for the backward or slightly backward type. A noisy fan usually is one which is operated at a point considerably beyond maximum efficiency.

For a given static pressure there is a corresponding outlet velocity and peripheral speed wherein maximum efficiency is obtained. If a fan be selected to operate at this point, the cost of operation and the noise can be held within control.

To aid in selecting fans as near as possible to the point of maximum efficiency, there are listed for each static pressure, corresponding outlet velocities and tip speeds which will give satisfactory results. The proper tip speed for a given static pressure varies with design of wheel and number of blades or vanes in wheel.

Lower outlet velocities than listed in Table 1 may be used, but care must be exercised when fans of the forward curved type are used to avoid selecting a fan for operation below its useful range.

In exhaust ventilating systems where the air column moves toward the fan, noise due to the higher tip speeds and outlet velocities, will not be so readily transmitted back through the air column to the building. Therefore higher outlet velocities may be used, but this will be at the expense of increased horsepower.

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

STATIC PRESSURE IN INCHES OF WATER	OUTLET VELOCITY FEET PER MINUTE	TIP SPEED FEET PER MINUTE
¼	1000–1100	1520–1700
⅜	1000–1100	1760–1900
½	1000–1200	1970–2150
⅝	1100–1300	2225–2450
¾	1200–1400	2480–2700
⅞	1300–1600	2660–2910
1	1500–1800	2820–3120
1¼	1600–1900	3162–3450
1½	1800–2100	3480–3810
1¾	1900–2200	3760–4205
2	2000–2400	4000–4500
2¼	2200–2600	4250–4740
2½	2300–2600	4475–4970
3	2500–2800	4900–5365

Amply large fans should always be used for both exhaust and supply systems, as there may be and usually is leakage despite the most careful workmanship, necessitating the delivery of more air at the fans than is exhausted from or supplied through the openings in the various rooms.

Long runs of distributing ducts, heaters, air washers, etc., usually are parts of any ventilating system where high static pressures are needed. Under such conditions it is practicable to select fans with higher outlet velocities and peripheral speeds since the duct system itself will tend to muffle objectionable air sounds.

Fans with low outlet velocities should be used regardless of the static pressure, if connected with short ducts to register faces, on account of noise.

The connection of a fan to a metallic duct system should be made by a canvas or similar flexible material so as to prevent the transmission of fan vibration or noises. Where fans are connected to concrete ducts such as are used in the ventilation of vehicular tunnels, the connection is made direct.

Fans for Drying

Both disc and centrifugal types of fans are used for drying work. Disc fans are well adapted to the removal of moisture-laden air when operating against low resistance and when handling air at low temperatures.

Motors on these fans usually are of the fully-enclosed moisture-proof types so that saturated air or air containing foreign material will not injure the motors.

Unit heaters employing disc or propeller type fans are widely used in the drying field. In drying, disc or propeller fans may be used where not too much duct work is required and where air is to be delivered against pressure, since the noise developed from the high peripheral speed of these fans is not ordinarily objectionable in process work of this nature.

Centrifugal fans or blowers of the multiblade type generally are selected to supply air for drying, as they are capable of delivering large volumes against all pressures with a minimum amount of power.

Belt driven fans usually are to be preferred to direct-connected fans as they make a more flexible and economical unit. Wherever drying is done throughout the year and where air requirements change as the drying conditions change, the drying can be speeded up or reduced through control of the fan capacity. This may be done by changing the fan speed or by varying the outlet area with dampers.

Due to the low speeds of forward curved multiblade or paddle wheel type fans, these can be direct-connected to reciprocating steam engines and the exhaust steam may be used in the heating apparatus. In selecting engine driven fans for drying processes, where a large quantity of exhaust steam is used in the heaters, a smaller fan and greater power consumption may be used, because power economy is not essential under this condition.

Where static pressure in a dryer varies, and where battery operation is required, the full backward curved fan is recommended. This type is well adapted for direct-connected motors of the higher speeds.

Fans for Dust Collecting and Conveying

The application of fans or exhausters for handling refuse, dust, fumes, etc., generated by machine equipment is covered in Chapter 25. Information is given regarding the methods for determining air quantities, velocity required for carrying various materials and method of determining maintained resistance or total static pressure at which the fan is to operate.

The selection of a proper size fan or exhauster is at times governed by the future requirements of the plant. In many instances, additional future capacity is anticipated and should be provided for.

Having determined the necessary volume of air and the maintained resistance or static pressure required, the proper size fan may be selected