

Dalton's Law of Partial Pressures as it Affects Dewpoint Measurements

The Definition of Dalton's Law

In chemistry and physics, Dalton's law (also called Dalton's law of partial pressures) states that in a mixture of non-reacting gases, the total pressure exerted is equal to the sum of the partial pressures of the individual gases.

Dalton's Law of Partial Pressure States:

- $P(\text{TOTAL}) = P_1 + P_2 + P_3 + \dots + P(N)$
 - WHERE
 - $P(\text{TOTAL})$ IS THE TOTAL PRESSURE OF THE SYSTEM
 - $P_1, P_2, P_3, \dots, P(N)$ ARE THE PARTIAL PRESSURES OF THE COMPONENTS COMPRISING THE GAS STREAM
 - $P(N) = P(\text{TOTAL})Y(N)$
 - WHERE $Y(N)$ IS THE MOLE FRACTION OF THE NTH COMPONENT IN THE GAS STREAM
 - AS $P(\text{TOTAL})$ CHANGES SO DO THE PARTIAL PRESSURES, I.E. $P_1, P_2, P_3, \dots, P(N)$
 - SINCE DEWPOINT (T) IS ASSOCIATED WITH PARTIAL PRESSURE, AS PARTIAL PRESSURE CHANGES, SO DOES DEWPOINT (T)
- HOWEVER, THE NUMBER OF MOLES IN THE GAS REMAINS THE SAME; THEREFORE, IF MOISTURE CONTENT IS MEASURED IN PPMV IT IS NOT AFFECTED BY PRESSURE

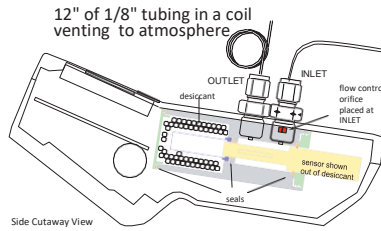
Effects of Pressure on Dewpoint Using Air as an Example:

- TOTAL AIR PRESSURE IS THE SUM OF THE PARTIAL PRESSURE OF THE CONSTITUENTS OF AIR:
 $P(\text{Total}) = P(\text{Nitrogen}) + P(\text{Oxygen}) + P(\text{water vapor}) + P(\text{other gasses})$
 - THE WETTER THE AIR THE HIGHER THE PARTIAL WATER VAPOR PRESSURE
- IF THE AIR IS COMPRESSED AND THE TOTAL PRESSURE INCREASES, THE PARTIAL WATER VAPOR PRESSURE INCREASES PROPORTIONALLY
 - THE DEWPOINT IS DEPENDENT ON THE PARTIAL WATER VAPOR PRESSURE THUS IT WILL INCREASE AS WELL

These drawings and any specifications and concepts contained are the property of Phymetrix Inc., are issued in strict confidence and shall not be used as the basis for the manufacture or sale of apparatus or services, or reproduced or copied or transmitted in any form or by any means without written permission.

Measuring at near Atmospheric Pressure - Recommended

Method 1

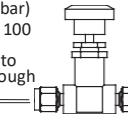


pressure to analyzer up to 100 psi 7 Bar

pressure inside analyzer 1.08 Bar

Model PPMa

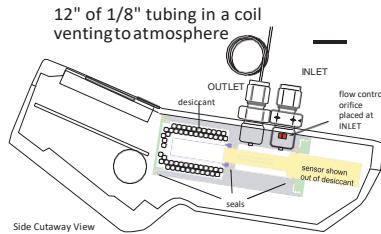
For pressures below 100 psi (7 bar) needle valve is optional, above 100 psi a needle valve or pressure regulator is advisable on order to control the flow rate of gas through the analyzer.



1/8" Swagelok fitting to connect to process



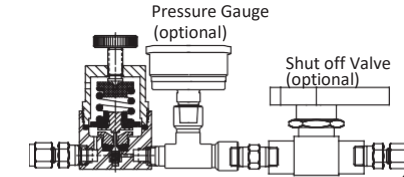
Method 2



pressure inside analyzer ~ 1.08 Bar

Model PPMa

Optionally, Braided Teflon Hose to withstand up to 3000psi (206bar) Can be used ahead of the regulator or as shown after the regulator; depending on convenience. However it is recommended to be connected as shown because the ambient moisture trapped in the tube will flush out quicker at lower pressure.



Pressure regulator to assure that the pressure in the analyzer is near atmospheric.

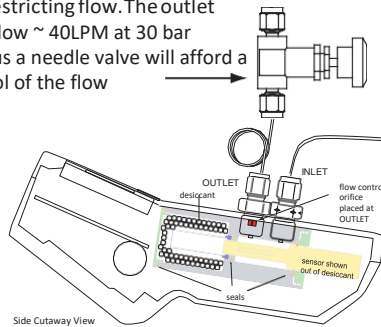
1/8" Swagelok fitting to connect to process



Measuring at Process Pressure

Optionally utilize a **Needle Valve** as a method of restricting flow. The outlet orifice will allow ~ 40LPM at 30 bar pressure, thus a needle valve will afford a better control of the flow

Method 3

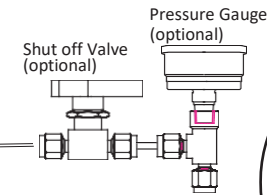


pressure to analyzer up to 500 psi 35 Bar

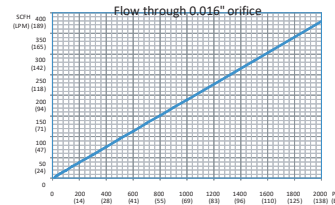
Braided Teflon Hose to withstand the high pressure

pressure inside analyzer < 35 Bar

Model PPMa-PH




1/8" Swagelok fitting to connect to process



The " -P" in the model name signifies that there is an internal pressure sensor option thus the exact pressure inside the measurement chamber can be viewed on the display and the analyzer can perform pressure correction calculations.

The " -H" in the model name signifies that the analyzer can be exposed up to 500 psi (35 bar) of pressure, without the H option the max analyzer pressure is 150 psi (10 bar).

 PhyMetrix®	Title:	
	Methods of moisture content measuring with a PPMa	
	Drawn by:	Date:
	BB	
Scale:		Page:
N/A		1 of 1
Part Number:		Rev:
		2

Unless otherwise specified dimensions are in inches

.x +/- 0.020"
.xx +/- 0.010"
.xxx +/- 0.005"