Z Tech Design-Zlatko Salihbegovic graduated mechanical engineer

GLV-gas lift valve with dual “fortress ™” seal

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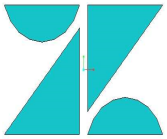

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- First, let's see what is the wrong way to design a gas lift valve.
- GLV are using either formed or edge welded bellows. First GLV designs were using formed bellows. Bellows used in GLV are made from three 0.005" thick layers/plys by rolling or hydro forming, usually rated by manufacturers to 250 PSI working pressure. Material used is usually Monel 400, Inc 625 and 718.
- **As far as I am aware, first GLV designs are the only engineered product on the market that is intentionally using a component, in this case formed bellow, exposed to extremely higher pressures, up to 2500 PSI, 10 times higher than recommended by bellow manufacturers. This is absolutely wrong approach.**
- **It appears to me that gas lift is the only oil industry segment where operators are stuck in the past and simply ignore every progress made in this filed by using old wrong designs.**
- Different methods are used in GLV designs to address high pressure issues as bellow crimping, GLV ageing and bellow hydraulic protection.
- Bellow crimping is correct process, but most GLV manufacturer usually use wrong method, crimping bellow after soldering it to mating parts. Bellows should be crimped as standalone component.
- GLV ageing is wrong process that should not be performed and results in deformed bellow shapes.

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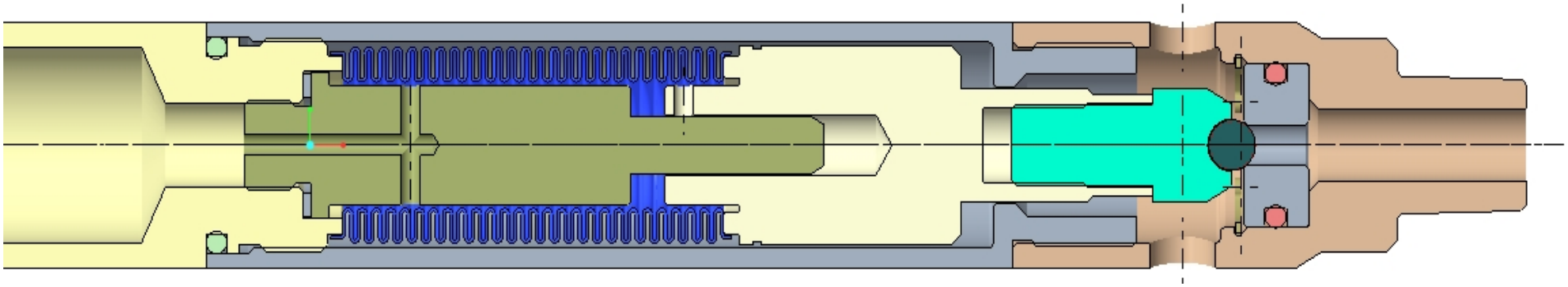
- So called bellow hydraulic protection is based on wrong principle where bellow is “protected” from high pressures by trapping “non compressible” silicone oil. However, silicone oil in GLV is in direct contact with pressurized Nitrogen, which is permanent gas that dissolves in oil rendering it compressible mixture of oil and Nitrogen. Permanent gas remains in gaseous state all the time and never liquifies, it doesn’t matter how high the pressures is. This renders “ hydraulic bellow protection” false assumption.
- Drawing below shows one of the first GLV designs. This valve does not have any bellow protection from high injection or dome pressure. Unfortunately, this is best selling valve. Everybody is cloning this valve.
- This is the cheapest valve on the market particularly if cloned in India and China.



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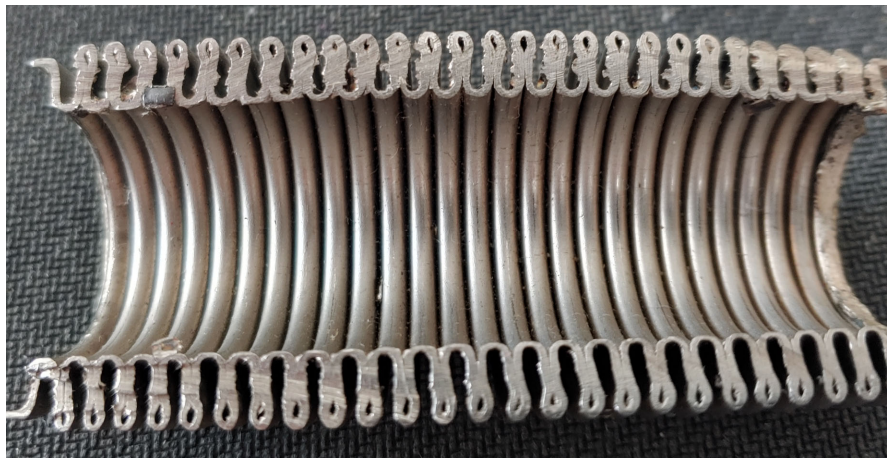
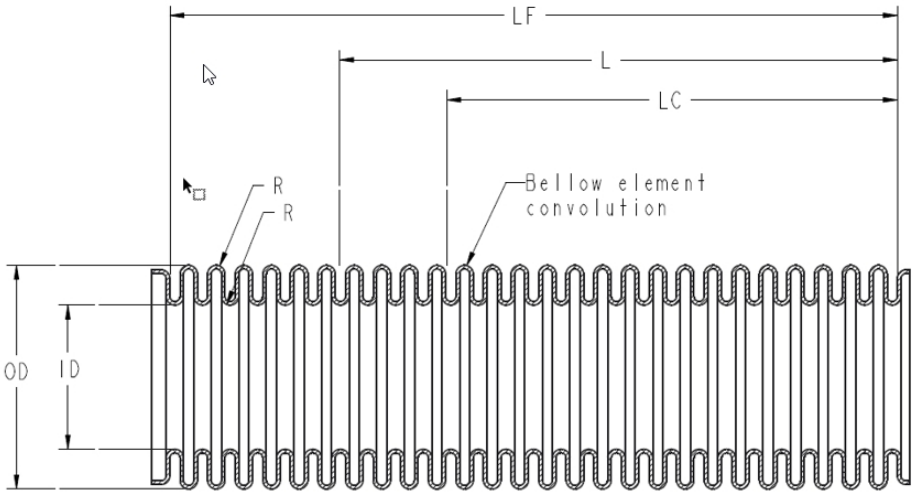
- Picture below left shows bellow cross section where it was exposed to 1000 PSI external pressure, note that ID convolution radiuses R are enlarged, while OD radiuses are reduced. Bellow convolution radiuses deforms plastically every time 500-600 PSI differential pressure is applied to below.
- Picture below right shows convoluted/formed bellow typical dimensions.





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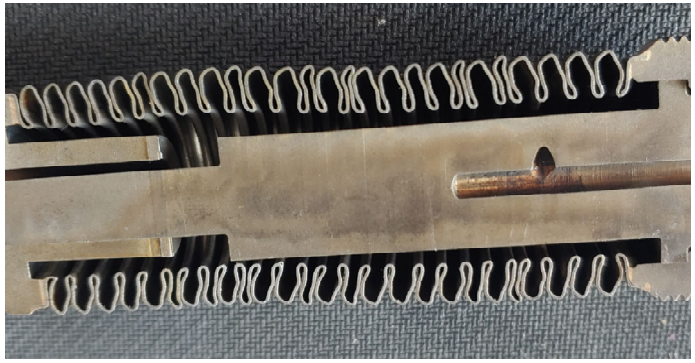
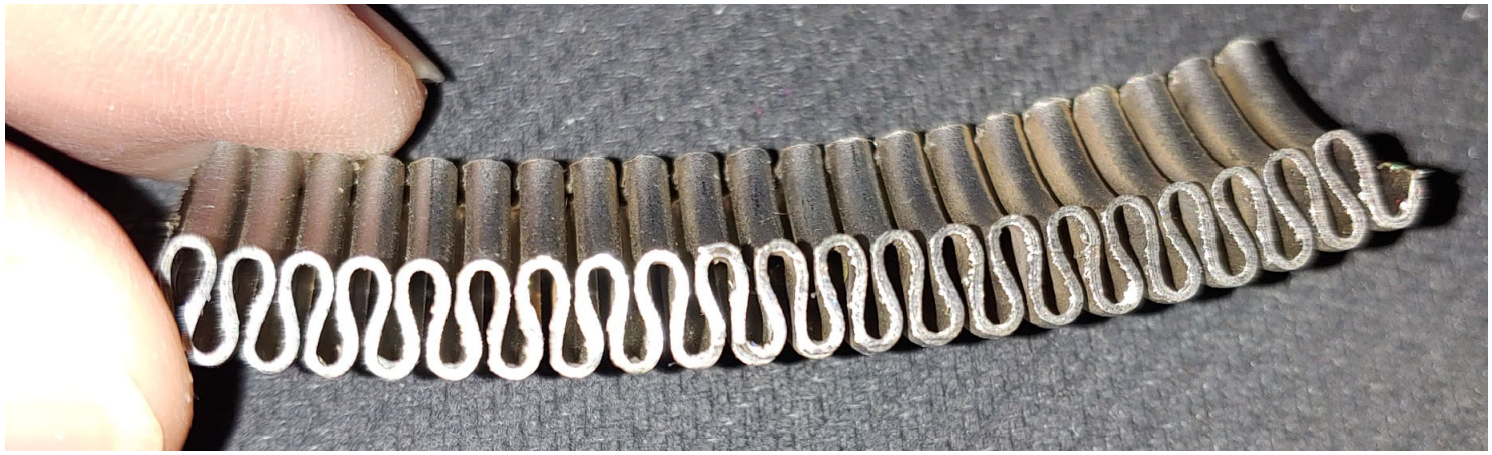
- The worst gas lift valve in the business:
- Picture bellow shows partial cross section of the bellow. This is very first GLV design, note horrible shape of bellow convolutions.
- This GLV bellow is first soldered against mating parts in free length L, crimped usually using external pressure and then aged. Picture is worth more than thousand words. Everything that could be wrong went wrong with this design.
- Unfortunately, this is the best selling GLV in the business.



- **Crimping bellows per my approved patent # US 11,845,120 B2**
- First step is proper bellow crimping where bellow length LF is changed to LC as per manufacturer recommendation. Proper bellow crimping must result in crimped bellow where it is essential to maintain bellow radiuses. Note perfectly formed bellow convolution Ω-omega shape.



- Picture below shows perfectly crimped bellow per my patent # US 11,845,120 B2 using custom designed crimping device. Note that bellow is crimped as self standing, not soldered against mating parts.

- Second, by design, GLV bellow should never be exposed to differential pressure higher than manufacturer recommended working pressure, usually 250 PSI for formed bellows.
- **Today, there is no GLV on the market that meet this criteria.**
- ***Introducing most advanced GLV on the market today, dual Fortress™ seals valve per my patent # US11,242,732.***
- Dual Fortress™ seal GLV features formed bellow that is never exposed to differential pressure higher than 200 PSI.
- Bellow in this GLV is completely protected from high injection and dome pressure by Fortress™ seals.
- Bellow in this valve is crimped per my patent # US 11,845,120 B2 resulting in perfectly crimped bellow.
- This GLV can be exposed to 15 KSI injection pressure without any danger for bellow.
- This GLV features spring loaded telescoping stem, which is complex, however applying my patent # US 11,643,910 B2-"GLV with two simultaneous mechanical stops" telescoping stem is not needed and is eliminated from design resulting in simpler and more reliable design.
- This gas lift valve is not aged, ageing is wrong and unnecessary procedure. Valve is prepared for use by charging dome with Nitrogen, where max dome pressure is 3500 PSI depending on bellow material used.

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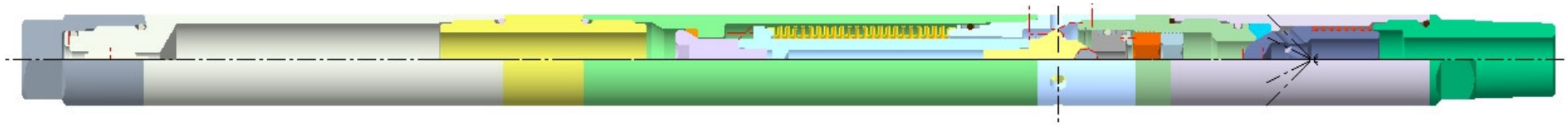
- Drawing bellow shows conventional GLV with dual Fortress™ design with applied two simultaneous mechanical stops per my approved patent # US 11,643,910 B2 and US 643,910 B2.



Z Tech Design, 1” TSMS-DFS-C1 conventional gas lift valve Inc 625 version. Max dome pressure 3500 PSI based on patents # US 1124273282 and US 643910B2
TSMS™-Two simultaneous mechanical stops
DFS™-Dual fortress seal
SFS-Single fortress seal
C-Conventional gas lift valve
R-wireline retrievable gas lift valve

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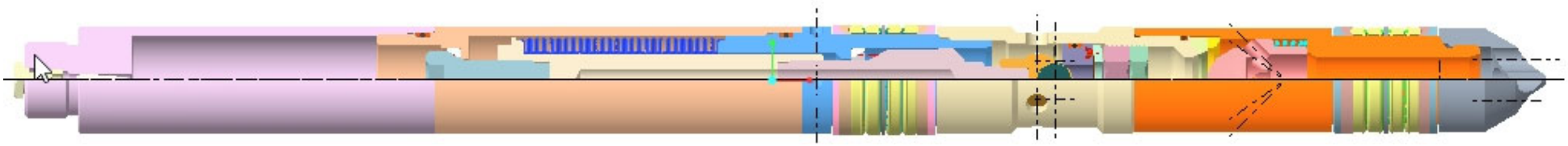
Drawing bellow shows wireline retrievable GLV with dual Fortress™ design with applied two simultaneous mechanical stops per my approved patent # US 11,643,910 B2 and US 11,242,732 B2.



Z Tech Design, 1.5” DFS-R2 conventional gas lift valve. Max dome pressure 2800 PSI (Monel 400) based on patent # US11,242,732 B2 and US 11,643,910 B2. Max check valve pressure 15KSI.
TSMS™-Two simultaneous mechanical stops
SFS-Single fortress seal
DFS™-Dual fortress seal
C-Conventional gas lift valve
R-Wireline retrievable gas lift valve

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