# NASA TECH BRIEF

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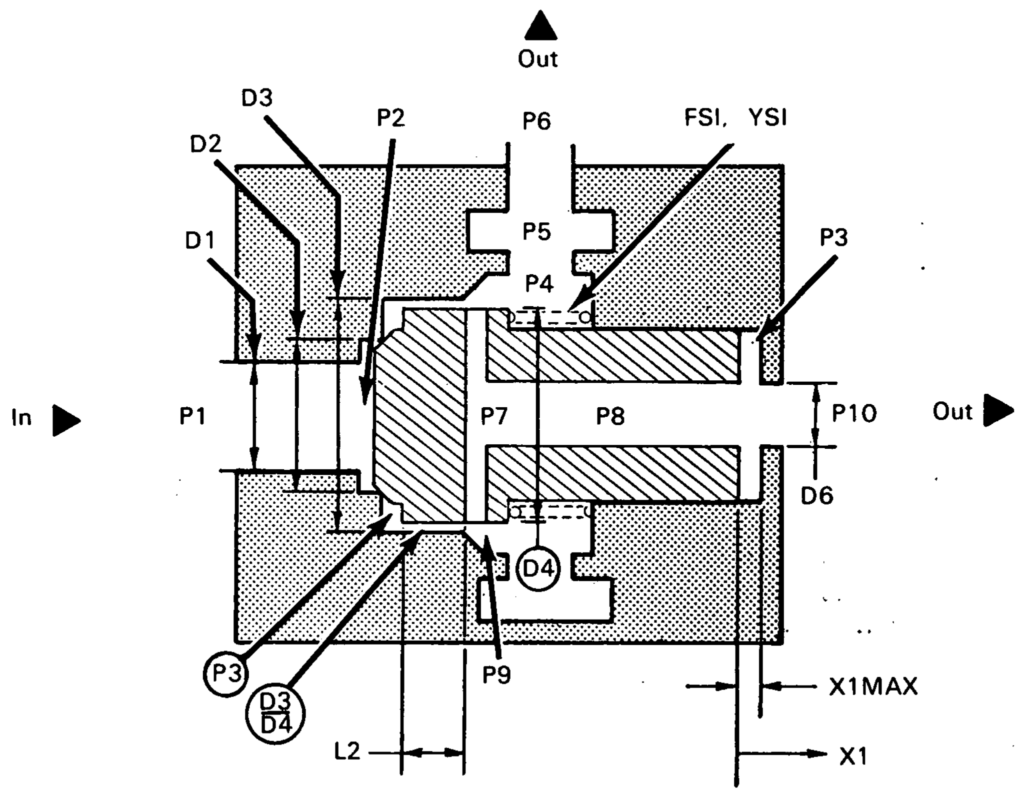
## Dynamically Stable Check Valve Concept for Wide Flow Range




A poppet-type check valve design has been conceived to accommodate a wide flow range without the usual chatter problem at low flow conditions.

The figure is a schematic of a pressure isolation check valve proposed for the J-2 rocket pneumatic package. Assuming line contact between the poppet and its seat, the seating circle is defined by diameter D2. Internal pressure P2 and P3 act against the poppet in its opening direction, and internal pressures P4, P7 and P9 act in the closing direction. A helical spring with installed load FS1 and spring rate YS1 applies a closing bias force. The spring installed load divided by the poppet seating circle cross-section area is equal to 10 psi.

Assuming outlet pressure P6 and P10 are equal, when the outlet pressures drop more than 10 psi below the inlet pressure the poppet unseats to permit gas flow through the check valve. As the poppet unseats, an

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annular clearance around the poppet circumference presents a flow restriction which reduces sharply at approximately one-half the poppet stroke. This restriction results in an internal pressure P3 which is greater than P4 under flowing conditions. As the poppet cracks and flow commences, the accompanying unbalanced force exerted by pressure P3 is an accelerating force in the opening direction.

When the poppet is fully stroked, the flow area through the clearances between the poppet and the seat and housing are from two to three times the cross-section area of the inlet port. When the poppet is fully stroked, the major pressure drop is from inlet pressure P1 to internal pressure P2.

Under flow demand conditions, when the pressure drop from inlet to outlet is only slightly more than 10 psi, the poppet will open, pressure P2 will decrease below P1, the pressure drop across the poppet will decrease below 10 psi, the poppet will close, and cyclic operation will result. During each opening of the poppet, pressure P3 applies an opening acceleration force which does not remain as a significant holding force due to the flow throat area transferring from the poppet to the inlet port. Under flowing conditions, the pressure drop from inlet to outlet required for holding the poppet in its fully open position is greater than the pressure drop required for cracking the poppet from its seat. As there is no significant dynamic damping of the poppet, cyclic operation will accompany any flow demand which can be satisfied with an overall pressure drop less than that required for a fully open poppet.

**Note:**

This development is in conceptual stage only, and, as of date of publication of this Tech Brief, neither a model nor prototype has been constructed.

**Patent status:**

No patent action is contemplated by NASA.

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