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:

$\triangle$	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
Ŧ	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.
- 4. 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

# Contents

1	Insta	llation	2
	1.1	Setup	2
2	Intro	duction	
	2.1	Features	
	2.2	Data Inputs & Units Screen	6
	2.3	Sizing Integral Orifice meters (1330L, FPD510 IOMaster)	
	2.4	Error Messages	
Ap	pendi	x A Fluid Properties Screen	

## 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 S	uite - [ Wed	ge Flow Meter - Liq M	ass]				
🙅 File Edit View	Start Results	s Window Help					_ 8 ×
🗃 🗐 🚳 🔍 🗼 🗉 🔳 🔎 🖤 🈭 🕼 🗰 Wedge Flow Meter - Lig Mass							
Data Inputs & Units	Fluid Properties	Comments & Info. Calc	ulated Results Flow	Curves	Calculate Pip	e & Flange Inf.	
- Selected Pipe Specific	cations:	Pipe Spec			Flange Specifications		
	O 0.0	Iron-Steel Pipe	/2 Inch 👻 🖣	► •	Type: Raised Face		~
(Standard Pipe S	Size) Ö	Stainless Steel	Schedule 40 - 4		Rating: 300#	극	
Include Sizing with Th	ermal Expansion	Effects			300#		
-Flow Element:	Flu	id: 🖲 Liq 🔎 Mass 🖗 Act	- Optional Specification Reference Temperature:		SG based on water	r	
-Helt-		C Gas C Vol C Std			C SG based on air		
New York	Element	Wedge Flow Meter	Reference Water Density:	62.37	lb/ft <sup>3</sup>	<b>T</b>	
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	<b>-</b>	
Temperature:	68	•F ▼ 60 °F ▼	Onlawlating Description		1 01111000		
Pressure:	100	psig -		Tap/Goal DP:	Differential Pressure Units:		
				1	in-H2O@60°F	-	
Viscosity:	1	centipoise 💌	Tap Pressure [	Drop = Calcul	ated in-H2O@60°F		
Compressibility:	1	Compressibility			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		
Input: Density:	62.37	lb/ft³ ▼	Wedg	e Flow Meter	- Liq Mass		
						-	
Vapor Pressure:	14.696	psia	Detailed Results	Kow Absolute V	/alues 🔽 Flow Curve	15	
Enter comments or no	otes to be save	d below:	,				
Comments:							
							~
							>
× W • 2	9 🕗 🔍 📼	3 3 8 6 6 8 4	99 3 7 5				

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 :

×
sia

Enter Required Data: Required Data:					
Nominal Diameter 1/2 Inch					
	Pipe ID (in)	0.622			
	Schedule	Schedule 40			
	Material	Carbon Steel			
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	
	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	
	Flow Measurement Elements	
	🚊 🧰 Liquid Flow	
	E Liquid Mass Flow	
	B <sup>B</sup> Liquid Mass Balanced Flow Meter	
	B <sup>B</sup> g <sup>B</sup> Liquid Mass Wedge Flow Meter	
	0 Liquid Mass Venturi Flow Meter	
	B Liquid Mass Orifice Flow Meter	
	Liquid Mass Nozzle Flow Meter	
	$\sum_{\mu} \hat{\theta}_{g}^{\mu}$ Liquid Mass Pitot Tube	
	⊡ Liquid Volume Flow	
	D0 <sup>H</sup> Liquid Volume Balanced Flow Meter	
1		
1		
	Liquid Volume Orifice Flow Meter	
3		
1		
	Gas How	
	u gas Mass Balanced Flow Meter	
	B A Gas Mass Wedge Flow Meter	
	B Gas Mass Venturi Elow Meter	
	B Gas Mass Orifice Flow Meter	
	Bog Gas Mass Nozzle 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-H<sub>2</sub>0 @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 Phy	🗧 ABB Fluid Physical Properties 🛛 🔀								
File Help									
– Process Data @ Flov	Process Data @ Flowing Conditions:					Process Data @ Standard Conditions:			
Temperature:	68	۴F		-	Temperature	68	۴F		•
Pressure:	60	psia		-	Pressure:	60	psia		•
Viscosity:	1	cent	ipoise	•	Viscosity:	Not Used	cent	tipoise	•
Compressibility:	1	Com	pressibility	•	Compressibility: C (z=1)std.:	5.850651E-03	Com	pressibility	•
Molecular Weight:	18.015	Mole	ecular Weight	-	Molecular Weight	18.015	Mole	ecular Weight	•
Cp/Cv Ratio:	1.4	Cp/0	Cv Ratio	•	Cp/Cv Ratio:	Not Used	Cp/0	Cv Ratio	•
Density:	62.37	Ib/ft <sup>e</sup>		•	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/h	đ	-	Mass Flow Rate:	56.58111	kg/ł	1r	-
Volumetric Flow Rate:	2	ft²/hr	1	•	Std. Vol. Flow Rate:	2	ft²/h	r	•
- Specific Gravity Data	@ Flowing Con	ditions			- Specific Gravity Data				
Reference Temperature:	60 °F		G based on water G based on Air	r	Reference Temperature: 60 °F SG based on water			r	
Reference Density:	62.37	lb/ft <sup>e</sup>		-	Reference Density:	62.37	Ib/ft®	1	-
- Select Fluid Property	Method @ Flow	ing Co	nditions:		-Select Fluid Propertie	es @ Standard Co	onditio	ons:	
Liquid Density	Steam/ <u>W</u> at	er	Ext-Lee- <u>K</u> esler	EoS	Liquid Density	Steam/ <u>W</u> at	er	Ext-Lee-Kesler	EoS
<u>V</u> apor Pressure	Air/+Spec Hun	nidity	Peng-Robinson	EoS	⊻apor Pressure	Air/+Spec Hum	nidity	Peng-Robinson	EoS
Entered Actual Volume	atric Flow Bate:	All.com	responding flow r	ates	Show Process & S	tandard Conditio	ns in F	Results.	
have been calculated		All Con	esponding now i	ales					
					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
	low Curves Calculate Pipe & 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:	
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 S	uite - [ Wed	lge Flow Meter - Act G	as Vol]	
🙅 File Edit View	Start Results	s Window Help		
<u> 28 8 8 8</u>	K Cuic Gray	ck View ph	🗎 🔯 🏼 🗿 Input Value(s) Ch	anged
Selected Pipe Specifi	edule 4 Size) Unit Iermal E: All L	el Word t Conversions Jnit Conversions vcity Head (coefficient K)	Jated Results Flow Curves fications: Inch • • • • • • chedule 40 • • • Optional Specifications:	Calculate     Pipg & Fla       Flange Specifications:     Type:       Type:     Raised Face ▼       Rating:     150#       C     SG based on water
H/D Ratio:	↓ Star 0 Carl	ailed Report ndard Steel bon Steel	Reference Temperature: 60 °F Reference Water Density: 62.37 Pipe Roughness: 0.00015	
Process Data at Flow		inless Steel	Tap Elevation Change: 0	ft
Act. Vol. Flow:	50	liter/sec 🔹	Calibration Factor: 1	Unitless
Temperature:	68	•F ▼ 60 °F ▼	Calculation Results:	Differential Pressure Units:
Pressure:	60	psia 💌	964.1372	mm-H2O@39.2°F
Viscosity:	1	centipoise	Tap Pressure Drop = 964.	1372 mm-H2O@39.2°F
Compressibility:	1	Compressibility		1372 mm-H2O@39.2°F
Molecular Weight:	18.015	Molecular Weight	Lievalor Pressure Change -	0 mm-H2O@39.2°F
Cp/Cv Ratio:	1.4	Cp/Cv Ratio		1635 mm-H2O@39.2°F
✓ Input: Density:	5	b/ft³ ▼	Wedge Flow Meter - Act G Wedge Flow Meter - Act Gas Vol - Sizi	
Vapor Pressure:	14.696	psia 💌	Detailed Results Vision Absolut	
Enter comments or no	otes to be save	d below:		
10				

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
		10101010101010	

ABB Program Suite	Calculation Results
Wedge Flo	w Meter - Act Gas Vol
21 April 20	011 14:35:42
Project Name:	
Project Number:	
	ions:(Standard Pipe Size)
Pipe ID	4.0260 Inch 4 Inch
Diameter Schedule	4 Inch Schedule 40
Pipe Roughness	0.00015 Steel (ft)
Material	Carbon Steel
	Carbon Steel
	low Element:
Tap Elevation Change	loft
H/D Ratio	0.5 (H/D Ratio: of 0.5)
Calibration Factor	1 Unitless
	·
Process Data	a at Flowing Conditions:
Act. Vol. Flow	50 Regised
Actual Gas Volume Flow	@Flowing Conditions
Temperature	68 'F
Pressure	5 bit
Density Cp/Cv Ratio	1.4 Cp/Cy Ratio
Viscostv	1 centinoise
Vapor Pressure	1 centicolse 14.696 paia
Wedge Flow Meter	- Act Gas Vol - Sizing Results:
Tap Pressure Drop	964 1372 mm-H2O(039.2*F
Flow Pressure Drop	964.1372 mm+H2O@39.2*F
Elevation Pressure Change	0 mmH2O@39.2*F
Permanent Pressure Loss	443.1635 mm-H2O@39.2*F
Pressure Recovery	54.03522 % 5.437
Total kd* Revnolds No.	6.437 49859.0
Reynolds No.	45855.0
This program is intended as an engineering tool to aid	In the selection of ABB Products
ABB instrumentation provides this package "as is", w	thout warranty of any kind.
The user or client assumes full responsibility for its an	plication and integrity of the program output.
Meter designs below 2 Inch-H2O or above 400 In ch-H2	O are not recommended.
Based on ISO, ISA, API, A SME and AGA standard s. We	eage dierwea from AGA Rep #3, Mart 1.
This program does not include the complete product of	Haring auxilabile from APP is strumentation
For purchase of ABB products, please contact your as	lies representative.
Pesul	ts Generated 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 🖻 💼		🖄 🔯 🏽 🛤 🔁	ite - [ Orifice Flow Meter	- L
Data Inputs & Units	Fluid Properties	Comments & Info. Cal	culated <u>R</u> esults Flow Curves	Calculate Pipe & I	Flan
Selected Pipe Specifi 1/2 Inch Sch (Standard Pipe S I Include Sizing with Th	edule 40 Size)	Iron-Steel Pipe Carbon Steel Stainless Steel	ifications: 1/2 Inch		
- Flow Element:	Flui	id: C Liq C Mass C Act	Optional Specifications: Reference Temperature: 60 °F	SG based on water SG based on air	
	Element:		Reference Water Density: 62.37	lb/ft <sup>3</sup>	
Beta(ß) Ratio:	0.2	Wedge Flow Meter Venturi Flow Meter	Pipe Roughness: 0.00015	Steel (ft)	
Process Data at Flow		Orifice Flow Meter Nozzle Flow Meter	Tap Elevation Change: 0	ft	
Mass Flow:	100	Elbow Flow Meter Pitot Tube	Calibration Factor: 1	Unitless	
Temperature:	68		Calculation Results:	Differential Pressure Units:	
Pressure:	100	psig 💌	1 1	in-H2O@60°F	
Viscosity:	1	centipoise 💌	Tap Pressure Drop = Calc	ulated in-H2O@60°F	
Compressibility:	1	Compressibility	Flow Pressure Drop = Calc	ulated in-H2O@60°F	
Molecular Weight:	18.015	Molecular Weight	Elevation Pressure Change = Calc	ulated in-H2O@60°F	
Cp/Cv Ratio:	1.4	Cp/Cv Ratio		ulated in-H2O@60°F	
Input: Density:	62.37	lb/ft <sup>3</sup>	Wedge Flow Met	er - Liq Mass	1
Vapor Pressure:	14.696	psia 💌	Detailed Results V Show Absolut	e Values 🔽 Flow Curves	1
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:	Flan	ge Specifications:	
1/2 Inch Schedule 40S	on-Steel Pipe arbon Steel Diameter: 1/2 Inch	▼ 4 → Ty	pe: Raised Face 👻
(Standard Pipe Size) ✓ Include Sizing with Thermal Expansion Eff	tainless Steel Schedule: Schedule 40S	▼ ◀ → Rat	ng: 150# 💌
Flow Flement Ontional Specifications			

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

- Flow Element:	Flui	id: C Liq C Mass C Act C Gas C Vol C Std
	Element:	Orifice Flow Meter
Beta(ß) Ra	tio: 0.2	(BETA RATIO)
Process Data at F	lowing Conditions:	(BETA RATIO) (Beta(ß) Ratio: of 0.2)
Act. Vol. Flo	2 2	(Beta(ß) Ratio: of 0.3)
Temperature: 68		(Beta(ß) Ratio: of 0.4) (Beta(ß) Ratio: of 0.5)
Pressu	ure: 100	(Beta(ß) Ratio: of 0.6) (Beta(ß) Ratio: of 0.7)
Viscos	ity: 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 Flowir	ng Conditions:	in 🔨
Act. Vol. Flow:	4	mil 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:	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:			Optional Specification	is:	
	Flu	id: • Liq C Mass • Act C Gas • Vol C Std	Reference Temperature:	60 °F 💌	<ul> <li>SG based on water</li> <li>SG based on air</li> </ul>
	Element	Orifice Flow Meter	Reference Water Density:	62.37	lb/ft <sup>3</sup>
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 [	) Drop = 155.10	029 mBars
Compressibility:	1	Compressibility	Flow Pressure (	Orop = 155.10	029 mBars
Molecular Weight:	18.015	Molecular Weight	Elevation Pressure Cha	nge = 0	mBars
Cp/Cv 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 - [ Orifice	Flow Meter - Act Gas Vol		_ 8 ×
🙅 File Edit View Start Result:	s Window Help		_ 8 ×
🛎 🖬 🙆 📐 🐚 🛍		🛅 🖾 🏽 🏨 Calculating Please Wait	
Data Inputs & Units Eluid Properties	s Comments & Info. Calo	culated Results Flow Curves Calculate Pipe & Flange Inf.	
Selected Pipe Specifications:	Iron-Steel Pipe		
Zinch Schedule 60 🕞	Carbon Steel	2 Inch   Type: Raised Face  Orifice Flow Meter - Act Gas Vol Tuesday, June 14, 2011 10:32:17 AM	-
	Stainless Steel Schedule:	Schedule 60         Image: Schedule 60         Image: Schedule 70         Image: Schedul	
Include Sizing with Thermal Expansion Flow Element:	Effects	Coptional Specifications:     Project Name:	
Flux Element.	ild:C Liq C Mass O Act O Gas O Vol C Std	Reference Temperature: 60 *F C SG based on water Project Number:	
Elamont	Orifice Flow Meter	Reference Water Density: 62.37	
		Pipe Specifications:(Standard Pipe Size)	
Beta(ß) Ratio: 0.2	(Beta(ß) Ratio: of 0.2)	Diameter = 1/2 loch	
Process Data at Flowing Conditions:		Tap Elevation Change: 0 ft Schedule = Schedule 40	
Act. Vol. Flow: 5000	ft³/hr 💌	Calibration Factor: 1 Unitless	
Temperature: 68	•F ▼ 60 *F ▼	Calculation Result	
Pressure: 1	psig 💌	ABB Engineering Program Error.	
Viscosity: 1	centipoise -	Error Description: Throat Mach number = 1. Please change flow conditions  Taw Pressu	
Compressibility: 1	Compressibility -	Flow Press.	
Molecular Weight: 18.015	Molecular Weight	Elevation Pressure www.	
		Actual Gas Volume Flow = @Flowing Conditions	
Cp/Cv Ratio: 1.4	Cp/Cv Ratio	Pressure = 1 pain	
Input: Density: 62.37	lb/ft <sup>z</sup>	Compressibility = 1 Compressibility	
Vapor Pressure: 14.696	psia 💌	Molecular Weight = 18.015 Molecular Weight Cp/Cv Ratio = 1.4 Cp/Cv Ratio	
		Detailed Results     Show Absolute Values     Flow Curves     Viscosity = 1 centipoise	
Enter comments or notes to be save	d 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 Elevation Pressure Change = I/O ERROR in-H2O@60"F	
		Permanent Pressure Loss = I/O ERROR in-H2O@60*F	
		Total Cd = 0.6110	
		Reynolds No. = 1.0	<b>_</b>
μ			<u>*</u>
🎒 Start 🛛 🞯 📰 🍳 💈 🖻	🖃 📴 🖉 🖉 🔝	🔟 🏉 🗿 📀 📲 🛛 🚺 🖗 🖉 🖳 😭 🛛	10:33 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 Property	erties		X
Saturated Liquid Density	for 1,1-Dichloro	propane (1) @ 68 °F	
Select the fluid, enter the correct temperature and click "D		Results Calculate	Close
Enter Fluid Temperature & Select Units: 68	°F 🔻		Liose
Select Substance:	Select Formula:	Select CAS Number:	
1,1-Dichloropropane (1)	C3H6Cl2	78999	
1.1-Dichloropropene (1) 1.2-Oirthive/colohexane 1.2-Artimethylbenzene 1.2-Dichloropropene 1.2-Dichloropropene 1.3-Dirtimethylbenzene 1.3-Butadne 1.8-Butanal 1-8-Butan	C3H6C12 C4H6 C3H6C12 C4H6 C3H6C12 C3H802 C3H802 C3H702 C4H80 C4H80 C4H80 C4H80 C4H80 C4H80 C4H80 C4H700 C4H8 C3H7C1	<ul> <li>▲ 78939</li> <li>► 590663</li> <li>● 5636</li> <li>&gt; 59575</li> <li>&gt; 78875</li> <li>&gt; 757556</li> <li>1 06578</li> <li>1 06578</li> <li>1 23728</li> <li>7 1363</li> <li>1 540545</li> </ul>	
Results and Equations:	Calculated	Results:	
Saturated Liquid Density for: 1,1-Dichloropropane (1) Structural Formula: C3H6Cl2 Molecular Weight: 112,986			
ICAS Number			
Name = 1,1-Dichloropropane (1) , Formula = C3	H6CI2 , CAS Nun	nber = 78999 OK	Cancel

## 2. Vapor Pressure

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

Sizing Options: Select Fluid Physical Pro	perties		X
Vapor Pressure	for 1,1-Dichloropropane	e@ 68 °F	
Select the fluid, enter the correct temperature and click Enter Fluid Temperature & Select Units: 68	"OK" to Continue °F	<u>R</u> esults <u>C</u> alculate	<u>C</u> lose
Select Substance:	Select Formula:	Select CAS Number:	
1,1-Dichloropropane	C3H6Cl2	78999	
1.1-Dichloropopane 1.2-Airlinethylbenzene 1.2-Airlinethylbenzene 1.2-Dichloropopane 1.2-Dichloropopane 1.3-Firmethylbenzene 1.3-Butadine 1-Butanal 1-Butanal 1-Butane 1-Butane 1-Butane	<ul> <li>○3H5Cl2</li> <li>○3H5Cl2</li> <li>○8H16</li> <li>○9H12</li> <li>○4H6</li> <li>○3H6Cl2</li> <li>○3H8Cl2</li> <li>○9H12</li> <li>○4H6</li> <li>○4H80</li> <li>○4H80</li> <li>○4H100</li>     &lt;</ul>	<ul> <li>▲ 78999</li> <li>● 590683</li> <li>● 590683</li> <li>● 590683</li> <li>● 590683</li> <li>● 50192</li> <li>− 78875</li> <li>● 78756</li> <li>■ 106578</li> <li>■ 106590</li> <li>■ 123728</li> <li>~ 105989</li> <li>■ 105989</li> <li>▼ 540545</li> </ul>	
Results and Equations:	Calculated Resu	ults:	
Vapor Pressue for: 1,1-Dichloropropane Structural Formula: C3H6DI2 Molecular Weight:			
112.986			
CAS Number			
Name = 1,1-Dichloropropane , Formula = C	3H6Cl2 , CAS Number =	78999 OK	Cancel

## 3. Steam/Water Density

THE 19	67 ASME	STEAM 1	FABLES		×
•	Steam Quality Molecular We Compressibility Density = 62.3 Viscosity = 1.0 Saturation Ter Saturation/Va Degrees of Su Degrees of	ight = 18.015 y = 3.062463E-1 33215 lb/ft <sup>8</sup> 10255 centipois mperature = 29; por Pressure = uperheat = 0 *F ubcooling = 224 alpy (Btu/Lbm) + py (Btu/Lbm/+ Cp, (Btu/Lbm/- CV, (Btu/Lbm/+	03 e 2.7109 °F 0.3388896 p 1.7109 °F = 36.22044 3) = 0.070745 "R)= 0.99857 "R)= 0.99823	sia 31 37	nd 60 psia are:
Resu	ilts			OK	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-Robin	son Fluid Proper	ty Evaluation	
Com	ponents	State & Transport Properties	Fugacity Coefficient(s)
Select Comp Methane Ethane Propane n-Butane n-Pentane	onent(s), then click "f n-Hexan n-Heptan n-Octanc n-Nonan n-Decan	e n-Undecane e n-Dodecane n-Tridecane e n-Tetradecane	Display Component: Name Formula CAS No. Search Value:
			Re-Select Components
1) Con	Clear Selection		
1) a. Se	onents Selected lect components component Select	from above list and clic	=k
Compositions ar (None)	nd Selected Compone	No	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.

	mponent Selection			omponent Coefficients	Component Co	mposit
Comp	positions (click on i	item and enter c	omposition):			
(X1	= 0.5) 1	CH4	Methane		74828	M
	= 0.25) 3	C3H8	Propane		74986	M
(X3	= 0.25) 4	C4H10	n-Butane		106978	M
	Input Compos	sition (X3)				
	Disease subscribes					
	Flease enter the	e composition fo	r:	OK		
	4 C4H10	n-Butane	106978	ОК		
	4 C4H10 MW: 58.123	n-Butane	r: 106978 PC: 3.7700E+06 OMEGA:			
Comp	4 C4H10 MW: 58.123	n-Butane	106978			
Comp (Xs	4 C4H10 MW: 58.123 0.197	n-Butane	106978			
	4 C4H10 MW: 58.123 0.197 X3 =	n-Butane	106978			
(Xs	4 C4H10 MW: 58.123 0.197 X3 =	n-Butane	106978			
	4 C4H10 MW: 58.123 0.197 X3 =	n-Butane	106978			
(Xs	4 C4H10 MW: 58.123 0.197 X3 =	n-Butane	106978 °C: 3.7700E+06 OMEGA:		MW: 16.0	43
(Xs electi	4 C4H10 MW: 58.123 0.197 X3 = 0.25	n-Butane TC: 425.12 P	106978 °C: 3.7700E+06 OMEGA:	Cancel	MW: 16.0 MW: 44.0	
(Xs electi 1	4 C4H10 MW: 58.123 0.197 X3 = 0.25 CH4	n-Bútane TC: 425.12 F Methane	106978 °C: 3.7700E+06 OMEGA:	Cancel		97

(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

## **Drives and Motors**

- AC and 6 Drives, AC and DC Machines, AC Motors to 1kV
- Drive Systems
- Force Measurement
- Servo Drives

#### **Controllers & Recorders**

- Single and Multi-loop Controllers
- 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
- Interface Modules

#### Valves, Actuators and Positioners

- Control Valves
- Actuators
- Positioners

#### Water, Gas & Industrial Analytics Instrumentation

- pH, Conductivity and Dissolved Oxygen Transmitters and Sensors
- 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

ABB Limited Process Automation Oldends Lane Stonehouse Gloucestershire GL10 3TA UK Tel: +44 1453 826 661 Fax: +44 1453 829 671

## ABB Inc.

## Process Automation

125 E. County Line Road Warminster PA 18974 USA Tel: +1 215 674 6000 Fax: +1 215 674 7183

## www.abb.com

#### Note

We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents in whole or in parts – is forbidden without prior written consent of ABB.

Copyright© 2011 ABB All rights reserved

