

Throughout our catalog, you will find terminology used for air moving selection and product sizing. Below are a few of the key terms:

Flow

- Volume Rate/Time
- ROTRON charts are in SCFM, m3/min, or L/S
- SCFM = Standard Cubic Feet Per Minute (American) where temperature = 68°F, air density = 0.075 lb/cubic foot, and altitude = 0 feet above sea level
- M3/min = Cubic Meters Per Minute (Metric)
- L/sec = Liters Per Second (Metric)
- 1 m3/min = 35.3 SCFM
- 1 L/sec = 2.119 SCFM
- See Standard Engineering Conversions for other flows on pg I-2.

Pressure

- Force/Area
- ROTRON charts are in IWG, PSIG, MM of Water, IHG, or mbar
- IWG = Inches of Water Gauge (American)
- PSIG = Pounds Per Square Inch Gauge (American)
- MM of Water = Millimeter of Water Gauge (Metric)
- IHG = Inches of Mercury Gauge (American)
- mbar = Millibar Gauge (Metric)
- PSIA = Pounds Per Square Inch Absolute (American)
- 27.7 IWG = 1 PSIG
- 703.58 MM of Water = 1 PSIG
- 2.036 IHG = 1 PSIG
- 0.069 Bars = 69 mbar = 1 PSIG
- Standard Atmosphere = 0 PSIG = 14.7 PSIA
- See Basic Fan Laws Chart for correcting pressure due to speed or density changes on pgs. I-5 and I-6

Density

- Weight/Volume
- Standard Air = 0.075 lb/cubic foot
- See Density Chart for other gases on pg. I-4
- See Density Correction Chart due to altitude and temperature changes on pg. I-3

Specific Gravity

- Density Ratio Relative to Air
- Standard Air SG = 1.0
- Methane SG = 0.55
- See Specific Gravity Chart for other gases on pg. I-4

Velocity

- Distance/Time or Flow/Area
- FPM = Feet Per Minute (American)
- MPH = Miles Per Hour (American)
- M/min = Meters Per Minute (Metric)
- Km/h = Kilometers Per Hour (Metric)
- 88 FPM = 1 MPH
- 26.82 M/min = 1 MPH
- 1.609 Km/h = 1 MPH
- See Standard Engineering Conversion Chart for other velocities on pg. I-2
- See Orifice Flow Calculation Chart for air flow equations on pg. I-7

Pressure Drop / Back Pressure / Impedance

- Friction causes air to slow down and lost energy is measured in pressure drop terms
- Typical pressure drop areas include piping, elbows, accessories and system
- Each fixed system has a fixed system impedance caused by a single or multiple pressure drop points
- Changing the system impedance will cause blowers work point to change
- Changing the blower with fixed system impedance will change the working back pressure
- See Friction Loss Per Foot of Tubing and Fitting Charts on pg. I-8

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Standard Engineering Conversion

MULTIPLY	BY	TO OBTAIN	MULTIPLY	BY	TO OBTAIN
Atmospheres	76.0	Cms. of Mercury	KGS./Cubic Meter	0.06243	Pounds/Cubic Foot
Atmospheres	29.92	Inches of Mercury	Kilometers	3281	Feet
Atmospheres	33.90	Feet of Water	Kilowatts	56.92	British Thermal Units/Min.
Atmospheres	10,333	Kgs./Sq. Inch	Kilowatts	737.6	Foot-Pounds/Sec.
Atmospheres	1.013 x 10 ⁵	Pascals	Kilowatts	1.341	Horsepower
Atmospheres	14.70	Pounds/Sq. Inch	Kilowatts	14.34	Kg.-Calories/Min.
Atmospheres	760	Torrs	Kilowatt-Hours	3415	British Thermal Units
Bars	0.9869	Atmospheres	Liters	10 ³	Cubic Centimeters
Bars	1. x 10 ⁶	Dynes/Sq. Cm.	Liters	61.02	Cubic Inches
Bars	1.020 x 10 ⁴	Kgs./Square Meter	Liters	10 ⁻³	Cubic Meters
Bars	14.50	Pounds/Sq. Inch	Log ₁₀ N	2.303	Log _e N or Ln N
British Thermal Units	0.2520	Kilogram-Calories	Log N or Ln N	0.4343	Log ₁₀ N
British Thermal Units	777.5	Foot-Pounds	Meters	100	Centimeters
British Thermal Units	3.927 x 10 ⁻⁴	Horsepower-Hours	Meters	3.2808	Feet
British Thermal Units	1054	Joules	Meters	39.37	Inches
British Thermal Units	107.5	Kilogram-Meters	Meters	10 ⁻³	Kilometers
British Thermal Units	2.928 x 10 ⁻⁴	Kilowatt-Hours	Meters/Minute	1.667	Centimeters/Sec.
Centimeters of Mercury	0.01316	Atmospheres	Meters/Minute	3.281	Feet/Minute
Centimeters of Mercury	0.4461	Feet of Water	Meters/Minute	0.06	Kilometers/Hour
Centimeters of Mercury	136.0	Kgs./Square Meter	Meters/Minute	0.03728	Miles/Hour
Centimeters of Mercury	0.1934	Pounds/Sq. Inch	Miles	5280	Feet
Centimeters/Second	1.969	Feet/Minute	Miles	1.6093	Kilometers
Centimeters/Second	0.6	Meters/Minute	Miles	1760	Yards
Cubic Centimeters	3.531 x 10 ⁻⁵	Cubic Feet	Miles/Hour	44.70	Centimeters/Sec.
Cubic Centimeters	6.102 x 10 ⁻²	Cubic Inches	Miles/Hour	88	Feet/Minute
Cubic Centimeters	10 ⁻⁶	Cubic Meters	Miles/Hour	1,467	Feet/Second
Cubic Centimeters	10 ⁻³	Liters	Miles/Hour	1.6093	Kilometers/Hour
Cubic Feet	2.832 x 10 ⁴	Cubic Cms.	Miles/Hour	26.82	Meters/Minute
Cubic Feet	1728	Cubic Inches	Mms. of Mercury	0.0394	Inches of Mercury
Cubic Feet	0.02832	Cubic Meters	Mms. of Mercury	1.3595 ⁻³	Kgs./Square Cm.
Cubic Feet	0.03704	Cubic Yards	Mms. of Mercury	0.01934	Pounds/Square Inch
Cubic Feet	7.481	Gallons	Pints (Liq.)	28.87	Cubic Inches
Cubic Feet	28.32	Liters	Pints (U.S. liquid)	473,179	Cubic Centimeters
Cu. Ft. of Water (60°F)	62.37	Pounds	Pints (U.S. liquid)	16	Ounces (U.S. fluid)
Cubic Feet/Minute	472.0	Cubic Cms./Sec.	Pounds	444,823	Dynes
Cubic Feet/Minute	0.4720	Liters/Second	Pounds	453.6	Grams
Cubic Feet/Minute	62.4	Lbs. of Water/Min.	Pounds	16	Ounces
Cubic Inches	16.39	Cubic Centimeters	Pounds of Carbon to CO ²	14,544	British Thermal Units (mean)
Cubic Inches	5.787 x 10 ⁻⁴	Cubic Feet	Pounds of Water	27.68	Cubic Inches
Cubic Inches	1.639 x 10 ⁻⁵	Cubic Meters	Pounds of Water	0.1198	Gallons
Cubic Inches	2.143 x 10 ⁻⁵	Cubic Yards	Pounds of Water		
Cubic Meters	10 ⁶	Cubic Centimeters	Evaporated at 212°F	970.3	British Thermal Units
Cubic Meters	35.31	Cubic Feet	Pounds/Cubic Foot	16.02	Kgs./Cubic Meter
Cubic Meters	61,023	Cubic Inches	Pounds/Square Foot	4,882	Kgs./Square Meter
Cubic Meters	1.308	Cubic Yards	Pounds/Square Inch	0.06804	Atmospheres
Cubic Yards	7.646 x 10 ⁵	Cubic Centimeters	Pounds/Square Inch	27.7	Inches of Water
Cubic Yards	27	Cubic Feet	Pounds/Square Inch	2.036	Inches of Mercury
Cubic Yards	46,656	Cubic Inches	Pounds/Square Inch	703.1	Kgs./Square Meter
Cubic Yards	0.7646	Cubic Meters	Pounds/Square Inch	6.895 x 10 ³	Pascals
Feet	30.48	Centimeters	Pounds/Square Inch	51.715	Millimeters of Mercury at 0°C
Feet	12	Inches	Square Centimeters	1.973 x 10 ⁶	Circular Mils
Feet	0.3048	Meters	Square Centimeters	1.076 x 10 ⁻³	Square Feet
Feet	1/3	Yards	Square Centimeters	0.1550	Square Inches
Feet of Air			Square Feet	929.0	Square Centimeters
(1 atmosphere 60°F)	5.30 x 10 ⁻⁴	Pounds/Square Inch	Square Feet	0.09290	Square Meters
Feet/Minute	0.5080	Centimeters/Sec.	Square Inches	1.273 x 10 ⁶	Circular Mils
Feet/Minute	0.01667	Feet/Second	Square Inches	6.452	Square Centimeters
Feet/Minute	0.01829	Kilometers/Hour	Square Inches	6.944 x 10 ⁻³	Square Feet
Feet/Minute	0.3048	Meters/Minute	Square Inches	10 ⁶	Square Mils
Feet/Minute	0.01136	Miles/Hour	Square Inches	645.2	Square Millimeters
Grams/Cu. Cm.	62.43	Pounds/Cubic Foot	Square Kilometers	10.76 x 10 ⁶	Square Feet
Horsepower	42.44	British Thermal Units/Min.	Square Kilometers	10 ⁶	Square Meters
Horsepower	33,000	Foot-Pounds/Min.	Square Kilometers	1.196 x 10 ⁶	Square Yards
Horsepower	10.70	Kg.-Calories/Min.	Square Meters	10.764	Square Feet
Horsepower	745.7	Watts	Square Meters	1.196	Square Yards
Horsepower-Hours	2547	British Thermal Units	Temp. (Degs. C.) + 273	1	Abs. Temp. (Degs. C.)
Inches	2.540	Centimeters	Temp. (Degs. C.) + 17.8	1.8	Temp. (Degs. Fahr.)
Inches	10 ³	Mils	Temp. (Degs. F.) + 460	1	Abs. Temp. (Degs. F.)
Inches of Mercury	0.03342	Atmospheres	Temp. (Degs. F.) -32	5/9	Temp. (Degs. Cent.)
Inches of Mercury	13.60	Inches of Water	Watts	0.05692	British Thermal Units/Min.
Inches of Mercury	345.3	Kgs./Square Meter	Watts	10 ⁷	Ergs/Second
Inches of Mercury	25.40	Mms. of Mercury	Watts	44.26	Foot-Pounds/Min.
Inches of Mercury	0.4912	Pounds/Square In.	Watts	1.341 x 10 ⁻³	Horsepower
Inches of Water	0.002458	Atmospheres	Watts	0.01434	Kg.-Calories/Min.
Inches of Water	0.07355	Inches of Mercury	Watts	10 ⁻³	Kilowatts
Inches of Water	25.40	Kgs./Square Meter	Watts-Hour	3.415	British Thermal Units
Inches of Water	5.204	Pounds/Square Ft.	Watts-Hour	1.341 x 10 ⁻¹	Horsepower/Hours
Inches of Water	0.03613	Pounds/Square In.	Watts-Hour	10 ⁻³	Kilowatt-Hours

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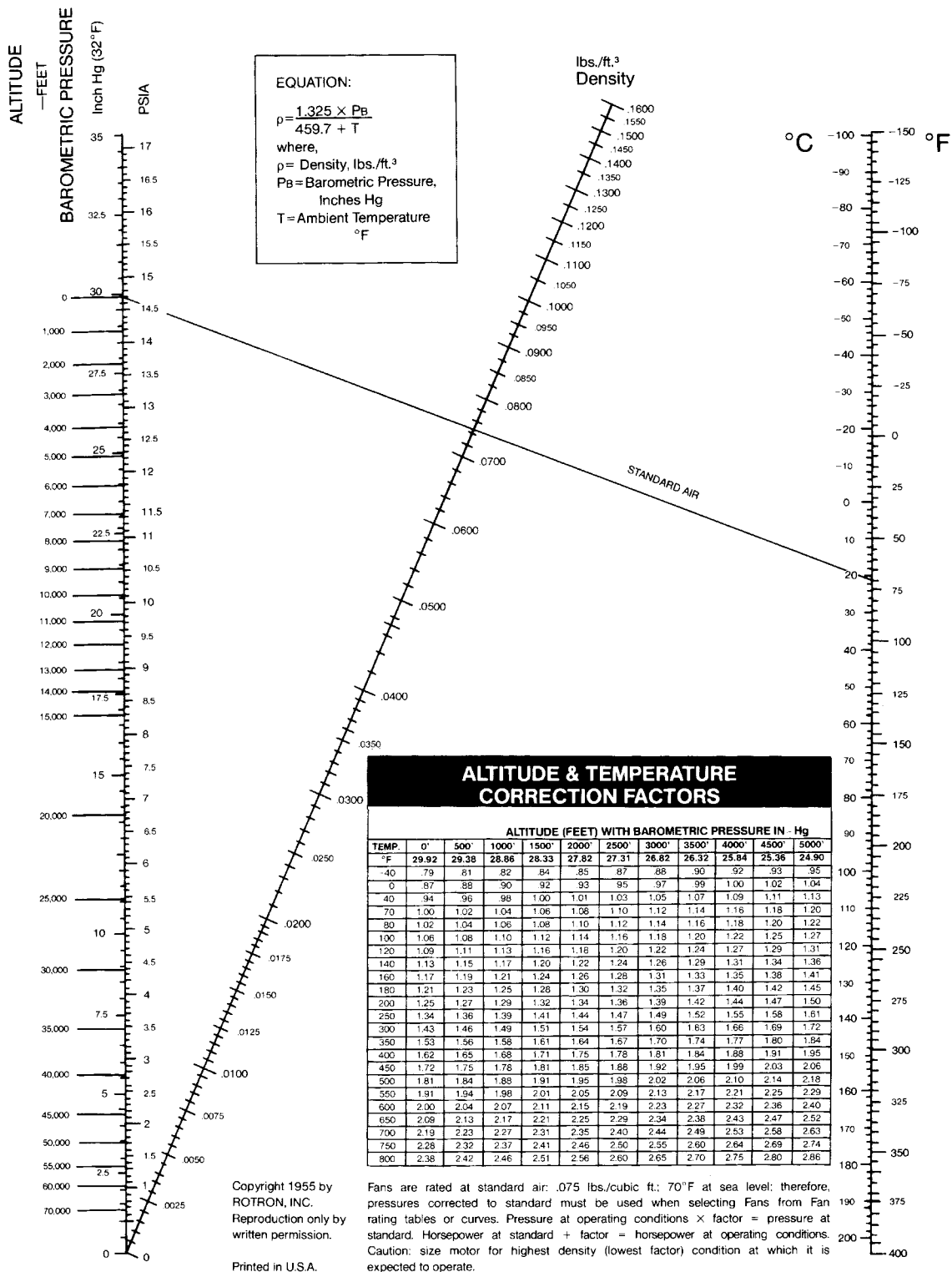
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Density Correction Chart



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Specific Gravity and Density of Various Gases at 60°F (1 ATM)

Gas or Vapor	Chemical Formula	Specific Gravity	Density (lbs./cu ft.)
Acetylene	C ₂ H ₂	0.899	.0686
Air	-	1.00	.0763
Ammonia	NH ₃	0.587	.0454
Argon	A	1.377	.1053
Benzene	C ₆ H ₆	2.70	.205
Carbon Dioxide	CO ₂	1.539	.1166
Chlorine	Cl ₂	2.448	.0738
Ethane	C ₂ H ₆	1.038	.0799
Ethylene	C ₂ H ₄	0.969	.0739
Helium	He	0.138	.01054
Hydrogen	H ₂	0.0695	.00531
Hydrogen Sulfide	H ₂ S	1.19	.0897
Methane	CH ₄	0.555	.0424
Methyl Chloride	CH ₃ Cl	1.785	.1356
Nitrogen	N ₂	0.967	.0738
Oxygen	O ₂	1.105	.0843
Propane	C ₃ H ₈	1.55	.1180
Sulfur Oxide	SO ₂	2.26	.1720
Water Vapor	H ₂ O	0.622	.0373

Explosive Atmosphere Classification

North American	European	
Class I Group A Group B Group C Group D	Zone 1 Group II C Group II B Group II A	Acetylene Hydrogen or equivalent hazard Ethyle ether vapors, ethylene or cyclopropane Gasoline, hexane, naptha, benzene, butane, alcohol, acetone, benzol, lacquer vapors or natural gas
Class II Group E Group F Group G	— — —	Metal dust Carbon black, coal or coke dust Flour, starch or grain

Temperature Conversion Chart

*In the center column, find the temperature to be converted. The equivalent temperature is in the left column, if converting to Celsius, and in the right column, if converting to Fahrenheit.

°C	Temp	°F	°C	Temp	°F	°C	Temp	°F	°C	Temp	°F
-78.9	-110	-166	1.7	35	95.0	27.2	81	177.8	182	360	680
-73.3	-100	-148	2.2	36	96.8	27.8	82	179.6	188	370	698
-67.8	-90	-130	2.8	37	98.6	28.3	83	181.4	193	380	716
-62.2	-80	-112	3.3	38	100.4	28.9	84	183.2	199	390	734
-56.7	-70	-94	3.9	39	102.2	29.4	85	185.0	204	400	752
-51.1	-60	-76	4.4	40	104.0	30.0	86	186.8	210	410	770
-45.6	-50	-58	5.0	41	105.8	30.6	87	188.6	216	420	788
-40.0	-40	-40	5.6	42	107.6	31.1	88	190.4	221	430	806
-34.4	-30	-22	6.1	43	109.4	31.7	89	192.2	227	440	824
-28.9	-20	-4	6.7	44	111.2	32.2	90	194.0	232	450	842
-23.3	-10	14	7.2	45	113.0	32.8	91	195.8	238	460	860
-17.8	0	32	7.8	46	114.8	33.3	92	197.6	243	470	878
-17.2	1	33.8	8.3	47	116.6	33.9	93	199.4	249	480	896
-16.7	2	35.6	8.9	48	118.4	34.4	94	201.2	254	490	914
-16.1	3	37.4	9.4	49	120.2	35.0	95	203.0	260	500	932
-15.6	4	39.2	10.0	50	122.0	35.6	96	204.8	266	510	950
-15.0	5	41.0	10.6	51	123.8	36.1	97	206.6	271	520	968
-14.4	6	42.8	11.1	52	125.6	36.7	98	208.4	277	530	986
-13.9	7	44.6	11.7	53	127.4	37.2	99	210.2	282	540	1004
-13.3	8	46.4	12.2	54	129.2	37.8	100	212.0	288	550	1022
-12.8	9	48.2	12.8	55	131.0	38.3	101	213.8	293	560	1040
-12.2	10	50.0	13.3	56	132.8	38.9	102	215.6	299	570	1058
-11.7	11	51.8	13.9	57	134.6	39.4	103	217.4	304	580	1076
-11.1	12	53.6	14.4	58	136.4	40.0	104	219.2	310	590	1094
-10.6	13	55.4	15.0	59	138.2	40.6	105	221.0	316	600	1112
-10.0	14	57.2	15.6	60	140.0	41.1	106	222.8	321	610	1130
-9.4	15	59.0	16.1	61	141.8	41.7	107	224.6	327	620	1148
-8.9	16	60.8	16.7	62	143.6	42.2	108	226.4	332	630	1166
-8.3	17	62.6	17.2	63	145.4	42.8	109	228.2	338	640	1184
-7.8	18	64.4	17.8	64	147.2	43.3	110	230.0	343	650	1202
-7.2	19	66.2	18.3	65	149.0	43.9	111	231.8	349	660	1220
-6.7	20	68.0	18.9	66	150.8	44.4	112	233.6	354	670	1238
-6.1	21	69.8	19.4	67	152.6	45.0	113	235.4	360	680	1256
-5.6	22	71.6	20.0	68	154.4	45.6	114	237.2	366	690	1274
-5.0	23	73.4	20.6	69	156.2	46.1	115	239.0	371	700	1292
-4.4	24	75.2	21.1	70	158.0	46.7	116	240.8	377	710	1310
-3.9	25	77.0	21.7	71	159.8	47.2	117	242.6	382	720	1328
-3.3	26	78.8	22.2	72	161.6	47.8	118	244.4	388	730	1346
-2.8	27	80.6	22.8	73	163.4	48.3	119	246.2	393	740	1364
-2.2	28	82.4	23.3	74	165.2	48.9	120	248.0	399	750	1382
-1.7	29	84.2	23.9	75	167.0	49.4	121	249.8	404	760	1400
-1.1	30	86.0	24.4	76	168.8	50.0	122	251.6	410	770	1418
-0.6	31	87.8	25.0	77	170.6	50.6	123	253.4	416	780	1436
0	32	89.6	25.6	78	172.4	51.1	124	255.2	421	790	1454
0.6	33	91.4	26.1	79	174.2	51.7	125	257.0	427	800	1472
1.1	34	93.2	26.7	80	176.0	52.2	126	258.8	432	810	1490

°F = 9/5C + 32

ABSOLUTE RANKIN (R) R = °F + 460

°C = 5/9 (F - 32)

ABSOLUTE KELVIN (K) K = °C + 273

NEMA Classifications

- NEMA Type 1 – General Purpose – Indoor
 Type 2 – Dripproof – Indoor
 Type 3 – Dusttight, Raintight and Sleet (Ice) Resistant – Outdoor
 3R – Rainproof and Sleet (Ice) Resistant – Outdoor
 3S – Dusttight, Raintight and Sleet (Ice) Proof – Outdoor
 Type 4 – Watertight and Dusttight – Indoor
 4X – Watertight, Dusttight and Corrosion Resistant – Outdoor
 Type 5 – Superseded by Type 12 for Control Apparatus

- Type 6 – Submersible, Watertight, Dusttight and Sleet Resistant – Indoor and Outdoor
 Type 7 – Class I, Group A, B, C or D Hazardous Locations; Air Break Equipment – Indoor
 Type 8 – Class I, Group A, B, C or D Hazardous Locations; Oil-immersed Equipment – Indoor
 Type 9 – Class II, Group E, F or G Hazardous Locations; Air-break Equipment – Indoor
 Type 10 – Bureau of Mines
 Type 11 – Corrosion Resistant and Dripproof; Oil-immersed – Indoor
 Type 12 – Industrial Use, Dusttight and Driptight – Indoor
 Type 13 – Oiltight and Dusttight – Indoor

Ref: NEMA Standards Publication, Pub. No. 1CS-1970

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Physical Laws for Blower Applications

In the following formulae these symbols are used:

P – Pressure in pounds per square inch (PSI) or inches of mercury column (inches Hg)

CFM – Volume in cubic feet per minute

RPM – Speed in revolutions per minute

D – Density in pounds per cubic foot (lbs./cu. ft.)

H – Height of air or gas column (ft.)

SG – Specific Gravity (ratio of density of gas to the density of air)

“Standard Air” – Air at 68°F (absolute temperature 528°) and 29.92” Hg. (barometric pressure at sea level). The density of such air is 0.075 lbs./cu. ft. and the specific volume is 13.29 cu. ft./lb. The specific gravity is 1.0.

The outlet pressure of a blower depends on the condition of the air or gas at the inlet. The inlet condition is influenced by:

a – Specific gravity (The ratio of density of the gas to density of standard air)

b – Altitude (location of blower)

c – Temperature of inlet air

Basic Fan Laws Chart

VARIABLE	VOLUME	PRESSURE	HORSEPOWER
WHEN SPEED CHANGES	Varies DIRECT with Speed Ratio $CFM_2 = CFM_1 \left(\frac{RPM_2}{RPM_1} \right)$	Varies with SQUARE of Speed Ratio $P_2 = P_1 \left(\frac{RPM_2}{RPM_1} \right)^2$	Varies with CUBE of Speed Ratio $HP_2 = HP_1 \left(\frac{RPM_2}{RPM_1} \right)^3$
WHEN DENSITY CHANGES	Does Not Change	Varies DIRECT with Density Ratio $P_2 = P_1 \left(\frac{D_2}{D_1} \right)$	Varies DIRECT with Density Ratio $HP_2 = HP_1 \left(\frac{D_2}{D_1} \right)$

Volume

The Volume changes in direct ratio to the speed.

Example – A blower is operating at 3500 RPM and delivering 1000 cfm. If the speed is reduced to 3000 RPM, what is the new volume?

V_1 = Original Volume (1000 CFM)

V_2 = New Volume

RPM_1 = Original Speed (3500 RPM)

RPM_2 = New Speed (3000 RPM)

$$V_2 = V_1 \left(\frac{RPM_2}{RPM_1} \right)^1 = 1000 \times \left(\frac{3000}{3500} \right)^1 = 1000 \times .857 = 857 \text{ CFM}$$

Pressure

Pressure (barometric) varies in direct proportion to altitude.

Example – A blower is to operate at an elevation of 6000 feet and is to deliver 3 PSI pressure. What pressure (standard air) blower is required?

$$\text{Pressure} = 3 \times \frac{29.92}{23.98} = 3.75 \text{ or } 3 \frac{3}{4} \text{ lb.}$$

If it is desired to determine what pressure a 3 lb. (standard air) blower will deliver at 6000 feet –

$$\text{Pressure} = 3 \times \frac{23.98}{29.92} = 2.4 \text{ or about } 2 \frac{1}{2} \text{ lb.}$$

When a blower is to operate at a high altitude it is frequently specified that the blower be capable of handling a given volume of “standard air”. It is then necessary to determine the equivalent volume of air at the higher altitude.

Example – A blower is to operate 6000 feet altitude and is to handle 1000 CFM of standard air. What is the CFM of air the blower must handle at 6000 feet altitude?

Let: V_1 = Volume of standard air (1000 CFM)

V_2 = Volume of thinner air

Hg_1 = Barometric pressure sea level (29.92)

Hg_2 = Barometric pressure 6000' (23.98)

$$V_2 = V_1 \times \frac{Hg_1}{Hg_2} = 1000 \times \frac{29.92}{23.98} = 1248 \text{ CFM}$$

The pressure changes as the square of the speed ratio.

Example – A blower is operating at a speed of 3500 RPM and delivering air at 5.0 pounds pressure. If the speed is reduced to 3000 RPM, what is the new pressure?

P_1 = Original Pressure (5 lbs.)

P_2 = New Pressure

RPM_1 = Original Speed (3500 RPM)

RPM_2 = New Speed (3000 RPM)

$$P_2 = P_1 \left(\frac{RPM_2}{RPM_1} \right)^2 = 5 \times \left(\frac{3000}{3500} \right)^2 = 5 \times .735 = 3.68 \text{ pounds}$$

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Pressure (Cont'd)

The Air Density varies in inverse proportion to the absolute temperature.

Example – A blower is to handle 200°F air at 3 PSI pressure. What pressure (standard air) blower is required?

Let: P_1 = Pressure hot air (3 PSI)
 P_2 = Pressure standard air
 AT_1 = Absolute temperature hot air (200+460=660°F)
 AT_2 = Absolute temperature standard air (68+460=528°F)

$$P_2 = P_1 \times \frac{AT_1}{AT_2} = 3 \times \frac{660}{528} = 3.75 \text{ or } 3 \frac{3}{4} \text{ lb.}$$

A blower is capable of delivering 3 PSI pressure with standard air. What pressure will it develop handling 200°F inlet air?

$$P_1 = P_2 \times \frac{AT_2}{AT_1} = 3 \times \frac{528}{660} = 2.4 \text{ or about } 2 \frac{1}{2} \text{ lb.}$$

The following table gives the barometric pressure of various altitudes:
 Absolute Pressure At Altitudes Above Sea Level (Based on U.S. Standard Atmosphere)

Altitude Feet	Pressure		Altitude Feet	Pressure		Altitude Feet	Pressure	
	In. Hg.	PSIA		In. Hg.	PSIA		In. Hg.	PSIA
0	29.92	14.70	2,500	27.31	13.41	7,000	23.09	11.34
500	29.38	14.43	3,000	26.81	13.19	7,500	22.65	11.12
600	29.28	14.38	3,500	26.32	12.92	8,000	22.22	10.90
700	29.18	14.33	4,000	25.84	12.70	8,500	21.80	10.70
800	29.07	14.28	4,500	25.36	12.45	9,000	21.38	10.50
900	28.97	14.23	5,000	24.89	12.23	9,500	20.98	10.30
1,000	28.86	14.18	5,500	24.43	12.00	10,000	20.58	10.10
1,500	28.33	13.90	6,000	23.98	11.77			
2,000	27.82	13.67	6,500	23.53	11.56			

Pressure varies in direct proportion to the density.

Example – A 3 lb. (standard air) blower is to be used to handle gas having a specific gravity of 0.5. What pressure does the blower create when handling the gas?

Let: P_a = Air pressure (3 lb.)
 P_g = Gas pressure
 SG = Specific gravity of gas (0.5)

$$P_g = P_a \times SG = 3 \times .5 = 1.5 \text{ lb.}$$

If we are required to handle a gas having a specific gravity of 0.5 at 1.5 lb. pressure, we can determine the standard air pressure blower as follows:

$$\text{Let: } P_a = \frac{P_g}{SG} = \frac{1.5}{.5} = 3 \text{ lb.}$$

Horsepower

The horsepower changes as the cube of the speed ratio.

Example – A blower is operating at a speed of 3500 RPM and requiring 50 horsepower. If the speed is reduced to 3000 RPM, what is the new required horsepower?

HP_1 = Original Horsepower (50)
 HP_2 = New Horsepower
 RPM_1 = Original Speed (3500 RPM)
 RPM_2 = New Speed (3000 RPM)

$$HP_2 = HP_1 \times \left(\frac{RPM_2}{RPM_1} \right)^3 = 50 \times \left(\frac{3000}{3500} \right)^3 = 50 \times .630 = 31.5 \text{ horsepower}$$

The above is known as the 1-2-3 rule of blowers.

Horsepower vs. Specific Gravity & Ratio of density.

The horsepower varies in direct proportion to the specific gravity (ratio of density of gas to density of air).

Example – A standard air blower requires a 10 HP motor. What horsepower is required when this blower is to handle a gas whose specific gravity is 0.5?

$$HP = 10 \times 0.5 = 5 \text{ horsepower}$$

It is possible that several of the above modifications may be required on one installation. Therefore, it may be necessary to use various combinations of these formulae.

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Orifice Flow

Orifice Flow Calculation

To determine air flow through an orifice:

$$V = CK \sqrt{P} \quad Q = AV \quad VP = \left(\frac{V}{K}\right)^2$$

Where:

V = Velocity in feet per minute (fpm)

C = Orifice Coefficient

K = Constant = 14,786 when P is expressed
in In. Hg
21,094 when P is expressed
in PSIG
4,005 when P is expressed
in In. of Water

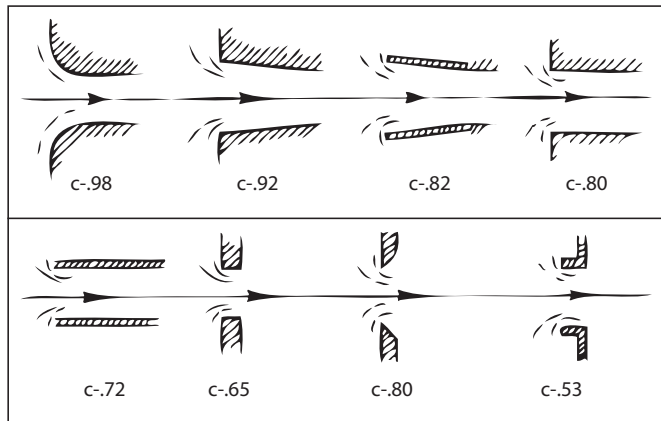
(Above constants are based on an air density
of 0.075 lbs/ft³)

P = Pressure differential across the orifice

Q = Flow rate in cubic feet per minute (CFM)

A = Total orifice area expressed in square feet

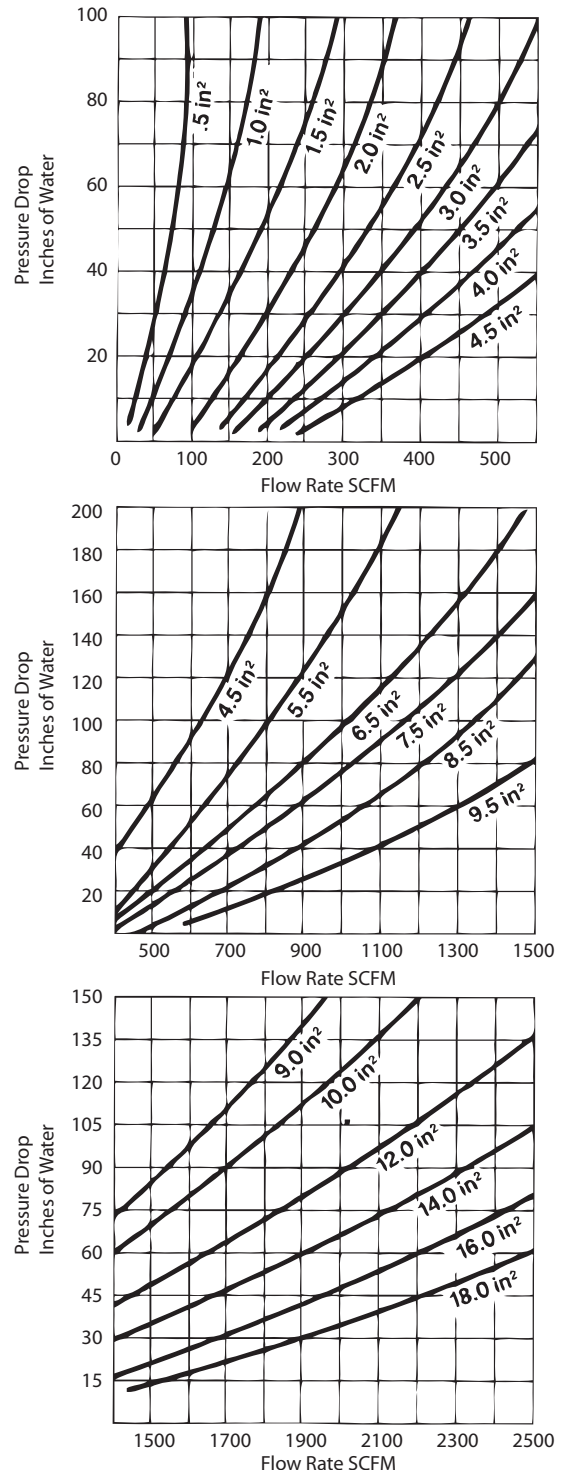
VP = Velocity pressure (units are those of pressure)

Coefficient C for Orifices Under
Vacuum or Pressure Flow

Area of Orifices Orifice Diameter in Inches		
Diameter in Inches	Square Inches	Square Feet
1/8	.01227	.000085
3/16	.02761	.00019
1/4	.04908	.00034
3/8	.11044	.00076
1/2	.19634	.00136
5/8	.30679	.00213
7/8	.60132	.00417
1.0	.78539	.00545

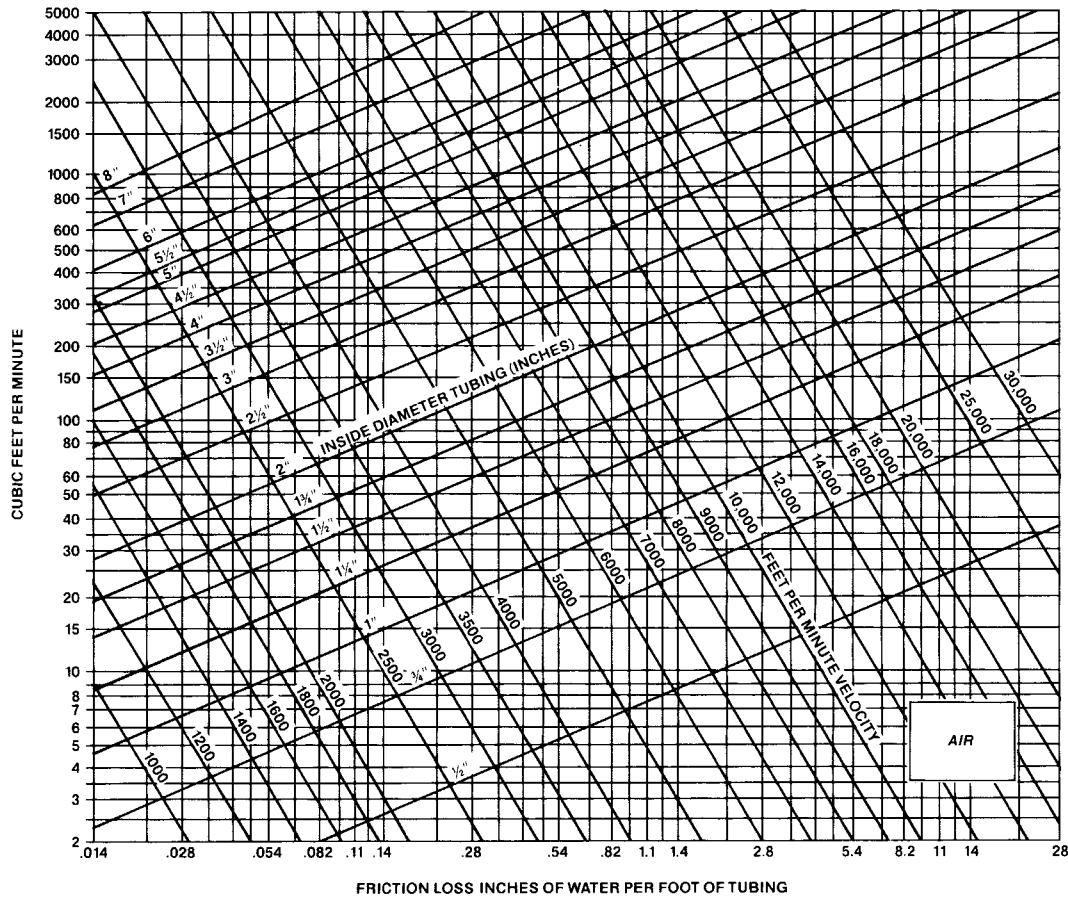
Orifice area (in sq. inches) = .25 X π X (orifice diameter in inches)²

Orifice area (in sq. feet) = Area in sq. inches ÷ 144

ORIFICE PRESSURE DROP AS A FUNCTION
OF FLOW AND ORIFICE AREA (C=.65)

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Friction Loss Per Foot of Tubing



Friction Loss in Fittings

To calculate friction loss in fittings use chart below. This chart will yield equivalent lengths (in feet) of tubing. Use this length with graph above to find friction loss in inches of water column.

NOMINAL PIPE SIZE (INCHES)	EQUIVALENT TUBING LENGTH (FEET)	
	90° EL	45° EL
1 1/4	3	1.5
1 1/2	4	2
2	5	2.5
2 1/2	6	3
3	7	4
4	10	5
5	12	6
6	15	7.5
8	20	10

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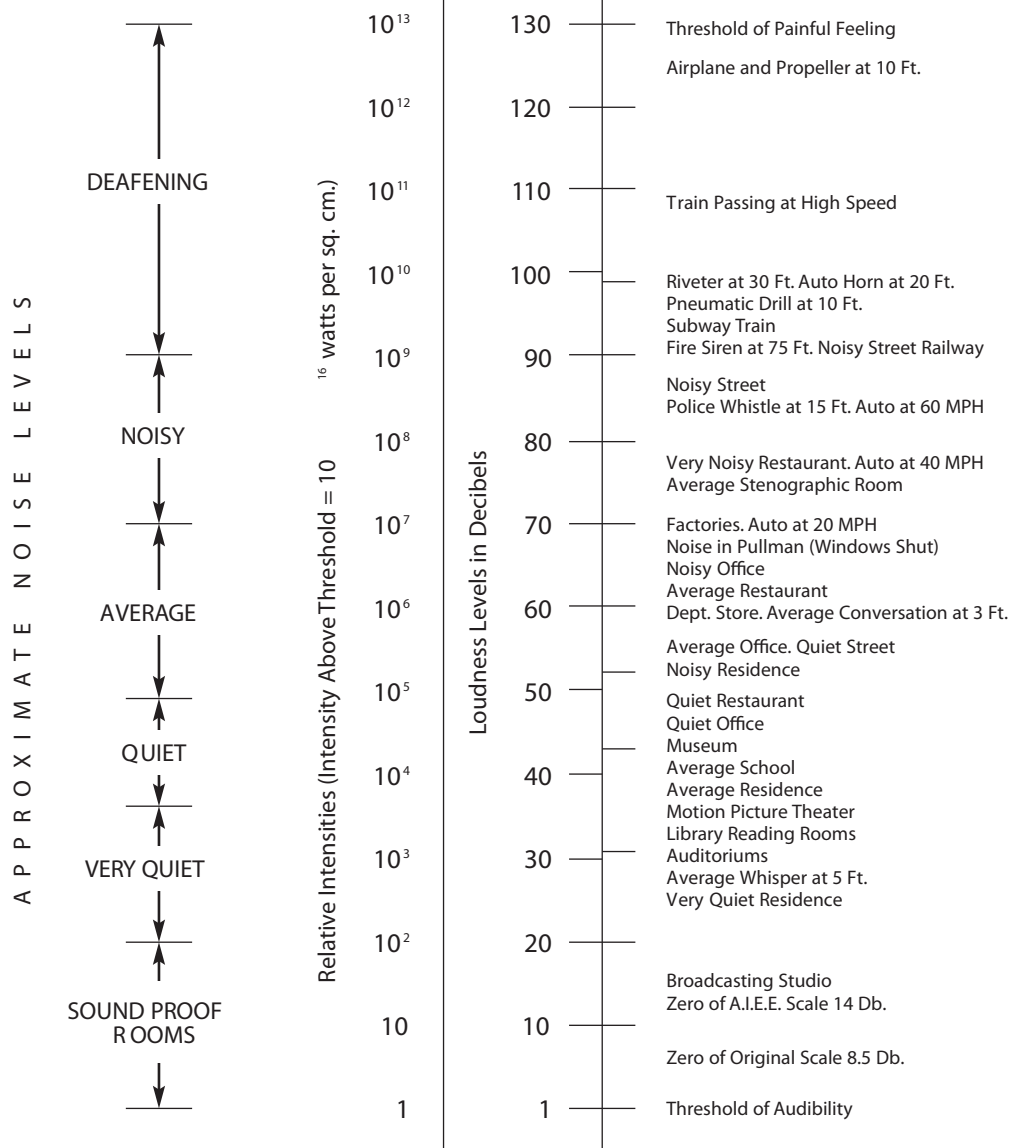
Noise Facts

- OSHA (Occupational Safety & Health Administration) regulates and monitors in-plant noise.
- Allowable noise is a function of dBA level at certain distance over an exposure time.
- OSHA regulations state 90 dBA for an 8 hour work period using slow resonic setting on meter.
- Adding a second noise producer of equal dBA will add 3 dBA to the first dBA reading.
- Sound pressure level (SPL) decreases with distance (d)

$$(SPL)_2 = (SPL)_1 - 20 \log \left(\frac{d_2}{d_1} \right)$$

Therefore, each doubling of distance results in 6 dBA reduction.

Loudness Levels of Familiar Noises (Approximate Average Including Ear Network)



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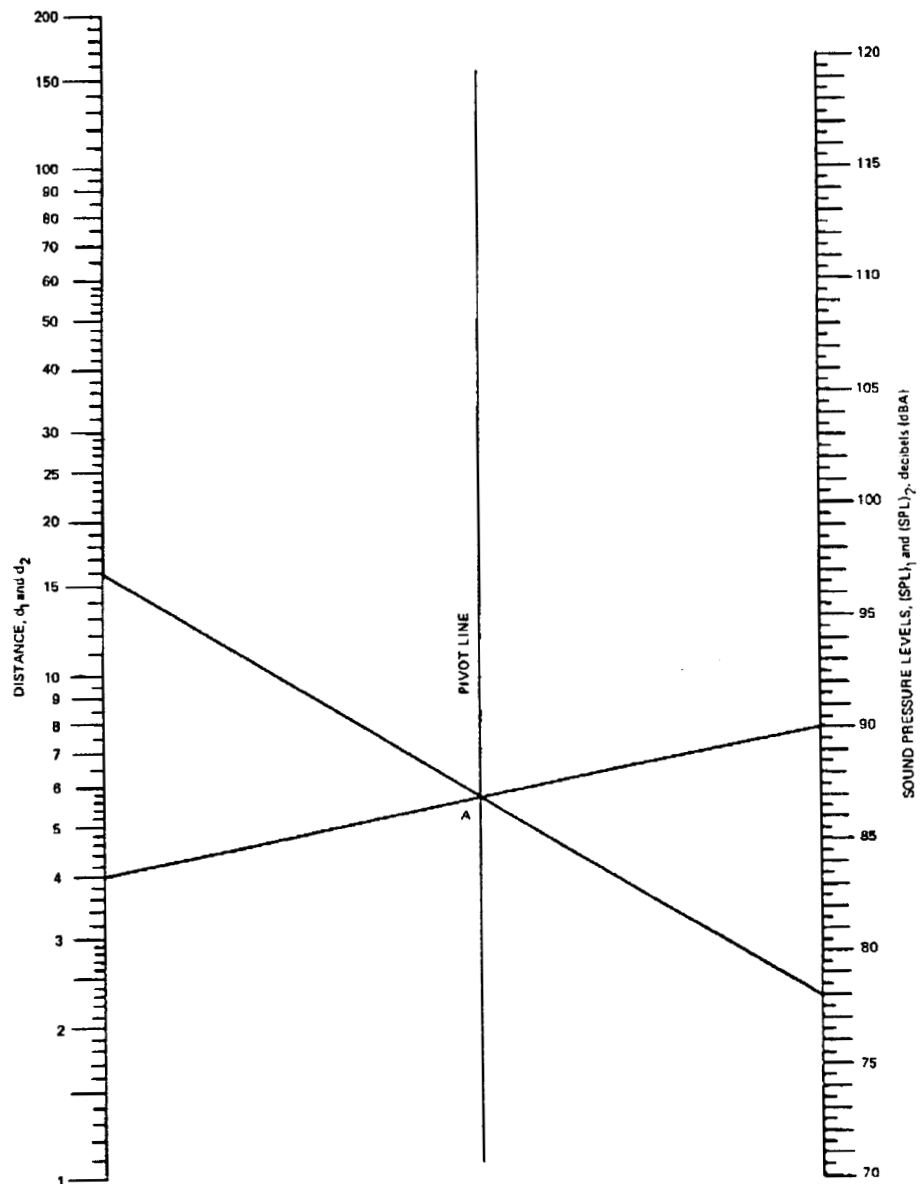
Industrial Blower Noise Chart* in dBA

Model	Mode		Model	Mode		Model	Mode		Model	Mode		Model	Mode	
	Suction	Pressure		Suction	Pressure		Suction	Pressure		Suction	Pressure		Suction	Pressure
SE	60-62	60-62	101	65-67	66-68	513	80-81	80-81	757	83-85	84-86	S/P 9	90-91	90-91
MF	64-65	64-65	202	67-69	68-70	505	77-78	76-77	808	84-85	84-85	909	81-82	84-86
RDC	76-78	76-78	303	65-67	67-69	523	82-83	82-83	633	81-82	81-82	1233	84-85	84-85
SL2	69-72	69-72	353	72-73	73-74	555	80-81	80-81	57	88-89	88-89	S/P 13	87-88	90-91
SL4	72-78	72-78	404	73-74	74-75	656	82-83	82-83	858	84-85	84-85	14	86-87	86-87
SL5	76-79	76-79	454	76-77	75-76	6	85-86	85-86	833	82-84	82-84	S/P 15	91-92	91-92

* Average at 1 meter, 4 places around the blower

dBA at Distance Conversion Chart

To read, use straight edge to connect blower distance and dBA rating. A pivot point A will be developed. Use straight edge again with new distance and pivot point A to read dBA at new distance.



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Standard Regenerative Blower Nomenclature Reference

This chart explains the nomenclature behind the catalogued blower model names. This tool can be used to explain to customers what the letters and numbers mean, and will also allow you to become familiar with our model names. This information should not affect the way orders are placed; please continue to use the model names shown in the catalog and price pages. Any special request should be noted on the order.

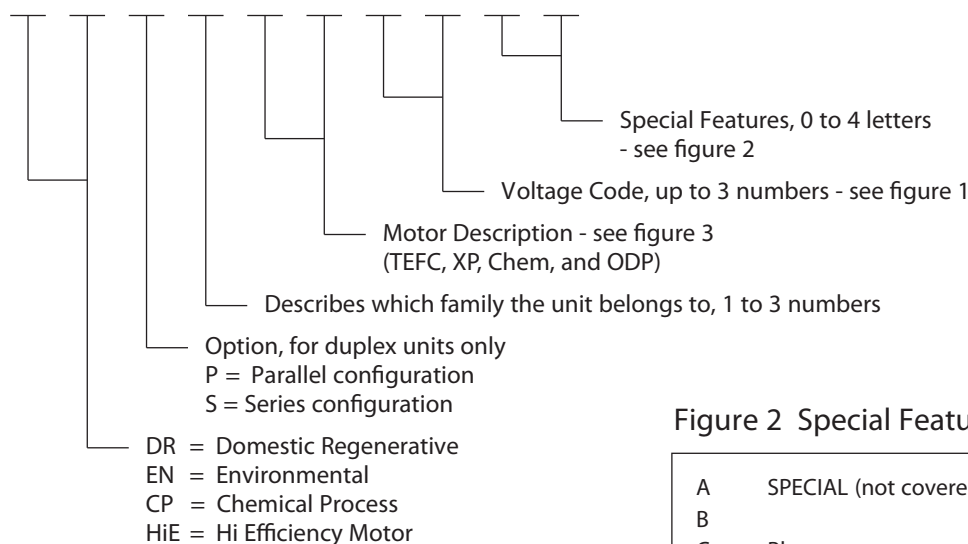


Figure 1 Voltage Code

5	230 VAC 60 Hz, Single Phase
9	115/230 VAC 50/60 Hz, Single Phase
33	230 VAC 60 Hz, Three Phase
58	115/230 VAC 60 Hz Single Phase
60	200 VAC 50/60 Hz Single Phase
72	230/460 VAC 60 Hz Three Phase
75	380 VAC 50 Hz Three Phase
86	575 VAC 60 Hz Three Phase
89	200-230/460 VAC 60 Hz, Three Phase
91	230/460 VAC 50/60 Hz, Three Phase
92	415 VAC 50 Hz, Three Phase
201	380 VAC 60 Hz

Figure 2 Special Features

A	SPECIAL (not covered by any other letter)
B	
C	Blower on pressure only
D	Blower on suction only
E	
F	
G	
H	Vapor recovery service - hydrocarbon
J	Nasty Gas face seal
K	
L	Lo leak option (lip seal)
M	Die Cast or muffler extension
P	
Q	
R	Chem-Tough™ construction
S	Special manifold
T	
U	
V	Valve
W	Rail mounted blower
X	Base mounted blower
Y	Slip on flange
Z	Package blower coupling drive
AA	Package blower belt drive, simplex
BB	Package blower drive belt, duplex
RD	Remote drive
NT	No Tower

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Standard Regenerative Blower Nomenclature Reference (Cont'd)

Figure 3 Motor Description

	HP	Motor Type	Thermal Protection		HP	Motor Type	Thermal Protection
D	5.0	TEFC	No	CJ	2.5	XP	Yes
E	5.0	ODP	No	CK	4.0	TEFC	No
F	5.0	XP	Yes	CR	4.0	CHEM TEFC	No
K	3.0	TEFC	No	CS	3.0	CHEMTEFC	No
M	3.0	XP	Yes	CT	2.0	CHEM TEFC	No
R	1.5	TEFC	No	CU	1.0	CHEM TEFC	No
V	1.5	ODP	Yes	DC	1/8	TEFC	Yes
W	1.5	XP	Yes	DJ	1/16	TEFC	Yes
X	7.5	ODP	No	DW	30	TEFC	No
Y	1/3	TEFC	No	DX	30	XP	Yes
AD	1/3	XP	Yes	EE	60	ODP	No
AE	1/2	TEFC	No	EZ	1.5	CHEM TEFC	No
AG	1/2	XP	No	FA	1/2	CHEM TEFC	No
AK	1/2	XP	Yes	FB	1/4	CHEM TEFC	No
AL	1.0	TEFC	No	FD	3/4	CHEM TEFC	No
AR	1.0	XP	Yes	FE	2.5	CHEM TEFC	No
AS	2.0	TEFC	No	FF	5	CHEM TEFC	No
AW	2.0	ODP	Yes	FG	7.5	CHEM TEFC	No
AX	2.0	XP	Yes	FH	10	CHEM TEFC	No
AY	7.5	TEFC	No	FJ	15	CHEM TEFC	No
BA	7.5	XP	Yes	FK	30	CHEM TEFC	No
BB	10	TEFC	No	FL	5.5	XP	Yes
BC	10	ODP	No	FM	1/4	CHEM XP	Yes
BD	10	XP	Yes	FN	1/2	CHEM XP	Yes
BE	15	TEFC	No	FQ	1.0	CHEM XP	Yes
BG	15	XP	Yes	FR	1.5	CHEM XP	Yes
BH	20	TEFC	No	FS	2.0	CHEM XP	Yes
BK	20	XP	Yes	FU	3.0	CHEM XP	Yes
BL	15	ODP	No	FW	5.0	CHEM XP	Yes
BM	20	ODP	No	FX	5.5	CHEM XP	Yes
BP	30	ODP	No	FY	7.5	CHEM XP	Yes
BQ	40	ODP	No	FZ	10	CHEM XP	Yes
BR	3/4	TEFC	No	GA	15	CHEM XP	Yes
BX	1/4	TEFC	No	GB	20	CHEM XP	Yes
CB	1/4	ODP	Yes	GC	30	CHEM XP	Yes
CC	1/4	XP	Yes	GD	20	CHEM TEFC	No
CD	2.5	TEFC	No	RD	Remote Drive - No Motor		

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Corrosion-Resistant and Sanitary Blowers Application Data Sheet

To obtain Application Engineering assistance or a quotation for your specific need, please photocopy this form, fill out as much as possible, and fax it back to Rotron. We look forward to working with you.

			GAS CONCENTRATION / DESCRIPTION		
			Percentage	Gas	Specific Gravity
COMPANY			_____ %	_____	(SG = _____)
CONTACT			_____ %	_____	(SG = _____)
ADDRESS			_____ %	_____	(SG = _____)
ADDRESS			_____ %	_____	(SG = _____)
CITY	STATE	ZIP			
PHONE	FAX		100 %	_____	(SG = _____)
GAS CLASSIFICATION:			Corrosive	<input type="checkbox"/> Yes <input type="checkbox"/> No	Explosive <input type="checkbox"/> Yes <input type="checkbox"/> No
AREA CLASSIFICATION:			Corrosive	<input type="checkbox"/> Yes <input type="checkbox"/> No	Explosive <input type="checkbox"/> Yes <input type="checkbox"/> No

PERFORMANCE REQUEST: Fill in and circle choice

FLOW	SCFM	INLET TEMPERATURE	° (F / C)
INLET PRESSURE	PSI (A / G)	AREA AMBIENT TEMPERATURE	° (F / C)
OUTLET PRESSURE	PSI (A / G)	SITE ALTITUDE	(Ft / M)

APPLICATION DESCRIPTION: Attach sketch if necessary

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Warranty Statement

Warranty Statements

1. AMETEK ROTRON DR, EN, and HiE regenerative direct drive blowers are guaranteed for one full year from the date of installation (limited to 18 months from the date of shipment.) to the original purchaser only. Should blower fail, we will evaluate the failure. If failure is determined to be workmanship or material defect related,

2. **Standard Products** - AMETEK ROTRON moisture separators, remote drives, packaged units, CP blowers, Nasty Gas™ models and special built (EO) products are guaranteed for one full year from the date of shipment for workmanship and material defect to the original purchaser only. Should the blower fail, we will evaluate the failure. If failure is determined to be workmanship or material defect related, we will at our option repair or replace the blower.

3. **Parts Policy** - AMETEK ROTRON spare parts and accessories are guaranteed for three months from the date of shipment for workmanship and material defect to the original purchaser only. If failure is determined to be workmanship or material defect related we will at our option repair or replace the part.

4. **Non-Standard Products** - Orders for specially-built products will be considered as non-cancellable. Any requested changed by customer after order acceptance will result in additional charges.

Corrective Action - A written report will be provided indicating reason(s) for failure, with suggestions for corrective action. Subsequent customer failures due to abuse, misuse, misapplication or repeat offense will not be covered. AMETEK ROTRON will then notify you or your options. Any failed unit that is tampered with by attempting repair or diagnosis will void the warranty unless authorized by the factory.

Terms and Conditions - Our warranty covers repairs or replacement or regenerative blowers only, and will not cover labor for installation, outbound and inbound shipping costs, accessories or other items not considered integral blower parts. Charges may be incurred on products returned for reasons other than failures covered by their appropriate warranty. Out-of-warranty product and in warranty product returned for failures determined to be caused by abuse, misuse, or repeat offense will be subject to an evaluation charge. Maximum liability will in no case exceed the value of the product purchased. Damage resulting from mishandling during shipping is not covered by this warranty. It is the responsibility of the purchaser to file claims with the carrier. Other terms and conditions of sale are stated on the back of the order acknowledgement.

Hazardous Locations Policy

AMETEK ROTRON will not knowingly specify, design or build any regenerative blower for installation in a hazardous, explosive location without proper NEMA motor enclosure. AMETEK ROTRON does not recognize sealed blowers as a substitute for explosion-proof motors. Sealed units with standard TEFC motors should never be utilized where local, state, and/or federal codes specify the use of explosion-proof equipment.

AMETEK ROTRON has a complete line of regenerative blowers with explosion-proof motors, Division 1 & 2, Class I, Group D; Class II, Groups F & G requirements are met with these standard explosion-proof blowers.

AMETEK ROTRON will not knowingly specify, design or build any regenerative blower for installation in a hazardous, corrosive environment without the proper surface treatment and sealing options.

AMETEK ROTRON has a complete line of Chemical Processing and Nasty Gas™ regenerative blowers with Chem-Tough™, stainless steel parts, and seals.

AMETEK ROTRON offers general application guidance, however, suitability of the particular blower selection is ultimately the responsibility of the purchaser, not the manufacturer of the blower.

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