

# INSTRUCALC 9.1

*Harness the Power of Over 70 Sizing Routines*





Featuring over 70 routines associated with:

- Control valves
- Flow elements
- Rupture disks
- Relief valves
- and process data collections

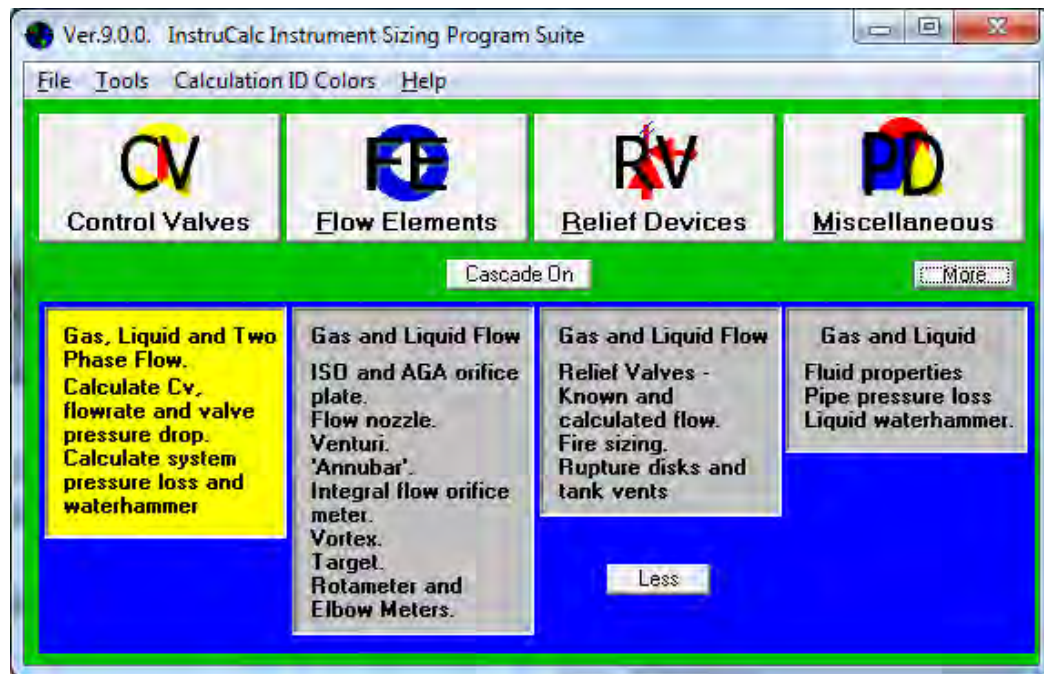
InstruCalc is one of the industry's most popular and complete desktop applications for instrumentation calculations and analyses.



InstruCalc is a set of engineering programs capable of determining the basic engineering data and requirements for equipment.

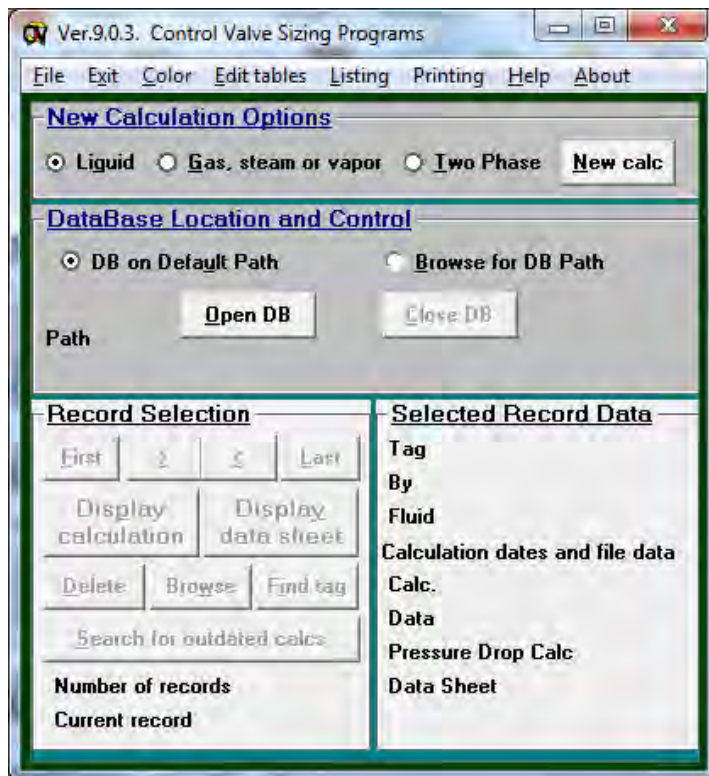
The programs are conveniently divided into 4 modules:

1. Control Valves
2. Flow Elements
3. Relief Devices
4. Miscellaneous



# Module 1- Control Valves

*For liquid, gas, steam, and two-phase flow using the ISA formulas*



Contains programs for calculating Cv and analyzing for cavitation within the valve, critical flow and flashing through the valve, and noise generated by the valve.

\*Messages are displayed to guide you to an optimum valve selection

# Module 1 – Control Valves

## Calculation screen for valve sizing

Ver.9.0.3. Control Valve Liquid Program - Calculate Valve Size

File Fluid properties Valve data Other options Help

**Input data**

Tag	Maximum	Normal	Minimum
Percent of nominal flow		50	
Liquid flow lb/h			
Pressure drop psi			
Flow temperature degF			
Inlet pressure psig			
Vapor pressure psia			
Critical pressure psia			
Viscosity @ FTP cp			
Specific gravity @ FTP			

**Output data**

	Maximum	Normal	Minimum
Required Cv			
Percent of valve lift			
Cavitation index			
Noise level dbA			
Flow status			
Cavitation or Flashing			
Sizing pressure drop psi			
Calculated FL			

Fluid name

Valve design  
 Standard  Lo Flow

Body style Trim

Restart sizing in

Size RatedCv Fd

Ports Flow to

Rated FL  
@100% @50% @10%

Pipe data  
Nominal diameter  
Inlet Outlet  
in in

Outlet wall thickness  
in

Date  
By  
App

Change setup

Note 1  
Note 2

Setup selections User saved mass units, data for all calculations, calculate size  
Calculation source ANSI/ISA-75.01.01-2012 Flow Equations for sizing control valves  
Calculation accuracy

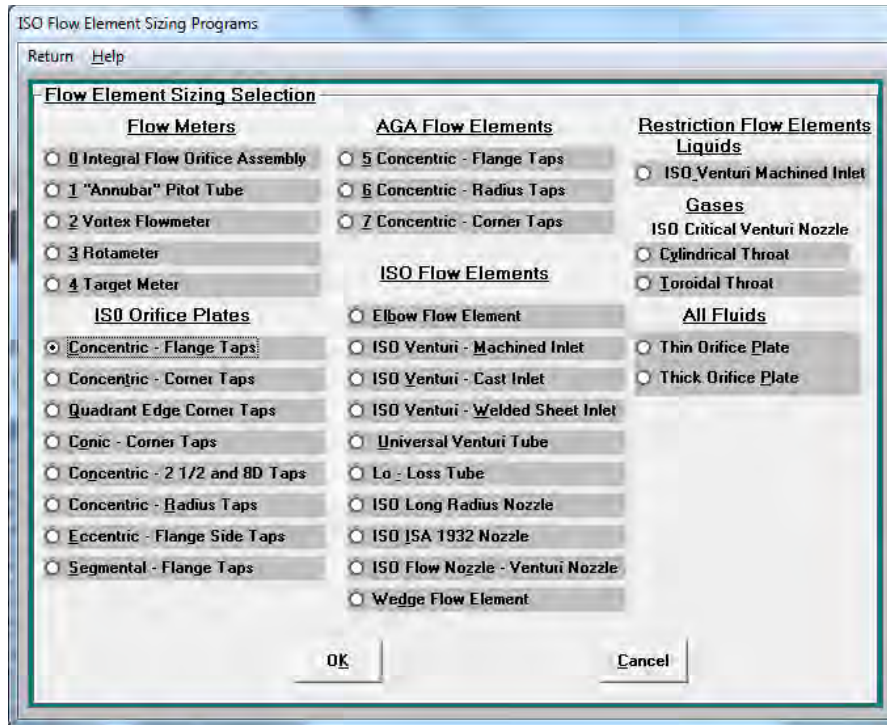
Required input fields highlighted.

Other options for calculate system pressure drop, water hammer (valve closing time), prepare data sheet and create graphs.

Change setup option to set units, select calculation from valve size, flowrate or pressure drop and other options.

# Module 2- Flow Elements

*For flow and restriction orifice plates; flow nozzles and venturies; gas, steam, vapor, and liquids; flange, radius, pipe, and corner taps.*



Uses concentric, eccentric, segmental, quadrant edge, and conical plates.

Calculates Beta ratio, orifice bore and flow for a selected bore.

# Module 2 - Flow Elements

## Calculation screen for Liquid Flow, Concentric Flange Taps

Ver.9.0.3. ISO Orifice Plate - Concentric - Flange Taps - Liquid Flow

File Fluid properties Options Transfer Help

**Input data**

Tag  Fluid

Maximum liquid flow  lb/h

Normal liquid flow  lb/h

Differential range  inH2O

Viscosity @ FTP  cp

Flow temperature  degF

Meter inlet pressure  psig

Pipe ID  in

SG @ flow conditions

Element material  304 Stainless steel

Pipe material  Carbon steel

**Output data**

Beta ratio

Norm differential  inH2O

Reynolds number

Max pressure loss  inH2O

Max power loss  hp

Uncertainty percent

Min plate thickness  in

**Calculated option data**

Orifice diameter  in

**Calculation factors @ normal flow**

Thermal expansion

Discharge coefficient

Calculate  By

App

Change setup

Note 1

Note 2

Setup selections English mass units, basic calculation, calculate size

Calculation source ISO 5167-2:2003. Orifice plates

Required input fields highlighted.

Options for calculating inlet pressure, preparing data sheets and creating graphs.

Change setup option for setting units, selecting calculation options from orifice size, flowrate or differential range, selecting drain and vent hole and other available options.

# Module 2 – Flow Elements

Ver.9.0.3. ISO Orifice Plate - Concentric - Flange Taps - Gas Flow

File Fluid properties Options Transfer Help

Input data			Output data		
Tag	1Fe-Air	Fluid	Mixture	Beta ratio	.63677
Maximum gas flow	lb/h	4999.85	Reynolds number	444047	
Normal gas flow	lb/h	3999.88	Max pressure loss	inH2O	59.5
Differential range	inH2O	100	Max power loss	hp	2.54
Viscosity @ FTP	cp	.01854	Min plate thickness	in	.125
Meter inlet pressure	psig	47.1525	Uncertainty percent		.6242
Molecular weight		29.0738	Normal differential	inH2O	64
Cp/Cv specific heat ratio		1.4	Max. diff. range	inH2O	340
Flow temperature	degF	85	Calculation factors @ normal flow		
Pipe ID	in	3.068	Thermal expansion		1.00014
Critical pressure	psia	548.4	Discharge coefficient		.608405
Critical temperature	degR	239	Gas expansion		.987539
Density @ FTP	lb/ft3	.308214	Base pressure factor		.999997
Element material		347 stainless steel	Base temperature fact.		1
Pipe material		Carbon steel	Compressibility factor		
Calculated option data			4/1/2006		
Orifice diameter	in	1.95361	Calculate	By	SWt
Note 1			App		
Note 2			Change setup		
Setup selections English mass units, data for all calculations, calculate size					
Calculation source ISO 5167-2:2003. Orifice plates					

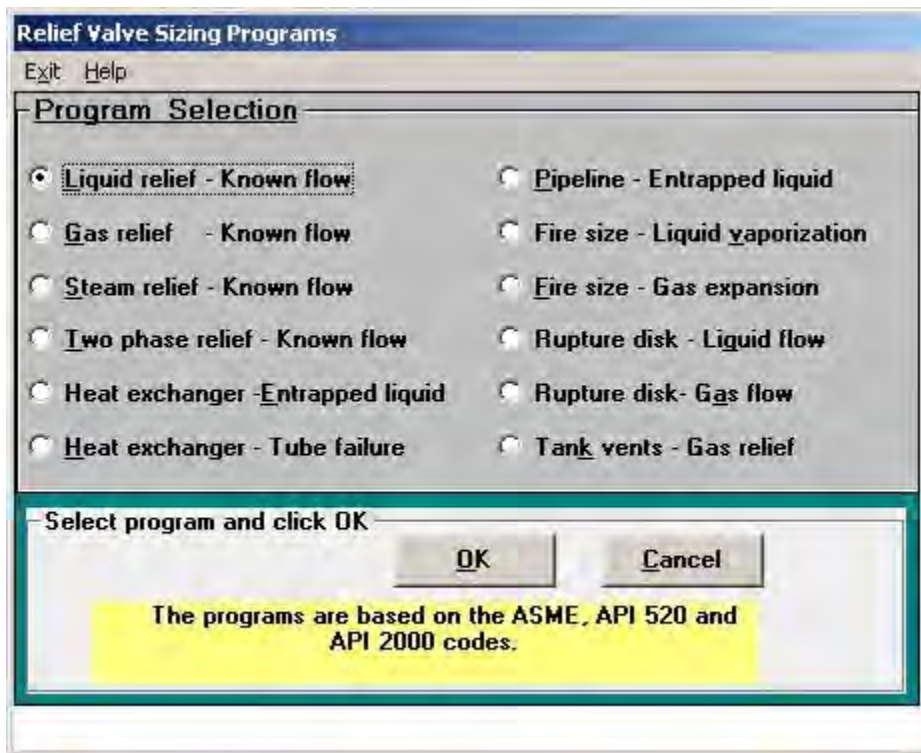
These programs determine the relationship between the flow rate, the pressure drop and the size of the hole.

They are based on ISO 5167 and follow the procedures described in The Flow Measurement Engineering Handbook by R. W. Miller.



# Module 3- Relief Devices

*For pressure-relief devices, rupture discs, and breather valves*



This liquid and gas application calculates API or ASME size for known flow, thermal expansion, and external fire.

The external fire program has the option of either the API or the NFPA heat input methods. It also calculates the maximum flow rate for the selected valve and the maximum back pressure, which maintains the required flow as well as the relieving forces.

# Module 3- Relief Devices

## Liquid relief known flow calculation screen

Ver.9.0.3. Relief Valve - Liquid relief - Known flow

File Fluid properties Options Help

**Input data**

Tag  Fluid

Code ASME section 8 - Single valve

Valve type Standard

Rupture disk No

Relief temperature degF

Valve set pressure psig

Normal liquid flow lb/h

Total back pressure psig

Specific gravity @ FTP

Viscosity @ FTP cp

Percent overpressure 10

Valve discharge coefficient .62

Select valve size in2

**Output data**

Calculated area in2

Relief pressure psig

Viscosity correction

Valve capacity lb/h

Valve orifice designation

Calculate By

App

Note 1

Note 2

Change setup

Setup selections English mass units, calculate size

Calculation source API 520

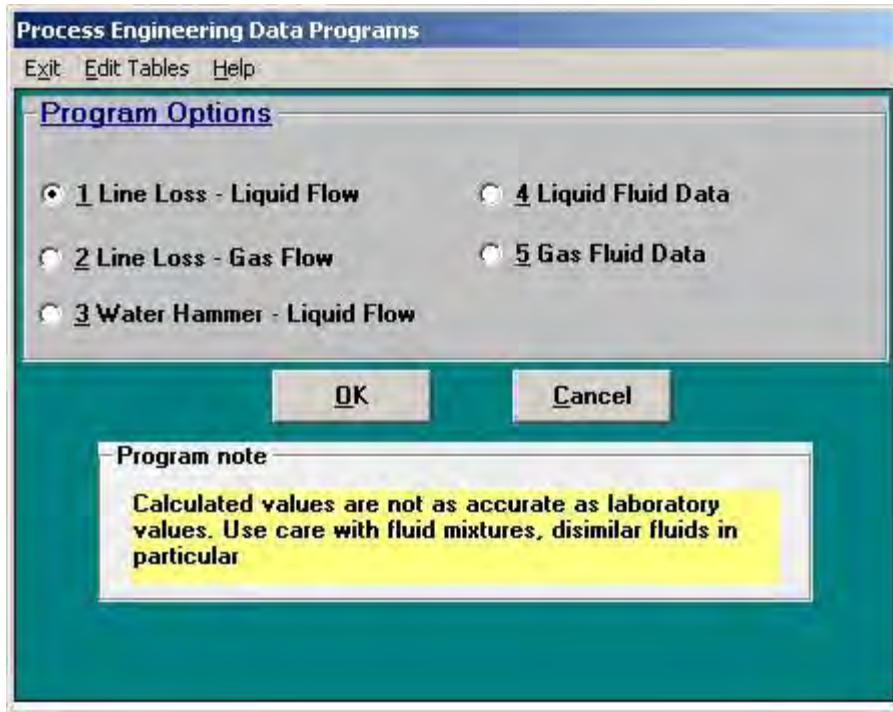
Required input fields highlighted.

Options for calculating pipe losses and preparing data sheets.

Change setup option for setting units, selecting calculation options from valve size or flowrate, and other available options.

# Module 4- Auxiliary Programs

*For determining line pressure drops for gas and liquids, calculates compressibility factor, flowing density, vapor pressure and temperature, latent heats at pressure and temperature, and physical properties of mixtures.*



These programs are useful for many other engineering activities, such as centrifugal pump line loss calculations and determining pressure available for control valve pressure drop.





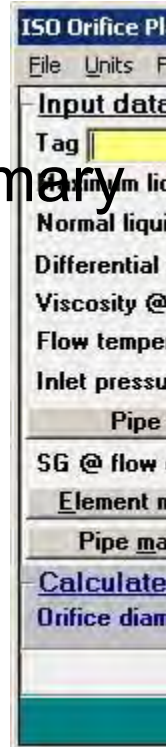
The background features a collage of industrial components, including valves and pipes, overlaid with technical drawings and mathematical formulas. The formulas include  $R_{EV} = \frac{5.0 d^3 W}{\mu_{CP} \sqrt{F_L C_V}}$ ,  $500 \sqrt{\Delta P}$ ,  $K_{B1} = 1 - \left(\frac{d}{D}\right)^4$ , and  $\left(\frac{B1}{0d^4} F_L^2 C_V^2 + 1\right)^{-0.5}$ .

# SPECIAL FEATURES

# Multi-functional

Each program allows you to:

- make calculations
- prepare data sheets
- and/or produce summary sheets



InstruCalc Ver 5.1

I-Size Solutions Inc

5/8/1995

Asco Refining  
Project . Crude Expansion

Water Hammer - Liquid flow

Tag number WaterHammer

Input Data

Fluid	Benzene
Liquid flow	25000 lb/h
Max allowable pressure	250 psig
Flow temperature	80 degF
Operating pressure	150 psig
SG @ flow conditions	.8731
Liquid bulk modulus	189598 psi
Pipe elastic mod	29200000 psi
Line length	1500 ft
Pipe inside diameter	3.068 in
Pipe wall thickness	.216 in
Pipe material	Carbon Steel
Selected closing time	3 secs

Output data

Critical closing time conditons

Critical closing time	.7807 secs
Wave velocity	3843 ft/s
Wave pressure	262.1 psig
Estimated thrust	828.5 lb

Closing time for allowable pressure

Minimum closing time	.8749 secs
----------------------	------------

Selected closing time conditions

Wave pressure	179.2 psig
Estimated thrust	215.6 lb

Note  
a  
b  
c

Notes :



## ***Customizable***

User may tailor calculations to fit specific needs by:

- selecting any set of engineering units for a given calculation, including a customized set.
- mixing and matching units and changing units in the middle of a calculation.
- calculating process data at flow conditions for 64 fluids (included in the program), either mixtures or single component.
- fluids file can be edited and also updated with additional fluids
- Control valve sizing program includes a set of common valves and is editable for user to add valves.

# Dynamic

Dynamic valve sizing is available for control valves.

**Control Valve - Liquid flow**

File Units Fluid properties Valve data Other options Help

**Input data**

	Maximum	Normal	Minimum
Tag			
Percent of system flow			
Liquid flow	lb/h		
Pressure drop	psi		
Flow temperature	degF		
Inlet pressure	psig		
Vapor pressure	psia		
Critical pressure	psia		
Viscosity @ FTP	cp		
SG @ flow conditions			

Fluid Name

Valve design

Standard  Lo Flow

Body style Trim

Clear sizes

Size in Fd

RatedCv Flow to

FL Ports

Pipe data

Nominal diameter

Inlet Outlet

in

Outlet wall thickness

in

Date

By

App

**Output data**

	Maximum	Normal	Minimum
Required Cv			
Percent of valve Cv			
Cavitation index			
Noise level	dbA		
Flow status			
Sizing pressure drop	psi		

Based on changing percentage of flow, the program has a scrolling system to instantly give a variety of data calculations.





The background features a faded industrial scene with various pipes, valves, and gauges. Overlaid on this are several mathematical formulas in a light, semi-transparent font. At the top right, the formula  $R_{EV} = \frac{5.0 d W}{\mu_{CP} \sqrt{F_L C_V}}$  is visible. In the middle right,  $C_V = \frac{W}{500 \sqrt{\Delta P}}$  is shown. At the bottom right,  $K_{B1} = 1 - \left(\frac{d}{D}\right)^4$  is present. On the left side, a complex formula  $\left( \frac{B1 F_L^2 C_V^2}{0 d^4} + 1 \right)^{-0.5}$  is partially visible. The central text 'Current References' is prominently displayed in a bold, black, sans-serif font.

# Current References



# Standards and references for Version 9 calculations.

- **Control Valves**

- ANSI/ISA-S75.01.01, 2012
- ISA 75.17 [Control Valve Aerodynamic Noise Prediction](#)
- ISA Handbook for Control Valves- J.W. Hutchison
- Masoneilan noise prediction formula
- Pressure drop calculation - Crane Technical paper No 410

- **Flow Element Sizing**

- ISO 5167 dated 2003
- ISO 5168 Accuracy Standard
- ISO 5024 Volumetric Standards (14.69595 psia & 59 F)
- Principles and Practice of Flowmeter Engineering, L.K. Spink, The Foxboro Company.
- The Flow Measurement Engineering Handbook, 3<sup>rd</sup> Ed. R. W. Miller, McGraw Hill, New York.



## Current References cont'

- **Flow Elements Continued**

- American Gas Association Report Number 3. "Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids".
- AGA8 Natural Gas in Flow Elements
- Annubar Flow Handbook, Dietrich Standard Corporation
- Annubar no longer requires viscosity correction for liquids less than 250 cp.

- **Pressure Relief Valves**

- API RP-520, parts 1 and 2, 9th Ed., 2014
- ASME Code Section 8, Pressure Vessel Code, UG-132
- ASME Code Section 1, Power Boiler Code Manufacturers
- API or NFPA 30 data for fire generated flowrate



## Current References cont'

- **Pressure Relief Valves continued**
  - ASME for new liquid trim valves, which is now mandatory for new work.
  - Option to use data published by National Fire Protection Association (NFPA 30)
- **Heat Exchanger, Piping Entrapped Liquid**
  - ASME Code, Section 8, Pressure Vessel Code, Summer 1984 addenda
  - API RP-520, parts 1 and 2, 9th Ed., 2014
  - ANSI B31
- **Tank Vents**
  - API 2000, 5<sup>th</sup> Edition 1998
  - API 620
  - API 650



## Current References cont'...

- **Rupture Disks**
  - ASME Code, Sections I and VIII.
  - Fike Metal Products Technical Bulletin, TB 8100-8102
- **Auxiliary Programs**
  - Line Pressure Drop- Crane Company Technical Paper, No. 410C
  - Compressibility Factor- Redlich-Kwong
  - Vapor Temperature- Lee and Kesler
  - Latent Heat of Vaporization- Watson

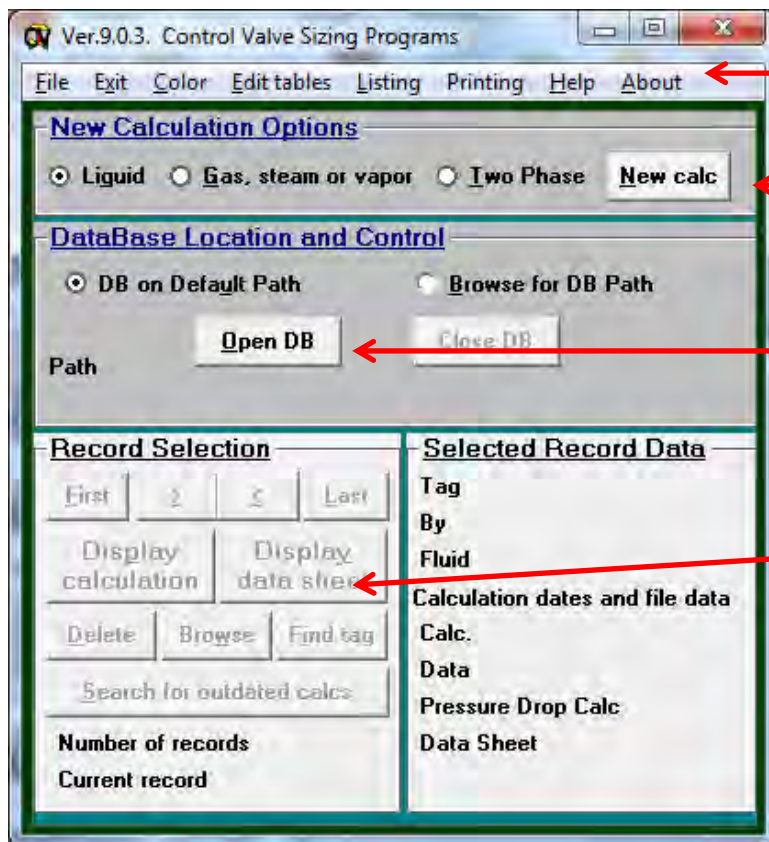


The background features a complex industrial scene with various pipes, valves, and gauges. Overlaid on this are several mathematical formulas in a light, semi-transparent font. These include the Reynolds number formula  $Re = \frac{\rho v d}{\mu}$ , the Colebrook-White equation  $\frac{1}{f} = -2 \log_{10} \left( \frac{\epsilon}{3.7d} + \frac{2.51}{Re \sqrt{f}} \right)$ , and the Darcy-Weisbach equation  $\Delta P = f \frac{L}{d} \frac{\rho v^2}{2}$ . Other visible formulas include  $K_{B1} = 1 - \left( \frac{d}{D} \right)^4$  and  $\left( \frac{B1}{d^4} \right) \left( \frac{f L^2 C_V^2}{v^2 + 1} \right)^{-0.5}$ . The text 'E-34' and 'E-2A' is also visible in the background.

# SAMPLE CALCULATIONS

# Sample - Control

*Main menu control valve module selection screen*



- User editable options
- For new calculation select phase and click New Calc
- To access existing records select Open DB
- After database opens select desired existing calculation

\*Messages are displayed to guide you to an optimum valve selection

# Control Valve—Valve Sizing Calculation

Ver.9.0.4. Control Valve Liquid Program - Calculate Valve Size

File Fluid properties **Valve data** Other options Help

**Input data**

Tag	Maximum	Normal	Minimum
Percent of nominal flow		50	
Liquid flow	lb/h		
Pressure drop	psi		
Flow temperature	degF		
Inlet pressure	psig		
Vapor pressure	psia		
Critical pressure	psia		
Viscosity @ FTP	cp		
Specific gravity @ FTP			

Fluid name

Valve design  
 Standard  Lo Flow  
Body style Trim

Restart sizing in

Size	RatedCv	Fd

Port Flow to

Rated FL @100%	Rated FL @50%	Rated FL @10%

Pipe data

Nominal diameter

Inlet	Outlet
in	

Outlet wall thickness

in

Date

By

App

Change setup

Note 1

Note 2

Setup selections User saved mass units, data for all calculations, calculate size

Calculation source ANSI/ISA-75.01.01-2012 Flow Equations for sizing control valves

Calculation accuracy

Required input data fields highlighted.

- Manually input fluid properties or select from included property database
- Select valve data from included selection of common valves
- Edit calculation options like units used, type of calculation, etc.



# Control Valve—Valve Sizing Calculation

Ver.9.0.3. Control Valve Liquid Program - Calculate Valve Size

File Fluid properties Valve data Other options Help

Input data		Maximum	Normal	Minimum
Tag	CV-Liq			
Percent of nominal flow		97.26	50	7.2
Liquid flow	kg/s	24.51	12.6	1.8144
Pressure drop	kPa	167.84	634.58	787.56
Flow temperature	degC	146.11	146.11	139.22
Inlet pressure	kPag	1449	1760.5	1861
Vapor pressure	kPaa			
Critical pressure	kPaa	20664	20664	20664
Viscosity @ FTP	Pa.s	1.4372E-04	1.4372E-04	1.5518E-04
Specific gravity @ FTP		.79201	.79269	.8026

Output data		Maximum	Normal	Minimum
Required Cv		88.56	23.4	3.006
Percent of valve lift		55	15	2
Cavitation index		9.2371	2.934	2.4917
Noise level	dba	64	70	63
Flow status		Normal	Normal	Normal
Cavitation or Flashing				
Sizing pressure drop	kPa	167.84	634.58	787.56
Calculated FL		.9045	.9424	.9644

Note 1 7  
Note 2 8

Setup selections SI mass units, basic calculation, calculate size  
 Calculation source ANSI/ISA-75.01.01-2012 Flow Equations for sizing control valves  
 Calculation accuracy

Fluid name: Water  
 Valve design:  Standard  Lo Flow  
 Body style: Trim  
 Globe  Cage Equal%   
 Restart sizing: mm  
 Size: 100 RatedCv: 160 Fd: .13  
 Ports: One  Both   
 Flow to: Rated FL  
 @100%: .9 @50%: .905 @10%: .95  
 Pipe data: Nominal diameter Inlet: 100 mm Outlet: 100 mm  
 Outlet wall thickness: 10.312 mm  
 Date: 3/23/2017  
 By:   
 App:   
 Change setup

- Selecting Max, Norm or Min run the calculation

Calculation source identified on calculation form

- Masoneilan noise prediction method
- and incipient cavitation technique

# ISO Orifice Plate Calculation

Ver.9.0.3. ISO Orifice Plate - Concentric - Flange Taps - Gas Flow

File Fluid properties Options Transfer Help

Input data			Output data		
Tag	1Fe-Air	Fluid	Mixture	Beta ratio	.63677
Maximum gas flow	lb/h	4999.85	Reynolds number	444047	
Normal gas flow	lb/h	3999.88	Max pressure loss	inH2O	59.5
Differential range	inH2O	100	Max power loss	hp	2.54
Viscosity @ FTP	cp	.01854	Min plate thickness	in	.125
Meter inlet pressure	psig	47.1525	Uncertainty percent		.6242
Molecular weight		29.0738	Normal differential	inH2O	64
Cp/Cv specific heat ratio		1.4	Max. diff. range	inH2O	340
Flow temperature	degF	85	Calculation factors @ normal flow		
Pipe ID	in	3.068	Thermal expansion		1.00014
Critical pressure	psia	548.4	Discharge coefficient		.608405
Critical temperature	degR	239	Gas expansion		.987539
Density @ FTP	lb/ft3	.308214	Base pressure factor		.999997
Element material		347 stainless steel	Base temperature fact.		1
Pipe material		Carbon steel	Compressibility factor		
Calculated option data			4/1/2006		
Orifice diameter	in	1.95361	Calculate	By	SWt
Note 1			App		
Note 2			Change setup		
Setup selections English mass units, data for all calculations, calculate size					
Calculation source ISO 5167-2:2003. Orifice plates					

These programs determine the relationship between the flow rate, the pressure drop and the size of the hole.

They are based on ISO 5167 and follow the procedures described in The Flow Measurement Engineering Handbook by R. W. Miller.



## Overview

ImageGrafix, as a leading system integrator, digitalizes the entire lifecycle of industrial facilities and commercial buildings from inception to ongoing management, offering comprehensive planning, design and engineering, construction, operation, and maintenance solutions across diverse industry sectors such as Energy, Building & Infrastructure, and Manufacturing.

Our partnerships with top-tier technology providers are enriched by the finest talent, ensuring excellence in implementation, customization, managed services, and training. Our esteemed clientele includes Fortune 500 corporations within Energy, Process, Marine, Engineering, Procurement & Construction (EPC), Building & Construction, Automobile, Defense and Aerospace sectors across Middle East and India.

# ImageGrafix Software Solutions Pvt. Ltd.

📍 Chaitanya "EXOTICA", 4B, #51/24, Venkatanarayana Road,  
T.Nagar, Chennai - 600 017,

☎ +91 44 43486500

✉ igss-energy@imagegrafix.com

🌐 imagegrafix.com

- 
- Chennai
  - New Delhi
  - Mumbai
  - Bengaluru
  - Kolkata
  - Kozhikode
  - Pune
  - Hyderabad

# InstruCalc 9.1

*Harness the Power of Over 70 Sizing Routines*

