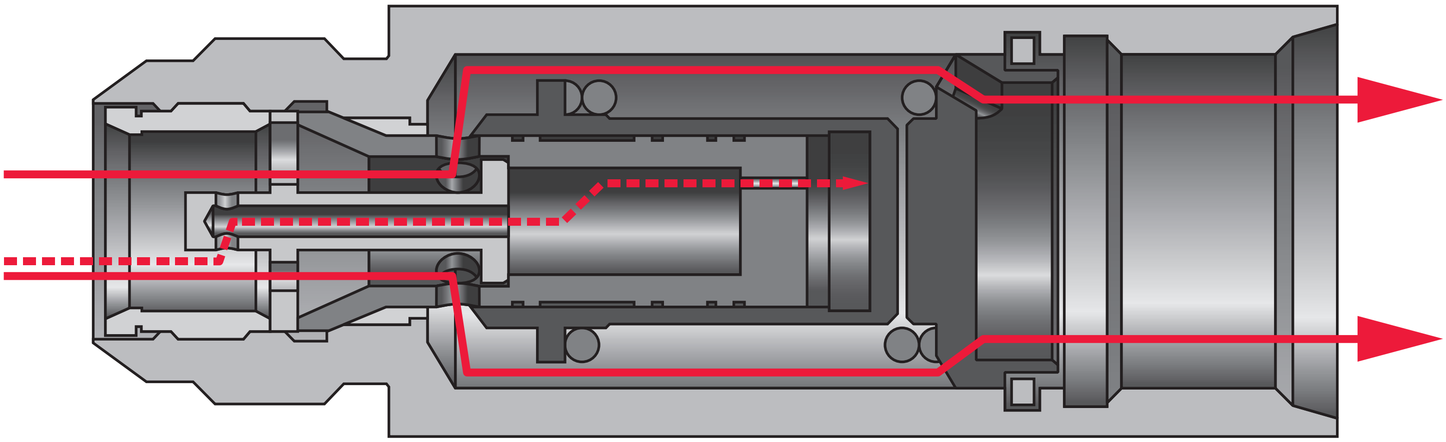
Liquid Fuel Check Valve Operation in Gas Turbine Applications



Liquid fuel check valve operation in dual fuel gas turbine applications is extremely severe. The impact of both system and environmental related anomalies on liquid fuel check valves lead to both premature failures of the valve and other fuel system components.

Check valve coking, high frequency oscillation, hydraulic hammer, tubing stress fatigue related failure, flow divider corrosion, fuel nozzle coking, fuel pump failure, magnetic clutch failure and fuel system evacuation are all problems which result from liquid fuel check valve failures. The resulting reliability issues significantly increase cost of ownership due to increased maintenance and valve replacement intervals.

Check valve coking is the first phenomena which will be discussed. The term coking is used to describe carbonization of diesel fuel on the check valve internal components when the turbine is operating on gaseous fuel. During this time, the liquid fuel system is idle and the diesel is stagnant in the check valve. Temperatures of 250 degrees F are typically enough to start the process and are easily achieved in the turbine compartment where the check valves are positioned.

Unfortunately, as diesel fuel becomes older and more unstable, the temperature threshold at which coke forms actually decreases. A key characteristic of coke is that once it forms, short of soaking the component in a strong solvent, it does not dissolve. At this point, crack pressure and sealing capability are significantly compromised.

Cracking pressure is defined as the point where check valves are designed to open and allow fuel flow to begin. Sealing ability both prevents diesel fuel from leaking downstream into the combustor and combustion gasses from traveling upstream through the valve into the fuel system. Coke formation inside of the check valve degrades both of these critical parameters.

As it relates to gas turbine operation, fuel system integrity suffers greatly from the partial or complete evacuation of liquid fuel when leakage exceeds an ANSI Class 6 standard. Symptoms of check valve leakage related failure include but are not limited to: multiple attempts required to achieve turbine ignition on liquid fuel, high exhaust temperature spreads both at start-up or when transferring from turbine operation on gaseous to liquid fuel.

Finally, data collected from gas turbine sites worldwide during the past several years has demonstrated that there is a solution available which mitigates the risk of check valve related failures. The development and use of water cooled liquid fuel check valves has shown that gas turbine owners can operate liquid fuel systems reliably for extended periods of time.

The benefit is that by maintaining check valve internal temperatures well below the coking threshold, liquid fuel check valve failure is all but eliminated. The ability to prevent coke formation allows the valve to maintain an ANSI Class 6 seal. This seal prevents fuel system evacuation and fuel leakage past the check valve into the fuel nozzles.

Maintaining a primed liquid fuel system allows all check valves to open at pressures which adhere to specification. The uniform opening of all liquid fuel check valves allows uniform fuel flow to the fuel nozzles. Thus, high exhaust temperature spread related system failures are avoided during turbine ignition on liquid fuel and during fuel transfers. Fuel transfer success rates nominally approach 100% on gas turbines which have implemented water cooled valve technology.

For those who are interested in learning more about this technology, associated products or would like to review customer references, please visit www.jasc-controls.com for more information.