NSRDS-NBS 72

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

NATIONAL STANDARD
NSRDS
REFERENCE DATA SYSTEM

Tables of Rate Constants for Gas Phase Chemical Reactions of Sulfur Compounds (1971-1980)

NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards[1] was established by an act of Congress on March 3, 1901. The Bureau's overall goal is to strengthen and advance the Nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the Nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau's technical work is performed by the National Measurement Laboratory, the National Engineering Laboratory, and the Institute for Computer Sciences and Technology.

THE NATIONAL MEASUREMENT LABORATORY provides the national system of physical and chemical and materials measurement; coordinates the system with measurement systems of other nations and furnishes essential services leading to accurate and uniform physical and chemical measurement throughout the Nation's scientific community, industry, and commerce; conducts materials research leading to improved methods of measurement, standards, and data on the properties of materials needed by industry, commerce, educational institutions, and Government; provides advisory and research services to other Government agencies; develops, produces, and distributes Standard Reference Materials; and provides calibration services. The Laboratory consists of the following centers:

Absolute Physical Quantities[2] — Radiation Research — Chemical Physics — Analytical Chemistry — Materials Science

THE NATIONAL ENGINEERING LABORATORY provides technology and technical services to the public and private sectors to address national needs and to solve national problems; conducts research in engineering and applied science in support of these efforts; builds and maintains competence in the necessary disciplines required to carry out this research and technical service; develops engineering data and measurement capabilities; provides engineering measurement traceability services; develops test methods and proposes engineering standards and code changes; develops and proposes new engineering practices; and develops and improves mechanisms to transfer results of its research to the ultimate user. The Laboratory consists of the following centers:

Applied Mathematics — Electronics and Electrical Engineering[2] — Manufacturing Engineering — Building Technology — Fire Research — Chemical Engineering[2]

THE INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY conducts research and provides scientific and technical services to aid Federal agencies in the selection, acquisition, application, and use of computer technology to improve effectiveness and economy in Government operations in accordance with Public Law 89-306 (40 U.S.C. 759), relevant Executive Orders, and other directives; carries out this mission by managing the Federal Information Processing Standards Program, developing Federal ADP standards guidelines, and managing Federal participation in ADP voluntary standardization activities; provides scientific and technological advisory services and assistance to Federal agencies; and provides the technical foundation for computer-related policies of the Federal Government. The Institute consists of the following centers:

Programming Science and Technology — Computer Systems Engineering.

[1] Headquarters and Laboratories at Gaithersburg, MD, unless otherwise noted;
mailing address Washington, DC 20234.

[2] Some divisions within the center are located at Boulder, CO 80303.

Tables of Rate Constants for Gas Phase Chemical Reactions of Sulfur Compounds (1971-1980)

NSRDS-NBS

Francis Westley

Chemical Kinetics Division
Center for Chemical Physics
National Bureau of Standards
Washington, DC 20234

Prepared for

Morgantown Energy Technology Center
Department of Energy
Morgantown, WV 26505

and

Office of Standard Reference Data
National Bureau of Standards
Washington, DC 20234

NATIONAL STANDARD
NSRDS
REFERENCE DATA SYSTEM

U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, Secretary
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director

Issued May 1982

Library of Congress Cataloging in Publication Data

Westley, Francis
Tables of rate constants for gas phase chemical reactions of sulfur compounds (1971-1980)

(NSRDS-NBS ; 72)
"Issued May 1982."
1. Chemical reaction, Rate of—Tables. 2. Sulphur compounds—Tables. I. Morgantown Energy Technology Center. II. United States. National Bureau of Standards. Office of Standard Reference Data. III. Title. IV. Series.
QC100.U573 no. 72 [QD502] 602'.18s 82-2094
[546'.7232] AACR2

NSRDS-NBS 72
Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 72, 42 pages (May 1982)
CODEN: NSRDAP

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1982

Foreword

The National Standard Reference Data System provides access to the quantitative data of physical science, critically evaluated and compiled for convenience and readily accessible through a variety of distribution channels. The System was established in 1963 by action of the President's Office of Science and Technology and the Federal Council for Science and Technology, and responsibility to administer it was assigned to the National Bureau of Standards.

NSRDS receives advice and planning assistance from a Review Committee of the National Research Council of the National Academy of Sciences-National Academy of Engineering. A number of Advisory Panels, each concerned with a single technical area, meet regularly to examine major portions of the program, assign relative priorities, and identify specific key problems in need of further attention. For selected specific topics, the Advisory Panels sponsor subpanels which make detailed studies of users' needs, the present state of knowledge, and existing data resources as a basis for recommending one or more data compilation activities. This assembly of advisory services contributes greatly to the guidance of NSRDS activities.

The System now includes a complex of data centers and other activities in academic institutions and other laboratories. Components of the NSRDS produce compilations of critically evaluated data, reviews of the state of quantitative knowledge in specialized areas, and computations of useful functions derived from standard reference data. The centers and projects also establish criteria for evaluation and compilation of data and recommend improvements in experimental techniques. They are normally associated with research in the relevant field.

The technical scope of NSRDS is indicated by the categories of projects active or being planned: nuclear properties, atomic and molecular properties, solid state properties, thermodynamic and transport properties, chemical kinetics, and colloid and surface properties.

Reliable data on the properties of matter and materials are a major foundation of scientific and technical progress. Such important activities as basic scientific research, industrial quality control, development of new materials for building and other technologies, measuring and correcting environmental pollution depend on quality reference data. In NSRDS, the Bureau's responsibility to support American science, industry, and commerce is vitally fulfilled.

Ernest Ambler.

ERNEST AMBLER, *Director*

Contents

Page

Reactions of:

Tables of Rate Constants for Gas Phase Chemical Reactions of Sulfur Compounds (1971–1980)

Francis Westley

Chemical Kinetics Division, Center for Chemical Physics, National Bureau of Standards, Washington, DC 20234

A table of rate constants for gas phase chemical reactions of sulfur compounds is presented. Specifically, it gives in tabular form the values of the parameters for the modified Arrhenius equation $k = AT^{n}\exp(-E/RT)$. The table covers the reactions of sulfur containing molecules and free radicals, S, S_2, SO, SO_2, SO_3, S_2O, SH, H_2S, $\dot{C}S$, CS_2, COS, $CH_3S\cdot$, CH_3SH, cy-CH_2CH_2S, $CH_3SCH_2\cdot$, and a number of thiols, thioethers, and thioesters, with other compounds. The table includes 19 unimolecular, 208 bimolecular, and 13 termolecular reactions totaling 240 distinct chemical reactions. There are 441 rate constants associated with these reactions, distributed as follows: 30 for first order reactions, 377 for second order reactions, and 34 for third order reactions. The kinetic data were compiled from 145 experimental papers and 8 critical reviews published between 1971 and 1980.

Key words: Arrhenius parameters; chemical kinetics; combustion; decomposition; free radicals; gas phase; hydrocarbons; hydrogen; nitrogen; oxygen; rate of reaction; sulfur.

1. Introduction

This publication consists of a table of rate constants for reactions of inorganic and organic sulfur compounds in the gas phase, as well as of their reactions with other substrates. The table is a compilation of rate constants given in 145 experimental papers and 8 critical reviews published between 1971 and 1980. Its purpose is to provide the kineticist and combustion modeler with a comprehensive and easy-to-use source of kinetic data for chemical processes involving sulfur compounds. The table gives 441 distinct reaction rate constants from the above mentioned sources. A list of references including the 153 papers, arranged alphabetically by author for each separate year, is appended at the end of the table.

The table includes a limited number of reactions involving excited states like $S^*(^1D)$ and SO_2^*; however, no attempt was made to cover all the papers from the literature dealing with such excited species. The reader interested in the reaction kinetics of electronically excited species is encouraged to consult Keith Schofield's excellent review: "Critically Evaluated Rate Constants for Gaseous Reactions of Several Electronically Excited Species," J. Phys. Chem. Ref. Data **8**, 723 (1979).

For ease of reference the sulfur-containing reactant in a bimolecular or termolecular reaction is always placed first, so that a grouping of the reactions according to the standard order of sulfur compounds is obtained. However, 18 bimolecular reactions and 1 termolecular reaction involve 2 sulfur-containing reactants. For that reason, these 19 reactions are listed twice, the second time with the order of the sulfur-containing reactants reversed, e.g., $COS + S \rightarrow CO + S_2$ is also listed as $S + COS \rightarrow S_2 + CO$. As a result, the total number of tabulated entries is 460, although the real number of distinct entries is only 441. The arrangement of the tables and the standard order of chemical compounds are described in detail in the next section "Guidelines for the User."

The presentation of kinetic data is standardized and simplified as much as possible. Rate constants are expressed in terms of the modified Arrhenius equation $k = AT^{n}\exp(-E/RT)$. In general, uncertainties are given only for the rate constant k itself and not for the individual parameters in this equation. Sometimes an uncertainty is given for the value E/R and has been included in the uncertainty stated for the value of the rate constant. Rate constants are expressed in units of s^{-1}, $cm^3mol^{-1}s^{-1}$, and $cm^6mol^{-2}s^{-1}$ for reactions of first, second, and third order, respectively. Conversion tables for other units are appended at the end of this publication.

This publication is not the result of the effort of a single person, but of the whole staff of the Chemical Kinetics Division. My thanks go to all of them. In particular, I wish to thank Dr. Robert F. Hampson, Jr., Director of the Chemical Kinetics Data Center, for his more than helpful suggestions and constant guidance; Dr. John T. Herron, Chief of the

Chemical Kinetics Division, and Dr. Wing Tsang, of the Chemical Kinetics Division, for their encouragement; Dr. Bert R. Staples, Manager of the Electrolyte Data Center, for assistance in computer formatting; Mrs. Bettijoyce Molino and Mrs. Carla G. Messina from the Office of Standard Reference Data for applying the OMNIDATA and GPSDIC programs to photocompose the present tables; Mrs. Janice L. Jones for typing the original text with particular care; and Mrs. Miriam Oland from the Technical Information and Publications Division for retyping the text for photocomposition.

2. Guidelines for the User

General

As pointed out above, the presentation of the kinetic data in this publication is an attempt to simplify and standardize them. Units for rate constants used in this table are the cubic centimeter, the mole, and the second. The uncertainties given in this table are derived from the error limits specified by the author of the original paper or critical review. These have been converted to a standard format, as described below. In the present tables the concern is with the overall uncertainty of a reaction rate constant and not with the expression of precision of a set of experimental measurements. Most of the uncertainty limits included in this table are uniform within the temperature range indicated. However, for a limited number of reactions, the data warrant or require variable limits. In such cases, a note under the respective data indicates for which interval of the temperature range there is a change in the uncertainty limits.

Uncertainty limits expressed in the form of lower and upper k factors, f and F, respectively, are used in this tabulation. Thus, if k_0 is the central value of a rate constant the limits of reliability for the rate constant k_0 are defined by the relationship:

$$fk_0 < k < Fk_0 \qquad (1)$$

i.e., multiplication of the central value k_0 by f and F gives, respectively, the lower and upper reliability limits of the rate constant. In this standardized formulation of uncertainty limits, the value of f is less than unity and the value of F is greater than unity.

However the k factors are not the only way to express the uncertainty limits of a rate constant and different authors use different forms to indicate the degree of reliability of a recommended rate constant. It follows that certain mathematical relationships are needed to translate the different forms of uncertainty limits into the standard form used in this table (lower and upper k factors). The formulas used to transform any form of uncertainty limits into the standard form were given and discussed at length in the introduction of a previous publication[1] and will not be repeated here.

Arrangement of the Table

The table arranged in nine columns gives the chemical reaction, the order of reaction n, the "third body" collision partner M, the rate constants ratio k/k_{ref}, the temperature range in kelvins, the parameters A, B, and E/R for the modified Arrhenius equation $k = AT^{B}\exp(-E/RT)$, and the uncertainty limits expressed as k factors f and F.

The bibliography includes the full references for the 145 experimental papers and 8 critical reviews from which the present table was compiled. Following the bibliography, two conversion tables for equivalent second and third order rate constant units are appended.

The arrangement of the table is as follows:

Column 1, the chemical reaction indicating both the reactants and the products. In the same column, under each chemical reaction, the names of the reactants are given. The chemical nomenclature adopted is the one used in the Chemical Substance Indexes of Chemical Abstracts. Alternative names are not given. The chemical names of the products are not given. The line with chemical names is indented with respect to the line above it. Under the chemical names, the short reference to the reviewer's book or article is given. It includes the last two digits of the year of the publication followed by the first three letters of the author's name. If two authors are given, a slash separates the first three letters of each author's name. Again, the short reference line is indented with respect to the line above it, e.g., 78 MAR/HER indicates the experimental rate constant for the reaction between dimethyl sulfide and ozone, published by Martinez and Herron in 1978.

Recommended values for rate constants or ratios are indicated in parentheses after the short reference, e.g., 76 BAU/DRY (Recommended k); 72 KER/PAR (Recommended ratio).

The last line of column 1, placed under the line including the short reference, is given only when necessary and might include information about the dependence of k factors on temperature range, or the reaction taken as reference when a value for the ratio k/k_{ref} is given in column 3, or other information pertinent to the reaction indicated above. For a couple of reactions taken from Baulch et al. (76 BAU/DRY) the relationship $k_1 = Kk_{-1}$ included in the note indicates that the rate constant was calculated from the equilibrium constant K and the rate constant k_{-1} of the reverse reaction. In such cases, the author usually gives the rate constant of the reverse reaction immediately after the data for the forward reaction. The arrangement of the present table based on the standard order, does not allow the forward rate constant of a reaction to be followed immediately by its reverse rate constant. The reader will have to locate the rate constant of a reverse in its proper place in the table.

Column 2, with the heading n, indicates the order of the reaction displayed in column 1. The value of n is 1, 2, or 3, which defines the proper standard units for the reactions, as follows:

1	for the first order reactions	s^{-1}
2	for the second order reactions	$cm^3mol^{-1}s^{-1}$
3	for third order reactions	$cm^6mol^{-2}s^{-1}$

---

[1] Westley, Francis, "Tables of Recommended Rate Constants for Chemical Reactions Occurring in Combustion," NBSIR 79-1941 (1979) (1st ed.); NSRDS-NBS 67 (1980) (2d ed.).

The reaction order is indicated for every reaction included in the table and the digit indicating its value is alined with the short reference.

Column 3, with the heading M, defines the inert reaction partner ("third body") when the chemical reaction displayed in column 1 includes the letter M. Most of the third bodies displayed in column 3 include no more than three characters, e.g., Ar, He, H_2O, N_2, N_2O, SO_2, SO_3, CO_2. For the reaction $SO_2 + OH + M \rightarrow HOSO_2 + M$, the third body, a mixture of N_2 and O_2, is indicated in the note in column 1. No indication is given if M is undefined in the paper. When displayed, the third body is alined with the short reference and the reaction order.

Column 4, with the heading k/k_{rel}, gives the ratio of the rate constant of the reaction indicated in column 1 and the rate constant of a reference reaction. In most cases this ratio is a dimensionless number. However, when the order of the reaction indicated in column 1 is different from the order of the reference reaction, the ratio of the rate constants is no longer dimensionless and the expression for the ratio of rate constants is not given in column 3 (for lack of space), but in the note at the end of column 1. The reference reaction is always indicated in the notes. The dimensionless rate ratios given in column 3 are alined with the short reference given in column 1 and with the reaction order given in column 2.

Column 5, with the heading T/K, gives the temperature range of validity for the corresponding rate parameters. For some reactions only one temperature is given, meaning that the reaction was studied only at one temperature. If no temperature is indicated, it means that the kinetic parameters of the corresponding reaction are valid throughout. The data estimated by Benson and Golden in their report "Estimating the Kinetics of Combustion" (75 BEN/GOL) are in this category. The temperatures are alined with the short references given in column 1, as well as with the reaction order given in column 2.

Column 6, with the heading A, gives the value of A for the equation $k = AT^{B}\exp(-E/RT)$. A is expressed as a number less than 10 followed by the exponent in parentheses, e.g., 3.5 (+14) should be read as $3.5 \times 10^{+14}$. The coefficient of the A factor has no more than one digit after the decimal point. The units of the A factor are the same as for the rate constant. For those cases when the recommended value is only for one temperature, the entry under this column is in fact the value of the rate constant k at this temperature. The data for the A factor are alined with the short reference and reaction order information. If a dash appears in this column, it means that no A factor value was reported by the evaluator for the corresponding reaction. In such a case a rate ratio is given in column 4.

Column 7, with the heading B, gives the value of B for the equation $k = AT^{B}\exp(-E/RT)$. The value of B usually lies between 0 and 4, negative or positive. No more than one digit is given after the decimal dot. A dash in this column means that no B value was reported by the evaluator. The data for B are alined with the short reference and reaction order information.

Column 8, with the heading E/R, indicates the value of E/R for the equation $k = AT^{B}\exp(-E/RT)$. Since E is the activation energy in cal mol^{-1} and R the gas constant with a value of 1.987 cal mol^{-1} K^{-1}, it follows that the units of E/R are kelvins. The values given in column 5 for E/R may vary from 0 to over 100,000 kelvins. The E/R values may be positive or negative. Some of the E/R values included in the table are followed by an uncertainty with plus or minus signs. As pointed out in the introduction, these uncertainties may be ignored, as they are included in the lower and upper k factors indicated in the right column of the table. A dash in this column means that no E/R value was reported by the evaluator. The values for the E/R factor are alined with the short reference and reaction order information.

Column 9, with the heading "k factors" and two subheadings, "f" and "F," indicates the two uncertainty k factors, the lower factor f in the left subcolumn and the upper factor F in the right subcolumn. To find the uncertainty limits of a reaction, its rate constant is to be multiplied by the two factors, as shown in (1): $fk_0 < k < Fk_0$. The values of both factors are always positive. If no uncertainty limits are indicated by the evaluator, both subcolumns of the column 6 are left blank. The k factors are alined with the short reference and reaction order information.

Ordering of Chemical Reactions

The general rule for ordering the chemical reactions listed in column 1 of the table is the standard order of arrangement as described in NBS Technical Note 270-3.[2] A detailed discussion of this rule was presented in the introduction to the publication noted in the preceding footnote (NBSIR 79-1941/1979, or NSRDS-NBS 67/1980) and will not be repeated here. It suffices to say that this rule is applied to the first reactants of the reactions listed in this table, as well as to the reactants following the first, and that the first reactant of a reaction takes precedence over the following ones. The compounds listed in the Contents, which give only the first reactants of the chemical reactions included in this work, are in the standard order (S, S_2, SO, SO_2, SO_3, S_2O, SH, H_2S, CS, CS_2, COS, $CH_3S\cdot$, cy-CH_2CH_2S, etc.) and are each part of the S–O–H–C system. The first reactant always includes an S atom, and may include any of the O, H, or C atoms. The second, or the third reactants may include any of the O, H, S, N, or C atoms, and this sequence arranged according to the standard order defines the O–H–S–N–C system.

A number of second and third order reactions includes a second and, respectively, third body M. For these reactions, M will always be placed after all other reactions, e.g.,

$$SO_3 + M \rightarrow SO_2 + O + M,$$

$$\text{or} \quad SO + O + M \rightarrow SO_2 + M.$$

---

[2] Wagman, D. D., Evans, W. H., Parker, V. B., Halow, I., Bailey, S. M., and Schumm, R. H., "Selected Values of Chemical Thermodynamic Properties," NBS Tech. Note 270-3, pp. 5, 16, 22 (1968).

Most of the chemical reactions included in the table are balanced. There are a number of reactions with unspecified products. In such a case, the word "products" appears after the arrow, e.g., $SO_2 + HO_2 \rightarrow$ products.

Display of Chemical Reactions and Formulae

In order to define the reaction products, the reactants are written using semi-structural formulas. All saturated normal hydrocarbons are written so as to show separately each methyl and methylene group in the chain: CH_4, CH_3CH_3, $CH_3CH_2CH_3$. Unsaturated hydrocarbons are written to show the position of double or triple bonds. The unpaired electron of an alkyl radical is always indicated, with the exception of methyl free radical, e.g.,

Methyl free radical	CH_3 (no dot)
Ethyl, 1-methyl-, free radical (isopropyl)	$(CH_3)_2CH\cdot$
Methyl, hydroxy-, free radical	$\cdot CH_2OH$
Methylthio free radical	$CH_3S\cdot$

If the unpaired electron of an alkyl radical belongs to a carbon in the middle of the chain, it is indicated inside parentheses following the carbon atom, e.g.,

Propyl, 1-methyl-, free radical
(sec-butyl) $CH_3CH_2CH(\cdot)CH_3$

If the oxygen atom of an oxy radical is attached to the terminal carbon atom, the radical is written in the usual manner: CH_3O. If the oxygen atom of the oxy radical is attached to a C atom in the middle of the chain, then the oxygen atom, together with the unpaired electron, are inside parentheses following the C atom: $(CH_3)_2C(O\cdot)CH_2CH_3$. The rules for writing peroxo, and other free radicals are the same as for the oxy free radicals: $CH_3O_2\cdot$, CH_3S.

Atoms like O, H, S, N, C, and simple radicals like OH, HO_2, SH, NH, CH, CH_2, CH_3, CS, CN are written without a dot.

Acknowledgment

This work was supported by the Department of Energy and by the Office of Standard Reference Data of the National Bureau of Standards.

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$S + O_2 \rightarrow SO + O$									
Sulfur atom + Oxygen molecule									
71 FAI/VAN	2			298	1.7(+12)	–	–	0.9	1.1
72 DAV/KLE1	2			252–423	1.3(+12)	0	0±50	0.8	1.2
72 DON/LIT	2			295	1.0(+12)	–	–	0.8	1.2
75 CLY/TOW	2			298	9.0(+11)	–	–	0.8	1.2
79 CLY/WHI	2			296–410	1.0(+12)	0	–153±108	0.7	1.4
80 BAU/COX (Recommended k).	2			230–400	1.2(+12)	0	0±100	0.7	1.4
k factors apply at 298K only.									
$S + O_3 \rightarrow SO + O_2$									
Sulfur atom + Ozone									
75 CLY/TOW	2			298	7.2(+12)	–	–	0.7	1.3.
80 BAU/COX (Recommended k).	2			298	7.2(+12)	–	–	0.5	2.0
$S + H_2 \rightarrow SH + H$									
Sulfur atom + Hydrogen molecule									
76 BAU/DRY (Recommended k).	2			298	1.3(–1)	–	–	0.5	1.5
$k_1 = Kk_{-1}$.									
75 BEN/GOL	2				2.5(+12)	0.5	13640		
Semi–empirical evaluation.									
$S^*(^1D) + H_2 \rightarrow$ products									
Sulfur atom + Hydrogen molecule									
72 LIT/DAL	2		0.22	300	–	–	–		
k_{ref}: $S^*(^1D) + CH_2{=}CH_2 \rightarrow$ products.									
$S + OH \rightarrow SO + H$									
Sulfur atom + Hydroxyl free radical									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
79 JOU/LEB	2			298	4.0(+13)	–	–	0.8	1.2
$S + OH \rightarrow SH + O$									
Sulfur atom + Hydroxyl free radical									
75 BEN/GOL	2				1.3(+12)	0.5	12700		
Semi–empirical evaluation.									
$S + S + M \rightarrow S_2 + M$									
Sulfur atom									
79 NIC/AMO	3			295	4.3(+18)	–	–	0.8	1.2
$S + S_2 \rightarrow S_2 + S$									
Sulfur atom + Sulfur dimer									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
$S + SO \rightarrow S_2 + O$									
Sulfur atom + Sulfur monoxide									
75 BEN/GOL	2				6.3(+11)	0.5	11500		
Semi–empirical evaluation.									
$S + SO \rightarrow SO + S$									
Sulfur atom + Sulfur monoxide									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
$S + SH \rightarrow S_2 + H$									
Sulfur atom + Mercapto free radical									
73 SCH	2			295	2.4(+13)	–	–		
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–emprical evaluation.									
79 NIC/AMO	2			295	<3.0(+12)	–	–		
Upper limit k.									

Table of Arrhenius parameters for gas phase chemical reactions of sulfur compounds — Continued

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$S + SH \rightarrow SH + S$									
Sulfur atom + Mercapto free radical									
75 BEN/GOL	2				6.3(+11)	0.5	4000		
Semi-empirical evaluation.									
$S + N_2 \rightarrow NS + N$									
Sulfur atom + Nitrogen molecule									
75 BEN/GOL	2				4.0(+12)	0.5	55200		
Semi-empirical evaluation.									
$S^*(^1D) + N_2 \rightarrow$ products									
Sulfur atom + Nitrogen molecule									
72/LIT/DAL	2		0.062	300	–	–	–		
k_{ref} : $S^*(^1D) + CH_2{=}CH_2$ + products									
$S + NO \rightarrow SO + N$									
Sulfur atom + Nitrogen oxide(NO)									
75 BEN/GOL	2				4.0(+11)	0.5	17260		
Semi-empirical evaluation.									
$S + NO \rightarrow NS + O$									
Sulfur atom + Nitrogen oxide(NO)									
75 BEN/GOL	2				1.0(+12)	0.5	17365		
Semi-empirical evaluation.									
$S^*(^1D) + NO \rightarrow$ products									
Sulfur atom + Nitrogen oxide(NO)									
72 LIT/DAL	2		0.68		–	–	–		
k_{ref}: $S^*(^1D) + CH_2{=}CH_2 \rightarrow$ products									
$S + NO + M \rightarrow SNO + M$									
Sulfur atom + Nitrogen oxide(NO)									
78 VAN/OBI	2	CO_2		298	9.3(+12)	–	–	0.8	1.2
Limiting high-pressure k.									
78 VAN OBI	3	CO_2		298	1.9(+17)	–	–		
k_0 (low pressure).									
$S + NO_2 \rightarrow SO + NO$									
Sulfur atom + Nitrogen oxide(NO_2)									
75 CLY/TOW	2			298	3.7(+13)	–	–	0.8	1.2
79 CLY/WHY	2			296–410	3.0(+13)	0	−84±60	0.8	1.2
$S^*(^1D) + N_2O \rightarrow NS + NO$									
Sulfur atom + Nitrogen oxide(N_2O)									
72 LIT/DAL	2		0.1	300	–	–	–		
k_{ref}: $S^*(^1D) + CH_2{=}CH_2 \rightarrow$ products									
(Approximate ratio).									
$S + NH \rightarrow SH + N$									
Sulfur atom + Imidogen free radical									
75 BEN/GOL	2				6.3(+11)	0.5	4000		
Semi-empirical evaluation.									
$S^*(^1D) + CO \rightarrow$ products									
Sulfur atom + Carbon monoxide									
72 LIT/DAL	2		0.19	300	–	–	–		
k_{ref}: $S^*(^1D) + CH_2{=}CH_2 \rightarrow$ products									
$S^*(^1D) + CO_2 \rightarrow$ products									
Sulfur atom + Carbon dioxide									
72 LIT/DAL	2		0.24	300	–	–	–		
k_{ref}: $S^*(^1D) + CH_2{=}CH_2 \rightarrow$ products									

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$S^*(^1D) + CH_4 \rightarrow CH_3SH$									
Sulfur atom + Methane									
72 LIT/DAL	2		0.076	300	–	–	–		
k_{ref}: $S^*(^1D) + CH_2{=}CH_2 \rightarrow$ products									
80 ADD/DON	2			295	1.1(+14)	–	–	0.7	1.3
$S + CS \rightarrow CS + S$									
Sulfur atom + Carbon monosulfide free radical									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
$S + CS \rightarrow S_2 + C$									
Sulfur atom + Carbon monosulfide free radical									
75 BEN/GOL	2				1.6(+12)	0.5	40463		
Semi–empirical evaluation.									
$S + CS + M \rightarrow CS_2 + M$									
Sulfur atom + Carbon monosulfide free radical									
76 BAU/DRY (Recommended k).	3			1800–3700	8.7(+13)	0	–4370	0.5	1.5
$k_1 = Kk_{-1}$.									
$S + CS_2 \rightarrow S_2 + CS$									
Sulfur atom + Carbon disulfide									
76 BAU/DRY (Recommended k).	2			298	3.9(+11)	–	–	0.5	1.5
$S + COS \rightarrow S_2 + CO$									
Sulfur atom + Carbon oxide sulfide									
72 JAK/AHM	2			298	1.1(+10)	–	–		
Evaluation.									
74 KLE/DAV	2			233–245	9.2(+11)	0	1825±60	0.9	1.1
76 BAU/DRY (Recommended k).	2			230–2600	1.7(+12)	0	2050±230	0.3	3.0
$S^*(^1D) + COS \rightarrow S_2 + CO$									
Sulfur atom + Carbon oxide sulfide									
72 LIT/DAL	2		1.5	300	–	–	–	0.7	1.3
k_{ref}: $S^*(^1D) + CH_2{=}CH_2 \rightarrow$ products									
79 ADD/BYR	2			290	7.2(+13)	–	–	0.8	1.3
79 SHE/SAF	2		2.4	298	–	–	–		
k_{ref}: $S^*(^1D) + COS \rightarrow S(^3P) + COS$									
(Optimization).									
80 ADD/DON	2			295	1.8(+14)	–	–	0.7	1.3
$S + CN \rightarrow CS + N$									
Sulfur atom + Cyanogen free radical									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
$S + C_2 \rightarrow CS + C$									
Sulfur atom + Carbon dimer									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
$S + CH{\equiv}CH \rightarrow$ cy–$CH{=}CHS$									
Sulfur atom + Ethyne									
71 STR/O'C	2			298–450	–	–	–		
k/k_{ref}: 6.2exp(–1007/T).									
k_{ref}: $S + CH_2{=}CH_2 \rightarrow$ cy–CH_2CH_2S									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	1.7(+11)	–	–		
$S + CH{\equiv}CH \rightarrow$ products									
Sulfur atom + Ethyne									
78 VAN/SAF	2			298–484	3.4(+13)	0	1510±200	0.4	1.6

Table of Arrhenius parameters for gas phase chemical reactions of sulfur compounds — Continued

Chemical reactions	n	M	k/k$_{ref}$	T/K	A	B	E/R (in K)	k factors f	F
$S + CD{\equiv}CD \rightarrow$ products									
Sulfur atom + Ethyne–d_2									
78 VAN/SAF	2			298	2.3(+11)	–	–	0.8	1.2
$S^*(^1D) + CH_2{=}CH_2 \rightarrow CH_2{=}CHSH$									
Sulfur atom + Ethene									
79 SHE/SAF	2			298	4.2(+13)	–	–		
Optimization.									
$S + CH_2{=}CH_2 \rightarrow$ cy–CH_2CH_2S									
Sulfur atom + Ethene									
71 CON/VAN	2			298	9.0(+11)	–	–	0.9	1.1
Flash photolysis method.									
71 STR/O'C	2		1.0	298–450	–	–	–		
k$_{ref}$: $S + CH_2{=}CH_2 \rightarrow$ cy–CH_2CH_2S									
Conventional photolysis method.									
72 DAV/KLE2	2			218–442	4.3(+12)	0	795±40	0.9	1.1
72 KER/PAR (Recommended k).	2			298	8.1(+11)	–	–		
$S^*(^1D) + CH_2{=}CH_2 \rightarrow$ cy–$CH_2CH_2S^*$									
Sulfur atom + Ethene									
79 SHE/SAF	2			298	3.8(+13)	–	–		
Optimization.									
$S + CD_2{=}CH_2 \rightarrow$ cy–CD_2CH_2S									
Sulfur atom + Ethene–1,1–d_2									
71 STR/O'C	2		1.07	298–450	–	–	–		
k$_{ref}$: $S + CH_2{=}CH_2 \rightarrow$ cy–CH_2CH_2S									
Conventional photolysis method.									
S + cis–$CHD{=}CHD \rightarrow$ cy–$CHDCHDS$									
Sulfur atom + cis–Ethene–1,2–d_2									
71 STR/O'C	2		1.04	298–450	–	–	–		
k$_{ref}$: $S + CH_2{=}CH_2 \rightarrow$ cy–CH_2CH_2S									
Conventional photolysis method.									
$S + CD_2{=}CD_2 \rightarrow$ cy–CD_2CD_2S									
Sulfur atom + Ethene–d_4									
71 STR/O'C	2		1.14	298–450	–	–	–		
k$_{ref}$: $S + CH_2{=}CH_2 \rightarrow$ cy–CH_2CH_2S									
Conventional photolysis method.									
$S^*(^1D) + CH_3CH_3 \rightarrow$ products									
Sulfur atom + Ethane									
72 LIT/DAL	2		0.17	300	–	–	–		
k$_{ref}$: $S^*(^1D) + CH_2{=}CH_2 \rightarrow$ products									
S + cy–$CH_2CH_2S \rightarrow S_2 + CH_2{=}CH_2$									
Sulfur atom + Thiirane									
71 STR/O'C	2			298–450	–	–	–		
k/k$_{ref}$: 8.3exp(+906/T)									
k$_{ref}$: $S + CH_2{=}CH_2 \rightarrow$ cy–CH_2CH_2S									
Conventional photolysis method.									
73 KLE/DAV1	2			298–355	2.7(+13)	0	0	0.9	1.1
$S + CH_3C{\equiv}CH \rightarrow$ cy–$(CH_3)C{=}CHS$									
Sulfur atom + 1–Propyne									
71 STR/O'C	2			298–450	–	–	–		
k/k$_{ref}$: 6.2exp(−453/T)									
k$_{ref}$: $S + CH_2{=}CH_2 \rightarrow$ cy–CH_2CH_2S									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	1.1(+12)	–	–		
$S + CH_3C{\equiv}CH \rightarrow$ products									
Sulfur atom + Propyne									
78 VAN/SAF	2			298–449	2.0(+13)	0	453±100	0.4	1.6

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$S + CH_3CH=CH_2 \rightarrow cy\text{-}(CH_3)CHCH_2S$									
Sulfur atom + Propene									
71 CON/VAN	2			298	6.0(+12)	–	–	0.8	1.2
Flash photolysis method.									
71 STR/O'C	2			298–450	–	–	–		
k/k_{ref}: 1.0exp(+574/T)									
k_{ref}: $S + CH_2=CH_2 \rightarrow cy\text{-}CH_2CH_2S$									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	5.8(+12)	–	–		
72 KER/PAR (Recommended ratio).	2		6.9	298	–	–	–		
k_{ref}: $S + CH_2=CH_2 \rightarrow cy\text{-}CH_2CH_2S$									
73 KLE/DAV2	2			214–500	3.6(+12)	0	190±45	0.2	5.2
$S^*(^1D) + CH_3CH=CH_2 \rightarrow cy\text{-}(CH_3)CHCH_2S$									
Sulfur atom + Propene									
72 KER/PAR (Recommended ratio).	2		1.7	300	–	–	–		
k_{ref}: $S^*(^1D) + CH_2=CH_2 \rightarrow cy\text{-}CH_2CH_2S$									
$S + cy\text{-}(CH_3)CHCH_2S \rightarrow S_2 + CH_3CH=CH_2$									
Sulfur atom + Thiirane,methyl–									
71 STR/O'C	2			298–450	–	–	–		
k/k_{ref}: 8.4exp(+1057/T)									
k_{ref}: $S + CH_2=CH_2 \rightarrow cy\text{-}CH_2CH_2S$									
Conventional photolysis method.									
$S + CH_3CH_2C\equiv CH \rightarrow$ products									
Sulfur atom + 1–Butyne									
78 VAN/SAF	2			298	3.3(+12)	–	–	0.9	1.1
$S + CH_3C\equiv CCH_3 \rightarrow cy\text{-}(CH_3)C=C(CH_3)S$									
Sulfur atom + 2–Butyne									
71 STR/O'C	2			298–450	–	–	–		
k/k_{ref}: 2.7exp(+654/T)									
k_{ref}: $S + CH_2=CH_2 \rightarrow cy\text{-}CH_2CH_2S$									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	1.9(+13)	–	–		
$S + CH_3C\equiv CCH_3 \rightarrow$ products									
Sulfur atom + 2–Butyne									
78 VAN/SAF	2			298	1.6(+13)	–	–	0.9	1.1
$S + CH_2=CHCH=CH_2 \rightarrow cy\text{-}(CH_2=CH)CHCH_2S$									
Sulfur atom + 1,3–Butadiene									
71 STR/O'C	2			298–450	–	–	–		
k/k_{ref}: 2.4exp(+1027/T)									
k_{ref}: $S + CH_2=CH_2 \rightarrow cy\text{-}CH_2CH_2S$									
Conventional photolysis method.									
72 KER/PAR (Recomended k).	2			298	6.0(+13)	–	–		
$S + CH_3CH_2CH=CH_2 \rightarrow cy\text{-}(CH_3CH_2)CHCH_2S$									
Sulfur atom + 1–Butene									
71 CON/VAN	2			298	9.0(+12)	–	–	0.9	1.1
Flash photolysis method.									
71 STR/O'C	2			298–450	–	–	–		
k/k_{ref}: 0.75exp(+866/T)									
k_{ref}: $S + CH_2=CH_2 \rightarrow cy\text{-}CH_2CH_2S$									
Conventional photolysis method.									
72 KER/PAR	2			298	9.3(+12)	–	–		
72 KER/PAR (Recommended ratio).	2		10.0	298	–	–	–		
k_{ref}: $S + CH_2=CH_2 \rightarrow cy\text{-}CH_2CH_2S$									
73 KLE/DAV2	2			216–475	4.5(+12)	0	180±45	0.1	4.0

Chemical reactions	n	M	k/k_{rel}	T/K	A	B	E/R (in K)	k factors f	F
S + cis–$CH_3CH{=}CHCH_3$ → cy–$(CH_3)CHCH(CH_3)S$									
Sulfur atom + cis–2–Butene									
71 STR/O'C	2			298–450	–	–	–		
k/k_{rel}: 0.53exp(+1050/T)									
k_{rel}: S + $CH_2{=}CH_2$ → cy–CH_2CH_2S									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	1.4(+13)	–	–		
72 KER/PAR (Recommended ratio).	2		16.0	298	–	–	–		
k_{rel}: S + $CH_2{=}CH_2$ → cy–CH_2CH_2S									
S + cis–$CH_3CH{=}CHCH_3$ → products									
Sulfur atom + cis–2–Butene									
73 DAV/KLE	2			219–500	2.8(+12)	0	-116±45	0.9	1.1
S + trans–$CH_3CH{=}CHCH_3$ → cy–$(CH_3)CHCH(CH_3)S$									
Sulfur atom + trans–2–Butene									
71 CON/VAN	2			298	1.2(+13)	–	–	0.8	1.2
Flash photolysis method.									
71 STR/O'C	2			298–450	–	–	–		
k/k_{rel}: 0.65exp(+1010/T)									
k_{rel}: S + $CH_2{=}CH_2$ → cy–CH_2CH_2S									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	1.4(+13)	–	–		
72 KER/PAR (Recommended ratio).	2		20.0	298	–	–	–		
k_{rel}: S + $CH_2{=}CH_2$ → cy–CH_2CH_2S									
S + $(CH_3)_2C{=}CH_2$ → cy–$(CH_3)_2CCH_2S$									
Sulfur atom + 1–Propene, 2–methyl–									
71 CON/VAN	2			298	3.6(+13)	–	–	0.9	1.1
Flash photolysis method.									
71 STR/O'C	2			298–450	–	–	–		
k/k_{rel}: 0.97exp(+1190/T)									
k_{rel}: S + $CH_2{=}CH_2$ → cy–CH_2CH_2S									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	4.0(+13)	–	–		
72 KER/PAR (Recommended ratio).	2		50.0	298	–	–	–		
k_{rel}: S + $CH_2{=}CH_2$ → cy–CH_2CH_2S									
$S^*(^1D)$ + $(CH_3)_2C{=}CH_2$ → cy–$(CH_3)_2CCH_2S$									
Sulfur atom + 1–Propene, 2–methyl–									
72 KER/PAR (Recommended ratio).	2		3.5	300	–	–	–		
k_{rel}: $S^*(^1D)$ + $CH_2{=}CH_2$ → cy–CH_2CH_2S									
S + $CH_3CH_2C{\equiv}CCH_3$ → products									
Sulfur atom + 2–Pentyne									
78 VAN/SAF	2			298	1.8(+13)	–	–	0.8	1.2
S + $CH_3CH_2CH_2CH{=}CH_2$ → cy–$(CH_3CH_2CH_2)CHCH_2S$									
Sulfur atom + 1–Pentene									
72 KER/PAR (Recommended k).	2			298	8.1(+12)	–	–		
S + $CH_3CH_2C(CH_3){=}CH_2$ → cy–$(CH_3CH_2)C(CH_3)CH_2S$									
Sulfur atom + 1–Butene, 2–methyl–									
71 STR/O'C	2			298–450	–	–	–		
k/k_{rel}: 0.78exp(+1424/T)									
k_{rel}: S + $CH_2{=}CH_2$ → cy–CH_2CH_2S									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	7.4(+13)	–	–		

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$S + CH_3CH{=}C(CH_3)_2 \rightarrow$ cy-$(CH_3)CH[C(CH_3)_2]S$									
Sulfur atom + 2-Butene, 2-methyl-									
71 STR/O'C	2			298–450	–	–	–		
k/k_{ref}: 0,51exp(+1515/T)									
k_{ref}: $S + CH_2{=}CH_2 \rightarrow$ cy-CH_2CH_2S									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	6.5(+13)	–	–		
72 KER/PAR (Recommended ratio).	2		56.0	298	–	–	–		
k_{ref}: $S + CH_2{=}CH_2 \rightarrow$ cy-CH_2CH_2S									
$S + (CH_3)_2C{=}C(CH_3)_2 \rightarrow$ cy-$[(CH_3)_2]CC[(CH_3)_2]S$									
Sulfur atom + 2-Butene, 2,3-dimethyl-									
71 CON/VAN	2			298	>6.2(+13)	–	–	0.9	1.1
Lower limit k.									
Flash photolysis method.									
71 STR/O'C	2			298–450	–	–	–		
k/k_{ref}: 0.50exp(+1690/T)									
k_{ref}: $S + CH_2{=}CH_2 \rightarrow$ cy-CH_2CH_2S									
Conventional photolysis method.									
72 KER/PAR (Recommended k).	2			298	8.5(+13)	–	–		
$S + (CH_3)_2C{=}C(CH_3)_2 \rightarrow$ products									
Sulfur atom + 2-Butene, 2,3-dimethyl-									
73 DAV/KLE	2			252–500	2.8(+12)	0	–650±115	0.6	1.4
$S_2 + O \rightarrow S + SO$									
Sulfur dimer + Oxygen atom									
73 SCH	2			1050	4.2(+12)	–	–		
Approximate k. Given with caution.									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi-empirical evaluation.									
$S_2 + H \rightarrow S + SH$									
Sulfur dimer + Hydrogen atom									
75 BEN/GOL	2				7.9(+12)	0.5	8355		
Semi-empirical evaluation.									
$S_2 + S \rightarrow S + S_2$									
Sulfur dimer + Sulfur atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi-empirical evaluation.									
$S_2 + S_2 + M \rightarrow S_4 + M$									
Sulfur dimer									
72 LAN/OLD	3	CO_2		293	9.1(+17)	–	–	0.1	10.
73 LAN/OLD	3	CO_2		293	3.6(+18)	–	–		
Given with caution.									
79 NIC/AMO	3			295	8.0(+18)	–	–	0.9	1.1
$S_2 + N \rightarrow S + NS$									
Sulfur dimer + Nitrogen atom									
75 BEN/GOL	2				6.3(+11)	0.5	4000		
Semi-empirical evaluation.									
$S_2 + C \rightarrow S + CS$									
Sulfur dimer + Carbon atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi-empirical evaluation.									
$S_2 + M \rightarrow S + S + M$									
Sulfur dimer									
80 HIG/SAI	2	Ar		4500–6000	4.8(+13)	0	38750		

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$SO + O \rightarrow O + SO$									
Sulfur monoxide + Oxygen atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi-empirical evaluation.									
$SO + O \rightarrow S + O_2$									
Sulfur monoxide + Oxygen atom									
75 BEN/GOL	2				2.0(+11)	0.5	2770		
Semi-empirical evaluation.									
$SO + O + M \rightarrow SO_2 + M$									
Sulfur monoxide + Oxygen atom									
71 MIY/TAKI	3	Ar		298	7.3(+16)	–	–	0.9	1.1
76 BAU/DRY (Recommended k).	3			298	6.7(+13)	–	–	0.7	1.3
$SO + O_2 \rightarrow SO_2 + O$									
Sulfur monoxide + Oxygen molecule									
72 BRE/MIL	2			297	<5.0(+7)	–	–		
Upper limit k.									
80 BAU/COX (Recommended k).	2			300–1000	3.6(+11)	0	3300±500	0.3	3.2
k factors apply at 298k only.									
$SO + O_3 \rightarrow SO_2 + O_2$									
Sulfur monoxide + Ozone									
80 BAU/COX (Recommended k).	2			220–300	1.5(+12)	0	1100±400	0.5	2.0
k factors apply at 298K only.									
80 ROB/SMI	2			296	5.2(+10)	–	–	0.8	1.2
$SO + O_3(v{=}n) \rightarrow SO_2^* + O_2$									
Sulfur monoxide + Ozone									
74 KAL/BRA	2		2.4	300	–	–	–	0.8	1.3
k_{ref}: $SO + O_3 \rightarrow SO_2^* + O_2$									
$SO + H \rightarrow O + SH$									
Sulfur monoxide + Hydrogen atom									
75 BEN/GOL	2				6.3(+11)	0.5	19930		
Semi-empirical evaluation.									
$SO + H \rightarrow S + OH$									
Sulfur monoxide + Hydrogen atom									
75 BEN/GOL	2				4.0(+12)	0.5	11200		
Semi-empirical evaluation.									
$SO + OH \rightarrow SO_2 + H$									
Sulfur monoxide + Hydroxyl free radical									
73 SCH (Recommended k).	2			298	3.3(+13)	–	–	0.5	2.0
79 JOU/LEB	2			298	5.1(+13)	–	–	0.8	1.2
$SO + S \rightarrow O + S_2$									
Sulfur monoxide + Sulfur atom									
75 BEN/GOL	2				6.3(+11)	0.5	11500		
Semi-empirical evaluation.									
$SO + S \rightarrow S + SO$									
Sulfur monoxide + Sulfur atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi-empirical evaluation.									

Table of Arrhenius parameters for gas phase chemical reactions of sulfur compounds — Continued

Chemical reactions	n	M	k/k$_{ref}$	T/K	A	B	E/R (in K)	k factors	
								f	F
$SO + SO \rightarrow SO_2 + S$									
Sulfur monoxide									
72 BRE/MIL	2			297	<3.0(+10)	–	–		
Upper limit k.									
73 SCH	2			300	<1.8(+9)	–	–		
Upper limit k.									
73 SCH	2			1000	<1.2(+11)	–	–		
Upper limit k.									
75 CHU/CAL	2			298	5.0(+8)	–	–	0.2	1.8
$SO + SO + M \rightarrow (SO)_2 + M$									
Sulfur monoxide									
80 HER/HUI	3			298	1.6(+17)	–	–		
2 – 8 torr.									
$SO + SO_3 \rightarrow SO_2 + SO_2$									
Sulfur monoxide + Sulfur trioxide									
75 CHU/CAL	2			298	1.2(+9)	–	–	0.4	1.6
$SO + (SO)_2 \rightarrow SO_2 + S_2O$									
Sulfur monoxide + Sulfur monoxide dimer									
80 HER/HUI	2			298	2.0(+10)	–	–		
2 – 8 torr.									
$SO + N \rightarrow O + NS$									
Sulfur monoxide + Nitrogen atom									
75 BEN/GOL	2				1.6(+12)	0.5	8254		
Semi–empirical evaluation.									
$SO + N \rightarrow S + NO$									
Sulfur monoxide + Nitrogen atom									
75 BEN/GOL	2				6.3(+11)	0.5	4000		
Semi–empirical evaluation.									
$SO + NO_2 \rightarrow SO_2 + NO$									
Sulfur monoxide + Nitrogen oxide(NO_2)									
71 CUP/GLA	2		1.6	300	–	–	–		
k$_{ref}$: $O + NO_2 \rightarrow O_2 + NO$									
71 MIY/TAK2	2			298	1.2(+16)	–	–	0.9	1.1
80 BAU/COX (Recommended k).	2			298	8.4(+12)	–	–	0.5	2.0
80 CLY/MAC	2			295	8.2(+12)	–	–	0.9	1.1
$SO + C \rightarrow O + CS$									
Sulfur monoxide + Carbon atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
$SO + C \rightarrow S + CO$									
Sulfur monoxide + Carbon atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
$SO + M \rightarrow S + O + M$									
Sulfur monoxide									
78 AST/GLA	2	Ar		5700–7200	1.6(+14)	0	55330±3610	0.3	4.0
Rate constant expressed as k[Ar].									
$SO_2 + O \rightarrow SO + O_2$									
Sulfur dioxide + Oxygen atom									
76 BAU/DRY (Recommended k).	2			440–2100	1.3(+14)	–0.5	9980	0.3	1.7
$k_1 = Kk_{-1}$.									
80 GRI/REE	2			2630–3570	4.0(+12)	0	9210	0.9	1.1
80 SLA/GRI	2			3500	3.8(+11)	–	–	0.9	1.1

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$SO_2 + O + M \rightarrow SO_3 + M$									
Sulfur dioxide + Oxygen ntom									
73 SCII	3			250–1000	3.6(+14)	0	–500	0.5	2.0
M = Ar, O_2, N_2, He.									
k factors are larger at other temperatures.									
74 ATK/PIT3	3	N_2O		299–392	3.3(+16)	0	1000±200		
75 WES/DEH2	3	He		248–415	3.9(+16)	0	1400±50	0.8	1.2
75 WES DEH2	3	He		297	3.0(+14)	–	–	0.9	1.1
M_{eff}: He(1.0)									
75 WES DEH2	3	SO_2		297	2.9(+15)	–	–	0.7	1.3
M_{eff}: SO_2(9.5)									
75 WES DEH2	3	N_2		297	7.2(+14)	–	–	0.9	1.1
M_{eff}: N_2(2.4)									
78 ATK/PIT4	3	Ar		299–400	1.1(+16)	0	1010±150		
78 ATK/PIT4	3	N_2		300	5.0(+14)	–	–	0.8	1.2
78 ATK PIT4	3	SO_2		299	3.4(+15)	–	–	0.7	1.3
79 MER/LEV	3			1685	7.4(+14)	–	–		
80 BAU/COX (Recommended k).	3	N_2		200–400	1.5(+16)	0	1000±200	0.5	2.
k factors apply at 298K only.									
80 BAU/COX (Recommended k).	3	Ar		200–2500	5.4(+28)	–3.75	2650±200	0.5	2.0
k factors apply at 298K only.									
$SO_2 + O_2^*(^1\Delta_g) \rightarrow SO_3 + O$									
Sulfur dioxide + Oxygen molecule									
76 DUM	2			298	1.3(+8)	–	–		
$SO_2^* + O_2 \rightarrow$ products									
Sulfur dioxide + Oxygen molecule									
78 PAR/HEI	2		0.05	298	–	–	–		
k_{ref}: $SO_2^* \rightarrow {}^1SO_2$, or SO_2									
(SO_2^* is a singlet formed on absorption).									
${}^1SO_2 + O_2 \rightarrow$ products									
Sulfur dioxide + Oxygen molecule									
78 PAR/HEI	2		0.29	298	–	–	–		
k_{ref}: ${}^1SO_2 + SO_2 \rightarrow$ products									
(${}^1SO_2$ is a fluorescent singlet).									
$SO_2^*(^3B_1) + O_2 \rightarrow$ products									
Sulfur dioxide + Oxygen molecule									
78 PAR/HEI	2		0.36	298	–	–	–		
k_{ref}: $SO_2^*(^3B_1) + SO_2 \rightarrow$ products									
$SO_2 + O_3 \rightarrow SO_3 + O_2$									
Sulfur dioxide + Ozone									
74 DAV/PRU	2			300	<6.0(+1)	–	–		
Upper limit k.									
$SO_2 + H + M \rightarrow HSO_2 + M$									
Sulfur dioxide + Hydrogen atom									
76 BAU/DRY (Recommended k).	3			1660–2120	5.1(+15)	–	–	0.5	1.5
$SO_2 + OH \rightarrow$ products									
Sulfur dioxide + Hydroxyl free radical									
80 COX/DER	2			297	4.0(+11)	–	–	0.8	1.2
$SO_2 + OH(v{=}9) \rightarrow HSO_3$									
Sulfur dioxide + Hydroxyl free radical									
72 WOR/COL	2			298	>1.4(+10)	–	–	0.8	1.2
Lower limit k.									
Unreported T assumed to be 298K.									

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$SO_2 + OH + M \rightarrow HOSO_2 + M$ *Sulfur dioxide + Hydroxyl free radical*									
74 COX2 Evaluation. Rate constant expressed as k[M] with $M = N_2 + O_2$ at 1 atm.	2			294	3.6(+11)	–	–	0.9	1.1
75 CAS/DAV Limiting high-pressure k (760 torr).	2	N_2		298	3.6(+11)	–	–		
75 CAS/DAV k_0 (low pressure: <20 torr).	3	N_2		298	5.8(+16)	–	–		
75 GOR/MUL1 In an atmosphere of water vapor.	2	H_2O		435	1.1(+12)	–	–	0.9	1.1
75 HAR/WAY	3	Ar		298	1.6(+17)	–	–	0.7	1.3
75 HAR/WAY	3	N_2		298	2.6(+17)	–	–	0.9	1.1
76 ATK/PER3 At 760 torr.	2	Ar		298	4.0(+11)	–	–	0.9	1.1
76 ATK/PER3 Limiting high-pressure k.	2	Ar		298	5.0(+11)	–	–		
76 ATK/PER3 k_0 (low-pressure k).	3	Ar		298	5.9(+16)	–	–	0.8	1.2
77 CAS/TAN Limiting high-pressure k (760 torr).	2	N_2		297	3.6(+11)	–	–		
77 CAS/TAN k_0 (low-pressure k).	3	N_2		297	5.8(+16)	–	–		
77 CAS/TAN k_0 (low-pressure). On the basis of k_0(297) and E_a experimental values.	3	N_2		253–297	5.0(+14)	0	–1410		
77 CAS/TAN k_0 (low-pressure k). Alternative T-dependent expression.	3	N_2		253–297	2.5(+29)	–5.1	0		
79 DAV/RAV Total pressure 1 atm. (extrapolated value).	2	N_2		298	5.4(+11)	–	–	0.8	1.3
80 BAU/COX (Recommended k). k_0 (low-pressure k). k factors apply at 298K only.	3	N_2		200–400	1.7(+24)	–2.9	0	0.5	2.0
80 BAU/COX (Recommended k). Limiting high-pressure k. k factors apply at 298K only.	2			200–400	1.2(+12)	0	0	0.4	2.5
80 HAR/ATK Total pressure 650 torr.	2	Ar		298–424	7.0(+9)	0	–1193±150	0.7	1.5
80 HAR/ATK Total pressure 650 torr.	2	SF_6		298–424	7.6(+10)	0	–753±150	0.7	1.
80 HAR/ATK Total pressure 650 torr.	2	N_2		298–424	2.4(+10)	0	–956		
$SO_2 + HO_2 \rightarrow SO_3 + OH$ *Sulfur dioxide + Hydroperoxyl free radical*									
73 PAY/STI Evaluation.	2			300	5.2(+8)	–	–	0.8	1.2
74 LLO Evaluation. Ratio data versus k_{ref} for reaction $HO_2 + HO_2 \rightarrow H_2O_2 + O_2$	2			300	5.2(+8)	–	–	0.9	1.2
79 BUR/CLI Upper limit k.				298	<1.2(+7)	–	–		
$SO_2 + HO_2 \rightarrow$ products *Sulfur dioxide + Hydroperoxyl free radical*									
79 GRA/WIN Upper limit k.	2			300	<6.0(+5)	–	–		
$SO_2 + HO_2 + M \rightarrow HO_2SO_2 + M$ *Sulfur dioxide + Hydroperoxyl free radical*									
79 BUR/CLI Upper limit k.	3	He		298	<1.5(+14)	–	–		

Chemical reactions	n	M	k/k$_{ref}$	T/K	A	B	E/R (in K)	k factors f	k factors F
$SO_2 + SO_2{}^*({}^1B_1) \rightarrow SO^*({}^1\Delta_g, {}^3\Sigma^-) + SO_3$ *Sulfur dioxide*									
75 CHU/CAL	2			298	2.2(+12)	–	–	0.8	1.2
$SO_2 + SO_2{}^*({}^3B_1) \rightarrow SO + SO_3$ *Sulfur dioxide*									
78 MAR/REI In an atmosphere of water vapor. (Approximate k).	2			298	2.0(+14)	–	–		
$SO_2 + SO_2{}^*({}^3B_1) \rightarrow SO^*({}^3\Sigma^-) + SO_3$ *Sulfur dioxide*									
75 CHU/CAL	2			298	4.2(+10)	–	–	0.9	1.1
$SO_2 + NO_2 \rightarrow SO_3 + NO$ *Sulfur dioxide + Nitrogen oxide(NO_2)*									
71 ARM/CUL	2			703–1193	6.3(+12)	0	13950		
77 FRE/PAL Extended validity of k reported in 71 ARM/CUL (above), up to 2000K.	2			430–1850	6.3(+12)	0	16000		
$SO_2 + NO_2{}^* \rightarrow$ products *Sulfur dioxide + Nitrogen oxide(NO_2)*									
78 IWA/PRE At 50 torr.	2			298	8.2(+10)	–	–		
$SO_2 + NO_3 \rightarrow SO_3 + NO_2$ *Sulfur dioxide + Nitrogen oxide(NO_3)*									
75 DAU/CAL Upper limit k.	2			300	<4.2(+3)	–	–		
$SO_2 + N_2O_5 \rightarrow SO_3 + N_2O_4$ *Sulfur dioxide + Nitrogen oxide(N_2O_5)*									
75 DAU/CAL Upper limit k.	2			300	<2.5(+1)	–	–		
${}^1SO_2{}^* + CO \rightarrow SO + CO_2$ *Sulfur dioxide + Carbon monoxide*									
73 CEH/HEI k$_{ref}$: ${}^1SO_2{}^* + SO_2 \rightarrow$ products. k/k$_{ref}$ = 5.0x10^{-3}(at 2537 A°)	2			300	–	–	–		
73 CEH HEI k/k$_{ref}$ = 1.5x10^{-3}(at 3130 A°)	2			300	–	–	–		
$SO_2{}^* + CO \rightarrow SO + CO_2$ *Sulfur dioxide + Carbon monoxide*									
73 CEH/HEI k$_{ref}$: $SO_2{}^* \rightarrow$ products k/k$_{ref}$ = 2.2x10^{-5} (3130 to 3261 A°) ($SO_2{}^*$ is a vibrationally excited singlet).	2			300	–	–	–		
$SO_2{}^{**} + CO \rightarrow SO + CO_2$ *Sulfur dioxide + Carbon monoxide*									
73 CEH/HEI k$_{ref}$: $SO_2{}^{**} \rightarrow SO_2$ k$_{ref}$ = 1.8x10^{-5} (2537 to 3261 A°) ($SO_2{}^{**}$ is a chemically active triplet).	2			300	–	–	–	0.7	1.4
$SO_2 + CO + M \rightarrow$ products *Sulfur dioxide + Carbon monoxide*									
71 BAU/JEF At 27–170 torr pressure.	2	Ar		1770–2453	2.7(+12)	0	24300±600	0.8	1.3

Table of Arrhenius parameters for gas phase chemical reactions of sulfur compounds — Continued

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors f	F
$SO_2 + CH_3 + M \rightarrow CH_3SO_2 + M$ *Sulfur dioxide + Methyl free radical* **73 JAM/KER** Limiting high–pressure k.	2			298	1.8(+11)	–	–	0.9	1.1
$SO_2 + CH_3O_2^{\cdot} \rightarrow CH_3O_2SO_2$ *Sulfur dioxide + Methyldioxy free radical* **79 SAN/SIM**	2			298	4.9(+9)	–	–	0.9	1.1
79 SIM/HEI k_{ref}: $NO + CH_3O_2^{\cdot} \rightarrow NO_2 + CH_3O^{\cdot}$	2		0.0025	296	–	–	–	0.8	1.2
$SO_2 + CH_3O_2^{\cdot} \rightarrow$ products *Sulfur dioxide + Methyldioxy free radical* **79 KAN/MCQ** Best k estimate, based on apparent rate constant (k_{app} 2k).	2			296	3.2(+9)	–	–	0.8	1.2
$SO_2 + CH{\equiv}CH \rightarrow$ products *Sulfur dioxide + Ethyne* **71 FIF/MOR** Given with caution.	2			1550–2150	3.2(+10)	0.5	20535		
$SO_2^{**} + CH_2{=}C{=}CH_2 \rightarrow$ products *Sulfur dioxide + 1,2–Propadiene* **78 PAR/HEI** k_{ref}: $SO_2^{**} + CH_2{=}C{=}CH_2 \rightarrow$ CO + other products (SO_2^{**} is a non–emitting triplet).	2		4.0	298	–	–	–		
$SO_2^{*}(^3B_1) + cis\text{–}CH_3CH{=}CHCH_3 \rightarrow [cis\text{–}CH_3CH{=}CHCH_3.SO_2]^{*}$ *Sulfur dioxide + cis–2–Butene* **74 DEM/CAL**	2			294	1.3(+14)	–	–	0.9	1.1
$SO_2^{*}(^3B_1) + trans\text{–}CH_3CH{=}CHCH_3 \rightarrow [trans\text{–}CH_3CH{=}CHCH_3.SO_2]^{*}$ *Sulfur dioxide + trans–2–Butene* **74 DEM/CAL**	2			294	1.2(+14)	–	–	0.9	1.1
$SO_2^{*}(^1B_1) + (CH_3)_3CH \rightarrow$ products *Sulfur dioxide + Propane, 2–methyl–* **78 SU /CAL** Evaluation.	2			298	8.4(+12)	–	–		
$SO_2^{*}(^3B_1) + (CH_3)_3CH \rightarrow$ products *Sulfur dioxide + Propane, 2–methyl–* **78 SU /CAL** Evaluation.	2			298	8.7(+11)	–	–		
$SO_2^{*}(^3B_1) + cis\text{–}CH_3CH_2CH{=}CHCH_3 \rightarrow [SO_2.CH_3CH_2CH{=}CHCH_3]^{*}$ *Sulfur dioxide + cis–2–Pentene* **76 WAM**	2			295	6.3(+13)	–	–	0.8	1.2
$SO_2^{*}(^3B_1) + trans\text{–}CH_3CH_2CH{=}CHCH_3 \rightarrow [SO_2.CH_3CH_2CH{=}CHCH_3]^{*}$ *Sulfur dioxide + trans–2–Pentene* **76 WAM**	2			295	1.0(+14)	–	–	0.7	1.3

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors f	F
$SO_2 + M \rightarrow SO + O + M$									
Sulfur dioxide									
75 KIE	2	Kr		2900–5200	1.7(+16)	0	56370±2000	0.6	1.6
78 AST/GLA	2	Ar		3700–6500	4.0(+14)	0	53890±2170	0.5	2.0
Rate constant expressed as k[Ar].									
78 JUS/RIM	2	Ar		2500–3400	2.9(+16)	0	58590±2270	0.5	2.2
79 GRI/REE	2	Ar		2800–3880	8.0(+15)	0	54355	0.7	1.3
80 SAI/YOK	2	Ar		4300–6200	3.5(+14)	0	52805		
80 TYA/BAB	2	Ar		4000–6000	3.3(+15)	0	54150		
80 TYA BAB	2	SO_2		4000–6000	5.0(+14)	0	33520		
$SO_3 + O \rightarrow SO_2 + O_2$									
Sulfur trioxide + Oxygen atom									
71 MER/LEV	2			1100–1400	6.5(+14)	0	5435		
k determined in H_2S flame.									
71 MER/LEV	2			900–1600	2.8(+14)	0	6040		
k determined in COS flame.									
72 JAC/WIN	2			300–500	1.5(+8)	0	500		
73 SCH	2			1480–1550	2.8(+14)	0	6040		
Given with caution.									
79 MER/LEV	2			1685	1.5(+11)	–	–		
$SO_3 + O + M \rightarrow SO_2 + O_2 + M$									
Sulfur trioxide + Oxygen atom									
75 WES/DEH1	3	He		298–507	5.0(+16)	0	–785	0.9	1.1
75 WES DEH1	3	He		298	7.3(+17)	–	–	0.9	1.1
M_{eff}: He(1.0)									
75 WES DEH1	3	SO_3		298	<7.3(+18)	–	–		
M_{eff}: SO_3(<10.0). Upper limit ratio.									
75 WES DEH1	3	N_2		298	1.0(+18)	–	–	0.9	1.1
M_{eff}: N_2(1.4)									
$SO_3 + H_2O \rightarrow H_2SO_4$									
Sulfur trioxide + Water									
75 CAS/DAV	2			298	5.5(+11)	–	–	0.8	1.2
$SO_3 + SO \rightarrow SO_2 + SO_2$									
Sulfur trioxide + Sulfur monoxide									
75 CHU/CAL	2			298	1.2(+9)	–	–	0.4	1.6
$SO_3 + N \rightarrow SO_2 + NO$									
Sulfur trioxide + Nitrogen atom									
72 JAC/WIN	2			300	3.0(+8)	–	–		
75 WES/DEH1	2			298	<6.0(+6)	–	–		
Upper limit k.									
$SO_3 + M \rightarrow SO_2 + O + M$									
Sulfur trioxide									
78 AST/GLA	2	Ar		1700–2500	3.2(+15)	0	31880±1320	0.6	1.6
Rate constant expressed as k[Ar].									
79 AST/GLA	2	Ar		1700–2500	3.2(+15)	0	31900±300	0.6	1.6
$S_2O + O \rightarrow SO + SO$									
Sulfur oxide(S_2O) + Oxygen atom									
74 STE/ALV	2			298	9.0(+11)	–	–	0.9	1.1
Evaluation.									
$SH + O \rightarrow S + OH$									
Mercapto free radical + Oxygen atom									
73 SCH	2			298–2500	2.3(+11)	0.67	956		
Theoretical estimate.									
75 BEN/GOL	2				6.3(+11)	0.5	4000		
Semi–empirical evaluation.									

Chemical reactions	n	M	k/k_{rel}	T/K	A	B	E/R (in K)	k factors	
								f	F
$SH + O \rightarrow SO + H$									
Mercapto free radical + Oxygen atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
75 CUP/GLA	2			295	9.6(+13)	–	–	0.7	1.3
$SH + H \rightarrow S + H_2$									
Mercapto free radical + Hydrogen atom									
72 LAN/OLD	2			293	<6.0(+12)	–	–		
73 BRA/TRU	2			298	2.5(+13)	–	–		
75 CUP/GLA	2			298	1.5(+13)	–	–	0.7	1.3
76 BAU/DRY (Recommended k).	2			298	1.5(+13)	–	–	0.5	1.5
79 NIC/AMO	2			295	1.3(+13)	–	–	0.8	1.2
$SH + H \rightarrow H + SH$									
Mercapto free radical + Hydrogen atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
$SH + S \rightarrow H + S_2$									
Mercapto free radical + Sulfur atom									
73 SCH	2			295	2.4(+13)	–	–		
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation									
79 NIC/AMO	2			295	<3.0(+12)	–	–		
Upper limit k.									
$SH + S \rightarrow S + SH$									
Mercapto free radical + Sulfur atom									
75 BEN/GOL	2				6.3(+11)	0.5	4000		
Semi–empirical evaluation.									
$SH + SH \rightarrow H_2 + S_2$									
Mercapto free radical									
73 SCH	2			295	<3.0(+10)	–	–		
Estimated upper limit k.									
$SH + SH \rightarrow H_2S + S$									
Mercapto free radical									
72 LAN/OLD	2			293	<1.8(+13)	–	–		
Upper limit k.									
73 BRA/TRU	2			298	7.8(+12)	–	–		
76 BAU/DRY (Recommended k).	2			295	7.8(+12)	–	–	0.5	1.5
79 NIC/AMO	2			295	1.9(+13)	–	–	0.9	1.1
$SH + N \rightarrow H + NS$									
Mercapto free radical + Nitrogen atom									
75 BEN/GOL	2				6.3(+11)	0.5	403		
Semi–empirical evaluation.									
$SH + N \rightarrow S + NH$									
Mercapto free radical + Nitrogen atom									
75 BEN/GOL	2				6.3(+11)	0.5	9060		
Semi–empirical evaluation.									
$SH + NO \rightarrow$ products									
Mercapto free radical + Nitrogen oxide(NO)									
73 BRA/TRU	2			298	6.3(+11)	–	–		
$SH + C \rightarrow H + CS$									
Mercapto free radical + Carbon atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									

Chemical reactions	n	M	k/k_{rel}	T/K	A	B	E/R (in K)	k factors	
								f	F
$SH + C \rightarrow S + CH$									
Mercapto free radical + Carbon atom									
75 BEN/GOL	2				4.0(+11)	0.5	6090		
Semi–empirical evaluation.									
$H_2S + O \rightarrow SH + OH$									
Hydrogen sulfide + Oxygen atom									
73 SCH	2			200–350	3.8(+11)	0	920±45	0.5	2.0
76 WHY/TIM	2			263–495	4.4(+12)	0	1660±50	0.9	1.1
78 WHY/TIM	2			263–495	4.4(+12)	0	1660±50	0.8	1.2
80 BAU/COX (Recommended k).	2			250–500	4.3(+12)	0	1660±150	0.8	1.3
k factors apply at 298K only.									
$D_2S + O \rightarrow SD + OD$									
Hydrogen sulfide(D_2S) + Oxygen atom									
76 WHY/TIM	2			298–450	6.3(+12)	0	2145±155	0.5	1.5
$H_2S + O \rightarrow$ products									
Hydrogen sulfide + Oxygen atom									
78 SLA/BAL	2			281–497	1.5(+13)	0	1920±45	0.8	1.2
k based on editor's least square fit of 6 given experimental points.									
79 SIN/IRW	2			297–502	1.6(+13)	0	2171±202	0.5	1.5
$H_2S + O_3 \rightarrow SO_2 + H_2O$									
Hydrogen sulfide + Ozone									
75 BEC/INO	2			298	<1.2(+4)	–	–		
Upper limit k.									
Unreported T assumed to be 298K.									
75 GLA/TOB1	2			293–343	4.9(+10)	0	3420		
Estimated k.									
75 GLA/TOB2	2			298–343	1.6(+12)	0	2620±600	0.2	6.3
75 BAU/DRY (Recommended k).	2			298	4.0(+2)	–	–	0.1	10.0
$H_2S + H \rightarrow SH + H_2$									
Hydrogen sulfide + Hydrogen atom									
71 KUR/PET	2			190–464	7.8(+12)	0	860±30	0.9	1.1
72 ROM/SCH	2			298	2.3(+11)	–	–	0.8	1.3
73 BRA/TRU	2			298	5.0(+11)	–	–		
76 BAU/DRY (Recommended k).	2			190–470	7.8(+12)	0	860±50	0.5	1.5
79 NIC/AMO	2			295	5.0(+11)	–	–	0.9	1.1
80 HUS/SLA	2			300	5.2(+11)	–	–	0.9	1.1
$D_2S + D \rightarrow SD + D_2$									
Hydrogen sulfide(D_2S) + Deuterium atom									
80 HUS/SLA	2			300	4.8(+11)	–	–	0.9	1.1
$H_2S + OH \rightarrow SH + H_2O$									
Hydrogen sulfide + Hydroxyl free radical									
73 WES/DEH3	2			298–885	1.4(+13)	0	443		
74 STU	2			298	1.9(+12)	–	–	0.8	1.2
76 BAU/DRY (Recommended k).	2			298–900	6.3(+12)	0	200±150	0.7	1.3
k factors changing to: f = 0.5 and F = 1.5 at 900K.									
76 PER/ATK1	2			297–427	3.1(+12)	0	0	0.9	1.1
80 BAU/COX (Recommended k).	2			250–400	6.6(+12)	0	225±225	0.8	1.3
k factors apply at 298K only.									
$H_2S + OH \rightarrow$ products (overall)									
Hydrogen sulfide + Hydroxyl free radical									
72 NIK/MOR1	2			300	5.2(+12)	–	–		
Approximate k.									
80 COX/SHE	2			297	3.0(+12)	–	–	0.9	1.1

Table of Arrhenius parameters for gas phase chemical reactions of sulfur compounds — Continued

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$H_2S + OH(v=9) \rightarrow$ products									
Hydrogen sulfide + Hydroxyl free radical									
72 WOR/COL	2			298	>1.5(+11)	–	–	0.6	1.4
Lower limit k.									
Unreported T assumed to be 298K.									
$H_2S + CH_3 \rightarrow SH + CH_4$									
Hydrogen sulfide + Methyl free rndical									
76 KER/PAR	2			300–600	2.0(+11)	0	2065±150	0.4	2.5
Tentative k value.									
$H_2S + M \rightarrow SH + H + M$									
Hydrogen sulfide									
76 HIG/SAI	2	Ar		2380–3000	1.3(+16)	0	46300		
77 BOW/DOD	2	Ar		2700–3800	2.0(+13)	0	37300±960	0.7	1.5
$CS + O \rightarrow S + CO$									
Carbon monosulfide free radical + Oxygen atom									
71 HAN/SMI	2			298	8.4(+12)	–	–		
Evaluation.									
73 SCH	2			298	8.4(+12)	–	–	0.5	2.0
Approximate k.									
73 SCH	2			900	9.0(+13)	–	–	0.5	2.0
Approximate k.									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi–empirical evaluation.									
77 LIL/RIC	2			150–300	1.6(+14)	0	760±140	0.8	1.2
78 KOL	2			300	1.3(+13)	–	–	0.8	1.2
Unreported T assumed to be 300K.									
80 BAU/COX (Recommended k).	2			150–300	1.6(+14)	0	760±250	0.8	1.3
k factors apply at 298K only.									
$CS + O \rightarrow S + CO(v=n)$									
Carbon monosulfide free radical + Oxygen atom									
72 HAN/RID	2		0.1	298	–	–	–		
k_{ref}: $CS + O \rightarrow S + CO(v=13)$									
Ratio increasing from 0.1 to 0.9 between v=7 and v=12, then decreasing to 0.3 from v=14 to v=15.									
Unreported T assumed to be 298K.									
75 SLA/GRA1	2			305	1.2(+13)	–	–	0.9	1.1
76 BID/BRE	2			300	1.4(+13)	–	–	0.8	1.2
$CS + O \rightarrow SO + C$									
Carbon monosulfide free radical + Oxygen otom									
75 BEN/GOL	2				1.6(+12)	0.5	28940		
Semi–empirical evaluation.									
$CS + O_2 \rightarrow SO + CO$									
Carbon monosulfide free radical + Oxygen molecule									
73 SCH	2			298	<1.8(+6)	–	–		
Estimated upper limit k.									
$CS + O_2 \rightarrow COS + O$									
Carbon monosulfide free radical + Oxygen molecule									
73 SCH	2			298	<1.8(+6)	–	–		
Estimated upper limit k.									
$CS + H \rightarrow S + CH$									
Crbon monosulfide free radical + Hydrogen atom									
75 BEN/GOL	2				1.3(+13)	0.5	50930		
Semi–empirical evaluation.									

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$CS + H \rightarrow SH + C$									
Carbon monosulfide free radical + Hydrogen atom									
75 BEN/GOL	2				2.0(+13)	0.5	48870		
Semi-empirical evaluation.									
$CS + S \rightarrow S + CS$									
Carbon monosulfide free radical + Sulfur atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi-empirical evaluation.									
$CS + S \rightarrow C + S_2$									
Carbon monosulfide free radical + Sulfur atom									
75 BEN/GOL	2				1.6(+12)	0.5	40463		
Semi-empirical evaluation.									
$CS + S + M \rightarrow CS_2 + M$									
Carbon monosulfide free radical + Sulfur atom									
76 BAU/DRY (Recommended k).	3			1800–3700	8.7(+13)	0	–4370	0.5	1.5
$k_1 = Kk_{-1}$									
$CS + N \rightarrow S + CN$									
Carbon monosulfide free radical + Nitrogen atom									
75 BEN/GOL	2				1.3(+12)	0.5	1160		
Semi-empirical evaluation.									
$CS + N \rightarrow C + NS$									
Carbon monosulfide free radical + Nitrogen atom									
75 BEN/GOL	2				4.0(+12)	0.5	37200		
Semi-empirical evaluation.									
$CS + C \rightarrow S + C_2$									
Carbon monosulfide free radical + Carbon atom									
75 BEN/GOL	2				5.0(+11)	0.5	20435		
Semi-empirical evaluation.									
$CS + C \rightarrow C + CS$									
Carbon monosulfide free radical + Carbon atom									
75 BEN/GOL	2				6.3(+11)	0.5	0		
Semi-empirical evaluation.									
$CS_2 + O \rightarrow CO + S_2$									
Carbon disulfide + Oxygen atom									
79 HSU/SHA	2			298	3.5(+10)	–	–	0.9	1.1
$CS_2 + O \rightarrow CS + SO$									
Carbon disulfide + Oxygen atom									
71 TAK	2			298	1.4(+12)	–	–	0.9	1.1
75 WEI/TIM	2			218–293	1.7(+13)	0	645±35	0.9	1.1
76 BAU/DRY (Recommended k).	2			200–1000	2.2(+13)	0	700	0.7	1.3
$CS_2 + O \rightarrow COS + S$									
Carbon disulfide + Oxygen atom									
73 SCH	2			1100	1.2(+12)	–	–		
Approximate k.									
74 SLA/GIL	2		0.093	302	–	–	–		
k_{ref}: $CS_2 + O \rightarrow$ products									
76 BAU/DRY (Recommended k).	2			302	2.2(+11)	–	–	0.5	1.5
77 GRA/GUT	2		0.098	249–500	–	–	–		
k_{ref}: $CS_2 + O \rightarrow$ products within the given T range, the k/k_{ref} ratio decreases from 0.098±0.004 at 249K to 0.081±0.007 at 500K.									

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$CS_2 + O \rightarrow COS + S$ —continued									
77 GRA GUT	2			249–500	1.7(+11)	–	–	0.9	1.2
Within the given T range, k increases from $1.7x10^{11}$ at 249K to $5.5x10^{11}cm^3mol^{-1}s^{-1}$ at 500K.									
$CS_2 + O \rightarrow$ products									
Carbon disulfide + Oxygen atom									
74 SLA/GIL	2			302	2.4(+12)	–	–		
74 GRA/GUT	2			249–500	1.7(+12)	–	–	0.9	1.1
Non-linear Arrhenius behavior. Within the given T range, k increases from $1.7x10^{12}$ at 249K to $6.7x10^{12}cm^3mol^{-1}s^{-1}$ at 500K.									
80 BAU/COX (Recommended k).	2			200–500	3.5(+13)	0	700±100	0.6	1.6
k factors apply at 298K only.									
$CS_2 + OH \rightarrow$ products									
Carbon disulfide + Hydroxyl free radical									
78 ATK/PER1	2			300	<4.2(+10)	–	–		
Upper limit k.									
78 ATK PER1	2			425	<6.0(+10)	–	–		
Upper limit k.									
78 KUR2	2			296	1.1(+11)	–	–	0.8	1.2
80 BAU/COX (Recommended k).	2			298	<1.2(+11)	–	–		5.0
Upper limit k.									
80 COX/SHE	2			297	2.6(+11)	–	–	0.7	1.3
80 IYE/ROW	2			298	<1.8(+9)	–	–		
Upper limit k.									
80 WIN/SHA	2			251	<6.0(+9)	–	–		
Upper limit k.									
80 WIN SHA	2			297	<9.0(+8)	–	–		
Upper limit k.									
80 WIN SHA	2			363	<9.6(+8)	–	–		
Upper limit k.									
$CS_2 + S \rightarrow CS + S_2$									
Carbon disulfide + Sulfur atom									
76 BAU/DRY (Recommended k).	2			298	3.9(+11)	–	–	0.5	1.5
$CS_2 + M \rightarrow CS + S + M$									
Carbon disulfide									
76 BAU/DRY (Recommended k).	2	Ar		1800–3700	2.6(+15)	0	38960±9000	0.5	1.5
80 SAI/TOR	2	Ar		2000–2900	2.5(+14)	0	37240		
$CS_2 + M \rightarrow$ products									
Carbon disulfide									
74 TRA	2				6.8(+14)	0	36000±700		
k measured in shock tube. Unspecified high T range.									
$COS + O \rightarrow SO + CO$									
Carbon oxide sulfide + Oxygen atom									
71 KRE	2			300–523	9.8(+12)	0	2265		
71 KRE/SIM	2			300–523	9.8(+12)	0	2265		
72 BRE/MIL	2			297	7.2(+9)	–	–	0.8	1.2
74 KLE/STI	2			263–502	9.9(+12)	0	2167±28	0.9	1.1
75 WEI/TIM	2			239–404	1.2(+13)	0	2150±35	0.8	1.2
76 MAN/BRA (Recommended k).	2			296	8.4(+9)	–	–	0.9	1.1
k factors changing to: f = 0.3 and F = 3.0 above 300K.									
78 YOS/SAI	2			298	7.1(+9)	–	–	0.9	1.1
80 BAU/COX (Recommended k).	2			220–600	1.6(+13)	0	2250±150	0.6	1.6
k factors apply at 298K only.									
80 ROB/SMI	2			296	1.0(+10)	–	–	0.9	1.1

Table of Arrhenius parameters for gas phase chemical reactions of sulfur compounds — Continued

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors f	F
$COS + O^*(^1D) \rightarrow SO + CO$									
Carbon oxide sulfide + Oxygen atom									
75 GAU/SNE	2		4.1	300	–	–	–		
k_{ref}: $O_2 + O^*(^1D) \rightarrow O_2^*(^1\Sigma_g^+) + O$									
75 GAU SNE	2			300	1.8(+14)	–	–		
Evaluation.									
$COS + H \rightarrow CO + SH$									
Carbon oxide sulfide + Hydrogen atom									
72 ROM/SCH	2			298	1.3(+10)	–	–	0.8	1.3
75 TSU/YOK	2			300–525	9.1(+12)	0	1965±185	0.9	1.1
76 BAU/DRY (Recommended k).	2			298	1.3(+10)	–	–	0.8	1.3
76 LEE	2			298–478	9.8(+13)	0	2775±40	0.9	1.1
77 LEE/STI	2			261–500	5.5(+12)	0	1940±55	0.8	1.2
$COS + OH \rightarrow$ products									
Carbon oxide sulfide + Hydroxyl free radical									
78 ATK/PER1	2			299	<4.2(+9)	–	–		
Upper limit k.									
78 ATK PER1	2			430	<1.2(+10)	–	–		
Upper limit k.									
78 KUR2	2			296	3.4(+10)	–	–		
80 BAU/COX (Recommended k).	2			298	<3.6(+10)	–	–		5.0
Upper limit k.									
80 COX/SHE	2			297	<2.4(+10)	–	–		
Upper limit k.									
$COS + OH(v=9) \rightarrow$ products									
Carbon oxide sulfide + Hydroxyl free radical									
72 WOR/COL	2			298	1.5(+10)	–	–	0.4	1.6
Unreported T assumed to be 298K.									
$COS + S \rightarrow CO + S_2$									
Carbon oxide sulfide + Sulfur atom									
72 JAK/AHM	2			298	1.1(+10)	–	–		
Evaluation.									
74 KLE/DAV	2			233–245	9.2(+11)	0	1825±60	0.9	1.1
76 BAU/DRY (Recommended k).	2			230–2600	1.7(+12)	0	2050±230	0.3	3.0
$COS + S^*(^1D) \rightarrow CO + S_2$									
Carbon oxide sulfide + Sulfur atom									
72 LIT/DAL	2		1.5	300	–	–	–		
k_{ref}: $CH_2{=}CH_2 + S^*(^1D) \rightarrow$ products									
78 SHE/SAF	2		2.4	298	–	–	–		
k_{ref}: $COS + S^*(^1D) \rightarrow COS + S(^3P)$									
Optimization.									
79 ADD/BYR	2			290	7.2(+13)	–	–	0.8	1.3
80 ADD/DON	2			295	1.8(+14)	–	–	0.7	1.3
$COS + CD_3 \rightarrow CO + CD_3S$									
Carbon oxide sulfide + Methyl-d_3 free radical									
72 JAK/AHM	2			354–490	3.8(+11)	0	5710±175	0.6	1.8
Evaluation.									
$COS + CN \rightarrow SCN + CO$									
Carbon oxide sulfide + Cyanogen free radical									
79 ADD/LEI	2			295	>1.8(+13)	–	–		
Lower limit k.									
$COS + M \rightarrow$ products									
Carbon oxide sulfide									
74 TRA	2				8.3(+14)	0	31700±650		
k measured in shock tube.									
Unspecified, high T range.									

Chemical reactions	n	M	k/k_{rel}	T/K	A	B	E/R (in K)	k factors f	k factors F
$CH_3S + CH{\equiv}CH \rightarrow CH_3SCH{=}CH$									
Methylthio free radical + Ethyne									
72 KER/PAR (Recommended k).	2			298–333	7.9(+7)	–	–		
$CH_3S + CH_2{=}CH_2 \rightarrow CH_3SCH_2CH_2$									
Methylthio free radical + Ethene									
72 KER/PAR (Recommended k).	2			298	4.8(+8)	–	–		
$CH_3S + cy\text{-}CH_2CH_2S \rightarrow CH_3S_2 + CH_2{=}CH_2$									
Methylthio free radical + Thiirane									
72 JAK/AHM	2			304–478	3.2(+11)	0	4430		
Approximate k.									
$CH_3S + CH_3CH{=}CHCH_3 \rightarrow CH_3CH(SCH_3)CH()CH_3$									
Methylthio free radical + 2–Butene									
72 KER/PAR	2			298–333	1.6(+9)	–	–		
cis–trans equilibrium–weighted k.									
$CH_3SH \rightarrow CH_3 + SH$									
Methanethiol									
70 BEN/O'N	1			1005–1102	3.2(+15)	0	38550		
Critical evaluation.									
$CH_3SH + O \rightarrow$ products									
Methanethiol + Oxygen atom									
76 SLA/GRA	2			300	1.1(+12)	–	–		
78 KIR/VET	2			300–661	8.5(+12)	0	–625±36	0.9	1.1
78 SLA/BAL	2			254–495	1.1(+12)	–	–		
Non–linear Arrhenius behavior. Within the given T range, k increasing from $1.1\mathrm{x}10^{12}$ at 254K to $2.6\mathrm{x}10^{12}\mathrm{cm}^3\mathrm{mol}^{-1}\mathrm{s}^{-1}$ at 495K.									
$CH_3SH + OH \rightarrow$ products									
Methanethiol + Hydroxyl free radical									
80 COX/SHE	2			297	5.4(+13)	–	–	0.9	1.1
$CH_3SH + CH_3 \rightarrow CH_2SH + CH_4$									
Methanethiol + Methyl free radical									
76 KER/PAR (Recommended k).	2			303	1.2(+8)	–	–	0.5	2.0
$CD_3SH + CH_3 \rightarrow CD_3S + CH_4$									
Methane–d₃–thiol + Methyl free radical									
76 KER/PAR (Recommended k).	2			400–500	1.1(+11)	0	2065±500	0.5	2.0
$CD_3SH + CH_3 \rightarrow CD_2SH + CH_3D$									
Methane–d₃–thiol + Methyl free radical									
76 KER/PAR (Recommended k).	2			400–500	7.6(+10)	0	4200±250	0.5	2.0
76 KER/PAR (Recommended k).	2			400–500	1.1(+11)	0	2065±500	0.5	2.0
$CD_3SH + CH_3 \rightarrow CD_2SH + CH_3D$									
Methane–d₃–thiol + Methyl free radical									
76 KER/PAR (Recommended k).	2			400–500	7.6(+10)	0	4200±250	0.5	2.0
$cy\text{-}CH_2CH_2S^* \rightarrow CH_2{=}CHSH$									
Thiirane									
79 SHE/SAF	1			298	5.0(+10)	–	–		
$cy\text{-}CH_2CH_2S + O \rightarrow CH_2{=}CH_2 + SO$									
Thiirane + Oxygen atom									
76 LEE/TIM	2			268–424	8.1(+12)	0	18±20	0.9	1.1

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors f	F
$cy\text{-}CH_2CH_2S + O_3 \rightarrow CH_2{=}CH_2$ + other products *Thiirane + Ozone* **80 MAR/HER** 8 torr. pressure.	2			296	<1.0(+4)	–	–		
$cy\text{-}CH_2CH_2S + H \rightarrow CH_2{=}CH_2 + SH$ *Thiirane + Hydrogen atom* **75 YOK/AHM**	2			300–425	5.7(+13)	0	978±88	0.9	1.1
$cy\text{-}CH_2SCH_2 + H \rightarrow cy\text{-}CH_2SCH + H_2$ *Thiirane + Hydrogen atom* **76 LEE**	2			298	7.1(+11)	–	–	0.8	1.2
$cy\text{-}CH_2CH_2S + S \rightarrow CH_2{=}CH_2 + S_2$ *Thiirane + Sulfur atom* **71 STR/O'C** k/k_{ref}: 8.3exp(+906/T) k_{ref}: $CH_2{=}CH_2 + S \rightarrow cy\text{-}CH_2CH_2S$ Conventional photolysis method.	2			298–450	–	–	–		
73 KLE/DAV1	2			298–355	2.7(+13)	0	0	0.9	1.1
$cy\text{-}CH_2CH_2S + CH_3 \rightarrow CH_2{=}CH_2 + CH_3S$ *Thiirane + Methyl free radical* **72 JAK/AHM**	2			304–478	7.1(+10)	0	3370±400	0.3	3.3
$cy\text{-}CH_2CH_2S + CD_3 \rightarrow CH_2{=}CH_2 + CD_3S$ *Thiirane + Methyl-d_3 free radical* **72 JAK/AHM** Evaluation.	2			303–477	5.9(+10)	0	3270±500	0.2	4.4
$cy\text{-}CH_2CH_2S + CD_3 \rightarrow cy\text{-}CH_2CH()S + CD_3H$ *Thiirane + Methyl-d_3 free radical* **72 JAK/AHM** Evaluation.	2			303–477	2.2(+11)	0	4800±500	0.3	4.0
76 KER/PAR (Recommended k).	2			300–500	2.2(+11)	0	4800±500	0.5	2.0
$cy\text{-}CH_2CH_2S + CH_3S \rightarrow CH_2{=}CH_2 + CH_3S_2^{\cdot}$ *Thiirane + Methylthio free radical* **72 JAK/AHM** Approximate k.	2			304–478	3.2(+11)	0	4430		
$CH_3SCH_2^{\cdot} + CH_4 \rightarrow (CH_3)_2S + CH_3$ *Methyl, (methylthio)–, free radical + Methane* **76 ART/LEE** Evaluation based on k_{-1} and thermodynamic data.	2			393–518	6.3(+11)	0	7662		
$CH_3CH_2SH \rightarrow CH_2{=}CH_2 + H_2S$ *Ethanethiol* **70 BEN/O'N** Critical evaluation.	1			785–938	1.0(+13)	0	25900		
$CH_3CH_2SH \rightarrow CH_3CH_2 + SH$ *Ethanethiol* **70 BEN/O'N** Critical evaluation.	1			785–938	6.3(+15)	0	36336		
$CH_3CH_2SH + O \rightarrow$ products *Ethanethiol + Oxygen atom* **76 SLA/GRA**	2			300	1.7(+12)	–	–		
78 KIR/VET	2			304–421	5.8(+12)	0	–391±18	0.9	1.1
78 SLA/BLA Non-linear Arrhenius behavior. Within the given T range, k increasing from 1.9×10^{12} at 257K to 3.2×10^{12} $cm^3mol^{-1}s^{-1}$ at 495K.	2			257–495	1.9(+12)	–	–		

Table of Arrhenius parameters for gas phase chemical reactions of sulfur compounds — Continued

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors f	k factors F
$CH_3CH_2SH + CH_3 \rightarrow$ products									
Ethanethiol + Methyl free radical									
76 KER/PAR	2			303	3.5(+7)	–	–	0.5	2.0
Tentative k.									
$(CH_3)_2S + O \rightarrow CH_3S(O) + CH_3$									
Methane, thiobis–, + Oxygen atom									
76 LEE/TIM	2			268–424	8.6(+12)	0	–366±16	0.9	1.1
76 SLA/GRA	2			300	3.8(+13)	–	–		
78 SLA/BAL	2			252–493	3.8(+13)	–	–		
Possible non–linear Arrhenius behavior. Within the given T range, k decreasing from 3.8×10^{13} at 252K to 2.2×10^{13} $cm^3 mol^{-1} s^{-1}$ at 493K.									
80 LEE/TAN1	2			272–472	7.7(+12)	0	–404±30	0.9	1.1
$(CH_3)_2S + O \rightarrow$ products									
Methune,thiobis–, + Oxygen atom									
74 CAD/WIC	2			300	3.3(+11)	–	–		
$(CH_3)_2S + O_3 \rightarrow$ products									
Methane, thiobis–, + Ozone									
78 MAR/HER	2			296	<5.0(+5)	–	–		
Upper limit k.									
$(CH_3)_2S + H \rightarrow CH_3SH + CH_3$									
Methane, thiobis–, + Hydrogen atom									
79 YOK/STR	2			300–472	1.7(+13)	0	1320±44	0.8	1.2
80 YOK/STR	2			300–472	1.7(+13)	0	1319±44	0.8	1.2
Indirect measurement.									
$(CH_3)_2S + H \rightarrow CH_3SCH_2^{\cdot} + H_2$									
Methune, thiobis–, + Hydrogen atom									
76 LEE	2			300	9.0(+10)	–	–	0.7	1.3
$(CH_3)_2S + OH \rightarrow$ products									
Methane, thiobis–, + Hydroxyl free radical									
78 ATK/PER1	2			300	5.9(+12)	–	–	0.9	1.1
78 ATK PER1	2			299–430	3.3(+12)	0	–179±150		
78 KUR1 (Recommended k).	2			273–426	3.7(+12)	0	134±135	0.6	1.4
80 COX/SHE	2			297	5.5(+12)	–	–	0.8	1.2
$(CH_3)_2S + CH_3 \rightarrow CH_3SCH_2 + CH_4$									
Methane, thiobis–, + Methyl free radical									
76 ART/LEE	2			393–518	4.2(+11)	0	4613±82	0.8	1.2
$CH_3SSCH_3 + O \rightarrow$ products									
Disulfide, dimethyl–, + Oxygen atom									
80 LEE/TAN2	2			270–329	1.3(+14)	0	0	0.9	1.1
$CH_3SSCH_3 + H \rightarrow CH_3S + CH_3SH$									
Disulfide, dimethyl–, + Hydrogen atom									
80 EKW/JOD	2			298–428	5.7(+12)	0	–50±50	0.8	1.2
$CH_3SSCH_3 + OH \rightarrow$ products									
Disulfide, dimethyl–, + Hydroxyl free radical									
80 COX/SHE	2			297	1.3(+14)	–	–	0.6	1.4
$CH_3SO_2CH_3 \rightarrow CH_3SO_2 + CH_3$									
Methane, sulfonylbis–									
70 BEN/O'N	1			783–913	2.0(+14)	0	30500		
Critical evaluation.									

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors f	k factors F
cy–$CH_2CH_2CH_2S + CH_3 \rightarrow$ cy–$CH_2CH()CH_2S + CH_4$ *Thietane + Methyl free radical* **76 KER/PAR** Tentative k.	2			300–450	3.2(+11)	0	4630±750		
cy–$(CH_3)CHCH_2S + S \rightarrow CH_3CH{=}CH_2 + S_2$ *Thiirane, methyl–, + Sulfur atom* **71 STR/O'C** k/k_{ref}: 8.4exp(+1057/T) k_{ref}: $CH_2{=}CH_2 + S \rightarrow$ cy–CH_2CH_2S Conventional photolysis method.	2			298–450	–	–	–		
cy–$(CH_3)CHCH_2S + CH_3 \rightarrow CH_3CH{=}CH_2 + CH_3S$ *Thiirane, methyl–, + Methyl free radical* **72 JAK/AHM** Evaluation.	2			339–435	2.1(+11)	0	3750±830	0.1	8.3
cy–$(CH_3)CHCH_2S + CH_3 \rightarrow$ cy–$[(CH_2)CHCH_2]S + CH_4$ *Thiirane, methyl–, + Methyl free radical* **72 JAK/AHM**	2			339–435	1.0(+11)	0	4160±440	0.3	3.0
$CH_3CH_2CH_2SH + O \rightarrow$ products *1–Propanethiol + Oxygen atom* **78 KIR/VET**	2			303–421	8.3(+12)	0	–494±22	0.9	1.1
$(CH_3)_2CHSH + CH_3 \rightarrow$ products *2–Propanethiol + Methyl free radical* **76 KER/PAR** Tentative k.	2			303	4.1(+7)	–	–		
cy–$CH_2CH_2CH_2CH_2S + H \rightarrow CH_2CH_2CH_2CH_2SH$ *Thiophene, tetrahydro–, + Hydrogen atom* **78 HOR/NIS** At 5 torr.	2			295–576	8.5(+12)	0	1010		
$CH_3C(S)SCH_2CH_3 \rightarrow CH_4 + CS_2 + CH_2{=}CH_2$ *Ethane(dithioic) acid ethyl ester* **78 ALA/BIG** **78 ALA BIG** k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$.	1 1			629 651–716	1.8(–3) 9.2(+12)	– 0	– 22730		
$CH_3CH_2CH_2CH_2SH + O \rightarrow$ products *1–Butanethiol + Oxygen atom* **78 KIR/VET**	2			306–419	5.8(+12)	0	–321±19	0.9	1.1
$CH_3CH_2CH_2CH_2SH + H \rightarrow CH_3CH_2CH_2CH_2 + H_2S$ *1–Butanethiol + Hydrogen atom* **78 HOR/NIS** At 5 torr.	2			295–576	1.6(+12)	0	1120		
$CH_3CH_2CH_2CH_2SH + H \rightarrow CH_3CH_2CH_2CH_2S + H_2$ *1–Butanethiol + Hydrogen atom* **78 HOR/NIS** At 5 torr.	2			295–576	1.3(+13)	0	1600		
$(CH_3)_3CSH \rightarrow (CH_3)_2C{=}CH_2 + H_2S$ *2–Propanethiol, 2–methyl–* **70 BEN/O'N** Critical evaluation.	1			950–1230	2.5(+13)	0	27830		
$(CH_3)_3CSH + CH_3 \rightarrow (CH_3)_3CS + CH_2C(CH_3)_2SH + CH_4$ *2–Propanethiol, 2–methyl–, + Methyl free radical* **76 KER/PAR** Tentative k.	2			303	5.9(+7)	–	–		

Chemical reactions	n	M	k/k_{ref}	*T*/K	*A*	*B*	*E*/*R*	k factors	
							(in K)	f	F
$CH_2{=}CHCH_2SO_2CH_3 \rightarrow CH_2{=}CHCH_2 + CH_3SO_2$									
1–Propene, 3–methylsulfonyl–									
70 BEN/O'N	1			573–633	5.0(+12)	0	28030		
Critical evaluation.									
$CH_3SC(O)OCH_2CH_3 \rightarrow CH_3SH + CO_2 + CH_2{=}CH_2$									
Cnrbonothioic acid O–ethyl S–methyl ester									
79 ALA/BIG	1			629	1.0(−4)	–	–		
79 ALA BIG	1			490–550	1.8(+12)	0	23500		
k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$.									
$CH_3OC(O)SCH_2CH_3 \rightarrow CH_3OH + COS + CH_2{=}CH_2$									
Carbonothioic acid S–ethyl O–methyl ester									
79 ALA/BIG	1			629	7.8(−7)	–	–		
79 ALA BIG	1			490–550	1.2(+13)	0	27800		
k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$.									
$CH_3CH_2CH_2CH_2CH_2SH + O \rightarrow$ products									
1–Pentonethiol + Oxygen ntom									
78 KIR/VET	2			302–409	6.2(+12)	0	−328±19	0.9	1.1
$CH_3OC(O)SCH(CH_3)_2 \rightarrow CH_3OH + COS + CH_3CH{=}CH_2$									
Cnrbonothioic ocid O–methyl S–(l–methylethyl) ester									
79 ALA/BIG	1			629	4.6(−5)	–	–		
79 ALA BIG	1			440–480	8.4(+12)	0	25000		
k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$.									
$CH_3SC(O)OCH(CH_3)_2 \rightarrow CH_3SH + CO_2 + CH_3CH{=}CH_2$									
Corbonothioic ocid S–methyl O–(1–methylethyl) ester									
79 ALA/BIG	1			629	9.4(−3)	–	–		
79 ALA BIG	1			547–584	6.7(+11)	0	20060		
k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$. (Evacuated sealed tube method).									
$CH_3SC(O)OC(CH_3)_3 \rightarrow CH_3SHH + CO_2 + CH_2{=}C(CH_3)_2$									
Carbonothioic ocid O–(1,1–dimethylethyl) S–methyl ester									
79 ALA/BIG	1			629	4.2(−1)	–	–		
79 ALA BIG	1			479–502	5.4(+10)	0	16080		
k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$. (Inhibited sealed tube method).									
$CH_3OC(O)SC(CH_3)_3 \rightarrow CH_3OH + COS + CH_2{=}C(CH_3)_2$									
Carbonothioic ocid S–(1,1–dimethylethyl) O–methyl ester									
79 ALA/BIG	1			629	1.2(−3)	–	–		
79 ALA BIG	1			370–420	1.4(+12)	0	21800		
k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$.									
$CH_3C(S)SCH_2CH_2CH_2CH_3 \rightarrow$ $CH_4 + CS_2 + CH_2{=}CHCH_2CH_3$									
Ethane(dithioic) ocid butyl ester									
78 ALA/BIG	1			629	3.3(−3)	–	–		
78 ALA BIG	1			651–716	1.2(+13)	0	22500		
k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$.									
$CH_3C(S)SCH(CH_3)CH_2CH_3 \rightarrow$ $CH_4 + CS_2 + CH_2{=}CHCH_2CH_3$ + cis–, and trans–$CH_3CH{=}CHCH_3$									
Ethane(dithioic) acid 1–methylpropyl ester									
78 ALA/BIG	1			629	7.4(−2)	–	–		
78 ALA BIG	1			584–639	6.7(+12)	0	20210		
k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$.									

Table of Arrhenius parameters for gas phase chemical reactions of sulfur compounds — Continued

Chemical reactions	n	M	k/k_{ref}	T/K	A	B	E/R (in K)	k factors	
								f	F
$CH_3C(S)SC(CH_3)_3 \rightarrow CH_4 + CS_2 + (CH_3)_2C=CH_2$									
Ethane(dithioic) acid 1,1-dimethylethyl ester									
78 ALA/BIG	1			629	3.1(−1)	–	–		
78 ALA BIG	1			448–502	1.1(+13)	0	19600		
k based on reported $\Delta H^{\dagger}$ and $\Delta S^{\dagger}$									
$(CH_3)_3CSC(CH_3)_3 \rightarrow (CH_3)_2=CH_2 + H_2S + (CH_3)_3SH + (CH_3)_3SH$									
Propane, 2,2'-thiobis[2-methyl-									
80 MAR/BAR	1			633–686	1.3(+15)	0	27545±962	0.5	2.0
$(CH_3)_3CSSC(CH_3)_3 \rightarrow (CH_3)_2C=CH_2$ + other products									
Disulfide, bis(1,1-dimethylethyl)-									
76 MAR/BAR	1			603–673	4.0(+14)	0	22130±480	0.4	2.5
In a stirred-flow system.									
76 MAR BAR	1			519–573	4.0(+13)	0	21290±240	0.6	1.6
In a static system.									

3. Bibliography

1970

70 BEN/O'N Benson, S. W., and O'Neal, H. E., "Kinetic Data on Gas Phase Unimolecular Reactions," NSRDS-NBS 21 (1970). (Supt. Doc., U.S. Govt. Printing Office, Washington, DC 20402).

1971

71 ARM/CUL Armitage, J. W., and Cullis, C. F., "Studies of the Reaction Between Nitrogen Dioxide and Sulfur Dioxide," Combust. Flame **16**, 125 (1971).

71 BAU/JEF Bauer, S. H., Jeffers, P., Lifshitz, A., and Yadava, B. P., "Reaction Between CO and SO_2 at Elevated Temperatures: A Shock-Tube Investigation," Symp. (Int.) Combust., (Proc.) **13**, 1970 (Publ. 1971) 417.

71 CON/VAN Connor, J., Van Roodselaar, A., Fair, R. W., and Strausz, O. P., "The Addition of Group Via Atoms to Tetramethylthylene. An Addition Reaction with a Negative Activation Energy," J. Am. Chem. Soc. **93**, 560 (1971).

71 CUP/GLA Cupitt, L. T., and Glass, G. P., "Calculation of Absolute Concentrations of SH and SO from the E. S. R. Spectra," Trans. Faraday Soc. **67**, 1 (1971).

71 FAI/VAN Fair, R. W., Van Roodselaar, A., and Strausz, O. P., "The Reaction of $S(^3P)$ Atoms with Molecular Oxygen," Can. J. Chem. **49**, 1659 (1971).

71 FIF/MOR Fifer, R., Moreau, R., and Bauer, S. H., "The Reactions Between SO_2 and C_2H_2 (and C_2H_4) at Elevated Temperature. A Single-Pulse Shock Tube Investigation," Int. J. Chem. Kinet. **3**, 249 (1971).

71 HAN/SMI Hancock, G., and Smith, I. W. M., "Infra-red Chemiluminescence from Vibrationally Excited CO. Part 1. The Reaction of Atomic Oxygen with Carbon Disulphide," Trans. Faraday Soc. **67**, 2586 (1971).

71 KRE Krezenski, D. C., "Competitive Reaction of $O(^3P)$ with Ozone and Carbonyl Sulfide," Diss. Abstr. Int. B **32**, 2633 (1971).

71 KRE/SIM Krezenski, D. C., Simonaitis, R., and Heicklen, J., "The Reactions of $O(^3P)$ with Ozone and Carbonyl Sulfide," Int. J. Chem. Kinet. **3**, 467 (1971).

71 KUR/PET Kurylo, M. J., Peterson, N. C., and Braun, W., "Absolute Rate of the Reaction H + H_2S," J. Chem. Phys. **54**, 943 (1971).

71 MER/LEV Merryman, E. L., and Levy. A., "Sulfur Trioxide Flame Chemistry—H_2S and COS Flames," Symp. (Int.) Combust., (Proc.) **13**, 1970 (Publ. 1971) 427.

71 MIY/TAK1 Miyazaki, S., and Takahashi, S., "On the Reaction of Oxygen Atom with Carbon Disulphide, Part 2," Mem. Def. Acad. Math. Phys. Chem. Eng. Yokosuka, Jpn. **11**, 307 (1971).

71 MIY/TAK2 Miyazaki, S., and Takahashi, S., "On the Reaction of Oxygen Atom with Carbon Disulphide. Part 3," Mem. Def. Acad. Math. Phys. Chem. Eng. Yokosuka, Jpn. **11**, 329 (1971).

71 STR/O'C Strausz, O. P., O'Callaghan, W. B.. Lown, E. M., and Gunning, H. E., "Reactions of Sulfur Atoms. XII. Arrhenius Parameters for the Addition to Olefins and Acetylenes." J. Am. Chem. Soc. **93**, 559 (1971).

71 TAK Takahashi, S., "On the Reaction of Oxygen Atom with Carbon-Disulphide. Part 1," Mem. Def. Acad. Math. Phys. Chem. Eng. Yokosuka, Jpn. **11**, 191 (1971).

1972

72 BRE/MIL Breckenridge, W. H., and Miller, T. A., "Kinetic Study by EPR of the Production and Decay of $SO(^1\Delta)$ in the Reaction of $O_2(^1\Delta_g)$ with $SO(^3\Sigma^-)$," J. Chem. Phys. **56**, 465 (1972).

72 DAV/KLE1 Davis, D. D., Klemm, R. B., and Pilling, M., "A Flash Photolysis-Resonance Fluorescence Kinetics Study of Ground-State Sulfur Atoms: I. Absolute Rate Parameters for Reaction of $S(^3P)$ with $O_2(^3\Sigma)$," Int. J. Chem. Kinet. **4**, 367 (1972).

72 DAV/KLE2 Davis, D. D., Klemm, R. B., Braun, W., and Pilling, M., "A Flash Photolysis-Resonance Fluorescence Kinetics Study of Ground-State Sulfur Atoms. II. Rate Parameters for Reaction of $S(^3P)$ with C_2H_4," Int. J. Chem. Kinet. **4**, 383 (1972).

72 DON/LIT Donovan, R. J., and Little, D. J., "The Rate of the Reaction $S(^3P_J)$ + O_2," Chem. Phys. Lett. **13**, 488 (1972).

72 HAN/RID Hancock, G., Ridley, B. A., and Smith, I. W. M., "Infra-red Chemiluminescence from Vibrationally Excited CO. Part 2. Product Distribution from the Reaction O + CS → CO + S," J. Chem. Soc. Faraday Trans. II **68**, 2117 (1972).

72 JAC/WIN Jacob, A., and Winkler, C. A., "Kinetics of the Reactions of Oxygen Atoms and Nitrogen Atoms with Sulfur Trioxide," J. Chem. Soc. Faraday Trans. I **68**, 2077 (1972).

72 JAK/AHM Jakubowski, E., Ahmed, M. G., Lown, E. M., Sandhu, H. S., Gosavi, R. K., and Strausz, O. P., "Sulfur Atom Abstraction from Episulfides and Carbonyl Sulfide by Methyl Radicals," J. Am. Chem. Soc. **94**, 4094 (1972).

72 KER/PAR Kerr, J. A., and Parsonage, M. J., "Evaluated Kinetic Data on Gas Phase Addition Reactions: Reactions of Atoms and Radicals with Alkenes, Alkynes and Aromatic Compounds," (Butterworths, London, 1972).

72 LAN/OLD Langford, R. B., and Oldershaw. G. A., "Flash Photolysis of H_2S," J. Chem. Soc. Faraday Trans. I **68**, 1550 (1972).

72 LIT/DAL Little, D. J.. Dalgleish, A., and Donovan, R. J., "Relative Rate Data for the Reactions of $S(^1D_2)$ using the NS Radical as Spectroscopic Marker," Faraday Discuss. Chem. Soc. **53**, 211 (1972).

72 NIK/MOR1 Niki, H., Morris, E. D., Jr., and Breitenbach, L. P., "Reaction of OH with H_2S," Am. Chem. Soc. 164th Meeting (Abstracts of Papers) **164**, PHYS-116 (1972).

72 ROM/SCH Rommel, H., and Schiff, H. I., "The Reactions of H Atoms with H_2S and COS," Int. J. Chem. Kinet. **4**, 547 (1972).

72 WOR/COL Worley, S. D., Coltharp, R. N., and Potter, A. E., Jr. "Rates of Interaction of Vibrationally Excited Hydroxyl (v = 9) with Diatomic and Small Polyatomic Molecules," J. Phys. Chem. **76**, 511 (1972).

1973

73 BRA/TRU Bradley, J. N., Trueman, S. P., Whytock, D. A., and Zaleski, T. A., "Electron Spin Resonance Study of the Reaction of Hydrogen Atoms with Hydrogen Sulphide," J. Chem. Soc. Faraday Trans. I **69**, 416 (1973).

73 CEH/HEI Cehelnik, E., Heicklen, J., Braslavsky, S., Stockburger, L., and Mathias, E., "Photolysis of SO_2 in the Presence of Foreign Gases IV. Wavelength and Temperature Effects with CO," J. Photochem. **2**, 31 (1973).

73 DAV/KLE Davis, D. D., and Klemm, R. B., "A Flash Photolysis-Resonance Fluorescence Kinetics Study of the Reactions of Ground-State Sulfur Atoms. V. Rate Parameters for the Reaction of $S(^3P)$ with cis-2-Butene and Tetramethylethylene," Int. J. Chem. Kinet. **5**, 841 (1973).

73 JAM/KER James, F. C., Kerr, J. A., and Simons, J. P., "Direct Measurement of the Rate of Reaction of the Methyl Radical with Sulphur Dioxide," J. Chem. Soc. Faraday Trans. I **69**, 2124 (1973).

73 KLE/DAV1 Klemm, R. B., and Davis, D. D., "A Flash Photolysis Resonance Fluorescence Kinetics Study of Ground-State Sulfur Atoms. III. Rate Parameters for Reaction of $S(^3P)$ with Ethylene Episulfide," Int. J. Chem. Kinet. **5**, 149 (1973).

73 KLE/DAV2 Klemm, R. B., and Davis, D. D., "A Flash Photolysis-Resonance Fluorescence Kinetics Study of Ground-State Sulfur Atoms. IV. Rate Parameters for Reaction of $S(^3P)$ with Propene and 1-Butene," Int. J. Chem. Kinet. **5**, 375 (1973).

73 LAN/OLD Langford, R. B., and Oldershaw, G. A., "Mechanism of Sulfur Formation in the Flash Photolysis of Carbonyl Sulphide," J. Chem. Soc. Faraday Trans. I **69**, 1389 (1973).

73 PAY/STI Payne, W. A., Stief, L. J., and Davis, D. D., "A Kinetics Study of the Reaction of HO_2 with SO_2 and NO," J. Am. Chem. Soc. **95**, 7614 (1973).

73 SCH Schofield, K., "Evaluated Chemical Kinetic Rate Constants for Various Gas Phase Reactions," J. Phys. Chem. Ref. Data **2**, 25 (1973).

73 WES/DEH3 Westenberg, A. A., and DeHaas, N., "Rate of the Reaction $OH + H_2S \rightarrow SH + H_2O$ over an Extended Temperature Range," J. Chem. Phys. **59**, 6685 (1973).

1974

74 ATK/PIT3 Atkinson, R., and Pitts, J. N., Jr., "Rate Constants for the Reaction of $O(^3P)$ Atoms with $SO_2(M=N_2O)$ Over the Temperature Range 299–392 K," Chem. Phys. Lett. **29**, 28 (1974).

74 CAD/WIC Cadle, R. D., Wickman, H. H., Hall, C. B., and Eberle, K. M., "The Reaction of Atomic Oxygen with Formaldehyde, Crotonaldehyde, and Dimethyl Sulfide," Chemosphere **3**, 115 (1974).

74 COX2 Cox, R. A., "The Photolysis of Nitrous Acid in the Presence of Carbon Monoxide and Sulphur Dioxide," J. Photochem. **3**, 291 (1974).

74 DAV/PRU Davis, D. D., Prusazcyk, J., Dwyer, M., and Kim, P., "A Stop-Flow Time-of-Flight Mass Spectrometry Kinetics Study. Reaction of Ozone with Nitrogen Dioxide and Sulfur Dioxide," J. Phys. Chem. **78**, 1775 (1974).

74 DEM/CAL Demerjian, K. L., Calvert, J. G., and Thorsell, D. L., "A Kinetic Study of the Chemistry of the $SO_2(^3B_1)$ Reactions with cis- and trans-2-Butene," Int. J. Chem. Kinet. **6**, 829 (1974).

74 KAL/BRA Kaldor, A., Braun, W., and Kurylo, M. J., "Infrared Laser Enhanced Reactions: $O_3 + SO$," J. Chem. Phys. **61**, 2396 (1974).

74 KLE/DAV Klemm, R. B., and Davis, D. D., "A Flash Photolysis-Resonance Fluorescence Kinetics Study of the Reaction $S(^3P) + OCS$," J. Phys. Chem. **78**, 1137 (1974).

74 KLE/STI Klemm, R. B., and Stief, L. J., "Absolute Rate Parameters for the Reaction of Ground State Atomic Oxygen with Carbonyl Sulfide," J. Chem. Phys. **61**, 4900 (1974).

74 LLO Lloyd, A. C., "Evaluated and Estimated Kinetic Data for Gas Phase Reactions of the Hydroperoxyl Radical," Int. J. Chem. Kinet. **6**, 169–228 (1974).

74 SLA/GIL Slagle, I. R., Gilbert, J. R., and Gutman, D., "Kinetics of the Reaction Between Oxygen Atoms and Carbon Disulfide," J. Chem. Phys. **61**, 704 (1974).

74 STE/ALV Stedman, D. H., Alvord, H., and Baker-Blocker, A., "Chemiluminescent Reactions of Disulfur Monoxide," J. Phys. Chem. **78**, 1248 (1974).

74 STU Stuhl, F., "Determination of the Rate Constant for the Reaction $OH + H_2S$ by a Pulsed Photolysis-Resonance Fluorescence Method," Ber. Bunsenges. Phys. Chem. **78**, 230 (1974).

74 TRA Trafton, W. E., Jr., "High Temperature Gas Phase Kinetic Studies of Carbonyl Sulfide, Nitrous Oxide, and Carbon Disulfide in a Shock Tube with Boundary Layer Corrections," Diss. Abstr. Int. B **34**, 5935 (1974).

1975

75 BEC/INO Becker, K. H., Inocencio, M. A., and Schurath, U., "The Reaction of Ozone with Hydrogen Sulfide and Its Organic Derivatives," Int. J. Chem. Kinet. **7** (Symp. I), 205 (1975).

75 BEN/GOL Benson, S. W., Golden, D. M., Lawrence, R. W., Shaw, R., and Woolfolk, R. W., Estimating the Kinetics of Combustion Including Reactions Involving Oxides of Nitrogen and Sulfur," Environmental Protection Agency Report No. EPA-600/2-75-019, August 1975.

75 CAS/DAV Castleman, A. W., Jr., Davis, R. E., Munkelwitz, H. R., Tang, I. N., and Wood, W. P., "Kinetics of Association Reactions Pertaining to H_2SO_4 Aerosol Formation," Int. J. Chem. Kinet. **7** (Symp. I), 629 (1975).

75 CHU/CAL Chung, K., Calvert, J. G., and Bottenhelm, J. W., "The Photochemistry of Sulfur Dioxide Excited within Its First Allowed Band (3130 Å) and the "Forbidden" Band (3700–4000 Å)," Int. J. Chem. Kinet. **7**, 161 (1975).

75 CLY/TOW Clyne, M. A. A., and Townsend, L. W., "Rate Constant Measurements for Rapid Reactions of Ground State Sulphur $3p^4(^3P_J)$ Atoms," Int. J. Chem. Kinet. **7** (Symp. I), 73 (1975).

75 CUP/GLA Cupitt, L. T., and Glass, G. P., "Reactions of SH with Atomic Oxygen and Hydrogen," Int. J. Chem. Kinet. **7** (Symp. I), 39 (1975).

75 DAU/CAL Daubendiek, R. L., and Calvert, J. G., "A Study of the N_2O_5-SO_2-O_3 Reaction System," Environ. Lett. **8**, 103 (1975).

75 GAU/SNE Gauthier, M. J. E., and Snelling, D. R., "La Photolyse de L'ozone a 253.7 nm: Desactivation de $O(^1D)$ et de $O_2(^1\Sigma)$ par Les Gas de L'atmosphere," J. Photochem. **4**, 27 (1975).

75 GLA/TOB1 Glavas, S., and Tohy, S., "The Reaction Between Ozone and Hydrogen Sulfide: Kinetics and Effect of Added Gases," Am. Chem. Soc. ACS Symp. Ser. **17**, 122 (1975).

75 GLA/TOB2 Glavas, S., and Toby, S., "Reaction Between Ozone and Hydrogen Sulfide," J. Phys. Chem. **79**, 779 (1975).

75 GOR/MUL1 Gordon, S., and Mulac, W. A., "Reaction of the $OH(X\ ^2\Pi)$ Radical Produced by the Pulse Radiolysis of Water Vapor," Int. J. Chem. Kinet. (Symp. 1), 289 (1975).

75 HAR/WAY Harris, G. W., and Wayne, R. P., "Reaction of Hydroxyl Radicals with NO, NO_2 and SO_2," J. Chem. Soc. Faraday Trans. I **71**, 610 (1975).

75 KIE Kiefer, J. H., "Densitometric Measurements of the Rate of Sulfur Dioxide Dissociation in Shock Waves," J. Chem. Phys. **62**, 1354 (1975).

75 SLA/GRA1 Slagle, I. R., Graham, R. E., Gilbert, J. R., and Gutman, D., "Direct Atoms with Carbon Monosulphide," Chem. Phys. Lett. **32**, 184 (1975).

75 TSU/YOK Tsunashima, S., Yokota, T., Saferik, I., Gunning, H. E., Strausz, O. P., "Abstraction of Sulfur Atoms from Carbonyl Sulfide by Atomic Hydrogen," J. Phys. Chem. **79**, 775 (1975).

75 WEI/TIM Wei, C-N., and Timmons, R. B., "ESR Study of the Kinetics of the Reactions of $O(^3P)$ Atoms with CS_2 and OCS," J. Chem. Phys. **62**, 3240 (1975).

75 WES/DEH1 Westenberg, A. A., and DeHaas, N., "Rate of the $O + SO_3$ Reaction," J. Chem. Phys. **62**, 725 (1975).

75 WES/DEH2 Westenberg, A. A., and DeHaas, N., "Rate of the Reaction $O + SO_2 + M \rightarrow SO_3 + M$," J. Chem. Phys. **63**, 5411 (1975).

75 YOK/AHM Yokota, T., Ahmed, M. G., Safarik, I., Strausz, O. P., and Gunning, H. E., "Reaction of Hydrogen Atoms with Thiirane," J. Phys. Chem. **79**, 1758 (1975).

1976

76 ART/LEE Arthur, N. L., and Lee, M-S., "Reactions of Methyl Radicals, I. Hydrogen Abstraction from Dimethyl Sulphide," Aust. J. Chem. **29**, 1483 (1976).

76 ATK/PER3 Atkinson, R., Perry, R. A., and Pitts, J. N., Jr., "Rate Constants for the Reactions of the OH Radical with NO_2(M=Ar and N_2) and SO_2(M=Ar)," J. Chem. Phys. **65**, 306 (1976).

76 BAU/DRY Baulch, D. L., Drysdale, D. D., and Horne, D. G., "Evaluated Kinetic Data for High Temperature Reactions, Vol. 2: Homogeneous Gas Phase Reactions of the O_2-O_3 System, the CO-O_2-H_2 System, and Sulphur-Containing Species," (Butterworths, London, 1976).

76 BID/BRE Bida, G. T., Breckenridge, W. H., and Kolin, W. S., "A Kinetic Study of the Very Fast Reaction: O(^{3}P) + CS → CO + S(^{3}P)," J. Chem. Phys. **64**, 3296 (1976).

76 DUM Dumas, J. L., "Etude de la Reactivite Chimique de l'oxygene singulet produit en Phase Gazeuse. I. Etudes en Phase Homogene," Bull. Soc. Chim. France, 658 (1976).

76 HIG/SAI Higashihara, R., Saito, Ko., and Yamamura, H., "S_2 Formation During the Pyrolysis of H_2S in Shock Waves," Bull. Chem. Soc. Jpn. **40**, 965 (1976).

76 KER/PAR Kerr, J. A., and Parsonage, J. J., "Evaluated Kinetic Data on Gas Phase Hydrogen Transfer Reactions of Methyl Radicals," (Butterworths, London 1976).

76 LEE Lee, J. H., "Gas Phase Kinetic Study of Some Simple Atom-Molecule Reactions Using Fast Flow and Flash Photolysis-Resonance Fluorescence Techniques," Diss. Abstr. Int. B **36**, 6192 (1976).

76 LEE/TIM Lee, J. H., Timmons, R. B., and Stief, L. J., "Absolute Rate Parameters for the Reaction of Ground State Atomic Oxygen with Dimethyl Sulfide and Episulfide," J. Chem. Phys. **64**, 300 (1976).

76 MAN/BRA Manning, R. G., Braun, W., and Kurylo, M. J., "The Effect of Infrared Laser Excitation on Reaction Dynamics: O + C_2H_4 and O + OCS," J. Chem. Phys. **65**, 2609 (1976).

76 MAR/BAR Martin, G., and Barroeta, N., "Gas-phase Thermolysis of Sulphur Compounds. Part I. Di-t-butyl Disulphide," J. Chem. Soc. Perkin Trans. **2**, 1421 (1976).

76 PER/ATK1 Perry, R. A., Atkinson, R., and Pitts, J. N., Jr., "Rate Constants for the Reaction OH + H_2S → H_2O + SH and OH + NH_3 → H_2O + NH_2 Over the Temperature Range 297–427 °K," J. Chem. Phys. **64**, 3237 (1976).

76 SLA/GRA Slagle, I. R., Graham, R. E., and Gutman, D., "Direct Identification of Reactive Routes and Measurement of Rate Constants in the Reactions of Oxygen Atoms with Methanethiol, Ethanethiol, and Methylsulfide," Int. J. Chem. Kinet. **8**, 451 (1976).

76 WAM Wampler, F. B., "Photochemistry of the SO_2, 2-Pentene System at 3660 Å," Int. J. Chem. Kinet. **8**, 935 (1976).

76 WHY/TIM Whytock, D. A., Timmons, R. B., Lee, J. H., Michael, J. V., Payne, W. A., and Stief, L. J., "Absolute Rate of the Reaction of O(^{3}P) with Hydrogen Sulfide Over the Temperature Range 263 to 495 K," J. Chem. Phys. **65**, 2052 (1976).

1977

77 BOW/DOD Bowman, C. T., and Dodge, L. G., "Kinetics of the Thermal Decomposition of Hydrogen Sulfide Behind Shock Waves," Symp. (Int.) Combust. (Proc.) **16**, 1976 (Publ. 1977) 971.

77 CAS/TAN Castleman, A. W., Jr., and Tang, I. N., "Kinetics of the Association Reaction of SO_2 with the Hydroxyl Radical," J. Photochem. **6**, 349 (1977).

77 FRE/PAL Freund, H., and Palmer, H. B., "Shock-Tube Studies of the Reactions of NO_2 with NO_2, SO_2, and CO," Int. J. Chem. Kinet. **9**, 887 (1977).

77 GRA/GUT Graham, R. E., and Gutman, D., "Temperature Dependence of Rate Constants and Branching Ratios for the Reaction of Oxygen Atoms with Carbon Disulfide," J. Phys. Chem. **81**, 207 (1977).

77 LEE/STI Lee, J. H., Stief, L. J., and Timmons, R. B., "Absolute Rate Parameters for the Reaction of Atomic Hydrogen with Carbonyl Sulfide and Ethylene Episulfide," J. Chem. Phys. **67**, 1705 (1977).

77 LIL/RIC Lilenfeld, H. V., and Richardson, R. J., "Temperature Dependence of the Rate Constant for the Reaction Between Carbon Monosulfide and Atomic Oxygen," J. Chem. Phys. **67**, 3991 (1977).

1978

78 ALA/BIG Al-Awadi, N., Bigley, D. B., and Gabbott, R. E., "The Gas-phase Pyrolysis of Dithioacetates: A Remarkable Constancy of Substituent Effects," J. Chem. Soc. Perkin Trans. II, 1223 (1978).

78 AST/GLA Astholz, D. C., Glaenzer, K., and Troe, J., "UV Absorption Study of the Thermal Decomposition of SO, SO_2, and SO_3," Shock Tube Wave Res., Proc. Int. Symp. **11**, 1977 (Publ. 1978) 232.

78 ATK/PER1 Atkinson, R., Perry, R. A., and Pitts, J. N., Jr., "Rate Constants for the Reaction of OH Radicals with COS, CS_2 and CH_3SCH_3 Over the Temperature Range 299–430 K," Chem. Phys. Lett. **54**, 14 (1978).

78 ATK/PIT4 Atkinson, R., and Pitts, J. N., Jr., "Kinetics of the Reaction O(^{3}P) + SO_2 + M → SO_3 + M Over the Temperature Range of 299°–440 °K," Int. J. Chem. Kinet. **10**, 1081 (1978).

78 HOR/NIS Horie, O., Nishino, J., and Amano, A., "The Reaction of Hydrogen Atoms with 1-Butanethiol and Thiolane: The Role of Chemically Activated 1-Butanethiol," Int. J. Chem. Kinet. **10**, 1043 (1978).

78 IWA/PRE Iwamoto, K., Presser, N., and Ross, J., "Kinetics of Aerosol Formation in Irradiated Gaseous NO_2–SO_2 Mixtures," J. Chem. Phys. **68**, 663 (1978).

78 JUS/RIM Just, T., and Rimpel, G., "The Thermal Decomposition of SO_2 Between 2500 and 3400 °K," Shock Tube Wave Res., Proc. Int. Symp., **11**, 1977 (Publ. 1978) 226.

78 KIR/VET Kirchner, K., Vettermann, R., and Indruch, H., "Kinetics of the Reactions of Mercaptans with O(^{3}P) Under Consideration of the Influence of Molecular Oxygen," Ber. Bunsenges. Phys. Chem. **82**, 1223 (1978).

78 KOL Kollin, W. S., "Gas Phase Reactions of Carbon Monosulfide Studied by the Fast Flow Technique," Diss. Abst. Int. **B** **39**, 771 (1978).

78 KUR1 Kurylo, M. J., "Flash Photolysis Resonance Fluorescence Investigation of the Reaction of OH Radicals with Dimethyl Sulfide," Chem. Phys. Lett. **58**, 233 (1978).

78 KUR2 Kurylo, M. J., "Flash Photolysis Resonance Fluorescence Investigation of the Reactions of OH Radicals with OCS and CS_2," Chem. Phys. Lett. **58**, 238 (1978).

78 MAR/HER Martinez, R. I., and Herron, J. T., "Stopped-Flow Study of the Gas-Phase Reaction of Ozone with Organic Sulfide: Dimethyl Sulfide," Int. J. Chem. Kinet. **10**, 433 (1978).

78 MAR/REI Marvin, D. C., and Reiss, H., "Cloud Chamber Study of the Gas Phase Photooxidation of Sulfur Dioxide," J. Chem. Phys. **69**, 1897 (1978).

78 PAR/HEI Partymiller, K., and Heicklen, J., "The Photolysis of Sulfur Dioxide in the Presence of Foreign Gases XII: Photolysis of SO_2 at 313.0 nm in the Presence of Both Allene and Oxygen," J. Photochem. **8**, 167 (1978).

78 SLA/BAL Slagle, I. R., Balocchi, F., and Gutman, D., "Study of the Reactions of Oxygen Atoms with Hydrogen Sulfide, Methanethiol, Ethanethiol, and Methyl Sulfide," J. Phys. Chem. **82**, 1333 (1978).

78 SU/CAL Su, F., and Calvert, J. G., "The Mechanism of the Photochemical Reactions of SO_2 with Isobutane Excited," Int. J. Chem. Kinet. **10**, 557 (1978).

78 VAN/OBI Van Roodselaar, A., Obi, K., and Strausz, O. P., "The Reaction of S(^{3}P) Atoms with Nitric Oxide," Int. J. Chem. Kinet. **10**, 31 (1978).

78 VAN/SAF Van Roodselaar, A., Safarik, I., Strausz, O. P., and Gunning, H. E., "The Reactions of Sulfur Atoms. 15. Absolute Rate Parameters for the $S(^3P_{2,1,0})$ + Alkyne Reactions," J. Am. Chem. Soc. **100**, 4068 (1978).

78 WHY/TIM Whytock, D. A., and Timmons, R. B., "Absolute Rate of the Reaction of $O(^3P)$ with Hydrogen Sulphide," Nat. Bur. Stand. Spec. Pub. 526, 339 (1978).

78 YOS/SAI Yoshida, N., and Saito, S., "Application of Microwave Spectroscopy to Kinetic Study of Carbonyl Sulfide with Atomic Oxygen," Bull. Chem. Soc. Jpn. **51**, 1635 (1978).

1979

79 ADD/BYR Addison, M. C., Byrne, C. D., and Donovan, R. J., "Direct Observation of $S(3^1D_2)$ and Determination of the Absolute Rate of Reaction with OCS," Chem. Phys. Lett. **64**, 57 (1979).

79 ADD/LEI Addison, M. C., Leitch, A. J., Fotakis, C., and Donovan, R. J., "Reactions of $CH(X\ ^2\Sigma^+)$ with OCS and Formation of SCN," J. Photochem. **10**, 273 (1979).

79 ALA/BIG Al-Awadi, N., and Bigley, D. B., "Carbonate Pyrolysis. Part 5. The Gas-Phase Pyrolysis of Some Unsymmetrical Monothioicarbonates and a Rationalisation of the Rates of Some Related Reactions," J. Chem. Soc. Perkin Trans. II, 497, (1979).

79 AST/GLA Astholz, D. C., Glanzer, K., and Troe, J., "The Spin-Forbidden Dissociation-Recombination Reaction $SO_3 \rightleftharpoons SO_2 + O$," J. Chem. Phys. **70**, 2409 (1979).

79 BUR/CLI Burrows, J. P., Cliff, D. I., Harris, G. W., Thrush, B. A., and Wilkinson, J. P. T., "Atmospheric Reactions of the HO_2 Radical Studied by Laser Magnetic Resonance Spectroscopy," Proc. R. Soc. London **A 368**, 463 (1979).

79 CLY/WHI Clyne, M. A., and Whitefield, P. D., "Atomic Resonance Fluorescence for Rate Constants of Rapid Bimolecular Reactions," J. Chem. Soc. Faraday Trans. II **75**, 1327 (1979).

79 DAV/RAV Davis, D. D., Ravishankara, A. R., and Fischer, S., "SO_2 Oxidation via the Hydroxyl Radical: Atmospheric Fate of HSO_3 Radicals," Geophys. Res. Lett. **6**, 113 (1979).

79 GRA/WIN Graham, R. A., Winer, A. M., Atkinson, R., and Pitts, J. N., Jr., "Rate Constants for the Reaction of HO_2 with HO_2, SO_2, CO, N_2O, trans-2-Butene, and 2,3-Dimethyl-2-Butene at 300 K," J. Phys. Chem. **83**, 1563 (1979).

79 GRI/REE Grillo, A., Reed, E., and Slack, M. W., "Infrared Measurements of Sulfur Dioxide Thermal Decomposition Rate in Shock Waves," J. Chem. Phys., **70**, 1634 (1979).

79 HSU/SHA Hsu, D. S. Y., Shaub, W. M., Burks, T. L., and Lin, M. C., "Dynamics of Reactions of $O(^3P)$ Atoms with CS, CS_2 and OCS," Chem. Phys. **44**, 143 (1979).

79 JOU/LEB Jourdain, J. L., Le Bras, G., and Combourieu, J., "Kinetic Study of Some Elementary Reactions of Sulfur Compounds Including Reactions of S and SO with OH Radicals," Int. J. Chem. Kinet. **11**, 569 (1979).

79 KAN/MCQ Kan, C. S., McQuigg, R. D., Whitbeck, M. R., and Calvert, J. G., "Kinetic Flash Spectroscopic Study of the CH_3O_2–CH_3O_2 and CH_3O_2–SO_2 Reactions," Int. J. Chem. Kinet. **11**, 921 (1979).

79 MER/LEV Merryman, E. L., and Levy, A., "Enhanced SO_3 Emissions from Staged Combustion," Symp. (Int.) Combust. (Proc.), **17**, (Publ. 1979) 727.

79 NIC/AMO Nicholas, J. E., Amodio, C. A., and Baker, M. J., "Kinetics and Mechanism of the Decomposition of H_2S, CH_3SH and $(CH_3)_2S$ in a Radio-Frequency Pulse Discharge," J. Chem. Soc. Faraday Trans. I **75**, 1868 (1979).

79 SAN/SIM Sanhueza, E., Simonaitis, R., and Heicklen, J., "The Reaction of CH_3O_2 with SO_2," Int. J. Chem. Kinet. **11**, 907 (1979).

79 SHE/SAF Sherwood, A. G., Safarik, I., Verkoczy, B., Almadi, G., Wiehe, H. A., and Strausz, O. P., "Unimolecular Isomerization of Chemically Activated Thiirane to Vinylthiol," J. Am. Chem. Soc. **101**, 3000 (1979).

79 SIM/HEI Simonaitis, R., and Heicklen, J., "The Mechanism of SO_2 Oxidation by CH_3O_2 Radicals. Rate Coefficients for the Reactions of CH_3O_2 with SO_2 and NO," Chem. Phys. Lett. **65**, 361 (1979).

79 SIN/IRW Singleton, D. L., Irwin, R. S., Nip, W. S., and Cvetanovic, R. J., "Kinetics and Mechanism of the Reaction of Oxygen Atoms with Hydrogen Sulfide," J. Phys. Chem. **83**, 2195 (1979).

79 YOK/STR Yokota, T., and Strausz, O. P., "Reaction of Hydrogen Atoms with Dimethyl Sulfide," J. Phys. Chem. **83**, 3196 (1979).

1980

80 ADD/DON Addison, M. C., Donovan, R. J., and Fotakis, C., "Resonance Fluorescence Study of Electronically Excited Sulfur Atoms: Reactions of $S(3^1D_2)$," Chem. Phys. Lett. **74**, 58 (1980).

80 BAU/COX Baulch, D. L., Cox, R. A., Hampson, R. F., Jr., Kerr, J. A., Troe, J., and Watson, R. T., "Evaluated Kinetic and Photochemical Data for Atmospheric Chemistry," J. Phys. Chem. Ref. Data **9**, 295 (1980).

80 CLY/MAC Clyne, M. A. A., and Macrobert, A. J., "Kinetic Studies of Free Radical Reactions by Mass Spectrometry. I. The Reactions of $SO + NO_2$ and $ClO + NO$," Int. J. Chem. Kinet. **12**, 79 (1980).

80 COX/SHE Cox, R. A., and Sheppard, D., "Reactions of OH Radicals with Gaseous Sulphur Compounds," Nature (London) **284**, 330 (1980).

80 EKW/JOD Ekwenki, M. M., Jodhan, A., and Strausz, O. P., "Reaction of Hydrogen Atoms with Dimethyldisulfide," Int. J. Chem. Kinet. **12**, 431 (1980).

80 GRI/REE Grillo, A., Reed, R., and Slack, M. W., "Thermal Decomposition of SO_2 Monitored by IR Emission," Shock Tubes Waves, Proc. Int. Symp., 12th, 1979 (Publ. 1980) 486.

80 HAR/ATK Harris, G. W., Atkinson, R., and Pitts, J. N., Jr., "Temperature Dependence of the Reaction $OH + SO_2 + M = HSO_3 + M = Ar$ and SF_6," Chem. Phys. Lett. **69**, 378 (1980).

80 HER/HUI Herron, J. T., and Huie, R. E., "Rate Constants at 298 K for the Reactions $SO + SO + M \rightarrow (SO)_2 + M$ and $SO + (SO)_2 \rightarrow SO_2 + S_2O$," Chem. Phys. Lett. **76**, 322 (1980).

80 HIG/SAI Higashihara, T., Saito, K., and Murakami, I., "The Dissociation Rate of S_2 Produced from COS Pyrolysis," Bull. Chem. Soc. Jpn. **53**, 15 (1980).

80 HUS/SLA Husain, D., and Slater, N. K. H., "Kinetic Study of the Reactions of Hydrogen and Deuterium Atoms with Hydrogen Bromide and Deuterium Bromide by Time-Resolved Resonance Fluorescence," J. Chem. Soc. Faraday Trans. 2 **76**, 276 (1980).

80 IYE/ROW Iyer, R. W., and Rowland, F. S., "A Significant Upper Limit for the Rate of Formation and OCS from the Reaction of OH with CS_2," Geophys. Res. Lett. **7**, 797 (1980).

80 LEE/TAN1 Lee, J. H., Tang, I. N., and Klemm, R. B., "Absolute Rate Constant for the Reaction of $O(^3P)$ with CH_3SCH_3 from 272 to 472 K," J. Chem. Phys. **72**, 1793 (1980).

80 LEE/TAN2 Lee, J. H., and Tang, I. N., "Absolute Rate Constant for the Reaction of $O(^3P)$ with CH_3SSCH_3 from 270 to 329 K," J. Chem. Phys. **72**, 5718 (1980).

80 MAR/BAR Martin, G., and Barroeta, N., "Gas Phase Thermolysis of Sulfur Compounds. II. Ditertiary Butyl Sulfide," Int. J. Chem. Kinet. **12**, 699 (1980).

80 MAR/HER Martinez, R. I., and Herron, J. T., "Stopped-Flow Study of the Gas-Phase Reactions of Ozone with Organic Sulfides: Thiirane," Chem. Phys. Lett. **72**, 74 (1980).

80 ROB/SMI Robertshaw, J. H., and Smith, I. W. M., "Rate Data for $O + OCS \rightarrow SO + CO$ and $SO + O_3 \rightarrow SO_2 + O_2$ by a New Time Resolved Technique," Int. J. Chem. Kinet. **12**, 729 (1980).

80 SAI/TOR Saito, K., Toriyama, Y., Yokubo, T., Higashihara, R., and Murakami, I., "A Measurement of the Thermal Decomposition of CS_2 Behind Reflected Shock Waves," Bull. Chem. Soc. Jpn. **53**, 1437 (1980).

80 SAI/YOK Saito, K., Yokubo, T., and Murakami, I., "On the Thermal Decomposition of SO_2 Diluted in Ar Behind Reflected Shock Waves," J. Chem. Phys. **73**, 3017 (1980).

80 SLA/GRI Slack, M., and Grillo, A., "Rate Coefficient Measurements for $SO_2 + O = SO + O_2$," J. Chem. Phys. **73**, 967 (1980).

80 TYA/BAB Tyaga Raju, M., Babu, S. V., and Subba Rao, V., "Dissociation Rate Measurements in $SO_2 + Ar$ Mixtures Behind Incident Shock Waves," Chem. Phys. **48**, 411 (1980).

80 WIN/SHA Wine, P. H., Shah, R. C., and Ravishankara, A. R., "Rate of Reaction of OH with CS_2," J. Phys. Chem. **84**, 2499 (1980).

80 YOK/STR Yokota, T., and Strausz, O. P., "Reaction of Hydrogen Atoms with Dimethyl Sulfide," J. Phys. Chem. **83**, 3196 (1980).

Appendix: Conversion Tables

Equivalent second order rate constants

B A	cm^3 mol^{-1} s^{-1}	dm^3 mol^{-1} s^{-1}	m^3 mol^{-1} s^{-1}	cm^3 $molecule^{-1}$ s^{-1}	$(mm\ Hg)^{-1}$ s^{-1}	atm^{-1} s^{-1}	ppm^{-1} min^{-1}	$m^2\ kN^{-1}\ s^{-1}$
1 $cm^3\ mol^{-1}\ s^{-1}$=	1	10^{-3}	10^{-6}	1.66×10^{-24}	$1.604 \times 10^{-5}\ T^{-1}$	$1.219 \times 10^{-2}\ T^{-1}$	2.453×10^{-9}	$1.203 \times 10^{-4}\ T^{-1}$
1 $dm^3\ mol^{-1}\ s^{-1}$=	10^3	1	10^{-3}	1.66×10^{-21}	$1.604 \times 10^{-2}\ T^{-1}$	$12.19\ T^{-1}$	2.453×10^{-6}	$1.203 \times 10^{-1} T^{-1}$
1 $m^3\ mol^{-1}\ s^{-1}$=	10^6	10^3	1	1.66×10^{-18}	$16.04\ T^{-1}$	$1.219 \times 10^4\ T^{-1}$	2.453×10^{-3}	$120.3\ T^{-1}$
1 $cm^3\ molecule^{-1}\ s^{-1}$=	6.023×10^{23}	6.023×10^{20}	6.023×10^{17}	1	$9.658 \times 10^{18}\ T^{-1}$	$7.34 \times 10^{21}\ T^{-1}$	1.478×10^{15}	$7.244 \times 10^{19}\ T^{-1}$
1 $(mm\ Hg)^{-1}\ s^{-1}$=	$6.236 \times 10^4\ T$	$62.36\ T$	$6.236 \times 10^{-2}\ T$	$1.035 \times 10^{-19}\ T$	1	760	4.56×10^{-2}	7.500
1 $atm^{-1}\ s^{-1}$	$82.06\ T$	$8.206 \times 10^{-2}\ T$	$8.206 \times 10^{-5}\ T$	$1.362 \times 10^{-22}\ T$	1.316×10^{-3}	1	6×10^{-5}	9.869×10^{-3}
1 $ppm^{-1}\ min^{-1}$= at 298 K, 1 atm total pressure	4.077×10^8	4.077×10^5	407.7	6.76×10^{-16}	21.93	1.667×10^4	1	164.5
1 $m^2\ kN^{-1}\ s^{-1}$=	$8314\ T$	$8.314\ T$	$8.314 \times 10^{-3}\ T$	$1.38 \times 10^{-20}\ T$	0.1333	101.325	6.079×10^{-3}	1

To convert a rate constant from one set of units A to a new set B find the conversion factor for the row A under column B and multiply the old value by it, e.g. to convert $cm^3\ molecule^{-1}\ s^{-1}$ to $m^3\ mol^{-1}\ s^{-1}$ multiply by 6.023×10^{17}.

Table adapted from High Temperature Reaction Rate Data No. 5, The University, Leeds (1970).

Equivalent third order rate constants

B A	cm^6 mol^{-2} s^{-1}	dm^6 mol^{-2} s^{-1}	m^6 mol^{-2} s^{-1}	cm^6 $molecule^{-2}$ s^{-1}	$(mm\ Hg)^{-2}$ s^{-1}	atm^{-2} s^{-1}	ppm^{-2} min^{-1}	$m^4\ kN^{-2}\ s^{-1}$
1 $cm^6\ mol^{-2}\ s^{-1}$=	1	10^{-6}	10^{-12}	2.76×10^{-46}	$2.57 \times 10^{-10}\ T^{-2}$	$1.48 \times 10^{-4}\ T^{-2}$	1.003×10^{-19}	$1.447 \times 10^{-6}\ T^{-2}$
1 $dm^6\ mol^{-2}\ s^{-1}$=	10^6	1	10^{-6}	2.76×10^{-42}	$2.57 \times 10^{-4}\ T^{-2}$	$148\ T^{-2}$	1.003×10^{-13}	$1.447 \times 10^{-2}\ T^{-2}$
1 $m^6\ mol^{-2}\ s^{-1}$=	10^{12}	10^6	1	2.76×10^{-36}	$257\ T^{-2}$	$1.48 \times 10^8\ T^{-2}$	1.003×10^{-7}	$1.447 \times 10^4\ T^{-2}$
1 $cm^6 molecule^{-2}\ s^{-1}$=	3.628×10^{47}	3.628×10^{41}	3.628×10^{35}	1	$9.328 \times 10^{37}\ T^{-2}$	$5.388 \times 10^{43}\ T^{-2}$	3.64×10^{26}	$5.248 \times 10^{39}\ T^{-2}$
1 $(mm\ Hg)^{-2}\ s^{-1}$=	$3.89 \times 10^9\ T^2$	$3.89 \times 10^3\ T^2$	$3.89 \times 10^{-3}\ T^2$	$1.07 \times 10^{-38}\ T^2$	1	5.776×10^5	3.46×10^{-5}	56.25
1 $atm^{-2}\ s^{-1}$=	$6.733 \times 10^3\ T^2$	$6.733 \times 10^{-3}\ T^2$	$6.733 \times 10^{-9}\ T^2$	$1.86 \times 10^{-44}\ T^2$	1.73×10^{-6}	1	6×10^{-11}	9.74×10^{-5}
1 $ppm^{-2}\ min^{-1}$= at 298 K, 1 atm total pressure	9.97×10^{18}	9.97×10^{12}	9.97×10^6	2.75×10^{-29}	2.89×10^4	1.667×10^{10}	1	1.623×10^6
1 $m^4\ kN^{-2}\ s^{-1}$=	$6.91 \times 10^7\ T^2$	$69.1\ T^2$	$6.91 \times 10^{-5}\ T^2$	$1.904 \times 10^{-40}\ T^2$	0.0178	1.027×10^4	6.16×10^{-7}	1

See note to table for second order rate constants.

NBS-114A (REV. 2-80)

U.S. DEPT. OF COMM. **BIBLIOGRAPHIC DATA SHEET** *(See instructions)*	1. PUBLICATION OR REPORT NO. NSRDS-NBS 72	2. Performing Organ. Report No.	3. Publication Date May 1982

4. TITLE AND SUBTITLE

Tables of Rate Constants for Gas Phase Chemical Reactions of Sulfur Compounds (1971-1980)

5. AUTHOR(S) Francis Westley

6. PERFORMING ORGANIZATION *(If joint or other than NBS, see instructions)*

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

7. Contract/Grant No.

8. Type of Report & Period Covered N/A

9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS *(Street, City, State, ZIP)*

Morgantown Energy Technology Center
Department of Energy
Morgantown, WV 26505

and Office of Standard Reference Data
National Bureau of Standards
Washington, DC 20234

10. SUPPLEMENTARY NOTES

Library of Congress Catalog Card Number: 82-2094

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)*

A table of rate constants for gas phase chemical reactions of sulfur compounds is presented. Specifically, it gives in tabular form the values of the parameters for the modified Arrhenius equation $k = AT^B \exp(-E/RT)$. The table covers the reactions of sulfur containing molecules and free radicals, S, S_2, SO, SO_2, SO_3, S_2O, SH, H_2S, CS, CS_2, COS, $CH_3S\cdot$, CH_3SH, cy-CH_2CH_2S, $CH_3SCH_2\cdot$ and a number of thiols, thioethers, and thioesters, with other compounds. The table includes 19 unimolecular, 208 bimolecular, and 13 termolecular reactions totaling 240 distinct chemical reactions. There are 441 rate constants associated with these reactions, distributed as follows: 30 for first order reactions, 377 for second order reactions, and 34 for third order reactions. The kinetic data were compiled from 145 experimental papers and 8 critical reviews published between 1971 and 1980.

12. KEY WORDS *(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)*

Arrhenius parameters; chemical kinetics; combustion; decomposition; free radicals; gas phase; hydrocarbons; hydrogen; nitrogen; oxygen; rate of reaction; sulfur

13. AVAILABILITY

☒ Unlimited
☐ For Official Distribution. Do Not Release to NTIS
☐ Order From Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
☒ Order From National Technical Information Service (NTIS), Springfield, VA. 22161

14. NO. OF PRINTED PAGES 42

15. Price

Announcement of New Publications in National Standard Reference Data Series

Superintendent of Documents,
Government Printing Office,
Washington, D.C. 20402

Please add my name to the announcement list of new publications to be issued in the series: National Standard Reference Data Series—National Bureau of Standards.

Name____

Company______________________________________

Address______________________________________

City______________State__________Zip Code____________

(Notification Key N-519)

NBS TECHNICAL PUBLICATIONS

PERIODICALS

JOURNAL OF RESEARCH—The Journal of Research of the National Bureau of Standards reports NBS research and development in those disciplines of the physical and engineering sciences in which the Bureau is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology and the basic technology underlying standardization. Also included from time to time are survey articles on topics closely related to the Bureau's technical and scientific programs. As a special service to subscribers each issue contains complete citations to all recent Bureau publications in both NBS and non-NBS media. Issued six times a year. Annual subscription: domestic $18; foreign $22.50. Single copy, $4.25 domestic; $5.35 foreign.

NONPERIODICALS

Monographs—Major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

Handbooks—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications—Include proceedings of conferences sponsored by NBS, NBS annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

Applied Mathematics Series—Mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

National Standard Reference Data Series—Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NBS under the authority of the National Standard Data Act (Public Law 90-396).

NOTE: The principal publication outlet for the foregoing data is the Journal of Physical and Chemical Reference Data (JPCRD) published quarterly for NBS by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements available from ACS, 1155 Sixteenth St., NW, Washington, DC 20056.

Building Science Series—Disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

Technical Notes—Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other government agencies.

Voluntary Product Standards—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NBS administers this program as a supplement to the activities of the private sector standardizing organizations.

Consumer Information Series—Practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

Order the **above** *NBS publications from: Superintendent of Documents, Government Printing Office, Washington, DC 20402.*

Order the **following** *NBS publications—FIPS and NBSIR's—from the National Technical Information Services, Springfield, VA 22161.*

Federal Information Processing Standards Publications (FIPS PUB)—Publications in this series collectively constitute the Federal Information Processing Standards Register. The Register serves as the official source of information in the Federal Government regarding standards issued by NBS pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

NBS Interagency Reports (NBSIR)—A special series of interim or final reports on work performed by NBS for outside sponsors (both government and non-government). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Services, Springfield, VA 22161, in paper copy or microfiche form.

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, DC 20234