

**PRESSURE & VELOCITY VALUES**

A critical element in the design of plastic bearings is the combined effect of **Pressure (P)** and **Velocity (V)**

- \* **Pressure (P)** is the load placed on a bearing assembly
- \* **Velocity (V)** is the surface speed at which an object, such as a shaft, moves.
- \* **P-V** is defined as the combination effect of the pressure of the object and the velocity at which it moves on the bearing surface (P×V).

A direct relationship exists between the PV value and the amount of frictional heat generated within a bearing and thus the point of failure since plastics are thermal insulators AND typically have lower melting points than materials such as bronze, lead or steel.

**DETERMINING THE P-V VALUE OF AN APPLICATION:**

Consider this example:

A 2" dia shaft turns at 100 RPM and exerts a total load of 140 lbs on a 2" long bearing.

For a rotating shaft, velocity (V) is determined using the formula:

$V = .262 \times \text{rpm} \times D$ , where,  
 V = Velocity (in feet per minute, FPM)  
 rpm = Shaft Revolutions per minute  
 D = shaft diameter (in inches)  
 .262 = the constant for circumference of a circle in feet. (3.14 ÷ 12)

Therefore, in our example,

$V = .262 \times \text{rpm } 100 \times D \ 2$   
 $V = 52.4$  feet per minute (fpm)

**Pressure (P)** is determined in a sleeve bearing application by dividing the total load on the bearing by its bearing area.

**Bearing area (BA)** is determined by multiplying shaft dia. X length of bearing.

$BA = \text{Shaft dia.} \times \text{Length of bearing}$

In our example, the bearing area is as follows:

$BA = 2" \text{ dia shaft} \times 2" \text{ length of bearing} = 4 \text{ in}^2$

Pressure may be determined by dividing the total load of 140 lbs. by the bearing area of 4 in<sup>2</sup>

$P = 140/4 = 35 \text{ psi}$

Total PV for this application can be quickly calculated now by multiplying the values P and V obtained above, or:

$52.4 \times 35 = 1834$

Various ASTM and AMS tests are used to determine maximum PV Values. Different testing methods can produce different results.

**Using P-V Value to design plastic bearings:**

Maximum PV Values for various plastic materials are available by determining the PV Value of an application and comparing it to the maximum PV Value of a material. You can determine if a material meets the most important suitability criteria. While the PV Value of the application must not exceed the maximum allowable PV Value of the material under consideration, not all PV Values are alike. Pressure and Velocity are separate and distinct functions. Some materials excel at high load, low speed applications, while others perform best in low load, high speed applications.

Consider the following 2 applications:

2" dia shaft at 150 rpm and 50 psi.

$V = 2 \times 150 \times .262 = 78.6$

$PV = 78.6 \times 50 = 3930$

1.5" dia shaft at 50 rpm and 200 psi.

$V = 1.5 \times 50 \times .262 = 19.65$

$PV = 19.65 \times 200 = 3930$

As you can see, these 2 applications are very different, yet the PV is the same. In all new applications, testing the proposed material in an actual bearing installation is strongly suggested.