Tech Bulletin

Pressure Drop / Flow Rate Charts and Graphs

Following you will find multiple graphs and charts that represent expected conditions based on a variety of end user specified inputs. These values are calculated estimates and your individual results may vary.

This table covers useful information as it particularly pertains to hose. Some of the data in these tables has been extracted from standard engineering texts; devised specifically by the Hose Technical Committee of the Industrial Products Division, are based on average conditions and are not to be used as a minimum-maximum but merely as a guide. Conversion to metric units have been rounded for convenience.

Caution:
The reader is cautioned that the following tables are intended for general reference and general applicability only, and should not be relied upon as the sole or presice source of information available with respect to the subject covered. The reader should also refer to and follow manufacturers' specific instructions and recommendations with regard to such information, where they exist.

WATER DISCHARGE
FLOW OF WATER THROUGH 100 FOOT LENGTHS HOSE, STRAIGHT-SMOOTH BORE
U.S. GALLONS PER MINUTE

Psi at Hose Inlet	Nominal Hose Diameters — Inches											
	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8
20	4	8	12	26	47	76	161	290	468	997	2895	6169
30	5	9	15	32	58	94	200	360	582	1240	3603	7679
40	6	11	18	38	68	110	234	421	680	1449	4209	8970
50	7	12	20	43	77	124	264	475	767	1635	4748	10118
60	8	14	22	47	85	137	291	524	846	1804	5239	11165
75	9	15	25	53	95	154	329	591	955	2035	5910	12595
100	10	18	29	62	112	180	384	690	1115	2377	6904	14712
125	11	20	33	70	126	203	433	779	1258	2681	7788	16595
150	12	22	36	77	139	224	478	859	1388	2958	8593	18313
200	15	26	42	90	162	262	558	1004	1621	3455	10038	21390

Figures are used as a guide since the hose inside diameter tolerance, the type of fittings used, and orifice restriction all influence the actual discharge. Thus, variations plus or minus from the table may be obtained in actual service.

$$Q = 0.443Cd^{2.63}\left(\frac{P_1 - P_2}{L}\right)^{.54}$$

C value is the Hazen-Williams coefficient; smaller values must be used for rougher tube surfaces.

Where: Q=quantity in U.S. gallons per minute
C=140 for clean, extremely smooth bore and straight hose
d=inside diameter of hose in inches
$P_1 - P_2$=pressure change in lbs. per square inch
L=length of hose in feet

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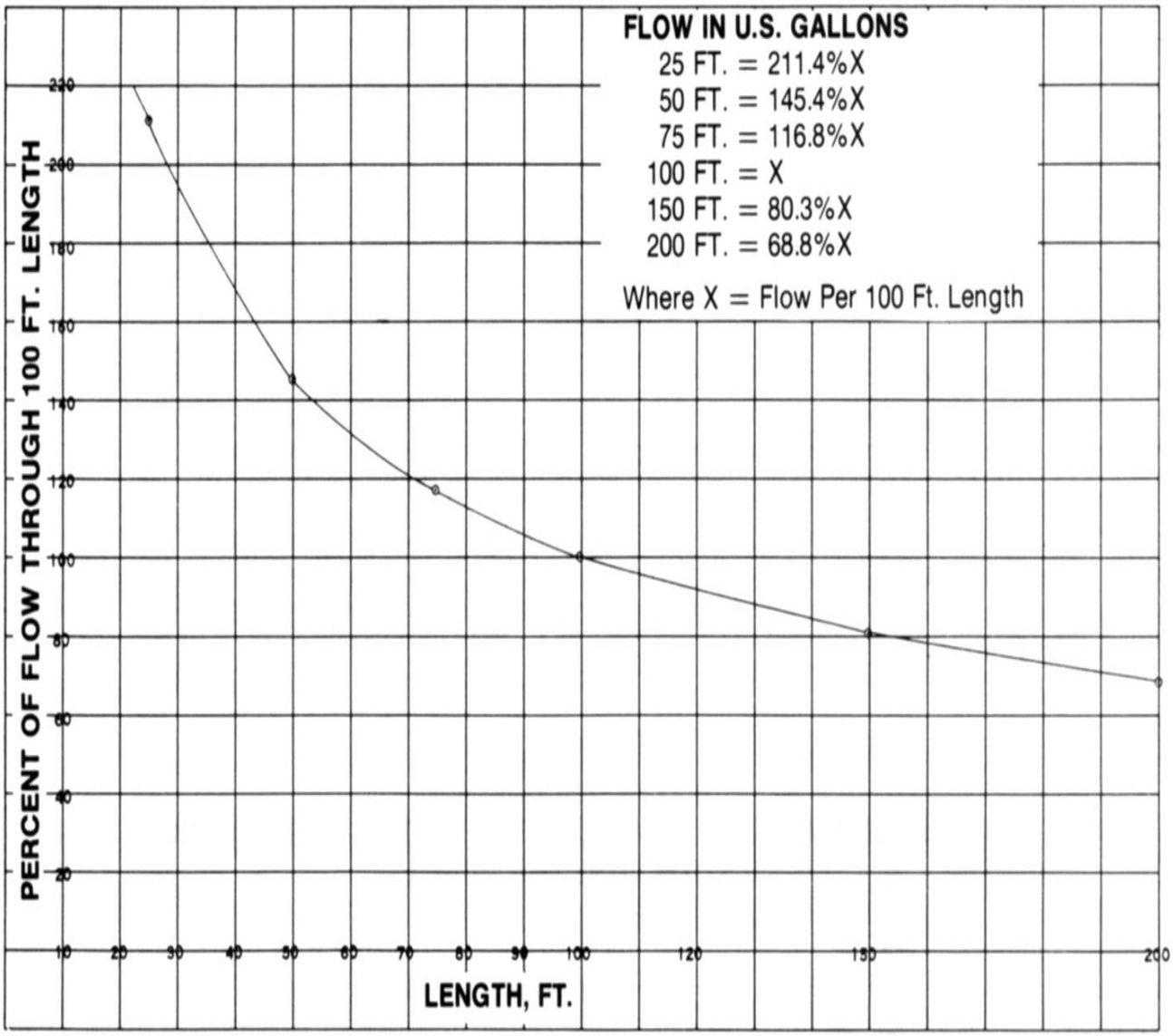
REELCRAFT®

CONVERSION FACTOR
FLOW OF WATER THROUGH LENGTHS OTHER THAN 100 FEET
STRAIGHT-SMOOTH BORE



***Charts are provided by Rubber Manufacturers Association**

FRICTION LOSS IN WATER HOSE
POUNDS PER SQUARE INCH PER 100 FOOT LENGTH
STRAIGHT-SMOOTH BORE

Flow of Water in U.S. Gal. Per Min.	ACTUAL INTERNAL DIAMETER — INCHES														
	1/2	5/8	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	5	6	8	10	12
1	1.41														
2	5.09	1.72	0.71												
5	27.7	9.36	3.85	0.95	0.32	0.13									
10	100	33.7	13.9	3.42	1.15	0.47	0.12								
15		71.4	29.4	7.24	2.44	1.00	0.25	0.08							
20		122	50.0	12.3	4.16	1.71	0.42	0.14							
25			75.6	18.6	6.28	2.59	0.64	0.21							
30			106	26.1	8.80	3.62	0.89	0.30	0.12						
35			141	34.7	11.7	4.82	1.19	0.40	0.16						
40				44.4	15.0	6.17	1.52	0.51	0.21						
45				55.3	18.6	7.67	1.89	0.64	0.26						
50				67.1	22.7	9.32	2.30	0.77	0.32						
60				94.1	31.7	13.1	3.22	1.09	0.45						
70				125	42.2	17.4	4.28	1.44	0.59						
80					54.0	22.2	5.48	1.85	0.76						
90					67.2	27.7	6.81	2.30	0.95	0.23					
100					81.7	33.6	8.28	2.79	1.15	0.28					
125					123	50.8	12.5	4.22	1.74	0.43					
150						71.1	17.5	5.91	2.43	0.60	0.20				
175						94.6	23.3	7.86	3.24	0.80	0.27				
200						121	29.8	10.1	4.14	1.02	0.34				
225							37.1	12.5	5.15	1.27	0.43				
250							45.1	15.2	6.26	1.54	0.52				
275							53.8	18.1	7.47	1.84	0.62				
300							63.2	21.3	8.77	2.16	0.73	0.30			
350							84.0	28.3	11.7	2.87	0.97	0.40			
400							108	36.3	14.9	3.68	1.24	0.51			
450								45.1	18.6	4.57	1.54	0.64			
500								54.8	22.6	5.56	1.88	0.77	0.19		
600								76.8	31.6	7.79	2.63	1.08	0.27		
700								102	42.1	10.4	3.49	1.44	0.35	0.12	
800								131	53.8	13.3	4.47	1.84	0.45	0.15	
1000									81.4	20.0	6.76	2.78	0.69	0.23	0.10
1200									114	28.1	9.47	3.90	0.96	0.32	0.13
1400									152	37.3	12.6	5.18	1.28	0.43	0.18
1600										47.8	16.1	6.64	1.64	0.55	0.23
1800										59.5	20.0	8.25	2.03	0.69	0.28
2000										72.2	24.4	10.0	2.47	0.83	0.34
2500											36.8	15.2	3.73	1.26	0.52
3000											51.6	21.2	5.23	1.76	0.73

To convert PSI to Megapascals (MPa) multiply by 0.006895
To convert from PSI to feet of Hydraulic Head multiply by 2.309
To convert from U.S. gallons per minute to cubic feet per minute multiply by 0.1337
To convert from U.S. gallons per minute to cubic meters per second multiply by .00006309

NOTE: Friction loss can vary by 20% due to temperature. Bends can increase friction loss by 50%.

C value is the Hazen-Williams coefficient; smaller values must be used for rougher tube surfaces.

$$\triangle P = 4.51(Q/C)^{1.85} \times \frac{L}{d^{4.87}} \quad \text{or} \quad \triangle P = \frac{0.0483Q}{d^{4.87}} \quad @60^\circ F\ (15.6^\circ C)$$

where : P= pressure loss in lbs. per square inch
Q=quantity in U.S. gallons per minute
C=140 for clean, extremely smooth bore and straight hose
L=Length of hose in feet
d=inside diameter of hose in inches

***Charts are provided by Rubber Manufacturers Association**

FRICTION LOSS OF PRESSURE IN AIR HOSE (PULSATING PRESSURE FLOW)

I.D. of Hose	Gauge Pressure	CUBIC FEET AIR PER MINUTE THROUGH 100 FT. HOSE LINES LOSS OF PRESSURE IN LBS. PER SQ. INCH 40	50	60	70	80	90	100	110	120	130	140	150
	50	20.2	36.2										
	60	16.8	29.6	46.8									
	70	14.0	24.8	40.0	56.8								
1/2" Hose	80	12.0	21.6	34.8	50.4	69.2							
(Coupled)	90	10.8	19.0	29.6	44.0	61.0	82.0						
	100	9.6	16.8	26.6	38.6	54.4	73.3						
	110	8.6	15.2	24.0	35.2	49.2	66.6	89.0					
	50	3.0	4.8	7.0	8.8	13.0	17.0	22.8	28.4				
	60	2.4	3.8	5.6	7.6	10.4	13.6	17.2	22.4	28.2			
	70	1.8	3.0	4.6	6.4	8.4	11.0	14.0	17.6	22.0			
3/4" Hose	80	1.6	2.6	3.8	5.6	7.2	9.4	11.6	14.4	17.6	21.2		
(Coupled)	90	1.4	2.2	3.2	4.6	6.2	8.0	10.0	12.4	15.0	18.0	21.6	
	100	1.2	2.0	2.8	4.0	5.4	7.0	8.8	10.8	13.2	15.8	18.8	22.2
	110	1.0	1.8	2.6	3.6	4.8	6.2	7.8	9.8	11.8	14.2	16.8	19.8
	50	0.6	1.0	1.6	2.2	3.0	4.0	5.2	7.0	9.6	14.0		
	60	0.6	0.8	1.2	1.6	2.4	3.0	4.0	5.2	6.6	8.2	11.0	14.4
	70	0.4	0.8	1.0	1.4	2.0	2.6	3.2	4.0	5.0	6.2	7.6	9.4
1" Hose	80	0.4	0.6	1.0	1.4	1.6	2.2	2.8	3.4	4.0	4.8	5.4	7.0
(Coupled)	90	0.4	0.6	0.8	1.2	1.4	1.8	2.4	2.8	3.4	4.0	4.8	5.6
	100	0.4	0.4	0.8	1.0	1.2	1.6	2.0	2.4	3.0	3.6	4.2	4.8
	110	0.4	0.4	0.6	0.8	1.2	1.4	1.8	2.2	2.6	3.0	3.6	4.2
	50		0.4	0.4	0.6	0.8	1.0	1.4	2.0				
	60		0.2	0.4	0.6	0.6	1.0	1.2	1.6	2.0	2.4	3.0	
	70			0.4	0.4	0.6	0.8	0.8	1.2	1.4	1.6	2.0	2.6
1 1/4" Hose	80			0.2	0.4	0.4	0.6	0.8	1.0	1.2	1.4	1.6	2.0
(Coupled)	90				0.4	0.4	0.6	0.6	0.8	1.0	1.2	1.4	1.6
	100				0.2	0.4	0.4	0.6	0.8	0.8	1.0	1.2	1.4
	110				0.2	0.4	0.4	0.6	0.6	0.8	1.0	1.0	1.2
	50					0.4	0.4	0.4	0.6	0.8	0.8	1.0	1.2
	60					0.2	0.4	0.4	0.4	0.6	0.6	0.8	1.0
	70						0.2	0.4	0.4	0.6	0.6	0.6	0.8
1 1/2" Hose	80							0.2	0.4	0.4	0.4	0.6	0.8
(Coupled)	90								0.2	0.4	0.4	0.4	0.6
	100									0.4	0.4	0.4	0.4
	110									0.4	0.4	0.4	0.4

Note: Values shown are presumed to be based on actual test data.

***Charts are provided by Rubber Manufacturers Association**

RECOMMENDED HOSE SIZE FOR AIR TOOLS AT MAXIMUM LOAD

FREE AIR CFM	25 FT. HOSE I.D. IN.	50 FT. HOSE I.D. IN.
0-20	3/8	1/2
20-30	3/8	1/2
30-40	1/2	1/2
40-50	1/2	3/4
50-60	3/4	3/4
60-70	3/4	3/4
70-80	3/4	3/4
80-90	3/4	1
90-100	3/4	1

Determining Air Volume (CFM) Requirements

EQUIPMENT AIR REQUIREMENT AVERAGES

Always use free air (CFM) and pressure (PSI) specifications from nameplate on the device, or from the manufacturer, CFM free air figures below are averages and should not be considered accurate for any specific brand. If manufacturers' data are not available, the tables below may be used as an approximate guide.

Miscellaneous Portable Tools at 70 to 90 PSI Range	CFM Consumption at 25% Use Factor	Miscellaneous Portable Tools at 70 to 90 PSI Range	CFM Consumption at 25% Use Factor	Miscellaneous Portable Tools at 70 to 90 PSI Range	CFM Consumption at 25% Use Factor
Drill 1/16" to 3/8"	6.25	Horizontal Grinder, 4"	15.0	Air Motor, 1 HP	6.3
Drill 3/8" to 5/16"	8.75	Horizontal Grinder, 6"	15.0	Air Motor, 2 HP	12.5
Screwdriver, #2 to #6 Screw	3.0	Horizontal Grinder, 8"	20.0	Air Motor, 3 HP	18.75
Screwdriver, #6 to 5/16" Screw	6.0	Vertical Grinders and Sanders		Air Motor Hoist	1 cu. ft.
Tapper, to 3/8"	5.0	5" Pad	8.75	1000#	per ft. of lift
Nutsetters, to 3/8"	5.0	7" Pad	15.0	Air Motor Hoist	1 cu. ft.
Nutsetters, to 3/8"	6.0	9" Pad	17.5	2000#	per ft. of lift
Nutsetters, to 3/4"	7.5	Burring Tool, Small	3.75	Paint Spray Gun	5.0
Impact Wrench, 1/4"	3.75	Burring Tool, Large	6.0	Scaling Hammer	3.0
Impact Wrench, 3/8"	5.0	Rammers, Small	3.25	Chipping Hammer	7.5
Impact Wrench, 1/2"	7.5	Rammers, Medium	8.5	Riveting Hammer	7.5
Impact Wrench, 3/4"	8.75	Rammers, Large	10.0	Circular Saw, 8"	11.25
Impact Wrench, 1-1/4"	13.75	Backfill Tamper	6.25	Circular Saw, 12"	16.25
Die Grinder, Small	3.75	Compression Riveter	.2 cu. ft. per cycle	Lightweight Chain Saw	7.0
Die Grinder, Medium	6.0			Heavy Duty Chain Saw	21.8
Horizontal Grinder, 2"	5.0				

AUTOMOTIVE EQUIPMENT AIR REQUIREMENT AVERAGES

Equipment PSI Range	Portable Tools	CFM Required Per Unit	Equipment PSI Range	Portable Tools	CFM Required Per Unit
70-100	Air Filter Cleaner *	3.0	125-150	Tire Inflation Line	1.5
70-100	Body Polisher *	2.0	125-150	Tire Spreader	1.0
70-100	Body Sander, Orbital *	5.0	90-100	Air Hammer *	4.0
70-100	Brake Tester	3.5	90-100	Tire Hammer	12.0
70-100	Carbon Remover *	3.0	125-150	Bead Breaker	12.0
90-100	Dusting Blow Gun *	2.5	90-100	Spring Oiler	4.0
70-90	Drill 1/16" to 3/8" *	4.0	90-100	Spray Gun Engine Cleaner *	5.0
70-90	Impact Wrench 3/8" sq. dr. *	2.0	90-100	Production Paint Spray Gun *	8.5
70-90	Impact Wrench 1/2" sq. dr. *	3.5	90-100	Touch-Up Paint Spray Gun *	3.5
70-90	Impact Wrench 3/4" sq. dr. *	7.5	90-100	Undercoat Paint Spray Gun *	19.0
70-90	Impact Wrench 1" sq. dr. *	10.0	120-150	Grease Gun *	3.0
70-90	Die Grinder *	5.0	145-175	Hydraulic Lift †	6.0
90-100	Vertical Disc Sanders *	10.0	125-150	Hydraulic Floor Jack	6.0
90-100	Filing/Sawing Machine, Small *	3.0	125-150	Pneumatic Garage Door	3.0
90-100	Filing/Sawing Machine, Large *	5.0	90-100	Radiator Tester	1.0
125-150	Tire Rim Stripper	6.0	70-100	Fender Hammer *	9.0
125-150	Tire Changer	1.0	70-100	Medium Duty Sander *	40.0

(*) These devices are considered as continuously operating

(†) This is for 8,000 lbs. capacity. For additional 1,000 lbs. add .65 CFM.

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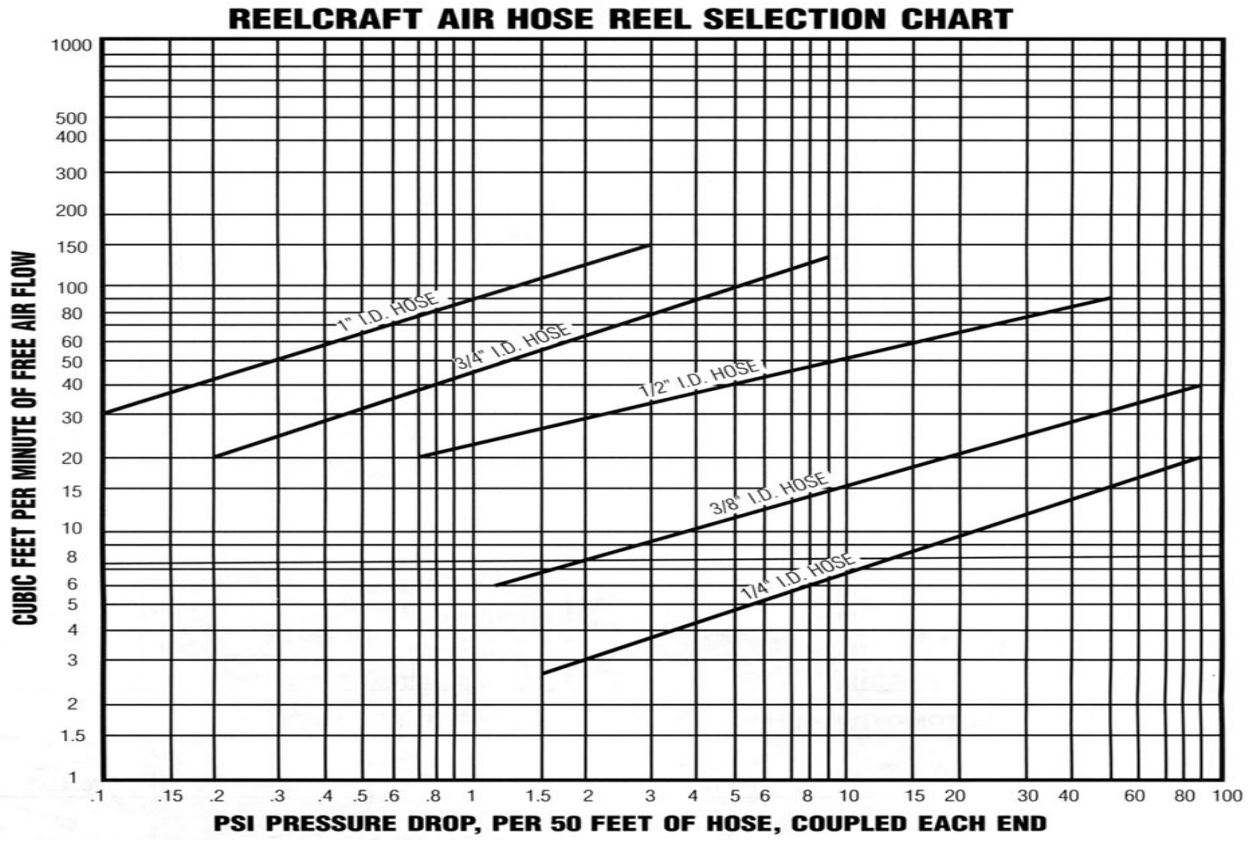

To select the proper size for a particular reel, it is essential to know the following:

1. Cubic feet per min. “free air“ requirements of the equipment to be used.
2. The minimum pressure at which the equipment will operate efficiently. (If this is not available, it is recommended that the pressure drop not exceed 10 p.s.i. at 90 p.s.i. inlet pressure.)
3. Pressure loss, p.s.i. per 50 ft of hose, coupled each end.

Note: 1. Pressure loss is directly proportional to the length. For example, if the pressure loss is given for 50 feet of hose, the loss for 100 feet will be twice as much, and the loss for 25 feet will be half as much.

Note: 2. Above curve is based on inlet pressure - 90 p.s.i. (Standard pressure for shop purposes.)

PROBLEM 1: Find the size hose required to operate a paint spray gun (production type) that requires 8 C.F.M. of “free air” at 80 to 100 p.s.i. pressure.

Using the above curve-based on 90 p.s.i. inlet pressure and a recommended maximum pressure drop of 10 p.s.i. follow the 10 p.s.i. vertical line upward until it intersects with the horizontal line representing the 8 C.F.M. air flow.

Note that this point is above the 1/4” I.D. hose range and that if continued further to the right, intersects the 1/4 I.D. hose curve at 15 p.s.i. pressure loss. The 1/4” I.D. hose cannot be recommended. Next larger size hose 3/8” must be recommended.

PROBLEM 2: Find the maximum cubic feet of “free air” flow through a 1/2” I.D. hose with a 10 p.s.i. pressure loss at 90 p.s.i. inlet pressure. Follow the 10 p.s.i. vertical line upward until it intersects with the 1/2” I.D. curve, follow horizontal line left for cubic feet per minute air flow. Approximately 50 C.F.M. is indicated for 1/2” I.D. hose.

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