QPCalc

Quick Pressure Drop for Liquids

User Manual

SYSTEK Technologies, Inc.

www.systek.us

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Version 1.8
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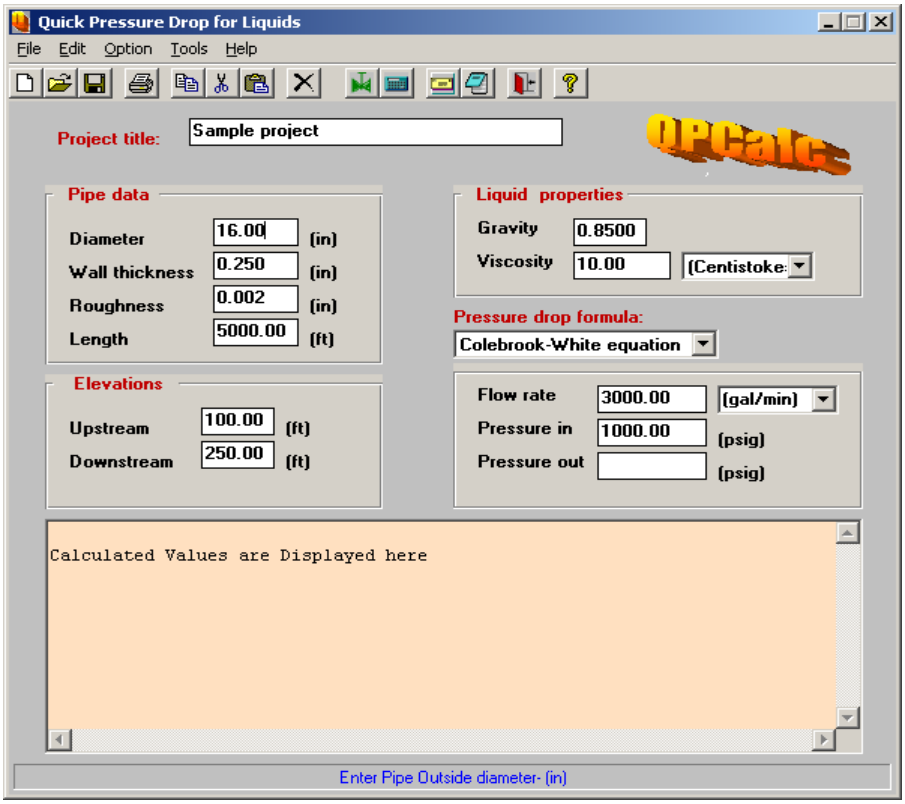
CONTENTS

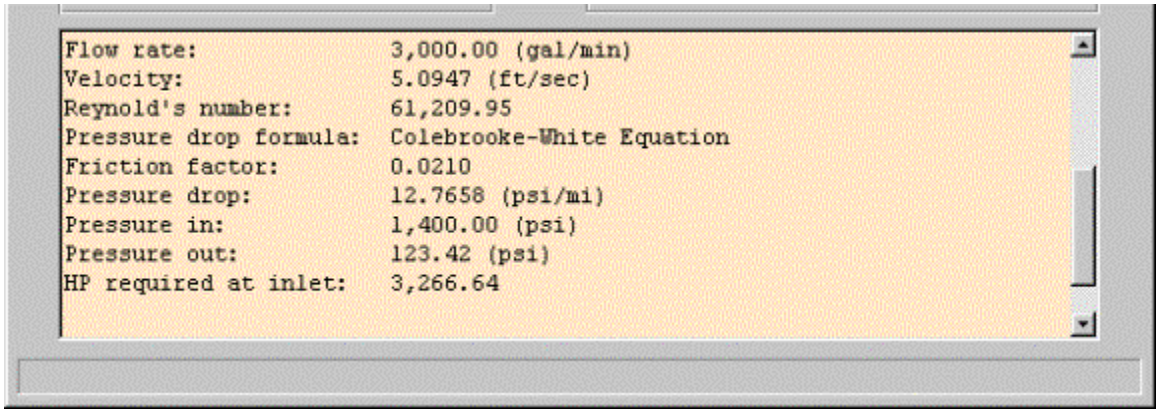
Introduction

QPCALC® can be used for quickly calculating the liquid pressure drop in a pipe segment. Valves and fittings can also be included. English and Metric units are handled.



The pipe length, diameter, wall thickness and pipe absolute roughness can be specified for the pipe segment along with the upstream and downstream elevations. Next, the liquid properties such as specific gravity or API gravity and viscosity in centistokes, SSU, etc. are entered. Choose a pressure drop formula from the drop down combo box. Choices available are Colebrook-White, Moody, Hazen-Williams, MIT, Miller and the T.R. Aude equation. Enter the flow rate in the pipe segment in the required units, such as gallons/min, bbl/hr or bbl/day. If the inlet pressure is to be calculated, leave that field blank and enter the desired outlet pressure. Alternately, if the inlet pressure of the pipe segment is known, the outlet pressure can be calculated for a specified flow rate. Of the three items: flow rate, inlet pressure and outlet pressure, given any two items, the third can be calculated.

The calculated results, including velocity, Reynold's number, friction factor, pressure drop per unit length of pipe and the segment inlet and outlet pressures are displayed in the text area at the bottom portion of the window as shown:



The horsepower (HP) calculated is based on the inlet pressure and flow rate with zero suction pressure and assuming a hypothetical pump efficiency of 75%. This HP must be adjusted to reflect the actual suction pressure and efficiency. For example, the above HP shown will be corrected as follows for a 50 psig suction pressure and 85% efficiency as follows:

Corrected HP = (3,226.64)*(1400-50)/1400*(75/85) = 2,745.36

The calculated results can be saved to disk by choosing **Save** from the **File** menu. The results can also be printed.

If you choose the Hazen-Williams equation for pressure drop, a C-value may be input or QPCalc can calculate an approximate C-value using the liquid viscosity. Similarly, if the T.R. Aude equation is selected for the pressure drop equation, a K-factor may be input.

You can use the e-mail icon  on the toolbar to send the results of calculations to a colleague or contact SYSTEK in the event of a problem with the software.

The Notepad icon is to launch Windows Notepad, if you want to do some quick text editing or cut and paste results.

This software can be run on Pentium and Athlon based computers and compatibles with a minimum of 64 MB RAM running Microsoft Windows 98/2000/XP and Windows Vista. A minimum hard disk space of 20 MB is required for installing the program.

The software is licensed for use on one computer, at a time with a hardware key (dongle) known as KEYLOK. Network and multi-user licenses are available.

Getting Started

The software program is supplied on a CD-ROM that must be installed on your computer's hard disk as described below. *If you purchased a dongle or hardware key version (parallel port key or USB key) refer to the* ***Read Me First*** *document that accompanied the software or the section titled* ***Installation for Hardware Key Users.***

This single user license entitles you to use the software only on one computer at a time. If you purchased a multi-user or network license, you are entitled to use the software on more than one computer as described in other documentation that accompanied the software.

Installation

Before starting the installation process, close all currently running programs and turn off any virus checking software, if present on the hard disk. If you want to ensure that the program disk is free of any virus you may run the virus scanning software and check the program CD prior to starting installation.

Insert the software CD into the CD-ROM drive. If *Autostart* is enabled on the CD-ROM drive, setup will start automatically. If not, from the Windows **Start** button choose **Run.**

Type the following in the resulting screen:

`G:\setup` and press Enter

Where G represents the drive letter for your CD-ROM drive.

Follow the subsequent screen instructions to continue with the installation process.

After the setup is completed, the **User Registration screen** will prompt you to enter your name, company name and the program serial number. ***The serial number found on the program CD container must be entered exactly***. Otherwise the installation will be incomplete.

You must be connected to the Internet to register the program and obtain a license. Otherwise you will not be able to run the software after installation.

You may launch the program from the Windows **Start** button. You may also create a shortcut to the program on your desktop.

Installation on a Network

If you are licensed to use the program in a network environment, the software may be installed on multiple workstations on your network. The software can then be run from any workstation on the network, subject to the maximum user limit programmed during the installation process and in accordance with your license.

Retaining and Releasing the Program

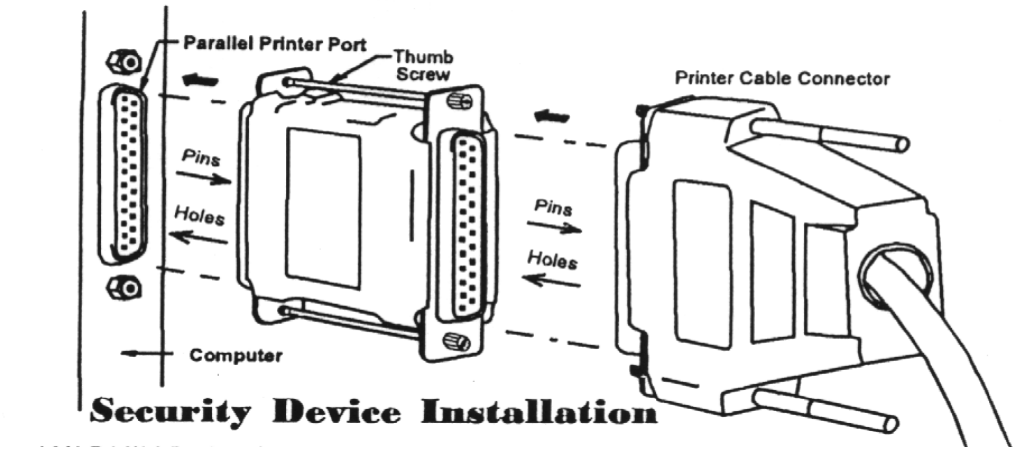
To launch the program, you will either use the Windows **Start** button or click the program icon from the **Program** menu. If the program is properly registered and the license obtained, you will be able to start the program.
When you quit the program, you will be prompted to either **retain** control or **release** control of the program in the event you (or another user) want to use the current license on another computer. This feature allows you to run the program on multiple computers (one user at a time) even though this is a single user, non-network version. *This enables you to quit the program on your work computer, release control and restart the program on your home computer or on a laptop while traveling. However each time you quit the program you must release control so that you may restart the program on another computer.*
Remember that once a program is registered and control is retained on the computer, the license can only be released from *that* computer. If you have multiple SYSTEK programs installed on your computer, you can use the handy utility called **SYSTEK Control Panel** to release or retain control of selected SYSTEK programs.

Installation for Hardware Key Users

The software program is supplied on a CD-ROM that must be installed onto your computer's hard disk as described below for optimum operation. Depending on the type of hardware key you received (parallel port key or a USB port key) follow the instruction for the installation of that particular type of hardware key (dongle or KEYLOK) as described below.

Parallel port hardware key installation

This software is protected by a hardware key security device (dongle) that plugs into your computer's parallel printer port. This dongle *must* be in place for the software to operate properly. *With the computer turned off, plug the dongle into the parallel port of your computer between the computer and the printer cable as shown in the diagram below.*



All printer commands are passed through unaffected, transparent to the *dongle.* Since the *dongle* is critical to the operation of the software, it must be stored safely when not in use. It is recommended that Laptop computer users remove the *dongle* from the printer port before packing the laptop in its carrying case.

USB port hardware key installation

The software will work **only** with the specific USB hardware key (dongle) included with the program CD. The USB dongles cannot be interchanged. Each dongle is specific to the software.

With one licensed copy, the program may be concurrently installed on more than one computer. However, the software will only run on the computer that has the USB dongle attached.

USB dongle installation

The software is protected by a USB dongle that plugs into your computer's USB port. This dongle is plugged into the USB port *after* the installation of the software. ***Do not attach the dongle until after the dongle installation step is completed.***

Since the dongle is critical to the operation of the software, it must be stored safely when not in use. It is recommended that Laptop computer users remove the dongle from the USB port before packing the laptop in its carrying case.

A lost or damaged dongle is equivalent to losing the software. A replacement dongle can only be obtained at the full retail price of the software. In other words, the dongle costs as much as the software itself.

Installation

Before starting the installation process, close all running applications and turn off any virus checking software, if currently present on the hard disk. If you want to ensure that the program disk is free of any virus you may run the virus scanning software and check the program CD prior to starting installation.

Step-1:

Insert the software CD into the CD-ROM drive. If *Autostart* is enabled on the CD-ROM drive, setup will start automatically. If not, from the **Start** button choose **Run.**

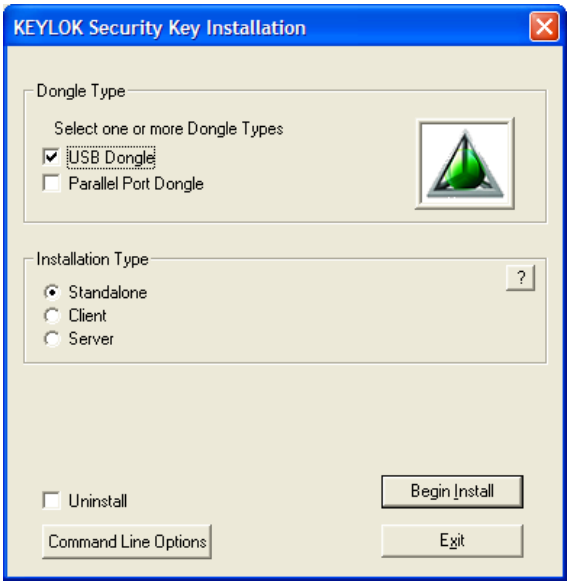
Type the following in the resulting screen: `G:\setup` and press Enter

Where G represents the drive letter for your CD-ROM drive.

Follow the subsequent screen instructions to continue with the installation process.

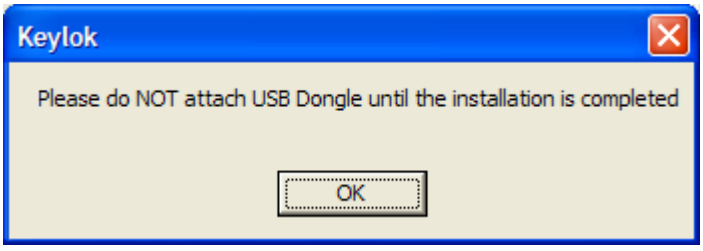
Step-2:
After the software is installed, the Dongle Installation will automatically start.
Do not attach the dongle until after the dongle installation step is completed.

Initially, the screen below is displayed:

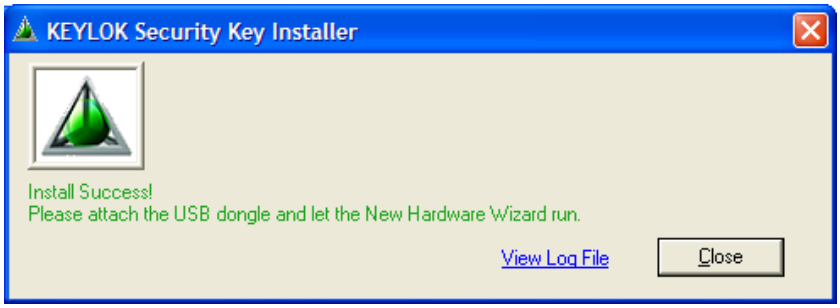


Choose the **USB Dongle** type and **Standalone** installation type as shown and click **Begin Install**.

Next, the following screen is displayed. Click OK to confirm.



When the dongle installation is completed (may take a few minutes), and a message is displayed to this effect, you should attach the dongle to one of the USB ports as directed in screen below.



The computer will recognize the dongle and the software driver will be installed automatically.

After the setup is completed and you start QPCalc software from the Windows Start button, the User Registration screen will prompt you to enter your name, company and the software serial number.

The serial number found on the* software *CD container must be entered exactly. Otherwise the installation will be incomplete.

The Licensed User is eligible to receive **free** technical support for 60 days from the date of purchase. After this 60-day period, the User may sign up for an annual Software Maintenance Program. After this 60-day period, the User may sign up for an annual Software Maintenance Program.

Put your original software CD-ROM away safely.

Manual Installation of dongle files

If for some reason the dongle installation does not start automatically then you must manually start the dongle program (Keylok.exe) from the Start/Run button as follows:

Keylok /B *and press enter*

The above must be executed from the SYSTEK folder containing the Keylok.exe program. After this go back to Step 2 above to continue installation.

Un-installation

Prior to uninstalling **QPCalc,** save all data files and results of calculations that you may need for later use. To **uninstall** the software from the hard disk, go to the **Start button** and choose **Settings**. Next select the **Control Panel** and click on **Add/Remove** Programs. Follow subsequent instruction to uninstall **QPCalc.**

*You can no longer run the program, until you **re-install** it again as described in the Installation section.*

Features

QPCALC® is used for quickly calculating the pressure drop in a pipe segment.

The pipe length, diameter, wall thickness and pipe absolute roughness can be specified for the segment along with the upstream and downstream elevations. Liquid specific gravity or API gravity may be specified. Liquid viscosity may be entered in centistokes, SSU, etc. Several choices are available for the pressure drop calculations. These include the Colebrook-White, Moody method, Hazen-Williams, MIT, Miller and the T.R. Aude equation. The flow rate in the pipe segment may be specified in commonly used units, such as gallons/min, bbl/hr or bbl/day. If the inlet pressure of the pipe segment is to be calculated, leave that field blank and enter the desired outlet pressure. Alternatively, if the inlet pressure is known, the outlet pressure can be calculated for a specified flow rate. Of the three items: flow rate, inlet pressure and outlet pressure, given any two items, the third can be calculated.

QPCalc is an easy to use software program. Online HELP is available under menu item **Help** and the program has extensive error checking features. In addition, a Menu item **How do I…**. under the **Help** menu provides a quick way to get up to speed with the software.

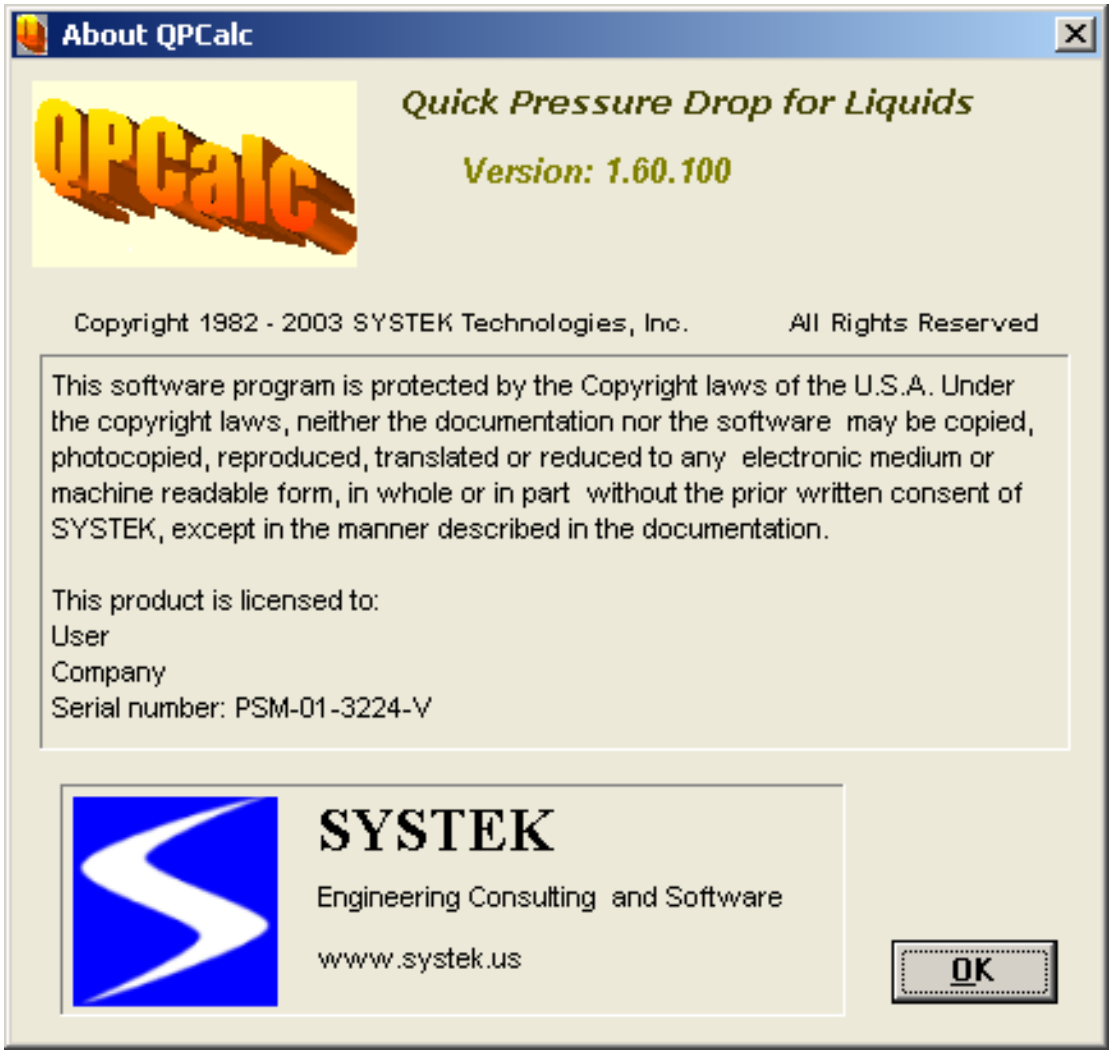
Here is a sampling of QPCalc's features:

- Calculate pressure drop in pipe segments quickly.
- Elevation of both ends of pipe segment can be included.
- Various pressure drop formulas, such as Colebrook-White, Hazen- Williams, etc can be used.
- Valves and Fittings can be modeled.
- Custom pressure drop devices, such as meters, filters, strainers can be included.
- The required pumping HP can be calculated.
- English and Metric Units are handled.
- Email feature to quickly send the results of calculations to a colleague or report a software problem to SYSTEK.
- On-line Help is included.

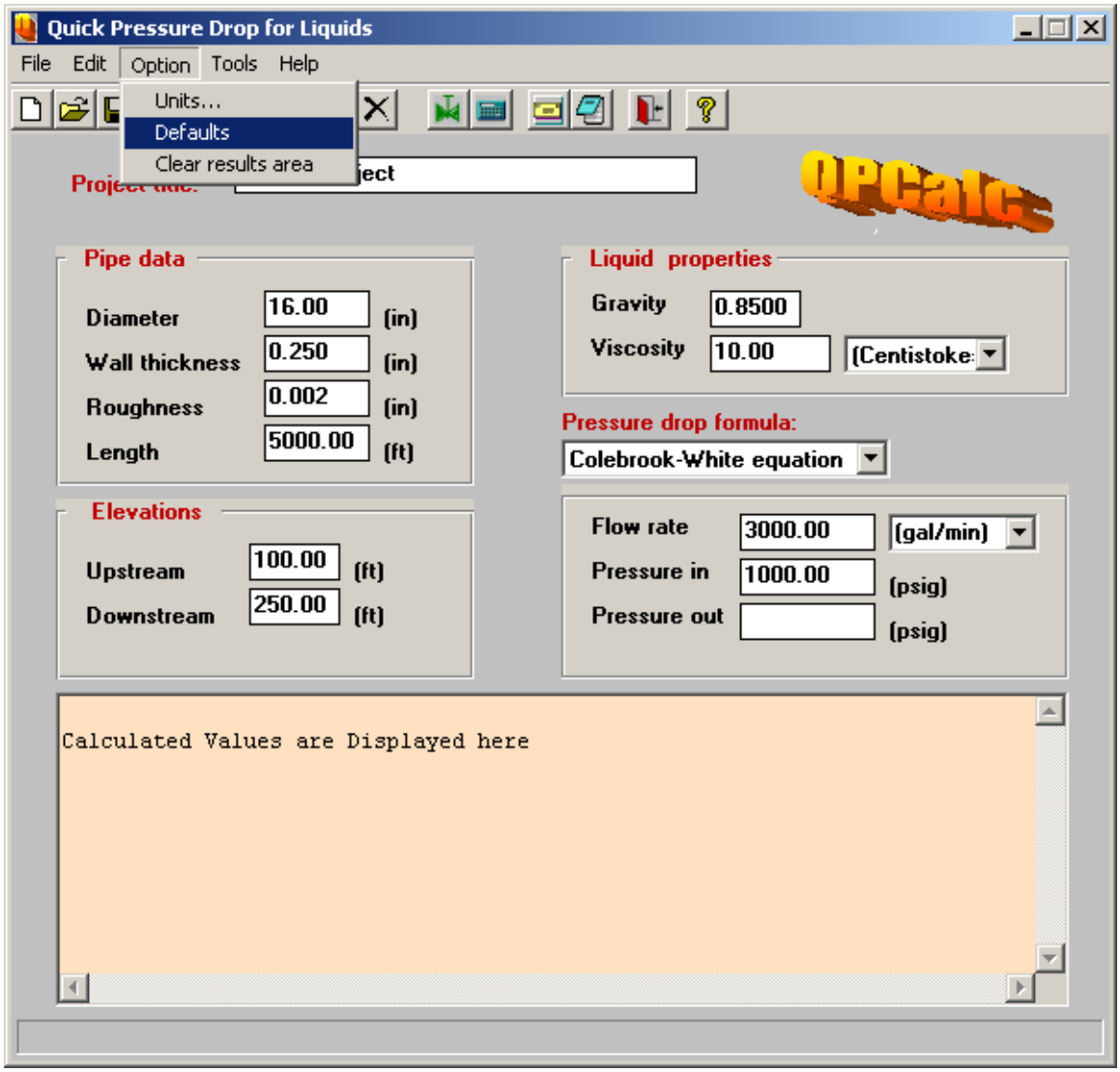
Running the Program

To run the program, click on the **QPCalc** program icon or select **Start/Run** and type the appropriate sub-directory name and filename, such as: **`C:\QPCalc\QPCalc.exe`** and press Enter.

The initial program screen will be momentarily displayed as follows:



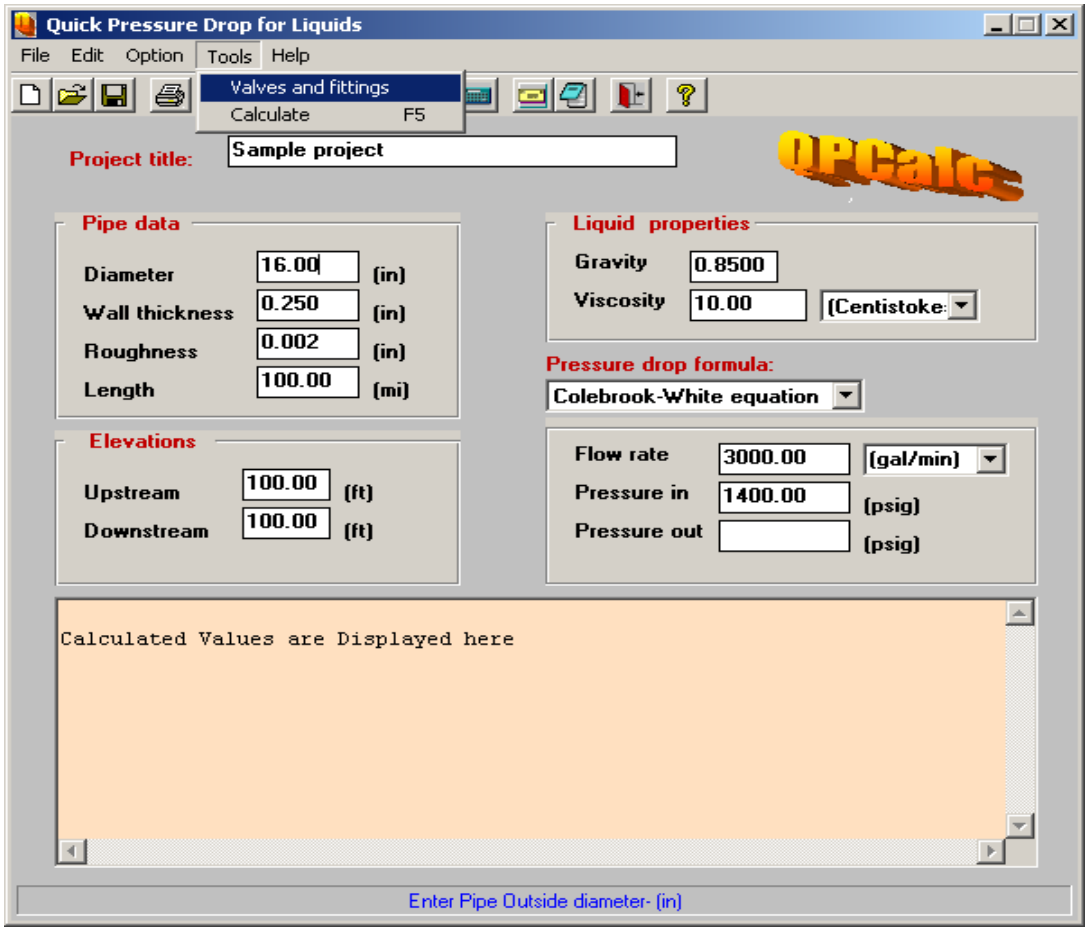
The main program screen is displayed next as shown below. The menu items **File** and **Edit** contain the familiar pull-down menu items, such as New, Open, etc. Under the **Option** menu, there are choices for **Units** of calculation (English/Metric), **Defaults** and **Clear Results area.**



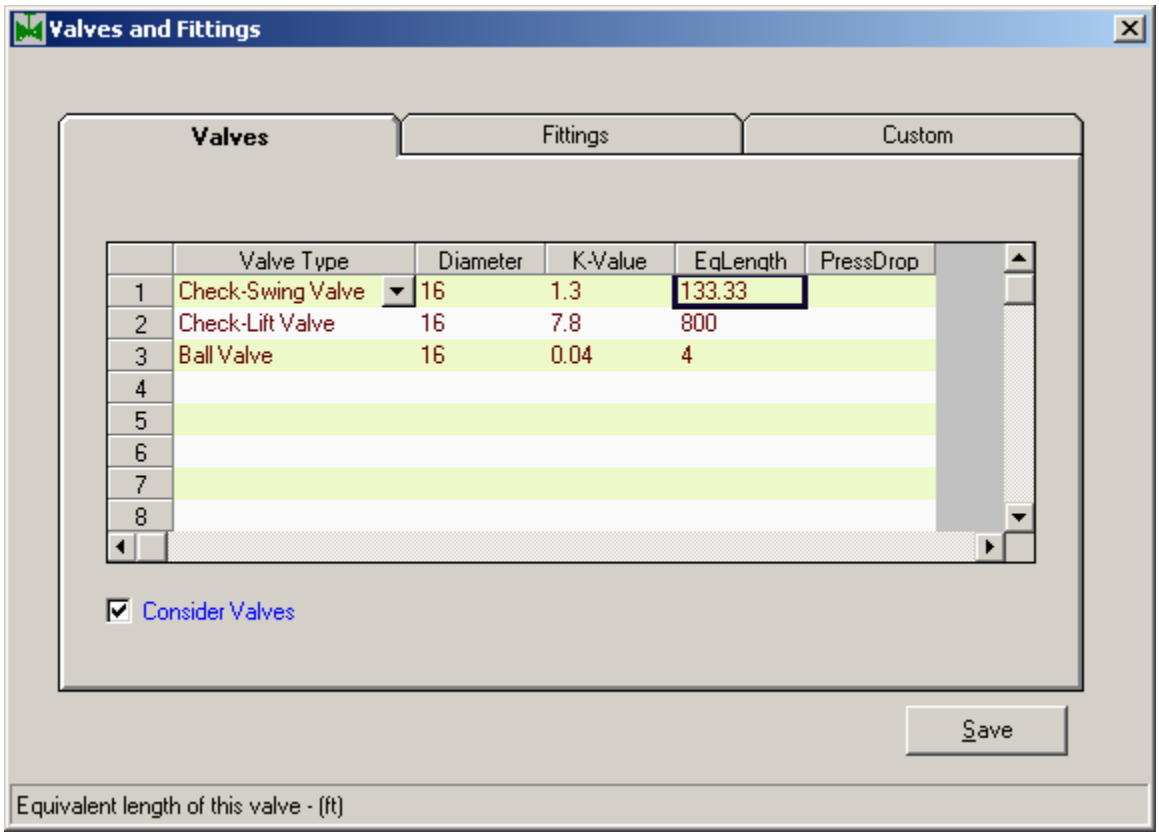
The pull down menu item **Defaults** will populate the text entry fields with default data for a 16-inch pipe segment flowing 3,000 gal/min of a liquid with a specific gravity of 0.85 and viscosity of 10.0 centistokes.

Clear Results Area simply clears the lower portion of the screen where calculated results are displayed. The Results Area contains the calculated results, appended to the previous results, each time calculation is initiated by clicking on the **Calculate** icon.

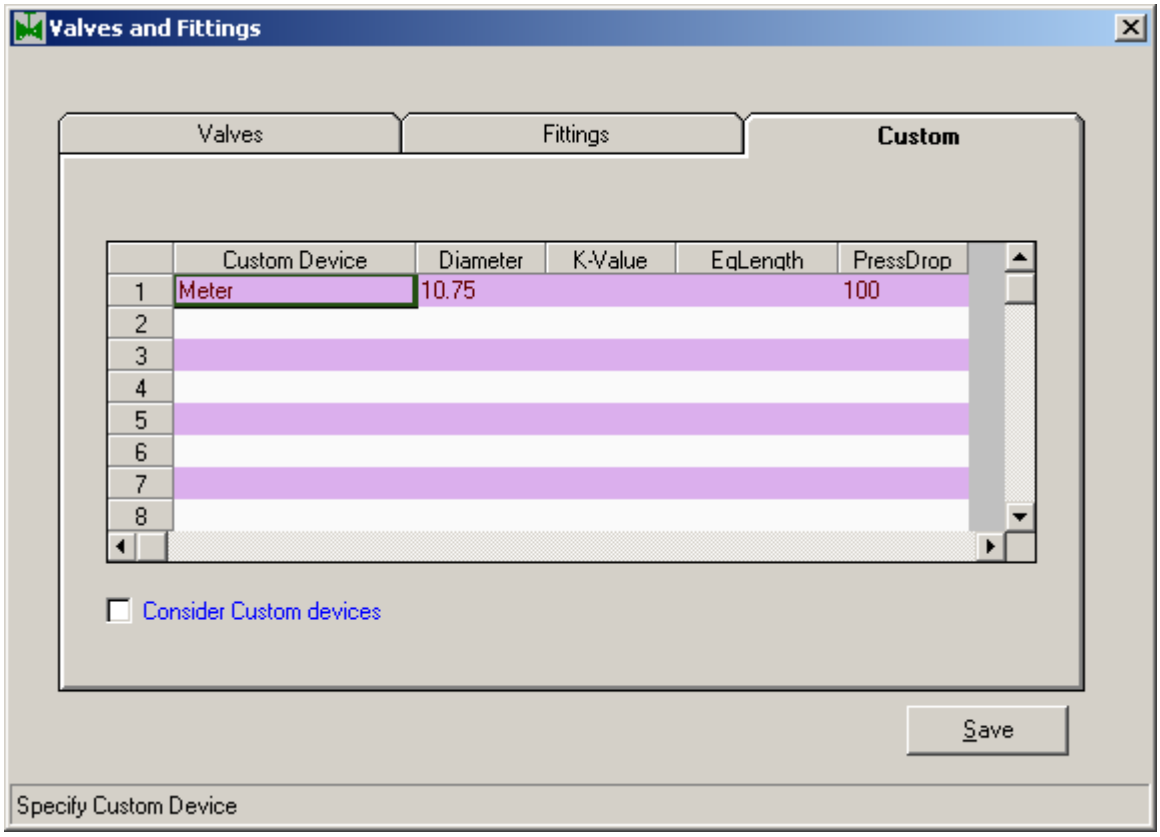
Under the **Tools** menu, there are choices for **Valves and Fittings** and **Calculate.** The **F5** key may also be used as a shortcut to start calculations. Additionally, the **Calculator** icon on the toolbar will also initiate calculations.



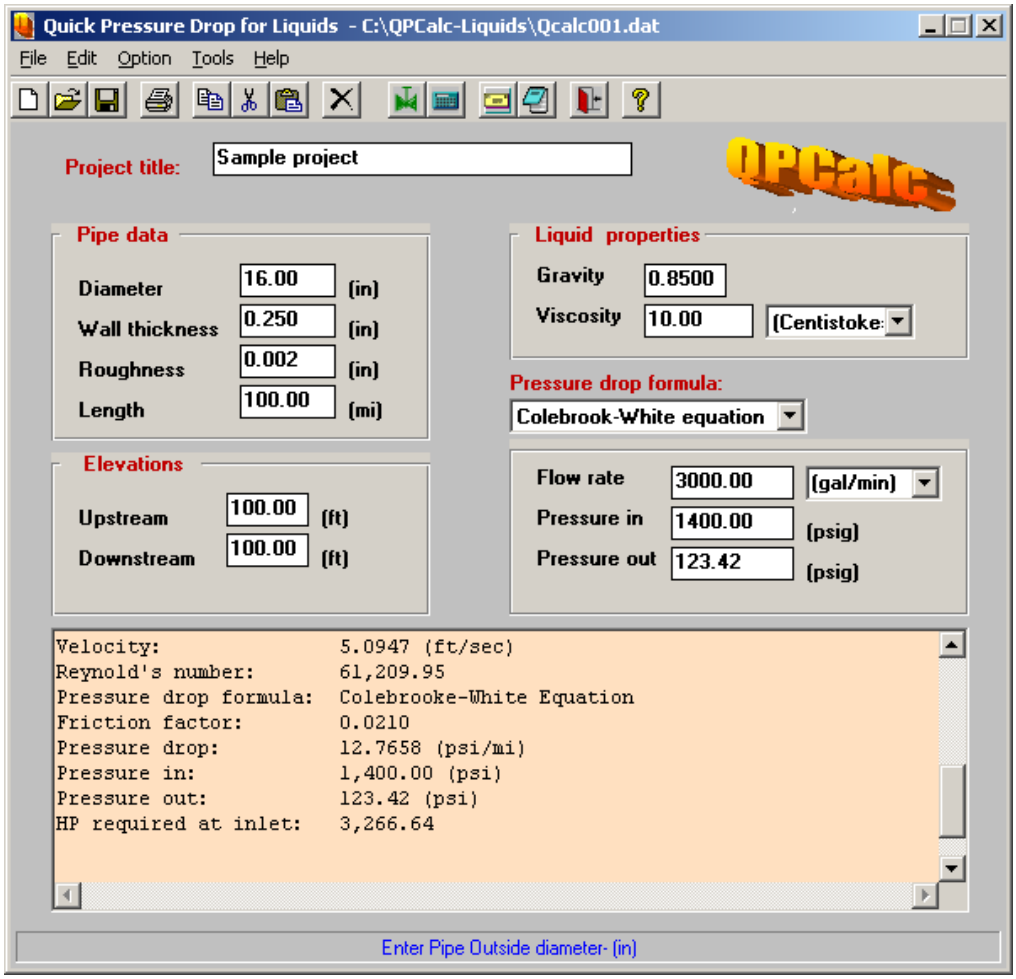
The pull down menu item **Valves and Fittings** will display the following tabbed screen for specifying Valves, Fittings and Custom pressure drop devices. For a selected list of commonly used valves and fittings, the K-factors and the corresponding equivalent lengths of each component will automatically be displayed once you select the Valve or Fitting type and enter its nominal diameter. The K-factor and the equivalent length can be over-ridden by entering a specific pressure drop for the valve or fitting in the last column. *If the pressure drop column is filled in, the equivalent length and K-factors are ignored.*



The **Custom** tab may be used to specify a device that is not included in the standard list. For example, you may want to specify a filter or meter with a fixed pressure drop of 100 psig. This tab may also be used to include other pipe segments.



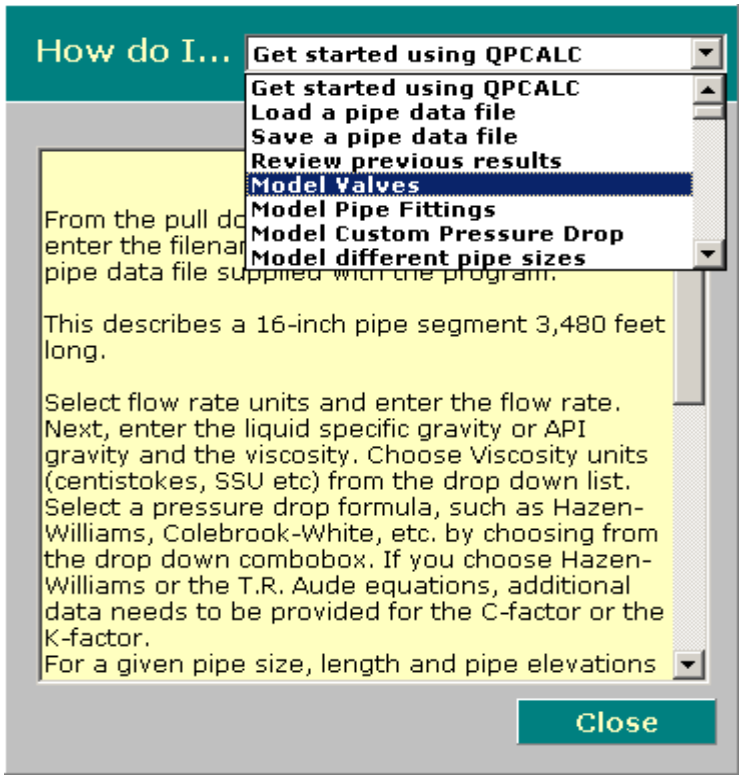
After entering all data, pressing the F5 key or clicking on the **Calculate** icon, will display the results in the Text area as shown in the screen shot below:



The calculated results can be saved or printed. Since each set of calculations is appended to the previous results in the text area above, you may want to clear the results area to start a new set of calculations. To do this, choose the pull down menu Clear results area under the Option menu. The toolbar icon Clear all Fields can be used to clear all the fields and start with a blank screen for inputting new data. The pull-down menu item Defaults under the Option menu may be used to load the default data, which consists of a 16" pipe segment, 100 miles long, flowing 3,000 gal/min of a liquid with a specific gravity of 0.85 and viscosity of 10 centistokes.

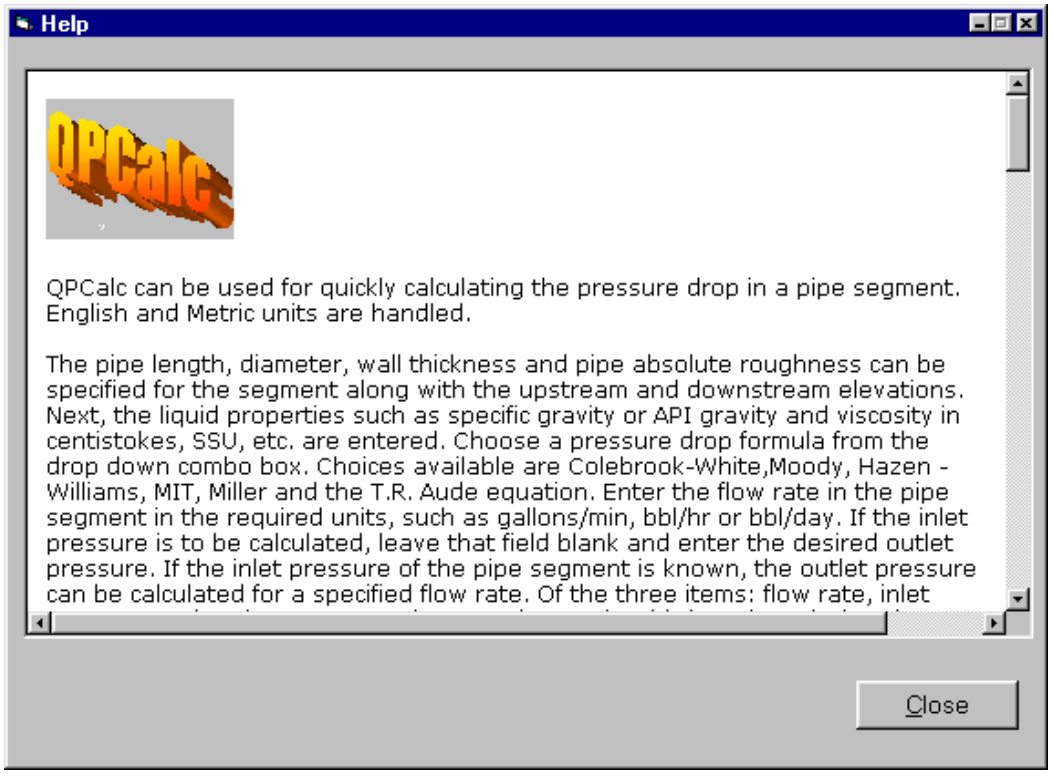
The menu bar item on the extreme right titled **Help** provides information about the program, such as version number, licensed user information and General Help on the program.

The Help menu has two options for getting Help. The **How do I…** option shows a screen with several commonly asked question on using QPCalc as shown in the screenshot below:



Using the drop down combo box above, you may choose the Help item desired. A short explanation of how to accomplish a specific task is displayed in the Help screen as shown.

Clicking on the menu item **General Help** or the **F1** key brings up the General Help Screen shown below:



Reference

This section provides an explanation of formulas and variable names used.

Hydraulic Formulas

The formulas used in QPCalc are as follows:

1. Gravity and Viscosity conversion:

Specific gravity = 141.5/(131.5 + API)

Viscosity, cSt = 0.226(SSU) - 195/(SSU) for SSU <=100

cSt = 0.220(SSU) - 135/(SSU) for SSU >100

cSt = 2.24(SSF) - 184/(SSF) for 25<SSF<=40

cSt = 2.16(SSF) - 60/(SSF) for SSF>40

2. Pressure Drop Calculation

Velocity $Vel = 0.408(Q)/D^2$
$= 0.0119(B)/D^2$

Reynold's number $R = 3162.5(Q)/(VD)$
$= 92.24(B)/(VD)$

Pressure drop $Pm = 284.6\ (Q/F)^2\ S/D^5$
$= 0.2421\ (B/F)^2\ S/D^5$
(Darcy-Weisbach equation)

Discharge Pressure

$Pd = Pm(Length) + (H2- H1)S/2.31+Pdel$

Horsepower $HP = \frac{(Pd * 2.31)*Q}{39.60 * Eff}$

The pressure drop equation above uses the *Transmission factor* F instead of a *friction factor.* These two parameters have a reciprocal relationship as follows:

Transmission factor $F = 2 / f^{0.5}$
Darcy or Moody friction factor $f = 4 / F^2$

Where F is the transmission factor and f is referred to as the *Darcy or Moody friction factor.* There is another friction factor called the *Fanning friction factor* which is related to the Moody friction factor as follows:

Fanning friction factor = f /4

The Transmission factor F used in the pressure drop equation 2, on the previous page is calculated as follows:

Colebrook-White Equation:

F = SQRT(R)/4 for laminar flow (R <= 2100)

F = 1/SQRT((R-2100)/1277500 + 0.008)
for transition flow (2100 < R <= 4555)

F = -4 Log(K/(3.7D)+1.4125(F/R))
for turbulent flow (R > 4555)

Moody friction factor:

F = SQRT(R)/4 for laminar flow (R <= 2100)

F = 1/SQRT((R-2100)/1277500 + 0.008)
for transition flow (2100 < R <= 4555)

F = -4 Log(K/(3.7D)+1.25(F/R))
for turbulent flow (R > 4555)

MIT Equation:

F = SQRT(R)/4 for laminar flow (R <= 2100)

$F = 1/(.0018 + .159 / (R)^{0.355})^{0.5}$
for turbulent flow (R > 2100)

Several other pressure drop formulas are discussed below. These do not use a friction factor or transmission factor. They either use an experience factor or some modified form of calculating pressure drop from the flow rate.

Miller Equation:

BConst1 = .1692
BConst2 = 4.35
BConst3 = (Q / 24) * (Q / 24) * S / (BConst1 * BConst1 * D^5)
BConst4 = $(Dia^3 * SG) / (Vis* SG)^2$
BConst5 = .4343
Pm = BConst3 / (BConst5 * Log(BConst4 * Pm) + $BConst2)^2$

Hazen-William Equation:
This pressure drop equation is widely used in the water industry as well as in calculating pressure drop in pipelines transporting products such as gasoline and diesel. This equation uses a C factor to calculate the flow rate in bbl/day from a given pressure drop Pm in psi/mi as follows:

$$Q = 0.1482\ (Cfact)(D)^{2.63}(Pm/Sg)^{0.54}$$

The C factor is usually a number between 100 and 200, based on experience with different products. Typical values in the range 120 to 160 are used for petroleum products.

In the absence of data, the C factor may be approximated by the following viscosity related equation:

$$Cfact = 146.59 / (V)^{0.08}$$

T. R. Aude Equation:
This pressure drop equation is used by some petroleum companies to calculate pressure drop in pipelines transporting products such as gasoline and diesel. This equation uses an efficiency factor Kfact to calculate the pressure drop Pm in psi/mi from a given flow rate in bbl/hr as follows:

$$Pm = ((BBL/HR * z^{0.104} * S^{0.448})/(0.871 * Kfact * D^{2.656}))^{1.812}$$

The value of the Kfact usually ranges from 0.92 to 0.98, and is based on experience with various products.

Symbols

API		API gravity.
S,Sg		Specific gravity.
V,cSt		Vicosity in centistokes.
SSU		Viscosity in Saybolt Universal Seconds.
SSF		Viscosity in Seconds Furol.
Q		Pipeline flow rate, gal/min .
B		Pipeline flow rate, bbl/day
Cfact		C factor used in Hazen-Williams equation.
D		Inside diameter of pipe, inches.
Z,Vis		Viscosity of liquid at flowing temperature, centipoise (cp)
Vel		Velocity, ft/sec
R		Reynold's number, dimensionless.
K		Absolute roughness of pipe, inches. (use 0.0018 inch for new steel pipe).
Kfact		K factor or efficiency factor used in T.R. Aude equation. A value such as 0.94 may be used.
f		Moody or Darcy friction factor, dimensionless.
F		Transmission factor, dimensionless.
Pm		Pressure drop due to friction, psi/mile.
Pdel	-	Pipe delivery pressure, psi.
Eff	-	Pump efficiency, percent.
SQRT	-	Stands for square root.

Bibliography

1. The Properties of Petroleum Fluids, William D. McCain, Jr., Petroleum Publishing Company, Tulsa, Oklahoma, 1973.

2. Crane Publication 410- Flow of Fluids through Valves, Fittings and Pipe, Crane Company, 1980.

Troubleshooting

QPCalc is a powerful software for calculating pressure drop of liquids. Despite the complexity of the program it is very user friendly. Online HELP is available and the program has extensive error checking features. However, there is always a possibility that some extraneous or invalid data was entered and the program may hang up. In such cases, try quitting the program by using the **File/Exit** menu item or click on the **Exit** icon on the toolbar. If this does not work, you have no choice but to perform a shut down using the Windows Task Manager.

If you cannot get **QPCalc** to run properly even after following the steps outlined in the Getting *Started* section of this manual, please check the following *before* you call Technical Support. Have your program disk serial number and program version number handy to facilitate quick response.

Error Messages:

Following are some errors that you may encounter while running **QPCalc**:

1. **Divide by zero error**
   This is generally due to some data input value that is zero. Check all input data for zero values.

2. **Illegal Function call**
   This is generally due to some illegal mathematical operation such as trying to extract the square root of a negative value. Ensure that there are no inadmissible negative values, such as a negative value for viscosity or specific gravity.

3. **File not found**
   A common error when a file specified cannot be located on the hard disk or does not exist. When trying to open a file, make sure the file is present in the sub-directory or folder containing QPCalc. Otherwise, ensure that the file name is typed in correctly, including the full path.

If the above problems persist or you cannot successfully install the software on your hard disk, contact Technical Support.

Technical Support

Please read the Troubleshooting section of this manual before you call us for technical support.

In order to facilitate quick response, please have your disk serial number and program version available when you call us.

How to contact us:

You may contact SYSTEK in any of the following ways:

Phone/Fax: (928) 453-9587

E-mail: techsupport@systek.us

Web site: www.systek.us

Mail: SYSTEK Technologies Inc.
3900 Chickasaw Dr
Lake Havasu City, AZ 86406
USA

Free Technical Support is provided for registered users of this software for a period of sixty (60) days from the initial purchase date. After that period, Technical Support can be provided only if an annual Software Maintenance and Technical Support plan has been purchased. Call or write for details.

If you did not purchase this software directly from SYSTEK, you must fill out the Software Registration Form to receive the free 60 day Technical Support and future program update information.

Sample Output

Sample Problem-1

A 16-inch pipeline(0.250” wall thickness), 3480 feet long with several valves and fittings and a meter with a 10 psi pressure drop is modeled below for a flow rate of 3,000 gal/min. In addition to the main 16-inch pipe segment, there is a 520 feet segment of 14-inch pipe included. The liquid specific gravity and viscosity are 0.85 and 10.0 centistokes, respectively. It is required to calculate the delivery pressure at the end of the piping system, with an inlet pressure of 1400 psig. Assume 0.002” for pipe roughness and Colebrook-White equation for pressure drop and 150 ft elevation increase from inlet to outlet. The valves and fittings are as follows:
One Swing-Check Valve - 16” dia.
One Ball Valve - 16” dia.
One ELBOW-LR 16” dia.
One Pipe Bend R/D = 1 10.75” dia. – 10 psig pressure drop

Calculated Results:

```
Project:                Sample Problem-1
Pipe data file:         C:\QPCalc-Liquids\Qcalc001.dat
Pipe outside diameter:  16.0000 (in)
Wall thickness:         0.2500 (in)
Pipe roughness:         0.0020 (in)
Pipe Length:            3480.0000 (ft)
Upstream elevation:     100.0000 (ft)
Downstream elevation:   250.0000 (ft)

Valve  pressure drops considered:
Check-Swing Valve  Dia = 16 (in)  Equiv. length  = 133.33(ft)
Ball Valve  Dia = 16 (in)  Equiv. length  = 4(ft)

Fittings pressure drops considered:
ELBOW-LR  Dia = 16 (in)  Equiv. length  = 16(ft)
 PIPE BEND R/D = 1  Dia = 10.75 (in) Pressure drop = 10 (psi)

Custom device pressure drops considered:
Meter  Dia = 10.75 (in) Pressure drop = 10 (psi)
PIPE  Dia = 14 (in) Length  = 520 (ft)

Total Equivalent Pipe Length in terms of  16 (in) pipe: 4647.1552 (ft)

Liquid gravity:         0.8500
Liquid viscosity:       10.0000 (CST)
Flow rate:              3,000.00 (gal/min)
Velocity:               5.0947 (ft/sec)
Reynold's number:       61,209.95
Pressure drop formula:  Colebrooke-White Equation
Friction factor:        0.0210
Pressure drop:          2.4178 psi/thousand ft
Pressure in:            1,400.00 (psi)
Pressure out:           1,313.57 (psi)
HP required at inlet:   3,266.64
```

Sample Problem-2

A plant piping consists of pipes and fittings, connected together with gate valves. The piping system starts with a 200 mm dia pipe, 6 mm wall thickness, 450 meters long, connected to a 200 mm Gate Valve and two 90-degree short radius elbows. This is followed by a 300 meter length of 275 mm dia pipe, 8 mm wall thickness and two gate valves of 275 mm nominal size. At a flow rate of 100 m^3/hr and inlet pressure of 500 kPa, calculate the total pressure drop in the piping system. Use Hazen Williams formula for pressure drop with C factor = 110. For liquid properties, use Specific gravity= 0.74 and viscosity = 0.65 centistokes. Assume no elevation difference.

Calculated Results:

```
Project:                Sample Problem -2
Pipe data file:         C:\QPCalc-Liquids\QCalc0015.DAT
Pipe outside diameter:  200.0000 (mm)
Wall thickness:         6.0000 (mm)
Pipe roughness:         0.0500 (mm)
Pipe Length:            450.0000 (m)
Upstream elevation:     100.0000 (m)
Downstream elevation:   100.0000 (m)

Valve  pressure drops considered:
Gate Valve  Dia = 200 (mm)  Equiv. length  = 1.6(m)
Gate Valve  Dia = 275 (mm)  Equiv. length  = 2.2(m)
Gate Valve  Dia = 275 (mm)  Equiv. length  = 2.2(m)

Fittings pressure drops considered:
ELBOW-90 DEG  Dia = 200 (mm)  Equiv. length  = 6.(m)
ELBOW-90 DEG  Dia = 200 (mm)  Equiv. length  = 6.(m)

Custom device pressure drops considered:
PIPE  Dia = 275 (mm) Length  = 300 (m)

Total Equivalent Pipe Length in terms of 200 (mm) pipe: 525.61 (m)

Liquid gravity:         0.7400
Liquid viscosity:       0.6500 (CST)
Flow rate:              100.00 (m3/hr)
Velocity:               0.9994 (m/sec)
Reynold's number:       289,421.66
Pressure drop formula:  Hazen-Williams Equation
C-factor:               110.0000
Pressure drop:          0.0574 (kPa/m)
Pressure in:            500.00 (kPa)
Pressure out:           469.84 (kPa)
HP required at inlet:   24.83
```

SOFTWARE REGISTRATION

Please complete and return this sheet *today* in order to be eligible for customer support, new product information and special offers on program upgrades.

PLEASE PRINT

Name: _____

Company:_____

Address:_____

_____

City: _____ State:_____ Zip: _____ Country:_____

Phone: ( )_____ Fax : ( )_____

Email address: _____

I have read the accompanying License Agreement and Limited Warranty, understand it and agree to be bound by its terms and conditions as expressed therein.

Signature: _____ Date: _____

Product name: **QPCalc** for Liquids Version:_____

Disk Serial number:_____

COMMENTS:_____

_____

_____

Thank you!

Fax this to SYSTEK at: (928) 453 - 9587