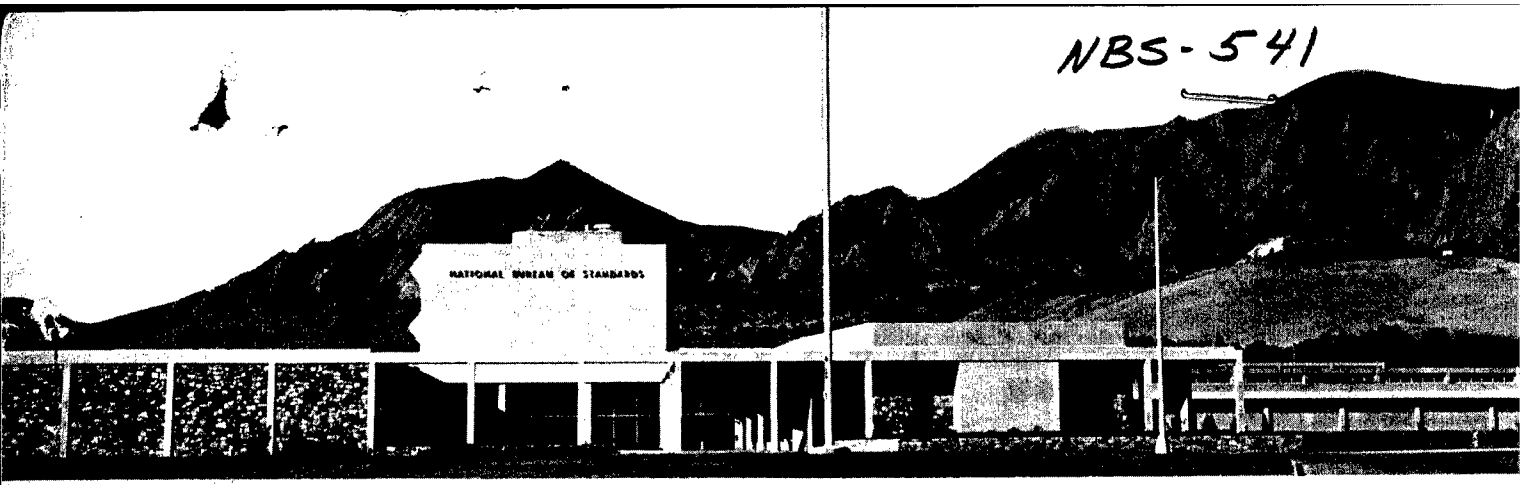

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NBS REPORT

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THERMAL CONDUCTIVITY STANDARD REFERENCE

MATERIALS FROM 4 TO 300K. I. ARMCO IRON

by

J. G. Hust

NBS

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
Institute for Basic Standards
Boulder, Colorado 80302

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THERMAL CONDUCTIVITY STANDARD REFERENCE MATERIALS FROM 4 TO 300 K. I. ARMCO IRON

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U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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ABSTRACT

Thermal conductivity, electrical resistivity, Lorenz ratio, and thermopower data are reported for several specimens of Armco iron for temperatures from 4 to 300K. At low temperatures the electrical resistivity and thermal conductivity vary from specimen to specimen by more than 10%. However, the Lorenz ratios of these specimens differ by less than 1.5%; and the intrinsic resistivities calculated using Matthiessen's rule differ by less than 0.2% of the total resistivities. Thus, Armco iron specimens can be used as standards by measuring the residual resistivities and utilizing the Lorenz ratio reported here.

KEY WORDS

Cryogenics, electrical resistivity, iron, Lorenz ratio, Seebeck effect, thermal conductivity, transport properties.

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* This work was carried out at the National Bureau of Standards under the sponsorship of the NASA-Space Nuclear Propulsion Office, Cleveland.

1. Introduction

Design and development engineers in the aerospace industry continue to have urgent need for thermal and mechanical property data for new materials. For most materials, especially new or uncommon alloys measured values of thermal conductivity are not available and predictions cannot be made with adequate confidence. To help satisfy these needs, we have constructed an apparatus for the simultaneous measurement of thermal conductivity, electrical resistivity and thermopower. Measurements have been conducted on several aerospace alloys, Hust, et al.[1] Another phase of this program, to establish standard reference data on several standard reference materials (or specimens), has begun. We intend to measure several specimens of materials which appear to be useful as standards. For some materials, material variability may be so great that only standard specimens (not standard materials) will be useful. Standard reference specimens or materials are useful for intercomparison of existing apparatus, for debugging new apparatus, and for calibration of comparative apparatus. The apparent large differences between the results of various investigators for a given material (50% is not unheard of) is evidence of the need for intercomparisons, calibrations, and standardization. The availability of standard reference materials will result in more accurate and more permanent transport property data for technically important solids.

This paper contains the results of our measurements on the transport properties of Armco iron.* Armco iron was investigated at low temperatures primarily because of its extensive use as a thermal conductivity standard at higher temperatures.[2]

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* The use in this paper of trade names of specific products is essential to the proper understanding of the work presented. Their use in no way implies any approval, endorsement, or recommendations by NBS. Armco iron is a registered trade name of a commercially pure iron produced by Armco Steel Corporation.

2. Apparatus and Data Analysis

The apparatus is based on the axial one-dimensional heat flow method. The specimen is a cylindrical rod 3.6 mm in diameter and 23 cm long with an electric heater at one end and a temperature controlled sink at the other. The specimen is surrounded by glass fiber and a temperature controlled shield. Eight thermocouples are mounted at equally spaced points along the length of the specimen to determine temperature gradients in the range 4 to 300 K.

The experimental data are represented by arbitrary functions over the entire range and smooth tables are generated from these functions. The number of terms used to represent each of the data sets is optimized, through the use of orthonormal functions, so that none of the precision of the data is lost by "underfitting" nor are any necessary oscillations introduced by "overfitting." A detailed description of this apparatus and the methods of data analysis is given by Hust, et al.[1] Further details are given in the Appendix of this report.

3. Specimen Characterization

An Armco iron rod (2.54 cm diameter and 35.6 cm long) was obtained from Battelle Memorial Institute. Typical composition of Armco iron in weight percent is: 0.015 C, 0.028 Mn, 0.005 P, 0.025 S, 0.003 Si, 0.04 Cu, and 99.9 Fe. This rod was annealed by the supplier as follows: $\frac{1}{2}$ hour at 870 °C in a gas-heated air muffle, and then in a quartz capsule at 1×10^{-6} torr for $1\frac{1}{2}$ hours at 875 °C, furnace cooled to 150 °C, held at 150 °C for 24 hours, and furnace cooled to room temperature. We cut the rod into quarters along its axis and cut a 5 cm long piece from each end of each quadrant. These eight pieces were used for electrical residual resistivity ratio, hardness, and grain size measurements. Two of the center 25 cm sections were measured in the thermal conductivity apparatus. The division of the rod and the labeling of specimens is shown in figure 1.

The hardness of these specimens, after machining, was B-40.0. The specimens were subsequently reannealed using the same procedure indicated by the supplier. The hardness after anneal was B-37.1. The grain size approximated from ASTM Chart E112, plate 1 was 0.053 mm and 0.064 mm after machining and after reannealing respectively.

The electrical residual resistivity ratios, RRR, of the eight specimens (1A.... 4A, 1B.... 4B) after machining and of two of these specimens after reannealing are recorded in table 1. These ratios obtained from electrical resistance measurements at 273 K and 4 K in a specially fabricated dip probe, are estimated to be accurate to about 0.2%. Table 1 also contains the resistivity ratios of specimens 2C and 4C. The data marked with asterisks were obtained from the thermal conductivity apparatus.

C. F. Lucks of Battelle Memorial Institute performed similar measurements on another bar of Armco iron.[3] The rms deviation of his results on six specimens is 6.5% of the mean while the rms deviation of our ten specimens is 3.6%. Lucks made his RRR measurements from 4 K to 298 K; in order to compare absolute values, I adjusted his values to $\rho_{273\,K}/\rho_{4\,K}$ by using $d\rho/dT = 0.05\,\mu\Omega cm/K$ at the ice point. This value of $d\rho/dT$ comes from my measurements in the thermal conductivity apparatus. The mean value of RRR (13.65) determined from my data is 5.5% below the mean value reported by Lucks. It is noted from table 1 that the RRR values are lower after annealing. This is an unexplained phenomena at this time, but probably is connected with diffusion of impurities from the grain boundaries upon heat treatment.

4. Results

The transport properties of specimens 2C and 4C were measured in the thermal conductivity apparatus. Specimen 2C was subsequently annealed (same annealing procedure as described before) and remeasured. These data are presented in tables 2 through 7. These specimens are referred to as 2 and 4 respectively in these tables. Specimen 2C after annealing is referred to as 2a.

The experimental data were functionally represented with the following equations:

$$\ell n\lambda = \sum_{i=1}^{n} a_i \, [\ell n\, T]^{i+1} \tag{1}$$

$$\rho = \sum_{i=1}^{m} b_i \, [\ell n\, T]^{i+1} \tag{2}$$

$$S = \sum_{i=1}^{\ell} c_i \, [\ell n\, T']^{i} / T'; \; T' = \frac{T}{10} + 1 \tag{3}$$

where λ = thermal conductivity, ρ = electrical resistivity, S = thermopower, and T = temperature. Temperatures are based on the IPTS-68 scale above 20 K and the NBS P2-20 (1965) scale below 20 K. The parameters, a_i, b_i, and c_i, determined by least squares, are presented in tables 8, 9, and 10. Further details of this procedure are described by Hust, et al.[1] The deviations of the experimental data from these equations are given in tables 11 through 19 and in figures 2 through 10. The "observed" thermal conductivities are computed from the mean temperature gradients indicated by adjacent thermocouples. Calculated values of λ, ρ, S, and $L = \rho\lambda/T$ (Lorenz ratio) are presented in tables 20, 21, and 22 and in figures 11, 12, and 13.

A detailed error analysis for these measurements has been presented previously by Hust, et al.[1] Based on this analysis of systematic and random errors the uncertainty estimates (with 95% confidence) are as follows:

thermal conductivity:	2.5% at 300 K, decreasing as T^4 to 0.70% at 200 K, 0.70% from 200 K to 50 K, increasing inversely with temperature to 1.5% at 4 K.
electrical resistivity:	0.25%
thermopower:	0.5% + 0.2 μV/K at 4 K, 0.2% + 0.05 μV/K at 30 K, and 0.1% + 0.03 μV/K above 76 K.

The thermopower values given here are absolute values although our measurements were carried out with respect to normal silver wire. The absolute thermopowers of normal silver reported by Borelius, et al[4] were used to convert the experimental data to the absolute scale.

5. Discussion

The thermal conductivities of these specimens differ by as much as 10% at low temperatures; the differences observed in electrical resistivity are similar. The thermal conductivity deviations of the three sets of values are shown in figure 14. These data would suggest that Armco iron is a poor thermal conductivity standard at low temperatures. However, upon further examination it is found that this conclusion is not valid. The Lorenz ratio for these measurements is much less variable at low temperatures than either ρ or λ. Figure 15 illustrates the deviations of the Lorenz ratios for each specimen from the mean value.

Since these deviations are not appreciably larger than the uncertainty in the measured Lorenz ratio, the Lorenz ratio is assumed to be invariant from specimen to specimen. Thus one can obtain the electrical resistivity of a particular specimen of Armco iron and compute the thermal conductivity using the Lorenz ratio reported here.

In order for the above procedure to be practical one needs a relatively quick method of generating a ρ vs T curve for a particular specimen from relatively few measurements. Matthiessen's rule indicates that $\rho = \rho_o + \rho_i$, where ρ_o is the residual resistivity of the specimen and ρ_i is the intrinsic resistivity of the material. It is known that this rule is not satisfied exactly and that a correction term $\Delta(\rho_o, \rho_i)$ exists. However, if this correction term is sufficiently small one can reconstruct a sufficiently accurate ρ vs T curve for a given specimen from knowledge of ρ_i and measurement of ρ_o (only one measurement). To investigate this possibility, ρ_i was computed for each specimen using Matthiessen's rule. The relative deviations of the computed values of ρ_i from the mean of three sets is shown in figure 16. This plot shows that ρ_i values for specimens 2, 2a, and 4, as computed from Matthiessen's rule, differ from the mean by less than 0.3% of the resistivity. This deviation is only slightly larger than the estimated uncertainty of the measurements. It is not unreasonable to assume that this result can be extended to other specimens of Armco iron having similar values of ρ_o and thus, Armco iron can be a useful low temperature standard reference material. This is especially significant, since Armco iron is already in extensive use as a high temperature standard reference material.[2] The thermal conductivity, λ, of standard reference specimen of Armco iron can be computed from

$$\lambda = \frac{LT}{\rho} = \frac{LT}{\rho_i + \rho_o} \qquad (4)$$

where L and ρ_i are given in table 23 and ρ_o is determined by a relatively simple measurement.

The absolute thermopowers of these three specimens are compared in figure 17. The deviations between specimens are only slightly larger than the uncertainty in the tabulated values; thus no significant difference between specimens can be detected from this property.

6. Acknowledgments

I wish to thank C. F. Lucks of Battelle Memorial Institute for supplying the Armco iron rod and information regarding annealing. R. P. Reed and R. L. Durcholz of this laboratory did the hardness and grain size testing. This measurement program has been carried out under the helpful guidance of R. L. Powell.

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2. R. W. Powell, "Armco Iron as a Thermal Conductivity Standard, Review of Published Data", Progress in International Research on Thermodynamics and Transport Properties (eds. J. F. Masi and D. H. Tsai, Academic Press, New York, 1962), pp. 454-465.

3. C. F. Lucks, Private communication.

4. G. Borelius, W. H. Keesom, C. H. Johansson, and J. O. Linde, "Establishment of an Absolute Scale for the Thermoelectric Force", Proc. Kon. Akad. Amsterdam 35, 10 (1932).

Table 1

Residual resistivity ratio (ρ_{273K}/ρ_{4K}) of Armco iron

Specimen	After machining	After annealing
1A	14.12	
2A	13.81	
3A	14.13	
4A	12.99	
1B	13.81	
2B	14.51	12.88
3B	14.09	
4B	12.77	11.52
2C	13.86, 13.83*	12.58*
4C	12.44, 13.31*	

* These values were determined from measurements using the thermal conductivity apparatus.

The data listed in tables 2 thru 7 are, in part, card images of experimental data as read into the computer for data processing. These data are not clearly labelled. The following is a line by line explanation of tables 2, 4, and 6.

1st line - Data identification.

2nd line - Sample heater voltage (μV), current (mA), platinum resistance thermometer voltage (μV), cryogenic bath pressure (mm of Hg), room temperature (°C), platinum resistance thermometer current (mA), code indicating type of cryogenic bath (1 = liquid helium, 2 = liquid hydrogen, 3 = liquid nitrogen, 4 = dry ice-alcohol, 5 = ice-water).

3rd line - Thermocouple emfs (μV).

4th line - Seebeck emf (μV), specimen current (mA), specimen voltage drop (μV).

5th line - Thermocouple temperatures (K).

6th line - Heater power (W), reference temperature (K), specimen resistance (Ω).

Table 2. Basic semi-processed temperature gradient data for Armco iron, specimen 2.

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 27AUG68 135PM
  2901060   30.1000   3841.95      92.8      21.0       1.0       3.0
  155.85   192.39   229.93   267.77   305.95   344.43   383.00   422.30
   129.98    200.00     52.46
THERMOCOUPLE TEMPERATURES
  77.251   79.254   81.302   83.354   85.418   87.487   89.555   91.649
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 8.7322-002            68.606              2.6227-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 28AUG68 625 PM
  3856750   40.0000   4687.70     650.0      21.0       1.0       3.0
  292.10   363.46   437.18   511.91   587.84   664.82   742.62   822.12
   318.51    200.00     75.26
THERMOCOUPLE TEMPERATURES
  92.137   95.916   99.790  103.686  107.619  111.577  115.555  119.591
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.5427-001            76.349              3.7630-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 29AUG68 1145AM
  6754900   70.0000   4738.42     653.0      21.0       1.0       3.0
  743.45   992.50  1254.80  1525.50  1804.70  2091.04  2384.58  2686.87
  1343.50    200.00     150.26
THERMOCOUPLE TEMPERATURES
 116.024  128.583  141.579  154.774  168.184  181.757  195.516  209.535
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 4.7284-001            76.811              7.5130-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68  100AM
  9614249   99.5800   4780.40     653.0      21.0       1.0       3.0
 1661.95  2251.69  2878.90  3531.45  4208.12  4903.67  5616.50  6353.80
  2724.50    200.00     315.78
THERMOCOUPLE TEMPERATURES
 161.685  189.631  218.693  248.394  278.803  309.855  341.683  374.600
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 9.5739-001            77.192              1.5789-003
-------------------------------------------------------------------
```

Table 2 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68 220PM
   399637    4.1500      -0.00      666.0       21.0        1.0        1.0
   13.25     15.97     18.95     21.87     24.36     27.04     29.63     31.85
    -0.03     100.00      11.66
THERMOCOUPLE TEMPERATURES
   5.010     5.229     5.446     5.650     5.846     6.032     6.206     6.378
HEATER POWER    REFERENCE TEMPERATURE    SPECIMEN RESISTANCE
 1.6585-003              4.073               1.1660-004
-------------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68 330PM
   827760    8.6000      -0.00      666.0       21.0        1.0        1.0
   41.08     50.58     59.93     68.88     76.99     84.86     92.26     99.07
     0.13     200.00      23.36
THERMOCOUPLE TEMPERATURES
   6.992     7.643     8.252     8.820     9.348     9.836    10.286    10.719
HEATER POWER    REFERENCE TEMPERATURE    SPECIMEN RESISTANCE
 7.1187-003              4.073               1.1680-004
-------------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68 630PM
  1265000   13.1350      -0.00      653.4       21.0        1.0        1.0
  109.77    125.17    140.09    154.29    167.46    179.87    191.55    202.52
     0.51     200.00      23.43
THERMOCOUPLE TEMPERATURES
  11.356    12.274    13.159    13.990    14.776    15.497    16.169    16.821
HEATER POWER    REFERENCE TEMPERATURE    SPECIMEN RESISTANCE
 1.6616-002              4.054               1.1715-004
-------------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68 710PM
  2182120   22.6700      -0.00      654.0       21.0        1.0        1.0
  216.53    247.33    276.33    303.43    328.52    351.88    373.74    394.64
     3.60     200.00      23.77
THERMOCOUPLE TEMPERATURES
  17.616    19.415    21.096    22.666    24.144    25.509    26.786    28.033
HEATER POWER    REFERENCE TEMPERATURE    SPECIMEN RESISTANCE
 4.9469-002              4.055               1.1885-004
-------------------------------------------------------------------------
```

Table 2 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 3SEPT68 347PM
  1155030   12.0000    110.75     652.7      21.0       1.0       2.0
   56.30    63.18     70.20     77.29     83.88     90.48     96.96    102.94
     1.04    200.00     23.82
THERMOCOUPLE TEMPERATURES
  23.127   23.540   23.947   24.356   24.753   25.137   25.509   25.873
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.3860-002            19.875              1.1910-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 3SEPT68 505PM
  3480880   36.1300    111.85     652.7      21.0       1.0       2.0
  263.95   310.00    356.00    401.20    445.40    489.10    532.40    576.00
    47.20    200.00     27.43
THERMOCOUPLE TEMPERATURES
  35.483   38.257   41.016   43.716   46.360   48.946   51.488   54.051
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.2576-001            19.935              1.3715-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 4SEPT68 120PM
  4860190   50.4200    113.10     653.0      20.0       1.0       2.0
  496.40   583.20   673.60   766.45   861.80   960.30  1061.60  1167.10
   241.42    200.00     39.59
THERMOCOUPLE TEMPERATURES
  49.435   54.534   59.758   65.046   70.418   75.879   81.419   87.134
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 2.4505-001            20.003              1.9795-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 4SEPT68 430PM
  2335100   24.2510    111.21     654.0      21.0       1.0       2.0
  106.20   131.40   156.33   180.38   203.26   225.37   246.36   266.92
     8.19    200.00     24.42
THERMOCOUPLE TEMPERATURES
  26.074   27.570   29.041   30.461   31.854   33.150   34.397   35.641
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 5.6629-002            19.900              1.2210-004
-------------------------------------------------------------------
```

Table 2 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 6SEPT68 1130AM
  4149800   42.9900  17240.50     631.0      21.0       1.0       4.0
  239.86   352.79   468.08   583.74   700.83   818.62   937.37  1057.68
   544.20    200.00    240.24
THERMOCOUPLE TEMPERATURES
 204.212  209.434  214.746  220.057  225.417  230.792  236.196  241.657
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.7840-001           193.055              1.2012-003
-----------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 7SEPT68 430 PM
  6270555   64.9600  17299.40     627.4      22.0       1.0       4.0
  733.74  1001.22  1277.22  1556.20  1841.25  2129.90  2422.95  2722.05
  1174.06    100.00    160.62
THERMOCOUPLE TEMPERATURES
 227.472  239.645  252.132  264.687  277.470  290.357  303.441  316.795
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 4.0734-001           193.620              1.6062-003
-----------------------------------------------------------------
```

The data listed in tables 2 thru 7 are, in part, card images of experimental data as read into the computer for data processing. These data are not labelled clearly. The following is a line by line explanation of tables 3, 5, and 7.

1st line - Data identification.

2nd line - Platinum resistance thermometer voltage (μV), cryogenic bath pressure (mm of Hg), room temperature (°C), platinum resistance thermometer current (mA), code indicating type of cryogenic bath (1 = liquid helium, 2 = liquid hydrogen, 3 = liquid nitrogen, 4 = dry ice-alcohol, 5 = ice-water), specimen current (mA), specimen voltage (μV), mean emf of eight thermocouples (μV).

3rd line - Reference temperature (K), specimen resistance (Ω), specimen temperature (K).

Table 3. Basic semi-processed isothermal electrical resistivity data for Armco iron, specimen 2.

ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 26AUG68 840AM							
3242.83	93.20	21.00	1.00	3.00	200.00	35.64	4.77
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
63.027		1.7820-004			63.298		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 26AUG68 930AM							
3243.31	93.20	21.00	1.00	3.00	200.00	35.54	0.79
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
63.031		1.7770-004			63.076		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 26AUG68 950AM							
3773.15	92.80	21.00	1.00	3.00	200.00	44.90	144.01
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
67.971		2.2450-004			75.983		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 28AUG68 930AM							
4689.61	651.60	21.00	1.00	3.00	200.00	57.58	247.16
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
76.367		2.8787-004			89.764		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 29AUG68 110PM							
4737.00	653.00	20.00	1.00	3.00	200.00	77.94	590.44
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
76.798		3.8970-004			108.179		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 29AUG68 600PM							
4813.05	652.50	21.00	1.00	3.00	200.00	124.82	1298.03
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
77.489		6.2410-004			144.310		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 5SEPT68 845PM							
17246.80	631.50	20.00	1.00	4.00	200.00	206.33	167.69
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
193.115		1.0316-003			200.924		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 6SEPT68 1125PM							
17316.30	628.60	21.00	1.00	4.00	100.00	118.02	569.56
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
193.782		1.1802-003			220.121		

Table 3 (Cont.)

```
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 30AUG68 150PM
   -0.00   666.00    21.00    -0.00     1.00   100.00    11.66    11.12
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       4.073                1.1660-004              4.941
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 30AUG68 420PM
   -0.00   654.50    21.00    -0.00     1.00   200.00    23.34    46.74
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       4.055                1.1670-004              7.440
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 30AUG68 520PM
   -0.00   654.00    21.00    -0.00     1.00   200.00    23.37    99.10
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       4.055                1.1685-004             10.762
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 30AUG68 650PM
   -0.00   654.00    21.00    -0.00     1.00   200.00    23.48   195.44
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       4.055                1.1740-004             16.463
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 3SEPT68 205PM
  110.30   653.00    21.00     1.00     2.00   200.00    23.59     0.27
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
      19.851                1.1795-004             19.866
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 3SEPT68 255PM
  110.70   653.00    21.00     1.00     2.00   200.00    23.72    51.78
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
      19.873                1.1860-004             22.883
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 4SEPT68 1115AM
  112.74   652.00    20.00     1.00     2.00   200.00    27.63   442.23
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
      19.983                1.3815-004             46.231
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(2) 4SEPT68 255PM
  110.86   654.00    20.00     1.00     2.00   200.00    23.78    69.66
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
      19.881                1.1890-004             23.936
-----------------------------------------------------------------
```

Table 4. Basic semi-processed temperature gradient data for Armco iron, specimen 2a.

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 9 MAR 69 900 AM
  3857600   40.0000   4707.44     647.0       24.0        1.0        3.0
  176.41   246.46   318.77   392.53   467.41   543.60   620.64   699.16
   300.24    200.00      70.64
THERMOCOUPLE TEMPERATURES
  86.123   89.880   93.726   97.617  101.539  105.499  109.478  113.503
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.5430-001             76.529              3.5320-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 10 MAR 69 1020 AM
  5788935   60.0000   4703.45     648.0       23.0        1.0        3.0
  222.71   384.56   555.17   732.56   915.93  1104.85  1298.58  1497.87
   815.92    200.00      95.86
THERMOCOUPLE TEMPERATURES
  88.574   97.165  106.066  115.174  124.455  133.888  143.444  153.156
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 3.4734-001             76.493              4.7930-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 10 MAR 69 500 PM
  8067000   83.5700   4767.78     648.0       23.0        1.0        3.0
  560.81   909.22  1282.68  1675.24  2083.94  2507.94  2946.02  3399.18
  1922.36    200.00     169.05
THERMOCOUPLE TEMPERATURES
 106.908  124.653  143.186  162.222  181.652  201.478  221.674  242.313
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 6.7416-001             77.078              8.4525-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 11 MAR 69 440 PM
  3860100   40.0000   4859.08     667.0       24.0        1.0        3.0
 1077.97  1163.31  1251.43  1340.03  1428.79  1518.60  1608.94  1700.87
   432.88    200.00     133.38
THERMOCOUPLE TEMPERATURES
 133.833  138.057  142.394  146.730  151.054  155.405  159.763  164.175
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.5440-001             77.907              6.6690-004
-------------------------------------------------------------------
```

Table 4 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 12 MAR 69 1007 AM
  5792200   60.0000   4857.50     667.0      23.0       1.0       3.0
 1134.58  1329.67  1532.21  1738.83  1949.00  2163.80  2382.15  2605.36
  1023.47    200.00    165.30
THERMOCOUPLE TEMPERATURES
 136.624  146.213  156.052  165.979  175.979  186.106  196.320  206.680
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 3.4753-001            77.893              8.2650-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 25 MAR 69 345 PM
  3378470   35.0000  17217.60     630.0      24.0       1.0       4.0
   84.92   160.20   236.41   312.91   389.76   466.91   544.41   622.65
   364.64    100.00    110.50
THERMOCOUPLE TEMPERATURES
 196.796  200.298  203.834  207.374  210.922  214.476  218.037  221.625
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.1825-001            192.835             1.1050-003
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 26 MAR 69 1200 NOON
  4730400   49.0000  17334.50     628.0      24.0       1.0       4.0
  325.98   476.80   630.52   785.49   941.76  1099.34  1258.45  1419.74
   708.45    100.00    129.94
THERMOCOUPLE TEMPERATURES
 209.087  216.035  223.084  230.162  237.273  244.419  251.611  258.878
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 2.3179-001            193.957             1.2994-003
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 26 MAR 69 715 PM
  6446500   66.7800  17323.50     628.0      24.0       1.0       4.0
  393.58   676.56   967.21  1262.70  1562.96  1867.55  2177.29  2492.78
  1276.16    100.00    150.84
THERMOCOUPLE TEMPERATURES
 212.101  225.086  238.326  251.701  265.212  278.865  292.694  306.779
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 4.3050-001            193.851             1.5084-003
-------------------------------------------------------------------
```

Table 4 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 13 MAR 69 1215 PM
  3485400   36.1700    113.35     649.0      23.0       1.0       2.0
  121.93   179.47   233.65   285.60   334.52   382.52   429.04   474.74
    35.68    200.00     28.20
THERMOCOUPLE TEMPERATURES
  27.118   30.535   33.761   36.867   39.815   42.691   45.459   48.185
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.2607-001            20.016              1.4100-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 13 MAR 69 300 PM
  5068460   52.5700    115.82     649.0      23.0       1.0       2.0
  219.36   324.83   426.15   526.76   627.07   729.72   834.48   943.00
   175.46    200.00     34.37
THERMOCOUPLE TEMPERATURES
  33.034   39.367   45.427   51.371   57.226   63.110   69.019   75.068
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 2.6645-001            20.147              1.7185-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 13 MAR 69 520 PM
  5634400   58.4200    120.00     649.0      23.0       1.0       2.0
  413.50   534.83   660.15   790.32   925.50  1066.90  1213.85  1367.52
   368.80    200.00     44.98
THERMOCOUPLE TEMPERATURES
  44.888   52.073   59.343   66.746   74.305   82.053   89.959   98.108
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 3.2916-001            20.364              2.2490-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 7 MAR 69 500 PM
  2404575   24.9400   4655.48     643.0      24.0       1.0       3.0
   39.78    65.57    91.85   118.38   145.02   171.87   198.65   225.74
    89.71    200.00     53.60
THERMOCOUPLE TEMPERATURES
  78.236   79.648   81.081   82.521   83.965   85.414   86.858   88.310
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 5.9970-002            76.056              2.6800-004
-------------------------------------------------------------------
```

Table 4 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 19 MAR 69 433PM
   456730    4.7420      -0.00      672.0       24.0        1.0        1.0
   11.55     15.56     19.62     23.72     27.26     31.03     34.60     37.75
     0.01    200.00      25.84
THERMOCOUPLE TEMPERATURES
   4.889     5.207     5.503     5.792     6.061     6.321     6.560     6.793
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 2.1658-003              4.082              1.2920-004
-------------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 19 MAR 69 545 PM
   696128    7.2300      -0.00      672.0       24.0       -0.0        1.0
   27.32     35.46     43.27     51.01     57.87     64.80     71.31     77.23
     0.10    200.00      25.86
THERMOCOUPLE TEMPERATURES
   6.045     6.629     7.159     7.668     8.133     8.576     8.983     9.372
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 5.0330-003              4.082              1.2930-004
-------------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 19 MAR 69 715 PM
  1151310   11.9600      -0.00      672.0       24.0       -0.0        1.0
   49.97     68.54     85.71    101.86    116.22    130.11    142.94    154.76
     0.43    200.00      25.90
THERMOCOUPLE TEMPERATURES
   7.595     8.816     9.893    10.880    11.763    12.590    13.342    14.053
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.3770-002              4.082              1.2950-004
-------------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 19 MAR 69 810 PM
  1908125   19.8200      -0.00      672.0       23.0       -0.0        1.0
  100.81    138.67    172.10    202.63    229.38    254.61    277.63    298.90
     1.99    200.00      26.03
THERMOCOUPLE TEMPERATURES
  10.813    13.098    15.061    16.832    18.398    19.857    21.185    22.437
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 3.7819-002              4.082              1.3015-004
-------------------------------------------------------------------------
```

Table 4 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 20 MAR 69 1045 AM
  2325375   24.1500      -0.00      673.0       24.0       -0.0        1.0
  139.30   186.94   228.56   266.27   299.35   330.40   358.83   385.28
     4.21    200.00      26.18
THERMOCOUPLE TEMPERATURES
  13.124   15.930   18.345   20.525   22.462   24.271   25.929   27.501
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 5.6158-002              4.083              1.3090-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 20 MAR 69 1200 NOON
  1263105   13.1210      -0.00      673.0       24.0       -0.0        1.0
  188.06   200.57   212.93   225.14   236.24   247.37   257.94   267.77
     0.84    200.00      26.05
THERMOCOUPLE TEMPERATURES
  15.983   16.723   17.438   18.139   18.796   19.438   20.043   20.627
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.6573-002              4.083              1.3025-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 12 MAR 69 540 PM
  1433200   14.8850     110.03      649.0       23.0        1.0        2.0
   23.33    35.79    48.24    60.57    72.00    83.41    94.39   104.71
     1.82    200.00      26.28
THERMOCOUPLE TEMPERATURES
  21.168   21.904   22.625   23.339   24.018   24.682   25.318   25.937
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 2.1333-002             19.836              1.3140-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 13 MAR 69 1015 AM
  2022330   21.0000     111.79      649.0       23.0        1.0        2.0
   58.57    81.15   103.20   124.72   144.72   164.32   182.98   200.74
     5.37    200.00      26.58
THERMOCOUPLE TEMPERATURES
  23.316   24.648   25.938   27.199   28.391   29.549   30.649   31.719
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 4.2469-002             19.932              1.3290-004
-------------------------------------------------------------------
```

Table 4 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 27 MAR 69 445 PM
  2896500    30.0000  17492.50      624.0       24.0        1.0        4.0
   836.10    894.12    953.57  1012.84  1071.74  1130.78  1190.16  1250.63
    263.21     100.00     137.56
THERMOCOUPLE TEMPERATURES
 233.947  236.585  239.285  241.973  244.641  247.312  249.995  252.724
HEATER POWER    REFERENCE TEMPERATURE    SPECIMEN RESISTANCE
 8.6895-002            195.473               1.3756-003
-----------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 3 APRIL 69 430 PM
  2878800    29.8200  25486.20      620.0       23.0        1.0        5.0
    60.32    121.19    182.76    244.43    306.20    368.06    430.24    492.86
    245.31     100.00     173.34
THERMOCOUPLE TEMPERATURES
 275.998  278.715  281.464  284.218  286.975  289.737  292.513  295.309
HEATER POWER    REFERENCE TEMPERATURE    SPECIMEN RESISTANCE
 8.5846-002            273.288               1.7334-003
-----------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 4 APRIL 69 920 AM
  2896200    30.0000  25510.00      628.0       23.0        1.0        5.0
    60.90    122.44    184.73    247.11    309.60    372.20    435.15    498.55
    247.90     100.00     173.69
THERMOCOUPLE TEMPERATURES
 276.257  279.005  281.786  284.571  287.361  290.156  292.966  295.797
HEATER POWER    REFERENCE TEMPERATURE    SPECIMEN RESISTANCE
 8.6886-002            273.523               1.7369-003
-----------------------------------------------------------------
```

Table 5. Basic semi-processed isothermal electrical resistivity data for Armco iron, specimen 2a.

```
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON (2A) 19 MAR 69 230 PM
   -0.00   665.00    24.00    -0.00     1.00   200.00    25.83      0.75
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
        4.071                1.2915-004                4.132
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON (2A) 12 MAR 69 445 PM
  109.62   649.00    23.00     1.00     2.00   200.00    26.10      0.09
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       19.813                1.3050-004               19.818
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON (2A) 7 MAR 69 125 PM
 4641.75   643.00    23.00     1.00     3.00   100.00    23.58      0.05
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       75.931                2.3580-004               75.934
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON (2A) 8 MAR 69 1020 AM
 4702.60   643.00    23.00     1.00     3.00   200.00    54.44    141.37
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       76.485                2.7220-004               84.195
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON (2A) 11 MAR 69 1055 AM
 4859.10   665.00    24.00     1.00     3.00   200.00   109.88   1034.62
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       77.907                5.4940-004               131.684
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON (2A) 23 MAR 69 730 PM
17207.00   632.00    25.00     1.00     4.00   200.00   196.01      0.57
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
      192.734                9.8005-004               192.760
-----------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON (2A) 2 APRIL 69 415 PM
25477.80   624.00    26.00     1.00     5.00   100.00   162.50      0.22
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
      273.206                1.6250-003               273.215
-----------------------------------------------------------------
```

Table 6. Basic semi-processed temperature gradient data for Armco iron, specimen 4.

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 11DEC68      1140AM
  1922030   19.9400   4653.41      644.0       22.0        1.0        3.0
   45.40     62.00     78.90     95.80    112.82    129.86    146.96    164.28
    55.32     200.00      52.72
THERMOCOUPLE TEMPERATURES
   78.525    79.434    80.357    81.276    82.202    83.124    84.052    84.986
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 3.8325-002             76.037              2.6360-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 11DEC68      540PM
  3369920   34.9500   4657.94      636.0       23.0        1.0        3.0
   180.11    233.73    288.93    344.72    401.42    458.72    516.92    576.13
    218.50     200.00      67.46
THERMOCOUPLE TEMPERATURES
   85.882    88.762    91.707    94.665    97.655   100.657   103.692   106.759
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.1778-001             76.078              3.3730-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 12 DEC 68    1130AM
  5301325   54.9500   4692.75      636.0       21.0        1.0        3.0
   477.40    622.71    774.73    930.44   1090.42   1253.67   1420.97   1592.19
    734.22     200.00     108.19
THERMOCOUPLE TEMPERATURES
  101.934   109.460   117.232   125.095   133.085   141.150   149.336   157.630
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 2.9131-001             76.395              5.4095-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 13 DEC 68     915AM
  7239100   75.0000   4792.45      653.0       23.0        1.0        3.0
  1467.10   1786.68   2122.80   2467.42   2821.28   3183.34   3554.75   3935.23
   1636.76     200.00     223.17
THERMOCOUPLE TEMPERATURES
  152.379   167.752   183.675   199.786   216.138   232.694   249.537   266.661
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 5.4293-001             77.302              1.1159-003
-------------------------------------------------------------------
```

Table 6 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 13 DEC 68    835PM
  7249400   75.1000   4807.35     665.0      23.0       1.0       3.0
 2475.63  2824.80  3191.90  3565.48  3947.07  4335.84  4734.08  5140.98
  1597.60    200.00    305.46
THERMOCOUPLE TEMPERATURES
 200.283  216.414  233.198  250.132  267.304  284.703  302.485  320.650
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 5.4443-001            77.437              1.5273-003
-------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4)  19DEC 68    500PM
  4114970   42.6300  17179.60     621.0      22.0       1.0       4.0
  227.50   338.91   453.24   568.14   684.31   801.22   919.39  1038.88
   534.88    200.00    241.62
THERMOCOUPLE TEMPERATURES
 203.059  208.216  213.488  218.768  224.090  229.429  234.810  240.238
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.7542-001            192.471             1.2081-003
-------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4)  20DEC 68     1025AM
  6274450   65.0000  17299.90     621.0      21.0       1.0       4.0
 1005.08  1279.67  1565.42  1854.66  2149.00  2446.90  2750.30  3059.00
  1149.44    200.00    348.82
THERMOCOUPLE TEMPERATURES
 239.825  252.247  265.105  278.073  291.214  304.515  318.060  331.843
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 4.0784-001            193.625             1.7441-003
-------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4)  20DEC 68     340PM
  5075600   52.5800  17290.80     620.0      21.0       1.0       4.0
  630.10   804.70   985.10  1166.90  1351.14  1536.93  1725.25  1916.18
   794.32    200.00    290.30
THERMOCOUPLE TEMPERATURES
 222.654  230.628  238.835  247.070  255.385  263.742  272.191  280.736
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 2.6688-001            193.537             1.4515-003
-------------------------------------------------------------
```

Table 6 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68  1135 AM
   404476    4.2000     -0.00     653.0      23.0      -0.0       1.0
   17.57    20.46    23.52    26.60    29.29    32.21    35.13    37.71
    -0.03    200.00     26.06
THERMOCOUPLE TEMPERATURES
   5.313    5.541    5.760    5.972    6.179    6.379    6.572    6.766
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.6988-003             4.053              1.3030-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68  1225PM
   712335    7.4000     -0.00     654.0      24.0      -0.0       1.0
   40.55    48.39    56.02    63.42    70.15    76.91    83.48    89.53
     0.06    200.00     26.09
THERMOCOUPLE TEMPERATURES
   6.940    7.482    7.982    8.455    8.901    9.324    9.727   10.118
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 5.2713-003             4.054              1.3045-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68   130PM
  1102950   11.4600     -0.00     653.0      24.0      -0.0       1.0
   90.17   104.38   117.90   130.75   142.61   154.17   165.30   175.69
     0.31    200.00     26.14
THERMOCOUPLE TEMPERATURES
  10.137   11.021   11.835   12.597   13.314   13.991   14.636   15.258
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.2640-002             4.053              1.3070-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68   505PM
   404467    4.2000     -0.00     654.0      24.0      -0.0       1.0
   17.78    20.81    23.93    27.07    29.79    32.76    35.66    38.19
    -0.02    200.00     26.06
THERMOCOUPLE TEMPERATURES
   5.330    5.568    5.791    6.007    6.215    6.418    6.609    6.800
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.6988-003             4.054              1.3030-004
-------------------------------------------------------------------
```

Table 6 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68   540PM
  1973298   20.5000     -0.00     654.0      23.0      -0.0       1.0
  200.92   230.19   257.34   282.63   306.01   328.25   349.51   369.68
     2.68    200.00     26.44
THERMOCOUPLE TEMPERATURES
  16.710   18.421   19.993   21.455   22.829   24.124   25.361   26.560
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 4.0453-002             4.054              1.3220-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68   600PM
  1973298   20.5000     -0.00     654.0      23.0      -0.0       1.0
  201.11   230.50   257.74   283.13   306.70   328.90   350.22   370.46
     2.72    200.00     26.44
THERMOCOUPLE TEMPERATURES
  16.721   18.439   20.016   21.484   22.870   24.162   25.403   26.606
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 4.0453-002             4.054              1.3220-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68   635PM
  1386400   14.4050     -0.00     654.0      23.0      -0.0       1.0
  146.98   164.66   181.48   197.47   212.33   226.66   240.45   253.44
     0.73    200.00     26.24
THERMOCOUPLE TEMPERATURES
  13.557   14.608   15.589   16.512   17.389   18.216   19.007   19.775
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.9971-002             4.054              1.3120-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 17DEC68     1140AM
   869115    9.0300    110.56     654.0      23.0       1.0       2.0
   32.21    36.70    41.39    46.06    50.39    54.87    59.34    63.47
     0.49    200.00     26.45
THERMOCOUPLE TEMPERATURES
  21.713   21.986   22.256   22.522   22.785   23.044   23.297   23.551
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 7.8481-003            19.865              1.3225-004
-------------------------------------------------------------------
```

Table 6 (Cont.)

```
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 17DEC68      115PM
  1250400   12.9900    110.86     653.0      23.0       1.0       2.0
   62.52     71.31     80.14     88.85     97.15    105.37    113.61    121.38
    1.41    200.00     26.60
THERMOCOUPLE TEMPERATURES
  23.496    24.021    24.535    25.039    25.537    26.017    26.494    26.964
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.6243-002            19.881              1.3300-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 17DEC68      230PM
  2211800   22.9700    111.59     653.0      23.0       1.0       2.0
  129.90    153.78    177.13    199.70    221.34    242.44    263.27    283.47
    8.60    200.00     27.30
THERMOCOUPLE TEMPERATURES
  27.491    28.914    30.295    31.632    32.934    34.192    35.431    36.655
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 5.0805-002            19.921              1.3650-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 17DEC68      455PM
  3816900   39.6100    113.55     653.0      23.0       1.0       2.0
  300.91    359.37    417.23    474.16    530.87    587.49    645.15    703.60
   77.53    200.00     32.00
THERMOCOUPLE TEMPERATURES
  37.794    41.316    44.772    48.148    51.501    54.807    58.139    61.507
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 1.5119-001            20.027              1.6000-004
-------------------------------------------------------------------
THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 18DEC68      1150AM
  4648820   48.2200    117.32     653.0      22.0       1.0       2.0
  638.00    724.70    815.35    908.42   1004.10   1102.30   1204.40   1309.75
   282.46    200.00     48.53
THERMOCOUPLE TEMPERATURES
  57.922    62.903    68.026    73.216    78.500    83.843    89.327    94.938
HEATER POWER   REFERENCE TEMPERATURE   SPECIMEN RESISTANCE
 2.2417-001            20.226              2.4265-004
-------------------------------------------------------------------
```

Table 7. Basic semi-processed isothermal electrical resistivity data for Armco iron, specimen 4.

ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 16DEC68 1050AM							
-0.00	653.00	23.00	-0.00	1.00	200.00	26.06	4.28
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
4.053		1.3030-004			4.394		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 16DEC68 100PM							
-0.00	654.50	24.00	-0.00	1.00	200.00	26.10	81.83
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
4.055		1.3050-004			9.696		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 16DEC68 155PM							
-0.00	653.00	24.00	-0.00	1.00	200.00	26.20	183.83
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
4.053		1.3100-004			15.786		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 16DEC68 700PM							
-0.00	654.00	23.00	-0.00	1.00	200.00	26.33	257.60
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
4.054		1.3165-004			20.069		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 17DEC68 1045AM							
110.22	653.50	23.00	1.00	2.00	200.00	26.32	0.55
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
19.846		1.3160-004			19.878		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 17DEC68 140PM							
111.62	653.00	23.00	1.00	2.00	200.00	26.71	116.83
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
19.923		1.3355-004			26.745		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 17DEC68 255PM							
113.58	653.50	23.00	1.00	2.00	200.00	27.83	269.55
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
20.028		1.3915-004			35.938		
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 17DEC68 530PM							
117.54	653.00	23.00	1.00	2.00	200.00	34.06	593.61
REFERENCE TEMPERATURE		SPECIMEN RESISTANCE			SPECIMEN TEMPERATURE		
20.237		1.7030-004			55.386		

Table 7 (Cont.)

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ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 18DEC68 250PM
  117.92   653.50    22.00     1.00     2.00   200.00    48.59   978.12
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       20.257               2.4295-004              77.113
-------------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 10DEC68 620PM
 4604.18   630.00    23.00     1.00     3.00   200.00    47.55     2.71
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       75.589               2.3775-004              75.738
-------------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 11DEC68 143PM
 4658.02   636.00    23.00     1.00     3.00   200.00    55.20   151.78
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       76.079               2.7600-004              84.360
-------------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 11DEC68 1000PM
 4689.33   636.00    22.00     1.00     3.00   200.00    69.23   402.76
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       76.364               3.4615-004              98.003
-------------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 12DEC68 445PM
 4766.59   636.00    24.00     1.00     3.00   200.00   127.62  1302.61
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       77.067               6.3810-004             144.158
-------------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 13DEC68 510PM
 4808.22   666.00    24.00     1.00     3.00   200.00   196.50  2293.19
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
       77.445               9.8250-004             191.793
-------------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 19DEC68 145PM
17156.40   621.00    22.00     1.00     4.00   200.00   197.80    19.11
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
      192.249               9.8900-004             193.141
-------------------------------------------------------------------
ISOTHERMAL RESISTIVITY DATA FOR ARMCO IRON(4) 19DEC68 620PM
17290.00   621.00    22.00     1.00     4.00   200.00   260.64   866.01
REFERENCE TEMPERATURE   SPECIMEN RESISTANCE   SPECIMEN TEMPERATURE
      193.530               1.3032-003             233.413
-------------------------------------------------------------------
```

Table 8. Parameters in eqs. 1, 2, and 3 for Armco iron, specimen 2.

THERMAL CONDUCTIVITY	COEFFICIENTS FOR ELECTRICAL RESISTIVITY	THERMOPOWER
4.51614994+000	-4.95025810-007	-3.44881675+002
-4.13926935+000	1.65473929-006	2.37913833+003
2.07599685+000	-2.37099406-006	-6.68364762+003
-8.61606749-001	1.93668635-006	9.99411766+003
3.39315321-001	-9.95191337-007	-8.67747098+003
-9.99896812-002	3.31399468-007	4.46376537+003
1.79360964-002	-7.18946332-008	-1.32173829+003
-1.71155124-003	9.77121499-009	2.08103179+002
6.66070951-005	-7.54546890-010	-1.35462989+001
	2.52377946-011	

Table 9. Parameters in eqs. 1, 2, and 3 for Armco iron, specimen 2a.

THERMAL CONDUCTIVITY	COEFFICIENTS FOR ELECTRICAL RESISTIVITY	THERMOPOWER
7.43890940+000	-4.20510751-007	-5.10933863+002
-1.14675555+001	1.45081937-006	3.36812410+003
9.73124560+000	-2.12826875-006	-9.06609424+003
-5.28250471+000	1.77366602-006	1.30552541+004
1.89245802+000	-9.25249389-007	-1.09917641+004
-4.41102771-001	3.13228379-007	5.52800895+003
6.37973455-002	-6.87884712-008	-1.61455399+003
-5.17020759-003	9.44600166-009	2.52389423+002
1.78835874-004	-7.35822503-010	-1.63749922+001
	2.47951038-011	

Table 10. Parameters in eqs. 1, 2, and 3 for Armco iron, specimen 4.

THERMAL CONDUCTIVITY	COEFFICIENTS FOR ELECTRICAL RESISTIVITY	THERMOPOWER
8.21226100+000	-5.03088441-007	-6.42943844+002
-1.32577224+001	1.69059561-006	4.14540857+003
1.14738701+001	-2.42733181-006	-1.09289158+004
-6.21776147+000	1.98402296-006	1.54381788+004
2.19527810+000	-1.01722378-006	-1.27838650+004
-5.01619108-001	3.39158569-007	6.34295244+003
7.10720281-002	-7.35034919-008	-1.83456286+003
-5.64940725-003	9.97927431-009	2.84809534+002
1.91995267-004	-7.69854134-010	-1.83820643+001
	2.57278514-011	

These parameters are listed in E format. This format is illustrated by the following example: 1.788-004 = 1.788×10^{-4}

Table 11 Thermal conducticity deviations for Armco iron, specimen 2.

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 28AUG68 625 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
94.026	3.779	9.86+001	9.88+001	-0.2
97.853	3.874	9.59+001	9.73+001	-1.5
101.738	3.896	9.55+001	9.60+001	-0.5
105.653	3.933	9.45+001	9.47+001	-0.2
109.598	3.958	9.41+001	9.35+001	0.6
113.566	3.978	9.36+001	9.24+001	1.3
117.573	4.036	9.24+001	9.14+001	1.1

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 29AUG68 1145AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
122.304	12.559	9.09+001	9.03+001	0.7
135.081	12.996	8.76+001	8.79+001	-0.2
148.177	13.194	8.64+001	8.60+001	0.5
161.479	13.410	8.49+001	8.46+001	0.4
174.970	13.572	8.41+001	8.35+001	0.7
188.636	13.759	8.29+001	8.25+001	0.5
202.525	14.020	8.15+001	8.16+001	-0.2

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68 100AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
175.658	27.946	8.27+001	8.34+001	-0.9
204.162	29.062	7.94+001	8.15+001	-2.7
233.544	29.701	7.77+001	7.95+001	-2.3
263.598	30.409	7.58+001	7.72+001	-1.9
294.329	31.053	7.44+001	7.47+001	-0.4
325.769	31.827	7.26+001	7.23+001	0.3
358.141	32.917	7.03+001	7.06+001	-0.5

Table 11 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68 220PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
5.119	0.219	1.83+001	1.80+001	1.7
5.338	0.217	1.84+001	1.89+001	-2.7
5.548	0.204	1.96+001	1.98+001	-1.0
5.748	0.196	2.04+001	2.06+001	-1.3
5.939	0.186	2.15+001	2.14+001	0.4
6.119	0.173	2.31+001	2.21+001	4.2
6.292	0.172	2.32+001	2.28+001	1.8

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68 330PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
7.317	0.651	2.64+001	2.67+001	-1.2
7.947	0.610	2.81+001	2.91+001	-3.5
8.536	0.568	3.02+001	3.12+001	-3.1
9.084	0.528	3.25+001	3.31+001	-2.1
9.592	0.488	3.52+001	3.50+001	0.8
10.061	0.449	3.82+001	3.66+001	4.2
10.502	0.433	3.98+001	3.82+001	3.9

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68 630PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
11.805	0.938	4.27+001	4.28+001	-0.2
12.717	0.885	4.52+001	4.61+001	-1.9
13.575	0.831	4.82+001	4.92+001	-2.0
14.383	0.786	5.09+001	5.21+001	-2.3
15.136	0.721	5.56+001	5.48+001	1.5
15.833	0.672	5.96+001	5.73+001	3.9
16.495	0.652	6.16+001	5.97+001	3.2

Table 11 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 30AUG68 710PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
18.516	1.798	6.60+001	6.67+001	-0.5
20.255	1.681	7.09+001	7.26+001	-2.4
21.881	1.570	7.60+001	7.78+001	-2.4
23.405	1.478	8.06+001	8.24+001	-2.3
24.826	1.365	8.75+001	8.65+001	1.2
26.147	1.277	9.35+001	9.00+001	3.7
27.409	1.247	9.59+001	9.32+001	2.8

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 3SEPT68 347PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
23.334	0.413	8.10+001	8.22+001	-1.6
23.744	0.407	8.21+001	8.34+001	-1.6
24.151	0.409	8.18+001	8.46+001	-3.5
24.554	0.397	8.41+001	8.57+001	-2.0
24.945	0.384	8.72+001	8.68+001	0.4
25.323	0.373	8.98+001	8.78+001	2.1
25.691	0.364	9.20+001	8.88+001	3.4

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 3SEPT68 505PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
36.870	2.774	1.09+002	1.10+002	-0.1
39.637	2.758	1.10+002	1.12+002	-2.2
42.366	2.700	1.12+002	1.14+002	-1.6
45.038	2.645	1.15+002	1.15+002	-0.6
47.653	2.586	1.17+002	1.16+002	1.3
50.217	2.542	1.19+002	1.16+002	2.8
52.769	2.563	1.19+002	1.16+002	2.3

Table 11 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 4SEPT68 120PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
51.984	5.099	1.16+002	1.16+002	0.1
57.146	5.224	1.13+002	1.15+002	-1.7
62.402	5.288	1.12+002	1.13+002	-1.2
67.732	5.372	1.10+002	1.11+002	-0.8
73.149	5.461	1.08+002	1.08+002	0.1
78.649	5.539	1.07+002	1.06+002	1.1
84.276	5.715	1.04+002	1.03+002	0.6

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 4SEPT68 430PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
26.822	1.496	9.14+001	9.17+001	-0.4
28.305	1.470	9.28+001	9.53+001	-2.7
29.751	1.421	9.61+001	9.84+001	-2.4
31.148	1.373	9.95+001	1.01+002	-1.8
32.492	1.316	1.04+002	1.04+002	0.4
33.774	1.247	1.10+002	1.06+002	3.7
35.019	1.244	1.10+002	1.07+002	2.4

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 27AUG68 135PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
78.252	2.003	1.05+002	1.06+002	-0.5
80.278	2.048	1.03+002	1.05+002	-2.0
82.328	2.053	1.03+002	1.04+002	-1.2
84.386	2.064	1.02+002	1.03+002	-1.0
86.452	2.069	1.02+002	1.02+002	-0.1
88.521	2.068	1.02+002	1.01+002	0.8
90.602	2.094	1.01+002	1.00+002	0.6

Table 11 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 6SEPT68 1130AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
206.823	5.222	8.25+001	8.13+001	1.4
212.090	5.312	8.09+001	8.10+001	-0.1
217.401	5.311	8.10+001	8.07+001	0.4
222.737	5.359	8.02+001	8.03+001	-0.2
228.104	5.375	8.01+001	7.99+001	0.2
233.494	5.404	7.97+001	7.95+001	0.1
238.926	5.461	7.89+001	7.91+001	-0.3

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2) 7SEPT68 430 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
233.559	12.173	8.08+001	7.95+001	1.6
245.889	12.487	7.86+001	7.86+001	-0.1
258.409	12.554	7.82+001	7.77+001	0.8
271.078	12.783	7.67+001	7.66+001	0.1
283.913	12.887	7.63+001	7.56+001	1.0
296.899	13.084	7.51+001	7.45+001	0.8
310.118	13.354	7.37+001	7.35+001	0.3

Table 12 Electrical resistivity deviations for Armco iron, specimen 2.

MEAN TEMPERATURE	TEMPERATURE RANGE	OBSERVED RESISTANCE	CALCULATED RESISTANCE	PERCENT DEVIATION	INTRINSIC RESISTANCE
5.729	1.368	1.166-004	1.166-004	-0.03	2.034-009
9.006	3.727	1.168-004	1.168-004	-0.02	2.020-007
14.277	5.485	1.171-004	1.171-004	0.04	5.520-007
23.205	10.416	1.188-004	1.189-004	-0.01	2.252-006
24.534	2.746	1.191-004	1.192-004	-0.07	2.502-006
44.935	18.568	1.372-004	1.370-004	0.10	2.055-005
67.905	37.699	1.980-004	1.983-004	-0.16	8.135-005
31.044	9.567	1.221-004	1.222-004	-0.12	5.502-006
84.402	14.398	2.623-004	2.624-004	-0.05	1.457-004
105.715	27.454	3.763-004	3.763-004	-0.01	2.597-004
161.880	93.511	7.513-004	7.510-004	0.03	6.347-004
265.025	212.914	1.579-003	1.580-003	-0.08	1.462-003
222.796	37.445	1.201-003	1.202-003	-0.03	1.085-003
271.407	89.322	1.606-003	1.604-003	0.12	1.490-003
4.941	0.000	1.166-004	1.166-004	0.01	2.034-009
7.440	0.000	1.167-004	1.166-004	0.07	1.020-007
10.762	0.000	1.168-004	1.170-004	-0.12	2.520-007
16.463	0.000	1.174-004	1.173-004	0.13	8.020-007
19.866	0.000	1.179-004	1.179-004	0.08	1.352-006
22.883	0.000	1.186-004	1.186-004	-0.04	2.002-006
46.231	0.000	1.381-004	1.379-004	0.20	2.155-005
23.956	0.000	1.189-004	1.190-004	-0.07	2.302-006
63.298	0.000	1.782-004	1.783-004	-0.04	6.160-005
63.076	0.000	1.777-004	1.776-004	0.07	6.110-005
75.983	0.000	2.245-004	2.245-004	-0.00	1.079-004
89.764	0.000	2.879-004	2.880-004	-0.06	1.713-004
108.179	0.000	3.897-004	3.895-004	0.04	2.731-004
144.310	0.000	6.241-004	6.231-004	0.16	5.075-004
200.924	0.000	1.032-003	1.033-003	-0.14	9.151-004
220.121	0.000	1.180-003	1.180-003	0.01	1.064-003

Table 13 Thermovoltage deviations for Armco iron, specimen 2.

UPPER TEMPERATURE	LOWER TEMPERATURE	OBSERVED THERMOVOLTAGE	CALCULATED THERMOVOLTAGE	DEVIATION
6.378	5.010	-0.03	-0.03	0.01
10.719	6.992	0.13	0.18	-0.04
16.821	11.336	0.51	0.40	0.11
28.033	17.616	3.60	3.71	-0.11
25.873	23.127	1.04	1.15	-0.11
54.051	35.483	47.20	46.99	0.21
87.134	49.435	241.42	241.65	-0.23
35.641	26.074	8.19	8.15	0.04
91.649	77.251	129.98	129.81	0.17
119.591	92.137	318.51	318.18	0.33
209.535	116.024	1343.50	1343.64	-0.15
374.600	161.685	2724.50	2724.48	0.02
241.657	204.212	544.20	543.87	0.33
316.795	227.472	1174.06	1174.17	-0.11

Table 14 Thermal conductivity deviations for Armco iron, specimen 2a.

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 9 MAR 69 900 AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
88.001	3.756	9.92+001	9.91+001	0.1
91.803	3.846	9.66+001	9.77+001	-1.1
95.671	3.891	9.56+001	9.64+001	-0.8
99.578	3.922	9.47+001	9.52+001	-0.5
103.519	3.960	9.41+001	9.41+001	0.0
107.488	3.979	9.36+001	9.30+001	0.6
111.490	4.025	9.26+001	9.20+001	0.7

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 10 MAR 69 1020 AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
92.869	8.591	9.76+001	9.74+001	0.2
101.615	8.902	9.40+001	9.46+001	-0.6
110.620	9.108	9.20+001	9.22+001	-0.2
119.815	9.281	9.01+001	9.01+001	-0.0
129.171	9.433	8.89+001	8.84+001	0.5
138.666	9.556	8.77+001	8.70+001	0.8
148.300	9.712	8.64+001	8.59+001	0.6

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 10 MAR 69 500 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
115.780	17.746	9.17+001	9.10+001	0.8
133.920	18.533	8.76+001	8.77+001	-0.1
152.704	19.036	8.54+001	8.54+001	0.0
171.957	19.430	8.36+001	8.36+001	-0.1
191.565	19.826	8.21+001	8.21+001	-0.0
211.576	20.196	8.05+001	8.05+001	0.0
231.993	20.639	7.89+001	7.89+001	0.1

Table 14 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 11 MAR 69 440 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
135.945	4.224	8.83+001	8.74+001	1.0
140.226	4.337	8.58+001	8.68+001	-1.3
144.562	4.336	8.59+001	8.63+001	-0.5
148.892	4.323	8.60+001	8.58+001	0.2
153.229	4.351	8.57+001	8.53+001	0.4
157.584	4.359	8.55+001	8.49+001	0.7
161.969	4.411	8.46+001	8.45+001	0.1

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 12 MAR 69 1007 AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
141.419	9.589	8.75+001	8.67+001	0.9
151.133	9.839	8.51+001	8.56+001	-0.6
161.016	9.927	8.44+001	8.46+001	-0.2
170.979	10.000	8.37+001	8.37+001	-0.0
181.042	10.127	8.28+001	8.29+001	-0.1
191.213	10.214	8.21+001	8.21+001	-0.0
201.500	10.359	8.11+001	8.13+001	-0.3

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 25 MAR 69 345 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
198.547	3.502	8.15+001	8.15+001	-0.0
202.066	3.536	8.06+001	8.13+001	-0.9
205.604	3.541	8.05+001	8.10+001	-0.6
209.148	3.548	8.03+001	8.07+001	-0.6
212.699	3.553	8.03+001	8.04+001	-0.1
216.257	3.561	8.01+001	8.01+001	-0.0
219.831	3.587	7.96+001	7.99+001	-0.3

Table 14 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 12 MAR 69 540 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
21.536	0.736	7.00+001	7.02+001	-0.4
22.265	0.722	7.12+001	7.23+001	-1.5
22.982	0.713	7.21+001	7.44+001	-3.1
23.678	0.679	7.57+001	7.63+001	-0.8
24.350	0.665	7.75+001	7.81+001	-0.8
25.000	0.636	8.09+001	7.98+001	1.4
25.628	0.619	8.33+001	8.14+001	2.3

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 13 MAR 69 1015 AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
23.982	1.332	7.70+001	7.71+001	-0.1
25.293	1.290	7.93+001	8.05+001	-1.5
26.569	1.261	8.12+001	8.37+001	-3.0
27.795	1.192	8.58+001	8.65+001	-0.8
28.970	1.158	8.86+001	8.91+001	-0.6
30.099	1.100	9.31+001	9.14+001	1.9
31.184	1.070	9.59+001	9.34+001	2.6

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 13 MAR 69 1215 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
28.826	3.418	8.91+001	8.88+001	0.3
32.148	3.226	9.41+001	9.52+001	-1.1
35.314	3.106	9.79+001	1.00+002	-2.2
38.341	2.948	1.03+002	1.04+002	-0.6
41.253	2.875	1.06+002	1.06+002	-0.3
44.075	2.769	1.10+002	1.08+002	1.7
46.822	2.725	1.12+002	1.09+002	2.4

Table 14 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 13 MAR 69 300 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
36.201	6.333	1.02+002	1.01+002	0.4
42.397	6.060	1.06+002	1.07+002	-1.0
48.399	5.943	1.08+002	1.10+002	-1.3
54.298	5.855	1.10+002	1.10+002	-0.4
60.168	5.885	1.09+002	1.09+002	0.2
66.065	5.909	1.09+002	1.07+002	1.3
72.043	6.049	1.06+002	1.05+002	1.1

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 13 MAR 69 520 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
48.480	7.184	1.11+002	1.10+002	0.9
55.708	7.270	1.09+002	1.10+002	-0.7
63.045	7.403	1.07+002	1.08+002	-1.0
70.526	7.558	1.05+002	1.06+002	-0.9
78.179	7.748	1.03+002	1.03+002	-0.3
86.006	7.907	1.00+002	9.98+001	0.6
94.033	8.148	9.76+001	9.70+001	0.6

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 7 MAR 69 500 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
78.942	1.412	1.03+002	1.03+002	0.0
80.364	1.433	1.01+002	1.02+002	-1.2
81.801	1.440	1.00+002	1.01+002	-1.0
83.243	1.444	1.00+002	1.01+002	-0.8
84.690	1.448	9.99+001	1.00+002	-0.4
86.136	1.444	1.00+002	9.98+001	0.4
87.584	1.452	9.98+001	9.92+001	0.5

Table 14 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 19 MAR 69 433PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
5.048	0.317	1.65+001	1.63+001	1.1
5.355	0.296	1.76+001	1.74+001	0.9
5.647	0.289	1.81+001	1.85+001	-2.1
5.926	0.269	1.94+001	1.95+001	-0.5
6.191	0.261	2.01+001	2.04+001	-1.8
6.441	0.239	2.19+001	2.13+001	2.8
6.677	0.233	2.24+001	2.21+001	1.5

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 19 MAR 69 545 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
6.337	0.584	2.08+001	2.09+001	-0.5
6.894	0.530	2.29+001	2.28+001	0.2
7.413	0.509	2.39+001	2.46+001	-3.1
7.900	0.465	2.61+001	2.62+001	-0.7
8.355	0.444	2.74+001	2.77+001	-1.3
8.780	0.407	2.99+001	2.91+001	2.4
9.178	0.389	3.12+001	3.05+001	2.5

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 19 MAR 69 715 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
8.206	1.220	2.72+001	2.72+001	0.0
9.355	1.078	3.08+001	3.10+001	-0.9
10.386	0.986	3.37+001	3.44+001	-2.3
11.321	0.883	3.75+001	3.75+001	0.1
12.176	0.827	4.02+001	4.03+001	-0.3
12.966	0.753	4.41+001	4.29+001	2.7
13.698	0.711	4.68+001	4.54+001	3.1

Table 14 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 19 MAR 69 810 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
11.955	2.286	3.99+001	3.96+001	0.9
14.080	1.963	4.64+001	4.66+001	-0.5
15.947	1.771	5.15+001	5.28+001	-2.4
17.615	1.565	5.82+001	5.81+001	0.1
19.127	1.459	6.26+001	6.29+001	-0.6
20.521	1.328	6.87+001	6.72+001	2.2
21.811	1.252	7.30+001	7.10+001	2.7

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 20 MAR 69 1045 AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
14.527	2.806	4.83+001	4.81+001	0.5
17.137	2.415	5.60+001	5.66+001	-1.1
19.435	2.180	6.21+001	6.39+001	-2.8
21.494	1.937	6.98+001	7.01+001	-0.4
23.366	1.809	7.50+001	7.54+001	-0.6
25.100	1.659	8.17+001	8.00+001	2.0
26.715	1.571	8.63+001	8.40+001	2.7

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 20 MAR 69 1200 NOON

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
16.353	0.740	5.41+001	5.41+001	0.0
17.080	0.715	5.58+001	5.64+001	-1.1
17.789	0.701	5.70+001	5.87+001	-3.0
18.468	0.657	6.08+001	6.09+001	-0.2
19.117	0.641	6.24+001	6.29+001	-0.8
19.740	0.605	6.61+001	6.48+001	1.9
20.335	0.585	6.85+001	6.66+001	2.7

Table 14 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 26 MAR 69 1200 NOON

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
212.561	6.947	8.06+001	8.04+001	0.1
219.559	7.049	7.92+001	7.99+001	-0.8
226.623	7.078	7.90+001	7.93+001	-0.4
233.717	7.111	7.85+0,1	7.87+001	-0.3
240.846	7.146	7.85+001	7.81+001	0.2
248.015	7.192	7.78+001	7.76+001	0.3
255.244	7.267	7.71+001	7.70+001	0.1

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 26 MAR 69 715 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
218.594	12.985	8.00+001	8.00+001	0.1
231.706	13.240	7.83+001	7.89+001	-0.7
245.013	13.375	7.76+001	7.78+001	-0.2
258.456	13.512	7.67+001	7.67+001	-0.0
272.039	13.653	7.61+001	7.58+001	0.4
285.779	13.829	7.51+001	7.50+001	0.2
299.737	14.086	7.38+001	7.45+001	-0.8

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 27 MAR 69 445 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
235.266	2.638	7.95+001	7.86+001	1.2
237.935	2.700	7.75+001	7.84+001	-1.1
240.629	2.688	7.80+001	7.82+001	-0.2
243.307	2.668	7.84+001	7.79+001	0.6
245.976	2.671	7.85+001	7.77+001	1.0
248.654	2.683	7.81+001	7.75+001	0.8
251.360	2.729	7.69+001	7.73+001	-0.5

Table 14 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 3 APRIL 69 430 PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
277.356	2.718	7.63+001	7.55+001	1.1
280.090	2.749	7.52+001	7.53+001	-0.1
282.841	2.753	7.52+001	7.51+001	0.1
285.596	2.758	7.50+001	7.50+001	-0.1
288.356	2.762	7.50+001	7.49+001	0.2
291.125	2.776	7.46+001	7.48+001	-0.2
293.911	2.796	7.42+001	7.46+001	-0.6

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(2A) 4 APRIL 69 920 AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
277.631	2.748	7.63+001	7.54+001	1.2
280.395	2.781	7.53+001	7.53+001	-0.0
283.178	2.785	7.52+001	7.51+001	0.1
285.966	2.790	7.50+001	7.50+001	0.0
288.758	2.795	7.50+001	7.49+001	0.2
291.561	2.811	7.46+001	7.47+001	-0.2
294.382	2.831	7.42+001	7.46+001	-0.6

Table 15 Electrical resistivity deviations for Armco iron, specimen 2a.

MEAN TEMPERATURE	TEMPERATURE RANGE	OBSERVED RESISTANCE	CALCULATED RESISTANCE	PERCENT DEVIATION	INTRINSIC RESISTANCE
5.898	1.904	1.292-004	1.292-004	-0.00	5.572-008
7.857	3.327	1.293-004	1.293-004	0.02	1.557-007
11.158	6.458	1.295-004	1.296-004	-0.05	3.557-007
17.293	11.624	1.301-004	1.301-004	0.03	1.006-006
21.110	14.377	1.309-004	1.309-004	-0.04	1.756-006
18.412	4.644	1.302-004	1.302-004	0.07	1.106-006
23.634	4.770	1.314-004	1.315-004	-0.07	2.256-006
27.699	8.402	1.329-004	1.330-004	-0.11	3.756-006
38.111	21.067	1.410-004	1.409-004	0.05	1.186-005
54.224	42.033	1.719-004	1.716-004	0.12	4.271-005
70.853	53.219	2.249-004	2.249-004	0.01	9.576-005
83.251	10.074	2.680-004	2.682-004	-0.08	1.389-004
99.650	27.379	3.532-004	3.534-004	-0.05	2.241-004
120.150	64.582	4.793-004	4.793-004	-0.01	3.502-004
172.780	135.405	8.452-004	8.446-004	0.07	7.161-004
148.915	30.341	6.669-004	6.664-004	0.07	5.378-004
171.185	70.055	8.265-004	8.260-004	0.06	6.974-004
209.164	24.828	1.105-003	1.106-003	-0.10	9.759-004
233.794	49.790	1.299-003	1.299-003	0.03	1.170-003
258.759	94.678	1.508-003	1.508-003	0.01	1.379-003
243.303	18.777	1.376-003	1.374-003	0.11	1.246-003
285.611	19.312	1.733-003	1.734-003	-0.04	1.604-003
285.981	19.540	1.737-003	1.737-003	-0.03	1.608-003
4.132	0.000	1.291-004	1.292-004	-0.00	5.721-009
19.818	0.000	1.305-004	1.304-004	0.06	1.356-006
75.934	0.000	2.358-004	2.358-004	-0.01	1.067-004
84.195	0.000	2.722-004	2.724-004	-0.06	1.431-004
131.684	0.000	5.494-004	5.489-004	0.09	4.203-004
192.760	0.000	9.801-004	9.820-004	-0.20	8.509-004
273.215	0.000	1.625-003	1.624-003	0.04	1.496-003

Table 16 Thermovoltage deviations for Armco iron, specimen 2a.

UPPER TEMPERATURE	LOWER TEMPERATURE	OBSERVED THERMOVOLTAGE	CALCULATED THERMOVOLTAGE	DEVIATION
6.793	4.889	0.01	-0.13	0.14
9.372	6.045	0.10	0.24	-0.14
14.053	7.595	0.43	0.48	-0.05
22.437	10.813	1.99	1.84	0.15
27.501	13.124	4.21	4.21	0.00
20.627	15.983	0.84	0.88	-0.04
25.957	21.168	1.82	1.99	-0.17
31.719	23.316	5.37	5.59	-0.22
48.185	27.118	35.68	35.66	0.02
75.068	33.034	175.46	175.26	0.20
98.108	44.888	368.80	369.03	-0.23
88.310	78.256	89.71	89.65	0.06
113.503	86.123	300.24	300.21	0.03
153.156	88.574	815.92	815.81	0.11
242.313	106.908	1922.36	1922.21	0.15
164.175	133.833	432.88	433.24	-0.36
206.680	136.624	1023.47	1023.63	-0.16
221.625	196.796	364.64	364.50	0.14
258.878	209.087	708.45	708.36	0.09
306.779	212.101	1276.16	1276.24	-0.08
252.724	233.947	263.21	263.59	-0.38
295.309	275.998	245.31	245.17	0.14
295.797	276.257	247.90	247.79	0.11

Table 17 Thermal conductivity deviations for Armco iron, specimen 4.

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 11DEC68 1140AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
78.980	0.909	1.02+002	1.02+002	-0.1
79.895	0.923	1.01+002	1.02+002	-1.2
80.816	0.919	1.01+002	1.01+002	-0.3
81.739	0.926	1.00+002	1.01+002	-0.6
82.663	0.923	1.01+002	1.01+002	0.3
83.588	0.928	1.00+002	1.00+002	-0.0
84.519	0.934	9.96+001	1.00+002	-0.4

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 11DEC68 540PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
87.322	2.880	9.89+001	9.89+001	-0.0
90.234	2.946	9.68+001	9.78+001	-1.1
93.186	2.957	9.66+001	9.68+001	-0.2
96.160	2.990	9.56+001	9.58+001	-0.2
99.156	3.002	9.54+001	9.49+001	0.6
102.174	3.035	9.42+001	9.39+001	0.3
105.226	3.067	9.32+001	9.31+001	0.1

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 12 DEC 68 1130AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
105.697	7.526	9.36+001	9.29+001	0.7
113.346	7.772	9.07+001	9.10+001	-0.3
121.163	7.863	8.98+001	8.94+001	0.5
129.090	7.990	8.85+001	8.80+001	0.5
137.118	8.065	8.78+001	8.69+001	1.1
145.243	8.186	8.64+001	8.59+001	0.6
153.483	8.294	8.52+001	8.51+001	0.2

Table 17 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 13 DEC 68 915AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
160.065	15.373	8.54+001	8.45+001	1.0
175.714	15.923	8.25+001	8.34+001	-1.0
191.731	16.111	8.17+001	8.25+001	-0.8
207.962	16.352	8.06+001	8.12+001	-0.8
224.416	16.556	7.97+001	8.00+001	-0.4
241.116	16.843	7.83+001	7.87+001	-0.5
258.099	17.124	7.69+001	7.72+001	-0.3

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 13 DEC 68 835PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
208.349	16.131	8.16+001	8.12+001	0.5
224.806	16.785	7.85+001	8.00+001	-1.9
241.665	16.934	7.80+001	7.86+001	-0.8
258.718	17.172	7.69+001	7.71+001	-0.2
276.003	17.399	7.61+001	7.56+001	0.6
293.594	17.782	7.44+001	7.42+001	0.2
311.567	18.165	7.27+001	7.31+001	-0.5

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 19DEC 68 500PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
205.638	5.156	8.23+001	8.14+001	1.0
210.852	5.272	8.05+001	8.10+001	-0.6
216.128	5.280	8.06+001	8.07+001	-0.1
221.429	5.321	8.00+001	8.03+001	-0.3
226.759	5.339	7.99+001	7.98+001	0.0
232.120	5.381	7.92+001	7.94+001	-0.3
237.524	5.427	7.84+001	7.90+001	-0.7

Table 17 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68 1135 AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
5.427	0.228	1.80+001	1.76+001	2.4
5.650	0.219	1.88+001	1.84+001	2.1
5.866	0.212	1.94+001	1.91+001	1.5
6.075	0.207	1.99+001	1.99+001	0.4
6.279	0.200	2.07+001	2.06+001	0.5
6.475	0.193	2.14+001	2.12+001	0.7
6.669	0.194	2.12+001	2.19+001	-3.0

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68 1225PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
7.211	0.542	2.35+001	2.37+001	-0.7
7.732	0.501	2.55+001	2.54+001	0.2
8.219	0.473	2.70+001	2.70+001	0.0
8.678	0.446	2.87+001	2.85+001	0.6
9.113	0.423	3.03+001	3.00+001	1.0
9.526	0.403	3.18+001	3.13+001	1.4
9.922	0.391	3.27+001	3.26+001	0.4

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68 130PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
10.579	0.884	3.46+001	3.48+001	-0.6
11.428	0.815	3.76+001	3.76+001	0.0
12.216	0.761	4.03+001	4.01+001	0.5
12.955	0.717	4.28+001	4.26+001	0.5
13.653	0.677	4.54+001	4.49+001	1.1
14.314	0.645	4.76+001	4.70+001	1.2
14.947	0.622	4.95+001	4.91+001	0.5

Table 17 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68 505PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
5.449	0.238	1.73+001	1.77+001	-2.3
5.679	0.223	1.85+001	1.85+001	-0.2
5.899	0.216	1.91+001	1.93+001	-0.9
6.111	0.209	1.98+001	2.00+001	-1.1
6.317	0.203	2.03+001	2.07+001	-1.6
6.514	0.191	2.16+001	2.14+001	0.9
6.705	0.190	2.16+001	2.20+001	-1.6

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68 540PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
17.565	1.711	5.72+001	5.75+001	-0.6
19.207	1.572	6.23+001	6.27+001	-0.6
20.724	1.462	6.71+001	6.72+001	-0.2
22.142	1.375	7.14+001	7.14+001	0.1
23.477	1.295	7.60+001	7.51+001	1.2
24.743	1.237	7.94+001	7.84+001	1.2
25.961	1.199	8.18+001	8.15+001	0.4

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68 600PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
17.580	1.718	5.69+001	5.76+001	-1.1
19.227	1.577	6.21+001	6.27+001	-1.0
20.750	1.468	6.68+001	6.73+001	-0.7
22.177	1.386	7.08+001	7.15+001	-0.9
23.516	1.292	7.61+001	7.52+001	1.2
24.782	1.241	7.92+001	7.85+001	0.8
26.005	1.204	8.15+001	8.16+001	-0.1

Table 17 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 16 DEC 68 635PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
14.083	1.051	4.59+001	4.63+001	-0.7
15.096	0.980	4.93+001	4.96+001	-0.5
16.051	0.924	5.24+001	5.27+001	-0.5
16.951	0.876	5.53+001	5.56+001	-0.5
17.802	0.827	5.87+001	5.83+001	0.7
18.612	0.791	6.13+001	6.08+001	0.8
19.391	0.767	6.32+001	6.32+001	-0.1

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 17DEC68 1140AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
21.850	0.273	6.95+001	7.05+001	-1.4
22.121	0.270	7.05+001	7.13+001	-1.2
22.389	0.266	7.15+001	7.21+001	-0.8
22.654	0.263	7.23+001	7.28+001	-0.7
22.914	0.258	7.39+001	7.35+001	0.4
23.170	0.253	7.53+001	7.42+001	1.3
23.424	0.254	7.50+001	7.49+001	0.1

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 17DEC68 115PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
23.759	0.525	7.48+001	7.58+001	-1.4
24.278	0.513	7.66+001	7.72+001	-0.8
24.787	0.504	7.81+001	7.86+001	-0.6
25.288	0.498	7.91+001	7.98+001	-0.9
25.777	0.480	8.23+001	8.11+001	1.5
26.255	0.477	8.27+001	8.22+001	0.6
26.729	0.470	8.38+001	8.34+001	0.5

Table 17 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 17DEC68 230PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
28.203	1.423	8.63+001	8.67+001	-0.5
29.605	1.381	8.90+001	8.97+001	-0.7
30.964	1.337	9.22+001	9.23+001	-0.1
32.285	1.302	9.47+001	9.47+001	0.0
33.563	1.258	9.82+001	9.68+001	1.4
34.811	1.239	9.96+001	9.86+001	0.9
36.043	1.224	1.01+002	1.00+002	0.4

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 17DEC68 455PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
39.555	3.522	1.04+002	1.04+002	-0.3
43.044	3.456	1.06+002	1.07+002	-0.9
46.460	3.375	1.09+002	1.08+002	0.1
49.824	3.353	1.09+002	1.09+002	0.1
53.154	3.306	1.11+002	1.10+002	1.4
56.473	3.332	1.10+002	1.09+002	0.7
59.823	3.368	1.09+002	1.09+002	0.1

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 18DEC68 1150AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
60.412	4.981	1.09+002	1.09+002	0.2
65.465	5.124	1.06+002	1.07+002	-1.2
70.621	5.190	1.05+002	1.05+002	-0.6
75.858	5.284	1.03+002	1.03+002	-0.4
81.171	5.343	1.02+002	1.01+002	0.7
86.585	5.484	9.93+001	9.92+001	0.1
92.133	5.612	9.69+001	9.72+001	-0.2

Table 17 (Cont.)

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 20DEC 68 1025AM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
246.036	12.423	7.94+001	7.82+001	1.4
258.676	12.858	7.68+001	7.71+001	-0.4
271.589	12.968	7.63+001	7.60+001	0.4
284.644	13.141	7.53+001	7.49+001	0.6
297.864	13.300	7.45+001	7.39+001	0.9
311.287	13.546	7.31+001	7.31+001	0.1
324.952	13.782	7.18+001	7.25+001	-1.0

THERMAL CONDUCTIVITY DATA FOR ARMCO IRON(4) 20DEC 68 340PM

MEAN TEMPERATURE	TEMPERATURE DIFFERENCE	OBSERVED THERMAL CONDUCTIVITY	CALCULATED THERMAL CONDUCTIVITY	PERCENT DEVIATION
226.641	7.974	8.09+001	7.98+001	1.3
234.731	8.205	7.87+001	7.92+001	-0.6
242.951	8.236	7.86+001	7.85+001	0.1
251.227	8.316	7.79+001	7.78+001	0.1
259.564	8.357	7.76+001	7.70+001	0.8
267.967	8.449	7.67+001	7.63+001	0.5
276.464	8.545	7.58+001	7.56+001	0.3

Table 18 Electrical resistivity deviations for Armco iron, specimen 4.

MEAN TEMPERATURE	TEMPERATURE RANGE	OBSERVED RESISTANCE	CALCULATED RESISTANCE	PERCENT DEVIATION	INTRINSIC RESISTANCE
6.063	1.452	1.303-004	1.303-004	-0.01	-4.826-008
8.629	3.178	1.304-004	1.304-004	0.05	1.017-007
12.870	5.121	1.307-004	1.308-004	-0.06	3.517-007
6.096	1.470	1.303-004	1.303-004	0.00	-4.826-008
21.974	9.850	1.322-004	1.322-004	0.02	1.852-006
22.005	9.885	1.322-004	1.322-004	0.01	1.852-006
16.855	6.218	1.312-004	1.311-004	0.07	8.517-007
22.646	1.838	1.323-004	1.323-004	-0.01	1.902-006
25.268	3.468	1.330-004	1.331-004	-0.08	2.652-006
32.210	9.164	1.365-004	1.366-004	-0.05	6.152-006
49.762	23.713	1.600-004	1.598-004	0.11	2.965-005
76.035	37.016	2.427-004	2.429-004	-0.12	1.123-004
81.743	6.461	2.636-004	2.639-004	-0.11	1.333-004
96.208	20.877	3.373-004	3.371-004	0.05	2.070-004
129.306	55.696	5.409-004	5.405-004	0.08	4.106-004
208.443	114.282	1.116-003	1.114-003	0.16	9.855-004
259.243	120.367	1.527-003	1.525-003	0.12	1.397-003
221.493	37.178	1.208-003	1.209-003	-0.11	1.078-003
285.007	92.018	1.744-003	1.746-003	-0.09	1.614-003
251.364	58.082	1.452-003	1.451-003	0.04	1.321-003
4.394	0.000	1.303-004	1.303-004	-0.00	-4.826-008
9.696	0.000	1.305-004	1.306-004	-0.06	1.517-007
15.786	0.000	1.310-004	1.309-004	0.04	6.517-007
20.069	0.000	1.317-004	1.316-004	0.03	1.302-006
19.878	0.000	1.316-004	1.316-004	0.02	1.252-006
26.745	0.000	1.336-004	1.336-004	-0.07	3.202-006
35.938	0.000	1.392-004	1.391-004	0.03	8.802-006
55.386	0.000	1.703-004	1.701-004	0.12	3.995-005
77.113	0.000	2.429-004	2.434-004	-0.17	1.126-004
75.738	0.000	2.378-004	2.376-004	0.06	1.074-004
84.360	0.000	2.760-004	2.759-004	0.02	1.457-004
98.003	0.000	3.462-004	3.460-004	0.04	2.158-004
144.158	0.000	6.381-004	6.378-004	0.05	5.078-004
191.793	0.000	9.825-004	9.817-004	0.09	8.522-004
193.141	0.000	9.890-004	9.918-004	-0.28	8.587-004
233.413	0.000	1.303-003	1.303-003	0.02	1.173-003

Table 19 Thermovoltage deviations for Armco iron, specimen 4.

UPPER TEMPERATURE	LOWER TEMPERATURE	OBSERVED THERMOVOLTAGE	CALCULATED THERMOVOLTAGE	DEVIATION
6.766	5.313	-0.03	-0.12	0.09
10.118	6.940	0.06	0.28	-0.22
15.258	10.137	0.31	0.24	0.07
6.800	5.330	-0.02	-0.12	0.10
26.560	16.710	2.68	2.71	-0.03
26.606	16.721	2.72	2.73	-0.01
19.775	13.557	0.73	0.58	0.15
23.551	21.713	0.49	0.57	-0.08
26.964	23.496	1.41	1.54	-0.13
36.655	27.491	8.60	8.72	-0.12
61.507	37.794	77.53	77.36	0.17
94.938	57.922	282.46	282.65	-0.19
84.986	78.525	55.32	55.19	0.13
106.759	85.882	218.50	218.42	0.08
157.630	101.934	734.22	734.13	0.09
266.661	152.379	1636.76	1636.91	-0.15
320.650	200.283	1597.60	1597.72	-0.12
240.238	203.059	534.88	534.46	0.42
331.843	239.825	1149.44	1149.36	0.08
280.736	222.654	794.32	794.22	0.10

Table 20 Transport properties of Armco iron, specimen 2.

Temp (K)	Thermal Conductivity ($Wm^{-1}K^{-1}$)	Electrical Resistivity (μohm m)	Lorenz ratio x 10^8 (V^2/K^2)	Thermo-power ($\mu V/K$)
6	21.7	0.006905	2.49	0.02
7	25.6	0.006903	2.52	0.06
8	29.2	0.006911	2.53	0.07
9	32.8	0.006920	2.53	0.06
10	36.4	0.006926	2.52	0.07
12	43.5	0.006929	2.51	0.13
14	50.7	0.006932	2.51	0.22
16	57.9	0.006941	2.51	0.32
18	65.0	0.006957	2.51	0.43
20	71.8	0.006981	2.50	0.54
25	87.0	0.007067	2.46	0.82
30	98.9	0.007196	2.37	1.18
35	107	0.007386	2.26	1.67
40	113	0.007664	2.16	2.28
45	115	0.008051	2.06	3.00
50	116	0.008562	1.99	3.79
55	115	0.009202	1.93	4.63
60	114	0.009976	1.89	5.51
65	112	0.01088	1.87	6.38
70	110	0.01191	1.87	7.24
75	107	0.01306	1.87	8.07
80	105	0.01432	1.88	8.86
85	103	0.01568	1.89	9.60
90	100	0.01713	1.91	10.30
95	98.4	0.01867	1.93	10.95
100	96.6	0.02028	1.96	11.54
110	93.4	0.02371	2.01	12.58
120	90.8	0.02736	2.07	13.44
130	88.7	0.03119	2.13	14.13
140	87.1	0.03516	2.19	14.67
150	85.8	0.03923	2.24	15.07
160	84.7	0.04340	2.30	15.37
170	83.9	0.04765	2.35	15.57
180	83.1	0.05196	2.40	15.69
190	82.4	0.05633	2.44	15.74
200	81.8	0.06077	2.48	15.73
220	80.5	0.06983	2.55	15.56
240	79.1	0.07918	2.61	15.23
260	77.5	0.08888	2.65	14.77
280	75.9	0.09903	2.68	14.19
300	74.3	0.10970	2.72	13.51

Table 21 Transport properties of Armco iron, specimen 2a.

Temp (K)	Thermal Conductivity ($Wm^{-1}K^{-1}$)	Electrical Resistivity (μ ohm m)	Lorenz ratio x 10^8 (V^2/K^2)	Thermo-power ($\mu V/K$)
6	19.7	0.007645	2.52	-0.02
7	23.2	0.007645	2.53	0.08
8	26.6	0.007658	2.54	0.11
9	29.9	0.007669	2.55	0.11
10	33.2	0.007674	2.55	0.11
12	39.8	0.007676	2.54	0.15
14	46.4	0.007676	2.54	0.23
16	52.9	0.007685	2.54	0.33
18	59.4	0.007702	2.54	0.44
20	65.6	0.007726	2.53	0.56
25	79.8	0.007812	2.49	0.87
30	91.2	0.007936	2.41	1.25
35	99.6	0.008119	2.31	1.75
40	105	0.008388	2.21	2.37
45	108	0.008766	2.11	3.09
50	110	0.009268	2.04	3.87
55	110	0.009902	1.98	4.72
60	109	0.01067	1.94	5.58
65	108	0.01157	1.92	6.45
70	106	0.01259	1.91	7.30
75	104	0.01374	1.91	8.12
80	102	0.01500	1.91	8.91
85	100	0.01635	1.93	9.65
90	98.4	0.01781	1.95	10.34
95	96.7	0.01934	1.97	10.97
100	95.1	0.02096	1.99	11.56
110	92.3	0.02438	2.05	12.59
120	90.1	0.02803	2.10	13.43
130	88.3	0.03185	2.16	14.10
140	86.9	0.03581	2.22	14.63
150	85.7	0.03988	2.28	15.02
160	84.7	0.04404	2.33	15.31
170	83.8	0.04827	2.38	15.50
180	83.0	0.05258	2.42	15.62
190	82.2	0.05694	2.46	15.67
200	81.4	0.06137	2.50	15.66
220	79.8	0.07042	2.56	15.50
240	78.2	0.07978	2.60	15.18
260	76.6	0.08952	2.64	14.72
280	75.3	0.09971	2.68	14.14

Table 22 Transport properties of Armco iron, specimen 4.

Temp (K)	Thermal Conductivity ($Wm^{-1}K^{-1}$)	Electrical Resistivity (μohm m)	Lorenz ratio x 10^8 (V^2/K^2)	Thermo-power ($\mu V/K$)
6	19.6	0.007675	2.51	-0.07
7	23.0	0.007664	2.52	0.07
8	26.3	0.007673	2.52	0.11
9	29.6	0.007685	2.53	0.11
10	32.9	0.007694	2.53	0.11
12	39.4	0.007702	2.53	0.13
14	46.0	0.007706	2.53	0.19
16	52.5	0.007715	2.53	0.28
18	58.9	0.007730	2.53	0.39
20	65.1	0.007752	2.52	0.50
25	79.1	0.007834	2.48	0.80
30	90.5	0.007960	2.40	1.18
35	98.9	0.008149	2.30	1.66
40	105	0.008427	2.20	2.27
45	108	0.008814	2.11	2.97
50	109	0.009324	2.04	3.74
55	110	0.009965	1.98	4.58
60	109	0.01074	1.95	5.44
65	107	0.01164	1.92	6.30
70	106	0.01267	1.91	7.15
75	104	0.01382	1.91	7.98
80	102	0.01507	1.92	8.77
85	99.8	0.01643	1.93	9.51
90	97.9	0.01789	1.95	10.20
95	96.2	0.01942	1.97	10.85
100	94.6	0.02104	1.99	11.44
110	91.8	0.02446	2.04	12.47
120	89.6	0.02811	2.10	13.31
130	87.9	0.03193	2.16	13.99
140	86.5	0.03589	2.22	14.51
150	85.4	0.03996	2.28	14.91
160	84.5	0.04412	2.33	15.20
170	83.8	0.04836	2.38	15.39
180	83.1	0.05267	2.43	15.51
190	82.4	0.05704	2.47	15.56
200	81.8	0.06146	2.51	15.55
220	80.4	0.07052	2.58	15.39
240	78.8	0.07986	2.62	15.07
260	77.0	0.08957	2.65	14.62
280	75.3	0.09973	2.68	14.05
300	73.8	0.11040	2.71	13.36

Table 23 The Lorenz ratio and intrinsic electrical resistivity of Armco iron (average of the results from specimens 2, 2a, and 4.)

Temp (K)	Lorenz ratio $\times 10^8$ (V^2/K^2)	Intrinsic Electrical Resistivity (μ ohm m)
4	2.263	0.0000
5	2.455	0.0000
6	2.505	0.0000
7	2.523	0.0000
8	2.531	0.0000
9	2.533	0.0000
10	2.532	0.0000
12	2.529	0.0000
14	2.528	0.0000
16	2.528	0.0000
18	2.527	0.0001
20	2.521	0.0001
25	2.477	0.0002
30	2.395	0.0003
35	2.292	0.0005
40	2.188	0.0008
45	2.096	0.0011
50	2.021	0.0016
55	1.965	0.0023
60	1.927	0.0030
65	1.905	0.0040
70	1.895	0.0050
75	1.895	0.0061
80	1.903	0.0074
85	1.917	0.0087
90	1.935	0.0102
95	1.956	0.0117
100	1.980	0.0134
110	2.034	0.0168
120	2.091	0.0204
130	2.150	0.0242
140	2.209	0.0282
150	2.266	0.0323
160	2.320	0.0364
170	2.371	0.0407
180	2.418	0.0450
190	2.461	0.0494
200	2.499	0.0538
220	2.562	0.0628
240	2.610	0.0722
260	2.647	0.0819
280	2.682	0.0921
300	2.724	0.1028

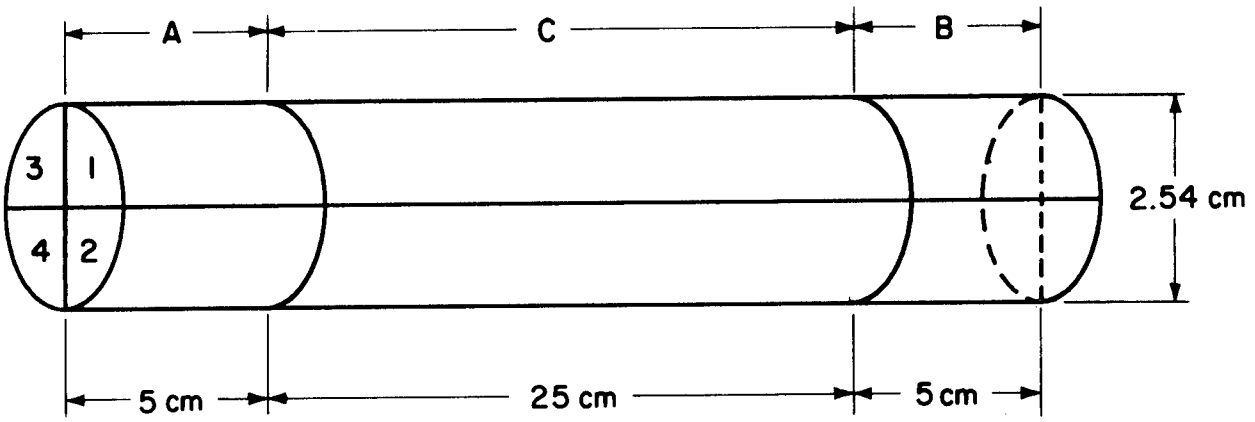

Figure 1. Division of Armco iron rod. Each of the 12 pieces shown was machined into a circular cylinder for measurement.

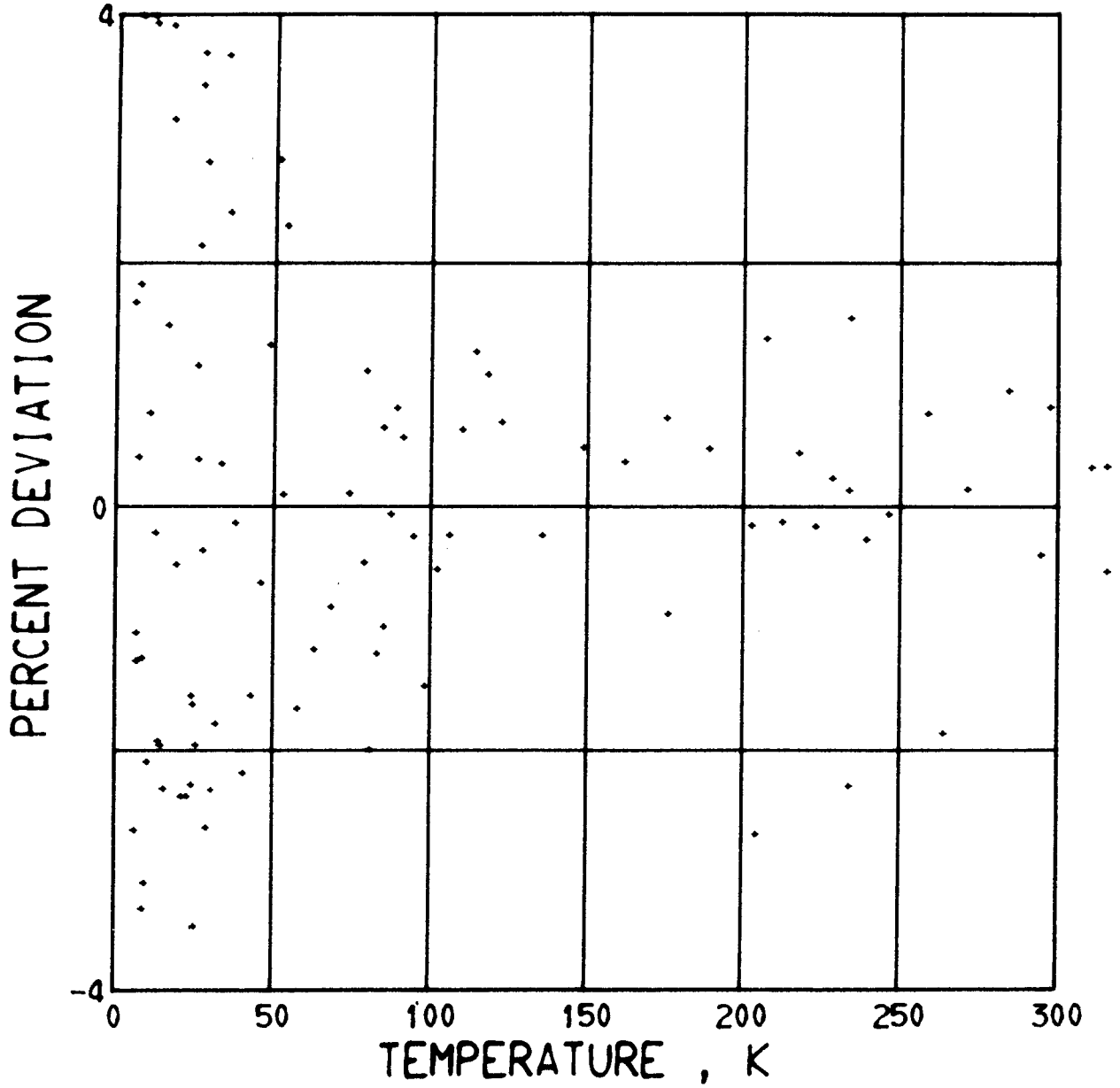

Figure 2. Thermal conductivity deviations for Armco iron, specimen 2.

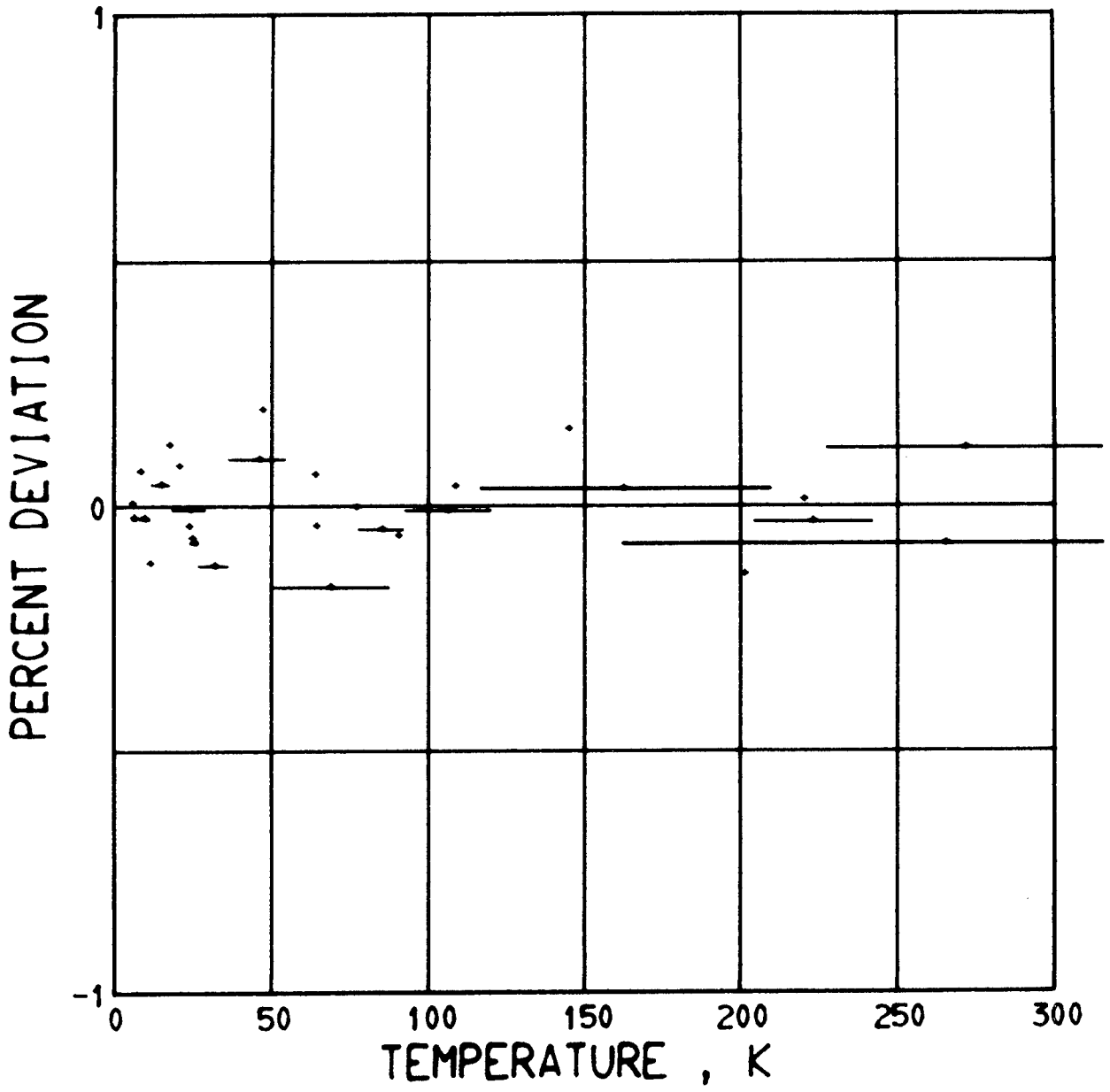

Figure 3. Electrical resistivity deviations for Armco iron, specimen 2.

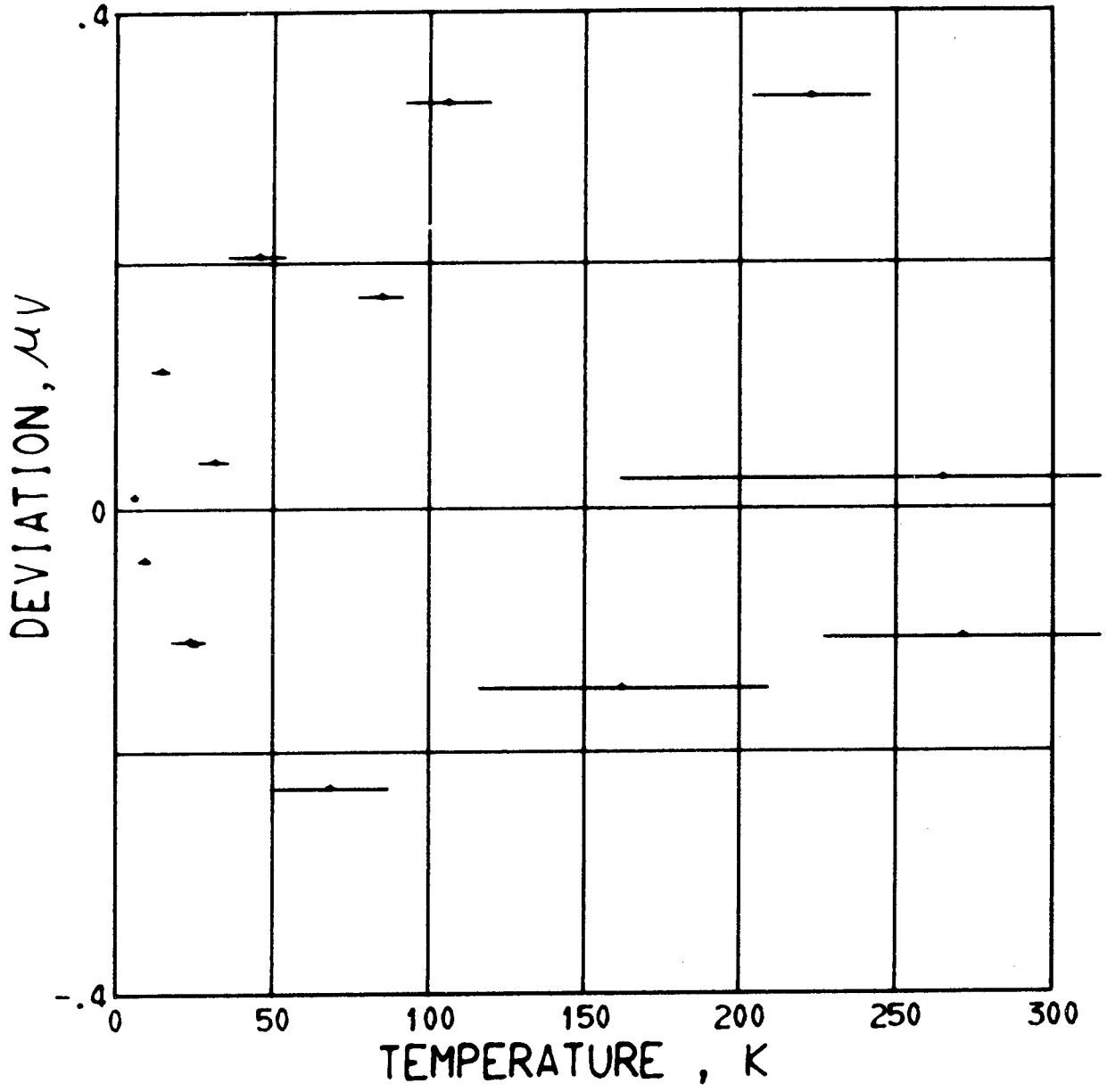

Figure 4. Thermovoltage deviations for Armco iron, specimen 2.

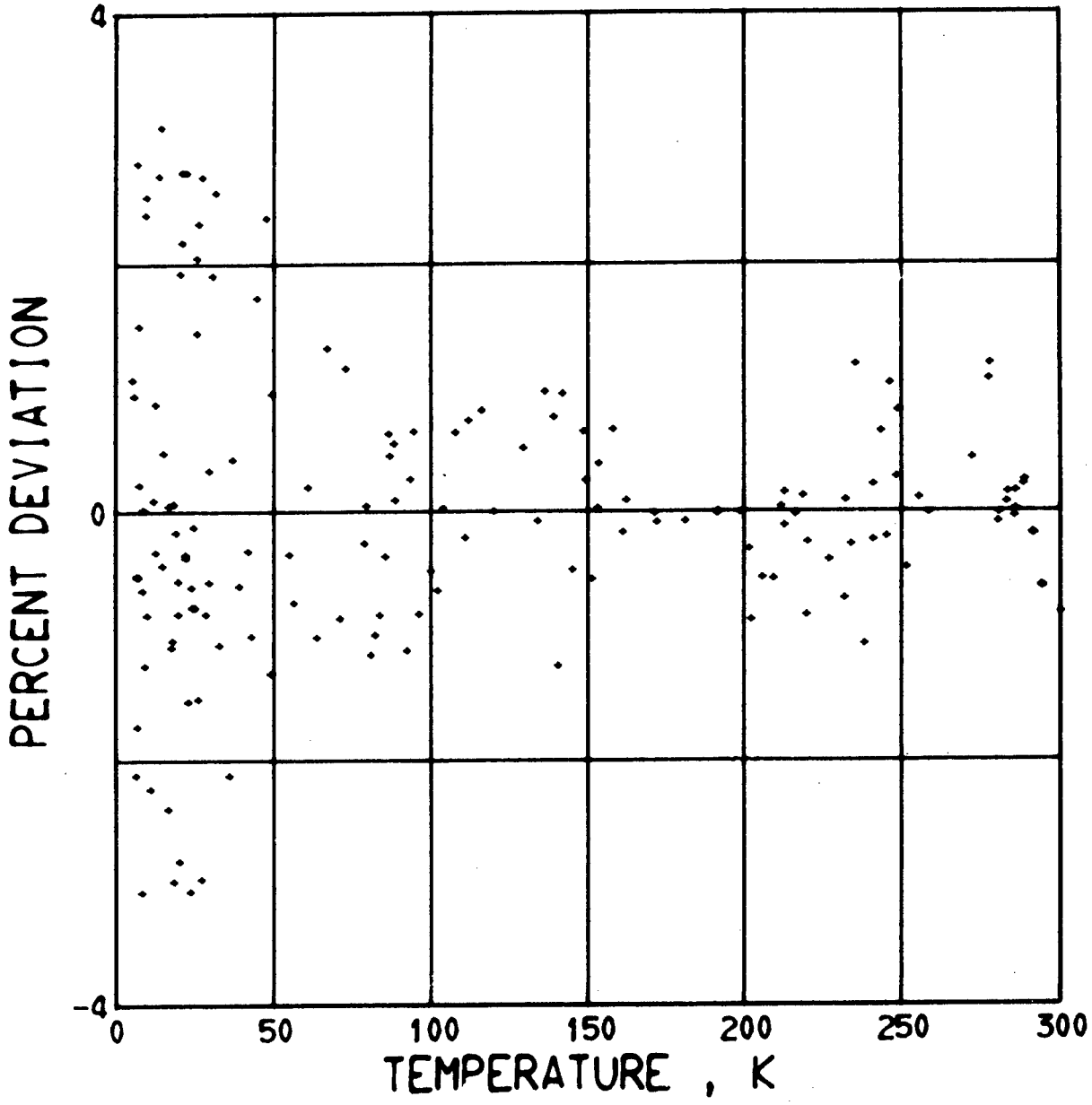

Figure 5. Thermal conductivity deviations for Armco iron, specimen 2a.

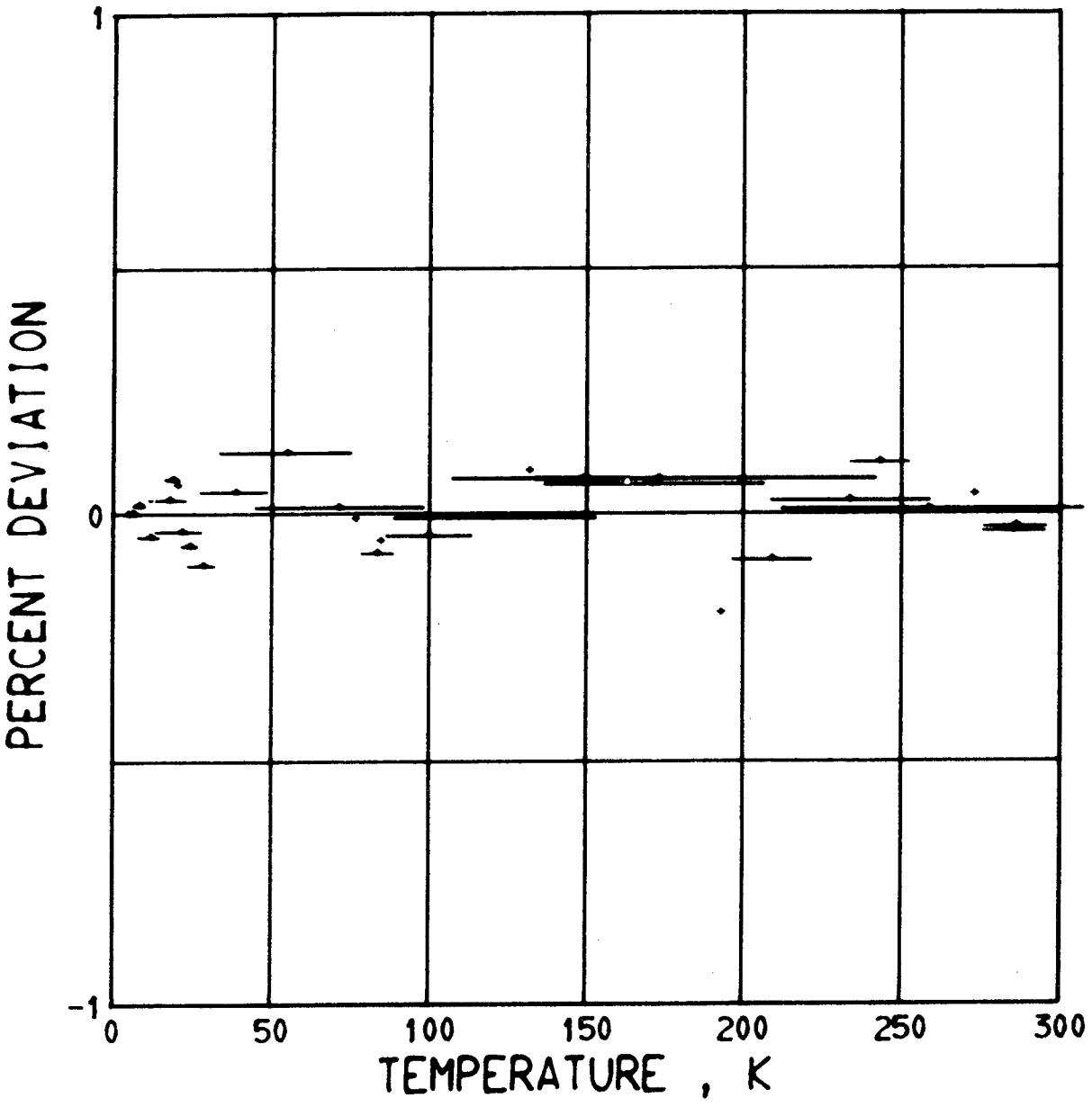

Figure 6. Electrical resistivity deviations for Armco iron, specimen 2a.

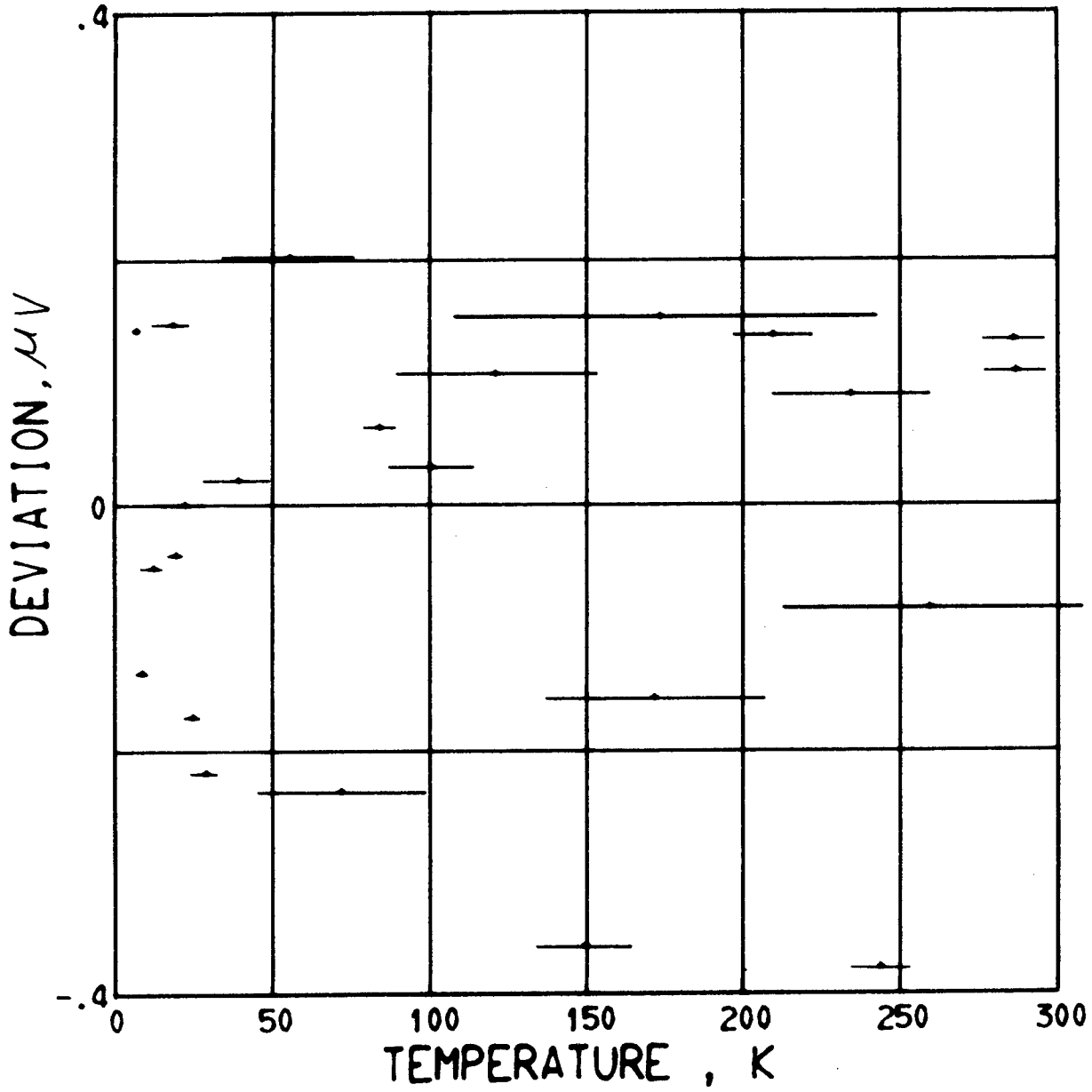

Figure 7. Thermovoltage deviations for Armco iron, specimen 2a.

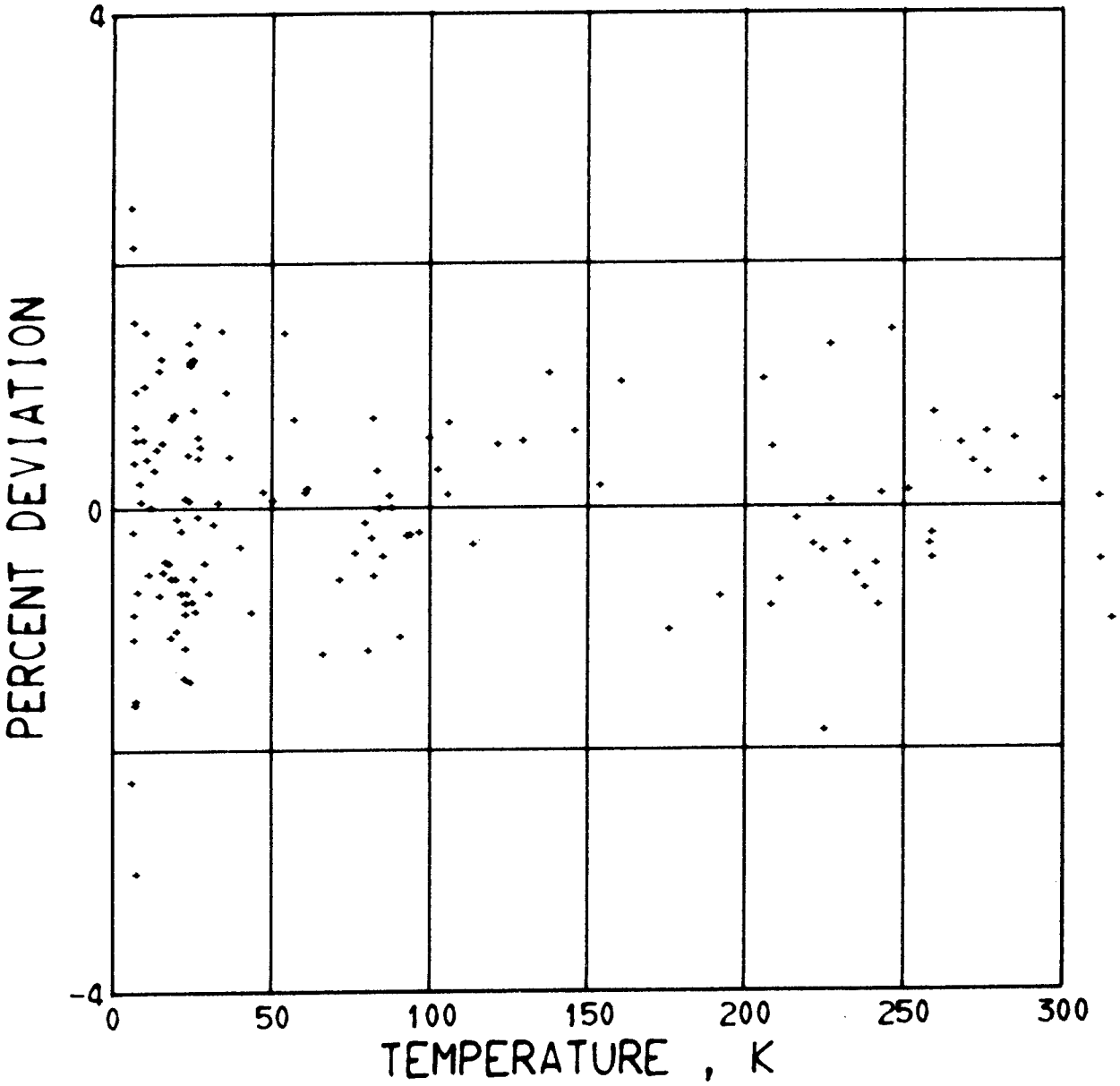

Figure 8. Thermal conductivity deviations for Armco iron, specimen 4.

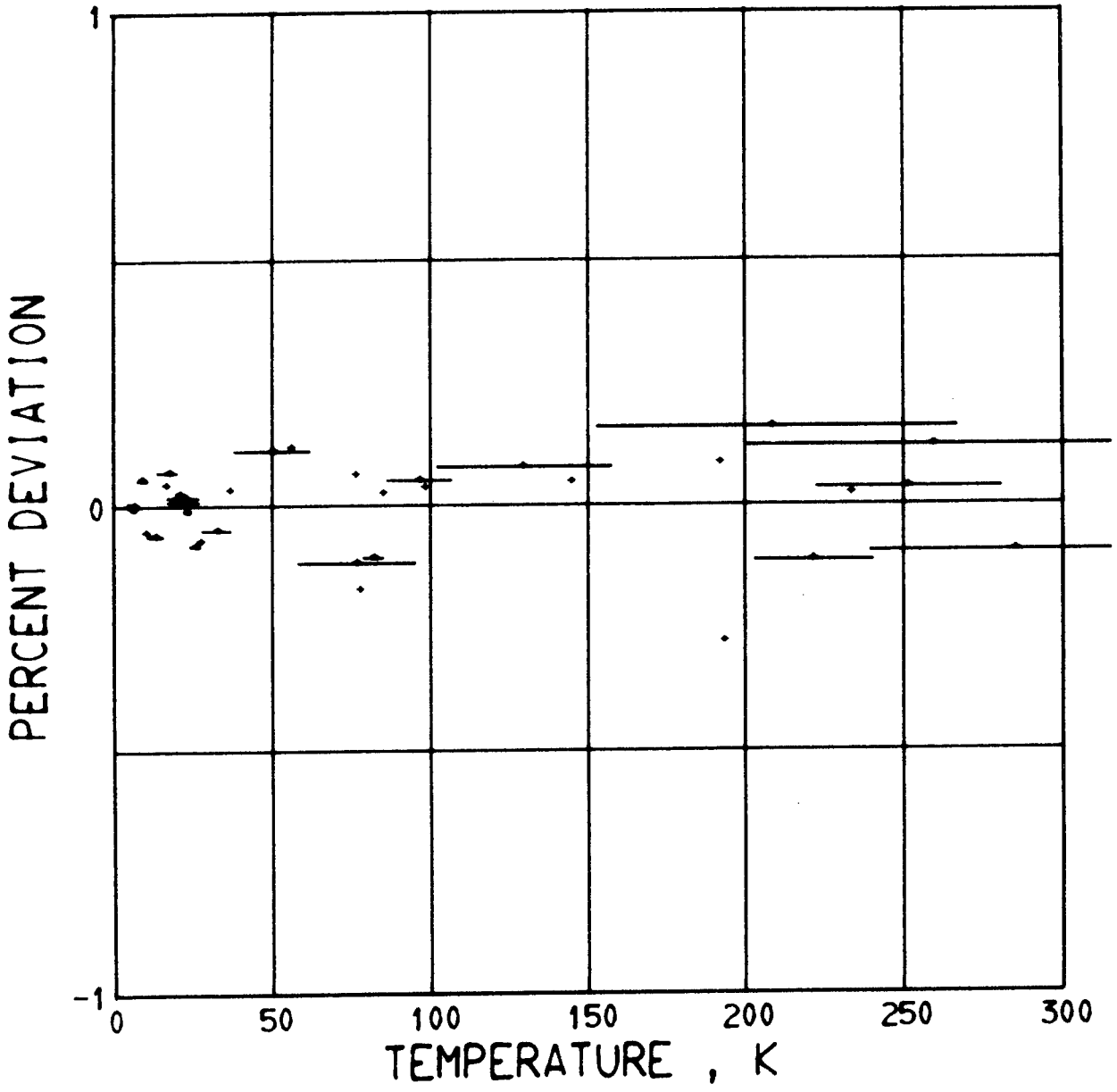

Figure 9. Electrical resistivity deviations for Armco iron, specimen 4.

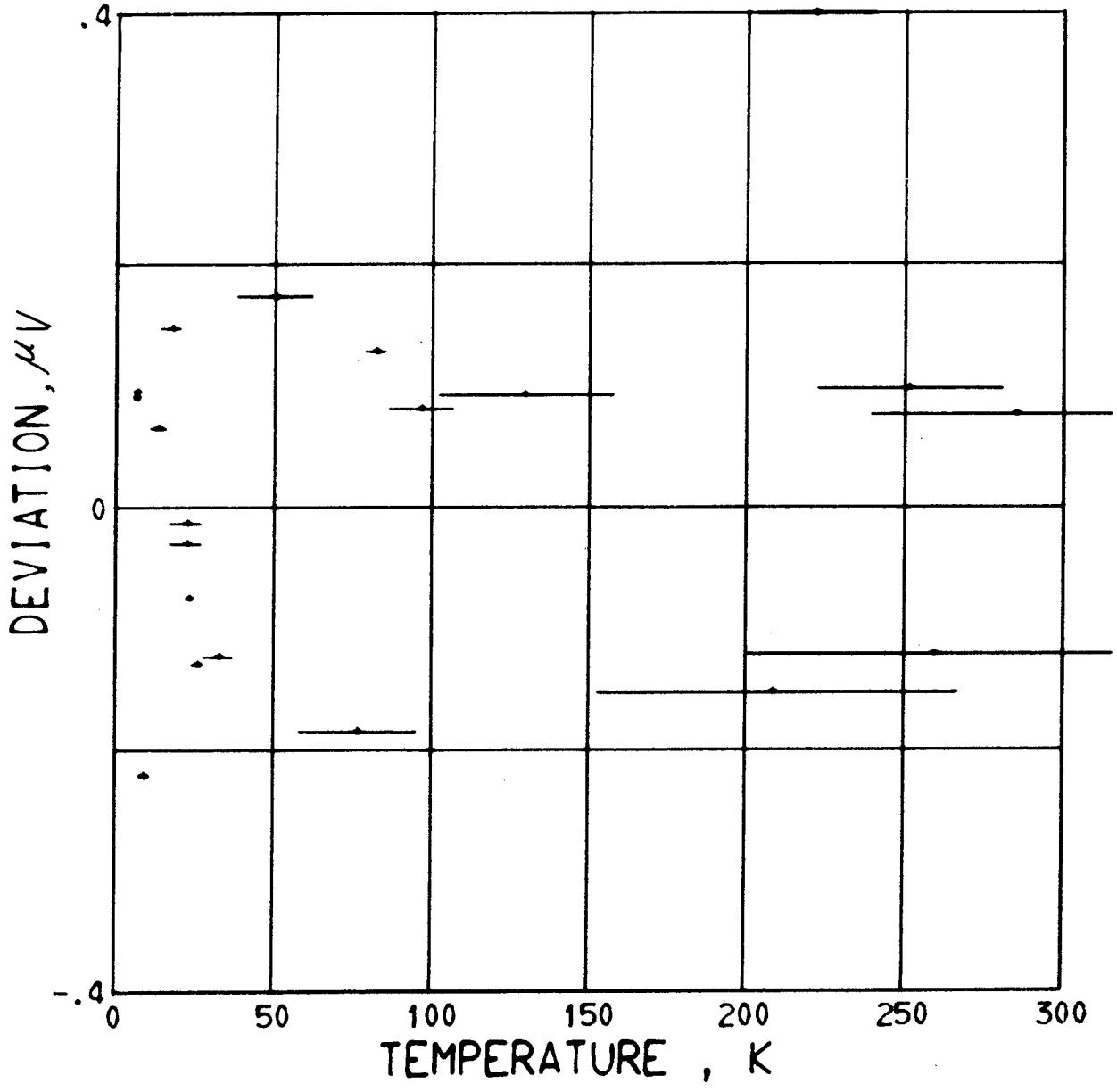

Figure 10. Thermovoltage deviations for Armco iron, specimen 4.

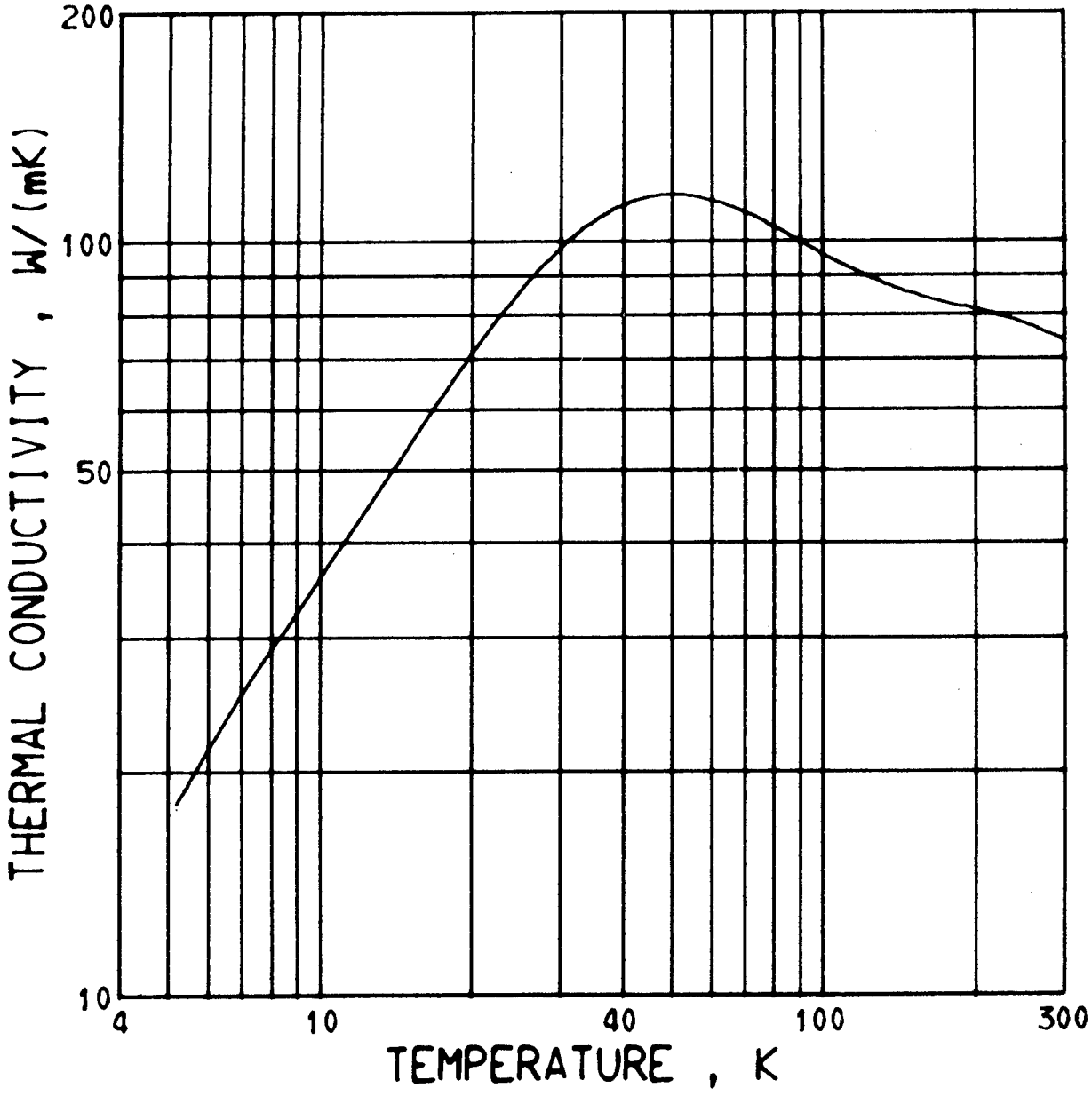

Figure 11a. Thermal conductivity of Armco iron, specimen 2.

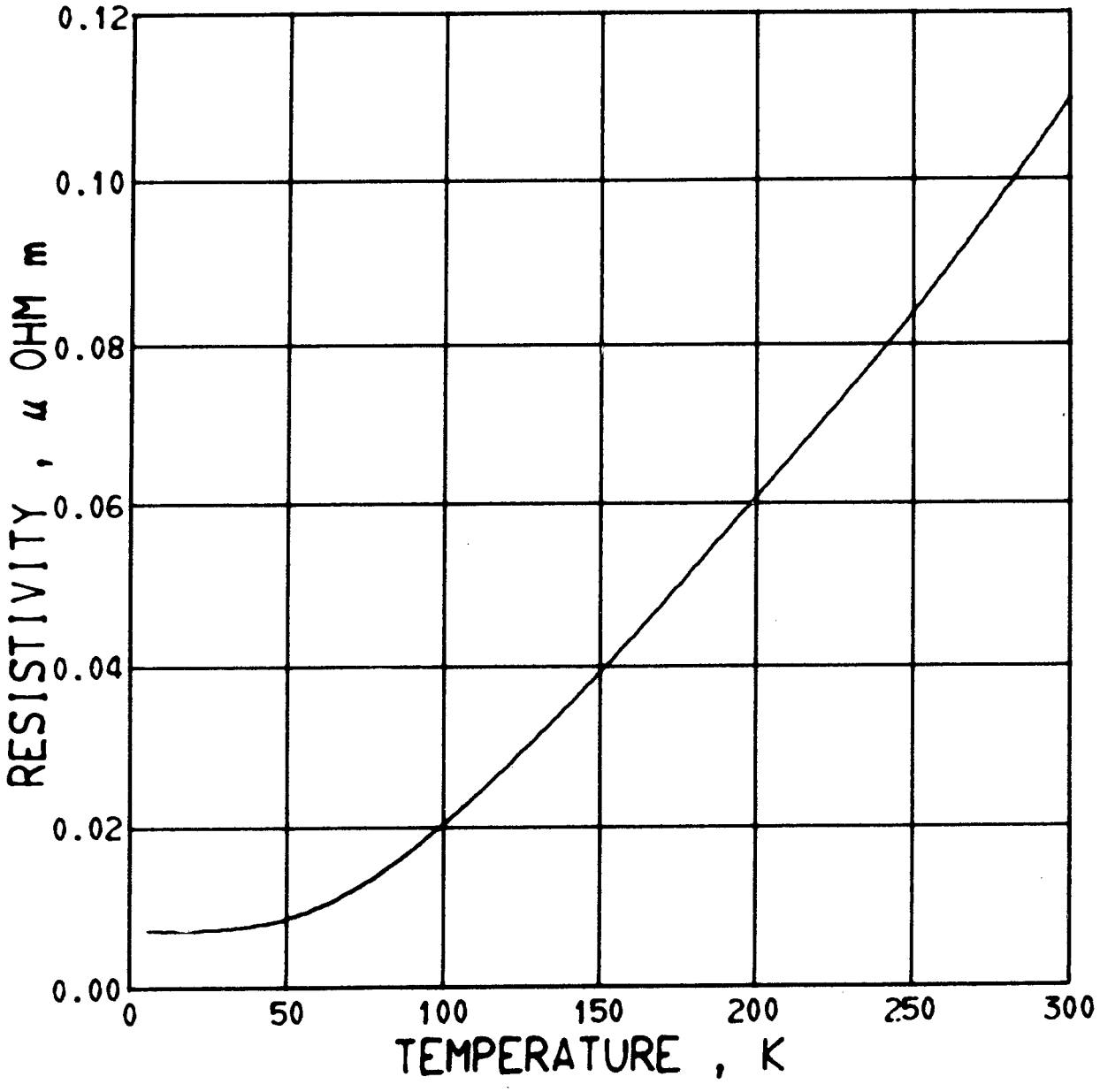

Figure 11b. Electrical resistivity of Armco iron, specimen 2.

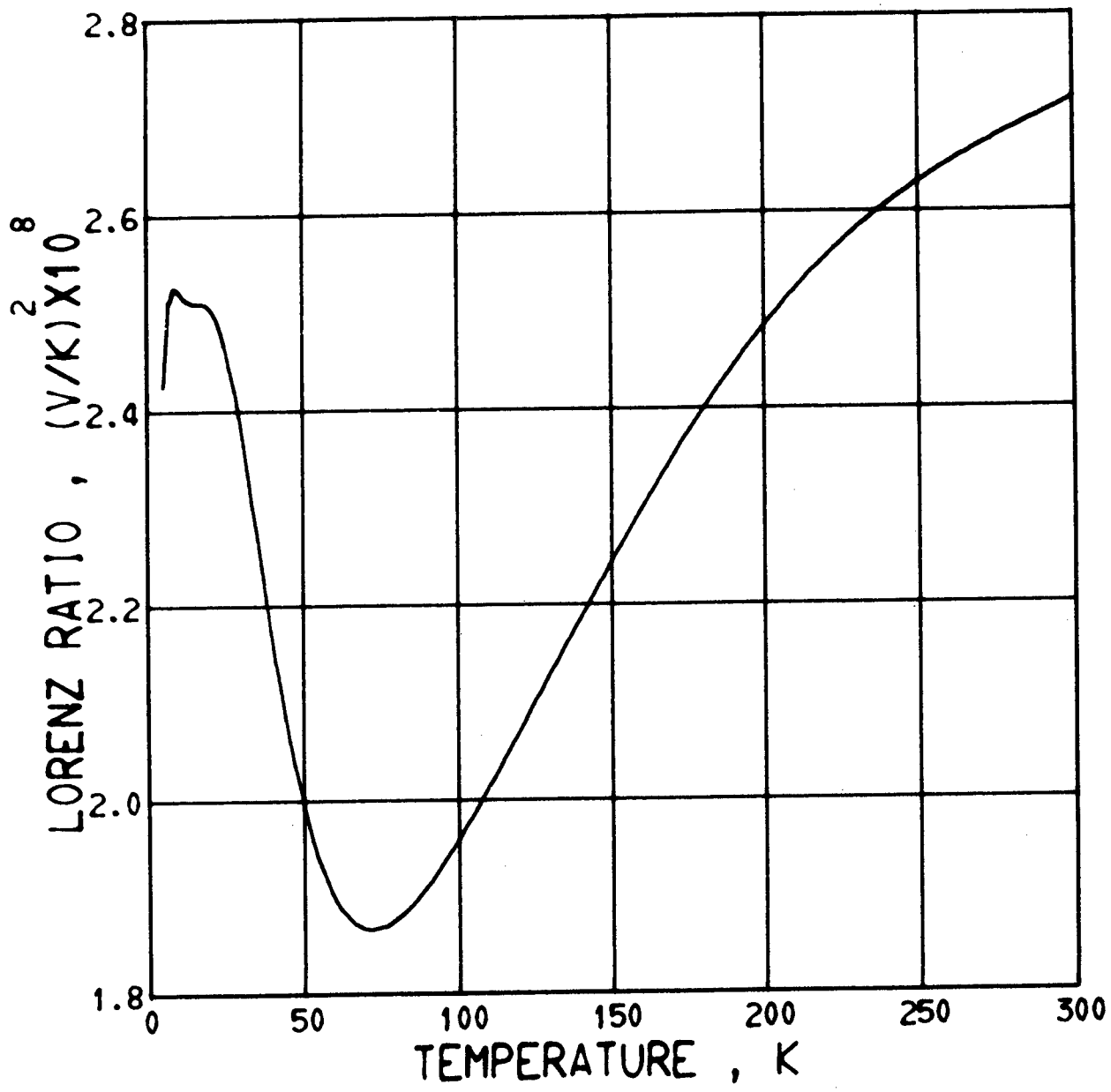

Figure 11c. Lorenz ratio of Armco iron, specimen 2.

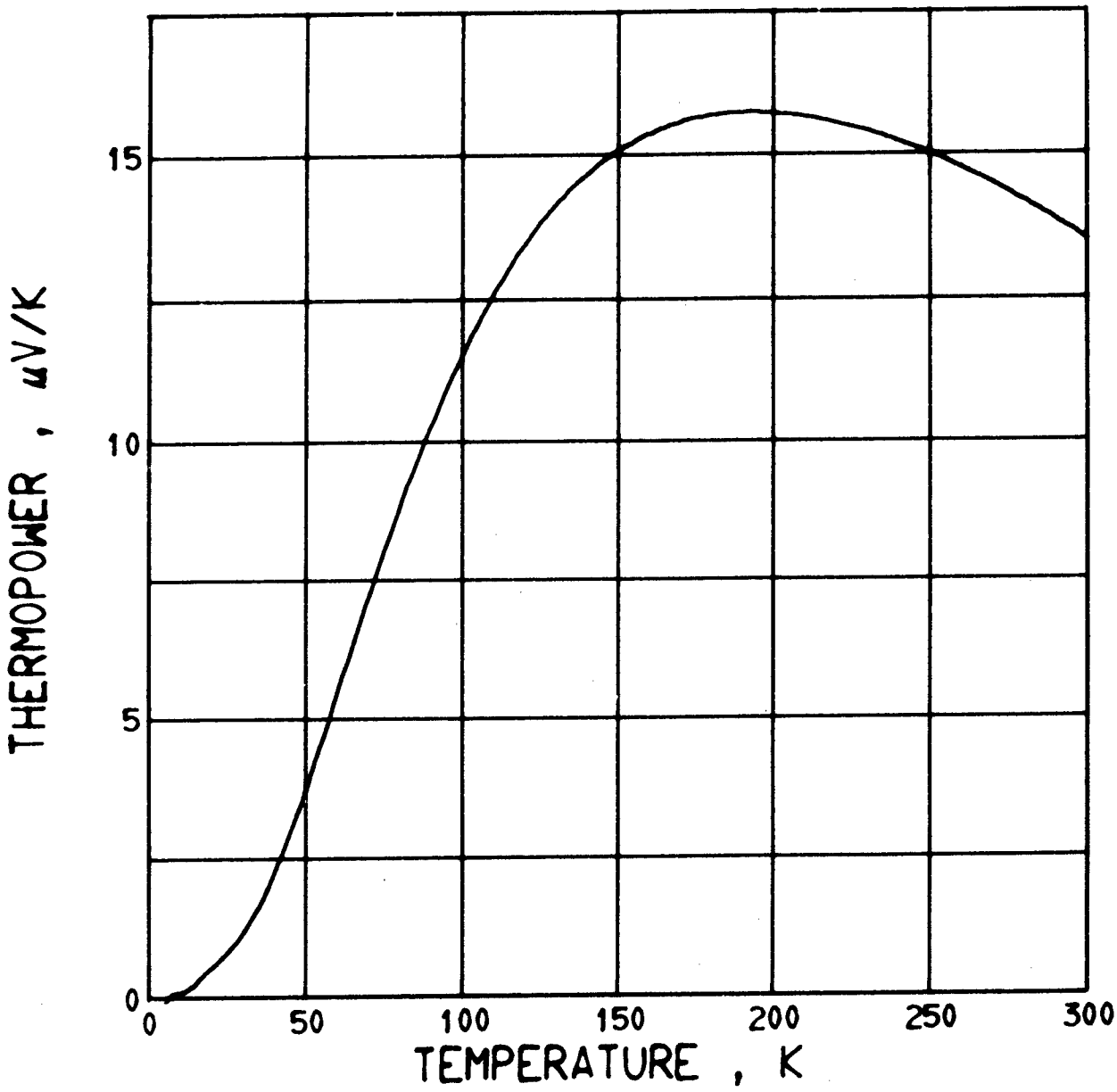

Figure 11d. Thermopower of Armco iron, specimen 2.

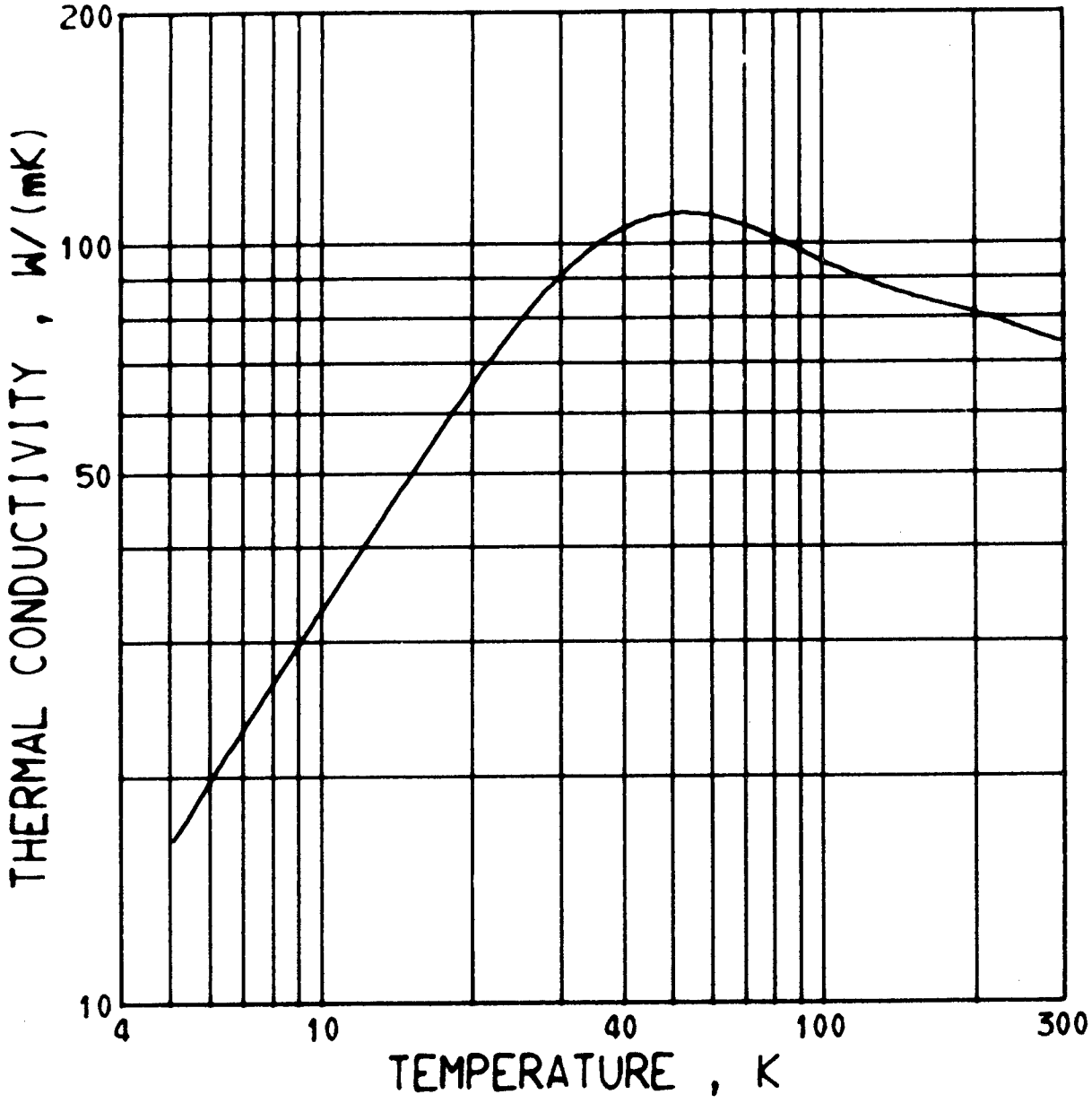

Figure 12a. Thermal conductivity of Armco iron, specimen 2a.

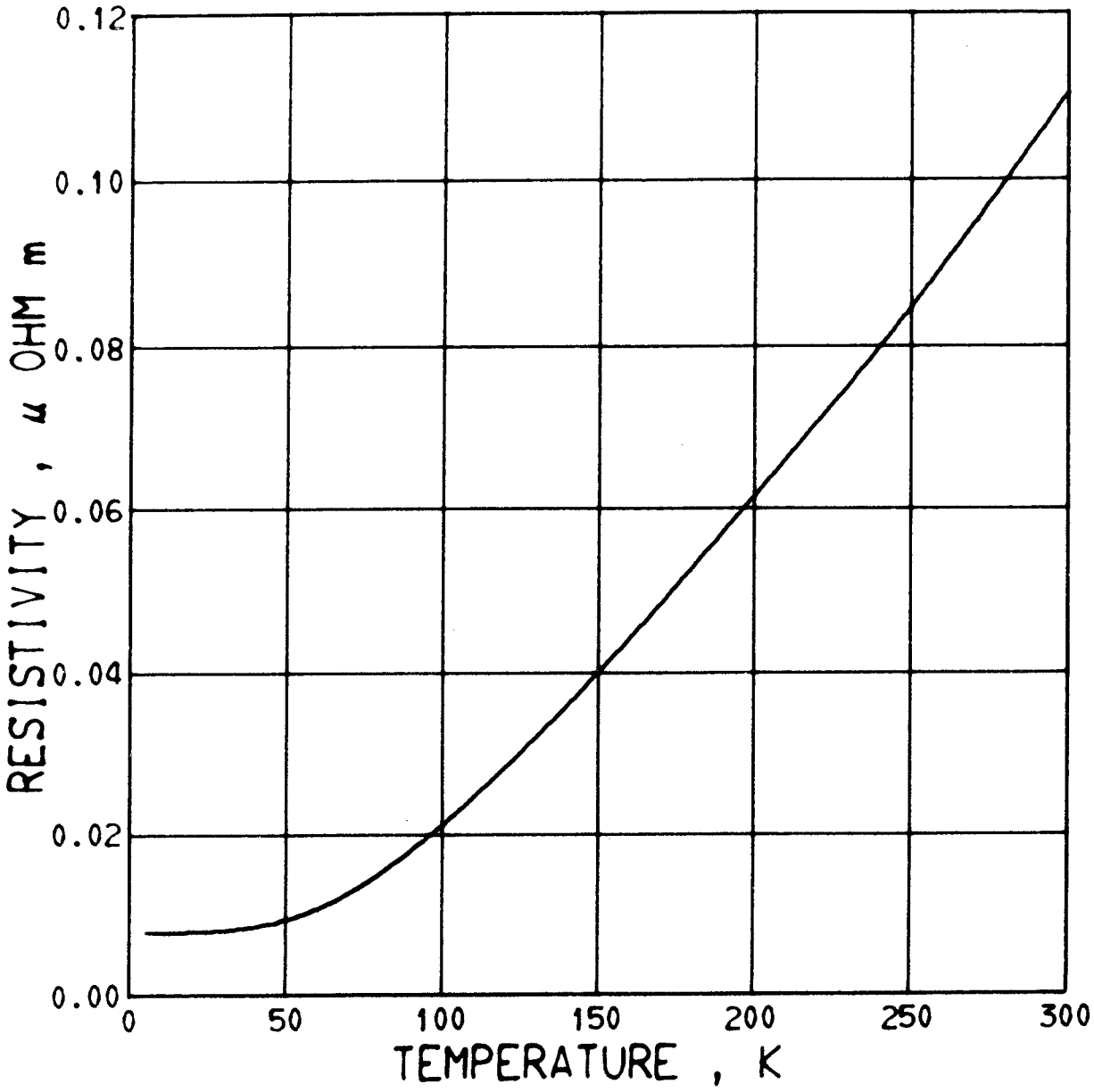

Figure 12b. Electrical resistivity of Armco iron, specimen 2a.

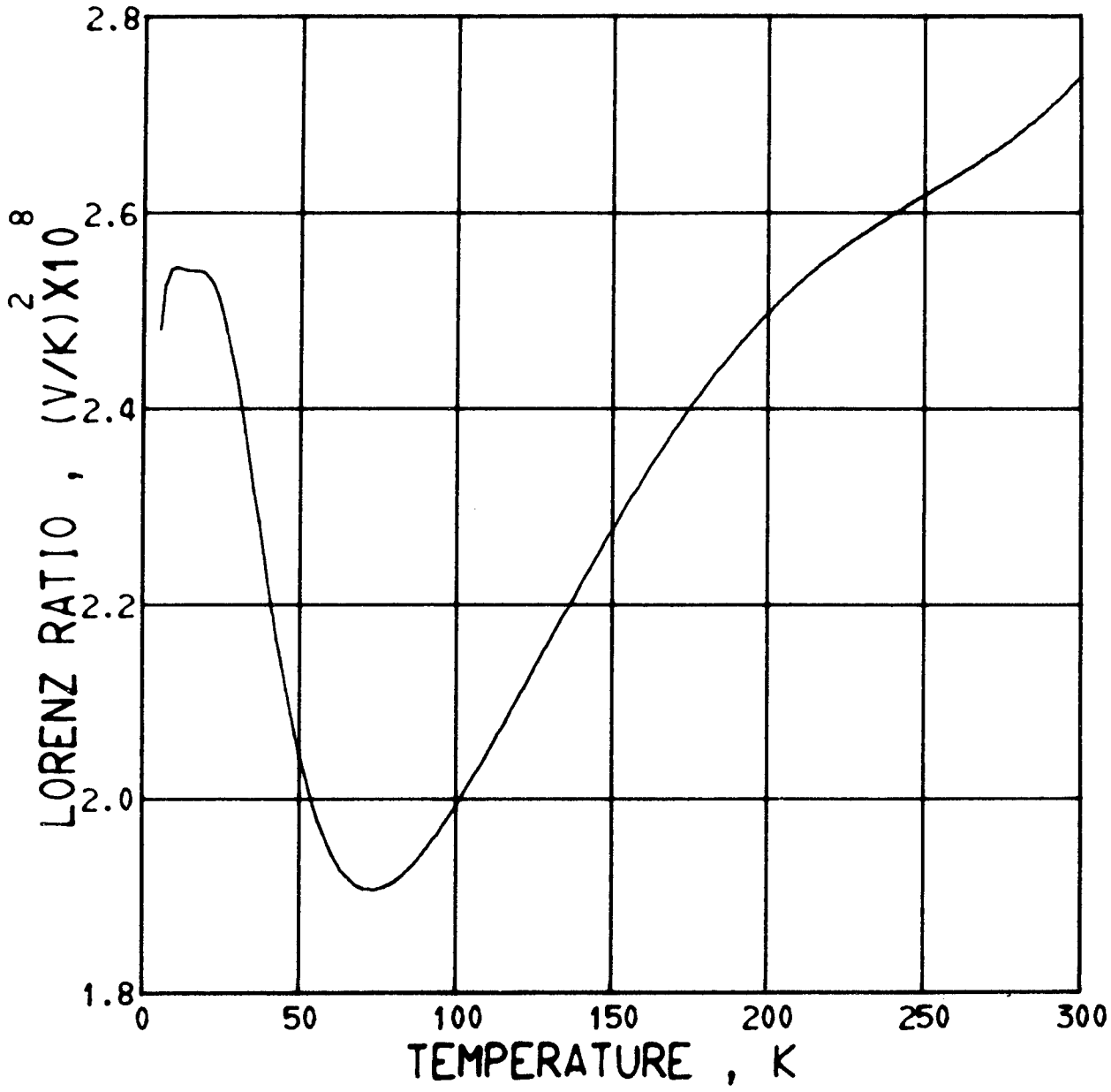

Figure 12c. Lorenz ratio of Armco iron, specimen 2a.

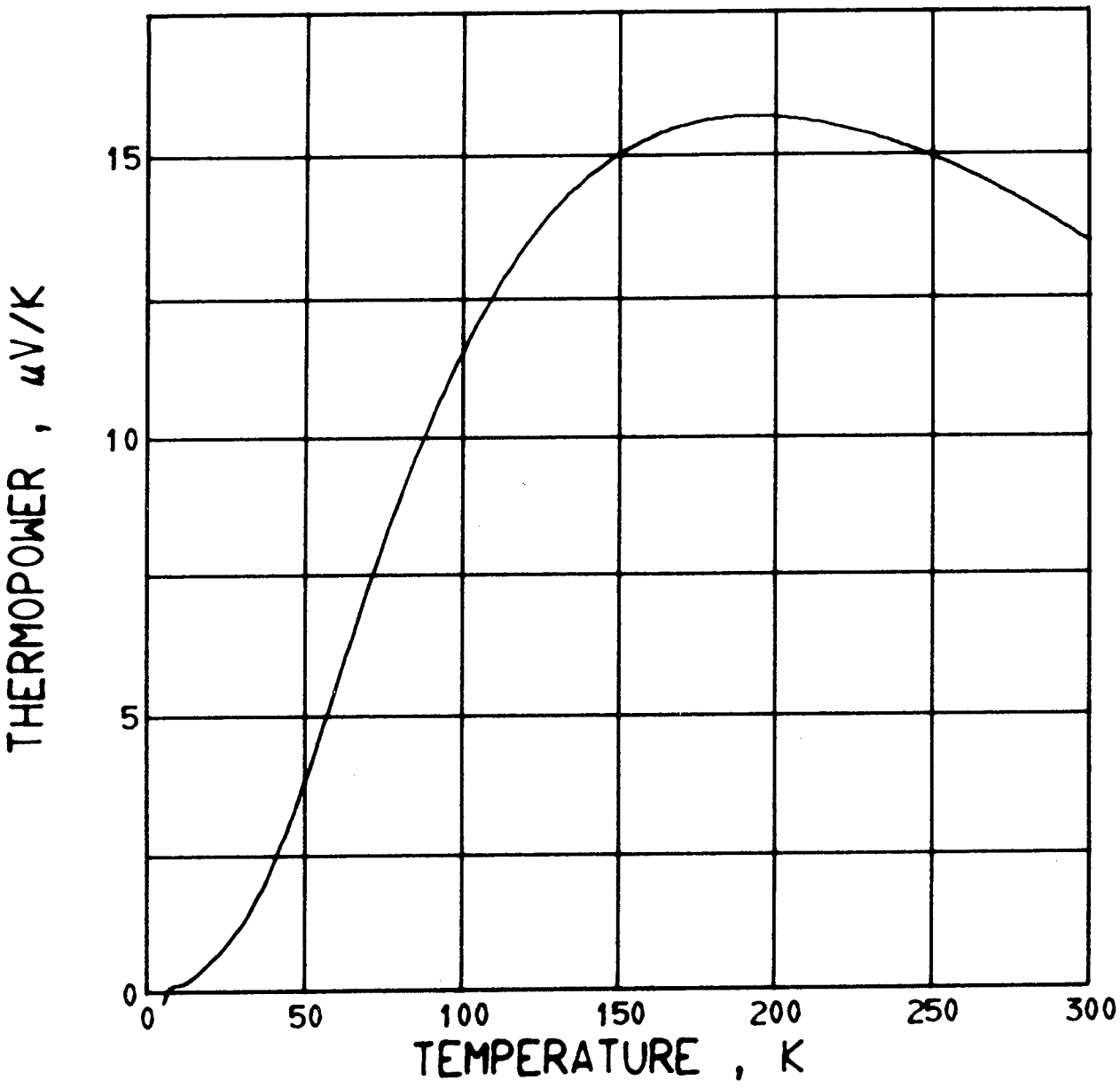

Figure 12d. Thermopower of Armco iron, specimen 2a.

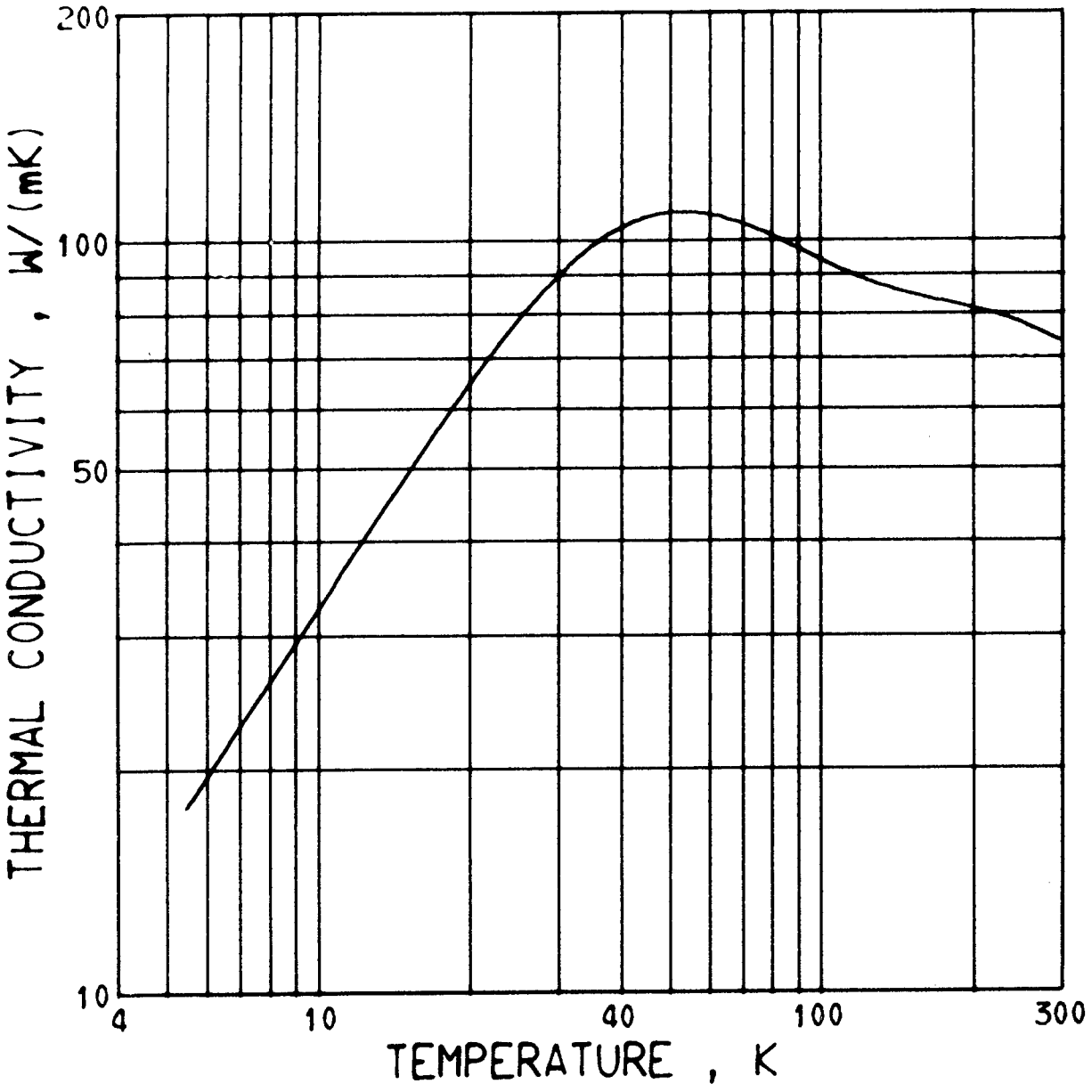

Figure 13a. Thermal conductivity of Armco iron, specimen 4.

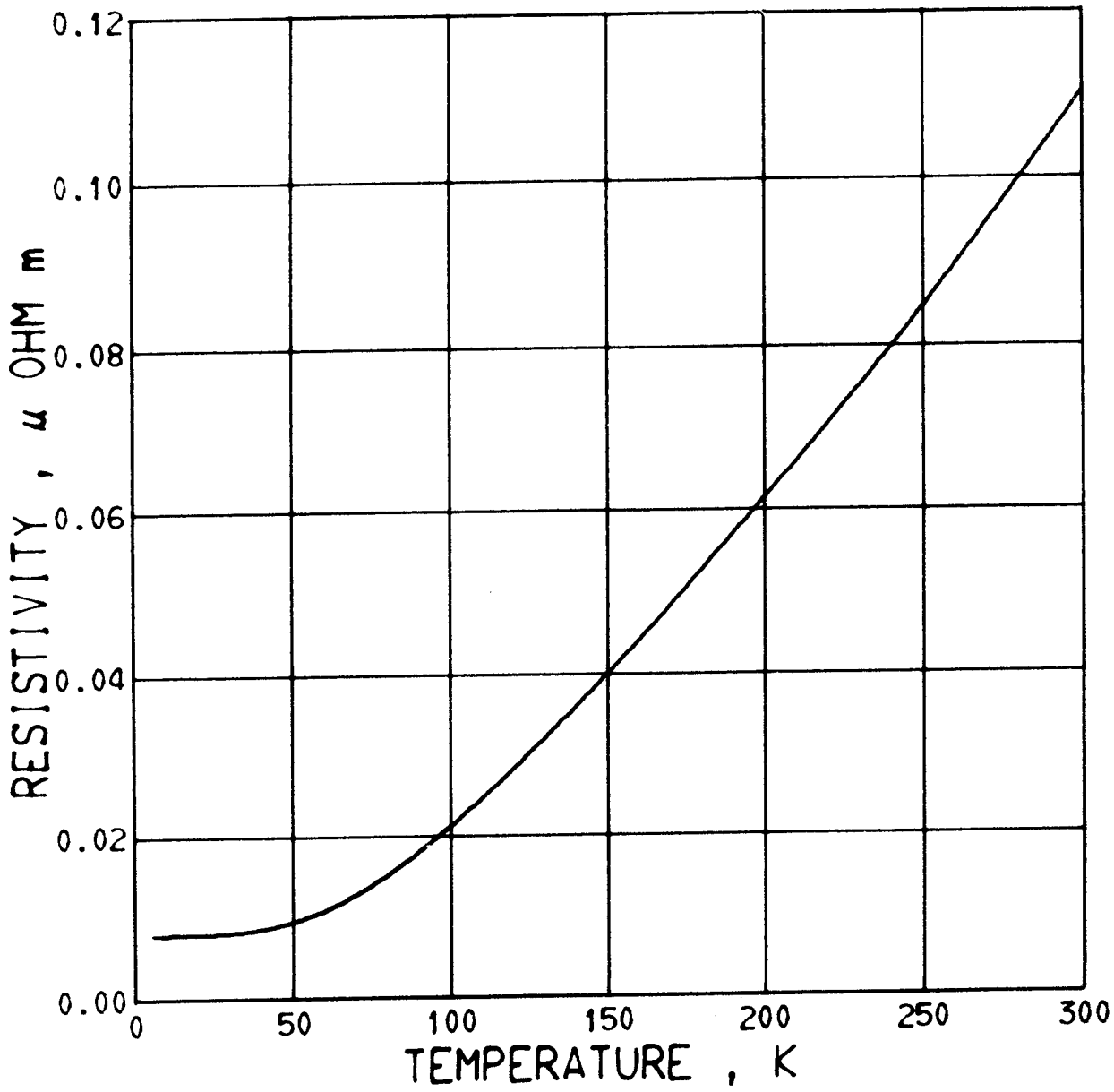

Figure 13b. Electrical resistivity of Armco iron, specimen 4.

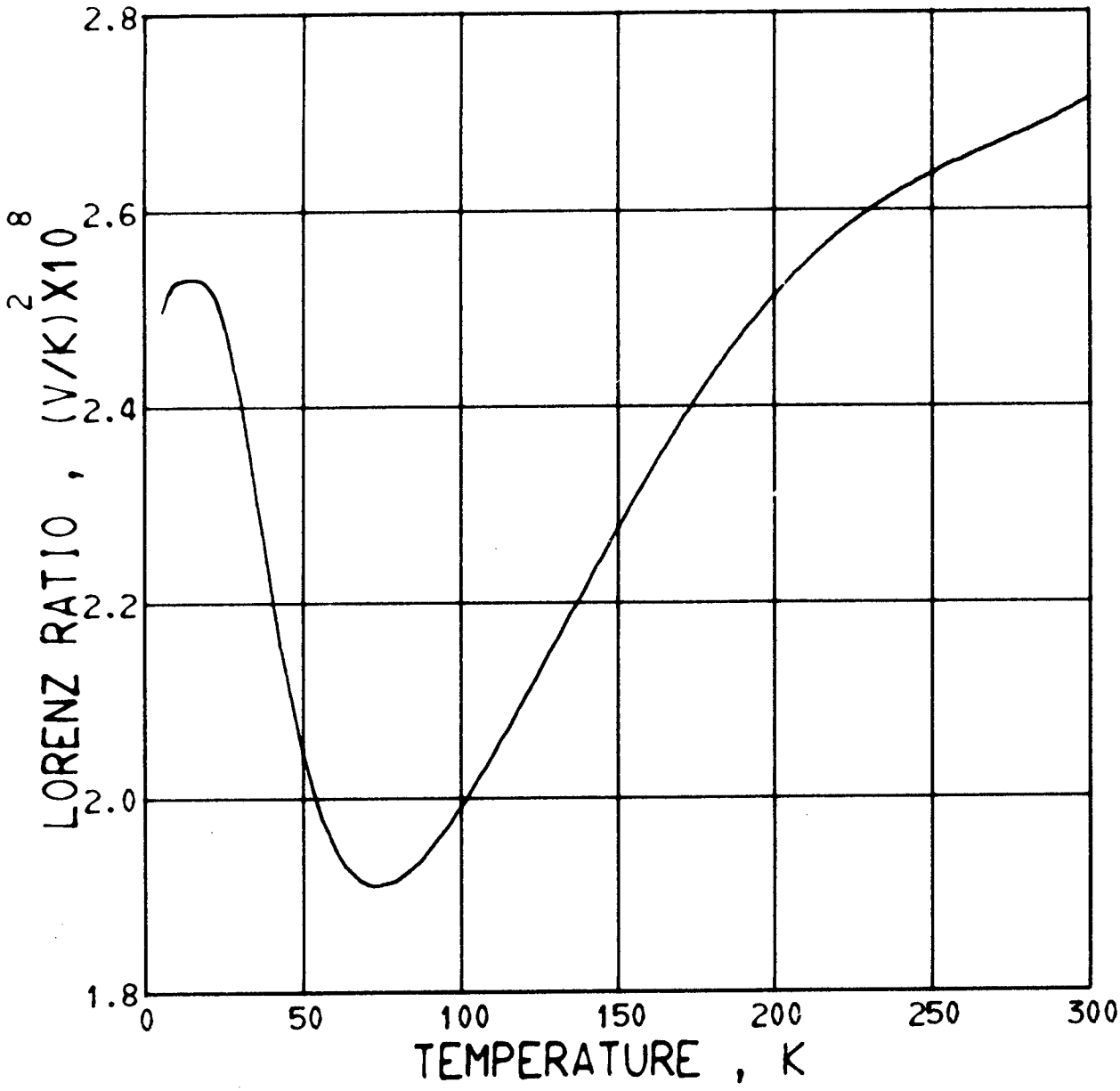

Figure 13c. Lorenz ratio of Armco iron, specimen 4.

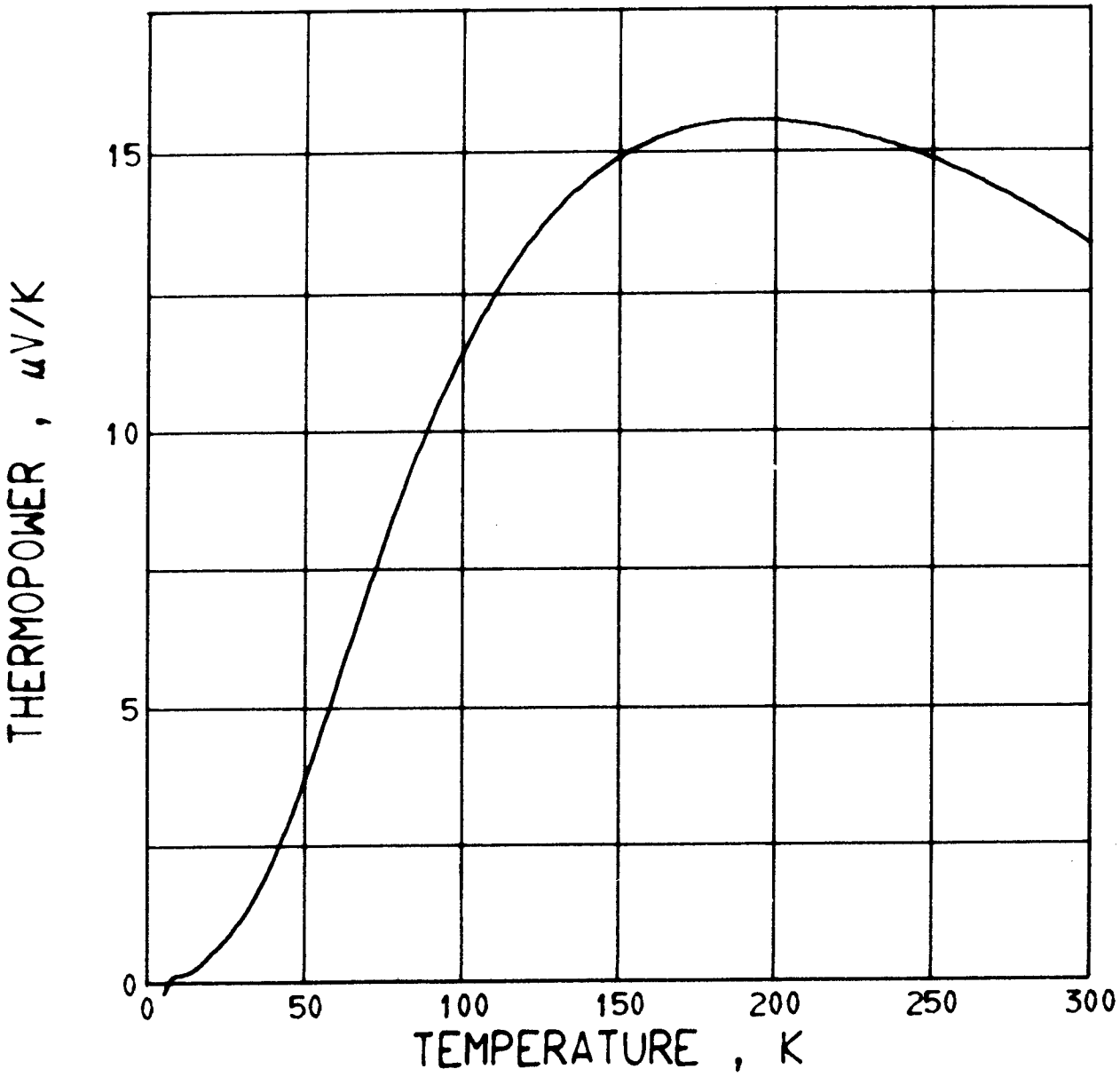

Figure 13d. Thermopower of Armco iron, specimen 4.

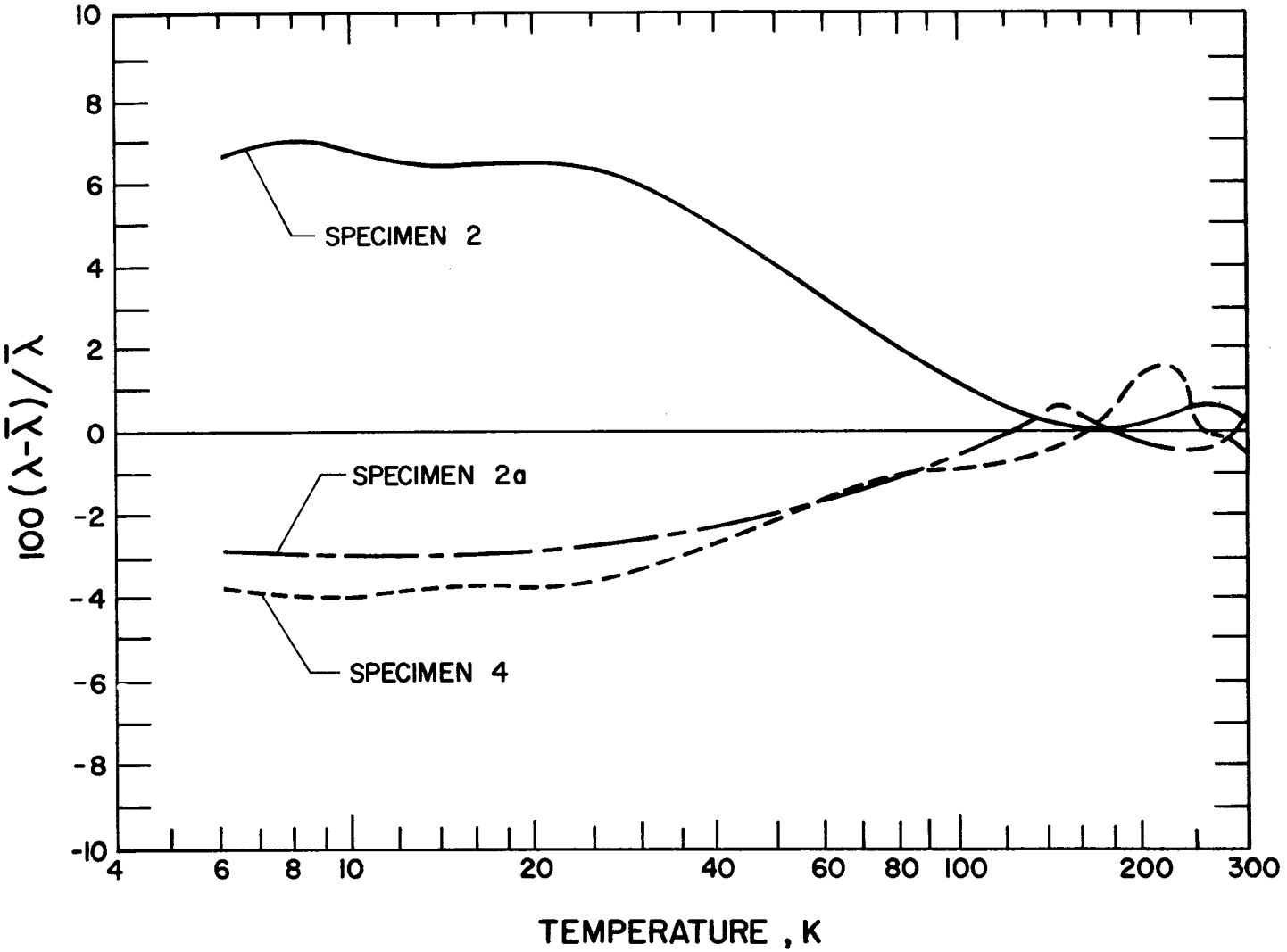

Figure 14. Deviations of the thermal conductivities of each specimen from the mean values.

B-83377

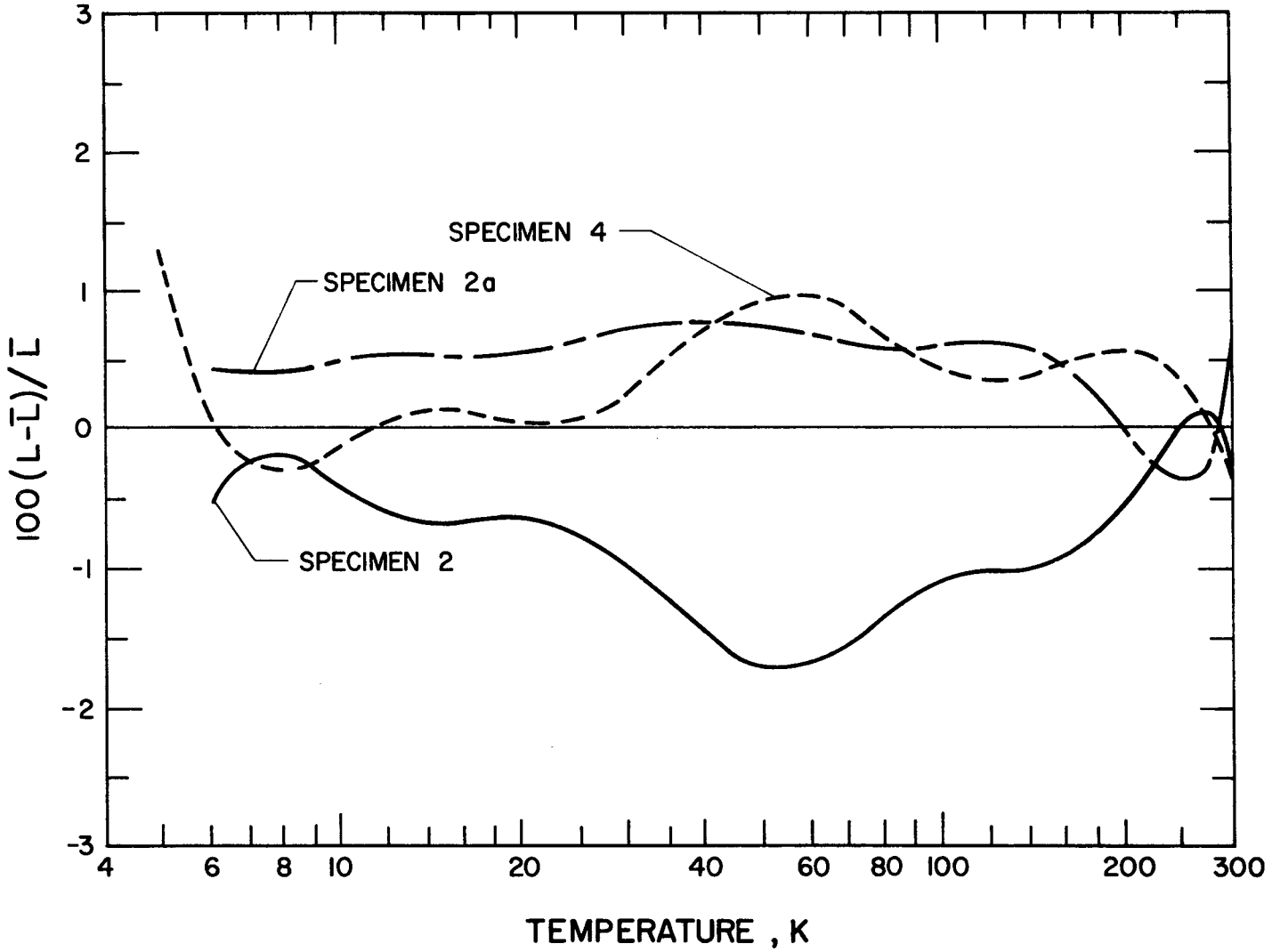

Figure 15. Deviations of the Lorenz ratios of each specimen from the mean values.

B-83378

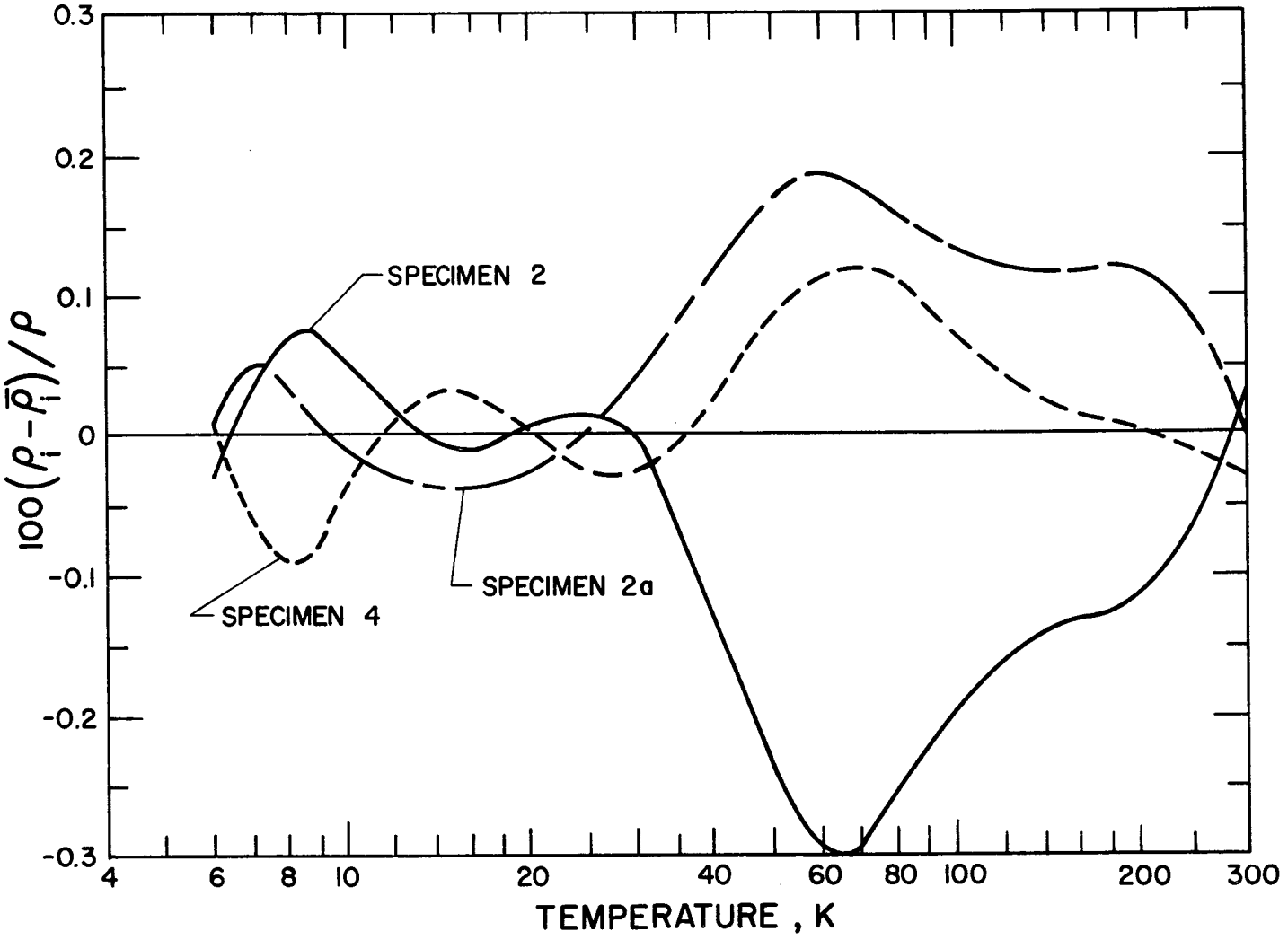

Figure 16. Deviations of the computed intrinsic electrical resistivities from the mean values for the three specimens.

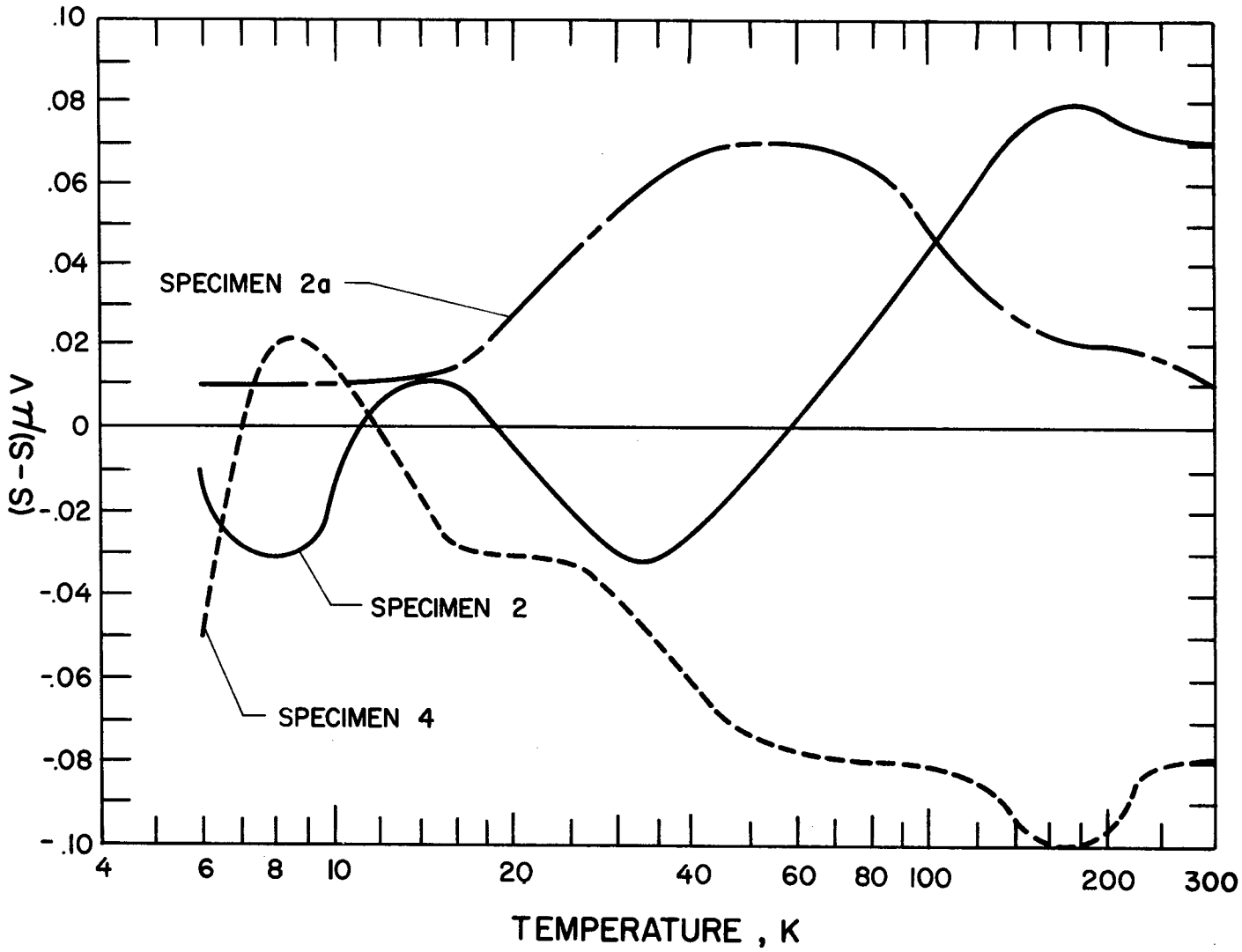

Figure 17. Deviations of the thermopowers from the mean values for three specimens of Armco iron.

8. Appendix

A complete documentation of experimental and numerical procedures was intended to be given in a previous report (Hust, et al.[1]) so that future manipulations with the experimental data could be performed if necessary. Some useful information, overlooked in the preparation of that report, is included here.

The calibration table for the Chromel vs Au-Fe (Au-0.07 at.% Fe) thermocouples is given in table I. The derivation of this table is explained in reference [1].

To compute the reference ring temperature from the experimental data one needs the calibration of the platinum resistance thermometer. Table II is the calibration table for the PRT used in this apparatus and designated LN-1037903.

To reanalyze any of the reported data one must have the actual thermocouple positions (nominally 2.54 cm apart) and the diameter of the specimen. Table II contains these data for the previously reported specimens as well as for Armco iron.

As reported by Hust, et al.,[1] zero emfs were read for each thermocouple to eliminate, as much as possible, the effect of spurious emfs in the potentiometric circuitry. These zero emfs differ for each cryogenic bath and are listed in table IV.

Table I - Calibration table for Chromel vs Au-Fe (Au-0.07 at.% Fe) thermocouple

T (K)	Emf (μV)	T (K)	Emf (μV)
		51	819.32
		52	836.35
		53	853.44
4	39.59	54	870.57
5	52.40	55	887.74
6	66.07	56	904.96
7	80.48	57	922.22
8	95.50	58	939.53
9	111.03	59	956.89
10	126.98	60	974.30
11	143.27	61	991.75
12	159.83	62	1009.24
13	176.61	63	1026.79
14	193.55	64	1044.38
15	210.61	65	1062.01
16	227.75	66	1079.70
17	244.96	67	1097.42
18	262.19	68	1115.20
19	279.44	69	1133.02
20	296.68	70	1150.88
21	313.90	71	1168.79
22	331.10	72	1186.75
23	348.26	73	1204.74
24	365.38	74	1222.79
25	382.47	75	1240.87
26	399.50	76	1259.00
27	416.50	77	1277.17
28	433.45	78	1295.39
29	450.35	79	1313.65
30	467.22	80	1331.95
31	484.05	81	1350.29
32	500.84	82	1368.67
33	517.61	83	1387.10
34	534.34	84	1405.57
35	551.05	85	1424.08
36	567.74	86	1442.63
37	584.42	87	1461.22
38	601.08	88	1479.85
39	617.74	89	1498.52
40	634.39	90	1517.23
41	651.05	91	1535.98
42	667.73	92	1554.77
43	684.44	93	1573.60
44	701.17	94	1592.46
45	717.94	95	1611.37
46	734.74	96	1630.31
47	751.58	97	1649.29
48	768.45	98	1668.31
49	785.37	99	1687.36
50	802.32	100	1706.45

Table I - Calibration table for Chromel vs Au-Fe (Au-0.07 at.% Fe) thermocouple (Continued)

T (K)	Emf (μV)	T (K)	Emf (μV)
101	1725.58	151	2721.26
102	1744.74	152	2741.86
103	1763.94	153	2762.48
104	1783.17	154	2783.12
105	1802.44	155	2803.78
106	1821.75	156	2824.47
107	1841.08	157	2845.18
108	1860.45	158	2865.92
109	1879.86	159	2886.67
110	1899.30	160	2907.45
111	1918.77	161	2928.25
112	1938.27	162	2949.07
113	1957.80	163	2969.92
114	1977.37	164	2990.78
115	1996.97	165	3011.67
116	2016.60	166	3032.58
117	2036.26	167	3053.51
118	2055.95	168	3074.46
119	2075.67	169	3095.43
120	2095.42	170	3116.42
121	2115.20	171	3137.43
122	2135.01	172	3158.46
123	2154.85	173	3179.50
124	2174.72	174	3200.57
125	2194.61	175	3221.66
126	2214.54	176	3242.77
127	2234.49	177	3263.89
128	2254.47	178	3285.04
129	2274.48	179	3306.20
130	2294.51	180	3327.38
131	2314.57	181	3348.58
132	2334.66	182	3369.79
133	2354.78	183	3391.03
134	2374.92	184	3412.28
135	2395.09	185	3433.55
136	2415.29	186	3454.83
137	2435.51	187	3476.13
138	2455.75	188	3497.45
139	2476.03	189	3518.79
140	2496.33	190	3540.14
141	2516.65	191	3561.51
142	2537.00	192	3582.90
143	2557.38	193	3604.30
144	2577.78	194	3625.72
145	2598.20	195	3647.15
146	2618.65	196	3668.60
147	2639.12	197	3690.07
148	2659.62	198	3711.55
149	2680.15	199	3733.05
150	2700.69	200	3754.56

Table I - Calibration table for Chromel vs Au-Fe (Au-0.07 at.% Fe) thermocouple (Continued)

T (K)	Emf (μV)	T (K)	Emf (μV)
201	3776.09	251	4869.70
202	3797.64	252	4891.86
203	3819.20	253	4914.03
204	3840.77	254	4936.21
205	3862.36	255	4958.40
206	3883.97	256	4980.60
207	3905.59	257	5002.80
208	3927.22	258	5025.02
209	3948.87	259	5047.24
210	3970.54	260	5069.48
211	3992.22	261	5091.72
212	4013.91	262	5113.97
213	4035.62	263	5136.22
214	4057.34	264	5158.49
215	4079.08	265	5180.76
216	4100.83	266	5203.03
217	4122.60	267	5225.31
218	4144.38	268	5247.60
219	4166.17	269	5269.89
220	4187.97	270	5292.19
221	4209.79	271	5314.49
222	4231.62	272	5336.79
223	4253.47	273	5359.10
224	4275.32	274	5381.41
225	4297.19	275	5403.73
226	4319.08	276	5426.06
227	4340.97	277	5448.40
228	4362.88	278	5470.75
229	4384.79	279	5493.12
230	4406.72	280	5515.50
231	4428.66	281	5537.90
232	4450.62	282	5560.30
233	4472.58	283	5582.69
234	4494.55	284	5605.09
235	4516.54	285	5627.49
236	4538.53	286	5649.89
237	4560.54	287	5672.29
238	4582.56	288	5694.68
239	4604.58	289	5717.08
240	4626.62	290	5739.48
241	4648.67	291	5761.88
242	4670.73	292	5784.28
243	4692.80	293	5806.67
244	4714.87	294	5829.07
245	4736.96	295	5851.47
246	4759.06	296	5873.87
247	4781.17	297	5896.27
248	4803.29	298	5918.66
249	4825.42	299	5941.06
250	4847.56	300	5963.46

Table II - Calibration table for platinum resistance thermometer designated LN-1037903

T (K)	R (ohms)	T (K)	R (ohms)
		51	2.02192
		52	2.11806
		53	2.21540
		54	2.31385
		55	2.41334
		56	2.51381
		57	2.61520
		58	2.71745
		59	2.82051
10	0.02343	60	2.92435
11	0.02636	61	3.02891
12	0.03008	62	3.13413
13	0.03479	63	3.23997
14	0.04071	64	3.34636
15	0.04806	65	3.45326
16	0.05705	66	3.56058
17	0.06786	67	3.66829
18	0.08067	68	3.77634
19	0.09568	69	3.88468
20	0.11305	70	3.99329
21	0.13294	71	4.10213
22	0.15548	72	4.21119
23	0.18082	73	4.32046
24	0.20905	74	4.42992
25	0.24025	75	4.53954
26	0.27448	76	4.64932
27	0.31178	77	4.75925
28	0.35218	78	4.86933
29	0.39566	79	4.97954
30	0.44224	80	5.08988
31	0.49192	81	5.20035
32	0.54466	82	5.31092
33	0.60042	83	5.42157
34	0.65915	84	5.53229
35	0.72078	85	5.64307
36	0.78522	86	5.75391
37	0.85236	87	5.86480
38	0.92213	88	5.97569
39	0.99441	89	6.08654
40	1.06909	90	6.19732
41	1.14607	91	6.30805
42	1.22526	92	6.41869
43	1.30656	93	6.52925
44	1.38988	94	6.63972
45	1.47513	95	6.75011
46	1.56222	96	6.86042
47	1.65106	97	6.97064
48	1.74153	98	7.08078
49	1.83356	99	7.19083
50	1.92706	100	7.30079

Table II - Calibration table for platinum resistance thermometer designated LN-1037903 (Continued)

T (K)	R (ohms)	T (K)	R (ohms)
101	7.41069	151	12.81232
102	7.52050	152	12.91870
103	7.63023	153	13.02502
104	7.73988	154	13.13128
105	7.84945	155	13.23748
106	7.95894	156	13.34363
107	8.06836	157	13.44973
108	8.17769	158	13.55577
109	8.28695	159	13.66175
110	8.39613	160	13.76768
111	8.50524	161	13.87355
112	8.61427	162	13.97937
113	8.72322	163	14.08513
114	8.83210	164	14.19085
115	8.94091	165	14.29650
116	9.04964	166	14.40211
117	9.15830	167	14.50766
118	9.26688	168	14.61316
119	9.37539	169	14.71861
120	9.48383	170	14.82401
121	9.59220	171	14.92936
122	9.70050	172	15.03465
123	9.80873	173	15.13990
124	9.91689	174	15.24510
125	10.02497	175	15.35024
126	10.13299	176	15.45534
127	10.24094	177	15.56039
128	10.34883	178	15.66539
129	10.45664	179	15.77034
130	10.56439	180	15.87524
131	10.67207	181	15.98010
132	10.77968	182	16.08491
133	10.88723	183	16.18967
134	10.99471	184	16.29439
135	11.10213	185	16.39905
136	11.20949	186	16.50368
137	11.31677	187	16.60825
138	11.42400	188	16.71278
139	11.53116	189	16.81727
140	11.63826	190	16.92171
141	11.74530	191	17.02611
142	11.85227	192	17.13046
143	11.95918	193	17.23477
144	12.06604	194	17.33903
145	12.17283	195	17.44325
146	12.27956	196	17.54743
147	12.38623	197	17.65156
148	12.49284	198	17.75565
149	12.59939	199	17.85970
150	12.70589	200	17.96371

Table II - Calibration table for platinum resistance thermometer designated LN-1037903 (Continued)

T (K)	R (ohms)	T (K)	R (ohms)
201	18.06767	251	23.21758
202	18.17160	252	23.31969
203	18.27548	253	23.42178
204	18.37932	254	23.52383
205	18.48312	255	23.62585
206	18.58688	256	23.72784
207	18.69060	257	23.82980
208	18.79428	258	23.93172
209	18.89792	259	24.03362
210	19.00152	260	24.13548
211	19.10508	261	24.23732
212	19.20860	262	24.33912
213	19.31208	263	24.44089
214	19.41552	264	24.54263
215	19.51893	265	24.64435
216	19.62230	266	24.74603
217	19.72563	267	24.84768
218	19.82892	268	24.94930
219	19.93217	269	25.05088
220	20.03539	270	25.15245
221	20.13856	271	25.25397
222	20.24171	272	25.35547
223	20.34481	273	25.45694
224	20.44788		
225	20.55091		
226	20.65390		
227	20.75686		
228	20.85979		
229	20.96268		
230	21.06553		
231	21.16835		
232	21.27113		
233	21.37388		
234	21.47659		
235	21.57927		
236	21.68192		
237	21.78453		
238	21.88771		
239	21.98965		
240	22.09216		
241	22.19463		
242	22.29707		
243	22.39948		
244	22.50186		
245	22.60420		
246	22.70651		
247	22.80879		
248	22.91103		
249	23.01325		
250	23.11543		

Table III. Thermocouple positions and specimen diameter

Al-7039	
Thermocouple positions (inches from floating sink)	0.87540, 1.87550, 2.87560, 3.87540, 4.87570, 5.87560, 6.87560, 7.87580
Specimen diameter (inches)	0.14499
Be	
Thermocouple positions (inches from floating sink)	0.86375, 1.86380, 2.86300, 3.86365, 4.86420, 5.86385, 6.86360, 7.86265
Specimen diameter (inches)	0.14421
Hastelloy-X	
Thermocouple positions (inches from floating sink)	0.87640, 1.87630, 2.87650, 3.87640, 4.87650, 5.87640, 6.87640, 7.87620
Specimen diameter (inches)	0.44432
Ti A-110 AT	
Thermocouple positions (inches from floating sink)	0.87570, 1.87570, 2.87580, 3.87630, 4.87620, 5.87610, 6.87610, 7.87630
Specimen diameter (inches)	0.44425
Inconel 718	
Thermocouple positions (inches from floating sink)	0.87580, 1.87580, 2.87680, 3.87590, 4.87710, 5.87710, 6.87740, 7.87740
Specimen diameter (inches)	0.44380
PO-3 graphite	
Thermocouple positions (inches from floating sink)	0.87500, 1.87500, 2.87500, 3.87500, 4.87500, 5.87500, 6.87500, 7.87500
Specimen diameter (inches)	0.42400
Armco iron (2c)	
Thermocouple positions (inches from floating sink)	0.87520, 1.87560, 2.87580, 3.87620, 4.87490, 5.87550, 6.87540, 7.87560
Specimen diameters (inches)*	0.14412, 0.14427, 0.14420, 0.14418, 0.14415, 0.14413, 0.14405
Armco iron (4c)	
Thermocouple positions (inches from floating sink)	0.87720, 1.87700, 2.87740, 3.87750, 4.87690, 5.87770, 6.87780, 7.87760
Specimen diameters (inches)*	0.14397, 0.14393, 0.14378, 0.14368, 0.14365, 0.14368, 0.14372

* These diameters are average values between successive thermocouples starting with the end nearest the floating sink.

Table IV. Zero emfs of specimen temperature measuring thermocouples
(Thermocouple number 1 is nearest the floating sink)

Cryogenic bath	Zero emf (μV)							
	Thermocouple number							
	1	2	3	4	5	6	7	8
liquid helium	1.22	1.01	1.05	1.17	0.94	1.01	1.15	0.91
liquid hydrogen	0.39	0.19	0.25	0.35	0.16	0.21	0.34	0.12
liquid nitrogen	0.10	0.09	0.09	0.12	0.11	0.14	0.10	0.13
alcohol and CO_2	0.00	0.12	0.08	0.09	0.12	0.12	0.09	0.14
ice and water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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