Engineering Bulletin: Pressure Drop in Pipes

It is a common misconception that the velocity of air exiting an air knife is the most important performance measurement. What really is the most important is how much Fluid Power is available at the air knife.

Fluid Power = Flow Rate * Pressure

To achieve the highest Fluid Power, it is critical to minimize the pressure drop in piping between the blower and the target.

Best Practices for Minimizing Pressure Drops

- Position the blower as close as possible to the target.
- Use large size piping, equal to the blower discharge or larger
- Use as few elbows as possible. When needed, use long sweep elbows. Short elbows are not recommended.
- Use hard pipe with smooth interior walls, such as PVC pipe or Stainless Steel thin wall tubing. Flexible hose connections should be minimized.
- Use the appropriate pipe connections such as Paxton Zero Loss Adapters
- Use well designed dividers with smooth transitions
- Only use flexible hose at the end of the piping system to connect the air knifes or manifolds. Smooth tubing typically has 70% less pressure drop. Avoid kinks in the hoses or sharp bends – these will lead to high pressure drops.
- High velocity air tends to do better when traveling straight or around smooth transitions. Avoid going over sharp corners or edges.
- One last tip, how do you know if the system is OK? The best measurement is to use a Differential Pressure gauge to measure a pressure difference between the blower outlet and the end of the air knife or manifold. This is exactly what the Paxton Engineers do when they install systems.

How to Calculate Pressure Drops

There are many factors that go into calculating pressure drop in a blower-driven system, including air flow rate, temperature, pipe geometry (ID), and the interior smoothness of the pipe. This Technical Bulletin is intended to help design piping systems in the field. If your piping distances are long, or you need help, please contact us.

PVC pipe is used for example purposes in this Bulletin. Thin wall stainless steel tubing works well also, and is similar in pressure drop.

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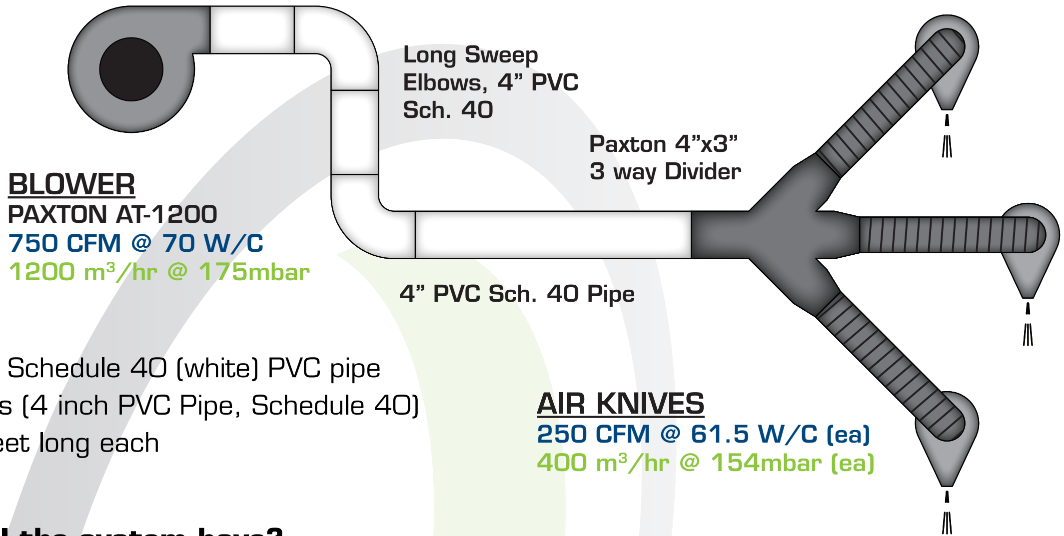
Example: Paxton AT-1200 Blower, producing 750 CFM @ 70 inches of water column pressure (US Units) or 1200 m³/hr @ 174mbar pressure (Metric) operating three (3) Air Knives.

Including a Paxton 3 way Divider and Paxton 4in PVC Adapters.



System Piping:

(US 5 feet)/(Metric 2m) of 4 inch Schedule 40 (white) PVC pipe
2 x 90 Degree Long Sweep Elbows (4 inch PVC Pipe, Schedule 40)
3 x Flexible hoses, 3 inch ID x 3 feet long each

How much pressure drop will the system have?

Type	Pipe Diameter	Pressure Drop Per Table	Multiplier	Total Pressure Drop*, in W/C / in mbar
Straight PVC	4 inch	0.42 per ft 2.95 mbar per m	5 feet 2 meters	2.1 5.9
Elbow	4 inch	1.97 each 4.59 mbar each	2 2	3.9 9.2
Flex Hose	3 inch	0.83 per ft 5.89 mbar per m	3 feet 1 meter	2.5 5.9
				8.5 inches of water column 21.0 mbar

*Actual pressure drop is expected to be less, as this method employs safety factors and approximations.

So, the performance at the Air Knives will each be:

250 CFM at 61.5" W/C. (70 in W/C at blower – 8.5 in W/C pressure drop) or 1200 m³/hr @ 154 mbar.

To Calculate the Fluid Power:

Units	Fluid Power in hp/kW	Power at Blower	Power at each Air Knife
US	cfm*pressure ÷ 6643	750 cfm * 70 inch of water column = 8.28 hp	750 cfm ÷ 3 * (70-8.5) inch of water column ÷ 6343 = 2.42 hp
Metric	m³/hr * mbar ÷ 35984	1200 m³/hr * 175 mbar ÷ 35984 = 5.84 kW	1200 m³/hr ÷ 3 * (175 – 21.0) mbar ÷ 35984 = 1.65 kW

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Pipe Pressure Drop Quick Reference (US Units)

Flow Rate (CFM)	Pressure Drop in W/C (in H_2O): 3 in PVC Pipe, Sch. 40 (3.068" ID) per ft of pipe	90 Degree Long Sweep Elbow, 3 in PVC Pipe, Sch. 40 per elbow	3 in Flex Hose (3 in ID) per ft of hose
50	0.07	0.13	0.17
100	0.13	0.27	0.33
150	0.20	0.40	0.50
200	0.26	0.53	0.67
250	0.33	0.67	0.83
300	0.39	0.80	1.00
350	0.46	0.93	1.17
400	0.52	1.07	1.33
450	0.59	1.20	1.50
500	0.65	1.33	1.67
550	0.72	1.47	1.83
600	0.78	1.60	2.00

This reference is intended to be used as a quick guide for calculating pressure drop in PVC pipe and 3 in ID Flex hose. Many factors go into calculating and verifying pressure drops. Figures used in this sheet are approximations with a 15% safety factor, and are based on physical tests. Please contact Paxton for a review of your application. In some cases Paxton will conduct physical tests of your system to ensure proper design of your system.

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Flow Rate (CFM)	Pressure Drop in W/C (in H_2O): 4 in PVC Pipe, Sch. 40 (4.026" ID) per ft of pipe	90 Degree Long Sweep Elbow, 4 in PVC Pipe, Sch. 40 per elbow
50	0.03	0.13
100	0.06	0.26
150	0.08	0.39
200	0.11	0.53
250	0.14	0.66
300	0.17	0.79
350	0.20	0.92
400	0.22	1.05
450	0.25	1.18
500	0.28	1.31
550	0.31	1.44
600	0.34	1.58
650	0.36	1.71
700	0.39	1.84
750	0.42	1.97
800	0.45	2.10
850	0.48	2.23
900	0.50	2.36
950	0.53	2.49
1000	0.56	2.63
1050	0.59	2.76
1100	0.61	2.89
1150	0.64	3.02
1200	0.67	3.15

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Pipe Pressure Drop Quick Reference (Metric)

Flow Rate (m³/hr)	Pressure Drop, mbar: 3 in PVC Pipe, Sch. 40 (77.9mm ID) per meter of pipe	Pressure Drop, mbar: 90 Degree Long Sweep Elbow, 3 in PVC Pipe, Sch. 40 per elbow	Pressure Drop, mbar: 3 in Flex Hose (76.2mm ID) per ft of hose
100	0.92	0.39	1.47
200	1.83	0.77	2.95
300	2.75	1.16	4.42
400	3.67	1.54	5.89
500	4.58	1.93	7.37
600	5.50	2.31	8.84
700	6.42	2.70	10.31
800	7.34	3.08	11.78
900	8.25	3.47	13.26
1000	9.17	3.85	14.73

Flow Rate (m³/hr)	Pressure Drop, mbar: 4 in PVC Pipe, Sch. 40 (102.3mm ID) per meter of pipe	Pressure Drop, mbar: 90 Degree Long Sweep Elbow, 4 in PVC Pipe, Sch. 40 per elbow
100	0.25	0.38
200	0.49	0.77
300	0.74	1.15
400	0.98	1.53
500	1.23	1.91
600	1.47	2.30
700	1.72	2.68
800	1.97	3.06
900	2.21	3.44
1000	2.46	3.83
1100	2.70	4.21
1200	2.95	4.59
1300	3.20	4.97
1400	3.44	5.36
1500	3.69	5.74
1600	3.93	6.12
1700	4.18	6.50
1800	4.42	6.89
1900	4.67	7.27
2000	4.92	7.65

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