

References:	1. NASA GRC Online (http://www.grc.nasa.gov/WWW/k-12/airplane/mflchk.html) 2. Data Sheet for Norgren Quietaire exhaust muffler (model #MA008A)
Description:	Assessment of Deluge Pneumatic Exhaust Mufflers in CP-0001 and CP-0003
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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_2

Calculations:

Using the following values (SI units),

$A = 2.48 \times 10^{-6} \text{ m}^2$ (orifice size of .070" as specified per RS&H Drawing; Sheets M-612 and M-632)

$P_t = 11.37635 \text{ MPa}$ (1650 psig supply at inlet)

$T_t = 273.2 \text{ K}$ (32°F)

$\gamma = 1.4$

$R = 297 \text{ J/kg}\cdot\text{K}$

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

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

Equation 1:

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

Where:

A = Area

R = Gas Constant

γ = Specific Heat Ratio

T_t = Total Temperature

P_t = Total Pressure

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.

