An efficient and simple way to calculate the pressure loss in a piping system is the "Equivalent Pipe Length Method". 1. Make a Diagram of the Piping System Make a diagram where the system is structured with nodes as shown below. In the very simply circulating system used in this example the first node (0) is the pump. The next node is the tees (2) where the piping system splits up. The other nodes are the heating radiators. In many systems the structure can be simplified as above since the piping in both directions are of same size. If a more fine grained approach is required, additional nodes can be added in both directions as shown below. 2. Make a calculation table With the most simplified nodes structure above a calculation table can be made as shown below. Each section from node to node is calculated by supplying length, volume flow, pipe size, pressure loss from diagrams or tables for the actual pipes and components in the sections and their individual equivalent length substituting the the minor loss. Resistance and Equivalent Length of Fittings An excel template with the table above can be downloaded here: Equivalent Pipe Length Method - Excel Template Note! The flow and pressure units must be adjusted to the data available for your piping system. 3. Add Volume flow, Pipe Size and Pressure Loss for each Section Add actual pipe size and in each section. Use tabulated data or a diagrams. The pressure loss may alternatively be calculated with the Hazen-Williams Equation or the Darcy-Weisbach Formula. Pressure loss for many types of pipes can be found here. 4. Add Equivalent Length of all Valves, Fittings and Straight Pipes Add the equivalent length of all valves, components, fittings and straight pipes in the sections. 5. Summarize the Pressure Loss in each Section Calculate and summarize the pressure loss in each section. 6. Summarize the Pressure Loss in all Paths Finally, add up the pressure loss in all sections that form unique paths. In the example above there are two unique paths - one is section 0 - 2 - 3, the other is section 0 - 2 - 4. Add extra columns for additional paths in more complicated systems. The highest pressure loss determines the pump head. 7. Add Balancing Valves Add valves where it is necessary to balance the system. In the example above a balancing valve is added in section 2-4. Note! The Equivalent Pipe Length Method can be adapted to most piping systems - like water supply systems, gravity heating systems and similar. Copper tube fittings and equivalent lengths - in feets of straight tube. The Darcy-Weisbach equation can be used to calculate the major pressure and head loss due to friction in ducts, pipes or tubes. The equal friction method for sizing air ducts is easy and straightforward to use. Rectangular equivalent diameter for air flows between 100 - 50000 cfm. Convert rectangular and oval duct geometry to a equivalent circular diameter - online calculator with imperial and SI-units. Friction head loss (ftH2O per 100 ft pipe) in water pipes can be estimated with the empirical Hazen-Williams equation. Free online design tool for designing hot water heating systems - metric units. Online design tool for hot water heating systems. Equivalent length of fittings like bends, returns, tees and valves in hot water heating systems - equivalent length in feet and meter. Minor loss coefficients for components used in pipe and tube systems. Pipe is supplied and refered to as single random, double random or cut lengths Minor loss in PVC and CPVC fittings expressed as equivalent length of straight pipe. Water flow in thermoplastic PVC and CPVC pipes Schedule 80 - friction loss (ft/100 ft, psi/100 ft) and flow velocities at dimensions ranging 1/2 to 16 inches. Pipe fittings including tees, elbows, bends, couplings, and valves contribute a substantial amount of pressure loss in a piping system. Hence, it is important to take them into account during the design process in order to properly size the motors and pumps needed to transport the process fluid within the system. One way to estimate this pressure loss is by obtaining the Equivalent Length of Pipe Fittings. By definition, the equivalent length of a fitting is the length of a similarly-sized straight pipe that would yield the same pressure drop at the same flow rate. In doing piping calculations, the equivalent lengths of all components are added to the total pipe length before using the Hazen-Williams Equation or the Darcy-Weisbach Formula to calculate the total pressure loss. Before learning how to calculate the equivalent length of pipe fittings, it is important to understand the different types of pressure losses in a piping system. As fluid flows within a piping system, it incurs pressure losses caused by flow resistance along the network of pipes, fittings, and valves. These losses are categorized into two types: major losses and minor losses. Advance in Excel with engineering-focused training that equips you with the skills to streamline projects and accelerate your career. Major losses refer to pressure losses incurred along straight pipes caused by both the internal friction within the fluid (i.e., its viscosity) and the friction between the fluid and the pipe wall. On the other hand, minor losses refer to the additional losses incurred across components like fittings and valves, usually induced by curvature or recirculation. Hence, obtaining the equivalent length of pipe fittings is like converting minor losses into an equivalent major loss. The minor loss of a fitting can be calculated using the formula: Where: ξ = minor loss coefficient of the fitting [unitless] ρ_f = fluid density [kg/m3] v = fluid velocity [m/s] On the other hand, the major loss can be calculated using the formula: Where: f_d = Darcy friction factor of the fluid flow inside the pipe connected to the fitting [unitless] l = length of pipe [m] d_h = hydraulic diameter [m] Equating the two losses, the formula for the equivalent length of a pipe fitting results to the following equation: The minor loss coefficient is a dimensionless value normally obtained based on experiments, while the friction factor can be estimated using the Moody Diagram or the Colebrook equation. ASHRAE, or the American Society of Heating, Refrigerating and Air-Conditioning Engineers, publishes a table of minor loss coefficients for common fittings. Based on the ASHRAE Fundamentals Handbook, the minor loss coefficients of some of the most common fittings are listed below. It should be noted that the minor loss is predominantly affected by the fitting’s geometry and its impact on the fluid movement. The material used for the fitting as well as the fluid properties only has little effect on the pressure drop. Therefore, a plastic tee will almost have the same pressure drop as a steel tee with the same geometry. However, since the major loss is strongly affected by the friction factor, the equivalent length will also be affected by the roughness of the pipe the fitting is connected with. For example, a 100-mm flanged regular 90-degree elbow with a minor loss coefficient of 0.3 and connected to a steel pipe with a friction factor of 0.03 will have an equivalent length equal to 1 meter, as shown in the calculations below. Using the formula above for each and every fitting can be tedious, especially since most piping networks use a lot of fittings. Hence, the estimated equivalent lengths of the most common fittings have already been tabulated below for easy reference. Even though factors like pipe roughness and fluid properties are likely to be different from the conditions under which these data have been obtained, it was found that changes in these parameters result in minuscule variations in the Equivalent Length / Diameter ratio. It means that the le/dh ratio is virtually constant for a specific type of fitting, making it possible to have this kind of table. It should be noted, however, that using these tabulated values in pressure loss calculations can result in up to a 30% error for turbulent flow and up to 50% error for laminar flow. These are fine in doing most preliminary calculations. However, using other methods like the 3K method is more appropriate to obtain accurate results. The table below shows the equivalent lengths of common valves and fittings, expressed as a ratio of the length to the diameter, or le/dh. It is important to note that the tabulated values below are le/dh ratios. Some publications specify the actual equivalent lengths of pipe fittings instead of these ratios. Follow us on Twitter Question, remark ? Contact us at contact@myengineeringtools.com 1. Introduction 2. Equivalent length common valves - globe valve, ball valve, seat valve... 3. Equivalent length of common fittings - elbows, tee, reduction, enlargement... 1. Definition : pressure drop of piping elements When calculating the pressure drop in a pipe, the pressure drop due to singularities, typically valves and fittings, can be calculated thanks to a pressure drop coefficient. However, another method consists in considering that the fitting is equivalent in terms of pressure drop, to a certain longer of straight pipe. This length is called "equivalent length". This page is giving the equivalent length of some common fittings and valves, it can be especially useful for shortcut calculation during preliminary studies or troubleshooting. For pressure drop calculations, you can also revert to the following pages : The following tables are detailing the equivalent length that can be used to calculate the pressure drop for the following type of valves : Globe valve Ball check valve Angle valve Swing check valve Plug valve Gate or ball valve The 1st table gives the equivalent length in ft (US units) The next table gives the equivalent length in m (SI units)   The equivalent length of common fittings found in piping is given for : 45° elbows Short radius 90° elbows Long radius 90° elbows Tees Bends Enlargement Contractions The data are given in ft or in m. Pipe fittings including tees, elbows, bends, couplings, and valves contribute a substantial amount of pressure loss in a piping system. 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These losses are categorized into two types: major losses and minor losses. Advance in Excel with engineering-focused training that equips you with the skills to streamline projects and accelerate your career. Major losses refer to pressure losses incurred along straight pipes caused by both the internal friction within the fluid (i.e., its viscosity) and the friction between the fluid and the pipe wall. On the other hand, minor losses refer to the additional losses incurred across components like fittings and valves, usually induced by curvature or recirculation. Hence, obtaining the equivalent length of pipe fittings is like converting minor losses into an equivalent major loss. 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It is important to note that the tabulated values below are le/dh ratios. Some publications specify the actual equivalent lengths of pipe fittings instead of these ratios. At left side is a pipe equivalent calculator developed by OilGas Engineers. Below is the steps to calculate a piping system equivalent length: Select a nominal pipe size, NPS.Fill in straight pipe length in feet.Fill the number of valves, fittings in the piping system. Scroll to the end of the page where you can find the total equivalent length of the piping system in feet. Note: Different fitting has different suitable NPS diameter range for using this calculator. Please DO NOT use the calculator if a fitting’s diameter is outside the shown NPS range in the calculator. The pipe Expander and Reducer equivalent length is in terms of small diameter. For pipe with sections in different size, each section need to be calculated separated. 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