

# Technical Information

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## SEQUENCING CONTROL VALVES

When the rangeability requirements rule out a valve that would otherwise be suitable for the application, it may be feasible to use two control valves arranged for sequential action. The valves are installed in parallel so that their individual flow rates are additive. Careful selection of each valve size is required to achieve the necessary rangeability. Total valve rangeability will be the ratio of the minimum controllable  $C_v$  of the smaller valve to the combined maximum  $C_v$ 's of both valves. The maximum  $C_v$  of the smaller valve must be at least equal to the minimum controllable  $C_v$  of the larger valve.

The large valve should not be so much larger than the small valve that its leakage rate affects the total flow rate more than the small valve does. Thus, with a balanced or double seated globe valve having a leakage capacity of 1/2 percent of maximum  $C_v$ , the best possible rangeability using sequenced parallel valves would be 200:1, independent of the minimum controllable  $C_v$  of the smaller valve. A single seated globe valve or a tight shutoff ball, butterfly or Saunders diaphragm type control valve would remove this consideration.

It is usually advisable, however, to keep the two valves as close in size as possible while still obtaining the required rangeability. For example, two 3-inch balanced equal percentage globe valves with diaphragm actuators and split-range positioners would be able to pass as much flow as one 4-inch and one 1 1/2-inch balanced equal percentage globe valves. Total rangeability of the two 3-inch valves would be 100:1 as opposed to 200:1 for the 4-inch and 1 1/2-inch valves, limited by the 4-inch leakage capacity. A slightly lower cost would result with the two 3-inch valves, along with a much simpler and less expensive manifold arrangement.

Saunders diaphragm type control valves often require sequenced parallel valves to satisfy rangeability requirements. It is usually not possible to use two valves of equal size, but this does not cause a control problem since they are tight shutoff valves. As with any valve type, of course, the greatest rangeability theoretically possible with two valves is the square of the rangeability of one valve. Thus the absolute maximum rangeability of two Saunders diaphragm type control valves is 15<sup>2</sup> or 225:1. In practice, the maximum rangeability would be in the order of 125:1 due to the problem of matching the valve sizes.

**Example:** Given a required maximum  $C_v$  of 180, and a required minimum  $C_v$  of 3 in an application where Saunders diaphragm type control valves are desired, determine the proper size selections required. Glass lined Model V2000 Saunders diaphragm valves are to be used.

For good control, the combined maximum  $C_v$  values of the two valves should be approximately 250. A 2 1/2-inch and 2-inch size combined will deliver a  $C_v$  of 253. The minimum  $C_v$  of the 2-inch is approximately 6, which would not satisfy the application, and rules out the 2 1/2-inch and 2-inch combination. A 3-inch and 1-inch size combined will deliver a  $C_v$  of 257. The minimum  $C_v$  of the 1 inch is approximately 1.5, which is satisfactory. The maximum  $C_v$  of the 1-inch is 22, and exceeds the minimum  $C_v$  of the 3 inch which is 16. This combination in parallel, operating sequentially from a 3-9/9-15 psi control signal will cover a  $C_v$  range of 1.5 to 257, which satisfies the application.