Originally ball valves were designed to have soft seats made from plastic based materials to form a tight seal against a floating ball. The energy to affect the seat seal comes from three sources, the resilience of the selected seat material, the dimensional control of valve parts to achieve a preload on the seats, and from the action of line pressure against a closed ball. In this design the seats always stay in direct contact with the ball giving ball stability and guidance when operated. Problems such as cold flow of the seat itself from high preload or high line pressures and the desire to increase to higher service temperatures have been challenges to valve manufactures for many years.

During the past 30 or so years, new seat materials and/or blends have come to offer certain properties to enhance seat performance in certain applications. The original materials first used in ball valves, although very good in a wide range of media applications did present limits. Even adding of high temperature materials into the base material for example to improve temperature resistance have only had limited success. The performance in high temperature service has always been just out of reach. Enter metal seats in ball valves. In theory metal seats can take the valve temperature up to the full rated temperature of the valve body.

Metal seats present new challenges to the ball valve designers. The first problem with metal seats is the lack of resilience. The lip seal seat design and flexible materials work well to exert continuous pressure against the ball for reliable sealing both up and down stream and maintain low to moderate operating torques. Metal seats have no flexibility therefore cannot work the same way. The seal with metal seats is initially developed by careful machining and lapping of seat-to-ball contact.

The ball in the closed position moves toward the downstream seat by line pressure to increase the sealing force between the seat and ball. A flexible seal must be installed behind the downstream metal seat to prevent leakage around the back of the seat. This normal ball movement unloads the upstream seat reducing the ability to maintain a seal. A spring or a resilient material is installed behind the upstream seat to maintain upstream seat-to-ball contact.

The Flow-Tek metal seated valves are manufactured and offered in three leakage classes as defined in Fluid Control Institute standard, FCI 70-2-1998 titled “Control Valve Seat Leakage”. Flow-Tek offers metal seats in both our control valves and valves intended for on-off service. The three classes are not the same in allowable leakage or in price.

Class IV: from the standard….”This class establishes the maximum permissible leakage generally associated with commercial unbalanced single–seat control valves and balanced single-seat control valves with extra tight piston rings or other sealing means and metal-to-metal seats.”
Comment: Flow-Tek ball valves are balanced single-seat (without piston rings) design.

a. Seat test media is water at pressure equal to +/- 5 % of CWP or air at 45 to 60 psig.
b. Both seats tested.
c. Allowable seat leakage is 0.01% of the valve capacity.
d. Valve capacity must be determined or known based on the conditions the valve is to be used. When capacity is unknown Flow-Tek will use the max flow coefficient value, Cv, as the max capacity.

Class V: from the standard…."This class is usually specified for critical applications where control valve(s) may be required to be closed, without a blocking valve, for long periods of time against high pressure. It requires special manufacturing, assembly and testing techniques. This class is generally associated with metal seats(s), unbalanced single-seat control valve or balanced single-seat designs with exceptional seat and seal tightness."

Comment: Flow-Tek ball valves are balanced single–seat design.

a. Seat test media is water at pressure equal to +/-5% of CWP.
b. Both seats tested.
c. Allowable seat leakage is 0.0005 ml/minute/inch of seat diameter.

Class VI: from the standard…."This class establishes the maximum permissible seat leakage generally associated with resilient seating control valves either unbalanced or balanced single-seat with "O" rings or similar gapless seals."

Comment: Class VI leakage has never been intended for metal seated valves. Class VI is the standard Flow-Tek applies to all resilient seated valves tested to our normal standards. Class VI allowable leakage is the toughest criteria to meet with metal-to-metal seats. Flow-Tek will offer metal-to-metal seated ball valves to Class VI as an unbalanced single-seat design. Metal seats to Class VI require special seat design, manufacturing and assembly techniques. Flow-Tek Class VI metal seated valves will be unidirectional with the upstream seat spring loaded and only the downstream seat tested.

a. Seat test media is air at 60 to 100 psig.
b. Down stream seat tested only.
c. Allowable seat leakage per Table 2 of FCI 70-2.

Summary: Flow-Tek will offer metal-to-metal seated ball valves to three leakage classes as defined in FCI 70-2-1998 at different pricing levels. Each leakage class represents a tighter allowable leakage as the class number increases. Classes IV and V are bi-directional design and Class VI is unidirectional. In most cases the majority of metal seated ball valves offered shall be Class V.

Flow-Tek offers metal seated ball valves as meeting the offered leakage class at the time of shipment. No guaranties or additional warranty is offered or implied that seat tightness will remain in the same class after shipment.

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