Development of a New Refrigeration Ball Valve

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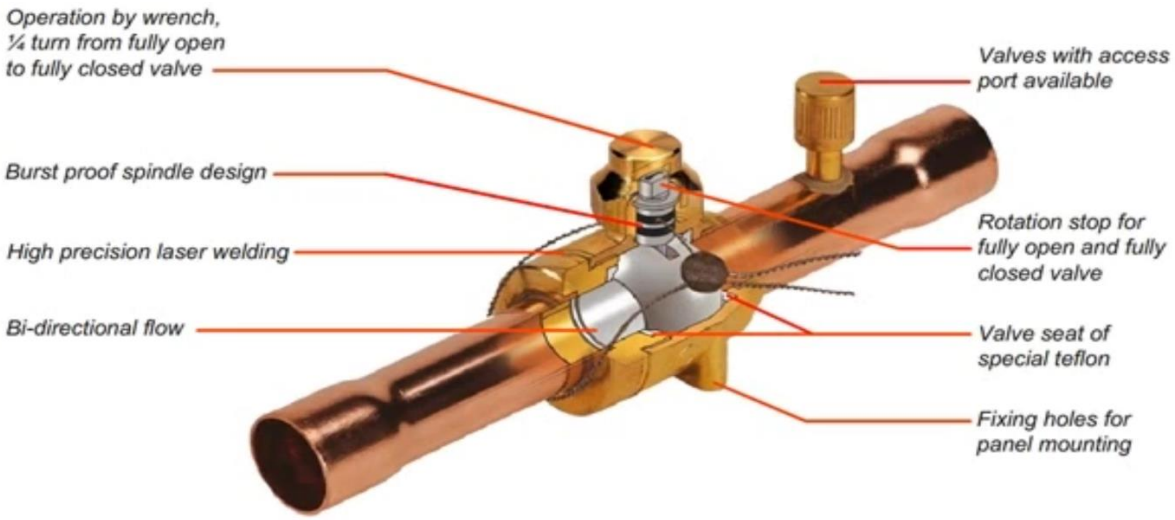


Introduction

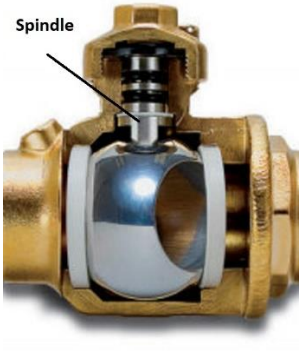
Refrigeration ball valves have been in use for over 20 years. They are used to isolate parts of a refrigeration system when service is needed. In the past 20 years, the refrigeration industry has made significant changes to the type of refrigerants that are used. R22 has operated at around 220 PSI, while newer refrigerants like R-410a work at around 600 PSI. In recent years, CO2 was introduced as an environmentally friendly refrigerant, however the working pressure is around 2000 PSI.

Refrigerant leaks are bad for the environment and costly to large consumers, like commercial and industrial refrigeration facilities, both from a maintenance point of view and due to severe penalties for releasing gas into the atmosphere.

Many times we find leaks at the stem (or spindle) of the ball valve (see picture 1) due to several factors:

A. Poor design.
B. O-ring material dries and cracks after a refrigerant change.
C. Higher working pressure in newer refrigerants in conjunction with old design from 20 years ago.

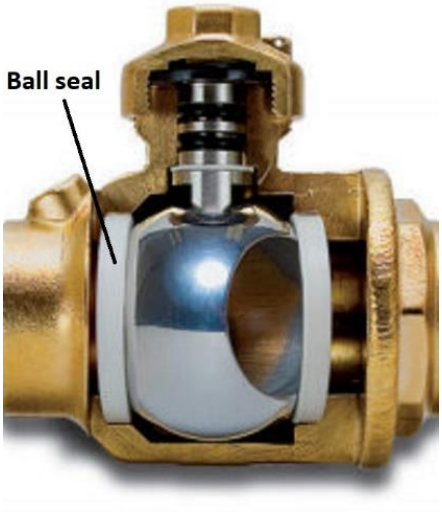
We estimate the market size for a new design to be around $130 Million. It’s time to update the design to meet the new refrigerants’ working pressure ratings and find an innovative way to develop a leak proof valve.



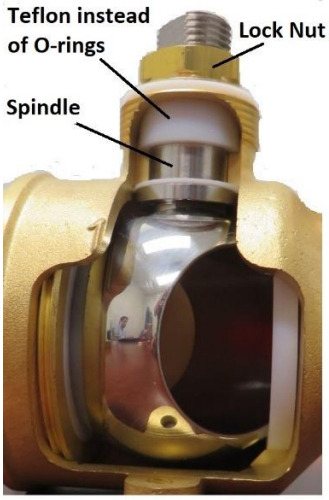
Picture 1

Brief Project Description

Having a spindle to turn an internal ball from an external location presents a potential leak point. NDL has made changes to the design to solve part of the problem by using Teflon seals instead of neoprene O-rings, however, by eliminating the O-rings we needed to use a lock nut at the top of the spindle to compress the Teflon top and bottom seals against the valve body. This creates a possible leak problem since contractors mistakenly loosen the nut thinking that it will help with the friction in turning the spindle from the closed to the open position. The friction is caused by the two large seals on each side of the ball and not the nut (see picture 2).



Picture 2



NDL current design

Expected Outcomes

NDL is expecting as best case scenario to receive a new revolutionary conceptual design that will completely change the valve operation. If this is not possible, the next best outcomes would be to eliminate the spindle while allowing the ball to turn from open to close or a new spindle design that will eliminate potential leaks.

Resources Available from the Customer

NDL is committed to supporting the student team. We will make ourselves available to meet in person or by Zoom at any time during the project.

CAD drawings of our current design will be made available, as well as several actual valves for the students to play with.

We can provide prototypes of the brass or stainless steel valve body or cutaways (as in picture 2) once students have completed the design phase and supplied NDL with a production drawing.

Financial support to gather information such as ASME standards, other research papers, or any 3D printing, tools, etc, will be available as well.

Customer Requirements

Must have:

1. Can pass the Undewriter Laboratories' (UL) burst pressure test of 5x working pressure (i.e., in the case of R410a refrigerant, the working pressure is 600 PSI and burst pressure is 3000PSI).
2. Eliminate the possibility of a leak from the spindle seals or eliminate the spindle itself completely.
3. No flow restrictions. Inside diameter of flow controller (i.e., ball) should not be smaller than the pipe inside diameter.
4. All materials should have a melting/deformation temperature high enough to allow the valve brazing process.
5. The new design should allow NDL to manufacture the valve at a reasonable cost.

A nice to have would be a complete "revolution" of the design rather than just improve the existing one.