

Rometec s.r.l.

Via Alessandro Minuziano, 87-89 00178 Roma

Rometec srl - www.rometec.it - info@rometec.it - Rometec srl - www.rometec.it - info@rometec.it

TEL. 065001033 - FAX 065001072

Sito web: www.rometec.it - email: info@rometec.it

P. IVA 04120621000 - CCIAA RM 736916

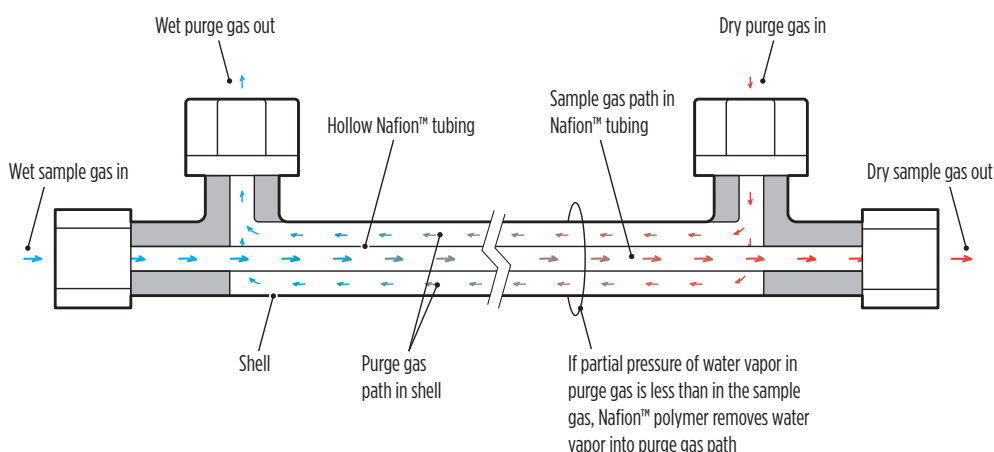
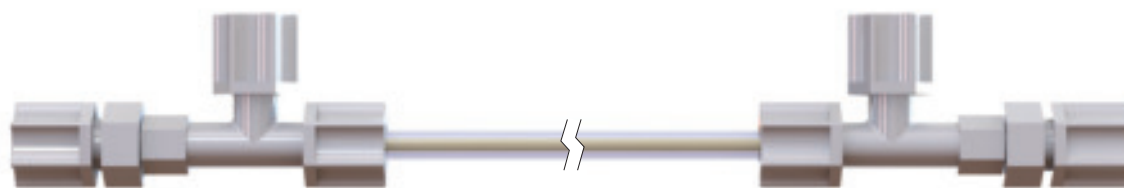
Reg. Soc. Tribunale RM 9229/91 - Cap. soc. 46'482,00 €



MD-Series Gas Dryers

Powered by Nafion™ tubing, Perma Pure gas dryers selectively remove water from a gas sample. This **selectivity for water vapor** allows our dryers to **remove more moisture than other gas drying solutions**, while **keeping analytes in the gas sample**.

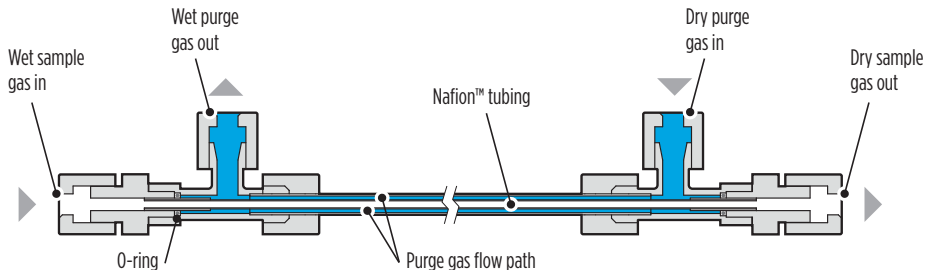
Monotube Dryer Series (MD-Series) gas dryers contain a single Nafion™ tube. The MD-Series can dry a gas to humidity levels **as low as -40 °C dew point** and is ideal for applications with flow rates **up to 4 lpm**.



HOW IT WORKS

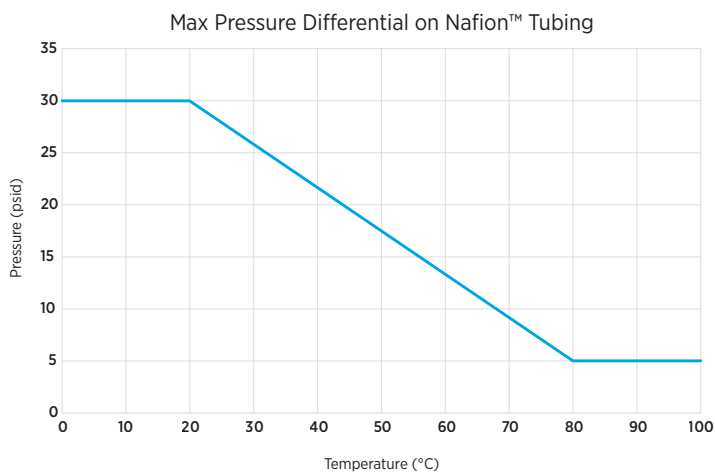
Flow your sample gas **through** the Nafion™ tubing and flow a dry purge gas **outside** the Nafion™ tubing, countercurrent to the sample gas flow.

While the partial pressure of water in the purge gas is less than in the sample gas, Nafion™ polymer will selectively transfer water and water vapor from the sample gas across its membrane and into the purge gas flow, yielding a drier sample gas at the sample gas output.



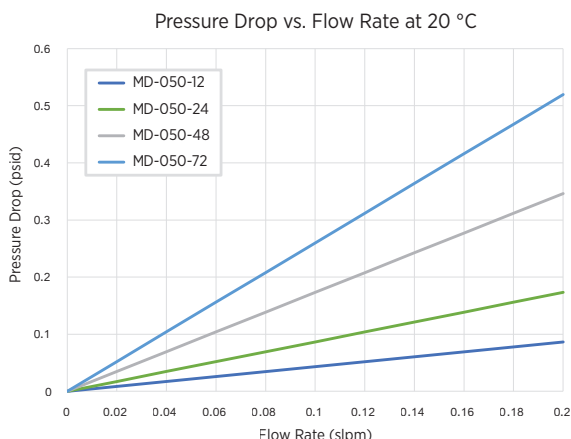
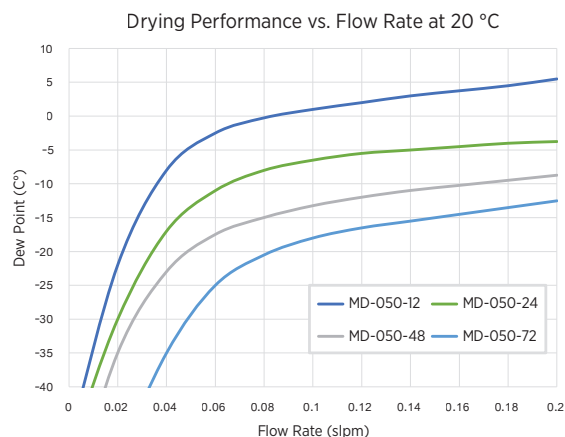
SPECIFICATIONS

Nafion™ Tubing Outer Diameter Options	0.050" (MD-050), 0.070" (MD-070), 0.110" (MD-110)
Max. Flow Rate	0.2 lpm (MD-050), 4 lpm (MD-070), 4 lpm (MD-110)
Housing Materials Available	Polypropylene, Fluorocarbon, or Stainless Steel
Max. Operating Temperatures	80 °C for polypropylene housing, 100 °C for fluorocarbon or stainless steel housing
Sample Gas Port - End Fitting Options	Port 1/16" Compression (MD-050, Stainless Steel Only) Port 1/8" Compression (All models) Port 1/4" Compression (MD-070, MD-110)
Purge Gas Port - End Fitting Size	Port 1/8" Compression (MD-050) Port 1/4" Compression (MD-070, MD-110)
Purge Gas Recommendations	<ul style="list-style-type: none"> • Purge gas must be drier than sample gas • Purge gas can be instrument quality air (max -40 °C dew point) or nitrogen • Purge gas should flow at 2 or 3 times the sample rate <p><small>*Alternate methods to using a purge gas are possible, such as recycling the dry sample gas, or pulling vacuum through the purge gas flow path. See website for more information.</small></p>
Coiled Configurations	Certain models are shipped coiled based on length. See page 4 for nominal diameters. Contact us for custom coiled solutions.

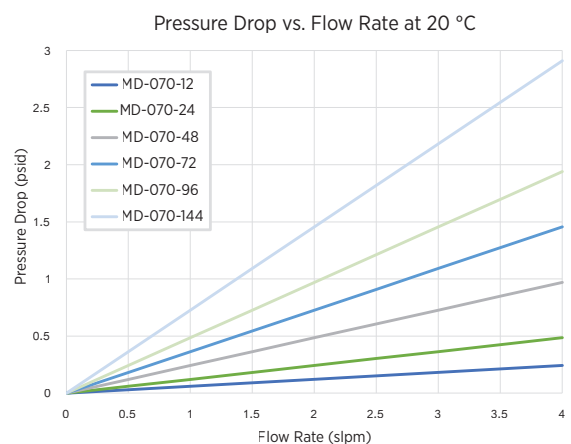
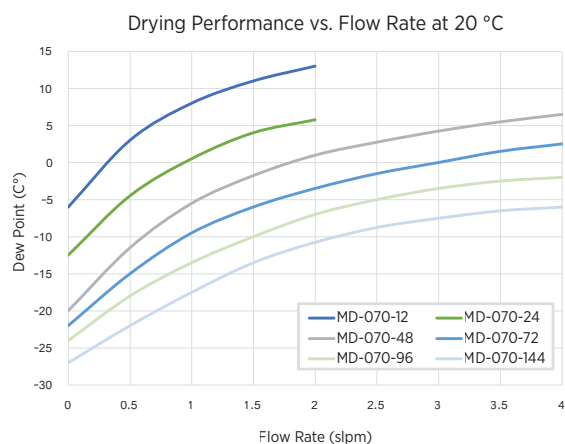


psid (psi-differential) = [sample gas pressure (psig) at inlet] - [sample gas pressure at outlet (psig)]

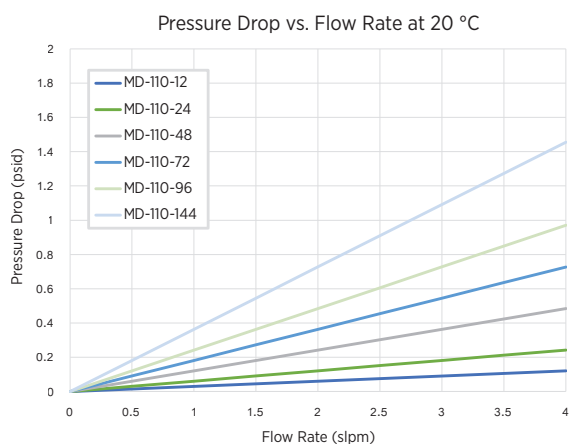
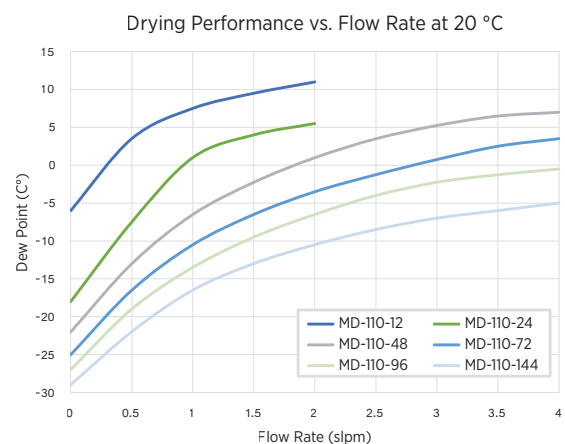
MD-050 Model: Flow rates up to 0.2 lpm



MD-070 Model: Flow rates up to 4 lpm



MD-110 Model: Flow rates up to 4 lpm

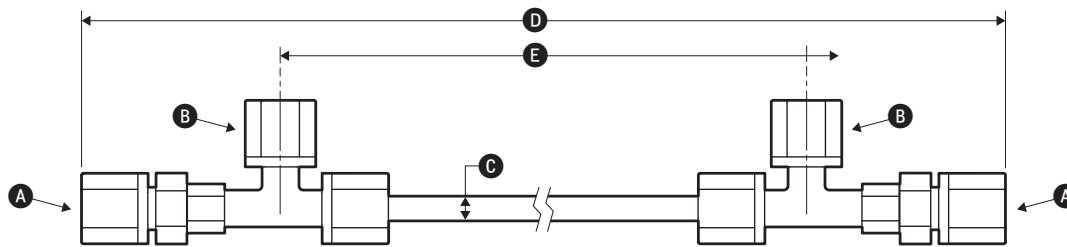


The performance curves above are based upon a sample inlet dew point of 20°C and purge flow rate of 2x the sample flow rate. Consult our team for operation with sample gases condensing above ambient temperature.
 psid (psi-differential) = [sample gas pressure at inlet (psig)] - [sample gas pressure at outlet (psig)], based on atmospheric pressure at outlet.

MATERIAL CODE	MATERIALS FOR END FITTINGS AND SHELL
P	Molded polypropylene fittings, polypropylene shell
F	Molded fluorocarbon fittings, fluorocarbon shell
FP	Molded fluorocarbon fittings, polypropylene shell
S	Stainless steel fittings, stainless steel shell
FS	Molded fluorocarbon fittings, stainless steel shell

END FITTING CODE	MATERIALS FOR END FITTINGS
1	1/16" Compression (MD-050, Material codes S and FS only)
2	1/8" Compression (All models)
4	1/4" Compression (MD-070 and MD-110 only)

PHYSICAL DIMENSIONS BY MODEL



MODEL	NOMINAL COIL DIAMETER*	MATERIAL CODES: F, P, FP					MATERIAL CODES: S, FS				
		A	B	C	D	E	A	B	C	D	E
MD-050-12	--	1/8"	1/8"	1/8"	14 3/8"	11 1/8"	1/8" or 1/16"	1/8"	1/8"	13 5/8"	11 1/8"
MD-050-24	--	1/8"	1/8"	1/8"	26 3/8"	23 1/8"	1/8" or 1/16"	1/8"	1/8"	25 5/8"	23 1/8"
MD-050-48	4"	1/8"	1/8"	1/8"	50 3/8"	47 1/8"	1/8" or 1/16"	1/8"	1/8"	49 5/8"	47 1/8"
MD-050-72	4"	1/8"	1/8"	1/8"	74 3/8"	71 1/8"	1/8" or 1/16"	1/8"	1/8"	73 5/8"	71 1/8"
MD-070-12	--	1/4" or 1/8"	1/4"	1/4"	14 1/4"	10"	1/4" or 1/8"	1/4"	1/4"	13 3/4"	10 3/4"
MD-070-24	--	1/4" or 1/8"	1/4"	1/4"	26 1/4"	22"	1/4" or 1/8"	1/4"	1/4"	25 3/4"	22 3/4"
MD-070-48	7"	1/4" or 1/8"	1/4"	1/4"	50 1/4"	46"	1/4" or 1/8"	1/4"	1/4"	49 3/4"	46 3/4"
MD-070-72	7"	1/4" or 1/8"	1/4"	1/4"	74 1/4"	70"	1/4" or 1/8"	1/4"	1/4"	73 3/4"	70 3/4"
MD-070-96	7"	1/4" or 1/8"	1/4"	1/4"	98 1/4"	94"	1/4" or 1/8"	1/4"	1/4"	97 3/4"	94 3/4"
MD-070-144	7"	1/4" or 1/8"	1/4"	1/4"	146 1/4"	142"	1/4" or 1/8"	1/4"	1/4"	145 3/4"	142 3/4"
MD-110-12	--	1/4" or 1/8"	1/4"	1/4"	14 1/4"	10"	1/4" or 1/8"	1/4"	1/4"	13 3/4"	10 3/4"
MD-110-24	--	1/4" or 1/8"	1/4"	1/4"	26 1/4"	22"	1/4" or 1/8"	1/4"	1/4"	25 3/4"	22 3/4"
MD-110-48	7"	1/4" or 1/8"	1/4"	1/4"	50 1/4"	46"	1/4" or 1/8"	1/4"	1/4"	49 3/4"	46 3/4"
MD-110-72	7"	1/4" or 1/8"	1/4"	1/4"	74 1/4"	70"	1/4" or 1/8"	1/4"	1/4"	73 3/4"	70 3/4"
MD-110-96	7"	1/4" or 1/8"	1/4"	1/4"	98 1/4"	94"	1/4" or 1/8"	1/4"	1/4"	97 3/4"	94 3/4"
MD-110-144	7"	1/4" or 1/8"	1/4"	1/4"	146 1/4"	142"	1/4" or 1/8"	1/4"	1/4"	145 3/4"	142 3/4"

*Models with a Nominal Coil Diameter are shipped coiled.

Part Number = [Model][Material Code]-[End Fitting Code]. For example: MD-050-12-P-2



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Via Alessandro Minuziano, 87-89 , 00128 Roma

Tel. 065061635 – Fax 065061542

Sito web: www.rometec.it – email: info@rometec.it

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MRD Gas Sample Dryers

Perma Pure MRD™-Series gas sample dryer series (Monotube Dryer) is a variation of the MD-Series dryer with a number of important enhancements. Just like the MD Series, the MRD Series uses a single Nafion™ tubing selectively permeable membrane tube to continuously dry gas streams removing only water vapor. These dryers operate over a wide range of temperatures, pressures and flow rates, and dry to dew points as low as -60°C. Here are the benefits over the standard MD Series:

- Special rotating ends allow easy adjustment of the purge gas fitting placement without twisting the inner tube
- Standard materials of FEP tubing / Kynar end fittings
- Improved o-ring sealing system, separating the sample and purge gas
- A wider range of end connections available, including metric 6mm
- Available with 070 and 110 tubing sizes

Principle of Operation

MRD-Series gas dryers transfer moisture from one gas stream to a counter-flowing purge gas stream, much like a shell-and-tube heat exchanger transfers heat. Water molecules migrate through the Nafion™ tubing wall, transferring to the purge gas stream. The differential in the partial vapor pressure of water between the two gas streams drives the reaction, quickly drying the air or gas. Purge gas should be dry (-40°C dew point) air or other gas. If no dry gas is available, the differential in the water vapor pressure can be created by pulling a vacuum on the purge side by using a portion of the gas dried by the MRD-Series dryer as the purge gas in a split-stream or reflux method. Visit the Purge Gas Configurations page to learn more about the purge methods Perma Pure customers deploy in their equipment.

MRD Series Flow Diagram



Codice ordinativo

MRD	110	-	072	T	K	V	-	2222
Series	Tubing		Length	Shell	Fitting	Ferrule		Connections 1-4

1 – Series	
MD-R (Monotube Dryer) Series	MRD
2 – Tubing Size	
0.070" Nafion™ Tubing	070
0.110" Nafion™ Tubing	110
3 – Dryer Lengths	
12" (30 cm)	012
24" (60 cm)	024
48" (120 cm)	048
72" (180 cm)	072
96" (240 cm)	096
144" (360 cm)	144
4 – Shell Material	
Fluorocarbon (FEP / PVDF)	T
5 – Fitting Material	
Kynar	K
6 – Ferrule Material	
Viton	V
7 – Connector 1-4	
1 Left Sample 2 Left Purge	
3 Right Purge 4 Right Sample	
NONE (5/32" F)	0
1/4" Quick Connect	1
1/8" Quick Connect	2
6mm Quick Connect	4

Recommended Sample Gas Flow Rates:

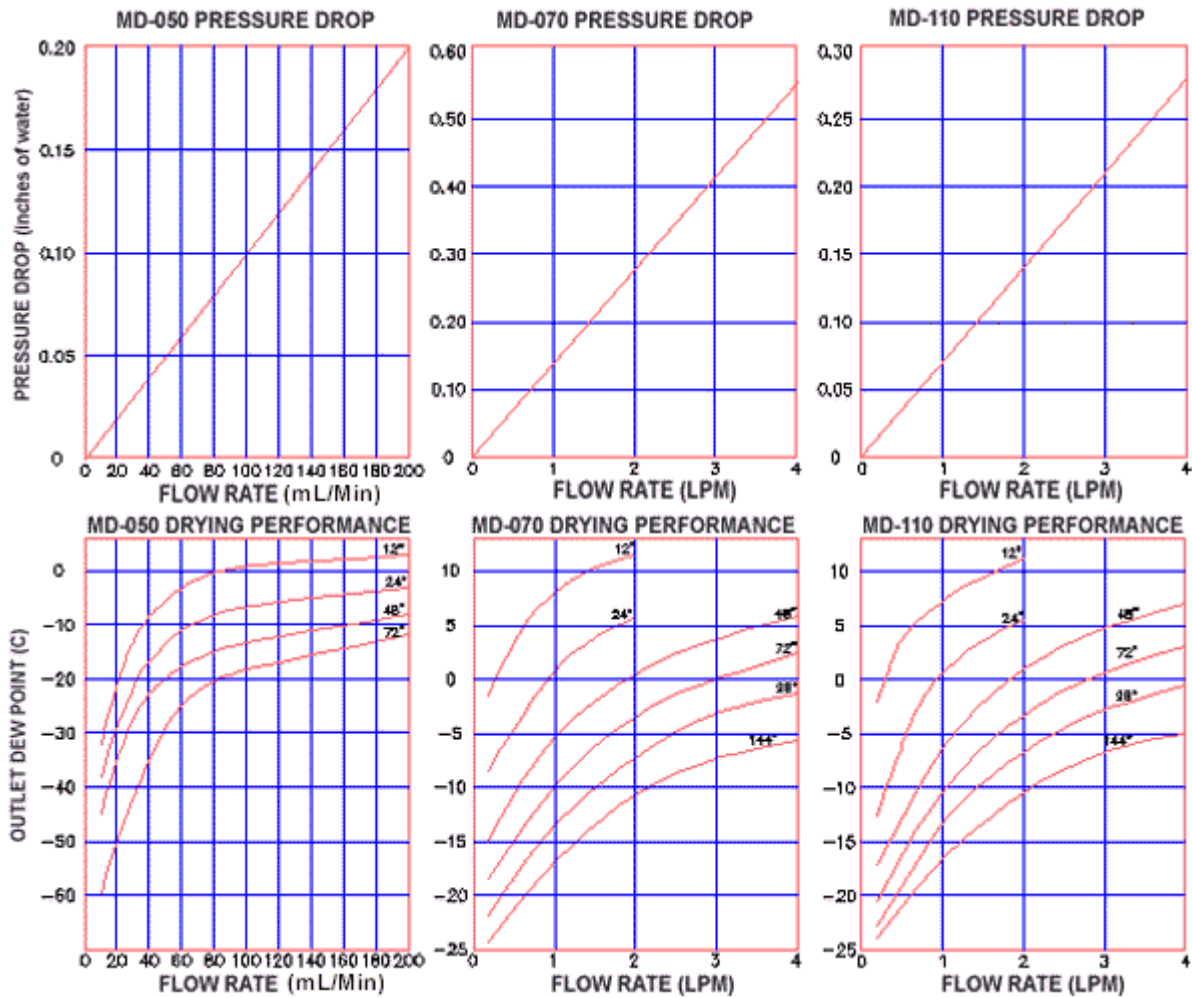
0.1-2 lpm: MDR-070 Series

1-4 lpm: MDR-110 Series

Selection Guide Notes

MDR-070 and MDR-110 offer approximately the same drying performance. Specify MD-110 when pressure drop is a concern, MD-070 to minimize dead volume. For higher flow rates, please see our PD-Series dryers.

MRD Dryer Series Performance Curves



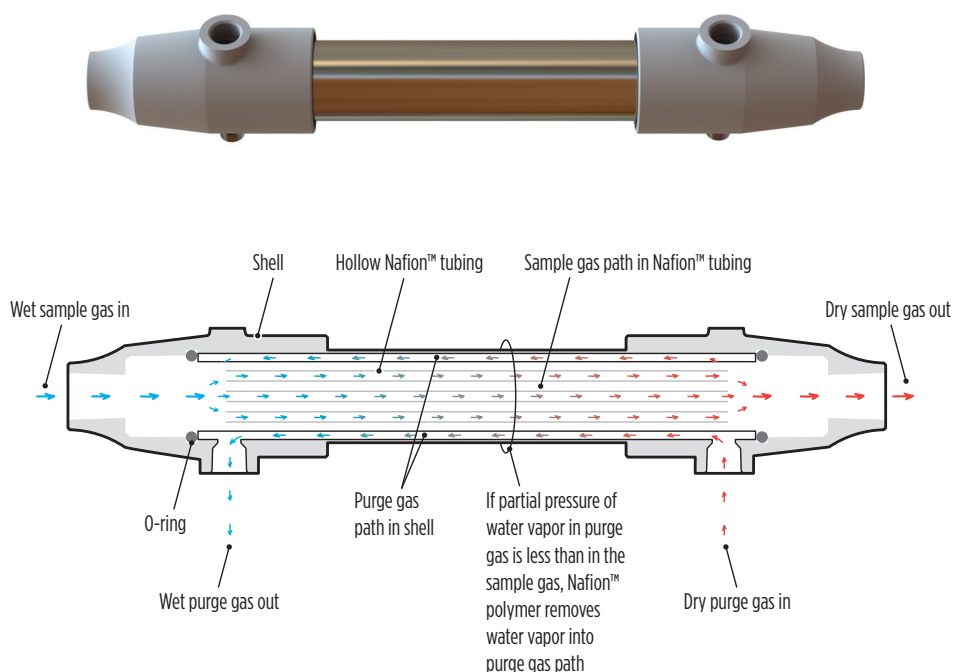
NOTE:

The pressure drop is per inch of dryer. For example, the pressure drop of 100 ml/min through an MD-050-24 is equal to 2.4 inches of water. These performance curves are based upon an inlet sample dew point of 20°C, a purge gas with a dew point of -40°C, and a purge flow rate which is 2-3 times the sample flow rate. For conditions higher than ambient temperature, it is assumed that the first half of the dryer will be used to bring the dew point down to ambient. For this reason, read the value of the next shorter dryer. For example, a stream with an initial dew point of 50°C, flowing at 2 slpm; an MD-070-48 should yield an outlet dew point of 6°C, the performance of the 24" unit.

PD-Series Gas Dryers

Powered by Nafion™ tubing, Perma Pure gas dryers selectively remove water vapor from a gas sample. This **selectivity for water vapor** allows our dryers to **remove more moisture than other gas drying solutions**, while **keeping analytes in the gas sample**.

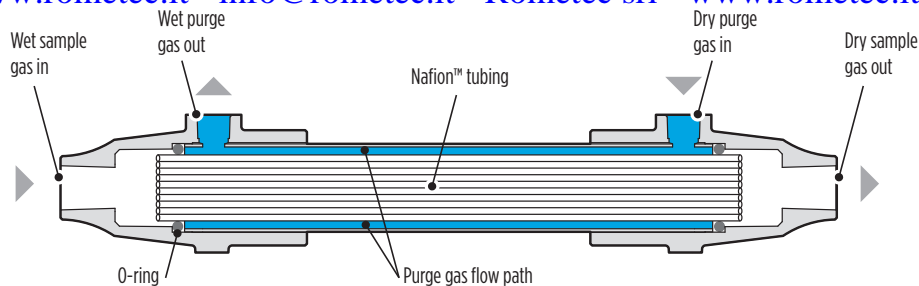
Unlike our other single-tube gas dryers, **Polytube Dryer Series** (PD-Series) gas dryers contain multiple Nafion™ tubes bundled together allowing for a higher volume of gas movement in a shorter sample path. This makes the PD-Series the ideal choice for high flow rate gas drying applications (**up to 40 lpm**). Because of this greater surface area of Nafion™ tubing, **the PD-Series offers our highest drying capacity**.



HOW IT WORKS

Flow your sample gas **through** the Nafion™ tubing and flow a dry purge gas **outside** the Nafion™ tubing, countercurrent to the sample gas flow.

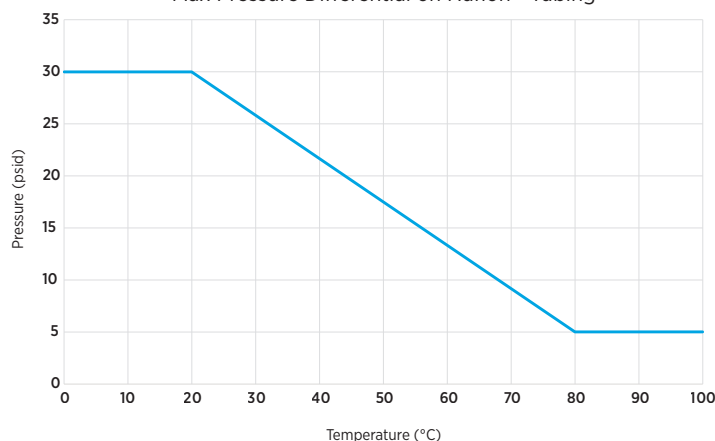
While the partial pressure of water in the purge gas is less than in the sample gas, Nafion™ polymer will selectively transfer water and water vapor from the sample gas across its membrane and into the purge gas flow, yielding a drier sample gas at the sample gas output.



SPECIFICATIONS

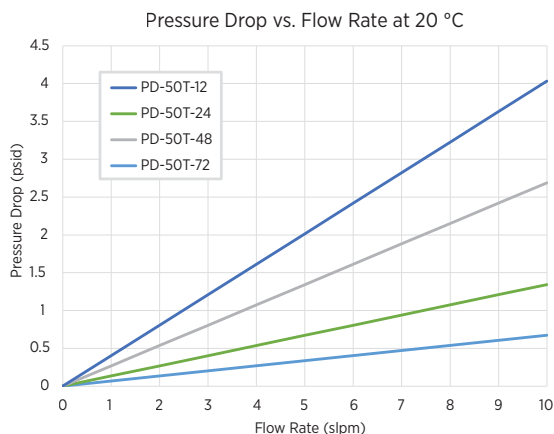
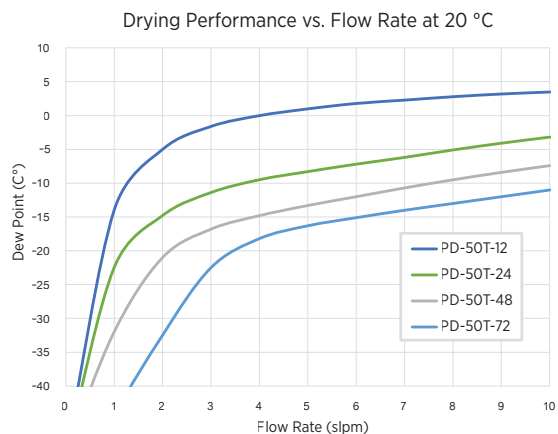
Number of Nafion™ Tubes Inside	50 (PD-50T), 100 (PD-100T), or 200 (PD-200T)
Max Flow Rate	10 lpm (PD-50T), 20 lpm (PD-100T), 40 lpm (PD-200T)
Housing Materials Available	Polypropylene, Fluorocarbon, or Stainless Steel
Max Operating Temperatures	80 °C for polypropylene housing, 100 °C for fluorocarbon or stainless steel housing
Sample Gas Port - End Fittings	Port 1/4" NPT
Purge Gas Port - End Fittings	Port 1/8" NPT
Purge Gas Recommendations	<ul style="list-style-type: none"> • Purge gas must be drier than sample gas • Purge gas can be instrument quality air (max -40 °C dew point) or nitrogen • Purge gas should flow at 2 or 3 times the sample rate <p><small>*Alternate methods to using a purge gas are possible, such as recycling the dry sample gas, or pulling vacuum through the purge gas flow path. See website for more information.</small></p>

Max Pressure Differential on Nafion™ Tubing

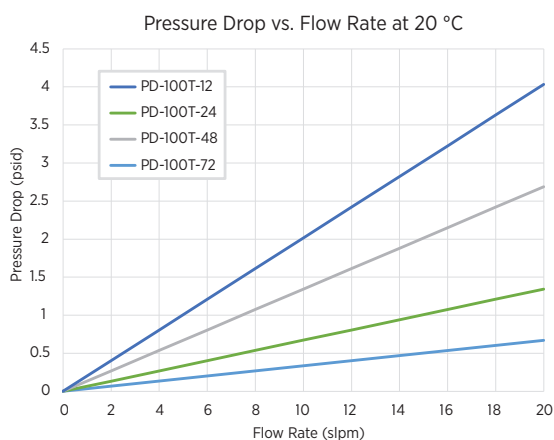
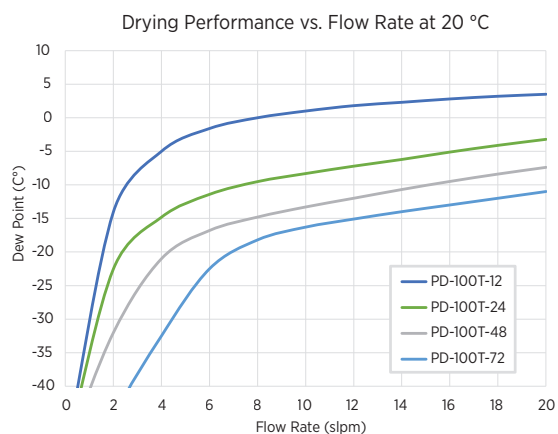


psid (psi-differential) = [sample gas pressure (psig) at inlet] - [sample gas pressure at outlet (psig)]

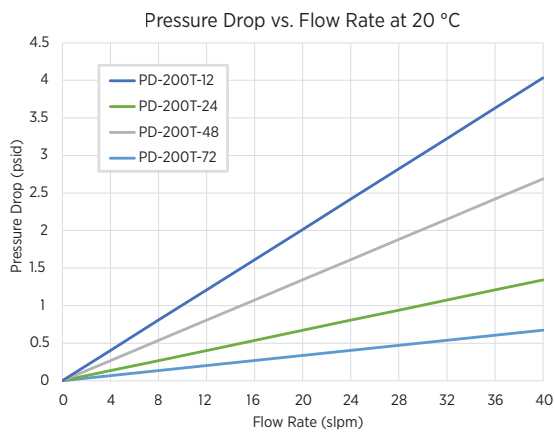
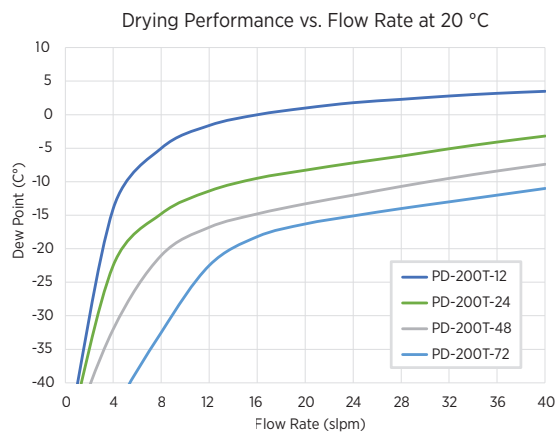
PD-50T Model: Flow rates up to 10 lpm



PD-100T Model: Flow rates up to 20 lpm



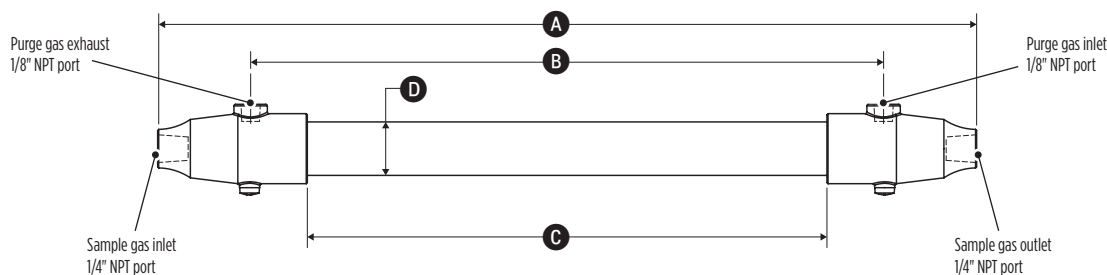
PD-200T Model: Flow rates up to 40 lpm



The performance curves above are based upon a sample inlet dew point of 20°C and purge flow rate of 2x the sample flow rate. Consult our team for operation with sample gases condensing above ambient temperature.
 psid (psi-differential) = [sample gas pressure at inlet (psig)] - [sample gas pressure at outlet (psig)], based on atmospheric pressure at outlet.

MATERIAL CODE	MATERIALS FOR END FITTINGS AND SHELL
MPP*	Molded polypropylene fittings, polypropylene shell
MPS	Molded polypropylene fittings, stainless steel shell
MPR	Molded polypropylene fittings, rubber shell
MKA	Molded fluorocarbon fittings, anodized aluminum shell
MKS	Molded fluorocarbon fittings, stainless steel shell
MKR	Molded fluorocarbon fittings, rubber shell
MKC	Molded fluorocarbon fittings, corrugated stainless steel shell
MSA	Machined stainless steel fittings, anodized aluminum shell
MSS	Machined stainless steel fittings and shell
MSR	Machined stainless steel fittings, rubber shell
MSC	Machined stainless steel fittings, corrugated stainless steel shell

PHYSICAL DIMENSIONS BY MODEL



MODEL	A	B	C	D	D	D
				MPP*, MPS, MKA, MKS, MSA, MSS	MKC, MSC	MPR, MKR, MSR
PD-50T-12	15.3"	11.8"	9.7"	0.75"	1.04"	1.13"
PD-50T-24	23.3"	19.8"	17.7"	0.75"	1.04"	1.13"
PD-50T-48	47.3"	43.8"	41.7"	0.75"	1.04"	1.13"
PD-50T-72	71.3"	67.8"	65.7"	0.75"	1.04"	1.13"
PD-100T-12	15.3"	11.8"	9.7"	1.00"	1.24"	1.38"
PD-100T-24	23.3"	19.8"	17.7"	1.00"	1.24"	1.38"
PD-100T-48	47.3"	43.8"	41.7"	1.00"	1.24"	1.38"
PD-100T-72	71.3"	67.8"	65.7"	1.00"	1.24"	1.38"
PD-200T-12	15.3"	11.8"	9.7"	1.00"	1.24"	1.38"
PD-200T-24	23.3"	19.8"	17.7"	1.00"	1.24"	1.38"
PD-200T-48	47.3"	43.8"	41.7"	1.00"	1.24"	1.38"
PD-200T-72	71.3"	67.8"	65.7"	1.00"	1.24"	1.38"

*MPP material only available in PD-50T models

Part Number = [Model]-[Material]. For example: PD-50T-12-MPP