LIBRARY OF PHYSICO-CHEMICAL PROPERTY DATA

Handbook of Thermal Conductivity

Volume 2

Organic Compounds C_5 to C_7

Carl L. Yaws

Handbook of Thermal Conductivity

Volume 2

Organic Compounds C_5 to C_7

LIBRARY OF PHYSICO-CHEMICAL PROPERTY DATA

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Volume 1: C_1 to C_4 Compounds (Product #5189)
Volume 2: C_5 to C_7 Compounds (Product #5190)
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Handbook of Thermal Conductivity

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LIBRARY OF PHYSICO-CHEMICAL PROPERTY DATA

Handbook of Thermal Conductivity

Volume 2

Organic Compounds C_5 to C_7

Carl L. Yaws

Gulf Publishing Company
Houston, London, Paris, Zurich, Tokyo

Handbook of Thermal Conductivity, Volume 2

Gulf Publishing Company
Book Division
P.O. Box 2608 □ Houston, Texas 77252-2608

10 9 8 7 6 5 4 3 2 1

Printed on Acid-Free Paper (∞)

Library of Congress Cataloging-in-Publication Data

Yaws, Carl L.
Handbook of thermal conductivity / Carl L. Yaws.
p. cm. — (Library of physico-chemical property data)
Includes bibliographical references.
Contents: v. 1. Organic compounds, C_1 to C_4 — v. 2. Organic compounds, C_5 to C_7 — v. 3. Organic compounds, C_8 to C_{28}.
ISBN 0-88415-382-7 (v. 1). — **ISBN 0-88415-383-5** (v. 2). — ISBN 0-88415-384-3 (v. 3)
1. Heat—Conduction—Handbooks, manuals, etc.
I. Title. II. Series.
QD257.7.Y38 1995
661.8—dc20 95-5676
CIP

CONTENTS

Preface vii

Thermal Conductivity Graphs for C_5 to C_7 Compounds 1

References 368

Appendix A: Coefficients for Liquid Thermal Conductivity Equation 370

Appendix B: Coefficients for Gas Thermal Conductivity Equation . .376

Appendix C: Data Code for Compounds 382

Appendix D: Compound List by Formula 387

Appendix E: Compound List by Name 395

CONTRIBUTORS

Li Bu	Graduate student, Chemical Engineering Department, Lamar University, Beaumont, Texas 77710, U.S.A.
Jack R. Hopper	Professor and Chair, Chemical Engineering Department, Lamar University, Beaumont, Texas 77710, U.S.A.
Xiaoyan Lin	Graduate student, Chemical Engineering Department, Lamar University, Beaumont, Texas 77710, U.S.A.
Sachin Nijhawan	Graduate student, Chemical Engineering Department, Lamar University, Beaumont, Texas 77710, U.S.A.
Carl L. Yaws	Professor, Chemical Engineering Department, Lamar University, Beaumont, Texas 77710, U.S.A.

ACKNOWLEDGMENTS

Many colleagues and students have made contributions and helpful comments over the years. The author is grateful to each: Jack R. Hopper, Joe W. Miller, Jr., C.S. Fang, K.Y. Li, Keith C. Hansen, Daniel H. Chen, P.Y. Chiang, H.C. Yang, Xiang Pan, Xiaoyan Lin, Duane G. Piper, Jr., Li Bu, and Sachin Nijhawan.

The author wishes to extend special appreciation to his wife (Annette) and family (Kent, Michele, Chelsea, and Brandon; Lindsay and Rebecca; and Matthew and Sarah).

The author wishes to acknowledge that the Gulf Coast Hazardous Substance Research Center provided partial support to this work.

DISCLAIMER

PREFACE

Thermal conductivity data are important in many engineering applications in the chemical processing and petroleum refining industries. The objective of this book is to provide the engineer with such data. The data are presented in graphs covering a wide temperature range to enable the engineer to quickly determine values at the temperatures of interest. The contents of the book are arranged in the following order: graphs, references, and appendixes.

The graphs for thermal conductivity as a function of temperature are arranged by carbon number and chemical formula to provide ease of use. Most of the graphs for the liquid cover a wide temperature range extending from melting point to boiling point to near the critical point. The graphs for gas cover a wide temperature range and are applicable at low pressure. Common units are used for thermal conductivity (W/m K). For those involved in English usage, each graph displays a conversion factor to provide the English units.

The coverage encompasses a wide range of organic compounds including hydrocarbons such as alkanes, olefins, acetylenes, and cycloalkanes; oxygenates such as alcohols, aldehydes, ketones, acids, ethers, glycols, and anhydrides; halogenates such as chlorinated, brominated, fluorinated, and iodinated compounds; nitrogenates such as nitriles, amines, cyanates, and amides; sulfur compounds such as mercaptans, sulfides, and sulfates; silicon compounds such as silanes and chlorosilanes; and many other chemical types.

The graphs for liquids are based on both experimental data and estimates. Estimates for liquid thermal conductivity were primarily based on modified Missenard and Pachaiyappan methods. Both experimental data and estimates were then regressed to provide the same equation with wide and extended temperature coverage for all compounds.

Very limited experimental data for liquid thermal conductivities are available at temperatures in the region of the melting point. Also, there are very few reliable data at temperatures above a reduced temperature of $T_f = 0.65$. Thus, the values in the regions of melting point and reduced temperatures above 0.65 should be considered rough approximations. The values in the intermediate region (above melting point and below reduced temperature of 0.65) are more accurate.

The graphs for gases are also based on both experimental data and estimates. In the absence of experimental data, estimates were primarily based on correlations of Roy and Thodos; Misic and Thodos; and Stiel and Thodos and modified Eucken models. Experimental data and estimates were then regressed to provide the same equation for all compounds. The graphs are applicable for low pressure gas. The presented values may be adjusted to provide values at higher pressure using the methods in Reid, Prausnitz, and Poling (25).

Very limited experimental data for gases are available for highly polar and high molecular weight compounds. Also, very few experimental data are available for organic compounds at high temperatures above 600 K. Thus, the values for these compounds and high temperatures should be considered rough approximations.

The literature has been carefully searched in construction of the graphs. The references are given in the section following the graphs near the end of the book. The references provide documentation for the original sources used in preparing the work.

The equations for liquid and gas thermal conductivities are:

$$\log_{10} \lambda_{liq} = A + B\,[1 - T/C]^{2/7} \qquad \text{(liquid)}$$

$$\lambda_{gas} = A + B\,T + C\,T^2 \qquad \text{(gas)}$$

The coefficients for the equations are provided in the appendix near the end of the book. The tabulated values are especially arranged for quick usage with hand calculator or computer. Computer programs, containing coefficients for all compounds, are available for liquid and gas.

Each program is in ASCII which can be accessed by other software. For information, contact Carl L. Yaws, Ph.D., P.O. Box 10053, Beaumont, Texas 77710, phone/fax (409) 880-8787.

A list of compounds is also given near the end of the book to aid the user in quickly locating the compound of interest by the chemical formula or name.

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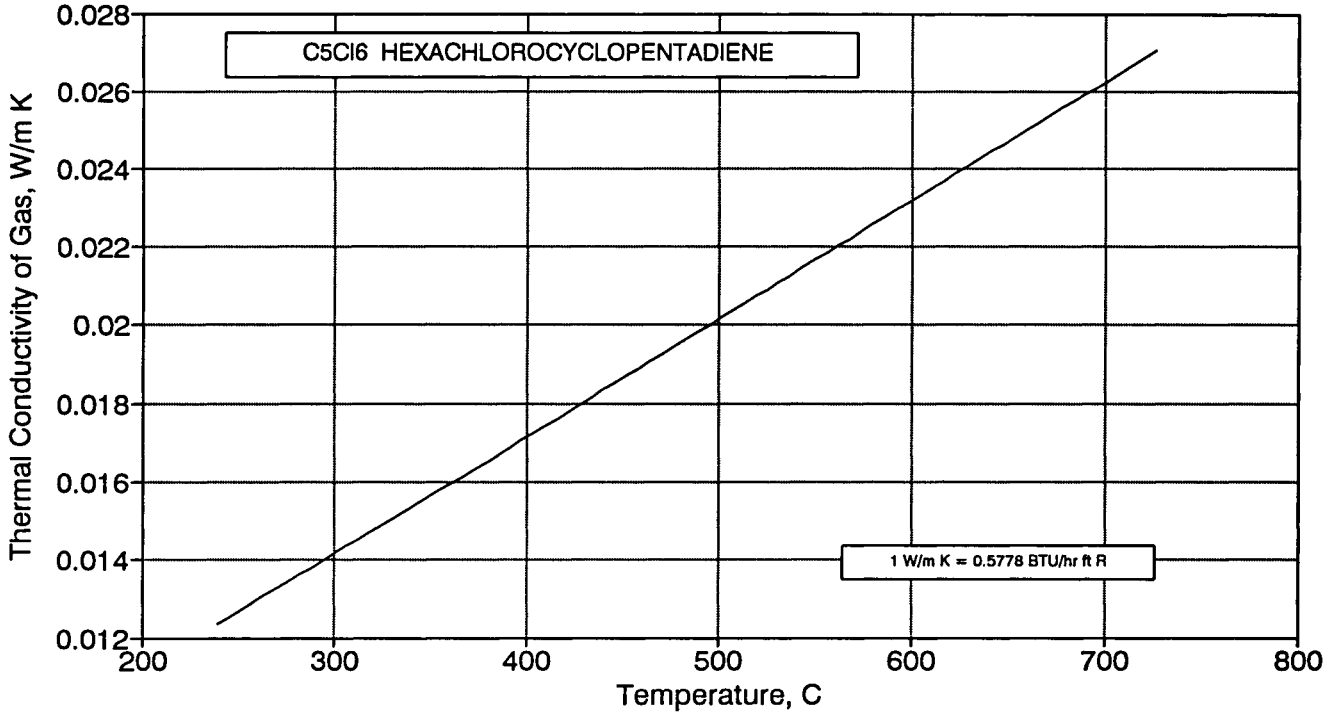
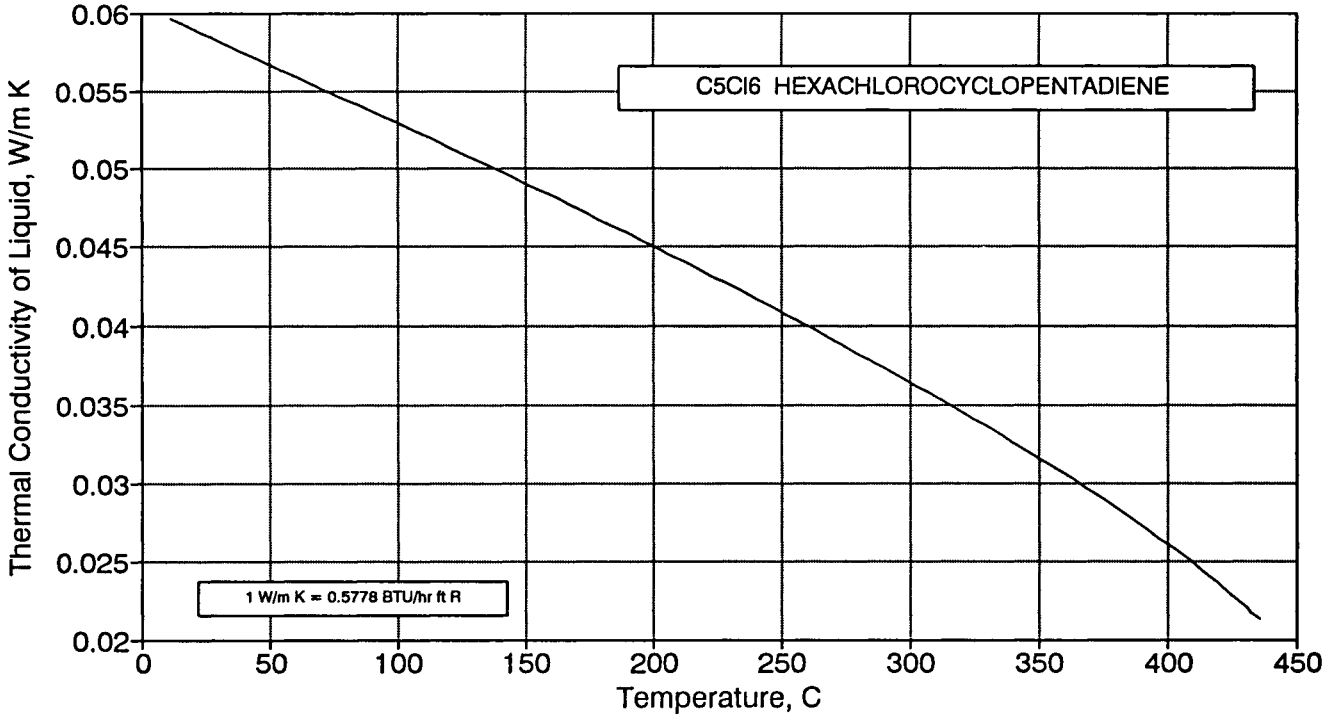
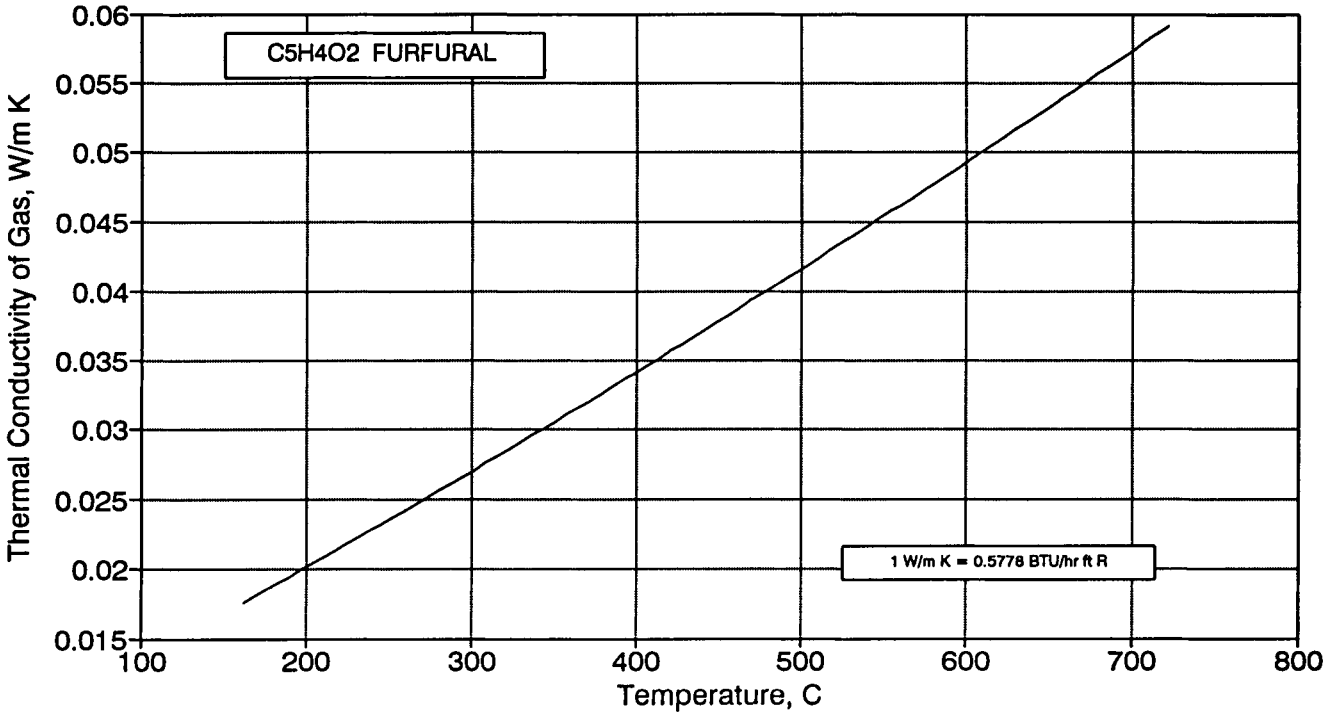
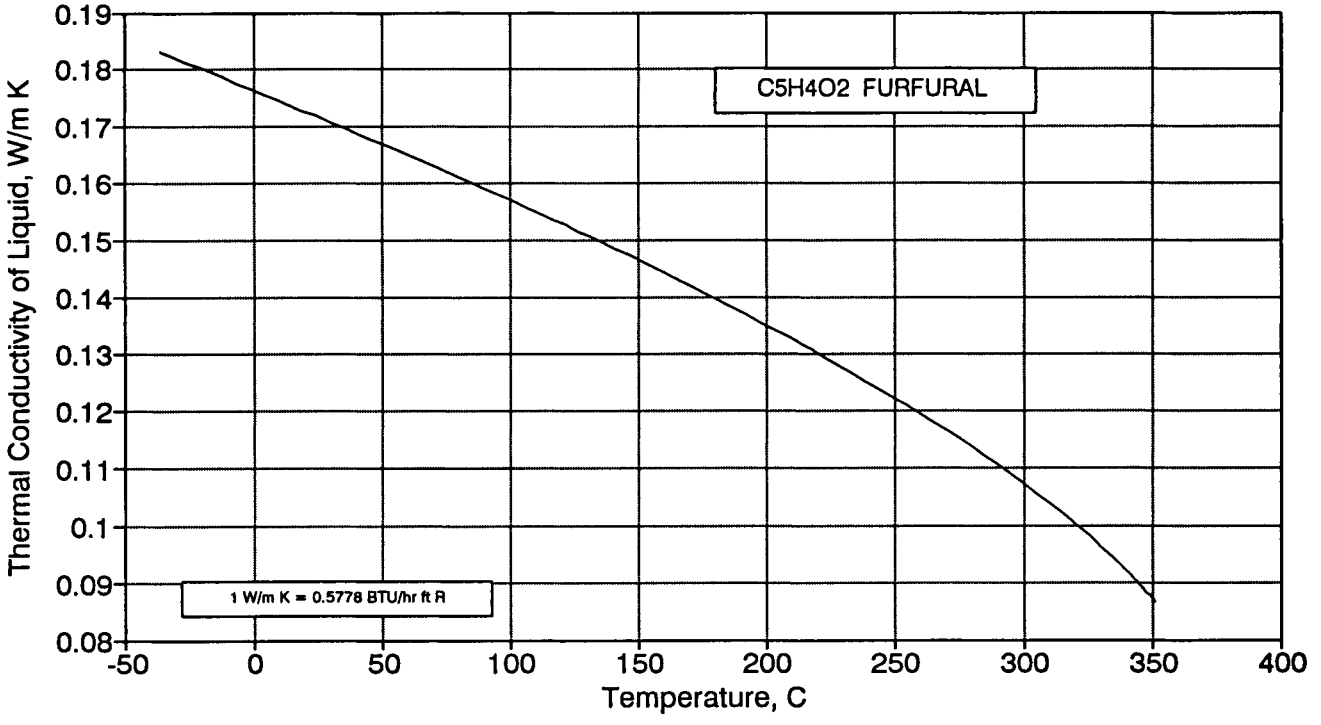

C5Cl6 HEXACHLOROCYCLOPENTADIENE
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Gas, W/m K
0.028
0.026
0.024
0.022
0.02
0.018
0.016
0.014
0.012
200
300
400
500
600
700
800
Temperature, C


C5Cl6 HEXACHLOROCYCLOPENTADIENE
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Liquid, W/m K
0.06
0.055
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0
50
100
150
200
250
300
350
400
450
Temperature, C


C5H4O2 FURFURAL
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Gas, W/m K
0.06
0.055
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
100
200
300
400
500
600
700
800
Temperature, C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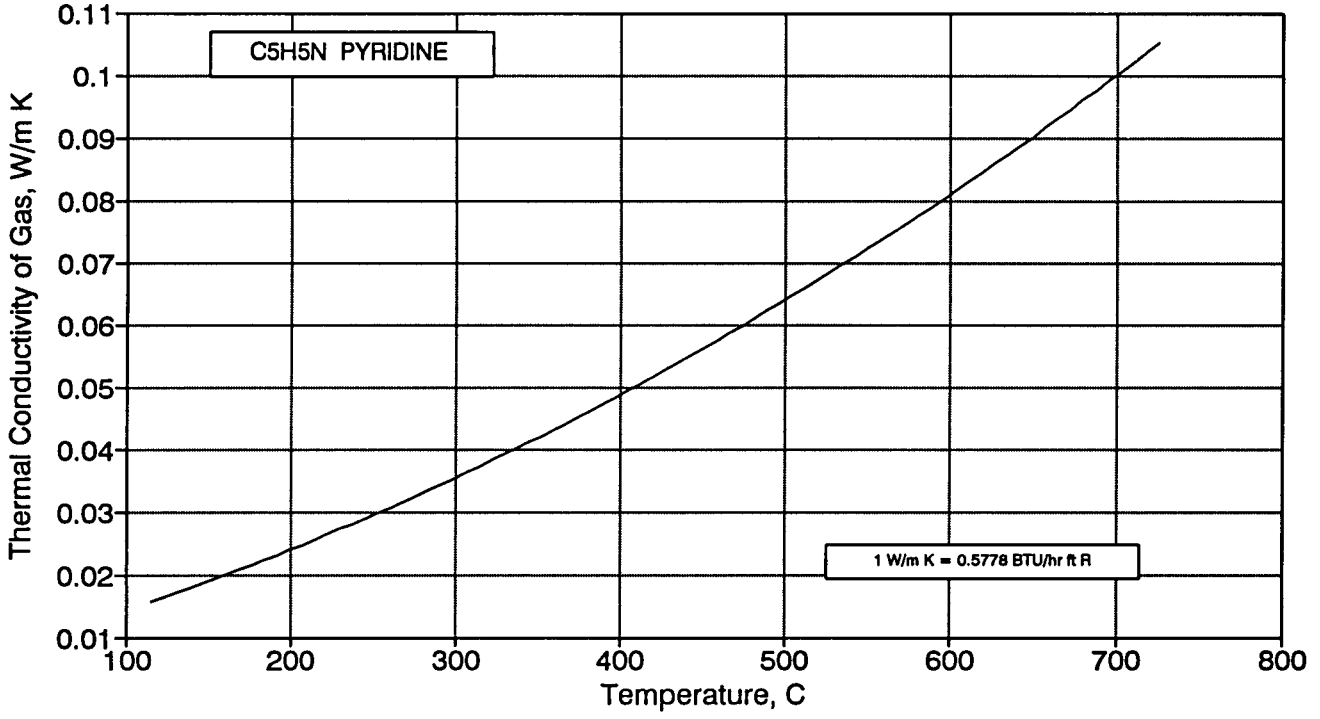
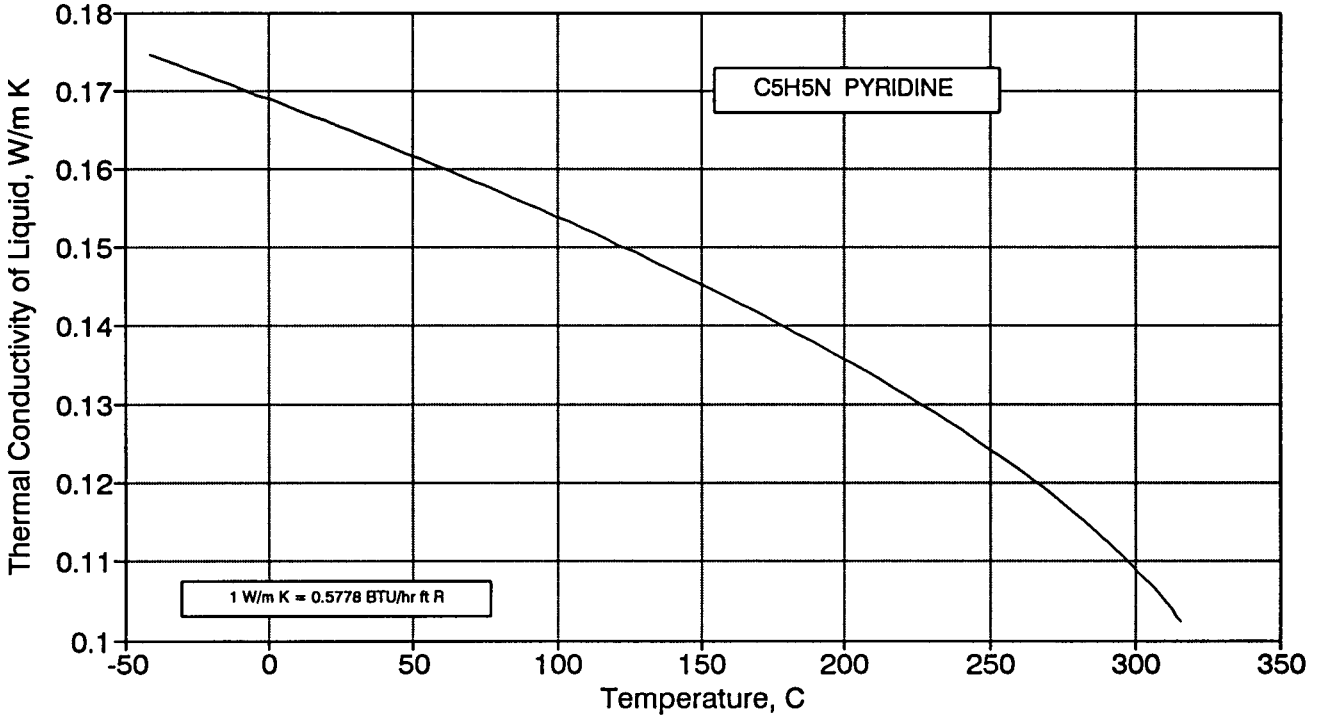
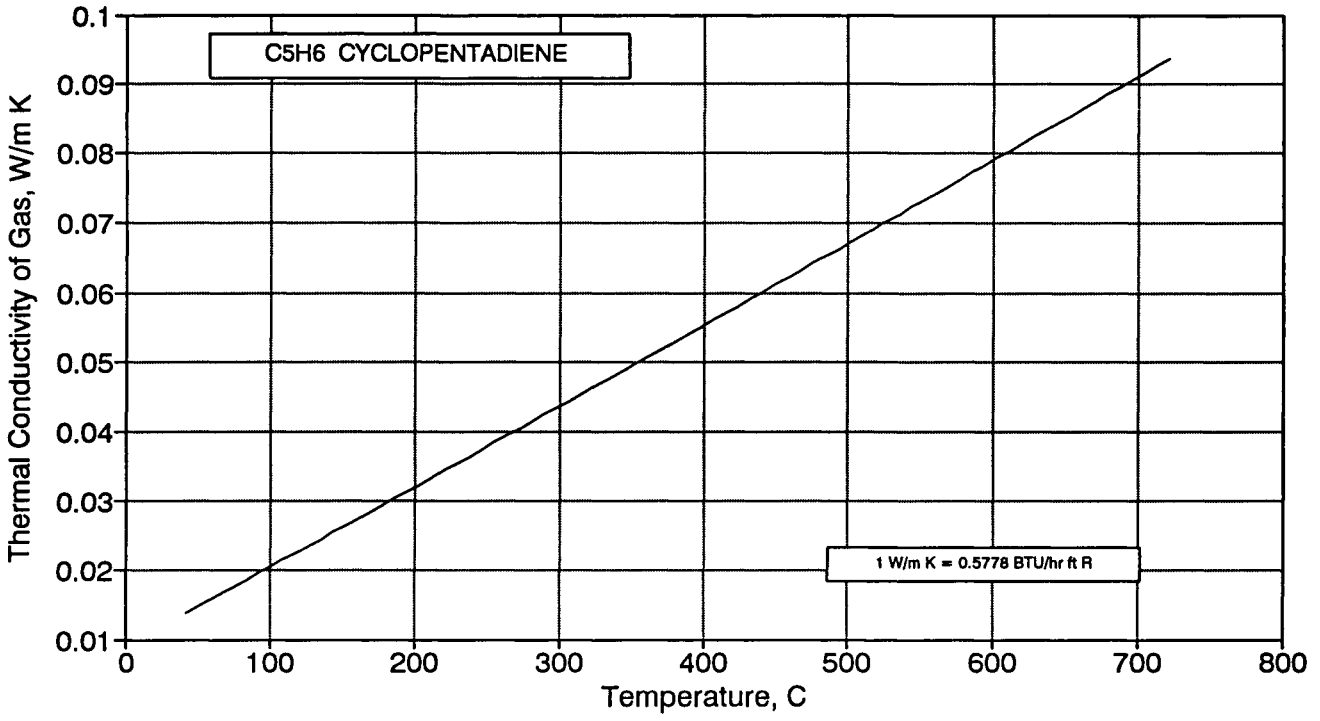
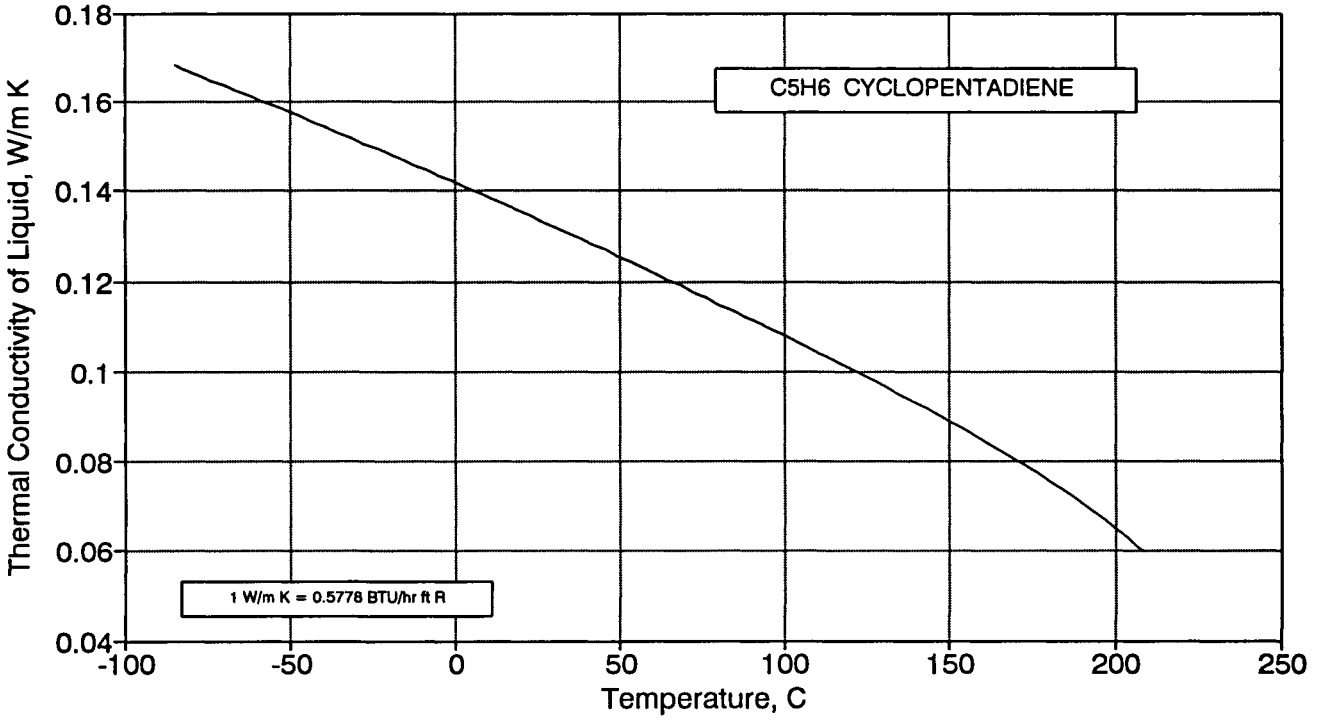
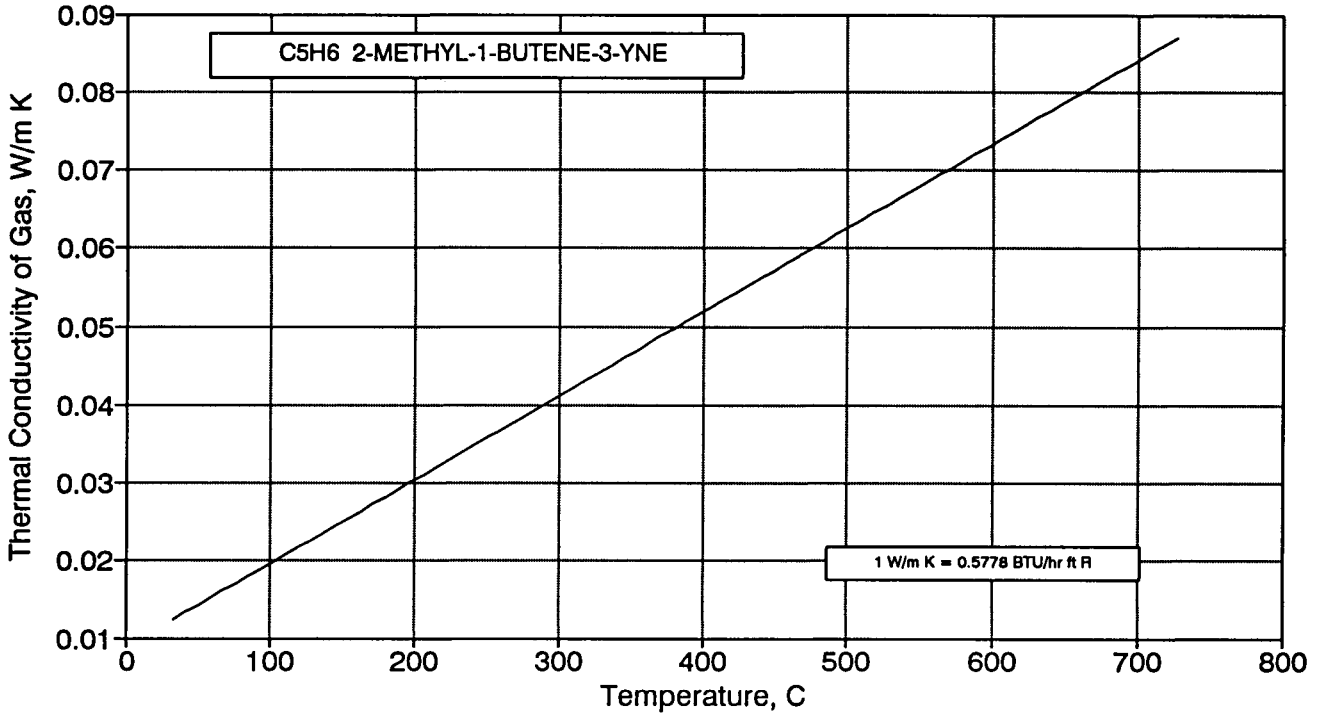
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Liquid, W/m K
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
-50
0
50
100
150
200
250
300
350
400
Temperature, C

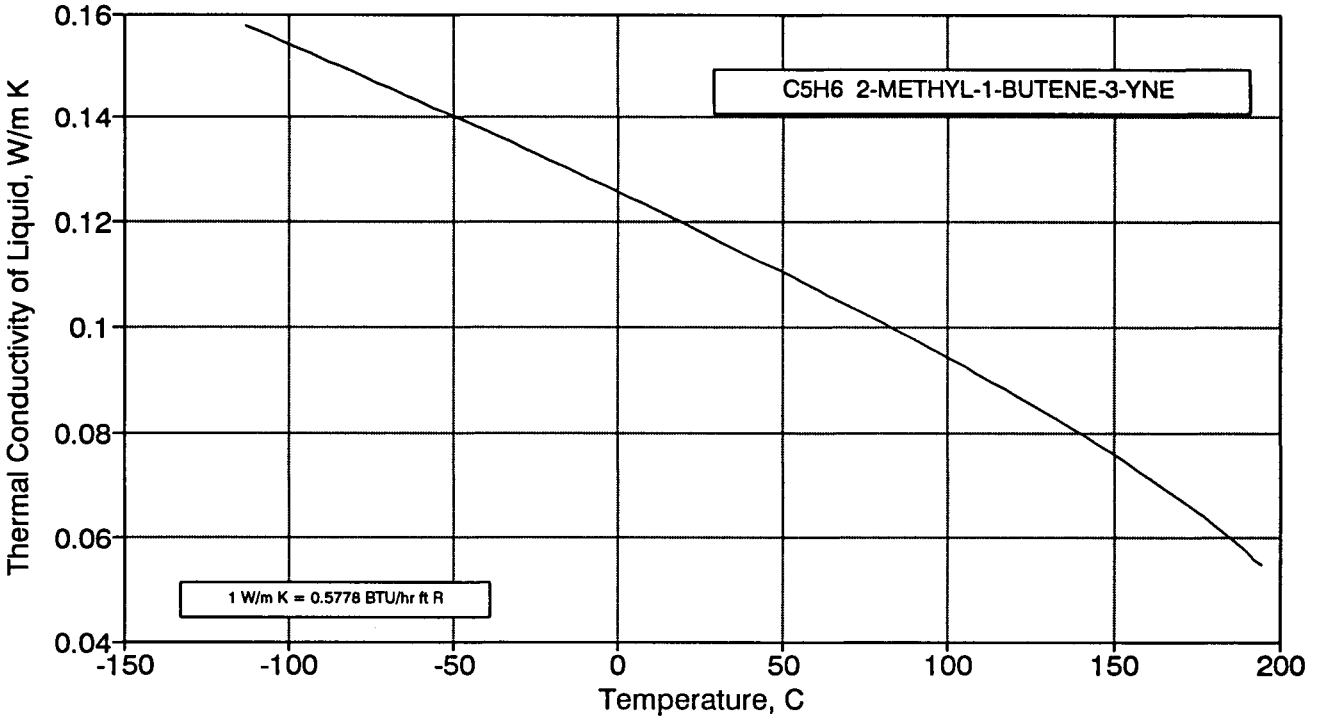

C5H5N PYRIDINE
Thermal Conductivity of Gas, W/m K
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
100
200
300
400
500
600
700
800
Temperature, C
1 W/m K = 0.5778 BTU/hr ft R

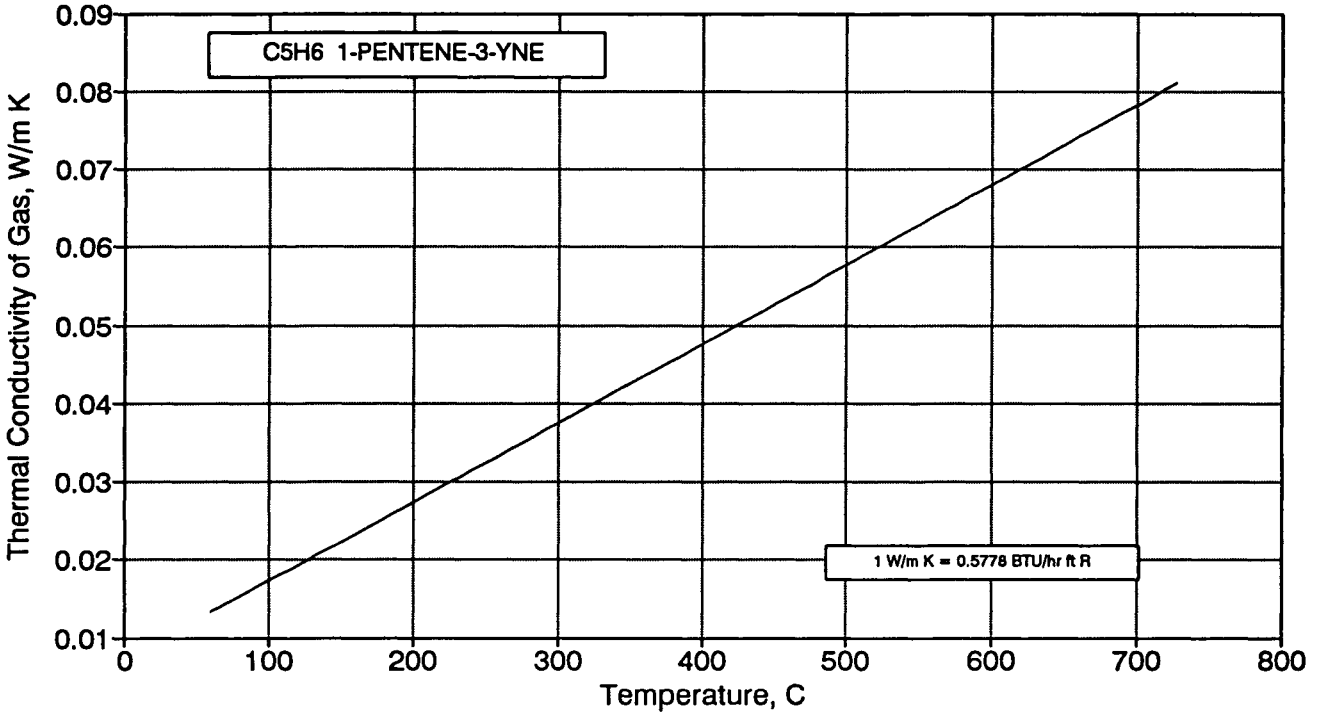

C5H5N PYRIDINE
Thermal Conductivity of Liquid, W/m K
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
-50
0
50
100
150
200
250
300
350
Temperature, C
1 W/m K = 0.5778 BTU/hr ft R

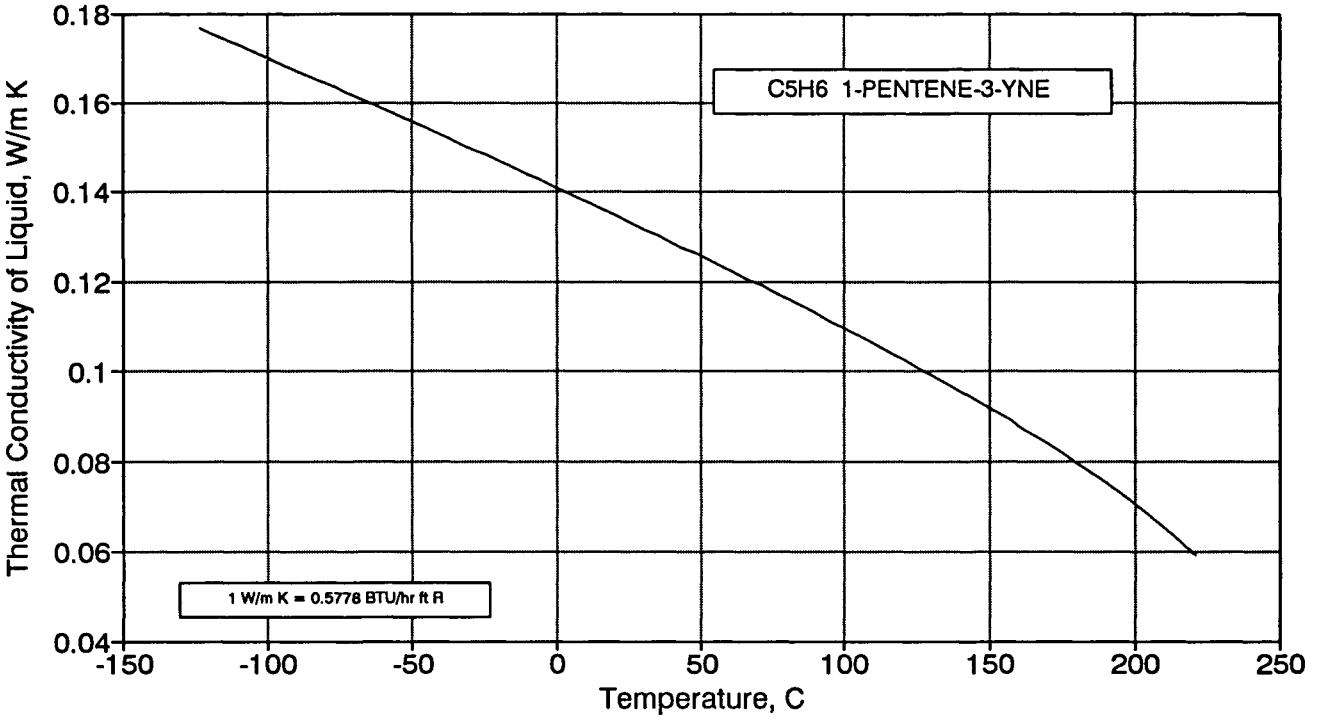

C5H6 CYCLOPENTADIENE
Thermal Conductivity of Gas, W/m K
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
100
200
300
400
500
600
700
800
Temperature, C
1 W/m K = 0.5778 BTU/hr ft R

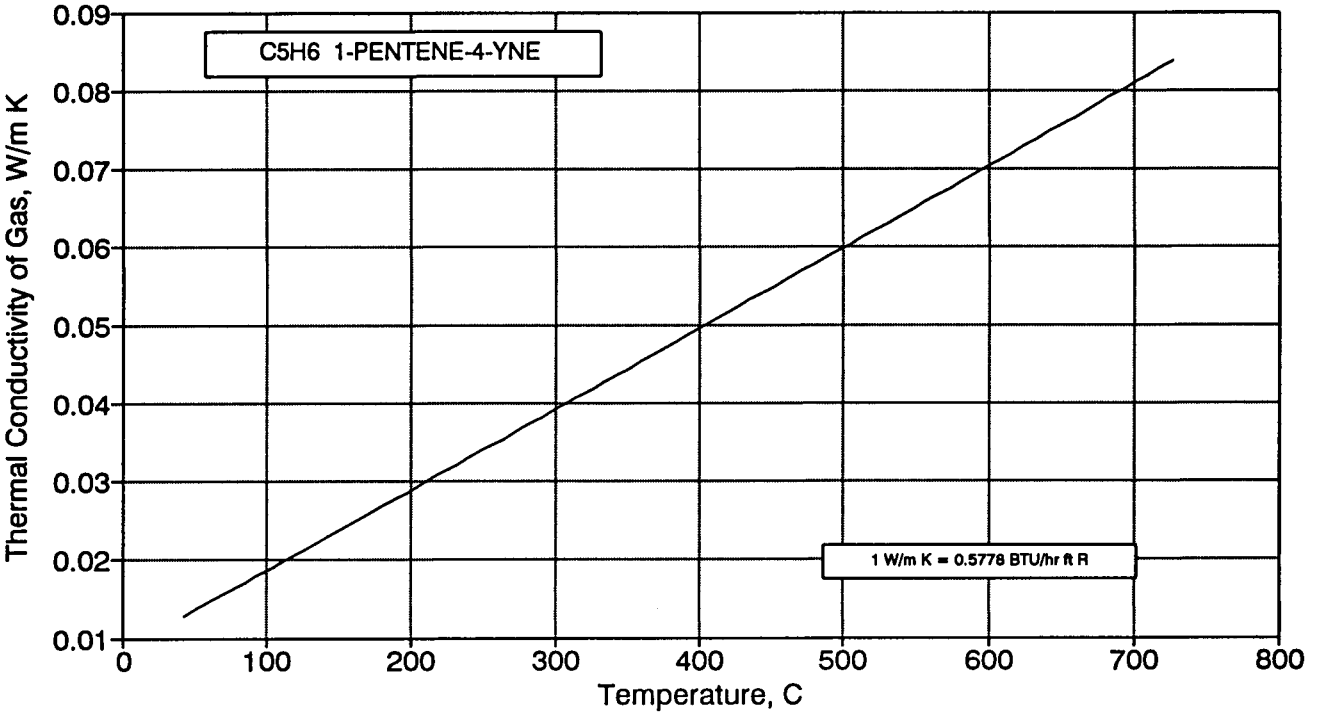

C5H6 CYCLOPENTADIENE
Thermal Conductivity of Liquid, W/m K
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
-100
-50
0
50
100
150
200
250
Temperature, C
1 W/m K = 0.5778 BTU/hr ft R

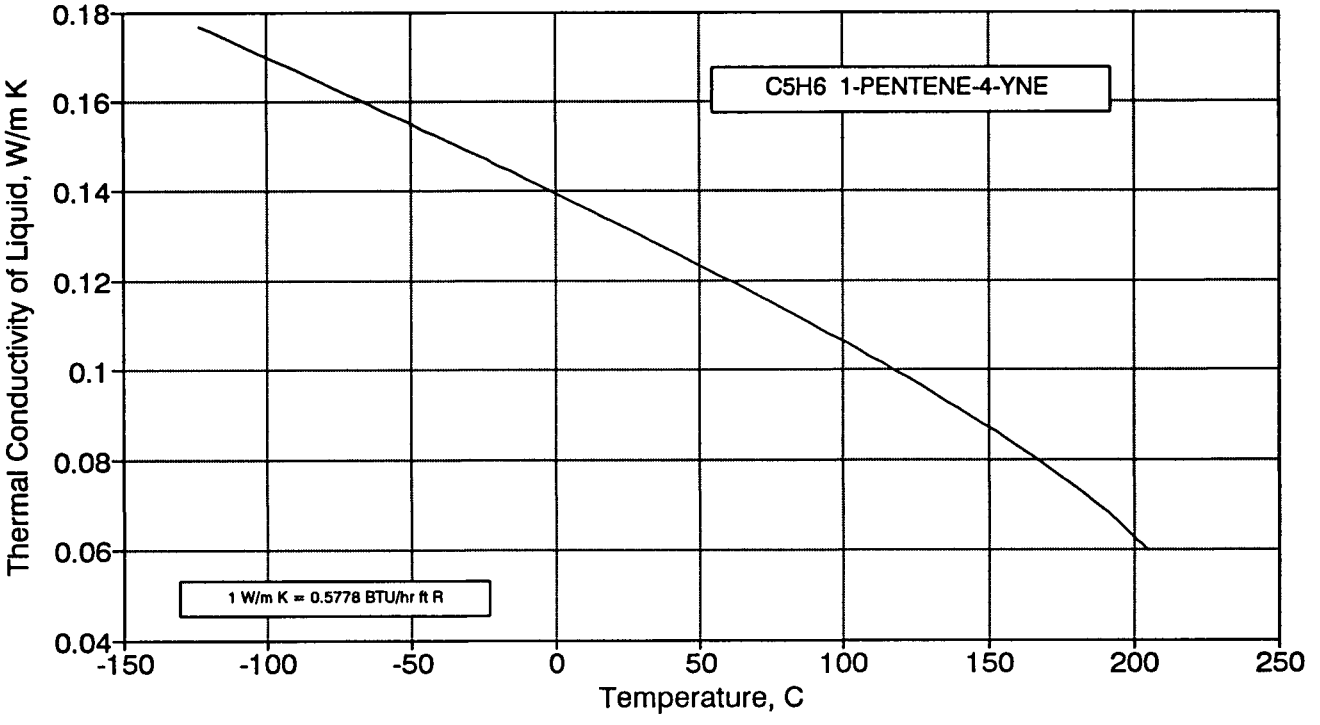

C5H6 2-METHYL-1-BUTENE-3-YNE
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Gas, W/m K
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
100
200
300
400
500
600
700
800
Temperature, C

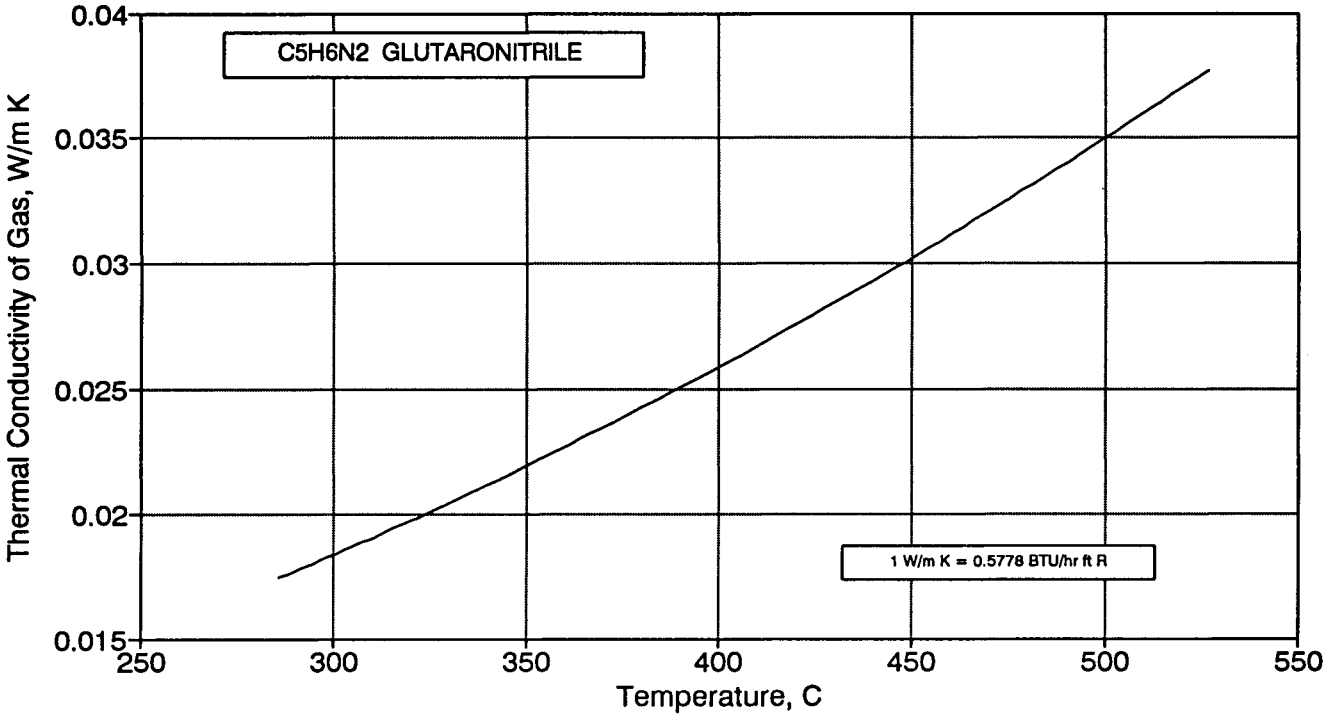

C5H6 2-METHYL-1-BUTENE-3-YNE
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Liquid, W/m K
0.16
0.14
0.12
0.1
0.08
0.06
0.04
-150
-100
-50
0
50
100
150
200
Temperature, C

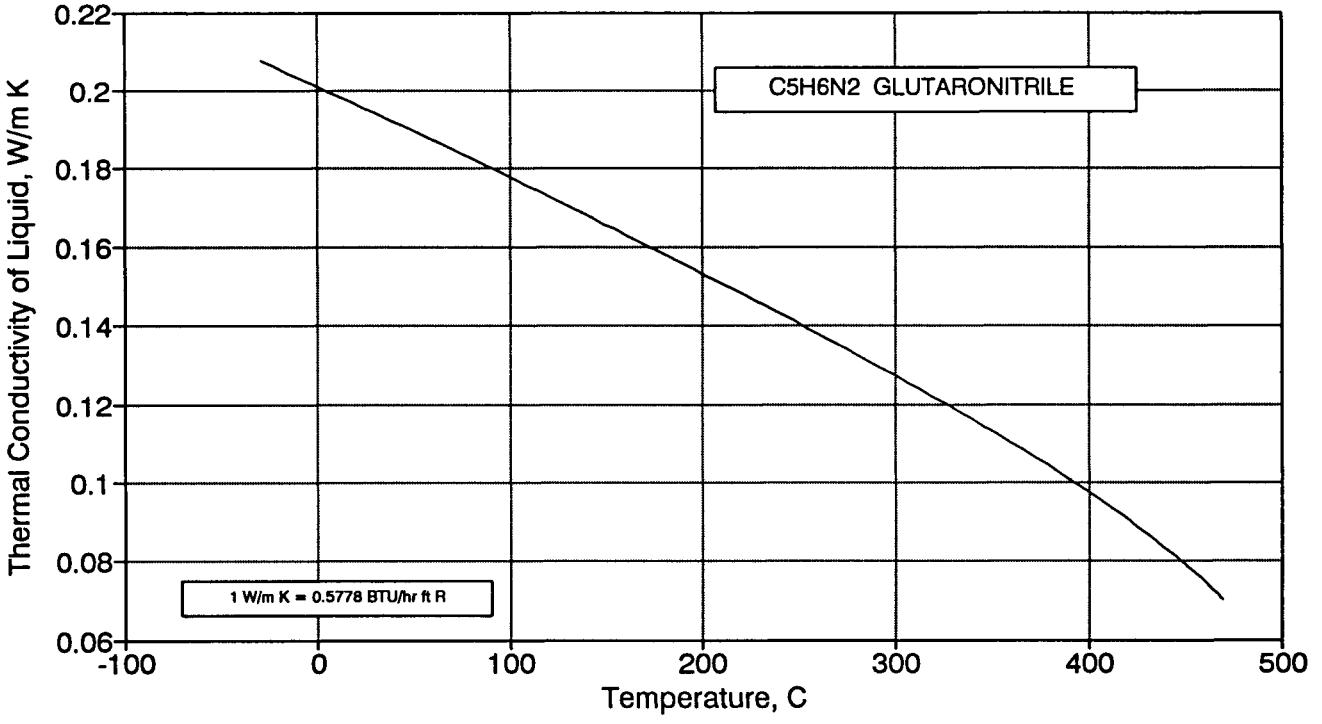

C5H6 1-PENTENE-3-YNE
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Gas, W/m K
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
100
200
300
400
500
600
700
800
Temperature, C

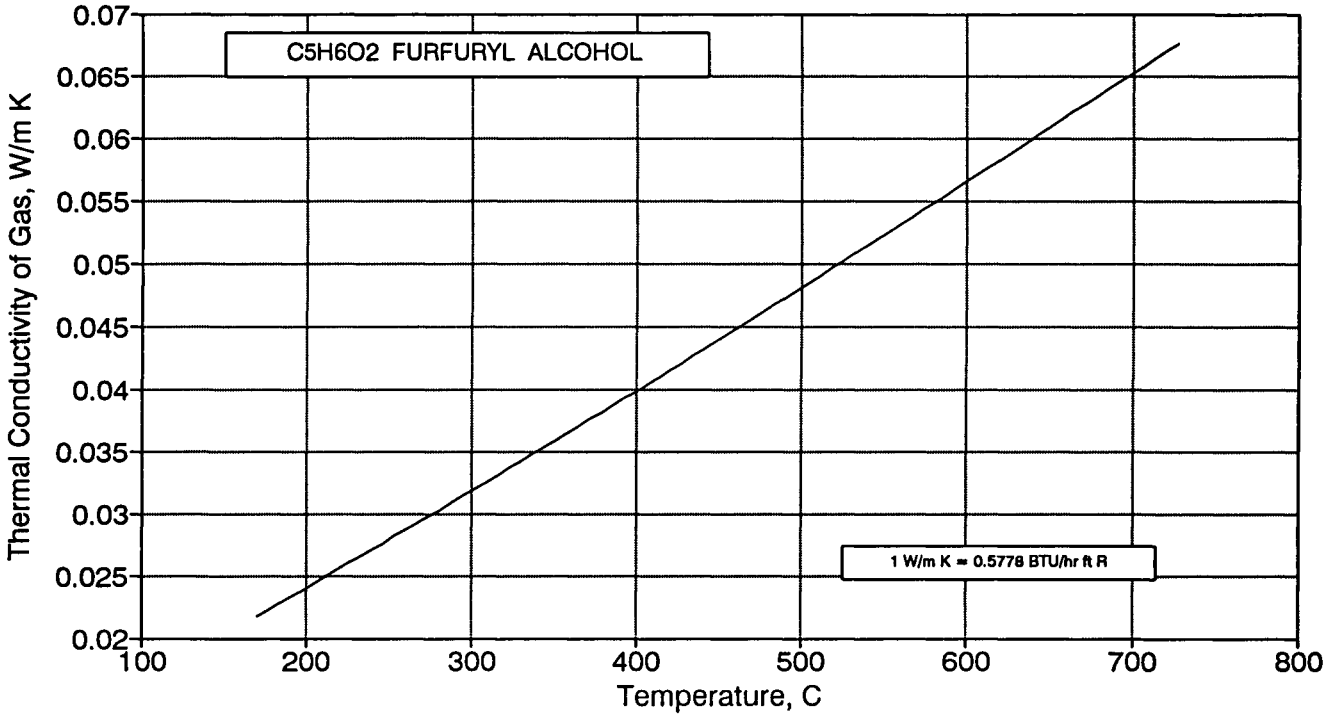

C5H6 1-PENTENE-3-YNE
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Liquid, W/m K
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
-150
-100
-50
0
50
100
150
200
250
Temperature, C

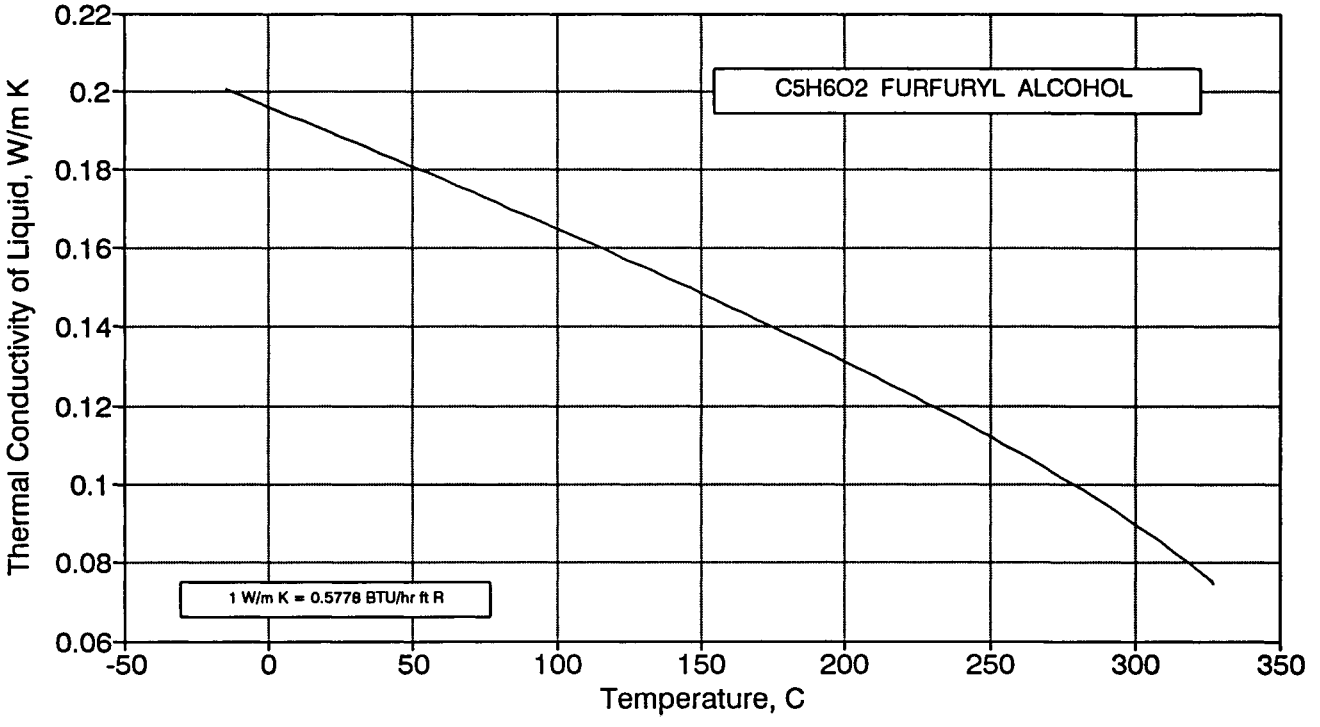

C5H6 1-PENTENE-4-YNE
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Gas, W/m K
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
100
200
300
400
500
600
700
800
Temperature, C

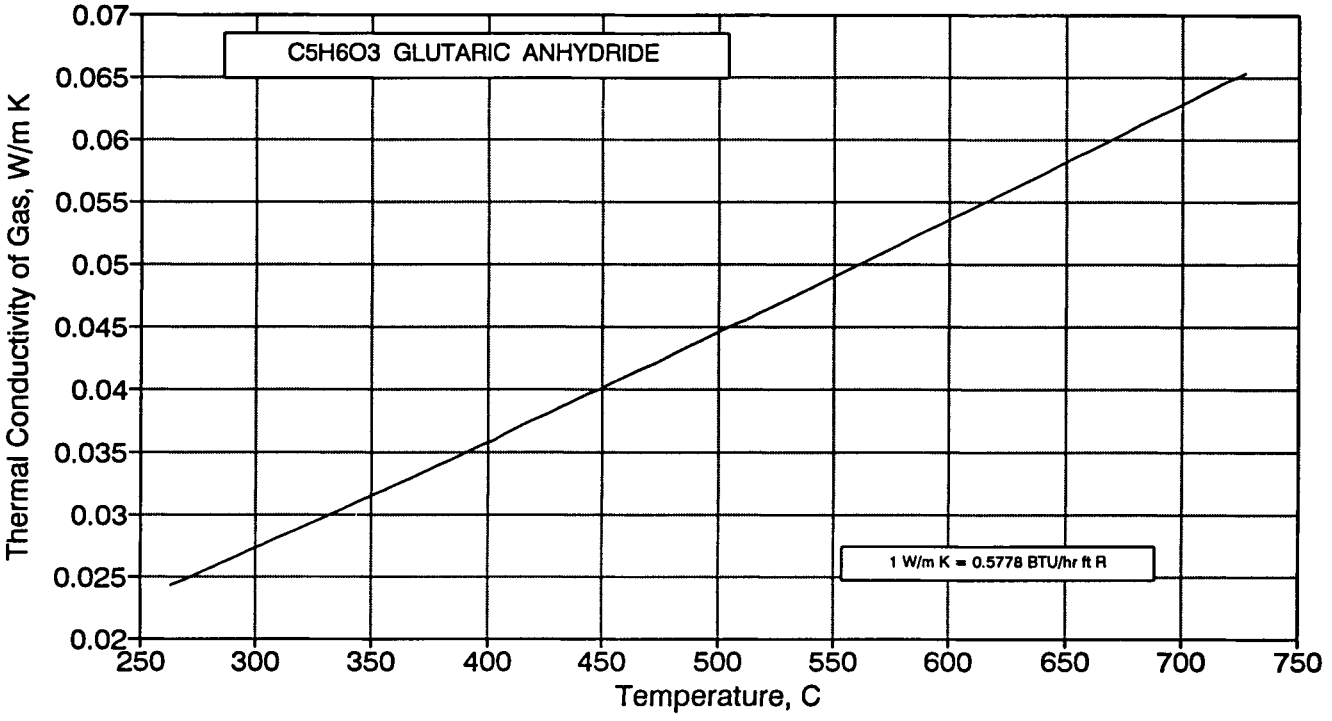

C5H6 1-PENTENE-4-YNE
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Liquid, W/m K
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
-150
-100
-50
0
50
100
150
200
250
Temperature, C

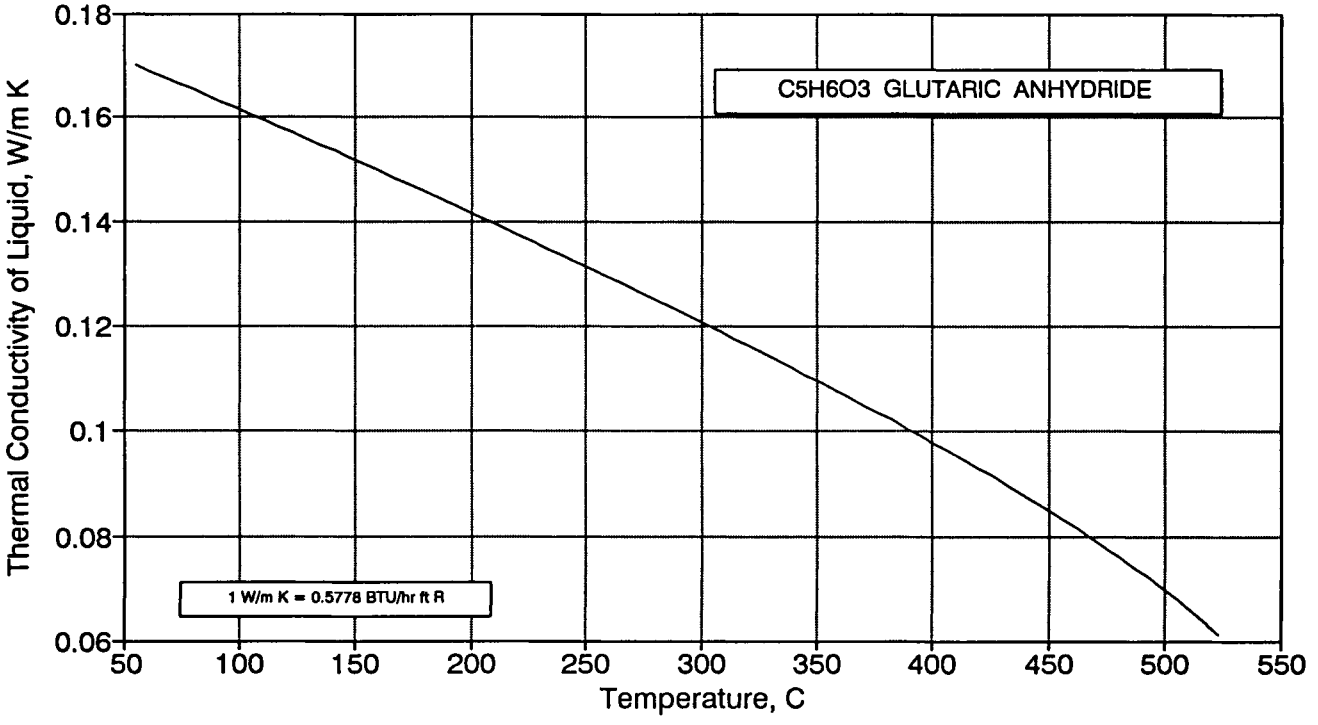

C5H6N2 GLUTARONITRILE
Thermal Conductivity of Gas, W/m K
0.04
0.035
0.03
0.025
0.02
0.015
250
300
350
400
450
500
550
Temperature, C
1 W/m K = 0.5778 BTU/hr ft R


C5H6N2 GLUTARONITRILE
Thermal Conductivity of Liquid, W/m K
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
-100
0
100
200
300
400
500
Temperature, C
1 W/m K = 0.5778 BTU/hr ft R


C5H6O2 FURFURYL ALCOHOL
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Gas, W/m K
0.07
0.065
0.06
0.055
0.05
0.045
0.04
0.035
0.03
0.025
0.02
100
200
300
400
500
600
700
800
Temperature, C


C5H6O2 FURFURYL ALCOHOL
1 W/m K = 0.5778 BTU/hr ft R
Thermal Conductivity of Liquid, W/m K
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
-50
0
50
100
150
200
250
300
350
Temperature, C


C5H6O3 GLUTARIC ANHYDRIDE
Thermal Conductivity of Gas, W/m K
0.07
0.065
0.06
0.055
0.05
0.045
0.04
0.035
0.03
0.025
0.02
250
300
350
400
450
500
550
600
650
700
750
Temperature, C
1 W/m K = 0.5778 BTU/hr ft R


C5H6O3 GLUTARIC ANHYDRIDE
Thermal Conductivity of Liquid, W/m K
0.18
0.16
0.14
0.12
0.1
0.08
0.06
50
100
150
200
250
300
350
400
450
500
550
Temperature, C
1 W/m K = 0.5778 BTU/hr ft R