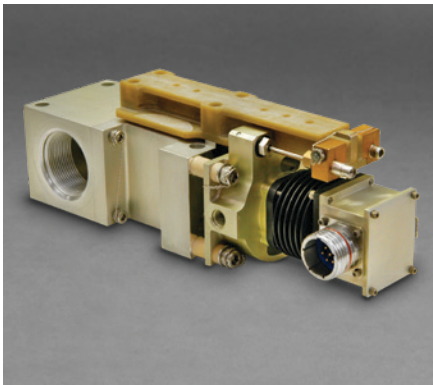


## CRYOGENIC SPECIAL APPLICATION VALVES

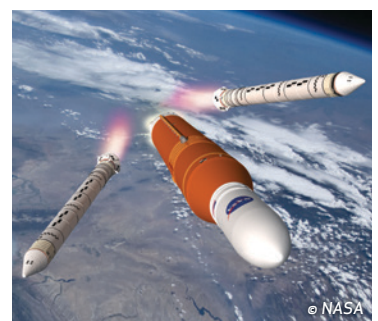


Moog produces a variety of fluid control components used in space launch vehicles as part of their cryogenic fluid control systems. These components handle media including gaseous and cryogenic hydrogen and oxygen, and provide very specific functionality in the cryogenic fluid system. Two of the valves presented below manage tank ullage gas pressure. The third valve works in the propellant feed system, controlling LOx flow

to provide a damping capability that reduced the “pogo” effect in the Delta IV launch vehicle. The three valves are pneumatically-operated, using nitrogen or helium to provide actuation pressure. Their pilot-operated designs provide low-weight solutions relative to their flow capacity.

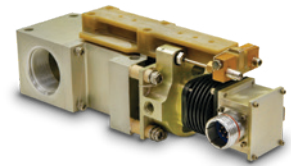
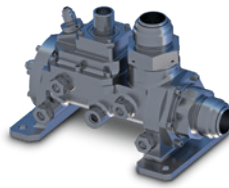
### KEY VALVE CAPABILITIES INCLUDE

- High performance at temperatures down to  $-423^{\circ}\text{F}$
- Operating pressures up to 500 psig MEOP
- $C_v = 83\text{-}100$  gal/minute  $\text{H}_2\text{O}$  (vent-relief valve)
- $C_d A \geq 0.3$  in<sup>2</sup> (Pogo valve)
- Designs address human rating requirements



# CRYOGENIC SPECIAL APPLICATION VALVES

## PERFORMANCE CHARACTERISTICS



Valve	Model 50E1389 Vent-Relief Valve	Model 54X164 Continuous Vent Valve	Model 50-918 POGO-Suppression Valve
Media	Gaseous Oxygen and Hydrogen	Gaseous Hydrogen	Liquid and Gaseous Oxygen
Unit Mass	8.5 lbm	4.5 lbm	7.6 lbm
Dimensions (L W H)	5.0" x 5.0" x 11.0"	7.6" x 4.0" x 4.7"	4.3" x 5.4" x 12.0"
MEOP	500 psig	40 psig	Nominal: 300 psig / Surge: 580 psig
Actuation Pressure	500 psig	500 psig	645 psig
Factors of Safety	Proof: 1.5x MEOP; Burst: 2.5x MEOP	Proof: 1.5x MEOP; Burst: 2.5x MEOP	Proof: 1.5x MEOP; Burst: 2.5x MEOP
Valve Flow Sizing	$C_v = 83-100$ gal/minute $H_2O$ @ 1.0 psid across valve, 60°F	$C_dA = 0.2$ in <sup>2</sup> minimum	$C_dA \geq 0.3$ in <sup>2</sup>
Internal Leakage	5 scc/minute GHe	~30 SCIM GHe @ 40 psig and -452°F (liquid helium)	163 scc/minute GHe ambient/cryogenic
External Leakage	25 scc/minute GHe	~600 SCIM GHe @ -452°F (liquid helium)	5 scc/hour GHe ambient
Actuation Voltage	N/A	N/A	20 – 34 VDC
Pull-in / Drop Out Voltage	N/A	N/A	Pull in: $\leq 18$ VDC / Drop out: $\geq 2$ VDC
Response Time	$1 \pm 0.5$ sec (open or close)	1.5 sec (open or close)	0.100 msec (open or close)
Position Indication	N/A	Microswitches: one open / one close	N/A
Operating Temperature	-320°F – 160°F	-423°F – 170°F	-320°F – 160°F
Filtration	N/A	10 micron nominal, 25 micron absolute	N/A
Random Vibration	31 Grms	14 Grms – In-Plane Axes 39 Grms – Normal Axis	80 Grms (qual level)
Shock	1000 G	1000 G	1000 G
Cycle Life	500 cycles	400 cycles	1000 cycles
Materials of Construction	Aluminum, CRES, Vespel, PCTFE	Aluminium, CRES, PTFE, and PEEK	Aluminum, CRES, Vespel, PTFE



For More Information:  
 Bill Vogt  
 bvogt@moog.com  
 www.moog.com/space



Moog Space and Defense



@MoogSDG



@MoogSDG



@MoogSDG



@MoogInc

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