NBS TECHNICAL NOTE

464

The NBS Alloy Data Center:

Function, Bibliographic System, Related Data Centers, and Reference Books

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards

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NATIONAL BUREAU OF STANDARDS • A. V. Astin, Director

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ABSTRACT

The Alloy Data Center, part of the National Standard Reference Data System, has two primary functions. One is to stimulate cooperation and coordination among the existing data centers in the area of the physical properties of well characterized alloys. The final data generated by these centers for publication should be consistent with one another where correlation or possible overlap exists. The other purpose is the collection (from publications as well as private communications), evaluation, and publication of data in some areas where special competence exists in the Alloy Physics Section. Of interest to the center are metals, semimetals, intermetallic compounds, and alloys. Excluded are those materials which have ill-defined constitutions and heat treatments. An automated system has been developed to meet the bibliographic needs of the center. This system will be described as well as the specific properties of interest. The system presently contains a complete annotated file on papers dealing with NMR Knight shift measurements. The soft X-ray spectroscopy compilation is being kept up-to-date with the same system.

Key words: alloys; annotation; automated; bibliography; data; indexing; information; Knight shifts; metals; NMR; soft X-ray spectroscopy.

INDEX

Table of Lists

List of Figures

INTRODUCTION

In the introductory paragraph of Chapter 18, "Theory of Alloys", of his more recent book, Quantum Theory of Solids (1), C. Kittel writes:

> "Many interesting practical and intellectual problems arise when a solid solution of one element in another is prepared. We can ask a number of questions about the alloy, including solubility limits, energy of solution, lattice dilation, electrical resistivity, magnetic moment, magnetic coupling, Knight shift, nuclear quadrupole broadening, and superconducting properties (energy gap, transition temperature, critical field). ..."

The Alloy Data Center (2) is concerned with the type of property indicated above: properties which can be understood through application of the modern theory of the electronic structure of metals and alloys, including descriptions of their density of states, Fermi surfaces, and band structures.

There are two reasons for the establishment of the Alloy Data Center under the NSRDS. One is to maintain an awareness and to stimulate communication and exchange of information between already existing Data Centers (the final data generated by the Centers for publication should be consistent with one another where correlation or possible overlap exists). The other is the collection and evaluation of data in those fields where special competence exists within the Alloy Physics Section. The Alloy Data Center is part of the Alloy Physics Section within the Metallurgy Division of the National Bureau of Standards. Areas in which the Section is carrying out programs of active research are: nuclear magnetic resonance (NMR), ferromagnetic nuclear resonance, soft X-ray spectroscopy, Mössbauer effect, low temperature measurements of specific heat and susceptibility, and other magnetic properties. Where data compilation programs are already in existence elsewhere, duplication is avoided. At the Alloy Data Center documents have been compiled for NMR in metals and alloys. All documentation on experimental Knight shift results is complete and up-to-date. An annotated bibliography on soft X-ray spectroscopy (3) has already been prepared in the Alloy Physics Section at an earlier date and this compilation is also being kept current by our Center. The Knight shifts are now being evaluated for publication. Other NMR parameters may be evaluated at a later date. The evaluation of the soft X-ray spectra will be underway shortly.

A single bibliographic system was designed to be an effective tool for aiding us with our tasks. The main object of this Note is to give a detailed description of the automated system, as it may be used directly by others who intend to maintain files of documents in this area. The system can also be used very effectively for the documentation of papers not directly within our scope of properties, but remaining within our scope of materials, using a modified thesaurus, while the structure and most of the coding (4) as well as the computer programs (5) can be left unaltered. Other data groups dealing with metals and alloys, who make use of our system for the storage and retrieval of their own documents, could have our files added onto their magnetic tapes for their use. Our current List of Properties is strongly oriented towards the storage and retrieval of papers dealing with experimental results or papers with direct bearing on experimental results. The automated bibliographic system also has built into it a method for bringing together papers in related fields. This is an important feature for data evaluators in that it facilitates a check on the internal

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1. C. Kittel, Quantum Theory of Solids, John Wiley & Sons, New York, 1963.
2. In operation since April 1966 as part of the National Standard Reference Data System.
3. H. Yakowitz and J. R. Cuthill, "Annotated Bibliography on Soft X-ray Spectroscopy", National Bureau of Standards Monograph 52, U. S. Government Printing Office, 1962. This compilation is being kept up-to-date.
4. Appendix C of this paper gives a list of journal abbreviations used by the Alloy Data Center (ACS standard abbreviations are generally adhered to; unpublished information is referenced in the system as well).
5. Appendix D of this paper gives the main programs used by the Center.

consistency between tables of different properties.

In general, the type of materials of interest to the Alloy Data Center is in accord with the policy of the National Standard Reference Data System as is set forth in the NSRDS-NBS 1 publication, "Plan of Operation" (6):

> "Operationally, these guidelines [establishing the scope of the NSRDS] shall not be concerned with the compilation of data relating to systems of uncertain, variable, or uncontrollable composition nor of data that are sensitive to unknowable details of the structure of the material. This principle carries with it the corollary that the system or material may be well-defined for one property but not for another. In putting this principle into practice, the program of the NSRDS must include careful examinations of the available data in a variety of fields in order to determine whether the data are appropriate for systematic compilation activities; that is, a critical review of quantitative knowledge is first required.
>
> Application of the general guidelines also leads to the exclusion from the NSRDS of data whose values depend upon both the system or substance being measured and the measuring technique itself - in other words, data which are not characteristic of intrinsic properties of the system or substance. ..."

The Alloy Data Center does not intend to acquire in its data files all information on all the well-defined properties, but rather, it intends to maintain an awareness of the existing data centers (7) and existing data compilations (8) that fall within this broad scope. This is in harmony with one of the objectives of the NSRDS as indicated on page 3 of the above named report (6):

> " ..The general objective of this system is to coordinate and integrate existing data compilation and evaluation activities into a systematic program, supplementing and expanding technical coverage when necessary, establishing and maintaining standards for the output of the various groups, and providing mechanisms for the dissemination of the output as required. ..."

SCOPE

Both an experimental point of view and the present theory of metals and alloys have pointed to the inclusion in our program of the materials and properties described below.

Materials. Metals, semimetals, intermetallic compounds, and alloys consisting of two, three, and sometimes more components are of interest. In the last few years there has been an increased interest in the physical behavior of ternary and quaternary systems. All the materials to be included are the well-defined and well-characterized metals and alloys. Specifically we exclude materials which have ill-defined constitutions or heat treatments. and from which we cannot derive information on the physical properties which describe the material. Though in our scope semiconductors are not included, often some work on these materials may shed some light on other materials within our scope so that some of the more important papers are also included. Some materials are semiconducting in one phase and metallic (including superconducting) in other phases. We are generally concerned only with the metallic phases. High pressure phases are similarly included.

6. E. M. Brady and M. B. Wallenstein, NSRDS-NBS 1, available for 15 cents from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, and from the Clearinghouse, U. S. Department of Commerce, Springfield, Virginia 22151
7. Appendix A of this Technical Note gives a listing of Data Centers within our general scope, indicating which properties they evaluate.
8. Appendix B of this Technical Note gives a listing of data compilations and tables of properties within our general scope, listing these under "Basic Handbooks", "Property Category" or "Metal or Alloy".

Properties. Physical properties of different character can be distinguished:

a) Those of specific definition where the property is a direct result of the experimental technique. Examples are: Knight shift in nuclear magnetic resonance, isomer shift in the Mössbauer effect, Verdet constant in the Faraday rotation.

b) Those of specific definition, where one may arrive at values of that property through different experimental techniques. Examples are: density, various transition temperatures, Fermi surface parameters.

c) Those of specific definition but peculiar to several different types of experiments and therefore of different meaning. Examples are: linewidths and line shapes as in different types of spectroscopy and resonance experiments, relaxation times, transition probabilities.

d) Those which themselves have no importance for our evaluation or which have no unique values associated with them. However, they are included as properties because they have a bearing on the properties which will be evaluated. We have given them names of general designation rather than specific meaning and these names are used for clarity in indexing and ease of retrieval. Examples for the elemental metals are: residual resistivity, mean free path, resistivity ratios. More general examples: interfacial phenomena such as properties of solid-liquid interfaces, grain boundary energies, etc.; effects of dislocations or sample irradition on various physical properties; state of the sample, e.g. superconducting or metastable.

LIST OF PROPERTIES AND ITS FUNCTION AS A THESAURUS

We have made a list of all the properties for which we want to maintain a general awareness. This list includes those properties for evaluation and tabulation (a,b,c above) and those few that help in clarity of indexing (d). We have not separated these from one another in importance, but rather have brought properties belonging to similar topics together to form "categories". In so doing we have occasionally listed a property which may fall under more than one category under both topics. These are redundancies, but often result in effective searching. Since the List of Properties is highly controlled, we can afford to deviate from our general rules whenever this is of particular use to us.

The resulting List of Properties is described in the following paragraph and given in List #1. The List was used for one year as an indexing tool and is continually modified as seen necessary. Category 9, dealing with soft X-ray spectroscopy, and the nuclear magnetic resonance (NMR) section of Category 4 (involving 4A through 4K and 4R) are the only two in which we are doing complete literature searches at present, and for this reason these categories are developed in more detail than the others. Those categories for which other Data Centers are known to be actively compiling documents are developed only to the extent that is useful to us as general awareness. We have indicated in List #1 those properties which are, to our knowledge, being compiled elsewhere. A compilation of other data activities including information on the listed properties is given in Appendix A. As the Alloy Data Center expands the areas in which it performs critical evaluations or as it gains cooperation with other data groups in the fields where it is presently only maintaining awareness, the List will be altered and improved to the extent needed for proper, detailed indexing of such material. The List is, therefore, subject to changes within the structure of the system. It should be noted that although the properties given in this List are not of value to data groups interested in other topics, the same method of structuring by categories and assignment of indexing codes can be applied for other subject fields and property contents.

The letters omitted in the List are open for future expansion. This List of Properties forms our working thesaurus or keyword index. The "code" of the property is given by the "Category number" followed by the letter which precedes the property (e.g. for electrical resistivity, B, under Category 1, the code is 1B).

List #1

List of Properties

The code of the property is the category number followed by the alphabetic symbol at the left of the property. The numbers following the properties refer to those Data Centers listed in Appendix A which have compiled evaluated data on these properties (a #10 corresponds to the Alloy Data Center). The deleted letters are open for future assignment.

Category 1
ELECTRONIC TRANSPORT PROPERTIES (ETP).

A. Temperature coefficients of resistivity.
B. Electrical resistivity; conductivity. 1, 2, 3, 5
C. Thermal conductivity; anharmonic force constants. 1, 2, 3, 5
D. Residual resistivity; mean free path; resistivity ratios. 2
E. Effective number of charge carriers; number of electrons; number of holes. 2
F. Ferromagnetic anisotropy of magnetoresistance.
(Magnetoresistance, see Category 5).
H. Hall coefficients, R, R_O; R_S. 2
I. Peltier coefficient, π. 2
J. Ettingshausen-Nernst effect. 2
K. Thompson coefficient. 2
L. Lorentz number, Wiedemann-Franz ratio.
M. Mobility; drift velocity. 2
P. Ettingshausen coefficient, P. 2
Q. Nernst coefficient, Q_N. 2
S. Righi-Leduc coefficient, S. 2
T. Thermoelectric power, Seebeck effect. 2

Category 2
MAGNETIC PROPERTIES (MAG).

B. Electronic magnetic moment; effective number of Bohr magnetons (including neutron diffraction results and moments of clusters). (See NEU)‡ 3
C. Curie constants. 2
D. Néel point; Morin transition; other magnetic transitions; etc. (except 2T, below). 2, 3, 6, 7, 11
E. Residual inductance; coercive force. 2
F. Remanent magnetization; saturation remanence; etc. 2
G. $(HB)_{max}$; hysteresis. 2
H. Total energy loss; loss angle; eddy current losses; quality factor, Q. 2
I. Saturation magnetization; saturation moment; intrinsic moment ($\neq$ 2B). 2, 3
J. Magnetic exchange energy of electrons, J.
K. Magnetostrictive coupling constant, K (both isotropic and anisotropic). 2
L. Molecular field coefficient, Weiss constant.
M. Magnetocrystalline anisotropy constant. 2
N. Magnetocaloric or magnetothermal effect (oscillatory under 5K).
O. Electrostrictive mechanical coupling coefficient; magnetoelectric properties. 2
P. Permeability: initial; effective; maximum; reversible. 2
Q. Elastoresistance.
R. Magnetomechanical damping; magnetoelastic effect; (magnetomechanical properties). 2
T. Curie temperature: paramagnetic, ferromagnetic. 2, 3, 6, 7, 11
X. Susceptibility (magnetization); antiferromagnetic susceptibility. 2, 3,

Ferromagnetic Kerr effect, see under 6M.

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‡See List #3 for a list of techniques and their abbreviations.

Category 3
MECHANICS (MEC).

A. Atomic volume; atomic radius.
B. Stacking faults and other interfacial phenomena, such as grain boundary energies; properties of solid-liquid interfaces; etc.
C. Viscosity. 5
D. Density. 3, 5, 9
E. Acoustic and ultrasonic attenuation. (See ACO)‡ 9
F. Acoustic impedance. (See ACO)
G. Elastic properties. 9
H. Young's modulus (modulus of elasticity in tension or compression), E; compressibility, β. 9
I. Bulk modulus, K. 9
J. Shear modulus, shearing modulus; torsion modulus; modulus of rigidity, G. 9
K. Poisson's ratio, σ. 9
L. Elastic constants, c_{ij}'s (elastic stiffness parameter, elastic coefficients); s_{ij}'s (elastic compliances). 9
M. Compliances. 9
N. Structure-sensitive properties (e.g. effect of dislocations, irradiation, etc. on physical properties).
O. Lattice parameters, lattice constants, cell dimensions (including c/a ratios); space groups; superlattice formation. (See XRA, NEU, etc.)‡ 3, 7, 8
P. Unpaired spin density; local nuclear magnetic moments; nuclear polarization. (See NPL, OVR, etc.)‡
Q. Electron probability density, charge density.
R. Phonon spectra.
S. Spin wave spectra. (See SPW)‡
T. Scattering factors.
U. Form factors; structure factors.
V. Sound velocity. 9

Category 4
NUCLEAR AND OTHER RESONANCE PROPERTIES (NMR, EPR, etc.).

A. Line width.(for all spectroscopic techniques).
B. Line shape; line intensity; enhancement factor.
C. Hyperfine field, internal field, effective field at the nucleus, etc. (no Knight shifts). (See FNR or MOS)‡ 11
E. Electric field gradient at the nucleus; electric quadrupole coupling constant. 11, 12
F. Spin-lattice relaxation time, T_1, longitudinal relaxation time, thermal relaxation time. (See NMR)
G. Spin-spin relaxation time, T_2, transverse relaxation time, spin-phase memory time. (See NMR)
H. Nuclear g-factor; nuclear magnetic moment (dipole, quadrupole, etc.). 12
J. Spin echoes.
K. Knight shift. (See NMR) 3, 10
L. Chemical shift. (See NMR) (This is not a metallic property, but is important in Knight shift, 4K, data evaluations).
M. Spin diffusion.
N. Isomer shift. 3, 11
O. Debye-Waller factor. (See MOS or XRA) 4, 11
P. Ferromagnetic shift. (See FER)
Q. Electronic g-values and shifts; spectroscopic splitting factors. 2, 3
R. Nuclear coupling constants, R-K, A_{ij}, A_z; hyperfine interaction constant; antishielding factors.
T. Exchange stiffness parameter. (See FER)
X. Scattering cross-sections (including electronic, spin-flip, etc.). 2, 11

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‡See List #3 for a list of techniques and their abbreviations.

Category 5
QUANTUM DESCRIPTION OF SOLIDS (QDS).

A. Fermi velocity; Fermi momentum. 2
B. Band structure. 2
C. Cyclotron resonance frequency. 2
D. Density of states. 2
E. Effective mass (as determined by different methods). 2
F. Fermi surface; energy surface dimensions. 2
G. Anomalous skin effect. 2
H. de Haas-van Alphen effect. 2
I. Magnetoresistance (non-oscillatory). 2
J. Magnetic breakdown; magnetic breakthrough.
K. Shubnikov-de Haas effect (oscillatory magnetoresistance). 2
L. Oscillatory magnetostriction; oscillatory magnetocaloric effect; other oscillatory effects not listed elsewhere.
M. Magnetoacoustic effect, geometric resonance. 2
N. Screening parameter, α_{eff}.
O. Volume per electron; radius per electron, r_s.
P. Positron annihilation. (See POS)‡
Q. Angular correlation or anisotropy of emitted γ- rays.
S. Madelung constant; cohesive energy; electrostatic interaction energy.
T. Various quantum numbers: total electronic angular momentum, J, etc. 12
U. Electronic transitions (excluding single-particle transitions, which are listed under 6T); semimetal-to-metal transitions; Mott transitions; energy gaps. 2
V. Binding, or dissociation energies, including those for foreign particles, pairs, vacancies, etc.
W. Wave functions of electrons in metals.
X. Crystal field splitting; exchange interaction energies and splitting; other characteristic energies of electronic states. 2
Y. Relaxation times, electronic or other; all except T_1 (4F) and T_2 (4G) - this code includes the cross-relaxation time, T_{12}. 2

Category 6
ELECTROMAGNETIC RADIATION (RAD).

A. Absorptivity. 2, 4, 5
B. Emissivity (normal spectral). 2, 4, 5
C. Reflectivity. 2, 4, 5
D. Percent reflectance of (polished) metal.
E. Extinction coefficient, $K(\lambda)$. 2
F. Fermi edge energy.
G. Photoemission spectra. (See PES) 2
H. Secondary emission yield. 2
I. Index of refraction, $n(\lambda)$. 2
J. Impedance; reactance (for acoustic impedance, see 3F).
L. L·S splitting of energy levels. (See also 4Q)
M. Magneto-optical constants; magneto-optical rotation; Kerr effect (also ferromagnetic); magneto-reflectance; Faraday rotation; saturation rotation; Verdet constant.
N. Extinction potential.
O. Absorption edge energy. (See SXS)‡ 2
P. Peak energy. (See SXS)
Q. Field emission.
R. Edge shift versus specimen orientation. (See SXS)
S. Edge shift versus chemical composition. (See SXS)
T. Transition probability.
U. Energy level. 2
W. Work function: thermionic; photoelectric; contact potential. 2
Note: for line width, see 4A; for line shape, see 4B.

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‡See List #3 for a list of techniques and their abbreviations.

Category 7
SUPERCONDUCTIVITY (SUP).

A. a of } $\frac{C_{es}}{\gamma T_c} = a \exp\left(\frac{-bT_c}{T}\right)$, where C_{es} is the electronic specific heat in the superconducting state and γ is the coefficient of the linear term of the specific heat in the normal state.
B. b of }
D. Skin depth, penetration depth. 2
E. Energy gap for superconducting electrons; order parameter.
F. Penetration depth of electron pairs, λ. 2
G. Flux lines; flux flow; structure of flux lines.
H. Critical field, H_c; H_{c1}; H_{c2}; H_{c3}. 2, 3, 4
J. Critical current, I_c.
K. Landau-Ginzburg constant, K, κ.
M. Magnetization in superconductors.
S. Superconducting state (to be used only when essential for clarity).
T. Critical temperature, T_c. 2, 3, 4
V. Electron-electron interaction parameter, V; (multiplied by the density of states = $N(E_F)V$).
X. Coherence distance, ξ_o, range of coherence, correlation length.

Category 8
THERMODYNAMICS (THE).

A. Heat capacity, specific heat, C_v, C_p. 1, 3, 4, 5, 14, 17, 20, 21
B. Nuclear hyperfine structure; spin specific heat (of ions in materials, etc.), nuclear specific heat.
C. Electronic specific heat. 2, 21
D. Magnetic specific heat.
E. Stark and other specific heats.
F. Phase transformations and diagrams. 6, 15, 20, 21
G. Melting point. 5, 6, 20, 21
H. Boiling point. 20, 21
I. Latent heats. 5, 20, 21
J. Entropy of mixing; heat of solution. 20, 21
K. Entropy (other); enthalpy, heat content; Gibbs free energy, Helmholtz free energy; etc. 14, 20, 21
L. Cohesion energy. 21
M. Solubility. 6, 20
N. Vapor pressure; evaporation; sublimation. 5, 20, 21, 22
O. Thermal expansion. 1, 3, 5, 7
P. Debye temperature. 4, 11
Q. Diffusion. (See DIF)‡ 16, 18
R. Activation energy. (See DIF) 2, 16
S. Diffusion constant. (See DIF) 2, 16
T. Fermi-Dirac degeneracy temperature.
U. Order-disorder; clustering. 6, 21.

Category 9
SOFT X-RAY SPECTROSCOPY (SXS).

A. Absorption spectra. 10
B. Absorption coefficient.
C. Optical constants; dielectric constants. 2
D. Characteristic energy losses of electrons.
E. Emission spectra. 10
F. Fine structure.
G. Fluorescence yield (spectra).
I. Intensity determinations.

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‡See List #3 for a list of techniques and their abbreviations.

K. K - spectra. 10
L. L - spectra. 10
M. M - spectra. 10
N. N - spectra. 10
O. O - spectra. 10
P. P - spectra. 10
S. Satellites.
T. Auger transition.
U. Ion neutralization spectra. (See INS)‡
V. Coster-Kronig transition.

Zero Descriptors. In addition to the physical properties listed in these nine categories we have included a miscellaneous set of descriptors which have proven to be very important in indexing and are employed as all the properties are. These are similar in function to the properties described above under type (d). They are designated by a zero followed by the appropriate letter under which they are given in the table of so-called Zero Descriptors (List #2). It is important to keep in mind when these descriptors are used that they mean "also measured under that condition" and not necessarily "only measured under that condition."† The description of these indexing terms should be sufficient as it appears on the List.

List #2

Zero Descriptors

OD: Data reduction procedures and techniques employed by the experimenter (indexed only when the discussions have an effect on results reported in other papers).
OI: Instrumentation (indexed only when important new techniques are described).
OL: Measurement made in liquid phase.
OM: Measurement made in metastable phase.
OO: A material not within the defined scope of this work (e.g., salts, semiconductors, etc.).
OS: Effect of sample size on properties measured.
OX: Measurement made on single crystal, or as a function of crystal orientation.
OZ: Measurement made at high pressure, or as a function or pressure.

Categories. Since the nine categories often do not reflect the nature of the experiment or topic, we have further developed the designation of the Category. The total number of categories remains nine and the subdivision of the properties still remains the same, but in each category several experimental approaches exist to measure properties listed therein. For this reason we have included in our indexing system, as part of our Property List, a list of experimental procedures and their abbreviations used for indexing (List #3). These abbreviations are to replace those of the general category when such indexing can properly describe the nature of the experiment. This now allows us to discriminate in indexing whether a linewidth was measured, for example, in an EPR, NMR, or Mössbauer effect study, and resolves the problem of indexing synonomous names of properties such as described under types (b) and (c) (see page 3).

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‡See List #3 for a list of techniques and their abbreviations.
†For example, for a paper reporting measurements of the Knight shift (code 4K) as the materials go through the melting point (OL), the use of 4K,OL means ... "measurements of the Knight shift also made in the liquid phase."

List #3

Categories

1. ETP - Electronic transport properties.
2. MAG - Magnetic properties.
3. MEC - Mechanical properties.
4. NRP - Nuclear and resonance properties (this abbreviation is not used; specific nature of resonance should be noted here; (see below).
5. QDS - Quantum description of solids (Fermi surface and band structure work in included here.
6. RAD - Electromagnetic radiation (except for the soft X-ray region).
7. SUP - Superconductivity.
8. THE - Thermodynamics.
9. SXS - Soft X-ray spectroscopy.
0. - Zero descriptors (this is not a category).

Topics or Experimental Techniques

(If used, these replace the category abbreviations.)

ACO - Acoustic experiment.
ATM - Atomic beam experiment.
CON - Constitution; phase diagram determination.
DIF - Diffusion.
EAR - Electronic acoustic resonance.
ELT - Electron beam or electron emission experiment.
END - Endor (electron-nuclear double resonance).
EPR - Electron paramagnetic resonance; electron spin resonance; paramagnetic resonance.
ERR - Published erratum to a paper in the file or to a paper to be added to the file.
FER - Ferromagnetic electron resonance; antiferromagnetic electron resonance.
FNR - Ferromagnetic nuclear resonance.
HEL - Helicon experiment.
INS - Ion neutralization spectra.
MOL - Molecular beam experiment.
MOS - Mössbauer effect.
NAR - Nuclear acoustic resonance.
NEU - Neutron diffraction.
NMR - Nuclear magnetic resonance.
NOT - A technique not used in the study of a property in List #1.
NPL - Nuclear polarization.
NQR - Nuclear quadrupole resonance.
NUC - Nuclear physics experiment.
OPP - Optical pumping.
OPT - Electromagnetic radiation in optical region.
OVR - Overhauser effect.
PES - Photo-electron spectra.
POS - Positron annihilation experiment.
SPW - Spin wave resonance; spin wave spectra.
XRA - X-ray diffraction or spectroscopy techniques.

List #3 can be added to by any of the collaborating scientists during their indexing either because a new experimental technique becomes available, or because it is felt that papers dealing with a specific topic should be easily separable. It should be noted here that these topics or experimental techniques can be used independently and in place of a main category, regardless of the category to which the following properties belong. This will become clear once the annotation format is described. For example, XRA may be used if the X-ray technique was employed to determine lattice constants (30), but it may be used equally well for properties listed under any other category, such as 80 (thermal expansion), or 8F (phase transformation), or 40 (Debye-Waller factor), or 6T (transition probability).

A Few Generalized Names for Groups of Materials. We now give a few material codes which have proven to be useful for the inclusion in our files of review articles and theoretical papers:

List #4

Codes for Groups of Materials

AA - alkali metals.
G - garnet (marginal to our scope).
IG - iron garnet (marginal to our scope).
TT - transition metals.
RR - rare earth metals.
X - a metal.

These symbols were chosen so that they differed from those of the elements in the periodic table.

In short, the List of Properties described above is the tool we use for all our indexing. There are two types of information included in the List. One is the experimental method used and described in the paper (if a paper discusses two methods, the paper will be entered under both, on separate EAM cards). The other information is the properties measured and reported on in the paper, whether it is the primary information sought or an incidental result to which the author devotes a mere sentence (maybe in a footnote). Especially in the case of the incidental result, it is important to index such a property as it can then be brought to the attention of the appropriate data group(s), lest the information be lost.

ANNOTATION METHODS - STRUCTURE OF EAM CARD

Based on our prior experience we have decided on a format which will now be described in detail. The bibliographic system is quite simple for metals and binary alloys, which are the materials for which a complete file is desired. For the ternary and quaternary alloys, a unique coding is more complex but coverage for these materials is not emphasized in the program. However, those documents concerning alloys of more than two components that are indexed for the system are stored as accurately as the other papers.

The basic unit of record was chosen to be an EAM card on which specific locations or "fields" are reserved for specific details of bibliographic and technical information.

Structure of EAM Card. In Fig. 1 the layout of the card is displayed. The field structure is detailed here. For the file-description used in the COBOL programs, see Appendix D.

COLUMN	CONTENTS
1-9	AUTHOR. Only the first nine letters of the first author's last name are entered (left justified). This suffices for identification purposes.
10	INITIAL. First initial of first author.
11	NUMBER OF AUTHORS. Total number of authors.
12	TAPE MAINTENANCE CODE. The code numbers and their meaning are: 1 for a record that is to be added onto the tape, 2 for a record that is to replace on the tape a record in error, 3 for a record that is to be erased from the tape.
13-27	JOURNAL. Journal name or abbreviation. The American Chemical Society standard abbreviations (as in Chemical Abstracts) are adhered to when given and when sufficiently compact. All journal abbreviations used thus far are given in Appendix C. Unpublished reports, theses, etc. are also named in this field.
28-30	VOLUME NUMBER.
31	VOLUME SECTION. A, B, etc.

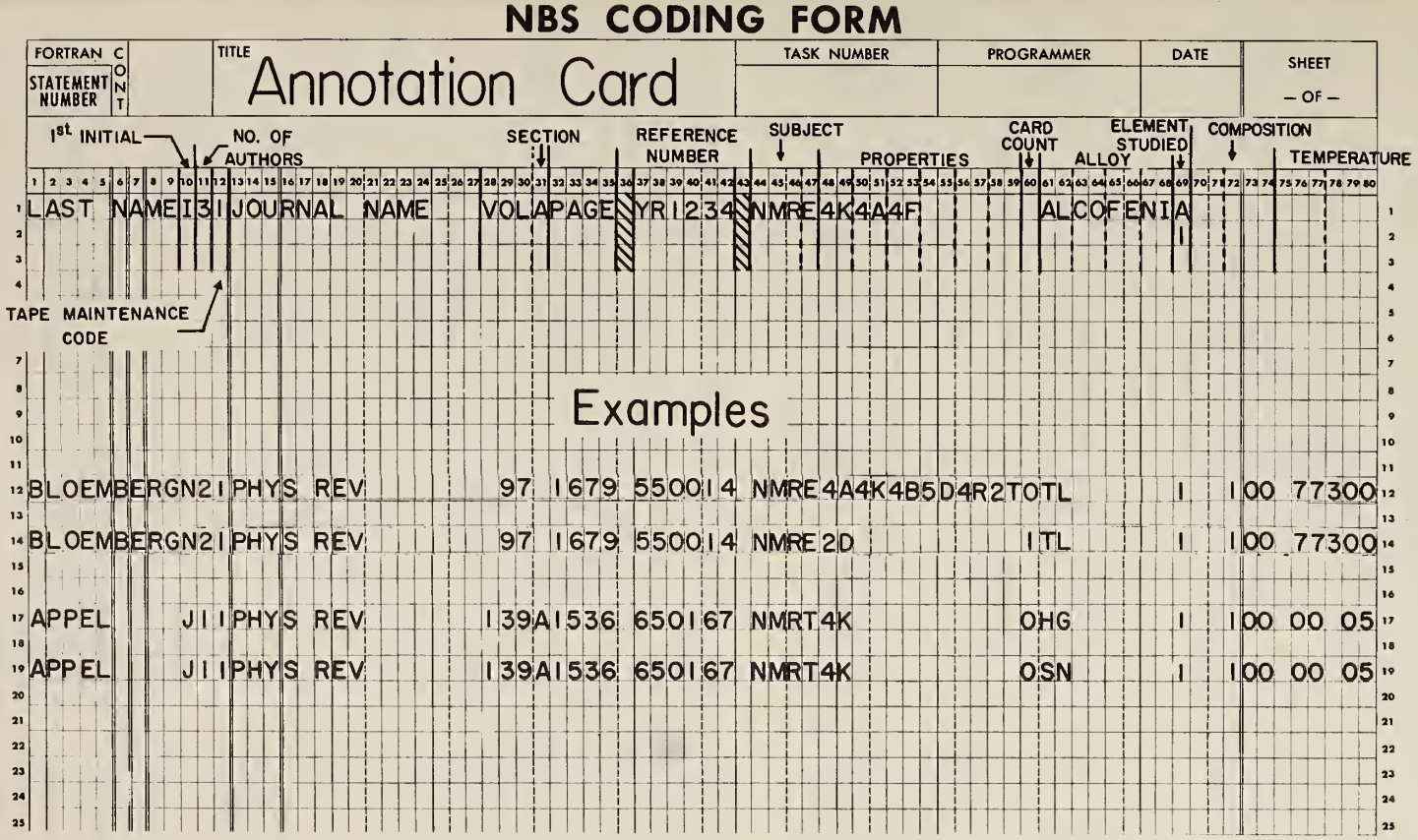

Fig. 1. Layout of the ANNOTATION card. The use of the various fields is described in the main text. The ACS standard journal abbreviations are used for the JOURNAL NAME when space permits. Theses, reports, and other unpublished material are referenced as well using this space (CODIN, a more compact set of abbreviations, is available for published literature only). The last two digits of the year in which the document appeared form the first two digits of the REFERENCE NUMBER. Under EXPERIMENT the abbreviation for the category under which the document belongs (underlined letters in the main text represent abbreviations and may be replaced by more specific topic names or experimental techniques, such as NMR). CARD COUNT is for identification of additional cards for a given paper when needed for additional annotation. In the ALLOY field, alloy components are entered alphabetically by chemical symbol (the computer is asked to "permute" before printing a Material Index, so that FeTi also appears under TiFe, for example). ELEMENT CODE is used only when the nucleus or the component of the alloy is to be specified, as, for example, in NMR, or in the Mössbauer effect (MOS).

COLUMN	CONTENTS
32-35	PAGE NUMBER.
36	BLANK.
37-38	YEAR. Last two digits of year of publication (example, 67 for 1967). These two digits are also the first two of the reference number of the article and are immediately followed by the counting number.
39-42	COUNTING NUMBER. The last four digits of the reference number. Thus the reference number immediately reveals the year of publication. At the beginning of each calendar year, the counting numbers of the articles published that year start over at 0000. Currently the Soft X-ray Data Group is independently adding papers to the system. The block of numbers reserved for them in their reference number assignment is 9000 to 9999 of any year of publication. The remainder of the numbers are for our own uses or are for future reservation for other groups.
43	BLANK.
44-46	CATEGORY OR EXPERIMENTAL METHOD. As in List #3.
47	TYPE OF PAPER. One of the three letters E, T, or R, can be entered here: E for a paper that has any new experimental information on any of the properties and material punched on this specific record. Theoretical discussions are ignored in this case. T for a paper that only contains theoretical treatments of the properties and material punched on this specific record. R for a paper giving a general review on the properties and material punched on this specific record.
48-49, 50-51, 52-53, 54-55, 56-57 & 58-59	PROPERTY CODES. Properties in the two digit designation, as given in List #1, are entered here in decreasing order of importance when possible. The field allows for six properties, if fewer are indexed only the first locations are filled; if more than six are indexed, more cards can be added. A further description of methods of expansion will be given below (Column 60).
60	CARD COUNT NUMBER. The purpose of this number is primarily for computer use. A zero is always entered here unless: a. A record (a punched card) is a continuation or a "follow-up card" of the previous one for the indexing of more properties (the record is otherwise identical). The follow-up cards then are sequentially numbered in this column and they will appear in the printout in the sequence designated here. b. The material is a ternary or quaternary alloy. Then there are three or four cards needed to record the alloy composition uniquely. This will also be discussed under Alloy Composition (Columns 70-74). For ternaries, where the three cards belong to one alloy system, the card count will then be 0, 1, 2 and for quaternaries it will be 0, 1, 2 and 3. In the case of these higher order alloys, such follow-up cards automatically give more property code locations in which additional properties can be entered. In Fig. 2 an example is shown. c. If the paper has not been fully read and annotated this column is left blank on the card. The computer then generates an asterisk in this position in the printout (See Figs. 2 and 3). The reason for the flexibility of the inclusion of "semi-annotated" papers will be discussed at the end of this section.
61-62, 63-64, 65-66 & 67-68	MATERIAL OR ALLOY STUDIED. a. If an elemental metal (that is a metal with no attempted impurity added or with less than 1/2% known impurity) is to be indexed, the chemical symbol of that metal is entered in columns 61 and 62, or in the case of a one letter symbol, column 61 is used. b. If a binary alloy is to be indexed, columns 61-62 are used for the chemical symbol first occuring in the alphabet and the chemical symbol further along in the alphabet is entered in columns 63-64 (or in 63 only in the case of a one letter symbol). It will be noted that the composition of a binary alloy is completely described on one card. c. If a ternary alloy is to be indexed, columns 61 through 66 are used and the chemical symbols are again entered in alphabetic order. In this case, three cards are needed and the follow-up procedure applies. The card count columns now need the 0, 1 and 2 in order to keep them in the desired sequence (Fig. 4).

MARTIN	D3	PHYS LET	9	224	660363	RADE6M2P5B6T	0FE		100	
MARTIN	D3	PHYS LET	9	224	660363	RADE6M2P5B6T	0NI		100	
MARTIN	D1	PHYS REV	146	614	660589	ERR				
MARTIN	D1	PHYS REV LET	18	839	670251	THE				
MARTIN	P2	PHYS REV LET	3	322	590068	NMRE4K2X	0			00 01
MARTIN	S2	TRANS FARAD SOC	50	343	540045	THET8F8L30	0H 0 ZR		00	67648999
MARTIN	S2	TRANS FARAD SOC	50	343	540045	THET	1H 0 ZR		00	50648999
MARTIN	S2	TRANS FARAD SOC	50	343	540045	THET	2H 0 ZR			648999
MARTIN	S2	TRANS FARAD SOC	50	343	540045	THET8F8L	0H ZR		00	67648999
MASON	W1	TECH REPORT AD	636	706	660373	SUPT7E3E3N	0PB			01300
MASSALSKI	T2	PHYS REV	138A	139	650243	THE				
MASUDA	Y2	J PHYS SOC JAP	9	82	540009	NMRE004E4K	0CLH		50	
MASUDA	Y1	J PHYS SOC JAP	12	523	570028	NMRE4K4A4B0S	0AL	1	100	
MASUDA	Y1	J PHYS SOC JAP	12	523	570028	NMRE4K4A4F4B5W	0CD	1	100	
MASUDA	Y1	J PHYS SOC JAP	13	597	580060	NMRE4F4G4A4D8S8R	0CD			300575
MASUDA	Y1	J PHYS SOC JAP	13	597	580060	NMRE4K	1CD			300575
MASUDA	Y1	J PHYS SOC JAP	19	460	580060	ERRE4F	0CD			300575
MASUDA	Y2	BULL AM PHYSSOC	5	176	600101	NMRE4F7E	0AL			00 01
MASUDA	Y2	INTCONFLOWTPHYS	7	412	600100	NMRE4F7T7H7E5D	0AL	1		00 01
MASUDA	Y1	PRIVATECOMM LHB			600102	NMRE4F7E7H	0AL			00 05

Fig. 2. Printout using a straight listing of the cards.

RUN DATE 12-19-67 NATIONAL BUREAU OF STANDARDS PAGE NO. 236

ALLOY DATA BIBLIOGRAPHY

**** AUTHOR INDEX ****

FIRST AUTHOR	NO OF AUTHORS	JOURNAL NAME	VOL.	PAGE	YEAR	REFER. NUMBER	SUBJECT	PROPERTIES	CARD NO.	ALLOY	ELE STY	COMP. LO	COMP. HI	TEMP. LO	TEMP. HI
MARTIN	3	PHYS LET	9	224	1966	660363	RAD E	6M 2P 5B 6T		FE		100			
MARTIN	3	PHYS LET	9	224	1966	660363	RAD E	6M 2P 5B 6T		NI		100			
MARTIN	1	PHYS REV	146	614	1966	660589	ERR		*						
MARTIN	1	PHYS REV LET	18	639	1967	670251	THE		*						
MARTIN	2	PHYS REV LET	3	522	1959	590068	NMR E	4K 2X						00	01
MARTIN	2	TRANS FARAD SOC	50	343	1954	540045	THE T	8F 8L 3O		H O ZR		0	67	648	999
MARTIN	2	TRANS FARAD SOC	50	343	1954	540045	THE T		1	H O ZR		0	50	648	999
MARTIN	2	TRANS FARAD SOC	50	343	1954	540045	THE T		2	H O ZR				648	999
MARTIN	2	TRANS FARAD SOC	50	343	1954	540045	THE T	8F 8L		H ZR		0	67	648	999
MASON	1	TECH REPORT AD	636	706	1966	660375	SUP T	7E 3E 3N		PB				01	300
MASSALSKI	2	PHYS REV	138	139	1965	650243	THE		*						
MASUDA	2	J PHYS SOC JAP	9	82	1954	540009	NMR E	00 4E 4K		CL H			50		
MASUDA	1	J PHYS SOC JAP	12	523	1957	570028	NMR E	4K 4A 4B 0S		AL	1		100		
MASUDA	1	J PHYS SOC JAP	12	523	1957	570028	NMR E	4K 4A 4F 4B 5W		CD	1		100		
MASUDA	1	J PHYS SOC JAP	13	597	1958	580060	NMR E	4F 4G 4A 4D 8S 8R		CD				300	575
MASUDA	1	J PHYS SOC JAP	13	597	1958	580060	NMR E	4K	1	CD				300	575
MASUDA	1	J PHYS SOC JAP	19	460	1958	580060	ERR E	4F		CD				300	575
MASUDA	2	BULL AM PHYSSOC	5	176	1960	600101	NMR E	4F 7E		AL				00	01
MASUDA	2	INTCONFLOWTPHYS	7	412	1960	600100	NMR E	4F 7T 7H 7E 5D		AL	1			00	01
MASUDA	1	PRIVATECOMM LAB			1960	600102	NMR E	4F 7E 7H		AL				00	05
MASUDA	1	BULL AM PHYSSOC	6	122	1961	610263	NMR E	4F 7T 7E		AL	1		100	01	20
MASUDA	1	BULL AM PHYSSOC	6	122	1961	610263	NMR E	4F 7T 7E		AL GE	1	99	100	01	20
MASUDA	1	BULL AM PHYSSOC	6	122	1961	610263	NMR E	4F 7T 7E		AL ZN	1	99	100	01	20
MASUDA	1	IBM J RES DEVP	6	24	1962	620102	NMR E	4F		CD	1		100	00	01
MASUDA	2	PHYS REV	125	159	1962	620101	NMR E	4F 4B 7E 5D		AL	1		100	00	02

Fig. 3. Printout of the same records as were used for Fig. 2, using the editing program (Appendix D). This is a page of the Author Index. The records with an asterisk in the Card No. column (column 60) are references to those papers which have yet to be deep-indexed. These are called the "semiannotated" papers. Those records inside the blocked areas are references to errata. The upper one is an erratum to paper number 660589, which itself must still be put onto the tape. The lower box contains an original paper, with seven properties indexed (six on the first record and the seventh on the follow-up card marked "1" in column 60). This paper is immediately followed by the erratum (ERR in the Subject field) which contains the property found in error, 4F.

ALLOY DATA BIBLIOGRAPHY

**** PERMUTED ALPHABETICAL MATERIAL INDEX ****

FIRST AUTHOR		NO OF AUTHORS	JOURNAL NAME	VOL.	PAGE	YEAR	REFER. NUMBER	SUBJECT	PROPERTIES	CARD NO.	ALLOY	ELE STY	COMP. LO	COMP. HI	TEMP. LO	TEMP. HI
HOEVE	H	1	BULL AM PHYSSOC	11	474	1966	660088	MAG T	2X 1B 1A		CU FE		99	100		
HOUSLEY	R	2	PHYS LET	10	270	1964	640247	MOS T	4C 2B		CU FE	2				
HOWLING	D	1	PHYS REV LET	17	253	1966	660271	NMR E	4K 4A 4B		CU FE	1	98	100		
HUND	C	1	BULL AM PHYSSOC	12	348	1967	670042	MAG E	2X 2B		CU FE			100	06	300
KOI	Y	4	J PHYS SOC JAP	17B	96	1962	620079	NMR E	4C 5W 3P		CU FE	1		01		300
KONTANI	M	2	J PHYS SOC JAP	22	345	1967	670297	ENR E	4J 4C		CU FE	1	0	02		04
KUSHIDA	T	4	J APPL PHYS	33S	1079	1962	620088	NMR E	4C		CU FE	1				
MARSHALL	W	2	J PHYS RADIUM	23	733	1962	620092	NMR T	4C 3P 2B 5T		CU FE			00		
NUSSBAUM	R	2	NUCL PHYS	68	145	1965	650178	MOS E	4X 4A 4N 4B 6T 4O		CU FE	2				300
QAIM	S	1	PROC PHYS SOC	90	1065	1967	670151	MOS E	4N		CU FE	2		100		300
STEYERT	W	2	BULL AM PHYSSOC	12	504	1967	670009	ETP E	1B 2T 2B		CU FE					
SUGAWARA	T	1	J PHYS SOC JAP	12	309	1957	570029	NMR E	4K 4A 4F		CU FE	1		100	04	100
SUGAWARA	T	1	J PHYS SOC JAP	14	643	1959	590039	NMR E	4A 4K 4F 2C 2T		CU FE	1		100	01	85
TAUER	K	2	BULL AM PHYSSOC	6	125	1961	610014	NEU R	2B 2D 2T 2X		CU FE			50	300	999
VASSEL	C	1	J PHYS CHEM SOL	7	190	1958	580021	ETP E	1D 5B 5A		CU FE			99		
WILLIAMS	R	2	PHYS REV LET	18	1129	1967	670045	MAG E	2X 2B 2T		CU FE			100	06	300
SATO	H	2	PHYS REV	124	1833	1961	610029	XRA E	3O 8F 3N 5F 5U 3A		CU FE AU				500	700
SATO	H	2	PHYS REV	124	1833	1961	610029	XRA E	8L	1	CU FE AU				500	700
SATO	H	2	PHYS REV	124	1833	1961	610029	XRA E		2	CU FE AU				500	700
BORG	R	5	BULL AM PHYSSOC	11	770	1966	660431	MOS E	4A 4B 3P		CU FE MN					
BORG	R	5	BULL AM PHYSSOC	11	770	1966	660431	MOS E		1	CU FE MN					
BORG	R	5	BULL AM PHYSSOC	11	770	1966	660431	MOS E		2	CU FE MN					
CATHEY	W	2	BULL AM PHYSSOC	11	528	1966	660285	MOS E	4N 3O		CU FE NI	2	0	100		
CATHEY	W	2	BULL AM PHYSSOC	11	528	1966	660285	MOS E		1	CU FE NI	2		00		
CATHEY	W	2	BULL AM PHYSSOC	11	528	1966	660285	MOS E		2	CU FE NI	2	0	100		

Fig. 4. A page of the Material Index, using the editing program. The records inside the blocked area are an example of how a ternary alloy is entered and how the properties columns of the follow-up cards can be used for the indexing of additional properties after the first record is filled.

d. If a quaternary alloy is to be entered, columns 61 through 68 are used and the procedure is otherwise as in c. A total of four cards with card count numbers 0 through 3 in the desired order are required.

69 ELEMENT STUDIED (or "ISOTOPE CODE"). This is generally not needed for most of the topics covered in the Property List and can be left blank. Whenever a paper deals with a measurement at a specific nuclear site in the alloy, the code is needed to designate on which component of the alloy the measurement was performed. The codes have the following meaning:

Binary and Ternary Alloys

1 = element of lowest alphabetic occurrence
2 = element of next alphabetic occurrence
3 = element of third alphabetic occurrence
4 = 1 and 2 both studied

Ternary Alloys Only

5 = 2 and 3 both studied
6 = 1 and 3 both studied
7 = 1, 2 and 3 all studied

Quaternary Only

A = 1st element in alphabetical occurrence
B = 2nd element in alphabetical occurrence
C = 3rd element in alphabetical occurrence
D = 4th element in alphabetical occurrence
E = 1st and 2nd element in alphabetical occurrence
F = 1st and 3rd element in alphabetical occurrence
G = 1st and 4th element in alphabetical occurrence
H = 2nd and 3rd element in alphabetical occurrence
I = 2nd and 4th element in alphabetical occurrence
J = 3rd and 4th element in alphabetical occurrence
K = all but 4th element in alphabetical occurrence
L = all but 1st element in alphabetical occurrence
M = all but 2nd element in alphabetical occurrence
N = all but 3rd element in alphabetical occurrence
O = all elements

70-74 COMPOSITION RANGE. Always in atomic percent.

a. A pure metal ("pure" as under Material, a.):in column 61-62 one hundred (100) will appear in columns 72-74.
b. A binary alloy: the composition of the component whose chemical symbol first appears in the alphabet is entered only. The lowest composition studied is entered in columns 70 and 71, the highest composition studied or the only composition studied is entered in columns 73-74 unless it is 100% in which case it is as in case a.

Here some flexibility exists for further clarification of annotation, as in the following examples. If a composition range is studied at small intervals, say 20 to 100% of A in steps of 5% of A in an alloy AB, then the columns would read "20100". If only a 20% A, 80% B alloy was studied, the columns would read "ΔΔΔ20" where the Δ's designate blanks. If in addition only one other alloy of 99% A, 1% B was studied, one might write in the field "20Δ99". Alternately, one might make out two cards for the two different alloys, one with "ΔΔΔ20" and one with "ΔΔΔ99" in order to specifically indicate that no work was done in the intermediate range. The choice depends on the importance of the work and the likelihood of improper retrieval. In the latter case, the card count (column 60) will have a zero for both cards. If the paper describes the whole range in detail and thereby concludes the existence of an intermetallic phase A_3B with implications as to the behavior of other mentioned properties, one can make out two cards. One for the total composition range (annotate in the columns 70-74 "20100") and a separate one for A_3B ("ΔΔΔ75"). This card can then indicate other properties in the Properties columns, for example, phase transformations (8F) which is not mentioned on the first card.

For impurity studies in pure metals as in the case of a paper on CuMn, where from zero to 0.003% Mn was reported in the paper, the proper indexing is: columns 61 to 64, "CUMN", and columns 70-74, "ΔΔ100". This conveys quite clearly the idea "impurity study" and specifically means that less than 1/2 at.% is the upper limit of

Mn content.

c. and d. A ternary or quaternary alloy. The composition range of the component whose chemical symbol appears lowest in the alphabet will be indicated on the card with card count number (column 60) of zero. The composition range of the component whose chemical symbol appears next in alphabetical order will appear on the card following it (card count of 1), etc. (See Fig. 4). This is the reason why the follow-up cards are necessary for ternary and quaternary alloys. In the development of the system, it has become necessary to include all follow-up cards for ternaries and quaternaries, whether the composition range is given in a paper or not: these follow-up cards must always be present.

Note that all follow-up cards are duplicates of one another except for: 1. the card count number; 2. the properties studied; 3. in the case of ternary and quaternary alloys the composition ranges of cards 0 through 2 (or 3) refer to those of the components of which the ternary (or quaternary) is comprised, in increasing alphabetic order. For metals and binary alloys (cases a) and b)) the follow-up cards in cases of more than 6 properties have identical compositions or composition ranges.

75-80 TEMPERATURE RANGE. Always in degrees Kelvin. The maximum temperature range of the total study is usually entered here. But if this is misleading as to the content of the paper, the important temperature range is indexed here. For example, a paper on low temperature specific heats which also reports a resistivity ratio for which one measurement was made at room temperature, this paper is better indexed if the room temperature does not appear in this field. Or if room temperature measurements of another property were made and it is desired to index this, then a follow-up card should be made indicating the specific measurement at the appropriate temperature.

Columns 75-77 are used for the lowest temperature studied and columns 78-80 are used for the highest temperature studied or the only temperature studied if the work was done at a single temperature. Any entry of 999 here indicates that the paper deals with temperatures above 1000°K. To date for all bibliographic purposes we have had no need for further temperature discrimination in literature indexing.

The detailed description of the ANNOTATION, or EAM card, as given above, has provided the desired minimum requirements we attempted to include in our system. It is inevitable that more is desired than can be included, and that, as a result, not all demands of such a system are equally well satisfied. The system is designed for the retrieval of papers giving information on specific data for specific properties from the point of view of the data evaluator. Its function is neither as a general current awareness bibliography nor for full coverage of theoretical papers. Consequently, it is quite detailed and has what one may call "high precision" in retrieving per material, per property, and per experiment, but in some other respects, the system is rather limited.

It is for this reason that we specify these cards as ANNOTATION cards. The job of storing coauthors, titles of papers, and laboratories where the work was carried out is a simpler one and will be discussed in a later section. As in most bibliographic work of this kind, as many cards as are desired can be added. By use of the reference number of the document such files can always be interconnected. In order to gain efficiency in data searching, it was felt desirable to keep such voluminous bibliographic files separate from the ANNOTATION file. In addition, the clerical efforts involved in bibliographic files are a serious limitation to the desirability of such documentation. This type of information handling would be particularly well suited for optical scanning procedures, that is, reading in directly from the journals and bypassing the keypunching. Such instrumentation is not yet available at practical prices and their handling is still cumbersome.

DISCUSSION

We have attempted to incorporate seven desirable features in this annotated bibliography system. These will now be reviewed.

1. Legibility. After the cards are punched they are manually filed in alphabetic order by first author. Such a file can then be printed immediately using a listing machine. A sample of such a printout, using some selected records, is given in Fig. 2. The author, bibliographic reference, reference number, experimental method or category, and the alloy studied are easily identified on the punched card or straight listing. Without much additional effort, all other information can be read except for the property codes and isotope codes, or "element studied." However, anyone working with the system soon becomes familiar with the more important codes. These records are read only by the few that handle them for entry onto the magnetic tape. For the user not quite so closely involved in the work, the records are printed out from the tape using a 132 character field available on the printer. Fig. 3 is a reproduction of a page of such an author listing; Fig. 4 is such a printout listing the records alphabetically by alloy. A listing by increasing reference number is also part of the regular program. In these "edited" printouts, the tape maintenance code (column 12) is deleted, though present on the tape. The year of publication appears in full, followed by the total reference number. The card count number is not printed out when a zero appears in that field (column 60). As is apparent from the examples, the follow-up records carry all the bibliographic information that the initial card contains.

In this version of printout the composition and temperature ranges can be read clearly and the property codes can be scanned easily by eye. These edited printouts form the indices of our system. They can be consulted by other users with very little explanation of searching procedures. The Material Index (Fig. 4 gives a page) is the one most frequently used in practical applications of the system. The Author Index is employed primarily as a record of what has been entered and what has yet to be entered. The reference number index is self-explanatory.

2. Compactness. We have achieved within our requirement of legibility a compact form which in general requires one card for each metal or alloy studied in a given paper. Whenever more information is to be included, this may be achieved by use of follow-up cards. Repetition of some of the information of the initial card is necessary for ease of computer manipulation.

3. Ease of Searching.

a. The results for manual searching are already discussed under requirement 1. The facility for browsing is obviously present. For this purpose the chemical symbols are permuted before the material sort is performed. In this manner, the alloy AB will be listed both under A and under B.

b. For the regular programs generating the Alloy Data Indices a general edit program is used together with sorting subroutines. These subroutines are already in the computer library at many computer facilities. Because the format of the file is so highly structured, sorting is straightforward. The programs are written in the COBOL compiler language which seems to be quite adequate for our purposes. The capability provided in this language for sorting on various fields in the order of their designated importance is particularly useful. Appendix D gives the programs which are presently available for the ANNOTATION file.

The structure of the file is quite well suited to the printout of bibliographies in various experimental fields. For example, the question of preparing a nuclear magnetic resonance bibliography may arise. Accordingly, we ask for all NMR records to be printed out. If we want to include work in NMR on ferromagnetic materials we also must print out all FNR (ferromagnetic nuclear resonance) references, etc. If only the papers dealing with Knight shifts are needed then one asks for a search in the property fields only for those records which contain 4K, whether the paper is indexed as NMR, QDS, or any of the other experimental designations. This immediately brings us to the next point.

4. Exactness of Retrieving. There will be no loss of papers on any physical property given in the Property List due to retrieval procedures. Papers are lost only due to incorrect indexing or keypunching. Some keypunching errors are detected when the record is added to the system in the regular update program which checks the various fields for the appropriate numerical, alphabetical, alphanumerical, or blank coding, whichever is applicable in the format.

5. Interlinking of papers either directly or indirectly. With the Material Index one is immediately made aware of other work in the same, or related fields on the material in question. This information one should have at hand when evaluating results in the property research covered by the Alloy Data Center. This is the reason why all the properties are grouped together by category or experimental procedure and why these categories are made to appear together in the Alloy Data indices. The interrelation of these properties listed in this way is of considerable aid in data evaluation as well as in reviewing papers submitted for publication.

Errata: The system also has quite specific capabilities of interlinking papers which contain corrections or evaluations of other indexed documents. These and published errata are handled in the following manner: The letters ERR are punched in the field, columns 44-46, for category or experiment (See Fig. 3). The author and bibliographic reference of the erratum or evaluation is entered in the appropriate bibliographic fields. The reference number of the paper to which this erratum refers is entered in the Reference Number field. Thus, the ERR card does not get a reference number of its own and in the edited printouts the year of publication is suppressed. Only the properties found in question by the author of this erratum are indexed in the Properties field, and only the material to which it pertains. In this fashion, it is immediately apparent from the printouts whether or not the error is of importance for the property of interest. Specifically, this method of handling errata can also be used when a published paper gives indications of evaluation of earlier work by the author himself or by others. Since the volume number of the journal containing the erratum or evaluation already defines the year of publication, there is no loss of information in following this procedure. In the case of unpublished work, the references are often of unclear origin and accordingly, the importance of such errata might be questioned. In the Alloy Data file of copies of the papers, the errata, whether published or not, are filed with the papers to which they refer. When a published paper disagrees specifically with an earlier published statement, then the paper does get a unique number and a regular annotation. In addition, that paper gets a card with its bibliographic information, the reference number of the earlier paper found in error, and the letters ERR in the Category field, and the property(ies) and alloy(s) found in error. The only documentation of such linkages is through the ERR records.

From the point of view of linking together all work published by a single group working in a specific laboratory, but with different first author names, the ANNOTATION file does not satisfy the requirements. A following section on Author, Title, Laboratory files will give a description of such linkage.

6. Flexibility of the System. The flexibility of the system should be apparent now. The structuring of the records has restricted the possibilities of indexing. This is the price paid for ease of searching. In the sense of programming or other machine manipulation of the records, the above format has many advantages over a more open-ended approach. Sufficient flexibility exists for addition and alteration of the indexing codes as far as needed space for future additions is concerned. Finally, the system does allow for the addition of any number of open-ended records, if such need may arise, by simple use of the reference number of the document on each added EAM card.

7. Simplicity of the System. A system which attempts to fulfill several requirements is likely to satisfy each of these only partially. For a new user, both the Alloy Data indices and the Property List must be consulted. Here simplicity has made way for compactness and ease of computer searching. On the other hand, the system was designed as a tool for the Alloy Data Center and beneficial use of the collaborating professional scientists of the Alloy Physics Section. Further, it is noted that for those in close contact with the program, a bulky bibliography due to lengthy wording causes some waste of professional time. If the need arises for a decoded annotated bibliography, such extended indices can be generated as well by computer programs in which the codes and abbreviations of the Property List are translated back to the unabbreviated names.

Semiannotation: In order to keep as few separate indices as possible, the author and bibliographic information of newly acquired and unannotated papers are entered onto the same tape. Whenever a title or an abstract of the paper immediately reveals some content of the paper, the annotations thereof are also added in the appropriate fields. Such

records are marked with an asterisk (*) in the card count field, column 60 (See Fig. 3). All the semiannotated papers are physically kept separate awaiting annotation.

Asterisk: The asterisk in column 60 means specifically that whatever annotation appears for this record was taken from part of the paper only and therefore the annotation is incomplete and not always reliable. All other records are those that have already been fully annotated, or "deep-indexed", as it is customarily called when the paper is read from beginning to end. The value of the semiannotation entries should not be underestimated however. Papers that do not deal directly with our current fields of interest may not receive immediate attention, as deep-indexing is time-consuming if done correctly. For example, in evaluating Knight shifts of the silver-palladium system, it is very helpful to know that a paper exists on susceptibility measurements in AgPd independent of the additional contents of that paper.

ANNOTATION POLICIES

The accuracy of annotation is a question which may be looked upon with varying points of view. We have adhered to the following procedures:

a. Order of Importance. First list the most important property the paper investigates; next, the lesser ones in descending order of importance, if such an order exists; otherwise, a random order is used. It should be noted that an indirectly related new datum referred to in a single line can be an important contribution of the paper and should be indexed. It is especially these papers that would likely be absent from the files of the appropriate Data Centers unless they are indexed by us and at regular intervals are retrieved and forwarded.

b. Relevance or Importance. Any new information on any of the properties, either qualitative or quantitative, should be indexed. For example, the information "the resistivity increased with decreasing temperature in the temperature range studied" should be indexed as 1B (resistivity) in the properties field and the temperature range should be indicated in the appropriate columns (75-80). Such a paper is marked as an experimental paper although theory may also have been developed. If the theory is thought to be of substantial significance a second card can be added; the bibliographic information on this card is repetitious while the properties field is used to indicate which properties are affected by the theory. The letter T (for Theory) should then be punched in column 47. Usually theory has very little influence in the evaluation of the actual data. Any significant theory is likely to be known by the evaluator, and is often quite well documented in textbooks and review articles. For this reason, theory of a minor, speculative, or repetitive nature is usually not indexed. A theoretical paper or a review article should be deep-indexed because often some new measurements are casually included, either as done by the author or as obtained through private communication with another researcher. The tables given in such papers should be checked in detail because values may or may not be referenced with a footnote. Whenever a datum is marked as private communication, or is not referenced at all, the paper must be indexed as experimental for these tabulated material properties. The same is true for information referenced as "to be published". Whenever such information becomes published, or is known to be published at the time of indexing, the corresponding property should not be indexed as experimental, but, if indexed at all, it should be marked as T or as R. The annotation cards that are initially marked as having new data are subsequently changed to R or T by use of the "update" program, as the publications of the experimental work are entered into the system. As evaluation proceeds, the papers are reread and the need for updating becomes apparent at that time.

With all indexing the important question one should ask in regard to the relevance is: "Does this give new experimental information of which the evaluator may otherwise be unaware?" If so, it should always be entered.

For the indexing of theoretical papers, the main category and the main property are often sufficient to reveal the topic of the paper. As such papers become less relevant to data evaluation they will become more difficult to index as the system was not set up for their annotation. For example, a paper giving band calculations in nickel need only be marked as category QDS, T, and as only property 5B (band structure). However, a paper concerned with

electron correlation problems without relating these to the specific properties of the list or to specific materials will not only be insufficiently indexed from the point of view of the theorist, but also proper retrieval will be difficult. However, from the point of view of the data evaluator, this is an advantage as such papers will not be retrieved and will not waste his time unnecessarily.

There is one type of non-experimental paper which is very important to the evaluator, namely that which elaborates on methods of data reduction. Values of properties are influenced by two "data reduction" effects: (1) experimental procedures and instrumentation, and (2) methods of treating the measured set of data points. All experimental papers belong to the first kind. Not many discuss problems of the second kind. Whenever such a treatment is included it should be indexed with the code 0D (zero D). Also, those papers on instrumentation which include such discussions are coded as 0D in addition to their 0I, for instrumentation.

Review articles are often best annotated with the use of the generalizing terms given in List #4. For example, a review of magnetic properties of transition metals is indexed as MAG, R, _ _ _ _ _ _ _ _ _ _ _ _, TT. The dashes are the 12 spaces of the Properties field, where the appropriate magnetic properties , or maybe properties listed under other categories are entered. If the word "binary alloys" instead of "metals" is to be indexed, then TTTT or TTXΔ should be entered instead of TT (transition metal) depending on whether the alloys are made up of two transition metals or whether one is a more general component. Even if the article tabulates specific alloys, it is sufficient to use the generalizing terms if no new data are given and the article is not particularly relevant to the requirements of the data evaluator. This holds for theoretical papers as well.

One more point of consideration under the topic of relevance is that of papers that are obtained but turn out not to contain pertinent information. It is very important that these papers are not just thrown away, but are entered into the system with the full bibliographical information, the category included, when possible, and indexed as property 00 (zero 0). This indicates that the material is not one of metallic character and permits these papers to be excluded at will. If the paper is entirely out of the realm of consideration the letters NOT are indexed in the category field. Otherwise, it is better to indicate, within reasonable indexing effort, the topic with which the paper deals as well as the main property. Duplication in efforts to obtain the paper for the system are avoided in this way.

Keeping in mind the key question of relevance, it has been our policy not to deep-index the NOT papers and to be complete with the annotation of theoretical and review papers only where possible inclusions of new data are concerned. It is not our task to rework the theories developed or to re-review chapters of summaries and condensations which generally have been written by authors capable in their own fields. We do want to be aware of such literature. The extent to which one wishes retrievability strongly determines the degree of the use of generalizing terms. In using generalized coding, it should be kept in mind that the searcher first looks under specific alloys (e.g. FETI) when in need of information rather than under a general name (TTTT).

c. Redundancies. There are certain redundancies and overlapping properties entered in the Property List. These were purposely introduced to facilitate retrievability. For example, in Category 8 we have 8A for specific heat, 8B for nuclear specific heat, and 8C for electronic specific heat. The latter two are obtained from different low temperature regions of the specific heat measured as a function of temperature. Now if a paper deals with electronic specific heat it will be indexed as 8C, without also adding 8A. Conversely, if a paper reports measurements in the temperature range of 1 to 300°K it is indexed as 8A and the temperature range will indicate the fact that some information on 8B and 8C is implied. On the other hand, if this paper explicitly discusses nuclear specific heat then 8B should also be added. Other properties where some redundancy occurs are in Category 2, Magnetism (MAG). Papers concerned with the measurement of "saturation magnetizations", (2I), need not be indexed under "magnetic moment", 2B. In fact, here 2B would cause a retrieval which would mix saturation moments together with magnetic moments as measured by other techniques. The measurement of 2I already implies a value for 2B.

Another example is the use of the property "internal field", 4C. There are many measurements that imply internal fields. If nuclear specific heat, 8B, is known, a 4C

value can be obtained easily from it. Then 4C is not again indexed as a rule. Thus the user is assumed to have a basic knowledge of physics and the interconnection by simple theory is not indexed repeatedly.

d. Reading between the lines. Upon indexing papers quite often one finds that a composition range or temperature range or other information is not mentioned by the author. For such a paper one should, strictly speaking, leave the appropriate fields of the EAM card blank. As a result of the blank field, these papers will always be included upon retrieval as relevant to more specific questions. These papers that are less accurate in their reporting usually are of less value. For this reason it is advantageous to the evaluator and user if reasonable upper and lower limits of composition and temperature are entered on the card. For example, a paper dealing with "dilute amounts of Mn in Cu" is really indexed insufficiently if no composition is given on the EAM card and to prevent it from being retrieved when not appropriate, a reasonable estimate of the range is desirable. Often such shortcomings occur in short notes, letters, and abstracts of papers presented at conferences. Usually these are the ones with little information for the data evaluator and the system should not become flooded with the many inadequately written summaries. However, one must also be able to include the useful parts into the system. Such "reading between the lines" is a very helpful policy in these cases. If there is any question as to the loss of information those questionable annotation fields are left blank and can be updated later. The penalty then is that it is also retrieved when not relevant to the desired ranges requested. In either case it will be retrieved when relevant.

AUTHOR, TITLE, AND LABORATORY FILES

In some of the evaluation work it is desirable to have a method for retrieving articles from the names of any of the co-authors, or by the name of the laboratory at which the work was done. In many instances a display of the title of the articles is also very useful. The system is capable of handling this information as well. Due to the bulk of such information these files are kept separate from the indices (the Author Index presently is over 400 pages long). Whenever the necessity arises to print out all the information stored for each article, the files can be merged to form one grand index. A program is presently being written for searches of these files.

The format of the Author, Title, and Laboratory cards is such that straight listing has reasonable legibility on the one hand, and that computer handling is quite simple on the other hand. In Fig. 5 examples of the three types of cards are given with their layouts. It is important that on each card the reference number of the paper is entered in the proper field and that the card designation (AUTHOR, TITLE, or LAB) and the counting number are given. On the "AUTHOR 1" card appears on the left the last name of the first author in full, followed by a comma and a space, after which follows the first initial, a period and a space, and so on as it appears on the paper. This field extends from column 1 through column 31. The field of entry of the second author's name is from column 32 through column 64. The third and fourth authors are entered on the "AUTHOR 2" card, and as many additional AUTHOR cards can be used as are necessary. The TITLE cards and the LAB cards of the same article are sequenced similarly using the format indicated in Fig. 5.

SUMMARY

A bibliographic system was created to be used as a tool in assisting the Alloy Data Center in both its task of "awareness and interaction" with other related Data Centers and its task of evaluations. Up to the present time each Data Center working within the scope of our efforts uses its own bibliographic system and each Center does its own searching. This bibliographic system is an attempt to pull some of these separated projects closer together. We have succeeded in totally combining the separate data efforts in the Alloy Physics Section, in the two fields of NMR and soft X-ray spectroscopy. The system is currently being used for the evaluation of NMR Knight shift values.

Note for the Future. We are hopeful and have reason to expect that we will successfully adjust our Property List so that other data groups can use the same system. In this way the same programs and the same tapes can be used by various groups and the papers located by one

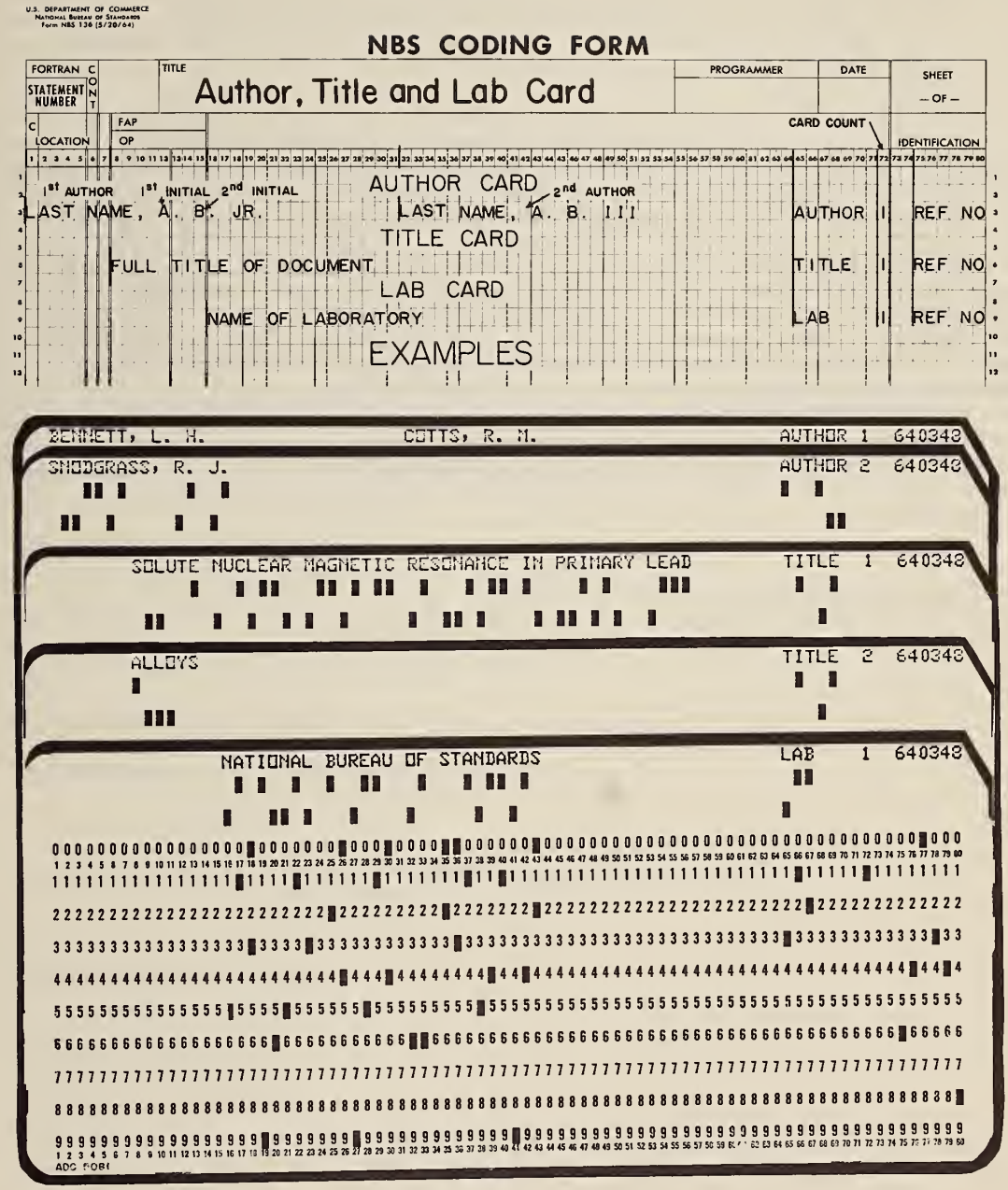

Fig. 5. Layout of the AUTHOR, TITLE and LAB cards.

group automatically will fall in the hands of the other group when annotated as being relevant to that latter group. As computer facilities are often incompatible with one another at the different Centers, the practicality of the communication of magnetic tapes and programs is still somewhat questionable. Where compatability exists, such exchanges would be a very efficient way of communication of the files.

The usefulness of the system has already been proven for our compilations. This is a first step towards a uniform bibliographic system which is hoped to have enough flexibility to serve a few of the other Data Centers properly. The question of computer compatability is one that needs further attention only after it is shown that a single system serving several Centers properly is not only possible, but also practical.

We are grateful to several members of the Metallurgy Division for assistance in this work. Helpful discussions with R. C. Dobbyn and J. S. Philo have been of considerable value in developing the present bibliographic system. M. L. Williams, N. M. Wolcott, H. C. Burnett, and R. W. Mebs have made valuable contributions to the reference book compilation (Appendix B). Throughout the course of preparation, helpful discussions with Dr. F. L. Carter of the Naval Research Laboratories have helped to improve the quality of this Note. Several of the listed Data Centers have responded to questionnaires, thus improving the value of Appendix A as well as giving references to books for Appendix B. Our thanks also to the staff of the NBS library for their help in arranging inter-library loans when necessary.

Appendix A

CONTINUING DATA PROGRAMS - METALS AND ALLOYS

This list is a compilation of Data Centers which publish tables of evaluated data and update these tables at regular intervals. Several Data Centers of somewhat different nature are in existence, but are not included in the Appendix in order to keep it compact.

The specific properties which the Centers evaluate are entered by common name and by code in this Appendix. With the codes we mean to imply coverage of all synonymous and "almost synonymous" names as described in the Property List. A property noted in this Appendix as "incidental" is a property which is included as a side remark in tables listing other properties, but is not tabulated separately. A property on which documents are compiled without further data reduction is indicated appropriately.

Two major compilation programs which include our entire scope are the Landolt-Börnstein Tabellen and the Gmelin Handbuch der anorganische Chemie (see Appendix B for details). Both of these reference books are in German. The former gives the index and page headings in English in its latest volumes. (English is expected to be used in future volumes). The latter uses English only for subject-remarks in the margin. If these two voluminous data programs were to be included in this Appendix, they would appear under each of the categories. Most of the properties of many of the materials are included, though often the properties are not separately tabulated. For individual descriptions of these and other tables, Appendix B should be consulted.

A few outstanding Information Centers in the field of metals and alloys are given below. These do not publish complete tables as much as that they prepare reports and bibliographies or select data as a result of requests. They also publish review articles including tables of data when this is felt desirable.

1. Cobalt Information Center

   Main Office: Centre d'Information du Cobalt, S.A.
   35 Rue des Colonies
   Brussels, Belgium

   American Office: Cobalt Information Center located at
   Battelle Memorial Institute
   (see under 2).

2. Defense Metals Information Center

   Battelle Memorial Institute
   505 King Avenue
   Columbus, Ohio 43201
   Telephone - 614-299-3151

   The Center gives evaluated information on special request. Generally all topics and materials within our scope as well as engineering information are covered.

3. Karl A. Gschneidner, Jr.
   Rare-Earth Information Center

   Ames Laboratory Iowa State University
   Ames, Iowa 50010
   Telephone - 515-294-2272

   This Center furnishes answers to requests and prepares bibliographies as well as review articles, which often include tables of data on properties pertinent to our scope.

4. T. F. Connolly, Director
Research Materials Information Center

Solid State Division of the
Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee 37831
Telephone - 615-483-1287

The Center gives information on quality and sources of research materials, thereby collecting documents falling within the range of our studies.

Some references giving information on Data and Information Centers covering a much broader scope are:

Specialized Science Information Services in the United States

National Science Foundation, NSF 61-68, Washington, D.C. 20550, November, 1961. Out of print; new edition available in several sections, of which the following two are pertinent to this compilation.

1. A Directory of Information Resources in the United States: Physical Sciences, Biological Sciences, Engineering

   Published by the National Referral Center for Science and Technology (The Library of Congress) 1965, price $2.25.

2. A Directory of Information Resources in the United States Federal Government

   Published by the National Referral Center for Science and Technology (The Library of Congress) 1967, price $2.75.

A Directory of Federally Supported Information Analysis Centers

Prepared by COSATI. Published by the Clearinghouse, Springfield, Virginia 22151, 1968, price $3.00.

Continuing Numerical Data Projects - A Survey and Analysis

2nd Edition (Office of Critical Tables, NAS-NRC)
Publication 1463, NAS-NRC, National Academy of Sciences-National Research Council, Washington, D.C., 1966, price $5.00.

The form of the listing in this Appendix follows that of the List of Properties. Each Data Center covering a specific property in a specific category will be listed under that category and the property will be indicated as well as the level of evaluation. Each Center is given a unique number which is that number appearing in the List of Properties immediately following the property(ies).

Category 1. Electronic Transport Properties (ETP)

1. Cryogenics Data Center
   Victor J. Johnson, Director
   National Bureau of Standards
   Boulder Laboratories
   Boulder, Colorado 80301 Telephone - 303-447-3257

The Center deals with many of the properties listed within our scope of materials including metals and alloys (many of the engineering type). Evaluation of properties falling in categories 1 and 8 is part of their continuing program. Document collection is done in most of the other categories. The Center prepares bibliographies and will provide data on request. Other services are available as well. Some of the pertinent reference data material produced by this Center is listed in Appendix B.

ETP properties: Documents are collected on all properties of this category except 1E, 1F, 1M, and 1S.
Evaluated and tabulated are:
Resistivity, 1B,
Thermal conductivity, 1C.

2. Electronic Properties Information Center
   For inquiries, Attention: Emil Schafer
   Hughes Aircraft Company
   Culver City, California 90230 Telephone - 213-391-0711

This Information Analysis Center deals with many of the properties within our scope, on materials which include the metals and binary alloys (a large part of their publications cover semiconductors). The Center provides information and data at various levels of accuracy and evaluation. Those near the level of our interest for this Appendix are called "Data Sheets". These generally give evaluated data for one specific material and include the selected values for most of the properties within our scope (tables giving one property for many materials are generally not prepared).

ETP properties: All properties of this category are evaluated and given (when the literature is available) for the specific material on which the set of Data Sheets is being prepared.

3. High Pressure Data Center
   H. Tracy Hall, Director
   Brigham Young University
   Provo, Utah 84601 Telephone - 801-374-1211

All the properties within our scope on which high pressure research is known to be published are documented and reviewed at this Center. Evaluated data on these topics are being prepared.

ETP properties: All the properties listed in this category are included for evaluation.

4. Superconductive Materials Data Center
   B. W. Roberts, Director
   General Electric Research and Development Center
   Schenectady, New York 12301 Telephone - 518-346-8771

The Center deals with all superconductive materials and several properties of such materials which do not fall in category 7 (Superconductive Properties) but are measured in the temperature region of interest. Such properties are "incidentally included."

ETP properties: Effective number of charge carriers, 1E (incidental, when pertinent).

5. Thermophysical Properties Research Center
   Y. S. Touloukian, Director

Purdue University
2595 Yeager Road
West Lafayette, Indiana 47906 Telephone - 317-743-3827

The part of their program of interest in this Appendix is that of critical evaluation and tabulation of the specific properties given below. The Center includes in its scope all materials. The pertinent publications will appear in Appendix B. One of the Center's plans for the future is a change of the format of their data sheets which have been available in the past in rather bulky form.

ETP properties: Thermal conductivity, lC,
also thermal diffusivity (selected materials, full documentation).

Category 2. Magnetic Properties (MAG)

6. Binary Metal and Metalloid Constitution Data Center
N. M. Parikh, Director (previously under R. P. Elliott)
Illinois Institute of Technology Research Institute
Chicago, Illinois 60616 Telephone - 312-225-9630

The Center operates as a data center rather than an information center, though inquiries are answered. The Center primarily intends to continue and to update the phase diagram work first published by M. Hansen (see Appendix B).

MAG properties: Curie temperature, 2T (included on phase diagrams when they occur above room temperature),
Further references to the literature on magnetic investigations are included.

1. Cryogenic Data Center

MAG properties: Document compilation only on the following properties:
Coercive force, 2E,
Magnetocaloric effect, 2N,
Susceptibility, 2X.

2. Electronic Properties Information Center

MAG properties: All of the magnetic properties listed are included in principle, and may or may not appear among the collected Data Sheets of the specific material being evaluated.

3. High Pressure Data Center

MAG properties: All of the magnetic properties listed in this category are included for evaluation when high pressure results are available.

7. Lattice Constants and Structural Data
W. B. Pearson, Director
National Research Council
Division of Pure Physics
Ottawa 7, Ontario, Canada Telephone - 613-232-8211 (extension 20183)

This Data Center critically evaluates structural data as a result of which magnetic transitions are noted.

MAG properties: Curie temperature, 2T (incidentally included),
Néel temperature and other magnetic transition temperatures, 2D, (incidentally included).

Category 3. Mechanical Properties (MEC)

1. Cryogenic Data Center

MEC properties: Document compilation only on the following:
Acoustic attenuation, 3E,
Young's modulus, 3H,
Bulk modulus, 3I,
Shear modulus, 3J,
Poisson ratio, 3K,
Elastic constants, 3L,
Compliances, 3M,
Lattice parameters, 30,
Velocity of sound, 3V.

8. Crystal Data Center
J. D. H. Donnay, Chief Editor (Johns Hopkins University)
National Bureau of Standards
Washington, D.C. 20234 Telephone - 301-921-2837

The main task of this Center involves maintenance of updated files on crystallographic information and critically evaluating the data for the generation of a revised edition of the reference data provided in the publication "Crystal Data." The materials include metals and intermetallics, but not alloys in the ranges of solid solution.

MEC properties: Lattice parameters, 30.

9. Elastic Constants and Calculated Aggregate Properties
Gene Simmons, Director
Massachusetts Institute of Technology
Building 54-314
Cambridge, Massachusetts 02139

Metals and intermetallics are included for evaluation and tabulation of various elastic properties (also see under Appendix B, MEC-THE of Table III).

MEC properties: Density, 3D (incidentally included),
Acoustic attenuation, 3E (not yet started, future plans),
Young's modulus, 3H,
Bulk modulus, 3I,
Shear modulus, 3J,
Poisson ratio, 3K (incidentally included),
Elastic constants, 3L,
Compliances, 3M (incidentally included),
Velocity of sound, 3V.

3. High Pressure Data Center

MEC properties: All the mechanical properties listed in this category are included for evaluation when high pressure results are available.

7. Lattice Constants and Structural Data

MEC properties: Density, 3D,
Lattice constants, 30.

4. Superconductive Materials Data Center

MEC properties: Lattice constants, including crystal structure types, 30 (incidental, noted in bibliographic references).

5. Thermophysical Properties Information Center

MEC properties: Density, 3D (high strength materials published),
Viscosity, 3C (full documentation, some evaluation),
Surface tension, 3B, is also incidentally included.

10. Alloy Data Center
For inquiries, Attention: Gesina C. Carter
Alloy Physics Section, Metallurgy Division
National Bureau of Standards
Washington, D.C. 20234 Telephone - 301-921-2917

The main text of this Note describes the activities of the Center in detail.

N-R-P properties: Knight shifts, 4K (also anisotropic Knight shifts),
Hyperfine interaction constants, 4R,
Document compilation only for the other NMR properties listed in this category.

2. Electronic Properties Information Center

N-R-P properties: Electronic g-factors, 4Q (incidentally included),
Occasionally also other properties of this category are evaluated.

3. High Pressure Data Center

N-R-P properties: All the properties listed in this category are included for evaluation when high pressure results are available.

11. Mössbauer Effect Data Center
A. H. Muir, Jr.
North American Aviation Science Center
1049 Camino Dos Rios
Thousand Oaks, California 91360 Telephone - 805-498-4545

The Center maintains updated files and records of the experimental results of each published paper and provides computer generated indices of this information, not giving an indication of "best values."

N-R-P properties: Mössbauer transition probabilities, 6T,
Cross sections, 4X,
Half lives, 5Y,
Isomer shift, 4N (incidental),
Internal fields, 4C (incidental),
Line width and shape, 4A, 4B (incidental),
Quadrupole coupling constant, 4Q (incidental),
Debye temperature, 8P (incidental),
Magnetic transition temperatures, 2D, 2T (incidental).

4. Superconductive Materials Data Center

N-R-P properties: Debye-Waller factor, 4O (incidental, noted in bibliographic references).

12. Varian Associates, Inc.
Palo Alto, California 94303 Telephone - 415-326-4000

The group prints a chart of best values of specific properties which is updated at set intervals.

N-R-P properties: Electric quadrupole moments, 4E,
Nuclear magnetic moments, 4H,
Nuclear spin (indexed under 5T).

Category 5. Quantum Description of Solids (QDS)

1. Cryogenic Data Center

QDS properties: Document compilation only for the following:
Anomalous skin effect, 5G,
Magnetoresistance (oscillatory and non-oscillatory), 5F, 5K,
Other "oscillatory effects", 5L,
Magnetoacoustic effect, 5M,
Relaxation times, 5Y.

2. Electronic Properties Information Center

QDS properties: Band structure, 5B,
Density of states, 5D,
Fermi surface dimensions, 5A, 5F, as determined by 5C, 5H, 5J, 5K, 5M, and other experiments of this kind.
The other properties listed under this category are also included in their Data Sheets on each specific material, when such data is known to exist.

Category 6. Electromagnetic Radiation (RAD)

1. Cryogenic Data Center

RAD properties: Document compilation only for the following:
Absorptivity, 6A,
Emissivity, 6B,
Reflectivity, 6C,
Percent reflectance, 6D,
Index of refraction, 6I,
Work function, 6W.

2. Electronic Properties Information Center

RAD properties: All the magnetic properties listed are included in principle, and may or may not appear among the collected Data Sheets of the specific material being evaluated.

3. High Pressure Data Center

RAD properties: All the radiation properties listed in this category are included for evaluation when high pressure results are available.

13. Ralph Klein
Chemistry Building, Room B-246
National Bureau of Standards
Washington, D.C. 20234 Telephone: 301-921-2161

A document compilation is kept up-to-date collecting all articles on field emission and work functions published since the cut-off date of the "Handbook of Thermionic Properties" by V. S. Fomenko, (see Appendix B, Table III, RAD). No data reduction in process.

5. Thermophysical Properties Research Center

RAD properties: Absorptance, 6A,
Emittance, 6B,
Reflectance, 6C.
Also, transmittance is evaluated. For all these, the hemispherical, normal, angular, and spectral quantities are tabulated.

Category 7. Superconductivity (SUP)

1. Cryogenic Data Center

SUP properties: Documentation only on all the properties listed in this category except the last two; the interaction parameter $N(E_F)V$ and the coherence distance.

2. Electronic Properties Information Center

SUP properties: Primarily the following properties are evaluated and incidentally included when pertinent:
Skin depth, 7D,
Penetration depth (of electron pairs), 7F,
Critical field, 7H,
Critical temperature, 7T.

3. High Pressure Data Center

SUP properties: All the properties listed in this category are included for evaluation when high pressure results are available.

4. Superconductive Materials Data Center

SUP properties: Critical field, 7H (including H_{C_1}, H_{C_2}, H_{C_3} where found),
Critical temperature, 7T.

6. Binary Metal and Metalloid Constitution Data Center

THE properties: Phase transformation, 8F,
Melting point (solidus, liquidus), 8G,
Documents are also collected on some related topics, such as Solubility, 8M.

14. Chemical Thermodynamics Data Group
D. D. Wagman, Director
Institute for Materials Research
National Bureau of Standards
Washington, D.C. 20234 Telephone - 301-921-2131

The group functions primarily as a Data Center rather than an Information Center and prepares tables of self-consistent values for thermodynamic properties. The materials include the metals and intermetallics, but not alloys in ranges of solid solution. The Data Center makes its values uniform with those of the Data Centers below when possible.

THE properties: Heat capacity, 8A,
Entropy, enthalpy, etc., under 8K.

1. Cryogenic Data Center

THE properties: Heat capacity, 8A,
Electronic specific heat, 8C (document compilation only),
Thermal expansion, 8O,
Debye temperature, 8P (document compilation only).

15. Data Group for Binary Oxides
Robert S. Roth, Director
Institute for Materials Research
National Bureau of Standards
Washington, D.C. 20234 Telephone - 301-921-2893

This Group is primarily engaged in research but also maintains a file of the literature on metal-oxide systems and binary phase diagrams of such systems, i.e., metal-metal-oxide ternaries. Publication of phase diagrams is planned for the future.

16. Diffusion in Metals and Alloys Data Center
John R. Manning, Director
Institute for Materials Research
National Bureau of Standards
Washington, D.C. 20234 Telephone - 301-921-3354

The Center currently is collecting all papers on diffusion in metals and alloys, and plans to publish reference data for activation energies (8R) and diffusion constants (8S) when the files have been completed.

2. Electronic Properties Information Center

THE properties: The Center incidentally includes data on several of the properties listed in this Category except for those on basic thermodynamics as covered under #21 of this List. Among the included properties:
Specific heat, 8A and 8C,
Activation energy, 8R,
Diffusion constant, 8S.

3. High Pressure Data Center

THE properties: The properties listed in this Category are included for evaluation when data on pressure effects are available.

7. Lattice Constant and Structural Data

THE properties: Thermal expansion, 8O (incidental).

17. Low Temperature Specific Heats
George Furukawa, Director
Institute for Basic Standards
National Bureau of Standards
Washington, D.C. 20234 Telephone - 301-921-2742

The Center deals with heat capacity data only for the elemental materials and compounds including intermetallics (no alloys in ranges of solid solution). The data will be tabulated as a function of temperature in the temperature range between room temperature and absolute zero.

18. Physical Adsorption of Gases on Solids
S. Brunauer, Director
Clarkson College of Technology
Potsdam, New York 13676

The topics are somewhat outside the scope of our research (surface effects only) and the level of evaluation is not that of most of the Centers listed here. However, this Center is given as it may be of interest to the reader for information peripheral to our scope.

4. Superconductive Materials Data Center

THE properties: Heat capacity, 8A (incidentally included),
Debye temperatures, 8P (incidentally included),
Electronic specific heat, 8C.

19. Thermal Expansion
Richard K. Kirby, Director
Metrology Building, Room A-221
National Bureau of Standards
Washington, D.C. 20234 Telephone - 301-921-2744

The group has, up to the present time, evaluated data for a few selected metals and generally deals with materials of a much larger scope than that of the Alloy Data Center.

THE properties: Thermal expansion, 8O,
Debye temperatures, 8P.

20. Thermodynamic Properties of Liquid Metals and Liquid Oxides
John R. Elliott
Department of Metallurgy and Materials Science
Room 8-109
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

The group evaluates data outside our scope as well as the following data within our scope.

THE properties: Heat capacity, 8A (incidentally included),
Phase transformations, 8F (incidentally included),
Melting point, 8G (incidentally included),
Boiling point, 8H (incidentally included),
Latent heat, 8I (incidentally included),
Entropy of mixing, heat of solution, 8J,
Free energies, 8K,
Solubility, 8M,
Vapor pressure, 8N (incidentally included),
Activity coefficients.

21. Thermodynamic Properties of Metals and Alloys
Ralph Hultgren, Director
Department of Metallurgy
Lawrence Radiation Laboratory

University of California
Berkeley, California 94720 Telephone - 415-843-2740 (extension 3817)

This Data Center maintains an awareness of documents pertaining to transitions listed in other categories (magnetic transitions, electronic transitions such as under 5U, and superconducting transition temperatures). In addition, the available literature on the thermodynamic properties 8A through 8P and 8U are compiled for further evaluation of these properties. The materials included fall within our scope and include ternaries (also in the liquid phase).

THE properties: Specific heat, 8A, 8C,
Entropies, enthalpies, latent heats, etc., 8K,
Activity coefficients, heats of formation (also liquid alloys),
Solubility limits, 8M (incidental),
Phase diagrams, 8F (discussed in the text and often sections of diagrams given,)
Vapor pressure, 8N.

5. Thermophysical Properties Research Center

THE properties: Many of these on specific materials as indicated in Appendix B, Table I.
Specific heat, 8A,
Melting point, 8G,
Latent heats, 8I,
Vapor pressure, 8N (high strength materials),
Thermal expansion, 8O,
Thermal diffusion.

22. Vapor Pressure Data Center
J. J. Diamond, Director
Materials Building, Room A-311
National Bureau of Standards
Washington, D.C. 20234 Telephone - 301-921-2893

The Center has recently been initiated and is currently compiling the documents necessary for future evaluation of vapor pressures. Initially data for some pure metals, to be used as vapor pressure standards, will be evaluated. The total scope includes all the metals and alloys in ranges of solid solution, as well as other inorganic materials in the condensed state.

Category 9. Soft X-ray Spectroscopy (SXS)

10. Alloy Data Center
John R. Cuthill, Group Director
Alloy Physics Section, Metallurgy Division
National Bureau of Standards
Washington, D.C. 20234 Telephone - 301-921-2913

The group maintains an updated annotated bibliography on the subject matter covered by this Category as well as a few properties listed under Category 6. Plans for the future are for evaluation and publication of soft X-ray spectra.

1. Cryogenic Data Center

SXS properties: Optical constants, 9C (document compilation only).

2. Electronic Properties Information Center

SXS properties: Optical constants, 9C (incidentally included).
Also occasionally other properties listed in this Category.

REFERENCE BOOKS AND DATA COMPILATIONS - METALS AND ALLOYS

Index to Appendix B

Appendix B

INTRODUCTION

In this Appendix a list of books is given which may serve as reference literature when searching for data pertinent to the scope of the Alloy Data Center. An attempt was made to give a working definition of a "reference book." As a result, it was decided that such a definition would be a rather ambiguous but not very useful one. It is hoped that in spite of these difficulties the listing may have some value as an index to some of the possible sources of information concerning the topics described in this Note. For this compilation no special attempt was made to locate review articles, conference proceedings, bibliographies, tables compiled at an early date, and textbooks with occasional tables.

The books will be listed under one or more of the tables described below:

Table I. This will include basic handbooks and general treatments of topics covering several of the categories. Some of the largest compilations will be detailed further as far as the contents of specific volumes or sections is concerned. A few of these parts will also be indicated in the other two Tables if they are specifically applicable to the properties or materials of those lists. Further reference will then be given to this Table.

Table II. In this Table, books concerned with one or a few metals or alloys will be listed alphabetically under the chemical symbols describing them. When the general annotation of the book appears elsewhere, appropriate reference to the location of the description will be given. This Table is somewhat similar to our "Material List."

Table III. Here books pertaining only to one or a few of the categories will be listed under all the categories to which they pertain. Again annotations will not be repeated unnecessarily by use of appropriate referencing.

The last two of these three versions of subdivision are similar to those described in this Note for single annotated documents, except that the automated system gives the annotations in each list using our present programs. Classification into the general categories is usually sufficient for the books. Sub-indexing by property appears to be rather cumbersome and of little advantage. Those books covering topics in thermodynamics usually fall in the "Mechanical Properties" category as well. For this reason these two categories have been listed together under "MEC-THE" in Table III. Similarly, the SXS category is listed under RAD in this Table. All other categories remain separated and cover the properties listed thereunder in the List of Properties.

The book files have not been automated and for this reason books generally appear under one or maybe a few of the headings, as their major topics indicate. Those books covering a specific topic will appear under that category only and the annotation will indicate the nature of the book and its data. If a few properties of other categories are included but not emphasized, they may appear in the annotation, but the book will not be listed under those categories as well.

A book on a specific metal and its alloys, giving all its properties, will not be listed under all the categories of Table III, but rather, only under the chemical symbol of the metal in the Materials List, Table II. The annotation will then give an indication of which specific properties are among the ones discussed in the book.

Books which cover several categories and/or several materials are listed under Table I. Some of the handbooks are very extensive and have separate volumes completely falling under one category or one material. Such volumes are listed under these headings (either category or material) and for the annotation the reader is referred to Table I rather than repeating the descriptions.

There are, in addition, several journals which publish very useful reviews, including compilations of reference data. These are not included in this Appendix. Collections of review articles of specific interest also appear in the following series:

1. "Solid State Physics", edited by F. Seitz and D. Turnbull,

2. "Progress in Materials Science", formerly "Progress in Metal Physics" (through Volume 8), edited by B. Chalmers (Articles deal mainly with thermodynamic and metallographic properties),

3. "Reports on Progress in Physics", edited by A. C. Strickland,

4. "Index to the Literature of Magnetism", published by the Technical Information Libraries, Bell Telephone Labs, Inc. (An unannotated bibliography which includes a permuted title index, computer generated),

5. "Magnetism", edited by G. T. Rado and H. Suhl (More important for its subject treatments than as a source for reference data).

It should again be emphasized that it is extremely difficult to make a consistent compilation of reference books. One reason is the question of identifying a book as a reference book. (Should a textbook including ten pages of tables be excluded, but a book containing less data which is called a DATA book in its title be included?) This Appendix represents one of the first attempts within the NSRDS to develop a classification system of data compilations. Criteria for the recognition of data compilations are still ill-defined. Methods of searching raise problems as well. Many of the books entered in this compilation were found by searching through the NBS library stacks (where the useful books may be out on loan). Letters were written to several of the publishing companies indicating clearly the field of interest and the use of the books in the reference book compilation. Answers were generally unsuccessful, and in one case produced references to books dealing with agricultural topics. Another reason for inconsistency is that if a large number of partially relevant books are included, the compilation becomes bulky and the quality poor. This Appendix is biased towards the more recent books and those covering topics described by the current theory of metals and alloys, with special emphasis on fields of competence within the Alloy Physics Section (though it is found that not many compilations are available in several currently developed fields when compared with Mechanical and Thermodynamic properties). In this respect the compilation is expected to have some value to other scientists working in similar fields - some books of which they were not previously aware might be brought to their attention. A few books which are not particularly data-oriented, but have been of frequent use to us, have also been included. Such books are noted as "Not a data book". On the other hand, certain data books which would be of use in this Appendix may not have come to our attention. We would very much appreciate being made aware of omissions of such books as well as possible other methods of listing these reference books for future improvement.

Short annotations accompany each entry. These are comments which happen to come to mind when looking through the book, and do not survey each book on the same points. Quality of the data is usually not commented on, and data on properties not covered by the Alloy Data Center are not discussed. The general contents pertaining to the physical properties is usually indicated. In the margin it will be noted when a book includes information on ternary alloys or liquid alloys whenever such information seems to be of interest. Also, when a book is listed under a specific category, the corresponding abbreviation (as given in List 3) will be noted in the margin.

Table I of Appendix B

HANDBOOKS COVERING SEVERAL PROPERTIES OF SEVERAL MATERIALS
(INCLUDING HIGH PRESSURE EFFECTS)

Adams, R. M., editor, Boron, Metallo-Boron Compounds, and Boranes, published by Interscience, New York, 1964.

The book consists of several sections written by different authors with experience in the specific topics they cover. Some of the sections are on extraction and recovery, chemistry, and engineering-type topics.

Elemental boron is discussed in a chapter by A. E. Newkirk, which includes a description of the element's physical properties. Among these are: electrical resistivity, effective number of charge carriers, thermal conductivity, dielectric constant, density, compressibility, Young's modulus, crystal structure, absorption, reflectivity, refractive index, nuclear and atomic properties, specific heat, phase transformations, melting and boiling points, latent heats, entropy, vapor pressure, thermal expansion. The author gives 364 references in this chapter.

Another chapter (written by B. Post) discusses refractory binary borides - their preparation, structural classification, lattice parameters, electrical resistivity, Hall coefficients, thermoelectric power, electronic magnetic moment, Curie temperature (paramagnetic-to-ferromagnetic), magnetic susceptibility, density, detailed structure descriptions (with figures), interatomic distances, a few elastic constants, melting points, thermal expansion, a few phase relationships, and other thermodynamic information as well as superconducting transition temperatures. One hundred and fifty two references to the literature are given.

American Society of Mechanical Engineers, ASME Handbook

Volume I S. L. Hoyt, editor - "Metal Properties" - 1954.
Engineering alloys are the main topic of this compilation. Mostly engineering properties are discussed, but some data on physical properties are also given (electrical resistivity, thermal conductivity, specific heat, thermal expansion as a function of temperature, and others).

Volume II J. Huckert, editor - "Engineering Tables" - 1956.
Not pertinent to our scope.

Volume III O. J. Horger, editor - "Metals Engineering-Design" - 1965.
Not pertinent to our scope.

Volume IV R. W. Bolz, editor - "Metals Engineering-Processes" - 1958.
Not pertinent to our scope.

Aronsson, B., Borides - Part A - Basic Factors (a chapter from the book, Modern Materials 2, 143-190, 1960, edited by H. H. Hausner), published by Academic Press, New York.

The author gives a brief description of elemental boron. Transition metal-boron intermetallic compounds, together with information on crystal structure and constitution for each occurring structure are discussed in much greater detail. The borides of the alkali metals, alkaline earths, rare earths, and actinides are also briefly discussed.

Several properties of the intermetallic phases are tabulated or discussed. Among these are: electrical resistivity and its temperature coefficient, thermal conductivity, Hall coefficients, thermoelectric power, density, crystal structure, work function, thermoemission constants, superconducting properties, melting point, heat of formation, and thermal expansion.

ternary Ternary systems containing two different metals and boron are also treated and that which the author refers to as "quasi-binary systems" (i.e. Me_1B - Me_2B system). The ranges of solubility and a few of the properties mentioned above are discussed. References to the original literature are given throughout the text, as well as in a bibliography of 192 entries.

Borides - Part B - Fabrication, Properties, and Applications

Another chapter in this volume, by R. Steinitz, is devoted primarily to the mechanical and chemical properties of the materials. A few data on density, elastic properties, and melting point are included.

Aronsson, B., Lundstrom, T., and Rundqvist, S., Borides, Silicides, and Phosphides, published by John Wiley, New York, 1965.

This booklet reviews and summarizes the structures and composition ranges of existing phases, as well as other properties such as: electrical resistivities, magnetic susceptibilities, energy gaps, superconducting transition temperatures, metallic radii, melting points, and heats of formation. The second half of the book is devoted to crystal chemistry. Hardback; 120 pages.

Baumeister, T., editor, Marks' Mechanical Engineers' Handbook, published by Mc-Graw-Hill, New York, 1958 (6th edition).

This is a basic handbook for building and engineering information. Many of the pages are devoted to descriptions of the materials rather than to tabulation. However, many tables are also given, among which some physical properties on some engineering metals and alloys are included (such as densities, thermal expansion, resistivity, and elastic properties).

Bureau of Mines (listing of pertinent Bulletins) - See under U. S. Department of the Interior in this Table.

Clark, G. L., editor in chief, The Encyclopedia of Chemistry, published by Reinhold, New York, 1966 (2nd edition).

The encyclopedia presents discussions of the metals and some of their alloys, as well as formation of compounds. Physical properties are briefly noted (values are given) but no references to the original literature are given. Physical properties and topics such as are in our Lists are generally not described (electrical resistivity, lattice dynamics, and Fermi surface work are not found).

De Vries, K. L., Baker, G. S., and Gibbs, P., A Survey of High Pressure Effects of Solids, University of Utah, published by U. S. Department of Defense - AD 247,247 (1960).

This report is a summary of all "known" work done between 1947 and 1959. Sections on instrumentation are given as well as data. A bibliography and cross-index are included. The data reported fall in all categories of properties we include.

The High Pressure Data Center at Brigham Young University, Utah (see Appendix A) maintains files on all high pressure work and is presently directed by H. Tracy Hall. No specific data compilations published by this Center are known to us.

Doyle, W. D. and Harris, A. B., editors, Magnetism and Magnetic Materials: 1967 Digest.

This represents a survey of the literature appearing in 1966. For further annotation see under Magnetic Materials Digest in the Magnetic Properties category of Table III.

Eldridge, E. A. and Deem, H. W., Report on Physical Properties of Metals and Alloys from Cryogenic to Elevated Temperatures, American Society for Testing and Materials, STP 296,

1961 (206 pages).

The report contains about 650 data sheets and 80 curves of physical properties of Al, Co, Fe, Mg, Mo, Ni, and many of their more common alloys. The temperature range is from -457 to +4500°F (1.3 to 2756°K). Reference to the original literature is given. The properties include: density, thermal expansion, specific heat, electrical resistivity, and thermal conductivity.

Electronic Properties Information Center (Also listed in Appendix A), Hughes Aircraft Company, Culver City, California 90232.

The Center prepares as one of its outputs, descriptions of single materials giving evaluated data on many properties of that material only. These reports are referred to as Data Sheets. Among the ones more pertinent to our field of interest are:

Data Sheet DS-137 - Silicon,	M. Neuberger, May, 1964.
Data Sheet DS-141 - Niobium,	D. L. Grigsby, Nov., 1964.
Data Sheet DS-143 - Germanium,	M. Neuberger, Feb., 1965.
Data Sheet DS-151 - Boron,	J. Milek, Feb., 1967.
Data Sheet DS-152 - Niobium-Zirconium,	D. L. Grigsby, Nov., 1966.
Data Sheet DS-156 - Copper,	S. J. Welles, May, 1967.
Data Sheet DS-157 - Cadmium-Mercury,	M. Neuberger, Aug., 1967.

Several Data Sheets on semiconducting compounds are also available as well as other types of reports such as the following: Electrical Conductivity and Resistivity of Selected Metals and Alloys, U. S. Department of Defense, AD 484,040 - June, 1966. The Center prepares bibliographies as well.

English, J. J., at Defense Metals Information Center: Binary and Ternary Phase Diagrams of Niobium, Molybdenum, Tantalum, and Tungsten, U. S. Department of Commerce, Clearinghouse, AD 257,739, 1961.

This compilation contains 93 phase diagrams of binary systems and 68 phase diagrams of ternary systems, each with a short discussion. 223 references are given.
Ternary Other DMIC technical reports on physical and engineering information are available. For information write to:

Defense Metals Information Center
505 King Avenue
Columbus, Ohio 43201

Flügge, S., editor, Handbuch der Physik, published by Springer-Verlag, New York.

Several volumes have been prepared covering topics in physics from a theoretical point of view, often giving textbook style treatments of various subjects. Each volume is written by one or a few authors who have competence in their field. Accordingly, some of the sections or groups of chapters are written in different languages. Data are included only occasionally in the text. Some, but not all volumes discussing topics covered by our scope, are listed under the appropriate categories.

Forsythe, W. E., editor, Smithsonian Physical Tables, Smithsonian Institution, Washington, D.C., 1954 (9th rev. edition).

This is a basic reference book giving compact tables of many properties of the elemental materials and some alloys (usually commercial). The physical properties include: specific heat, thermal expansion, thermal conductivity, latent heats, density, modulus of elasticity, velocity of sound, diffusion, electrical resistivity, saturation magnetization, permeability, hysteresis loss, coercive force, magnetic susceptibility, Curie constants, electron emission, photoelectric and contact potential, constants of nuclear physics, and other data. Like most of the basic handbooks, the coverage, as far as materials go, is far from complete.

Francombe, M. H. and Heeger, A. J., editors, Magnetic Materials Digest: The Literature of 1962.

A survey of the literature appearing in 1962 is presented. For further annotation, see under Magnetic Materials Digest in the Magnetic Properties category of Table III.

Gaule, G. K., editor, Boron, Volume 2: Preparation, Properties, and Applications (based on papers presented at the 1964 Paris International Symposium on Boron), published by Plenum Press, New York, 1965.

Papers presented at the Symposium cover topics such as: crystal structure, electronic transport properties, mechanical properties, optical properties, EPR, and band structure.

Gmelin, L., first editor and director (Pietsch, E., present editor), Gmelin Institut für Anorganische Chemie und Grenzgebiete in der Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Gmelins Handbuch der Anorganischen Chemie, publications since 1817, Verlag Chemie, GmbH., Weinheim/Gerbstr and Berlin.

The first compilations in this series appeared in the early 19th century and were published by Leopold Gmelin. The present general editor is Erich Pietsch. Contributions to the compilation, processing, and evaluation of the data have been by scientists in the fields of chemistry, physics, metallurgy, and engineering in contact with research on metals and alloys as well as other materials. Handbooks have been published as data became available ever since the beginning of the project.

The compilation program is a very extensive and thorough one and is conducted at the Max Planck Institut in Frankfurt, Germany. Through the years many books have been published, describing in each case, a specific material, or group of materials (for example: System #35, Aluminum, part A, book 5, Alloys with Zinc to Uranium.) The books are all written in German with topics noted in English in the margin. The most recent volumes include an English Table of Contents. Such volumes are marked with a dagger, †. Abbreviations of words are used frequently in the text. Due to the extensiveness of the chemistry, one may or may not find the desired physical property described in the discussions. The text gives a description of a trend of the properties when no decision can easily be made on a better value, and gives references to the literature. Updating of the volumes is extremely slow. Their future plans for evaluation are developed for the next ten years and their data acquisition program is concerned only with those materials and properties stipulated by this schedule, hereby excluding a certain amount of properties and materials within the scope of the Alloy Data Center. We will list here the pertinent information that is available to us at this time.

System No. 10, Selenium, Part A: History. Occurrence. The element.

Section 1: History. Occurrence. The element (except electrical properties). 1942, reprint 1959, (292 pages, 7 graphs), paper bound.
Section 2: Electrical properties I (including photoresistance). 1950, (122 pages, 106 graphs), paper bound.
Section 3: Electrical properties II (Selenium rectifier. Selenium photocell). 1953, (184 pages, 158 graphs), paper bound.

System No. 10, Part B: Selenium compounds. 1959, (195 pages, 11 graphs), paper bound.

System No. 11, Tellurium: 1940, reprint 1955, (363 pages, 4 graphs), paper and cloth bound.

System No. 12, Polonium and Isotopes: 1941, reprint 1955, (187 pages, 8 graphs), paper and cloth bound.

System No. 15, Silicon, Part A: Not yet published.

† System No. 15, Silicon, Part B: The element and the inorganic compounds of silicon. 1959, (923 pages, 154 graphs), paper and cloth bound.

System No. 18, Antimony, Part A: History. Occurrence. Preparation of the metal.

† Section 1: History. Occurrence. 1942, reprint 1963, (226 pages, 1 graph), paper bound.
Section 2: Concluding occurrence. 1943, reprint 1958, (76 pages), paper bound.
Section 3: Formation and preparation in laboratory. Manufacture. 1950, (49 pages, 6 graphs), paper bound.

System No. 18, Antimony, Part B: Properties of the element and compounds.

Section 1: Physical properties (including electrical resistivity). 1943, reprint 1958, (128 pages, 4 graphs), paper bound.
Section 2: Concluding the element. Compounds up to Antimony and Iodine. 1949, (368 pages, 50 graphs), paper bound.
Section 3: Concluding antimony compounds. 1949, (68 pages, 4 graphs), paper bound.

System No. 19, Bismuth and radioactive Isotope : 1927, (229 pages, 11 graphs), paper bound.
† Supplement Volume, 1964, (866 pages, 212 graphs), paper bound.

System No. 20, Lithium: 1927, (254 pages, 13 graphs), paper bound.
† Supplement Volume, 1960, (525 pages, 73 graphs), paper and cloth bound.

System No. 21, Sodium: 1928, reprint 1959, (992 pages, 75 graphs), paper and cloth bound.
Supplement Volume

† Section 1: Technology of sodium and its compounds. 1964, (399 pages, 35 graphs), cloth bound.
† Section 2: The element. Compounds with hydrogen and with oxygen. 1965, (496 pages, 66 graphs), cloth bound.
† Section 3: Compounds with nitrogen, sulfur, selenium, tellurium, polonium, boron, and carbon (up to sodium amidocarbonate). 1966.
† Section 4: Compounds with carbon (from sodium cyanide), silicon, phosphorus, arsenic, antimony, and bismuth. 1966.

System No. 22, Potassium:

† Section 1: The element. Compounds up to potassium and oxygen. 1936, reprint 1959, (246 pages, 7 graphs), paper bound.
† Section 2: Compounds up to potassium and chlorine. 1937, reprint 1963, (268 pages, 12 graphs), paper bound.
† Section 3: Compounds up to potassium and tellurium. 1937, reprint 1963, (290 pages, 17 graphs), paper bound.
† Section 4: Compounds up to potassium acetate. 1937, reprint 1963, (128 pages, 6 graphs), paper bound.
† Section 5: Compounds up to potassium and bismuth. 1938, reprint 1963, (142 pages, 11 graphs), paper bound.
† Section 6: Concluding potassium compounds. 1938, reprint 1963, (156 pages, 47 graphs), paper bound.

System No. 24, Rubidium: 1937, reprint 1955, (250 pages, 7 graphs), paper and cloth bound.

System No. 25, Cesium:

Section 1: Occurrence. Preparation and properties of the metal. 1938, reprint 1955, (104 pages, 3 graphs), paper bound.
Section 2: Cesium compounds. Ecasesium (presently called Francium). 1938, reprint 1955, (164 pages, 5 graphs), paper bound.

System No. 26, Beryllium: 1930, reprint 1958, (180 pages, 10 graphs), paper and cloth bound.

System No. 27, Magnesium, Part A: History. Occurrence. The element. The alloys.

† Section 1: History. Occurrence. Preparation of the metal. 1937, reprint 1965, (156 pages, 1 graph), paper bound.
† Section 2: Properties of magnesium metal. 1937, reprint 1965, (216 pages, 13 graphs), paper bound.
Section 3: Magnesium alloys with silicon up to radium. 1942, reprint 1959, (110 pages, 56 graphs), paper bound.
Section 4: Concluding magnesium alloys. Surface treatment of magnesium and magnesium alloys. 1952, (336 pages, 96 graphs), paper bound.

System No. 27, Magnesium, Part B: Magnesium compounds.

† Section 1: Compounds up to magnesium and iodine. 1937, reprint 1963, (200 pages, 15 graphs), paper bound.
† Section 2: Compounds up to magnesium carbonates. 1938, reprint 1963, (130 pages, 4 graphs), paper bound.
† Section 3: Compounds up to magnesium and bismuth. 1938, reprint 1963, (92 pages, 4 graphs), paper bound.
† Section 4: Concluding magnesium compounds. Manufacture of magnesium compounds. 1939, reprint 1963, (127 pages, 16 graphs), paper bound.

System No. 28, Calcium, Part A: History. Occurrence. The element. The alloys.

Section 1: History. 1950, (68 pages), paper bound.
Section 2: Occurrence. The element. The alloys. 1957, (420 pages, 29 graphs), paper bound.

System No. 28, Calcium, Part B: Calcium compounds.

Section 1: Technology. 1956, (264 pages, 28 graphs), paper bound.
Section 2: Calcium compounds up to dithionite. 1957, (392 pages, 46 graphs), paper bound.
† Section 3: Concluding calcium compounds. 1961, (912 pages, 133 graphs), cloth bound.

System No. 29, Strontium: 1931, (239 pages, 26 graphs), paper bound.
† Supplement Volume, 1960, (306 pages, 39 graphs), paper and cloth bound.

System No. 30, Barium: 1932, reprint 1955, (390 pages, 31 graphs), paper and cloth bound.
† Supplement Volume, 1960, (569 pages, 76 graphs), paper and cloth bound.

System No. 31, Radium and Isotopes: 1928, (80 pages, 4 graphs), paper bound.

System No. 32, Zinc: 1924, reprint 1957, (329 pages, 14 graphs), paper and cloth bound.
Supplement Volume, 1956, (1025 pages, 191 graphs), paper and cloth bound.

System No. 33, Cadmium: 1925, (214 pages, 23 graphs), paper bound.
† Supplement Volume, 1959, (802 pages, 218 graphs), paper and cloth bound.

System No. 34, Mercury, Part A: History. Occurrence. The element. The alloys.

† Section 1: History. Occurrence. Preparation. Physical properties. 1960, (466 pages, 53 graphs), paper bound.
† Section 2: Electrochemistry. Chemical reactions. Alloys. 1962, (709 pages, 285 graphs), cloth bound.

System No. 34, Mercury, Part B: Mercury compounds.

† Section 1: Compounds up to mercury and nitrogen including other Hg compounds containing nitrogen. 1965, (400 pages, 28 graphs), cloth bound.
† Section 2: Mercury compounds with halogens. 1967.
† Section 3: Concluding mercury compounds. In press 1968.

System No. 35, Aluminum, Part A: History. Occurrence. The element. The alloys.

Division I:
† Section 1: History. Occurrence. Preparation. Allotropic modifications. Structure. Recrystallization. Physical properties. 1934, reprint 1966, (284 pages, 27 graphs), paper bound.
† Section 2: Corrosion. Electrochemical behavior of aluminum. 1934, reprint 1966, (166 pages, 3 graphs), paper bound.
† Section 3: Surface treatment of aluminum and aluminum alloys. 1936, reprint 1966, (84 pages, 23 graphs), paper bound.

Division II:
Section 4: Aluminum alloys with silicon up to radium. 1936, reprint 1953, (148 pages, 92 graphs), paper bound.
Section 5: Aluminum alloys with zinc up to uranium. 1937, reprint 1953, (204 pages, 108 graphs), paper bound.
† Section 6: Aluminum alloys with manganese up to rhenium. 1939, reprint 1966, (224 pages, 97 graphs), paper bound.
† Section 7: Aluminum alloys with iron. 1941, reprint 1966, (124 pages, 53 graphs), paper bound.
ternary Section 8: Ternary alloy systems: Al--Fe--C, Al--Fe--Si. 1950, (136 pages, 78 graphs), paper bound.

System No. 35, Aluminum, Part B: Aluminum compounds.

† Section 1: Compounds up to aluminum and carbon. 1933, reprint 1963, (308 pages, 10 graphs), paper bound.
† Section 2: Concluding compounds. 1934, reprint 1963, (305 pages, 33 graphs), paper bound.

System No. 35, Gallium: 1936, reprint 1955, (100 pages, 8 graphs), paper and cloth bound.

System No. 37, Indium: 1936, reprint 1958, (116 pages, 8 graphs), paper and cloth bound.

System No. 38, Thallium and Isotopes:

† Section 1: History. Occurrence. Preparation. Physical properties. Electrochemical behavior. Chemical reactions. Detection. 1939, reprint 1962, (186 pages, 6 graphs), paper bound.
† Section 2: Alloys. Compounds up to Tl-I. 1940, reprint 1962, (152 pages, 21 graphs), paper bound.
† Section 3: Concluding compounds. 1940, reprint 1962, (189 pages, 16 graphs), paper bound.

System No. 39, Rare Earth Elements:

Section 1: Summary. History. Occurrence. 1938, reprint 1955, (122 pages, 7 graphs), paper bound.

System No. 40, Actinium and Isotopes ($MsTh_2$): (The latter is the name sometimes used for the decay product ^{228}Ac). 1942, reprint 1955, (82 pages), paper and cloth bound.

System No. 41, Titanium: 1951, (481 pages, 100 graphs), paper and cloth bound.

† System No. 42, Zirconium: 1958, (448 pages, 57 graphs), paper and cloth bound.

† System No. 43, Hafnium: 1941, reprint 1964, (62 pages, 1 graph), paper and cloth bound.
Supplement Volume, 1958, (23 pages, 1 graph), paper and cloth bound.

System No. 44, Thorium and Isotopes: 1955, (406 pages, 35 graphs), paper and cloth bound.

† System No. 45, Germanium: 1931, reprint 1961, (62 pages, 2 graphs), paper and cloth bound.
Supplement Volume, 1958, (576 pages, 290 graphs), paper and cloth bound.

System No. 46, Tin: To be published.

System No. 47, Lead and Isotopes: To be published.

System No. 48, Vanadium, Part A: The element. Published 1968.

System No. 48, Vanadium, Part B: The compounds.

† Section 1: Compounds up to vanadium and bismuth, 1967.
† Section 2: Concluding compounds, alloys, and coordination compounds. 1967.

System No. 49, Niobium: To be published.

System No. 50, Tantalum: To be published.

System No. 51, Protactinium: 1942, reprint 1955, (99 pages), paper and cloth bound.

System No. 52, Chromium, Part A: History. Occurrence. The element and its alloys.

† Section 1: History. Occurrence. Technology. The elements up to physical properties. 1962, (418 pages, 38 graphs), cloth bound.
† Section 2: Electrochemistry. Chemical reactions. Alloys. 1963, (312 pages, 111 graphs), cloth bound.

† System No. 52, Chromium, Part B: Compounds (without complex compounds with neutral ligands). 1962, (942 pages, 74 graphs), cloth bound.

† System No. 52, Chromium, Part C: Coordination compounds with neutral ligands and ligands forming inner complexes. 1965, (431 pages, 31 graphs), cloth bound.

System No. 53, Molybdenum: 1935, reprint 1955, (393 pages, 13 graphs), paper and cloth bound.

System No. 54, Tungsten: 1933, reprint 1955, (397 pages, 30 graphs), paper and cloth bound.

System No. 55, Uranium and Isotopes: Including a part on transuranium elements. 1936, reprint 1955, (279 pages, 4 graphs), paper and cloth bound.

System No. 56, Manganese: To be published.

System No. 57, Nickel, Part A: History. Occurrence. The element.

† Division I: History. Occurrence. Technology. Preparation. Published 1967.

Division II:

† Section 1: Physical properties of the element. To be published 1968.

† Section 2: Electrochemical behavior. Chemical reaction. Detection and determination. To be published 1968.

System No. 57, Nickel, Part B: Alloys and Compounds.

† Section 1: The alloys of nickel. 1965, (314 pages, 141 graphs), cloth bound.

† Section 2: Compounds up to nickel and polonium. 1966, (450 pages, 106 graphs) cloth bound.

† Section 3: Concluding nickel compounds. Published 1966.

System No. 57, Nickel, Part C: Not within our scope.

System No. 58, Cobalt, Part A: History. Occurrence. The element. Cobalt compounds (without cobalt ammines).

Section 1: History. Occurrence. The element and its alloys. 1931, (220 pages, 19 graphs), paper bound.

Section 2: Cobalt compounds (without cobalt ammines). 1932, (282 pages, 14 graphs), paper bound.

† Supplement Volume, 1961, (886 pages, 188 graphs), cloth bound.

Cobalt in alloyed steel see: System No. 59, Iron, Part D, Supplement 2, "Magnetic Materials."

System No. 58, Cobalt, Part B: and Supplement Volume: Not within our scope.

System No. 59, Iron, Part A: History, Occurrence. The element. Iron metallurgy. The alloys.

Division I:

Section 1: History. Occurrence. Forms and preparation of pure iron. 1929, reprint 1955, (224 pages, 2 graphs), paper bound.

Section 2: The atom. Allotropic modifications. Crystallographic and optical properties of pure iron. Electrochemical behavior. 1929, (88 pages, 4 graphs), paper bound.

Section 3: Passivity, chemical reactions, and corrosion or pure and technical iron. Metallurgy of iron. 1930, reprint 1955, (274 pages, 28 graphs), paper bound.

Section 4: Continuing iron metallurgy. 1932, reprint 1955, (260 pages, 174 graphs), paper bound.

Section 5: Concluding iron metallurgy. 1933, reprint 1960, (320 pages, 213 graphs). Subject index for Division I, paper bound.

† Supplement Volume I for Sections 3-5: Gmelin-Durrer, Metallurgy of Iron. Volume 1a, Volume 1b. Edition IV. History. Definition. General Physico-chemical Principles. Thermal pretreatment of Iron Ores. Vol. 1a: 1964, (583 pages). Vol. 1b: 1964, (344 pages, 668 graphs), cloth bound.

Division II:

Section 6: Systems of iron. Fe-S to Fe-C. Freezing, cooling, hardening, and surface treatment of carbon steels. 1934, (254 pages, 146 graphs), paper bound.

Section 7: Continuing Fe-C. Magnetic and electrical properties of pure and

carbon bearing iron. 1934, reprint 1957, (214 pages, 120 graphs), paper bound.

Section 8: Concluding Fe-C. Mechanical and thermal properties of pure and ternary carbon bearing iron. Systems Fe-C-H to Fe-Be-K. 1936, (184 pages, 92 graphs), paper bound.

Section 9: Systems of Fe with Mg, Ca, Sr, Ba, Ra, Zn, Cd, Hg, Al, Ga, In, Tl, rare earths, Ac, Ti, Zr, Hf, Th, Ge, Sn, Pb, V, Nb, Ta, Pa. 1939, reprint 1955, (129 pages, 58 graphs), Subject index for Division II, paper bound.

Division III: Systems of iron with Cr, Mo, W, U, Mn, Ni, Co, Cu. To be published.

System No. 59, Iron, Part B: Iron compounds.

Section 1: Compounds up to Fe-Cl. 1929, (312 pages, 22 graphs), paper bound.
Section 2: Compounds up to Fe-C. 1930, reprint 1957, (200 pages, 15 graphs), paper bound.
Section 3: Continuing compounds Fe-C. 1930, reprint 1955, (144 pages), paper bound.
Section 4: Compounds up to Fe-Bi. 1931, reprint 1957, (216 pages, 9 graphs), paper bound.
Section 5: Concluding compounds. 1932, (294 pages, 16 graphs), paper bound.

System No. 59, Iron, Part C: Test methods and mechanical and technological properties of carbon bearing and alloyed steels. Not within our scope.

System No. 59, Iron, Part D: Magnetic and electrical properties of alloyed steels. 1936, (466 pages, 342 graphs), paper bound.

1. Supplement Volume to iron Part A, Section 7, and iron Part D: Magnetic and electrical properties of iron and its alloys. 1937, reprint 1955, (148 pages, 166 graphs), paper and cloth bound.
† 2. Supplement Volume: "Magnetic materials", supplementing iron Part D, cobalt and nickel volumes (also Supplements 56, 52). 1959, (580 pages, 308 graphs), paper and cloth bound.

System No. 59, Iron, Part E: Corrosion and corrosion protection of alloyed steels. To be published.

System No. 59, Iron, Part F: Iron and steel analysis.

Division I:

Section 1: Sampling. Gases. Residue analysis. 1939, reprint 1955, (164 pages, 30 graphs, and 4 pages of illustrations), paper bound.
Section 2: Detection and determination of alloying elements. 1941, reprint 1955, (266 pages, 6 graphs). Subject index for Divisions I and II, paper bound.

Division II:

Section 1: Primary alloying elements. Other elements. 1939, reprint 1955, (164 pages, 7 graphs), paper bound.
Section 2: Concluding other elements. Special methods. Standards. 1939, reprint 1955, (224 pages, 12 graphs), paper bound.

System No. 59, Iron, Part G: Cast Iron. To be published.

System No. 60, Copper, Part A: History. Occurrence. The element.

Section 1: History. Occurrence. Metallurgy. Manufacture of copper salts. 1955, (710 pages, 190 graphs), paper bound.
Section 2: The element. Formation and preparation. Physical properties.

Electrochemical behavior and chemical reactions. Physiological hazards. Detection and determination. 1955, (755 pages, 235 graphs), paper bound.

System No. 60, Copper, Part B: Copper compounds.

Section 1: Copper compounds up to copper tellurates. 1958, (624 pages, 58 graphs), paper bound.
† Section 2: Copper-boron to copper-bismuth compounds. 1961, (352 pages, 38 graphs), cloth bound.
† Section 3: Copper-lithium to copper-iron compounds. Reactions of copper ions. 1965, (476 pages, 73 graphs), cloth bound.
† Section 4: Not within our scope.

System No. 60, Copper, Part C: Alloys of copper. Publication deferred.

System No. 60, Copper, Part D: Electrical properties of copper oxides. 1963, (168 pages, 136 graphs), cloth bound. Not within our scope.

System No. 61, Silver: To be published.

System No. 62, Gold:

Section 1: History. 1950, (100 pages), paper bound.
Section 2: Occurrence. Manufacture. Formation and preparation in pure state. Special forms. Colloidal gold. Surface treatment. 1954, (306 pages, 20 graphs), paper bound.
Section 3: Physical Properties. Electrochemical behavior and chemical reactions. Detection and determination. Gold compounds. Gold alloys. 1954, (558 pages, 201 graphs), paper bound.

System No. 63, Ruthenium: 1938, reprint 1955, (124 pages, 1 graph), paper and cloth bound.

System No. 64, Rhodium: 1938, reprint 1955, (153 pages, 5 graphs), paper and cloth bound.

System No. 65, Palladium:

Section 1: The element. 1941, reprint 1955, (114 pages, 19 graphs), paper bound.
Section 2: Palladium compounds. 1942, reprint 1955, (321 pages, 51 graphs), paper bound.

System No. 66, Osmium: With Supplement on ecaosmium (presently called plutonium). 1939, reprint 1955, (100 pages), paper and cloth bound.

System No. 67, Iridium: 1939, reprint 1955, (196 pages, 3 graphs), paper and cloth bound.

System No. 68, Platinum, Part A: History. Occurrence. Formation and preparation of all platinum metals. Platinum alloys.

† Section 1: History. Occurrence. 1938, reprint 1963, (144 pages, 2 graphs), paper bound.
† Section 2: Concluding occurrence. 1939, reprint 1963, (166 pages, 1 graph), paper bound.
† Section 3: Preparation of platinum metals. 1939, reprint 1963, (129 pages), paper bound.
Section 4: Detection and determination of platinum metals. 1940, reprint 1959, (102 pages), paper bound.

Section 5: Platinum metals alloys: ruthenium, rhodium, palladium. 1959, (186 pages, 61 graphs), paper bound.
Section 6: Platinum metals alloys: osmium, iridium, platinum. 1951, (136 pages, 74 graphs), paper bound.

System No. 68, Platinum, Part B: The element platinum.

† Section 1: Physical properties of the metal (up to thermal properties). 1939, reprint 1963, (72 pages, 7 graphs), paper bound.
† Section 2: Physical properties of the metal (up to electrical properties). 1939, reprint 1963, (108 pages, 4 graphs), paper bound.
† Section 3: Electrochemical behavior of the metal (over-voltage phenomena). 1939, reprint 1963, (82 pages, 48 graphs), paper bound.
Section 4: Concluding the electrochemical behavior. Chemical reactions. 1942, reprint 1958, (76 pages, 11 graphs), paper bound.

System No. 68, Platinum, Part C: Platinum compounds.

† Section 1: Platinum compounds up to platinum and bismuth. 1939, reprint 1962, (140 pages, 13 graphs), paper bound.
† Section 2: Compounds up to platinum and cesium. 1940, reprint 1962, (120 pages, 3 graphs), paper bound.
† Section 3: Compounds up to platinum and iridium. 1940, reprint 1962, (92 pages, 1 graph), paper bound.

System No. 68, Platinum, Part D: Not within our scope.

Systems No. 69/70, Masurium (presently called Technetium)/Rhenium: 1941, reprint 1955, (10 and 154 pages, 12 graphs), paper and cloth bound.

System No. 71, Transuranium elements: To be published.

Goldsmith, A., Waterman, T. E., Hirschhorn, H. H., editors, Handbook of Thermo-Physical Properties of Solid Materials (5 volumes), published by Macmillan, New York, 1961, sponsored by Wright-Patterson Air Force Base at Armour Research Foundation (now called IITRI).

For a recent version of this compilation, see under Y. S. Touloukian, Thermophysical Properties of High Temperature Solid Materials, published by Macmillan, New York, 1967. This work contains some 50% more data material than the earlier one.

The tabulated data are based on literature published between 1940 and 1957; alloys and intermetallics with melting points above 1000°F are included. The properties covered include melting point, density, latent heat, specific heat, thermal conductivity, thermal diffusivity, emissivity, reflectivity, thermal expansion, vapor pressure, and electrical resistivity.

The manuscripts are also available from the Clearinghouse, Document No. AD 247, 193, and from U. S. Department of Defense, Wright-Patterson AFB, Ohio, WADS Technical Report 58-476, 1960.

Goodwin, T. C., Jr., and Aryton, M. W., Thermal Properties of Certain Metals, Wright Air Development Center (WADC) Technical Report 56-423, USAF Delivery Order No. AF 33(616)55-10.

Part I, 1956, (available from the Clearinghouse as AD 111,846). Values are listed for heat capacity, thermal conductivity, emmissivity, thermal diffusivity, and thermal expansion of Mo, Cr, Ta, graphite, and Cu.

Part II, 1958, (available from the Clearinghouse as AD 157,169). The same properties as are listed in Part I are listed here for Fe, Be, Ir, Rh, Pd, Pt and W.

Gray, D. E., coordinating editor, American Institute of Physics Handbook, 2nd edition, published by McGraw-Hill, New York, 1963.

This is a basic handbook covering the properties included in our scope, giving tables of values for many materials including some of the metals. Alloys are also included when there are important materials described by the tabulated properties (e.g. magnetic alloys will be tabulated extensively under magnetic properties, but will be absent in other tables). For specific properties see the descriptions under the general categories in Table III of this Appendix. On the first two pages of this book a listing of the basic handbooks published by McGraw Hill is given. Subjects also include marginally pertinent topics as well as non-pertinent ones (engineering, industrial, and nuclear data as well as mathematical tables).

Gschneidner, K. A., Jr., Physical Properties and Interrelationships of Metallic and Semimetallic Elements (a chapter from the Solid State Physics series, edited by F. Seitz and D. Turnbull: 16, 275-446, 1964), published by Academic Press, New York.

This article presents a compilation of evaluated data giving tables and graphs for the materials described in the title, on the following properties: elastic, bulk, and shear moduli, Poisson's ratio, isothermal atomic volume, primary and secondary fixed points on the International Practical Temperature Scale, melting and boiling points, heats of fusion and sublimation, cohesive energy, specific heat (also electronic) at constant pressure and at constant volume, Debye temperatures obtained by various experimental methods, entropies of fusion and vaporization, Grüneisen constant, and size factors.

Haas, C. W. and Jarrett, H. S., editors, Magnetism and Magnetic Materials: 1966 Digest.

This is a survey of the literature appearing in 1965. For further annotation, see under Magnetic Materials Digest in the Magnetic Properties category of Table III in this Appendix.

Hampel, C. A., editor, Rare Metals Handbook, 2nd edition, published by Reinhold, New York, 1961 (732 pages).

The book contains separate chapters by various authors on 55 different metals with references to both secondary sources and the original literature. Information ranging from the economic value of the metals to their physical properties is included. Summarizing tables are given for electrical resistivities, thermal conductivities, densities, elastic moduli, thermal neutron cross sections, specific heats, melting and boiling points, and latent heats of fusion and vaporization. Some phase diagrams and lattice structures of binary alloys are also included.

Hellwege, K. H. and A. M. (editors)

See under Landolt-Börnstein, listed in this Table.

Hoyt, S. L., Metal Data (revised edition of Metals and Alloys Data Book), published by Reinhold, New York, 1952.

This is a basic reference book primarily for engineering properties of commercial alloys. Data on physical properties are occasionally included. Among these properties are: density, thermal expansion, electrical resistivity, thermal conductivity, melting point, specific heat, and moduli of elasticity.

International Nickel Company, 67 Wall Street, New York, New York, 10005

The International Nickel Company prints short condensed reviews of the platinum group metals and their alloys, as well as of commercial alloys, mainly steels. The physical properties are summarized at room temperature. Included in the more

detailed summaries are: crystal structure, density, melting and boiling points, electrical resistivity and its temperature coefficient, linear thermal expansion, specific heat, Young's modulus, thermal emf, reflectivity, emissivity, and thermionic work function. For a recent compilation on the properties of nickel and its alloys, see under S. J. Rosenburg, Table II of this Appendix.

Jackson, C. B. and Mansteller, J. R., (a chapter on liquid metals in Volume III (1962) of Modern Materials: Advances in Development and Application, edited by H. H. Hausner), published by Academic Press, New York (in 5 volumes).

Tables are given for physical properties of metals with melting points below 660°C (melting point of Al). The properties given for metals and a few alloys include the melting points, and for the metals only: electrical resistivity,
liquid thermal conductivity, density, viscosity, surface tension, boiling point, latent heats, vapor pressure, specific heat, and neutron cross sections.

Kirk, R. E. and Olthmer, D. F., editors, Encyclopedia of Chemical Technology, published by Interscience, New York.

Generally, this encyclopedia is directed toward chemical descriptions of various metals, and of plastics, petroleums, perfumes, etc. A particular heading brought to our attention is Platinum Group Metals, Alloys, and Compounds (10, 819-859, 1953) which gives tables of physical properties of Ru, Rh, Pd, Os, Ir, and Pt. The properties include: electrical resistivity and its temperature coefficient, thermal conductivity, magnetic susceptibility, Young's modulus, work functions, heat capacity, thermal expansion, and vapor pressure (at the melting point). Apparently not all of the elements are described separately in these volumes, but rather, under generalized names.

Landolt-Börnstein Tables - Zahlenwerte und Funktionen aus Physik, Chemie, Astronomie, Geophysik und Technik, edited by K. H. and A. M. Hellwege, published by Springer-Verlag, New York.

In these extensive tables compilations are published as prepared by (1) scientists actively involved in research in the concerned topics, and (2) existing data centers. The quality and degree of completeness of the various compilations, therefore, varies. Some volumes are devoted to listings by the property in question, and other volumes describe in detail a selected group of materials. Overlap of the contents thus exists appropriately. In some cases there appears to be a gap in the availability of specific data. A few topics in our List of Properties as yet have not been covered (examples are: Knight shifts, Fermi surface, and band structure determinations for the metals; they cover these later two properties for semiconductors). The rate of updating is slightly sluggish. At times the data given in the tables are copied directly from the original literature. Discussions are limited and the original literature must often be consulted. These tables are very extensive (about 30 volumes) and form one of the most complete general reference compilations available at present. In the past they were published in German, but recently have included English tables of contents and page headings. It is expected that English will be used in the text in future volumes.

The annotations of the specific volumes as are pertinent to this compilation are given in the appropriate locations of this Table: those volumes covering spec-
liquid ific topics are listed under their categories, those volumes discussing materials are listed under those materials (Table II). Two sections on liquid alloys are included in the following volumes:

II Band, 9. Teil - Magnesische Eigenschaften I, 1962 (sections in German and English.)

IV Band: TECHNIK. 2. Teil - Leichtmetalle. Sonderwerkstoffe. Halbleiter. Korrosion., 1965 (in German).

Loung, P. Y., Graphic Handbook of Chemistry and Metallurgy, published by the Chemical Publishing Company, New York, 1965.

Values of the properties of the elemental materials are plotted as a function of increasing atomic number. The pertinent properties given are: atomic volumes, melting points (also for oxides), boiling points, densities, crystal structures, compressibilities, electrical resistivities, superconducting transition temperatures, latent heats, magnetic susceptibilities, elastic and shear moduli, thermal conductivities, thermal expansion, and thermal neutron absorption cross sections. Binary alloy formation information is also included.

Lyman, T., editor, Metals Handbook, 8th edition, published by the American Society for Metals, Metals Park, Ohio.

Volume I — Properties and Selection of Metals (1961). A major compilation primarily directed toward use by metallurgical engineers. Many important physical properties are included. Among these are for the metals: melting points, boiling points, densities, thermal expansions, latent heats, specific heats, structure and lattice parameters, electrical resistivity, and thermal conductivity. For magnetic steels densities, thermal expansions, resistivities and magnetization curve parameters (H_c, B_r, $(HB)_{max}$) are included. For some ternary other alloys values are given for: atomic volumes, densities, lattice structures, resistivity and its temperature coefficients, thermal emf's, thermal expansions, thermal conductivities, vapor pressures, and other properties.

Volume II — Heat Treating, Cleaning, Finishing (1964). Contains no information regarding physical properties.

Volume III — Machining (1967). Contains no information regarding physical properties.

Lyon, R. N., editor, Liquid-Metals Handbook, 2nd edition, Report NAVEXOS P-733 (rev.), 1942, U. S. Government Printing Office, Liquid-Metals Handbook: Sodium - (NaK), Supplement, C. B. Jackson, editor, 1955, see under NaK, Table II for annotation.

liquid — A chapter is included giving physical properties of liquid metals tabulating thermal and electrical properties together with short discussions and giving phase diagrams (liquidus curves only) of low melting point alloys, including ternary higher order alloys. Other chapters cover topics such as system design, safety precautions, and other information of this kind. Some of the specific properties for the metals are: melting points, boiling points, latent heats, vapor pressures, specific heats, thermal expansions (also of fusion), densities, viscosities, electrical resistivities, thermal conductivities, and also neutron cross sections. Free energies of formation for some of the metallic oxides are also included.

Margolin, H. and Nielsen, J. P., (a chapter on titanium in Volume II, 1960, of Modern Materials: Advances in Development and Application, edited by H. H. Hausner), published by Academic Press, New York (in 5 volumes).

This chapter gives many physical properties and some phase diagram information, with 165 references to the literature. For general annotation, see under Ti in Table II of this Appendix.

Merriman, A. D., A Concise Encyclopedia of Metallurgy, published by Elsevier, New York, 1965.

Definitions of metallurgical terms, named alloys, etching reagents, etc., are given in somewhat more detail than is usual in a simple dictionary. Some of the definitions are illustrated by tables or charts showing composition or properties. Also included are brief tables of common abbreviations and symbols (British), and

abbreviations used in foreign (mostly German) literature. Descriptions of general topics are kept very brief (for example, superconductivity is restricted to some 100 words without mention of the major superconductors). One of the main values of the book to the physicist probably is the information on compositions of commercially named alloys. The encyclopedia includes a brief description of the metals. A compact table gives values of some of their physical properties, including electrical resistivities, thermal conductivities, heat capacities, thermal expansions, densities, moduli of elasticity, and their melting and boiling points.

Miller, G. L,, (a chapter on zirconium in Volume I of Modern Materials: Advances in Development and Application, edited by H. H. Hausner), published by Academic Press, New York, 1958 (in 5 volumes).

This chapter includes a listing of several physical and engineering properties, with 104 references to the literature. For general annotation, see under Zr in Table II of this Appendix.

Morrish, A. H., Prosen, R. J., and Rubens, S. M., editors, Magnetic Materials Digest: The Literature of 1963, published by M. W. Lads, Philadelphia, 1964.

A survey of the literature appearing in 1963. For further annotation, see under Magnetic Materials Digest in the Magnetic Properties category of Table III.

Mott, N. F., Electrons in Disordered Structures, Advances in Physics 16, 49, 1967.

The author gives a state-of-the-art review which includes some data throughout the text, though generally not in the sense of data compilations. A one page table giving electrical conductivities and their temperature coefficients for liquid semiconductors and semimetals is given on page 100. The paper covers topics such as: density of states, electrical conductivity, optical absorptivity, liquid metals at high temperatures and pressures, metal-ammonia solutions, and metal-tungsten bronzes. Twelve pages of references to the original literature are given.

liquid

Mott, N. F., The Cohesive Forces in Metals and Alloys, Reports on Progress in Physics: 25, 218-243, 1962, published by the Physical Society, London (A. C. Strickland, executive editor).

This review article includes several short tables and graphs throughout the text, ranging from cohesive energies, free energies, enthalpies, etc., of solution, and other thermodynamic data to density of states functions, Hall effect, and magnetic susceptibility.

Mott, N. F. and Jones, H., Theory and Properties of Metals and Alloys, published by Claredon Press, 1936; reprinted from corrected sheets by Dover Publications, New York, 1958.

The authors develop, with simple quantum-mechanical treatments, the basic relations describing the properties of metals and alloys. Many data are given throughout the text, though many of these are several years old. The categories treated in the text include: electronic transport properties, magnetic properties, mechanical properties, quantum description of solids, radiation (including the soft X-ray region), and thermodynamic properties.

Palmer, W., editor, Magnetic Materials Digest: The Literature of 1961.

A survey of the literature appearing in 1961. For further annotation, see under Magnetic Materials Digest in the Magnetic Properties category of Table III.

Pascal, P., general editor, Nouveau Traité de Chimie Minérale, Volume XX, Alliages Metalliques (3 sections), published by Masson et Cie, 120 Boulevard Saint-Germain, Paris 6^{e}, (text in French).

This series represents a major compilation and evaluation of data. Each metal is given a very detailed treatment from many points of view. Essentially all the properties of our interest are covered for the metals and phase diagrams for the alloys. The bibliographies are indicative of a major literature search. No plans for updating have been formulated at this time of writing.

The first 19 volumes are on specific materials. Volume 20 is specifically on
ternary alloys. It has phase diagrams and references to the original literature. (Further annotation for this volume under Mechanical and Thermodynamic Properties.)

The volumes and sections are listed in the appropriate locations of Table II.

Pietsch, E., editor - See under Gmelin in this Table.

Peters, R. L., Materials Data Nomographs, published by Reinhold, New York, 1965 (224 pages).

Data are given only in graphical representations and include the following properties: (engineering) strength of materials, elastic constants, density, electronic and magnetic properties, thermodynamic properties and superconducting transition temperatures. A fairly good coverage is given for the more practical metals and alloys, and occasionally, the known values for the elemental metals are given. Nuclear magnetic moments, nuclear scattering cross sections, velocity of sound, and reflectivity are occasionally represented as well.

The graphical representations are useful for rough value determination only.

Robson, J., Basic Tables in Physics, published by McGraw-Hill, New York, 1967.

This handbook gives general tables in compact form (354 pages, paper-back) covering tables of mathematical functions, electricity and magnetism, mechanical properties, optical and acoustic properties, and thermodynamic properties of a selected group of materials. Generally, the book is not of any use as a reference or listing of best values in any given field because each table gives a sample representation of all materials that are available in the more extensive handbooks. Many of the tables are parts taken from larger compilations. The tables were set out to be published in the form of a manipulable size handbook, rather than in bulky volumes. (The book has a spiral binder and is fairly lightweight).

Rosebury, F., Handbook of Electron Tube and Vacuum Techniques, published by Addison-Wesley, New York, 1965.

This data book includes some tables of data pertinent to our scope. Among the properties tabulated are: thermocouple emf's and thermal conductivities, densities, thermal expansions, melting points, electrical resistivities, elastic properties, and a few magnetic properties of commercial alloys.

Sachs, G., editor, Air Weapons Materials Application Handbook: Metals and Alloys, 1st edition, available from the Clearinghouse as AD 252,301, 1959.

Sections on non-ferrous, ferrous, high temperature alloys are presented. A cross-index of the commercial alloys is included. Values of many chemical, physical, and mechanical properties are given. The bulk of the contents covers mechanical
ternary properties of alloys containing 3 or more components. Included are thermal and electrical and magnetic properties. The mechanical properties include moduli of elasticity and rigidity. Some low-temperature data are also given. References to the literature are not included.

Samsonov, G. V., editor, High Temperature Materials, (translated from the Russian), published by Plenum Press, New York, 1964.

Volume I Materials Index by P. T. B. Shafter
Volume II Properties Index by G. V. Samsonov

This is a handbook giving critically evaluated data falling in several of our covered categories. Among the properties are: electrical resistivity and its temperature coefficient, thermal conductivity, Hall effect and thermoelectric power, Curie temperature, atomic radius, density, shear strength, compressive
ternary strength, modulus of elasticity, compressibility, lattice structures and parameters, emission coefficient, infrared absorption spectra and thermionic emission properties, dielectric constant, entropies, latent heats of various transitions, vapor pressure, melting and boiling points, specific heats, thermal expansions, Debye temperature and diffusion parameters.

The materials include the elemental metals, intermetallics, oxides, silicides, borides and carbides, as well as some of their alloys.

Samsonov, G. V., Refractory Compounds of the Rare Earth Metals with Non-metals, published by Consultants Bureau, New York, 1965.

The book gives a compilation of various physical, chemical, and structural types of information together with pages of discussions. Included are the borides, carbides, nitrides, silicides and sulfides of the rare earth metals. The properties include: phase diagrams, lattice parameters, ionization potentials, thermal expansions, heats of formation, electrical resistivity, thermionic emission, electron work functions, magnetic moments, magnetic susceptibilities, thermoelectric emf's, thermal conductivities, coefficients of refraction and absorption constants, soft X-ray spectra, melting points, latent heats, heat capacities, densities, Hall coefficients, work functions, secondary emission; in short essentially all the data available to the authors on the materials in question.

Savitskii, E. M., Terekhova, V. F., Burov, I. F., Markova, I. A., and Maumkin, O. P., Rare Earth Alloys, available from the Clearinghouse , number AEC-TR-6151, 1962, (349 pages, paper-back).

The book is divided into three chapters. The first one discusses the electronic structure and the chemical, physical, mechanical, and technological properties of
ternary the rare earth metals. The second chapter contains binary and ternary phase diagrams (generally without lattice parameter data) of rare earth metals, and the interactions between rare earth elements and many elements of the periodic table are discussed. The third chapter discusses rare earth metals in ferrous and nonferrous metallurgy, in heat-resistant and high melting point alloys, in atomic technology, in radio and electronics, in the silicate industry, in chemistry, medicine, etc.

The data were compiled using all published literature, as well as unpublished experimental results from Russian laboratories. For the rare earth metals, tables of physical properties are given. These include: electrical resistivity and its temperature coefficients, thermal conductivity, magnetic transition temperatures and magnetization curve parameters, elastic and shear moduli, Poisson's ratio, density, structural data, specific heats, thermal expansion, and several of the other thermodynamic properties, including those for allotropic transformations.

The book has an appendix concerning isotopes of the rare earth metals, the composition and structure of chemical compounds, and also a discussion of the most likely applications of rare earth metals. The book also has a subject index, which considerably facilitates its use.

Seitz, F., The Physics of Metals, published by McGraw-Hill, New York, 1943.

This is primarily a textbook describing metals and alloys with the use of quantum mechanics. Graphs and short tables of values are given throughout the text. Among the data are: elastic constants, diffusion constants and activation energies, rough band widths, and densities of states. Parts of the book are devoted

to engineering properties.

Slonczewski, J. D. and Palmer, W., editors, Magnetic Materials Digest: The Literature of 1960.

A survey of the literature appearing in 1960. For further annotation, see under Magnetic Materials Digest in the Magnetic Properties category of Table III.

Smithells, C. J., Metals Reference Book, (Volumes I, II, III, 1967, 4th edition), published by Butterworth, London, 1962, also available from Plenum Press, New York.

ternary The books contain equilibrium diagrams of binary and ternary systems and references to quaternary and quinary systems; many of these diagrams were taken from secondary sources, however. The volumes are oriented toward engineering applications. Phase diagrams are included and thermodynamic quantities are tabulated for many of the more common alloys. For the metals, tables and graphs are given for density, thermal expansion, melting point, boiling point, electrical resistivity and its coefficients, thermal conductivity, elastic properties, work functions, secondary emission, superconductivity, transition temperatures, permeabilities, saturation magnetization, and other magnetic properties. Such tables are given for metals and a rather select group of alloys only. Volume II gives a relatively good coverage of diffusion data.

Steinitz, R., Borides - Part B - Fabrication, Properties, and Applications, (a chapter from the book Modern Materials 2, 191-224, 1960, edited by H. H. Hausner).

This chapter is devoted primarily to mechanical and chemical properties of borides. A few data on density, elastic properties, and melting points are included.

Tipton, C.R., Jr., editor, Reactor Handbook, Volume I Materials. (See under U. S. Atomic Energy Commission).

Touloukian, Y. S., director and general editor, Thermophysical Properties Research Center, Purdue University, West Lafayette, Indiana.

Several books containing data compilations have been compiled by the Center. Among these:

1. Retrieval Guide to Thermophysical Properties Research Literature.
   Three volumes are presented here which give bibliographic information only on the following properties: thermal conductivity, viscosity, specific heat, emissivity, diffusion coefficient, thermal diffusivity and Prandtl number. This is not a data book.

2. Recommended Values of Thermophysical Properties of Eight Alloys, Major constituents (elements) and Their Oxides, (a report prepared under Sub-Contract No. CST-7590 of NASA Order R-45.)
   The properties included in this report are: thermal conductivity and diffusivity, viscosity, thermal emissivity, emittance, specific heat, density, and surface tension.

3. Standard Reference Data on the Thermal Conductivity of Selected Materials, NSRDS-NBS 8 (Nov. 25, 1966) by R. W. Powell, C. Y. Ho, and P. E. Liley, available from the Clearinghouse.
   Included among the materials are: aluminum, copper, gold, silver, iron, Armco iron, manganin alloy, mercury, platinum, tungsten and a 40% Rh-60% Pt alloy.

4. Thermophysical Properties of High Temperature Solid Materials, published by Macmillan, New York, 1967.
   Exhaustive coverage of thermophysical properties is given, including data taken at high pressures. The materials include metals and alloys (mainly binary) and the data are given in graphical form together with some numerical

values. When non-agreeing data exist, critical evaluation may not be included. For the most probably values listed no error estimates are given. Occasionally data are taken from secondary references and often data sheets from the earlier volumes by Goldsmith, Waterman, and Hirschhorn are repeated, or sections thereof, deleting information that was previously listed without replacement by newer data. The data are published in the following volumes:

Volume 1. Elements.
Volume 2. Nonferrous Alloys.
Volume 3. Ferrous Alloys.
Volume 4. Oxides and their Solutions and Mixtures.
Volume 5. Nonoxides and their Solutions and Mixtures, Including Miscellaneous Ceramic Materials.
Volume 6. Intermetallics, Cermets, Polymers and Composite Systems.

In each of these volumes the following properties are evaluated: density, melting point, heat of fusion, heat of vaporization, heat of sublimation, electrical resistivity, specific heat (at constant pressure), thermal conductivity, thermal expansion, absorptance, emittance, reflectance, transmittance, and vapor pressure.

These volumes are a recent version of the compilation by Goldsmith, Waterman, and Hirschhorn (cut-off date of compilation 1957) and contain some 50% more data material.

5. Thermophysical Properties Research Center Data Books.
These loose leaf data sheets have been published at set intervals, giving data in the form of graphs and numbers, but not discussions of the evaluations. It is expected that the size of the data sheets (formerly 11" x 17") will be reduced to a more manageable size and that these loose leaf sheets will be regrouped and published by a commercial publisher in the near future (1968). Volume I tabulates evaluated data of metallic elements and their alloys (mainly binary) in the solid, liquid, and gaseous states. The other two volumes deal with subjects not included in the scope of the Alloy Data Center. The properties include: emittance, absorptance, reflectance, transmittance (hemispherical, normal, angular, total, and spectral), thermal conductivity, diffusivity, viscosity, and specific heat.

liquid

U. S. Atomic Energy Commission, Division of Technical Information, Reactor Handbook, published by Interscience, New York.

Volume I — Materials, Tipton, C. R., Jr., editor, 1960.
This volume includes several chapters on fuel materials, including their physical properties. Among the materials are: U, Th, Pu, Co, Cr, steels, Mg, Mo, Nb, Ni, Ta, W, Al, Ag, Be, rare earths, B, Hf, Cd, Ti, V, Zr, and their alloys. Liquid metals and alloys are also included. Each mentioned metal is discussed in a separate chapter by contributing authors. A bibliography on (binary) constitutional diagrams is given in an appendix.

liquid

Volume II — Fuel Processing, Stoller, S. M. and Richards, R. B., editors, 1961.
Not within our scope.

Volume III — Part A, Physics, Soodak, H., editor, 1962.
Densities and cross sections for various situations are tabulated. Other nuclear data included are mainly outside our scope.

Volume IV — Engineering, McLain, S. and Martens, J. S., editors, 1964.
Not within our scope.

U. S. Department of the Interior, Bureau of Mines, Bulletins of interest:

Number	Title	Pages	Year
434	Contributions to the Data on Theoretical Metallurgy (henceforth abbreviated CDTM), part IX, Entropies of Inorganic Substances (by K. K. Kelly).	115	1941
476	CDTM, part X, High-Temperature Heat-Content, Heat Capacity, and Entropy Data for Inorganic Compounds (by K. K. Kelly).	235	1949
477	CDTM, part XI, Entropies of Inorganic Substances (by K. K. Kelly).	141	1950
542	CDTM, part XII, Heats and Free Energies of Formation of Inorganic Oxides (by J. P. Coughlin).	77	1954
561	Zirconium - Its Production and Properties (by S. M. Shelton).	165	1956
584	CDTM, part XIII, High-Temperature Heat-Content, Heat Capacity, and Entropy Data for the Elements and Inorganic Compounds (by K. K. Kelly).	232	1960
592	CDTM, part XIV, Entropies of the Elements and Inorganic Compounds (by K. K. Kelly and E. G. King).	149	1961
601	CDTM, part XV, A Reprint of Bulletins 383, 384, 393, and 406 (by K. K. Kelly).	525	1962
605	Thermodynamic Properties of 65 Elements - their Oxides, Halides, Carbides, and Nitrides (by C. E. Wicks and F. E. Block).	146	1963
619	Corrosion Properties of Titanium and its Alloys (by D. Schlain).	228	1964
624	Manganese-Copper Damping Alloys (by J. W. Jensen and D. F. Walsh).	54	1965
631	Nature of the Carbides of Iron (by L. J. E. Hofer).	59	1966

van Arkel, A. E., Reine Metalle, published by Verlag von Julius Springer, Berlin, 1939.

The book has an introductory part on the production and purification of metals. The remaining chapters are devoted to descriptions of each of the metals. Some of the chapters are in German, and a few in French and English. Some of the chapters are written by other authors. Various physical properties of the metals are given (as were available at that time).

Vogt, E., Physikalische Eigenschaften der Metalle, published by Akademische Verlagsgesellschaft Geest & Portig, K.-G., 1958 (in German); available from Johnson Reprint Co., New York.

The book describes many properties pertinent to metals and alloys. Tables and graphical representations of properties for the more common metals include values for: electrical resistivity, magnetic susceptibility, magnetic moments, coercive force, residual magnetization, $(HB)_{max}$, magnetization curves, magnetostriction, saturation magnetization, permeability, Curie temperature, atomic volume, elastic constants and other elastic properties, thermal expansion (also Grüneisen constants), melting points of the metals, electronic specific heat, specific heat as a function of temperature, and other properties.

Vol, A. E., Handbook of Binary Metallic Systems (translated from the Russian), available from the Clearinghouse as Document Numbers TT 66-51149 and TT 66-51150.

Volume I Physiochemical Properties of the Elements. Systems of Actinium, Aluminum, Americium, Barium, Beryllium, Boron and Nitrogen, 1959, (635 pages).

Volume II Physicochemical Properties of the Elements. Systems of Bismuth, Dysprosium, Europium, Gadolinium, Gallium, Germanium, Hafnium, Holmium, Hydrogen, Iron, Tungsten and Vanadium, 1962, (870 pages).

The handbook contains phase diagram information on approximately 260 binary alloys. Descriptions of the diagrams are included. Specific mention is made of intermetallic compound formation, its structure, density, and other related properties. Physical properties of the systems are often also given, such as electrical resistivity, thermal conductivity, etc.. More often, engineering information (mechanical properties) is included. Chemical properties are generally also described.

Generally, more diagrams and graphs of the other physical and mechanical properties are given for the included alloys, making this compilation a more general reference book than Hansen's Constitution of Binary Alloys, though not all binary alloys are included. Discussions are more elaborate and contain more peripheral, or "incidental" data.

A table of all elements appears at the beginning of the handbook, listing transformation temperatures, structures, lattice parameters (at various temperatures), and atomic diameters.

Weast, R. C., Selby, S. M., and Hogdman, O. D., editors, Handbook of Chemistry and Physics, published by Chemical Rubber Company, Cleveland, 45th edition, 1964.

This is a compilation of physical and chemical properties condensed into about 1500 pages. Where alloy data is very important, some is included, but generally only the pure metals are treated. Where different evaluators give values on the same property, they are often not made uniform.

Westbrook, J. H., editor, Intermetallic Compounds, published by J. Wiley, New York, 1967.

Chapters by contributing authors are given. The chapters include topics on magnetism, electronic transport properties, superconductive properties, mechanical properties, thermodynamic properties (including phase diagram and diffusion information), and a few chapters on bonding. Data falling in these categories are scattered throughout the text. Several short tables are included.

White, R. L. and Wickersheim, K. A., editors, Magnetism and Magnetic Materials: 1965 Digest, published by Academic Press, New York, 1965.

A survey of the literature appearing in 1964. For further annotation, see under Magnetic Materials Digest in the Magnetic Properties category of Table III.

Zwikker, C., Physical Properties of Solid Materials, published by Pergamon Press, New York, 1954.

The book discusses, among others, the topics of phase transformations and anisotropic effects. Other properties discussed are in the fields of: elasticity, thermal properties, ferromagnetism, and electronic properties. Each topic has small, but useful tables and graphical representations of data pertinent to the text. The categories Radiation and Mechanical Properties are also represented. Everything but superconductivity seems to be presented to some extent. Nonmetallic materials are also included.

Table II of Appendix B

BOOKS DEALING WITH ONE (OR A FEW) METALS OR ALLOYS, GIVING VALUES FOR SEVERAL PROPERTIES FALLING IN SEVERAL CATEGORIES.

Listing of metals and alloys is alphabetically by chemical symbol. Books dealing with many transition metals or with the platinum group metals are listed in this Table under "transition metals, TT" ; those dealing with several rare earths and actinides are listed under "Rare Earths".

Some elements have been referred to with more than one name or symbol. The customary symbols are used in this Table as well as in the annotated bibliography system. The following summary of synonymous names was taken from C. Zwikker (see under Table I).

Z.	Elements		Names
4	Be	=	beryllium = glucinium
11	Na	=	natrium = sodium
19	K	=	kalium = potassium
41	Nb=Cb	=	niobium = columbium
71	Lu	=	lutetium = cassiopeum
74	W	=	wolfram = tungsten
86	Rn	=	radon = niton = emanation

Ac Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH., Berlin. System No. 40, Actinium and Isotopes (M_5TH_2), 1942, reprint 1955, (481 pages), no update, (Text in German).

For general annotation, see under Gmelin, Table I.

Ac Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volumes 7a and b: Sc, Y, Ac, and the Rare Earths, 1959, (706 and 770 pages respectively), (in French).

The two volumes are separated by the properties they cover. For general annotation, see under Pascal, Table I.

Ag Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil. Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Ag Pascal, P., editor, Nouveau Traite de Chimie Minérale, published by Masson et Cie., Paris. Volume 3: Rb, Cs, Fr, and also Cu, Ag, and Au, 1957, (822 pages), (in French).

For general annotation, see under Pascal, Table I.

Al Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 35, Aluminum, Part A: Sections 1-8; Part B: Sections 1-2, (in German). Various sections printed 1934-50, reprinted 1953-66. No update.

For general annotation and titles of sections, see under Gmelin, Table I.

Al Herenguel, J., Métallurgie Spéciale, published by Presses Universitaires de France, 108 Boulevard Saint-Germain, Paris VI, 1962, (in French).

Volume I Aluminum and its Alloys; Magnesium and its Alloys.
Historic and economic background is given; production of the metals

from their ores is described. A substantial amount of metallurgical and engineering data is given in the book. This volume has no index.

For Al metal: electrical resistivity, thermal conductivity, density, lattice parameters, reflectance, emissivity (for thin films), specific heat, latent heats, melting and boiling points, vapor pressure, and thermal expansion.

For Al alloys: electrical resistivity and phase diagram data (also a ternary few ternary diagrams).

For Mg metal: see annotation under Mg.

Al Mondolfo, L. F., Metallography of Aluminum Alloys, published by John Wiley, New York, 1943.

ternary The book gives many binary, ternary, and quaternary phase diagrams, as well as metallographic and mechanical properties; 1004 references to the literature are included.

Al Pagonis, G. A., The Light Metals Handbook, published by D. Van Nostrand, Princeton, N. J., 1954, (199 and 185 pages, 2 sections).

ternary The book contains tables as well as descriptions of properties of magnesium and aluminum alloys (binary and higher order). Most of the tables are concerned with engineering properties. The physical properties given are: densities, electrical resistivities, thermal conductivities, specific heats, thermal expansions, and some constitutional information though phase diagrams do not seem to be included.

Al Pascal, P., editor, Nouveau Traité de Chimie Minerale, published by Masson et Cie., Paris. Volume 6: B, Al, Ga, In, and Tl, 1961, (1022 pages), (in French).

For general annotation, see under Pascal, Table I.

Al Phillips, H. W. L., Annotated Equilibrium Diagrams of Some Aluminum Alloy Systems, published by The Institute of Metals, London, 1959, (86 pages).

ternary The book covers twenty binary systems and twelve ternary systems containing aluminum as one of the elements, showing the diagrams, and giving references to the original literature. Compositions are given in weight percent only.

Al Van Horn, K. R., editor, Aluminum Vol. I: Properties, Physical Metallurgy, and Phase Diagrams, published by the American Society for Metals, Metals Park, Ohio, 1965, (425 pages).

A textbook treatment of aluminum and many of its alloys (binary and higher order) ternary including many physical properties is given. Among these properties are: electrical resistivity, thermal conductivity, magnetic susceptibility, magnetic transformations, density, crystal structures, lattice parameters, compressibilities, modulus of elasticity, optical constants, reflection, emission, neutron cross sections, specific heat, vapor pressure, thermodynamic energies, melting point, boiling point, viscosity, solution potentials, and phase diagrams (also as a function of pressure).

Volume II Design and Application. Not within our scope.

Volume III Fabrication and Finishing. Not within our scope.

As Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 11: As, Sb, and Bi, 1959, (836 pages), (in French).

For general annotation, see under Pascal, Table I.

Au Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 62, Gold: Sections 1-3, 1950, 1954 and 1954, (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Au Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a Section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Au Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 3: Rb, Cs, Fr, and also Cu, Ag, and Au, 1957, (822 pages), (in French).

For general annotation, see under Pascal, Table I.

Au Wise, E. M., editor, Gold: Recovery, Properties, and Applications, published by D. Van Nostrand, Princeton, N. J., 1964.

The book discusses the metal in connection with its various uses. Recovery, economics, metallurgy, and physics are among the subjects discussed. Many of the given properties were taken from secondary references, such as specific heat and other thermodynamic data, taken from Hultgren, and phase diagrams, taken from Hansen. Other physical properties include for the metal: density, lattice constants, electrical resistivity (also as a function of pressure), thermal expansion, thermal conductivity, vapor pressure, self (and other) diffusion, compressibilities, elastic modulus, thermal emf's (for thermocouples), Hall coefficients, magnetic susceptibility, dielectric constant, reflectance, X-ray emission, work functions, neutron cross sections, half lives of radioactive isotopes, and a table of maximum solubilities and formations of intermetallic compounds. For some of the more common alloys, electrical resistivity and its temperature coefficient, thermal emf's, Hall constants, thermal expansion, and diffusion parameters are given.

B Milek, J., Boron, Electronic Properties Information Center - Data Sheet No. DS-151, 1967.

A compilation of the critically evaluated data of many of the physical properties of the material. The Center is described in Appendix A.

B Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 6: B, Al, Ga, In, and Tl, 1961, (1022 pages), (in French).

For general annotation, see under Pascal, Table I.

Ba Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 30, Barium, 1932, reprint 1960, (399 pages), (in German). Supplement Volume, 1960, (569 pages).

For general annotation and titles of sections, see under Gmelin, Table I.

Ba Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 4: Be, Mg, Ca, Sr, Ba, and Ra, 1958, (955 pages), (in French).

For general annotation, see under Pascal, Table I.

Be Darwin, G. E. and Buddery, J. H., Beryllium (Metallurgy of the Rarer Metals - Series No 7), published by Academic Press, New York, 1960.

This is a rather carefully written book containing considerable data including phase diagrams, crystallographic, physical, thermal, chemical, and magnetic

properties of beryllium, its alloys, and compounds. Often secondary references are used and sometimes out-of-date references are quoted. The book also includes a chapter on the nuclear properties and health hazards of beryllium. The properties included for the metal are: electrical resistivity, thermal conductivity, thermoelectric power, density, crystal structure and lattice constants, Young's modulus, compression modulus, Poisson ratio, velocity of sound, thermal expansion, heat capacity, melting point and boiling point, latent heat, entropy, enthalpy, vapor pressure, optical spectra , and some line intensities.

Be Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 26, Beryllium, 1930, reprint 1958, (180 pages), (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Be Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil. Part c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Be Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris, Volume 4: Be, Mg, Ca, Sr, Ba, Ra, 1958, (955 pages), (in French).

For general annotation, see under Pascal, Table I.

Be Samsonov, G. V., Beryllides, (translated from the Russian book published in 1966), available from the Clearinghouse as Document No. JPRS 43, 479.

The text of this book has been translated, but its tables are still in the original Russian. The metal-beryllium compounds are described (lattice constants given) and some of their phase diagrams are included. Preparation methods are mentioned.

Be White, D. W. and Burke, J. E., editors, The Metal Beryllium, published by the American Society for Metals, Metals Park, Ohio, 1955.

This book includes a chapter on the physical properties of the metal, giving values for: electrical resistivity, thermal conductivity, thermoelectric power, atomic diameter, velocity of sound, density, emissivity (in both solid and liquid liquid), reflectivity, photoelectric work function, heat capacity, melting and boiling points, latent heats, enthalpy, entropy, thermal expansion, vapor pressure, and several nuclear properties.

Bi Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 19, Bismuth and Radioactive Isotope, (229 pages), 1927, (in German). Supplement Volume, (866 pages), 1964.

For general annotation and titles of sections, see under Gmelin, Table I.

Bi Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 11: As, Sb, and Bi, 1959, (836 pages), (in French).

For general annotation, see under Pascal, Table I.

Ca Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 28, Calcium, Part A: Sections 1-2, 1950 and 1957; Part B: Sections 1-3, 1956, 1957, and 1961, (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Ca Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 4: Be, Mg, Ca, Sr, Ba and Ra, 1958, (955 pages), (in French).

For general annotation, see under Pascal, Table I.

Cd Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 33, Cadmium, 1925, (214 pages), (in German). Supplement, 1959, (802 pages).

For general annotation and titles of sections, see under Gmelin, Table I.

Cd Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 5: Zn, Cd, and Hg, 1962, (954 pages), (in French).

For general annotation, see under Pascal, Table I.

Cd Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part b) Sinterwerkstoffe. Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Table I.

Ce Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil. part c) Leichmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Table I.

Co Centre d'Information du Cobalt, 35 Rue des Colonies, Brussels, Belgium. Cobalt Monograph, published by Battelle Memorial Institute, Columbus, Ohio, 1960.

The book gives a detailed treatment of topics ranging from its economics and geographic occurences to the chemistry and physics of the metal. The Center also furnishes information on cobalt-containing alloys, and can be contacted through Battelle Memorial Institute, 505 King Avenue, Columbus, Ohio 43201. The Center also publishes a quarterly journal "Cobalt". Among the electronic transport properties are: electrical resistivity and its temperature coefficient (also as a function of pressure), thermal conductivity, Peltier effect, Thompson effect, Hall effect, and thermoelectric power. For alloys: electrical resistivity. Magnetic properties include: magnetic moment, Curie temperature, magnetization curves (also as a function of crystal orientation), hysteresis loss, permeabilities, saturation magnetization, coercive force, magnetostriction, magnetic anisotropy constant, and magnetothermal effect. For alloys (including some high temperature alloys and higher order alloys): residual induction, coercive force, $(BH)_{max}$, saturation magnetization, crystal structures and lattice parameters, atomic volume, elastic modulus, shear modulus, stiffness moduli (cij's), compliances (sij's), velocity of sound, nuclear parameters and electronic g-factors, nuclear half lives, characteristic X-radiation, the emission spectrum from 2,000 to 10,000 Å and relative intensities of the strongest lines, reflectivity, emissivity, absorption, and dielectric constant. Thermodynamic properties include: temperature of transformation, thermal expansion, heat capacity, vapor pressure, diffusion constant and activation energy, heat content, absolute entropy, and free energy. For alloys (including some high temperature alloys and higher order alloys): structure and lattice constants, phase diagrams (some from secondary references), and solubilities.

ternary

Co Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 58, Cobalt, Part A: Sections 1-2, 1931 and 1932, and a Supplement, 1961, (886 pages), (in German). Part B: Not within our scope.

For general annotation and titles of sections, see under Gmelin, Table I.

Co Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band. Technik. 2. Teil. part b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Co Morral, F. R., Cobalt and its Alloys, published by Battelle Memorial Institute, Columbus, Ohio, 1967, (3rd edition).

ternary A bibliography on cobalt: its allotropic forms and alloys containing up to 8 components. No annotations are included.

Co Ostertag, W., Strnat, K., and Hoffer, G. I., Tech. Report AFML-TR-66-420, February, 1967. Crystallographic and Magnetic Investigation of the Rare Earth-Cobalt Compounds R_2Co_{17}, available from the Clearinghouse as Document No. AD 652,837.

The report covers the materials R_2Co_{17}, where R represents Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Lu, and Y. The report gives lattice constants and structural data (also intensities from X-ray diffraction powder patterns), saturation magnetization, Curie temperatures, and also sublattice magnetization.

Co Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 17b: Co and Ni, 1963, (878 pages), (in French). Volume 18: Fe, Ni and Co compounds, 1959, (923 pages), (in French).

For general annotation, see under Pascal, Table I.

Co Young, R. S., Cobalt, published by Reinhold, New York, 1960. (ACS Monograph Series No. 149.)

The book contains chapters mostly on chemical and engineering data. Many of the chapters are written by contributing authors not given above. They include phase diagrams for binary alloys (in chapter 7 by A. G. Metcalfe) and magnetic and electric properties (in chapter 8 by E. A. Nesbitt).

Cr Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 52, Chromium, Part A: Sections 1-2, 1962 and 1963. Parts B and C: Not pertinent to our scope. (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Cr Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Bank: Technik. 2. Teil, part b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Cr Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 14: Cr, Mo, and W, 1959, (998 pages), (in French).

For general annotation, see under Pascal, Table I.

Cr Goodwin, T. C. and Ayton, M. W., Thermal Properties of Certain Metals, available from the Clearinghouse as Document No. AD 111, 846, 1956.

The report contains annotated bibliographies; coverage is from July 1, 1955 to June 30, 1956. Materials listed are molybdenum, chromium, tantalum, copper, and graphite. Properties listed are heat capacity, thermal conductivity, emissivity, thermal diffusivity, and thermal expansion. Contains 380 references and an author index. See also Document No.'s AD 105, 099 and AD 105, 100 of the same title (these are bibliographies).

Cr Sully, A. H., Chromium, (Metallurgy of the Rarer Metals - Series No. 1), published by Academic Press, New York, 1954.

The book gives a detailed treatment of the metal, ranging from a description of its production and metallurgy to its physical and chemical properties. It pre-
ternary sents a chapter on constitution diagrams of binary and ternary chromium alloys with references to the original literature. Physical properties of pure chromium are also given. Among these are: structures and lattice constants, melting point, boiling point, density, latent heat, vapor pressures, elastic moduli, compressibility, electrical resistivity and its temperature coefficients, thermoelectric power, magnetic susceptibility, magnetic transition temperatures, thermionic properties, reflectivity, and absorptivity.

Cr Udy, M. D., editor, Chromium, (2 volumes), published by Reinhold, New York, 1956.

Volume I discusses general historical, medical, and other practical uses of the metal and the properties of some of its nonmetallic compounds. Volume II discusses the recovery from its ores, and physical and metallurgical properties of the metal and its alloys (mainly in Chapter 22). The properties include: phase diagrams (about 25), lattice constants and structural information, electronic structure, density, compressibility, melting points, boiling points, specific heats, heat content, entropy, free energy, vapor pressure, electrical resistivity, thermoelectric power, magnetic susceptibility, optical reflectivity, moduli of compression, elasticity, and shear, and Poisson ratio.

Cs Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 25, Cesium and Francium: Sections 1-2, 1938, both reprinted in 1955, no update, (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Cs Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 3: Rb, Cs, Fr, and also Cu, Ag, and Au, 1957, (822 pages), (in French).

For general annotation, see under Pascal, Table I.

Cs Perel'man, F. M., Rubidium and Caesium, (translated from the Russian by R. W. Clarke), published by the Macmillan Company, New York, 1965.

The book describes these two alkali metals in the areas of their occurence, chemistry and preparation methods, and chemical and physical properties. Among the properties of interest are: electrical resistivity (as a function of temperature), atomic volume, ionization potential, electron emission, specific heat, latent heats, melting and boiling points, heats of formation of some compounds, and alloying behavior of the metals with other alkali metals. Over 350 references are included; the book contains 146 pages.

Cu Butts, A., Copper - The Science and Technology of the Metal - Its Alloys and Compounds, published by Reinhold, New York, 1954, (936 pages).

Different authors have contributed to 46 chapters dealing with their fields of interest - a very wide range in total. Chapters on thermodynamic and other physical properties are included. The properties included for the metal are: electrical resistivity and its temperature coefficient, Hall effect, thermal conductivity, magnetic susceptibility (also for a few alloys), elastic properties, Poisson ratio and other elastic properties, structure and lattice constants, velocity of sound, density of states, reflectivity, emissivity, index of refraction, melting point, boiling point, latent heats, specific heat, vapor pressure, and diffusion. For alloys (mainly binary): phase diagrams, crystal structures, solubilities, and diffusion are included.

Cu Goodwin, T. C. and Ayton, M. W., Thermal Properties of Certain Metals, available from the Clearinghouse as Document No. AD 111, 846, 1956.

The report contains annotated bibliographies; coverage is from July 1, 1955 to June 30, 1956. Materials listed are molybdenum, chromium, tantalum, copper, and graphite. Properties listed are heat capacity, thermal conductivity, emissivity, thermal diffusivity, and thermal expansion. The compilation contains 380 references and an author index. See also, Document No's. AD 105, 099 and AD 105, 100 of the same title (these are also bibliographies).

Cu Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 60, Copper, Part A: Sections 1-2, 1955, (text in German). Part B: Sections 1-4, 1958, 1961, 1965, and 1966. Part C: publication deferred. Part D: not pertinent to our scope.

For general annotation and titles of sections, see under Gmelin, Table I.

Cu Herenguel, J., Métallurgie Spéciale, Vol. II: Copper and its Alloys, published by Presses Universitaires de France, 108 Boulevard Saint-Germain, Paris, 1962, (in French).

Historic and economic background is given; production of the metal from its ore is described. A substantial amount of metallurgical and engineering data is given in the book. This volume has no index. For Cu metal: electrical resistivity, thermal conductivity, density, elastic properties, lattice parameters, emittance and reflectance, specific heat, latent heats, melting and boiling points, vapor pressure, thermal expansion, and self-diffusion coefficients are given. For Cu alloys: electrical resistivity, thermal conductivity, magnetic susceptibility, a few binary phase diagrams, and solubility of H in Cu and in oxidized Cu are given.

Cu Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Cu Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 3: Rb, Cs, Fr, and also Cu, Ag, and Au, 1957, (822 pages), (in French).

For general annotation, see under Pascal, Table I.

Cu Reed, R. P. and Mikesell, R. P., Low Temperature Mechanical Properties of Copper and Selected Copper Alloys, available from the Clearinghouse as NBS Monograph 101, 1967.

The book gives graphical representations of the evaluated data for copper and some of its more common alloys (mainly brasses and bronzes). The data are of engineering properties mainly; moduli of elasticity and rigidity (mainly up to 500°K) are included. References to the original literature are included. Data which were not selected as "best values" are given in a separate section.

Cu Welles, S., Copper, Electronic Properties Information Center - Data Sheet No. DS-156, 1967.

A compilation of the critically evaluated data for the material. Some effects of alloying on the properties are also included for the more dilute regions (up to about 10%). Some of the data are taken from secondary references. The properties on which data are given include all those listed under Electronic Transport Properties where data is available (also as a function of pressure). Among the other properties are: magnetic susceptibility, density, lattice parameters, viscosity, elastic properties, thermodynamic properties (including vapor pressure, cohesive energies, and specific heats), thermal expansion, band structure and

density of states. Experiments giving Fermi surface determinations are reviewed.

Cu Wilkins, R. A. and Bunn, E. S., Copper and Copper-Base Alloys, published by McGraw-Hill, New York, 1943.

The book gives for the largest part engineering data on copper and many copper-base alloys, at temperatures ranging between -253°C and room temperature. Some data are given on: Young's modulus, melting points, densities, coefficients of thermal expansion, electrical conductivities, and thermal conductivities (though these are rather outdated).

Fe Cleaves, H. E. and Thompson, J. G., The Metal - Iron, published by McGraw-Hill, New York, 1935.

This book contains a formidable amount of information on the metal. Some of its compounds and alloys are also discussed. However, its value as a source of data on physical properties is rather limited due to its early date of publication.

Fe Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 59, Iron, Part A: (3 Divisions), Sections 1-9. Supplement to Sections 3-5 in several parts, 1964, (text in German). Part B: Sections 1-5. Part C: Sections 1-2, Not pertinent to our scope. Part D: 1 Section, with Supplement. Part E: (to be published), not pertinent to our scope. Part F: Divisions 1 and 2. Iron and Steel Analysis, marginal to our scope.

For general annotation and titles of sections, see under Gmelin, Table I.

Fe Hume-Rothery, W., The Structure of Alloys of Iron - An Elementary Introduction, published by Permagon Press, New York, 1966.

The book treats structures of binary iron alloys mainly; several phase diagrams are included, as well as a few tables and graphs of other related data.

Fe Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part a) Grundlagen, Prufverfahren, Eisenwerkstoffe, 1963, (in German).

This volume gives extensive data on iron and its alloys. Metallographic information on steels as well as physical properties listed in several of our categories are included for the metal and its binary alloys.

Fe Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 17a: Fe, 1967, (925 pages), (in French). Volume 18: Fe, Ni and Co compounds, 1959, (923 pages), (in French).

For general annotation, see under Pascal, Table I.

Fe FeRu Stepakoff, G. L. and Kaufman, L., Thermodynamic Properties of HCP Iron and Iron Ruthenium Alloys, (Technical Report No. 13 of Contract Nonr. 2600(00), prepared by Manlabs, Inc.), April, 1967.

This is a report of original research, rather than a compilation, giving extensive tables of values for specific heat and Debye temperatures (between 60 and 300°K), and for vapor pressures at 1600°K.

Fr Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 25: Section 2, Cesium Compounds. Ecacesium (Francium), 1938, reprint 1955, (164 pages), (in German), no update.

For general annotation, see under Gmelin, Table I.

Fr Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 3: Rb, Cs, Fr, and also Cu, Ag, and Au, 1957, (822 pages), (in French).

For general annotation, see under Pascal, Table I.

Ga Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 36, Gallium: 1936, reprint 1955, (100 pages), (in German). No update.

For general annotation and titles of sections, see under Gmelin, Table I.

Ga Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 6: B, Al, Ga, In, and Tl, 1961, (1022 pages), (in French).

For general annotation, see under Pascal, Table I.

Ge Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 45, Germanium: 1 Section, 1931, reprint 1961, (62 pages), (in German). Supplement, 1958, (579 pages).

For general annotation and titles of sections, see under Gmelin, Table I.

Ge Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 8c: Ge, Sn, and Pb, 1962, (803 pages), (in French).

For general annotation, see under Pascal, Table I.

Hf Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 43, Hafnium: 1941, reprint 1964, (62 pages), (in German). Supplement, 1958, (23 pages).

For general annotation, see under Gmelin, Table I.

Hf Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Hf Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 9: Ti, Zr, Hf, Th, 1963, (1121 pages), (in French).

For general annotation, see under Pascal, Table I.

Hf Thomas, D. E. and Hayes, E. T., editors, The Metallurgy of Hafnium, U.S. AEC, U.S. Government Printing Office, Washington, D.C., 1957.

The first half of the book is devoted to applications, production, and other engineering aspects related to the metal. The second half is devoted to topics somewhat more related to the physical properties of hafnium and its alloys (some 30 binaries). Physical properties for the metal include: melting point, boiling point, heat capacity, and other thermodynamic data, thermal expansion, crystal structure and lattice parameters, density, elastic properties, electrical resistivity, Hall effect, thermoelectric power, magnetic susceptibility, emissivity, and electron emission. For the alloys, the emphasis is on phase diagrams and structural formation.

Hg Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 34, Mercury, Part A: Sections 1-2, 1960 and 1962. Part B: Sections 1-2, 1965 and 1967, Section 3 in press, (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Hg Gordon, C. L. and Wichers, E., editors, Annals of the New York Academy of Sciences: Vol. 65, Art. 5, "Mercury and Its Compounds", p. 369, 1957.

liquid This review article lists a large number of physical constants of liquid mercury, including references to the original work. A few alloys are also discussed in connection with solubilities and diffusion. Among the properties are: melting point, boiling point (as a function of pressure), heat content, entropy, vapor pressure, heat capacity, thermal expansion, diffusion constants, elastic properties, density, lattice constants, viscosity, electrical resistivity, magnetic susceptibility, reflectivity, index of refraction, and work functions.

Hg Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 5: Zn, Cd, and Hg, 1962, (954 pages), (in French).

For general annotation, see under Pascal, Table I.

In Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 37, Indium: 1936, reprint 1958, (116 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

In Ludwick, M. T., Indium, published by Indium Corporation of America, Utica, New York, 1959.

ternary Included are phase diagrams for binary, ternary, quaternary, and quinary alloy systems with indium. Not many rare earth or transition metal alloys have been included. An apparently complete, well-annotated bibliography of indium broken down into different classifications including general physical properties, magnetic properties, crystal structure, etc. is given. A table of physical constants of the metal includes: atomic radius, (atomic volume), melting point, boiling point, density, thermal expansion, specific heat, latent heats, thermal conductivity, electrical resistivity, compressibility, vapor pressure, lattice constants, and structures.

In Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 6: B, Al, Ga, In, and Tl, 1961, (1022 pages), (in French).

For annotation, see under Pascal, Table I.

In Peretti, E. A., Constitution of Indium Alloy Systems, published by the Indium Corporation of America, Utica, New York, 1956.

ternary This 93-page booklet describes 34 binary, 8 ternary (plus a few others briefly mentioned), and 4 quaternary systems, giving their phase diagrams. The system In-Cd-Ge-Zn-Sn is also discussed but no diagrams are given for this system.

Ir Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 67, Iridium: 1939, reprint 1955, (196 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

Ir International Nickel Company, Inc., Iridium: the metal, its alloys, chemical compounds, and catalytic properties, published by the company, 67 Wall Street, New York, New York 10005.

The International Nickel Company prints short condensed reviews of the platinum group metals and their alloys, as well as of commercial alloys, mainly steels. The physical properties are summarized at room temperature. Included in the more detailed summaries are: crystal structure, density, melting point, boiling point, electrical resistivity and its temperature coefficient, linear thermal expansion, specific heat, Young's modulus, thermal emf's, reflectivities, emissivity and

thermionic work functions.

Ir Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 19: Ru, Rh, Pd, Os, Ir, and Pt, 1958, (953 pages), (in French).

For general annotation, see under Pascal, Table I.

K Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 22, Potassium: Sections 1-7, 1936-1938, Section 1 reprinted in 1959, all others in 1963, (in German). No update.

For general annotation and titles of sections, see under Gmelin, Table I.

K Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 2b: Potassium, 1963, (749 pages), (in French).

For general annotation, see under Pascal, Table I.

Li Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 20, Lithium: 1927, (254 pages), (in German). Supplement, 1960, (525 pages).

For general annotation and titles of sections, see under Gmelin, Table I.

Li Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Li Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 2a: Li and Na, 1966, (1031 pages), (in French).

For general annotation, see under Pascal, Table I.

Li Shamrai, F. I., Lithium and its Alloys, available from the Clearinghouse as Document No. AEC-TR-3436. (Translated from a publication of the Academy of Sciences of the USSR, Moscow), 1952.

The book gives a detailed treatment of the mechanical, chemical, and physical characteristics of lithium metal, and descriptions of the various forms of solids in which Li occurs naturally. Among the properties given for the metal are: lattice structure and parameters, melting and boiling points, thermal expansion, density, Young's modulus and compressibility, optical and X-ray information, electrical resistivity and its temperature coefficient, Hall effect, thermoelectric power, and Nernst effect.

ternary Constitutional diagrams of many binary and some ternary systems are given (covers 166 pages), on the basis of the author's own studies and evaluation of previous work up to 1950. Occasionally, other physical properties of the alloys are included. References are given to the original literature. No index seems to be included.

Mg Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 27, Magnesium, Part A: Sections 1-2, 1937, reprint 1965, Section 3, 1942, reprint 1959, No updates, Section 4, 1952. Part B: Sections 1-4, 1937-1939, reprint 1963, (in German). No updates.

For general annotation and titles of sections, see under Gmelin, Table I.

Mg Herenguel, J., Métallurgie Spéciale, Vol. I: Aluminum and its alloys; Magnesium and its alloys, published by Presses Universitaires de France, 108 Boulevard Saint-Germain, Paris, 1962, (in French).

Historic and economic background is given; production of the metals from their ores is described. A substantial amount of metallurgical and engineering data is given in the book. This volume has no index. For Al: see annotatation under Al. For Mg metal: electrical resistivity and its temperature coefficient, magnetic susceptibility, density, lattice parameters, specific heat, latent heats, melting and boiling points, vapor pressure, thermal expansion, reflectance, solubility of Fe in Mg and in Mg with Mn impurity, and diffusion constants of Mg in Al and Al with 2.7% Zn are given. For Mg alloys: electrical resistivity, thermal conductivity, binary phase diagrams, and heats of formation of intermetallic compounds are given.

Mg Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Mg Pagonis, G. A., The Light Metals Handbook, published by D. Van Nostrand, Princeton, N. J., (2 sections of 199 and 185 pages).

This handbook contains tables as well as descriptions of properties of magnesium and aluminum alloys (binary and higher order). Most of the tables are concerned
ternary with engineering properties. The physical properties given are: densities, electrical resistivities, thermal conductivities, specific heats, thermal expansions, and some constitutional information though phase diagrams do not seem to be included.

Mg Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 4: Be, Mg, Ca, Sr, Ba, and Ra, 1958, (955 pages), (in French).

For general annotation, see under Pascal, Table I.

Mg Raynor, G. V., Physical Metallurgy of Mg and Its Alloys, published by Pergamon Press, New York, 1950.

This is a complete textbook including references to the original literature,
ternary phase diagrams, crystallographic information, lattice spacings, elastic constants, and other physical properties of Mg and its alloys. Higher order alloys are included.

Mg Roberts, C. S., Magnesium and Its Alloys, published by John Wiley, New York, 1960.

A detailed physical and structural description is given of magnesium at room temperature and above, including properties pertinent to electron theory. Phase diagrams, solubilities, and ordering in binary systems are discussed. Some
ternary ternary systems are included. Engineering and chemical properties are also discussed. References are given to the original literature.

Mn Dean, R. S., Electrolytic Manganese and Its Alloys, published by Ronald, New York, 1952.

This book includes a considerable amount of data taken from the original literature on physical properties of Mn alloys. Electronic transport properties for the metal and several of its alloys include: resistivity and its temperature coefficient, thermal emf's for thermocouples. Magnetic properties for the metal include: susceptibility. Some magnetic properties of CuMn, NiMn, and CuNiMn are also discussed. Other properties of the metal include: density, lattice structure and constants, transition temperatures and associated heats of formation,

and heat capacity. For several of the alloys: modulus of elasticity, shear modulus and Poisson ratio, crystal structure, lattice parameters, and phase diagrams.

Mn Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin.

No separate compilation on this system has appeared as yet. Manganese is treated together with Cr, Fe, Co, and Ni in Magnetic Materials of System No. 59, Iron, Part D: second supplement, 1959, (580 pages). For general annotation of this series, see under Gmelin, Table I.

Mn Kirchmayr, H. R. and Lihl, F., Rare Earth-Manganese Alloys, Their Preparation, Crystal Structures, Phase Diagrams, and Magnetic Properties, available from the Clearinghouse as Document No. AD 654, 653, Jan., 1967. Also noted as AFML-TR-66-366.

This report is the direct result of experimental investigations rather than a compilation from the literature, but will be included in this compilation as a report of interest. It deals with compounds of the type: R_RMn_2, $R_{R_6}Mn_{23}$, and $^{RR}Mn_{12}$, giving lattice parameters, some phase diagram determination results and the corresponding thermodynamic data, and magnetic data (transition temperatures, effective number of Bohr magnetons, susceptibilities, etc.).

Mn Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Mn Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 16: F, Cl, Br, I, At, Mn, Tc, Re, 1960, (1195 pages), (in French).

For general annotation, see under Pascal, Table I.

Mn Sully, A. H., Manganese, (Metallurgy of the Rarer Metals, Series No. 3), published by Academic Press, New York, 1955.

The book gives a detailed treatment of the metal, ranging from a description of its production and metallurgy to its physical and chemical properties. It pre-
ternary sents a chapter on constitutional diagrams of binary and ternary manganese alloys with references to the original literature. Physical properties of manganese are also given. Among these are: electrical resistivity and its temperature coefficients (these also given as a function of pressure), thermal conductivity, magnetic susceptibility (in different phases), density, atomic volume, lattice parameters, elastic and compressive moduli, Néel temperature, thermionic emission, emission spectra, optical absorption, reflectance, index of refraction, X-ray spectra, melting point, boiling point, heat capacity, latent heat, free energy, vapor pressure, and thermal expansion.

Mo Climax Molybdenum Company, Molybdenum Metal, 1960, (a 110 page booklet).

Many physical and mechanical properties, mainly of the unalloyed metal, are given. Graphical representations of their temperature dependences are included. The information given is based on data published in the literature (references given), as well as on research conducted by the company. Included discussions pertain mainly to industrial applications. The company also has available phase diagram and other information on Mo alloys. For information on any Mo-containing material, write to: Climax Molybdenum Company, 1270 Avenue of the Americas, New York, New York 10020. For this book the following properties are included: electrical resistivity, thermal conductivity, velocity of sound, modulus of elasticity and other elastic constants, lattice structure and parameters, atomic volume, melting point, boiling point, heat capacity, thermal expansion, diffusion,

absorptivity, reflectivity, and emissivity.

Mo English, J. J., Binary and Ternary Phase Diagrams of Niobium, Molybdenum, Tantalum, and Tungsten, (prepared at the Defense Metals Information Center), available from the Clearinghouse as Document No. AD 257, 739, 1961.

ternary This compilation contains 93 phase diagrams of binary systems and 68 phase diagrams of ternary systems, each with a short discussion; 233 references are given. Other DMIC technical reports on physical and engineering information are available. For information write to: Defense Metals Information Center, 505 King Avenue, Columbus, Ohio 43201.

Mo Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 53, Molybdenum: 1935, reprint 1955, (393 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

Mo Goodwin, T. C. and Anton, M. W., Thermal Properties of Certain Metals, available from the Clearinghouse as Document No. AD 111, 846, 1956.

The report contains annotated bibliographies: coverage is from July 1, 1955 to June 30, 1956. Materials listed are Molybdenum, Chromium, Tantalum, Copper, and Graphite. Properties listed are heat capacity, thermal conductivity, emissivity, thermal diffusivity, and thermal expansion. Contains 380 references and an author index.

Mo Killeffer, D. H. and Linz, A., (with a chapter by L. Pauling on the structural chemistry of molybdenum), Molybdenum Compounds, published by Interscience, 1952.

The book describes the metal and its properties, among which are: melting and boiling points, vapor pressure, specific heat, thermal expansion, thermodynamic properties related to the formation of oxides, nitrides, carbides, sulfides, and halides, electrical resistivity, thermal conductivity, atomic radius and volume, density, and Young's modulus.

Mo Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Mo Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 14: Cr, Mo, and W., 1959, (998 pages), (in French).

For general annotation, see under Pascal, Table I.

Na Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 21, Sodium: 1928, reprint 1959, (in German), Supplement Sections 1-2, published 1964 and 1965; Sections 3-4, published 1966.

For general annotation and titles of sections, see under Gmelin, Table I.

Na Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 2a: Li and Na, 1966, (1031 pages), (in French).

For general annotation, see under Pascal, Table I.

Na Sittig, M., Sodium: Its Manufacture, Properties and Uses, published by Reinhold, New York, 1956 (ACS monograph no. 133).

A monograph summarizing the main literature and information available on sodium.

A large number of references to the literature are given. Subjects covered are: manufacturing, handling, uses of the metal, and reactions of sodium with several elements and compounds. A large section of the book (pp. 361-504) gives tables of data on physical and thermodynamic properties of the metal (as a function of
liquid temperature and also in the liquid): densities, viscosities, surface tension, thermal conductivity, electrical resistivity, heat capacity, velocity of sound, compressibility, entropies, heat content, free energies, vapor pressure, latent heats, boiling point (as a function of pressure). For alloys a section on alloy formation is included together with some phase diagrams. Short tables for the alkali metals and NaK alloys give values for: density, atomic radius and volume, boiling point, heat of fusion, heat of vaporization, entropy, thermal conductivity, and electrical conductivity and resistivity.

NaK Jackson, C. B., editor, Liquid-Metals Handbook: Sodium-(NaK) Supplement, 1955. This is a supplement to the Liquid-Metals Handbook, R. N. Lyon, editor, Report Navexos P-773 (rev.), U. S. Government Printing Office, 1952, (2nd edition). (See under Table I).

This supplement gives data for Na, K,and their alloys only. Among these data are for sodium: solubilities, alloy formations, density, electrical resistivity,
liquid thermal conductivity, specific heat, vapor pressure, enthalpy, entropy, and vapor pressures. For the alloy system densities, resistivities, thermal conductivities, specific heats, boiling points, and vapor pressures are included.

Nb English, J. J., Binary and Ternary Phase Diagrams of Niobium, Molybdenum, Tantalum, and Tungsten, (prepared at the Defense Metals Information Center), available from the Clearinghouse as Document No. AD 257,739, 1961.

This compilation contains 93 phase diagrams of binary systems and 68 phase dia-
ternary grams of ternary systems, each with a short discussion; 233 references given. Other DMIC technical reports on physical and engineering information are available. For information write to: Defense Metals Information Center, 505 King Avenue, Columbus, Ohio 43201.

Nb Francis, E. L., compiler, Niobium Data Manual, published by the United Kingdom Atomic Energy Authority, originally in October 1958, revised April, 1961.

Data sheets on many physical, chemical, and mechanical properties of niobium are given. Among the physical properties are: isotopic and nuclear properties, melting and boiling points, latent heats, entropy, specific heat, thermal expansion, electrical resistivity (273-1173°K with various impurities added), thermal conductivity, magnetic susceptibility, thermionic work function, spectral emissivity, vapor pressure, Hall coefficient, self-diffusion, and the elastic properties. Equilibrium diagrams of 10 binary alloys are included. Effects or irradiation on some of the physical properties are also discussed. Fifty-one references are cited.

Nb Grigsby, D. L., Niobium, Electronic Properties Information Center, Data Sheet DS-No. 141, 1964.

A compilation of critically evaluated data of the material. References to the literature are given. All the electronic transport properties included in our List of Properties are covered where literature is available and will not be listed here. Other properties include: magnetization curves (at low temperatures), susceptibility, magnetoelectric properties, electron field emission and thermionic emission, work functions, emissivities, absorptivities, irradiation effects, transition temperature, penetration depth, electronic specific heat, and Debye temperatures.

Nb Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Nb Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 12: V, Nb, Ta, and Pa, 1958, (680 pages), (in French).

For general annotation, see under Pascal, Table I.

Nb-Zr Grigsby, D. L., Niobium-Zirconium, Electronic Properties Information Center, Data Sheet DS-No. 152, 1966.

A compilation of the critically evaluated data of the material is presented. Electronic transport properties include (generally giving temperature dependences): resistivity, residual resistivity, thermal conductivity, Hall coefficient, and thermoelectric power. Among the other evaluated properties are: susceptibilities, magnetization curves, crystal structure and lattice constants, modulus of elasticity (also some engineering properties), ultrasonic attenuation, specific heat, Debye temperatures, superconducting critical temperature, critical field, critical current, energy gap, and flux characteristics.

Nb Miller, G. L., Tantalum and Niobium (Metallurgy of the Rarer Metals, Series No. 6), published by Academic Press, New York, 1959.

The book gives a detailed treatment of the metals, ranging from a description of their production, purification, and metallurgy, to their physical properties. A physical description of the simpler alloys is given, but without elaboration. Properties of the metals described include: electrical resistivity and its temperature coefficients (these also given as a function of pressure), thermal conductivity, Hall coefficients, thermoelectric power, magnetic susceptibility, density, elastic and shear moduli, lattice parameters, velocity of sound, structure sensitive properties, refractive index, work functions, electron emission, secondary emission, superconducting transition temperatures, melting and boiling points, heat capacity, latent heat, entropy, and thermal expansion.

Ni Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 57, Nickel, Part A: Division I, 1967, Division II, Section 1, 1967, Sections 2-3 to be published 1968. Part B: Section 1, 1965, Sections 2-3, 1966. Part C: Not pertinent to our scope.

For general annotation and titles of sections, see under Gmelin, Table I.

Ni International Nickel Company, Inc., 67 Wall Street, New York, New York 10005

The International Nickel Company prints short condensed reviews of the platinum group metals and their alloys, as well as of commercial alloys, mainly steels. The physical properties are summarized at room temperature. Included in the more detailed summaries are: crystal structure, density, melting point, boiling point, electrical resistivity and its temperature coefficient, linear thermal expansion, specific heat, Young's modulus, thermal emf's, reflectivities, emissivity, and thermionic work function. Among the reviews are: Iridium: the metal, its alloys, chemical compounds, and catalytic properties; The Platinum Group metals in industry (Ru, Rh, Pd, Os, Ir, and Pt; Ruthenium: the metal, its alloys, chemical compounds, and catalytic properties; Rhodium: the metal, its alloys, chemical compounds, and catalytic properties; Palladium: the metal, its properties, and applications; Platinum: the metal, its properties, and applications.

Ni Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Ni Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 17b: Co and Ni, 1963, (878 pages), (in French). Volume 18: Fe, Ni and Co compounds, 1959, (932 pages).

For general annotation, see under Pascal, Table I.

Ni Rosenberg, S. J., Nickel and its Alloys, available from the Clearinghouse as NBS Monograph 106, in press, 1968.

This is a revision of the compilation on high purity - and commercial nickel and its alloys by J. G. Thompson (see following entry).

Ni Thompson, J. G., Nickel and its Alloys, available from the Clearinghouse as NBS Circular 592, 1958. (See previous entry for a recent version by S. J. Rosenberg).

Physical and engineering properties are compiled for nickel and its more common alloys. Among the properties for pure nickel are given: neutron cross sections, refractive index and absorption coefficients for λ = 4200 to 22,500 Å, specific heat, melting and boiling points, thermal expansion, thermal conductivity, electrical resistivity, some thermal emf's, magnetostriction, elastic constants, and modulus of elasticity. Also some phase diagrams including Curie temper-
ternary atures as a function of alloy composition are given. Tables of some commercial alloys and their compositions are also included.

Np Makarov, E. S., Crystal Chemistry of Simple Compounds of Uranium, Thorium, Plutonium, Neptunium, (translated from the Russian), published by Consultants Bureau, New York, 1959.

The book includes an interesting introductory section on general crystal chemistry. Given are coordination numbers, interatomic distances, and crystal structures for the compounds of the four elements listed in the title. A small amount of information on other actinides is also given. The author includes 119 references to the literature.

Os Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 66, Osmium: 1939, reprint 1955, (100 pages), with Supplement on plutonium, (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Os Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 19: Ru, Rh, Pd, Os, Ir, and Pt, 1958, (953 pages), (in French).

For general annotation, see under Pascal, Table I.

Pa Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 51, Protactinum: 1942, reprint 1955, (99 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

Pa Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 12: V, Nb, Ta, and Pa, 1958, (680 pages), (in French).

For general annotation, see under Pascal, Table I.

Pb Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 8c: Ge, Sn, and Pb, 1962, (803 pages), (in French).

For general annotation, see under Pascal, Table I.

Pd Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Pd Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 65, Palladium: Sections 1-2, 1941 and 1942, reprints 1955, (in German). (No update).

For general annotation and titles of sections, see under Gmelin, Table I.

Pd International Nickel Company.

See under Nickel, this Table.

Pd Pascal, P., editor, Nouveau Traité de Chimie Minerale, published by Masson et Cie., Paris. Volume 19: Ru, Rh, Pd, Os, Ir, and Pt, 1958, (935 pages), (in French).

For general annotation, see under Pascal, Table I.

Po Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 12, Polonium and Isotopes: 1941, reprint 1955, (187 pages), (in German). No update.

For general annotation and titles of sections, see under Gmelin, Table I.

Po Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris, Volume 13a: O_2, O_3, H_2O_2 and S, 1960, (1126 pages), (in French). Volume 13b: S, Se, Te, and Po, 1960, (1024 pages), (in French).

For general annotation, see under Pascal, Table I.

Pt Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 68, Platinum, Part A: (includes all the platinum metals), Sections 1-3, 1938, 1939 and 1939, reprints in 1963; Section 4, 1940, reprint 1959; Sections 5-6, 1949 and 1951. Part B: Sections 1-3, 1939, reprint 1963; Section 4, 1942, reprint 1958, (not pertinent to our scope); Part C: Sections 1-3, 1939, 1940 and 1940, reprints 1962; Part D: (not pertinent to our scope).

For general annotation and titles of sections, see under Gmelin, Table I.

Pt International Nickel Company.

See under Nickel, this Table.

Pt Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris, Volume 19: Ru, Rh, Pd, Os, Ir, and Pt, 1958, (953 pages), (in French).

For general annotation, see under Pascal, Table I.

Pu Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 66, Osmium, with a Supplement on Plutonium: 1939, reprint 1955, (100 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

Pu Kubaschewski, O., editor, Plutonium: Physico-Chemical Properties of its Compounds and Alloys, International Atomic Energy Agency (VIENNA). Atomic Energy Review - Vol. 4: special issue No. 1, 1966.

A compilation and tabulation of critical values of: thermodynamic properties, densities, crystallographic data, phase diagrams, and diffusion rates in the condensed states. References to the original work are included.

Pu Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Pu Makarov, E. S., Crystal Chemistry of Simple Compounds of Uranium, Thorium, Plutonium, Neptunium, (translated from the Russian), published by Consultants Bureau, New York, 1959.

The book includes an interesting introductory section on general crystal chemistry. Given are coordination numbers, interatomic distances, and crystal structures for the compounds of the four elements listed in the title. A small amount of information on other actinides is also given. The author includes 119 references to the literature.

Pu Taube, M., Plutonium, published by the Macmillan Company, New York, 1964.

The book discusses the nuclear, chemical, and physical properties, as well as physiological effects and technical problems encountered in the use of plutonium. Nuclear data are given primarily. Other properties on which data are given are: electrical resistivity, density (as a function of temperature), crystal structure, heat capacity, heats of transformation, and thermal expansion. Some alloy systems and intermetallic compounds are discussed. A relatively large bibliography is included, as well as cross references.

Ra Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 31, Radium and Isotopes: 1928, (80 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

Ra Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 4: Be, Ca, Sr, Ba, and Ra, 1958, (955 pages), (in French).

For general annotation, see under Pascal, Table I.

BOOKS COVERING THE RARE EARTHS AND TRANSURANIC ELEMENTS

For books covering a single element in these series, see under the chemical symbol in the alphabetic listing.

Rare Earths Gibson, J. A., Miller, J. F., Kennedy, P. S., and Rengstorff, G. W. P., The Properties of the Rare Earth Metals and Compounds, published by Battelle Memorial Institute, May 1959.

This is a basic compilation of the properties of the materials named in the title. Values are listed for the following properties of the elemental metals (usually at room temperature): electrical resistivity and its temperature coefficients, thermal conductivity, magnetic moment, magnetic susceptibility, density, crystal structure and lattice parameters, atomic volume, thermal neutron cross sections, velocity of sound (both longitudinal and shear), elastic properties, specific heat, melting and boiling points, latent heats, vapor pressures, thermal expansion, transition temperatures. Oxide formation and other data are also included. Properties listed for the compounds: crystal structures and lattice parameters, heats and energies of formation, and phase diagrams.

Rare Earths Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 39, Rare Earth Elements: 1938, reprint 1955, (122 pages), (in German). No update. System No. 55, Uranium and Isotopes: (includes other transuranic elements), 1936, reprint 1955. No update.

For general annotation, see under Gmelin, Table I.

Rare Earths

Gschneider, K. A., Rare Earth Alloys, (prepared under the auspices of the Office of Technical Information, Atomic Energy Commission), published by D. Van Nostrand, Princeton, New Jersey, 1961.

This book contains a considerable amount of information on rare earth alloys and intermetallic compounds and includes about 100 original phase diagrams integrated with accompanying information in the text. The book includes numerous indices and references. Included are 653 references and a cross reference index to the alloy systems as well as an index of structure type and an author index.

Among the mentioned properties for the metals are: electrical resistivity, Hall effect, and thermal conductivity. For some of the alloys are: electrical resistivity, Hall effect, Seebeck effect, and Lorentz number. Magnetic properties include for the metals and some of the alloys: average magnetic moments, Curie constants, Curie temperatures, magnetic susceptibilities, and saturation magnetization. Mechanical properties include for the metals: densities, metallic radii, lattice structures and constants, compressibilities, elastic and shear moduli and Poisson ratio. Thermodynamic properties include for the metal: thermal expansion, Debye temperature, heat capacity, heat content, entropies, latent heats, and phase transformations. For the alloys: phase diagrams for binary, ternary, and higher order systems, with structural information, lattice constants, thermal expansion, heat capacity, solubilities only occasionally included for the alloys. Radiation properties include for the metals and a few alloys: ionization potential, work functions, spectral emissivity, and emission current density. Superconductive properties include critical temperatures for the metals and a few of the alloys.

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Rare Earths

Kirchmayr, H. R. and Lihl, F., Rare Earth-Manganese Alloys, Their Preparation, Crystal Structures, Phase Diagrams, and Magnetic Properties, available from the Clearinghouse as Document No. AD 654,653, January 1967; also noted as AFML-TR-66-366.

For annotation, see under "Mn-Rare Earth" in this Table.

Rare Earths

Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Rare Earths

Ostertag, W., Strnat, K., and Hoffer, G. I., Crystallographic and Magnetic Investigation of the Rare Earth-Cobolt Compounds R_2Co_{17}, (Tech Report AFML-TR-66-420, February 1967), available from the Clearinghouse as Document No. AD 652, 837.

The report covers the materials R_2Co_{17} where R represents Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Lu, and Y. The report gives lattice constants and structural data (also intensities from X-ray diffraction powder patterns), saturation magnetization, Curie temperatures, and also sublattice magnetization.

Rare Earths

Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volumes 7a and b: Sc, Y, Ac, and the rare earths, 1959, (706 and 770 pages respectively); Volume 15a: U, 1960, (725 pages); Volume 15b: U compounds, 1960, (630 pages); Volume 15c: Transuranic elements, 1962, (1080 pages). (Text in French).

For general annotation, see under Pascal, Table I.

Rare Earths

Samsonov, G. V., Refractory Compounds of the Rare Earth Metals with Nonmetals, published by Consultants Bureau, New York, 1965.

The book gives a compilation of various physical, chemical, and structural types of information together with pages of discussions. Included are the

borides, carbides, nitrides, silicides, and sulfides of the rare earth metals. The properties include: phase diagrams, lattice parameters, ionization potentials, thermal expansions, heats of formation, electrical resistance, thermionic emission, electron work functions, magnetic moments, magnetic susceptibilities, thermo-electric emf's, thermal conductivities, coefficients of refraction and absorption constants, soft X-ray spectra, melting points, latent heats, heat capacities, densities, magnetic susceptibilities, Hall coefficients, work functions, secondary emission; in short essentially all the data available to the authors on the materials in question.

Rare Earths — Samsonov, G. V., Markovskii, L. Y, Zhigach, A. F., and Valyashko, M. G., Boron, Its Compounds and Alloys, 1960, available from the Clearinghouse as Document No. AEC-TR-5032, (2 volumes).

For annotation, see under TT, Table II.

Rare Earths — Savitskii, E. M., Terekhova, V. F., Burov, I. F., Markova, I. A., and Maumkin, O.P., Rare Earth Alloys, available from the Clearinghouse as Document No. AEC-TR-6151, 1962, (349 pages), (paperback).

The book is divided into three chapters. The first one discusses the electronic structure and the chemical, physical, mechanical, and technological properties of the rare earth metals. The second chapter contains binary and ternary phase diagrams (generally without lattice parameter data) of rare earth metals, and the interactions between rare earth elements and many elements of the periodic table are discussed. The third chapter discusses rare earth metals in ferrous and non-ferrous metallurgy, in heat-resistant and high melting point alloys, in atomic technology, in radio technology and electronics, in the silicate industry, in chemistry, medicine, etc..

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The data were compiled using all published literature, as well as unpublished experimental results from Russian laboratories. For the rare earth metals, tables of physical properties are given. These include: electrical resistivity and its temperature coefficients, thermal conductivity, magnetic transition temperatures and magnetization curve parameters, elastic and shear moduli, Poisson's ratio, density, structural data, specific heats, thermal expansion, and several of the other thermodynamic properties, including those for allotropic transformations.

The book has an appendix concerning isotopes of the rare earth metals, the composition and structure of chemical compounds, and a discussion of the most likely applications of rare earth metals. The book also has a subject index which considerably facilitates its use.

Rare Earths — Seaborg, G. T., The Transuranium Elements, published by Addison-Wesley, New York, 1958.

The textbook does not specifically list physical properties together, but among the "Chemical properties" are found: nuclear data, melting points, boiling points, heats of vaporization, crystal structures and parameters, densities, and other properties of the elemental materials and similar properties for compounds containing transuranic elements. Some data on the lanthanides are included as well. A large part of the book is devoted to discussions of nuclear properties, giving data in accompanying tables and graphs.

Rare Earths — Spedding, F. H., Legvold, S., Daane, A. H., and Jennings, L. D., Some Physical Properties of the Rare Earth Metals, (a chapter from Progress in Low Temperature Physics: II, 368-394, 1957, edited by C. J. Gorter), published by Interscience, New York.

This review article discusses each rare earth element separately and presents some results; mainly of magnetization curves. Values for the following properties are given in a table: density, crystal structures and lattice parameters,

compressibility, elastic and shear moduli, Poisson's ratio, spectroscopic states, melting and boiling points, transition temperature, Debye temperature, latent heat, and experimental entropies.

Rb Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 24, Rubidium: 1937, reprint 1955, (250 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

Rb Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, part c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Rb Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 3: Rb, Cs, Fr, and also Cu, Ag, and Au, 1957, (822 pages), (in French).

For general annotation, see under Pascal, Table I.

Rb Perel'man, F. M., Rubidium and Caesium, (translated from the Russian by R. W. Clarke), published by the Macmillan Company, New York, 1965.

The book describes these two alkali metals in the areas of their occurence, chemistry and preparation methods, and chemical and physical properties. Among the properties of interest are: electrical resistivity (as a function of temperature), atomic volume, ionization potential, electron emission, specific heat, latent heats, melting and boiling points, heats of formation of some compounds, and alloying behavior of the metals with other alkali metals. Over 350 references are included; the book contains 146 pages.

Re Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. Systems No. 69/70, Masurium (now called Technetium)/Rhenium: 1941, (154 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

Re Lebedev, K. B., The Chemistry of Rhenium, published by Butterworth (London) and Plenum Press (New York), 1962.

The book includes a chapter on physical properties of the metal. Included are: electrical resistivity and its temperature coefficient, magnetic susceptibility, density, atomic volume, lattice parameters, Young's modulus, melting and boiling points, heat capacity, thermal expansion, and a few phase diagrams of binary alloys (with structures and lattice constants noted in the accompanying text).

Re Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 16: F, Cl, Br, I, At, Mn, Tc, Re, 1960, (1195 pages), (in French).

For general annotation, see under Pascal, Table I.

Re Tribalat, S., Rhenium et Technetium, published by Gauthier-Villars, Paris, 1957, (in French).

The text gives an introductory chapter of about 100 pages on general physical properties, including electrical resistivity and its temperature coefficient, thermal conductivity, magnetic susceptibility, density, lattice parameters, Young's modulus, work function, electron emission, ionization potential, X-ray and optical emission spectra, melting point, latent heats, and thermal expansion.

Rh Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 64, Rhodium: 1938, reprint 1955, (153 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

Rh International Nickel Company, Rhodium: The Metal, Its Alloys, Chemical Compounds, and Catalytic Properties.

See under Nickel in this Table.

Rh Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Rh Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 19: Ru, Rh, Pd, Os, Ir, and Pt, 1958, (953 pages), (in French).

For general annotation, see under Pascal, Table I.

Ru Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 63, Ruthenium: 1938, reprint 1955, (124 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

Ru International Nickel Company, Ruthenium: The Metal, Its Alloys, Chemical Compounds, and Catalytic Properties.

See under Nickel in this Table.

Ru Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 19: Ru, Rh, Pd, Os, Ir, and Pt, 1958, (953 pages), (in French).

For general annotation, see under Pascal, Table I.

Sb Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 19, Antimony, Part A: Sections 1-2, 1942 and 1943, reprints 1963 and 1958 (no update); Section 3, 1950. Part B: Section 1, 1943, reprint 1958 (no update); Sections 2-3, 1949, (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Sb Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, B) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Sb Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris, Volume 11: As, Sb, and Bi, 1959, (836 pages), (in French).

For general annotation, see under Pascal, Table I.

Sc Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volumes 7a and b: Sc, Y, Ac, and the Rare Earths, 1959, (706 and 770 pages respectively), (in French).

The two volumes are separated by the properties they cover. For general

annotation, see under Pascal, Table I.

Se Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 10, Selenium, Part A: Section 1, 1942, reprint 1959, (no update); Sections 2-3, 1950 and 1953. Part B: 1949, (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Se Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 13b: S, Se, Te, and Po, 1960, (1024 pages), (in French).

For general annotation, see under Pascal, Table I.

Si Berezhnoi, A. S., Silicon and its Binary Alloys, published by Consultants Bureau, New York, 1960.

The silicon binary systems are described in the text, with structural information given as well. Phase diagrams are also included. The bibliography lists 1716 references.

Si Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 15, Silicon, Part A: not yet published.

For general annotation, see under Gmelin, Table I.

Si Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 8b: Si, 1965, (682 pages), (in French).

For general annotation, see under Pascal, Table I.

Sn Greenfield, L. T. and Forrester, P. G., The Properties of Tin Alloys, Tin Research Institute, Middlesex, England, 1962.

See under Sn, the Tin Research Institute, this Table.

Sn Hedges, E. S., editor, Tin and its Alloys, published by Edward Arnold, London, 1960.

Most of the chapters are written by different authors who are specialists in the specific topics they discuss. Chapters giving physical properties are included. Among the properties given for the metal are: electrical resistivity and thermal conductivity, density, Young's modulus, modulus of rigidity, Poisson ratio, specific heat, thermal expansion, boiling point, melting point, latent heats, vapor pressure, and diffusion coefficients. For some commercial alloys are given: phase diagram information, latent heats, thermal expansion, heat capacity, and density.

Sn Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Sn Mantell, C. L., Tin, published by Reinhold, New York, 1949.

The book contains two chapters on constitutional, equilibrium diagrams including
ternary binary, ternary, and quaternary systems with references to the original literature.

Sn Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 8c: Ge, Sn, and Pb, 1962, (803 pages), (in French).

For general annotation, see under Pascal, Table I.

Sn Tin Research Institute, The Properties of Tin, published by the Tin Research Institute, Greenford, Middlesex, England, 1954.

This is a 53 page compilation of the following data for tin: electrical resistivity, thermal conductivity, Hall effect, thermoelectric power, Peltier and Thomson coefficients, magnetic susceptibility, atomic radius, density, viscosity, elastic properties, velocity of sound, crystal structural data and lattice parameters, line spectral data, X-ray data (characteristic X-ray emission spectra, scattering factors, mass absorption coefficient, and X-ray diffraction data), liquid optical properties (for both solid and liquid), photoelectric threshold and work function, superconductive properties, specific heats, latent heats, melting and boiling points, vapor pressure, entropy, thermal emissivity, thermal expansion, and (self-) diffusion coefficient.

Sn Greenfield, L. T. and Forrester, P. G., The Properties of Tin Alloys, Tin Research Institute, Middlesex, England, 1962.

A summary of general mechanical properties is given for several Sn-containing ternary systems with up to 5 (metallic) components. Densities are generally included and occasionally, other physical properties too. List of 98 references; 44 pages long. Properties include: densities, elastic properties, viscosity, phase diagrams of systems with up to 5 components.

Sr Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 29, Strontium: 1931. Supplement, 1960, (306 pages), (in German).

For general annotation, see under Gmelin, Table I.

Sr Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 4: Be, Mg, Ca, Sr, Ba, and Ra, 1958, (55 pages), (in French).

For general annotation, see under Pascal, Table I.

Ta English, J. J., Binary and Ternary Phase Diagrams of Niobium, Molybdenum, Tantalum, and Tungsten, (prepared at the Defense Metals Information Center), available from the Clearinghouse as Document No. AD 257, 739, 1961.

This compilation contains 93 phase diagrams of binary systems and 68 phase diagrams of ternary systems, each with a short discussion; 233 references given. ternary Other DMIC technical reports on physical and engineering information are available. For information, write to: Defense Metals Information Center, 505 King Avenue, Columbus, Ohio 43201.

Ta Goodwin, T. C. and Ayton, M. W., Thermal Properties of Certain Metals, available from the Clearinghouse as Document No. AD 111, 846, 1956.

The report contains annotated bibliographies; coverage is from July 1, 1955 to June 30, 1956. Materials listed are molybdenum, chromium, tantalum, copper, and graphite. Properties listed are: heat capacity, thermal conductivity, emissivity, thermal diffusivity, and thermal expansion. The report contains 380 references and an author index.

See also, Document Nos. AD 105, 099 and AD 105, 100 of the same title (these are also bibliographies.)

Ta Klopp, W. D., Schwartzberg, F. R., Holden, F. G., Sims, C. T., Ogden, H. R., and Jaffee, R. I., Investigation of the Properties of Tantalum and its Alloys, (prepared at Battelle Memorial Institute), available from the Clearinghouse as Document No. AD 206, 073, 1958, (78 pages).

A literature survey to July, 1958, is presented in narrative style. The data and references to the original literature are presented in four major sections:

Process Metallurgy, Physical Properties, Chemical Properties, and Metallurgical Properties. Results obtained by different authors are critically discussed, and presented in tabular or graphic form. References to the literature are given. Among the given properties are: electrical resistivity, thermal conductivity, magnetic susceptibility, density, lattice parameters, superconducting transition temperature, spectral emissivity, specific heat, thermal expansion, melting point, boiling point, vapor pressures, diffusion, nuclear data, and 9 phase diagrams of binary alloys (21 diagrams discussed).

Ta Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Ta Miller, G. L., Tantalum and Niobium (Metallurgy of the Rarer Metals - Series No. 6), published by Academic Press, New York, 1959.

The book gives a detailed treatment of the metals, ranging from a description of their production, purification, and metallurgy, to their physical properties. A physical description of the simpler alloys is given, but without elaboration. Properties of the metals described include: electrical resistivity and its temperature coefficients (these also given as a function of pressure), thermal conductivity, Hall Coefficients, thermoelectric power, magnetic susceptibility, density, elastic and shear moduli, lattice parameters, velocity of sound, structure sensitive properties, refractive index, work functions, electron emission, secondary emission, superconducting transition temperature, melting and boiling points, heat capacity, latent heat, entropy, and thermal expansion.

Ta Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 12: V, Nb, Ta, and Pa, 1958, (680 pages), (in French).

For general annotation, see under Pascal, Table I.

Ta Schmidt, F. F., Tantalum and Tantalum Alloys, available from the Clearinghouse as Document No. AD 242, 242, DMIC Report No. 133, 1960.

A reference book of 325 pages. Most of the physical properties listed are for
ternary the metal. Many binary and ternary systems are discussed, including phase diagrams. In addition, 251 references to the literature are given. Critical values are not always given. When several data exist, they are sometimes listed together without further discussion.

Tc Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 69, Technetium: 1941, reprint 1955, (154 pages), (in German). No update.

For general annotation and titles of sections, see under Gmelin, Table I.

Tc Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 16: F, Cl, Br, I, At, Mn, Tc, Re, 1960, (1195 pages), (in French).

For general annotation, see under Pascal, Table I.

Tc Tribalat, S., Rhenium et Technetium, published by Gauthier-Villars, Paris, 1957, (in French).

The text gives an introductory chapter of about 100 pages on general physical properties, including electrical resistivity and its temperature coefficient, thermal conductivity, magnetic susceptibility, density, lattice parameters, Young's modulus, work functions, electron emission, ionization potential, X-ray and optical emission spectra, melting point, latent heats, and thermal expansion.

Te Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 11, Tellurium: 1940, reprint 1955, (in German). No update.

For general annotation, see under Gmelin, Table I.

Te Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 13b: S, Se, Te, and Po, 1960, (1024 pages), (in French).

For annotation, see under Pascal, Table I.

Th Cuthbert, F. L., Thorium Production Technology, published by Addison-Wesley, New York, 1958.

The book describes historical as well as metallurgical, chemical, and physical topics related to the metal. A chapter on physical properties gives data on: structure and lattice parameters, density, melting point, thermal expansion, Young's modulus, shear modulus, compressibility, Poisson ratio, electrical resistivity and its temperature coefficient, work functions, spectral emissivity, heat capacity, heat contents and entropies, compound formations, and a few alloys, though no phase diagrams are given.

Th Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 44, Throium and Isotopes: 1955, (406 pages), (in German).

For general annotation, see under Gmelin, Table I.

Th Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Th Makarov, E. C., Crystal Chemistry of Simple Compounds of Uranium, Thorium, Plutonium, Neptunium, (translated from the Russian), published by Consultants Bureau, New York, 1959.

The book includes an interesting introductory section on general crystal chemistry. Given are coordination numbers, interatomic distances,and crystal structures for the compounds of the four elements listed in the title. A small amount of information on other actinides is also given. The author includes 119 references to the literature.

Th Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 9: Ti, Zr, Hf, Th, 1960, (1121 pages), (in French).

For general annotation, see under Pascal, Table I.

Th Rough, F. A. and Bauer, A. A., editors, Constitution of Uranium and Thorium Alloys, published by Battelle Memorial Institute, Columbus, Ohio, 1958.

ternary This is a compilation and critical evaluation of constitutional diagrams of binary and a few ternary alloys containing either uranium or thorium or both. Crystallographic data are included. References are given to the literature.

Ti Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 41, Titanium: 1951, (481 pages), (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Ti Kornilov, I. I., editor in chief, Physical Metallurgy of Titanium, (Works of the Fifth Conference on Metallurgy, Physical Metallurgy, and Application of Titanium and its Alloys, March 1953, Moscow), available from the Clearinghouse as Document No. NASA TT F-338, November, 1965.

ternary The only subject covered here which is directly related to our scope is that of phase equilibria in alloys containing up to 5 components. Only rarely are other properties, such as electrical resistivity or elastic properties, etc. included for these materials.

Ti Kornilov, I. I., editor, Titanium and its Alloys - Publication No. 10: Investigation of Titanium Alloys, (translated from the Russian, 1966), available from the Clearinghouse as Document No. TT-65-50139.

ternary This book includes phase diagram information for systems containing 3, 4, 5, or 6 components. In addition, a few other properties are indicated for the metal and several of its alloys. The most extensively covered of these properties are: elastic properties and the effects of adsorbed gases on these properties.

Ti Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Ti Margolin, H. and Nielson, J. P., a chapter on titanium in Modern Materials: Advances in Development and Application, (in 5 volumes), edited by H. H. Hausner, published by Academic Press, New York, Volume II, 1960.

The chapter includes many physical properties among which are electrical resistivity, thermal conductivity, thermoelectric power, magnetic susceptibility, density, lattice constants, elastic,bulk and shear moduli, Poisson ratio, neutron cross sections, emissivities, X-ray spectra, work functions, thermal expansion, specific heat, temperatures and heats of transformation. Phase diagrams and solubilities are included for a few alloys.

Ti McQuilliam, A. D. and McQuillan, M. K., Titanium (Metallurgy of the Rarer Metals - Series No. 4), published by Academic Press, New York, 1956.

ternary The book gives a detailed treatment of the metal, emphasizing engineering topics such as its production, metallurgy, and welding properties. It presents a chapter on constitution diagrams of binary and ternary titanium alloys with references to the original literature. Physical properties of pure titanium are also given. Among these are: electrical resistivity, thermal conductivity, Hall effect, thermoelectric power, magnetic susceptibility, density, crystal lattice structure and constants, Young's modulus, modulus of rigidity, Poisson's ratio, velocity of sound, neutron cross section, emission spectra, work functions, emissivity, superconducting critical field and temperature, specific heat, thermal expansion, transition temperatures, latent heats, and vapor pressures.

The phase diagrams and lattice structures of binary alloys are described in detail. A table of investigations of ternary phase diagrams is included.

Ti Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 9: Ti, Zr, Hf, Th, 1963, (1121 pages), (in French).

For general annotation, see under Pascal, Table I.

Ti Rossini, F. D, Cowie, P. A., Ellison, F. O., and Browne, C. C., Properties of Titanium Compounds and Related Substances, Office of Naval Research, Department of the Navy, Washington, D.C. 20350, 1956.

Numerous thermodynamic and physical properties of titanium compounds are given for both metallic and nonmetallic types of materials. The compilation appears to be a complete listing of references as of December 31, 1954. The preface states: "In carrying on this work, the following two prior compilations were used as a starting point (1) Selected Values of Chemical Thermodynamic Properties, Rossini et.al, NBS Circular No. 500, 1952, (2) Titanium and Its Compounds, G. Skinner et.al., H. L. Johnston Enterprises, Columbus, Ohio, 1954." (listed under MEC-THE of Table III and elsewhere in this Table.)

Ti Skinner, G., Johnston, H. L., and Beckett, C., Titanium and Its Compounds, published by H. L. Johnston Enterprises, Columbus, Ohio, 1954.

A review of the literature is given on thermal, structural, electronic, magnetic, and other physical properties, covering the literature through 1951. The metal is discussed and some of its nonmetallic compounds. The properties given include: melting point, boiling point, heat content, specific heat, entropy, free energy, vapor pressure, crystal structure and lattice constants, density,velocity of sound, modulus of elasticity, and compressibility.

Tl Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 38, Thallium and Isotopes: Sections 1-3, 1939-40, reprints 1962, (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

Tl Pascal, P., editor, Nouveau Traite de Chimie Minerale, published by Masson et Cie., Paris. Volume 6: B, Al, Ga, In, and Tl, 1961, (1022 pages), (in French).

For general annotation, see under Pascal, Table I.

BOOKS COVERING TRANSITION METALS, (TT), INCLUDING MAGNETIC, REFRACTORY, AND PLATINUM METALS

For books covering a single element in these series, see under the chemical symbol in the alphabetic listing.

TT Adams, R. M., editor, Boron, Metallo-Boron Compounds, and Boranes, published by Interscience, New York, 1964.

For annotation, see under R. M. Adams, Table I.

TT Aronsson, B., Borides - Part A - Basic Factors, (a chapter from the book, Modern Materials: 2, 143-190, 1960, edited by H. H. Hausner).

The author gives a brief description of elemental boron. Transition metal-boron intermetallic compounds, together with information on crystal structure and constitution for each occuring structure are discussed in much greater detail. The borides of the alkali metals, alkaline earths, rare earths, and actinides are also briefly discussed.

Several properties of the intermetallic phases are tabulated or discussed. Among these are: electrical resistivity and its temperature coefficient, thermal conductivity, Hall coefficients, thermoelectric power, density, crystal structure, work function, thermoemission constants, superconducting properties, melting point, heat of formation, and thermal expansion.

ternary Ternary systems containing two different metals and boron are treated and those which the author refers to as "quasi-binary systems" (i.e. Me_1B - Me_2B system). The ranges of solubility and a few of the properties mentioned above are discussed. Ternary systems involving only one metallic component are also

discussed. References to the original literature are given throughout the text, as well as in a bibliography of 192 entries.

TT Bozorth, R. M., Ferromagnetism, published by VanNostrand, Princeton, N.J., 1951, (968 pages).

Magnetic properties include essentially all of those given in our List of Properties under that category (MAG) and only a few outside this topic. For further annotation, see under MAG in Table III.

TT Eldridge, E. A. and Deem, H. W., Report on Physical Properties of Metals and Alloys from Cryogenic to Elevated Temperatures, American Society for Testing and Materials - STP 296, 1961, (206 pages).

For annotation see under Table I.

TT English, J. J., Binary and Ternary Phase Diagrams of Niobium, Molybdenum, Tantalum, and Tungsten, available from the Clearinghouse as Document No. AD 257,739.

For annotation see under Table I.

TT Heiniger, F., Bucher, E., and Muller, J., Low Temperature Specific Heats of Transition Metals and Alloys, an article in Physik der Kondensierten Materie: 5, 243, 1966.

ternary The review article summarizes and tabulates values for the electronic specific heats, γ, and Debye temperatures of transition metals and their binary and ternary alloys (with both transition and non-transition metals). Graphs of γ versus electron concentration are also presented. One hundred and ninety references to the literature are given.

TT Hoselitz, K., Ferromagnetic Properties of Metals and Alloys, published by Clarendon Press, Oxford, 1952.

For annotation see under MAG in Table III.

TT International Nickel Company, The Platinum Group Metals in Industry (Ru, Rh, Pd, Os, Ir, and Pt).

See under Nickel, this Table.

TT Kaufman, L., Bernstein, H., and Sarney, A., Thermodynamics of Interstitial Solid Solutions and Refractory Compounds, Technical Documentary Report No. ASD-TR-61-445, Part III, November 1963, (Sponsored by Air Force Materials Laboratory, Wright-Patterson AFB, Ohio).

A thermodynamic analysis of the systems Ti-C, Zr-C, Hf-C, Nb-C, Ta-C, Ti-O, Zr-O, Ti-N, and Zr-N is given. Phase diagrams (also from secondary sources) are given. Evaporation rates and vapor pressures, as well as other thermodynamic properties are presented. Some values for thermal expansion coefficients and Debye temperatures are given for HfC and ZrC.

TT Kaufman, L. and Clougherty, E. V., Investigation of Boride Compounds for Very High Temperature Applications, Technical Documentary Report No. RTD-TDR-63-4096, Part I, December 1963, (Sponsored by Air Force Materials Laboratory, Wright-Patterson AFB, Ohio).

The report deals primarily with original research on TiB_2, ZrB_2, HfB_2, NbB_2, and TaB_2. Tables of values are included for electrical resistivity, thermal conductivity (measurements made primarily from room temperature to 1,000°C), elastic properties, density, oxidation rates and related information, lattice constants and other crystallographic data, thermal expansion, Debye temperatures, entropies, heats of formation, vapor pressure, and total and electronic heat capacities (some low temperature and some high temperature values). Phase diagrams are also given and discussed. For the metallic constituents, the thermodynamic

properties are also listed up to very high temperatures.

TT Kirk, R. E. and Olthmer, D. F., editors, Encyclopedia of Chemical Technology, published by Interscience, New York.

Generally, this encyclopedia is directed toward chemical descriptions of various metals, and of plastics, petroleums, perfumes, etc. A particular heading brought to our attention is Platinum Group Metals, Alloys, and Compounds (10, 819-859, 1953) which gives tables of physical properties of Ru, Rh, Pd, Os, Ir, and Pt. The properties include: electrical resistivity and its temperature coefficient, thermal conductivity, magnetic susceptibility, Young's modulus, work functions, heat capacity, thermal expansion, and vapor pressure (at the melting point). Apparently not all of the elements are described separately in these volumes, but rather under generalized names.

TT McClaine, L. A., editor, Thermodynamic and Kinetic Studies for a Refractory Materials Program, Technical Documentary Report No. ASD-TDR-62-204, in 3 parts, (Sponsored by the Air Force Materials Laboratory, Wright-Patterson AFB, Ohio), (prepared under Contract No. AF 33(616) 7472 by A. D. Little, Inc.). Part I: April, 1962; Part II: May, 1963; Part III: April, 1964.

The reports cover original work mainly, rather than representing compiled data. The materials emphasized are ZrB_2, HfB_2, ZrC, TaC, and Hf metal. The properties on which values are tabulated include: heat capacity, entropy, vapor pressures, oxidation rates, and rate constants for a few chemical reactions. Electrical resistivity of ZrO_2 is given and diffusion information is included (also for oxygen in selected oxides.

TT Platinum Metals Review (Pt, Pd, Rh, Ir, Os, and Ru), published by Johnson, Matthey, and Company, Ltd., London.

This quarterly journal contains papers which include information on properties within our scope.

TT Rudy, E., chief investigator, Ternary Phase Equilibria in Transition Metal-Boron-Carbon-Silicon Systems, (a series of reports prepared by the Aerojet-General Corporation for the Air Force Materials Laboratory, Wright-Patterson AFB, Ohio).

Determinations of phase diagrams via literature searched as well as by new experimental determinations are given. All reports are available from the Clearinghouse.

Part I: Related binaries.

Vol.		
I:		Mo-C system. Not yet received.
II:	AD 467,838	Ti-C and Zr-C systems.
III:	AD 469,450	Mo-B and W-B systems.
IV:	AD 472,697	Hf-C system.
V:	AD 478,182	Ta-C and some work on V-C and Nb-C systems.
VI:	AD 480,948	W-C system and supplemental information on Mo-C system.
VII:	AD 480,826	Ti-B system.
VIII:	AD 480,949	Zr-B system.
IX:	AD 480,812	Hf-B system.
X:	AD 482,358	V-B, Nb-B, and Ta-B systems.
XI:	AD 816,189	Mo-C system (final report).
XII:	AD 823,638	V-C and Nb-C systems.

ternary Part II: Ternary systems.

Vol.		
I:	AD 470,827	Ta-Hf-C system.
II:	AD 475,018	Ti-Ta-C system.
III:	AD 476,624	Zr-Ta-C system.
IV:	AD 480,801	Ti-Zr-C, Ti-Hf-C, and Zr-Hf-C systems.
V:	AD 482,359	Ti-Hf-B system.

VI: AD 489,154 - Zr-Hf-B system.
VII: AD 482,360 - Ti-Si-C, Nb-Si-C, and W-Si-C systems.
VIII: AD 487,622 - Ta-W-C system.
IX: AD 489,140 - Zr-W-B system.
X: AD 489,752 - Zr-Si-C, Hf-Si-C, Zr-Si-B, and Hf-Si-B systems.
XI: AD 800,389 - Hf-Mo-B and Hf-W-B systems.
XII: AD 803,913 - Ti-Zr-B system.
XIII: AD 803,270 - Ti-B-C, Zr-B-C, and Hf-B-C systems.
XIV: AD 820,649 - Hf-Ir-B system.
XV: AD 819,810 - Nb-Mo-C system.
XVI: AD 664,344 - V-Nb-C system.
XVII: AD 664,345 - Ta-Mo-C system.

Part III: Special Experimental Techniques.
Vol. I: AD 469,132 - High-temperature differential thermal analysis.
II: AD 816,123 - Pirani-furnace for the precision determination of the melting temperature of refractory metallic substances.

Part IV: Thermochemical Calculations.
Vol. I: AD 467,839 - Thermodynamic properties of Group IV, V, and VI binary transition metal carbides.
ternary II: AD 482,279 - Thermochemical interpretation of ternary phase diagrams.
ternary III: AD 803,914 - Computational approach to the calculation of ternary phase diagrams.

Progress Reports:
1 Jan. to 28 Feb., 1964 - AD 442,760.
1 Jan. to 15 Sept., 1964 - AD 461,653.
15 Sept., 1964 to 15 Feb., 1965 - AD 463,105.
1 Jan. to 15 Dec., 1964 - AD 463,558.

TT Samsonov, G. V., Markovskii, L. Y., Zhigach, A. F., and Valyashko, M. G., Boron, Its Compounds and Alloys, 1960, available from the Clearinghouse as Document No. AEC-TR-5032 (2 volumes).

Book I: Several of the chapters are on properties of interest. Values for properties of the element are given for: electrical resistivity, thermal conductivity, magnetic susceptibility, density, crystal structure and lattice parameter data, thermal neutron cross section, melting and boiling points, specific heat, latent heats, heats of transformation, entropy, and thermal expansion. References to the literature are given. The systems B-C, B-Si, B-Ge, B-N, B-P, and B-S are discussed in separate chapters. Properties such as electrical resistivity, thermal conductivity, Hall effect, density, electron probability density, lattice parameters, elastic moduli, thermal expansion, phase transformations, etc. are discussed for these systems at various compositions.

Book II: This book treats crystal structures and lattice constants in some detail, describing conditions for formation. The materials include primarily transition metal and rare earth borides. Included for some of these borides are: electrical resistivity and its temperature coefficient, density, elastic modulus, work function, emissivity, superconductive transition temperatures, melting point, phase diagrams, entropy, thermal expansion, and others such as magnetic properties.

TT Sara, R. V., et.al., Research Study to Determine the Phase Equilibrium Relations of Selected Metal Carbides at High Temperatures, Technical Documentary Report No. WADD TR-60-143, (Sponsored by the Air Force Materials Laboratory, Wright-Patterson AFB, Ohio; prepared under Contract No. AF 33(657)-8025 and earlier numbers by the Union Carbide Corp.)

The reports discuss phase diagram determinations in metal-carbon systems.

Part I. (not yet received in the Alloy Data Library)
Part II. (not yet received in the Alloy Data Library)
Part III. 1962 - W-C and Zr-C systems, by Sara, R. V. and Dolloff, R. T.
Part IV. 1963 - Zr-C, Ta-C, and B-C systems, by Sara, R. V., Lowell, C. E., and Dolloff, R. T.
ternary Part V. 1964 - Ta-C, Hf-C, HfC-TaC, and B-C systems, by Sara, R. V. and Lowell, C. E.

TT Schwarzkopf, P. and Kieffer, R., in collaboration with W. Leszynski and F. Benesovsky, Refractory Hard Metals: Borides, Carbides, Nitrides, and Silicides, published by Macmillan, New York, 1953.

For annotation see under Table III (MEC-THE).

TT Thermophysical Properties Research Center, Thermophysical Properties of High Temperature Solid Materials, Y. S. Touloukian, editor, published by Macmillan, New York. Volume 3: Ferrous Alloys, 1967.

For general annotation and listing of all volumes, see under Table I. The properties on which evaluated data are presented include: density, melting point, heat of fusion, heat of vaporization, heat of sublimation, electrical resistivity, specific heat (at constant pressure), thermal conductivity, thermal expansion, absorptance, emittance, reflectance, transmittance, and vapor pressure.

TT Tietz, T. E. and Wilson, J. W., Behavior and Properties of Refractory Metals, published by Stanford University Press, 1965.

Data on seven of the more important refractory metals - chromium, niobium, molybdenum, rhenium, tantalum, tungsten, vanadium, and their alloys - are presented in detail, with emphasis on mechanical behavior and properties. Properties discussed include ductile-brittle behavior, tensile properties, creep and stress-rupture, oxidation behavior, and thermal conductivity and expansion.

TT Williams, W. S. and Lye, R. G., Research to Determine the Mechanisms Controlling the Brittle-Ductile Behavior of Refractory Cubic Carbides, Technical Documentary Report No. ML-TDR-64-25: March 1964, (Sponsored by Air Force Materials Laboratory, Wright-Patterson AFB, Ohio, and prepared under Contract No. AF 33(657)-10109 by Union Carbide Corp.).

This report includes sections on electrical resistivity, Hall coefficient, thermoelectric power, drift velocity, magnetic susceptibility, elastic constants, and cohesive energy. These are discussed in relation to a possible band structure. The report is primarily a result of experimental investigations on TiC, rather than a compilation from the literature.

U Gittus, J. H., Uranium (Metallurgy of the Rarer Metals - Series No. 8), published by Academic Press, New York, 1963.

This rather carefully written book contains a considerable amount of data including phase diagrams, crystallographic, physical, thermal, chemical, and magnetic properties of uranium, its alloys, and compounds. Each chapter contains a list of references to the original literature and to other reviews. The book also includes a chapter on diffusion in uranium and some of its alloys and describes some of its nuclear properties. Properties included for the metal are: thermal conductivity, electrical resistivity and its temperature coefficient, Hall effect, thermoelectric power, magnetic susceptibility, Kohler diagrams for transverse magnetoresistance, density, lattice structure and constants, bulk modulus, Young's modulus, Poisson ratio, elastic stiffness and elastic compliance coefficients, velocity of sound, heat capacity, thermal expansion, melting point, boiling point, latent heats, vapor pressure, diffusion, reflectivity, emissivity, and isotope shifts of spectral lines. Superconductive properties include transition temperatures. For some 46 binary alloys: phase diagrams (no alkalis mentioned), and diffusion are included.

U Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 55, Uranium and Isotopes: 1936, reprint 1955, (279 pages), (in German). No update.

For general annotation and titles of sections, see under Gmelin, Table I.

U Holden, A. N., Physical Metallurgy of Uranium, published by Addison-Wesley, New York, 1958.

The book contains a large number of graphs, tables, and references on a wide variety of physical, chemical, and mechanical properties of uranium and its alloys. Among the physical properties are: electrical resistivity, thermal conductivity, magnetic susceptibility, density, elastic, bulk, and shear moduli, Poisson ratio, lattice constants, thermoelectric potential, thermionic and photoelectric emission, optical emissivity, heat capacity, thermal expansion, vapor pressure, phase transformations, latent heats, entropies, diffusion, and nuclear data.

U Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

U Makarov, E. S., Crystal Chemistry of Simple Compounds of Uranium, Thorium, Plutonium, Neptunium, (translated from the Russian), published by Consultants Bureau, New York, 1959.

The book includes an interesting introductory section on general crystal chemistry. Given are coordination numbers, interatomic distances, and crystal structures for the compounds of the four elements listed in the title. Some projections are included showing atomic positions within the unit cell. A small amount of information on other actinides is also given. The author includes 119 references to the literature.

U Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 15a: Uranium, 1960, (725 pages), (in French); Volume 15b: U compounds, 1960, (630 pages), (in French); Volume 15c: Transuranic Elements, 1962, (1080 pages), (in French).

For general annotation, see under Pascal, Table I.

U Rand, M. H. and Kubaschewski, O., The Thermochemical Properties of Uranium Compounds, published by Interscience, New York, 1963, (96 pages).

The book contains discussions of the heats of formation and entropies of uranium compounds. It also includes tabulation of these properties with references to 212 papers* and interesting illustrated discussions of how the thermochemical data can be used for calculation of equilibrium diagrams.

*(pp. 66-72), giving numbers for heats of formation, standard entropies, boiling points, melting points, latent heats for transformations of both the first and second kind, heat capacities, vapor pressures, and free energies.

U Rough, F. A. and Bauer, A. A., editors, Constitution of Uranium and Thorium Alloys, published by Battelle Memorial Institute, Columbus, Ohio, June 1958.

This is a compilation and critical evaluation of constitutional diagrams of
ternary binary and a few ternary alloys containing either uranium or thorium or both. Crystallographic data are included. References are given to the literature.

V Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 48, Vanadium, Part A: Section 1, 1968; Part B: Sections 1-2, 1967, (in German).

For general annotation and titles of sections, see under Gmelin, Table I.

V Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

V Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 12: V, Nb, Ta, and Pa, 1958, (680 pages), (in French).

For general annotation, see under Pascal, Table I.

V Rostoker, W., The Metallurgy of Vanadium, published by John Wiley, New York, 1958.

Most of the chapters are on engineering topics. Some binary and higher order
ternary alloys of the metal are discussed briefly in connection with phase diagrams. Some lattice parameters are also given for binary alloys. A chapter on physical properties gives data on: ionization potential (atomic), excitation potential for K emission spectra, K absorption edge, X-ray absorption coefficients, structure and lattice parameters, thermal neutron cross sections, density, melting point, boiling point, vapor pressure, latent heats, specific heats (also electronic), spectral emissivities, thermal expansion, thermal conductivity, electrical resistivity (including pressure and temperature coefficients thereof), superconductive transition temperatures, thermal emf's, magnetic susceptibilities, compressibilities, Young's modulus, shear modulus, and Poisson ratio.

W English, J. J., Binary and Ternary Phase Diagrams of Niobium, Molybdenum, Tantalum, and Tungsten, (prepared at the Defense Metals Information Center), available from the Clearinghouse as Document No. AD 257,739, 1961.

This compilation contains 93 phase diagrams of binary systems and 68 phase dia-
ternary grams of ternary systems, each with a short discussion. 233 references given. Other DMIC technical reports on physical and engineering information are available. For information, write to: Defense Metals Information Center, 505 King Avenue, Columbus, Ohio 43201.

W Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 54, Tungsten: 1933, reprint 1955, (397 pages), (in German). No update.

For general annotation, see under Gmelin, Table I.

W Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

W Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 14: Cr, Mo, and W, 1959, (998 pages), (in French).

For general annotation, see under Pascal, Table I.

W Rieck, G. D., Tungsten and Its Compounds, published by Pergamon Press, New York, 1967.

A concise treatment of the properties of the metal is given including physical as

well as chemical and metallurgical properties in the first half of the book. The second half discusses intermetallic and other tungsten compounds, mainly their structural properties and occasionally others. Among the properties given for the metal are: electrical resistivity (including residual resistivity), thermal conductivity, Hall effect, thermoelectric power, magnetic susceptibility, atomic volume, density, crystal structure and lattice constants, Young's modulus, optical emissivity, X-ray emission and absorption spectra, electron emission, melting and boiling points, latent heats, entropies, enthalpies, diffusion, and neutron absorption cross sections.

W Smithells, D. J., Tungsten, published by the Chemical Publishing Company, Cleveland, 1953.

Metallurgical and several physical properties of the metal are discussed, mainly in relation to its commercial use and applications. Tables of optical properties (including emissivities) at various temperatures are included. Some of the given data are for heat capacity, thermal conductivity, I-V characteristics, thermionic properties, work functions, ion emission, thermocouple values, and the Thompson and Seebeck effects (also as a function of pressure). Some of the more important tungsten alloys are discussed, including data on physical and mechanical properties.

Y Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volumes 7a and b: Sc, Y, Ac, and the Rare Earths, 1959, (706 and 770 pages respectively), (in French).

For general annotation, see under Pascal, Table I.

Y Vickery, R. C., Chemistry of Yttrium and Scandium, published by Pergamon Press, New York, 1960.

A critical review of the literature concerning these elements is given, with references at the end of each chapter. No alloy data are given, but chemical and physical properties of yttrium metal and its nonmetallic compounds are discussed. Scandium is not treated very extensively as far as physical properties are concerned. The introduction states that the literature has been abstracted as comprehensively as possible up to December, 1958, with some later references included.

Zn Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 32, Zinc, 1924, reprint 1957, (329 pages), (in German). No update.

For general annotation and titles of sections, see under Gmelin, Table I.

Zn Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, b) Sinterwerkstoffe, Schwermetalle, 1964, (in German).

The metal and its properties are described separately in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Zn Mathewson, C. H., Zinc - The Science and Technology of the Metal, Its Alloys, and Compounds, (ACS Series No. 142), published by Reinhold, New York, 1959.

ternary The book is almost entirely devoted to production and engineering topics. One chapter covers phase diagram and structural data of zinc alloys, both binary and ternary. (Here some values of electrical resistivities and moduli of elasticity are tabulated). Some of the data were taken from secondary sources.

Zn Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 5: Zn, Cd, and Hg, 1962, (954 pages), (in French).

For general annotation, see under Pascal, Table I.

Zr Blumenthal, W. B., The Chemical Behavior of Zirconium, published by D. Van Nostrand, Princeton, New Jersey, 1958.

The book includes a chapter on interstitial solid solutions and intermetallic compounds of Zr. A table of their crystallographic structures and melting points is included. A large number of references are given. Data include: crystallographic information, structures, constitutional information,and melting points.

Zr Boulger, F. W., The Properties of Zirconium, U. S. Atomic Energy Commission, Document No. AECD-2726, March, 1949.

A compilation on various physical, chemical,and metallurgical properties is presented. Depending on the particular property sought, the information is somewhat outdated. These properties include: electrical resistivity and its temperature coefficient (also as a function of pressure), thermal conductivity and thermoelectric power, magnetic susceptibility, density, lattice structure and constants, modulus of elasticity, Poisson's ratio, emissivity, photoelectric threshold, work functions, superconducting transition temperature, melting and boiling points, entropies, enthalpies, vapor pressure, transformation temperatures, and thermal expansion. Essentially no data for Zr alloys are included.

Zr Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, GmbH, Berlin. System No. 42, Zirconium, 1958, (448 pages), (in German).

For general annotation, see under Gmelin, Table I.

Zr Herenguel, J., Métallurgie Spéciale, Volume III: Zirconium and its alloys, published by Presses Universitaires de France, 108 Boulevard Saint-Germain, Paris, 1962, (in French).

Historic and economic background is given; production of the metal from its ore is described. A substantial amount of metallurgical and engineering data is given in the book. This volume has no index.

For Zr metal: electrical resistivity and its temperature coefficient, thermal conductivity, magnetic susceptibility, density, elastic properties, lattice parameters, emittance, electron emission, specific heat, latent heats, heats of transformation, melting and boiling points, vapor pressure, thermal expansion, and self-diffusion are given. For Zr alloys: electrical resistivity, free energies of formation of carbides, chlorides, oxides, nitrides, and sulfides as a function of temperature, and diffusion constants of U in αZr and of Sn in Zr are given. Properties of Zircalloy are treated in an appendix: composition, electrical resistivity, thermal conductivity, density, elastic properties, thermal expansion, and transformation temperature limits.

Zr Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York. IV Band: Technik. 2. Teil, c) Leichtmetalle, Sonderwerkstoffe, Halbleiter, Korrosion, 1965, (in German).

The metal and its properties are described in a section of this volume. For the general annotation, see under Landolt-Börnstein Tabellen, Table I.

Zr Miller, G. L., Zirconium (Metallurgy of the Rarer Metals - Series No. 2), published by Academic Press, New York, 1954.

The book gives a detailed treatment of the metal, ranging from a description of its production and metallurgy to its physical and chemical properties. It presents a chapter describing Zr-base commercial alloys, but does not generally include phase diagrams.

Physical properties of pure zirconium are also given. Among these are: electrical resistivity and its temperature coefficients (these also given as a function

of pressure), thermal conductivity, magnetic susceptibility (also given for metastable phases), density, lattice parameters, elastic and shear moduli, velocity of sound, neutron diffraction work, thermoelectric power, work functions, electron emission, photoelectric threshold, spectral emissivity, optical spectra, K and L series X-ray spectra, melting and boiling points, heat capacity, phase transformation, latent heats, entropy, vapor pressure, and thermal expansion. Superconducting properties of the metal and some of its alloys are discussed.

Zr Miller, G. L., Zirconium, (a chapter from Modern Materials: Advances in Development and Application, Vol. I, 1958, edited by H. H. Hausner), published by Academic Press, New York, (5 volumes).

Among the listed properties in this chapter are: electrical resistivity and its temperature coefficients, thermal conductivity, lattice constants, specific heat, thermal expansion, latent heats, and vapor pressure. The text includes 104 references.

Zr Pascal, P., editor, Nouveau Traité de Chimie Minérale, published by Masson et Cie., Paris. Volume 9: Ti, Zr, Hf, Th, 1963, (1121 pages), (in French).

For general annotation, see under Pascal, Table I.

Zr Shelton, S. M., Zirconium - Its Production and Properties, U. S. Department of Interior, Bureau of Mines, Bulletin 561, 1956.

The bulletin consists of a set of chapters written by several contributing authors. Part V, by Earl T. Hayes, gives physical and other data of the metal and Part VII, by the same author, describes a substantial amount of binary Zr alloy systems.

Properties for the described metals include: compressibility, elastic and shear moduli, Poisson ratio, structural information, lattice parameters, magnetic susceptibility, spectral emissivity and photoelectric properties. For the alloys, phase diagrams are given only (no structural information).

Table III of Appendix B

BOOKS DEALING WITH ONE (OR A FEW) CATEGORIES
GIVING VALUES FOR SEVERAL MATERIALS.

Listing is per first author or editor's name, under the Category to which they pertain given in the following order: ETP (Category 1); MAG (Category 2); MEC-THE (Categories 3 and 8 merged); N-R-P (Category 4); QDS (Category 5); RAD-SXS (Categories 6 and 9 merged); and SUP (Category 7).

Category 1 - ETP - Electronic Transport Properties

Borelius, G., The Changes in Energy Content, Volume,and Resistivity with Temperature in Simple Solids and Liquids, (an article in Solid State Physics: 15, 2-51, 1963, edited by F. Seitz and D. Turnbull), published by Academic Press, New York.

This article gives values in graphical form for the specific heat and thermal expansion of several elemental metals. The author has also included graphs depicting the temperature dependence of the temperature coefficient of resistance, $\frac{1}{r_o}\frac{dr}{dt}$, for a selected number of metals.

Bridgeman, P. W., The Resistance of 72 Elements, Alloys, and Compounds to 100,000 kg/cm^2, (an article in Proceedings of the American Academy of Arts and Sciences: 81, 165-251, March, 1952), published by the Academy, Cambridge.

This is a review article and presents a compilation of resistivity data as a function of pressure and temperature, giving both graphical representations as well as data in tabular form.

Bundy, F. P. and Strong, H. M., Behavior of Metals at High Temperatures and Pressures, (a chapter from the Solid State Physics Series: 13, 81-146, 1962, edited by F. Seitz and D. Turnbull), published by Academic Press, New York.

This article includes several graphical representations of data for compressibility and electrical resistivity changes with pressure. Among some of the other data are results of the application of pressure on thermal emf's for thermocouple materials.

Cusak, N. E., The Electronic Properties of Liquid Metals, (an article in Reports on Progress in Physics: 26, 361-410, 1963, A. C. Strickland, executive editor), published by the Physical Society, London.

This review article includes melting points, electrical resistivity, optical con-
liquid stants, Hall coefficients, thermoelectric power, thermal conductivity, magnetic susceptibility, and Knight shifts mostly of pure liquid metals.

Drickamer, H. G., The Effect of High Pressure on the Electronic Structure of Solids, (a chapter from Solid State Physics: 17, 1-133, 1965, edited by F. Seitz and D. Turnbull), published by Academic Press, New York.

This article includes a section on metals, giving graphical data on electrical resistivity as a function of pressure for several metals. Experiments implying changes of the Fermi surface with pressure are also described along with calculated values for changes in the dimensions of hole and electron pockets and overlap where the Fermi surface is not simply connected.

Eldridge, E. A. and Deem, H. W., Report on Physical Properties of Metals and Alloys from Cryogenic to Elevated Temperatures, published by the American Society for Testing and Materials as STP 296, 1961, (206 pages).

This report contains about 650 data sheets and 80 curves of physical properties of Al, Co, Fe, Mg, Mo, Ni, and many of their more common alloys. The temperature range is from -457 to +4500°F (1.3 to 2756°K). References to the original literature are given. Electronic transport properties include resistivities and thermal conductivities.

Flügge, S., editor, Handbuch der Physik, published by Springer-Verlag, New York. Volume 20: Electrical Conductivity, 1957, (Sections in German, English, or French).

For general annotations, see under Table I.

Forsythe, W. E., editor, Smithsonian Physical Tables, 9th revised edition, published by the Smithsonian Institution, Washington, D.C., 1954.

The electronic transport properties include resistivities and several of the other properties listed in this category. For general annotation, see under Table I.

Goldsmith, A., Waterman, T. E., and Hirschhorn, H. T., editors, Handbook of Thermo-Physical Properties of Solid Materials (5 volumes), published by Macmillan, New York, 1961. (Also available from the Clearinghouse as Document No. AD 247,193 and from U. S. Department of Defense - Wright-Patterson AFB, Ohio - WADC Technical Report 58-476, 1960).

A revised version is now available in 6 volumes, from Macmillan, as prepared by the Thermophysical Properties Research Center (Y. S. Touloukian, director). For annotations, see under Table I.

Gray, D. E., coordinating editor, American Institute of Physics Handbook, 2nd edition, published by McGraw-Hill, New York, 1963.

For general annotation, see under Table I.

Some of the ETP properties included for metallic materials in this handbook are: conductivities for copper wires and Hall coefficients for several ferromagnetic alloys. For the metals some thermal conductivities and electrical resistivities are given as a function of temperature and pressure. Other ETP properties such as Hall coefficients, etc., are also tabulated for the metals.

Hampel, C. A., editor, Rare Metals Handbook, 2nd edition, published by Reinhold, New York, 1961, (732 pages).

The electronic transport properties include resistivities and thermal conductivities. For general annotation, see under Table I.

Johnson, V. J., editor, A Compendium of the Properties of Materials at Low Temperatures (Phase I, Part II, Properties of Solids), available from the Clearinghouse as Document No. AD 249,786, October, 1960.

The following chapter is pertinent to this category: Chapter 3: Thermal Conductivity at Low Temperatures.

A separate table of contents is listed for each chapter. The compendium consists of tabular as well as graphical representationsof the data. A few transition metal alloys are included. Values are often taken from secondary sources and early literature. For other publications, see under listing under Mechanical and Thermodynamics properties (MEC-THE) in this Table.

Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York.

For general annotation, see under Table I. Some specific volumes tabulating properties of this category are:

II Band: 6. Teil, Elektrische Eigenschaften I, 1959, (in German).
7. Teil, Elektrische Eigenschaften II, 1960, (in German).
Among the properties included are resistivity and its temperature coefficients (also as a function of pressure), magnetoresistance, superconductors and their properties, thermoelectric power, Peltier effect, Thomson effect, Hall effect (including data for ferromagnetic alloys), and others. Large parts of these volumes are devoted to non-metallic materials and some of the electronic transport properties of metals and alloys are listed in other volumes devoted to such materials, listing all their properties together.

IV Band: 3. Teil, Technik - Elektrotechnik, Lichttechnik, Röntgentechnik, 1957, (in German).
Some resistivities and their temperature coefficients, and thermoelectric materials and their properties are given in this volume.

Powell, R. L. and Blanpied, W. A., Thermal Conductivity of Metals and Alloys at Low Temperatures: A Review of the Literature, U. S. Department of Commerce - NBS Circular 556, September, 1954. (Available from the Clearinghouse).

Forty-eight graphs of thermal conductivity versus T (0-300°K) are given, along with tables of the less extensive data. References to the literature are given in the text as well as in a bibliography. The search includes most of the literature published from 1900 to early 1954 and includes pure metals and binary and ternary higher order alloys.

Powell, R. W., Ho, C. Y., and Liley, P. E., Standard Reference Data on the Thermal Conductivity of Selected Materials, NSRD-NBS-8, November 25, 1966, available from the Clearinghouse.

Included among the materials are aluminum, copper, gold, silver, iron, Armco iron, manganin alloy, mercury, platinum, tungsten, and a 40% Rh-60% Pt alloy.

Smith, D. P., Hydrogen in Metals, published by the University of Chicago Press, 1948.

The book deals with the subject from a phenomenological, rather than theoretical point of view. Topics include solubilities of hydrogen in metals and binary alloys, and the influence of hydrogen content on some physical properties of the metals (though the data are rather scarce on the latter). Selected data on other properties are given throughout the text. Electrical resistivities are among these properties. 1467 references to the literature are given.

For H-Pd: electrical resistivity and its temperature coefficient, magnetic susceptibility, crystal structure, and solubilities. For H-Fe: magnetic transition temperatures, susceptibilities, and solubilities. For others: some selected data are given throughout the text.

Stanley, J. K., editor, Electrical and Magnetic Properties of Metals, published by the American Society for Metals, Metals Park, Ohio, 1963.

The book does not go into the details of modern theory, but rather, gives introductions with examples and short tables throughout the text. Among the properties tabulated are:

For rare earth metals: electrical resistivity and its temperature coefficient.
For other elemental metals: electrical resistivity and its temperature coefficient,

thermal conductivity, Hall coefficient, thermoelectric power, electronic g-factor, saturation magnetization, magnetic permeability, Curie temperature, magnetic susceptibility, magnetostriction, magnetocrystalline anisotropy, coercive force, density, field emission, secondary emission, and superdonducting transition temperature. For alloys: electrical resistivity and its temperature coefficient, thermal conductivity, electronic magnetic moment, saturation magnetization, magnetic permeability, Lorentz number, Curie temperature, magnetostriction, magnetocrystalline anisotropy, coercive force, residual magnetization, density, superconducting transition temperature, magnetization curves of several commercial alloys, and $(HB)_{max}$.

Stewart, R. B. and Johnson, V. J., editors, A Compendium of the Properties of Materials at Low Temperatures (Phase II), available from the Clearinghouse as Document No. AD 272,769, December, 1961.

The compilation contains six chapters, two of which are applicable: thermal conductivity integrals of solids, and electrical resistivity of metallic elements. References to the literature are given with the data. Much of the given data is from secondary sources and publications of early date. Gaps in the modern literature cause the compendium to be incomplete and values not up-to-date. The bibliography lists references alphabetically by author and also by property and by material.

For a listing of other publications by this group, see Johnson, V. J., under Category ETP and under Category MEC-THE in this Table.

Tietz, T. E. and Wilson, J. W., Behavior and Properties of Refractory Metals, published by Stanford University Press, 1965.

Data for the refractory metals chromium, niobium(columbium), molybdenum, rhenium, tantalum, tungsten, vanadium, and their alloys are presented in detail, with emphasis on their mechanical behavior and properties. The properties discussed include ductile-brittle behavior, tensile properties, creep and stress-rupture, oxidation behavior, and thermal conductivity and expansion.

Touloukian, Y. S., director, Thermophysical Properties Research Center, West Lafayette, Indiana.

See listing of publications under Thermophysical Properties Research Center, Table I.

Bates, L. F., Modern Magnetism, published by the Cambridge University Press, 1961, (514 pages), (paperback).

The author develops the theory of magnetism and gives only occasional short tables of values throughout the text. A compilation of susceptibilities for the bulk elemental materials at room temperature is included. Generally the book is not a data book.

Bozorth, R. M., Ferromagnetism, published by D. Van Nostrand, Princeton, N.J., 1951, (968 pages).

The book includes large amounts of data in tabular and graphical form together with discussions of the subjects. The text is written from a practical, more than a theoretical point of view, always immediately relating phenomena to actual experience and data. Most often these data are for metals and alloys of the first transition series. The book treats all aspects of magnetism as included in our scope, except for nuclear magnetism.

Elliott, R. P., Constitution of Binary Alloys, 1st supplement, published by McGraw-Hill, New York, 1965.

See under Elliott and under Hansen and Anderko in the MEC-THE category of this Table.

Forsythe, W. E., editor, Smithsonian Physical Tables, 9th revised edition, published by the Smithsonian Institution, Washington, D.C., 1954.

The magnetic properties include saturation magnetization, permeability, hystersis loss, coercive force, Curie constants, and susceptibilities. For general annotation see under Table I.

Flügge, S., editor, Handbuch der Physik, published by Springer-Verlag, New York. Volume 18/2: Ferromagnetism, 1966, (Sections written in German and in English).

For general annotation, see under Table I.

Gmelins Handbuch der Anorganische Chemie, E. Pietsch, editor, published by Verlag Chemie, Berlin.

For general annotation, see under Gmelin, Table I. A specific volume on magnetic materials is: Magnetic Materials of System No. 59, Iron, Part D: second supplement, 1959, (580 pages). This also supplements volumes on Cr, Mn, Ni and Co.

Gray, D. E., coordinating editor, American Institute of Physics Handbook, 2nd edition, published by McGraw-Hill, New York, 1963.

For the more common magnetic materials the following properties are tabulated (a section by Bozorth): magnetization curves and their parameters (saturation magnetization, etc.), Curie temperature (also as a function of pressure), Néel point, magnetic moments, hysteresis loss, magnetostriction, gyromagnetic ratios, and magnetic susceptibilities.

Hansen, M. and Anderko, K., Constitution of Binary Alloys, 2nd edition, published by McGraw-Hill, New York, 1958.

This basic reference book for phase diagrams of binary alloys discusses the diagrams and their estimated reliability as well as indicating references to the literature dealing with other properties such as lattice parameters and electronic, magnetic, and thermodynamic measurements. The book gives information on nearly 1300 alloy systems (for temperatures not below room temperature and at atmospheric pressure). Supplements are presently being prepared (See Elliot, R. P., MEC-THE

Category of this Table. Magnetic properties include regions of spontaneous magnetization on phase diagrams and the Curie temperatures, when they occur above room temperature.

Hoselitz, K., Ferromagnetic Properties of Metals and Alloys, published by Clarendon Press, Oxford, 1952, (317 pages).

This book includes a number of tables for magnetic properties of metals and alloys, apparently taken from the original literature. Of particular interest is the saturation intensity of magnetization and Curie temperature of iron, cobalt, nickel, and 34 binary alloys and 8 intermetallic compounds containing these metals. In addition, there are 18 tables scattered throughout the book giving various properties such as coercive forces.

Kneller, B., Ferromagnetismus, published by Springer-Verlag, New York, 1962, (in German).

A textbook on magnetism, including a treatment of ferromagnetism, anti-ferromagnetism, ferri-, para-, and diamagnetism. The book contains several tables and graphical representations of magnetic properties pertaining to metals and alloys (mainly binary and of the first transition series). Included are topics such as: ferromagnetic resonance and a treatment of the application of alternating fields. Magnetoresistance and the Hall effect apparently are not included. Over 2,000 references are given.

Landolt-Börnstein Tabellen, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York.

For general annotation, see under Table I. The following volume tabulates properties of this category.

II Band: 9. Teil, Magnetische Eigenschaften I, 1962,(with sections in German and sections in English).
Essentially all the magnetic properties on our Property List have been included in addition to other metallic properties of elemental metals and alloys. A section on liquid liquid alloys is also included. Tables of susceptibilities include values for the metals, intermetallic compounds, and some binary alloys.

Magnetic Materials Digest, now called Magnetism and Magnetic Materials and published by Academic Press, New York. (Published in 1961 by the American Physical Society; published in 1963 and 1964 by Lads, Philadelphia).

An annual survey of the literature concerning topics in magnetism and magnetic properties is presented in the form of brief extractions of data and other information taken from the publications of the preceeding year. The information is grouped under specific topic headings. The main sources of the listed references are in the "Index to the Literature of Magnetism" (prepared at the Bell Telephone Laboratories), and available from the American Institute of Physics, New York. Additional references are also included. Each year's Digest is prepared by different editors.

Oak Ridge National Laboratory, Bibliography of Magnetic Materials and Tabulation of Magnetic Transition Temperatures (no author given), published as report ORNL-RMIC-7, March, 1968.

The compilation gives a non-critical listing of magnetic transition temperatures, with references to the literature for each listed value. Metals, alloys, and intermetallic compounds are listed as well as non-metallic materials.

Rado, G. T. and Suhl, H., editors, Magnetism - A Treatsie on Modern Theory and Materials, published by Academic Press, New York.

Some volumes are:

Vol. I: Magnetic Ions in Insulators, Their Interactions, Resonances, and Optical Properties, 1963.
Vol. IIA: Statistical Models, Magnetic Symmetry, Hyperfine Interactions, and Metals, 1965.
Vol. IIB: Interactions and Metals, 1966.
Vol. III: Spin Arrangements and Crystal Structure, Domains, and Micromagnetics, 1963.
Vol. IV: Exchange Interactions Among Itinerant Electrons, 1966.

The theories pertaining to the above and other topics are developed, giving occasional data. Generally these are not data books.

Sanford, R. L. and Cooter, I. L., Basic Magnetic Quantities and the Measurement of the Magnetic Properties of Materials, available from the Clearinghouse as NBS Monograph No. 47, May, 1962.

Basic magnetic measurements and units are described. Some magnetic data on selected materials are also given, mainly in relation to magnetization curves. High frequency a.c. measurements are specifically not treated in this Monograph.

Selwood, P. W., Magnetochemistry, 2nd edition, published by Interscience, New York, 1956.

The book treats ionic, as well as metallic, materials and includes discussions of magnetization curves of ferromagnetic materials. A section of approximately 12 pages containing a compilation of susceptibilities in pure metals (and their temperature dependences), which is reasonably complete, is included. Effective numbers of Bohr magnetons are also discussed and some values given.

Stanley, J. K., editor, Electrical and Magnetic Properties of Metals, published by the American Society for Metals, Metals Park, Ohio, 1963.

The book does not go into the details of modern theory but rather gives introductions with examples and short tables throughout the text. For detailed annotation, see under the category ETP in this Table.

Stoner, E. C., Ferromagnetism: Magnetization Curves, (an article in Reports on Progress in Physics: 13, 83-183, 1950, A. C. Strickland, executive editor), published by the Physical Society, London.

Some magnetization curves and magnetic data (for Fe, Co, and Ni, mainly) are given both for single and poly-crystalline metal samples. No real data compilations are included.

Vogt, E., Physikalische Eigenschaften der Metalle, published by the Akademische Verlagsgesellschaft, Geest & Portig K.-G., Leipzig, 1958, (in German). (Available from the Johnson Reprint Co., New York.)

The book describes in the text many of the properties pertinent to metals and alloys. Tables and graphical representations of properties for the more common metals include values for: electrical resistivity, magnetic susceptibility, magnetic moments, coercive force, residual magnetization, $(HB)_{max}$, magnetization curves, magnetostriction, saturation magnetization, permeability, Curie temperature, atomic volume, elastic constants and other elastic properties, thermal expansion (also Grüneisen constants), melting points of the metals, electronic specific heat, total specific heat as a function of temperature, and other properties.

Aronsson, B., Borides and Silicides of the Transition Metals, available from the Clearinghouse as Document No. AD 244,438, July, 1960.

ternary — The report discusses and summarizes the materials and their crystal chemistry. A compilation of structures and lattice parameters is included (listing ternary phases as well), together with shorter tables giving melting points, electrical resistivities, heats of formation, metallic radii, and environmental information for various structures.

Arp, V., Wilson, J. H., Winrich, L., and Sikora, P., Thermal Expansion of Some Engineering Materials from 20 to 293 Degrees K, (an article in Cryogenics: 2, 230-235, 1962), published by Heywood, London.

The article presents original data (not a compilation from the literature) for thermal expansion between 20 and 293°K for several commercial alloys of aluminum, cobalt, copper, iron, nickel, and titanium.

Bijl, D., The Representation of Specific Heat and Thermal Expansion Data of Simple Solids, (a chapter from Progress in Low Temperature Physics, Vol. II, 395-430, 1957, edited by C. J. Gorter), published by Interscience, New York.

Methods of data presentation are discussed. Tables are included for Debye temperatures (at various temperatures), c/a ratios, and crystal structures. Thermal expansion and specific heat data are not included.

Bockris, J. O. M., White, J. L., and Mackenzie, J. D., Physico-chemical Measurements at High Temperatures, published by Butterworth, London, 1959.

Fifteen separate articles, including several tables of physical data derived from different types of measurements are presented. Among the 7 appendices, the following properties fall within our scope: thermal expansion of high temperature materials, melting points and vapor pressures of the elements, and data for radiation pyrometry.

Borelius, G., Changes of State of Simple Solid and Liquid Metals, (a chapter from the Solid State Physics series: 6, 65-94, 1958, edited by F. Seitz and D. Turnbull), published by Academic Press, New York.

liquid — Some thermodynamic data are given in this paper.

Borelius, G., The Changes in Energy Content, Volume, and Resistivity with Temperature in Simple Solids and Liquids, (a chapter from the Solid State Physics series, 15, 2-51, 1963, edited by F. Seitz and D. Turnbull), published by Academic Press, New York.

liquid — This article includes data for specific heats. For further annotation, see under ETP in this Table.

Corruccini, R. J. and Gniewek, J. J., Specific Heats and Enthalpies of Technical Solids at Low Temperatures, available from the Clearinghouse as NBS Monograph 21, October, 1960.

Most of the more common metals and a few commercial alloys are included in this tabulation of values for enthalpy, specific heat at constant pressure, electronic specific heat, and Debye temperatures.

Corruccini, R. J. and Gniewek, J. J., Thermal Expansion of Technical Solids at Low Temperatures, available from the Clearinghouse as NBS Monograph 29, May, 1961.

Data for most of the more common metals are tabulated, as well as values for several commercial alloys.

Cotterill, P., The Hydrogen Embrittlement of Metals, (a chapter from Progress In Materials Science : 9, 205-301, 1961, edited by B. Chalmers), published by Pergamon Press, New York.

Several short tables on the solubility of hydrogen in metals and alloys are included in this article.

Coughlin, J. P., Contributions to the Data on Theoretical Metallurgy XII. Heats and Free Energies of Formation of Inorganic Oxides, Bureau of Mines Bulletin 542, U. S. Department of the Interior, Washington, D.C.

Thermodynamic properties included are of chemical nature rather than those included in our scope, but we have included this Bulletin for completeness of a series of publications by K. K. Kelly (see under K. K. Kelly, MEC-THE, this Table, for a listing of Bulletins on more pertinent thermodynamic data).

Daunt, J. G., The Electronic Specific Heats in Metals, (a chapter from Progress in Low Temperature Physics: I, 202-223, 1955, edited by C. J. Gorder), published by Interscience, New York.

This chapter presents values for the electronic specific heats of pure metals as obtained in various ways. Where several values are available, no choice of the "best value" is made. A few values for effective masses are included in the tables.

Donnay, J. D. H., general editor, Crystal Data - Determinative Tables, 2nd edition, American Crystallographic Association Monograph 5, 1963, available from Polycrystal Book Service, P. O. Box 11567, Pittsburgh, Pa. 15238.

Crystallographic data are tabulated in this major compilation. Metals and intermetallic compounds are included in the tables. References to the original literature are given. An updated edition is to be published in 1968, and will be available from the Clearinghouse as an NSRDS-NBS publication.

Drickamer, H. G., Lynch, R. W., Clendenen, R. L., and Perez-Albuerne, E. A., X-ray Diffraction Studies of the Lattice Parameters of Solids under Very High Pressure, (a chapter from the Solid State Physics Series: 19, 135-228, 1966, edited by F. Seitz and D. Turnbull), Published by Academic Press, New York.

This article includes many tables of data giving compressibility $[V(P)/V_o]$ versus lattice parameters for metals and several binary alloys. Graphical presentations of data on a few metal oxides, carbides, and sulfides are also included.

Edwards, H. S., Rosenberg, A. F., and Bittel, J. T., Thorium Oxide-Diffusion of Oxygen, Compatibility with Borides, and Feasibility of Coating Borides by Pyrohydrolysis of Metal Halides, Technical Documentary Report No. ASD-TDR-63-635, July, 1963, (sponsored by Air Force Materials Laboratory, Wright-Patterson AFB, Ohio), (prepared under Contract No. AF33 (657)-8470 by General Electric Co.).

This report reflects results from original work rather than a compilation, and includes values for diffusion constants derived from experiment. Fortran programs for numerical solutions of a few physical properties are given among which are: melting point, range of solubility, and thermal expansion.

Eldridge, E. A. and Deem, H. W., Report on Physical Properties of Metals and Alloys from Cryogenic to Elevated Temperatures, published by the American Society for Testing and Materials, Philadelphia, as STP 296, 1961.

The report contains about 650 data sheets and 80 curves of physical properties of Al, Co, Fe, Mg, Mo, Ni, and many of the more common alloys. The temperature range is from -457 to +4500°F (1.3 to 2756°K). References to the original literature are given. The properties include densities, thermal expansion, and specific heat.

Elliott, R. P., Constitution of Binary Alloys, 1st Supplement, published by McGraw-Hill, New York, 1965.

This is the first supplement to the famous reference book on phase diagrams by Hansen and Anderko (see under Hansen). Future supplements are expected to be published by R. P. Elliott and collaborators at approximately two year intervals (a second supplement has gone to press). In the earlier part of the next decade, a revised publication covering all binary alloys is expected to appear. The given properties include lattice structures and phase transformations of binary systems studied since 1958, including indications of magnetic transitions.

English, J. J., Binary and Ternary Phase Diagrams of Niobium, Molybdenum, Tantalum, and Tungsten, available from the Clearinghouse as Document No. AD 257,739, (prepared at the Defense Metals Information Center), 1961.

ternary

This compilation contains 93 phase diagrams of binary systems and 68 phase diagrams of ternary systems, each with a short discussion. 233 references to the literature are given. Other DMIC technical reports on physical and engineering information are available. For information, write to: Defense Metals Information Center, 505 King Avenue, Columbus, Ohio 43201.

Fast, J. D., Interactions of Metals and Gases, Volume 1: Thermodynamic and Phase Relations, published by Academic Press, New York, 1965.

liquid

Thermodynamic data related to phase transformations are included in the text . A substantial amount of data on solubilities and activity coefficients of gases in metals and binary alloys (both solid and liquid phases) are included.

Fineman, J., Some Equilibrium Properties of Elemental Superconductors, available from the Clearinghouse as Document No. AD 261,866, August, 1961.

For annotation, see under the SUP category of this Table.

Forsythe, W. E., editor, Smithsonian Physical Tables, 9th revised edition, published by the Smithsonian Institution, Washington, D.C., 1954.

A basic, but compact, reference book giving tables of many properties on the elemental materials and some alloys, though often commercial. The physical properties pertinent to this category include: specific heats, thermal expansions, latent heats, densities, moduli of elasticity, velocity of sound, and diffusion. As with most of the basic handbooks, the coverage, as far as materials goes, is far from complete.

Furukawa, K., The Radial Distribution Curves of Liquids by Diffraction Methods, (Reports on Progress in Physics: 25, 395-440, 1962, A. C. Strickland, executive editor), published by the Physical Society, London.

liquid

Some data are given throughout the text. A one-page table is included, giving some values for melting point, volume change on fusion, density at several temperatures, and diffraction parameters for the ideal gases and for Li, Na, K, Rb, Cs, Ag, Au, Zn, Cd, Hg, Al, Ga, In, Tl, Ge, Sn, Pb, Bi, and Sb.

Goldsmith, A., Waterman, T. E., and Hirschhorn, H. T., editors, Handbook of Thermo-Physical Properties of Solid Materials, (5 volumes), published by Macmillan, 1961. (Also available from the Clearinghouse as Document No. AD 247,193 and from U. S. Department of Defense, Wright-Patterson AFB, Ohio, as WADC Technical Report 58-476, 1960).

A revised version is now available in 6 volumes, from Macmillan, as prepared by the Thermophysical Properties Research Center (Y. S. Touloukian, director). For annotation, see under Table I.

Gopal, E. S. Raja, Specific Heats at Low Temperatures, International Cryogenics Monograph, published by Plenum Press, New York, 1966.

The book includes specific heats and Debye temperatures for the elemental metals, but alloys are generally not included. Einstein and Debye internal energy functions and specific heat functions are tabulated numerically in the appendices.

Gray, D. E., coordinating editor, American Institute of Physics Handbook, 2nd edition, published by McGraw-Hill, New York, 1963.

For general annotation, see under Table I. Mechanical properties include a tabulation of lattice constants, densities, velocity of sound and acoustic attenuation, acoustic impedance, Young's modulus, bulk modulus, compliances (S_{ij}), and elastic constants (C_{ij}). The thermodynamic properties include melting points, specific heats, thermal expansions, phase diagrams (also effects of pressure on phase transformations), and some vapor pressure data.

Guertler, W., Guertler, M., and Anastasiadias, E., A Compendium of Constitutional Ternary Diagrams of the Metallic Systems, available from the Clearinghouse in three parts: Part 1, March, 1959: AD 210,719. Ternary alloy systems only; Part 2, June, 1959: AD 215,427. Ternary and many binary systems included; Part 3, March, 1962: AD 276,162. Ternary alloy systems only.

ternary This represents a major compilation of ternary phase diagrams. In the accompanying text, lattice constants are usually included when available in the literature. At present the text is in German and only poorly legible hard copies are available from the Clearinghouse. Application has been made for a translation into English. The date of publication of the translation is not known to us yet.

Hanemann, H. and Schrader, A., Atlas Metallographicus, published by Verlag-Stahleisen, m.b.H., Düsseldorf, (in German).

	Vol. I, 1933:	Carbon Steels - Basic metallurgy only.
	Vol. II, part 1, 1936:	Cast Iron - Basic metallurgy only.
	Vol. II, part 2, 1936:	Cast Iron - Basic metallurgy only.
	Vol. III, part 3, 1941:	Binary Aluminum Alloys - A few phase diagrams are included. Discussions are of metallurgical topics only.
ternary	Vol. III, part 2, 1952:	Ternary Aluminum Alloys - This part includes some ternary phase diagrams, tabulation of lattice constants, and further discussions which are again strongly metallurgically oriented.

Hansen, M. and Anderko, K., Constitution of Binary Alloys, 2nd edition, published by McGraw-Hill, New York, 1958.

This basic reference book for phase diagrams of binary alloys discusses the diagrams and their estimated reliability as well as indicating references to literature dealing with other properties such as lattice parameters and electronic, magnetic, and thermodynamic measurements. The book gives information on nearly 1300 alloy systems (for temperatures generally not below room temperature and at atmospheric pressure). Supplements are presently being prepared (see under R. P. Elliott in this Table). The properties include lattice structure, phase transformations, including magnetic transformations, and phase diagrams of binary systems.

Hampel, C. A., editor, Rare Metals Handbook, 2nd edition, published by Reinhold, New York, 1961, (732 pages).

The book contains separate chapters by various authors on 55 different metals with references to both secondary sources and the original literature. Information is included which ranges from the economic value of the metals to their

physical properties. Summarizing tables are given for densities, melting points, boiling points, latent heats of fusion and vaporization, specific heats, electrical resistivities, thermal conductivities, moduli of elasticity, and thermal neutron cross sections. Some phase diagrams of binary alloys and lattice structures are also included.

Heiniger, F., Bucher, E., and Muller, J., Low Temperature Specific Heats of Transition Metals and Alloys, Physik der Kondensierten Materie: 5, 243, 1966, published by Springer-Verlag, New York.

The review article summarizes and tabulates values for the electronic specific heats, γ, and Debye temperatures of transition metals and their binary and
ternary ternary alloys (with both transition and non-transition metals). Graphs of γ versus electron concentration are also presented. One hundred and ninety references to the literature are given.

Huntington, H. B., The Elastic Constants of Crystals, (a chapter from the Solid State Physics Series: 7, 213-351, 1958, edited by F. Seitz and D. Turnbull), published by Academic Press, New York.

This article gives several tables throughout the text, including values for elastic properties, such as compliance moduli and elastic stiffness moduli (also as a function of pressure), for metals and a few binary alloys.

Janaf Thermochemical Tables, prepared by the Dow Chemical Company, Midland, Michigan, 1965.

Tabulated reference data covering the thermodynamic properties of propellants are presented. Some metallic materials (Be, K, Li, and others) are also included. Specific heat, heat content, entropy, free energy, enthalpy, and equilibriun constants are listed at 100° intervals from 0° K to very high temperatures. Values for melting and boiling points, heat of formation, latent heat, etc., are also given, together with references to the literature.

Jänecke, E., Kurzgefasstes Handbuch Aller Legierungen, published by R. Kiepert, Berlin-Charlottenburg, 1940, (in German).

This is one of the earlier compilations and includes a systematized treatment of
ternary ternary alloys. Also included are several alloys containing four or more components. The compilation contains over 800 phase diagrams and 80 tables. Many graphs indicating numerical values of physical quantities are given. For binary alloys data on vapor pressures are given; for ternaries phase diagrams are given only. References to the original literature are noted.

Johnson, V. J., editor, A Compendium of the Properties of Materials at Low Temperatures, available from the Clearinghouse as the indicated Document Nos. Phase I, Part I, 1960, (AD 249,644): Properties of Fluids; Phase I, Part II, 1960, (AD 249,786): Properties of Solids.

A separate table of contents is listed for each chapter. Tables include sources of data; graphical representations of the data are given. A few transition metal alloys are included.

Chapter 1: (not included).
Chapter 2: Thermal expansion of solids at low temperatures.
Chapter 3: Thermal conductivity of solids at low temperatures.
Chapter 4: Specific heat and enthalpy of solids at low temperatures.

Phase I, Part III, 1960, (AD 249,777): Bibliography of References.

Phase II, 1961, (AD 272,769): A Compendium of the Properties of Materials at Low Temperatures, edited by R. B. Stewart and V. J. Johnson.

This report contains 6 chapters, 2 of which are applicable: thermal conductivity integrals of solids, and electrical resistivity of metallic elements. References to the literature are given with the data. The bibliography lists references alphabetically by author and also by property and by material.

Much of the given data in these volumes is from secondary sources and publications of early date. Gaps in the modern literature cause the compendium to be incomplete and values not up-to-date.

Jost, W., Diffusion in Solids, Liquids, and Gases, published by Academic Press, New York, 1960.

The author gives a textbook treatment of the subject and includes some tables of selected values as are pertinent to the text. The topics include self-diffusion and diffusion of gases and metals in host metals. Activation energies and diffusion constants are among the tabulated data.

Kaufman, L. and Clougherty, E. V., Investigation of Boride Compounds for Very High Temperature Applications, Technical Documentary Report No. RTD-TDR-63-4096, Part I, December 1963, (Sponsored by Air Force Materials Laboratory, Wright-Patterson AFB, Ohio).

The report deals primarily with original research on TiB_2, ZrB_2, HfB_2, NbB_2, and TaB_2. Tables of values are included for electrical resistivity, density, oxidation rates and related information, lattice constants and other crystallographic data, thermal expansion, Debye temperatures, entropies, and total and electronic heat capacities (some low temperature and some high temperature values). Phase diagrams are also given and discussed. For the metallic constituents, the thermodynamic properties are also listed to very high temperatures.

Kelly, K. K., Contributions to the Data on Theoretical Metallurgy, Bulletins published by the Bureau of Mines, U. S. Department of the Interior.

Bulletin No. 476, Part X :	"High Temperature Heat Content, Heat Capacity, and Entropy Data for Inorganic Compounds", 1949, (235 pages).
Bulletin No. 477, Part XI :	"Entropies of Inorganic Substances", 1950, (141 pages). (Supercedes Bulletin No. 434.)
Bulletin No. 542, Part XII :	"Chemical Thermodynamics". See under T.P. Coughlin in this section of the Table.
Bulletin No. 584, Part XIII:	"High Temperature Heat Content, Heat Capacity, and Entropy". Data for the Elements and Inorganic Compounds , 1960, (232 pages). (Supercedes Bulletin No. 476.)
Bulletin No. 584, Part XIV :	"Entropies of the Elements and Inorganic Compounds", by K. K. Kelly and E. G. King, 1961, (149 pages). (Supercedes Bulletin No. 477.)
Bulletin No. 605 :	"Thermodynamic Properties of 65 Elements - Their Oxides, Halides, Carbides and Nitrides". (See under F. E. Block in this section of the Table.)

For other related Bulletins of the Bureau of Mines, see under U. S. Department of the Interior in Table I of this Appendix.

Kubaschewski, O. and Catterall, J. A., Thermochemical Data of Alloys, published by Pergamon Press, New York, 1956.

ternary The book contains thermochemical data on 342 binary and 133 ternary alloys, with 537 references to the original literature. Short discussions of the tabulated values are included. The listed properties include: boiling points, melting points, latent heats, heats of formation, and entropies.

Kubaschewski, O. and Evans, E. L., Metallurgical Thermochemistry, published by Pergamon Press, New York, 1958, (495 pages).

A textbook treatment of the subject is given, followed by extensive tables of thermochemical data. The properties tabulated for metals and intermetallic compounds include heats of formation, standard entropies and structures, triple points, melting points, boiling points, specific heats, heats of transformation, fusion, and evaporation, heat capacities, vapor pressures, and standard free energies of reaction. A section of the tables is devoted to the heat contents and standard entropies of binary metallic systems. 765 references to the original literature are given.

Landolt-Bornstein Tables - Zahlenwerte und Functionen aus Physik, Chemie, Astronomie, Geophysik und Technik, edited by K. H. and A. M. Hellwege, published by Springer-Verlag, New York.

For general annotation, see under Table I. Some specific volumes tabulating properties of this category are:

I Band 4. Teil: Kristalle, 1955 (in German). - This volume includes crystal structures and lattice parameters of metals, alloys (binary mainly) and intermetallic compounds. The volume also includes a compilation of soft X-ray spectra.

II Band 2. Teil: Eigenschaften der Materie in Ihren Agregatzustanden.

a) Gleichgewichte Dampf - Kondensat und Osmotische Phänomene, 1960, (in German).
This volume contains vapor pressures for the metals and some binary alloys, phase diagrams for binary alloys (also as a function of pressure) with information on some of the thermodynamic quantities related to the transitions.

b) Lösungsgleichgewichte I, 1962, (in German).
Thermodynamic properties are given in this volume. Among these
liquid
are solubilities of gases in metals and alloys (also in the liquid phase).

II Band 3. Teil: Schmelzgleighgewitchte und Grenzflachenerscheinungen, 1956, (in
ternary
German). - This includes a section on binary and ternary phase diagrams (lattice constants and discussions are not given).

II Band 4. Teil: Kalorische Zustandgrössen, 1961, (in German). - This volume includes the following calorimetric data: specific heats, entropies, enthalpies, free energies, and also some heats of mixing for alloys.

IV Band: Technik 2. Teil.

a) Grundlagen. Prüfverfahren. Eisenwerkstoffe, 1963, (in German).
This part is devoted to metals and alloys (including commercial alloys) entirely and includes a large section on iron and its alloys.

b) Sinterwerkstoffe. Schwermetalle, 1964, (in German).
Chapters are included, each describing a metal and its alloys. The following metals are discussed: W, Rh, Ta, Mo, Nb, V, Cr, Co, Ni, Mn, Cu, Ag, Au, Sb, Zn, Cd, Pb, Bi, and Sn.

c) Leichtmetalle. Sonderwerkstoffe. Halbleiter. Korrosion, 1965, (in German).
This is a continuation of part b) for: Ti, Be, Mg, Li, Rb, Cs, U,
liquid
Pu, Zr, Hf, and Th, liquid metals and alloys, rare earths, binary,
ternary
ternary, and commercial alloys (their mechanical and engineering properties).

New Series III/1: Elastic, Piezoelectric and Related Constants of Crystals, (in German with English titles). - This volume includes c_{ij} and s_{ij} values for elemental metals and a few intermetallic compounds and alloys (binary alloys mainly).

le Claire, A. D., Diffusion of Metals in Metals, (a chapter in Progress in Metals Physics: 1, 306-379, 1949, edited by B. Chalmers), published by Pergamon Press, New York.

This review article includes some tables of diffusion data, as well as occasional graphical representations.

Levin, E. M., Robbins, C. R., and McMurdie, H. F., Phase Diagrams for Ceramists, published by the American Ceramic Society, Inc., Columbus, Ohio, 1964. (Earlier edition in 1956 by E. M. Levin, H. F. McMurdie, and P. F. Hale, with M. K. Resser as editor.)

ternary Among the materials covered are: oxides (up to quinary systems), carbonates, hydroxides, sulfates, halides, and materials containing a combination of these. The compilation contains over 2,000 phase diagrams, a selected annotated bibliography on 8 related topics, tables of melting points of oxides, and molecular weights of oxides. An author index and system index are included.

Lumsden, J., Thermodynamics of Alloys, published by the Institute of Metals, London, 1957.

liquid A textbook treatment is presented of the thermodynamics of phase equilibria in metals and alloys (including liquid phases). The thermodynamic values of many materials are listed throughout the text giving large tables of properties such as melting points, latent heats, entropies, and vapor pressures. A few common binary alloy systems are discussed in detail.

Makarov, E. D., Crystal Chemistry of Simple Compounds of Uranium, Thorium, Plutonium, Neptunium, published by Consultants Bureau, New York, 1959, (translated from the Russian).

The book includes an interesting introductory section on general crystal chemistry. Given are coordination numbers, interatomic distances, and crystal structures for the compounds of the four elements listed in the title as well as a small amount of information on other actinides. The author includes 119 references to the literature.

Mason, W. P., Physical Acoustics and the Properties of Solids, published by D. Van Nostrand, Princeton, N. J., 1958.

The author treats the subject matter in textbook style, including graphs and tables throughout the text. These data are sometimes taken from secondary references. Attenuation, elastic property data, and piezomagnetic constants are included as well as other data.

Mirkin, L. I., Handbook of X-ray Structure Analysis of Polycrystalline Materials, published by Consultants Bureau, New York, 1964, (762 pages), (translated from the Russian).

The book gives large quantities of data: indexed X-ray patterns, graphs, and tables of intensity values.

Mondolfo, L. F., Metallography of Aluminum Alloys, published by John Wiley, New York, 1943.

ternary The book gives many binary, ternary, and quaternary phase diagrams as well as metallographic and mechanical properties. 1004 references to the literature are included.

National Research Council, Consolidated Index of Selected Property Values - Physical Chemistry and Thermodynamics, Office of Critical Tables, Publication No. 976, 1962, (274 pages).

This index summarizes and gives complete referencing to the content of the following six data compilations (with materials arranged in the "standard order"):

1. "Selected Values of Properties of Hydrocarbons and Related Compounds" (American Petroleum Institute Research Project 44).
2. "Selected Values of Properties of Chemical Compounds" (Manufacturing Chemists' Association Research Project).
3. "Selected Values of Chemical Thermodynamic Properties" (NBS Circular 500; see under Rossini in this section of the Table).
4. "Thermodynamic Properties of the Elements" (see under D. R. Stull and G. C. Sinke in this section of the Table).
5. "Contributions to the Data on Theoretical Metallurgy" (U. S. Bureau of Mines Bulletins 383, 384, 393, 406, 477, and 542 (see under K. K. Kelly in this section of the Table).
6. "Selected Values for the Thermodynamic Properties of Metals and Alloys" (Minerals Research Laboratories, Univ. of California; see under R.R. Hultgren in this section of the Table).

Parkinson, D. H., The Specific Heats of Metals at Low Temperatures, (an article in Reports on Progress in Physics: 21, 226-270, 1958, edited by A. C. Strickland), published by the Physical Society, London.

The article includes short tables and graphs representing electronic specific heat data.

Pascal, P., editor, Nouveau Traité de Chimie Minérale, Volume 20, "Alliages Metalliques", (3 sections), published by Masson et Cie., Paris, 1963, (in French).

This volume is specifically on alloys. It has phase diagrams and references to the original literature. Properties such as specific heat, thermal conductivity, and crystal structure are presented for some (but by no means all) of the alloys. When the data are available immediately elsewhere, reference is made to that work. When new material is important it is discussed and diagrams are given. Binary, ternary ternary, and quaternary alloys are included. The material index appears on pp. 2989-3005 only (not at the end of each of the three sections).

Pearson, W. B., A Handbook of Lattice Spacings and Structures of Metals and Alloys, published by Pergamon Press, New York, Volume 2, 1967, (1446 pages).

This basic reference book contains information on the crystal structures and lattice spacings of alloys. It is an updated version of the 1958 edition and in- ternary cludes the earlier information together with new data on binary and ternary alloys.

Prokoshkin, D. A. and Vasileva, E. V., Niobium Alloys, published by Science (Nachka), Moscow, 1964, (text in Russian).

This book includes detailed discussions of phase diagrams and oxidation rates as a ternary function of composition for niobium alloys (Nb-M-O). There are also some values given for electrical resistivity and several for crystal structures and hardness.

Quill, L. L., editor, The Chemistry and Metallurgy of Miscellaneous Materials, Thermodynamics, published by Mc-Graw-Hill, New York, 1950.

The chapters given in this book are written by several authors. The papers tabulate the following physical properties: heat content, entropy, free energies, latent heats, entropies of vaporization, solubilities, melting points, and boiling points for a large number of intermetallic compounds and elemental metals.

Reed, R. P. and Mikesell, R. P., Low Temperature Mechanical Properties of Copper and Selected Copper Alloys, NBS Monograph No. 101, December, 1967, available from the Clearinghouse.

A compilation of engineering-type properties is presented. The moduli of elasticity and rigidity are also included for both low and high temperatures (mainly up to 500°K), by means of graphical representation. In this compilation the brasses and bronzes are of primary interest.

Reed, R. P. and Breedis, J. F., Low-Temperature Phase Transformations, published by the American Society for Testing and Materials, Philadelphia, as Document STP No. 387,60-132, 1966.

The review article is concerned with low-temperature phase transformations (martensitic transformations) and gives 702 references to the literature, representing almost all of the papers published in English on the topic since 1940. The references are given in tabular form for specific metals and alloys and for specific types of experimental methods. The materials include ternaries and higher order alloys. In the accompanying text, some phase diagrams are given.

ternary

Rexer, E., editor, Reinststoff Probleme, published by Akademie-Verlag, Berlin, 1967, (in German).

Band III: Realstruktur und Eigenschaften von Reinststoffen, International Symposium "Reinststoffe in Wissenschaft und Technik", Dresden, 28 Sept.-2 Oct., 1965. Teil 3: edited by J. Kumze, B. Pegel, and D. Schulze.

The papers report primarily on original work. Research on metals and intermetallic compounds is included. Topics border on engineering-type investigations, but also include some properties within our scope.

Rossini, F. D., Wagman, D. D., Evans, W. H., Levine, S., and Jaffe, I., Selected Values of Chemical Thermodynamic Properties, NBS Circular 500, Feb., 1952; available from the Clearinghouse.

These are basic tables of critically evaluated thermodynamic data, including heat capacities, latent heats, entropies, and so on for materials which include metals and intermetallic compounds, but not alloys in ranges of solid solution. The tables are being updated in several steps. The most current revised section is NBS Technical Note 270-3 (for details, see under D. D. Wagman in this section of the Table). Other sections of updated tables will appear at a later date.

Rudy, E., chief investigator, Ternary Phase Equilibria in Transition Metal-Boron-Carbon-Silicon Systems, (a series of reports prepared by the Aerojet-General Corporation for the Air Force Materials Laboratory, Wright-Patterson AFB, Ohio).

Determinations of phase diagrams via literature searches as well as by new experimental determinations are given. All reports are available from the Clearinghouse.

Part I: Related Binaries.

Vol.		
I:		- Mo-C system.
II:	AD 467,838	- Ti-C and Zr-C systems.
III:	AD 469,450	- Mo-B and W-B systems.
IV:	AD 472,697	- Hf-C system.
V:	AD 478,182	- Ta-C and some work on V-C and Nb-C systems.
VI:	AD 480,948	- W-C system and supplemental information on Mo-C system.
VII:	AD 480,826	- Ti-B system.
VIII:	AD 480,949	- Zr-B system.
IX:	AD 480,812	- Hf-B system.
X:	AD 482,358	- V-B, Nb-B, and Ta-B systems.
XI:	AD 816,189	- Mo-C system (final report).
XII:	AD 823,638	- V-C and Nb-C systems.

ternary Part II: Ternary Systems.

Vol. I: AD 470,827 - Ta-Hf-C system.
II: AD 475,018 - Ti-Ta-C system.
III: AD 476,624 - Zr-Ta-C system.
IV: AD 480,801 - Ti-Zr-C, Ti-Hf-C, and Zr-Hf-C systems.
V: AD 482,359 - Ti-Hf-B system.
VI: AD 489,154 - Zr-Hf-B system.
VII: AD 482,360 - Ti-Si-C, Nb-Si-C, and W-Si-C systems.
VIII: AD 487,622 - Ta-W-C system.
IX: AD 489,140 - Zr-W-B system.
X: AD 489,752 - Zr-Si-C, Hf-Si-C, Zr-Si-B, and Hf-Si-B systems.
XI: AD 800,389 - Hf-Mo-B and Hf-W-B systems.
XII: AD 803,913 - Ti-Zr-B system.
XIII: AD 803,270 - Ti-B-C, Zr-B-C, and Hf-B-C systems.
XIV: AD 820,649 - Hf-Ir-B system.
XV: AD 819,810 - Nb-Mo-C system.
XVI: AD 664,344 - V-Nb-C system.
XVII: AD 664,345 - Ta-Mo-C system.

Part III: Special Experimental Techniques.
Vol. I: AD 469,132 - High-temperature differential thermal analysis.
II: AD 816,123 - Pirani-furnace for the precision determination of the melting temperature of refractory metallic substances.

Part IV: Thermochemical Calculations.
Vol. I: AD 467,839 - Thermodynamic properties of Group IV, V, and VI binary transition metal carbides.
ternary II: AD 482,279 - Thermochemical interpretation of ternary phase diagrams.
ternary III: AD 803,914 - Computational approach to the calculation of ternary phase diagrams.

Progress reports:
1 Jan. to 28 Feb., 1964 - AD 442,760.
1 Jan. to 15 Sept., 1964 - AD 461,653.
15 Sept.,1964 to 15 Feb.1965 - AD 463,105.
1 Jan. to 15 Dec., 1964 - AD 463,558.

Samsonov, G. V., Beryllides, (translated from the Russian book published in 1966), available from the Clearinghouse as Document No. JPRS 43,479.

This translation has its text translated but its tables still in the original Russian. The metal-beryllium compounds are described (lattice constants given) and some of their phase diagrams are included. Preparation methods are mentioned.

Sara, R. V., et.al., Research Study to Determine the Phase Equilibrium Relations of Selected Metal Carbides at High Temperatures, Technical Documentary Report No. WADD TR-60-143, (Sponsored by the Air Force Materials Laboratory, Wright Patterson AFB, Ohio), (Prepared under Contract No. AF 33(657)-8025 and earlier numbers by the Union Carbide Corp.).

The reports discuss phase diagram determinations in metal-carbon systems.

Part I : (not yet received in the Alloy Data Library).
Part II : (not yet received in the Alloy Data Library).
Part III : W-C and Zr-C systems, by R. V. Sara and R. T. Dolloff, 1962.
Part IV : Zr-C, Ta-C, and B-C systems, by R. V. Sara, C. E. Lowell, and R. T. Dolloff, 1963.
Part V : Ta-C, Hf-C, HfC-TaC, and B-C systems, by R. V. Sara and C. E. Lowell, 1964.

Schubert, K., Kristallstrukturen zweikomponentiger Phasen, published by Springer-Verlag, New York, 1964, (text in German).

The author includes in this book complete tables of crystal structures and lattice parameters of the intermetallic compounds and binary compounds involving one metallic and one non-metallic element. Theoretical discussions of compound formation and discussions of each structure type are given, and pictorial representations of the spatial distribution of atoms are presented. Correlations and trends for lattice parameters and structure formation are pointed out (also graphically). A substantial amount of reference data is included in this book.

Schwartzenberg, F. R., Osgood, S. H., Keys, R. D. and Kiefer, T. F., Cryogenic Materials Data Handbook, (work done at Air Force Materials Laboratory, Wright-Patterson AFB, Ohio), available from the Clearinghouse as Document No. AD 609,562, August, 1964.

The handbook includes strengths, hardness, elastic properties, etc., for commercial alloys, stainless steels, titanium alloys, and others.

Supplement No.1 - Feb., 1965 - AD 611,165
Supplement No.2 - July, 1965 - AD 618,065
Supplement No.3 - March, 1966 - AD 633,388
No further supplement through 3rd quarter 1967.

Schwarzkopf, P. and Kieffer, R., in collaboration with W. Leszynski and F. Benesovsky, Refractory Hard Metals; Borides, Carbides, Nitrides, (and) Silicides, published by Macmillan, New York, 1953.

ternary

This reference book includes methods of preparation and some applications, as well as descriptions of the materials. Included are phase diagrams and structural information. Other physical properties such as electrical resistivities and elastic properties are mentioned only occasionally. References to the original work are given. The book is 447 pages long.

Simmons, G., Single Crystal Elastic Constants and Calculated Aggregate Properties, (Journal of the Graduate Research Center, Southern Methodist University, Dallas, 34, Nos. 1 and 2, March, 1965), also available from the Clearinghouse as Document No. AD 615,727.

This book gives a compilation of data on the elastic properties of single crystals. The elastic properties included are Young's modulus, shear modulus, bulk modulus, Poisson ratio, compressibility, and density and sound velocity. These values are calculated according to the schemes of Voigt and Reuss. The materials include single crystals and isotropic aggregates of metals and non-metals. Alloys are generally not within their scope. References are given to the original literature.

Smith, D. P., Hydrogen In Metals, published by University of Chicago Press, 1948.

The book deals with the subject from a phenomenological, rather than theoretical point of view. Topics include solubilities of hydrogen in metals and binary alloys, and the influence of hydrogen content on some physical properties of the metals (though the data are rather scarce on the latter). Selected data are given throughout the text. Electrical resistivities are among these properties. 1467 references to the literature are given.

For H-Pd: electrical resistivity and its temperature coefficient, magnetic susceptibility, crystal structure, and solubilities. For H-Fe: magnetic transition temperatures, susceptibilities, and solubilities. For others: some selected data are given throughout the text.

Smithells, C. J., Metals Reference Book, (3 volumes), published by Butterworth , London, and Plenum Press, New York, 1967.

For annotation, see under Table I.

Stewart, R. B. and Johnson, V. J., A Compendium of the Properties of Materials at Low Temperatures.

See listing under V. J. Johnson in this category (MEC-THE).

Storms, E. K., The Refractory Carbides, published by Academic Press, New York, 1967.

The book covers the materials described in the title, their preparation, phase diagrams, structural and thermodynamic information, as well as a few topics not directly covered by the scope of the Alloy Data Center.

Stull, D. R. and Sinke, G. C., Thermodynamic Properties of the Elements, published by the American Chemical Society, Washington, D.C., 1956.

The book is devoted entirely to the tabulation of critically evaluated thermodynamic data of the elements and is a preliminary part of the JANAF thermochemical tables, resembling its structure and property content (see under JANAF, MEC-THE). Values are given for densities, melting and boiling points, and latent heats. Tables giving values at 100° intervals from 298°K to very high temperatures list specific heat, heat content, entropy, free energy, heats of formation and equilibrium constants.

Taylor, A. and Kagle, B. J., Crystallographic Data on Metal and Alloy Structures, published by Dover, New York, 1963, (263 pages).

The book contains a compilation of crystallographic information on metals, intermetallic compounds, and intermediate phases including borides, carbides, hydrides, oxides, and nitrides.

Touloukian, Y. S., Director, Thermophysical Properties Research Center, West Lafayette, Indiana.

See listing of publications and their annotations under Thermophysical Properties Research Center, Table I.

Tietz, T. E. and Wilson, J. W., Behavior and Properties of Refractory Metals, published by the Stanford University Press, 1965.

Detailed data are given on seven of the more important refractory metals: chromium, niobium, molybdenum, rhenium, tantalum, tungsten, vanadium, and their alloys. The emphasis is on mechanical behavior and related properties. Discussions include topics such as ductile-brittle behavior, tensile properties, creep and stress-rupture, oxidation behavior, and thermal conductivity and expansion.

Vol, A. E., Handbook of Binary Metallic Systems, (translated from the Russian), available from the Clearinghouse as Document Nos. TT 66-51149 and TT 66-51150. Volume I, Physicochemical Properties of the Elements. Systems of Actinium, Aluminum, Americium, Barium, Beryllium, Boron, and Nitrogen, 1959, (635 pages). Volume II, Physicochemical Properties of the Elements. Systems of Bismuth, Dysprosium, Europium, Gadolinium, Gallium, Germanium, Hafnium, Holminium, Hydrogen, Iron, Tungsten, and Vanadium, 1962, (870 pages).

The handbook contains phase diagram information on approximately 260 binary alloys. Descriptions of the diagrams are included. Specific mention is made of intermetallic compound formation, its structure, density, and other related properties. Physical properties of the systems are often also given, such as electrical resistivity, thermal conductivity, etc. More often, engineering information (mechanical properties) is included. Chemical properties are generally also described. Generally, more diagrams and graphs of the other physical and mechanical properties are given for the included alloys, making this compilation a more general reference book than Hansen's Constitution of Binary Alloys, though not all binary alloys are included. Discussions are more elaborate and contain more peripheral,

or "incidental" data. A table of all elements appears at the beginning of the handbook, listing transformation temperatures, structures, lattice parameters (at various temperatures), and atomic diameters.

Wagman, D. D., Evans, W. H., Halow, I., Parker, V. B., Bailey, S. M., and Schumm, R. H., Selected Values of Chemical Thermodynamic Properties, available from the Clearinghouse as NBS Technical Note 270.

These tables supersede the corresponding parts of NBS Circular 500 (see under Rossini in this section of the Table).

Part 1 (Oct., 1965): Tables for the first 23 elements in the "standard order of arrangement" (O through C).
Part 2 (May , 1966): Tables for the elements 24 through 32 in the "standard order of arrangement" (Si through Tl).
Part 3 (Jan., 1968): Supersedes 270-1 and 270-2.

Wagner, C., Thermodynamics of Alloys, published by Addison-Wesley, New York, 1952.

This 161 page book treats the theory of thermodynamics and includes in a later chapter several tables of experimental results, giving values for heats of formation for liquid alloys and solid alloys (intermetallic compounds), activity coefficients for liquid alloys and free energies of solid alloys. An alloy index is included, indicating that some 37 ternary alloys are covered.

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Westbrook, J. H., Mechanical Properties of Intermetallic Compounds, published by John Wiley, New York, 1960, (out of print).

The physical properties included in some of the contributed papers are: densities and elastic properties (including those of the Nb, Ta, Zr, Mo, and Ti beryllides), the elastic constants, c_{ij}'s, of some intermetallics, and a table of allotropic transformations of the elemental metals, as well as their melting points, and a table of crystal structures of some intermetallics.

Wicks, C. E. and Block, F. E., Thermodynamics Properties of 65 Elements - Their Oxides, Halides, Carbides, and Nitrides, Bureau of Mines Bulletin No. 605, 1963, (146 pages).

Basic thermodynamic data are tabulated in this Bulletin for the indicated materials (among the elements are several metals).

Wilkinson, W. D., Uranium Metallurgy, published by Interscience, New York, 1962.

Vol. I: Uranium Process Metallurgy. Contains engineering data only.
Vol.II: Uranium Corrosion and Alloys. This volume contains engineering data primarily, but also a few chapters on alloy systems giving phase diagrams and tables of solubility limits.

Some of the other physical properties include the elastic properties, lattice constants, densities, heat capacity, thermal expansion, thermal conductivity, and thermodynamic data.

Wyckoff, R. W. G., Crystal Structures, published by Interscience, New York.

Vol. I: (No name)- contains: elements, RX_1, RX_2, (1963).
Vol. II: Inorganic Compounds RX_n, RMX_2, R_nMX_3, (1964).
Vol. III: Hydrates and Ammoniates, (1965).

These books give evaluated crystal structure data and are the second edition in bound form of the famous loose-leaf versions. Structural data of metals and intermetallic compounds are included but the alloys are not treated in these volumes.

American Society for Metals, Resonance and Relaxation in Metals, (Proceedings of a seminar held October 31 - November 1, 1959), published by Plenum Press, New York, 1964.

Review articles of resonance and relaxation experiments in metals are presented. Eleven types of such experiments are covered in basic theory and application. References to the literature are given. Several tables of resulting data are included.

Bagguley, D. M. S. and Owen, J., Microwave Properties of Solids, (an article in Reports on Progress in Physics: 20, 304-378, 1957, edited by A. C. Strickland), published by the Physical Society, London.

This article includes in its short tables, values for g-factors of some metals and alloys.

Barnes, R. G., Nuclear Magnetic Resonance Techniques in the Study of Intermetallics, (a paper presented at the International Symposium on Compounds of Interest in Nuclear Reactor Technology, 1964 , edited by J. T. Waber, P. Chiotti, and W. N. Miner), published in Nuclear Metallurgy, Vol. 10 of the AIME, New York.

This review article includes a table of isotropic and axial Knight shifts as well as quadrupole moments, and nuclear gyromagnetic ratios for metallic elements and some non-metallic materials.

Boyle, A. J. F. and Hall, H. E., The Mössbauer Effect, (an article in Reports on Progress in Physics: 25, 441-524, 1962, edited by A. C. Strickland), published by the Physical Society, London.

The article includes a two-page compilation of the properties of Mössbauer nuclei, giving the photon energies, recoilless fractions, mean lives, spin states, internal conversion factors, resonance absorption, cross sections, and efficiency (i.e., the fraction of the source decaying in this transition).

Drain, L. E., Nuclear Magnetic Resonance in Metals, (published in Metallurgical Reviews: Review 119, p. 195, Dec. 1967), published by the Institute of Metals, London.

The author presents in this article the various applications of nuclear magnetic resonance to the study of metals and alloys. Some tables are included giving
liquid values in metals for: Knight shifts (also in liquid metals), anisotropic Knight shifts, electric quadrupole moments, and spin-lattice relaxation times. Application of NMR measurements to the study of the structure of alloys, diffusion, and magnetic and superconducting properties is reviewed.

Forsythe, W. E., editor, Smithsonian Physical Tables, 9th revised edition, available from the Smithsonian Institution, Washington, D.C., 1954.

For annotation, see under Table I.

Fuller, G. H. and Cohen, V. W., Nuclear Moments, Appendix I to Nuclear Data Sheets, May, 1965, (out of print).

This is a compilation of nuclear moments as measured by various methods. "Best values" are selected and presented. A revised edition is in preparation and is expected to be completed by late 1968 or early 1969. The revision is to be published by Academic Press, New York, and will be included as a part of the journal, "Nuclear Data Tables".

Gray, D. E., coordinating editor, American Institute of Physics Handbook, 2nd edition, published by McGraw-Hill, New York, 1963.

For general annotation, see under Table I. The book gives very little data

pertinent to this category.

Knight, W. D., Electron Paramagnetism and Nuclear Magnetic Resonance in Metals, (a chapter from Solid State Physics: 2, 93-136, 1956, edited by F. Seitz and D. Turnbull), published by Academic Press, New York.

This article includes a few tables giving bulk susceptibilities, hyperfine coupling constants, Knight shifts, and chemical shifts in metals, semimetallic materials, and a few elemental semiconductors. Knight shifts for a few binary alloys are included.

Kopfermann, H., Nuclear Moments, published by Academic Press, New York, 1958.

The book includes tables of values for nuclear electric quadrupole moments (both measured and calculated), and relativity corrections to nuclear magnetic moments. Occasional short tables of data are also given throughout the text.

Muir, A. J. Jr., Ando, K. J., and Coogan, H. M., Mössbauer Effect Data Index 1958-1965, published by Interscience, New York, 1966.

A computerized representation of the bibliography and also of the values given in the papers for isomer shift, quadrupole splittings, "dips", line shapes, and state of the material. Metallic and non-metallic materials are included. In addition, various parameters of the transitions of the "Mössbauer nuclei" are given for some 44 different isotopes.

Landolt-Börnstein Tables, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York.

For general annotation, see under Table I. The following volume gives data for properties pertinent to this category:

II Band 9. Teil: Magnetische Eigenschaften I, 1962, (sections in German and sections in English).
This volume includes sections on EPR, ferromagnetic resonance, and nuclear magnetic relaxation, tabulating some data for metallic materials. The Varian chart of nuclear moments is also repeated in this volume (see under Varian in this section of the Table).

Orton, J. W., Paramagnetic Resonance Data, (a chapter in Reports on Progress in Physics: 22, 204, 1959, edited by A. C. Strickland), published by the Physical Society, London.

A compilation of all data up to 1958 is presented, including the available EPR data for metals. Tabulated are: wavelength, g-factor, fine structure, nuclear electric quadrupole and magnetic dipole moments. (The temperature of measurement is indicated.)

Portis, A. M. and Lindquist, R. H., Nuclear Resonance in Ferromagnetic Materials, (a chapter from the book Magnetism, 2A, 357-383, 1965, edited by G. T. Rado and H. Suhl), published by Academic Press, New York.

In this article, tables of data on internal fields as measured by Ferromagnetic Nuclear Resonance are given for metallic and non-metallic materials. Pressure effects are also discussed. One hundred and one references to the literature are given.

Prather, J. L., Atomic Energy Levels in Crystals, available from the Clearinghouse as NBS Monograph No. 19, February, 1961.

The Monograph presents a tabulation of calculated energy levels. Group theoretical treatment, tabulation of group characteristics, selection rules for

transitions, and Wigner coefficients are discussed.

Qaim, S. M., Mössbauer Effect of Fe in Various Hosts, Proc. Phys. Soc. 90, 1065, 1967.

The paper includes a table of isomer shifts and line shape information for a small percentage of iron embedded in 32 metals. The table gives values as measured by the author as well as values found in the earlier literature.

Rowland, T. J., Nuclear Magnetic Resonance in Metals, (a chapter from Progress in Materials Science: 9, 1-92, 1961, edited by B. Chalmers), published by Pergamon Press, New York.

This article includes a tabulation of Knight shifts and NMR linewidths (at room temperature) for the metallic, semi-metallic, and a few of the semiconducting elements.

Stacey, D. N., Isotope Shifts and Nuclear Charge Distributions, (an article in Reports on Progress in Physics: 29, 171-215, 1966, edited by A. C. Strickland), published by the Physical Society, London.

The article includes tabulations of parameters related to nuclear deformation and charge distribution, and the isotope shifts of atomic spectra (some 4 pages of data).

Tipton, C. R. Jr., editor, Reactor Handbook, Vol. I, Materials.

See under U. S. Atomic Energy Commission.

U. S. Atomic Energy Commission; Division of Technical Information, Reactor Handbook, published by Interscience, New York.

Vol. I: Materials, C. R. Tipton, Jr., editor, 1960. This volume includes several chapters on fuel materials, including their physical properties. Among the materials are: U, Th, Pu, Co, Cr, steels, Mg, Mo, Nb, Ni, Ta, W, Al, Ag, Be, rare earths, B, Hf, Cd, Ti, V, Zr, and their alloys. liquid Liquid metals and alloys are also included. Each mentioned metal is discussed in a separate chapter by contributing authors. A bibliography on (binary) constitutional diagrams is given in an appendix.

Vol. II: Fuel Processing, S. M. Stoller and R. B. Richards, editors, 1961. Not within our scope.

Vol. III: Part A, Physics, H. Soodak, editor, 1962. Densities and cross sections for various nuclear reactions are tabulated. Other nuclear data included are mainly outside our scope.

Vol. III: Part B, Shielding, E. P. Blizard and L. S. Abbott, editors, 1962. The data given in this part are generally outside the scope of our collection.

Vol. IV: Engineering, S. McLain and J. H. Martens, editors, 1964. Not within our scope.

Varian Associates, Inc., Palo Alto, California 94303, Nuclear Magnetic Resonance Table, 5th edition, 1965.

The "Varian Chart" gives a table of selected values for nuclear magnetic moments, nuclear electric quadrupole moments, and nuclear spins.

Wertz, J. E., Nuclear and Electronic Magnetic Resonance, available from the Clearinghouse as Document No. AD 67,517, May, 1955.

A review is presented which is directed primarily towards readers with little

previous experience in the fields of NMR and EPR (mainly in non-metallic materials). The "Varian Chart" (see under N-R-P, Varian, this Table) is reproduced in this document. Values for chemical shifts in many materials are tabulated (together with some Knight shifts).

Bhalla, C. P., Tables of Electron Radial Functions and Tangents of Phase Shifts for Light Nuclei (Z = 1 through 10), available from the Clearinghouse as NBS Monograph 81, August, 1964.

Title self-explanatory.

Drickamer, H. G., The Effect of High Pressure on the Electronic Structure of Solids, (a chapter from Solid State Physics: 17, 1-133, 1965, edited by F. Seitz and D. Turnbull), published by Academic Press, New York.

This article includes a section on metals, giving graphical data on electrical resistivity as a function of pressure for several metals. Experiments implying changes of the Fermi surface with pressure are also described along with calculated values for changes in the dimensions of hole and electron pockets and overlap where the Fermi surface is not simply connected.

Gray, D. E., coordinating editor, American Institute of Physics Handbook, 2nd edition, published by McGraw-Hill, New York, 1965.

For general annotation, see under Table I. Section nine includes some Fermi surface parameters and related properties for a few metals (effective masses, Fermi topology and energies, etc.).

Harrison, W. A. and Webb, M. B., editors, The Fermi Surface (Proceedings of an International Conference held at Cooperstown, New York on August 22-24, 1960), published by John Wiley, New York, 1960.

Many of the contributed papers give state-of-the-art presentations of various fields related to studies of the Fermi surface, both theoretical and experimental. A few references to the more recent literature are given. Topics include de Haas-van Alphen effect, galvanomagnetic effects, cyclotron resonance, anomalous skin effect, and electronic transport properties. This last includes a discussion on alloys.

Herman, F. and Skillman, S., Atomic Structure Calculations, published by Prentice-Hall, New York, 1963.

This is a compilation of tables of Hartree-Fock-Slater self-consistent potential functions, atomic orbital energy eigenvalues, and atomic orbital radial wave functions.

Pikus, I. M., Cohesive Energy of the Noble Metals, prepared by the General Electric Co., 1966, available from the Clearinghouse as AD 482,800.

A theoretical treatment of the subject is given including a few tables which compare some experimental results with theoretically derived values. References to the literature are given.

Raynor, G. V., The Band Structure of Metals, (an article in Reports on Progress in Physics: 15, 173-248, 1952, edited by A. C. Strickland), published by the Physical Society, London.

Several graphical representations of density of states curves (as obtained by different methods) accompany the text of this review article.

Shoenberg, D., The de Haas-van Alphen Effect, (a chapter from Progress in Low Temperature Physics: II, 226-265, 1957, edited by C. J. Gorter), published by Interscience, New York.

This article presents pictures of some experimentally-obtained results. A table of Fermi surface parameters, derived from such experiments, is given for Al, As, Be, Bi, C, Cd, Ga, Hg, In, Mg, Pb, Sb, Sn, Tl, and Zn.

Slater, J. C., Advances in Quantum Chemistry, Vol. I, published by Academic Press, New York, 1964.

This book presents a summary of recent energy band calculations by the APW method.

Bockris, J. O. M., White, J. L.,and Mackenzie, J. D., Physico-chemical Measurements at High Temperatures, published by Butterworth, London, 1959.

Fifteen separate articles, including several tables of physical data derived from different types of measurements are presented. Among the properties in the 7 appendices of the book, the following fall within our scope: thermal expansion of high-temperature materials, melting points and vapor pressures of the elements, and data for radiation pyrometry.

Dickson, P. F. and Jones, M. C., Infrared Reflectances of Metals at Cryogenic Temperatures - a Compilation from the Literature, available from the Clearinghouse as NBS Technical Note No. 348, October, 1966.

Room temperature and low temperature spectral reflectances in the infrared region have been compiled from the literature and are presented in this Technical Note for: Al, Sb, Bi, Bi-Te alloys, Cu, Au, Pb, Ni, Ag, Na, Sn, and alpha brasses. Total reflectances are given for: Al, Cu, Au, Pb, Ni, Ni alloys, Ag, some steels, Sn, and some brasses.

Fomenko, V. S. and Samsonov, G. V., editors, Handbook of Thermionic Properties: Electronic Work Functions and Richardson Constants of Metals and Compounds, published by Plenum Press, New York, 1966.

This compilation presently represents the most up-to-date and complete compilation of work functions known to us. It includes the metals, some intermetallics, alloys and their oxides, as well as other materials. Reported values as obtained by different methods are tabulated and recommended values are given. References published in 1965 seem to be the most recent ones appearing in the bibliography. The tabulated properties include work functions as determined by methods of thermionic emission, photoelectron emission, field emission, effusion, contact potential difference, calorimetry and theoretical calculation.

Forsythe, W. E., editor, Smithsonian Physical Tables, 9th revised edition, available from the Smithsonian Institution, Washington, D.C. , 1954.

For annotation, see under Table I.

Flügge, S., editor, Handbuch der Physik, published by Springer-Verlag, New York.

Among the volumes pertinent to this category are:

Vol. 25/1 : Crystal Optics; Diffraction, 1961, (sections written in German or English).
Vol. 25/2a : Light and Matter Ia, 1967, (written in English).
Vol. 26 : Light and Matter II, 1958, (sections written in English or French).
Vol. 30 : X-rays, Tables of electron-energy levels and X-ray wavelengths, (in English).

Goldsmith, A., Waterman, T. E., and Hirschhorn, H. J., Handbook of Thermo-Physical Properties of Solid Materials, 5 volumes, published by Macmillan, New York, 1961.

A revised version is now available in 6 volumes, as prepared by the Thermophysical Properties Research Center (Y.S. Touloukian, Director). For annotation, see under Table I. Also available from the Clearinghouse as Document No. AD 247,193.

Gray, D. E., coordinating editor, American Institute of Physics Handbook, 2nd edition, published by McGraw-Hill, New York, 1963.

For general annotation, see under Table I. Section nine includes data on secondary emission and work functions; Faraday rotation data are given in an earlier section. Other optical data are also included.

Gubareff, G. G., Janssen, J. E., and Torborg, R. H., Thermal Radiation Properties Survey, Minneapolis-Honeywell Research Center, Minneapolis, 1960, (293 pages).

Thermal radiation property values are given for metals and commercial alloys, with references to the literature.

Landolt-Börnstein Tables, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York.

For general annotation, see under Table I. Some specific volumes tabulating data on properties listed in this category are:

I Band 4. Teil: Atom-und Molekularphysik-Kristalle, 1955, (in German).
This volume deals with topics included in Categories 6 and 9. A compilation of soft X-ray spectra is given and also electron emission band structures, density of states, etc., are compiled for this volume.

II Band 6. Teil: Elektrische Eigenschaften I, 1959, (in German).
Includes thermionic emission and secondary emission.

II Band 8. Teil: Optische Konstanten, 1962, (in German).
This volume contains most of the properties listed under Category 6 of our List of Properties for metallic and non-metallic materials, including some data on binary alloys.

IV Band 3. Teil: Technik-Elektrotechnik. Lichtechnik. Röntgentechnik, 1957, (in German).
This volume includes properties of Category 6 in the optical and X-ray regions of radiation.

Meroz, I., editor, Optical Transition Probabilities: A Representative Collection of Russian Articles, 1932-1962, Office of Technical Services No. OTS 63-11135, available from the Clearinghouse.

This collection includes some papers which give tables giving a substantial amount of data on elements in atomic or ionic states. This is an update of an earlier edition (Document No. OTS-63-11437) covering the literature from 1924 to 1960.

Mirkin, L. I., Handbook of X-ray Structure Analysis of Polycrystalline Materials, published by Consultants Bureau, New York, 1964, (translated from the Russian).

The book gives large quantities of data: indexed X-ray patterns, graphs, and tables of intensity values.

Schütz, W., Handbuch der Experimentalphysik : 16 Magnetooptik, published by Akademische Verlagsgesellschaft, Geest and Portig, K.-G., Leipzig, 1936. (Also available from the Johnson Reprint Company, New York.)

The book includes a section on magnetooptical rotation in ferromagnetic metals. Data on thin films of Fe, Ni, and Co are included.

Stacey, D. N., Isotope Shifts and Nuclear Charge Distributions, (an article in Reports on Progress in Physics: 29, 171-215, 1966, edited by A. C. Strickland), published by the Physical Society, London.

The article includes tabulations of parameters related to nuclear deformation and charge distribution, and the isotope shifts of atomic spectra (some 4 pages of data).

Svet, D. Y., Thermal Radiation: Metals, Semiconductors, Ceramics, Partly Transparent Bodies, and Films, published by Consultants Bureau, New York, 1965, (translated from the Russian).

This is a presentation of thermal radiation data which includes a section on metals. Data are given in tables as well as in graphical form. Comments on the chosen values are included.

Touloukian, Y. D., Director, Thermophysical Properties Research Center, West Lafayette, Indiana.

For a listing of publications, see under Thermophysical Properties Research Center in Table I.

Yakowitz, H. and Cuthill, J. R., Annotated Bibliography on Soft X-ray Spectroscopy, NBS Monograph No. 52, 1962, available from the Clearinghouse.

The compilation contains references to the literature from 1950 through 1960. These are indexed by element, subject, and author; an up-dated compilation is in progress. Critically evaluated data will be published in the future.

Wood, W. D., Deem, H. W., and Lucks, C. F., Thermal Radiative Properties, Plenum Press Handbooks of High Temperature Materials: No. 3, published by Plenum Press, New York, 1964.

The book gives a compilation of data on emittance, absorptance, and reflectance of metals and many commercially named alloys. A short introductory section is included.

Category 7 - SUP - Superconductivity

Douglass, D., Jr., Schmitt, R. W., and Nichols, G. E., editors, International Conference on the Science of Superconductivity, (sponsored by the International Union of Pure and Applied Physics, the Advanced Research Projects Agency, the National Science Foundation, and the General Electric Research Laboratory), (held at Colgate University, Hamilton, N. Y., August 26-29, 1963), published in Reviews of Modern Physics: 36, 1-504, 1964.

These Conference Proceedings include papers giving a substantial amount of original data. Papers on pressure and isotope effects are included, as well as papers dealing with the effects of alloying on various superconductive properties.

Douglass, D. H., Jr. and Falicov, L. M., The Superconducting Energy Gap, (a chapter from Progress in Low Temperature Physics: IV, 97-193, 1964, edited by C. J. Gorter), published by Interscience, New York.

The article includes tabulated data for energy gaps as measured by different experimental techniques. The bibliography includes 154 references to the literature.

Fineman, J., Some Equilibrium Properties of Elemental Superconductors, a report prepared at the Lincoln Laboratory, M.I.T., available from the Clearinghouse as Document No. AD 261,866, August, 1961.

This compilation gives tables and formulae of the critical temperature (T_c) and critical field (H_c) including temperature, pressure, and isotope dependence and the specific heats of elemental superconductors. The data are unevaluated and occasionally inaccurate. The compilation is not complete. About 190 references span the period from 1923 to 1960. Graphs of H_c versus T_c are given.

Flügge, S., editor, Handbuch der Physik, published by Springer-Verlag, New York.

For general annotation, see under Table I. A volume of particular interest which falls in this Category is Vol. 15, Low Temperature Physics, 1956, written in English.

Gray, D. E., coordinating editor, American Institute of Physics Handbook, 2nd edition, published by McGraw-Hill, New York, 1963.

For general annotation, see under Table I. Section nine includes a listing of the superconducting metals, alloys, and compounds and their critical temperatures.

Landolt-Börnstein Tables, K. H. and A. M. Hellwege, editors, published by Springer-Verlag, New York.

For general annotation, see under Table I. A specific volume giving data for properties of this Category is:

II Band 7. Teil: Elektrische Eigenschaften I, 1959, (in German).
Superconducting transition temperatures and other related topics are included in this volume.

Levy, M. and Olsen, J. R., Superconductivity Under Pressure, (a chapter in Physics of High Pressures and Condensed Phases: pages 525-555, 1965, edited by A. van Itterbeek), published by John Wiley, New York.

This chapter includes several data for $\frac{\partial Hc}{\partial P})_{T=0}$, $\frac{\partial Tc}{\partial P})_{T=0}$, and for $\frac{\partial \ln N(0)A}{\partial \ln V}$ (as in 7V of the List of Properties) for elemental superconductors. Data on a few V_3X-type compounds are also given.

Matthias, B. T., Geballe, T. H., and Compton, V. B., Superconductivity, (an article in Reviews of Modern Physics: 35, 1, 1963), published by the American Physical Society, New York;

Errata : Matthias et.al., Reviews of Modern Physics: 35, 414, 1963.

This is a review article giving data on superconductivity and crystal structure for a very large number of metallic compounds. It includes a discussion of empirical rules collating the data. (32 tables, 295 references.)

Rickayzen, G., Theory of Superconductivity, (Interscience Monographs and Texts in Physics and Astronomy: Vol. 14), published by Interscience, New York, 1965.

The book is written in textbook style. Several graphical representations and short tables of values are included for metals and a few binary alloys. Among the properties presented are: superconducting transition temperatures (and isotope effects), Debye temperatures, the coupling constant N(O) V (7V in the List of Properties), energy gap, critical field, electronic specific heat ratios of the superconducting to normal state (related to 7A and 7B in the List of Properties), penetration depth, λ, Landau-Ginzburg parameters, etc. Some thermodynamic functions are tabulated at small incremental values of T/T_c, and a few other functions are given as well. A subject index is included and references to the original literature are given.

Roberts, B. W., Superconductive Materials and Some of their Properties, NBS Technical Note No. 408, September 1966, available for 45 cents from the Supt. of Documents, Government Printing Office, and the Clearinghouse.

A non-critical tabulation of values of the superconducting transition temperature and magnetic fields as compiled from a literature search covering Oct. 1963 - Dec. 1965 is given. For the elemental superconductors T_c, H_c, crystal structure,
ternary θ_D (Debye temperature), and γ (electronic specific heat) are tabulated. The latter two properties are not given in the general table for materials in which no T_c has been observed. For such materials the lowest temperatures at which they were tested for superconductivity is indicated. Metals, alloys, and intermetallics are all included in the general table though notation for composition is not uniform. Noted in the references are a few additional properties such as thermal conductivity, effective number of charge carriers, etc.

ADDENDA - LATE ENTRIES

Freeman, A. J. and Frankel, R. B., editors, Hyperfine Interactions, published by Academic Press, New York, 1967.

The book presents articles written by various contributing authors, giving both theoretical and some experimental treatments. The book includes only short tables of data, relating to internal fields and hyperfine interactions.

Grigsby, D. L., Data Sheet DS-148 - Niobium Alloys and Compounds, published by Electronic Properties Information Center, Hughes Aircraft Company, Culver City, California 90232, January, 1966.

A description of the Center and some of its other data sheets will be found in Table I of this Appendix,under Electronic Properties Information Center.

Hearmon, R. F. S., The Elastic Constants of Anisotropic Materials (a two-part compilation). Part I: Reviews of Modern Physics: 18, 409-440, 1946. Part II: Advances in Physics: 5, 323-382, 1956.

The later (revised) compilation of elastic constants tabulates s_{ij}'s and c_{ij}'s for many materials, including some metals and a few alloys.

A still more recent publication, The Elastic Constants of Non-piezoelectric Crystals, appears in the Landolt-Börnstein Tables (New Series, Volume III/I, 1966); see Landolt-Börnstein Tables under categories MEC-THE of Table III in this Appendix.

Lederer, C. M., Hollander, J. M., and Perlman, I., Table of Isotopes, sixth edition, published by J. Wiley, New York, 1968.

These tables include values for half-lives, type of decay, thermal neutron cross sections, energies and intensities of resulting radiation, and other related nuclear data, including energy level diagrams. References to the literature are included.

Mondolfo, L. F., The Aluminum-Magnesium-Zinc Alloys: A Review of the Literature, published by Revere Copper and Brass, Inc., Rome, New York, May, 1967.

ternary

This article gives phase diagrams and structural information of the alloy system (and also non-equilibrium structures). A section of the 253-page long article treats minor alloying additions (of 19 different metals) to the system. Some other engineering data are also included.

Schwarzkopf, P. and Kieffer, R., in collaboration with W. Leszynski and F. Benesovsky, Refractory Hard Metals, published by the Macmillan Co., New York, 1953.

ternary

The book deals with transition metal carbides, nitrides, borides, and silicides. The book discusses crystal structures and lattice constants, electronic structures, phase diagrams (including ternary and quaternary systems), as well as elastic moduli, density, electrical resistivity, and melting points. The book is 447 pages long.

Schubert, K., Kristallstrukturen zweikomponentiger Phasen (Reine und angewandte Metallkunde in Eizeldarstellungen - 17), published by Springer-Verlag, Berlin, 1964, (in German).

This is a reference book for structures of compounds containing one or two components. The relative positions of the atoms in the unit cell are described and often pictorially indicated. c/a ratios are given.

Chapter 1 : General background of structure research.
2 : Brass-type phases and other closest packing configurations.
3 : T - T phases.

Chapter 4 : B - B phases.
5 : A - B phases.
6 : T - B^L phases (except T - Li and T - Be phases).
7 : T - B phases (except T - B^L phases).
8 : Tables
8.1 : Structures.
8.11 : Elemental phases.
8.12 : Binary phases.
8.2 : Index of (binary) materials and their general structure names.
8.3 : Bibliography.
8.4 : Listing of symmetries.
8.5 : Cross-index.

Appendix C

JOURNAL ABBREVIATIONS

In this Appendix the journal abbreviations which are employed for the Alloy Data indices will be given. When possible, the American Chemical Society standard abbreviations are used. Those A.C.S. abbreviations which exceed 15 characters (letters and spaces) are further reduced in such a way as to display the titles with minimum loss of legibility in the allotted space. The Journal Name field is also used for referencing documents other than formal publications: theses, technical reports, books, private communications, etc., can be designated in this field. References of this kind are also present in the list of abbreviations given below. The listing is in alphabetical order by journal abbreviation; these appear in the right-hand column of each page. The list is complete as of the publication data; new abbreviations are added when necessary.

JOURNAL OR REFERENCE	ABBREVIATION
ACTA CHEMICA SCANDINAVICA.	ACTA CHEM SCAND
ACTA CRYSTALLOGRAPHICA.	ACTA CRYST
ACTA METALLURGICA.	ACTA MET
ACTA PHYSICA.	ACTA PHYS
ACTA PHYSICA AUSTRIACA.	ACTA PHYS AUSTR
ACTA PHYSICA POLONICA.	ACTA PHYS POLON
ADVANCES IN CHEMICAL PHYSICS.	ADVAN CHEM PHYS
ADVANCES IN PHYSICS.	ADVAN PHYS
AGARDOGRAPH.	AGARDOGRAPH
ABSTRACT BULLETIN OF THE AMERICAN INSTITUTE OF MINING, METALLURGICAL, AND PETROLEUM ENGINEERS.	AIME ABSTR BULL
AKUSTICHESKII ZHURNAL (IN RUSSIAN).	AKUST ZH USSR
ALUMINUM.	ALUMINUM
AMERICAN JOURNAL OF PHYSICS.	AM J PHYS
ANALYTICAL CHEMISTRY.	ANAL CHEM
ANNALES OF PHYSICS.	ANN PHYS
ANNALEN DER PHYSIK.	ANN PHYSIK
ANNALES DE PHYSIQUE.	ANN PHYSIQUE
ANNUAL REVIEW OF PHYSICAL CHEMISTRY.	ANNREV PHYSCHEM
APPLIED OPTICS.	APPL OPT
APPLIED PHYSICS LETTERS.	APPL PHYS LET
APPLIED SPECTROSCOPY.	APPL SPECTRY
ARCHIVES DES SCIENCES.	ARCH SCI
ARKIV FOR FYSIK.	ARKIV FYSIK
ATOMIC AND ELECTRONIC STRUCTURES OF METALS (BOOK EDITED BY J.J. GILMAN AND W.A.TILLER FOR THE AMERICAN SOCIETY FOR METALS).	ASM BOOK GILMAN
AUSTRALIAN JOURNAL OF PHYSICS.	AUSTRAIL J PHYS
BELL SYSTEM TECHNICAL JOURNAL.	BELL SYST TECHJ
BERICHTE-BUNSENGESELLSCHAFT FUR PHYSIKALISCHE CHEMIE.	BERBUN PHYSCHEM
FLUCTUATION, RELAXATION, AND RESONANCE IN MAGNETIC SYSTEMS (BOOK EDITED BY D. TER HAAR).	BOOK D TER HAAR

BRITISH JOURNAL OF APPLIED PHYSICS.	BRITJ APPL PHYS
BULLETIN OF THE AMERICAN PHYSICAL SOCIETY.	BULL AM PHYSSOC
BULLETIN OF THE INSTITUTE OF THEORETICAL PHYSICS (IN RUSSIAN).	BULL INSTHEPHYS
BULLETIN DE L'ACADEMIE POLONAISE DES SCIENCES.	BULLACADPOLSCI
BULLETIN OF THE ACADEMY OF SCIENCE OF THE USSR.	BULLACADSCIUSSR
BULLETIN DE L'INSTITUT INTERNATIONAL DU FROID.	BULLINSINTFROID
BULLETIN DE LA SOCIETE FRANCAISE DE MINERALOGIE ET DE CRYSTALLOGRAPHIE.	BULSOCFRMINERAL
CAHIERS DE PHYSIQUE.	CAHIERS PHYS
CANADIAN JOURNAL OF CHEMISTRY.	CAN J CHEM
CANADIAN JOURNAL OF PHYSICS.	CAN J PHYS
CANADIAN METALLURGICAL QUARTERLY.	CAN MET QUARTER
CHEMICAL ENGINEERING.	CHEM ENG
CHEMICAL REVIEWS.	CHEM REVS
CONFERENCE PROCEEDINGS FROM U S DEP'T OF COMMERCE, OFFICE OF TECHNICAL SERVICES.	COMM OTS CONF
COMPTES RENDUS DE L'ACADEMIE DES SCIENCES.	COMPT REND
CONFERENCE ON MAGNETIC RESONANCE IN METALS.	CONFMAGRESMETAL
CONFERENCE ON THE PROPERTIES OF LIQUID METALS (ABSTRACTS OF PAPERS).	CONFPROP LIQMET
CONTEMPORARY PHYSICS.	CONTEMP PHYS
CONTROL ENGINEERING.	CONTROL ENG
CORNELL UNIVERSITY REPORT.	CORNELL UNIVREP
CRYOGENICS.	CRYOGENICS
CURRENT SCIENCE.	CURRENT SCI
CZECHOSLOVAK JOURNAL OF PHYSICS.	CZECH J PHYS
DISCUSSIONS OF THE FARADAY SOCIETY.	DISC FARADAYSOC
DISSERTATION ABSTRACTS.	DISSERT ABSTR
DOPOVIDI AKADEMII NAUK UKRANS'KOI RSR.	DOP ACADNAUKUKR
ELECTRONICS AND POWER.	ELECTRON PWR
ELEKTROTECHNISCHE ZEITSCHRIFT.	ELEKTROTECH Z

EXPERIMENTALLE TECHNIK DER PHYSIK.	EXP TECH PHYSIK
FIZIKA METALLOV I METALLOVEDENIE (IN RUSSIAN).	FIZ METAL METAL.
FIZIKA TVERDOGA TELA (IN RUSSIAN).	FIZ TVERD TELA
FORTSCHRITTE DER PHYSIK.	FORTSCHR PHYSIK
GENERAL ELECTRIC COMPANY REPORT.	GENL ELECT REP
HELVITICA PHYSICA ACTA.	HELV PHYS ACTA
HUNGARIAN ACADEMY OF SCIENCES REPORT.	HUNGACADSCI REP
HYPERFINE INTERACTIONS (BOOK EDITED BY A. J. FREEMAN AND R. B. FRANKEL).	HYPERFINE INT
IBM JOURNAL OF RESEARCH AND DEVELOPMENT.	IBM J RES DEVP
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS TRANSACTIONS ON CIRCUIT THEORY.	IEEE T CIRCTHEO
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS TRANSACTIONS ON NUCLEAR SCIENCE.	IEEETRANSNUCSCI
INDUSTRIAL ELECTRONICS.	IND ELECTRONICS
INDUSTRIAL AND ENGINEERING CHEMISTRY.	IND ENG CHEM
INDUSTRIAL LABORATORY (USSR).	IND LAB
INDIAN JOURNAL OF PURE AND APPLIED PHYSICS.	INDIAN J PAPHYS
INDIAN JOURNAL OF PHYSICS.	INDIAN J PHYS
INDUSTRIAL RESEARCH.	INDUSTRIAL RES
INORGANIC CHEMISTRY.	INORGANIC CHEM
INSTRUMENTS AND CONTROL SYSTEMS.	INSTR CONT SYST
INSTRUMENTS AND EXPERIMENTAL TECHNIQUES (USSR).	INSTR EXP TECH
INSTRUMENT PRACTICE.	INSTR PRACT
INTERNATIONAL INSTRUMENT CONGRESS.	INT INSTR CONG
COLLOQUE INTERNATIONAL DU C.N.R.S. (HELD AT ORSAY).	INTCOLLOQ ORSAY
COLLOQUE INTERNATIONAL DU C.N.R.S. (HELD AT PARIS).	INTCOLLOQ PARIS
INTERNATIONAL CONFERENCE ON THE ELECTRONIC PROPERTIES OF METALS AT LOW TEMPERATURES (HELD AT GENEVA, NEW YORK).	INTCONFGENEVANY
INTERNATIONAL CONFERENCE ON LOW TEMPERATURE PHYSICS AND CHEMISTRY.	INTCONFLOWTPHYS
INTERNATIONAL CONFERENCE ON PHYSICS AT VERY LOW TEMPERATURES.	INTCONFPHYSLOWT
INSTITUTE OF RADIO ENGINEERS TRANSACTIONS ON NUCLEAR SCIENCE.	IRETRANS NUCSCI

INSTRUMENT SOCIETY OF AMERICA TRANSACTIONS.	ISA TRANS
IZVESTIYA AKADEMII NAUK SSSR (IN RUSSIAN).	ISV SSSR NEORG
JOURNAL OF THE AMERICAN CERAMIC SOCIETY.	J AM CERAM SOC
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.	J AM CHEM SOC
JOURNAL OF APPLIED PHYSICS.	J APPL PHYS
JOURNAL OF CHEMICAL EDUCATION.	J CHEM EDUC
JOURNAL OF CHEMICAL PHYSICS.	J CHEM PHYS
JOURNAL DE CHIMIE PHYSIQUE.	J CHIM PHYS
JOURNAL OF ELECTRONICS AND CONTROL.	J ELECTRON CONT
JOURNAL OF THE INSTITUTE OF METALS.	J INST METALS
JOURNAL OF THE IRON AND STEEL INSTITUTE.	J IRONSTEELINST
JOURNAL OF THE LESS-COMMON METALS.	J. LESS COM MET
JOURNAL OF MATERIALS SCIENCE.	J MATL SCI
JOURNAL OF METALS.	J METALS
JOURNAL OF NUCLEAR MATERIALS.	J NUCL MATL
JOURNAL OF THE OPTICAL SOCIETY OF AMERICA.	J OPT SOC AM
JOURNAL OF PHYSICAL CHEMISTRY.	J PHYS CHEM
JOURNAL OF PHYSICS AND CHEMISTRY OF SOLIDS.	J PHYS CHEM SOL
JOURNAL DE PHYSIQUE ET LE RADIUM.	J PHYS RADIUM
JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN.	J PHYS SOC JAP
JOURNAL OF PHYSICS.	J PHYSICS
JOURNAL OF QUANTITATIVE SPECTROSCOPY AND RADIATIVE TRANSFER.	J QUAN SPECT RT
JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS.	J RES NBS
JOURNAL OF SCIENCE OF THE HIROSHIMA UNIVERSITY.	J SCI HIROSH U
JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH.	J SCI INDUS RES
JOURNAL OF SCIENTIFIC INSTRUMENTS.	J SCI INSTR
JOURNAL OF TECHNICAL PHYSICS.	J TECH PHYS
JOURNAL OF VACUUM SCIENCE AND TECHNOLOGY.	J VAC SCI TECH
JAPANESE JOURNAL OF APPLIED PHYSICS.	JAP J APPL PHYS
JOURNAL OF THE ELECTROCHEMICAL SOCIETY.	JELECTROCHEMSOC
KRISTALLOGRAFIYA.	KRIST

L'EFFET MOSSBAUER (BOOK BY A. ABRAGAM).	L EFFET MOSSBAU
LOW TEMPERATURE PHYSICS (PROCEEDINGS OF AN INTERNATIONAL CONFERENCE).	LOW TEMP PHYS
LUBRICATION ENGINEERING.	LUB ENG
MASTER'S THESIS.	M THESIS
MACHINE DESIGN.	MACHINE DESIGN
MACHINERY LLOYD.	MACHINERY LLOYD
MAGNETISM (BOOK EDITED BY G. T. RADO AND H. SUHL).	MAGNETISM
MATERIALS IN DESIGN ENGINEERING.	MAT DESIGN ENG
MEMOIRES DE L'ACADEMIE ROYALE DE BELGIQUE.	MEMACADROYBELG
METAL PROGRESS.	METAL PROGRESS
METALLIC SOLID SOLUTIONS (PROCEEDINGS OF A SYMPOSIUM ON THEIR ELECTRONIC AND ATOMIC STRUCTURE)- EDITED BY J. FRIEDEL AND A. GUINIER.	METALSOLIDSOLNS
MONATSBERICHTE DER DEUTSCHEN AKADEMIE DER WISSENSCHAFTEN.	MONATSBER DEUT
MONATSHEFTE FUER CHEMIE.	MONATSH CHEM
NATURE.	NATURE
NATURWISSENSCHAFTEN.	NATURWISSEN
NATIONAL BUREAU OF STANDARDS MONOGRAPH.	NBS MONOGRAPH
NATIONAL BUREAU OF STANDARDS TECHNICAL NEWS BULLETIN.	NBSTECHNEWSBULL
NEDERLANDS TIJDSCHRIFT VOOR NATUURKUNDE.	NED TIJDS NAT
NUCLEAR INSTRUMENTS AND METHODS.	NUCL INSTR METH
NUCLEAR PHYSICS.	NUCL PHYS
NUKLEONIK.	NUKLEONIK
NUOVO CIMENTO.	NUOVO CIMENTO
ONDE ELECTRIQUE.	ONDE ELECT
OPTICA ACTA.	OPT ACTA
OPTICS AND SPECTROSCOPY.	OPT SPECTR
OPTIKA I SPEKTROSKOPIIA (IN RUSSIAN).	OPTIK SPEKT
PHILOSOPHICAL MAGAZINE.	PHIL MAG
PHILIPS RESEARCH REPORTS.	PHILIPS RES REP
PHILIPS TECHNICAL REVIEW.	PHILIPS TECHREV

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY.	PHILTRANSROYSOC
PHYSICS AND CHEMISTRY OF SOLIDS.	PHYS CHEM SOLID
PHYSIK DER KONDENSIERTEN MATERIE.	PHYS KOND MATER
PHYSICS LETTERS.	PHYS LET
PHYSICS OF METALS AND METALLOGRAPHY.	PHYS METALMETAL
PHYSICAL REVIEW.	PHYS REV
PHYSICAL REVIEW LETTERS.	PHYS REV LET
PHYSICA STATUS SOLIDI.	PHYS STAT SOLID
PHYSICS TODAY.	PHYS TODAY
PHYSICA.	PHYSICA
PHYSICS.	PHYSICS
PHYSIKALISCHE VERHANDLUNGEN.	PHYSIK VERHANDL
PROCEEDINGS OF THE BRISTOL CONFERENCE ON DEFECTS IN CRYSTALLINE SOLIDS.	PROCBRISTOLCONF
POLYMER.	POLYMER
PRIBORY I TEKHNIKA EKSPERIMENTA (IN RUSSIAN).	PRIB TEK EKSPER
PRINCETON APPLIED RESEARCH CORPORATION TECHNICAL NOTE.	PRINCETONAPRESS
PRIVATE COMMUNICATION (FOLLOWED BY THE INITIALS OF THE PERSON IN THE ALLOY PHYSICS SECTION TO WHOM THE COMMUNICATION WAS ADRESSED).	PRIVATECOMM XXX
PROCEEDINGS OF THE COLLOQUE AMPERE.	PROC COL AMPERE
PROCEEDINGS OF THE INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS.	PROC IEEE
PROCEEDINGS OF THE INDIAN ACADEMY OF SCIENCES.	PROC INDACADSCI
NOTTINGHAM CONFERENCE.	PROC INTCONFMAG
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON MAGNETISM.	PROC INTCONFMAG
PROCEEDINGS OF THE ENRICO FERMI INTERNATIONAL SCHOOL OF PHYSICS.	PROC INTSCHPHYS
PROCEEDINGS OF THE JAPAN ACADEMY.	PROC JAP ACAD
PROCEEDINGS OF THE KONINKLIJKE NEDERLANDSE ACADEMIE.	PROC KONNEDACAD
PROCEEDINGS OF THE PHYSICAL SOCIETY (LONDON).	PROC PHYS SOC
PROCEEDINGS OF THE ROYAL SOCIETY.	PROC ROY SOC
PROCEEDINGS OF THE ACADEMY OF SCIENCES OF THE USSR.	PROCACADSCIUSSR

PROCEEDINGS OF THE BULGARIAN ACADEMY OF SCIENCES.	PROCBULGACADSCI
PROGRESS IN LOW TEMPERATURE PHYSICS.	PROGLOWTEMPPHYS
PROGRESS IN MATERIALS SCIENCE.	PROG MATL SCI
PROGRESS IN NON-DESTRUCTIVE TESTING.	PROG ND TESTING
PROGRESS IN PHYSICS.	PROG PHYS
PROGRESS IN THEORETICAL PHYSICS.	PROG THEO PHYS
PROGRESS IN INORGANIC CHEMISTRY.	PROGINORGANCHEM
PLATINUM METALS REVIEW.	PT METALS REV
PROCEEDINGS OF THE RARE EARTH CONFERENCE.	RARE EARTH CONF
REPORTS ON PROGRESS IN PHYSICS.	REP PROG PHYS
RESONANCE PARAMAGNETIQUE NUCLEAIRE (BOOK).	RES PARAMAG NUC
RESONANCE AND RELAXATION IN METALS (BOOK).	RES RELAX METAL
REVIEW OF SCIENTIFIC INSTRUMENTS.	REV SCI INSTR
REVIEWS OF MODERN PHYSICS.	REVSMODERN PHYS
REVUE DE PHYSIQUE APPLIQUEE (SUPPLEMENT TO J PHYS RADIUM).	REV PHYSIQUE AP
REVUE DU NICKEL.	REVUE DU NICKEL
SCIENTIFIC AMERICAN.	SCI AMERICAN
SCIENTIFIC REPORTS OF TOHOKU UNIVERSITY.	SCI REP TOHOKUU
SCIENCE.	SCIENCE
SEMICONDUCTOR PRODUCTS AND SOLID STATE TECHNOLOGY.	SCP SOL ST TECH
SOLID STATE COMMUNICATIONS.	SOLIDSTATE COMM
SOLID STATE PHYSICS.	SOLIDSTATE PHYS
SOVIET PHYSICS- CRYSTALLOGRAPHY.	SOV PHYS CRYST
SOVIET PHYSICS- DOKLADY.	SOV PHYS DOKL
SOVIET PHYSICS- JETP.	SOV PHYS JETP
SOVIET PHYSICS- ACOUSTICS.	SOVPHYS ACOUST
SOVIET PHYSICS- SOLID STATE.	SOVPHYS SOLIDST
SOVIET PHYSICS- USPEKHI.	SOVPHYS USPEKHI
SOVIET PHYSICS- TECHNICAL PHYSICS.	SOVPHYSTECHPHYS
SPACE/AERONAUTICS.	SPACE AERONAUT
SPACE SCIENCE REVIEWS.	SPACE SCI REV

SPECTROCHIMICA ACTA.	SPECTROCHIMACTA
SPECTROSCOPY SYMPOSIUM HELD AT BOMBAY.	SPECTSYM BOMBAY
STEEL.	STEEL
TECHNICAL DOCUMENTARY REPORT.	TECH DOC REP
TECHNICAL REPORT - ASTIA DOCUMENT (FOLLOWED BY ITS NUMBER).	TECH REPORT AD
TECHNICAL REPORT - UNIVERSITY OF DENVER RESEARCH INSTITUTE.	TECH REPORT DRI
TECHNICAL REPORT - OFFICE OF NAVAL RESEARCH (FOLLOWED BY ITS NUMBER).	TECH REPORT ONR
TECHNICAL REPORT - AIR FORCE MATERIALS LABORATORY.	TECHREP AFML TR
THESIS (DOCTORAL).	THESIS
TRANSACTIONS OF THE FARADAY SOCIETY.	TRANS FARAD SOC
TRANSACTIONS OF THE METALLURGICAL SOCIETY OF THE AMERICAN INSTITUTE OF MINING, METALLURGICAL, AND PETROLEUM ENGINEERS.	TRANSMETSOCAIME
TRANSLATION - ASTIA DOCUMENT (FOLLOWED BY ITS NUMBER).	TRANSLATION AD
UNION CARBIDE METALS COMPANY.	UNIONCARBMETALS
USPEKHI FIZICHESKIKH NAUK (IN RUSSIAN).	USP FIZ NAUK
VACUUM.	VACUUM
LE VIDE.	VIDE
ZAVODSKAIA LABORATORIIA (IN RUSSIAN).	ZAVOD LAB
ZEITSCHRIFT FUER ANGEWANDTE PHYSIK.	Z ANGEW PHYSIK
ZEITSCHRIFT FUR ANORGANISCHE UND ALLGEMEINE CHEMIE.	Z ANORGALL CHEM
ZEITSCHRIFT FUER INSTRUMENTENKUNDE.	Z INSTR
ZEITSCHRIFT FUER METALLKUNDE.	Z METALLKUNDE
ZEITSCHRIFT FUER NATURFORSCHUNG.	Z NATURFORSCH
ZEITSCHRIFT FUER PHYSIKALISCHE CHEMIE.	Z PHYS CHEMIE
ZEITSCHRIFT FUER PHYSIK.	Z PHYSIK
ZHURNAL EKSPERIMENTAL'NOI I TEORETICHESKOI FIZIKI (IN RUSSIAN).	ZHEKSPERTEORFIZ

(END)

Appendix D

COMPUTER PROGRAMS: EXISTING COMPUTER PROGRAMS USED FOR GENERAL INDICES AND SPECIFIC SEARCHES

The ANNOTATION records are those EAM cards containing the abbreviated bibliographic information of the papers and the codes pertaining to the detailed contents of these documents, as determined by reading the entire document. The major part of the main text of this article was devoted to the description of the ANNOTATION card. Our BIBLIO-MASTER-FILE is the one containing all the ANNOTATION records and is kept on magnetic tape at the NBS computer facilities. The corresponding punched cards are kept in storage in our Alloy Data Library. The AUTHOR, TITLE and LAB cards presently are not available for all the papers that are in our BIBLIO-MASTER-FILE. These files will also be stored on tape. A few programs were written for these files for compilation on the Honeywell 200 COBOL compiler. They will not be listed here. Other programs for these files are currently being prepared for compilation on the Univac 1108. Most of our programs do not concern these AUTHOR, TITLE and LAB files, but rather the ANNOTATION file which is called the "BIBLIO-MASTER-FILE" and is currently on tape. The updating (additions, deletions and replacements) of the tape is done whenever this is thought necessary by the users of the system. From this tape, indices are printed as needed. Before August 1967, the cards had a somewhat different format. A few of the programs written for this "old format" will be listed below. Only minor alterations will be needed for their use with the present format. All programs that were written for the old format will be noted as such. A few of the programs were written for card input. They can readily be altered to handle tape input, and therefore, will be given here as well. The language used for all the source programs is COBOL.

Short programs will be listed first. These were written by J. S. Philo[†]. The main program which presently contains eight options and which is used for the generation of our Alloy Data Indices will follow, including a computer listing of the program. This program was prepared by D. L. Crown of the Computer Services Section at the National Bureau of Standards. Other options of the main program are being prepared by the latter author to incorporate and expand some of the existing short programs into the general program.

SHORT PROGRAMS

Lister Program (Bibliography Program)

Purpose: To produce listings of all ANNOTATION records by first author and by reference numbers, containing a specific category, for example, an SXS bibliography, or an EPR bibliography, etc.
Input: ANNOTATION card file.
Output: Double spaced, computer-edited listings by first author (the order in which the cards are fed in) and sub-sorted by increasing reference number.
Note: This program can readily be adjusted to print out any other category or experimental method as given in List #3.

Main Property Index Program

Purpose: To produce a listing of the ANNOTATION records, sorted by the property appearing in the left-most property-code field of the annotation card, the year, the journal, and the reference number.
Input: ANNOTATION card file.
Output: Double spaced, computer-edited listing, in the above mentioned order.

Subject Index Program (All Properties Index)

Purpose: To produce a listing of the ANNOTATION records under each property which appears

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[†]Employed in our group on the Summer Student Trainee Program.

on the record. For each coded property, this program thus lists every record which contains that property, thereby producing a property index for all properties.

Input: ANNOTATION card file.

Output: A single-spaced listing sorted by property and reference number. The property under which it is being listed appears to the left of the 80 column printed record.

Ternary Printout Program

Purpose: To identify all cards with data relating to ternary systems.

Input: ANNOTATION card file, old format.‡

Output: Double spaced listing of all the records pertaining to ternary or higher order alloys.

Alloy Search Program (Specific Properties of a Specific Alloy)

Purpose: To find all documents containing data on a specific alloy for a specific property, for example, all papers on Knight shifts (4K) in Cu-Zn alloys.

Input: Master tape file, BIBLIO-MASTER-FILE.

Output: Double spaced listing in the following format:

Alloy	Element Studied	Comp. LO	Comp. HI	Temp. LO	Temp. HI	Props.	Author	Journ.	Vol.	Pg.	Ref.No.	Subj.
CUZN	1	50	100	77	620	4K4A4E4B	BLOEMBERGN2	ACTA MET	1	731	530029	NMRE

Element Search Program

Purpose: To find all documents containing data on a specific property in any system containing some particular element; for example, Knight shifts (4K) in any alloy system containing copper.

Input: Master tape file, BIBLIO-MASTER-FILE.

Output: Double spaced listing in the format given in the Alloy Search Program (previous entry.)

Properties Printout Program

Purpose: To find all documents containing one or more of the property codes from the Property List in any alloy system, for example, all papers on Knight shifts (4K) or on linewidths (4A) in any alloy system.

Input: Master tape file, BIBLIO-MASTER-FILE.

Output: Double spaced listing in the format given in the Alloy Search Program.

MAIN ALLOY DATA BIBLIOGRAPHY PROGRAM

Bibliography File Update and Printout

Purpose: To update master file and/or produce various printouts depending on the following options punched in date/control card.

1. Update master file or create master file.
2. Author Index printout (example shown in Fig. 3).
3. NMR Author Index printout.
4. Reference Number Index printout.
5. Normal Alloy Index printout
6. Normal NMR Alloy Index printout.
7. Permuted Alloy Index printout (e.g. ALNI listed under the AL alloys and the NI alloys). (Example shown in Fig. 4).

‡Note: This program is written for the old format, but can easily be changed to new format.

8. Permuted NMR Alloy Index printout (example as in Option 7).

Input: Options 1-8.
a. Annotation tape file, BIBLIO-MASTER-FILE.
b. Object program deck and date/control card.
c. ANNOTATION cards to be added, replaced or deleted from tape file.

Options 2-8.
a. Annotation tape file, BIBLIO-MASTER-FILE.
b. Object program deck and date/control card.

Output: Options 1-8.
a. Updated BIBLIO-MASTER-FILE.
b. Transaction edit and master file update printout.
c. Punchout of EAM ANNOTATION addition and replacement cards.
d. Printout of selected edited indices.

Options 2-8.
a. Printout of selected edited indices.

Note: (1) Change code, column 12 of ANNOTATION cards is printed on Option 1 only.
(2) The alloy element, columns 61-68 of ANNOTATION cards are underlined based on the "element studied", column 69 on printouts for Options 2-6 only.
(3) The program as currently written is limited to 2000 input changes and 20,000 BIBLIO-MASTER-FILE records. Once the input data exceed these limits, changes in the internal drum allocations will have to be made in the environment division of the program.

Structure of BIBLIO-MASTER-FILE, (ANNOTATION CARD format).

The detailed description of these fields and the meanings of the various codes are described in the main text.

COLUMN	CONTENTS
1-9 ...	AUTHOR (A). First nine letters of the first author's surname.
10 ...	INITIAL (A). First initial of first author's given neme.
11 ...	NUMBER OF AUTHORS (N). Total number of authors.
12 ...	†CHANGE CODE (N). File maintenance code. "1" - Additions to file. "2" - Replacements of records in file. "3" - Deletions of records in file.
13-27 ..	JOURNAL (A). Journal name or abbreviation, as given in Appendix C.
28-30 ..	VOLUME NUMBER (N). All spaces and/or leading spaces permitted in lieu of zeros.
31 ...	VOLUME SECTION (A). A, B, C, etc.
32-35 ..	PAGE NUMBER (N). All spaces and/or leading space permitted in lieu of zeros.
36 ...	BLANK FIELD (A).
37-38 ..	YEAR (N). Last two digits of year of publication (example: 68 for 1968).
39-42 ..	COUNTING NUMBER (N). The last four digits of the reference number.
43 ...	BLANK FIELD (A).
44-46 ..	SUBJECT CATEGORY (A). e.g. MAG, NMR, etc.
47 ...	TYPE OF PAPER (A). Letters E, T, R, or space.
48-59 ..	PROPERTY CODES (A/N). Maximum of six two-position codes are possible. The first position is numeric and the second position is alphabetic.
60 ...	CARD COUNT NUMBER (N). Digits 0-9 or space are permitted (upon printout an asterisk is generated here for semiannotated documents).

†Appears on the input card, but is left open in the tape file and the printout.

COLUMN	CONTENTS
61-68	ALLOY ELEMENTS (A). Maximum of four two-position codes are possible.
69	ELEMENT STUDIED (A/N). Digits 1-9 and A-Z.
70-74	COMPOSITION RANGE (N). Columns 70-71 are the low range and columns 72-74 are the high range. All spaces and/or leading spaces permitted in both low and high ranges in lieu of leading zeros.
75-80	TEMPERATURE RANGE (N). Columns 75-77 are the low range and columns 78-80 are the high range. All spaces and/or leading spaces permitted in both low and high ranges in lieu of leading zeros.
81-84	#BLANK.

Note:
(1) Change code (column 12) is recorded in the ANNOTATION change cards (or "update cards") only and is blank in the master tape file.
(2) Columns 81-84 are blank in the master tape file.
(3) The ANNOTATION change cards (additions, replacements and deletions) are checked for consistency with the above format and content prior to updating and if these do not meet the criteria outlined above, the change cards that are in error are not processed. A listing of such rejected records is printed out.
(4) Key to alpha and/or numeric data elements is as follows:
(A) - Alphabetic Data, A-Z and space.
(N) - Numeric Data, 0-9.
(A/N) - Alpha/numeric data, A-Z, space, 0-9 and special characters allowed in the COBOL character set.

Structure of DATE/CONTROL Card - (See Fig. D-1).

COLUMN	CONTENTS
1-4	CARD IDENT (A). Must contain the literal 'DATE'.
5-10	RUN DATE (N). Scheduled run date (mo. da. yr.) of computer run (e.g. 011568).
11-16	AS OF DATE (N). The date (mo. da. yr.) on which the BIBLIO-MASTER-FILE was last updated (e.g. 123067).
17-21	JULIAN DATE (N). The date (yr. day) on which the program was submitted to computer operations (e.g. 68015).
22-24	SPECIAL PROGRAM OPTIONS (A/N). a. Blank - No special options. b. X01 - Special extract only. c. X02 - Special extract and journal name printout. d. X03 - Journal name printout only.
25-32	NORMAL PROGRAM OPTIONS (A/N). a. Option 1. "A" - Create BIBLIO-MASTER-FILE from ANNOTATION cards; "X" - Update BIBLIO-MASTER-FILE; "1" - Bypass updating of BIBLIO-MASTER-FILE. b. OPTION 2. "X" - Produce Author Index printout; "1" - Bypass Author Index printout. c. Option 3. "X" - Produce NMR Author Index printout; "1" - Bypass NMR Author Index printout. d. Option 4. "X" - Produce Reference Number Index printout; "1" - Bypass Reference Number Index printout. e. Option 5. "X" - Produce Normal Alloy Index printout; "1" - Bypass Normal Alloy Index printout. f. Option 6. "X" - Produce normal NMR Alloy Index printout; "1" - Bypass normal NMR Alloy Index printout. g. Option 7. "X" - Produce Permuted Alloy Index printout; "1" - Bypass Permuted Alloy Index printout. h. Option 8. "X" - Produce Permuted NMR Alloy Index printout; "1" - Bypass Permuted NMR Alloy Index printout.
33-56	TERMINATE OR CONTINUE RUN (A/N). If "edit errors" existed in the update phase of the program and it is desirable to continue the run, the literal '*EDIT ERRORS-CONT RUN*' should be punched. If it is desirable to terminate the run if "EDIT

- DATE/CONTROL CARD -

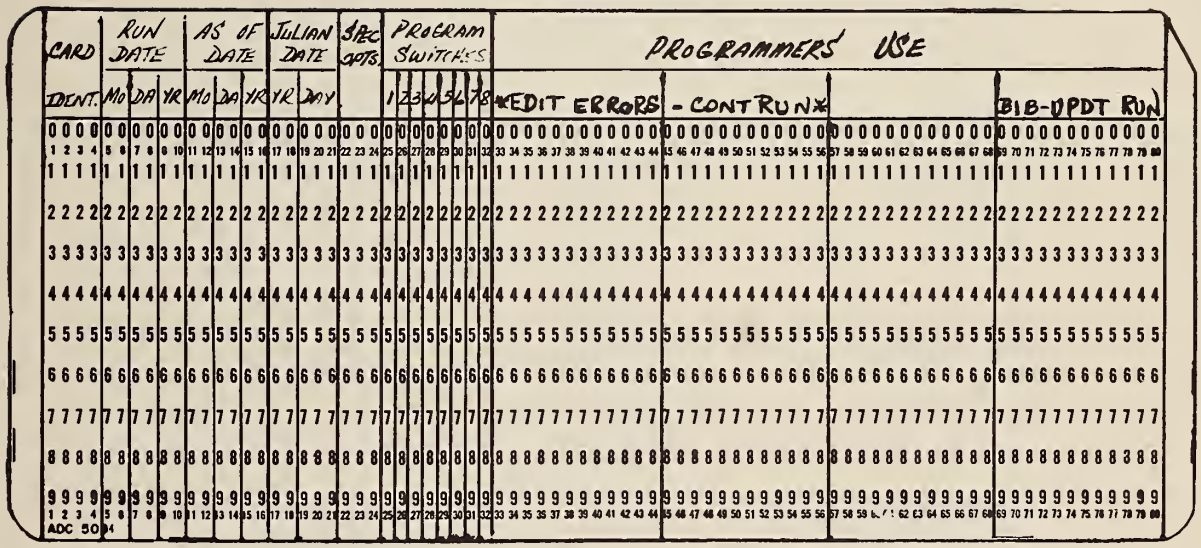


Fig. D-1. Layout of control card.

ERRORS" existed in the update phase of the program, leave these columns blank.

57-68. . MASTER FILE EDIT (A/N).If it is desirable to edit the BIBLIO-MASTER-FILE due to edit criteria changes, punch the literal "EDIT MAST-IN";otherwise leave these columns blank.

69-70. . RUN IDENT (A/N). The literal 'BIB-UPDT RUN' should be punched in these card columns.

Note: The date/control card must be the first data card following the "XQT BIBUDT" EXEC II control card. The date/control card is read, stored, and edited in the housekeeping section of the program and if the format and content of this card does not meet the criteria outlined above, the computer run will be aborted.

Key to alpha and/or numeric data elements is as under "BIBLIO-MASTER-FILE".

The flow chart of the Main Alloy Data Bibliography Program is shown in Figure D-2.

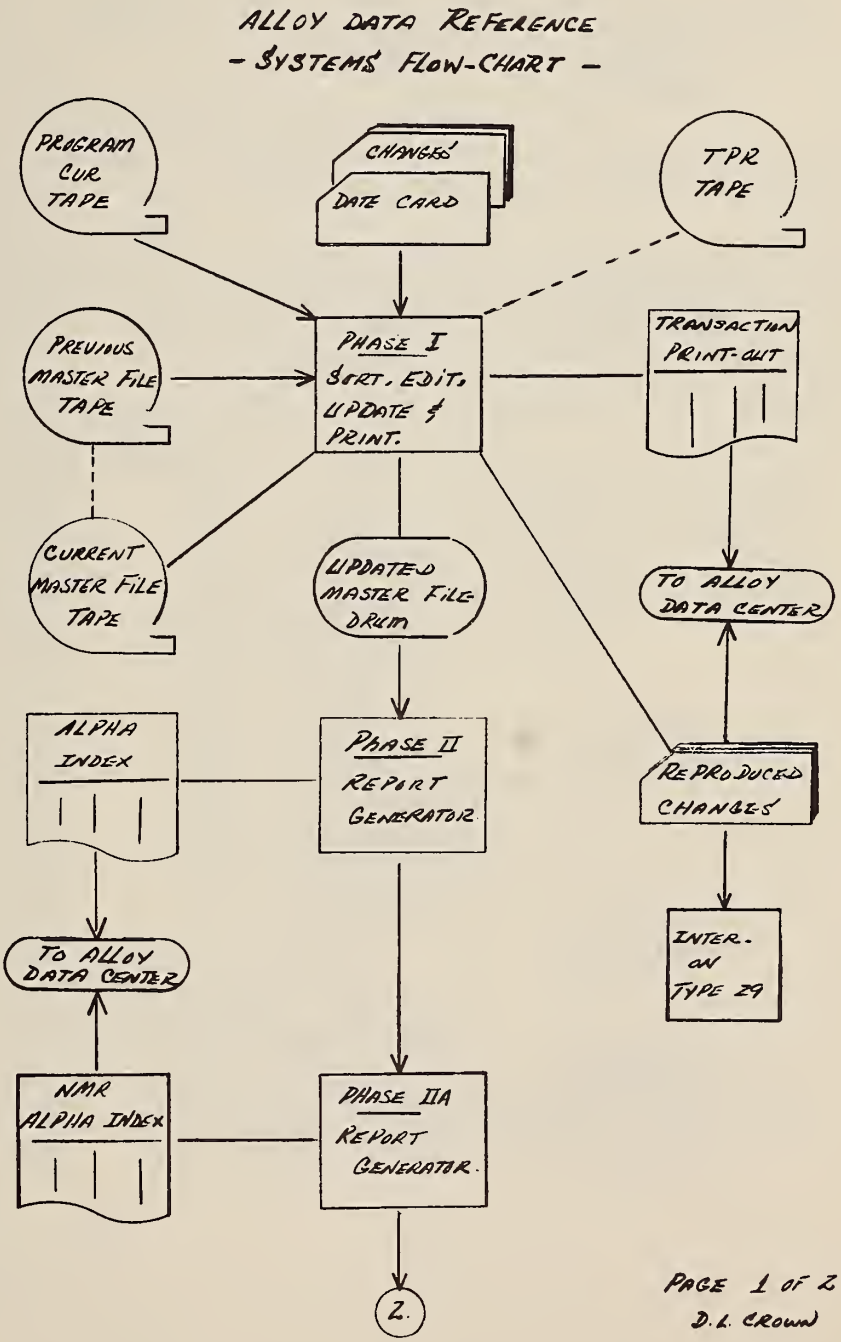
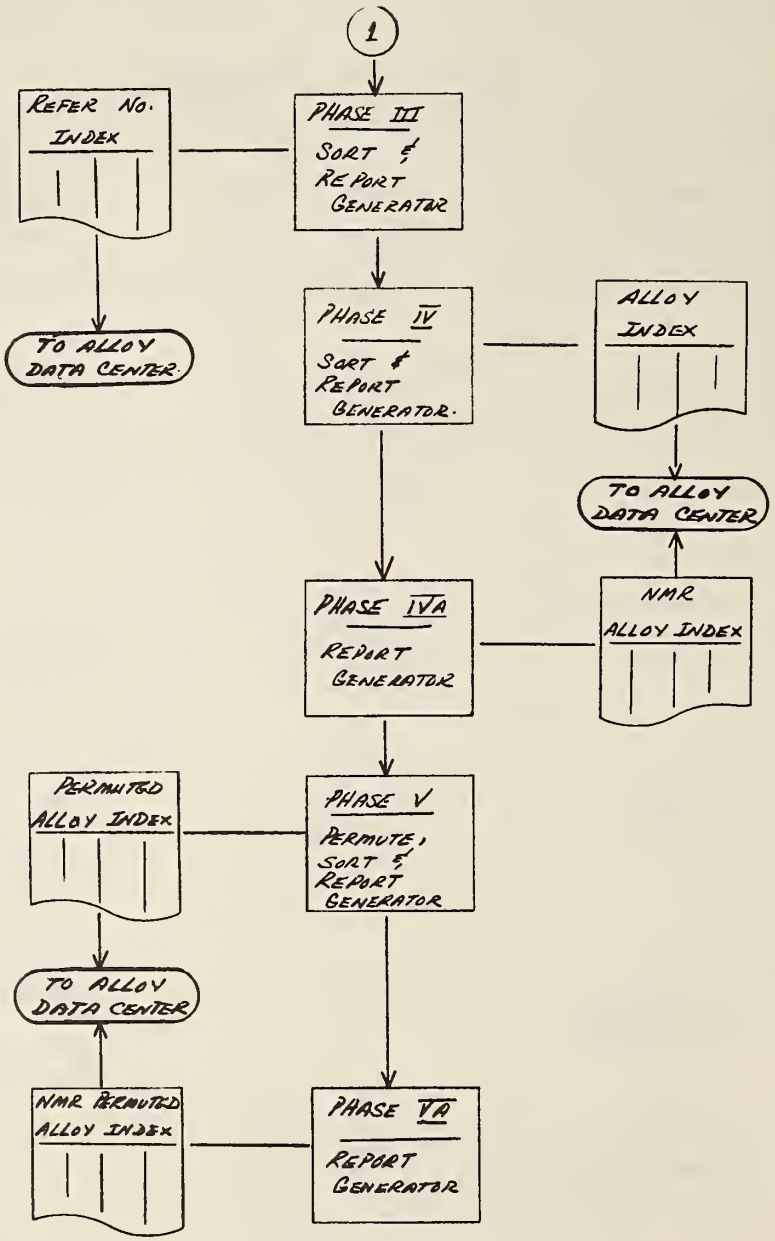


Fig. D-2. Flow chart of Main Alloy Data Program.



PAGE 2 OF 2

D.L. CROWN

Fig. D-2. Flow chart of Main Alloy Data Program, continued.

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PAGE:      2

@EIU   COB BIBUDT,BIBUDT
COBOL BL4D  LCC-2301-0015
COMPILED ON -  25 MAR 68 AT 14:39:13
   1            001000 IDENTIFICATION DIVISION.                                          BIB-UPDT
   2            001010 PROGRAM-ID. BIBLIOGRAPHY FILE UPDATE AND PRINTOUT.                BIB-UPDT
   3            001020 AUTHOR. D.L. CROWN, COMPUTER SERVICES DIVISION, TASK 19171        BIB-UPDT
   4            001030 INSTALLATION. NBS METALLURGY DIVISION, BLDG. 223, RM. B139,       BIB-UPDT
   5            001040                DR. CARTER, X-2917, TASK 22496.                    BIB-UPDT
   6            001050 DATE-WRITTEN.                                                     BIB-UPDT
   7            001060 DATE-COMPILED.   02:39 PM,   MAR 25, 1968.                       BIB-UPDT
   8            001070 SECURITY. UNCLASSIFIED.                                           BIB-UPDT
   9            001080 REMARKS.    THIS PROGRAM UTILIZES PUNCHED CARDS (CHANGES) AND     BIB-UPDT
  10            001083     MAGNETIC TAPE (MASTER FILE) INPUT TO PRODUCE AN UPDATED      BIB-UPDT
  11            001085     MASTER FILE ON MAGNETIC TAPE AND A PUNCHOUT OF EDITED CHANGE BIB-UPDT
  12            001087     CARDS.                                                       BIB-UPDT
  13            001090         IN ADDITION TO UPDATING THE MASTER FILE, THE PROGRAM     BIB-UPDT
  14            001093     EDITS THE CHANGES AND CHECKS FOR DUPLICATES. CHANGES THAT    BIB-UPDT
  15            001095     FAIL TO PASS THE EDITS OR DUPLICATES ARE PRINTED OUT WITH    BIB-UPDT
  16            001097     THE DATA ELEMENTS THAT ARE IN ERROR NOTED BY AN 'X' AND      BIB-UPDT
  17            001100     REJECTED BY THE PROGRAM. A BEFORE AND AFTER UPDATE PRINTOUT  BIB-UPDT
  18            001103     OF THE MASTER FILE IS ALSO PROVIDED BY THE PROGRAM.          BIB-UPDT
  19            001105         A DATE CARD MUST PRECEDE THE CHANGES OR THE PROGRAM WILL BIB-UPDT
  20            001107     NOT RUN (REFER TO DATE-CARD IN WORKING-STORAGE SECTION FOR   BIB-UPDT
  21            001110     FORMAT). EIGHT SWITCHES ARE PROVIDED IN THE DATE CARD TO     BIB-UPDT
  22            001113     CONTROL THE FOLLOWING OPTIONS.                               BIB-UPDT
  23            001115         SWT-1. 'X'-UPDATE; '1'-BYPASS; 'A'-INITIAL PROCESS.      BIB-UPDT
  24            001117         SWT-2. 'X'-AUTHOR INDEX PRINTOUT; '1'-BYPASS.            BIB-UPDT
  25            001120         SWT-3. 'X'-NMR AUTHOR INDEX PRINTOUT; '1'-BYPASS.        BIB-UPDT
  26            001123         SWT-4. 'X'-REFER. NO. INDEX PRINTOUT; '1'-BYPASS.        BIB-UPDT
  27            001125         SWT-5. 'X'-NORMAL ALLOY PRINTOUT; '1'-BYPASS.            BIB-UPDT
  28            001127         SWT-6. 'X'-NORMAL NMR ALLOY PRINTOUT; '1'-BYPASS.        BIB-UPDT
  29            001130         SWT-7. 'X'-PERMUTED ALLOY PRINTOUT; '1'-BYPASS.          BIB-UPDT
  30            001135         SWT-8. 'X'-PERMUTED NMR ALLOY PRINTOUT; '1'-BYPASS.      BIB-UPDT
  31            001140     SEQUENCE OF MASTER FILE IS AS FOLLOWS.                       BIB-UPDT
  32            001143         MAJOR - AUTHORS-NAME.                                    BIB-UPDT
  33            001145         INTER - REFER-YR.                                        BIB-UPDT
  34            001147         MIN1  - JOURNAL-NAME.                                    BIB-UPDT
  35            001150         MIN2  - VOLUME.                                          BIB-UPDT
  36            001153         MIN3  - PAGE.                                            BIB-UPDT
  37            001155         MIN4  - REFER-NO.                                        BIB-UPDT
  38            001157         MIN5  - ALLOY-ELEMENTS.                                  BIB-UPDT
  39            001159         MIN6  - SUBJECT-CATEGORY.                                BIB-UPDT
  40            001160         MIN7  - CARD-COUNT-NUMBER.                               BIB-UPDT
  41            001163         MIN8  - COMPOSITION-RANGE.                               BIB-UPDT
  42            001170     CHANGE CODES ARE AS FOLLOWS.                                 BIB-UPDT
  43            001173          '1'  - NEW ENTRIES.                                     BIB-UPDT
  44            001175          '2'  - REPLACEMENTS.                                    BIB-UPDT
  45            001177          '3'  - DELETIONS.                                       BIB-UPDT
  46            001200 ENVIRONMENT DIVISION.                                            BIB-UPDT
  47            001205 CONFIGURATION SECTION.                                           BIB-UPDT
  48            001210 SOURCE-COMPUTER. UNIVAC-1108.                                    BIB-UPDT
  49            001220 OBJECT-COMPUTER. UNIVAC-1108.                                    BIB-UPDT
  50            001300 INPUT-OUTPUT SECTION.                                            BIB-UPDT
  51            001310 FILE-CONTROL.                                                    BIB-UPDT
  52            001320     SELECT CARD-IN ASSIGN TO CARD-READER-EIGHTY.                 BIB-UPDT
  53            001330     SELECT OPTIONAL CARD-OUT ASSIGN TO CARD-PUNCH-EIGHTY.        BIB-UPDT
  54            001340     SELECT PRINT-OUT ASSIGN TO PRINTER.                          BIB-UPDT
  55            001350     SELECT DRUM-STORE ASSIGN TO DRUM  28000 WORDS.               BIB-UPDT
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 56              001360     SELECT OPTIONAL MASTER-IN ASSIGN TO UNISERVO A.                BIB-UPDT
 57              001370     SELECT OPTIONAL MASTER-OUT ASSIGN TO UNISERVO B.               BIB-UPDT
 58              001380     SELECT DRUM-SORT ASSIGN TO DRUM  28000 WORDS.                  BIB-UPDT
 59              001390     SELECT MASTER-HOLD ASSIGN TO DRUM 280000 WORDS.                BIB-UPDT
 60              001400     SELECT TAPE-SORT ASSIGN TO UNISERVO C, D,                      BIB-UPDT
 61              001410         DRUM 280000 WORDS.                                         BIB-UPDT
 62              001420     SELECT REPORT-STORE ASSIGN TO UNISERVO E.                      BIB-UPDT
 63              001500 I-O-CONTROL.                                                       BIB-UPDT
 64              001510     APPLY STANDBY ON MASTER-IN, MASTER-OUT, REPORT-STORE.          BIB-UPDT
 65              010000 DATA DIVISION.                                                     BIB-UPDT
 66              010010 FILE SECTION.                                                      BIB-UPDT
 67              010020 FD  CARD-IN;                                                       BIB-UPDT
 68              010030     FILE CONTAINS ABOUT  2000 RECORDS;                             BIB-UPDT
 69              010040     RECORDING MODE IS BLANK;                                       BIB-UPDT
 70              010050     RECORD CONTAINS 80 CHARACTERS;                                 BIB-UPDT
 71              010060     LABEL RECORD IS OMITTED;                                       BIB-UPDT
 72              010070     DATA RECORD IS CARDIN-REC.                                     BIB-UPDT
 73              010100 01  CARDIN-REC; SIZE IS 80; CLASS IS ALPHANUMERIC.                BIB-UPDT
 74              010110     03  AUTHORS-NAME.                                             BIB-UPDT
 75              010120         05  LAST-NAME;       PICTURE X(9).                       BIB-UPDT
 76     1 3      010130         05  1ST-INITIAL;     PICTURE X(1).                       BIB-UPDT
 77     1 4      010140     03  NO-OF-AUTHORS;       PICTURE 9(1).                       BIB-UPDT
 78     1 5      010150     03  CHANGE-CODE;         PICTURE X(1).                       BIB-UPDT
 79     2 0      010160     03  JOURNAL-NAME;        PICTURE X(15).                      BIB-UPDT
 80     4 3      010170     03  VOLUME.                                                  BIB-UPDT
 81     4 3      010180         05  VOL-NO;          PICTURE 9(3).                       BIB-UPDT
 82     5 0      010190         05  VOL-XX;          PICTURE X(1).                       BIB-UPDT
 83     5 1      010200     03  PAGE;                PICTURE 9(4).                       BIB-UPDT
 84     5 5      010210     03  FILLER;              PICTURE X(1).                       BIB-UPDT
 85     6 0      010220     03  REFERENCE-NUMBER.                                        BIB-UPDT
 86     6 0      010230         05  REFER-YR;        PICTURE 9(2).                       BIB-UPDT
 87     6 2      010240         05  REFER-NO;        PICTURE 9(4).                       BIB-UPDT
 88     7 0      010250     03  FILLER;              PICTURE X(1).                       BIB-UPDT
 89     7 1      010260     03  SUBJECT-CATEGORY.                                        BIB-UPDT
 90     7 1      010270         05  BROAD-CATE;      PICTURE X(3).                       BIB-UPDT
 91     7 4      010280         05  SPEC-CATE;       PICTURE X(1).                       BIB-UPDT
 92     7 5      010290     03  PROPERTIES.                                              BIB-UPDT
 93     7 5      010300         05  PROP-CODE;       OCCURS  6 TIMES.                    BIB-UPDT
 94     7 5      010310             07  1ST-POST;.   PICTURE X(1).                       BIB-UPDT
 95     8 0      010320             07  2ND-POST;    PICTURE X(1).                       BIB-UPDT
 96     9 5      010330     03  CARD-COUNT-NUMBER;    PICTURE X(1).                      BIB-UPDT
 97    10 0      010340     03  ALLOY-ELEMENTS.                                          BIB-UPDT
 98    10 0      010350         05  GROUP-CODE;      OCCURS  4 TIMES.                    BIB-UPDT
 99    10 0      010360             07  ALLOY-ID;    PICTURE X(2).                       BIB-UPDT
100    11 2      010370     03  ELEMENT-STUDIED;      PICTURE X(1).                      BIB-UPDT
101    11 3      010380     03  COMPOSITION-RANGE.                                       BIB-UPDT
102    11 3      010390         05  LO-COMP;         PICTURE X(2).                       BIB-UPDT
103    11 5      010400         05  HI-COMP;         PICTURE X(3).                       BIB-UPDT
104    12 2      010410     03  TEMPERTURE-RANGE.                                        BIB-UPDT
105    12 2      010420         05  LO-TEMP;         PICTURE X(3).                       BIB-UPDT
106    12 5      010430         05  HI-TEMP;         PICTURE X(3).                       BIB-UPDT
107              011000 FD  MASTER-IN;                                                     BIB-UPDT
108              011010     FILE CONTAINS ABOUT 20000 RECORDS;                             BIB-UPDT
109              011020     BLOCK CONTAINS 10 RECORDS;                                     BIB-UPDT
110              011030     RECORD CONTAINS 84 CHARACTERS;                                 BIB-UPDT
111              011040     LABEL RECORD IS STANDARD;                                      BIB-UPDT
112              011050     VALUE OF ID IS 'BIBLIO-MASTER-FILE';                           BIB-UPDT
113              011060     DATA RECORD IS MAST-IN-REC.                                    BIB-UPDT
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114                011100 01  MAST-IN-REC; SIZE IS 84; CLASS IS ALPHANUMERIC.                BIB-UPDT
115                011110     03  AUTHORS-NAME.                                              BIB-UPDT
116                011120         05  LAST-NAME;        PICTURE X(9).                       BIB-UPDT
117          1 3   011130         05  1ST-INITIAL;      PICTURE X(1).                       BIB-UPDT
118          1 4   011140     03  NO-OF-AUTHORS;        PICTURE 9(1).                       BIB-UPDT
119          1 5   011150     03  CHANGE-CODE;          PICTURE X(1).                       BIB-UPDT
120          2 0   011160     03  JOURNAL-NAME;         PICTURE X(15).                      BIB-UPDT
121          4 3   011170     03  VOLUME.                                                    BIB-UPDT
122          4 3   011180         05  VOL-NO;           PICTURE 9(3).                       BIB-UPDT
123          5 0   011190         05  VOL-XX;           PICTURE X(1).                       BIB-UPDT
124          5 1   011200     03  PAGE;                 PICTURE 9(4).                       BIB-UPDT
125          5 5   011210     03  FILLER;               PICTURE X(1).                       BIB-UPDT
126          6 0   011220     03  REFERENCE-NUMBER.                                         BIB-UPDT
127          6 0   011230         05  REFER-YR;         PICTURE 9(2).                       BIB-UPDT
128          6 2   011240         05  REFER-NO;         PICTURE 9(4).                       BIB-UPDT
129          7 0   011250     03  FILLER;               PICTURE X(1).                       BIB-UPDT
130          7 1   011260     03  SUBJECT-CATEGORY.                                         BIB-UPDT
131          7 1   011270         05  BROAD-CATE;       PICTURE X(3).                       BIB-UPDT
132          7 4   011280         05  SPEC-CATE;        PICTURE X(1).                       BIB-UPDT
133          7 5   011290     03  PROPERTIES.                                               BIB-UPDT
134          7 5   011300         05  PROP-CODE;        OCCURS  6 TIMES.                    BIB-UPDT
135          7 5   011310             07  1ST-POST;     PICTURE X(1).                       BIB-UPDT
136          8 0   011320             07  2ND-POST;     PICTURE X(1).                       BIB-UPDT
137          9 5   011330     03  CARD-COUNT-NUMBER;     PICTURE X(1).                      BIB-UPDT
138       10 0     011340     03  ALLOY-ELEMENTS.                                           BIB-UPDT
139       10 0     011350         05  GROUP-CODE;       OCCURS  4 TIMES.                    BIB-UPDT
140       10 0     011360             07  ALLOY-ID;     PICTURE X(2).                       BIB-UPDT
141       11 2     011370     03  ELEMENT-STUDIED;      PICTURE X(1).                       BIB-UPDT
142       11 3     011380     03  COMPOSITION-RANGE.                                        BIB-UPDT
143       11 3     011390         05  LO-COMP;          PICTURE X(2).                       BIB-UPDT
144       11 5     011400         05  HI-COMP;          PICTURE X(3).                       BIB-UPDT
145       12 2     011410     03  TEMPERTURE-RANGE.                                         BIB-UPDT
146       12 2     011420         05  LO-TEMP;          PICTURE X(3).                       BIB-UPDT
147       12 5     011430         05  HI-TEMP;          PICTURE X(3).                       BIB-UPDT
148       13 2     011440     03  FILLER;               PICTURE X(4).                       BIB-UPDT
149                012000 FD  MASTER-OUT;                                                    BIB-UPDT
150                012010     FILE CONTAINS ABOUT 20000 RECORDS;                             BIB-UPDT
151                012020     BLOCK CONTAINS 10 RECORDS;                                     BIB-UPDT
152                012030     RECORD CONTAINS 84 CHARACTERS;                                 BIB-UPDT
153                012040     LABEL RECORD IS STANDARD;                                      BIB-UPDT
154                012050     VALUE OF ID IS 'BIBLIO-MASTER-FILE';                           BIB-UPDT
155                012060     DATA RECORD IS MAST-OUT-REC.                                   BIB-UPDT
156                012100 01  MAST-OUT-REC; SIZE IS 84; CLASS IS ALPHANUMERIC.              BIB-UPDT
157                012110     03  AUTHORS-NAME.                                             BIB-UPDT
158                012120         05  LAST-NAME;        PICTURE X(9).                       BIB-UPDT
159          1 3   012130         05  1ST-INITIAL;      PICTURE X(1).                       BIB-UPDT
160          1 4   012140     03  NO-OF-AUTHORS;        PICTURE 9(1).                       BIB-UPDT
161          1 5   012150     03  CHANGE-CODE;          PICTURE X(1).                       BIB-UPDT
162          2 0   012160     03  JOURNAL-NAME;         PICTURE X(15).                      BIB-UPDT
163          4 3   012170     03  VOLUME.                                                    BIB-UPDT
164          4 3   012180         05  VOL-NO;           PICTURE 9(3).                       BIB-UPDT
165          5 0   012190         05  VOL-XX            PICTURE X(1).                       BIB-UPDT
166          5 1   012200     03  PAGE;                 PICTURE 9(4).                       BIB-UPDT
167          5 5   012210     03  FILLER;               PICTURE X(1).                       BIB-UPDT
168          6 0   012220     03  REFERENCE-NUMBER.                                         BIB-UPDT
169          6 0   012230         05  REFER-YR;         PICTURE 9(2).                       BIB-UPDT
170          6 2   012240         05  REFER-NO;         PICTURE 9(4).                       BIB-UPDT
171          7 0   012250     03  FILLER;               PICTURE X(1).                       BIB-UPDT
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172     7 1     012260      03  SUBJECT-CATEGORY.                                    BIB-UPDT
173     7 1     012270          05  BROAD-CATE;      PICTURE X(3).                  BIB-UPDT
174     7 4     012280          05  SPEC-CATE;       PICTURE X(1).                  BIB-UPDT
175     7 5     012290      03  PROPERTIES.                                          BIB-UPDT
176     7 5     012300          05  PROP-CODE;       OCCURS  6 TIMES.               BIB-UPDT
177     7 5     012310              07  1ST-POST;    PICTURE X(1).                  BIB-UPDT
178     8 0     012320              07  2ND-POST;    PICTURE X(1).                  BIB-UPDT
179     9 5     012330      03  CARD-COUNT-NUMBER;    PICTURE X(1).                BIB-UPDT
180    10 0     012340      03  ALLOY-ELEMENTS.                                     BIB-UPDT
181    10 0     012350          05  GROUP-CODE;      OCCURS  4 TIMES.               BIB-UPDT
182    10 0     012360              07  ALLOY-ID;    PICTURE X(2).                  BIB-UPDT
183    11 2     012370      03  ELEMENT-STUDIED;      PICTURE X(1).                BIB-UPDT
184    11 3     012380      03  COMPOSITION-RANGE.                                  BIB-UPDT
185    11 3     012390          05  LO-COMP;         PICTURE X(2).                  BIB-UPDT
186    11 5     012400          05  HI-COMP;         PICTURE X(3).                  BIB-UPDT
187    12 2     012410      03  TEMPERTURE-RANGE.                                   BIB-UPDT
188    12 2     012420          05  LO-TEMP;         PICTURE X(3).                  BIB-UPDT
189    12 5     012430          05  HI-TEMP;         PICTURE X(3).                  BIB-UPDT
190    13 2     012440      03  FILLER;              PICTURE X(4).                  BIB-UPDT
191              013000 FD  DRUM-STORE;                                             BIB-UPDT
192              013010     FILE CONTAINS ABOUT  2000 RECORDS;                      BIB-UPDT
193              013020         BLOCK CONTAINS 10 RECORDS;                          BIB-UPDT
194              013030         RECORD CONTAINS 84 CHARACTERS;                      BIB-UPDT
195              013040         LABEL RECORD IS OMITTED;                            BIB-UPDT
196              013050         DATA RECORD IS BIBLIO-REC.                          BIB-UPDT
197              013100 01  BIBLIO-REC; SIZE IS 84; CLASS IS ALPHANUMERIC.         BIB-UPDT
198              013110     03  AUTHORS-NAME.                                       BIB-UPDT
199              013120         05  LAST-NAME;       PICTURE X(9).                  BIB-UPDT
200     1 3      013130         05  1ST-INITIAL;     PICTURE X(1).                  BIB-UPDT
201     1 4      013140     03  NO-OF-AUTHORS;       PICTURE 9(1).                  BIB-UPDT
202     1 5      013150     03  CHANGE-CODE;         PICTURE X(1).                  BIB-UPDT
203     2 0      013160     03  JOURNAL-NAME;        PICTURE X(15).                 BIB-UPDT
204     4 3      013170     03  VOLUME.                                             BIB-UPDT
205     4 3      013180         05  VOL-NO;          PICTURE 9(3).                  BIB-UPDT
206     5 0      013190         05  VOL-XX;          PICTURE X(1).                  BIB-UPDT
207     5 1      013200     03  PAGE;                PICTURE 9(4).                  BIB-UPDT
208     5 5      013210     03  FILLER;              PICTURE X(1).                  BIB-UPDT
209     6 0      013220     03  REFERENCE-NUMBER.                                   BIB-UPDT
210     6 0      013230         05  REFER-YR;        PICTURE 9(2).                  BIB-UPDT
211     6 2      013240         05  REFER-NO;        PICTURE 9(4).                  BIB-UPDT
212     7 0      013250     03  FILLER;              PICTURE X(1).                  BIB-UPDT
213     7 1      013260     03  SUBJECT-CATEGORY.                                   BIB-UPDT
214     7 1      013270         05  BROAD-CATE;      PICTURE X(3).                  BIB-UPDT
215     7 4      013280         05  SPEC-CATE;       PICTURE X(1).                  BIB-UPDT
216     7 5      013290     03  PROPERTIES.                                         BIB-UPDT
217     7 5      013300         05  PROP-CODE;       OCCURS  6 TIMES.               BIB-UPDT
218     7 5      013310             07  1ST-POST;    PICTURE X(1).                  BIB-UPDT
219     8 0      013320             07  2ND-POST;    PICTURE X(1).                  BIB-UPDT
220     9 5      013330     03  CARD-COUNT-NUMBER;    PICTURE X(1).                BIB-UPDT
221    10 0      013340     03  ALLOY-ELEMENTS.                                     BIB-UPDT
222    10 0      013350         05  GROUP-CODE;      OCCURS  4 TIMES.               BIB-UPDT
223    10 0      013360             07  ALLOY-ID;    PICTURE X(2).                  BIB-UPDT
224    11 2      013370     03  ELEMENT-STUDIED;      PICTURE X(1).                BIB-UPDT
225    11 3      013380     03  COMPOSITION-RANGE.                                  BIB-UPDT
226    11 3      013390         05  LO-COMP;         PICTURE X(2).                  BIB-UPDT
227    11 5      013400         05  HI-COMP;         PICTURE X(3).                  BIB-UPDT
228    12 2      013410     03  TEMPERTURE-RANGE.                                   BIB-UPDT
229    12 2      013420         05  LO-TEMP;         PICTURE X(3).                  BIB-UPDT
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230    12 5    013430          05  HI-TEMP;          PICTURE X(3).                BIB-UPDT
231    13 2    013440      03  FILLER;               PICTURE X(4).                BIB-UPDT
232            014000 FD   MASTER-HOLD;                                            BIB-UPDT
233            014010      FILE CONTAINS ABOUT 20000 RECORDS;                      BIB-UPDT
234            014020      BLOCK CONTAINS 10 RECORDS;                              BIB-UPDT
235            014030      RECORD CONTAINS 84 CHARACTERS;                          BIB-UPDT
236            014040      LABEL RECORD IS OMITTED;                                BIB-UPDT
237            014050      DATA RECORD IS HOLD-REC.                                BIB-UPDT
238            014100 01   HOLD-REC; SIZE IS 84; CLASS IS ALPHANUMERIC.            BIB-UPDT
239            014110      03  AUTHORS-NAME.                                       BIB-UPDT
240            014120          05  LAST-NAME;           PICTURE X(9).             BIB-UPDT
241     1 3    014130          05  1ST-INITIAL;         PICTURE X(1).             BIB-UPDT
242     1 4    014140      03  NO-OF-AUTHORS;           PICTURE 9(1).             BIB-UPDT
243     1 5    014150      03  FILLER;                  PICTURE X(1).             BIB-UPDT
244     2 0    014160      03  JOURNAL-NAME;            PICTURE X(15).            BIB-UPDT
245     4 3    014170      03  VOLUME.                                             BIB-UPDT
246     4 3    014180          05  VOL-NO;              PICTURE 9(3).             BIB-UPDT
247     5 0    014190          05  VOL-XX;              PICTURE X(1).             BIB-UPDT
248     5 1    014200      03  PAGE;                    PICTURE 9(4).             BIB-UPDT
249     5 5    014210      03  FILLER;                  PICTURE X(1).             BIB-UPDT
250     6 0    014220      03  REFERENCE-NUMBER.                                   BIB-UPDT
251     6 0    014230          05  REFER-YR;            PICTURE 9(2).             BIB-UPDT
252     6 2    014240          05  REFER-NO;            PICTURE 9(4).             BIB-UPDT
253     7 0    014250      03  FILLER;                  PICTURE X(1).             BIB-UPDT
254     7 1    014260      03  SUBJECT-CATEGORY.                                   BIB-UPDT
255     7 1    014270          05  BROAD-CATE;          PICTURE X(3).             BIB-UPDT
256     7 4    014280          05  SPEC-CATE;           PICTURE X(1).             BIB-UPDT
257     7 5    014290      03  PROPERTIES.                                         BIB-UPDT
258     7 5    014300          05  PROP-CODE;           OCCURS  6 TIMES.          BIB-UPDT
259     7 5    014310              07  1ST-POST;        PICTURE X(1).             BIB-UPDT
260     8 0    014320              07  2ND-POST;        PICTURE X(1).             BIB-UPDT
261     9 5    014330      03  CARD-COUNT-NUMBER;       PICTURE X(1).             BIB-UPDT
262    10 0    014340      03  ALLOY-ELEMENTS.                                     BIB-UPDT
263    10 0    014350          05  GROUP-CODE;          OCCURS  4 TIMES.          BIB-UPDT
264    10 0    014360              07  ALLOY-ID;        PICTURE X(2).             BIB-UPDT
265    11 2    014370      03  ELEMENT-STUDIED;         PICTURE X(1).             BIB-UPDT
266    11 3    014380      03  COMPOSITION-RANGE.                                  BIB-UPDT
267    11 3    014390          05  LO-COMP;             PICTURE X(2).             BIB-UPDT
268    11 5    014400          05  HI-COMP;             PICTURE X(3).             BIB-UPDT
269    12 2    014410      03  TEMPERTURE-RANGE.                                   BIB-UPDT
270    12 2    014420          05  LO-TEMP;             PICTURE X(3).             BIB-UPDT
271    12 5    014430          05  HI-TEMP;             PICTURE X(3).             BIB-UPDT
272    13 2    014440      03  FILLER;                  PICTURE X(4).             BIB-UPDT
273            015000 SD   DRUM-SORT;                                              BIB-UPDT
274            015010      FILE CONTAINS ABOUT  2000 RECORDS                       BIB-UPDT
275            015050      DATA RECORD IS DRUM-REC.                                BIB-UPDT
276            015100 01   DRUM-REC; SIZE IS 84; CLASS IS ALPHANUMERIC.            BIB-UPDT
277            015110      03  AUTHORS-NAME.                                       BIB-UPDT
278            015120          05  LAST-NAME;           PICTURE X(9).             BIB-UPDT
279     1 3    015130          05  1ST-INITIAL;         PICTURE X(1).             BIB-UPDT
280     1 4    015140      03  NO-OF-AUTHORS;           PICTURE 9(1).             BIB-UPDT
281     1 5    015150      03  CHANGE-CODE;             PICTURE X(1).             BIB-UPDT
282     2 0    015160      03  JOURNAL-NAME;            PICTURE X(15).            BIB-UPDT
283     4 3    015170      03  VOLUME.                                             BIB-UPDT
284     4 3    015180          05  VOL-NO;              PICTURE 9(3).             BIB-UPDT
285     5 0    015190          05  VOL-XX;              PICTURE X(1).             BIB-UPDT
286     5 1    015200      03  PAGE;                    PICTURE 9(4).             BIB-UPDT
287     5 5    015210      03  FILLER;                  PICTURE X(1).             BIB-UPDT
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288     6 0     015220      03  REFERENCE-NUMBER.                                   BIB-UPDT
289     6 0     015230          05  REFER-YR;          PICTURE 9(2).               BIB-UPDT
290     6 2     015240          05  REFER-NO;          PICTURE 9(4).               BIB-UPDT
291     7 0     015250      03  FILLER;                PICTURE X(1).               BIB-UPDT
292     7 1     015260      03  SUBJECT-CATEGORY.                                   BIB-UPDT
293     7 1     015270          05  BROAD-CATE;        PICTURE X(3).               BIB-UPDT
294     7 4     015280          05  SPEC-CATE;         PICTURE X(1).               BIB-UPDT
295     7 5     015290      03  PROPERTIES.                                         BIB-UPDT
296     7 5     015300          05  PROP-CODE;         OCCURS  6 TIMES.            BIB-UPDT
297     7 5     015310              07  1ST-POST;      PICTURE X(1).               BIB-UPDT
298     8 0     015320              07  2ND-POST;      PICTURE X(1).               BIB-UPDT
299     9 5     015330      03  CARD-COUNT-NUMBER;     PICTURE X(1).               BIB-UPDT
300    10 0     015340      03  ALLOY-ELEMENTS.                                     BIB-UPDT
301    10 0     015350          05  GROUP-CODE;        OCCURS  4 TIMES.            BIB-UPDT
302    10 0     015360              07  ALLOY-ID;      PICTURE X(2).               BIB-UPDT
303    11 2     015370      03  ELEMENT-STUDIED;       PICTURE X(1).               BIB-UPDT
304    11 3     015380      03  COMPOSITION-RANGE.                                  BIB-UPDT
305    11 3     015390          05  LO-COMP;           PICTURE X(2).               BIB-UPDT
306    11 5     015400          05  HI-COMP;           PICTURE X(3).               BIB-UPDT
307    12 2     015410      03  TEMPERTURE-RANGE.                                   BIB-UPDT
308    12 2     015420          05  LO-TEMP;           PICTURE X(3).               BIB-UPDT
309    12 5     015430          05  HI-TEMP;           PICTURE X(3).               BIB-UPDT
310    13 2     015440      03  FILLER;                PICTURE X(4).               BIB-UPDT
311              016000 FD  CARD-OUT;                                                BIB-UPDT
312              016010     RECORD CONTAINS 80 CHARACTERS;                           BIB-UPDT
313              016020     LABEL RECORD IS OMITTED;                                 BIB-UPDT
314              016030     DATA RECORD IS PUNX-REC.                                 BIB-UPDT
315              016100 01  PUNX-REC; SIZE IS 80; CLASS IS ALPHANUMERIC.            BIB-UPDT
316              016110     03  AUTHORS-NAME.                                       BIB-UPDT
317              016120         05  LAST-NAME;         PICTURE X(9).               BIB-UPDT
318     1 3      016130         05  1ST-INITIAL;       PICTURE X(1).               BIB-UPDT
319     1 4      016140     03  NO-OF-AUTHORS;         PICTURE 9(1).               BIB-UPDT
320     1 5      016150     03  CHANGE-CODE;           PICTURE X(1).               BIB-UPDT
321     2 0      016160     03  JOURNAL-NAME;          PICTURE X(15).              BIB-UPDT
322     4 3      016170     03  VOLUME.                                             BIB-UPDT
323     4 3      016180         05  VOL-NO;            PICTURE Z(3).               BIB-UPDT
324     5 0      016190         05  VOL-XX;            PICTURE X(1).               BIB-UPDT
325     5 1      016200     03  PAGE;                  PICTURE Z(4).               BIB-UPDT
326     5 5      016210     03  FILLER;                PICTURE X(1).               BIB-UPDT
327     6 0      016220     03  REFERENCE-NUMBER.                                   BIB-UPDT
328     6 0      016230         05  REFER-YR;          PICTURE 9(2).               BIB-UPDT
329     6 2      016240         05  REFER-NO;          PICTURE 9(4).               BIB-UPDT
330     7 0      016250     03  FILLER;                PICTURE X(1).               BIB-UPDT
331     7 1      016260     03  SUBJECT-CATEGORY.                                   BIB-UPDT
332     7 1      016270         05  BROAD-CATE;        PICTURE X(3).               BIB-UPDT
333     7 4      016280         05  SPEC-CATE;         PICTURE X(1).               BIB-UPDT
334     7 5      016290     03  PROPERTIES.                                         BIB-UPDT
335     7 5      016300         05  PROP-CODE;         OCCURS  6 TIMES.            BIB-UPDT
336     7 5      016310             07  1ST-POST;      PICTURE X(1).               BIB-UPDT
337     8 0      016320             07  2ND-POST;      PICTURE X(1).               BIB-UPDT
338     9 5      016330     03  CARD-COUNT-NUMBER;     PICTURE X(1).               BIB-UPDT
339    10 0      016340     03  ALLOY-ELEMENTS.                                     BIB-UPDT
340    10 0      016350         05  GROUP-CODE;        OCCURS  4 TIMES.            BIB-UPDT
341    10 0      016360             07  ALLOY-ID;      PICTURE X(2).               BIB-UPDT
342    11 2      016370     03  ELEMENT-STUDIED        PICTURE X(1).               BIB-UPDT
343    11 3      016380     03  COMPOSITION-RANGE.                                  BIB-UPDT
344    11 3      016390         05  LO-COMP;           PICTURE X(2).               BIB-UPDT
345    11 5      016400         05  HI-COMP;           PICTURE X(3).               BIB-UPDT
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346    12 2    016410      03  TEMPERTURE-RANGE.                                                    BIB-UPDT
347    12 2    016420          05  LO-TEMP;          PICTURE X(3).                                  BIB-UPDT
348    12 5    016430          05  HI-COMP;          PICTURE X(3).                                  BIB-UPDT
349            017000 FD   PRINT-OUT;                                                               BIB-UPDT
350            017010      RECORD CONTAINS 132 CHARACTERS;                                          BIB-UPDT
351            017020      LABEL RECORD IS OMITTED;                                                 BIB-UPDT
352            017030      VALUE OF LINES-PER-PAGE IS 58,                                           BIB-UPDT
353            017040      LINES-AT-TOP IS 4,                                                       BIB-UPDT
354            017050      LINES-AT-BOTTOM IS 4,                                                    BIB-UPDT
355            017060      LINE-SPACING IS 1;                                                       BIB-UPDT
356            017070      DATA RECORD IS PRINT-REC.                                                BIB-UPDT
357            017100 01   PRINT-REC; SIZE IS 132; CLASS IS ALPHANUMERIC.                           BIB-UPDT
358            017110      03  AUTHORS-NAME.                                                       BIB-UPDT
359            017120          05  LAST-NAME;        PICTURE X(9).                                  BIB-UPDT
360     1 3    017125          05  FILLER;           PICTURE X(1).                                  BIB-UPDT
361     1 4    017130          05  1ST-INITIAL;      PICTURE X(1).                                  BIB-UPDT
362     1 5    017135      03  FILLER;               PICTURE X(4).                                  BIB-UPDT
363     2 3    017140      03  NO-OF-AUTHORS;        PICTURE 9(1).                                  BIB-UPDT
364     2 3    017145      03  NOAUTHORS-REDEF REDEFINES NO-OF-AUTHORS;   PICTURE X(1).           BIB-UPDT
365     2 4    017145      03  FILLER;               PICTURE X(3).                                  BIB-UPDT
366     3 1    017160      03  JOURNAL-NAME;         PICTURE X(15).                                 BIB-UPDT
367     5 4    017165      03  FILLER;               PICTURE X(2).                                  BIB-UPDT
368     6 0    017170      03  VOLUME.                                                              BIB-UPDT
369     6 0    017180          05  VOL-NO;           PICTURE Z(3).                                  BIB-UPDT
370     6 3    017190          05  VOL-XX;           PICTURE X(1).                                  BIB-UPDT
371     6 4    017195      03  FILLER;               PICTURE X(2).                                  BIB-UPDT
372     7 0    017200      03  PAGE;                 PICTURE Z(4).                                  BIB-UPDT
373     7 4    017210      03  FILLER;               PICTURE X(2).                                  BIB-UPDT
374     8 0    017220      03  REFERENCE-NUMBER.                                                   BIB-UPDT
375     8 0    017225          05  REFER-CENT;       PICTURE Z(2).                                  BIB-UPDT
376     8 2    017230          05  REFER-YR;         PICTURE Z(2).                                  BIB-UPDT
377     8 4    017235          05  FILLER;           PICTURE X(2).                                  BIB-UPDT
378     9 0    017240          05  YEAR-REFER;       PICTURE 9(2).                                  BIB-UPDT
379     9 2    017245          05  REFER-NO;         PICTURE 9(4).                                  BIB-UPDT
380    10 0    017250      03  FILLER;               PICTURE X(3).                                  BIB-UPDT
381    10 3    017260      03  SUBJECT-CATEGORY.                                                   BIB-UPDT
382    10 3    017270          05  BROAD-CATE;       PICTURE X(3).                                  BIB-UPDT
383    11 0    017275          05  FILLER;           PICTURE X(1).                                  BIB-UPDT
384    11 1    017280          05  SPEC-CATE;        PICTURE X(1).                                  BIB-UPDT
385    11 2    017285      03  FILLER;               PICTURE X(3).                                  BIB-UPDT
386    11 5    017290      03  PROPERTIES.                                                         BIB-UPDT
387    11 5    017300          05  PROP-CODE;        OCCURS  6 TIMES.                               BIB-UPDT
388    11 5    017310              07  1ST-POST;     PICTURE X(1).                                  BIB-UPDT
389    12 0    017320              07  2ND-POST;     PICTURE X(1).                                  BIB-UPDT
390    12 1    017323              07  FILLER;       PICTURE X(1).                                  BIB-UPDT
391    14 5    017325      03  FILLER;               PICTURE X(2).                                  BIB-UPDT
392    15 1    017330      03  CARD-COUNT-NUMBER;    PICTURE X(1).                                  BIB-UPDT
393    15 1    017333      03  CRDCNT-REDEF REDEFINES CARD-COUNT-NUMBER;  PICTURE Z(1).            BIB-UPDT
394    15 2    017335      03  FILLER;               PICTURE X(2).                                  BIB-UPDT
395    15 4    017340      03  ALLOY-ELEMENTS.                                                     BIB-UPDT
396    15 4    017350          05  GROUP-CODE;       OCCURS  4 TIMES.                               BIB-UPDT
397    15 4    017360              07  ALLOY-ID;     PICTURE X(2).                                  BIB-UPDT
398    16 0    017363              07  FILLER;       PICTURE X(1).                                  BIB-UPDT
399    17 4    017365      03  FILLER;               PICTURE X(1).                                  BIB-UPDT
400    17 5    017370      03  ELEMENT-STUDIED;      PICTURE X(1).                                  BIB-UPDT
401    18 0    017375      03  FILLER;               PICTURE X(4).                                  BIB-UPDT
402    18 4    017380      03  COMPOSITION-RANGE.                                                  BIB-UPDT
403    18 4    017390          05  LO-COMP;          PICTURE X(2).                                  BIB-UPDT
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404     18 4    017393          05  LOCOMP-REDEF REDEFINES LO-COMP;         PICTURE Z9.   BIB-UPDT
405     19 0    017395          05  FILLER;             PICTURE X(1).                     BIB-UPDT
406     19 1    017400          05  HI-COMP;            PICTURE X(3).                     BIB-UPDT
407     19 1    017403          05  HICOMP-REDEF REDEFINES HI-COMP;         PICTURE ZZ9.  BIB-UPDT
408     19 4    017405      03  FILLER;                 PICTURE X(2).                     BIB-UPDT
409     20 0    017410      03  TEMPERTURE-RANGE.                                        BIB-UPDT
410     20 0    017420          05  LO-TEMP;            PICTURE X(3).                     BIB-UPDT
411     20 0    017423          05  LOTEMP-REDEF REDEFINES LO-TEMP;         PICTURE ZZ9.  BIB-UPDT
412     20 3    017425          05  FILLER;             PICTURE X(1).                     BIB-UPDT
413     20 4    017430          05  HI-TEMP;            PICTURE X(3).                     BIB-UPDT
414     20 4    017433          05  HITEMP-REDEF REDEFINES HI-TEMP;         PICTURE ZZ9.  BIB-UPDT
415     21 1    017440      03  FILLER;                 PICTURE X(1).                     BIB-UPDT
416     21 2    017450      03  TRANS-MESS              PICTURE X(2).                     BIB-UPDT
417     21 4    017460      03  FILLER;                 PICTURE X(1).                     BIB-UPDT
418     21 5    017470      03  CHANGE-CODE             PICTURE X(1).                     BIB-UPDT
419             018000 SD   TAPE-SORT;                                                   BIB-UPDT
420             018010      FILE CONTAINS ABOUT 50000 RECORDS                           BIB-UPDT
421             018050      DATA RECORD IS SORT-REC.                                    BIB-UPDT
422             018100 01   SORT-REC; SIZE IS 84; CLASS IS ALPHANUMERIC.                BIB-UPDT
423             018110      03  AUTHORS-NAME.                                          BIB-UPDT
424             018120          05  LAST-NAME;          PICTURE X(9).                  BIB-UPDT
425      1 3    018130          05  1ST-INITIAL;        PICTURE X(1).                  BIB-UPDT
426      1 4    018140      03  NO-OF-AUTHORS;          PICTURE 9(1).                  BIB-UPDT
427      1 5    018150      03  CHANGE-CODE;            PICTURE X(1).                  BIB-UPDT
428      2 0    018160      03  JOURNAL-NAME;           PICTURE X(15).                 BIB-UPDT
429      4 3    018170      03  VOLUME.                                                BIB-UPDT
430      4 3    018180          05  VOL-NO;             PICTURE 9(3).                  BIB-UPDT
431      5 0    018190          05  VOL-XX;             PICTURE X(1).                  BIB-UPDT
432      5 1    018200      03  PAGE;                   PICTURE 9(4).                  BIB-UPDT
433      5 5    018210      03  FILLER;                 PICTURE X(1).                  BIB-UPDT
434      6 0    018220      03  REFERENCE-NUMBER.                                      BIB-UPDT
435      6 0    018230          05  REFER-YR;           PICTURE 9(2).                  BIB-UPDT
436      6 2    018240          05  REFER-NO;           PICTURE 9(4).                  BIB-UPDT
437      7 0    018250      03  FILLER;                 PICTURE X(1).                  BIB-UPDT
438      7 1    018260      03  SUBJECT-CATEGORY.                                      BIB-UPDT
439      7 1    018270          05  BROAD-CATE;         PICTURE X(3).                  BIB-UPDT
440      7 4    018280          05  SPEC-CATE;          PICTURE X(1).                  BIB-UPDT
441      7 5    018290      03  PROPERTIES.                                            BIB-UPDT
442      7 5    018300          05  PROP-CODE;          OCCURS  6 TIMES.               BIB-UPDT
443      7 5    018310              07  1ST-POST;       PICTURE X(1).                  BIB-UPDT
444      8 0    018320              07  2ND-POST;       PICTURE X(1).                  BIB-UPDT
445      9 5    018330      03  CARD-COUNT-NUMBER;      PICTURE X(1).                  BIB-UPDT
446     10 0    018340      03  ALLOY-ELEMENTS.                                        BIB-UPDT
447     10 0    018350          05  GROUP-CODE;         OCCURS  4 TIMES.               BIB-UPDT
448     10 0    018360              07  ALLOY-ID;       PICTURE X(2).                  BIB-UPDT
449     11 2    018370      03  ELEMENT-STUDIED;        PICTURE X(1).                  BIB-UPDT
450     11 3    018380      03  COMPOSITION-RANGE.                                     BIB-UPDT
451     11 3    018390          05  LO-COMP;            PICTURE X(2).                  BIB-UPDT
452     11 5    018400          05  HI-COMP;            PICTURE X(3).                  BIB-UPDT
453     12 2    018410      03  TEMPERTURE-RANGE.                                      BIB-UPDT
454     12 2    018420          05  LO-TEMP;            PICTURE X(3).                  BIB-UPDT
455     12 5    018430          05  HI-TEMP;            PICTURE X(3).                  BIB-UPDT
456     13 2    018440      03  FILLER;                 PICTURE X(4).                  BIB-UPDT
457             019000 FD   REPORT-STORE;                                               BIB-UPDT
458             019010      FILE CONTAINS ABOUT 50000 RECORDS;                          BIB-UPDT
459             019020      BLOCK CONTAINS 10 RECORDS;                                  BIB-UPDT
460             019030      RECORD CONTAINS 84 CHARACTERS;                              BIB-UPDT
461             019040      LABEL RECORD IS OMITTED;                                    BIB-UPDT
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462                 019050     DATA RECORD IS STORE-REC.                                    BIB-UPDT
463                 019100 01  STORE-REC; SIZE IS 84; CLASS IS ALPHANUMERIC.                BIB-UPDT
464                 019110     03  AUTHORS-NAME.                                            BIB-UPDT
465                 019120         05  LAST-NAME;        PICTURE X(9).                     BIB-UPDT
466      1  3       019130         05  1ST-INITIAL;      PICTURE X(1).                     BIB-UPDT
467      1  4       019140     03  NO-OF-AUTHORS;        PICTURE 9(1).                     BIB-UPDT
468      1  5       019150     03  CHANGE-CODE;          PICTURE X(1).                     BIB-UPDT
469      2  0       019160     03  JOURNAL-NAME;         PICTURE X(15).                    BIB-UPDT
470      4  3       019170     03  VOLUME.                                                  BIB-UPDT
471      4  3       019180         05  VOL-NO;           PICTURE 9(3).                     BIB-UPDT
472      5  0       019190         05  VOL-XX;           PICTURE X(1).                     BIB-UPDT
473      5  1       019200     03  PAGE;                 PICTURE 9(4).                     BIB-UPDT
474      5  5       019210     03  FILLER;               PICTURE X(1).                     BIB-UPDT
475      6  0       019220     03  REFERENCE-NUMBER.                                       BIB-UPDT
476      6  0       019230         05  REFER-YR;         PICTURE 9(2).                     BIB-UPDT
477      6  2       019240         05  REFER-NO;         PICTURE 9(4).                     BIB-UPDT
478      7  0       019250     03  FILLER;               PICTURE X(1).                     BIB-UPDT
479      7  1       019260     03  SUBJECT-CATEGORY.                                       BIB-UPDT
480      7  1       019270         05  BROAD-CATE;       PICTURE X(3).                     BIB-UPDT
481      7  4       019280         05  SPEC-CATE;        PICTURE X(1).                     BIB-UPDT
482      7  5       019290     03  PROPERTIES.                                             BIB-UPDT
483      7  5       019300         05  PROP-CODE;        OCCURS  6 TIMES.                  BIB-UPDT
484      7  5       019310             07  1ST-POST;     PICTURE X(1).                     BIB-UPDT
485      8  0       019320             07  2ND-POST;     PICTURE X(1).                     BIB-UPDT
486      9  5       019330     03  CARD-COUNT-NUMBER;    PICTURE X(1).                     BIB-UPDT
487     10  0       019340     03  ALLOY-ELEMENTS.                                         BIB-UPDT
488     10  0       019350         05  GROUP-CODE;       OCCURS  4 TIMES.                  BIB-UPDT
489     10  0       019360             07  ALLOY-ID;     PICTURE X(2).                     BIB-UPDT
490     11  2       019370     03  ELEMENT-STUDIED;      PICTURE X(1).                     BIB-UPDT
491     11  3       019380     03  COMPOSITION-RANGE.                                      BIB-UPDT
492     11  3       019390         05  LO-COMP;          PICTURE X(2).                     BIB-UPDT
493     11  5       019400         05  HI-COMP;          PICTURE X(3).                     BIB-UPDT
494     12  2       019410     03  TEMPERTURE-RANGE.                                       BIB-UPDT
495     12  2       019420         05  LO-TEMP;          PICTURE X(3).                     BIB-UPDT
496     12  5       019430         05  HI-TEMP;          PICTURE X(3).                     BIB-UPDT
497     13  2       019440     03  FILLER;               PICTURE X(4).                     BIB-UPDT
498                 020000 WORKING-STORAGE SECTION.                                         BIB-UPDT
499                 020010 77  TRANS-IN-COUNT           PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
500      1  0       020020 77  MASTER-IN-COUNT          PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
501      2  0       020030 77  NO-SCOR-SWT              PICTURE 9(1)    VALUE 1.          BIB-UPDT
502      3  0       020040 77  LINE-COUNT               PICTURE 9(2)    VALUE ZEROS.      BIB-UPDT
503      4  0       020050 77  EDIT-ERR-SWT-1           PICTURE 9(1)    VALUE ZEROS.      BIB-UPDT
504      5  0       020060 77  TRANS-DUP-COUNT          PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
505      6  0       020070 77  MAST-DUP-COUNT           PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
506      7  0       020080 77  ALY-TBL-CNT              PICTURE 9(2)    VALUE 23.         BIB-UPDT
507      8  0       020090 77  LOW-ENTRY                PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
508      9  0       020100 77  HIGH-ENTRY               PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
509     10  0       020110 77  PAGE-COUNTER             PICTURE 9(4)    VALUE ZEROS.      BIB-UPDT
510     11  0       020120 77  MAST-OUT-COUNT           PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
511     12  0       020130 77  MAST-STOR-COUNT          PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
512     13  0       020140 77  TRANS-ERR-COUNT          PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
513     14  0       020150 77  NEW-MAST-COUNT           PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
514     15  0       020160 77  TRANS-PROC-COUNT         PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
515     16  0       020180 77  DEL-MAST-COUNT           PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
516     17  0       020190 77  DELETE-SWT               PICTURE 9(1)    VALUE ZERO.       BIB-UPDT
517     18  0       020200 77  NMR-SWT                  PICTURE 9(1)    VALUE ZERO.       BIB-UPDT
518     19  0       020210 77  TRANS-PUNX-COUNT         PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
519     20  0       020300 77  MIN-CNTR                 PICTURE 9(6)    VALUE ZEROS.      BIB-UPDT
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520    21 0    020310 77  INTER-CNTR  PICTURE 9(6)    USAGE COMPUTATIONAL VALUE ZEROS. BIB-UPDT
521    22 0    020320 77  EDIT-ERR-SWT-2          PICTURE 9(1)    VALUE ZERO.          BIB-UPDT
522    23 0    020330 77  PAGE-EJECT-SWT          PICTURE 9(1)    VALUE ZERO.          BIB-UPDT
523    24 0    020910 77  XR1         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE ZEROS. BIB-UPDT
524    25 0    020920 77  XR2         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE ZEROS. BIB-UPDT
525    26 0    020930 77  XR3         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE ZEROS. BIB-UPDT
526    27 0    020940 77  XR4         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE ZEROS. BIB-UPDT
527    28 0    021100 01  ERROR-REC; SIZE IS 132; CLASS IS ALPHANUMERIC.              BIB-UPDT
528    28 0    021110       03  AUTHERS-NAME.                                        BIB-UPDT
529    28 0    021120           05  LAST-NAME;       PICTURE X(9).                   BIB-UPDT
530    29 3    021125           05  FILLER;          PICTURE X(1).                   BIB-UPDT
531    29 4    021130           05  1ST-INITIAL;     PICTURE X(1).                   BIB-UPDT
532    29 5    021135       03  FILLER;              PICTURE X(4).                   BIB-UPDT
533    30 3    021140       03  NO-OF-AUTHORS;       PICTURE X(1).                   BIB-UPDT
534    30 4    021145       03  FILLER;              PICTURE X(3).                   BIB-UPDT
535    31 1    021160       03  JOURNAL-NAME;        PICTURE X(15).                  BIB-UPDT
536    33 4    021165       03  FILLER;              PICTURE X(2).                   BIB-UPDT
537    34 0    021170       03  VOLUME.                                              BIB-UPDT
538    34 0    021180           05  VOL-NO;          PICTURE X(3).                   BIB-UPDT
539    34 3    021190           05  VOL-XX;          PICTURE X(1).                   BIB-UPDT
540    34 4    021195       03  FILLER;              PICTURE X(2).                   BIB-UPDT
541    35 0    021200       03  PAGE;                PICTURE X(4).                   BIB-UPDT
542    35 4    021210       03  FILLER;              PICTURE X(2).                   BIB-UPDT
543    36 0    021220       03  REFERENCE-NUMBER.                                    BIB-UPDT
544    36 0    021225           05  REFER-CENT;      PICTURE X(2).                   BIB-UPDT
545    36 2    021230           05  REFER-YR;        PICTURE X(2).                   BIB-UPDT
546    36 4    021235           05  FILLER;          PICTURE X(2).                   BIB-UPDT
547    37 0    021237           05  YEAR-REFER;      PICTURE X(2).                   BIB-UPDT
548    37 2    021240           05  REFER-NO;        PICTURE X(4).                   BIB-UPDT
549    38 0    021250       03  FILLER;              PICTURE X(3).                   BIB-UPDT
550    38 3    021260       03  SUBJECT-CATEGORY.                                    BIB-UPDT
551    38 3    021270           05  BROAD-CATE;      PICTURE X(3).                   BIB-UPDT
552    39 0    021275           05  FILLER;          PICTURE X(1).                   BIB-UPDT
553    39 1    021280           05  SPEC-CATE;       PICTURE X(1).                   BIB-UPDT
554    39 2    021285       03  FILLER;              PICTURE X(3).                   BIB-UPDT
555    39 5    021290       03  PROPERTIES.                                          BIB-UPDT
556    39 5    021300           05  PROP-CODE;       OCCURS  6 TIMES.                BIB-UPDT
557    39 5    021310               07  1ST-POST;    PICTURE X(1).                   BIB-UPDT
558    40 0    021320               07  2ND-POST;    PICTURE X(1).                   BIB-UPDT
559    40 1    021323               07  FILLER;      PICTURE X(1).                   BIB-UPDT
560    42 5    021325       03  FILLER;              PICTURE X(2).                   BIB-UPDT
561    43 1    021330       03  CARD-COUNT-NUMBER;   PICTURE X(1).                   BIB-UPDT
562    43 2    021335       03  FILLER;              PICTURE X(2).                   BIB-UPDT
563    43 4    021340       03  ALLOY-ELEMENTS.                                      BIB-UPDT
564    43 4    021350           05  GROUP-CODE;      OCCURS  4 TIMES.                BIB-UPDT
565    43 4    021360               07  ALLOY-ID;    PICTURE X(2).                   BIB-UPDT
566    44 0    021363               07  FILLER;      PICTURE X(1).                   BIB-UPDT
567    45 4    021365       03  FILLER;              PICTURE X(1).                   BIB-UPDT
568    45 5    021370       03  ELEMENT-STUDIED;     PICTURE X(1).                   BIB-UPDT
569    46 0    021375       03  FILLER;              PICTURE X(4).                   BIB-UPDT
570    46 4    021380       03  COMPOSITION-RANGE.                                   BIB-UPDT
571    46 4    021390           05  LO-COMP;         PICTURE X(2).                   BIB-UPDT
572    47 0    021395           05  FILLER;          PICTURE X(1).                   BIB-UPDT
573    47 1    021400           05  HI-COMP;         PICTURE X(3).                   BIB-UPDT
574    47 4    021405       03  FILLER;              PICTURE X(2).                   BIB-UPDT
575    48 0    021410       03  TEMPERTURE-RANGE.                                    BIB-UPDT
576    48 0    021420           05  LO-TEMP;         PICTURE X(3).                   BIB-UPDT
577    48 3    021425           05  FILLER;          PICTURE X(1).                   BIB-UPDT
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578   48 4   021430          05  HI-TEMP;          PICTURE X(3).                          BIB-UPDT
579   49 1   021435          05  FILLER;           PICTURE X(1).                          BIB-UPDT
580   49 2   021440      03  REJT-MESS;            PICTURE X(2).                          BIB-UPDT
581   49 4   021450      03  FILLER;               PICTURE X(1).                          BIB-UPDT
582   49 5   021460      03  CHANGE-CODE;          PICTURE X(1).                          BIB-UPDT
583   50 0   022000 01  DATE-CARD; SIZE IS 80; CLASS IS ALPHANUMERIC.                      BIB-UPDT
584   50 0   022010      03  CARD-IDENT;           PICTURE X(4).                          BIB-UPDT
585   50 4   022020      03  DATE-OF-RUN.                                                 BIB-UPDT
586   50 4   022030          05  MO-RUN;           PICTURE 9(2).                          BIB-UPDT
587   51 0   022040          05  DA-RUN;           PICTURE 9(2).                          BIB-UPDT
588   51 2   022050          05  YR-RUN;           PICTURE 9(2).                          BIB-UPDT
589   51 4   022060      03  AS-OF-DATE.                                                  BIB-UPDT
590   51 4   022070          05  MO-DATE;          PICTURE 9(2).                          BIB-UPDT
591   52 0   022080          05  DA-DATE;          PICTURE 9(2).                          BIB-UPDT
592   52 2   022090          05  YR-DATE;          PICTURE 9(2).                          BIB-UPDT
593   52 4   022100      03  JULIAN-DATE.                                                 BIB-UPDT
594   52 4   022110          05  JULIAN-YEAR;      PICTURE 9(2).                          BIB-UPDT
595   53 0   022120          05  JULIAN-DAY;       PICTURE 9(3).                          BIB-UPDT
596   53 3   022130      03  SPECIAL-OPTIONS;      PICTURE X(3).                          BIB-UPDT
597   54 0   022140      03  PROGRAM-SWITCHES.                                            BIB-UPDT
598   54 0   022150          05  SWT-1;            PICTURE X(1).                          BIB-UPDT
599   54 1   022160          05  SWT-2;            PICTURE X(1).                          BIB-UPDT
600   54 2   022170          05  SWT-3;            PICTURE X(1).                          BIB-UPDT
601   54 3   022180          05  SWT-4;            PICTURE X(1).                          BIB-UPDT
602   54 4   022190          05  SWT-5;            PICTURE X(1).                          BIB-UPDT
603   54 5   022200          05  SWT-6;            PICTURE X(1).                          BIB-UPDT
604   55 0   022203          05  SWT-7;            PICTURE X(1).                          BIB-UPDT
605   55 1   022205          05  SWT-8;            PICTURE X(1).                          BIB-UPDT
606   55 2   022210      03  SWITCH-MESSAGES.                                             BIB-UPDT
607   55 2   022220          05  MESSAGE-1;        PICTURE X(12).                         BIB-UPDT
608   57 2   022230          05  MESSAGE-2;        PICTURE X(12).                         BIB-UPDT
609   59 2   022240          05  MESSAGE-3;        PICTURE X(12).                         BIB-UPDT
610   61 2   022250          05  MESSAGE-4;        PICTURE X(12).                         BIB-UPDT
611   64 0   023000 01  HED-1   SIZE IS 132.                                            BIB-UPDT
612   64 0   023010      03  FILLER      PICTURE X(9)    VALUE 'RUN DATE '.             BIB-UPDT
613   65 3   023020      03  HED-MO      PICTURE 9(2)    VALUE ZEROS.                   BIB-UPDT
614   65 5   023030      03  FILLER      PICTURE X(1)    VALUE '-'.                     BIB-UPDT
615   66 0   023040      03  HED-DA      PICTURE 9(2)    VALUE ZEROS.                   BIB-UPDT
616   66 2   023050      03  FILLER      PICTURE X(1)    VALUE '-'.                     BIB-UPDT
617   66 3   023060      03  HED-YR      PICTURE 9(2)    VALUE ZEROS.                   BIB-UPDT
618   66 5   023070      03  FILLER      PICTURE X(20)   VALUE SPACES.                  BIB-UPDT
619   70 1   023080      03  FILLER      PICTURE X(19)   VALUE 'N A T I O N A L    '.  BIB-UPDT
620   73 2   023090      03  FILLER      PICTURE X(20)   VALUE 'B U R E A U   O F   '.BIB-UPDT
621   76 4   023100      03  FILLER      PICTURE X(17)   VALUE 'S T A N D A R D S'.    BIB-UPDT
622   79 3   023110      03  FILLER      PICTURE X(26)   VALUE SPACES.                  BIB-UPDT
623   83 5   023120      03  FILLER      PICTURE X(9)    VALUE 'PAGE NO. '.             BIB-UPDT
624   85 2   023130      03  PAGE-NO     PICTURE Z(4)    VALUE SPACES.                  BIB-UPDT
625   86 0   023200 01  HED-2   SIZE IS 132.                                            BIB-UPDT
626   86 0   023210      03  FILLER  PICTURE X(39)   VALUE SPACES.                      BIB-UPDT
627   92 3   023220      03  FILLER  PICTURE X(15)   VALUE 'A L L O Y      '.          BIB-UPDT
628   95 0   023230      03  FILLER  PICTURE X(13)   VALUE 'D A T A      '.           BIB-UPDT
629   97 1   023240      03  FILLER  PICTURE X(23)   VALUE 'B I B L I O G R A P H Y'. BIB-UPDT
630  101 0   023250      03  FILLER  PICTURE X(42)   VALUE SPACES.                      BIB-UPDT
631  108 0   023300 01  HED-3   SIZE IS 132.                                            BIB-UPDT
632  108 0   023310      03  FILLER  PICTURE X(37)   VALUE SPACES.                      BIB-UPDT
633  114 1   023320      03  FILLER  PICTURE X(14)   VALUE '==============='.         BIB-UPDT
634  116 3   023330      03  FILLER  PICTURE X(14)   VALUE '==============='.         BIB-UPDT
635  118 5   023340      03  FILLER  PICTURE X(14)   VALUE '==============='.         BIB-UPDT
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636   121 1    023350      03  FILLER  PICTURE X(14)   VALUE '==============='.          BIB-UPDT
637   123 3    023360      03  FILLER  PICTURE X(39)   VALUE SPACES.                      BIB-UPDT
638   130 0    023400 01   HED-4       PICTURE X(132)  VALUE SPACES.                      BIB-UPDT
639   152 0    023500 01   UPDATE-PRINTOUT     SIZE IS 132.                             BIB-UPDT
640   152 0    023510      03  FILLER  PICTURE X(38)   VALUE SPACES.                      BIB-UPDT
641   156 2    023520      03  FILLER  PICTURE X(24)   VALUE '* * * * TRANSACTION EDIT'.BIB-UPDT
642   162 2    023530      03  FILLER  PICTURE X(24)   VALUE ' AND MASTER FILE UPDATE '.BIB-UPDT
643   166 2    023540      03  FILLER  PICTURE X(7)    VALUE '* * * *'.                   BIB-UPDT
644   167 3    023550      03  FILLER  PICTURE X(39)   VALUE SPACES.                      BIB-UPDT
645   174 0    023600 01   AUTHOR-PRINTOUT     SIZE IS 132.                             BIB-UPDT
646   174 0    023610      03  FILLER  PICTURE X(44)   VALUE SPACES.                      BIB-UPDT
647   181 2    023620      03  FILLER  PICTURE X(24)   VALUE '* * * *  A U T H O R    '.BIB-UPDT
648   185 2    023630      03  FILLER  PICTURE X(18)   VALUE 'I N D E X  * * * *'.        BIB-UPDT
649   188 2    023650      03  FILLER  PICTURE X(46)   VALUE SPACES.                      BIB-UPDT
650   196 0    023700 01   NMR-AUTHOR-PRINTOUT         SIZE IS 132.                     BIB-UPDT
651   196 0    023710      03  FILLER  PICTURE X(33)   VALUE SPACES.                      BIB-UPDT
652   201 3    023720      03  FILLER  PICTURE X(22)   VALUE '* * * AUTHOR INDEX OF '.   BIB-UPDT
653   205 1    023730      03  FILLER  PICTURE X(18)   VALUE 'NUCLEAR AND OTHER '.        BIB-UPDT
654   208 1    023735      03  FILLER  PICTURE X(10)   VALUE 'RESONANCE '.                BIB-UPDT
655   209 5    023740      03  FILLER  PICTURE X(16)   VALUE 'PROPERTIES * * *'.          BIB-UPDT
656   212 3    023750      03  FILLER  PICTURE X(33)   VALUE SPACES.                      BIB-UPDT
657   218 0    023800 01   REFER-NO-PRINTOUT   SIZE IS 132.                            BIB-UPDT
658   218 0    023810      03  FILLER  PICTURE X(38)   VALUE SPACES.                      BIB-UPDT
659   224 2    023820      03  FILLER  PICTURE X(24)   VALUE '* *  R E F E R E N C E  '.BIB-UPDT
660   228 2    023830      03  FILLER  PICTURE X(17)   VALUE '  N U M B E R    '.       BIB-UPDT
661   231 1    023840      03  FILLER  PICTURE X(14)   VALUE 'I N D E X  * *'.            BIB-UPDT
662   233 3    023850      03  FILLER  PICTURE X(39)   VALUE SPACES.                      BIB-UPDT
663   240 0    023900 01   ALLOY-PRINTOUT      SIZE IS 132.                             BIB-UPDT
664   240 0    023910      03  FILLER  PICTURE X(33)   VALUE SPACES.                      BIB-UPDT
665   245 3    023915      03  FILLER  PICTURE X(5)    VALUE '* *  '.                     BIB-UPDT
666   246 2    023920      03  FILLER  PICTURE X(24)   VALUE 'A L P H A B E T I C A L '.BIB-UPDT
667   250 2    023930      03  FILLER  PICTURE X(22)   VALUE '   M A T E R I A L    '.  BIB-UPDT
668   254 0    023940      03  FILLER  PICTURE X(14)   VALUE 'I N D E X  * *'.            BIB-UPDT
669   256 2    023950      03  FILLER  PICTURE X(34)   VALUE SPACES.                      BIB-UPDT
670   262 0    024000 01   COL-1   SIZE IS 132.                                         BIB-UPDT
671   262 0    024010      03  FILLER  PICTURE X(3)    VALUE SPACES.                      BIB-UPDT
672   262 3    024020      03  FILLER  PICTURE X(9)    VALUE 'FIRST    '.                 BIB-UPDT
673   264 0    024030      03  FILLER  PICTURE X(5)    VALUE 'NO OF'.                     BIB-UPDT
674   264 5    024040      03  FILLER  PICTURE X(37)   VALUE SPACES.                      BIB-UPDT
675   271 0    024050      03  FILLER  PICTURE X(6)    VALUE 'REFER.'.                    BIB-UPDT
676   272 0    024060      03  FILLER  PICTURE X(29)   VALUE SPACES.                      BIB-UPDT
677   276 5    024070      03  FILLER  PICTURE X(17)   VALUE 'CARD             '.        BIB-UPDT
678   279 4    024080      03  FILLER  PICTURE X(7)    VALUE 'ELE    '.                   BIB-UPDT
679   280 5    024090      03  FILLER  PICTURE X(9)    VALUE 'COMP.    '.                 BIB-UPDT
680   282 2    024100      03  FILLER  PICTURE X(6)    VALUE 'TEMP. '.                    BIB-UPDT
681   283 2    024110      03  FILLER  PICTURE X(4)    VALUE 'CHAN'.                      BIB-UPDT
682   284 0    024200 01   COL-2   SIZE IS 132.                                         BIB-UPDT
683   284 0    024210      03  FILLER  PICTURE X(2)    VALUE SPACES.                      BIB-UPDT
684   284 2    024220      03  FILLER  PICTURE X(9)    VALUE 'AUTHOR   '.                 BIB-UPDT
685   285 5    024230      03  FILLER  PICTURE X(9)    VALUE 'AUTHORS  '.                 BIB-UPDT
686   287 2    024240      03  FILLER  PICTURE X(16)   VALUE 'JOURNAL NAME    '.        BIB-UPDT
687   290 0    024250      03  FILLER  PICTURE X(6)    VALUE 'VOL.  '.                    BIB-UPDT
688   291 0    024260      03  FILLER  PICTURE X(6)    VALUE 'PAGE  '.                    BIB-UPDT
689   292 0    024270      03  FILLER  PICTURE X(14)   VALUE 'YEAR  NUMBER  '.           BIB-UPDT
690   294 2    024280      03  FILLER  PICTURE X(12)   VALUE 'SUBJECT     '.             BIB-UPDT
691   296 2    024290      03  FILLER  PICTURE X(16)   VALUE 'PROPERTIES      '.         BIB-UPDT
692   299 0    024300      03  FILLER  PICTURE X(7)    VALUE 'NO.    '.                   BIB-UPDT
693   300 1    024305      03  FILLER  PICTURE X(9)    VALUE 'ALLOY    '.                 BIB-UPDT
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694   301 4    024310      03  FILLER  PICTURE X(6)     VALUE 'STY   '.                  BIB-UPDT
695   302 4    024320      03  FILLER  PICTURE X(9)     VALUE 'LO  HI   '.               BIB-UPDT
696   304 1    024330      03  FILLER  PICTURE X(7)     VALUE 'LO  HI '.                 BIB-UPDT
697   305 2    024340      03  FILLER  PICTURE X(4)     VALUE 'CODE'.                    BIB-UPDT
698   306 0    024400 01   COL-3   SIZE IS 132.                                          BIB-UPDT
699   306 0    024410      03  FILLER  PICTURE X(13)    VALUE '----------  '.           BIB-UPDT
700   308 1    024420      03  FILLER  PICTURE X(6)     VALUE '---   '.                 BIB-UPDT
701   309 1    024430      03  FILLER  PICTURE X(17)    VALUE '--------------  '.       BIB-UPDT
702   312 0    024440      03  FILLER  PICTURE X(6)     VALUE '----  '.                 BIB-UPDT
703   313 0    024450      03  FILLER  PICTURE X(6)     VALUE '----  '.                 BIB-UPDT
704   314 0    024460      03  FILLER  PICTURE X(14)    VALUE '----  ------  '.         BIB-UPDT
705   316 2    024470      03  FILLER  PICTURE X(9)     VALUE '-------  '.              BIB-UPDT
706   317 5    024480      03  FILLER  PICTURE X(18)    VALUE '----------------  '.     BIB-UPDT
707   320 5    024490      03  FILLER  PICTURE X(5)     VALUE '---- '.                   BIB-UPDT
708   321 4    024500      03  FILLER  PICTURE X(12)    VALUE '----------  '.          BIB-UPDT
709   323 4    024510      03  FILLER  PICTURE X(5)     VALUE '---  '.                  BIB-UPDT
710   324 3    024520      03  FILLER  PICTURE X(9)     VALUE '--- ---  '.               BIB-UPDT
711   326 0    024530      03  FILLER  PICTURE X(8)     VALUE '--- --- '.                BIB-UPDT
712   327 2    024540      03  FILLER  PICTURE X(4)     VALUE '----'.                    BIB-UPDT
713   328 0    025000 01   ALLOY-ELEMENT-TABLE SIZE IS 276.                             BIB-UPDT
714   328 0    025010      03  FILLER  SIZE 12 AN  VALUE   '           '.                BIB-UPDT
715   330 0    025020      03  FILLER  SIZE 12 AN  VALUE   'A==        '.                BIB-UPDT
716   332 0    025030      03  FILLER  SIZE 12 AN  VALUE   'B   ==     '.                BIB-UPDT
717   334 0    025040      03  FILLER  SIZE 12 AN  VALUE   'C      ==  '.                BIB-UPDT
718   336 0    025060      03  FILLER  SIZE 12 AN  VALUE   'D        =='.                BIB-UPDT
719   338 0    025070      03  FILLER  SIZE 12 AN  VALUE   'E== ==     '.                BIB-UPDT
720   340 0    025080      03  FILLER  SIZE 12 AN  VALUE   'F==    ==  '.                BIB-UPDT
721   342 0    025090      03  FILLER  SIZE 12 AN  VALUE   'G==       =='.                BIB-UPDT
722   344 0    025100      03  FILLER  SIZE 12 AN  VALUE   'H   == ==  '.                BIB-UPDT
723   346 0    025110      03  FILLER  SIZE 12 AN  VALUE   'I   ==    =='.                BIB-UPDT
724   348 0    025120      03  FILLER  SIZE 12 AN  VALUE   'J      == ==',                BIB-UPDT
725   350 0    025130      03  FILLER  SIZE 12 AN  VALUE   'K== == ==  '.                BIB-UPDT
726   352 0    025140      03  FILLER  SIZE 12 AN  VALUE   'L   == == ==',                BIB-UPDT
727   354 0    025150      03  FILLER  SIZE 12 AN  VALUE   'M==    == ==',                BIB-UPDT
728   356 0    025160      03  FILLER  SIZE 12 AN  VALUE   'N== ==    ==',                BIB-UPDT
729   358 0    025170      03  FILLER  SIZE 12 AN  VALUE   'O== == == ==',                BIB-UPDT
730   360 0    025300      03  FILLER  SIZE 12 AN  VALUE   '1==         '.                BIB-UPDT
731   362 0    025310      03  FILLER  SIZE 12 AN  VALUE   '2   ==     '.                BIB-UPDT
732   364 0    025320      03  FILLER  SIZE 12 AN  VALUE   '3      ==  '.                BIB-UPDT
733   366 0    025330      03  FILLER  SIZE 12 AN  VALUE   '4== ==     '.                BIB-UPDT
734   368 0    025340      03  FILLER  SIZE 12 AN  VALUE   '5   == ==  '.                BIB-UPDT
735   370 0    025350      03  FILLER  SIZE 12 AN  VALUE   '6==    ==  '.                BIB-UPDT
736   372 0    025360      03  FILLER  SIZE 12 AN  VALUE   '7== == ==  '.                BIB-UPDT
737   328 0    025400 01   UNDER-SCORE REDEFINES ALLOY-ELEMENT-TABLE.                    BIB-UPDT
738   328 0    025410      03  ALLOY-LOOKUP    OCCURS  23  TIMES.                       BIB-UPDT
739   328 0    025420          05  UND-SCOR-ARGUE          PICTURE X(1).                BIB-UPDT
740   328 1    025430          05  UND-SCOR-FUNCTION       PICTURE X(11).               BIB-UPDT
741   374 0    026000 01   CURR-CHAN-CONTROL.                                           BIB-UPDT
742   374 0    026010      03  CURRENT-READ.                                           BIB-UPDT
743   374 0    026020          05  AUTHORS-NAME;       PICTURE X(10).                   BIB-UPDT
744   375 4    026030          05  REFER-YR;           PICTURE 9(2).                    BIB-UPDT
745   376 0    026040          05  JOURNAL-NAME;       PICTURE X(15).                   BIB-UPDT
746   378 3    026050          05  VOLUME;             PICTURE X(4).                    BIB-UPDT
747   379 1    026060          05  PAGE;               PICTURE 9(4).                    BIB-UPDT
748   379 5    026070          05  REFER-NO;           PICTURE 9(4).                    BIB-UPDT
749   380 3    026080          05  ALLOY-ELEMENTS;     PICTURE X(8).                    BIB-UPDT
750   381 5    026085          05  SUBJECT-CATEGORY;   PICTURE X(4).                    BIB-UPDT
751   382 3    026090          05  CARD-COUNT-NUMBER;  PICTURE X(1).                    BIB-UPDT
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752   382 4    026100          05  COMPOSITION-RANGE;  PICTURE X(5).                    BIB-UPDT
753   383 3    026110      03  CHANGE-CODE;            PICTURE X(1).                    BIB-UPDT
754   384 0    026120 01  PREV-CHAN-CONTROL.                                            BIB-UPDT
755   384 0    026130      03  PREVIOUS-READ;          PICTURE X(57).                   BIB-UPDT
756   393 3    026140      03  CHANGE-CODE;            PICTURE X(1).                    BIB-UPDT
757   394 0    026200 01  CURR-MAST-CONTROL.                                           BIB-UPDT
758   394 0    026210      03  CURRENT-READ.                                           BIB-UPDT
759   394 0    026220          05  AUTHORS-NAME;       PICTURE X(10).                   BIB-UPDT
760   395 4    026225          05  REFER-YR;           PICTURE 9(2).                    BIB-UPDT
761   396 0    026230          05  JOURNAL-NAME;       PICTURE X(15).                   BIB-UPDT
762   398 3    026235          05  VOLUME;             PICTURE X(4).                    BIB-UPDT
763   399 1    026240          05  PAGE;               PICTURE 9(4).                    BIB-UPDT
764   399 5    026245          05  REFER-NO;           PICTURE 9(4).                    BIB-UPDT
765   400 3    026250          05  ALLOY-ELEMENTS;     PICTURE X(8).                    BIB-UPDT
766   401 5    026255          05  SUBJECT-CATEGORY;   PICTURE X(4).                    BIB-UPDT
767   402 3    026260          05  CARD-COUNT-NUMBER;  PICTURE X(1).                    BIB-UPDT
768   402 4    026270          05  COMPOSITION-RANGE;  PICTURE X(5).                    BIB-UPDT
769   404 0    026280 01  PREV-MAST-CONTROL.                                           BIB-UPDT
770   404 0    026290      03  PREVIOUS-READ;          PICTURE X(57).                   BIB-UPDT
771   414 0    027100 01  EOJ-UPDATE-SWT.                                              BIB-UPDT
772   414 0    027110      03  CHAN-IN-SWT     PICTURE 9(1)    VALUE   ZEROS.          BIB-UPDT
773   414 1    027120      03  MAST-IN-SWT     PICTURE 9(1)    VALUE   ZEROS.          BIB-UPDT
774   415 0    028100 01  PERMUTED-ALLOY-PRINTOUT         SIZE IS 132.                BIB-UPDT
775   415 0    028110      03  FILLER  PICTURE X(38)   VALUE SPACES.                   BIB-UPDT
776   421 2    028120      03  FILLER  PICTURE X(18)   VALUE '* * * *  PERMUTED '.     BIB-UPDT
777   424 2    028130      03  FILLER  PICTURE X(22)   VALUE 'ALPHABETICAL MATERIAL '. BIB-UPDT
778   428 0    028140      03  FILLER  PICTURE X(14)   VALUE 'INDEX  * * * *'.         BIB-UPDT
779   430 2    028150      03  FILLER  PICTURE X(40)   VALUE SPACES.                   BIB-UPDT
780   437 0    029100 01  NMR-PERMUTED-ALLOY-PRINTOUT     SIZE IS 132.                BIB-UPDT
781   437 0    029110      03  FILLER PICTURE X(25)    VALUE SPACES.                   BIB-UPDT
782   441 1    029120      03  FILLER PICTURE X(20)    VALUE '* *  PERMUTED ALPHA '.   BIB-UPDT
783   444 3    029130      03  FILLER PICTURE X(18)    VALUE 'MATERIAL INDEX OF '.     BIB-UPDT
784   447 3    029140      03  FILLER PICTURE X(18)    VALUE 'NUCLEAR AND OTHER '.     BIB-UPDT
785   450 3    029150      03  FILLER PICTURE X(22)    VALUE 'RESONANCE PROPERTIES  '. BIB-UPDT
786   454 1    029160      03  FILLER PICTURE X(3)     VALUE '* *'.                    BIB-UPDT
787   454 4    029170      03  FILLER PICTURE X(26)    VALUE SPACES.                   BIB-UPDT
788   459 0    029300 01  NMR-ALLOY-PRINTOUT               SIZE IS 132.                BIB-UPDT
789   459 0    029310      03  FILLER PICTURE X(29)    VALUE SPACES.                   BIB-UPDT
790   463 5    029320      03  FILLER PICTURE X(20)    VALUE '* *  ALPHA MATERIAL '.   BIB-UPDT
791   467 1    029330      03  FILLER PICTURE X(21)    VALUE 'INDEX OF NUCLEAR AND '.  BIB-UPDT
792   470 4    029340      03  FILLER PICTURE X(16)    VALUE 'OTHER RESONANCE '.       BIB-UPDT
793   473 2    029350      03  FILLER PICTURE X(15)    VALUE 'PROPERTIES  * *'.        BIB-UPDT
794   475 5    029360      03  FILLER PICTURE X(31)    VALUE SPACES.                   BIB-UPDT
795   481 0    029400 01  JOURNAL-NAME-PRINTOUT            SIZE IS 132.                BIB-UPDT
796   481 0    029410      03  FILLER  PICTURE X(40)   VALUE SPACES.                   BIB-UPDT
797   487 4    029420      03  FILLER  PICTURE X(20)   VALUE '* * *  ALPHABETICAL '.  BIB-UPDT
798   491 0    029430      03  FILLER  PICTURE X(13)   VALUE 'JOURNAL NAME '.          BIB-UPDT
799   493 1    029440      03  FILLER  PICTURE X(16)   VALUE 'REFERENCE  * * *'.       BIB-UPDT
800   495 5    029450      03  FILLER  PICTURE X(43)   VALUE SPACES.                   BIB-UPDT
801   503 0    030000 01  EOJ-MESSAGE.                                                BIB-UPDT
802   503 0    030010      03  CTRL-MESS   PICTURE X(20)   VALUE '* END OF JOB COUNTS*'.BIB-UPDT
803   506 2    030020      03  FILLER      PICTURE X(16)   VALUE SPACES.               BIB-UPDT
804   509 0    030030      03  EOJ-DATE.                                               BIB-UPDT
805   509 0    030040          05  EOJ-MO  PICTURE 9(2)    VALUE ZEROS.               BIB-UPDT
806   509 2    030050          05  FILLER  PICTURE X(1)    VALUE '-'.                 BIB-UPDT
807   509 3    030060          05  EOJ-DA  PICTURE 9(2)    VALUE ZEROS.               BIB-UPDT
808   509 5    030070          05  FILLER  PICTURE X(1)    VALUE '-'.                 BIB-UPDT
809   510 0    030080          05  EOJ-YR  PICTURE 9(2)    VALUE ZEROS.               BIB-UPDT
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 810   511 0    030110 01  EOJ-MESS-1.                                                                BIB-UPDT
 811   511 0    030120     03  FILLER  PICTURE X(24)   VALUE '*** TRANS-RCDRS-READ ***'.BIB-UPDT
 812   515 0    030130     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 813   515 5    030140     03  CNT-1   PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 814   517 0    030210 01  EOJ-MESS-2.                                                                BIB-UPDT
 815   517 0    030220     03  FILLER  PICTURE X(24)   VALUE '*** TRANS-RCDRS-REJT ***'.BIB-UPDT
 816   521 0    030230     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 817   521 5    030240     03  CNT-2   PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 818   523 0    030310 01  EOJ-MESS-3.                                                                BIB-UPDT
 819   523 0    030320     03  FILLER  PICTURE X(24)   VALUE '*** TRANS-RCDRS-DUPL ***'.BIB-UPDT
 820   527 0    030330     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 821   527 5    030340     03  CNT-3   PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 822   529 0    030410 01  EOJ-MESS-4.                                                                BIB-UPDT
 823   529 0    030420     03  FILLER  PICTURE X(24)   VALUE '*** TRANS-RCDRS-PROC ***'.BIB-UPDT
 824   533 0    030430     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 825   533 5    030440     03  CNT-4   PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 826   535 0    030510 01  EOJ-MESS-5.                                                                BIB-UPDT
 827   535 0    030520     03  FILLER  PICTURE X(24)   VALUE '*** MASTR-RCDRS-READ ***'.BIB-UPDT
 828   539 0    030530     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 829   539 5    030540     03  CNT-5   PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 830   541 0    030610 01  EOJ-MESS-6.                                                                BIB-UPDT
 831   541 0    030620     03  FILLER  PICTURE X(24)   VALUE '*** MASTR-RCDRS-DELX ***'.BIB-UPDT
 832   545 0    030630     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 833   545 5    030640     03  CNT-6   PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 834   547 0    030710 01  EOJ-MESS-7.                                                                BIB-UPDT
 835   547 0    030720     03  FILLER  PICTURE X(24)   VALUE '*** MASTR-RCDRS-DUPL ***'.BIB-UPDT
 836   551 0    030730     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 837   551 5    030740     03  CNT-7   PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 838   553 0    030810 01  EOJ-MESS-8.                                                                BIB-UPDT
 839   553 0    030820     03  FILLER  PICTURE X(24)   VALUE '*** MASTR-RCDRS-ADDX ***'.BIB-UPDT
 840   557 0    030830     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 841   557 5    030840     03  CNT-8   PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 842   559 0    030910 01  EOJ-MESS-9.                                                                BIB-UPDT
 843   559 0    030920     03  FILLER  PICTURE X(24)   VALUE '*** MASTR-RCDRS-PROC ***'.BIB-UPDT
 844   563 0    030930     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 845   563 5    030940     03  CNT-9   PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 846   565 0    031010 01  EOJ-MESS-10.                                                               BIB-UPDT
 847   565 0    031020     03  FILLER  PICTURE X(24)   VALUE '*** TRANS-RCDRS-PUNX ***'.BIB-UPDT
 848   569 0    031030     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 849   569 5    031040     03  CNT-10  PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 850   571 0    031110 01  EOJ-MESS-11.                                                               BIB-UPDT
 851   571 0    031120     03  FILLER  PICTURE X(24)   VALUE '*** MASTR-RCDRS-STOR ***'.BIB-UPDT
 852   575 0    031130     03  FILLER  PICTURE X(5)    VALUE SPACES.                     BIB-UPDT
 853   575 5    031140     03  CNT-11  PICTURE Z(6)    VALUE SPACES.                     BIB-UPDT
 854   577 0    040100 01  REPORT-REC; SIZE IS 84; CLASS IS ALPHANUMERIC.                             BIB-UPDT
 855   577 0    040110     03  AUTHORS-NAME.                                                          BIB-UPDT
 856   577 0    040120         05  LAST-NAME;       PICTURE X(9).                                   BIB-UPDT
 857   578 3    040130         05  1ST-INITIAL;     PICTURE X(1).                                   BIB-UPDT
 858   578 4    040140     03  NO-OF-AUTHORS;       PICTURE 9(1).                                   BIB-UPDT
 859   578 4    040145     03  NOAUTHORS-REDEF REDEFINES NO-OF-AUTHORS;   PICTURE X(1).           BIB-UPDT
 860   578 5    040150     03  CHANGE-CODE;         PICTURE X(1).                                   BIB-UPDT
 861   579 0    040160     03  JOURNAL-NAME;        PICTURE X(15).                                  BIB-UPDT
 862   581 3    040170     03  VOLUME.                                                              BIB-UPDT
 863   581 3    040180         05  VOL-NO;          PICTURE 9(3).                                   BIB-UPDT
 864   582 0    040190         05  VOL-XX;          PICTURE X(1).                                   BIB-UPDT
 865   582 1    040200     03  PAGE;                PICTURE 9(4).                                   BIB-UPDT
 866   582 1    040205     03  PAGE-REDEF REDEFINES PAGE;                PICTURE X(4).             BIB-UPDT
 867   582 5    040210     03  FILLER;              PICTURE X(1).                                   BIB-UPDT
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868   583 0    040220     03  REFERENCE-NUMBER.                                                    BIB-UPDT
869   583 0    040230         05  REFER-YR;          PICTURE 9(2).                                 BIB-UPDT
870   583 2    040240         05  REFER-NO;          PICTURE 9(4).                                 BIB-UPDT
871   584 0    040250     03  FILLER;                PICTURE X(1).                                 BIB-UPDT
872   584 1    040260     03  SUBJECT-CATEGORY.                                                    BIB-UPDT
873   584 1    040270         05  BROAD-CATE;        PICTURE X(3).                                 BIB-UPDT
874   584 4    040280         05  SPEC-CATE;         PICTURE X(1).                                 BIB-UPDT
875   584 5    040290     03  PROPERTIES.                                                          BIB-UPDT
876   584 5    040300         05  PROP-CODE;         OCCURS  6 TIMES.                              BIB-UPDT
877   584 5    040310             07  1ST-POST;      PICTURE X(1).                                 BIB-UPDT
878   585 0    040320             07  2ND-POST;      PICTURE X(1).                                 BIB-UPDT
879   586 5    040330     03  CARD-COUNT-NUMBER;     PICTURE X(1).                                 BIB-UPDT
880   586 5    040335     03  CRDCNT-REDEF REDEFINES CARD-COUNT-NUMBER;  PICTURE 9(1).            BIB-UPDT
881   587 0    040340     03  ALLOY-ELEMENTS.                                                      BIB-UPDT
882   587 0    040350         05  GROUP-CODE;        OCCURS  4 TIMES.                              BIB-UPDT
883   587 0    040360             07  ALLOY-ID;      PICTURE X(2).                                 BIB-UPDT
884   588 2    040370     03  ELEMENT-STUDIED;       PICTURE X(1).                                 BIB-UPDT
885   588 3    040380     03  COMPOSITION-RANGE.                                                   BIB-UPDT
886   588 3    040390         05  LO-COMP.                                                         BIB-UPDT
887   588 3    040392             07  LOCOMP-D1;     PICTURE X(1).                                 BIB-UPDT
888   588 4    040394             07  FILLER;        PICTURE X(1).                                 BIB-UPDT
889   588 3    040395         05  LOCOMP-REDEF REDEFINES LO-COMP;        PICTURE 9(2).            BIB-UPDT
890   588 5    040400         05  HI-COMP.                                                         BIB-UPDT
891   588 5    040402             07  HICOMP-D1;     PICTURE X(1).                                 BIB-UPDT
892   589 0    040404             07  FILLER;        PICTURE X(2).                                 BIB-UPDT
893   588 5    040405         05  HICOMP-REDEF REDEFINES HI-COMP;        PICTURE 9(3).            BIB-UPDT
894   589 2    040410     03  TEMPERTURE-RANGE.                                                    BIB-UPDT
895   589 2    040420         05  LO-TEMP.                                                         BIB-UPDT
896   589 2    040422             07  LOTEMP-D1;     PICTURE X(1).                                 BIB-UPDT
897   589 3    040424             07  FILLER;        PICTURE X(2).                                 BIB-UPDT
898   589 2    040425         05  LOTEMP-REDEF REDEFINES LO-TEMP;        PICTURE 9(3).            BIB-UPDT
899   589 5    040430         05  HI-TEMP.                                                         BIB-UPDT
900   589 5    040432             07  HITEMP-D1;     PICTURE X(1).                                 BIB-UPDT
901   590 0    040434             07  FILLER;        PICTURE X(2).                                 BIB-UPDT
902   589 5    040435         05  HITEMP-REDEF REDEFINES HI-TEMP;        PICTURE 9(3).            BIB-UPDT
903   590 2    040440     03  FILLER;                PICTURE X(4).                                 BIB-UPDT
904   591 0    050000 01  CURR-REFER-CONTROL.                                                      BIB-UPDT
905   591 0    050010     03  REFERENCE-NUMBER;          PICTURE 9(6).                            BIB-UPDT
906   592 0    050020     03  AUTHORS-NAME;              PICTURE X(10).                           BIB-UPDT
907   593 4    050030     03  ALLOY-ELEMENTS;            PICTURE X(8).                            BIB-UPDT
908   595 0    050040     03  CARD-COUNT-NUMBER;         PICTURE X(1).                            BIB-UPDT
909   595 1    050050     03  COMPOSITION-RANGE;         PICTURE X(5).                            BIB-UPDT
910   596 0    050060     03  FILLER;                    PICTURE X(23)   VALUE SPACES.            BIB-UPDT
911   600 0    050100 01  PREV-REFER-CONTROL.                                                      BIB-UPDT
912   600 0    050110     03  FILLER;                    PICTURE X(53)   VALUE SPACES.            BIB-UPDT
913   609 0    050200 01  CURR-ALLOY-CONTROL.                                                      BIB-UPDT
914   609 0    050210     03  ALLOY-ELEMENTS;            PICTURE X(8).                            BIB-UPDT
915   610 2    050220     03  AUTHORS-NAME;              PICTURE X(10).                           BIB-UPDT
916   612 0    050230     03  REFERENCE-NUMBER;          PICTURE 9(6).                            BIB-UPDT
917   613 0    050240     03  CARD-COUNT-NUMBER;         PICTURE X(1).                            BIB-UPDT
918   613 1    050250     03  COMPOSITION-RANGE;         PICTURE X(5).                            BIB-UPDT
919   614 0    050260     03  FILLER;                    PICTURE X(23)   VALUE SPACES.            BIB-UPDT
920   618 0    050300 01  PREV-ALLOY-CONTROL.                                                      BIB-UPDT
921   618 0    050310     03  FILLER;                    PICTURE X(53)   VALUE SPACES.            BIB-UPDT
922   627 0    050400 01  ALLOY-ROTATE.                                                            BIB-UPDT
923   627 0    050410     03  ALLOY-ELEMENTS.                                                      BIB-UPDT
924   627 0    050420         05  GROUP-CODE;        OCCURS  4 TIMES.                              BIB-UPDT
925   627 0    050430             07  ALLOY-ID;      PICTURE X(2).                                 BIB-UPDT
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926   629 0     060100 01  REPORT-LEGEND.                                                    BIB-UPDT
927   629 0     060105     03  LEGEND-LINE-1.                                                BIB-UPDT
928   629 0     060110         05  FILLER      PICTURE X(51)   VALUE SPACES.                BIB-UPDT
929   637 3     060120         05  FILLER      PICTURE X(13)   VALUE '* * *  NOTE  '.       BIB-UPDT
930   639 4     060130         05  FILLER      PICTURE X(5)    VALUE '* * *'.              BIB-UPDT
931   640 3     060140         05  FILLER      PICTURE X(63)   VALUE SPACES.               BIB-UPDT
932   651 0     060210     03  LEGEND-LINE-2.                                                BIB-UPDT
933   651 0     060220         05  FILLER      PICTURE X(30)   VALUE SPACES.               BIB-UPDT
934   656 0     060230         05  FILLER      PICTURE X(16)   VALUE 'ALL COMPOSITIONS'.BIB-UPDT
935   658 4     060240         05  FILLER      PICTURE X(15)   VALUE ' ARE IN ATOMIC '. BIB-UPDT
936   661 1     060250         05  FILLER      PICTURE X(12)   VALUE 'PERCENT AND '.       BIB-UPDT
937   663 1     060260         05  FILLER      PICTURE X(13)   VALUE 'REFER TO THE '.      BIB-UPDT
938   665 2     060270         05  FILLER      PICTURE X(13)   VALUE 'FIRST ELEMENT'.      BIB-UPDT
939   667 3     060280         05  FILLER      PICTURE X(33)   VALUE SPACES.               BIB-UPDT
940   673 0     060300     03  LEGEND-LINE-3.                                                BIB-UPDT
941   673 0     060310         05  FILLER      PICTURE X(45)   VALUE SPACES.               BIB-UPDT
942   680 3     060320         05  FILLER      PICTURE X(16)   VALUE 'ALL TEMPERATURES'.BIB-UPDT
943   683 1     060330         05  FILLER      PICTURE X(16)   VALUE ' ARE IN DEGREES '.BIB-UPDT
944   685 5     060340         05  FILLER      PICTURE X(6)    VALUE 'KELVIN'.             BIB-UPDT
945   686 5     060350         05  FILLER      PICTURE X(49)   VALUE SPACES.               BIB-UPDT
946             090000 CONSTANT SECTION.                                                     BIB-UPDT
947             090010 77  KON1     PICTURE X(26)   VALUE '** BIBLIO-FILE PROCESS  **'.  BIB-UPDT
948     5 0     090020 77  KON2     PICTURE X(26)   VALUE '**** DATE-CARD EDITED ****'.  BIB-UPDT
949    10 0     090030 77  KON3     PICTURE X(26)   VALUE '**** DATE-CARD ERROR  ****'.  BIB-UPDT
950    15 0     090040 77  KON4     PICTURE X(26)   VALUE '****** RUN ABORTED  ******'.  BIB-UPDT
951    20 0     090050 77  KON5     PICTURE X(20)   VALUE '* SEQ ERROR-CHANGE *'.         BIB-UPDT
952    24 0     090060 77  KON6     PICTURE X(20)   VALUE '* SEQ ERROR-MASTER *'.         BIB-UPDT
953    28 0     090070 77  KON7     PICTURE X(20)   VALUE '* END OF JOB COUNTS*'.         BIB-UPDT
954    32 0     090080 77  KON8     PICTURE X(26)   VALUE '** END OF BIBLIO-UPDATE **'.  BIB-UPDT
955    37 0     090090 77  KON9     PICTURE X(26)   VALUE '* END OF AUTHOR-PRINTOUT *'.  BIB-UPDT
956    42 0     090100 77  KON10    PICTURE X(26)   VALUE '** END OF NMR-PRINTOUT ** '.  BIB-UPDT
957    47 0     090110 77  KON11    PICTURE X(28)   VALUE '* END OF REFER-NO PRINTOUT *'.BIB-UPDT
958    52 0     090120 77  KON12    PICTURE X(28)   VALUE '* END OF N-ALLOY PRINTOUT * '.BIB-UPDT
959    57 0     090130 77  KON13    PICTURE X(28)   VALUE '*END N-ALLOY PRINTOUT - NMR*'.BIB-UPDT
960    62 0     090140 77  KON14    PICTURE X(27)   VALUE '* EOJ-UPDATE-SWT NOT = 11 *'. BIB-UPDT
961    67 0     090150 77  KON15    PICTURE X(26)   VALUE '* EDIT ERRORS - STOP RUN *'.  BIB-UPDT
962    72 0     090160 77  KON16    PICTURE X(26)   VALUE '* INPUT CLEAN - CONT RUN *'.  BIB-UPDT
963    77 0     090170 77  KON17    PICTURE X(28)   VALUE '* END OF X-ALLOY PRINTOUT * '.BIB-UPDT
964    82 0     090180 77  KON18    PICTURE X(28)   VALUE '*END X-ALLOY PRINTOUT - NMR*'.BIB-UPDT
965    87 0     090200 77  KON19    PICTURE 9(2)    VALUE 19.                            BIB-UPDT
966    88 0     090205 77  KON20    PICTURE X(20)   VALUE '*END CHAN CARD SORT*'.        BIB-UPDT
967    92 0     090210 77  ONE      PICTURE 9(1)    VALUE 1.                             BIB-UPDT
968    93 0     090220 77  KON21    PICTURE X(26)   VALUE '* EDIT ERRORS - CONT RUN *'.  BIB-UPDT
969    98 0     090230 77  KON22    PICTURE X(28)   VALUE '** END OF BIBLIO-PROCESS ** '.BIB-UPDT
970   103 0     090240 77  KON23    PICTURE X(28)   VALUE '** END JOURNAL-NAME REFER **'.BIB-UPDT
971   108 0     091010 77  CON1         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000001.BIB-UPDT
972   109 0     091020 77  CON2         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000002.BIB-UPDT
973   110 0     091030 77  CON3         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000003.BIB-UPDT
974   111 0     091040 77  CON4         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000004.BIB-UPDT
975   112 0     091050 77  CON5         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000005.BIB-UPDT
976   113 0     091060 77  CON6         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000006.BIB-UPDT
977   114 0     091070 77  CON7         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000007.BIB-UPDT
978   115 0     091080 77  CON8         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000008.BIB-UPDT
979   116 0     091090 77  CON9         PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000009.BIB-UPDT
980   117 0     091100 77  CON10        PICTURE 9(6)    USAGE COMPUTATIONAL VALUE 000010.BIB-UPDT
981             100000 PROCEDURE DIVISION.                                                   BIB-UPDT
982             100010 HOUSEKEEPING SECTION.                                                 BIB-UPDT
983             100020     OPEN INPUT CARD-IN.                                               BIB-UPDT
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 984  100030     OPEN OUTPUT PRINT-OUT.                                    BIB-UPDT
 985  100040     MOVE SPACES TO PRINT-REC.                                 BIB-UPDT
 986  100050     MOVE KON1 TO PRINT-REC.                                   BIB-UPDT
 987  100060     WRITE PRINT-REC AFTER ADVANCING 66 LINES.                 BIB-UPDT
 988  100070     MOVE SPACES TO PRINT-REC.                                 BIB-UPDT
 989  100080     READ CARD-IN AT END GO TO DATE-CARD-ERROR.                BIB-UPDT
 990  100090     MOVE CARDIN-REC TO DATE-CARD.                             BIB-UPDT
 991  100100     MOVE DATE-CARD TO PRINT-REC.                              BIB-UPDT
 992  100110     WRITE PRINT-REC AFTER ADVANCING 2 LINES.                  BIB-UPDT
 993  100120     IF CARD-IDENT IS NOT EQUAL TO 'DATE'                      BIB-UPDT
 994  100130     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
 995  100140     IF DATE-OF-RUN IS NOT NUMERIC                             BIB-UPDT
 996  100150     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
 997  100160     IF AS-OF-DATE IS NOT NUMERIC                              BIB-UPDT
 998  100170     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
 999  100180     IF JULIAN-DATE IS NOT NUMERIC                             BIB-UPDT
1000  100190     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
1001  100200     IF SWT-1 IS EQUAL TO 'A'                                  BIB-UPDT
1002  100210     GO TO EXIT-SWT-1.                                         BIB-UPDT
1003  100220     IF SWT-1 IS EQUAL TO 'X'                                  BIB-UPDT
1004  100230     GO TO EXIT-SWT-1.                                         BIB-UPDT
1005  100240     IF SWT-1 IS NOT EQUAL TO '1'                              BIB-UPDT
1006  100250     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
1007  100260 EXIT-SWT-1.                                                   BIB-UPDT
1008  100270     IF SWT-2 IS EQUAL TO 'X'                                  BIB-UPDT
1009  100280     GO TO EXIT-SWT-2.                                         BIB-UPDT
1010  100290     IF SWT-2 IS NOT EQUAL TO '1'                              BIB-UPDT
1011  100300     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
1012  100310 EXIT-SWT-2.                                                   BIB-UPDT
1013  100320     IF SWT-3 IS EQUAL TO 'X'                                  BIB-UPDT
1014  100330     GO TO EXIT-SWT-3.                                         BIB-UPDT
1015  100340     IF SWT-3 IS NOT EQUAL TO '1'                              BIB-UPDT
1016  100350     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
1017  100360 EXIT-SWT-3.                                                   BIB-UPDT
1018  100370     IF SWT-4 IS EQUAL TO 'X'                                  BIB-UPDT
1019  100380     GO TO EXIT-SWT-4.                                         BIB-UPDT
1020  100390     IF SWT-4 IS NOT EQUAL TO '1'                              BIB-UPDT
1021  100400     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
1022  100410 EXIT-SWT-4.                                                   BIB-UPDT
1023  100420     IF SWT-5 IS EQUAL TO 'X'                                  BIB-UPDT
1024  100430     GO TO EXIT-SWT-5.                                         BIB-UPDT
1025  100440     IF SWT-5 IS NOT EQUAL TO '1'                              BIB-UPDT
1026  100460     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
1027  100470 EXIT-SWT-5.                                                   BIB-UPDT
1028  100480     IF SWT-6 IS EQUAL TO 'X'                                  BIB-UPDT
1029  100490     GO TO EXIT-SWT-6.                                         BIB-UPDT
1030  100500     IF SWT-6 IS NOT EQUAL TO '1'                              BIB-UPDT
1031  100510     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
1032  100520 EXIT-SWT-6.                                                   BIB-UPDT
1033  100525     IF SWT-7 IS EQUAL TO 'X'                                  BIB-UPDT
1034  100530     GO TO EXIT-SWT-7.                                         BIB-UPDT
1035  100535     IF SWT-7 IS NOT EQUAL TO '1'                              BIB-UPDT
1036  100540     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
1037  100550 EXIT-SWT-7.                                                   BIB-UPDT
1038  100555     IF SWT-8 IS EQUAL TO 'X'                                  BIB-UPDT
1039  100560     GO TO EXIT-SWT-8.                                         BIB-UPDT
1040  100565     IF SWT-8 IS NOT EQUAL TO '1'                              BIB-UPDT
1041  100570     GO TO DATE-CARD-ERROR.                                    BIB-UPDT
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1042  100600 EXIT-SWT-8.                                                    BIB-UPDT
1043  100610     MOVE KON2 TO PRINT-REC.                                    BIB-UPDT
1044  100620     WRITE PRINT-REC AFTER ADVANCING 2 LINES.                   BIB-UPDT
1045  100630     MOVE SPACES TO PRINT-REC.                                  BIB-UPDT
1046  100640     WRITE PRINT-REC BEFORE ADVANCING 66 LINES.                 BIB-UPDT
1047  100650     MOVE MO-RUN  TO HED-MO, EOJ-MO.                            BIB-UPDT
1048  100660     MOVE DA-RUN  TO HED-DA, EOJ-DA.                            BIB-UPDT
1049  100670     MOVE YR-RUN  TO HED-YR, EOJ-YR.                            BIB-UPDT
1050  100720     GO TO CHECK-SWT-1.                                         BIB-UPDT
1051  101100 DATE-CARD-ERROR.                                               BIB-UPDT
1052  101110     MOVE KON3 TO PRINT-REC.                                    BIB-UPDT
1053  101120     WRITE PRINT-REC AFTER ADVANCING 2 LINES.                   BIB-UPDT
1054  101130     MOVE SPACES TO PRINT-REC.                                  BIB-UPDT
1055  101140     MOVE KON4 TO PRINT-REC.                                    BIB-UPDT
1056  101150     WRITE PRINT-REC AFTER ADVANCING 2 LINES.                   BIB-UPDT
1057  101160     MOVE SPACES TO PRINT-REC.                                  BIB-UPDT
1058  101170     WRITE PRINT-REC BEFORE ADVANCING 66 LINES.                 BIB-UPDT
1059  101180     CLOSE CARD-IN.                                             BIB-UPDT
1060  101190     CLOSE PRINT-OUT.                                           BIB-UPDT
1061  101200     STOP RUN.                                                  BIB-UPDT
1062  102000 CHECK-SWT-1.                                                   BIB-UPDT
1063  102010     CLOSE CARD-IN.                                             BIB-UPDT
1064  102020     IF SWT-1 IS EQUAL TO '1'                                   BIB-UPDT
1065  102030     GO TO SPIN-MASTER.                                         BIB-UPDT
1066  102033     OPEN INPUT CARD-IN.                                        BIB-UPDT
1067  102035     OPEN OUTPUT DRUM-STORE.                                    BIB-UPDT
1068  102040 SORT-CHANGE-REC.                                               BIB-UPDT
1069  102050     SORT DRUM-SORT ON ASCENDING KEY                            BIB-UPDT
1070  102060         AUTHORS-NAME OF DRUM-REC                               BIB-UPDT
1071  102065         REFER-YR OF DRUM-REC                                   BIB-UPDT
1072  102070         JOURNAL-NAME OF DRUM-REC                               BIB-UPDT
1073  102075         VOLUME OF DRUM-REC                                     BIB-UPDT
1074  102080         PAGE OF DRUM-REC                                       BIB-UPDT
1075  102085         REFER-NO OF DRUM-REC                                   BIB-UPDT
1076  102090         ALLOY-ELEMENTS OF DRUM-REC                             BIB-UPDT
1077  102093         SUBJECT-CATEGORY OF DRUM-REC                           BIB-UPDT
1078  102095         CARD-COUNT-NUMBER OF DRUM-REC                          BIB-UPDT
1079  102100         COMPOSITION-RANGE OF DRUM-REC                          BIB-UPDT
1080  102110         CHANGE-CODE OF DRUM-REC                                BIB-UPDT
1081  102140     INPUT PROCEDURE IS SORT-CHANIN THRU SORT-CHANIN-FINIS      BIB-UPDT
1082  102150     OUTPUT PROCEDURE IS SORT-CHANOUT THRU SORT-CHANOUT-FINIS.  BIB-UPDT
1083  102160     GO TO FIRST-TIME-INITIALIZE.                               BIB-UPDT
1084  102200 SORT-CHANIN.                                                   BIB-UPDT
1085  102210     READ CARD-IN AT END GO TO SORT-CHANIN-FINIS.               BIB-UPDT
1086  102310     RELEASE DRUM-REC FROM CARDIN-REC.                          BIB-UPDT
1087  102320     ADD 1 TO TRANS-IN-COUNT.                                   BIB-UPDT
1088  102330     GO TO SORT-CHANIN.                                         BIB-UPDT
1089  102400 SORT-CHANIN-FINIS.                                             BIB-UPDT
1090  102410     CLOSE CARD-IN.                                             BIB-UPDT
1091  102500 SORT-CHANOUT.                                                  BIB-UPDT
1092  102510     RETURN DRUM-SORT INTO BIBLIO-REC                           BIB-UPDT
1093  102520     AT END GO TO SORT-CHANOUT-FINIS.                           BIB-UPDT
1094  102530     WRITE BIBLIO-REC.                                          BIB-UPDT
1095  102540     ADD 1 TO TRANS-PROC-COUNT.                                 BIB-UPDT
1096  102550     GO TO SORT-CHANOUT.                                        BIB-UPDT
1097  102600 SORT-CHANOUT-FINIS.                                            BIB-UPDT
1098  102610     CLOSE DRUM-STORE.                                          BIB-UPDT
1099  102900 FIRST-TIME-INITIALIZE.                                         BIB-UPDT
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1100    102910     MOVE KON20 TO CTRL-MESS.                              BIB-UPDT
1101    102920     PERFORM UPDATE-FINIS.                                 BIB-UPDT
1102    102930     WRITE PRINT-REC BEFORE ADVANCING 66 LINES.            BIB-UPDT
1103    102940     MOVE KON7 TO CTRL-MESS.                               BIB-UPDT
1104    102950     PERFORM INITIALIZE-COUNTER.                           BIB-UPDT
1105    102955     MOVE UPDATE-PRINTOUT TO HED-4.                        BIB-UPDT
1106    102960     PERFORM REPORT-HEADER-1.                              BIB-UPDT
1107    103000 FIRST-TIME-PROCESS.                                       BIB-UPDT
1108    103010     IF SWT-1 IS EQUAL TO 'A'                              BIB-UPDT
1109    103020     GO TO INITIAL-PROCESS.                                BIB-UPDT
1110    103030     OPEN INPUT MASTER-IN.                                 BIB-UPDT
1111    103040     PERFORM READ-MASTER.                                  BIB-UPDT
1112    103050     OPEN OUTPUT CARD-OUT.                                 BIB-UPDT
1113    103100 OPEN-UPDATE-FILES.                                        BIB-UPDT
1114    103110     OPEN INPUT DRUM-STORE.                                BIB-UPDT
1115    103120     PERFORM READ-CHANGE.                                  BIB-UPDT
1116    103130     OPEN OUTPUT MASTER-OUT.                               BIB-UPDT
1117    103200 OPEN-REPORT-FILES.                                        BIB-UPDT
1118    103210     OPEN OUTPUT MASTER-HOLD.                              BIB-UPDT
1119    103220     GO TO UPDATE-MASTER.                                  BIB-UPDT
1120    103300 INITIAL-PROCESS.                                          BIB-UPDT
1121    103310     OPEN OUTPUT MASTER-IN.                                BIB-UPDT
1122    103320     CLOSE MASTER-IN.                                      BIB-UPDT
1123    103330     MOVE ALL '9' TO CURR-MAST-CONTROL.                    BIB-UPDT
1124    103340     MOVE 1 TO MAST-IN-SWT.                                BIB-UPDT
1125    103350     GO TO OPEN-UPDATE-FILES.                              BIB-UPDT
1126    103600 SPIN-MASTER.                                              BIB-UPDT
1127    103610     OPEN INPUT DRUM-STORE.                                BIB-UPDT
1128    103620     CLOSE DRUM-STORE.                                     BIB-UPDT
1129    103630     MOVE ALL '9' TO CURR-CHAN-CONTROL.                    BIB-UPDT
1130    103640     MOVE 1 TO CHAN-IN-SWT.                                BIB-UPDT
1131    103650     OPEN INPUT MASTER-IN.                                 BIB-UPDT
1132    103660     PERFORM READ-MASTER.                                  BIB-UPDT
1133    103670     OPEN OUTPUT MASTER-OUT.                               BIB-UPDT
1134    103680     CLOSE MASTER-OUT.                                     BIB-UPDT
1135    103690     GO TO OPEN-REPORT-FILES.                              BIB-UPDT
1136    110000 READ-CHANGE.                                              BIB-UPDT
1137    110010     READ DRUM-STORE AT END GO TO CHANGE-FINIS.            BIB-UPDT
1138    110020     ADD 1 TO TRANS-IN-COUNT.                              BIB-UPDT
1139    110022     IF SWT-1 IS EQUAL TO 'A'                              BIB-UPDT
1140    110025     MOVE '1' TO CHANGE-CODE OF BIBLIO-REC.                BIB-UPDT
1141    110030     MOVE AUTHORS-NAME OF BIBLIO-REC                       BIB-UPDT
1142    110035     TO AUTHORS-NAME OF CURR-CHAN-CONTROL.                 BIB-UPDT
1143    110040     MOVE REFER-YR OF BIBLIO-REC                           BIB-UPDT
1144    110045     TO REFER-YR OF CURR-CHAN-CONTROL.                     BIB-UPDT
1145    110050     MOVE JOURNAL-NAME OF BIBLIO-REC                       BIB-UPDT
1146    110055     TO JOURNAL-NAME OF CURR-CHAN-CONTROL.                 BIB-UPDT
1147    110060     MOVE VOLUME OF BIBLIO-REC                             BIB-UPDT
1148    110065     TO VOLUME OF CURR-CHAN-CONTROL.                       BIB-UPDT
1149    110070     MOVE PAGE OF BIBLIO-REC                               BIB-UPDT
1150    110075     TO PAGE OF CURR-CHAN-CONTROL.                         BIB-UPDT
1151    110080     MOVE REFER-NO OF BIBLIO-REC                           BIB-UPDT
1152    110085     TO REFER-NO OF CURR-CHAN-CONTROL.                     BIB-UPDT
1153    110090     MOVE ALLOY-ELEMENTS OF BIBLIO-REC                     BIB-UPDT
1154    110093     TO ALLOY-ELEMENTS OF CURR-CHAN-CONTROL.               BIB-UPDT
1155    110095     MOVE SUBJECT-CATEGORY OF BIBLIO-REC                   BIB-UPDT
1156    110097     TO SUBJECT-CATEGORY OF CURR-CHAN-CONTROL.             BIB-UPDT
1157    110100     MOVE CARD-COUNT-NUMBER OF BIBLIO-REC                  BIB-UPDT
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1158  110105      TO CARD-COUNT-NUMBER OF CURR-CHAN-CONTROL.                    BIB-UPDT
1159  110110      MOVE COMPOSITION-RANGE OF BIBLIO-REC                         BIB-UPDT
1160  110115      TO COMPOSITION-RANGE OF CURR-CHAN-CONTROL.                   BIB-UPDT
1161  110120      MOVE CHANGE-CODE OF BIBLIO-REC                               BIB-UPDT
1162  110125      TO CHANGE-CODE OF CURR-CHAN-CONTROL.                         BIB-UPDT
1163  110200 CHAN-SEQ-CHECK.                                                   BIB-UPDT
1164  110210      IF CURR-CHAN-CONTROL IS GREATER THAN PREV-CHAN-CONTROL       BIB-UPDT
1165  110220      MOVE CURR-CHAN-CONTROL TO PREV-CHAN-CONTROL                  BIB-UPDT
1166  110230      GO TO UPDATE-MASTER.                                         BIB-UPDT
1167  110240      IF CURR-CHAN-CONTROL IS LESS THAN PREV-CHAN-CONTROL          BIB-UPDT
1168  110250      GO TO CHANGE-SEQ-ERROR.                                      BIB-UPDT
1169  110260      MOVE BIBLIO-REC TO REPORT-REC.                               BIB-UPDT
1170  110270      MOVE 'CD' TO TRANS-MESS.                                     BIB-UPDT
1171  110280      MOVE SPACES TO ERROR-REC.                                    BIB-UPDT
1172  110290      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.             BIB-UPDT
1173  110300      ADD 1 TO TRANS-DUP-COUNT.                                    BIB-UPDT
1174  110310      GO TO READ-CHANGE.                                           BIB-UPDT
1175  110400 CHANGE-SEQ-ERROR.                                                 BIB-UPDT
1176  110410      MOVE KON5 TO CTRL-MESS.                                      BIB-UPDT
1177  110420      GO TO UPDATE-FINIS.                                          BIB-UPDT
1178  110500 CHANGE-FINIS.                                                     BIB-UPDT
1179  110510      MOVE ALL '9' TO CURR-CHAN-CONTROL.                           BIB-UPDT
1180  110520      MOVE 1 TO CHAN-IN-SWT.                                       BIB-UPDT
1181  110530      CLOSE DRUM-STORE.                                            BIB-UPDT
1182  110540      GO TO UPDATE-MASTER.                                         BIB-UPDT
1183  120000 READ-MASTER.                                                      BIB-UPDT
1184  120010      READ MASTER-IN AT END GO TO MASTER-FINIS.                    BIB-UPDT
1185  120020      ADD 1 TO MASTER-IN-COUNT.                                    BIB-UPDT
1186  120030      MOVE AUTHORS-NAME OF MAST-IN-REC                             BIB-UPDT
1187  120035      TO AUTHORS-NAME OF CURR-MAST-CONTROL.                        BIB-UPDT
1188  120040      MOVE REFER-YR OF MAST-IN-REC                                 BIB-UPDT
1189  120045      TO REFER-YR OF CURR-MAST-CONTROL.                            BIB-UPDT
1190  120050      MOVE JOURNAL-NAME OF MAST-IN-REC                             BIB-UPDT
1191  120055      TO JOURNAL-NAME OF CURR-MAST-CONTROL.                        BIB-UPDT
1192  120060      MOVE VOLUME OF MAST-IN-REC                                   BIB-UPDT
1193  120065      TO VOLUME OF CURR-MAST-CONTROL.                              BIB-UPDT
1194  120070      MOVE PAGE OF MAST-IN-REC                                     BIB-UPDT
1195  120075      TO PAGE OF CURR-MAST-CONTROL.                                BIB-UPDT
1196  120080      MOVE REFER-NO OF MAST-IN-REC                                 BIB-UPDT
1197  120085      TO REFER-NO OF CURR-MAST-CONTROL.                            BIB-UPDT
1198  120090      MOVE ALLOY-ELEMENTS OF MAST-IN-REC                           BIB-UPDT
1199  120093      TO ALLOY-ELEMENTS OF CURR-MAST-CONTROL.                      BIB-UPDT
1200  120095      MOVE SUBJECT-CATEGORY OF MAST-IN-REC                         BIB-UPDT
1201  120097      TO SUBJECT-CATEGORY OF CURR-MAST-CONTROL.                    BIB-UPDT
1202  120100      MOVE CARD-COUNT-NUMBER OF MAST-IN-REC                        BIB-UPDT
1203  120105      TO CARD-COUNT-NUMBER OF CURR-MAST-CONTROL.                   BIB-UPDT
1204  120110      MOVE COMPOSITION-RANGE OF MAST-IN-REC                        BIB-UPDT
1205  120115      TO COMPOSITION-RANGE OF CURR-MAST-CONTROL.                   BIB-UPDT
1206  120200 MAST-SEQ-CHECK.                                                   BIB-UPDT
1207  120210      IF CURR-MAST-CONTROL IS GREATER THAN PREV-MAST-CONTROL       BIB-UPDT
1208  120220      MOVE CURR-MAST-CONTROL TO PREV-MAST-CONTROL                  BIB-UPDT
1209  120230      GO TO UPDATE-MASTER.                                         BIB-UPDT
1210  120240      IF CURR-MAST-CONTROL IS LESS THAN PREV-MAST-CONTROL          BIB-UPDT
1211  120250      GO TO MASTER-SEQ-ERROR.                                      BIB-UPDT
1212  120260      MOVE MAST-IN-REC TO REPORT-REC.                              BIB-UPDT
1213  120270      MOVE 'OM' TO TRANS-MESS.                                     BIB-UPDT
1214  120275      MOVE 'D' TO CHANGE-CODE OF REPORT-REC.                       BIB-UPDT
1215  120280      MOVE SPACES TO ERROR-REC.                                    BIB-UPDT
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1216  120290      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.          BIB-UPDT
1217  120300      ADD 1 TO MAST-DUP-COUNT.                                  BIB-UPDT
1218  120310      GO TO READ-MASTER.                                        BIB-UPDT
1219  120400 MASTER-SEQ-ERROR.                                              BIB-UPDT
1220  120410      MOVE KON6 TO CTRL-MESS.                                   BIB-UPDT
1221  120420      GO TO UPDATE-FINIS.                                       BIB-UPDT
1222  120500 MASTER-FINIS.                                                  BIB-UPDT
1223  120510      MOVE ALL '9' TO CURR-MAST-CONTROL.                        BIB-UPDT
1224  120520      MOVE 1 TO MAST-IN-SWT.                                    BIB-UPDT
1225  120530      CLOSE MASTER-IN.                                          BIB-UPDT
1226  130000 UPDATE-MASTER.                                                 BIB-UPDT
1227  130003      MOVE SPACES TO ERROR-REC.                                 BIB-UPDT
1228  130005      IF EDIT-ERR-SWT-1 IS EQUAL TO 1                           BIB-UPDT
1229  130007      MOVE 1 TO EDIT-ERR-SWT-2                                  BIB-UPDT
1230  130009      MOVE ZERO TO EDIT-ERR-SWT-1.                              BIB-UPDT
1231  130010      IF DELETE-SWT IS EQUAL TO 1                               BIB-UPDT
1232  130015      MOVE ZERO TO DELETE-SWT                                   BIB-UPDT
1233  130020      GO TO READ-MASTER.                                        BIB-UPDT
1234  130030      IF CURRENT-READ OF CURR-CHAN-CONTROL IS LESS THAN         BIB-UPDT
1235  130040      CURRENT-READ OF CURR-MAST-CONTROL                         BIB-UPDT
1236  130050      GO TO NEW-MASTER.                                         BIB-UPDT
1237  130060      IF CURRENT-READ OF CURR-CHAN-CONTROL IS EQUAL TO          BIB-UPDT
1238  130070      CURRENT-READ OF CURR-MAST-CONTROL                         BIB-UPDT
1239  130080      GO TO CHANGE-MASTER.                                      BIB-UPDT
1240  130083      IF MESSAGE-3 IS NOT EQUAL TO 'EDIT MAST-IN'               BIB-UPDT
1241  130085      GO TO BYPASS-MASTER-EDIT.                                 BIB-UPDT
1242  130087 MASTER-FILE-EDIT.                                              BIB-UPDT
1243  130090      MOVE MAST-IN-REC TO REPORT-REC.                           BIB-UPDT
1244  130100      PERFORM TRANS-EDIT THRU TRANS-EDIT-EXIT.                  BIB-UPDT
1245  130110      IF EDIT-ERR-SWT-1 IS EQUAL TO 1                           BIB-UPDT
1246  130120      MOVE 'OM' TO TRANS-MESS                                   BIB-UPDT
1247  130130      MOVE 'X' TO CHANGE-CODE OF REPORT-REC                     BIB-UPDT
1248  130140      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT           BIB-UPDT
1249  130150      ADD 1 TO DEL-MAST-COUNT                                   BIB-UPDT
1250  130160      GO TO READ-MASTER.                                        BIB-UPDT
1251  130165 BYPASS-MASTER-EDIT.                                            BIB-UPDT
1252  130170      MOVE MAST-IN-REC TO MAST-OUT-REC.                         BIB-UPDT
1253  130180      PERFORM WRITE-MASTER THRU WRITE-MASTER-EXIT.              BIB-UPDT
1254  130190      GO TO READ-MASTER.                                        BIB-UPDT
1255  130200 WRITE-MASTER.                                                  BIB-UPDT
1256  130210      IF  CHANGE-CODE OF MAST-OUT-REC IS EQUAL TO '2'           BIB-UPDT
1257  130220      MOVE MAST-OUT-REC TO REPORT-REC                           BIB-UPDT
1258  130230      MOVE 'NM' TO TRANS-MESS                                   BIB-UPDT
1259  130240      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.          BIB-UPDT
1260  130250      IF CHANGE-CODE OF MAST-OUT-REC IS NOT EQUAL TO SPACE      BIB-UPDT
1261  130260      MOVE SPACE TO CHANGE-CODE OF MAST-OUT-REC                 BIB-UPDT
1262  130270      PERFORM PUNCHOUT-CHANGES.                                 BIB-UPDT
1263  130275      MOVE MAST-OUT-REC TO HOLD-REC.                            BIB-UPDT
1264  130280      IF SWT-1 IS NOT EQUAL TO '1'                              BIB-UPDT
1265  130290      WRITE MAST-OUT-REC                                        BIB-UPDT
1266  130300      ADD 1 TO MAST-OUT-COUNT.                                  BIB-UPDT
1267  130610      WRITE HOLD-REC.                                           BIB-UPDT
1268  130620      ADD 1 TO MAST-STOR-COUNT.                                 BIB-UPDT
1269  130700 WRITE-MASTER-EXIT.                                             BIB-UPDT
1270  130710      EXIT.                                                     BIB-UPDT
1271  140000 NEW-MASTER.                                                    BIB-UPDT
1272  140010      MOVE BIBLIO-REC TO REPORT-REC.                            BIB-UPDT
1273  140020      IF CHANGE-CODE OF BIBLIO-REC IS NOT EQUAL TO '1'          BIB-UPDT
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1274    140030      GO TO CHAN-CODE-1-ERR.                                  BIB-UPDT
1275    140040      PERFORM TRANS-EDIT THRU TRANS-EDIT-EXIT.                BIB-UPDT
1276    140050      IF EDIT-ERR-SWT-1 IS EQUAL TO 1                         BIB-UPDT
1277    140060      GO TO CHANGE-REJECT.                                    BIB-UPDT
1278    140070      MOVE 'CN' TO TRANS-MESS.                                BIB-UPDT
1279    140110      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.        BIB-UPDT
1280    140150      MOVE BIBLIO-REC TO MAST-OUT-REC.                        BIB-UPDT
1281    140160      ADD 1 TO TRANS-PROC-COUNT.                              BIB-UPDT
1282    140170      ADD 1 TO NEW-MAST-COUNT.                                BIB-UPDT
1283    140173      IF SWT-1 IS EQUAL TO 'A'                                BIB-UPDT
1284    140175      MOVE SPACE TO CHANGE-CODE OF MAST-OUT-REC.              BIB-UPDT
1285    140190      PERFORM WRITE-MASTER THRU WRITE-MASTER-EXIT.            BIB-UPDT
1286    140200      GO TO READ-CHANGE.                                      BIB-UPDT
1287    140300  CHAN-CODE-1-ERR.                                            BIB-UPDT
1288    140310      MOVE 1 TO EDIT-ERR-SWT-1.                               BIB-UPDT
1289    140320      MOVE 'X' TO CHANGE-CODE OF ERROR-REC.                   BIB-UPDT
1290    140330  CHANGE-REJECT.                                              BIB-UPDT
1291    140335      MOVE 'CR' TO TRANS-MESS.                                BIB-UPDT
1292    140340      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.        BIB-UPDT
1293    140350      ADD 1 TO TRANS-ERR-COUNT.                               BIB-UPDT
1294    140360      GO TO READ-CHANGE.                                      BIB-UPDT
1295    150000  CHANGE-MASTER.                                              BIB-UPDT
1296    150010      IF EOJ-UPDATE-SWT IS EQUAL TO '11'                      BIB-UPDT
1297    150020      MOVE KON7 TO CTRL-MESS                                  BIB-UPDT
1298    150030      GO TO UPDATE-FINIS.                                     BIB-UPDT
1299    150035      MOVE BIBLIO-REC TO REPORT-REC.                          BIB-UPDT
1300    150040      IF CHANGE-CODE OF BIBLIO-REC IS EQUAL TO '3'            BIB-UPDT
1301    150050      GO TO DELETE-MASTER.                                    BIB-UPDT
1302    150060      IF CHANGE-CODE OF BIBLIO-REC IS IS NOT EQUAL TO '2'     BIB-UPDT
1303    150070      GO TO CHAN-CODE-1-ERR.                                  BIB-UPDT
1304    150090      PERFORM TRANS-EDIT THRU TRANS-EDIT-EXIT.                BIB-UPDT
1305    150100      IF EDIT-ERR-SWT-1 IS EQUAL TO 1                         BIB-UPDT
1306    150140      GO TO CHANGE-REJECT.                                    BIB-UPDT
1307    150150      MOVE MAST-IN-REC TO REPORT-REC.                         BIB-UPDT
1308    150160      MOVE 'OM' TO TRANS-MESS.                                BIB-UPDT
1309    150200      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.        BIB-UPDT
1310    150210      MOVE 'CP' TO TRANS-MESS.                                BIB-UPDT
1311    150220      MOVE BIBLIO-REC TO REPORT-REC.                          BIB-UPDT
1312    150230      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.        BIB-UPDT
1313    150240      MOVE BIBLIO-REC TO MAST-IN-REC.                         BIB-UPDT
1314    150260      ADD 1 TO TRANS-PROC-COUNT.                              BIB-UPDT
1315    150270      GO TO READ-CHANGE.                                      BIB-UPDT
1316    151000  DELETE-MASTER.                                              BIB-UPDT
1317    151020      MOVE 'CP' TO TRANS-MESS.                                BIB-UPDT
1318    151040      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.        BIB-UPDT
1319    151050      ADD 1 TO TRANS-PROC-COUNT.                              BIB-UPDT
1320    151060      MOVE MAST-IN-REC TO REPORT-REC.                         BIB-UPDT
1321    151070      MOVE 'OM' TO TRANS-MESS.                                BIB-UPDT
1322    151080      MOVE 'D' TO CHANGE-CODE OF REPORT-REC.                  BIB-UPDT
1323    151090      MOVE SPACES TO ERROR-REC.                               BIB-UPDT
1324    151100      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.        BIB-UPDT
1325    151110      ADD 1 TO DEL-MAST-COUNT.                                BIB-UPDT
1326    151120      MOVE 1 TO DELETE-SWT.                                   BIB-UPDT
1327    151140      GO TO READ-CHANGE.                                      BIB-UPDT
1328    210000  CHECK-SWT-2.                                                BIB-UPDT
1329    210003      MOVE ZERO TO EDIT-ERR-SWT-1.                            BIB-UPDT
1330    210005      MOVE SPACES TO ERROR-REC.                               BIB-UPDT
1331    210007      MOVE ZERO TO NO-SCOR-SWT.                               BIB-UPDT
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1332  210010      IF SWT-2 IS EQUAL TO '1'                                  BIB-UPDT
1333  210020      GO TO CHECK-SWT-3.                                        BIB-UPDT
1334  210030      MOVE AUTHOR-PRINTOUT TO HED-4.                            BIB-UPDT
1335  210040      MOVE ZEROS TO EOJ-UPDATE-SWT.                             BIB-UPDT
1336  210100 REPT-1-OPENER.                                                 BIB-UPDT
1337  210105      PERFORM LEGEND-PRINTOUT.                                  BIB-UPDT
1338  210110      PERFORM INITIALIZE-COUNTER.                               BIB-UPDT
1339  210120      PERFORM REPORT-HEADER-1.                                  BIB-UPDT
1340  210130      OPEN INPUT MASTER-HOLD.                                   BIB-UPDT
1341  210200 MASTER-HOLD-READ.                                              BIB-UPDT
1342  210210      READ MASTER-HOLD AT END GO TO MASTER-HOLD-FINIS.          BIB-UPDT
1343  210220      ADD 1 TO MASTER-IN-COUNT.                                 BIB-UPDT
1344  210230      MOVE AUTHORS-NAME OF HOLD-REC                             BIB-UPDT
1345  210235      TO AUTHORS-NAME OF CURR-MAST-CONTROL.                     BIB-UPDT
1346  210240      MOVE REFER-YR OF HOLD-REC                                 BIB-UPDT
1347  210245      TO REFER-YR OF CURR-MAST-CONTROL.                         BIB-UPDT
1348  210250      MOVE JOURNAL-NAME OF HOLD-REC                             BIB-UPDT
1349  210255      TO JOURNAL-NAME OF CURR-MAST-CONTROL.                     BIB-UPDT
1350  210260      MOVE VOLUME OF HOLD-REC                                   BIB-UPDT
1351  210265      TO VOLUME OF CURR-MAST-CONTROL.                           BIB-UPDT
1352  210270      MOVE PAGE OF HOLD-REC                                     BIB-UPDT
1353  210275      TO PAGE OF CURR-MAST-CONTROL.                             BIB-UPDT
1354  210280      MOVE REFER-NO OF HOLD-REC                                 BIB-UPDT
1355  210285      TO REFER-NO OF CURR-MAST-CONTROL.                         BIB-UPDT
1356  210290      MOVE ALLOY-ELEMENTS OF HOLD-REC                           BIB-UPDT
1357  210295      TO ALLOY-ELEMENTS OF CURR-MAST-CONTROL.                   BIB-UPDT
1358  210300      MOVE SUBJECT-CATEGORY OF HOLD-REC                         BIB-UPDT
1359  210305      TO SUBJECT-CATEGORY OF CURR-MAST-CONTROL.                 BIB-UPDT
1360  210310      MOVE CARD-COUNT-NUMBER OF HOLD-REC                        BIB-UPDT
1361  210315      TO CARD-COUNT-NUMBER OF CURR-MAST-CONTROL.                BIB-UPDT
1362  210320      MOVE COMPOSITION-RANGE OF HOLD-REC                        BIB-UPDT
1363  210325      TO COMPOSITION-RANGE OF CURR-MAST-CONTROL.                BIB-UPDT
1364  210330      MOVE HOLD-REC TO REPORT-REC.                              BIB-UPDT
1365  210400 MASTER-HOLD-SEQCK.                                             BIB-UPDT
1366  210410      IF CURR-MAST-CONTROL IS GREATER THAN PREV-MAST-CONTROL    BIB-UPDT
1367  210420      MOVE CURR-MAST-CONTROL TO PREV-MAST-CONTROL               BIB-UPDT
1368  210430      GO TO PRINT-AUTHOR-REPT.                                  BIB-UPDT
1369  210440      IF CURR-MAST-CONTROL IS LESS THAN PREV-MAST-CONTROL       BIB-UPDT
1370  210450      MOVE KON6 TO CTRL-MESS                                    BIB-UPDT
1371  210460      PERFORM UPDATE-FINIS                                      BIB-UPDT
1372  210480      WRITE PRINT-REC BEFORE ADVANCING 66 LINES                 BIB-UPDT
1373  210490      CLOSE MASTER-HOLD                                         BIB-UPDT
1374  210500      CLOSE PRINT-OUT                                           BIB-UPDT
1375  210510      STOP RUN.                                                 BIB-UPDT
1376  210570      IF PAGE-EJECT-SWT IS EQUAL TO 1                           BIB-UPDT
1377  210580      MOVE ZERO TO PAGE-EJECT-SWT                               BIB-UPDT
1378  210590      GO TO PRINT-AUTHOR-REPT.                                  BIB-UPDT
1379  210600      MOVE SPACES TO AUTHORS-NAME OF REPORT-REC.                BIB-UPDT
1380  210610      MOVE SPACES TO NOAUTHORS-REDEF OF REPORT-REC.             BIB-UPDT
1381  210620      MOVE SPACES TO JOURNAL-NAME OF REPORT-REC                 BIB-UPDT
1382  210630      MOVE SPACES TO VOLUME OF REPORT-REC.                      BIB-UPDT
1383  210640      MOVE SPACES TO PAGE-REDEF OF REPORT-REC.                  BIB-UPDT
1384  210660      MOVE SPACES TO CARD-COUNT-NUMBER OF REPORT-REC.           BIB-UPDT
1385  211000 PRINT-AUTHOR-REPT.                                             BIB-UPDT
1386  211010      IF EOJ-UPDATE-SWT IS EQUAL TO ZEROS                       BIB-UPDT
1387  211020      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT           BIB-UPDT
1388  211030      ADD 1 TO MAST-OUT-COUNT                                   BIB-UPDT
1389  211040      GO TO MASTER-HOLD-READ.                                   BIB-UPDT
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1390            211050      MOVE CON1 TO XR1.                                                BIB-UPDT
1391            211060      MOVE ZERO TO NMR-SWT.                                            BIB-UPDT
1392            211070      PERFORM NMR-SEARCH-ONE 6 TIMES.                                  BIB-UPDT
1393            211080      IF NMR-SWT IS EQUAL TO ZERO                                      BIB-UPDT
1394            211090      GO TO NON-NMR-RCDS.                                              BIB-UPDT
1395            211100      MOVE CON1 TO XR1.                                                BIB-UPDT
1396            211105      MOVE ZERO TO NMR-SWT.                                            BIB-UPDT
1397            211110      PERFORM NMR-SEARCH-TWO THRU NMR-SEARCH-EXIT 6 TIMES.             BIB-UPDT
1398            211120      IF NMR-SWT IS EQUAL TO ZERO                                      BIB-UPDT
1399            211130      GO TO NON-NMR-RCDS.                                              BIB-UPDT
1400            211140      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.                 BIB-UPDT
1401            211150      ADD 1 TO MAST-OUT-COUNT.                                         BIB-UPDT
1402            211160      GO TO MASTER-HOLD-READ.                                          BIB-UPDT
1403            211170  NON-NMR-RCDS.                                                        BIB-UPDT
1404            211180      ADD 1 TO DEL-MAST-COUNT.                                         BIB-UPDT
1405            211190      GO TO MASTER-HOLD-READ.                                          BIB-UPDT
1406            211300  MASTER-HOLD-FINIS.                                                   BIB-UPDT
1407            211310      MOVE KON7 TO CTRL-MESS.                                          BIB-UPDT
1408            211320      PERFORM UPDATE-FINIS.                                            BIB-UPDT
1409            211330      IF EOJ-UPDATE-SWT IS EQUAL TO ZEROS                              BIB-UPDT
1410            211340      MOVE KON9 TO PRINT-REC                                           BIB-UPDT
1411            211350      WRITE PRINT-REC BEFORE ADVANCING 66 LINES                        BIB-UPDT
1412            211360      CLOSE MASTER-HOLD                                                BIB-UPDT
1413            211370      GO TO CHECK-SWT-3.                                               BIB-UPDT
1414            211380      MOVE KON10 TO PRINT-REC.                                         BIB-UPDT
1415            211390      WRITE PRINT-REC BEFORE ADVANCING 66 LINES.                       BIB-UPDT
1416            211400      CLOSE MASTER-HOLD.                                               BIB-UPDT
1417            211410      GO TO CHECK-SWT-4.                                               BIB-UPDT
1418            220000  CHECK-SWT-3.                                                         BIB-UPDT
1419            220010      IF SWT-3 IS EQUAL TO '1'                                         BIB-UPDT
1420            220020      GO TO CHECK-SWT-4.                                               BIB-UPDT
1421            220030      MOVE NMR-AUTHOR-PRINTOUT TO HED-4.                               BIB-UPDT
1422            220040      MOVE '11' TO EOJ-UPDATE-SWT.                                     BIB-UPDT
1423            220050      GO TO REPT-1-OPENER.                                             BIB-UPDT
1424            220100  CHECK-SWT-4.                                                         BIB-UPDT
1425            220110      IF SWT-4 IS EQUAL TO '1'                                         BIB-UPDT
1426            220120      GO TO CHECK-SWT-5.                                               BIB-UPDT
1427            220130      PERFORM INITIALIZE-COUNTER.                                      BIB-UPDT
1428            220140      OPEN INPUT MASTER-HOLD.                                          BIB-UPDT
1429            220150      OPEN OUTPUT REPORT-STORE.                                        BIB-UPDT
1430            220200  SORT-REFER-REPT.                                                     BIB-UPDT
1431            220210      SORT TAPE-SORT ON ASCENDING KEY                                  BIB-UPDT
1432            220220          REFERENCE-NUMBER OF SORT-REC                                 BIB-UPDT
1433            220230          AUTHORS-NAME OF SORT-REC                                     BIB-UPDT
1434            220240          ALLOY-ELEMENTS OF SORT-REC                                   BIB-UPDT
1435            220250          CARD-COUNT-NUMBER OF SORT-REC                                BIB-UPDT
1436            220260          COMPOSITION-RANGE OF SORT-REC                                BIB-UPDT
1437            220270      INPUT PROCEDURE IS SORT-REFERIN THRU SORT-REFERIN-FINIS          BIB-UPDT
1438            220280      OUTPUT PROCEDURE IS SORT-REFEROUT THRU SORT-REFEROUT-FINIS.      BIB-UPDT
1439            220290      GO TO OPEN-REFER-REPORT.                                         BIB-UPDT
1440            220400  SORT-REFERIN.                                                        BIB-UPDT
1441            220410      READ MASTER-HOLD AT END GO TO SORT-REFERIN-FINIS.                BIB-UPDT
1442            220420      RELEASE SORT-REC FROM HOLD-REC.                                  BIB-UPDT
1443            220430      ADD 1 TO TRANS-IN-COUNT.                                         BIB-UPDT
1444            220440      GO TO SORT-REFERIN.                                              BIB-UPDT
1445            220450  SORT-REFERIN-FINIS.                                                  BIB-UPDT
1446            220460      CLOSE MASTER-HOLD.                                               BIB-UPDT
1447            221000  SORT-REFEROUT.                                                       BIB-UPDT
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1448          221010      RETURN TAPE-SORT INTO STORE-REC                                  BIB-UPDT
1449          221020      AT END GO TO SORT-REFEROUT-FINIS.                                BIB-UPDT
1450          221030      WRITE STORE-REC.                                                 BIB-UPDT
1451          221040      ADD 1 TO TRANS-PROC-COUNT.                                       BIB-UPDT
1452          221050      GO TO SORT-REFEROUT.                                             BIB-UPDT
1453          221060  SORT-REFEROUT-FINIS.                                                 BIB-UPDT
1454          221070      CLOSE REPORT-STORE.                                              BIB-UPDT
1455          221100  OPEN-REFER-REPORT.                                                   BIB-UPDT
1456          221110      MOVE REFER-NO-PRINTOUT TO HED-4.                                 BIB-UPDT
1457          221120      MOVE 'XX' TO EOJ-UPDATE-SWT.                                     BIB-UPDT
1458          222000  REPT-3-OPENER.                                                       BIB-UPDT
1459          222005      PERFORM LEGEND-PRINTOUT.                                         BIB-UPDT
1460          222010      PERFORM REPORT-HEADER-1.                                         BIB-UPDT
1461          222020      OPEN INPUT REPORT-STORE.                                         BIB-UPDT
1462          222100  REPT-STORE-READ.                                                     BIB-UPDT
1463          222110      READ REPORT-STORE AT END GO TO REPT-STORE-FINIS.                 BIB-UPDT
1464          222120      ADD 1 TO MASTER-IN-COUNT.                                        BIB-UPDT
1465          222125      MOVE STORE-REC TO REPORT-REC.                                    BIB-UPDT
1466          222130      IF EOJ-UPDATE-SWT IS NOT EQUAL TO 'XX'                           BIB-UPDT
1467          222140      GO TO PRINT-ALLOY-REPT.                                          BIB-UPDT
1468          222150      MOVE REFERENCE-NUMBER OF STORE-REC                               BIB-UPDT
1469          222160      TO REFERENCE-NUMBER OF CURR-REFER-CONTROL.                       BIB-UPDT
1470          222170      MOVE AUTHORS-NAME OF STORE-REC                                   BIB-UPDT
1471          222180      TO AUTHORS-NAME OF CURR-REFER-CONTROL.                           BIB-UPDT
1472          222190      MOVE ALLOY-ELEMENTS OF STORE-REC                                 BIB-UPDT
1473          222200      TO ALLOY-ELEMENTS OF CURR-REFER-CONTROL.                         BIB-UPDT
1474          222210      MOVE CARD-COUNT-NUMBER OF STORE-REC                              BIB-UPDT
1475          222220      TO CARD-COUNT-NUMBER OF CURR-REFER-CONTROL.                      BIB-UPDT
1476          222230      MOVE COMPOSITION-RANGE OF STORE-REC                              BIB-UPDT
1477          222240      TO COMPOSITION-RANGE OF CURR-REFER-CONTROL.                      BIB-UPDT
1478          222250      MOVE CURR-REFER-CONTROL TO CURR-MAST-CONTROL.                    BIB-UPDT
1479          222300  REPT-STORE-SEQCK.                                                    BIB-UPDT
1480          222310      IF CURR-MAST-CONTROL IS GREATER THAN PREV-MAST-CONTROL           BIB-UPDT
1481          222320      MOVE CURR-MAST-CONTROL TO PREV-MAST-CONTROL                      BIB-UPDT
1482          222330      GO TO PRINT-REFER-REPT.                                          BIB-UPDT
1483          222340      IF CURR-MAST-CONTROL IS LESS THAN PREV-MAST-CONTROL              BIB-UPDT
1484          222350      MOVE KON6 TO CTRL-MESS                                           BIB-UPDT
1485          222360      PERFORM UPDATE-FINIS                                             BIB-UPDT
1486          222370      WRITE PRINT-REC BEFORE ADVANCING 66 LINES                        BIB-UPDT
1487          222380      CLOSE REPORT-STORE                                               BIB-UPDT
1488          222390      CLOSE PRINT-OUT                                                  BIB-UPDT
1489          222400      STOP RUN.                                                        BIB-UPDT
1490          230000  PRINT-REFER-REPT.                                                    BIB-UPDT
1491          230010      IF EOJ-UPDATE-SWT IS NOT EQUAL TO 'XX'                           BIB-UPDT
1492          230020      GO TO TEST-BLANK-ALLOY.                                          BIB-UPDT
1493          230030  PRINT-DATA-LINE.                                                     BIB-UPDT
1494          230040      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.                 BIB-UPDT
1495          230050      ADD 1 TO MAST-OUT-COUNT.                                         BIB-UPDT
1496          230060      GO TO REPT-STORE-READ.                                           BIB-UPDT
1497          230100  PRINT-ALLOY-REPT.                                                    BIB-UPDT
1498          230110      MOVE ALLOY-ELEMENTS OF STORE-REC                                 BIB-UPDT
1499          230120      TO ALLOY-ELEMENTS OF CURR-ALLOY-CONTROL.                         BIB-UPDT
1500          230130      MOVE AUTHORS-NAME OF STORE-REC                                   BIB-UPDT
1501          230140      TO AUTHORS-NAME OF CURR-ALLOY-CONTROL.                           BIB-UPDT
1502          230150      MOVE REFERENCE-NUMBER OF STORE-REC                               BIB-UPDT
1503          230160      TO REFERENCE-NUMBER OF CURR-ALLOY-CONTROL.                       BIB-UPDT
1504          230170      MOVE CARD-COUNT-NUMBER OF STORE-REC                              BIB-UPDT
1505          230180      TO CARD-COUNT-NUMBER OF CURR-ALLOY-CONTROL.                      BIB-UPDT
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1506  230190      MOVE COMPOSITION-RANGE OF STORE-REC                          BIB-UPDT
1507  230200      TO COMPOSITION-RANGE OF CURR-ALLOY-CONTROL.                  BIB-UPDT
1508  230210      MOVE CURR-ALLOY-CONTROL TO CURR-MAST-CONTROL.                BIB-UPDT
1509  230230      GO TO REPT-STORE-SEQCK.                                      BIB-UPDT
1510  230300 REPT-STORE-FINIS.                                                 BIB-UPDT
1511  230310      MOVE KON7 TO CTRL-MESS.                                      BIB-UPDT
1512  230320      PERFORM UPDATE-FINIS.                                        BIB-UPDT
1513  230330      IF EOJ-UPDATE-SWT IS EQUAL TO 'XX'                           BIB-UPDT
1514  230340      MOVE KON11 TO PRINT-REC                                      BIB-UPDT
1515  230350      WRITE PRINT-REC BEFORE ADVANCING 66 LINES                    BIB-UPDT
1516  230360      CLOSE REPORT-STORE                                           BIB-UPDT
1517  230370      GO TO CHECK-SWT-5.                                           BIB-UPDT
1518  230380      IF EOJ-UPDATE-SWT IS EQUAL TO ZEROS                          BIB-UPDT
1519  230390      MOVE KON12 TO PRINT-REC                                      BIB-UPDT
1520  230400      WRITE PRINT-REC BEFORE ADVANCING 66 LINES                    BIB-UPDT
1521  230410      CLOSE REPORT-STORE                                           BIB-UPDT
1522  230420      GO TO CHECK-SWT-6.                                           BIB-UPDT
1523  230430      IF EOJ-UPDATE-SWT IS EQUAL TO '10'                           BIB-UPDT
1524  230440      MOVE KON13 TO PRINT-REC                                      BIB-UPDT
1525  230450      WRITE PRINT-REC BEFORE ADVANCING 66 LINES                    BIB-UPDT
1526  230460      CLOSE REPORT-STORE                                           BIB-UPDT
1527  230470      GO TO CHECK-SWT-7.                                           BIB-UPDT
1528  230480      IF EOJ-UPDATE-SWT IS EQUAL TO '01'                           BIB-UPDT
1529  230490      MOVE KON17 TO PRINT-REC                                      BIB-UPDT
1530  230500      WRITE PRINT-REC BEFORE ADVANCING 66 LINES                    BIB-UPDT
1531  230510      CLOSE REPORT-STORE                                           BIB-UPDT
1532  230520      GO TO CHECK-SWT-8.                                           BIB-UPDT
1533  230610      MOVE KON18 TO PRINT-REC.                                     BIB-UPDT
1534  230620      WRITE PRINT-REC BEFORE ADVANCING 66 LINES.                   BIB-UPDT
1535  230630      CLOSE REPORT-STORE.                                          BIB-UPDT
1536  230640      GO TO FINAL-WRAP-UP.                                         BIB-UPDT
1537  235000 TEST-BLANK-ALLOY.                                                 BIB-UPDT
1538  235010      IF ALLOY-ELEMENTS OF STORE-REC IS EQUAL TO SPACES            BIB-UPDT
1539  235020      ADD 1 TO MAST-DUP-COUNT                                      BIB-UPDT
1540  235030      GO TO REPT-STORE-READ.                                       BIB-UPDT
1541  235040      IF CHAN-IN-SWT IS EQUAL TO ZERO                              BIB-UPDT
1542  235050      GO TO PRINT-DATA-LINE.                                       BIB-UPDT
1543  235060      MOVE CON1 TO XR1.                                            BIB-UPDT
1544  235070      MOVE ZERO TO NMR-SWT.                                        BIB-UPDT
1545  235080      PERFORM NMR-SEARCH-ONE 6 TIMES.                              BIB-UPDT
1546  235090      IF NMR-SWT IS EQUAL TO ZERO                                  BIB-UPDT
1547  235100      GO TO OTH-THAN-NMR.                                          BIB-UPDT
1548  235110      MOVE CON1 TO XR1.                                            BIB-UPDT
1549  235120      MOVE ZERO TO NMR-SWT.                                        BIB-UPDT
1550  235130      PERFORM NMR-SEARCH-TWO THRU NMR-SEARCH-EXIT 6 TIMES.         BIB-UPDT
1551  235140      IF NMR-SWT IS NOT EQUAL TO ZERO                              BIB-UPDT
1552  235150      GO TO PRINT-DATA-LINE.                                       BIB-UPDT
1553  235200 OTH-THAN-NMR.                                                     BIB-UPDT
1554  235210      ADD 1 TO DEL-MAST-COUNT.                                     BIB-UPDT
1555  235220      GO TO REPT-STORE-READ.                                       BIB-UPDT
1556  240000 CHECK-SWT-5.                                                      BIB-UPDT
1557  240010      IF SWT-5 IS EQUAL TO '1'                                     BIB-UPDT
1558  240020      GO TO CHECK-SWT-6.                                           BIB-UPDT
1559  240030      MOVE ALLOY-PRINTOUT TO HED-4.                                BIB-UPDT
1560  240040      MOVE ZEROS TO EOJ-UPDATE-SWT.                                BIB-UPDT
1561  240050 OPEN-NALLOY-REPORT.                                               BIB-UPDT
1562  240060      PERFORM INITIALIZE-COUNTER.                                  BIB-UPDT
1563  240070      OPEN INPUT MASTER-HOLD.                                      BIB-UPDT
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1564  240080      OPEN OUTPUT REPORT-STORE.                                    BIB-UPDT
1565  240100 SORT-NALLOY-REPORT.                                               BIB-UPDT
1566  240110      SORT TAPE-SORT ON ASCENDING KEY                              BIB-UPDT
1567  240120          ALLOY-ELEMENTS OF SORT-REC                               BIB-UPDT
1568  240130          AUTHORS-NAME OF SORT-REC                                 BIB-UPDT
1569  240140          REFERENCE-NUMBER OF SORT-REC                             BIB-UPDT
1570  240150          CARD-COUNT-NUMBER OF SORT-REC                            BIB-UPDT
1571  240160          COMPOSITION-RANGE OF SORT-REC                            BIB-UPDT
1572  240170      INPUT PROCEDURE IS SORT-REFERIN THRU SORT-REFERIN-FINIS      BIB-UPDT
1573  240180      OUTPUT PROCEDURE IS SORT-REFEROUT THRU SORT-REFEROUT-FINIS.  BIB-UPDT
1574  240190      GO TO REPT-3-OPENER.                                         BIB-UPDT
1575  251000 CHECK-SWT-6.                                                      BIB-UPDT
1576  251010      IF SWT-6 IS EQUAL TO '1'                                     BIB-UPDT
1577  251020      GO TO CHECK-SWT-7.                                           BIB-UPDT
1578  251030      MOVE NMR-ALLOY-PRINTOUT TO HED-4.                            BIB-UPDT
1579  251040      MOVE '10' TO EOJ-UPDATE-SWT.                                 BIB-UPDT
1580  251060      IF SWT-5 IS EQUAL TO '1'                                     BIB-UPDT
1581  251070      GO TO OPEN-NALLOY-REPORT.                                    BIB-UPDT
1582  251080      PERFORM INITIALIZE-COUNTER.                                  BIB-UPDT
1583  251090      GO TO REPT-3-OPENER.                                         BIB-UPDT
1584  251500 CHECK-SWT-7.                                                      BIB-UPDT
1585  251510      IF SWT-7 IS EQUAL TO '1'                                     BIB-UPDT
1586  251520      GO TO CHECK-SWT-8.                                           BIB-UPDT
1587  251530      MOVE PERMUTED-ALLOY-PRINTOUT TO HED-4.                       BIB-UPDT
1588  251540      MOVE '01' TO EOJ-UPDATE-SWT.                                 BIB-UPDT
1589  251600 OPEN-XALLOY-REPORT.                                               BIB-UPDT
1590  251610      MOVE 1 TO NO-SCOR-SWT.                                       BIB-UPDT
1591  251620      MOVE SPACES TO ERROR-REC.                                    BIB-UPDT
1592  251630      PERFORM INITIALIZE-COUNTER.                                  BIB-UPDT
1593  251640      OPEN INPUT MASTER-HOLD.                                      BIB-UPDT
1594  251650      OPEN OUTPUT REPORT-STORE.                                    BIB-UPDT
1595  252000 SORT-XALLOY-REPORT.                                               BIB-UPDT
1596  252010      SORT TAPE-SORT ON ASCENDING KEY                              BIB-UPDT
1597  252020          ALLOY-ELEMENTS OF SORT-REC                               BIB-UPDT
1598  252030          AUTHORS-NAME OF SORT-REC                                 BIB-UPDT
1599  252040          REFERENCE-NUMBER OF SORT-REC                             BIB-UPDT
1600  252050          CARD-COUNT-NUMBER OF SORT-REC                            BIB-UPDT
1601  252060          COMPOSITION-RANGE OF SORT-REC                            BIB-UPDT
1602  252070      INPUT PROCEDURE IS SORT-ALLOYIN THRU SORT-ALLOYIN-FINIS      BIB-UPDT
1603  252080      OUTPUT PROCEDURE IS SORT-ALLOYOUT THRU SORT-ALLOYOUT-FINIS.  BIB-UPDT
1604  252090      GO TO REPT-3-OPENER.                                         BIB-UPDT
1605  253000 SORT-ALLOYIN.                                                     BIB-UPDT
1606  253010      MOVE CON1 TO XR1.                                            BIB-UPDT
1607  253020      MOVE CON2 TO XR2.                                            BIB-UPDT
1608  253030      MOVE CON3 TO XR3.                                            BIB-UPDT
1609  253040      MOVE CON4 TO XR4.                                            BIB-UPDT
1610  253100      READ MASTER-HOLD AT END GO TO SORT-ALLOYIN-FINIS.            BIB-UPDT
1611  253110      MOVE ALLOY-ELEMENTS OF HOLD-REC                              BIB-UPDT
1612  253120      TO ALLOY-ELEMENTS OF ALLOY-ROTATE.                           BIB-UPDT
1613  253130      RELEASE SORT-REC FROM HOLD-REC.                              BIB-UPDT
1614  253140      ADD 1 TO TRANS-IN-COUNT.                                     BIB-UPDT
1615  253143      IF ALLOY-ELEMENTS OF HOLD-REC IS EQUAL TO SPACES             BIB-UPDT
1616  253145      ADD 1 TO TRANS-ERR-COUNT                                     BIB-UPDT
1617  253147      GO TO SORT-ALLOYIN.                                          BIB-UPDT
1618  253150      IF ALLOY-ID OF HOLD-REC (CON4) IS NOT EQUAL TO SPACES        BIB-UPDT
1619  253160      GO TO 4-ALLOYS.                                              BIB-UPDT
1620  253170      IF ALLOY-ID OF HOLD-REC (CON3) IS NOT EQUAL TO SPACES        BIB-UPDT
1621  253180      GO TO 3-ALLOYS.                                              BIB-UPDT
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1622  253190      IF ALLOY-ID OF HOLD-REC (CON2) IS EQUAL TO SPACES          BIB-UPDT
1623  253200      GO TO SORT-ALLOYIN.                                        BIB-UPDT
1624  253300 2-ALLOYS.                                                       BIB-UPDT
1625  253310      MOVE ALLOY-ID OF ALLOY-ROTATE (XR2)                        BIB-UPDT
1626  253320      TO ALLOY-ID OF HOLD-REC (XR1).                             BIB-UPDT
1627  253330      MOVE ALLOY-ID OF ALLOY-ROTATE (XR1)                        BIB-UPDT
1628  253340      TO ALLOY-ID OF HOLD-REC (XR2).                             BIB-UPDT
1629  253350      PERFORM RECORD-RELEASE.                                    BIB-UPDT
1630  253360      GO TO SORT-ALLOYIN.                                        BIB-UPDT
1631  254000 3-ALLOYS.                                                       BIB-UPDT
1632  254010      MOVE ALLOY-ID OF ALLOY-ROTATE (XR2)                        BIB-UPDT
1633  254020      TO ALLOY-ID OF HOLD-REC (XR1).                             BIB-UPDT
1634  254030      MOVE ALLOY-ID OF ALLOY-ROTATE (XR3)                        BIB-UPDT
1635  254040      TO ALLOY-ID OF HOLD-REC (XR2).                             BIB-UPDT
1636  254050      MOVE ALLOY-ID OF ALLOY-ROTATE (XR1)                        BIB-UPDT
1637  254060      TO ALLOY-ID OF HOLD-REC (XR3).                             BIB-UPDT
1638  254070      PERFORM RECORD-RELEASE.                                    BIB-UPDT
1639  254080      MOVE ALLOY-ID OF ALLOY-ROTATE (XR3)                        BIB-UPDT
1640  254090      TO ALLOY-ID OF HOLD-REC (XR1).                             BIB-UPDT
1641  254100      MOVE ALLOY-ID OF ALLOY-ROTATE (XR1)                        BIB-UPDT
1642  254110      TO ALLOY-ID OF HOLD-REC (XR2).                             BIB-UPDT
1643  254120      MOVE ALLOY-ID OF ALLOY-ROTATE (XR2)                        BIB-UPDT
1644  254130      TO ALLOY-ID OF HOLD-REC (XR3).                             BIB-UPDT
1645  254140      PERFORM RECORD-RELEASE.                                    BIB-UPDT
1646  254150      GO TO SORT-ALLOYIN.                                        BIB-UPDT
1647  255000 4-ALLOYS.                                                       BIB-UPDT
1648  255010      MOVE ALLOY-ID OF ALLOY-ROTATE (XR2)                        BIB-UPDT
1649  255020      TO ALLOY-ID OF HOLD-REC (XR1).                             BIB-UPDT
1650  255030      MOVE ALLOY-ID OF ALLOY-ROTATE (XR3)                        BIB-UPDT
1651  255040      TO ALLOY-ID OF HOLD-REC (XR2).                             BIB-UPDT
1652  255050      MOVE ALLOY-ID OF ALLOY-ROTATE (XR4)                        BIB-UPDT
1653  255060      TO ALLOY-ID OF HOLD-REC (XR3).                             BIB-UPDT
1654  255070      MOVE ALLOY-ID OF ALLOY-ROTATE (XR1)                        BIB-UPDT
1655  255080      TO ALLOY-ID OF HOLD-REC (XR4).                             BIB-UPDT
1656  255090      PERFORM RECORD-RELEASE.                                    BIB-UPDT
1657  256100      MOVE ALLOY-ID OF ALLOY-ROTATE (XR3)                        BIB-UPDT
1658  256110      TO ALLOY-ID OF HOLD-REC (XR1).                             BIB-UPDT
1659  256120      MOVE ALLOY-ID OF ALLOY-ROTATE (XR4)                        BIB-UPDT
1660  256130      TO ALLOY-ID OF HOLD-REC (XR2).                             BIB-UPDT
1661  256140      MOVE ALLOY-ID OF ALLOY-ROTATE (XR1)                        BIB-UPDT
1662  256150      TO ALLOY-ID OF HOLD-REC (XR3).                             BIB-UPDT
1663  256160      MOVE ALLOY-ID OF ALLOY-ROTATE (XR2)                        BIB-UPDT
1664  256170      TO ALLOY-ID OF HOLD-REC (XR4).                             BIB-UPDT
1665  256180      PERFORM RECORD-RELEASE.                                    BIB-UPDT
1666  256300      MOVE ALLOY-ID OF ALLOY-ROTATE (XR4)                        BIB-UPDT
1667  256310      TO ALLOY-ID OF HOLD-REC (XR1).                             BIB-UPDT
1668  256320      MOVE ALLOY-ID OF ALLOY-ROTATE (XR1)                        BIB-UPDT
1669  256330      TO ALLOY-ID OF HOLD-REC (XR2).                             BIB-UPDT
1670  256340      MOVE ALLOY-ID OF ALLOY-ROTATE (XR2)                        BIB-UPDT
1671  256350      TO ALLOY-ID OF HOLD-REC (XR3).                             BIB-UPDT
1672  256360      MOVE ALLOY-ID OF ALLOY-ROTATE (XR3)                        BIB-UPDT
1673  256370      TO ALLOY-ID OF HOLD-REC (XR4).                             BIB-UPDT
1674  256380      PERFORM RECORD-RELEASE.                                    BIB-UPDT
1675  256390      GO TO SORT-ALLOYIN.                                        BIB-UPDT
1676  256500 RECORD-RELEASE.                                                 BIB-UPDT
1677  256510      RELEASE SORT-REC FROM HOLD-REC.                            BIB-UPDT
1678  256520      ADD 1 TO TRANS-DUP-COUNT.                                  BIB-UPDT
1679  256530 SORT-ALLOYIN-FINIS.                                             BIB-UPDT
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1680    256540      CLOSE MASTER-HOLD.                                  BIB-UPDT
1681    257000  SORT-ALLOYOUT.                                          BIB-UPDT
1682    257010      RETURN TAPE-SORT INTO STORE-REC                     BIB-UPDT
1683    257020      AT END GO TO SORT-ALLOYOUT-FINIS.                   BIB-UPDT
1684    257030      WRITE STORE-REC.                                    BIB-UPDT
1685    257040      ADD 1 TO TRANS-PROC-COUNT.                          BIB-UPDT
1686    257050      GO TO SORT-ALLOYOUT.                                BIB-UPDT
1687    257060  SORT-ALLOYOUT-FINIS.                                    BIB-UPDT
1688    257070      CLOSE REPORT-STORE.                                 BIB-UPDT
1689    260000  CHECK-SWT-8.                                            BIB-UPDT
1690    260010      IF SWT-8 IS EQUAL TO '1'                            BIB-UPDT
1691    260020      GO TO FINAL-WRAP-UP.                                BIB-UPDT
1692    260030      MOVE NMR-PERMUTED-ALLOY-PRINTOUT TO HED-4.          BIB-UPDT
1693    260040      MOVE '11' TO EOJ-UPDATE-SWT.                        BIB-UPDT
1694    260060      IF SWT-7 IS EQUAL TO '1'                            BIB-UPDT
1695    260070      GO TO OPEN-XALLOY-REPORT.                           BIB-UPDT
1696    260080      PERFORM INITIALIZE-COUNTER.                         BIB-UPDT
1697    260090      GO TO REPT-3-OPENER.                                BIB-UPDT
1698    290000  LEGEND-PRINTOUT.                                        BIB-UPDT
1699    290005      MOVE ZEROS TO PAGE-NO.                              BIB-UPDT
1700    290010      MOVE HED-1 TO PRINT-REC.                            BIB-UPDT
1701    290020      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1702    290030      MOVE HED-2 TO PRINT-REC.                            BIB-UPDT
1703    290040      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1704    290050      MOVE HED-3 TO PRINT-REC.                            BIB-UPDT
1705    290060      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1706    290070      MOVE HED-4 TO PRINT-REC.                            BIB-UPDT
1707    290080      WRITE PRINT-REC AFTER ADVANCING 2 LINES.            BIB-UPDT
1708    290090      MOVE LEGEND-LINE-1 TO PRINT-REC.                    BIB-UPDT
1709    290100      WRITE PRINT-REC AFTER ADVANCING 3 LINES.            BIB-UPDT
1710    290110      MOVE LEGEND-LINE-2 TO PRINT-REC.                    BIB-UPDT
1711    290120      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1712    290130      MOVE LEGEND-LINE-3 TO PRINT-REC.                    BIB-UPDT
1713    290140      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1714    290150      MOVE LEGEND-LINE-1 TO PRINT-REC.                    BIB-UPDT
1715    290160      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1716    290170      MOVE SPACES TO PRINT-REC.                           BIB-UPDT
1717    290180      WRITE PRINT-REC BEFORE ADVANCING 66 LINES.          BIB-UPDT
1718    300000  REPORT-HEADER-1.                                        BIB-UPDT
1719    300010      ADD ONE TO PAGE-COUNTER.                            BIB-UPDT
1720    300020      MOVE PAGE-COUNTER TO PAGE-NO.                       BIB-UPDT
1721    300030      MOVE HED-1 TO PRINT-REC.                            BIB-UPDT
1722    300040      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1723    300050      MOVE HED-2 TO PRINT-REC.                            BIB-UPDT
1724    300060      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1725    300070      MOVE HED-3 TO PRINT-REC.                            BIB-UPDT
1726    300080      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1727    300090      MOVE HED-4 TO PRINT-REC.                            BIB-UPDT
1728    300100      WRITE PRINT-REC AFTER ADVANCING 1 LINE.             BIB-UPDT
1729    300110      MOVE COL-1 TO PRINT-REC.                            BIB-UPDT
1730    300120      WRITE PRINT-REC AFTER ADVANCING 2 LINES.            BIB-UPDT
1731    300130      MOVE COL-2 TO PRINT-REC.                            BIB-UPDT
1732    300140      WRITE PRINT-REC.                                    BIB-UPDT
1733    300150      MOVE COL-3 TO PRINT-REC.                            BIB-UPDT
1734    300160      WRITE PRINT-REC.                                    BIB-UPDT
1735    300170      MOVE SPACES TO PRINT-REC.                           BIB-UPDT
1736    310000  TRANS-EDIT.                                             BIB-UPDT
1737    310010      IF LAST-NAME OF REPORT-REC IS EQUAL TO SPACES       BIB-UPDT
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1738  310015      MOVE ALL 'X' TO LAST-NAME OF ERROR-REC                          BIB-UPDT
1739  310020      MOVE 1 TO EDIT-ERR-SWT-1                                        BIB-UPDT
1740  310025      GO TO EDIT-1ST-INITIAL.                                         BIB-UPDT
1741  310030      IF LAST-NAME OF REPORT-REC IS NOT ALPHABETIC                    BIB-UPDT
1742  310040      MOVE ALL 'X' TO LAST-NAME OF ERROR-REC                          BIB-UPDT
1743  310050      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1744  310055 EDIT-1ST-INITIAL.                                                    BIB-UPDT
1745  310060      IF 1ST-INITIAL OF REPORT-REC IS NOT ALPHABETIC                  BIB-UPDT
1746  310070      MOVE 'X' TO 1ST-INITIAL OF ERROR-REC                            BIB-UPDT
1747  310080      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1748  310083      IF NO-OF-AUTHORS OF REPORT-REC IS NOT NUMERIC                   BIB-UPDT
1749  310085      MOVE 'X' TO NO-OF-AUTHORS OF ERROR-REC                          BIB-UPDT
1750  310087      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1751  310090      IF CHANGE-CODE OF REPORT-REC IS LESS THAN 1                     BIB-UPDT
1752  310100      GO TO CHAN-CODE-ERROR.                                          BIB-UPDT
1753  310110      IF CHANGE-CODE OF REPORT-REC IS NOT GREATER THAN 3              BIB-UPDT
1754  310120      GO TO EDIT-VOL-NO.                                              BIB-UPDT
1755  310130 CHAN-CODE-ERROR.                                                     BIB-UPDT
1756  310133      IF CHANGE-CODE OF REPORT-REC IS EQUAL TO SPACE                  BIB-UPDT
1757  310135      AND MESSAGE-3 IS EQUAL TO 'EDIT MAST-IN'                        BIB-UPDT
1758  310137      GO TO EDIT-VOL-NO.                                              BIB-UPDT
1759  310140      MOVE 'X' TO CHANGE-CODE OF ERROR-REC.                           BIB-UPDT
1760  310150      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1761  310160 EDIT-VOL-NO.                                                        BIB-UPDT
1762  310163      IF JOURNAL-NAME OF REPORT-REC IS NOT ALPHABETIC                 BIB-UPDT
1763  310165      MOVE ALL 'X' TO JOURNAL-NAME OF ERROR-REC                       BIB-UPDT
1764  310167      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1765  310170      IF VOL-NO OF REPORT-REC IS NOT NUMERIC                          BIB-UPDT
1766  310180      MOVE ALL 'X' TO VOL-NO OF ERROR-REC                             BIB-UPDT
1767  310190      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1768  310200      IF VOL-XX OF REPORT-REC IS NOT ALPHABETIC                       BIB-UPDT
1769  310210      MOVE 'X' TO VOL-XX OF ERROR-REC                                 BIB-UPDT
1770  310220      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1771  310230      IF PAGE OF REPORT-REC IS NOT NUMERIC                            BIB-UPDT
1772  310240      MOVE ALL 'X' TO PAGE OF ERROR-REC                               BIB-UPDT
1773  310250      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1774  310260      IF REFERENCE-NUMBER OF REPORT-REC IS NOT NUMERIC                BIB-UPDT
1775  310270      MOVE ALL 'X' TO REFERENCE-NUMBER OF ERROR-REC                   BIB-UPDT
1776  310280      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1777  310290      IF BROAD-CATE OF REPORT-REC IS NOT ALPHABETIC                   BIB-UPDT
1778  310300      MOVE ALL 'X' TO BROAD-CATE OF ERROR-REC                         BIB-UPDT
1779  310310      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1780  310320      IF SPEC-CATE OF REPORT-REC IS NOT ALPHABETIC                    BIB-UPDT
1781  310330      MOVE 'X' TO SPEC-CATE OF ERROR-REC                              BIB-UPDT
1782  310340      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1783  310350      MOVE CON1 TO XR1.                                               BIB-UPDT
1784  310360      PERFORM PROPERTIES-EDIT THRU PROPERTIES-EDIT-EXIT 6 TIMES.      BIB-UPDT
1785  310363      IF CARD-COUNT-NUMBER OF REPORT-REC IS EQUAL TO SPACE            BIB-UPDT
1786  310367      GO TO EDIT-ALLOY-ELEMENTS.                                      BIB-UPDT
1787  310370      IF CARD-COUNT-NUMBER OF REPORT-REC IS NOT NUMERIC               BIB-UPDT
1788  310380      MOVE 'X' TO CARD-COUNT-NUMBER OF ERROR-REC                      BIB-UPDT
1789  310400      MOVE 1 TO EDIT-ERR-SWT-1.                                       BIB-UPDT
1790  310410 EDIT-ALLOY-ELEMENTS.                                                 BIB-UPDT
1791  310415      MOVE CON1 TO XR1.                                               BIB-UPDT
1792  310420      PERFORM ALLOY-EDIT THRU ALLOY-EDIT-EXIT 4 TIMES.                BIB-UPDT
1793  310430      IF ELEMENT-STUDIED OF REPORT-REC IS LESS THAN '1'               BIB-UPDT
1794  310440      GO TO CONT-ELEMENT-EDIT.                                        BIB-UPDT
1795  310450      IF ELEMENT-STUDIED OF REPORT-REC IS LESS THAN '8'               BIB-UPDT
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1796    310460      GO TO EDIT-COMPOSITION.                                  BIB-UPDT
1797    310470 ELEMENT-STUDIED-ERROR.                                        BIB-UPDT
1798    310480      MOVE 'X' TO ELEMENT-STUDIED OF ERROR-REC.                BIB-UPDT
1799    310490      MOVE 1 TO EDIT-ERR-SWT-1.                                BIB-UPDT
1800    310500      GO TO EDIT-COMPOSITION.                                  BIB-UPDT
1801    310510 CONT-ELEMENT-EDIT.                                            BIB-UPDT
1802    310513      IF ELEMENT-STUDIED OF REPORT-REC IS EQUAL TO SPACE       BIB-UPDT
1803    310515      GO TO EDIT-COMPOSITION.                                  BIB-UPDT
1804    310520      IF ELEMENT-STUDIED OF REPORT-REC IS LESS THAN 'A'        BIB-UPDT
1805    310530      GO TO ELEMENT-STUDIED-ERROR.                             BIB-UPDT
1806    310540      IF ELEMENT-STUDIED OF REPORT-REC IS GREATER THAN 'O'     BIB-UPDT
1807    310550      GO TO ELEMENT-STUDIED-ERROR.                             BIB-UPDT
1808    310560 EDIT-COMPOSITION.                                             BIB-UPDT
1809    310563      IF LO-COMP OF REPORT-REC IS EQUAL TO SPACES              BIB-UPDT
1810    310565      GO TO CONT-COMPOSITION-EDIT.                             BIB-UPDT
1811    310567      IF LOCOMP-D1 OF REPORT-REC IS EQUAL TO SPACE             BIB-UPDT
1812    310568      MOVE ZERO TO LOCOMP-D1 OF REPORT-REC.                    BIB-UPDT
1813    310570      IF LO-COMP OF REPORT-REC IS NOT NUMERIC                  BIB-UPDT
1814    310580      MOVE ALL 'X' TO LO-COMP OF ERROR-REC                     BIB-UPDT
1815    310590      MOVE 1 TO EDIT-ERR-SWT-1.                                BIB-UPDT
1816    310593 CONT-COMPOSITION-EDIT.                                        BIB-UPDT
1817    310595      IF HI-COMP OF REPORT-REC IS EQUAL TO SPACES              BIB-UPDT
1818    310597      GO TO EDIT-TEMPERATURE.                                  BIB-UPDT
1819    310598      IF HICOMP-D1 OF REPORT-REC IS EQUAL TO SPACE             BIB-UPDT
1820    310599      MOVE ZERO TO HICOMP-D1 OF REPORT-REC.                    BIB-UPDT
1821    310600      IF HI-COMP OF REPORT-REC IS NOT NUMERIC                  BIB-UPDT
1822    310610      GO TO HI-COMP-ERROR.                                     BIB-UPDT
1823    310620      IF HI-COMP OF REPORT-REC IS NOT GREATER THAN 100         BIB-UPDT
1824    310630      GO TO EDIT-TEMPERATURE.                                  BIB-UPDT
1825    310640 HI-COMP-ERROR.                                                BIB-UPDT
1826    310650      MOVE ALL 'X' TO HI-COMP OF ERROR-REC.                    BIB-UPDT
1827    310660      MOVE 1 TO EDIT-ERR-SWT-1.                                BIB-UPDT
1828    310670 EDIT-TEMPERATURE.                                             BIB-UPDT
1829    310673      IF LO-TEMP OF REPORT-REC IS EQUAL TO SPACES              BIB-UPDT
1830    310675      GO TO CONT-TEMPERATURE-EDIT.                             BIB-UPDT
1831    310677      IF LOTEMP-D1 OF REPORT-REC IS EQUAL TO SPACE             BIB-UPDT
1832    310678      MOVE ZERO TO LOTEMP-D1 OF REPORT-REC.                    BIB-UPDT
1833    310680      IF LO-TEMP OF REPORT-REC IS NOT NUMERIC                  BIB-UPDT
1834    310690      MOVE ALL 'X' TO LO-TEMP OF ERROR-REC                     BIB-UPDT
1835    310700      MOVE 1 TO EDIT-ERR-SWT-1.                                BIB-UPDT
1836    310703 CONT-TEMPERATURE-EDIT.                                        BIB-UPDT
1837    310705      IF HI-TEMP OF REPORT-REC IS EQUAL TO SPACES              BIB-UPDT
1838    310707      GO TO TRANS-EDIT-EXIT.                                   BIB-UPDT
1839    310708      IF HITEMP-D1 OF REPORT-REC IS EQUAL TO SPACE             BIB-UPDT
1840    310709      MOVE ZERO TO HITEMP-D1 OF REPORT-REC.                    BIB-UPDT
1841    310710      IF HI-TEMP OF REPORT-REC IS NOT NUMERIC                  BIB-UPDT
1842    310720      MOVE ALL 'X' TO HI-TEMP OF ERROR-REC                     BIB-UPDT
1843    310730      MOVE 1 TO EDIT-ERR-SWT-1.                                BIB-UPDT
1844    310740 TRANS-EDIT-EXIT.                                              BIB-UPDT
1845    310750      EXIT.                                                    BIB-UPDT
1846    320000 TRANS-PRINTOUT.                                               BIB-UPDT
1847    320010      MOVE LAST-NAME OF REPORT-REC                             BIB-UPDT
1848    320020      TO LAST-NAME OF PRINT-REC.                               BIB-UPDT
1849    320030      MOVE 1ST-INITIAL OF REPORT-REC                           BIB-UPDT
1850    320040      TO 1ST-INITIAL OF PRINT-REC.                             BIB-UPDT
1851    320050      MOVE NO-OF-AUTHORS OF REPORT-REC                         BIB-UPDT
1852    320060      TO NO-OF-AUTHORS OF PRINT-REC.                           BIB-UPDT
1853    320070      MOVE JOURNAL-NAME OF REPORT-REC                          BIB-UPDT
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1854    320080     TO JOURNAL-NAME OF PRINT-REC.                                  BIB-UPDT
1855    320090     MOVE VOL-NO OF REPORT-REC                                      BIB-UPDT
1856    320100     TO VOL-NO OF PRINT-REC.                                        BIB-UPDT
1857    320110     MOVE VOL-XX OF REPORT-REC                                      BIB-UPDT
1858    320120     TO VOL-XX OF PRINT-REC.                                        BIB-UPDT
1859    320130     MOVE PAGE OF REPORT-REC                                        BIB-UPDT
1860    320140     TO PAGE OF PRINT-REC.                                          BIB-UPDT
1861    320150     MOVE KON19 TO REFER-CENT OF PRINT-REC.                         BIB-UPDT
1862    320160     MOVE REFER-YR OF REPORT-REC                                    BIB-UPDT
1863    320170     TO REFER-YR OF PRINT-REC.                                      BIB-UPDT
1864    320173     MOVE REFER-YR OF REPORT-REC                                    BIB-UPDT
1865    320175     TO YEAR-REFER OF PRINT-REC.                                    BIB-UPDT
1866    320180     MOVE REFER-NO OF REPORT-REC                                    BIB-UPDT
1867    320190     TO REFER-NO OF PRINT-REC.                                      BIB-UPDT
1868    320193     IF BROAD-CATE OF REPORT-REC IS EQUAL TO 'ERR'                  BIB-UPDT
1869    320195     MOVE ZEROS TO REFER-CENT OF PRINT-REC                          BIB-UPDT
1870    320197     MOVE ZEROS TO REFER-YR OF PRINT-REC.                           BIB-UPDT
1871    320200     MOVE BROAD-CATE OF REPORT-REC                                  BIB-UPDT
1872    320210     TO BROAD-CATE OF PRINT-REC.                                    BIB-UPDT
1873    320220     MOVE SPEC-CATE OF REPORT-REC                                   BIB-UPDT
1874    320230     TO SPEC-CATE OF PRINT-REC.                                     BIB-UPDT
1875    320240     MOVE CON1 TO XR1.                                              BIB-UPDT
1876    320250     PERFORM PROPERTIES-MOVE THRU PROP-MOVE-EXIT 6 TIMES.           BIB-UPDT
1877    320253     IF CARD-COUNT-NUMBER OF REPORT-REC IS EQUAL TO SPACE           BIB-UPDT
1878    320255     MOVE '*' TO CARD-COUNT-NUMBER OF REPORT-REC.                   BIB-UPDT
1879    320260     IF CRDCNT-REDEF OF REPORT-REC IS NUMERIC                       BIB-UPDT
1880    320265     MOVE CRDCNT-REDEF OF REPORT-REC                                BIB-UPDT
1881    320270     TO CRDCNT-REDEF OF PRINT-REC                                   BIB-UPDT
1882    320273     ELSE MOVE CARD-COUNT-NUMBER OF REPORT-REC                      BIB-UPDT
1883    320275     TO CARD-COUNT-NUMBER OF PRINT-REC.                             BIB-UPDT
1884    320280     MOVE CON1 TO XR1.                                              BIB-UPDT
1885    320290     PERFORM ALLOY-ELEMENTS-MOVE THRU ELE-MOVE-EXIT 4 TIMES.        BIB-UPDT
1886    320300     MOVE ELEMENT-STUDIED OF REPORT-REC                             BIB-UPDT
1887    320310     TO ELEMENT-STUDIED OF PRINT-REC.                               BIB-UPDT
1888    320320     IF LOCOMP-REDEF OF REPORT-REC IS NUMERIC                       BIB-UPDT
1889    320325     MOVE LOCOMP-REDEF OF REPORT-REC                                BIB-UPDT
1890    320330     TO LOCOMP-REDEF OF PRINT-REC                                   BIB-UPDT
1891    320333     ELSE MOVE LO-COMP OF REPORT-REC                                BIB-UPDT
1892    320335     TO LO-COMP OF PRINT-REC.                                       BIB-UPDT
1893    320340     IF HICOMP-REDEF OF REPORT-REC IS NUMERIC                       BIB-UPDT
1894    320345     MOVE HICOMP-REDEF OF REPORT-REC                                BIB-UPDT
1895    320350     TO HICOMP-REDEF OF PRINT-REC                                   BIB-UPDT
1896    320353     ELSE MOVE HI-COMP OF REPORT-REC                                BIB-UPDT
1897    320355     TO HI-COMP OF PRINT-REC.                                       BIB-UPDT
1898    320360     IF LOTEMP-REDEF OF REPORT-REC IS NUMERIC                       BIB-UPDT
1899    320365     MOVE LOTEMP-REDEF OF REPORT-REC                                BIB-UPDT
1900    320370     TO LOTEMP-REDEF OF PRINT-REC                                   BIB-UPDT
1901    320373     ELSE MOVE LO-TEMP OF REPORT-REC                                BIB-UPDT
1902    320375     TO LO-TEMP OF PRINT-REC.                                       BIB-UPDT
1903    320380     IF HITEMP-REDEF OF REPORT-REC IS NUMERIC                       BIB-UPDT
1904    320385     MOVE HITEMP-REDEF OF REPORT-REC                                BIB-UPDT
1905    320390     TO HITEMP-REDEF OF PRINT-REC                                   BIB-UPDT
1906    320393     ELSE MOVE HI-TEMP OF REPORT-REC                                BIB-UPDT
1907    320395     TO HI-TEMP OF PRINT-REC.                                       BIB-UPDT
1908    320400     MOVE CHANGE-CODE OF REPORT-REC                                 BIB-UPDT
1909    320410     TO CHANGE-CODE OF PRINT-REC.                                   BIB-UPDT
1910    320420     WRITE PRINT-REC AFTER ADVANCING 1 LINE.                        BIB-UPDT
1911    320423     IF EDIT-ERR-SWT-1 IS EQUAL TO 1                                BIB-UPDT
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1912            320425      MOVE 'RJ' TO REJT-MESS.                                          BIB-UPDT
1913            320430      MOVE ERROR-REC TO PRINT-REC.                                     BIB-UPDT
1914            320440      IF NO-SCOR-SWT IS EQUAL TO ZERO                                  BIB-UPDT
1915            320450      PERFORM ALLOY-LOOKUP THRU ALLOY-LOOKUP-EXIT.                     BIB-UPDT
1916            320470      IF LINE-COUNT IS LESS THAN 24                                    BIB-UPDT
1917            320480      WRITE PRINT-REC AFTER ADVANCING 1 LINE                           BIB-UPDT
1918            320490      ADD 1 TO LINE-COUNT                                              BIB-UPDT
1919            320495      MOVE SPACES TO PRINT-REC                                         BIB-UPDT
1920            320500      GO TO TRANS-PRINTOUT-EXIT.                                       BIB-UPDT
1921            320520      WRITE PRINT-REC AFTER ADVANCING 1 LINE.                          BIB-UPDT
1922            320525      MOVE SPACES TO PRINT-REC.                                        BIB-UPDT
1923            320530      WRITE PRINT-REC BEFORE ADVANCING 66 LINES.                       BIB-UPDT
1924            320535      MOVE ZEROS TO LINE-COUNT.                                        BIB-UPDT
1925            320540      MOVE 1 TO PAGE-EJECT-SWT.                                        BIB-UPDT
1926            320545      PERFORM REPORT-HEADER-1.                                         BIB-UPDT
1927            320550 TRANS-PRINTOUT-EXIT.                                                  BIB-UPDT
1928            320560      EXIT.                                                            BIB-UPDT
1929            330010 PROPERTIES-MOVE.                                                      BIB-UPDT
1930            330020      MOVE 1ST-POST OF REPORT-REC (XR1)                                BIB-UPDT
1931            330030      TO 1ST-POST OF PRINT-REC (XR1).                                  BIB-UPDT
1932            330040      MOVE 2ND-POST OF REPORT-REC (XR1)                                BIB-UPDT
1933            330050      TO 2ND-POST OF PRINT-REC (XR1).                                  BIB-UPDT
1934            330060      ADD CON1 TO XR1.                                                 BIB-UPDT
1935            330063 PROP-MOVE-EXIT.                                                       BIB-UPDT
1936            330065      EXIT.                                                            BIB-UPDT
1937            330070 ALLOY-ELEMENTS-MOVE.                                                  BIB-UPDT
1938            330080      MOVE ALLOY-ID OF REPORT-REC (XR1)                                BIB-UPDT
1939            330090      TO ALLOY-ID OF PRINT-REC (XR1).                                  BIB-UPDT
1940            330100      ADD CON1 TO XR1.                                                 BIB-UPDT
1941            330110 ELE-MOVE-EXIT.                                                        BIB-UPDT
1942            330120      EXIT.                                                            BIB-UPDT
1943            330210 PROPERTIES-EDIT.                                                      BIB-UPDT
1944            330220      IF 1ST-POST OF REPORT-REC (XR1) IS NOT EQUAL TO SPACE            BIB-UPDT
1945            330230      GO TO CONT-PROP-EDIT.                                            BIB-UPDT
1946            330240      IF 2ND-POST OF REPORT-REC (XR1) IS EQUAL TO SPACE                BIB-UPDT
1947            330250      GO TO UP-PROP-XREG.                                              BIB-UPDT
1948            330260 CONT-PROP-EDIT.                                                       BIB-UPDT
1949            330270      IF 1ST-POST OF REPORT-REC (XR1) IS NOT NUMERIC                   BIB-UPDT
1950            330280      MOVE 'X' TO 1ST-POST OF ERROR-REC (XR1)                          BIB-UPDT
1951            330290      MOVE 1 TO EDIT-ERR-SWT-1.                                        BIB-UPDT
1952            330300      IF 2ND-POST OF REPORT-REC (XR1) IS EQUAL TO SPACE                BIB-UPDT
1953            330310      GO TO PROP-2ND-POST-ERR.                                         BIB-UPDT
1954            330320      IF 2ND-POST OF REPORT-REC (XR1) IS ALPHABETIC                    BIB-UPDT
1955            330330      GO TO UP-PROP-XREG.                                              BIB-UPDT
1956            330340 PROP-2ND-POST-ERR.                                                    BIB-UPDT
1957            330350      MOVE 'X' TO 2ND-POST OF ERROR-REC (XR1).                         BIB-UPDT
1958            330360      MOVE 1 TO EDIT-ERR-SWT-1.                                        BIB-UPDT
1959            330370 UP-PROP-XREG.                                                         BIB-UPDT
1960            330380      ADD CON1 TO XR1.                                                 BIB-UPDT
1961            330390 PROPERTIES-EDIT-EXIT.                                                 BIB-UPDT
1962            330400      EXIT.                                                            BIB-UPDT
1963            330510 ALLOY-EDIT.                                                           BIB-UPDT
1964            330520      IF ALLOY-ID OF REPORT-REC (XR1) IS NOT ALPHABETIC                BIB-UPDT
1965            330530      MOVE ALL 'X' TO ALLOY-ID OF ERROR-REC (XR1)                      BIB-UPDT
1966            330540      MOVE 1 TO EDIT-ERR-SWT-1.                                        BIB-UPDT
1967            330550      ADD CON1 TO XR1.                                                 BIB-UPDT
1968            330560 ALLOY-EDIT-EXIT.                                                      BIB-UPDT
1969            330570      EXIT.                                                            BIB-UPDT
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1970     340010 ALLOY-LOOKUP.                                                    BIB-UPDT
1971     340020     IF ELEMENT-STUDIED OF ERROR-REC IS EQUAL TO 'X'              BIB-UPDT
1972     340030     GO TO BAD-ELEMENT-CODE.                                      BIB-UPDT
1973     340040     ADD ALY-TBL-CNT, ONE GIVING HIGH-ENTRY.                      BIB-UPDT
1974     340050     MOVE ZEROS TO LOW-ENTRY.                                     BIB-UPDT
1975     340100 ALY-BINARY-SEARCH.                                               BIB-UPDT
1976     340110     ADD HIGH-ENTRY, LOW-ENTRY GIVING XR1;                        BIB-UPDT
1977     340115     ON SIZE ERROR GO TO BAD-ELEMENT-CODE.                        BIB-UPDT
1978     340120     DIVIDE CON2 INTO XR1 GIVING INTER-CNTR.                      BIB-UPDT
1979     340125     MOVE INTER-CNTR TO XR1.                                      BIB-UPDT
1980     340130     IF ELEMENT-STUDIED OF REPORT-REC IS EQUAL TO                 BIB-UPDT
1981     340140     UND-SCOR-ARGUE (XR1)                                         BIB-UPDT
1982     340150     MOVE UND-SCOR-FUNCTION (XR1) TO                              BIB-UPDT
1983     340160     ALLOY-ELEMENTS OF PRINT-REC                                  BIB-UPDT
1984     340170     GO TO ALLOY-LOOKUP-EXIT.                                     BIB-UPDT
1985     340180     IF ELEMENT-STUDIED OF REPORT-REC IS LESS THAN                BIB-UPDT
1986     340190     UND-SCOR-ARGUE (XR1)                                         BIB-UPDT
1987     340200     MOVE XR1 TO HIGH-ENTRY                                       BIB-UPDT
1988     340210     ELSE MOVE XR1 TO LOW-ENTRY.                                  BIB-UPDT
1989     340212     ADD LOW-ENTRY, ONE GIVING MID-CNTR;                          BIB-UPDT
1990     340215     ON SIZE ERROR GO TO BAD-ELEMENT-CODE.                        BIB-UPDT
1991     340220     IF MID-CNTR IS NOT EQUAL TO HIGH-ENTRY                       BIB-UPDT
1992     340230     GO TO ALY-BINARY-SEARCH.                                     BIB-UPDT
1993     340240 BAD-ELEMENT-CODE.                                                BIB-UPDT
1994     340250     MOVE CON1 TO XR1.                                            BIB-UPDT
1995     340260     MOVE UND-SCOR-FUNCTION (XR1) TO ALLOY-ELEMENTS OF PRINT-REC. BIB-UPDT
1996     340270 ALLOY-LOOKUP-EXIT.                                               BIB-UPDT
1997     340280     EXIT.                                                        BIB-UPDT
1998     340400 PUNCHOUT-CHANGES.                                                BIB-UPDT
1999     340410     MOVE MAST-OUT-REC TO PUNX-REC.                               BIB-UPDT
2000     340420     MOVE VOL-NO OF MAST-OUT-REC                                  BIB-UPDT
2001     340430     TO VOL-NO OF PUNX-REC.                                       BIB-UPDT
2002     340440     MOVE PAGE OF MAST-OUT-REC                                    BIB-UPDT
2003     340450     TO PAGE OF PUNX-REC.                                         BIB-UPDT
2004     340500     WRITE PUNX-REC.                                              BIB-UPDT
2005     340510     ADD 1 TO TRANS-PUNX-COUNT.                                   BIB-UPDT
2006     350000 NMR-SEARCH-ONE.                                                  BIB-UPDT
2007     350010     IF 1ST-POST OF REPORT-REC (XR1) IS EQUAL TO '4'              BIB-UPDT
2008     350020     MOVE 1 TO NMR-SWT.                                           BIB-UPDT
2009     350030     ADD CON1 TO XR1.                                             BIB-UPDT
2010     350100 NMR-SEARCH-TWO.                                                  BIB-UPDT
2011     350110     IF 2ND-POST OF REPORT-REC (XR1) IS LESS THAN 'A'             BIB-UPDT
2012     350120     GO TO NMR-SEARCH-EXIT.                                       BIB-UPDT
2013     350130     IF 2ND-POST OF REPORT-REC (XR1) IS LESS THAN 'I'             BIB-UPDT
2014     350140     GO TO SETON-NMR-SWT.                                         BIB-UPDT
2015     350150     IF 2ND-POST OF REPORT-REC (XR1) IS EQUAL TO 'H'              BIB-UPDT
2016     350160     GO TO SETON-NMR-SWT.                                         BIB-UPDT
2017     350170     IF 2ND-POST OF REPORT-REC (XR1) IS NOT EQUAL TO 'R'          BIB-UPDT
2018     350180     GO TO NMR-SEARCH-EXIT.                                       BIB-UPDT
2019     350300 SETON-NMR-SWT.                                                   BIB-UPDT
2020     350310     MOVE 1 TO NMR-SWT.                                           BIB-UPDT
2021     350350 NMR-SEARCH-EXIT.                                                 BIB-UPDT
2022     350360     ADD CON1 TO XR1.                                             BIB-UPDT
2023     410000 INITIALIZE-COUNTER.                                              BIB-UPDT
2024     410010     MOVE ZEROS TO TRANS-IN-COUNT.                                BIB-UPDT
2025     410020     MOVE ZEROS TO TRANS-ERR-COUNT.                               BIB-UPDT
2026     410030     MOVE ZEROS TO TRANS-DUP-COUNT.                               BIB-UPDT
2027     410040     MOVE ZEROS TO TRANS-PROC-COUNT.                              BIB-UPDT
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2028  410050      MOVE ZEROS TO MASTER-IN-COUNT.                          BIB-UPDT
2029  410060      MOVE ZEROS TO DEL-MAST-COUNT.                           BIB-UPDT
2030  410070      MOVE ZEROS TO MAST-DUP-COUNT.                           BIB-UPDT
2031  410080      MOVE ZEROS TO NEW-MAST-COUNT.                           BIB-UPDT
2032  410090      MOVE ZEROS TO MAST-OUT-COUNT.                           BIB-UPDT
2033  410100      MOVE ZEROS TO TRANS-PUNX-COUNT.                         BIB-UPDT
2034  410110      MOVE ZEROS TO MAST-STOR-COUNT.                          BIB-UPDT
2035  410120      MOVE ZEROS TO LINE-COUNT.                               BIB-UPDT
2036  410130      MOVE ZEROS TO PAGE-COUNTER.                             BIB-UPDT
2037  410140      MOVE SPACES TO PREV-CHAN-CONTROL.                       BIB-UPDT
2038  410150      MOVE SPACES TO CURR-CHAN-CONTROL.                       BIB-UPDT
2039  410160      MOVE SPACES TO PREV-MAST-CONTROL.                       BIB-UPDT
2040  410170      MOVE SPACES TO CURR-MAST-CONTROL.                       BIB-UPDT
2041  420000 UPDATE-FINIS.                                                BIB-UPDT
2042  420010      MOVE SPACES TO PRINT-REC.                               BIB-UPDT
2043  420020      MOVE KON1 TO PRINT-REC.                                 BIB-UPDT
2044  420030      WRITE PRINT-REC AFTER ADVANCING 66 LINES.               BIB-UPDT
2045  420040      MOVE EOJ-MESSAGE TO PRINT-REC.                          BIB-UPDT
2046  420050      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2047  420060      MOVE TRANS-IN-COUNT TO CNT-1.                           BIB-UPDT
2048  420070      MOVE TRANS-ERR-COUNT TO CNT-2.                          BIB-UPDT
2049  420080      MOVE TRANS-DUP-COUNT TO CNT-3.                          BIB-UPDT
2050  420090      MOVE TRANS-PROC-COUNT TO CNT-4.                         BIB-UPDT
2051  420100      MOVE MASTER-IN-COUNT TO CNT-5.                          BIB-UPDT
2052  420110      MOVE DEL-MAST-COUNT TO CNT-6.                           BIB-UPDT
2053  420120      MOVE MAST-DUP-COUNT TO CNT-7.                           BIB-UPDT
2054  420130      MOVE NEW-MAST-COUNT TO CNT-8.                           BIB-UPDT
2055  420140      MOVE MAST-OUT-COUNT TO CNT-9.                           BIB-UPDT
2056  420150      MOVE TRANS-PUNX-COUNT TO CNT-10.                        BIB-UPDT
2057  420160      MOVE MAST-STOR-COUNT TO CNT-11.                         BIB-UPDT
2058  420170      MOVE SPACES TO PRINT-REC.                               BIB-UPDT
2059  420180      MOVE EOJ-MESS-1 TO PRINT-REC.                           BIB-UPDT
2060  420190      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2061  420200      MOVE EOJ-MESS-2 TO PRINT-REC.                           BIB-UPDT
2062  420210      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2063  420220      MOVE EOJ-MESS-3 TO PRINT-REC.                           BIB-UPDT
2064  420230      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2065  420240      MOVE EOJ-MESS-4 TO PRINT-REC.                           BIB-UPDT
2066  420250      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2067  420260      MOVE EOJ-MESS-5 TO PRINT-REC.                           BIB-UPDT
2068  420270      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2069  420280      MOVE EOJ-MESS-6 TO PRINT-REC.                           BIB-UPDT
2070  420290      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2071  420300      MOVE EOJ-MESS-7 TO PRINT-REC.                           BIB-UPDT
2072  420310      WRITE PRINT-REC AFTER ADVANCING 2 LINES                 BIB-UPDT
2073  420320      MOVE EOJ-MESS-8 TO PRINT-REC.                           BIB-UPDT
2074  420330      WRITE PRINT-REC AFTER ADVANCING 2 LINES                 BIB-UPDT
2075  420340      MOVE EOJ-MESS-9 TO PRINT-REC.                           BIB-UPDT
2076  420350      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2077  420360      MOVE EOJ-MESS-10 TO PRINT-REC.                          BIB-UPDT
2078  420370      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2079  420380      MOVE EOJ-MESS-11 TO PRINT-REC.                          BIB-UPDT
2080  420390      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2081  420400      MOVE SPACES TO PRINT-REC.                               BIB-UPDT
2082  420410      MOVE PREV-CHAN-CONTROL TO PRINT-REC.                    BIB-UPDT
2083  420420      WRITE PRINT-REC AFTER ADVANCING 2 LINES                 BIB-UPDT
2084  420430      MOVE CURR-CHAN-CONTROL TO PRINT-REC.                    BIB-UPDT
2085  420440      WRITE PRINT-REC AFTER ADVANCING 1 LINE.                 BIB-UPDT
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2086     420450      MOVE PREV-MAST-CONTROL TO PRINT-REC.                    BIB-UPDT
2087     420460      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2088     420470      MOVE CURR-MAST-CONTROL TO PRINT-REC.                    BIB-UPDT
2089     420480      WRITE PRINT-REC AFTER ADVANCING 1 LINE.                 BIB-UPDT
2090     420490      MOVE SPACES TO PRINT-REC.                               BIB-UPDT
2091     420500      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2092     420990 EOJ-PRINTOUT-EXIT.                                           BIB-UPDT
2093     421010      IF CTRL-MESS IS EQUAL TO KON7                           BIB-UPDT
2094     421020      MOVE KON8 TO PRINT-REC                                  BIB-UPDT
2095     421030      ELSE MOVE KON4 TO PRINT-REC.                            BIB-UPDT
2096     421040      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2097     421043      MOVE SPACES TO PRINT-REC.                               BIB-UPDT
2098     421045      WRITE PRINT-REC BEFORE ADVANCING 66 LINES.              BIB-UPDT
2099     421050      IF SWT-1 IS EQUAL TO 'X'                                BIB-UPDT
2100     421060      CLOSE CARD-OUT.                                         BIB-UPDT
2101     421065      IF SWT-1 IS NOT EQUAL TO '1'                            BIB-UPDT
2102     421070      CLOSE MASTER-OUT.                                       BIB-UPDT
2103     421090      CLOSE MASTER-HOLD.                                      BIB-UPDT
2104     422010      IF EOJ-UPDATE-SWT IS EQUAL TO '11'                      BIB-UPDT
2105     422020      GO TO CHECK-EDIT-ERRORS.                                BIB-UPDT
2106     422030      MOVE KON14 TO PRINT-REC.                                BIB-UPDT
2107     422100 PRINTER-EXIT.                                                BIB-UPDT
2108     422110      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2109     422120      MOVE SPACES TO PRINT-REC.                               BIB-UPDT
2110     422130      WRITE PRINT-REC BEFORE ADVANCING 66 LINES.              BIB-UPDT
2111     422200 PRINTER-FINIS.                                               BIB-UPDT
2112     422210      GO TO FINAL-WRAP-UP.                                    BIB-UPDT
2113     422300 CHECK-EDIT-ERRORS.                                           BIB-UPDT
2114     422310      IF EDIT-ERR-SWT-2 IS EQUAL TO ZERO                      BIB-UPDT
2115     422320      MOVE KON16 TO PRINT-REC                                 BIB-UPDT
2116     422330      PERFORM PRINTER-EXIT                                    BIB-UPDT
2117     422340      GO TO CHECK-SWT-2.                                      BIB-UPDT
2118     422350      IF MESSAGE-1 IS EQUAL TO SPACES                         BIB-UPDT
2119     422360      MOVE KON15 TO PRINT-REC                                 BIB-UPDT
2120     422370      GO TO PRINTER-EXIT.                                     BIB-UPDT
2121     422380      MOVE KON21 TO PRINT-REC.                                BIB-UPDT
2122     422390      PERFORM PRINTER-EXIT.                                   BIB-UPDT
2123     422400      GO TO CHECK-SWT-2.                                      BIB-UPDT
2124     990000 FINAL-WRAP-UP.                                               BIB-UPDT
2125     990003      IF SPECIAL-OPTIONS IS EQUAL TO ALL 'X'                  BIB-UPDT
2126     990005      GO TO JOURNAL-NAME-SPECIAL.                             BIB-UPDT
2127     990007 FINAL-CLOSE-OUT.                                             BIB-UPDT
2128     990010      MOVE KON7 TO CTRL-MESS.                                 BIB-UPDT
2129     990020      MOVE SPACES TO PRINT-REC.                               BIB-UPDT
2130     990030      MOVE KON1 TO PRINT-REC.                                 BIB-UPDT
2131     990040      WRITE PRINT-REC AFTER ADVANCING 66 LINES.               BIB-UPDT
2132     990050      MOVE EOJ-MESSAGE TO PRINT-REC.                          BIB-UPDT
2133     990060      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2134     990070      MOVE KON22 TO PRINT-REC.                                BIB-UPDT
2135     990080      WRITE PRINT-REC AFTER ADVANCING 2 LINES.                BIB-UPDT
2136     990090      MOVE SPACES TO PRINT-REC.                               BIB-UPDT
2137     990100      WRITE PRINT-REC BEFORE ADVANCING 66 LINES.              BIB-UPDT
2138     990910      CLOSE PRINT-OUT.                                        BIB-UPDT
2139     990920      STOP RUN.                                               BIB-UPDT
2140     991000 JOURNAL-NAME-SPECIAL.                                        BIB-UPDT
2141     991010      MOVE 1 TO NO-SCOR-SWT.                                  BIB-UPDT
2142     991020      MOVE SPACES TO ERROR-REC.                               BIB-UPDT
2143     991030      MOVE SPACES TO CURR-MAST-CONTROL.                       BIB-UPDT
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2144            991040      MOVE SPACES TO PREV-MAST-CONTROL.                    BIB-UPDT
2145            991050      MOVE SPACES TO PRINT-REC.                            BIB-UPDT
2146            991070      SORT TAPE-SORT ON ASCENDING KEY                      BIB-UPDT
2147            991080          JOURNAL-NAME OF SORT-REC                         BIB-UPDT
2148            991090      USING MASTER-HOLD GIVING REPORT-STORE.               BIB-UPDT
2149            991100      PERFORM INITIALIZE-COUNTER.                          BIB-UPDT
2150            991110      MOVE JOURNAL-NAME-PRINTOUT TO HED-4.                 BIB-UPDT
2151            991120      PERFORM REPORT-HEADER-1.                             BIB-UPDT
2152            991130      OPEN INPUT REPORT-STORE.                             BIB-UPDT
2153            991200  JOURNAL-READ.                                            BIB-UPDT
2154            991210      READ REPORT-STORE AT END GO TO JOURNAL-FINIS.        BIB-UPDT
2155            991220      ADD 1 TO MASTER-IN-COUNT.                            BIB-UPDT
2156            991230      MOVE STORE-REC TO REPORT-REC.                        BIB-UPDT
2157            991240      MOVE JOURNAL-NAME OF STORE-REC                       BIB-UPDT
2158            991250      TO JOURNAL-NAME OF CURR-MAST-CONTROL.                BIB-UPDT
2159            991260      IF CURR-MAST-CONTROL IS EQUAL TO PREV-MAST-CONTROL   BIB-UPDT
2160            991270      ADD 1 TO MAST-DUP-COUNT                              BIB-UPDT
2161            991280      GO TO JOURNAL-READ.                                  BIB-UPDT
2162            991290      MOVE CURR-MAST-CONTROL TO PREV-MAST-CONTROL.         BIB-UPDT
2163            991300      PERFORM TRANS-PRINTOUT THRU TRANS-PRINTOUT-EXIT.     BIB-UPDT
2164            991310      ADD 1 TO MAST-OUT-COUNT.                             BIB-UPDT
2165            991320      GO TO JOURNAL-READ.                                  BIB-UPDT
2166            991500  JOURNAL-FINIS.                                           BIB-UPDT
2167            991510      MOVE KON7 TO CTRL-MESS.                              BIB-UPDT
2168            991520      PERFORM UPDATE-FINIS.                                BIB-UPDT
2169            991530      MOVE KON23 TO PRINT-REC.                             BIB-UPDT
2170            991540      WRITE PRINT-REC BEFORE ADVANCING 66 LINES.           BIB-UPDT
2171            991550      CLOSE REPORT-STORE.                                  BIB-UPDT
2172            991560      GO TO FINAL-CLOSE-OUT.                               BIB-UPDT


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