

<b>References:</b>	1. NASA GRC Online ( <a href="http://www.grc.nasa.gov/WWW/k-12/airplane/mflchk.html">http://www.grc.nasa.gov/WWW/k-12/airplane/mflchk.html</a> ) 2. Data Sheet for Norgren Quietaire exhaust muffler (model #MA008A)
<b>Description:</b>	Assessment of Deluge Pneumatic Exhaust Mufflers in CP-0001 and CP-0003
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<b>Date:</b>	10/6/2014

**Problem:**  
MARS would like to add exhaust mufflers to the outlets of each of the deluge pneumatic panel vent lines. There is one vent per panel in CP-0001 and CP-0003. In an effort to save money, it is recommended that lower pressure rated mufflers be used on the vent lines of CP-0001 and CP-0003. This will require small orifices to be installed upstream to reduce the outlet pressure at the vents (mufflers rated for 300 psi).

- Assumptions/ Inputs:**
- 1) The vent is flowing to atmosphere (0 psig)
  - 2) Choked flow exists through the orifice (M=1)
  - 3) The pressure stored in the system is 1650 psig (maximum allowable pressure via RV-5190)
  - 4) The solenoid vent valves open instantaneously to release the stored N<sub>2</sub>

**Calculations:**  
Using the following values (SI units),

A = 2.48e-6 m<sup>2</sup> (orifice size of .070" as specified per RS&H Drawing; Sheets M-612 and M-632)  
P<sub>t</sub> = 11.37635 MPa (1650 psig supply at inlet)  
T<sub>t</sub> = 273.2 K (32°F)  
γ = 1.4  
R = 297 J/kg·K

And using Equation 1 to the right (Ref. #1):

$$\dot{m} = \frac{A P_t}{\sqrt{T_t}} \sqrt{\frac{\gamma}{R}} \left(\frac{\gamma+1}{2}\right)^{-\frac{\gamma+1}{2(\gamma-1)}}$$

**Equation 1:**

**Where:**  
A = Area  
R = Gas Constant  
γ = Specific Heat Ratio  
T<sub>t</sub> = Total Temperature  
p<sub>t</sub> = Total Pressure

$\dot{m} = 0.06790 \text{ kg/s} = \underline{123.94 \text{ SCFM}}$

**Results/Conclusion:**  
Per the chart to the right taken from the Norgren datasheet (Ref. #2), the expected back pressure inside the muffler at the calculated flow rate of 123.94 SCFM is approximately 10 psig. Therefore, the existing configuration of CP-0001 and CP-0003 will allow 300 psi rated mufflers to be installed in this system.

Back Pressure (psig)	MS012A (scfm)	MS010A (scfm)	MS008A (scfm)	MS006A (scfm)	MS004A (scfm)	MS003A (scfm)	MS002A (scfm)	MS001A (scfm)
0	0	0	0	0	0	0	0	0
2	~20	~15	~10	~8	~6	~4	~3	~2
4	~40	~30	~20	~15	~10	~7	~5	~3
6	~60	~45	~30	~20	~13	~9	~6	~4
8	~80	~60	~40	~25	~16	~11	~7	~5
10	~100	~75	~50	~30	~19	~13	~8	~6
12	~120	~90	~60	~35	~22	~15	~10	~7