DYNAMIC BULK SYSTEMS®

The New York Blower Company®

# USEFUL FAN ENGINEERING DATA

## FAN LAWS and FORMULAS used in Performance Calculations

Fan efficiencies remain constant for symmetrical design. When one or more conditions change, the other conditions vary according to certain fan laws for an established fan size, system of ductwork and air density.

**When fan speed is varied:**

1. Fan's air-delivery will vary directly as the RPM ratio.

$$CFM_2 = \left(\frac{RPM_2}{RPM_1}\right)\left(CFM_1\right)$$

2. Developed fan pressures will vary as the RPM ratio squared.

$$SP_2 = \left(\frac{RPM_2}{RPM_1}\right)^2\left(SP_1\right)$$

3. Horsepower absorbed by fan will vary as the RPM ratio cubed.

$$HP_2 = \left(\frac{RPM_2}{RPM_1}\right)^3\left(HP_1\right)$$

**When fan pressure varies:**

1. Fan's air-delivery and RPM will vary as the square root of pressure ratio.
2. Horsepower absorbed by fan will vary as the square root of the pressure ratio cubed.

**When density of air varies:**

1. For constant pressure — fan speed, air-delivery and horsepower absorbed vary inversely as the square root of the density.
2. For constant air-delivery and fan speed — horsepower absorbed by fan and pressure developed vary directly as the air density.
3. For constant amount of air by weight — air-delivery, fan speed and developed pressure vary inversely as the density ratio.
4. For constant amount of air by weight — horsepower absorbed by fan varies inversely as the square of the density ratio.

**TO CALCULATE:**

Velocity = CFM — Duct Area (in Sq. Ft.)

ALTERNATE METHOD:

$$\text{Velocity} = \frac{\text{CFM x 144}}{\text{Duct area (in sq. in.)}}$$

CFM = Velocity X duct area (in sq. ft.)

ALTERNATE METHOD:

$$\text{CFM} = \frac{\text{Velocity X duct area (in sq. in.)}}{144}$$

Tip Speed = Circumference X RPM

$$\text{BHP} = \frac{\text{Total Watts input X motor eff.}}{746}$$

## Equivalent Pressures

| Advancing by Ounces per Square Inch | | | | | |
|---|---|---|---|---|---|
| Oz. per Sq. In. | Lbs. per Sq. In. | In. of Water | Ft. of Water | In. of Mercury | KILOPASCAL |
| .25 | .0156 | .4330 | .0361 | .0319 | .1074 |
| .50 | .0312 | .8660 | .0772 | .0638 | .2151 |
| .75 | .0469 | 1.2990 | .1083 | .0957 | .3227 |
| 1 | .0625 | 1.7320 | .1443 | .1276 | .4302 |
| 1.50 | .0937 | 2.5980 | .2165 | .1913 | .6453 |
| 2 | .125 | 3.4640 | .2887 | .2551 | .8605 |
| 3 | .1875 | 5.1960 | .4330 | .3827 | 1.2907 |
| 4 | .25 | 6.9280 | .5773 | .5102 | 1.7209 |
| 5 | .3125 | 8.6600 | .7217 | .6378 | 2.1511 |
| 6 | .375 | 10.3921 | .8660 | .7653 | 2.5814 |
| 7 | .4375 | 12.1241 | 1.0103 | .8929 | 3.0116 |
| 8 | .5 | 13.8561 | 1.1547 | 1.0204 | 3.4419 |
| 9 | .5625 | 15.5832 | 1.2990 | 1.1480 | 3.8709 |
| 10 | .625 | 17.3202 | 1.4433 | 1.2755 | 4.3023 |
| 11 | .6875 | 19.0520 | 1.5877 | 1.4030 | 4.7325 |
| 12 | .75 | 20.7842 | 1.7320 | 1.5306 | 5.1628 |
| 13 | .8125 | 22.5162 | 1.8764 | 1.6582 | 5.5930 |
| 14 | .875 | 24.2483 | 2.0207 | 1.7857 | 6.0233 |
| 15 | .9375 | 25.9803 | 2.1650 | 1.9133 | 6.4535 |
| 16 | 1. | 27.7123 | 2.3094 | 2.0408 | 6.8837 |
| 18 | 1.125 | 31.1763 | 2.5980 | 2.2959 | 7.7442 |
| 20 | 1.25 | 34.6404 | 2.8867 | 2.5510 | 8.6047 |
| 24 | 1.5 | 41.5684 | 3.4640 | 3.0612 | 10.3256 |
| 28 | 1.75 | 48.4965 | 4.0414 | 3.5714 | 12.0465 |
| 32 | 2. | 55.4246 | 4.6187 | 4.0816 | 13.7675 |

| HP | Full Load Watts Input | General Purpose Full Load Watts Input Including Service Factor (S.F.) |
|---|---|---|
| 1/3 | 436 | 540 |
| 1/2 | 600 | 700 |
| 3/4 | 860 | 1050 |
| 1 | 1100 | 1300 |
| 1 1/2 | 1500 | 1700 |
| 2 | 2000 | 2200 |

## TERMS and DEFINITIONS

**AHP.** — or Air Horsepower, is work done by the fan expressed as horsepower.

$$\text{AHP} = \frac{\text{CFM X TP}}{6356}$$

**BHP.** — or Brake Horsepower, is the horsepower absorbed by the fan.

**BTU.** — or British Thermal Unit, is the amount of heat required to raise one pound of water from 63˚F to 64˚F.

**CFM.** — or Cubic Feet Per Minute, is the volume of air moved per minute.

**EDR.** — or Equivalent Direct Radiation, is the amount of heating surface which will give off 240 BTU. per hour.

**FPM.** — or Feet Per Minute, is the velocity of the airstream.

**Final Temperature** — is the temperature of air after passing over heating coils under specified conditions.

**Free Delivery** — is the condition under which a fan operates when no static pressure or resistance is present.

**HP.** — or Horsepower, is the actual rated output of the fan motor used.

**ME.** — or Mechanical Efficiency, is the ratio of horsepower absorbed (BHP) to horsepower delivered by the fan (AHP).

$$\text{ME} = \frac{\text{AHP}}{\text{BHP}}$$

**Plenum Chamber** — is an air compartment maintained under pressure to serve one or more distributing ducts.

**RPM.** — or Revolutions Per Minute, is the number of times the fan shaft revolves per minute.

**Standard Air** — is air which weighs .075 pounds per cubic foot, which is dry air 70˚F dry bulb with a barometric pressure of 29.92 inches of mercury.

**SE.** — or Static Efficiency, is expressed as

$$\text{SE} = \frac{\text{CFM X SP}}{6356 \text{ X BHP}}$$

**SP.** —or Static Pressure, is a measure of the force exerted by the fan in moving air though any ventilation system.

**TS.** —or Tip-Speed, is the peripheral speed in feet per minute of a propeller tip at any specified RPM.

**TE.** —or Total Efficiency, may be expressed as

$$\text{TE} = \frac{\text{CFM X TP}}{6356 \text{ X BHP}}$$

**VP.** —or Velocity Pressure, is equal to the kinetic energy per unit volume of the flowing air. It can be calculated from the formula

$$\text{VP} = \left[\frac{\text{FPM}}{4005}\right]^2$$

**TP.** —or Total Pressure, is the sum of the static pressure (SP), and the velocity pressure (VP) at any given point in a ventilating system.

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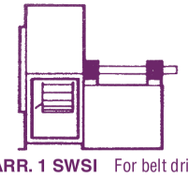
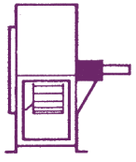
## DRIVE ARRANGEMENTS FOR CENTRIFUGAL FANS

SW — Single Width DW — Double Inlet
SI — Single Inlet DI — Double Inlet

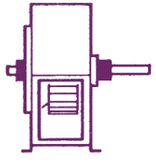
Arrangements 1, 3, 7 and 8 are also available with bearings mounted on pedestals or base set independent of the fan housing.



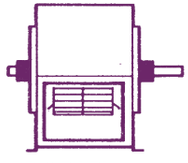
**ARR. 1 SWSI** For belt drive or direct connection. Impeller overhung. Two bearings on base.



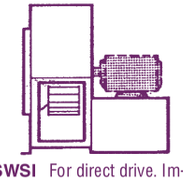
**ARR. 2 SWSI** For belt drive or direct connection. Impeller overhung. Bearing in bracket supported by fan housing.



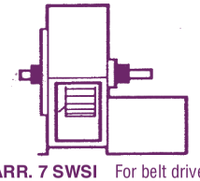
**ARR. 3 SWSI** For belt drive or direct connection. One bearing on each side and supported by fan housing.



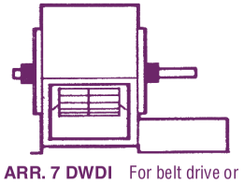
**ARR. 3 DWDI** For belt drive or direct connection. One bearing on each side and supported by fan housing.



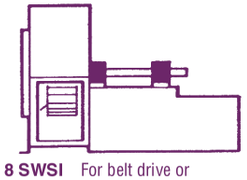
**ARR. 4 SWSI** For direct drive. Impeller overhung on prime mover shaft. No bearings on fan. Prime mover base mounted or integrally directly connected.



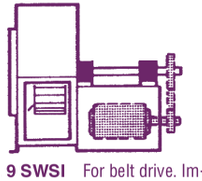
**ARR. 7 SWSI** For belt drive or direct connection. Arrangement 3 plus base for prime mover.



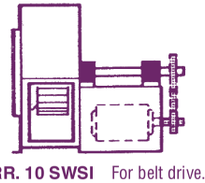
**ARR. 7 DWDI** For belt drive or direct connection. Arrangement 3 plus base for prime mover.



**ARR. 8 SWSI** For belt drive or direct connection. Arrangement 1 plus extended base for prime mover.



**ARR. 9 SWSI** For belt drive. Impeller overhung, two bearings, with prime mover outside base.



**ARR. 10 SWSI** For belt drive. Impeller overhung, two bearings, with prime mover inside base.

## CALL US TOLL-FREE
## 1-800-314-FANS
## (3267)

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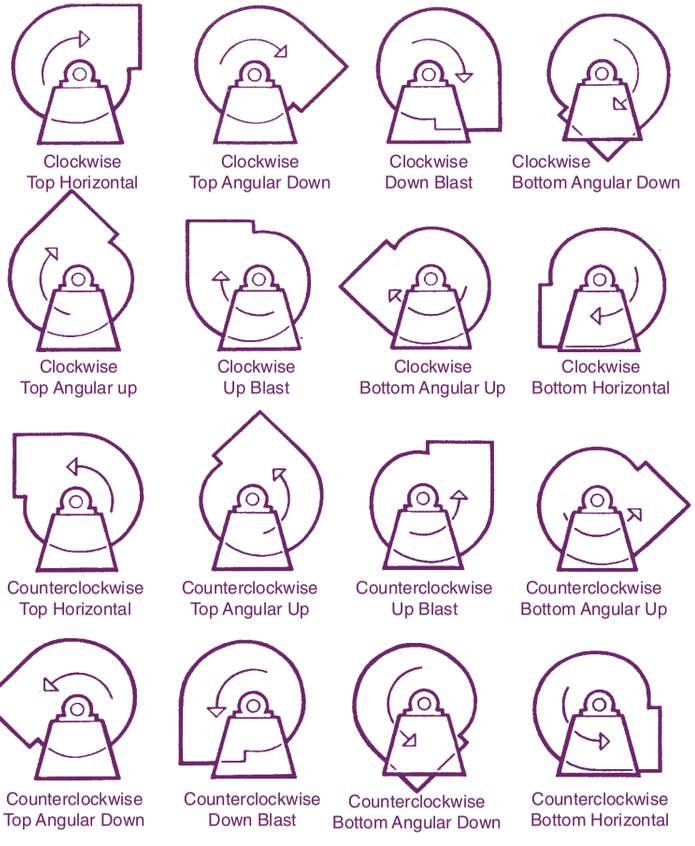
## DESIGNATIONS FOR ROTATION AND DISCHARGE OF CENTRIFUGAL FANS




**Direction of rotation is determined from drive side of fan.**
Direction of discharge is determined in accordance with diagrams. Angle of discharge is referred to the horizontal axis of fan and designed in degrees above or below such standard reference axis.

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