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Pump Vibration 101

Contributed by Zoeller Engineering Department

Recently, we have received questions on how Zoeller Grinder pumps behave when operating at low heads, specifically below the knee of the head/capacity curve on high head grinder pumps. Many of the questions pertain to pump life and increased vibration when operating in the vertical region of the curve. Should we operate the pump at low heads? Will the pump have a shortened life due to this operating point? This article will hopefully resolve some of these concerns.

To resolve these questions we performed vibration analysis on 4 grinder pumps (E7010, E7011, J7110, F7112). Each test was performed by recording the entire spectrum RMS velocity readings at every 10' total dynamic head increment for the entire pump curve. None of the readings that we obtained were anywhere close to a high or even moderate level of vibration.
The vibration spectrum was however different than that of a typical centrifugal pump. Typically for a centrifugal pump the highest vibration readings are generated at both ends of the curve and drop off as the pump reaches the Best Efficiency Point (BEP) operation. On the grinders the vibration readings did not perform this way. Even on some pumps the readings were higher at BEP and dropped off as the pump reached shut off head. Full spectrum analysis of the peak-to-peak readings revealed a 'noisy' type vibration spectrum (i.e. not very well defined peaks). On a typical centrifugal non-clog there is one vibration peak at the running speed. On the grinders there were multiple peaks around the running speed. Typically this would indicate a loose piece of equipment but we do not believe so in this case. We believe that what we are seeing is the cutter and disc action creating extra 'noise'. Due to our cutter arrangement all flow must pass through the holes in the cutter plate. These holes are sometimes covered and sometimes not covered by the rotating star cutter. As a hole is uncovered, water is forced into the pump through the hole. When that hole is covered the flow is instantly cut off. This happens hundreds of times every second since the cutter is rotating at 3450 RPM and there are multiple holes. This action of turning the flow on and off rapidly through the holes is giving us the vibration spectrum that we are seeing.

With all of that said - NONE OF THE READINGS WE GOT WERE EVEN CLOSE TO
ALARMING. If anything we have no problem at all, which is good, and we should NOT worry about operating the grinder pumps at low heads. Some of the problems historically experienced with grinder pumps are due to increased vibration when particulate is wrapped on the cutter. This throws the balance of the pump off and could cause a problem if a long-term unbalance condition was to occur. With our reversing design we have limited this effect since within a few pump cycles the material will be cleared. With the single direction design the particulate could stay on the cutter for longer periods. The only way to limit the vibration would be to make an even more robust pump with larger seals and shaft but this is not cost effective. We believe our single direction designs are already better equipped to handle this unbalance than our competitor's pumps, especially since we have a heavier duty design than the competition.

In concluding, based on these test results, we do NOT want to shy away from low head applications. We have thousands of units operating trouble free in the field at very low heads. We have no conclusive evidence that there is a problem with operating Zoeller Grinder pumps at low heads. As for the "Other Guys" pumps . . . you're on your own.