Dynapore®

Fluidizing media for bulk powder handling and processing

The high-strength cleanable easily fabricated porous metal sheet for all fluidizing applications

NO ONE BUT MKI CAN GIVE YOU:

Dynapore®

Dynapore LFM™ and HFM™ controlled permeability media are constructed of multiple layers of carefully selected stainless steel wire mesh, laminated by precision sintering (diffusion bonding) and calendering. The resultant monolithic structure is permanently bonded and has highly uniform flow characteristics. Dynapore laminates are ideal for even flow distribution of gases in fluidizing and aeration applications.

Dynapore is constructed of 100% AISI type 316 stainless steel. Other temperature and corrosion resisting alloys are available on special request. Custom laminates offering enhanced mechanical strength are also available.

Dynapore media are easily sheared, formed, punched, welded and cleaned using standard equipment and methods. Dynapore laminates are available from stock in convenient 24"x 48" and 36" x 36" sheets. Larger TIG butt-welded sizes are also available. MKI, of course, offers custom fabrication services.

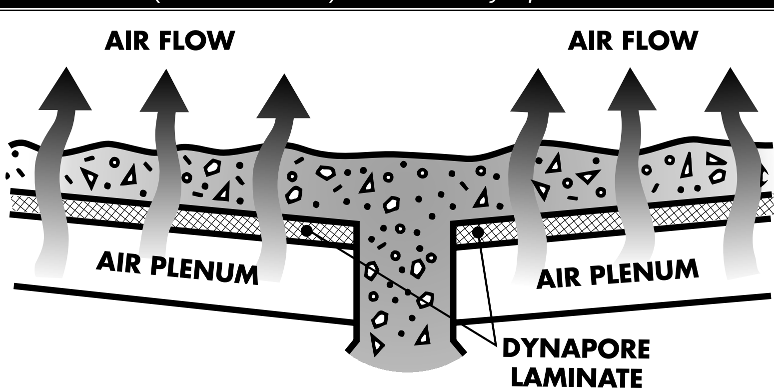
Dynapore media are abrasion and puncture resistant and will not chip, flake or shed fibers. Depending upon load, Dynapore can withstand continuous operating temperatures up to 1000˚F with intermittent spikes of 1200˚F. The abrasion, corrosion, and temperature resisting properties of Dynapore media are superior to that of polyester, metal felts, or sintered powder metals.

Dynapore LFM and HFM air flow ratings and pressure drop curves are presented on the adjacent page. LFM 3-layer media range in air flow from 5 to 25 scfm/sf @ 2 in. water column pressure drop. HFM 2-layer media range from 50 to 400 scfm/sf @ 2 in. water column. Custom permeabilities are available on special request.

For more information, request the following Bulletins:

401 Mechanical Properties
402 Installation Recommendations
403 Fluidized Conveyor Truss and Bolt Spacing
404 Flow Equations and Permeability Constants

Alumina (aluminum oxide) fluidized on *Dynapore* flows like water.



- ❑ LIME
- ❑ CEMENT
- ❑ FLY ASH
- ❑ GYPSUM
- ❑ ALUMINA
- ❑ TEREPHTHALIC ACID

- BINS ❑
- SILOS ❑
- DRYERS ❑
- HOPPERS ❑
- REACTORS ❑
- AIR-GRAVITY CONVEYORS ❑

AIR FLOW CHARACTERISTICS

The air flow rating values for 3-layer LFM and 2-layer HFM Dynapore laminates are presented in the following tables. LFM laminates cover the air flow range from 5 to 25 scfm/ft2 @ 2 in. water column pressure drop. HFM laminates flow from 50 to 400 cfm/ft2 @ 2 in. water column. In general, HFM media are lower in weight and thickness, and have larger mean pore sizes.

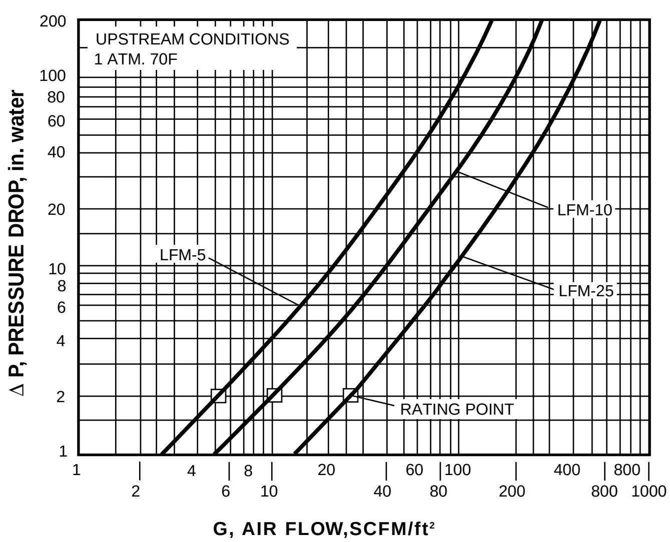
LFM

3-LAYER LAMINATE (WEIGHT 2.0 LBS/FT^2)			
MEDIUM TYPE	PART NUMBER	AIR FLOW SCFM/FT^2 @ ΔP 2 IN. WATER	NOMINAL THICKNESS INCHES
LFM-5	407520	5.0	0.054
LFM-10	401300	10.0	0.058
LFM-25	407530	25.0	0.061

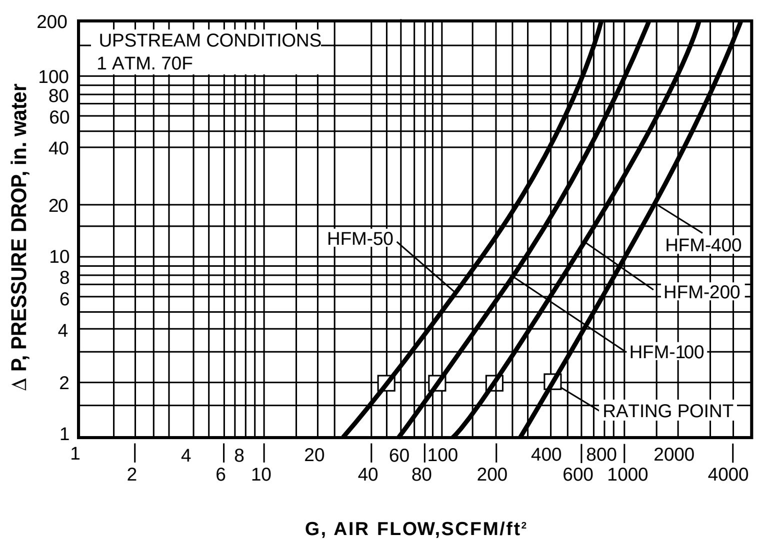
HFM

2-LAYER LAMINATE (WEIGHT 1.5 LBS/FT^2)			
MEDIUM TYPE	PART NUMBER	AIR FLOW SCFM/FT^2 @ ΔP 2 IN. WATER	NOMINAL THICKNESS INCHES
HFM-50	401420	50	0.041
HFM-100	401430	100	0.044
HFM-200	401440	200	0.050
HFM-400	407570	400	0.060

PRESSURE DROP vs AIR FLOW - 3 LAYER DYNAPORE



PRESSURE DROP vs AIR FLOW - 2 LAYER DYNAPORE



BULK POWDERS FLOW LIKE LIQUIDS ON

Dynapore®

STAINLESS STEEL FLUIDIZING MEDIA

Dynapore®

A proven product for more than 25 Years

cleanability

Dynapore is easy to clean because ordinary water and detergent, high pressure steam or chemical methods may be used to remove most oil and dirt.

easily fabricated

Dynapore can be easily fabricated, punched, sheared, or formed. Weldability is excellent using TIG or other standard methods. ***Dynapore*** is available from stock, in seamless 24" x 48" and 36" x 36" sheets.

air flow uniformity

High temperature diffusion bonding and precision calendering create the precise and uniform air flow properties of ***Dynapore***.

engineered porous media

application versatility

Dynapore laminates are not limited to LFM and HFM construction. By careful mesh selection and sequencing, a porous metal medium can be engineered to fit almost any specification for: pore size; pore density; tortuosity; mechanical strength; permeability; corrosion resistance; and acoustical resistance.

For extremely fine powders, MKI offers Dynapore *Particle Control Fluidizing Media™*. ***PCM™ media are available in the same flow ranges as LFM and HFM but with particle barrier meshes as fine as two microns sintered to the downstream surface. Consult the factory for more information.***

- Fluidized hoppers, beds and slides
- Air film conveyors
- Air bearings
- Spargers and diffusers
- Transpiration cooling media
- Flame and spark arresters
- Flow restricters
- Pressure snubbers
- Acoustical mufflers
- Propellant surface tension devices
- Resin and catalyst beds
- Filter leaves and cartridges
- Particle classification screens
- Vacuum forming and molding media
- Drying/de-watering media

MKI

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Fluidizing Media Mechanical Properties

MEDIA TYPE	Ultimate Tensile Strength (psi)	Yield Strength @ 0.2% offset (psi)	Elongation, 2 in. gauge length (%)	Tensile modulus of elasticity (psi x 10^6)	Thickness (in) approximate
LFM-5	40,000	28,500	9.0	13.3	0.054
LFM-10	39,000	27,000	13.5	13.0	0.058
LFM-25	30,000	19,000	14.5	12.7	0.061
LFM-50	25,500	14,250	16.0	11.0	0.068
HFM-50	26,000	19,000	9.0	11.0	0.041
HFM-100	24,000	17,000	11.0	9.7	0.044
HFM-200	18,850	11,250	16.5	8.8	0.050
HFM-400	16,000	7,600	22.5	8.3	0.060
HFM-600	13,900	5,400	24.3	7.6	0.065

Notes

1.) Approximate weight: LFM 2.0 lbs/sq. ft.
HFM 1.5 lbs/sq. ft.

2.) Testing in accordance with ASTM A 370-95a.

3.) All data are approximate or average, and are based on standard AISI T-316 stainless steel construction.

4.) Specifications are subject to change without notice.

5.) Designs should reflect the decreasing yield strength of type 316 stainless steel at temperatures over 400° F.

- *Sintered wire mesh laminates*
- *Sintered powder metal*
- *Sintered fiber metal*

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Dynapore®
Installation Recommendations

1.0 Fitting Dynapore LFM & HFM Fluidizing Media:

Generally speaking, Dynapore fluidizing media can be handled as if they were solid stainless steel sheets. They may be readily cut to size on a power shear, band saw, or nibbler of proper capacity. These media may also be formed using suitable bend radii. (Please consult factory for recommendations). Dynapore media may be punched using standard punches and dies. A punch-to-die clearance of 3½% per side is suggested.

2.0 Welding:

Welding Dynapore sheets together to make larger pieces can be accomplished readily through butt-welding. After shearing or cutting the media to obtain a clean straight edge, butt the sheet edges together on top of a copper plate or bar for support and to serve as a heat sink. TIG weld the joint with an initial setting of around 32 volts and 45 amps. Use a 0.063” diameter 2% thoriated Tungsten electrode and T-347 filler wire of 0.032” to 0.040” diameter. If cleaning the weld is required, use only a STAINLESS STEEL wire brush. These media can also be welded using plasma, laser, and electron beam methods.

3.0 Chemical Finishing:

Some applications may require passivation or electropolishing of the media. Dynapore media may be finished by either of these chemical finishing processes. However, due to variances in bath compositions and concentrations, residence times may vary. Always test a small sample or test coupon before proceeding with the production lot. In addition, thorough rinsing is very important.

4.0 Caulking:

Airflow losses must be prevented around the panel edges where the media are clamped between plenum flanges. An appropriate caulking compound should be applied to seal both upper and lower surfaces of the media. Where Dynapore media are used to retrofit an existing slide, or in conjunction with another medium, shimming may be required if variations in media thicknesses are greater than flange adjustment allowances.

5.0 Air Supply:

To provide optimal operating life, the fluidizing air supply must be of instrument quality, i.e., clean and dry. Regular replacement of the air supply filters, as well as providing moisture free air, will help insure long life. In addition, thorough cleaning of the plenum prior to installation will prevent immediate plugging, assuming the plenum has been properly and adequately sealed.

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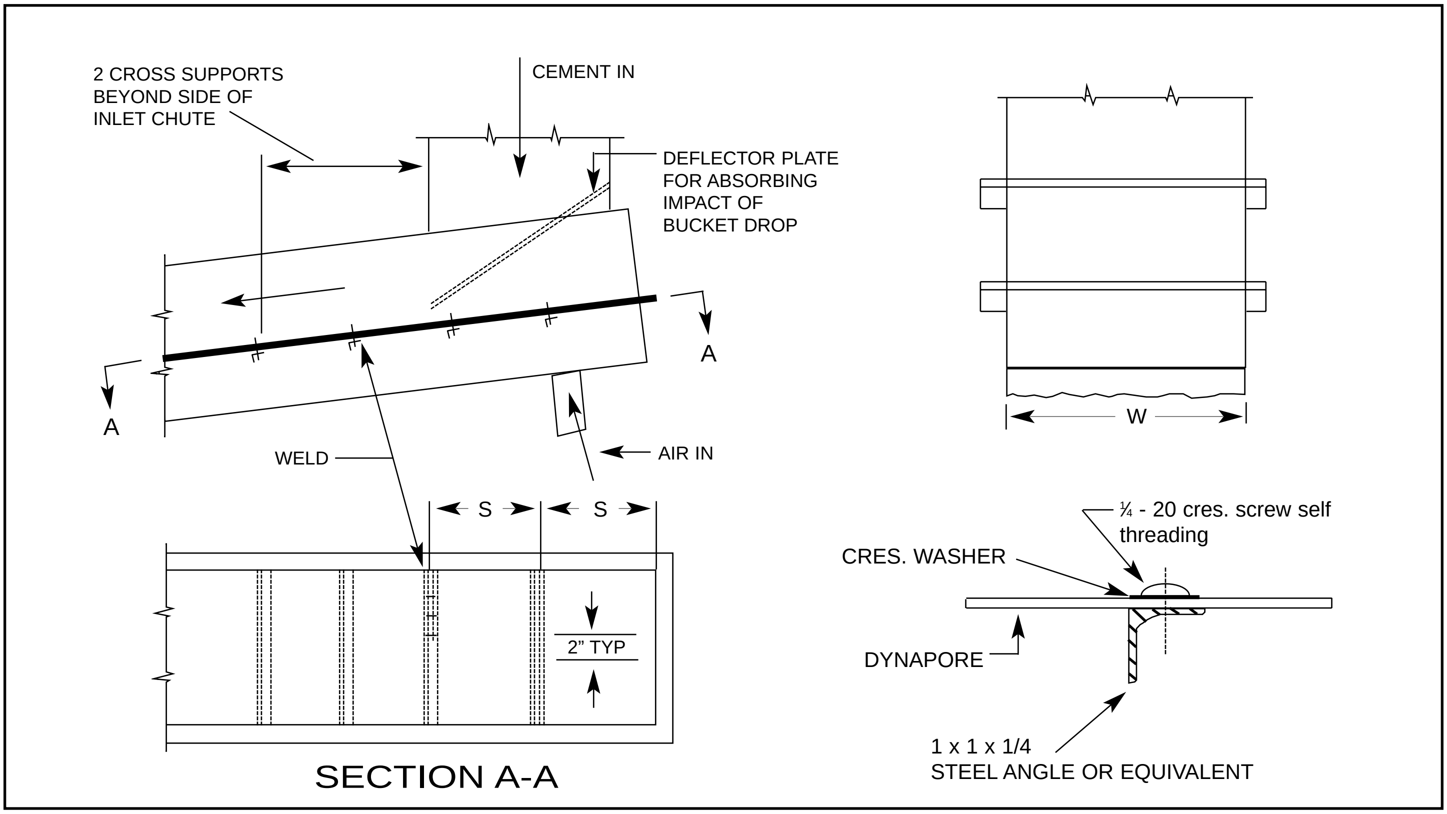
Installation Recommendations

In applications where the conveyor is subjected to an intermittent load from dropping powder, a deflector plate, cross supports and bolting arrangement, as shown in the sketch, are recommended. The accompanying table gives the support spacing for a range of inside conveyor widths and air supply pressures.



WIDTH "W"	SPACING OF CROSS SUPPORTS, "S", Inches					
	1 PSIG	2 PSIG	3 PSIG	4 PSIG	5 PSIG	6 PSIG
6	-	-	-	-	6.0	4.5
8	-	-	8.5	6.0	6.0	4.5
10	-	-	8.0	6.0	6.0	4.5
12	-	10.0	7.0	6.0	6.0	4.5
14	-	9.0	7.0	6.0	6.0	4.5
16	16.0	9.0	7.0	6.0	6.0	4.5
18	15.0	9.0	7.0	6.0	6.0	4.5
20	14.5	9.0	7.0	6.0	6.0	4.5
22	14.5	9.0	7.0	6.0	6.0	4.5
24	14.5	9.0	7.0	6.0	6.0	4.5

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Fluidizing Media Technical Data

AIR FLOW CHARACTERISTICS

The air flow rating values for the 3-layer and 2-layer Dynapore laminates are presented in the following table. The 3-layer laminate covers the air flow range from 5 to 25 SCFM/ft^2 at 2 in. water pressure drop. The 2-layer laminate flows from 50 to 400 SCFM/ft^2 at 2 in. water pressure drop.

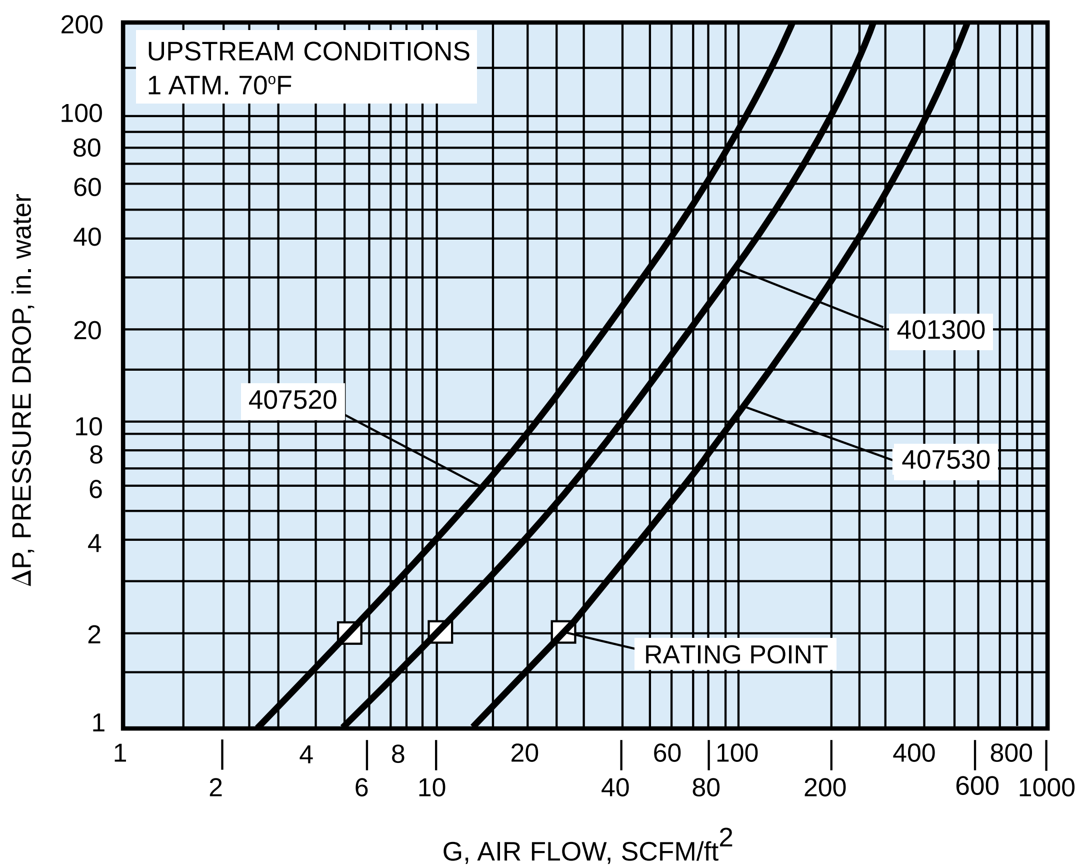
AIR FLOW RATING

3-LAYER LAMINATE (WEIGHT 2.0 LBS./SQ. FT.)		
PART NUMBER	AIR FLOW SCFM/FT.^{2}@ΔP 2 IN. WATER	NOMINAL THICKNESS INCHES
407520	5.0	0.054
401300	10.0	0.058
407530	25.0	0.061

2-LAYER LAMINATE (WEIGHT 1.5 LBS./SQ. FT.)		
PART NUMBER	AIR FLOW SCFM/FT.^{2}@ΔP 2 IN. WATER	NOMINAL THICKNESS INCHES
401420	50	0.041
401430	100	0.044
401440	200	0.050
407570	400	0.060

Pressure drop curves for the 3-layer and the 2-layer laminates are given in the following figures for standard pressure and temperature air entry conditions. For other conditions, flow equations are provided to facilitate pressure drop calculation.

PRESSURE DROP VS AIR FLOW - 3-LAYER DYNAPORE



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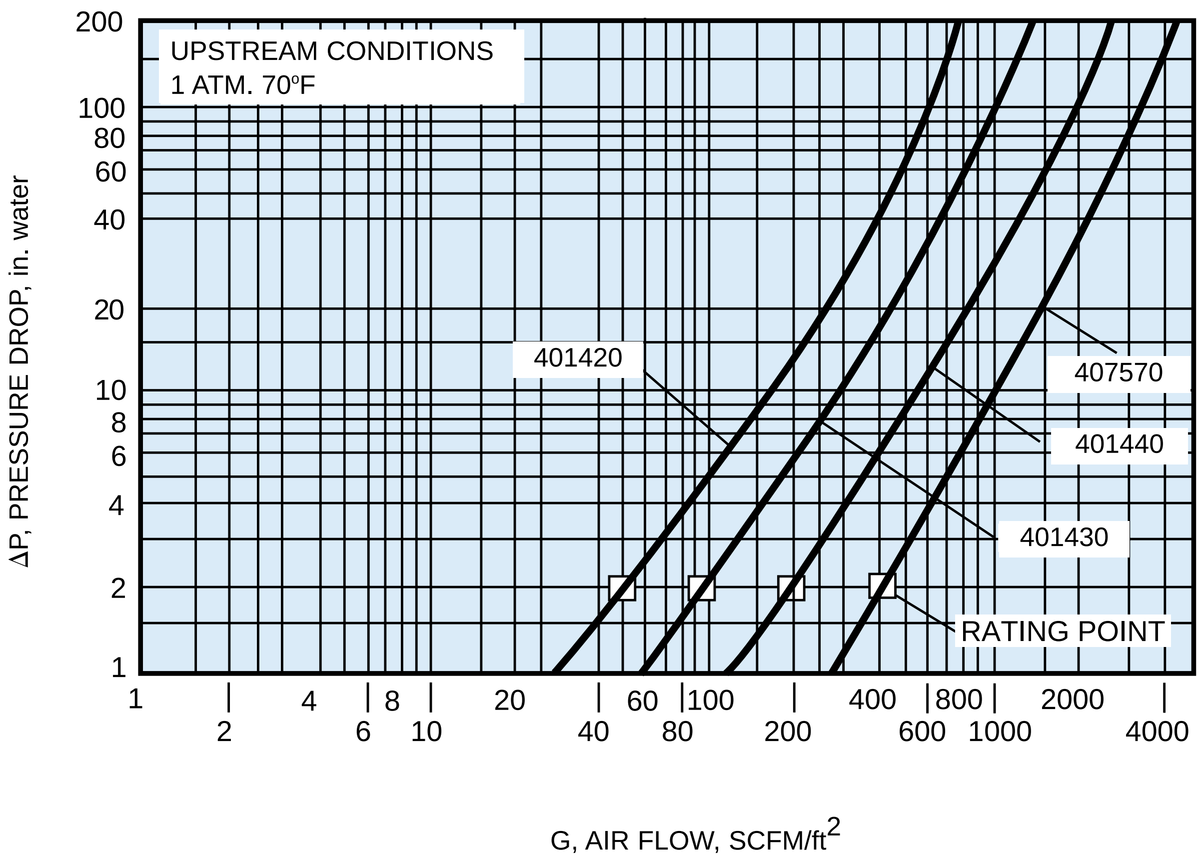
PRESSURE DROP VS AIR FLOW - 2 LAYER DYNAPORE



The flow permeability of Dynapore material may be presented in equation form for estimating the flow characteristics for a variety of conditions and fluids.

For incompressible air flow the equation is:

$$\Delta P = AG + BG^2$$

Where ΔP is pressure drop (in. water column) and G is air flow ($SCFM/ft^2$ @ 70ºF). The constants A (viscous flow coefficient) and B (inertial flow coefficient) are listed in the table.

For compressible air flow the equation is:

$$\overline{\Delta P}^2 = AG + BG^2$$

Where $\overline{\Delta P}^2 = P_1^2 - P_2^2$, and P_1 is the upstream pressure and P_2 is the downstream pressure, (both in in. water column absolute. G is air flow ($SCFM/ft^2$ @ 70ºF). The applicable constants, A and B are listed in the table. Note that they are different than for incompressible flow.

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AIR FLOW EQUATION CONSTANTS

PART NUMBER	FLOW SCFM/FT.^{2}@ΔP 2 IN. WATER	INCOMPRESSIBLE[1] (ΔP, IN. WATER G, SCFM/FT.^{2})		COMPRESSIBLE[2] ($\overline{\Delta P^2}$, IN. WATER^2 G,SCFM/FT.^{2})	
		A	B, x 10^{-3}	A	B
3-LAYER LAMINATES					
407520	5.0	0.375	4.95	300.0	4.40
401300	10.0	0.181	1.90	147.0	1.45
407530	25.0	0.0697	0.415	58.0	0.33
2-LAYER LAMINATES					
401420	50.0	0.0295	0.210	24.2	0.165
401430	100.0	0.0130	0.070	10.8	0.054
401440	200.0	0.0050	0.025	4.60	0.0177
407570	400.0	0.00192	0.0077	1.78	0.0057

1. Incompressible - upstream conditions: 70ºF, 1 Atm.
2. Compressible - upstream conditions: 70ºF

When estimating the flow permeability for air at temperatures other than 70ºF, or for other fluids the more general gas flow equations are applicable.

For incompressible gas (or liquid) the equation is:

$$\Delta P = A\mu V + B\rho V^2$$

Where μ is absolute viscosity (in centipoise, CP) ρ is specific weight (lb/ft^3), ΔP is pressure drop (in. water) and V is flow (CFM/ft^2). The constants for A and B are obtained from the gas flow table.

For compressible gas the equation is:

$$\overline{\Delta P^2} = A\mu \frac{T}{M} G + B \frac{T}{M} G^2$$

Where $\overline{\Delta P^2} = P_1^2 - P_2^2$ and P_1 is the upstream pressure, P_2 is downstream (in. water column), G is flow (SCFM/ft^2 referred to 70F, 1 Atm.), T is absolute temperature (ºR), M is molecular weight, and μ is viscosity (centipoise), the constants A and B are given in the gas flow table for compressible flow.

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Fluidizing Media Technical Data

GAS FLOW EQUATION CONSTANTS

PART NUMBER	FLOW SCFM/FT.^{2}@ΔP 2 IN. WATER	GAS OR LIQUID INCOMPRESSIBLE (ΔP, IN. WATER V, CFM/FT.^{2})		GAS COMPRESSIBLE ($\overline{\Delta P}^2$, IN. WATER^2 G,SCFM/FT.^{2})	
		A	B, x 10^{-3}	A	B, x 10^{-3}
3-LAYER LAMINATES					
407520	5.0	20.60	66.10	900.0	241.00
401300	10.0	9.92	25.40	441.0	79.40
407530	25.0	3.82	5.54	174.0	18.10
2-LAYER LAMINATES					
401420	50.0	1.616	2.80	72.6	9.00
401430	100.0	0.712	0.934	32.4	2.90
401440	200.0	0.274	0.336	13.8	0.969
407570	400.0	0.105	0.103	5.34	0.312

SAMPLE CALCULATIONS

To illustrate the use of the flow equations, sample calculations are presented for the four equations for Dynapore Part No. 401300 (10 SCFM/ft^2 @ 2 in. water) for the following conditions:

INCOMPRESSIBLE AIR FLOW

Air Flow, G = 100 SCFM/ft^2
Upstream Temperature = 70ºF
Upstream Pressure = 1 Atm.
$\Delta P = AG + BG^2$
$\Delta P = 0.181\ (100) + 1.90 \times 10^{-3}\ (100)^2$
ΔP = 37.1 in. water

From Air Flow Table:
A = 0.181
B = 1.90×10^{-3}

COMPRESSIBLE AIR FLOW

Air Flow, G = 250 SCFM/ft^2
Upstream Temperature = 70ºF
Upstream Pressure, P_1 = 814.4 in. water absolute
$\overline{\Delta P}^2 = AG + BG^2$
$\overline{\Delta P}^2 = 147(250) + 1.45(250)^2$
$\overline{\Delta P}^2 = 127{,}375 = P_1^2 - P_2^2$

$P^2 = \sqrt{(814.4)^2 - 127{,}375} = 732.0$ in. water
$\Delta P = P_1 - P_2 = 814.4 - 732.0 = 82.4$ in. water

Subscripts:
0 = Standard
1 = Upstream
2 = Downstream

From Air Flow Table:
A = 147
B = 1.45

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INCOMPRESSIBLE GAS FLOW (OR LIQUID)

Upstream Air Conditions:

P_1 = 814.4 in. water absolute
T_1 = 200ºF + 460º = 660ºR
V_1 = 62 CFM/ft^2

$$\rho_1\text{, specific weight} = \rho_0 \frac{P_1}{P_0} \times \frac{T_0}{T_1} = \frac{0.07493(814.4)\,(70 + 460)}{(407.2)\,(660)} = 0.1203 \text{ lb./ft}^3$$

μ_1 = viscosity = 0.02127 centipoise @ 660ºR

$$\Delta P = A\,\mu_1 V_1 + B\,\rho_1 V_1^2$$

$$\Delta P = 9.92(0.02127)62 + 25.4 \times 10^{-3}\,(0.1203)(62)^2$$

ΔP = 24.8 in. water

From Gas Table:
A = 9.92
B = 25.4 x 10^{-3}

COMPRESSIBLE GAS FLOW

Upstream Air Conditions:

P_1 = 814.4 in. water absolute
T_1 = 200ºF + 460º = 660ºR
V_1 = 248 CFM/ft^2

$$G = V_1 \frac{P_1}{P_0} \times \frac{T_0}{T_1} = \frac{248(814.4)\,(70 + 460)}{(407.2)\,(660)} = 398.3 \text{ SCFM/ft}^2$$

From Gas Table:
A = 441
B = 79.4 x 10^{-3}

$$\rho_1\text{, specific weight} = \rho_0 \frac{P_1}{P_0} \times \frac{T_0}{T_1} = \frac{0.07493(814.4)\,(70 + 460)}{(407.2)\,(660)} = 0.1203 \text{ lb./ft}^3$$

μ_1 = viscosity = 0.02127 centipoise
M = Molecular weight = 28.97

$$\overline{\Delta P}^2 = A\,\mu_1 \frac{T_1}{M}\,G + B\,\frac{T_1}{M}\,G^2$$

$$\overline{\Delta P}^2 = \frac{441(0.02127)(660)(398.3)}{28.97} + \frac{79.4 \times 10^{-3}\,(660)\,(398.3)^2}{28.97}$$

$$\overline{\Delta P}^2 = 372{,}086 = P_1^2 - P_2^2$$

$$P_2 = \sqrt{(814.4)^2 - 372{,}086} = 539.6 \text{ in. water}$$

$$\Delta P = P_1 - P_2 = 814.4 - 539.6 = 274.8 \text{ in. water}$$

VISCOSITY OF AIR

TEMPERATURE		VISCOSITY CENTIPOISE
ºF	ºR	
-60	400	0.0145
70	530	0.0182
140	600	0.0200
340	800	0.0250
540	1000	0.0285
1040	1500	0.0370

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