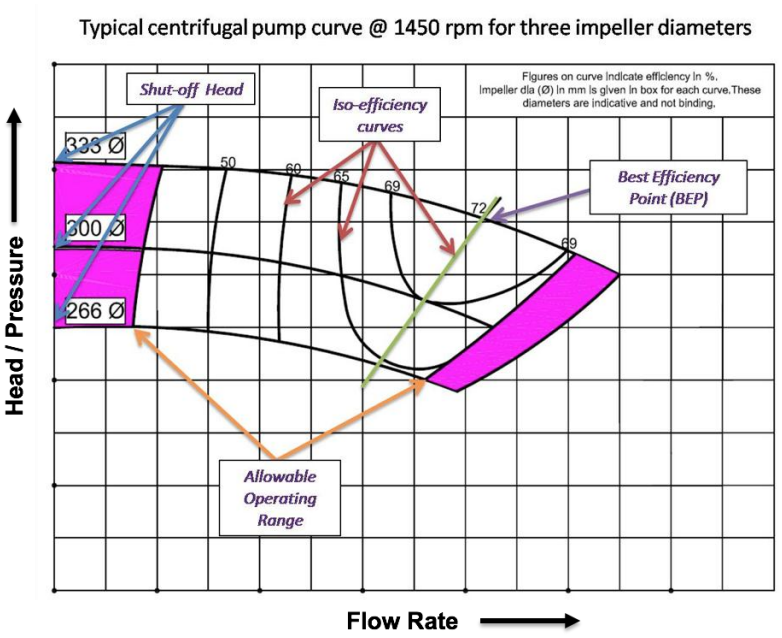
EquiThrux™ - Overcoming Safe Operating Zone Limits in Vertical Pumps

Pump operators have to be contended with the safe operating zone given by the manufacturer. This restricts flexibility in adapting to the dynamic pumping requirements. With EquiThrux™ technology pumps, the operators gain the flexibility to operate the vertical pumps from near shut off to full flow without worrying about damage.

The concept of safe operating zone in centrifugal pumps:

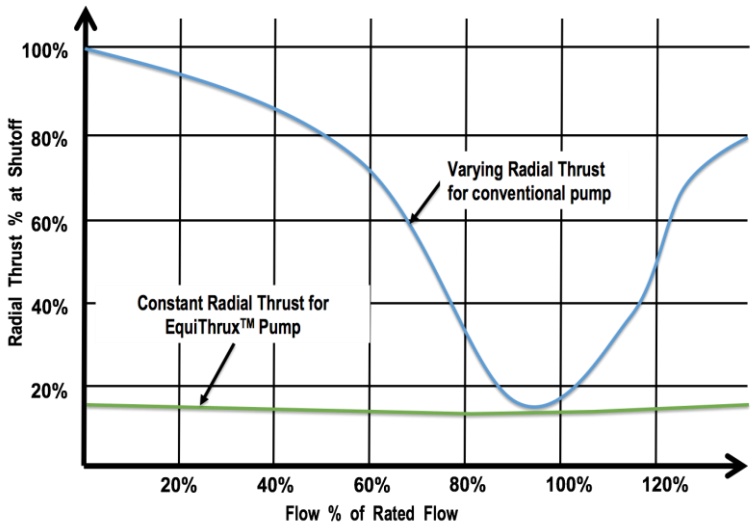


Every manufacturer of centrifugal pump, designs a pump based on a certain zone of operation. The philosophy behind recommending the allowable operating zone (asafe zone) is to restrict the mechanical wear and tear on the pump parts and ensure long life of operation. Any given centrifugal pump has the the lowest wear and tear when the pump is operating at or near its best efficiency point (BEP). The more the operating point shifts towards right or left of the BEP, there is increased chance of a mechanical wear and tear due to imbalanced thrusts (forces) on the pump. One of the primary forces contributing to the wear and tear of the pump is a force known as radial thrust. It is paramount for pump longevity that the pump is designed to handle the radial thrust during operation. Radial thrust is the lowest at or very near to the BEP and increases as the operating point shift either to the left or right of the BEP.

Radial Thrust: The Achilles heel of all pumps:

Radial thrust, (the main culprit in pump wear and tear) is the force due to liquid leaving the pressurised casing chamber (based on Newton's 3rd law). It is a function of the impeller vane thickness and the casing pressure. Radial thrust gives rise to deflection on the entire rotating assembly of the pump, which includes the impeller, shaft, intermediate shaft supports (in case of vertical pumps) and the bearings. The effect of radial thrust is especially enhanced in a vertical pump due to the long rotating assembly. Due to the design structure of the vertical pump, the radial thrust is absorbed by the wet bearings and finally by the upper dry bearings. Due to

this deflection, there arises a need to continually monitor the health of the bearings by vibration monitoring and motor current spikes. Also, longer the installation depth of the pump, bigger the concern of deflection on the pump and more the wear and tear. For the same duty point with the same design basis, vertical pumps have a narrower safe operating zone than horizontal pump, primarily due the larger deflection due to radial thrust.



EquiThrux™ to the rescue:

It is clear from the above arguments that one of the main criteria for deciding the sale operating zone of a pump depends on the radial thrust which the pump is designed to handle. With EquiThrux™, the radial thrust is completely balanced and nullifies its effect on the pump i.e. deflection of the rotating assembly is more or less zero. As with any force, in mechanical design, it is the unbalanced nature of the force which creates the problem. If the force can be balanced, most of the mechanical design issues are simplified. The same happens with EquiThrux™. The casing design ensures that the liquid, with same pressure leaves the casing in equal volume from diametrically opposite ends. Since there is radial thrust in same magnitude with opposite in direction, the effect of radial thrust, i.e. deflection on the rotating assembly, is minimised if not eliminated. Since the deflection is minimised, the resulting wear and tear on the wet and dry bearings is minimised improving the reliability drastically. Further, there may not be a need to have wet bearings for most of the applications. Even if the operating point of the pump shifts away from the BEP, the resultant radial thrust increase is nullified by an equal amount of radial thrust increase in the opposite direction. Therefore, no matter where the pump operates on the curve, at any point the radial thrust is balanced. The pump can be operated to near shut off to full valve (near pump runout) without much wear and tear on the pump. If the pump is a cantilever pump, then also there will not be any damage even if the pump runs dry.

Benefits of the EquiThrux™ Design Vertical Pump:

- Balanced hydraulics for trouble free operation with long life
- Eliminates maintenance associated with intermediate supports like sleeve & bush in cantilever design pumps
- No external flushing / lubrication required for cantilever design pumps
- Pump can run any head & flow point point even at shut off without any damage
- Internal pumped liquid lubrication using for pumps with longer installation depths.
- Pump can run completely dry for long time without any damage in cantilever design
- Less spares needed compared to conventional design

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