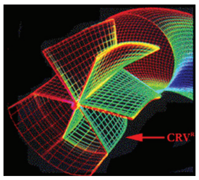
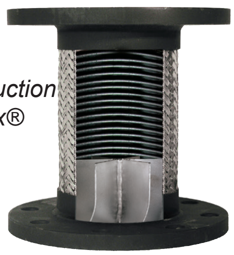
# Suction Diffuser Flex Operating Principles

Flow through a plain elbow is illustrated in Figure 1(a)-left. As a result of the forces acting on the fluid as it passes through the elbow, two flow separation regions result where a void




or vapor space is created. Because of the existence of these flow separation regions, the remaining pipe cross-sectional area through which the fluid must pass is significantly reduced, as shown in Figure 1(b)-left, and the local velocity is increased and directed towards the outer wall of the elbow. This high velocity region is one of the reasons why elbows exhibit high pressure drop as compared to a straight pipe. Measured velocity profiles of the fluid downstream of a plain elbow at six locations are shown in Figure 1(c)-left. As expected for a plain elbow, Figure 3 (c)-left shows that there is a high velocity region in the straight section of pipe along the outside of the elbow, and a low velocity/backflow region in the straight section of pipe along the inside of the elbow.



*Metraflex Suction Diffuser Flex® cutaway.*

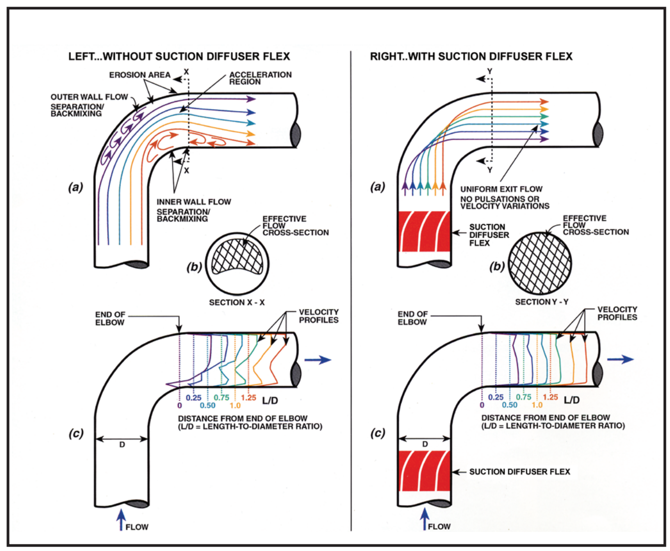



*FIGURE 1: In a plain elbow (left), a skewed velocity profile results. With the Suction Diffuser Flex® rotation vane in front of the elbow (right), there is a flat velocity profile.*

When the Suction Diffuser Flex Rotation-Vane is placed immediately upstream of an elbow, it rotates the flow entering the elbow. As a consequence, the fluid negotiates the turn with all the streamlines traveling approximately the same distance (equal flow path lengths) from entrance to exit, as illustrated in Figure 1(a)-right, and the flow separation regions are eliminated. The entire pipe cross-sectional area is available for fluid flow as shown | in Figure 1(b)-right. For this reason, the total pressure drop of a Suction Diffuser Flex-plus-elbow-combination is 25% to 50% less than that of a plain elbow without a Suction Diffuser Flex. In Figure 1(c)-right, the measured velocity profile with a Suction Diffuser Flex becomes relatively flat at the elbow exit and almost perfectly flat at a downstream position of L/D (length-to-diameter ratio) =1.25.

## Suction Diffuser Flex Operating Principles (continued)

Flow separation and the rotational effect of the Suction Diffuser Flex Rotation-Vane are also shown in Figures 2(a) and 2(b) where the use of different colored dyes trace the flow streamlines in a transparent 6-inch diameter short radius elbow carrying water. In Figure 2(a), the dyes follow the elbow flow streamlines, and the inner and outer flow separation regions can be seen along with exit turbulence. In Figure 2(b) where the dyes are injected at the end of the Suction Diffuser Flex (beginning of elbow), the dye streamlines rotate 180-degrees, as does the fluid itself, producing equal fluid flow path lengths around the elbow. The rotation virtually terminates at the elbow exit. The blade angle of a Suction Diffuser Flex is uniquely designed to match each elbow geometry and flow path length. Examples are short and long radius 45° and 90° elbows, U-bends, miters, tee's, Y's, or other fittings.

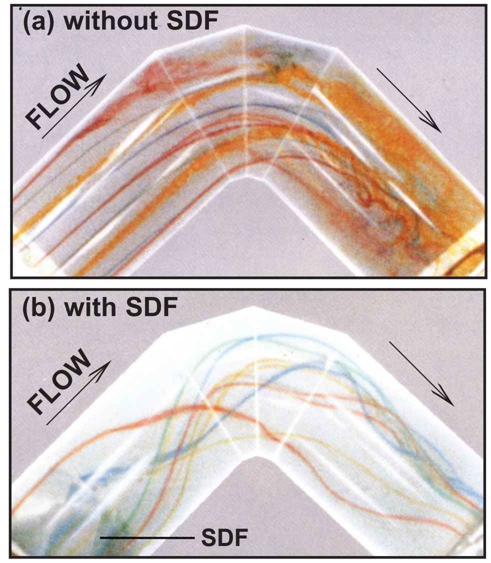



Figure 2 - When water flows through an elbow (a), flow becomes turbulent. WWith a Suction Diffuser Flex® upstream of the elbow, the flluid negotiates the turn (b) with all streamlines traveling equal flow paths.

Using computational fluid dynamics modeling, one can simulate, in Figure 3, the laboratory-measured velocity profiles of Figures 1(c). The plain elbow velocity profile is shown in Figure 3(a)-left and illustrates the high velocity along the outer wall of the elbow and the low/backflow velocity along the inner wall of the elbow. Figure 3(b)-left shows the velocity profile of the cross-sectional area at the end of the simulation. Figures 3(a)-right and 3(b)-right show the same simulation with a Suction Diffuser Flex located directly in front of the elbow. Note the dramatic flattening of the velocity profile and the resultant elimination of flow separation/backflow regions.

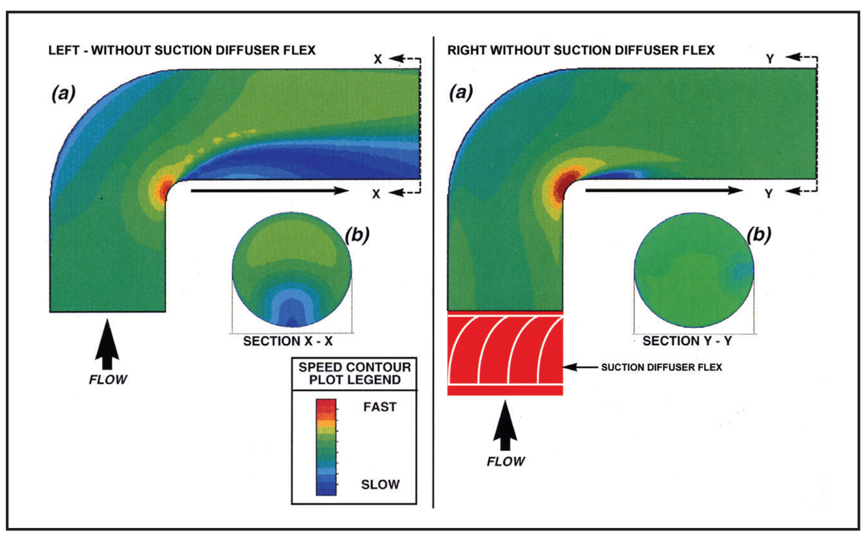



FIGURE 3 - Computational fluid dynamics modeling illustrates elbow flow dynamics without (left) and with a Suction Diffuser Flex® (right).