

In the past two issues, *Run Times* has presented various impeller styles and their application. All the impellers we have featured are suitable for common industrial applications with specific speeds ranging from approximately 1000 (20 SI) to 2500 (50 SI)<sup>1</sup> at synchronous motor speeds. In this issue, we discuss the partial emission pump, a specialty design for low flow, high head applications. Partial emission pumps have specific speeds of less than 1000 (20 SI) at synchronous speeds.

Note: We had originally planned to include two other low-flow high-head designs in this issue; the pitot tube and the regenerative turbine, but found that the newsletter was getting too long for a single issue. Therefore, we will devote next month's issue to these two impellers.

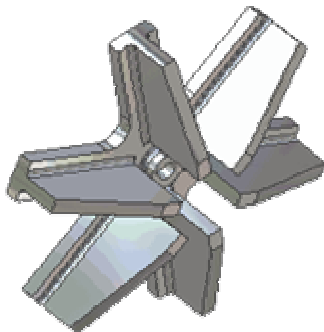


Dale B. Andrews – Editor

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## Barski or Partial Emission Pumps

This pump has an interesting history. It had its start in the aviation industry during the late 1950's. At that time, jet powered aircraft were becoming more common at airports originally designed for the shorter take off distances required by propeller driven aircraft. When Boeing developed the 707, they looked for a way to boost engine thrust during take-off. The partial emissions pump was developed as a small, light, high head pump that could inject water into the engines during take-off to provide the increased thrust. Several years later, partial emissions technology found its way into the industrial pump market, where it has since become a mainstay in the petroleum and petrochemical industries.

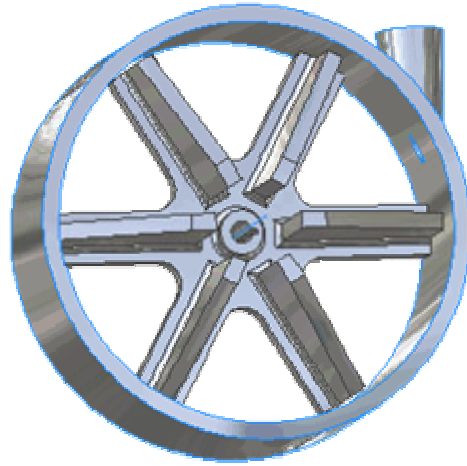


A partial emission (PE) pump is descriptively named because only a small percentage of the impeller's total fluid volume exits the pump with each revolution of the impeller. In a standard centrifugal pump, both the fluid velocity and the area at the impeller inlet are designed to match the best efficiency point flow for the impeller. The designer wants the impeller to move the fluid from inlet to outlet in as few revolutions as possible in order to maximize the efficiency of the pump. A PE pump is characterized by large radial vanes oriented 90° to the axis of rotation. It has an inlet fluid design capacity of several times the design flow of the pump. The primary purpose of the partial emission impeller vanes is to accelerate

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<sup>1</sup> For more information on specific speed go to our Aug. 2004 newsletter at [http://www.lawrencepumps.com/newsletter/news\\_v04\\_i3\\_Aug.html](http://www.lawrencepumps.com/newsletter/news_v04_i3_Aug.html)

the entire fluid body within the pump to speeds closely approaching the rotational speed of the pump rather than to move fluid through the pump quickly. Flowrate in a standard centrifugal pump is determined by the impeller inlet design. Flowrate in a PE pump is controlled by the throat of a discharge nozzle that is mounted tangentially within a circular casing. A partial emissions pump generates TDH by conversion of the high fluid rotational velocity into pressure in a diverging nozzle downstream of the throat.



### **Advantages of a PE pump:**

- A PE pump has a higher TDH capability for a given impeller diameter than a standard centrifugal impeller. This is because the fluid velocity leaving the impeller is almost tangential allowing the tangential discharge nozzle to take near full advantage of the available kinetic energy. A standard pump impeller has a fluid discharge angle of about 15° to 30° from tangential, resulting in a lower percentage of useful available kinetic energy.
- Efficiencies are typically higher than for standard centrifugal pumps operating under similar conditions.
- PE pumps are subject to lower side thrust at best efficiency point due a circular casing design.
- An open impeller design virtually eliminates TDH related axial thrust.
- A PE pump has a relatively large inlet that results in low fluid relative velocities<sup>2</sup>. This yields characteristically low NPSH requirements and excellent wear resistance when handling abrasive slurries.

### **Disadvantages of a PE Pump**

- A PE pump often (but not always) exhibits a drooping characteristic at shut-off that can make it unsuitable for parallel operation.
- PE pumps may have higher side thrust than a standard centrifugal pump when operated away from best efficiency point, due to the circular casing design.

### **Additional note:**

PE pumps are often run at high non synchronous speeds (greater than 3600 rpm) through use of a gear box or VFD.. Heads over 10,000 feet (3100M) are obtainable with very good efficiencies. The trade off is a pump that is very intolerant to any off design operation.

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<sup>2</sup> Relative velocity is the difference in speed between the fluid and the speed of the impeller. Zero relative velocity would mean zero wear because the impeller and the slurry would be moving in unison.