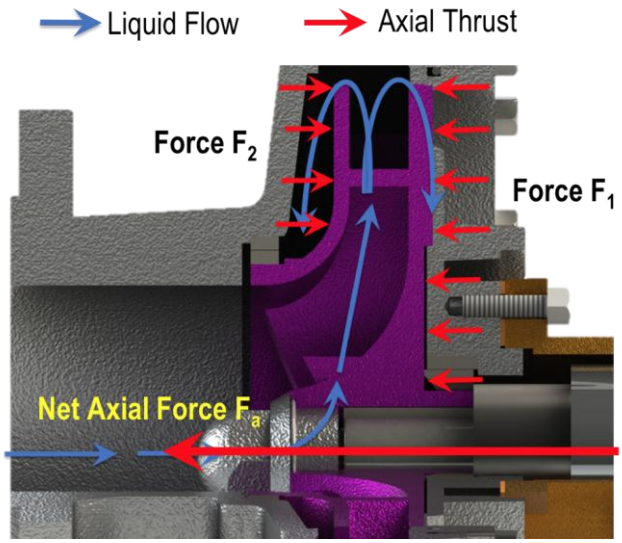
RedAx™ -A new thinking in impeller design

How a radical new design thinking of the humble closed impeller enhances reliability and efficiency

The problems with conventional closed impeller design:

Impellers are the most important part in any centrifugal pump. For years, the design thinking for impellers revolved around the need to maximise efficiency and lower cavitation. Very little consideration was given to the impact the impeller design has on the other moving parts, especially the bearings, which have to ultimately handle the axial and radial thrusts emanating from the impeller rotation. This often led to heavy design of the bearings. The concept needed to evolve into reducing the effect of the unbalanced forces (the axial and radial thrusts) from the conventional thinking of "fighting" the forces by having a heavy design approach. If we can reduce the intensity of the forces and their impact on the support structure, it is possible to enhance the overall life and reliability of the pump.

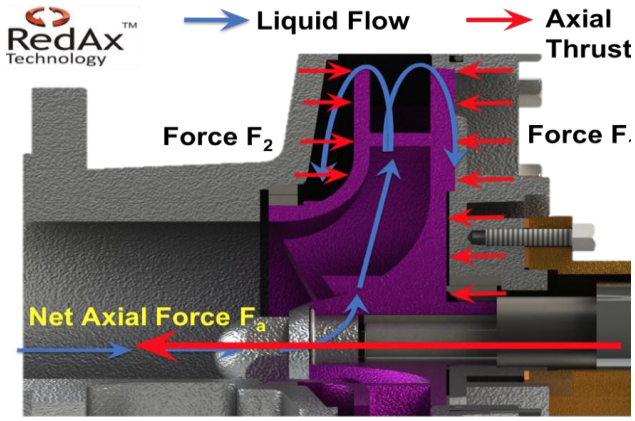


How the pumping thrusts transmit the forces to the bearings:

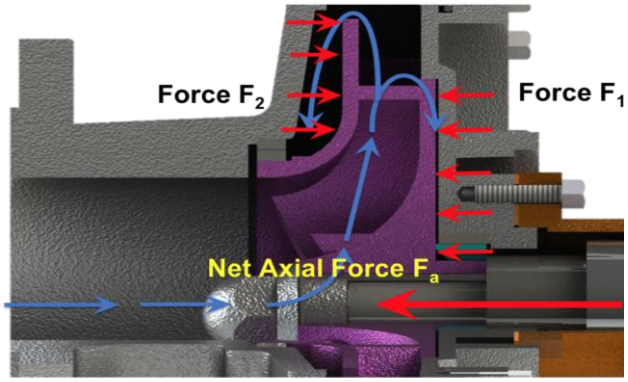
The casing being a hydraulic pressurized chamber, as per Pascal's Law, the liquid inside will exert equal pressure in all directions. When the pump is running, the liquid occupies the entire space inside the casing, which includes the back side and the front side of the impeller. The portion of the liquid present on the back side of the impeller exerts a pressure, equal in magnitude, on the impeller and the casing backplate. The casing backplate being a static member transmits the liquid pressure to the ground; however, the force exerted on the impeller has to be transmitted to the bearing since this is a rotating assembly. The pressure multiplied by the area of the back shroud of the impeller, is the force (F_1) acting on the impeller which is transmitted to the bearing. Similarly, on the front side of the impeller, the force (F_2) is acting on the bearing in opposite direction to F_1 but F_2 is lower in magnitude since the area of the front shroud is less than the area of the back shroud where F_1 is acting. The net force i.e. F_1-F_2 is the net force acting on the bearing. This force is called the axial force (F_a). Naturally, the lower the axial force, the more reliable and long lasting the bearing will be.

How the new design approach reduces axial force:

The idea behind the new RedAx™ impeller design is to reduce the axial force (F_a). To this end, the most logical approach is to reduce the area on which the pressure is acting since Force = Pressure x Area. The pressure cannot be reduced since that is the hydraulic requirement of the pump for the given application. So by reducing the area on which the pressure is acting, we can reduce the axial force (F_a). This is achieved by reducing the diameter of the back shroud which reduces F_a. These design modifications also eliminates the need to provide for balancing holes on the impeller, nor are any back vanes needed. This results in enhanced efficiency in addition to enhanced reliability.



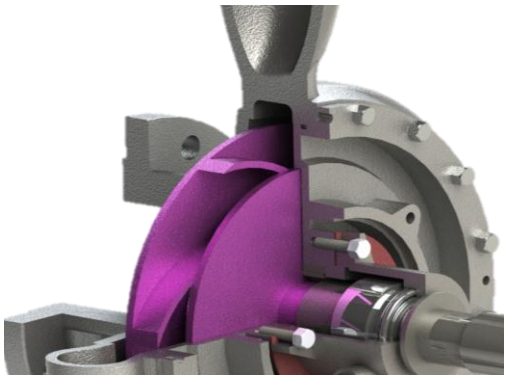
Conventional Impeller Design



Impeller with RedAx™ Design

Benefits of the RedAx™ impeller design:

- Longer bearing life
- Better efficiency
- Compact backplate design
- Lower impeller weight which reduces impact of dynamic imbalance


Back view of RedAx impeller fitment

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