AMCA International

Minimizing System Effect

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The New York Blower Company

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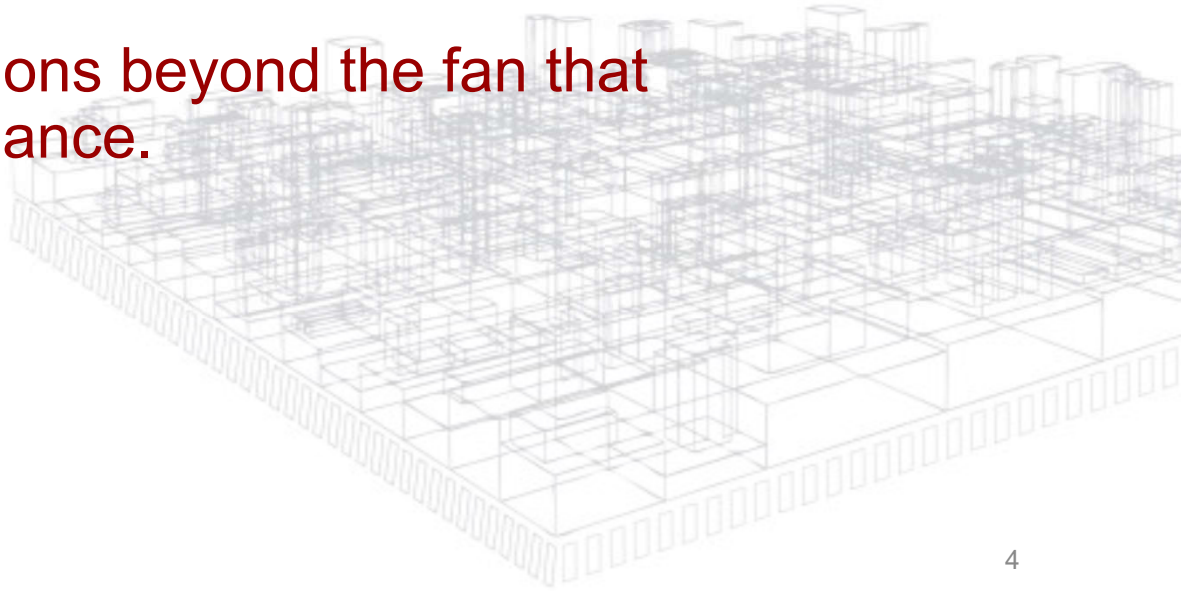
Professional Development Hours (PDH) Certificates

The Air Movement and Control Association International (AMCA), has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to the RCEP. A certificate of completion will be issued to each participant. As such, it does not include content that may be deemed or construed to be an approval or endorsement by NCEES or RCEP.

Copyright Materials

Learning Objectives

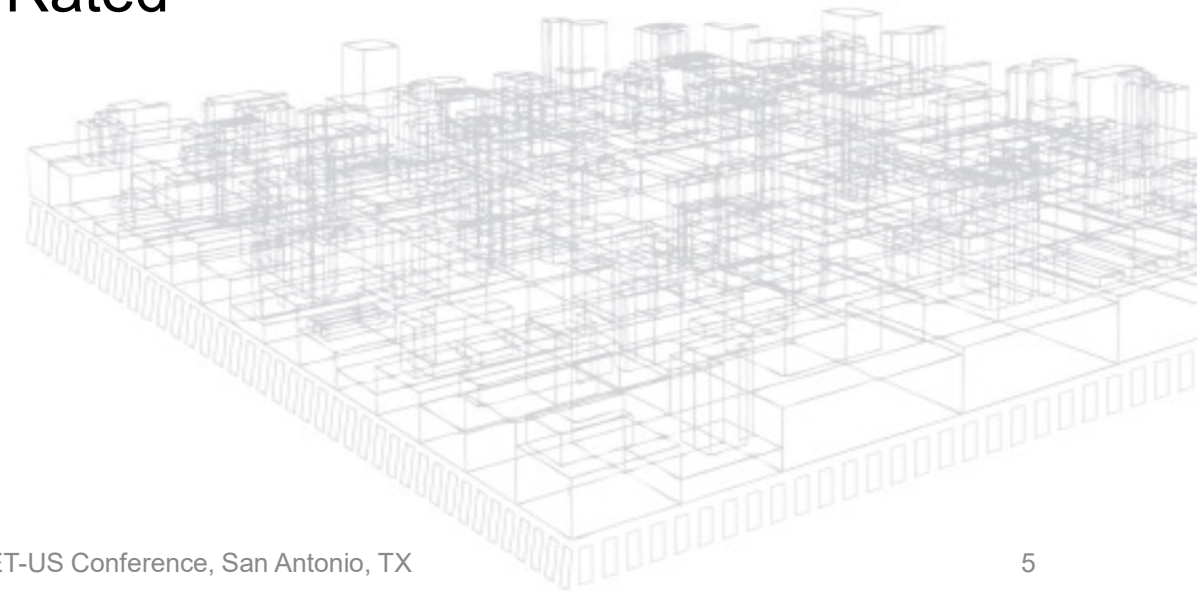
- Review the primary engineering principles involved in fan operation, rating, and performance.
- Understand conditions beyond the fan that impact fan performance.



Fan Fundamentals

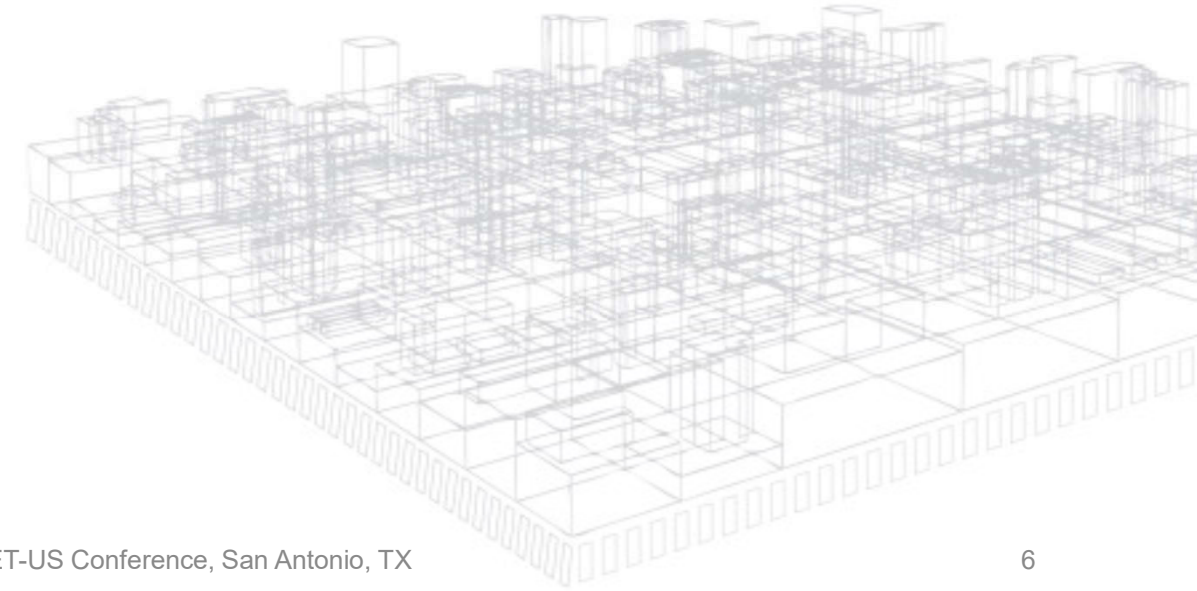
Subjects

- Fan Laws
- How Fans are Tested and Rated
- Various Fan Types
- System Effects

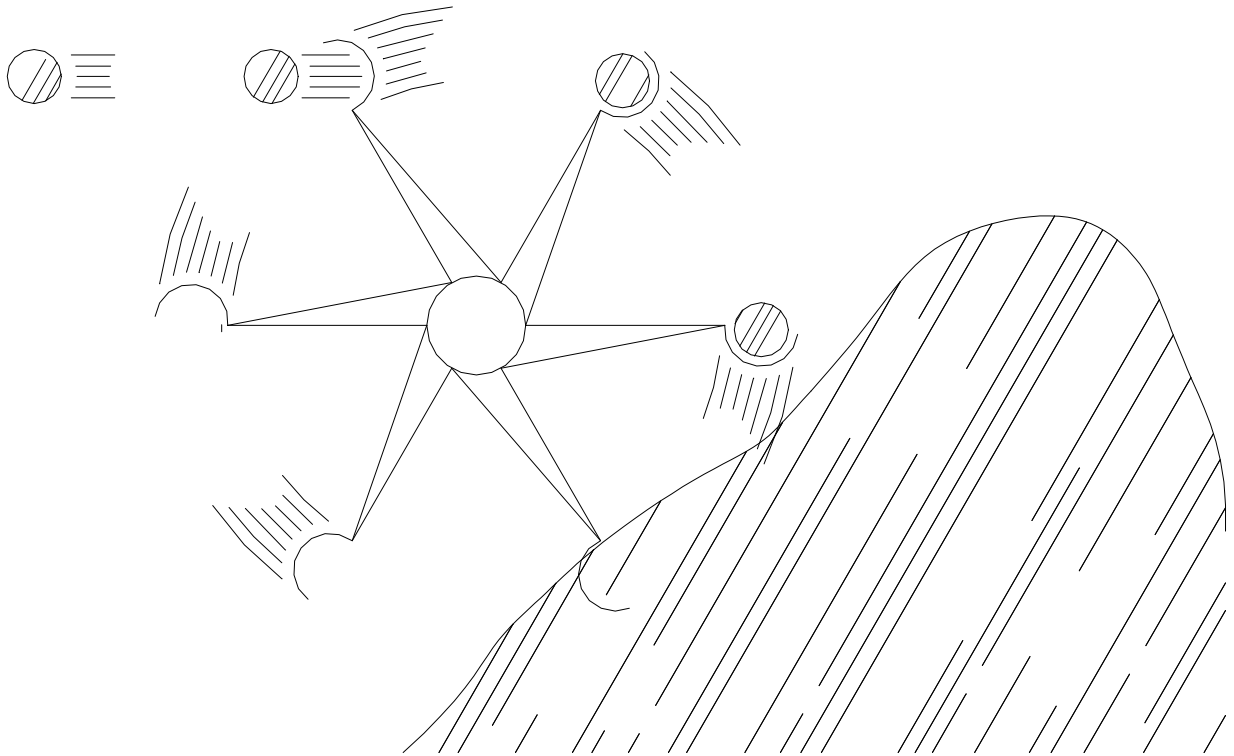


Key Terms

- CFM
- SP (Ps)
- VP (Pv)
- RPM
- BHP
- kW

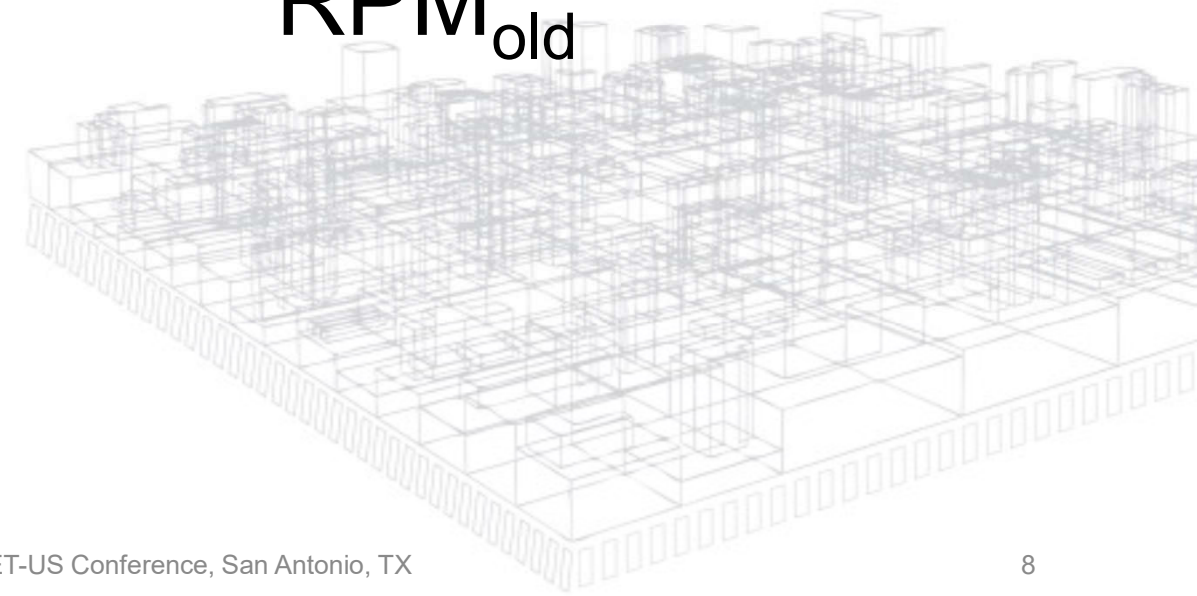


Fan Laws



Fan Laws

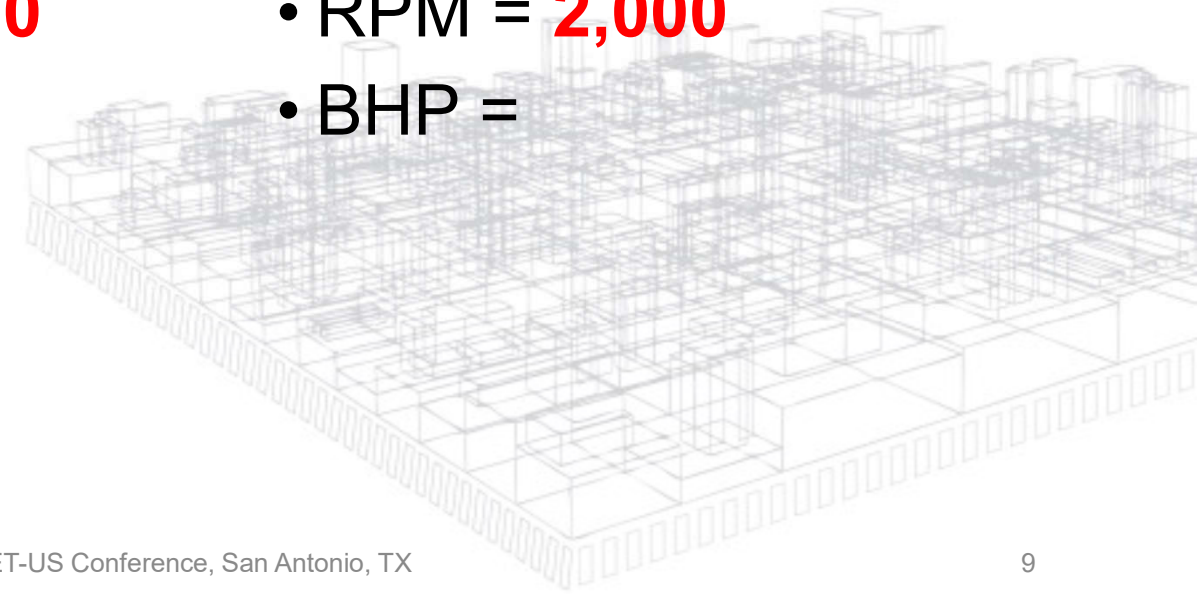
$$\frac{CFM_{new}}{CFM_{old}} = \frac{RPM_{new}}{RPM_{old}}$$



Fan Laws

- CFM = **10,000**
- SP = 1”
- RPM = **1,000**
- BHP = 10

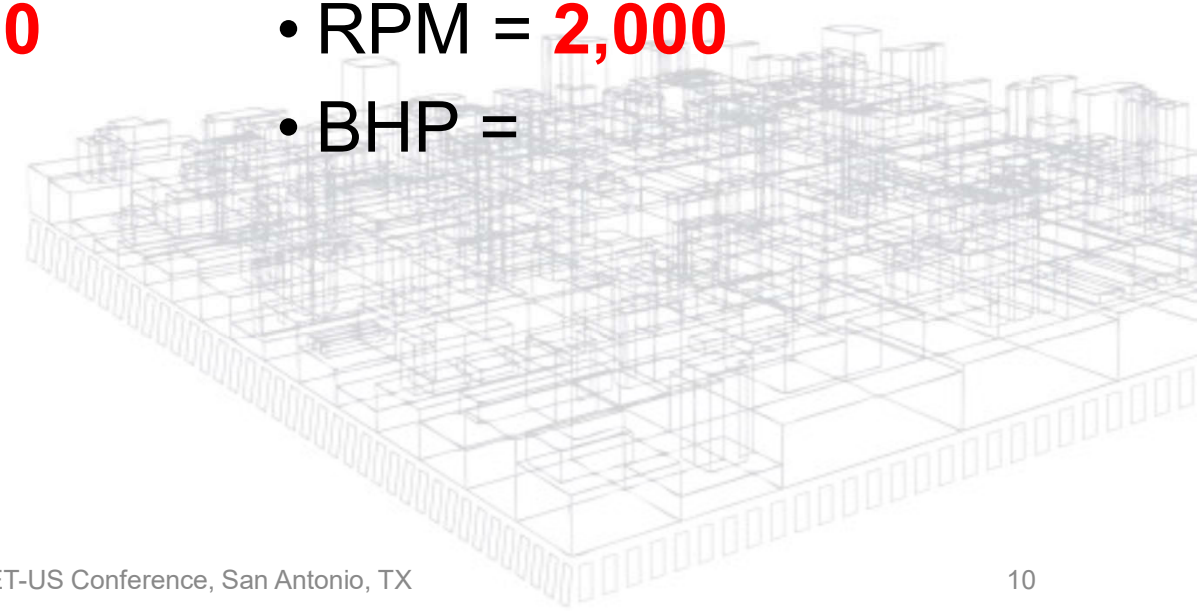
- CFM =
- SP =
- RPM = **2,000**
- BHP =



Fan Laws

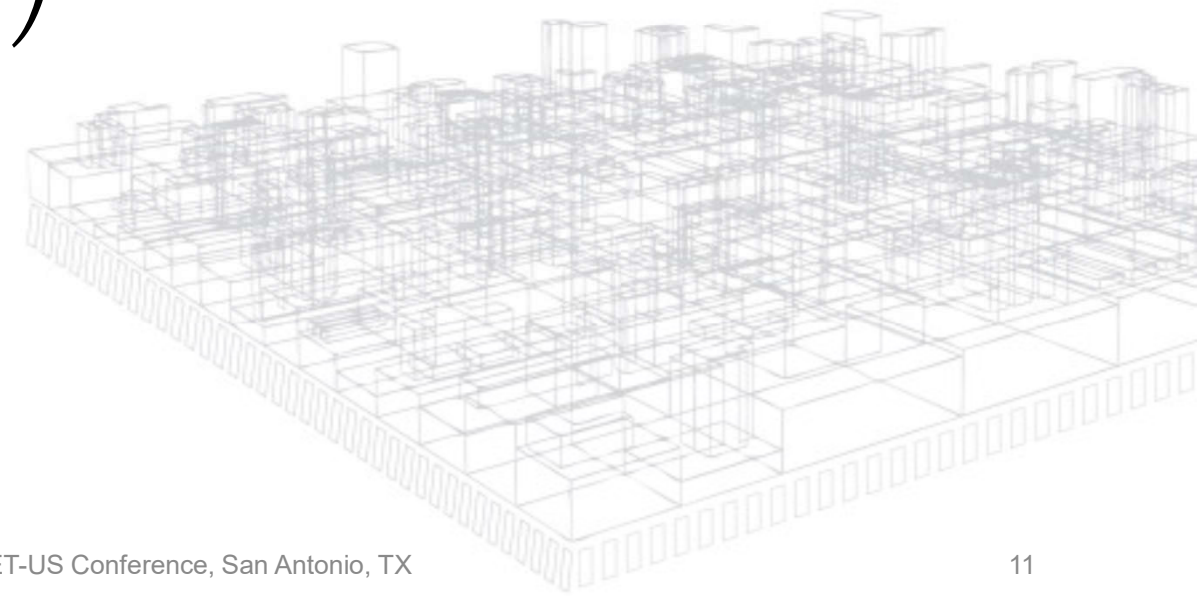
- CFM = **10,000**
- SP = 1”
- RPM = **1,000**
- BHP = 10

- CFM = **20,000**
- SP =
- RPM = **2,000**
- BHP =



Fan Laws

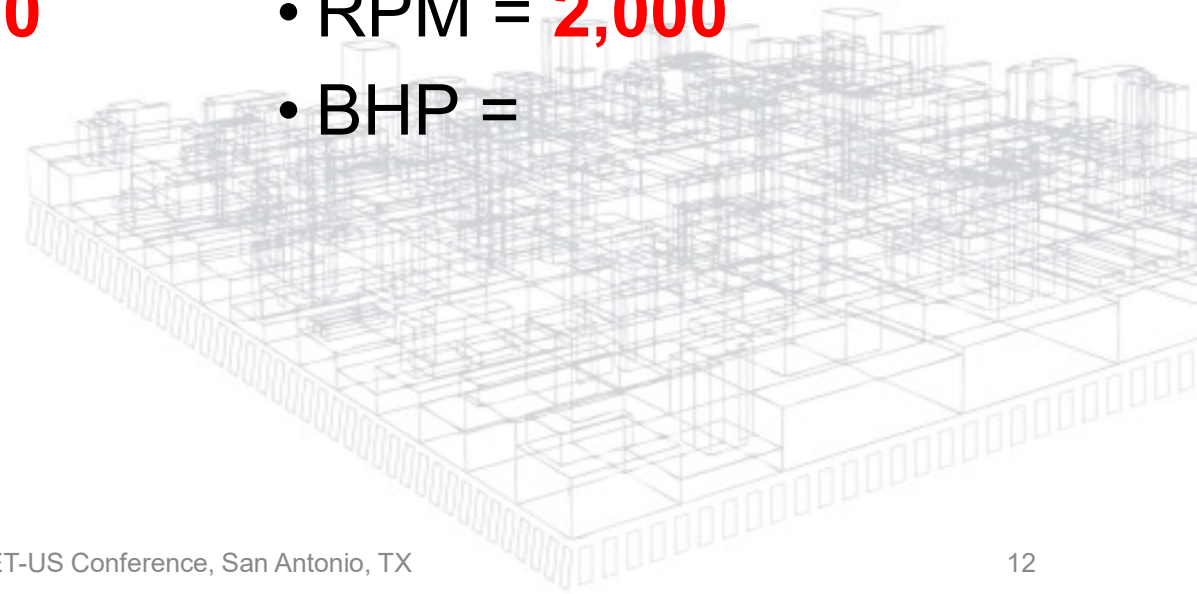
$$\frac{SP_{new}}{SP_{old}} = \left(\frac{RPM_{new}}{RPM_{old}}\right)^2$$



Fan Laws

- CFM = 10,000
- SP = **1”**
- RPM = **1,000**
- BHP = 10

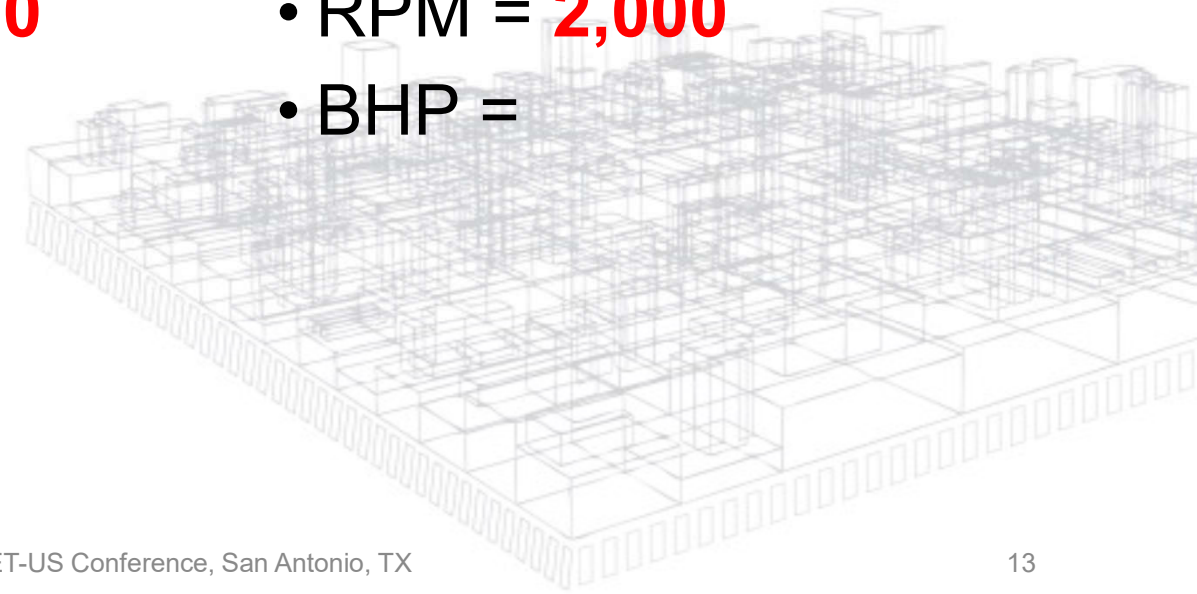
- CFM = 20,000
- SP =
- RPM = **2,000**
- BHP =



Fan Laws

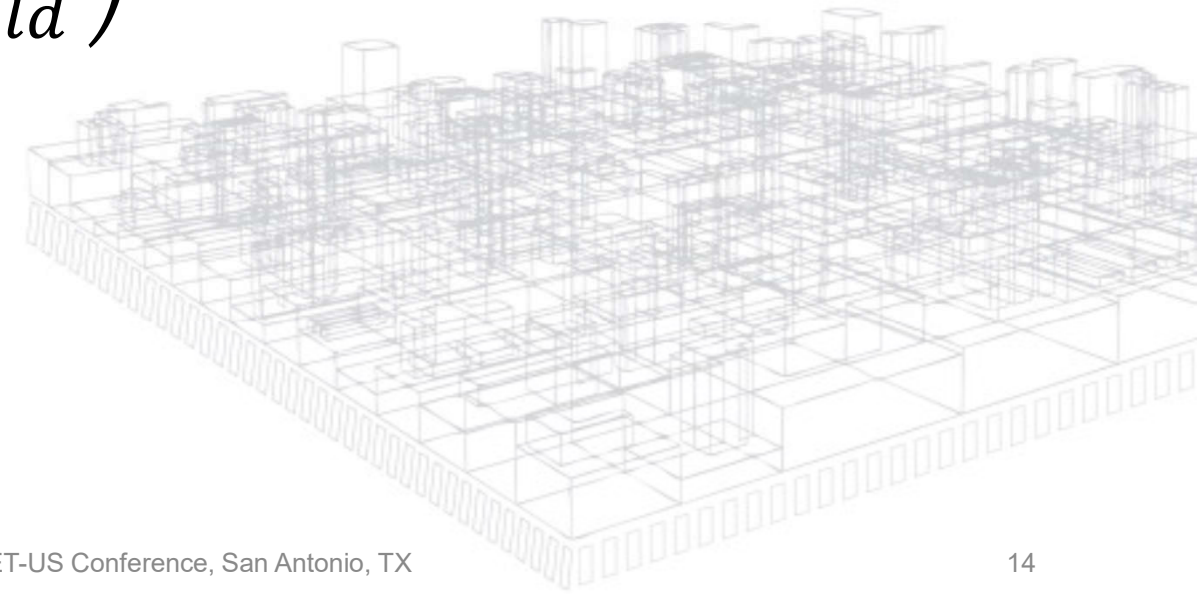
- CFM = 10,000
- SP = **1”**
- RPM = **1,000**
- BHP = 10

- CFM = 20,000
- SP = **4”**
- RPM = **2,000**
- BHP =



Fan Laws

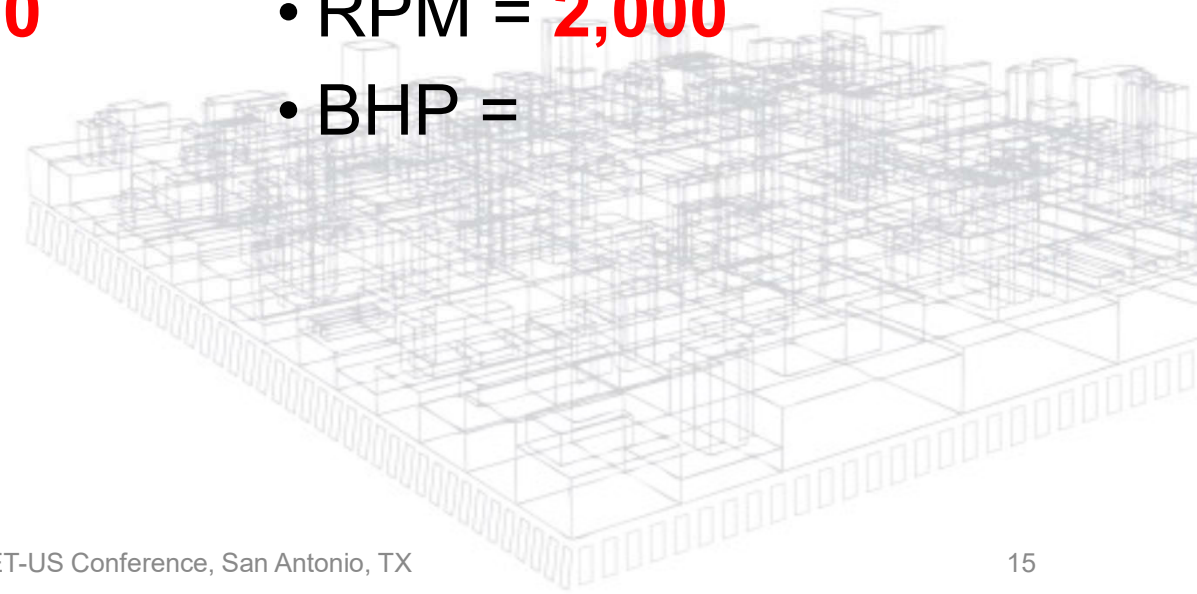
$$\frac{\mathrm{BH}P_{new}}{\mathrm{BH}P_{old}} = \left(\frac{RPM_{new}}{RPM_{old}}\right)^{3}$$



Fan Laws

- CFM = 10,000
- SP = 1”
- RPM = **1,000**
- BHP = **10**

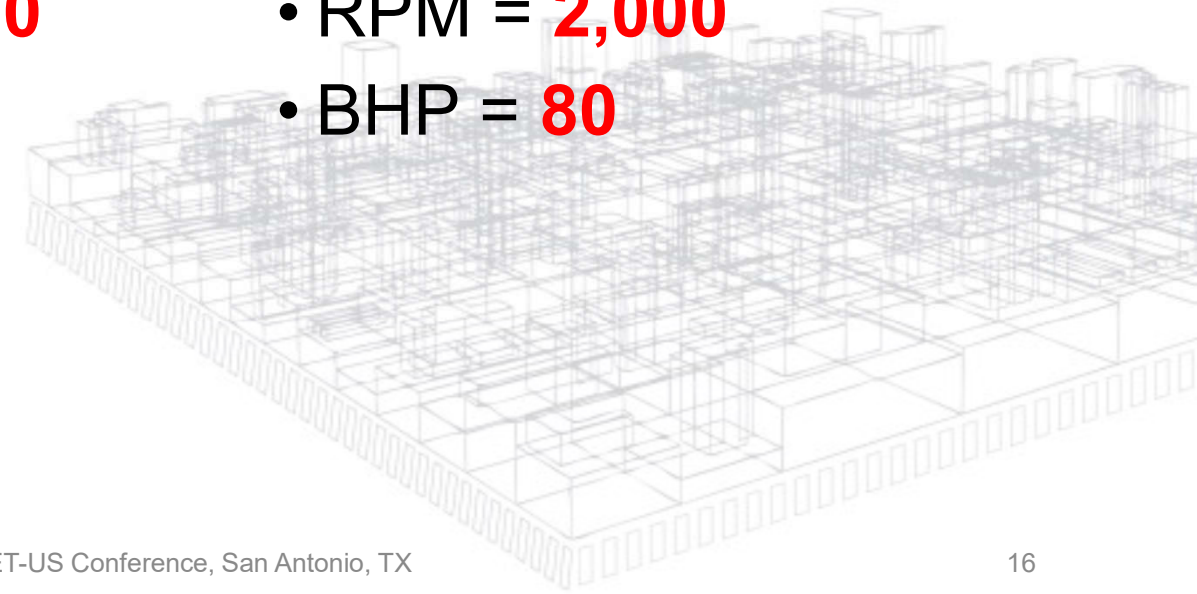
- CFM = 20,000
- SP = 4”
- RPM = **2,000**
- BHP =



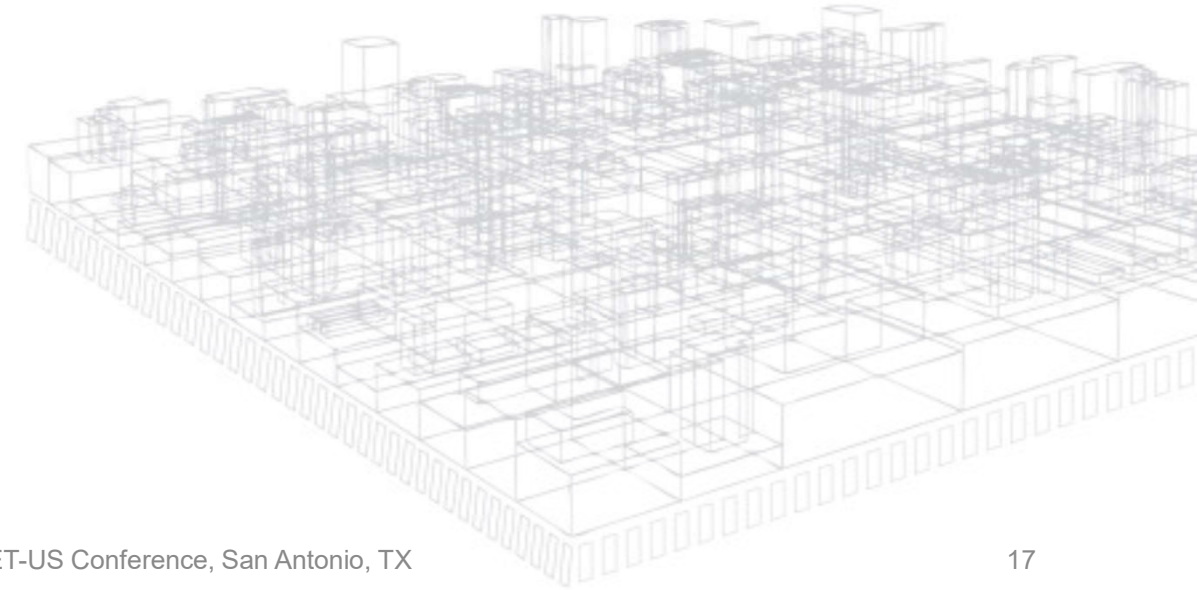
Fan Laws

- CFM = 10,000
- SP = 1
- RPM = **1,000**
- BHP = **10**

- CFM = 20,000
- SP = 4”
- RPM = **2,000**
- BHP = **80**



Testing

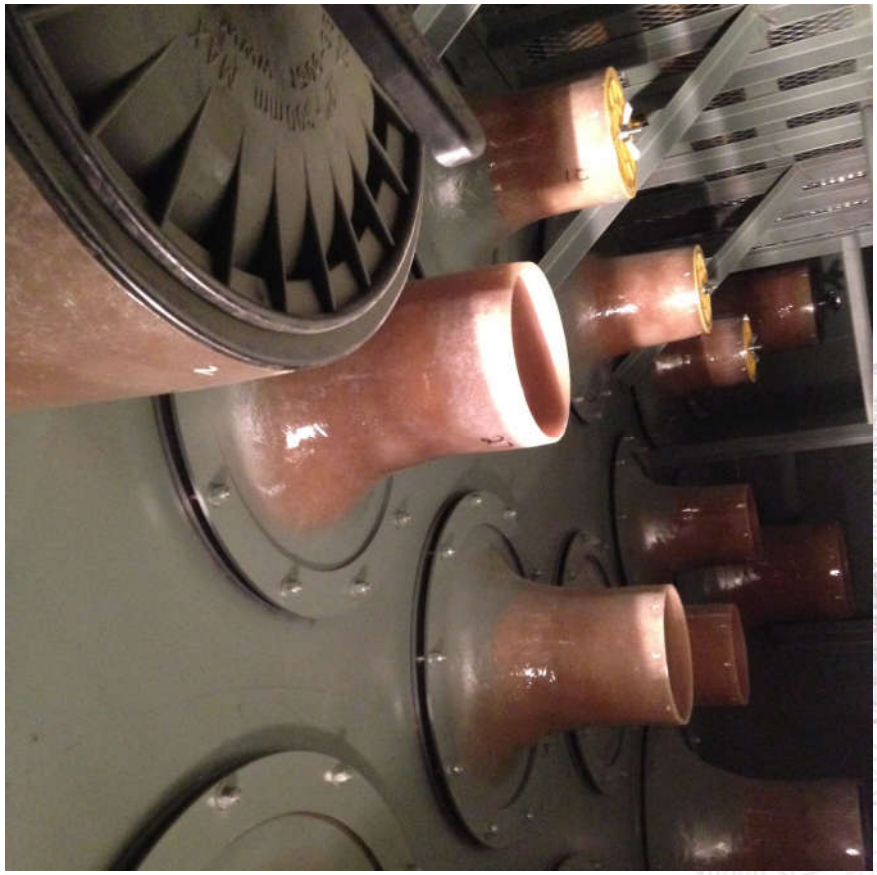


Testing

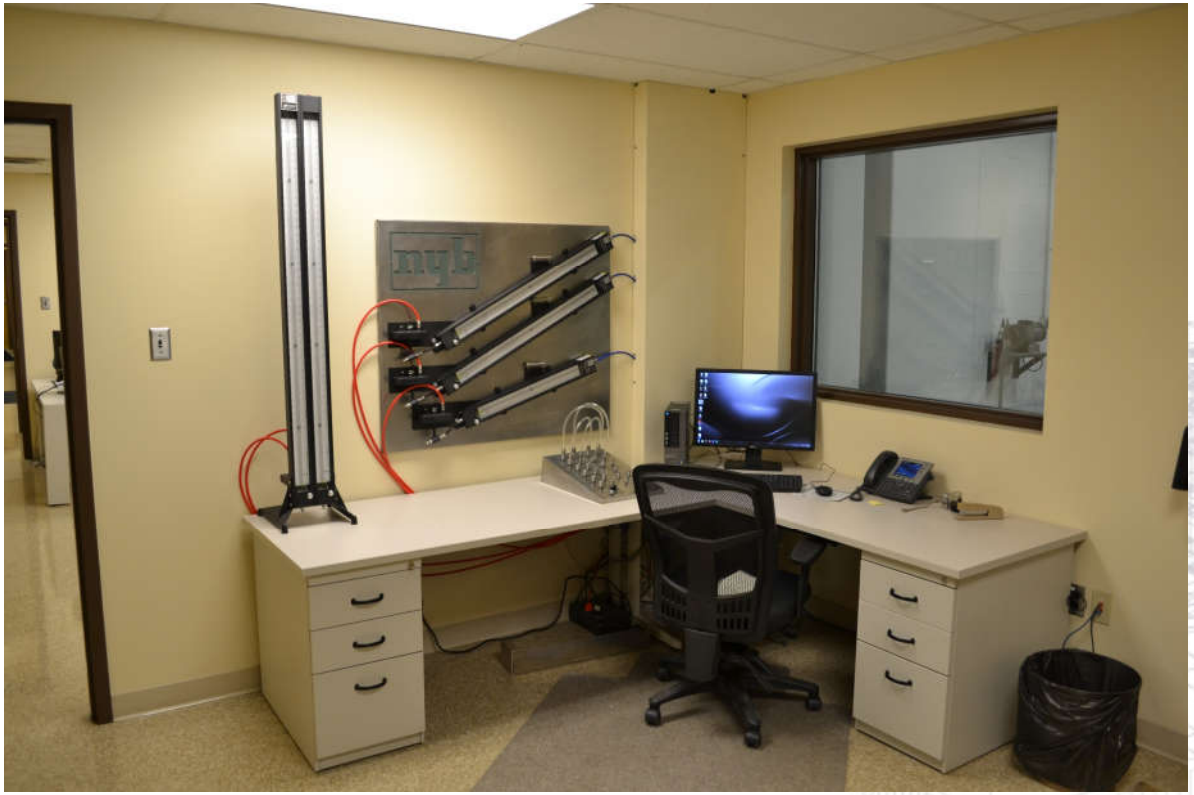
Testing

Testing

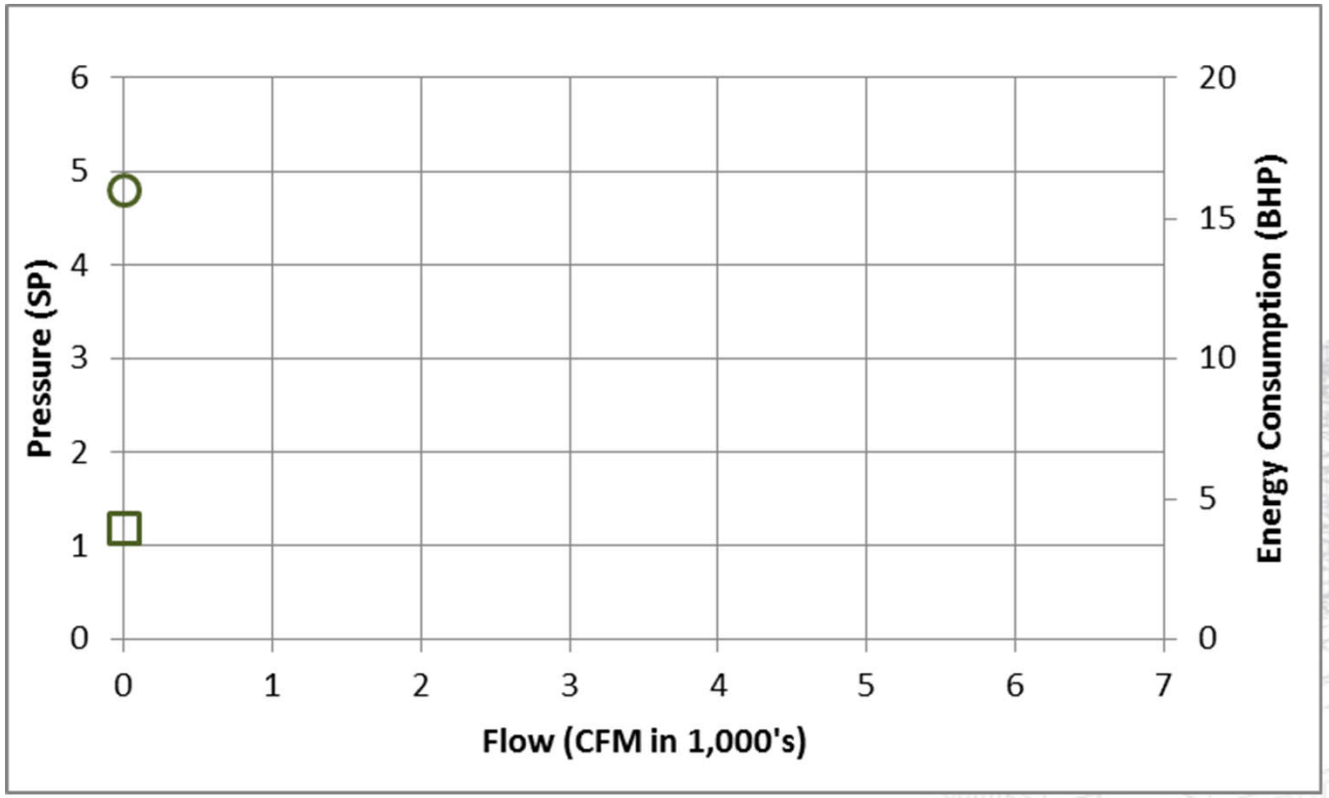
Testing



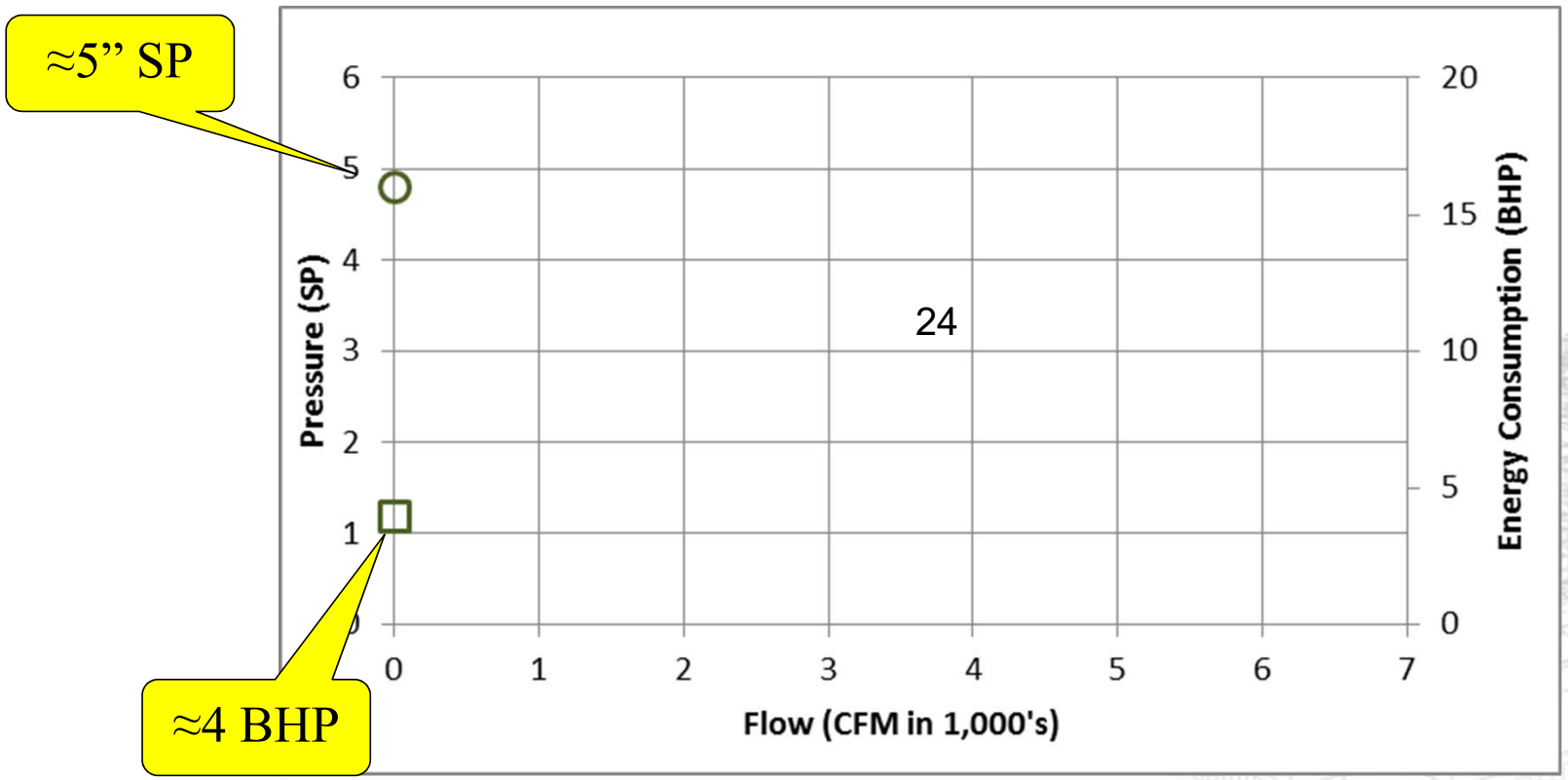
Testing



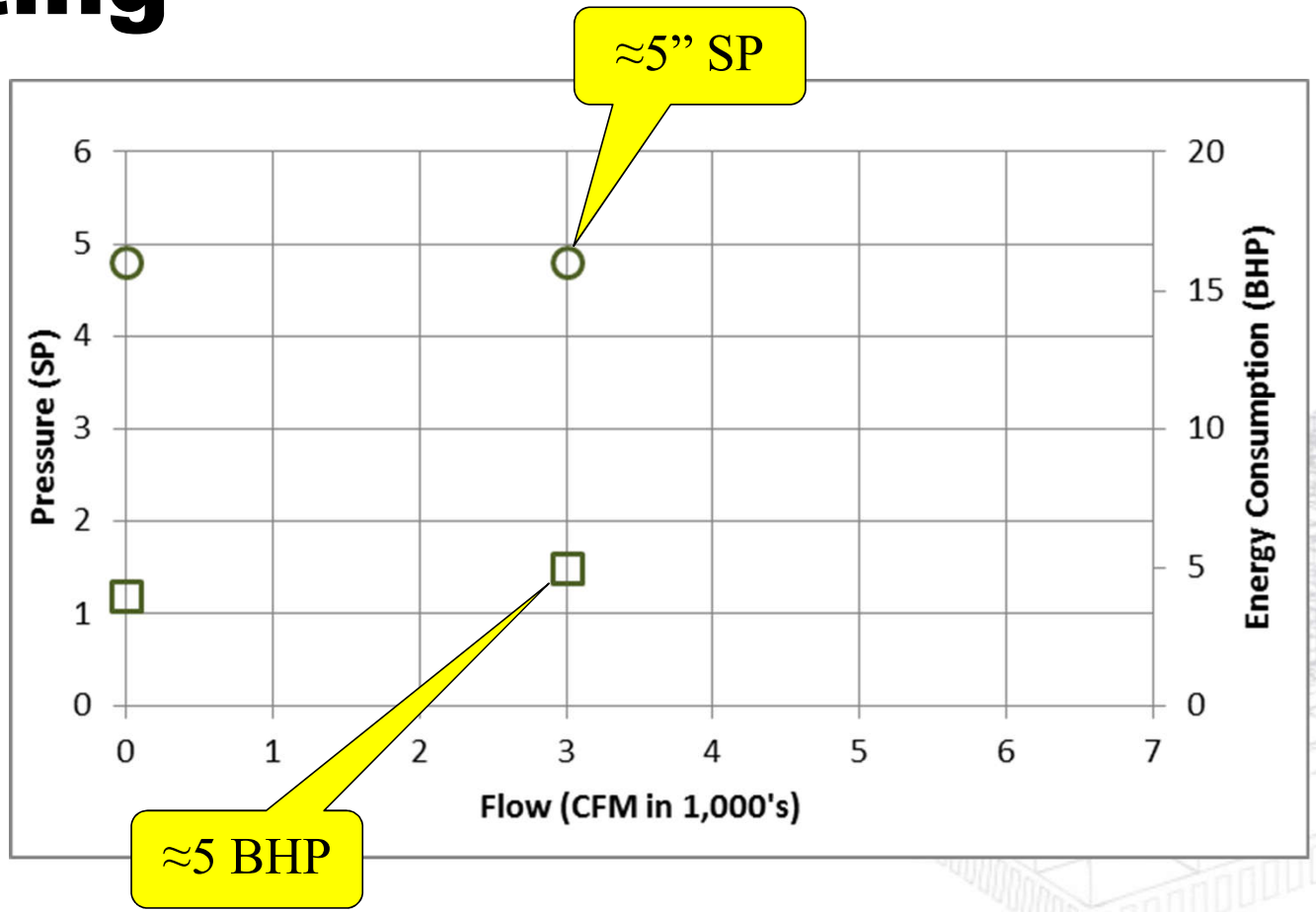
Testing


Pressure (SP)
Energy Consumption (BHP)
Flow (CFM in 1,000's)
0
1
2
3
4
5
6
7
0
5
10
15
20

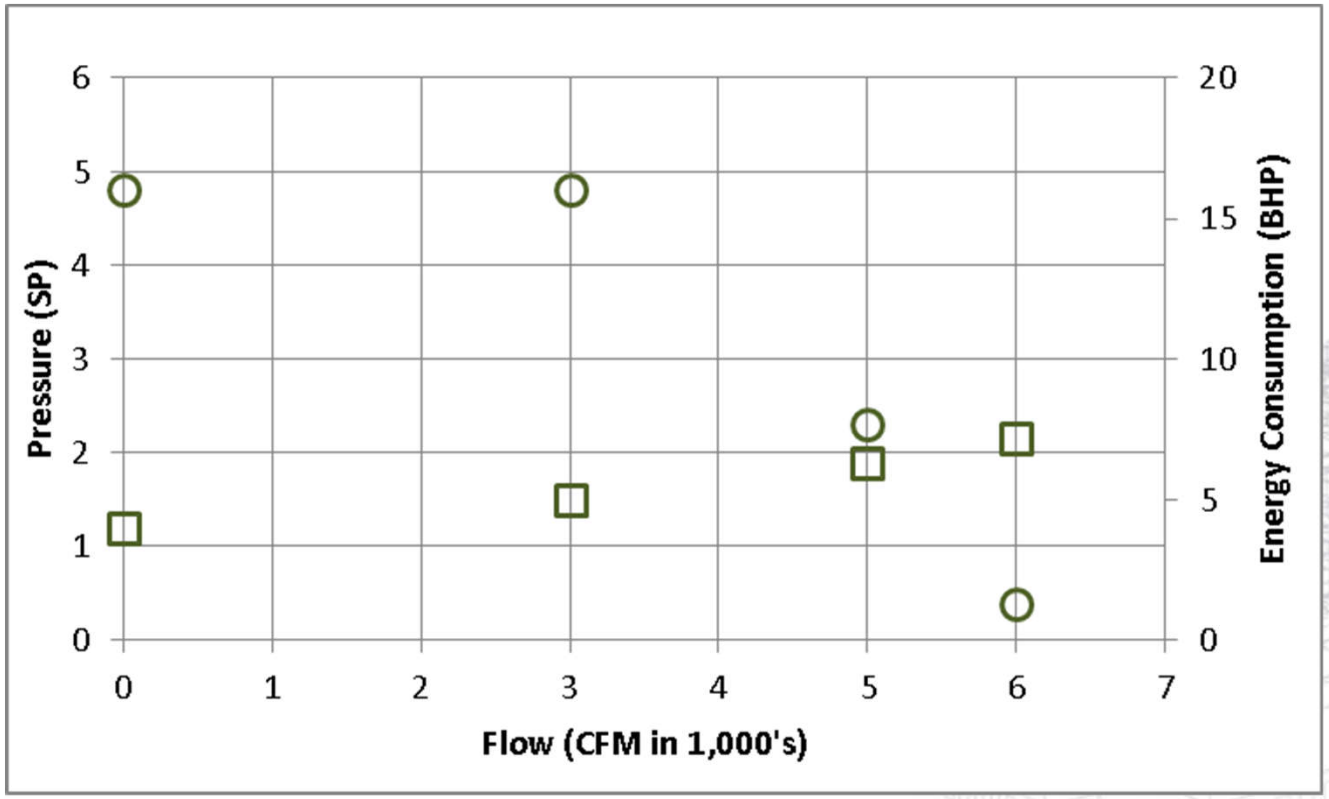
Testing


≈5” SP
≈4 BHP
Pressure (SP)
Energy Consumption (BHP)
Flow (CFM in 1,000's)
24
0
1
2
3
4
5
6
7
0
5
10
15
20

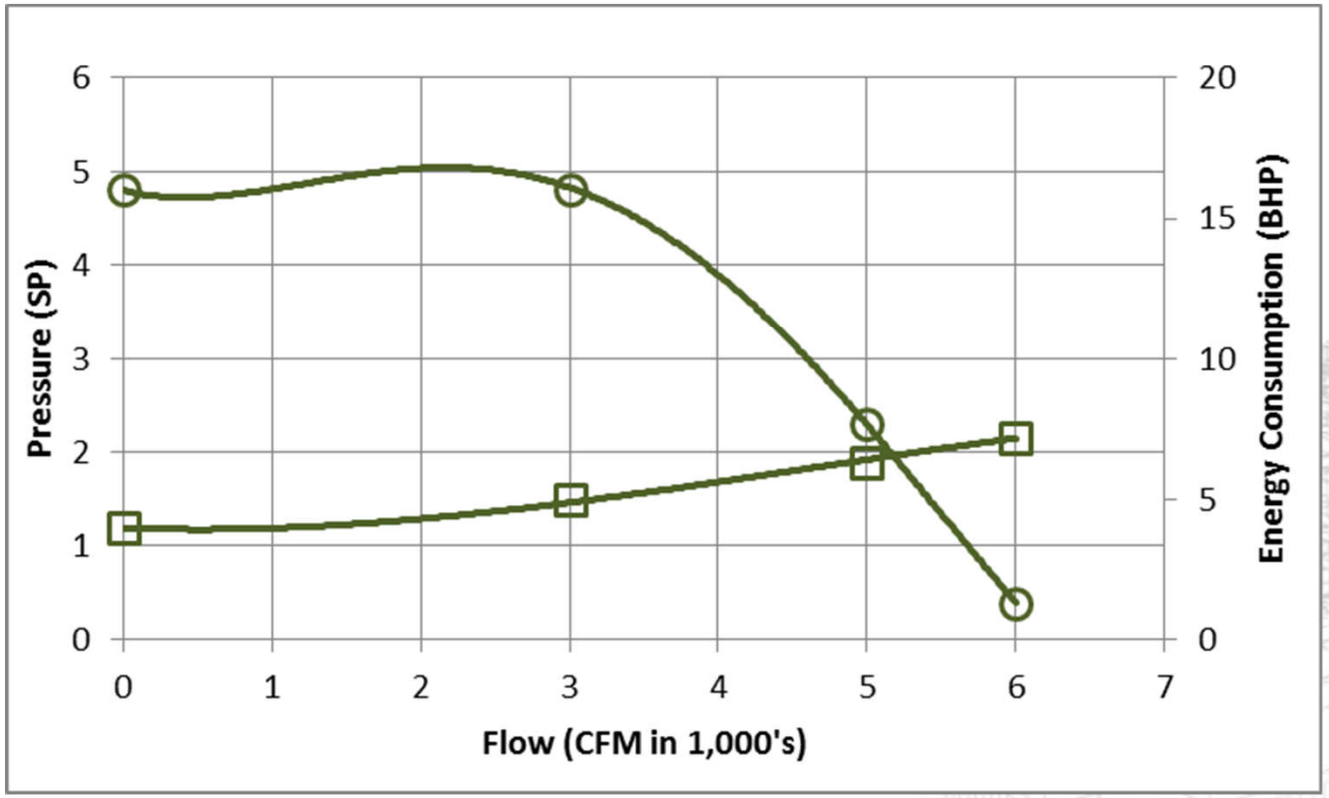
Testing


≈5” SP
≈5 BHP
Pressure (SP)
Energy Consumption (BHP)
Flow (CFM in 1,000's)
0
1
2
3
4
5
6
7
0
5
10
15
20

Testing


Pressure (SP)
Energy Consumption (BHP)
Flow (CFM in 1,000's)
0
1
2
3
4
5
6
7
0
5
10
15
20

Fan Performance Curve



Catalog Performance Tables

MODEL **405** — **WITH EVASE**

Wheel diameter: 40.3" | Wheel circumference: 10.5'

Outlet area: 10.2 sq. ft. | Maximum BHP = 24.5 $\left(\frac{RPM}{1000}\right)^3$

AF-30=2035 RPM | AF-40=2470 RPM | AF-50=2640 RPM

CFM	OV	18"SP		22"SP		26"SP		28"SP		30"SP		34"SP		38"SP		42"SP		46"SP		48"SP		50"SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
24000	2348	1640	76.9	1691	96	1828	116	1896	125	1960	136												
28800	2820	1674	86.9	1736	106	1876	126	1902	135	1968	146	2095	167	2208	189								
29400	2397	1615	96.5	1795	116	1868	136	1918	146	1976	157	2060	179	2210	204	2320	227	2462	253	2478	284		
31800	3112	1866	107	1775	126	1886	148	1947	160	2000	170	2111	194	2221	218	2320	242	2429	268	2478	291	2630	295
34400	3365	1721	119	1827	140	1928	162	1980	173	2096	198	2133	208	2241	235	2339	260	2448	286	2492	301	2639	314
37000	3620	1785	132	1880	154	1977	177	2023	188	2091	200	2173	227	2262	251	2360	278	2462	304	2601	318	2651	334
39800	3876	1860	147	1939	170	2034	196	2078	207	2124	220	2212	244	2302	271	2388	297	2491	326	2635	340	2667	354
42200	4129	1920	164	2004	188	2089	212	2131	225	2176	238	2260	265	2341	291	2429	319	2510	347	2643	362	2698	378
44800	4394	1991	181	2071	208	2160	232	2192	245	2232	260	2312	286	2396	315	2469	342	2562	372	2698	388	2829	402
47400	4638	2068	202	2144	228	2218	254	2259	268	2298	281	2378	311	2449	340	2519	367	2594	397	2833	418		

MODEL **445** — **WITH EVASE**

Wheel diameter: 44.5" | Wheel circumference: 11.7'

Outlet area: 12.5 sq. ft. | Maximum BHP = 40.3 $\left(\frac{RPM}{1000}\right)^3$

AF-30=1850 RPM | AF-40=2230 RPM | AF-50=2400 RPM

CFM	OV	18"SP		22"SP		26"SP		28"SP		30"SP		34"SP		38"SP		42"SP		46"SP		48"SP		50"SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
30000	2298	1409	97.6	1537	120	1661	144	1722	157	1780	169	1886	191.0										
33200	2584	1436	108	1564	131	1671	155	1730	170	1788	183	1892	210	1996	236	2099	266	2194	294	2249	311	2288	323
35400	2810	1466	118	1594	144	1682	170	1752	185	1805	199	1908	227	2006	256	2106	285	2199	315	2249	342	2288	347
39800	3186	1609	131	1616	158	1722	186	1773	200	1828	215	1934	244	2019	273	2116	305	2209	337	2294	369	2301	371
42800	3421	1566	146	1666	172	1752	201	1805	217	1861	231	1961	263	2039	293	2125	328	2221	360	2352	376	2306	393
46000	3677	1604	169	1697	187	1790	217	1840	234	1884	249	1978	283	2066	315	2150	348	2235	382	2280	401	2320	417
49200	3933	1661	175	1748	206	1834	236	1878	252	1924	270	2009	303	2092	335	2177	372	2257	406	2305	428	2343	446
52400	4189	1718	198	1801	224	1884	257	1923	273	1964	289	2060	326	2124	359	2205	396	2291	436	2325	452	2361	470
55600	4444	1780	213	1866	244	1933	278	1971	294	2010	312	2060	348	2166	386	2243	423	2315	469	2358	482	2391	499
58800	4700	1944	235	1915	267	1989	301	2026	319	2064	338	2137	374	2206	410	2280	450	2354	490	2390	510		

MODEL **495** — **WITH EVASE**

Wheel diameter: 49.0" | Wheel circumference: 12.8'

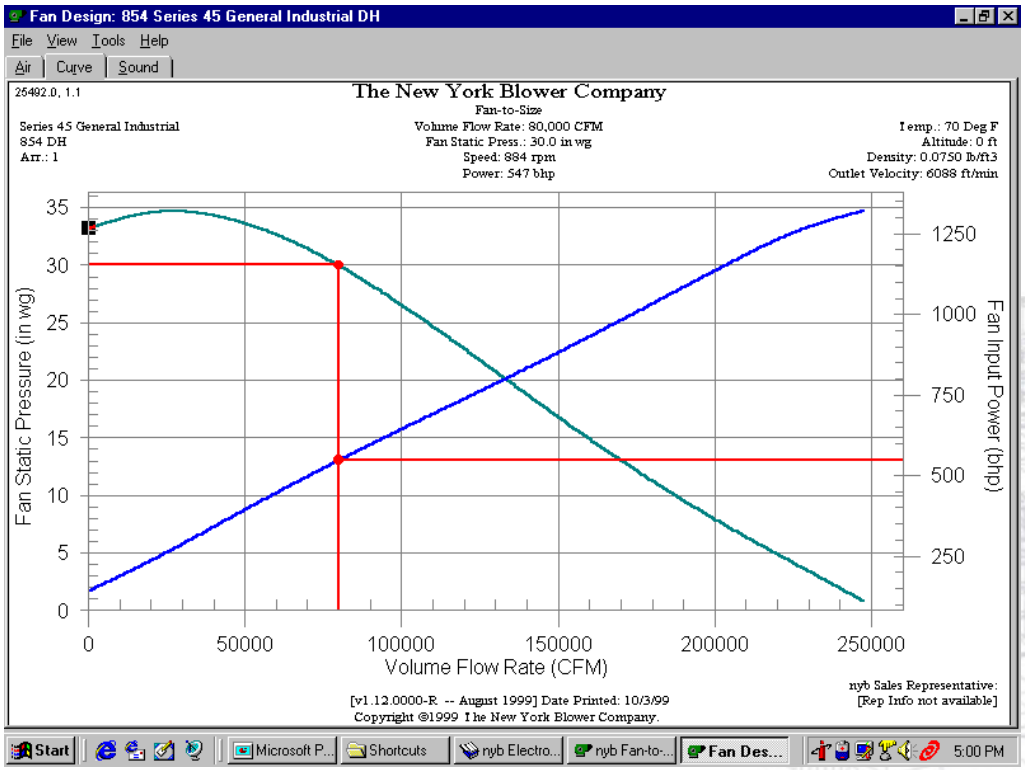
Outlet area: 15.3 sq. ft. | Maximum BHP = 65.5 $\left(\frac{RPM}{1000}\right)^3$

AF-30=1675 RPM | AF-40=2025 RPM | AF-50=2170 RPM

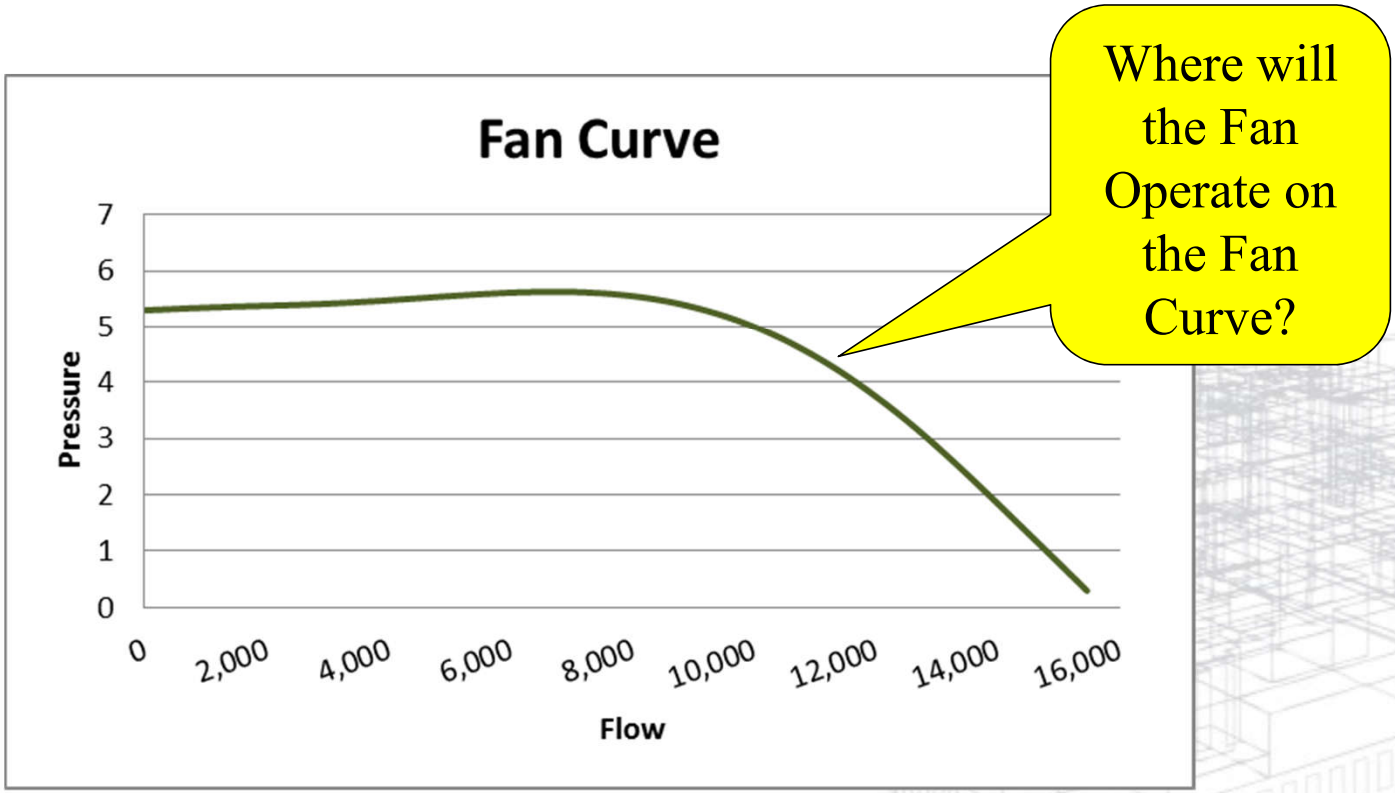
CFM	OV	18"SP		22"SP		26"SP		28"SP		30"SP		34"SP		38"SP		42"SP		46"SP		48"SP		50"SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
36000	2361	1267	116	1380	142	1500	172	1566	187	1610	202												
40000	2632	1296	130	1404	168	1507	197	1568	202	1611	218	1711	250	1810	286								
44000	2886	1336	146	1460	174	1526	206	1572	220	1621	236	1716	270	1811	306	1903	342	1990	378				
48000	3148	1388	164	1471	194	1568	226	1601	241	1646	258	1734	293	1822	329	1906	366	1990	403	2062	438	2076	444
52000	3410	1435	184	1516	216	1596	248	1637	265	1676	281	1768	317	1859	354	1922	391	2000	431	2068	461	2078	471
56000	3672	1498	207	1566	239	1640	272	1679	291	1716	308	1791	344	1867	381	1940	420	2018	462	2064	482	2091	503
60000	3934	1562	232	1621	266	1698	302	1728	320	1760	336	1831	375	1900	413	1969	452	2043	495	2076	515	2110	536
64000	4197	1615	260	1680	295	1744	331	1778	350	1813	370	1876	407	1941	447	2007	489	2072	531	2104	551	2137	573
68000	4459	1682	292	1741	327	1806	366	1834	386	1866	404	1926	444	1989	487	2049	527	2112	571	2142	593		
72000	4721	1748	325	1807	364	1867	401	1892	422	1923	440	1978	482	2037	525	2099	572	2156	616				

Performance shown is for AF Fans with evase discharges, with outlet ducts, and with or without inlet ducts. BHP does not include belt losses.

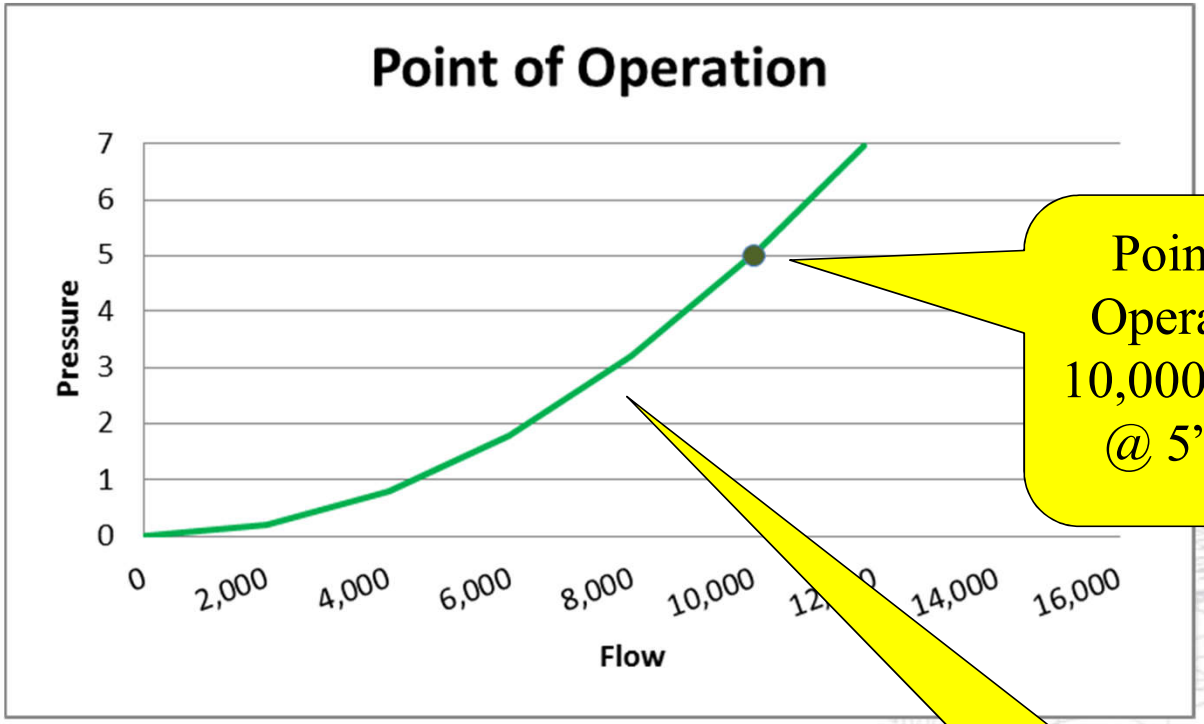
Product Selection Software



Operation in a System



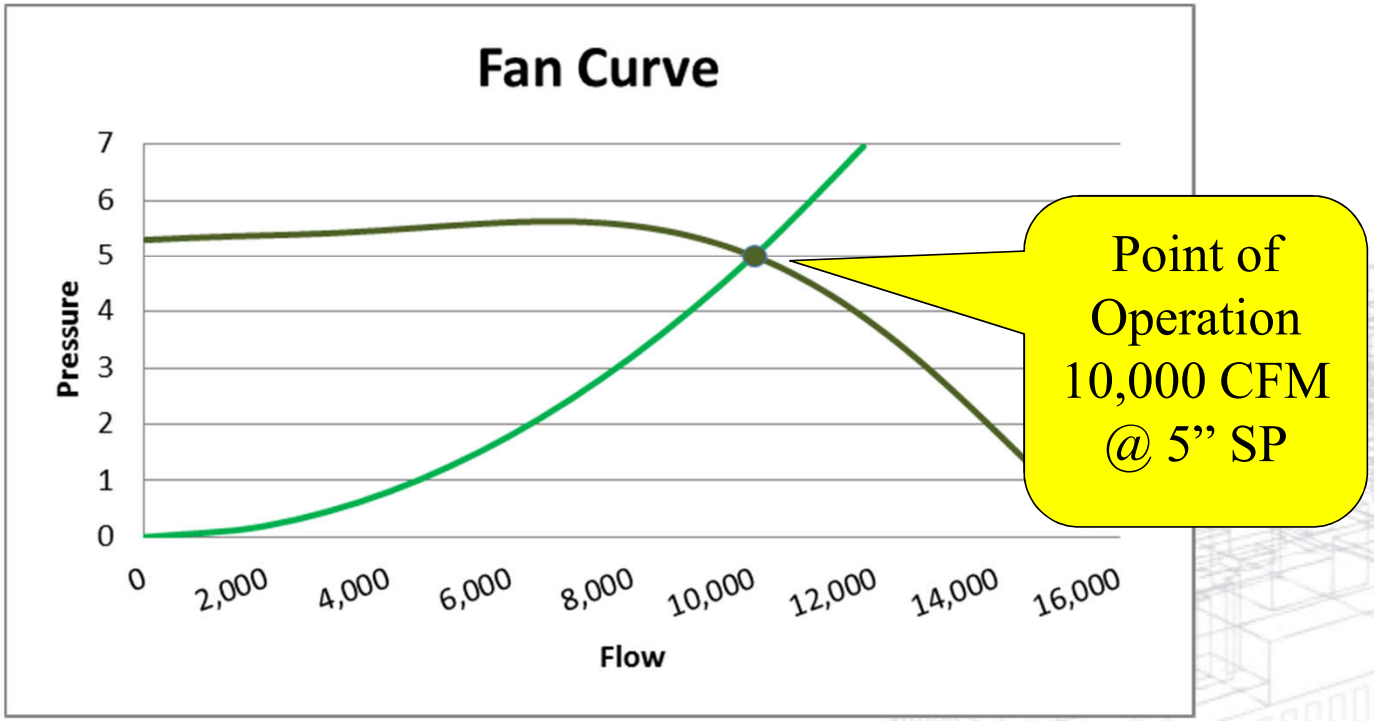
Operation in a System



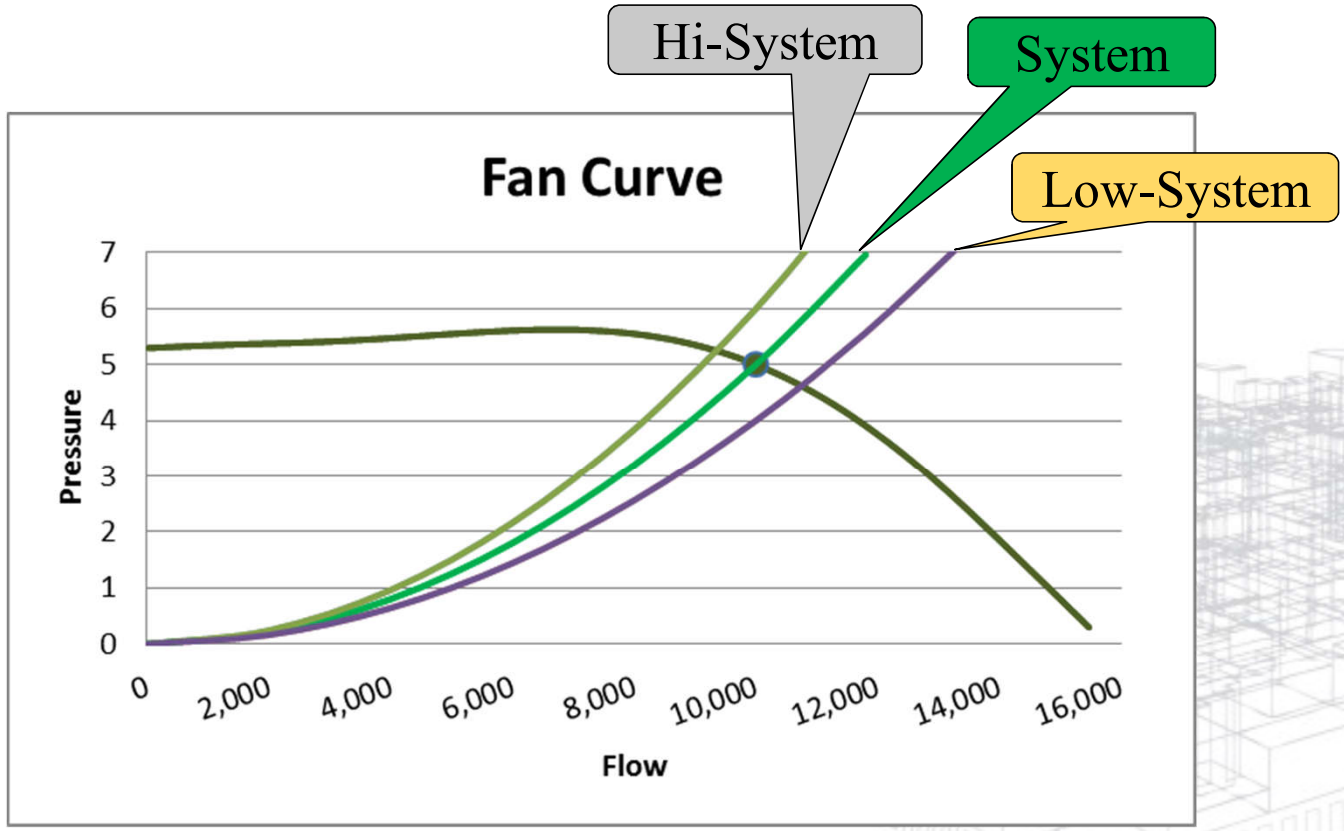
Point of Operation 10,000 CFM @ 5" SP

$\Delta SP = \Delta CFM^2$

Operation in a System



Operation in a System

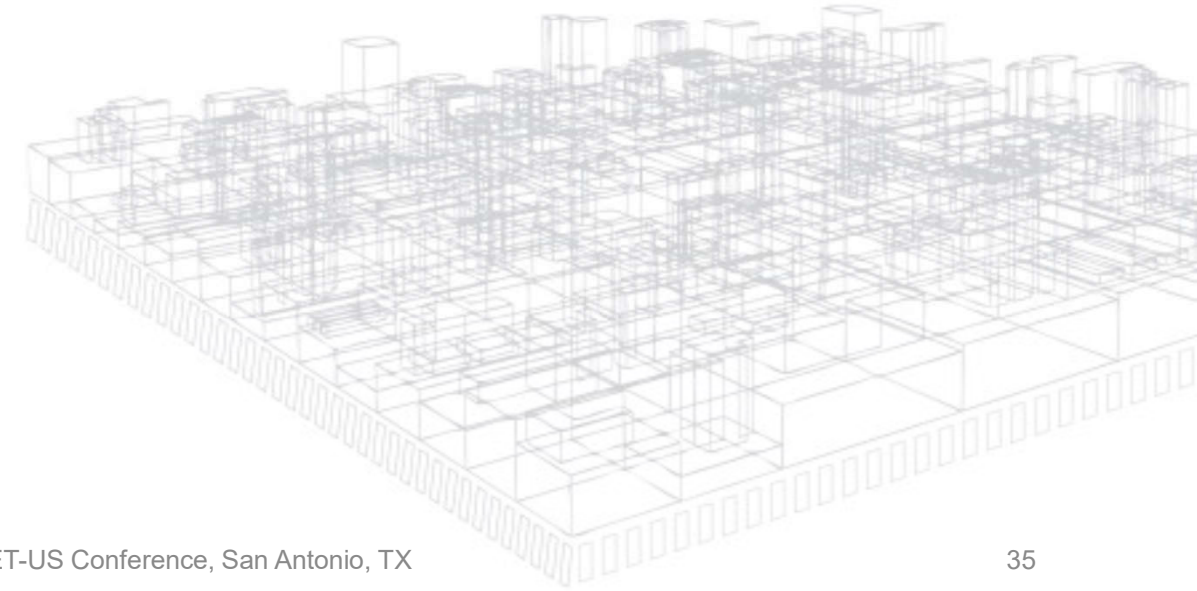


Density and Airstream

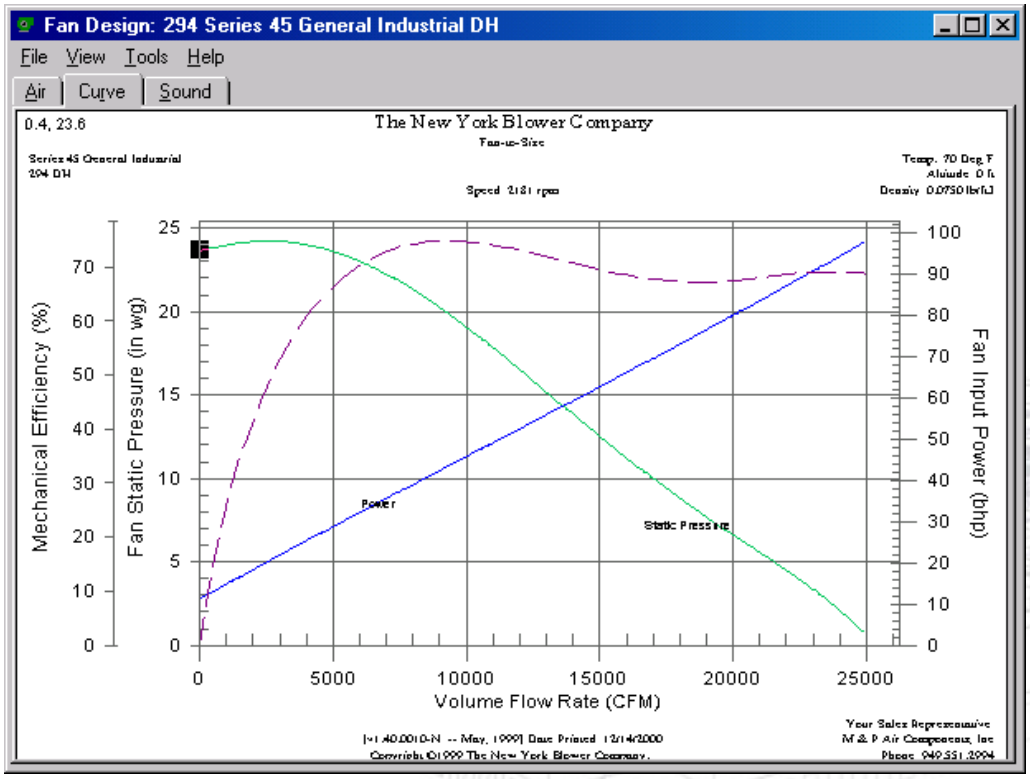
- A fan's operation is impacted by the density and the component make-up of the gas stream moving through the fan.
- The gas stream density is affected by temperature and altitude.
- The primary concern for the operating temperature of a fan is a *mechanical* issue.

Fan Types

- Different fan (impeller) types have differing characteristic (performance) curves.

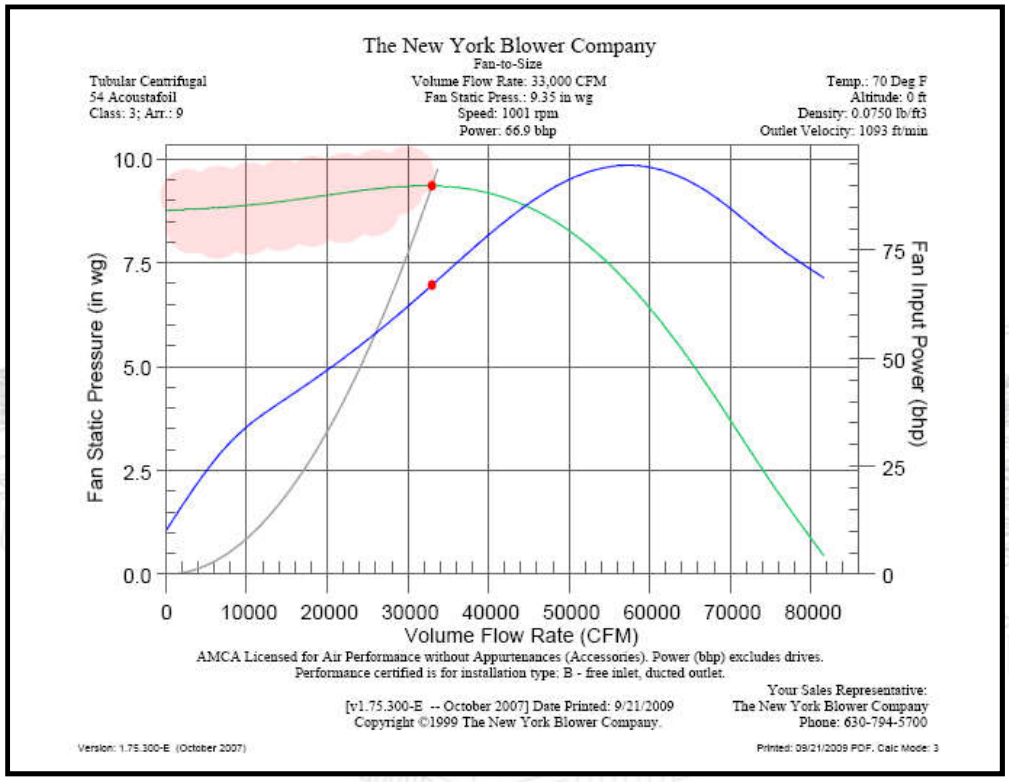


Radial


Fan Design: 294 Series 45 General Industrial DH
File View Tools Help
Air Curve Sound
0.4, 23.6
The New York Blower Company
Fan-u-Size
Speed 2181 rpm
Mechanical Efficiency (%)
Fan Static Pressure (in wg)
Fan Input Power (bhp)
Volume Flow Rate (CFM)
0
5000
10000
15000
20000
25000
Power
Static Pressure

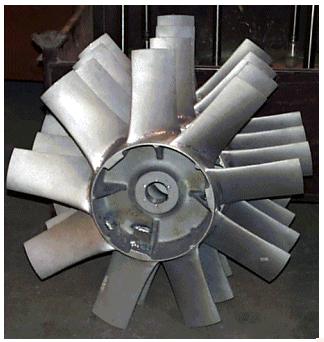
Radial

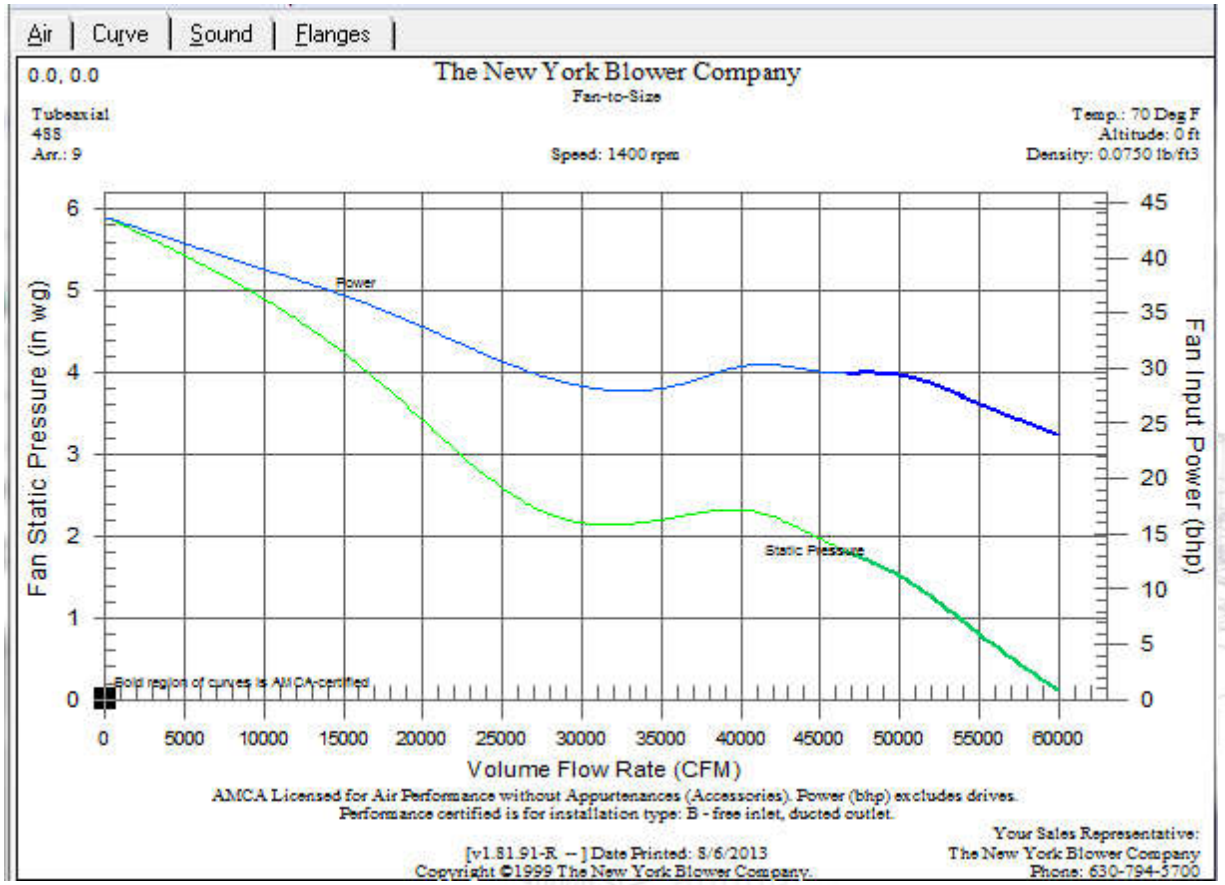
Backward Inclined



Backward Inclined

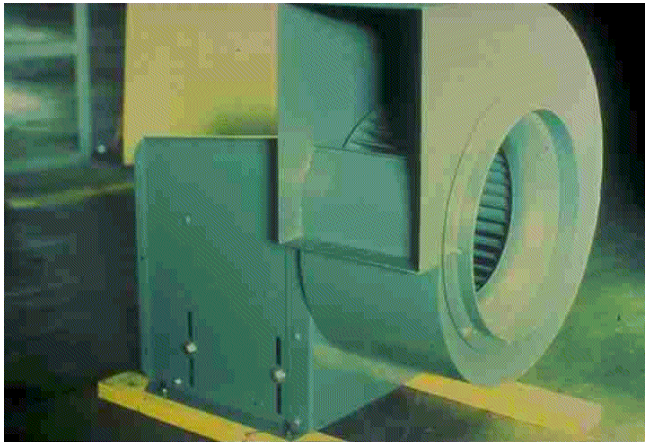
Axial

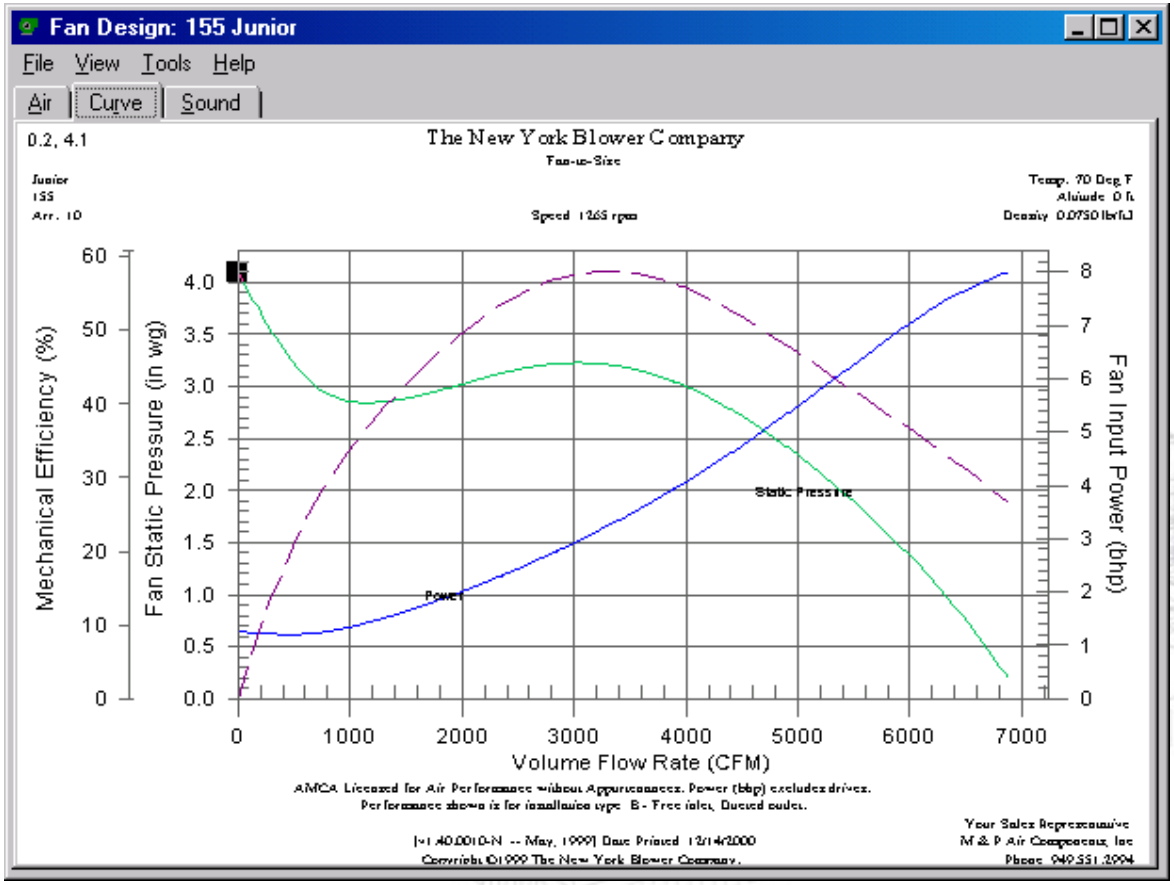



Air | Curve | Sound | Flanges |
0.0, 0.0
The New York Blower Company
Fan-to-Size
Tubeaxial
488
Arr.: 9
Speed: 1400 rpm
Temp.: 70 Deg F
Altitude: 0 ft
Density: 0.0750 lb/ft3
Fan Static Pressure (in wg)
Fan Input Power (bhp)
Power
Static Pressure
Bold region of curves is AMCA-certified
Volume Flow Rate (CFM)
AMCA Licensed for Air Performance without Appurtenances (Accessories). Power (bhp) excludes drives.
Performance certified is for installation type: B - free inlet, ducted outlet.
[v1.81.91-R --] Date Printed: 8/6/2013
Copyright ©1999 The New York Blower Company.
Your Sales Representative:
The New York Blower Company
Phone: 630-794-5700

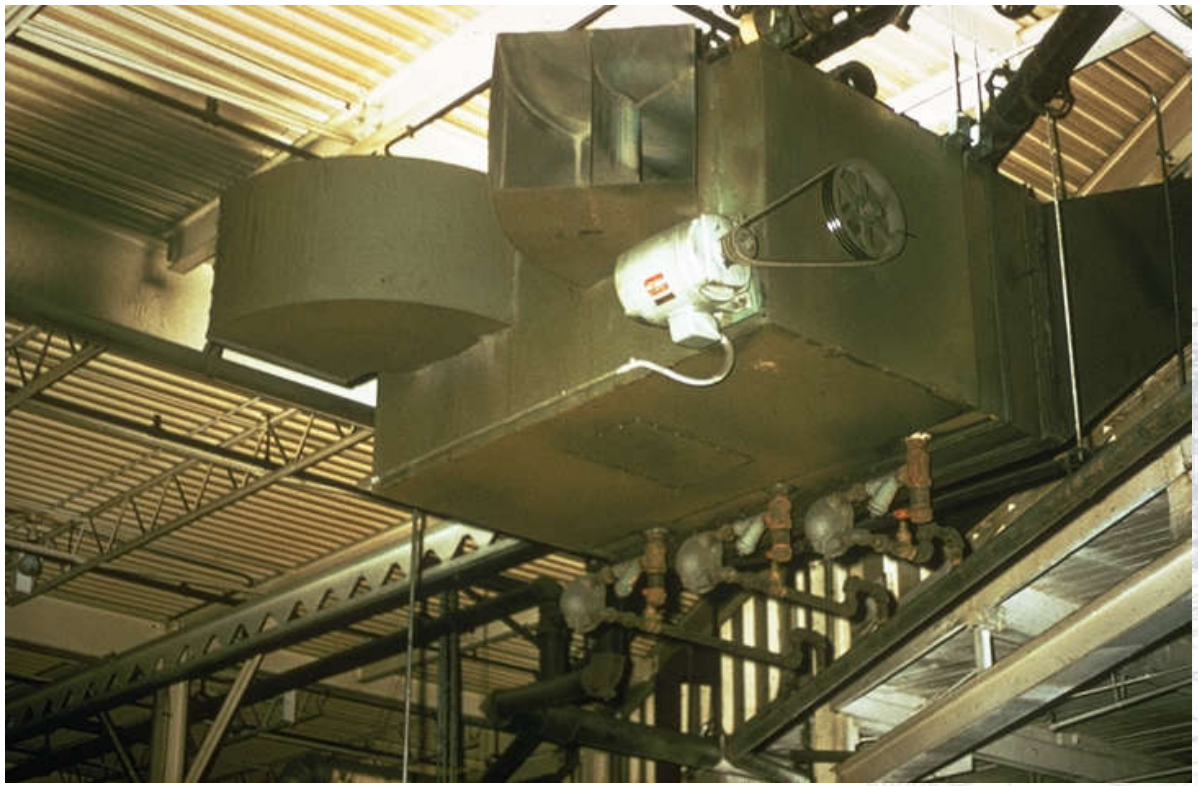
Axial

Forward Curve





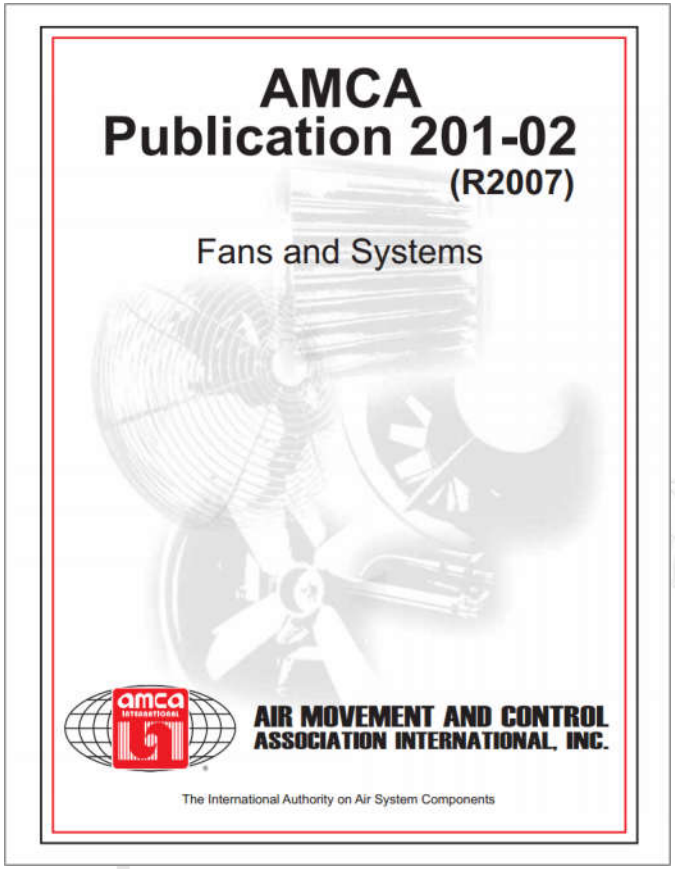
Forward Curve



System Effects

- Laboratory Environment
- Specified (AMCA) Configurations
- Inlet and outlet conditions specified…why?
  …to *minimize system effect*

System Effects



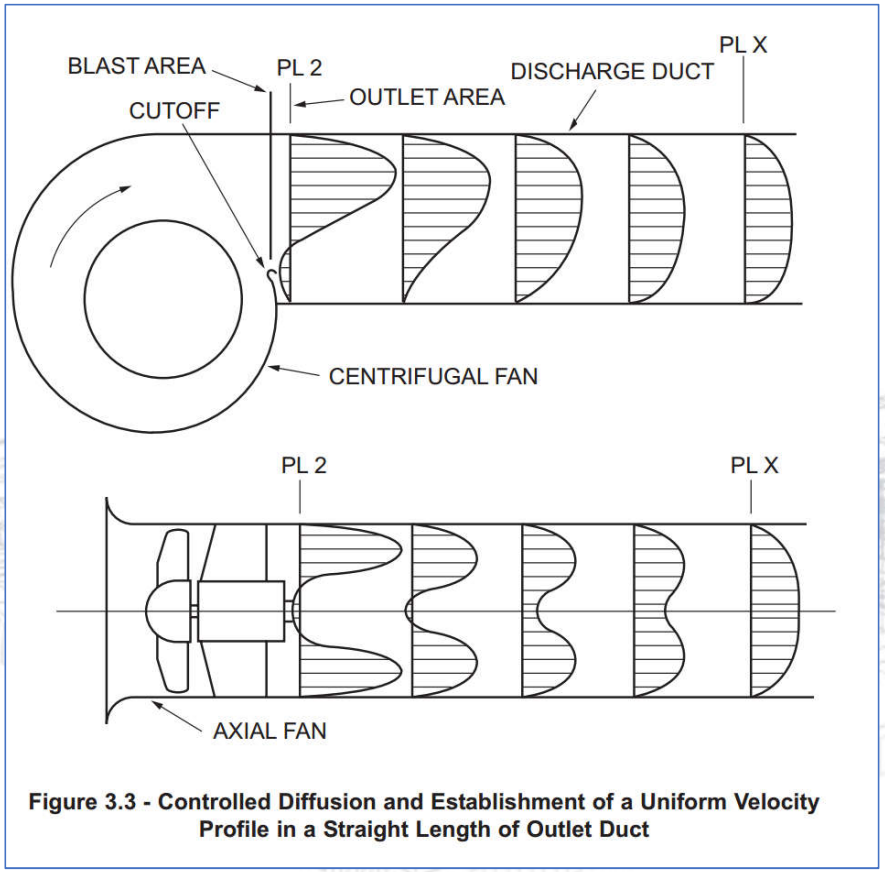
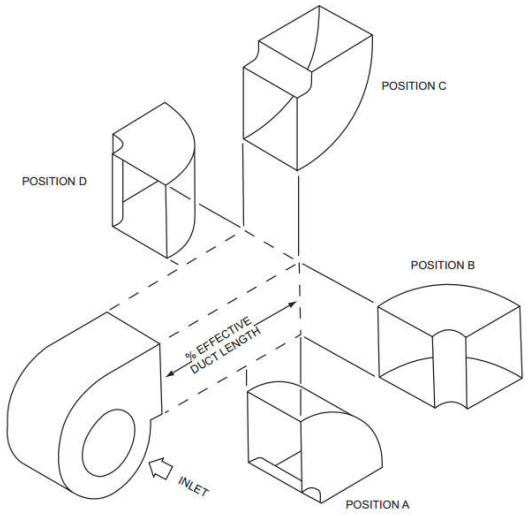


Figure 3.3 - Controlled Diffusion and Establishment of a Uniform Velocity Profile in a Straight Length of Outlet Duct

System Effects

AMCA 201-02 (R2007)



SWSI CENTRIFUGAL FAN SHOWN

Note: Fan Inlet and elbow positions must be oriented as shown for the proper application of the table on the facing page.

Figure 8.5 - Outlet Elbows on SWSI Centrifugal Fans

AMCA 201-02 (R2007)

Blast Area / Outlet Area	Outlet Elbow Position	No Outlet Duct	12% Effective Duct	25% Effective Duct	50% Effective Duct	100% Effective Duct
0.4	A	N	O	P-Q	S	*NO System Effect Factor*
	B	M-N	N	O-P	R-S	
	C	L-M	M	N	Q	
	D	L-M	M	N	Q	
0.5	A	O-P	P-Q	R	T	
	B	N-O	O-P	Q	S-T	
	C	M-N	N	O-P	R-S	
	D	M-N	N	O-P	R-S	
0.6	A	Q	Q-R	S	U	
	B	P	Q	R	T	
	C	N-O	O	Q	S	
	D	N-O	O	Q	S	
0.7	A	R-S	S	T	V	
	B	Q-R	R-S	S-T	U-V	
	C	P	Q	R-S	T	
	D	P	Q	R-S	T	
0.8	A	S	S-T	T-U	W	
	B	R-S	S	T	V	
	C	Q-R	R	S	U-V	
	D	Q-R	R	S	U-V	
0.9	A	T	T-U	U-V	W	
	B	S	S-T	T-U	W	
	C	R	S	S-T	V	
	D	R	S	S-T	V	
1.0	A	T	T-U	U-V	W	
	B	S-T	T	U	W	
	C	R-S	S	T	V	
	D	R-S	S	T	V	

SYSTEM EFFECT CURVES FOR SWSI FANS

DETERMINE *SEF* BY USING FIGURES 7.1 AND 8.1

For **DWDI** fans determine *SEF* using the curve for SWSI fans. Then, apply the appropriate multiplier from the tabulation below

MULTIPLIERS FOR DWDI FANS

ELBOW POSITION A = $\Delta P \times 1.00$
ELBOW POSITION B = $\Delta P \times 1.25$
ELBOW POSITION C = $\Delta P \times 1.00$
ELBOW POSITION D = $\Delta P \times 0.85$

Figure 8.5 - Outlet Elbows on SWSI Centrifugal Fans

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System Effects

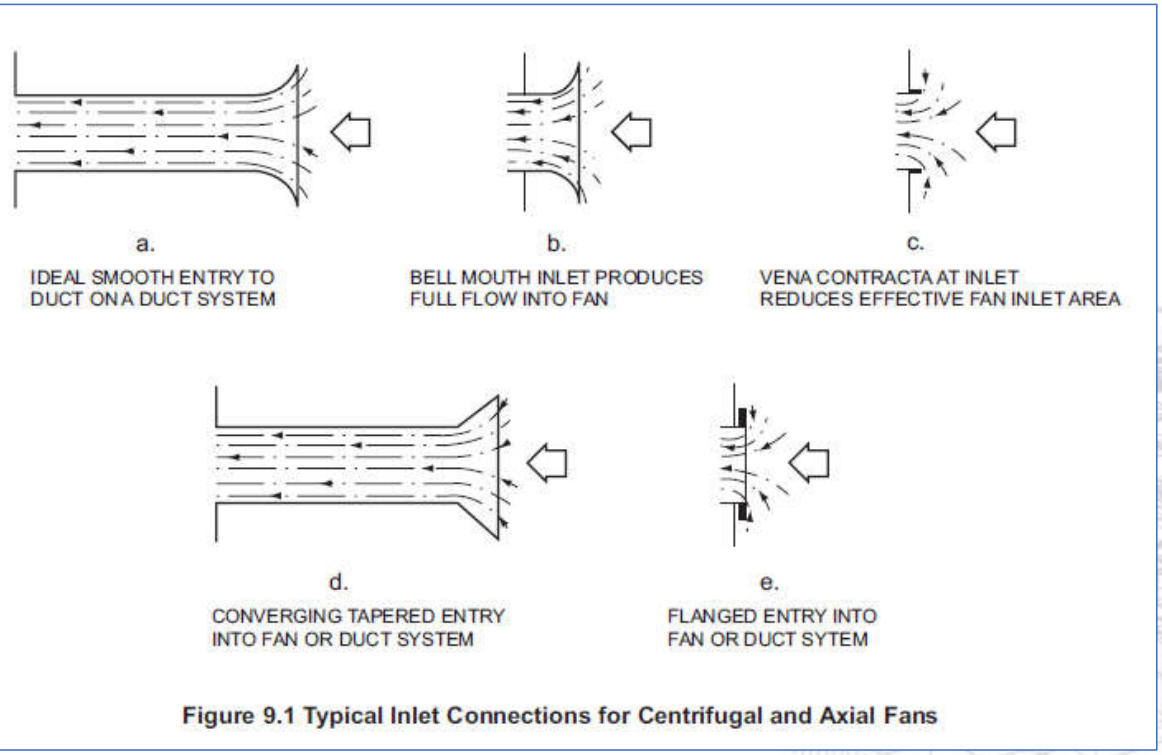


Figure 9.1 Typical Inlet Connections for Centrifugal and Axial Fans

System Effects

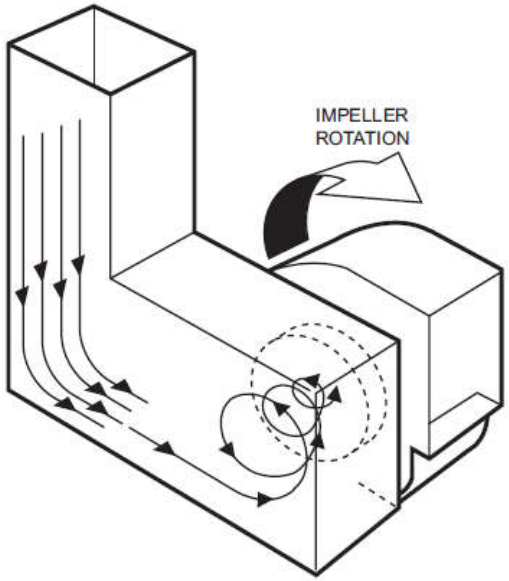


Figure 9.7 - Example of a Forced Inlet Vortex

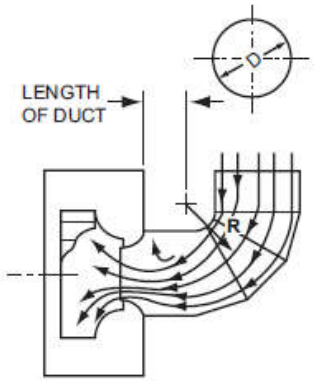


Figure 9.3A - Non-Uniform Airflow Into a Fan Inlet Induced by a 90°, 3-Piece Section Elbow-- No Turning Vanes

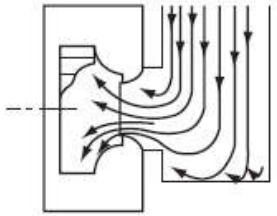


Figure 9.3B - Non-Uniform Airflow Induced Into Fan Inlet by a Rectangular Inlet Duct

System Effects

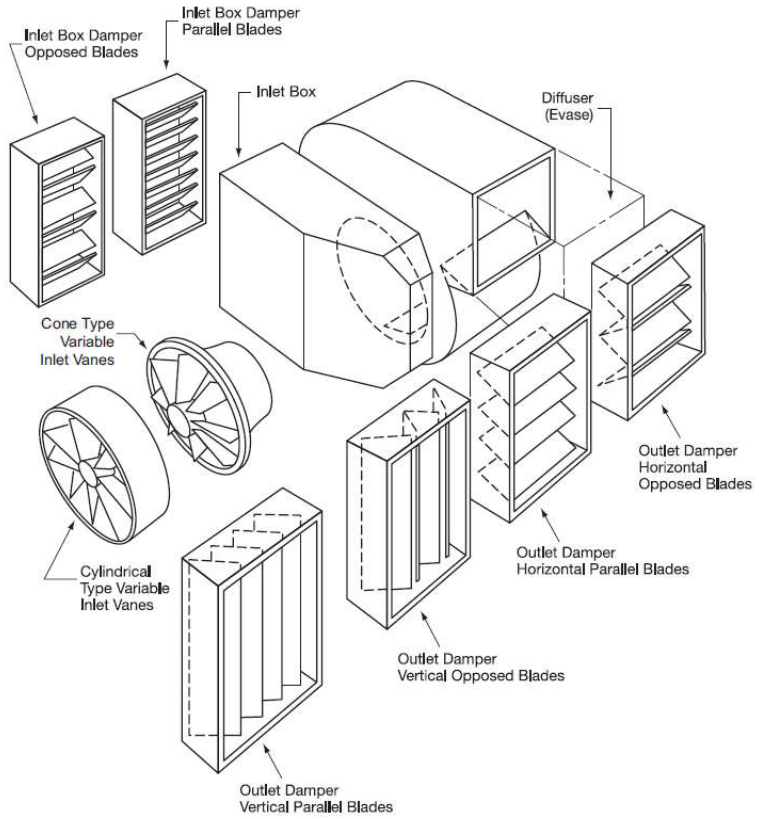


Figure 10.1 - Common Terminology for Centrifugal Fan Appurtenances

System Effects

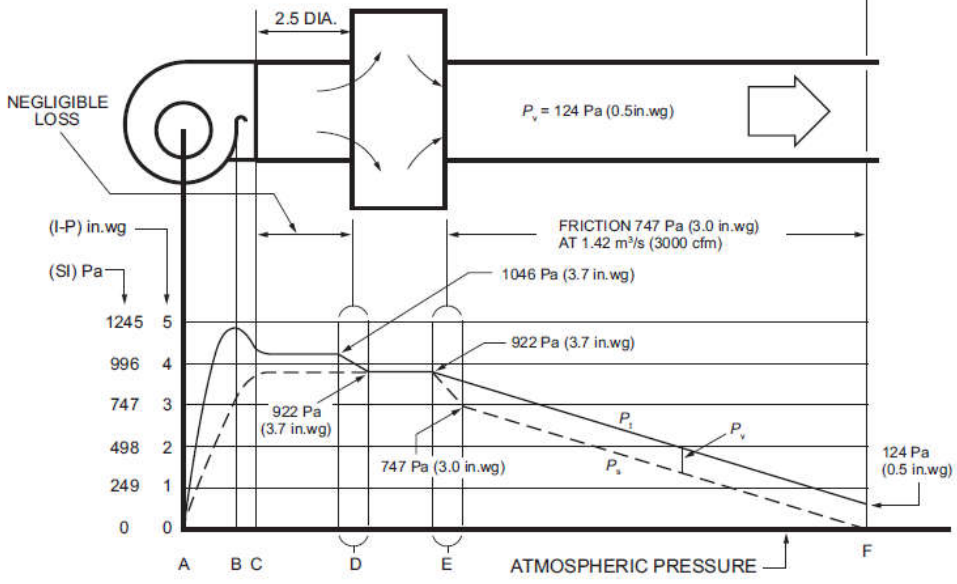


Figure D.2 - Pressure Gradients - Plenum Effect

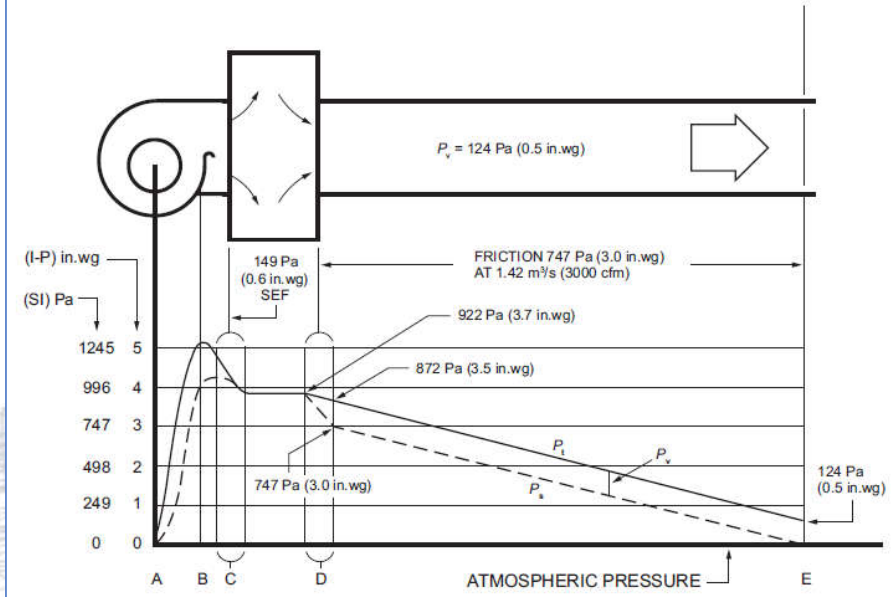
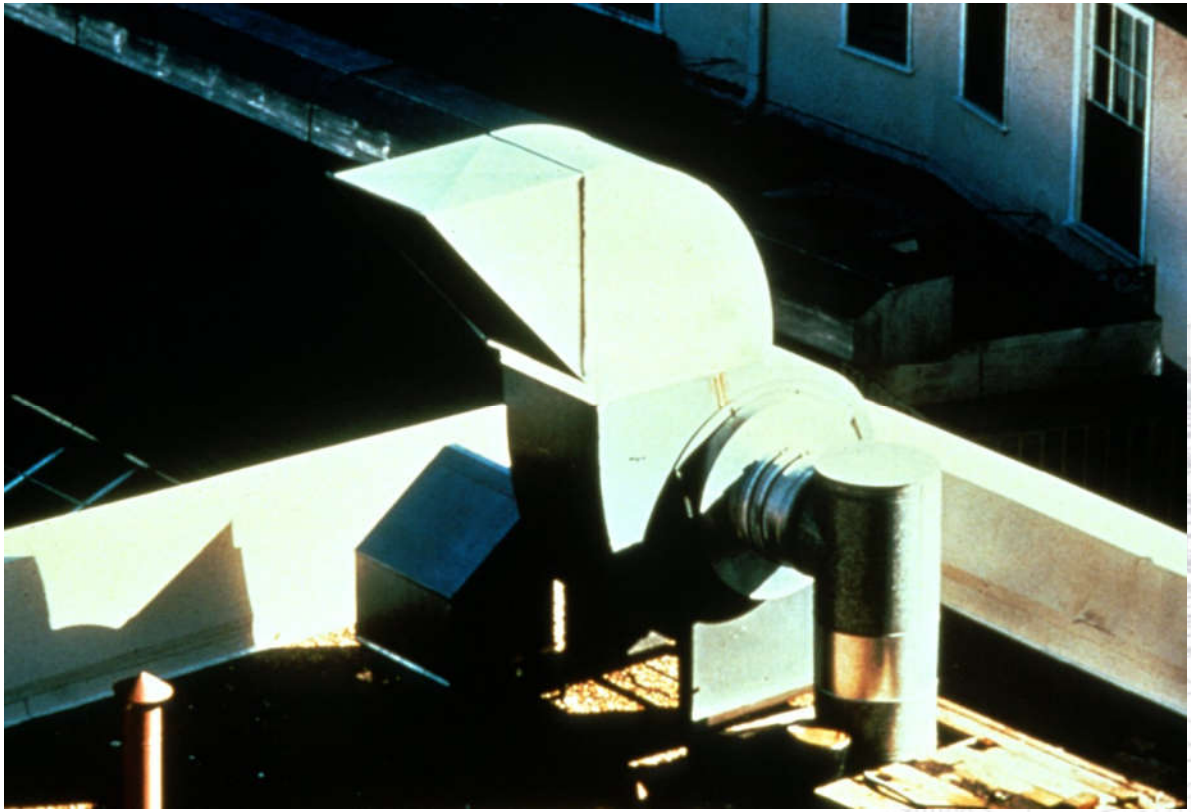


Figure D.3 - Pressure Gradients - Abrupt Expansion at Fan Outlet

System Effects



System Effects

System Effects

System Effects

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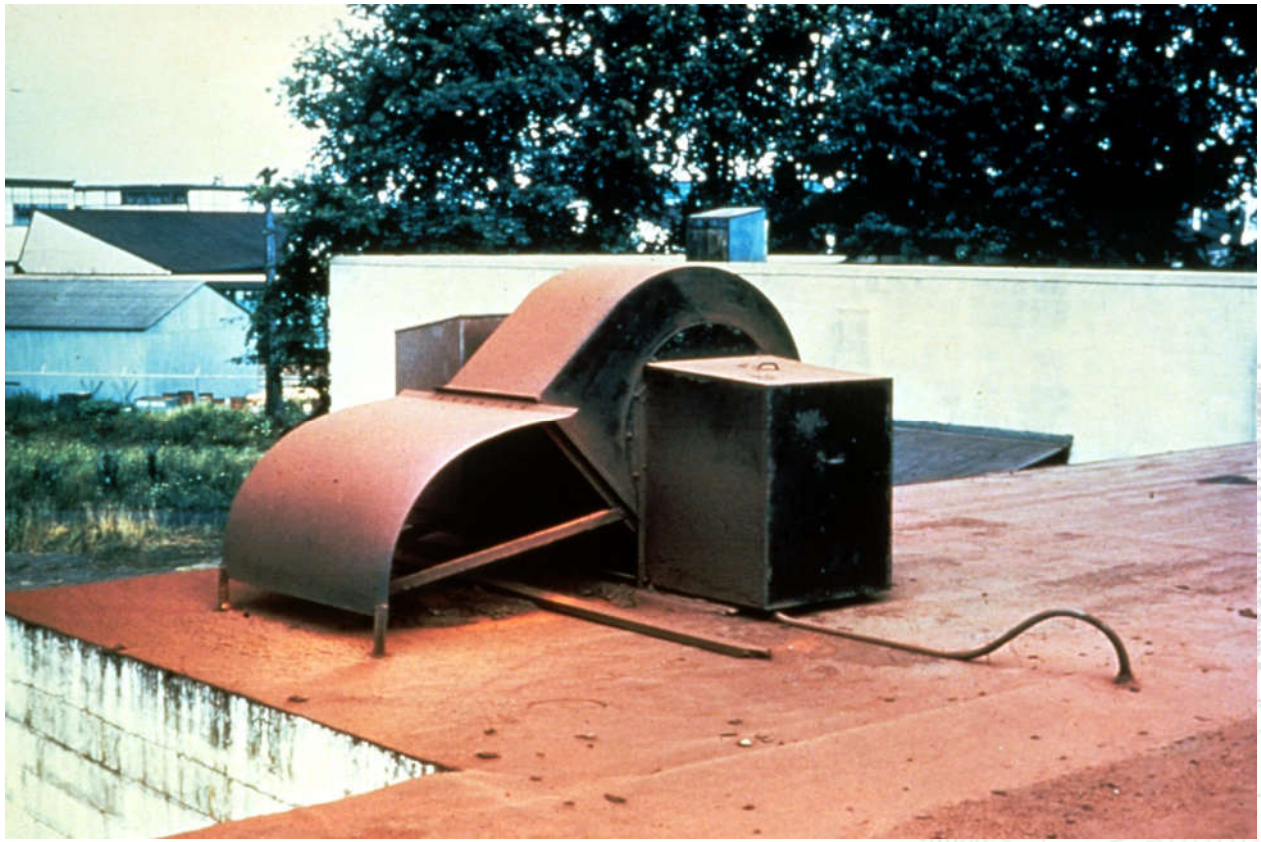
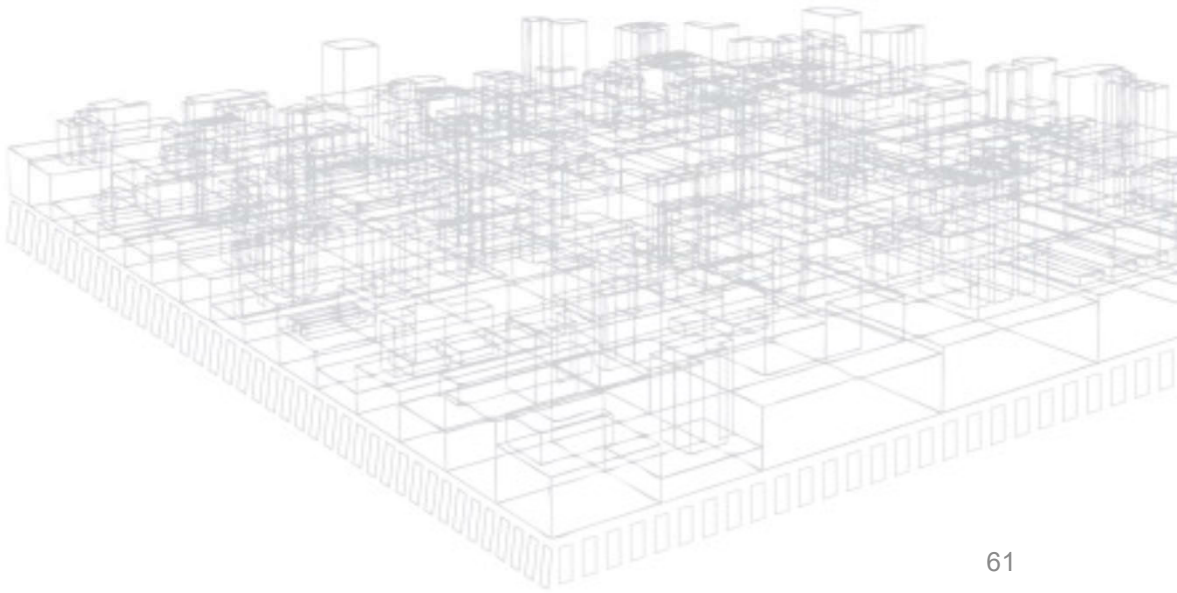
System Effects



System Effect Demonstration



Questions?

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