

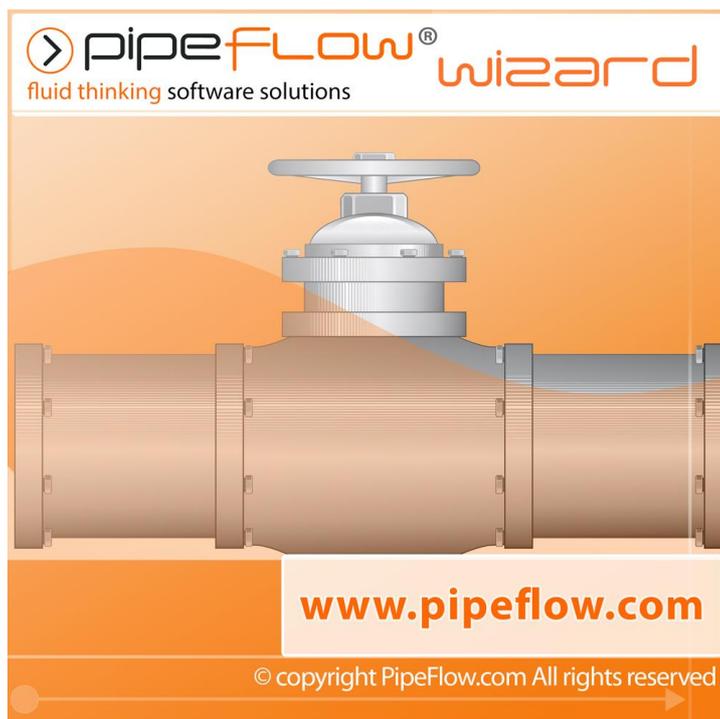


[www.pipeflow.com](http://www.pipeflow.com)

# Pipe Flow Wizard For Windows

Fluid Flow and Pressure Loss Calculations Software

## User Guide



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# 1 Introduction

Pipe Flow Wizard is a multi-platform software application that can perform calculations to find the pressure loss, flow rate, diameter or length for a single pipe.

Four separate calculation panels allow the user to easily specify the known information, calculate the answer and then generate Excel or PDF reports.

The Pipe Flow Wizard software has an intuitive interface that is consistent across platforms thereby making it easy for users to perform their calculations and share the results regardless of the device being used.

The software is backed up by an unrivalled support service that provides help to users when they need it.

## 1.1 Pipe Flow Wizard Software Overview

Pipeline systems range from single pipelines to very large complex networks with hundreds of interconnecting pipes. They may be simple, carrying water from one reservoir to another reservoir, or they may be complex with many interconnecting pipes that distribute fluid over a large area, or they could fall somewhere in-between such as a system that transfers a fluid from a supply container to a delivery point.

The Pipe Flow Wizard software is designed to calculate pressure loss, flow rate, diameter size, or length, for a single pipe. It is a useful tool for piping calculations that engineers often need to perform either at the office or out in the field (perhaps to work out a required pump head, or to check an expected flow rate or pressure drop).

Note: Our [Pipe Flow Expert](#) software can be used to model and calculate flow rates, pressure losses and pumping requirements within a complex pipe system.

Each calculation panel has a set of data input fields that enable the known information to be entered. This data typically includes:

- The internal size, roughness and length of the pipe.
- The elevation change between the start and end of the pipe.
- The type, quantity and position of fittings on the pipe.
- The type and characteristics of the fluid in the pipe.

Once the known information has been specified for the required calculation, the results can be obtained by clicking Calculate. The results panel slides up and over the inputs panel to concisely display the calculated data which typically includes:

- Friction losses, fitting losses, elevation change gain / losses.
- Flow type, Reynolds number and Friction factor.
- Entry and exit pressures.
- Entry and exit flow rates.
- Total pressures loss.

## 1.2 Minimum Operating System Requirements

Pipe Flow Wizard has been designed to work on the following operating systems:

- Microsoft® Windows 10 (All Versions)
- Microsoft® Windows 8 (all versions except RT [used on ARM based tablets])
- Microsoft® Windows 7 (all versions)

We recommended using one of the above operating systems, however the software will also run on:

- Microsoft® Windows Vista (all versions)
- Microsoft® Windows XP (all versions)

It is recommended that your computer system has at least the following minimum specification:

- Processor: 1.00 GHz or faster CPU
- Memory (RAM): 2Gb or higher
- Screen Display: 1024 x 768 pixels (minimum resolution)
- 1920 x 1080 pixels (or higher recommended)
- Graphics (RAM): 128 Mb or higher
- Hard Disk: 50 Mb install (200 Mb free space recommended)

Microsoft® Excel (or compatible software) is required if the user wishes to view an Excel Calculation Report.

A PDF viewer (such as Adobe® Acrobat Reader) is required if the user wishes to view a PDF Calculation Report.

Note:

If your computer will run Windows 7 (or later) then Pipe Flow Wizard should work without any issues.

## 1.3 Licensing Information

Pipe Flow Wizard for Windows is a software package that is provided for use on personal computer systems.

### Installation

When the software is installed it generates a unique product number that is shown on the Software License screen when you run the program. A matching license code must be entered to fully enable and license the software.

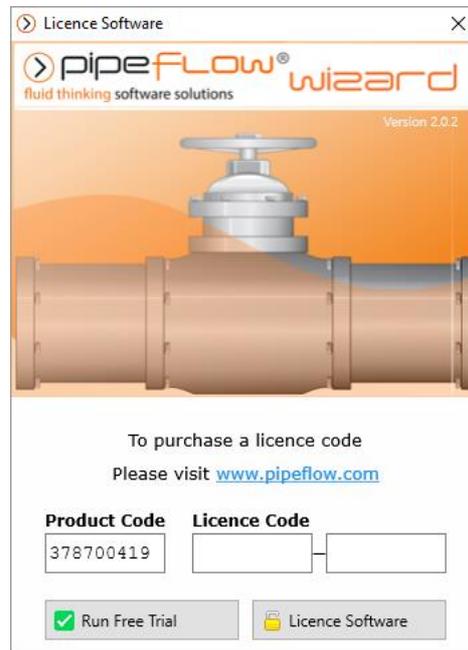


Figure 1 License Software

### Purchasing a License

Each installation of the Pipe Flow Wizard software requires a license code to be entered in order to fully activate the program. Until the license code is entered the software can only be used in trial mode.

When in Trial Mode, all functionality is available except for the following restrictions:

- Find Pressure - Pipe Diameter cannot be changed.
- Find Flow Pipe - Diameter cannot be changed.
- Find Diameter - Pipe Length cannot be changed.
- Find Length - Pipe Diameter cannot be change.
- The Gas Data Calculator cannot be used to compute the properties of compressible fluids at different temperatures and pressures.

License codes can be purchased from [www.pipeflow.com](http://www.pipeflow.com)

Standard licensing and pricing options are shown at [www.pipeflow.com](http://www.pipeflow.com)

You do not require an internet connection when licensing and enabling the software. The software does not need an internet connection to operate.

## Moving a License

We allow a user to move the license to another machine. The old license is deactivated which generates a License Removal Confirmation Number. We then provide a new license code for a new installation of the software. This service is provided at no further cost as part of the Annual License fee which also includes support.

## Network Licensing

Contact us at [info@pipeflow.com](mailto:info@pipeflow.com) for enquiries about network licensing.

## Software Distribution Note

Our software for personal computers is provided via download from our web sites at [www.pipeflow.com](http://www.pipeflow.com) and [www.pipeflow.co.uk](http://www.pipeflow.co.uk). This helps to reduce our costs, which allows us to offer lower prices for our customers and also guarantees that the user is always installing the latest version of the software. Users are free to make their own copy of the software, however every installation of the program will generate a new product code and a new license code will still be required.

Software that is available on mobile devices is completely fulfilled via the relevant App Store (e.g. Apple's App Store), please see [www.pipeflow.com](http://www.pipeflow.com) for which products are available on mobile devices.

## New Customers

Those of you who have previously purchased software from us will already be assured of our reputation and will not be concerned about receiving the software via download. However, we understand that as a new customer you may be concerned that you do not receive physical media with the software on.

If we provided the software on physical media, it would be the exact same program that you can download from our web site (in fact the web site will always carry the very latest version of the software). Having a physical media would not allow you to install and enable the software on multiple computers, since each installation would still generate a unique product number and would require a matching license code.

When you purchase a program from our web site, you will automatically be emailed with a unique purchase token and an invoice/receipt that confirms your purchase. This is all you need for proof of purchase and we will always be able to confirm your purchase in our database.

We have sold software via download for over 20 years. We are not one of those companies who you will not be able to contact or get a response from. As our

existing customers know, our service and assistance with any issues you may have is worth far more than just having the software on physical media.

In some cases, we may sell a license to use a copy of the software on a USB drive. When this option is purchased, we send you a 'Pipe Flow' branded USB drive and allow you to license this. This provides a completely portable copy of the software. There is nothing to install. The USB drive can be plugged in to any compatible personal computer and the software can then be run directly from the USB drive, up into the memory of the local computer. Please see [www.pipeflow.com](http://www.pipeflow.com) for which products are available on a USB drive.

## Summary

- The Pipe Flow Wizard software can be downloaded and installed for a free trial.
- A license code can be purchased from our web site at [www.pipeflow.com](http://www.pipeflow.com) that will enable use of the software for a specific time period (normally 12 months).
- A user can be up and running with a licensed version of the software within a few minutes.
- An Annual License fee must be paid to extend the license to use the software for a further 12 months, once any previous license period ends. The Annual License fee can be paid at [www.pipeflow.com](http://www.pipeflow.com).
- Software support and maintenance, including technical assistance, help with modeling issues and free upgrades to new releases, are provided for free while you are running a licensed copy of the Pipe Flow Wizard software. This ensures that you will always be able to use the latest version of the software.

## 1.4 Contacting Pipe Flow Software

**Email:** [wizard@pipeflow.com](mailto:wizard@pipeflow.com)

**Internet:** <http://www.pipeflow.com>

**UK Telephone:** +44 (0)161 408 3569

**USA Telephone:** +1 650-276-3569  
+1 650-276-FLOW

**Pipe Flow Software, PipeFlow.com and PipeFlow.co.uk are trading names of Daxesoft Ltd, a U.K. Registered Company)**

## 1.5 Additional Pipe Flow Software Programs

### **Pipe Flow Expert – software for designing piping and pumping systems**

Pipe Flow Expert can be used to model pipe systems with just a few pipes through to more complex systems with many hundreds of pipes.

For more information about Pipe Flow Expert, see:

[www.pipeflow.com/pipe-flow-expert-software](http://www.pipeflow.com/pipe-flow-expert-software)

### **Pipe Flow Advisor – software for calculating flow in Channels and Tanks**

Pipe Flow Advisor may be used to estimate water flow rate from various shaped channels and tanks. It can calculate:

- Open Channel Flow
- Water Flow Rates
- Time taken to empty tanks
- Volume, Capacity, Weight and Expansion

For more information about Pipe Flow Advisor, see:

[www.pipeflow.com/pipe-flow-advisor-software](http://www.pipeflow.com/pipe-flow-advisor-software).

Pipe Flow Software programs can all be downloaded for a free trial by visiting

[www.pipeflow.com](http://www.pipeflow.com).

Once you have installed a trial version of one of our software products it can be fully enabled and licensed by buying a license code from our web site. You can be up and running with a fully licensed program within just a couple of minutes.

## 2 Interface and Menus

This section details the different features of the Pipe Flow Wizard interface. For each feature, there is an explanation, a screen shot and a table providing descriptions for each element of the feature. The following sections provide instructions for using the Pipe Flow Wizard application.

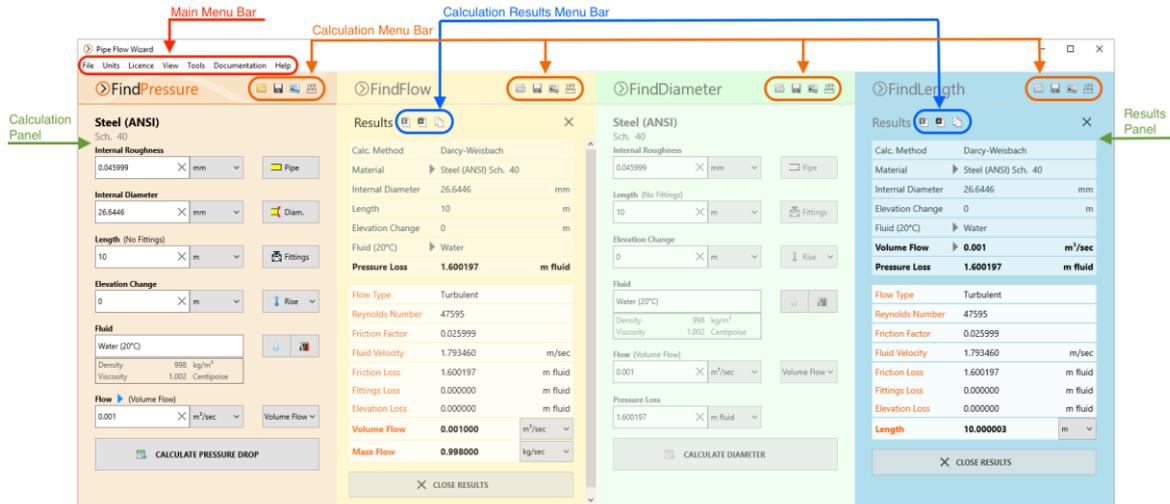


Figure 2 Interface and Menus

### 2.1 Main Menu Bar

The main menu bar has seven different sections to help you navigate and work in Pipe Flow Wizard.

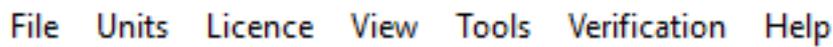


Figure 3 Main Menu Bar

## 2.1.1 File Menu

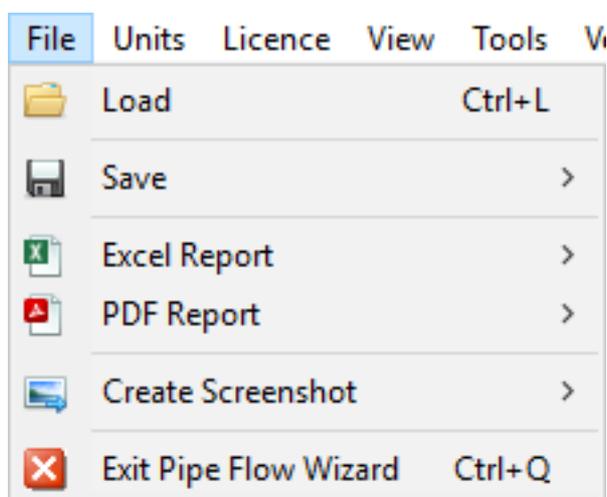


Figure 4 File Menu

Menu Items	Description
<b>Load</b>	Loads a previously saved calculation. The calculation type is defined by the extension of the filename. For more information about Pipe Flow Wizard file extensions: see <a href="#">Filename Extensions</a> . Keyboard shortcut: Ctrl + L
<b>Save</b>	Opens the Save sub-menu. Selecting the required calculation opens the <b>Save</b> dialog. Browse to where you want to save the calculation, name the file (the extension will be added automatically) and click <b>Save</b> .
<b>Excel Report</b>	Opens the Excel Report sub-menu. If the calculation is in results mode, selecting the required calculation will generate an Excel report for the calculation.
<b>PDF Report</b>	Opens the PDF Report sub-menu. If the calculation is in results mode, selecting the required calculation will generate a PDF report for the calculation.
<b>Create Screenshot</b>	Opens the Create Screenshot sub-menu. Selecting the required calculation will create a screenshot of that calculation panel.
<b>Exit Pipe Flow Wizard</b>	Closes the application. You can configure whether a confirmation dialog is displayed prior to the application being closed on the <a href="#">General</a> tab of the Settings screen. Keyboard shortcut: Ctrl + Q

## 2.1.2 Units Menu

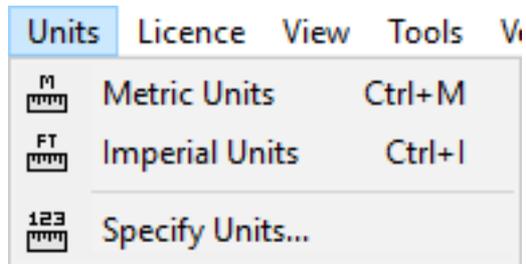


Figure 5 Units Menu

Menu Items	Description
<b>Metric Units</b>	Sets all units for all calculations to be metric units. Keyboard shortcut: Ctrl + M
<b>Imperial Units</b>	Sets all units for all calculations to be imperial units. Keyboard shortcut: Ctrl + I
<b>Specify Units...</b>	Open the Units tab of the Settings screen so that specific units for each calculation can be specified.

### 2.1.3 License Menu

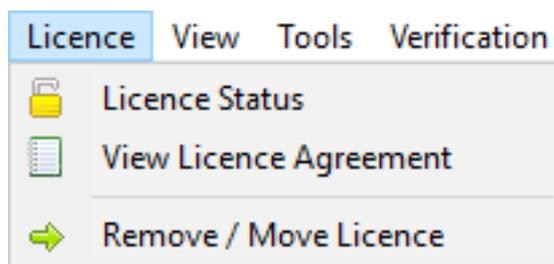


Figure 6 License Menu

Menu Items	Description
<b>License Status</b>	Displays the current license status and entry fields for entering license codes.
<b>View License Agreement</b>	View agreement between Licensor and Licensee.
<b>Remove / Move License</b>	Displays instructions that explain how to deactivate the current license to obtain a license removal confirmation code, which confirms the license is no longer in use. A license for a new installation can then be requested (any new installation will require a new license code).

## 2.1.4 View Menu

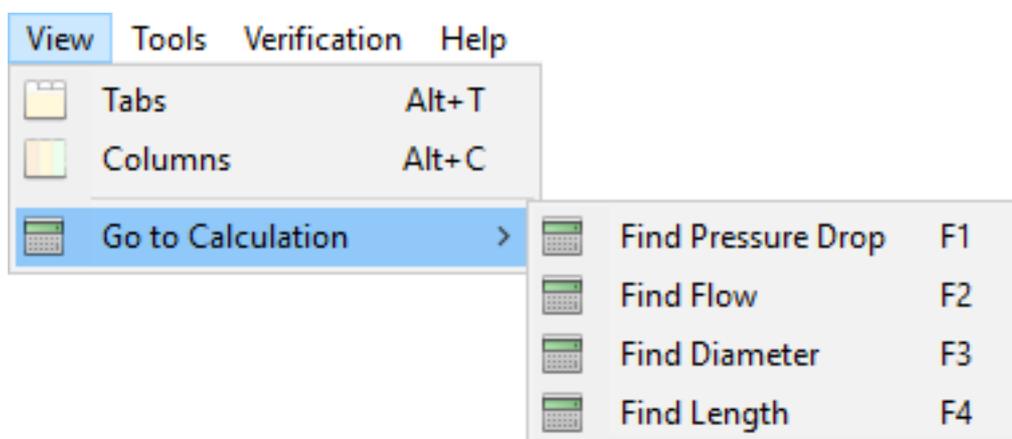


Figure 7 View Menu

Menu Items	Description
<b>Tabs</b>	Switches from the Column display format to Tab display format. Keyboard shortcut: Alt + T.
<b>Columns</b>	Switches from the Tab display format to the Column display format. Keyboard shortcut: Alt + C.
<b>Go to Calculation</b>	Opens the Go to Calculation sub menu to 'go to' a specific calculation. See Go to Calculation keyboard shortcuts in the table below.

Keyboard Shortcut	Description
<b>F1</b>	Go to the <b>Find Pressure</b> calculation.
<b>F2</b>	Go to the <b>Find Flow</b> calculation.
<b>F3</b>	Go to the <b>Find Diameter</b> calculation.
<b>F4</b>	Go to the <b>Find Length</b> calculation.

## 2.1.5 Tools Menu

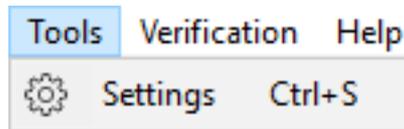


Figure 8 Tools Menu

Menu Items	Description
Settings	Open the <u>S</u> ettings screen. Keyboard shortcut: Ctrl + S

## 2.1.6 Verification Menu

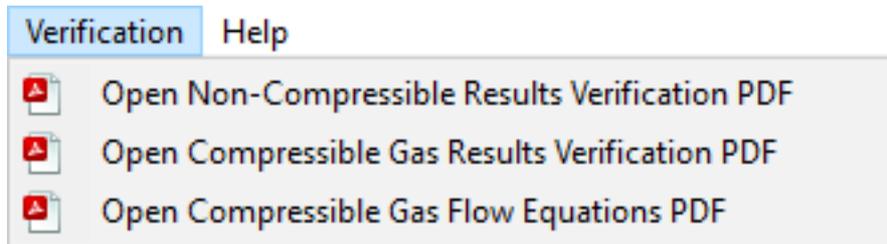


Figure 9 Verification Menu

Menu Items	Description
<b>Open Non-Compressible Results Verification PDF</b>	Open the Non-Compressible (Liquids) Calculation Results Verification PDF document.
<b>Open Compressible Gas Results Verification PDF</b>	Open the Compressible (Gases) Calculation Results Verification PDF document.
<b>Open Compressible Gas Flow Equations PDF</b>	Open the Compressible Flow Equations & formula descriptions PDF.

## 2.1.7 Help

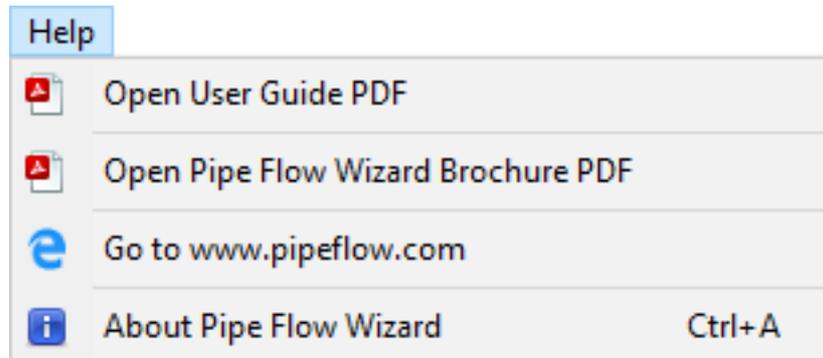


Figure 10 Help Menu

Menu Items	Description
<b>Open User Guide PDF</b>	Open the User Guide PDF document (this document).
<b>Open Pipe Flow Wizard Brochure PDF</b>	Open the Pipe Flow Wizard PDF Brochure.
<b>Go to <a href="http://www.pipeflow.com">www.pipeflow.com</a></b>	Open <a href="http://www.pipeflow.com">www.pipeflow.com</a> in a web browser.
<b>About Pipe Flow Wizard</b>	Open the Pipe Flow Wizard About screen. Keyboard shortcut: Ctrl + A.

## 2.2 Calculation Panel

Each calculation has its own colored calculation panel.

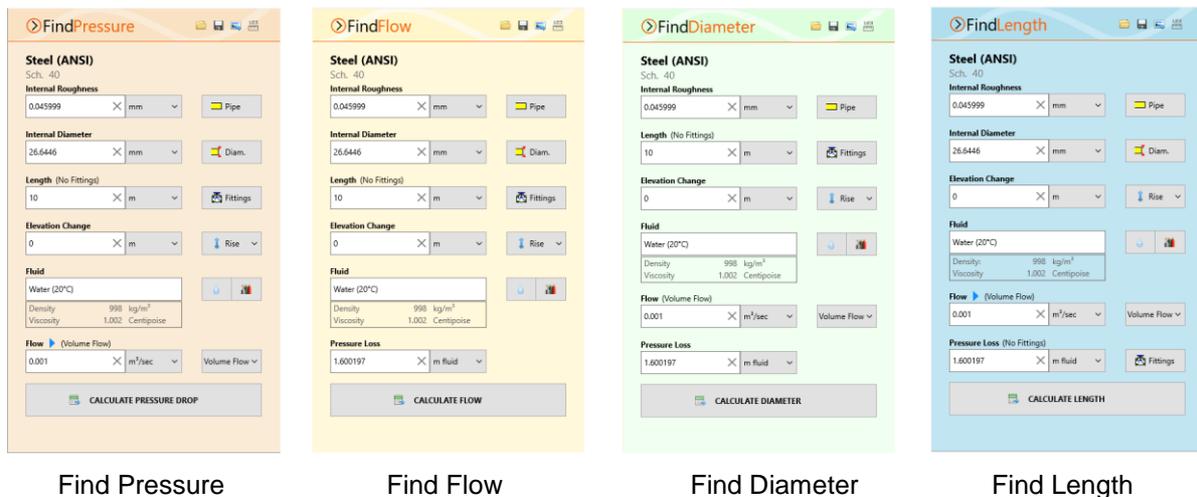


Figure 11 Calculation Panel

The calculation panel allows you to enter known information for the required calculation:

The **Material name**, **Schedule** and **Internal Roughness** of the pipe can be specified by clicking the **Pipe**  to open the **Pipe Material** screen from where a material can be selected from the database or a new material defined. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).

The **Internal Diameter** (for Find Pressure, Find Flow and Find Length) of the pipe can be specified by clicking the **Diam.**  button to open the **Pipe Diameter** screen from where a pipe size can be selected from the database or a new size defined. For more information about working with pipe diameters, see: [Pipe Material & Diameters](#).

**Fittings** can be added to the pipe by clicking the **Fittings**  button to open the **Fitting Screen** from where fittings can be selected, or new fittings defined. For more information about working with fittings, see: [Fittings & Valves](#)

The pipe's **Elevation** change can be specified by entering the difference in height from the start of the pipe to the end of the pipe in the **Elevation Change** field and specifying whether this is a rise or fall.

The **Fluid** in the pipe can be specified by clicking a fluid button (Liquids  or Gases ) to open the **Fluids Database** screen from where fluids can be selected, or new fluids defined. For more information about working with fluids, see [Fluids Database](#).

The **Flow** rate (For Find Pressure, Find Diameter and Find Length) of the fluid can be specified by entering the value into the **Flow** field or clicking the expander  button (where applicable) to open the **Flow Rate Calculator**. For more information about entering a flow rate based on a velocity using the **Flow Rate Calculator**, see: [Flow Rate Calculator / Helper](#).

The **Pressure Loss** (for Find Flow, Find Diameter and Find Length) in the pipe can be specified by entering the value into the **Pressure Loss** field.

Click the **Calculate** button to solve the calculation using the data supplied.

The **Results Panel** will slide up and over the calculation panel to display the results of the calculation. For more information about the results panel, see: [Results Panel](#).

 Depending upon the amount of information in the calculation panel and/or the height of the program window, it may be necessary to scroll down to reveal further information.

### 2.2.1 Calculation Menu Bar

In the header of each calculation panel is the calculation menu bar.

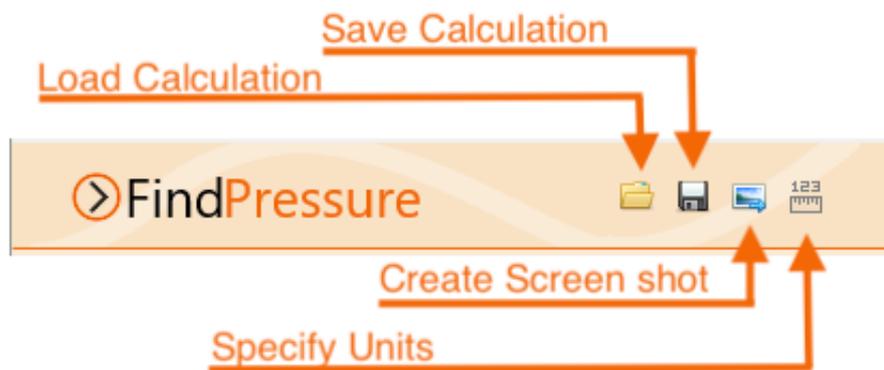


Figure 12 Calculation Menu Bar

The menu bar contains four buttons which provides quick access to:

Menu Items	Description
	Loading a new calculation from disk.
	Saving the currently active calculation.



Taking a screenshot of the currently active calculation.



Specifying the units for the currently active calculation.

---

## 2.3 Results Panel

When a calculation is solved, the **Results Panel** slides up and over the **Calculation Panel**.

The results panel displays the data that was entered by the user at the top in the **Inputs** section and displays the results beneath the inputs in the **Results** section.

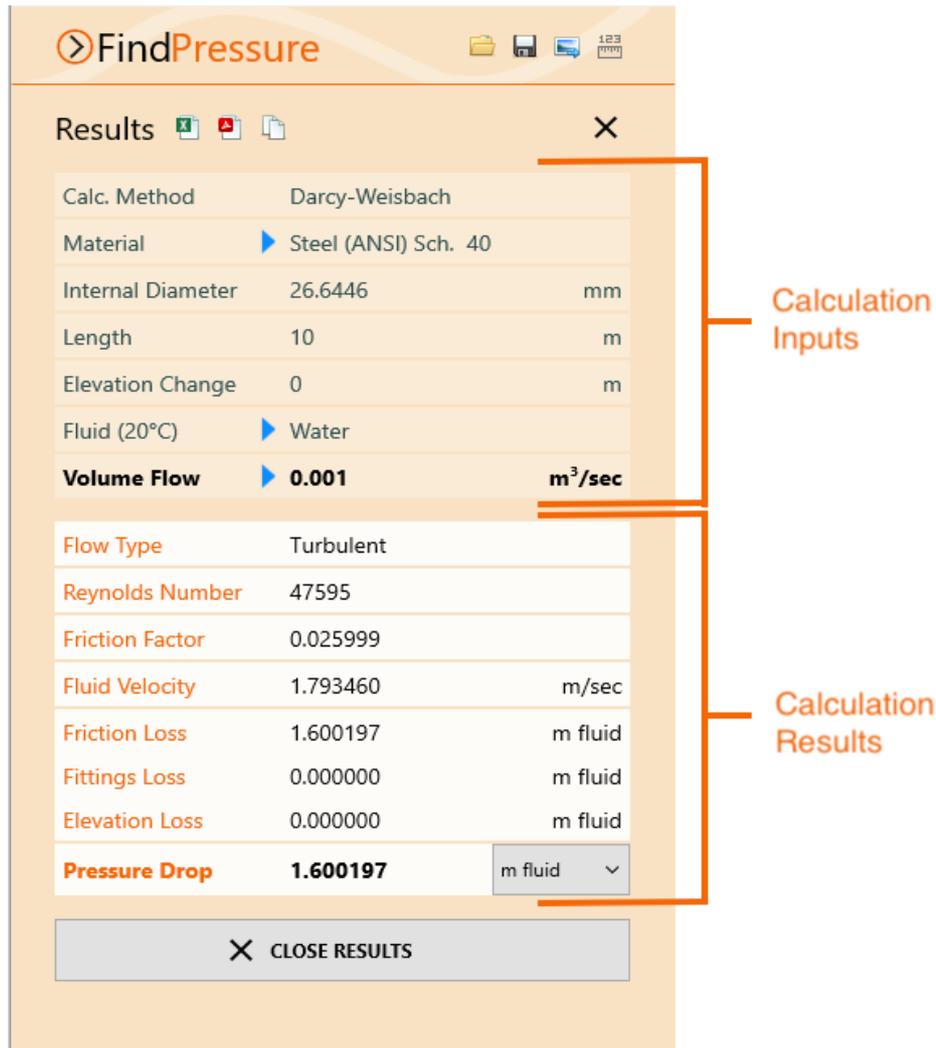


Figure 13 Results Panel

The display unit for each different item of data can be changed in Settings. In addition, for the main result (e.g. **Pressure Drop** for **Find Pressure**), the display unit can be changed by selecting the unit from the drop-down list. When the result panel is closed, and another calculation is performed, the result unit will be reset to the unit that is specified in settings for that attribute. For more information about setting units, see: [Units](#).

Clicking the expander  button for a result attribute will reveal further data associated with that attribute. For further information about expanders, see: [Expandable Sections](#).

### 2.3.1 Results Menu Bar

In the header of each result panel is the results menu bar.

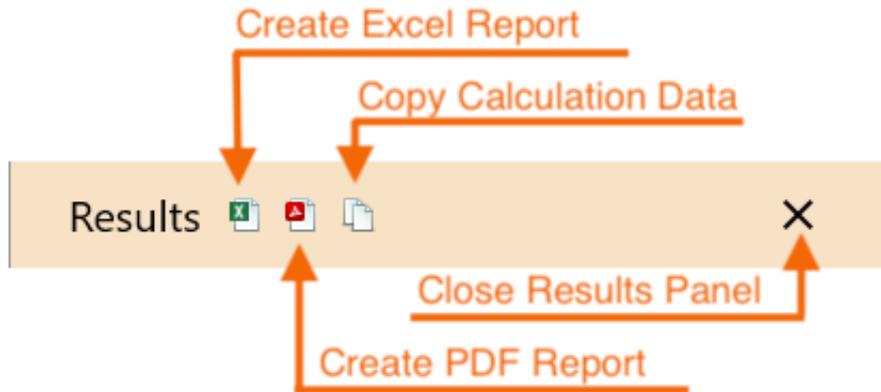


Figure 14 Results Menu Bar

The menu bar contains four buttons which provides quick access to:

Menu Items	Description
	Creating and viewing an Excel Report. For more information about Excel Reports, see: <a href="#">Creating a Report of the Results</a> .
	Creating and viewing a PDF Report. For more information about PDF Reports, see: <a href="#">Creating a Report of the Results</a> .
	Copying the calculation data to one or more calculations. For more information about copying calculations, see: <a href="#">Copying Calculation Results for use in another Calculation</a> .
	Closes the results panel.

 Depending upon the amount of information in the result panel and/or the height of the program window, it may be necessary to scroll down to reveal further information.

## 2.4 Expandable Sections

Pipe Flow Wizard uses expandable sections to allow the user to increase or reduce the information that is displayed. Sections that can be expanded display the expander button  which when clicked will expand the section to reveal more information. Clicking the expander button when the section is expanded will collapse the section.

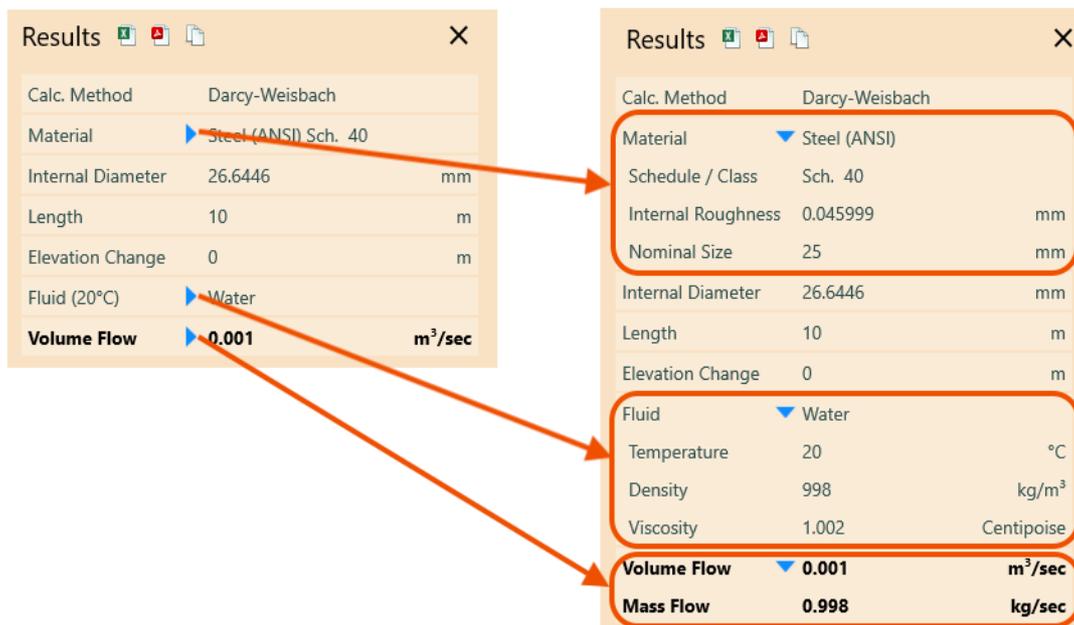


Figure 15 Expandable Sections

### 3 Views

Pipe Flow Wizard can be configured in either **Column** view or **Tab** view.

To view multiple calculations simultaneously, the column view can be used. If you need to see just a single calculation or prefer a more compact view, the Tab view can be used.

#### 3.1 Column View

The column view displays all calculations together, side by side (assuming there is sufficient screen resolution / width).

The column view can be displayed by selecting View > Columns on the main menu bar or by using the keyboard shortcut Alt + C.

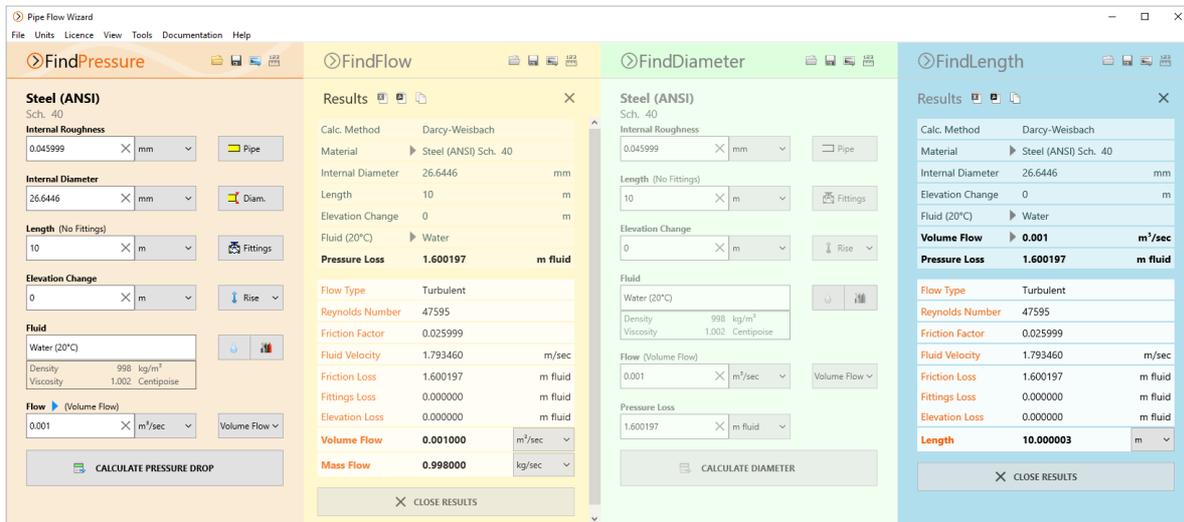


Figure 16 Column View

Clicking on a calculation panel or result panel will make that calculation active. The other calculations become inactive and are visually greyed out.

As the size of the Pipe Flow Wizard window is reduced in width, the calculation panels automatically collapse if there is insufficient room to display them. The collapsed panels are shown as 'book spine'. Clicking a collapsed calculation ('book spine') will expand that calculation and automatically collapsed another one, thereby always maintaining the same number of calculations visible.

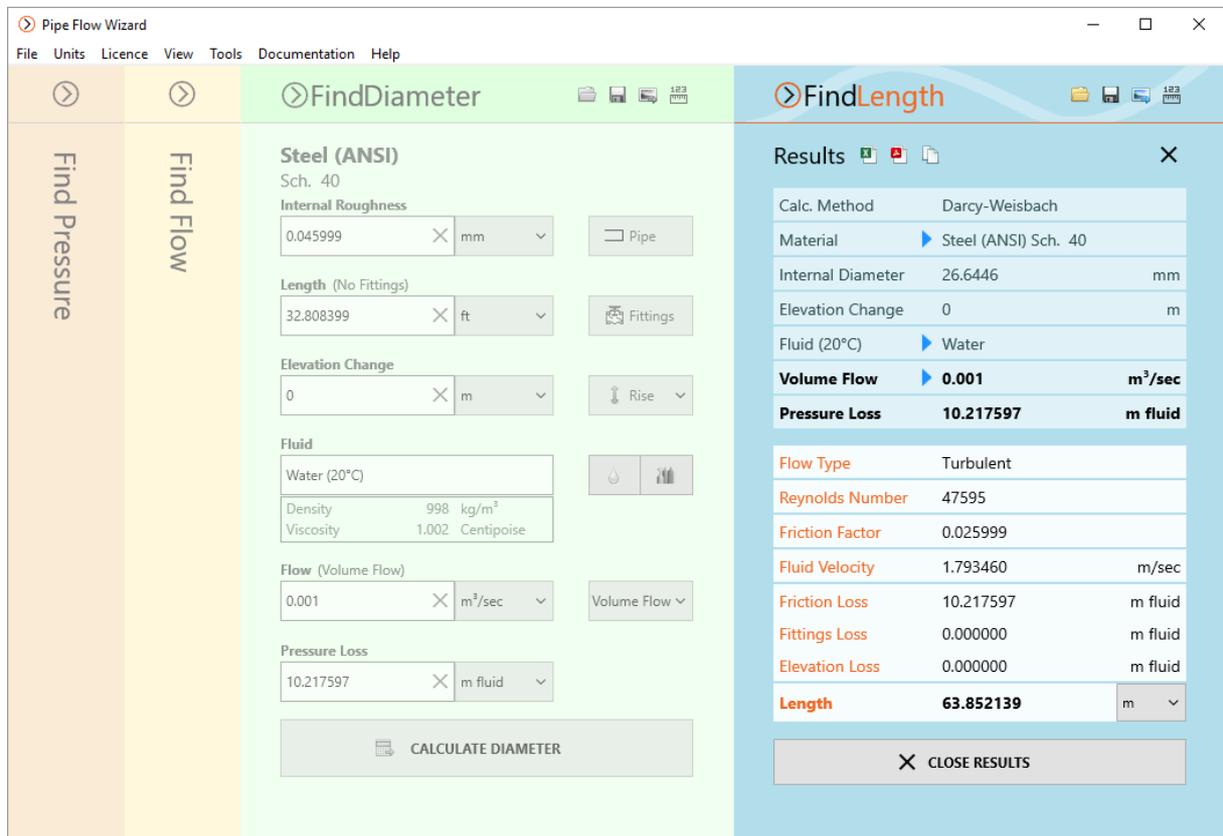


Figure 17 Column View - Collapsed

## 3.2 Tab View

The tab view displays a single calculation.

Each calculation can be accessed by the following methods:

- Click on the required calculation Tab
- Select View > Go to Calculation > [Required Calculation]
- Clicking the keyboard shortcut key for the required calculation. For information about the View menu item keyboard shortcuts, see: [View Menu](#).

The tab view can be displayed by selecting View > Tabs on the main menu bar or by using the keyboard shortcut Alt + T.

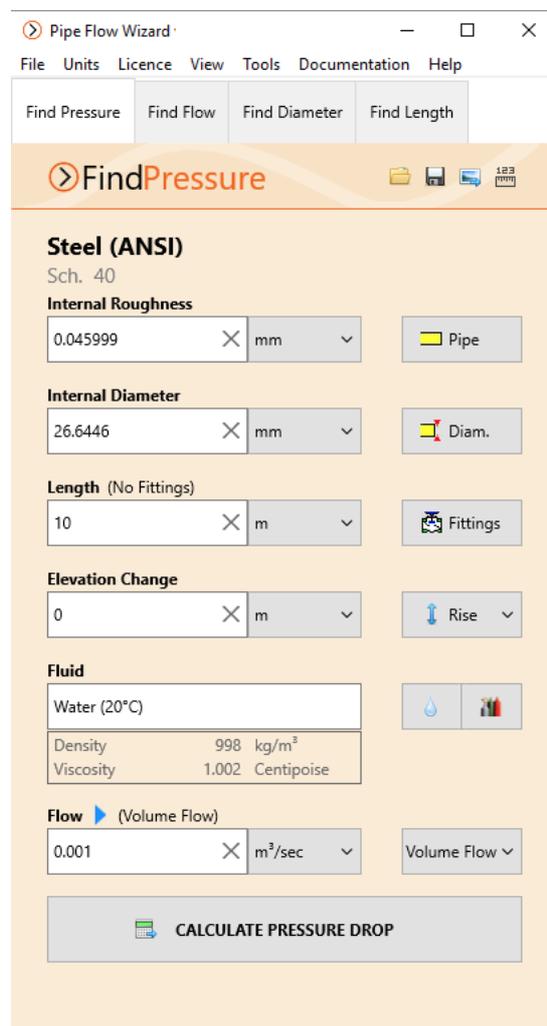


Figure 18 Tab View

## 4 Settings

Pipe Flow Wizard can be configured and set-up to the user's working preferences. The settings screen is opened by clicking Tools > Settings or using the shortcut Ctrl+S.

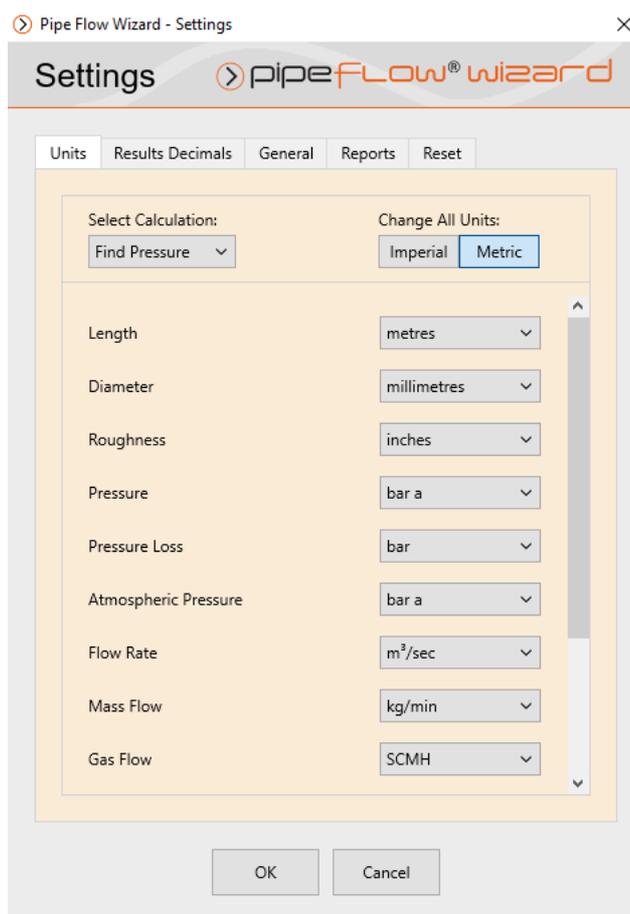
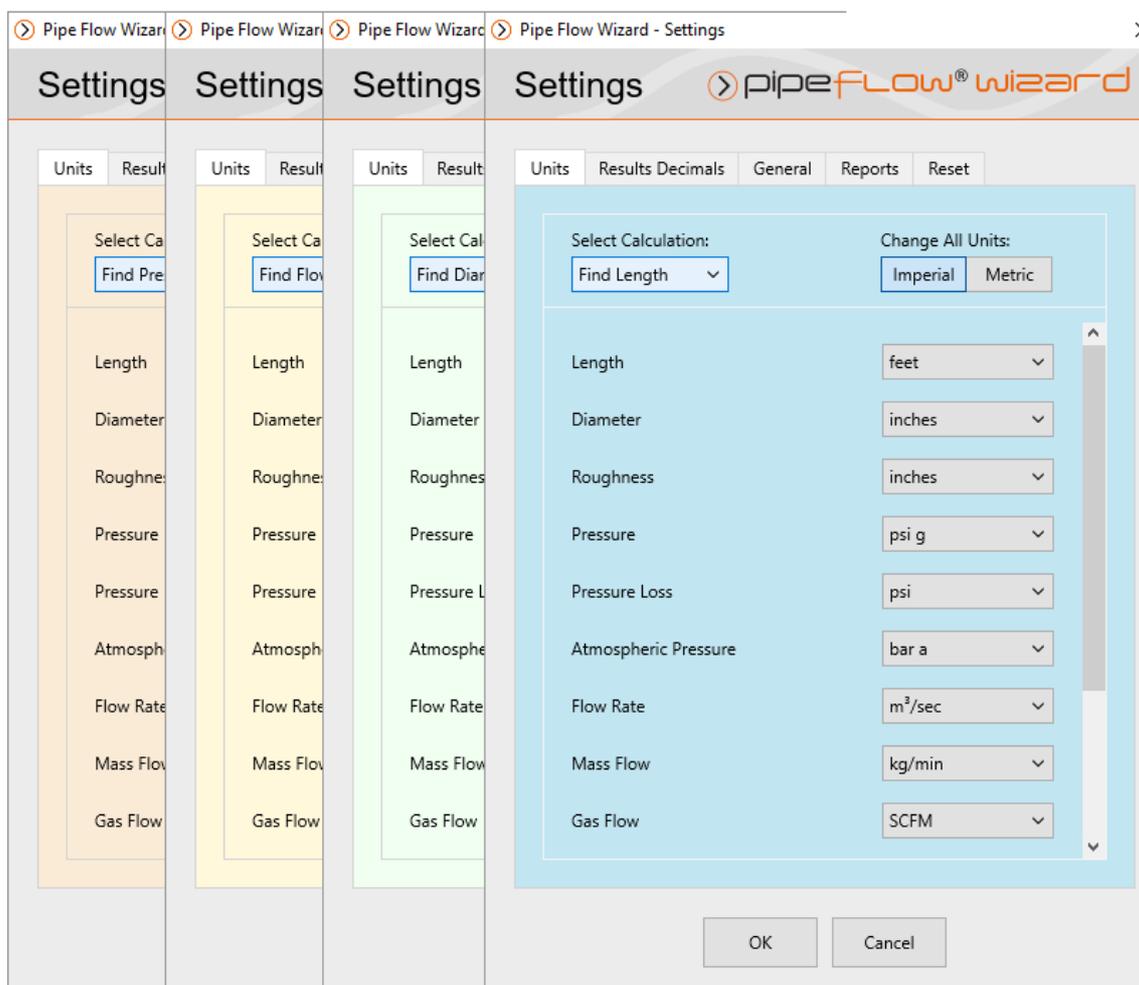


Figure 19 Settings

Tab Name	Description
<b>Units</b>	Configure the defaults units for each calculation.
<b>Results Decimals</b>	Configure the number of post decimal places used to display results values.
<b>General</b>	Configure system wide (non-calculation specific) program options.
<b>Reports</b>	Configure the Excel and PDF Reports.
<b>Reset</b>	Reset program settings and data.

## 4.1 Units

The Units screen is opened by clicking Units > Specify Units on the Main Menu Bar or clicking the Units  button in the Calculation Menu Bar of any of the calculations.



**Figure 20 Units**

Units for each of the calculations can be specified by:

1. Selecting the required calculation from the 'Select Calculation' drop down.
2. Selecting the required unit for each of the attributes, OR  
Selecting Imperial / Metric to change all units for that calculation.
3. Click OK.

 Scroll down to reveal more units.

## 4.2 Results Decimals

The Result Decimals screen is opened by clicking Tools > Settings on the Main Menu Bar and selecting the Results Decimals tab.

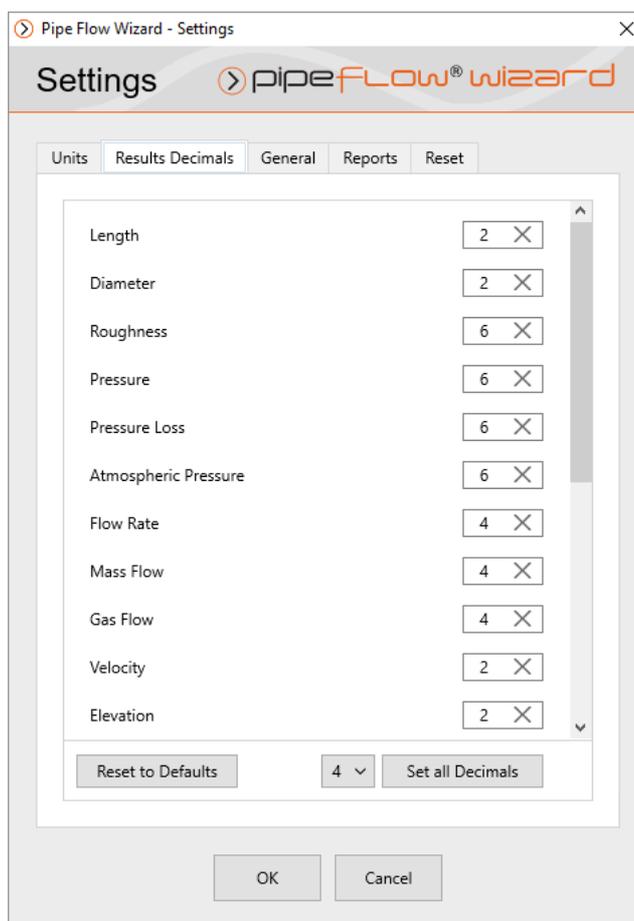


Figure 21 Results Decimals

The number of post decimal digits for each attribute can be specified individually, or all attributes can be set to the same number of post decimals by selecting a value from the **Set All Decimals** drop down and clicking **Set All Decimals**.

The number of post decimal digits can be reset to their default values by tapping **Reset to Defaults**.

All results data displayed on the Results Panel and in the Excel / PDF reports will be displayed to the number of post decimals specified.

 Scroll down to reveal more attributes.

## 4.3 General

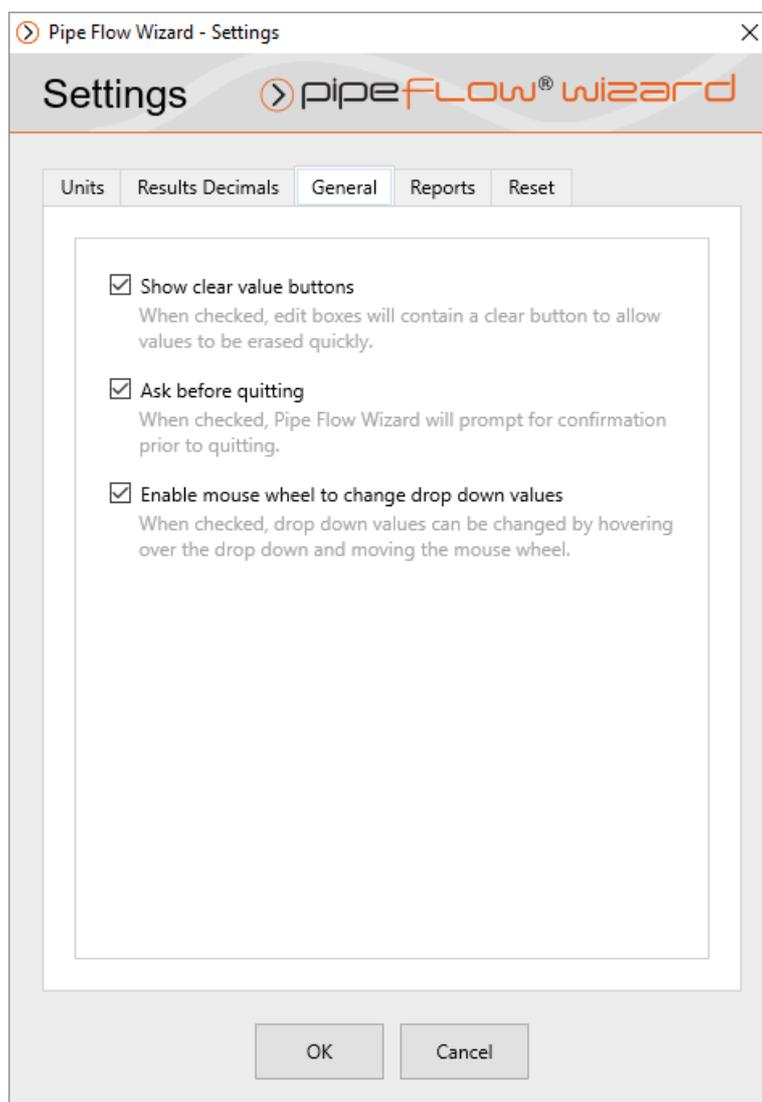


Figure 22 Settings General

Option	Description
<b>Show clear value buttons</b>	When checked, edit boxes contain a clear value  button that when clicked will erase the contents of the edit box.
<b>Ask before quitting</b>	When checked, Pipe Flow Wizard will display a confirmation dialog box before closing.
<b>Enable mouse wheel to change drop down values</b>	When checked, drop down values (e.g. units) can be changed by hovering over the drop down and moving the mouse wheel.

## 4.4 Reports

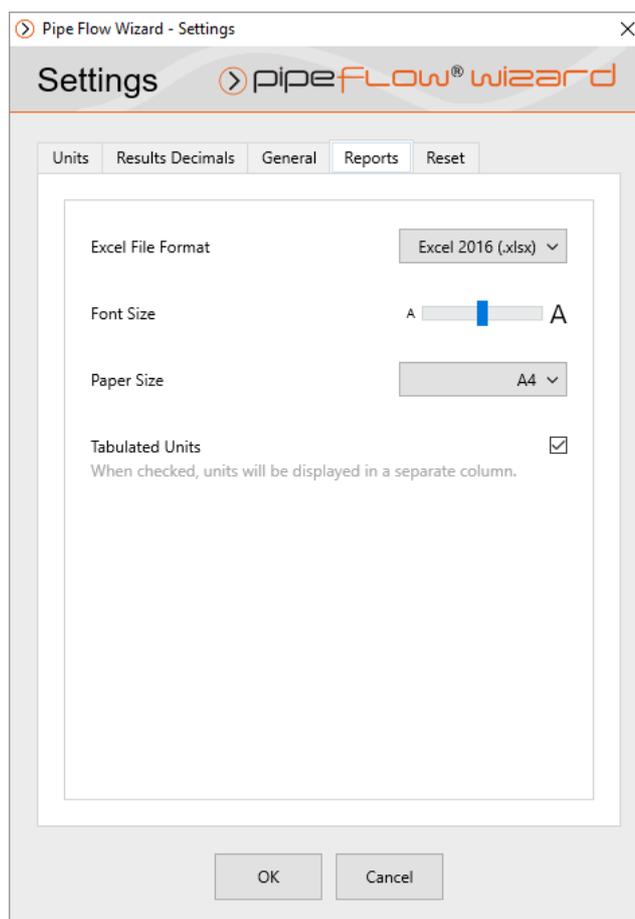


Figure 23 Settings - Reports

Option	Description
<b>Excel File Format</b>	Configure the version of Excel that will be used.
<b>Font Size</b>	Configure the font size to use for the report.
<b>Paper Size</b>	Configure the paper size to use for the report.
<b>Tabulated Units</b>	When checked, units will be displayed in their own column. When un-checked, units will be displayed next to their value in the same column. For examples of tabulated and non-tabulated reports, see: <a href="#">PDF Report Example – Tabulated Units</a> and <a href="#">PDF Report Example – Non-Tabulated Units</a>

## 4.5 Reset

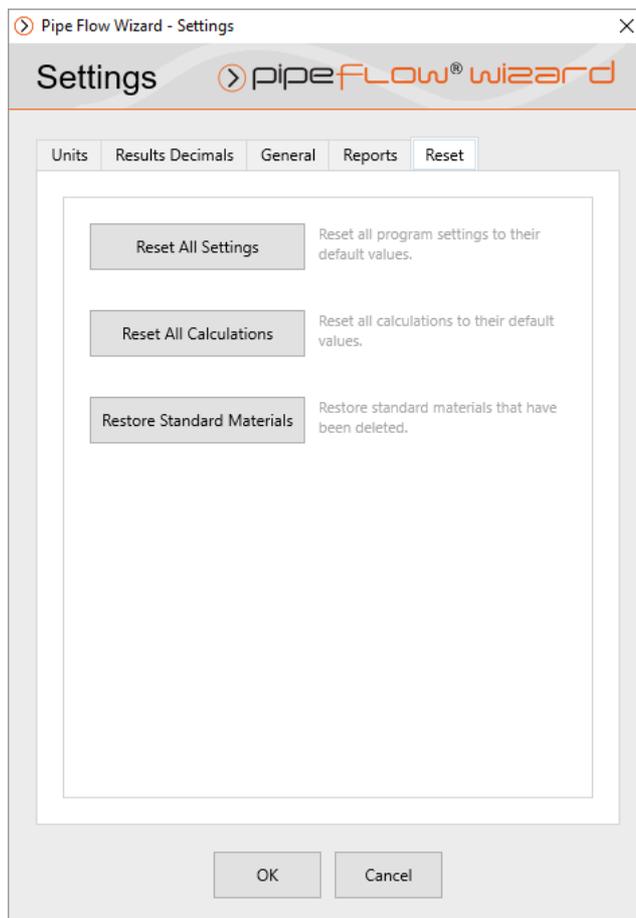


Figure 24 Settings - Reset

Option	Description
<b>Reset All Settings</b>	Reset all settings values to defaults. Only applied to the calculations if OK is clicked.
<b>Reset All Calculations</b>	Reset all calculation values to defaults. Applied immediately after confirmation has been given.
<b>Restore Standard Material</b>	Restore standard materials that have been deleted. Applied immediately after confirmation has been given.

## 5 File and Calculation Operations

### 5.1 Filename Extensions

The filename extensions for each calculation are as follows:

Calculation	File Extension
Find Pressure	pftp
Find Flow	pftf
Find Diameter	pftd
Find Length	pftl

### 5.2 Data File Location

The location of the data files (e.g. fluid data, pipe data, user configuration, licence etc.) is, by default, as follows:

```
Users\Public\Public Documents\Pipe Flow Wizard\
```

The location of the data files can be modified by editing the `pftwizarddata.ini` file which is in the same directory as the Pipe Flow Wizard program, e.g.:

```
Program Files (x86)\Pipe Flow Wizard
```

To specify a new location for the data files, open the `pftwizarddata.ini` file in a text edit (e.g. Notepad) and insert the following:

**Datapath:***<full absolute path for location of data files>*

e.g. `datapath:d:\mydata\pipeflowwizard`

Save and close the `pftwizarddata.ini` file and then re-start Pipe Flow Wizard.

The constants defined in the following table can be used within the `pftwizarddata.ini` file. Constants will be translated to their literal values by Pipe Flow Wizard.

e.g. `datapath:{INSTALLDIR}\mydata\pipeflowwizard`

Constant	Literal Value
{INSTALLDIR}	The directory in which Pipe Flow Wizard has been installed (e.g. c:\Program Files (x86)\Pipe Flow Wizard)

## 6 Pressure Drop Calculation

The **Pressure Drop** through the pipe can be calculated when the following values are known:

- Pipe internal roughness
- Pipe internal diameter
- Pipe length
- Pipe elevation change
- Fittings
- Flow rate

The **Pressure Drop** can be calculated for both Liquids and Gases. For information about selecting a fluid, see: [Fluids Database](#).

For more information about working with gases, see: [Working with Compressible Fluids](#).

For more information about the theory and formulas used to calculate the pressure loss, see [Calculation Theory and Method of Solution](#).

## 6.1 Pressure Drop Calculation - Liquid

The pressure drop for a liquid in a pipe can be calculated as follows:

1. Select the **Find Pressure** calculation.

The screenshot shows the 'FindPressure' application window. The title bar includes the application name and standard Windows icons. The main content area is titled 'Steel (ANSI)' with 'Sch. 40' below it. It features several input fields and buttons:

- Internal Roughness:** Input field with '0.045999', a unit dropdown set to 'mm', and a 'Pipe' button.
- Internal Diameter:** Input field with '26.6446', a unit dropdown set to 'mm', and a 'Diam.' button.
- Length (No Fittings):** Input field with '10', a unit dropdown set to 'm', and a 'Fittings' button.
- Elevation Change:** Input field with '0', a unit dropdown set to 'm', and a 'Rise' button with a dropdown arrow.
- Fluid:** A dropdown menu showing 'Water (20°C)'. Below it, a table displays properties: Density 998 kg/m<sup>3</sup> and Viscosity 1.002 Centipoise. There are also water and fluid icons.
- Flow:** A dropdown menu set to '(Volume Flow)'. Below it, an input field has '0.001', a unit dropdown set to 'm<sup>3</sup>/sec', and a 'Volume Flow' button.

At the bottom, there is a large grey button labeled 'CALCULATE PRESSURE DROP' with a small icon.

Figure 25 Find Pressure Calculation - Liquid

2. Select or define the **Material** and **Internal Roughness** of the pipe. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).
3. Select or define the **Internal Diameter** of the pipe. For more information about working with pipe diameters, see: [Pipe Material & Diameters](#).
4. Set the **Length** and **Elevation Change** of the pipe.
5. Add **Fittings** to the pipe if required. For more information about working with fittings, see: [Fittings & Valves](#).
6. Select the **Fluid** in the pipe. For more information about working with fluids, see: [Fluids Database](#).
7. Enter the **Flow Rate** of the fluid in the pipe. For more information about setting a flow rate based on a velocity, see: [Flow Rate Calculator / Helper](#).
8. Click **Calculate Pressure Drop** and the **Results Panel** will slide up.

 The internal diameter will be reset to 1.049" (26.64 mm) if running the trial version of Pipe Flow Wizard.

The **Find Pressure Results Panel** displays the calculation input data and the results of the **Pressure Drop** calculation. For more information about the Results Panel, see: [Results Panel](#).

The pressure loss unit can be changed as required. To change the pressure loss unit for all subsequent calculations, the pressure loss unit can be specified in Settings > Units. For more information about setting units, see: [Units](#)

To generate and view an Excel or PDF Report of the results, click the Excel  button or PDF  button. For more information about generating reports, see: [Creating a Report of the Results](#).

To copy the calculation data to one or more other calculations, click the Copy  button and select the required calculation(s).

To close the **Results Panel**, click the **Close**  button in the corner or the **Close Results**  button at the bottom.

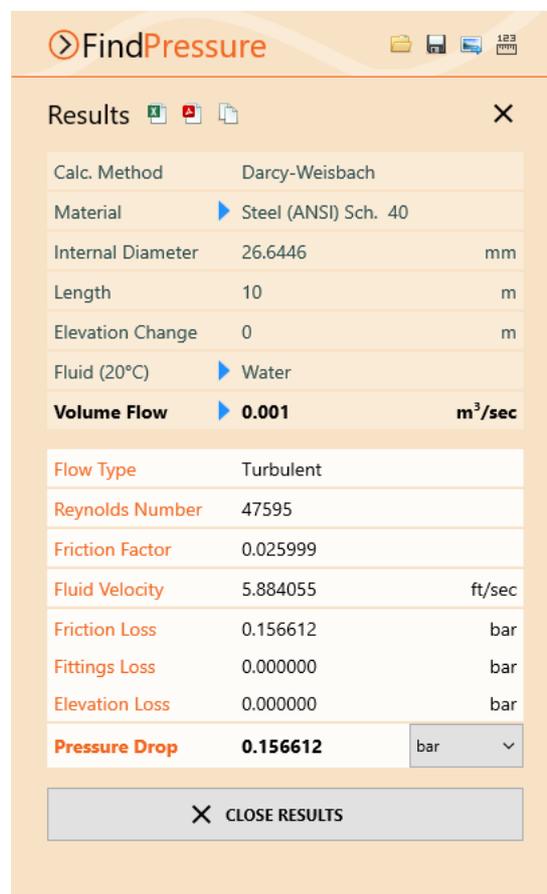


Figure 26 Find Pressure Results - Liquid

## 6.2 Pressure Drop Calculation - Gas

The pressure drop for a gas in a pipe can be calculated as follows:

1. Select the **Find Pressure** calculation.

**FindPressure**

**Steel (ANSI)**  
Sch. 40

**Internal Roughness**  
0.045999 × mm

**Internal Diameter**  
26.6446 × mm

**Length (No Fittings)**  
10 × m

**Elevation Change**  
0 × m

**Fluid**  
Air (20°C)  
@ 0 × bar g

Density 1.204 kg/m<sup>3</sup>  
Viscosity 0.018 Centipoise

**Flow** (Standard Volume)  
2.007293 × SCMH

**CALCULATE PRESSURE DROP**

Figure 27 Find Pressure Calculation - Gas

2. Select or define the **Material** and **Internal Roughness** of the pipe. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).
3. Select or define the **Internal Diameter** of the pipe. For more information about working with pipe diameters, see: [Pipe Material & Diameters](#).
4. Set the **Length** and **Elevation Change** of the pipe.
5. Add **Fittings** to the pipe if required. For more information about working with fittings, see: [Fittings & Valves](#).
6. Select the **Fluid** in the pipe. For more information about working with fluids, see: [Fluids Database](#).
7. Enter the **Pressure** of the fluid at the start of the pipe.
8. Enter the **Flow Rate** of the fluid in the pipe. For more information about setting a flow rate based on a velocity, see: [Flow Rate Calculator / Helper](#).

9. Click **Calculate Pressure Drop** and the **Results Panel** will slide up.

**i** The internal diameter will be reset to 1.049" (26.64 mm) if running the trial version of Pipe Flow Wizard.

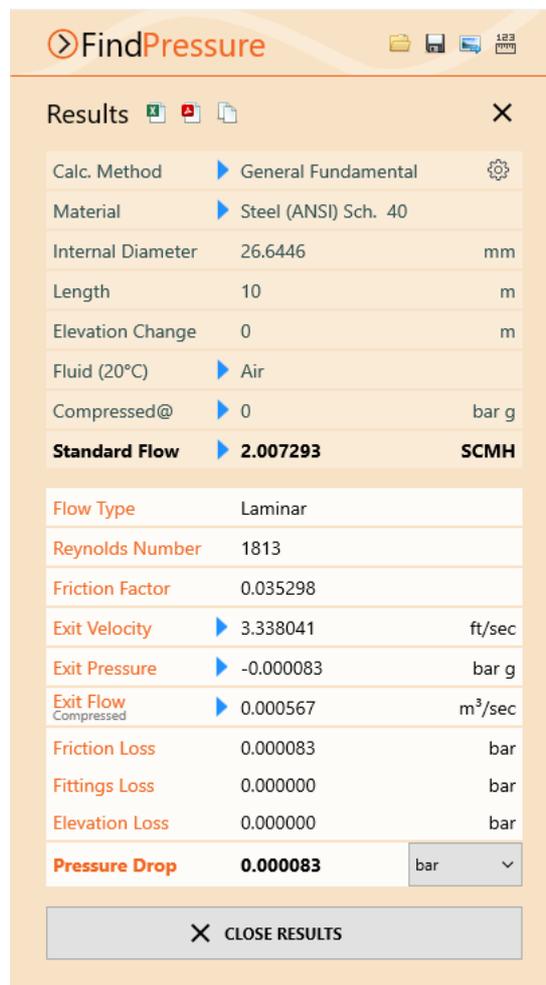
The **Find Pressure Results Panel** displays the calculation input data and the results of the **Pressure Drop** calculation. For more information about the Results Panel, see: [Results Panel](#).

The pressure loss unit can be changed as required. To change the pressure loss unit for all subsequent calculations, the pressure loss unit can be specified in Settings > Units. For more information about setting units, see: [Units](#)

To generate and view an Excel or PDF Report of the results, click the Excel  button or PDF  button. For more information about generating reports, see: [Creating a Report of the Results](#).

To copy the calculation data to one or more other calculations, click the Copy  button and select the required calculation(s).

To close the **Results Panel**, click the **Close**  button in the corner or the **Close Results**  button at the bottom.



The screenshot shows the 'FindPressure' application window with the 'Results' panel open. The panel displays the following data:

Parameter	Value	Unit
Calc. Method	General Fundamental	
Material	Steel (ANSI) Sch. 40	
Internal Diameter	26.6446	mm
Length	10	m
Elevation Change	0	m
Fluid (20°C)	Air	
Compressed@	0	bar g
<b>Standard Flow</b>	<b>2.007293</b>	<b>SCMH</b>
Flow Type	Laminar	
Reynolds Number	1813	
Friction Factor	0.035298	
Exit Velocity	3.338041	ft/sec
Exit Pressure	-0.000083	bar g
Exit Flow Compressed	0.000567	m <sup>3</sup> /sec
Friction Loss	0.000083	bar
Fittings Loss	0.000000	bar
Elevation Loss	0.000000	bar
<b>Pressure Drop</b>	<b>0.000083</b>	bar

At the bottom of the panel is a 'CLOSE RESULTS' button.

Figure 28 Find Pressure Results - Gas

## 7 Flow Rate Calculation

The **Flow Rate** through the pipe can be calculated when the following values are known:

- Pipe internal roughness
- Pipe internal diameter
- Pipe length
- Pipe elevation change
- Fittings
- Pressure Loss

The **Flow Rate** can be calculated for both Liquids and Gases. For information about selecting a fluid, see: [Fluids Database](#).

For more information about working with gases, see: [Working with Compressible Fluids](#).

For more information about the theory and formulas used to calculate the flow rate, see [Calculation Theory and Method of Solution](#).

## 7.1 Flow Rate Calculation - Liquid

The flow rate for a liquid in a pipe can be calculated as follows:

1. Select the **Find Flow** calculation.

The screenshot shows the 'FindFlow' calculation window. It is titled 'Steel (ANSI)' and 'Sch. 40'. The input fields are:

- Internal Roughness:** 0.045999 mm
- Internal Diameter:** 26.6446 mm
- Length (No Fittings):** 10 m
- Elevation Change:** 0 m
- Fluid:** Water (20°C)
- Pressure Loss:** 0.156612 bar

The fluid properties are listed as:

Density	998 kg/m <sup>3</sup>
Viscosity	1.002 Centipoise

A 'CALCULATE FLOW' button is located at the bottom of the window.

Figure 29 Find Flow Calculation - Liquid

2. Select or define the **Material** and **Internal Roughness** of the pipe. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).
3. Select or define the **Internal Diameter** of the pipe. For more information about working with pipe diameters, see: [Pipe Material & Diameters](#).
4. Set the **Length** and **Elevation Change** of the pipe.
5. Add **Fittings** to the pipe if required. For more information about working with fittings, see: [Fittings & Valves](#).
6. Select the **Fluid** in the pipe. For more information about working with fluids, see: [Fluids Database](#).
7. Enter the **Pressure Loss**.
8. Click **Calculate Flow**, the **Results Panel** will slide up.

 The internal diameter will be reset to 1.049" (26.64 mm) if running the trial version of Pipe Flow Wizard.

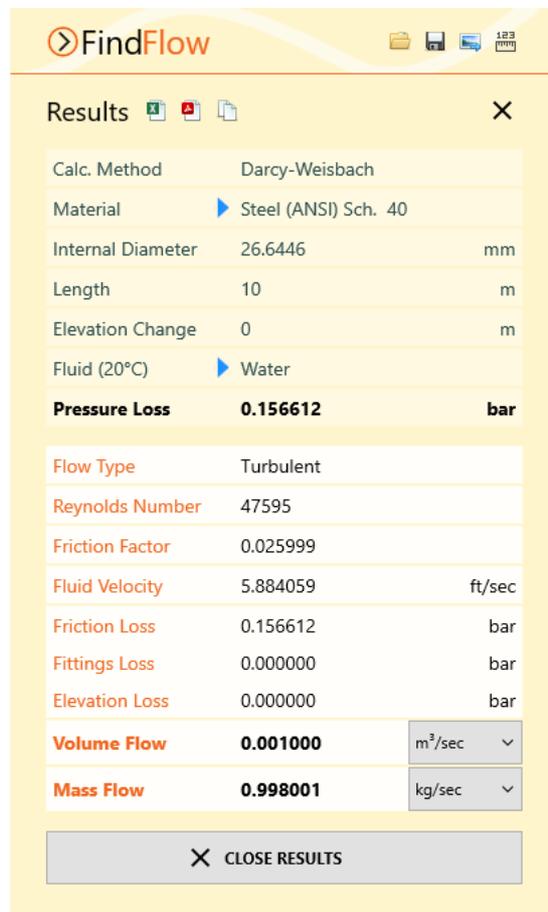
The **Find Flow Results Panel** displays the calculation input data and the results of the **Find Flow** calculation. For more information about the Results Panel, see: [Results Panel](#).

The **Flow** units can be changed as required. To change the flow units for all subsequent calculations, the flow unit can be specified in Settings > Units. For more information about setting units, see [Units](#).

To generate and view an Excel or PDF Report of the results, click the Excel  button or PDF  button. For more information about generating reports, see: [Creating a Report of the Results](#).

To copy the calculation data to one or more other calculations, click the Copy  button and select the required calculation(s).

To close the **Results Panel**, click the **Close**  button in the corner or the **Close Results**  button at the bottom.



FindFlow		183 mm
Results    <span style="float: right;">×</span>		
Calc. Method	Darcy-Weisbach	
Material	▶ Steel (ANSI) Sch. 40	
Internal Diameter	26.6446	mm
Length	10	m
Elevation Change	0	m
Fluid (20°C)	▶ Water	
<b>Pressure Loss</b>	<b>0.156612</b>	<b>bar</b>
<b>Flow Type</b>	Turbulent	
<b>Reynolds Number</b>	47595	
<b>Friction Factor</b>	0.025999	
<b>Fluid Velocity</b>	5.884059	ft/sec
<b>Friction Loss</b>	0.156612	bar
<b>Fittings Loss</b>	0.000000	bar
<b>Elevation Loss</b>	0.000000	bar
<b>Volume Flow</b>	<b>0.001000</b>	m <sup>3</sup> /sec ▼
<b>Mass Flow</b>	<b>0.998001</b>	kg/sec ▼
× CLOSE RESULTS		

Figure 30 Find Flow Results - Liquid

## 7.2 Flow Rate Calculation - Gas

The flow rate for a gas in a pipe can be calculated as follows:

1. Select the **Find Flow** calculation.

The screenshot shows the 'FindFlow' calculation window. The title bar includes the 'FindFlow' logo and system icons. The main content area is titled 'Steel (ANSI)' and 'Sch. 40'. It contains several input fields and buttons:

- Internal Roughness:** Input field with value 0.045999, unit mm, and a 'Pipe' button.
- Internal Diameter:** Input field with value 26.6446, unit mm, and a 'Diam.' button.
- Length (No Fittings):** Input field with value 10, unit m, and a 'Fittings' button.
- Elevation Change:** Input field with value 0, unit m, and a 'Rise' button.
- Fluid:** Input field with value 'Air (20°C)', a '@' symbol, and a pressure input field with value 0, unit bar g. Below this is a table showing fluid properties: Density 1.204 kg/m³ and Viscosity 0.018 Centipoise. To the right are 'Options' and 'General Iso. Z = 1' buttons.
- Pressure Loss:** Input field with value 0.156612, unit bar.

A large 'CALCULATE FLOW' button is located at the bottom of the window.

Figure 31 Find Flow Calculation - Gas

2. Select or define the **Material** and **Internal Roughness** of the pipe. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).
3. Select or define the **Internal Diameter** of the pipe. For more information about working with pipe diameters, see: [Pipe Material & Diameters](#).
4. Set the **Length** and **Elevation Change** of the pipe.
5. Add **Fittings** to the pipe if required. For more information about working with fittings, see: [Fittings & Valves](#).
6. Select the **Fluid** in the pipe. For more information about working with fluids, see: [Fluids Database](#).
7. Enter the **Pressure** of the fluid at the start of the pipe.
8. Enter the **Pressure Loss**.

9. Click **Calculate Flow**, the **Results Panel** will slide up.

 The internal diameter will be reset to 1.049" (26.64 mm) if running the trial version of Pipe Flow Wizard.

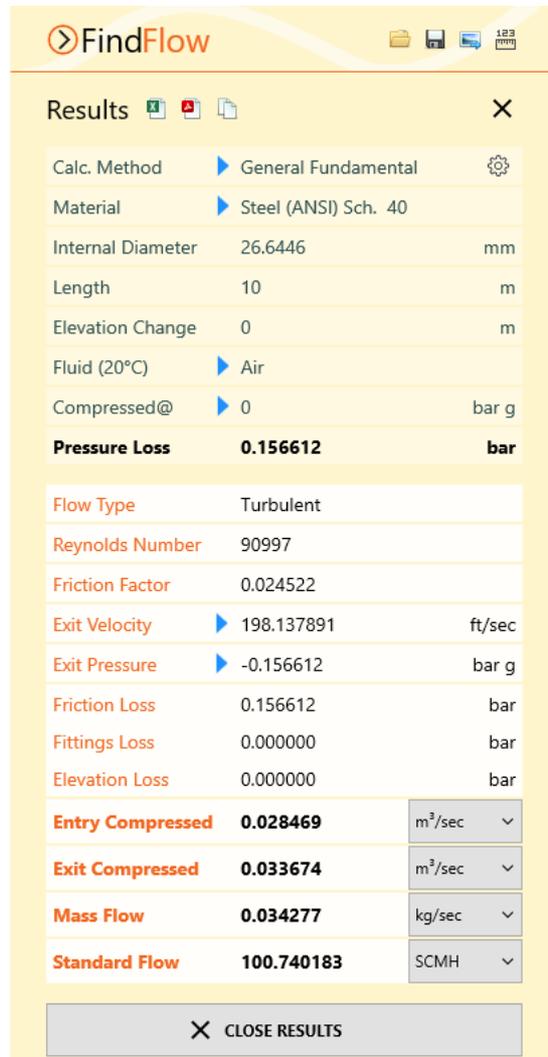
The **Find Flow Results Panel** displays the calculation input data and the results of the **Find Flow** calculation. For more information about the Results Panel, see: [Results Panel](#).

The **Flow** units can be changed as required. To change the flow units for all subsequent calculations, the flow unit can be specified in Settings > Units. For more information about setting units, see [Units](#).

To generate and view an Excel or PDF Report of the results, click the Excel  button or PDF  button. For more information about generating reports, see: [Creating a Report of the Results](#).

To copy the calculation data to one or more other calculations, click the Copy  button and select the required calculation(s).

To close the **Results Panel**, click the **Close**  button in the corner or the **Close Results**  button at the bottom.



Parameter	Value	Unit
Calc. Method	General Fundamental	
Material	Steel (ANSI) Sch. 40	
Internal Diameter	26.6446	mm
Length	10	m
Elevation Change	0	m
Fluid (20°C)	Air	
Compressed@	0	bar g
<b>Pressure Loss</b>	<b>0.156612</b>	<b>bar</b>
Flow Type	Turbulent	
Reynolds Number	90997	
Friction Factor	0.024522	
Exit Velocity	198.137891	ft/sec
Exit Pressure	-0.156612	bar g
Friction Loss	0.156612	bar
Fittings Loss	0.000000	bar
Elevation Loss	0.000000	bar
Entry Compressed	0.028469	m³/sec
Exit Compressed	0.033674	m³/sec
Mass Flow	0.034277	kg/sec
Standard Flow	100.740183	SCMH

Figure 32 Find Flow Results - Gas

## 8 Pipe Diameter Calculation

The **Minimum Internal Diameter** of the pipe can be calculated when the following values are known:

- Pipe internal roughness
- Pipe length
- Pipe elevation change
- Fittings
- Required flow rate
- Maximum allowed pressure drop

The **Pipe Diameter** can be calculated for both Liquids and Gases. For information about selecting a fluid, see: [Fluids Database](#).

For more information about working with gases, see: [Working with Compressible Fluids](#).

For more information about the theory and formulas used to calculate the pipe diameter, see [Calculation Theory and Method of Solution](#).

## 8.1 Pipe Diameter Calculation - Liquid

The minimum internal diameter of a pipe that contains a liquid can be calculated as follows:

1. Select the **Find Diameter** calculation.

The screenshot shows the 'FindDiameter' application window. The title bar includes the application name and standard Windows icons. The main content area is titled 'Steel (ANSI)' and 'Sch. 40'. It contains several input fields and buttons:

- Internal Roughness:** Input field with '0.045999', a clear button (X), and a unit dropdown set to 'mm'. A 'Pipe' button is to the right.
- Length (No Fittings):** Input field with '10', a clear button (X), and a unit dropdown set to 'm'. A 'Fittings' button is to the right.
- Elevation Change:** Input field with '0', a clear button (X), and a unit dropdown set to 'm'. A 'Rise' button with a dropdown arrow is to the right.
- Fluid:** A dropdown menu showing 'Water (20°C)'. Below it, a table displays properties: Density 998 kg/m<sup>3</sup> and Viscosity 1.002 Centipoise. A 'Fluid' button with a dropdown arrow is to the right.
- Flow (Volume Flow):** Input field with '0.001', a clear button (X), and a unit dropdown set to 'm<sup>3</sup>/sec'. A 'Volume Flow' button with a dropdown arrow is to the right.
- Pressure Loss:** Input field with '0.156612', a clear button (X), and a unit dropdown set to 'bar'.

At the bottom, there is a large 'CALCULATE DIAMETER' button with a calculator icon.

Figure 33 Find Diameter Calculation - Liquid

2. Select or define the **Material** and **Internal Roughness** of the pipe. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).
3. Set the **Length** and **Elevation Change** of the pipe.
4. Add **Fittings** to the pipe if required. For more information about working with fittings, see: [Fittings & Valves](#).
5. Select the **Fluid** in the pipe. For more information about working with fluids, see: [Fluids Database](#).
6. Enter the **Flow Rate** of the fluid in the pipe. For more information about setting a flow rate, see: [Flow Rate Calculator / Helper](#).
7. Enter the maximum **Pressure Loss** of in the pipe.
8. Click **Calculate Diameter** and the **Results Panel** will slide up.

 The length will be reset to 32.80 ft (10 m) if running the trial version of Pipe Flow Wizard.

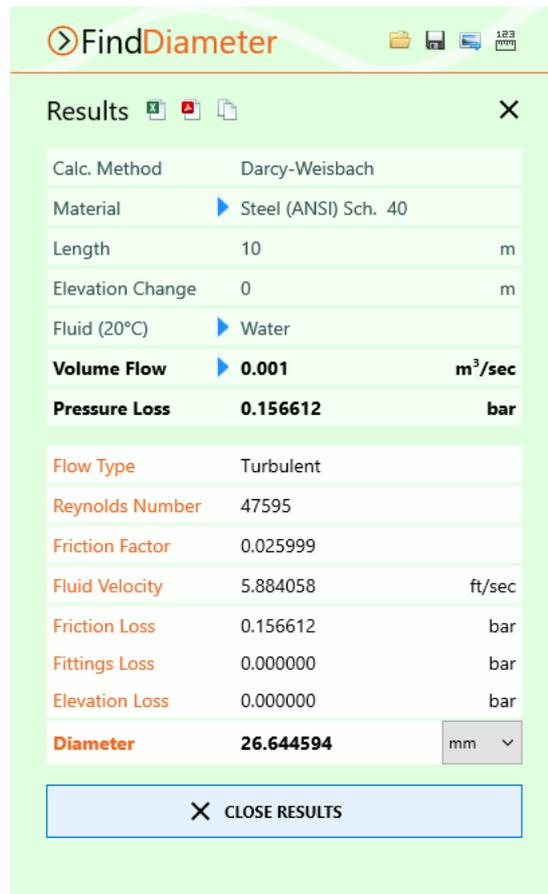
The **Find Diameter Results Panel** displays the calculation input data and the results of the **Find Diameter** calculation. For more information about the Results Panel, see: [Results Panel](#).

The **Diameter** units can be changed as required. To change the diameter units for all subsequent calculations, the diameter unit can be specified in Settings > Units. For more information about setting units, see: [Units](#).

To generate and view an Excel or PDF Report of the results, click the Excel  button or PDF  button. For more information about generating reports, see: [Creating a Report of the Results](#).

To copy the calculation data to one or more other calculations, click the Copy  button and select the required calculation(s).

To close the **Results Panel**, click the **Close**  button in the corner or the **Close Results**  button at the bottom.



FindDiameter		
Results    <span style="float: right;">X</span>		
Calc. Method	Darcy-Weisbach	
Material	▶ Steel (ANSI) Sch. 40	
Length	10	m
Elevation Change	0	m
Fluid (20°C)	▶ Water	
<b>Volume Flow</b>	<b>▶ 0.001</b>	<b>m<sup>3</sup>/sec</b>
<b>Pressure Loss</b>	<b>0.156612</b>	<b>bar</b>
Flow Type	Turbulent	
Reynolds Number	47595	
Friction Factor	0.025999	
Fluid Velocity	5.884058	ft/sec
Friction Loss	0.156612	bar
Fittings Loss	0.000000	bar
Elevation Loss	0.000000	bar
<b>Diameter</b>	<b>26.644594</b>	mm 
<span>X</span> CLOSE RESULTS		

Figure 34 Find Diameter Results - Liquid

## 8.2 Pipe Diameter Calculation - Gas

The minimum internal diameter of a pipe that contains a gas can be calculated as follows:

1. Select the **Find Diameter** calculation.

The screenshot shows the 'FindDiameter' application window. The title bar includes the application name and standard Windows icons. The main interface is titled 'Steel (ANSI)' and 'Sch. 40'. It features several input fields and buttons:

- Internal Roughness:** Input field with '0.045999', a clear button (X), and a unit dropdown set to 'mm'. A 'Pipe' button is to the right.
- Length (No Fittings):** Input field with '10', a clear button (X), and a unit dropdown set to 'm'. A 'Fittings' button is to the right.
- Elevation Change:** Input field with '0', a clear button (X), and a unit dropdown set to 'm'. A 'Rise' button with a downward arrow is to the right.
- Fluid:** A section with 'Air (20°C)' in a text box, a pressure input field with '@' and '0' and a unit dropdown set to 'bar g', and an 'Options' button. Below this are two rows of fluid properties: 'Density 1.204 kg/m³' and 'Viscosity 0.018 Centipoise'. To the right of these is a 'General Iso. Z = 1' button.
- Flow (Standard Volume):** Input field with '2.007392', a clear button (X), and a unit dropdown set to 'SCMH'. A 'Gas Flow' button is to the right.
- Pressure Loss:** Input field with '0.000083', a clear button (X), and a unit dropdown set to 'bar'.

At the bottom of the form is a large 'CALCULATE DIAMETER' button with a calculator icon.

Figure 35 Find Diameter Calculation - Gas

2. Select or define the **Material** and **Internal Roughness** of the pipe. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).
3. Set the **Length** and **Elevation Change** of the pipe.
4. Add **Fittings** to the pipe if required. For more information about working with fittings, see: [Fittings & Valves](#).
5. Select the **Fluid** in the pipe. For more information about working with fluids, see: [Fluids Database](#).
6. Enter the **Pressure** of the fluid at the start of the pipe.
7. Enter the **Flow Rate** of the fluid in the pipe. For more information about setting a flow rate, see: [Flow Rate Calculator / Helper](#).
8. Enter the maximum **Pressure Loss** in the pipe.

9. Click **Calculate Diameter** and the **Results Panel** will slide up.

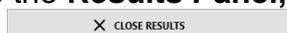
 The length will be reset to 32.80 ft (10 m) if running the trial version of Pipe Flow Wizard.

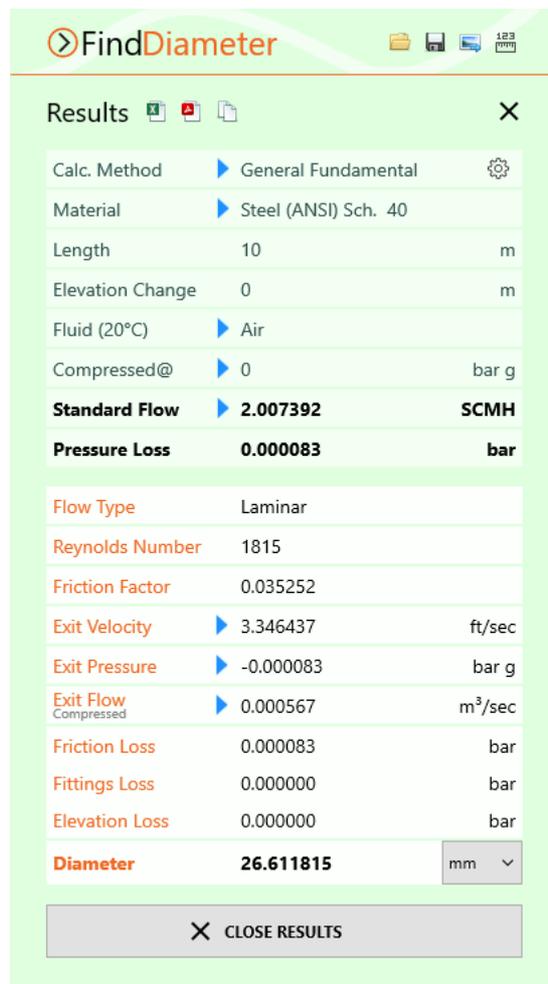
The **Find Diameter Results Panel** displays the calculation input data and the results of the **Find Diameter** calculation. For more information about the Results Panel, see: [Results Panel](#).

The **Diameter** units can be changed as required. To change the diameter units for all subsequent calculations, the diameter unit can be specified in Settings > Units. For more information about setting units, see: [Units](#).

To generate and view an Excel or PDF Report of the results, click the Excel  button or PDF  button. For more information about generating reports, see: [Creating a Report of the Results](#).

To copy the calculation data to one or more other calculations, click the Copy  button and select the required calculation(s).

To close the **Results Panel**, click the **Close**  button in the corner or the **Close Results**  button at the bottom.



The screenshot shows the 'FindDiameter' window with a 'Results' panel. The panel contains a table of calculation parameters and results. At the bottom of the panel is a 'CLOSE RESULTS' button.

Parameter	Value	Unit
Calc. Method	General Fundamental	
Material	Steel (ANSI) Sch. 40	
Length	10	m
Elevation Change	0	m
Fluid (20°C)	Air	
Compressed@	0	bar g
<b>Standard Flow</b>	<b>2.007392</b>	<b>SCMH</b>
<b>Pressure Loss</b>	<b>0.000083</b>	<b>bar</b>
Flow Type	Laminar	
Reynolds Number	1815	
Friction Factor	0.035252	
Exit Velocity	3.346437	ft/sec
Exit Pressure	-0.000083	bar g
Exit Flow Compressed	0.000567	m <sup>3</sup> /sec
Friction Loss	0.000083	bar
Fittings Loss	0.000000	bar
Elevation Loss	0.000000	bar
<b>Diameter</b>	<b>26.611815</b>	mm

Figure 36 Find Diameter Results - Gas

## 9 Pipe Length Calculation

The pipe **Length** can be calculated when the following values are known:

- Pipe internal roughness
- Pipe internal diameter
- Pipe elevation change
- Required flow rate
- Maximum allowed pressure drop

The **Pipe Length** can be calculated for both Liquids and Gases. For information about selecting a fluid, see: [Fluids Database](#).

For more information about working with gases, see: [Working with Compressible Fluids](#).

For more information about the theory and formulas used to calculate the pipe length, see [Calculation Theory and Method of Solution](#).

## 9.1 Pipe Length Calculation - Liquid

The maximum length of a pipe that contains a liquid can be calculated as follows:

1. Select the **Find Length** calculation.

The screenshot shows the 'FindLength' calculation window. The title bar includes the application name 'FindLength' and standard Windows icons. The main content area is light blue and contains the following sections:

- Steel (ANSI)**: Sch. 40
- Internal Roughness**: Input field with '0.045999', a clear button (X), and a unit dropdown set to 'mm'. A 'Pipe' button is to the right.
- Internal Diameter**: Input field with '26.6446', a clear button (X), and a unit dropdown set to 'mm'. A 'Diam.' button is to the right.
- Elevation Change**: Input field with '0', a clear button (X), and a unit dropdown set to 'm'. A 'Rise' button with a dropdown arrow is to the right.
- Fluid**: A text field containing 'Water (20°C)'. Below it, a table shows 'Density: 998 kg/m³' and 'Viscosity: 1.002 Centipoise'. A fluid selection icon is to the right.
- Flow**: A dropdown menu set to '(Volume Flow)'. Below it, an input field with '0.001', a clear button (X), and a unit dropdown set to 'm³/sec'. A 'Volume Flow' button with a dropdown arrow is to the right.
- Pressure Loss (No Fittings)**: Input field with '0.156612', a clear button (X), and a unit dropdown set to 'bar'. A 'Fittings' button with a dropdown arrow is to the right.
- A large grey button at the bottom labeled 'CALCULATE LENGTH' with a calculator icon.

Figure 37 Find Length Calculation - Liquid

2. Select or define the **Material** and **Internal Roughness** of the pipe. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).
3. Select or define the **Internal Diameter** of the pipe. For more information about working with pipe diameters, see: [Pipe Material & Diameters](#).
4. Set the **Elevation Change** of the pipe.
5. Select the **Fluid** in the pipe. For more information about working with fluids, see: [Fluids Database](#).
6. Enter the **Flow Rate** of the fluid in the pipe. For more information about setting a flow rate, see: [Flow Rate Calculator / Helper](#).
7. Enter the **Pressure Loss** in the pipe.
8. Add **Fittings** to the pipe if required. For more information about working with fittings, see: [Fittings & Valves](#).

9. Click **Calculate Length** and the **Results Panel** will slide up.

 The internal diameter will be reset to 1.049" (26.64 mm) if running the trial version of Pipe Flow Wizard.

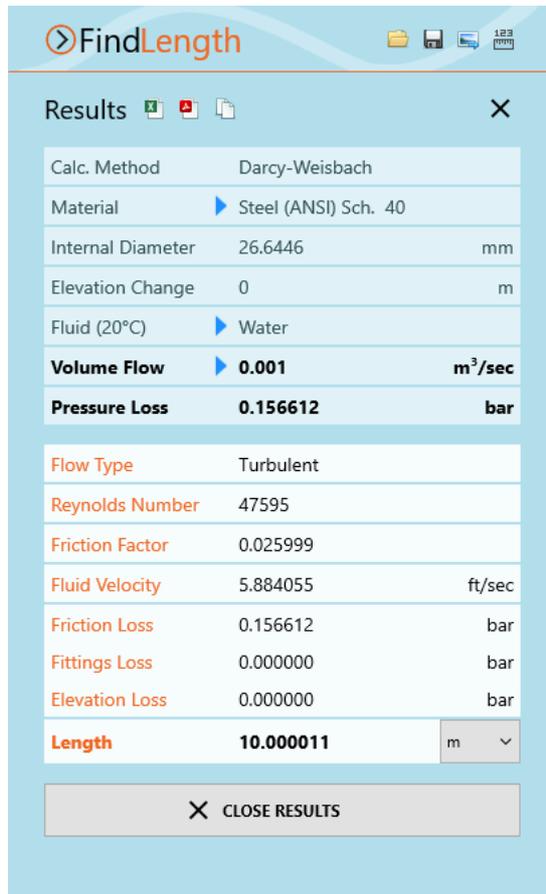
The **Find Length Results Panel** displays the calculation input data and the results of the **Find Length** calculation. For more information about the Results Panel, see: [Results Panel](#).

The **Length** units can be changed as required. To change the length units for all subsequent calculations, the length unit can be specified in Settings > Units. For more information about setting units, see: [Units](#).

To generate and view an Excel or PDF Report of the results, click the Excel  button or PDF  button. For more information about generating reports, see: [Creating a Report of the Results](#).

To copy the calculation data to one or more other calculations, click the Copy  button and select the required calculation(s).

To close the **Results Panel**, click the **Close**  button in the corner or the **Close Results**  button at the bottom.



FindLength		
Results    <span style="float: right;">×</span>		
Calc. Method	Darcy-Weisbach	
Material	Steel (ANSI) Sch. 40	
Internal Diameter	26.6446	mm
Elevation Change	0	m
Fluid (20°C)	Water	
<b>Volume Flow</b>	<b>0.001</b>	<b>m<sup>3</sup>/sec</b>
<b>Pressure Loss</b>	<b>0.156612</b>	<b>bar</b>
Flow Type	Turbulent	
Reynolds Number	47595	
Friction Factor	0.025999	
Fluid Velocity	5.884055	ft/sec
Friction Loss	0.156612	bar
Fittings Loss	0.000000	bar
Elevation Loss	0.000000	bar
<b>Length</b>	<b>10.000011</b>	m <span style="float: right;">▼</span>
<span style="border: 1px solid gray; padding: 5px;">×</span> CLOSE RESULTS		

Figure 38 Find Length Results - Liquid

## 9.2 Pipe Length Calculation - Gas

The maximum length of a pipe that contains a gas can be calculated as follows:

1. Select the **Find Length** calculation.

The screenshot shows the 'FindLength' software interface. The title bar includes the application name and standard Windows icons. The main window is titled 'Steel (ANSI)' and 'Sch. 40'. It contains several input fields and buttons:

- Internal Roughness:** Input field with '0.045999', a unit dropdown set to 'mm', and a 'Pipe' button.
- Internal Diameter:** Input field with '26.6446', a unit dropdown set to 'mm', and a 'Diam.' button.
- Elevation Change:** Input field with '0', a unit dropdown set to 'm', and a 'Rise' button.
- Fluid:** A section with 'Air (20°C)' selected, a pressure dropdown set to '0 bar g', and buttons for 'Options', 'General Iso.', and 'Z = Calculated'. Below this, it shows 'Density: 1.204 kg/m³' and 'Viscosity: 0.018 Centipoise'.
- Flow:** A section with '(Standard Volume)' selected, an input field with '2.007293', a unit dropdown set to 'SCMH', and a 'Gas Flow' button.
- Pressure Loss (No Fittings):** Input field with '0.000083', a unit dropdown set to 'bar', and a 'Fittings' button.

At the bottom of the interface is a large 'CALCULATE LENGTH' button.

Figure 39 Pipe Length Calculation - Gas

2. Select or define the **Material** and **Internal Roughness** of the pipe. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).
3. Select or define the **Internal Diameter** of the pipe. For more information about working with pipe diameters, see: [Pipe Material & Diameters](#).
4. Set the **Elevation Change** of the pipe.
5. Select the **Fluid** in the pipe. For more information about working with fluids, see: [Fluids Database](#).
6. Enter the **Flow Rate** of the fluid in the pipe. For more information about setting a flow rate, see: [Flow Rate Calculator / Helper](#).
7. Enter the **Pressure** of the fluid at the start of the pipe.
8. Enter the **Pressure Loss** in the pipe.

9. Add **Fittings** to the pipe if required. For more information about working with fittings, see: [Fittings & Valves](#).
10. Click **Calculate Length** and the **Results Panel** will slide up.

 The internal diameter will be reset to 1.049" (26.64 mm) if running the trial version of Pipe Flow Wizard.

The **Find Length Results Panel** displays the calculation input data and the results of the **Find Length** calculation. For more information about the Results Panel, see: [Results Panel](#).

The **Length** units can be changed as required. To change the length units for all subsequent calculations, the length unit can be specified in Settings > Units. For more information about setting units, see: [Units](#).

To generate and view an Excel or PDF Report of the results, click the Excel  button or PDF  button. For more information about generating reports, see: [Creating a Report of the Results](#).

To copy the calculation data to one or more other calculations, click the Copy  button and select the required calculation(s).

To close the **Results Panel**, click the **Close**  button in the corner or the **Close Results**  button at the bottom.

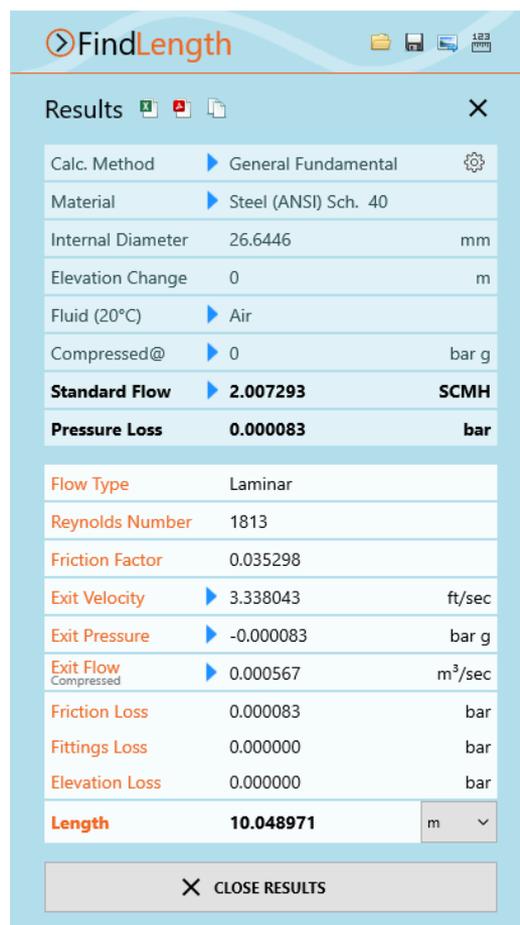


Figure 40 Pipe Length Results - Gas

# 10 Fluids Database

Pipe Flow Wizard includes a fluid database. The Fluid Properties list displays all the fluids available in the fluid database for either liquids or gases. When you are selecting a fluid to be used for a calculation, you can select an existing fluid, or enter your own fluid data. Once entered, new fluid data will show up in the list of fluids and can then be used just the same as the standard fluid data.

The Fluid Data can be defined and overwritten in the fluid properties section of the Fluid data screen.

New fluid data can be added to the existing database entries by clicking the Add Fluid button.

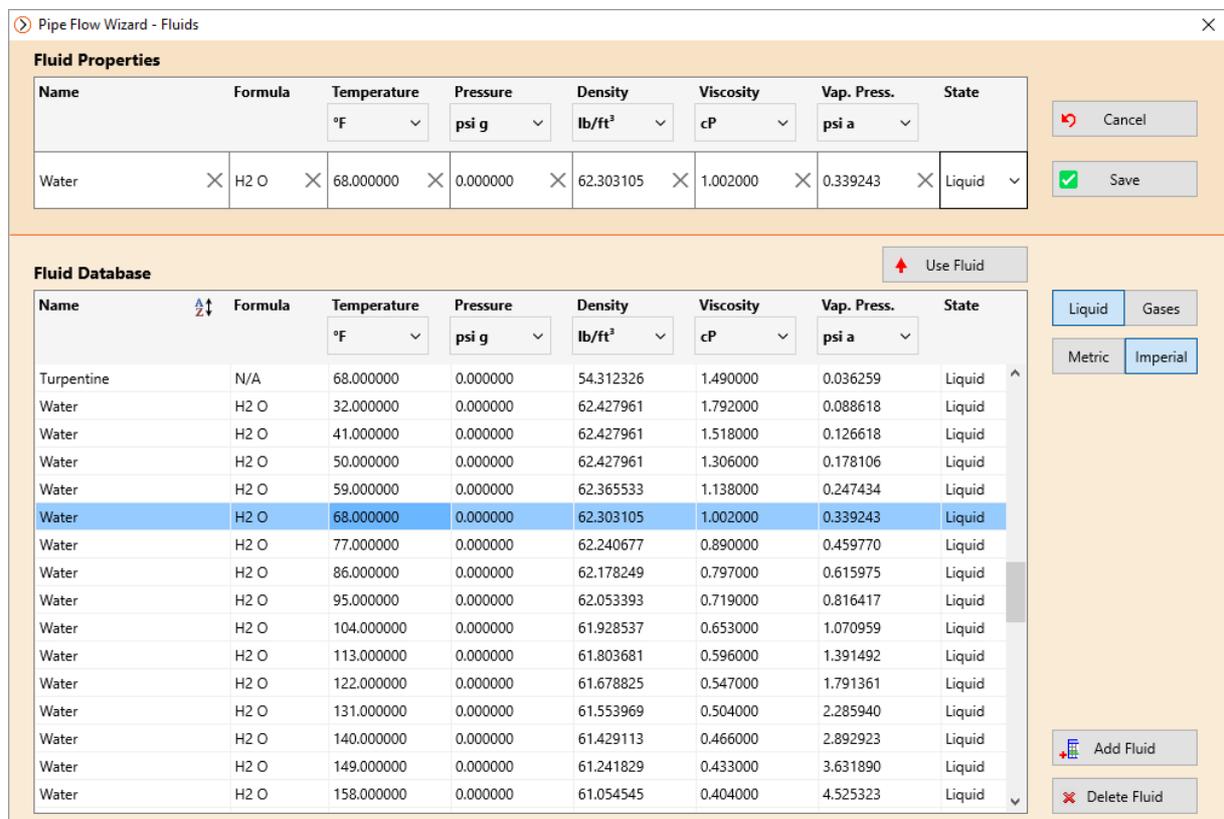


Figure 41 Fluids Database

To define the fluid and fluid properties for the currently selected calculation:

1. Click the fluid button (Liquids  or Gases  ) on the calculation panel.
2. Select the fluid contained in the pipe from the **Fluid Database** list.
3. If the fluid is not in the **Fluid Database** list, click the **Add Fluid** button to add the new fluid data to the list. For more information about adding fluid data, see: [Adding Fluid to the Fluid Database](#) and [Adding Gas Data to the Fluid Database](#).
4. Click the **Use Fluid** button or double-click the row containing the fluid.
5. The selected fluid is displayed in the **Fluid Properties** section.
6. Edit the applicable fluid properties in the **Fluid Properties** section.
7. The edits you make only affect the fluid properties for the calculation; they do not affect the database data.
8. Click **Save** to save the fluid data to be used with the currently selected calculation.

The name of the fluid is displayed in the calculation next to the fluid buttons.

## 10.1 Adding Fluid to the Fluid Database

If the fluid you are using does not exist in the Pipe Flow Wizard fluid database, you can quickly add the fluid to the database by clicking the Add Fluid button on the Fluids screen.

**NOTE:** Be sure to enter the value for the fluid's properties in the units displayed in the column header. For example, if you are using imperial units, °F for Fahrenheit is displayed under Temperature in the Temperature column. The temperature value in this case should be entered in degrees Fahrenheit.

To add a new fluid to the fluid database:

1. Click the **Fluid** button (Liquids  or Gases  ) on the calculation panel.
2. Click the **Add Fluid** button.
3. On the confirmation dialog that is displayed, click Yes if you want all current fluid properties in the **Fluid Properties** section to be cleared, otherwise click No to retain the current fluid property values so that you can modify them as required.
4. Enter the fluid's name in the **Name** field.
5. Enter the fluid's formula in the **Formula** field.
6. Enter the fluid's temperature in the **Temperature** field.
7. Enter the fluid's density in the **Density** field.
8. Enter the fluid's viscosity in the **Viscosity** field.
9. For a liquid, enter the fluid's vapor pressure in the **Vap. Press.** field.
10. For a gas, enter the fluid's specific heat ratio in the **Specific Heat Ratio** field.
11. Select whether the fluid is a liquid or a gas in the **State** drop down field.
12. Click **Save** to save the new fluid data to the **Fluid Database**.

## 10.2 Adding Gas Data to the Fluid Database

If the fluid you are using is one of the included gases, the viscosity and density of the gas at various temperatures and pressures can be calculated.

To add a new gas to the fluid database:

1. Click the **Gas** button  on the calculation panel.
2. Click the **Calculate Gas Data** button to display the **Gas Data Calculator**.

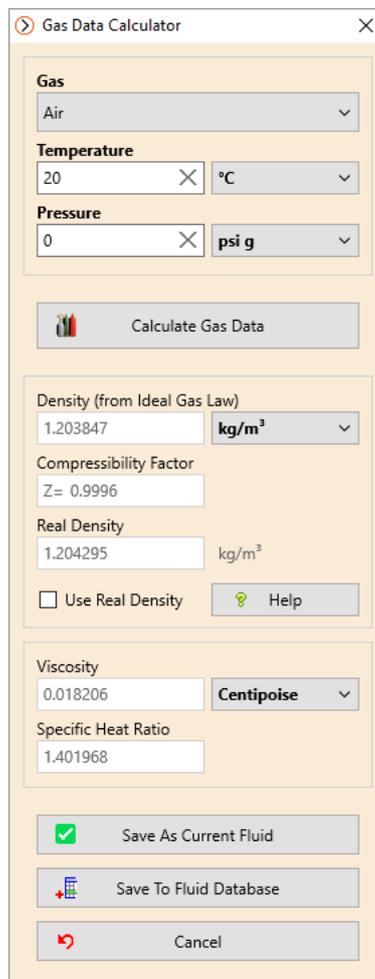


Figure 42 Gas Data Calculator

3. Choose a Gas from the drop-down listing.
4. Enter the temperature of the gas.
5. Enter the pressure of the gas.
6. Click **Calculate Gas Data**.
7. The density, viscosity and specific heat ratio for the gas are displayed.
8. Click **Save To Fluid Database** to add the data to the fluid database.

 The Gas Data Calculator will not generate fluid data if running the trial version of Pipe Flow Wizard.

# 11 Pipe Material & Diameters

Pipe Flow Wizard includes a database of common pipe materials for which a range of pipe characteristics (internal roughness, nominal size and internal diameter) are defined.

If the pipe you are using does not exist in the database, then its characteristics can be entered manually and optionally added to the database.

## 11.1 Selecting a Pipe Material

To select a pipe material:

1. Click the on the **Pipe**  button on the calculation panel to open the **Pipe Material** screen.

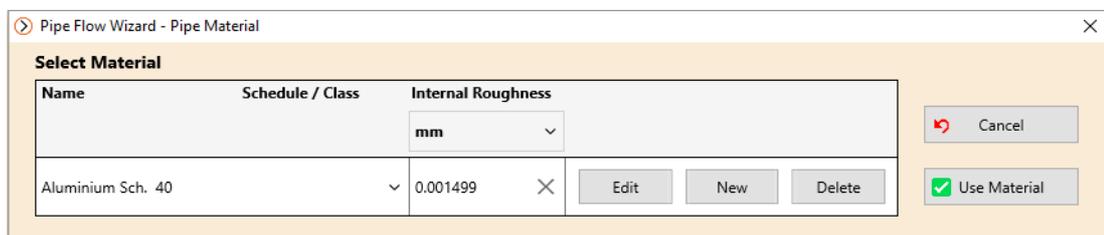


Figure 43 Pipe Material

2. Select the **Material** name from the drop-down list.
3. Click the **Use Material** button.

## 11.2 Editing a Pipe Material

To edit a pipe material:

1. Click the on the **Pipe**  button on the calculation panel to open the **Pipe Material** screen.
2. Click the **Edit** button.

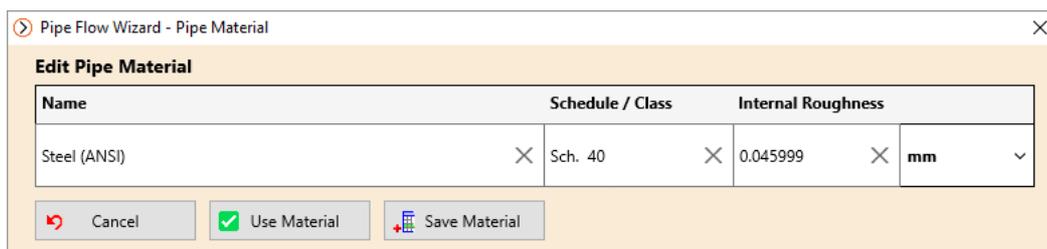


Figure 44 Edit Pipe Material

3. Overtypethe **Name**, **Schedule / Class**, and **Internal Roughness** values.
4. Click the **Use Material** button.

## 11.3 Adding a new Pipe Material

To add a pipe material:

1. Click the on the **Pipe**  button on the calculation panel to open the **Pipe Material** screen.
2. Click the **New** button.

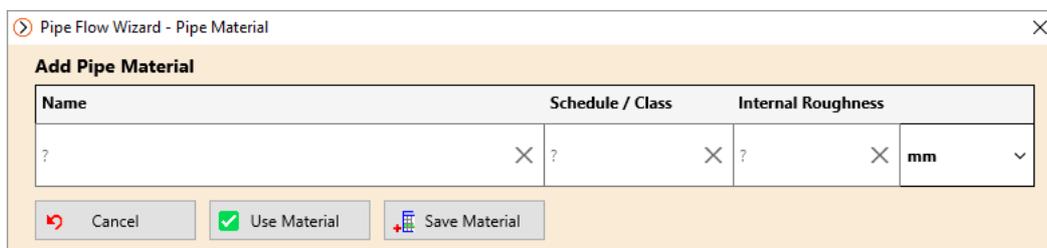


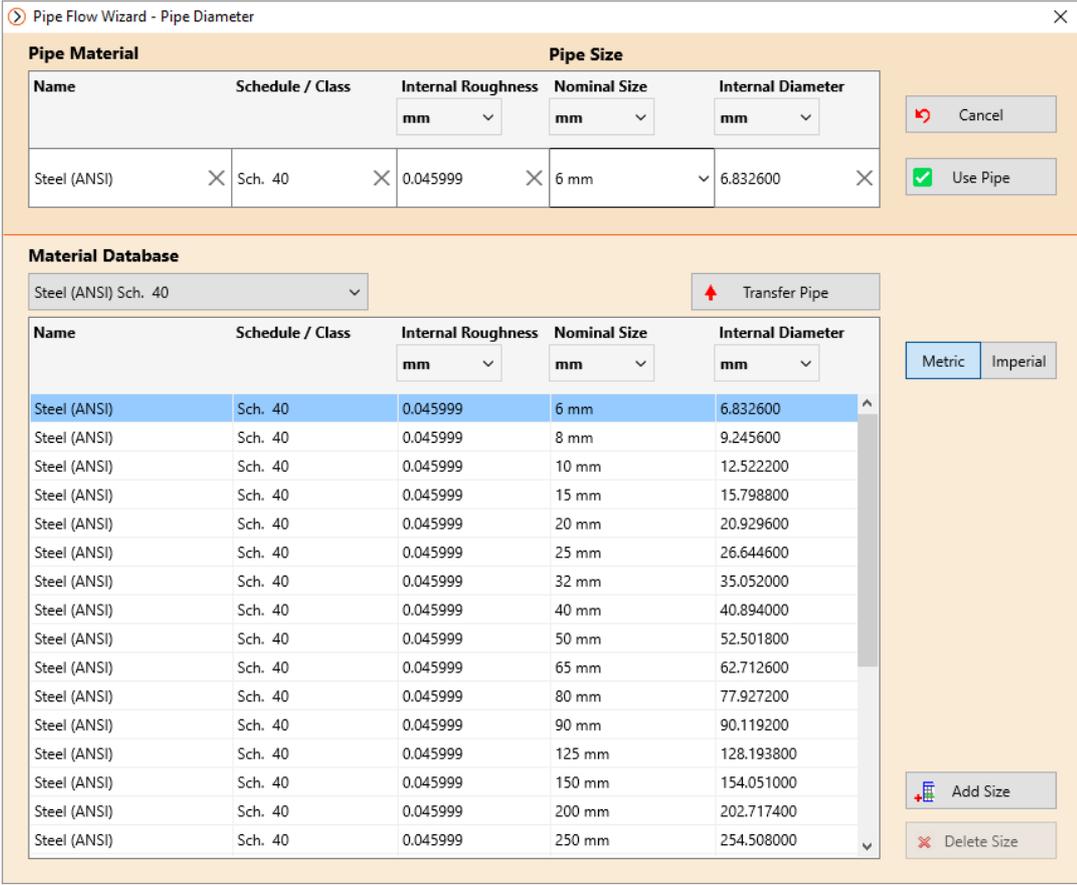
Figure 45 Add Pipe Material

3. Enter the **Name**, **Schedule / Cass**, and **Internal Roughness** values.
4. Click the **Save Material** button to save the new material to the database or click **Use Material** to apply the material to the calculation without saving.

## 11.4 Selecting a Pipe Diameter

To select a pipe diameter:

1. Click the **Diam.**  button on the calculation panel to open the **Pipe Diameter** screen.



**Pipe Material**

Name	Schedule / Class	Internal Roughness mm	Nominal Size mm	Internal Diameter mm
Steel (ANSI)	Sch. 40	0.045999	6 mm	6.832600

**Material Database**

Steel (ANSI) Sch. 40

Name	Schedule / Class	Internal Roughness mm	Nominal Size mm	Internal Diameter mm
Steel (ANSI)	Sch. 40	0.045999	6 mm	6.832600
Steel (ANSI)	Sch. 40	0.045999	8 mm	9.245600
Steel (ANSI)	Sch. 40	0.045999	10 mm	12.522200
Steel (ANSI)	Sch. 40	0.045999	15 mm	15.798800
Steel (ANSI)	Sch. 40	0.045999	20 mm	20.929600
Steel (ANSI)	Sch. 40	0.045999	25 mm	26.644600
Steel (ANSI)	Sch. 40	0.045999	32 mm	35.052000
Steel (ANSI)	Sch. 40	0.045999	40 mm	40.894000
Steel (ANSI)	Sch. 40	0.045999	50 mm	52.501800
Steel (ANSI)	Sch. 40	0.045999	65 mm	62.712600
Steel (ANSI)	Sch. 40	0.045999	80 mm	77.927200
Steel (ANSI)	Sch. 40	0.045999	90 mm	90.119200
Steel (ANSI)	Sch. 40	0.045999	125 mm	128.193800
Steel (ANSI)	Sch. 40	0.045999	150 mm	154.051000
Steel (ANSI)	Sch. 40	0.045999	200 mm	202.717400
Steel (ANSI)	Sch. 40	0.045999	250 mm	254.508000

Figure 46 Pipe Diameter

2. If required, change and select the pipe material from the **Material Database** list.
3. Double click on a row in the list of pipe diameters, or select a row from the list of pipe diameters and click the **Transfer Pipe** button, to update the Pipe Material and size information.
4. Click the **Use Pipe** button.

## 11.5 Editing a Pipe Diameter

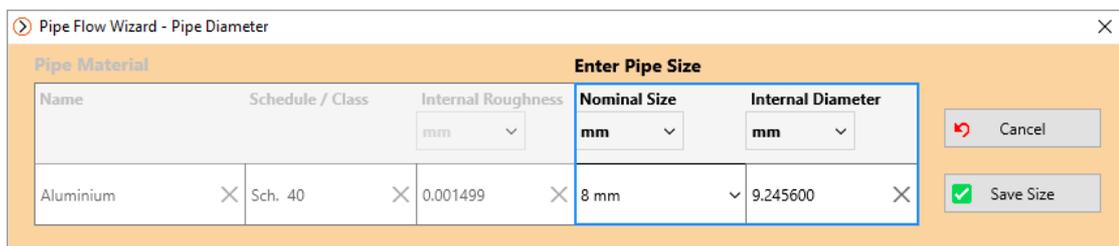
To edit a pipe diameter:

1. Click the **Diam.**  button on the calculation panel to open the **Pipe Diameter** screen.
2. In the **Pipe Material / Pipe Size** section, overwrite the values as required.
3. Click the **Use Pipe** button.

## 11.6 Adding a Pipe Diameter

To add a new pipe diameter:

1. Click the **Diam.**  button on the calculation panel to open the **Pipe Diameter** screen.
2. Click the **Add Size** button.



Pipe Material			Enter Pipe Size	
Name	Schedule / Class	Internal Roughness	Nominal Size	Internal Diameter
Aluminium	Sch. 40	0.001499	8 mm	9.245600

Figure 47 Add Pipe Diameter

3. Specify the **Nominal Size** and **Internal Diameter** values.
4. Click **Save Size**.

## 12 Fittings & Valves

Up to five different fitting types can be added to a pipe. Multiple fittings of each type can be specified, and each fitting type can be selected to be at the start or end of the pipe.

Fittings can be selected from the Pipe Flow Wizard Fitting database, or user fittings can be created using an appropriate K value.

### 12.1 Adding a Fitting to the Pipe

To add fittings to a pipe:

1. Click the **Fittings**  button on the calculation panel to open the **Fittings** screen.

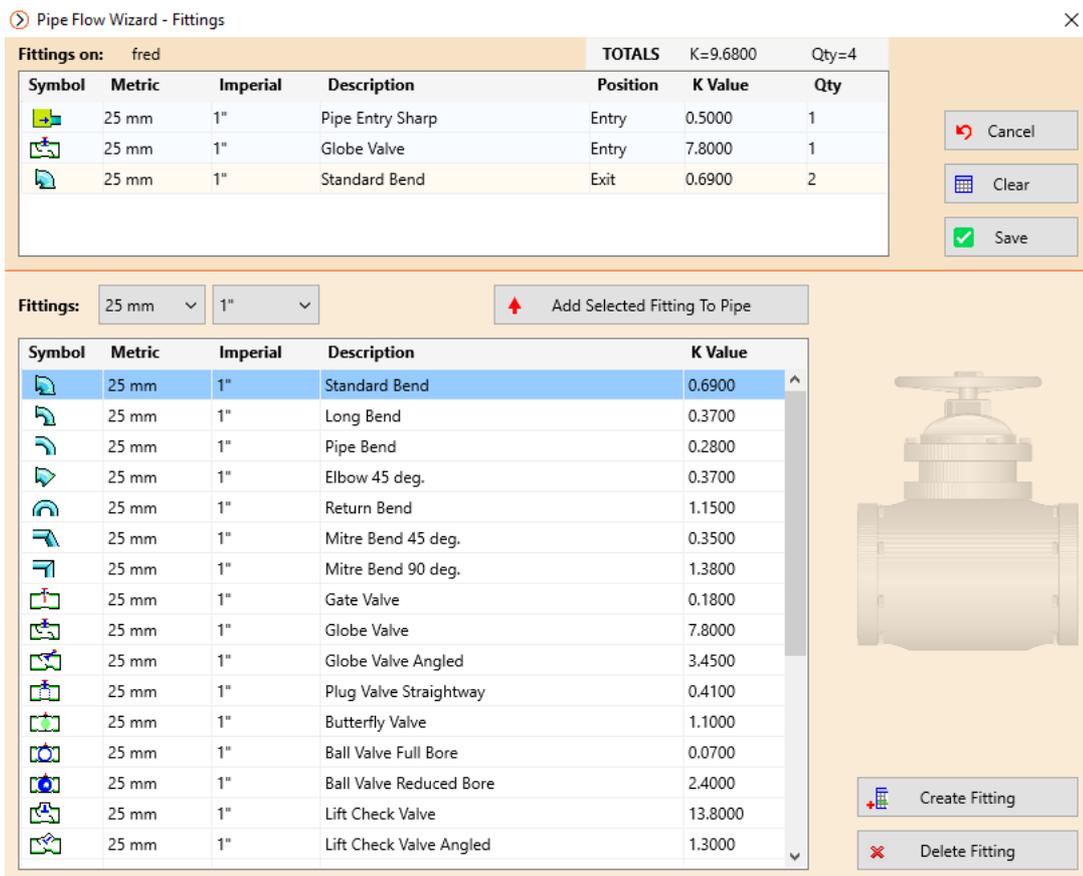


Figure 48 Fittings & Valves

2. The fittings on the pipe will be shown in the **Fittings on** section at the top of the screen.
3. A list of available fittings will be shown for the current pipe size.

4. If required, change the nominal metric or imperial size from the drop-down list to display the available fittings and their associated K value for a different size.
5. If the fitting is not in the **Fitting Database** list, click the **Create Fitting** button to add the new fitting to the list. For more information about adding a fitting to the database, see: Adding a Fitting to the Pipe.
6. **Double click** on a fitting from the list to add it to the fittings on the pipe.
7. The selected fitting is displayed in the **Fittings on** section of the **Fittings** screen.
8. Select the position of the fitting on the pipe to be either Entry or Exit, and select the quantity of each fitting from the Qty drop down list.
9. To add additional fittings to the pipe, repeat Steps 4 – 8.
10. Click **Save** to add the chosen fittings to the pipe, and to close the **Fittings** screen.

## 12.2 Removing a Fitting from the Pipe

To remove fittings from a pipe:

1. Click the **Fittings**  button on the calculation panel to open the **Fittings** screen.
2. Select the fitting to be removed in the **Fittings on** section of the **Fittings** screen.

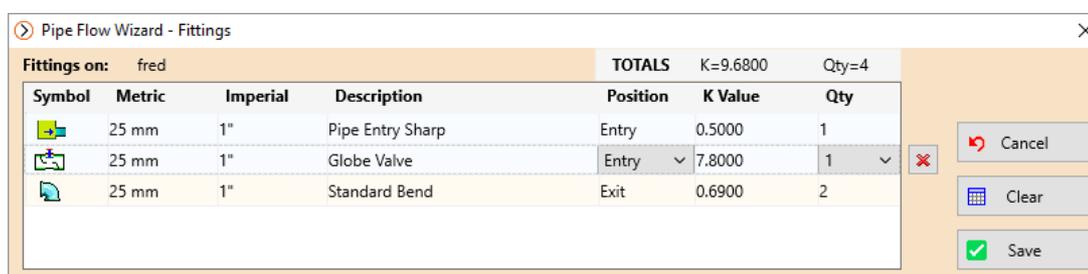


Figure 49 Fittings on the Pipe

3. Click the **Delete**  button for the selected fitting.

- Click **Save** to update the pipe with the chosen fittings, and to close the **Fittings** screen.

## 12.3 Adding a Fitting to the Database

To add a fitting to the database:

- Click the **Fittings**  button on the calculation panel to open the **Fittings** screen.
- Click the **Create Fitting** button to open the **Create New Fitting** section of the **Fittings** screen.



Symbol	Metric	Imperial	Description	K Value
	6 mm	1/8"	?	0.0000

Buttons: Change, Save Fitting, Clear

Figure 50 Create New Fitting

- To change the symbol representing the fitting, click the **Change** button to open the **Choose Symbol** screen.

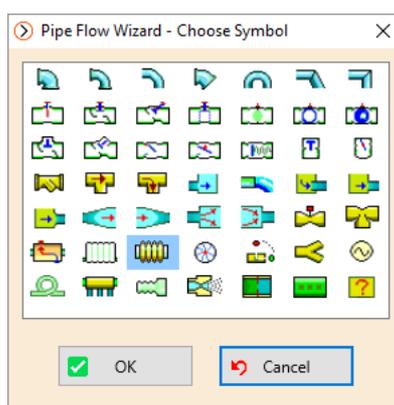


Figure 51 Choose Fitting Symbol

- Select the symbol you want to represent the fitting.
- Click **OK** to add the symbol to the **Symbol** field and close the **Choose Symbol** screen.
- Select the fitting's metric size from the **Metric** list or select the fitting's imperial size from the **Imperial** list.
- You only need to select the metric or imperial fitting size. Pipe Flow Wizard automatically populates the other size for you. For example, if you select 32mm from the **Metric** list, the imperial equivalent, 1-1/4", automatically appears in the **Imperial** field.

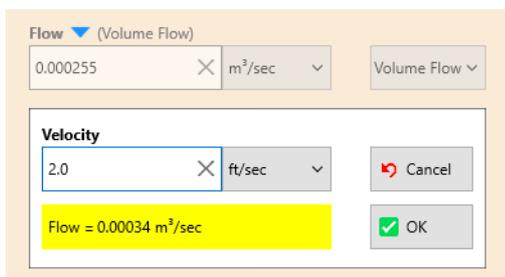
8. Enter a description of the fitting in the **Description** field.
9. Enter the K value for the fitting in the **K Value** field.
10. Click the **Save Fitting** to add the fitting to the **Fitting Database** list.

## 13 Flow Rate Calculator / Helper

For Pressure Drop Calculation and Pipe Length Calculation, Pipe Flow Wizard incorporates a Flow Rate Calculator which uses the current internal diameter and a fluid velocity to calculate a flow rate.

To open the **Flow Rate Calculator**:

1. Click the Flow  expander button:

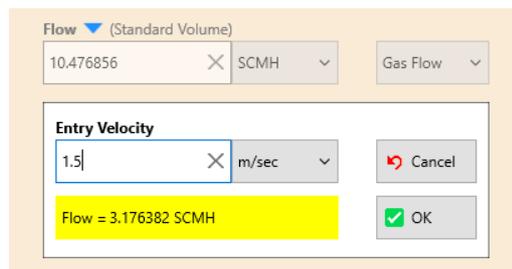


Flow (Volume Flow)  
0.000255 m<sup>3</sup>/sec  
Volume Flow

Velocity  
2.0 ft/sec  
Cancel

Flow = 0.00034 m<sup>3</sup>/sec  
OK

Figure 53 Flow Rate Calculator - Liquid



Flow (Standard Volume)  
10.476856 SCMh  
Gas Flow

Entry Velocity  
1.5 m/sec  
Cancel

Flow = 3.176382 SCMh  
OK

Figure 52 Flow Rate Calculator - Gas

2. Enter the required **Velocity**.
3. As you enter the **Velocity**, Pipe Flow Wizard automatically calculates the **Flow Rate** and displays it beneath the velocity.
4. Click **OK** to apply the calculated flow rate and close the **Flow Rate Calculator**.



Whilst the **Flow Rate Calculator** is open, no other operations can be performed in the calculation panel.

## 14 Calculations and Results

Once you have entered the required input data to a Calculation Panel (e.g. Find Pressure), you can calculate the results for that data by clicking the **Calculate** button. If the input data is valid, the Results Panel slides up and over the Calculation Panel to concisely display the calculated data.

The values in the results panel can be scrolled up and down as needed, and where applicable, result value can be expanded to reveal additional information related to that attribute. For more information about expanding attributes, see: Expandable Sections.

### 14.1 Automatic Checks and Updates

Before a calculation is solved, the software performs some automatic checking of the input data and allows users to accept various recommend updates to the make the calculation data consistent.

#### 14.1.1 Fitting Sizes

Fitting sizes will be checked and matched to the nominal pipe size.

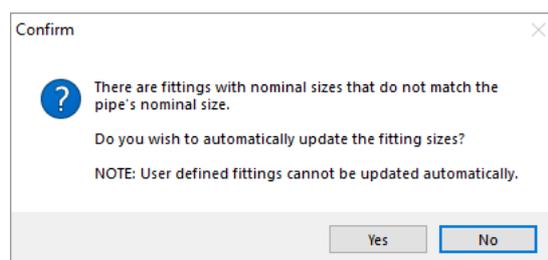


Figure 54 Fitting Sizes

If the nominal pipe size does not match some of the fitting sizes associated with the pipe, then the option to update the fittings sizes should normally be accepted. This will update the fitting sizes and the fitting 'K' values so that the fittings pressure losses will be calculated correctly.

 Pipe Flow Wizard cannot automatically update fitting sizes for user defined fittings.

## 14.2 Configuring the System Results

Once a calculation has been solved, the calculated results are displayed in the **Results Panel**. The options selected in the **Results Decimals** and **Units** sections of **Settings** determine how the results values are displayed.

## 14.3 Copying Calculation Results for use in another Calculation

When a calculation has been solved and the results panel is on display, click the **Copy**  button to display the **Copy Calculation** pop-up menu.

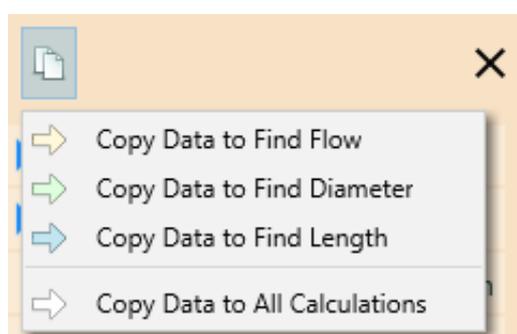


Figure 55 Copy Calculation Pop-up Menu

Click a menu item to copy the current calculation data to the input data of a different calculation, or copy it as the input data for all other calculations.

 The Copy Calculation action sheet is context sensitive and therefore will not include the active calculation in the menu.

## 14.4 Creating a Report of the Results

When a calculation has been solved and the **Results Panel** displayed, an Excel or PDF report can be created.

To create an Excel Report, click the **Excel** button. The report will be generated using the defined **Reports** settings and Pipe Flow Wizard will attempt to open it using **Microsoft Excel** (or compatible software) that is installed on your computer.

To create a PDF Report, click the **PDF** button. The report will be generated using the defined **Reports** settings and Pipe Flow Wizard will attempt to open it using **Adobe Acrobat** (or compatible software) that is installed on your computer.

The options selected in the Results Decimals, Units and Reports sections of Settings determine how the results values are displayed.

### 14.5 PDF Report Example – Tabulated Units



taking the pressure out of fluid flow calculations

**Find Pressure Drop**

**Inputs**

<b>Method of Calculation</b>	Darcy-Weisbach	
<b>Material</b>	Steel (ANSI)	
<b>Schedule</b>	Sch. 40	
<b>Internal Roughness</b>	0.045999	mm
<b>Nominal Size</b>	25	mm
<b>Internal Diameter</b>	26.6446	mm
<b>Length</b>	10	m
<b>Elevation Change</b>	0	m
<b>Fluid</b>	Water	
<b>Temperature</b>	20	°C
<b>Density</b>	998	kg/m <sup>3</sup>
<b>Viscosity</b>	1.002	Centipoise
<b>Volume Flow</b>	0.001	m <sup>3</sup> /sec
<b>Mass Flow</b>	0.998	kg/sec

**Results**

<b>Flow Type</b>	Turbulent	
<b>Reynolds Number</b>	47595	
<b>Friction Factor</b>	0.025999	
<b>Fluid Velocity</b>	5.884055	ft/sec
<b>Friction Loss</b>	0.156612	bar
<b>Fittings Loss</b>	0.000000	bar
<b>Elevation Loss</b>	0.000000	bar
<b>Pressure Drop</b>	0.156612	bar

Figure 56 PDF Report - Tabulated - Liquid



taking the pressure out of fluid flow calculations

**Find Pressure Drop**

**Inputs**

<b>Method of Calculation</b>	General Fundamental	
<b>Model of Compressibility</b>	Ideal Gas Law	
<b>Z=</b>	1	
<b>Material</b>	Steel (ANSI)	
<b>Schedule</b>	Sch. 40	
<b>Internal Roughness</b>	0.045999	mm
<b>Nominal Size</b>	25	mm
<b>Internal Diameter</b>	26.6446	mm
<b>Length</b>	10	m
<b>Elevation Change</b>	0	m
<b>Fluid</b>	Air	
<b>Temperature</b>	20	°C
<b>Compressed@</b>	0	bar.g
<b>Density</b>	1.204	kg/m <sup>3</sup>
<b>Viscosity</b>	0.018	Centipoise
<b>Atmosphere</b>	1.01325	bar a
<b>Standard Flow</b>	2.007293	SCMH
<b>Mass Flow</b>	0.000683	kg/sec
<b>Compressed Flow</b>	0.000567	m <sup>3</sup> /sec

**Results**

<b>Flow Type</b>	Laminar	
<b>Reynolds Number</b>	1813	
<b>Friction Factor</b>	0.035298	
<b>Entry Velocity</b>	3.337769	ft/sec
<b>Exit Velocity</b>	3.338041	ft/sec
<b>Entry Pressure</b>	0.000000	bar.g
<b>Exit Pressure</b>	-0.000083	bar.g
<b>Entry Density</b>	1.204000	kg/m <sup>3</sup>
<b>Exit Density</b>	1.203902	kg/m <sup>3</sup>
<b>Entry Flow (Standard Flow)</b>	0.000567	m <sup>3</sup> /sec
<b>Exit Flow (Standard Flow)</b>	0.000567	m <sup>3</sup> /sec
<b>Mass Flow</b>	0.000683	kg/sec
<b>Standard Flow</b>	2.007293	SCMH
<b>Friction Loss</b>	0.000083	bar
<b>Fittings Loss</b>	0.000000	bar
<b>Elevation Loss</b>	0.000000	bar
<b>Pressure Drop</b>	0.000083	bar

Figure 57 PDF Report - Tabulated - Gas

## 14.6 PDF Report Example – Non-Tabulated Units



taking the pressure out of fluid flow calculations

**Find Pressure Drop**

**Inputs**

<b>Method of Calculation</b>	Darcy-Weisbach
<b>Material</b>	Steel (ANSI)
<b>Schedule</b>	Sch. 40
<b>Internal Roughness</b>	0.045999 mm
<b>Nominal Size</b>	25 mm
<b>Internal Diameter</b>	26.644600 mm
<b>Length</b>	10.000000 m
<b>Elevation Change</b>	0.000000 m
<b>Fluid</b>	Water
<b>Temperature</b>	20 °C
<b>Density</b>	998.000000 kg/m <sup>3</sup>
<b>Viscosity</b>	1.002000 Centipoise
<b>Volume Flow</b>	0.001 m <sup>3</sup> /sec
<b>Mass Flow</b>	0.998 kg/sec

**Results**

<b>Flow Type</b>	Turbulent
<b>Reynolds Number</b>	47595
<b>Friction Factor</b>	0.025999
<b>Fluid Velocity</b>	5.884055 ft/sec
<b>Friction Loss</b>	0.156612 bar
<b>Fittings Loss</b>	0.000000 bar
<b>Elevation Loss</b>	0.000000 bar
<b>Pressure Drop</b>	0.156612 bar

Figure 58 PDF Report - Non-Tabulated - Liquid



taking the pressure out of fluid flow calculations

**Find Pressure Drop**

**Inputs**

<b>Method of Calculation</b>	General Fundamental
<b>Model of Compressibility</b>	Ideal Gas Law
<b>Z=</b>	1
<b>Material</b>	Steel (ANSI)
<b>Schedule</b>	Sch. 40
<b>Internal Roughness</b>	0.045999 mm
<b>Nominal Size</b>	25 mm
<b>Internal Diameter</b>	26.644600 mm
<b>Length</b>	10.000000 m
<b>Elevation Change</b>	0.000000 m
<b>Fluid</b>	Air
<b>Temperature</b>	20 °C
<b>Compressed@</b>	0.000000 bar g
<b>Density</b>	1.204000 kg/m <sup>3</sup>
<b>Viscosity</b>	0.018000 Centipoise
<b>Atmosphere</b>	1.013250 bar a
<b>Standard Flow</b>	2.007293 SCMH
<b>Mass Flow</b>	0.000683 kg/sec
<b>Compressed Flow</b>	0.000567 m <sup>3</sup> /sec

**Results**

<b>Flow Type</b>	Laminar
<b>Reynolds Number</b>	1813
<b>Friction Factor</b>	0.035298
<b>Entry Velocity</b>	3.337769 ft/sec
<b>Exit Velocity</b>	3.338041 ft/sec
<b>Entry Pressure</b>	0.000000 bar g
<b>Exit Pressure</b>	-0.000083 bar g
<b>Entry Density</b>	1.204000 kg/m <sup>3</sup>
<b>Exit Density</b>	1.203902 kg/m <sup>3</sup>
<b>Entry Flow (Standard Flow)</b>	0.000567 m <sup>3</sup> /sec
<b>Exit Flow (Standard Flow)</b>	0.000567 m <sup>3</sup> /sec
<b>Mass Flow</b>	0.000683 kg/sec
<b>Standard Flow</b>	2.007293 SCMH
<b>Friction Loss</b>	0.000083 bar
<b>Fittings Loss</b>	0.000000 bar
<b>Elevation Loss</b>	0.000000 bar
<b>Pressure Drop</b>	0.000083 bar

Figure 59 PDF Report - Non-Tabulated - Gas

## 15 Working with Compressible Fluids

The Pipe Flow Wizard software contains a Compressible Isothermal Flow Calculation Engine.

In a gas system, as pressure loss occurs along a pipe, the gas density will decrease, and the volume of the gas will expand. As the volume of gas increases, the velocity of the gas in the pipe will increase. Although the volume of gas and velocity in the pipe changes, the mass flow (weight of flow) in the pipe will remain constant.

Gas flow rates are therefore often referred to in terms of mass flow (weight of flow) or standard volume (which is the volume of gas at standard conditions, normally atmospheric pressure and some common temperature reference, since this standard volume also defines a constant mass flow).

Pipe Flow Wizard provides a choice of standard volume units for gas flow rate which include:

- SCCM (Standard Cubic Centimetres per Minute),
- SLM (Standard Litres per Minute),
- SCMH (Standard Cubic Meters per Hour)
- MMSCMH (Million Standard Cubic Meters per Hour)
- MMSCMD (Million Standard Cubic Meters per Day)
- SCFM (Standard Cubic Feet per Minute)
- SCFH (Standard Cubic Feet per Hour)
- SCFD (Standard Cubic Feet per Day)
- MMSCFH (Million Standard Cubic Feet per Hour)
- MMSCFD (Million Standard Cubic Feet per Day)

Each of the standard volume units for gas flow relate to the gas at a standard condition, however there are several slightly different standard reference conditions that are used worldwide depending on country and location. Pipe Flow Wizard provides a choice of standard reference conditions to be used when referring to the standard volume flow rate of gas and these include:

- 0°C, 100.000 kPa.a
- 0°C, 101.325 kPa.a
- 15°C, 101.325 kPa.a
- 20°C, 101.325 kPa.a
- 25°C, 101.225 kPa.a
- 60°F, 14.696 psi.a
- 68°F, 14.696 psi.a

Mass flow can also be used to refer to an amount of gas flow and the units for mass flow include:

- kg/sec
- kg/min
- kg/hour
- lb/sec
- lb/min
- lb/hour

## 15.1 Defining Gas Data

The calculations incorporate use of the Ideal Gas Law and if required a custom Compressibility Factor or use of the CNGA Compressibility Factor (that is calculated based on the pressures at the start and end of the pipe).

The Compressible Flow Calculation Engine will automatically take account of pressure changes within the pipe and will automatically adjust the density properties of the gas as appropriate when performing the gas flow rate, pressure loss, diameter size, and pipe length calculations. The equations used in the calculations currently assume isothermal flow where there is no change in temperature.

The Pipe Flow Wizard software will automatically account for changes in pressure and gas density within the pipe, however the original fluid properties must be defined for the operating temperature within the pipe (although the density may have been specified for a different pressure condition).

Normally the gas properties should be defined for the atmospheric pressure condition (0 bar.g or 0 psi.g) and the software will then automatically calculate the gas density at the start pressure condition prior to performing the appropriate calculation.

If the start pressure is a high pressure, and the real gas density at this condition varies from the ideal gas law prediction, then a compressibility factor other than 1.0 can be specified. This will be applied when calculating the gas density at the start pressure condition prior to performing the appropriate calculation.

### 15.1.1 Gas Calculator Data

The gas calculator helper within the Fluid Database can calculate and display the compressibility factor of certain gases at different temperature and pressure conditions, and it will show the real density of the gas at the specified condition.

The user should choose to either:

1. Define the gas properties at a condition on the ideal gas law line (normally say 0 bar.g) and then specify on the Options screen an appropriate compressibility factor for the pressure condition at the start of pipe.

OR

2. Define the gas properties at the start pressure condition using the real gas density at this pressure (if it differs from the predicted ideal gas law density at this condition) and then specify the compressibility 'Z=1.0'.

This ensures that the calculation proceeds to use the correct real gas density at the start pressure condition.

i.e.

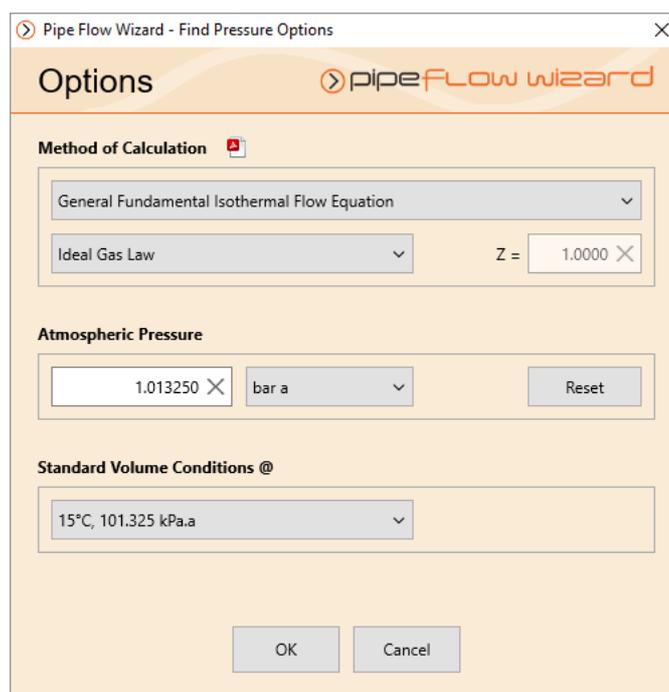
- a) If the gas properties are specified on the ideal gas law line then the predicted gas density at the start pressure condition will then be adjusted according to the compressibility factor that has been specified, in order to end up with the real gas density at the start condition.

OR

- b) If the gas properties are defined at a high-pressure condition, specifying the real gas density, then a compressibility factor of 'Z=1.0' should be used. The calculated density at the start pressure condition will then be derived from the real gas density (at the high-pressure condition) by applying the ideal gas law equation. This will normally give a good result in terms of predicting the real gas density at the start of the pipe, provided that the defined high-pressure condition and the start pressure are not too different.

This means that the gas properties should generally be specified on the ideal gas law line and a compressibility factor can be specified as appropriate, or if the real gas density is specified for the gas at a high-pressure condition at the start of the pipe then the compressibility factor should be set to 1.0.

## 15.2 Using Compressible Flow Equations



**Figure 60 Compressible Flow Equations**

There are a number of different equations that can be used to calculate flow rate and pressure loss in a compressible gas system and the type of design and user preference often determines which equation is chosen to calculate the results.

The Pipe Flow Wizard software allows for the selection of a specific compressible isothermal flow equation from a list that includes:

- General Fundamental Isothermal Flow Equation
- Complete Isothermal Flow Equation
- AGA Isothermal Flow Equation
- Weymouth Isothermal Flow Equation
- Panhandle A Isothermal Flow Equation
- Panhandle B Isothermal Flow Equation
- IGT Isothermal Flow Equation

**The General Fundamental Isothermal Flow Equation** (sometimes known as just the General Flow equation or the Fundamental Flow equation) provides perhaps the most universal method for calculating isothermal flow rates, however it relies on the inclusion of an accurate friction factor. The Pipe Flow Wizard software provides such a friction factor by calculating this using the Colebrook-White equation.

The preferred equation and method of calculation can be selected by clicking the **Options**  button on the calculation panel.

## 16 Calculation Theory and Method of Solution

The Pipe Flow Wizard software allows you to calculate the pressure loss, or the flow rate, or the required pipe diameter size, or the applicable pipe length, depending on what other information is known. The reported results include flow rates, fluid velocities, Reynolds numbers, friction factors, friction pressure loss, fittings, pressure losses and more.

### 16.1 Fluid Flow States

Fluids in motion are subjected to various resistance forces, which are due to friction. Friction may occur between the fluid and the pipe work, but friction also occurs within the fluid as sliding between adjacent layers of the fluid takes place.

The friction within the fluid is due to the fluid's viscosity. When fluids have a high viscosity, the speed of the flow tends to be low, and resistance to flow becomes almost totally dependent on the viscosity of the fluid. The condition is known as 'Laminar flow'.

Fluids which have a low viscosity are usually moving at higher velocities. The flow characteristics change, small eddy currents occur within the flow stream, and the friction between the pipe work and the fluid becomes a factor to be considered. This type of flow is known as 'Turbulent flow'.

### 16.2 Fluid Viscosity

A fluid viscosity can be described by its Dynamic viscosity (sometimes called Absolute viscosity), or it's Kinematic viscosity. These two expressions of viscosity are not the same, but are linked via the fluid density.

Kinematic viscosity = Dynamic viscosity / fluid density

#### Dynamic Viscosity

Water @ 20°C has a viscosity of  $1.00 \times 10^{-3}$  Pa • s or 1.00 Centipoise  
Water @ 70°F has a viscosity of  $2.04 \times 10^{-5}$  lbr •s/ft<sup>2</sup>

#### Kinematic Viscosity

Water @ 20°C has a viscosity of  $1.004 \times 10^{-6}$  m<sup>2</sup> /s or 1.004000 Centistokes  
Water @ 70°F has a viscosity of  $10.5900 \times 10^{-6}$  ft<sup>2</sup> /s

Pipe Flow Wizard has a database of viscosities and densities for common fluids.

## 16.3 Reynolds Numbers

Reynolds numbers (Re) describe the relationship between a fluid's velocity, the internal pipe diameter and the fluid's Kinematic viscosity.

Reynolds number = Fluid velocity x Internal pipe diameter / Kinematic viscosity

Note: Kinematic viscosity (not Dynamic viscosity) must be used to calculate Reynolds numbers. It is generally accepted that the 'changeover' point between laminar flow and turbulent flow, in a circular pipe, occurs when the Reynolds number (Re) is approximately 2100.

i.e. Laminar flow occurs when the Re is less than 2100. Turbulent flow occurs when the Re is greater than 4000. Between the Laminar and Turbulent flow conditions the flow may be neither wholly laminar nor wholly turbulent. In this transition region there is no exact equation to calculate the friction factor and therefore only an approximate friction factor can be used by way of appropriate interpolation.

## 16.4 Friction Factors

Many formulas have been developed to model the flow of fluids. The Hazen-Williams formula has been a popular method of estimating the head loss in piping systems for many years (particularly prior to the availability of today's modern computers). However, this empirical formula will only give reasonable accuracy if the fluid is water at 60°F or similar.

The Colebrook-White formula may be used with confidence to calculate an accurate friction factor applicable to the turbulent flow of fluids. The Colebrook-White formula is applicable over a whole range of fluid densities and viscosities, provided that the fluid flow is turbulent.

The Pipe Flow Wizard software uses the Colebrook-White friction factor with the Darcy-Weisbach equation when calculating friction loss for non-compressible flow (liquids). The Colebrook-White friction factor is also used with some compressible gas flow equations such as the General Fundamental Flow equation.

## 16.5 Colebrook-White Formula

The Colebrook-White formula:

$$1/\sqrt{f} = 1.14 - 2 \log_{10} [e/D + 9.35/(Re \times \sqrt{f})]$$

$f$  = friction factor

$e$  = internal roughness of pipe

$D$  = internal diameter of pipe

$Re$  = Reynolds number

Friction factors for turbulent flow calculated by Pipe Flow Wizard are based on the Colebrook-White formula.

The friction factor for Laminar flow is calculated from  $f = 64/Re$

## 16.6 Friction Losses (Resistance to Flow)

For liquids, the resistance to fluid flow is usually expressed in fluid head. This is the height of a column of fluid which would exert enough pressure on the fluid at the bottom of the column to make the fluid flow.

If the level of the fluid (fluid head) is increased in a supply container, the volume of fluid entering the system from the supply container will increase due to the increase in pressure (force).

## 16.7 Darcy-Weisbach Formula

For non-compressible fluids (liquids), fluid head resistance can be calculated by using the Darcy-Weisbach formula.

$$h_{\text{fluid}} = f(L/D) \times (v^2/2g)$$

$f$  = friction factor

$L$  = length of pipe work

$D$  = inner diameter of pipe work

$v$  = velocity of fluid

$g$  = acceleration due to gravity

Fluid head loss calculated by the Pipe Flow Wizard software when using the non-compressible (liquid) calculation engine is based on the Darcy-Weisbach formula.

This formula can be used for compressible (gas) calculations provided that the gas density at the start of the pipe is used to determine the fluid velocity, and provided that the pressure drop in the pipe is less than ten percent of the absolute pressure at the start condition.

For compressible (gas) calculations where the pressure drop is more than ten percent, but less than forty percent of the absolute pressure at the start of the pipe, the equation gives reasonable results provided that the gas density at the average pressure condition in the pipe is used to calculate the average velocity of the gas.

The Pipe Flow Wizard software however, does not allow use of the Darcy-Weisbach equation for compressible gas calculations since it uses the more accurate specialist compressible gas flow equations, which provide more accurate results, and which are not limited to working with pressure drops of up to a certain percentage of the initial start pressure.

## 16.8 Fitting Losses

The fluid head resistance through various pipe work fittings can be calculated if the 'K' factor of the fitting is known. Many manufacturers of pipe work fittings and valves publish 'K' factors for their products.

### 16.8.1 'K' Factor Fitting Head Loss Calculation for Liquids

For non-compressible (liquid) systems, fluid head loss through fittings and valves can be calculated from the following equation:

$$h_{\text{fluid}} = 'K' \times v^2 / 2g$$

'K' = manufacturer's published 'K' factor for the fitting

v = velocity of fluid

g = acceleration due to gravity

### 16.8.2 Equivalent Length Head Loss Calculation for Gases

For compressible gas flow calculations, the Pipe Flow Wizard software converts the 'K' factor of the fitting to an equivalent length of pipe, which will result in the same friction loss. This is done automatically during the calculation.

A 'K' factor can be converted to an equivalent length of pipe when the diameter of the pipe is known.

$$\text{Equivalent length} = (\text{K factor} \times \text{Diameter}) / \text{Friction factor}$$

The Pipe Flow Wizard software allows fittings to be placed at both the start and the end of the pipe, and with compressible flow, when pressure loss occurs along the pipe, the gas will 'expand' (become less dense), hence it's velocity will increase, to maintain the same mass flow rate.

The 'K' factor method for calculating head loss across a fitting requires that the density of the fluid entering the fitting is known, since the result is a head loss that is relative to this density, and with a compressible gas flow calculation, where there are fittings at the start and end of the pipe, the density of the gas is different at these points. In addition, the starting pressure of a gas flow calculation affects the overall

friction loss results (for the same flow rate) and therefore technically if there are fittings at the start of the pipe then the loss through these must be accounted for and the pressure immediately after the fittings would then need to be used as the start pressure for the friction loss calculation.

Using the equivalent length method for compressible gas flow calculations simplifies the problem. Once the overall loss through the pipe has been calculated (including the additional equivalent length for the fittings) then the amount of loss through the fittings at the start and the end of the pipe can be apportioned appropriately to break out the results in to the fittings losses and the pipe friction loss.

### 16.8.3 Fittings Database

Pipe Flow Wizard has a database of valve and fittings 'K' factors and calculation helpers for:

- gradual enlargements
- gradual contractions
- sudden enlargements
- sudden contractions
- rounded entrances
- long pipe bends

In systems where pipe lengths are relatively long, the effect of the fitting losses for bends may be minor (in comparison to the long pipe friction losses) and in these cases, fitting losses are sometimes ignored during initial assessment of the system.

If a partially open valve is part of the design, the effect of the valve should always be considered as the valve loss may be large.

## 16.9 Compressible Gas Flow Equations

Friction loss for a compressible fluid, such as a gas, needs to account for the change in density, as the gas moves along the pipe and loss of pressure occurs. When using the compressible flow calculation engine Pipe Flow Wizard can be set to use one of the following compressible flow equations:

- General Fundamental Isothermal Flow Equation
- Complete Isothermal Flow Equation
- AGA Isothermal Flow Equation
- Weymouth Isothermal Flow Equation
- Panhandle A Isothermal Flow Equation

- Panhandle B Isothermal Flow Equation
- IGT Isothermal Flow Equation

The formula for each of the above equations is detailed in a separate PDF document named 'Compressible Flow Equations'. This PDF is available from the 'Verification' menu inside the Pipe Flow Wizard software.

## 17 Glossary

Term	Description
<b>Absolute Pressure</b>	Pressure measured with respect to zero pressure.
<b>Atmosphere</b>	A standard atmospheric pressure of 1.01325 bar a or 14.696 psi a.
<b>Centipoise</b>	Absolute viscosity of a fluid expressed in $\text{Pa} \cdot \text{s} \times 10^{-3}$
<b>Centistokes</b>	Kinematic viscosity of a fluid expressed in $\text{m}^2/\text{s} \times 10^{-6}$
<b>Colebrook-White equation</b>	An equation used to calculate accurate friction factors from the internal diameter and internal roughness of a pipe and the Reynolds number for the flow conditions.
<b>Darcy-Weisbach equation</b>	An equation used to calculate the frictional head loss due to fluid flow from the friction factor, the length and diameter of the pipe, the velocity of the fluid and the gravitational constant.
<b>Friction Factor</b>	A factor to be used in the Darcy-Weisbach equation. Either calculated from the Colebrook-White equation or ready from the Moody diagram.
<b>Entry Pressure</b>	The pressure at the start of the pipe.
<b>Exit Pressure</b>	The pressure at the end of the pipe.
<b>Fixed Pressure Loss</b>	A static pressure loss which is independent of the flow rate.
<b>K Value</b>	Coefficient of frictional loss through a valve or pipe fitting.
<b>Moody Diagram</b>	A graphical representation of the relationship between Reynolds number, relative roughness and Friction factor.
<b>Pressure Loss</b>	The friction loss due to fluid flow expressed in a relative fluid head or a non-relative unit of pressure.
<b>Reynolds Number</b>	A dimensionless number derived from the fluid velocity, the internal diameter of the pipe and the Kinematic viscosity of the fluid.

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<b>Vapor Pressure</b>	The absolute pressure at which a liquid will start to evaporate.
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<b>Viscosity</b>	A measure of a fluid's resistance to flow.
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