All About Die Springs

Springs are used in a myriad of applications and are as essential to machines as bearings. Springs come in a wide variety of constructions but few are as tightly engineered as the style commonly referred to as compression or die springs. Die springs are engineered to give predetermined pressure at a given compression reliably and consistently.
This article will look at the basics of selecting die springs for punch tools using the following variables:

- Pressure required to perforate the material (shear off, punch hole).
- Stripping or hold down pressure.
- Travel (compression distance).
- Available space in the tool.

There are 3 main types of springs. Each type of spring has its best application depending on the pressure required.

- Engineered metal die springs good for any general application where performance is critical; pressure increases with the amount of
- compression.
  Urethane springs provide alternatives for punch tool design where traditional
  design is cumbersome; very good for forming curves; reduces marring stock
  surface.

Gas springs can provide high pressure in small areas beyond that of die springs or urethane; gas springs provide a flatter pressure curve through the compression.

The die springs primary task is to provide pressure to hold the target material in place while the punch perforates and then retracts or strips off (hence 'stripping pressure'). There are standard formulas for calculating perforating pressure. Stripper pressure is a function of perforating pressure usually 10 25% of perforating pressure. These are usually based on mild steel. Mild steel has a shear pressure of 50,000 lb psi or 25 tons. The perforating pressure calculations are usually done using 25 tons and then adjusted for other metals with a ratio reflecting the hardness of the other material to mild steel.

Material Hardness Tonnage Ration

Material Description	Tons/sq. inches	Shear Strength/ sq. inches	Multiplier to Nominal Mild Steel
Aluminum ≠ Soft Sheet	7.5	15,000 psi	.3
Aluminum ≠ Half Hard	9.5	19,000 psi	.38
Aluminum ≠ Hard	12 15	25,000 psi	.5 .6
Brass ≠ Soft Sheet	17.5	30,000 psi	.7
Brass ≠ Half Hard	14	35,000 psi	.57
Copper ≠ Rolled	25	28,000 psi	1.00
Steel ≠ Mild	30	50,000 psi	1.20
Steel ≠ ASTM A36	35	60,000 psi	1.40
Steel ≠ 50 Carbon	30	60,000 psi	1.20
Steel ≠ Cold Drawn	35	70,000 psi	1.40
Steel ≠ Stainless (18-8)			

Perforating pressure is calculated as follows:
(Length of shear in inches) x (Material thickness in inches) x 25 tons (for mild steel).

- The perimeter of a hole is the same as the length of the shear.

Example
Let's look at punching a ¼" hole in 20 gauge mild steel:

- (Perimeter of hole) x (Material thickness) x 25
- Perimeter of a circle = 3.14 x Diameter
- (3.14 x .25" x .036" x 25 tons)

Perforating (Pressure in tons): .71 tons

Stripping 15%: .11 tons (220 lbs)

Assume 4 springs moving ½" to attain minimum 220 lb.

- This could be accomplished with a 2" x ¾" blue die spring giving 72 lb at ½" x 4 = 288 lb (see **Metal Die Spring Pressure Comparison** chart below).
- A single 2" urethane stripper ¾" O.D. and ¼" ID would deliver 430 lb and may simplify the tool design especially if there is limited space available.
- 4 Gas springs 2.24" x ¾" compressing approx. 600" with a force of 65 lb deliver 260 lb.

Metal Die Spring Pressure Comparison

Die Spring Colour	Free Length (inches)	O.D. (inches)	Maximum Compression %	Maximum Compression Distance (inches)	Maximum Compression (lb)
Blue	2.0	3/4	50	1.0	144
Red	2.0	3/4	37	.74	183
Gold	2.0	3/4	30	.60	297
Green	2.0	3/4	25	.50	340

Excess pressure for perforating and stripping is usually not a problem only too little pressure. Total pressure is only limited by the power in the punch press to be used.

The amount of travel (or compression) in a spring is based on the punch tool design. Obviously different travel distances will require different spring lengths.
Die springs generally do not compress more than 50% with most no more than
30%. The spring above traveled 25%.

The permutations caused by the number of different punch presses and applications require a large selection of springs. Die springs come in 4 incremental strength grades by color blue, red, gold, and green. There are over 120 spring designs in each color grade.

Punch Tools carries over 500 types of springs including urethane and gas springs to meet your needs.

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