

## Next-Generation Bellows for Artificial Gas-Lift Systems

Alloy Bellows and Precision Welding has earned the trust of leading companies in the oil and gas industry because we understand that our components must withstand extreme conditions. For decades, our engineers have worked closely with these customers and supported them by manufacturing innovative, customized solutions used in oil and gas drilling. Our customers are leaders in the oil and gas industry, and our products are trusted to perform in remote locations around the world.

Alloy Bellows has long been an industry leader with its Monel bellows for artificial gas lift. But our engineers also offer customized solutions, and we're always looking ahead for ways to improve performance for our customers. Our latest innovation, the next-generation NeXtLift 'NXL-1.5' Inconel bellows, offers improved performance and a more durable product—among its many advantages.



### Background

Alloy Bellows manufactures artificial gas-lift bellows, seals, and assemblies designed to withstand the demands of oil and gas drilling. Our bellows offer impressive fatigue and corrosion resistance and are designed to handle the high temperatures and pressures found in today's deepest wells. All oil and gas products undergo the highest level of testing and quality control to ensure that these systems always perform well under these severe conditions.

### The Challenge

Monel has long been the industry standard material for both 1" and 1.5" bellows for gas-lift valves. With the industry working to access deeper and deeper wells, demand for a 1.5" design for larger valves is

increasing. Moreover, the highly corrosive environments of the deeper wells can challenge the limits of Monel.

### The Solution

In response, Alloy Bellows reviewed material options and invested in developing an Inconel version of a 1.5" artificial gas lift bellows.

Inconel 625 offers superior performance in the same size bellows at a comparable price. With over 50% greater yield strength and over 75% greater tensile strength compared to a similar Monel bellows, the new **NXL-1.5** design is also more temperature- and corrosion-resistant thanks to the high molybdenum content of the alternative material. Average elongation remains the same as in the Monel design (Figure 1).

Material Property	Monel 400	Inconel 625
Yield Strength	35 ksi	75 ksi
Tensile Strength	77 ksi	135 ksi
Average Elongation	50%	50%
Transition Temperature	800 °F	1200 °F

Figure 1: Material properties of Monel and Inconel

An optimized 1.5” gas lift bellow formed from Inconel 625 exhibits improved column stability at greater internal pressures—as high as 2,000 psi. Due to the more favorable mechanical properties of Inconel 625 over Monel 400, design optimization is achieved by customizing the convolution profile and number of convolutions along the bellow’s flexible length segment. Column stability becomes a concern when larger dome pressure charges are needed to balance the opening and closing pressures during injection pressure operated gas lift valve operation (Figure 2). The limiting internal design pressure based on column instability is a function of both the material’s elastic spring rate and the number of convolutions in the bellow (Figures 2 and 3).

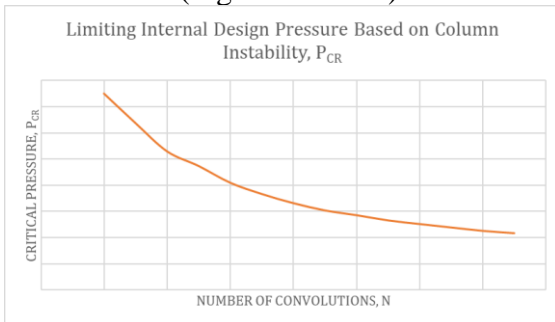


Figure 2: Number of convolutions vs. critical pressure

The new Inconel design also boasts a longer field life than the industry average. As usual, Alloy Bellows relies on its high-quality hydroforming process to manufacture bellows efficiently and with a high degree of precision. The result is a quality product produced rapidly and at a price our customers can afford.

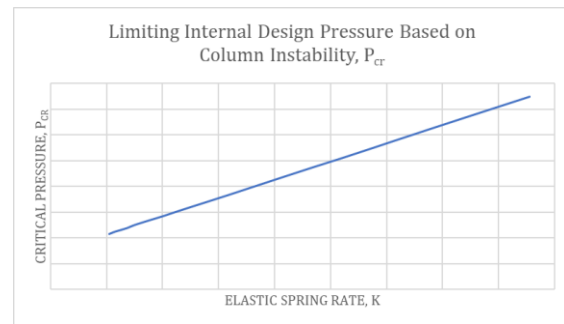


Figure 3: Spring rate vs. critical pressure

## Conclusion

The **NXL-1.5** will enable our customers to access new opportunities, including much deeper wells with their highly corrosive environments and higher temperatures and pressure. The optimized design results in significantly higher life cycle. Further, Alloy Bellows’ efficient and consistent hydroforming process provides a steady supply of bellows to an industry that maintains a high demand for the product.