

VII. MATERIAL CONVEYING

Bulky materials such as those shown in Table 1, page 7, can be conveyed pneumatically using a Cincinnati Fan "RBE" series exhauster. Follow the steps below to determine the fan best suited for your application.

EXAMPLE: Assume a requirement to move 2400 pounds per hour of barley through 200 feet of straight, horizontal, round duct.

NOTE: For each 90° elbow in your duct system, add 20 feet of straight duct to determine total equivalent straight duct length.

For each 10 feet of vertical duct, add 10 feet to your total straight duct length.

I. Convert pounds per hour to pounds per minute: $2400 \text{ lbs/hr} \div 60 = 40 \text{ lbs/min}$

II. Refer to Table 1, page 7. Find "barley" under material (column A) and read horizontally. Barley weighs 38 pounds per cubic foot (column B), requires 38 CFM of air per pound of material (column C) and a minimum of 5000 feet per minute conveying velocity (column D).

III. Determine the minimum cubic feet per minute (CFM) requirements:

$$\frac{\text{CFM/LB of Material} \times \text{lbs/Minute}}{\text{lbs/Minute}} = \frac{38 \text{ (from column C)} \times 40 \text{ (from step 1)}}{40}$$

1520 Total minimum CFM required @ 5000 ft/min conveying velocity (column D)

IV. Determine the system duct size and system static pressure requirements from Table 2, page 7. Read across the 5000 ft/min velocity line to the 8" duct size column since this is the first (smallest) duct size column over 1520 CFM.

We have selected 8" duct size with 1745 CFM (actual) and a velocity of 5000 ft/min.

The friction loss is 6.02" SP per 100' x 2 = 12.04" plus 3.5" SP suction pickup (column E, Table 1) = 15.54" total system static pressure for 200 feet of straight 8" duct.

V. Check fan rating tables for 1745 CFM at 15.54" SP at the lowest horsepower. From the RBE Industrial Exhauster catalog, we suggest a Model RBE-9. Interpolate 3499 RPM, 7.59 BHP.

VI. If material being conveyed will be going through the fan, the fan BHP can be significantly increased. The approximate increase is calculated as:

$$\text{Actual BHP} = \frac{\text{lbs/Minute of air} + \text{lbs/Minute of material}}{\text{lbs/Minute of air}} \times \text{Fan BHP (7.59, Step V)}$$

In this example: $\text{lbs/Minute of air} = 1745 \text{ (Actual CFM, Step IV)} \times .075 \text{ lbs/ft}^3 \left(\frac{\text{Standard Density}}{\text{Density}} \right) = 130.9$
 $\text{lbs/Minute of material} = 40$ See note 3

Therefore: $\frac{130.9 + 40}{130.9} = \frac{170.9}{130.9} = 1.31 \times 7.59 = 9.94 \text{ Actual BHP}$

- NOTES:** 1. For each 10 feet of vertical duct, add 10 feet to your total straight duct length.
 2. For equivalent losses through elbows, see chart on page 9.
 3. Make sure you use correct density for location of fan.

YOUR MATERIAL CONVEYING CALCULATIONS

(1) Material Being Conveyed	(1) _____	NOTE: If conveying long, stringy material, be sure to specify open type wheel. Consult factory.
(2) Pounds Conveyed/Hour	(2) _____ + 60	
(3) Pounds/Minute	(3) _____	
(4) Feet of Straight Duct	(4) _____ (Horizontal + 2 x vertical)	
(5) Number of 90° Elbows x 20 Ft.	(5) + _____	
(6) Total Equivalent Feet of Duct	(6) _____	
(7) Material Weight, lbs./Cu. Ft. (col. B)	(7) _____	
(8) CFM/Pound of Material (col. C)	(8) _____	
(9) Pounds/Minute (step 3)	(9) x _____	
(10) Total Min. CFM Required	(10) _____	
(11) Min. Conveying Velocity in FPM (col. D)	(11) _____	(12) _____ DUCT SIZE
(12) Duct Size to Get Total CFM (step 10) @ Minimum Velocity (step 11) per table 2		(13)* _____ ACTUAL CFM*
(13) Actual CFM for Duct (step 12)		
(14) Friction Loss/100 Ft.	(14) _____	
(15) Total Equivalent Feet of Duct (step 6) (in 100's of feet)	(15) x _____ (in 100's of feet)	
(16) Suction Pickup in Inches of WC (col. E)	(16) + _____	
(17) Total System SP		(17) _____ TOTAL SYSTEM SP
FAN MODEL TO GET #13 (Actual CFM) & #17 (Total SP) ABOVE _____		
FAN RPM _____		
*Must be equal or greater than Step 10.		ACTUAL FAN BHP _____ (See VI above)

TABLE 1

A	B	C	D	E
Material	Approx. Weight (Lbs. per Cu. Ft.)	CFM Per Lb. of Material	Min. Conveying Velocity (In fpm*)	Suction Pickup (Inches of W.C.)
Ashes, Coal	40	42	4500	3.0
Barley	38	38	5000	3.5
Beans, Soy	47	36	5200	4.0
Bran	16	56	3500	2.0
Cement, Portland	100	35	7000	5.0
Cinders, Coal	45	36	6000	4.0
Coal, Powdered	30	42	4000	3.0
Coffee, Beans	48	36	3500	3.0
Cork, Ground	15	59	3500	1.5
Corn, Cobs	25	44	5000	2.5
Corn, Meal	40	38	5500	3.5
Corn, Shelled	45	36	5500	3.5
Cotton, Dry	30	94	4000	2.0
Dust, Grinding	160-175	42	5000	3.0
Fruit, Dried	30	42	4000	3.0
Hair or Feathers, Dry	5	94	3000	1.5
Lime, Hydrated	53-64	42	5000	3.0
Malt, Dry	35	39	4800	3.0
Oats	26	44	4500	3.0
Plastic, Granulated	35	42	5400	3.0
Rags, Dry	30	42	4500	2.5
Salt, Coarse	48	36	5500	4.0
Sand, Dry	99	35	7000	5.0
Sawdust, Dry	7-15	63	3700	2.5
Wheat, Dry	48	37	5800	4.0
Wood Chips, Heavy	15-24	45	4500	3.0
Wood Shavings, Light	7-15	73	3400	2.0
Wool, Dry	5	94	5000	2.0

* Feet per minute

WARNING

Whereas fans are used in thousands of material conveying applications around the world, care must be used in their selection and location within each material conveying system. The material should be crushed, shredded or pulverized **before** it passes through the fan to eliminate premature fan housing, fan wheel and/or bearing failure which could cause severe personal injury and/or complete system failure. Please contact a Cincinnati Fan sales engineer in your area for correct, safe selection for your specific application.

TABLE 2
Friction Loss (FL) in Inches of Water per 100 Feet of Straight, Horizontal, Round Duct

VEL FPM	PIPE DIAMETER & AREA IN SQ. FT.																					
	4"		5"		6"		7"		8"		10"		12"		14"		16"		18"		20"	
	.087		.136		.196		.267		.349		.545		.785		1.069		1.396		1.767		2.182	
	CFM	FL	CFM	FL	CFM	FL	CFM	FL	CFM	FL	CFM	FL	CFM	FL	CFM	FL	CFM	FL	CFM	FL	CFM	FL
2600	227	3.26	355	2.60	511	2.17	695	1.86	909	1.63	1420	1.30	2040	1.08	2780	.93	3630	.81	4600	.72	5680	.65
2800	245	3.76	382	3.01	550	2.52	748	2.15	977	1.89	1530	1.61	2200	1.26	2990	1.07	3910	.93	4950	.83	6110	.75
3000	262	4.33	409	3.46	588	2.88	802	2.47	1048	2.08	1638	1.73	2355	1.44	3210	1.24	4180	1.08	5310	.96	6550	.86
3200	279	4.93	437	3.94	628	3.28	855	2.82	1118	2.47	1748	1.97	2510	1.64	3420	1.41	4470	1.23	5660	1.09	6980	.96
3400	297	5.56	464	4.45	668	3.71	910	3.18	1188	2.78	1855	2.22	2670	1.85	3630	1.59	4750	1.43	6020	1.24	7430	1.11
3500	304	5.89	476	4.71	686	3.93	935	3.37	1222	2.95	1908	2.35	2747	1.96	3741	1.68	4886	1.49	6184	1.31	7637	1.18
3600	314	6.23	492	4.98	707	4.15	962	3.56	1258	3.12	1965	2.49	2825	2.08	3840	1.78	5025	1.56	6370	1.38	7860	1.25
3700	322	6.59	503	5.26	725	4.38	988	3.76	1291	3.30	2017	2.63	2904	2.20	3955	1.88	5165	1.65	6537	1.46	8073	1.32
3800	332	6.95	518	5.55	746	4.62	1018	3.97	1327	3.48	2070	2.78	2985	2.32	4060	1.99	5300	1.74	6720	1.54	8300	1.39
4000	350	7.69	546	6.15	796	5.13	1070	4.40	1396	3.85	2184	3.08	3142	2.57	4280	2.20	5580	1.92	7080	1.71	8740	1.54
4200	367	8.48	573	6.78	825	5.65	1125	4.85	1467	4.25	2290	3.49	3300	2.83	4400	2.43	5870	2.12	7430	1.88	9170	1.70
4400	384	9.26	600	7.41	864	6.18	1176	5.30	1536	4.63	2400	3.71	3456	3.11	4700	2.66	6140	2.33	7780	2.06	9620	1.85
4500	392	9.70	612	7.77	882	6.48	1202	5.55	1571	4.86	2453	3.89	3532	3.25	4810	2.78	6282	2.44	7951	2.16	9819	1.94
4800	418	11.05	654	8.85	944	7.38	1284	6.32	1676	5.55	2620	4.43	3770	3.69	5130	3.17	6700	2.77	8480	2.46	10460	2.22
5000	435	12.02	680	9.67	980	8.02	1335	6.88	1745	6.02	2725	4.82	3925	4.01	5345	3.44	6980	3.01	8835	2.67	10910	2.41
5200	454	13.00	710	10.50	1022	8.66	1390	7.44	1818	6.50	2840	5.21	4080	4.34	5560	3.72	7260	3.25	9200	2.89	11360	2.61
5500	479	14.68	748	11.64	1078	9.68	1469	8.31	1920	7.28	2997	5.81	4317	4.85	5879	4.17	7678	3.64	9718	3.22	12001	2.91
5600	490	15.25	764	12.05	1100	10.05	1496	8.61	1954	7.55	3060	6.03	4400	5.05	5980	4.32	7820	3.78	9900	3.35	12220	3.02
5800	505	16.27	789	12.95	1137	10.78	1549	9.25	2024	8.10	3161	6.47	4553	5.40	6200	4.63	8096	4.05	10248	3.60	12655	3.24
6000	524	17.30	818	13.85	1176	11.52	1604	9.89	2096	8.66	3276	6.92	4710	5.76	6420	4.95	8360	4.33	10620	3.85	13100	3.46
7000	611	23.60	955	18.90	1375	15.65	1873	13.50	2445	11.80	3820	9.41	5500	7.82	7470	6.74	9770	5.90	12380	5.24	15300	4.72