applied to systems having characteristic curves A, B and C, will deliver 10,000, 13,000 or 16,400 cfm respectively.

The curves in Fig. 4 also illustrate the effect of errors which may be made in calculating the resistance of a ventilating system. For instance, if a given system requires 13,000 cfm and the resistance to flow of the system has been computed as 1.25 in. static pressure, such a system would be represented by system characteristic curve B in Fig. 4. If a 100 per cent error had been made and the resistance were 2.5 in. instead of 1.25 in., then the system characteristic would be as shown in curve A and would cross the fan curve at 10,000 cfm. Such an error would cause the flow of air to be decreased from a design volume of 13,000 cfm to 10,000 cfm. If the resistance to flow had been over estimated and

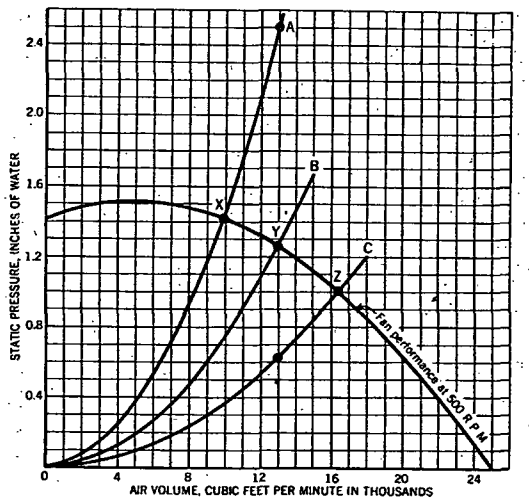


FIG. 4. PARABOLIC SYSTEM CHARACTERISTIC CURVES

the resistance actually were 0.625 in., the system characteristic curve would be as shown in curve C and the fan would deliver 16,400 cfm to the system instead of the design volume of 13,000 cfm.

In this example extreme errors have been selected to emphasize the effect the square function of the system characteristic has in maintaining the fan performance within comparatively narrow limits. In the first example a system estimated at half what it should have been, resulted in a drop of 23 per cent in volume; and in the second example, a system estimated at twice what it should have been resulted in an increase of 26 per cent in volume.

In some instances fans may be applied to variable flow systems. In such cases the limiting systems may be plotted and the effect on fan performance examined. For instance, a system might have a characteristic curve between A, shown in Fig. 4, as one limit, and B as the other limit. The fan performance will then fall between points X and Y on the fan curve at a point determined by the system characteristics at that

particular time. If A and B are the limiting characteristic curves of the systems, the fan performance will never be outside the points X or Y.

SELECTION OF FANS

The following information is required to select the proper type of fan:

1. Cubic feet of air per minute to be moved.
2. Static pressure required to move the air through the system.
3. Type of motive power available.
4. Whether fans are to operate singly or in parallel on any one duct.
5. What degree of noise is permissible.
6. Nature of the load, such as variable air quantities or pressures.

In order to facilitate the choice of apparatus, the various fan manufacturers supply fan tables or curves which usually show the following factors for each size of fan operating against a wide range of static pressures: (1) volume of air in cubic feet per minute (68 F, 50 per cent relative humidity, 0.075 lb per cubic foot), (2) outlet velocity, (3) revolutions per minute, (4) brake horsepower, (5) tip or peripheral speed, and (6) static pressure. The most efficient operating point of the fan is usually shown by either bold-face or italicized figures in the capacity tables.

Other important factors to be considered in selecting fans are: (1) efficiency, (2) space occupied, (3) sound emission, (4) first cost, and (5) speed (both peripheral and revolutions per minute). These factors are not necessarily shown in the order of importance. In some installations space occupied may be of first importance. In others lowest power consumption is desirable. In many cases quietness of operation of the entire system is essential. Practically all fans operate at their lowest sound level when selected at or near the peak of the static efficiency so that in selecting a fan for highest static efficiency the quietest operating range of the fan will also be obtained. Table 1 shows desirable outlet velocities and tip speeds, or peripheral velocities, for various static pressures. Fans selected accordingly will operate at or near the peak of

TABLE 1. GOOD OPERATING VELOCITIES AND TIP SPEEDS FOR MULTIBLADE VENTILATING FANS

Static Pressure Inches of Water	Forward Curved Blade Fans		Backward Tipped and Double Curved Blade Fans	
	Outlet Velocity Feet per Minute	Tip Speed Feet per Minute	Outlet Velocity Feet per Minute	Tip Speed Feet per Minute
¼	1000–1100	1520–1700	800–1100	2600–3100
⅜	1000–1100	1760–1900	800–1150	3000–3500
½	1000–1200	1970–2150	900–1300	3400–4000
⅝	1200–1400	2225–2450	1000–1500	3800–4500
¾	1300–1500	2480–2700	1100–1650	4200–5000
⅞	1400–1700	2660–2910	1200–1750	4500–5300
1	1500–1800	2820–3120	1200–1900	4800–5750
1¼	1600–1900	3162–3450	1300–2100	5300–6350
1½	1800–2100	3480–3810	1400–2300	5750–6950
1¾	1900–2200	3760–4205	1500–2500	6200–7550
2	2000–2400	4000–4500	1600–2700	6650–8050
2¼	2200–2600	4250–4740	1700–2800	7050–8550
2½	2300–2600	4475–4970	1800–2950	7450–9000
3	2500–2800	4900–5365	2000–3200	8200–9850