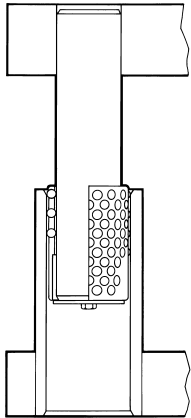


# Selecting the Proper Operating Conditions

## Type I

### Continuous Preload

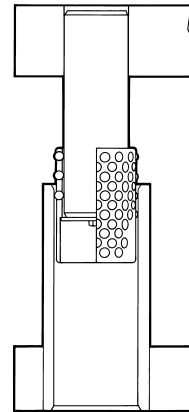


Type **I** is recommended for high speed, high production dies. Throughout the press stroke, all ball bearings remain in preloaded contact with the guide pin and bushing.

Please note that a Type **I** design may be run on a shorter stroke press, but not on a press whose stroke is longer than originally chosen.

## Type IIa

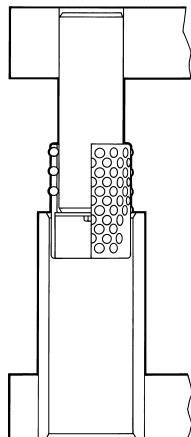
### Preload Partially Relieved



At top stroke, some ball bearings have left preload. On the down stroke they reengage the guide pin and bushing, producing a small upward force which helps counteract the natural tendency of the ball cage to creep downward.

## Type IIb

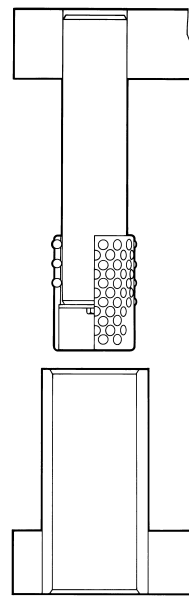
### Preload Relieved



Type **IIb** is recommended if creeping is a problem. As soon as the last ball leaves preload on the up stroke, the cage repositions itself. This feature can eliminate a nagging maintenance chore.

## Type III

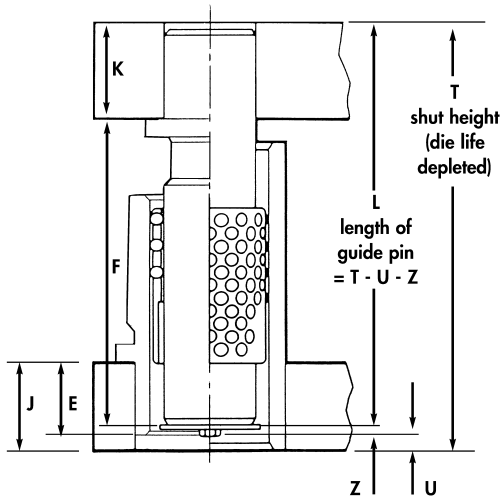
### Disengaged



Type **III** permits an unlimited stroke. Also, if shorter bushings and cages can be used, Type **III** is economical.

However, a pinch point is created when the components disengage, so Type **III** should not be selected if it compromises safety.

# Selecting the Correct Components



## Guide Pins

1. Calculate **L** using one of the following formulas:  
 $L = T - (U + Z)$  for assembly with sleeve bushings  
 $L = T - (U + Z) - J + E$  for demountable bushings
2. For straight pins, select a length equal to **L**. If **L** is not a standard length, choose a longer pin and cut to **L**, or choose a shorter length and recess the pin in the punch holder to **L**, making sure that the minimum press fit length is at least equal to the pin diameter.
3. For demountable pins, select a length so that **K + F** is as close as possible to **L** without exceeding it.

## Bushings

1. If the tool's working stroke is short and there are no off-center loads, select the shortest bushing which will produce the desired operating condition. Turn to the selection chart on pages 26 and 27, find the stroke, and read down that column until it intersects the operating condition you have selected. The bushing you need is listed on that line.
2. When rigidity and resistance to side load are required, use the selection chart to choose the longest bushing consistent with the desired operating condition.

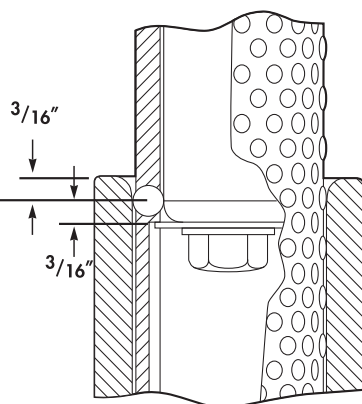
CAUTION: Make sure the top of the bushing does not strike the punch holder or the demountable pin clamp screw, either when the die is new or die life is depleted. If it does, select the next shorter bushing.

Guide Pin Length Selection

Nominal Guide Pin Diameter O	Z	U + Z	E
1"	15/32		1 3/16
1 1/4"	15/32		1 3/16
1 1/2"	1/2		1 7/16
1 3/4"	1/2	3/4	1 11/16
2"	1/2		1 15/16
2 1/2"	9/16		1 15/16
3"	9/16		1 15/16

Above this line, balls are released from rolling engagement allowing cage to reposition.

Below this line, balls are in rolling engagement.



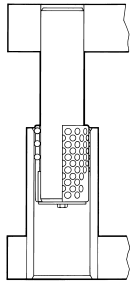
## Cages

1. The page 26-27 selection chart automatically gives you the correct cage. It is listed on the same line as the bushing you have selected.
2. Different combinations of cages and bushings are possible, but then the selection chart does not apply. You will need to make a layout of the cage travel from the start of preload to bottom stroke. This figure gives you the position of the guide pin, bushing, and cage at the start of preload. From that point on, the cage travels half the distance of the guide pin.

# Bushing and Ball Cage Operating Condition Selection Chart

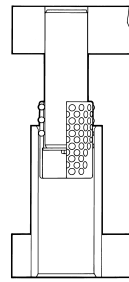
**Type I**

*Continuous Preload*



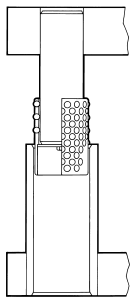
**Type IIa**

*Preload Partially Relieved*



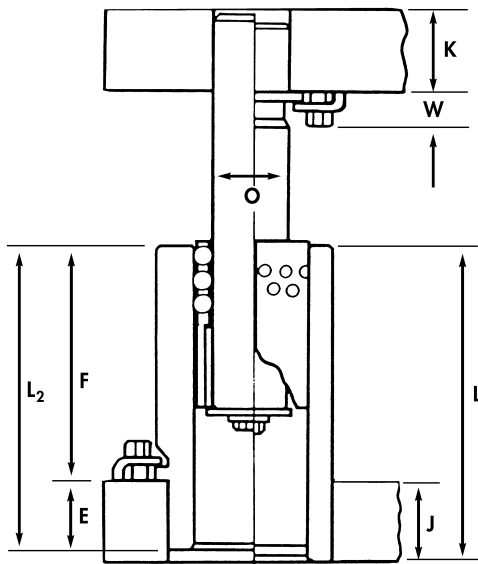
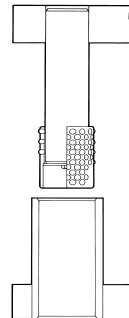
**Type IIb**

*Preload Relieved*



**Type III**

*Disengaged*



Nominal Pin Diameter O	Straight Sleeve L	Demountable Shoulder L <sub>2</sub>	
1"	2 1/2	2 7/16	
	3	2 15/16	
	3 1/2	3 7/16	
	4		
	4 1/2		
1 1/4"	3	2 15/16	
	3 1/2	3 7/16	
	4	3 15/16	
	4 1/2		
	5		
	6		
1 1/2"	3	2 15/16	
	3 3/4	3 11/16	
	4 1/2	4 7/16	
	5	4 15/16	
	6		
	7		
	8		
	9		
1 3/4"	3 1/2	3 7/16	
	4 1/4	4 3/16	
	5	4 15/16	
	6		
	7		
	8		
	9		
	2"	4	3 15/16
		4 3/4	4 11/16
5 1/2		5 7/16	
6 1/4		6 3/16	
7			
8			
9			
10			
2 1/2"		6	5 15/16
		6 3/4	6 11/16
	7 1/2	7 7/16	
	8 1/2		
	9 1/2		
	10 1/2		
3"	-	5 15/16	
	-	6 11/16	
	-	7 7/16	

**Caution:** Be sure bushing does not strike punch holder or demountable pin clamping screw at minimum shut height. If this condition exists, use a shorter bushing and corresponding ball cage.

