

Flow Calculation for Gases

The calculation of flow (Cv) is a formula which is used to determine a valve's flow under various conditions and to select the correct valve for a flow application. The Cv was designed to deal with liquid flows. It expresses the flow in gallons per minute at 60° F under one pound drop across the valve at 1 psi. However, this same Cv value can be used to determine gas flow through a valve. The formula however does indicate the gases, as gases are compressible fluids and are thus affected by temperature. Furthermore, gas formulas are required to accurately estimate flow. When the upstream pressure equals or exceeds two times the downstream pressure, it is known as a "choked flow" condition. This calls for use of the Critical Flow formula. If the upstream pressure is less than two times the downstream pressure, the Sub-Critical Flow formula should be used.

Critical Flow When: $P_1 \geq 2 \times P_2$	Sub-Critical Flow When: $P_1 < 2 \times P_2$
$Cv = Q_g \frac{\sqrt{S.G. \times T}}{0.16 \times P_1}$	$Cv = \frac{Q_g}{96.2} \sqrt{\frac{(S.G. \times T)}{(P_1^2 - P_2^2)}}$
$Q_g = Cv \frac{0.16 \times P_1}{\sqrt{S.G. \times T}}$	$Q_g = 96.2 \times Cv \sqrt{\frac{(P_1^2 - P_2^2)}{(S.G. \times T)}}$

where:

Q_g = Gas Flow in Standard cubic feet per hour

P_1 = Upstream static pressure in psi

T = Absolute temperature in °R, °F + 460

P_2 = Downstream static pressure in psi

P_1 = Absolute pressure. This is only large pressure plus 14.7 (atmospheric pressure)

$S.G.$ = Specific Gravity of medium where air at 60° F and 14.7 psi = 1.0

Example:

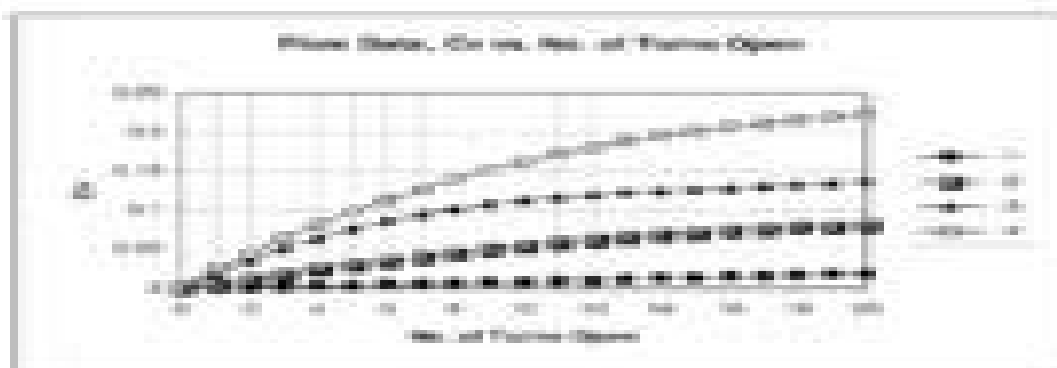
Estimate which valve size should be used for the following application. Upstream pressure is 100 psig, downstream is atmosphere. The medium is 60° F natural gas (S.G. = 0.6) and the desired flow range is up to 600 SCFH.

$$Cv = \frac{600}{96.2} \times \frac{\sqrt{0.6 \times 540}}{0.16 \times 114.7} = 1098$$

The Cv value at which 600 SCFH of medium will flow under the above conditions is 1098. Upon examination of our Cv table the pressure drop, we note that this value is reached at approximately size 8.1 with our 3-

10000 control gear or size 5.9 with our 4-1/2" control. This and most other valves become approximately 1.4 or 1.3 times all resulting providing for this application.

Specific Gravities of gases	
Gas	S.G.
Air (dry basis)	0.999
air	1.000
Acetylene	0.905
Argon	1.378
Carbon Dioxide	1.529
Carbon Monoxide	0.969
Fluorine	3.163
Hydrogen	0.069
Hydrogen Sulfide	1.360
Helium	0.178
Methane (dry basis)	0.554
Nitrogen	0.967
Nitrogen Trioxide	1.201
Oxygen	1.329
Propane (dry basis)	1.520



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Flow Calculation For Gases Needle Valve:

Fundamentals of Gas Lift Engineering Ali Hernandez, 2016-02-18 Fundamentals of Gas Lift Engineering Well Design and Troubleshooting discusses the important topic of oil and gas reservoirs as they continue to naturally deplete decline and mature and how more oil and gas companies are trying to divert their investments in artificial lift methods to help prolong their assets While not much physically has changed since the invention of the King Valve in the 1940s new developments in analytical procedures computational tools and software and many related technologies have completely changed the way production engineers and well operators face the daily design and troubleshooting tasks and challenges of gas lift which can now be carried out faster and in a more accurate and productive way assuming the person is properly trained This book fulfills this training need with updates on the latest gas lift designs troubleshooting techniques and real world field case studies that can be applied to all levels of situations including offshore Making operational and troubleshooting techniques central to the discussion the book empowers the engineer new and experienced to analyze the challenge involved and make educated adjustments and conclusions in the most economical and practical way Packed with information on computer utilization inflow and outflow performance analysis and worked calculation examples made for training the book brings fresh air and innovation to a long standing essential component in a well s lifecycle Covers essential gas lift design troubleshooting and the latest developments in R D Provides real world field experience and techniques to solve both onshore and offshore challenges Offers past and present analytical and operational techniques available in an easy to read manner Features information on computer utilization inflow and outflow performance analysis and worked calculation training examples

Quantitative Gas Chromatography for Laboratory Analyses and On-Line Process Control G. Guiochon, C.L. Guillemin, 1988-06-01 Here is an invaluable new book on quantitative gas chromatography which explains how the method can or should be used for accurate and precise analysis Gas chromatography is firmly established as one of the few major methods for the quantitative analysis of complex mixtures It is fast accurate and inexpensive with a broad range of applications It has however become very complex and involved over 200 stationary phases more than 10 detector principles and several very different column types are available from among the catalogs of over 100 manufacturers and major retailers The progressive changes in the nature of gas chromatography have created new needs for information which are not satisfied by the literature presently available This book provides a complete discussion of all the problems involved in the achievement of quantitative analysis by gas chromatography whether in the research laboratory in the routine analysis laboratory or in process control For this reason the presentation of theoretical concepts has been limited to the essential while extensive explanations have been devoted to the various steps involved in the derivation of precise and accurate data This starts with the selection of the instrumentation and column continues with the choice of optimum experimental conditions then calibration and ends with the use of correct procedures for data acquisition and calculations Finally there is almost always a

way to reduce errors and an entire chapter deals with this single issue Numerous relevant examples are presented The first part of the book presents the theoretical background simple enough to be understood by all analytical chemists but still complete and up to date It discusses the problems of flow dynamics retention and band broadening The changes in band profile associated with column overloading are explained without much recourse to mathematics The second part describes the gas chromatograph and discusses the properties of each of its parts gas flow and pressure controller sampling system oven column switching valves detectors The different implementations their advantages and drawbacks are discussed and compared In addition three chapters present packed column technology open tubular column technology and some sophisticated new phase systems respectively The new phase systems described use adsorbents modified by coating or grafting organic phase and carrier gases containing vapors which are sorbed by the stationary phase and modify it such as steam The third part discusses the applications in qualitative and quantitative analysis Calibration peak integration sources of errors arising from the various parts of the instrument as well as from the measurement process itself are carefully described in four detailed chapters Methods to carry out accurate and precise analysis are presented A last chapter is devoted to process control analysis and gives a number of detailed examples of applications A lexicon explaining the most important chromatographic terms and a detailed index complete the book This is a book which no chemical analyst should be without It should be on the library shelf of all universities instrument companies and any laboratory and plant where gas chromatography is used

A Theory for Industrial Gas-liquid Chromatographic Columns Robert Henry Houston, 1958

Flow Measurement Methods and Applications Jim E. Hardy, Jim O. Hylton, Tim E. McKnight, Carl J. Remenyik, Francis R. Ruppel, 1999-02-02 A practical guide to cutting edge techniques for flow measurement and control Unlike any other book on the subject this volume employs practical applications to illustrate flow measurement techniques in industrial processes Drawing on their work at the Oak Ridge National Laboratory five leading researchers present applications that test the limits of commercial flow instrumentation in harsh environments wide rangeability and a host of challenging situations encountered in research and industry This approach gives the reader highly effective tools for use in tackling a broad range of difficult flow measurement problems It offers tremendous insight into what flow measurement is all about from the underlying principles of the methodologies to state of the art instrumentation including such innovations as smart flow sensors Introducing terminology properties units and flow meters classification the book Details signal conditioning and analysis techniques that will produce meaningful results Offers tips on selecting the appropriate method for a given application Shows how modeling can improve mass flow metering accuracy Covers flow calibration and standards as well as issues related to cost maintenance and ease of use of instruments Addresses the effect of measurement uncertainty on calibration and field measurements Clear concise and generously illustrated Flow Measurement Methods and Applications is an invaluable resource for researchers and graduate students in physics mechanical engineering chemical engineering and

instrument engineering It is a must have reference for anyone wishing to assess flow processes accurately and reliably in the real world *The Code of Federal Regulations of the United States of America* ,1971 The Code of Federal Regulations is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government **Code of Federal Regulations** ,2007 Special edition of the Federal Register containing a codification of documents of general applicability and future effect as of July 1 with ancillaries **Process Development in Removing Sulfur Dioxide from Hot Flue Gases (in Four Parts)**. Dale W. Richardson,Daniel Bienstock,David M. Gullikson,Frederick E. Armstrong,K. K. Kershner,William Joseph Campbell,Frederick W. Hoertel,Joseph H. Field,Melvin Leon,Stephan Stecura,W. D. Howell,W. Hodge Caraway,Clark Grain,George Laurence Gates,J. Wade Watkins,John G. Myers,1961 **Understanding Anesthetic Equipment & Procedures** Dwarkadas K Baheti,Vandana V Laheri ,2021-10-31 Section A Historical Perspective Section B Role of Physical Principles Section C Medical Gases and Distribution System Section D Anaesthesia Machine and its Components Section E Airway Equipment Section F Monitoring Equipment Section G Equipments for Central Neuraxial Regional Blocks Section H Miscellaneous Section I Maintenance Safety and Hazards Section J Corona Covid 19 Anaesthetic Scenario in Corona Pandemic **Veterinary Anesthetic and Monitoring Equipment** Kristen G. Cooley,Rebecca A. Johnson,2018-08-06 Veterinary Anesthetic and Monitoring Equipment is the first veterinary specific resource solely dedicated to anesthetic and monitoring equipment used in clinical practice Offers a practical guide to anesthetic and monitoring equipment commonly used in veterinary medicine Provides clinically oriented guidance to troubleshooting problems that may occur Discusses general principles applicable to any equipment found in the practice Presents information associated with novel anesthetic equipment and monitors *Federal Register* ,2000-10

Elementary Principles of Chemical Processes Richard M. Felder,Ronald W. Rousseau,Lisa G. Bullard,2020-08-11 This best selling text prepares students to formulate and solve material and energy balances in chemical process systems and lays the foundation for subsequent courses in chemical engineering The text provides a realistic informative and positive introduction to the practice of chemical engineering **Ward's Anaesthetic Equipment** Andrew J. Davey,2005-01-01 Ward s Anaesthetic Equipment familiarizes the anesthetic trainee very thoroughly with anesthesia and intensive care equipment and it remains the recommended text for Parts II III and the final FRCA and FFARCSI exams The newest edition has been completely updated and revised to ensure the close integration of the physical principles and clinical applications of equipment throughout the text It is the only comprehensive equipment textbook based on UK equipment and practice This is a comprehensive and highly practical one stop source of information on the latest anesthetic and intensive care equipment currently in use Key points and key references are included in every chapter and the text has been rewritten to be very clear and concise Provides the trainee with a very accessible source of information to aid in the understanding of the basic and more advanced key principles behind equipment and design Extensively and painstakingly cross referenced by an

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Core Topics in Basic Anaesthesia: Prepare for the FRCA Nicholas Pace, 2015-11-20 This eBook is one of 10 carefully selected collections of key articles from the Anaesthesia and Intensive Care Medicine journal a continually updated evidence based learning resource based on the RCOA Curriculum It is an invaluable guide to essential core topics for those in the early stages of their specialty training and for when preparing for the FRCA or similar exams It will also prove an invaluable authoritative refresher for life long learning and CPD Related MCQs are included to test your understanding

Process Analyzer Sample-Conditioning System Technology Robert E. Sherman, 2002-01-11 Sampling systems are one part chemistry one part engineering electrical chemical mechanical civil and maybe even software No one person possesses all of the knowledge required Bob Sherman comes as close as anyone John A Crandall V P Sales Americas ABB Process Analytics This resource provides both novice and experienced technologist with the technical background necessary to choose sample conditioning system components that will allow the process analyzer system to function reliably with minimal maintenance The conditioned process sample presented to the process analyzer should be of similar quality to the calibration material used to zero and span the analyzer Filling a long standing void in the process field this book addresses the system concept of Process Analyzer Sample Conditioning Technology in light of the critical importance of delivering a representative sample of the process stream to the process analyzer Offering detailed descriptions of the equipment necessary to prepare process samples and listings of two or more vendors when available for equipment reviewed Process Analyzer Sample Conditioning System Technology discusses The importance of a truly representative sample Sample probes transfer lines coolers and pumps Sample transfer flow calculations for sizing of lines and system components Particulate filters gas liquid and liquid liquid separation devices Sample pressure measurement and control Enclosures and walk in shelters their electrical hazard ratings and climate control systems With extensive system and component examples including what worked and what didn't Process Analyzer Sample Conditioning System Technology gives the new technologist a basic source of design parameters and performance proven components as well as providing the experienced professional with a valuable reference resource to complement his or her experience

U.S. Navy Diving Manual: Mixed-gas diving United States. Naval Ship Systems Command. Supervisor of Diving, 1973

Fundamentals of Operating Department Practice Ann Davey, Colin S. Ince, 2000 This text is aimed at all non medical personnel training for the NVQ in Operating Department Practice Level 3 the aim of which is to train a non medical operating theatre worker to become competent in all of the professional aspects of operating

Clinical Calculations - E-Book Joyce LeFever Kee, Sally M. Marshall, Mary Catherine Forrester, Kathryn Woods, 2020-06-12
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US Navy diving manual, 1981 *Process Gas Chromatographs* Tony Waters, 2020-07-13 A guide to the fundamentals of applied gas chromatography and the process gas chromatograph with practical procedures for design and troubleshooting This comprehensive resource provides the theory that underpins a full understanding of the fundamental techniques of gas chromatography and the process analyzer Without relying on complex mathematics the book addresses hands on applications of gas chromatographs within process industries The author a noted expert on the topic details both the scientific information needed to grasp the material presented and the practical applications for professionals working in the field Process Gas Chromatographs Fundamentals Design and Implementation comprises 15 chapters a glossary of terms and a series of self assessment questions and quizzes This important resource Describes practical procedures for design and troubleshooting Contains concise chapters that provide a structured course for advanced students in process engineering Reviews the fundamentals of applied gas chromatography Details the operation and maintenance of process gas chromatographs Offers a summary and self assessment questions for every chapter Is written by an international expert in the field with extensive industry knowledge and teaching experience in courses on process sampling systems and gas chromatography Written for process analyzer engineers and technicians application engineers and industrial environmental engineers Process Gas Chromatographs Fundamentals Design and Implementation offers an essential guide to the basics of gas chromatography and reviews the applications of process gas chromatographs in industry today

Basic Gas Chromatography Harold M. McNair, James M. Miller, 2011-09-20 The New Edition of the Well Regarded Handbook on Gas Chromatography Since the publication of the highly successful first edition of Basic Gas Chromatography the practice of chromatography has undergone several notable developments Basic Gas Chromatography Second Edition covers the latest in the field giving readers the most up to date guide available while maintaining the first edition s practical applied approach to the subject and its accessibility to a wide range of readers The text provides comprehensive coverage of basic topics in the field such as stationary phases packed columns and inlets capillary columns and inlets detectors and qualitative and quantitative analysis At the same time the coverage also features key additions and updated topics including Gas chromatography mass spectrometry GC MS Sampling methods Multidimensional gas chromatography Fast gas chromatography Gas chromatography analysis of nonvolatile compounds Inverse gas chromatography and pyrolysis gas chromatography Along with these new and updated topics the references

resources and Web sites in Basic Gas Chromatography have been revised to reflect the state of the field Concise and fundamental in its coverage Basic Gas Chromatography Second Edition remains the standard handbook for everyone from undergraduates studying analytical chemistry to working industrial chemists

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