User guide OI/Genie-EN

Genie II – Sizing & Selection Software Wedge and Integral Orifice Flow Meters





The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

Cert. No. Q 05907 EN 29001 (ISO 9001)



Lenno, Italy - Cert. No. 9/90A

Stonehouse, U.K.



Electrical Safety

This equipment complies with the requirements of CEI/IEC 61010-1:2001-2 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use'. If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

Symbols

One or more of the following symbols may appear on the equipment labelling:

	Warning – Refer to the manual for instructions		Direct current supply only
	Caution – Risk of electric shock	\sim	Alternating current supply only
	Protective earth (ground) terminal	\sim	Both direct and alternating current supply
<u> </u>	Earth (ground) terminal		The equipment is protected through double insulation

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

- 1. The relevant sections of these instructions must be read carefully before proceeding.
- 2. Warning labels on containers and packages must be observed.
- 3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
- 5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- 6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

EN ISO 9001:2000

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1 Installation

It is always best to close any open Window applications or virus utilities before installing any Windows Program application. Additionally, system privileges must be provided for loading components into c:/windows/system directories.

Any previous version of the ABB GENIE II Program should be removed. This is done in the Windows Control Panel, Add/Remove Programs.

- 1. Download the ABB GENIE II Program.
- In the Windows Start Button on the Microsoft Task Bar, go to Settings>Control Panel>, then double-click on Add/Remove Programs and follow the on screen instructions for "Add New Programs". (For versions downloaded to your PC, go to the directory into which the Program was downloaded).
- 3. Click on the button for "Add a Program from Floppy Disk or CD-ROM ' and follow the on-screen instructions

The Setup Program should start by 'Copying initialization files.' If you are a first time user, the Setup may request to shutdown and restart your computer. This is a standard Microsoft setup and allows for proper registration. Click OK and allow the system to reboot. Any error during the install process should be reported to your IS administrator.

The Setup Program will check for sufficient disk space. If there is insufficient space, Setup will stop the installation process and advise you to clear space before proceeding.

1.1 Setup

To start the ABB GENIE II Program, click the Start button on the Microsoft Task Bar, then Programs>ABB Program Suite.

To have easy access to the ABB GENIE II Program, create a desktop icon. Once the desktop icon is created, all you need to do is double-click the icon.

System Requirements

Computer:	Pentium or better
Memory:	12 MB RAM
Minimum Disk Space:	25 MB
Operating System:	MS Windows *
Networking:	Capabilities Available
Other Software:	MS Office
Display resolution	800 x 600 pixels
Display color	256 color required, 32 bit preferred

*ABB Genie software has been demonstrated to execute successfully on Windows 7 operating systems however certain system configurations, firewall setups or other IT limiting applications may cause the program to crash, freeze or not run at all. If this is encountered is it recommended to run the software in the Windows XP mode.

2 Introduction

This software is an essential tool to assist in the selection and application of ABB flow meters and to support troubleshooting issues. Many features have been incorporated to provide access to standard physical properties, generic and intricate process engineering conversions and "what if" decision making with point and click simplicity.

Design specification changes are easily entered and instantly calculated. Entries that do not meet specific meter design criteria are color-coded, with results blocked in yellow - indicating caution – or blocked in red – indicating that a specification has been violated.

Advanced users may take advantage of entering specific data relating to tap elevation, pipe roughness and process variables to further define the sizing criteria.

Project information and other comments may be entered directly from the main sizing screen for future retrieval and printing.

The Results show meter calculations, design details, pressure drop factors, power consumption and flow element hourly and yearly operating costs, and more. References for the calculation basis can be extracted from the physical property and other standard data tables.

Results can be saved directly to Word and Excel formats, and e-mailed to end users, purchasing contacts, or co-workers.

Note. This program is intended to be used as a tool for the selection and sizing of ABB flow meters based on application conditions. All results are estimates using either empirical data or industry accepted equations and may not reflect exact results when in actual use. ABB Automation Inc. provides this program "as is" with no warranty of any kind. The user assumes full responsibility for its application and use of data and results.

2.1 Features

Text Toolbar: File, Edit, View, Start, Results, Window, Help

Icon Toolbar: Open, Save, Print, Print Preview, Cut, Copy, Paste, Start, Pause, Stop, Word Results, Excel Results, Quick View, Graph Results, and Windows Toolbar.

The Toolbar for the Initial Default Screen includes the following buttons:

- Data Inputs & Units Enter all required data and appropriate units.
- Fluid Properties Sets all fluid properties based on selected fluid.
- Standard Conditions Enter both standard and flowing conditions.
- Comments & Info Enter any information and comments to be saved.
- Calculated Results Calculate all results and displays in text format.
- Graphical Results Calculate all results and displays graphically.
- Calculate Calculate all sizing results.

There are two blank areas on the Initial Default Screen.

- The area at the bottom provides any area to enter any calculations or comments to be saved.
- The area at the right will provide the results of the selections after calculations are completed. The slide bars at the right hand side and bottom assist in viewing while in this initial screen.

🐔 ABB Program Suite - [Wedge Flow Meter - Liq Mass]									
👺 File Edit View Start Results Window Help 🗕									
😭 🔲 🙈 🛝 🛤 🏩 🕨 🔳 📟 🖏 🏠 🐼 😹 Wedge Flow Meter - Lig Mass									
Data Inote & Linze Fluid Properties Comments & Info Calculated Results Flow Curves Calculate [Fine & Flagne Inf]									
- Selected Pipe Specifi	cations:	Pine Spec	ifications:		- Elange Specifications	Calculated Results: -			
1/2 Inch Sch	edule 40 🎖	Iron-Steel Pipe Diameter:	/2 inch 🔻 🕇	F F	Type: Raised Face	Calculation Results:	~		
(Standard Pipe S	Nize) Ö	Stainless Steel Schedule:			Rating: Doom				
Include Sizing with Th	ermal Expansion	Effects			300#				
-Flow Element:	Flu	id: 🖲 Liq 🔎 Mass 🖗 Act	Optional Specification Reference Temperature	IS:	SG based on water	r			
-Helt-		C Gas C Vol C Std		00 7	C SG based on air				
New York	Element	Wedge Flow Meter	Reference Water Density:	62.37	lb/ft ³	—			
H/D Ratio:	0.2	(H/D Ratio: of 0.2)	Pipe Roughness:	0.00015	Steel (ft)				
Process Data at Flow	ing Conditions:		Tap Elevation Change:	0	ft	-			
Mass Flow:	100	lb/hr 💌	Calibration Factor:	1	Unitless	T			
Temperature:	68	•F ▼ 60 °F ▼	Onlawlating Description		1 01111000				
Pressure:	100		- Calculation Results: -	Tap/Goal DP:	Differential Pressure Units:				
Marriella				1	in-H2O@60°F	-			
viscosity:	1	centipoise	Tap Pressure [Drop = Calcul	ated in-H2O@60°F				
Compressibility:	1	Compressibility	Flow Pressure [Drop = Calcul	ated in-H2O@60°F				
Molecular Weight:	18.015	Molecular Weight	Elevation Pressure Cha	nge = Calcul	ated in-H2O@60°F				
Cp/Cv Ratio:	1.4	Co/Cy Ratio	Permanent Pressure L	oss = Calcul	ated in-H2O@60°F				
E Input: Density:	62.37	15/03	Wedg	e Flow Meter	- Liq Mass				
Marco December 1	02.01					•			
Vapor Pressure:	14.696	psia 💌	Detailed Results	Kow Absolute V	/alues 🔽 Flow Curve	es			
Enter comments or no	tes to be save	d below:							
Comments:									
							~		
							>		
	 ∕ 								

To start the program, click FILE in the upper left toolbar. Next click on NEW. This clears any data stored in the program registers from the previous session.

When selections are made which are outside of specification parameters, prompts appear to assist you. Two examples of such prompts are shown below :

\mathbf{X}
a

		Required Data:		
ī	Nominal Diameter	1/2 Inch		
F	Pipe ID (in)	0.622		
Schedule Schedule 40				
T	Material	Carbon Steel		
F	Pipe OD (in)	0.84		

The Windows Toolbar provides access to the ABB Program Suite Explorer and the following programs.

	ABB Program Suite Explorer	X
	🖃 🚔 Engineering Units Conversion	^
	🔣 EquationSolver	
	Units Conversion - Basic	
	Units Conversion - General	
	Units Conversion - Metric	
	Units Conversion - All	
	Units Conversion - Advanced	
	🖃 🧰 Physical Properties Programs	
	Physical Properties (Organic)	
	Heats of Fusion & Vaporization (Elements, Inorganic)	
	Heats of Vaporization (Inorganic, Organic)	
	Heat Capacities (Inorganic, Organic)	
	🗛 Heat Capacities (Inorganic, Organic - Ideal Gas State)	
	Heats & Free Energies of Formation (Inorganic)	
	Heats of Combustion (Inorganic, Organic)	
	Engineering Programs	
	E Flow Measurement Elements	
	E Liquid Flow	
	E Liquid Mass Flow	
	- 0, Liquid Mass Balanced Flow Meter	
	D Liquid Mass Onfice Flow Meter	
	Ball	
	Liquid Mass Elbow Flow Meter	
	N ^g Liquid Mass Pitot Tube	
	Liquid Volume Flow	
	Ban Liquid Volume Balanced Plow Meter	
1	Ban Liquid Volume Wedge Flow Meter	
1	Ben Liquid Volume Venturi Piow Meter	
	Bon Liquid Volume Orifice Flow Meter	
3	Contraction of the second seco	
	Ban Liquid Volume Elbow How Meter	
1		
	Gas How	
	Pa ^H Gas Mass Flow	
	Gas Mass Under Flow Meter	
	B Gas Mass Weuge How Meter	
	B Gas Mass Orifice Flow Meter	
	A Gas Mass Norzle Flow Meter	×

2.2 Data Inputs & Units Screen

The Data Inputs & Units screen is the default opening screen and sizing calculations may be performed with no further window selections, providing the process data is in actual conditions. Described below are the various sections of the opening screen.

Selected Pipe Specifications

- Select Nominal Diameter between ½ inch and 36 inch by utilizing the drop down menu, or the slide bar to the right of the drop down menu.
- Select Pipe Schedule by utilizing the drop down menu or the slide bar.
- Select the material from Iron-Steel, Carbon or Stainless Steel.

Note. Once selected, the chosen Pipe Specifications are highlighted at the left. If the text in this area is blue, the pipe sizing exists. If the text is red, it is a non-standard pipe size. For Wedge products, not all pipe sizes/schedules may be offered within the standard product line and may require a factory quotation.

Flow Element

Fluid – select the fluid phase (Liquid or Gas) and flow type (Mass or Volume units).

Note. Changes made in this section are reflected in the area below - "Process Data at Flowing Conditions".

Element – Select the type of element to be sized, using the drop down box. This selection changes the description and content of the meter characteristic selection below.

The meter types available (and the corresponding characteristic) are:

Wedge Flow Meter	(H/D ratio or input Kd2)
Venturi Flow Meter	(Beta ratio or input bore diameter)
Orifice Flow Meter	(Beta ratio or input bore diameter)
Nozzle Flow Meter	(Beta ratio or input bore diameter)
Elbow Flow Meter	(Radius of curvature)
Pitot Tube.	(Velocity Head factor)

Note.

- 1. The Pitot Tube option is historical and does not allow correct sizing of either a Torbar or a PitoMaster.
- The sizing of Venturi Tubes, Nozzles, etc is for guidance only and should only be used to establish that a particular DP value is viable for the entered flow data, not for establishing meter geometry or for calculating an accurate meter bore.

Example: If the selection is changed from a Wedge to a Nozzle, the box below changes from a H/D Ratio selection to a Radius of Curvature data entry. Select and highlight the default number of 1 and enter the correct radius value. In the drop down box to the right, select the unit of measurement appropriate to the radius value.

Note. based on the selection of, for example, Liquid or Gas, certain selections will be disabled and cannot be changed, selected or highlighted.

Process Data input

Process data may be entered in one of the following ways:

Actual Conditions

- 1. Process data for actual conditions may be entered directly on the opening default input screen. Items highlighted in blue are the required inputs.
- If required, select the Fluid Properties button, enter pressure, temperature and density, then select one of the fluid properties sections at the bottom of the window bottom and find the fluid being measured. Calculations for MW, vapor pressure etc are calculated and brought forward to the calculation screen.

The Process Data at Flowing Conditions can be selected, highlighted and new inputs entered. Drop down boxes contain additional options.

Note. If selection areas are disabled, they are not required for the current selection.

Parameters in the area "Process Data at Flowing conditions" :

- Volumetric Flow Rate
- Temperature
- Pressure
- Viscosity
- Compressibility
- Molecular Weight
- Cp/Cv Ratio
- Density
- Vapor Pressure

Parameters in the area "Optional Specifications" are as follows. If the conditions can be selected and highlighted, new inputs can be entered. Drop down boxes contain additional options.

Note. If selection areas are disabled, they are not required for the current selection.

- Reference Temperature (used for SG calculation)
- Reference Density
- Pipe Roughness
- Tap Elevation Change used when considering a vertical installation
- Calibration Factor changing the calibration factor (to any value other than 1) changes the default meter factor. Such changes should only be made by factory personnel.

Parameters in the area Calculation Results are as follows:

- Select Differential Pressure Units the default is "in-H₂0 @60F"
 All the following parameters will then be calculated in the selected units
- Tap Pressure Drop
- Flow Pressure Drop
- Elevation Pressure Drop
- Permanent Pressure Loss

Below these results, a drop box is available to select a program variable or constant and monitor the value based on program input or changes.

Calculated Results – this area to the right defaults to a short form version of the results of the calculation, updated as appropriate whenever the Start button (an icon on the menu bar) or the Calculate button are clicked. This displays the minimum level of data results for sizing. A long form report can be generated by clicking the box next to *Detailed Results* and clicking once more on Start or Calculate . This option can be deselected by clicking again.

Standard Conditions

It is important to understand that when measuring gases at standard volume conditions (i.e.SCFH), it is necessary to to select Std volume in the Flow Element fluid selection for proper calculation.



The reason for this is that the program internally performs calculations based on converted mass flow rates and will return volumetric rates at both standard and flowing conditions in the results page.

Additionally process data at both standard and flowing conditions may be entered under the fluid properties page for conversion from standard to actual conditions. Click on the *Fluid Properties* button which will display the following screen:-

🗧 ABB Fluid Physical Properties 🛛 🔀												
File Help												
– Process Data @ Flow	ving Conditions:				Process Data @ Standard Conditions:							
Temperature:	68	۴F		-		Temperature:	68	۴F		-		
Pressure:	60	psia		•		Pressure:	60	psia		-		
Viscosity:	1	centip	oise	-		Viscosity:	Not Used	cent	ipoise	-		
Compressibility:	1	Compr	ressibility	-		Compressibility: C (z=1)std.:	5.850651E-03	Com	pressibility	•		
Molecular Weight:	18.015	Molec	ular Weight	•	1	Molecular Weight:	18.015	Mole	ecular Weight	•		
Cp/Cv Ratio:	1.4	Cp/Cv	/ Ratio	-		Cp/Cv Ratio:	Not Used	Cp/I	Cv Ratio	-		
Density:	62.37	lb/ft ^e		-		Density:	62.37	Ib/f8	3	•		
Vapor Pressure:	14.696	psia		•		Vapor Pressure:	14.696	psia		•		
- Flow Rate @ Flowing	Conditions:				- Flow Rate @ Standard Conditions:							
Mass Flow Rate:	56.58111	kg/hr		-		Mass Flow Rate:	56.58111	kg/ł	nr	-		
Volumetric Flow Rate:	Þ	fê/hr		•	Std	I. Vol. Flow Rate:	2	ft²/h	r	-		
– Specific Gravity Data	@ Flowing Cond	ditions: -			- Speci	fic Gravity Data	a @ Standard Co	ndition	ns:			
Reference Temperature:	60 °F 🔽	SG SG SG	based on water based on Air	r	Reference Temperature: 60 °F SG based on water					r		
Reference Density:	62.37	lb/ft®		-	R	eference Density:	62.37	Ib/ft	3	-		
Select Fluid Property	Method @ Flowi	ng Con	ditions:		Selec	t Fluid Propertie	es @ Standard C	onditio	uns:			
Liquid Density	Steam/ <u>W</u> ate	er	Ext-Lee- <u>K</u> esler	EoS	Liq	uid Density	Steam/ <u>W</u> a	ter	Ext-Lee- <u>K</u> esler	EoS		
<u>V</u> apor Pressure	Air/+Spec Hum	nidity []	Peng-Robinson	EoS	⊻ap	or Pressure	<u>A</u> ir/+Spec Hur	midity	Peng-Robinson	n EoS		
Entered Actual Volume	tric Flow Rate: A	All corre	sponding flow r	ates	∏ Sh	ow Process & S	tandard Conditio	ons in F	Results.			
have been calculated :	successfully.											
						Apply	Cancel		OK			

Follow steps similar to those described above for actual conditions, but initially enter data for the fluid at both standard (eg STP, NTP, etc) and flowing (Actual) conditions. The pressure, temperature and density at standard conditions should be entered on the right half of the screen. Enter the flowing (Actual) pressure, temperature and density on the left side of the screen.

Data may be imported from the *Fluid Properties* buttons as before, but on this occasion for both standard and flowing conditions. Enter the flow rate at standard conditions and click *Apply*. The program will calculate mass and actual volumetric rate under the flowing conditions. As before clicking on *Apply* and *OK* will import the data to the main screen for final calculations.

Comments & Information Screen

Clicking on the *Comments and Info*. Button displays the following screen, which provides an easy workstation to enter information and comments to be saved with the calculation. Information can be entered directly from the keyboard or copied and pasted from another area or application.

👺 ABB Program Suite - [Wedge Flow Meter - Liq Vol]	
🙅 File Edit View Start Results Window Help	_ @ ×
🗃 🖬 🚳 🔈 🐁 🛍 🛍 🕨 💷 🔳 🐿 🖄 🖾 🐊 🜆	ut Value(s) Changed
Data Inputs & Units Eluid Properties Comments & Info. Calculated Results	lo <u>w</u> Curves <u>C</u> alculate Pip <u>e</u> & Flange Inf.
Enter Name and any other contact information:	Enter Number and any other sizing information:
Project Name:	Project Number:
Enter comments or notes to be saved below:	۱ ــــــــــــــــــــــــــــــــــــ
Comments:	

Calculated Results

Clicking on the Calculated Results button displays this screen which provides all the calculated results, displaying them in text format.



Flow Curves

Clicking on the Flow Curves button displays this screen which displays the results graphically.



Results

The ABB GENIE II program can display results within certain Microsoft products, including Word & Excel. From the menu bar select Results, followed by the format required.

🐐 ABB Program Si	uite - [Wed	ge Flow Meter - Act G	as Vol]	
🙅 File Edit View	Start Results	s Window Help		
B B	K Cuic Grat	sk View ph	🗎 🔯 🏼 🛤 Input Value(s) Cl	nanged
Data Inputs & Units Selected Pipe Specific 4 Inch Sche (Standard Pipe S ✓ Include Sizing with Thi Flow Element: → HD Retor: → HD Retor:	Eluid Pr cations edule 4 Vize) ermal E: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	el Word : Conversions Juit Conversions vicity Head (coefficient K) ailed Report ndard Steel bon Steel nless Steel	Idated Results Flow Curves Fications: Inch Chedule 40 Coptional Specifications: Reference Temperature: 60 *F Reference Water Density: 62.37 Pipe Roughness: 0.00015 Tap Fievation Chance 0	Calculate Pipg & Fil Flange Specifications: Type: Type: Raised Face Rang: 150# C SG based on water © SG based on water b/R* Steel (ft)
Act. Vol. Flow:	50	liter/sec 🔻	Calibration Factor: 1	
Temperature:	68 60	•F ● 60 °F ▼ psia ▼ ▼ ▼	Calculation Results: Tap/Goal DP:	Differential Pressure Units:
Viscosity:	1	centipoise 💌	Tap Pressure Drop = 964	.1372 mm-H20@39.2°F
Compressibility:	1	Compressibility	Flow Pressure Drop = 964	.1372 mm-H2O@39.2°F
Molecular Weight:	18.015	Molecular Weight	Elevation Pressure Change =	0 mm-H2O@39.2°F
Cp/Cv Ratio:	1.4	Cp/Cv Ratio	Permanent Pressure Loss = 443	.1635 mm-H2O@39.2°F
Input: Density:	5	lb/ft ³	Wedge Flow Meter - Act Gen Vol. Size	Bas Vol - Sizing Results:
Vapor Pressure:	14.696	psia 💌	Detailed Results Vi Show Absolut	le Values 🔽 Flow Curves
- Enter comments or no	tes to be save	d below:		

The Microsoft application will then open and be populated with the results. Samples of the text and graphical sheets for Word are shown below. These can be generated into a final report, logged for future reference, or e-mailed to project personnel. Results may be generated in a short or long form.

ABB	Program	Suite:	Wedge	Flow	Meter	 Act	Gas	Vol	Flow

ABB Program Suite	Calculation Results
Wedge Flow Me	eter - Act Gas Vol
21 April 2011	14:35:42
Project Name:	
Project Number:	
Pipe Specifications:	(Standard Pipe Size)
Pipe ID	4.0260 Inch
Diameter	4 Inch
Schedule	Schedule 40
Pipe Roughness	0.00015 Steel (ft)
Material	Carbon Steel
Flow E	lement:
Tap Elevation Change	0 ft
H/D Ratio	0.5 (H/D Ratio dr 0.5)
Calibration Factor	· KUSAMA
Process Data at F	lowing Conditions:
Actual Cas Values Films	50 Repared
Temperature	AS *F
Pressure	50 mia
Density	5 68
Cp/Qy Ratio	1.4 Cp/Cy Ratio
Viscosty	1 centipoise
Vapor Pressure	14.696 85.8
Wedge Flow Meter - Ac	t Gas Vol - Sizing Results:
Tap Pressure Drop	964.1372 mm-H2O@39.2*F
Flow Pressure Drop	964.1372 mm-H2O@39.2*F
Elevation Pressure Change	0 mmH2Og39.2*F
Permanent Pressure Loss	443.1035 mm+120(033.2*F
Total kd	54.03022 /s
Reynolds No.	49859.0
This program is intended as an engineering tool to aid in the	selection of ABB Products
ABB instrumentation provides this package "as is", without	warranty of any kind.
The user or client assumes full responsibility for it a application	on and integrity of the program output.
Meter designs below 2 Inch-H2O or above 400 in ch-H2O are n Read on 150, 155, API, A SME and A CA standard a Wedge d	tot recommended.
basis on rad, ran, ner, name and non standard a modge of	and the month of the second
This program do as not include the complete product offering	available from ABB instrumentation
For purchase of ABB products, please contact your sales rep	resentative.
Results Ge	nerated On:
Date	21/04/2011
Time	14:35:42

ABB Program Suite Graphics: Wedge Flow Meter - Act Gas Vol Flow versus Tap DP



ABB Program Suite Graphics: Wedge Flow Meter - Act Gas Vol Flow Curve



2.3 Sizing Integral Orifice meters (1330L, FPD510 IOMaster)

The following procedure describes the best way to select the most appropriate plate for an integral orifice meter such as the 130L or FPD510 IOMaster, and calculate the resultant DP generated.

1. Start the Genie program. The following screen will then display.

ABB Program S	uite - [Orifi	ce Flow Meter - Liq M	ass]	
🙅 File Edit View	Start Results	Window Help		
	ኤ 🖻 💼		🖆 🔯 😹 ABB Program Sui	te - [Orifice Flow Meter - Li
Data Inputs & Units	Fluid Properties	Comments & Info. Calc	culated <u>R</u> esults Flow Curves	Calculate Pipe & Flan
- Selected Pipe Specifi 1/2 Inch Sch (Standard Pipe S V Include Sizing with Th	cations: edule 40 Size) ermal Expansion	Iron-Steel Pipe Carbon Steel Stainless Steel Effects	ifications: /2 Inch	Flange Specifications: C Type: Raised Face Rating: 300#
- Flow Element:	Flui	id: C Liq C Mass C Act C Gas C Vol C Std	Optional Specifications: Reference Temperature: 60 °F	© SG based on water C SG based on air
	Element:	Orifice Flow Meter	Reference Water Density: 62.37	lb/ft ³
Beta(ß) Ratio:	0.2	Vedge Flow Meter Venturi Flow Meter	Pipe Roughness: 0.00015	Steel (ft)
Process Data at Flow	ving Conditions:	Orifice Flow Meter	Tap Elevation Change: 0	ft
Mass Flow:	100	Elbow Flow Meter	Calibration Factor: 1	Unitless
Temperature:	68		Calculation Results:	Differential Deserves Links
Pressure:	100	psig 💌	1 ap/Goal DP.	in-H20@60°F
Viscosity:	1	centipoise 💌	Tap Pressure Drop = Calcu	lated in-H2O@60°F
Compressibility:	1	Compressibility	Flow Pressure Drop = Calcu	lated in-H2O@60°F
Molecular Weight:	18.015	Molecular Weight	Elevation Pressure Change = Calcu	ated in-H2O@60°F
Cp/Cv Ratio:	1.4	Cp/Cv Ratio	Permanent Pressure Loss = Calcu	ated in-H2O@60°F
Input: Density:	62.37	lb/ft ³	Wedge Flow Mete	r - Liq Mass
Vapor Pressure:	14.696	psia 💌	Detailed Results 🔽 Show Absolute	Values 🔽 Flow Curves
Enter comments or no	otes to be saved	d below:		

- 2. In the Element pulldown, select Orifice Flow Meter.
- 3. In the *Flow Element* section, use the *Fluid* radio buttons to select either *Liquid* or *Gas* and to select either *Mass* or *Volume* units.
- 4. Select the Pipe *Diameter* (½, 1 or 1.5 in.) and *Schedule* (40S or 80S). Ignore the Flange *Type* and *Rating*.

Selected Pipe Specifications:	Flange Specifications:			
1/2 Inch Schedule 408 Carbon Steel	Diameter:	1/2 Inch		Type: Raised Face 💌
 Include Sizing with Thermal Expansion Effects 	Schedule:	Schedule 40S		Rating: 150#
Flow Element			ecifications:	

5. In the Beta (B) ratio pulldown, select Bore Diameter

- Flow Element: -		Flui	d: C Liq C Mass C Act C Gas C Vol C Std
		Element:	Orifice Flow Meter
Beta(ß)	Ratio:	0.2	(BETA RATIO)
Process Data a	at Flowing	Conditions:	(BETA RATIO) (Beta(ß) Ratio: of 0.2)
Act. Vol.	Flow:	2	(Beta(ß) Ratio: of 0.3)
Tempe	rature:	68	(Beta(Is) Ratio: of 0.4) (Beta(Is) Ratio: of 0.5)
Pre	ssure:	100	(Beta(ß) Ratio: of 0.6) (Beta(ß) Ratio: of 0.7)
Vis	cosity:	1	(BORE DIAMETER)

6. The parameter will change to read Bore Dia. Select the appropriate units (in. or mm.)

- Flow Element:	Flui	d: C Liq C Mass C Act C Gas C Vol C Std
	Element:	Orifice Flow Meter
Bore Dia.:	0.15	in 💌
- Process Data at Flowin	ong Conditions:	in 🔨
Act. Vol. Flow:	4	yd
Temperature:	20	mile m
Pressure:	5	cm mm
Viscosity:	1	km 💌

7. If the actual orifice bore is not already known, enter initially a value of bore in the middle of the range available for the meter size chosen, for example :

Size Suggested Bore

½ in.	0.15 in		
1 in.	0.196 in.		

1½ in. 0.75 in

8. Enter the process data, selecting the appropriate units for each parameter.

Process Data at Flowing Conditions:						
Act. Vol. Flow:	4	liter/min 💌				
Temperature:	20	°C ▼ 60 °F ▼				
Pressure:	5	(bars)g 💌				
Viscosity:	1	centipoise 💌				
Compressibility:	1	Compressibility				
Molecular Weight:	18.015	Molecular Weight				
Cp/Cv Ratio:	1.4	Cp/Cv Ratio				
Input: Density:	998	kg/m³ 💌				
Vapor Pressure:	14.696	psia 🗸				
Enter comments or no	otes to be save	d below:				

Press the *Calculate* button. Read off the calculated DP.
 If the units need to be amended, select the appropriate units and press the *Calculate* button again to recalculate the DP in the new units

- In this example the DP and overall pressure loss values are quite high.
 To reduce the DP, select the next higher bore size and enter the new value into the Orifice Bore box.
 To increase the DP, select the next lower bore size and enter the new value into the Orifice Bore box.
- 11. Hit Calculate button and read off the new DP and pressure loss.

Flow Element:	iow Element:						
	Element	Orifice Flow Meter	Reference Water Density:	62.37	lb/ft³		
Bore Dia.:	0.196	in 💌	Pipe Roughness:	0.00015	Steel (ft)		
Process Data at Flow	ing Conditions:		Tap Elevation Change:	0	ft 💌		
Act. Vol. Flow:	4	liter/min 💌	Calibration Factor:	1.0	Unitless		
Temperature:	20	°C 💌 60 °F 💌	- Calculation Results: -				
Pressure:	5	(bars)g		Tap/Goal DP: 155.1029	Differential Pressure Units: mBars		
Viscosity:	1	centipoise 💌	Tap Pressure [)rop = 155.10)29 mBars		
Compressibility:	1	Compressibility 💌	Flow Pressure D)rop = 155.10	029 mBars		
Molecular Weight:	18.015	Molecular Weight	Elevation Pressure Cha	nge = 0	mBars		
Cp/C∨ Ratio:	1.4	Cp/Cv Ratio	Permanent Pressure L	oss = 143.27	789 mBars		

Repeat steps 10 and 11 until an acceptable DP is found.

Record the values of the chosen orifice bore and the resultant DP value. They will be needed when the product is coded in ConfigurX to select the appropriate orifice bore and Transmitter element (DP Span).

For the latter, for optimum accuracy always choose the element with the lowest DP span that will accommodate the calculated DP.

2.4 Error Messages

Depending on the process condition entered the program may indicate errors associated with non-standard pipe size, high pressure drop, high velocities, cavitation or other potential problems.

If this occurs it may be necessary to revise the process data or change the pipe size.

🎬 ABB Program Suite - [Orifi	ice Flow Meter - Act Gas Vo	ij	_ 8 ×
🙅 File Edit View Start Re	esults Window Help		_ 8 ×
🖻 🖬 🥔 👗 🖻 🖻	8 🕨 💶 💌 🐿	🖄 🔯 calculating Please Wait	
Data Inputs & Units Eluid Prope	erties Comments & Info. Cal	Iculated Results Flow Curves Calculate Pipe & Flange Inf.	
- Selected Pipe Specifications:	C Iron Steel Bins	cifications: Calculated Results:	
2 Inch Schedule 60	Carbon Steel	2 Inch V 4 V Raised Face V Orifice Flow Meter - Act Gas Vol	-
(Non-Standard Pipe Size)	C Stainless Steel Schedule:	Schedule 80 VII Rating: 300# VI	
I Include Sizing with Thermal Expan Class Class and	ision Effects	Project Name:	
- Plow clement.	Fluid: C Liq C Mass Act Gas Vol C Std	Reference Temperature: 60 *F SG based on water C SG based on air	
Ela	Orifice Flow Meter	Reference Water Density: 62.37	
		Pipe Specifications:(Standard Pipe Size)	
Beta(ß) Rato: 0.2	(Beta(13) Ratio: of U.2)	Pipe ID = 0.6220 Inch	
Process Data at Flowing Condition	ons:	Tap Elevation Change: 0 ft Schedule = Schedule 40	
Act. Vol. Flow: 5000	ft®/hr 💌	Calibration Factor: 1 Unitless	
Temperature: 68	●F ▼ 60 °F ▼	ABB Program Suite	
Pressure: 1	psig	ABB Engineering Program Error.	
Viscosity: 1	centipoise	Error Description: Throat Mach number = 1. Please change flow conditions	
Compressibility: 1	Compressibility •	Flow Press.	
Molecular Illeight 19.015		Flevation Pressure	
10.013	Molecular Weight	Actual Gas Volume Flow = @Flowing Conditions	
Cp/Cv Ratio: 1.4	Cp/Cv Ratio	Permanent Pressure Loss = VOERROR III-FI20(geo F Pressure = 1 psig	
Density: 62.37	lb/ft ³	Orifice Flow Meter - Act Gas Vol - Sizing Results: Compressibility = 1 Compressibility	
Vapor Pressure: 14 696		Molecular Weight = 18.015 Molecular Weight	
14.030	l baid	Detailed Results Show Absolute Values Flow Curves Viscosity = 1 centipoise	
-Enter comments or notes to be s	saved below:	Vapor Pressure = 14.696 psia	
Comments:		Orifice Flow Meter - Act Gas Vol - Sizing Results:	
		Tap Pressure Drop = I/O ERROR in-H2O@60"F	
		Flow Pressure Drop = I/O ERROR in-H2O@60*F	
		Permanent Pressure Loss = 1/0 ERROR in-H20@60*F	
		Total Cd = 0.6110	
		Reynolds No. = 1.0	-
ļ			
🎒 Start 🛛 🞯 📩 🍳 💈 🛛	🖻 📼 💕 🖉 🔛 📓	👿 🏉 💿 📲 🚺 😥 🖉	0:33 AM

Appendix A Fluid Properties Screen

The Fluid Properties Screen sets all fluid properties based on the fluid selected. Options available are *Process Data @ Flowing Conditions, Flow Rate @ Flowing conditions* and *Specific Gravity @ Flowing Conditions*. If you have opted to enter or change information, click on Apply once all changes are complete.

Fluid Properties @ Flowing Conditions

This provides 4 options. Click on the relevant button.

1. Liquid Density

Simply select the fluid, enter the correct temperature and click OK to continue.

Sizing Options: Select Fluid Physical Proper	ties		
Saturated Liquid Density f	or 1,1-Dichloropropane (1)@68 °F	
Select the fluid, enter the correct temperature and click "OK Enter Fluid Temperature & Select Units: 68	" to Continue	<u>R</u> esults <u>C</u> alculate	<u>C</u> lose
Select Substance:	Select Formula:	Select CAS Number:	
1,1-Dichloropropane (1)	C3H6Cl2	78999	
1.10/ek/korozonene (1) 1.10/met/w/colchexane 1.2.47/met/w/benzene 1.2.9Ludiere 1.2.0/ek/nore 1.2.0/ek/nore 1.2.0/ek/nore 1.2.0/ek/nore 1.3.57/met/w/benzene 1.3.8Ludiene 1.8Lutanal 1.8Luta	C3H5CI2 C8H16 C3H12 C4H6 C3H6CI2 C3H6CI2 C3H802 C3H12 C4H6 C4H80 C4H80 C4H80 C4H80 C4H80 C4H700	 ▶ 79393 ▶ 96569 ▶ 96569 ▶ 96566 ▶ 95052 ▶ 9875 ▶ 7556 ▶ 106878 ▶ 106939 ▶ 133728 ▶ 71363 ▶ 106983 ▶ 500545 	
Results and Equations:	Calculated Results:		
Saturated Liquid Density for: 1.1-Dichloropropane [1] Structural Formula: C3H6D2 Molecula: 112.986 CAS Number			
Name = 1,1-Dichloropropane (1) , Formula = C3H	6Cl2 , CAS Number = 7899	9	Cancel

2. Vapor Pressure

Simply select the fluid, enter the correct temperature and click OK to continue.

Sizing Options: Select Fluid Physical Proper	ties		×				
Vapor Pressure for *	Vapor Pressure for 1,1-Dichloropropane @ 68 °F						
Select the fluid, enter the correct temperature and click "OK	to Continue		1				
Enter Fluid Temperature & Select Units: 68	°F 💌	<u>R</u> esults <u>Calculate</u>	<u>C</u> lose				
Select Substance:	Select Formula:	Select CAS Number:					
1,1-Dichloropropane	C3H6CI2	78999					
1.10/ek/korptopene 1.24/imet/u/ec/ek/aree 1.24/imet/u/ec/ek/aree 1.20/ic/korptopene 1.20/ic/korptopene 1.20/ic/korptopene 1.20/ic/korptopene 1.20/ic/korptopene 1.35/imet/u/benzene 1.36/ucdene 1.8utanol 1.8utanol 1.8utanol 1.8utene 1.Chloroptopene	0346012 C8H16 C9H12 C4H6 C3H6C2 C3H6C2 C3H802 C4H46 C4H80 C4H80 C4H100 C4H8 C3H7C1	 ▲ 78999 ● 590669 ● 95636 ● 590132 ● 78875 ● 57556 ● 100678 ● 100678<td></td>					
Results and Equations:	Calculated Results:						
Vapor Pressure for: 1,1-Dichloropropane							
Structural Formula: C3H6Cl2							
Molecular Weight: 112.986							
CAS Number							
Name = 1,1-Dichloropropane , Formula = C3H6	CI2 , CAS Number = 78999	ОК	Cancel				

3. Steam/Water Density

THE 19	67 A 9	SME ST	ЕАМ ТАВ	LES		×
•	The calc Steam Q Molecula Compress Density • Viscosity Saturatic Saturatic Degrees Degrees Specific Specific Specific Specific Specific Specific Cp/Cv F Critical/S	culated (Wat tuality (0-100 ar Weight = ' sibility = 3.0 = 62.33215' = 1.00255 on Temperat on Xapor Pr e of Subcooli Enthopy (Bit Heat, C.P. (E Heat, C.P. (E hatio = 1.000 Sonic Veloci	er) Physical Pr 1%) = 0 18.015 524632-03 b/f ⁰ centipoise ure = 292.710 sssure = 0.338 at 19.224,7109 at 224,7109 at 24.7	operties @ 9 "F 8896 psia) "F 12044 0707491 0.998237 67.533	968 °F and	60 psia are:
Resu	lts			0	IK	Cancel

4. Peng-Robinson (Fluid Property Evaluation)

Peng Robinson allows the user to enter a gas mixture and will then calculate density and other parameters for the pressure and temperature entered on the main sizing screen.

Peng-Robinson Fluid Property Evaluation									
Compone	ents State	& Transport Properties	Fugacity Coefficient(s)						
Select Component Methane Ethane Propane n-Butane n-Pentane	nt(s), then click "Button 1)" n-Hexane n-Heptane n-Octane n-Nonane n-Nonane n-Decane	n-Undecane n-Dodecane n-Tridecane n-Tetradecane n-Pentadecane	Display Component: Name Formula C CAS No. Search Value:						
			Re-Select Components						
1) Compon	Clear Selection								
Selection List:									
(No Components Selected.) 1) a. Select components from above list and click "Component Selection"or- V									
Compositions and Selected Components:									
(None)									
L			OK Cancel						

- (1) Ensure that the working pressure and temperature for the gas mixture (whether standard or flowing conditions) has been entered on the previous screen.
- (2) To set up a gas mixture, click on the 1st component required with the left mouse key. For subsequent components hold down the CTRL key and click on required components with left mouse key.
- (3) Once components are selected, click on the enter button to confirm entry, the next screen will appear.

😵 Com	ponent(s) Sel	ection & Com	positions					
Cor	Component Selection Component Properties C		Component Coefficients	Component Composition:				
Com	Compositions (click on item and enter composition):							
(X1	= 0.5) 1	CH4	Methane		74828	MW		
(X2	= 0.25) 3	C3H8	Propane		74986	MW		
(X3	= 0.25) 4	C4H10	n-Butane		106978	MW		
Please erer the composition for: 05978 M:W: 58.123 TC: 425.12 PC: 3.7700E+06 OMEGA: Comp 0.197 [X:x] X3 =								
1	CH4	Methane		74828	MW: 16.	043 1		
3	C3H8	Propane		74986	MW: 44.	097 1		
4	C4H10	n-Butan	e	106978	MW: 58.	123 1		
					OK	Cancel		

(4) Click on each compound in turn and enter the fraction of the mix for that component. The fraction is entered in a format such that 90%=0.9; 50% = 0.5; 10% = 0.1 etc. The composition sum must equal 1 or an error message will appear.

(5) Click enter to confirm to return to previous screen



- 6 Change any units required; ensure that the proper S.G. reference, fluid type and calculation units are selected.
- (7) Click on the density button and the density, compressibility and MW will be calculated. The data will then import to the previous screen.

Repeat procedure for flowing conditions if required.

Notes

Products and customer support

Automation Systems

- For the following industries:
- Chemical & Pharmaceutical
- Food & Beverage
- Manufacturing
- Metals and Minerals
- Oil, Gas & Petrochemical
- Pulp and Paper

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- Servo Drives

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- Circular Chart and Strip Chart Recorders
- Paperless Recorders
- Process Indicators

Flexible Automation

- Industrial Robots and Robot Systems

Flow Measurement

- Electromagnetic Flowmeters
- Mass Flowmeters
- Turbine Flowmeters
- Wedge Flow Elements

Marine Systems & Turbochargers

- Electrical Systems
- Marine Equipment
- Offshore Retrofit and Refurbishment

Process Analytics

- Process Gas Analysis
- Systems Integration

Transmitters

- Pressure
- Temperature
- Level
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Valves, Actuators and Positioners

- Control Valves
- Actuators
- Positioners

Water, Gas & Industrial Analytics Instrumentation

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- Ammonia, Nitrate, Phosphate, Silica, Sodium, Chloride, Fluoride, Dissolved Oxygen and Hydrazine Analyzers
- Zirconia Oxygen Analyzers, Katharometers, Hydrogen Purity and Purge-gas Monitors, Thermal Conductivity

Customer support

We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

UK

ABB Limited Tel: +44 (0)1453 826661 Fax: +44 (0)1453 829671

USA

ABB Inc. Tel: +1 215 674 6000 Fax: +1 215 674 7183

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.

Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

- A listing evidencing process operation and alarm logs at time of failure.
- Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

Contact us

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