Double block & bleed: understanding a barrier - part 6

Norwegian consultant and valve instructor, Ingolf Fra Holmslet, continues his bi-monthly series of informative articles.

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As illustrated in this series of articles, there are many ways of creating double block & bleed or double isolation and bleed. But under this name you need to have a depressurized volume between the two barriers and the name itself causes a problem. If taking a double piston ball valve like the one illustrated in Figure 27, with 100 % inlet pressure, 50 % pressure in the cavity and fully depressurized downstream side, you do have a valve with two barriers, but you don't have a depressurized volume between the two seats.

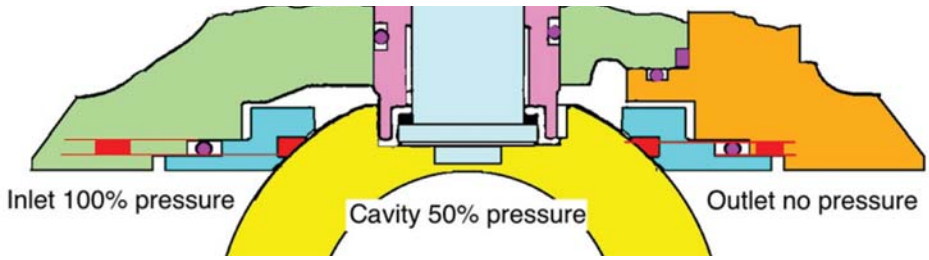

Figure 27.

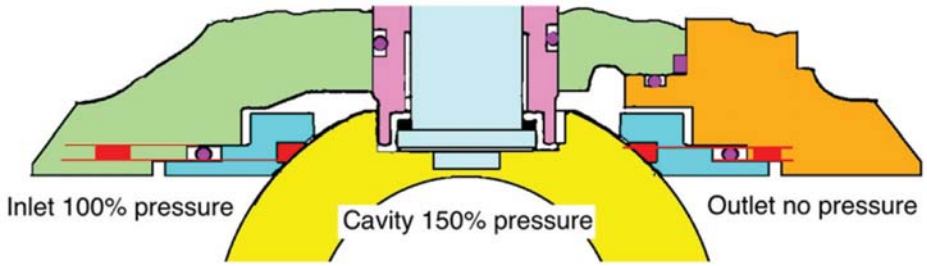

Figure 28.

Looking at Figure 28 it´s even worse. You do have two pressure-activated seats where the seal force is increased compared to the seal force in Figure 27, but you certainly do not have a bleed in-between the seats. As explained earlier, when taking the cavity pressure away you are taking the seal force away from the downstream seat, and you can end up with a leaky valve.
To explain: Taking a medium large valve such as a 16" class 900 as an example, to show what can happen if the seats are locked in the seat pockets due to high friction. The areas exposed to a differential pressure on a 16" valve are around 1250 cm^2. Looking at Figure 29 you will see that the valve is in the closed position with equal pressure on the inlet, cavity and outlet, the ball is in total balance with equal force acting on all sides as indicated by the red arrows. Let us use 120 bar as the system pressure in this class 900 valve. What happens when we depressurize the outlet of the valve, shown in Figure 30? When taking away the outlet pressure, the pressure in the cavity of 120 bar will act on the right side of the inside of the ball with a force equal to 150 tons (1250 cm^2 x 120 bar = 150 000 kp). This will make the outlet part of the ball oval and force the outlet seat slightly downwards – that's OK as the seats are floating. When depressurizing the cavity as indicated in Figure 31, the force towards the outlet side

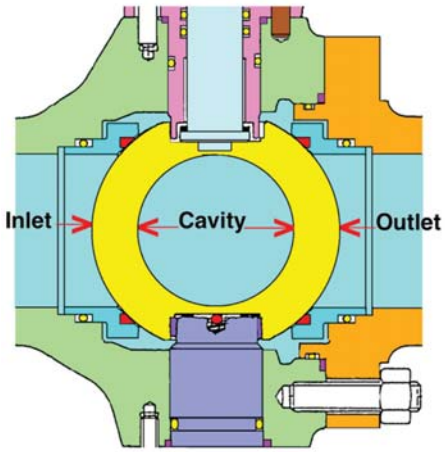

Figure 29.

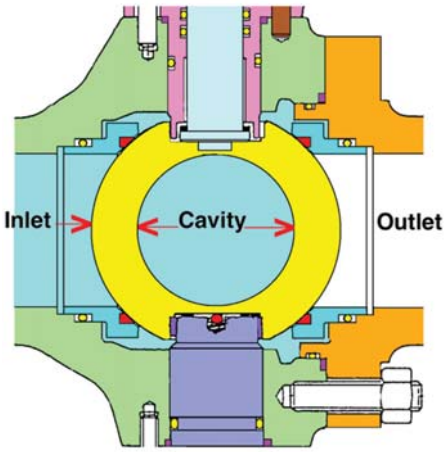

Figure 30.

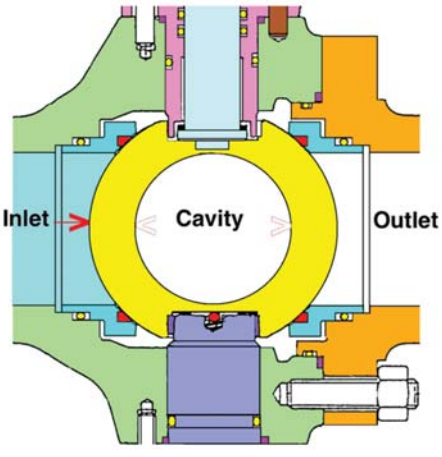

Figure 31.

of the ball is taken away and the ball gets back to its round shape. The floating seats are preloaded with coil springs, but the force of the springs is only a fraction of the force from the differential pressure and if the friction between the seat and the seat pocket is too high, the seat is stuck and in poor contact with the ball. You have created a small leak path on the outlet seat, but you still don´t know that.
Now, what happens on the inlet side of the ball? The inlet side was in perfect balance until the cavity was depressurized, but when taking away the support pressure from the inside of the ball bore as illustrated in Figure 31, the inlet pressure will now flatten the ball and force it slightly towards the downstream side away from the inlet seat. As long as the seat floats it´s OK, the inlet seat seals. But if the seat is stuck due to friction in the seat pocket you have created a small leak path. The inlet seat starts to leak and as long as there is lack of contact between the outlet seat and the ball the outlet seat will leak too. You do now have a leaky valve and a problem! This can be a difficult problem to solve, and if you are without lubrication fitting to the seats you may have to disassemble the valve. As everybody working with valve design knows it is challenging to design a valve. There are a lot of aspects to consider; dimension – material quality – the flexibility of the material – soft seals (O-ring or lip seal) – tolerances between moving surfaces – hard facing – lubrication to mention just some of the reasons for headaches. What happens with the valve when it is put into service? If using a 16" valve with lip seal as the radial seals on the seats, having a 0,3 mm clearance between the seat and the seat pocket you don´t need much imagination to understand that it is easy to experience a problem if you get a high temperature dry gas with sediments clogging up between the seat and the seat pocket, or if the round seats are becoming slightly oval. It's one thing to produce the valves, it's another thing to use them in the correct way.
I will end this series with a short account of what happened when everything was done in accordance with the company policy of double block and bleed.
It all started with a small hydrocarbon leak out of the spindle on a 2" class 600 wedge gate valve. I was called and asked what to do? My answer: Put the valve in the back seat position, test it and, if the valve seals, tighten or change the stem packings. The valve was placed in the back seat position and it sealed perfectly. The solution to change the packings under pressure was presented to the platform management whose answer was: "no, you don't have a double block and bleed." To change the spindle packings on the valve there had to be double block & bleed in all directions. A plan was set up, and all the valves to be closed and drains to be drained were marked up on the P&ID. How many valves were involved with this job I don´t know, but I was told there were a lot and that they had to shut down the production on the platform. The job of preparing to change spindle packings on this 2" valve took more than 12 hours with total shut down, and the time taken to change the spindle packings was 30 minutes. In my head this is total madness and lack of common sense.
The solution to this total lack of knowledge is training – valve training and valve understanding and maintenance procedures made up to fit the valves' construction and needs. Lack of knowledge is not SAFE.

Good luck with your valves!