

Title: Gas Lift Valve Bellow Crimping and Protection from High Dome and Injection Pressure

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Bellows are mechanical devices used to compensate linear, thermal, or angular movement/expansion. Said bellows can be manufactured in different shapes, sizes, using different materials. One typical example of bellows application is in pipelines to compensate for thermal expansion between solid points. In oil and gas industry, among other applications, bellows are used in gas lift valves as a slidable seal between Nitrogen charged in valve dome section and injection pressure. Currently, only two nominal bellow sizes are used in gas lift application, one Inch and one and a half Inch. Examples of gas lift valves using one-and three-quarter Inch were manufactured but are not widely used. However, as manufactured bellows having very thin walls are not well suited for pressures higher than 200 PSI, depending on bellow size, shape and material used. To withstand much higher pressures bellows are being crimped, method that compresses bellow to shorter length which increases bellow overall mechanical toughness. In addition, bellows in gas lift valves must be pressure balanced inside and outside as much as possible to withstand high pressure up to 2500 PSI. By design bellows used in typical gas lift valves feature internal seal that is engaged once valve is in fully open position and bellow is expanded trapping "noncompressible" fluid usually silicone oil of different density. Nitrogen in gas lift valve is in direct contact with silicone oil and penetrates/dissolves into oil in form of bubbles. Being so called permanent gas Nitrogen never liquifies and always remain in gaseous state at any pressure no matter how high. This renders so called "noncompressible" fluid compressible and it does not prevent bellow damage when exposed to extremely high injection pressures. This theory used for decades in oil and gas industry is completely wrong resulting in premature bellow failures. This paper analyses existing gas lift designs and offers solution for problems specified herein.