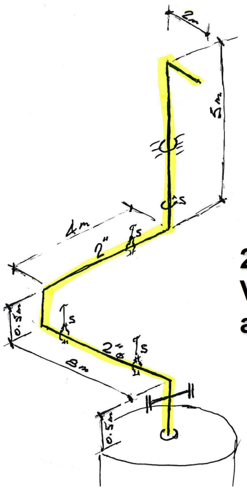
The 60 Second Guide to VisualPiper

This short guide will show you how to use VisualPiper to calculate pressure drops and flow rates for a two-phase mixture in an unbranched pipe.

Within 60 seconds from now you will have learned how to use VisualPiper to find out if the system below could cope with a required relief rate of 4 kg/s.



2" Schedule 40 pipe, roughness 0.05mm
Vessel contains water/ethanol (50/50 by mass)
at 3 barg and 120 C, relieving to atmosphere.

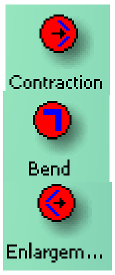
Okay now we are ready to start VisualPiper

1. Click on **Start** | **Programs** | **PEL** | **VisualPiper**. Click Enable Macros and the VisualPiper splash screen appears briefly on the screen.

   First we shall load a sketch to help us draw the pipe model.

2. On the menu bar, click on **VisualPiper** | **Load CAD Drawing**, and browse for the file **C:\Program Files\PEL\Examples\VisualPiper\VisualPiper.jpg**. (n.b. you may have installed PEL to a different folder).

   Now we need to draw the pipe.



3. Click on the **Contraction** in the Shapes window, and drag and drop it on to the sketch at the exit of the vessel at the bottom of the pipe.

4. Click on the **Bend** in the Shapes window, and drag and drop it on to the sketch at the first bend.

   A straight section should have been created joining the contraction to this bend.

   Repeat this step for each bend in the sketch.
   Finally click on the **Enlargement** in the Shapes window, and drag and drop it on to the sketch at the end of the pipe.

   Now we need to specify the pipe data.

5. Click on the **Edit Pipe** button. In the first row, specify a nominal value of 1000mm for the **Diameter In** for the contraction from the vessel to the pipe. Right-click in the **Diameter Out** cell and select **Pipe Inner Diameter Calculator**. In the new form select 2" schedule 40, click OK and see the diameter of 52.5mm propagate through the pipe fittings. Right-click in the **Roughness Out** cell and select **Roughness Calculator**. In the new form select 'Mild Steel (slightly corroded)' and click the OK button to return a value of 0.05mm. Right-click in the **Roughness Out** cell again and select **Copy**. Select all of the cells in the **Roughness In** column, right-click and select **Paste**.
   For the final **Enlargement** fitting, specify a **Roughness Out** of 0.05 mm and a **Diameter Out** of 1000 mm.
   For each bend, specify a **Bend Radius** of 52.5mm.
   Click OK.

6. In the drawing, double-click on each straight section in turn and on the **Edit Straight** form, specify the lengths as indicated on the drawing (0.5m, 8m, 0.5m, 4m, 5m, 2m) , and for the vertical sections specify the **Angle to Horizontal** as 90 deg.

pel software

Let's specify the type of calculation. We want to calculate the flow given the inlet and exit pressures.

7. Click on the **Conditions** button.
   Click the **Inlet & exit pressure** radio button.
   Click on the Flowrate (estimate 1) box and enter **1 kg/s**.
   Click on Inlet Pressure and type in **3 barg**, and click on System Back Pressure and type in **1 atm**.
   In each case, remember to include the space and VisualPiper will automatically convert to the correct units.

   Now we need to specify the Inlet Conditions.

8. Click the **Inlet Temperature** radio button and then type in **120 C** for the temperature.
   Click OK.

   *Next, we need to define the **physical properties**.*

9. Click on the **Physical Properties** button. First we need to select the components. Click on **Add Component** and type **W** in the **Search For Name** box. Four components are found beginning with the letter W. Click on **Water** and then click on **Add to Stream**. Next, delete **W** from the Search box and type in **ETHANOL** and press the Enter key to add **Ethanol** to the stream. Click **Close**.

   *Notice that if you click on the VLE tab, VisualPiper automatically switched the VLE Method to select **Ideal Gas/NRTL**. This is because mixture of water and ethanol is highly non-ideal and contains an azeotrope so the VLE method must be capable of correctly representing this non-ideality. This model will treat the vapour phase as an Ideal Gas but will use NRTL to model the non-ideality in the liquid phase.*

   *For more information on selecting the best VLE Methods click **Start** | **Programs** | **PEL** | **Documentation** | **Reference Guides**| **Physical Properties** | and then select **Phase Equilibrium Models**.*

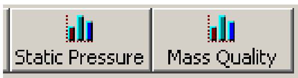
   *The last thing we need to do for the physical properties is to specify the composition. You can use the spreadsheet on the **Feeds** tab to specify the stream composition, both in terms of moles or mass, and as quantities or fractions.*

10. Click on the spreadsheet to give it "focus". Enter **0.5** in the **Mass Fraction** boxes for **both** Ethanol and Water. Piper updates the spreadsheet. If you wish, Piper will also normalise the values if they do not add up to 1. Click OK.

    That's it for the input. Now we're ready to run the calculations

11. Click the **Calculate** button on the toolbar. The word *Calculating. Please wait…* will appear in the window. When the calculations are complete, the results appear.

12. You will see that the calculated flowrate is **4.125 kg/s** so the system would cope with the required relief rate. You will also see that the flow is choked, and that this is the maximum non-choking flow. There are two phases at the outlet. The graphs and tables allow you to understand the results more clearly:



And that's it! How's the time doing? Did you beat the clock? If you still have time, try changing the pipe diameter to 3" Schedule 40 to see what effect this has on the relief rate.

This program is developed, maintained and supported by PEL Support Services, ABB. We run a Hotline telephone and email service to answer any queries about the PEL products. You can contact us:

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