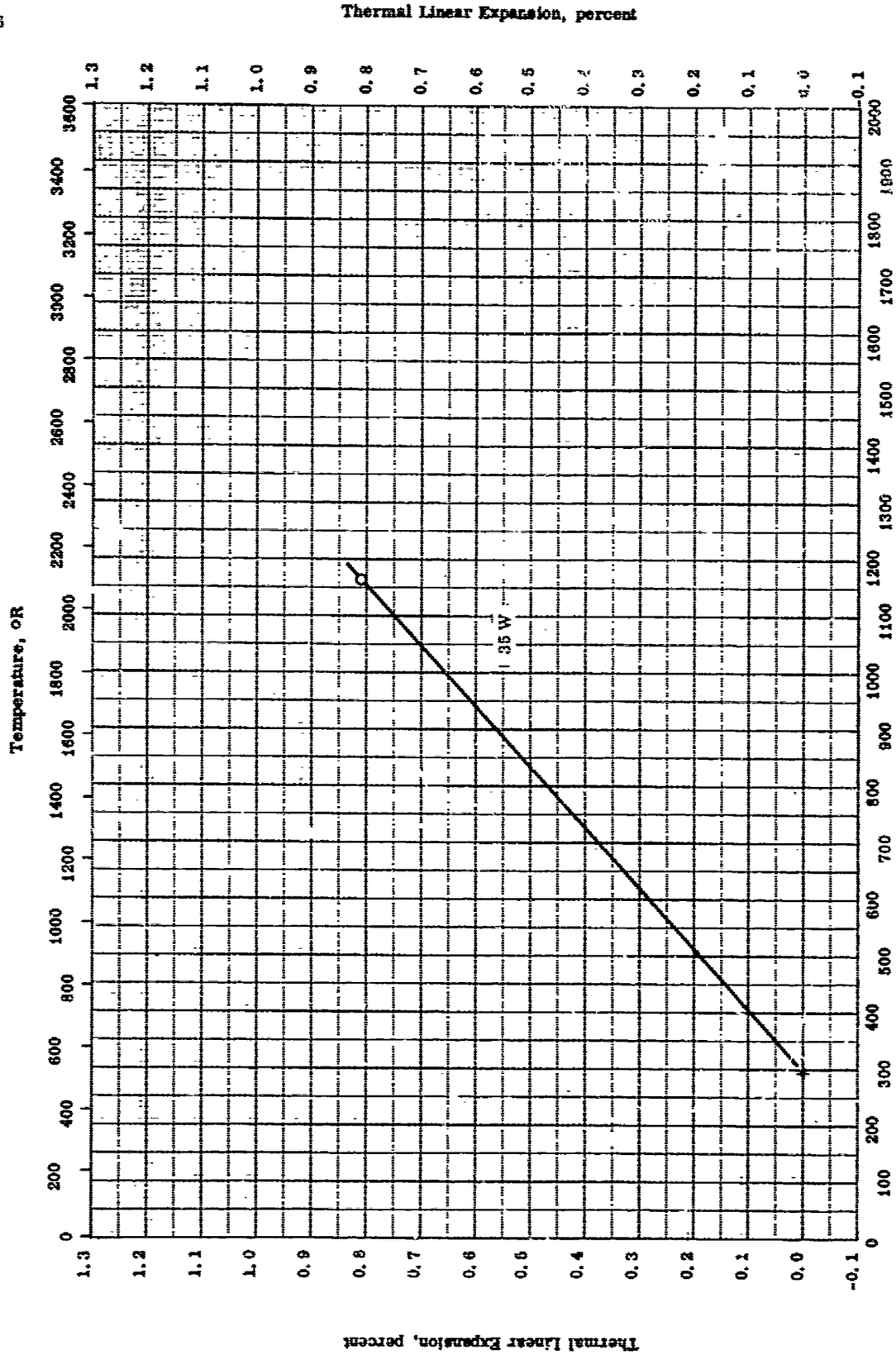
Density:	g cm^{-3}	lb ft^{-3}
O 30 W	8.68	542

PROPERTIES OF CHROMIUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	46-2	298		70 Cr, 30 W, and 0.026 C.	As cast.

TPRC



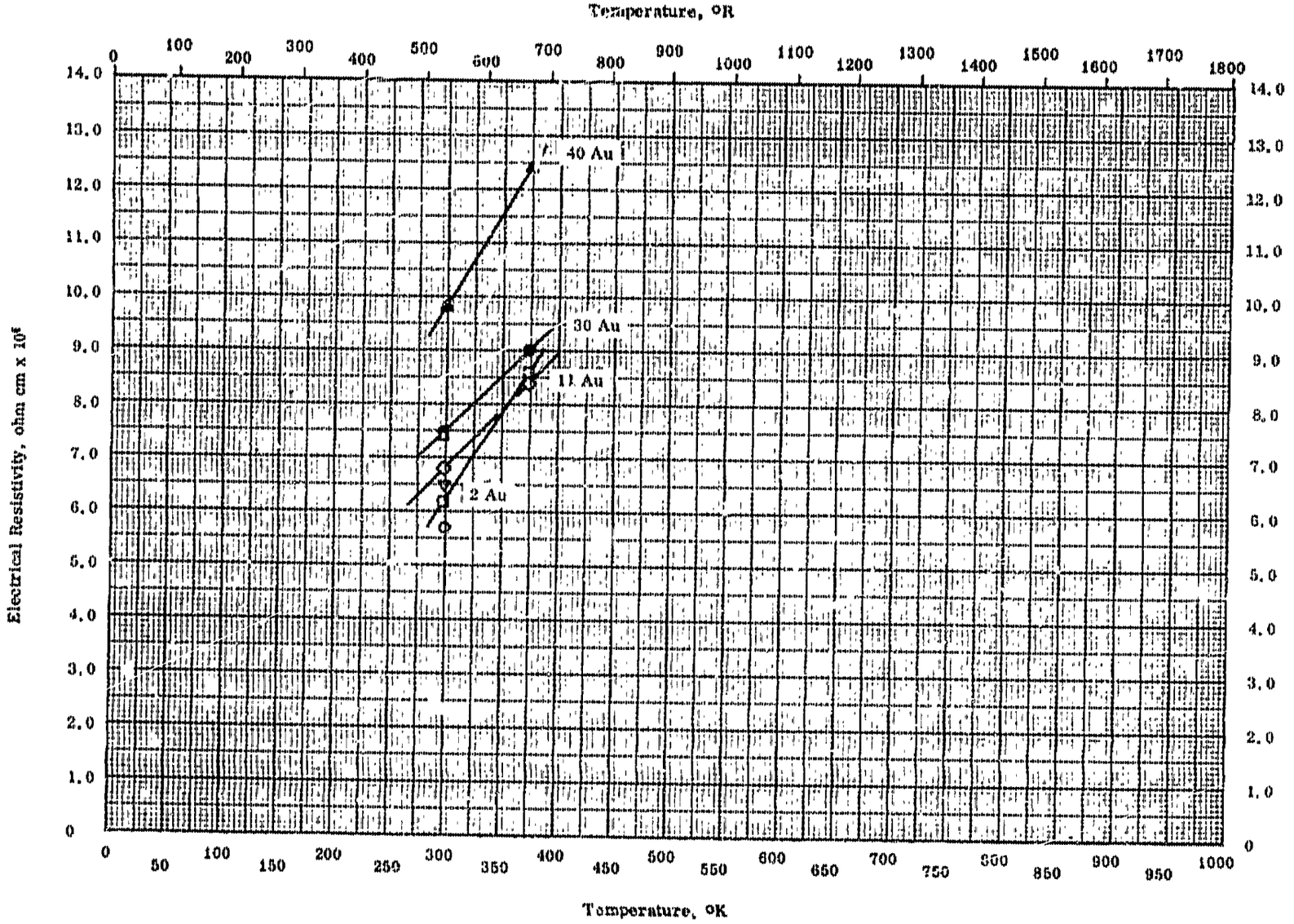
THERMAL LINEAR EXPANSION -- CHROMIUM + TUNGSTEN

THERMAL LINEAR EXPANSION -- CHROMIUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	46-2	297-1161		65 Cr and 35 W.	Author gives average coeff. of exp. 5.25 x 10^{-6} per F. 75 to 1630 F.

TPRC



ELECTRICAL RESISTIVITY COBALT + GOLD

Electrical Resistivity, ohm cm x 10⁶

ELECTRICAL RESISTIVITY -- COBALT + GOLD

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-33	298-373		98.0 Co, and 2.0 Au.	Melted from 99.99 Co and 99.99 Au.
△	56-33	298-373		92.5 Co, and 7.5 Au.	Same as above.
◇	56-33	298-373		89.0 Co, and 11.0 Au.	Same as above.
▽	56-33	298-373		87.0 Co, and 13.0 Au.	Same as above.
○	56-33	298-373		85.0 Co, and 15.0 Au.	Same as above.
●	56-33	298-373		70.0 Co, and 30.0 Au.	Same as above.
▲	56-33	298-373		60.0 Co, and 40.0 Au.	Same as above.

TPRC

PROPERTIES OF COBALT + IRON

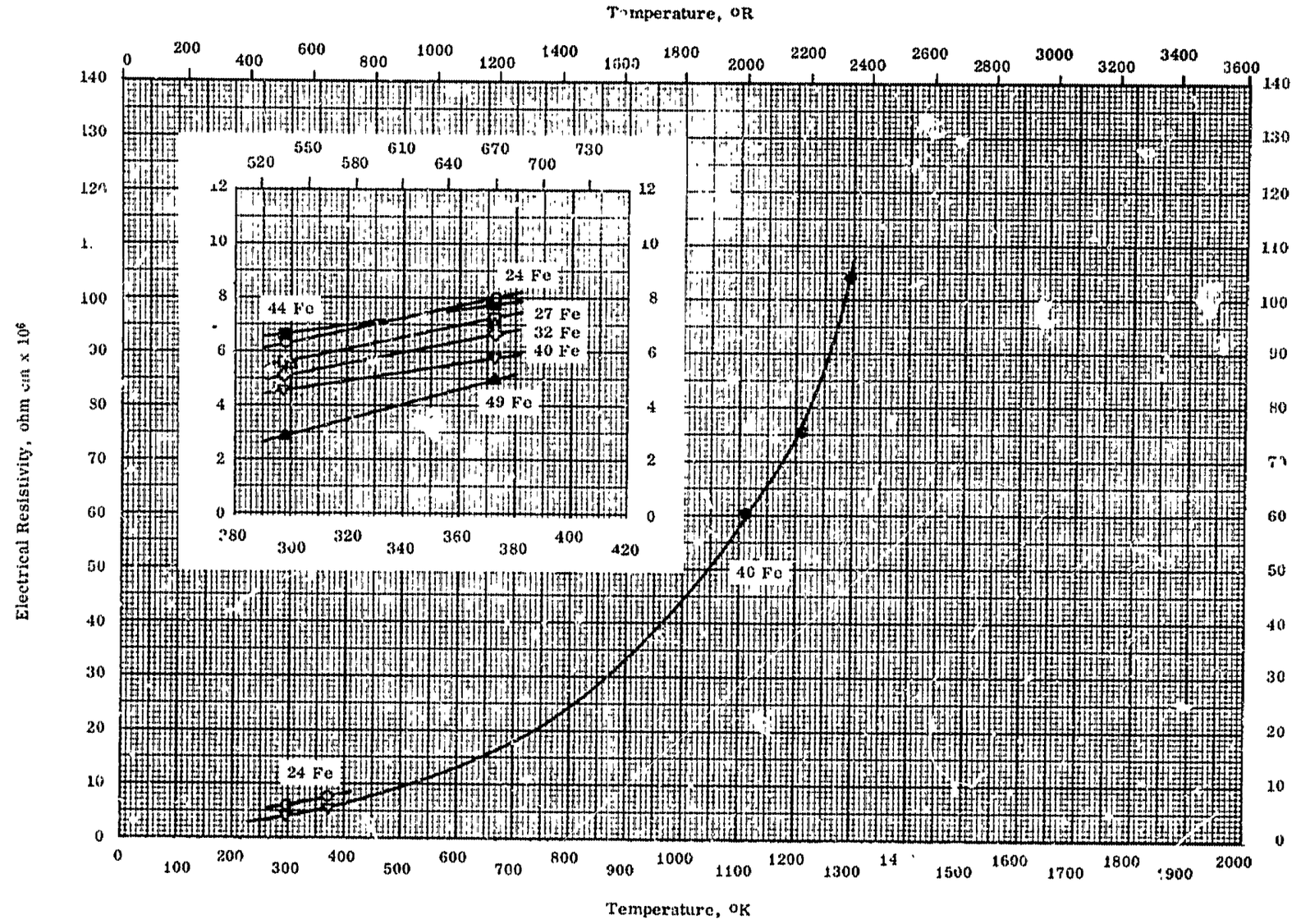
REPORTED VALUES

Heat of Sublimation	cal g^{-1}	Btu lb^{-1}
□ 0.2 Fe	$1616_{1400\,K}$	$2910_{2500\,R}$

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	54-9 also 55-10	2380-2740		99.3 Co, 0.2 Fe, 0.1 Cu, and 0.1 C.	Δh_s from vapor pressure data.

TPRC



ELECTRICAL RESISTIVITY - COBALT + IRON

TPRC

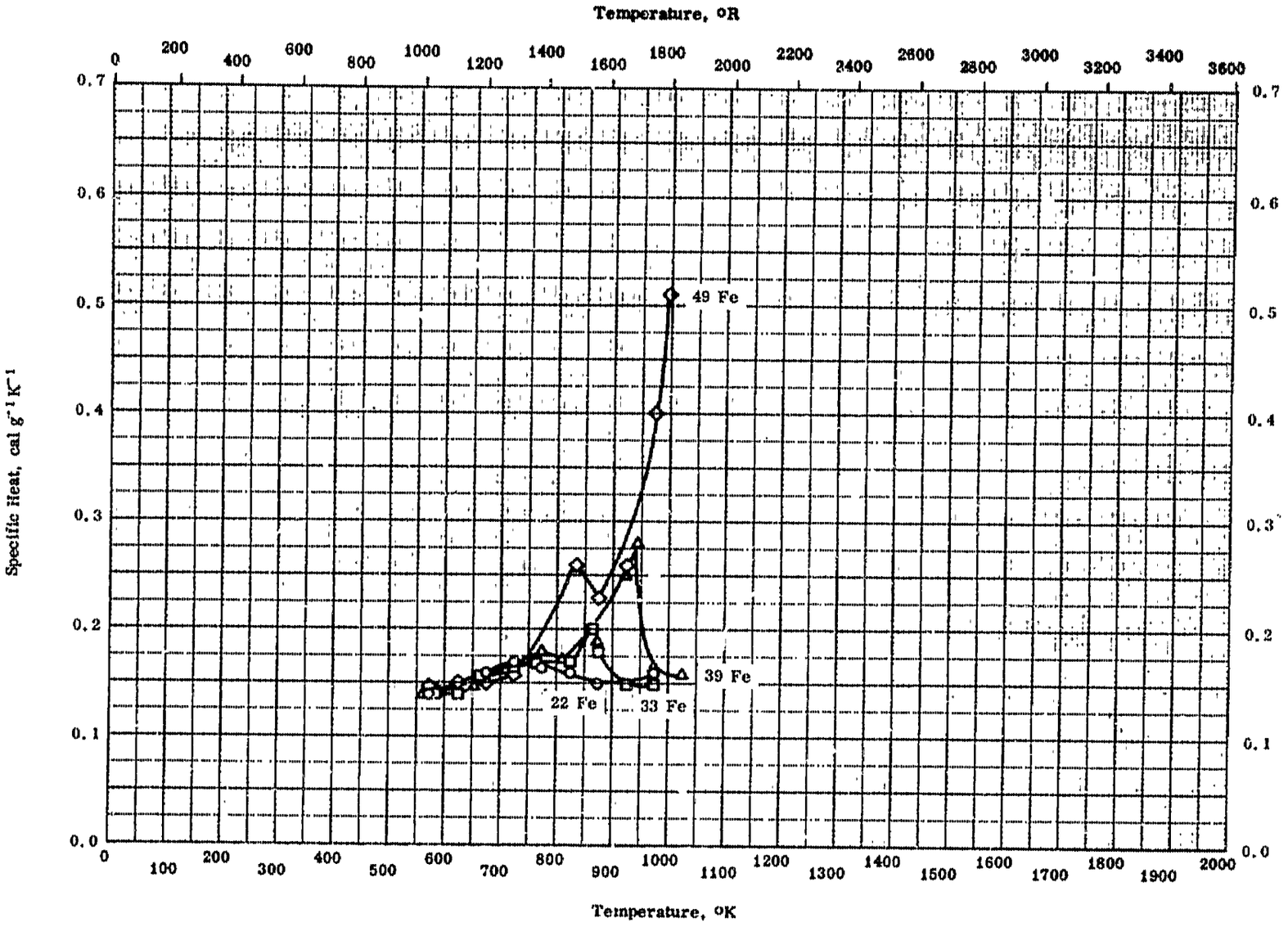
Electrical Resistivity, ohm cm x 10^6

ELECTRICAL RESISTIVITY -- COBALT + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-23	298-373		76.10 Co and 23.90 Fe.	Annealed up to 1500 hrs at 500 C.
□	57-23	298-373		73.24 Co and 26.76 Fe.	Same as above.
△	57-23	298-373		71.04 Co and 21.96 Fe.	Same as above.
◇	57-23	298-373		68.18 Co and 31.82 Fe.	Same as above.
▽	57-23	298-373		60.22 Co and 39.78 Fe.	Same as above.
●	48-2	1110-1292		60 Co and 40 Fe.	Alloy prepared electrolytically.
■	57-23	298-373		56.0 Co and 44.0 Fe.	Annealed up to 1500 hrs at 500 C.
▲	57-23	298-373		51.14 Co and 48.86 Fe.	Same as above.

TPRC



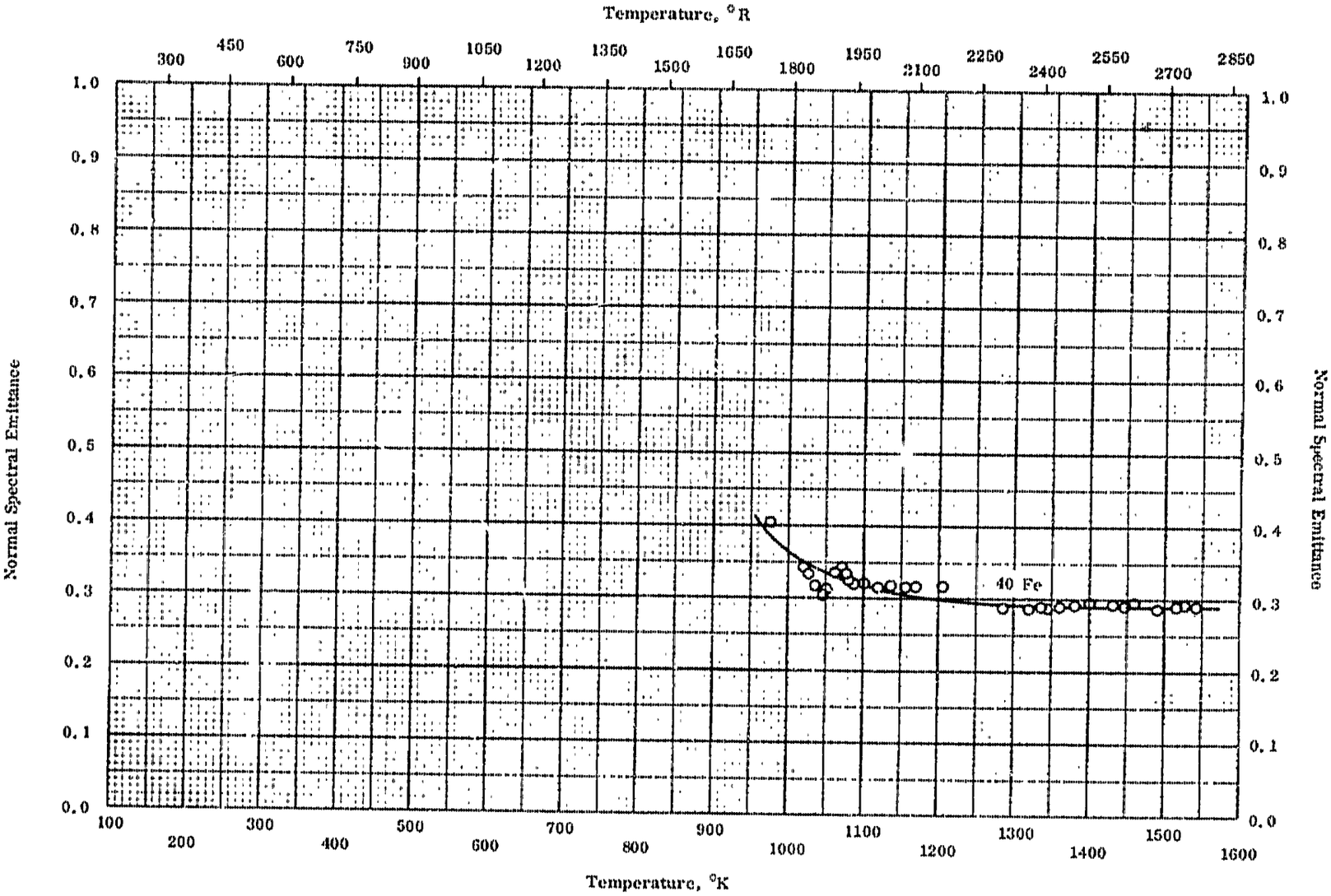
SPECIFIC HEAT -- COBALT + IRON

TPRC

SPECIFIC HEAT -- COBALT + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Reprt. Error %	Sample Specifications	Remarks
○	54-11	573-973		78 Co and 22 Fe.	Electrolytic Co and Fe; melted in H_2; annealed 2 hrs at 2292 R; cooled to 1248 R at 54 R hr^{-1}; held 10 days at 1248 R; cooled to room temperature at 54 R hr^{-1}.
□	54-11	573-973		67.3 Co and 32.7 Fe.	Same as above.
△	54-11	573-973		61 Co and 39 Fe.	Same as above.
◇	54-11	573-1023		51.4 Co and 48.6 Fe.	Same as above.



NORMAL SPECTRAL EMITTANCE -- COBALT + IRON

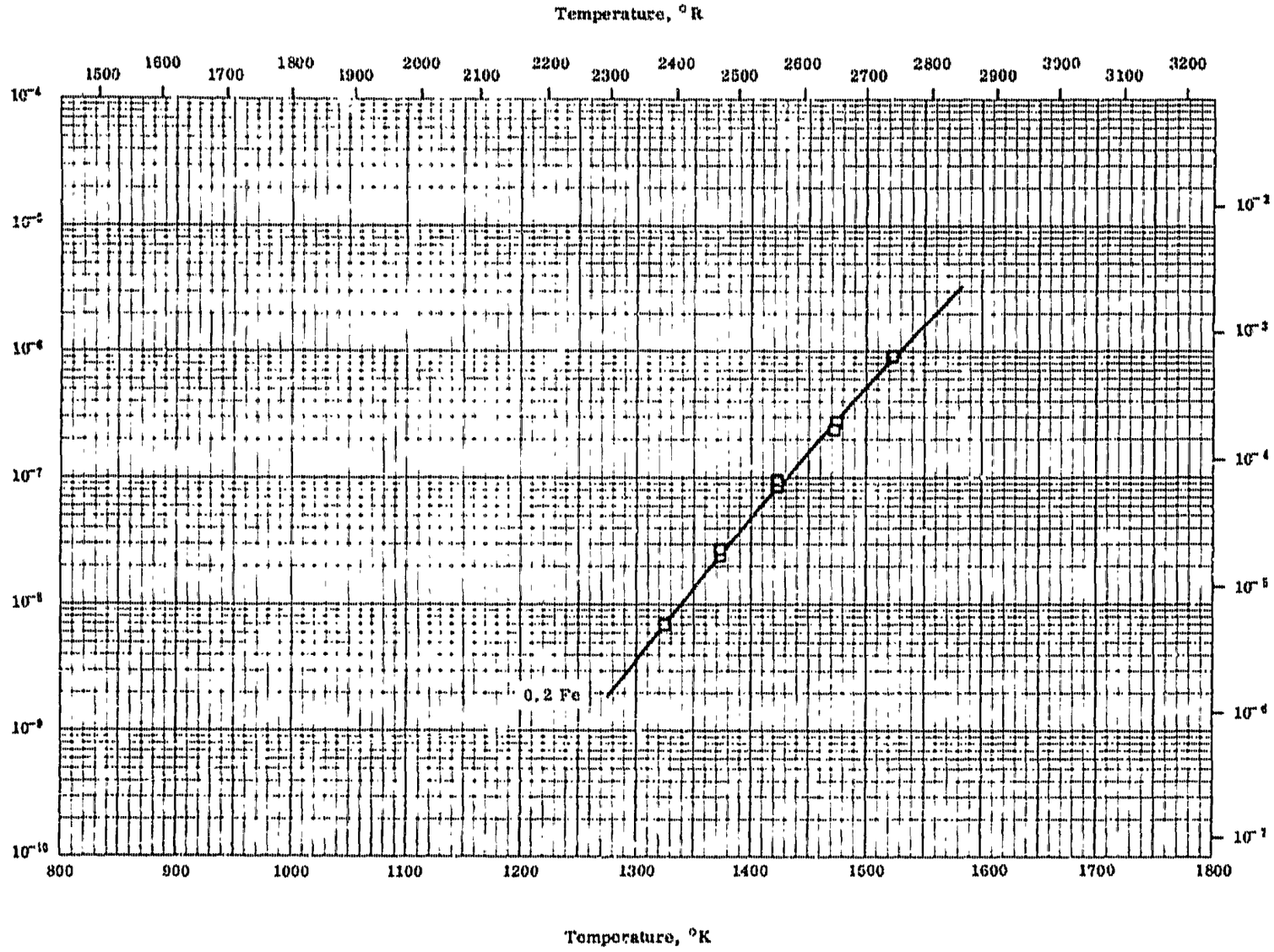
TPRC

NORMAL SPECTRAL EMITTANCE -- COBALT + IRON

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	48-2	0.667	975-1540		60 Co and 40 Fe.	Hydrogen surrounding.

TPEC



VAPOR PRESSURE -- COBALT + IRON

TPRC

VAPOR PRESSURE -- COBALT + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	54-9 also 55-10	1322-1523		99.3 Co, 0.2 Fe, and 0.1 Cu.	Ref. 54-56 lists an additional 0.1 C in the composition.

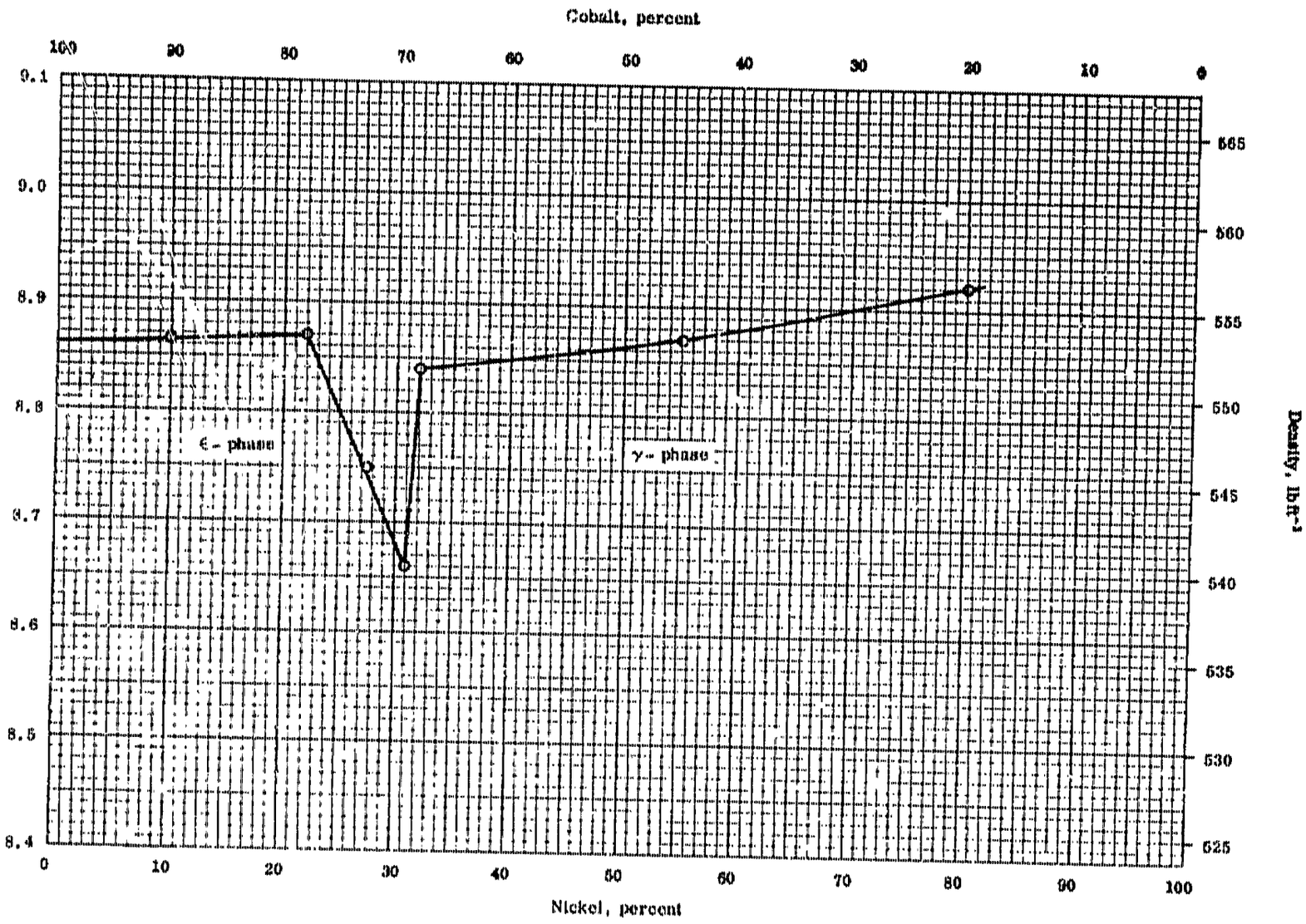
PROPERTIES OF COBALT + NICKEL

REPORTED VALUES

Density:	See figure	
Heat of Sublimation:	$cal\ g^{-1}$	$Btu\ lb^{-1}$
Δ 0.05-0.5 Ni	1794.4	3103.9

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
Δ	51-8	0		99.25 Co, 0.05 - 0.5 Ni, 0.01 - 0.1 Fe 0.005 - 0.05 each Si, Cu and Mn, 0.001 - 0.01 Al, and 0.001 - Ca.	Δh_s from vapor pressure data.

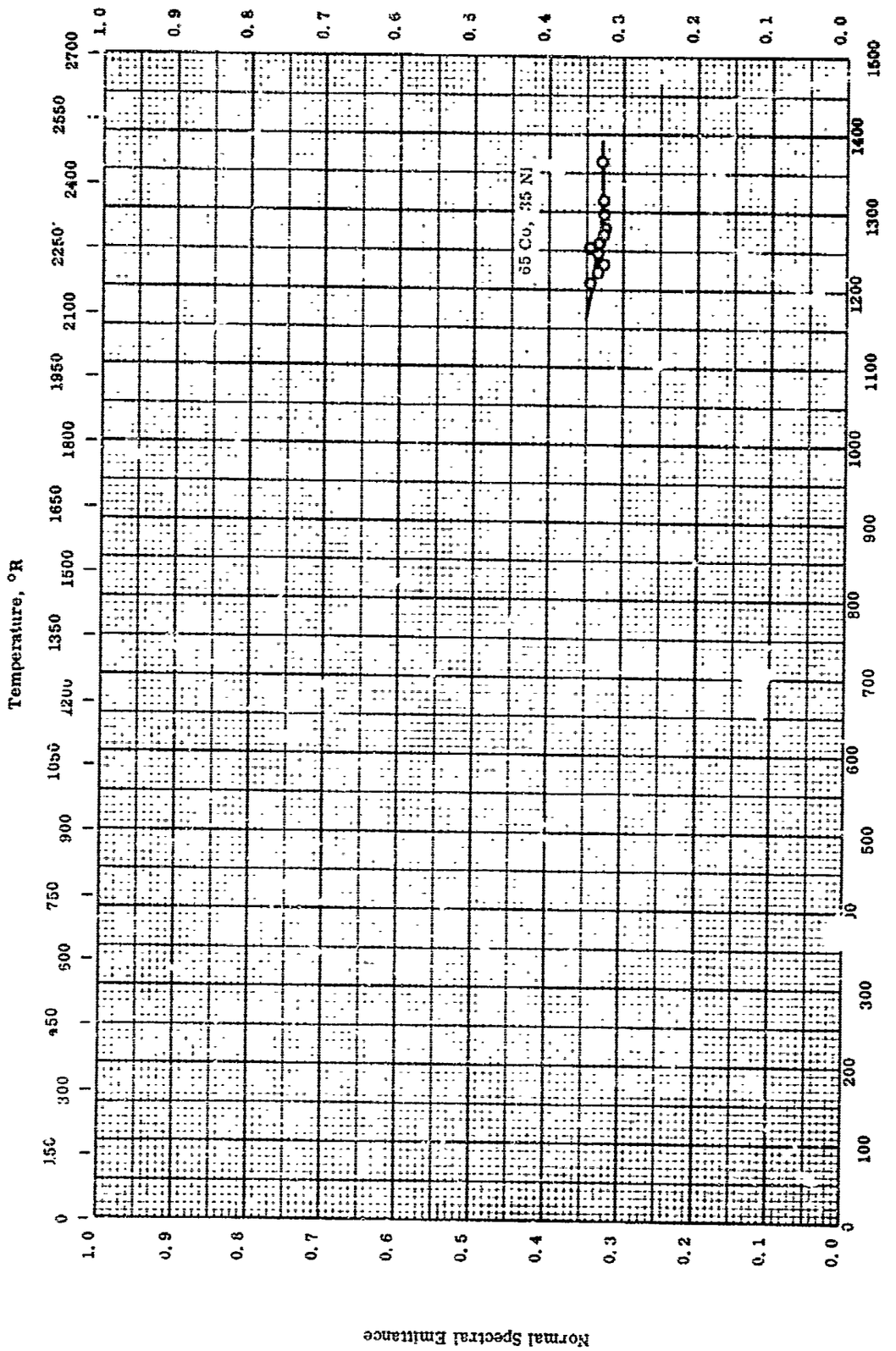


DENSITY — COBALT + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	60-12	298		10-32 Ni ; made from 99.92 pure electrolytic Ni (0.037 Fe, 0.030 Co, 0.023 As, 0.020 Cu, 0.01 C, 0.009 P, 0.001 Si, and 0.001 Mn), and 99.87 pure electrolytic Co (0.117 Fe, 0.06 C, 0.02 As, 0.04 Cu, 0.013 P, 0.091 Si, and 0.001 Mn).	Melted in aluminum tube, forged, annealed, rolled, annealed, machined to size, and annealed 2 hrs at 1100 C.

TPRC

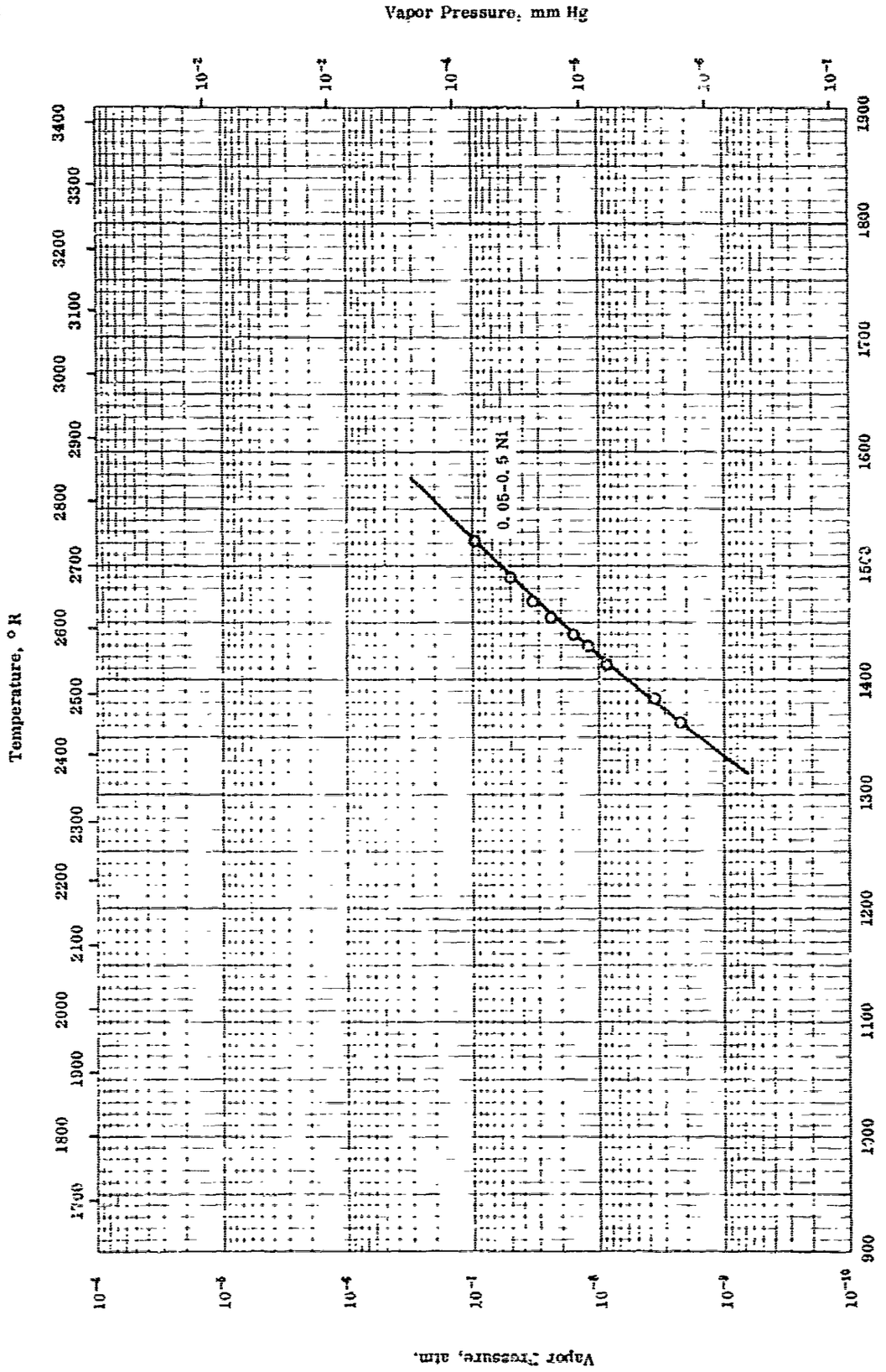


NORMAL SPECTRAL EMITTANCE -- COBALT + NICKEL

NORMAL SPECTRAL EMITTANCE -- COBALT + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range, °K	Rept. Error%	Sample Specifications	Remarks
○	48-6	0.667	1210-1366		65 Co and 35 Ni; manufactured by International Nickel Lab.	

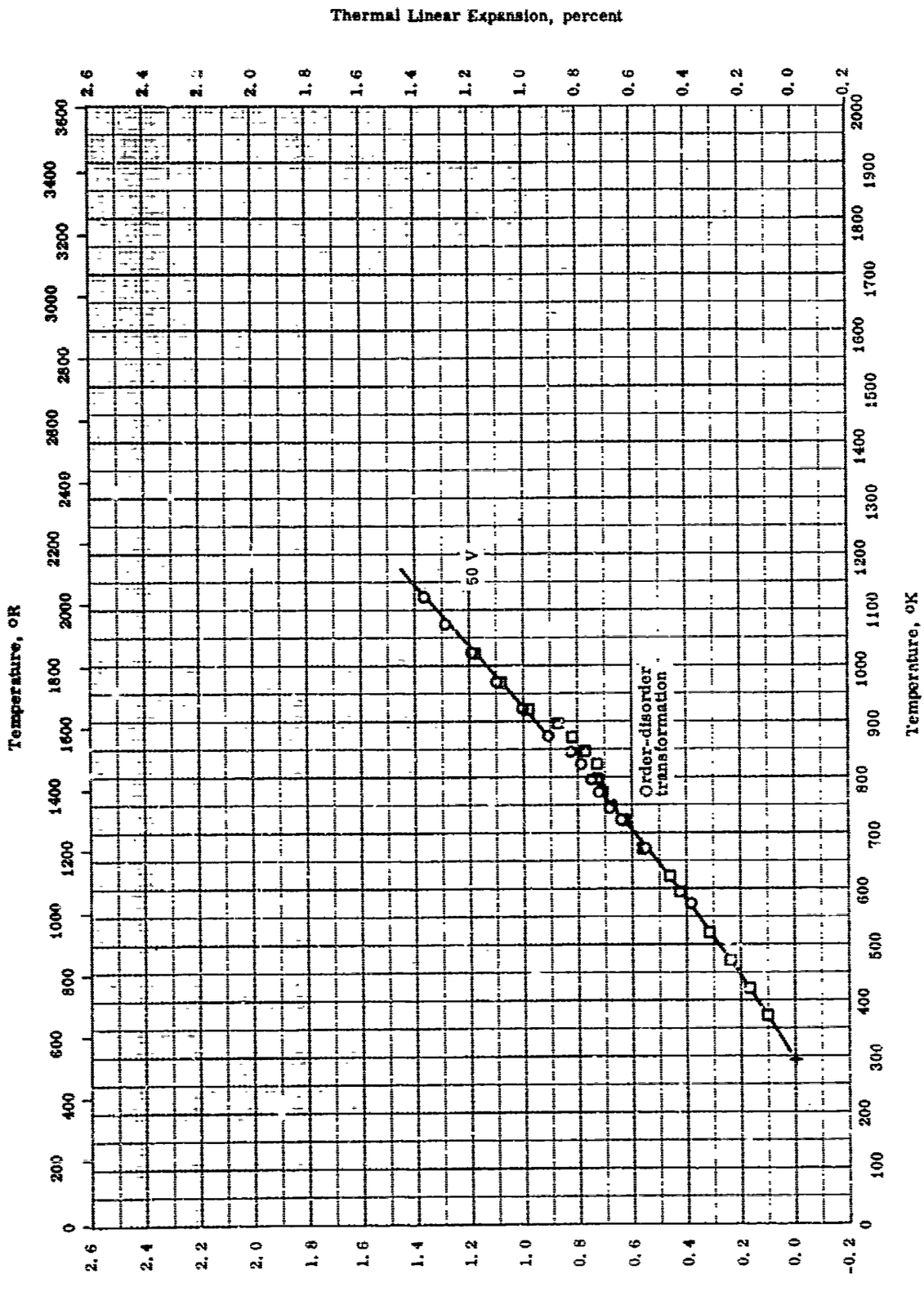


VAPOR PRESSURE — COBALT + NICKEL

VAPOR PRESSURE -- COBALT + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	51-8	1414-1523		99.25 Co, 0.05-0.5 Ni, 0.01-0.1 Fe, 0.005-0.05 ea Si, Cu, Mn, 0.001-0.01 Al, <0.001 Ca, and Mo not detected.	



THERMAL LINEAR EXPANSION — COBALT + VANADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	64-8	293-1123		50.004 Co and 49.996 V; dimension 50 mm by 4 mm by 4 mm.	Prepared by vacuum melting in zirconia molds in an induction furnace.
□	64-8	293-1073		Same as above.	Same as above except quenched at 800 C.

TPRC

PROPERTIES OF COPPER + ALUMINUM

REPORTED VALUES

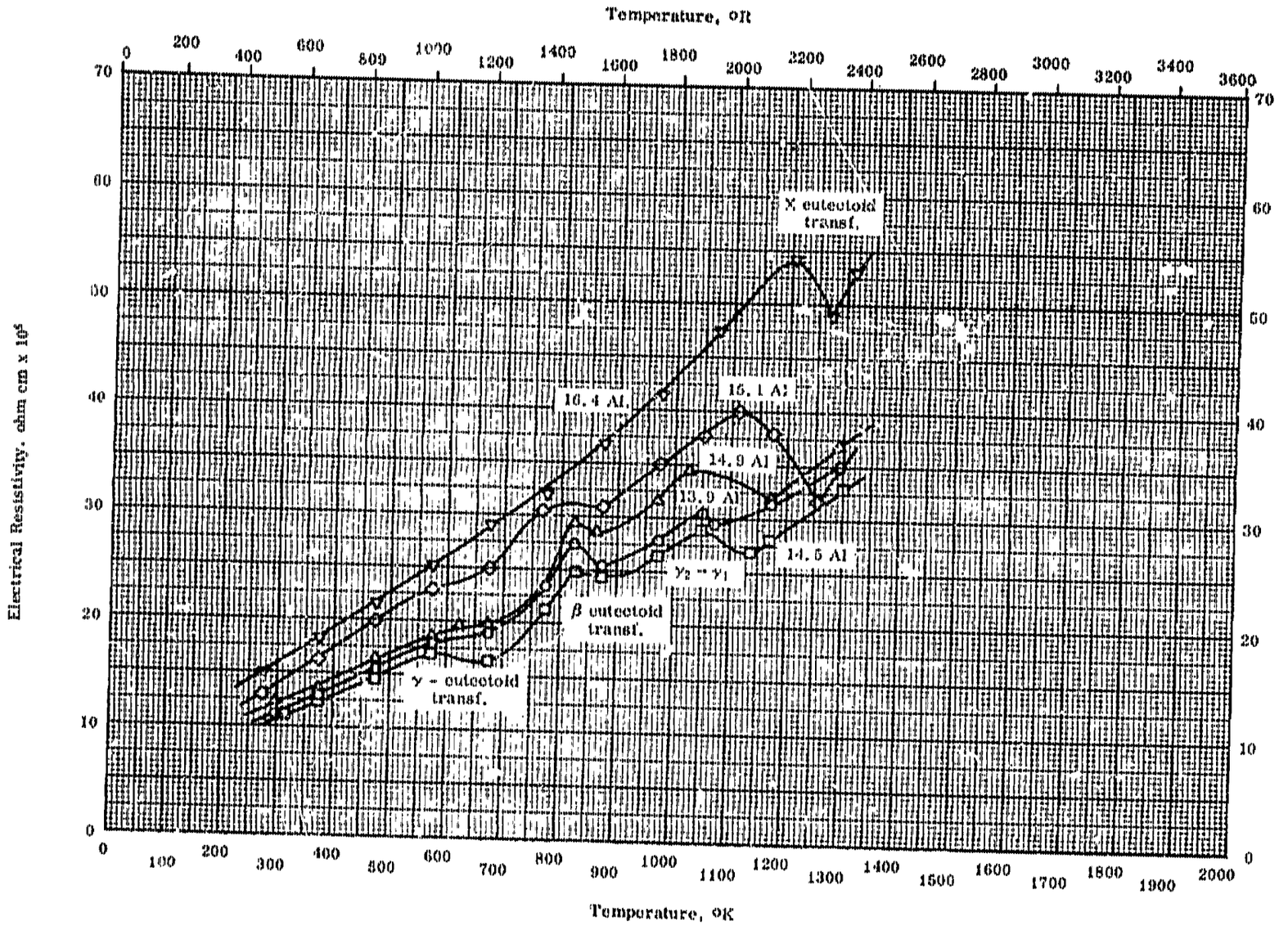
Density:	g cm^{-3}	lb ft^{-3}
O 11.95	7.28	455

PROPERTIES OF COPPER + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	53-24	298		11.95 Al	

TPRC

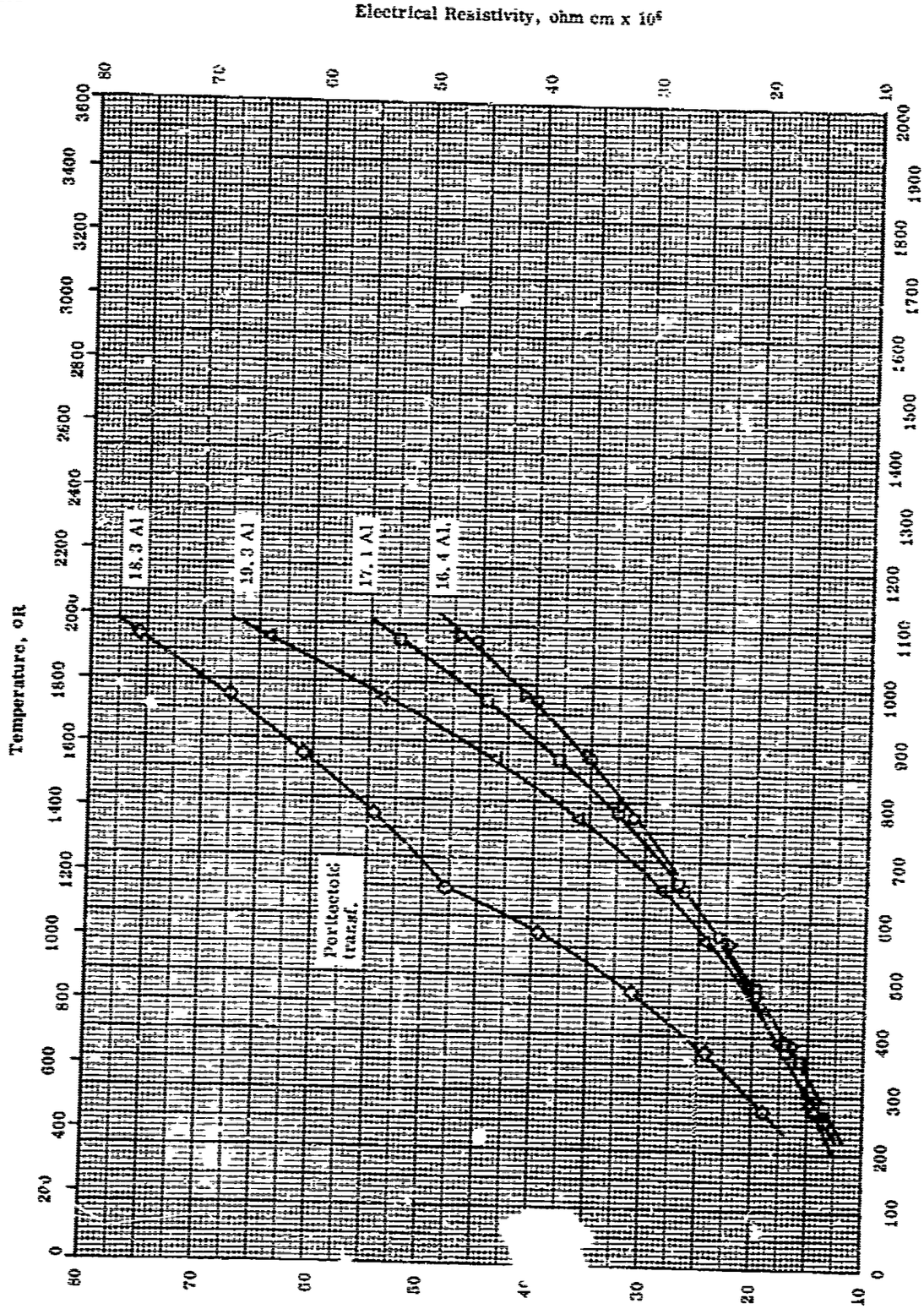


ELECTRICAL RESISTIVITY -- COPPER + ALUMINUM

ELECTRICAL RESISTIVITY -- COPPER + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-22	298-1203		13.9 Al.	
□	57-22	313-1303		14.6 Al.	
△	57-22	298-1293		14.9 Al.	
◇	57-22	273-1293		15.15 Al.	
▽	57-22	273-1313		16.4 Al.	



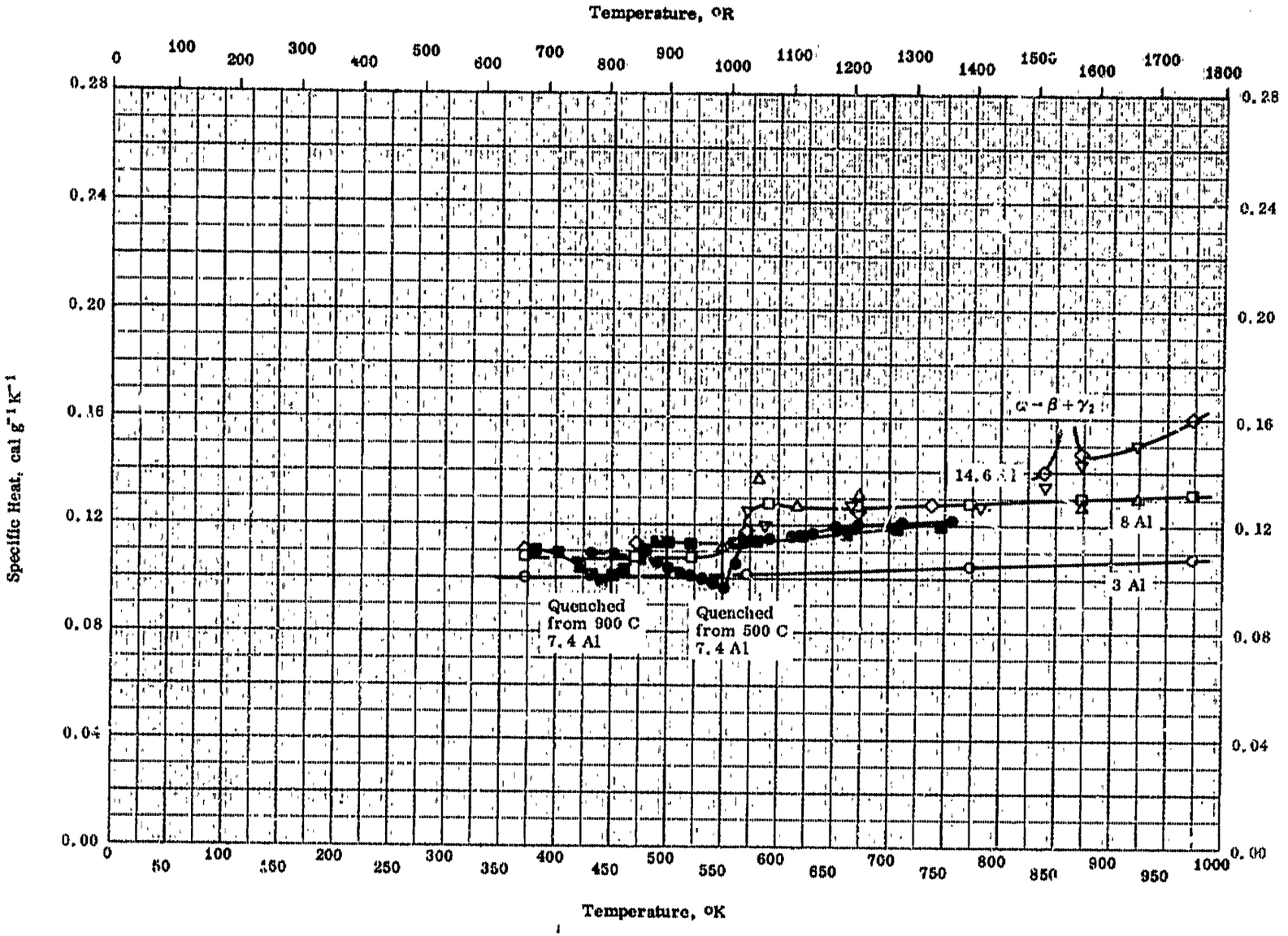
ELECTRICAL RESISTIVITY — COPPER + ALUMINUM
(In γ₂ phase)

TPRC

ELECTRICAL RESISTIVITY -- COPPER + ALUMINUM
(In γ_2 phase)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-28	273-1073		16.41 Al; in γ_2 phase.	
□	57-28	273-1073		17.05 Al; same as above.	
▽	57-28	273-1073		17.40 Al; same as above.	
◇	57-28	273-1073		18.30 Al; same as above.	
△	57-28	273-1073		19.30 Al; same as above.	



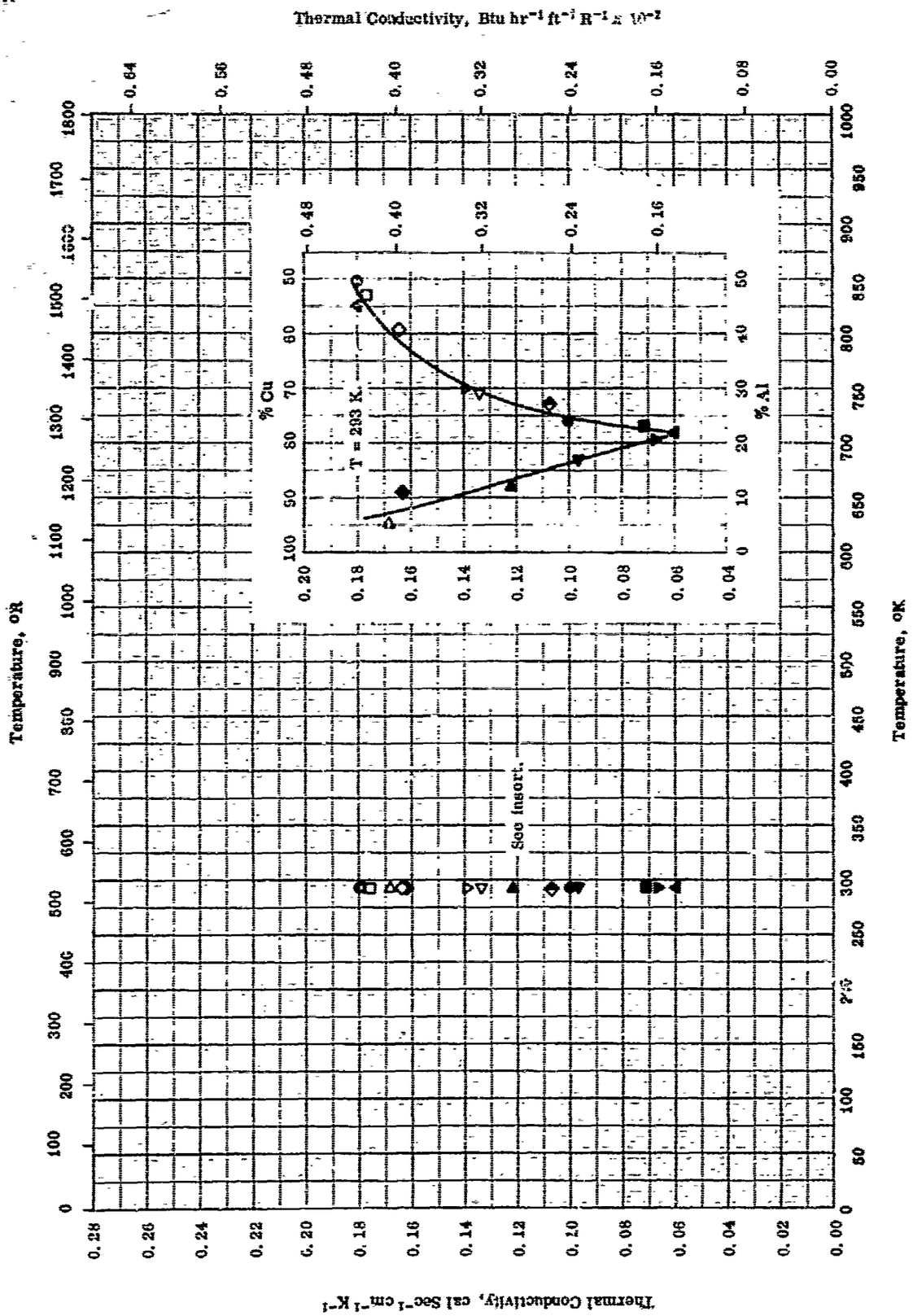
SPECIFIC HEAT -- COPPER + ALUMINUM

TPRC

SPECIFIC HEAT -- COPPER + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	54-12	373-973		96.87 Cu and 3.13 Al; prepared from Cu containing 0.02 S, Zn, 0.01 As, Pb and Sb; and Al containing 0.42 Si, 0.15 Fe, 0.04 Zn, 0.005 Cu, 0.001 S, trace Mn.	Annealed 1 hr at 700 C in vacuum, cooled at 30 C hr^{-1} to room temperature, reheated for 3-1/2 to 10 hrs at 550 C and cooled slowly.
□	54-12	373-973		91.95 Cu and 8.05 Al; raw materials same as above.	Same as above.
△	54-12	373-973		Same as above	Same as above; baked 220 hrs at 210 C.
◇	54-12	373-973		85.41 Cu and 14.59 Al; raw materials same as above.	Annealed 1 hr at 700 C in vacuum; cooled at 30 C hr^{-1} to room temperature; reheated 3-1/2 to 10 hrs at 550 C, cooled slowly.
▽	54-12	373-973		Same as above.	Same as above.
●	59-10	373-773	0.8	92.6 Cu and 7.4 Al.	Quenched from 500 C.
■	59-10	373-773	0.8	92.6 Cu and 7.4 Al.	Quenched from 900 C.

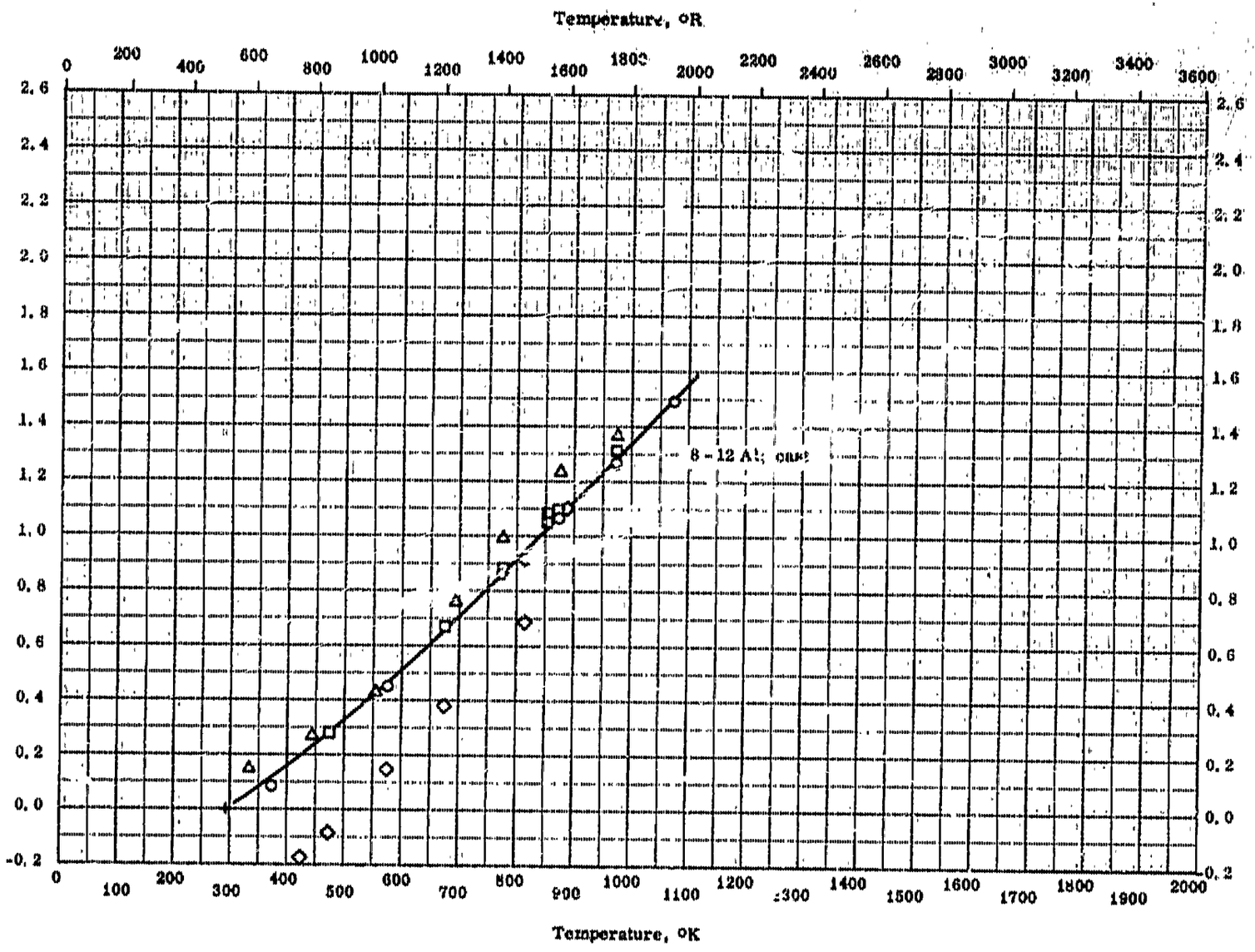


THERMAL CONDUCTIVITY — COPPER + ALUMINUM

THERMAL CONDUCTIVITY -- COPPER + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-4	298		50.45 Cu, 49.55 Al; raw materials electrolytically pure.	Annealed 5 hrs near melting point, and furnace cooled.
□	56-4	298		53.00 Cu, 47.00 Al; raw materials same as above.	Same as above.
△	56-4	298		55.00 Cu, 45.00 Al; raw materials same as above.	Same as above.
◇	56-4	298		59.62 Cu, 40.38 Al; raw materials same as above.	Same as above.
▽	56-4	298		69.99 Cu, 30.01 Al; raw materials same as above.	Same as above.
◁	56-4	298		71.00 Cu, 29.00 Al; raw material same as above.	Same as above.
◆	56-4	298		73.00 Cu, 27.00 Al; raw materials same as above.	Same as above.
●	56-4	298		76.00 Cu, 24.00 Al; raw materials same as above.	Same as above.
■	56-4	298		77.00 Cu, 23.00 Al; raw materials same as above.	Same as above.
▲	56-4	298		78.00 Cu, 22.00 Al; raw materials same as above.	Same as above.
▼	56-4	298		79.58 Cu, 20.42 Al; raw materials same as above.	Same as above.
◀	56-4	298		83.00 Cu, 17.00 Al; raw materials same as above.	Same as above.
▶	56-4	298		88.00 Cu, 12.00 Al; raw materials same as above.	Same as above.
◆	56-4	298		89.22 Cu, 10.78 Al; raw materials same as above.	Same as above.
▷	56-4	298		95.00 Cu, 5.00 Al; raw materials same as above.	Same as above.



Thermal Linear Expansion, percent

7PRC

Thermal Linear Expansion, percent

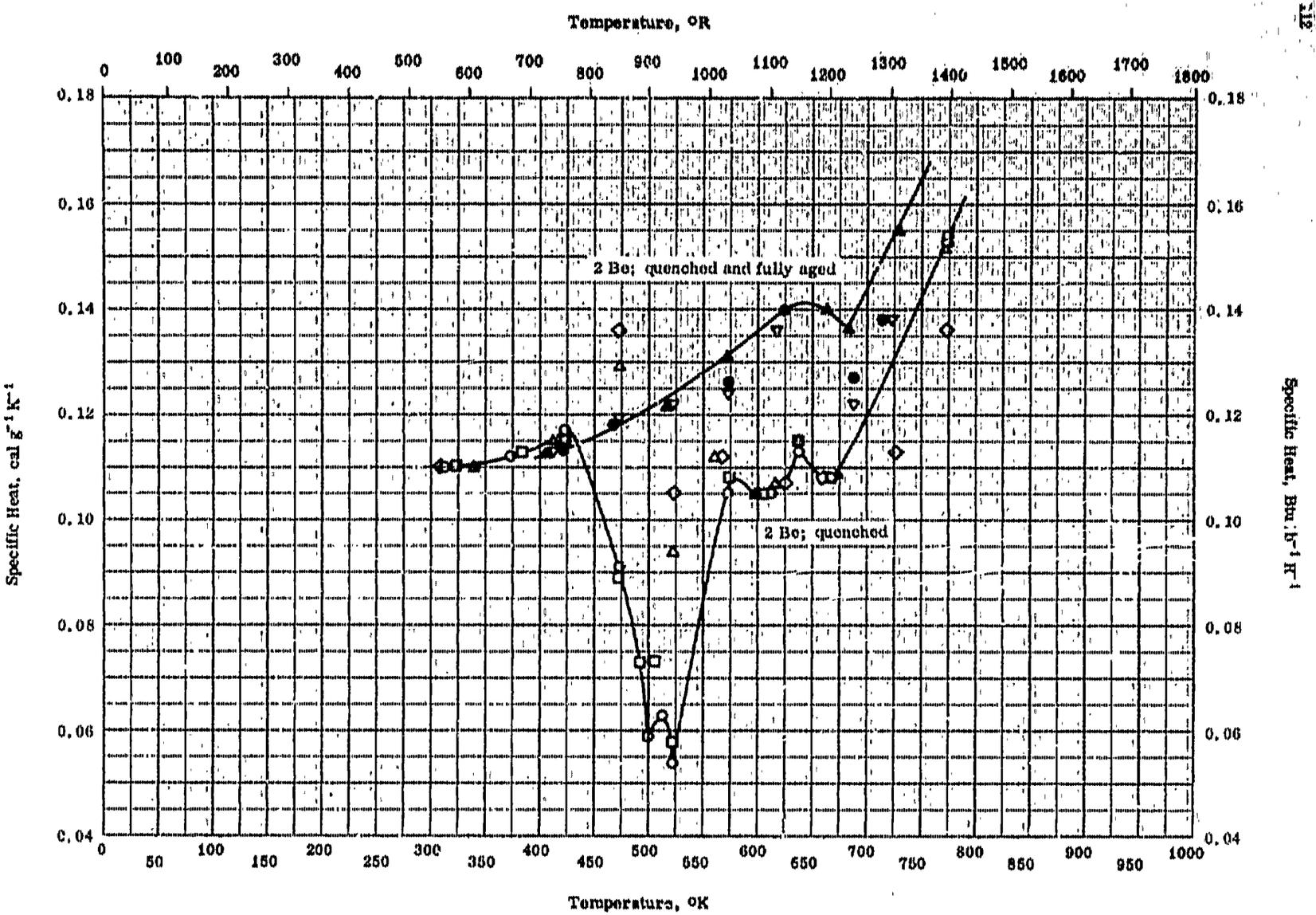
THERMAL LINEAR EXPANSION -- COPPER + ALUMINUM

THERMAL LINEAR EXPANSION --- COPPER + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	43-7	293-1073		91.49 Cu by diff., 8.40 Al, and 0.06 impurities.	Cast, heated at 950 C for 12 hrs, and cooled to room temperature in 400 hrs; tested at 1 C min^{-1}.
□	43-7	293-973		87.99 Cu by diff., 11.96 Al, and 0.06 impurities.	Same as above.
△	53-24	293-973		11.95 Al.	Heating rate 4 C min^{-1}.
◇	53-24	433-973		Same as above.	Cooling data of above specimen with cooling rate 0.3 C min^{-1}.

TPRC

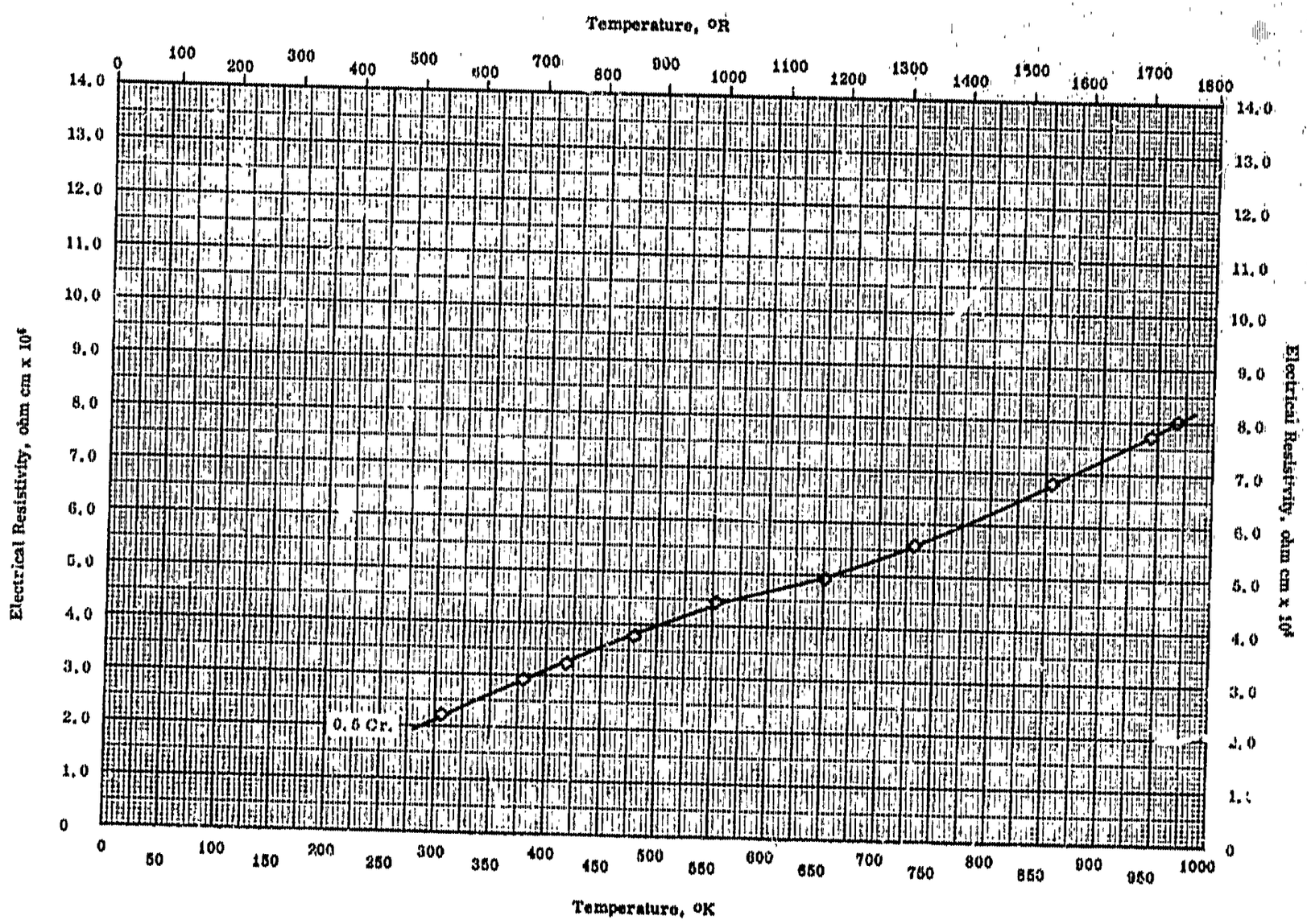


SPECIFIC HEAT — COPPER + BERYLLIUM

SPECIFIC HEAT -- COPPER + BERYLLIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-13	373-873		1.8 Be.	Heated 4 hrs at 800 C and quenched.
□	55-13	373-873		1.8 Be.	Heated 4 hrs at 800 C and quenched; aged 13 hrs at 130 C.
△	55-13	373-873		1.8 Be.	Heated 4 hrs at 800 C and quenched; aged 90 hrs at 130 C.
◇	55-13	373-873		1.8 Be	Heat 4 hrs at 800 C and quenched; aged 760 hrs at 130 C.
▽	55-13	373-873		1.8 Be.	Heated 4 hrs at 800 C and quenched; aged 1 hr at 300 C.
●	55-13	373-873		1.8 Be.	Heated 4 hrs at 800 C and quenched; aged 45 hrs at 300 C.
▲	55-13	373-873		1.8 Be.	Heated 4 hrs at 800 C and quenched; aged 264 hrs at 300 C.



ELECTRICAL RESISTIVITY — COPPER + CHROMIUM

TPRC

ELECTRICAL RESISTIVITY -- COPPER + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
◇	56-6	300-967		0.5 Cr.	Normalized.

TPRC

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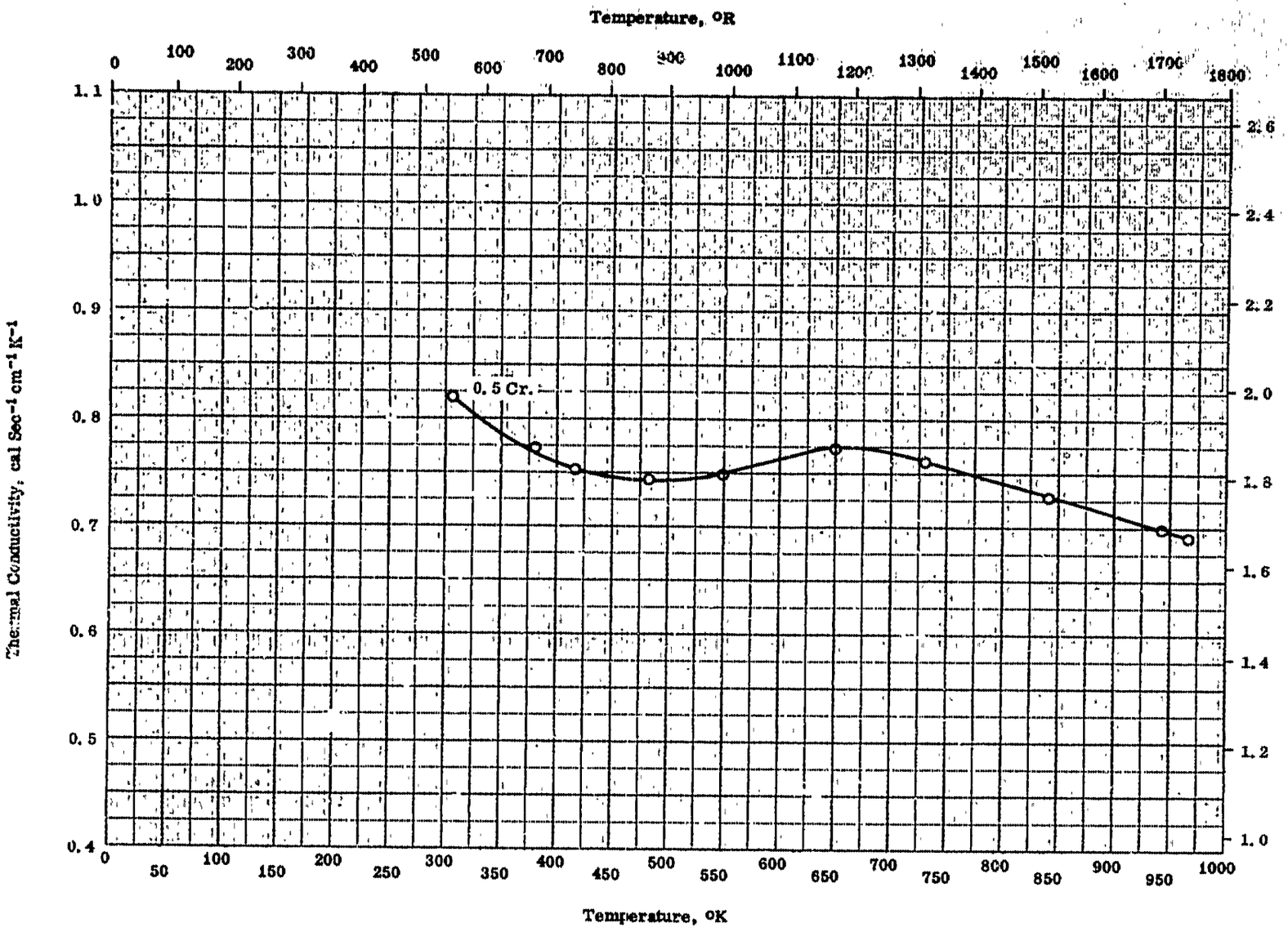
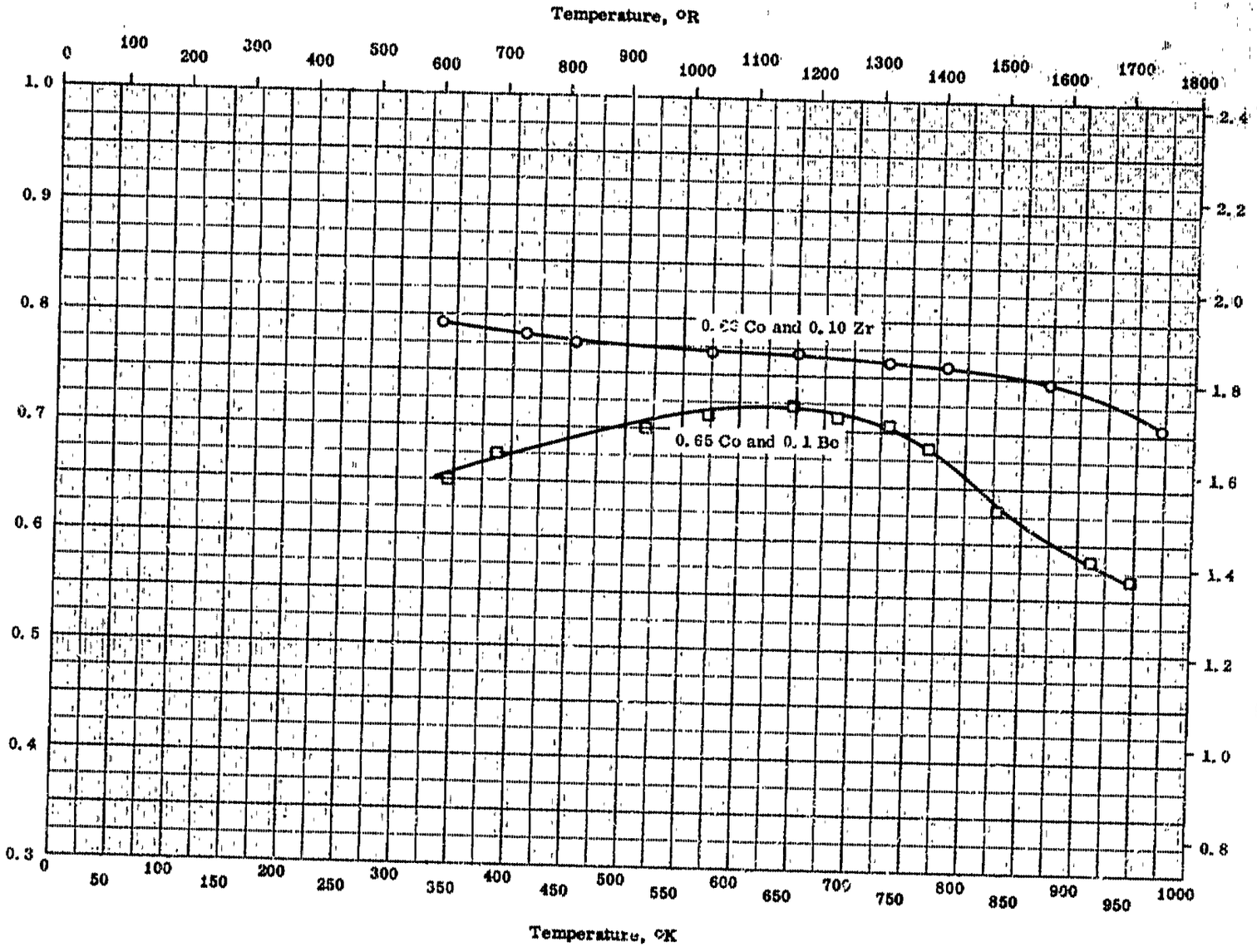


THERMAL CONDUCTIVITY -- COPPER + CHROMIUM

THERMAL CONDUCTIVITY -- COPPER + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-6	306-967		0.5 Cr.	Normalized.



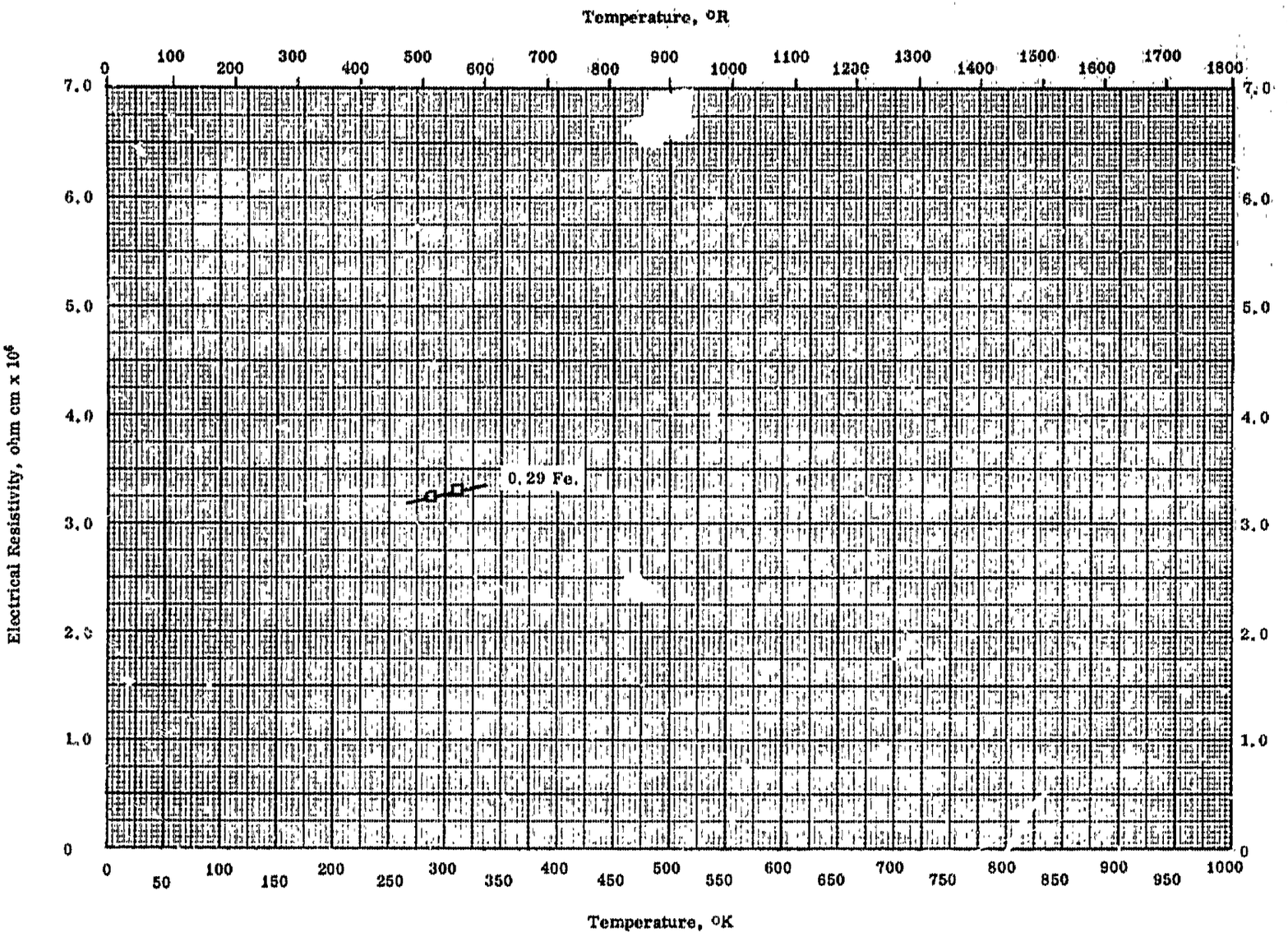
THERMAL CONDUCTIVITY -- COPPER + COBALT

PRC

THERMAL CONDUCTIVITY -- COPPER + COBALT

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-2	337-973		99.23 Cu, 0.60 Co, 0.10 Zr, and 0.03 F.	
□	59-1	345-948		99.25 Cu, 0.65 Co, and 0.1 Be.	



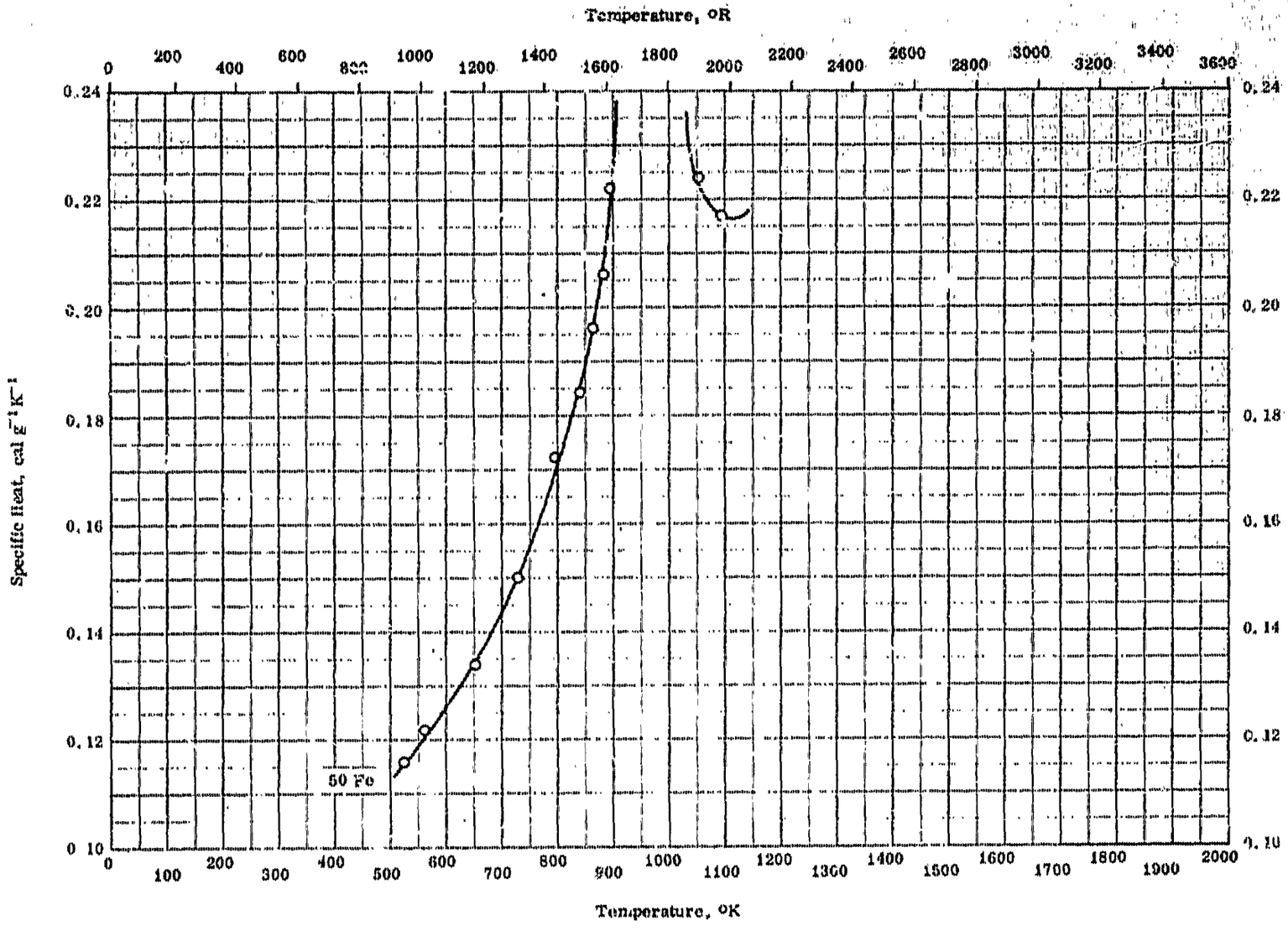
TPRC

ELECTRICAL RESISTIVITY -- COPPER + IRON

ELECTRICAL RESISTIVITY -- COPPER + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-32	288-313		0.291 Fe, 0.008> Mg, 0.004 > Si, 0.001 > each of others.	



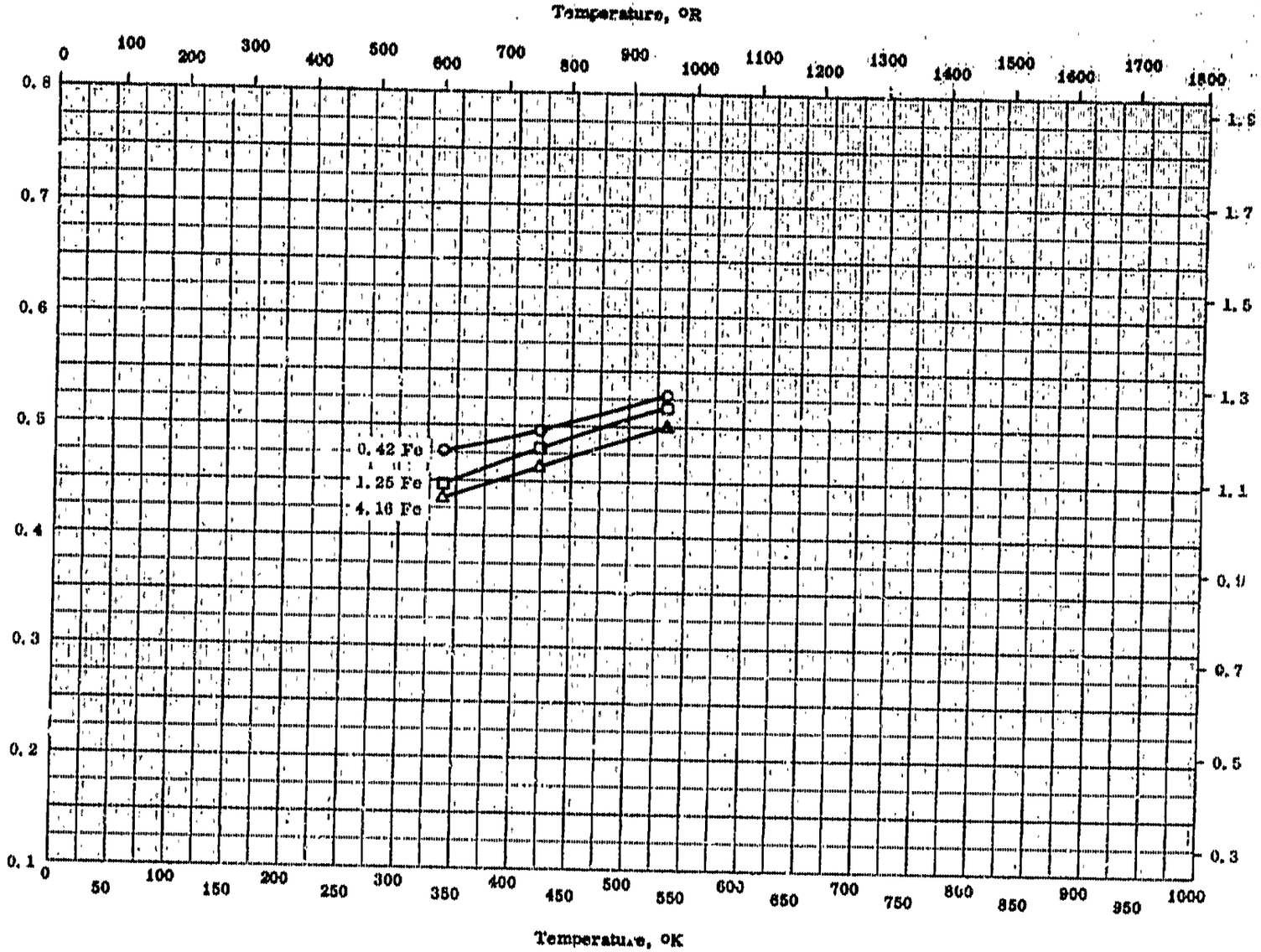
SPECIFIC HEAT — COPPER + IRON

TPRC

SPECIFIC HEAT -- COPPER + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-14	528-1095	≤5.0	50 Cu.	



THERMAL CONDUCTIVITY -- COPPER + IRON

THERMAL CONDUCTIVITY -- COPPER + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-1	329-532	±5	0.42 ±0.03 Fe and 0.012 ±0.001 P .	Prepared from electrolytic tough pitch copper.
□	52-1	339-533	±5	1.25 Fe, and 0.014 P.	Same as above.
△	52-1	337-533	±5	4.16 ±0.02 Fe and 0.018 P.	Same as above.

PROPERTIES OF COPPER + LEAD

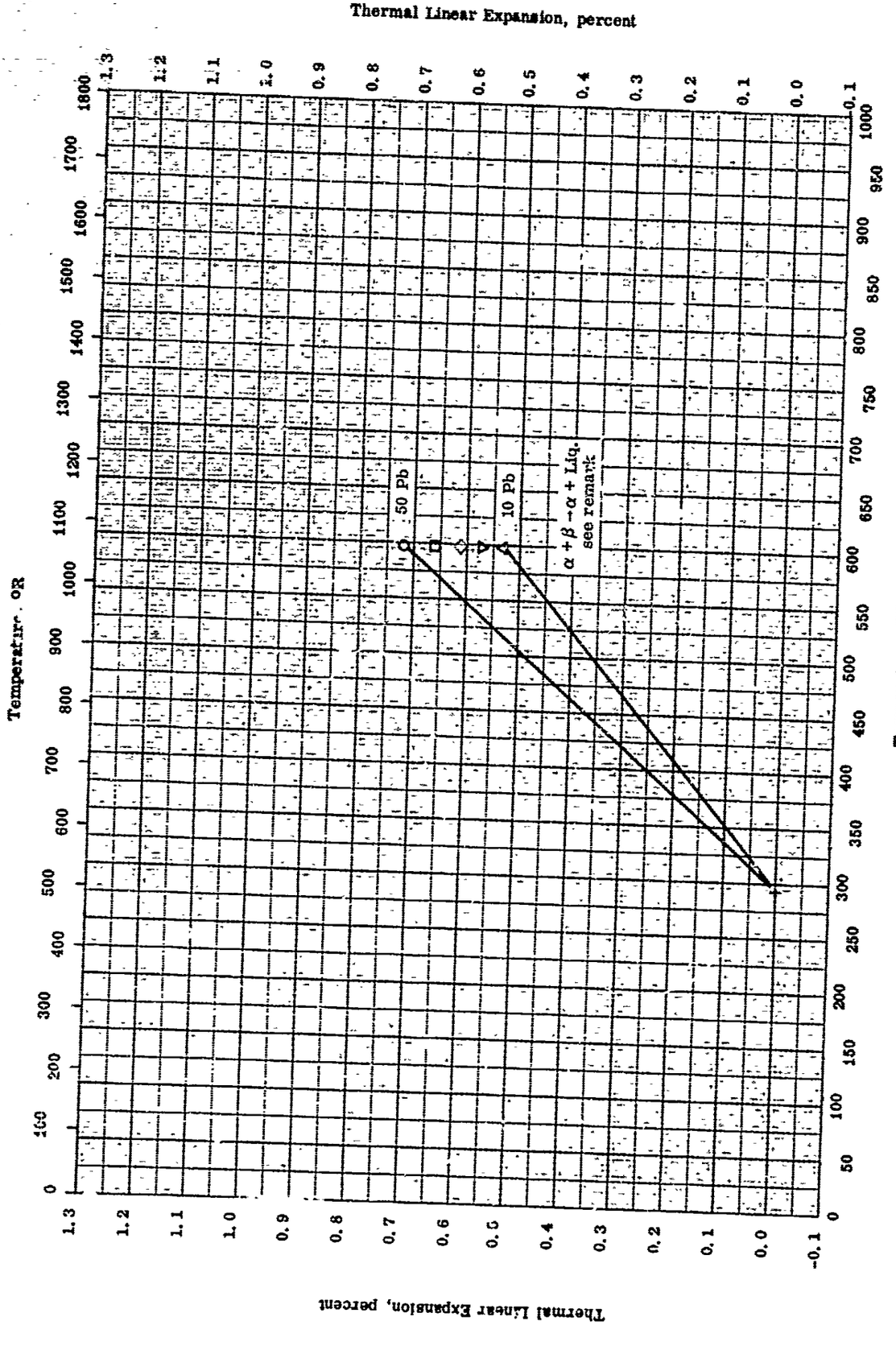
REPORTED VALUES

Density:		g cm^{-3}	lb ft^{-3}
○	10 Pb	9.13	570
□	20 Pb	9.33	582
△	30 Pb	9.54	595
▽	40 Pb	9.76	609
◇	50 Pb	10.0	624

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-40	298		10 Pb.	Density by weight in air and in water.
□	57-40	298		20 Pb.	Same as above.
△	57-40	298		30 Pb.	Same as above.
▽	57-40	298		40 Pb.	Same as above.
◇	57-40	298		50 Pb.	Same as above.

TPRC

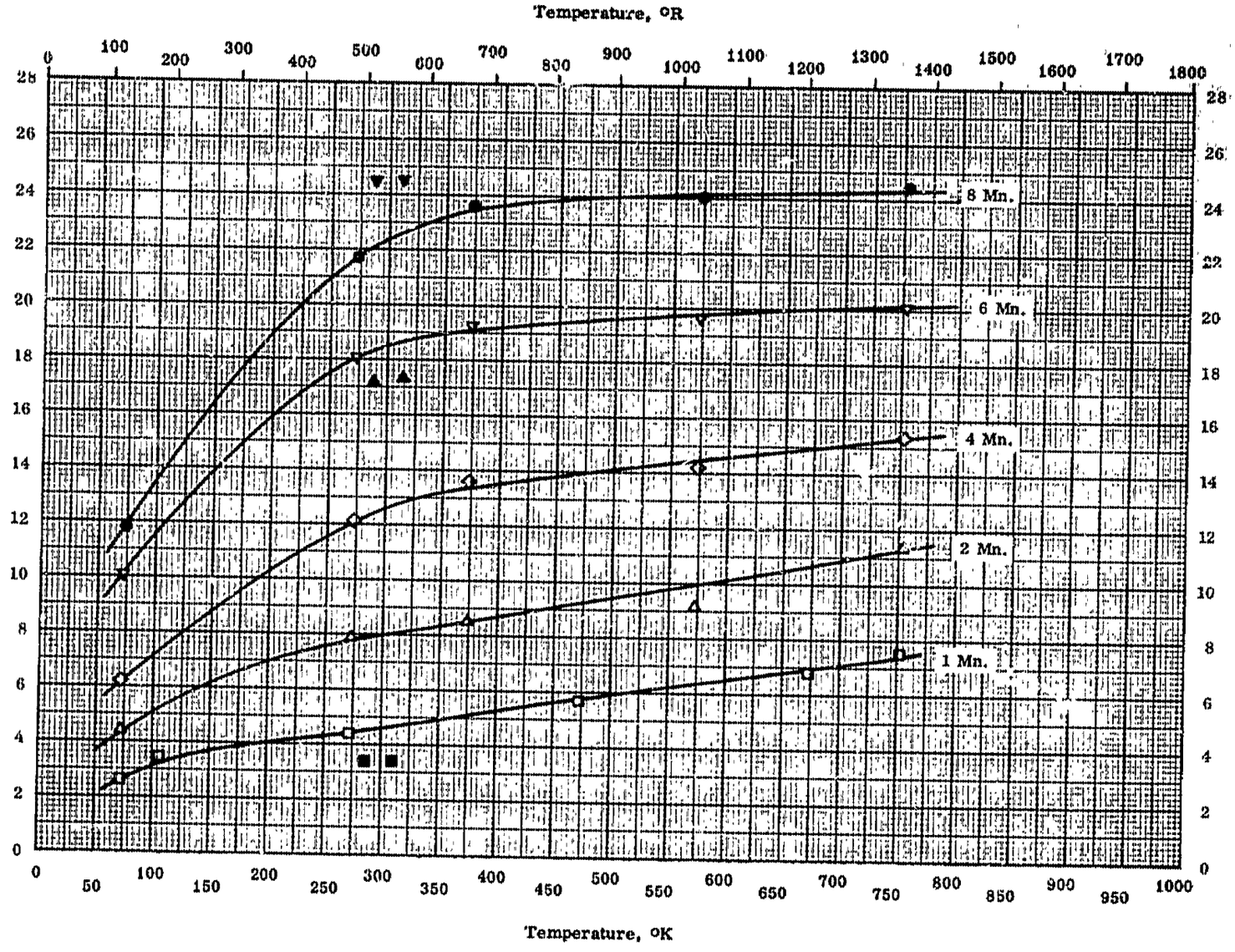


THERMAL LINEAR EXPANSION -- COPPER + LEAD

THERMAL LINEAR EXPANSION -- COPPER + LEAD

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
△	57-40	293-600		90 Cu and 10 Pb.	$\alpha + \beta \rightarrow \alpha$ + Liq. at 326 C; $\Delta L/L$ at 326 C = 0.
◇	57-40	293-600		80 Cu and 20 Pb.	Same as above; $\Delta L/L$ at 326 C = -0.043%.
▽	57-40	293-600		70 Cu and 30 Pb.	Same as above; $\Delta L/L$ at 326 C = -0.015%.
□	57-40	293-600		60 Cu and 40 Pb.	Same as above; $\Delta L/L$ at 326 C = -0.07%.
○	57-40	293-600		50 Cu and 50 Pb.	Same as above; $\Delta L/L$ at 326 C = -0.18%.



ELECTRICAL RESISTIVITY -- COPPER + MANGANESE

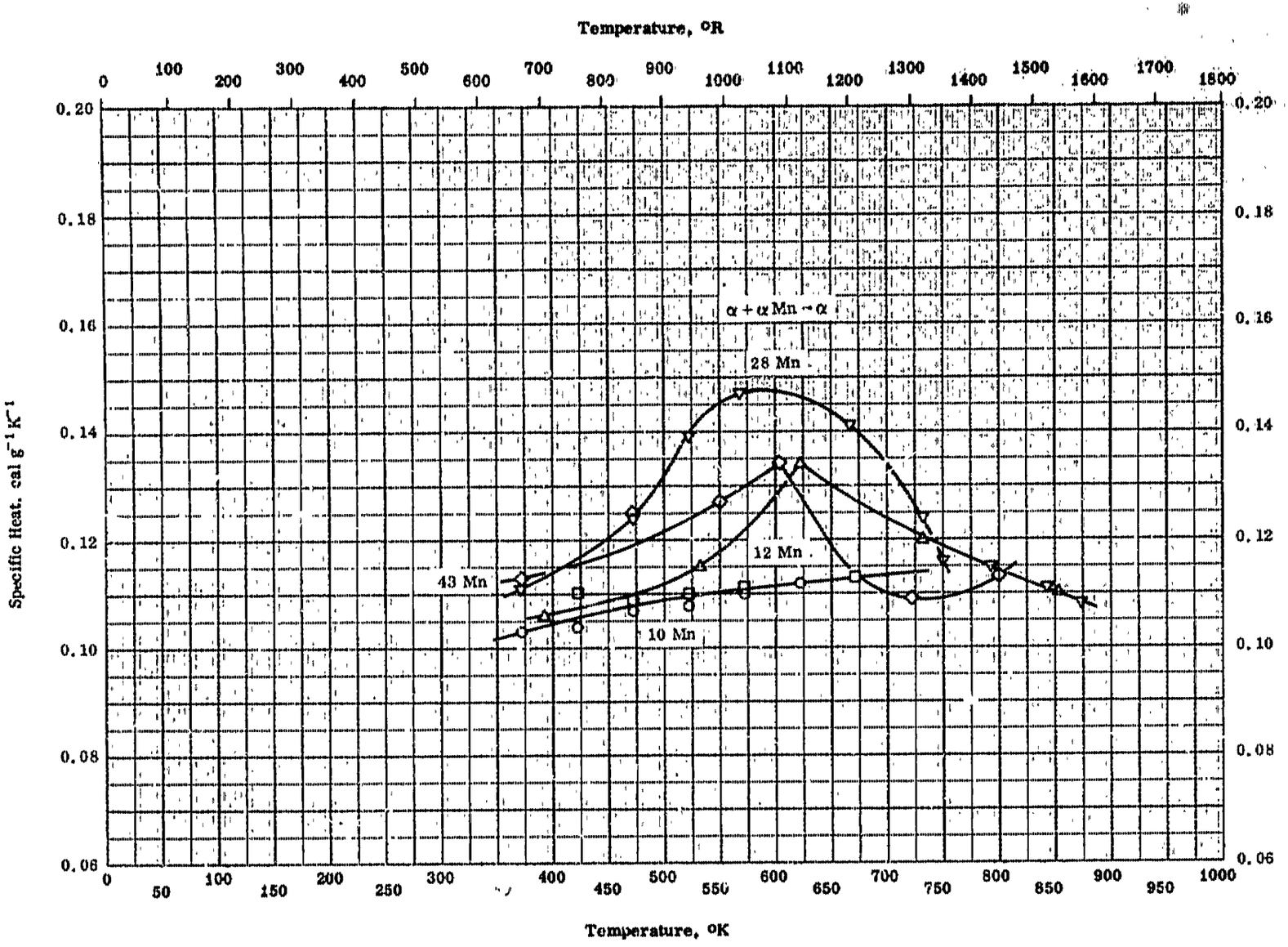
TPRC

ELECTRICAL RESISTIVITY -- COPPER + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-26	73-773		1 Mn; prepared from 99.99 pure raw material.	Vacuum melted 100 C above melting point, homogenized 24 hrs at 900 C, swaged, and annealed 1 hr at 500 C.
△	56-26	73-773		2 Mn, raw materials same as above.	Same as above.
◇	56-26	73-773		4 Mn, raw materials same as above.	Same as above.
▽	56-26	73-773		6 Mn, raw materials same as above.	Same as above.
●	56-26	73-773		8 Mn, raw materials same as above.	Same as above.
■	56-32	288-313		0.553 Mn, 0.004 > Si, 0.008 > Mg, and 0.001 > each of others.	Relative resistance values for many alloys in the system Cu + Mn + Ni + Fe.
▲	56-32	288-313		5.27 Mn, 0.004 > Si, 0.008 > Mg, and 0.001 > each of others.	
▼	56-32	288-313		7.44 Mn, 0.004 > Si, 0.008 > Mg, and 0.001 > each of others.	

TPRC

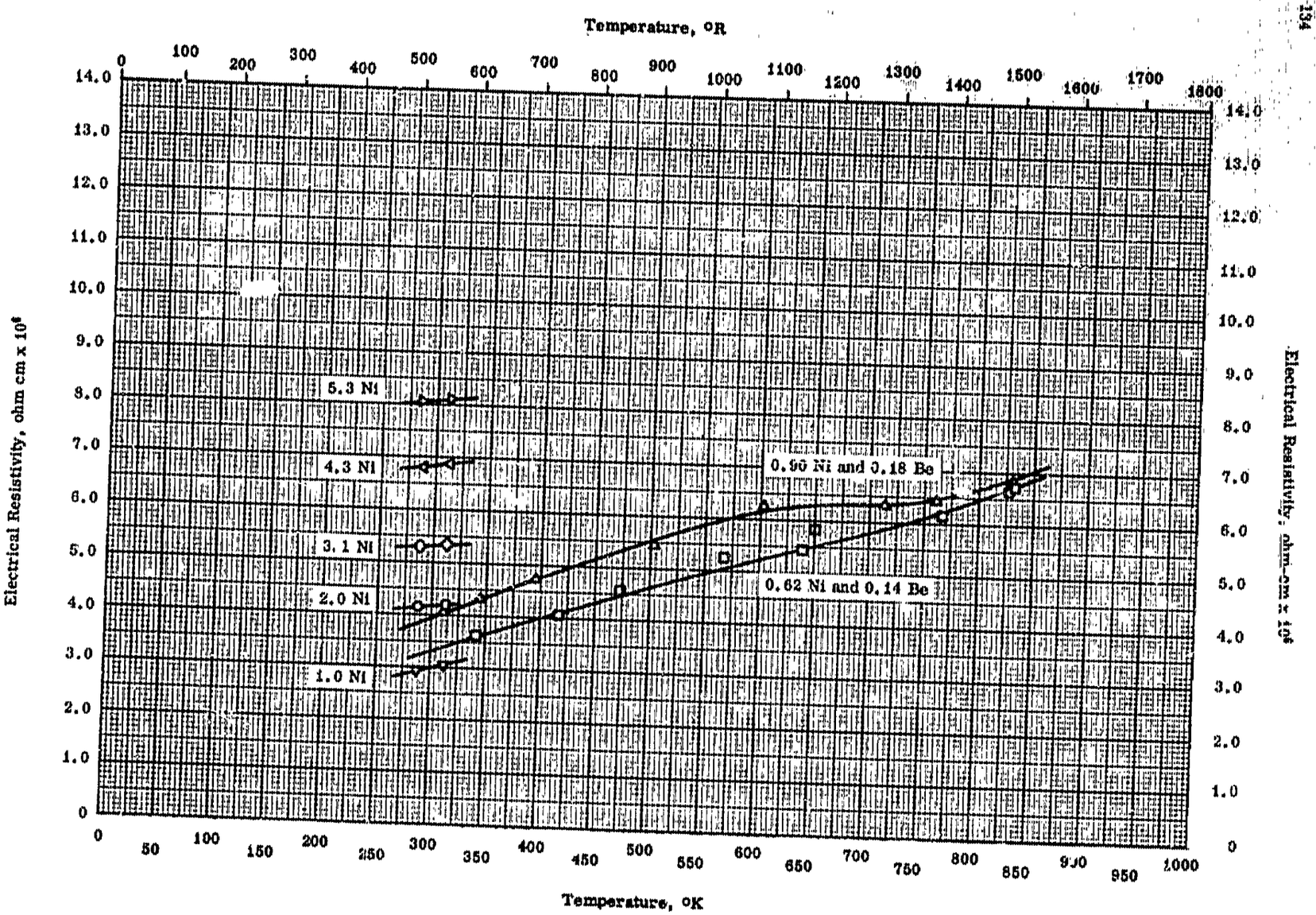


SPECIFIC HEAT -- COPPER + MANGANESE

SPECIFIC HEAT -- COPPER + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-[illegible]	373-673		90 Cu and 10 Mn.	Quenched from 800 C; annealed 2000 hrs at 130 C.
□	55-15	373-673		90 Cu and 10 Mn.	Cooled from 600 C at 3 C min^{-1}.
△	55-12	373-673		12.3 Mn.	Melted; homogenized 7 days at 800 C in CO_2 atmosphere; cooled 14 days at 200 C in furnace.
▽	55-12	373-873		28.3 Mn.	Same as above.
◇	55-12	373-873		43.1 Mn.	Same as above.



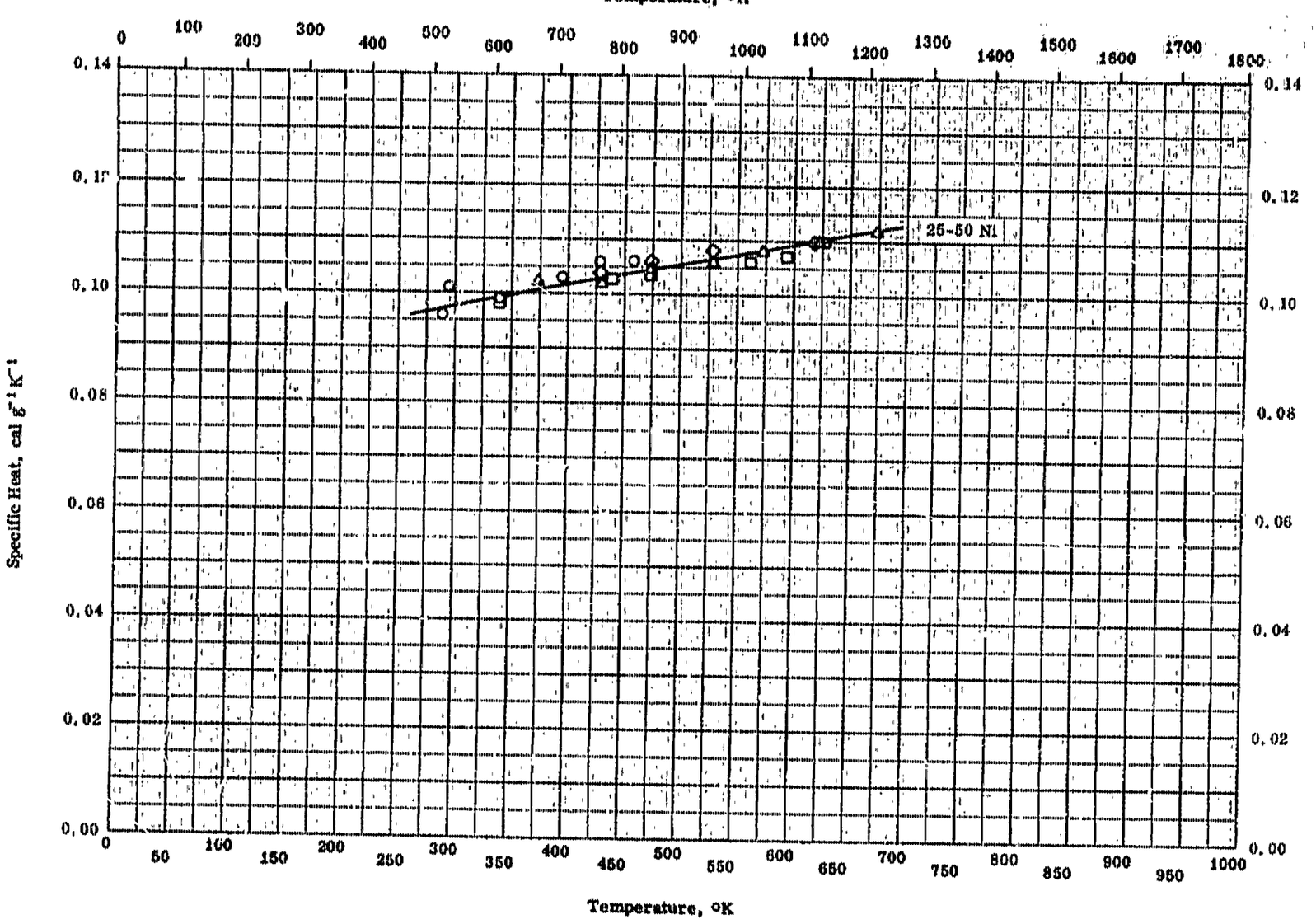
TPRC

ELECTRICAL RESISTIVITY -- COPPER +NICKEL

ELECTRICAL RESISTIVITY -- COPPER + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
▽	56-32	288-313		1.029 Ni, 0.008> Mg, 0.004 >Si, 0.001> each of others.	
○	56-32	288-313		2.012 Ni, 0.008 > Mg, 0.004 > Si, and 0.001> each of others.	
◇	56-32	288-313		3.101 Ni, 0.008> Mg, 0.004 >Si, and 0.001 > each of others.	
◁	56-32	288-313		4.327 Ni, 0.008 > Mg, 0.004 >Si, and 0.001 >each of others.	
▷	56-32	288-313		5.286 Ni, 0.008 > Mg, 0.004 >Si, and 0.001 > each of others.	
□	56-6	343-836		0.62 Ni and 0.14 Be.	Normalized.
△	56-6	311-831		0.90 Ni and 0.18 Be	Normalized.

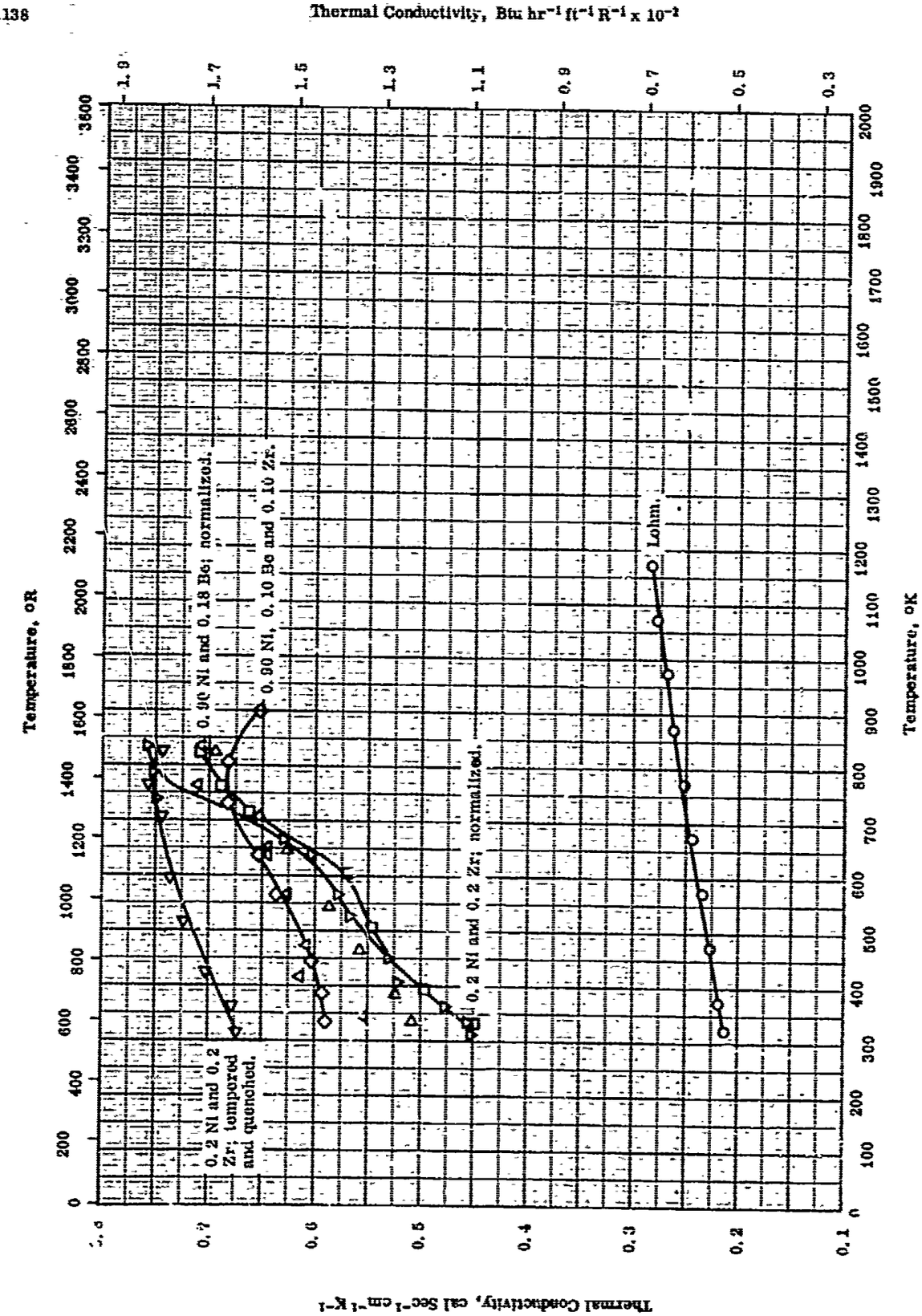


SPECIFIC HEAT -- COPPER + NICKEL

SPECIFIC HEAT -- COPPER + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	40-3	289-627	0.5	50 Cu and 50 Ni.	Under vacuum.
□	40-3	298-595	0.5	75 Cu and 25 Ni.	Same as above.
△	55-15	373-673		75 Cu and 25 Ni.	Quenched from 800 C; annealed 2000 hrs at 130 C.
◇	55-15	373-673		75 Cu and 25 Ni.	Cooled from 600 C at 3 C min^{-1}.

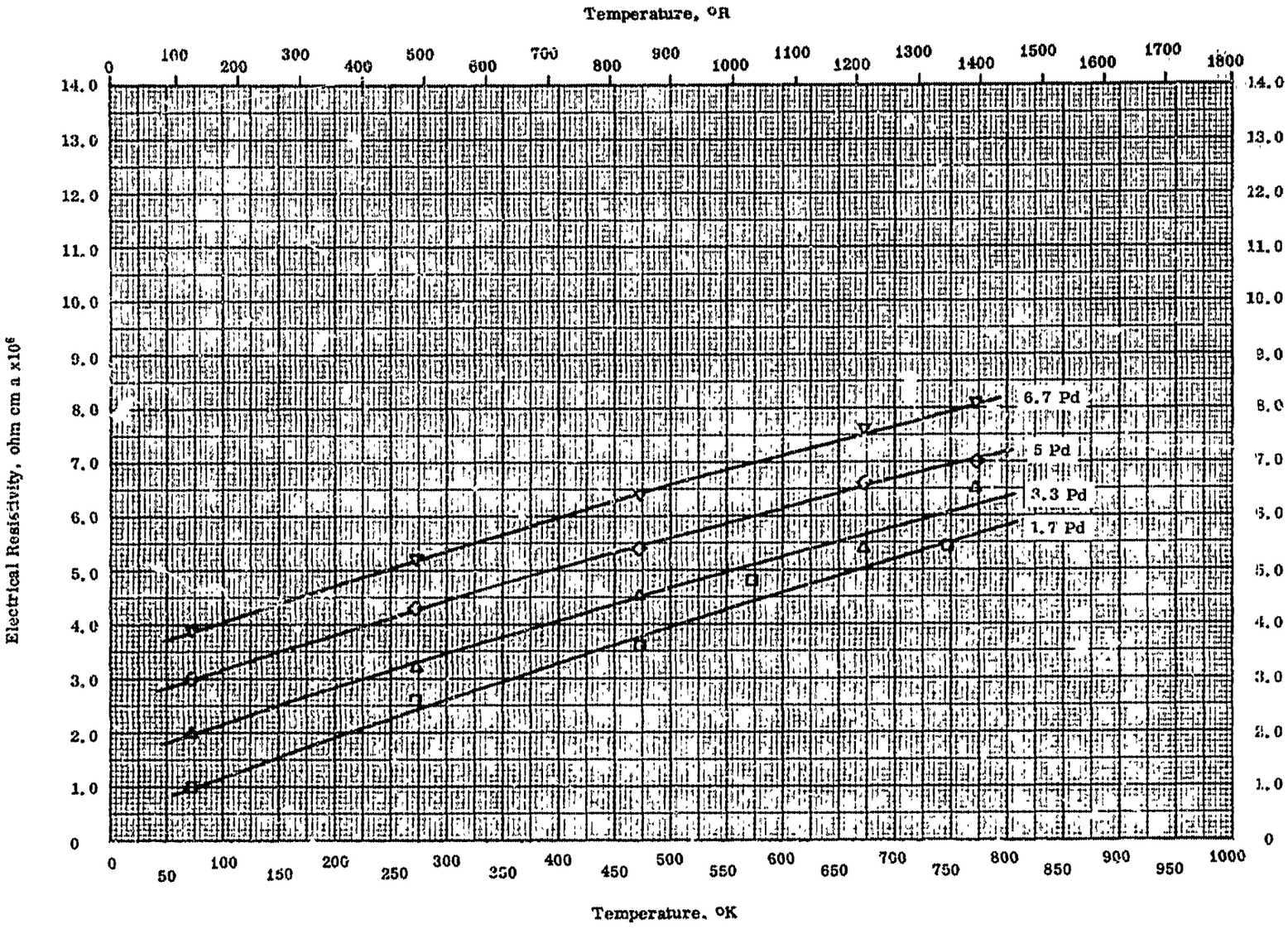


THERMAL CONDUCTIVITY -- COPPER + NICKEL

THERMAL CONDUCTIVITY — COPPER + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repl. Error %	Sample Specifications	Remarks
○	53-2	323-1173		Lohm; 93.4 Cu, 6.05 Ni, 0.01 each Mn and Si.	
□	56-6	311-831		0.90 Ni, 0.18 Be.	Normalized.
△	56-6	343-836		0.62 Ni, 0.14 Be.	Normalized.
▽	56-6	311-835		0.2 Ni, 0.2 Zr, 0.16 Cr, 0.1 - 0.2 Ta.	Normalized.
◁	56-6	314-827		Same as above.	Quenched and tempered.
▷	57-2	336-826		99.05 Cu, 0.70 Ni, 0.15 Co, and 0.10 Be.	
◇	57-3	333-900		98.9 Cu, 0.90 Ni, 0.10 Be, and 0.10 Zr.	



ELECTRICAL RESISTIVITY -- COPPER + PALLADIUM

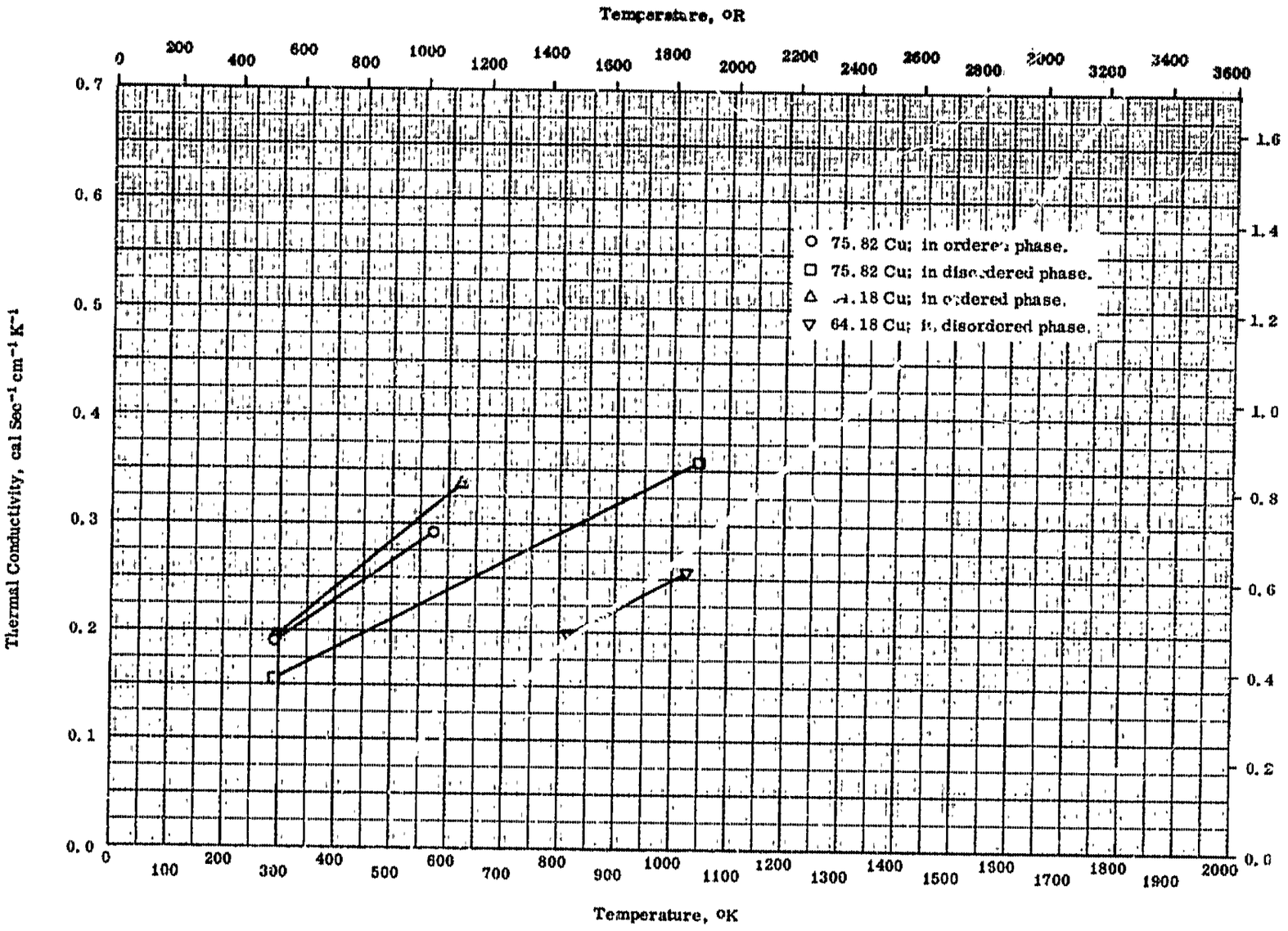
TPRC

ELECTRICAL RESISTIVITY -- COPPER + PALLADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-26	73-773		1.7 Pd; prepared from 99.99 pure raw materials.	Vacuum melted 100 C above melting point, homogenized 24 hrs at 900 C, swaged, and annealed 1 hr at 500 C.
△	56-26	73-773		3.3 Pd; raw materials same as above.	Same as above.
◇	56-26	73-773		5 Pd; raw materials same as above.	Same as above.
▽	56-26	73-773		6.7 Pd; raw materials same as above.	Same as above.

TPRC



THERMAL CONDUCTIVITY -- COPPER + PALLADIUM

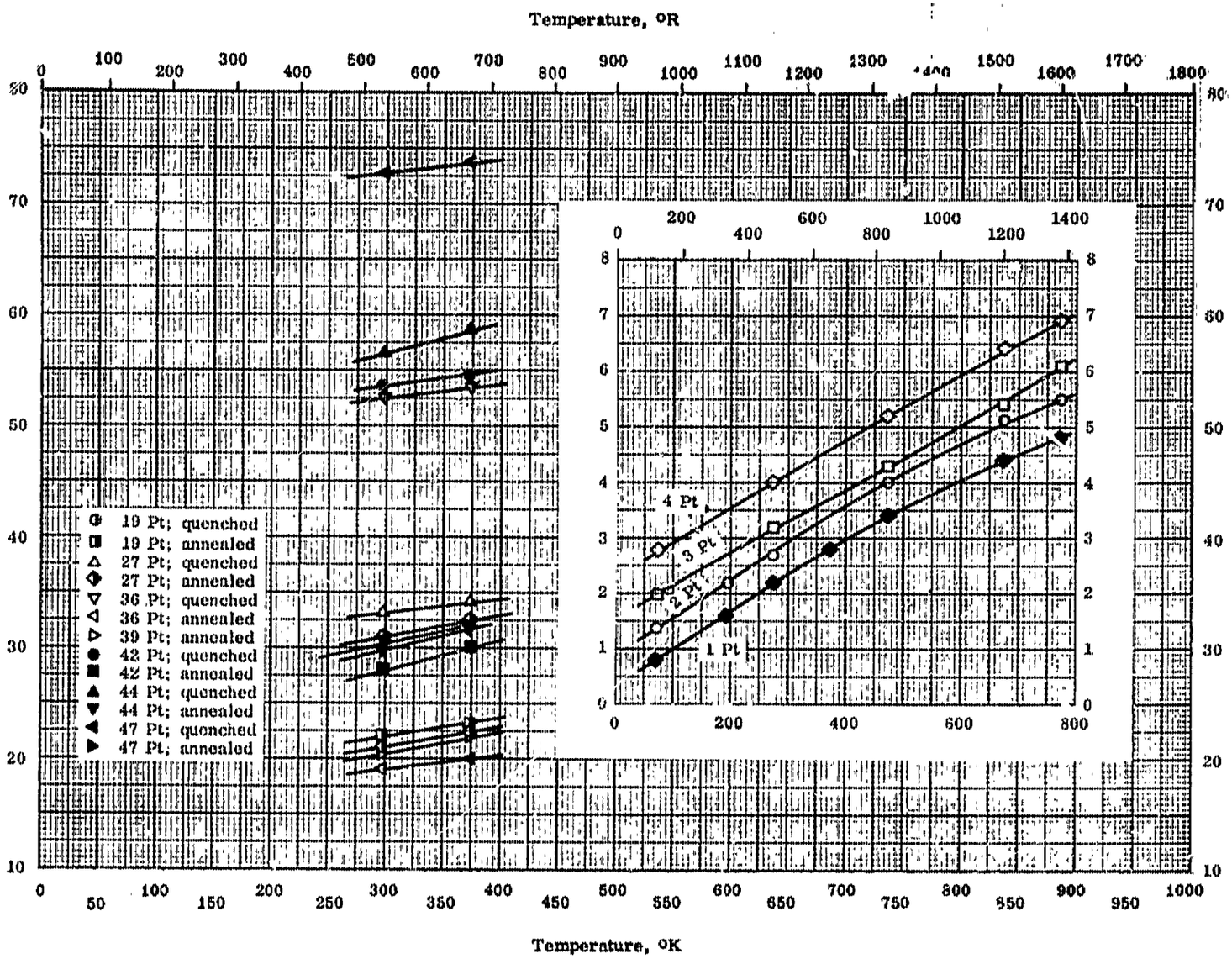
TPRC

THERMAL CONDUCTIVITY -- COPPER + PALLADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	58-4	293-573	3	75-82 Cu and 24.18 Pd; ordered atomic arrangement.	Annealed at 600-700 C for 2 hrs.
□	58-4	293-1048	3	Same as above; disordered atomic arrangement.	Same as above.
△	58-4	293-623	3	64.18 Cu and 35.82 Pd; ordered atomic arrangement.	Same as above.
▽	58-4	818-1023	3	Same as above; disordered atomic arrangement.	Same as above.

TPRC



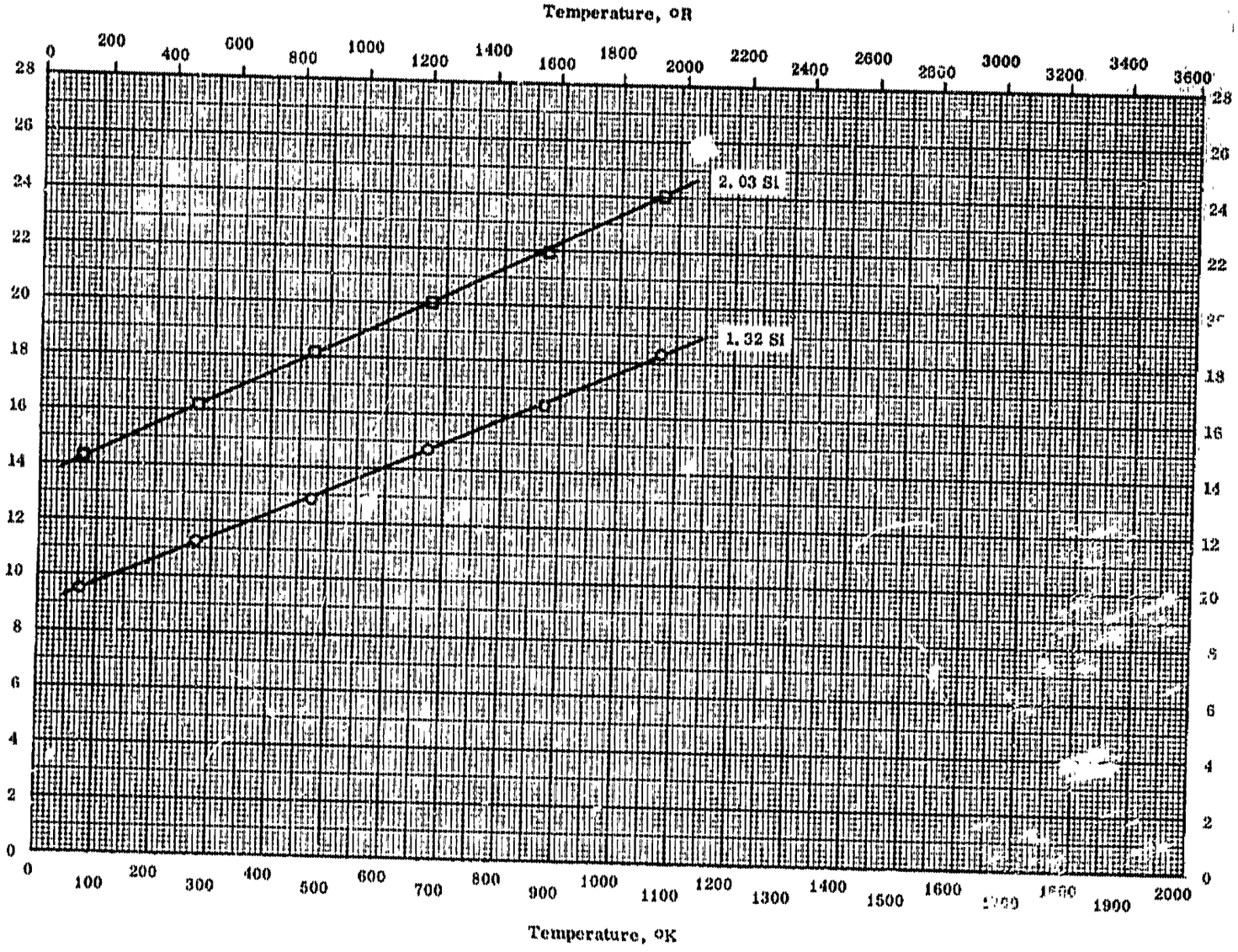
ELECTRICAL RESISTIVITY -- COPPER + PLATINUM

TPRC

ELECTRICAL RESISTIVITY -- COPPER + PLATINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
●	56-27	298-373		19.40 Pt.	Quenched from 900 C.
■	56-27	298-373		Same as above.	Annealed.
△	56-27	298-373		26.74 Pt.	Quenched from 900 C.
◆	56-27	298-373		Same as above.	Annealed.
▽	56-27	298-373		35.96 Pt.	Quenched from 900 C.
◁	56-27	298-373		Same as above.	Annealed.
▷	56-27	298-373		38.9 Pt.	Annealed.
●	56-27	298-373		41.58 Pt.	Quenched from 900 C.
■	56-27	298-373		Same as above.	Annealed.
▲	56-27	298-373		43.70 Pt.	Quenched from 900 C.
▼	56-27	298-373		Same as above.	Annealed.
◀	56-27	298-373		47.43 Pt.	Quenched from 900 C.
▶	56-27	298-373		Same as above.	Annealed.
◆	56-26	73-773		1.0 Pt; prepared from 99.99 pure raw materials.	Vacuum annealed at 100 C above melting point, homogenized 24 hrs at 900 C, swaged, and annealed 1 hr at 500 C.
○	56-26	73-773		2.0 Pt; same as above.	Same as above.
□	56-26	73-773		3.0 Pt; same as above.	Same as above.
◇	56-26	73-773		4.0 Pt; same as above.	Same as above.



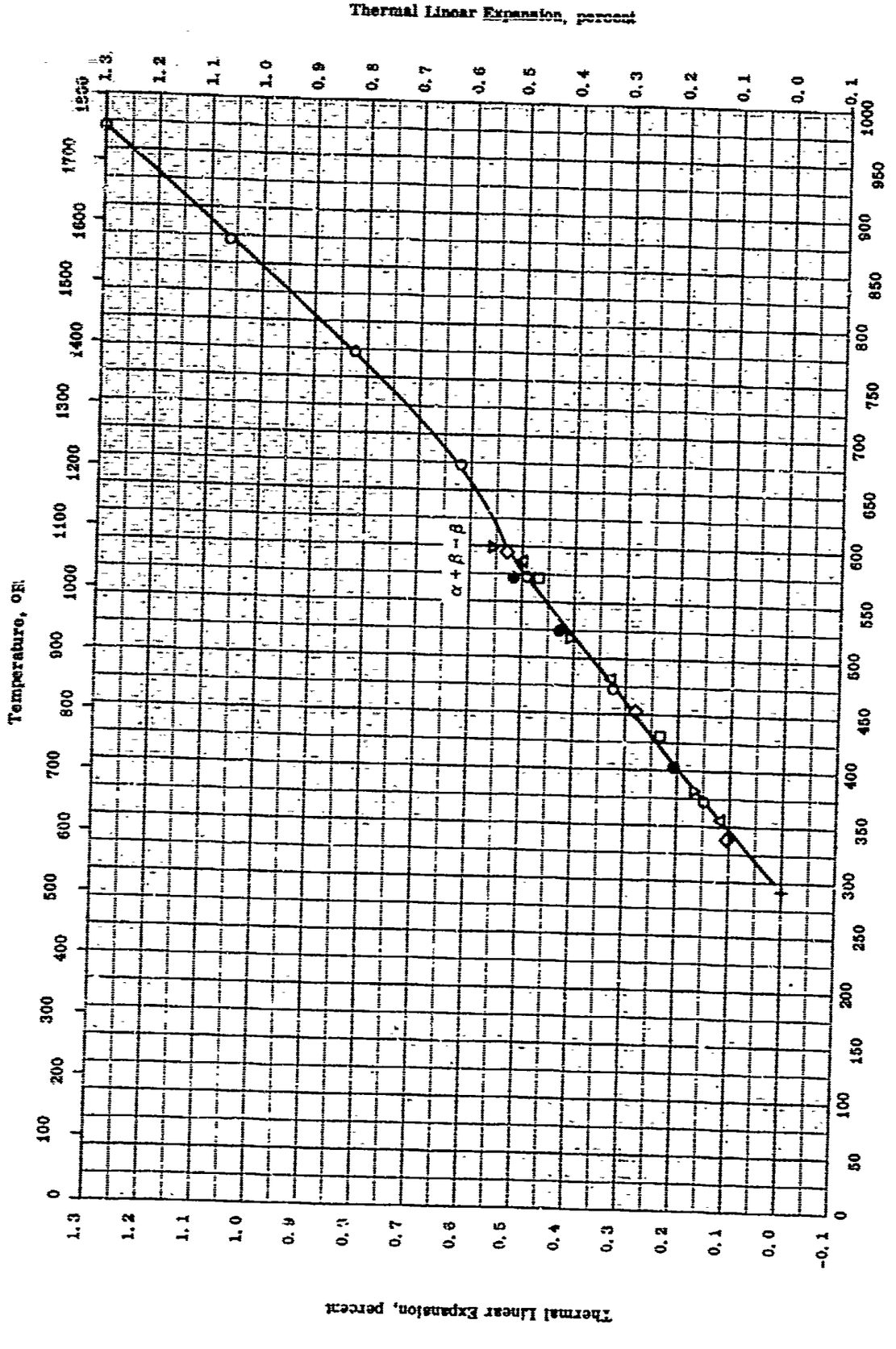
ELECTRICAL RESISTIVITY -- COPPER + SILICON

ELECTRICAL RESISTIVITY -- COPPER + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	53-16 also 55-6	73-1073		1.32 Si; prepared from 99.99 pure Cu and 99.97 pure Si (possibly 0.2 O_2).	Melted in graphite crucibles under vacuum and homogenized 18 hrs just below M. P.
□	53-16 also 55-6	73-1073		2.03 Si; raw materials same as above.	Same as above.

TPRC



THERMAL LINEAR EXPANSION -- COPPER + SILVER

THERMAL LINEAR EXPANSION -- COPPER + SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	49-12	288-973		93 Cu and 7 Ag.	Homogenized; heated at 1.6 C min^{-1} during test.
□	55-39	293-573		89.5 Cu, 10.4 Ag, 0.066 As, and 0.030 P.	Cast.
△	55-39	293-573		79.8 Cu, 20.1 Ag, 0.058 As, and 0.027 P.	Same as above.
◇	55-39	293-573		69.6 Cu, 30.0 Ag, 0.058 As, and 0.021 P.	Same as above.
▽	55-39	293-573		59.1 Cu, 40.9 Ag, 0.043 As, and 0.019 P.	Same as above.
●	55-39	293-573		50.01 Cu, 49.98 Ag, 0.032 As, and 0.0160 P.	Same as above.

TPRC

PROPERTIES OF COPPER + TELLURIUM

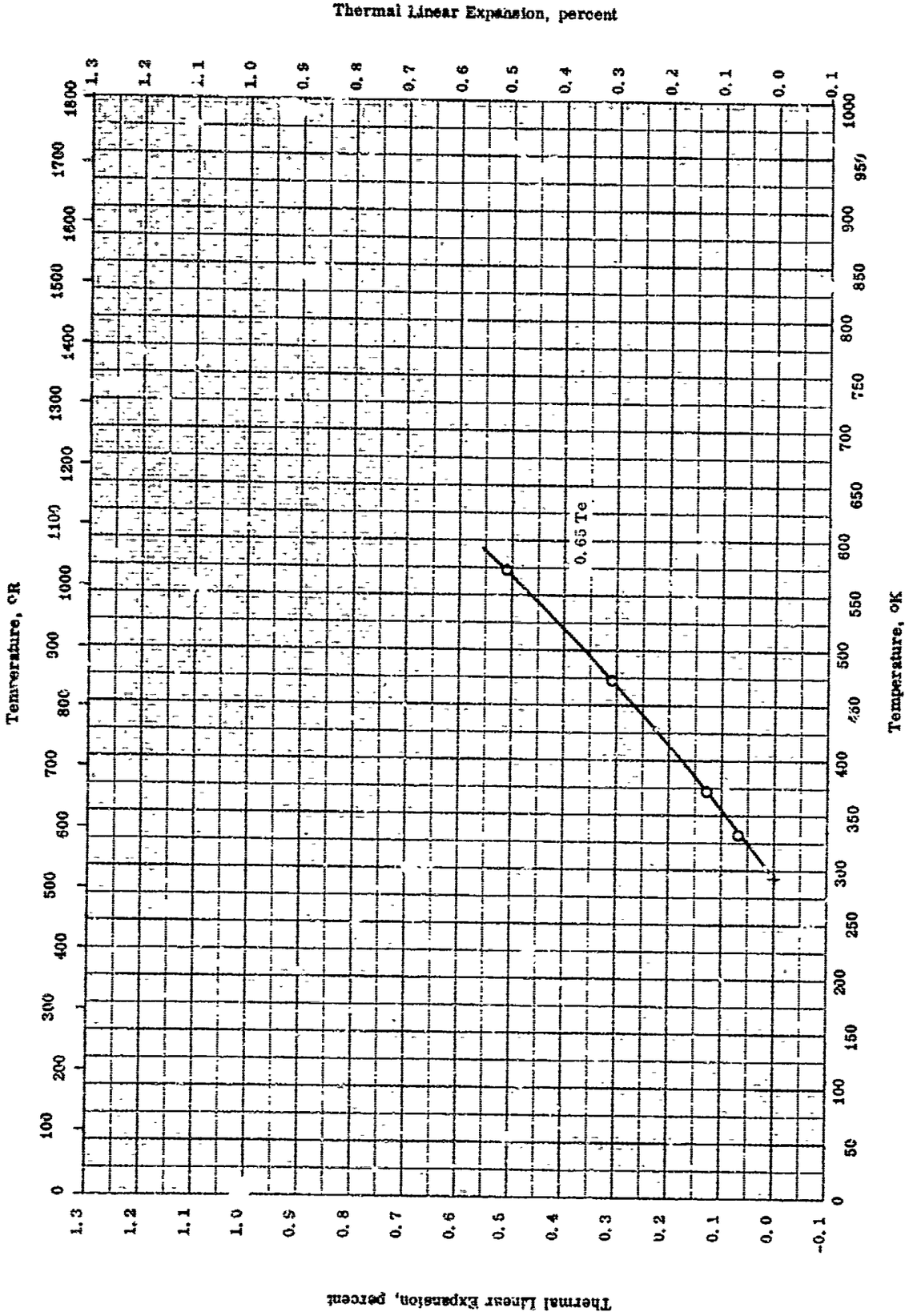
REPORTED VALUES

Density:	g cm^{-3}	lb ft^{-3}
○ 0.56 Te	8.9	560

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	57-34	298		0.50 Te, 0.007 P, 0.001 Fe, Si, Ag, and Zn, and 0.001 >each Al, Pb, Mg, Mn, and Sn.	

TPRC



THERMAL LINEAR EXPANSION -- CO[illegible]ER + TELLURIUM

THERMAL LINEAR EXPANSION -- COPPER + TELLURIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	47-6	293-573		Te copper; 99.27 Cu, 0.65 Te, 0.06 Zn, 0.01 Ni, and 0.003 Fe and Pb each.	Cold drawn and annealed at 1100 F.

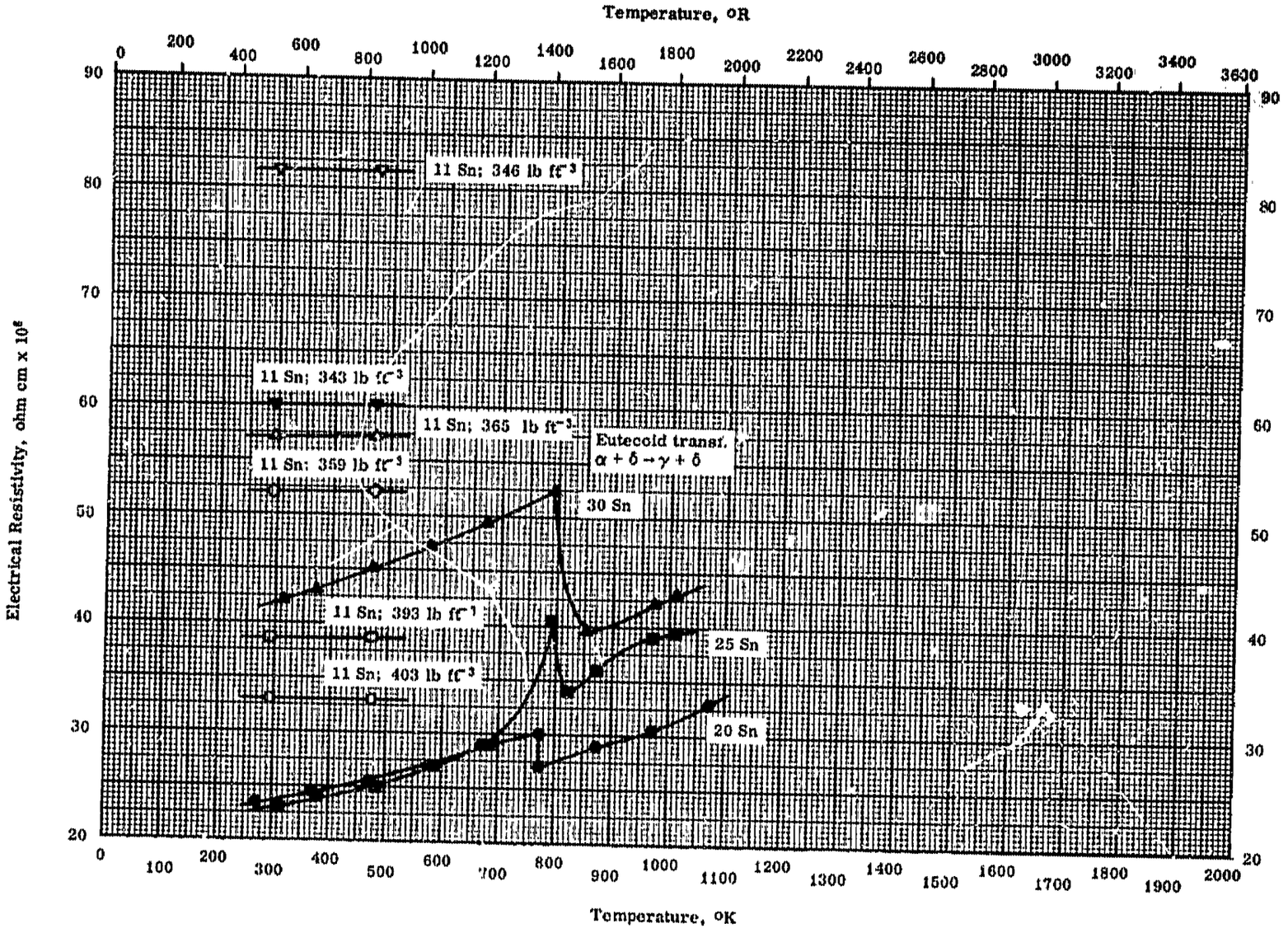
PROPERTIES OF COPPER + TIN

REPORTED VALUES

Density		g cm^{-3}	lb ft^{-3}
○	11 Sn; porous	6.45	402
□	Same as above	6.30	393
△	Same as above	5.85	365
◇	Same as above	5.55	346
▽	Same as above	5.75	359
●	Same as above	5.50	343

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-3	298		Bronze; nominal composition: 89 Cu and 11 Sn; prepared from powder with density 540 lb ft^{-3} and dia 0.00 133 cm.	Prepared by powder metallurgy.
□	52-3	298		Same as above except powder dia 0.00493 cm.	Same as above.
△	52-3	298		Same as above.	Same as above.
◇	52-3	298		Same as above except powder dia 0.01275 cm.	Same as above.
▽	52-3	298		Same as above except powder dia 0.02113 cm.	Same as above.
●	52-3	298		Same as above except powder dia 0.04000 cm.	Same as above.

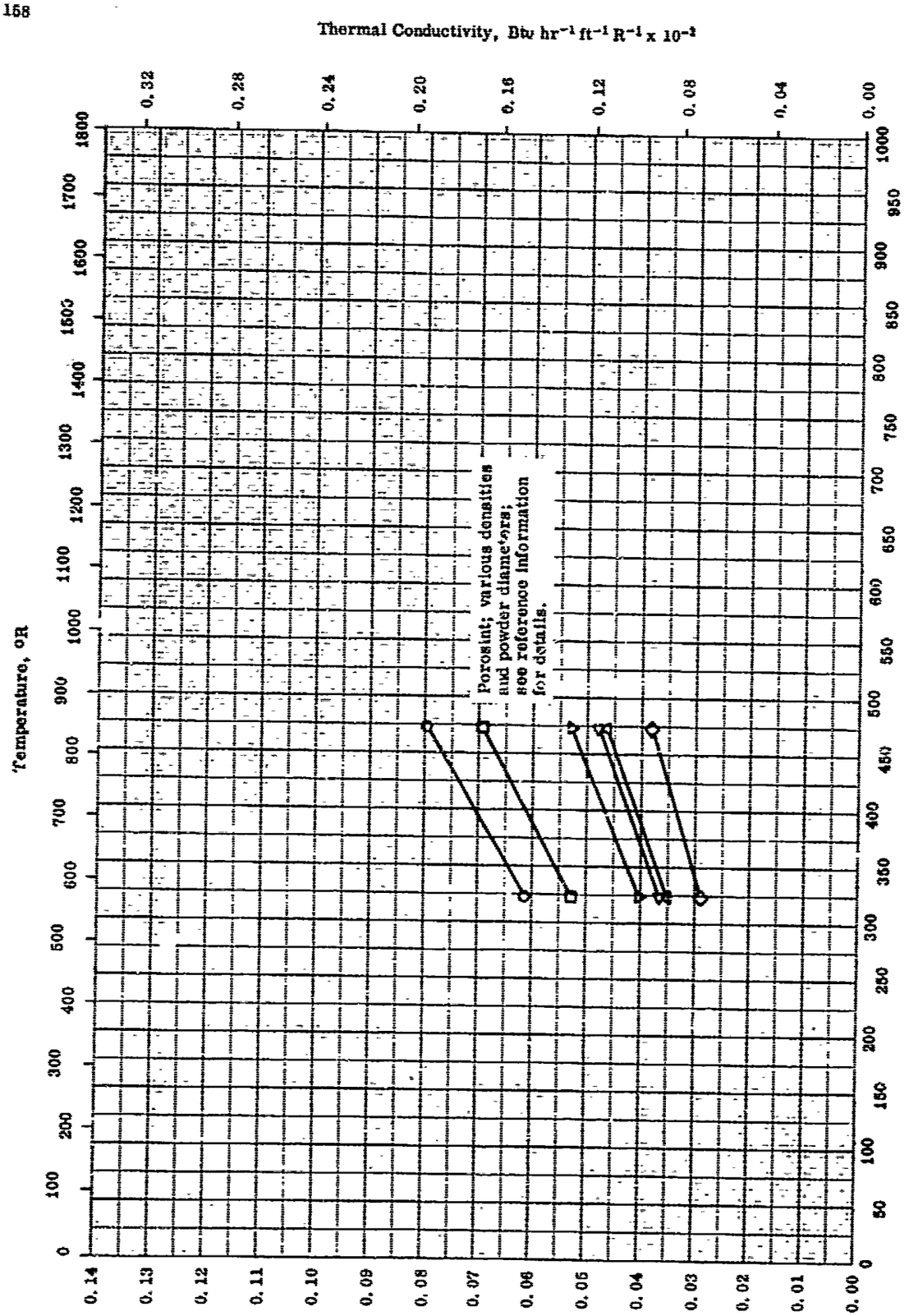


ELECTRICAL RESISTIVITY -- COPPER + TIN

TPRC

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-3	293-473		Bronze; from Porosint Sintered Product LTD.; nominal: 89 Cu and 11 Sn; density 403 lb ft^{-3}; porous.	Made from spherical shaped powder produced by atomization process; powder density 543 lb ft^{-3}.
□	52-3	293-473		Same as above; density 393 lb ft^{-3}.	Same as above.
△	52-3	293-473		Same as above; density 365 lb ft^{-3}.	Same as above.
◇	52-3	293-473		Same as above; density 359 lb ft^{-3}.	Same as above.
▽	52-3	293-473		Same as above; density 346 lb ft^{-3}.	Same as above.
▼	52-3	293-473		Same as above; density 343 lb ft^{-3}.	Same as above.
●	57-25	273-1053		Nominal: 80 Cu and 20 Sn.	
■	57-25	273-1053		Nominal: 75 Cu and 25 Sn.	
▲	57-25	273-1053		Nominal: 70 Cu and 30 Sn.	



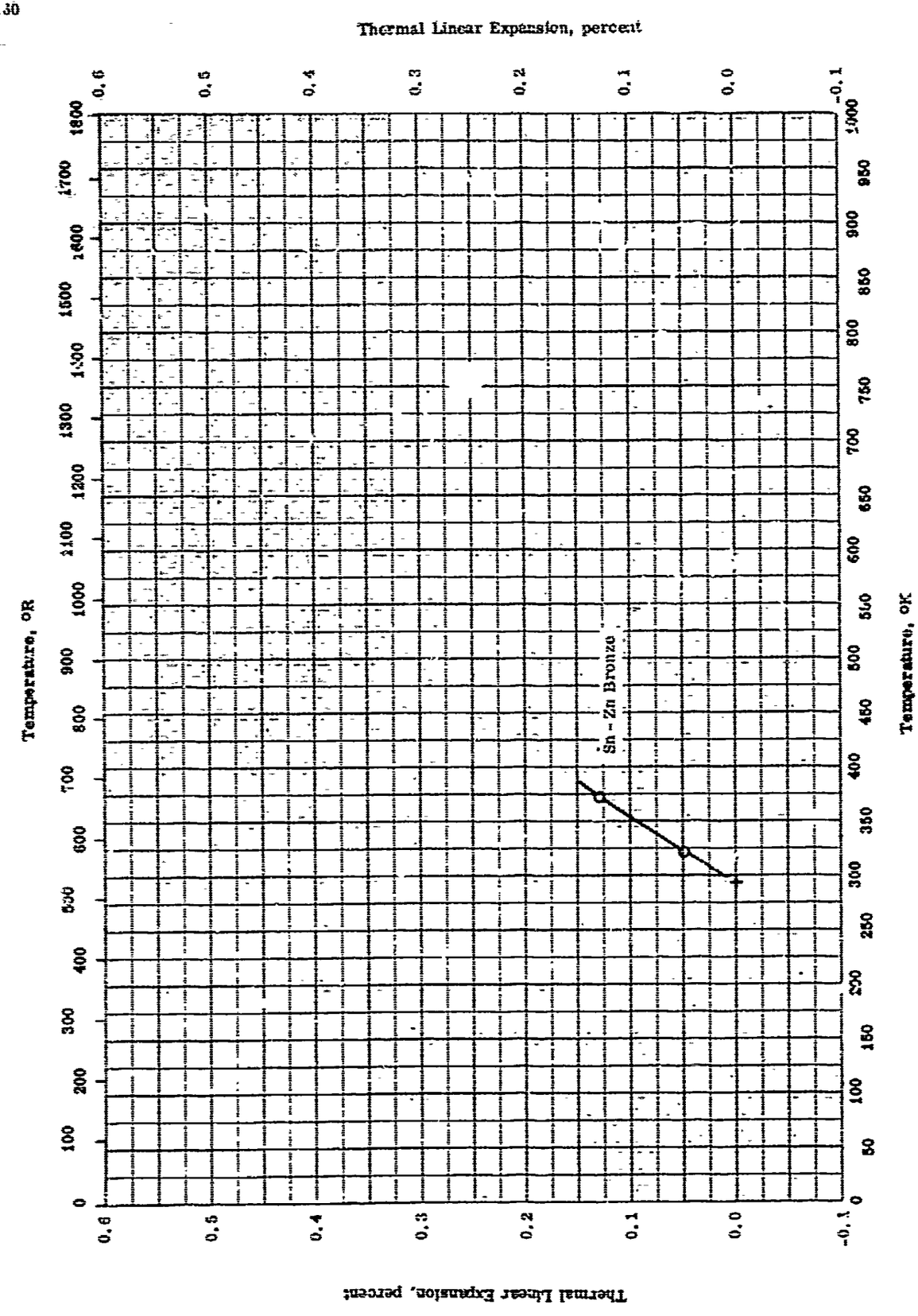
THERMAL CONDUCTIVITY -- COPPER + TIN

THERMAL CONDUCTIVITY -- COPPER + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	52-3	323-473		Porosint (Sintered Products Ltd.); 89 Cu and 11 Sn; density 402.5 lb ft^{-3}; powder dia 0.00133 cm.	Sintered.
□	52-3	323-473		Same as above; density 393.1 lb ft^{-3}; powder dia 0.00493 cm.	Sintered.
△	52-3	323-473		Same as above; density 365.0 lb ft^{-3}; powder dia 0.00493 cm.	Sintered.
◇	52-3	323-473		Same as above; density 346.3 lb ft^{-3}; powder dia 0.01275 cm.	Sintered.
▽	52-3	323-473		Same as above; density 358.8 lb ft^{-3}; powder dia 0.02113 cm.	Sintered.
◁	52-3	323-473		Same as above; density 343.2 lb ft^{-3}; powder dia 0.04000 cm.	Sintered.

TPRC



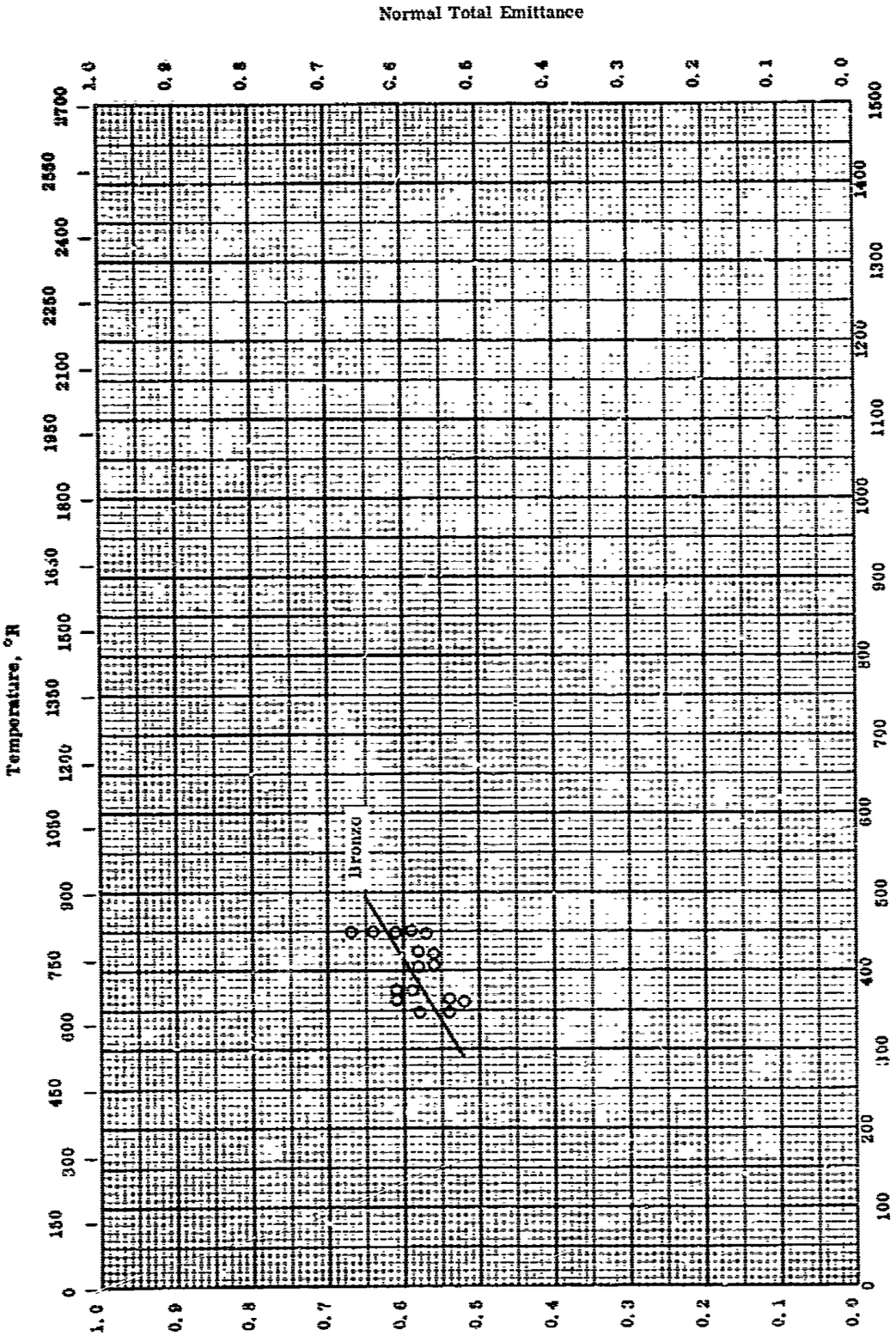
THERMAL LINEAR EXPANSION -- COPPER + TIN

THERMAL LINEAR EXPANSION - COPPER + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	43-8	273-373		Sn - Zn Bronze; 98.6 Cu, 1.3 Sn, and 0.02 Fe.	Hot rolled and annealed.

TPRC



NORMAL TOTAL EMITTANCE — COPPER + TIN

NORMAL TOTAL EMITTANCE -- COPPER + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-21	347-453		Porous bronze.	Measured in air.

PROPERTIES OF COPPER + TITANIUM

REPORTED VALUES

Density	g cm^{-3}	lb ft^{-3}
○ 40 Ti	8.80	518.0
Melting Point	K	R
□ 24 Ti	1123	2021

PROPERTIES OF COPPER + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-44	298		40 Ti ; from electrolytic Cu and sponge high purity Ti.	Vacuum melted and cast; turned, pressed, annealed at 650 C, and furnace cooled at 36 C hr^{-1}.
□	63-17	1123		76 Cu and 24 Ti.	

TPRC

PROPERTIES OF COPPER + URANIUM

REPORTED VALUES

Density:	g cm^{-3}	lb ft^{-3}
○ 42.8 U	10.6	662
□ 42.8 U	10.60 ± 0.02*	661.7 ± 1.2*
Melting Point:	**K**	**R**
△ 42.8 U	1325	2385

* Most probable value for alloys of this composition

PROPERTIES OF COPPER + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	49-11	298		UCu_5; 57.2 Cu and 42.8 U; prepared from 99.9+ U and electrolytic Cu.	Inductively melted in ZrO_2 or BeO crucible in vacuum.
□	49-11	298		Same as above.	Same as above; density computed from x-ray data.
△	49-11	1325		Same as above.	M. P. from breaking in time-temperature curve.

TPRC

PROPERTIES OF COPPER + ZINC

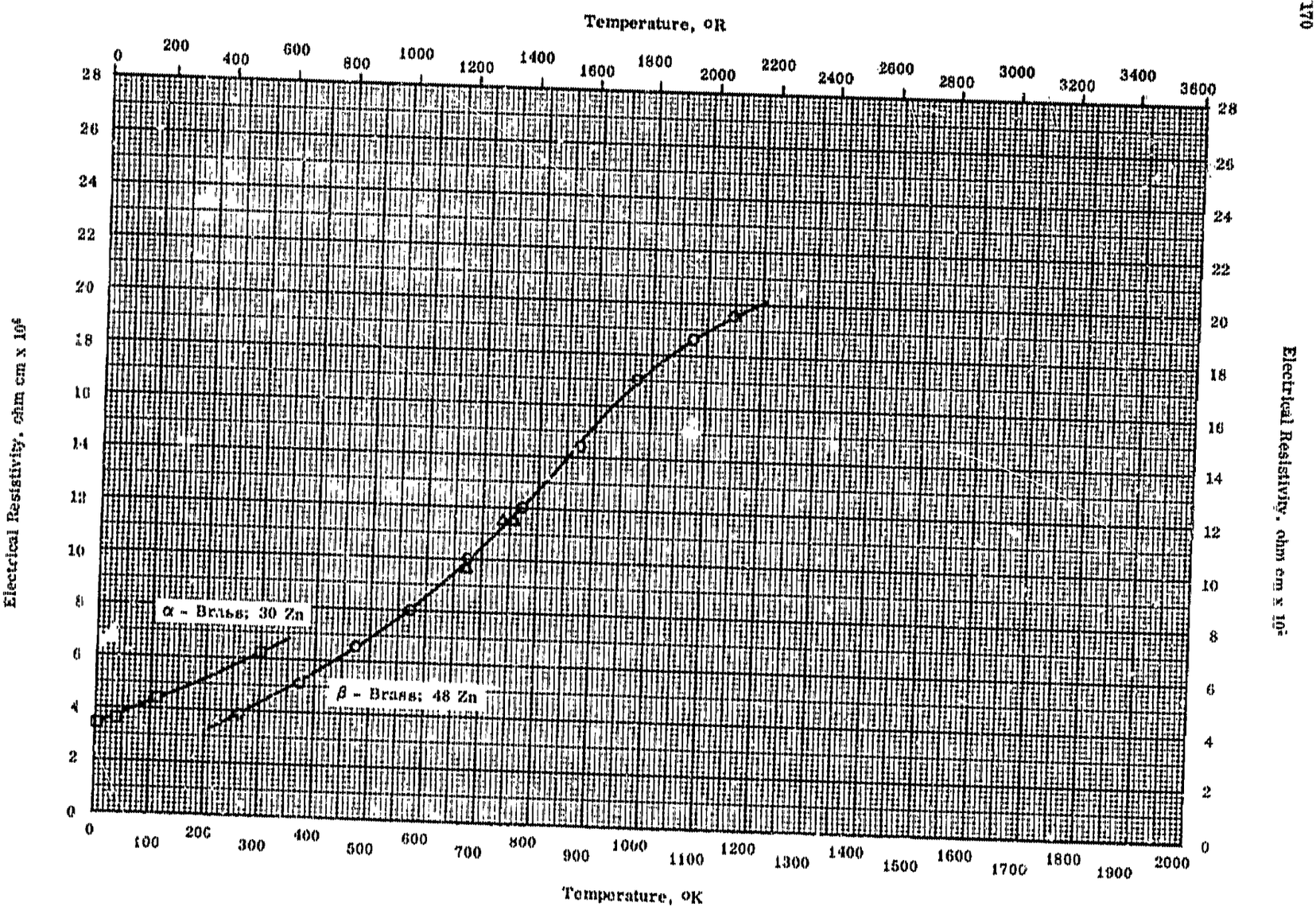
REPORTED VALUES

Density:	g cm^{-3}	lb ft^{-3}
○ 35.7 Zn and 3.27 Pb	8.46	528

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	57-34	298		Free cutting leaded brass; 35.7 Zn, 3.27 Pb, 1.0 Sn, and 0.01 each Bi, Cd, Fe, Ni, and Ag.	

TPRC



ELECTRICAL RESISTIVITY -- COPPER + ZINC

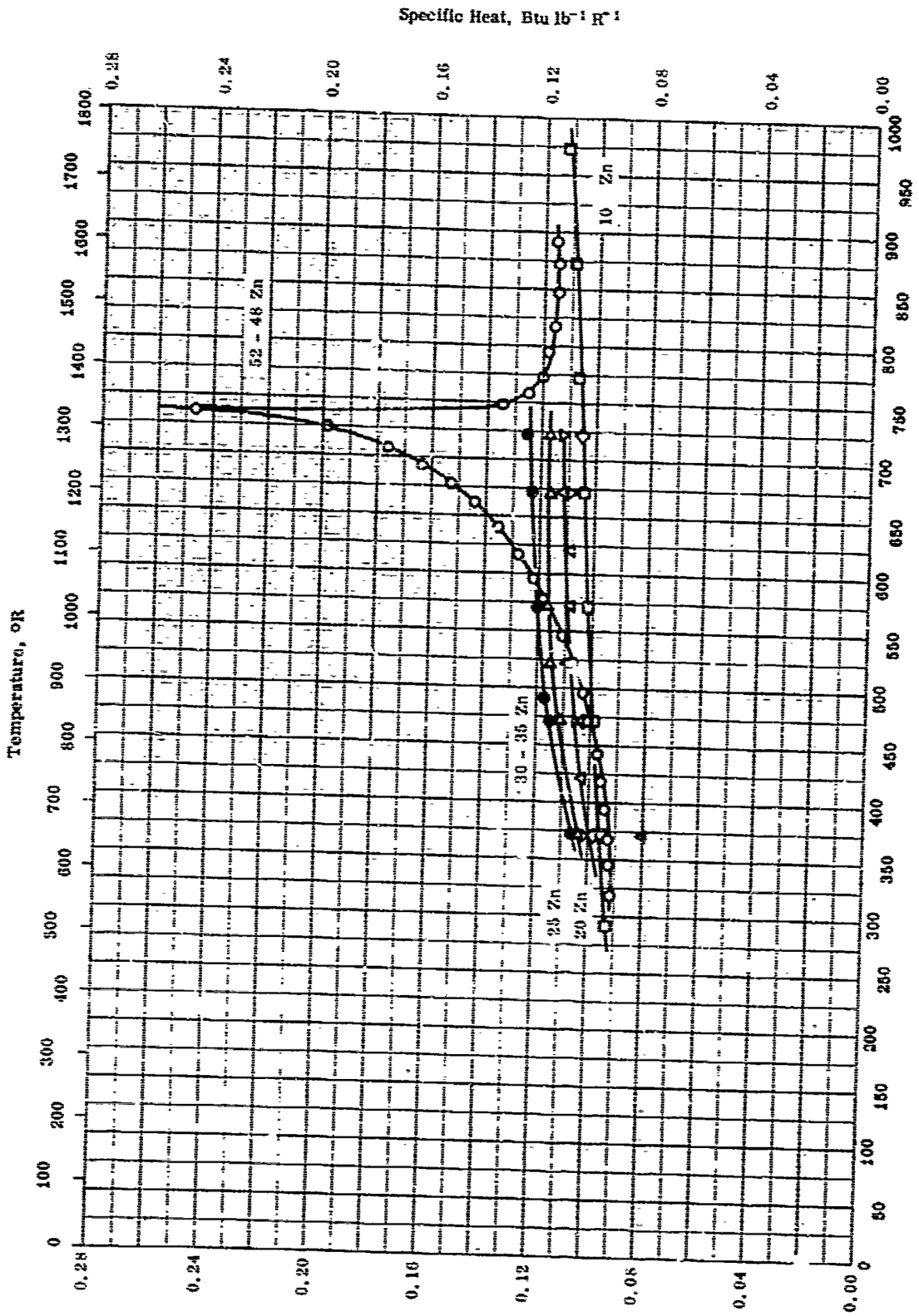
TPRC

ELECTRICAL RESISTIVITY — COPPER + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-25	273-1133		48 Zn.	
□	46-1	4-200		α Brass: 70 Cu and 30 Zn.	Drawn wire; annealed 3 hrs at 592 K.
△	52-10	671-753		β Brass: 52.21 Cu and 47.79 Zn.	Sample held 24 hrs at each temperature before each measurement.

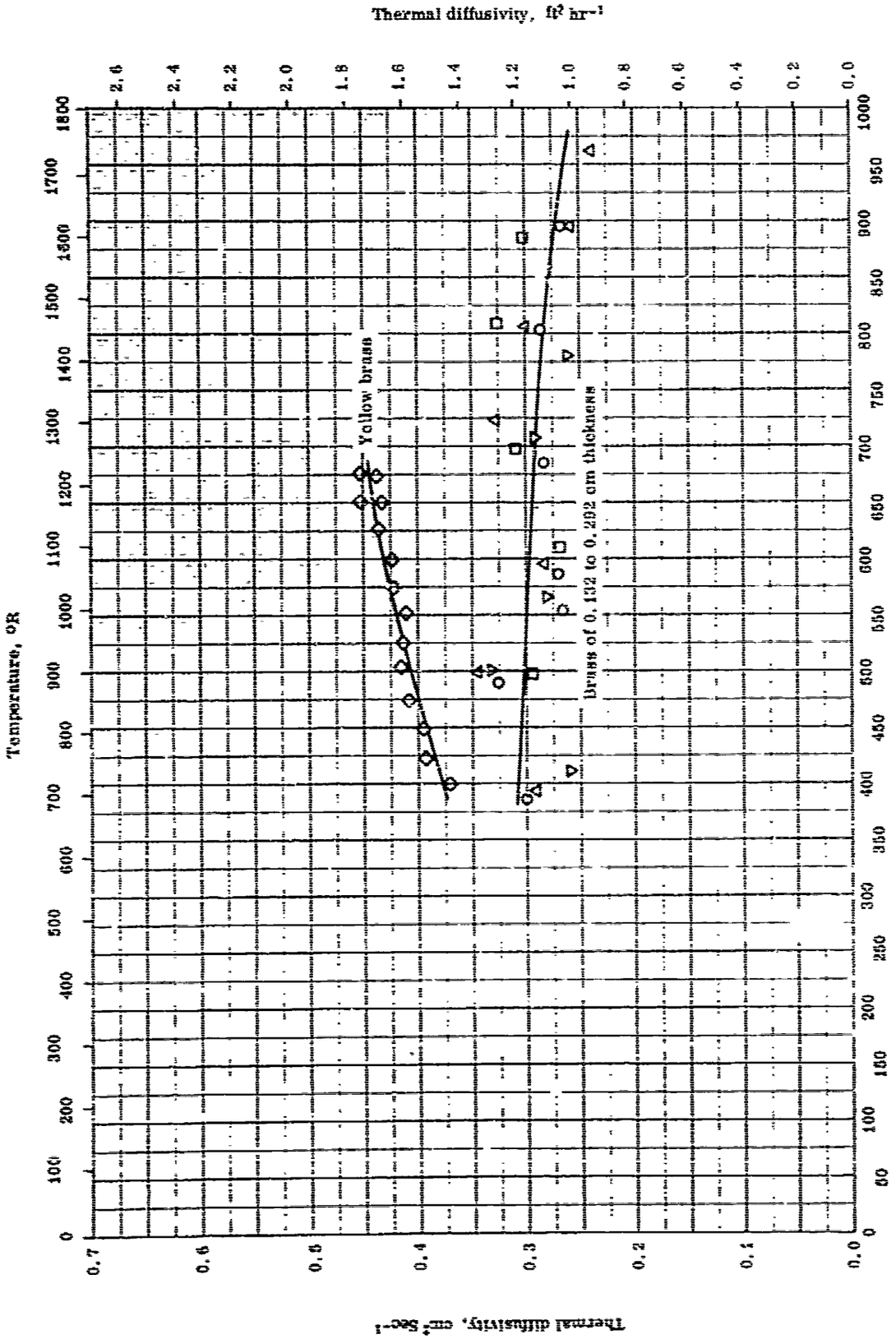
TPRC



SPECIFIC HEAT -- COPPER + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	36-1	322-803		Brass, β-phase; 51.8 Cu, 48.17 Zn, 0.03 Pb, and trace Fe.	Under argon atmosphere at reduced pressure.
□	10-4	293-973	2	Brass; 10-30 Zn.	Tempered several hrs at 500 C; tested in N_2 atmosphere.
△	55-16	373-673	4.0	70 Cu and 30 Zn.	Two samples: quenched from 800 C and annealed 2000 hrs at 130 C for sample 1 and cooled from 600 C at 3 C min^{-1} for sample 2.
◇	52-6	373-723	2.0	4.56, 12.25, and 16.00 Zn.	Annealed 1 hr at 700 C; slowly cooled; average of 3 samples containing 4.56, 12.25, and 16.00 Zn.
▽	52-6	373-723		20.75 Zn.	Annealed 1 hr at 700 C; slowly cooled.
▷	52-6	373-723	5.0	25.75 Zn.	Treatment 1 and 2: (1)Annealed 1 hr at 700 C; slowly cooled; (2)heated 700 C, held 30 min; furnace cooled to 500 C; held 10 min, and water quenched.
●	52-6	373-723	5.0	30.35 and 36.87 Zn.	Samples with 30.35 Zn given treatment as above and sample with 36.87 Zn given treatment (1) only.

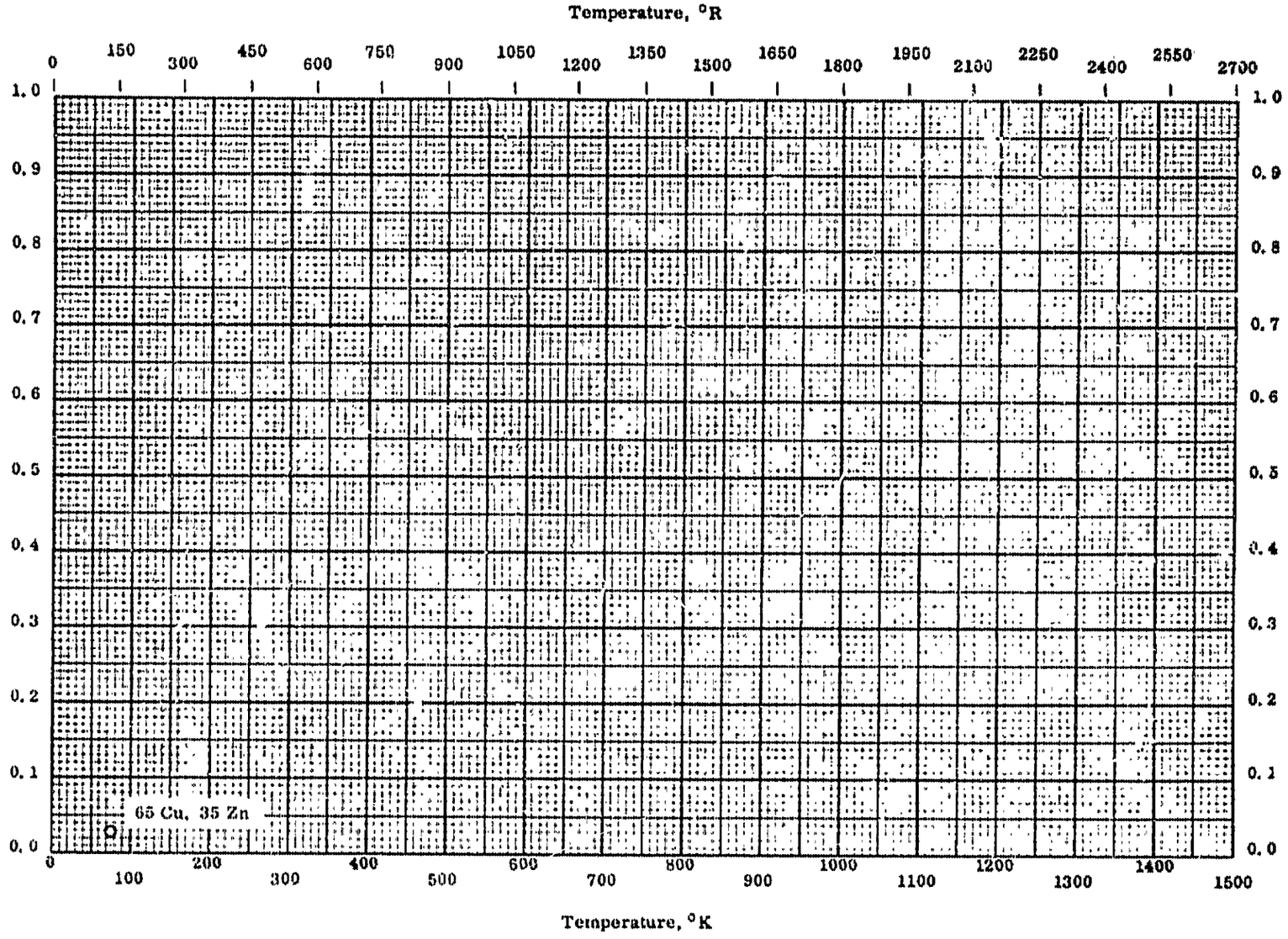


THERMAL DIFFUSIVITY — COPPER + ZINC

THERMAL DIFFUSIVITY — COPPER + ZINC

REFERENCE INFORMATION

Sym Sel	Ref.	Temp. Range °K	Reqt. Error %	Sample Specifications	Remarks
○	60-1	385-895		Brass; disc of 0.65 cm dia and 0.132 cm thick.	
□	60-1	407-885		Same as above except 0.130 cm thick.	
△	60-1	303-962		Same as above except 0.206 cm thick.	
▽	60-1	410-780		Same as above except 0.292 cm thick.	
◇	61-1	398-673	8	Yellow brass; 65 Cu and 35 Zn; sample in tube form with 122 cm in length; 1.91 cm in dia, and 0.318 cm in wall thickness.	



TPRC

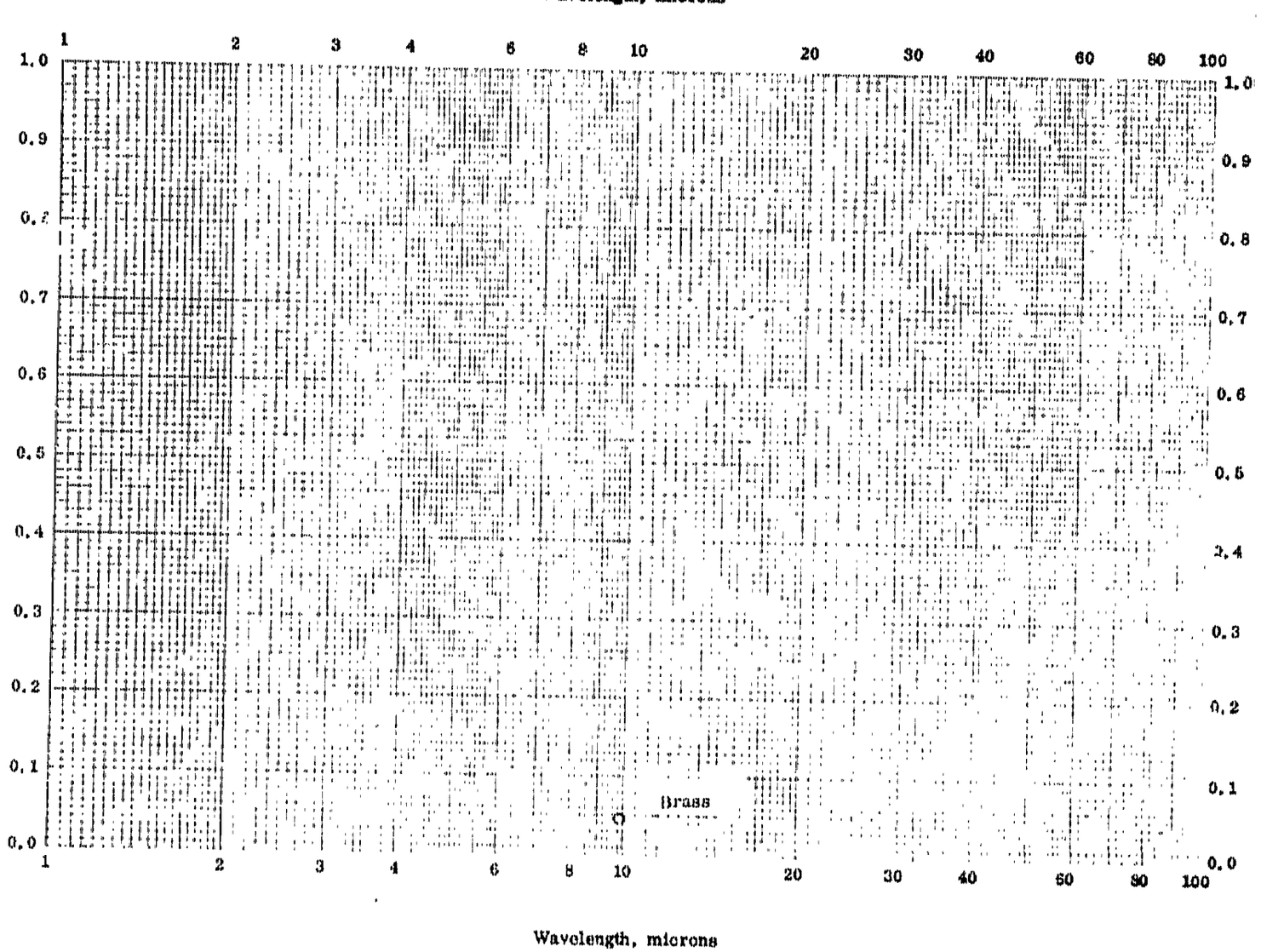
HEMISPHERICAL TOTAL EMITTANCE -- COPPER + ZINC

HEMISPHERICAL TOTAL EMITTANCE -- COPPER + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	60-17	76	5	65 Cu, 35 Zn.	Emittance for 300 K black body radiation.

TPRC



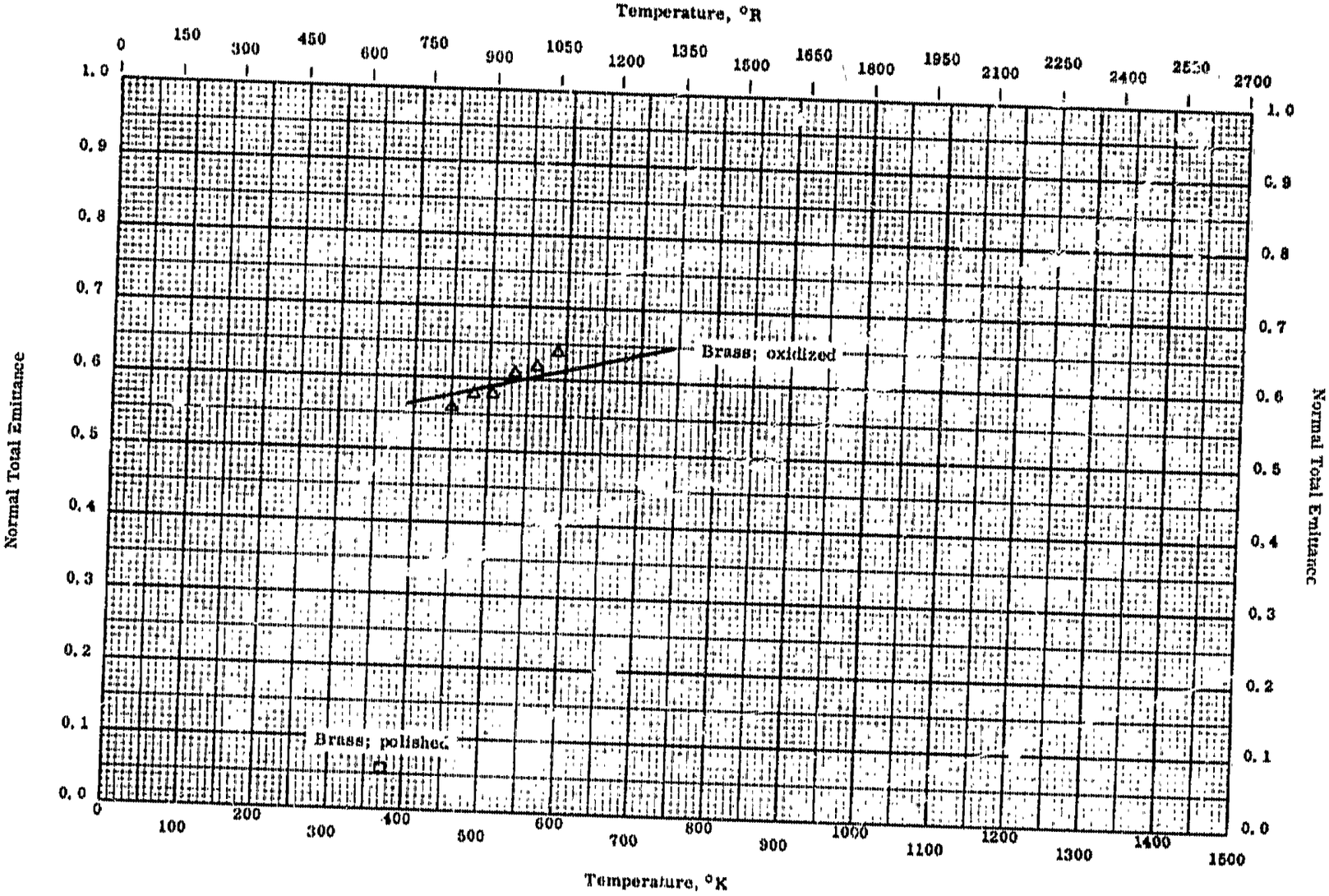
TPRC

HEMISPHERICAL SPECTRAL EMITTANCE -- COPPER + ZINC

HEMISPHERICAL SPECTRAL EMITTANCE — COPPER + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	48-8	9.96	90	< 20	Brass.	Measured in vacuum (10^{-5} mm Hg).

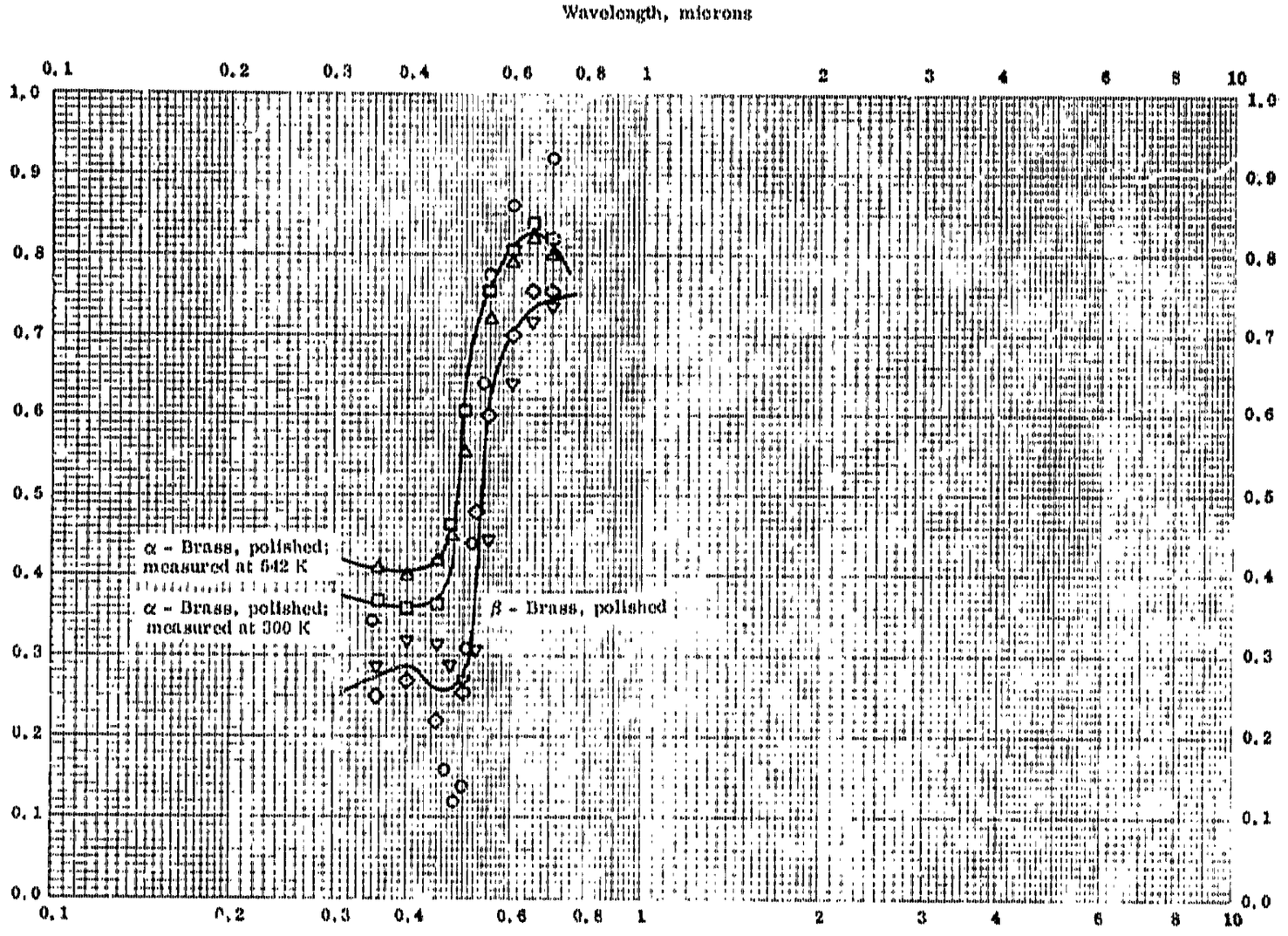


NORMAL TOTAL EMITTANCE -- COPPER + ZINC

NORMAL TOTAL EMITTANCE -- COPPER + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
△	58-23	450-589		Brass.	Oxidized.
□	47-5	373		Brass.	Polished.



ANGULAR SPECTRAL REFLECTANCE -- COPPER + ZINC

Angular Spectral Reflectance

TPRC

ANGULAR SPECTRAL REFLECTANCE -- COPPER + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. °K	Wavelength Range, μ	Rept. Error%	Sample Specifications	Remarks
○	61-24	298	0.35-0.70		β-brass; film 0.2μ thick.	Vacuum evaporated on glass; 45 degree illumination, 45 degree viewing; data extracted from smooth curve.
△	57-46	542	0.3575-0.700		α-brass.	Polished; 18 degree illumination, hemispherical viewing; measured in dry nitrogen atmosphere.
□	57-46	300	0.3575-0.700		α-brass.	The above specimen measured at room temperature after the elevated temperature run; 18 degree illumination, hemispherical viewing.
▽	57-46	548	0.356-0.700		β-brass.	Polished; 18 degree illumination, hemispherical viewing; measured in dry nitrogen atmosphere.
◇	57-46	300	0.356-0.700		β-brass.	The above specimen measured at room temperature after the elevated temperature run; 18 degree illumination hemispherical viewing.

PROPERTIES OF COPPER + ZIRCONIUM

REPORTED VALUES

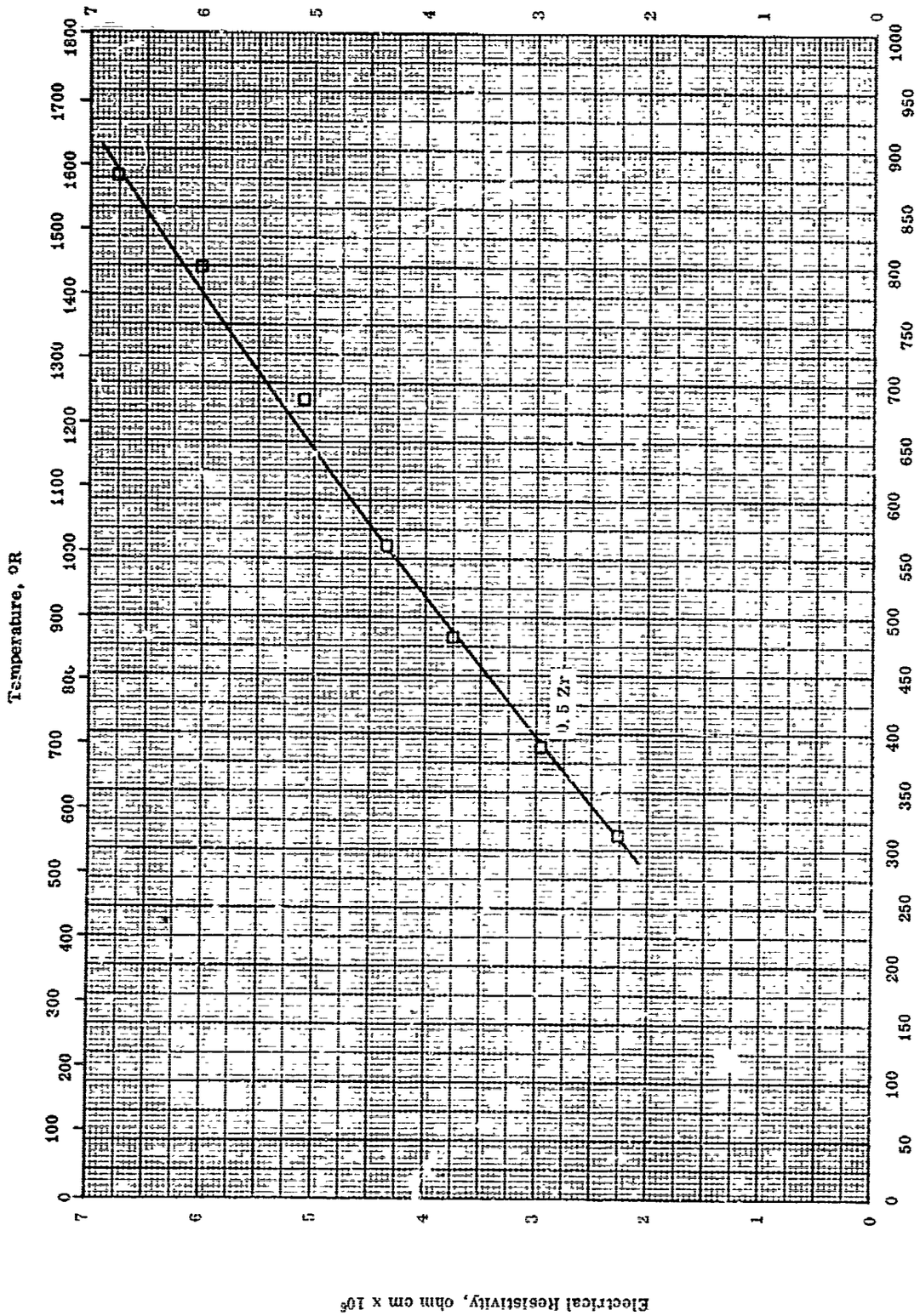
Density:	g cm^{-3}	lb ft^{-3}
O 0.8 Zr	8.81	550

PROPERTIES OF COPPER + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repl. Error %	Sample Specifications	Remarks
O	57-44	298		0.8 Zr; prepared from electrolytic Cu and pure Zr sponge.	Vacuum melted cast, pressed at 750 C, annealed 2 hrs at 650 C, furnace cooled, again annealed, and water quenched.

TPRC



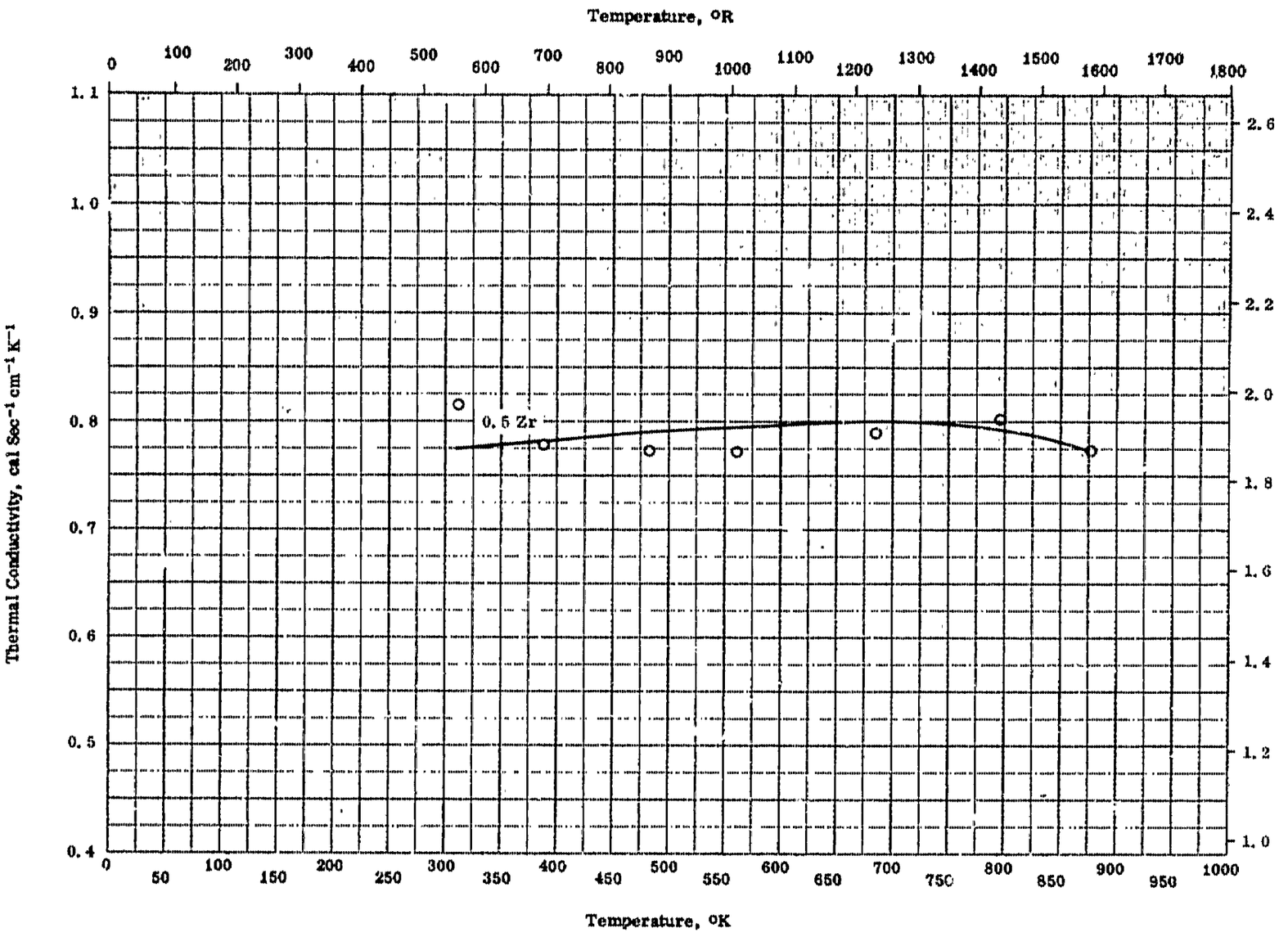
ELECTRICAL RESISTIVITY -- COPPER + ZIRCONIUM

ELECTRICAL RESISTIVITY -- COPPER + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-6	313-879		0.5 Zr.	Normalized.

TPRC



THERMAL CONDUCTIVITY -- COPPER + ZIRCONIUM

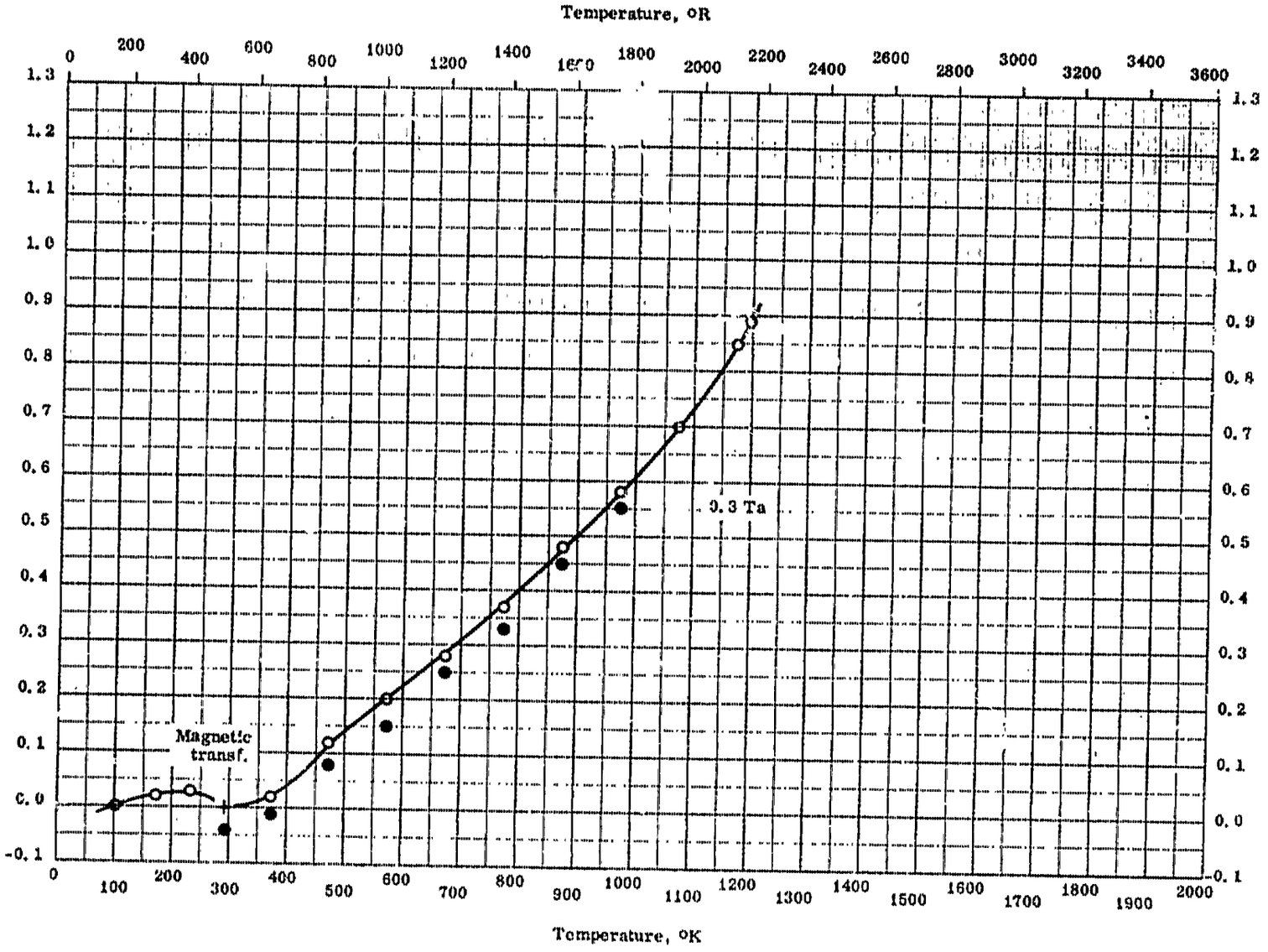
TPRC

THERMAL CONDUCTIVITY -- COPPER + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-6	313-879		0.5 Zr.	Normalized.

TPRC



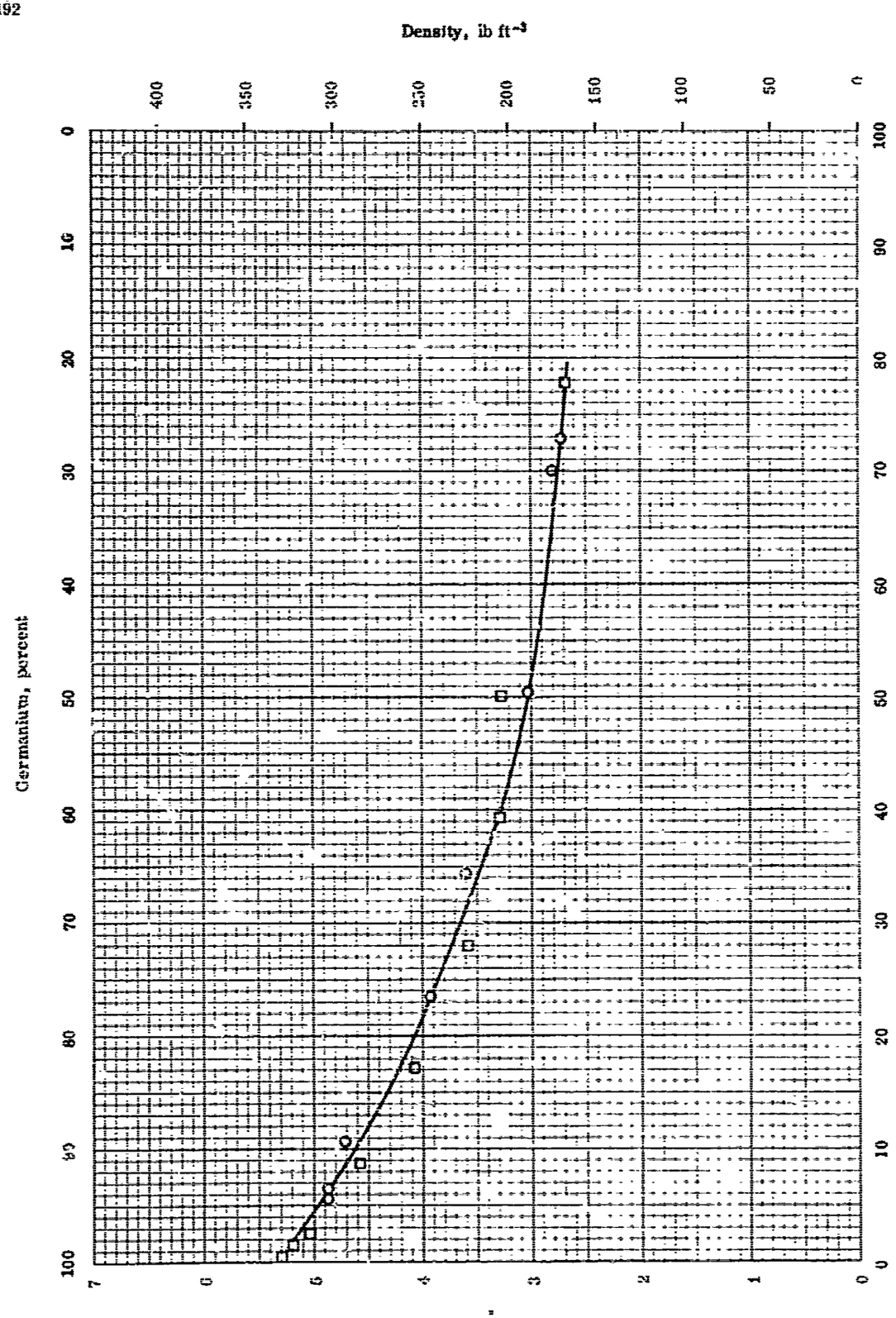
THERMAL LINEAR EXPANSION — GADOLINIUM + TANTALUM

Thermal Linear Expansion, percent

THERMAL LINEAR EXPANSION -- GADOLINIUM + TANTALUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	56-42 also 57-51	103-1193	±1	99.5 pure, 0.3 Ta, 0.04 Ca, and 0.01 Si, Fe, Mg each.	Ca reduced the fluoride, vacuum cast, recast into rod; tested in He; heating
●	57-51	293-1193	±1	Same as above.	The above specimen, cooling.

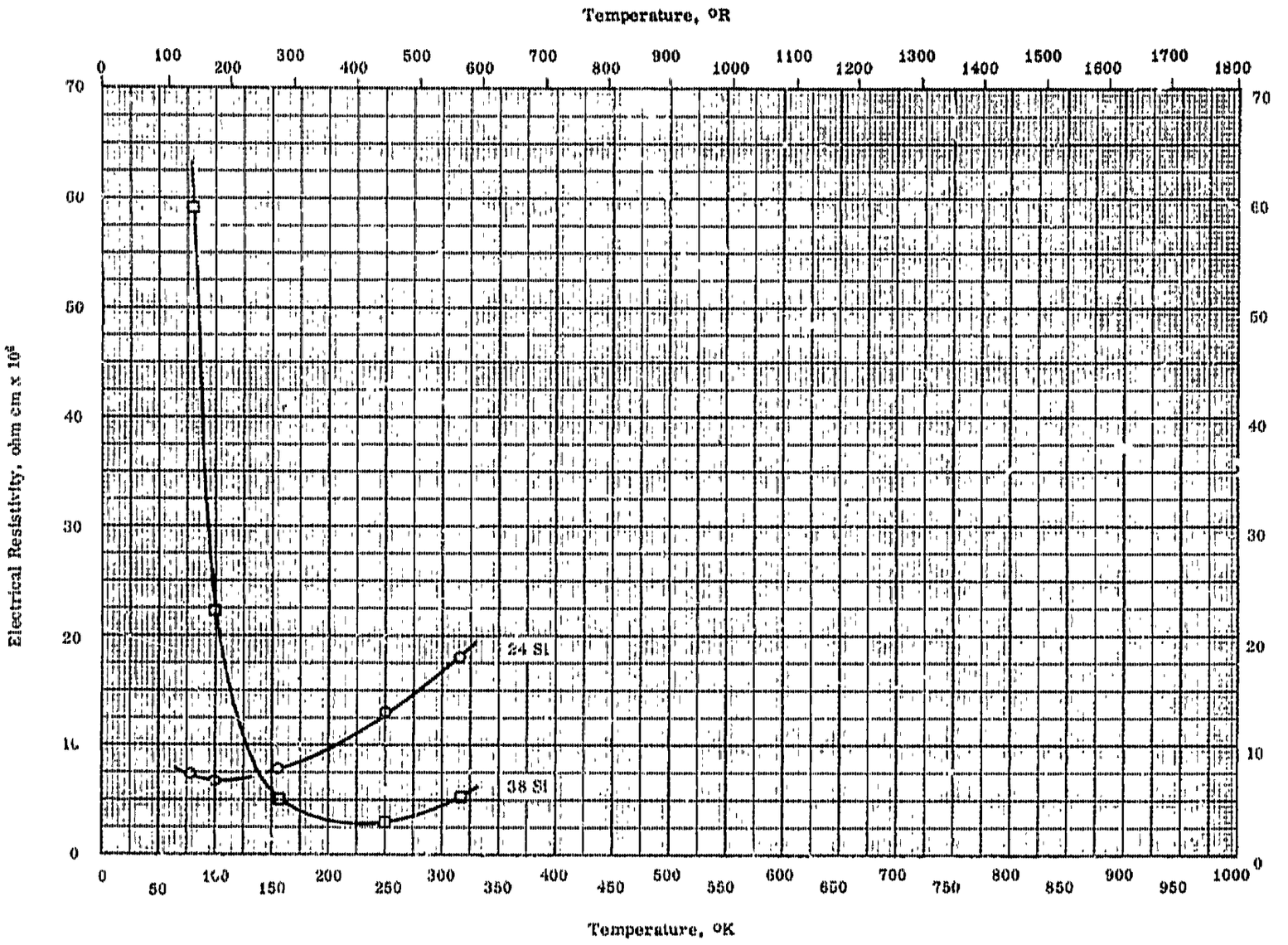


DENSITY -- GERMANIUM + SILICON

DENSITY -- GERMANIUM + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	55-26	298		From zone-refined Ge and by hyper-pure Si.	Prepared by isothermal solidification.
○	54-22	298			Author claim accuracy of a few percent.



ELECTRICAL RESISTIVITY — GERMANIUM + SILICON

Electrical Resistivity, ohm cm x 10⁶

ELECTRICAL RESISTIVITY — GERMANIUM + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-23	79-316		76 Ge and 24 Si.	
□	55-23	79-316		62.3 Ge and 37.7 Si.	

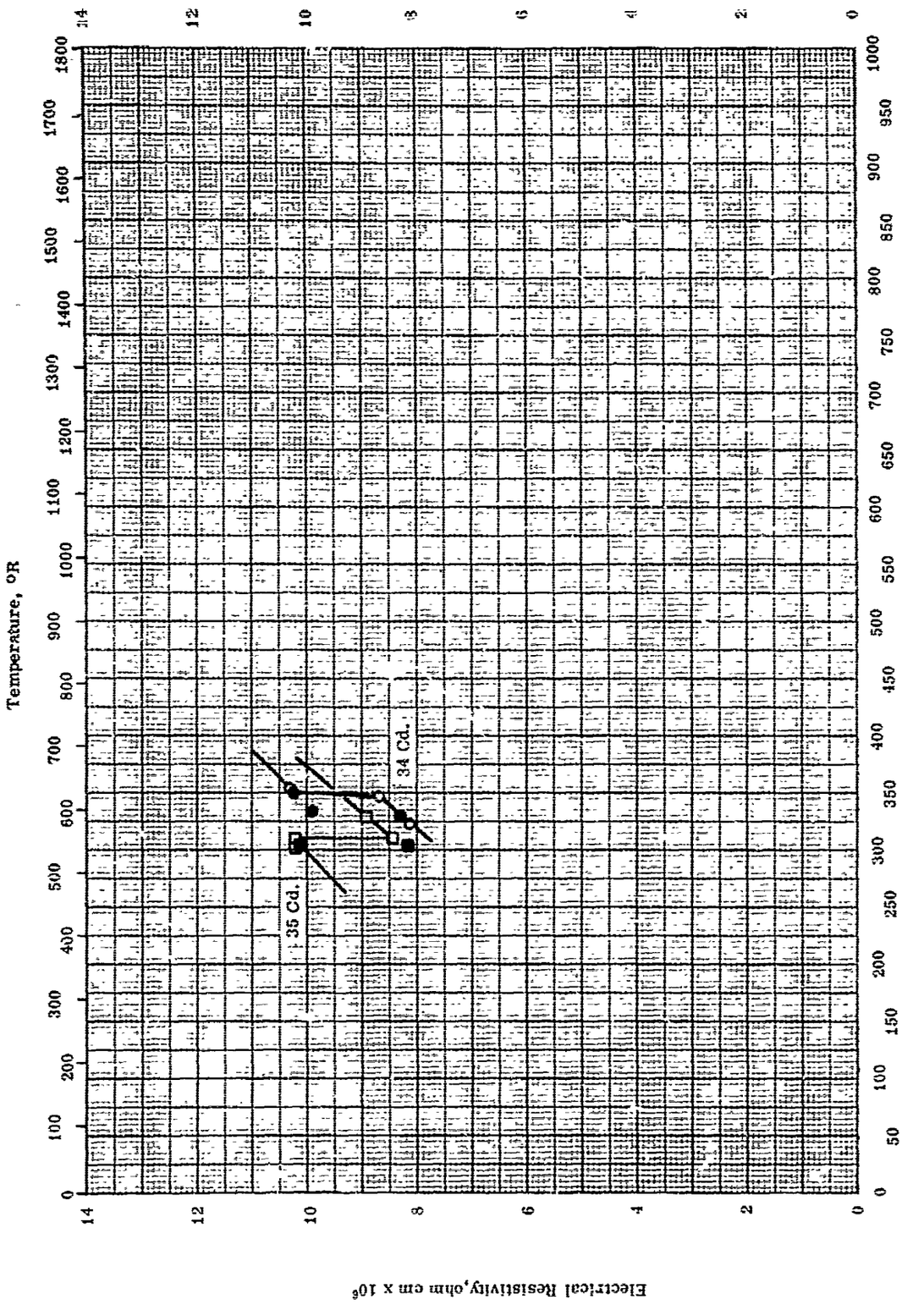
PROPERTIES OF GOLD + CADMIUM

REPORTED VALUES

Density		$g\ cm^{-3}$	$lb\ ft^{-3}$
○	35.4 – 36.5 Cd; cubic phase	13.96	871.5
□	35.4-36.5 Cd; tetragonal phase	14.49	904.6
△	35.4 Cd	13.911	868.44
Melting Point		K	R
◇	36.3 Cd	900	162
Heat of Fusion		$cal\ g^{-1}$	$Btu\ lb^{-1}$
▽	36.3 Cd	13.8 ± 0.8	24.9 ± 1.4

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repl. Error %	Sample Specifications	Remarks
○	54-17	298		35.4-36.6 Cd; cubic phase.	Density by pycnometer.
□	54-17	328		35.4-36.6 Cd; tetragonal phase.	Same as above.
△	57-39	298		36.4 Cd.	Quenched from 500 C; density by weight in air and and in acetylene tetrabromide.
◇	43-4	900		36.3 Cd; β-phase.	
▽	43-4	900		36.3 Cd; β-phase.	Δh_f from enthalpy above and below M.P.



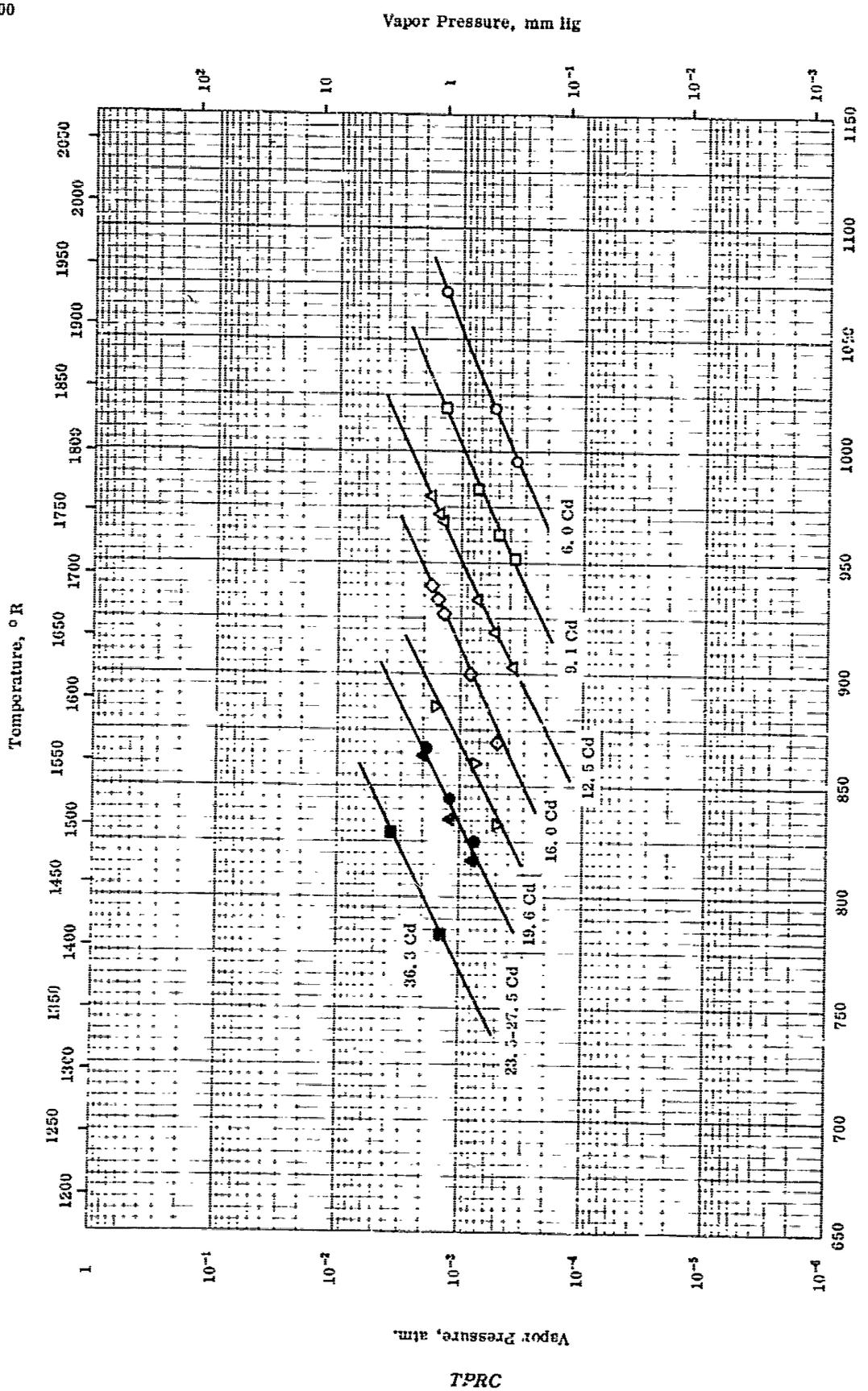
ELECTRICAL RESISTIVITY -- GOLD + CADMIUM

ELECTRICAL RESISTIVITY -- GOLD + CADMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	54-17	323-353		65.97 Au and 34.03 Cd; single crystal prepared from 99.95 Au and 99.99 Cd.	Vacuum-melted and grown into single crystal; measured heating.
●	54-17	323-353		Same as above.	Same as above except measured cooling.
□	54-17	301-333		64.61 Au and 35.39 Cd; same as above.	Same as above except data reported for third run; measured heating
■	54-17	301-333		Same as above.	Same as above; measured cooling.

TPRC



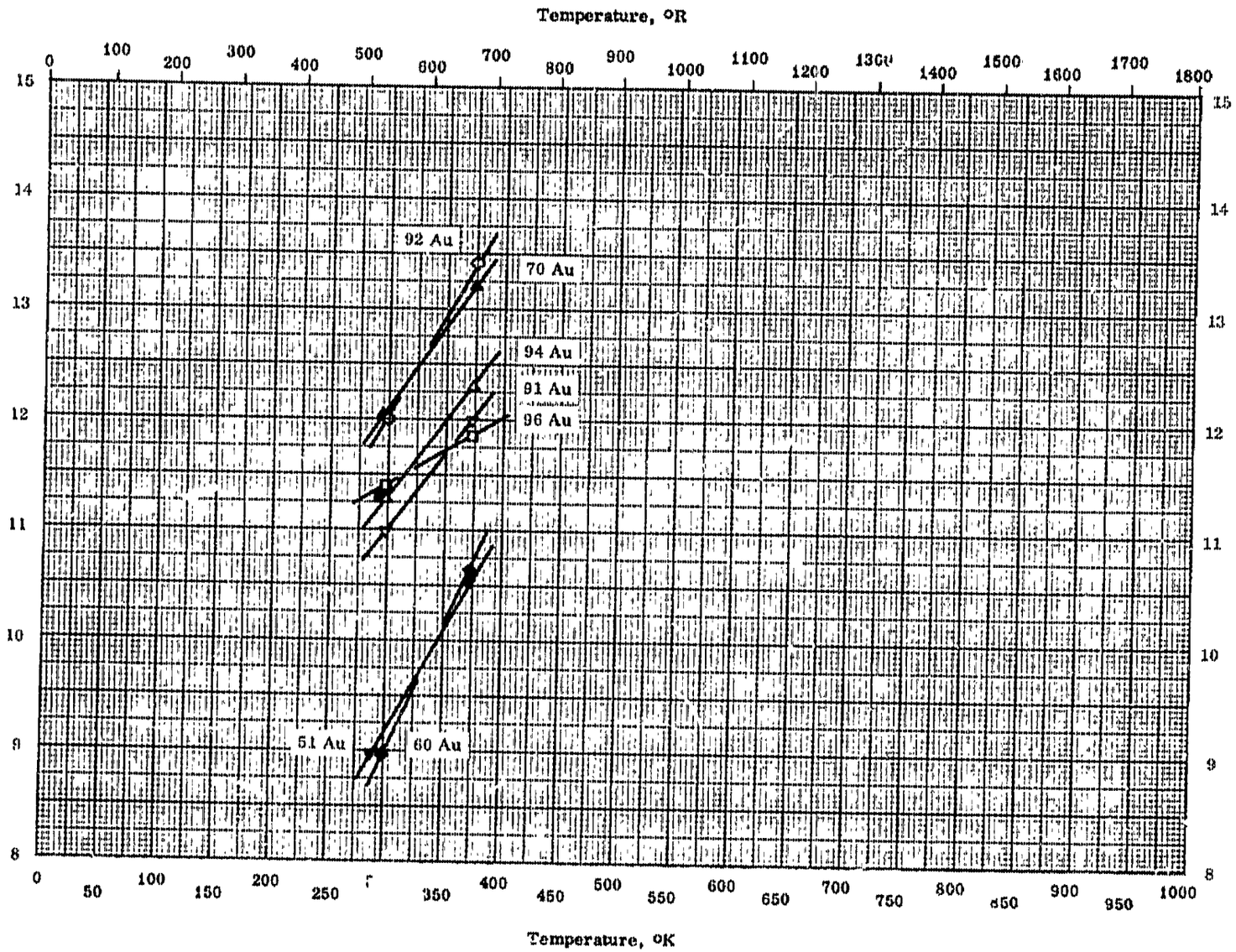
VAPOR PRESSURE -- GOLD + CADMIUM

VAPOR PRESSURE -- GOLD + CADMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-9	996-1073		6.0 Cd; α-phase.	Data are pressure of Cd vapor over the alloy.
□	55-9	996-1073		9.1 Cd; α-phase.	Same as above.
△	55-9	996-1073		12.5 Cd; α-phase.	Same as above.
◇	55-9	996-1073		16.0 Cd; α-phase.	Same as above.
▽	55-9	996-1073		19.6 Cd; α-phase.	Same as above.
●	55-9	996-1073		23.5 Cd; α-phase.	Same as above.
▲	55-9	996-1073		27.5 Cd; α + β phase.	Same as above.
■	55-9	996-1073		30.3 Cd; β-phase.	Same as above.

TPRC



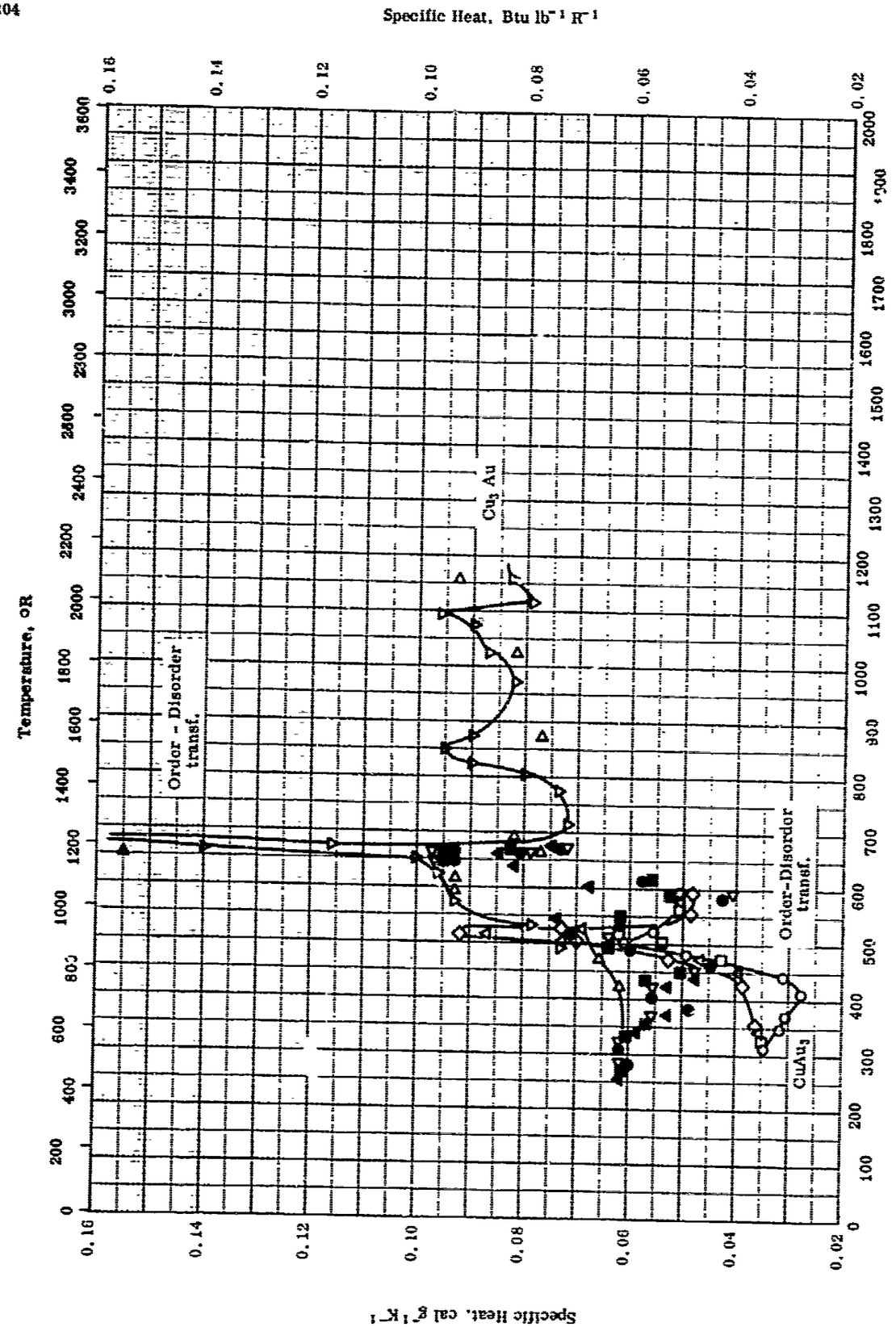
TPRC

ELECTRICAL RESISTIVITY -- GOLD + COBALT

ELECTRICAL RESISTIVITY -- GOLD + COBALT

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-33	298-373		96.0 Au, and 4.0 Co; initial elements 99.99 pure.	Sample prepared by sucking liquid alloy into a porcelain tube.
△	56-33	298-373		93.6 Au, and 6.4 Co; same as above.	Same as above.
◇	56-33	298-373		92.0 Au, and 8.0 Co; same as above.	Same as above.
▽	56-33	298-373		91.2 Au, and 8.8 Co; same as above.	Same as above.
■	56-33	298-373		80.0 Au, and 20.0 Co; same as above.	Same as above.
▲	56-33	298-373		70.2 Au, and 29.8 Co; same as above.	Same as above.
◆	56-33	298-373		60.0 Au, and 40.0 Co; same as above.	Same as above.
▼	56-33	298-373		51.2 Au, and 48.8 Co; same as above.	Same as above.

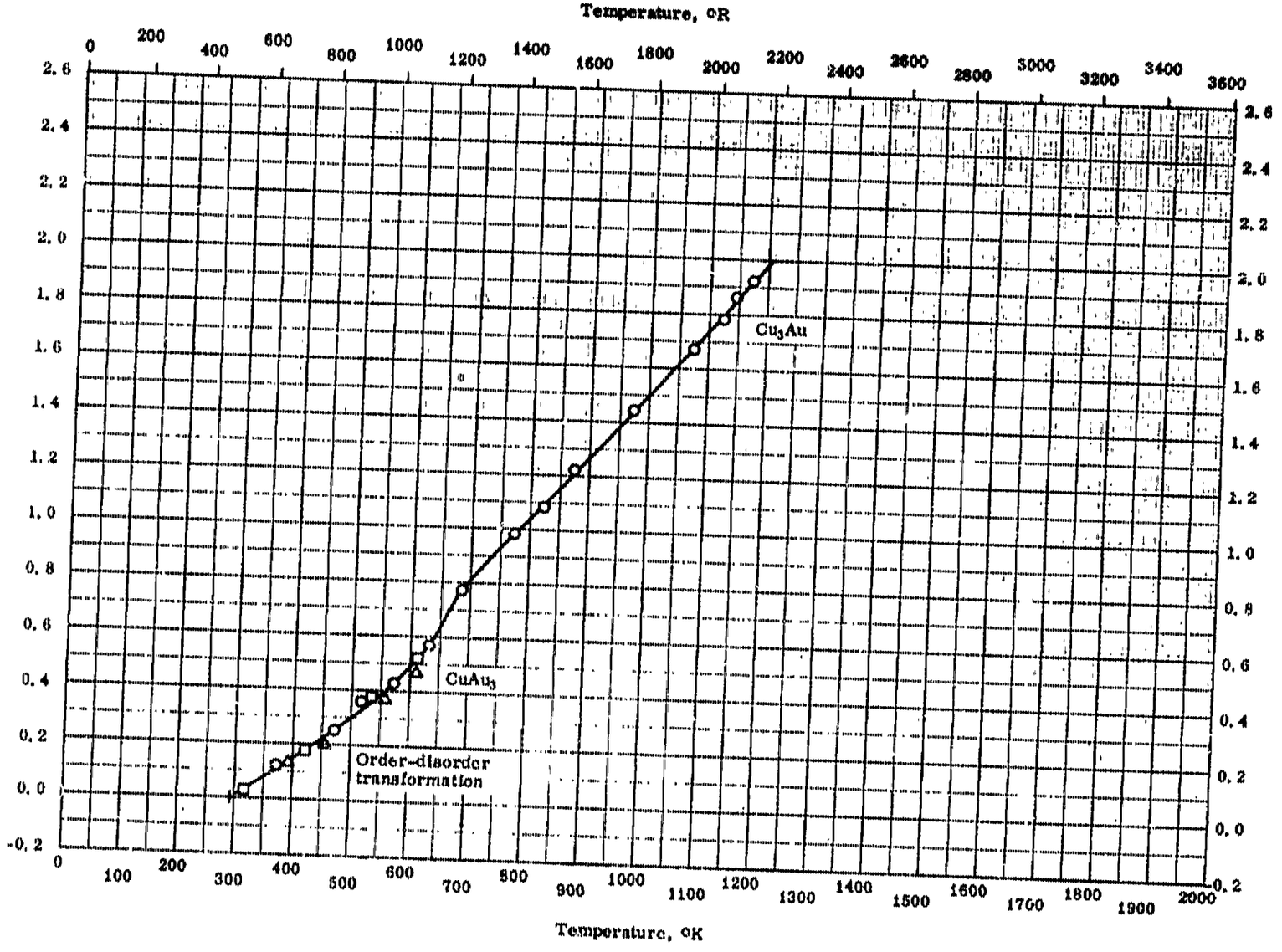


SPECIFIC HEAT -- GOLD + COPPER

SPECIFIC HEAT -- GOLD + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	51-9 also 52-7	313-573		Cu Au_3; 89.8 Au and 10.2 Cu.	Reheated slowly after water quenched from 600 C.
□	51-9 also 52-7	313-573		Same as above.	Air cooled before reheating.
△	51-9 also 52-7	313-573		Same as above.	Annealed 180 C for several days.
◇	51-9 also 52-7	313-573		Same as above.	Same as above.
▽	56-14	493-1173		Cu_3Au; 50.7 Au and 49.3 Cu; made from 99.98 Au and 99.97 Cu.	Swaged into rods and heat treated just below melting point for 10 days.
▷	57-15	288-1158		Cu_3Au; 50.7 Au and 49.3 Cu; ordered.	Annealed 3 weeks at 420-200 C.
◁	57-15	288-1158		Same as above.	Quenched from 530 C.
●	57-15	288-1158		Same as above.	Quenched from 600 C.
■	57-15	288-1158		Same as above.	Quenched from 670 C.
▲	57-15	288-1158		Same as above.	Quenched from 790 C.



THERMAL LINEAR EXPANSION -- GOLD + COPPER

THERMAL LINEAR EXPANSION -- GOLD + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-41	293-1173		Cu_3Au; 50.8 Au and 49.2 Cu; prepared from 99.986 Au and 99.97 Cu.	Melted in evacuated quartz tube from Au and Cu; swaged into rods and then heat treated 10 days just below melting point.
□	52-7	293-613		$CuAu_3$; 90 Au and 10 Cu.	Annealed 14 days at 180 C.
△	52-7	293-613		Same as above.	Water quenched from 400 C.

PROPERTIES OF GOLD + IRON

REPORTED VALUES

Density:	g cm^{-3}	lb ft^{-3}
O 9.86 Fe	16.29	1017

PROPERTIES OF GOLD + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	43-5	298		90.14 Au and 9.86 Fe.	Fe added to melted Au in H_2 atm; cast; remelted, and quenched from 850 C.

PROPERTIES OF GOLD + MANGANESE

REPORTED VALUES

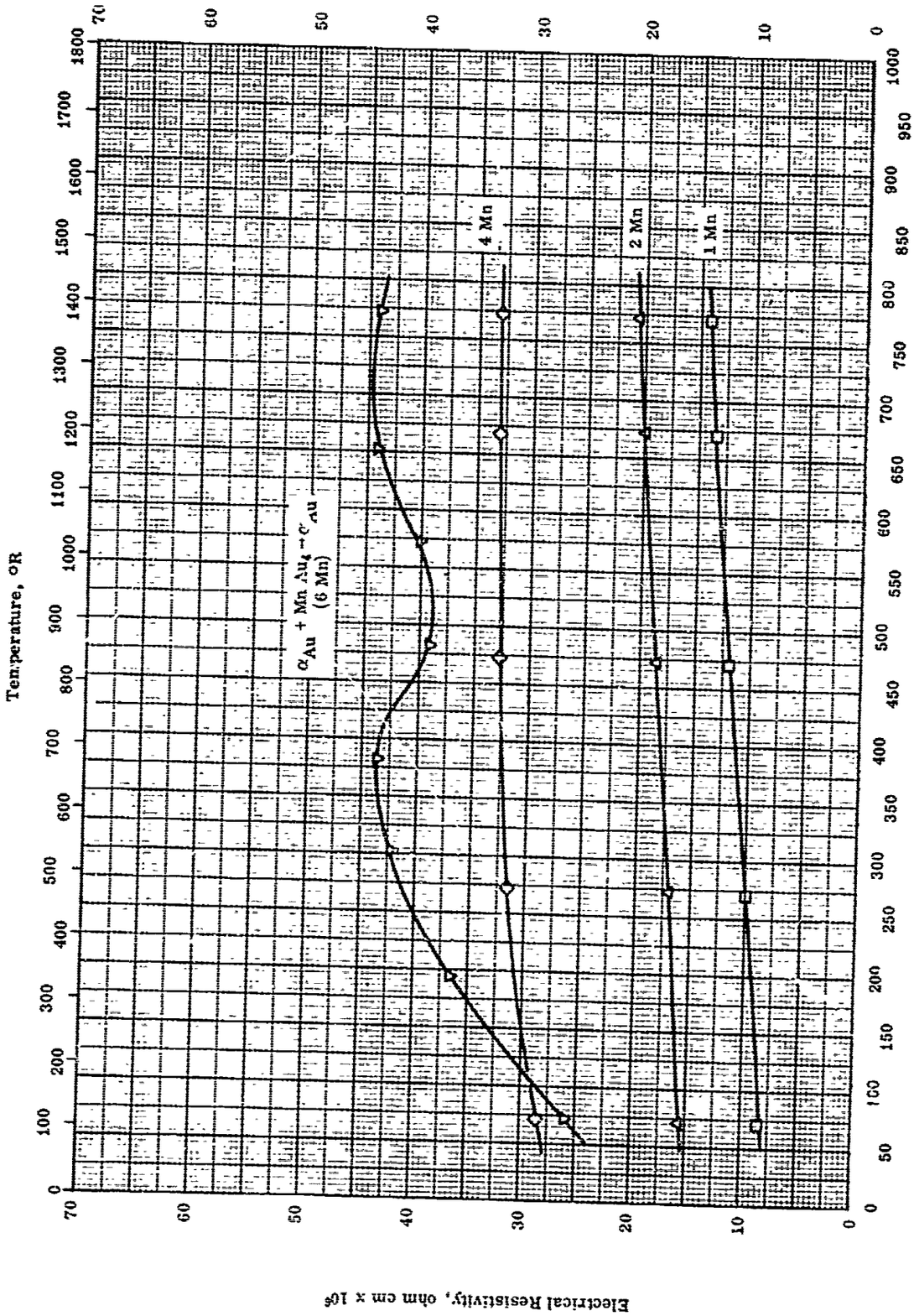
Density	g cm^{-3}	lb ft^{-3}
O 8.59Mn	15.86	990

PROPERTIES OF GOLD + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	43-5	298		91.41 Au and 8.59 Mn.	Mn added to melted Au in H_2 atm; cast, remelted, and quenched from 850 C.

TPRC



ELECTRICAL RESISTIVITY -- GOLD + MANGANESE

ELECTRICAL RESISTIVITY -- GOLD + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-26	73-773		1.00 Mn; prepared from 99.99 pure raw materials.	Heated to 100 C above MP in vacuum, homogenized 24 hrs at 900 C, swaged, and annealed 1 hr at 500 C.
△	56-26	73-773		2.00 Mn; raw materials same as above.	Same as above.
◇	56-26	73-773		4.00 Mn; raw materials same as above.	Same as above.
▽	56-26	73-773		6.00 Mn; raw materials same as above.	Same as above.

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PROPERTIES OF GOLD + NICKEL

REPORTED VALUES

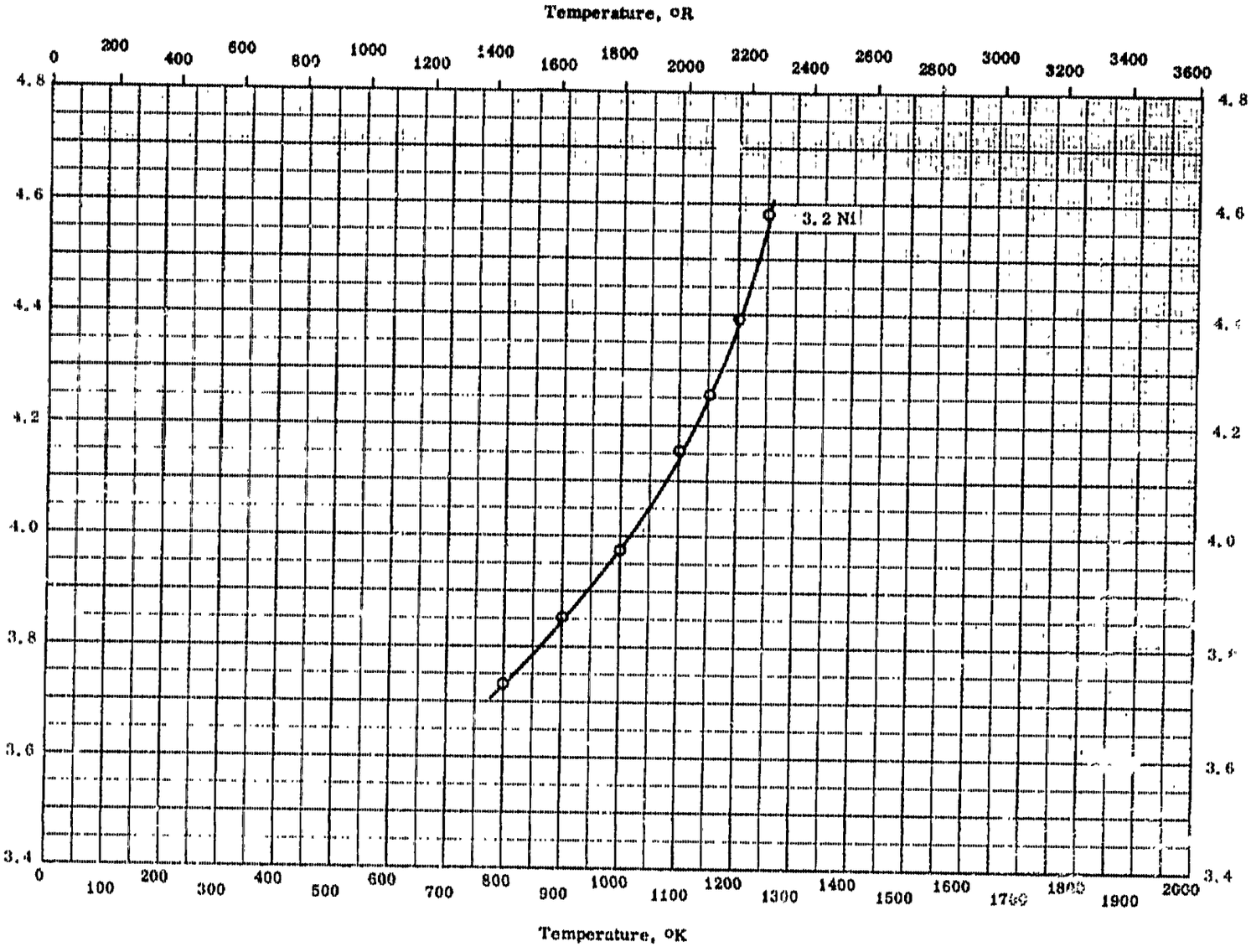
Density:	g cm^{-3}	lb ft^{-3}
○ 5.13 Ni	18.07	1128
□ 10.26 Ni	17.06	1065

PROPERTIES OF GOLD + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	43-5	298		94.87 Au and 5.13 Ni.	Ni added to melted Au in H_2 atm ; cast, remelted, and quenched from 850 C.
□	43-5	298		89.74 Au and 10.26 Ni.	Same as above.

TPRC



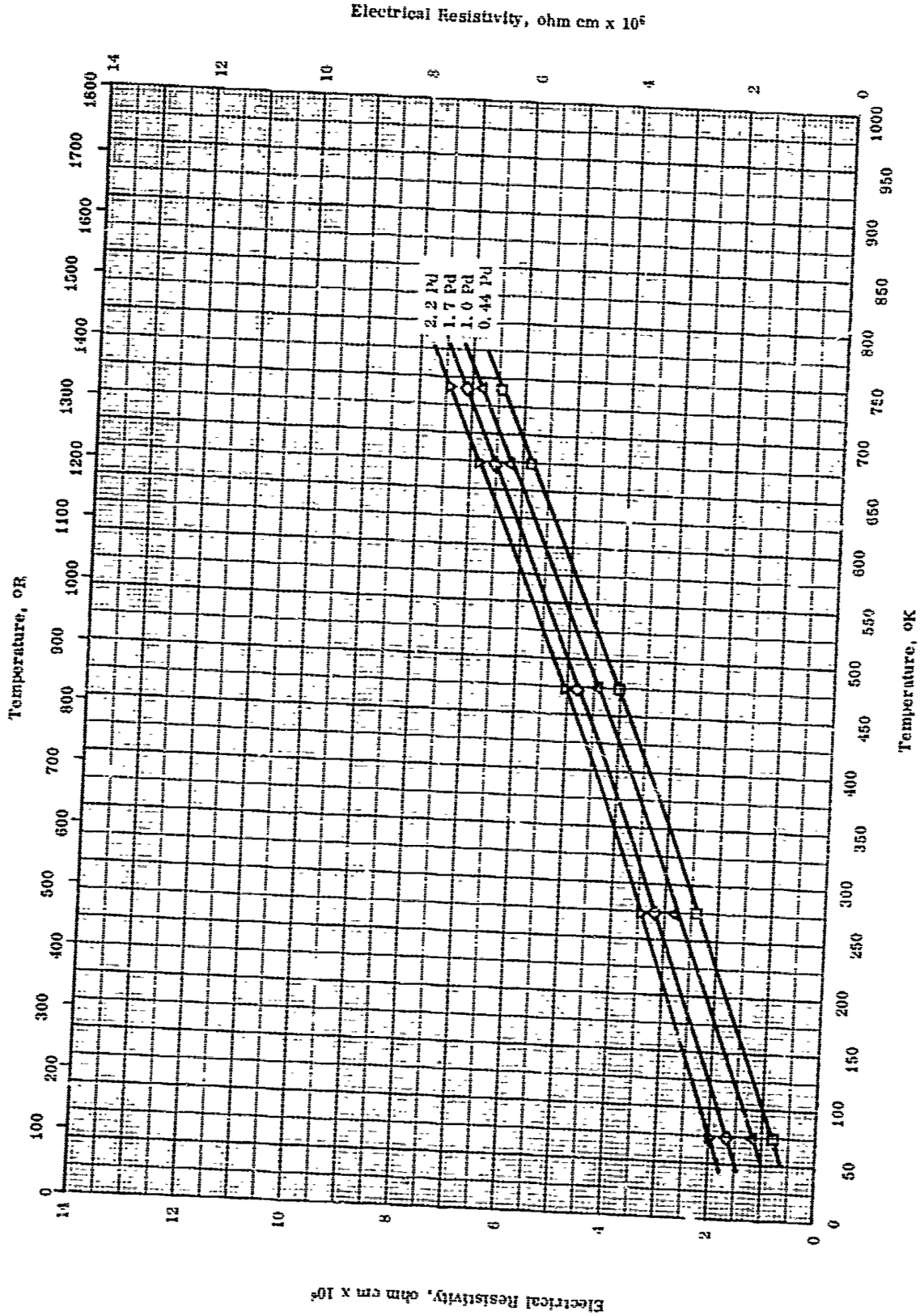
SPECIFIC HEAT -- GOLD + NICKEL

SPECIFIC HEAT -- GOLD + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-13	800-1250		$Au_{0.90}Ni_{0.10}$: 96.8 Au, 3.2 Ni; prepared from 99.95 Au and Ni.	Homogenized for more than 1 week above 50 C.

TPRC



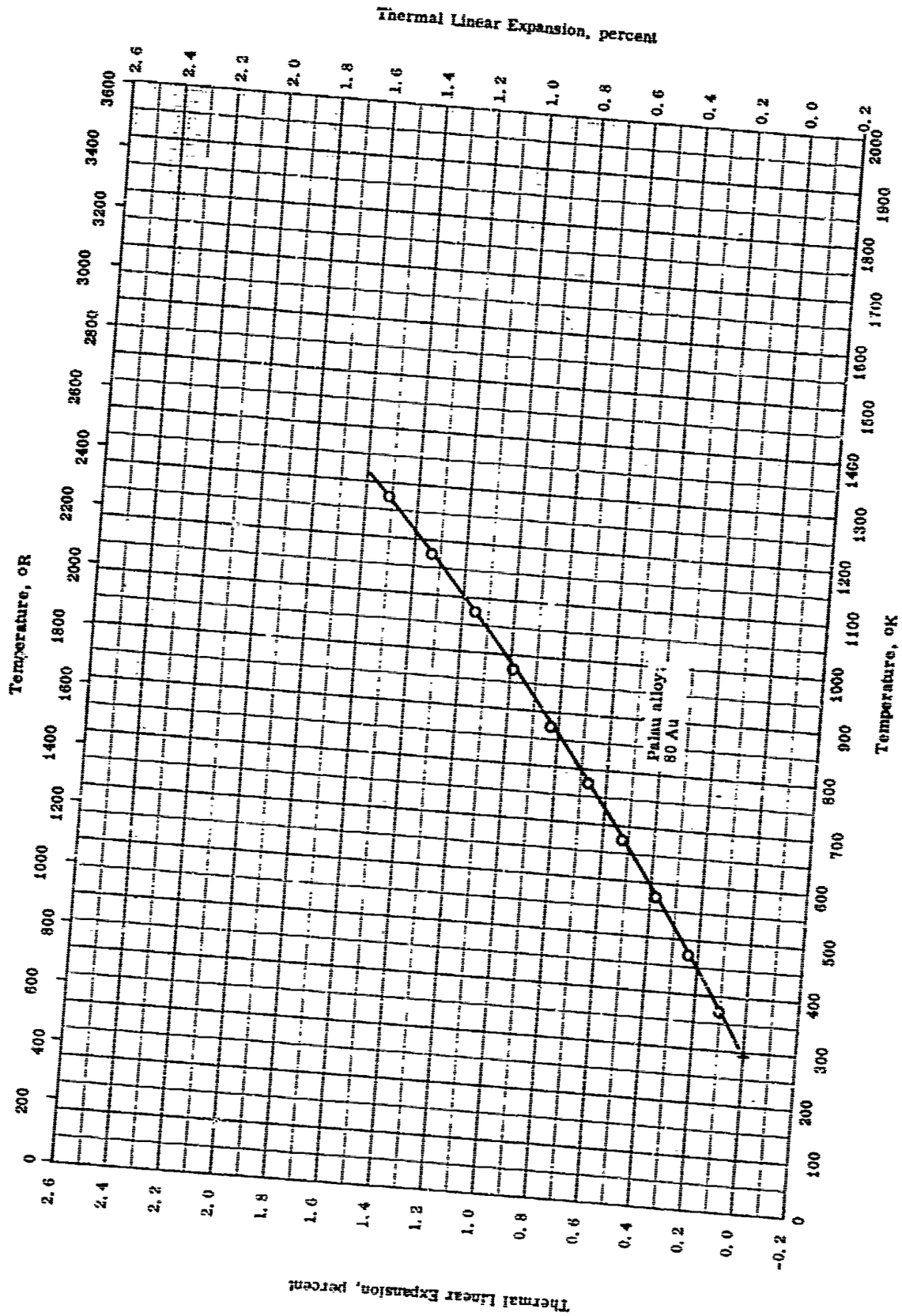
ELECTRICAL RESISTIVITY — GOLD + PALLADIUM

ELECTRICAL RESISTIVITY — GOLD + PALLADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-26	73-1073		0.44 Pd, prepared from 99.99 pure raw materials.	Heated to 100 C above MP, homogenized 24 hrs at 900 C, swaged, annealed 1 hr at 500 C.
△	56-26	73-1073		1.0 Pd, raw materials same as above.	Same as above.
◇	56-26	73-1073		1.7 Pd, raw materials same as above.	Same as above.
▽	56-26	73-1073		2.2 Pd, raw materials same as above.	Same as above.

TPRC

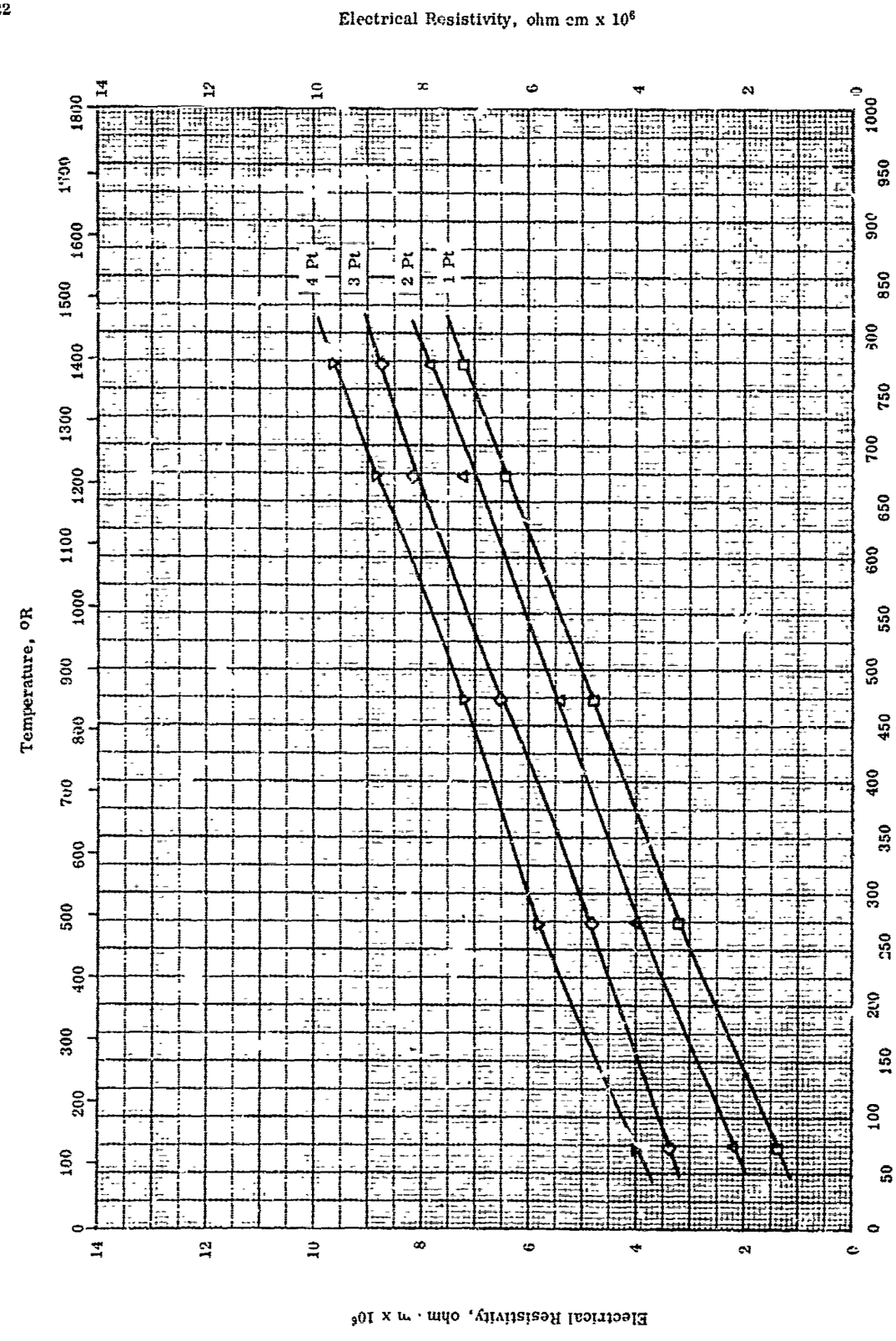


THERMAL LINEAR EXPANSION -- GOLD + PALLADIUM

THERMAL LINEAR EXPANSION -- GOLD + PALLADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	04-9	273-1273		Palau alloy: 80 Au and 20 Pd.	

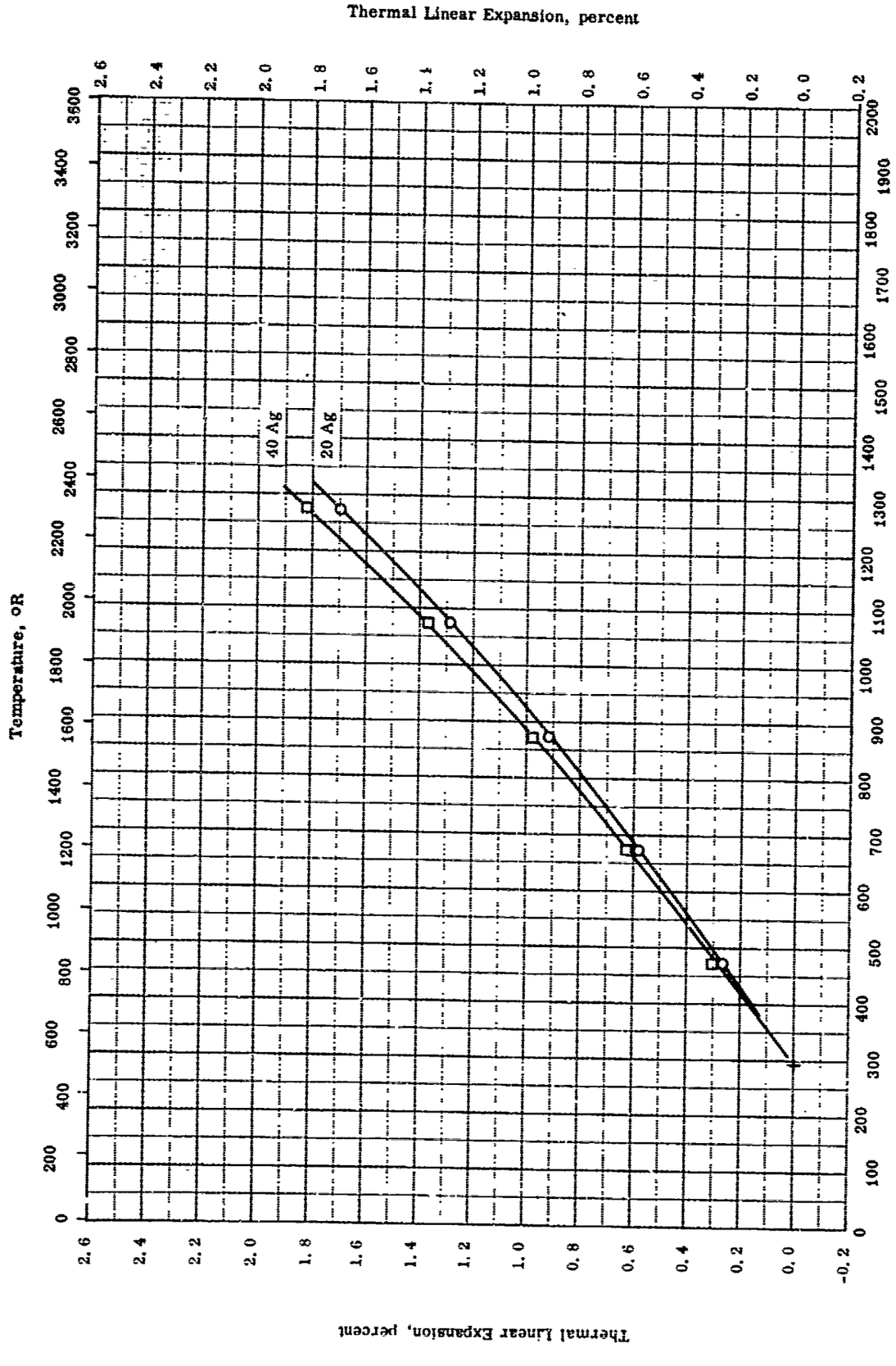


ELECTRICAL RESISTIVITY - GOLD - PLATINUM

ELECTRICAL RESISTIVITY -- GOLD + PLATINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-26	73-773		1.0 Pt; prepared from 99.99 pure metals.	Vacuum melted 100 C above MP from pure metals, homogenized 24 hrs at 900 C, swaged to 0.030 in. dia., and annealed 1 hr at 500 C.
△	56-26	73-773		2.00 Pt; same as above.	Same as above.
◇	56-26	73-773		3.1 Pt; same as above.	Same as above.
▽	56-26	73-773		4.0 Pt; same as above.	Same as above.

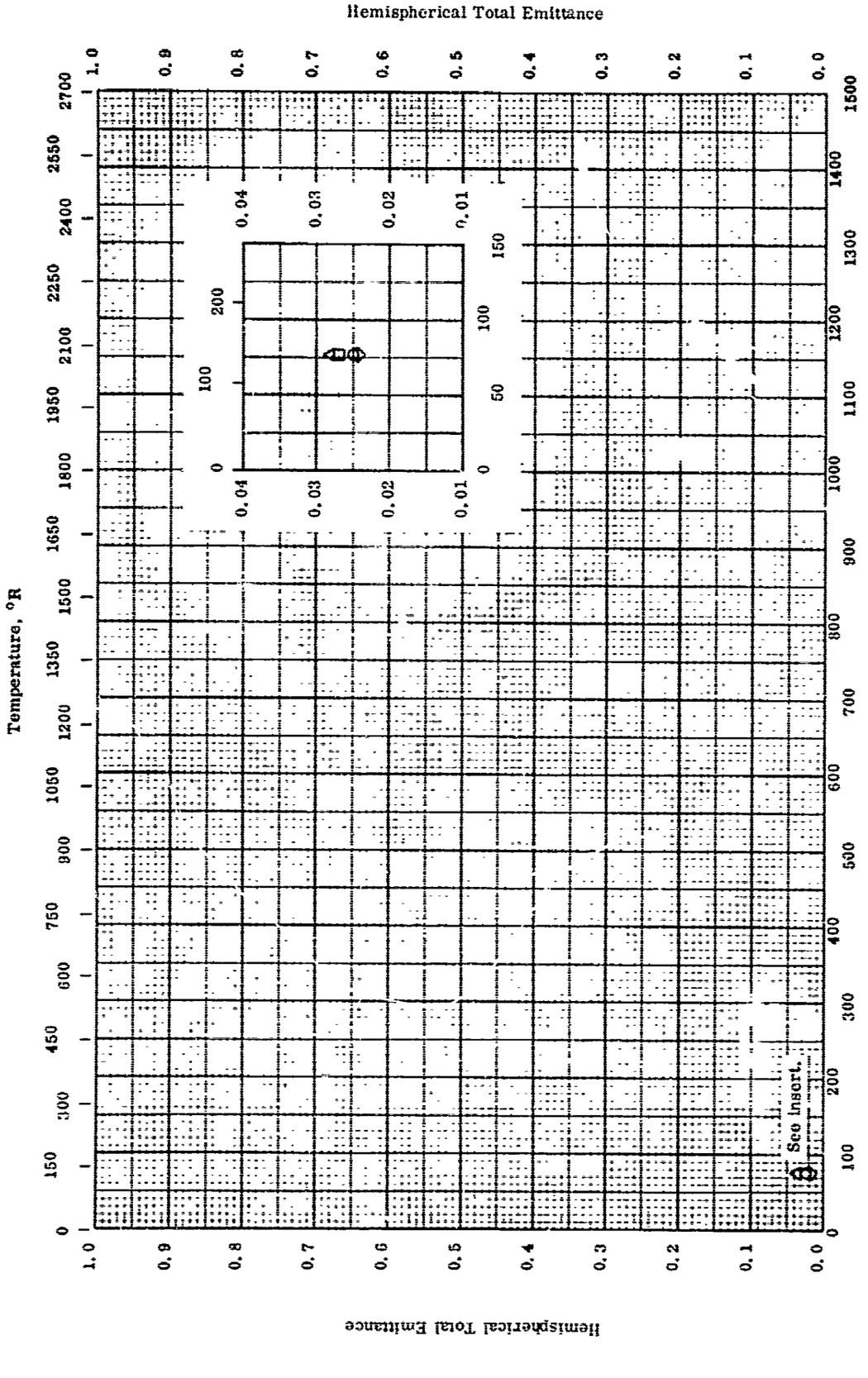


THERMAL LINEAR EXPANSION -- GOLD + SILVER

THERMAL LINEAR EXPANSION -- GOLD + SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	51-17	293-1273		80 Au and 20 Ag.	Homogenized.
□	51-17	293-1275		60 Au and 40 Ag.	Same as above.

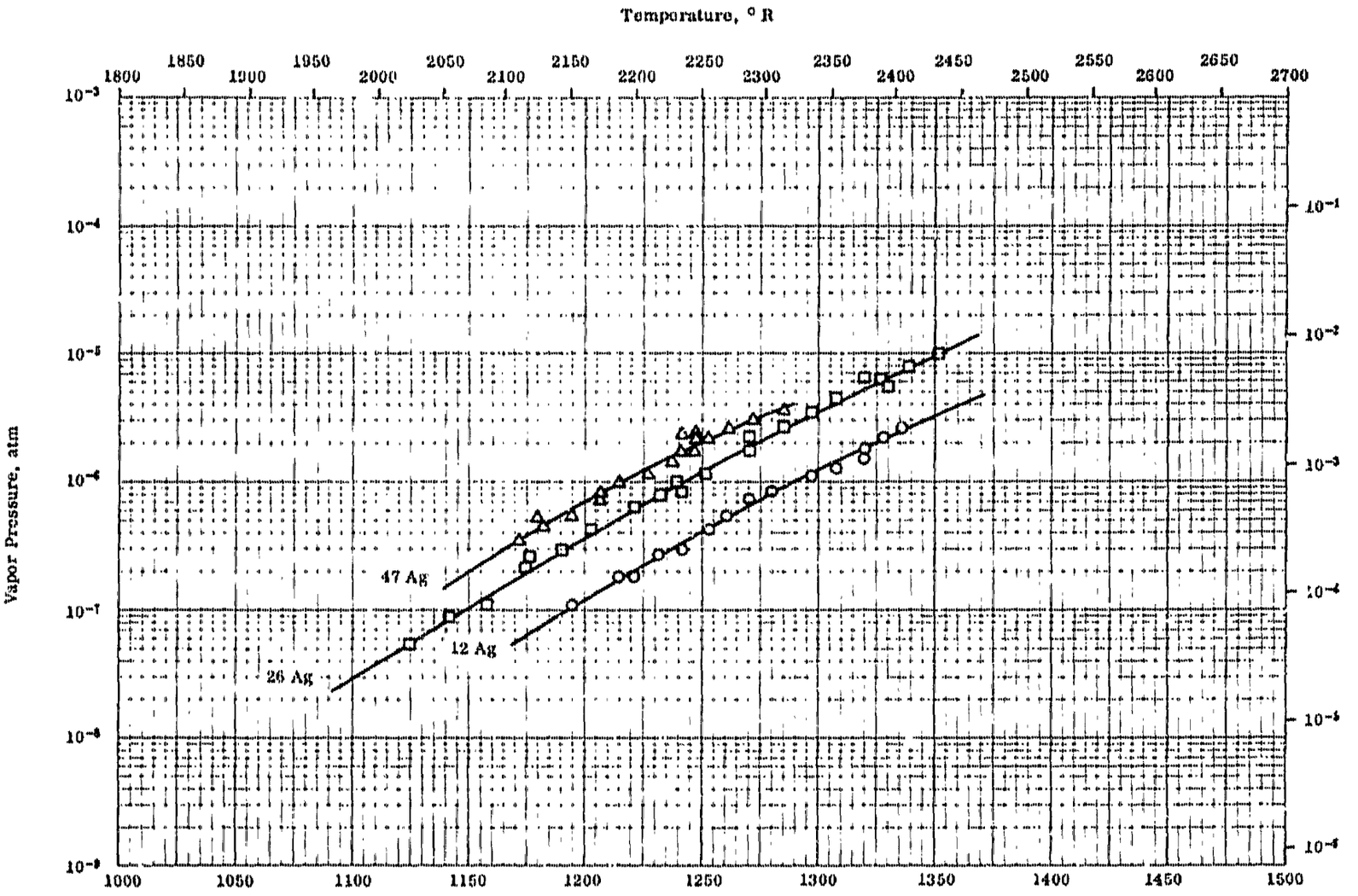


HEMISPHERICAL TOTAL EMITTANCE -- GOLD + SILVER

HEMISPHERICAL TOTAL EMITTANCE -- GOLD + SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	60-17	76	5	1 Ag.	0.0602 in. gold plated on stainless steel; emittance for 300 K black body radiation.
□	60-17	76	5	1 Ag.	0.0001 in. gold plated on stainless steel; emittance for 300 K black body radiation.
△	60-17	76	5	1 Ag.	0.00005 in. gold plated on stainless steel: emittance for 300 K black body radiation.
◇	60-17	76	5	1 Ag.	0.0002 in. gold plated on copper; emittance for 300 K black body radiation.



VAPOR PRESSURE -- GOLD + SILVER

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VAPOR PRESSURE -- GOLD + SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	53-10	1196-1336		88.3 Au and 11.7 Ag.	
□	53-10	1127-1364		74.2 Au and 25.8 Ag.	
△	53-10	1173-1285		52.8 Au and 47.2 Ag.	

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PROPERTIES OF GOLD + URANIUM

REPORTED VALUES

Density:	$g\ cm^{-3}$	$lb\ ft^{-3}$
O 9.32 U	18.60	1161

PROPERTIES OF GOLD + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	43-5	298		90.68 Au and 9.32 U.	U added to melted Au in H_2 atm; remelted, and quenched from 850 C.

PROPERTIES OF GOLD+ZINC

REPORTED VALUES

Melting Point	K	R
□ 24.9 Zn	1033	1860

Heat of Fusion	cal g^{-1}	Btu lb^{-1}
○ 24.9 Zn	22.4±1	40.3±1.8

PROPERTIES OF GOLD + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	43-4	1033		24.9 Zn; β - phase.	Δh_f from enthalpy data above and below M. P.
□	43-4	1033		24.9 Zn β- phase	

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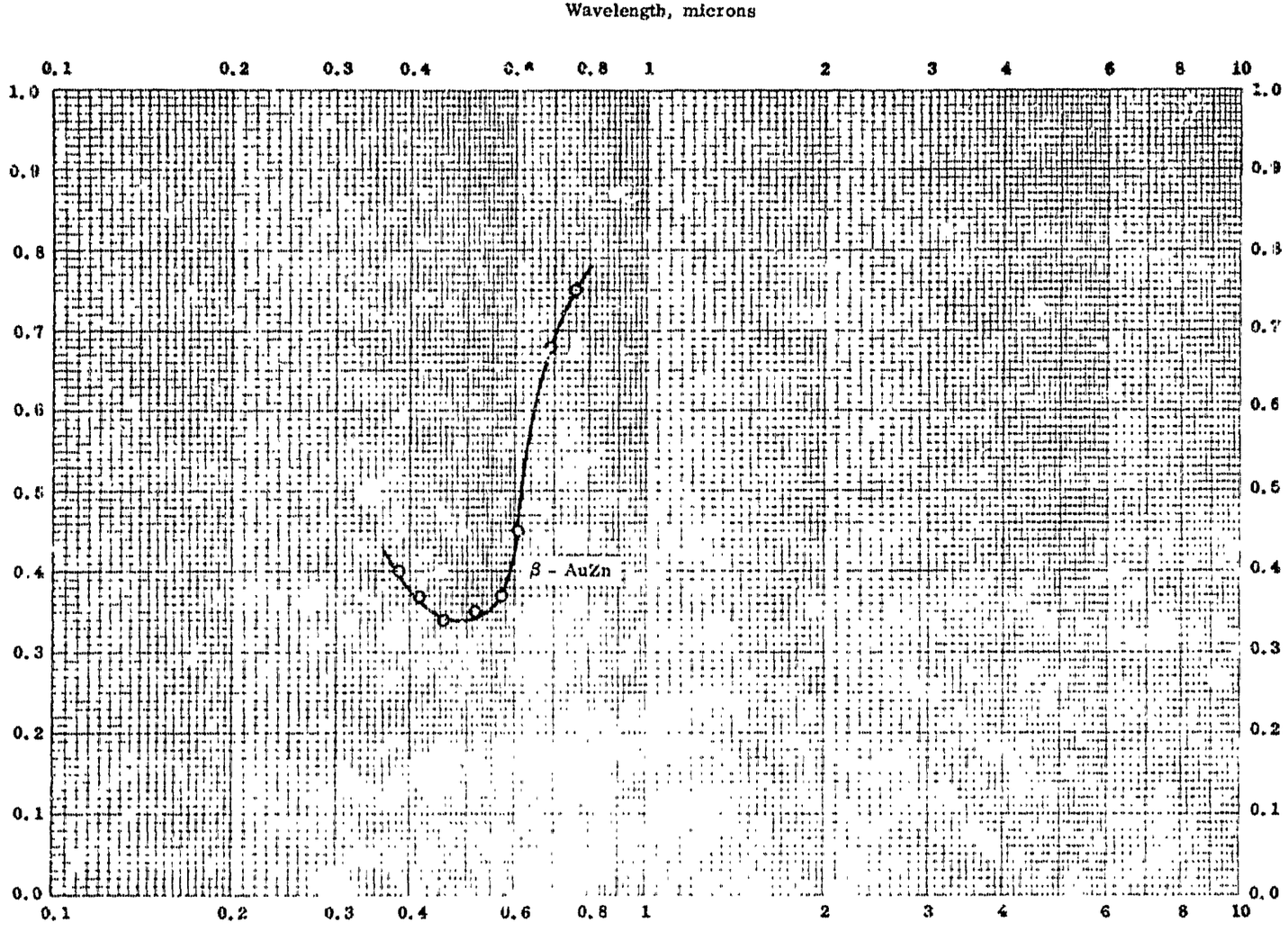
525



ANGULAR SPECTRAL REFLECTANCE -- GOLD + ZINC

Angular Spectral Reflectance

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ANGULAR SPECTRAL REFLECTANCE -- GOLD + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. °K	Wavelength Range, μ	Rept. Error%	Sample Specifications	Remarks
○	61-24	298	0.385-0.76		β - AuZn; 2000 Å film.	Vacuum evaporated on glass; 45 degree illumination and 45 degree viewing; data extracted from smooth curve.

PROPERTIES OF HAFNIUM + ZIRCONIUM

REPORTED VALUES

Density:	g cm^{-3}	lb ft^{-3}
○ 0.72 Zr	13.001 ± 0.005	811.6 ± 0.3
□ 0.72 Zr; density corrected	13.09 ± 0.01	817.2 ± 0.6
◇ 2 Zr	12.62	788
Melting Point:	**K**	**R**
△ 0.70 Zr	2248 ± 25	4047 ± 45

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	51-10	293		0.72 Zr, 0.068 Al, 0.043 O_2, 0.008 Si, 0.003 N_2, and 0.003 each of Ti and Fe.	Arc-melted, cold swaged (11% reductive), vacuum annealed at 1040 C.
□	51-10	293		Same as above.	Same as above except density corrected.
△	51-10	2222-2278		0.70 Zr, 0.018 Al, 0.015 Si, 0.006 Fe, and 0.003 > Ti; iodide crystal bar.	
◇	59-15	298		2 Zr.	Average of 3 samples.

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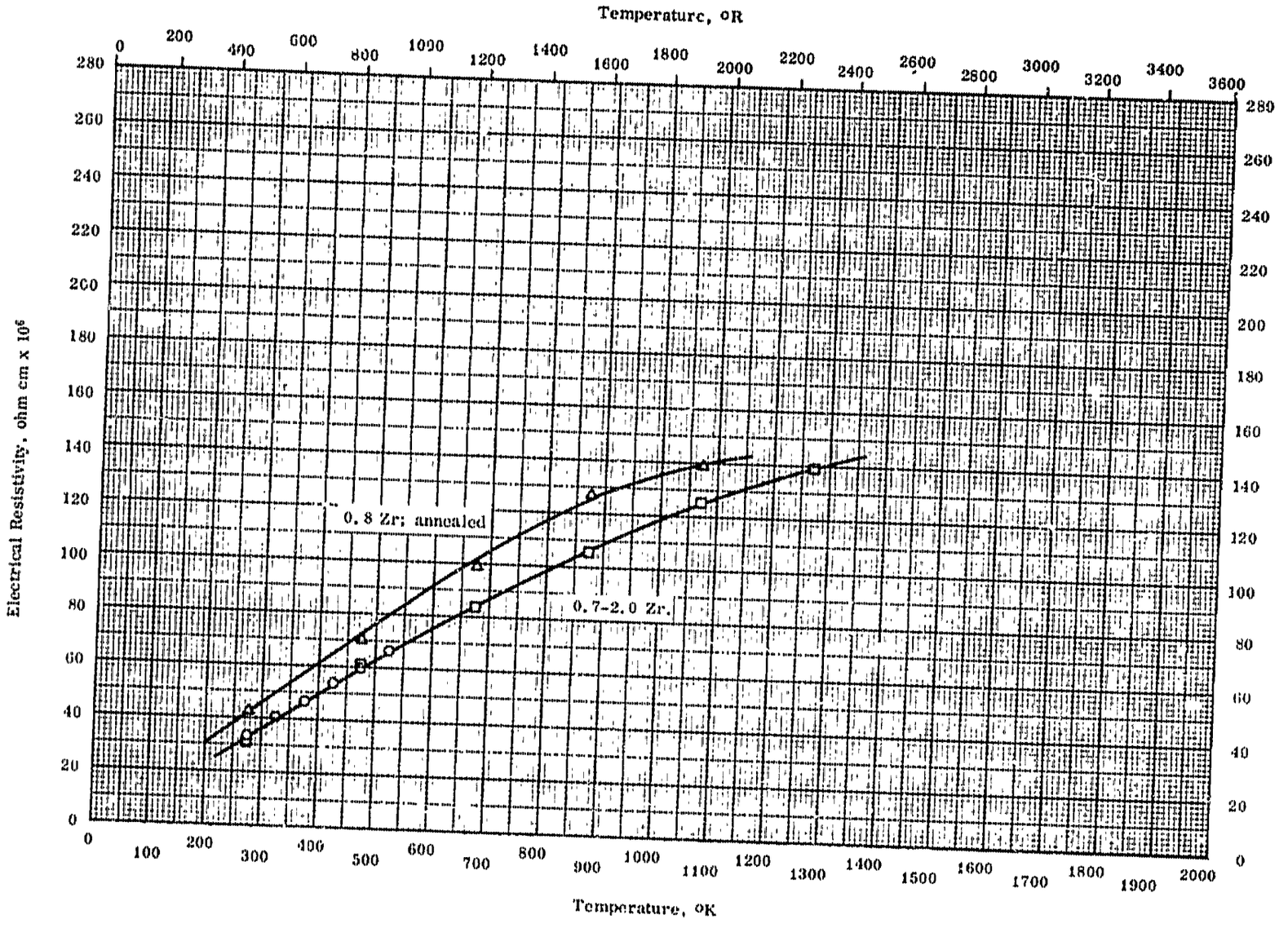

ELECTRICAL RESISTIVITY -- HAFNIUM + ZIRCONIUM

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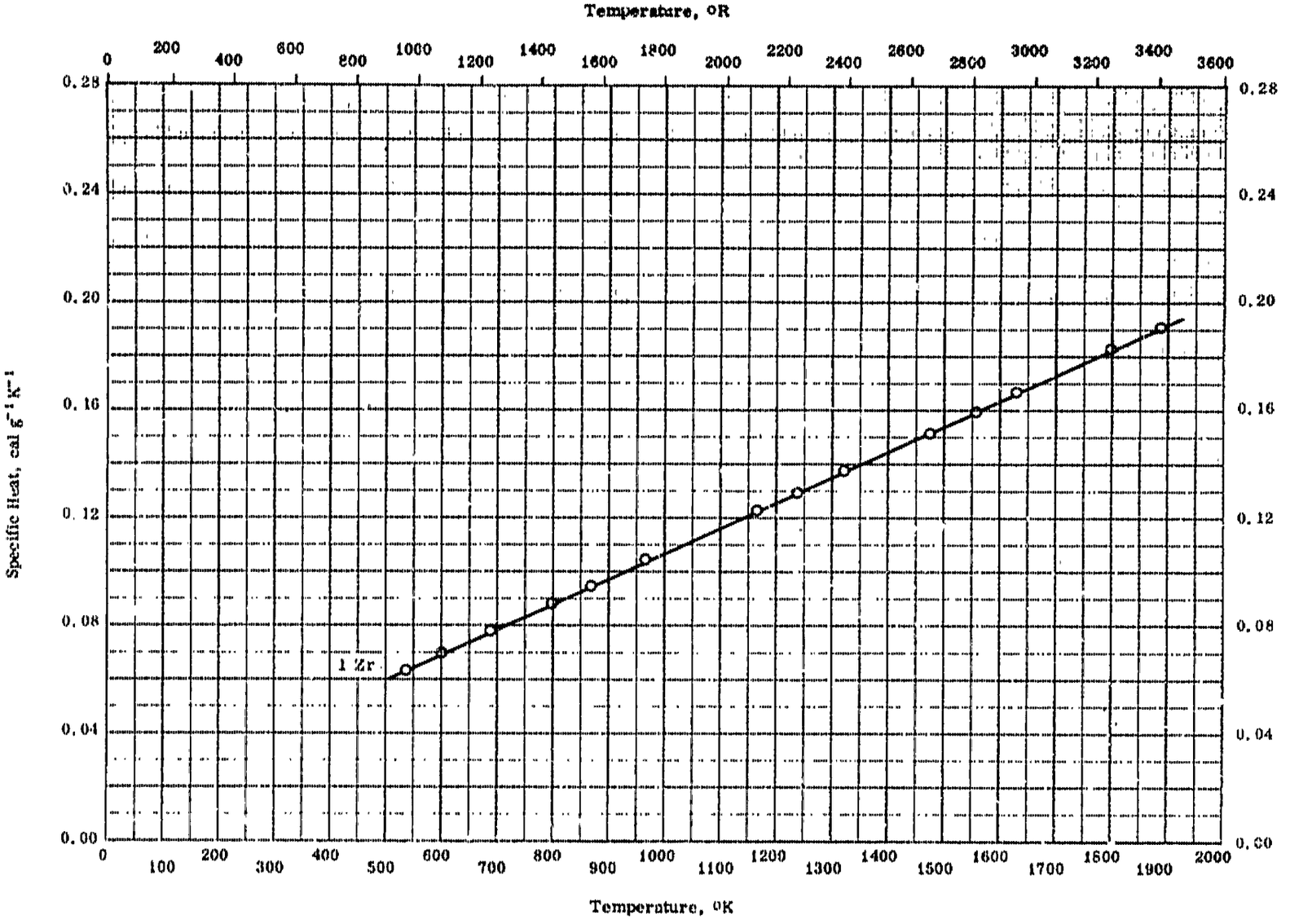
ELECTRICAL RESIST[illegible]Y -- HAFNIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	53-3	273-473		2 Zr, and traces of several elements.	
□	51-10	273-1273		0.70 Zr, 0.018 Al, 0.015 Si, 0.006 Fe, ≤ 0.003 Ti, and 0.002 N_2.	As deposited iodide crystal bar.
△	51-10	273-1073		0.78 Zr, 0.066 Al, 0.037 O_2, 0.034 Si, 0.004 N_2, and 0.003 > each Ti and Fe.	Arc melted, hot rolled, cold rolled, and annealed at 900 C; auth. suspects contamination during processing.

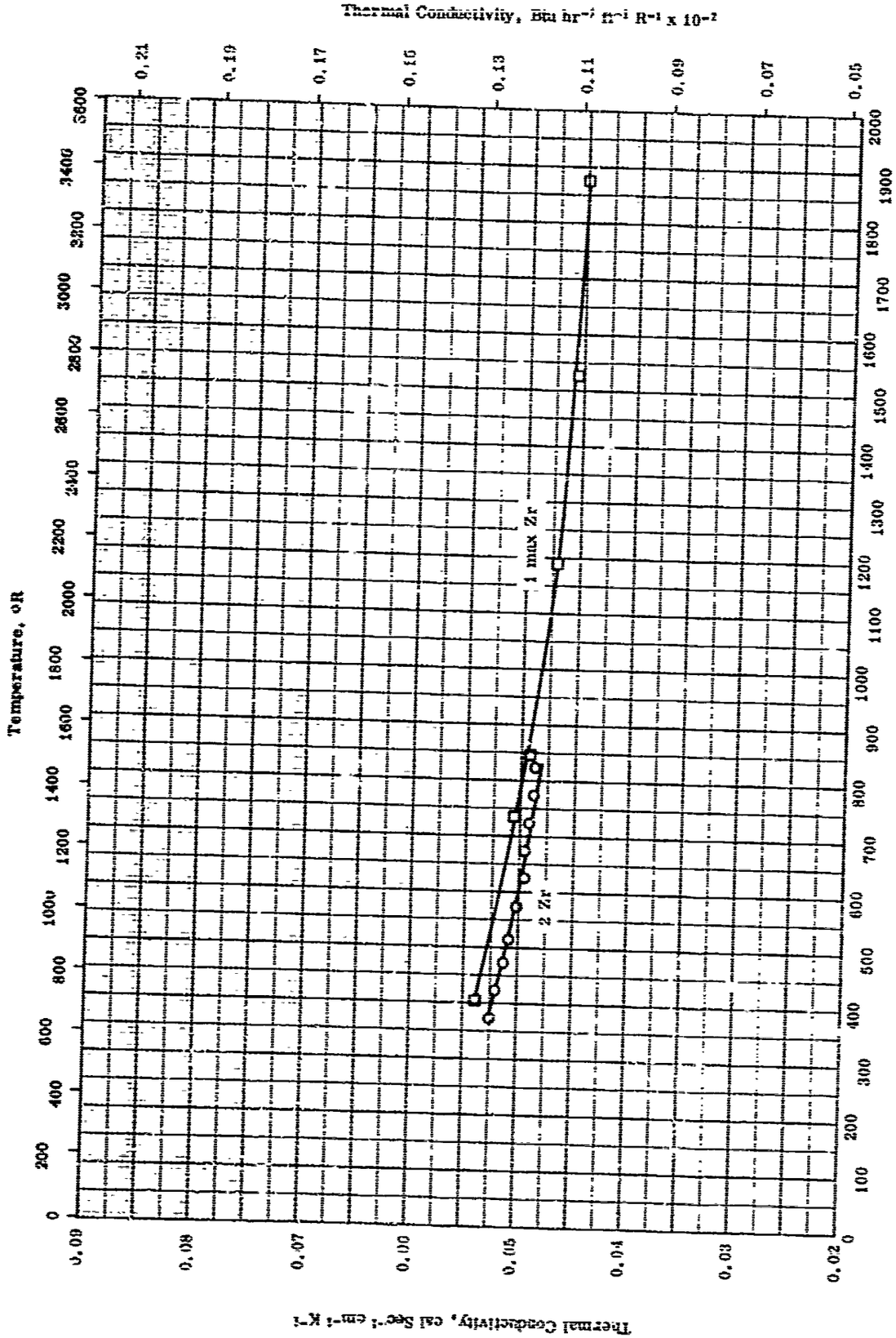


SPECIFIC HEAT -- HAFNIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	61-2	534-1884	3.0	Crystal bar hafnium; 99.0 Hf, 1 max Zr, 0.1 max (Ti + Si), 0.01 max (Fe + V + Zn), 0.001 max (Cu + Mn + Ni), and 0.0001 max Mg; density 813 lb ft^{-3}.	

TPRC

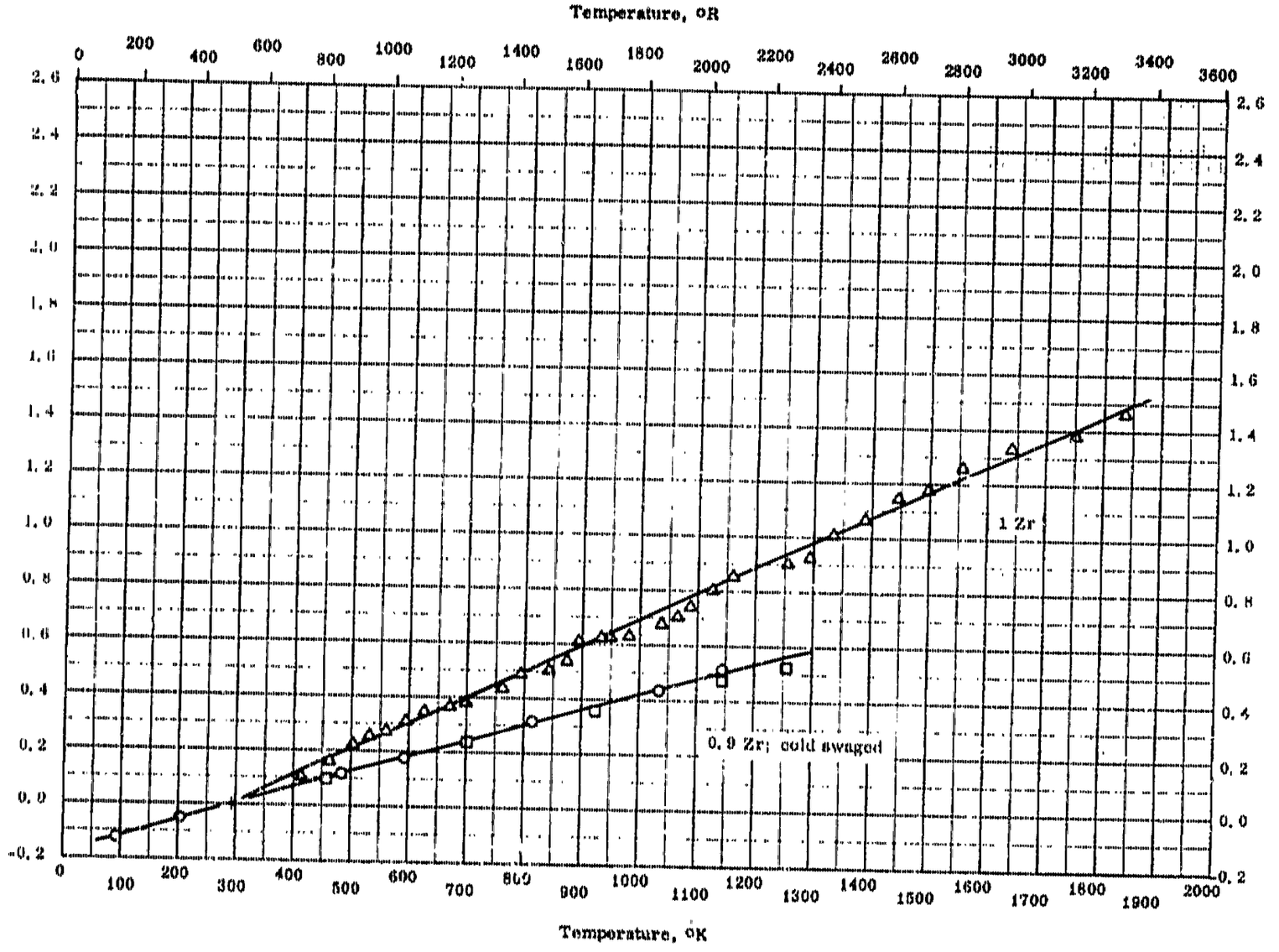


THERMAL CONDUCTIVITY — HAFNIUM + ZIRCONIUM

THERMAL CONDUCTIVITY -- HAFNIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	53-3	373-823		2 Zr, and traces of Pb, Al, W, Fe, Cu, and Zn.	
□	61-2	431-1878		1 max Zr, 0.1 max Ti and Si each, 0.01 max V and Zn each, 0.001 max Mn, Ni, and Cu each, and 0.0001 max Mg.	Sample contained 5 one-inch dia disks.



THERMAL LINEAR EXPANSION — HAFNIUM + ZIRCONIUM

Thermal Linear Expansion, percent

TPRC

THERMAL LINEAR EXPANSION — HAFNIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	61-10	91-1146		0.89 Zr, 0.084 Si, 0.074 Al, and 0.003 > Ti, Fe, each.	Cold swaged from iodide crystal bar and annealed at 1000 C.
□	61-10	478-1256		0.86 Zr, 0.047 O_2, 0.042 Al, 0.017 Si, and 0.003 > Ti, Fe each.	Same as above; cold swaged 20% after annealing.
△	61-2	294-1633		Crystal bar; 99 hafnium, 1 max Zr, 0.1 max Ti and Si, 0.01 max Fe, V, and Zn, 0.001 max Mn, Ni, and Cu, 0.0001 max Mg; density 13.09 g cm^{-3}.	

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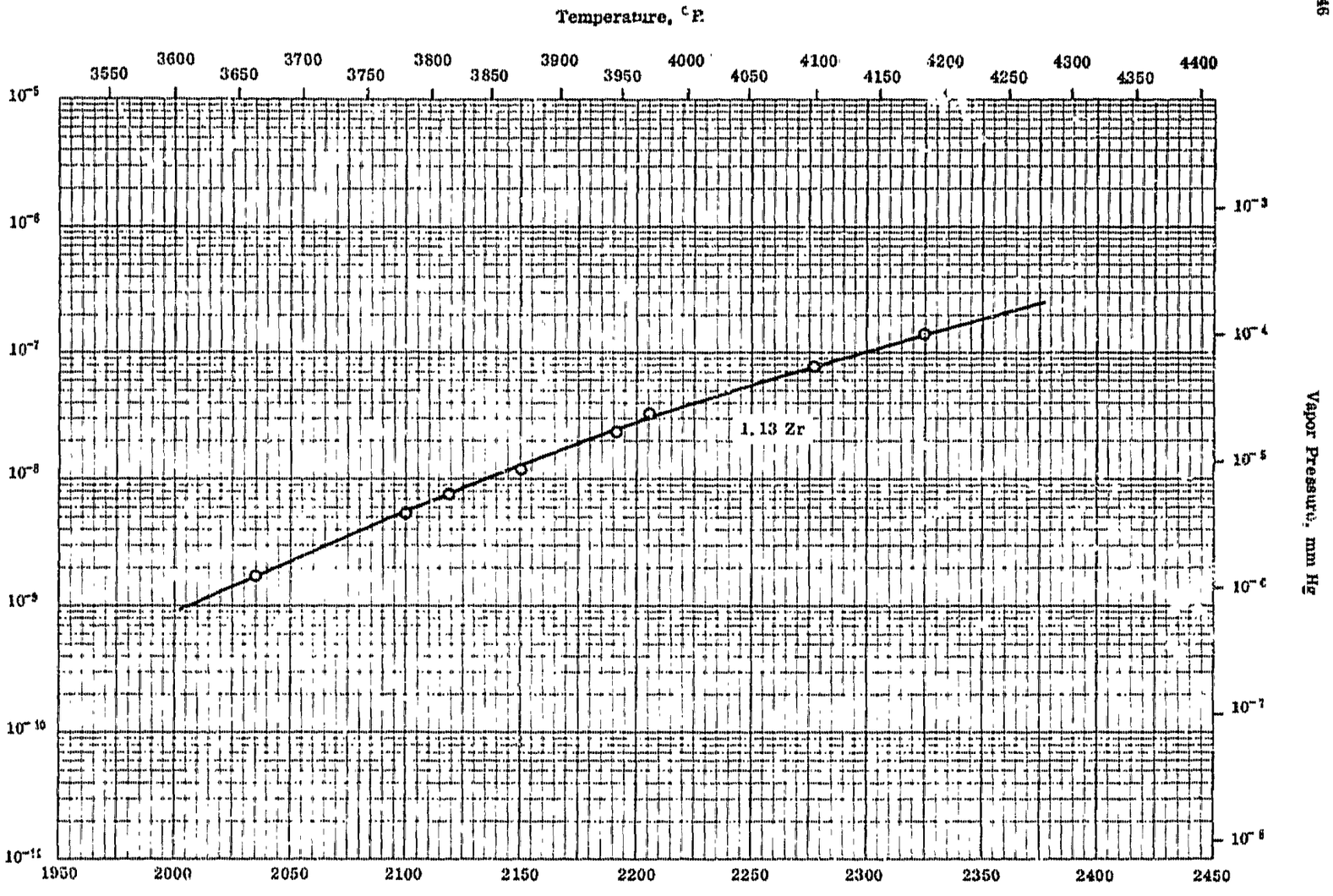


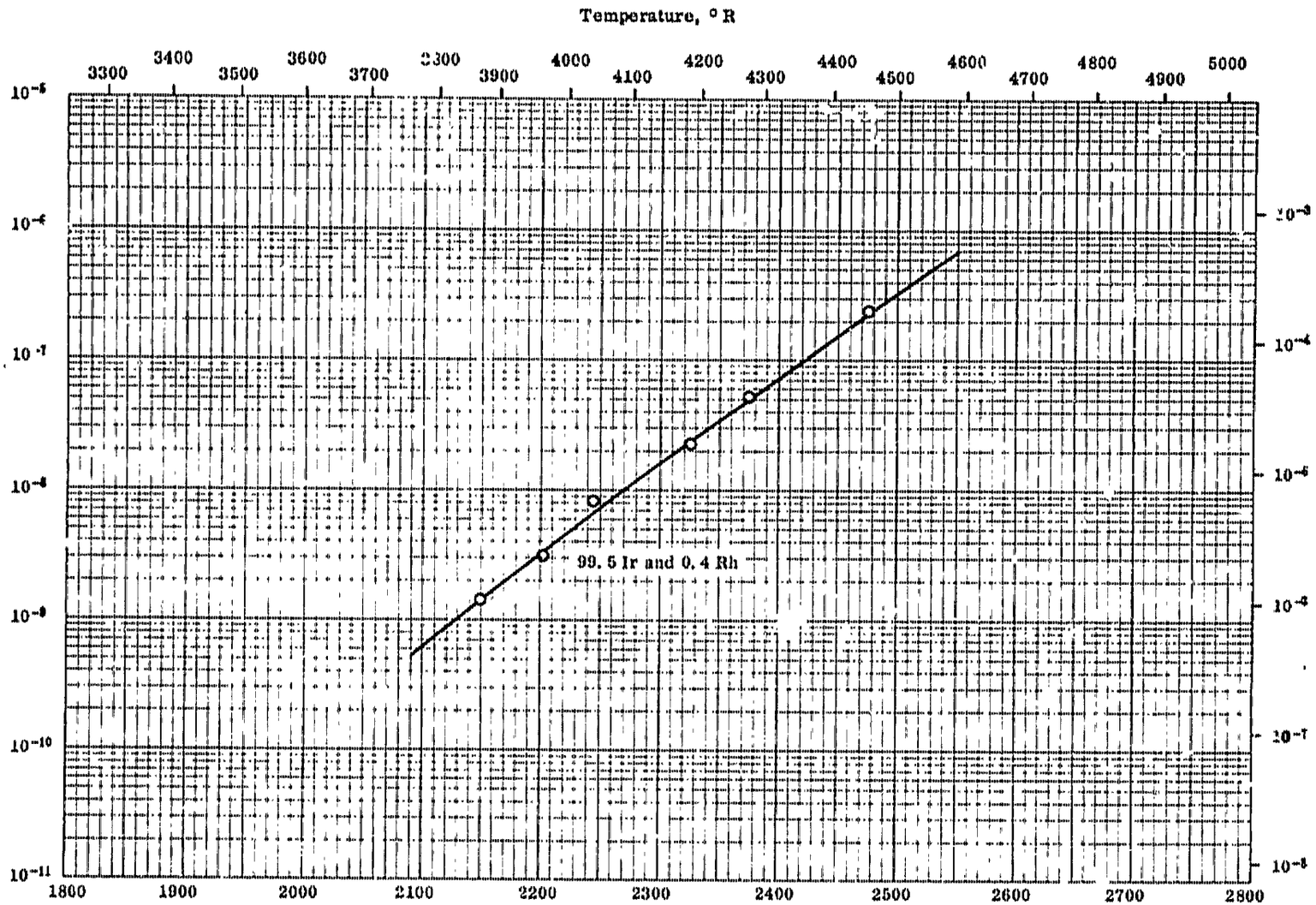
VAPOR PRESSURE -- HAFNIUM + ZIRCONIUM

TPRC

VAPOR PRESSURE -- HAFNIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	64-4	2035-2325		1.13 Zr, trace of Fe, Mg and Ti, 0.0081 N, 0.0069 O, and 0.0003 H.	Sample in ring shape.



VAPOR PRESSURE -- IRIDIUM + RHODIUM

VAPOR PRESSURE -- IRIDIUM + RHODIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	61-13	2140-2477		99.5 Ir and 0.4 Rh.	

PROPERTIES OF LANTHANUM + CALCIUM

REPORTED VALUES

Melting Point:	K	R
O 3.0 Ca	1134 ± 5	2042 ± 9

PROPERTIES OF LANTHANUM + CALCIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	48-5	1130-1140		3.0 Ca.	As reduced biscuits.

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PROPERTIES OF LANTHANUM + MAGNESIUM

REPORTED VALUES

Density:	$g\ cm^{-3}$	$lb\ ft^{-3}$
O 1.0 > Mg	5.97	373

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	52-11	298		1.0 Mg, 0.025 > Cu, 0.01 > other rare earth, and 0.085 Fe; 50% hexagonal close packed phase and 50% face centered cubic phase.	Extruded.

PROPERTIES OF LEAD + COPPER

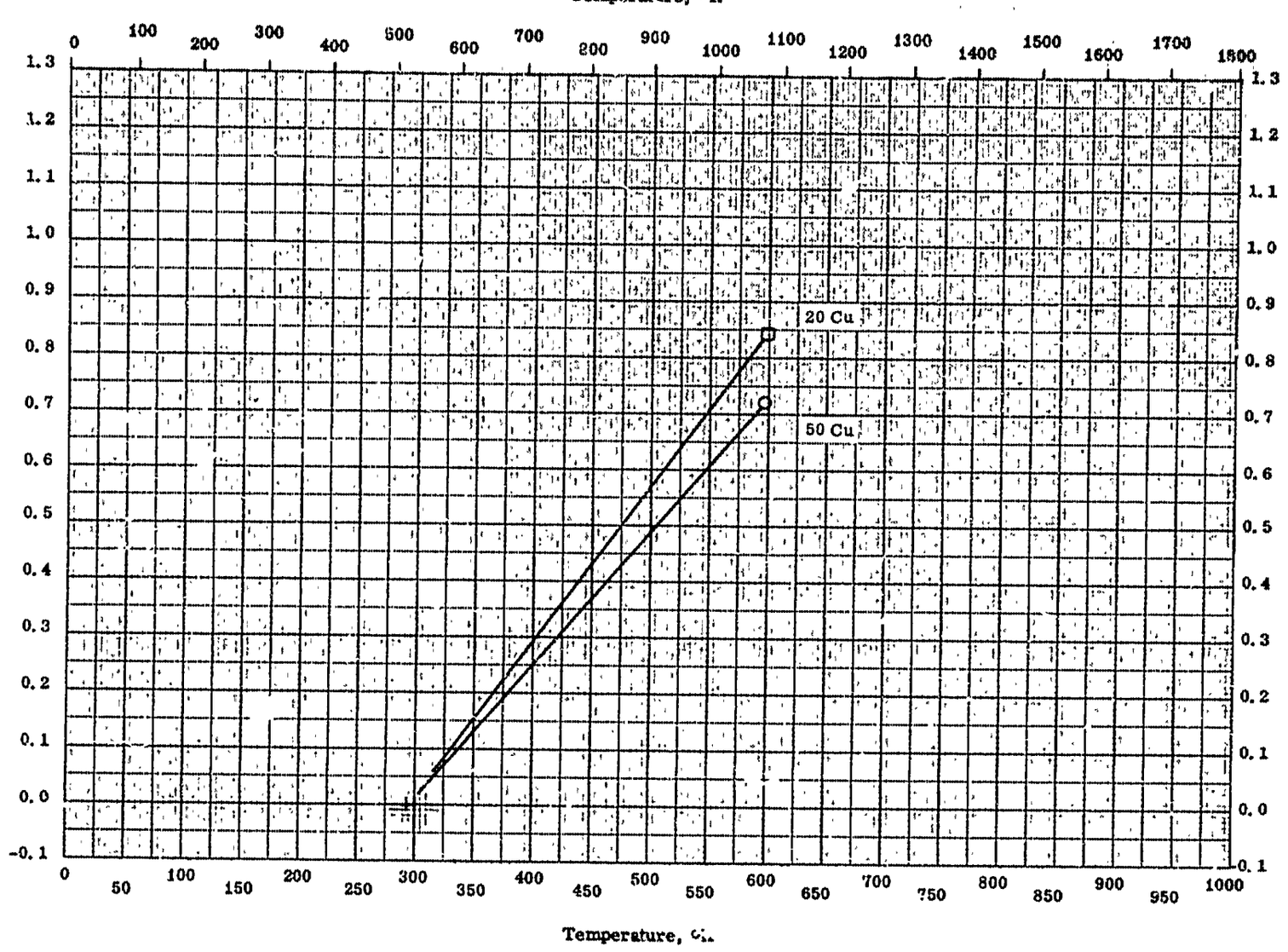
REPORTED VALUES

Density:

○	20 Cu	10.76	671.0
□	50 Cu	10.00	624.0

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Expt. Error %	Sample Specifications	Remarks
○	67-40	298		20 Cu.	Density from weight in air and in water.
□	67-40	298		50 Cu.	Same as above.



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Thermal Linear Expansion, percent

Thermal Linear Expansion, percent

THERMAL LINEAR EXPANSION -- LEAD + COPPER

THERMAL LINEAR EXPANSION -- LEAD + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	57-40	293-600		50 Pb and 50 Cu.	$\alpha + \beta \rightarrow \alpha$ + Liq. at 326 C; $\Delta L/L$ at 326 C = -0.13%.
□	57-40	293-600		80 Pb and 20 Cu.	Same as above; $\Delta L/L$ at 326 C not given.

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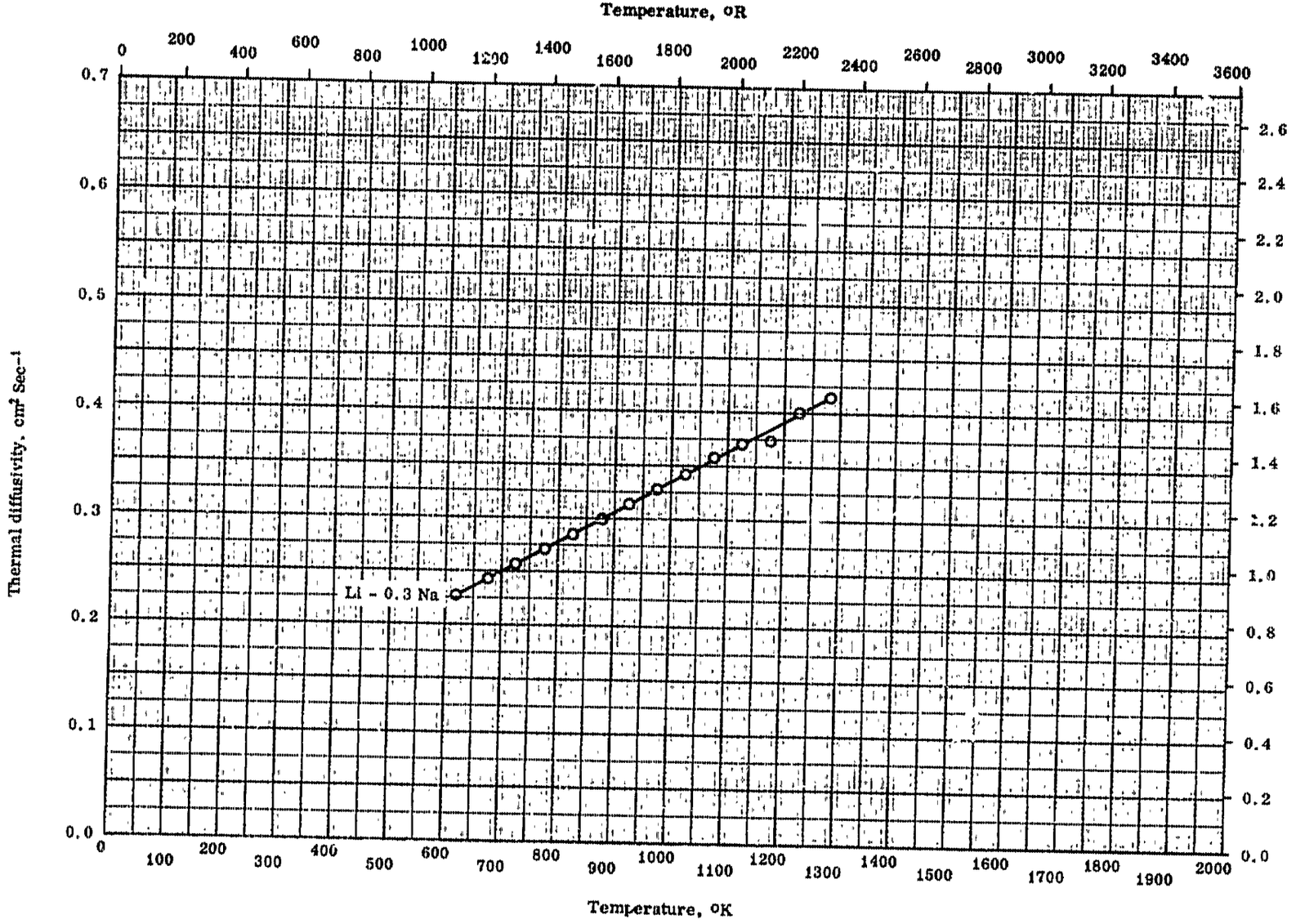
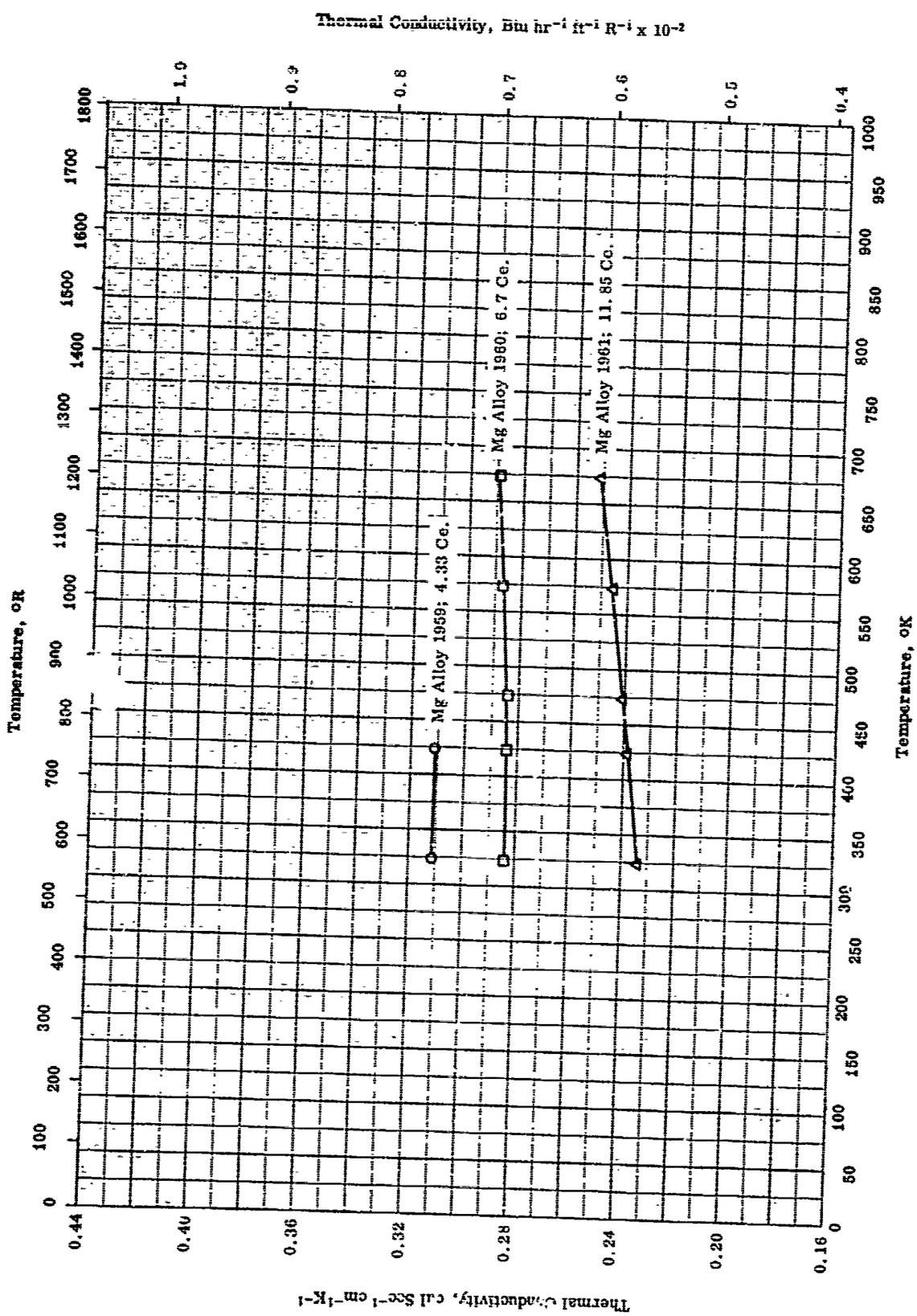


THERMAL DIFFUSIVITY -- LITHIUM + SODIUM

THERMAL DIFFUSIVITY -- LITHIUM + SODIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-1	618-1280	±2.9	98.98>Li, 0.27 Na, 0.19 Fe, 0.18 Mg, 0.08 C, 0.06 Cu, 0.052 Ni, 0.05 Cr, 0.032 Pb, 0.023 Sn, 0.016 Ti, 0.01 Co, 0.01>Sb, 0.01>Zn, 0.006 Ba, 0.0058 Mo, 0.0046 Ca, 0.0044 N, 0.0042 V, 0.0037 Al, 0.003 K, 0.0029 Mn, 0.002 Bi, 0.001 Be, 0.001 Cd, 0.001 In, and 0.0003>Ag.	Filtered through a capillary with an inside dia of 1.5 mm, poured and sealed in a thin-walled steel 1 Kh 18N9T tube with 230 mm long, 8.6 mm dia, and 0.2 mm wall thickness in a vacuum of ~ 1×10^{-2} mm Hg; measured in vacuum.



THERMAL CONDUCTIVITY — MAGNESIUM + CERIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	64-3	323-423		Mg Alloy 1959; 4.33 Ce in form of mischmetal; Mg contain ≈0.033 Al and ≈0.012 Zn.	Machined.
□	64-3	323-673		Mg Alloy 1960; same as above except 6.7 Ce.	Machined.
△	64-3	323-673		Mg Alloy 1961; same as above except 11.85 Ce.	Machined.

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PROPERTIES OF MAGNESIUM + THORIUM

REPORTED VALUES

Density:	See figure	
Melting Point:	K	R
△ HM 31 XA	878	1580
Heat of Fusion:	cal g^{-1}	Btu lb^{-1}
▲ HM 31 XA	79 ± 2	142 ± 4

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
△	57-18	878		Mg Alloy HM 31 XA; 1.93-3.28 Th, 0.05 >Zn, 0.03 >Al, 0.02> Fe, 0.01> each Ca, Si, and Sn, 0.005≥Cu, 0.001 >Ni and 0.001 >pb.	
▲	57-18	878		Same as above.	

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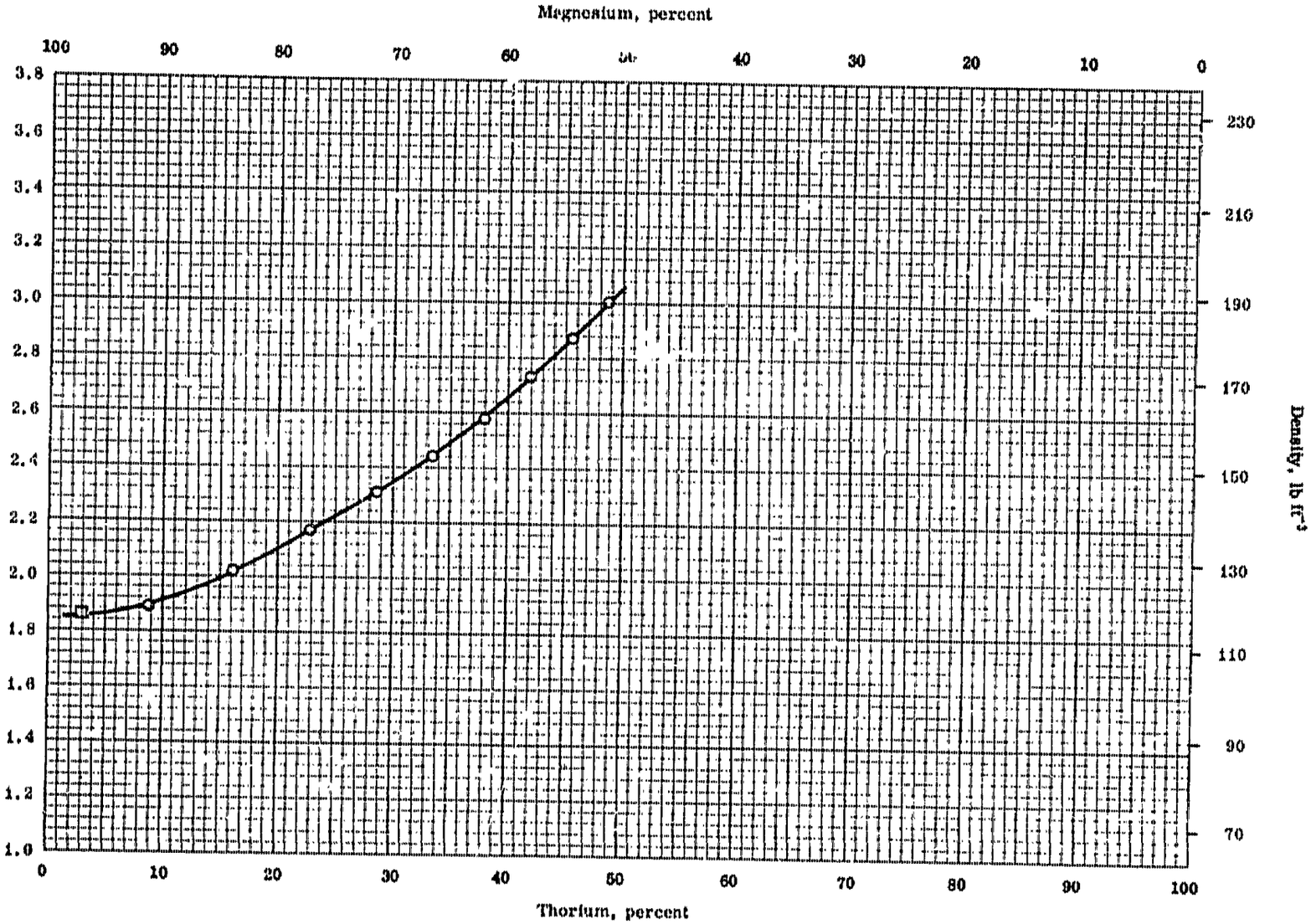


DENSITY -- MAGNESIUM + THORIUM

DENSITY -- MAGNESIUM + THORIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-17	298		8.8-49 Th.	
□	52-17	298		3 Th.	

PROPERTIES OF MAGNESIUM + ZINC

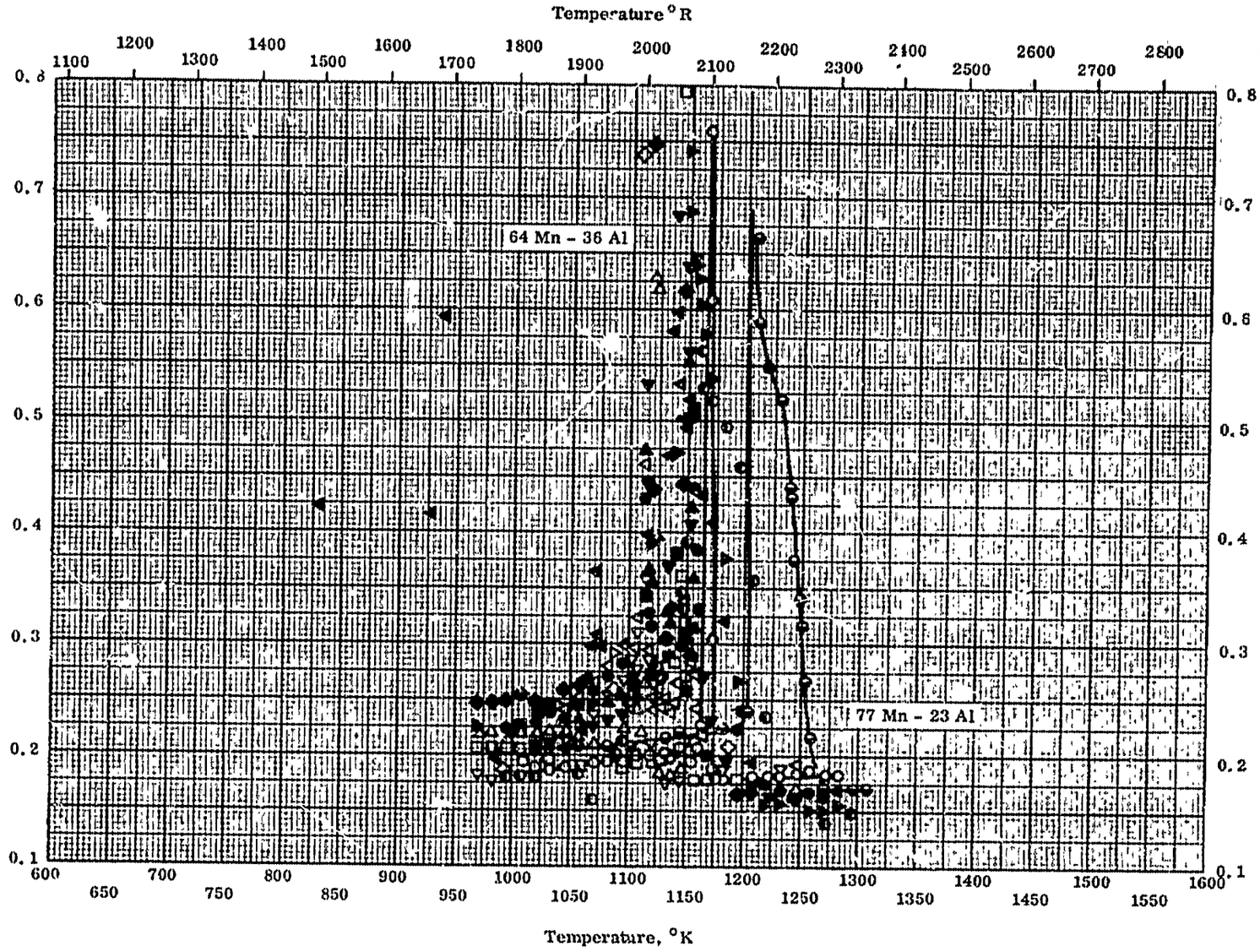
REPORTED VALUES

Melting Point:	K	R
O 6.22 Zn	617	1116

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	54-19	617		93.78 Mg and 6.22 Zn.	M. P. from metallographic inspection for signs of chilled liquid in sample quenched from various temperature levels.

TPRC



TPRC

SPECIFIC HEAT -- MANGANESE + ALUMINUM

SPECIFIC HEAT -- MANGANESE + ALUMINUM

REFERENCE INFORMATION

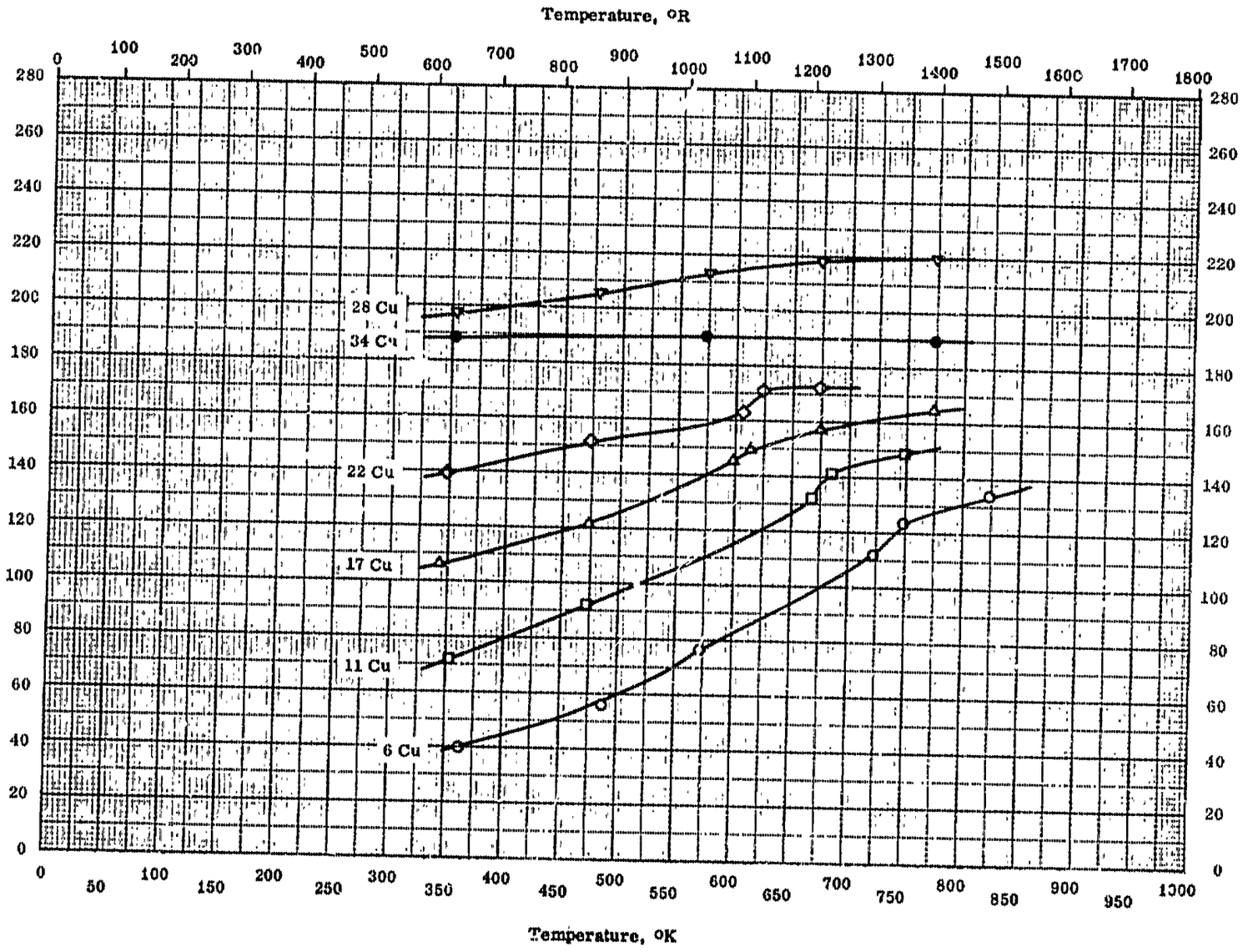
Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	58-17	970-1273		Mn alloy A-47; 64.4 Mn and 35.6 Al; prepared from 99.9 Mn and 99.99 Al.	Melted in an induction furnace, annealed for 1 hr at 950 C; slowly cooled to 700 C; annealed again at 950 C for 5 hrs then slowly cooled to room temperature in a vacuum.
□	58-17	970-1273		Mn alloy A-48; 65.3 Mn and 34.7 Al; same raw materials as above.	Same as above.
△	58-17	970-1273		Mn alloy A-49; 66.30 Mn and 33.70 Al; same raw materials as above.	Same as above.
◇	58-17	993-1188		Mn alloy A-49.5; same as above.	Same as above.
▽	58-17	970-1273		Mn alloy A-50; 67.1 Mn and 32.9 Al; same raw materials as above.	Same as above.
▷	58-17	1040-1189		A-50.5; same as above.	Same as above.
◁	58-17	970-1273		Mn alloy A-51; 69.0 Mn and 31.00 Al; same raw materials as above.	Same as above.
●	58-17	970-1273		Mn alloy A-52; 68.8 Mn and 31.2 Al; same raw materials as above.	Same as above.
■	58-17	970-1273		Mn alloy A-53; 70.4 Mn and 29.6 Al; same raw materials as above.	Same as above.
▲	58-17	970-1273		Mn alloy A-54; 71.4 Mn and 28.6 Al; same raw materials as above.	Same as above.

(Continued onto next page)

SPECIFIC HEAT -- MANGANESE + ALUMINUM (continued)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
◆	58-17	970-1273		Mn alloy A-55; 71.8 Mn and 28.2 Al; same raw materials as above.	Same as above.
▼	58-17	970-1273		Mn alloy A-56; 73.2 Mn and 26.5 Al; same raw materials as above.	Same as above.
▶	58-17	970-1273		Mn alloy A-57; 73.4 Mn and 26.6 Al; same raw materials as above.	Same as above.
◀	58-17	970-1273		Mn alloy A-58; 73.7 Mn and 26.3 Al; same raw materials as above.	Same as above.
◐	58-17	970-1273		Mn alloy A-59; 77.0 Mn and 23.0 Al; same raw materials as above.	Same as above.
●	58-17	970-1273		Mn alloy A-60; 77.3 Mn and 22.7 Al; same raw materials as above.	Same as above.



ELECTRICAL RESISTIVITY -- MANGANESE + COPPER

ELECTRICAL RESISTIVITY -- MANGANESE + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-29	363-823		94.26 Mn and 5.74 Cu.	
□	57-29	353-748		88.61 Mn and 11.39 Cu.	
△	57-29	343-773		83.05 Mn and 16.95 Cu.	
◇	57-29	348-673		77.57 Mn and 22.43 Cu.	
▽	57-29	353-773		72.17 Mn and 27.83 Cu.	
●	57-29	353-773		65.8 Mn and 34.20 Cu.	

TPRC

Specific Heat, Btu lb^{-1} R^{-1}

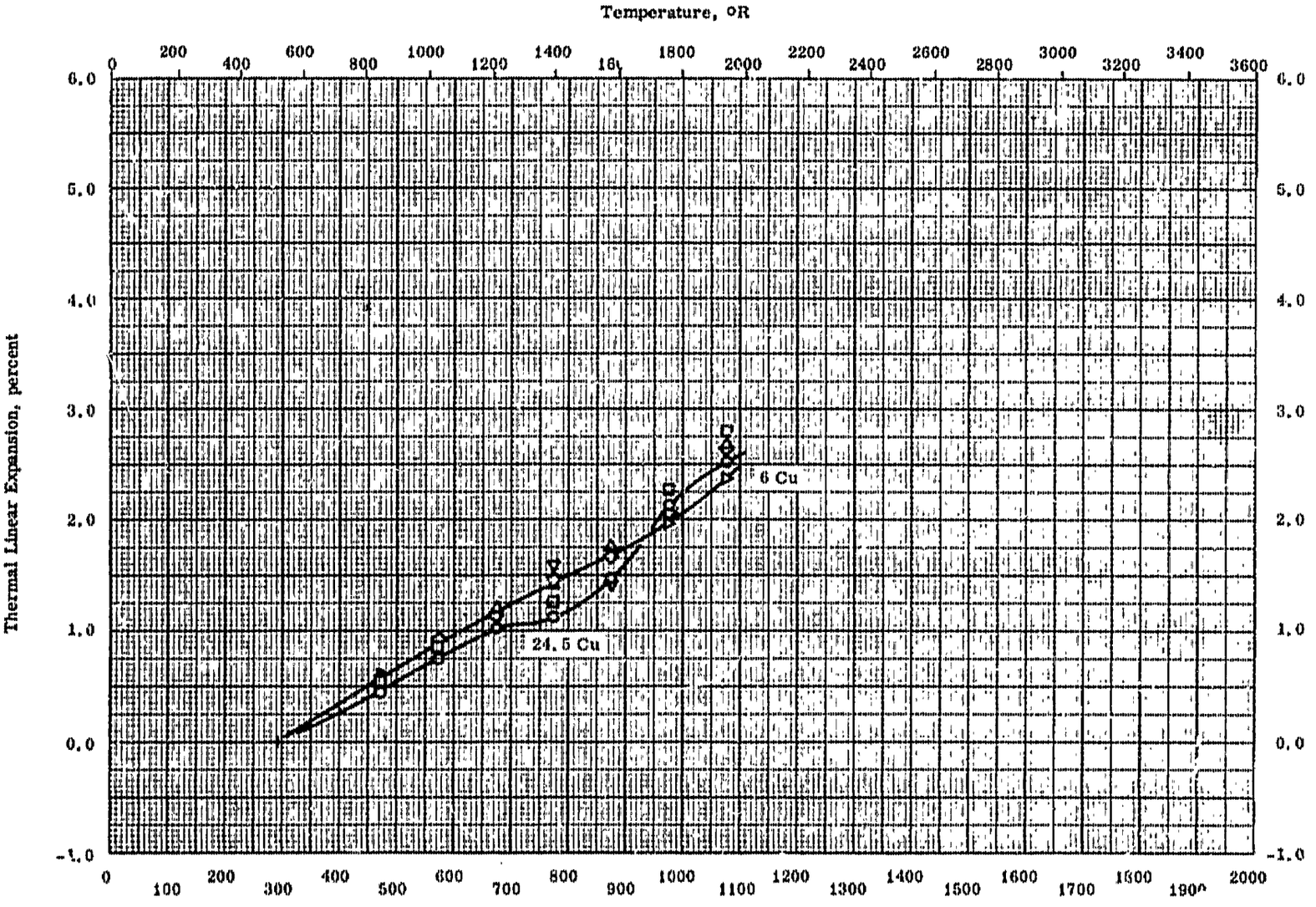
Specific Heat, cal g^{-1} K^{-1}

SPECIFIC HEAT — MANGANESE + COPPER

SPECIFIC HEAT -- MANGANESE + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Impurity %	Sample Specifications	Remarks
○	58-18	290-573		63.1 Mn and 36.9 Cu.	Cooled from 1932 R at 36 R hr^{-1}.
□	58-18	290-573		Same as above; face centered cubic α-phase; metastable.	Same values for 2 samples: (a) quenched from 1932 R in water at 531 R, (b) held 300 hrs at 1482 R and cooled to room temperature at 4 R hr^{-1}.
△	61-14	79-386		83.0 Mn and 17.0 Cu.	Prepared by melting Analar grade manganese and copper in argon arc furnace.
◇	61-14	79-307		61.6 Mn and 38.4 Cu.	Same as above.
▽	61-14	79-320		77.5 Mn and 22.6 Cu.	Same as above.



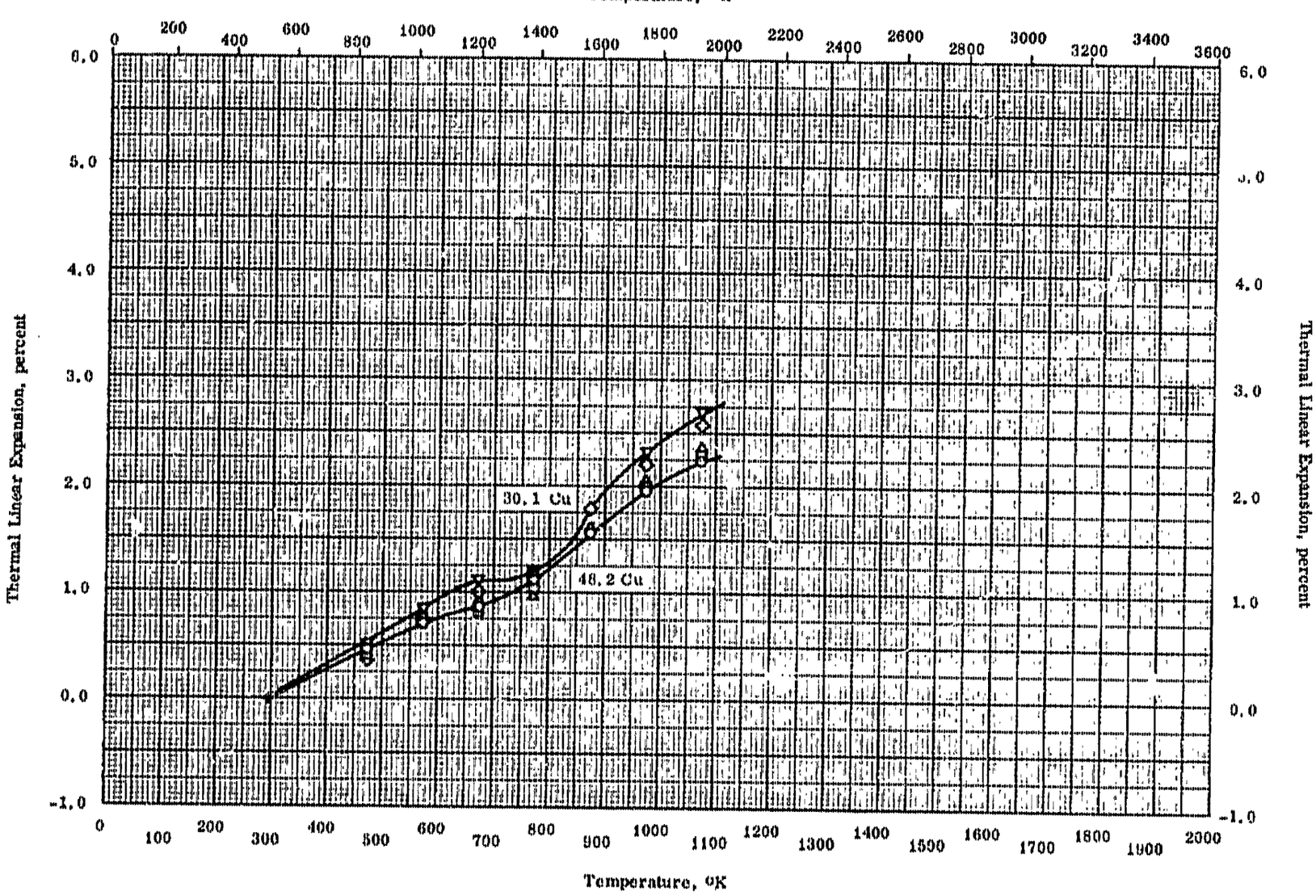
THERMAL LINEAR EXPANSION -- MANGANESE + COPPER
(5 < Cu < 25)

THERMAL LINEAR EXPANSION -- MANGANESE + COPPER
(5 < Cu < 25)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-38	473-1073		75.5 Mn and 24.5 Cu; prepared from electrolytic materials.	Quenched and annealed.
□	55-38	473-1073		79.4 Mn and 20.1 Cu; same as above.	Same as above.
△	55-38	473-1073		83.7 Mn and 15.6 Cu; same as above.	Same as above.
◇	55-38	473-1073		88.5 Mn and 10.5 Cu; same as above.	Same as above.
▽	55-38	473-1073		93.9 Mn and 5.6 Cu; same as above.	Same as above.
▷	55-38	473-1073		94.0 Mn and 6.0 Cu; same as above.	Same as above.

TPRC



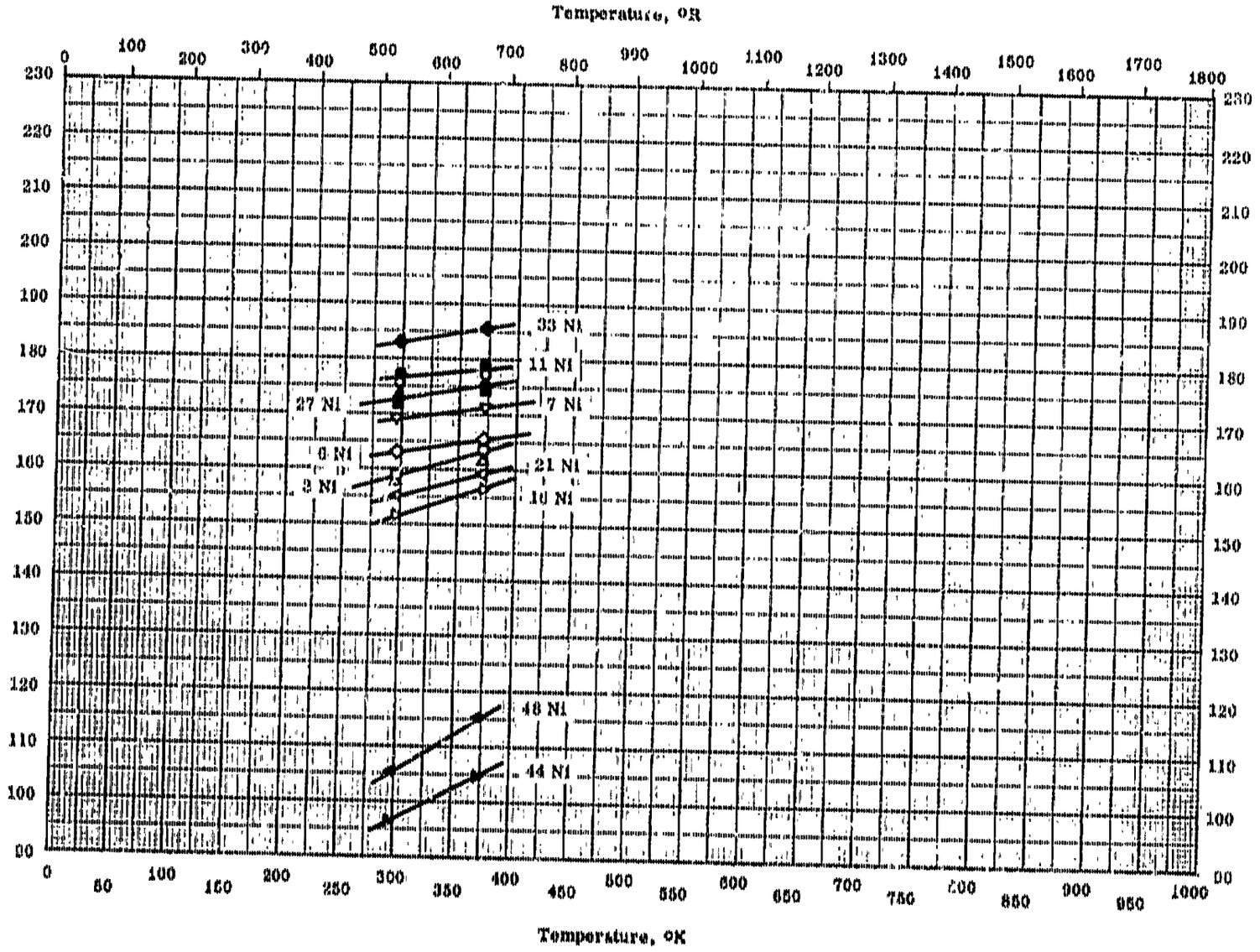
THERMAL LINEAR EXPANSION -- MANGANESE + COPPER
(30 < Cu < 50)

THERMAL LINEAR EXPANSION -- MANGANESE + COPPER
(30 < Cu < 50)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-38	473-1073		51.6 Mn, and 48.2 Cu; prepared from electrolytic pure materials.	Quenched and annealed.
□	55-38	473-1073		53.4 Mn, 45.7 Cu; same as above.	Same as above.
△	55-38	473-1073		58.6 Mn, 41.4 Cu; same as above.	Same as above.
◇	55-38	473-1073		65.0 Mn, 35 Cu; same as above.	Same as above.
▽	55-38	473-1073		69.9 Mn, 30.1 Cu; same as above.	Same as above.

TPRC



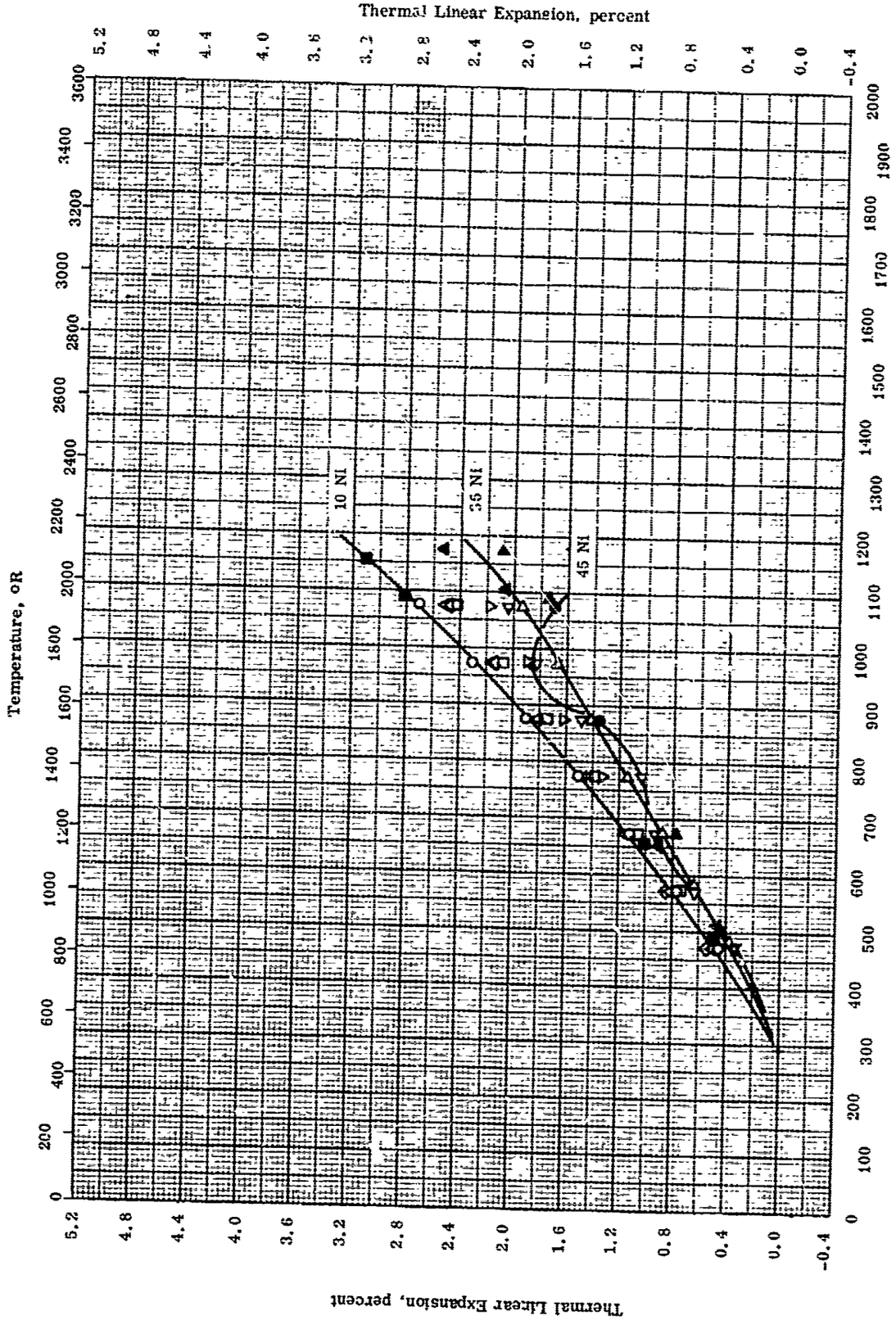
TPRC

ELECTRICAL RESISTIVITY — MANGANESE + NICKEL

ELECTRICAL RESISTIVITY -- MANGANESE + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	49-6	298-373		3.23 Ni.	Annealed in steps from 980 C to 500 C; the entire process lasting 5 days.
△	49-6	298-373		3.51 Ni.	Same as above.
◇	49-6	298-373		6.04 Ni.	Same as above.
▽	49-6	298-373		7.74 Ni.	Same as above.
○	49-6	298-373		10.79 Ni.	Same as above.
●	49-6	298-373		11.75 Ni.	Same as above.
▷	49-6	298-373		15.75 Ni.	Same as above.
◁	49-6	298-373		20.98 Ni.	Same as above.
■	49-6	298-373		26.32 Ni.	Same as above.
▲	49-6	298-373		26.98 Ni.	Same as above.
◆	49-6	298-373		32.69 Ni.	Same as above.
▶	49-6	298-373		43.99 Ni.	Same as above.
◀	49-6	298-373		47.60 Ni.	Same as above.



THERMAL LINEAR EXPANSION -- MANGANESE + NICKEL

THERMAL LINEAR EXPANSION -- MANGANESE + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-38	293-1073		89.7 Mn and 10.3 Ni; prepared from electrolytic purity raw materials.	Quenched and homogenized.
□	55-38	293-1073		84.0 Mn, and 16.0 Ni; same as above.	Same as above.
△	55-38	293-1073		79.8 Mn, and 20.2 Ni; same as above.	Same as above.
◇	55-38	293-1073		75.1 Mn, and 24.9 Ni; same as above.	Same as above.
▽	55-38	293-1073		70.1 Mn, and 29.9 Ni; same as above.	Same as above.
▷	55-38	293-1073		65.4 Mn, and 34.6 Ni; same as above.	Same as above.
◁	55-38	293-1073		59.3 Mn, and 40.7 Ni; same as above.	Same as above.
●	55-38	293-1073		54.8 Mn, and 45.2 Ni; same as above.	Same as above.
■	49-6	473-1173		89.21 Mn, and 10.79 Ni; same as above.	Prepared in alumina crucibles in an induction furnace.
▲	49-6	473-1173		67.31 Mn, and 32.69 Ni; same as above.	Same as above.
▶	49-6	473-1173		57.05 Mn, and 42.95 Ni; same as above.	Same as above.

PROPERTIES OF MANGANESE + TITANIUM

REPORTED VALUES

Density:	g cm^{-3}	lb ft^{-3}
○ 35.1 Ti	6.31	394
□ 48.3 Ti	5.96	372

PROPERTIES OF MANGANESE + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	54-20	298		35.1 Ti.	Density from weight in air and in water.
□	54-20	298		48.3 Ti	Same as above.

TPRC

PROPERTIES OF MOLYBDENUM + IRON

REPORTED VALUES

Density:	g cm^{-3}	lb ft^{-3}
O 0.25 Fe	10.22	638

PROPERTIES OF MOLYBDENUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-7	298		0.25 Fe, 0.073 Si, 0.021 Tl, 0.013 Cu, 0.007 C, and 0.003 Cr.	

TPRC

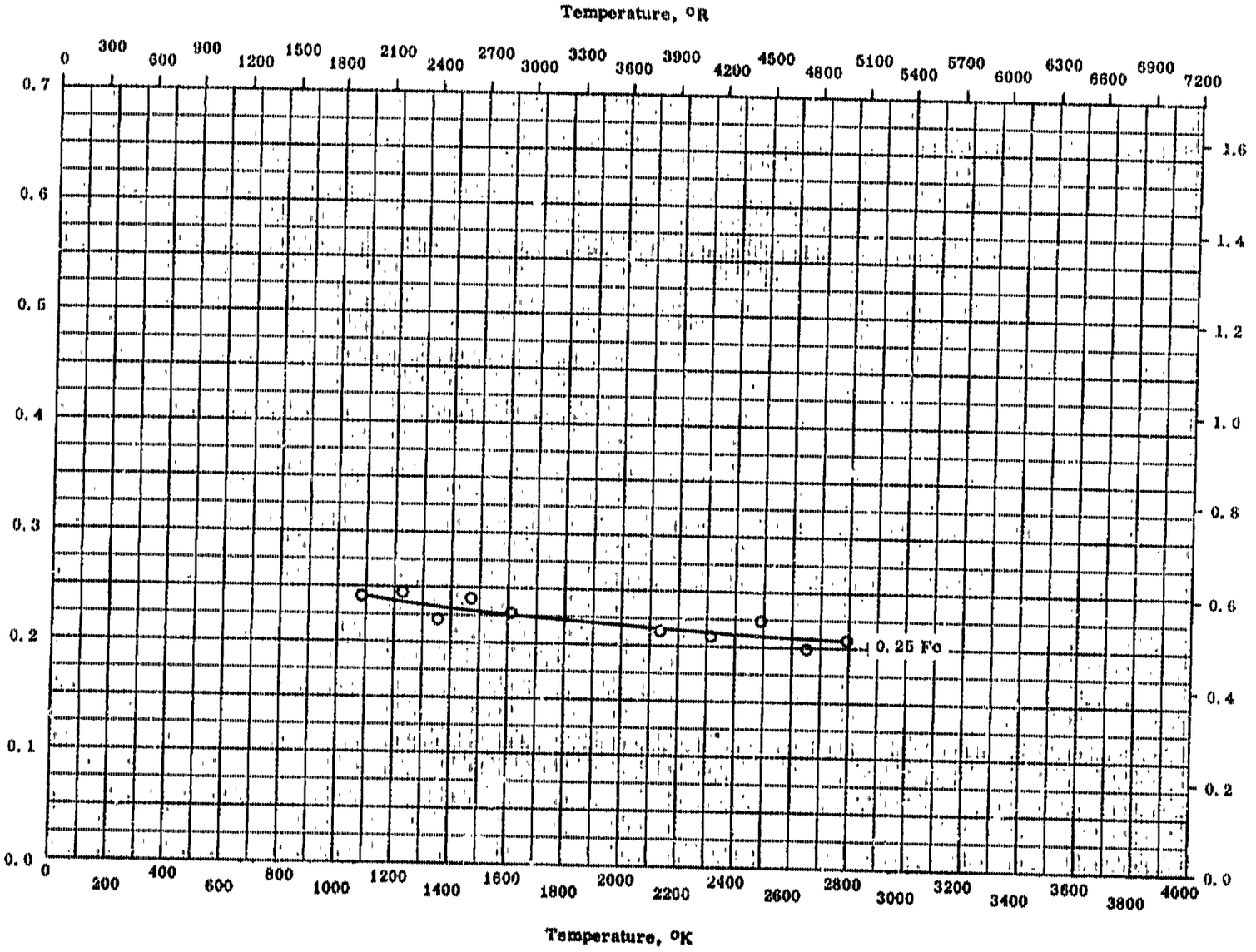
SPECIFIC HEAT -- MOLYBDENUM + IRON

SPECIFIC HEAT — MOLYBDENUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	56-7	1456-2811		Before test: 0.25 Fe, 0.073 Si, 0.021 Ti, 0.013 Cu, 0.007 C, 0.003 Cr; and after test: 0.003 Si, 0.008 C, others unchanged; density 638 lb ft^{-3}.	Arc melted; heating.
□	56-7	1456-2811		Same as above.	Same as above; cooling.

TPRC



Thermal Conductivity, cal sec^{-1} cm^{-1} K^{-1}

Thermal Conductivity, Btu hr^{-1} ft^{-1} R^{-1} x 10^{-2}

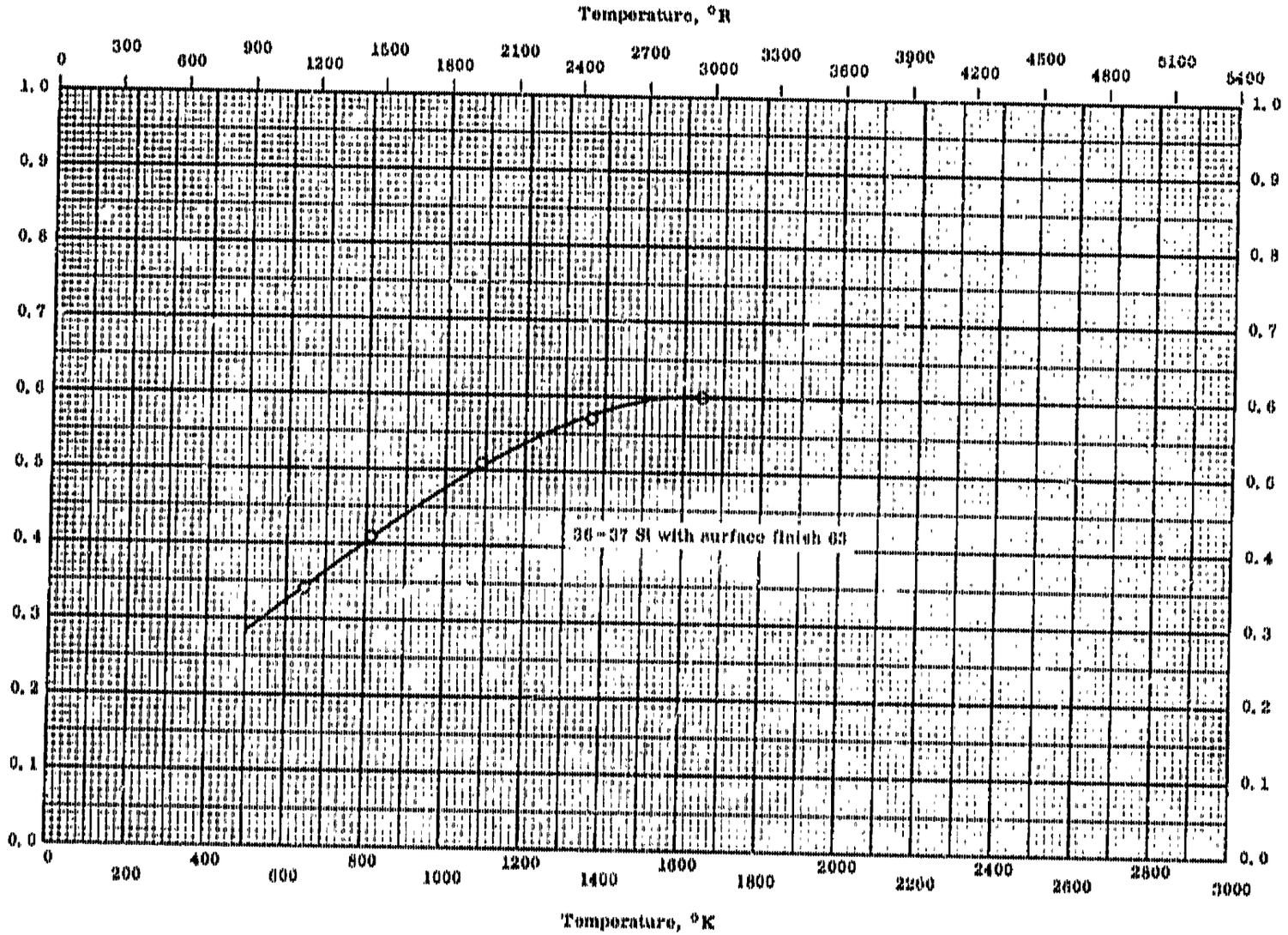
TPRC

THERMAL CONDUCTIVITY -- MOLYBDENUM + IRON

THERMAL CONDUCTIVITY -- MOLYBDENUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-7	1083-2747		Before test composition: 0.25 Fe, 0.073 Si, 0.021 Ti, 0.013 Cu, 0.007 C, 0.0003 Cr; after test composition: 0.663 Si, 0.008 C, and others unchanged; density 638 lb ft^{-3}	



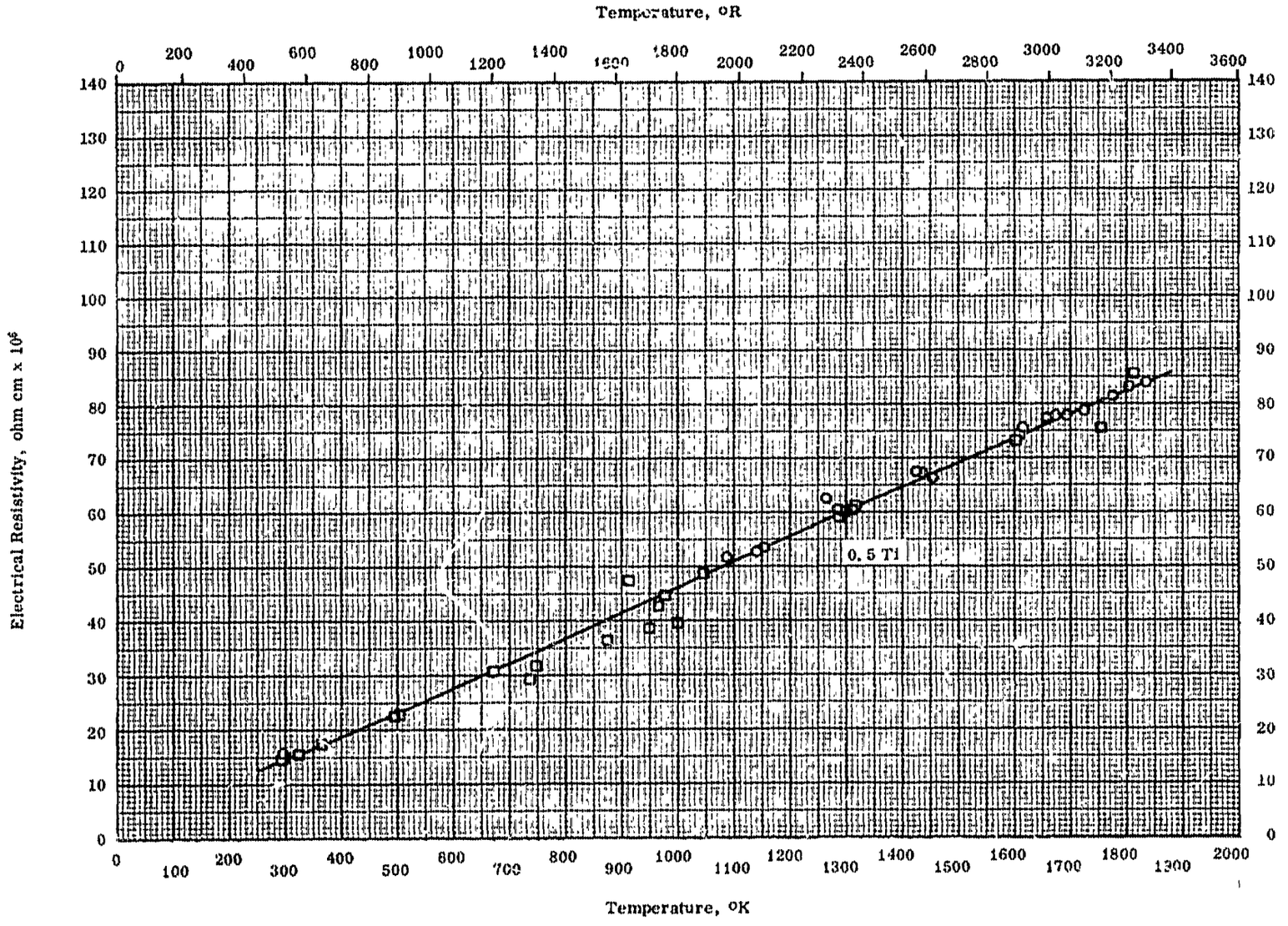
NORMAL TOTAL EMITTANCE — MOLYBDENUM + SILICON

NORMAL TOTAL EMITTANCE -- MOLYBDENUM + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	67-18	644-1644	± 20	62-63.5 Mo and 36-37 Si; block; surface finish 63.	Measured in moisture removed helium.

TPRC



ELECTRICAL RESISTIVITY -- MOLYBDENUM + TITANIUM

Electrical Resistivity, ohm cm x 10⁶

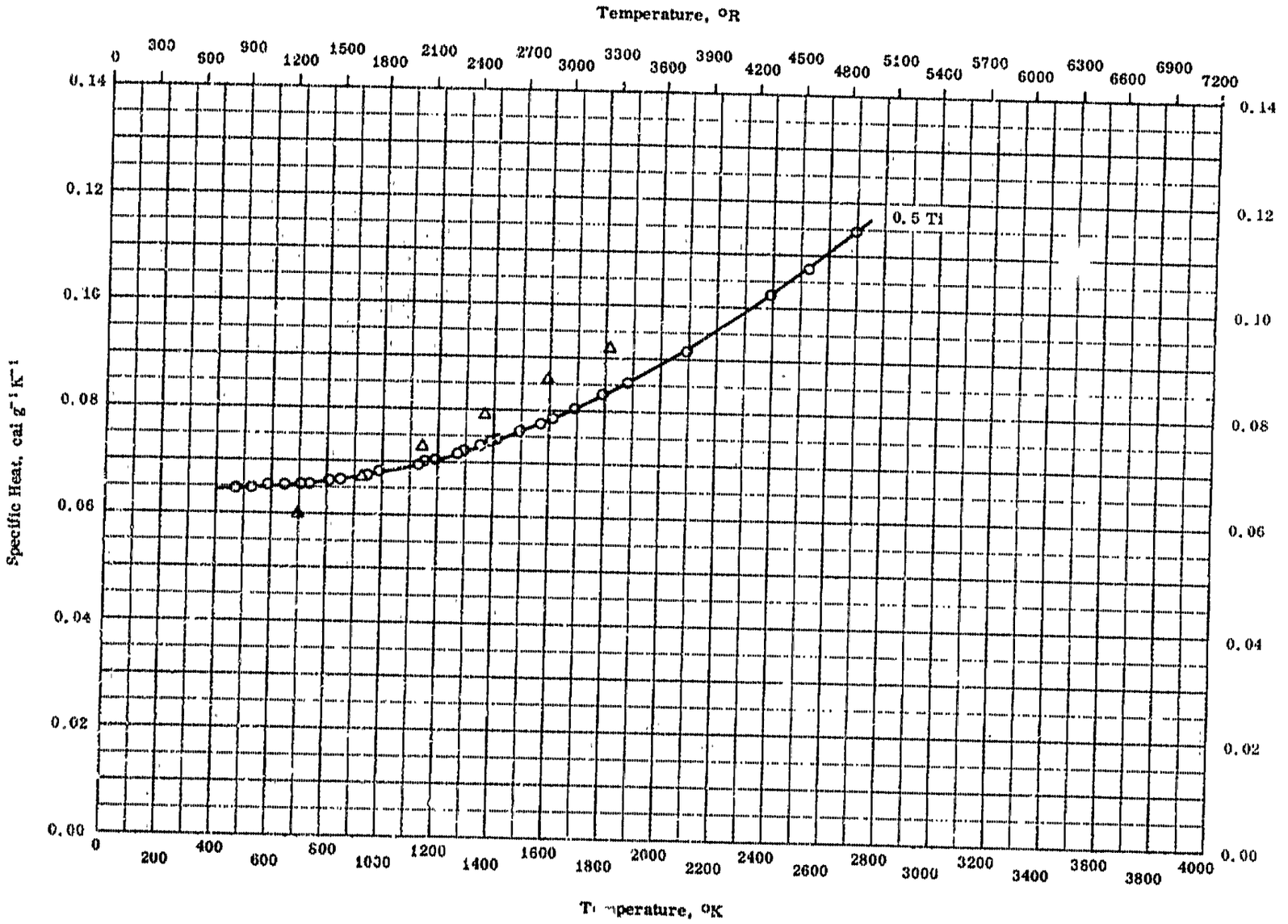
TPRC

293

ELECTRICAL RESISTIVITY -- MOLYBDENUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	62-4	297-1833	2.4	98.6 Mo and 0.5 Ti.	Hot pressed; maximum exposure temp. 4430 F.
□	62-4	297-1811	2.4	Same as above.	Same as above.



SPECIFIC HEAT -- MOLYBDENUM + TITANIUM

TPRC

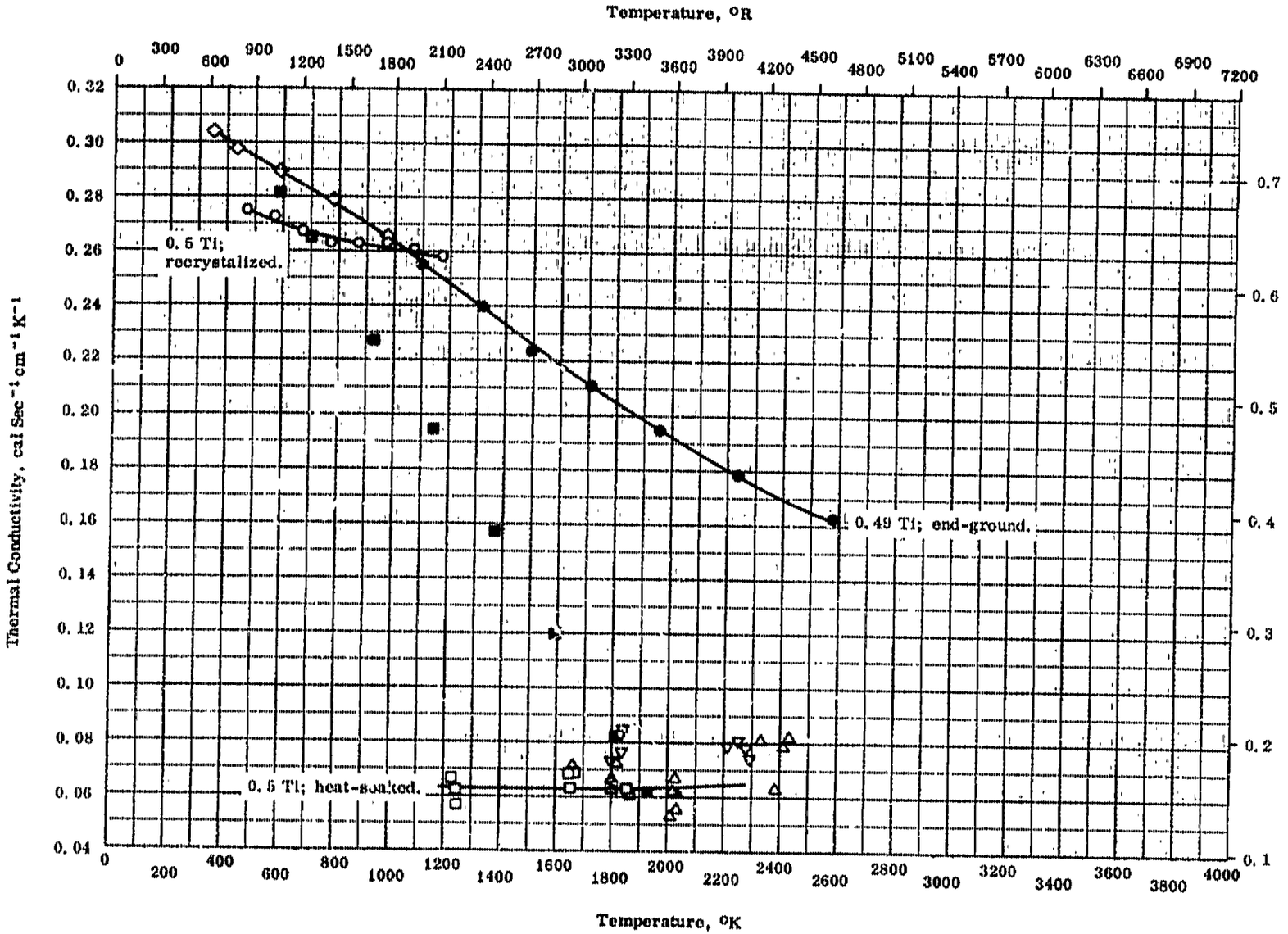
225

SPECIFIC HEAT -- MOLYBDENUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	63-1	475-2700	±5.0	Mo-0.5 Ti-0.08 Zr alloy; 0.5 Ti, 0.07 Zr, 0.029 C, 0.005 >Si, 0.002 >Fe, 0.001 >Ni, 0.0005 O_2, 0.0003 N_2, and 0.0001 H_2; density 622 lb ft^{-3}.	
△	60-11 also 61-6	700-1810	0.7-2.9	0.5 Titanium alloy of molybdenum.	Under helium atmosphere.

TPRC



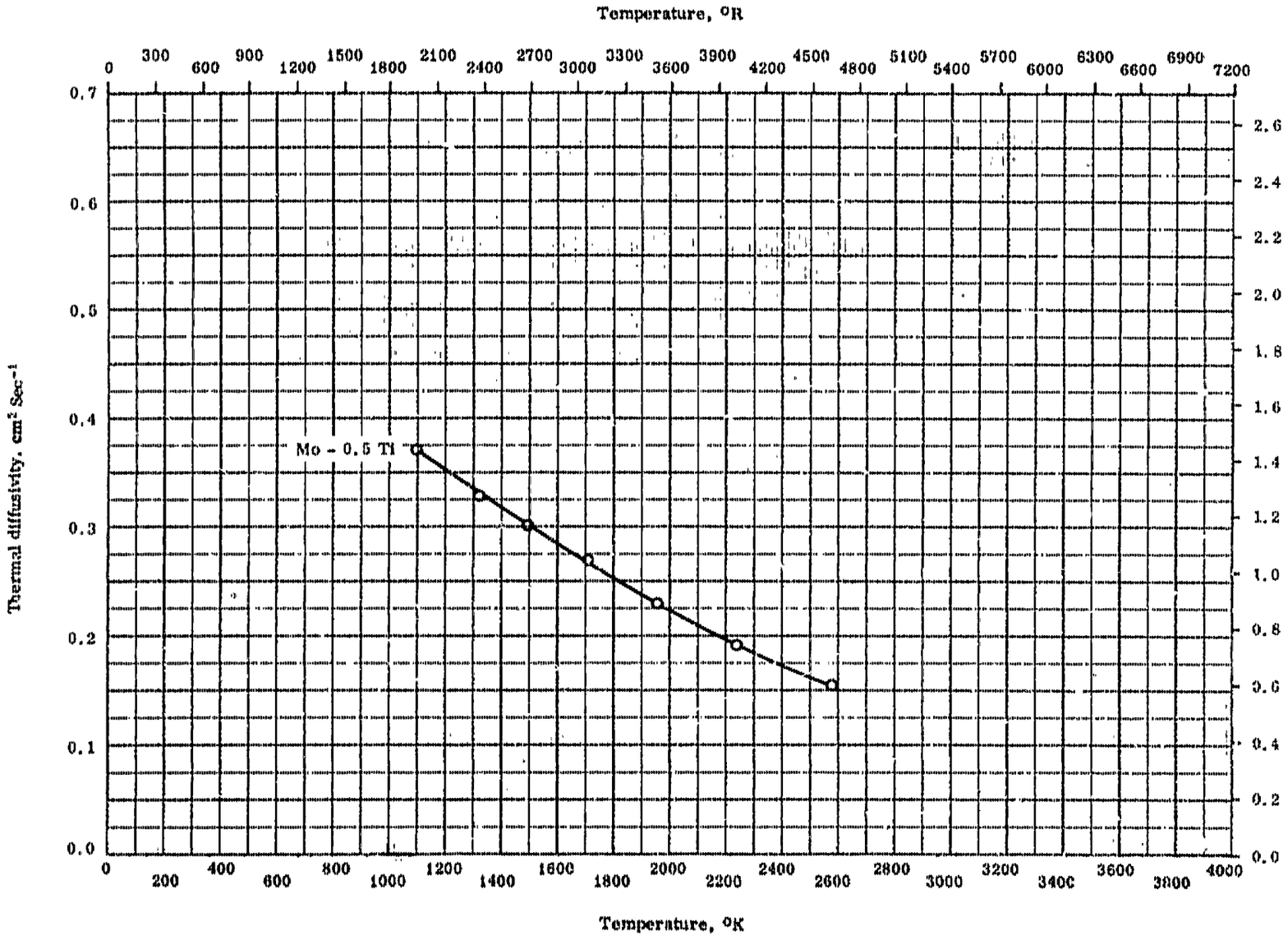
THERMAL CONDUCTIVITY -- MOLYBDENUM + TITANIUM

THERMAL CONDUCTIVITY - MOLYBDENUM + TITANIUM

REFFRENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-6	473-1173	5	99.5 Mo and 0.5 Ti.	Recrystallized at 2700 F; measured in a vacuum of 2×10^{-5} mm Hg.
□	62-4	1233-1863	5-7	Same as above.	Ground and polished to eliminate all the scratches on the surface of sample; heat-soak at 2800 F.
△	62-4	1660-2432	5-7	Same as above.	Same as above; sample found partially melted.
▽	62-4	1800-2287	5-7	Same as above.	Same as above; sample found unmelted but color changed.
◇	63-1	344-975	±4	0.49 Ti, 0.07 Zr, 0.0260 C, 0.001 > Fe, 0.001 > Ni, 0.001 > Si, 0.0001 H_2, and 0.0001 N_2; density 622 lb ft^{-3}.	End-ground to have flat and parallel end surfaces; measured in He atm.
●	63-1	1100-2578	±4	Same as above.	The above sample measured by periodic method in He atm.
■	61-6	589-1922		Same as above.	

TPRC



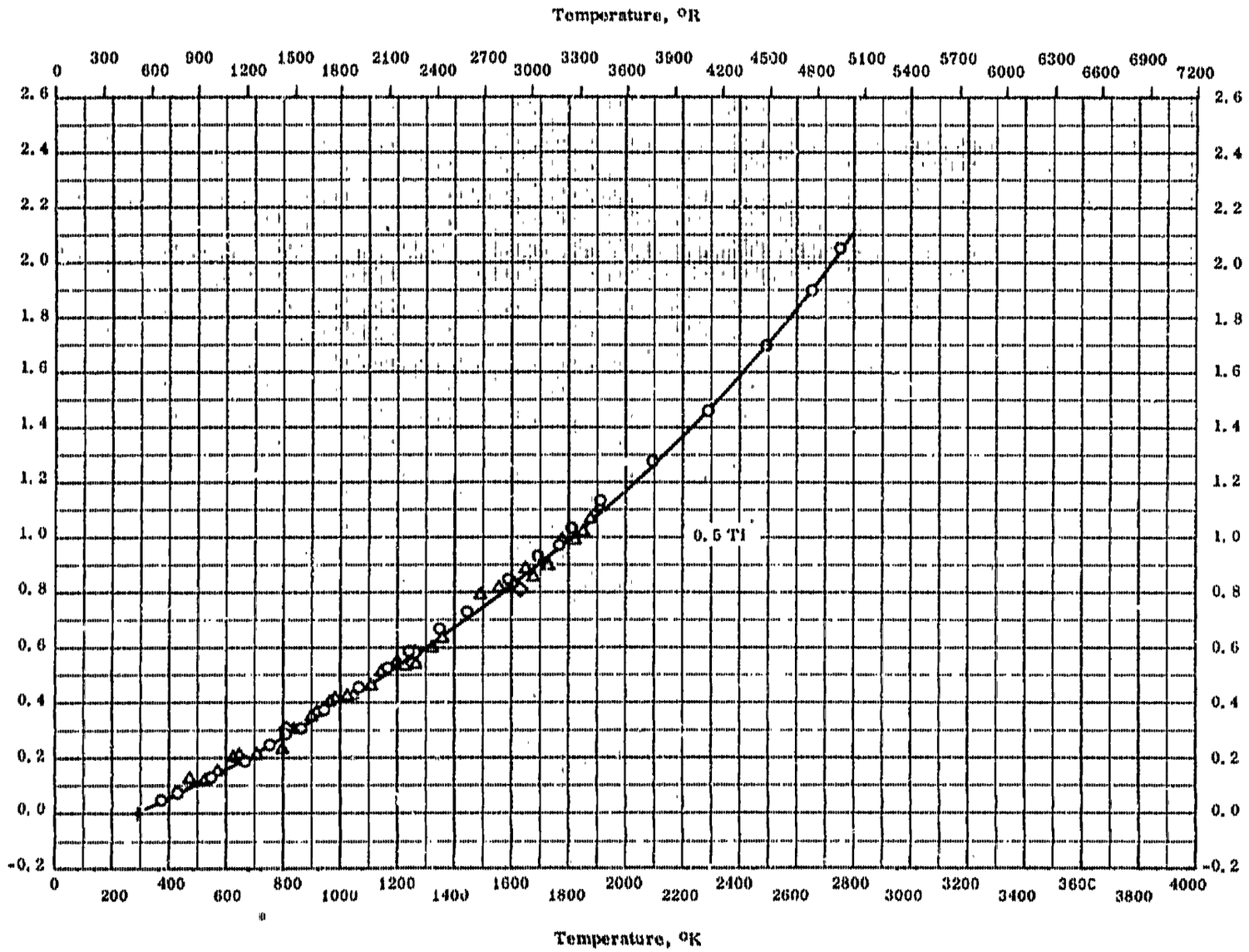
THERMAL DIFFUSIVITY — MOLYBDENUM + TITANIUM

THERMAL DIFFUSIVITY — MOLYBDENUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	69-1	1100-2580		0.49 Ti, 0.07 Zr, 0.026 C, 0.001> Fe, 0.001>Ni, 0.001 Si, 0.0007 O_2, 0.0001 H_2, and 0.0001 N_2; density 9.98 g cm^{-3}.	Surface ground discs.

TPRC



THERMAL LINEAR EXPANSION — MOLYBDENUM + TITANIUM

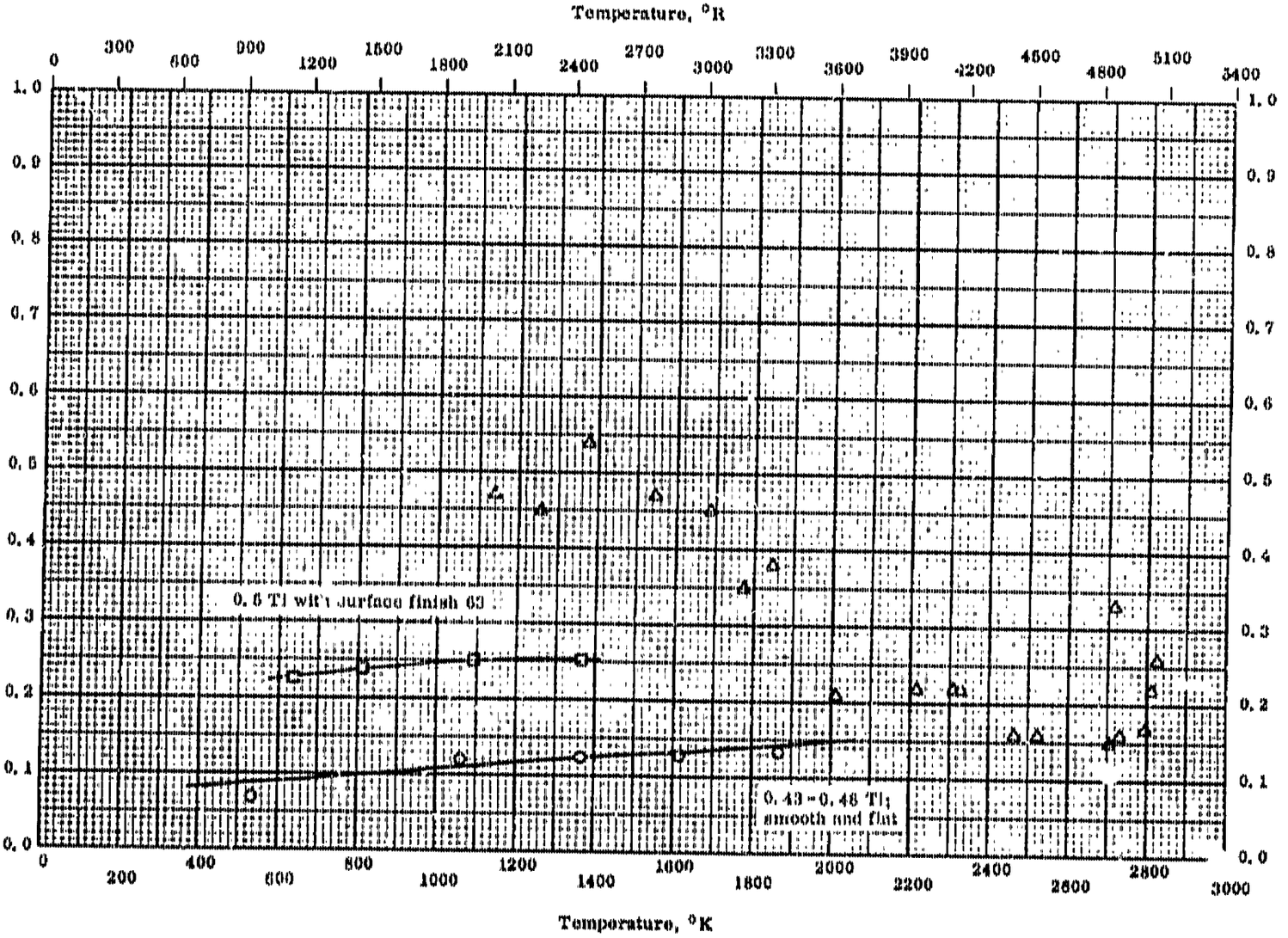
TPRC

THERMAL LINEAR EXPANSION -- MOLYBDENUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	63-1	300-2750	2	Climax Molybdenum Co.; 0.50 Ti, 0.07 Zr, 0.0200 C, < 0.005 Si, < 0.002 Fe, < 0.001 Ni, and traces of O, N, H; density 622 lb ft^{-3}; dimension 1/2 in. dia. by 6 in. long.	Measured in argon with heating rate of approx. 5 F per min.
△	60-11	293-1908	< 3	Supplied by General Electric Co., Cleveland, Ohio, nominal composition 0.5 Ti and 0.01 - 0.03 C.	Recrystallized at 2900 F for 35 min.
◇	60-16	300-1610	< 6	0.6 Ti from Am Metal Climax Co.	Recrystallized arc-cast billet at 2300 F, reduced approx. 60% by direct rolling, and then machined into 3/8 in. dia. by 3 in. long specimen.

TPRC

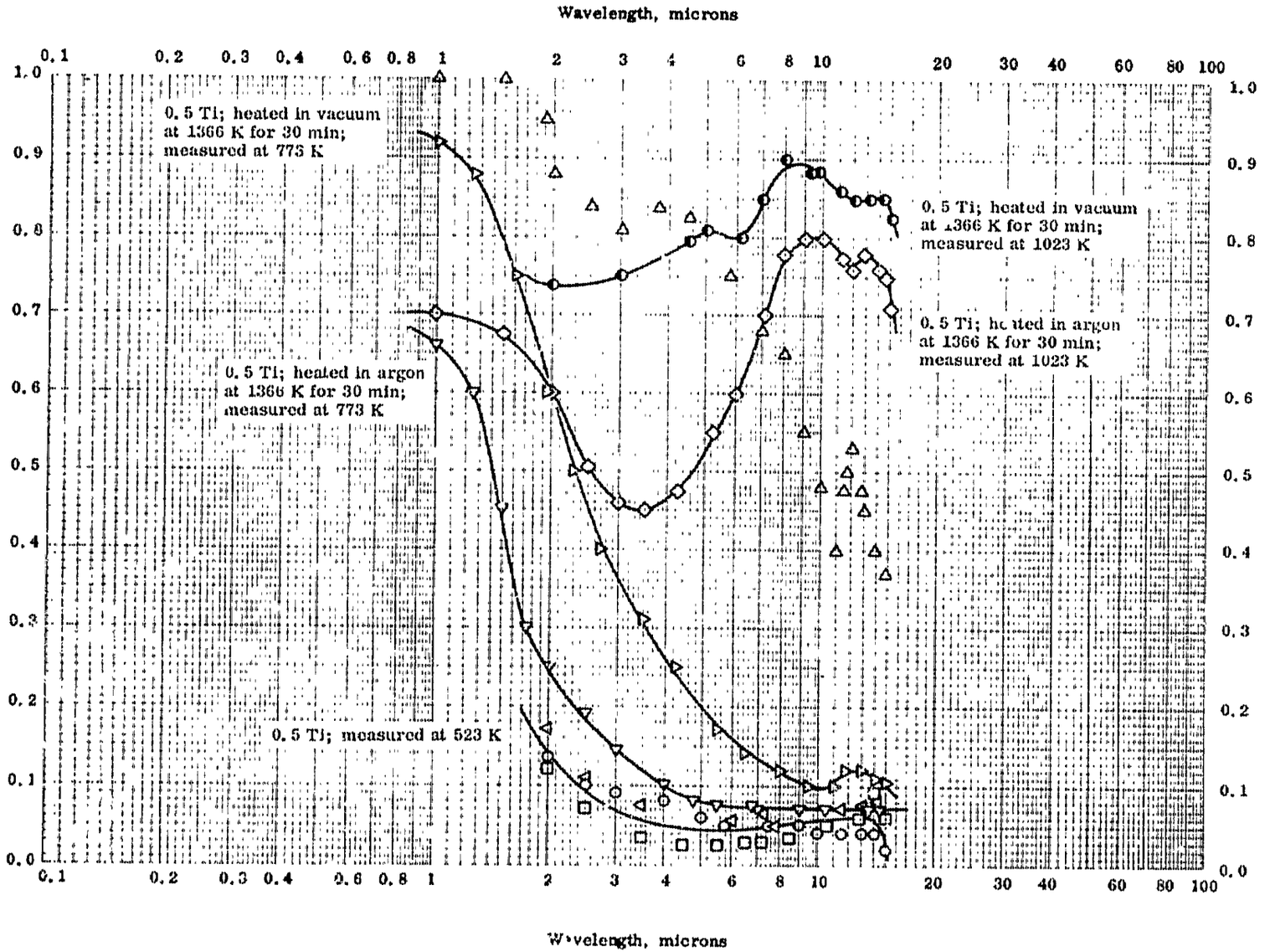


NORMAL TOTAL EMITTANCE — MOLYBDENUM + TITANIUM

NORMAL TOTAL EMITTANCE -- MOLYBDENUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	60-11	533-1866	±5	0.43 - 0.48 Ti, 0.024 - 0.31 C and 0.06 others.	Smooth and flat surface; exhibit metallic reflection both before and after heating; heated in an atmosphere of 90 Ar - 10 H_2 at 78 Cm Hg; averaged over two cycles.
△	62-4	1688-2716	10	0.5 Ti.	Measured in argon atmosphere.
□	60-18	644-1366		0.5 Ti; block; surface finish 63.	Measured in moisture removed helium.



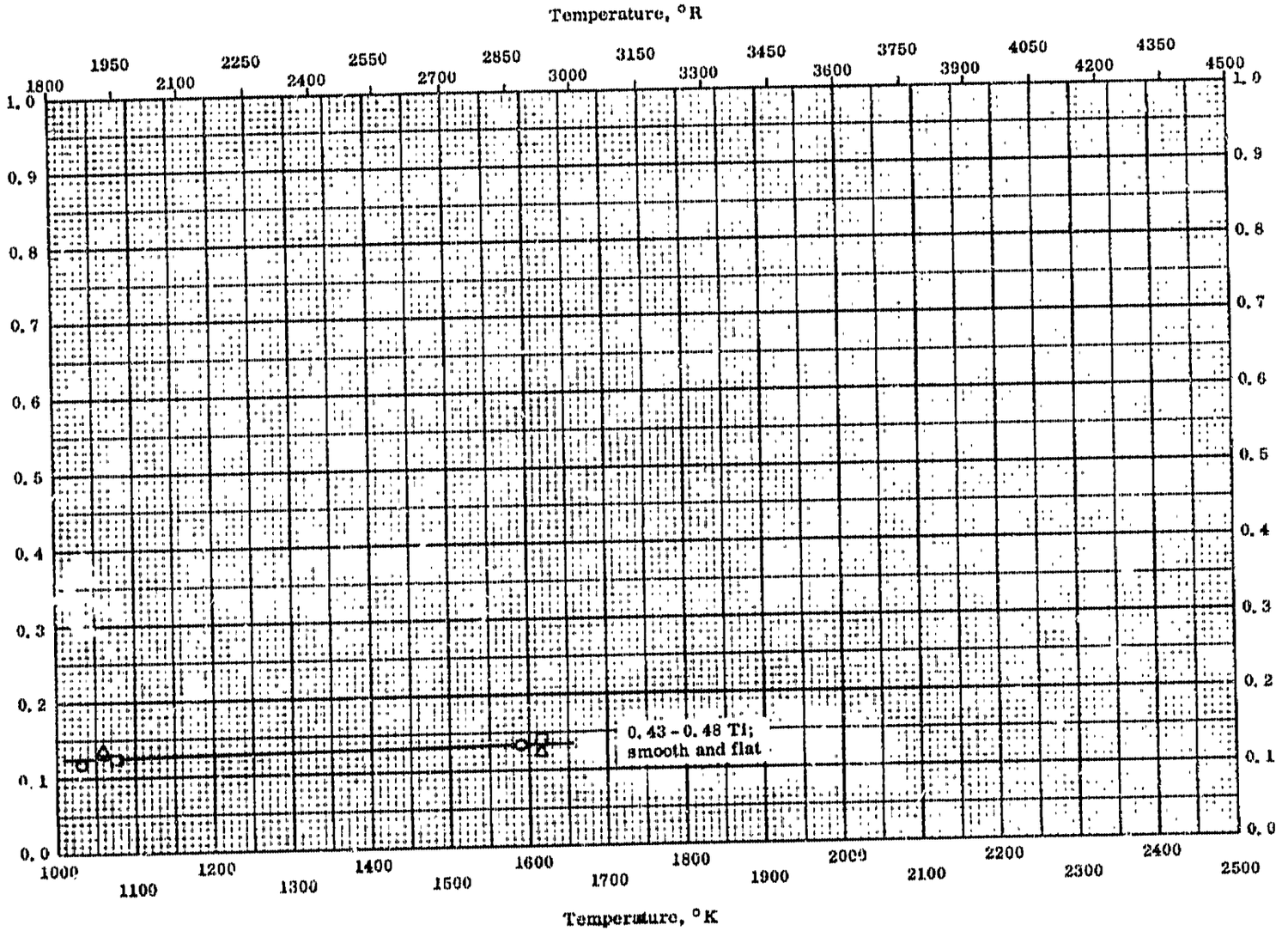
NORMAL SPECTRAL EMITTANCE -- MOLYBDENUM + TITANIUM

NORMAL SPECTRAL EMITTANCE -- MOLYBDENUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. °K	Wavelength Range, μ	Rept. Error%	Sample Specifications	Remarks
○	62-19	533.2	2.00-15.00		0.5 Ti; commercial; manufactured by Climax Molybdenum Co.	As received.
△	62-19	773.2	1.00-15.00		Same as above.	As received; another sample.
□	62-19	523.2	2.00-15.00		Same as above.	Heated in argon at 1366 K for 30 min.
▽	62-19	773.2	1.00-15.00		Same as above.	Same as above; another sample.
◇	62-19	1023	1.00-15.00		Same as above.	Same as above; another sample.
◁	62-19	523.2	2.00-15.00		Same as above.	Heated in a 22×10^{-5} mm Hg vacuum at 1366 K for 30 min.
▷	62-19	773.2	1.00-15.00		Same as above.	Same as above; another sample.
◐	62-19	1023	2.00-15.00		Same as above.	Same as above; another sample.

TPRC



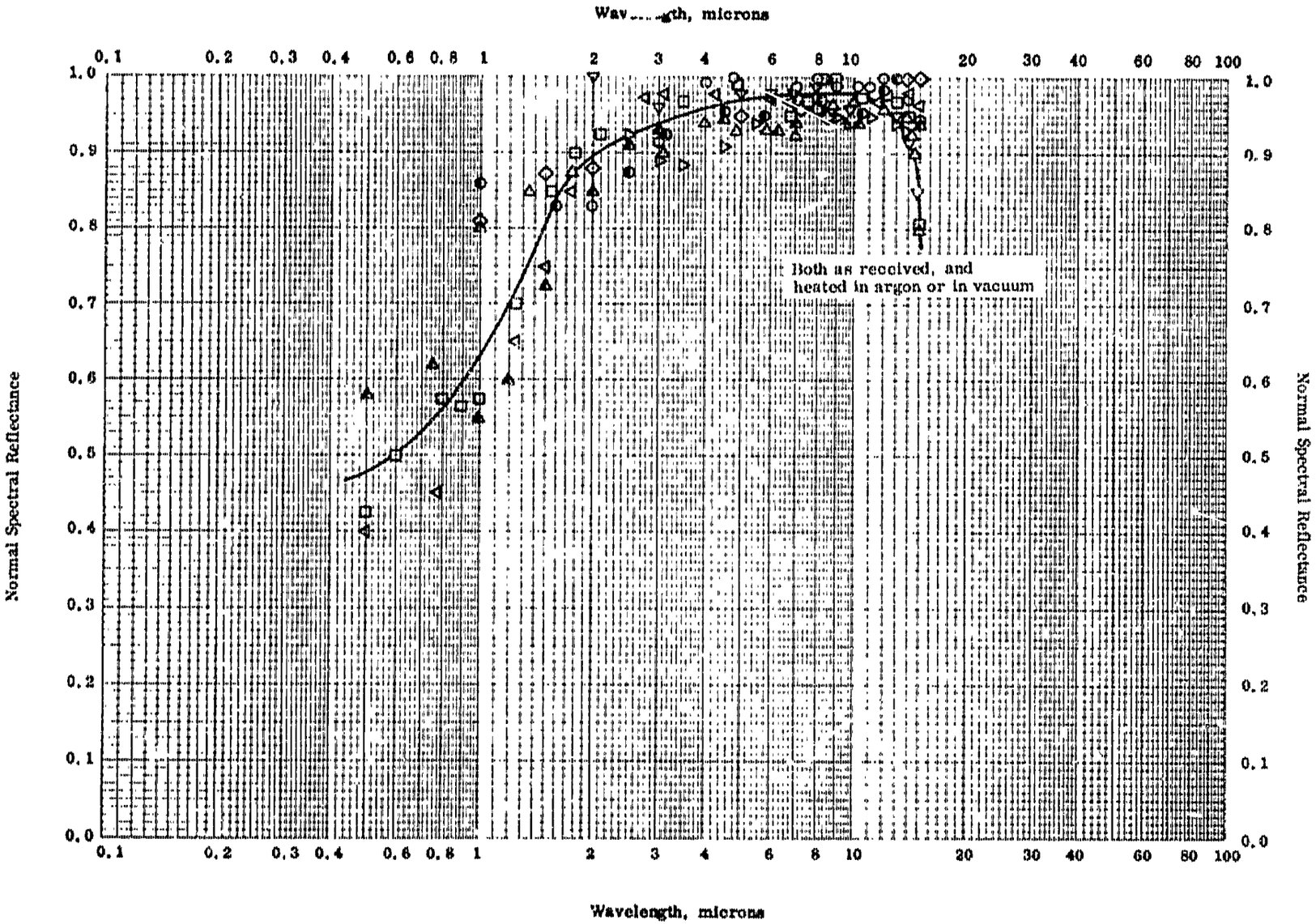
ANGULAR TOTAL EMITTANCE -- MOLYBDENUM + TITANIUM

ANGULAR TOTAL EMITTANCE -- MOLYBDENUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	60-11	1033-1589	±5	0.43 - 0.46 Ti, 0.024 - 0.31 C and 0.06 others.	Measured in argon-hydrogen atmosphere; 30° from normal.
△	60-11	1061-1616	±5	0.43 - 0.48 Ti, 0.024 - 0.31 C and 0.06 others.	Measured in argon-hydrogen atmosphere; 45° from normal.
□	60-11	1075-1616	±5	0.43 - 0.48 Ti 0.024 - 0.31 C and 0.06 others.	Measured in argon-hydrogen atmosphere; 60° from normal.

TPRC



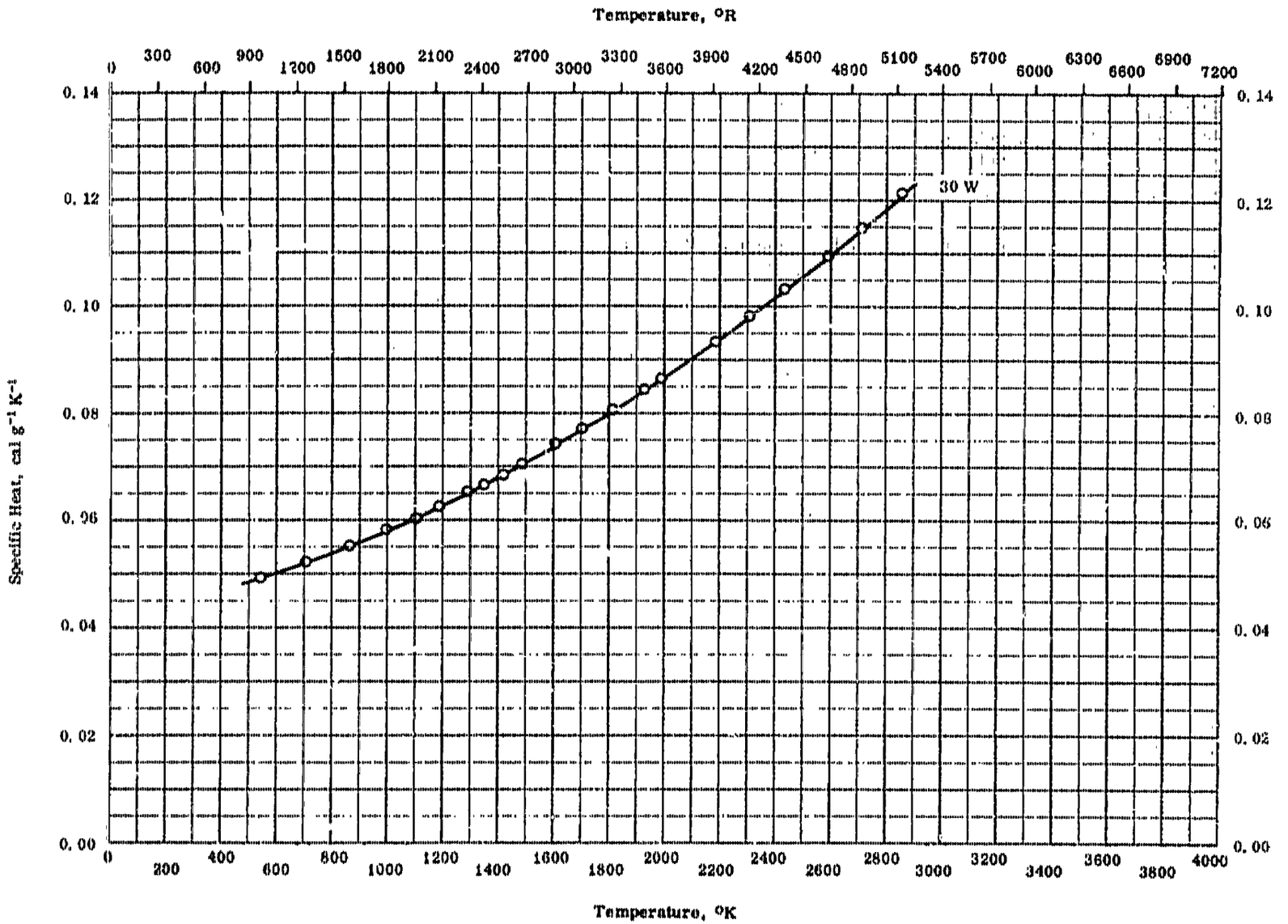
NORMAL SPECTRAL REFLECTANCE -- MOLYBDENUM + TITANIUM

NORMAL SPECTRAL REFLECTANCE -- MOLYBDENUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. °K	Wavelength Range, μ	Rept. Error %	Sample Specifications	Remarks
○	62-19	<322	2.0-15.00		0.5 Ti; commercial; manufactured by Climax Molybdenum Co.	As received; 523.2 K source; hemispherical illumination and normal viewing.
△	62-19	<322	1.00-15.00		Same as above.	As received; 773.2 K source; hemispherical illumination and normal viewing.
□	62-19	<322	0.50-15.00		Same as above.	As received; 1273 K source; hemispherical illumination and normal viewing.
▽	62-19	<322	2.00-15.00		Same as above.	Heated in argon at 1333 K for 0.5 hr.; 523.2 K source; hemispherical illumination and normal viewing.
◇	62-19	<322	1.00-15.00		Same as above.	Heated in argon at 1366 K for 30 min.; 773.2 K source; hemispherical illumination and normal viewing.
◁	62-19	<322	0.50-15.00		Same as above.	Heated in argon at 1366 K for 30 min.; 1273.2 K source; hemispherical illumination and normal viewing.
▷	62-19	<322	2.00-15.00		Same as above.	Heated in a 22×10^{-5} mm Hg vacuum at 1366 K for 30 min.; 523.2 K source; hemispherical illumination and normal viewing.
●	62-19	<322	1.00-14.00		Same as above.	Same as above except with 773.2 K source.
▲	62-19	<322	0.500-15.00		Same as above.	Same as above except with 1273 K source.

TPRC



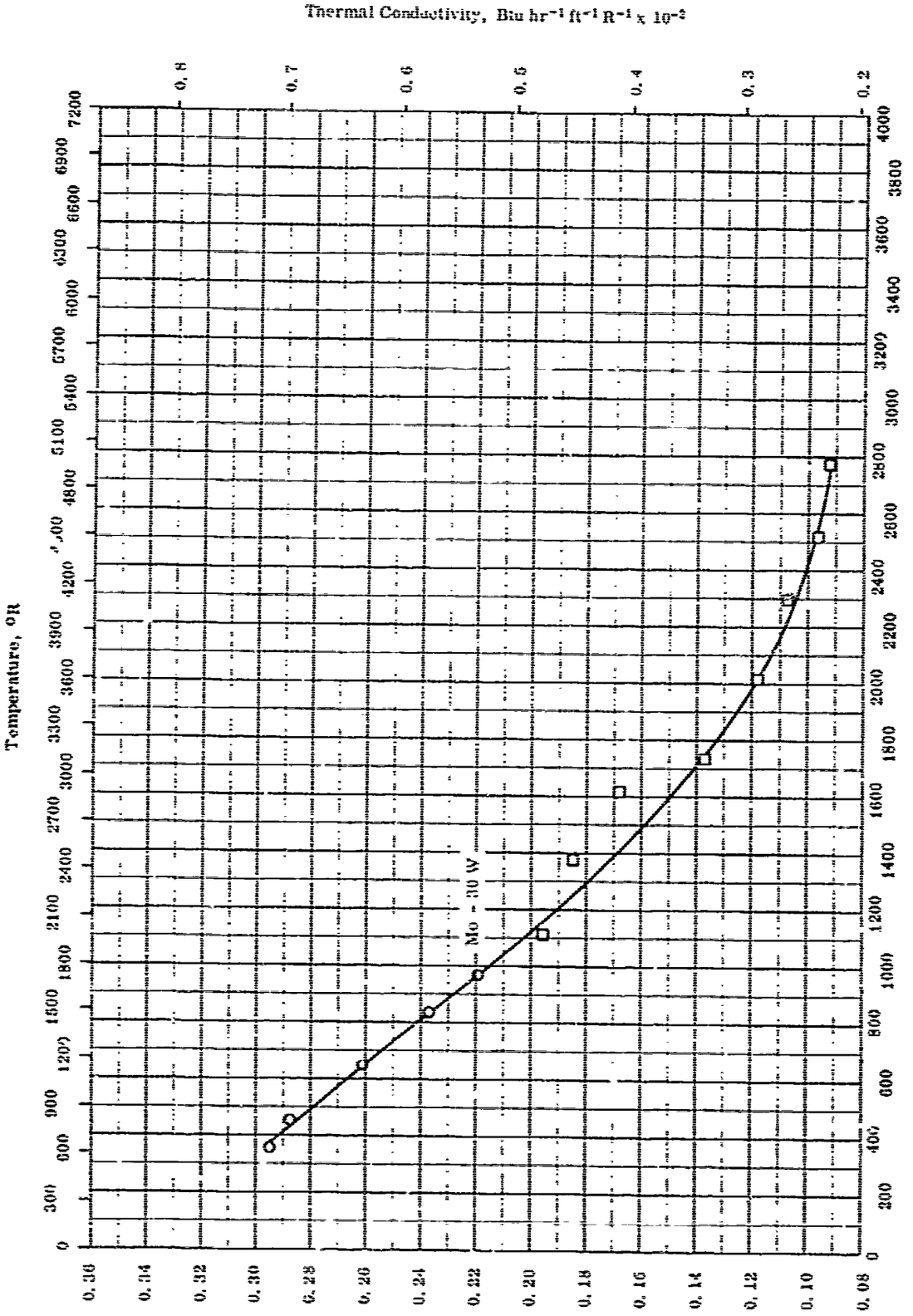
SPECIFIC HEAT -- MOLYBDENUM + TUNGSTEN

SPECIFIC HEAT -- MOLYBDENUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Expt. Error %	Sample Specifications	Remarks
O	63-1	520-2850	±5.0	Mo-29.83 W - 0.07 Zr - 0.012 C alloy; 29.83 W, 0.07 Cr, and 0.012 C.	

TPRC

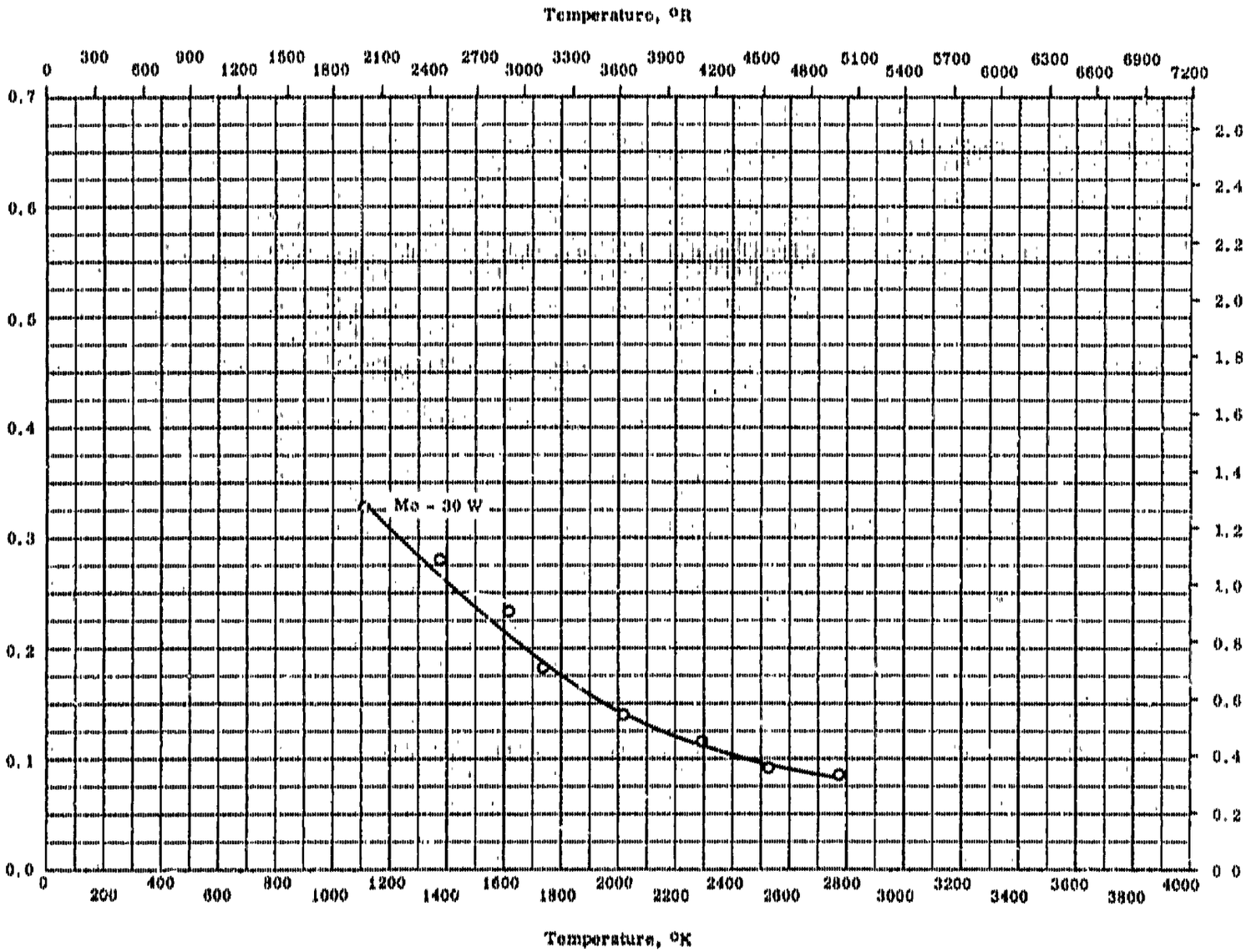


THERMAL CONDUCTIVITY — MOLYBDENUM + TUNGSTEN

THERMAL CONDUCTIVITY -- MOLYBDENUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	63-1	358-964	± 4	29.83 W, 0.07 Zr, and 0.0120 C; density 620 lb ft^{-3}.	End faces ground flat and parallel; measured in He atm.
□	63-1	1110-2772	± 4	Same as above.	Same as above except measured by another method.



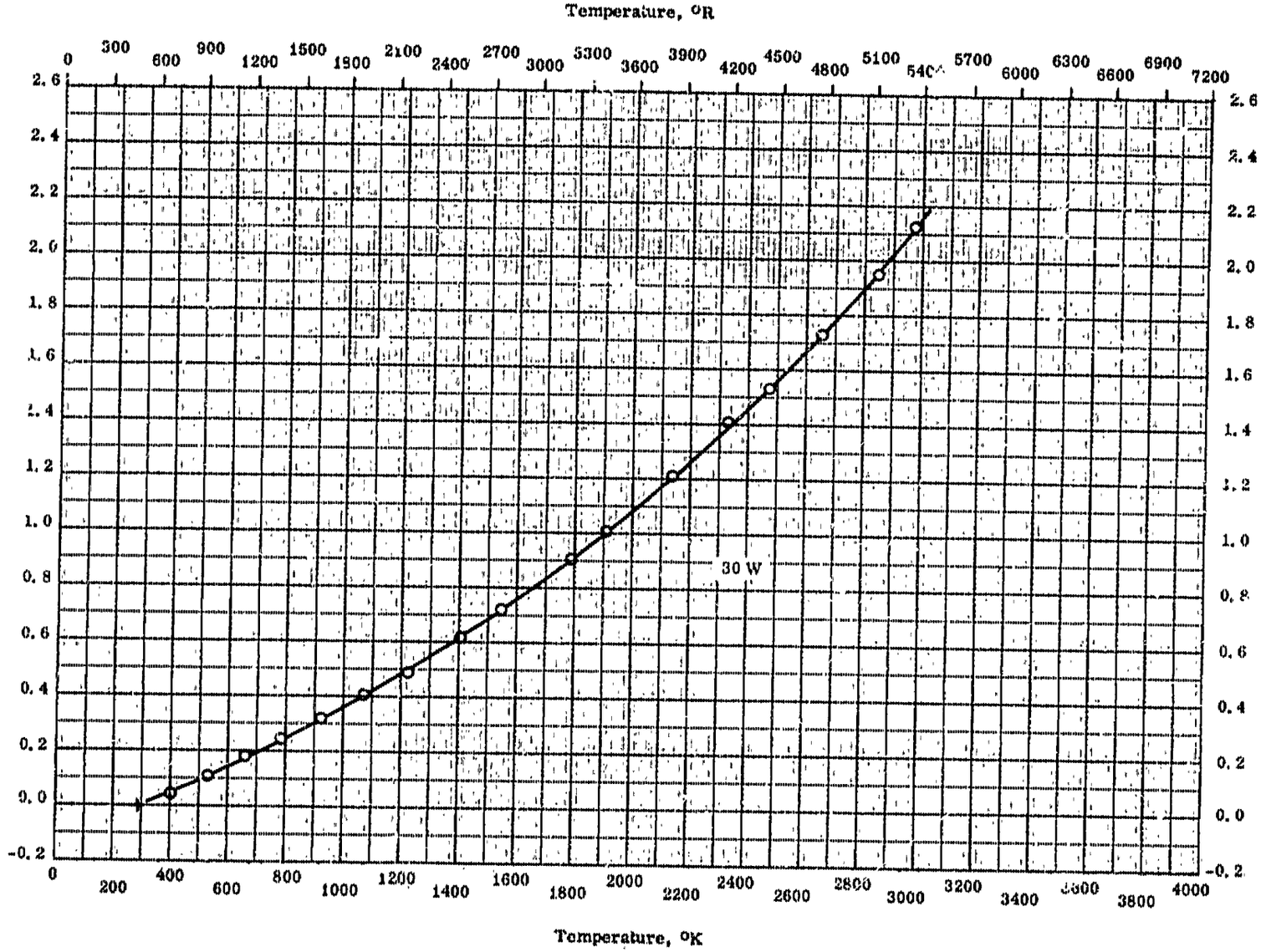
THERMAL DIFFUSIVITY — MOLYBDENUM + TUNGSTEN

THERMAL DIFFUSIVITY — MOLYBDENUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-1	1111-2774		70.088 Mo, 29.83 W, 0.07 Zr, and 0.012 C; density 9.93 g cm^{-3}.	Surface ground discs.

TPRC



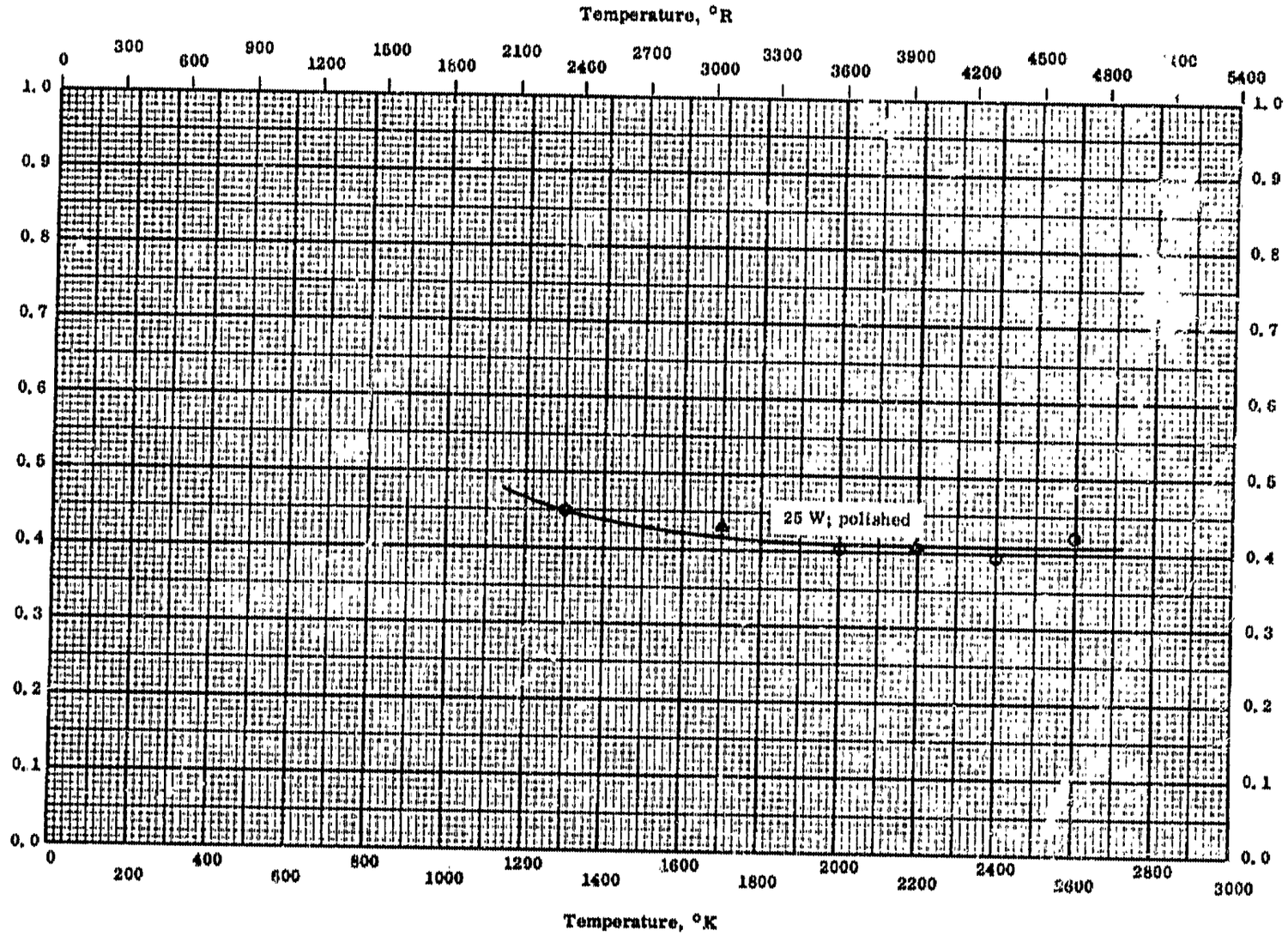
THERMAL LINEAR EXPANSION -- MOLYBDENUM + TUNGSTEN

THERMAL LINEAR EXPANSION -- MOLYBDENUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	63-1	300-2973	2	Climax Molybdenum Co.; 70.09 Mo, 29.83 W, 0.07 Zr, and 0.0120 C; density 620 lb ft^{-3}; specimen dimension 1/2 in. dia. by 6 in. long.	Measured in argon with heating rate of approx. 5 F per min.

TPRC



TPRC

NORMAL SPECTRAL EMITTANCE — MOLYBDENUM + TUNGSTEN

NORMAL SPECTRAL EMITTANCE -- MOLYBDENUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	33-1	0.660	1300-2600	±2	75 Mo and 25 W.	Electrolytically polished in KO_2 solution, further polish using 00, 000 and 0900 polishing papers.
△	36-2	0.660	1300-2400	±2	25 W; tubular filament.	Formed from powdered metal, sintered; electrolytically polished in KOH bath.

TPRC

PROPERTIES OF NEPTUNIUM + URANIUM

REPORTED VALUES

Density:	g cm^{-3}	lb ft^{-3}
Δ 0.20 U	19.5 ± 0.6	1220 ± 35
Melting Point:	**K**	**R**
∇ 0.20 U	913 ± 1	1644 ± 2

PROPERTIES OF NEPTUNIUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
△	50-16	298		0.2 U, 0.08 Fe, 0.02 Ca, and 0.013 Ba.	Ba reduced from NpF_3 ; density by measuring weight and volume of displacement of liquid.
▽	50-16	912-915		Same as above.	

PROPERTIES OF NEODYMIUM + MAGNESIUM

REPORTED VALUES

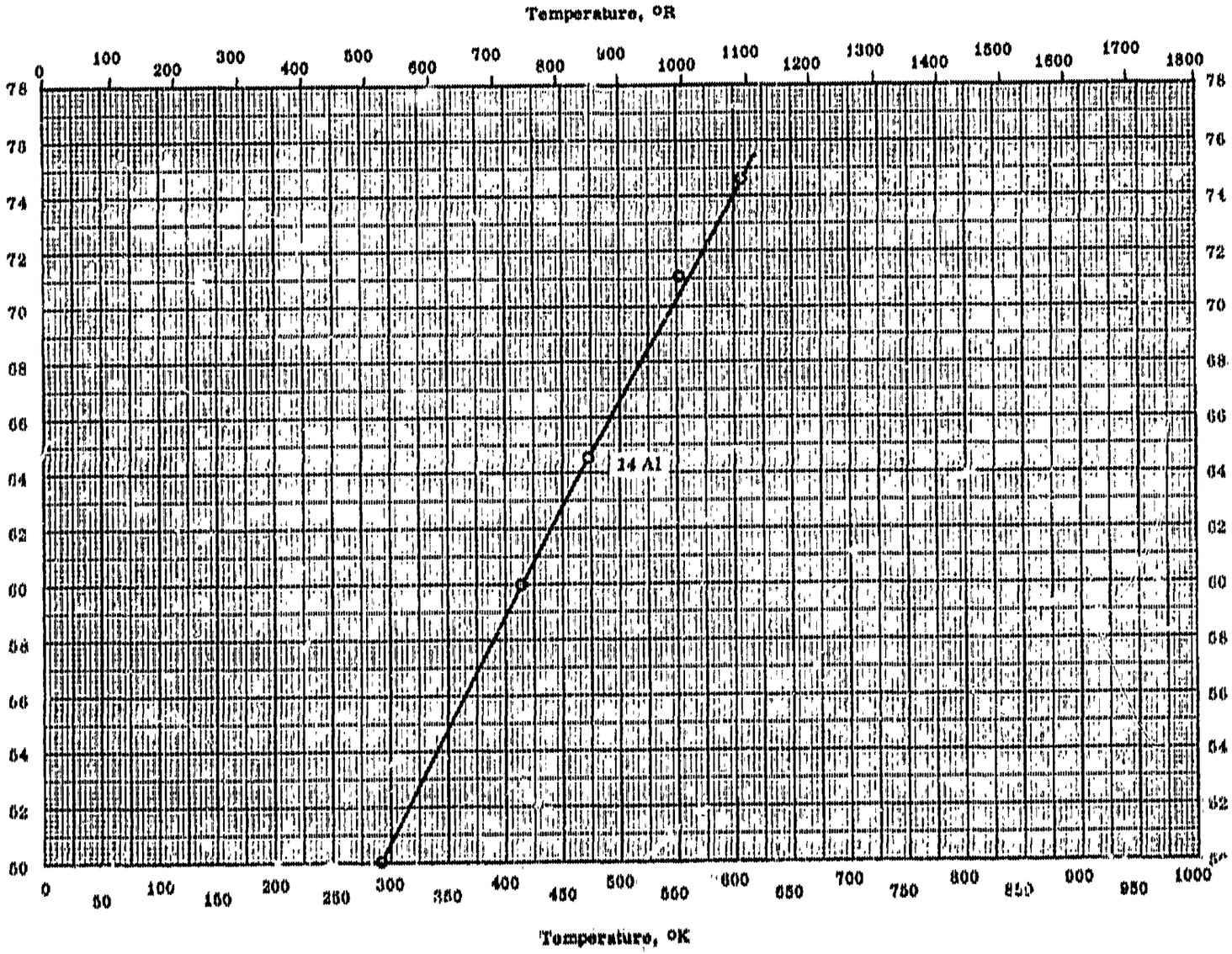
Density	$g\ cm^{-3}$	$lb\ ft^{-3}$
O 1.0 Mg	6.9	423

PROPERTIES OF NEODYMIUM + MAGNESIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	52-11	298		1.0 > Mg, 0.025 > Ca, 0.0178 Fe, 0.01 > other rare earth; entirely hexagonal close packed phase.	Cast then annealed for 19 hrs at 600 C.

TPRC



TPRC

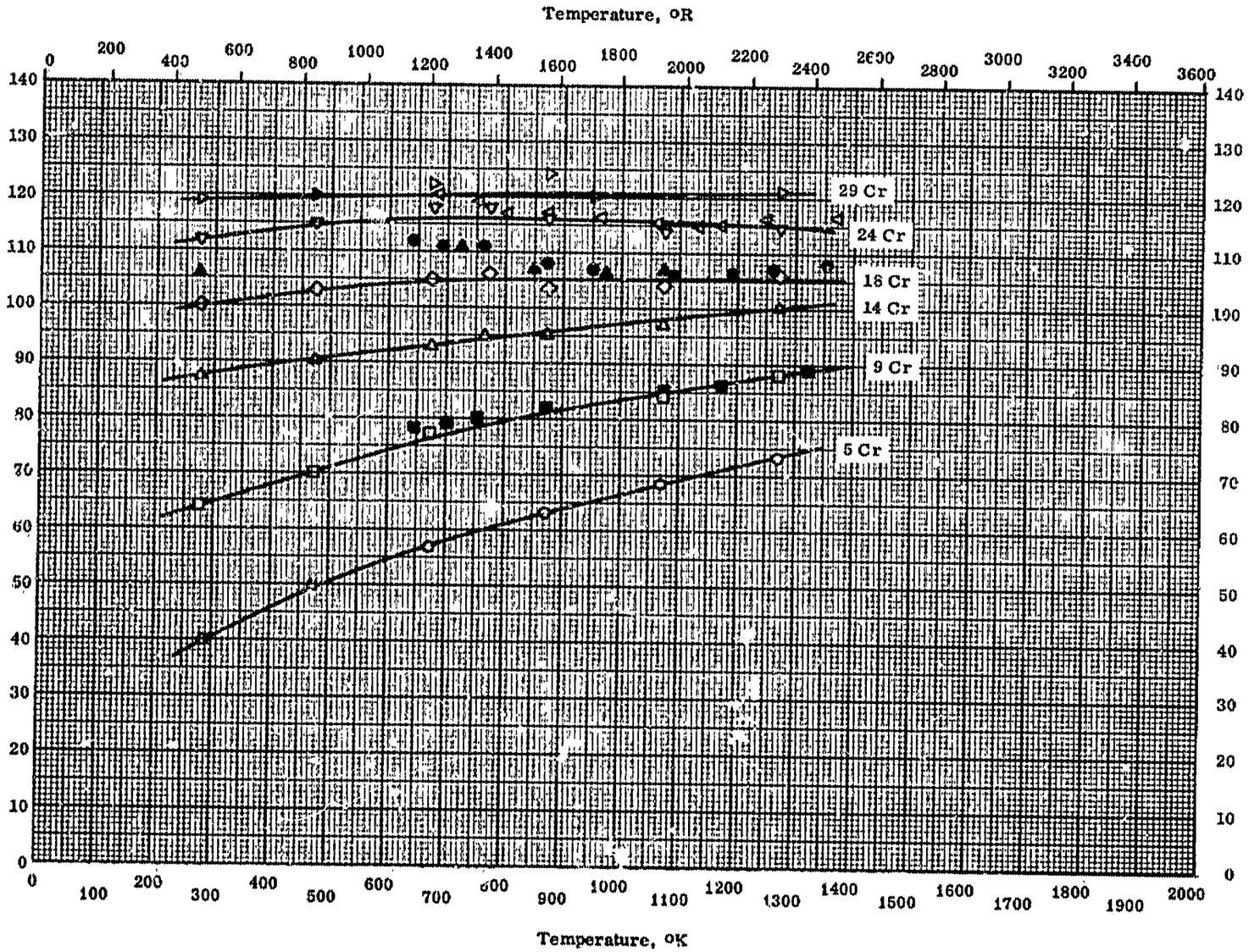
ELECTRICAL RESISTIVITY — NICKEL + ALUMINUM

ELECTRICAL RESISTIVITY -- NICKEL + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	54-18	293-606		86.2 Ni and 13.8 Al; prepared from 99.89 pure Mond carbonyl process Ni with 0.10 >C and 0.001 > Co and 99.99 pure Al with 0.001 each Cu, Fe, Si.	Heat treated 72 hrs at 1100 C, furnace cooled.

TPRC

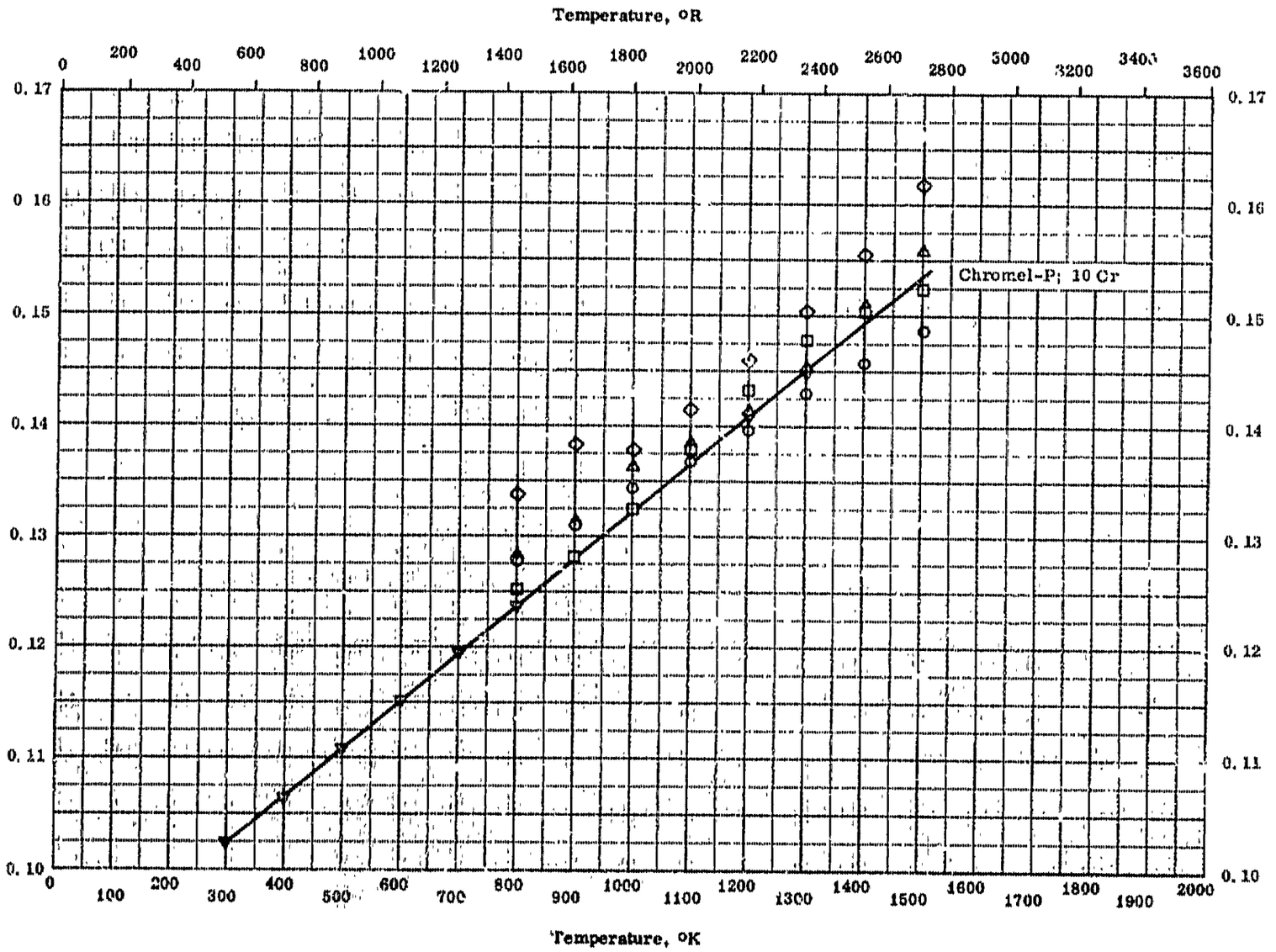


ELECTRICAL RESISTIVITY -- NICKEL + CHROMIUM

ELECTRICAL RESISTIVITY -- NICKEL + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	51-11	288-1273		Nominal: 95.15 Ni and 4.85 Cr.	Vacuum melted, forged, rolled, and then cold drawn into 0.4 mm wires.
□	51-11	273-1273		Nominal: 90.8 Ni and 9.2 Cr.	Same as above.
△	51-11	273-1273		Nominal: 85.6 Ni and 14.4 Cr.	Same as above.
◇	51-11	273-1273		Nominal: 81.9 Ni and 18.1 Cr.	Same as above.
▽	51-11	273-1273		Nominal: 76 Ni and 24 Cr.	Same as above.
▷	51-11	273-1273		Nominal: 71.1 Ni and 28.9 Cr.	Same as above.
◁	54-15	683-1373		70.6 Ni and 29.4 Cr; prepared from Mond Ni and electrolytic Cr.	Cr annealed at 1250 C in H_2 atmos. for 100 hrs to decrease O_2 and C content.
●	54-15	643-1353		79.8 Ni, 20.2 Cr, 0.03 O_2, 0.005 N_2, 0.002 C, and 0.002 S.	Same as above.
■	54-15	643-1323		90.2 Ni, and 9.8 Cr.	Same as above.
▲	57-31	273-1173	±0.1	18.1 Cr, 0.6 > Mn, and 0.3 > Si.	50% cold reduced by rolling; tempered 7 days at 435 C.



TPRC

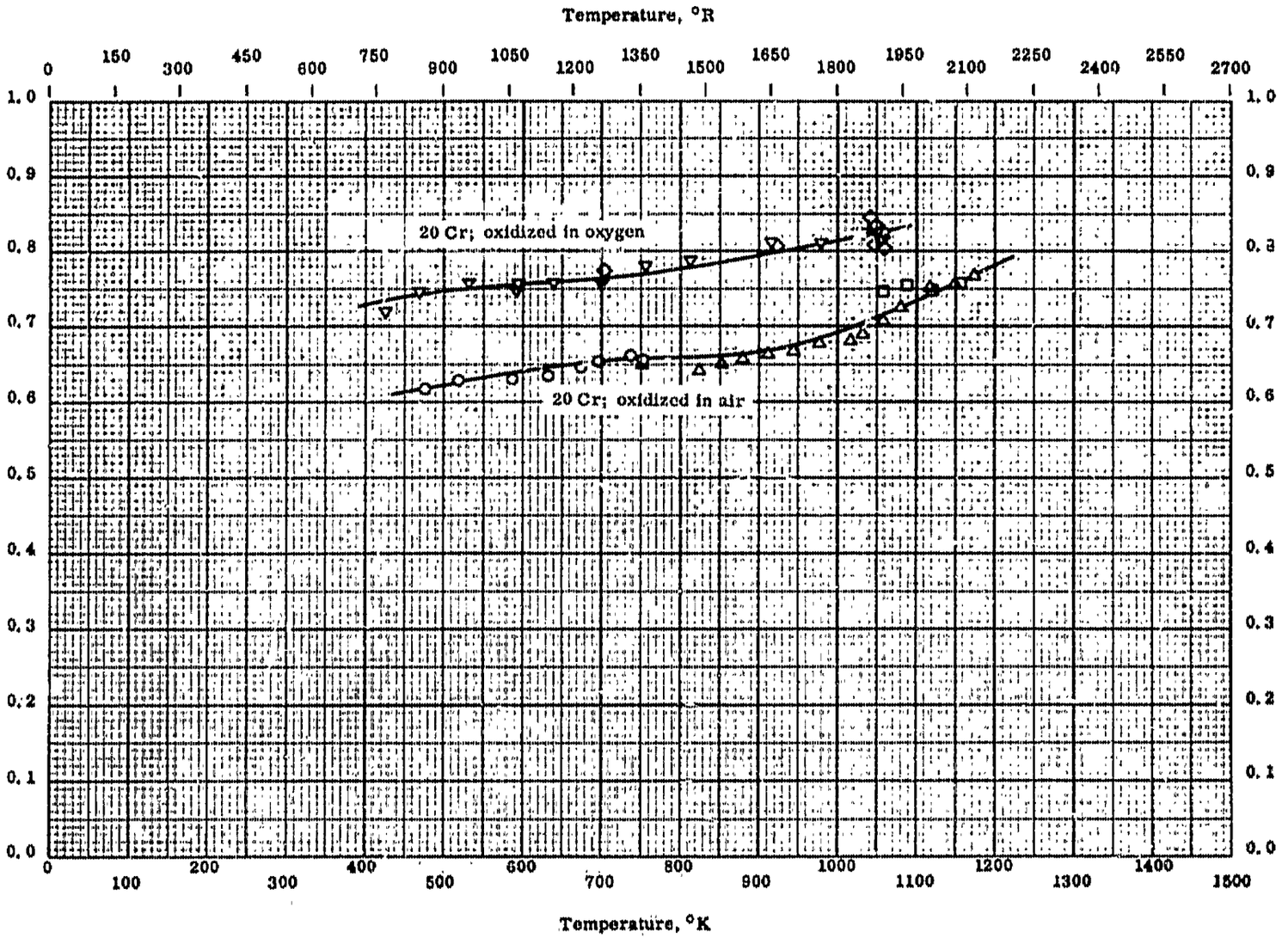
SPECIFIC HEAT -- NICKEL + CHROMIUM

SPECIFIC HEAT -- NICKEL + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	59-12	800-1500	± 0.3	$Ni_{0.9818}Cr_{0.0182}$; 98.39 Ni and 1.61 Cr.	Under argon atmosphere.
□	59-12	800-1500	± 0.3	$Ni_{0.9753}Cr_{0.0247}$; 97.81 Ni and 2.19 Cr.	Same as above.
△	59-12	800-1500	± 0.3	$Ni_{0.9562}Cr_{0.0438}$; 96.09 Ni and 3.91 Cr.	Same as above.
◇	59-12	800-1500	± 0.3	$Ni_{0.8897}Cr_{0.1103}$; 90.08 Ni and 9.92 Cr.	Same as above.
▽	63-13	298-1600		Chromel-P; 90 Ni and 10 Cr.	

TPRC



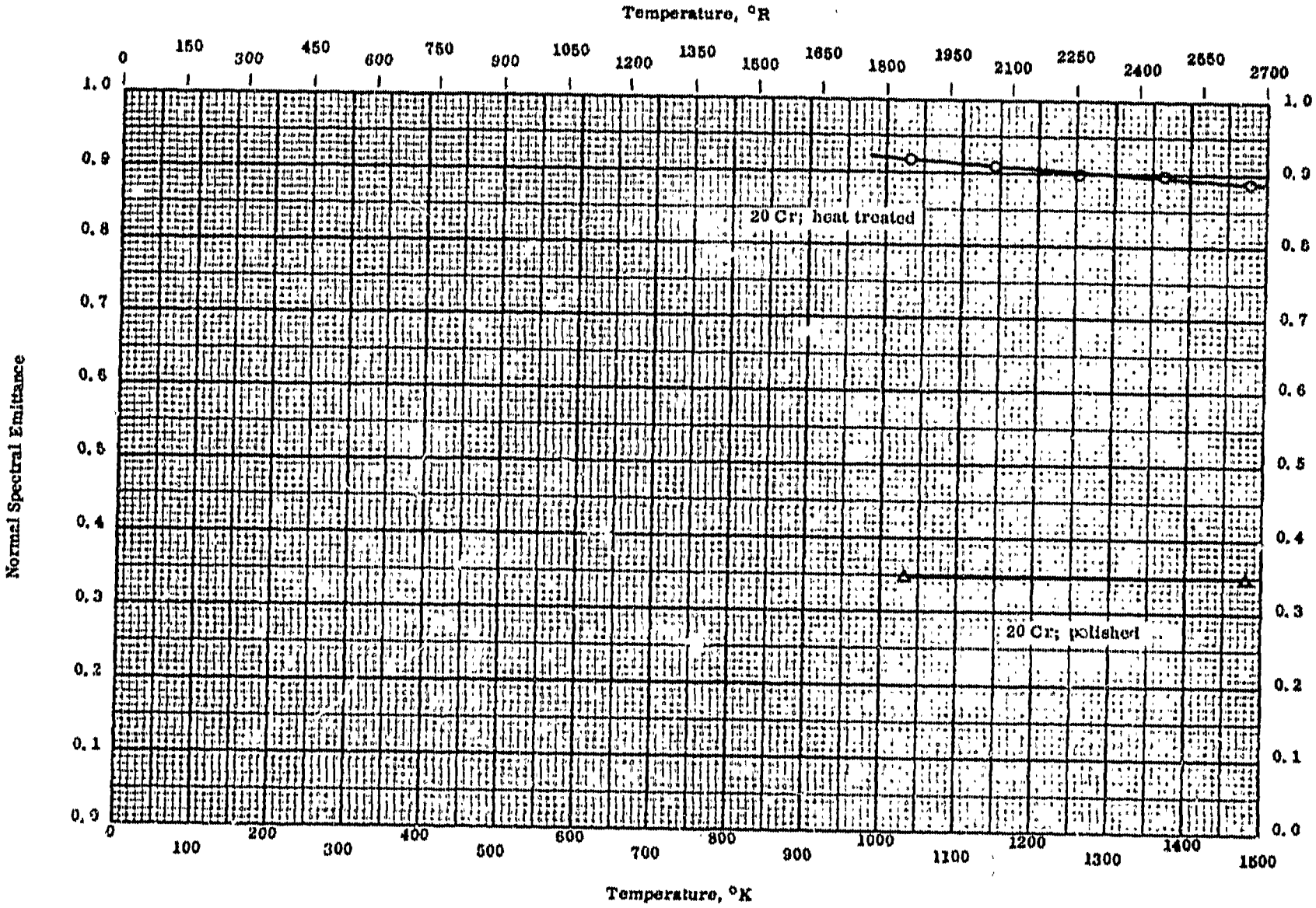
HEMISPHERICAL TOTAL EMITTANCE -- NICKEL + CHROMIUM

HEMISPHERICAL TOTAL EMITTANCE -- NICKEL + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	64-6	477-753		Nichrome; 80 Ni and 20 Cr.	Oxidized in air at 1800 F for 2 hrs; first run.
△	64-6	751-1174		Same as above.	Same as above; second heating.
□	64-6	1060-1157		Same as above.	Same as above; second cooling.
▽	64-6	427-1035		Same as above.	Oxidized in oxygen at 1800 F for 1/4 hr.; first run.
◇	64-6	705-1059		Same as above.	Same as above; second run.

TPRC



NORMAL SPECTRAL EMITTANCE — NICKEL + CHROMIUM

NORMAL SPECTRAL EMITTANCE -- NICKEL + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range, °K	Rept. Error%	Sample Specifications	Remarks
○	39-2	0.65	1033-1589	2	80 Ni and 20 Cr; bar.	Polished with rouge paper; heat 2 hrs at 1478 K; measured in air.
△	39-2	0.65	1033-1478	2	80 Ni and 20 Cr; bar.	Polished with rouge paper; measured in purified hydrogen; emittance constant over the temperature range from 1033 K to 1478 K.

TPRC

PROPERTIES OF NICKEL + COBALT

REPORTED VALUES

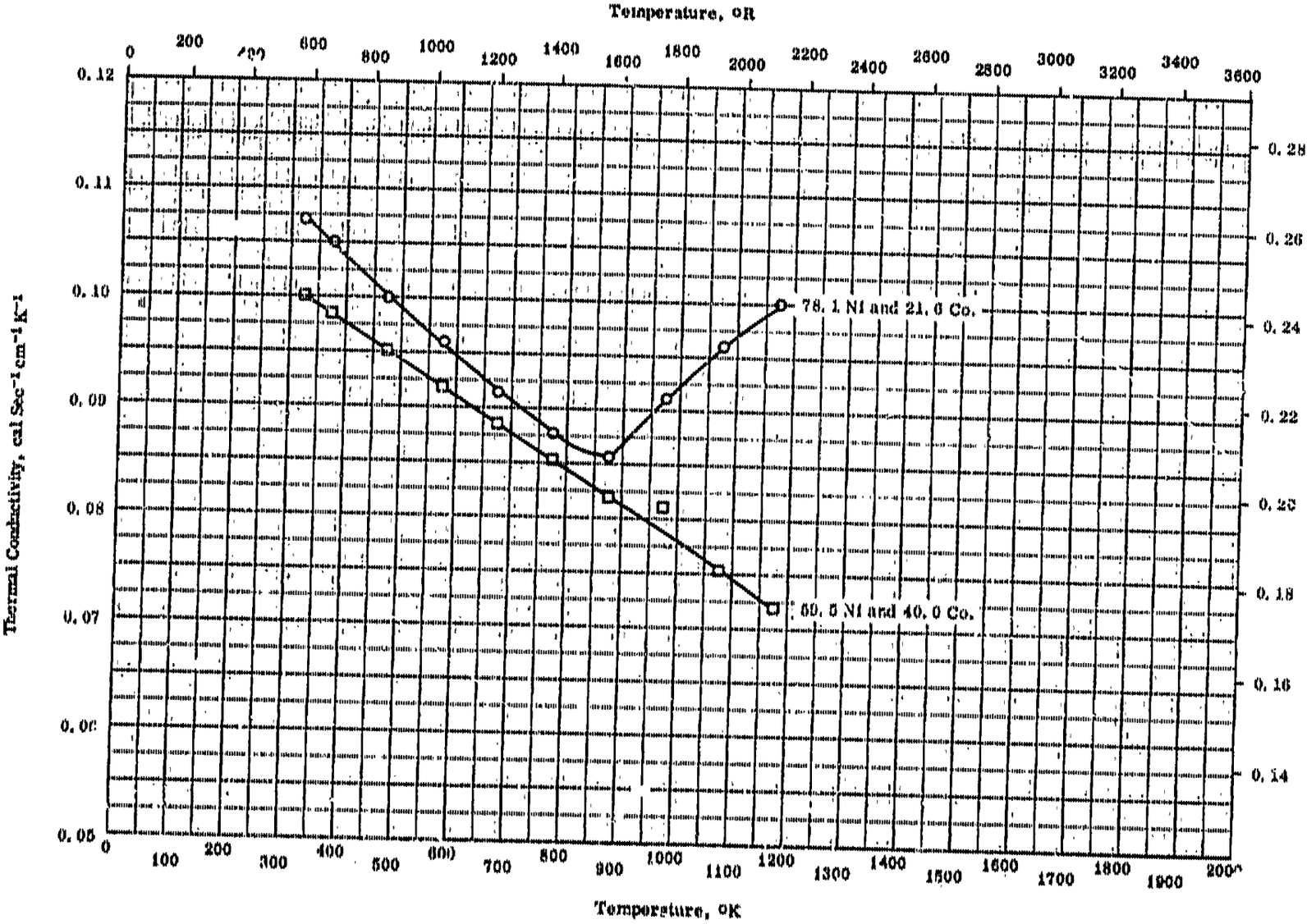
Density:	g cm^{-3}	lb ft^{-3}
○ 20 Co	8.89	555.3
□ 40 Co	8.87	554.3

PROPERTIES OF NICKEL + COBALT

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	50-12	298		20 Co; made from 99.92 electrolytic Ni (0.037 Fe, 0.030 Co, 0.023 As, 0.020 Cu, 0.01 C, 0.009 P, and 0.001 each Si and Mn).	Melted in alumina tube; forged, annealed, rolled annealed, machined to size, and annealed 2 hrs at 1100 C.
□	50-12	298		40 Co; same as above.	Same as above.

TPRC



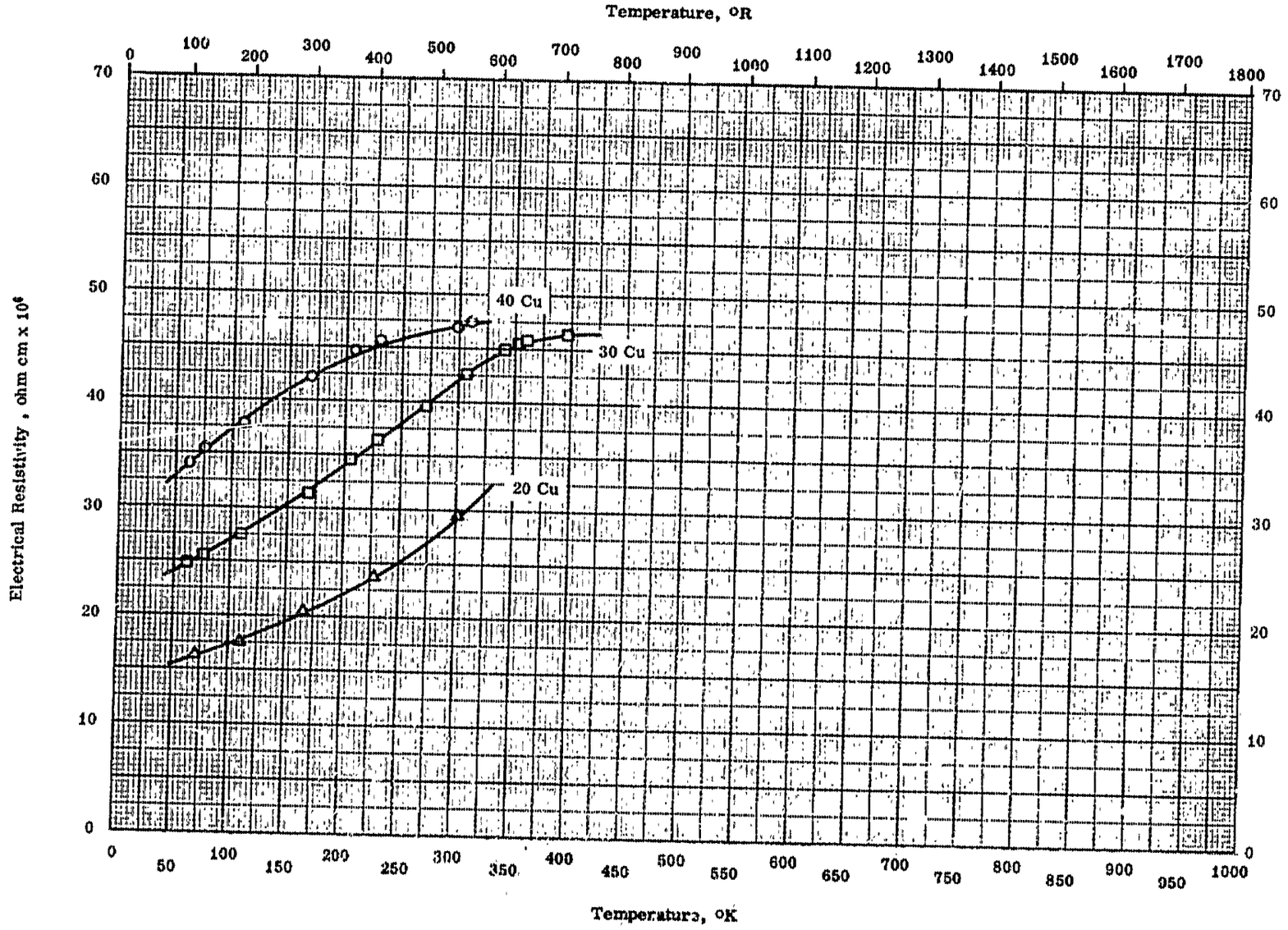
THERMAL CONDUCTIVITY — NICKEL + COBALT

THERMAL CONDUCTIVITY -- NICKEL + COBALT

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	53-2	328-1173		RCA-N97; 78.1 Ni, 21.6 Co, 0.105 Mn, 0.115 C, and 0.01 Mg.	
□	53-2	323-1173		RCA-N91; 59.5 Ni, 40.0 Co, 0.19 Si, 0.175 Mn, 0.132 C, and 0.01 Mg.	

TPRC



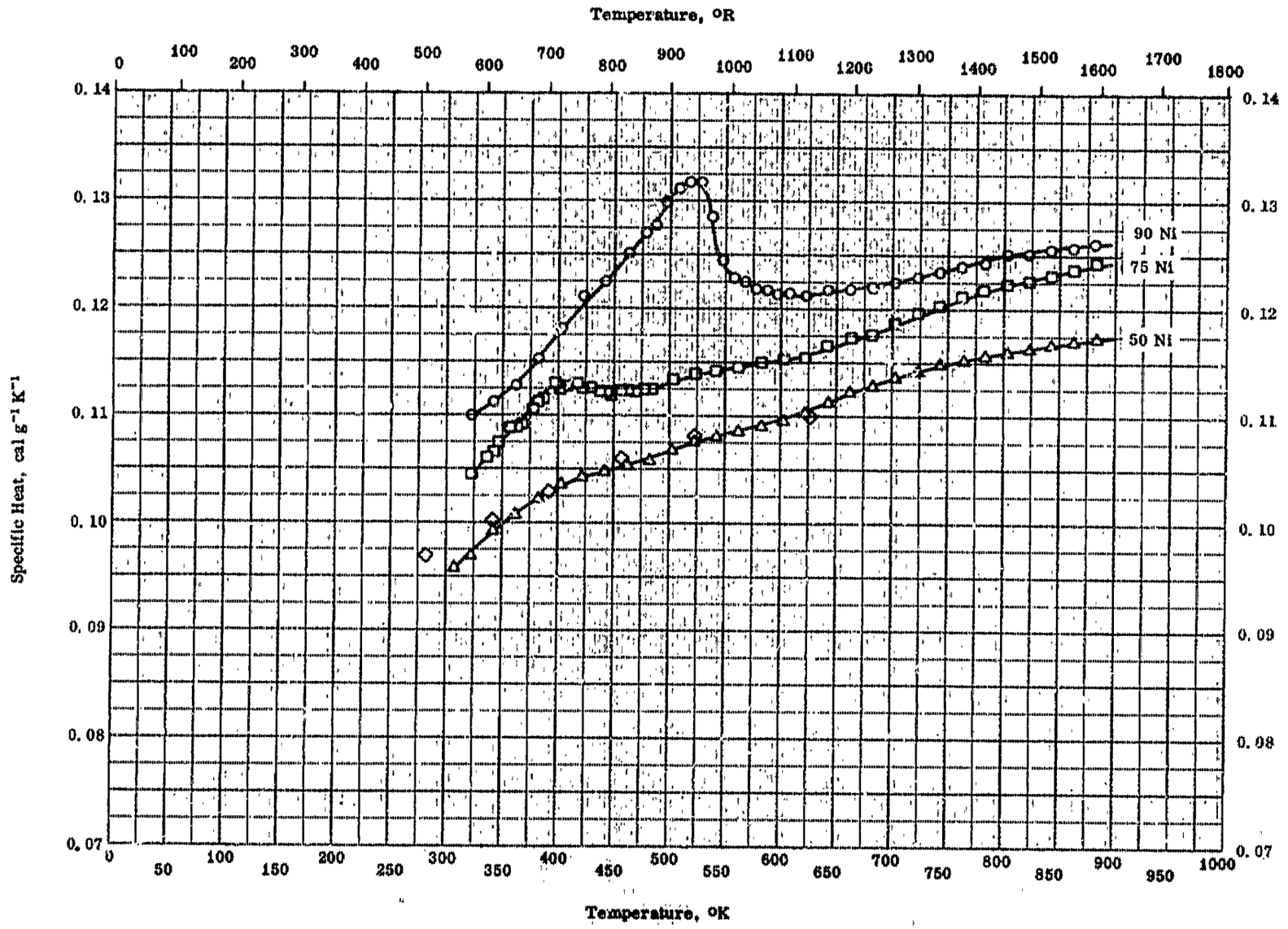
ELECTRICAL RESISTIVITY -- NICKEL + COPPER

TPRC

ELECTRICAL RESISTIVITY -- NICKEL + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-21 also 56-22	64-310		60 Ni and 40 Cu.	
□	56-21 also 56-22	64-399		70 Ni and 30 Cu.	
△	56-21 also 56-22	77-302		80 Ni and 20 Cu.	



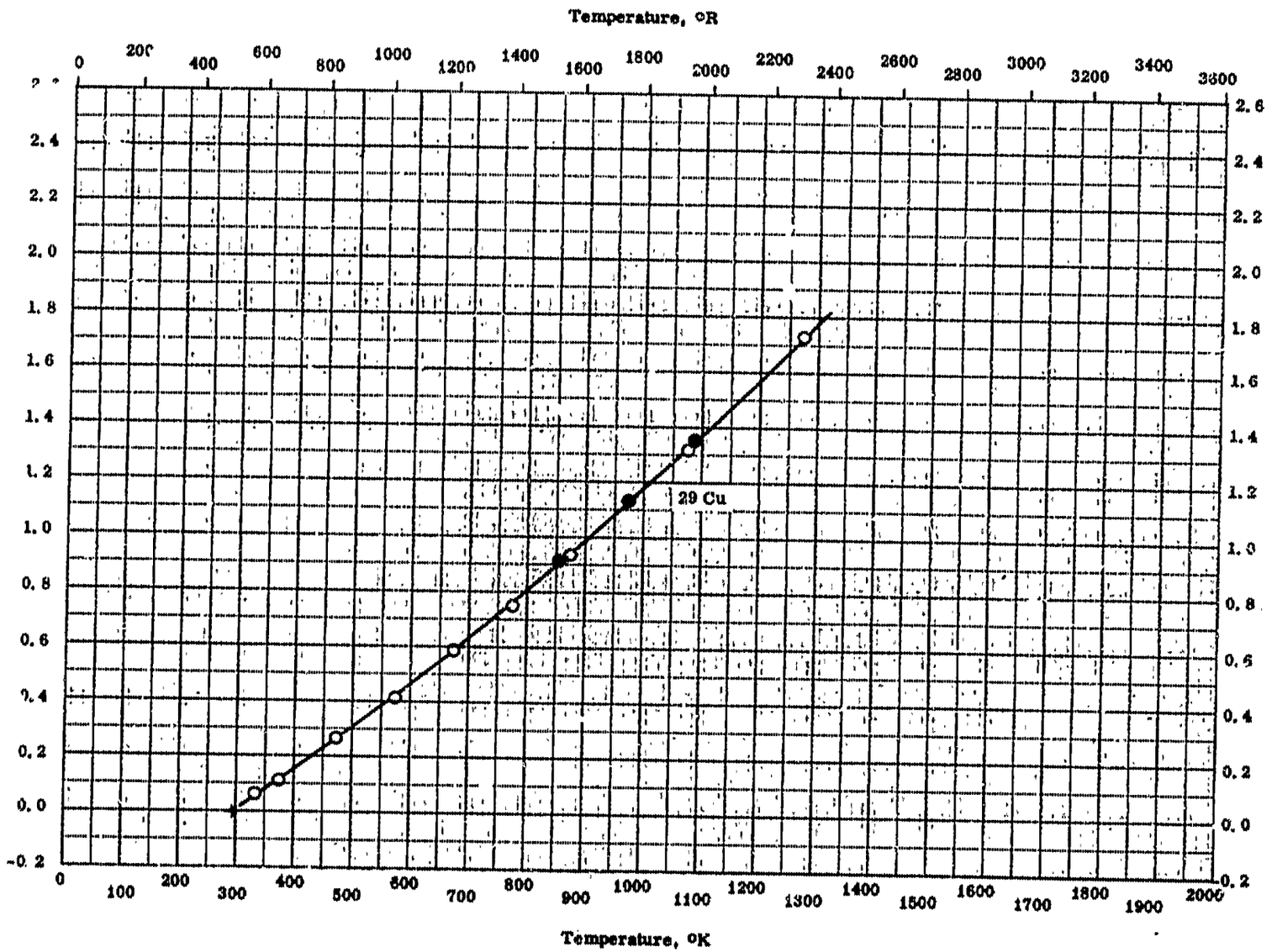
SPECIFIC HEAT -- NICKEL + COPPER

SPECIFIC HEAT -- NICKEL + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Expt. Error %	Sample Specifications	Remarks
○	59-9	323-883	± 0.5	90% Nickel alloy; 90.05 Ni and 9.95 Cu.	
□	59-9	323-883	± 0.5	75% Nickel alloy; 75.07 Ni and 24.93 Cu.	
△	59-9	308-883	± 0.5	50% Nickel alloy; 50.04 Ni and 49.96 Cu.	
◇	40-3	283-629	± 0.5	50 Ni and 50 Cu.	

TPRC



THERMAL LINEAR EXPANSION -- NICKEL + COPPER

THERMAL LINEAR EXPANSION -- NICKEL + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-52	293-1273		Monel; 66.4 Ni and 29.4 Cu.	Annealed 3 hrs at 1000 C in pure dry hydrogen furnace, cooled 150 C hr^{-1} from 1000 to 600 C, then at 85 C hr^{-1} to 20 C; heating.
●	57-52	853-1273		Same as above.	Cooling data of above specimen.

TPRC

Electrical Resistivity, ohm cm x 10^6

ELECTRICAL RESISTIVITY — NICKEL + IRON

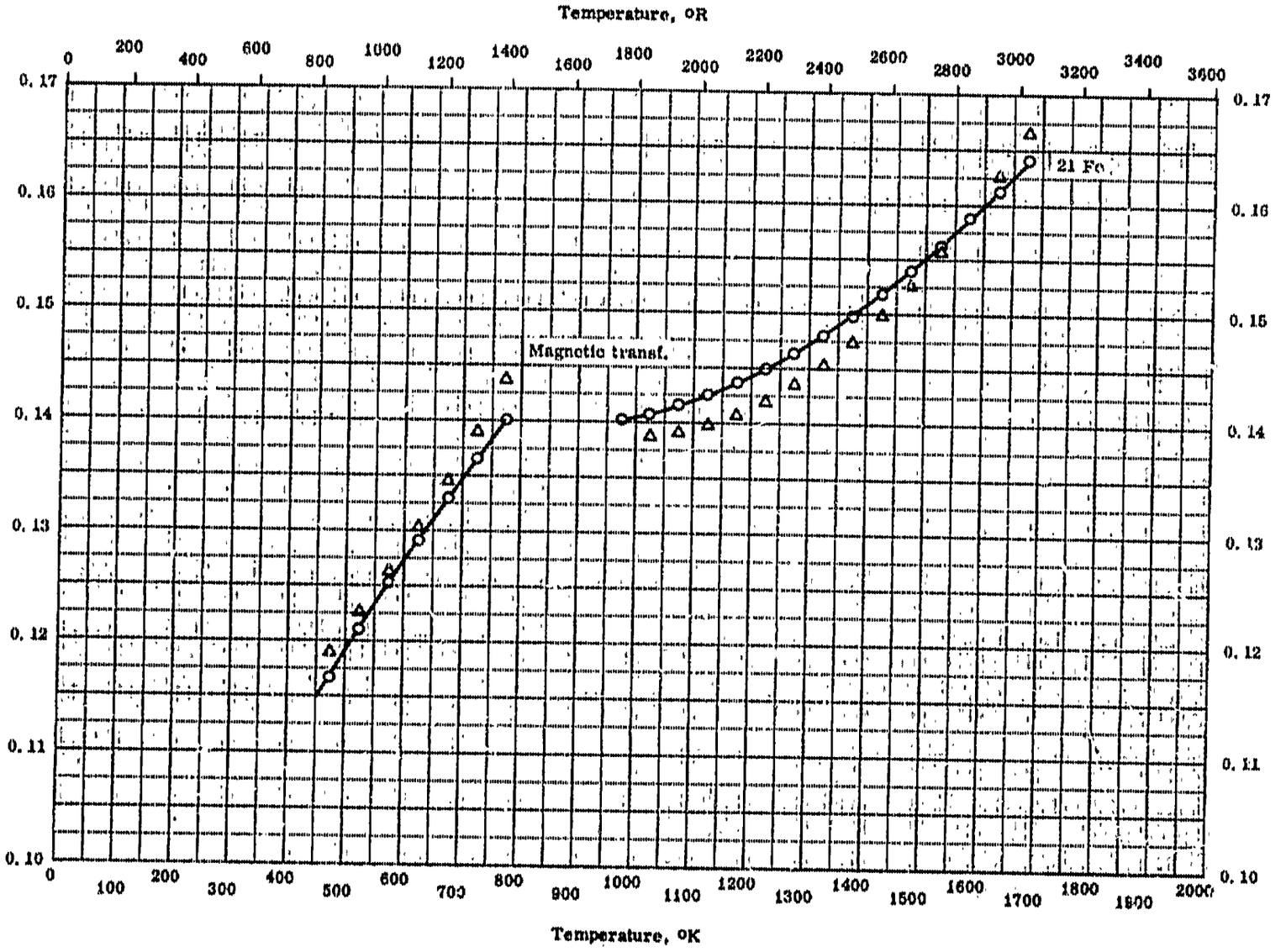
Electrical Resistivity, ohm cm x 10^6

ELECTRICAL RESISTIVITY -- NICKEL + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-24	298-373		91.39 Ni; prepared from electrolytic Fe and Ni with less than 0.01 C.	Slowly cooled 1200 hrs from 450 C to 400 C; data for samples quenched from 800 C also reported.
□	57-24	298-373		84.02 Ni; same as above.	Same as above.
△	57-24	298-373		81.32 Ni; same as above.	Same as above.
◇	57-24	298-373		80.04 Ni; same as above.	Same as above.
▽	57-24	298-373		80.22 Ni; same as above.	Same as above.
▷	57-24	298-373		79.13 Ni; same as above.	Same as above.
◁	57-24	298-373		77.27 Ni; same as above.	Same as above.
◐	57-24	298-373		76.11 Ni; same as above.	Same as above.
◒	57-24	298-373		75.90 Ni; same as above.	Same as above.
●	57-24	298-373		74.18 Ni; same as above.	Same as above.
■	57-24	298-373		73.05 Ni; same as above.	Same as above.
▲	57-24	298-373		71.21 Ni; same as above.	Same as above.
◆	57-24	298-373		66.43 Ni; same as above.	Same as above.
▼	57-24	298-373		61.18 Ni; same as above.	Same as above.
▶	57-24	298-373		56.23 Ni; same as above.	Same as above.
◀	57-24	298-373		51.24 Ni; same as above.	Same as above.

TPRC



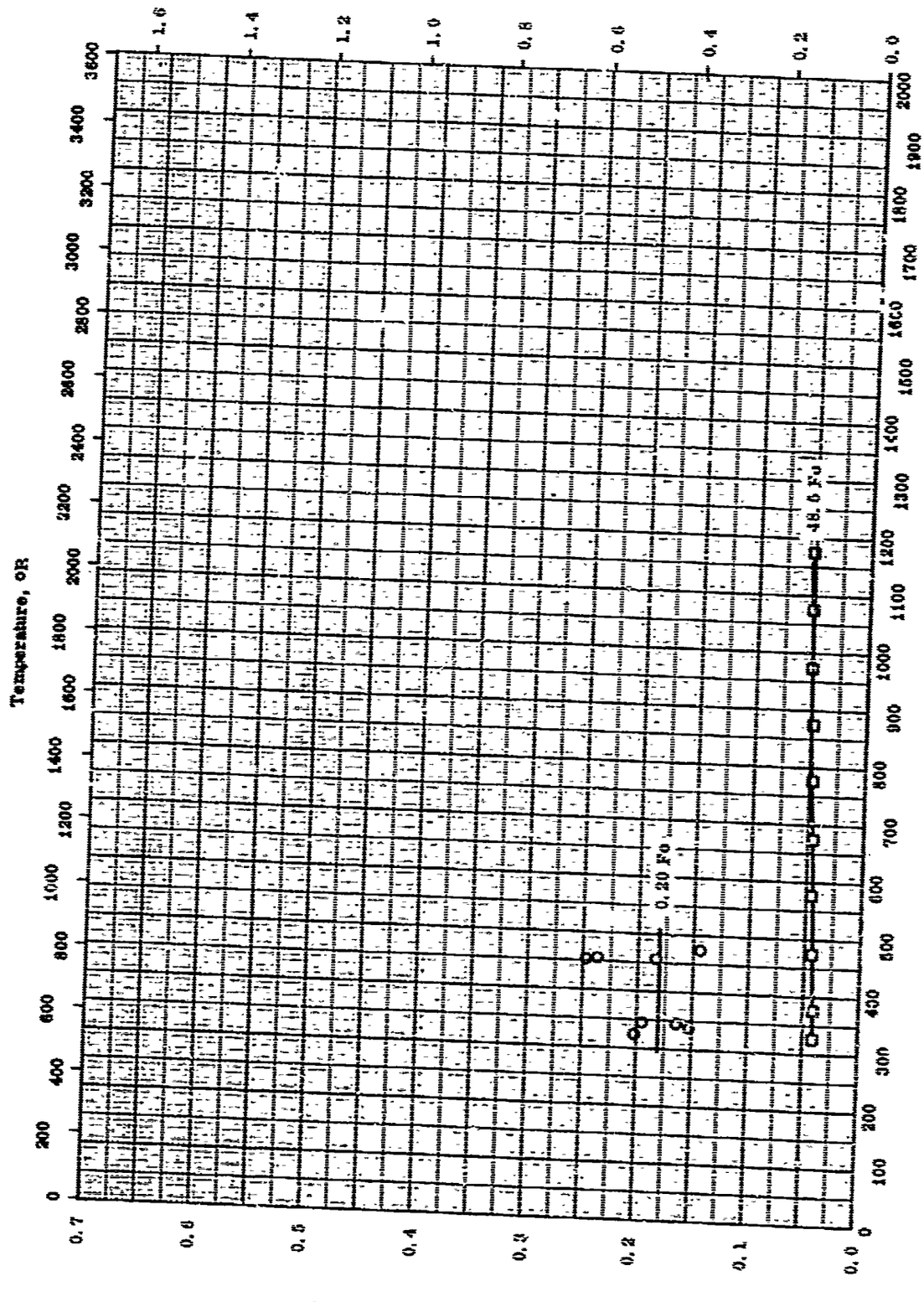
SPECIFIC HEAT -- NICKEL + IRON

SPECIFIC HEAT -- NICKEL + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	40-2	473-1673		79.3 Ni and 20.7 Fe.	
△	40-2	473-1673		69.76 Ni and 30.24 Fe.	

TPRC

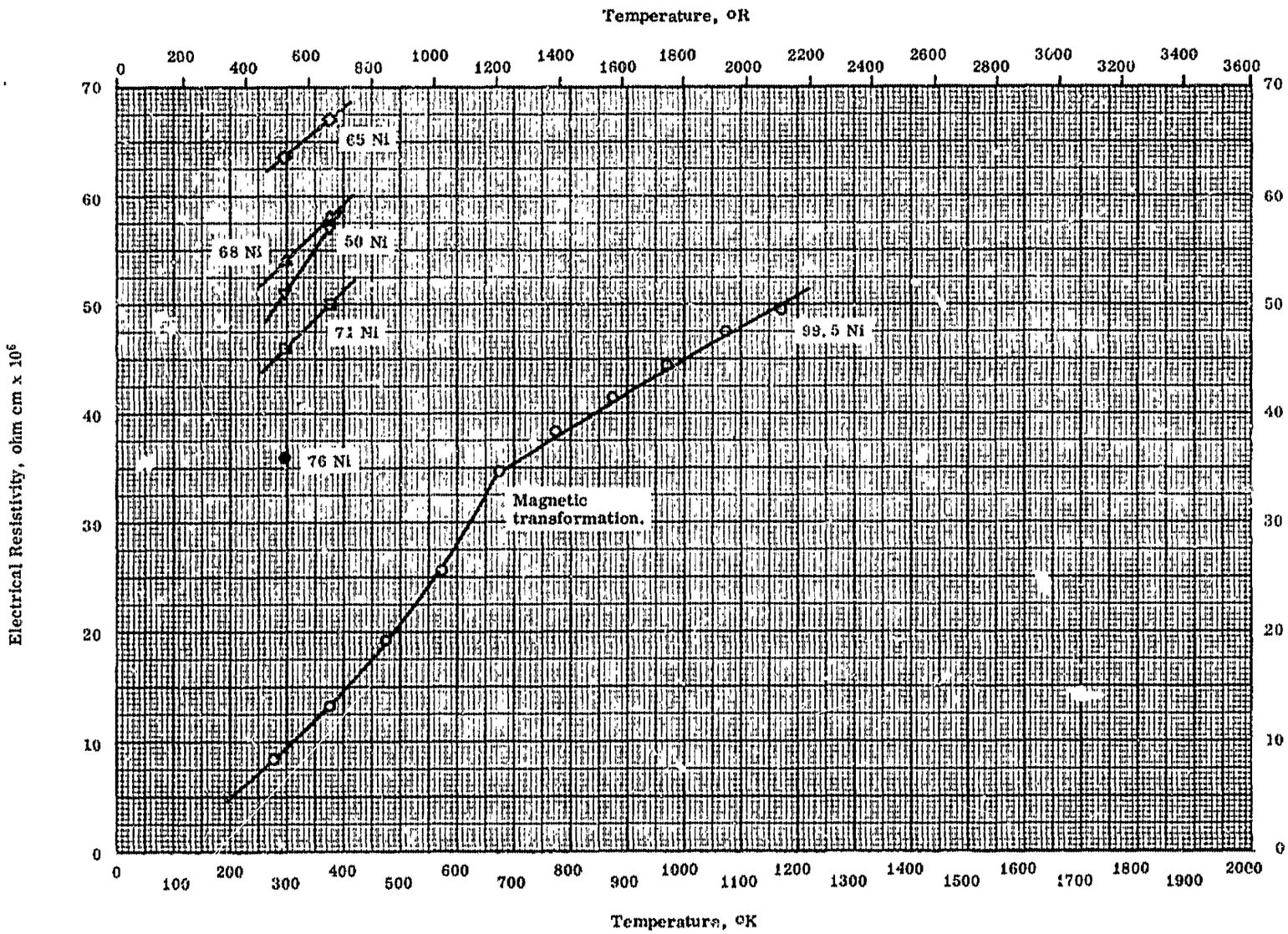


THERMAL CONDUCTIVITY -- NICKEL + IRON

THERMAL CONDUCTIVITY -- NICKEL + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	53-6	328-472		Commercial Grade; 99.4 Ni, 0.20 Fe, 0.10 Mg, 0.05 Co, 0.03 Sn, 0.026 C, 0.02 Si, 0.01 Cr and Mn each, 0.005 S, 0.003 Ti, and 0.002 Al and Pb each.	
□	53-2	323-1173		50.85 Ni, 48.5 Fe, 0.12 Mn, 0.024 C, and 0.003 S.	



TPRC

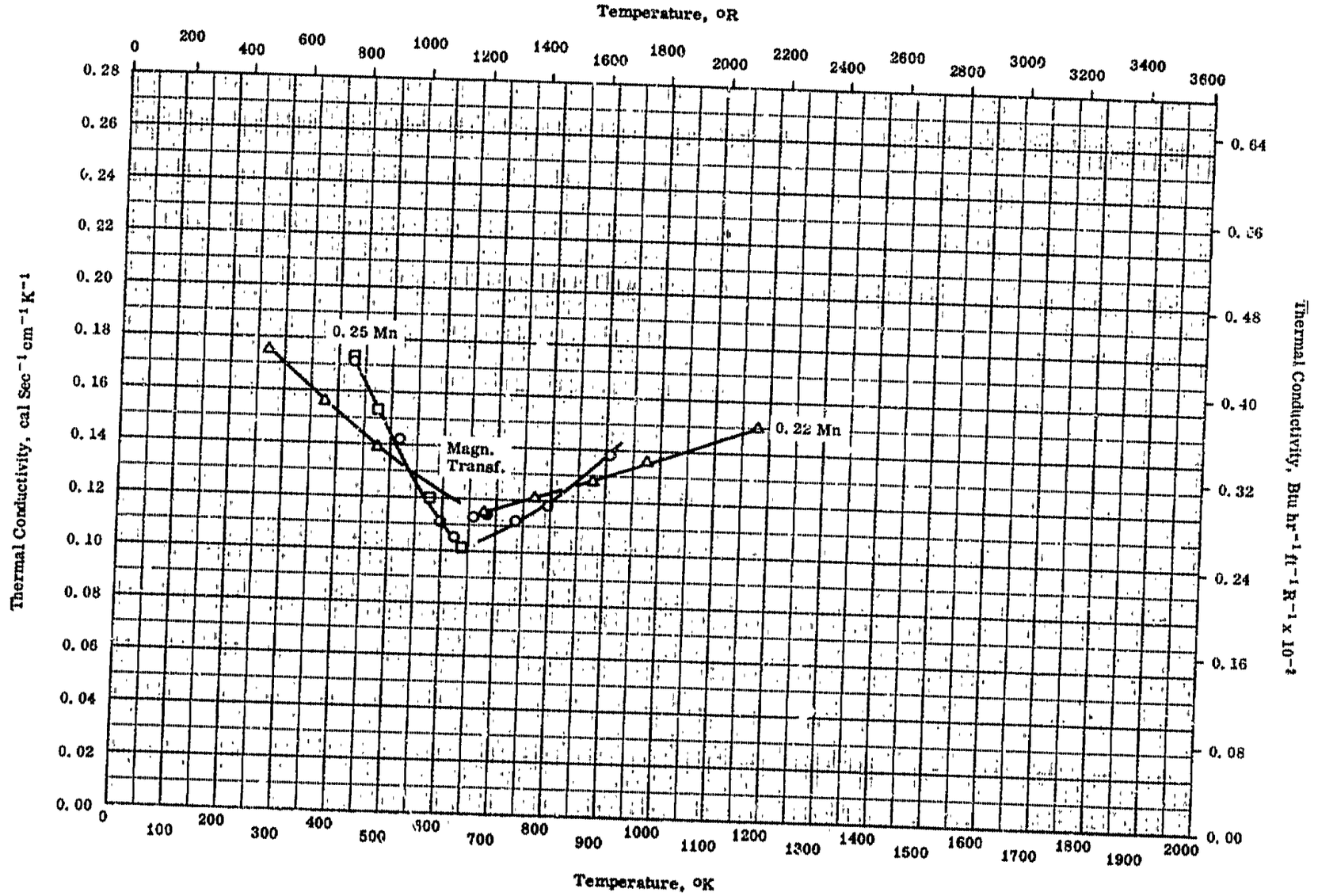
ELECTRICAL RESISTIVITY -- NICKEL + MANGANESE

ELECTRICAL RESISTIVITY -- NICKEL + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
●	49-6	298-373		75.89 Ni; made from electrolytic Mn and Ni in alumina crucibles in an induction furnace.	Annealed in steps from 980 C to 500 C, the ertire process lasting 5 days.
□	49-6	298-373		71.39 Ni.	Same as above.
△	49-6	298-373		69.46 Ni.	Same as above.
◇	49-6	298-373		66.39 Ni.	Same as above.
▽	49-6	298-373		51.90 Ni.	Same as above.
○	52-4	273-1173		99.48 Ni, 0.22 Mn, 0.14 Fe, 0.06 C, 0.05 Cu, 0.02 Si, and 0.005 S.	

TPRC

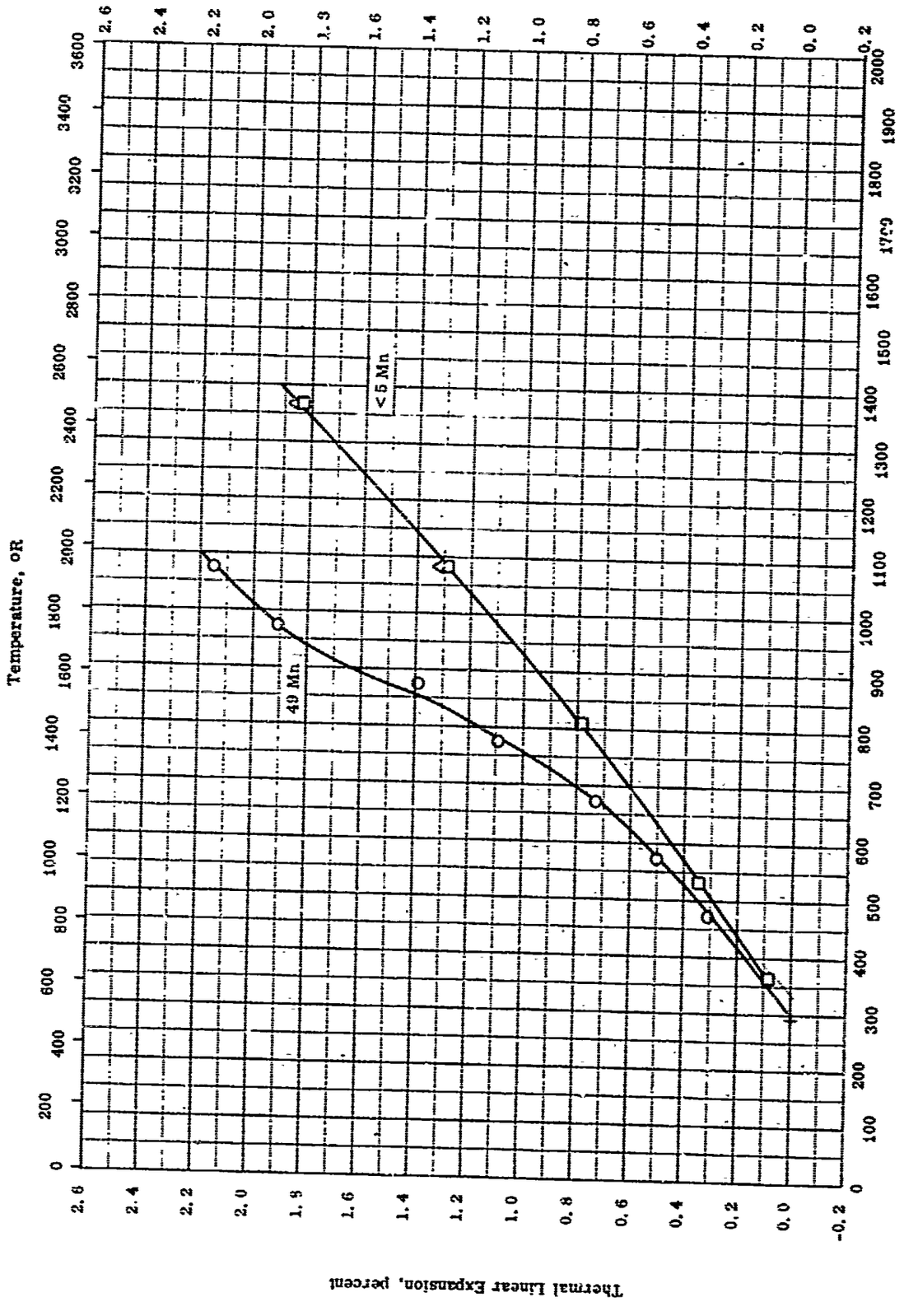


THERMAL CONDUCTIVITY -- NICKEL + MANGANESE

THERMAL CONDUCTIVITY -- NICKEL + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	54-2	422-910		Grade A; 99.542 Ni, 0.250 Mn, 0.068 Fe, 0.034 Co, 0.034 Mg, 0.030 Si, 0.020 Ti, 0.014 Cu, 0.006 Al, 0.001 B, 0.0005 Ca, and 0.0005 Cr.	In rod form; measured in vacuum of 2×10^{-5} mm Hg.
□	57-4	423-643		Grade A; 99.54 Ni, 0.25 Mn, 0.07 Fe, 0.03 Co, Mg, and Si each, and traces of others.	In rod form; measured in vacuum.
△	52-4	273-1173		99.48 Ni, 0.22 Mn, 0.14 Fe, 0.06 C, 0.05 Cu, 0.02 Si, and 0.005 S.	



THERMAL LINEAR EXPANSION -- NICKEL + MANGANESE

THERMAL LINEAR EXPANSION -- NICKEL + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-38	293-1073		50.6 Ni and 49.4 Mn; prepared from electrolytic purity metals.	Quenched and homogenized.
□	65-4	294-1367		Nickel 200; formally "A-Nickel" from International Nickel Co.; nominal: 99.5 Ni, 0.25 Mn, 0.15 Fe, 0.06 C, 0.05 Si, 0.05 Cu and 0.005 S; density 0.321 lb $in.^{-3}$ and M. P. 2615 - 2635 F.	
△	65-4	294-1367		Nickel 211; formall "D-Nickel" from International Nickel Co.; nominal: 95.0 Ni, 4.75 Mn, 0.10 C, 0.05 Fe, 0.05 Si, 0.03 Cu, and 0.005 S; density 0.315 lb $in.^{-3}$.	

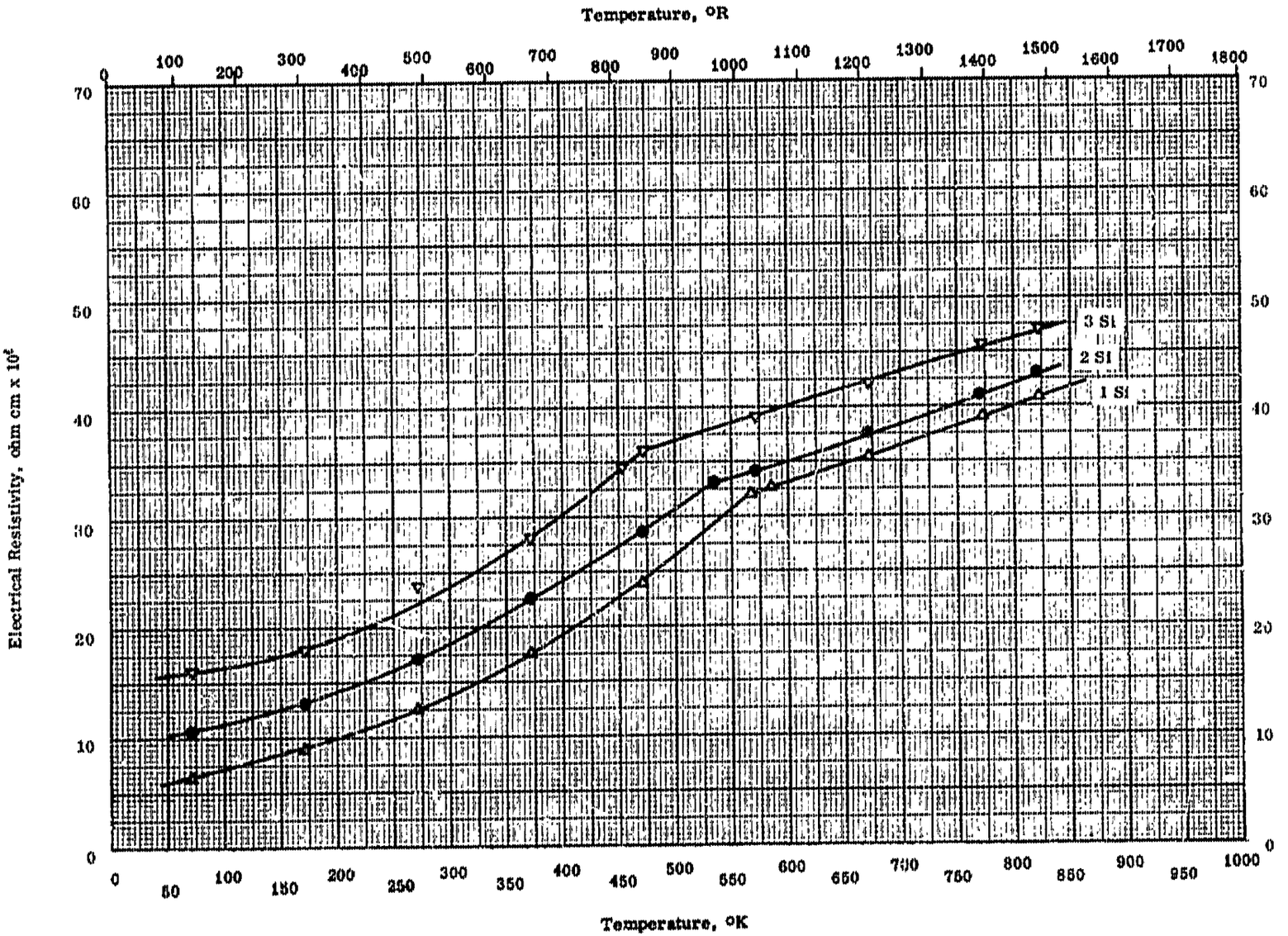
Electrical Resistivity, ohm cm x 10^6

ELECTRICAL RESISTIVITY -- NICKEL + PALLADIUM

ELECTRICAL RESISTIVITY -- NICKEL + PALLADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-20 also 57-21	293-743		83.04 Ni and 16.96 Pd.	Annealed 2 hrs at 1070 K in vacuum, furnace cooled 24 hrs; tested in vacuum.
□	57-20 also 57-21	293-743		81.04 Ni and 18.96 Pd.	Same as above.
△	57-20 also 57-21	293-743		60.77 Ni and 39.23 Pd.	Same as above.
◇	57-20 also 57-21	293-743		51.08 Ni and 48.92 Pd.	Same as above.
▽	56-19	0-325		60.77 Ni and 39.23 Pd.	Annealed 2 hrs at 1070 K in vacuum, furnace cooled 24 hrs.
◁	56-19	200-325		Two samples; a. 61 Ni and 39 Pd b. 50.2 Ni and 49.8 Pd.	Same as above.



ELECTRICAL RESISTIVITY — NICKEL + SILICON

TPRC

ELECTRICAL RESISTIVITY -- NICKEL + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
△	55-6	73-823		1.0015 Si.	Alloy prepared from 99.9 pure Ni and 99.95 pure Si homogenized 6-10 hrs just below M.P.
●	55-6	73-823		1.99 Si.	Same as above.
▽	55-6	73-823		3.00 Si.	Same as above.

TPRC

PROPERTIES OF NIOBIUM + TANTALUM

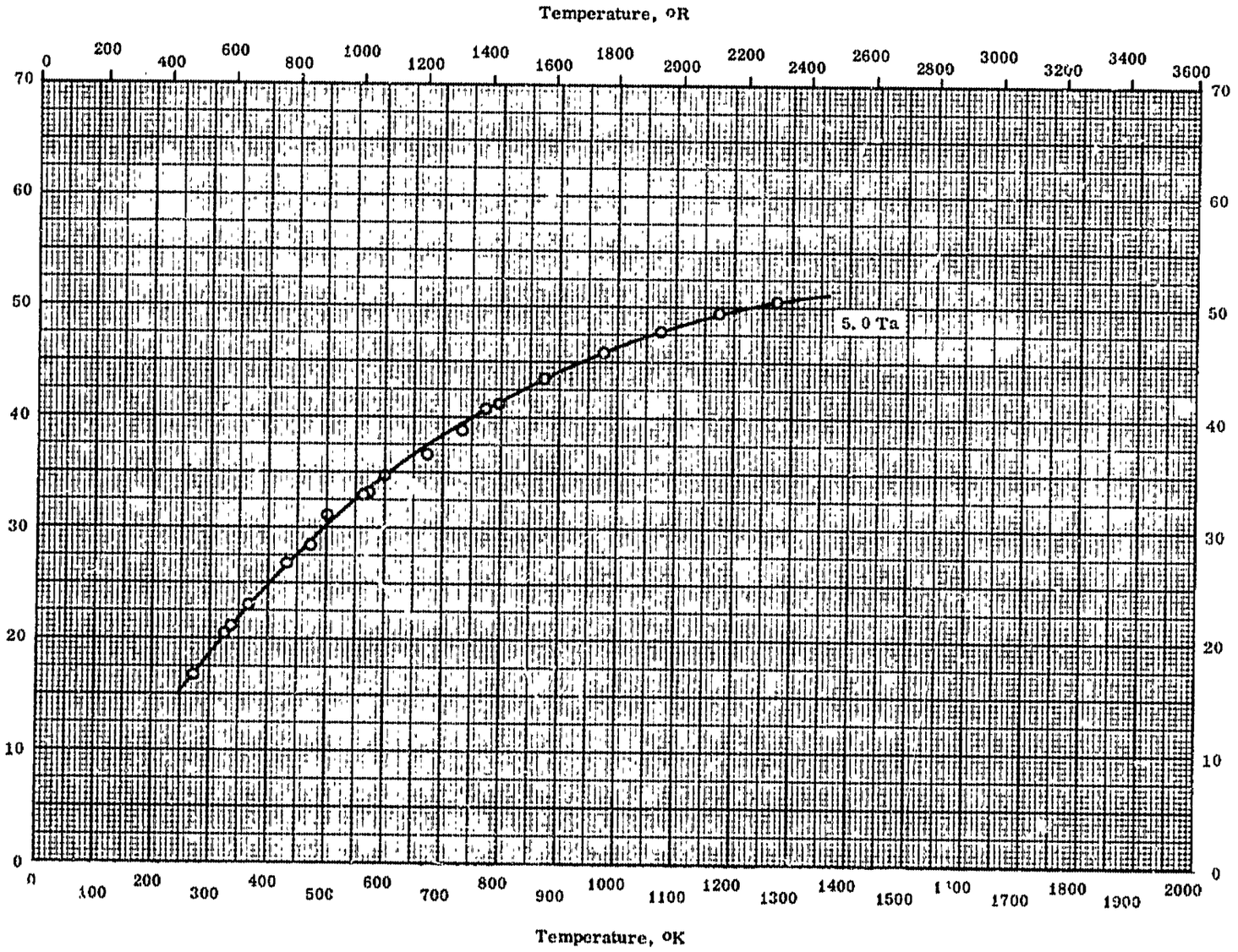
REPORTED VALUES

Melting Point:	K	R
○ 1.9 Ta	2741 ± 10	4934 ± 18
◇ 0.5 Ta	2768	4575

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-32	2731-2751	± 10C	1.9 ± 0.1 Ta, 0.0032 gas content, 0.0025 N_2, and 0.00013 H_2.	M. P. by liquid forming in black body cavity of sample.
◇	54-24 also 55-30	2708		0.5 Ta, 0.25 C, 0.05 Fe, 0.05 Si, and 0.05 Ti.	

TPRC



TPRC

ELECTRICAL RESISTIVITY -- NIOBIUM + TANTALUM

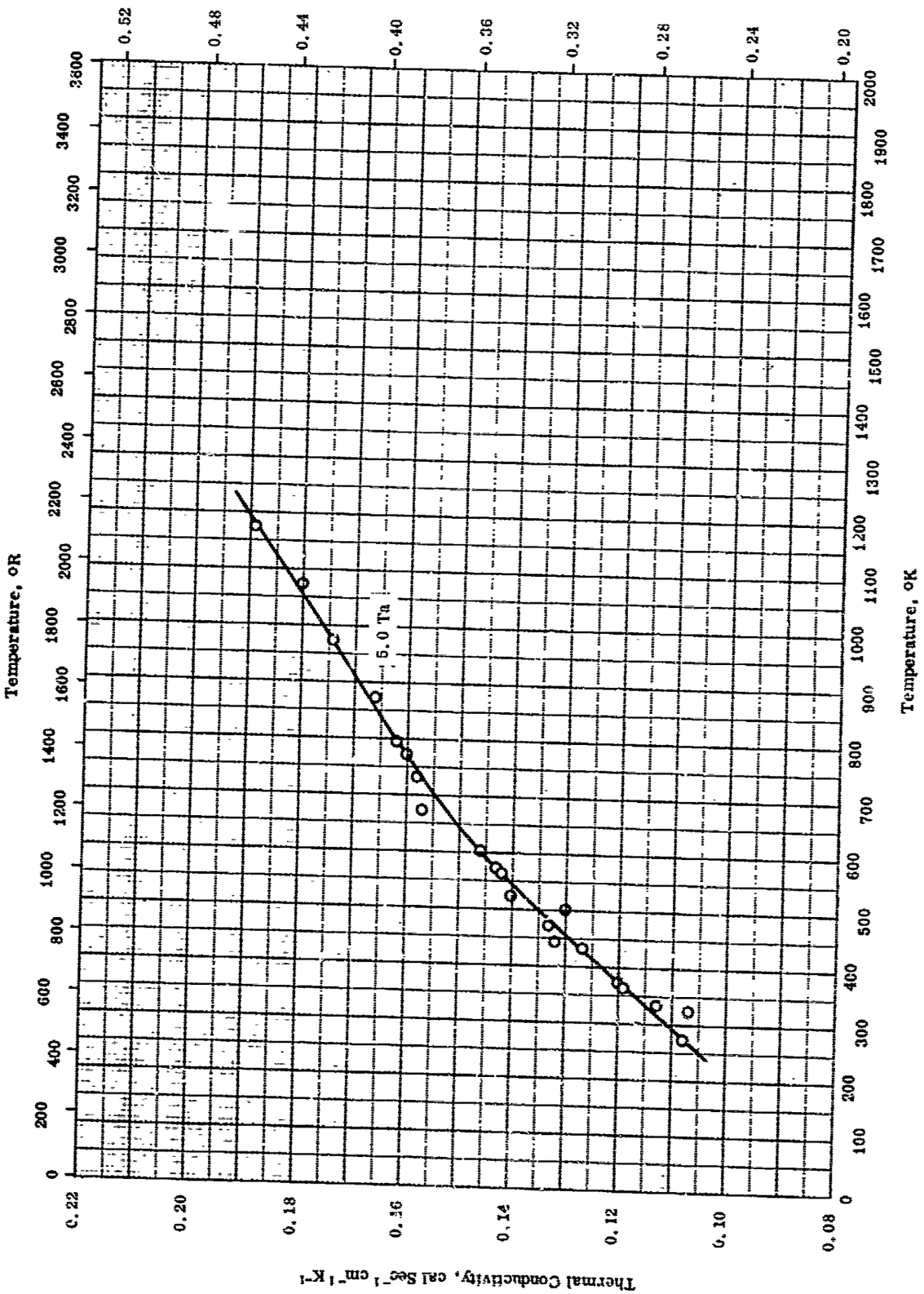
Electrical Resistivity, ohm cm x 10⁶

ELECTRICAL RESISTIVITY -- NIOBIUM + TANTALUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-10	273-1273		5.0 Ta, 0.17 W, 0.054 Fe, 0.04 Mo, 0.014 Ti, 0.014 Si, and 0.013 C.	Sintered in vacuum at 1373 F for 5 hrs, residual pressure in the furnace 10^{-3} mm Hg; finally sintered in a vacuum of 10^{-5} mm Hg at 2623 K for 5 hrs; refined twice by zone-melting.

TPRC



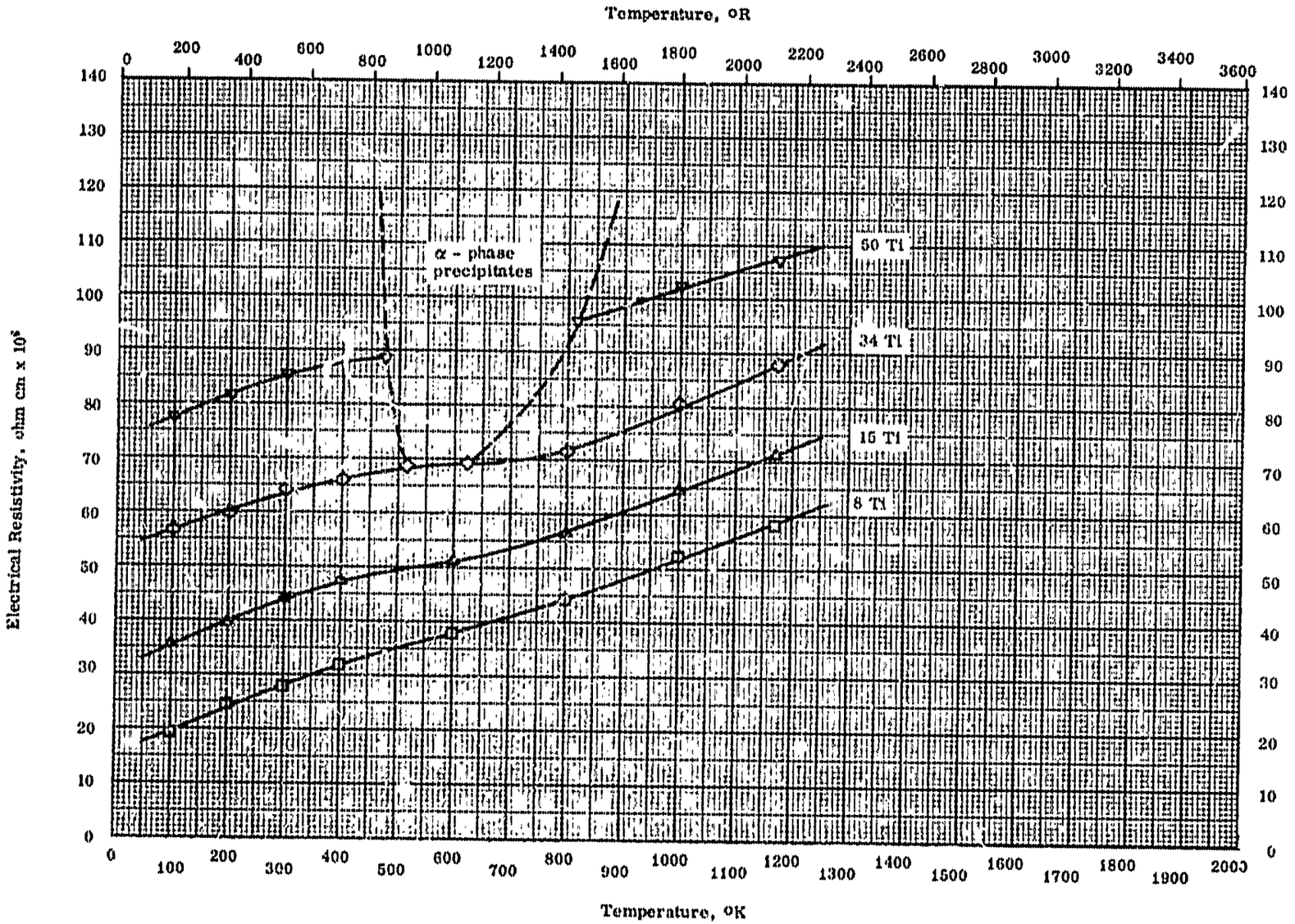
THERMAL CONDUCTIVITY -- NIOBIUM + TANTALUM

THERMAL CONDUCTIVITY -- NIOBIUM + TANTALUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-10	273-1173		5.0 Ta, 0.17 W, 0.054 Fe, 0.04 Mo, 0.014 Ti, 0.014 Si, and 0.013 C; prepared from electrolytic powders.	Pressed by 3.5 ton in^{-2} and double sintered at 1373K and 2623K in vacuum; forged and twice zone melted.

TPRC

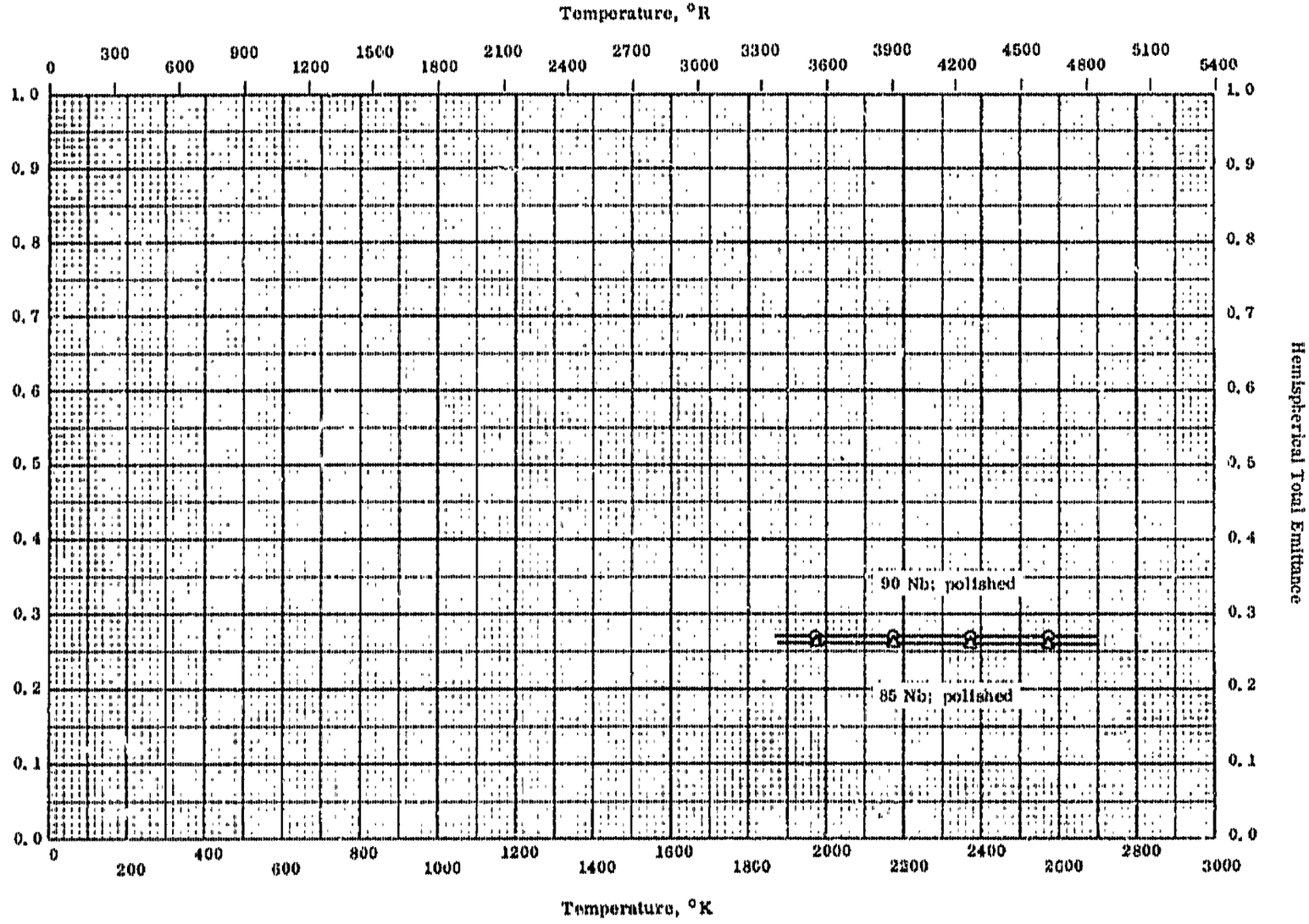


ELECTRICAL RESISTIVITY -- NIOBIUM + TITANIUM

ELECTRICAL RESISTIVITY -- NIOBIUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
□	54-16	100-1173		91.7 Nb and 8.3 Ti; β - phase; prepared from spectroscopically pure Nb and iodide Ti (0.2 atomic % Zr)	Cast; rolled in sheet, recrystallized, hot forged, surface layer removed, cold swaged, homogenized 70 hrs at 105° C in vacuum, and then quenched to retain β phase.
△	54-16	100-1173		84.7 Nb and 15.3 Ti; β - phase; raw materials same as above.	Same as above.
◇	54-16	100-1173		66 Nb and 34 Ti; β - phase; raw materials same as above.	Same as above.
▽	54-16	100-1173		50 Nb and 50 Ti; β - phase; raw materials same as above.	Same as above.



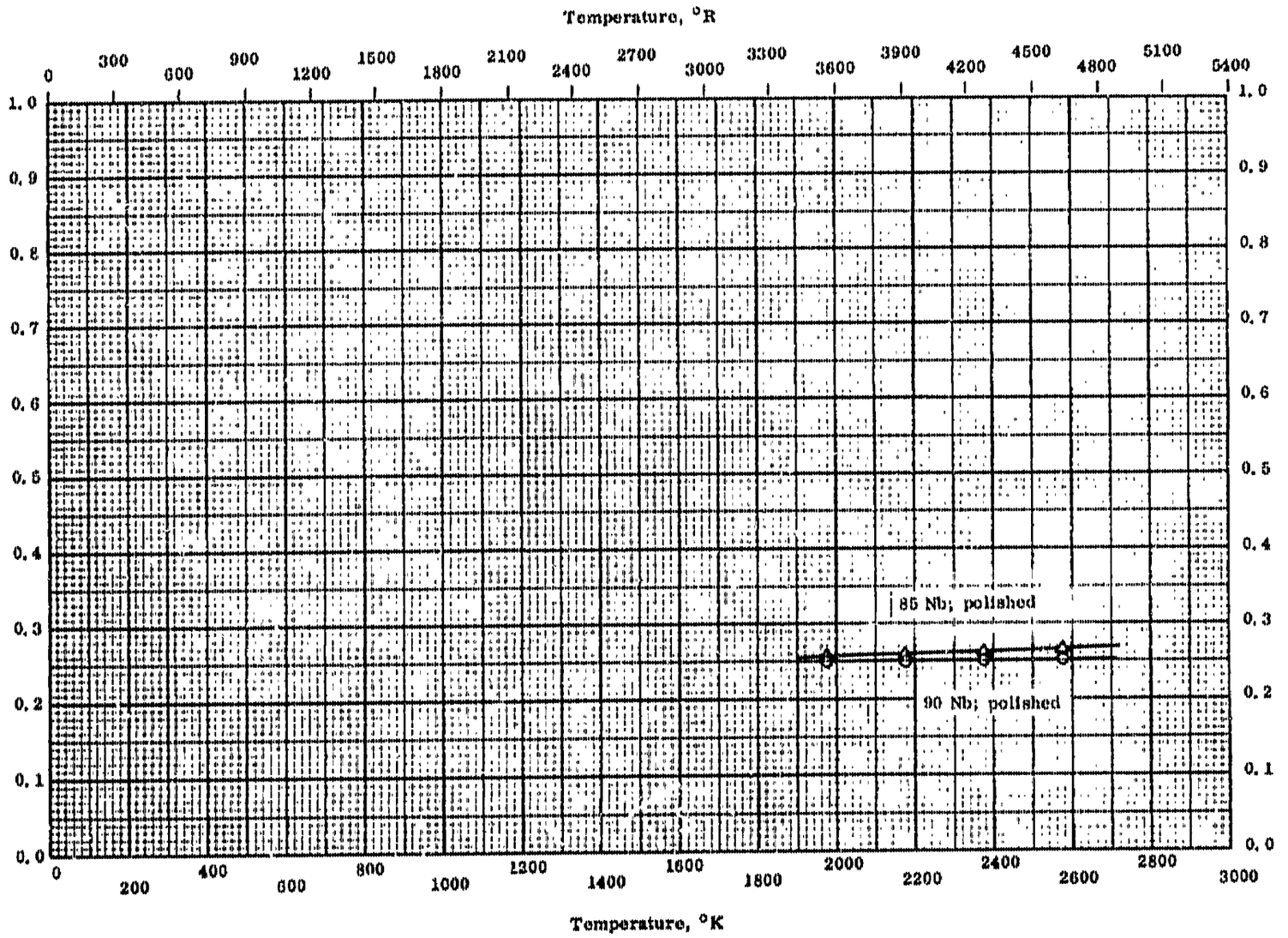
HEMISPHERICAL TOTAL EMITTANCE — NIOBIUM + TUNGSTEN

HEMISPHERICAL TOTAL EMITTANCE -- NIOBIUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-20	1973-2573		90 Nb and 10 W.	Polished with abrasive papers (No. 1, 0, 00, 000, and 0000); measured in argon.
Δ	62-20	1973-2573		85 Nb and 15 W.	. hed with abrasive papers (No. 1, 0, 00, 000, and 0000); measured in argon.

TPRC



TPRC

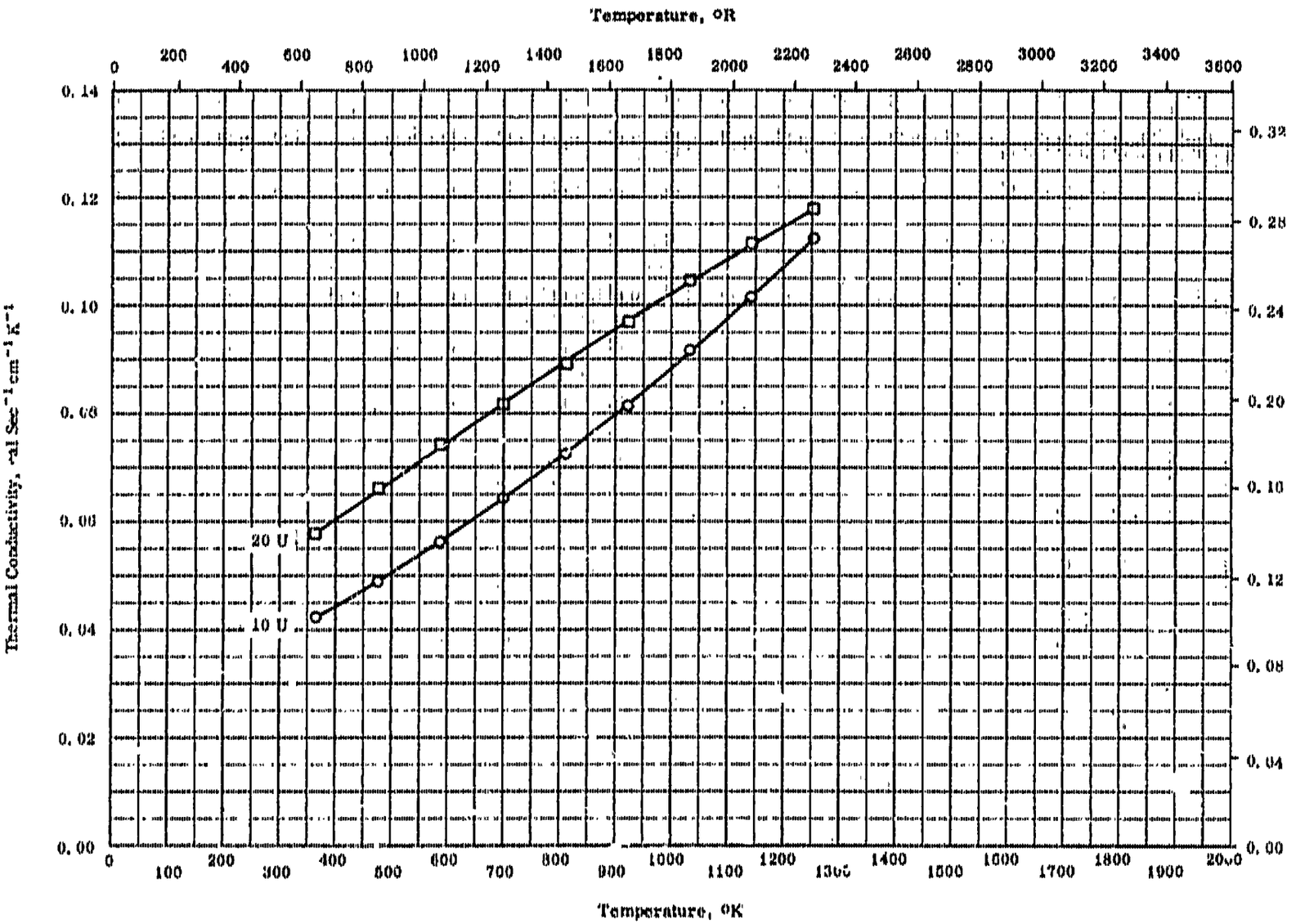
HEMISPHERICAL SPECTRAL EMITTANCE -- NIOBIUM + TUNGSTEN

HEMISPHERICAL SPECTRAL EMITTANCE -- NIOBIUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	62-20	0.65	1973-2573		90 Nb and 10 W.	Polished with abrasive papers (No. 1, 0, 00, 000, and 0000); measured in argon.
△	62-20	0.65	1973-2573		85 Nb and 15 W.	Polished with abrasive papers (No. 1, 0, 00, 000, and 0000); measured in argon.

TPRC



TPRC

THERMAL CONDUCTIVITY — NIOBIUM + URANIUM

573

THERMAL CONDUCTIVITY -- NIOBIUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	61-3	367-1255		90 Nb and 10 U.	Measured in a vacuum of approx 2×10^{-5} mm Hg.
□	61-3	367-1255		80 Nb and 20 U.	Same as above.

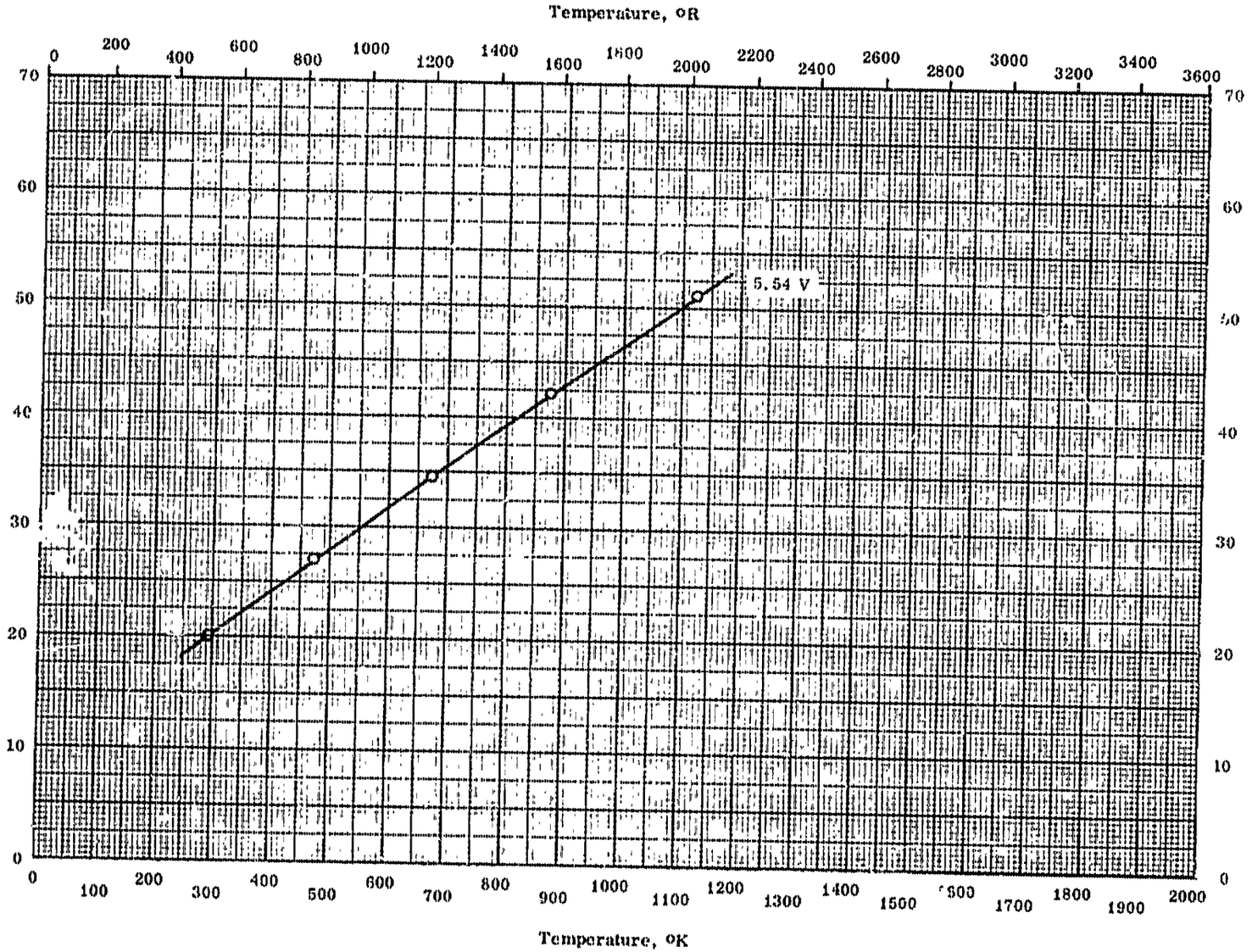
TPRC

THERMAL LINEAR EXPANSION -- NIOBIUM + URANIUM

THERMAL LINEAR EXPANSION -- NIOBIUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	61-3	293-1255		90 Nb and 10 U.	Thermal cycled twice from room temperature to about 1800 F and back to room temperature; measured in vacuum of at least 5×10^{-5} mm Hg.
□	61-3	293-1255		80 Nb and 20 U.	Same as above specimen.



TPRC

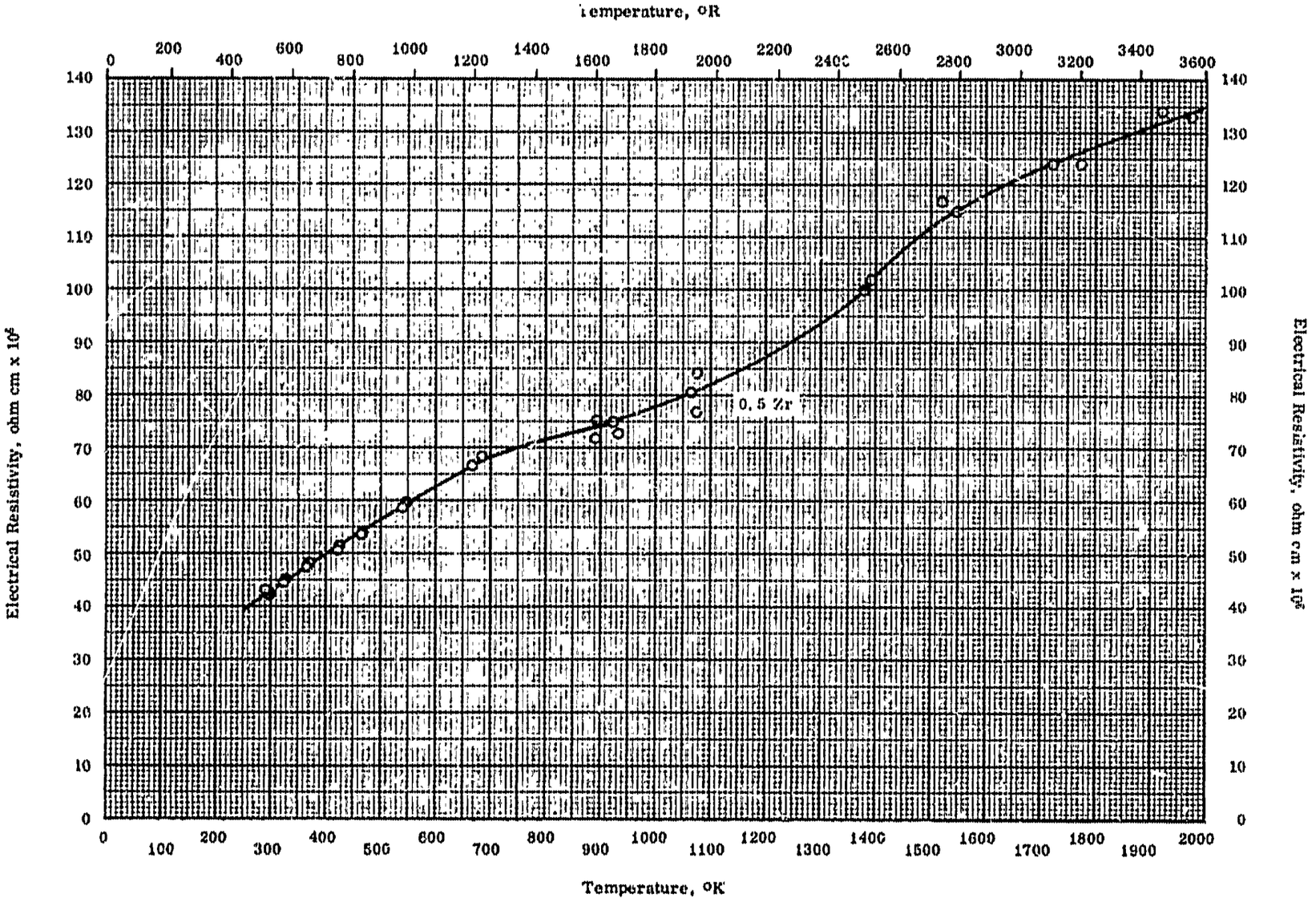
ELECTRICAL RESISTIVITY -- NIOBIUM + VANADIUM

ELECTRICAL RESISTIVITY -- NIOBIUM + VANADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	61-21	293-1123		5.54 V, 0.052 Ta, 0.0160 N, 0.0142 O, and 0.0065 C.	

TPRC



TPRC

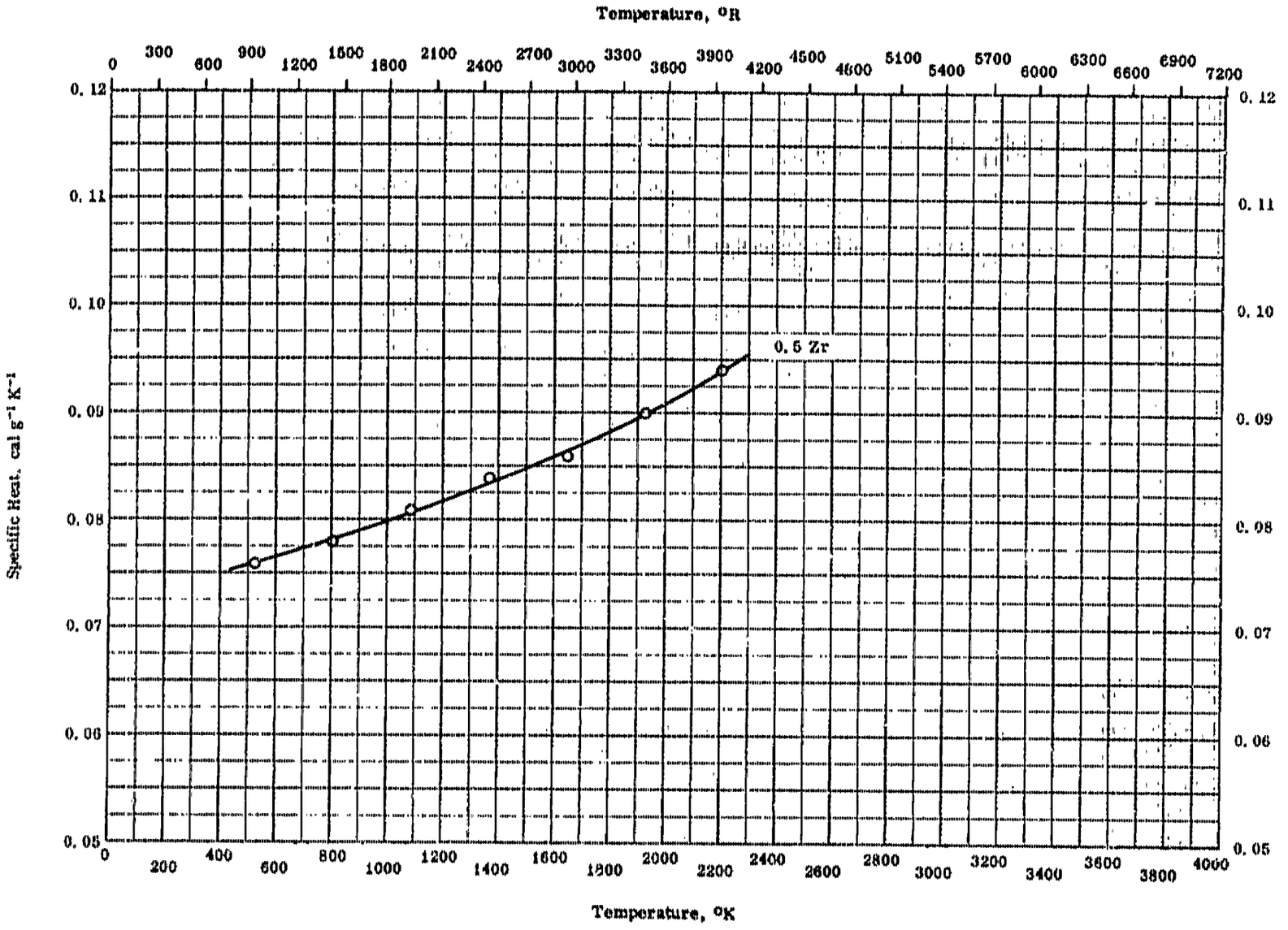
ELECTRICAL RESISTIVITY -- NIOBIUM + ZIRCONIUM

ELECTRICAL RESISTIVITY -- NIOBIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-4	298-1978	2.4	99.2 Nb and 0.5 Zr.	Hot pressed; maximum exposure temperature 4480 F.

TPRC



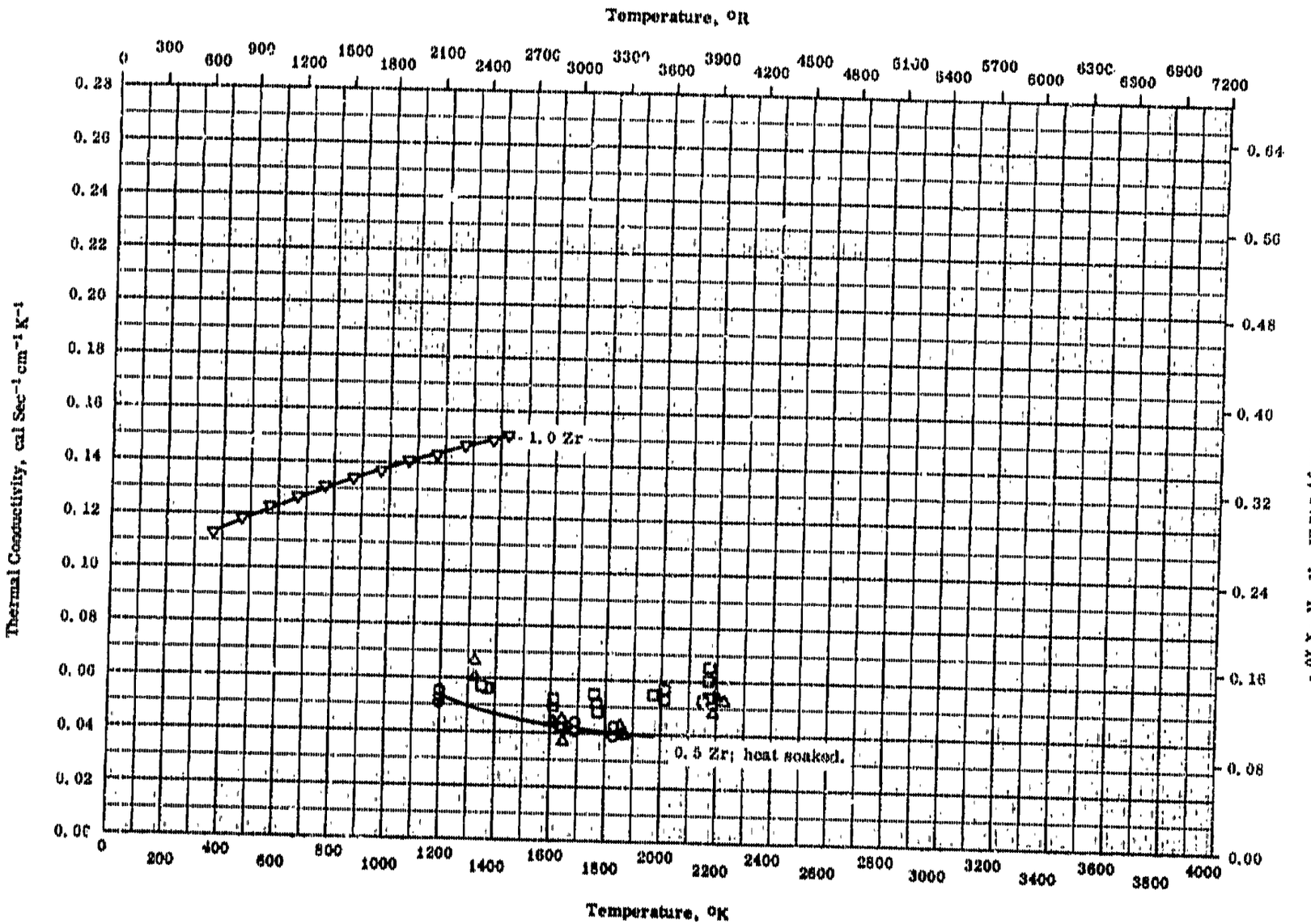
SPECIFIC HEAT -- NIOBIUM + ZIRCONIUM

SPECIFIC HEAT -- NIOBIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Reptd. Error %	Sample Specifications	Remarks
O	62-4	533-2200	≤5.0	Cb + 0.5% Zr; before test: 99.2 Nb, 0.6 Zr, <0.1 total elements; density 505 lb ft^{-3}; after test: 99.6 Nb, 0.41 C; density 529 lb ft^{-3}.	Crushed in hardened steel mortar to pass 100-mesh screen; hot pressed.

TPRC



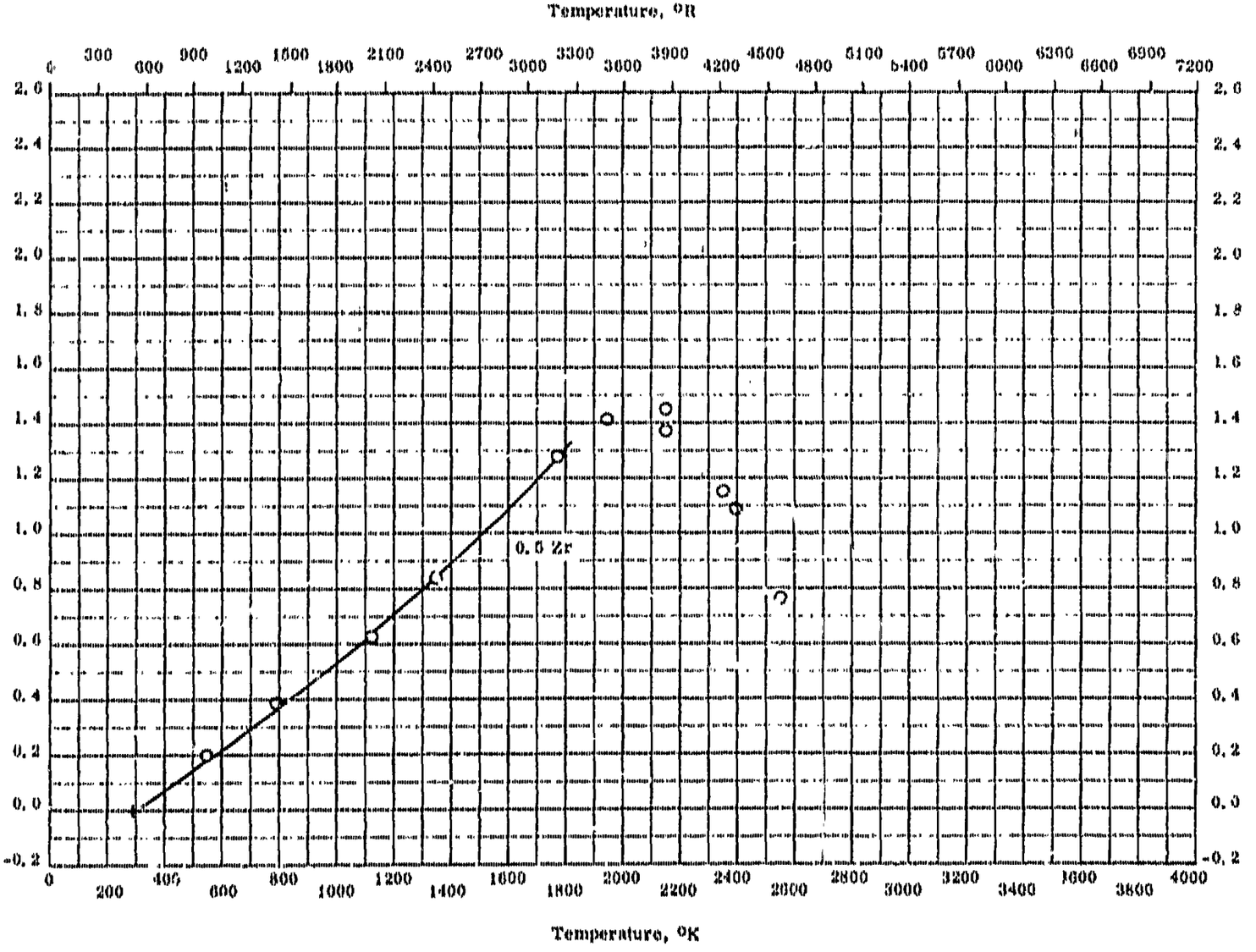
THERMAL CONDUCTIVITY -- NIOBIUM + ZIRCONIUM

THERMAL CONDUCTIVITY -- NIOBIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Reprt. Error %	Sample Specifications	Remarks
○	62-4	1200-1836	5-7	0.5 Zr.	Ground and polished to eliminate all scratches on the surface of the sample; heat soaked at 3350 F.
□	62-4	1352-2178	5-7	0.5 Zr.	Same as above except sample being partially melted.
△	62-4	1332-2225	5-7	0.5 Zr.	Same as above; sample found unmelted but color changed.
▽	63-7	373-1423	±3	1.0 Zr.	

TPRC



THERMAL LINEAR EXPANSION — NIOBIUM + ZIRCONIUM

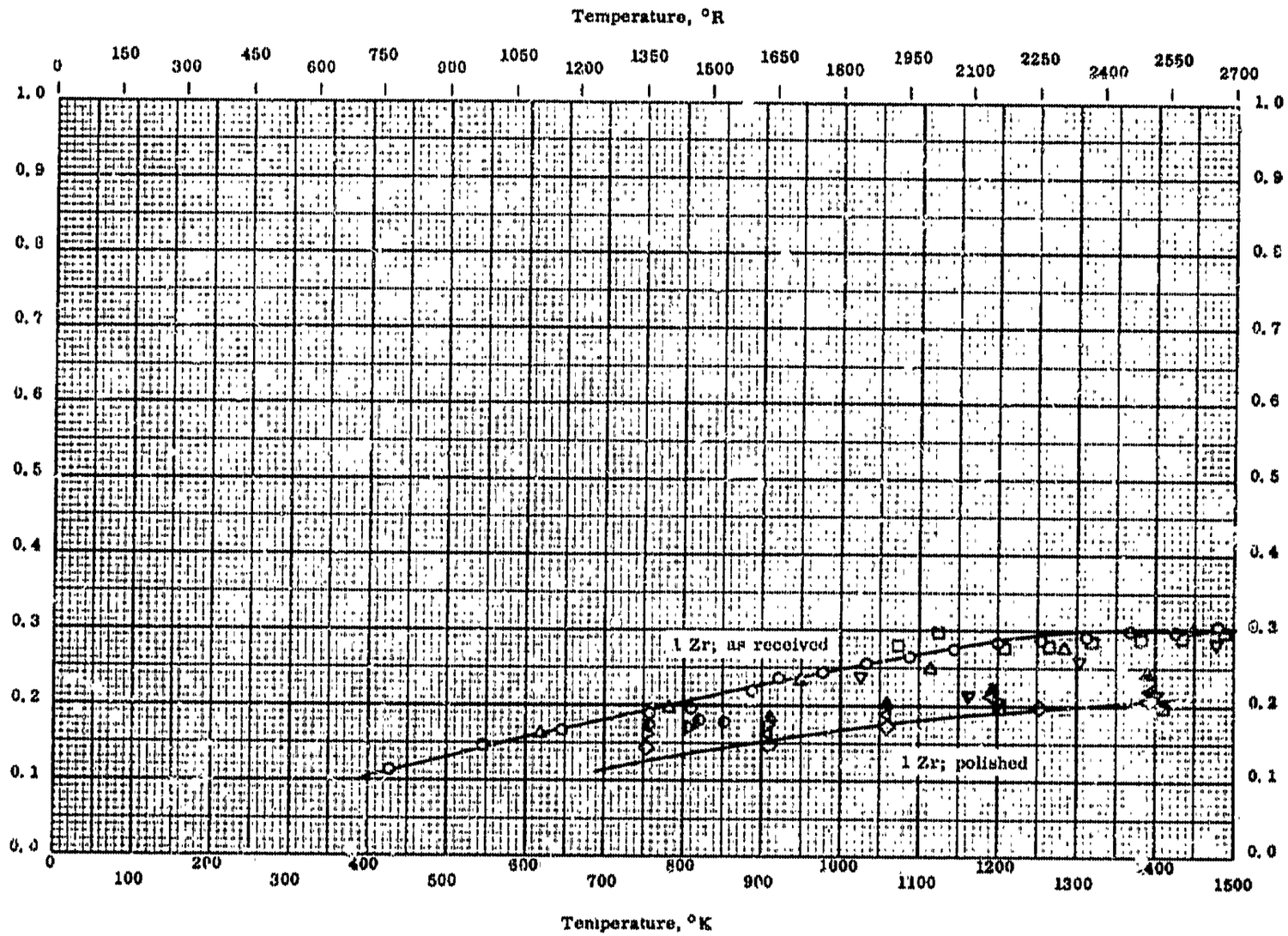
TPRC

THERMAL LINEAR EXPANSION -- NIOBIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-4	294-2628	5	General Astrometals Corp.; 99.2 Nb and 0.5 Zr and after exposure 99.5 Nb and 0.41 C; density 7.88 g cm^{-3} and after exposure 8.32 g cm^{-3}.	Hot pressed; measured in helium atmos; specimen melted.

TPRC

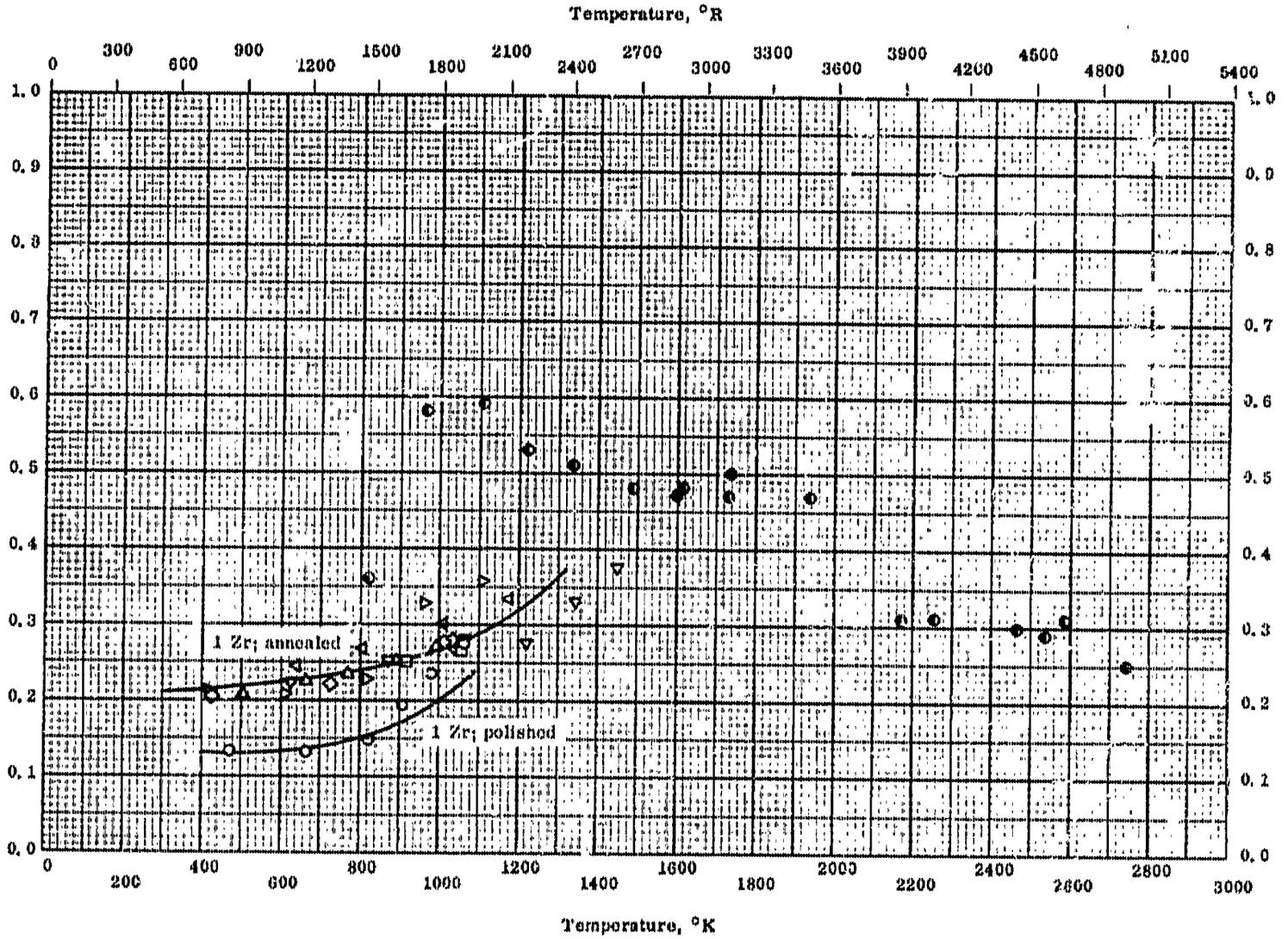


HEMISPHERICAL TOTAL EMITTANCE — NIOBIUM + ZIRCONIUM

HEMISPHERICAL TOTAL EMITTANCE -- NIOBIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Reprt. Error %	Sample Specifications	Remarks
○	64-6	428-1479		1 Zr; commercial.	As received; a vacuum of 2.1×10^{-3} mm Hg or higher; heating.
△	64-6	618-1450		1 Zr; commercial.	The above specimen; cooling.
□	64-6	1075-1469		1 Zr; commercial.	As received; a vacuum of 2.1×10^{-6} mm Hg or higher; heating.
▽	64-6	1127-1479		1 Zr; commercial.	The above specimen; cooling.
◇	64-6	755-1394		1 Zr; commercial.	Polished; a vacuum of 2.0×10^{-6} mm Hg or higher; first run.
◁	64-6	757-1393		1 Zr; commercial.	The above specimen; second run.
▷	64-6	755-1393		1 Zr; commercial.	The above specimen; third run.
⬮	64-6	757-1393		1 Zr; commercial.	The above specimen; fourth run.
▲	64-6	757-1391		1 Zr; commercial.	The above specimen; fifth run.
■	64-6	1202-1411		1 Zr; commercial.	Polished; a vacuum of 2.0×10^{-6} mm Hg or higher; first run.
▼	64-6	1163-1403		1 Zr; commercial.	The above specimen; second run.

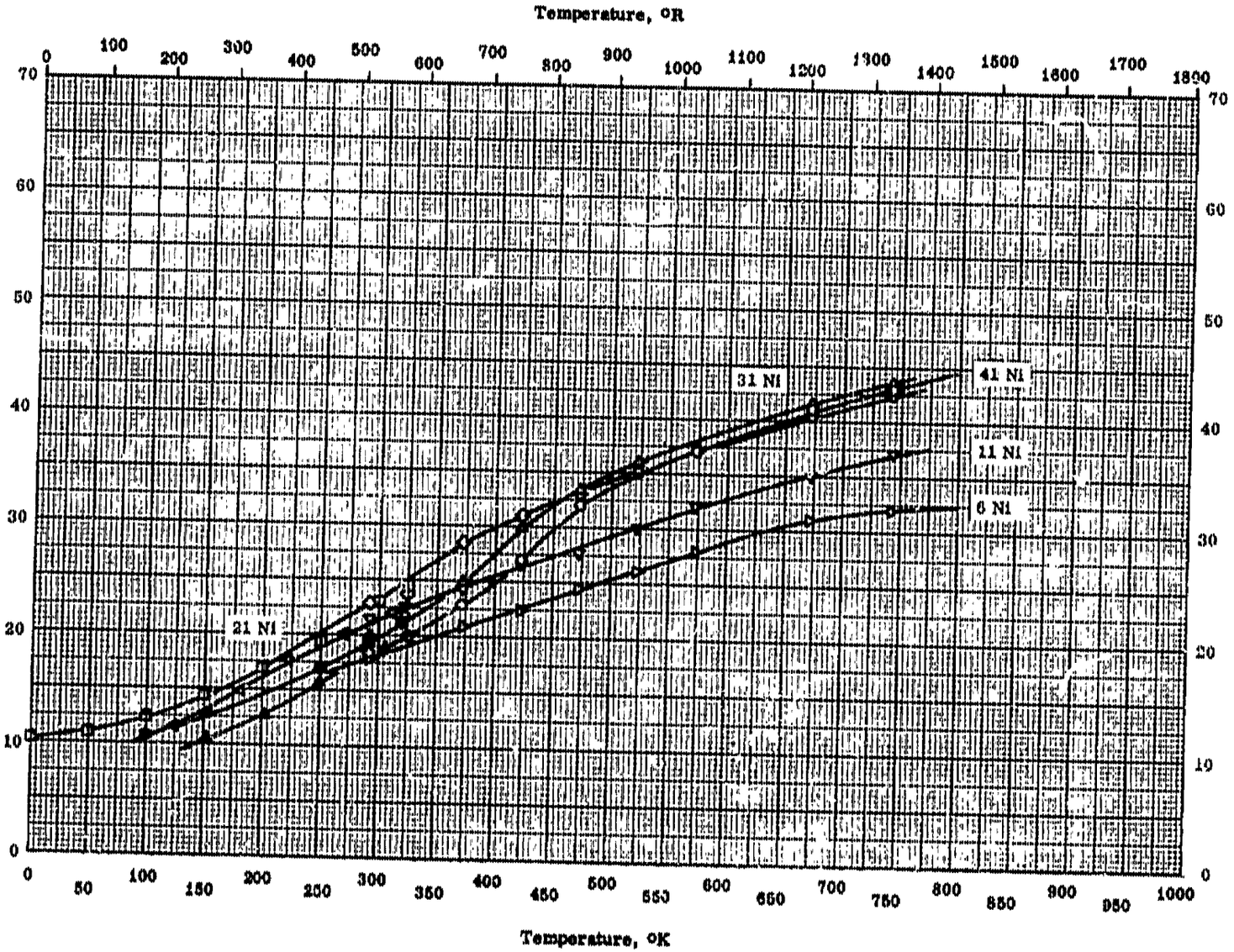


NORMAL TOTAL EMITTANCE — NIOBIUM + ZIRCONIUM

NORMAL TOTAL EMITTANCE -- NIOBIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	63-20	474-1066	±2.7	1 Zr.	Rough hand-polished with 4-F metallographic paper, A and B alumina, and diamond paste; 5×10^{-6} mm Hg vacuum; heating.
△	63-20	506-904	±2.7	1 Zr.	The above specimen, cooling.
□	63-20	919-1059	±2.7	1 Zr.	The above specimen annealed; cooling.
◇	63-20	431-1045	±2.7	1 Zr.	Same surface treatment as above, annealed; cooling.
▽	63-20	628-1452	±2.7	1 Zr.	The above specimen heated to 1266 C.
◁	63-20	641-1177	±2.7	1 Zr.	The above specimen cooled from 1200 C.
▷	63-20	424-1111	±2.7	1 Zr.	Roughened to rms 45 μin.; 5×10^{-6} mm Hg vacuum; heating.
●	62-4	322-2744	10	0.5 Zr.	Measured in argon atmosphere.



ELECTRICAL RESISTIVITY -- PALLADIUM + NICKEL

ELECTRICAL RESISTIVITY -- PALLADIUM + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	57-20	293-743		59.2 Pd and 40.8 Ni.	Annealed for 2 hrs at 1070 K in vacuum and furnace cooled in 24 hrs.
△	57-20	293-743		69.1 Pd and 30.9 Ni.	Same as above.
◇	57-20	293-743		79.0 Pd and 21.0 Ni.	Same as above.
▽	57-20	293-743		89.5 Pd and 10.5 Ni.	Same as above.
▷	57-20	293-743		94.2 Pd and 5.8 Ni.	Same as above.
□	56-19	0-325		79.4 Pd and 20.6 Ni.	Annealed for 2 hrs at 800 C in vacuum and gradually cooled in 24 hrs.
◁	56-19	100-325		89.4 Pd and 10.6 Ni.	Same as above.
●	56-19	100-325		70 Pd and 30 Ni.	Same as above.
▲	56-19	100-325		57.4 Pd and 42.6 Ni.	Same as above.

TPRC

PROPERTIES OF PALLADIUM + URANIUM

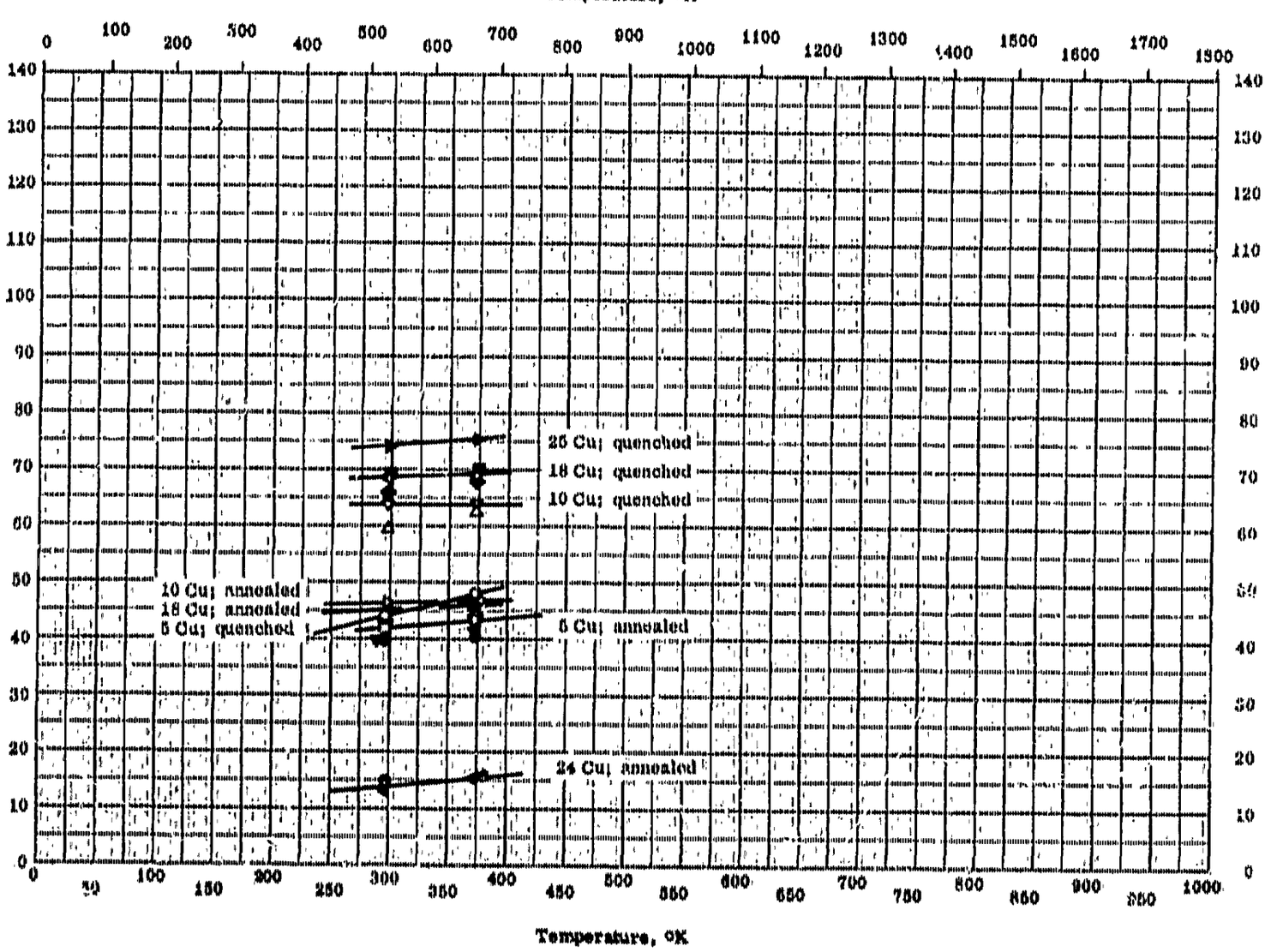
REPORTED VALUES

Melting Point	K	R
○ 42.72 U	1913	3444

PROPERTIES OF PALLADIUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	58-36	1913		UPd_3; 57.28 Pd and 42.72 U.	M. P. from break in time-temperature curve.



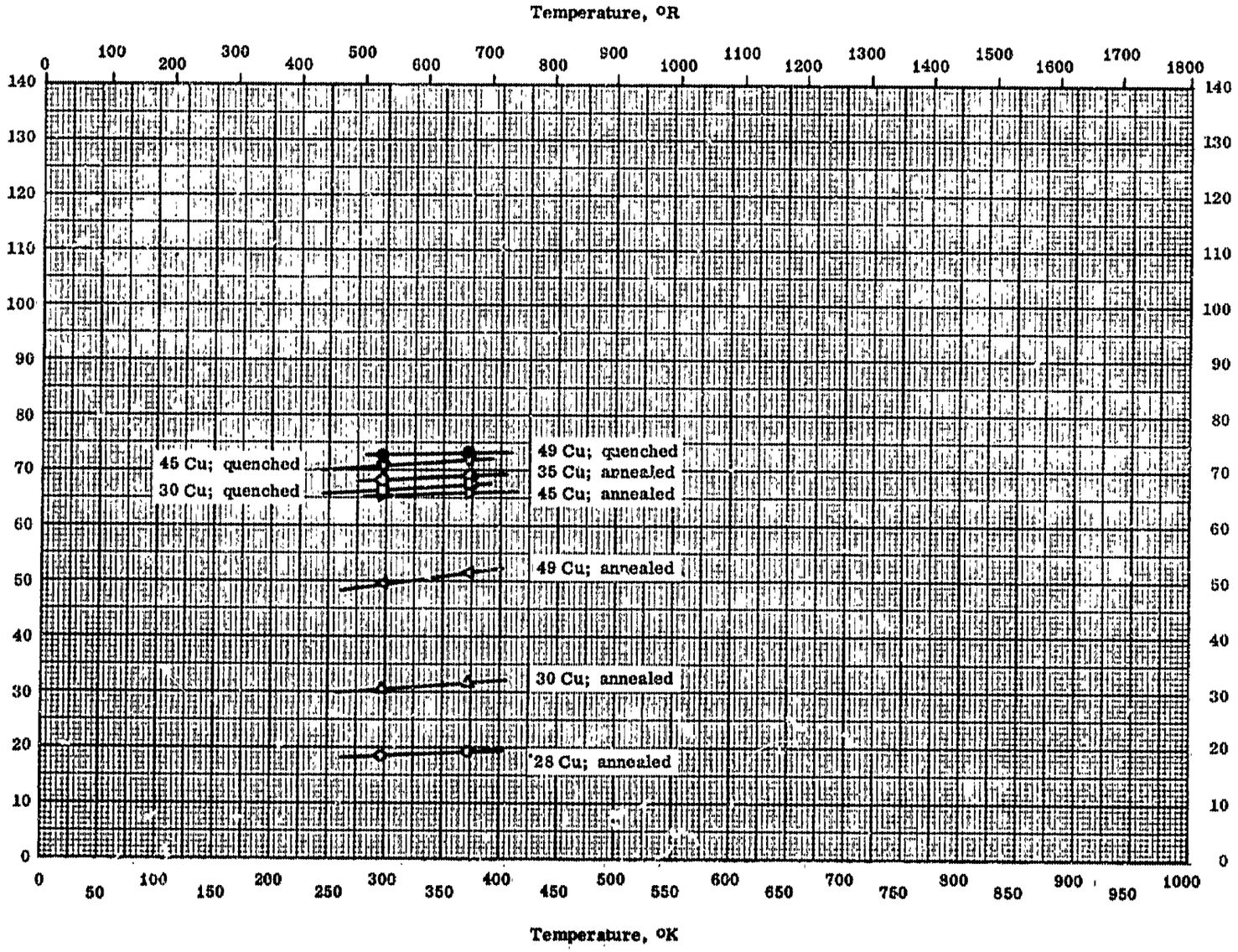
ELECTRICAL RESISTIVITY -- PLATINUM + COPPER
(4 - 25 Cu)

TPRC

ELECTRICAL RESISTIVITY -- PLATINUM + COPPER
(4 - 25 Cu)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-27	298-373		4.54 Cu.	Quenched from 900 C.
□	56-27	298-373		Same as above.	Annealed
△	56-27	298-373		7.45 Cu.	Quenched from 900 C.
◇	56-27	298-373		Same as above.	Annealed.
▽	56-27	298-373		10.09 Cu.	Quenched from 900 C.
▷	56-27	298-373		Same as above.	Annealed.
◁	56-27	298-373		12.45 Cu.	Quenched from 900 C.
●	56-27	298-373		Same as above.	Annealed.
■	56-27	298-373		17.56 Cu.	Quenched from 900 C.
▲	56-27	298-373		Same as above.	Annealed.
◆	56-27	298-373		21.56 Cu.	Quenched from 900 C.
▼	56-27	298-373		Same as above.	Annealed.
◀	56-27	298-373		23.22 Cu	Same as above.
▶	56-27	298-373		24.76 Cu.	Quenched from 900 C.
⊖	56-27	298-373		Same as above.	Annealed.



ELECTRICAL RESISTIVITY -- PLATINUM + COPPER
(25-50 Cu)

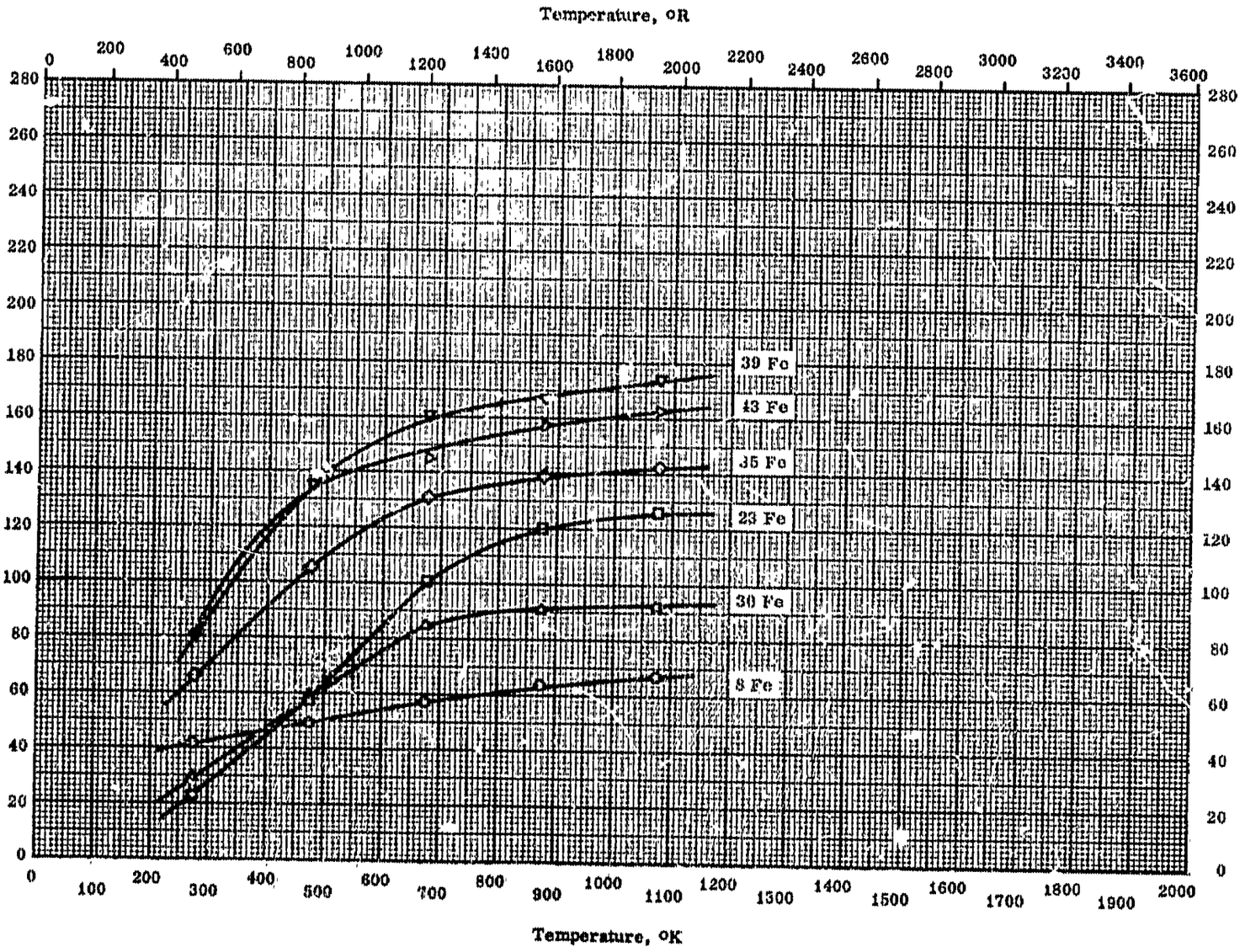
TPRC

ELECTRICAL RESISTIVITY -- PLATINUM + COPPER
(25-50 Cu)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-27	298-373		28.14 Cu.	Annealed.
□	56-27	298-373		30.15 Cu.	Quenched from 900 C.
△	56-27	298-373		Same as above.	Annealed.
◇	56-27	298-373		34.73 Cu.	Annealed.
▽	56-27	298-373		44.82 Cu.	Quenched from 900 C.
▷	56-27	298-373		Same as above.	Annealed.
●	56-27	298-373		49.14 Cu.	Quenched from 900 C.
◁	56-27	298-373		Same as above.	Annealed.

TPRC

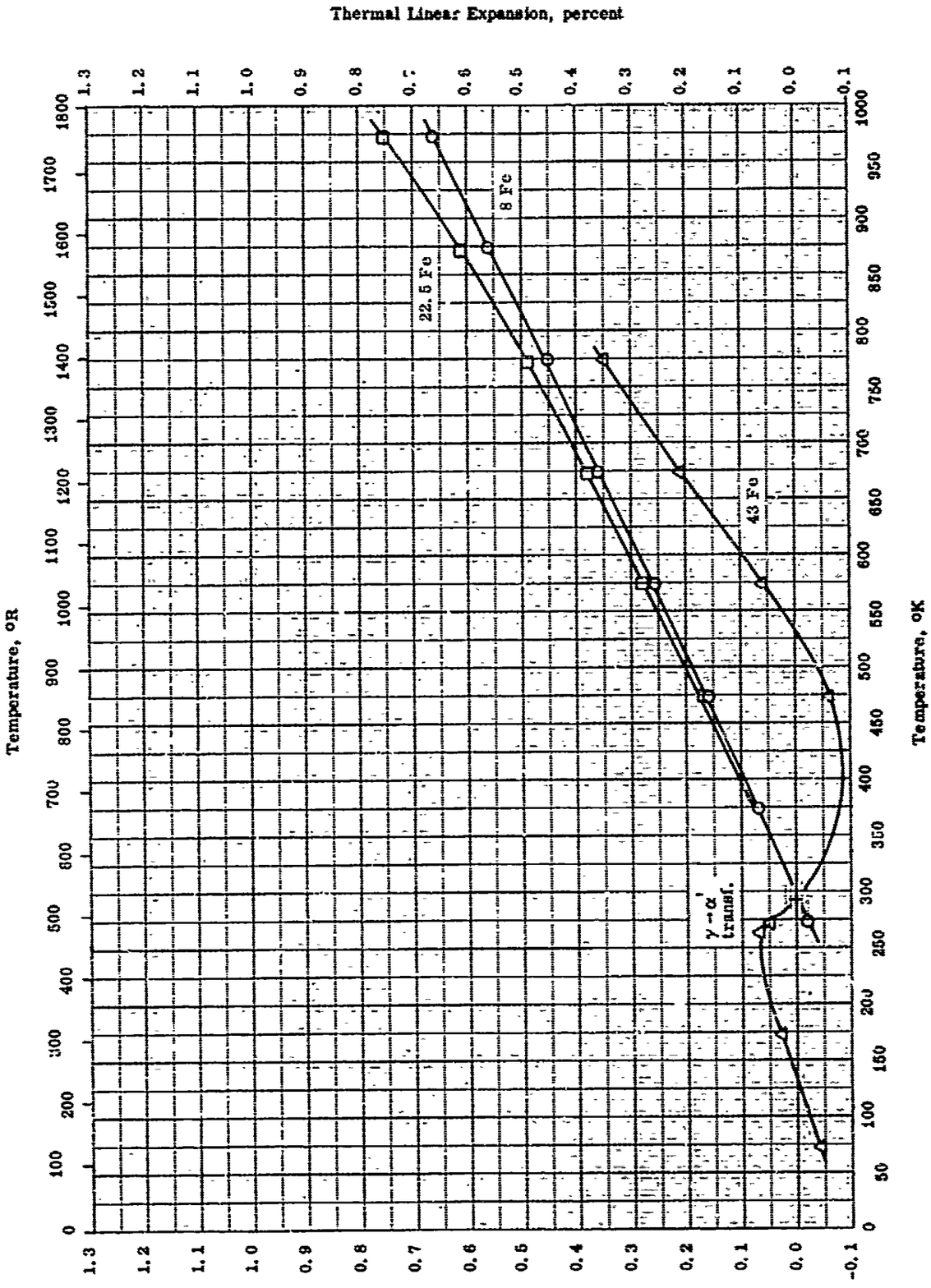


ELECTRICAL RESISTIVITY -- PLATINUM + IRON

ELECTRICAL RESISTIVITY -- PLATINUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	50-6	273-1073		92 Pt and 8 Fe; prepared from Armco Fe and technically pure Pt.	Induction melted in MgO crucible; tempered.
□	50-6	273-1073		77.5 Pt and 22.5 Fe; prepared as above.	Same as above.
△	50-6	273-1073		70 Pt and 30 Fe; prepared as above.	Same as above.
◇	50-6	273-1073		65 Pt and 35 Fe; prepared as above.	Same as above.
▽	50-6	273-1073		61 Pt and 39 Fe; prepared as above.	Same as above.
▷	50-6	273-1073		57 Pt and 43 Fe; prepared as above.	Same as above.

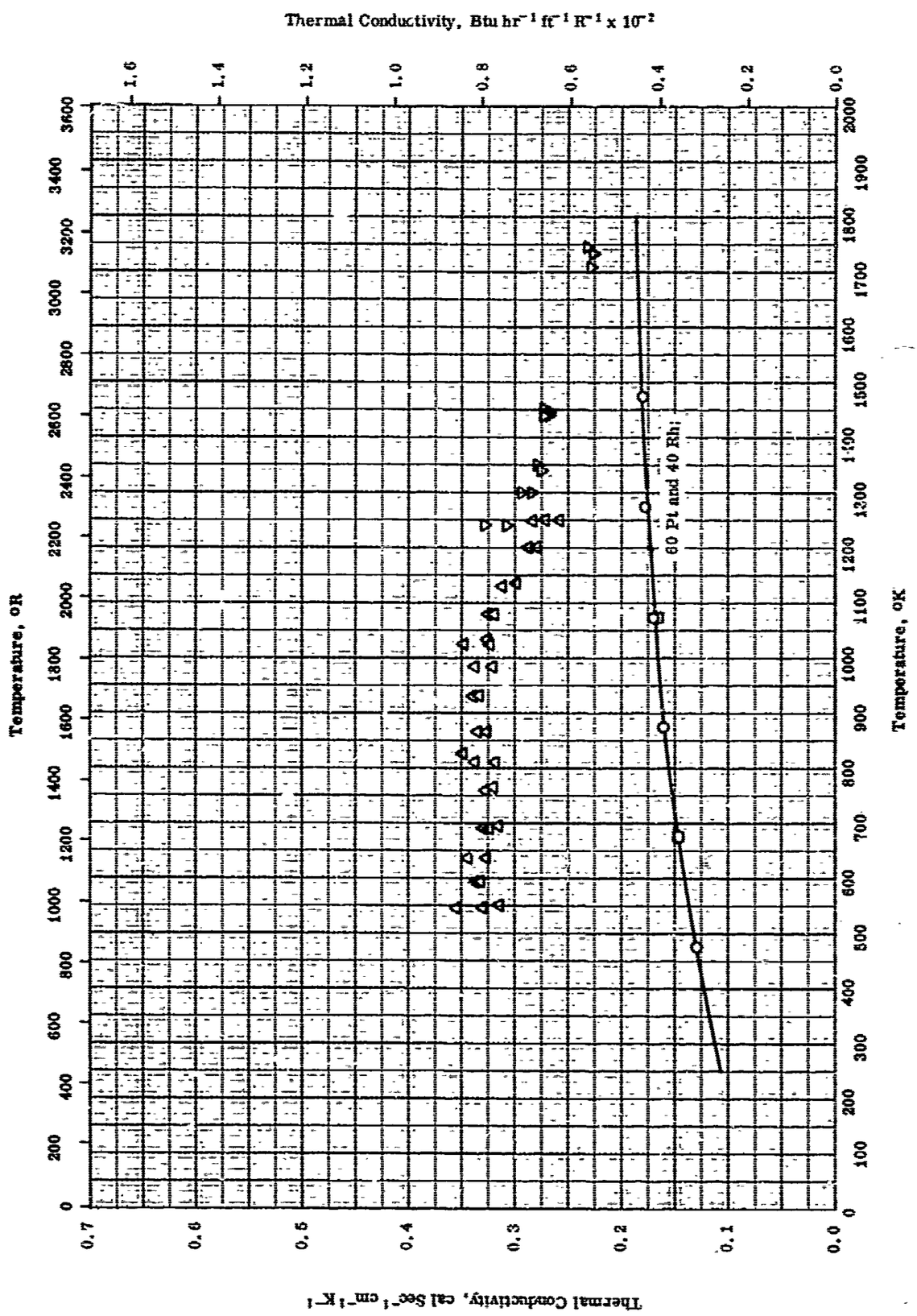


THERMAL LINEAR EXPANSION -- PLATINUM + IRON

THERMAL LINEAR EXPANSION -- PLATINUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	50-6	273-773		92 Pt and 8 Fe.	Prepared from Armco iron and technically pure platinum, melted in magnesia crucible, formed into rods; tempered.
□	50-6	273-973		77.5 Pt and 22.5 Fe.	Same as above.
△	50-6	73-773		57 Pt and 43 Fe.	Same as above.



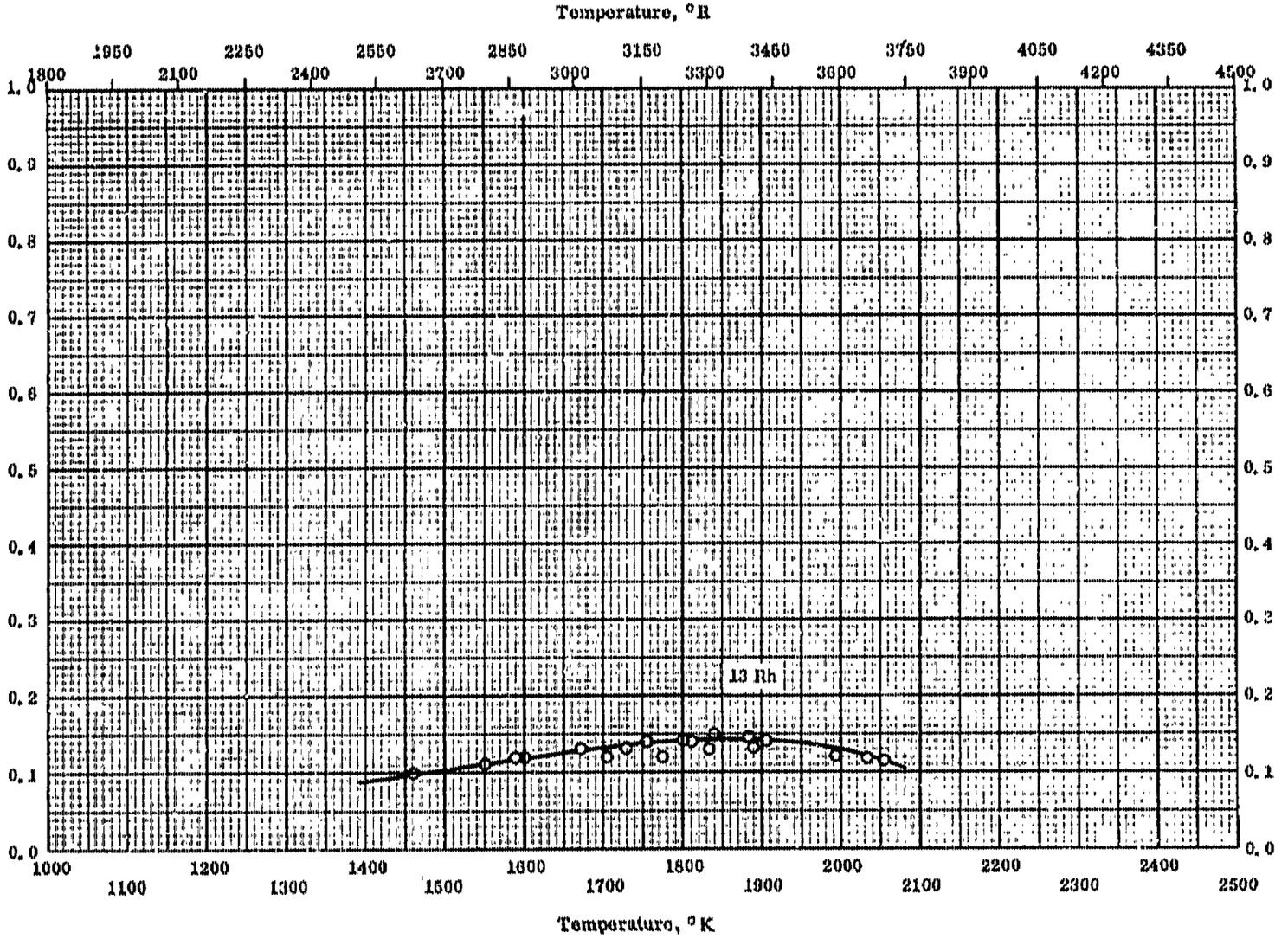
THERMAL CONDUCTIVITY -- PLATINUM + RHODIUM

THERMAL CONDUCTIVITY -- PLATINUM + RHODIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	62-10	473-1473		60 Pt, 40 Rh, 0.01-0.1 Fe, 0.001-0.01 Cu, Ir, Pd, Si, and Zr, and 0.001 >B and Ca.	Machined and annealed at 1000 C.
□	62-10	673-1073		Same as above.	Cooling curve of the above sample.
△	62-12	548-1254		60 Pt and 40 Rh; grain size exhibited an increase of 2 to 3 times larger than those before measurement.	Annealed at 1800 F for 30 min.
▽	62-12	1240-1747		Same as above.	Second run.

TPRC

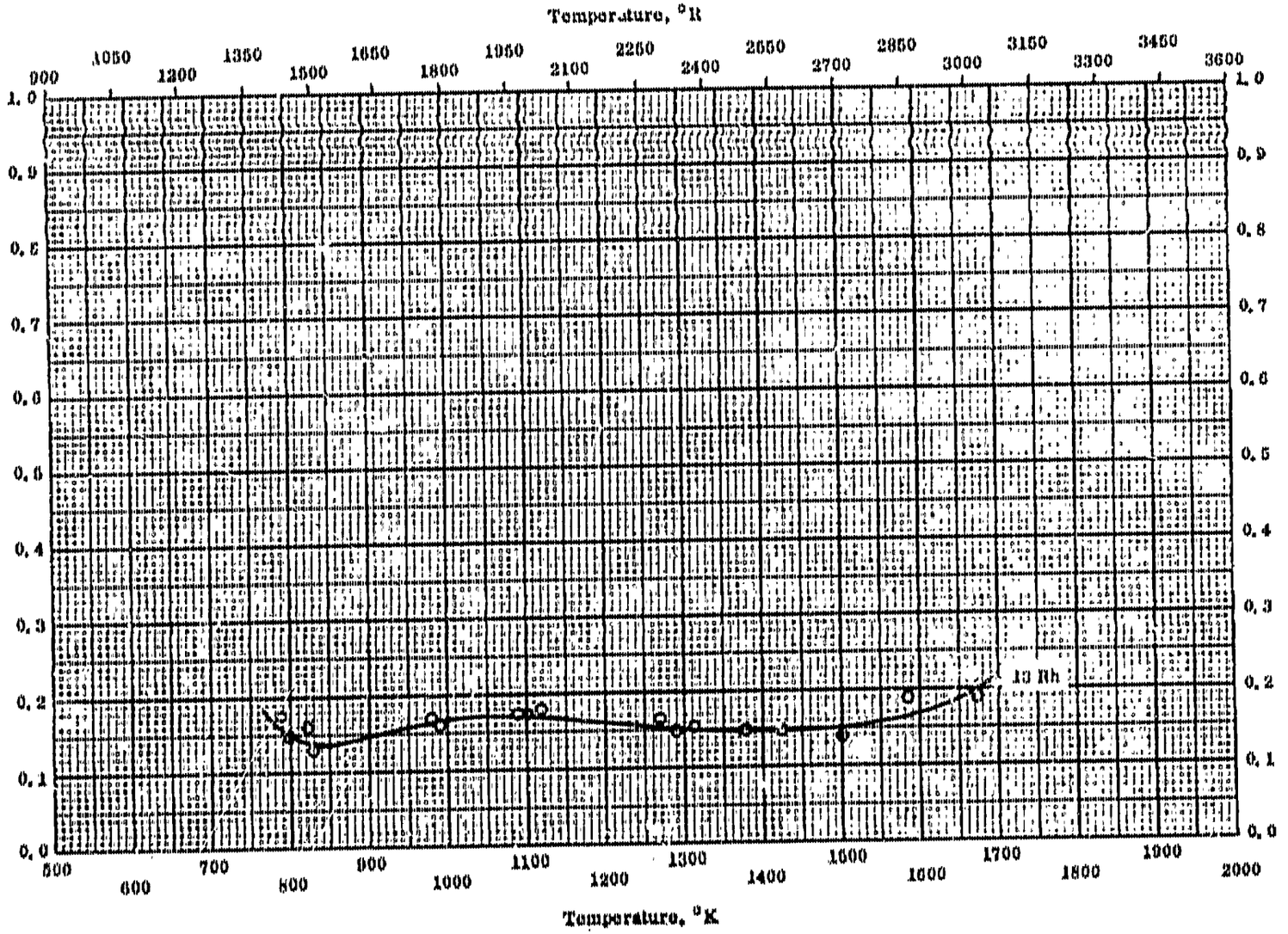


NORMAL TOTAL EMITTANCE -- PLATINUM + RHODIUM

NORMAL TOTAL EMITTANCE -- PLATINUM + RHODIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-19	1461-2055	± 10	87 Pt and 13 Rh.	Thin sheet.



NORMAL TOTAL REFLECTANCE -- PLATINUM + RHODIUM

NORMAL TOTAL REFLECTANCE -- PLATINUM + RHODIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-18	789-1672		87 Pt and 13 Rh.	Annealed in air at 1866 K for 1 hr.; measured in nitrogen atmosphere.

PROPERTIES OF PLUTONIUM + OSMIUM

REPORTED VALUES

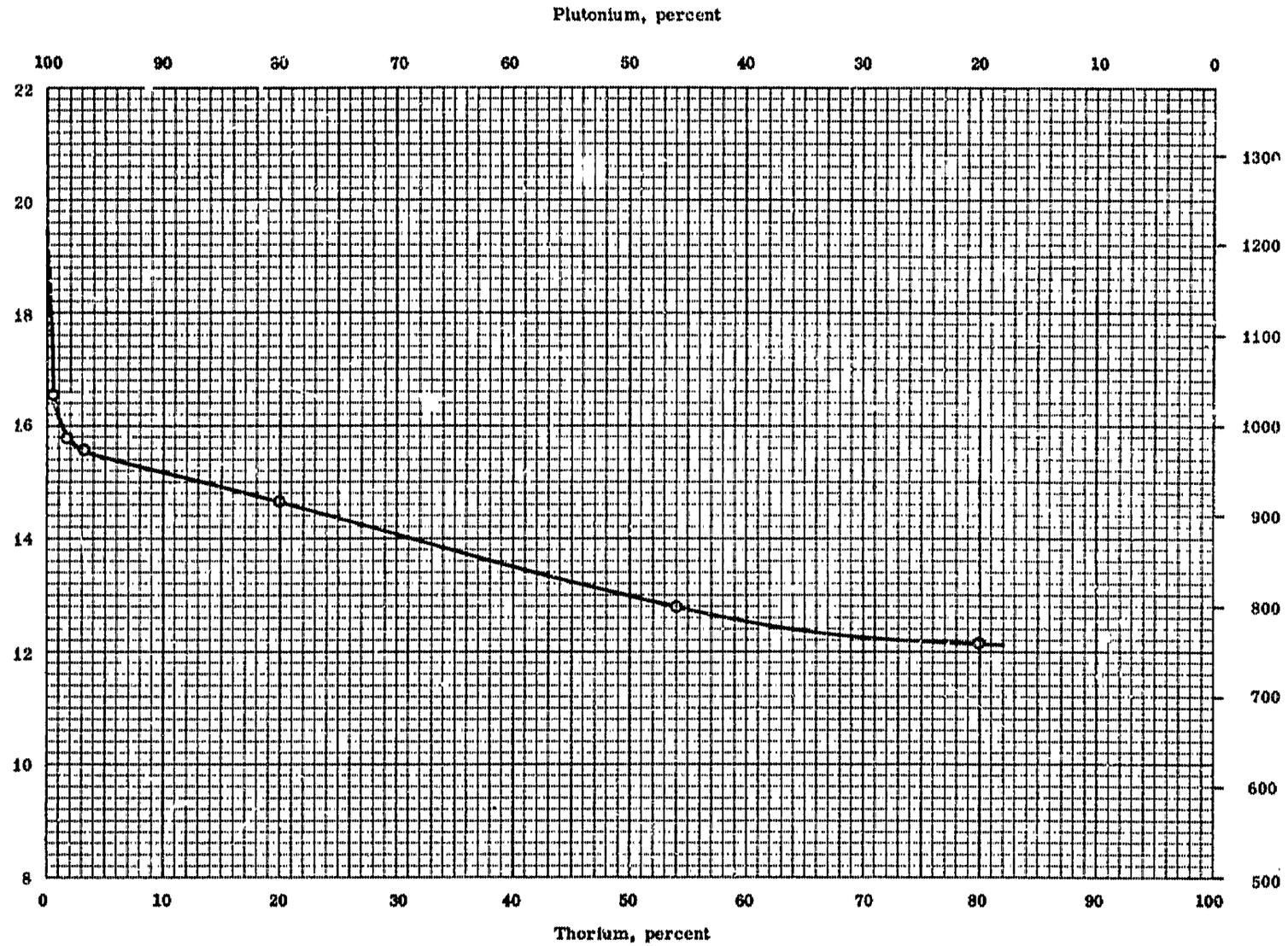
Density:	g cm^{-3}	lb ft^{-3}
O 3 Os	18.3	1140

PROPERTIES OF PLUTONIUM + OSMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	55-29	298		3 Os; eta-phase.	

TPRC



DENSITY -- PLUTONIUM + THORIUM

TRC

DENSITY --- PLUTONIUM + THORIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	57-33 also 57-37	300		0 - 80 Th.	As cast; density from weight in air, in water, and in ethylene bromide.

TPRC

PROPERTIES OF PRASEODYMIUM + MAGNESIUM

REPORTED VALUES

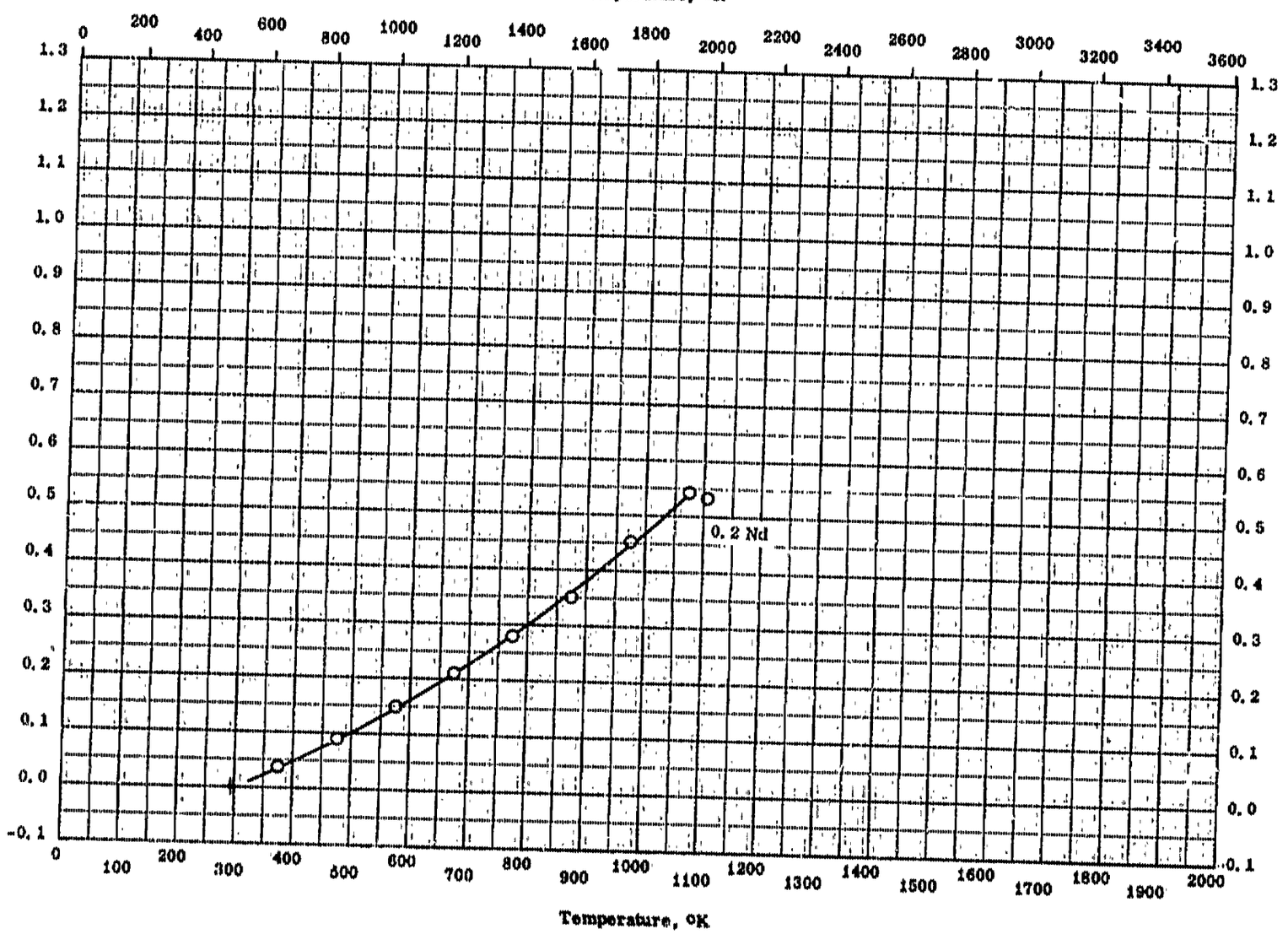
Density:	$g\ cm^{-3}$	$lb\ ft^{-3}$
O 1.0 > Mg	6.6	411

PROPERTIES OF PRASEODYMIUM + MAGNESIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-11	298		1.0 > Mg, 0.025 > Ca, 0.0135 Fe, and 0.01 > other rare earths; 75 % hexagonal close packed and 25 % face centered cubic phases.	Cast; annealed 19 hrs at 600 C.

TPRC

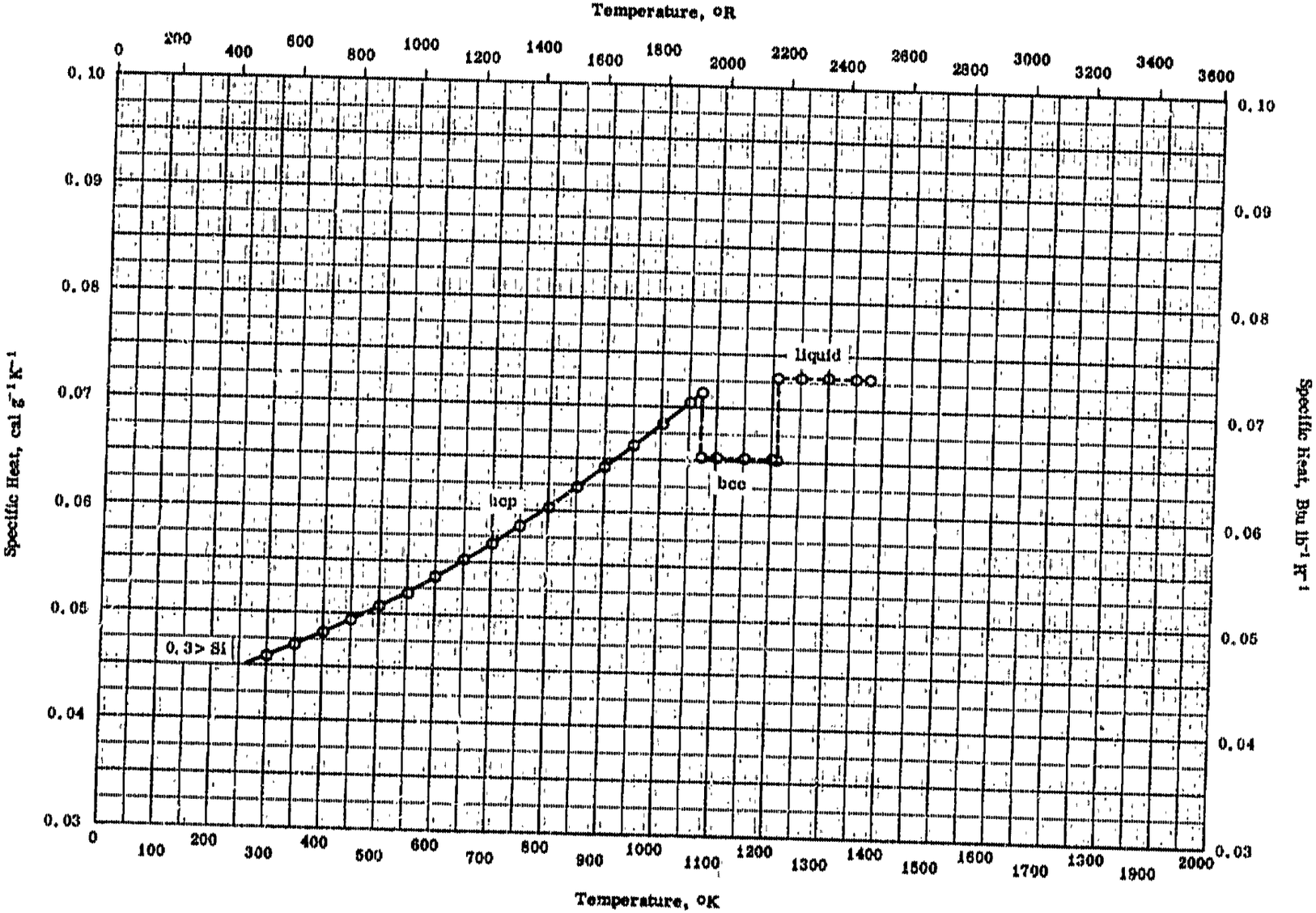


THERMAL LINEAR EXPANSION -- PRASEODYMIUM + NEODYMIUM

THERMAL LINEAR EXPANSION -- PRASEODYMIUM + NEODYMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-42 also 57-51	293-1103	±1	0.2 Nd, 0.1 Ce, 0.05 N, 0.03 C, Ta, Si each, 0.01 La, and 0.006 Fe.	Fluoride reduced with Ca, vacuum cast, recast into rod; tested in He; data obtained during heating, cooling data not shown because sample softened.



SPECIFIC HEAT -- PRASEODYMIUM + SILICON

SPECIFIC HEAT -- PRASEODYMIUM + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-14	273-1373		99.23 < Pr, 0.3 > Si, 0.10 > Ce, 0.10 > La, 0.10 > Nd, 0.10 > Ta, 0.05 > Ca, 0.01 > Fe, and 0.01 > Mg.	Prepared by metallothermic reduction of praseodymium fluoride with calcium metal; sealed under helium atmosphere.

PROPERTIES OF RHENIUM + TUNGSTEN

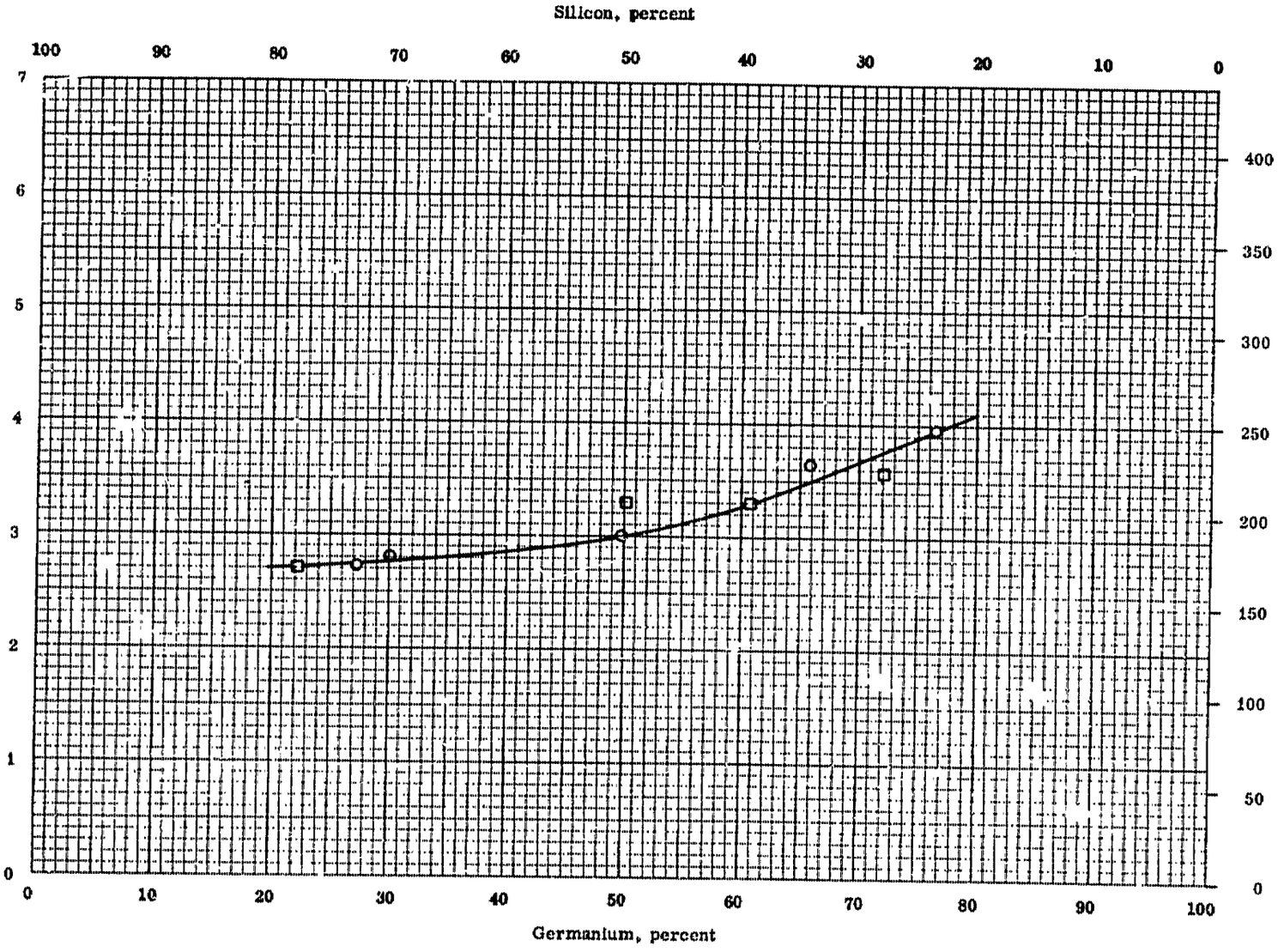
REPORTED VALUES

Melting Point:	K	R
O 33 W	3083	5550

PROPERTIES OF RHENIUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	55-33	3083		33 W.	M.P. from collapse of hole; the lowest melting eutectic for whole Re - W system.

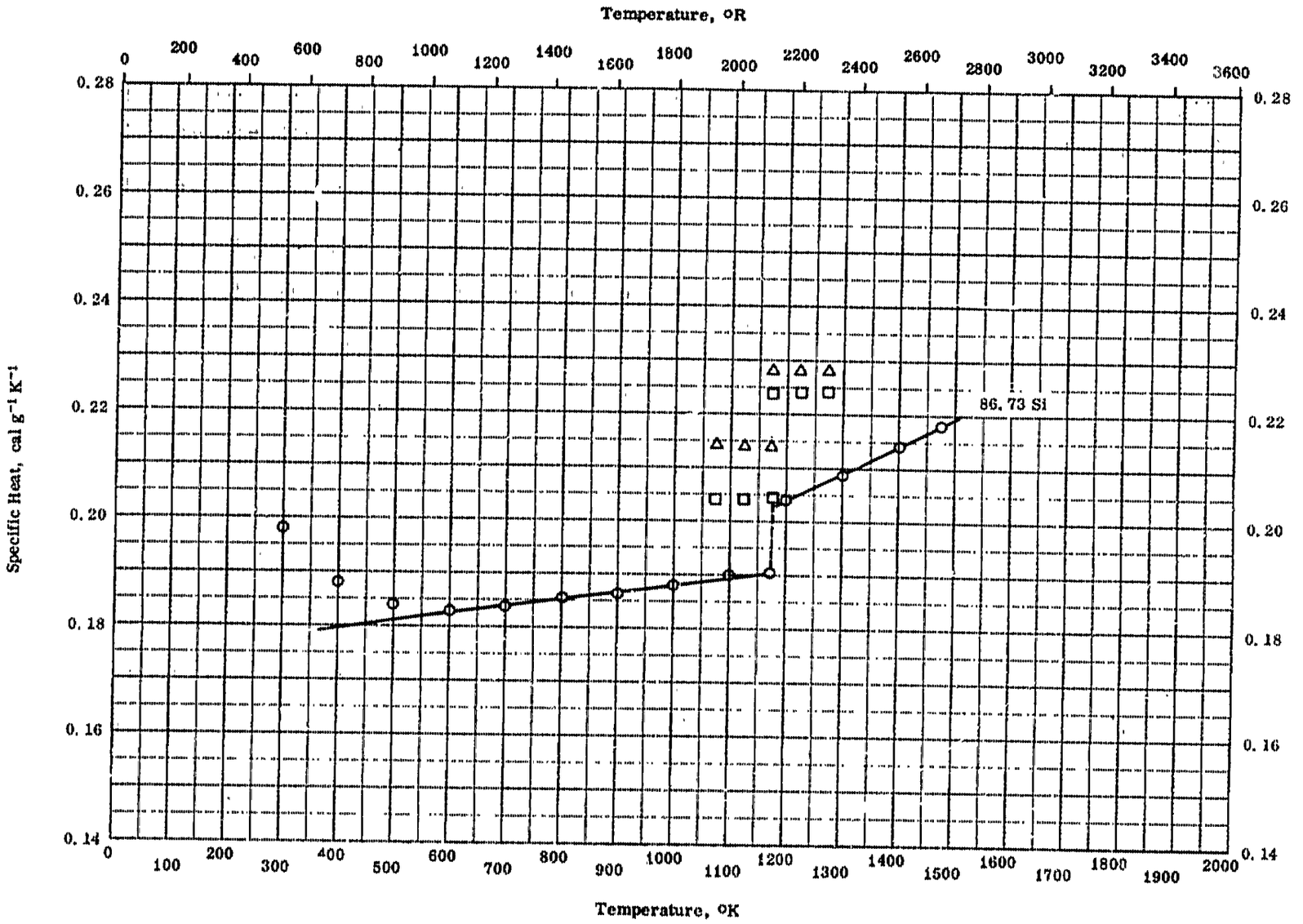


DENSITY --- SILICON + GERMANIUM

DENSITY -- SILICON + GERMANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	54-22	298		27-76 Ge.	Author claims accuracy within a few percent.
□	55-26	298		22-72 Ge; from zone-melted Ge and hyper-pure Si; alloy homogeneous.	Prepared by isothermal solidification.

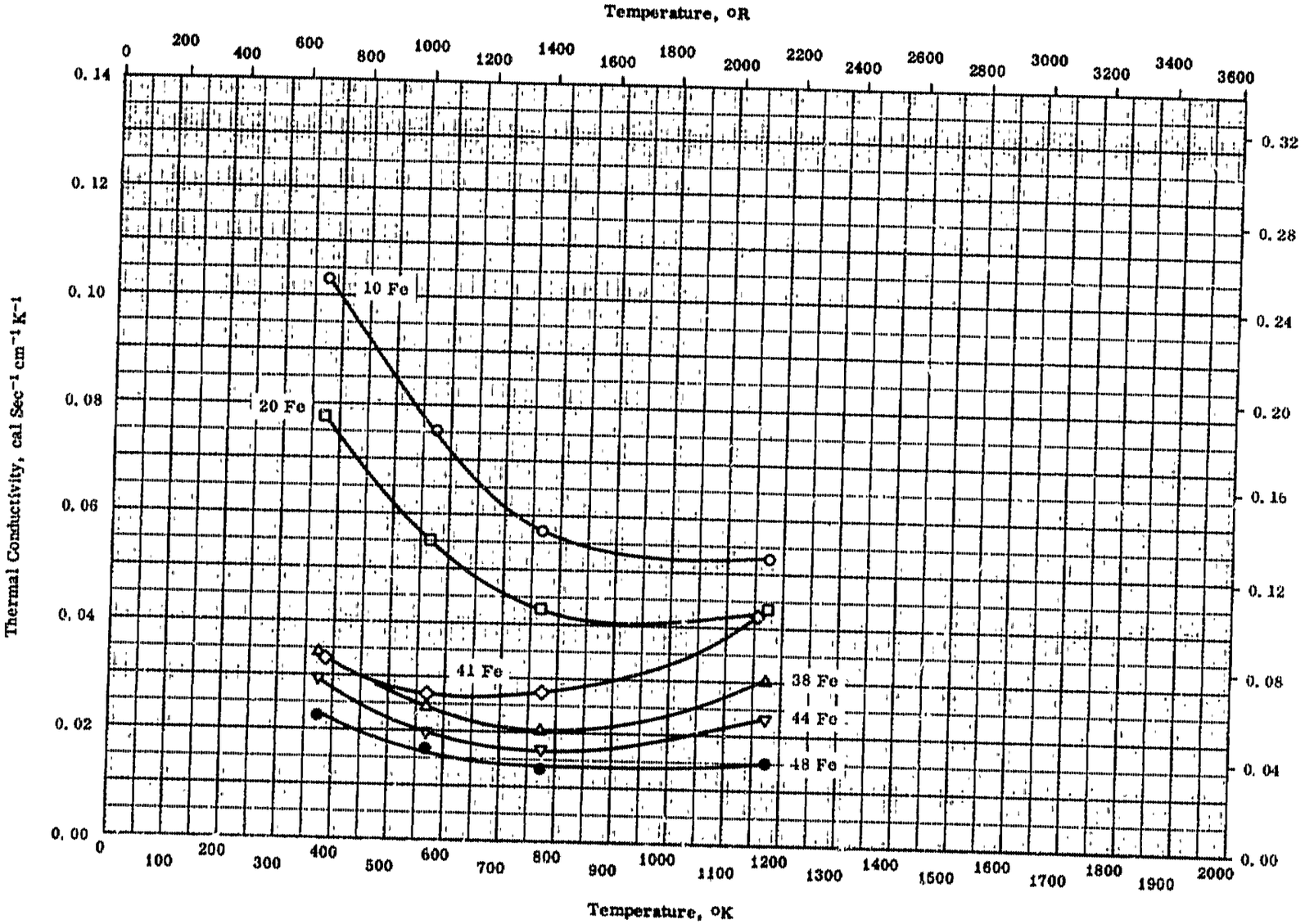


SPECIFIC HEAT -- SILICON + IRON

SPECIFIC HEAT -- SILICON + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	54-10	300-1473		86.73 Si; prepared from Armco iron and 99.2 Si.	Annealed 3 hrs at 700 C.
□	54-10	1073-1273		64.37 Si; raw materials same as above.	Same as above.
△	54-10	1073-1273		53.4 Si; raw materials same as above.	Same as above.



THERMAL CONDUCTIVITY -- SILICON + IRON

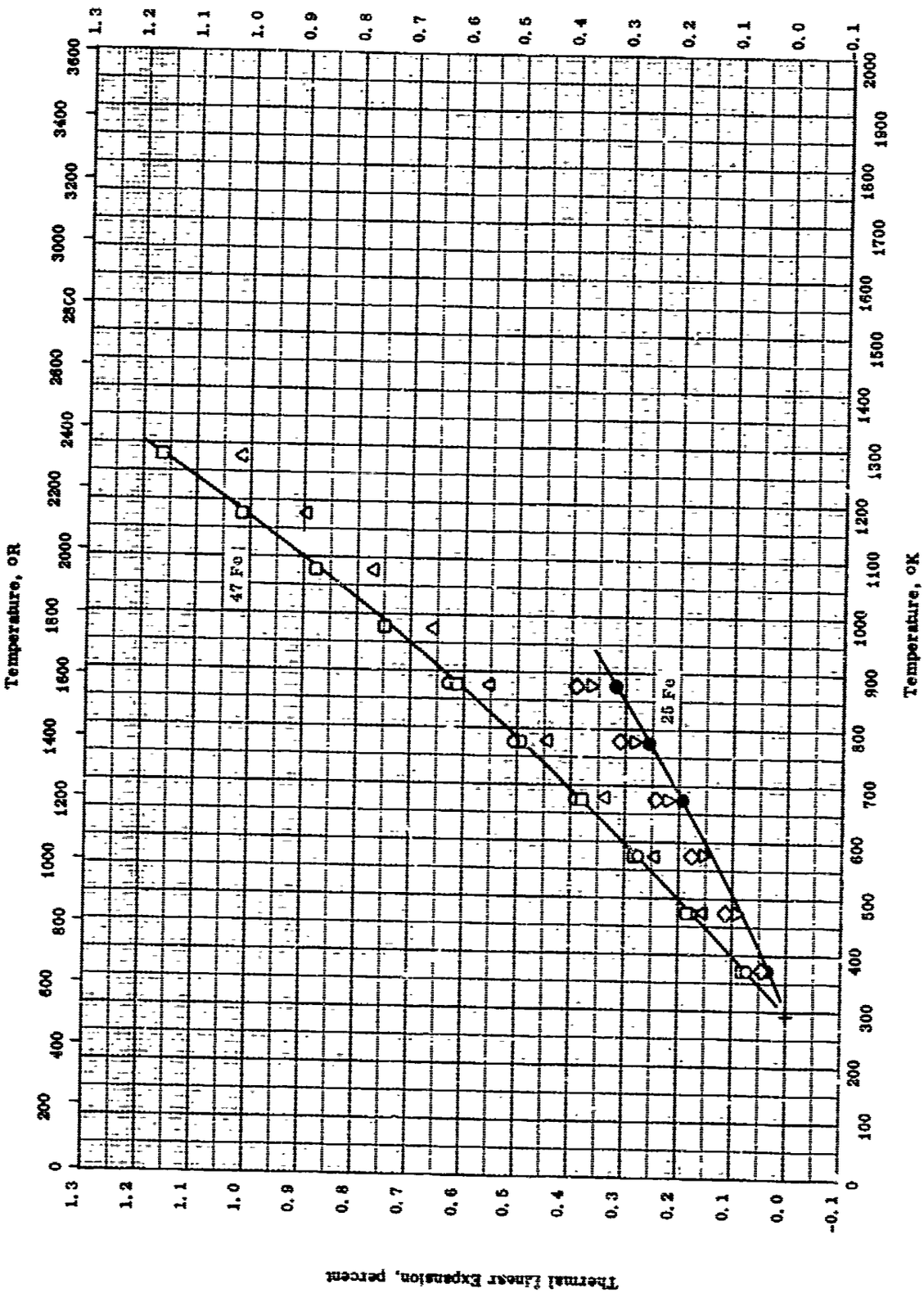
TPRC

THERMAL CONDUCTIVITY -- SILICON + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-10	373-1173	± 7	90 Si and 10 Fe.	
□	56-10	373-1173	± 7	80 Si and 20 Fe.	
△	56-10	373-1173	± 7	62 Si and 38 Fe.	
◇	56-10	373-1173	± 7	59 Si and 41 Fe.	
▽	56-10	373-1173	± 7	55.5 Si and 44.5 Fe.	
●	56-10	373-1173	± 7	52.5 Si and 47.5 Fe.	

TPRC



THERMAL LINEAR EXPANSION -- SILICON + IRON

THERMAL LINEAR EXPANSION -- SILICON + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-40	373-873		50.20 Si and 49.8 Fe.	Annealed.
□	56-40	373-1273		Lebolte; 53.38 Si and 46.62 Fe; α-phase.	Tempered from 950 C.
△	56-40	373-1273		Same as above; β-phase.	Annealed at 800 C.
◇	56-40	373-873		58.11 Si and 41.89 Fe.	Annealed.
▽	56-40	373-873		68.56 Si and 31.44 Fe.	Same as above.
●	56-40	373-873		75.03 Si and 24.97 Fe.	Same as above.

TPRC

PROPERTIES OF SILVER + ALUMINUM

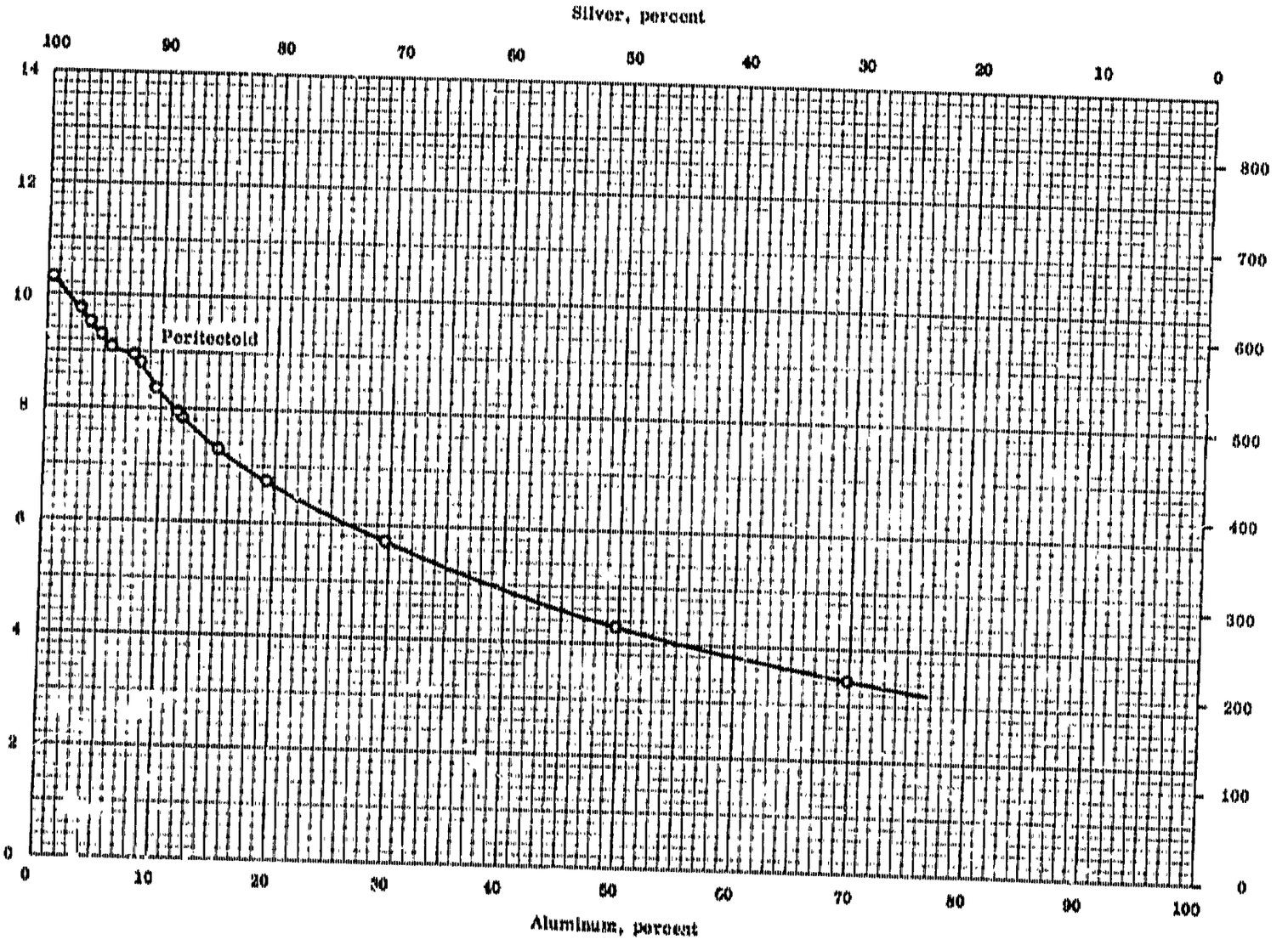
REPORTED VALUES

Density:		See figure	
Heat of Sublimation:		cal g^{-1}	Btu lb^{-1}
○	2 Al	451	812
□	3 Al	401	722
△	33.9 Al	394	710

PROPERTIES OF SILVER + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repl. Error %	Sample Specifications	Remarks
○	54-21	1013		2 Al.	
□	54-21	1003		3 Al.	
△	54-21	1048		33.9 Al.	

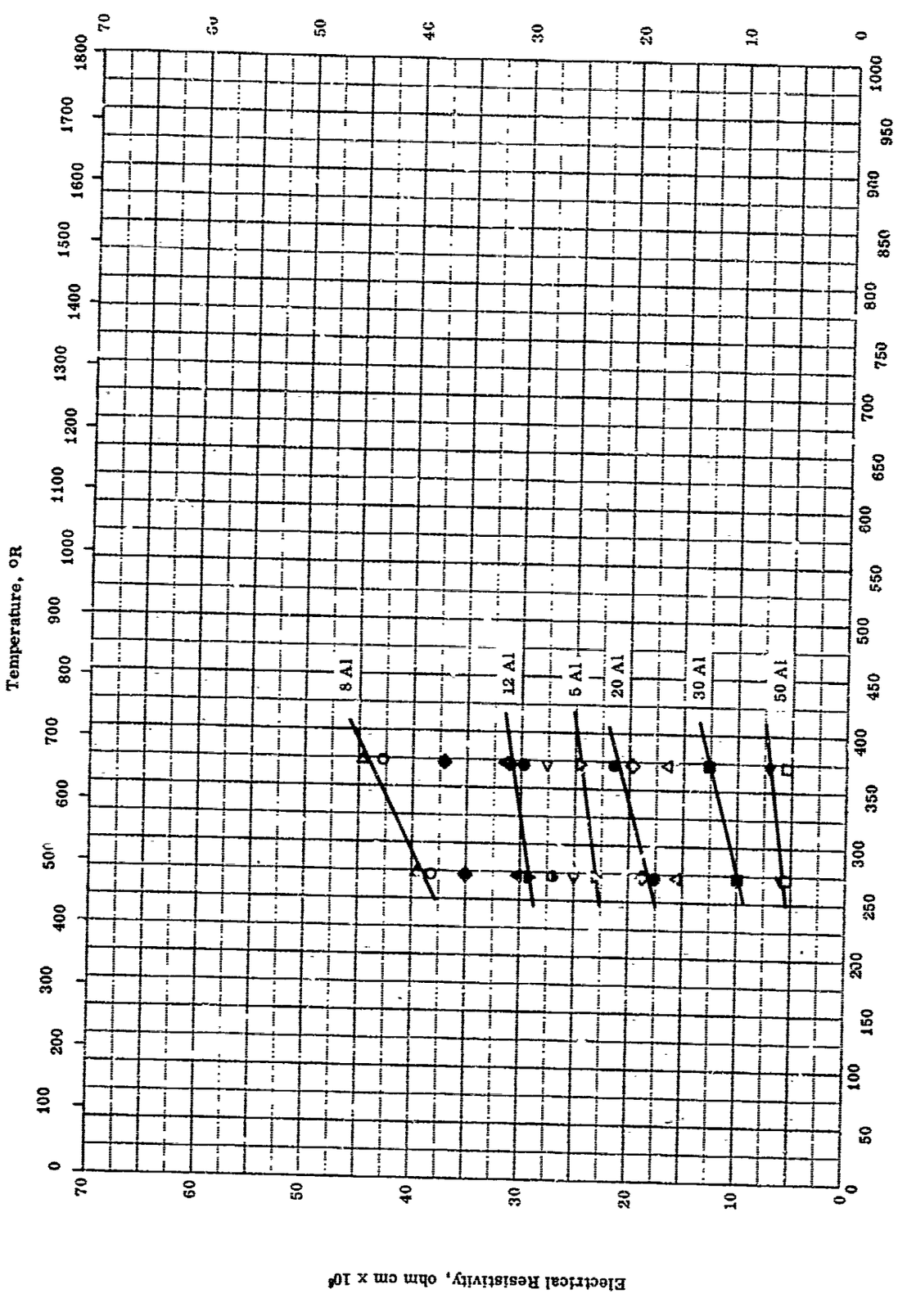


DENSITY — SILVER + ALUMINUM

DENSITY -- SILVER + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	43-1	298		0-70 Al; prepared from pure Ag and 99.99 Al.	Density by weight in air and in water.



ELECTRICAL RESISTIVITY -- SILVER + ALUMINUM

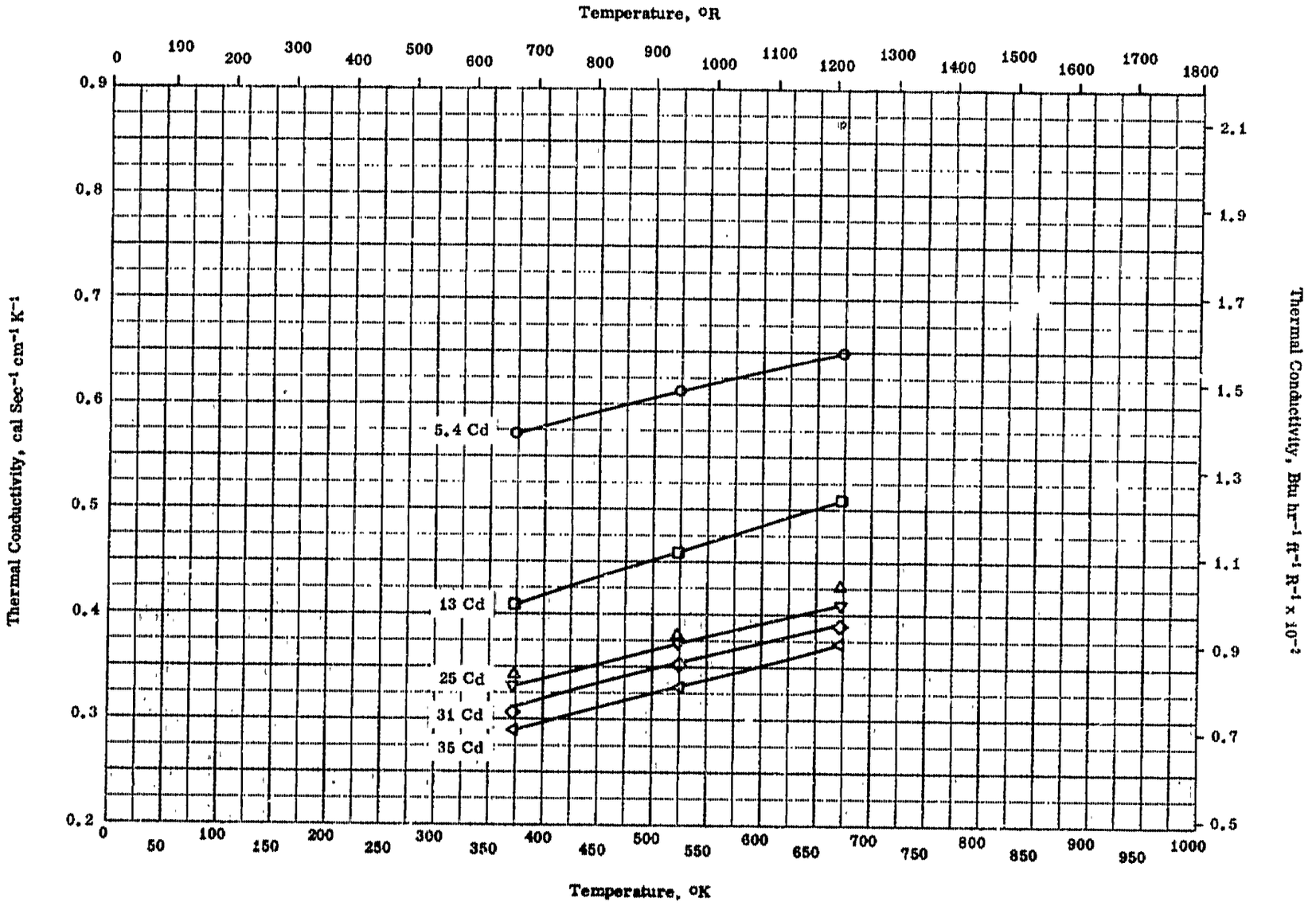
Electrical Resistivity, ohm cm x 10⁶

TPRC

ELECTRICAL RESISTIVITY -- SILVER + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	43-1	273-373		99.50 Ag and 0.50 Al; density 643 lb ft^{-3}.	
△	43-1	273-373		97.00 Ag and 3.00 Al; density 608 lb ft^{-3}.	
◇	43-1	273-373		96.11 Ag and 3.89 Al; density 592 lb ft^{-3}.	
▽	43-1	273-373		95.08 Ag and 4.92 Al; density 580 lb ft^{-3}.	
◁	43-1	273-373		94.29 Ag and 5.71 Al; density 567 lb ft^{-3}.	
▷	43-1	273-373		92.30 Ag and 7.70 Al; density 588 lb ft^{-3}.	
○	43-1	273-373		91.75 Ag and 8.25 Al; density 543 lb ft^{-3}.	
◆	43-1	273-373		90.40 Ag and 9.60 Al; density 524 lb ft^{-3}.	
▲	43-1	273-373		88.50 Ag and 11.50 Al; density 497 lb ft^{-3}.	
▼	43-1	273-373		87.96 Ag and 12.04 Al; density 490 lb ft^{-3}.	
⊖	43-1	273-373		84.74 Ag and 15.26 Al; density 455 lb ft^{-3}.	
●	43-1	273-373		80.60 Ag and 19.40 Al; density 421 lb ft^{-3}.	
■	43-1	273-373		70.23 Ag and 29.77 Al; density 357 lb ft^{-3}.	
◀	43-1	273-373		50.19 Ag and 49.81 Al; density 268 lb ft^{-3}.	



THERMAL CONDUCTIVITY — SILVER + CADMIUM

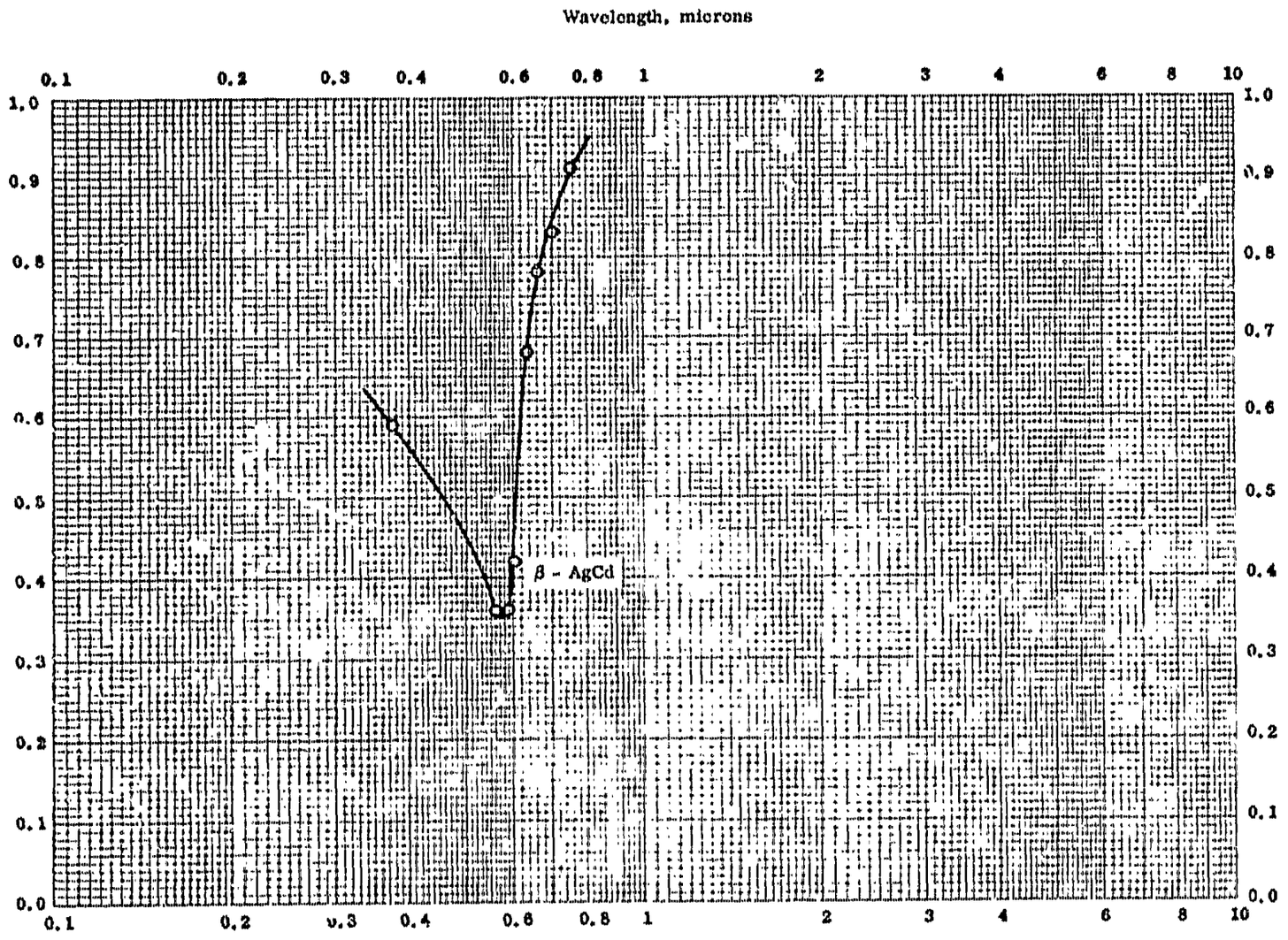
TPRC

THERMAL CONDUCTIVITY -- SILVER + CADMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	51-5	373-673		5.4 Cd.	
□	51-5	373-673		12.9 Cd.	
△	51-5	373-673		22.0 Cd.	Cross-section reduced 67% by rolling.
▽	51-5	373-673		24.5 Cd.	Same as above.
◇	51-5	373-673		31.8 Cd.	Cross-section reduced 67% by rolling.
◁	51-5	373-673		35.6 Cd.	

TPRC

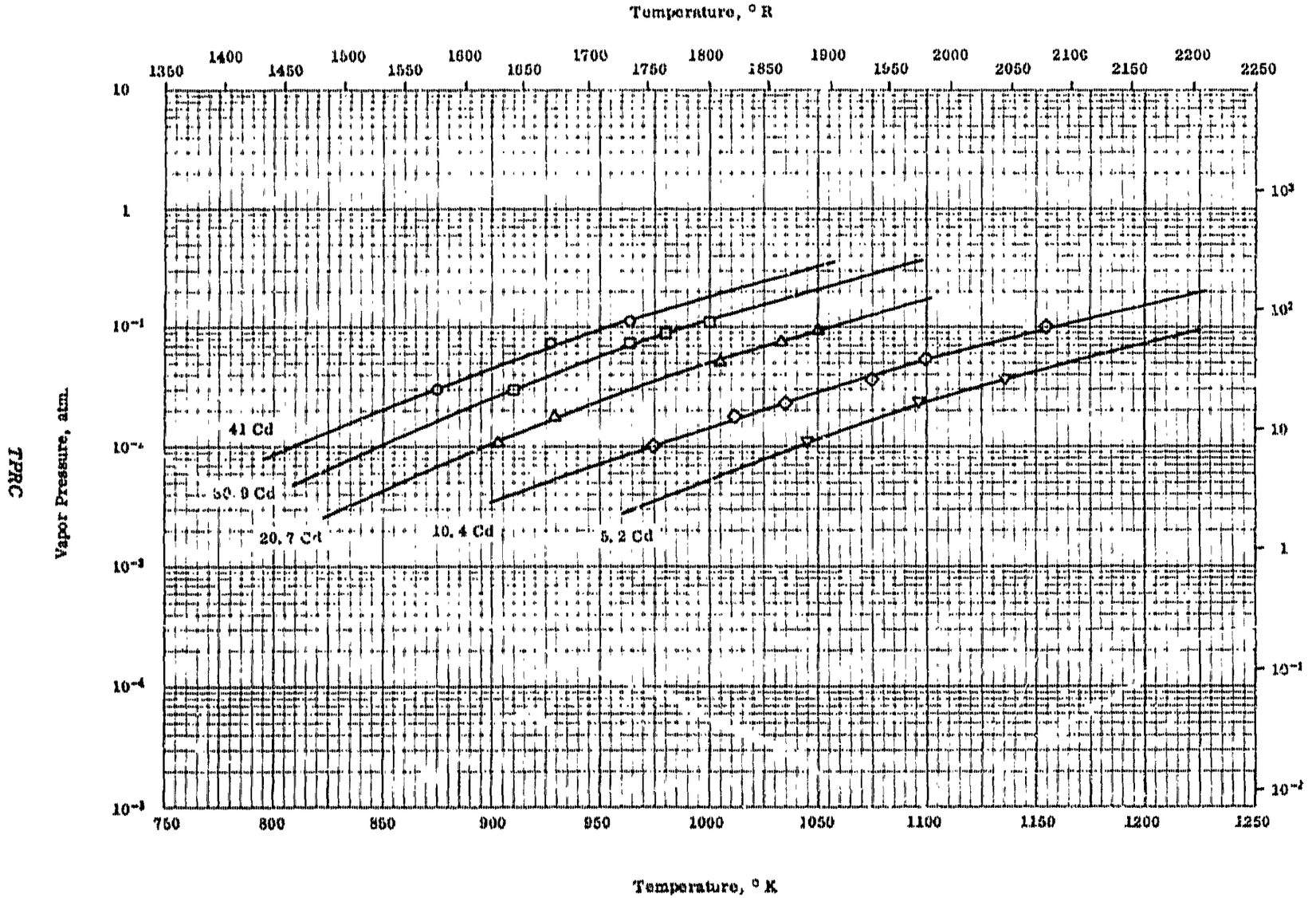


ANGULAR SPECTRAL REFLECTANCE -- SILVER + CADMIUM

ANGULAR SPECTRAL REFLECTANCE --- SILVER + CADMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. °K	Wavelength Range, μ	Rept. Error%	Sample Specifications	Remarks
O	61-24	298	0.375-0.75		β - AgCd; 2000 Å film.	Vacuum evaporated on glass; 45 degree illumination and 45 degree viewing; data extracted from smooth curve.



TPRC

VAPOR PRESSURE -- SILVER + CADMIUM

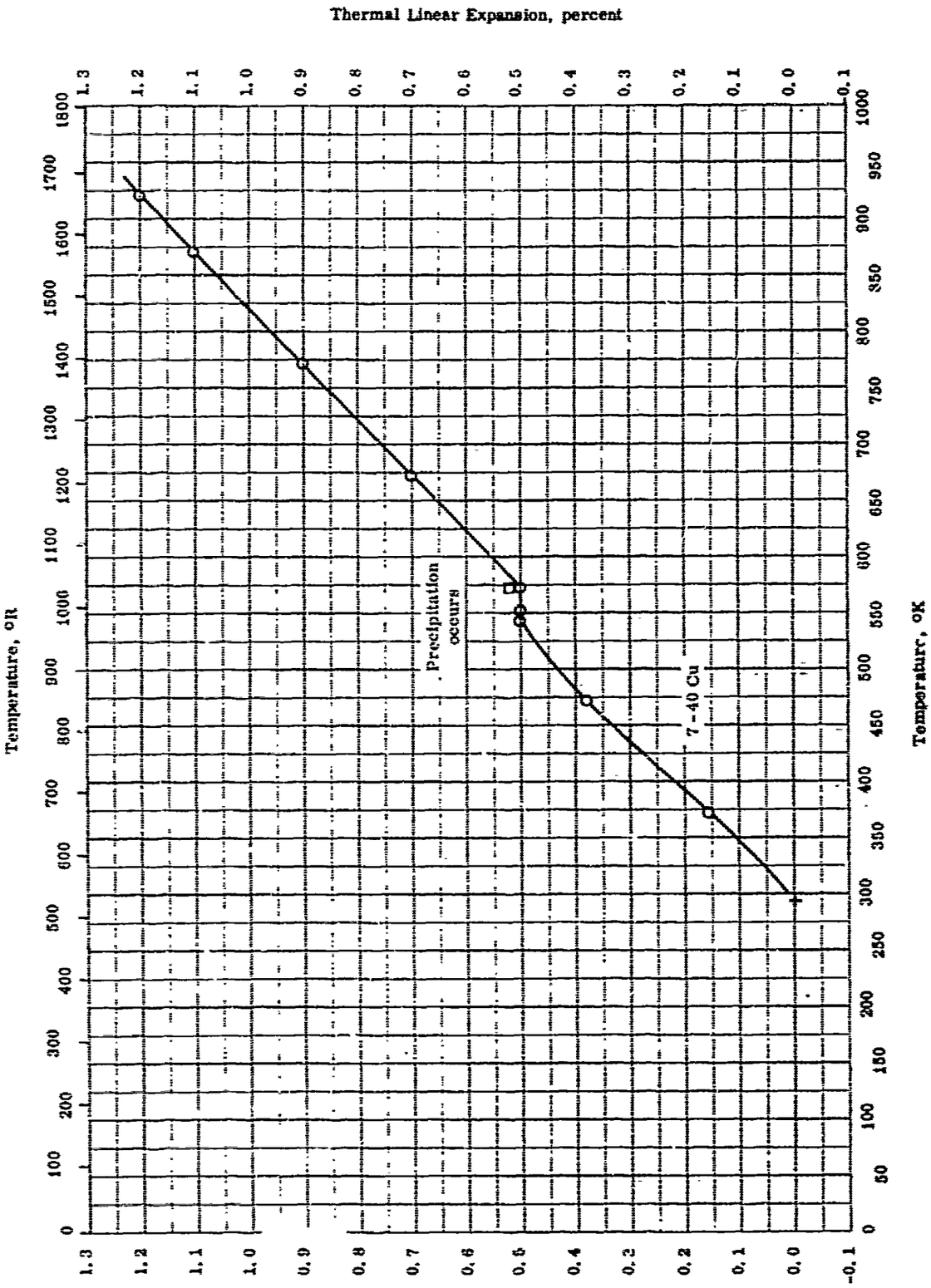
459

VAPOR PRESSURE -- SILVER + CADMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-9	873-963		41 Cd; $\alpha + \beta$ phase.	Data are pressure of Cd over the alloy.
□	55-9	911-998		30.9 Cd; α-phase.	Same as above.
△	55-9	902-1051		20.7 Cd; α-phase.	Same as above.
◇	55-9	976-1160		10.4 Cd; α-phase.	Same as above.
▽	55-9	1046-1136		5.2 Cd; α-phase.	Same as above.

TPRC



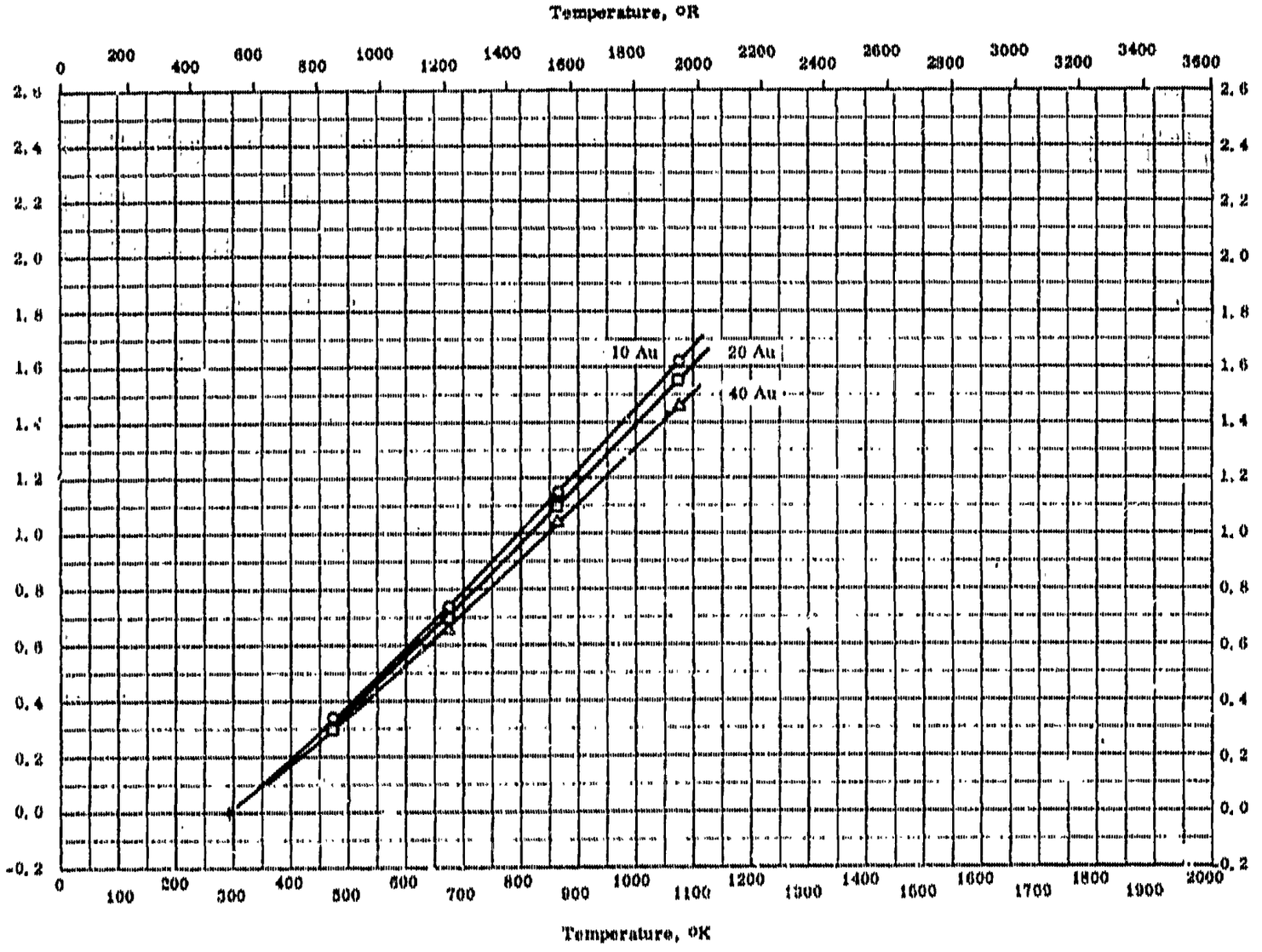
THERMAL LINEAR EXPANSION — SILVER + COPPER

THERMAL LINEAR EXPANSION -- SILVER + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	49-12	293-923		93 Ag and 7 Cu.	Homogenized; tested at 1.6 C min^{-1}.
□	35-39	293-573		6 samples: (a) 78.5 Ag, 21.4 Cu, 0.027 As, and 0.010 P. (b) 76.7 Ag, 23.2 Cu, 0.027 As, and 0.012 P. (c) 74.3 Ag, 25.4 Cu, 0.017 As, and 0.010 P. (d) 71.3 Ag, 28.6 Cu, 0.021 As, and 0.012 P. (e) 69.2 Ag, 30.2 Cu, 0.027 As, and 0.012 P. (f) 53.5 Ag, 46.3 Cu, 0.021 As, and 0.012 P.	Cast; values of the 6 samples within ± 5% of plotted point.

TPRC



TPRC

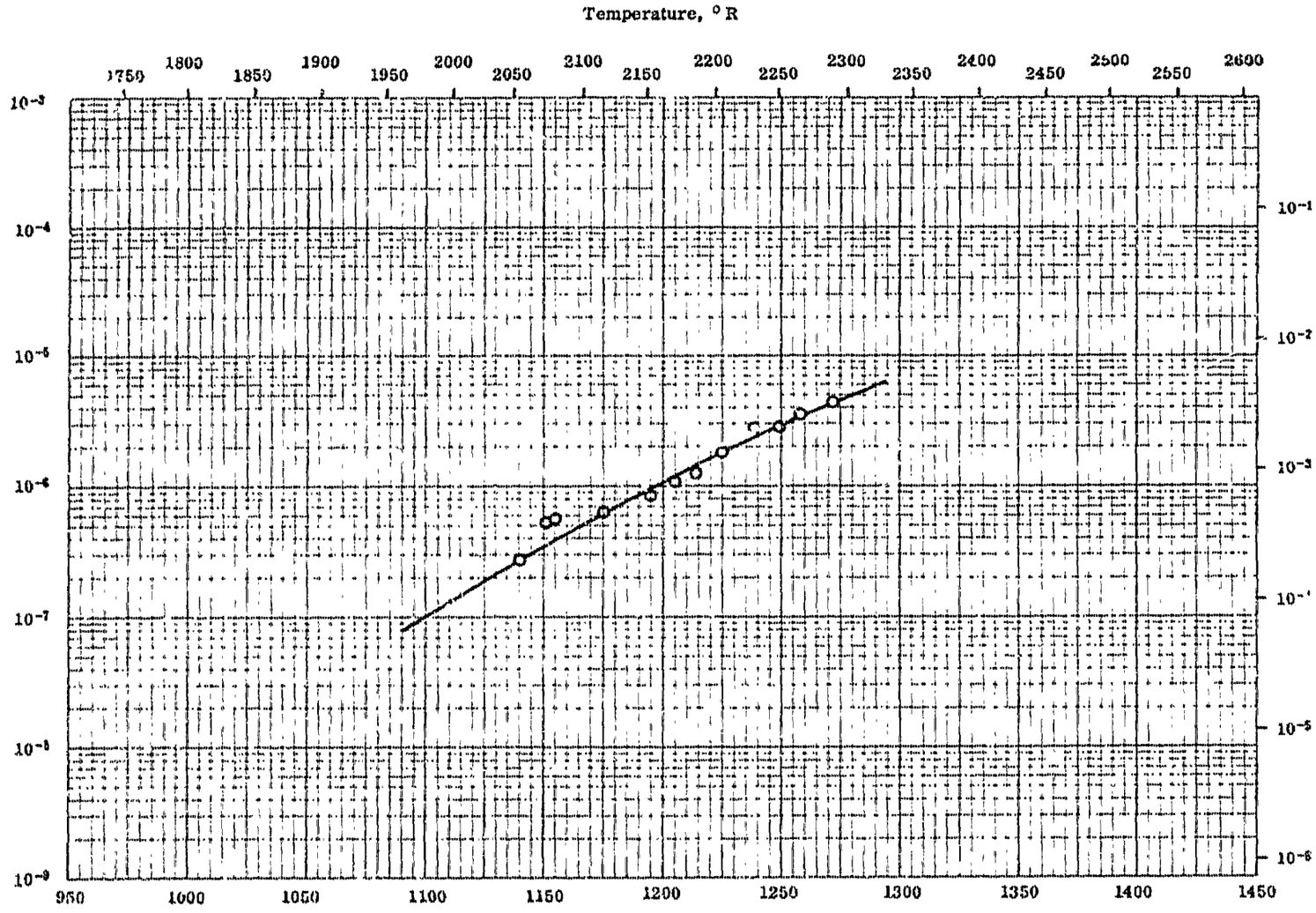
THERMAL LINEAR EXPANSION — SILVER +GOLD

THERMAL LINEAR EXPANSION -- SILVER +GOLD

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	51-17	293-1073		90 Ag and 10 Au.	Homogenized.
□	51-17	293-1073		80 Ag and 20 Au.	Same as above.
△	51-17	293-1073		60 Ag and 40 Au.	Same as above.

TPRC

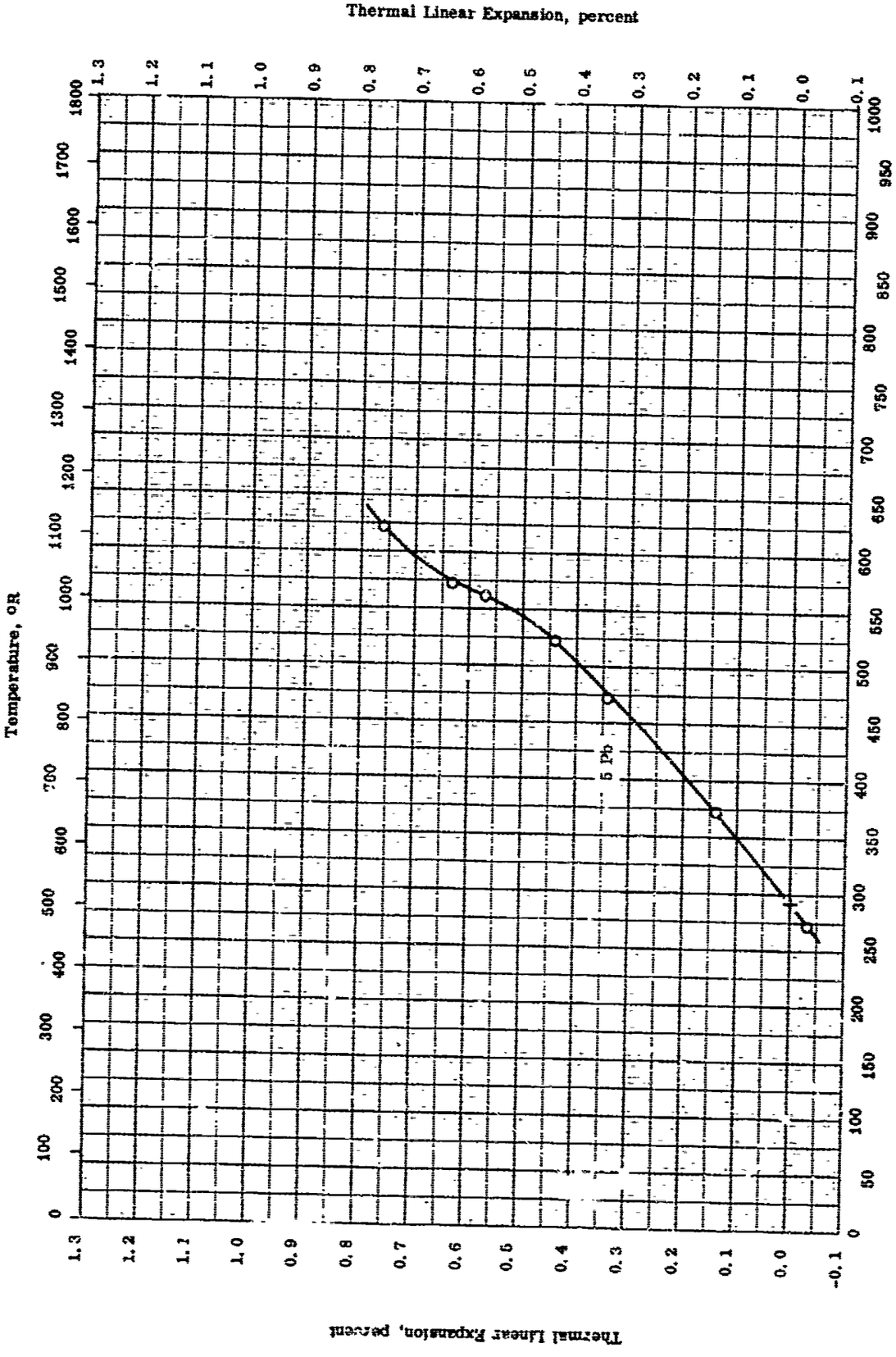


VAPOR PRESSURE -- SILVER + GOLD

VAPOR PRESSURE -- SILVER + GOLD

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	53-10	1141-1271		65.3 Ag and 34.7 Au.	



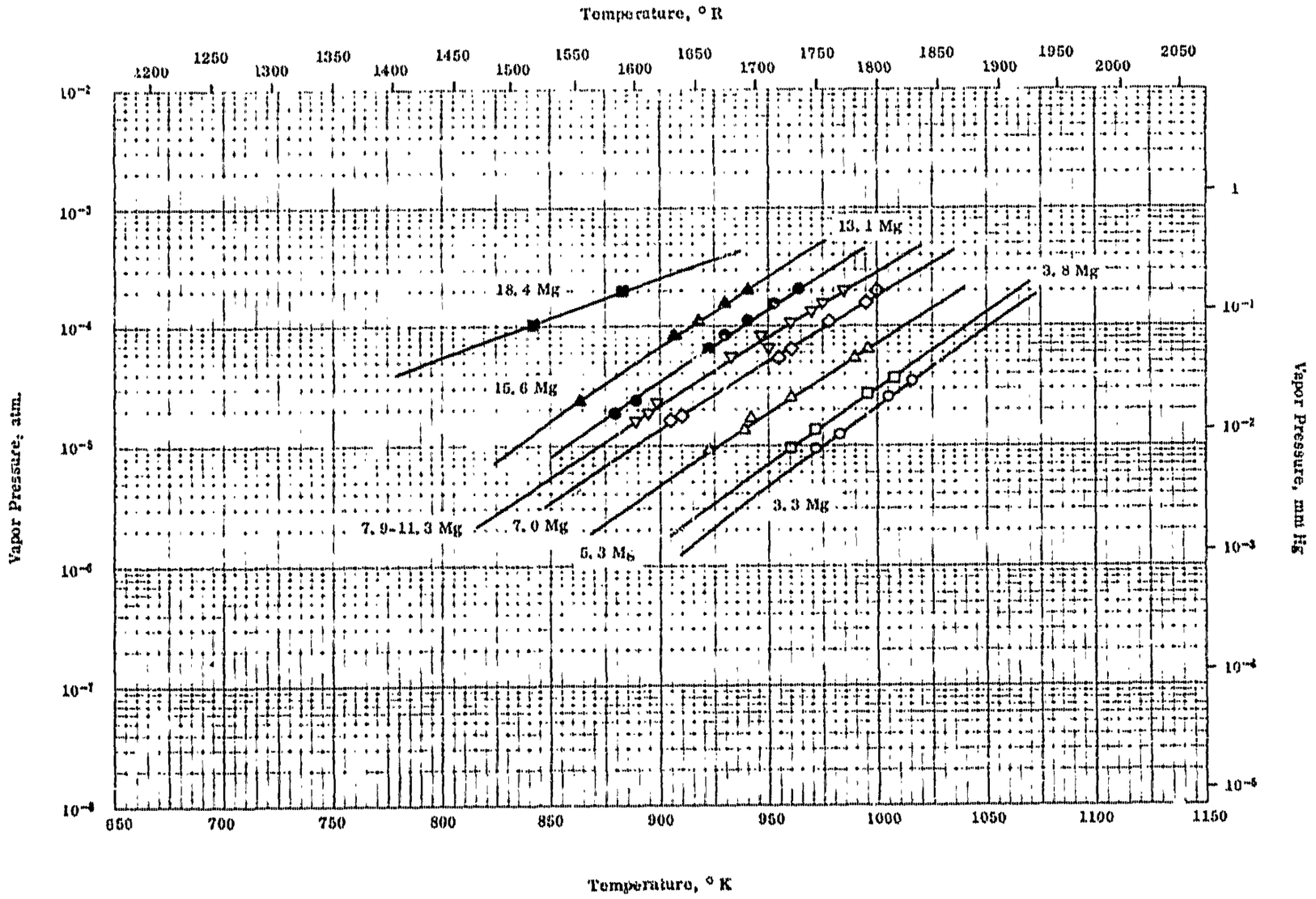
THERMAL LINEAR EXPANSION -- SILVER + LEAD

THERMAL LINEAR EXPANSION -- SILVER + LEAD

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	49-12	273-623		95 Ag and 5 Pb.	Homogenized; tested at 0.9 C min^{-1}.

TPRC



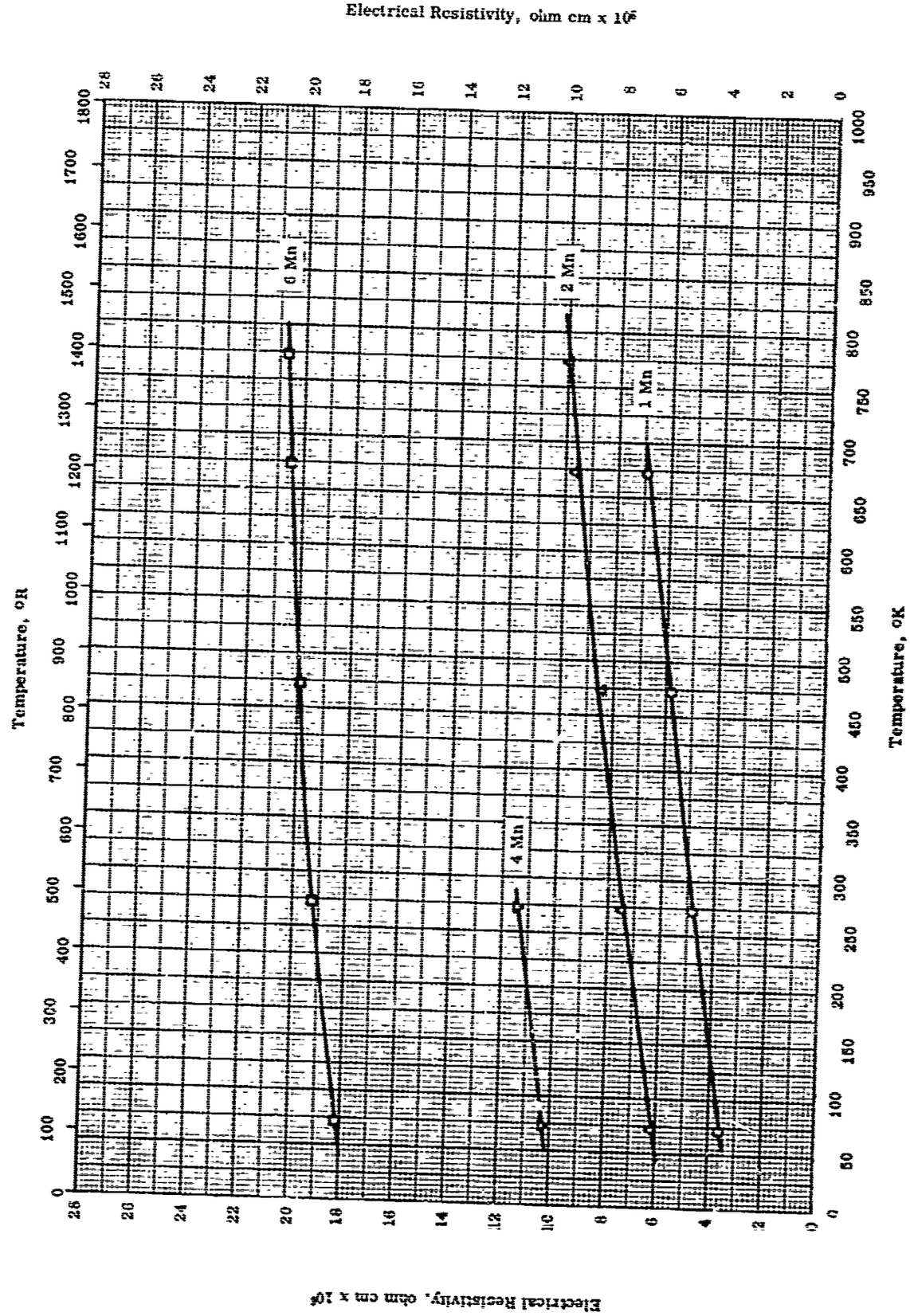
VAPOR PRESSURE -- SILVER + MAGNESIUM

VAPOR PRESSURE -- SILVER + MAGNESIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-12	843-1023		3.28 Mg; α phase.	Data are pressure of Mg vapor over the alloy.
□	57-12	843-1023		3.83 Mg; α phase.	Same as above.
△	57-12	843-1023		5.34 Mg; α phase.	Same as above.
◇	57-12	843-1023		6.99 Mg; α phase.	Same as above.
▽	57-12	843-1023		7.91 - 11.26 Mg; α + β phase (data constant over this compositional range).	Same as above.
●	57-12	843-1023		13.07 Mg; β phase.	Same as above.
▲	57-12	843-1023		15.58 Mg; β phase.	Same as above.
■	57-12	843-1023		18.40 Mg; β phase.	Same as above.

TPRC



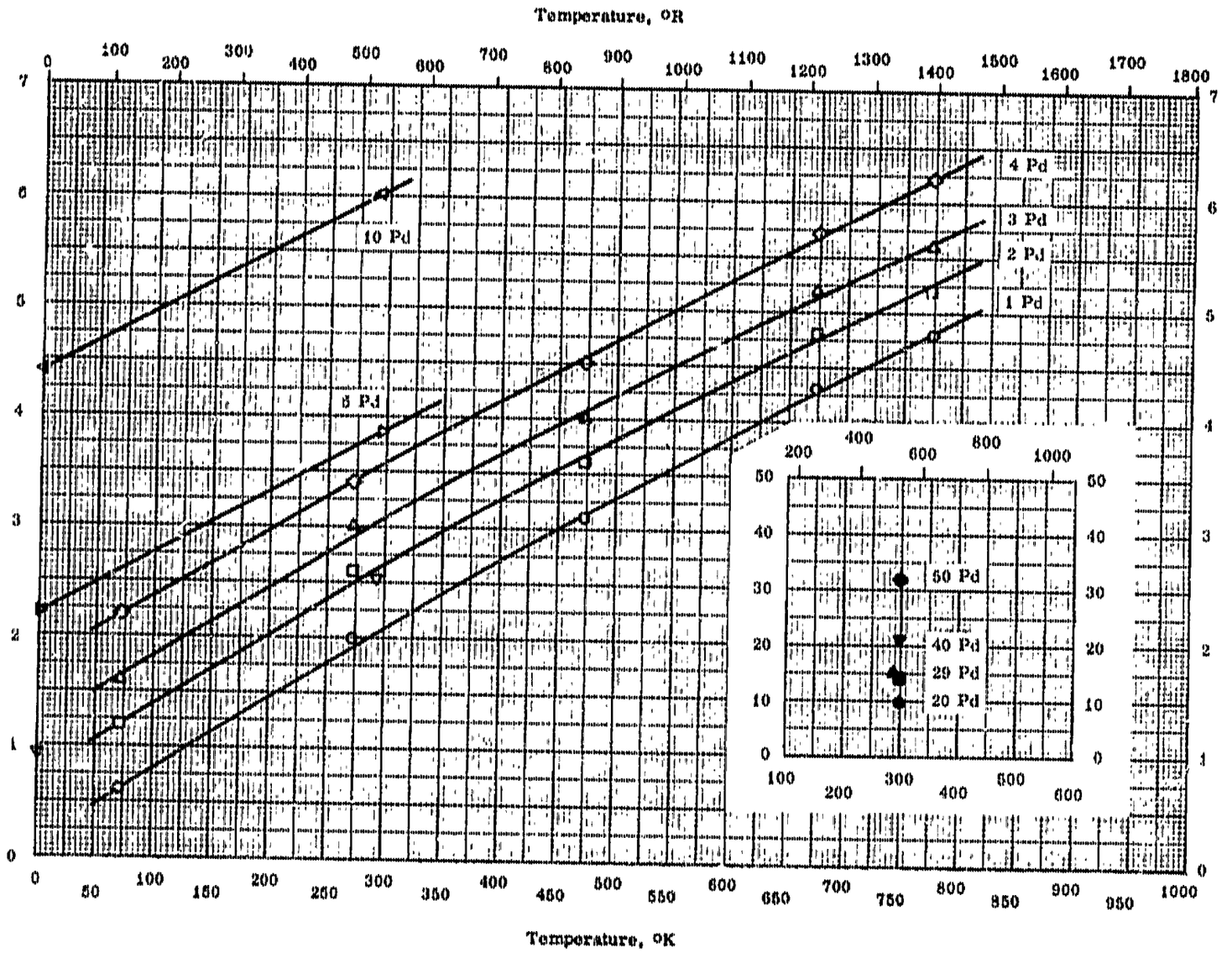
ELECTRICAL RESISTIVITY -- SILVER + MANGANESE

ELECTRICAL RESISTIVITY -- SILVER + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-26	73-673		1.0 Mn; made from 99.99 pure metals.	Melted 100 C above M.P., homogenized 24 hrs at 900 C, swaged to 0.030 in. dia., and annealed 1 hr at 700 C.
△	56-26	73-773		2.0 Mn; same as above.	Same as above.
□	56-26	73-773		6.0 Mn; same as above.	Same as above.
▽	56-26	73-273		4.0 Mn; same as above.	Same as above.

TPRC



ELECTRICAL RESISTIVITY — SILVER + PALLADIUM

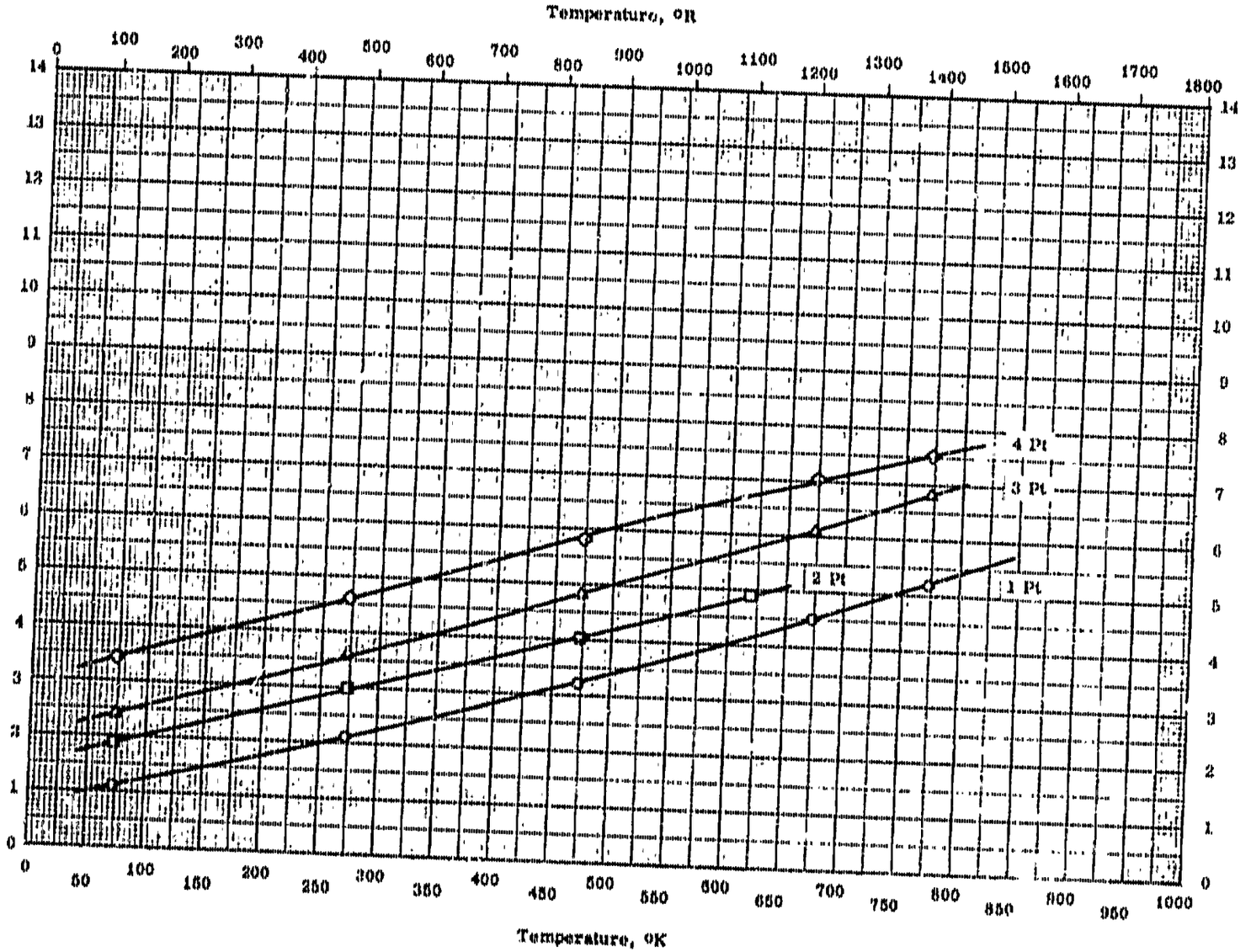
TPRC

ELECTRICAL RESISTIVITY - SILVER + PALLADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-26	76-773		1.1 Pd.	Vac. melted from 99.99 pure metals 100 C above MP, homogenized 24 hrs at 900 C, swaged to 0.030 inch dia., and annealed 1 hr at 500 C.
□	56-26	73-773		2.0 Pd.	Same as above.
△	56-26	73-773		3.0 Pd.	Same as above.
◇	56-26	73-773		4.1 Pd.	Same as above.
▽	56-23	0-293		2.08 Pd.	Plotted data avg. of two samples (within ± 0.5%); sample A, wire annealed at 610 C; sample B, rod annealed at 610 C.
▷	56-23	0-293		5.00 Pd.	Same as above.
◁	56-23	0-293		9.9 Pd.	Same as above, except annealed at 650 C.
●	56-23	293		26.08 Pd; wire.	Annealed at 650 C.
■	56-23	293		29.02 Pd; wire.	Same as above.
▲	56-23	293		Same as above; rod.	Annealed at 800 C.
▼	56-23	293		40 Pd.	Two samples: (a) Wire annealed at 880 C and 500 C. (b) Rod annealed at 880 C.
◆	56-23	293		50 Pd.	Same as above.

TPRC



ELECTRICAL RESISTIVITY — SILVER + PLATINUM

TPRC

455

ELECTRICAL RESISTIVITY --- SILVER + PLATINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-26	73-773		1.0 Pt; prepared from 99.99 pure metals.	Vacuum-melted at 100 C above MP, homogenized 24 hrs at 900 C, swaged to 0.030 in. dia., and annealed 1 hr at 500 C.
□	56-26	73-773		2.0 Pt; same as above.	Same as above.
△	56-26	73-773		3.0 Pt; same as above.	Same as above.
◇	56-26	73-773		4.0 Pt; same as above.	Same as above.

TPRC

PROPERTIES OF SILVER + ZINC

REPORTED VALUES

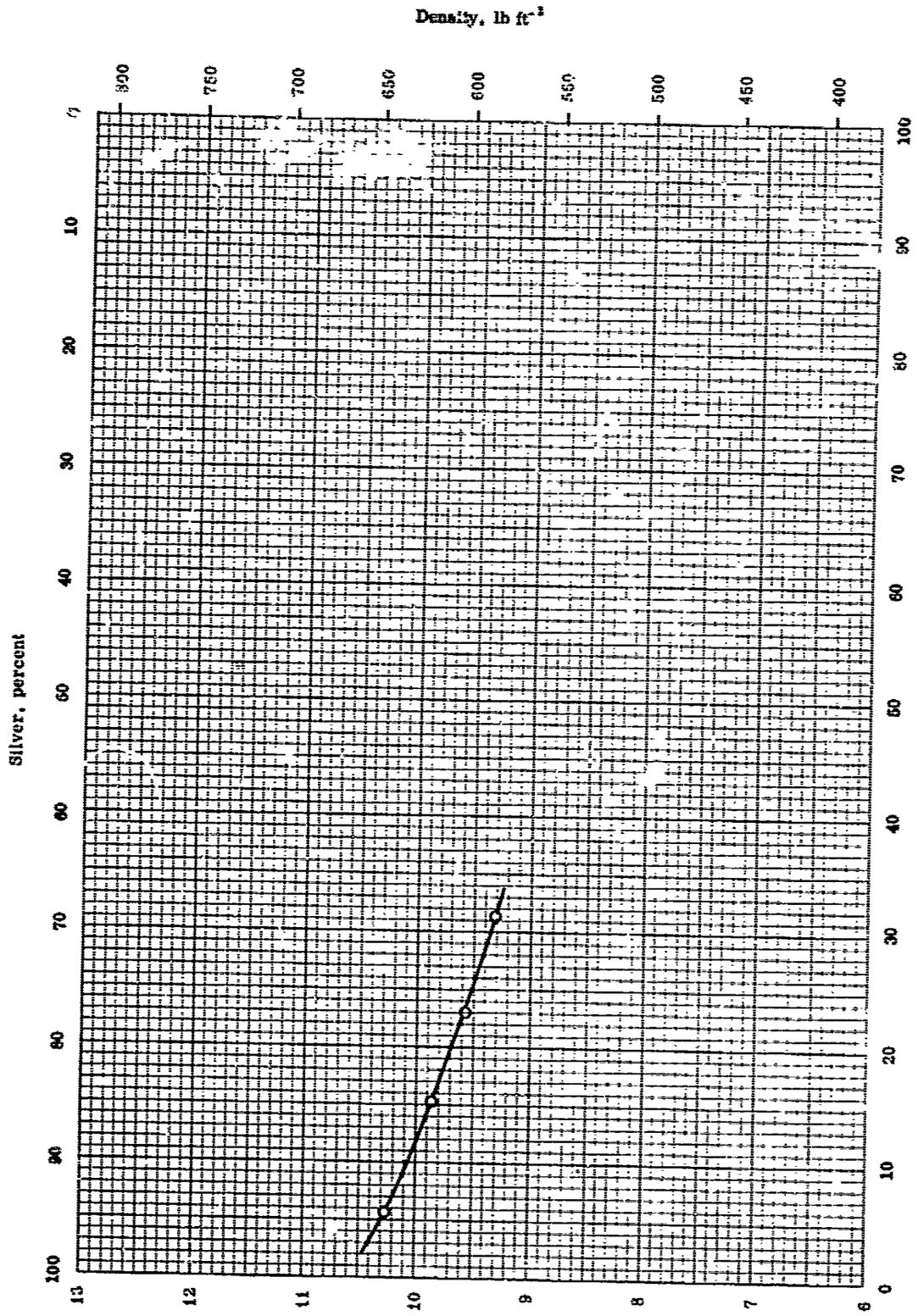
Density:	See figure	
Melting Point:	K	R
O 49.5 Zn	937	1687
Heat of Fusion:	cal g^{-1}	Btu lb^{-1}
□ 49.5 Zn	22.79± 0.98	41.02 ± 1.76

PROPERTIES OF SILVER + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	43-4	937		49.5 Zn; γ - phase.	M.P. from break in time-temperature curve.
□	43-4	937		Same as above.	Δh_f from enthalpy differences of solid and liquid measurements.

TPRC



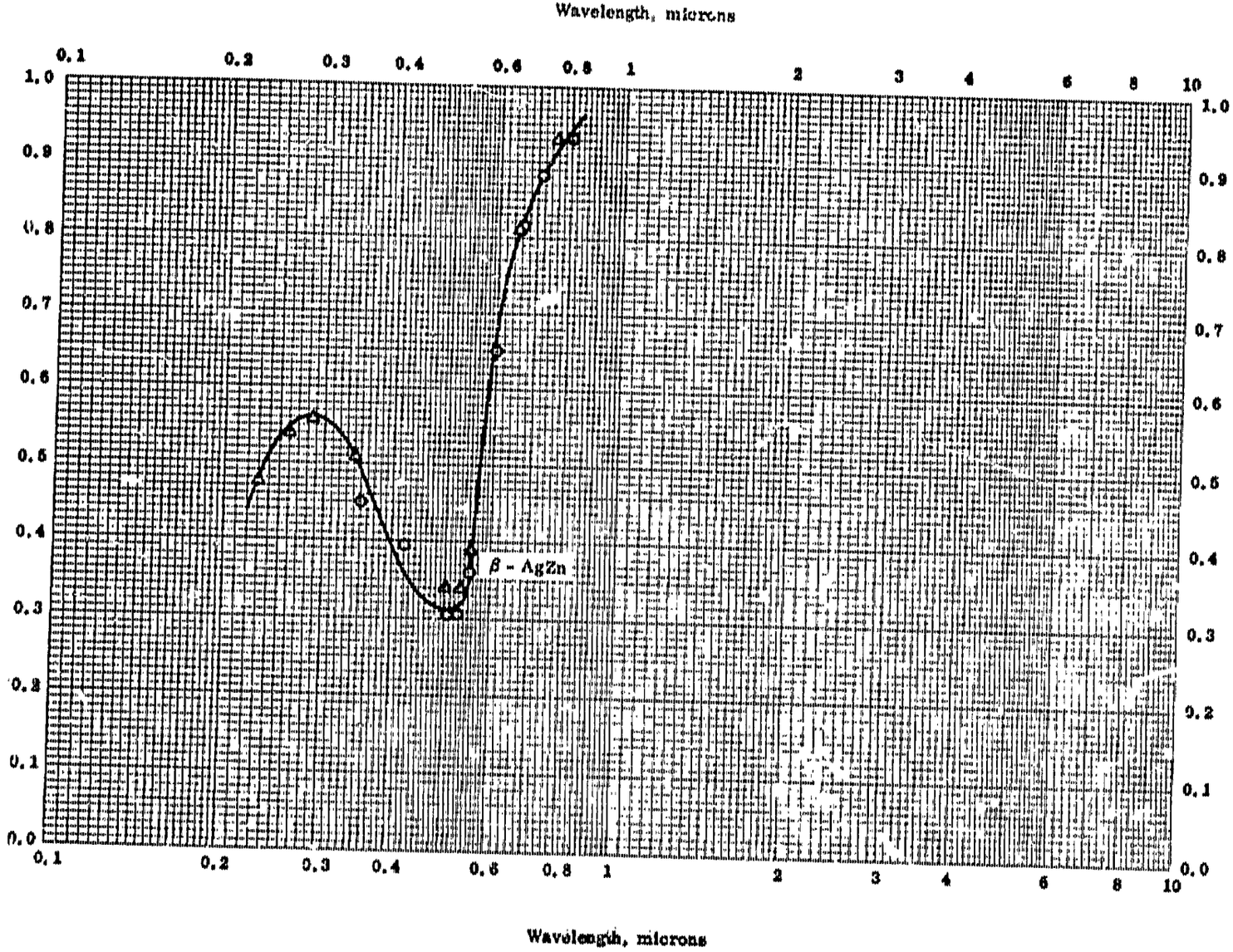
DENSITY — SILVER + ZINC

DENSITY --- SILVER + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	40-5	298		5-31 Zn and negligible impurities.	Density by weight in air and in CCl_4

TPRC

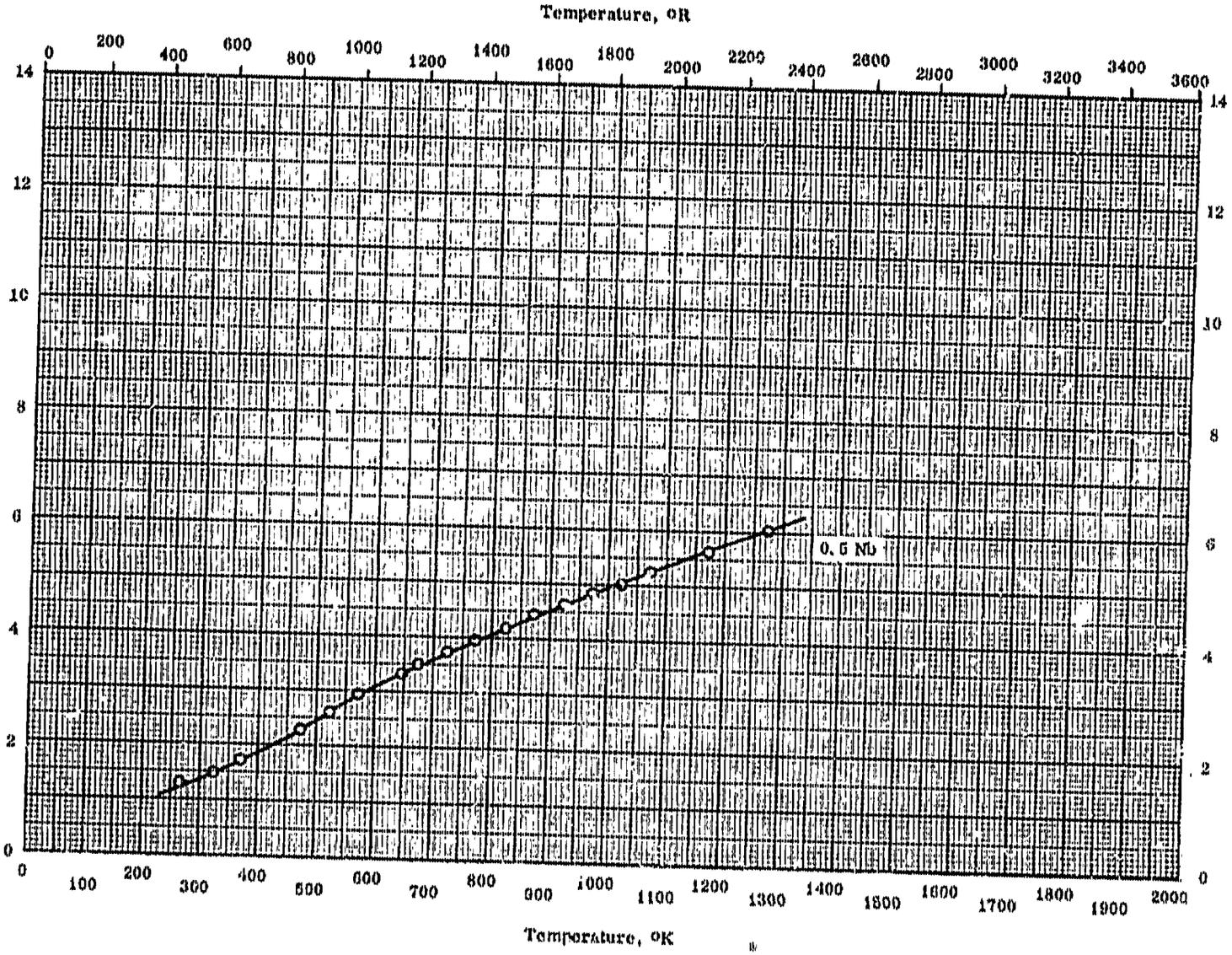


ANGULAR SPECTRAL REFLECTANCE --- SILVER + ZINC

ANGULAR SPECTRAL REFLECTANCE -- SILVER + ZINC

REFERENCE INFORMATION

Symbol	Ref.	Temp. °K	Wavelength Range, μ	Rept. Error%	Sample Specifications	Remarks
○	61-24	298	0.35-0.80		β - AgZn: 2600 Å film.	Vacuum evaporated on glass; 45 degree illumination and 45 degree viewing; data extracted from smooth curve.
△	61-24	298	0.23-0.75		Same as above.	The above specimen, different run.

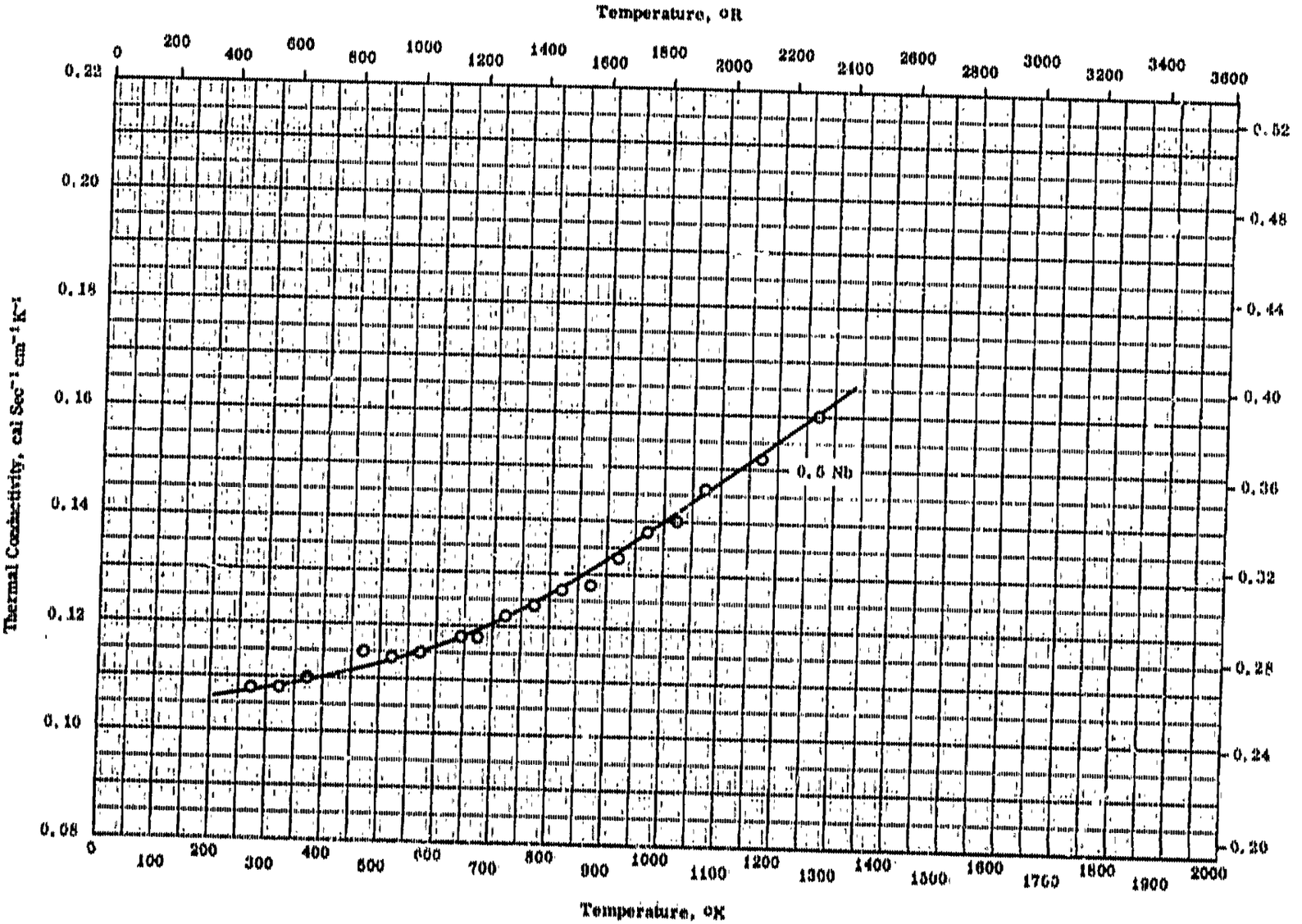


ELECTRICAL RESISTIVITY -- TANTALUM + NIOBIUM

ELECTRICAL RESISTIVITY — TANTALUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-10	273-1273		0.5 Nb, 0.06 Fe, 0.008 Ti, 0.005 W, 0.003 Si, 0.002 C, and 0.001 Mo.	Sintered in vacuum for 5 hrs at 1723 K, the residual pressure in the furnace 10^{-3} mm Hg; finally sintered in vacuum of 10^{-5} mm Hg for 5 hrs at 2873 K; refined twice by zone-melting.



THERMAL CONDUCTIVITY — TANTALUM + NIOBIUM

THERMAL CONDUCTIVITY — TANTALUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-10	273-1273	<5	0.5 Nb, 0.06 Fe, 0.008 Ti, 0.005 W, 0.003 Si, 0.002 C, and 0.001 Mo; prepared from electrolytic powders.	Pressed at 2.5 ton in^{-2} and double sintered at 1723 K for 5 hr and 2873 K in vacuum; forged and twice zone-melted.

TPRC

PROPERTIES OF TANTALUM + TITANIUM

REPORTED VALUES

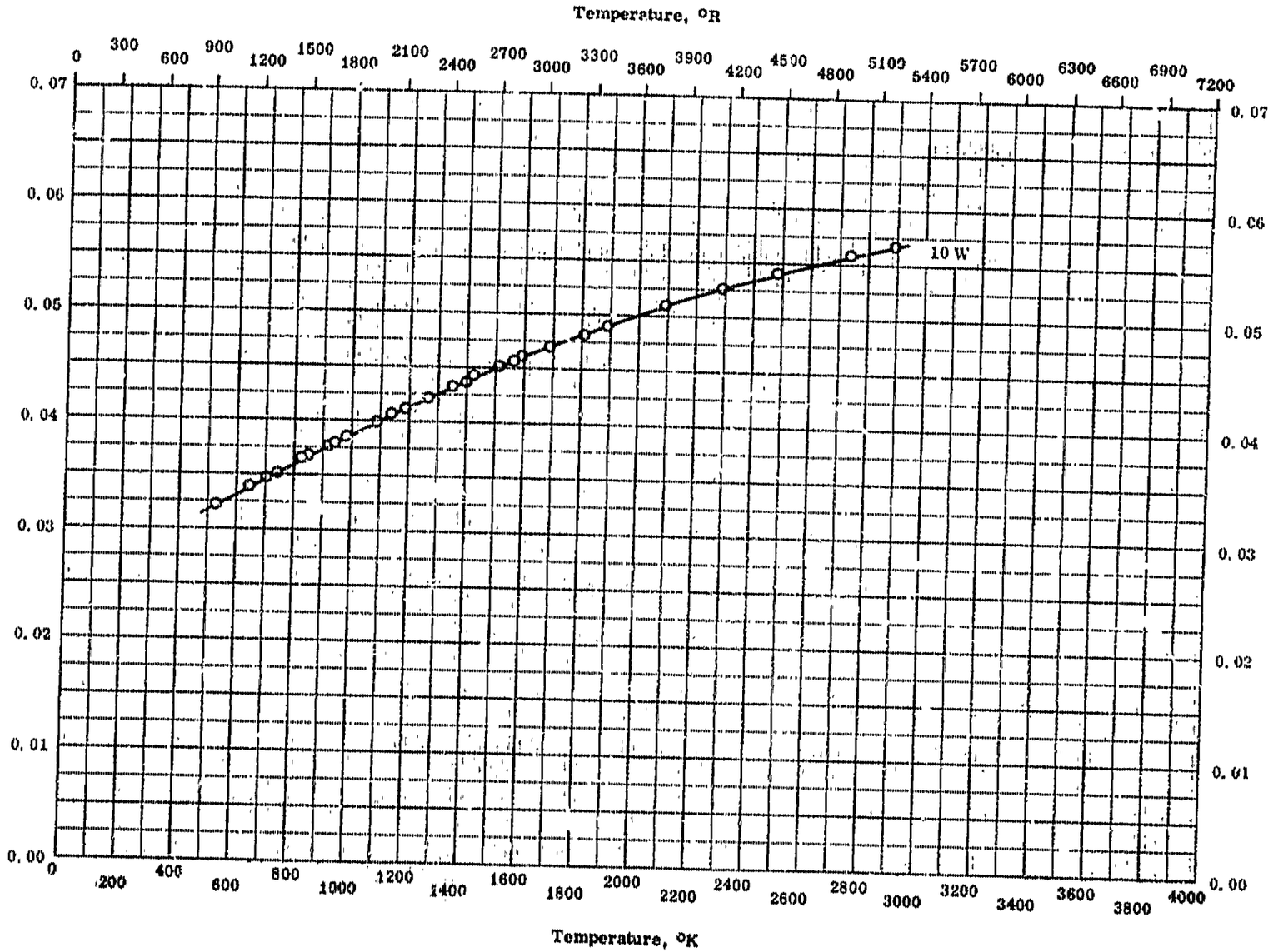
Density:	$g\ cm^{-3}$	$lb\ ft^{-3}$
○ 40 Ti	7.93	495.0
□ 50 Ti	7.07	441.0

PROPERTIES OF TANTALUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repl. Error %	Sample Specifications	Remarks
○	54-20	298		40 Ti.	Density from weight in air and water.
□	54-20	298		50 Ti.	Same as above.

TPRC

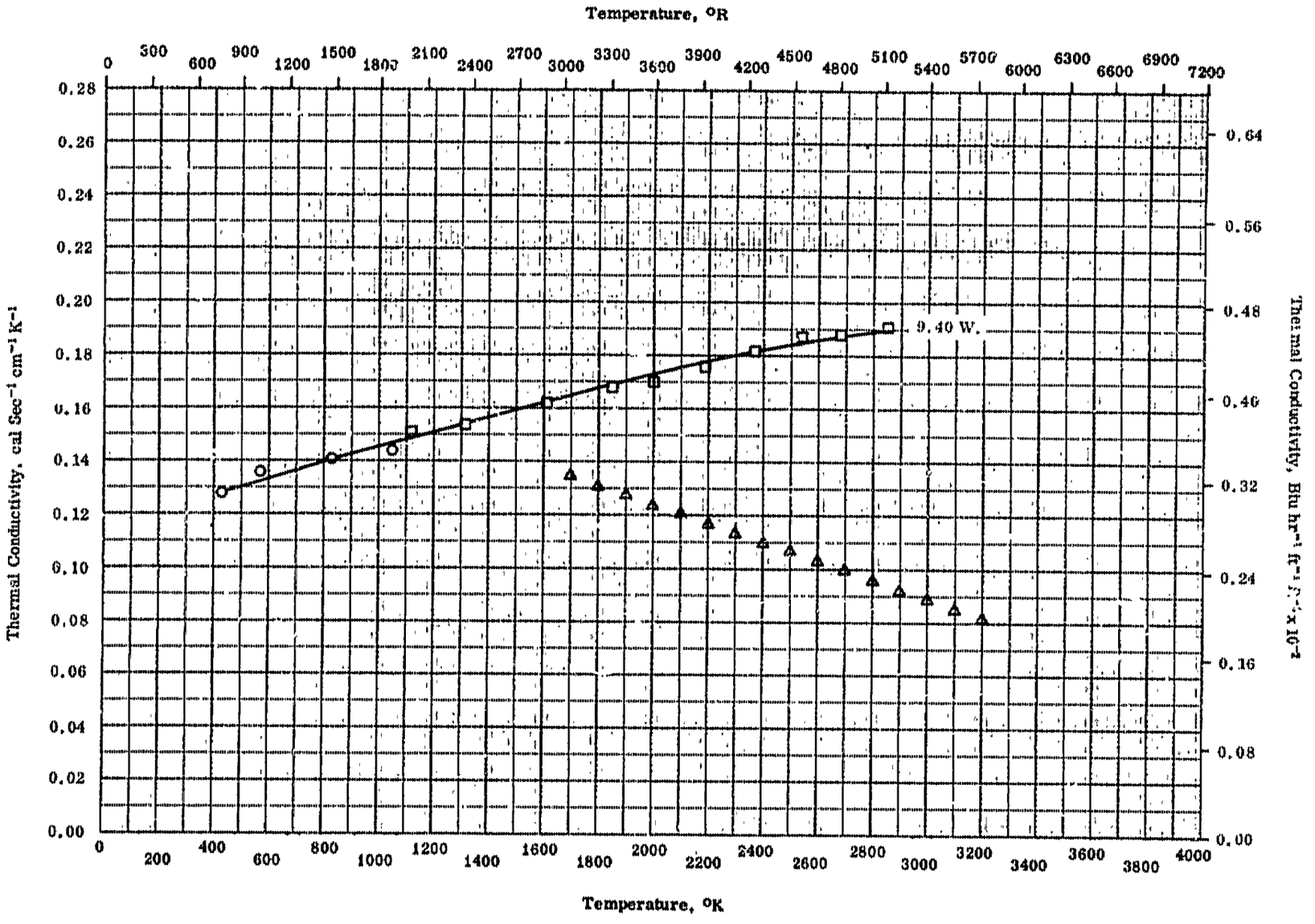


SPECIFIC HEAT -- TANTALUM + TUNGSTEN

SPECIFIC HEAT -- TANTALUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-1	537-2890	± 5.0	Ta - 10 W alloy; 9.50 W, 0.087 Nb, 0.02 Si; 0.02 Ti, 0.015 Mo, 0.005 Fe, 0.005 O_2, 0.003 N_2, and 0.0010 C; density 1035 lb ft^{-3}.	



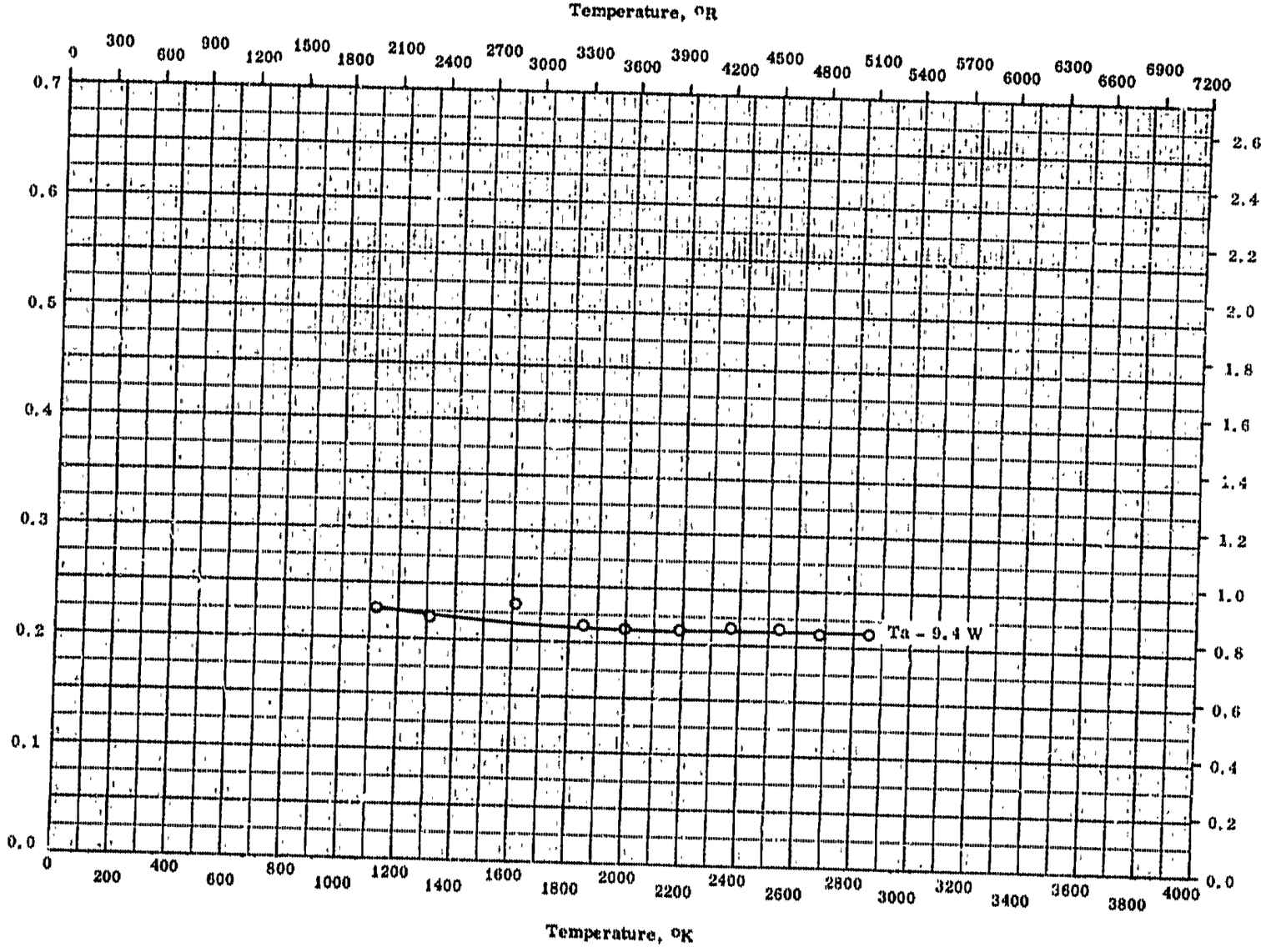
THERMAL CONDUCTIVITY -- TANTALUM + TUNGSTEN

THERMAL CONDUCTIVITY -- TANTALUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-1	435-1048	±4	90.43 Ta, 9.40 W, 0.10 Nb, 0.02 Si, 0.02 Ti, 0.01 Mo, 0.01 Ni, 0.005 Fe, and 0.004 C.	End surface ground flat and parallel; measured in He atm.
□	63-1	1122-2850	±4	Same as above.	Same as above but a different method.
Δ	63-8	1700-3200		9-11 W, 0.10 Nb, 0.10 Mo, 0.015 Si, 0.01 O, 0.01 Fe, 0.01 Ti, 0.005 C, 0.005 N, and 0.005 Ni.	

TPRC



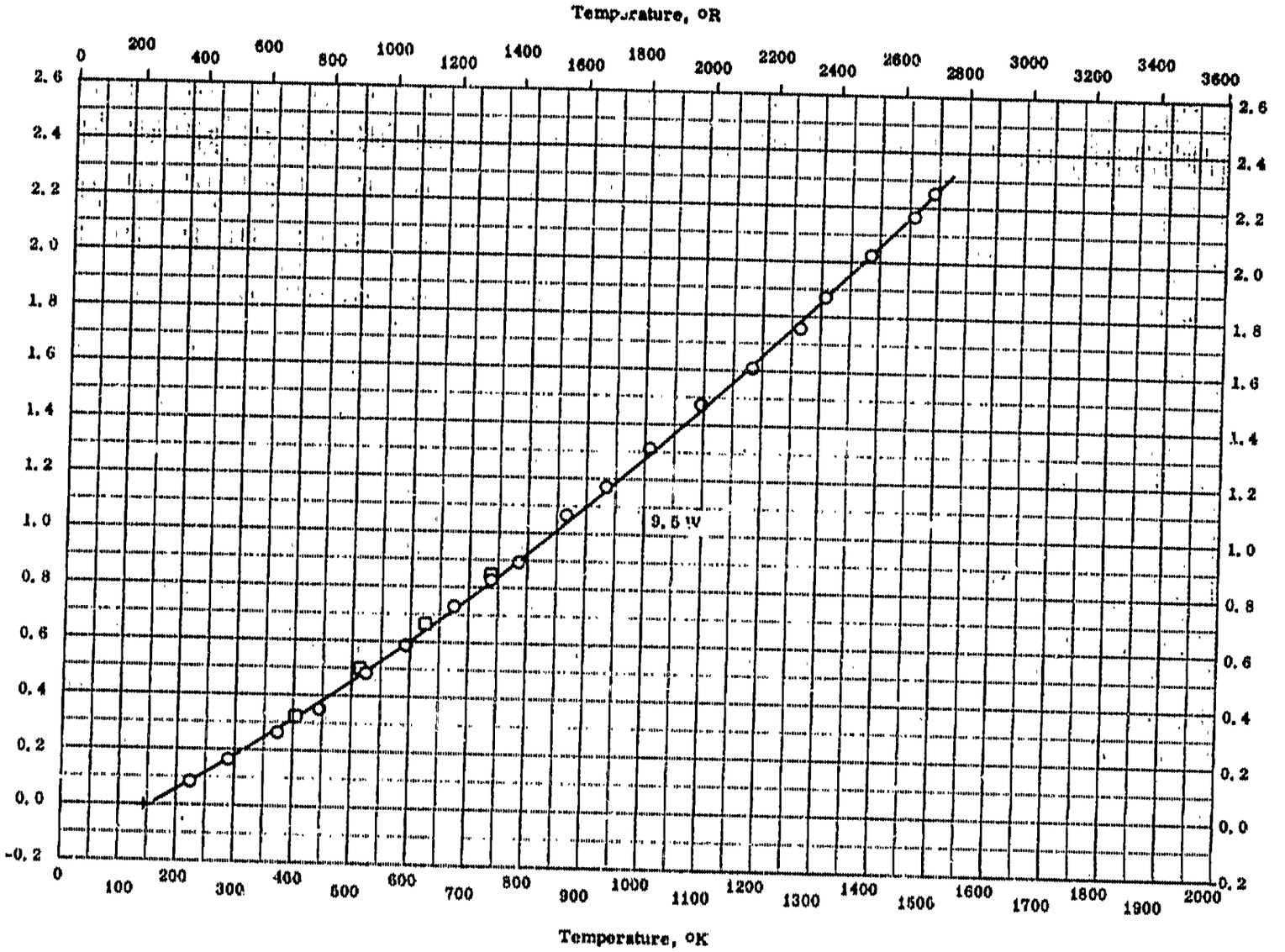
THERMAL DIFFUSIVITY — TANTALUM + TUNGSTEN

THERMAL DIFFUSIVITY — TANTALUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Expt. Error %	Sample Specifications	Remarks
O	63-1	1122-2852		9.40 W, 0.10 Nb, 0.02 Ti, 0.02 Si, 0.01 Mo, 0.01 Ni, 0.005 Fe, 0.0040 C, 0.0090 O_2, and 0.0030 N_2; density 16.68 g cm^{-3}.	Surface ground discs.

TPRC



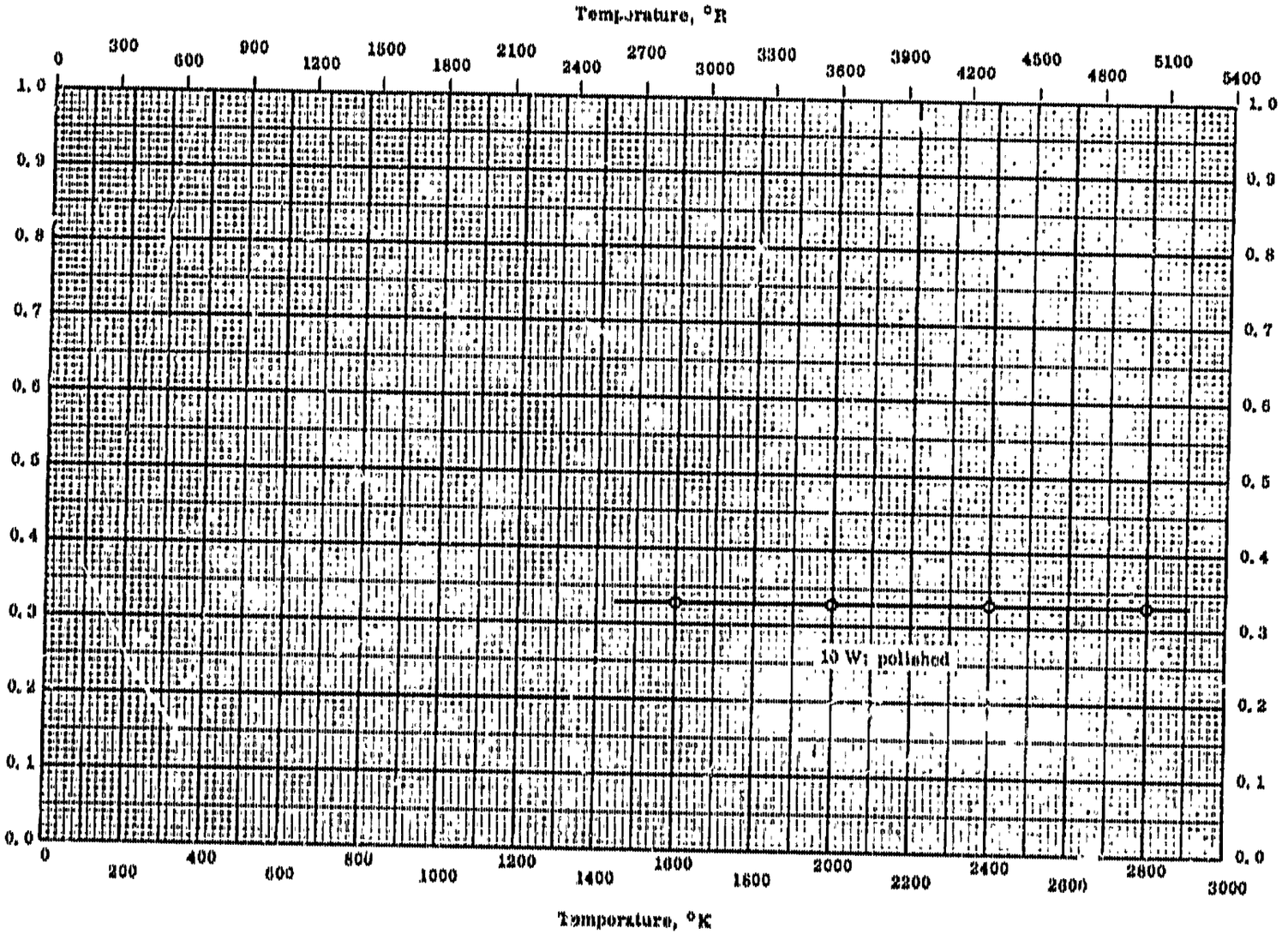
TPRC

THERMAL LINEAR EXPANSION — TANTALUM + TUNGSTEN

THERMAL LINEAR EXPANSION — TANTALUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	63-1	300-2981	2	Fansteel Metallurgical Corp.; 90.34 Ta, 9.60 W, 0.087 Nb, 0.015 Mo, 0.02 Ti, 0.005 Fe, 0.02 Si, 0.0010 C, 0.0050 O, and 0.0030 N; dimension 1/2 in. diameter by 6 in. long.	Measured in argon with heating rate of approx. 5 F min^{-1}.
□	63-27	300-1476	5	90 Ta, 10 W.	Measured in argon.



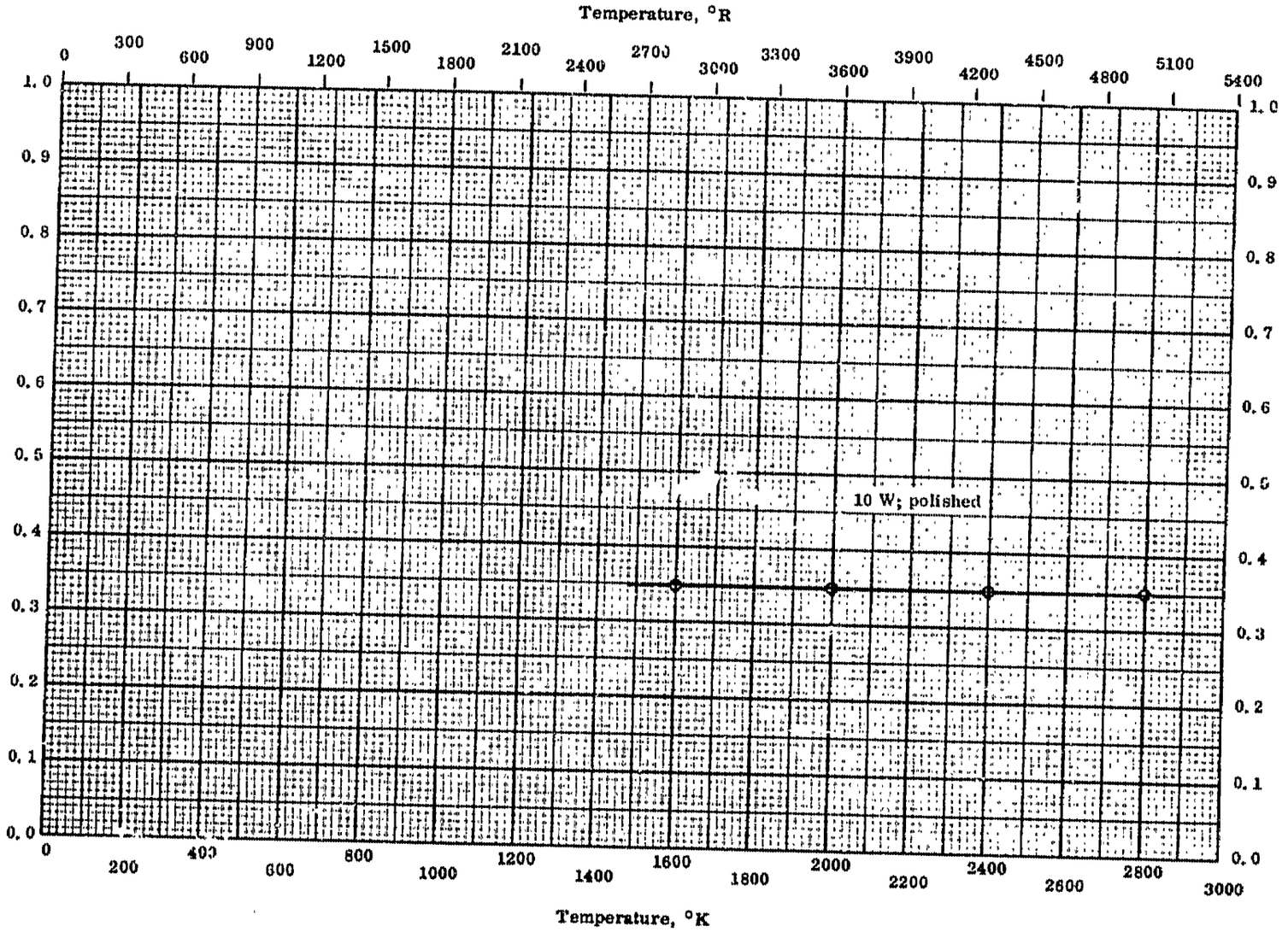
HEMISPHERICAL TOTAL EMITTANCE — TANTALUM-TUNGSTEN

TPRC

HEMISPHERICAL TOTAL EMITTANCE -- TANTALUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-20	1600-2800		90 Ta and 10 W.	Polished with abrasive papers (No. 1, 0, 00, 000, and 0000); measured in argon.



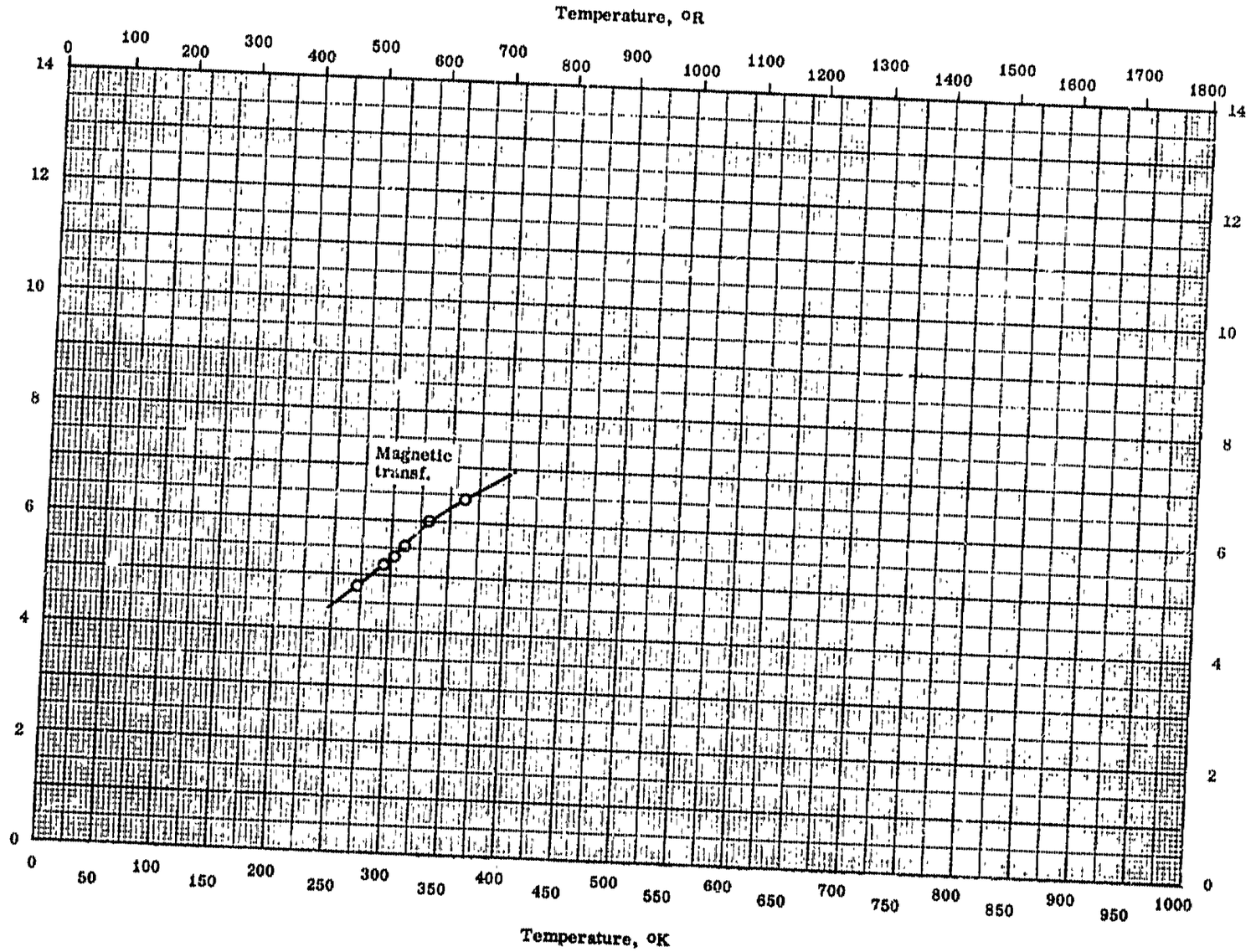
HEMISPHERICAL SPECTRAL EMITTANCE -- TANTALUM + TUNGSTEN

HEMISPHERICAL SPECTRAL EMITTANCE -- TANTALUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-20	0.65	1600-2500		90 Ta and 10 W.	Polished with abrasive papers (No. 1, 0, 00, 000 and 0000); measured in argon.

TPRC



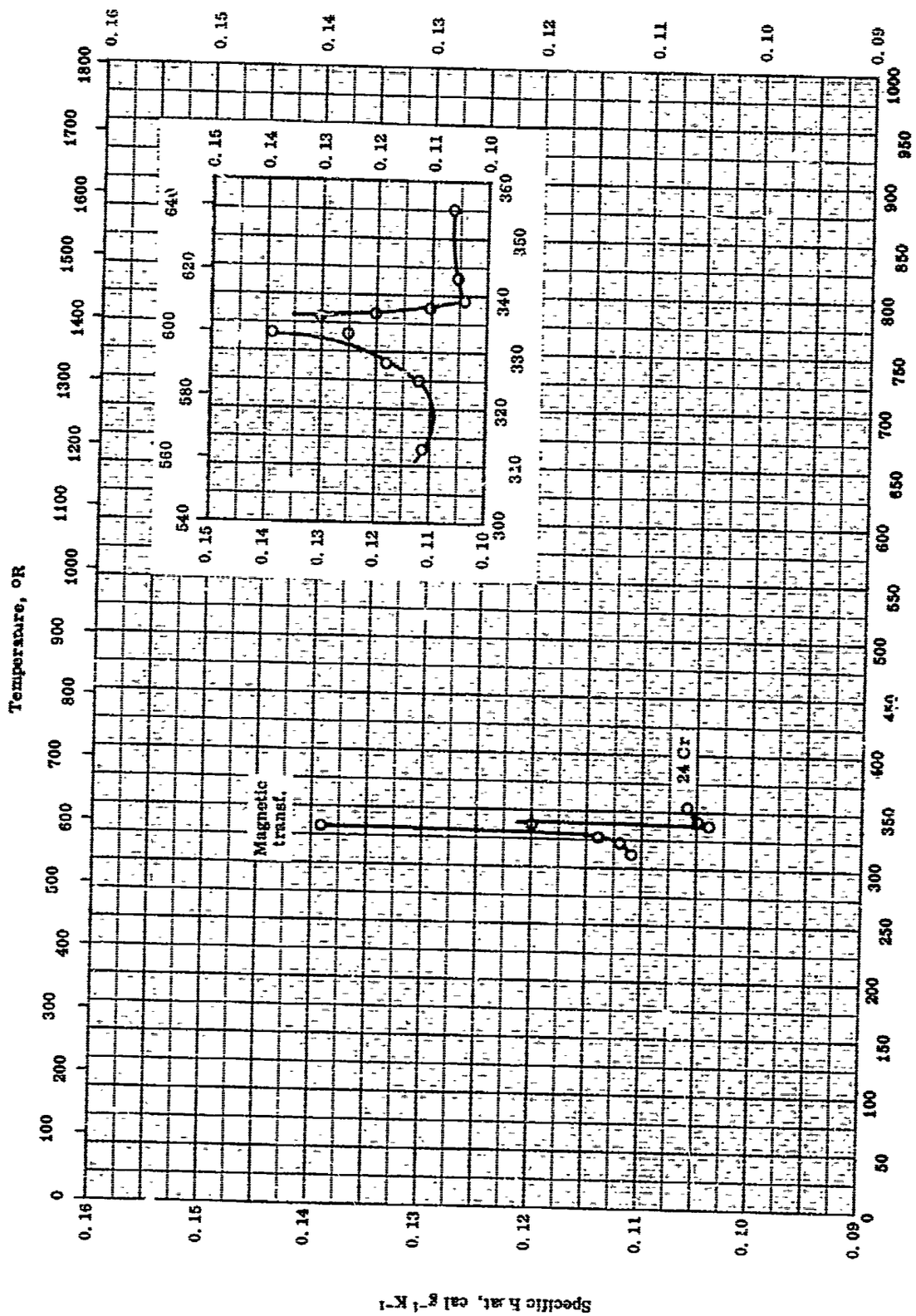
ELECTRICAL RESISTIVITY -- TELLURIUM + CHROMIUM

ELECTRICAL RESISTIVITY -- TELLURIUM + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	49-8	273-363		Nominal: 69.79 Te and 30.21 Cr.	Melted in silica tube at 1250 C in A atmos.

TPRC



SPECIFIC HEAT -- TELLURIUM + CHROMIUM

SPECIFIC HEAT -- TELLURIUM + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	49-3	313-355		75.7 Te and 24.3 Cr.	Prepared by fusion of Cr and Te powders at 1200 C under vacuum.

TPRC

PROPERTIES OF THORIUM - PLUTONIUM

REPORTED VALUES

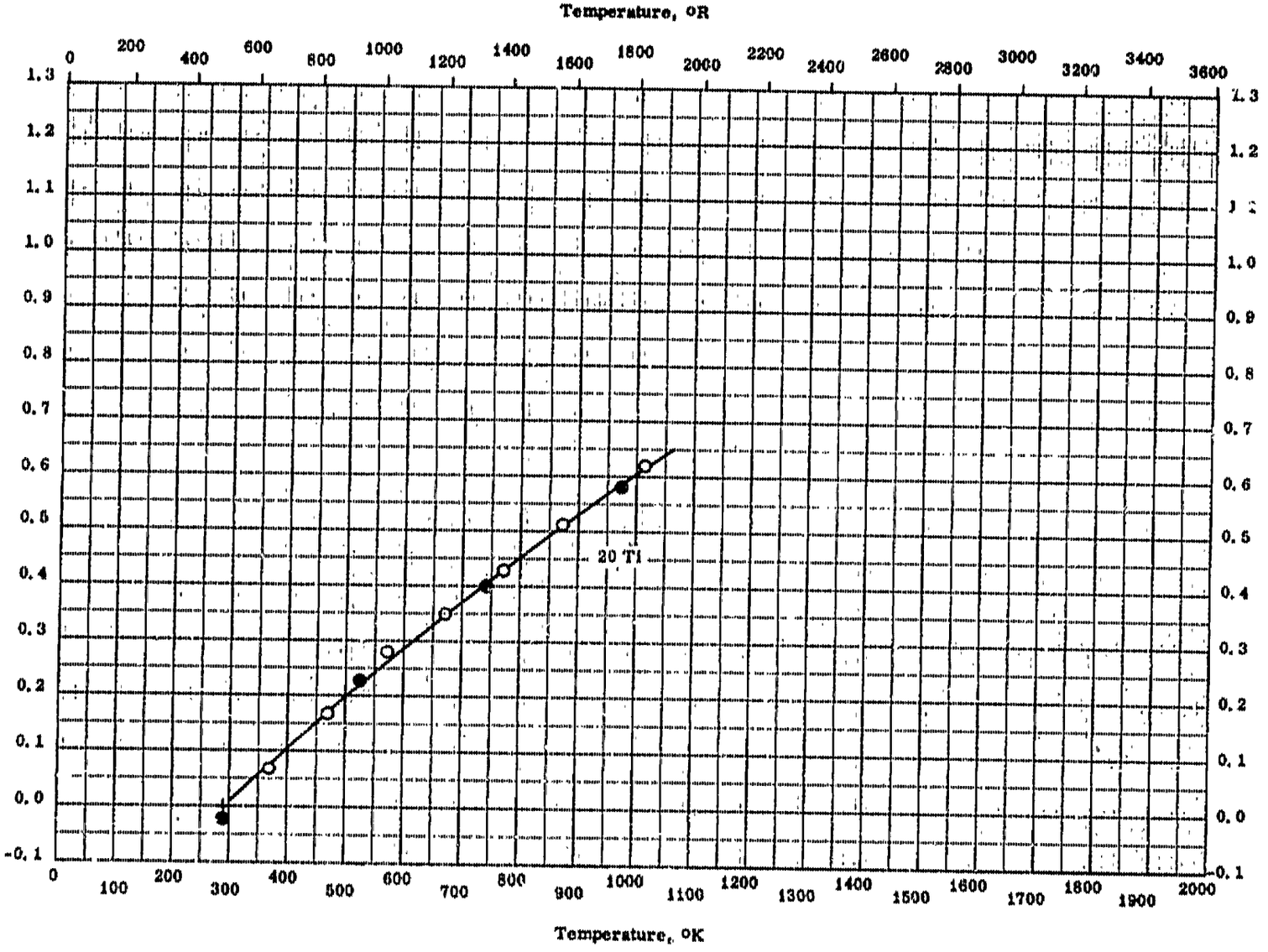
Density:	g cm^{-3}	lb ft^{-3}
○ 20 Pu	12.15	758
□ 46 Pu	12.79	798

PROPERTIES OF THORIUM + PLUTONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repl. Error %	Sample Specifications	Remarks
○	57-37	300		20 Pu.	Density from weight in air, in water, and in ethylene bromide.
□	57-37	300		46 Pu.	Same as above.

TPRC



THERMAL LINEAR EXPANSION — THORIUM + TITANIUM

THERMAL LINEAR EXPANSION -- THORIUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-23	293-1013		80 Th and 20 Ti.	Heating.
●	52-23	293-1013		Same as above.	Cooling.

TPRC

Electrical Resistivity, ohm cm x 10^6

Electrical Resistivity, ohm cm x 10^6

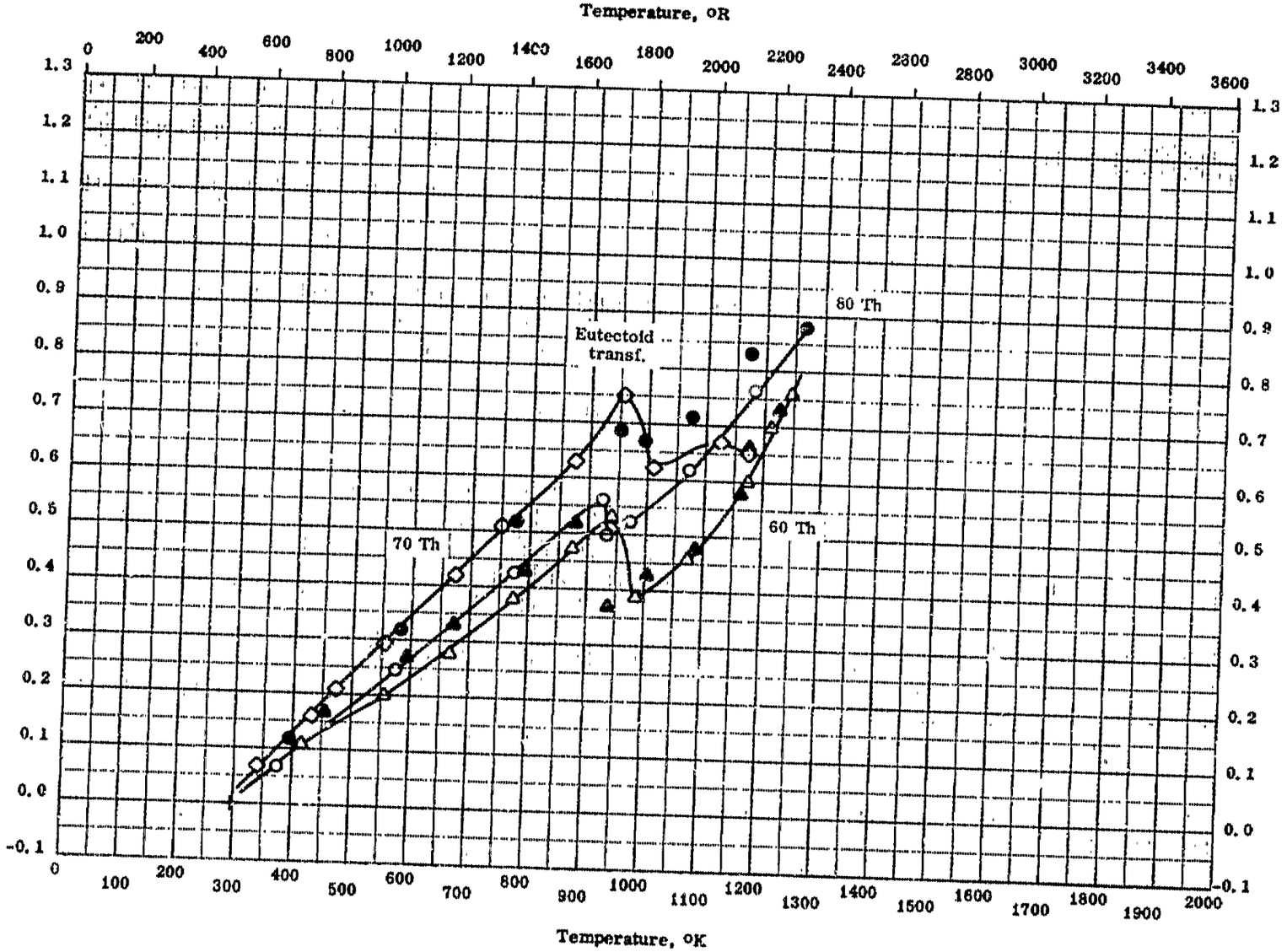
ELECTRICAL RESISTIVITY -- THORIUM + URANIUM

ELECTRICAL RESISTIVITY -- THORIUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	57-30	1073-1273	± 2	2-10 U.	Arc melted 5-7 times in He atmos., cast, cold swaged, annealed, and water quenched.
○	58-20	313-1743		0.29 U, 0.29 U alloy, 0.031 O, 0.005 C, 0.002 H, N, each, and balance Th.	Measured heating.
●	58-20	313-1743		Same as above.	Above sample measured cooling.

TPRC



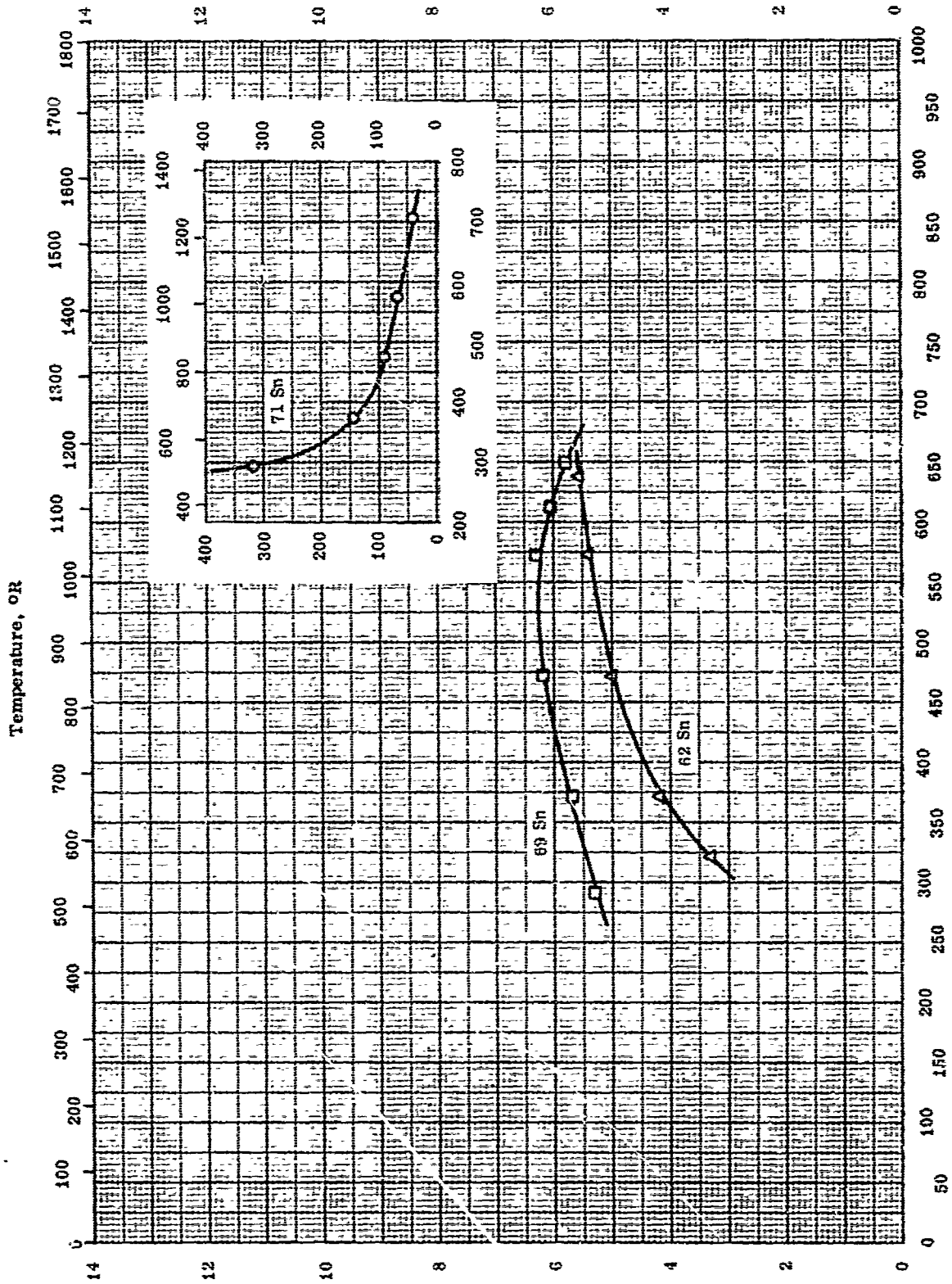
THERMAL LINEAR EXPANSION -- THORIUM + ZIRCONIUM

THERMAL LINEAR EXPANSION -- THORIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-23	293-1263		80 Th and 20 Zr.	Heating.
●	52-23	293-1263		Same as above.	Cooling.
◇	52-23	293-1173		70 Th and 30 Zr	
△	52-23	293-1248		60 Th and 40 Zr.	Heating.
▲	52-23	293-1248		Same as above.	Cooling.

TPRC



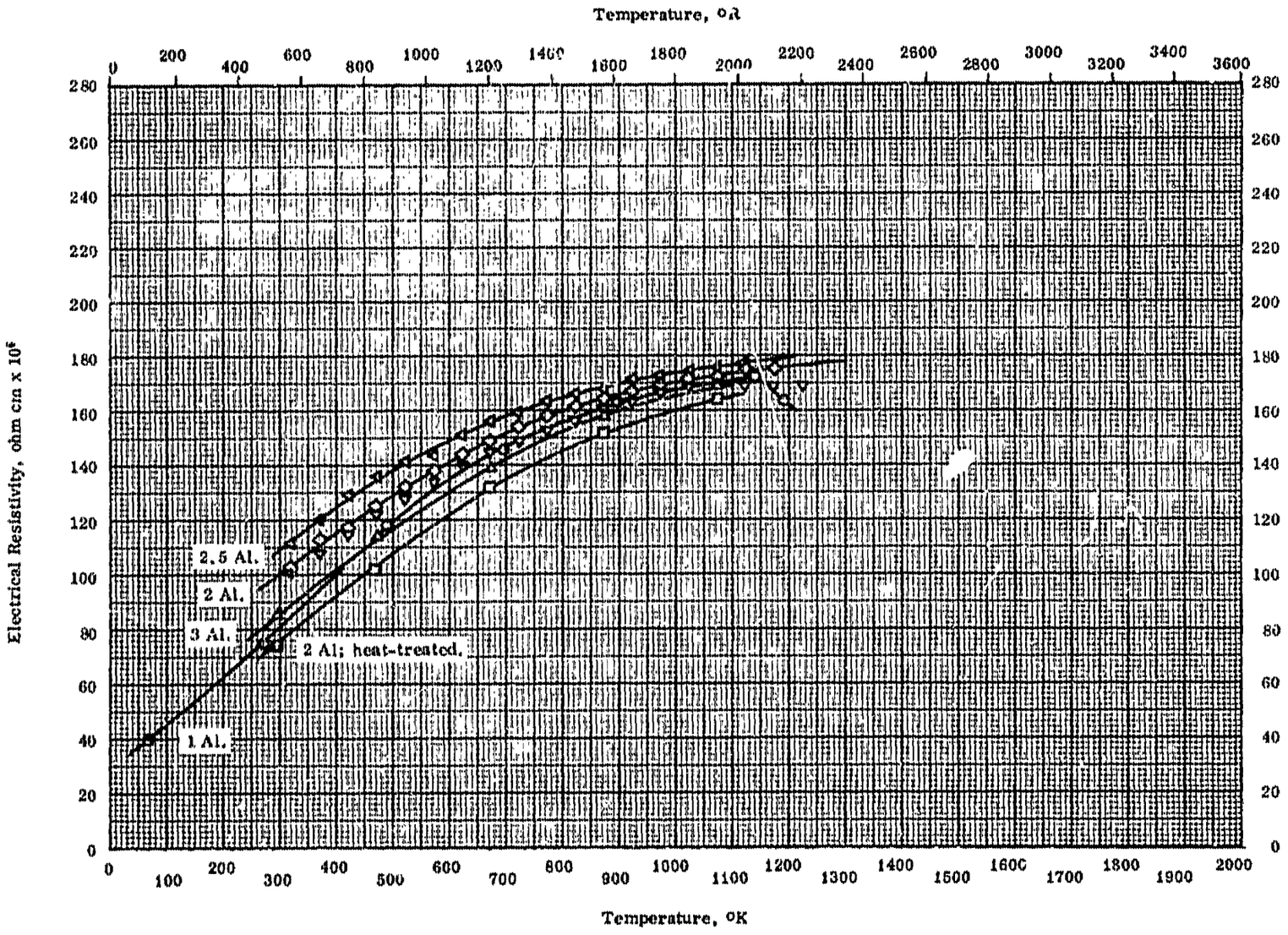
ELECTRICAL RESISTIVITY — TIN + MAGNESIUM

ELECTRICAL RESISTIVITY -- TIN + MAGNESIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	49-1	293-703		71.1 Sn and 28.9 Mg.	
□	49-7	293-648		68.5 Sn and 31.5 Mg.	
△	49-7	323-638		62.4 Sn and 37.6 Mg.	

TPRC



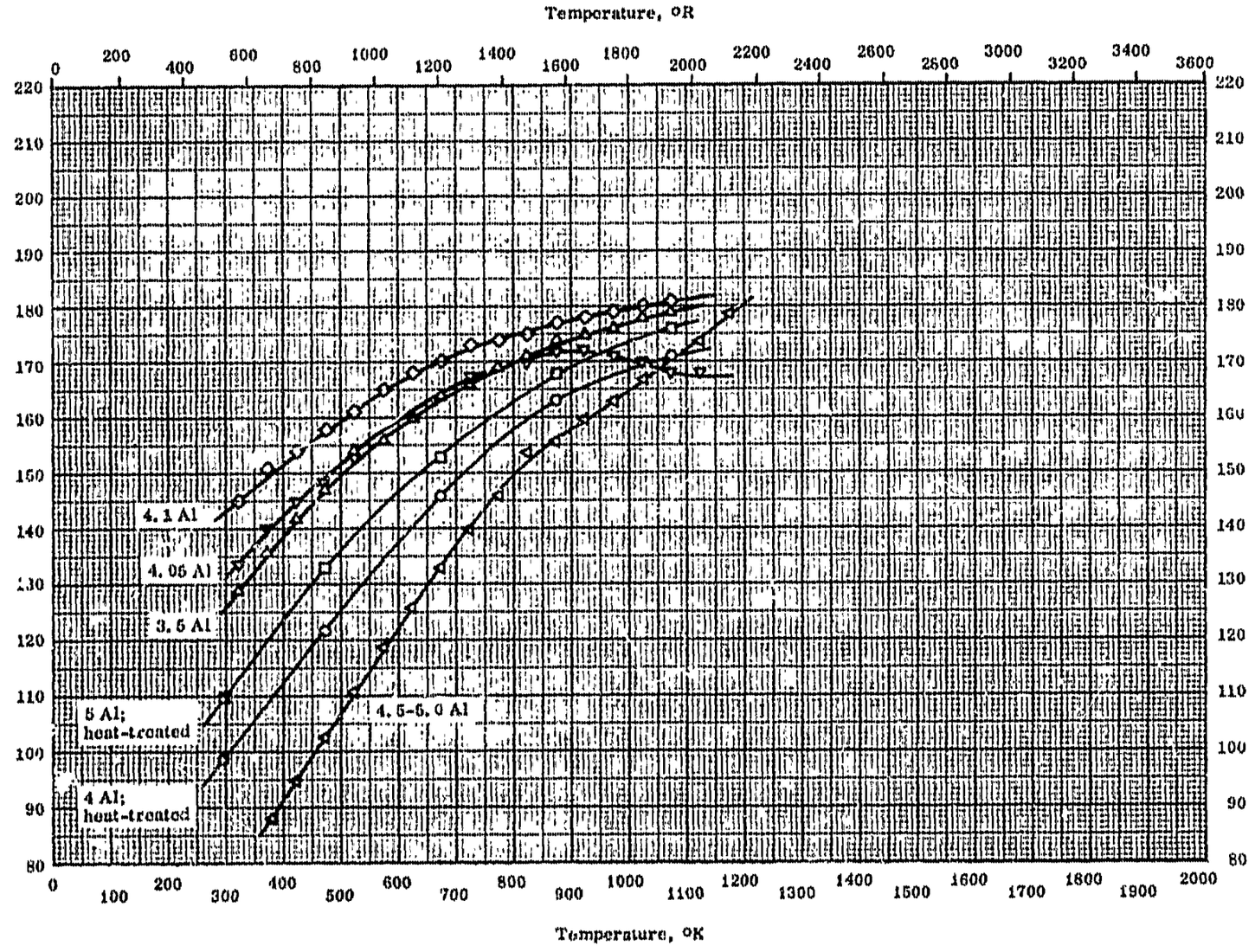
ELECTRICAL RESISTIVITY -- TITANIUM + ALUMINUM
(1.0 ≤ Al ≤ 3.0)

TPRC

ELECTRICAL RESISTIVITY -- TITANIUM + ALUMINUM
(1.0 ≤ Al ≤3.0)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-30 also 56-31	70-1193		1.0 Al; made from pure iodide - Ti or 99.96 pure Mg - reduced Ti and 99.99 Al.	Melted in arc furnace with W electrode, in 99.995 pure A atm.; remelted twice more; difference between heating and cooling < 3%.
□	56-18	298-1073	± 1	Ti, α - phase; 2 Al.	High temperature work in vacuum of 10^{-6} mm Hg.
△	56-18	298-1073		Ti, α - phase; 3 Al.	Same as above.
▽	61-11	323-1223		1.5 Al.	
◇	61-11	323-1173		2.0 Al.	
◁	61-11	323-1123		2.5 Al.	



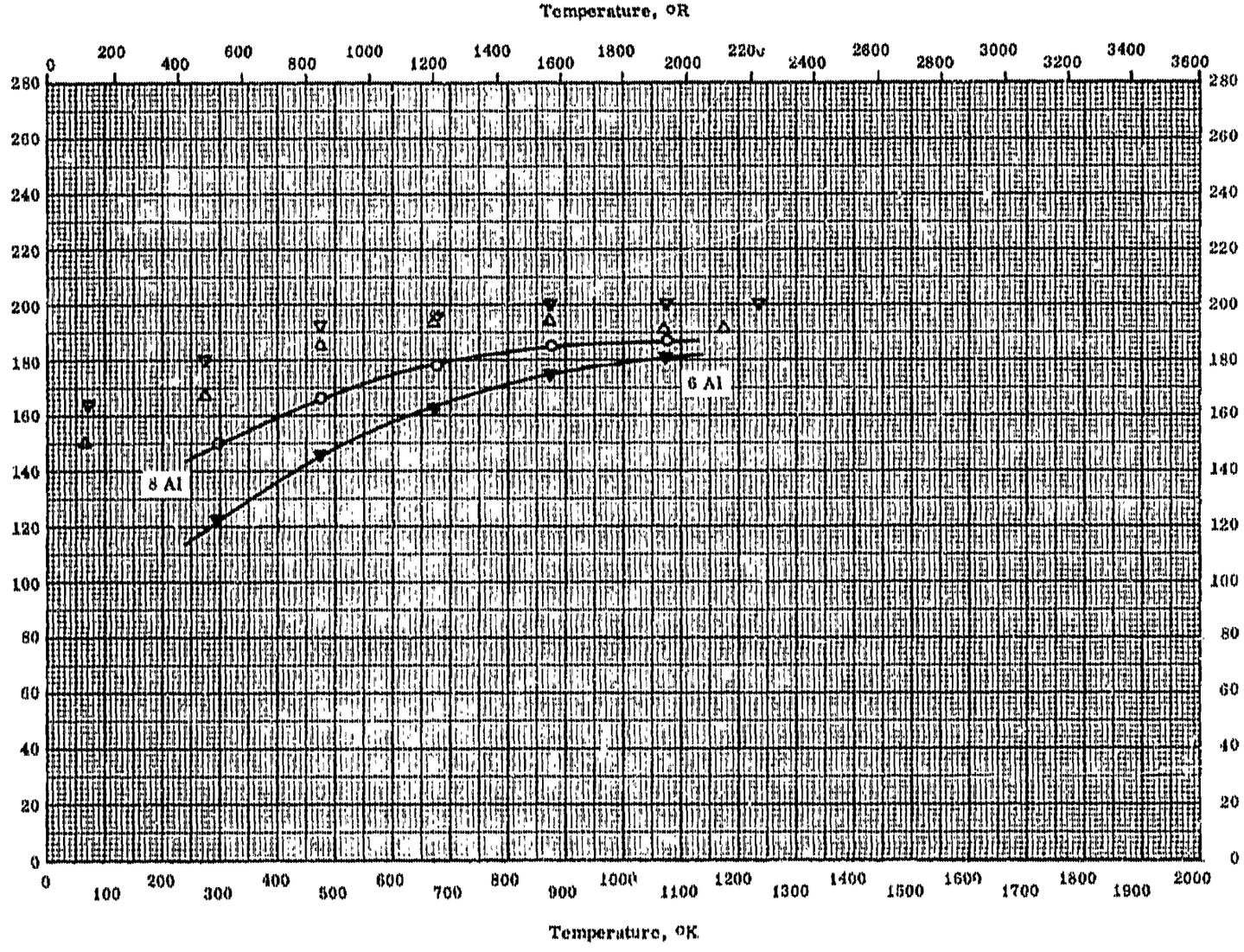
ELECTRICAL RESISTIVITY — TITANIUM + ALUMINUM
(3.0< Al ≤ 5.0)

ELECTRICAL RESISTIVITY -- TITANIUM + ALUMINUM
(3.0< Al ≤5.0)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-18	298-1073	±1	Ti, α-phase; 4 Al.	High temp. work in vacuum of 10^{-6} mm Hg.
□	56-18	298-1073	±1	Ti, α-phase; 5 Al.	Same as above.
△	61-11	323-1073		3.5 Al.	
▽	61-11	323-1123		4.05 Al.	
◇	61-11	323-1073		4.1 Al.	
◁	61-11	323-1173		4.5-5.0 Al.	

TPRC



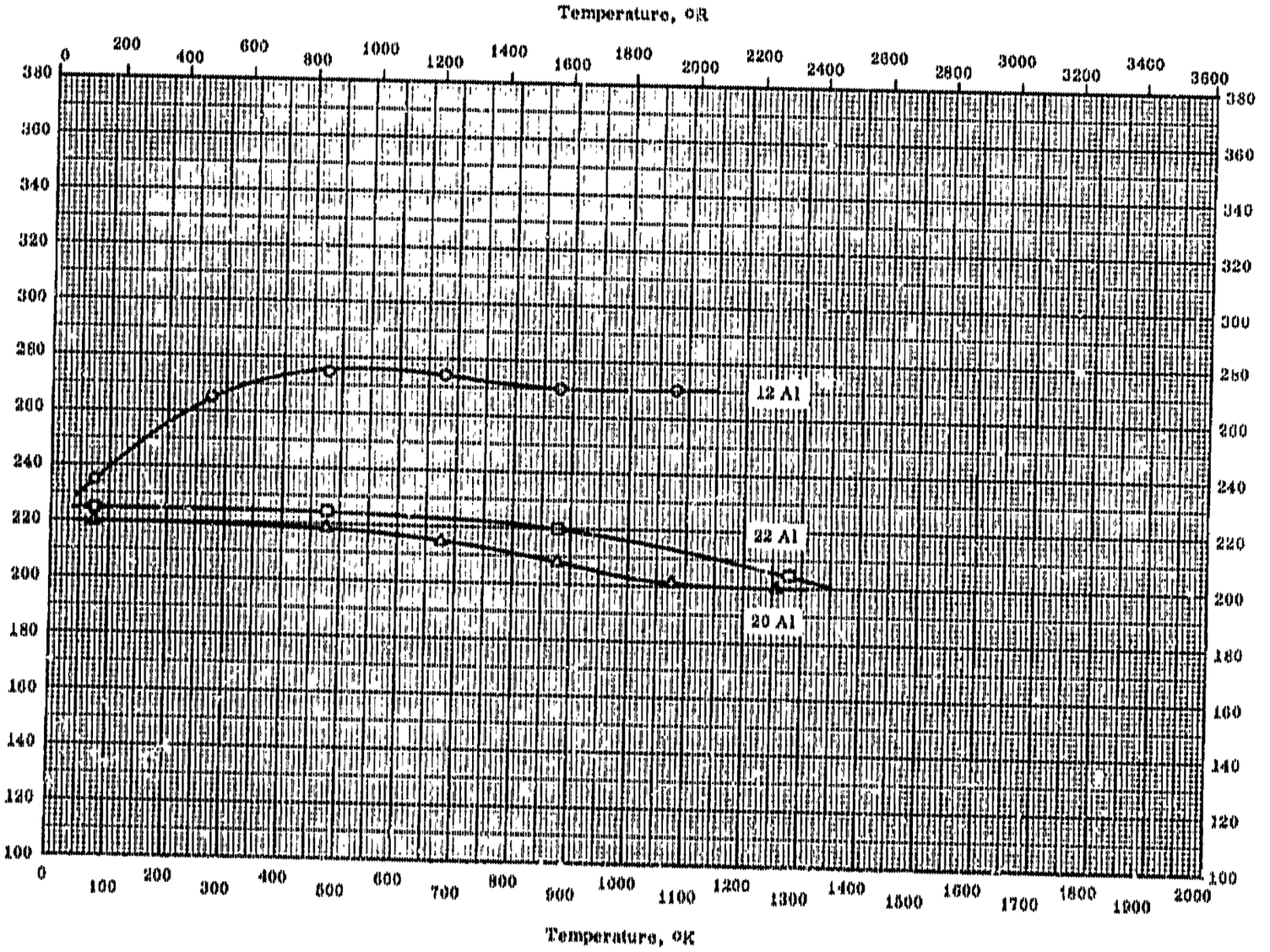
ELECTRICAL RESISTIVITY -- TITANIUM + ALUMINUM
(6 ≤ Al ≤ 8)

ELECTRICAL RESISTIVITY -- TITANIUM + ALUMINUM
(6 ≤ Al ≤ 8)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
▼	56-18	298-1073	± 1	Ti, α-phase; 6 Al.	High temperature work in vacuum of 10^{-6} mm Hg.
○	56-18	298-1073	± 1	Ti, α-phase; 8 Al.	Same as above.
△	56-30 also 56-31	68-1173		7.0 Al; made from pure iodide-Ti or 99.96 mg-reduced Ti and 99.99 pure Al.	Melted in arc furnace with W electrode, in 99.995 pure A atm; remelted twice more; difference between heating and cooling ≤ 3%.
▽	56-30 also 56-31	73-1233		8.0 Al; same as above.	Same as above.

TPRC



TPRC

ELECTRICAL RESISTIVITY -- TITANIUM + ALUMINUM
(10< Al <22)

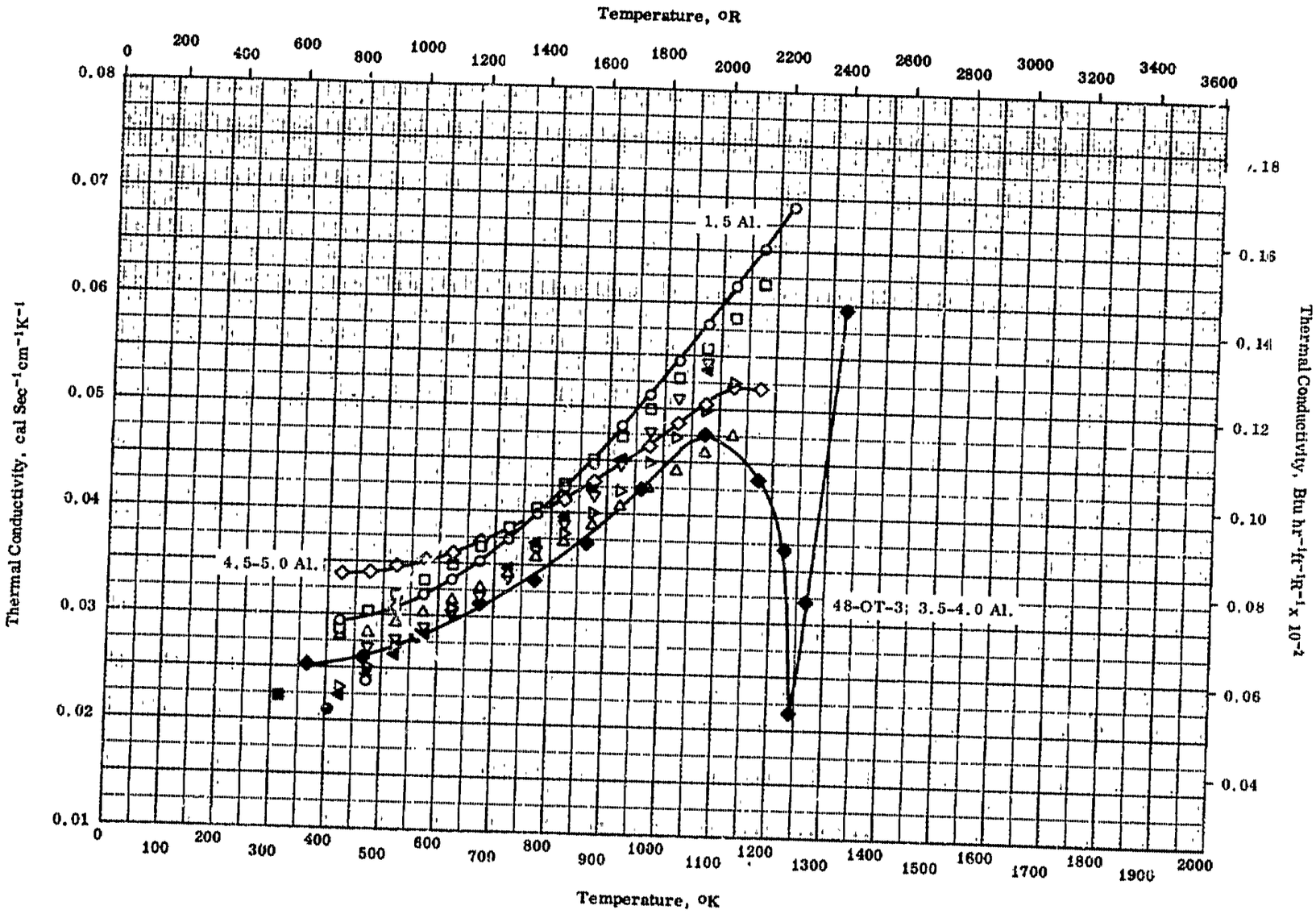
101

ELECTRICAL RESISTIVITY -- TITANIUM + ALUMINUM
(10< Al ≤22)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-30 also 56-31	83-1273		12 Al: prepared from iodide titanium or 99.96 pure Mg-reduced titanium and 99.99 pure Al.	Melted in arc furnace with W electrode in 99.995 pure A atm. and remelted twice more; difference between heating and cooling runs less than 3%.
△	56-30 also 56-31	83-1113		20 Al; same as above.	Same as above.
□	56-30 also 56-31	83-1233		22 Al; same as above.	Same as above.

TPRC

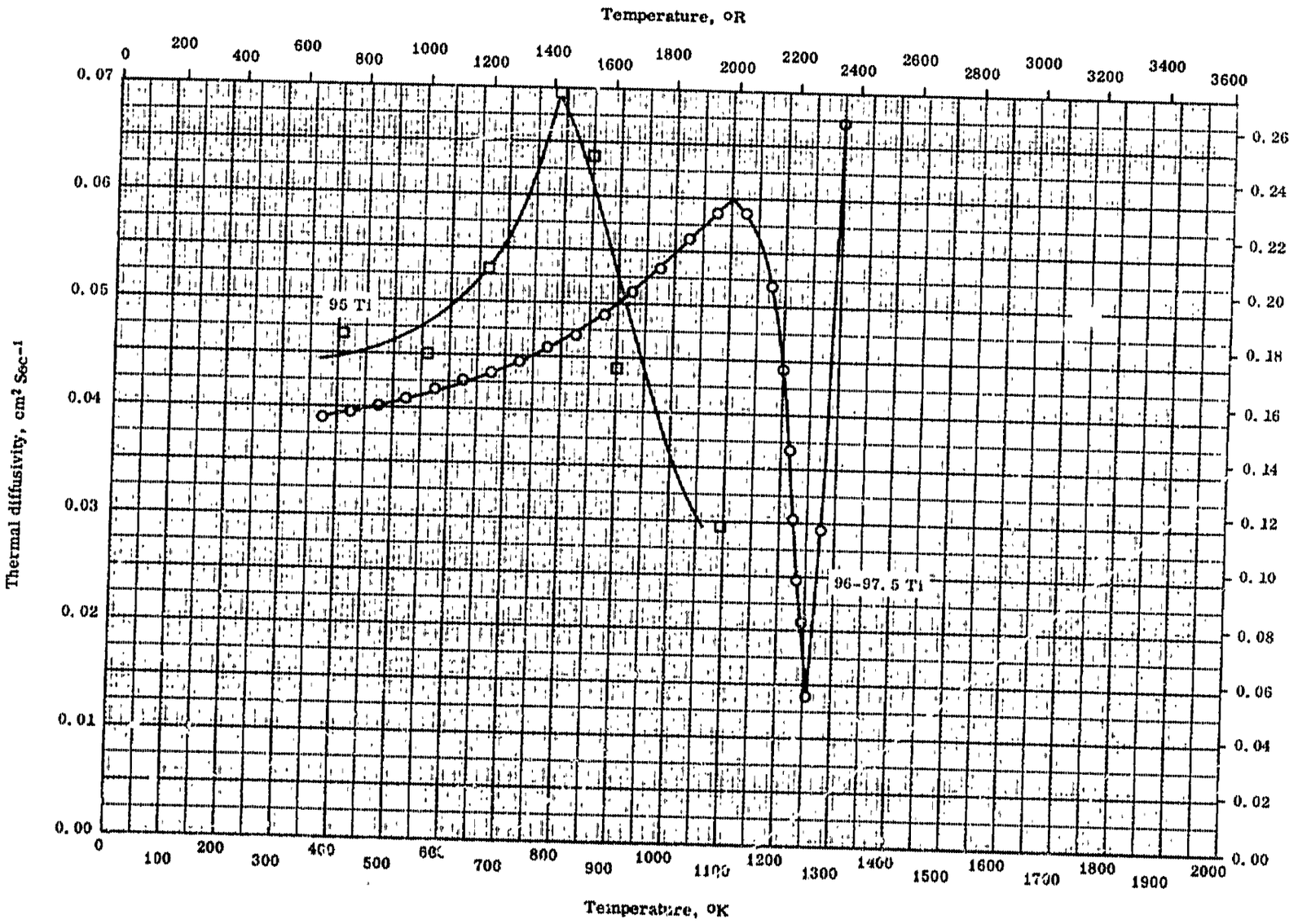


THERMAL CONDUCTIVITY -- TITANIUM + ALUMINUM

THERMAL CONDUCTIVITY -- TITANIUM + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
●	56-11	403		7 Al.	
■	56-12	317		8 Al.	
○	61-11	423-1223		1.5 Al.	
□	61-11	423-1173		2.0 Al.	
△	61-11	423-1123		2.5 Al.	
▽	61-11	473-1073		3.5 Al.	
◀	61-11	423-1073		4.1 Al.	
▷	61-11	423-1123		4.05 Al.	
◇	61-11	423-1173		4.5 - 5.0 Al.	
◆	61-6	366-1328		3.5 - 4 Al, 0.1 > N_2, and 0.1 > O_2; 48-OT-3.	



THERMAL DIFFUSIVITY — TITANIUM + ALUMINUM

TPRC

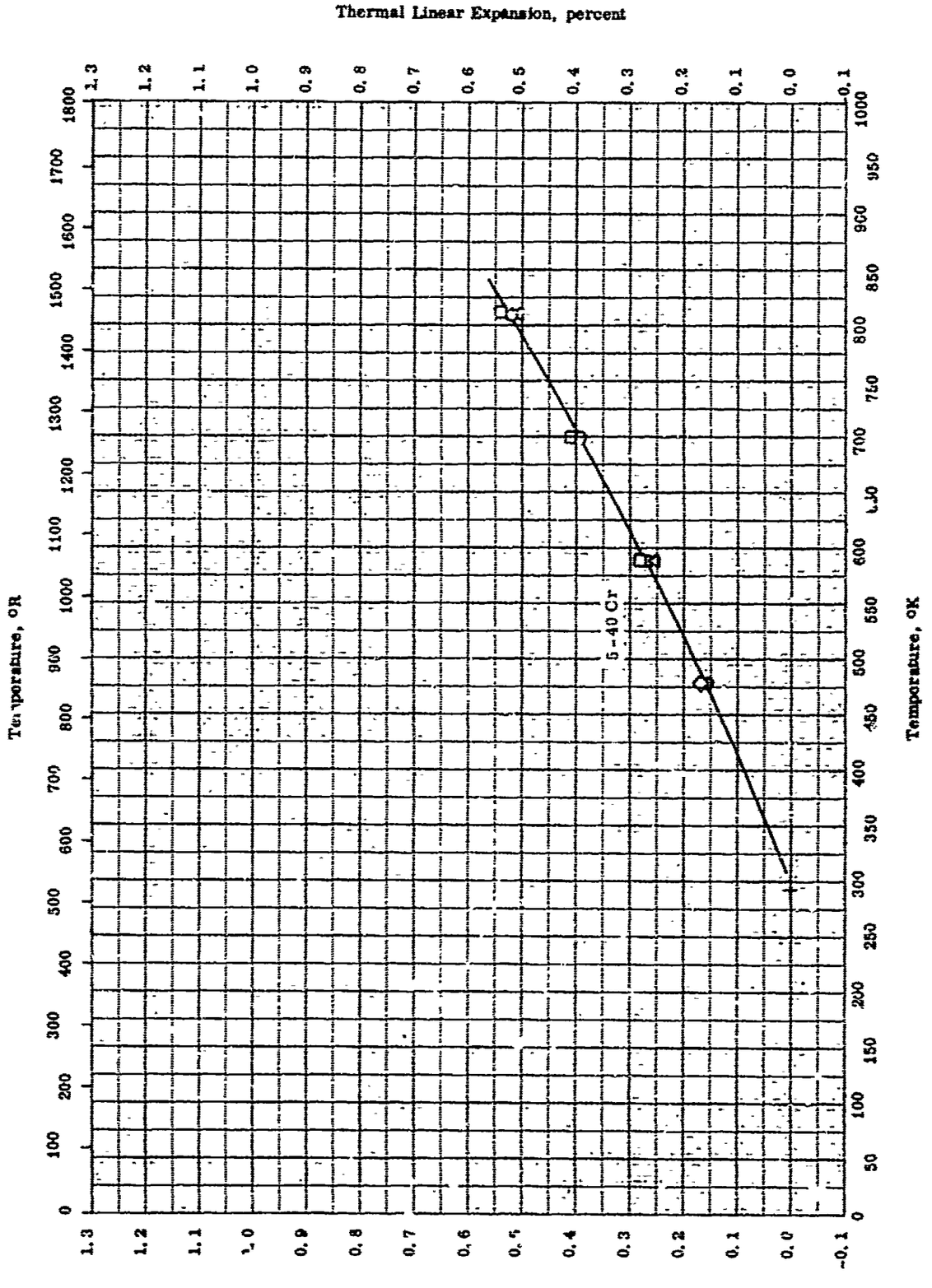
505

THERMAL DIFFUSIVITY -- TITANIUM +ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specification	Remarks
○	61-1	373-1298		48-OT-3; 96-97.5 Ti, 3.5-4.0 Al, 0.1 O_2, 0.1>N_2, and trace H_2; cylindrical sample with 100 mm dia and 400 mm long.	
□	62-2	403-1093		RT-5; 95 Ti and 5 Al; cylindrical sample with 3 mm dia and 300 mm long.	Vacuum annealed for 5 hrs at 720 C and annealed again in apparatus before beginning measurements.

TPRC



THERMAL LINEAR EXPANSION -- TITANIUM + CHROMIUM

THERMAL LINEAR EXPANSION -- TITANIUM + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	54-33	297-811		5.0 Cr.	
□	54-33	297-811		10.0 Cr.	
◇	54-33	297-478		15.0 Cr.	
△	54-33	297-811		40.0 Cr.	

TPRC

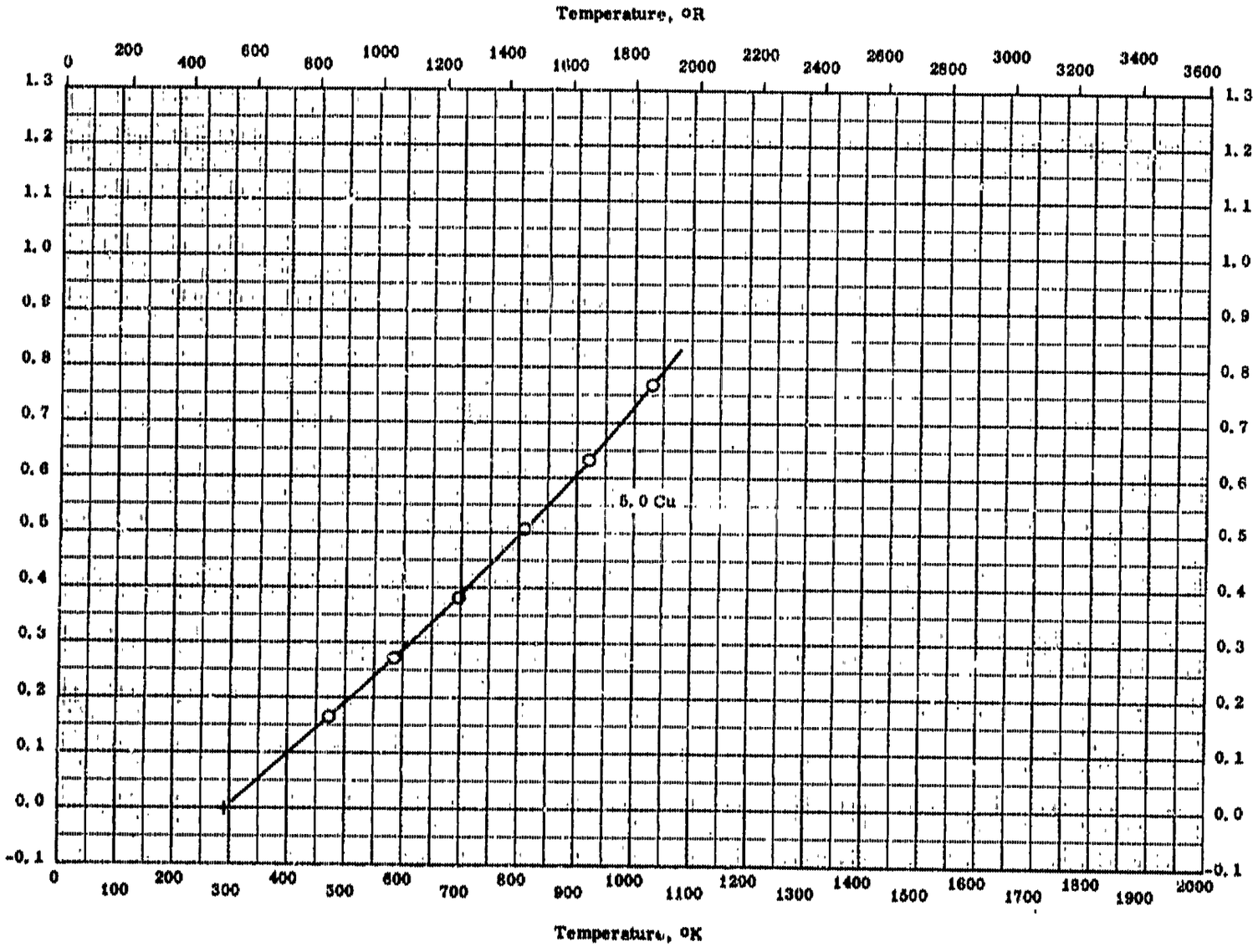
ELECTRICAL RESISTIVITY — TITANIUM + COPPER

ELECTRICAL RESISTIVITY -- TITANIUM + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-18	273-1023	± 1	Iodide Ti (α - phase); 1 Cu (99.99 pure).	High temp. work in vacuum of 10^{-6} mm Hg.

TPRC



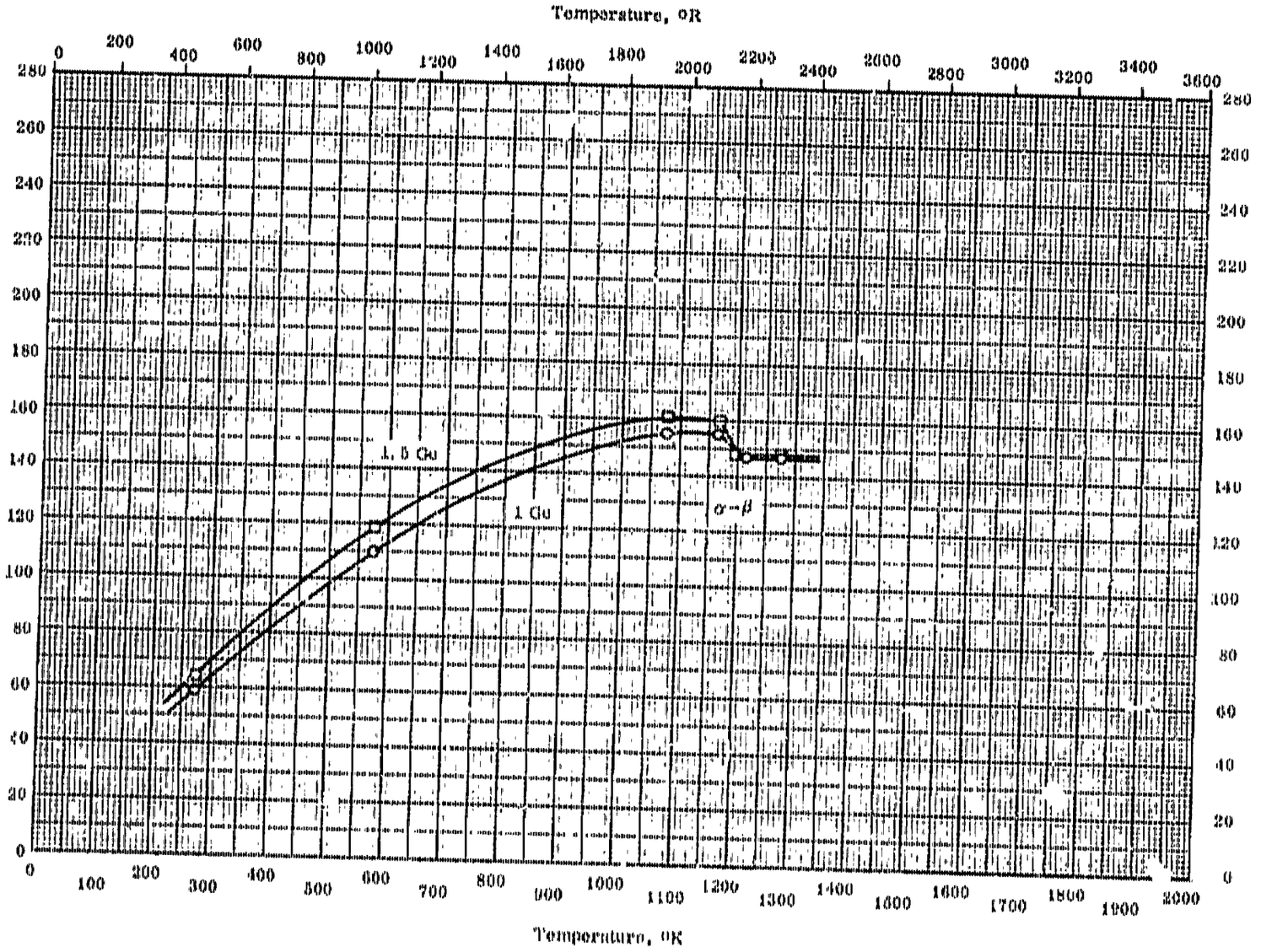
THERMAL LINEAR EXPANSION -- TITANIUM + COPPER

THERMAL LINEAR EXPANSION -- TITANIUM + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	54-33	207-1033		5.0 Cu.	

TPRC



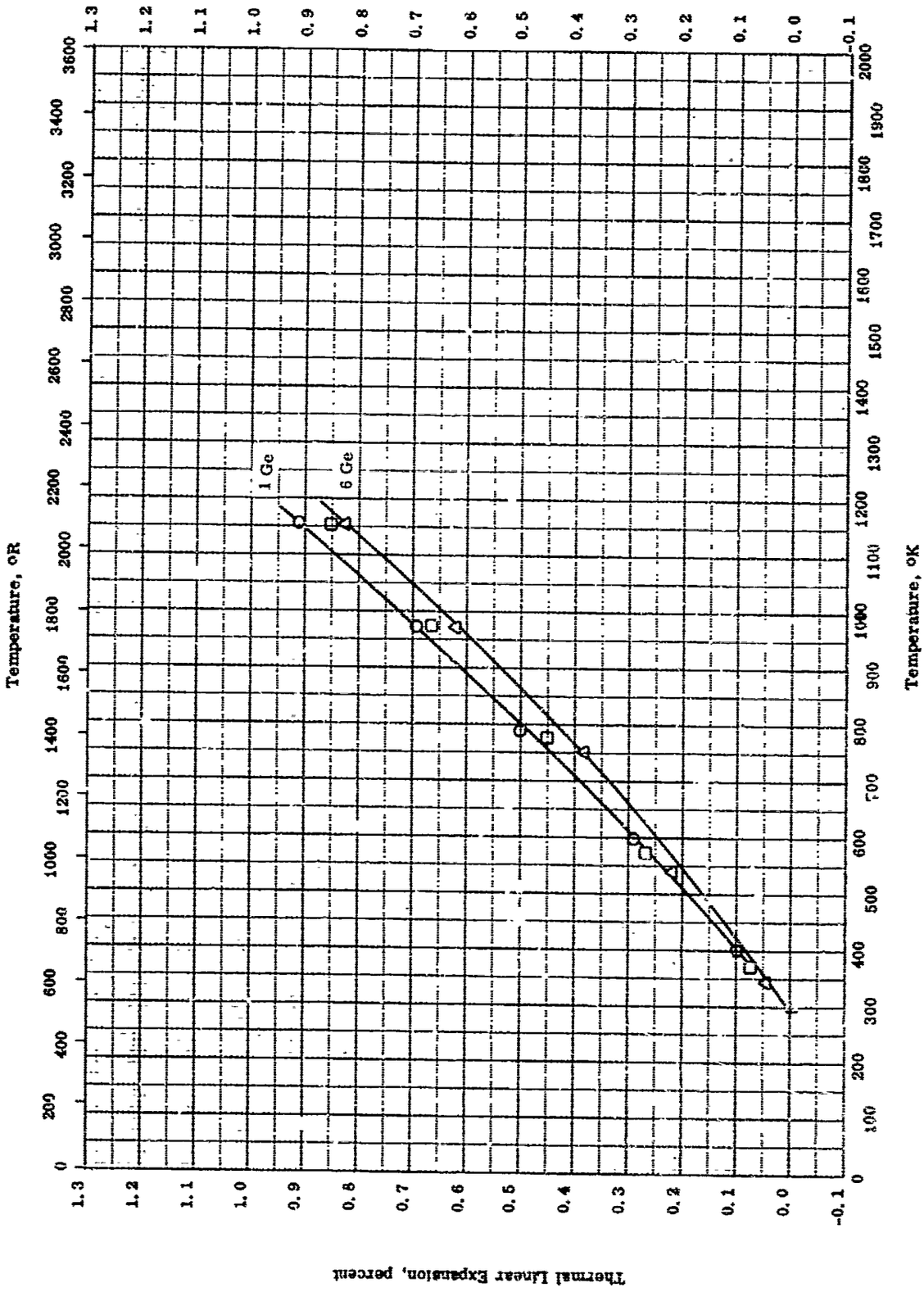
ELECTRICAL RESISTIVITY - - TITANIUM + GERMANIUM

ELECTRICAL RESISTIVITY -- TITANIUM + GERMANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-24	273-1273		99 Ti and 1 Ge.	Heating rate 50 C min^{-1}.
□	55-24	273-1273		98.5 Ti and 1.5 Ge.	Same as above.

TPRC



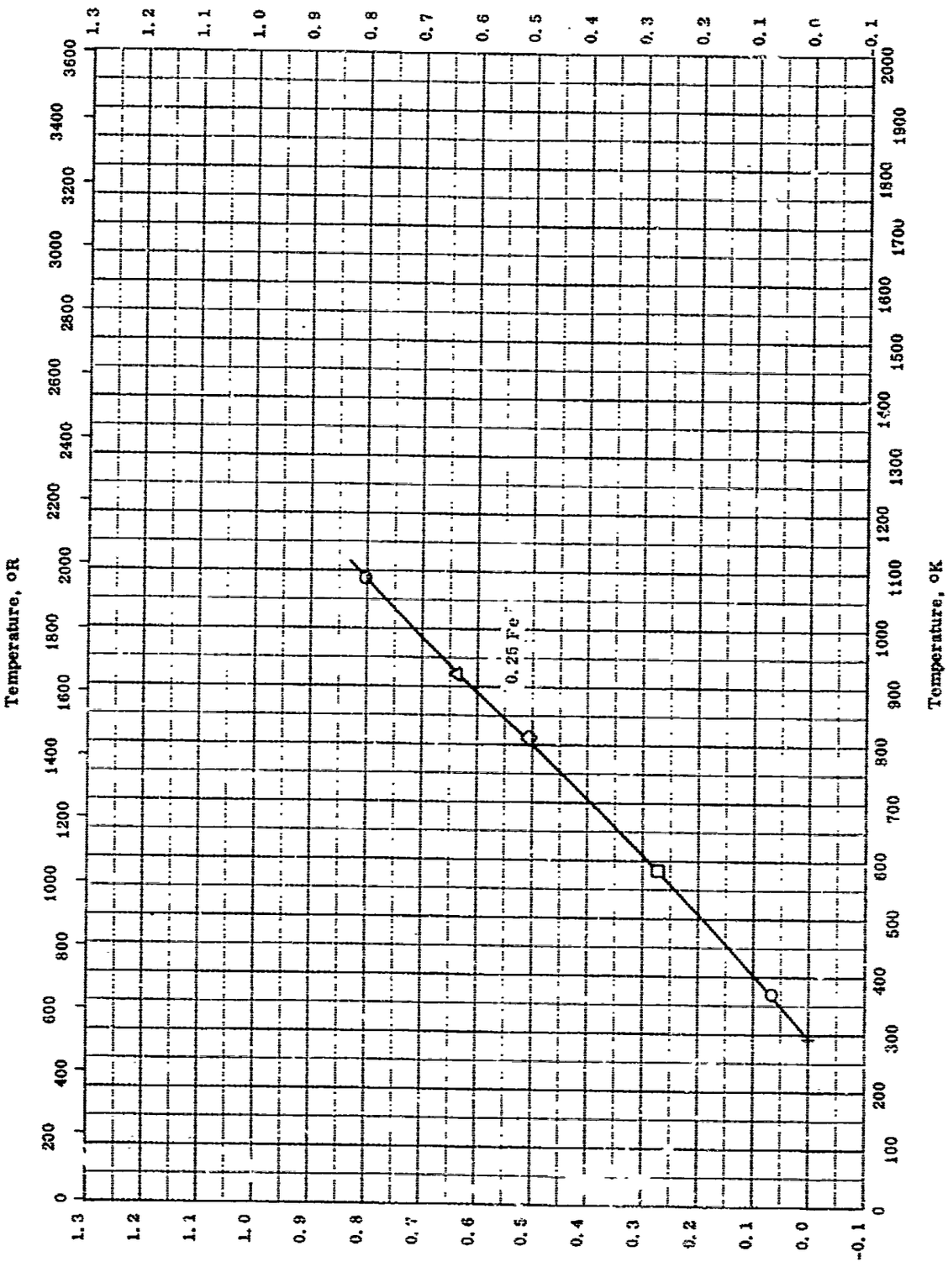
THERMAL LINEAR EXPANSION -- TITANIUM + GERMANIUM

THERMAL LINEAR EXPANSION — TITANIUM +GERMANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-24	293-1156		1 Ge.	Heating rate 50 C min $^{-1}$.
□	55-24	293-1156		2 Ge.	Same as above.
△	55-24	293-1156		6 Ge.	Same as above.

TPRC



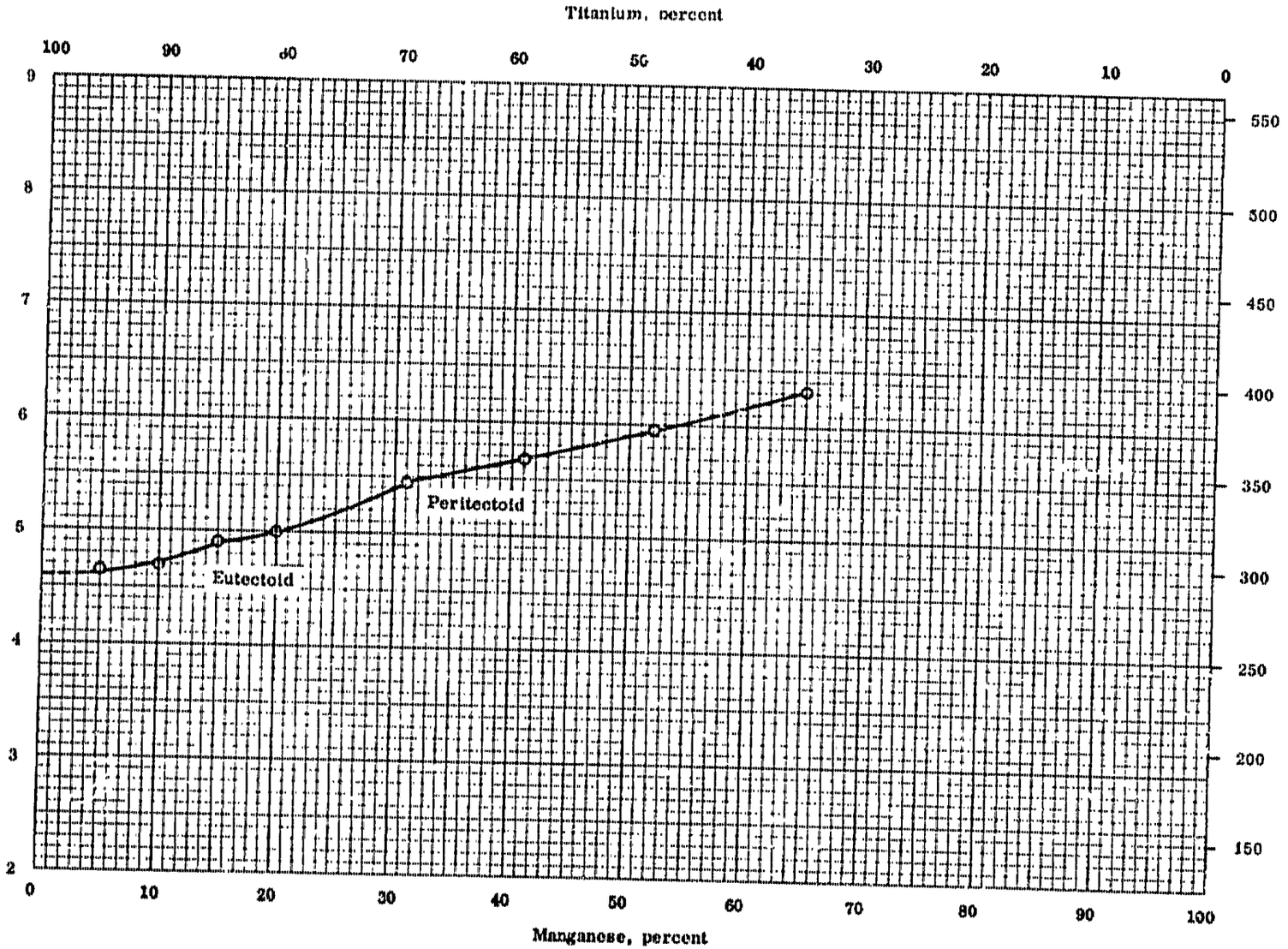
THERMAL LINEAR EXPANSION -- TITANIUM + IRON

THERMAL LINEAR EXPANSION -- TITANIUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	65-6	27[illegible] 1089		RMI - 30; Reactive Metals, Inc.; 0.25 Fe, 0.08 C, 0.05 N, and 0.01 - 0.015 H; density 0.163 lb $in.^{-3}$ and M.P. ~3040 F; beta transus 1630 ± 25 F.	Annealing temperature: full 1300 F for 2 hrs and air cooled; stress relief at 1000 - 1100 F for 30 min. and air cooled; forging temperature: blocking 1600 - 1700 F, finishing 1500 - 1600 F.
□	65-6	273-1089		RMI - 40; Reactive Metals, Inc.; 0.25 Fe, 0.08 C, 0.05 N, and 0.010 - 0.015 H; density 0.163 lb in^{-3} and M.P. ~3020 F; beta transus 1675 ± 25 F.	Same as above.
◇	65-6	273-1089		RMI - 55; Reactive Metals, Inc.; 0.25 Fe, 0.08 C, 0.05 N, and 0.010 - 0.015 H; density 0.163 lb in^{-3} and M.P. ~3020 F; beta transus 1690 ± 25 F.	Same as above.
△	65-6	273-1089		RMI - 70; Reactive Metals, Inc.; 0.25 Fe, 0.08 C, 0.05 N, and 0.010 - 0.015 H; density 0.164 lb in^{-3} and M.P. 3020 F; beta transus 1740 ± 25 F.	Same as above except forging temperature: blocking 1650 - 1700 F, finishing 1500 - 1600 F.

TPRC



DENSITY -- TITANIUM + MANGANESE

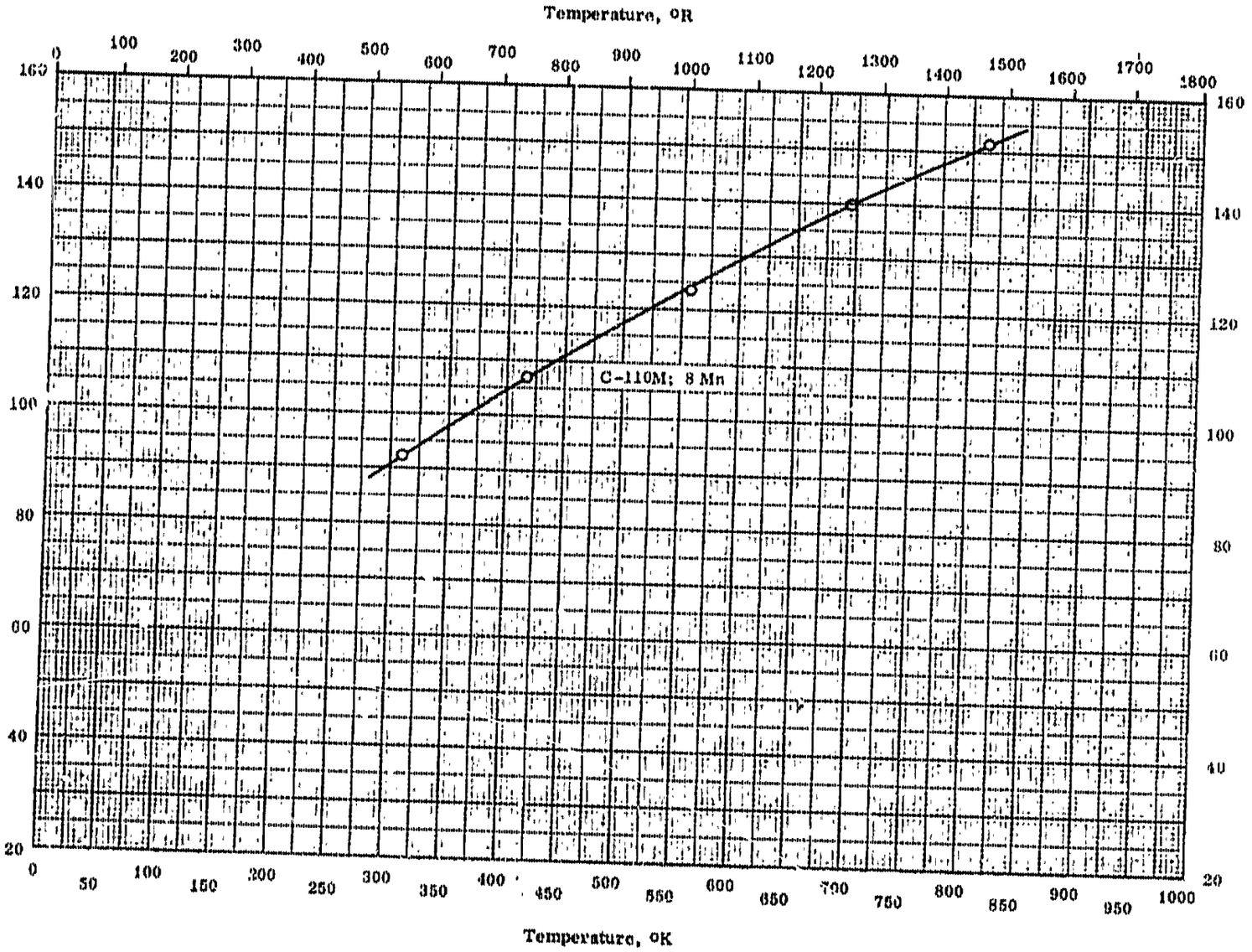
TPRC

DENSITY -- TITANIUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	54-20	298		0-05 Mn.	Density by weight in air and in water.

TPRC

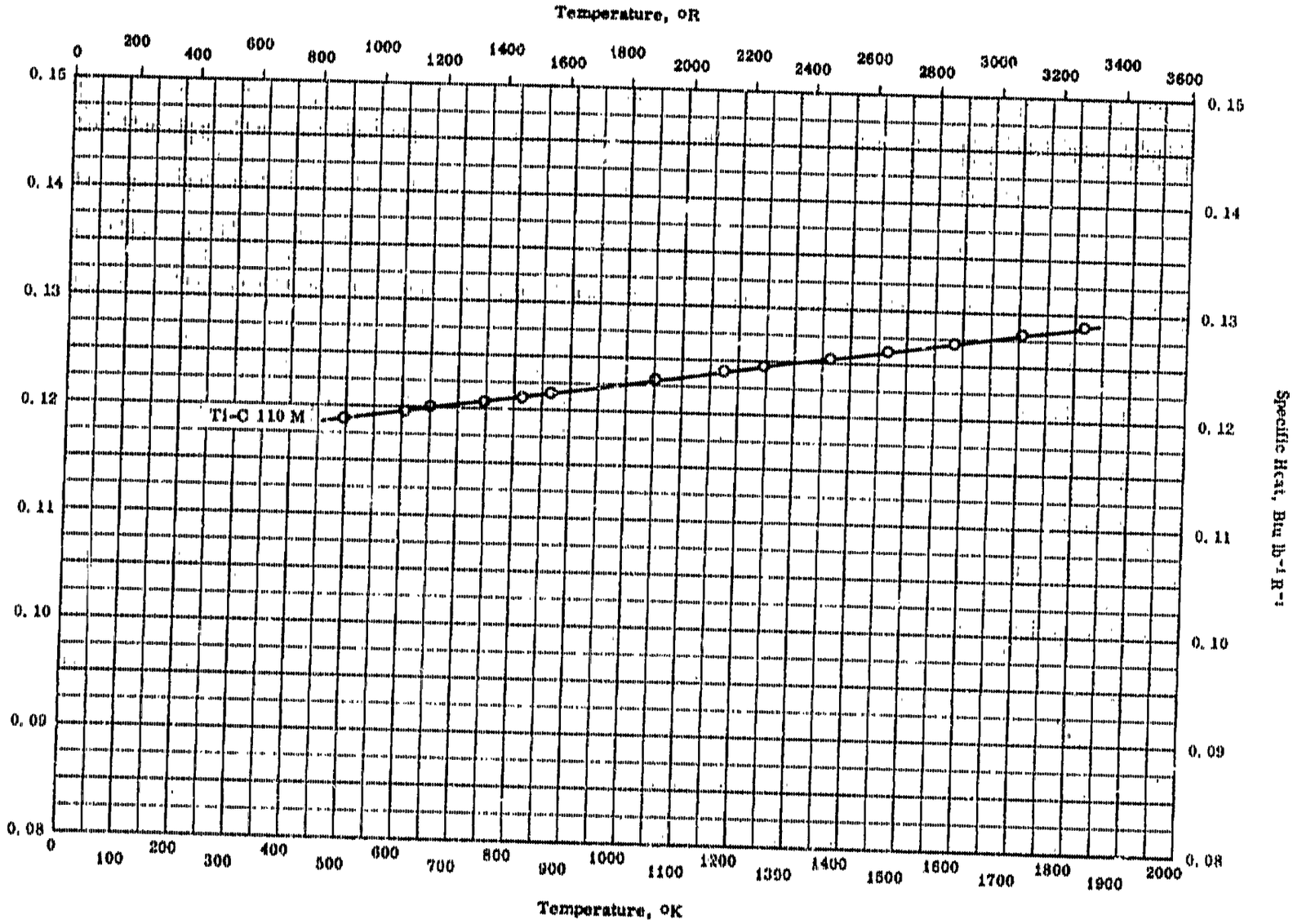


ELECTRICAL RESISTIVITY -- TITANIUM + MANGANESE

ELECTRICAL RESISTIVITY -- TITANIUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-14	311-611	± 1	Ti alloy C-110M (formerly RC-130A); nominal composition: 8 Mn.	



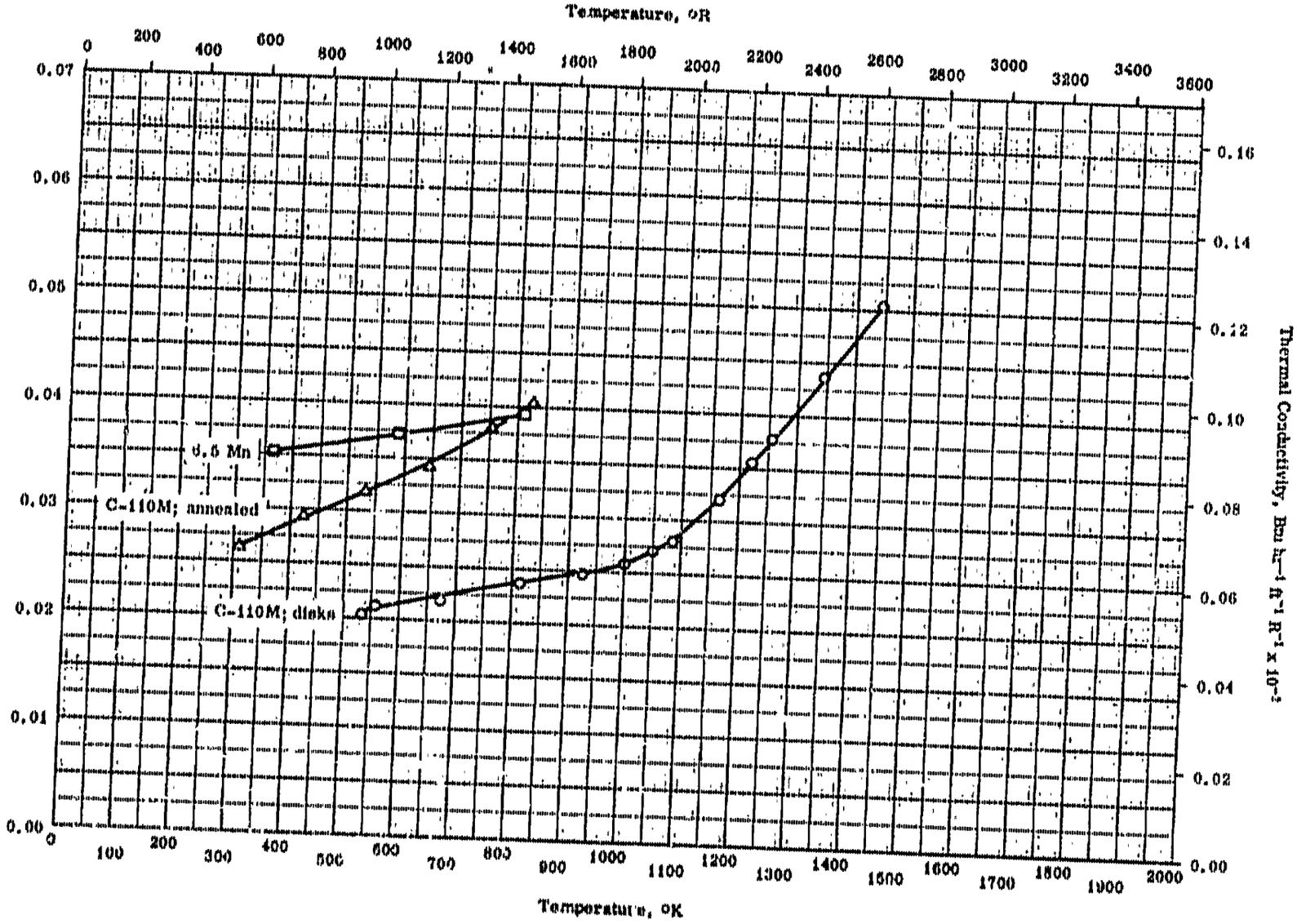
SPECIFIC HEAT -- TITANIUM + MANGANESE

SPECIFIC HEAT -- TITANIUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	61-2	497-1816	3.0	Ti-C 110 M; 91.81 Ti, 7.9 Mn, 0.15 O_2, 0.03 C, and 0.01 W; density 286 lb ft^{-3}.	Under helium atmosphere.

TPRC



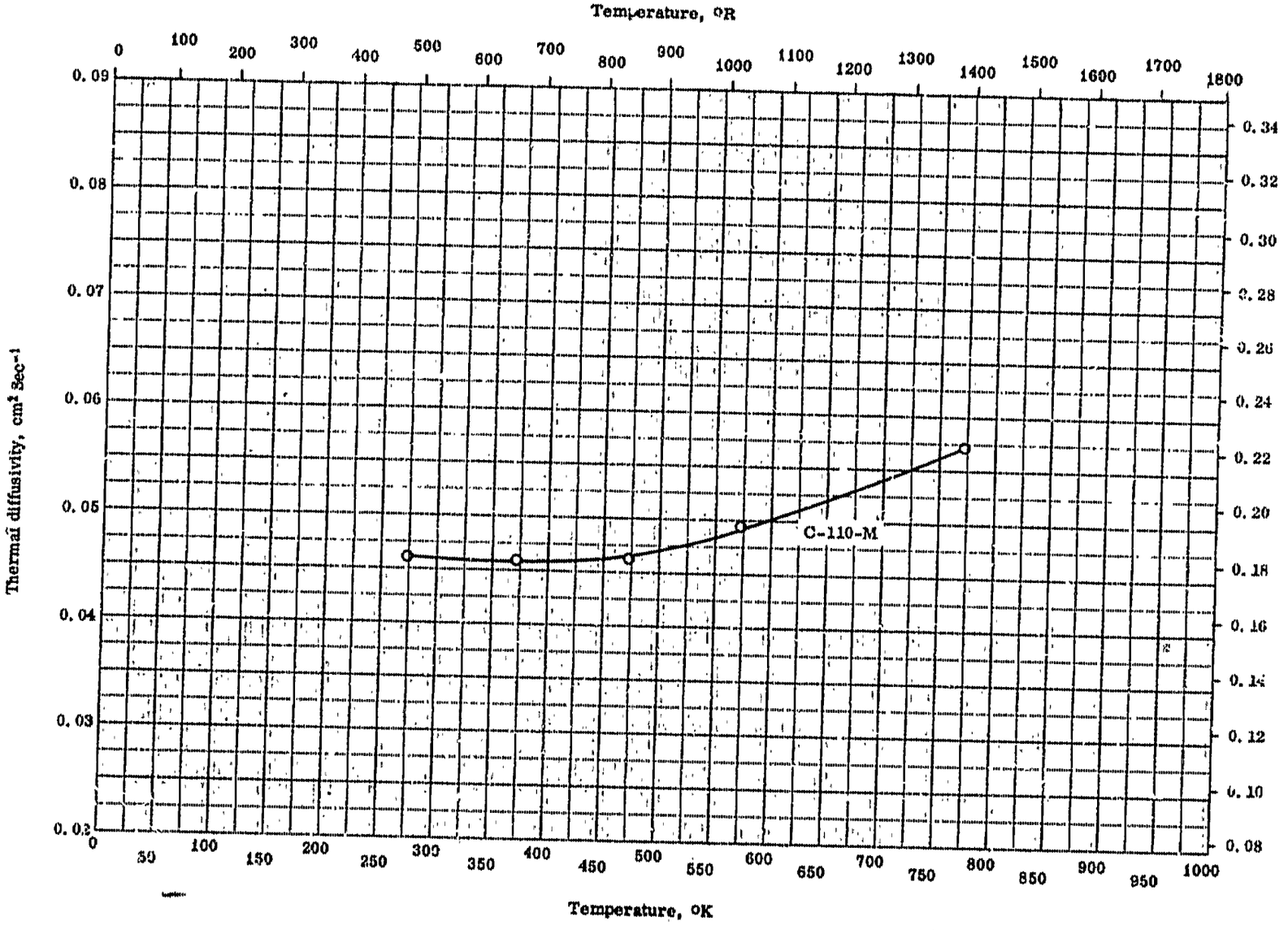
THERMAL CONDUCTIVITY -- TITANIUM +MANGANESE

THERMAL CONDUCTIVITY -- TITANIUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	56-9	366-811		93.21 Ti, 6.50 Mn, 0.20 Fe, 0.177 O, 0.05 C, 0.034 N, and 0.0069 H.	
△	58-14	311-828	±5	C-110M (Formerly RC - 130 A); 8 Mn; nominal composition.	In a mild annealed condition.
○	61-2	524-1446	<5	Ti C110M; 91.81 Ti, 7.9 Mn, 0.15 O, 0.03 C, and 0.01 W.	Sample contained 5 one-inch dia disks.

TPRC



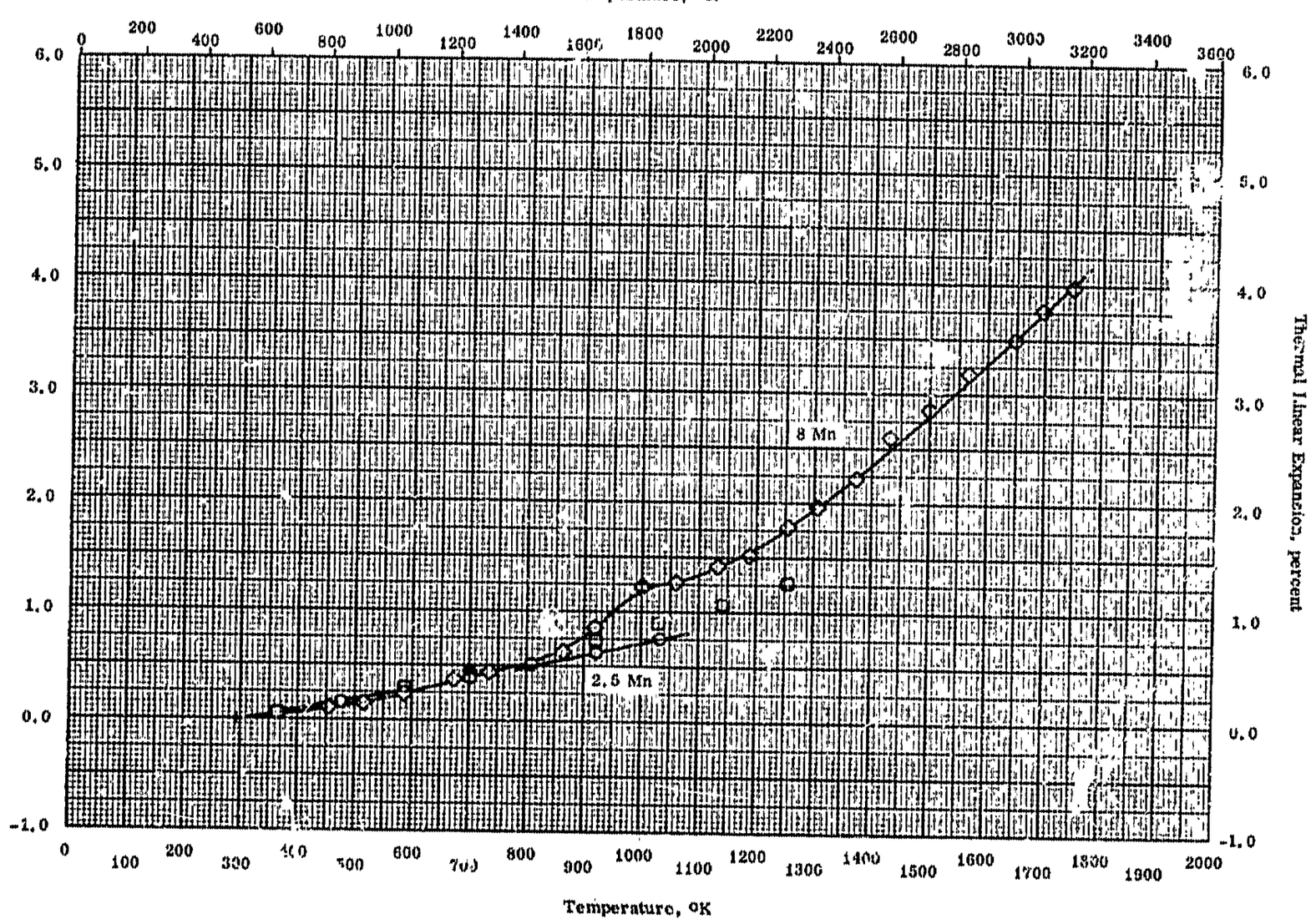
THERMAL DIFFUSIVITY -- TITANIUM + MANGANESE

THERMAL DIFFUSIVITY -- TITANIUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-1	273-773		C-110-M; 92 Ti and 8 Mn.	

TPRC



THERMAL LINEAR EXPANSION -- TITANIUM + MANGANESE

THERMAL LINEAR EXPANSION --- TITANIUM + MANGANESE

REFERENCE INFORMATION

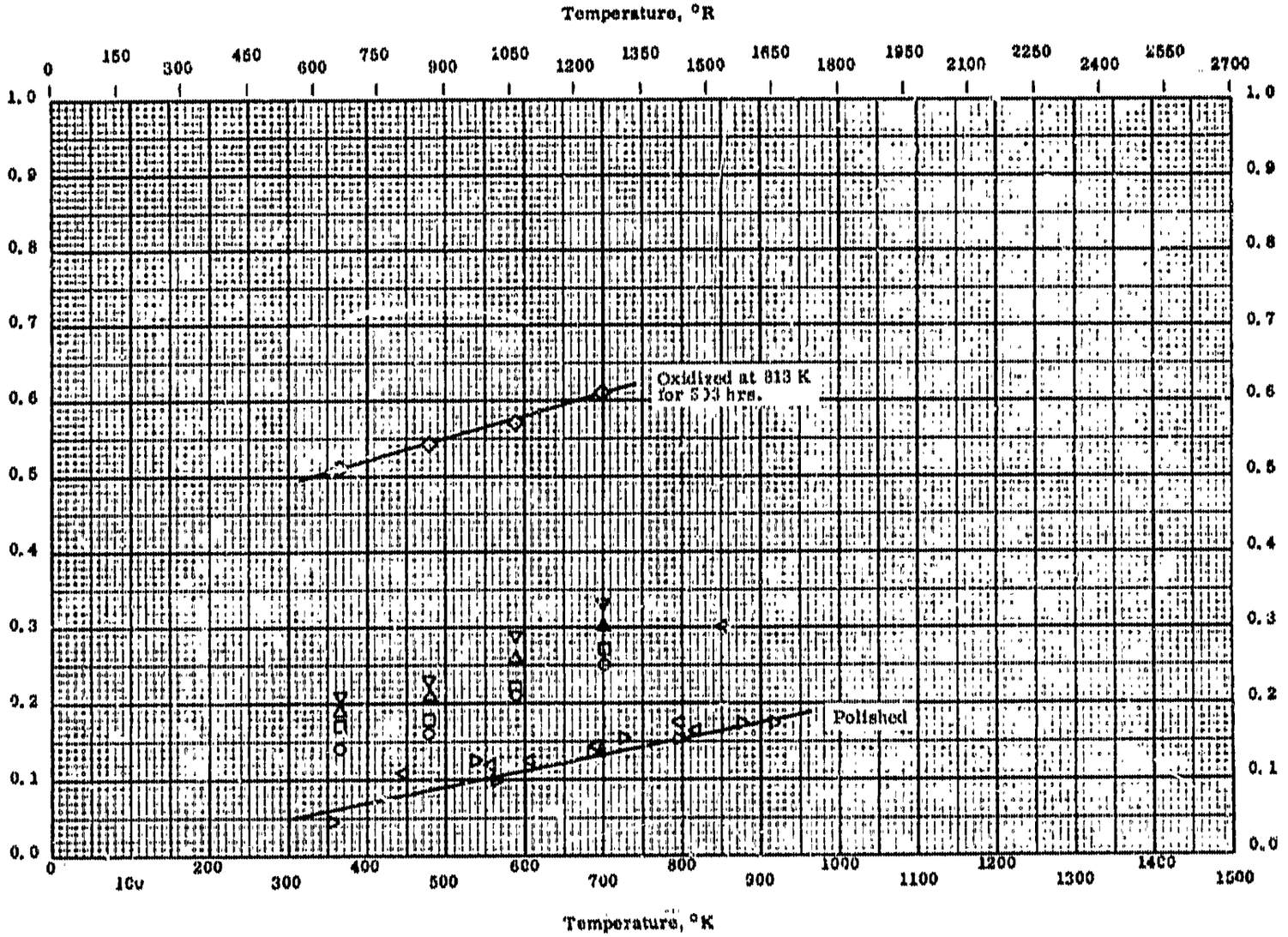
Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	54-33	297-1033		2.5 Mn.	
□	54-33	293-1255		RC - 130A (C110M); 8 Mn; density 0.172 lb in^{-3}.	
◇	61-2	300-1748		Titanium C110M; 91.81 Ti, 7.9 Mn, 0.15 O, 0.03 C, 0.01 W; density 4.59 g cm^{-3}.	
△	63-29	293-811		8 Mn; density 4.73 g cm^{-3}; alpha-beta alloy.	

HEMISPHERICAL TOTAL EMITTANCE -- TITANIUM + MANGANESE

HEMISPHERICAL TOTAL EMITTANCE -- TITANIUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	58-24	644-1089	>2	RS-120.	Stably oxidized in quiescent air at 1089 K.



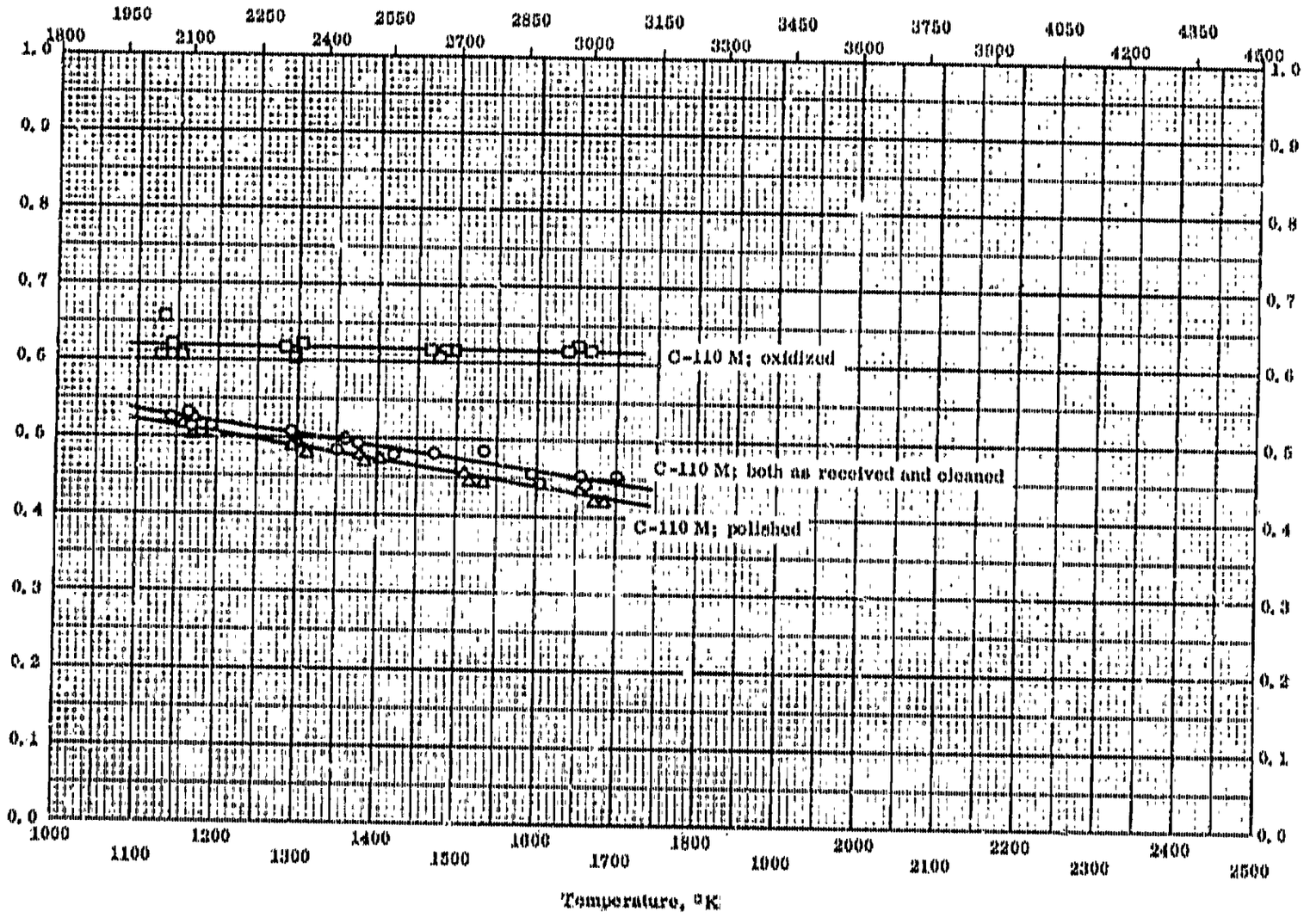
NORMAL TOTAL EMITTANCE -- TITANIUM + MANGANESE
(C-110M, AMS 4908)

NORMAL TOTAL EMITTANCE -- TITANIUM + MANGANESE
(C-110M, AMS 4908)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	58-26	366-700	± 21	C-110M, AMS 4908.	
□	58-26	366-700	± 18	C-110M, AMS 4908.	Oxidized at 680 K for 306 hrs.
△	58-26	366-700	± 16	C-110M, AMS 4908.	Oxidized at 705 K for 100 hrs.
▽	58-26	366-700	± 14	C-110M, AMS 4908.	Oxidized at 711 K for 306 hrs.
◇	58-26	366-700	± 6	C-110M, AMS 4908.	Oxidized at 813 K for 303 hrs.
▷	57-48	355-910	± 10	C-110M, AMS 4908.	Measured in vacuum (5×10^{-4} mm Hg); same data for as received, cleaned (with a liquid detergent) and polished (with fine polishing compound).
◁	57-48	444-850	± 10	C-110M, AMS 4908.	Oxidized in air at red heat for 30 min.; measured in vacuum (5×10^{-4} mm Hg).

TPRC



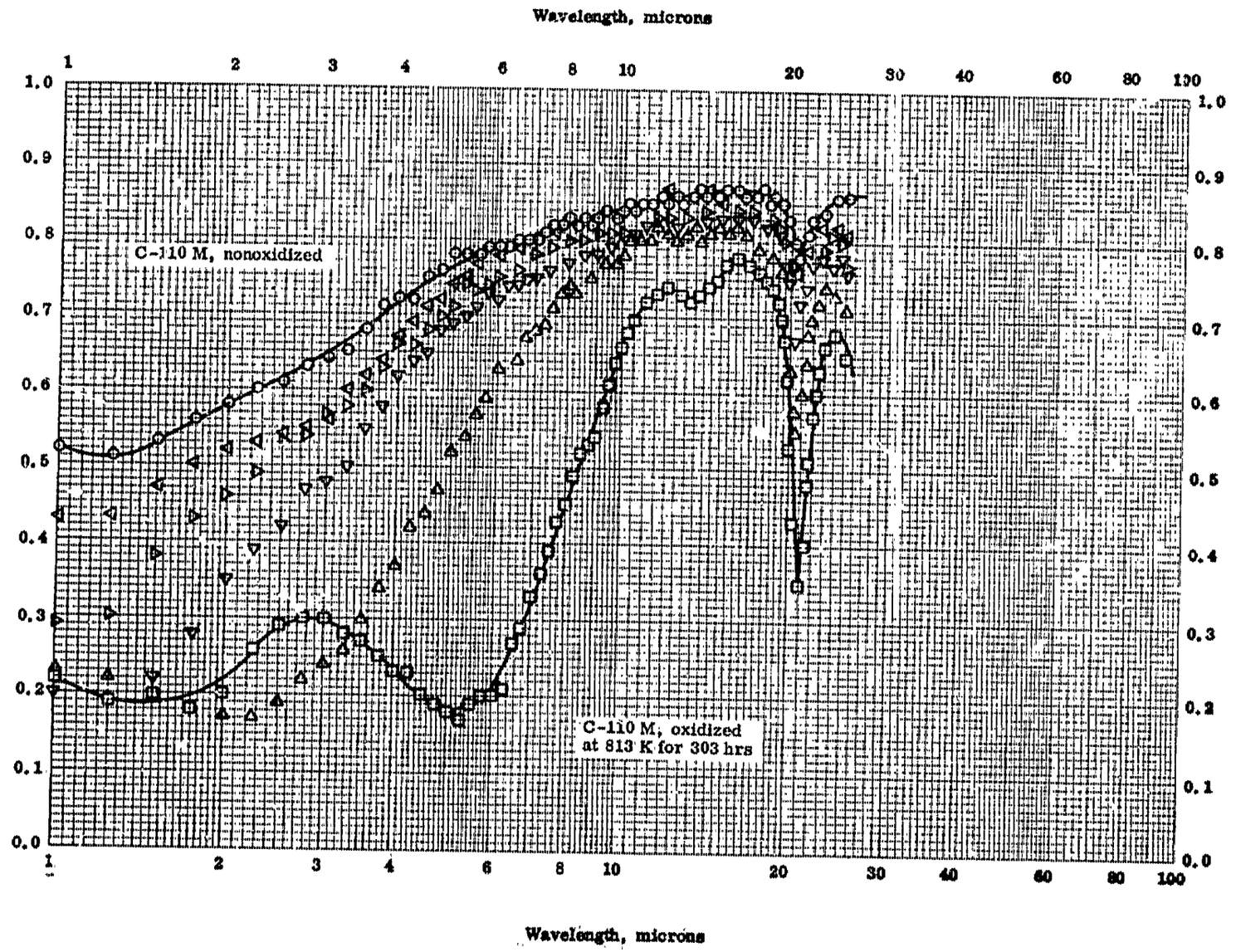
NORMAL SPECTRAL EMITTANCE — TITANIUM + MANGANESE

NORMAL SPECTRAL EMITTANCE -- TITANIUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-48	0.665	1144-1700		C-110 M.	Measured in vacuum; same data for as received and cleaned (with a liquid detergent).
△	57-48	0.665	1158-1686		C-110 M.	Polished with fine polishing compounds; measured in vacuum.
□	57-48	0.665	1130-1666		C-110 M.	Oxidized in air at red heat for 30 min.; measured in vacuum.

TPRC



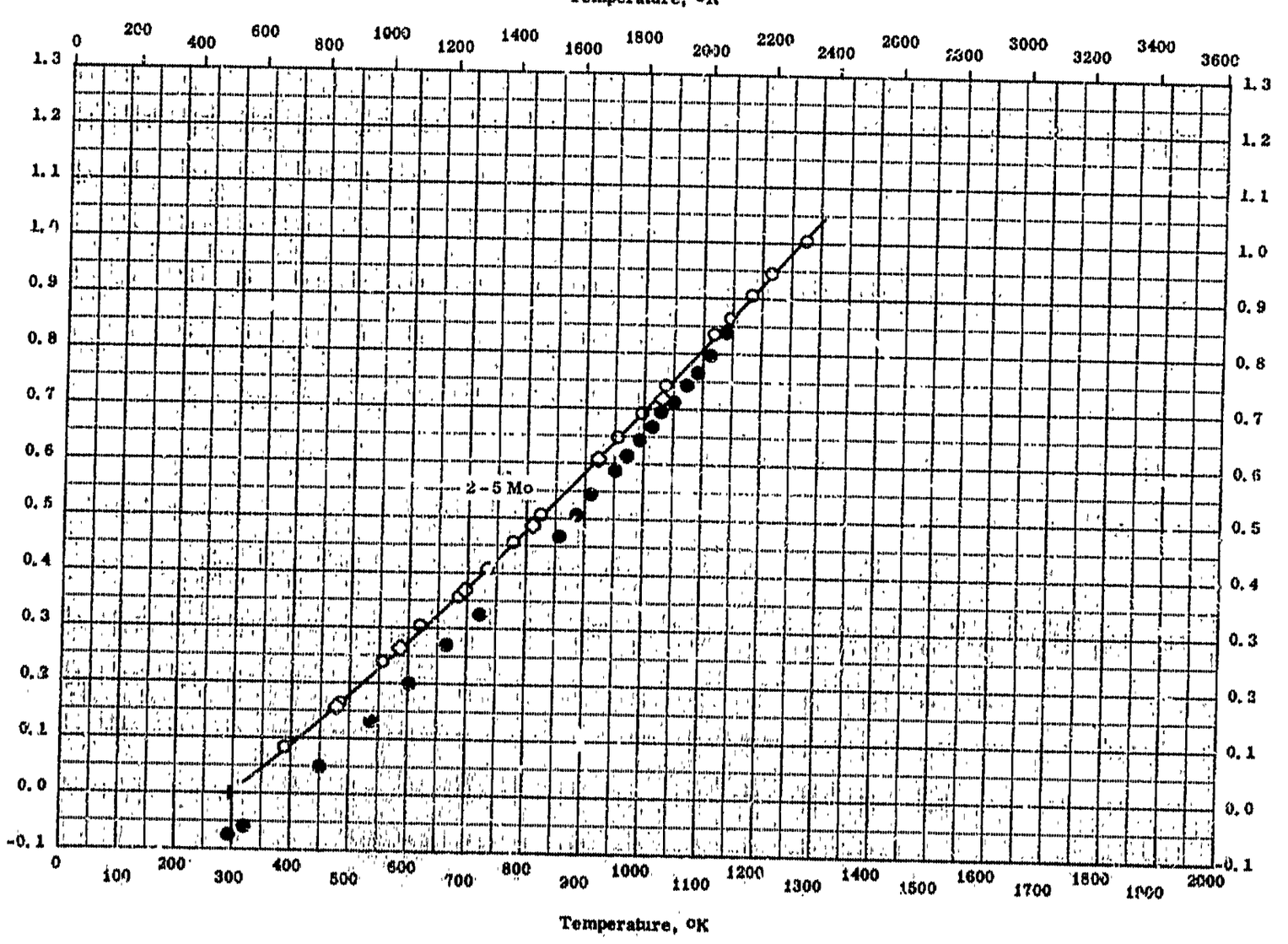
NORMAL SPECTRAL REFLECTANCE -- TITANIUM + MANGANESE

NORMAL SPECTRAL REFLECTANCE -- TITANIUM + MANGANESE

REFERENCE INFORMATION

Symbol	Ref.	Temp. °K	Wavelength Range, μ	Rept. Error%	Sample Specifications	Remarks
○	58-26	310.9	1.0-25.0		C-110 M, AMS 4908	
□	58-26	310.9	1.0-25.0		C-110 M, AMS 4908	Oxidized at 813 K for 303 hrs.
△	58-26	310.9	1.0-25.0		C-110 M, AMS 4908	Oxidized at 739 K for 203 hrs.
▽	58-26	310.9	1.0-25.0		C-110 M, AMS 4908	Oxidized at 711 K for 306 hrs.
▷	58-26	310.9	1.0-25.0		C-110 M, AMS 4908	Oxidized at 705 K for 100 hrs.
◁	58-26	310.9	1.0-25.0		C-110 M, AMS 4908	Oxidized at 580 for 306 hrs.

TPRC



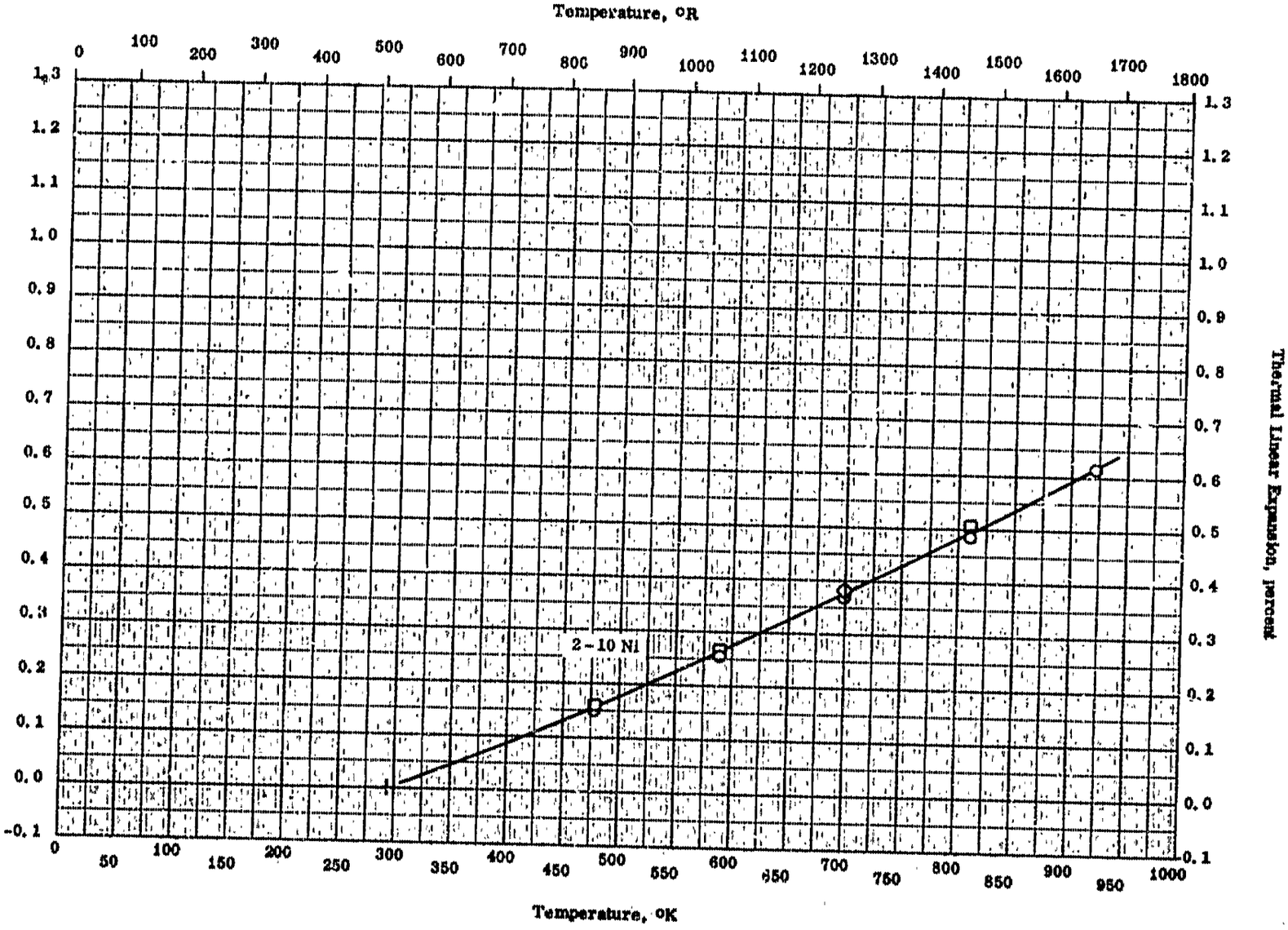
THERMAL LINEAR EXPANSION — TITANIUM + MOLYBDENUM

THERMAL LINEAR EXPANSION -- TITANIUM + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
◇	54-33	297-1033		5.0 Mo.	
○	64-12	298-1275		2.0 Mo.	Heat treated for 4 hrs in high vacuum at 1200 C; measured in vacuum of 10^{-5} mm Hg with a heating rate of 1 C min^{-1}; phase transition occurred at about 800 C.
●	64-12	293-1275		2.0 Mo.	Cooling curve of above specimen with a cooling rate of 18 C min^{-1}; permanent change in length -0.08% resulted.

TPRC



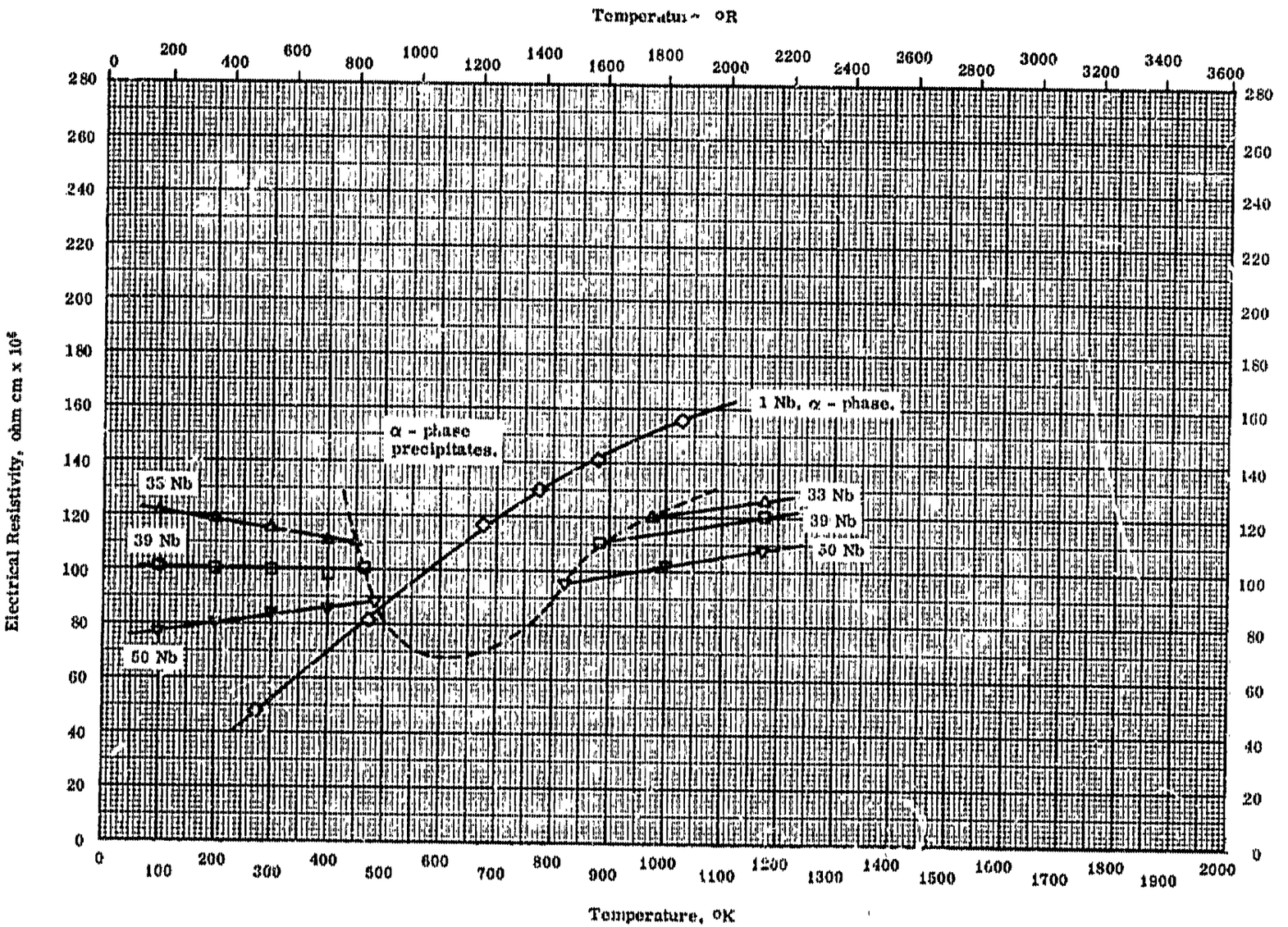
THERMAL LINEAR EXPANSION -- TITANIUM + NICKEL

THERMAL LINEAR EXPANSION -- TITANIUM + NICKEL

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	54-33	297-922		2.5 Ni.	
□	54-33	297-811		7.5 Ni.	
◇	54-33	297-811		10.0 Ni.	

TPRC

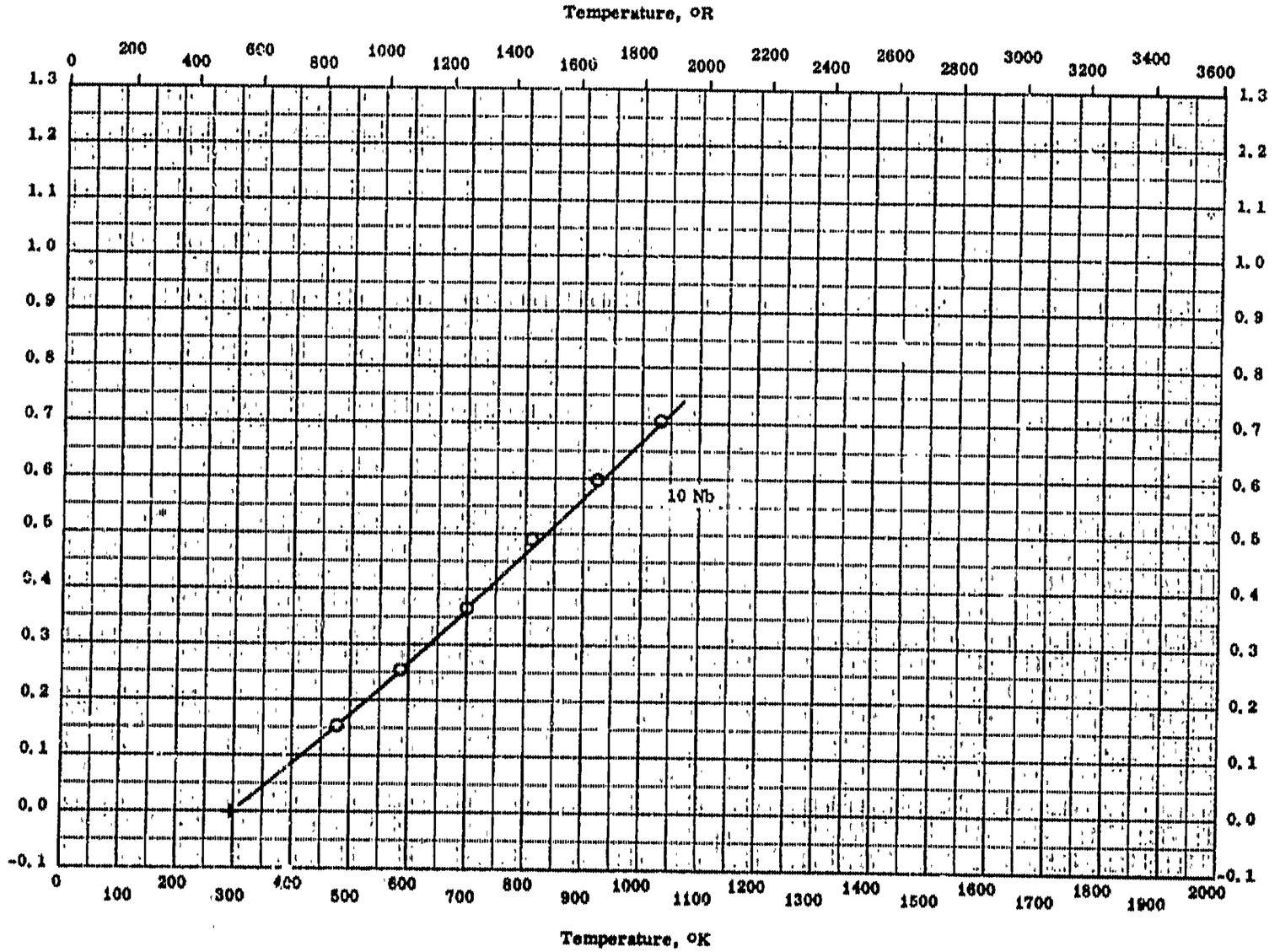


ELECTRICAL RESISTIVITY -- TITANIUM + NIOBIUM

ELECTRICAL RESISTIVITY -- TITANIUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
▽	54-16	100-1173		50 Ti and 50 Nb; β - phase; prepared from spectroscopically pure Nb and iodide refined Ti (0.2 atomic % Zr).	Cast, rolled, remelted, hot forged, surface layers removed, cold swaged, homogenized 70 hrs at 1050 C in vacuum, and quenched to retain β phase; tested in vacuum.
□	54-16	100-1173		60.7 Ti and 39.3 Nb; β - phase; raw materials same as above.	Same as above.
△	54-16	100-1173		67.3 Ti and 32.7 Nb; β - phase; raw materials same as above.	Same as above.
◇	56-18	273-1023	± 1	99 Ti and 1 Nb; α - phase; prepared from spectroscopically pure Nb and iodide refined Ti.	Tested in vacuum; anisotropy may exist.



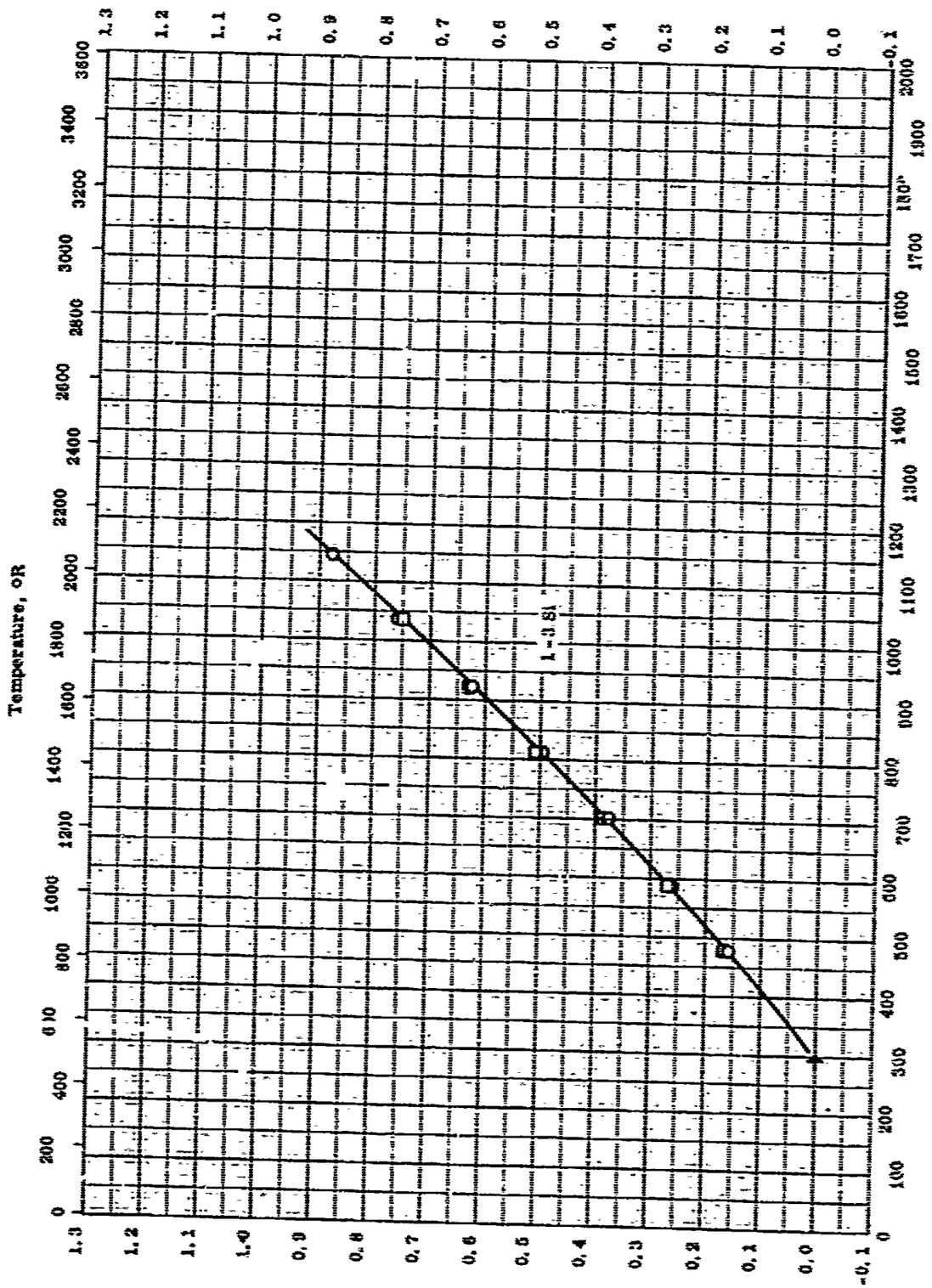
THERMAL LINEAR EXPANSION — TITANIUM + NIOBIUM

THERMAL LINEAR EXPANSION -- TITANIUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	54-33	297-1033		Iodide Ti and 10 Nb.	

TPRC



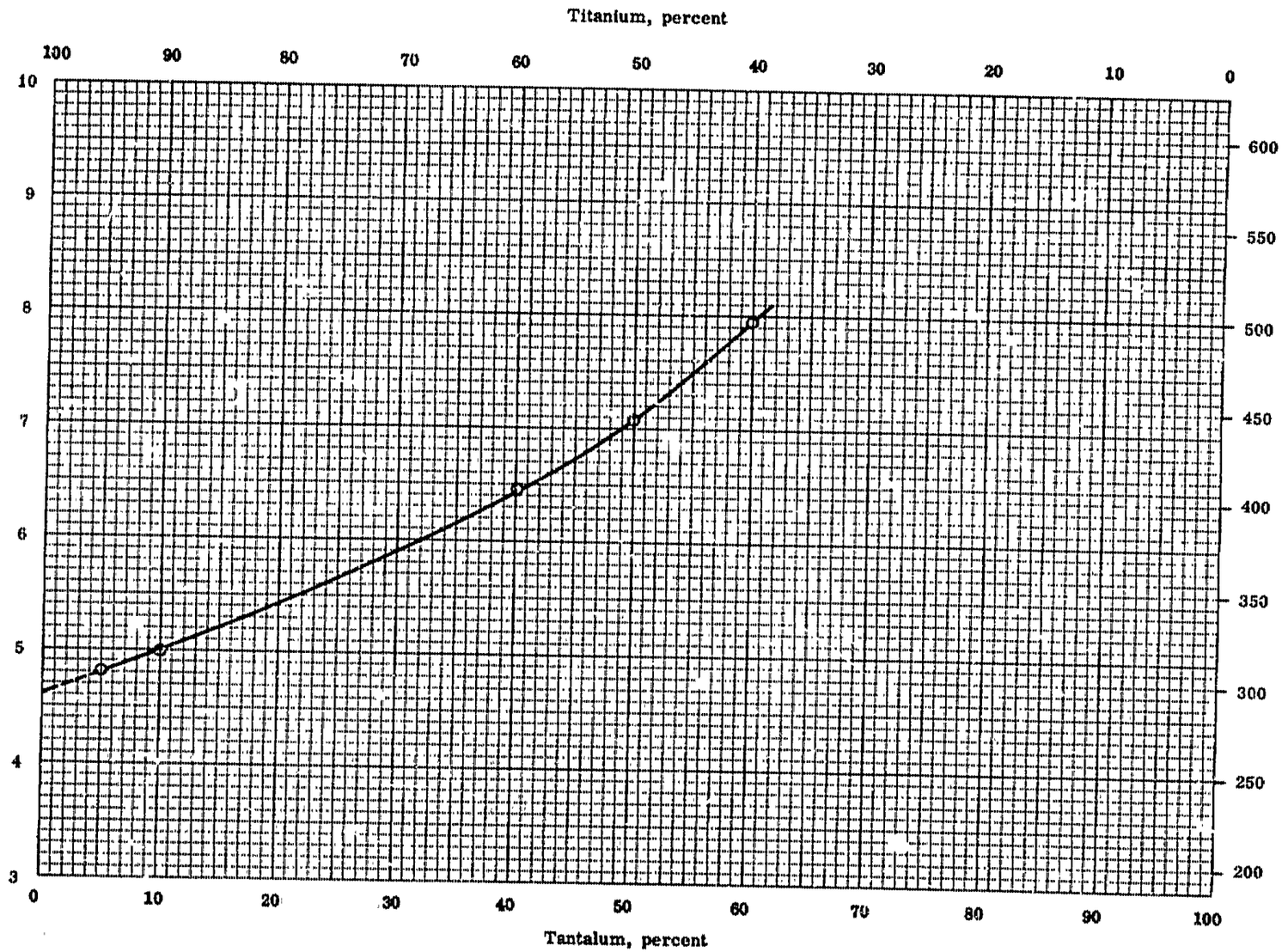
THERMAL LINEAR EXPANSION -- TITANIUM + SILICON

THERMAL LINEAR EXPANSION -- TITANIUM + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	54-33	297-1144		3.0 Si.	
□	54-33	297-1144		Iodide Ti and 1 Si.	

TPRC



DENSITY — TITANIUM + TANTALUM

DENSITY -- TITANIUM + TANTALUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	54-20	298		0-60 Ta.	Density by weight in air and in water.

TPRC

Electrical Resistivity, ohm cm x 10^5

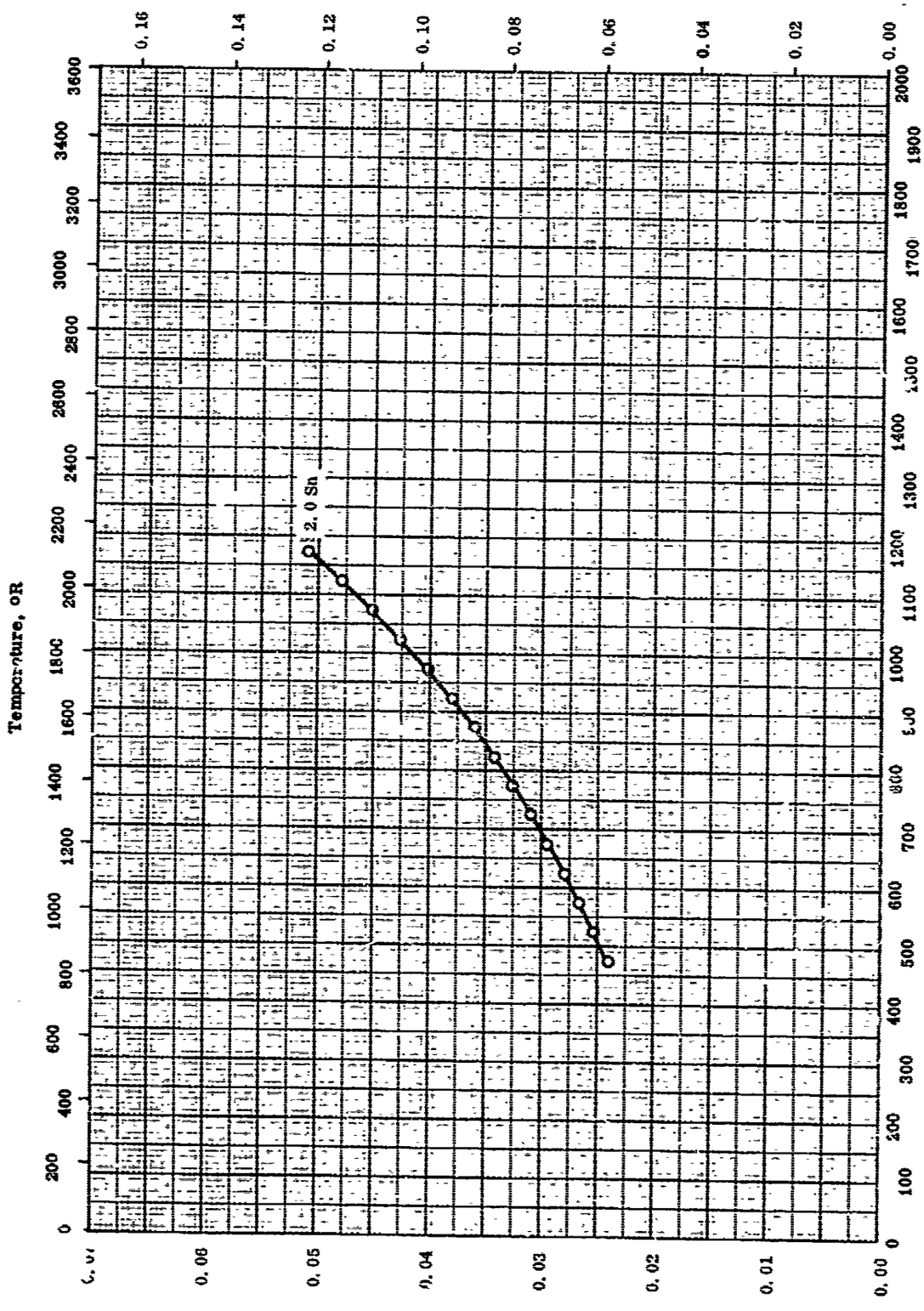
Electrical Resistivity, ohm cm x 10^6

ELECTRICAL RESISTIVITY -- TITANIUM + TIN

ELECTRICAL RESISTIVITY -- TITANIUM + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-18	273-1073	± 1	98 Ti and 2 Sn; α-phase; prepared from iodide refined Ti and 99.99 pure Sn.	Anisotropy may exist; tested in vacuum.
□	56-18	273-1073	± 1	97 Ti and 3 Sn; α-phase; raw materials same as above.	Same as above.
△	56-18	273-1073	± 1	95 Ti and 5 Sn; α-phase; raw materials same as above.	Same as above.
◇	56-18	273-1073	± 1	94 Ti and 6 Sn; α-phase; raw materials same as above.	Same as above.
▽	56-18	273-1073	± 1	92 Ti and 8 Sn; α-phase; raw materials same as above.	Same as above.
●	61-11	323-1173		2.0 Si.	

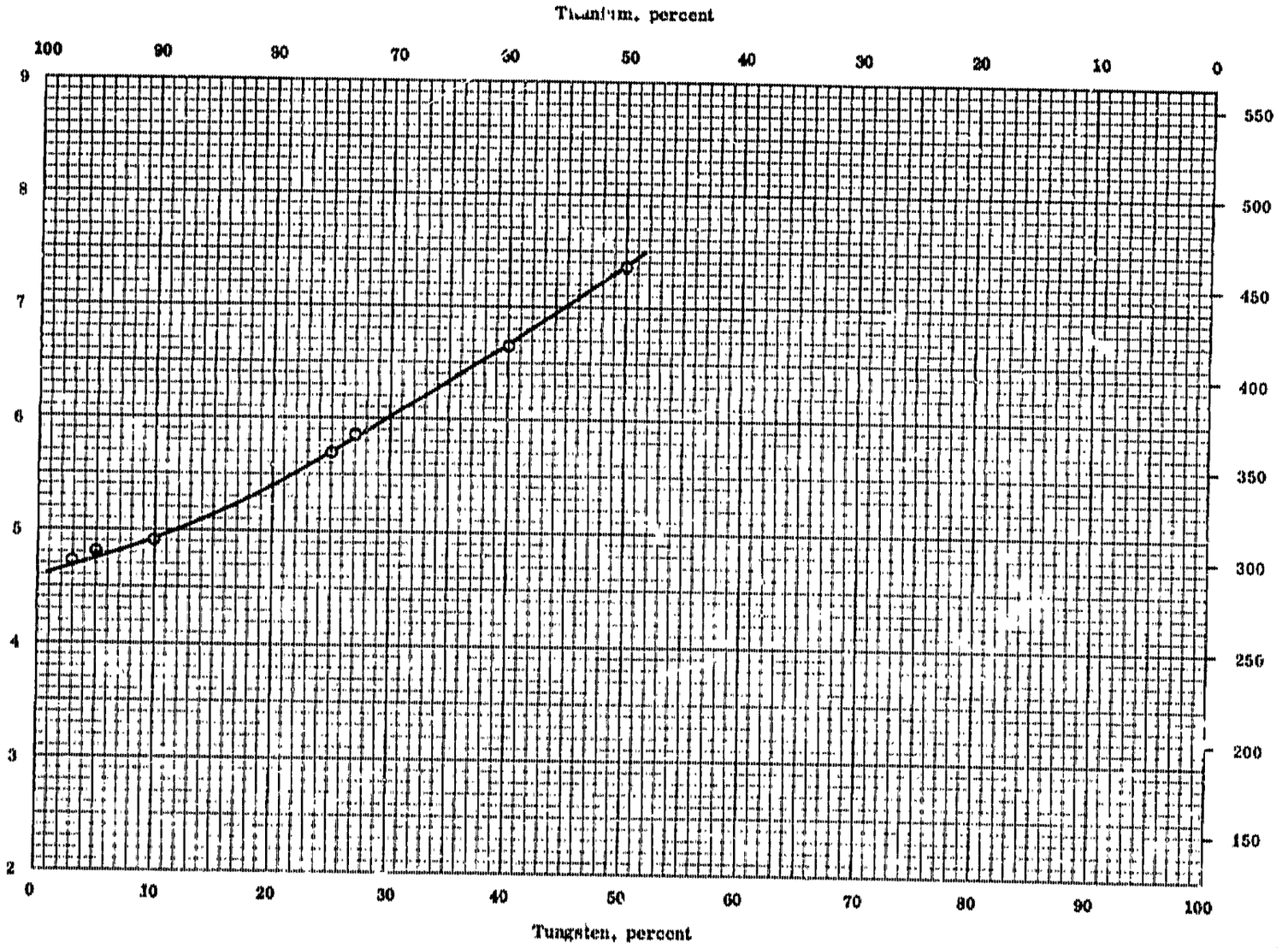


THERMAL CONDUCTIVITY -- TITANIUM + TIN

THERMAL CONDUCTIVITY -- TITANIUM + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	61-11	473-1173		2.0 Sn.	



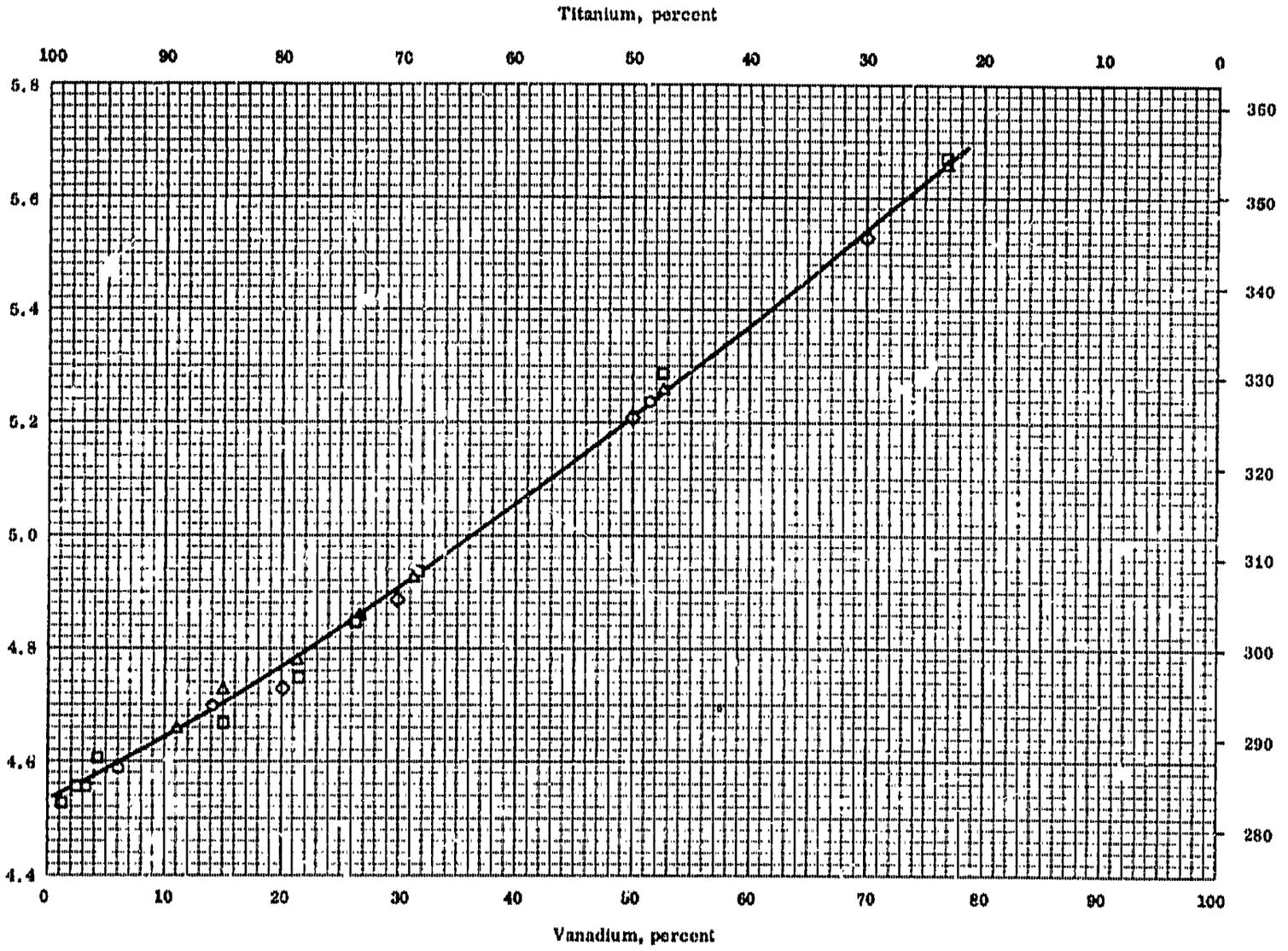
DENSITY — TITANIUM + TUNGSTEN

TPRC

DENSITY --- TITANIUM + TUNGSTEN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	54-20	298		0 - 50 W.	Density by weight in air and in water.



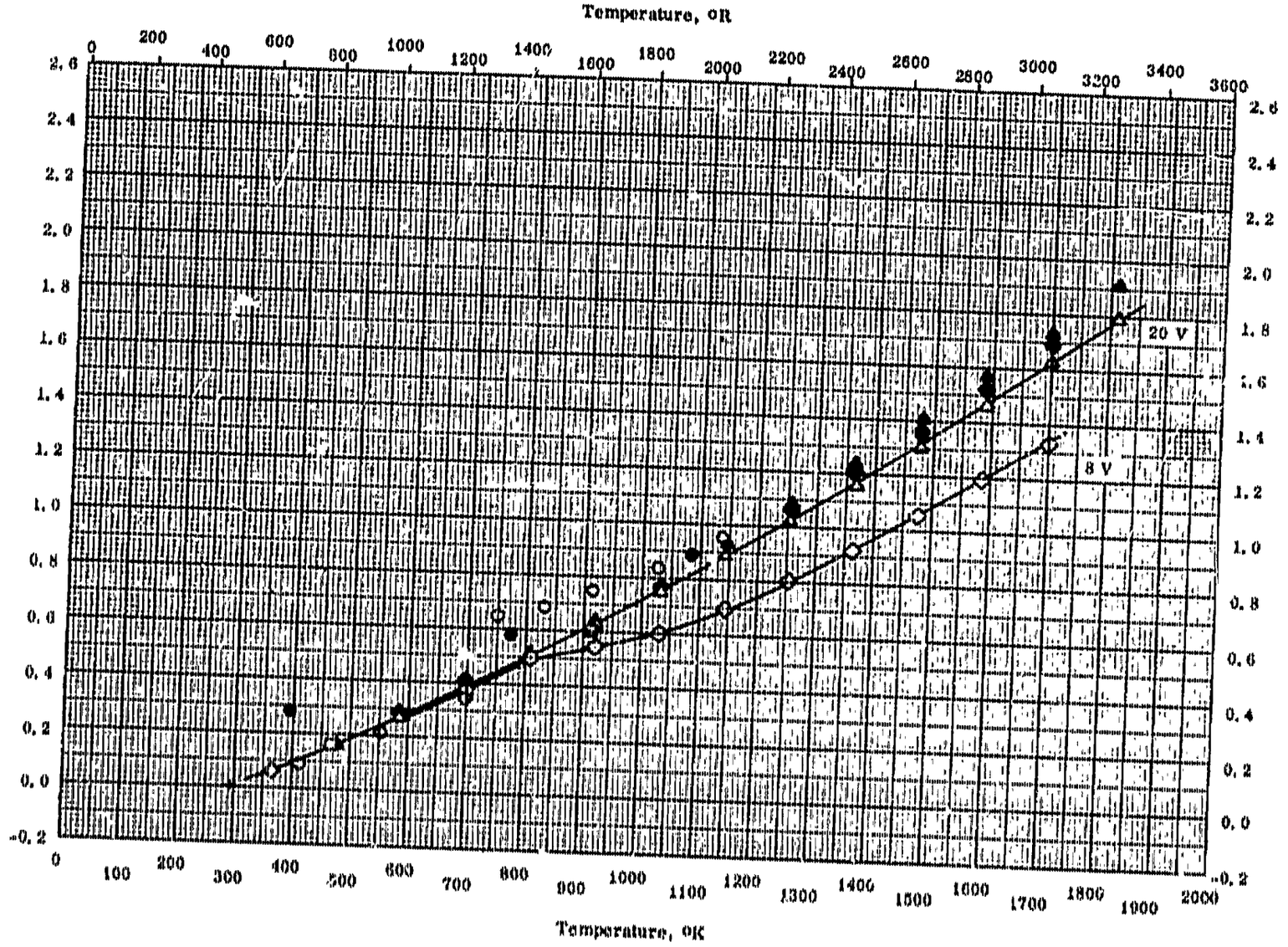
DENSITY -- TITANIUM + VANADIUM

DENSITY -- TITANIUM +VANADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-12	298		0-52 V; 0.4 impurities.	Density by weight in air and in water.
□	52-12	298		0-76 V; 1.8 impurities.	Hot-rolled; same as above.
△	52-12	298		11-76 V; 1.8 impurities	Arc-melted; same as above.
◇	52-12	298		20-70 V.	Density computed from x-ray measurements of lattice.

TPRC

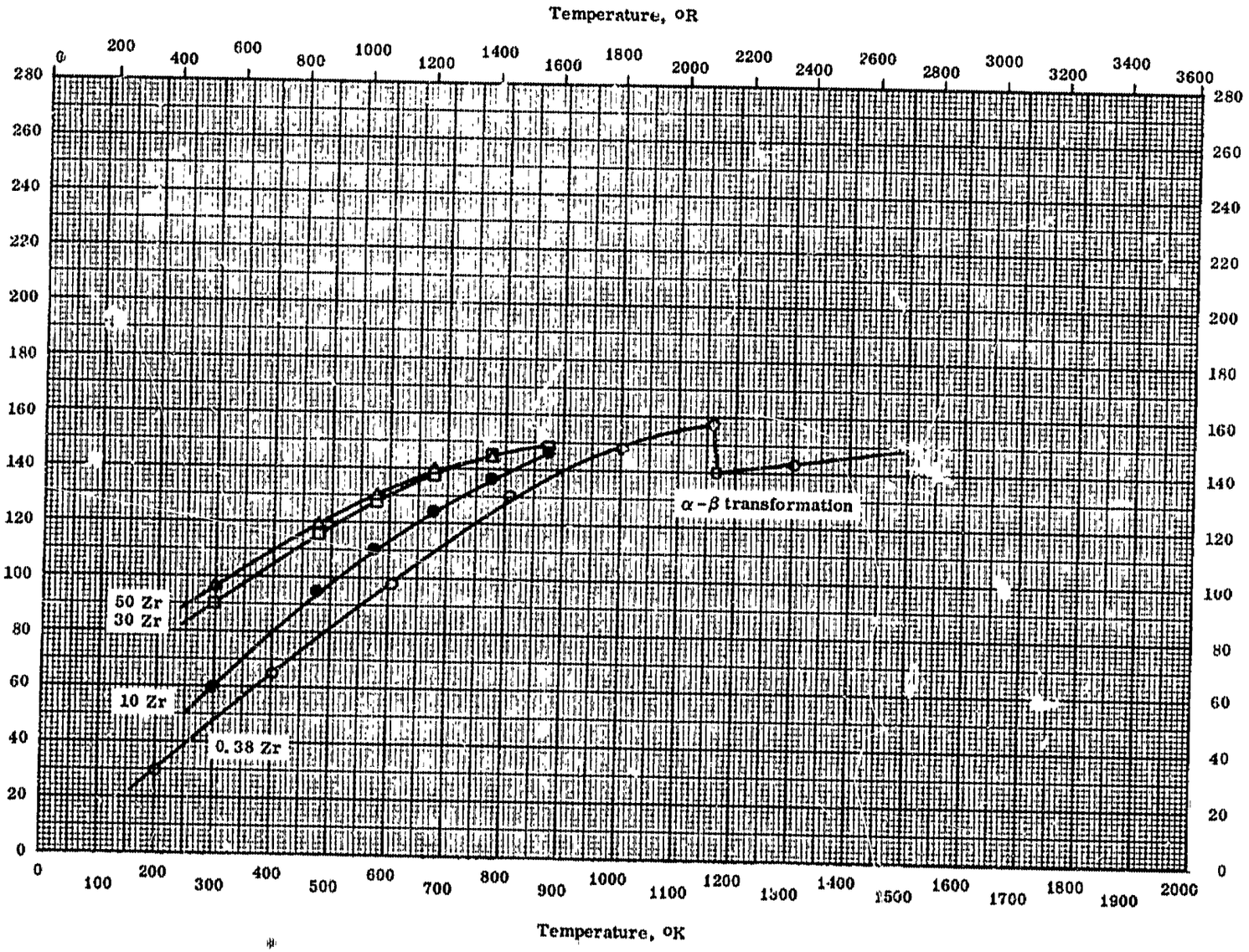


THERMAL LINEAR EXPANSION -- TITANIUM + VANADIUM

THERMAL LINEAR EXPANSION -- TITANIUM + VANADIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Expt. Error %	Sample Specifications	Remarks
○	52-24	293-1139		15 V, prepared from 99.8 pure V and 99.9 + pure Ti.	Cold rolled, 21 hrs at 1450 F, and water quenched; tested in vacuum; heating.
●	52-24	393-1139		Same as above.	Cooling data of above specimen.
□	52-24	293-1139		10 - 50 V; prepared from 99.8 pure V and 99.9+ pure Ti.	Cast, cold rolled, and vacuum annealed; average of 5 samples with 10, 20, 30, 40, and 50 V respectively; max deviation ± 1%; tested in vac.
◇	61-30	293-1700		8 V; prepared from 140 Bhn sponge.	Annealed; measured in vacuum of about 3×10^{-4} mm Hg; heating.
◆	61-30	293-1700		Same as above.	Cooling.
△	61-30	293-1811		20 V; prepared from 140 Bhn sponge.	Annealed; measured in vacuum of about 3×10^{-4} mm Hg; heating.
▲	61-30	293-1811		Same as above.	Cooling.

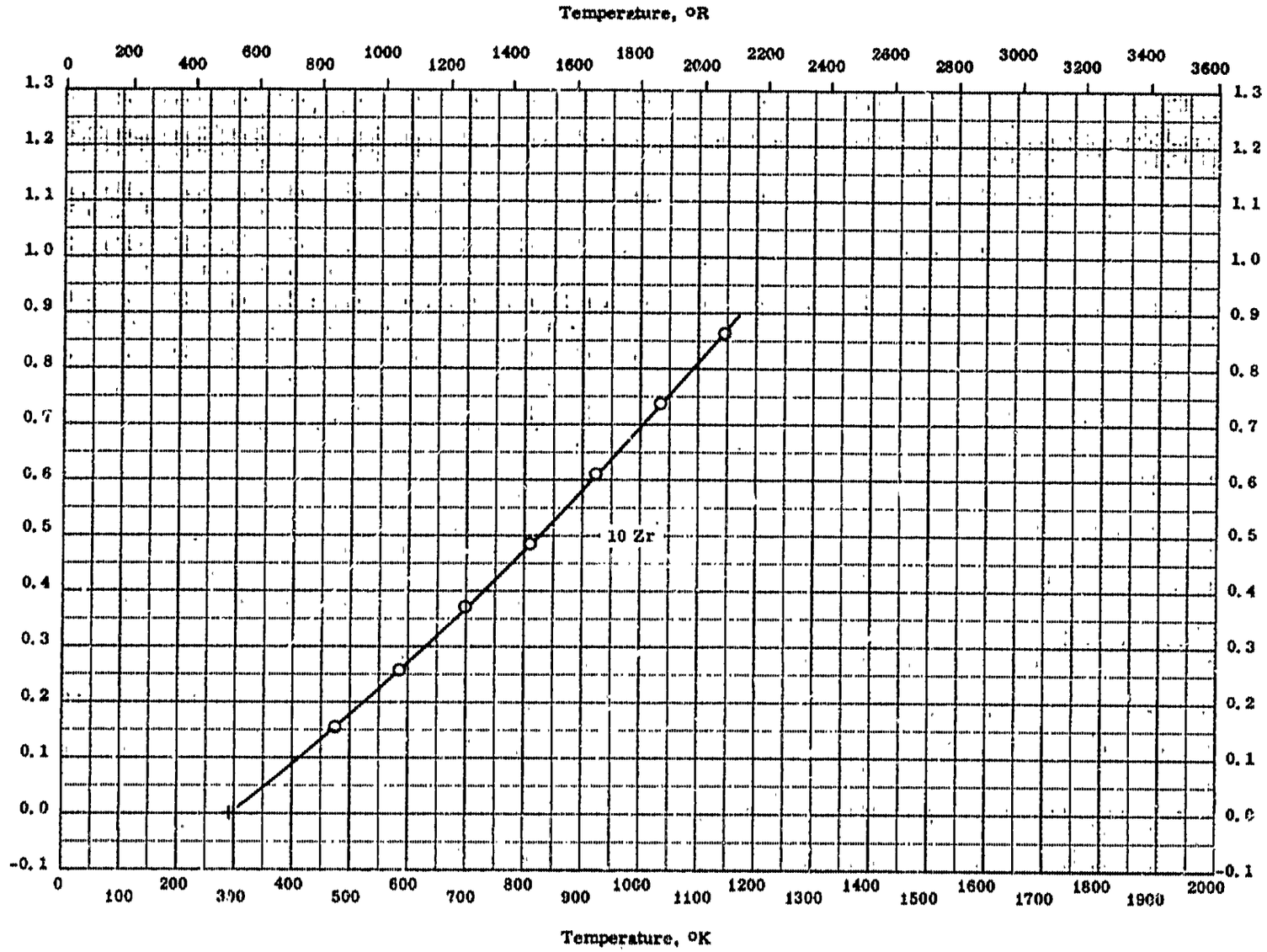


ELECTRICAL RESISTIVITY -- TITANIUM + ZIRCONIUM

ELECTRICAL RESISTIVITY -- TITANIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
●	56-18	298-873	± 1	90 Ti and 10 Zr; α-phase; prepared from iodide refined Ti and iodide refined Zr (containing ~ 2.5 Hf).	
□	56-18	298-873	± 1	70 Ti and 30 Zr; α-phase; raw materials same as above.	
△	56-18	298-873	± 1	50 Ti and 50 Zr; α-phase; raw materials same as above.	
○	54-16	200-1300		Iodide titanium; 0.38 Zr.	Homogenized for 70 hrs at 1000 C and then quenched



Thermal Linear Expansion, percent

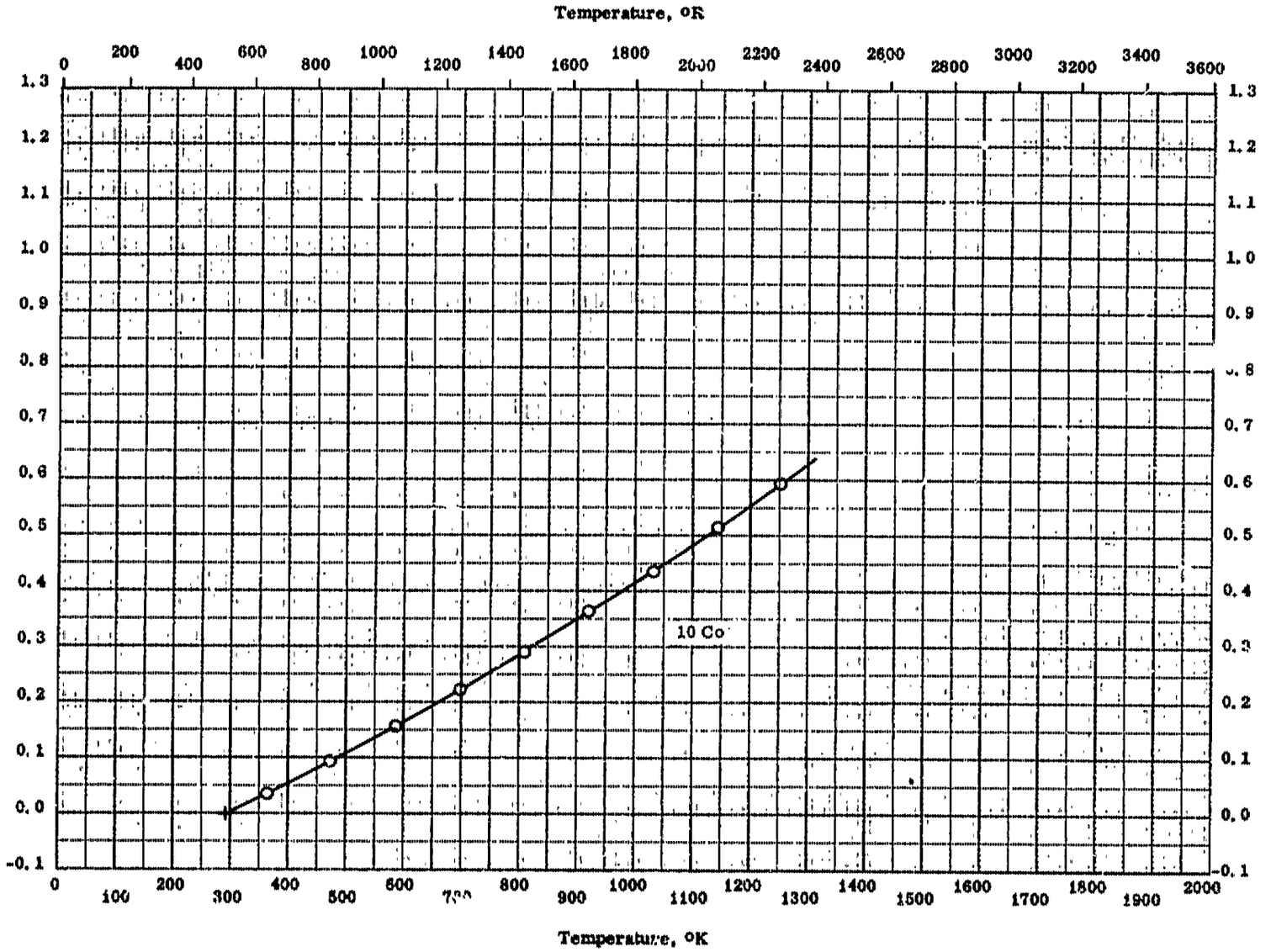
Thermal Linear Expansion, percent

THERMAL LINEAR EXPANSION -- TITANIUM + ZIRCONIUM

THERMAL LINEAR EXPANSION -- TITANIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	54-33	297-1144		10.0 Zr.	

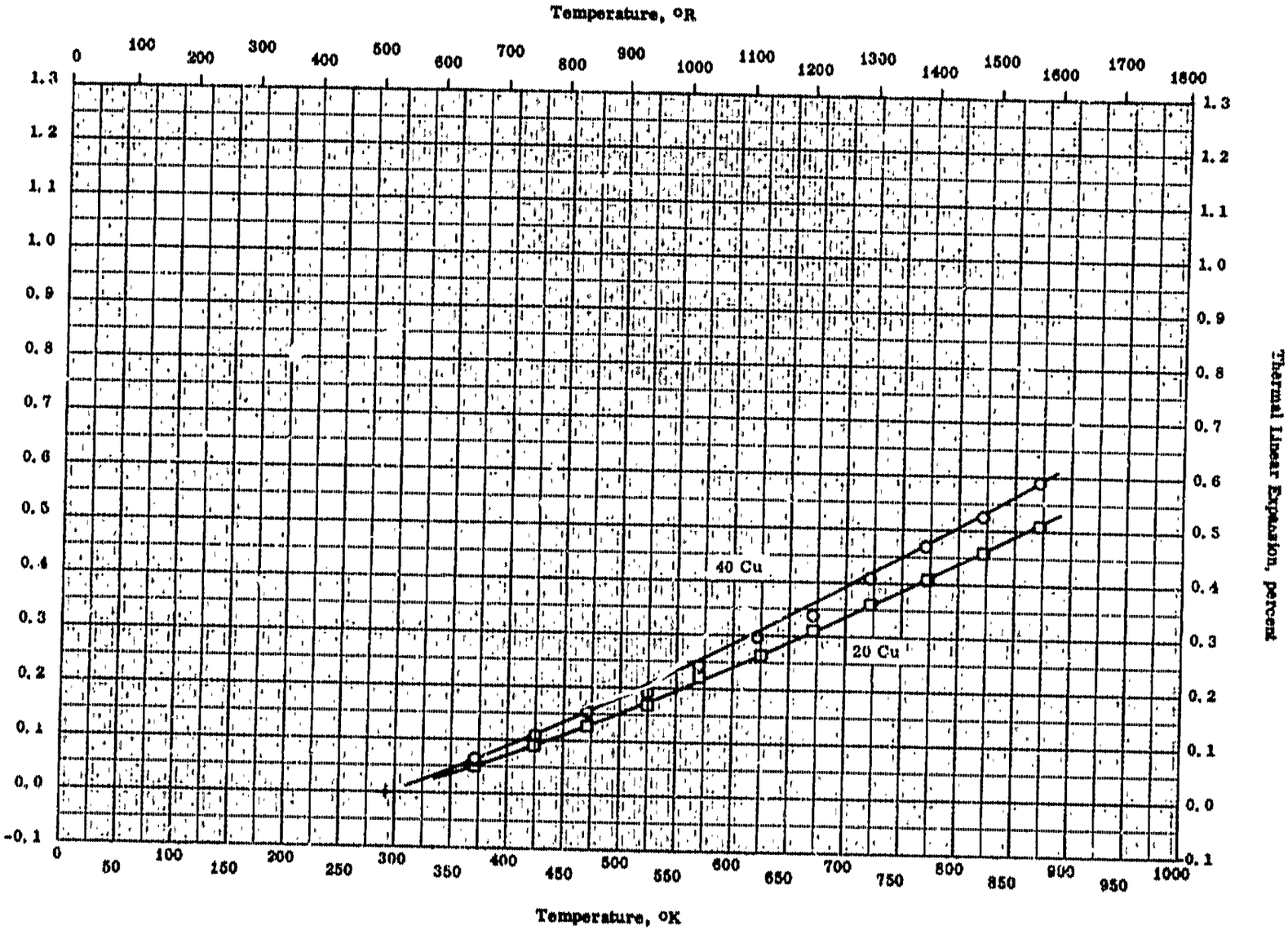


THERMAL LINEAR EXPANSION -- TUNGSTEN + COBALT

THERMAL LINEAR EXPANSION --- TUNGSTEN + COBALT

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-30	293-1255		K10; Kennametal Inc.; nominal: 90 W and 10 Co; density 14.38 g cm^{-3}; dimension 4 mm dia by 50 mm long.	Furnished machined specimen purchased from Kennametal Inc.; heated in vacuum at about 3 F min^{-1} and increased to 5 F min^{-1} at the end of heating; no significant permanent change in length observed after test.



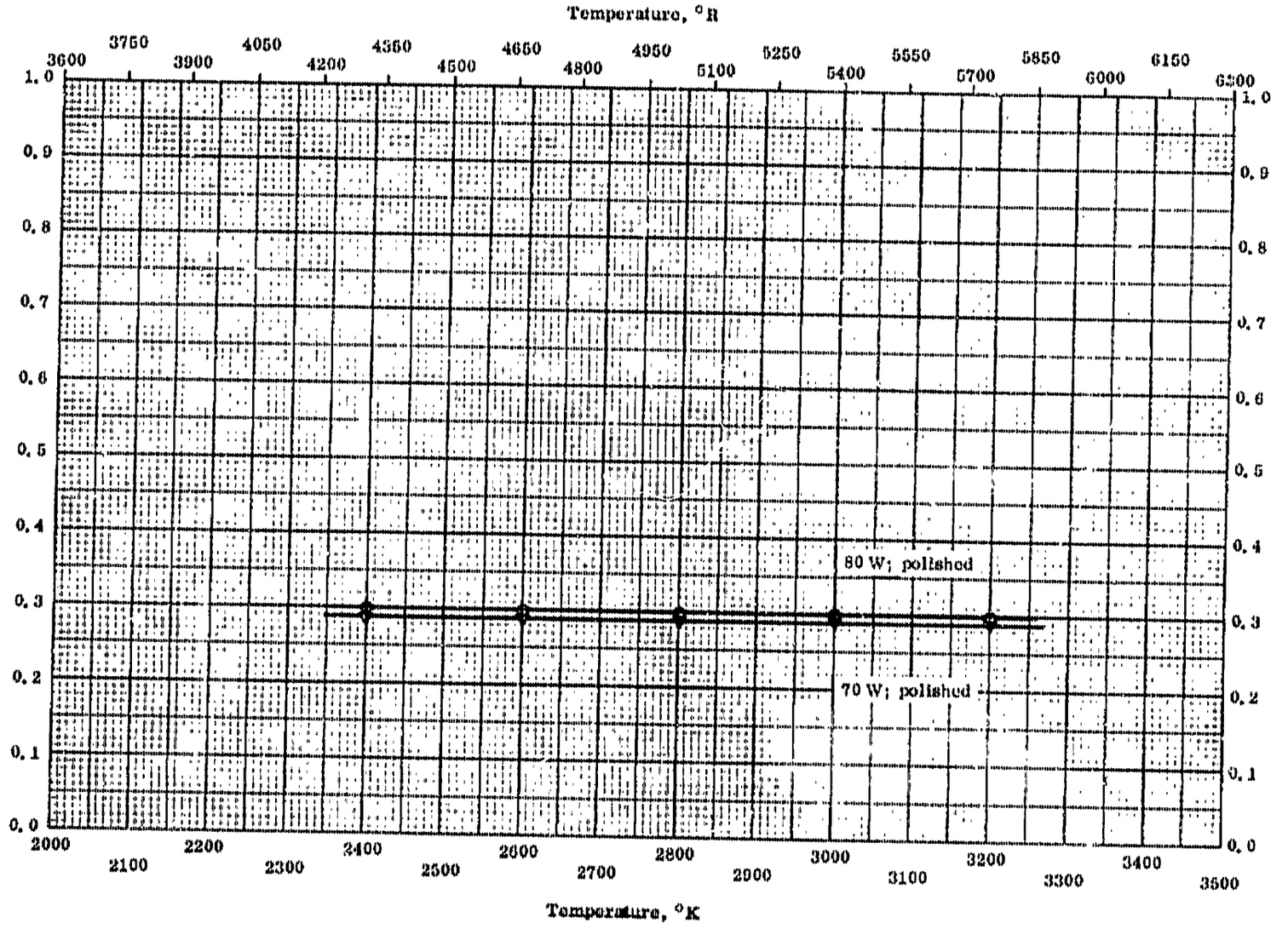
THERMAL LINEAR EXPANSION -- TUNGSTEN + COPPER
(Mixtures, not alloy)

THERMAL LINEAR EXPANSION -- TUNGSTEN +COPPER
(Mixtures, not alloy)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	42-2	293-872		60 W and 40 Cu.	
□	42-3	293-872		80 W and 20 Cu.	

TPRC

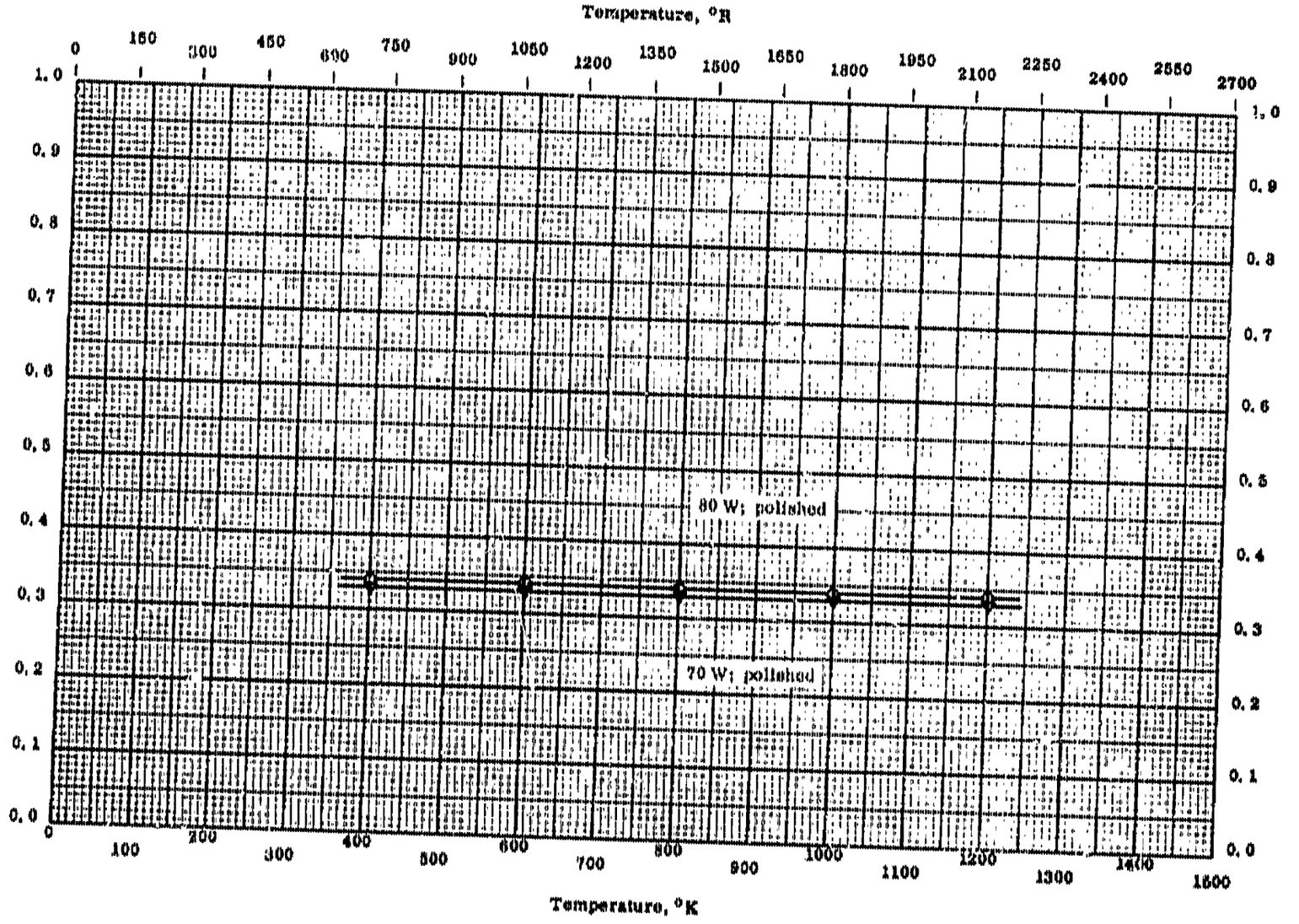


HEMISPHERICAL TOTAL EMITTANCE -- TUNGSTEN + MOLYBDENUM

HEMISPHERICAL TOTAL EMITTANCE — TUNGSTEN + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	62-20	2400-3200		80 W and 20 Mo.	Polished with abrasive papers (No. 1, 0, 00, 000, and 0000); measured in argon.
▽	62-20	2400-3200		70 W and 30 Mo.	Polished with abrasive papers (No. 1, 0, 00, 000, and 0000); measured in argon.



HEMISPHERICAL SPECTRAL EMITTANCE — TUNGSTEN + MOLYBDENUM

TPRC

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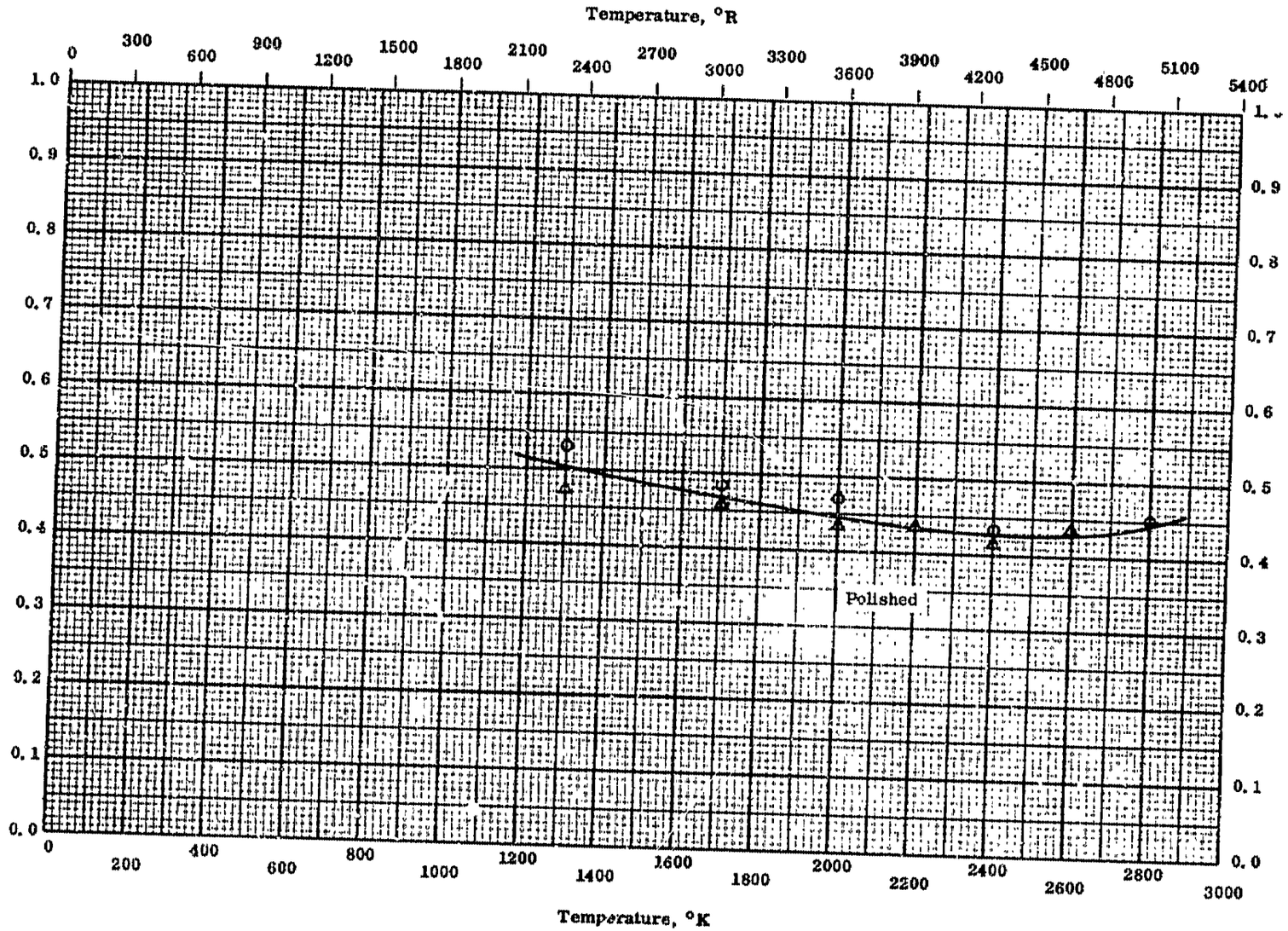
HEMISPHERICAL SPECTRAL EMITTANCE -- TUNGSTEN + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range, °K	Repr. Error%	Sample Specifications	Remarks
○	32-20	0.65	2400-3200		80 W and 20 Mo.	Polished with abrasive papers (No. 1, 00, 000 and 0000); measured in argon.
▽	62-20	0.65	2400-3200		70 W and 30 Mo.	Polished with abrasive papers (No. 1, 00, 000 and 0000); measured in argon.

TPRC



NORMAL SPECTRAL EMITTANCE — TUNGSTEN + MOLYBDENUM

NORMAL SPECTRAL EMITTANCE -- TUNGSTEN + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range K	Rept. Error %	Sample Specifications	Remarks
○	33-1	0.660	1300-2800	± 2	87.5 W and 12.5 Mo; tubular filament; manufactured by Cleveland Wire Works of the G. E. Co.	Formed from powdered metals; sintered; electrolytically polished in KOH solution, further polished by using 00, 000, and 0000 polishing papers (Manning Speed Grits).
△	33-1	0.660	1300-2600	± 2	62.5 W and 37.5 Mo; tubular filament; manufactured by Cleveland Wire Works of the G. E. Co.	Same as above.

PROPERTIES OF TUNGSTEN + NIOBIUM

REPORTED VALUES

Melting Point:		K	R
○	80 W and 20 Nb	3488	6278
□	70 W and 30 Nb	3293	5928
△	60 W and 40 Nb	3223	5802
▽	50 W and 50 Nb	3148	5667

PROPERTIES OF TUNGSTEN + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	58-21	3488		80 W and 20 Nb; prepared from 99.95 W and 99.2 Nb powders.	Pressed at 121,000 psi, sintered 24 hrs at 600-650 C and 100 hrs at 1150 C, formed into rods, sintered 100 hrs at 1200 C and 45 hrs at 1500 C.
□	58-21	3293		70 W and 30 Nb; same as above.	Same as above.
△	58-21	3223		60 W and 40 Nb; same as above.	Same as above.
▽	58-21	3148		50 W and 50 Nb; same as above.	Same as above.

ELECTRICAL RESISTIVITY -- TUNGSTEN + RHENIUM

ELECTRICAL RESISTIVITY -- TUNGSTEN + RHENIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	63-15	273-3473		3 Re.	Wire.
□	63-15	298-2273		5 Re.	Wire.
△	63-15	298-2273		26 Re.	Wire or tubing.
▽	64-5	433		25 Re.	Irradiated to 1.3×10^{19} nvt; annealed in argon at indicated temperatures for 1 hr; data measured at 196 C.

TPRC

PROPERTIES OF URANIUM + CHROMIUM

REPORTED VALUES

Density:		g cm^{-3}	lb ft^{-3}
○	0.594 Cr	18.697	1167.2
□	0.30 Cr	18.697	1167.2
●	5.27 Cr	17.44	1089
■	5.42 Cr	17.41	1087
△	5.60 Cr	17.25	1077
◇	5.60 Cr	17.57*	1097*
▽	5.32 Cr	17.26	1078
▲	5.0 Cr	17.56	1096
▼	5.0 Cr	17.3	1080

Melting Point:		K	R
◆	5.6 Cr	1132 ± 10*	2038 ± 20*

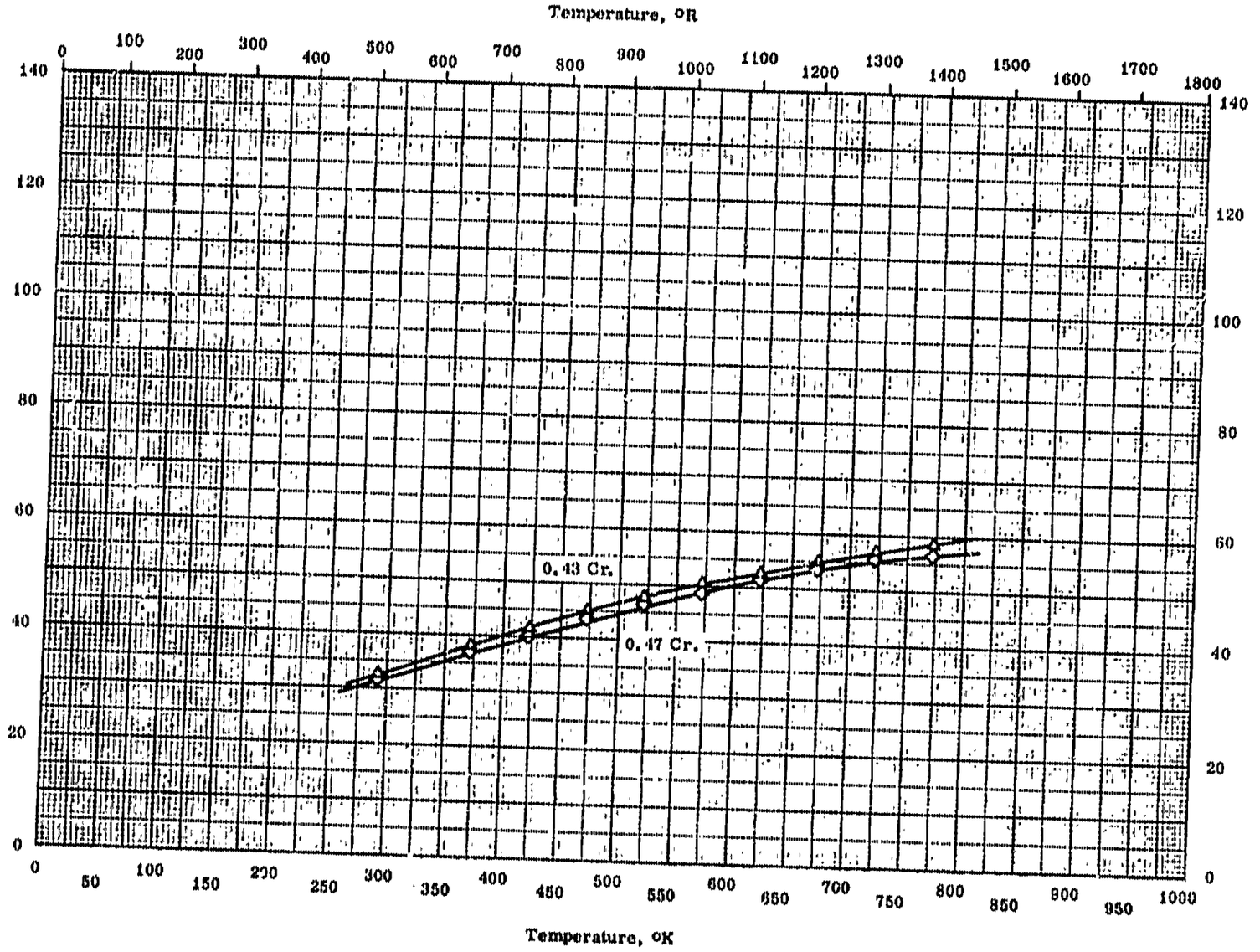
*Most probable value for alloys of this composition.

PROPERTIES OF URANIUM + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	51-14	298		0.594 Cr; single crystal with β- phase.	
□	50-9	298		0.30 Cr; single crystal.	Quenched from β- region.
●	53-11	298		5.27 Cr.	
■	53-11	298		5.42 Cr.	
△	53-11	298		5.60 Cr.	
◆	53-11	1122-1142		5.60 Cr.	
◇	53-11	298		5.60 Cr.	
▽	53-11	298		5.92 Cr.	
▲	53-11	298		5 Cr.	
▼	53-23	298		5.1 Cr and 0.025 C.	Vacuum cast at 5-35 μ Hg.

TPRC

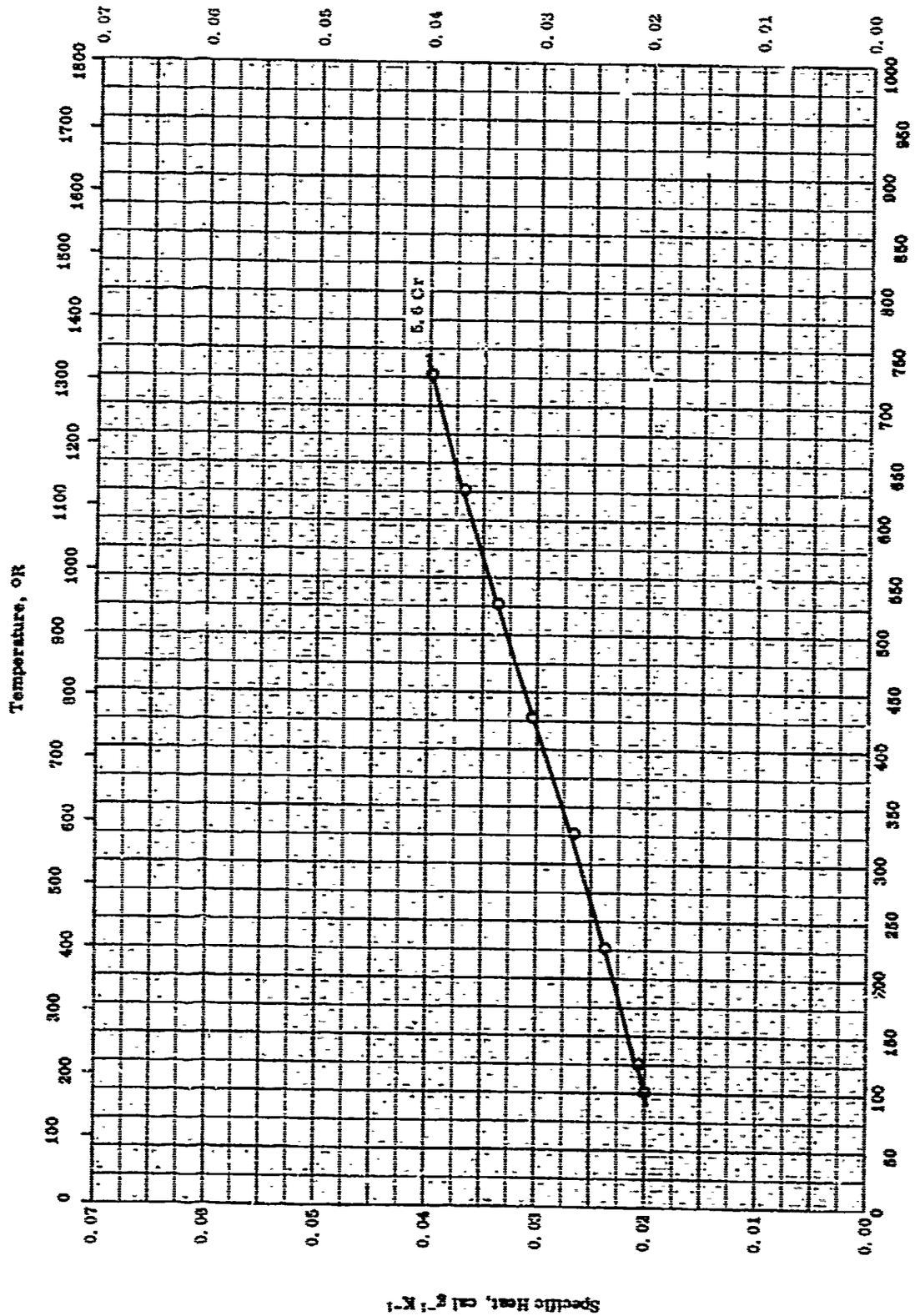


ELECTRICAL RESISTIVITY — URANIUM +CHROMIUM

ELECTRICAL RESISTIVITY -- URANIUM +CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
△	55-21	293-773		0.43 Cr and 0.01 > C.	Heated 15 min . at 715 ± 10 C; quenched to 575 ± 10 C; held 25 min, then water quenched, reheated 15 min. at 715 ± 10 C, quenched to 500 ±10 C, held 90 min; and water quenched.
◇	55-21	293-773		0.47 Cr and 0.08 C.	Same as above.



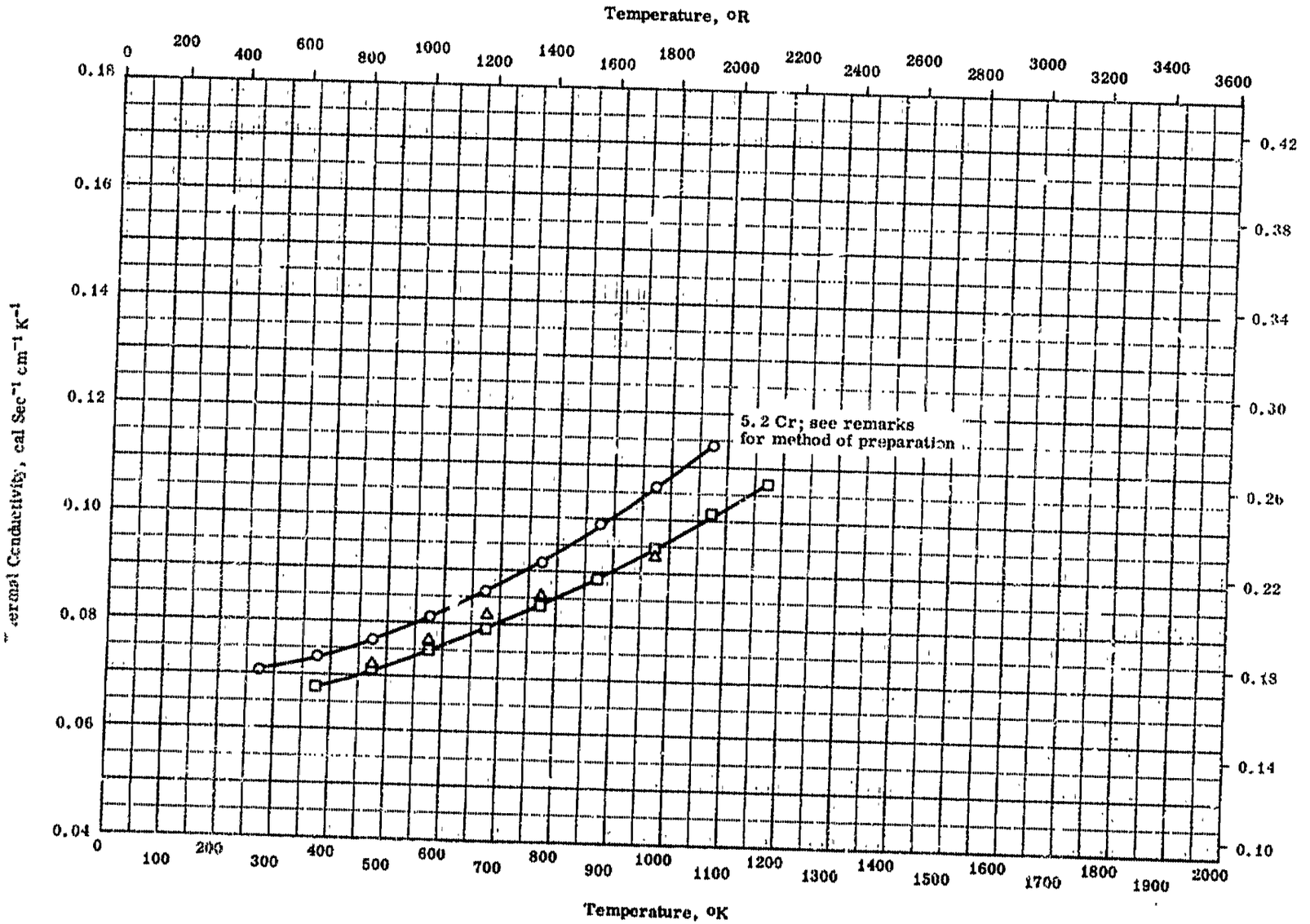
SPECIFIC HEAT -- URANIUM + CHROMIUM

SPECIFIC HEAT -- URANIUM + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	53-11	273-898		U-Cr eutectic alloy; 5.6 Cr.	Mean specific heat from 0 C to given temperature.

TPRC

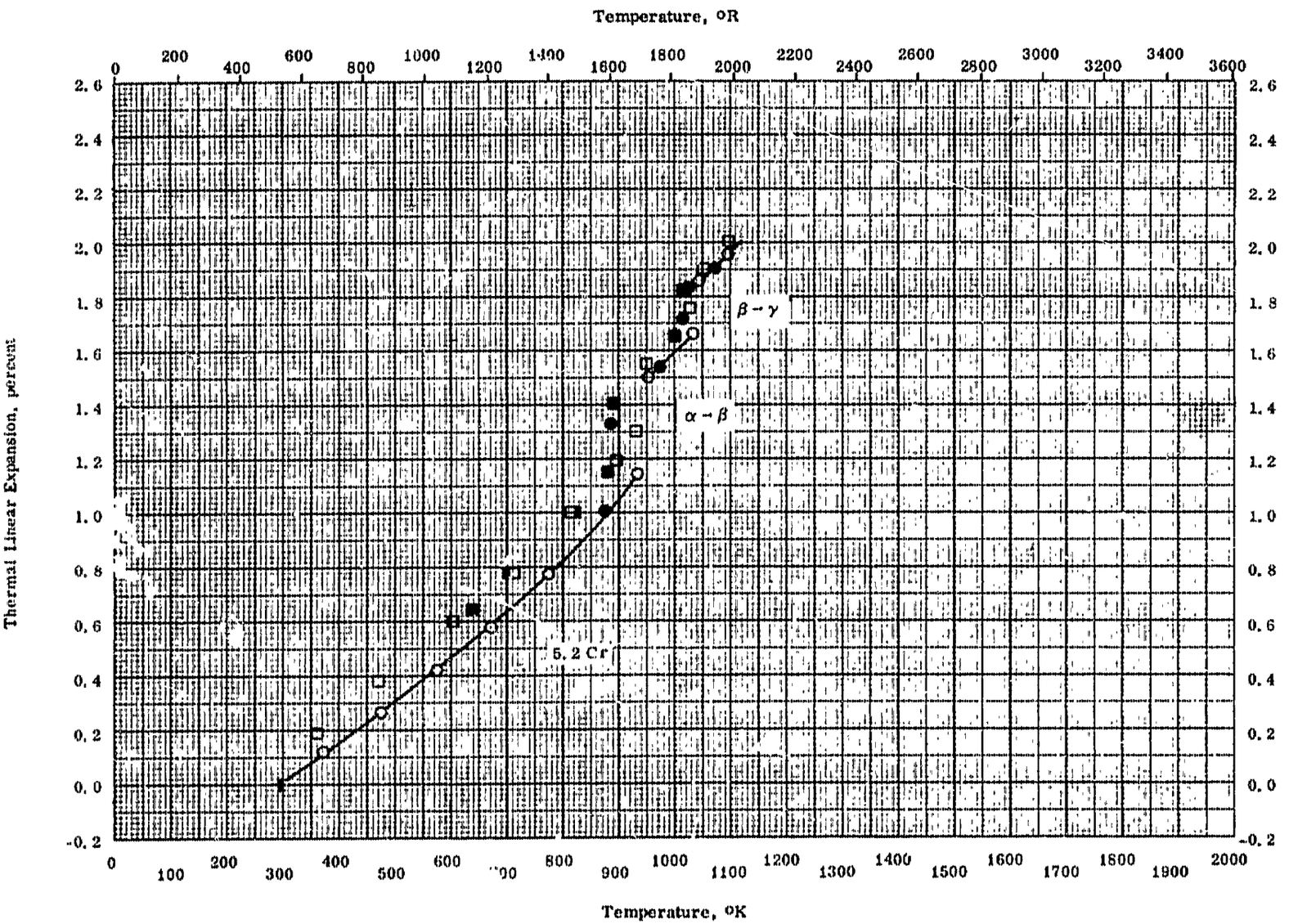


THERMAL CONDUCTIVITY -- URANIUM + CHROMIUM

THERMAL CONDUCTIVITY -- URANIUM + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	54-4	273-1073		5.2 Cr; Nominal composition.	Biscuit uranium cast in cold graphite; avg. of 2 samples within3%.
□	54-4	373-1173		Same as above.	Biscuit uranium cast in warm graphite; avg. of 2 samples within 4%.
△	54-4	373-1173		Same as above.	Biscuit uranium cast in copper.



THERMAL LINEAR EXPANSION -- URANIUM + CHROMIUM

THERMAL LINEAR EXPANSION -- URANIUM + CHROMIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. range °K	Rept. Error %	Sample Specifications	Remarks
○	54-4	293-1093		Eutectic Alloy; nominally 5.2 Cr.	12 samples; induction melted and formed in various ways; effect of method of forming is insignificant; heating.
●	54-4	293-1093		Same as above.	Cooling; below 1572 R, results same as heating curve.
□	53-23	348-1025		5.1 Cr and 0.0250 C.	Vacuum cast 5 - 35 μHg; heating; measured in argon.
■	53-23	348-1025		Same as above.	Cooling.

TPRC

PROPERTIES OF URANIUM + IRON

REPORTED VALUES

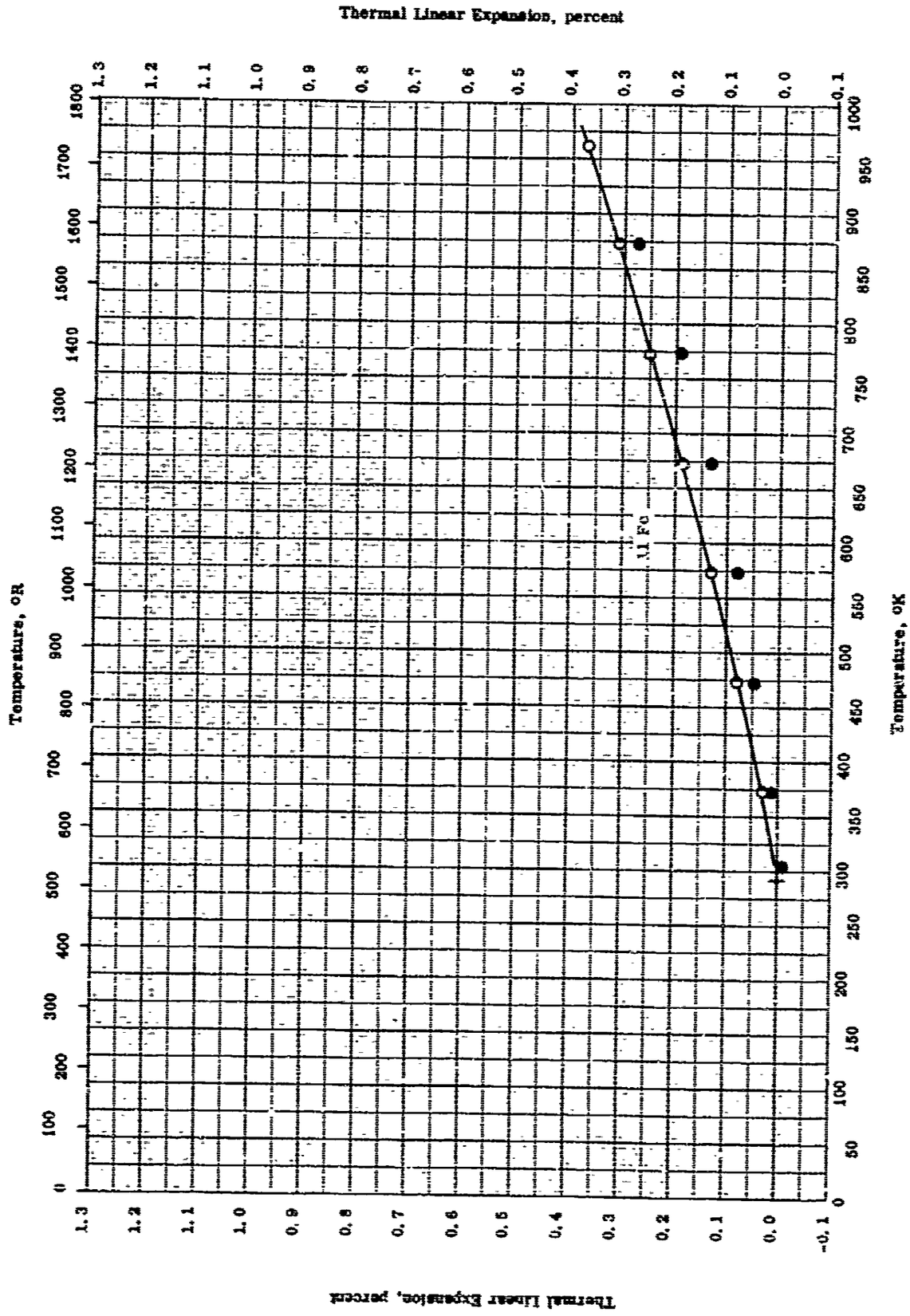
Density	g cm^{-3}	lb ft^{-3}
O 10.7 Fe	15.8	986

PROPERTIES OF URANIUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	53-23	298		19.7 Fe and 0.0335 C.	Cast at 5-35 μ Hg vacuum; density from weight and volume by water displacements.

TPRC



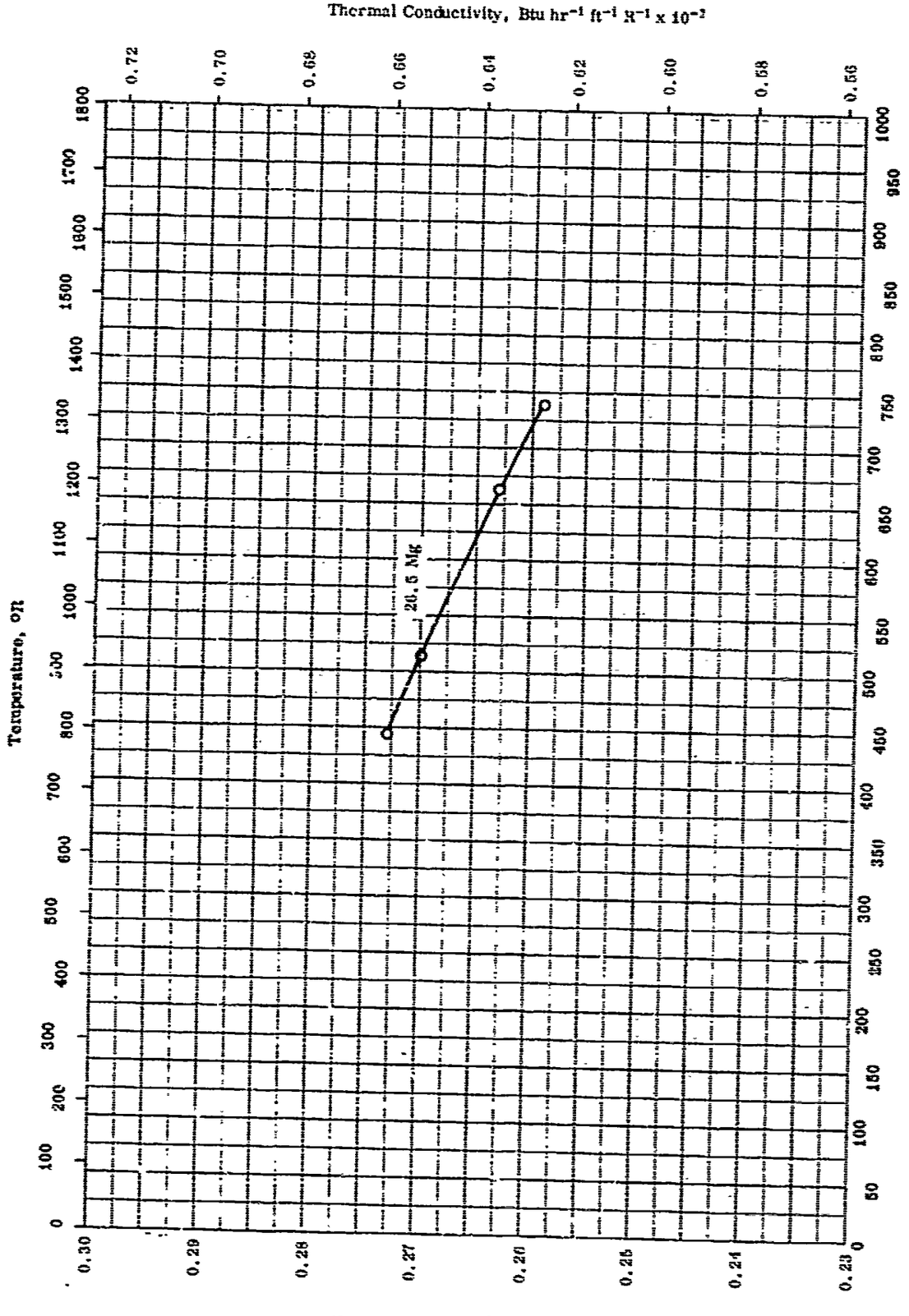
THERMAL LINEAR EXPANSION -- URANIUM + IRON

THERMAL LINEAR EXPANSION — URANIUM + IRON

REFERENCE INFORMATION

Symbol	Ref.	T. mp. Range °K	Repl. Error %	Sample Specifications	Remarks
○	53-23	300-963		10.7 Fe and 0.0335 C.	Cast at ' - 35 μ Hg vacuum: heating.
●	53-23	300-963		Same as above.	Cooling.

TPRC



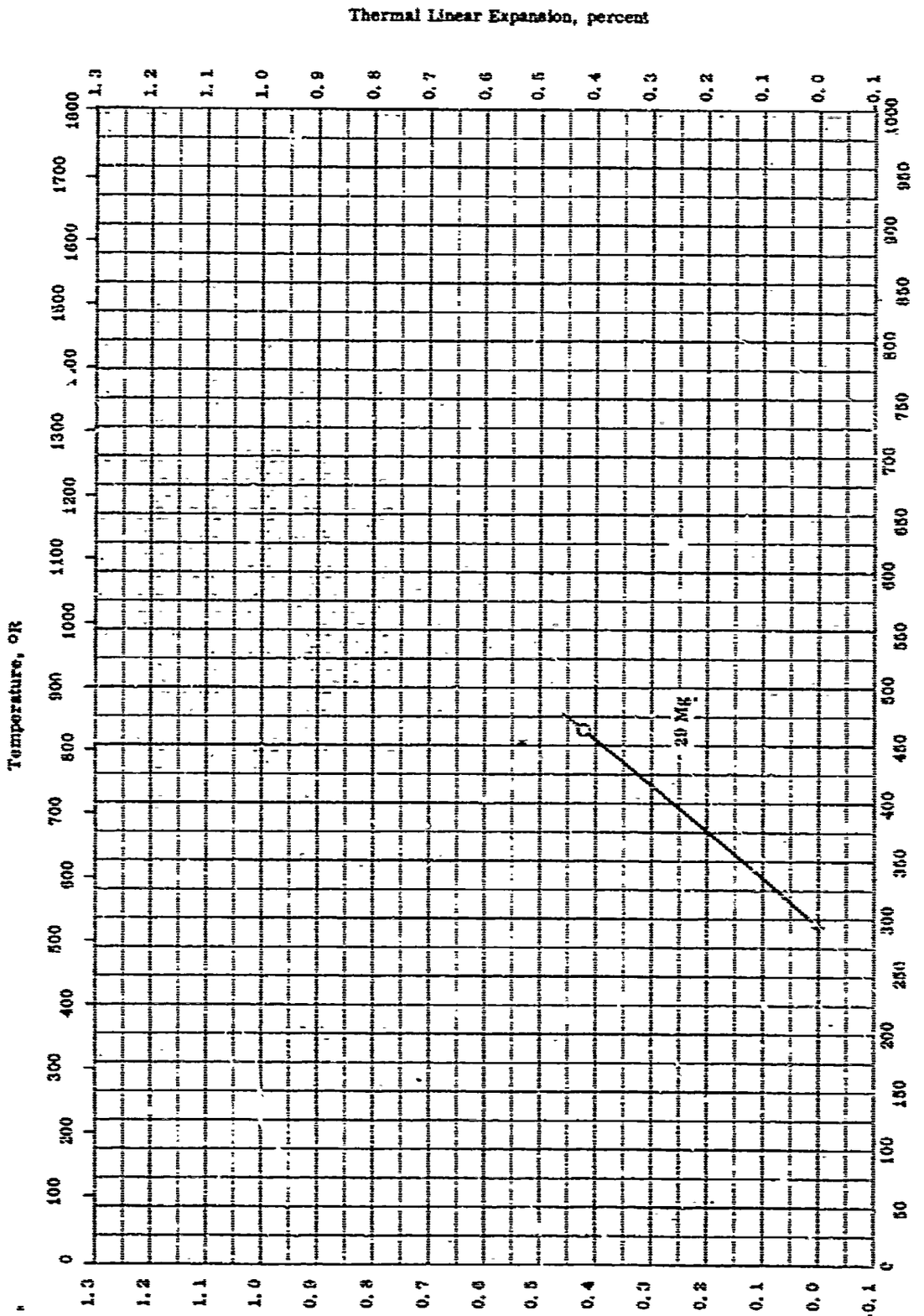
THERMAL CONDUCTIVITY — URANIUM + MAGNESIUM

THERMAL CONDUCTIVITY -- URANIUM + MAGNESIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	67-8	446-738		73.5 U and 26.5 Mg.	Extruded.

TPRC



THERMAL LINEAR EXPANSION -- URANIUM + MAGNESIUM

THERMAL LINEAR EXPANSION -- URANIUM + MAGNESIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repl. Error %	Sample Specifications	Remarks
O	52-26	293-463		71 U and 29 Mg.	Powders mixed, cold compacted, and hot extruded; measured parallel to direction of extrusion in argon.

PROPERTIES OF URANIUM + MOLYBDENUM

REPORTED VALUES

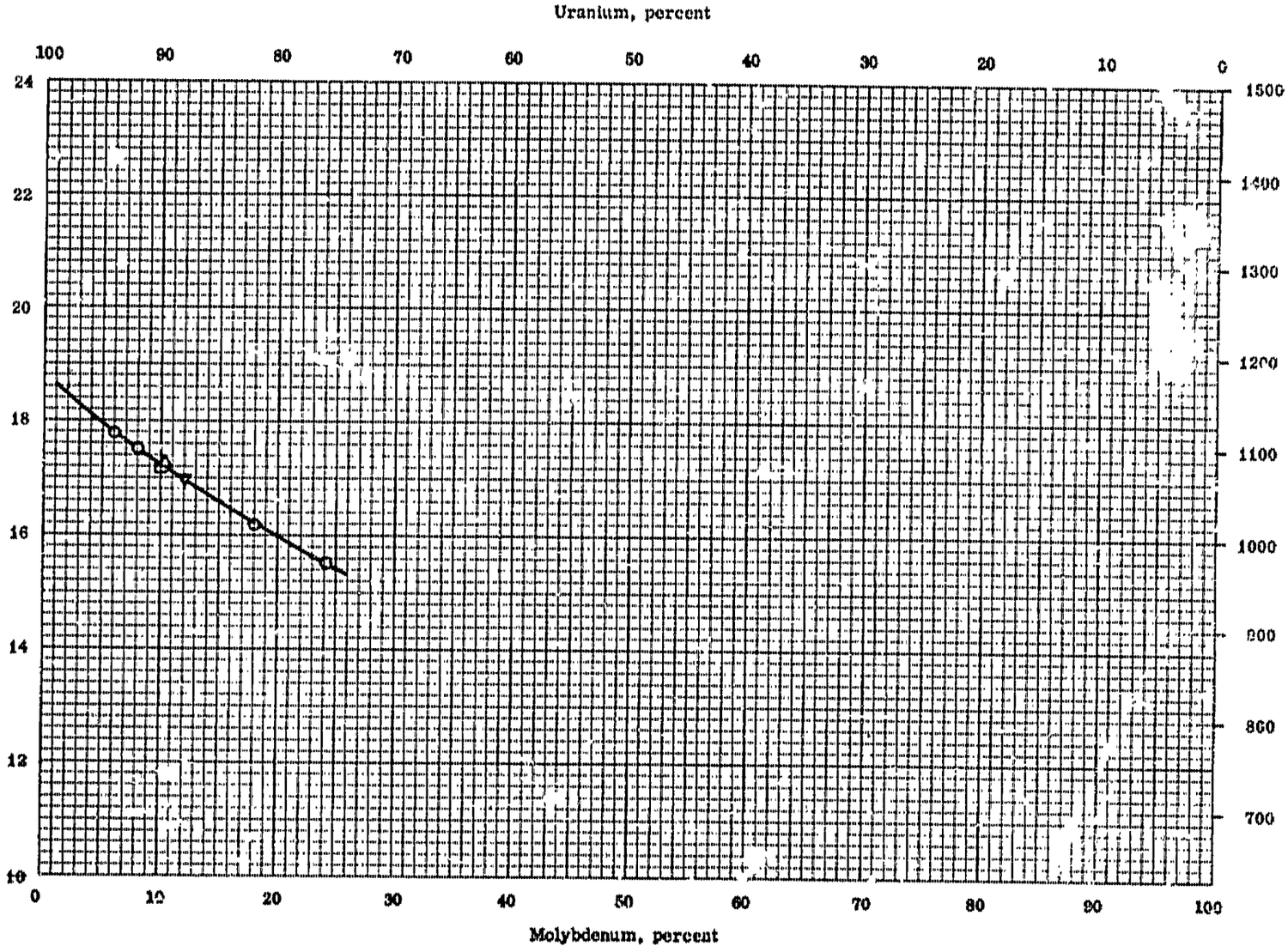
Density:		See figure	
Melting Point:		K	R
O	12 Mo	1423	2561

PROPERTIES OF URANIUM + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
C	55-8	1423	±4	12 Mo.	Quenched from 900 C.

TPRC



DENSITY -- URANIUM + MOLYBDENUM

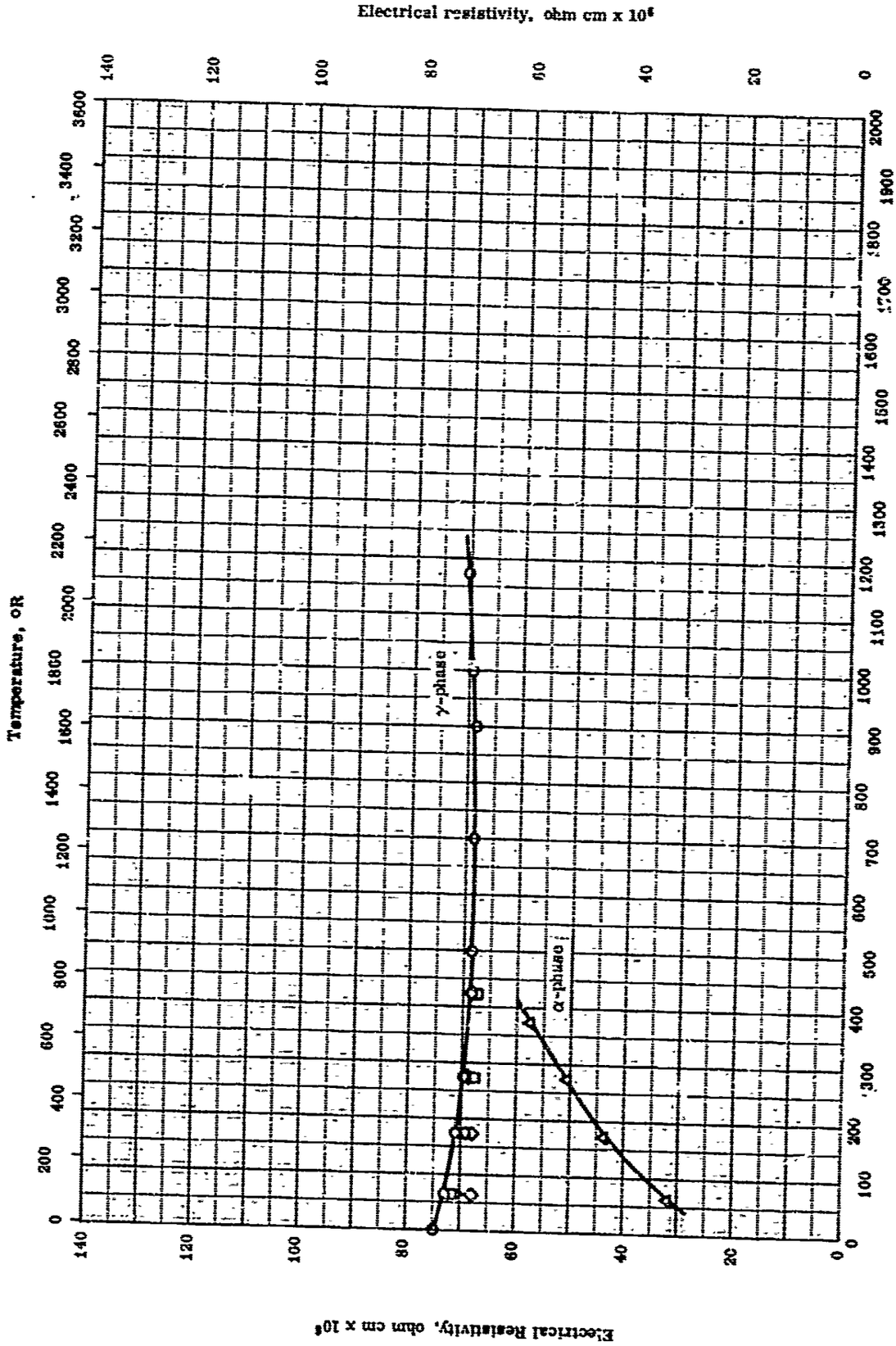
TPRC

DENSITY -- URANIUM + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-8	298	±4	0-24 Mo.	Quenched from 900 C; density by weight in air and in CCl_4.
□	57-45	298		90 U and 10 Mo; metastable γ - phase.	
△	57-45	298		90 U and 10 Mo; fully transformed stable phase (γ → α)	
▽	55-8	298	±4	12 Mo.	Quenched from 900 C; density by weight in air and and in CCl_4.

TPRC



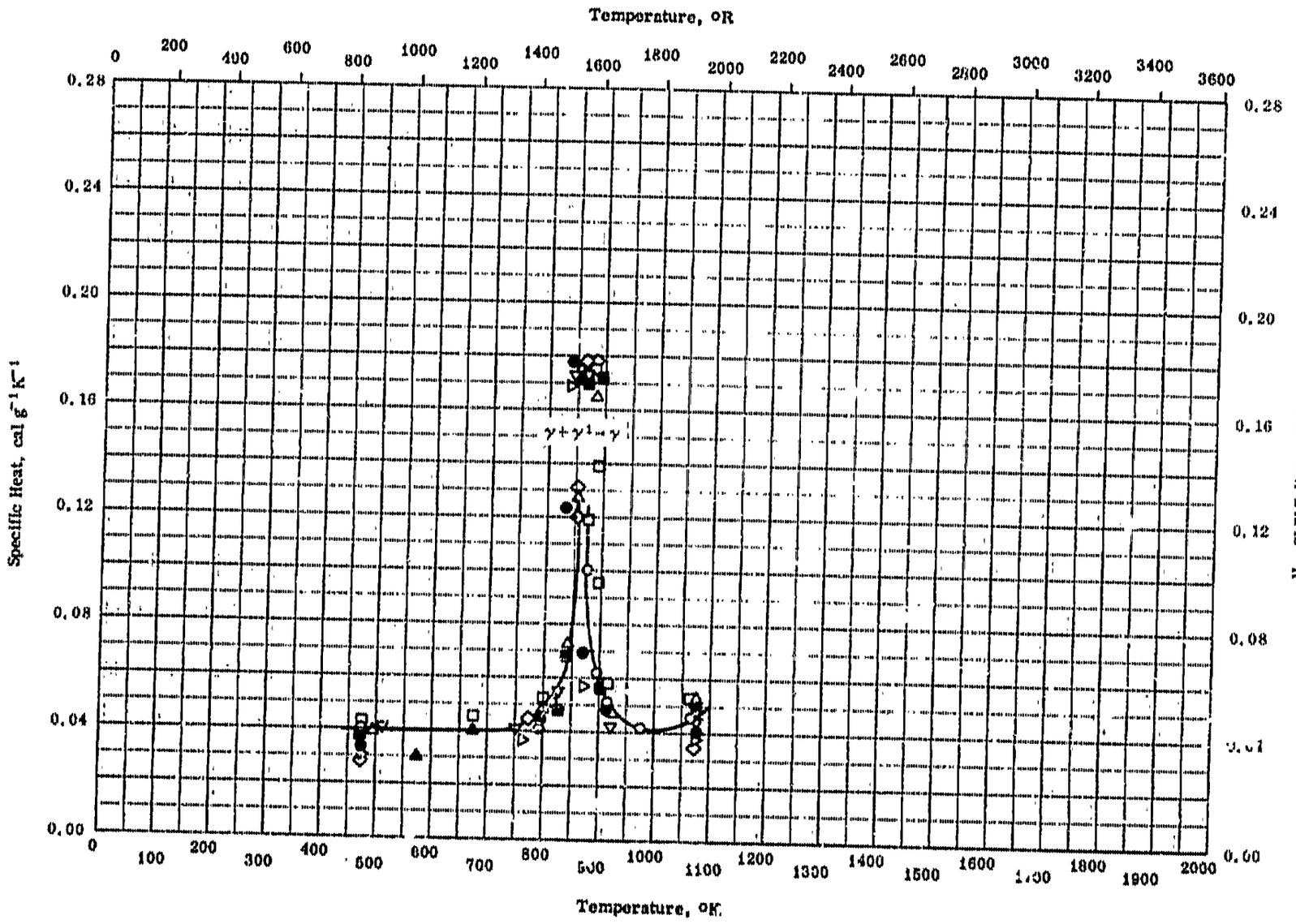
ELECTRICAL RESISTIVITY — URANIUM + MOLYBDENUM

TPRC

ELECTRICAL RESISTIVITY -- URANIUM + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-35 also 57-16	0-1172		9 Mo.	γ-quenched; relative data above 760 R, used $\rho_{540R} = 60.5 \times 10^{-6}$ ohm cm.
□	56-35 also 57-16	73-373		Same as above.	γ-quenched; 0.07% burnup.
△	56-35 also 57-16	73-373		Same as above.	γ-quenched, then α-transformed by 13 days at 525 C.
◇	56-35 also 57-16	73-373		Same as above.	γ-quenched, then α-transformed by 13 days at 525 C; 0.088% burnup.
▽	56-35 also 57-16	73-373		Same as above.	γ-quenched, then α-transformed by 13 days at 525 C; 0.092% burnup.



SPECIFIC HEAT -- URANIUM + MOLYBDENUM

TPRC

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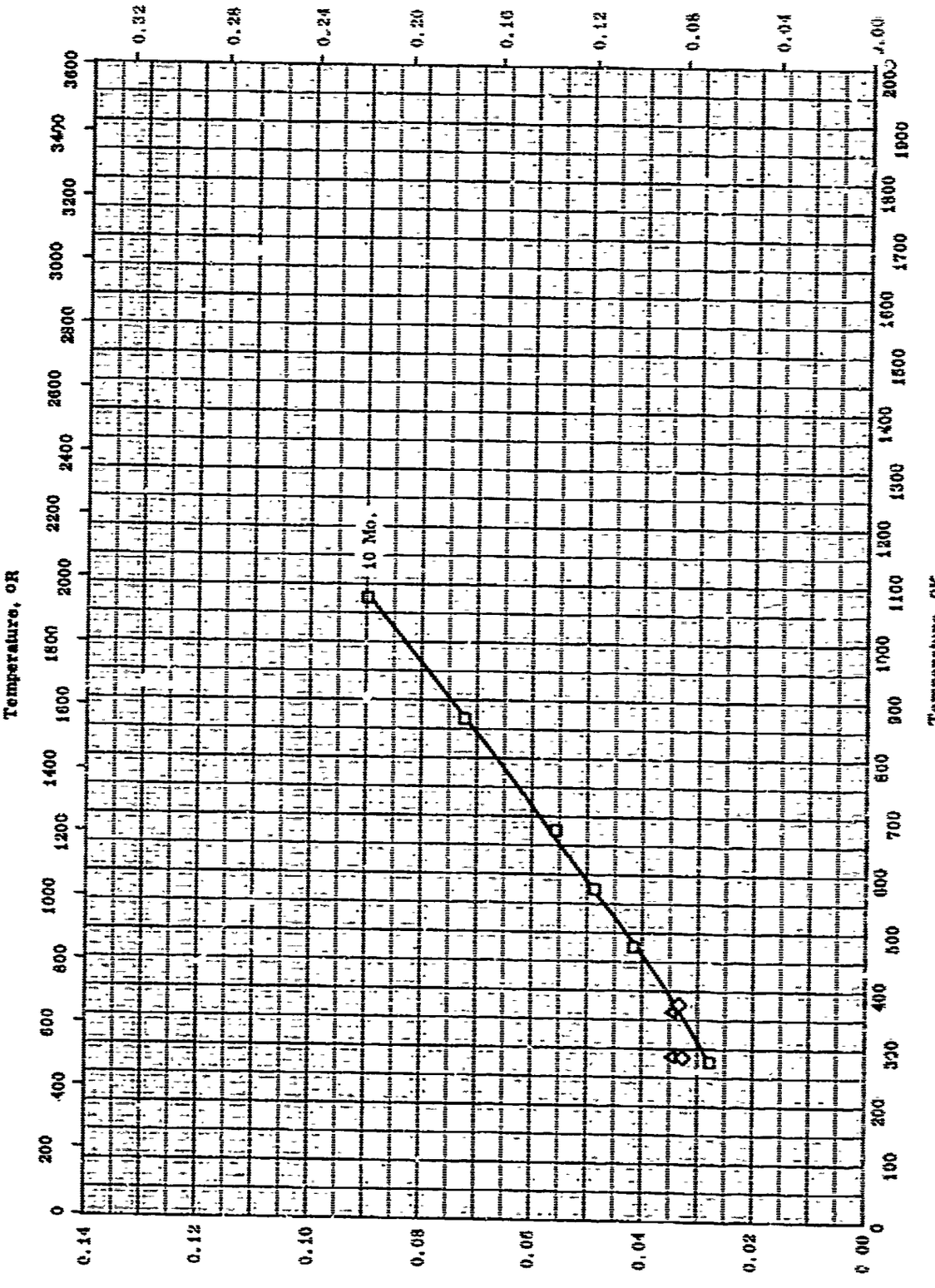
SPECIFIC HEAT -- URANIUM + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-16	473-1063		15.2 Mo.	Annealed 7 days at 590 C, held 44 days at 500 C.
□	56-15	473-1073		21.5 Mo.	Heated 24 hrs at 900 C to γ phase, water quenched, ordered 96 days at 500 C.
△	56-15	473-1073		7 Mo.	Heated 24 hrs at 900 C to γ phase, water quenched, ordered 7 days at 475 C.
◇	56-15	473-1073		8 Mo.	Heated 24 hrs at 900 C to γ phase, water quenched, ordered 159 days at 400 C.
▽	56-15	473-1073		10.5 Mo, 0.028 C.	Same as above.
●	56-15	473-1073		11.3 Mo, 0.046 C, 0.0035 N_2.	Same as above.
▷	56-15	473-1073		12 Mo, 0.008 C, 0.0071 N_2.	Heated 24 hrs, at 900 C to γ phase, water quenched, ordered 243 days at 400 C.
■	56-15	473-1073		15.2 Mo, 0.028 C, 0.007 N_2.	Heated 24 hrs at 900 C to γ phase, water quenched, ordered 95 days at 570 C.
▲	55-8	573-673		12 Mo, α uranium + ∈ phase.	

TPRC



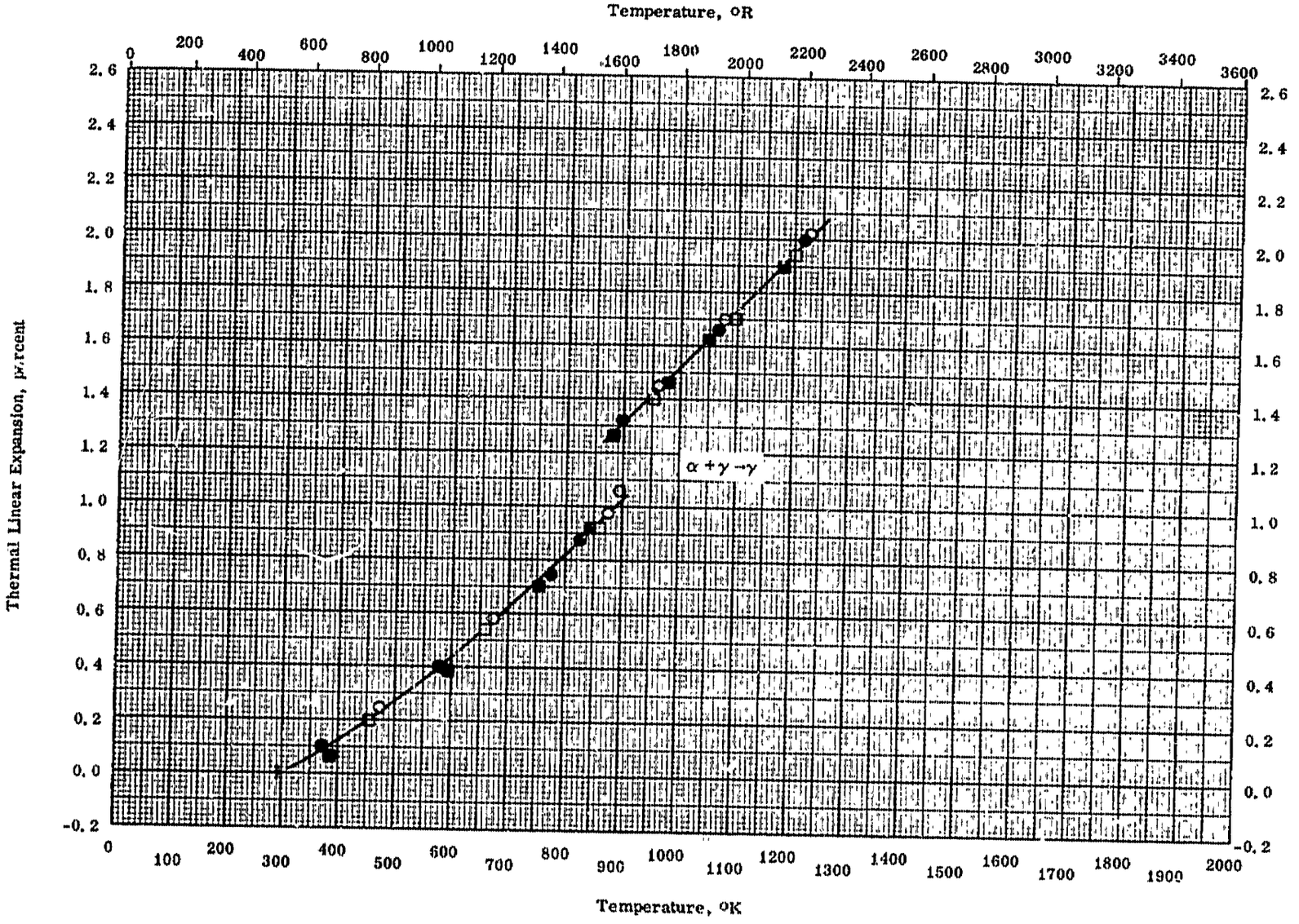
THERMAL CONDUCTIVITY — URANIUM + MOLYBDENUM

THERMAL CONDUCTIVITY -- URANIUM + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
□	58-13	273-1073		90 U and 10 Mo.	
△	55-8	283-373		92 U and 8 Mo.	α U + ϵ
◇	55-8	283-373		88 U and 12 Mo.	α U + ϵ

TPRC



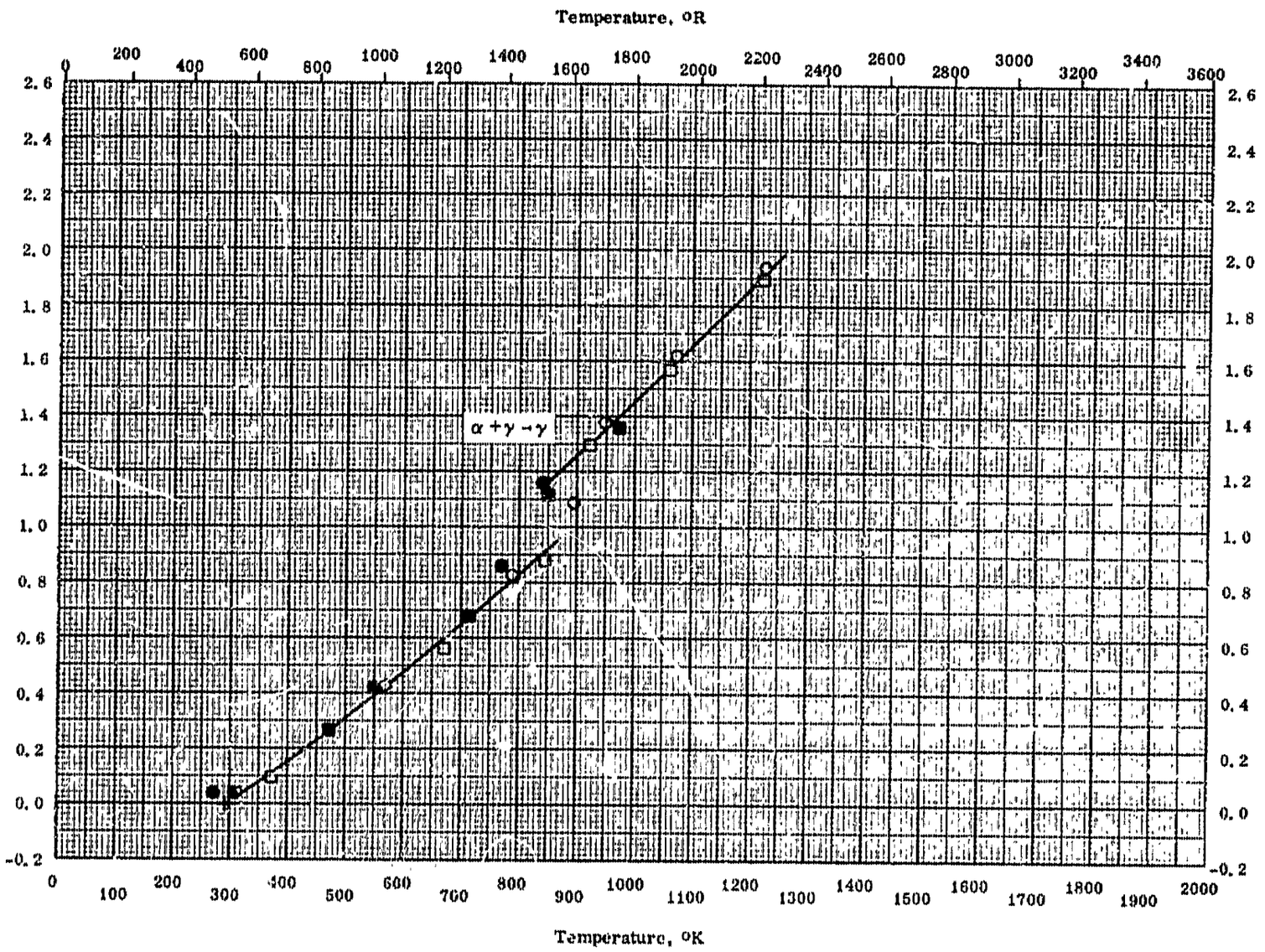
THERMAL LINEAR EXPANSION — URANIUM + MOLYBDENUM
(3.34 Mo)

THERMAL LINEAR EXPANSION -- URANIUM + MOLYBDENUM
(3.34 Mo)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-45	295-1222		3.34 Mo.	Heated 1 hr at 800 C and air cooled; specimen protected in glass envelope; heating.
●	56-45	373-1222		Same as above.	Cooling.
□	56-45	295-1222		Same as above.	Heated 1 hr at 800 C and water quenched; heating
■	56-45	389-1222		Same as above.	Cooling.

TPRC



THERMAL LIN AR EXPANSION -- URANIUM + MOLYBDENUM
(5 Mo)

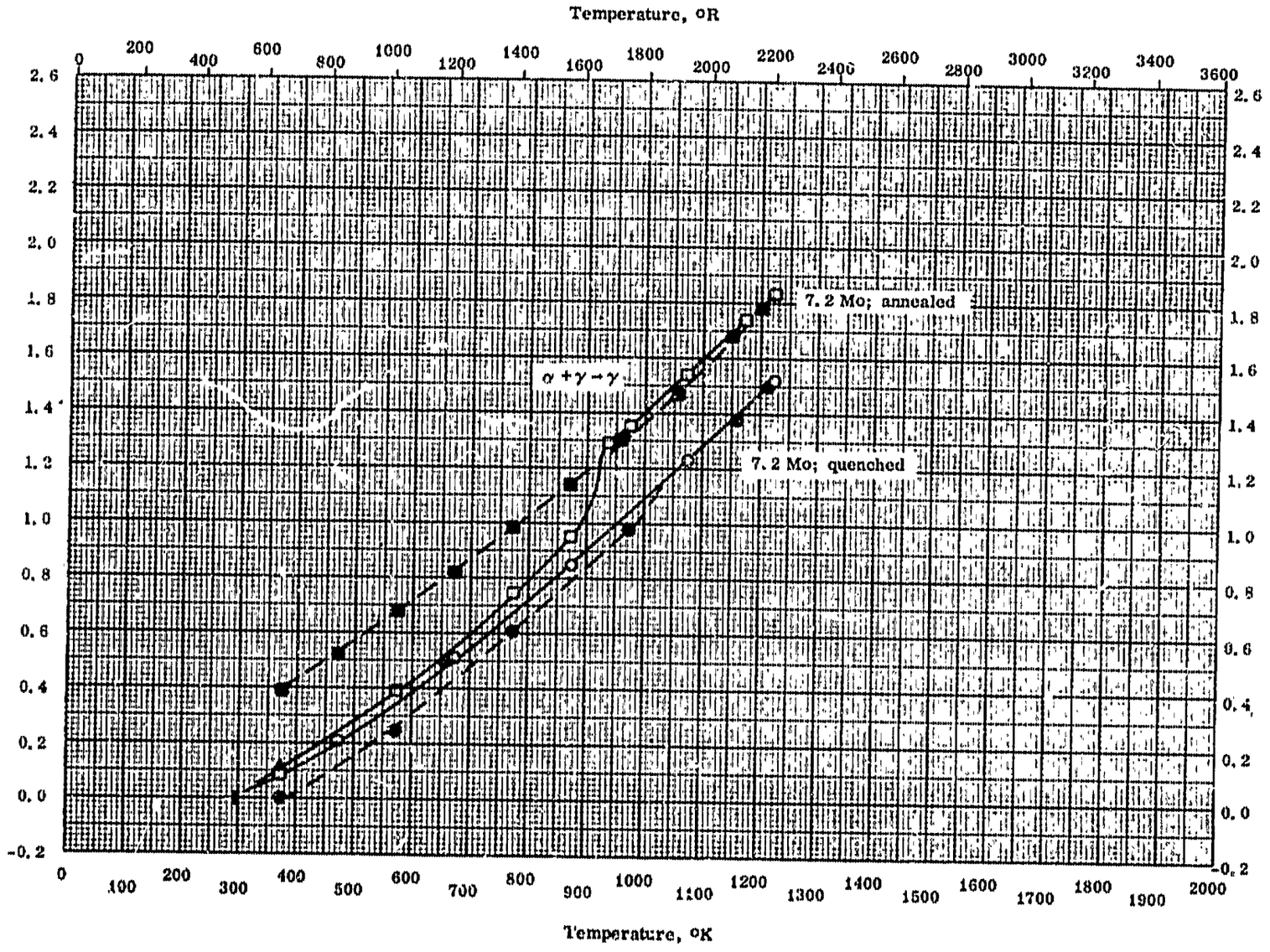
TPRC

THERMAL LINEAR EXPANSION -- URANIUM - MOLYBDENUM
(5 Mo)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-45	295-1223		4.99 Mo.	Held 1 hr at 800 C and water quenched; heating.
◑	56-45	277-1223		Same as above.	Cooling.
□	56-45	295-1223		Same as above.	Held 1 hr at 800 C, furnace cooled to 500 C, held 24 hrs, and furnace cooled; heating.
■	56-45	308-1223		Same as above.	Cooling.

TPRC



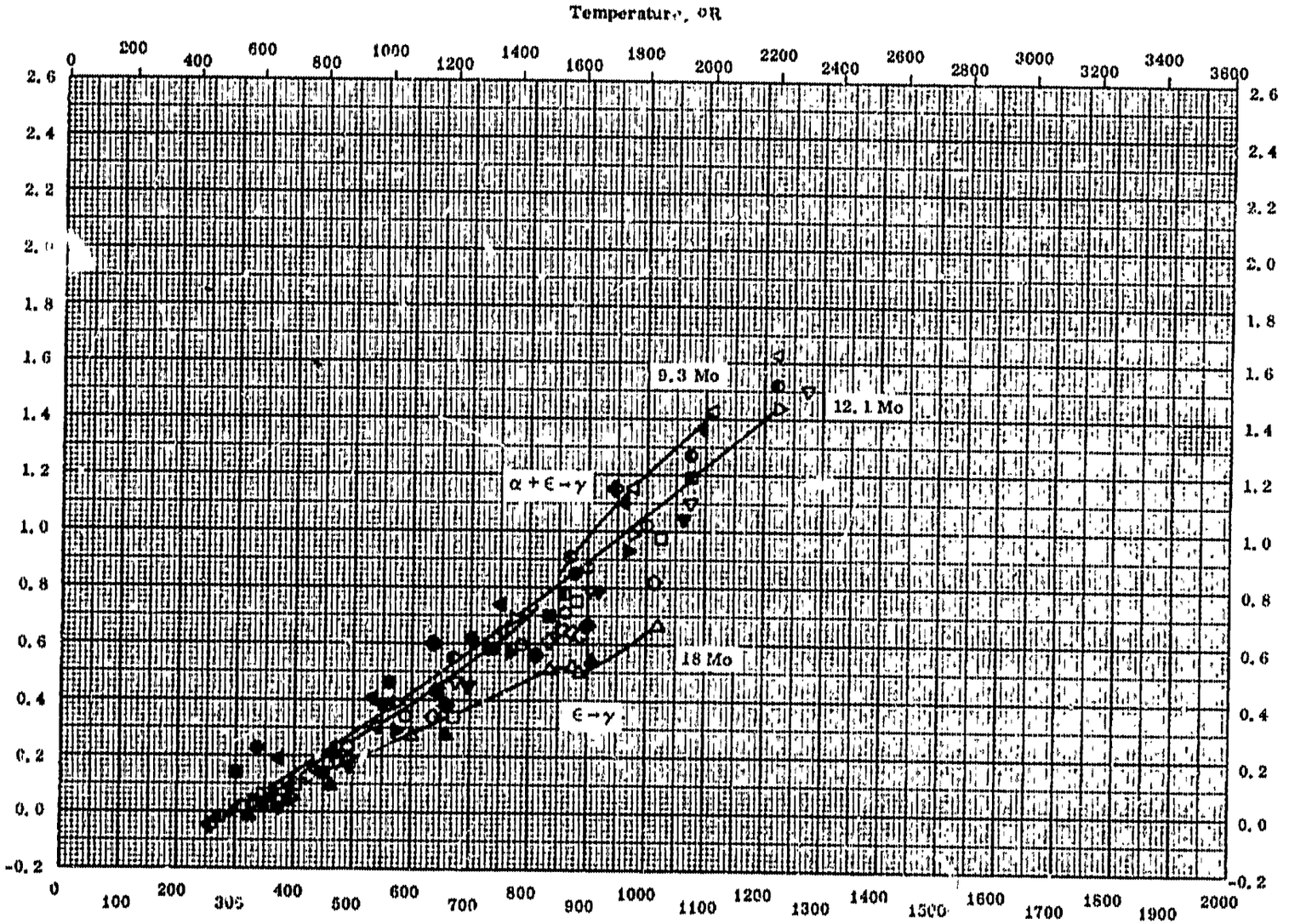
THERMAL LINEAR EXPANSION -- URANIUM + MOLYBDENUM
(7 < Mo ≤ 8)

THERMAL LINEAR EXPANSION — URANIUM + MOLYBDENUM
(7 < Mo ≤ 8)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-45	295-1223		7, 18 Mo.	Held 1 hr at 800 C and water quenched; heating.
●	56-45	373-1223		Same as above.	Cooling.
□	56-45	295-1223		Same as above.	Held 1 hr at 800 C, furnace cooled to 500 C, held 100 hrs at 500 C, and furnace cooled; heating.
■	56-45	373-1223		Same as above.	Cooling.
△	55-8	372-673		8 Mo.	

TPRC



THERMAL LINEAR EXPANSION — URANIUM + MOLYBDENUM
(9 ≤ Mo ≤ 18)

THERMAL LINEAR EXPANSION — URANIUM + MOLYBDENUM
(9 ≤ Mo ≤ 18)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-8, 56-35, also 57-16	333-998		9 Mo.	Annealed 16 days at 550 C, heating.
●	55-8, 56-35, also 57-16	333-998		Same as above.	Cooling.
□	55-8, 56-35, also 57-16	293-1028		12 Mo.	Same as above; heating.
■	55-8, 56-35, also 57-16	300-1028		Same as above.	Cooling.
◇	55-8, 56-35, also 57-16	313-1013		15 Mo.	Same as above; heating.

(continued onto next page)

TPRC

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
◆	56-8, 56-35, also 57-16	362-1013		Same as above.	Cooling.
△	56-8, 56-35, also 57-16	313-1013		18 Mo.	Same as above.
▲	56-8, 56-35, also 57-16	225-1013		Same as above.	Cooling.
▽	56-45	293-1273		12.1 Mo.	Held 1 hr at 800 C and water quenched; heating; tested in vac.
▼	56-45	377-1273		Same as above.	Cooling.
▷	56-45	293-1273		Same as above.	Same as above except furnace cooled at 500 C and held 2 weeks at 500 C instead of quenched; heating.
▶	56-45	400-1273		Same as above.	Cooling.
◁	56-45	293-1223		9.36 Mo.	Same as above; heating.
◀	56-45	371-1223		Same as above.	Cooling.

(continued onto next page)

THERMAL LINEAR EXPANSION — URANIUM + MOLYBDENUM (Continued)
(9 ≤ Mo ≤ 18)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
●	56-45	293-1223		Same as above.	Held 1 hr at 800 C and water quenched; heating, tested in vacuum.
■	56-45	365-1223		Same as above.	Cooling.
◆	57-45	293-948		10 Mo.	Extruded, heat treated at 900 C, and water quenched.

TPRC

PROPERTIES OF URANIUM + NIOBIUM

REPORTED VALUES

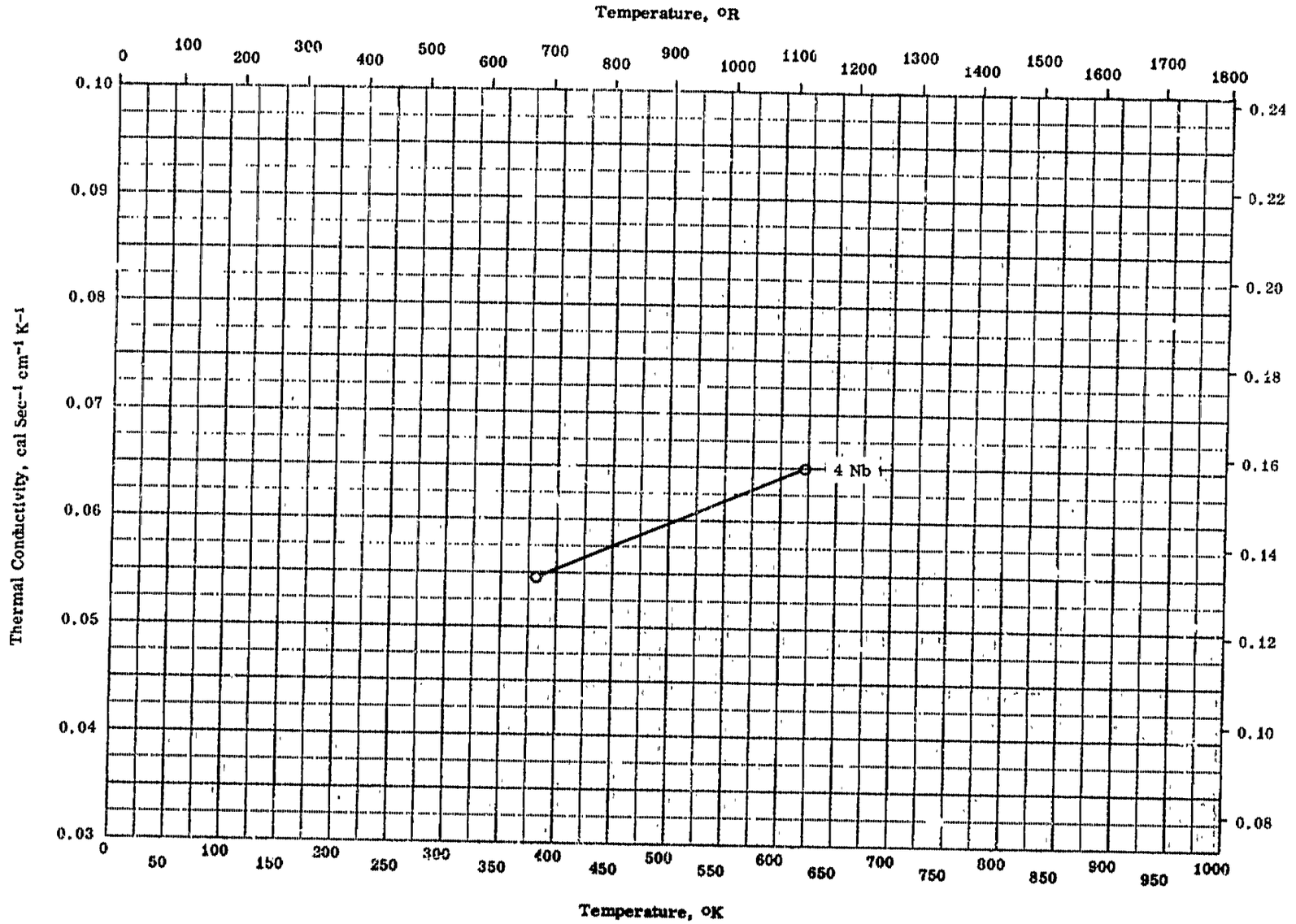
Melting Point:	K	R
O 10 Nb	1573	2531

PROPERTIES OF URANIUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	55-8	1573		10 Nb.	

TPRC

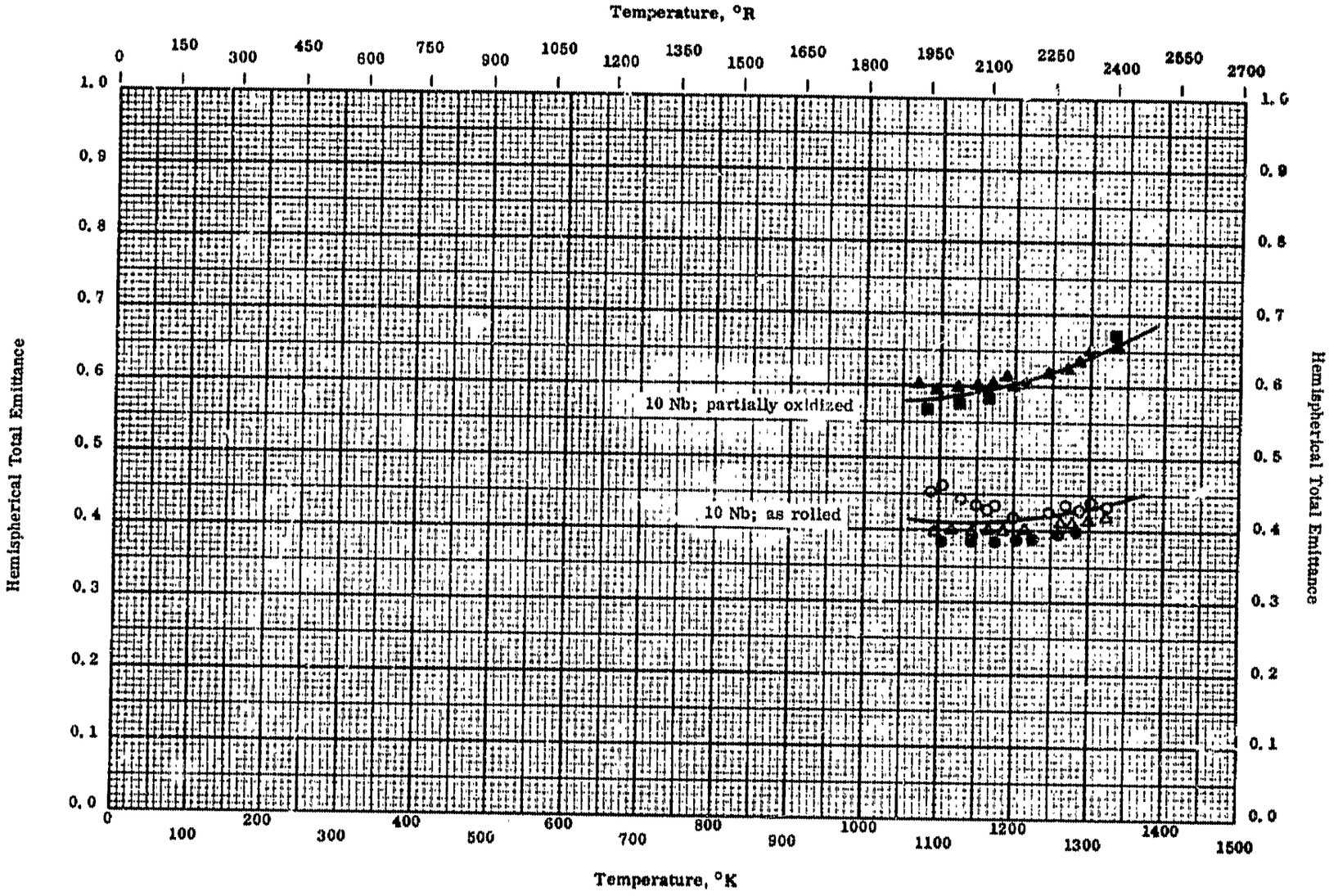


THERMAL CONDUCTIVITY -- URANIUM + NIOBIUM

THERMAL CONDUCTIVITY -- URANIUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	45-1	386-623		4 Nb	



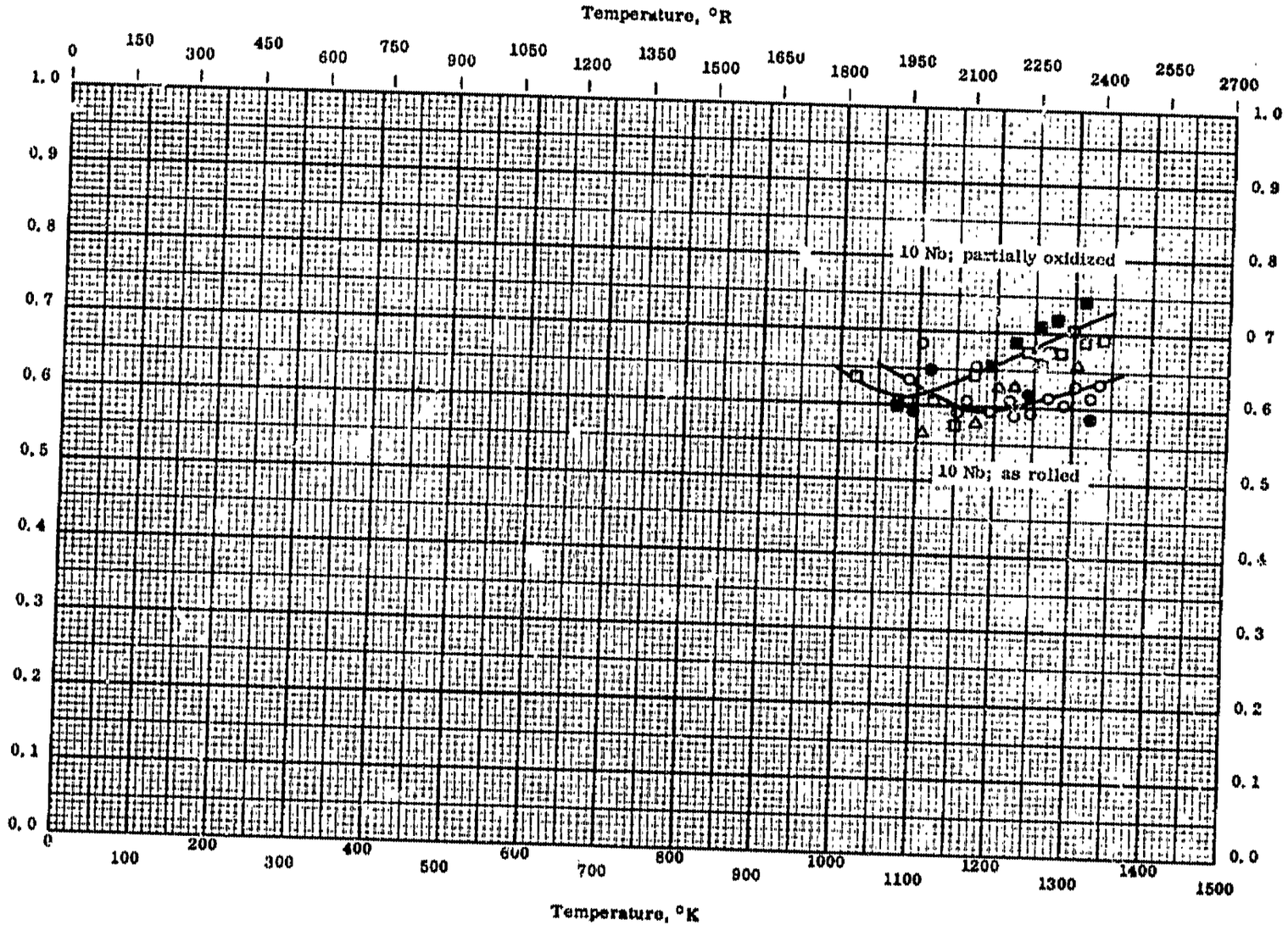
HEMISPHERICAL TOTAL EMITTANCE -- URANIUM + NIOBIUM

HEMISPHERICAL TOTAL EMITTANCE -- URANIUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-49	1090-1323		90 U, 10 Nb.	As rolled; measured in vacuum; first heating.
△	57-49	1095-1323		Same as above.	Same as above; first cooling.
●	57-49	1105-1283		Same as above.	Same as above; second cooling.
▲	57-49	1070-1335		Same as above.	Same as above except 15 charges (2.5 cm^3 at atmospheric pressure per charge) of oxygen added to vacuum chamber (chamber at 2×10^{-5} mm Hg and specimen at approximately 1173 °K); heating.
■	57-49	1082-1334		Same as above.	Same as above; cooling.

TPRC



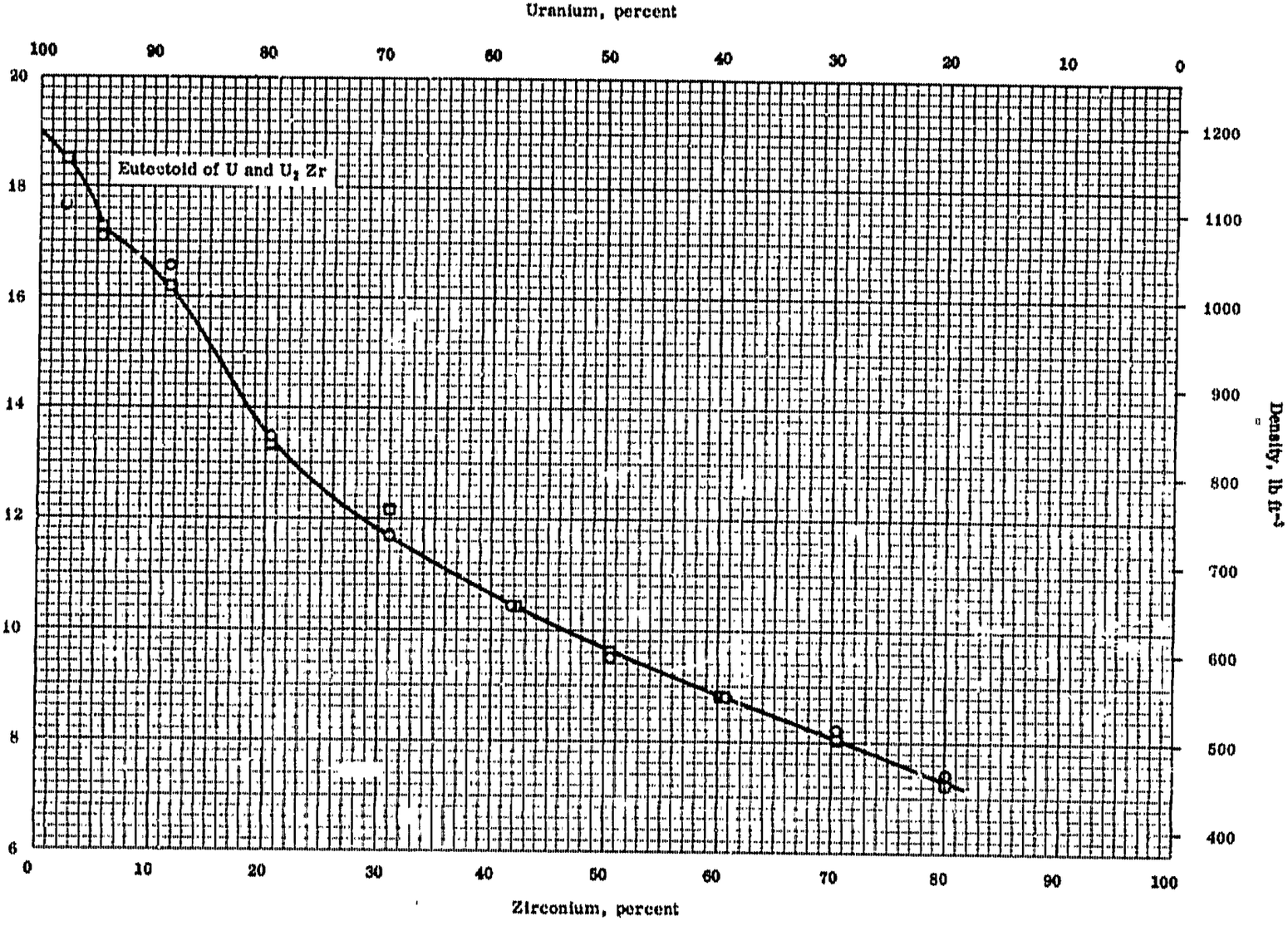
NORMAL SPECTRAL EMITTANCE — URANIUM + NIOBIUM

NORMAL SPECTRAL EMITTANCE -- URANIUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range, °K	Rept. Error%	Sample Specifications	Remarks
○	57-49	0.65	1090-1336		90 U, 10 Nb.	As rolled; measured in vacuum; first heating.
●	57-49	0.65	1095-1323		90 U, 10 Nb.	Same as above; first cooling.
△	57-49	0.65	1106-1306		90 U, 10 Nb.	Same as above, second cooling.
□	57-49	0.65	1020-1338		90 U, 10 Nb.	Same as above except 15 charges (2.5 cm^3 at atmospheric pressure per charge) of oxygen added to vacuum chamber (chamber at 2×10^{-5} mm Hg and specimen at approximately 1173 K); heating.
■	57-49	0.65	1081-1315		90 U, 10 Nb.	Same as above; cooling.

TPRC



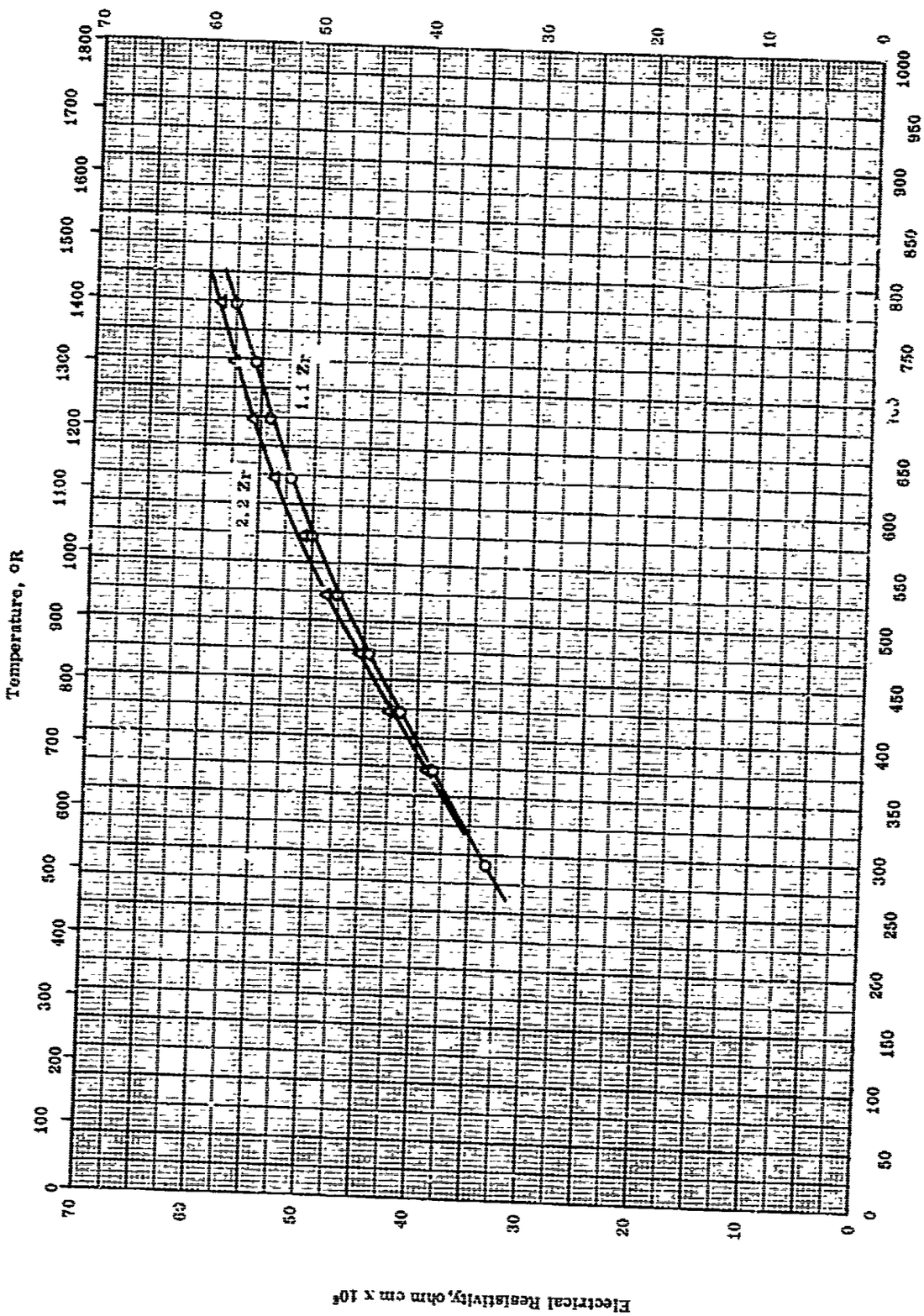
DENSITY -- URANIUM + ZIRCONIUM

DENSITY --URANIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	53-22	298		2-80 Zr.	Heat-treated 1 hr at 800 C and water quenched.
□	53-22	298		2-80 Zr.	Heat-treated 24 hrs at 575 C and furnace cooled.

TPRC



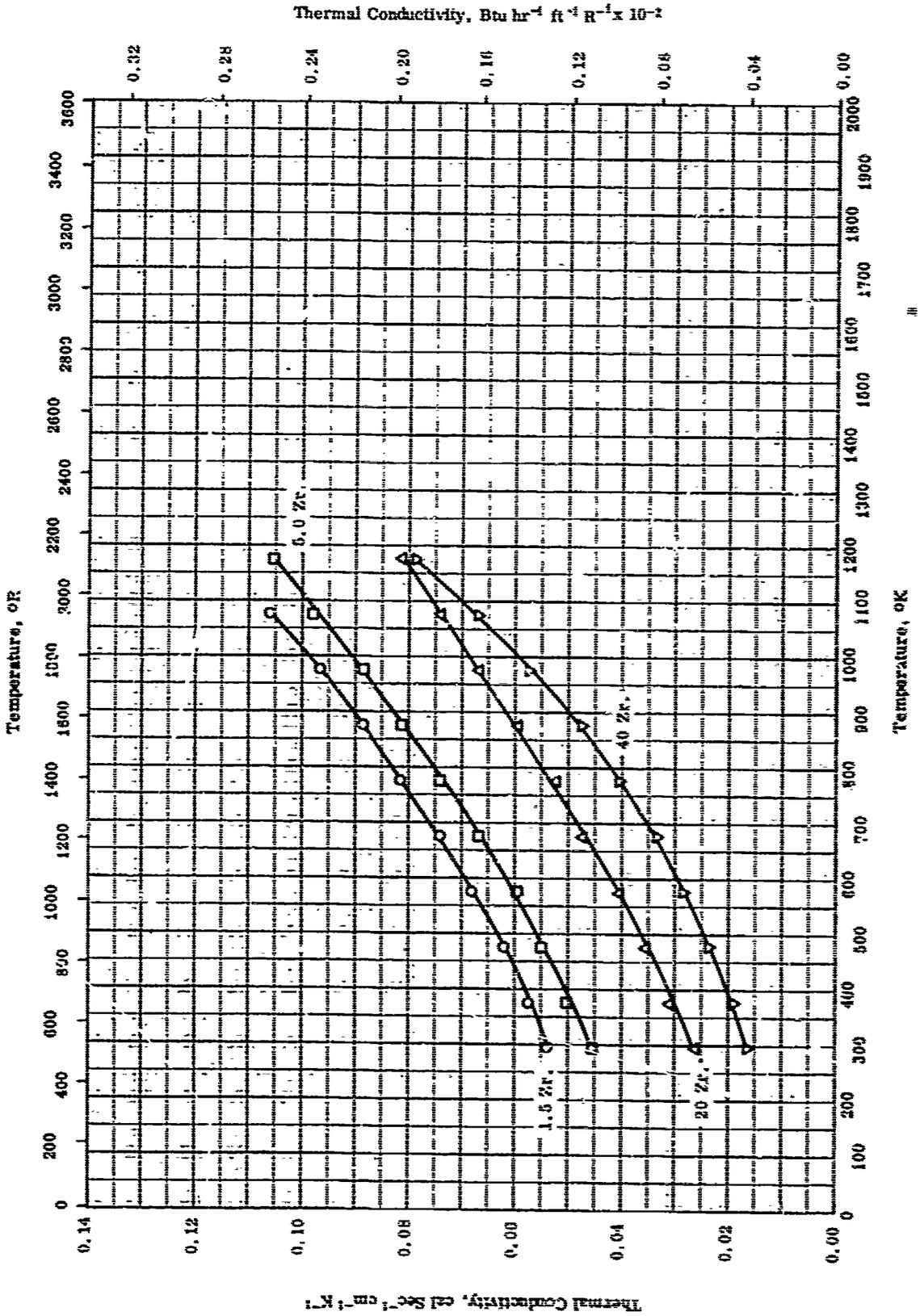
ELECTRICAL RESISTIVITY — URANIUM + ZIRCONIUM

ELECTRICAL RESISTIVITY --- URANIUM +ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	55-21	293-1073		1.13 Zr and <0.01 C.	Heated 1 hr at 725 C in vacuum and water quenched.
△	55-21	293-1073		2.22 Zr and <0.01 C.	Heated 1 hr. at 800 C in vacuum, 1 hr. at 500 C, and air cooled.

TPRC



THERMAL CONDUCTIVITY — URANIUM + ZIRCONIUM

THERMAL CONDUCTIVITY -- URANIUM + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	58-15	293-1073	< ± 5	U - 1.5 wt % Zr; 1.5 Zr.	Unclad rod before irradiation.
□	54-6	293-1173		5.0 Zr.	
△	54-6	293-1173		20.0 Zr.	
▽	54-6	293-1173		40.0 Zr.	

Thermal Linear Expansion, percent

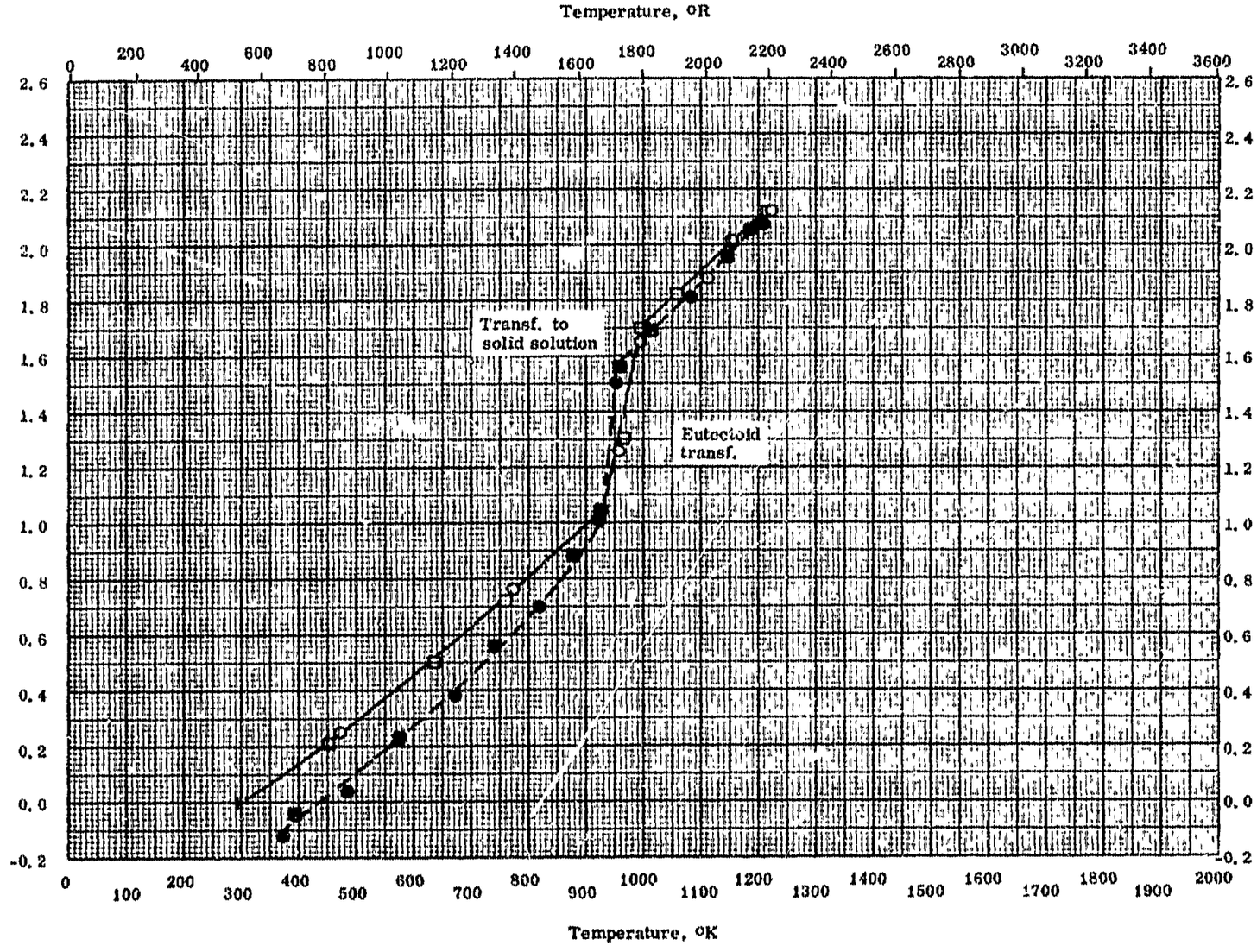
THERMAL LINEAR EXPANSION -- URANIUM + ZIRCONIUM (3 Zr)

THERMAL LINEAR EXPANSION -- URANIUM + ZIRCONIUM (3 Zr)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-45	295-1222		2.95 Zr.	Heated 1 hr at 800 C and 24 hrs at 670 C and furnace cooled; heating; tested in vacuum.
●	56-45	373-1222		Same as above.	Cooling of the above sample.
□	56-45	295-1222		Same as above.	1 hr at 800 C, isothermally transformed 2 hrs at 550 C, 5 min at 780 C, isothermally transformed 2 hrs at 550 C, 5 min at 780 C, 2 hrs 550 C; heating.
■	56-45	295-1222		Same as above.	Cooling of the above sample.

TPRC



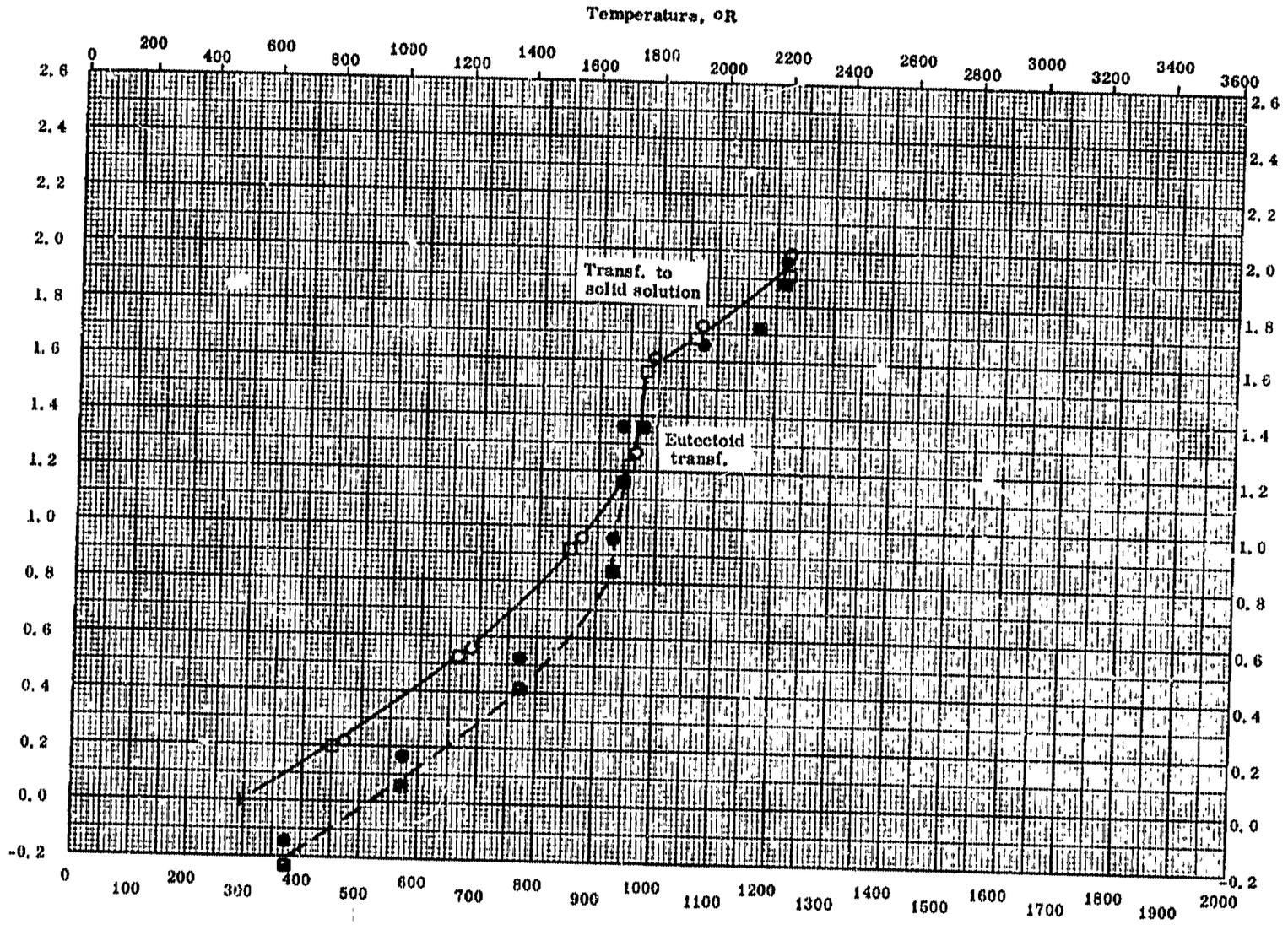
THERMAL LINEAR EXPANSION — URANIUM + ZIRCONIUM
(5 Zr)

THERMAL LINEAR EXPANSION -- URANIUM + ZIRCONIUM (5 Zr)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-45	295-1222		4.96 Zr.	Heated 1 hr at 800 C and 24 hrs at 670 C and furnace cooled; heating; tested in vacuum.
●	56-45	373-1222		Same as above.	Cooling of the above curve.
□	56-45	295-1222		Same as above.	1 hr at 800 C, isothermally transformed 2 hrs at 550 C, 5 min at 780 C, isothermally transformed 2 hrs at 550 C, 5 min at 780 C, 2 hrs at 550 C; heating; treated in vacuum.
■	56-45	395-1222		Same as above.	Cooling of the above sample.

TPRC



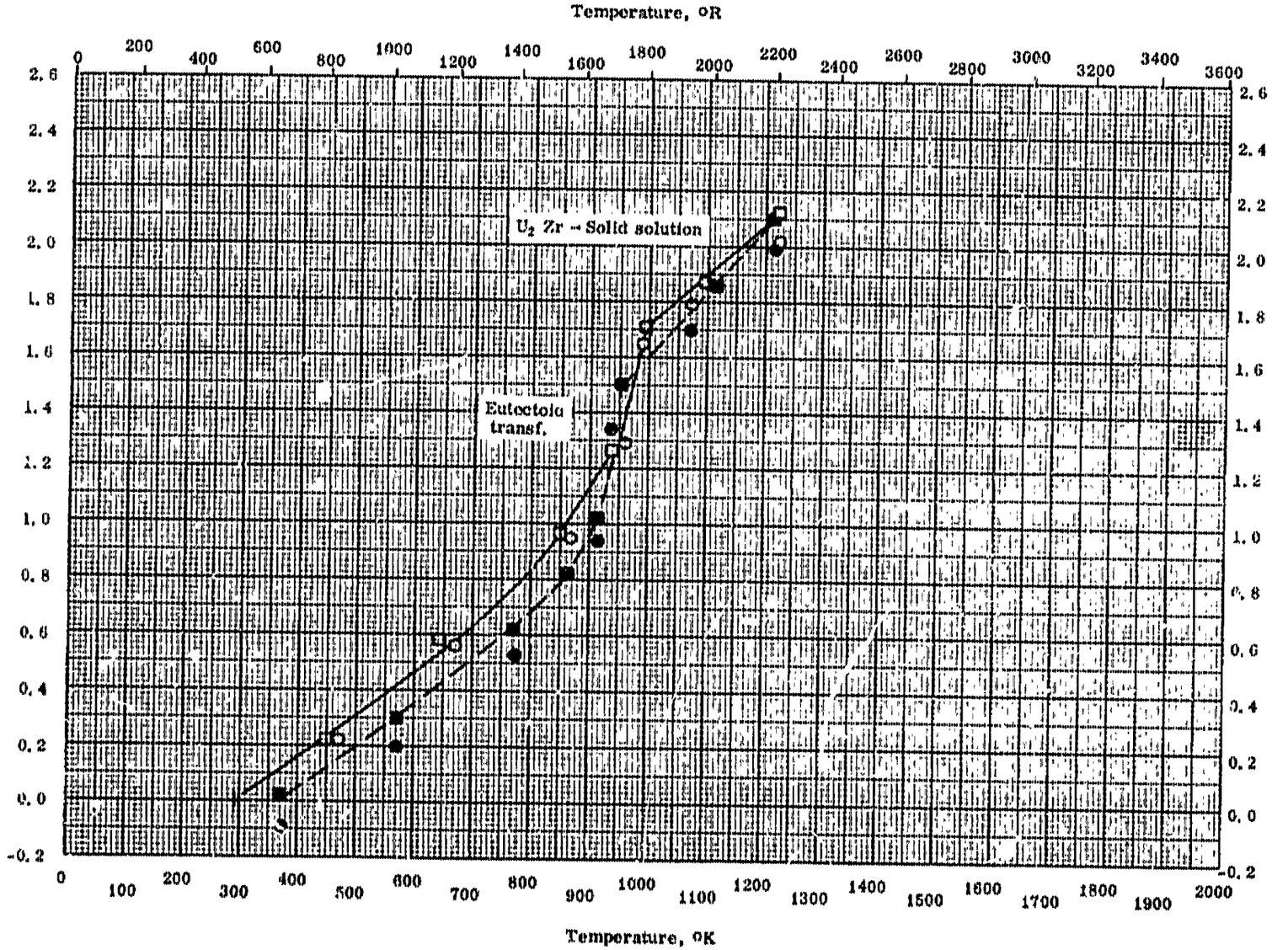
THERMAL LINEAR EXPANSION — URANIUM + ZIRCONIUM
(7.07 Zr)

THERMAL LINEAR EXPANSION -- URANIUM + ZIRCONIUM (7.07 Zr)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-45	293-1222		7.07 Zr.	Heated 1 hr at 800 C and 24 hrs at 670 C, and furnace cooled; heating; tested in vacuum.
●	56-45	373-1222		Same as above.	Cooling of the above sample.
□	56-45	295-1222		Same as above.	1 hr at 800 C, isothermally transformed 2 hr at 550 C, 5 min at 780 C, isothermally transformed 2 hrs at 550 C, 5 min at 780 C, 2 hrs at 550 C; heating; tested in vacuum.
■	56-45	373-1222		Same as above.	Cooling of the above sample.

TPRC



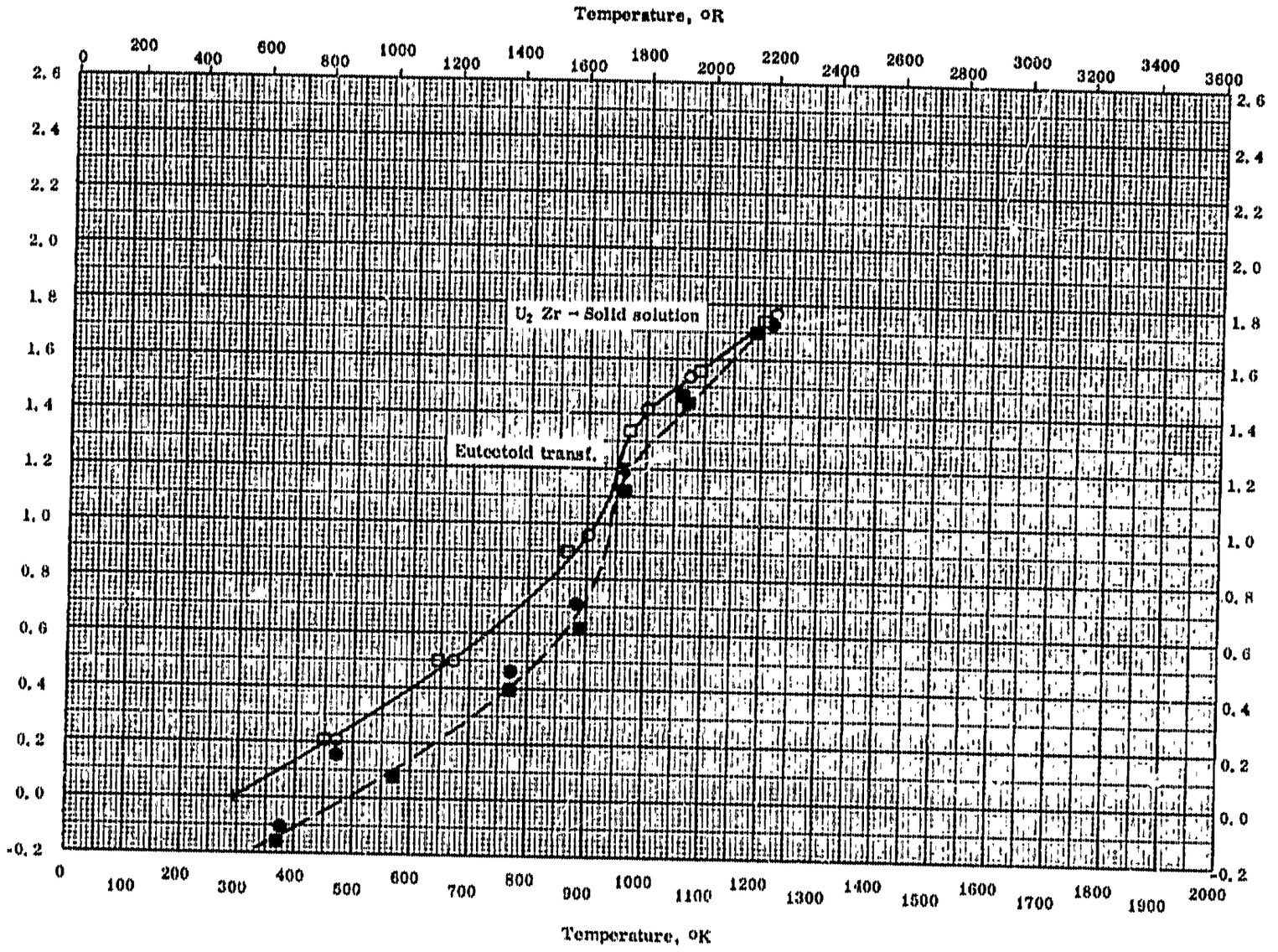
THERMAL LINEAR EXPANSION — URANIUM + ZIRCONIUM
(9.86 Zr)

THERMAL LINEAR EXPANSION — URANIUM + ZIRCONIUM (9.86 Zr)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-45	295-1222		9.86 Zr.	1 hr at 800 C, 24 hrs at 570 C, and furnace cooled; heating; tested in vacuum.
●	56-45	373-1222		Same as above.	Cooling of the above sample.
□	56-45	295-1222		Same as above.	1 hr at 800 C, furnace cooled to 750 C, furnace cooled from 750 C to 570 C at 1/2 C min^{-1}; heating; tested in vacuum.
■	56-45	373-1222		Same as above.	Cooling of the above sample.

TPRC



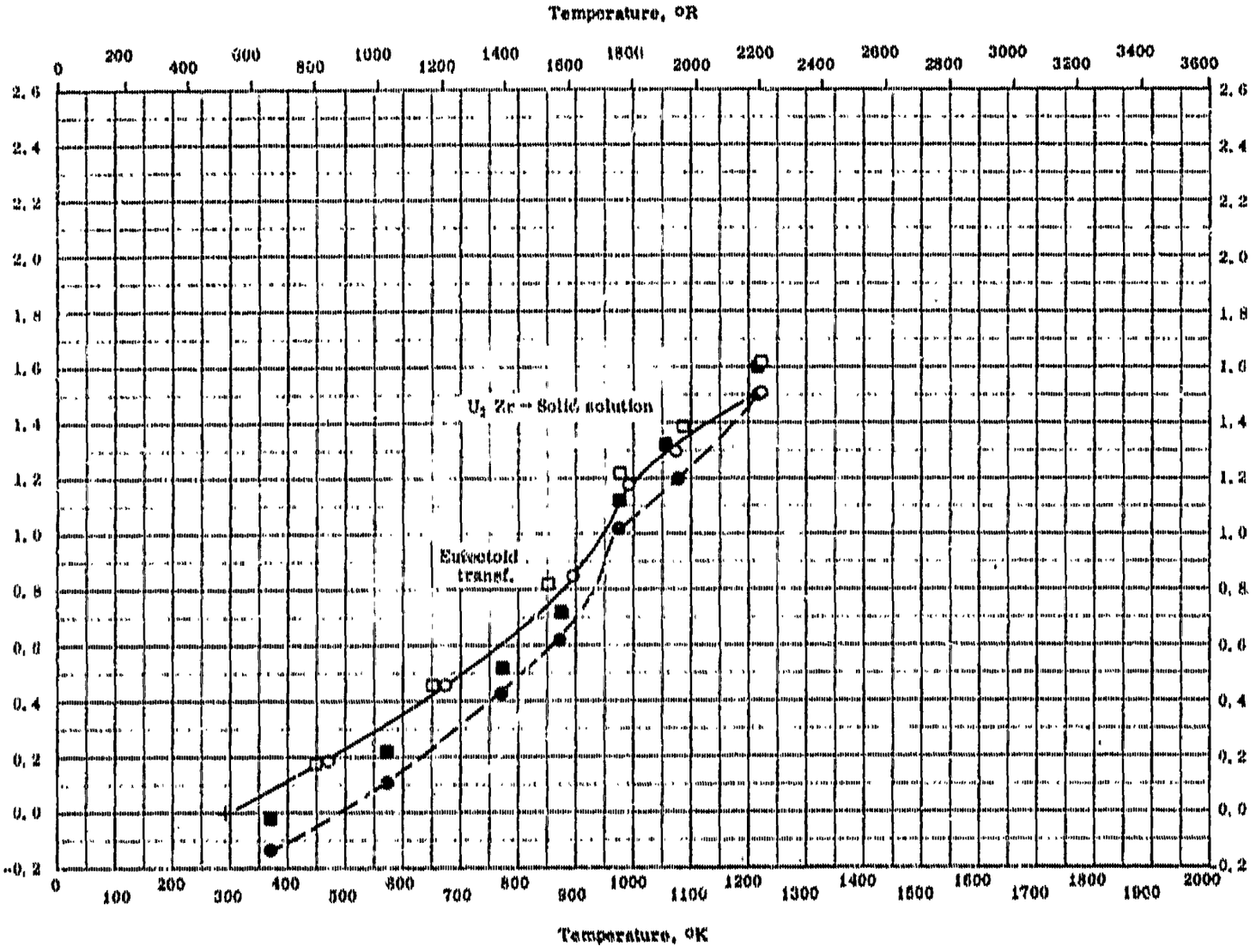
THERMAL LINEAR EXPANSION -- URANIUM + ZIRCONIUM
(15.5 Zr)

THERMAL LINEAR EXPANSION --- URANIUM + ZIRCONIUM (15.5 Zr)

REFERENCE INFORMATION

Sym Sel	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-45	295-1222		15.5 Zr.	Heated 1 hr at 800 C, 24 hrs at 670 C, and furnace cooled; heating; tested in vacuum.
●	56-45	373-1222		Same as above.	Cooling of the above sample.
□	56-45	295-1222		Same as above.	Heated 1 hr at 800 C, furnace cooled to 750 C, and furnace cooled from 750 C to 670 C at 1/2 C min^{-1}, heating; tested in vacuum.
■	56-45	373-1222		Same as above.	Cooling of the above sample.

TPRC



THERMAL LINEAR EXPANSION -- URANIUM + ZIRCONIUM
(20 Zr)

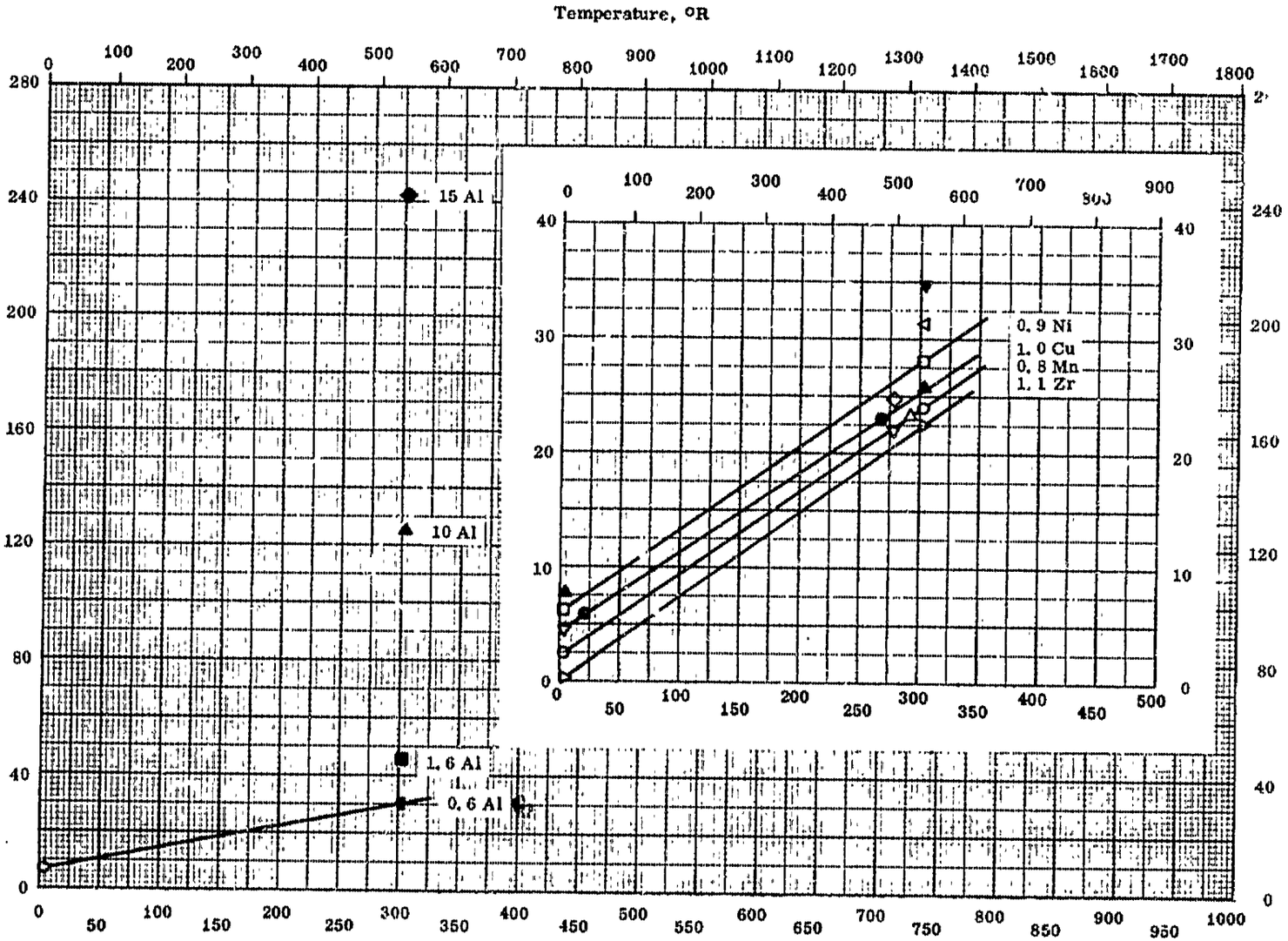
TPRC

THERMAL LINEAR EXPANSION -- URANIUM + ZIRCONIUM (20 Zr)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-45	293-1222		20 Zr.	1 hr 800 C, furnace cooled to 750 C, and furnace cooled from 750 C to 570 C at 1/2 C min^{-1}, heating; tested in vacuum.
●	56-45	373-1223		Same as above.	Cooling of the above sample.
□	56-45	293-1222		Same as above.	1 hr 800 C, isothermally transformed at 500 C for 2 hrs and water quenched; heating; tested in vacuum.
■	56-45	373-1223		Same as above.	Cooling of the above sample.

TPRC



TPRC

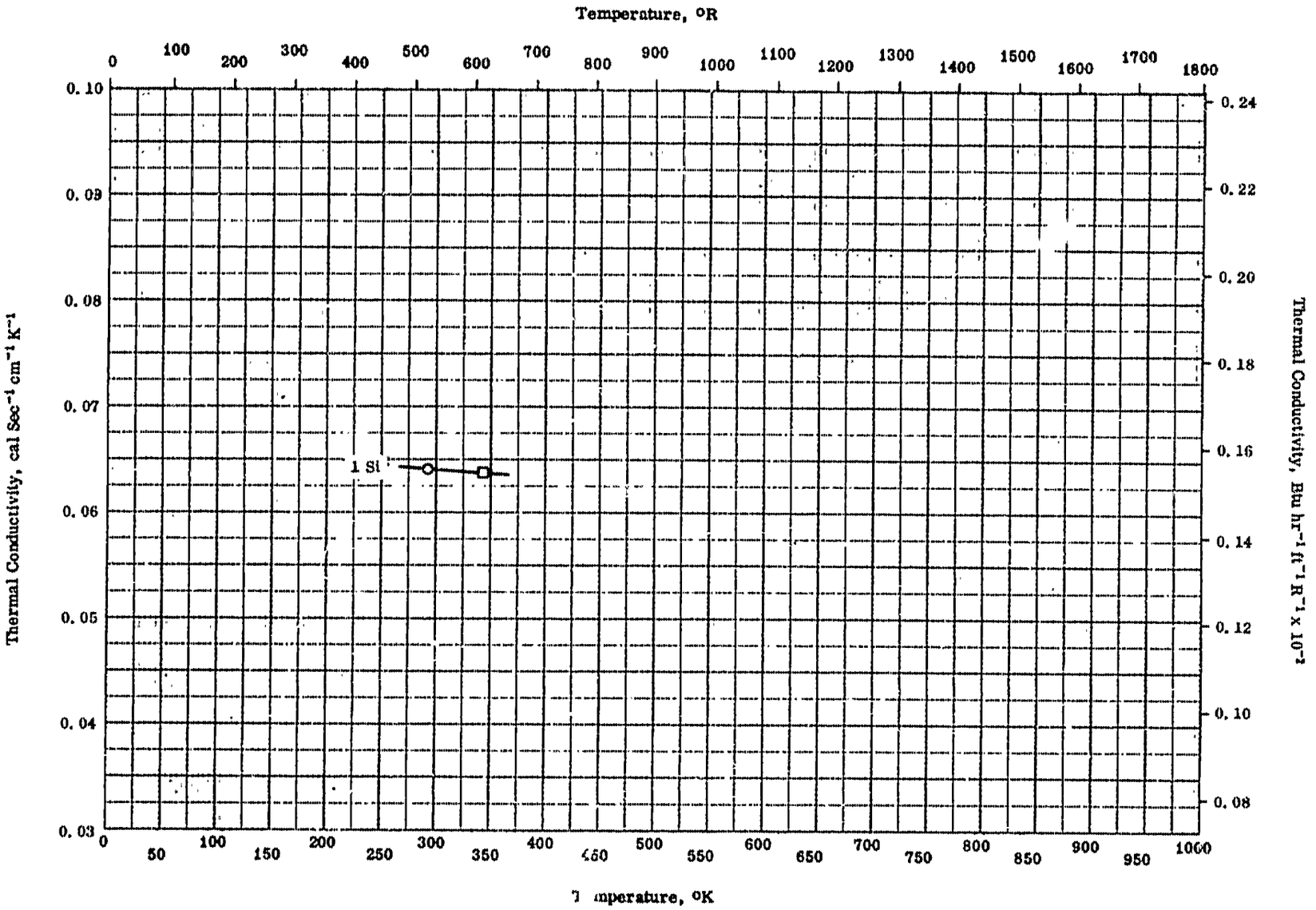
ELECTRICAL RESISTIVITY -- VANADIUM + ΣX_i

642

ELECTRICAL RESISTIVITY -- VANADIUM + ΣX_i

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-16	5-304	± 10	0.30 Mn.	Accuracy for values at room temp.
□	56-16	5-304	± 10	0.94 Ni.	Same as above.
△	56-16	5-304	± 10	0.98 Ti.	Same as above.
◇	56-16	5-304	± 10	0.99 Cr.	Same as above.
▽	56-16	5-304	± 10	1.00 Fe.	Same as above.
●	56-16	5-304	± 10	1.00 Cu.	Same as above.
▷	56-16	5-304	± 10	1.09 Zr.	Same as above.
▲	56-16	5-304	± 10	2.05 Pd.	Same as above.
◁	56-16	5-304	± 10	2.12 Sb.	Same as above.
▼	56-16	5-304	± 10	2.30 Sn.	Same as above.
◔	56-16	5-304	± 10	0.60 Al.	
◨	56-16	304	± 10	1.61 Al.	
◭	56-16	304	± 10	9.97 Al.	
◆	56-16	304	± 10	15.00 Al.	



THERMAL CONDUCTIVITY -- VANADIUM + SILICON

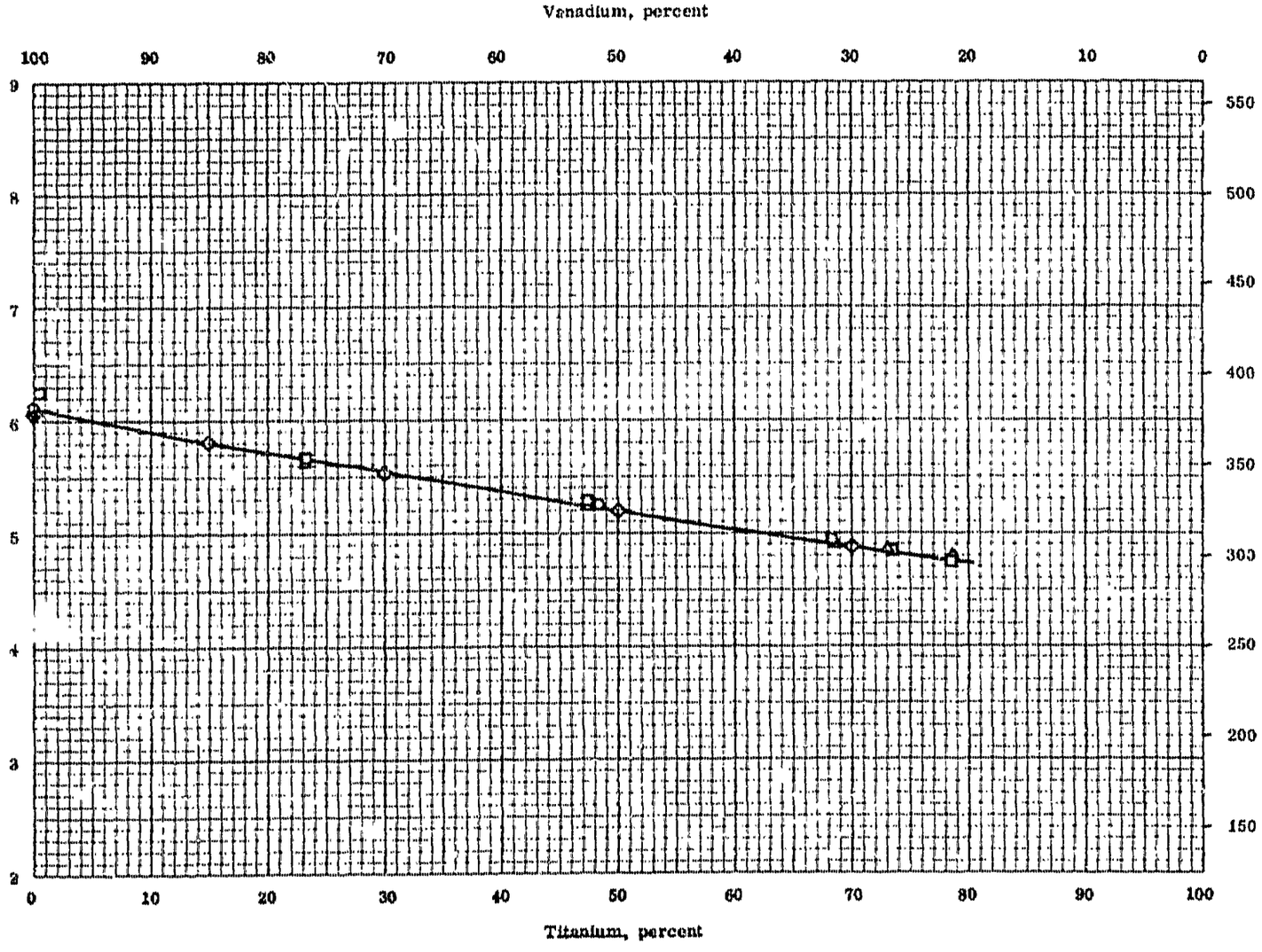
TPRC

645

THERMAL CONDUCTIVITY -- VANADIUM + SILICON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	57-5	293		1 Si.	
□	55-5	343	±3	1 Si; calcium-reduced 99.6+ V and 99+ Ti; homogeneous.	Alloy formed by arc melting raw materials and remelted several times without opening furnace to insure homogeneity; forged and machined.



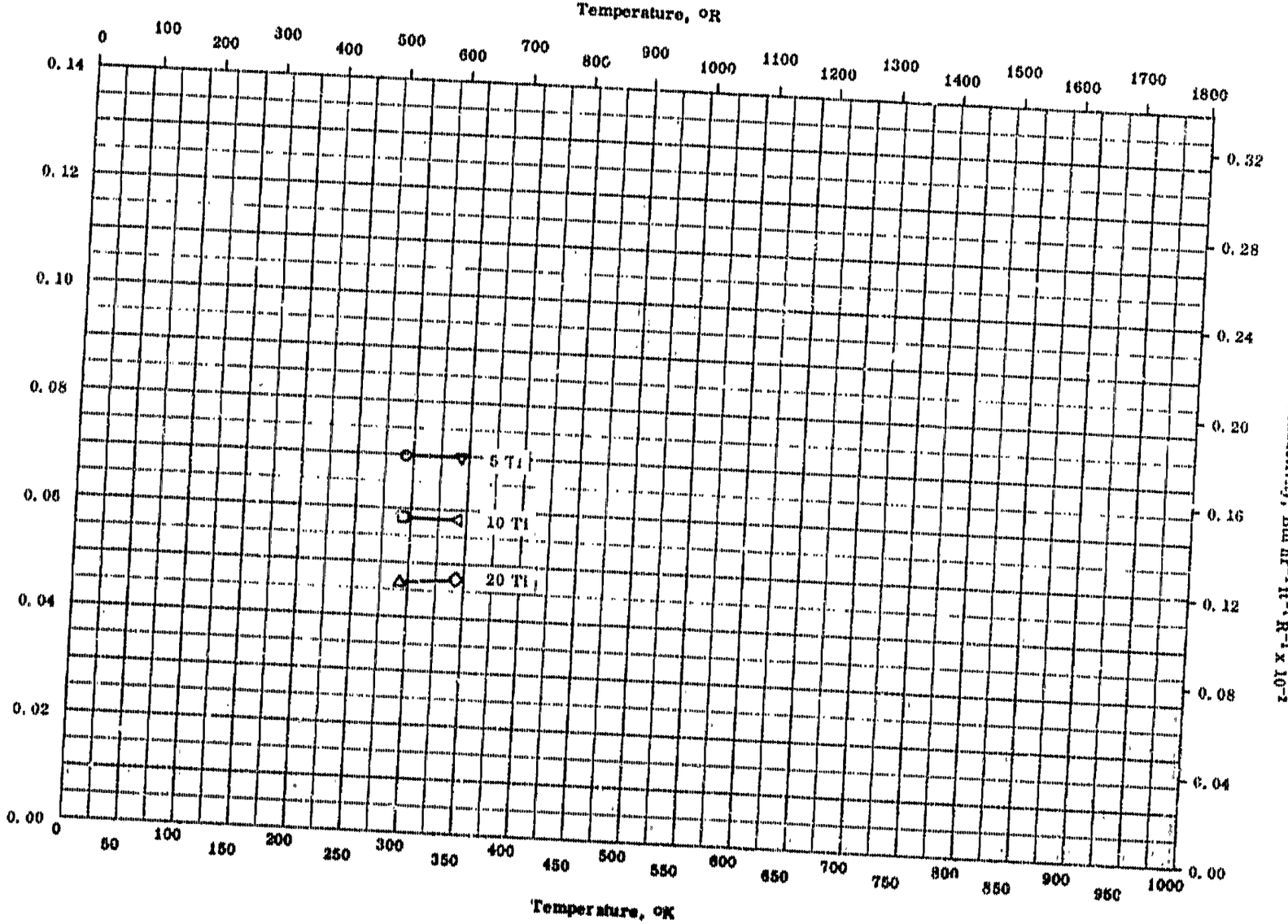
DENSITY -- VANADIUM + TITANIUM

DENSITY -- VANADIUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Reqt. Error %	Sample Specifications	Remarks
○	52-12	298		0-48 Ti; 0.4 impurities.	Density by weight in air and in water.
□	52-12	298		0-78 Ti; 1.8 impurities.	Hot-rolled; same as above.
△	52-12	298		0-78 Ti; 1.8 impurities.	Arc-melted; same as above.
◇	52-12	298		0-70 Ti.	Density computed from X-ray measurements of lattice.

TPRC

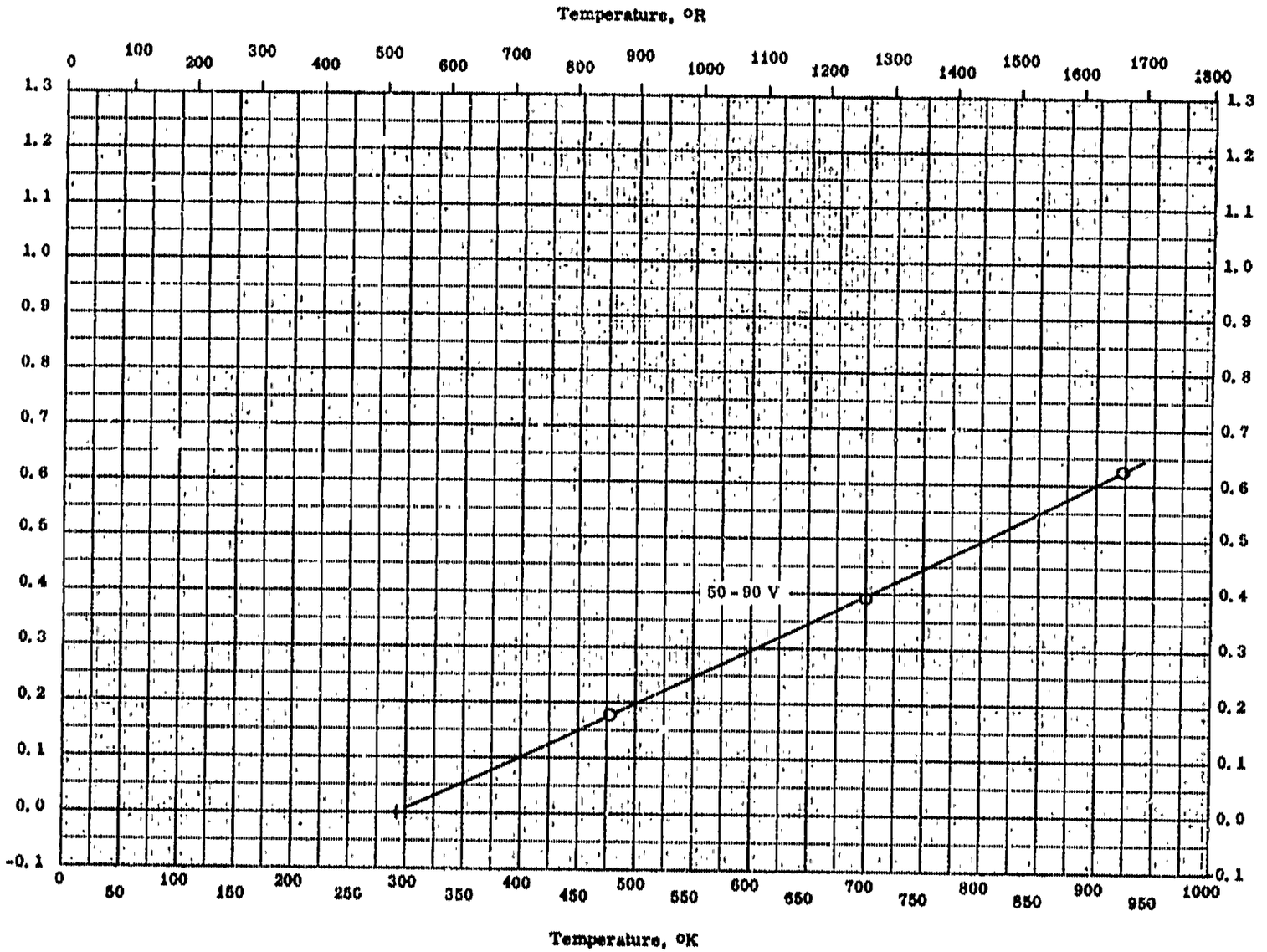


THERMAL CONDUCTIVITY -- VANADIUM + TITANIUM

THERMAL CONDUCTIVITY — VANADIUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-5	298		5 Ti.	
□	57-5	298		10 Ti	
△	57-5	298		20 Ti.	
▽	55-5	343	±3	5 Ti; calcium-reduced 99.6+ V and 99+ Ti; homogeneous.	Alloy formed by arc melting raw materials and remelted several times without opening furnace to insure homogeneity; forged and then machined.
◁	55-5	343	±3	Same as above except 10 Ti.	Same as above.
◇	55-5	343	±3	Same as above except 20 Ti.	Same as above.



THERMAL LINEAR EXPANSION -- VANADIUM + TITANIUM

THERMAL LINEAR EXPANSION -- VANADIUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	52-24	293-922		50 - 90 V; alloys prepared from 99.9 + pure Ti and 99.8 pure V.	Cast, cold rolled, vac. annealed; average of 4 samples with 50, 60, 70, and 90 V, respectively; Max deviation ± 1%; tested in vacuum.

TPRC

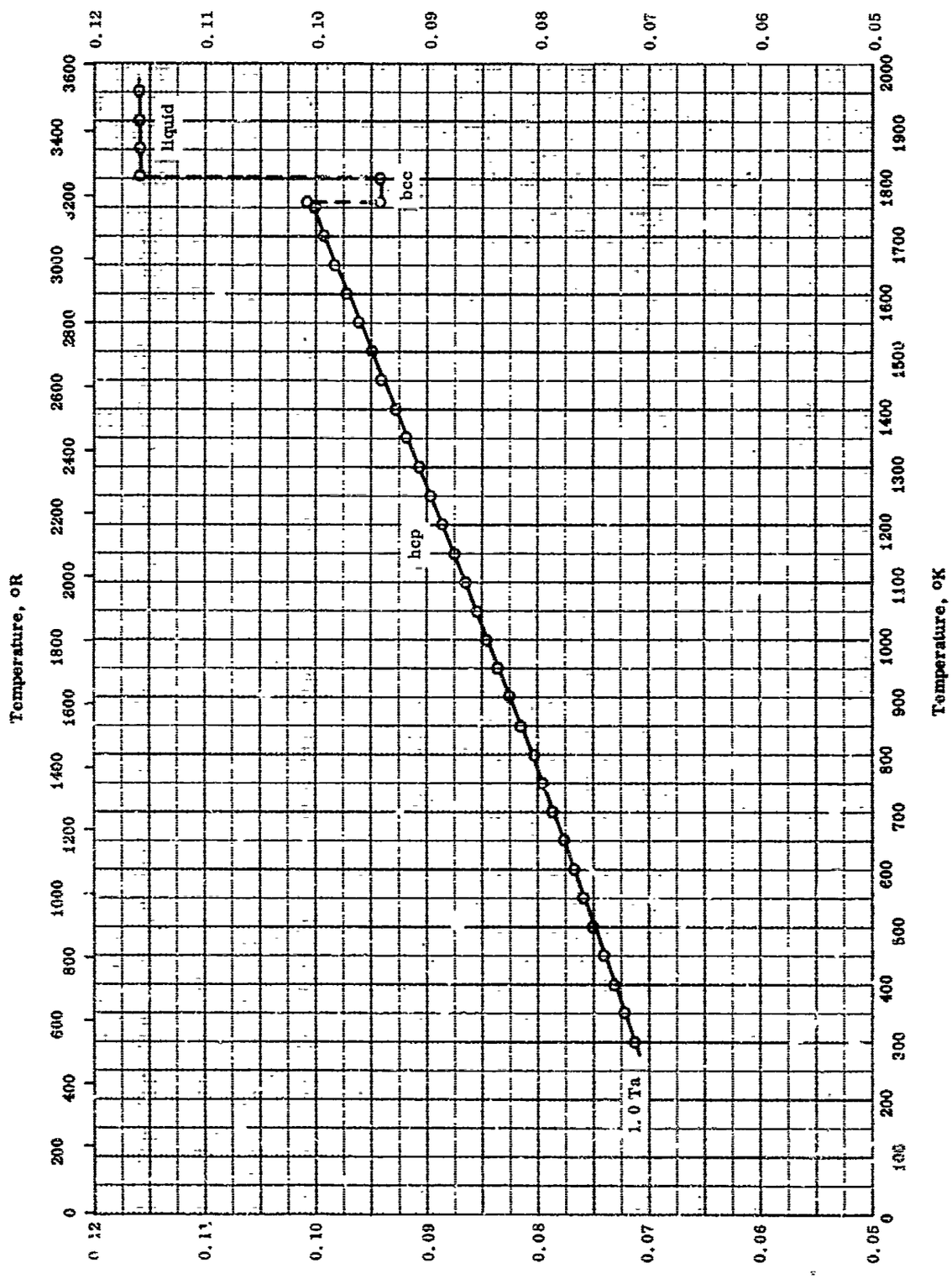
THERMAL LINEAR EXPANSION -- YTTERBIUM + CALCIUM

THERMAL LINEAR EXPANSION -- YTTERBIUM + CALCIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	56-42 also 57-51	293-1043		99.3 pure, 0.5 Ca, 0.06 C, 0.05 Fe, Si each, 0.03 Ta, 0.01 Tm, Er, N each, 0.005 Lu, and trace of Cu.	Reduced ytterbium oxide with La, distilled metal, cast into rod; heating; tested in helium.
●	57-51	293-1043		Same as above.	The above specimen, cooling; results same below 1600 R as of heating.

TPRC



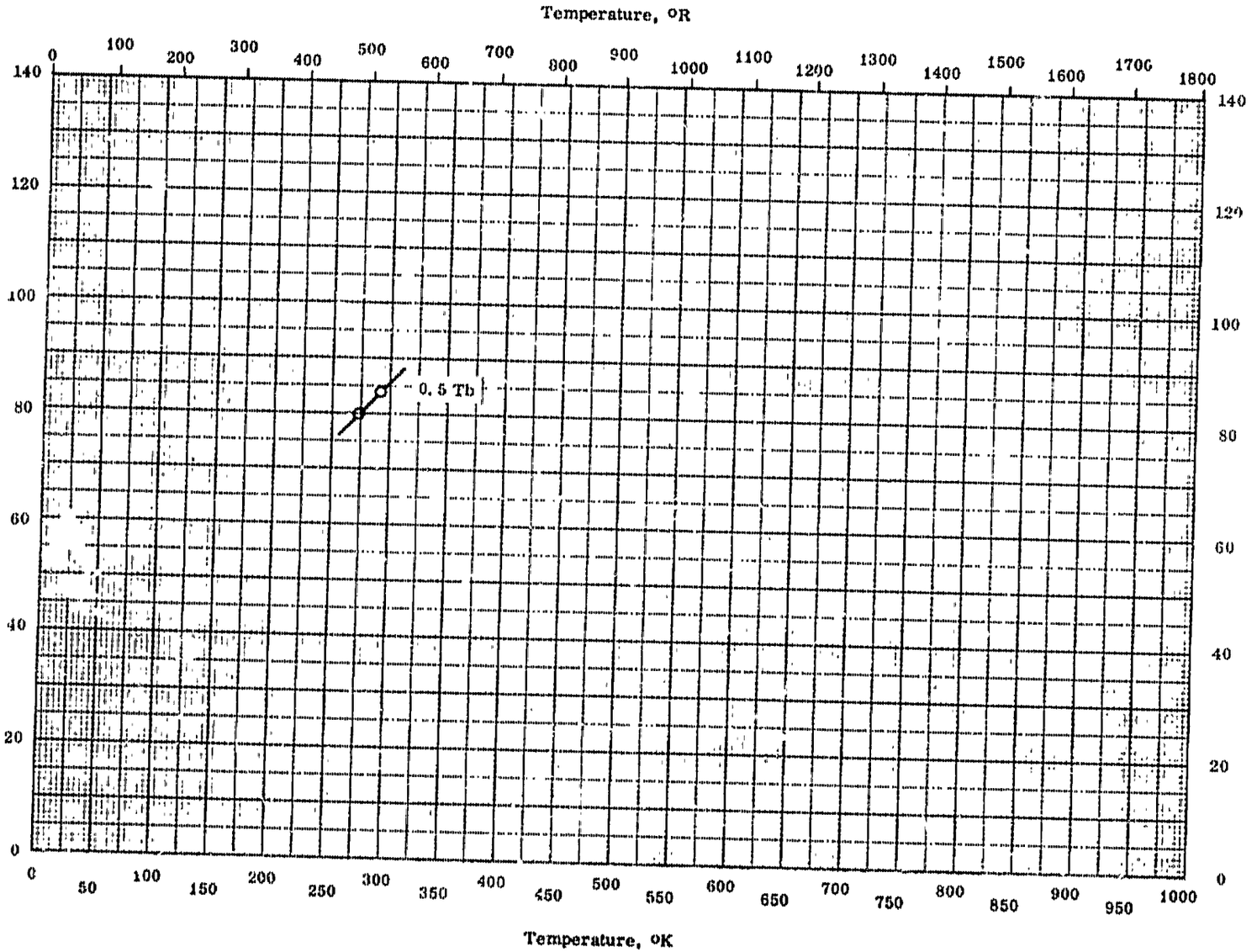
SPECIFIC HEAT -- YTTRIUM + TANTALUM

SPECIFIC HEAT -- YTTRIUM + TANTALUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	62-14 also 61-15	273-1948		>98.76 Y, >1.0 Ta, 0.10 F, <0.05 Ca, <0.05 Er, <0.05 Ho, <0.05 Yb, 0.025 O_2, <0.01 Fe, <0.01 Gd, <0.001 Si, 0.0077 C, 0.0070 N_2, <0.005 Dy, and <0.005 Mg; crystalline.	Pressed into 1/2-in. dia. rod; sealed under reduced pressure of helium.

TPRC



TPRC

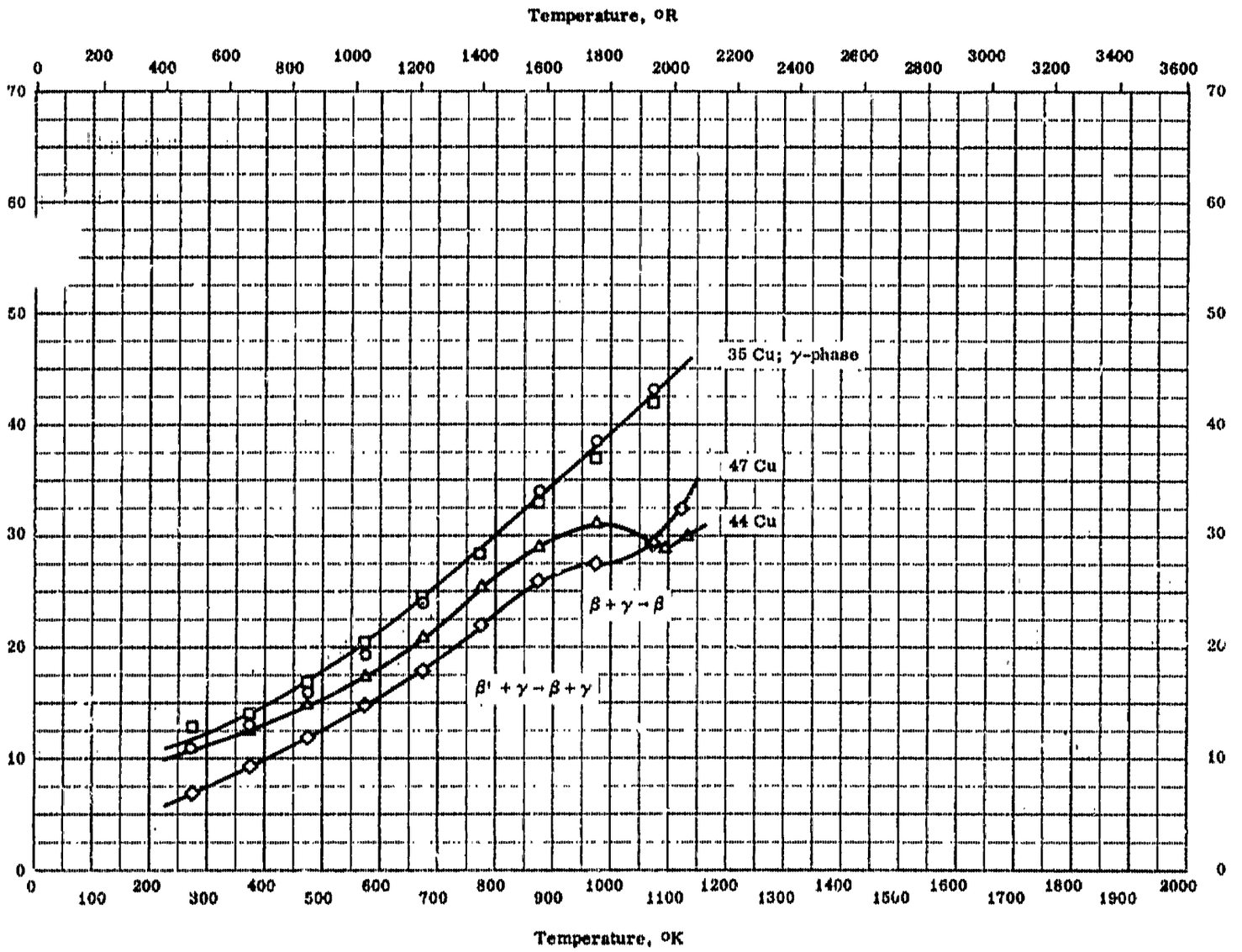
ELECTRICAL RESISTIVITY -- YTTRIUM + TERBIUM

657

ELECTRICAL RESISTIVITY -- YTTRIUM + TERBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	55-22	273-293		0.5 Tb, 0.2 Dy, 0.1 Er, trace of Fe, weak traces of Al, Ca, Mg, Si, and no Ho.	Annealed to red heat in He atomos. after shearing.



ELECTRICAL RESISTIVITY — ZINC + COPPER

ELECTRICAL RESISTIVITY — ZINC + COPPER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-25	273-1073		65 Zn and 35 Cu.	
□	57-25	273-1073		62 Zn and 38 Cu.	
△	57-25	273-1133		56.5 Zn and 43.5 Cu.	
◇	57-25	273-1123		53 Zn and 47 Cu.	

TPRC

PROPERTIES OF ZINC + SILVER

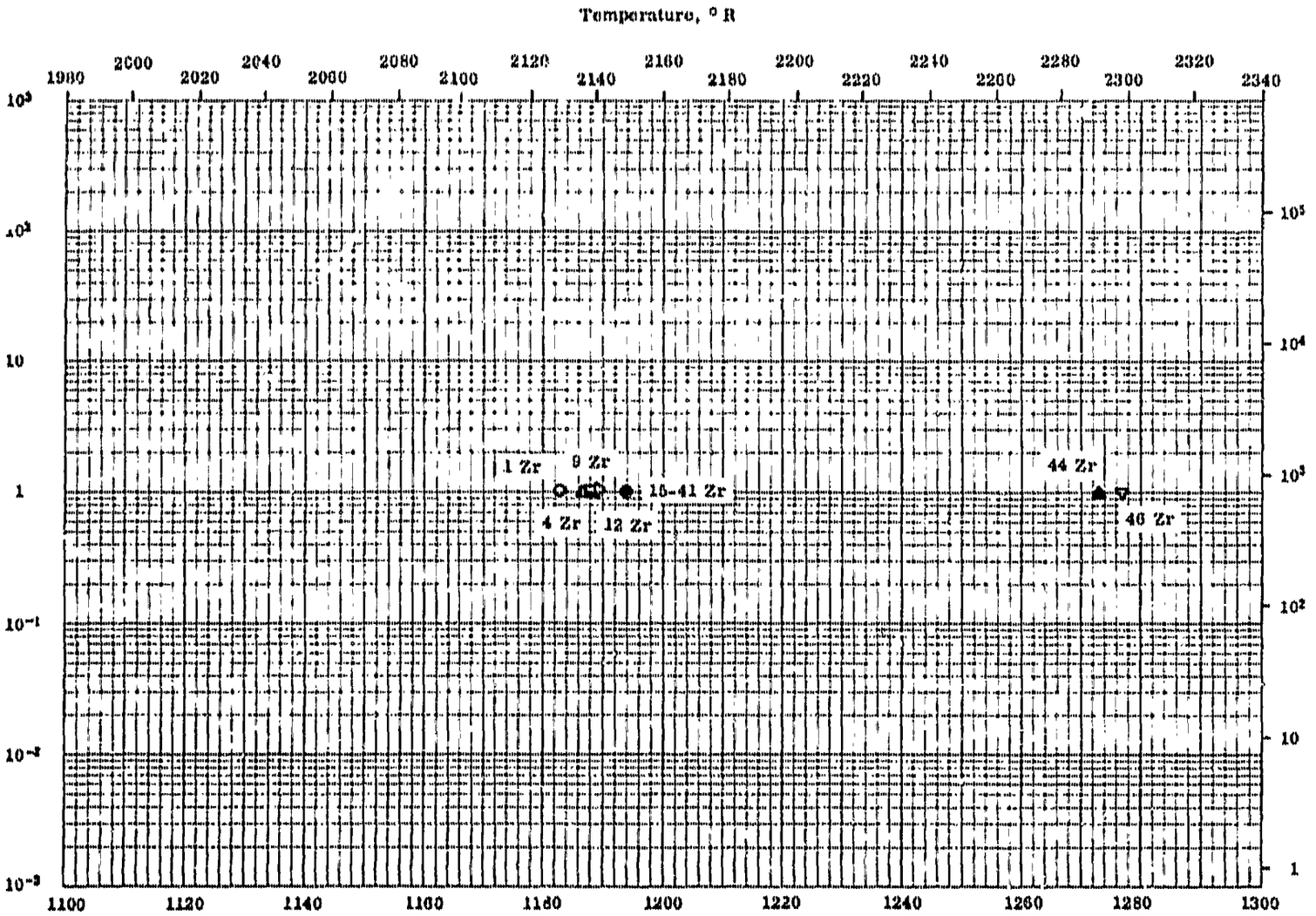
REPORTED VALUES

Melting Point:		K	R
○	39 Ag	905	1630
Heat of Fusion:		cal g^{-1}	Btu lb^{-1}
□	39 Ag	27.1 ± 1.3	48.7 ± 2.3

PROPERTIES OF ZINC +SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	43-4	905		61 Zn and 39 Ag; ϵ - phase.	M. P. from break in time-temperature curve.
□	43-4	905	± 2.3	Same as above.	ΔH_f from enthalpy difference of solid and liquid.



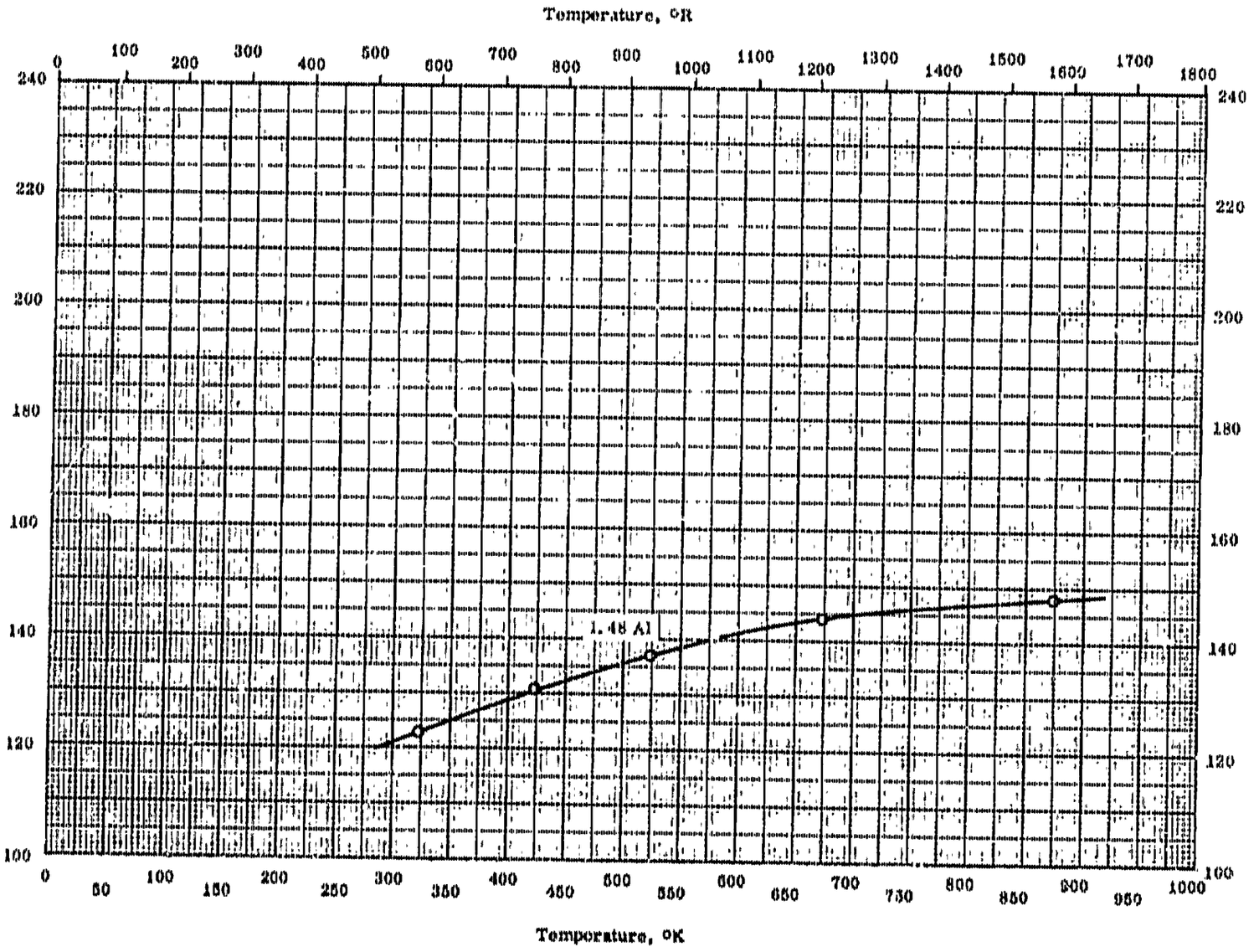
TPRC

VAPOR PRESSURE -- ZINC + ZIRCONIUM

VAPOR PRESSURE -- ZINC + ZIRCONIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-13	1183		1.08 Zr.	Measured temp. at which Zn pressure was 1 atm.
△	56-13	1187		4.0 Zr.	Same as above.
□	56-13	1138		2 alloys: 5.74 Zr and 9.0 Zr.	Same temp. for both alloys.
◇	56-13	1193		12.0 Zr.	Same as above.
●	56-13	1196		4 alloys: 15.0 Zr, 23.73 Zr, 24.7 Zr, 41 Zr.	Same temp. for the 4 alloys.
▽	56-13	1277		44 Zr.	Same as above.
▲	56-13	1273		46 Zr.	Same as above.



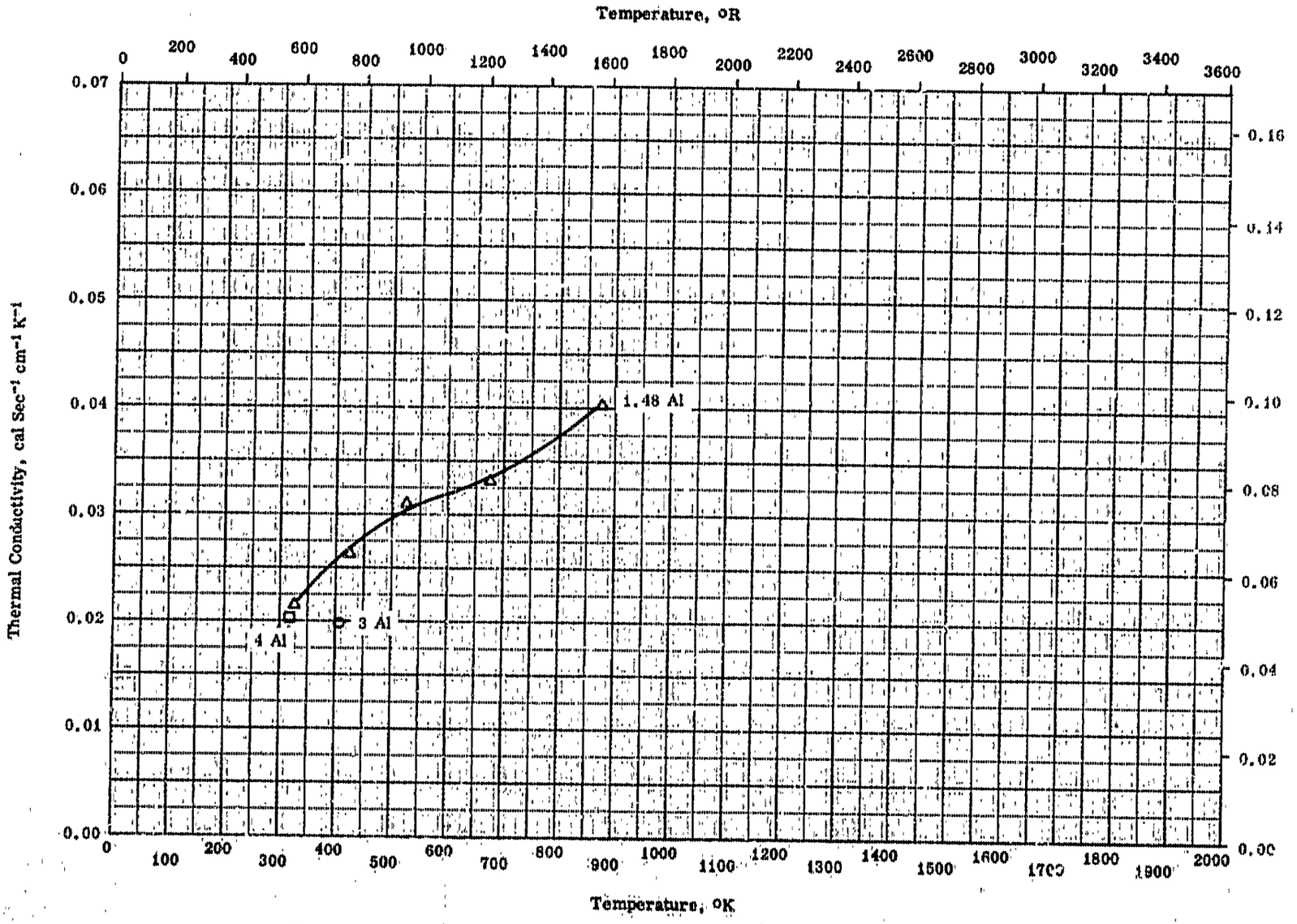
ELECTRICAL RESISTIVITY -- ZIRCONIUM + ALUMINUM

ELECTRICAL RESISTIVITY -- ZIRCONIUM + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
O	61-12	323-873	5	1.43 Al, 0.14 C, 0.11 Fe, 0.10 O_2, and 0.0045 N_2; prepared by graphite-melted Zr.	Extruded.

TPRC



THERMAL CONDUCTIVITY -- ZIRCONIUM + ALUMINUM

THERMAL CONDUCTIVITY -- ZIRCONIUM + ALUMINUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	56-11	373-407		3 Al.	
□	54-5	319		4 Al.	
△	61-12	323-873		1.48 Al, 0.14 C, 0.11 Fe, 0.10 O_2, 0.0045 N_2; graphite-melted Zr as raw material.	Extruded.

TPRC

PROPERTIES OF ZIRCONIUM + BORON

REPORTED VALUES

Density:		g cm^{-3}	lb ft^{-3}
○	0.44 B	6.5055	406.13
□	0.78 B	6.4940	405.41
△	1.21 B	6.4796	404.51
▽	1.77 B	6.4489	402.59

PROPERTIES OF ZIRCONIUM + BORON

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-38	298		0.44 B.	Alloy made by 2 consumable electrode melts in sequence in arc furnace with He atm and extruded repeatedly; average value of 2-4 test each from weight and volume by CCl_4 displacement.
□	57-38	298		0.78 B.	Same as above.
△	57-38	298		1.21 B.	Same as above.
▽	57-38	298		1.77 B.	Same as above.

TPRC

PROPERTIES OF ZIRCONIUM + HAFNIUM

REPORTED VALUES

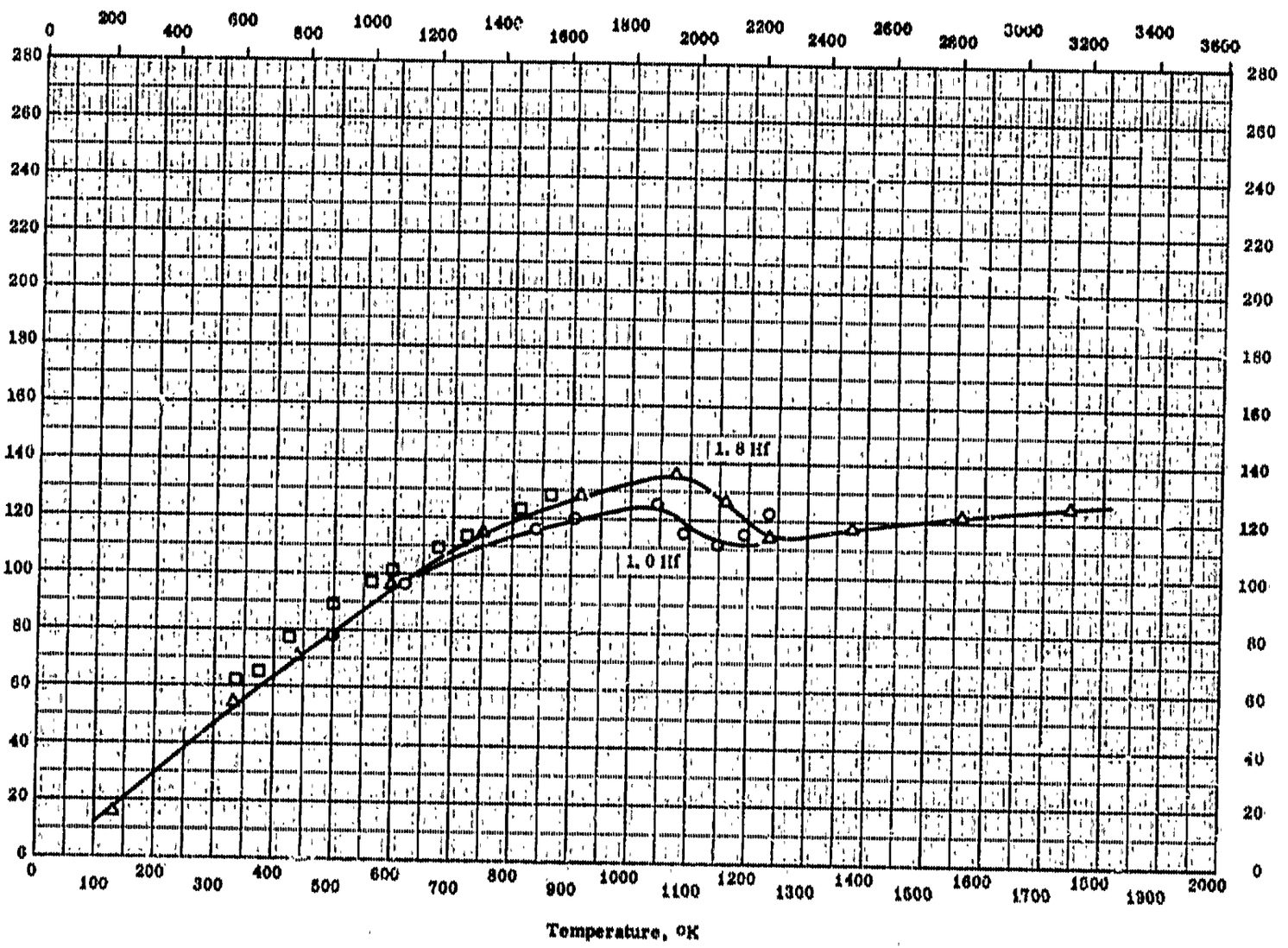
Density:		$g\ cm^{-3}$	$lb\ ft^{-3}$
□	2.4 Hf	6.565	409.8
△	2.4 Hf; annealed	6.566	409.9
▽	0.2 Hf	6.49	405

Heat of Sublimation:		$cal\ g^{-1}$	$Btu\ lb^{-1}$
◇	1.92 Hf	$1558 \pm 3.8_{0\,K}$	$2805 \pm 6.9_{0\,R}$

PROPERTIES OF ZIRCONIUM + HAFNIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
◇	51-12	0		1.92 Hf, 0.1 0 W, and 0.11 others (including Al and Si).	Δh_s from vapor pressure data
□	51-13	298		2.4 Hf, 0.115 Fe, 0.039 O_2, 0.022 Si, 0.010 >Mg, 0.009 Ti, 0.008 Al, 0.007 N_2, 0.005 >Cr, 0.005 >Ni, 0.002 Mn, and 0.002 Ca.	Density from x-ray lattice measurements
△	54-23	293		97.4 Zr and 2.4 Hf.	Annealed; density from x-ray lattice measurements.
▽	47-4	298		0.2 Hf and small amount of O, N, H, and C.	Density computed from x-ray lattice measurements.



TPRC

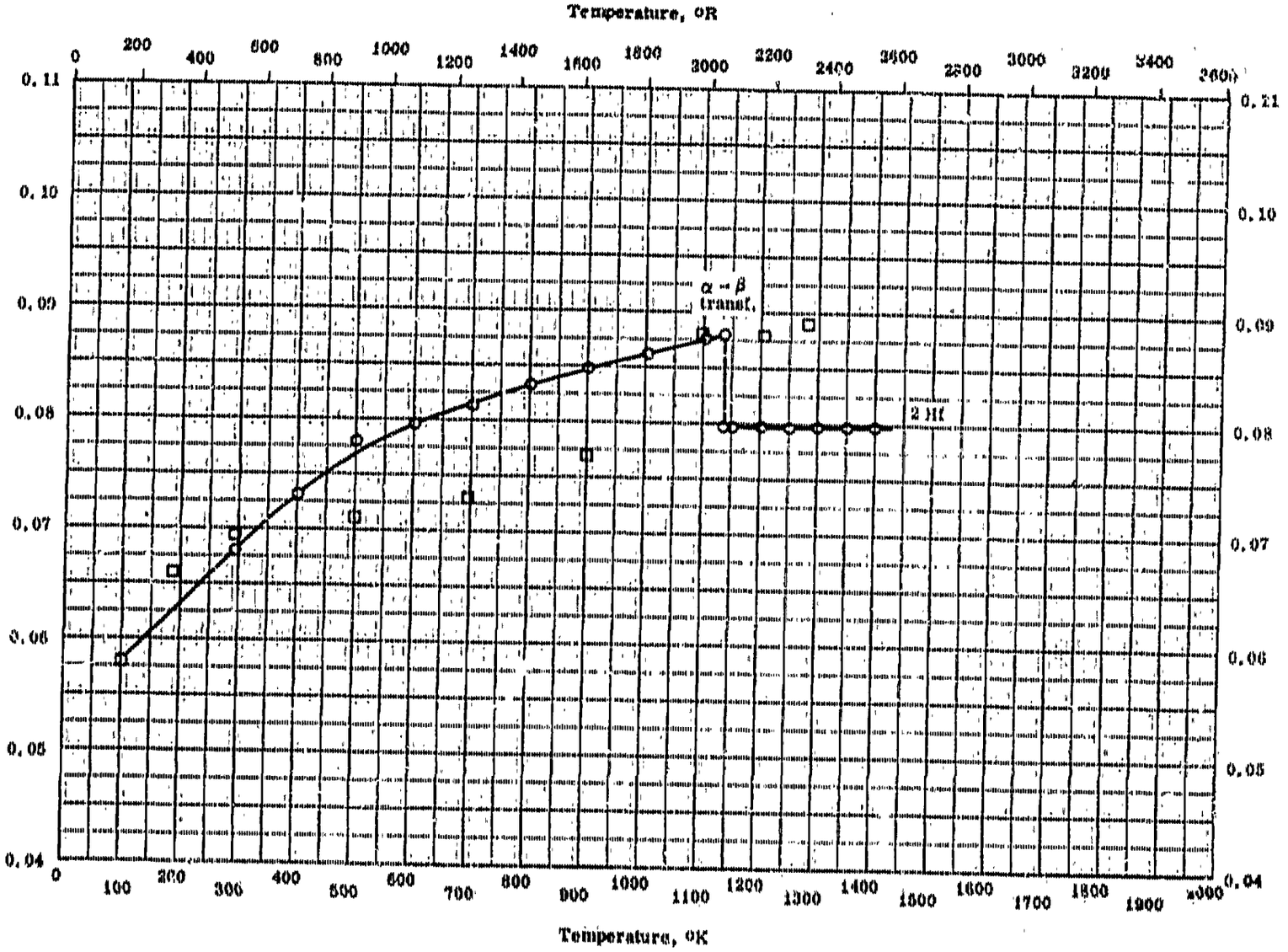
ELECTRICAL RESISTIVITY -- ZIRCONIUM + HAFNIUM

ELECTRICAL RESISTIVITY -- ZIRCONIUM + HAFNIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range, °K	Rept. Error %	Sample Specifications	Remarks
○	41-2	300-1256		1 Hf and 0.11 Fe; large crystals of ductile material.	Annealed in vacuum after swaging; tested in vacuum.
△	50-7	73-1773		1.8 Hf, 0.05 each Fe, Ta, 0.03 Si, 0.005 each Ti, Cr, 0.005> Cu, 0.003 Al, 0.002 Ni, 0.001 each Mg, Pb, Mo, 0.001> each Co, Mn, and C, 0.0005 Cu; foote crystal bar.	Annealed above recrystallization temp.
□	57-7	330-864		0.97 Hf and 0.3 C.	Annealed 2 hrs at 760 C and water-quenched.

TPRC

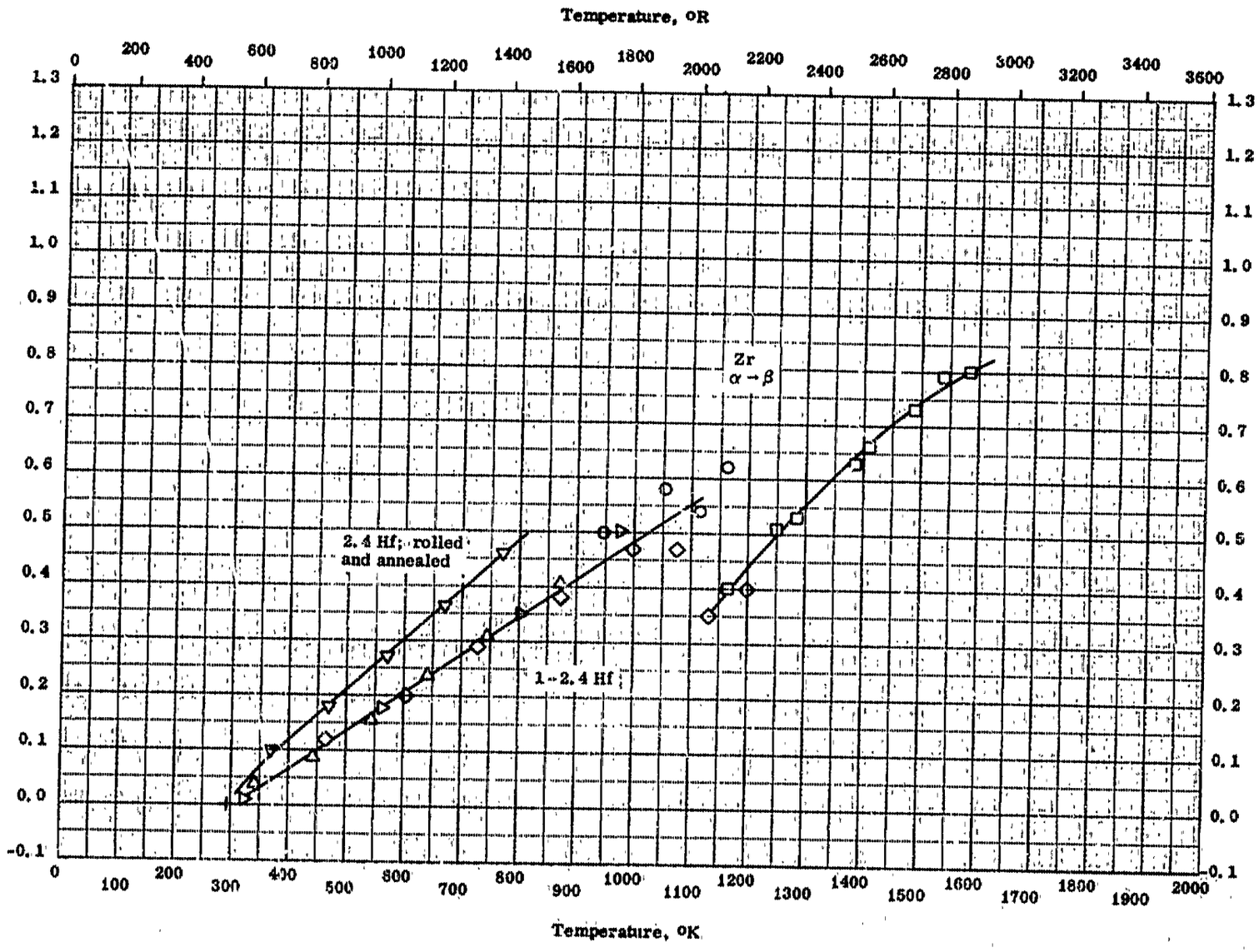


SPECIFIC HEAT — ZIRCONIUM + HAFNIUM

SPECIFIC HEAT -- ZIRCONIUM + HAFNIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	50-5	298-1400		2.15 Hf.	
□	41-2	100-1280		1.0 Hf, 0.11 Fe.	Large crystals of ductile material.



THERMAL LINEAR EXPANSION — ZIRCONIUM + HAFNIUM

TPRC

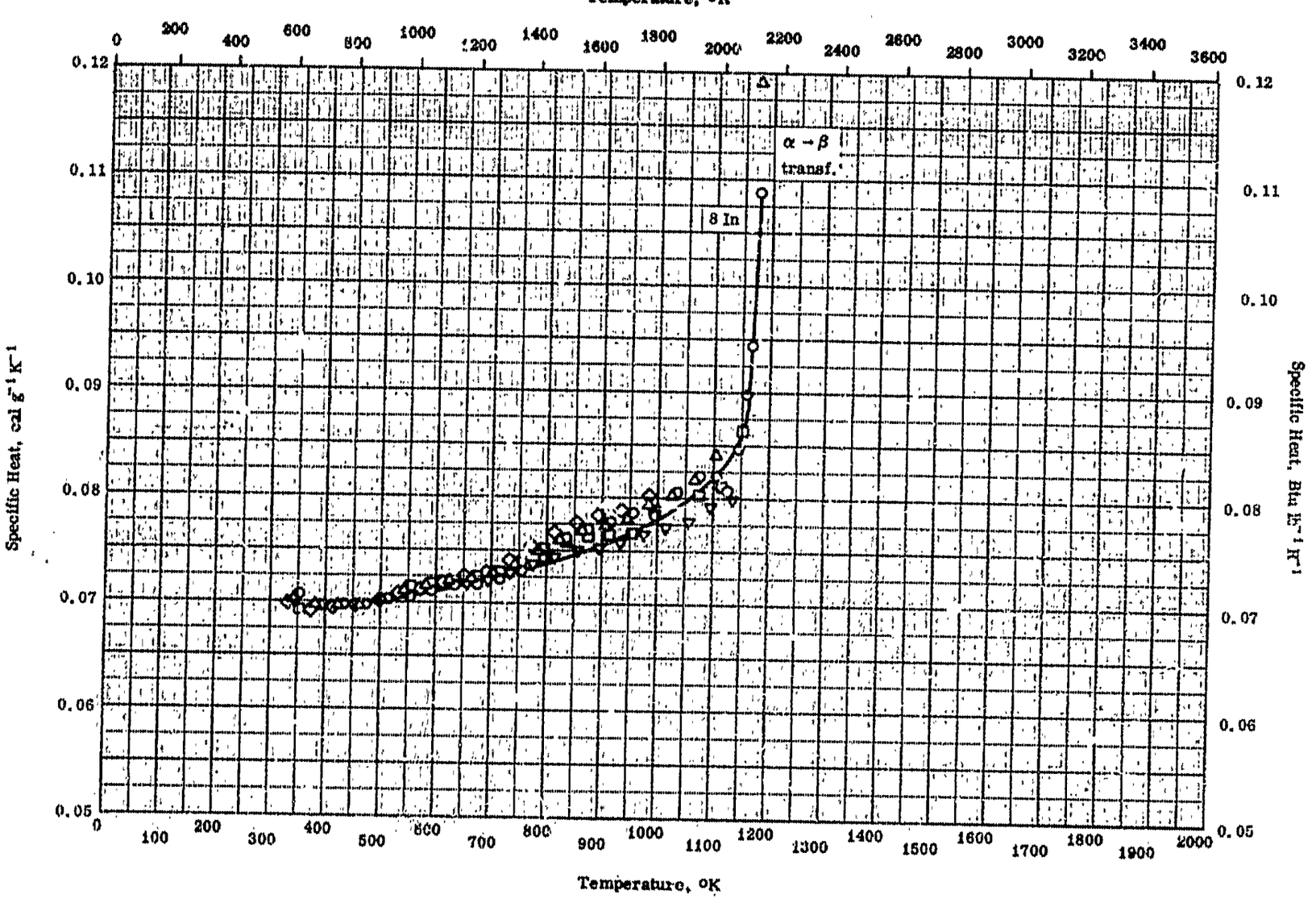
677

THERMAL LINEAR EXPANSION -- ZIRCONIUM + HAFNIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repr. Error %	Sample Specifications	Remarks
○	53-27	950-1164	10-14	α - Zr; hexagonal; 1.92 Hf, 0.10 W, and 0.4 others including Si and Al (assuming at. wt. of others is 100).	
□	53-27	1166-1584	7	β - Zr; cubic; same composition as above.	
◇	41-2	273-1200		1 Hf and 0.11 Fe.	Large Crystal of ductile material.
△	54-23	272-889		α - Zr, hexagonal close packed; 2.4 Hf.	Annealed.
▽	50-18	298-772		2.4 Hf, 0.0180 Al, 0.055 N, 0.0050 > Ni, Cr each, 0.003 O, 0.0025 Mg, 0.0025 > Mn, Ca each, and 0.0020 Si.	Rolled, prickpunched to decrease orientation effect of rolling, and vacuum annealed 30 hrs at 550 C.
▷	51-13	323-973		97.406 Zr (by diff.), 2.4 Hf, 0.115 Fe, 0.022 Si, 0.008 Al, 0.005 Ti, 0.005 > Cr, Ni each, 0.003 Mg, 0.0025 > Mn, and 0.002 Ca.	

TPRC



TPRC

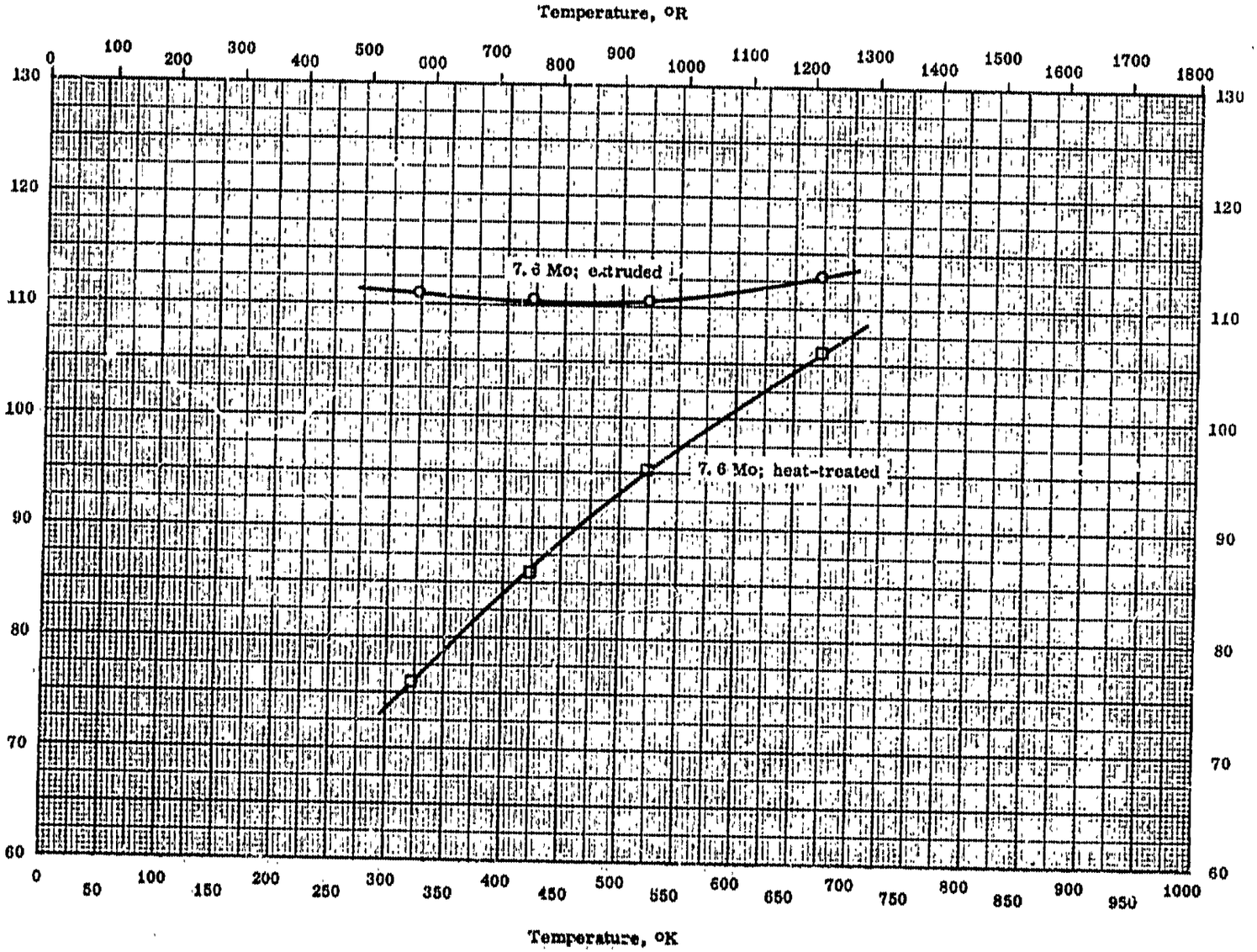
SPECIFIC HEAT -- ZIRCONIUM + INDIUM

679

SPECIFIC HEAT -- ZIRCONIUM + INDIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-17	363-1178		92.23 Zr, 7.77 In, 0.021 Fe, 0.016 O_2, 0.0067 C, 0.003 N_2, and 0.00051 H. [Author's design.: Run 54]	Arc melted; homogenized 14 days at 1300 C in vacuum.
□	57-17	363-1153		Same composition as above. [Author's design.: Run 55]	Same as above.
△	57-17	343-1173		Same composition as above. [Author's design.: Run 56]	Same as above.
◇	57-17	333-1013		Same composition as above. [Author's design.: Run 58]	Same as above.
▽	57-17	333-1133		Same composition as above. [Author's design.: Run 59]	Same as above.



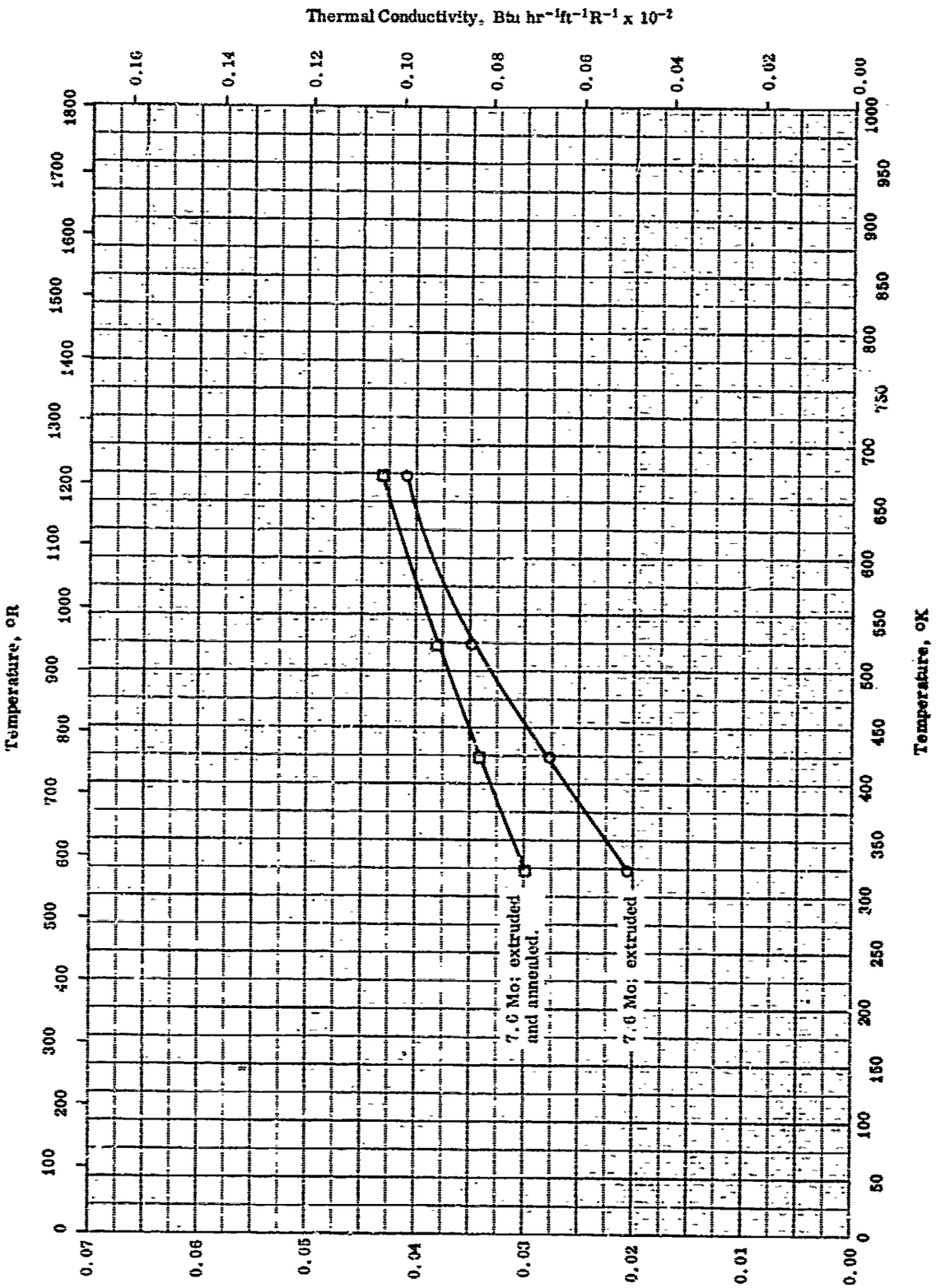
TPRC

ELECTRICAL RESISTIVITY -- ZIRCONIUM + MOLYBDENUM

ELECTRICAL RESISTIVITY -- ZIRCONIUM + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Reported Error %	Sample Specifications	Remarks
○	61-12	323-673		7.6 Mo, 0.14 C, 0.10 O_2, and 0.015 Fe; prepared by graphite-melted Zr.	Extruded.
□	61-12	323-673		Same as above.	Heat-treated to 620 C.



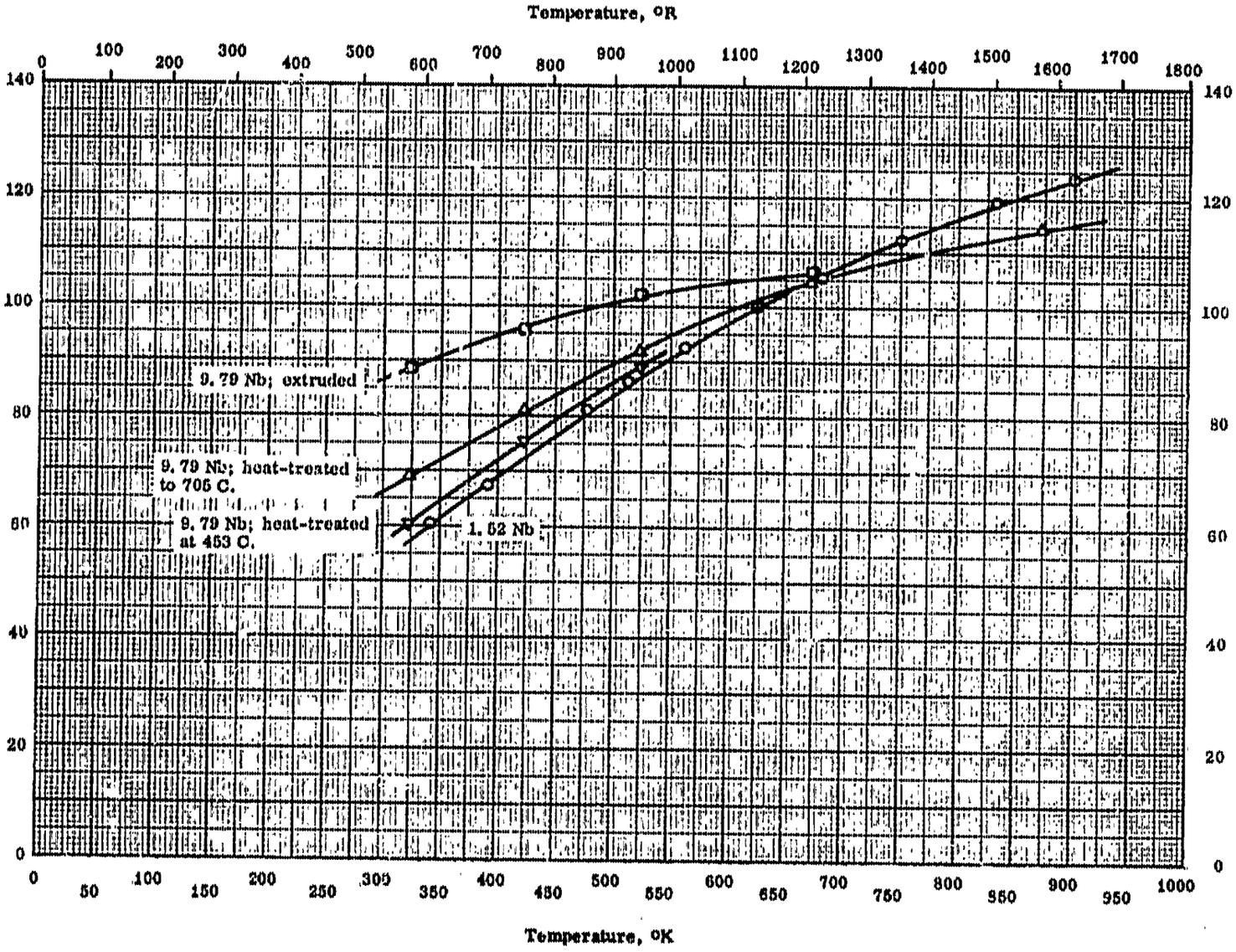
THERMAL CONDUCTIVITY -- ZIRCONIUM + MOLYBDENUM

THERMAL CONDUCTIVITY — ZIRCONIUM + MOLYBDENUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	61-12	323-673		7.6 Mo, 0.14 C, 0.10 O_2, and 0.015 Fe; graphite-melted Zr as raw material.	Extruded.
□	61-12	323-673		Same as above.	Extruded and heat-treated at 680 C.

TPRC

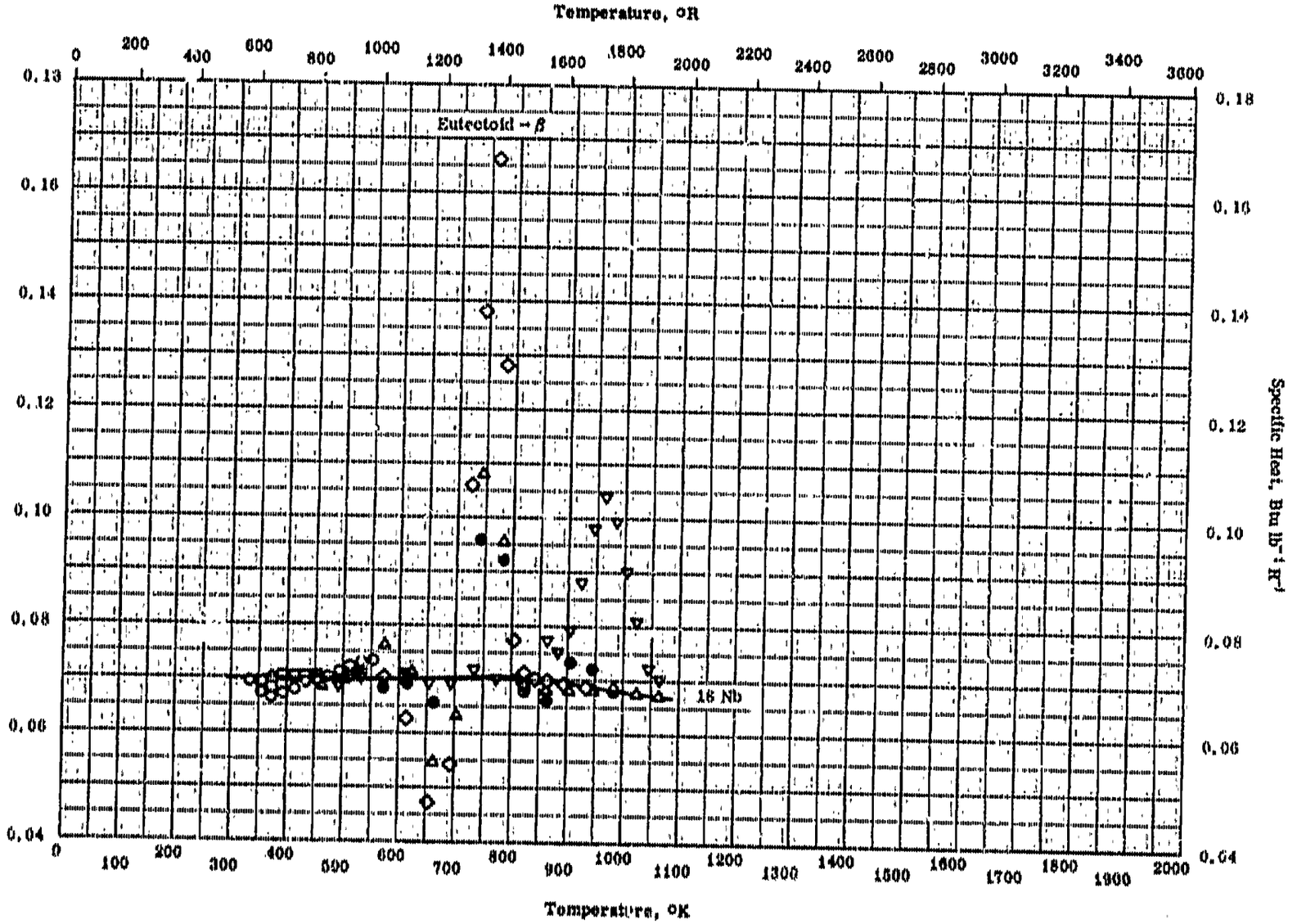


ELECTRICAL RESISTIVITY -- ZIRCONIUM + NIOBIUM

ELECTRICAL RESISTIVITY -- ZIRCONIUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-7	343-900		1.52 Nb, 0.14 Hf, and 0.08 C.	Annealed 48 hrs at 600 C in vacuum and water quenched.
□	61-12	323-673	5	0.70 Nb, 0.10 C, and 0.06 Fe; prepared from graphite-melted Zr.	Extruded.
△	61-12	323-873	5	Same as above.	Heat-treated to 705 C.
▽	61-12	323-623	5	Same as above.	Heat-treated at 453 C.



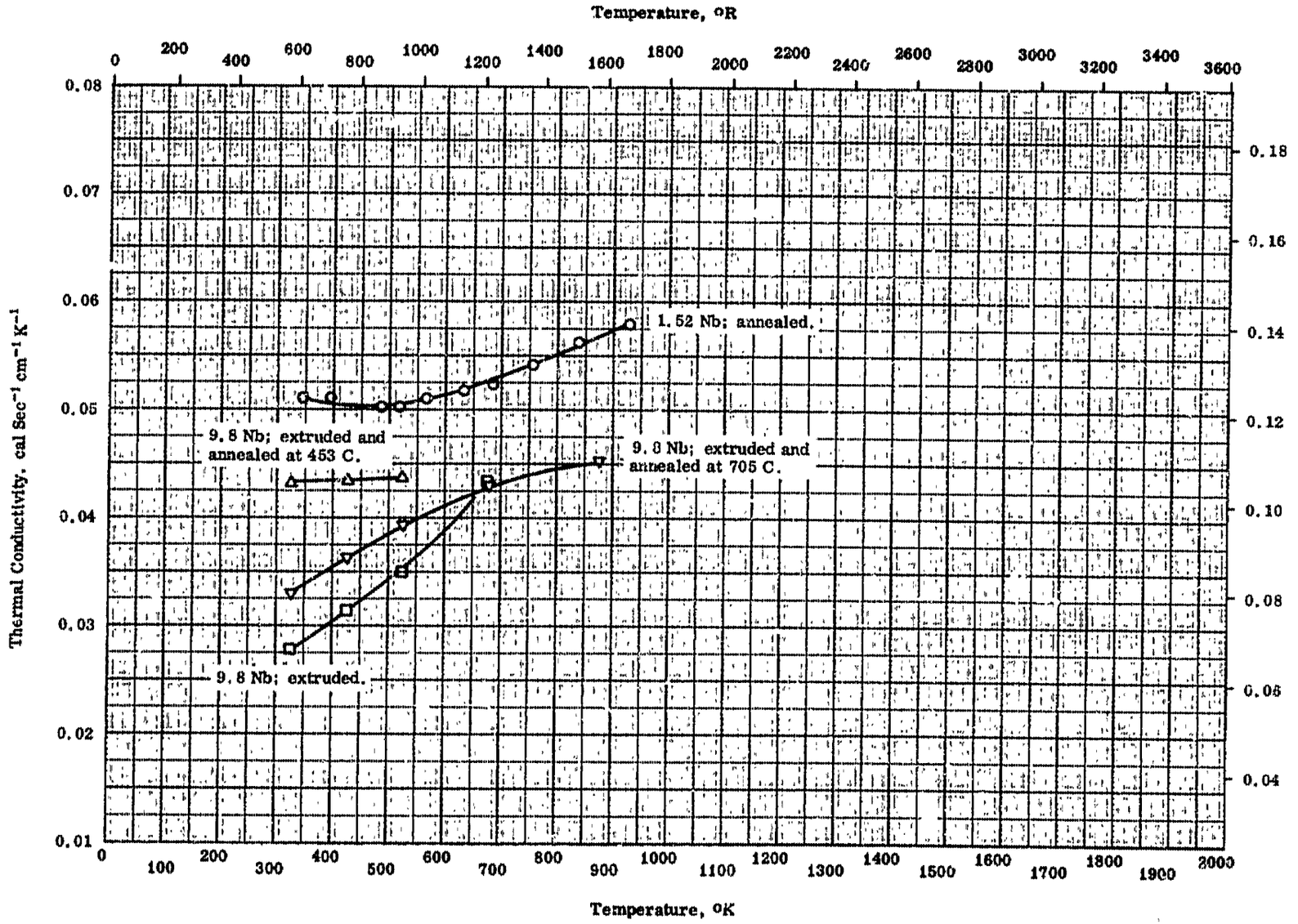
SPECIFIC HEAT — ZIRCONIUM + NIOBIUM

TPRC

SPECIFIC HEAT -- ZIRCONIUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specification	Remarks
○	57-17	333-553		Eutectoid composition; 82.5 Zr and 17.5 Nb. [Author's design.: Run 67]	Arc melted; cut into pieces and remelted twice.
□	57-17	333-553		Same as above. [Author's design.: Run 68]	Same as above.
△	57-17	343-1063		Same as above. [Author's design.: Run 69]	Same as above; heating rate during test at 200 C is 7 C min^{-1}.
◇	57-17	373-933		Same as above. [Author's design.: Run 70]	Same as above; cooled in the calorimeter to room temperature from temperature of Run 69.
▽	57-17	333-1063		Same as above. [Author's design.: Run 77]	Same as above; annealed two weeks at 600 C under rarefied argon.
●	57-17	373-983		Same as above. [Author's design.: Run 79]	Same as above; cooled to room temperature in the calorimeter from temperature of Run 77.



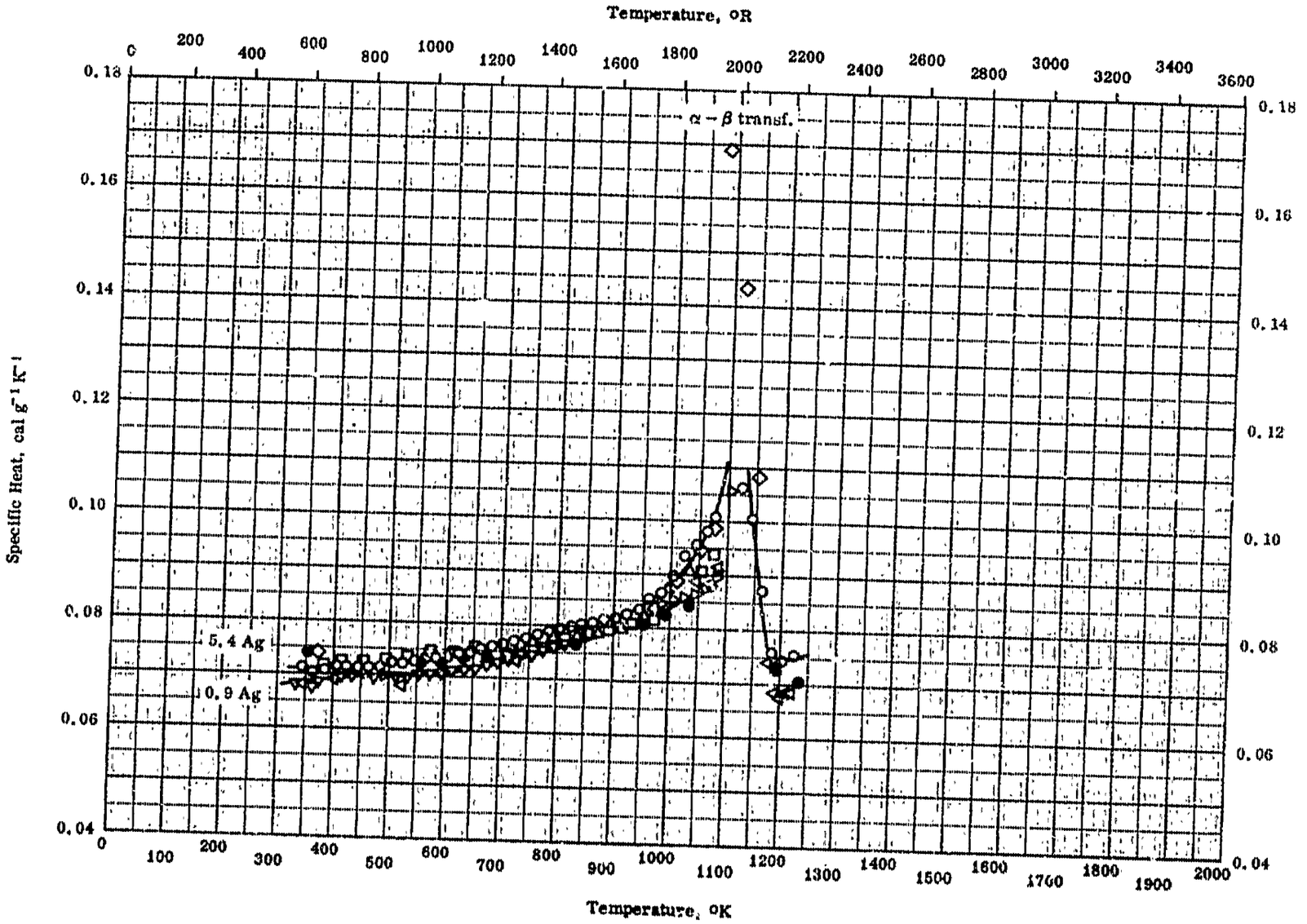
THERMAL CONDUCTIVITY -- ZIRCONIUM +NIOBIUM

THERMAL CONDUCTIVITY -- ZIRCONIUM + NIOBIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-7	342-928		1.52 Nb, 0.14 Hf, and 0.08 C.	Annealed 48 hrs at 600 C in vacuum and water quenched.
□	61-12	323-673		9.79 Nb, 0.19 C, and 0.06 Fe; graphite-melted Zr as raw material.	Extruded.
△	61-12	323-523		Same as above.	Extruded and heat-treated at 453 C.
▽	61-12	323-873		Same as above.	Extruded and heat-treated at 705 C.

TPRC



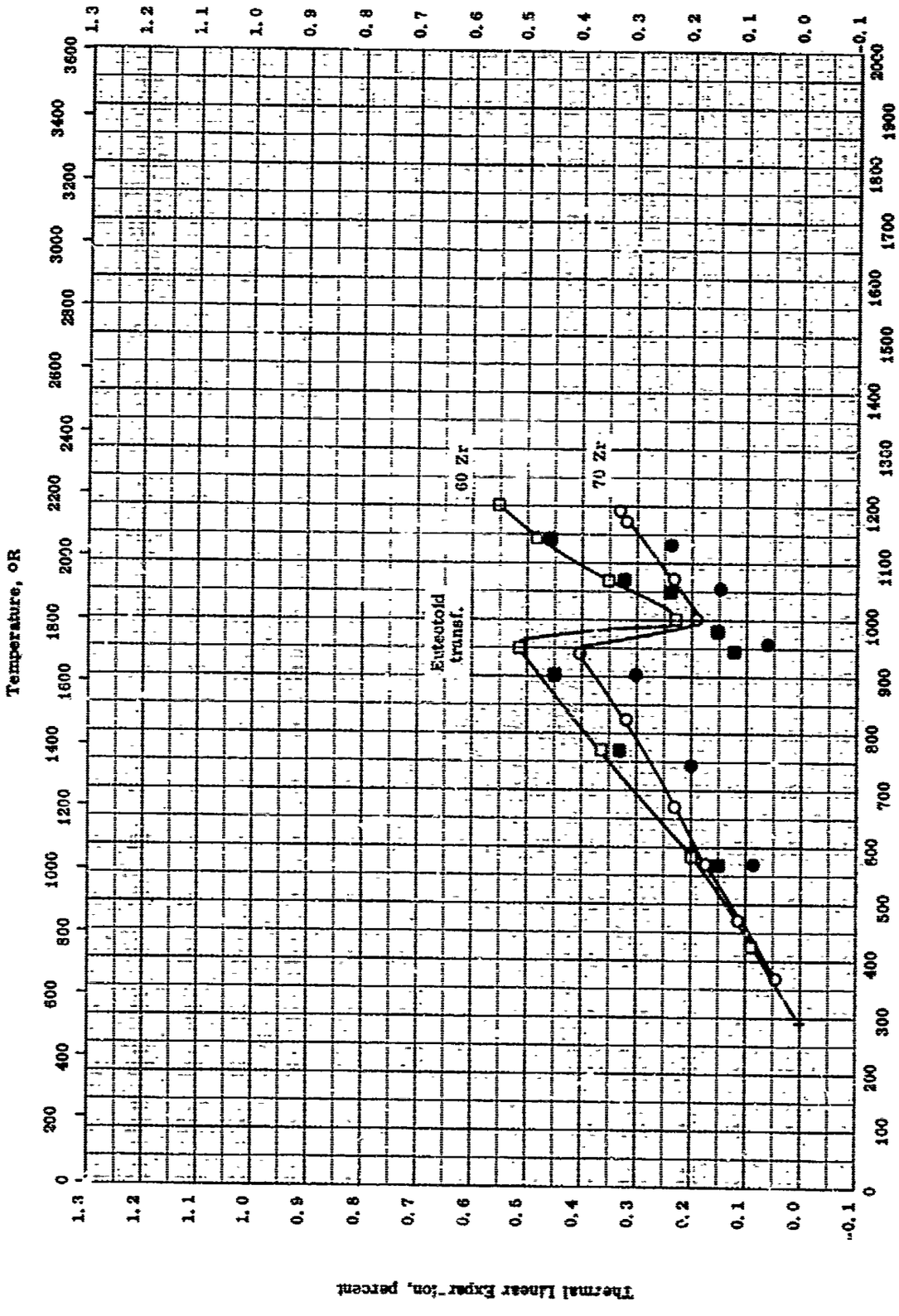
SPECIFIC HEAT -- ZIRCONIUM + SILVER

SPECIFIC HEAT -- ZIRCONIUM + SILVER

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-17	343-1223		5.37 Ag, 0.028 Fe, 0.042 O_2, 0.0130 C, 0.0020 Cu, 0.0011 H_2, and 0.00049 N_2. [Author's design.: Run 32]	Arc melted; homogenized 14 days at 1300 C under 0.01 μ Hg vacuum.
□	57-17	383-1078		Same composition as above. [Author's design.: Run 33]	Same as above.
△	57-17	633-1033		Same composition as above. [Author's design.: Run 36]	Same as above.
◇	57-17	373-1153		Same composition as above. [Author's design.: Run 37]	Same as above.
▽	57-17	333-873		0.881 Ag, 0.036 Fe, 0.015 O_2, 0.014 C, 0.004 Cu, 0.0008 N_2, 0.00044 H_2. [Author's design.: Run 13]	Arc melted; homogenized 14 days at 1300 C under 0.01 μ Hg vacuum.
▷	57-17	373-1103		Same composition as above. [Author's design.: Run 14]	Same as above.
◁	57-17	343-923		Same composition as above. [Author's design.: Run 15]	Same as above.
●	57-17	353-1233		Same composition as above. [Author's design.: Run 50]	Same as above.

TPRC



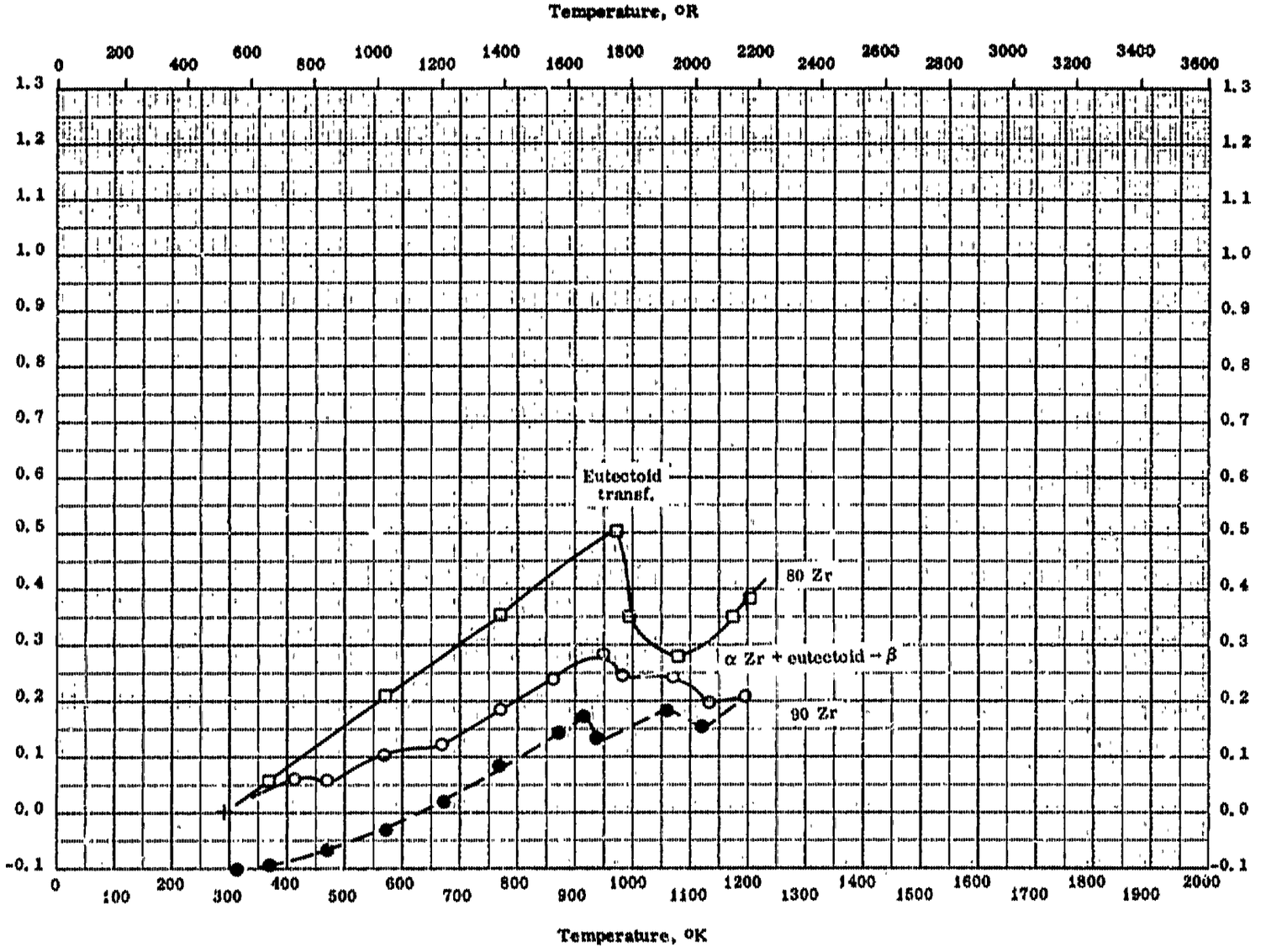
THERMAL LINEAR EXPANSION -- ZIRCONIUM + THORIUM
(60 ≤ Zr ≤70)

THERMAL LINEAR EXPANSION -- ZIRCONIUM + THORIUM
(60 ≤ Zr ≤70)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-23	293-1193		70 Zr and 30 Th.	Heating.
●	52-23	573-1193		Same as above.	Cooling.
□	52-23	293-1203		60 Zr and 40 Th.	Heating.
■	52-23	571-1203		Same as above.	Cooling.

TPRC



THERMAL LINEAR EXPANSION -- ZIRCONIUM + THORIUM
(80 ≤ Zr ≤90)

THERMAL LINEAR EXPANSION -- ZIRCONIUM + THORIUM
(80 ≤ Zr ≤ 90)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	62-23	293-1198		90 Zr and 10 Th.	Heating.
●	62-23	316-1198		Same as above.	Cooling.
□	62-23	293-1203		80 Zr and 20 Th.	

TPRC

PROPERTIES OF ZIRCONIUM + TIN

REPORTED VALUES

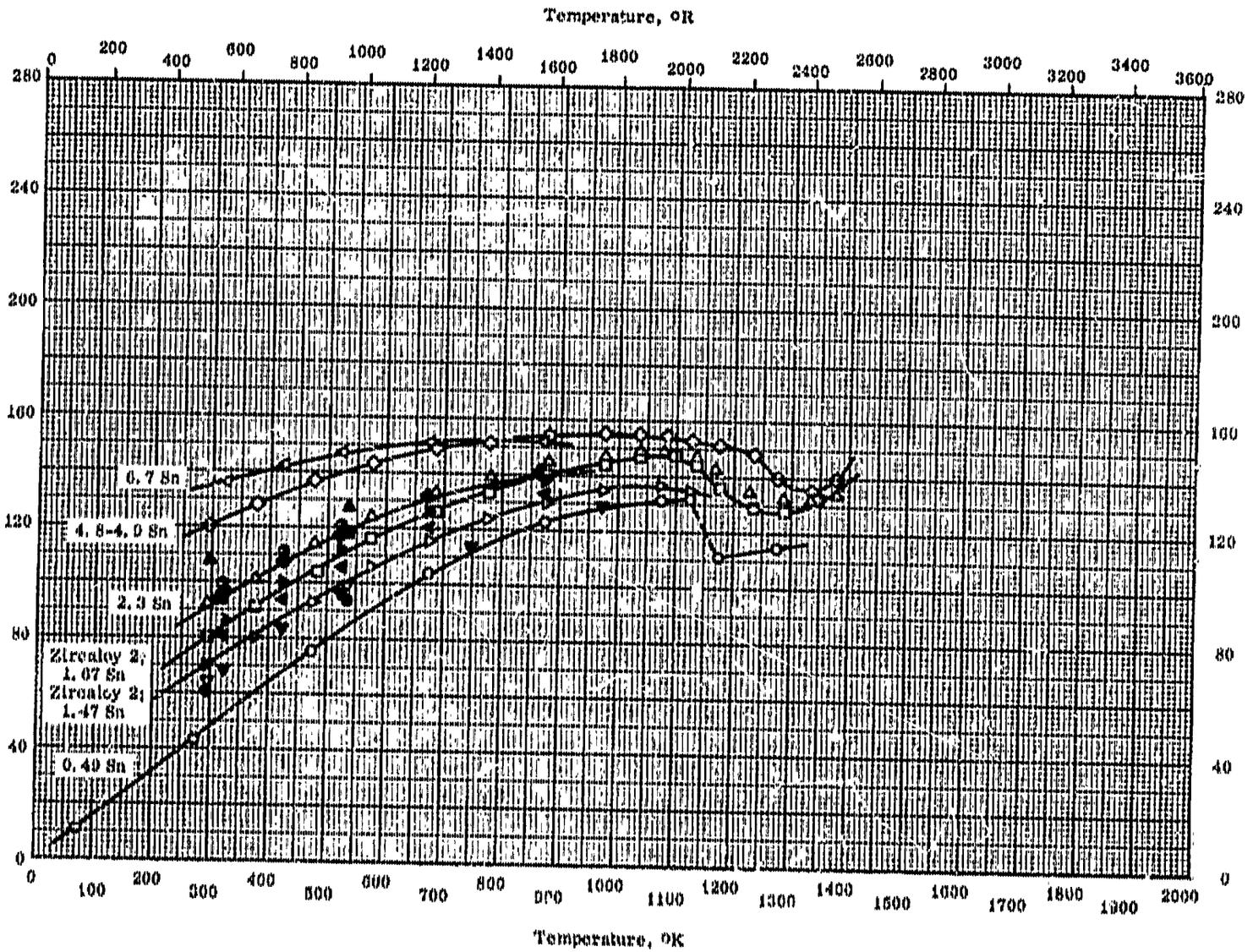
Density:		g cm^{-3}	lb ft^{-3}
○	1.36 Sn	6.4789	404.46
□	1.40 Sn	6.5399	408.27
△	1.46 Sn	6.4880	405.03
▽	1.54 Sn	6.5164	406.81
◇	1.58 Sn	6.4789	405.66

PROPERTIES OF ZIRCONIUM + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Repl. Error %	Sample Specifications	Remarks
○	57-38	298		1.30 Sn.	Alloy made by two consumable electrode melts in sequence in arc furnace with He atm and extruded repeatedly; average value of 2-4 test each from weight and volume by CCl_4 displacement.
□	57-38	298		1.40 Sn.	Same as above.
△	57-38	298		1.46 Sn.	Same as above.
▽	57-38	298		1.54 Sn.	Same as above.
◇	57-38	298		1.68 Sn.	Same as above.

TPRC



ELECTRICAL RESISTIVITY — ZIRCONIUM + TIN

TPRC

ELECTRICAL RESISTIVITY -- ZIRCONIUM + TIN

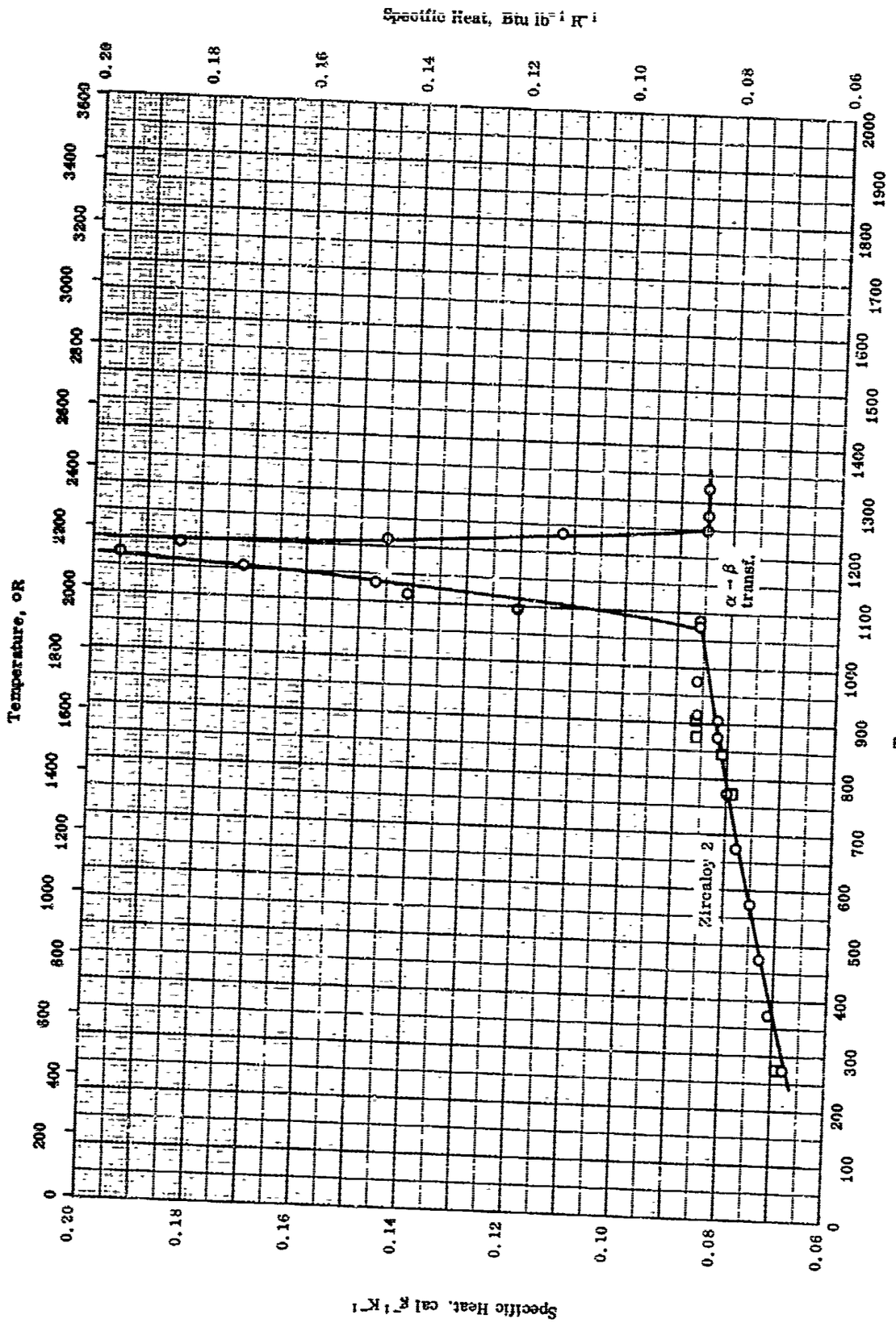
REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-26	73-1273		0.49 Sn, 0.08 O_2, 0.05> Hf, 0.02 Fe, and 0.01 C.	
□	54-14	293-1323	± 2	Zircaloy 2; 1.67 Sn, 0.20 Fe, 0.10-0.11 Cr, 0.05 Ni, and 0.17-0.20 C.	Melted in vacuum induction furnace; forged at 900 C and rolled at 815-840 C.
△	54-14	293-1323	± 2	Sponge Zirconium; 2.58-2.65 Sn, 0.16-0.21 C, and 0.009 N.	Melted in vacuum induction furnace; forged at 900-925 C and rolled at 815-840 C.
◇	54-14	293-1323	± 2	Sponge Zirconium; 4.60-4.93 Sn, 0.17-0.25 C, and 0.009 N.	Melted in vacuum induction furnace; forged at 980-1000 C and rolled at 840-870 C.
▽	51-7	298-533	± 1	1 Sn; actual: 1.00 Sn, 0.155 Fe, 0.022 Hf, 0.013 C, 0.009 Al, 0.005 N, and 0.001 Ti.	
●	51-7	298-533	± 1	1.03 Sn, 0.019 C, and 0.006 N.	
■	51-7	298-533	± 1	3 Sn; actual 2.97-3.02 Sn, 0.04-0.185 Fe, 0.03-0.085 Hf, and 0.1> total of C, Ti, Al, and N.	Mean values for 4 samples of various composition and treatments within a spread of ± 2%.
▲	51-7	298-533	± 1	5 Sn; actual 4.85 Sn, 0.12 C, and 0.1> total of Fe, Hf, Ti, Al, N, and Ni.	
▷	61-21	293-1123		Zircaloy 2; 1.47 Sn, 0.125 Fe, 0.086 Cr, and 0.056 Ni.	
▼	61-12	323-873	5	0.84 Sn, 0.1 C, and 0.04 Fe; prepared by graphite-melted Zr.	Extruded.
◀	61-12	323-873	5	1.37 Sn, 0.14 Fe, 0.13 C, 0.098 O_2, 0.09 Cr, 0.07 Ni, and 0.608 Ca; prepared by graphite-melted Zr.	Extruded.
▶	61-12	323-873	5	1.65 Sn, 0.14 O_2, 0.13 C, and 0.05 Fe; prepared by graphite-melted Zr.	Extruded.

(Continued onto next page)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
◆	61-12	323-873	5	2.3 Sn, 0.14 O_2, 0.10 C, 0.02 Fe, and 0.007 N_2; prepared by graphite-melted Zr.	Extruded.
●	61-12	323-873	5	2.38 Sn, 0.14 C, 0.14 O_2, 0.12 Fe, ≈0.1 Al, and ≈0.05 Nb; prepared by graphite-melted Zr.	Extruded.
◁	61-12	323-873	5	6.7 Sn, 0.10 C, 0.10 O_2, 0.05 Fe, and 0.007 N_2; prepared by graphite-melted Zr.	Extruded.

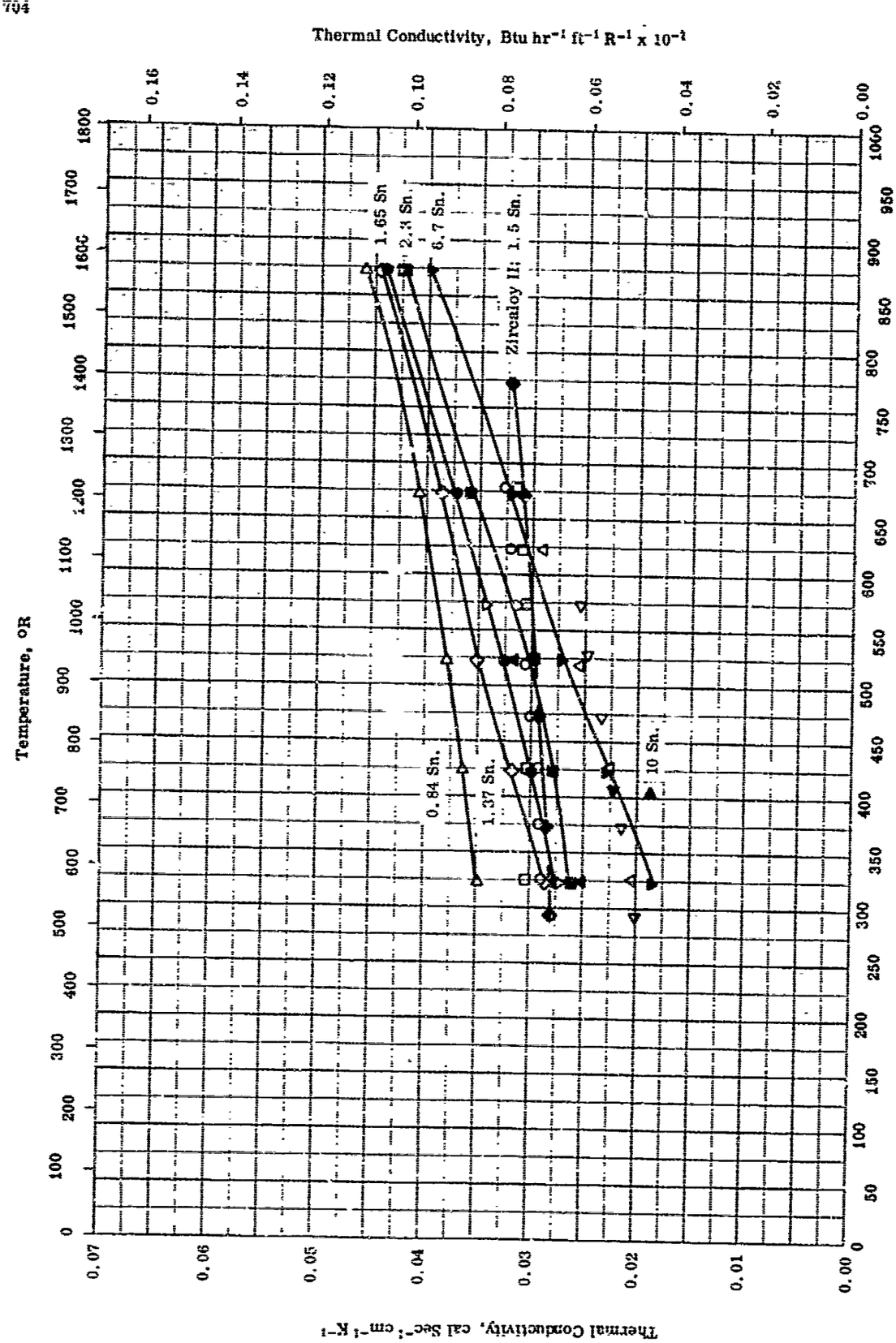


SPECIFIC HEAT -- ZIRCONIUM + TIN

SPECIFIC HEAT -- ZIRCONIUM + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-14	273-1323		Zircaloy 2; nominal composition: 1.5 Sn, 0.15 Fe, 0.10 Cr, and 0.05 Ni.	
□	63-14	273-1323		Low-nickel Zircaloy 2 (Zircaloy 4); nominal composition: 1.32 Sn, 0.152 Fe, 0.099 Cr, and 0.001 Ni.	



THERMAL CONDUCTIVITY — ZIRCONIUM + TIN

THERMAL CONDUCTIVITY -- ZIRCONIUM + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	53-9	323-673		2.3 Sn, 0.002 N_2; prepared from sponge Zr.	Arc-melted, forged, and rolled at 1600 F.
□	53-9	323-673		2.51 Sn, 0.005 N_2; prepared from WAPD Grade I crystal Zr and C. P. Sn.	Arc-melted and forged at 1700 F.
△	53-9	323-673		7.0 Sn; prepared from Foote Grade I crystal bar and C. P. Sn.	Arc-melted.
▽	55-7	323-873		3.0 Sn.	Double melted.
◁	61-7	323-573	±3	95 Zr and 5 Sn; nominal composition.	Induction melted in graphite from low Hf sponge and forged at 1800 F in air.
◀	56-11	407		7.0 Sn.	
▶	56-11	404		10.0 Sn.	
▷	61-12	323-873		0.84 Sn, 0.10 C, and 0.04 Fe; graphite-melted Zr as raw material.	Extruded.
◇	61-12	323-873		1.37 Sn, 0.14 Fe, 0.13 C, 0.098 O_2, 0.09 Cr, 0.07 Ni, and 0.008 Ca; graphite-melted Zr as raw material.	Extruded.
●	61-12	323-873		1.65 Sn, 0.14 O_2, 0.10 C, 0.02 Fe, and 0.007 N_2; graphite-melted Zr as raw material.	Extruded.
■	61-12	323-873		2.3 Sn, 0.14 O_2, 0.10 C, 0.02 Fe, and 0.007 N_2; graphite-melted Zr as raw material.	Extruded.
▲	61-12	323-873		2.38 Sn, 0.14 C, 0.14 O_2, 0.12 Fe, ≈0.1 Al, and ≈0.05 Nb; graphite-melted Zr as raw material.	Extruded.

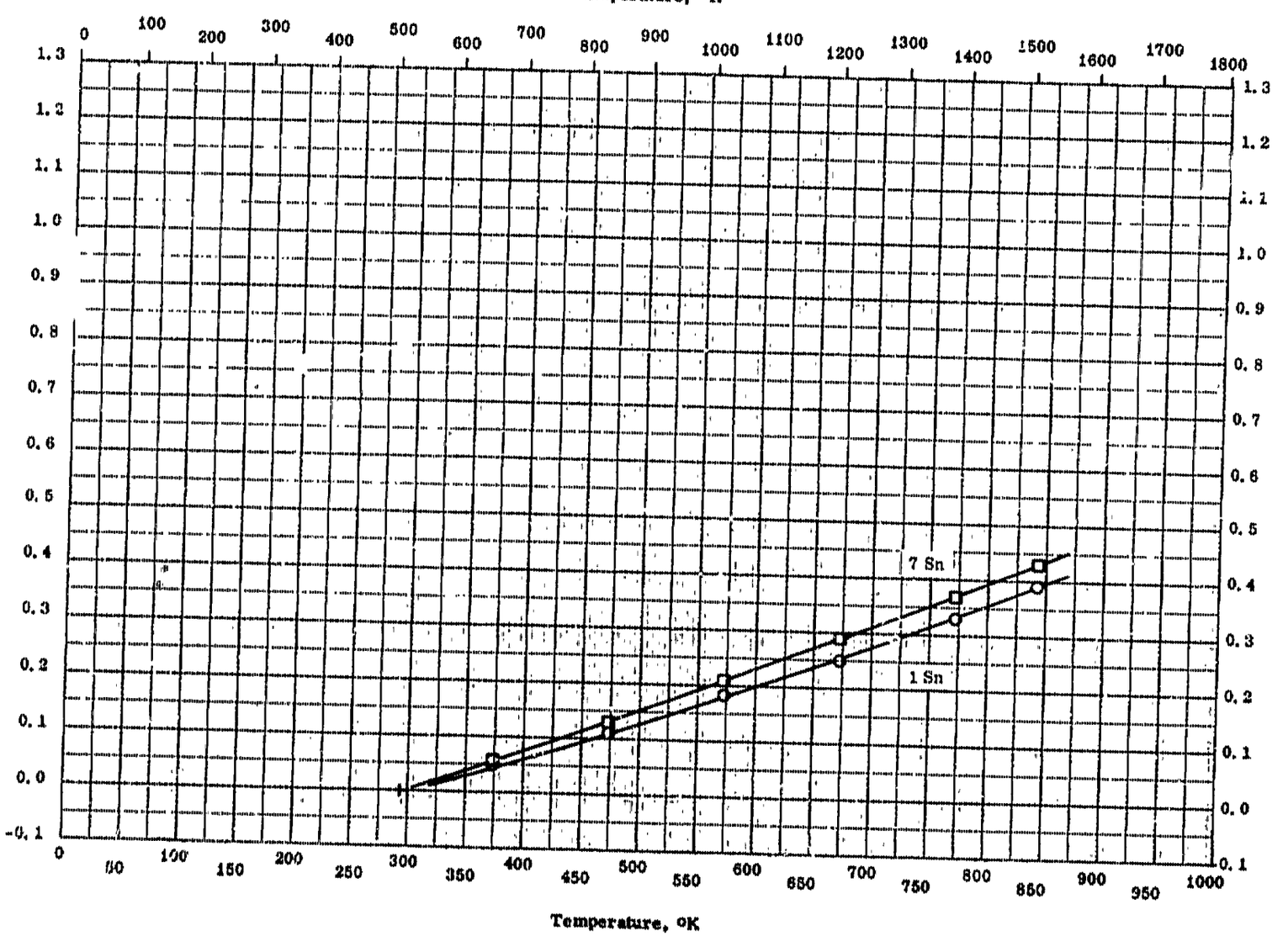
(Continued onto next page)

THERMAL CONDUCTIVITY — ZIRCONIUM + TIN (Continued)

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
▼	61-12	323-373		6.7 Sn, 0.10 C, 0.10 O_2, 0.05 Fe, and 0.007 N_2; graphite-melted Zr as raw material.	Extruded.
◆	59-5	293-772		Zircaloy II; 1.5 Sn, 0.15 Fe, 0.10 Cr, and 0.05 Ni.	

TPRC



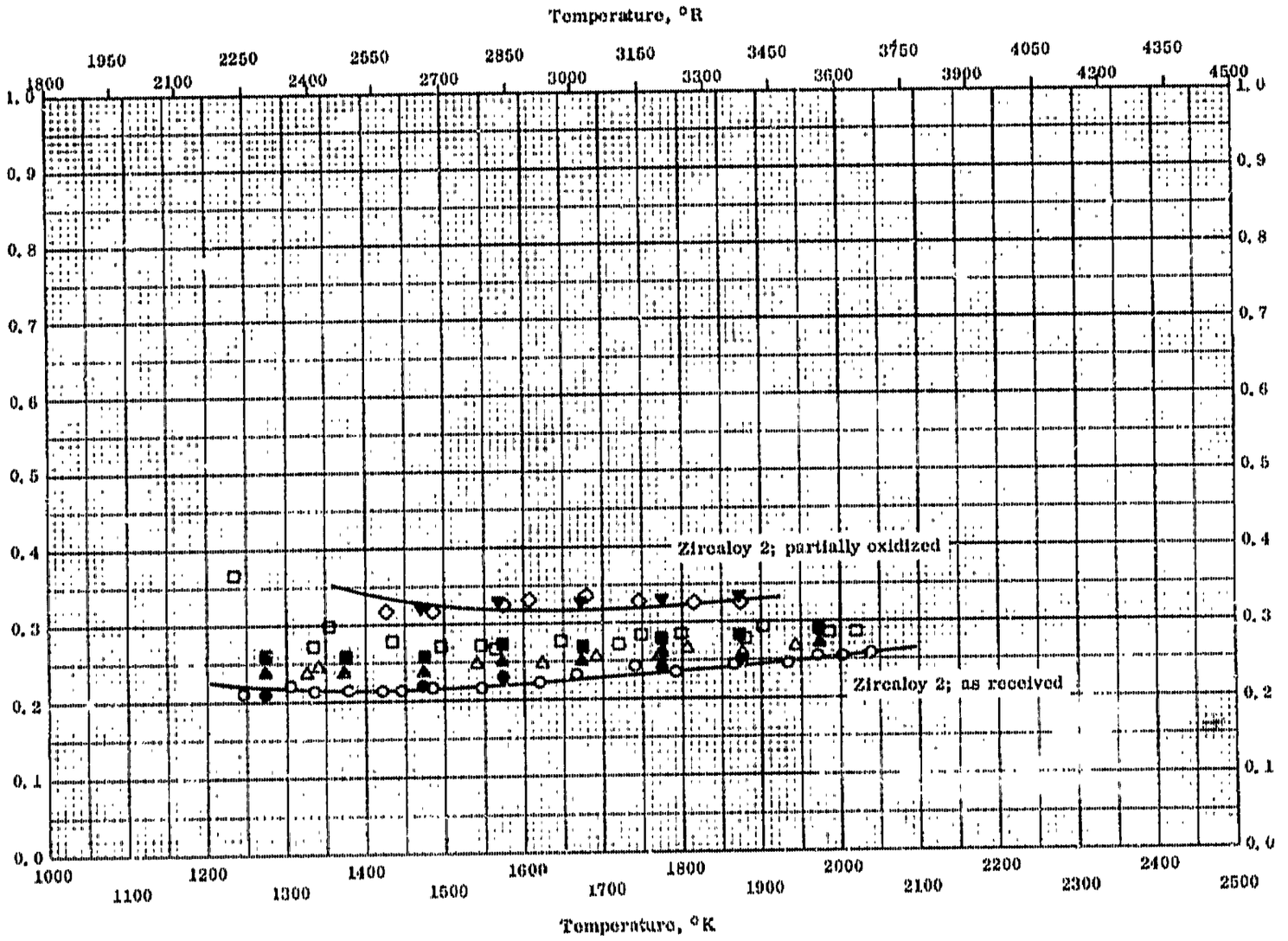
THERMAL LINEAR EXPANSION — ZIRCONIUM + TIN

THERMAL LINEAR EXPANSION -- ZIRCONIUM + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	52-21	303-843		99 Zr, 1 Sn.	Heated in Argon at 25 C min^{-1}; 325 mesh powders pressed at 75 tsi and sintered 10 hrs at 1270 C in vacuum.
□	52-21	303-843		93 Zr, 7 Sn.	Same as above.

TPRC



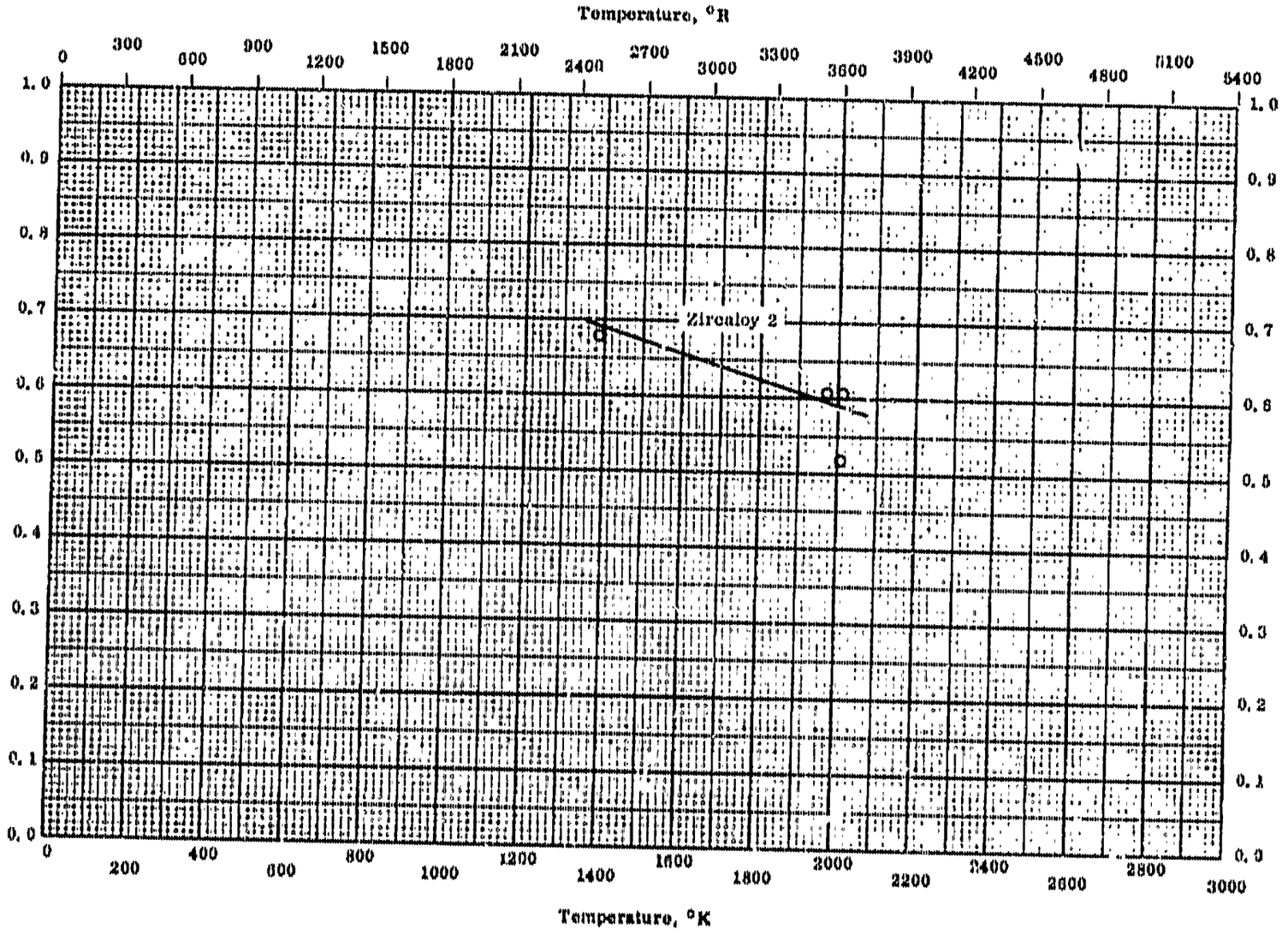
HEMISPHERICAL TOTAL EMITTANCE -- ZIRCONIUM + TIN

HEMISPHERICAL TOTAL EMITTANCE -- ZIRCONIUM + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-47	1246-2038	±3	Zircaloy 2; 98.2 Zr, 1.5 Sn, 0.15 Fe, 0.10 Cr and 0.05 Ni.	As received; measured in vacuum.
△	57-47	1329-1941	±3	Same as above.	5 atomic % oxygen.
□	57-47	1236-2021	±3	Same as above.	10 atomic % oxygen.
◇	57-47	1426-1873	±3	Same as above.	22 atomic % oxygen.
●	56-39	1273-1973		Zircaloy 2; nominal: 1.5 Sn, 0.15 Fe, 0.10 Cr, and 0.05 Ni.	As received.
▲	56-39	1273-1973		Same as above.	Approximately 7.5 atomic % oxygen.
■	56-39	1273-1973		Same as above.	Approximately 15 atomic % oxygen.
▼	56-39	1473-1873		Same as above.	Approximately 30 atomic % oxygen.

TPRC

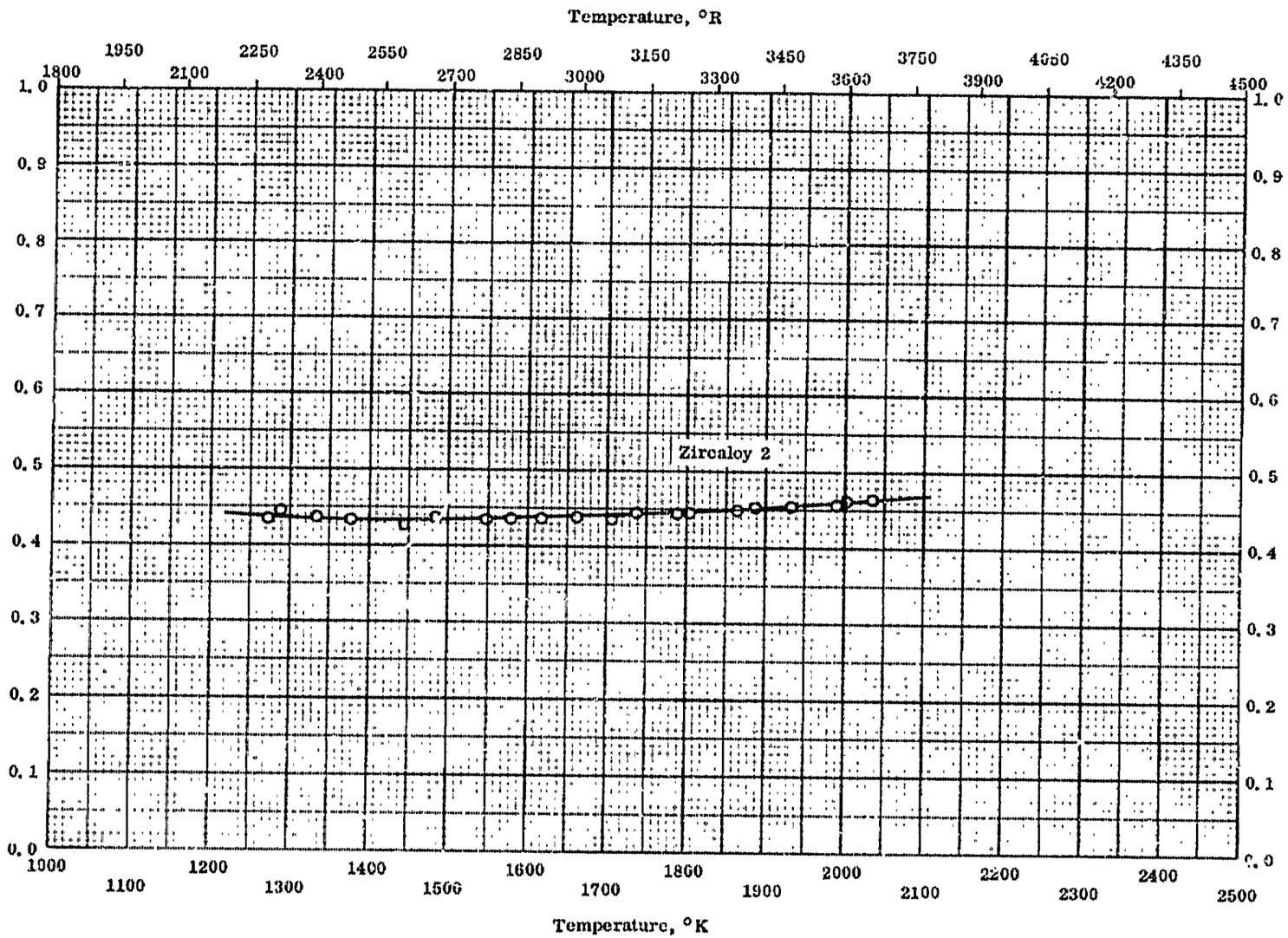


NORMAL TOTAL EMITTANCE -- ZIRCONIUM + TIN

NORMAL TOTAL EMITTANCE -- ZIRCONIUM + TIN

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	57-47	1385-1973		Zircaloy 2; 98.2 Zr, 1.5 Sn, 0.15 Fe, 0.10 Cr, and 0.05 Ni.	Liquid state; measured in vacuum.



TPRC

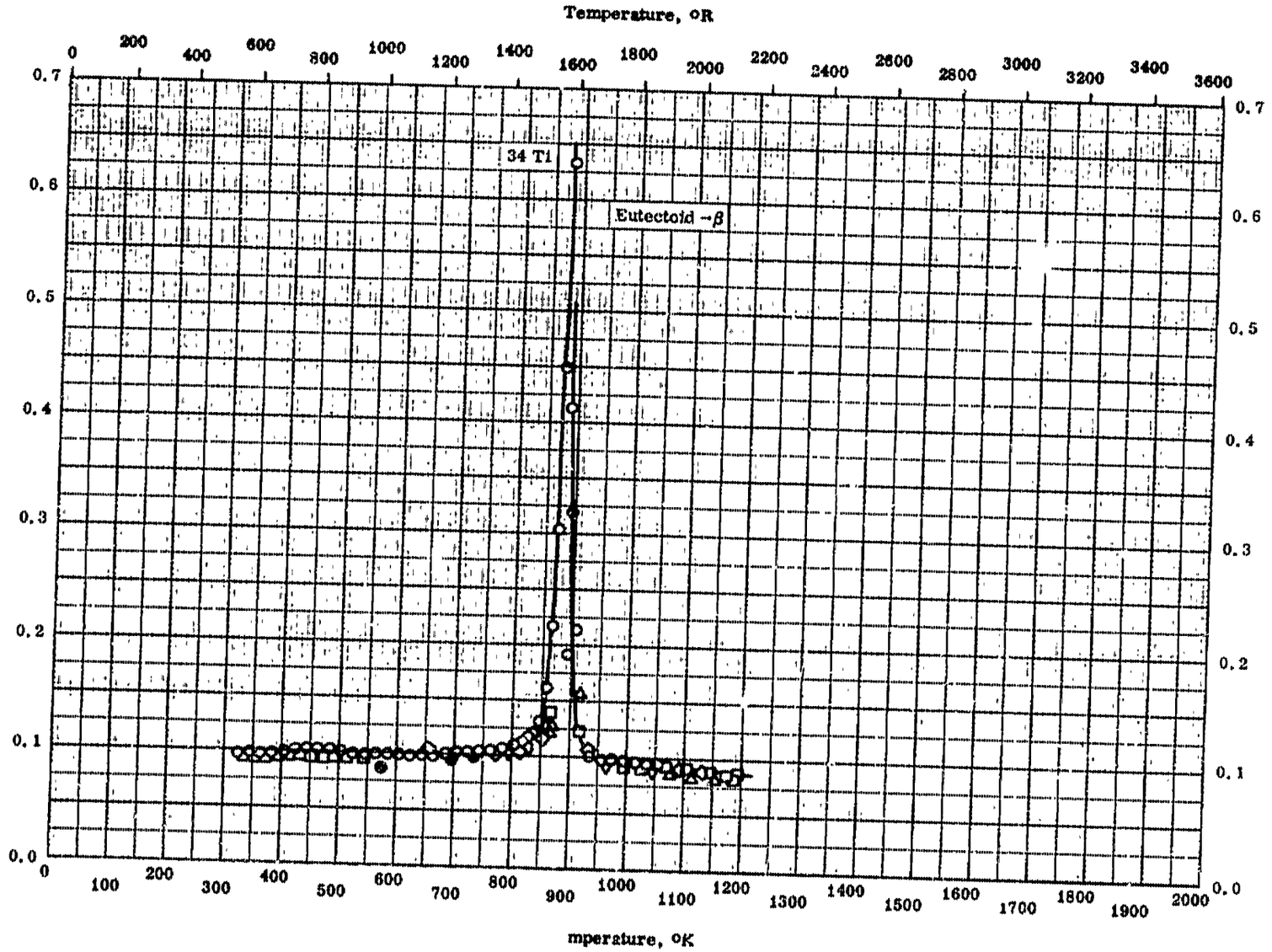
NORMAL SPECTRAL EMITTANCE -- ZIRCONIUM + TIN

NORMAL SPECTRAL EMITTANCE -- ZIRCONIUM + TIN

REFERENCE INFORMATION

Symbol	Ref.	Wavelength μ	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	57-47	0.65	1273-2035	±5	Zircaloy 2; 98.2 Zr, 1.5 Sn, 0.15 Fe and 0.10 Cr.	As received; measured in vacuum.

TPRC



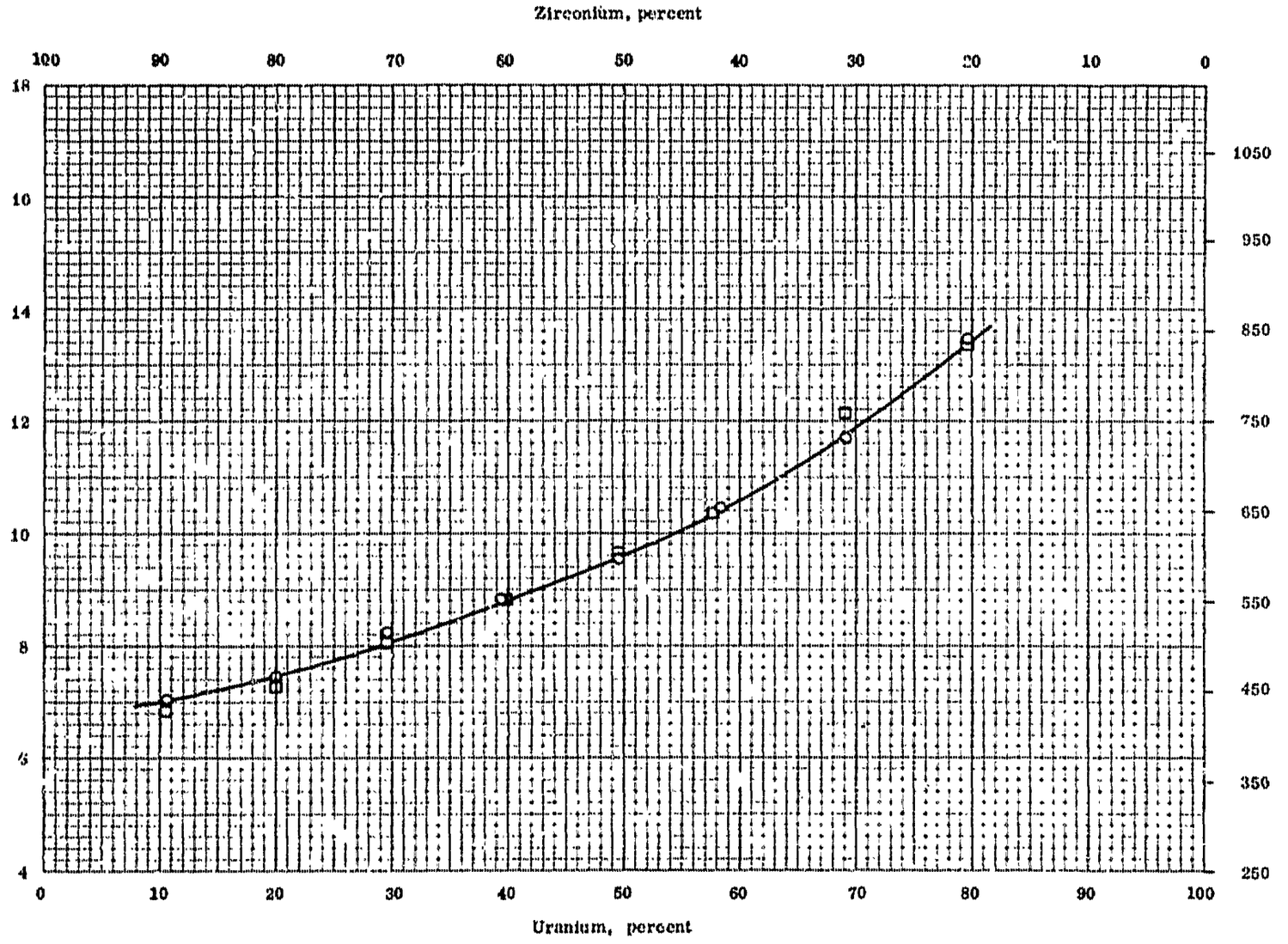
SPECIFIC HEAT -- ZIRCONIUM + TITANIUM

SPECIFIC HEAT -- ZIRCONIUM + TITANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-17	323-1053		Eutectoid composition; 65.6 Zr and 34.4 Ti [Author's design.; Run 43]	Arc melted from iodide process Zr and Ti.
□	57-17	333-1183		Same composition as above. [Author's design.: Run 45]	Same as above.
△	57-17	403-1153		Same composition as above. [Author's design.: Run 46]	Same as above.
◇	57-17	373-1133		Same composition as above. [Author's design.: Run 47]	Same as above.
▽	57-17	353-1133		Same composition as above. [Author's design.: Run 48]	Same as above.
●	57-17	333-1053		Same composition as above. [Author's design.: Run 79]	Same as above; homogenized at 800 C for 2 hrs and water quenched.

TPRC



DENSITY -- ZIRCONIUM + URANIUM

TPRC

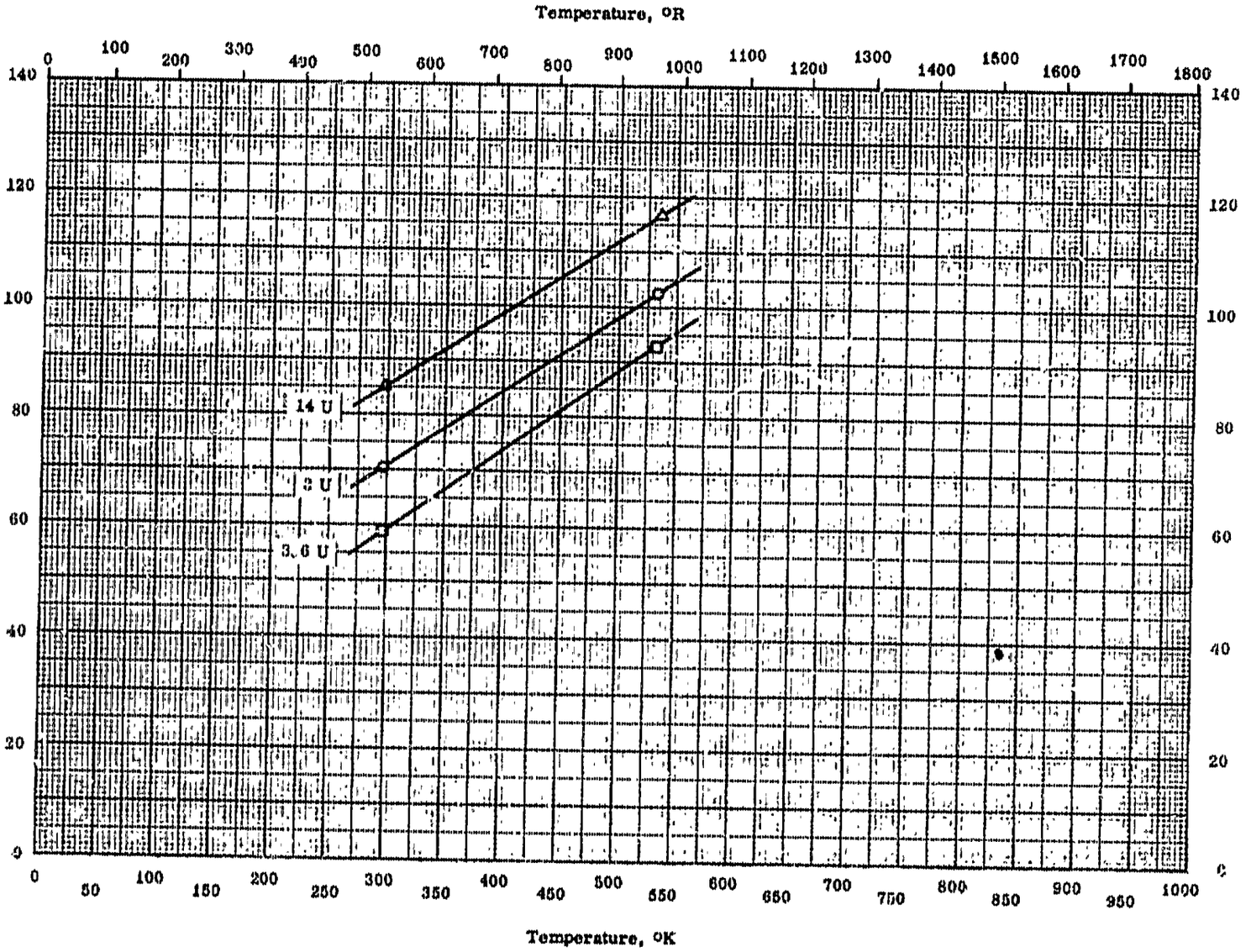
717

DENSITY -- ZIRCONIUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	53-22	298		10-80 U.	Heat-treated 1 hr at 800 C and water quenched.
□	53-22	298		10-80 U.	Heat-treated 24 hrs at 575 C and furnace cooled.

TPRC



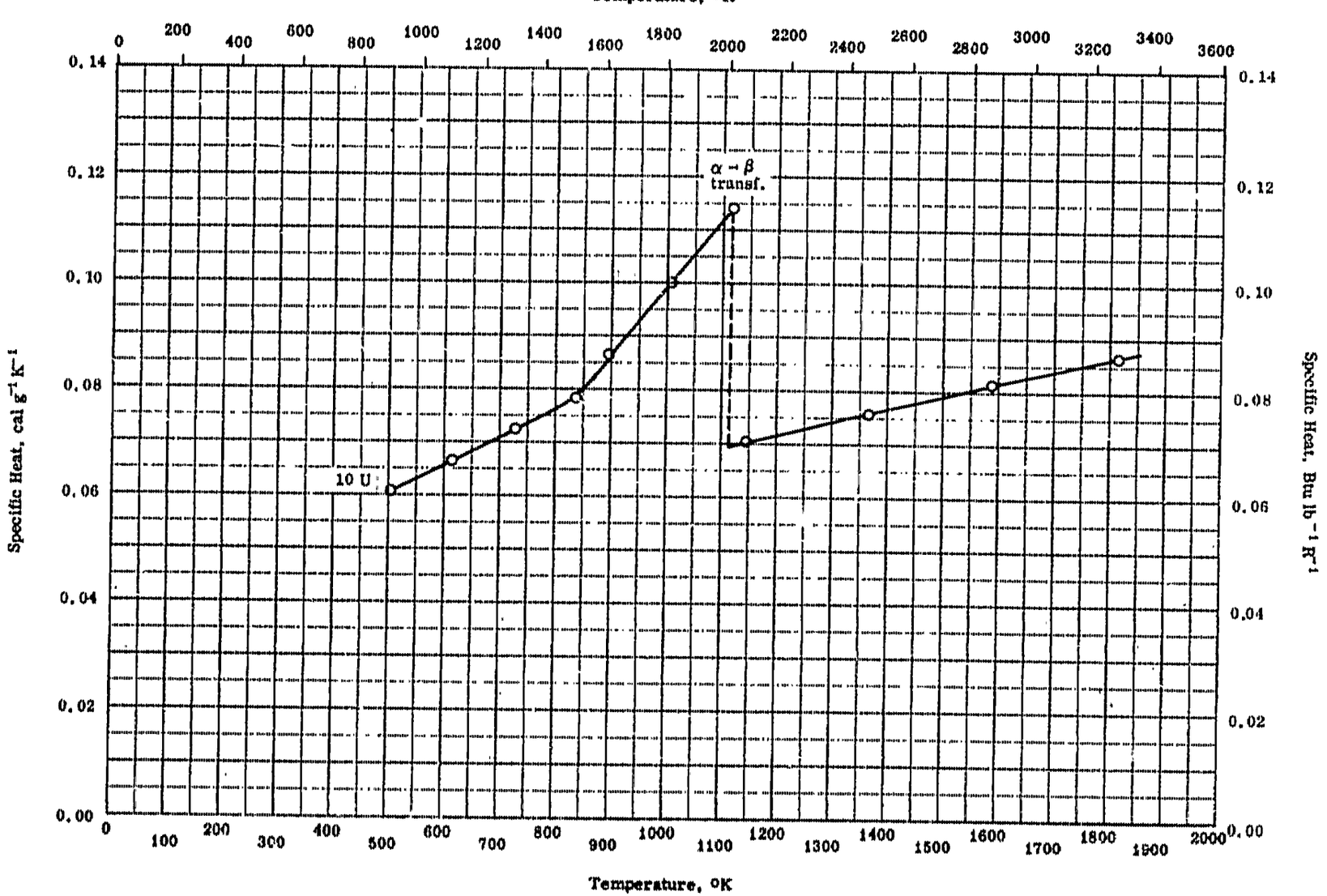
ELECTRICAL RESISTIVITY -- ZIRCONIUM + URANIUM

719

ELECTRICAL RESISTIVITY -- ZIRCONIUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	61-7	298-533	± 1	3 U.	
□	61-7	298-533	± 1	3.61 U, 0.05 C, and 0.007 N.	Low hafnium crystal bar; double arc melted, forged at 1650 F, rolled at 1250 F, and annealed at 1460 F.
△	61-7	298-533	± 1	14 U.	



SPECIFIC HEAT -- ZIRCONIUM + URANIUM

SPECIFIC HEAT -- ZIRCONIUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
O	63-12	422-1575	± 2.0	89.52 Zr and 10.48 U; density 430 lb ft^{-3}.	Under argon atmosphere.

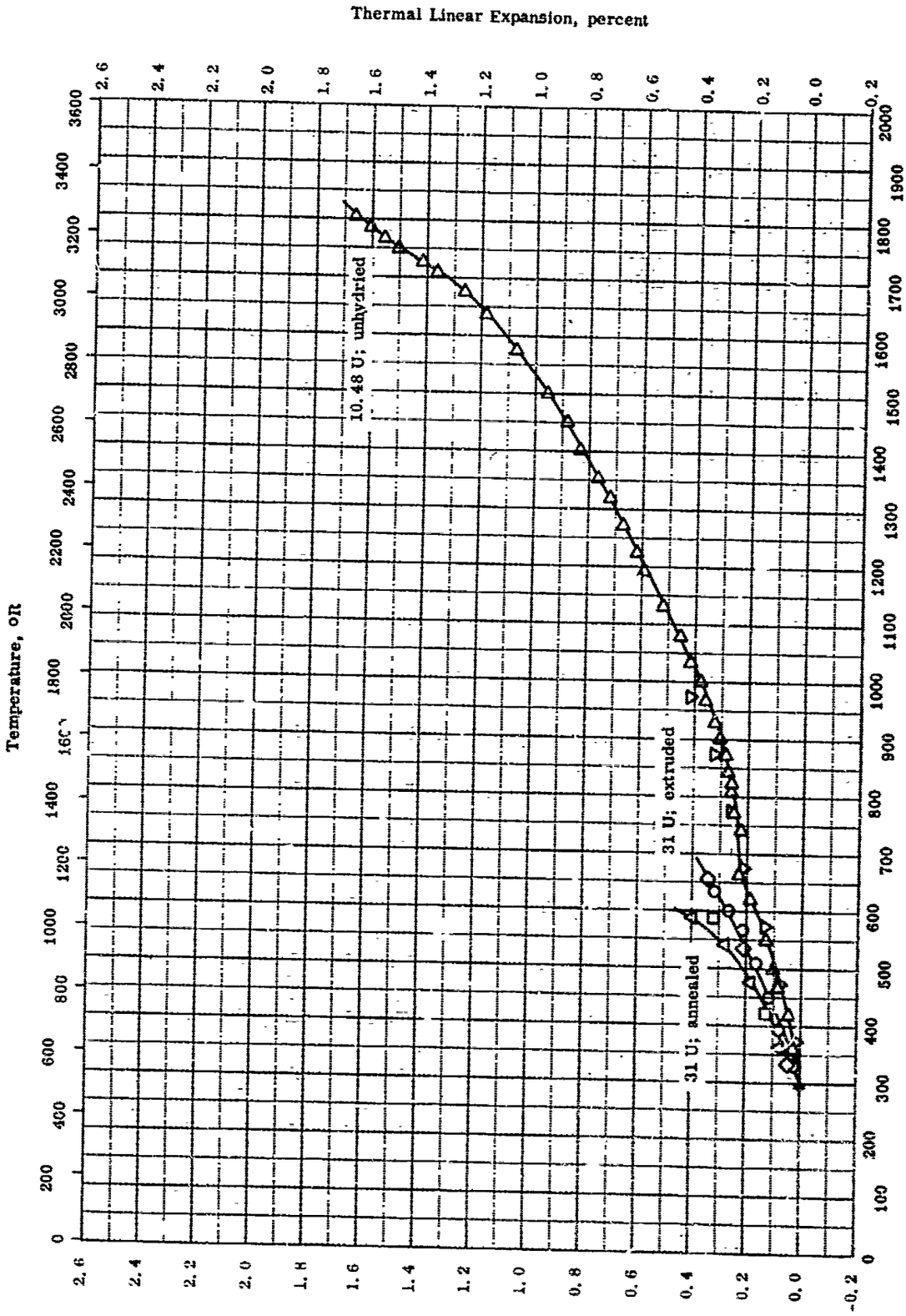
THERMAL CONDUCTIVITY — ZIRCONIUM + URANIUM

THERMAL CONDUCTIVITY -- ZIRCONIUM + URANIUM

REFERENCE INFORMATION

Symbol	Ref.	Temp. Range °K	Rept. Error %	Sample Specifications	Remarks
○	57-6	293-589		2.0 U.	
■	57-6	293-589		3.0 U.	
△	57-6	293-589		4.0 U.	
▽	57-6	293-589		6.0 U.	
◇	57-6	293-589		8.0 U.	
●	57-6	293-589		10.0 U.	
□	57-6	293-589		12.0 U.	
▲	57-6	293-589		14.0 U.	
▼	54-6	293-1173		30.0 U.	

TPRC



THERMAL LINEAR EXPANSION -- ZIRCONIUM + URANIUM

Thermal Linear Expansion, percent