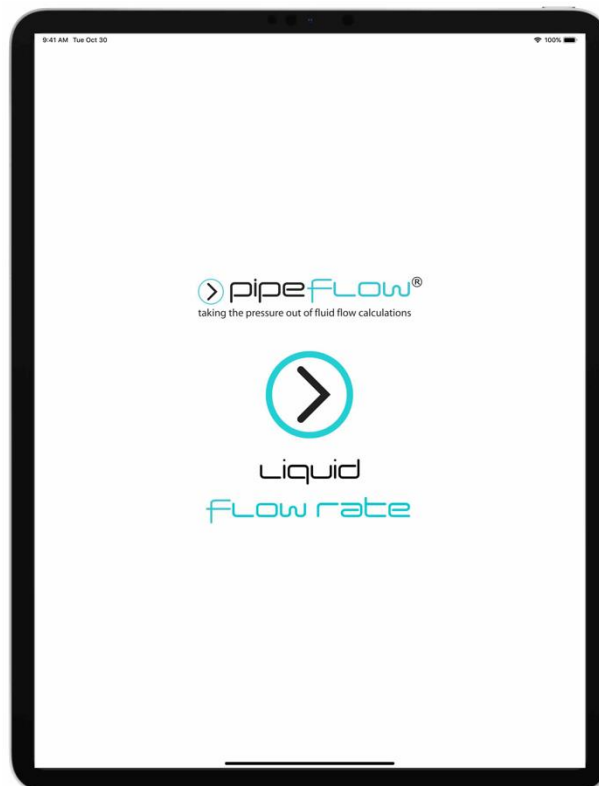




www.pipelflow.com

Pipe Flow Liquid Flow Rate For iOS

User Guide



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Contents

1 Introduction	6
1.1 Pipe Flow Liquid Flow Rate Software Overview	6
1.2 Device Compatibility	7
1.3 Licensing Information	8
1.4 Contacting Pipe Flow Software	10
1.5 Additional Pipe Flow Software Programs	11
1.5.1 Mobile - iPhone and iPad	11
1.5.2 Desktop – Windows & MacOS	11
2 Interface and Menus	12
2.1 Main Menu	14
2.1.1 Help & User Guide Menu	15
2.1.2 Results Verification Menu	16
2.2 Calculation Panel	17
2.3 Results Panel	19
2.3.1 Results Menu Bar	21
2.4 Results Share Action Sheet	22
2.5 Expandable Sections	23
2.6 Notifications & Action Sheets	24
3 Settings	26
3.1 Pipe Flow Liquid Flow Rate	27
3.1.1 Rate on the App Store	28
3.1.2 Recommend Pipe Flow Liquid Flow Rate	28
3.1.3 Reset	29
3.2 Units	30
3.3 Results Decimals	31
3.4 General	32
3.5 Reports	33
4 File and Calculation Operations	34
4.1 Filename Extension	34
4.2 Saving a Calculation	34
4.3 Saved Files	35
4.3.1 Export / Backup all Files	36
4.4 Sharing a Calculation	36
4.5 Loading a Calculation	38
4.5.1 Load Calculation from Saved Files	38
4.5.2 Load Calculation from Shared File	38
4.5.3 Display Filename of Loaded Calculation	38
5 Liquid Flow Rate	40

5.1 Liquid Flow Rate Calculation	41
6 Fluids Database	43
6.1 Adding Liquids to the Fluid Database	44
7 Pipe Material & Diameters	46
7.1 Selecting a Pipe Material	47
7.2 Duplicating a Pipe Material	48
7.3 Adding a new Pipe Material	50
7.4 Selecting a Pipe Diameter	51
7.5 Adding a Pipe Diameter	52
8 Fittings & Valves	53
8.1 Adding a Fitting to the Pipe	53
8.2 Removing a Fitting from the Pipe	55
8.3 Adding a Fitting to the Database	56
9 Calculations and Results	58
9.1 Automatic Checks and Updates	58
9.1.1 Fitting Sizes	58
9.2 Configuring the System Results	58
9.3 Creating a Report of the Results	59
9.4 PDF Report Example	60
10 Calculation Theory and Method of Solutions	62
10.1 Fluid Flow States	62
10.2 Fluid Viscosity	62
10.3 Reynolds Numbers	62
10.4 Friction Factors	63
10.5 Colebrook-White Formula	63
10.6 Friction Losses (Resistance to Flow)	64
10.7 Darcy-Weisbach Formula	64
10.8 Fitting Losses	64
10.8.1 'K' Factor Fitting Head Loss Calculation for Liquids	64
10.8.2 Fittings Database	65
11 Glossary	66

Table of Figures

Figure 1 License Software	8
Figure 2 Calculation Panel Interface	13
Figure 3 Results Panel Interface	13
Figure 4 Main Menu	14
Figure 5 Help & User Guide	15
Figure 6 Results Verification Menu	16
Figure 7 Calculation Panel	17
Figure 8 Results Panel	19
Figure 9 Results Menu Bar	21
Figure 10 Results Share Action Sheet	22
Figure 11 Expandable Sections	23
Figure 12 Temporary Notification	24
Figure 13 Temporary Notification with Additional Information	24
Figure 14 Notification with Action Sheet	25
Figure 15 Settings	26
Figure 16 Pipe Flow Liquid Flow Rate Menu	27
Figure 17 Reset	29
Figure 18 Units	30
Figure 19 Results Decimals	31
Figure 20 Settings General	32
Figure 21 Settings Reports	33
Figure 22 Save Dialog	34
Figure 23 Saved Files	35
Figure 24 Saved Files (Action Buttons)	35
Figure 25 Results Panel Share Action Sheet	36
Figure 26 Calculation Panel Share Action Sheet	36
Figure 27 Calculation Loaded Screen Title	38
Figure 28 Filename of Loaded Notification	39
Figure 29 Liquid Flow Rate Calculation Panel	41
Figure 30 Liquid Flow Rate Results Panel	42
Figure 31 Fluid Database - Liquids	43
Figure 32 Liquid Properties	44
Figure 33 Pipe Material Database	47
Figure 34 Pipe Material List Actions Menu	48
Figure 35 Material Database - Material Action Sheet	49
Figure 36 Add New Pipe Material	50
Figure 37 Pipe Diameter	51
Figure 38 Add Pipe Diameter	52
Figure 39 Fittings & Valves	53
Figure 40 Fitting Database	54
Figure 41 Remove Fitting from the Pipe	55
Figure 42 Create New Fitting	56
Figure 43 Choose Fitting Symbol	56
Figure 44 Fitting Sizes	58
Figure 45 PDF Report - Tabulated	60
Figure 46 PDF Report – Non Tabulated	61

1 Introduction

Pipe Flow Liquid Flow Rate is a software application developed for iOS that can perform calculations to find the flow rate of a liquid that occurs for a given pressure difference between the start and end of a single pipe. With an intuitive and easy to use interface, it allows the user to quickly specify the known information, calculate the answer, view the comprehensive results, generate Excel or PDF reports, save and share the calculation.

The required calculation data can be entered manually, leveraging the wide range of metric and imperial units available or selected from the integrated fluid, material, pipe and fitting databases. The software is also backed up by an unrivalled support service that provides help to users when they need it.

1.1 Pipe Flow Liquid Flow Rate 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 Liquid Flow Rate software is designed to calculate flow rate 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.

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.

The Pipe Flow Liquid Flow Rate 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 liquid in the pipe.

Once the known information has been specified for the required calculation, the results can be obtained by tapping 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 gains / losses.
- Flow type, Reynolds number and Friction factor.
- Entry and exit pressures and densities.
- Entry and exit flow rates.
- Total pressures loss.

1.2 Device Compatibility

Requires iOS 11.0 or later.

Please see the Compatibility section of Pipe Flow Liquid Flow Rate in the App Store for a full list of compatible devices.

1.3 Licensing Information

Pipe Flow Liquid Flow Rate for iOS is a software package that is provided for use on Apple iOS devices.

Installation

When the software is installed from the App Store, it can be used in Trial Mode.

When in Trial Mode, calculations can be performed however the pipe diameter cannot be changed. In addition, Excel & PDF reports that were produced with a licensed version of the software cannot be viewed.

To enable the above functionality, the software must have a valid license.

To purchase a license, tap the **Buy** button **BUY** in the footer to display the **License Software** screen, then tap the **Buy Pipe Flow Liquid Flow Rate**.

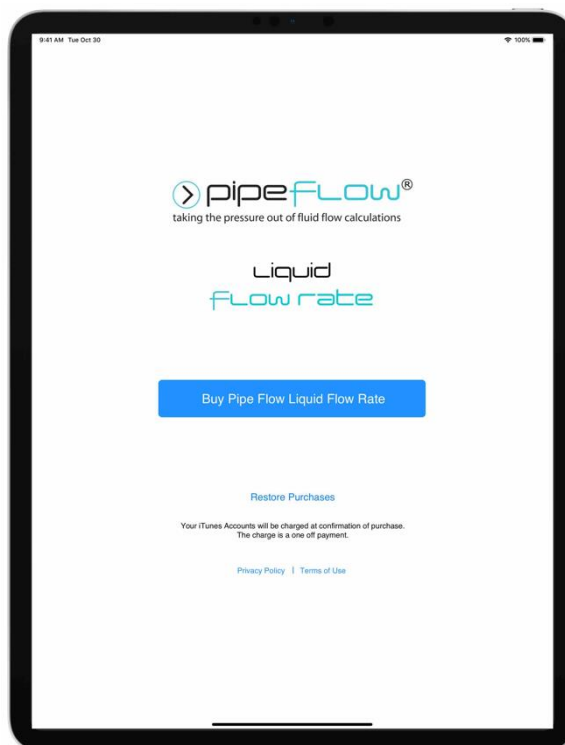


Figure 1 License Software

Purchasing a License

App purchases are entirely managed by Apple Inc. The license fee will be charged to your iTunes Account at confirmation of purchase. The license fee is a **one-time** cost that provides access to the software for its lifetime.

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

Manage License

If you delete and re-install Pipe Flow Liquid Flow Rate, or install the App on a new device, Pipe Flow Liquid Flow Rate will return to trial mode.


To restore your license, launch Pipe Flow Liquid Flow Rate, tap the **Main Menu**  button and then In App Purchases > Restore Purchases.

Additional Devices

The Pipe Flow Liquid Flow Rate software can be downloaded to all your compatible Apple devices.

If you have purchased a license, then this license is valid on all compatible Apple devices that share the same Apple ID (or family sharing).

To enable a license on another device:

Launch Pipe Flow Liquid Flow Rate, tap the **Main Menu**  button and then In App Purchases > Restore Purchases.

Summary

- The Pipe Flow Liquid Flow Rate software can be downloaded and installed for a free trial.
- A license can be purchased via the Apple App Store In App Purchase that will enable use of the software for its lifetime.
- A user can be up and running with a licensed version of the software within a few minutes.
- 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 Liquid Flow Rate software.

1.4 Contacting Pipe Flow Software

Email: support@pipeflow.com

Internet: 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

1.5.1 Mobile - iPhone and iPad

Single pipe liquid pressure drop and flow rate calculators:

- [*Pipe Flow Liquid Pressure Drop*](#)
- [*Pipe Flow Liquid Flow Rate*](#) (This software program)
- [*Pipe Flow Liquid Pipe Length*](#)
- [*Pipe Flow Liquid Pipe Diameter*](#)

Single pipe gas pressure drop and flow rate calculators:

- [*Pipe Flow Gas Pressure Drop*](#)
- [*Pipe Flow Gas Flow Rate*](#)
- [*Pipe Flow Gas Pipe Length*](#)
- [*Pipe Flow Gas Pipe Diameter*](#)

Pipe Flow GasRef – gas properties calculator

[*Pipe Flow GasRef*](#) can be used to calculate the density, z compressibility, viscosity, specific heat ration at different temperature and pressure conditions for a number of common gases.

1.5.2 Desktop – Windows & MacOS

Pipe Flow Expert - for designing piping and pumping systems (Windows)

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, with multiple supply points, multiple discharge points, and multiple pumps running in series or in parallel.

For more information about Pipe Flow Expert, see:

www.pipeflow.com/pipe-flow-expert-software

Pipe Flow Wizard – Flow Rate and Pipe Pressure Drop Calculators (Windows & MacOS)

Pipe Flow Wizard software makes it easy to calculate pressure loss, flow rate, size a pipe diameter and calculate pipe length. It allows users to perf ‘What If?’ calculations on both liquids and gases flowing in a single length of pipe between a

start and end elevation, when pipe fittings can be added to represent valves and bends.

For more information about Pipe Flow Wizard, see:

<https://www.pipeflow.com/pipe-flow-wizard-software>

Pipe Flow Advisor - for Channels and Tanks (Windows)

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

All desktop software program can be downloaded for a free trial by visiting:

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 Liquid Flow Rate 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 Liquid Flow Rate application.

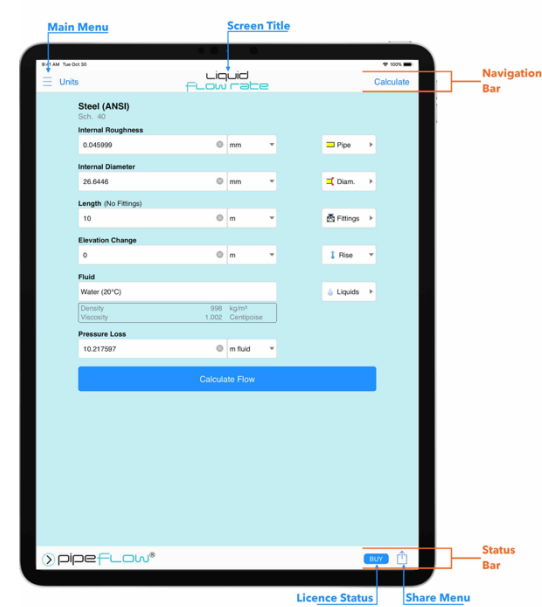



Figure 2 Calculation Panel Interface



Figure 3 Results Panel Interface

2.1 Main Menu

Tap the **Main Menu**  button to display the Pipe Flow Liquid Flow Rate main menu.

The main menu has five different sections to help you navigate and work in Pipe Flow Liquid Flow Rate.

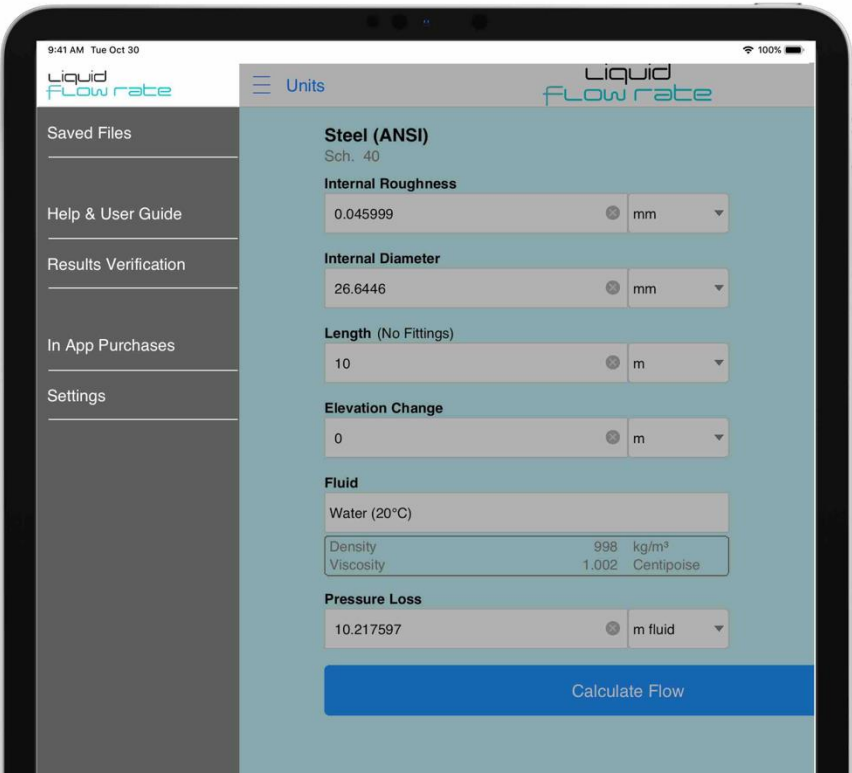


Figure 4 Main Menu

Menu Items	Description
Saved Files	Display the Saved Files screen. For more information, see: Saved Files .
Help & User Guide	Displays the Help & User Guide menu. For more information, see: Help & User Guide Menu .
Results Verification	Display the Results Verification menu. For more information, see Results Verification Menu .
In App Purchases	Display the In App Purchase or Purchase screen. For more information, see Licensing Information .
Settings	Display the Settings menu. For more information, see Settings .

Select an option from the menu or tap the Liquid Flow Rate logo to close the menu.

2.1.1 Help & User Guide Menu

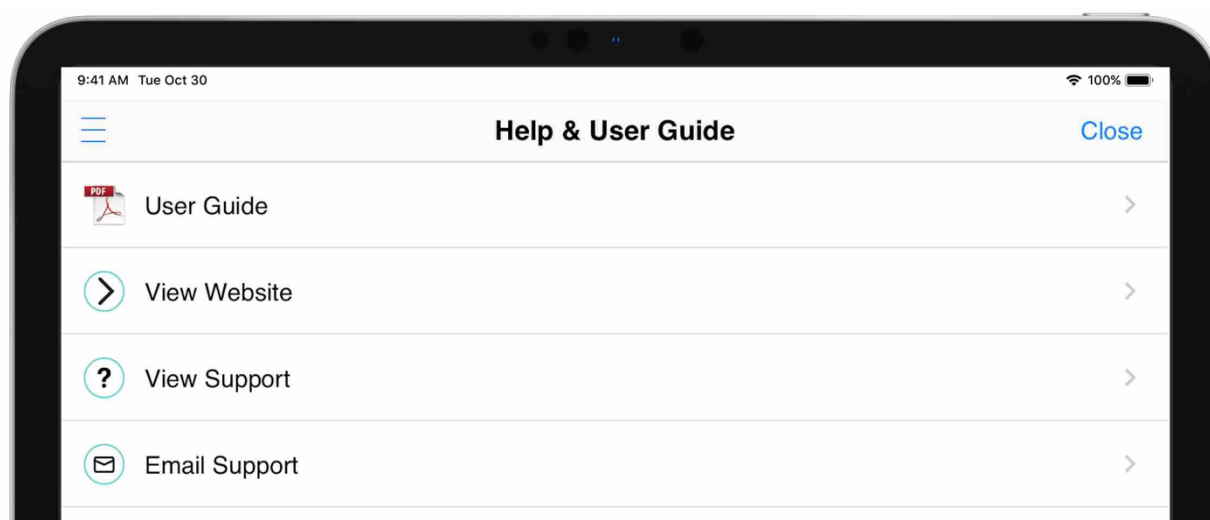


Figure 5 Help & User Guide

Menu Items	Description
User Guide	Open the User Guide PDF document (this document).
View Website	Open the Pipe Flow website.
View Support	Open Pipe Flow Liquid Flow Rate's support pages on the web.
Email Support	Send an e-mail to our support team.

2.1.2 Results Verification Menu

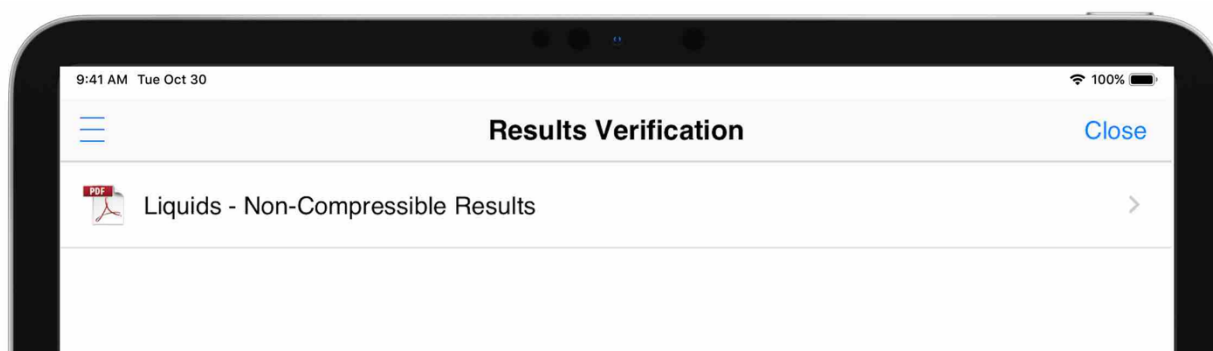


Figure 6 Results Verification Menu

Menu Items	Description
Liquids – Non-Compressible Results	Open the Non-Compressible (Liquids) Calculation Results Verification PDF document.

2.2 Calculation Panel

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

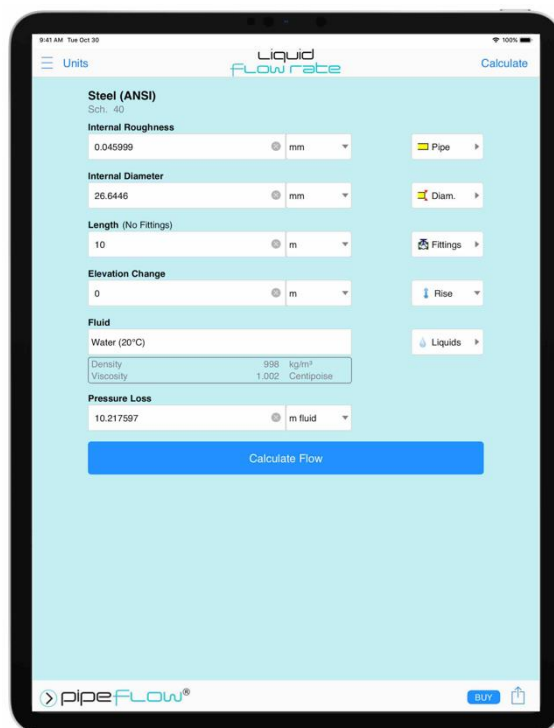

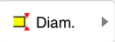




Figure 7 Calculation Panel

The **Material name**, **Schedule** and **Internal roughness** of the pipe can be specified by tapping the **Pipe**  button 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** of the pipe can be specified by tapping 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 tapping 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 **Liquid** in the pipe can be specified by tapping the **Liquids**  button to display the Fluid Database. For more information about working with fluids, see: [Fluids Database](#).

The **Pressure Loss** in the pipe can be specified by entering the value into the **Pressure Loss** field.

Tap 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.

2.3 Results Panel

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

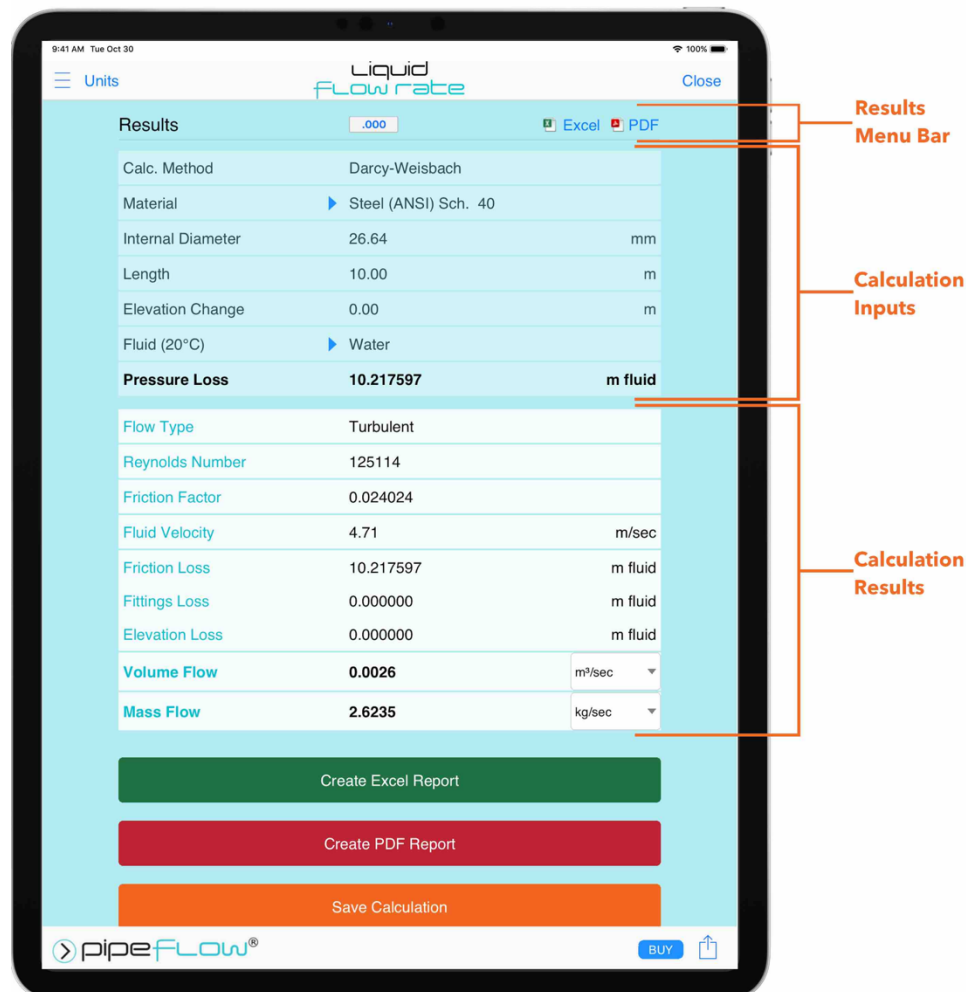



Figure 8 Results Panel

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

The display unit for each different item of data can be changed in Settings. In addition, for the main result, 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](#).

Tapping 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.

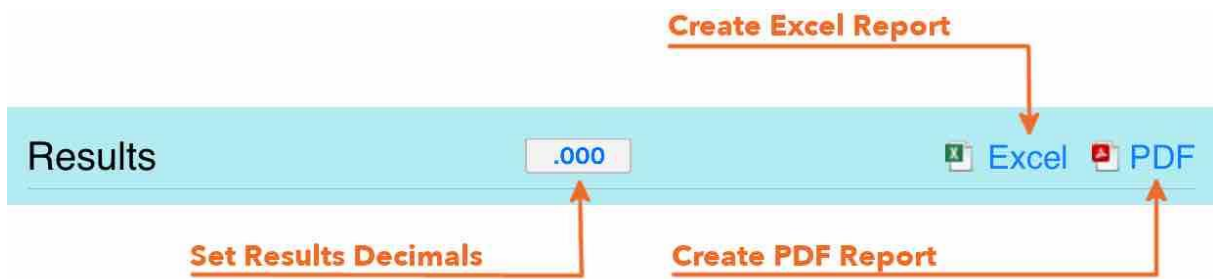





Figure 9 Results Menu Bar


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

Menu Items	Description
	Setting the decimals for the results. For more information about results decimals, see: Results Decimals .
	Creating and viewing an Excel Report. For more information about Excel Reports, see: Creating a Report of the Results .
	Creating and viewing a PDF Report. For more information about PDF Reports, see: Creating a Report of the Results .



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 Results Share Action Sheet

In the footer of each result panel is the status bar. Tap the **Share**  button to open the **Share Action Sheet**.

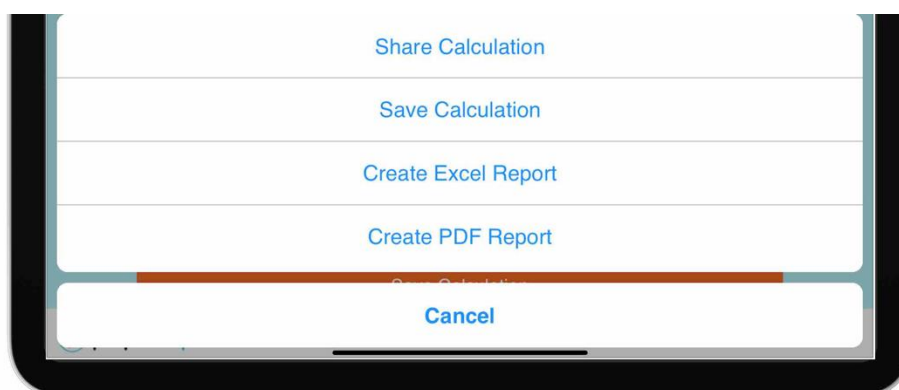



Figure 10 Results Share Action Sheet

Menu Items	Description
Share Calculation	Opens the iOS Share Action Sheet to allow the calculation to be exported from the device (e.g. via AirDrop, mail, DropBox etc.). For more information about sharing calculations, see: Sharing a Calculation .
Save Calculation	Saving the calculation to the local storage on the device. For more information, see Saved Files .
Create Excel Report	Create and view an Excel Report. For more information about Excel Reports, see: Creating a Report of the Results .
Create PDF Report	Create and view a PDF Report. For more information about PDF Reports, see: Creating a Report of the Results .
Cancel	Close the Share action sheet.

2.5 Expandable Sections

Pipe Flow Liquid Flow Rate 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 tapped will expand the section to reveal more information.

Tapping the expander button when the section is expanded will collapse the section.

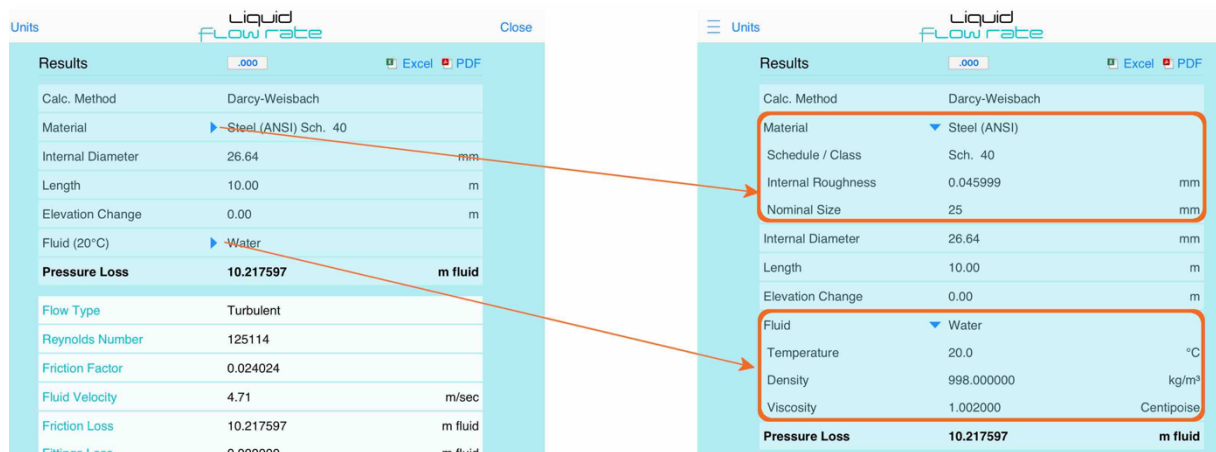


Figure 11 Expandable Sections

2.6 Notifications & Action Sheets

Messages that do not require user acknowledgement / interaction are displayed as a notification at the top of the screen.

These notifications are displayed for a short period of time.

To close a notification, tap or swipe up on the notification banner.

To prevent a notification from closing, press and hold on the notification banner.

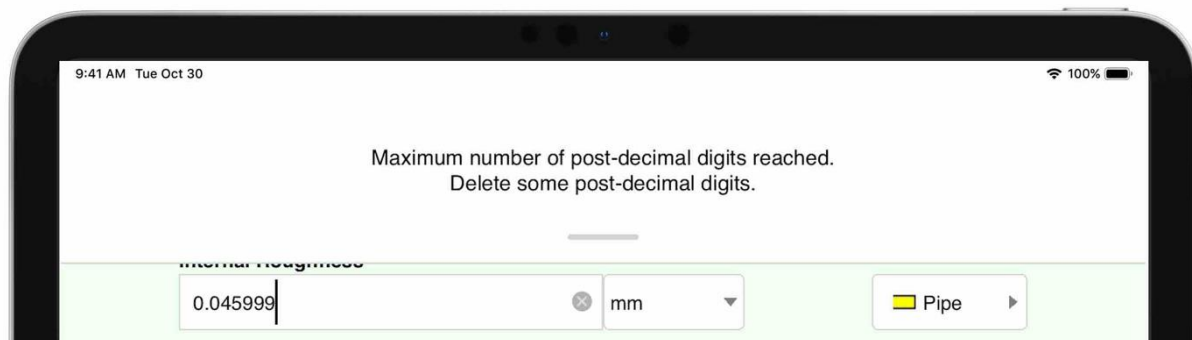


Figure 12 Temporary Notification

Some notifications may also display a button in the bottom right corner (e.g. More Details, or Learn More), which when tapped will open an information panel providing additional information about the notification.



Figure 13 Temporary Notification with Additional Information

Action Sheets display at the bottom of the screen and allow the user to select certain options.

In some cases, action sheets are displayed in conjunction with a notification. When notifications appear with action sheets, the notification will remain on display and will be removed when an option on the action sheet has been selected – the notification cannot be removed by tapping or swiping.

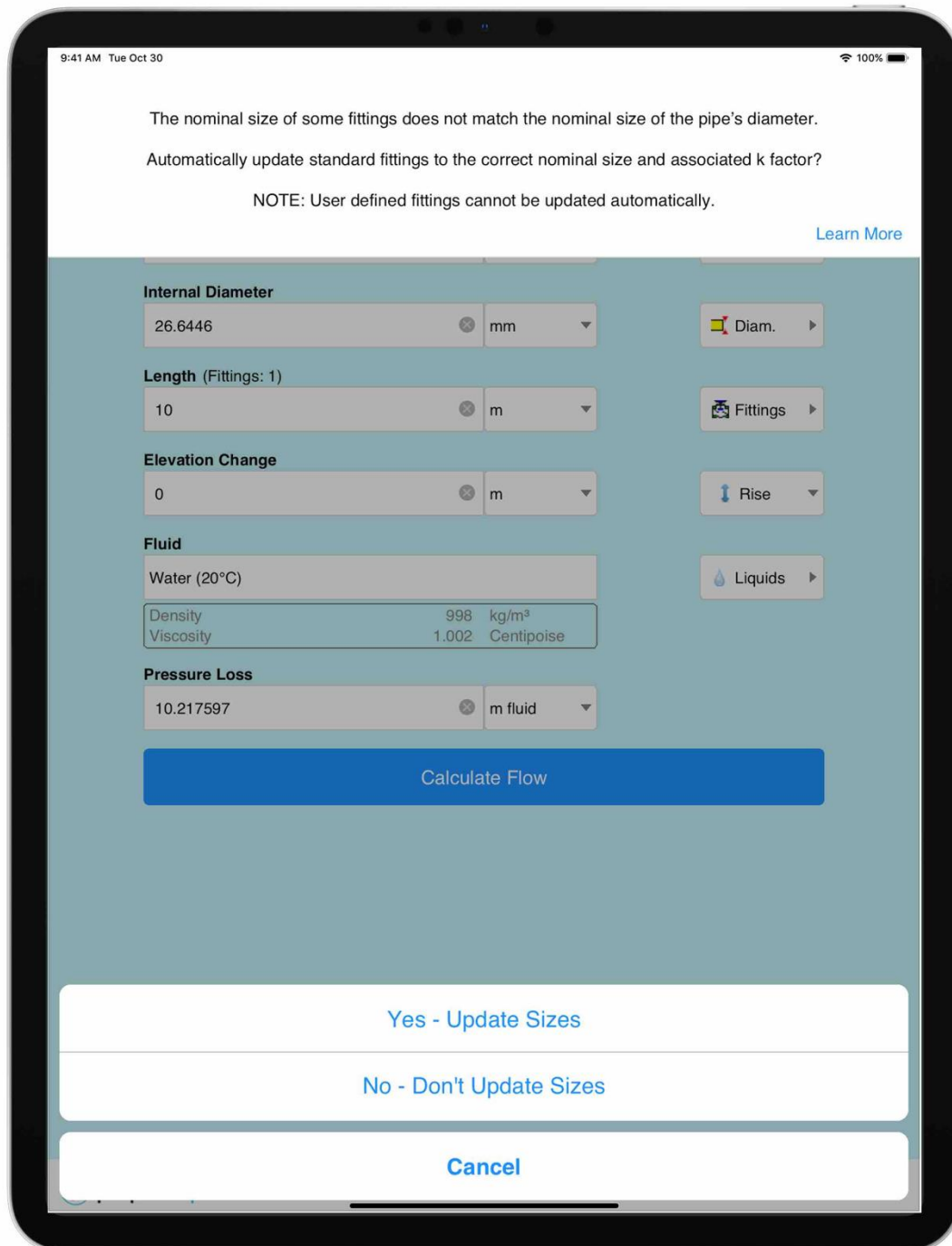



Figure 14 Notification with Action Sheet

3 Settings

Pipe Flow Liquid Flow Rate can be configured and set-up to suit the user’s working preferences.

The settings screen is opened by tapping the **Main Menu**  button and then **Settings**.

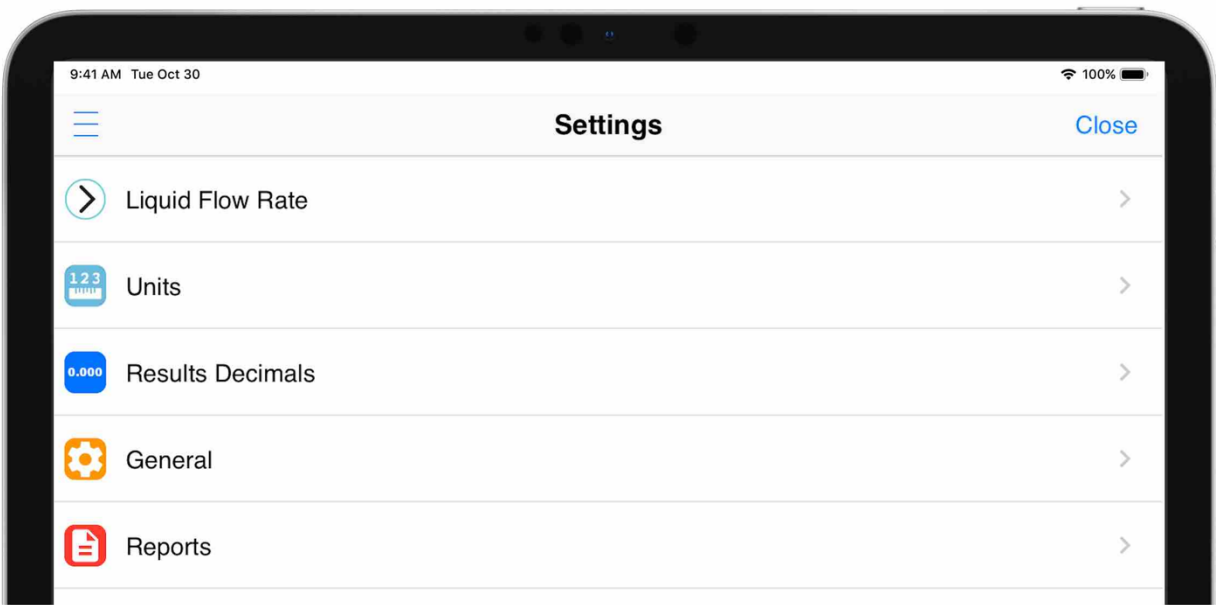




Figure 15 Settings

Menu Items	Description
Pipe Flow Liquid Flow Rate	Open the Pipe Flow Liquid Flow Rate screen. For more information, see: Liquid Flow Rate .
Units	Open the Units screen. For more information, see: Units .
Results Decimals	Open the Results Decimals screen. For more information, see: Results Decimals .
General	Open the General menu. For more information, see: General .
Reports	Open the Reports screen. For more information, see: Reports .

3.1 Pipe Flow Liquid Flow Rate

The **Pipe Flow Liquid Flow Rate** screen is displayed by tapping the **Main Menu**  button, **Settings** and then the **Pipe Flow Liquid Flow Rate**  menu item.

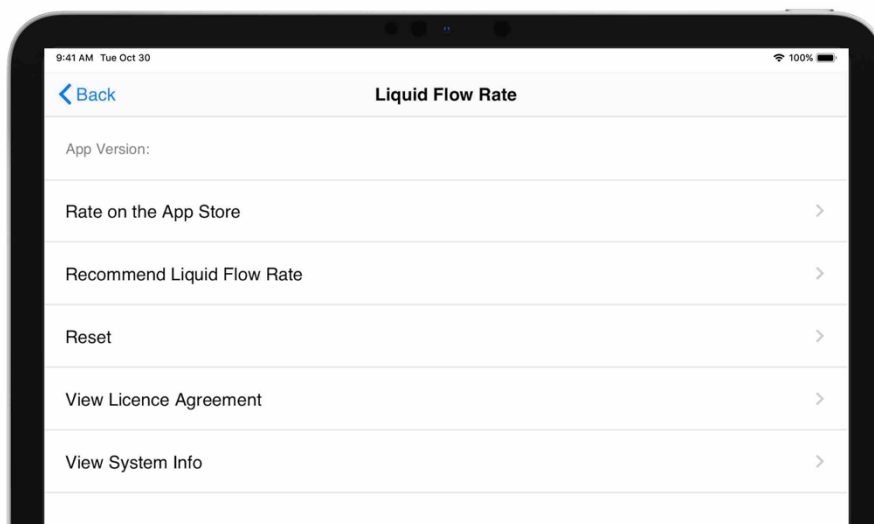




Figure 16 Pipe Flow Liquid Flow Rate Menu



Menu Items	Description
App Version	Displays the Pipe Flow Liquid Flow Rate version number.
Rate on the App Store	Open the Apple App Store so that you can provide a rating / review of Pipe Flow Liquid Flow Rate. For more information, see: Rate on the App Store.
Recommend Pipe Flow Liquid Flow Rate	Easily send a Pipe Flow Liquid Flow Rate recommendation e-mail to a friend or colleague. For more information, see: Recommend Pipe Flow Liquid Flow Rate .
Reset	Open the Reset screen. For more information, see: Reset .
View License Agreement	Displays the Pipe Flow Liquid Flow Rate license agreement.
View System Info	Displays information about the version of Pipe Flow Liquid Pipe Flow and your device.

3.1.1 Rate on the App Store

To provide a rating and/or review of Pipe Flow Liquid Flow Rate on the Apple App Store, tap the **Main Menu**  button, **Settings > Pipe Flow Liquid Flow Rate**  and then the **Rate on the App Store** menu item.

The App Store application on your device will be launched and the Pipe Flow Liquid Flow Rate App display from where you can leave a review / rating.



3.1.2 Recommend Pipe Flow Liquid Flow Rate

To easily recommend Pipe Flow Liquid Flow Rate to a friend or colleague, tap the **Main Menu**  button, **Settings > Pipe Flow Liquid Flow Rate**  and then the **Recommend Pipe Flow Liquid Flow Rate** menu item.

The Mail application on your device will be launched and new Email prepared containing some default text and a link to download the Pipe Flow Liquid Flow Rate.

Enter the email addresses of the people you wish to send the recommendation to and edit the body text as needed, then tap Send.

3.1.3 Reset

The **Reset** screen is displayed by tapping the **Main Menu**  button, **Settings** > **Pipe Flow Liquid Flow Rate**  and then the **Reset** menu item.

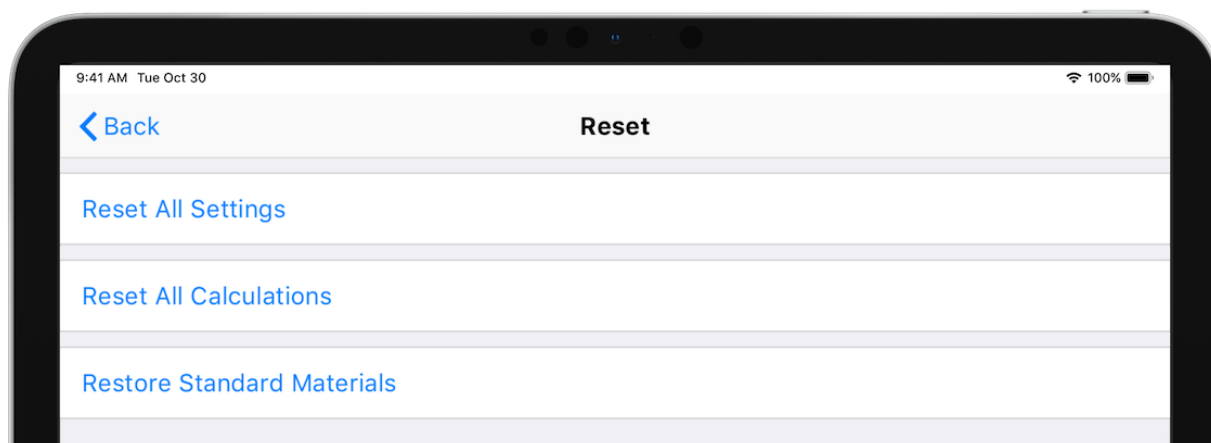




Figure 17 Reset

Option	Description
Reset All Settings	Reset all settings values to defaults.
Reset All Calculations	Reset all calculation values to defaults.
Restore Standard Material	Restore standard materials that have been deleted.

3.2 Units

The **Units** screen is displayed by tapping the **Main Menu**  button, **Settings** and then **Units**  menu item.

It can also be displayed by tapping the **Units** button in the **Navigation Bar** from any calculation.

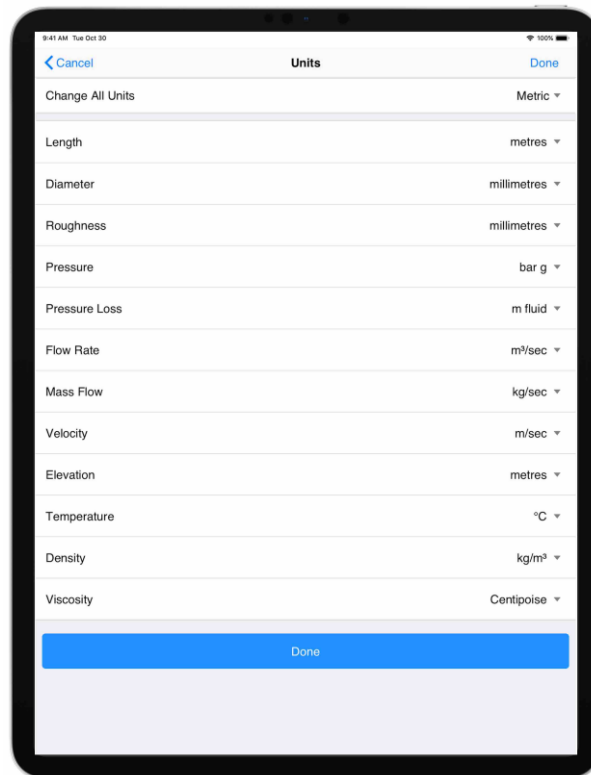





Figure 18 Units


Units for the calculation can be specified by:

1. Selecting the required unit for each of the attributes, OR
Selecting Imperial / Metric to change all units for that calculation.
2. Tap Done.

 Scroll down to reveal more units if not all units are displayed.

3.3 Results Decimals

The **Results Decimals** screen is displayed by tapping the **Main Menu**  button, **Settings** and then **Results Decimals**  menu item.

It can also be displayed by tapping on the  **Results Decimals** button in the **Results Menu Bar** from the calculation panel. For more information, see: [Results Menu Bar](#).

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.

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.

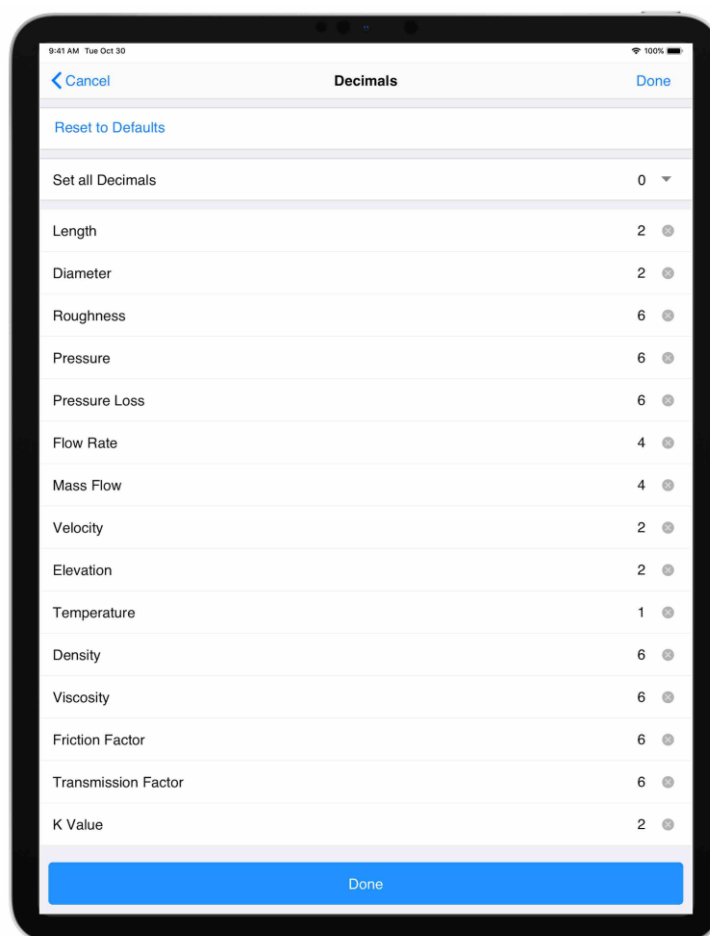




Figure 19 Results Decimals

 Scroll down to reveal more attributes.

3.4 General

The **General** screen is displayed by tapping the **Main Menu**  button, **Settings** and then **General**  menu item.

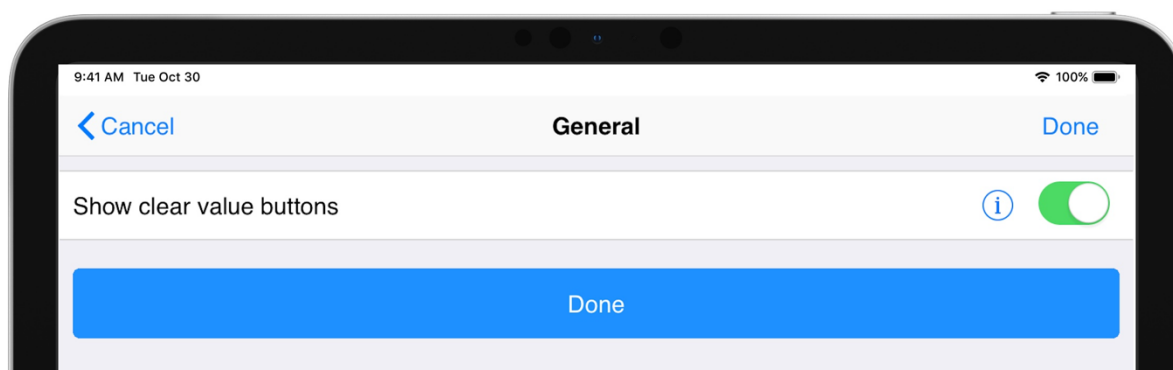





Figure 20 Settings General

Option	Description
Show clear value buttons	When checked, edit boxes contain a clear value  button that when tapped will erase the contents of the edit box.

3.5 Reports

The **Reports** screen is displayed by tapping the **Main Menu**  button, **Settings** and then **Reports**  menu item.

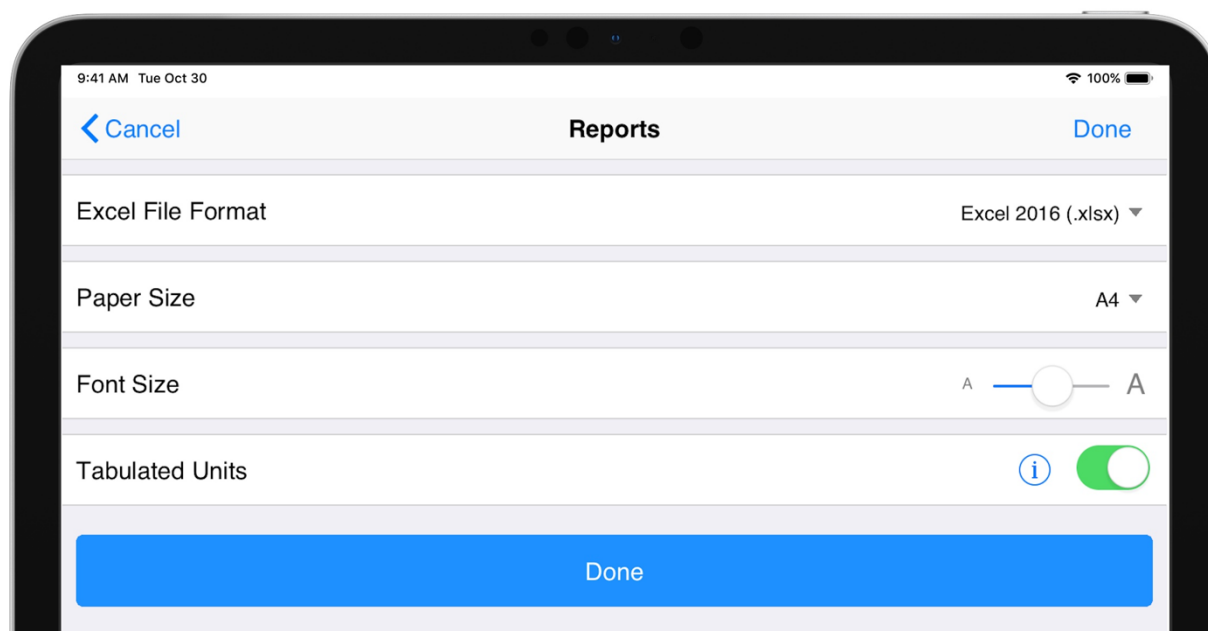


Figure 21 Settings Reports

Option	Description
Excel File Format	Configure the version of Excel that will be used.
Font Size	Configure the font size to use for the report.
Paper Size	Configure the paper size to use for the report.
Tabulated Units	When enabled, 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: PDF Report Example .

4 File and Calculation Operations

4.1 Filename Extension

The filename extension for the Liquid Flow Rate calculation is .pflfr

4.2 Saving a Calculation

When on the results panel of a calculation, tap **Save Calculation** to display the filename dialog. It is not necessary to add the file extension. The filename will be pre-populated with a default filename, alternatively this can be cleared / overtyped with your own filename.

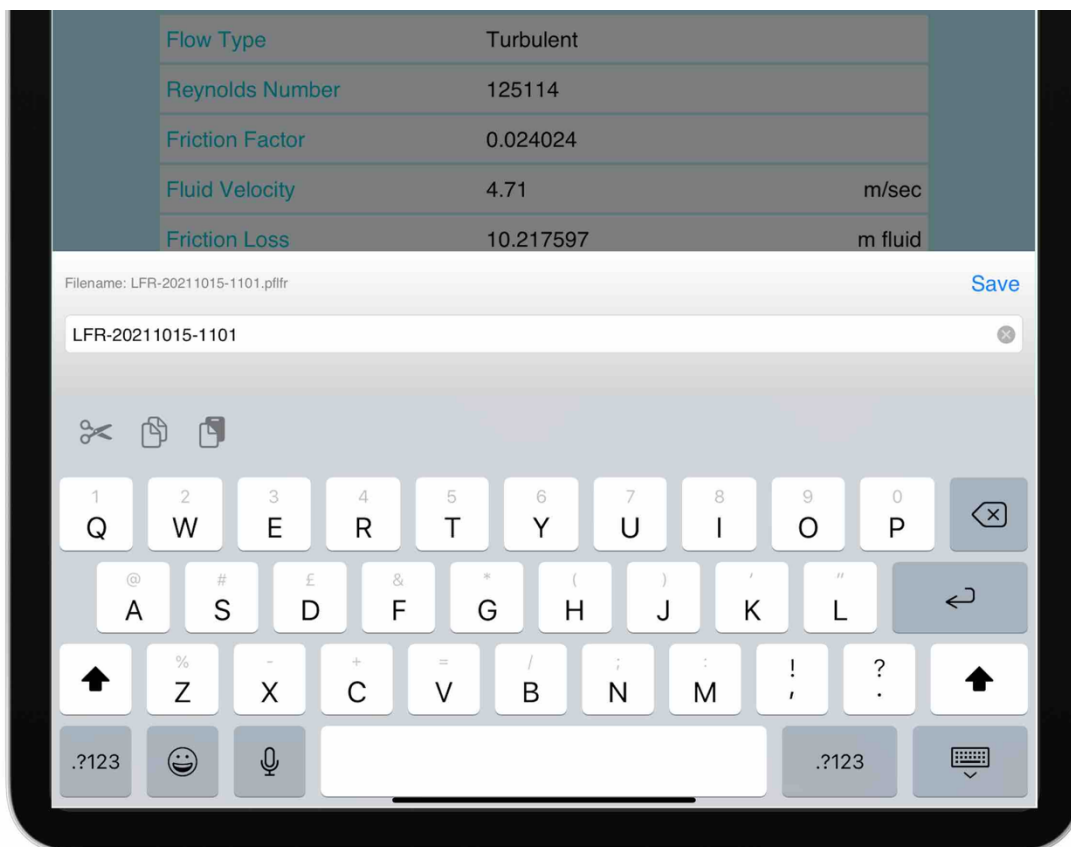


Figure 22 Save Dialog

Saved calculations are stored on your device and can be accessed by tapping **Saved Files** on the **Main Menu**.

4.3 Saved Files

The **Saved Files** screen displays all calculations that have been saved to your device. The file list can be sorted date ascending or descending.

Tap on a row in the list to load the calculation.

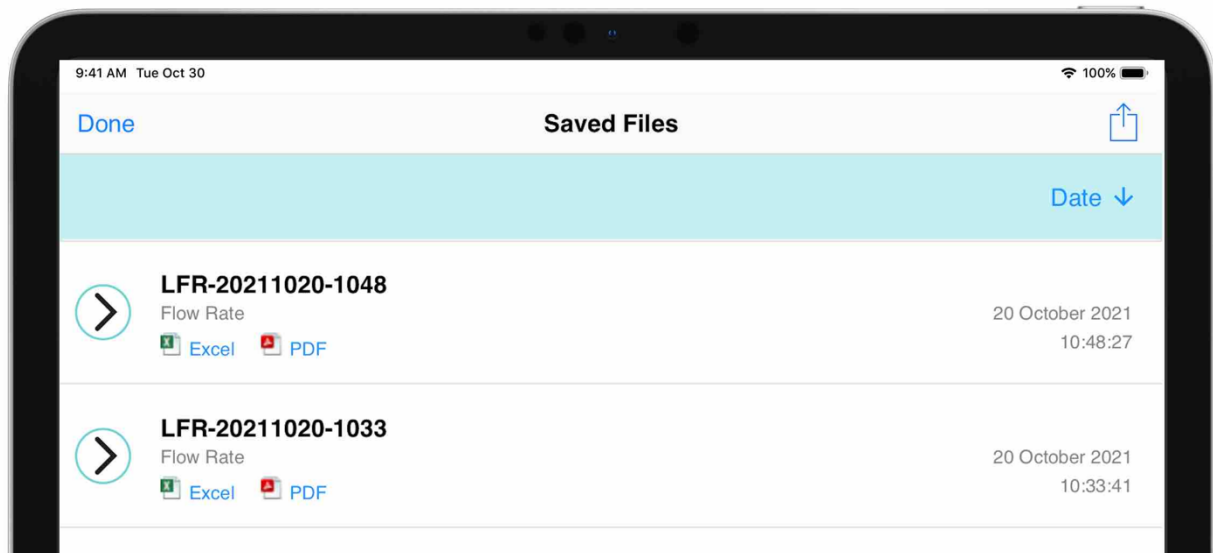


Figure 23 Saved Files

Tap the **Excel** or **PDF** buttons to create and view a calculation report directly from the **Saved Files** screen.

Swipe right to left, on a row in the list, to display the additional action buttons for the saved file.

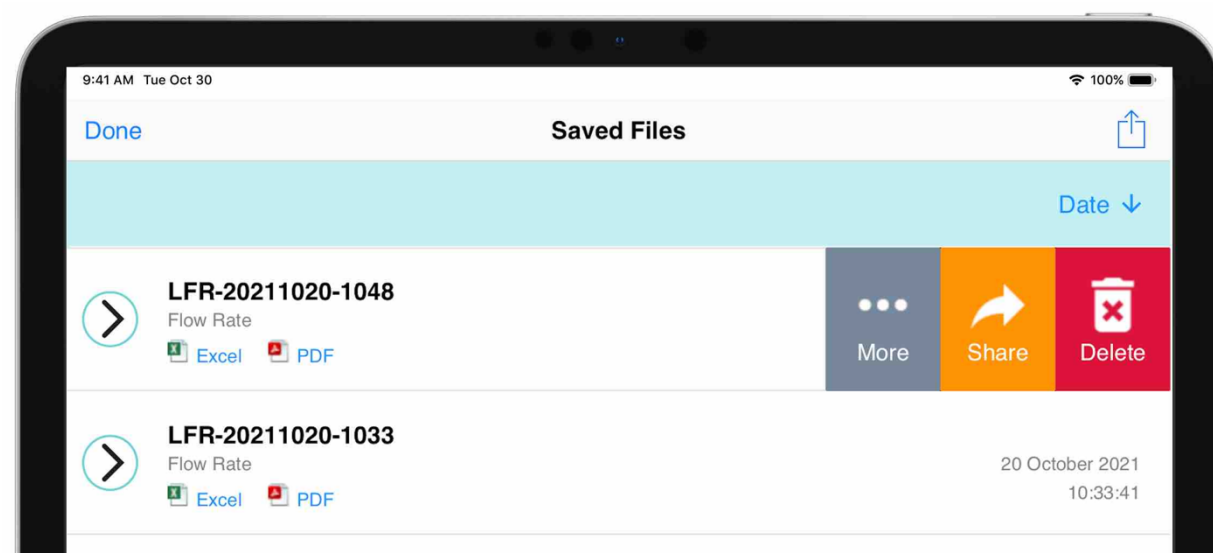



Figure 24 Saved Files (Action Buttons)


Action Button	Description
More	Displays the more action sheet with options to create an Excel or PDF report.
Share	Displays the iOS Share Action Sheet so that the calculation can be shared with other Pipe Flow Liquid Flow Rate users (on any device).
Delete	Delete the selected file from your device. A confirmation dialog will be displayed to confirm the file deletion. Once deleted, the file cannot be recovered.

4.3.1 Export / Backup all Files

To export / backup all calculation files on your device, tap the  button to display the **Share Action** sheet and tap **Export all Calculations**. Pipe Flow Liquid Flow Rate will create a compressed folder (zip) containing all the calculation files and then display the **iOS Share Action** sheet from where you can select how to share the zip file. For example, you can select to send the zip file via e-mail or use a third-party cloud service such as Drop Box.

4.4 Sharing a Calculation

The calculation data can be shared with other Pipe Flow Liquid Flow Rate users (on any device).

To share a calculation, tap the **Share**  button to display the associated action sheet. This will be either the Results Panel Share Action Sheet (depending upon the current panel shown) or the Calculation Panel Share Action Sheet.

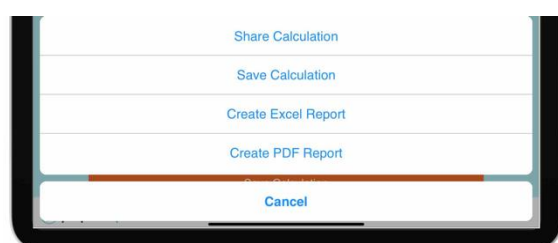


Figure 25 Results Panel Share Action Sheet

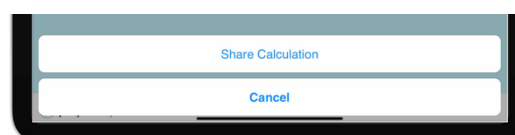


Figure 26 Calculation Panel Share Action Sheet

Tap **Share Calculation** to show the **iOS Share Action Sheet**.

Tap the required method of sharing the calculation.




The options / applications available on the iOS Share Sheet will depend upon the applications installed on the device and how the share sheet is configured.

4.5 Loading a Calculation

Calculations that have been saved on your device, or that have been shared with you (e.g. via email) can be opened in Pipe Flow Liquid Flow Rate.

4.5.1 Load Calculation from Saved Files


The Saved Files screen is displayed by tapping the **Main Menu**  button, then **Saved Files**. For more information, see [Saved Files](#).

Tap the required calculation in the list to load it from your device.

4.5.2 Load Calculation from Shared File

A calculation that has been shared (e.g. via email) can be opened in Pipe Flow Liquid Flow Rate.

1. Open the e-mail that contains the Pipe Flow Liquid Flow Rate attachment. For more information on the type of files Pipe Flow Liquid Flow Rate uses see: [Filename Extension](#).
2. Tap the attachment to open the **iOS Share Sheet**.
3. Tap Copy to Liquid Flow Rate.

 If the **Copy to Liquid Flow Rate** option is not immediately available, it may be necessary to swipe the applications to the left.

4.5.3 Display Filename of Loaded Calculation

When a calculation has been loaded from a file, a blue information icon appears next to the calculation title.



Figure 27 Calculation Loaded Screen Title

Tapping the app title or the blue information icon will display the name of the loaded file in a temporary notification.

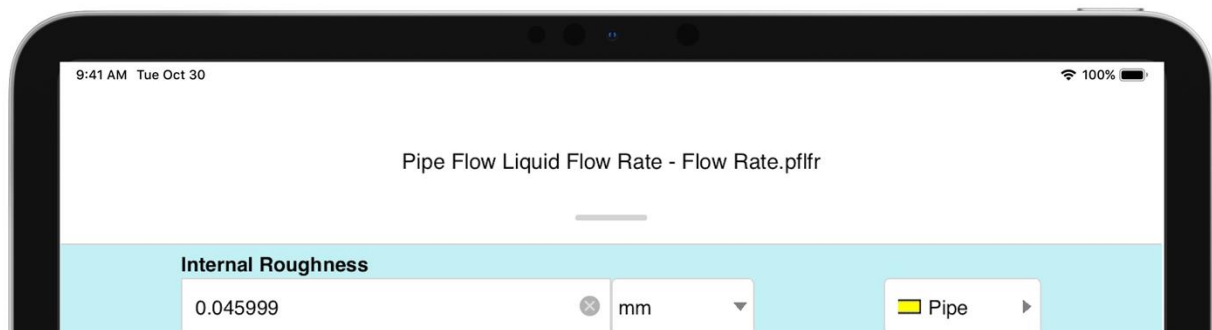


Figure 28 Filename of Loaded Notification

5 Liquid Flow Rate

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

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

5.1 Liquid Flow Rate Calculation

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

Figure 29 Liquid Flow Rate Calculation Panel

1. Select or define the **Material** and **Internal Roughness** of the pipe. For more information about working with pipe materials, see: [Pipe Material & Diameters](#).
2. Select or define the **Internal Diameter** of the pipe. For more information about working with pipe diameters, 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 **Liquid** in the pipe. For more information about working with fluids, see: [Fluids Database](#).
6. Enter the **Pressure Loss**.
7. Tap **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 Liquid Flow Rate.

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

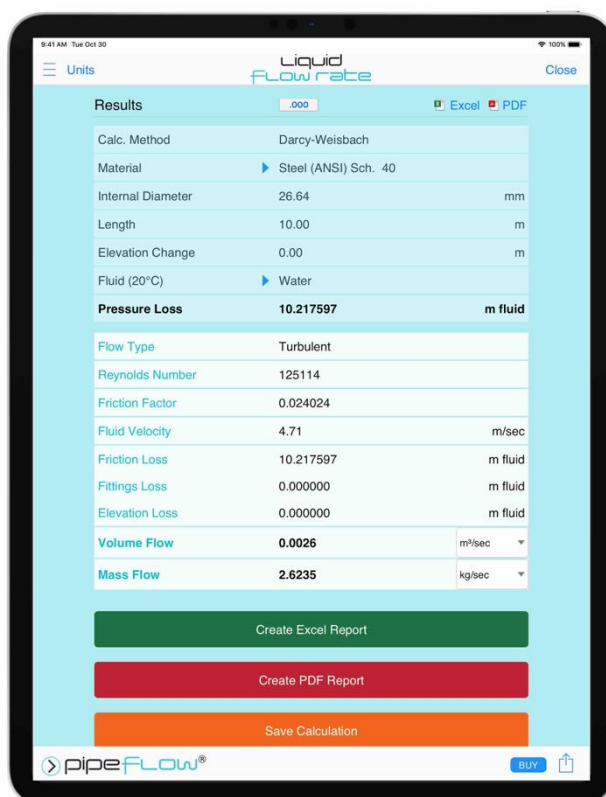


Figure 30 Liquid Flow Rate Results Panel

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, tap the Excel  button or PDF  button. For more information about generating reports, see: [Creating a Report of the Results](#).

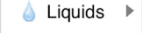
To change the number of decimals the results are displayed to, tap the **.000** **Results Decimals** button in the **Results Menu Bar**. For more information, see: [Results Menu Bar](#).

To close the **Results Panel**, tap the **Close** button in the **Navigation Bar** or the **Close Results**  button at the bottom.

6 Fluids Database

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

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

1. Tap the **Liquids**  button on the calculation panel to display the liquids in the Fluids Database. Sheet.

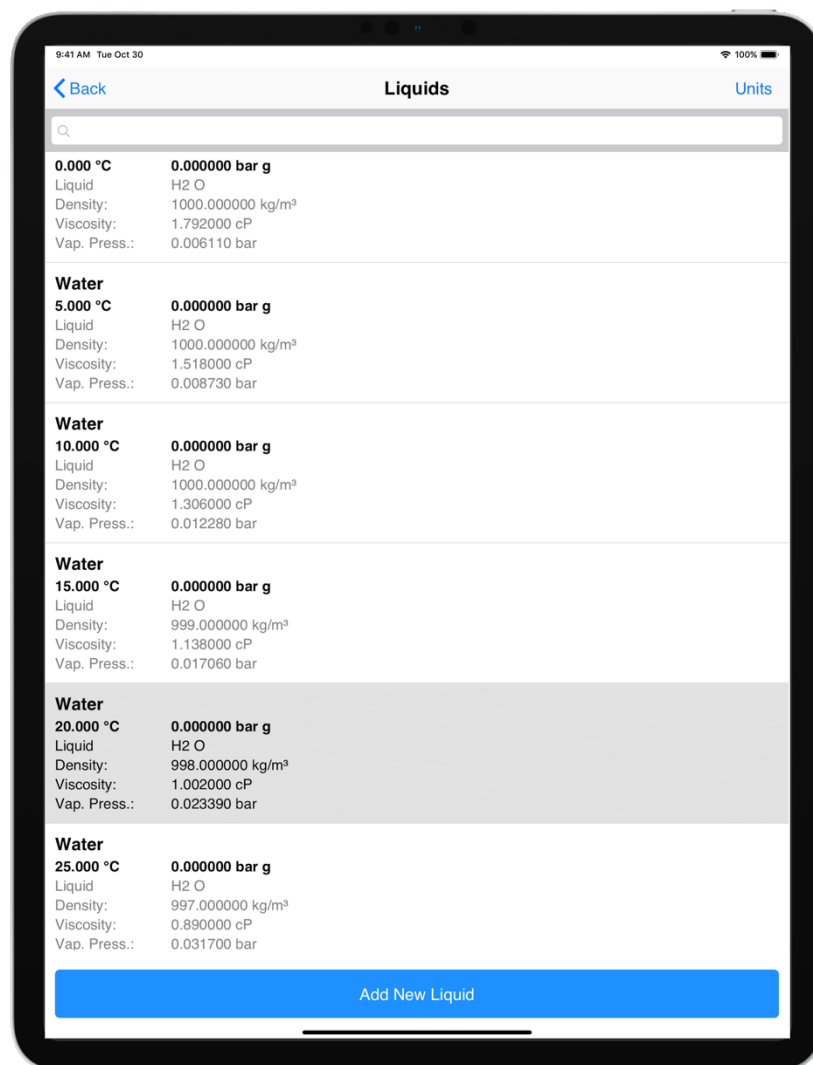


Figure 31 Fluid Database - Liquids

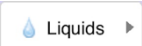
2. Select the liquid contained in the pipe from the **Fluid Database** list. The name of the liquid is displayed in the calculation next to the liquids button.

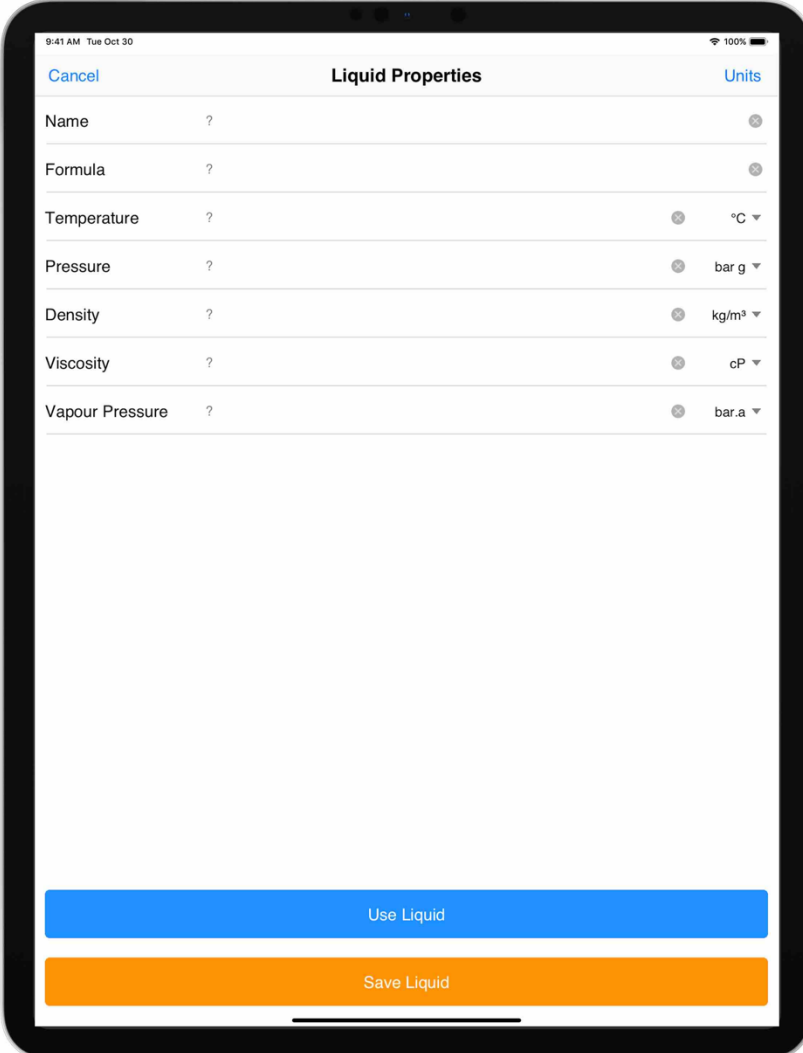
6.1 Adding Liquids to the Fluid Database

If the liquid you are using does not exist in the Pipe Flow Liquid Flow Rate fluid database, you can quickly add the liquid to the database by tapping the Add Liquid button on the Fluid Database screen.

NOTE: Be sure to enter the value for the liquid'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 liquid to the fluid database:

1. Tap the **Liquids**  button on the calculation panel to display the liquids in the Fluids Database.




The screenshot shows the 'Liquid Properties' screen on an iPad. The screen has a white background with a black border. At the top, there is a status bar showing '9:41 AM Tue Oct 30' and '100%' battery. Below the status bar, there is a header bar with 'Cancel' on the left, 'Liquid Properties' in the center, and 'Units' on the right. The main area contains a table with the following rows:



Name	?		
Formula	?		
Temperature	?		°C ▼
Pressure	?		bar g ▼
Density	?		kg/m³ ▼
Viscosity	?		cP ▼
Vapour Pressure	?		bar.a ▼

At the bottom of the screen, there are two buttons: a blue button labeled 'Use Liquid' and an orange button labeled 'Save Liquid'.

Figure 32 Liquid Properties

2. Tap the **Add New Liquid** button to display the **Liquid Properties** screen.
3. Enter the liquid's name in the **Name** field.

4. Enter the liquid's formula in the **Formula** field.
5. Enter the liquid's temperature in the **Temperature** field.
6. Enter the liquid's density in the **Density** field.
7. Enter the liquid's viscosity in the **Viscosity** field.
8. Enter the liquid's vapor pressure in the **Vap. Pressure.** field.
9. Tap the **Save Liquid**  button to save the new liquid data to the **Fluid Database**.

 To use the defined liquid in the calculation without saving it to the database, tap the **Use Liquid**  button.


7 Pipe Material & Diameters

Pipe Flow Liquid Flow Rate 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.

7.1 Selecting a Pipe Material

To select a pipe material:

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

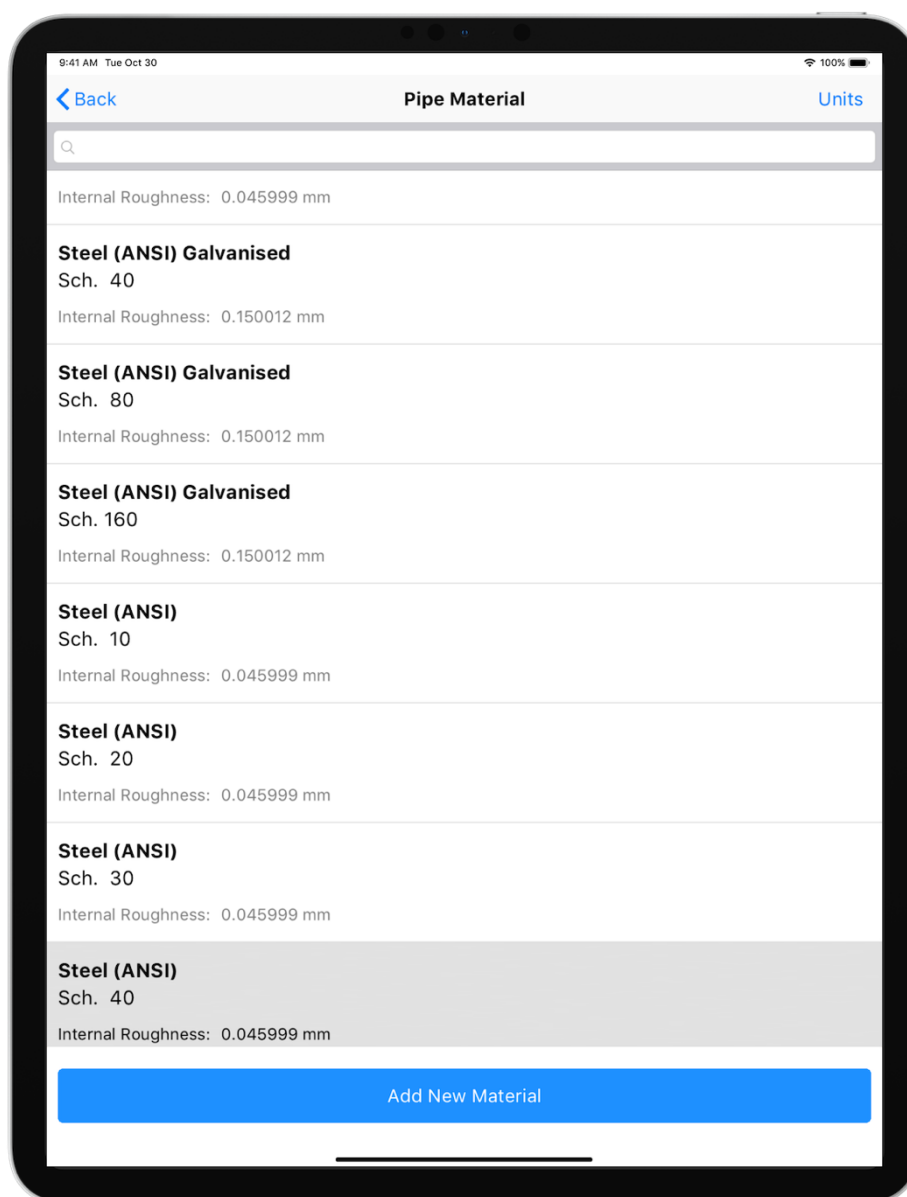



Figure 33 Pipe Material Database

Tap the required Material in the Material Database list.

7.2 Duplicating a Pipe Material

To select a pipe material:

1. Tap the on the **Pipe**  button on the calculation panel to open the **Pipe Material** screen.
2. Swipe right to left on a material in the material database list to display the actions menu.

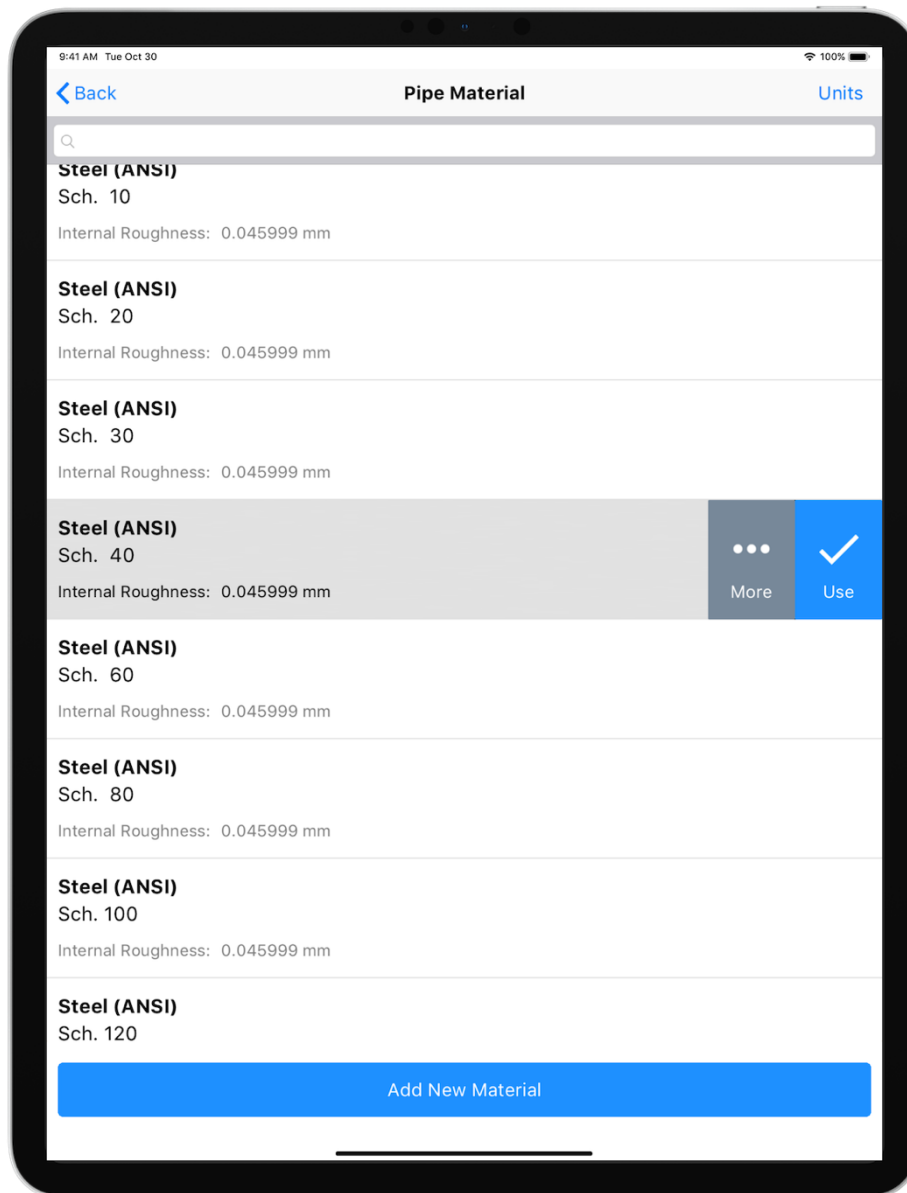


Figure 34 Pipe Material List Actions Menu

3. Tap the **More...** button to display the **Material Action Sheet**.

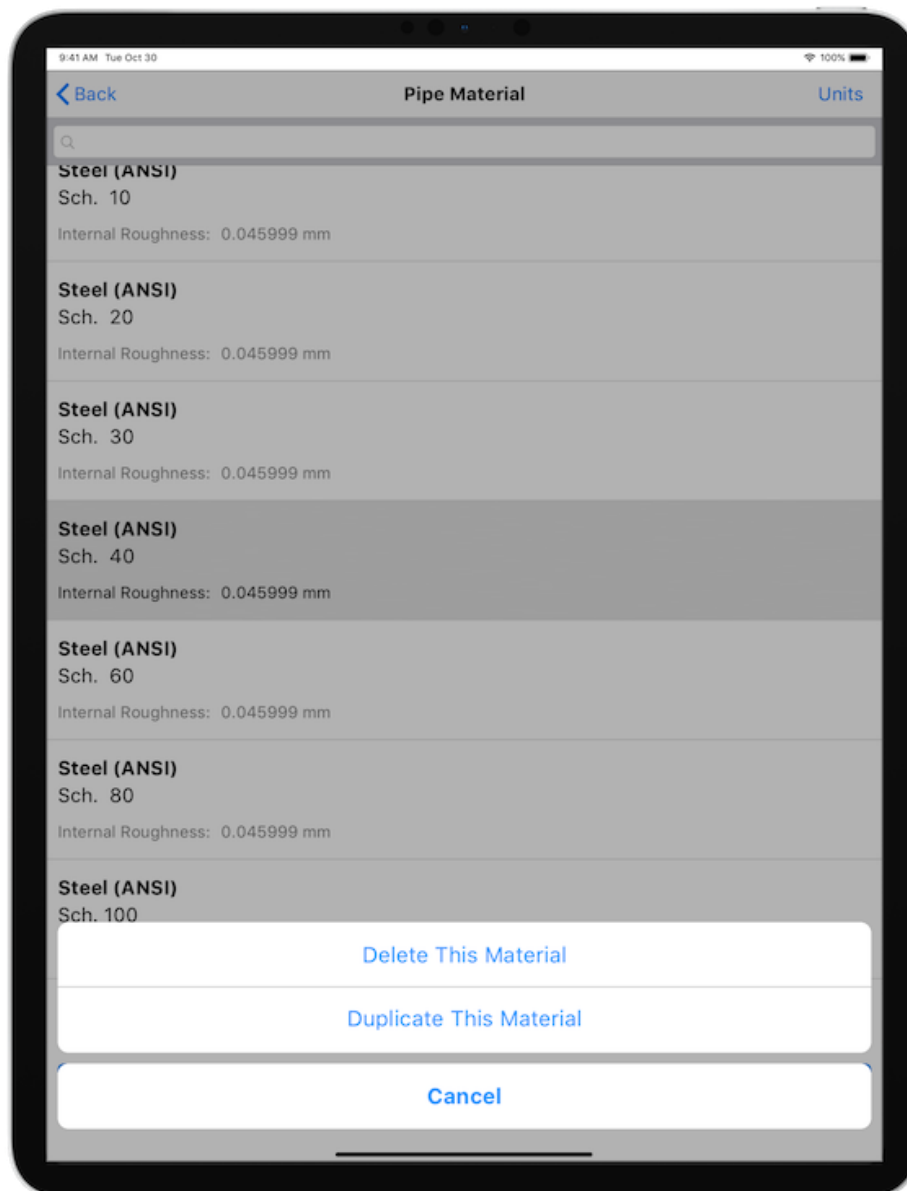




Figure 35 Material Database - Material Action Sheet

Tap the **Duplicate This Material** button to display the **Add New Material** screen with the field values pre-populated with the material to be duplicated.

4. Edit the **Name** field.
5. Edit the **Schedule / Class** field.
6. Edit the **Internal Roughness** field.
7. Tap the **Save Material** button to add the new material to the material database.

7.3 Adding a new Pipe Material

To select a pipe material:

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

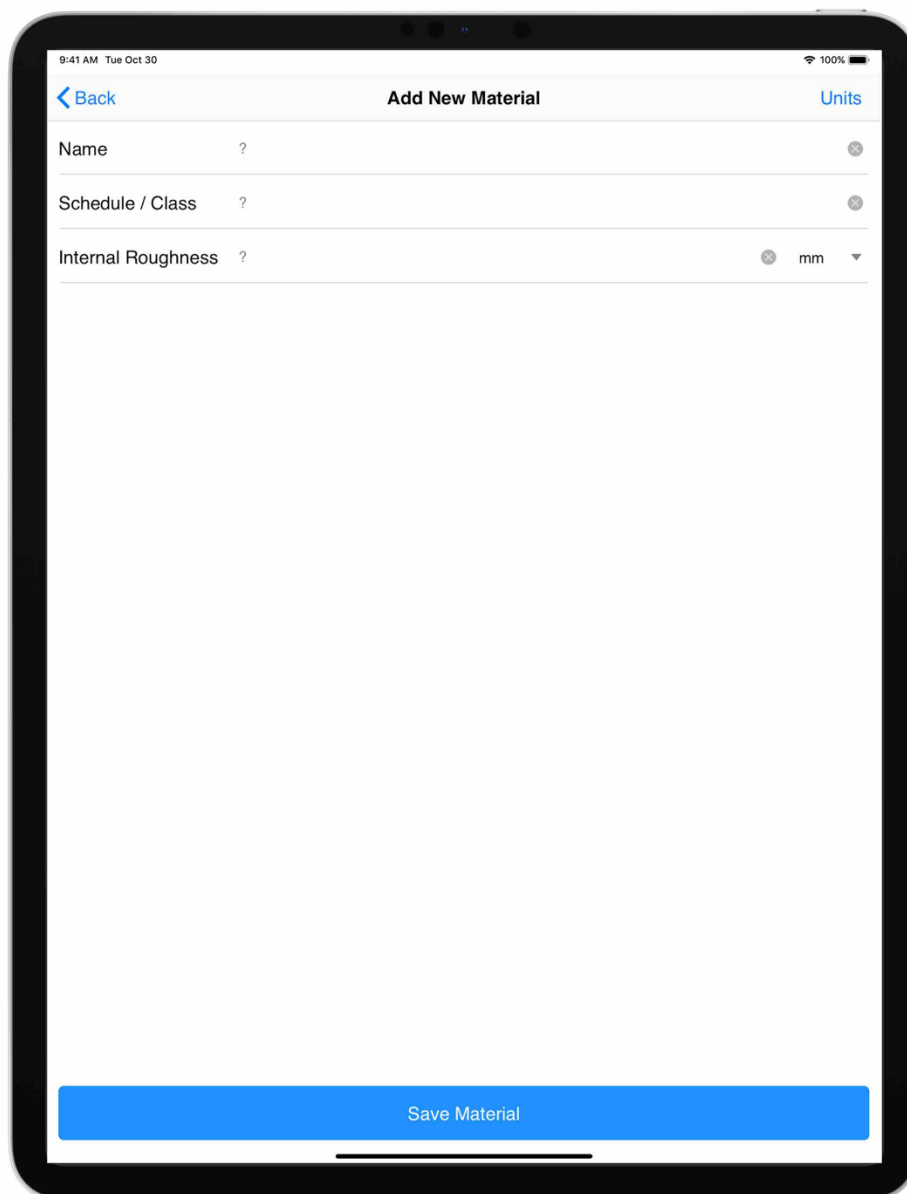



Figure 36 Add New Pipe Material

3. Enter the **Name**, **Schedule / Class**, and **Internal Roughness** values.
4. Tap the **Save Material** button to save the new material to the database.

7.4 Selecting a Pipe Diameter

To select a pipe diameter:

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

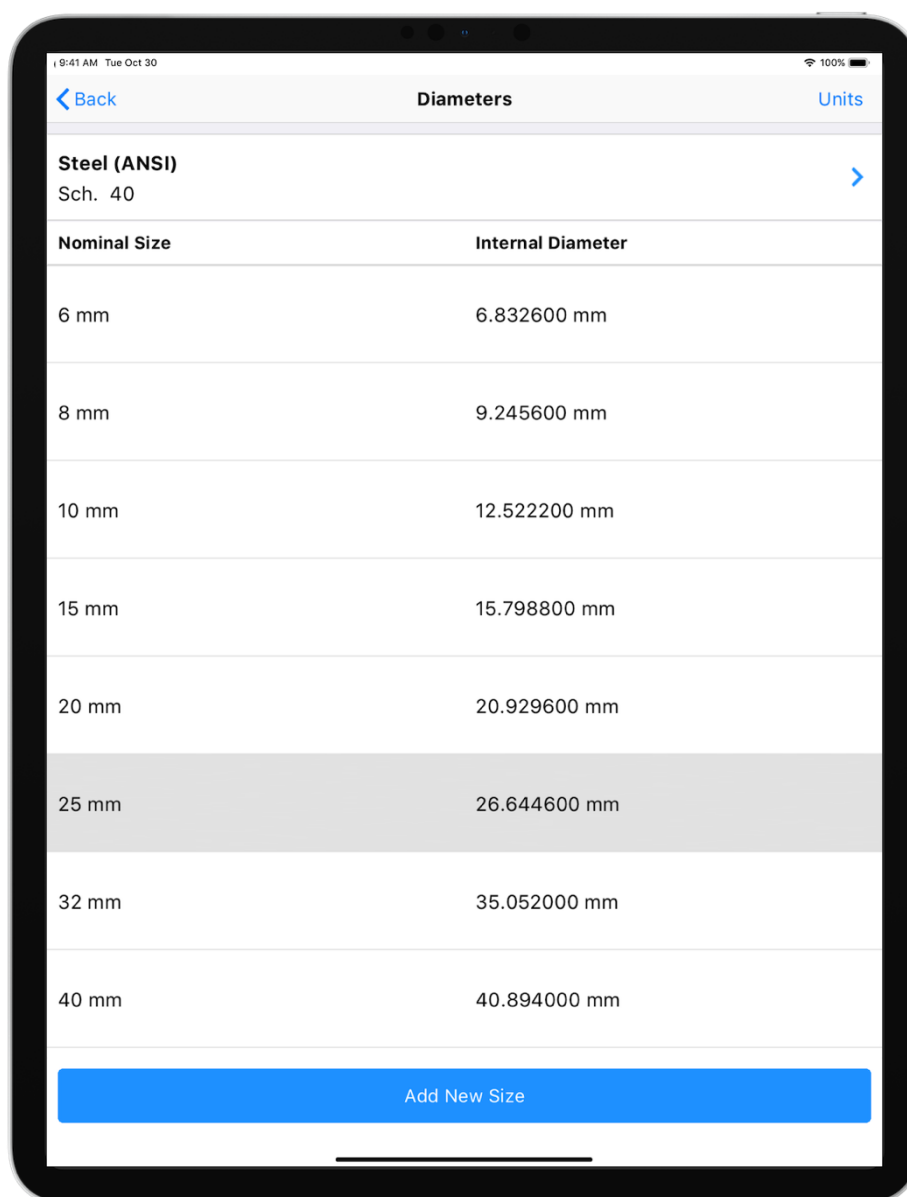
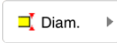



Figure 37 Pipe Diameter

2. If required, change the pipe material by tapping the currently selected material above the list of pipe diameters.
3. Tap the required **Diameter** in the **Pipe Diameter** database list.

7.5 Adding a Pipe Diameter

To add a new pipe diameter:

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

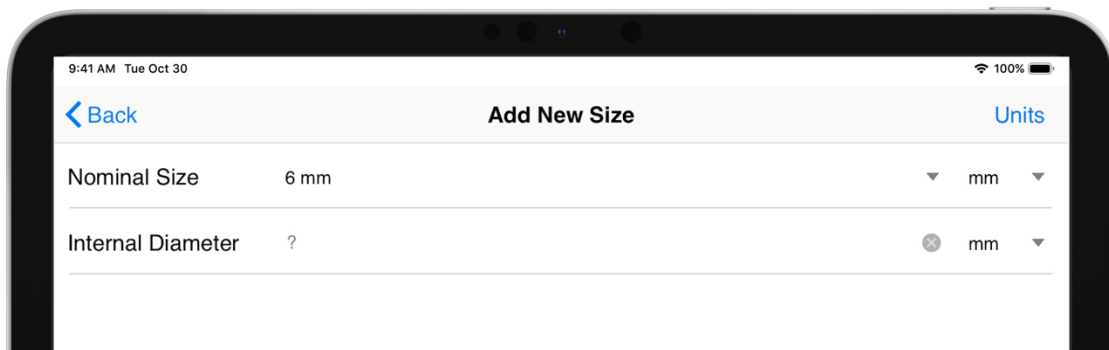



Figure 38 Add Pipe Diameter

3. Specify the **Nominal Size** and **Internal Diameter** values.
4. Tap the **Save Size**  button.
Note: Pipe Flow Liquid Flow Rate will verify that the Nominal Size value and Internal Diameter value are equivalent, and if not, will prevent the new pipe diameter from being saved.

8 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 Liquid Flow Rate Fitting database, or user fittings can be created using an appropriate K value.

8.1 Adding a Fitting to the Pipe

To add fittings to a pipe:

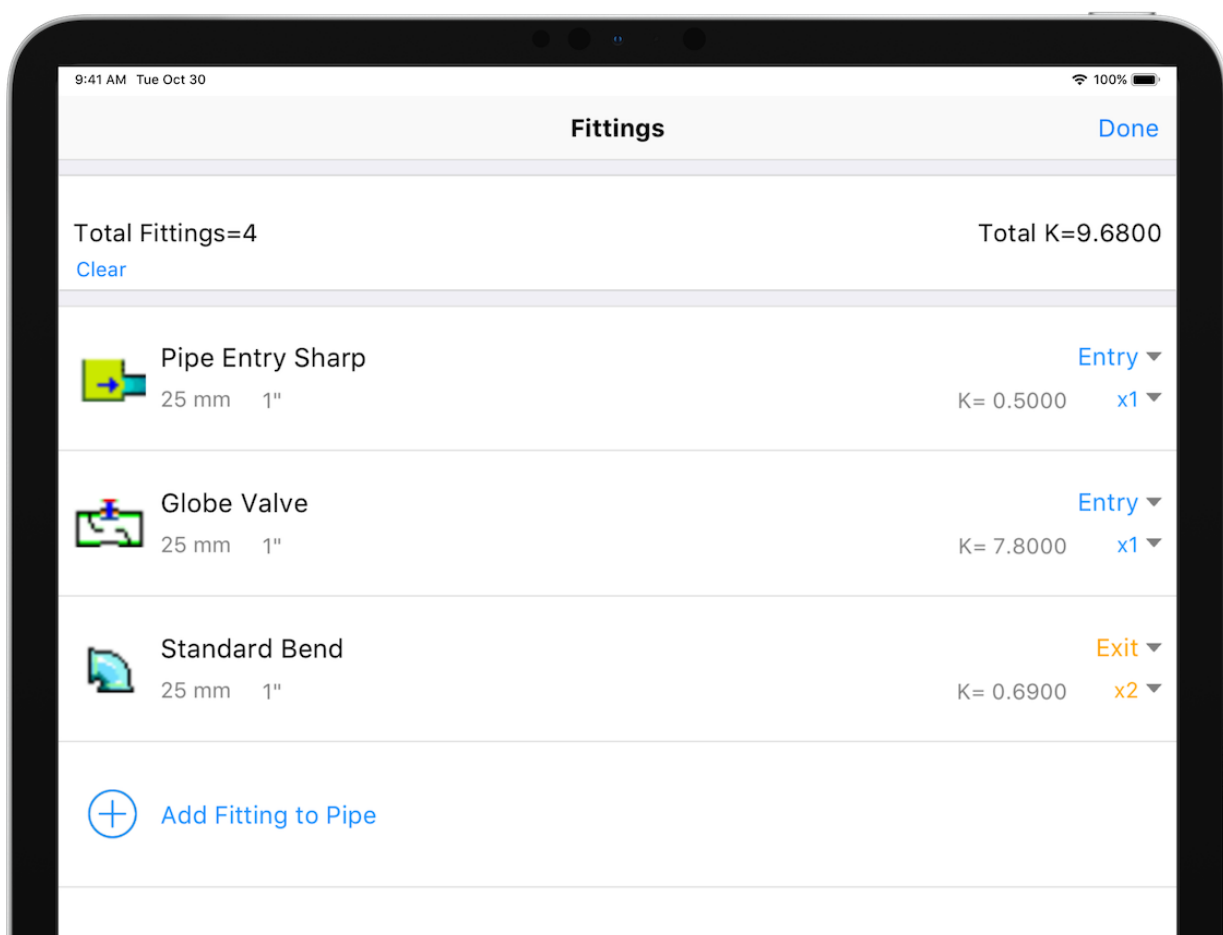



Figure 39 Fittings & Valves

1. Tap the **Fittings**  button on the calculation panel to open the **Fittings** screen.
2. The fittings on the pipe will be shown.
3. Tap the **Add Fitting to Pipe** button to display the **Fitting Database**.

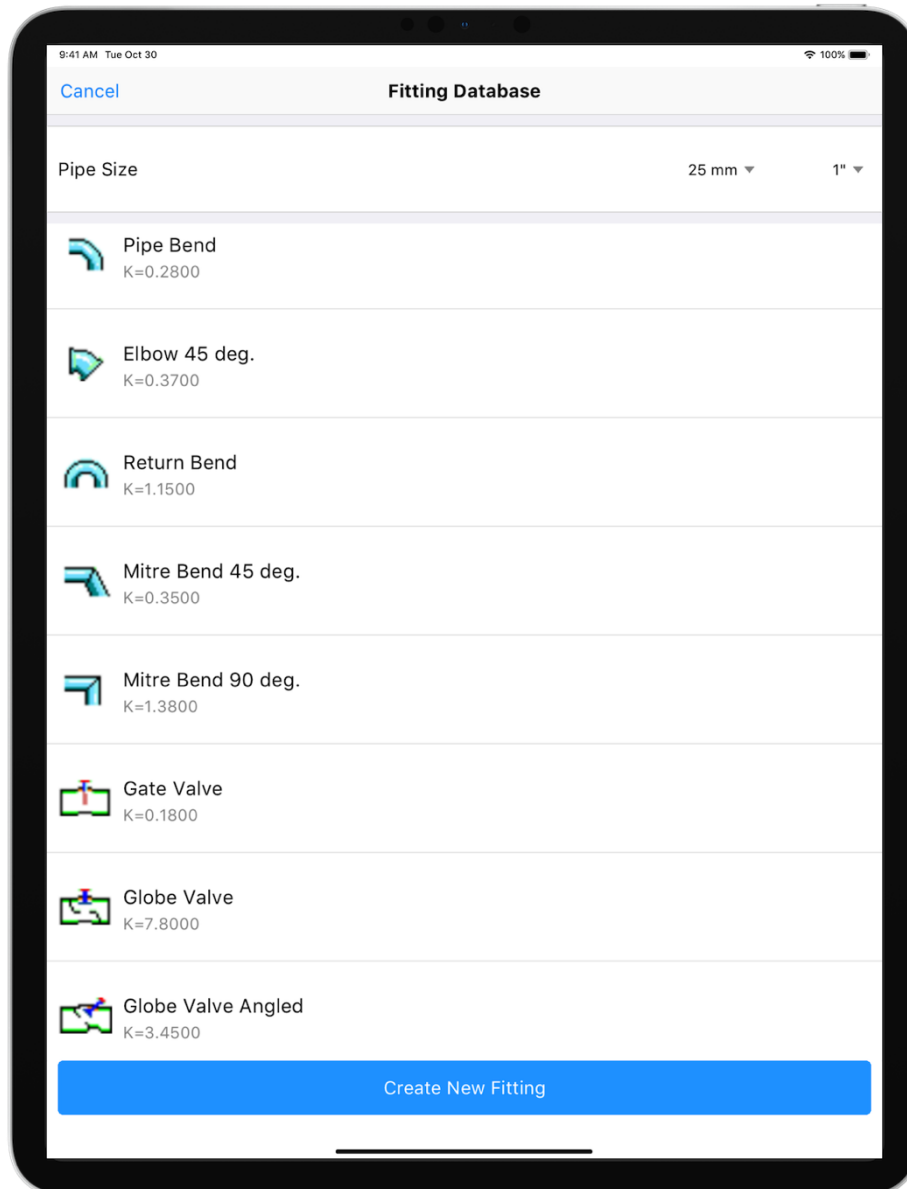


Figure 40 Fitting Database


A list of available fittings will be shown for the current pipe size.

4. If required, change the nominal size by selecting from the metric or imperial 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, tap 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. Tap on a fitting from the list to add it to the fittings on the pipe.

7. The selected fitting is displayed in **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 3 – 9.
10. Tap **Done** to add the chosen fittings to the pipe, and to close the **Fittings** screen.

8.2 Removing a Fitting from the Pipe

To remove fittings from a pipe:

1. Tap the **Fittings**  button on the calculation panel to open the **Fittings** screen.
2. Swipe right to left on the fitting to be removed and tap **Remove**, or set the quantity for the fitting to be removed to zero.

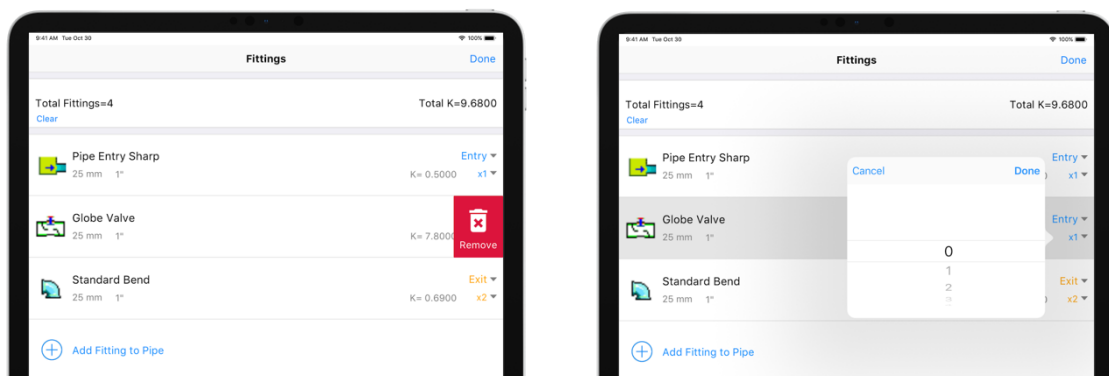



Figure 41 Remove Fitting from the Pipe

3. Tap **Done** to update the pipe with the chosen fittings, and to close the **Fittings** screen.

8.3 Adding a Fitting to the Database

To add a fitting to the database:

1. Tap the **Fittings**  button on the calculation panel to open the **Fittings** screen.
2. Tap the **Create New Fitting** button to open the **Create New Fitting** screen.

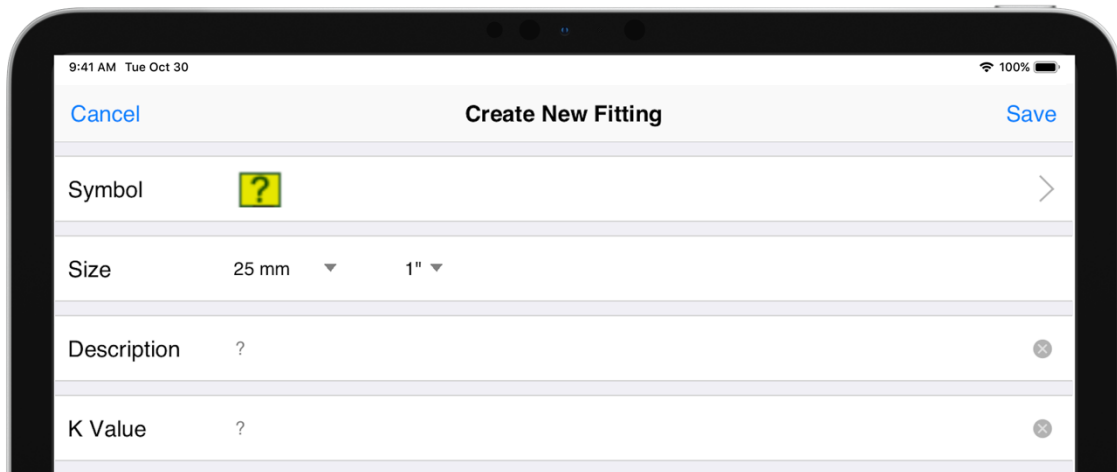


Figure 42 Create New Fitting

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

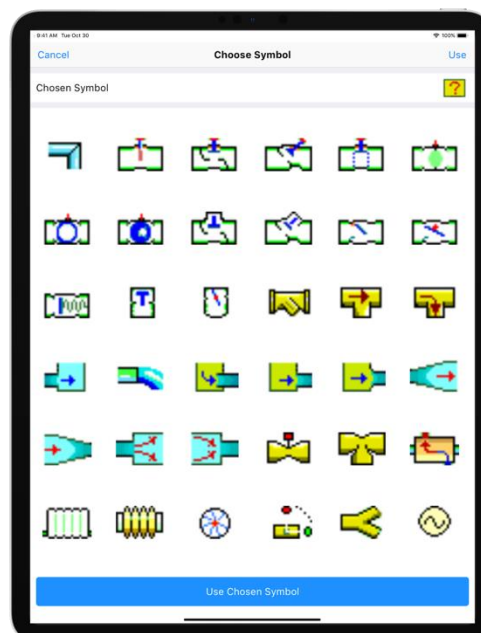


Figure 43 Choose Fitting Symbol

4. Select the symbol you want to represent the fitting.

5. Tap **Use Chosen Symbol** to add the symbol to the **Symbol** field and close the **Choose Symbol** screen.
6. Select the fitting's metric size from the **Metric** list or select the fitting's imperial size from the **Imperial** list.
7. You only need to select the metric or imperial fitting size. The Pipe Flow Liquid Flow Rate software 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. Tap the **Save Fitting** to add the fitting to the **Fitting Database** list.

 Scroll down to reveal additional symbols.

9 Calculations and Results

Once you have entered the required input data to a Calculation Panel, you can calculate the results for by tapping 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, a result value can be expanded to reveal additional information related to that attribute. For more information about expanding attributes, see: Expandable Sections.

9.1 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 recommended updates to the make the calculation data consistent.

9.1.1 Fitting Sizes

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



Figure 44 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 correct data for the given pipe size is used, such that the pressure losses will be appropriately calculated.



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

9.2 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.

9.3 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, tap the **Excel** button. The report will be generated using the defined Reports settings and the Pipe Flow Liquid Flow Rate software will attempt to open it using **Microsoft Excel** (or compatible software) that is installed on your computer.

To create a PDF Report, tap the **PDF** button. The report will be generated using the defined Reports settings and Pipe Flow Liquid Flow Rate 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.

9.4 PDF Report Example

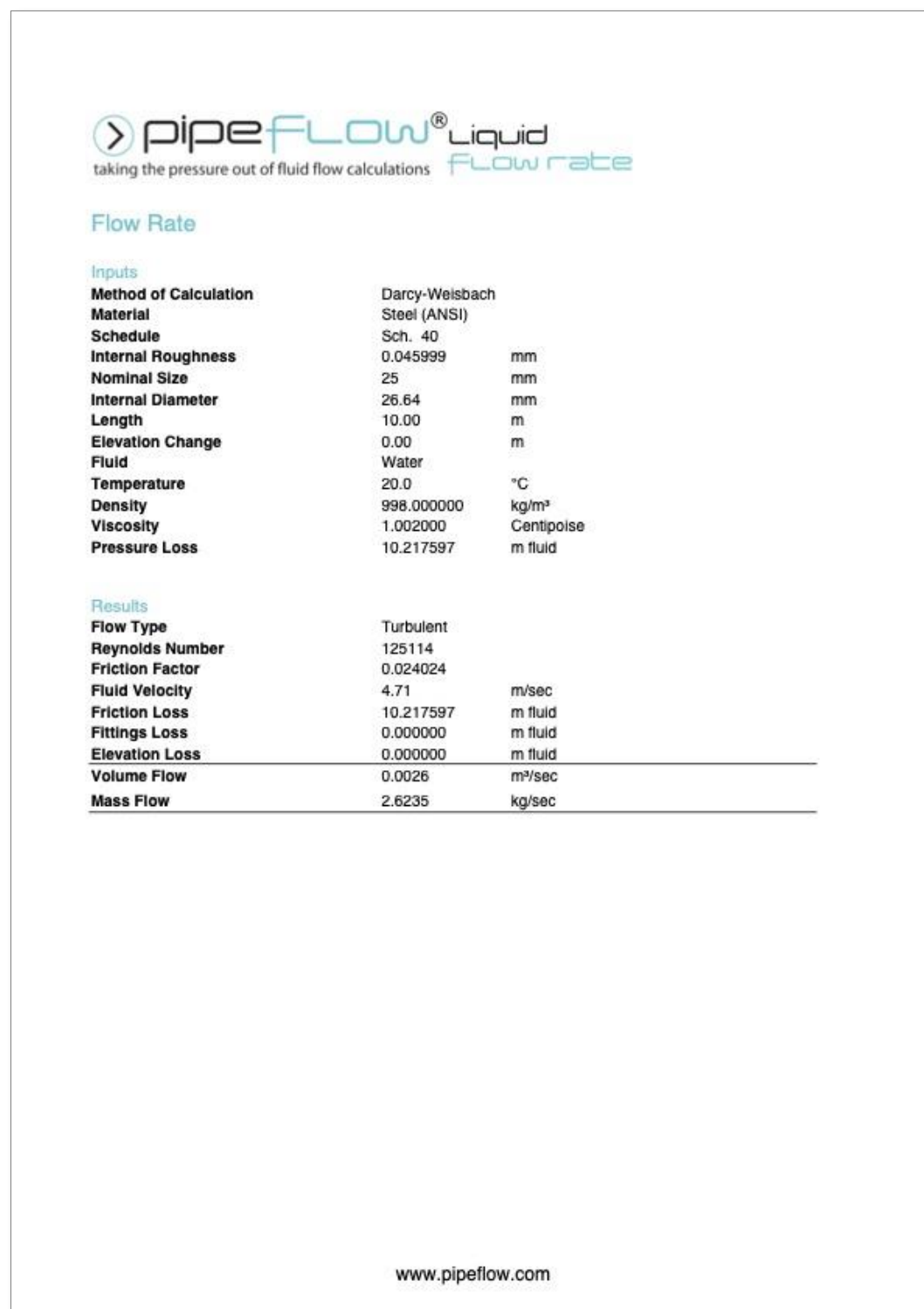


Figure 45 PDF Report - Tabulated

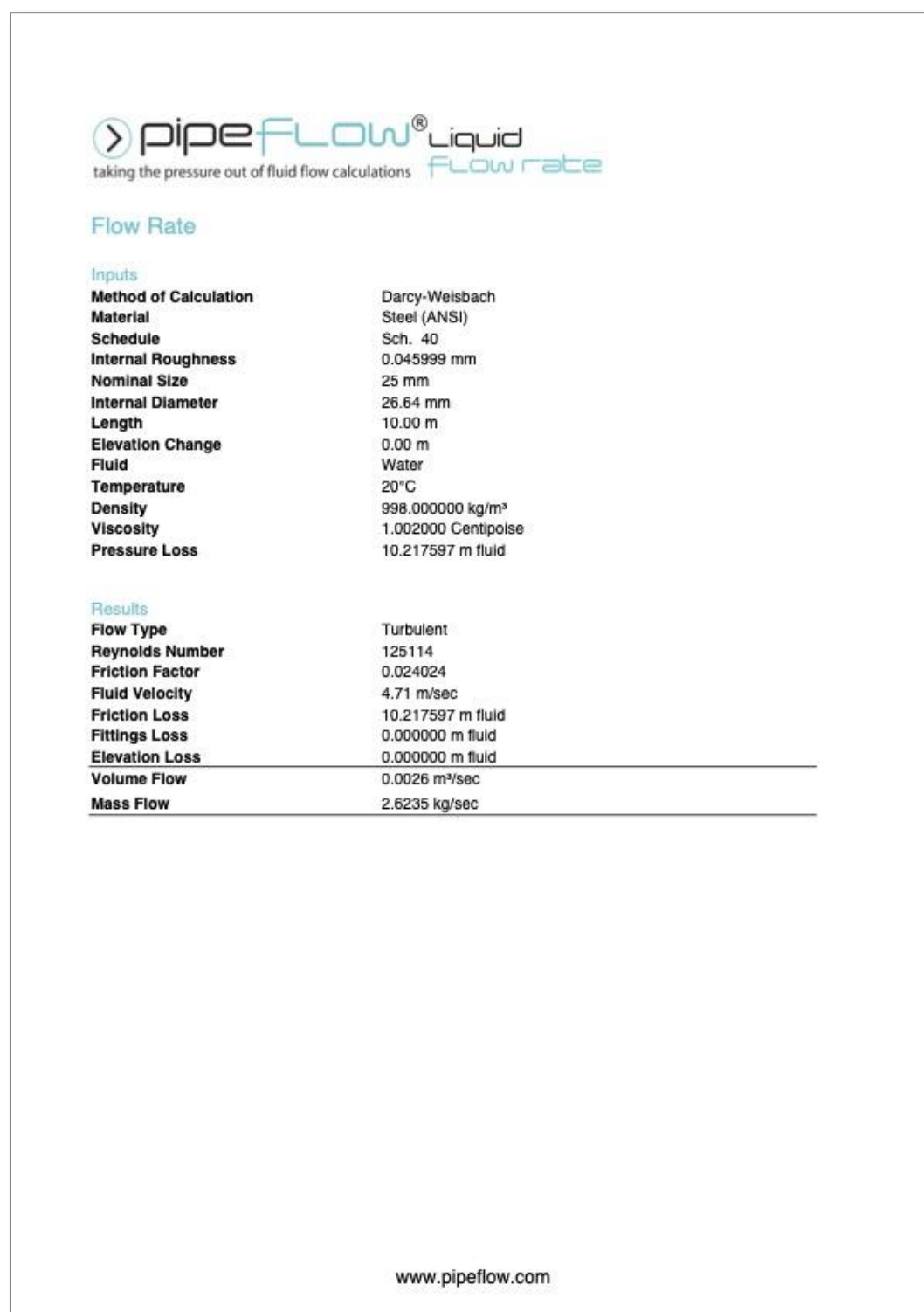


Figure 46 PDF Report – Non Tabulated

10 Calculation Theory and Method of Solutions

10.1 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'.

10.2 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 $1.00 \times 10^{-3} \text{ Pa} \cdot \text{s}$ or 1.00 Centipoise
 Water @ 70°F has a viscosity of $2.04 \times 10^{-5} \text{ lbf} \cdot \text{s/ft}^2$

Kinematic Viscosity

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

Pipe Flow Liquid Pressure Drop has a database of viscosities and densities for common fluids.

10.3 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.

10.4 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 Liquid Pressure Drop software uses the Colebrook-White friction factor with the Darcy-Weisbach equation when calculating friction loss for non-compressible flow (liquids).

10.5 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 Liquid Pressure Drop are based on the Colebrook-White formula.

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

10.6 Friction Losses (Resistance to Flow)

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

10.7 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 Liquid Pressure Drop software when using the non-compressible (liquid) calculation engine is based on the Darcy-Weisbach formula.

10.8 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.

10.8.1 '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

10.8.2 Fittings Database

Pipe Flow Liquid Pressure Drop 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.

11 Glossary

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

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