NBS TECHNICAL NOTE

408

Superconductive Materials and Some of Their Properties

B. W. ROBERTS

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards

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TECHNICAL NOTE 408

ISSUED SEPTEMBER 26, 1966

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A report prepared for the
Office of Standard Reference Data
Institute for Basic Standards
National Bureau of Standards
Washington, D.C., 20234

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402
Price 45 cents.

Foreword

The National Standard Reference Data System is a government-wide effort to give to the technical community of the United States optimum access to the quantitative data of physical science, critically evaluated and compiled for convenience. This program was established in 1963 by the President's Office of Science and Technology, acting upon the recommendation of the Federal Council for Science and Technology. The National Bureau of Standards has been assigned responsibility for administering the effort. The general objective of the System is to coordinate and integrate existing data evaluation and compilation activities into a systematic, comprehensive program, supplementing and expanding technical coverage when necessary, establishing and maintaining standards for the output of the participating groups, and providing mechanisms for the dissemination of the output as required.

The NSRDS is conducted as a decentralized operation of nationwide scope with central coordination by NBS. It comprises a complex of data centers and other activities, carried on in government agencies, academic institutions, and non-governmental laboratories. The independent operational status of existing critical data projects is maintained and encouraged. Data centers that are components of the NSRDS produce compilations of critically evaluated data, critical reviews of the state of quantitative knowledge in specialized areas, and computations of useful functions derived from standard reference data.

The primary output of the NSRDS—compilations and critical reviews—is to be published in a new series, called the National Standard Reference Data Series, within the NBS publications program. However, it has become apparent that uncritical data compilations which are essential elements of the compilation and evaluation process, have a substantial value of their own to the technical public. Plans have therefore been made to publish a number of uncritical data compilations. Some of these will appear as NBS Technical Notes; others will be published and distributed through channels connected with their authors or cosponsors.

Contents

Superconductive Materials and Some of Their Properties

B. W. Roberts

This is a noncritical compilation of data on superconductive materials that has been extracted from the literature published between October 1963 and December 1965. The properties concerned are composition, critical temperature, critical field crystallographic data, and lowest temperature tested for superconductivity. The compilation also includes, bibliography, general reference review articles and a special tabulation of high magnetic field superconductors.

Key Words: Bibliography, compilation of data, composition, critical field, critical temperature, crystallographic data, low temperature, superconductivity.

INTRODUCTION

This monograph extends the data set on superconductive materials published in Vol. IV of Progress in Cryogenics, 1964, pages 160-231 (subsequently denoted as PC IV). The new material includes that readily available to the author subsequent to October 1963 up to approximately December 1965. The format has been maintained except for several minor modifications such as an indication of those references which contain data on thermodynamic parameters, for instance, electronic specific heats and Debye temperatures.

More than one-half century of research on superconductivity has led to a current steady world activity in attempts at further understanding and exploitation. The use of superconductive coils to produce high magnetic fields, now approaching 150 kilogauss, has spawned a modest business activity for several companies. A superconductive device called a flux pump has been developed to energize the superconductive coils to their high current carrying levels. Extensive studies have been made at all major high energy particle centers to ascertain the applicability of superconductive magnets to particle accelerators.

Extensive additional studies on superconductive materials have been observed in the last three years. In the PC IV article more than 900 entries were presented. This addendum includes more than 500 additional entries. Thus the explosion of knowledge on superconductive materials continues as suggested by extrapolation in Figure 1 of PC IV.

GENERAL PROPERTIES OF SUPERCONDUCTORS

The historically first observed and most distinctive property of a superconductive body is the near total loss of resistance at a critical temperature T_c characteristic of each material. Figure 1(a) illustrates schematically two types of possible transitions. The sharp vertical discontinuity is indicative of that found for a single crystal of a very pure element or one of a few well annealed alloy compositions. The broad transition, illustrated by broken lines, suggests the transition shape seen for materials that are inhomogeneous and contain unusual strain distributions. Careful testing of the resistivity limits for superconductors shows that it is less than 4×10^{-23} ohm-cm, while the lowest resistivity observed in metals is of the order of 10^{-13} ohm-cm. If one compares the resistivity of a superconductive body to that of copper at room temperature the superconductive body is at least 10^{17} times less resistive.

The temperature interval ΔT_c, over which the transition between the normal and superconductive states takes place, may be of the order of as little as $10^{-4}{}^{o}K$ or several degrees in width, depending upon the material state.

A superconductive body below T_c, as exemplified by a pure metal, exhibits perfect diamagnetism and excludes a magnetic field up to some critical field H_c, whereupon it reverts to the normal state as shown in the H-T diagram of Figure 1(b).

The difference in entropy near absolute zero between the superconductive and normal states relates directly to the electronic specific heat, γ;

$$(S_s - S_n)_{T-0} = -\gamma T$$

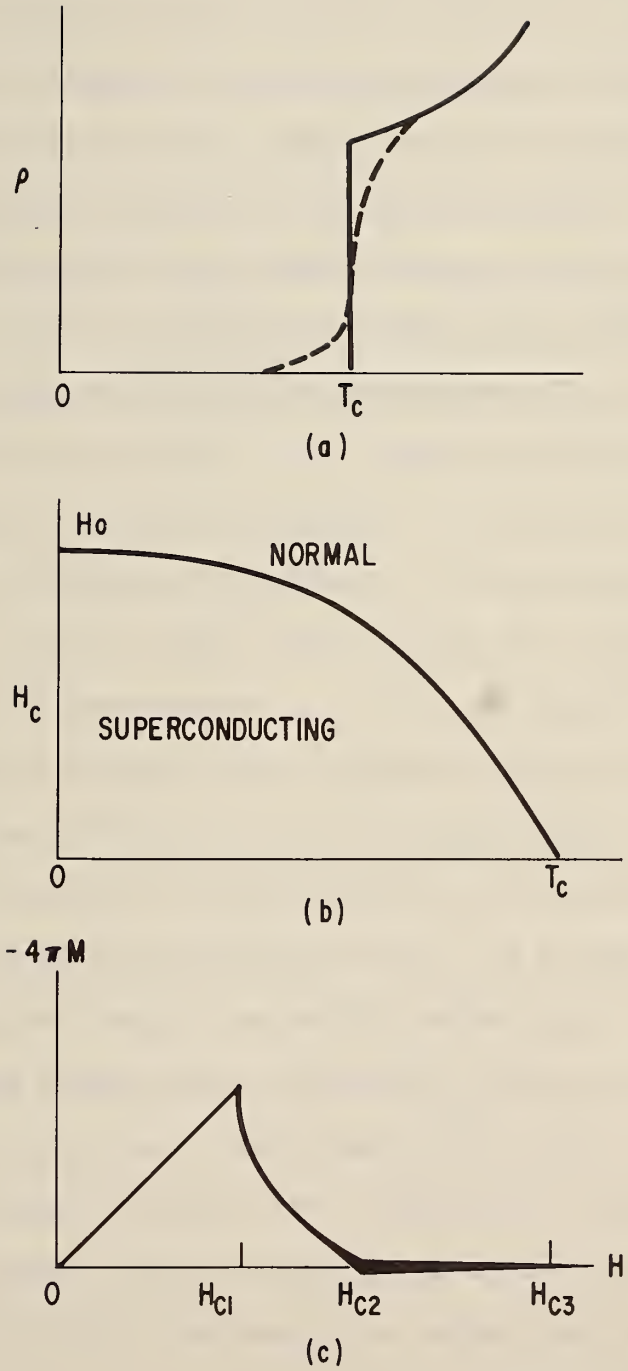

Figure 1. Physical properties of superconductors. (a) Resistivity versus temperature for a pure and perfect lattice (solid line). Impure and/or imperfect lattice (dashed line). (b) Magnetic field-temperature dependence for Type I or "soft" superconductors. (c) Schematic magnetization curve for "hard" or Type II superconductors.

HIGH FIELD SUPERCONDUCTIVITY

The discovery of the large current-carrying capability of Nb_3Sn and other similar alloys has led to an extensive study of the physical properties of these alloys. In brief, a high field superconductor, or Type II superconductor, passes from the perfect diamagnetic state at low magnetic fields to a mixed state and finally to a sheathed state before attaining the normal resistive state of the metal. The magnetization of a typical high field superconductor is shown in Figure 1(c). The magnetic field values separating the four stages are given as H_{c1}, H_{c2}, and H_{c3}. The superconductive state below H_{c1} is perfectly diamagnetic just as one obtains for most pure metals of the "soft" or Type I superconductor type. Between H_{c1} and H_{c2} a "mixed superconductive state" is found in which fluxons (a minimal unit of magnetic flux) create lines of normal superconductors in a superconductive matrix. The volume of the normal state is proportional to $-4\pi M$ in the "mixed state" region. Thus at H_{c2} the fluxon density has become so great as to drive the interior volume of the superconductive body completely normal. Between H_{c2} and H_{c3} the superconductor has a sheath of current-carrying superconductive material at the body surface, and above H_{c3} the normal state exists. With several types of careful measurement, it is possible to determine H_{c1}, H_{c2}, and H_{c3}. This data set includes those values now presented in the literature for these high field parameters.

The high field superconductive phenomena are related to specimen configuration. For instance, the Type I superconductor, Hg, has entirely different magnetization behavior in high magnetic fields when contained in the very fine set of filamentary tunnels in an unprocessed Vycor glass. The great majority of superconductive materials are Type II. The elements in very pure form with the possible exceptions of vanadium and niobium and a very few very stoichiometric and well annealed compounds are Type I.

CRITERIA FOR THE EXISTENCE OF THE SUPERCONDUCTIVE STATE

Experimental and theoretical attempts to evolve concretely the criteria for superconductivity in elements, alloys and materials still persist. A useful criterion has been found in Matthias' rules. These were developed empirically and then qualitatively shown to be derivable from the electronic properties of the atoms as presented in the periodic table. The primary empiricism of Matthias' rules is the prediction that alloys with average numbers of valence electrons per atom on the low sides of valence 5 and valence 7 will with some probability have high T_c. The average number of valence electrons is taken directly from the periodic table and an example of the validity of the empiricism is shown in Figure 2. Here the critical temperature of the known superconductive compounds having the A15 (β-W) or CrO_3 crystal structure are shown with the critical temperatures plotted versus the mean number of valence electrons per atom. Other parameter considerations such as the atomic volume and the mass of the constituent atoms have been useful but only in comparison within very similar systems.

Some semiconductive compounds have been found to be superconductive when studied after or during the application of high pressure. Recently the very high pressure phases of silicon and germanium have been shown to become superconductive in new dense phases. The additional discoveries of superconductive modifications

of antimony and bismuth and the discovery of the very low critical temperature of tungsten leads to the repeated prediction that all metals are superconductive even if critical temperatures are currently too low to be measured. Some valid correlations now suggest that the noble metals such as gold and platinum will be superconductive if taken to temperatures of a few times 10^{-4} or 10^{-5}°K.

The crystal structure of known superconductors has been a useful guide in discovering others. The classic example is the large number of superconductive A15 compounds. Other crystal structures such as the Laves phases and the χ-phase or α-Mn structure show a pronounced tendency to be superconductive. It is thought that the crystal structure has a secondary influence on the critical temperature, however, and that the important consideration is the electronic structure which leads to a high density of electron states at the fermi level. Since very few band structures are known for alloys with the structural complexity of the A15 type, little general theory has been achieved to date. Correlations of the electronic specific heat the the Debye Θ's have tended to confirm the BCS (Bardeen-Cooper-Schrieffer) prediction within selected groups of superconductive materials. However there is evidence that precise correlation with the BCS theory is not always possible.

One notable change in the data presented are the new very low critical temperatures and the number of non-superconductive materials studied down to temperatures well below 1°K. A

disappointing and possibly frustrating result is the lack of discovery of new superconductive materials with critical temperatures greater than 18.5^{o}K. This outlines a definite theoretical problem. Is there a limit to superconductive critical temperatures somewhere in the vicinity of 19 or 20^{o}K or are there undiscovered materials with critical temperatures above this? The technical desirability of finding superconductors with higher T_c follows since critical magnetic fields will be proportionately higher.

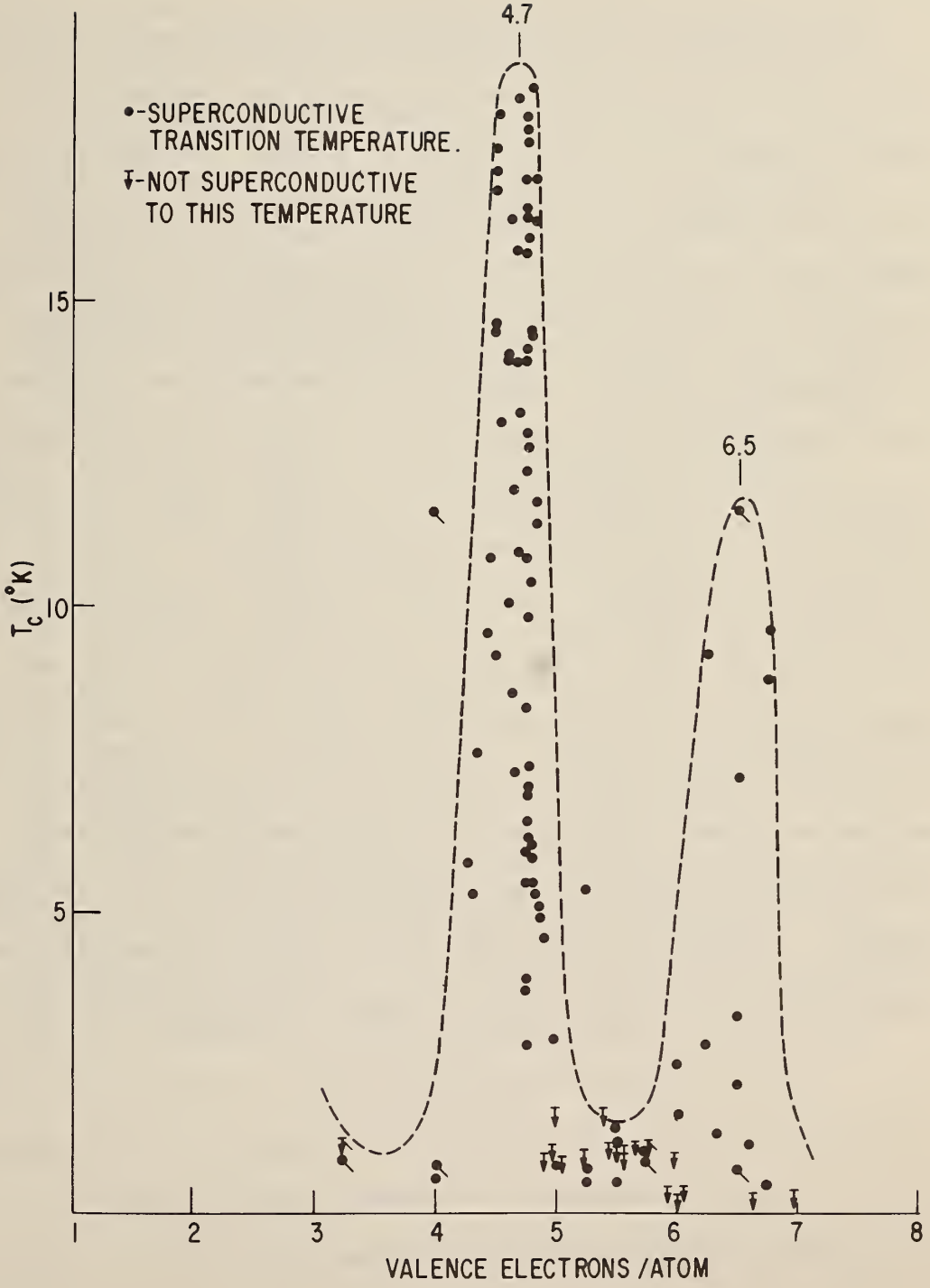

Figure 2. Critical temperature versus valence electron/atom ratio for "β-W" or A15 (Cr_3O)-type compounds.

METALLURGICAL ASPECTS

The sensitivity of superconductive properties to the material state is most pronounced and has been used in a reverse sense to study and specify the detailed state of alloys. The mechanical state, the homogeneity, and the presence of impurity atoms and other electron scattering centers are all capable of controlling the critical temperature and the current-carrying capabilities in high magnetic fields. Well annealed specimens tend to show sharper transitions than those that are strained or inhomogeneous. This sensitivity to mechanical state underlines a general problem in the tabulation of properties for superconductive materials. The occasional divergent values of the critical temperature and of the critical fields quoted for a Type II superconductor may lie in the variation in sample preparation. Critical temperatures of materials studied early in the history of superconductivity must be evaluated in light of the probable metallurgical state of the material as well as the availability of less pure starting elements. It has been noted that recent work has given extended consideration to the metallurgical aspects of sample preparation.

NOTES CONCERNING DATA IN THE MONOGRAPH

Table 1 lists the elements and some of their superconductive properties. The data have been selected generally from recent studies in which sample purity and perfection appear to have been considered. The data given have not been critically evaluated.

Table 2 contains superconductive materials reported during the period plus all materials that have been reported to be tested specifically for a superconducting transition down to some temperature T_n without discovery of a transition. All compositions are denoted on an atomic basis, i.e. AB, AB_2 or AB_3 for compounds, unless noted. Solid solutions or odd compositions may be denoted as A_zB_{1-z}, or A_zB. A series of three or more alloys is indicated as A_xB_y or by actual indication of the atomic fraction range such as $A_{0-0.6}B_{1-0.4}$. The critical temperature of such a series of alloys is denoted by a range of values or possibly the maximum value. In many cases several references will be found for the same alloy. This usually denotes a separate measurement by each source, and in a few cases may even indicate a disagreement over the superconductive properties. In view of the previous discussions concerning the variability of the superconductive properties as a function of purity and other metallurgical aspects, it is recommended that the appropriate literature be checked to determine the most probable critical temperature or critical field of a given alloy. Another unfortunate point lies in the selection of

a number for the critical temperature from a transition observed in the effective permeability or the change in resistance, or possibly the incremental changes observed in frequency observed by certain techniques. Most authors choose the mid-point of such curves as the probable critical temperature of the idealized material, and others will choose the highest temperature at which a deviation from the normal state property is observed.

Table 3 lists a supplementary tabulation of high magnetic field superconductors.

A list of review articles primarily concerned with the experimental and material aspects of superconductivity is appended as well as a complete alphabetical cross-reference to authors by reference number.

Acknowledgements

Preprints and courtesy copies of reports on superconductive materials have been kindly sent by many researchers in the field and found most useful and are gratefully acknowledged. Skilled, persistent and dedicated assistance of Mrs. Marilyn Brown and formerly of Mrs. Jean Slaggie have greatly contributed to the accuracy and completeness of this monograph. The thorough coverage of the scientific literature is due to the library staff's fine efforts in seeking pertinent articles, especially by Mrs. Ethel Fontanella and Mrs. Maryde Orr.

Table 1. Properties of Superconductive Elements (References given in Table 2, as well as Crystal Structure Data and Information on Non-superconductive Elements)

Element	T_c (°K) Cal.	T_c (°K) Mag.	H_o (oersteds) Cal.	H_o (oersteds) Mag.	Θ_D (°K)	γ (mJ mole^{-1} deg.K^{-2})
Al	1.183	1.196	104	99	420†	1.36†‡
Cd	0.54, 0.518	0.56	29.6	30	209	0.688
Ga	1.087, 1.078	1.091	59.4, 58.9	51	317, 324.7	0.601, 0.596
Hg (α)	4.16	4.153	380	412	87, 71.9	1.91, 1.79
Hg (β)		3.949		339	93	1.37
In	3.396	3.4035	278	293	109	1.81
Ir		0.14		19		3.1
La (α)	4.80	~5.0				
La (β)	5.91	6.06		1,600	132	6.7
Mo	0.915-0.918	0.92	95	98	382-461, 470	1.81-1.89, 1.91
Nb	9.17	9.22, 9.47	1,944	1,980, HF*	238, 271	7.53
Os		0.655		65		2.35
Pa		1.4				
Pb	7.23	7.193		803	96.3	3.0
Re	1.699	1.698	188	198	210	2.35
Ru		0.49		66		2.4
Sb		2.6-2.7		HF*		
Sn	3.722	3.722	303	309	195	1.75
Ta	4.39	4.483	780	830,HF*	255	6.4
Tc		8.22				
Th		1.368	131	162	168	4.65
Ti	0.42	0.39	56	100	430, 415	3.30
Tl	2.38	2.39	176.5	171	78.5	1.47
U (α)		0.68			206	10.6
U (pseudo-γ)		1.80 (extrapolated value)				
V	5.03	5.30	1,310	1,020,HF*	338	6.4
W		0.012		1,070		
Zn	0.852	0.875	51.8	53	309	0.66
Zr		0.546		47	265	2.9
Zr (ω)		0.65				

Element	T_c (°K) Cal.	T_c (°K) Mag.	H_o (oersteds) Cal.	H_o (oersteds) Mag.	Θ_D (°K)	γ (mJ mole^{-1} deg.K^{-2})
Thin films formed below 10°K						
Be		~6, ~8.4		$H_{c2} \gg 11$		
Bi		~6.0				
Ga		8.4				
In		3.95-4.25				
Sn		4.6-4.7				
Under high pressure						
				Pressure		
Bi II		3.916		25,000 atm		
		3.90		25,200 atm		
		3.86		26,800 atm		
Bi III		7.25		27,000-28,400 atm, HF*		
Ge		4.85-5.4		~120 kbar		
Se II		6.75, 6.95		~130 kbar		
				Pressure		
Si		7.1		120-130 kbar		
Te		~3.3		~56,000 atm		

† For another data set see Mendelssohn, K., Cryophysics, p. 178 (Interscience, New York, 1960).

‡ Parkinson, D. H., Rep. progr. Phys. 21, 226 (1958).

* See later table for additional data on H_{c1}, H_{c2} and H_{c3}.

Table 2. Tabulation of Superconductive Materials (including Proven Non-superconductors) with Critical Temperatures and Fields, Some Crystal Structure Data, and References

Symbols used:

* Eutectic alloy.

Δ Uncertain composition.

R Resistance measurements.

M Denotes maximum T_c in specimen series.

** T_n is the lowest temperature at which a material has been checked for a superconductive transition.

HF In H_o column indicates that some information is available in Table 3 on high field magnetic properties.

∇ On material or reference indicates a thin film study.

ω All cell edges are intended to be quoted in Ångström units.

T_c' (----) Denotes incremental changes in T_c from pure metal.

o Impure material.

C Calorimetric determination.

VA Valence electron/atom.

SS Solid solution.

n Number of carriers in semiconductive materials.

Electronic specific heat Debye Θ data given.

(Some of the above symbols may be found only in PROGRESS IN CRYOGENICS article.)

Key to Crystal Structure Types Found in Table 2

"Struckturbericht" Type*	Example	Class
A1	Cu	Cubic, f.c.
A2	W	Cubic, b.c.
A3	Mg	Hexagonal, close packed
A4	Diamond	Cubic, f.c.
A5	White Sn	Tetragonal, b.c.
A6	In	Tetragonal, b.c. (f.c. cell usually used)
A7	As	Rhombohedral
A8	Se	Trigonal
A10	Hg	Rhombohedral
A12	α-Mn	Cubic, b.c.
A13	β-Mn	Cubic
A15	β-W	Cubic
B1	NaCl	Cubic, f.c
B2	CsCl	Cubic
$B8_1$	NiAs	Hexagonal
$B8_2$	Ni_2In	Hexagonal
B10	PbO	Tetragonal
B11	γ-CuTi	Tetragonal
B17	PtS	Tetragonal
B18	CuS	Hexagonal

* See W. B. Pearson, Reference 108, p. 79.

"Struckturbericht" Type*	Example	Class
B20	FeSi	Cubic
B27	FeB	Ortho-rhombic
B31	MnP	Ortho-rhombic
B32	NaTl	Cubic, f.c.
B34	PdS	Tetragonal
B_f	ζ-CrB	Ortho-rhombic
B_g	MoB	Tetragonal, b.c.
B_h	WC	Hexagonal
B_i	γ'-MoC	Hexagonal
C1	CaF_2	Cubic, f.c.
$C1_b$	MgAgAs	Cubic, f.c.
C2	FeS_2	Cubic
C6	CdI_2	Trigonal
C11b	$MoSi_2$	Tetragonal, b.c.
C12	$CaSi_2$	Rhombohedral
C14	$MgZn_2$	Hexagonal
C15	Cu_2Mg	Cubic, f.c.
$C15_b$	$AuBe_5$	Cubic
C16	$CuAl_2$	Tetragonal, b.c.
C18	FeS_2	Ortho-rhombic
C22	Fe_2P	Trigonal
C32	AlB_2	Hexagonal

"Struckturbericht" Type*	Example	Class
C36	$MgNi_2$	Hexagonal
C37	Co_2Si	Ortho-rhombic
C49	$ZrSi_2$	Ortho-rhombic
C54	$TiSi_2$	Ortho-rhombic
C_c	Si_2Th	Tetragonal, b.c.
DO_3	BiF_3	Cubic, f.c.
DO_{11}	Fe_3C	Ortho-rhombic
DO_{18}	Na_3As	Hexagonal
DO_{19}	Ni_3Sn	Hexagonal
DO_{20}	$NiAl_3$	Ortho-rhombic
DO_{22}	$TiAl_3$	Tetragonal
DO_e	Ni_3P	Tetragonal, b.c.
$D1_3$	Al_4Ba	Tetragonal, b.c.
$D1_c$	$PtSn_4$	Ortho-rhombic
$D2_c$	MnU_6	Tetragonal, b.c.
$D2_d$	$CaZn_5$	Hexagonal
$D5_2$	La_2O_3	Trigonal
$D5_8$	Sb_2S_3	Ortho-rhombic
$D7_3$	Th_3P_4	Cubic, b.c.
$D7_b$	Ta_3B_4	Ortho-rhombic
$D8_1$	Fe_3Zn_{10}	Cubic, b.c.
$D8_2$	Cu_5Zn_8	Cubic, b.c.

"Struckturbericht" Type*	Example	Class
$D8_3$	Cu_9Al_4	Cubic
$D8_8$	Mn_5Si_3	Hexagonal
$D8_b$	CrFe	Tetragonal
$D8_i$	Mo_2B_5	Rhombohedral
$D10_2$	Fe_3Th_7	Hexagonal
$E9_3$	Fe_3W_3C	Cubic, f.c.
$L1_0$	CuAu	Tetragonal
$L1_2$	Cu_3Au	Cubic
L'_{2b}	ThH_2	Tetragonal, b.c.
L'_3	Fe_2N	Hexagonal

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal structure ∞	Ref.
$Ag_{3.3}Al$			0.34	like A13, a=6.92	486
Ag_5Ba			0.34	$D2_d$, a=5.71, c=4.64	486
$Ag_{0.95-0.81}Ga_{0.05-0.19}$			1.4		533
$Ag_{0.80-0.30}Ga_{0.20-0.70}$	6.5-8				533
$Ag_{0.29-0.02}Ga_{0.71-0.98}$			1.4		533
$Ag_xGa_yIn_{0.10}$	6.5-8				533
$Ag_xGa_ySn_{0.10}$	4.2				533
$Ag_xGa_yZn_{0.10}$	6.5-8				533
Ag_4Ge	0.85			Hex., h.c.p.	487
$Ag_{0.438}Hg_{0.562}$	0.64			$D8_{1,2,3}$ "gamma brass," complex, b.c.c.	489, 511
Ag_3In			1.4		533
$Ag_{0.1}In_{0.9}Te$ ($n=1.40\times10^{22}$)	1.20-1.89			B1, a=6.12	470
$Ag_{0.2}In_{0.8}Te$ ($n=1.07\times10^{22}$)	0.77-1.00			B1, a=6.08	470
$AgSi_2$			1.4		533
Ag_5Sn			0.34	A3, a=2.94, c=4.77	486
Ag_5Sr			0.34	$D2_d$, a=5.68, c=4.62	486
$AgTe_3$	2.6			Cubic, primitive	487
Al_2Au			0.34	C1, a=6.01	486
$AlAu_4$	0.4-0.7			Like A13, a=6.92	486
Al_2CCr_3			4.2	Hex., "H-phase," a=2.47, c=7.39	496, 497
Al_2CMo_3	10.0			A13, a=6.867	496, 497
$AlCNb_2$			4.2	Hex.	497
Al_2CNb_3			4.2	Hex., "H-phase," a=2.67, c=8.02	496, 497
Al_2CTa_3			4.2	Hex., "H-phase," a=2.68, c=7.97	496, 497
Al_2CTi_3			4.2	Hex., "H-phase," a=2.63, c=7.87	496, 497
Al_2CV_3			4.2	Hex., "H-phase," a=2.52, c=7.52	496, 497
$Al_{0.107}Co_{0.088}Fe_{0.805}$			1.4	Cubic	514#
$Al_{0.107}Co_{0.176}Fe_{0.717}$			1.4	Cubic	514#
$Al_{0.107}Co_{0.259}Fe_{0.634}$			1.4	Cubic	514#

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$Al_{0.118}Co_{0.446}Fe_{0.436}$			1.4	Cubic	514#
$Al_{0.118}Co_{0.523}Fe_{0.359}$			1.4	Cubic	514#
$Al_{0.119}Co_{0.352}Fe_{0.529}$			1.4	Cubic	514#
$Al_{0.119}Co_{0.610}Fe_{0.271}$			1.4	Cubic	514#
$Al_{0.049}Cr_{0.951}$			1.4	A2	514#
$Al_{0.10}Cr_{0.90}$			1.4	Cubic	514#
$Al_{0.146}Cr_{0.854}$			1.4	Cubic	514#
$Al_{0.20}Cr_{0.80}$			1.4	Cubic	514#
$Al_{0.250}Cr_{0.750}$			1.4	Cubic	514#
$Al_{0.30}Cr_{0.70}$			1.4	Cubic	514#
$Al_{0.089}Cr_{0.544}Fe_{0.367}$			1.4	Cubic	514#
$Al_{0.09}Cr_{0.046}Fe_{0.866}$			1.4	Cubic	514#
$Al_{0.09}Cr_{0.228}Fe_{0.682}$			1.4	Cubic	514#
$Al_{0.091}Cr_{0.817}Fe_{0.092}$			1.4	Cubic	514#
$Al_{0.095}Cr_{0.453}Fe_{0.452}$			1.4	Cubic	514#
$Al_{0.096}Cr_{0.679}Fe_{0.225}$			1.4	Cubic	514#
$Al_{0.097}Cr_{0.726}Fe_{0.177}$			1.4	Cubic	514#
$Al_{0.100}Cr_{0.632}Fe_{0.268}$			1.4	Cubic	514#
$Al_{0.104}Cr_{0.849}Fe_{0.047}$			1.4	Cubic	514#
$Al_{0.105}Cr_{0.753}Fe_{0.142}$			1.4	Cubic	514#
$Al_{0.10}Cr_{0.63}V_{0.27}$			1.4	Cubic	514#
$Al_{0.111}Cr_{0.801}V_{0.089}$			1.4	Cubic	514#
$Al_{0.114}Cr_{0.267}V_{0.618}$			1.4	Cubic	514#
$Al_{0.115}Cr_{0.708}V_{0.177}$			1.4	Cubic	514#
$Al_{0.115}Cr_{0.839}V_{0.045}$			1.4	Cubic	514#
$Al_{0.122}Cr_{0.458}V_{0.42}$			1.4	Cubic	514#
$Al_{0.131}Cr_{0.088}V_{0.781}$	1.46			Cubic	514#
Al_2La	3.2			C15, a=813	486
$Al_{0.19-0.30}Nb_{0.81-0.70}$ (As cast)	17.3M				479
$Al_{0.19-0.30}Nb_{0.81-0.70}$ (Annealed)	18.3M				479
Al_xNb_{1-x}	6-9			Cubic	497
Al_xNb_{1-x}	<4.2-13.5			$D8_b$, a=9.318, c=4.813 to a=9.295, c=4.819	497

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
Al_xNb_{1-x}	12-17.5			A15	513
Al_xNb_{1-x}	12			A15, a=5.196	513
Al_xNb_{1-x}	17.5			A15, a=5.185	513
$AlNb_3$	12.5-17.5			A15	497
$Al_{0.27}Nb_{0.73}$	17.5			A15, a=5.185	497
$Al_{0.27}Nb_{0.73-0.48}V_{0-0.25}$	14.5-17.5			A15, a=5.136-5.185	497
$Al_{0.27}Nb_{0-0.50}V_{0.73-0.23}$			4.2	Cubic, a=3.055-3.18	497
$AlNb_xV_y$	<4.2-13.5				497
AlPb▽ (superimposed films)	1.2-7				512▽
AlPt			0.34	Cubic, a=4.85	486
Al_2Pt	0.48-0.55			C1, a=5.92	486
$Al_{0.10}Ti_{0.63}V_{0.27}$	3.62			Cubic	514#
$Al_{0.11}Ti_{0.149}V_{0.741}$	2.05			Cubic	514#
$Al_{0.120}Ti_{0.328}V_{0.552}$	2.70			Cubic	514#
$Al_{0.125}Ti_{0.520}V_{0.355}$	3.44			Cubic	514#
$Al_{0.127}Ti_{0.693}V_{0.180}$	3.52			Cubic	514#
$Al_{0.15}Ti_{0.595}V_{0.255}$	2.36			Cubic	514#
$Al_{0.25}Ti_{0.525}V_{0.255}$			1.4	Cubic	514#
$Al_{0.30}Ti_{0.49}V_{0.21}$			1.4	Cubic	514#
$Al_{0.108}V_{0.892}$	1.82			Cubic	514#
$Al_{0.188}V_{0.812}$			1.4	Cubic	514#
$Al_{0.27}V_{0.73}$			4.2	Cubic, a=3.055	497
$Al_{0.308}V_{0.692}$			1.4	Cubic	514#
$Al_{0.402}V_{0.598}$			1.4	Cubic	514#
Al_2Y			0.34	C15, a=7.86	486
$As_{0.33}InTe_{0.67}$ (n=1.24x10^{22})	0.85-1.15			B1, a=5.98	470
$As_{0.5}InTe_{0.5}$ (n=0.97x10^{22})	0.44-0.62			B1, a=5.91	470
AsIr			0.35		491
$AsIr_2$			0.35		491
$AsPd_2$ (low temperature)	0.60			Hex., a=9.79, c=6.62	491
$AsPd_2$ (high temperature)	1.70			C22, a=6.65, c=3.58	491
$AsPd_2$ (quenched)	1.71			C22, a=6.65, c=3.57	530
$AsPd_2$ (annealed)	0.6			Hex., a=9.79, c=6.61	530
$AsPd_3$			0.35	DO_e, a=9.986, c=4.830	491

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$AsPd_3$			0.3	$D0_e$, a=9.98, c=4.83	530
$AsPd_7$			1.1		530
As_2Pd			1.1		530
As_2Pd_5	0.46			Complex	491
As_2Pd_5	0.43-0.50				530
As_2Pt			0.35		491
As_3Pt_2			0.35		491
AsRh	0.58			B31, a=5.65, b=3.58, c=6.00	491
$AsRh_{1.4-1.6}$	<0.03-0.56			Hex.	491
$AsRh_{1.4}$				Hex., a=9.15, c=3.53 + weak a=9.15, c=5.19	491
$AsRh_{1.6}$				Hex., a=9.32, c=3.67	491
$AsRh_{1.7}$ (quenched)				Ortho. Rh_2As + $Rh_{1.6}As$ phase	491
AsRu			0.35		491
$AsRu_2$			0.35		491
AsSn (n=2.14x10^{22})	3.41-3.65			B1, a=5.72	470
$As_{\sim 2}Sn_{\sim 3}$	3.5-3.6, 1.21-1.17				470
As_3Sn_4 (n=0.56x10^{22})	1.16-1.19			Rhomb., a=12.23, ∝=19.23	470
Au (rapid quench)			0.32	A1, f.c.c.	487
Au_5Ba	0.4-0.7			$D2_d$, a=5.69, c=4.54	486
Au_5Ca	0.34-0.38			$C15_b$, a=7.747	486, 535
AuGa	1.2			B31, a=6.40, b=6.27, c=3.42	486
$AuGa_2$			0.34	C1, a=6.07	486
$Au_{0.30}Ge_{0.70}$			0.32	h.c.p. + Ge	487
$Au_{0.33}Ge_{0.67}$			0.32	weak complex + h.c.p. + Ge	487
$Au_{0.40}Ge_{0.60}$	1.63			h.c.p. + Ge + weak complex	487
$Au_{0.47}Ge_{0.53}$	1.63			complex + weak Ge	487
$Au_{0.50}Ge_{0.50}$	1.63			complex + weak Ge	487
$Au_{0.54}Ge_{0.46}$	1.50			complex	487
$Au_{0.61}Ge_{0.39}$	1.31			complex	487
$Au_{0.70}Ge_{0.30}$	1.09			complex	487
$Au_{0.725}Ge_{0.275}$	0.99			complex + weak h.c.p.	487
$Au_{0.75}Ge_{0.25}$	Trace @ 0.5		0.32	Hex., h.c.p. + weak complex	487
$Au_{0.775}Ge_{0.225}$	Trace @ 0.5		0.32	Hex., h.c.p. weak + complex + f.c.c.	487

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$Au_{0.90}Ge_{0.10}$	Trace @ 0.9		0.32	Cubic, f.c.c.	487
$Au_{0.92}Ge_{0.08}$	Trace @ 0.9		0.32	Cubic, f.c.c.	487
$Au_{0.80}Hg_{0.20}$			0.32		489
$Au_{0.85}Hg_{0.15}$			0.32		489
AuIn	0.4-0.6			Complex	486
$AuIn_2$			0.34	C1, a=6.51	486
Au_5K			0.34	$D2_d$, a=5.64, c=4.48	486
Au_2Na			0.34	C15, a=7.81	486
$AuNb_3$	11.5			A15, a=5.2027	492
$Au_{0.02}Nb_3Rh_{0.98}$	2.53			A15, a=5.133	492
$Au_{0.05}Nb_3Rh_{0.95}$	2.52			A15, a=5.137	492
$Au_{0.10}Nb_3Rh_{0.90}$	2.70			A15, a=5.1412	492
$Au_{0.30}Nb_3Rh_{0.70}$	4.6			A15, a=5.1573	492
$Au_{0.50}Nb_3Rh_{0.50}$	6.6			A15, a=5.1688	492
$Au_{0.70}Nb_3Rh_{0.30}$	9.5			A15, a=5.1827	492
$Au_{0.90}Nb_3Rh_{0.10}$	10.8			A15, a=5.1960	492
$Au_{0.95}Nb_3Rh_{0.05}$	11.0			A15, a=5.200	492
$Au_{0.98}Nb_3Rh_{0.02}$	10.9			A15, a=5.203	492
$AuPb_2$	3.15				475, 521
$AuPb_2$▽	4.3				521▽
$AuPb_3$	4.40				475, 521
$AuPb_3$▽	4.25				521▽
Au_2Pb	1.18			C15, a=7.94	486
Au_5Rb			0.34	$D2_d$, a=5.6, c=4.4	486
AuSn	1.25			$B8_1$, a=4.32, c=5.52	486
Au_5Sn	0.7-1.1			A3, a=2.92, c=4.77	486
Au_3Te_5	1.62			Primitive cubic	487
$AuTi_3$				A15, a=5.094	522
$BCMo_2$	5.4			Ortho-rhombic	497
$B_xC_{1-x}Mo$ (quenched)	14.2 (broad 17.5-12.2)			Cubic + some Hex.	497
BMo	0.5 (extrapolated)				497
BTi				B27, a=6.12, b=3.06, c=4.56	522
B_2Ti				C32, a=3.030, c=3.227	522
BW_2	3.1				474

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
Be▽	~6.5	HF			550▽
BiII		HF			437
BiIII		HF			437
$Bi_{0.019}In_{0.981}$	3.86				544
BiIr			0.35		491
$BiIr_2$			0.35		491
$BiNb_3$			2.25	Cubic, a=3.327	508
$BiNb_3$ (high pressure and temperature)	3.05			A15, a=5.320	508
$Bi_{1-0}Pb_{0-1}$▽	7.25-8.67				484▽
$Bi_{0.95}Pb_{0.05}$▽			1.03		484▽
$Bi_{0.99}Pb_{0.01}$▽			1.03		484▽
BiRu			0.35		491
$BiRu_2$			0.35		491
C (pyrolytic graphite)			0.011		494
C_8Cs (gold)	0.020-0.135				494
$C_{16}Cs$ (blue)			0.011		494
C_8K (gold)	up to 0.55	HF			494
$C_{16}K$ (blue)			0.011		494
$\alpha C_{1-x}Mo_x$ (quenched)	14.2			Cubic + some Hex.	497
$C_{1-x}Mo_x$ (quenched)	8.8			Hex., ηMo_3C_2	497
$C_{1-x}Mo_x$ (quenched)	9.4-11.7			ηMo_3C_2 + partial αMoC_{1-x}	497
$C_{0.40}Mo_{0.60}$ (quenched)	11.7			Some B1	497
$CMo_{0.83}Ti_{0.17}$	10.2			B1, a=4.290	522
CNb_2	9.1				474
$C_{\sim 0.7-1.0}Nb_{\sim 0.3-\sim 0}$	6-11			B1	497
C_8Rb (gold)	0.023-0.151				494
$C_{16}Rb$ (blue)			0.011		494
CTa▽ (sputtered)	5.09			B1	505▽
CTa_2	3.2				474
CTi				B1, a=4.329	522
$CaCu_5$			0.34	$D2_d$, a=5.09, c=4.09	486
$CaZn_5$			0.34	$D2_d$, a=5.42, c=4.19	486
Cd	0.518	29.6, HF			537
Cd (isotopes)					546

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
Ce (0-10,000 atm.)			1.25	∝-Ce dense f.c.c.	542
$CeIr_3$	3.34				469
$CeIr_5$	1.82				469
$CeIr_{1.8}$			0.32	C15, a=7.581	469
$CePt_2$			0.32	C15, a=7.730	469
$CePt_3$			0.32	C15, a=7.640	469
$CePt_5$			0.32	$D2_d$, a=5.369, c=4.385	469
$Ce_{0.20-0.173}Pt_{0.80-0.826}$	1.26-0.70, 1.55M (portion only)				469
$CoLa_3$	4.01			DO_{20}, a=7.279, b=10.088, c=6.578	469
$CoLu_3$	0.35+++ (portion only)				469
Co_2Lu			0.32	C15, a=7.123	469
$Co_{0.02}Nb_3Rh_{0.98}$	2.28			A15, a=5.132	492
$Co_{0.05}Nb_3Rh_{0.95}$	1.96			A15, a=5.135	492
$Co_{0.10}Nb_3Rh_{0.90}$	1.90			A15, a=5.1347	492
$CoSc_2$			0.32	C16, a=6.374, c=5.616	469
$CoSc_3$			0.32		469
$Co_{0.28-0.32}Sc_{0.72-0.68}$	0.35+++ (portion only)				469
Co_5Th			0.32	$D2_d$, a=5.005, c=3.987	469
Co_xTi_y					522
$Co_{0.28}Y_{0.72}$	0.34				469
CoY_2			0.32		469
CoY_3	0.34+++ (portion only)				469
Cr			1.4	A2	514#
Cr▽			0.3		503▽
$Cr_{0.025}Ti_{0.975}$	3.5			+ω?	477#
Cr_xTi_y (quenched)			1.1		523
Cr_xTi_y					522
$Cr_{0.011}Ti_{0.967}V_{0.022}$	3.6			+ω?	477#
Cs			0.011		494
$Cs_{0.32}O_3W$	1.12			Hex., a=7.4, c=7.6	500
Cu					537#
Cu_3Ga			1.4		533
CuTi				B11, a=3.108, c=5.887	522
$Fe_{0.5}PPd_3$			0.35		491

+++ Beginning of transition

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$Fe_{0.01}Ti_{0.99}$	2.3				477#
$Fe_{0.015}Ti_{0.985}$	2.8				477#
$Fe_{0.08}Ti_{0.92}$				A2	477#
Fe_xTi_y					522
Ga	1.078	58.9			537#
GaN			~2.		528
GaPt			0.34	B20, a=4.91	486
Ga_2Pt	1.7-1.9				486
$Ga_{0.23-0.26}V_{0.77-0.74}$ (annealed)	14.3M				479
$Ga_{0.23-0.26}V_{0.77-0.74}$ (annealed)	14.5R				479
Ge (~120 kbar pressure)	4.85-5.4				540
Ge_7Ir_3	0.87 (portion only)				491
$GeMo_3$	1.4				474
$GeNb_3$ (quenched)	17.-6. + some below 4.			A15	498
$Ge_{0.25-0.29}Nb_{0.75-0.71}$	6.			A15	498
$Ge_{0.29}Nb_{0.71}$	6.			A15, a=5.149	498
$GePd_2$			0.35		491
$Ge_{1.5}Pd$	Trace				491
Ge_2Pd_5			0.35		491
GeTe (Ag doped) ($n=27\times10^{20}$)	0.21				481
GeTe (Ag doped) ($n=64\times10^{20}$)	0.41				481
$Ge_{1-x}Te_x$ ($n=9-16\times10^{20}$)	0.07-0.31			B1	482
$Ge_{0.937}Te$ ($n=14.3\times10^{20}$)	0.30				501
$Ge_{0.950}Te$ ($n=11.8\times10^{20}$)	0.24				501
$Ge_{0.963}Te$ ($n=9.3\times10^{20}$)	0.17				501
$Ge_{0.976}Te$ ($n=8.5\times10^{20}$)	0.07				501
$Ge_{1.006}Te$ ($n=7.5\times10^{20}$)			0.02		501
Ge_3Te_4 ($n=1.06\times10^{22}$)	1.55-1.80			Rhomb., a=13.11, ∝=17.93	470
Ge_2Ti				C54, a=8.594, b=5.030, c=8.864	522
Ge_3Ti_5				$D8_8$, a=7.552, c=5.234	522
GeV_3	6.0				474
$H_{1.8}La$ (with free La)			1.1		488
$H_{1.96}La$			0.33		488

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$H_{2.03}La$			1.1		488
$H_{2.11}La$			1.1		488
$H_{2.15}La$			1.1		488
$H_{2.36}La$			1.1		488
Hg	4.16	380			527#
$Hg_{0.80}Pt_{0.20}$			0.32		489
In ▽					532▽
$InNb_3$			2.25	Cubic, a=3.326	508
$InNb_3$ (high pressure and temperature)	4-8			A15, a=5.303	508
$In_{1-0.90}Pb_{0-0.10}$	0.7-1.1	HF			480#
InPd	0.7			B2	489
InRh			0.32	B2	489
InSb	2.1	1100			471
InSb (metallic)	1.6-2.1			β-Sn structure, a=5.72, b=3.18	502
InSbII (quenched)	2.1			Tet., a=5.79, c=3.15	539
InSbII-β-$Sn_{0.02-0.80}$ (quenched)	4.0-4.4				539
InSbII-β-$Sn_{0.05-0.80}$ (heat treated, quenched)	3.8-4.6				539
InSbII-β-$Sn_{0.05-0.90}$ (heat treated, quenched)	3.8-5.1				539
$In_{0.82}Te$ ($n=0.83\times10^{-22}$)	1.02-1.06			B1, a=6.052	506, 515
$In_{0.83}Te$ ($n=0.88\times10^{-22}$)	1.09-1.15			B1, a=6.055	506, 515
$In_{0.87}Te$ ($n=1.09\times10^{-22}$)	1.40-1.55			B1, a=6.081	506, 515
$In_{0.91}Te$ ($n=1.28\times10^{-22}$)	1.87-2.04			B1, a=6.110	506, 515
$In_{0.95}Te$ ($n=1.47\times10^{-22}$)	2.5-2.7			B1, a=6.14	506, 515
InTe ($n=1.71\times10^{-22}$)	3.2-3.45			B1, a=6.16	506
InTe ($n=1.71\times10^{-22}$)	3.20-3.45			B1, a=6.177	470, 515
InTe			1.6	InTe(I)	507
$In_{1.015}Te$ ($n=1.67\times10^{-22}$)	3.25-3.51			B1, a=6.178	515
$In_{1.05}Te$ ($n=1.58\times10^{-22}$)	2.95-3.41			B1, a=6.181	515
$In_{1.10}Te$ ($n=1.45\times10^{-22}$)	2.55-2.80			B1, a=6.182	515
$In_{1.15}Te$ ($n=1.34\times10^{-22}$)	2.35-2.60			B1, a=6.179	515
In_2Te_3			1.0		515
In_3Te_4 ($n=0.47\times10^{22}$)	1.15-1.25			Rhomb., a=13.75, α=17.80	470, 515

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$In_{1.000}Te_{1.002}$ II	3.5-3.7	HF		B1, a=6.154	507
Ir ▽			0.3		503▽
Ir_2La	0.48++			C15, a=7.686	469
Ir_3La	2.46				469
Ir_3La_7	2.24			$D10_2$, a=10.235, c=6.473	469
Ir_5La	2.13				469
IrLu			0.32	B2, a=3.330	469
$IrLu_2$	0.84 (portion only)				469
$IrLu_3$			0.32		469
Ir_2Lu	2.47			C15, a=7.443	469
Ir_3Lu	2.89			C15, a=7.434	469
Ir_3Lu_7	0.78 (portion only)				469
$IrNb_3$			1.7	A15, a=5.1356	492
$Ir_{0.02}Nb_3Rh_{0.98}$	2.43			A15, a=5.131	492
$Ir_{0.05}Nb_3Rh_{0.95}$	2.38			A15, a=5.132	492
$Ir_{0.10}Nb_3Rh_{0.90}$			1.7	A15, a=5.1329	492
$Ir_{0.30}Nb_3Rh_{0.70}$			1.7	A15, a=5.1340	492
$Ir_{0.50}Nb_3Rh_{0.50}$			1.7	A15, a=5.1349	492
$Ir_{0.70}Nb_3Rh_{0.30}$			1.7	A15, a=5.1349	492
$Ir_{0.90}Nb_3Rh_{0.10}$			1.7	A15, a=5.1345	492
IrP			0.35		491
Ir_2P			0.35		491
IrS			0.32		552
$IrS_{2.6}$			0.32		552
IrSb			0.35		491
Ir_2Sb			0.35		491
IrSc			0.32	B2, a=3.205	469
$Ir_{0.32}Sc_{0.68}$			0.32		469
$IrSc_3$			0.32		469
Ir_2Sc	2.07			C15, a=7.347	469
$Ir_{2.5}Sc$	2.46			C15, a=7.343	469
$Ir_{2.5}Sc$	0.42+ (portion only)				469
$Ir_{2.5}Sc$	2.13++				469

\+ Beginning of transition of powdered sample
++ Powder transition

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure σ)	Ref.
Ir_3Sc			0.32		469
$IrSe_2$			0.32	Ortho-rhombic, a=20.94, b=5.93, c=3.74	552
$IrSe_{2.9}$			0.32		552
$IrSn_2$	0.65-0.78			C1, a=6.34	486
$Ir_{0.5}Te_{0.5}$	3.0^{+++}				552
$IrTe_2$			0.32	C6, a=3.930, c=5.393	552
$IrTe_3$	1.18			C2, a=6.413	552
IrTh	0.37^{+}			B_f, a=3.894, b=11.13, c=4.266	469
Ir_3Th	4.71				469
Ir_5Th	3.93			$D2_d$, a=5.315, c=4.288	469
IrV_3			0.35	A15	498
$Ir_{0.33}V_{2.67}$	1.39			A15	498
IrY_4			0.32		469
$Ir_{0.01}Y_{0.99}$	0.35 (portion only)				469
$Ir_{0.0175}Y_{0.9825}$	0.49^{+++} (portion only)				469
$Ir_{0.65}Y_{0.35}$	1.38			C15, a=7.525	469
$Ir_{0.69}Y_{0.31}$	1.98			C15, a=7.501	469
$Ir_{0.69}Y_{0.31}$	1.44^{++}			C15, a=7.501	469
$Ir_{0.70}Y_{0.30}$	2.16^{++}			C15, a=7.501-7.512	469
Ir_2Y	1.09			C15, a=7.518	469
Ir_2Y	2.18, 0.88			C15, a=7.500-7.520	469
Ir_2Y_3	1.61				469
$Ir_{3 \text{ or } 4}Y$	3.50				469
K			0.011		494
$K_{0.27-0.31}O_3W$	0.50			Hex., a=7.4, c=7.6	500
$K_{0.40-0.57}O_3W$	1.5			Tet., a=12.3, c=3.8	500
β-La	6.06			A1, a=5.29 (95% A1)	536
$LaPd_3$			0.32	$L1_2$, a=4.233	469
$LaPt_2$	0.46			C15, a=7.776	469
$La_{0.28}Pt_{0.72}$	0.54			C15, a=7.722	469

\+ Beginning of transition of powdered sample
++ Powder transition
+++ Beginning of transition

Material	T_c (°K)	H_o (oersted)	T_n**	Crystal Structure »	Ref.
$LaPt_5$			0.32	$D2_d$, a=5.386, c=4.376	469
$LaRh_2$			0.32	C15, a=7.646	469
$LaRh_3$	2.60				469
$LaRh_5$	1.62				469
La_7Rh_3	2.58			$D10_2$, a=10.145, c=6.434	469
La_3S_4 + additional compositions	6.5	HF		$D7_3$, a=8.73	534
LaSe			1.25		534
La_2Se_3			1.25		534
La_3Se_4 +additional compositions	8.6	HF		$D7_3$, a=9.05	534
LuRh			0.32	B2, a=3.334	469
$LuRh_2$			0.32	C15, a=7.404	469
$Lu_{0.275}Rh_{0.725}$	1.27			C15, a=7.355	469
$LuRh_5$	0.49				469
Lu_2Rh			0.32		469
Lu_3Rh			0.32		469
$Mn_{0.0028}Ti_{0.9972}$ (quenched)	2.6R				523
$Mn_{0.0028-0.04}Ti_{0.9972-0.96}$ (quenched from 1000°C)			1.1		523
$Mn_{0.0028-0.04}Ti_{0.9972-0.96}$ (quenched from 690°C)	~3.0R			pure α + pure β	523
$Mn_{0.01}Ti_{0.99}$	1.2				490
$Mn_{0.01-0.14}Ti_{0.99-0.86}$ (quenched from 1000°C)	<1.4				523
$Mn_{0.02}Ti_{0.98}$	1.7				477
$Mn_{0.02}Ti_{0.98}$ (quenched)	1.9				523
$Mn_{0-0.0065}Ti_y$			0.06		490
Mn_xTi_y	0.2-0.4				490
Mn_xTi_y					522
Mo	0.915-0.918	95			543#
Mo▽	~5			A2 + extra lines	503▽
Mo_3Si	1.3				474
Mo_3Sn			1.0	Cubic, a=3.165	509
Mo_3Sn (high pressure and temperature)			0.35	A15, a=5.094	509

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$Mo_{0.025}Ti_{0.975}$	1.8				477#
$Mo_{0.04}Ti_{0.96}$	2.0			b.c.c., ω + h.c.p.	477
Mo_xTi_y					522
NNb_x				B1	483
NNb^{∇} (sputtered)	6-9			B1	505∇
NNb_xO_y	13.5-17.0	HF		B1	483
$N_xNb_yZr_z$		HF			517
NTa^{∇} (sputtered)	4.84			B1	505∇
NTa_2^{∇} (sputtered)			1.2	Hex.	505∇
$Na_{0.2}O_3W$	0.55			Tet., a=12.1, c=3.7	500
$Na_{0.28-0.35}O_3W$	0.56			Tet., a=12.1, c=3.75	472
$Na_{0.10}O_3W$			0.040	Tet. II, a=5.2, c=3.9	500
Na_xO_3W			0.011	Perovskite, a=3.8	500
Nb		HF			538
Nb	9.22 + 9.25*	HF			544, 505, 525#, 531#
Nb^{∇}		HF			518∇
Nb^{∇} (2000-20000Å)	6.5-9.4				529∇
Nb^{∇} (420-6000Å)	6.70-9.11				505∇
Nb^{∇}	< bulk				503∇
NbO	1.25				481
Nb_3Os			1.7	A15, a=5.1359	492
$Nb_3Os_{0.02}Rh_{0.98}$	2.42			A15, a=5.134	492
$Nb_3Os_{0.05}Rh_{0.95}$	2.39			A15, a=5.132	492
$Nb_3Os_{0.10}Rh_{0.90}$	2.30			A15, a=5.1302	492
$Nb_3Os_{0.30}Rh_{0.70}$			1.7	A15, a=5.1315	492
$Nb_3Os_{0.50}Rh_{0.50}$			1.7	A15, a=5.1334	492
$Nb_3Os_{0.70}Rh_{0.30}$			1.7	A15, a=5.1345	492
$Nb_3Os_{0.90}Rh_{0.10}$			1.7	A15, a=5.1354	492
$Nb_3Pd_{0.02}Rh_{0.98}$	2.50			A15, a=5.133	492
$Nb_3Pd_{0.05}Rh_{0.95}$	2.49			A15, a=5.134	492
$Nb_3Pd_{0.10}Rh_{0.90}$	2.55			A15, a=5.1345	492
Nb_3Pt	10.9			A15, a=5.1547	492
$Nb_3Pt_{0.02}Rh_{0.98}$	2.52			A15, a=5.132	492
$Nb_3Pt_{0.05}Rh_{0.95}$	2.53			A15, a=5.133	492

* Residual Resistivity Ratio = ~500

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$Nb_3Pt_{0.10}Rh_{0.90}$	2.8			A15, a=5.1336	492
$Nb_3Pt_{0.30}Rh_{0.70}$	5.1			A15, a=5.1395	492
$Nb_3Pt_{0.50}Rh_{0.50}$	6.25			A15, a=5.1450	492
$Nb_3Pt_{0.70}Rh_{0.30}$	7.4			A15, a=5.1487	492
$Nb_3Pt_{0.90}Rh_{0.10}$	7.9			A15, a=5.1534	492
$Nb_3Pt_{0.95}Rh_{0.05}$	8.9			A15, a=5.160	492
$Nb_3Pt_{0.98}Rh_{0.02}$	9.6			A15, a=5.157	492
Nb_3Rh	2.64			A15, a=5.1317	492
$Nb_3Rh_{0.90}Ru_{0.10}$	2.44			A15, a=5.1346	492
$Nb_3Rh_{0.95}Ru_{0.05}$	2.42			A15, a=5.135	492
$Nb_3Rh_{0.98}Ru_{0.02}$	2.42			A15, a=5.132	492
Nb_3Sn	18.0			A15, a=5.289	473
Nb_3Sn (quenched)	4-16.7			A15	498
Nb_3Sn (sintered)		HF			485
$Nb_{0.5-0.83}Sn_{0.5-0.17}$ (as cast)	17.6M				479
$Nb_{0.5-0.83}Sn_{0.5-0.17}$ (annealed)	17.95M				479
$NbSnTa_2$	10.8			A15, a=5.280	473
Nb_2SnTa	16.4			A15, a=5.289	473
$Nb_{2.5}SnTa_{0.5}$	17.6			A15	473
$Nb_{2.75}SnTa_{0.25}$	17.8			A15	473
NbSnTaV	6.2			A15, a=5.175	473
$Nb_2SnTa_{0.5}V_{0.5}$	12.2			A15	473
$NbSnV_2$	5.5			A15, a=5.115	473
Nb_2SnV	9.8			A15, a=5.171	473
$Nb_{2.5}SnV_{0.5}$	14.2			A15	473
$Nb_{0.10}Ta_{0.90}$		HF			478
$Nb_{0.5}Ta_{0.5}$	6.25				544
$Nb_{0.025}Ti_{0.975}$	1.5			Hex.	499
$Nb_{0.04}Ti_{0.96}$					477#
Nb_xTi_y					522
Ni			0.35		270
Np			0.41		495
$O_3Rb_{0.27-0.29}W$	1.98			Hex., a=7.4, c=7.6	500

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure [20]	Ref.
OTi	0.58				481
$PPd_{3.0-3.2}$	<0.35-0.7			DO_{11}	491
$PPd_{3.0}$				DO_{11}, a=5.18, b=6.00, c=7.46	491
P_2Pd				Monoclinic, a=6.20, b=5.857, c=5.874, β=111.80°	491
P_3Pd_7 (high temperature)	1.00			Rhombohedral, a=7.28, α=110.12°	491
P_3Pd_7 (low temperature)	0.70			Complex	491
P_7Pt_{20}			0.35		491
PRh_2	1.3			C1, a=5.516	491
PRu			0.35		491
PRu_2			0.35		491
Pa	1.4			Tet., a=3.925, c=3.238	504
Pb	7.19				476#
$PbRh_2$			0.32		489
PdS			0.35		491
$Pd_{2.2}S$ (quenched)	1.63			Cubic, a=8.93	491
$Pd_{2.8}S$			0.35		491
Pd_4S			0.32	Tet., a=5.1147, c=5.5903	552
$PdSb_2$			0.35		491
$Pd_{0.63}Sb_{0.37}$ (quenched)			0.35		491
$PdSc_2$			0.32	$E9_3$, a=12.442	469
PdSe			0.32	B34, a=6.727, c=6.912	552
Pd_4Se	0.42			Tet., a=5.2324, c=5.6470	552
$Pd_{6 \text{ or } 7}Se$	0.66			Similar to Pd_4Te compound	552
$Pd_{17}Se_{15}$			0.32	Cubic, a=10.606	552
PdSn	0.41			B31, a=3.87, b=6.13, c=6.32	491
Pd_2Sn	0.41			C37, a=8.12, b=5.65, c=4.31	491
Pd_3Sn_2	0.47-0.64			$B8_2$, a=4.399, c=5.666	491
PdTe	3.85			$B8_1$, a=4.152, c=5.670	552#
$PdTe_{1.02}$	2.56			$B8_1$, a=4.144, c=5.661	552
$PdTe_{1.04}$	2.11			$B8_1$, a=4.143, c=5.659	552#
$PdTe_{1.06}$	2.11			$B8_1$, a=4.138, c=5.652	552
$PdTe_{1.08}$	1.88			$B8_1$, a=4.135, c=5.647	552

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$PdTe_2$	1.69			C6, a=4.036, c=5.132	552
$PdTe_{2.1}$	1.89			C6, a=4.037, c=5.128	552
$PdTe_{2.3}$	1.85			C6, a=4.037, c=5.127	552
$Pd_{1.1}Te$	4.07			$B8_1$, a=4.152, c=5.671	552
$Pd_{0.71}Te_{0.29}$	0.40			X-ray evidence of Pd_3Te, $Pd_{2.5}Te$ and Pd_2Te	552
Pd_3Te	0.76			X-ray evidence of Pd_3Te, $Pd_{2.5}Te$ and Pd_2Te	552
Pd_4Te			0.32	Cubic, a=12.674	552
$PdTh_2$	0.85			C16, a=7.33, c=5.93	469
Pd_5Th			0.32		469
Pd_3Y			0.32	$L1_2$, a=4.076	469
Pt▽			0.3		503▽
$Pt_{0.87}S_{0.13}$				B17-type + Pt	552
PtSc			0.32	B2, a=3.268	469
$PtSc_4$			0.32		469
Pt_3Sc			0.32	$L1_2$, a=3.958	469
$Pt_{0.87}Se_{0.13}$				Monoclinic $PtSe_{0.80}$ + Pt	552
PtSn	0.37			$B8_1$, a=4.11, c=5.44	486
$PtSn_2$			0.34	C1, a=6.42	486
PtTe	0.59			Ortho-rhombic, a=6.6144, b=5.6360, c=11.865	552
PtTh	0.44			B_f, a=3.900, b=11.09, c=4.454	469
Pt_3Th_7	0.98			$D10_2$, a=10.126, c=6.346	469
Pt_2Th			0.32		469
Pt_3Th			0.32		469
Pt_4Th			0.32		469
Pt_5Th	3.13				469
$PtV_{2.5}$	1.36			A15	498
PtV_3	2.83			A15	498
$PtV_{3.5}$	1.26			A15	498
$Pt_{0.42}Y_{0.58}$	0.76*, 0.33+++				469

* Probably associated with Y_3Pt_2
+++ Beginning of transition

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
$Pt_{0.77}Y_{0.23}$	1.80 (portion only)				469
$Pt_{0.80}Y_{0.20}$	1.96 (portion only)				469
$Pt_{0.77-0.80}Y_{0.23-0.20}$	1.6-2.0 (portion only)				469
PtY			0.32		469
Pt_2Y_3	0.90				469
$Pt_{2.2}Y$	1.70			C15, a=7.576	469
Pt_3Y			0.32	Ll_2, a=4.075	469
Pt_3Y_7	0.82			$D10_2$, a=9.864, c=6.299	469
Pt_5Y			0.32		469
Pu			0.50		495
Rb			0.011		494
Re ▽	1.9-~7				503 ▽
Re_xTi_y					522
Rh ▽			0.3		503 ▽
$RhSc_4$			0.32		469
$Rh_{0.24}Sc_{0.76}$	0.92 (portion only)				469
$Rh_{0.25}Sc_{0.75}$	0.88 (portion only)				469
$Rh_{0.32}Sc_{0.68}$			0.32		469
Rh_3Sc			0.32	Ll_2, a=3.898	469
$Rh_{0.67}Te_{0.33}$	0.49				552
RhTh	0.36			B_f, a=3.866, b=11.24, c=4.22	469
Rh_2Th			0.32		469
Rh_3Th			0.32	Ll_2	469
Rh_5Th	1.07				469
Rh_xTi_y					522
RhY			0.32	B2, a=3.410	469
RhY_2			0.32		469
RhY_3	0.65				469
Rh_2Y			0.32	C15, a=7.489	469
Rh_2Y_3	1.48				469
Rh_3Y	1.07			C15, a=7.424	469
Rh_3Y_7			0.32	$D10_2$, a=9.793, c=6.196	469

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure	Ref.
Rh_5Y	0.56				469
RuS_2			0.32	C2, a=5.609	552
RuSb			0.35		491
Ru_2Sb			0.35		491
$RuSe_2$			0.32	C2, a=5.934	552
$RuTe_2$			0.32	C2, a=6.391	552
Ru_xTi_y					522
Sb *	2.6-2.7	HF			520
SbSn	1.30-1.42, 1.42-2.37			B1 or distorted B1	470
$Sb_{0.01}V_{0.99}$	3.76			A2	514#
$Sb_{0.02}V_{0.98}$	3.29			A2	514#
$Sb_{0.03}V_{0.97}$	2.63			A2	514#
Se (~130 kbar)	6.75 + 6.95			Se II (unknown)	547
Si (~120-130 kbar)	7.1				540
αSi_2Th	3.2				474
βSi_2Th	2.4				474
Si_2Ti				C54, a=8.252, b=4.783, c= 8.540	522
Si_3Ti_5				$D8_8$, a=7.475, c=5.162	522
SiV_3	17.1				474
$Si_{0.1-0.38}V_{0.99-0.62}$ (as cast)	16.7M				479
$Si_{0.1-0.38}V_{0.99-0.62}$ (annealed)	16.95M				479
Si_2W_3	2.8				474
β-Sn (quenched)	3.7			Tet., a=5.819, c=3.175	539
Sn▽					516▽, 532▽
$SnTa_3$	6.4			A15, a=5.278	473
$SnTaV_2$	2.8			A15, a=5.041	473
$SnTa_2V$	3.7			A15, a=5.174	473
Sn_xTe_y (n=10.5-20x10^{20})	0.07-0.22			B1	482
$Sn_{0.02}V_{0.98}$	2.87			A2	514#
$Sn_{0.04}V_{0.96}$	1.86			A2	514#
$Sn_{0.057}V_{0.943}$	~1.6			A2	514#

* Formed at 120 kbar, pressure removed at 77°K.

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
SnV_3	3.8			A15, a=4.96	473
Ta	4.48				505
Ta		HF			519
Ta					525
Ta▽ (1100-<5000Å)	3.25-4.30				505▽,529▽
Ta▽	≮bulk				503▽
$Ta_{0.025}Ti_{0.975}$	1.3			Hex.	499
$Ta_{0.05}Ti_{0.95}$	2.9			Hex.	499
Ta_xTi_y					522
$Tc_{0.05}W_{0.95}$			~0.8	Cubic, a=3.1617	524
$Tc_{0.10}W_{0.90}$	1.25			Cubic, a=3.1553	524
$Tc_{0.20}W_{0.80}$	3.85			Cubic, a=3.147	524
$Tc_{0.30}W_{0.70}$	5.75	HF		Cubic, a=3.134	524
$Tc_{0.40}W_{0.60}$	7.18	HF		Cubic, a=3.126	524
$Tc_{0.50}W_{0.50}$	7.52	HF		α + trace σ, a=3.117	524
$Tc_{0.60}W_{0.40}$	7.88	HF		trace α + σ, @α-a=3.117, @σ-a=9.520, c=5.003	524
Te (~56,000 atm.)	~3.3				510
Th	1.4				504
Ti	0.14				523
Ti	0.42	56			490#
Ti					477#
TiU_2				C32, a=4.82, c=2.84	522
$Ti_{0.70}V_{0.30}$	6.14			Cubic	514#
$Ti_{0.96}V_{0.04}$	2.7				477#
$Ti_{0.975}V_{0.025}$	1.4			Hex.	499
TiV					522
$Ti_{0.5}Zr_{0.5}$ (annealed)	1.23				477
$Ti_{0.5}Zr_{0.5}$ (quenched)	2.0				477
Tl	2.38	176.5			527#
U	1.8			Cubic	504
V	5.31*	HF			548
V					525

* Residual Resistivity Ratio = 27

Material	T_c (°K)	H_o (oersteds)	T_n**	Crystal Structure ∞	Ref.
W	0.012	1.070			493
W	0.005-0.011	~1			526
W▽ (various films)	0.4-3.35		0.012	A15 (when superconductive)	503▽
W▽ (~20-310Å)	4.1M				541▽
Zr	0.65			Hex., ω-Zr, a=5.03, c=3.12	549
Zr (annealed)	0.6			ω-Zr converted to α-Zr	549
Zr	0.70 + 0.73			α-Zr	549
Zr (annealed)	~0.46				551

Table 3. High Magnetic Field Superconductive Materials and Some of Their Properties

(NOTE: All fields are quoted in kilo-oersteds. T_{obs} indicates temperature of measurement in degrees Kelvin. See text for discussion of field nomenclature.)

Material	T_c	H_{c1}	H_{c2}	H_{c3}	T_{obs}	Ref.
Be ▽	~6.5		$\gg$11			550▽
Bi II, Bi III		(High field data given)				437
C_8K (Excess K)	0.55		0.160 (H⊥C)		0.32	494
	0.55		0.730 (H∥C)		0.32	494
C_8K (Stoichiometric)	0.39		0.025 (H⊥C)		0.32	494
	0.39		0.250 (H∥C)		0.32	494
$In_{1-0.90}Pb_{0-0.1}$	0.7-1.1	($H_{c2,3}$ measured but quoted in ratio form)				480
$In_{1.000}Te_{1.002}$ II	3.5-3.7		1.2		0. (extrapolated)	507
La_3S_4	6.5	0.15	>25		1.3	534
La_3Se_4	8.6	0.2	>25		1.25	534
NNb_xO_y	13.5-17.0	(H_{c2} - some samples <38 kgauss)				483
$N_xNb_yZr_z$			>130		4.2	517
Nb	9.15		1.710		4.2	531
	9.15		2.020		1.4	531
Nb (unstrained)	1.1-1.8		3.40	6.0-9.1	4.2	538
Nb (strained)	1.25-1.92		3.44	6.0-8.7	4.2	538
Nb (cold drawn wire)	2.48		4.10	≈10	4.2	538
Nb▽			> 25		4.2	518▽
Nb_3Sn (sintered)		(Critical current density fields quoted)				485
$Nb_{0.10}Ta_{0.90}$		0.084	0.154		4.195	478
Sb*	2.6-2.7		4.4		1.55	520
Ta (99.95%)		0.090	0.375		3.72	519
		0.275	1.175		2.66	519
		0.325	1.425		2.27	519
		0.425	1.850		1.30	519
$Tc_{0.30}W_{0.70}$	5.75		7.5		4.2	524
$Tc_{0.40}W_{0.60}$	7.18		19.0		4.2	524
$Tc_{0.50}W_{0.50}$	7.52		29.0		4.2	524
$Tc_{0.60}W_{0.40}$	7.88		43.5		4.2	524
V	5.31	~0.80	~3.40		1.79	548
	5.31	~0.75	~3.15		2.	548
	5.31	~0.45	~2.20		3.	548
	5.31	~0.30	~1.20		4.	548

* Formed at 120 kbar, pressure removed at 77°K.

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