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THERMAL CONDUCTIVITY OF TEN CRYOGENIC LIQUIDS

A BIBLIOGRAPHY

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by

L. A. Hall

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April 15, 1963

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NASA CR-50,292

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ABSTRACT

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This bibliography contains 73 citations concerning the thermal conductivity of the following liquids: helium-3, helium-4, hydrogen, parahydrogen, deuterium, neon, air, fluorine, oxygen, nitrogen, argon, carbon monoxide and methane. The information given in each citation includes author, title, reference, and subject and descriptor terms. In addition, the article is coded as to language, temperature range, form of data (numeric, graphic), type of article (experimental, review or compilation, theoretical, etc.), and general availability of the document. An index by fluid and an index by author are included to facilitate reference to pertinent documents which are listed serially by accession number.

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THERMAL CONDUCTIVITY OF TEN CRYOGENIC LIQUIDS

A BIBLIOGRAPHY

1. INTRODUCTION

The citations included in this bibliography were obtained from the following sources:

1. Cryogenic Data Center's Storage and Retrieval System,
2. Retrieval Guide to Thermophysical Properties Research Literature, Y. S. Touloukian, Editor, McGraw-Hill Book Company, Inc., New York (1960),
3. A Compendium of the Properties of Materials at Low Temperatures (Phase I), Properties of Fluids, V. J. Johnson, Editor, Natl. Bur. Standards, Cryogenic Eng. Lab., WADD Tech. Rept. 60-56 (1960),
4. Cryogenic Data Center's Data Compilation Unit literature files.

Each article was reviewed and coded from the full document, except as noted. The contents are identified by subject and descriptor terms and by the characteristic coding designations* for: C (temperature range), D (type of data), and E (experimental, theoretical, compilation or review.) A specific current library search for this subject was not made, however, the Data Center's literature awareness furnishes a fairly broad coverage of the report and publication literature.

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Author(s),

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Document identification

Chemical Abstract number or ASTIA number, when they are known, microfilm number (assigned by Cryogenic Data Center for filing),

Characteristic coding*,

Subject terms (asterisked) and descriptors.

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* Characteristic coding is explained in detail on Page 2.

3. CHARACTERISTIC CODING DESIGNATIONS for CRYOGENIC LITERATURE

Categories

A-1: Books, Reviews, Surveys, Bibliographies, Proceedings, etc.
A-2: Properties of Solids
A-3: Properties of Fluids
A-4: Solid State, Theoretical, Phenomena, Basic Physics, etc.
A-5: Cryogenic Techniques, Tricks, Unique Methods, Unusual Procedures, etc.
A-6: Cryogenic Processes, Heat Transfer, Purification, Fluid Flow, Liquefaction, Safety Procedures, etc.
A-7: Laboratory Equipment and Instrumentation
A-8: Cryogenic Equipment
A-9: General Interest Literature, News, Management, Programs, Accidents, Miscellaneous

Language

B-1: English, B-2 French, B-3 German, B-4 Dutch, B-5 Italian, B-6 Japanese, B-7 Russian, B-8 Spanish, B-9 Other

Cryogenic Interest

C-1: Cryogenic Temperature Range (0 to 130°K where not specifically designated in C-4 through C-7 below)
C-2: Cryogenic Interest but not in Cryogenic Temperature Range (except where designated C-8)
C-3: Not of Direct Cryogenic Interest
C-4: Below 1°K
C-5: 1 to 10°K
C-6: 10 to 50°K
C-7: 50 to 130°K
C-8: 130 to 300°K

Form of Data (Omitted where not pertinent)

D-1: Numerical Data Included
D-2: No Data
D-3: Graphical Data Only

Type of Article (Omitted where not pertinent)

E-1: Experimental, Experimental and Theoretical, Original Work
E-2: Review Article, Compilation, Correlation, Discussion
E-3: Theoretical Only, No Specific Data Given

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G-8: Patents (U.S. and Foreign)
G-9: Other (Unpublished, Informal, Preprints, Letters, Notes, Term Papers, Talks, etc.)

4. BIBLIOGRAPHY INDEX (ARRANGED BY LIQUID)

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5. AUTHOR INDEX

05077 AGARWAL, B.K.
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05088 ANDRADE, E.N. DE C.
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00821 BURTON, J.T.A. ZIEBLAND, H.
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05385 KEESOM, W.H. DUYCKAERTS, G.
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14730 KEESOM, W.H. SARIS, B.F. MEYER, L.
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12842 MC CALL, D.M. PAIN, H.J.
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14761 MEYER, L. BAND, W.
14731 MEYER, L. BAND, W.
05461 MEYER, L. MELLINK, J.H.
01870 NAKAJIMA, S. TOMITA, K. USUI, T.
11043 OLIVIER, J.R. DEMPSTER, W.E.
11847 OWENS, E. THODOS, G.
11052 POWERS, R.W. JOHNSTON, H.L. MATTOX, R.W.
00704 POWERS, R.W. MATTOX, J. JOHNSTON, H.L.
00756 POWERS, R.W. MATTOX, R.W. JOHNSTON, H.L.
05528 POWERS, R.W. MATTOX, R.W. JOHNSTON, H.L.
08093 POWERS, R.W. MATTOX, R.W. JOHNSTON, H.L.
14422 POWERS, R.W. MATTOX, R.W. JOHNSTON, H.L.
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05405 PROSAD, SURAJDEO
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13476 ROGERS, J. ZEIGLER, R. MC WILLIAMS, P.
13492 ROGERS, J. ZEIGLER, R. MC WILLIAMS, P.
00378 SATTERLY, J.
05727 SCHAEFER, C.A. THODOS, G.
10799 SCHAEFER, C.A. THODOS, G.
06156 TRIKHA, S.K.
00717 TSEDERBERG, N.V. TIMROT, D.L.
00418 VAN GROENOU, A.B. POLL, J.D. DELSING, A.M.G. GORTER, J.C.
12917 WALKER, E.J. FAIRBANK, H.A.
12485 WARD, H.C. RHODAS, J.E. ZIEGLER, W.T. ROSS, L.W.
05701 WATERMAN, T.E. KIRSH, D.P. BRABETS, R.I.
05784 WHITE, D. GONZALES, O. JOHNSTON, H.
13633 WILKS, J.
06368 WOOLLEY, H. SCOTT, R.B. BRICKWEDDE, F.
06746 ZIEBLAND, H.
05766 ZIMAN, J.M.
14764 ZWANZIG, R. KIRKWOOD, J. OPPENHEIM, I. ALDER, B.

6. BIBLIOGRAPHY OF REFERENCES (arranged by accession number)

00378 The physical properties of solid and liquid helium
Satterly,John
Rev. Mod. Phys. 8, 347-57 (Oct 1936) 18 fig 1 tab 19 ref
MF No. 62-A A3 B1 C5 D1 E2 F6 G1
*helium, *liquid, *thermodynamic property, *density, coefficient of expansion, *surface tension, *viscosity, *compressibility, *electrical property, *velocity of sound, *refractive index, *solidified gas, *entropy, *thermal conductivity

00406 The thermal conductivity of liquid and gaseous oxygen.
Burton,J.T.A. Ziebland,H.
Gt. Brit. Ministry of Supply, Rept. No. E.R.D.E. 2/R56 (Jan 1956) 11 pp 4 fig 3 tab 15 ref
ASTIA AD 90 759 MF No. 75-H A3 B1 C7 D E1 F5 G5
*oxygen, *liquid, *gaseous, *thermal conductivity, temperature effect

00418 The viscosity of the normal part of liquid helium II from heat conduction experiments.
Van Groenou,A.B. Poll,J.D. Delsing,A.M.G. Gorter,C.J.
Physica 22, 905-10 (Oct 1956) Communs. Kamerlingh Onnes Lab. Univ. Leiden No. 304f (1956) 6 pp
CA 52 9690 A3 B1 C5 D1 E1 F6 G1
*helium, helium II, *liquid, *viscosity, *thermal conductivity

00704 The thermal conductivity of liquid nitrogen between 65 and 90 degrees K.
Powers,R.W. Mattox,R.W. Johnston,H.L.
Ohio State Univ., Cryogenic Lab. Columbus, Tech. Rept. No. TR 264-9 (1954) Contr. No. W33-038-ac-14794(16243) 16 pp 4 fig 2 tab 6 ref
ASTIA ATI 105 926 A3 B1 C7 D1 E1 F5 G5
*thermal conductivity, *nitrogen, *liquid, temperature effect

00717 An experimental determination of the thermal conductivity of liquid oxygen.
Tsederberg,N.V. Timrot,D.L.
Soviet Phys. Tech. Phys. 1, 1791-7 (1956) 4 fig 4 tab 15 ref (Trans. from Zhur. Tekh. Fiz. 26, 1849-56, 1956)
MF No. 66-Q A3 B1 C7 D1 E1 F6 G1
*oxygen, *liquid, *gaseous, *thermal conductivity, temperature effect

00756 Thermal conductivity of condensed gases. III. The thermal conductivity of liquid deuterium from 19 to 26 degrees K.
Powers,R.W. Mattox,R.W. Johnston,H.L.
J. Am. Chem. Soc. 76, 5974 (Dec 1954)
A3 B1 C6 D1 E1 F6 G1
*thermal conductivity, *deuterium, *liquid, equation, temperature effect
Coded from abstract.

00821 The thermal conductivities of nitrogen and argon in the liquid and gaseous states.
Burton,J.T.A. Ziebland,H.
Gt. Brit. Ministry of Supply, Rept. No. E.R.D.E. 11/R/57 (Oct 1957) 15 pp 2 fig 5 tab 13 ref
ASTIA AD 145 956 A3 B1 C7 D E F5 G5
*nitrogen, *argon, *gaseous, *liquid, *thermal conductivity

00935 Heat conductivity of liquid helium I.
Bowers,R. Mendelssohn,K.
Nature 167, 111 (Jan 1951)
A3 B1 C5 D E1 F7 G1
*helium, helium I, *liquid, *thermal conductivity, temperature effect, lambda temperature
Coded from abstract.

01464 The theory of the propagation of second sound in helium I.
Dingle,R.B.
Proc. Phys. Soc. (London) B61, 9-21 (Jul 1948)
A3 B1 C5 D E3 F6 G1
*helium, *liquid, *velocity of sound, *thermal conductivity, *physical property, helium II, sound absorption, temperature effect, theory
Coded from abstract.

01870 The phenomenological theory of liquid helium II.
Nakajima,S. Tomita,K. Usui,T.
Phys. Rev. 78, No. 6, 768-79 (Jun 1950) 11 fig 2 tab 22 ref
A4 B1 C5 D1 E2 F6 G1
*thermal conductivity, *helium, *liquid, helium II, temperature effect

02020 Cryogenic data book (Eng. Units)
Chelton,D.B. Mann,D.B.
Univ. of Dayton, Ohio, WADC Tech. Rept. 59-8 (Mar 1959) Contr. AF 33(616)-3294, 113 pp
ASTIA AD 208 155 A3 B1 C5 D1 E2 F5 G2
*liquid, *gaseous, *nitrogen, *helium, *deuterium, *heat of vaporization, *density, *vapor pressure, *entropy, enthalpy, T-S diagram, *hydrogen, *viscosity, *specific heat, *surface tension, *dielectric constant, *thermal conductivity, *air, *melting curve, *oxygen, *aluminum, *stainless steel, *glass, *copper, *lead, *iron, *steel, *thermal expansion, *alloy, aluminum alloy, beryllium copper, everdur, phosphorbronze, *tensile property, *monel, *notch property, *insulation, polystyrene, santocel, *teflon, *nylon, *thermoelectricity, thermoelectric EMF, copper constantan, gold cobalt

02171 HELIUM.
Keesom,W.H.
Elsevier Publishing Co., New York (1942) 494 pp
MF No. 65-N,O A3 B1 C4 D1 E2 F6 G2
*helium, *PVT data, *gaseous, *liquid, *density, *specific heat, *velocity of sound, *viscosity, *thermal conductivity, *vapor pressure, *melting curve, *phase transition property, *solidified gas, *thermodynamic property, *superfluidity, lambda temperature, second sound, fountain effect, helium II, theory, *atomic molecular property

04588 A bibliography of the thermophysical properties of oxygen at low temperatures.
Hust,J.G. Wallace,L.D. Crim,J.A. Hall,L.A. Stewart,R.B.
Natl. Bur. Standards Tech. Note No. 137 (Feb 1962)
83 pp 237 ref
A3 B1 C6 D2 E2 F3 G6
*oxygen, *PVT data, *compressibility, *liquid, *expansivity, *equation of state, virial coefficient, *specific heat, *velocity of sound, *vapor pressure, *critical constants, *phase transition property, *gaseous, *solidified gas, *entropy, *enthalpy, *free energy, *thermal conductivity, *viscosity, *transport property, prandtl number, diffusion coefficients, *joule-thomson coefficient, *density, *melting curve, *triple point, solid-solid transition, *heat of fusion, *heat of sublimation, *heat of vaporization, thermal expansion, *surface tension, adsorption, *gaseous mixture, *liquid mixture, *binary mixture, *ternary mixture

05077 Heat conductivity and viscosity of liquid He3.
Agarwal,B.K.
Prog. Theoret. Phys. (Kyoto) 14, 493-94 (Nov 1955) 6 ref
MF No. 160-W A3 B1 C4 D2 E3 F7 G1
*helium, *liquid, helium 3, theory, *thermal conductivity, *viscosity

05088 Viscosity and thermal conductivity of liquid argon.
Andrade,E.N.deC.
Nature 170, 794-5 (1952)
MF No. 77-O A3 B1 C1 D2 E2 F7 G1
*liquid, *viscosity, *thermal conductivity, *argon, melting point

05333 Heat conduction by the unsaturated helium I film.
Long,E. Meyer,L.
Phys. Rev. 87, 153 (Jul 1952)
A3 B1 C5 D1 E F6 G1
*helium, helium II, *liquid, *thermal conductivity, film
Coded from abstract.

05385 Measurements on the thermal conductivity and the thermomechanical effect of liquid helium II.
Keesom,W.H. Duyckaerts,G.
Physica 13, 153-80 (May 1947)
A3 B2 C5 D1 E1 F6 G1
*helium, helium II, *liquid, *thermal conductivity, temperature effect

05405 Thermal conductivity of liquid nitrogen.
Prosad,Surajdeo
Current Sci. (India) 20, 264 (1951)
CA 46 6920h A3 B1 C7 D1 E F7 G1
*thermal conductivity, *nitrogen, *liquid
Coded from abstract.

05461 The thermomechanical effects in liquid helium II.
Meyer,L. Mellink,J.H.
Physica 13, 197-215 (May 1947) 3 fig 4 tab 21 ref, Communs. Kamerlingh Onnes Lab., Univ. Leiden, No. 272b
A3 B1 C5 D1 E1 F6 G1
*helium, *liquid, helium II, *thermal conductivity, temperature effect

05472 New measurements on the fountain effect and the heat conductivity of liquid helium I.
Mellink,J.H.
Physica 13, No. 4-5, 180-96 (May 1947) 9 fig 3 tab 5 ref, Communs. Kamerlingh Onnes Lab., Univ. Leiden, No. 272a
A3 B1 C5 D1 E1 F6 G1
*helium, *liquid, helium II, *thermal conductivity, temperature effect

05524 Thermal conductivity of liquid oxygen.
Prosad,S.
J. Appl. Phys. 3, 58-9 (1952)
CA 46 5949g MF No. 71-U A3 B1 C7 D1 E1 F6 G1
*thermal conductivity, *liquid, *oxygen, temperature effect

05528 Thermal conductivity of condensed gases. II. The thermal conductivities of liquid normal and of liquid parahydrogen from 15 to 27 degrees K.
Powers,R.W. Mattox,R.W. Johnston,H.L.
J. Am. Chem. Soc. 76, 5972-73 (1954)
MF No. 27-K A3 B1 C6 D1 E1 F6 G1
*hydrogen, normal hydrogen, *parahydrogen, *liquid, *thermal conductivity, temperature effect, equation

05701 Thermal conductivity of liquid ozone.
Waterman,T.E. Kirsh,D.P. Brabets,R.I.
J. Chem. Phys. 29, 905-8 (1958)S
MF No. 71-O A3 B1 C7 D1 E1 F6 G1
*thermal conductivity, *ozone, *oxygen, *liquid

05727 Reduced thermal conductivity correlation. Gaseous and liquid hydrogen.
Schaefer,C.A. Thodos,G.
Ind. Eng. Chem. 50, 1585-7 (1958)
MF No. 75-U A3 B1 C6 D1 E3 F6 G1
*thermal conductivity, *hydrogen, *liquid, high pressure, *reduced variable, *gaseous, calculation

05766 The propagation of heat in liquid helium.
Ziman,J.M.
Phil. Mag. 45, 100-02 (Jan 1954) 1 fig 8 ref
A4 B1 C5 D2 E2 F6 G1
*helium, helium II, *liquid, second sound, phonon, heat conductivity, theory

05784 Heat conduction of the boundary layer in liquid helium II.
White,D. Gonzales,O.D. Johnston,H.L.
Phys. Rev. 89. No. 3, 593-94 (Feb 1953) 3 fig 4 ref
A3 B1 C5 D3 E1 F6 G1
*helium, *liquid, helium II, *thermal conductivity

05785 Thermal conductivity of liquid helium 3.
Lee,D.M. Donnelly,R.J. Fairbank,H.A.
Bull. Am. Phys. Soc. (2) 2, 64 (1957) 2 ref
MF No. 50-C A3 B1 C4 D1 E1 F6 G1
*helium, *thermal conductivity, *liquid, helium 3

05988 Warmeleitfahigkeit von flussigem Sauerstoff, flussigem Stickstoff und ihren Gemischen. Thermal conductivity of liquid oxygen and liquid nitrogen and their mixtures.
Hammann,Gunther
Ann. Physik 32, 593-607 (1938) 7 fig 1 tab 15 ref
CA 32 8907 MF No. 137-V A3 B3 C1 D1 E1 F7 G1
*oxygen, *nitrogen, *liquid, *liquid mixture, *binary system, *thermal conductivity, temperature effect

05992 Thermal conductivity of liquid helium.
Grenier,C.
Phys. Rev. 81, 598-603 (1951) 7 fig 2 tab 8 ref
A3 B1 C5 D1 E1 F6 G1
*helium, *liquid, *thermal conductivity, temperature effect, lambda temperature

06151 Les Nombres de Prandtl des Fluides Frigorifiques. The prandtl numbers of refrigerants.
Codegone,Cesare
Bull. IIR 33, 61-66 (1953) 5 fig 2 tab 1 ref
CA 49-539f MF No. 50-W A3 B2 C8 C1 E2 F7 G1
*hydrocarbon, heptane, pentane, *gaseous, *viscosity, *thermal conductivity, *ethane, *transport property, prandtl number, *helium, *hydrogen, *air, *nitrogen, *oxygen, *carbon dioxide, *water, *ammonia, *methane, *inorganic fluid, sulfur dioxide, *refrigerant, methyl chloride, paraffin class, *propane, freon 12, *butane

06156 Viscosity and heat conductivity of liquid-helium 3.
Trikha,S.K.
Progr. Theoret. Phys. (Kyoto) 17, 609-11 (1957)
MF No. 50-H A3 B1 C5 D3 E2 F7 G1
*helium, helium 3, *liquid, *viscosity, *thermal conductivity, specific heat

06368 Compilation of thermal properties of hydrogen in its various isotopic and ortho-para modifications
Woolley,H.W. Scott,R.B. Brickwedde,F.G.
Reprinted from J. Research Natl. Bur. Standards 41, 379-475 (Nov 1948) (Research Paper RP1932)
A3 B1 C6 D1 E2 F6 G4
*hydrogen, *deuterium, *hydrogen deuteride, *gaseous, *specific heat, *entropy, *enthalpy, *free energy, *PVT data, *orthohydrogen, *liquid, *density, *vapor pressure, *melting curve, *solidified gas, *heat of vaporization, *heat of sublimation, *heat of fusion, *thermal conductivity, compressibility factor, second virial coefficient, entropy change, saturated vapor, T-S diagram, viscosity

06497 Technical data (pertaining to air, its liquefaction and distillation)
Lobo,W.E.
M. W. Kellogg Co., Final Rept. OSRD No. 4206 (Oct 1944)
Contr. No. OEM-sr-365, 52 pp 52 fig
MF No. 130-P A3 B1 C7 D1 E2 F8 G5
*nitrogen, *argon, *oxygen, *helium, *carbon dioxide, *air, *entropy, *enthalpy, *T-S diagram, *density, *vapor pressure, *viscosity, *liquid, *thermal conductivity, *phase equilibrium, *gaseous mixture, *liquid mixture, dew point curve, *binary system

06746 The thermal conductivity of nitrogen, oxygen and argon in the liquid and gaseous states.
Ziebland,H.
Dechema Monograph 32, 74-82 (1959) 8 fig 1 tab 39 ref TPRC
Translation by Mrs. J.K. Gerritsen (Oct 29, 1959)
CA 50 75626 A3 B1 C7 D1 E1 F8 G5
*thermal conductivity, *nitrogen, *oxygen, *argon, *liquid, *gaseous, *critical region, critical density, temperature effect

07052 Transport properties in the liquid state and the corresponding state principle
Cini-Castagnoli,G. Pizzella,G. Ricci,F.P.
Nuovo cimento 11, No. 3, 466-67 (Feb 1959) 2 fig 9 ref
A3 B1 C7 D3 E2 F7 G1
*argon, *oxygen, *carbon monoxide, *nitrogen, *methane, *liquid, *viscosity, *thermal conductivity, temperature effect, *reduced variable, law of corresponding states

08093 Thermal conductivities of condensed gases. I. The thermal conductivity of liquid nitrogen between 65 and 90 degrees K.
Powers,R.W. Mattox,R.W. Johnston,H.L.
J. Am. Chem. Soc. 76, 5968-71 (1954)
CA 49 3597 MF No. 27-K A3 B1 C7 D1 E1 F6 G1
*nitrogen, *liquid, *thermal conductivity, temperature effect, equation

09249 ARGON, HELIUM AND THE RARE GASES. THE ELEMENTS OF THE HELIUM GROUP. VOL. I: HISTORY, OCCURRENCE, AND PROPERTIES
Cook,G.A.
Interscience Publishers, Inc., New York (1961) 394 pp
A3 B1 C5 D1 E2 F7 G2
*book, inert gas, *atomic molecular property, *chemical property, *thermal conductivity, *viscosity, *solidified gas, *PVT data, *liquid, *gaseous, *thermodynamic property, *velocity of sound, *phase transition property, *thermal property, *density

10548 Summary of measured thermal conductivities and values of viscosities.
Keyes,F.G.
TRANSPORT PROPERTIES IN GASES, 51-4 (1958) Proc. of the Second Biennial Gas Dynamics Symposium, Northwestern University Press, Evanston, Ill. 1 tab
A3 B1 C1 D1 E1 F6 G2
*thermal conductivity, *gases, temperature effect, *liquid, *technical gas, *inert gas, *ammonia, water vapor, *methane, *ethane, freon, oxide of nitrogen, *ethylene, mixture

10731 Survey of recent work on the viscosity, thermal conductivity, and diffusion of gases and liquefied gases below 500 K.
Liley,P.E.
Purdue Univ., Thermophysical Properties Research Center, Lafayette, Ind. TPRC Rept. No. 13, (Jun 1961) 33 pp 2 tab 394 ref
A3 B1 C1 D2 E2 F8 G5
*viscosity, *thermal conductivity, diffusion, *technical gas, *inert gas, oxide of nitrogen, *fluorinated refrigerant, *methane, *ethane, *deuterium, *hydrocarbon, *liquid, mixture, bibliography, *properties of fluids, gases, liquids

10799 Thermal conductivity of diatomic gases: Liquid and gaseous states
Schaefer,C.A. Thodos,G.
Am. Inst. Chem. Engrs. J. 5, No. 5, 367-72 (Sept 1959) 6 fig 1 tab 65 ref
MF No. 135-S A3 B1 C1 D1 E1 F6 G1
*thermal conductivity, *gas, diatomic, inert gas, *halogen, liquid, density, *reduced variable, nitrogen, chlorine, oxygen, hydrogen, halide

11043 Orbital storage of liquid hydrogen.
Olivier,J.R. Dempster,W.E.
Natl. Aeronaut. Space Admin. Tech. Note No. D-559 (Aug 1961) 69 pp 31 fig 11 ref
NASA N62 71133 A6 B1 C6 D3 E1 F3 G6
saturn, liquid hydrogen, *storage, space application, surface, propellant, *hydrogen, *liquid, *density, thermal diffusivity, *thermal conductivity, *vapor pressure, *specific heat, *heat of vaporization, *insulation, linde SI

11052 The thermal conductivity of liquid nitrogen between 65 degrees and 90 degrees K.
Powers,R.W. Johnston,H.L. Mattox,R.W.
Proc. Intern. Congr. Refrig. 8th, London, 186-94 (1951) 4 fig 2 tab 6 ref
MF No. 139-R A3 B1 C7 D1 E1 F7 G2
*thermal conductivity, *measurement, liquid nitrogen, *nitrogen, *liquid, temperature effect

11415 Thermal conduction in rotating liquid helium II.
Chase,C.E.
Phys. Rev. 120, 688-96 (Nov 1960) 11 fig 9 ref
A3 B1 C5 D3 E1 F6 G1
*helium, *liquid, *thermal conductivity, helium II, *superfluidity, rotation, relaxation time, damping

11582 Production and properties of liquid ozone and liquid ozone-oxygen mixtures, a review
Hersh,C.K.
PROGRESS IN ASTRONAUTICS AND ROCKETRY 2, 427-44, Academic Press Inc., New York (1960) 8 fig 7 tab 42 ref
A3 B1 C7 D1 E2 F6 G2
*oxygen, *ozone, *liquid mixture, *liquid, *phase transition property, *critical constant, *thermal conductivity, *heat of vaporization, *binary system, surface tension, *viscosity, *density

11789 Hydrogen transport property correlations
Rogers,J.D. Zeigler,R.K. McWilliams,P.
Univ. of Calif., Los Alamos Sci. Lab., New Mexico, LA Rept. No. 2527 (1961) 19 pp 1 tab 79 ref
A3 B1 C6 D2 E3 F8 G5
*hydrogen, *gaseous, *thermal conductivity, *para hydrogen, *viscosity, *liquid, *mathematical analysis, equation

11847 Thermal-conductivity-reduced-state correlation for the inert gases
Owens,E.J. Thodos,G.
Am. Inst. Chem. Engrs. Journal 3, No. 4, 454-61 (Dec 1957) 7 fig 3 tab 58 ref
MF No 145-R A3 B1 C5 D1 E2 F6 G1
*helium, *neon, *argon, *gaseous, *rare gas, krypton, xenon, *liquid, law of corresponding states, *thermal conductivity, reduced variable temperature effect, density, compilation

11893 Liquid and solid helium-3.
Grilly,E.R. Hammel,E.F.
PROGRESS IN LOW TEMPERATURE PHYSICS II, Chapt. 4, 113-52, North-Holland Publishing Company, Amsterdam (1961) 15 fig 7 tab 95 ref
A3 B1 C4 D1 E2 F7 G2
*helium, helium 3, *liquid, *PVT data, *expansivity, *theory, *solidified gas, *melting curve, *specific heat, *entropy, *thermal conductivity, *viscosity, *velocity of sound, *solid, diffusion coefficient, *phase diagram

11987 Thermal conductivity of liquid He-3
Anderson,A.C. Salinger,G.L. Wheatley,J.C.
Phys. Rev. Letters 6, No. 9, 443-46 (1961) (Abstracted in Bull. inst. intern. froid 42, No. 9, 390 (1962) 2 fig 13 ref
MF No. 146-W A3 B1 C4 D3 E1 F6 G1
*helium, helium 3, *liquid, *thermal conductivity, temperature effect

11995 Thermodynamic data on oxygen and nitrogen
Brewer,Jerome
Air Products Inc., Allentown, Pa. Tech. Documentary Rept. No. ASD-TR-61-625 (Sept 1961) Contr. No. AF 33(616)-8287, Proj. No. 1 (1-3048) Task 304802, 151 pp 39 fig 19 tab 239 ref (Available from OTS & ASTIA)
A3 B1 C7 D1 E2 F8 G5
*oxygen, *air, *nitrogen, *gaseous, *liquid, *viscosity, *thermal conductivity, *density, *transport property, prandtl number, saturated liquid, compilation, bibliography, temperature effect, *gaseous mixture, *liquid mixture, *phase equilibrium, dew point, bubble point, concentration effect, binary system

12018 A compendium of the properties of materials at low temperature (Phase I) Part I. Properties of fluids.
Johnson,V.J. (Editor)
Natl. Bur. Standards, Cryogenic Eng. Lab., WADD Tech. Rept. 60-56 (1960) WADD Contr. No. AF 33(616)-58-4, 489 pp.
A3 B1 C5 D1 E2 F1 G6
*carbon monoxide, *hydrogen, *neon, *nitrogen, *fluorine, *methane, *oxygen, *air, *helium, *argon, *vapor pressure, *thermal conductivity, *dielectric constant, *surface tension, *phase transition property, *viscosity, *specific heat, *density, *enthalpy, *expansivity

12353 Thermal conductivity of liquid helium I.
Grenier,Claude
LOW TEMPERATURE PHYSICS 193-94, Natl. Bur. Standards Circ. 519, U.S. Gov't. Printing Office, Wash. D.C. (Oct 1952)
1 fig 1 tab 4 ref
A3 B1 C5 D1 E1 F6 G2
*helium, helium I, *liquid, *thermal conductivity, temperature effect

12400 Thermal conductivity of liquid He-3
Anderson,A.C.
Illinois Univ., Urbana, Ph.D. Thesis (1961) (Abstracted in Dissertation Abstr. 22, No. 5, 1681 (1961) (Univ. Microfilm, Inc., Ann Arbor, Mich. Order No. 61-4250, mi $2.75, xerox $4.20)
A3 B1 C4 D1 E1 F9 G7
*helium, helium-3, *liquid, *thermal conductivity, temperature effect
Coded from abstract.

12485 Analytical investigation of two-phase vapor-liquid ratio measuring systems and two-phase flow literature survey supplement.
Ward,H.C. Rhodas,J.E. Ziegler,W.T. Ross,L.W.
Georgia Inst. Technol. Eng. Expt. Sta., Atlanta, Ga. WADC Tech. Note 59-230 (Aug 1959) Contr. No. AF 33(616)-5810, 109 pp 2 fig 6 tab 431 ref
ASTIA AD 273 146 A6 B1 C6 D3 E3 F5 G5
*fluid flow, two-phase flow, *hydrogen, mathematical analysis, equation, *measuring equipment, *flow measurement, review, *parahydrogen, *liquid, *gaseous, *critical constants, *vapor pressure, *density, saturated liquid, saturated vapor, *heat of vaporization, *PVT data, *specific heat, *velocity of sound, *thermal conductivity, *dielectric constant, *bibliography, annotated bibliography

12842 The thermal conductivity of liquid ortho and para hydrogen
McCall,D.M. Pain,H.J.
Atomic Energy Research Establ. (Gt. Brit.) Progr. Rept. (Feb 1952-Feb 1953) Contr. No. 13/5/165/318, 6 pp 1 fig 1 tab
A3 B1 C6 D1 E1 F8 G5
*hydrogen, *liquid, *thermal conductivity, pressure effect, normal

12843 The thermal conductivity of liquid ortho and para hydrogen.
McCall,D.M. Pain,H.J.
Atomic Energy Research Establ. (Gt. Brit.) Progr. Rept. (Mar 1953-Sept 1953) Contr. No. 13/5/165/318, 4 pp 1 fig
A3 B1 C6 D3 E1 F8 G5
*para hydrogen, *liquid, prandtl number, *thermal conductivity, grashof number, *hydrogen, convection, *heat transfer

12917 Thermal resistivity of isotopic mixtures of solid helium
Walker,E.J. Fairbank,H.A.
Am. Phys. Soc. Meeting, New York, N.Y. (Jan 27-30, 1960)
Paper C5 (Abstracted in Bull. Am. Phys. Soc. 5, No. 1, 13,
Jan 1960) 2 ref
A3 B1 C5 D E1 F8 G2
*helium, *liquid, helium 3- helium 4 mixture, *solidified gas,
*thermal conductivity, concentration effect, *isotope

13476 Hydrogen transport property correlations Part II.
Rogers,J.D. Zeigler,R.K. McWilliams,P.
Los Alamos Sci. Lab., Los Alamos, N. Mex. Rept. No. LA-2719
(Jun 1962) Contr. No. W-7405-eng-36, 40 pp 2 fig 11 tab 10 ref
A3 B1 C6 D1 E3 F8 G5
*hydrogen, *gaseous, *thermal conductivity, normal hydrogen,
*para hydrogen, *viscosity, *liquid, calculation

13492 Hydrogen transport property correlations.
Rogers,J.D. Zeigler,K. McWilliams,P.
Chem. Eng. Data 7, No. 2, 179-82 (Apr 1962) 2 fig 1 tab 81 ref
A3 B1 C6 D1 E3 F6 G1
*hydrogen, *gaseous, *liquid, *thermal conductivity, *viscosity,
density, equation, calculation

13578 Thermal conductivity and diffusion in weak He3-He4 solutions
in the temperature range from the lambda point to 0.6 degrees K
Ptukha,T.P.
Soviet Phys. JETP 13, No. 6, 1112-19 (Dec 1961) 6 fig 1 tab
13 ref
MF No. 156-L A3 B1 C4 D3 E1 F6 G1
*helium, helium 3-helium 4 solution, *liquid, *thermal
conductivity, *transport property, diffusion coefficient,
coefficient, concentration effect, temperature effect

13633 The thermal conductivity of condensed helium
Wilks,J.
Nuovo cimento Suppl. 9, No. 1, 84-94 (1958) 10 fig 30 ref
MF No. 160-G A3 B1 C4 D3 E1 F7 G1
*helium, *liquid, *thermal conductivity, helium 4, *solidified
gas, *gaseous, helium 3, *argon, *viscosity

13636 Thermal conductivity of liquid helium II in very narrow channels
Atkins,K.R.
Phys. Rev. 108, No. 4, 911-13 (Nov 1957) 1 fig 3 ref
MF No. 160-B A3 B1 C4 D3 E3 F6 G1
*helium, helium II, *liquid, *viscosity, *thermal conductivity

13639 The heat conductivity and viscosity of liquid helium II
Brewer,D.F. Edwards,D.O.
Proc. Roy. Soc. (London) A251, 247-64 (Jun 1959) 9 fig 27 ref
MF No. 159-V A3 B1 C5 D3 E1 F6 G1
*thermal conductivity, *viscosity, *helium, helium II, *liquid,
*density

14422 The thermal conductivities of liquid normal and of liquid
para hydrogen from 15 degrees to 27 degrees K.
Powers,R.W. Mattox,R.W. Johnston,H.L.
Ohio State Univ., Cryogenic Lab. Columbus, Tech. Rept. No.
TR 264-10 (n.d.) Contr. No. W33-038-ac-14794(16243) (1956)
10 pp 2 fig 1 tab 3 ref
ASTIA ATI 105 927 A3 B1 C6 D1 E1 F5 G5
*hydrogen, *parahydrogen, *liquid, *thermal conductivity,
temperature effect

14423 Technical data on liquid nitrogen.
Linde Air Products Co., New York, Rept. No. F-1018 (1957)
20 pp 7 fig 2 tab 7 ref
A3 B1 C7 D3 E2 F8 G5
*nitrogen, *liquid, *gaseous, saturated liquid, saturated vapor, *thermal conductivity, *viscosity, *thermodynamic property, mollier diagram, superheated, *PVT data, *enthalpy, *phase diagram, *boiling temperature, melting temperature, *critical constants, *heat of vaporization, *density, *water, *carbon dioxide, *rare gas, krypton, xenon, *argon, *air, *neon, *hydrogen, *helium

14729 Further measurements on the heat conductivity of liquid helium II.
Keesom,W.H. Saris,B.F.
Physica 7, No. 3, 241-52 (Mar 1940) 5 fig 2 tab 7 ref Communs. Kamerlingh Onnes Lab., Univ. Leiden, No. 257d
A3 B1 C5 D1 E1 F6 G1
*helium, *liquid, saturated liquid, helium II, *thermal conductivity, temperature effect

14730 New measurements on the heat conductivity of liquid helium II.
Keesom,W.H. Saris,B.F. Meyer,L.
Physica 7, No. 9, 817-30 (Nov 1940) 6 fig 3 tab 12 ref, Communs. Kamerlingh Onnes Lab., Univ. Leiden, No. 260a
A3 B1 C5 D1 E1 F6 G1
*helium, *liquid, helium I, *thermal conductivity, temperature effect

14731 On a connection between the fountain effect, second sound, and thermal conductivity in liquid helium II.
Meyer,L. Band,W.
Phys. Rev. 71, 828 (1947) 5 ref
A4 B1 C5 D2 E3 F6 G1
*helium, *liquid, helium II, *superfluidity, fountain effect, second sound, thermal conductivity, theory

14732 Thermometrische Leitfahigkeit von flussigem Helium II. Thermal conductivity of liquid helium II.
Ganz,E.
Helv. Phys. Acta, 12, 294-95 (1939)
A3 B3 C5 D2 E3 F7 G1
*helium, *liquid, helium II, *thermal conductivity

14733 Neue Warmeleitfahigkeitsmessungen an organischen Flussigkeiten. New thermal conductivity measurements for organic liquids.
Riedel,L.
Chem. Ing. Tech. 23, 321-24 (1951) 4 fig 3 tab 19 ref
A3 B3 C8 D1 E1 F7 G1
*liquid, *thermal conductivity, *organic fluid, benzene, toluene, ethyl benzene, xylene, carbon tetrachloride, organic halide, alcohol, ether, acetone, amine, *reduced variable, *nitrogen, *oxygen, *methane

14735 Das supraflussige Helium I. Superliquid helium II.
Grassman,P.
VDI Zeitschrift 92, 221-22 (Mar 1950) 1 fig 9 ref
A3 B3 C5 D2 E2 F7 G1
*helium, helium II, *liquid, *thermal conductivity

14761 Relaxation theory of thermal conduction in helium II.
Meyer,L. Band,W.
Phys. Rev. 74, No. 4, 394-96 (Aug 1948) 1 fig 1 tab 3 ref
A3 B1 C5 D1 E3 F6 G1
*helium, helium II, *liquid, *thermal conductivity, temperature effect

14764 Statistical mechanical theory of transport processes. VI. The coefficient of thermal conductivity of monatomic liquids.
Zwanzig, R.W. Kirkwood, J.G. Oppenheim, I. Alder, B.J.
J. Chem. Phys. 22, No. 5, 783-90 (May 1954) 3 ref
A4 B1 C1 D2 E3 F6 G1
*transport property, thermal conductivity, theory, *liquid, monatomic, *argon, calculation