

INSTRU CALC 9.0

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

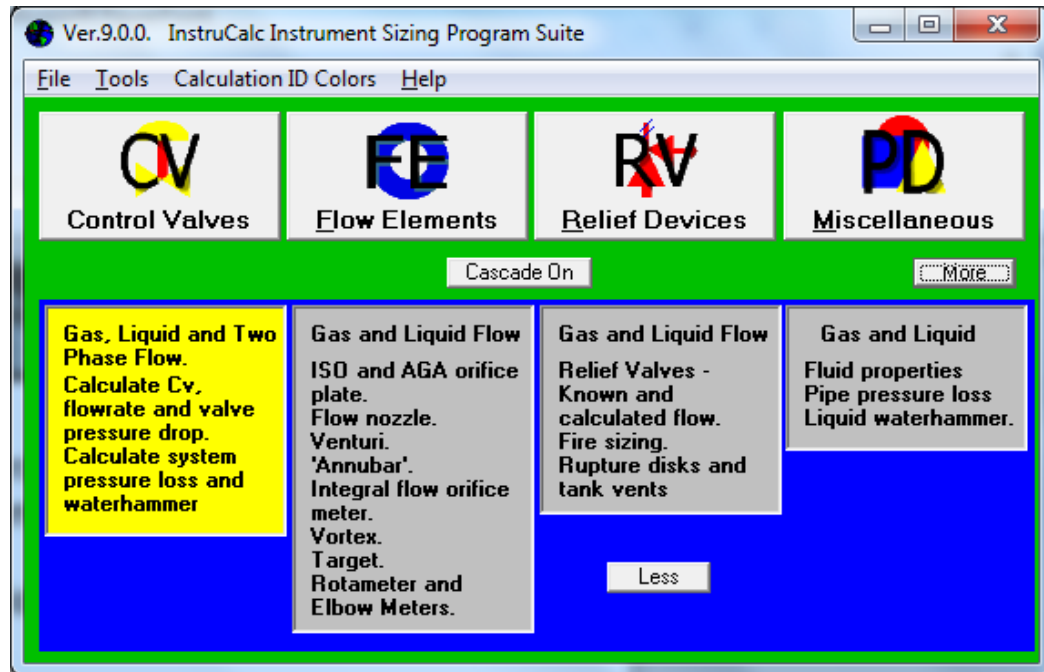
InstruCalc is one of the industry's most popular and complete desktop applications for instrumentation calculations and analyses.



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

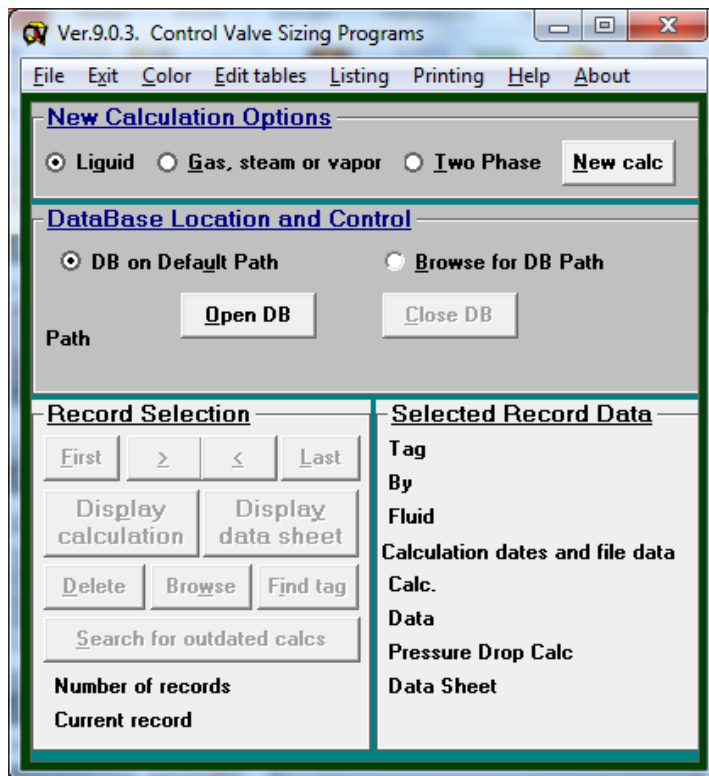
The programs are conveniently divided into 4 modules:

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

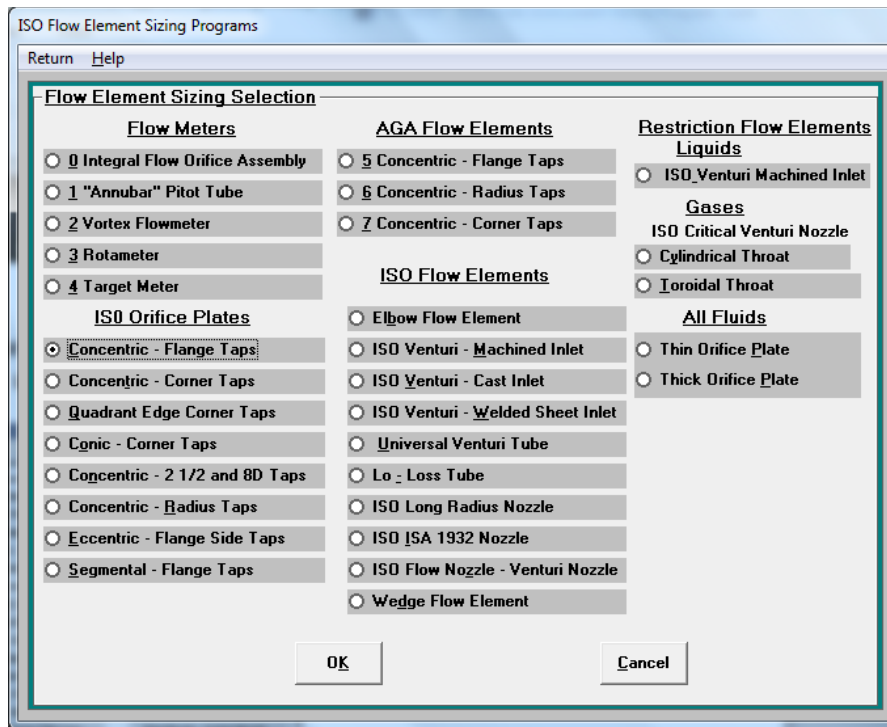
Required input fields highlighted.

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 ventureries; 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

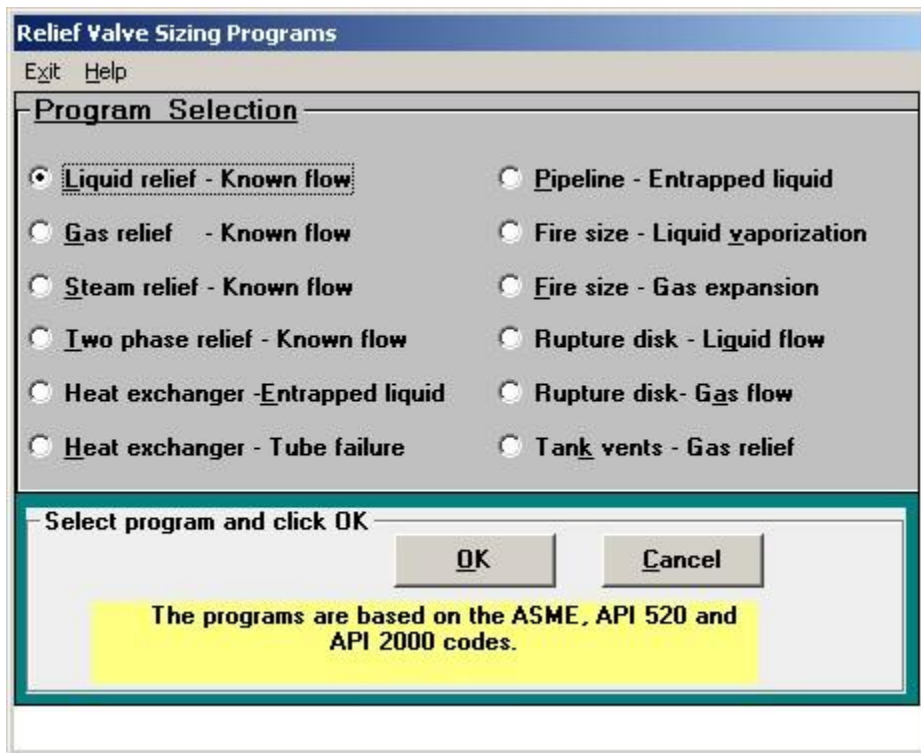
Input data			Output data	
Tag	Fluid	Mixture	Beta ratio	.63677
Maximum gas flow	lb/h	4999.85	Reynolds number	444047
Normal gas flow	lb/h	3999.88	Max pressure loss inH2O	59.5
Differential range	inH2O	100	Max power loss hp	2.54
Viscosity @ FTP	cp	.01854	Min plate thickness in	.125
Meter inlet pressure	psig	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	<u>Calculation factors @ normal flow</u>	
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	
<u>Calculated option data</u>				
Orifice diameter	in	1.95361	Calculate	4/1/2006
Note 1				By SWt
Note 2				App
Setup selections	English mass units, data for all calculations, calculate size			Change setup
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

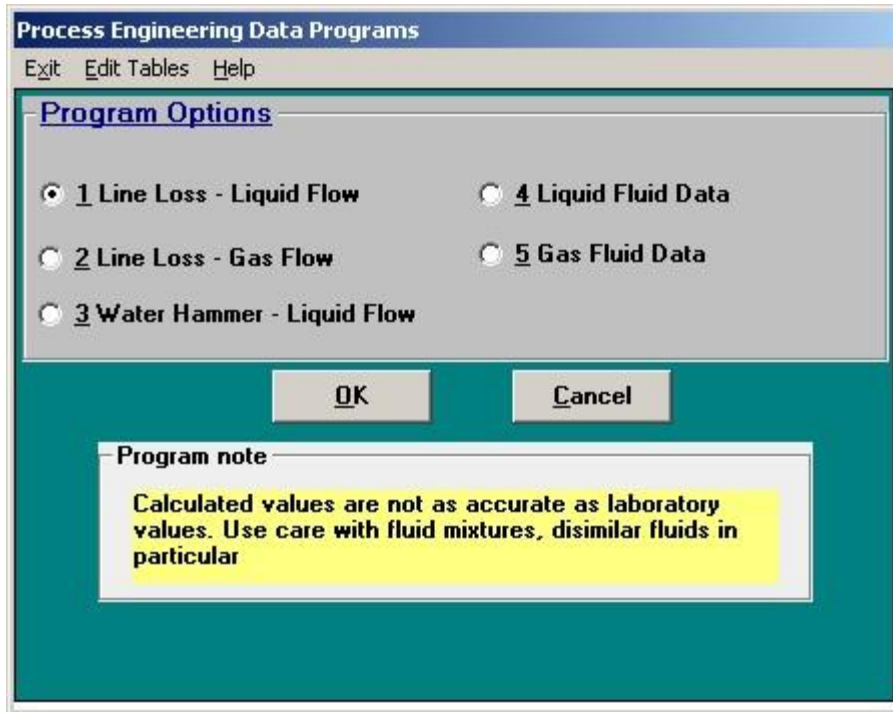
Required input fields highlighted.

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.

Module 4- Auxiliary Programs

Line loss – Liquid flow calculation screen

Calculate liquid destination pressure

File Fluid Properties Help

Piping configuration
Number of pipe fittings
Entrance
Gate valves
Globe valves
Check valves
90 deg ells
45 deg ells
Thru. tees
Branch tees
Exit

Total length of straight pipe
ft

Pipe inside diameter
in Data

Elevations ft
Start
End

Pipe material

Pipe % fouling. New=0

Cancel

Input data
Tag Fluid

		Maximum	Normal	Minimum
Liquid flowrate	lb/h	<input type="text"/>	<input type="text"/>	<input type="text"/>
Temperature	degF	<input type="text"/>	<input type="text"/>	<input type="text"/>
Source pressure	psig	<input type="text"/>	<input type="text"/>	<input type="text"/>
Viscosity	cp	<input type="text"/>	<input type="text"/>	<input type="text"/>
Equipment losses	psi	<input type="text"/>	<input type="text"/>	<input type="text"/>
Specific gravity @ FTP		<input type="text"/>	<input type="text"/>	<input type="text"/>

Output data
Loss per 100 ft psi
Destination pressure psig
Fluid velocity ft/s
Reynolds number

Calculate
 Destination pressure
 Source pressure

By
App

Change setup

Note 1
Note 2

Setup selections English mass units, calculate data
Calculation source Colebrook equation, Darcy formula and Crane Technical Paper No. 410

Required input fields highlighted.

Change setup option for setting units, selecting fluid density options (density or specific gravity).



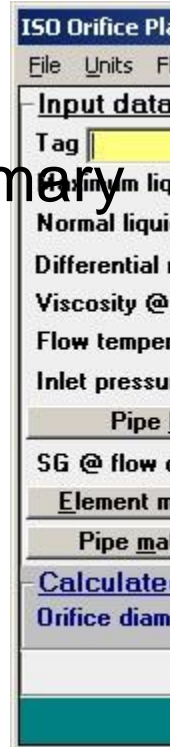
**SPECIAL
FEATURES**

The background features a collage of industrial valves and pipes. Overlaid on this are technical drawings and mathematical formulas. Visible formulas include: $R_{EV} = \mu_{CP} \sqrt{F_L C_V}$, $500 \sqrt{\Delta P}$, $K_{B1} = 1 - \left(\frac{d}{D} \right)^4$, and $\left(\frac{B1}{0d^4} \right) \left(F_L^2 C_V^2 + 1 \right)^{-0.5}$. Other elements include labels like 'REV', 'E-34', 'E-2A', and 'W'.

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	Fluid Name
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				

Output data

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

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

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



The background features a grayscale image of industrial machinery, including valves and pipes. Overlaid on this are several mathematical formulas in a light gray font. At the top, there is a formula $R_{EV} = \frac{3.101 d^5 W}{\mu_{CP} \sqrt{F_L C_V}}$. Below it, a horizontal line contains the labels E-31, E-32, E-34, and E-2A. To the right of the main title, there is a formula $C_V = \frac{W}{500 \sqrt{\Delta P}}$. At the bottom, there is a complex formula $K_{B1} = 1 - \left(\frac{d}{D} \right)^4$ and another formula $\left(\frac{B1}{0d^4} \right) \left(F_L^2 C_V^2 + 1 \right)^{-0.5}$.

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, 3rd 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, 5th 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

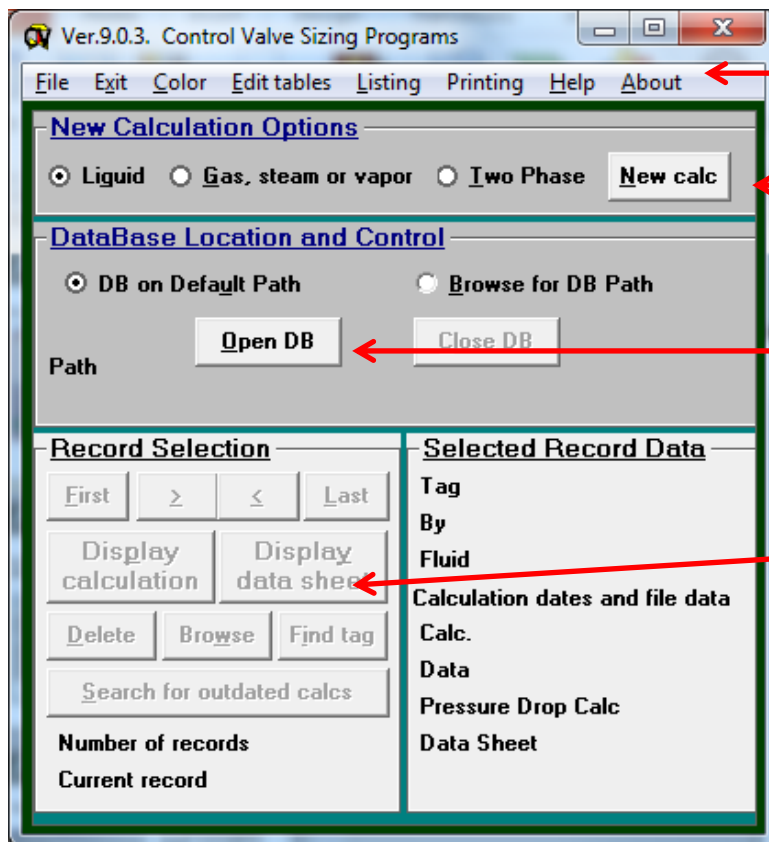


The background features a complex industrial scene with various pipes, valves, and gauges. Overlaid on this are several mathematical formulas in a light, semi-transparent font. These include: $R_{EV} = \frac{3.106 d W}{\mu_{CP} \sqrt{F_L C_V}}$, $K_{B1} = 1 - \left(\frac{d}{D} \right)^4$, $\left(\frac{B1}{0.0d^4} \right) \left(\frac{F_L^2 C_V^2}{+1} \right)^{-0.5}$, and $100 \sqrt{\Delta P}$. The text 'E-34' and 'E-2A' are 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

	Maximum	Normal	Minimum
Tag			
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

Ports Flow to

Rated FL	@100%	@50%	@10%

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			

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

Fluid name
Water

Valve design
 Standard Lo Flow
 Body style Trim
 Globe Cage Equal%

Restart sizing mm
 Size RatedCv Fd
 100 160 .13

Ports Flow to
 One Both

Rated FL
 @100% @50% @10%
 .9 .905 .95

Pipe data
 Nominal diameter
 Inlet Outlet
 mm 100 100
 Outlet wall thickness
 mm 10.312

3/23/2017
 By
 App

Change setup

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

- 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	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	<u>Calculation factors @ normal flow</u>	
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	
<u>Calculated option data</u>			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.



InstruCalc 9.0

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Harness the Power of Over 70 Sizing Routines

