



The redesigned blender supports advanced health and safety requirements and is easier to access for improved maintenance in the field.  
(Source: BJ Services)

## Engineering a new pumping approach

Improvements began with building reliability and performance into pressure pumping systems.

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**P**ressure pumping in North America has undergone an enormous evolution over the past decade. Completions intensity has increased exponentially with the combination of longer lateral lengths, higher flow rates and treating pressures, and longer pump times. Meanwhile, the equipment has remained relatively unchanged, with a primarily iterative design.

Coming out of the downturn, BJ Services was presented with a unique opportunity to make a fresh start with standardized, well-maintained equipment, comprising the third largest fleet in North America. An opportunity existed to address changing operating conditions by applying new engineering designs across the equipment. More specifically, the company took a systemwide approach to engineering with the intent of delivering a new level of reliability and performance for clients.

The company's journey began with a comprehensive understanding of the mixing systems coupled with across-the-board failure analytics. The result was a redesign of each component within the mixing system to not only operate under the new demands but to work together more efficiently and to integrate with recent advances in fracturing chemistry.

### Systems approach

Engineering a system is accomplished by first designing to remove failure points and then to anticipate failures. By doing both throughout the system, an equipment system can operate continuously through the largest operations.

To achieve a new level of reliability, the process started with analyzing every component—control system, transmission, fluid ends and more—to determine how to get the maximum value and return out of each.

In addition, it was important to understand the expected operating performance levels, fluid systems used and the environmental conditions that can all impact equipment wear and tear. This optimized fracturing platform has enabled the company to efficiently activate 35 fleets in just over 15 months.

### Blender improvements

Perfecting operational execution in the field means planning and anticipating failure and then managing how to correct failure to deliver a successful operation. There are two key methods. The first is to engineer failure out of the system as much as possible, and the second is to design equipment so that it can be maintained and tuned very quickly. This combination ensures all operations are successful.

For example, blenders are recognized as a frequent critical point of failure in the system since all fluids pass through a blender. Blenders mix sand, water and additives before feeding the fluids to the fracturing pumps. If the blender underperforms or fails during a stimulation program, the result can be a poor fracturing job, damage to the pumps or an entire stoppage of the operation, resulting in costly shutdowns for the operator. Because the blender is key to operational success, a typical operation requires two blenders per fleet.

For these reasons, the company prioritized redesigning the blender. This process took about four months to redesign and prototype. The first prototype deployed

in the fourth quarter of 2017 has had zero unplanned downtime over eight months of operations.

The redesign specifically addressed and eliminated problematic components. For example, the simplified piping minimized erosion and allowed more efficient flow. Additionally, the blender tub was designed for ease of access to enable routine maintenance to be done on location.

After pumping 215 MMlb of sand through one blender over six months in the Permian Basin, there was no major component failure. Typically, for many other pieces of equipment, pipe erosion, component failure and other wear and tear would occur. The continued evaluation will enable increased efficiencies as well as add opportunities for further design enhancements.

### Beyond the mixing system

After achieving increased uptime with blenders, the company expanded its scope to look at the changing nature of inputs into a fracturing operation as well as how to improve future designs.

The sand and fluids pumped downhole play a critical role in overall equipment performance and functionality. Proppant mesh size, increasing pressures and flow rate, water quality and advanced chemicals can all contribute to component erosion, increased horsepower and equipment failure.

Designing fluids that not only improve reservoir recovery but extend equipment component life and ensure mechanical integrity can have significant positive

impacts. By considering and integrating technology as part of the wellsite delivery efficiency, it ensures longer time between maintenance, makes maintenance safer and easier and increases overall productivity by improving pumping time and efficiency.

In-house engineering, manufacturing and maintenance are crucial to creating agile and responsive solutions. The engineering support and maintenance functions are under the same roof at BJ, enabling its teams to collaborate effectively and quickly respond to evolving conditions. Teams work together to deliver a modern, scalable fleet that offers maximum horsepower for longer laterals, thus servicing longer horizontal wells with more stages and high-rate pressure pumping.

### Planning for the future

The company has implemented integrated, real-time measurement and predictability to improve pumping efficiency, minimize unplanned interruptions and deliver value. This allows the team to determine and address potential premature equipment failures before they occur in the field.

Applying the learning of other industries, parallels can be drawn in the evolution of equipment where the first solutions attempted to correct single points of failure, making individual components stronger and more durable. Past experience has shown that this approach has limited impact on overall improvement. Anticipating failure and engineering the system for a higher overall tolerance with components that work together is the first step to perfection.

Next, BJ is building field automation systems that enable higher speed of knowledge to get the right information to the right person to make the right decision at the right time.

Fracturing fleets will be engineered with future foresight around maximizing efficiency and ensuring unconventional resources are economically viable. Equipment solutions that meet the needs of today and anticipate future industry challenges will continue to best serve clients and the industry. **ESP**



**The redesigned blender handles the demands for longer laterals, higher volumes and less maintenance.**  
(Source: BJ Services)