

# The Benefits of Stainless Steel Impellers in Double Suction Pumps

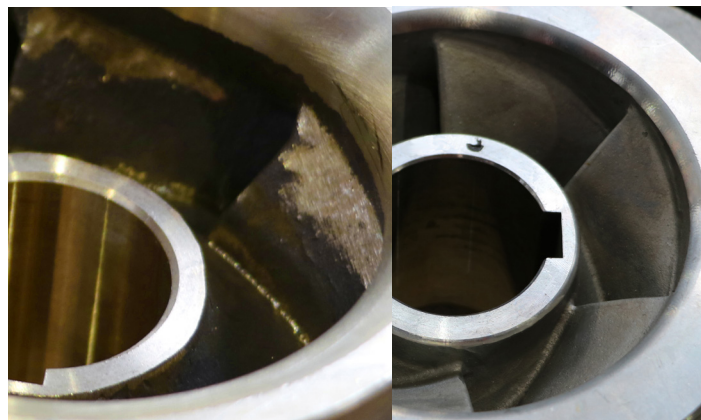


The newly designed Bell & Gossett e-HSC pump standardized on a stainless steel shaft and impeller. This paper outlines the benefits of stainless steel in performance and product life.

In 2014 Bell & Gossett launched modernized versions of its Series 1510 base mounted end suction centrifugal pumps. This began the “Power of e” campaign and the “e” designation denotes improved performance characteristics. Since then there has been a re-design of the inline pumps and most recently the horizontal split case pump. Each of these re-designs utilized computational fluid dynamics (CFD) analysis to optimize efficiency and minimize net positive suction head requirements (NPSHR). Most recently, Bell & Gossett launched the e-HSC pump, which broadened and standardized the horizontal split case line while incorporating the latest design technologies.

Another key enhancement to all of these pumps has been the transition from bronze to 304SS impellers. Bronze had been the industry standard for many years based on economics and manufacturing technologies available at the time. Although bronze performs adequately, stainless steel has always been the superior material. The widespread use of stainless steel was cost prohibitive and the manufacture of stainless steel impellers was possible only in specialized facilities working on custom projects. Mass production of these components was not an option. Stainless steel was reserved for only the most demanding applications for this reason. Advances in manufacturing technology and reduced costs for stainless steel material versus bronze have finally made stainless steel use possible on a widespread basis.

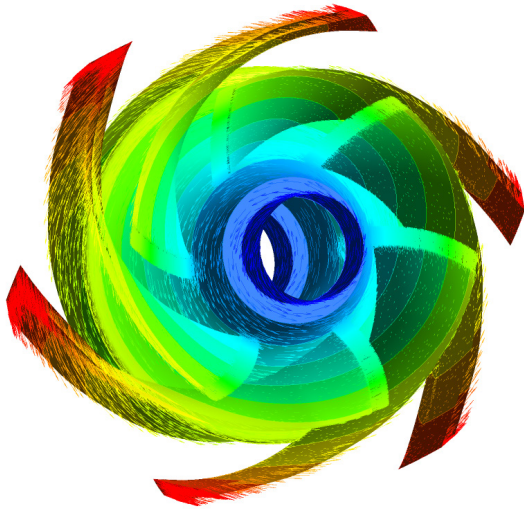
In clean water applications bronze remains a suitable choice, but bronze does not offer the same corrosion resistance properties of stainless steel and has a greater potential for degradation. Over time the surface characteristics of bronze can cause it to wear faster than stainless steel - leading to reduced pumping efficiency.



**Figure 1**  
**Impeller eye of a bronze sand cast double suction impeller with vane cleanup (left) compared to a stainless steel investment cast impeller (right).**

The common bronze alloy used in impellers is especially susceptible to a process called dezincification in which chlorine dissolves the zinc material (4-12% of volume) from the metal. There are specialty grades of bronze with comparable corrosion resistance to stainless, but they are higher cost and harder to manufacture.

The stainless steel impellers are made as “investment castings<sup>1</sup>”. These are created using a lost-wax process that results in a significantly improved surface and part quality than the more common die-cast process or the sand-cast process historically used on bronze casting. The end results of this process are greater efficiency, consistency between impellers, greater durability and more sustainable hydraulic performance. As shown in figure 1, a sample sand cast impeller (left) typically require grinding to address surface imperfections. Investment cast impellers (right) have cleaner edges and a more consistent surface. Impeller performance is not only dictated by the geometric design, but performance enhancements based on surface improvements can also be modeled (figure 2). In order to offer both stainless and bronze impellers, two sets of tooling would be required. By making stainless steel the standard offering and leveraging economies of scale, the benefits of stainless steel are available for all applications without increased cost.



**Figure 2**  
**CFD modeling assists in the design for optimal energy transfer**

We can also compare the two materials by the numbers. In figure 3 you can see that stainless steel is equal in strength, but has superior crack resistance when compared with bronze. Data also shows the stainless steel material to be harder than bronze, resulting in equal

or less wear and longer life. Stainless steel also has equal or better corrosion resistance for many fluids. Most importantly, stainless steel has no added lead, eliminating the concerns of lead contamination in the pumped fluid which exists with some bronze materials.

The transition from bronze to stainless steel impellers has leveraged the latest manufacturing technologies and offers the power savings, corrosion resistance and reduced wear of stainless steel without the cost penalties that kept this out of reach in the past.

Attribute	Bronze (C87500)	Stainless Steel (CF8)
Tensile Strength	66,700 psi	70,000 psi
Yield Strength	29,700 psi	30,000 psi
Hardness	134-163 BHN	180-201 BHN

**Figure 3**

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<sup>1</sup> Available on impellers up to 18"