



## TECHNOLOGY SOLUTION

### Mechanical and Fluid Systems



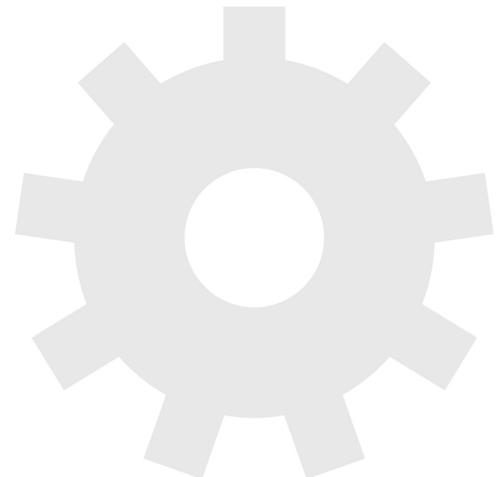
# Cryogenic Cam Butterfly Valve

Tight seals across broad temperature ranges.

Typical butterfly valves cannot seal at both ambient and cryogenic temperatures. At cryogenic temperatures, valves grow and shrink, changing critical dimensions such as distance between the disc and seat. Ideally, valves would compensate. The inability of existing butterfly valves to do this triggered the innovative design of the Cryogenic Cam Butterfly Valve (CCBV). The CCBV is designed so that the disc rides on a cam shaft and is held rigid by a torsion spring, which provides both axial movement of the disc in addition to the standard 90 degree rotation of a standard butterfly valve. Because the valves disc can rotate and translate, it can hold a tighter seal, preventing leakage despite dimensional changes caused by changing operating temperatures. The novel concept enables functional advantages similar to a globe valve. The CCBV enables low leakage at both ambient and cryogenic temperatures. Compared to competing valves, it is a simpler design which results in reduced manufacturing and maintenance costs.

#### BENEFITS

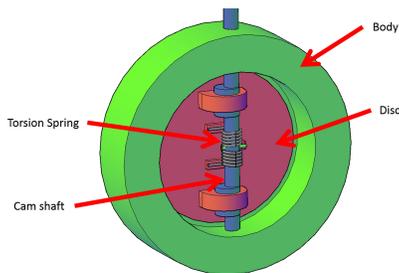
- Improved performance over a wide temperature range
- Simple seat design



## THE TECHNOLOGY

A globe valve controls flow by translating a disc over an opening. A butterfly valve controls flow by rotating a disc in an opening. The disc and seat of a butterfly valve have to create a tight seal exactly when the disc meets the 90 degree mark. If additional torque (energy) is added to the actuator of a butterfly valve, the disc will rotate past 90 degrees and the valve will open again. Therefore, with a standard butterfly valve, additional actuator energy cannot be added to reduce or minimize seat leakage, like with a globe valve.

The novel Cryogenic Cam Butterfly Valve (CCBV) design functions like a typical butterfly valve, rotated to open or close the valve. However, unlike a typical butterfly valve disc that can only rotate, the CCBV can be translated and rotated to control flow. The main parts of the CCBV include a body, disc, cam shaft, torsion spring and 180 degree actuator. In the full open position, disc rotation is 0 degrees and the disc is approximately perpendicular to the valve body to enable maximum flow. However, unlike a typical butterfly valve where the disc is not pinned to the shaft, the CCBV has a preloaded torsion spring mounted concentrically on the shaft with the spring legs against the disc, and a pin to keep the disc coupled to the shaft. The torsion spring is preloaded with sufficient torque so that the disc/shaft assembly acts like the disc is rigidly pinned to the shaft. The first 90 degrees of the actuator and shaft rotation rotates the disc, just like a typical butterfly valve; however, at approximately 90 degrees, one edge of the disc makes contact with the body seat, while the opposite edge is slightly off of the body seat. At this point, the disc can no longer rotate. The cam shaft then converts rotatory motion into translational motion. Because of the cam shaft lobes, as the actuator continues to rotate the shaft, the disc can now translate towards the body, and enables more of the disc to seal against the body seat. Therefore, all actuator and shaft rotation beyond 90 degrees translates the disc towards the body seat to create a tighter seal, similar to how globe valve functions. When the valve is in this position, seat leakage will be reduced and with additional actuator rotation, stopped. Eventually, a tight seal is formed in the full closed position. Then, with opposite shaft rotation, the valve will open. The CCBV incorporated the advantages of a globe to achieve tight seals from ambient to cryogenic temperatures.



Conceptual Illustration of the Cryogenic Butterfly Valve

## APPLICATIONS

The technology has several potential applications:

- Aerospace
- Petrochemical plants-piping systems
- Chemical industry-piping systems
- Cryogenic fluid systems, fluid

## PUBLICATIONS

Patent No: 9506571

[technology.nasa.gov](http://technology.nasa.gov)

More Information

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