

System Resistance Curve in PIPE-FLO

System Resistance Curve Overview

The System Resistance Curve (SRC) is a graph of the head loss of a piping system as a function of flow rate and gives a visual representation of the energy addition and losses of the overall system when plotted on the pump curve. The SRC is a **single curve** that represents the resistance curves of all the pipes, valves, fittings, and other devices, as well as the amount of static head in the system.

The SRC is an accurate representation for **single path open systems** or **single loop closed systems**, however, for **multi-path branched systems** and **multi-loop closed systems**, there is **no single curve** that can be drawn that represents the entire system.

Several things are done in PIPE-FLO to generate the SRC, and users should be aware of the process to understand what the curve represents. The SRC is viewed from the pump's perspective by determining the total head the pump must produce as flow is varied from zero to the maximum flow rate on the pump curve.

System Resistance Curves in PIPE-FLO version 12 and Above

The SRC can only be generated by selecting a **Centrifugal Pump** with curve data using the Right Click menu. The SRC is graphed on the pump curve generated from the PUMP-FLO engine.

Several changes were implemented in version 12 that differ from version 2009 that may result in differences between the two curves. All flow rate devices are **removed** from the system and **turned into nodes** in order to avoid the Over Controlled error and allow calculations to occur. These include:

- all flow demands (no change from v2009)
- all sizing valves set to FCV, BPV, PRV, or fully open (no change from v2009)
- all designed control valves set to FCV, BPV, or PRV (change from v2009)
- all sizing pumps (change from v2009)
- all centrifugal pumps (except the selected pump) set to Variable Speed (change from v2009)

The changes to the treatment of control valve have the following implications:

- In v2009, control valves with data were set to fully open regardless of their operating mode, so the resistance based on the flow coefficient at 100% position was included in the SRC.
- By turning them into nodes in v12, the valve adds no resistance to the system. This results in a separation between the pump curve and the SRC at the operating point as shown in Figure 1, so in this case the SRC represents the **baseline resistance** of the system. The difference between the SRC and pump curve is the amount of head loss that would have to occur at the control valves in order to obtain the operating point flow rate.
- To eliminate the separation between the pump curve and SRC as shown in Figure 2, the user can set all of the Control Valves to 100% open before creating the SRC. This can be easily accomplished through a group edit of the valves. This also gives the user the ability to set the valves to other positions and have that resistance represented in the SRC.

The changes to the treatment of pumps have the following implications:

- In v2009, all centrifugal pumps (regardless of the operating mode) except the selected pump were automatically isolated before the SRC was generated. In v12, other centrifugal pumps are not automatically isolated. This may result in an inaccurate curve as shown in Figure 3.
- The user will have to isolate the pumps themselves if they have more than one active pump in the system. If the other pumps are set to a flow rate (Sizing Pump and Centrifugal Pumps set to Variable Speed), they are automatically removed from the system and turned into nodes.

System Resistance Curves in PIPE-FLO version 2009 and Prior

In version 2009 and before, the SRC is generated by first setting all controls to fully open and all flow demands to zero. All pumps except the selected pump are automatically isolated and then the flow varied through the selected pump and the total head at each flow rate calculated to develop the SRC.

The SRC can be generated by selecting a centrifugal pump with curve data and selecting "Resistance Curve..." from the System Menu. The curve is graphed along with the pump curve.

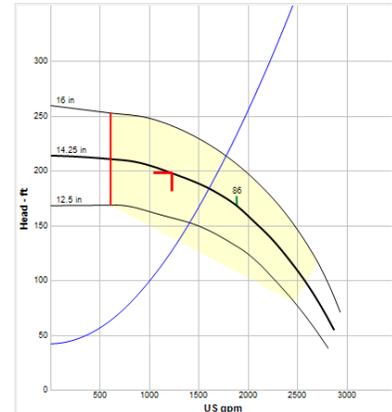


Figure 1. Separation caused by control valves not set to a position. Resistance of the control valves are not included in the SRC and the separation is the head loss expected to occur at the control valves. SRC is a baseline reference curve.

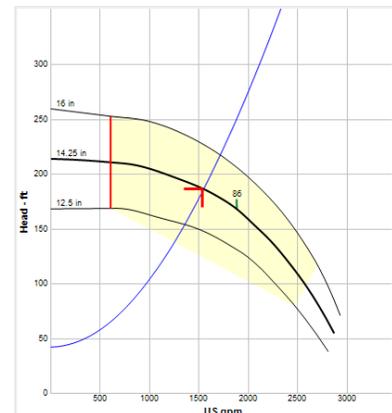


Figure 2. SRC with control valves set to a percent open. Resistance of the control valves are included in the SRC.

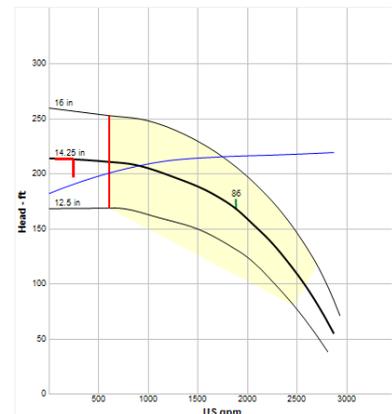


Figure 3. Incorrect SRC with parallel pumps not isolated.

