Using the Spread Sheet to Model Pneumatic Circuits

This activity sheet will familiarize the BBIQ participant with the use of a spread sheet to solve pneumatic problems typical of those encountered in the design and fabrication of a BattleBot.

Please Note: The volume values calculated under the Results column in the spread sheet are for double acting cylinders. Divide the volume values by 2 for single acting cylinders.

Work through the example problem in order to learn the pneumatic terminology required to use the spreadsheet. Then solve the problems that follow.

Example Problem

Using the spreadsheet tool provided in Lesson 6 of the Pneumatics Chapter, analyze the performance of a pneumatic circuit as specified below:

Supply Pressure	150 psi
Diameter of Pneumatic Cylinder	40 mm (1-1/2")
Stroke	3"

Find the C_V (Coefficient of Flow) necessary to fully extend a horizontal cylinder rod in 0.10 seconds with an allowable pressure drop of 10% of supply pressure. Assume a tubing diameter of 0.25" and a total tubing length of 24" inches.

Procedure:

1.) Download the spreadsheet by clicking on the link near the bottom of page 2 of this lesson.
2.) Enter the data as follows and read the results in the yellow cells:

Operating Pressure	150
Suggested Delta P	0.10 (or 10%)
Bore	1.5 (inches)
Stroke	3 (inches)
# of Cylinders	1
Load Ratio	0.70
Line Length	24 (inches)
ID	0.25 (inches)
# of Elbow Fittings	4
Rate Cycle Time	DNA use default 1 (second)
Speed**	30 (inches per second)
Operations per Minute	DNA use default
Number of Shifts	DNA use default
Annual #Days Worked	DNA use default
Desired Cycles/Min	DNA use default
Time for 1 Cycle	DNA use default

** Speed = Distance/Time In this case Rod Speed = 3"/0.1 seconds or 30" ips (inches per second.)

Pneumatic Design Problems

Directions: Using the spreadsheet tool provided in Lesson 6 of the Pneumatics Chapter, analyze the performance of the following pneumatic circuits. Write your answer in the space provided.

1.) Use the following data;

Supply Pressure	150 psi
Diameter of Pneumatic Cylinder	80 mm (Approximately 3")
Stroke	2"

Find the Cv (Coefficient of Flow) necessary to fully extend a horizontal cylinder rod in 0.20 seconds with an allowable pressure drop of 10% of supply pressure. Assume a tubing diameter of 0.375" and a total tubing length of 48" inches.

What forces can this cylinder be expected to develop?

_____Cv

_____Expected Force (Horizontal)

_____Expected Force (Vertical)

2.) Use the following data;

Supply Pressure	100 psi
Diameter of Pneumatic Cylinder	50 mm (Approximately 2")
Stroke	4"

Find the Cv (Coefficient of Flow) necessary to fully extend a horizontal cylinder rod in 0.30 seconds with an allowable pressure drop of 10% of supply pressure. Assume a tubing diameter of 0.250" and a total tubing length of 48" inches.

What forces can this cylinder be expected to develop?

_____Cv

_____Expected Force (Horizontal)

_____Expected Force (Vertical)

Once the required Cv is an important value to determine. In order to obtain the calculated piston speeds it is necessary for ALL the components selected to have a Cv as large or larger than the calculated Cv. Valve Cv's should always be larger than the calculated Cv.