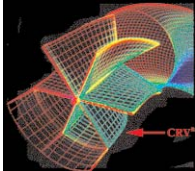


## CRV Flex and Pump Applications

Since all centrifugal pumps require well-developed inlet flow to meet their potential, a pump may not perform or be as reliable as expected due to a faulty suction piping layout such as a close-coupled elbow on the inlet flange.



When poorly developed flow enters the pump impeller, it strikes the vanes and is unable to follow the impeller passage. The liquid then separates from the vanes causing mechanical problems due to cavitation\* and vibration, and performance problems due to turbulence and

poor filling of the impeller. This results in premature seal, bearing and impeller failure, high maintenance costs, high power consumption, and less-than-specified head and/or flow.

Metraflex CRV®  
Flex cutaway.



In many instances, pump purchasers buy the least expensive pump that will deliver the specified flow and head within the NPSH available.

Such a pump with high suction specific speed operating at 3,600 rpm or greater requires a well developed, uniform flow pattern at a narrow flow rate range since the impeller inlet eye and vanes are optimized to not create turbulence at design flow. This pump design feature is very susceptible to non-uniform inlet flow because when liquid velocity varies and does not meet the pump design assumption of a uniform velocity striking the impeller eye, flow separation results which causes cavitation and associated problems.

To have a well-developed flow pattern, pump manufacturers' manuals recommend about 10 diameters of straight pipe run upstream of the pump inlet flange. Unfortunately, piping designers and plant personnel must contend with space and equipment layout constraints and usually cannot comply with this recommendation. Instead, it is common to use an elbow close-coupled to the pump suction which creates a poorly developed flow pattern at the pump suction.

### CAVITATION

*Cavitation is the formation and subsequent collapse of vapor bubbles in liquid. Bubbles or cavities of vapor are formed in the liquid when static pressure drops below vapor pressure. The process is completed when static pressure rises rapidly above vapor pressure causing bubbles to abruptly implode. This results in pressure shocks and fluid turbulence which causes cavitation noise, mechanical vibration and if it occurs near a pump surface, may result in equipment damage. Elbows close coupled to pumps cause cavitation in two ways.*

*First, as liquid passes through an elbow in front of a pump, it experiences a drop in pressure on the inside of the elbow and vapor bubbles are formed which are carried into the impeller and collapse on the high pressure side causing tremendous vibration and fatigue damage.*

*Second, any flow velocity non-uniformity causes local fluid acceleration at the impeller vanes which generates cavitation bubbles.*

## Pump Applications (continued)

With a double-suction pump tied to a close-coupled elbow, flow distribution to the impeller is poor and causes reliability and performance shortfalls. The elbow divides the flow unevenly with more channeled to the outside of the elbow as shown in Figure 1(a).

Consequently, one side of the double-suction impeller receives more flow at a higher velocity and pressure while

the starved side receives a highly turbulent and potentially damaging flow. This degrades overall pump performance (delivered head, flow and power consumption) and causes axial imbalance which shortens seal, bearing and impeller life.

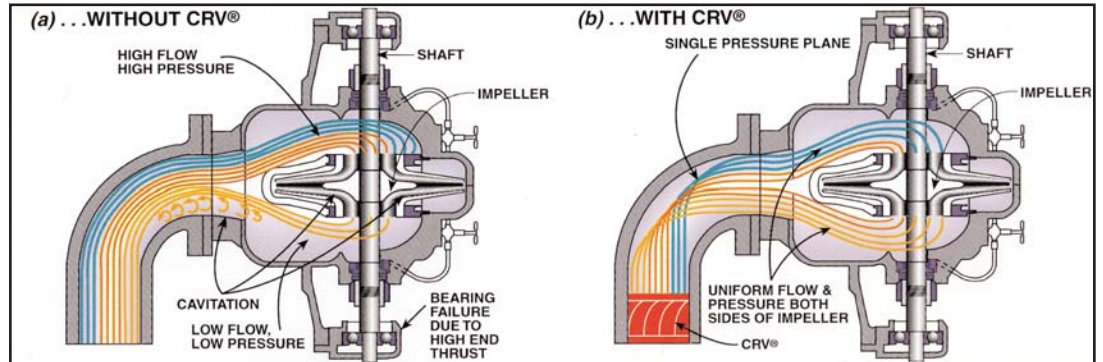


Figure 1 - top view of double-suction pump showing plain elbow (a) creates cavitation while a CRV® Flex (b) promotes an even fluid distribution.

By imparting a swirl to the flow entering the elbow, the CRV Rotation-Vane enables the liquid to negotiate the turn and be evenly distributed to each side of the impeller, as shown in Figure 1(b). With the CRV, flow and head characteristics will approach factory rated pump test performance, cavitation and noise will diminish, and seal, bearing, and impeller life will improve.

The CRV Rotation-Vane compensates for specification and installation constraints and attacks the root-cause of poor pump performance due to faulty suction piping layout. With CRV installation, pump performance and reliability will be maintained despite close-couple elbows on pump suction, even when applied in high suction specific speed, and double suction pumps.

## Case History 1

As an example, one can consider the feed piping configuration of a 3,550 rpm double-suction pump utilizing an 8-inch CRV Rotation-Vane, as shown in Figure 2. Prior to installing the CRV, pump operation had been noisy and the unit required an overhaul every four months. A vibration spectrum of the

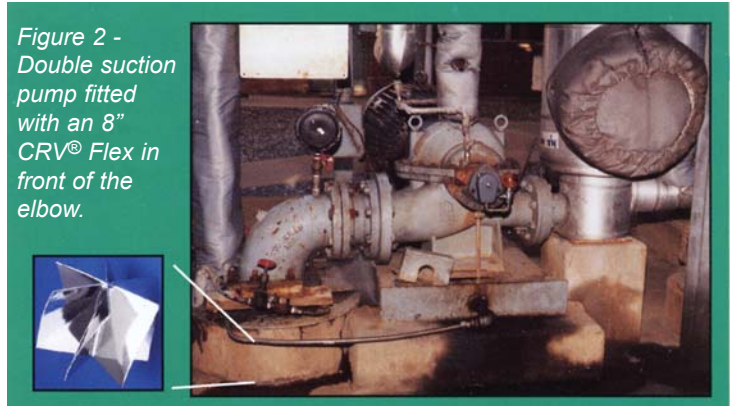


Figure 2 - Double suction pump fitted with an 8" CRV® Flex in front of the elbow.

## Pump Applications (continued)

pump just prior to CRV installation is shown in Figure 3(a) and just after CRV installation is shown in Figure 3(b). The dramatic reduction in measured cavitation (6-14 range on frequency scale) also resulted in a reduction in impeller imbalance (1 on frequency scale), which reduced noise, extended seal, bearing, and impeller life, and increased delivered head and flow. Prior to CRV installation, three identical pumps in parallel operation were required to deliver the required flow rate. After the CRV was installed on each pump, two pumps met the flow rate requirement and the third pump serves as an installed spare.

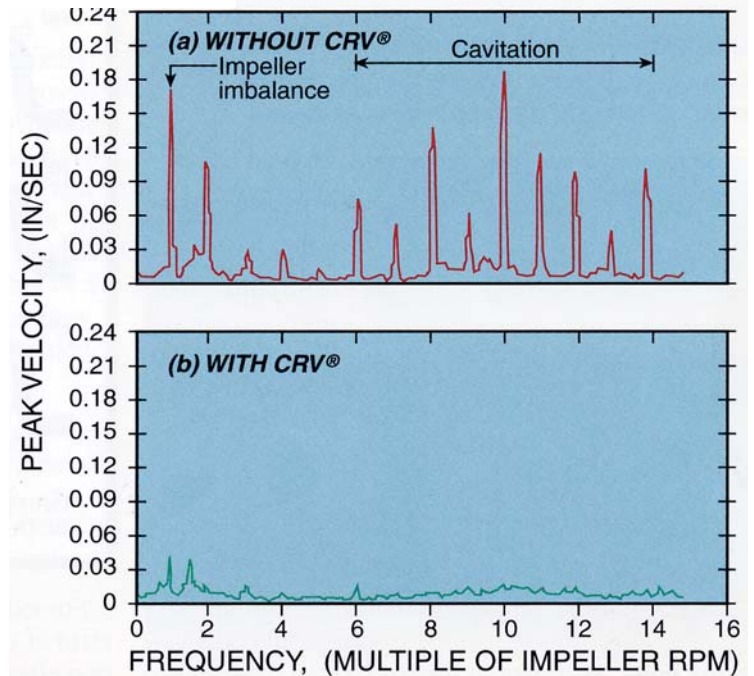


Figure 3 - Comparison vibration spectrum of 3,550 rpm double-suction pump with (b) and without (a) a CRV® Flex.

## Case History 2

With overhung centrifugal pumps, the same performance and maintenance improvements can be realized by the use of a CRV Rotation-Vane. Figure 4 shows an overhung centrifugal pump which required a complete rebuild every six months. After installing the CRV, the pump has been operating for 11/2 years without a pump rebuild.

## Case History 3

Dramatic improvements have also been witnessed with magnetically driven pumps, which are extremely sensitive to cavitation and impeller imbalance. In particular, flow in one installation increased 41/2% from 1,086 gpm to 1,135 gpm after the CRV Rotation-Vane was installed. At the same time, the horsepower draw dropped 7% from 43 to 40 and the discharge head 3 increased 8.6% from 81 to 88 ft. The key benefit, however, was reduced vibration, which eliminated a frequent repair cost of \$5,000 on the shaft and bearings as well as an occasional severe-failure repair cost of \$ 14,000 per occurrence.



Figure 4 - CRV® Flex installation just upstream of a short radius elbow and overhung centrifugal pump.