Die Springs

TECHNICAL

Common Die Spring Terminology

HOLE DIAMETER This identifies the outside diameter (OD) of the die spring. Ondrives die springs are available in eight different hole sizes matched to standard drill sizes. Each spring is made to fit in the hole, so the OD of the spring is actually less than the hole diameter.
ROD DIAMETER This is a nominal identification of the inside diameter (ID) of the die spring. Ondrives die springs are available in eight different hole sizes matched to standard stripper bolts. Each spring is made to fit over the rod, so the ID of the springs is actually greater than the rod diameter.
FREE LENGTH The length of a die spring before it is subject to any operating force or load.
PRELOAD The distance the free length of the die spring is reduced by the pressure of assembled tool.
OPERATING TRAVEL The distance which is subtracted from the spring length after operating force has been applied.
DEFLECTION The amount of change in spring length after operating force has been applied. The compressed length is computed by subtracting the initial compression and the operating travel form the free length.
SOLID HEIGHT The length of a spring when it is compressed by enough load to bring all the coils into contact with each other.
REMOVE SET The manufacturing process of closing a compression spring to solid to eliminate load loss in operation.
PERMANENT SET This happens when the elastic limits are exceeded and the spring does not return to its original length when the load is released.
ELASTIC LIMIT The maximum compression stress that a die spring can endure without taking permanent set.
LOAD This is the force built up by compressing the spring. Load is expressed in terms of total Newtons, which is the load on the spring per a specific unit of deflection. Load is generated and stress on the coils increases.
STRESS In a spring, this describes the internal force that resists deflection under load. This force is equal to, and in the opposite direction of, the external load. Stress is expressed in Newtons per square millimetre of sectional area.

Selecting Die Springs

A general rule to observe in spring selection is to always use as many springs as the die will accommodate which will produce the required load with the least amount of deflection. This will increase the useful life of the spring, reduce the chances of spring failure and the resulting downtime, loss of production and increased maintenance cost.
Die spring costs are a very small percentage of the total cost of the die. An effort to save a few pennies on die springs is a misguided act that can cost a lot of money in lost time and labour.
The more rapidly a spring works, the more attention must be paid to its fatigue limits. In slow moving dies or fixtures, it is possible to get good performance with springs operating near maximum deflection. As the working speed increases, the life expectancy of the spring at that deflection decreases.
Springs for strippers, pressure pads, and other die components can be selected from the following pages. When selecting a die spring it is necessary to determine the type of performance required of the springs: short, normal, or long run. For short or normal run applications use the deflections tabulated in the long life columns. For long run applications use deflections based on optimum life.
Another approach when selecting a spring is to work back from the amount of operating travel the springs will be subjected to as indicated by the die layout. Select springs in the appropriate duty range which will operate efficiently at the required travel. Calculate the number of springs needed by dividing the load supplied by one spring into the total load required. Round the total number of springs to the next higher even number for balanced performance.

Problems and Answers

Most problems that arise in the use of die springs usually result from improper application. Failure to take advantage of and protect the features engineered into the spring.
SPRING FAILURE Die springs are produced under such careful controls that manufacturing problems have virtually been eliminated. Die spring failure is usually due to either poor spring design and manufacture or incorrect application of the spring. The most common problem source is the use of die springs too close to, or beyond, the springs' physical limitations. The solution, of course, lies with careful selection of die springs for each application.
Other solutions to common spring problems are as follows:
SPRING GUIDANCE Die springs are manufactured with ends ground and squared so that they stand on their own base and compress evenly under load. There is a positive relationship between the spring's outside diameter and total length which determines whether or not a spring will buckle under load.
Generally, if the free length is more than four times the mean diameter of the spring, it could have a buckling problem under compression. This is solved by providing guidance by a pocket, a rod, or both to reduce buckling. it is always recommended to provide guidance for any die spring.
Fig. A provides information as to whether a specific spring with squared, ground ends is subject to buckling may occur to a squared-and-ground spring, both ends of which are compressed against parallel plates, if the values fall above and to the right of the curve
HOLES AND RODS Holes or pockets provided in the die for springs must be the specified size. Springs increase in diameter as they are compressed. If the hole is undersized, a wearing or binding action will produce early spring failure.
Holes also must have flat bottoms with square corners. This will allow the spring to work on a flat surface and provide uniform stress on the coils when the spring is compressed.
Working a spring over a rod also provides good protection again buckling. Care should be taken to be sure the rod is smooth. If the rod is shorter than the spring, it should have a tapered nose so that there is no danger of the spring coils coming into contact with a sharp edge.
ALIGNMENT Care should be taken to make certain that whatever device is used to contain or guide the spring is properly aligned on both sides of the die. Holes or rods that do not match can cause problems that create spring failure and damage to the tool.
TEMPERATURE Heat is a frequently ignored factor in spring failure or load loss. The maximum rated service temperature for our chromium alloy steel is 230°C. The table overleaf shows the percentage of load-loss due to heat and stress combinations. Thought should be given

ANTI-VIBRATION & SPRINGS

Die Springs

Deflection to Compressed Length Conversion Table

Free Length	Compressed Length (mm) - Deflection is % free length											
	Light Duty			Medium Duty			Heavy Duty			Extra Heavy Duty		
	25%	30%	35%	20%	25%	30%	15%	20%	25%	15%	17%	20%
25	18.8	17.5	16.3	20.0	18.8	17.5	21.3	20.0	18.8	21.3	20.8	20.0
32	24.0	22.4	20.8	25.6	24.0	22.4	27.2	25.6	24.0	27.2	26.6	25.6
38	28.5	26.6	24.7	30.4	28.5	26.6	32.3	30.4	28.5	32.3	31.5	30.4
44	33.0	30.8	28.6	35.2	33.0	30.8	37.4	35.2	33.0	37.4	36.5	35.2
51	38.3	35.7	33.2	40.8	38.3	35.7	43.4	40.8	38.3	43.4	42.3	40.8
64	48.0	44.8	41.6	51.2	48.0	44.8	54.4	51.2	48.0	54.4	53.1	51.2
76	57.0	53.2	49.4	60.8	57.0	53.2	64.6	60.8	57.0	64.6	63.1	60.8
89	66.8	62.3	57.9	71.2	66.8	62.3	75.7	71.2	66.8	75.7	73.9	71.2
102	76.5	71.4	66.3	81.6	76.5	71.4	86.7	81.6	76.5	86.7	84.7	81.6
115	86.3	80.5	74.8	92.0	86.3	80.5	97.8	92.0	86.3	97.8	95.5	92.0
127	95.3	88.9	82.6	101.6	95.3	88.9	108.0	101.6	95.3	108.0	105.4	101.6
139	104.3	97.3	90.4	111.2	104.3	97.3	118.2	111.2	104.3	118.2	115.4	111.2
152	114.0	106.4	98.8	121.6	114.0	106.4	129.2	121.6	114.0	129.2	126.2	121.6
178	133.5	124.6	115.7	142.4	133.5	124.6	151.3	142.4	133.5	151.3	147.7	142.4
203	152.3	142.1	132.0	162.4	152.3	142.1	172.6	162.4	152.3	172.6	168.5	162.4
254	190.5	177.8	165.1	203.2	190.5	177.8	215.9	203.2	190.5	215.9	210.8	203.2
305	228.8	213.5	198.3	244.0	228.8	213.5	259.3	244.0	228.8	259.3	253.2	244.0

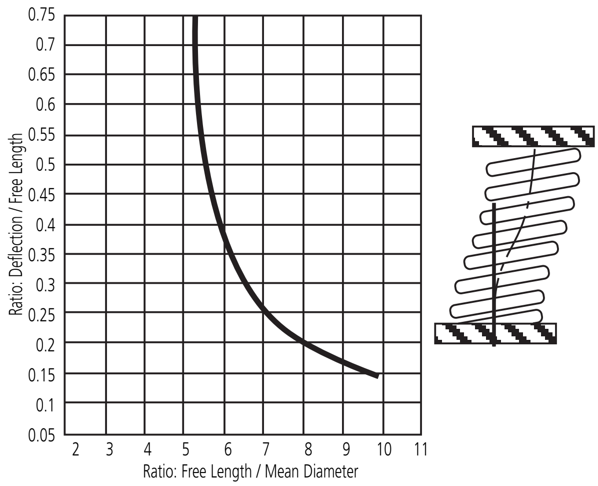
to the heat generated by the working die which can be significant in many applications. Heat absorbed by the tool can be transferred to the springs resulting in a loss of load and premature spring failure.

DEFLECTION Deflection beyond the manufacturer's recommendation can cause early spring failure. Check the press or die travel to be sure of the actual deflection to which the spring will be subjected. If it is beyond a safe limit, changes should be made without delay.

SPRING ALTERATION Each die spring is carefully engineered to perform within specific areas of work. Altering the spring such as reducing its length or number of coils, grinding the inside or outside diameter, or placing restrictions on the movement of the coils, can cause early spring failure. Trying to alter a spring by grinding down its end can change the temper of the material and negatively affect spring performance.

CORROSION Frequently, spring failure can be traced to corrosive elements. Reduction of material or pitting of the spring will reduce its useful life. Be alert to conditions that may effect the spring's surface such as rust, lubricants, soaps, chemicals, etc. Clean, protected springs give the best job performance.

Fig. A. Curve for finding Critical Buckling Conditions



Load Loss vs. Temperature

Initial Stress MPa	Carbon Steel Degrees C			Chromium Alloy Degrees C		
	120	177	200	120	177	230
276	2.0	3.5	4.5	1.0	2.0	5.0
345	2.0	4.0	5.0	1.0	2.0	5.0
414	2.5	4.5	5.5	1.0	2.0	5.5
483	3.0	5.5	6.5	1.0	2.5	6.0
552	3.0	6.0	8.0	1.5	2.5	6.0
620	4.0	8.0	9.0	1.5	3.0	7.0
689	4.5	9.5	10.5	2.0	4.0	8.0
758	7.0	11.5	14.0	2.0	5.0	10.0
827	9.5	13.0	17.5	3.5	8.0	13.0

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