Bore Sizes and Shaft Tolerances

English (inches)

Bore and shaft tolerances listed below will give the recommended fit for each size clutch. If a press fit is necessary, never exceed .001" (.025mm) interference fit. For all bore and shaft sizes not listed below use same tolerances and fits as next larger size.

Shaft and key length must be equal to the length of the inner race of the clutch for proper engagment. If the shaft to clutch bore engagement is less than 100% contact Formsprage Engineering.

Sleeve Bearing Clutches

Series	Nominal Bore	Bore Diameter	Shaft Diameter
FS	.250	.250/.252	.250/.249
	.375	.375/.377	.3745/.374
	.500	.500/.502	.4995/.499
	.625	.625/.626	.6245/.6240
FSR	.375	.375/.376	.3745/.374
	.500	.500/.501	.4995/.499
	.625	.625/.626	.6245/.624
	.687	.687/.688	.6865/.6860
	.750	.750/.751	.7495/.749
	.875	.875/.876	.8745/.874
	1.000	1.000/1.001	.9995/.999
	1.125	1.125/1.126	1.1245/1.1235
	1.250	1.250/1.251	1.2495/1.2485
	1.375	1.375/1.376	1.3745/1.3735
	1.500	1.500/1.501	1.4995/1.4985
	1.625	1.625/1.626	1.6245/1.6235
	1.750	1.750/1.751	1.7495/1.7485
	1.875	1.875/1.876	1.8745/1.8735
	2.000	2.000/2.001	1.9995/1.9985
	2.187	2.187/2.188	2.1865/2.1855

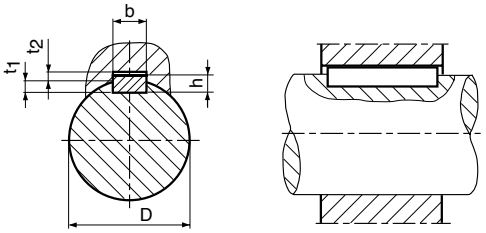
* For LLH series, see page 80.

Metric Key Assemblies

For all overrunning clutch inner races connected to shaft by a key, our standard bore tolerance is H7, with keyway to JS10.

We recommend a shaft tolerance of h6 or j6. For maximum indexing accuracy, adjusted keys should be machined to give no clearance.

(Metric keyseat dimensions listed on page 127.)



Ball Bearing Clutches (except LLH Series)

	Nominal Bore	Bore Diameter	Shaft Diameter
	.500	.499/.500	.499/.498
	.625	.624/.625	.624/.623
	.750	.749/.750	.749/.748
	.875	.874/.875	.874/.873
	1.000	0.999/1.000	.999/.998
	1.125	1.124/1.125	1.124/1.123
	1.250	1.249/1.250	1.249/1.248
	1.312	1.312/1.313	1.311/1.310
	1.375	1.374/1.375	1.374/1.373
	1.500	1.499/1.500	1.499/1.498
	1.625	1.624/1.625	1.624/1.623
	1.750	1.749/1.750	1.749/1.748
	1.937	1.9365/1.9375	1.9365/1.9355
5	2.000	1.999/2.000	1.999/1.998
	2.125	2.124/2.125	2.124/2.123
	2.250	2.2485/2.2500	2.2485/2.2475
	2.375	2.375/2.376	2.375/2.374
1	2.437	2.4360/2.4375	2.4360/2.4350
1	2.437	2.4365/2.4375	2.4365/2.4355
	2.500	2.4985/2.5000	2.4985/2.4975
	2.625	2.624/2.625	2.624/2.623
	2.750	2.7485/2.7500	2.7485/2.7475
	2.937	2.9360/2.9375	2.9360/2.9350
	3.000	2.9985/3.0000	2.9985/2.9975
	3.250	3.2485/3.2500	3.2485/3.2475
	3.437	3.4360/3.4375	3.4360/3.4350
	3.500	3.4985/3.5000	3.4985/3.4975
	3.750	3.7485/3.7500	3.7485/3.7475
	3.937	3.9360/3.9375	3.9360/3.9350
6	3.937	3.9355/3.9370	3.9355/3.9345
	4.000	3.9985/4.0000	3.9985/3.9975
2, 6	4.000	3.998/4.000	3.998/3.997
	4.250	4.248/4.250	4.248/4.247
2	4.250	4.2485/4.2500	4.2485/4.2470
	4.437	4.4355/4.4375	4.4355/4.4345
2	4.437	4.4360/4.4375	4.4360/4.4350
	4.500	4.498/4.500	4.498/4.497
	4.750	4.748/4.750	4.748/4.747
2	4.937	4.9355/4.9375	4.9355/4.9345
2	4.937	4.9360/4.9375	4.9360/4.9345
	5.000	4.998/5.000	4.998/4.997
4	5.000	5.002/5.004	5.001/5.000
	5.250	5.248/5.250	5.248/5.247
	5.437	5.4355/5.4375	5.4355/5.4345
3	5.437	5.435/5.437	5.435/5.434
	5.500	5.498/5.500	5.498/5.497
	5.750	5.748/5.750	5.748/5.747
3	5.937	5.9355/5.9375	5.9355/5.9345
3	5.937	5.9360/5.9375	5.9360/5.9350
	6.000	5.998/6.000	5.998/5.997
	6.250	6.248/6.250	6.248/6.247
	6.437	6.4355/6.4375	6.4355/6.4345
3	6.437	6.436/6.438	6.436/6.435
	6.500	6.498/6.500	6.498/6.497
	6.750	6.748/6.750	6.748/6.747
	6.937	6.9355/6.9375	6.9355/6.9345

Note: On Models 750 thru 5000, Formsprag may elect to supply a stepped key in the event of keyseat distortion during heat treat of inner race.

Nominal Bore	Bore Diameter	Shaft Diameter
7.000	7.000/6.998	6.997/6.998
7.500	7.504/7.506	7.503/7.502
7.750	7.754/7.756	7.753/7.752
8.000	8.004/8.006	8.003/8.002
8.250	8.254/8.256	8.253/8.252
8.500	8.504/8.506	8.503/8.502
8.750	8.754/8.756	8.753/8.752
9.000	9.004/9.006	9.003/9.002
9.250	9.254/9.256	9.253/9.252
9.500	9.504/9.506	9.503/9.502
9.750	9.754/9.756	9.753/9.752
10.000	10.004/10.006	10.003/10.002
10.500	10.504/10.506	10.503/10.502
11.000	11.004/11.006	11.003/11.002
11.500	11.504/11.506	11.503/11.502
12.000	12.004/12.006	12.003/12.001
12.250	12.254/12.256	12.253/12.251
12.500	12.504/12.506	12.503/12.501
13.000	13.004/13.006	13.003/13.001
13.250	13.254/13.256	13.253/13.251
13.500	13.504/13.506	13.503/13.501
13.750	13.754/13.756	13.753/13.751
14.000	14.004/14.006	14.003/14.001
14.250	14.254/14.256	14.253/14.251
14.500	14.504/14.506	14.503/14.501
14.750	14.754/14.756	14.753/14.751
15.000	15.004/15.006	15.003/15.001
15.250	15.254/15.256	15.253/15.251
15.500	15.504/15.506	15.503/15.501
15.750	15.754/15.756	15.753/15.751
16.000	16.004/16.007	16.003/16.001
16.250	16.254/16.257	16.253/16.251
16.500	16.504/16.507	16.503/16.501
16.750	16.754/16.757	16.753/16.751
17.000	17.004/17.007	17.003/17.001
17.250	17.254/17.257	17.253/17.251
17.500	17.504/17.507	17.503/17.501
17.750	17.754/17.757	17.753/17.751
18.000	18.004/18.007	18.003/18.001
18.250	18.254/18.257	18.253/18.251
18.500	18.504/18.507	18.503/18.501
18.750	18.754/18.757	18.753/18.751
19.000	19.004/19.007	19.003/19.001
20.000	20.004/20.007	20.003/20.001

1 Model 750 only

2 Model 900 only

3 Model 1027 only

4 Model 1051 only

5 FSO 600/2.00 tolerance 2.000/2.001

6 Model 800 only

Metric Keyseat Dimensions

Bore size (mm)	DIN 6885.1 (mm)				DIN 6885.3 (mm)			
	b (width)	h (key height)	t1 (keyseat-shaft)	t2 (keyseat-housing)	b (width)	h (key height)	t1 (keyseat-shaft)	t2 (keyseat-housing)
6 – 8.0	2 ± 0,020	2	1,2 + 0,1	1 + 0,3				
8.1 – 10.0	3 ± 0,020	3	1,8 + 0,1	1,4 + 0,3				
10.1 – 12.0	4 ± 0,024	4	2,5 + 0,1	1,8 + 0,3				
12.1 – 17.0	5 ± 0,024	5	3 + 0,1	2,3 + 0,3	5 ± 0,024	3	1,9 + 0,1	1,2 + 0,3
17.1 – 22.0	6 ± 0,024	6	3,5 + 0,1	2,8 + 0,3	6 ± 0,024	4	2,5 + 0,1	1,6 + 0,3
22.1 – 30.0	8 ± 0,029	7	4 + 0,2	3,3 + 0,4	8 ± 0,029	5	3,1 + 0,1	2 + 0,3
30.1 – 38.0	10 ± 0,029	8	5 + 0,2	3,3 + 0,4	10 ± 0,029	6	3,7 + 0,2	2,4 + 0,3
38.1 – 44.0	12 ± 0,035	8	5 + 0,2	3,3 + 0,4	12 ± 0,035	6	3,9 + 0,2	2,2 + 0,3
44.1 – 50.0	14 ± 0,035	9	5,5 + 0,2	3,8 + 0,4	14 ± 0,035	6	4 + 0,2	2,1 + 0,3
50.1 – 58.0	16 ± 0,035	10	6 + 0,2	4,3 + 0,4	16 ± 0,035	7	4,7 + 0,2	2,4 + 0,3
58.1 – 65.0	18 ± 0,035	11	7 + 0,2	4,4 + 0,4	18 ± 0,035	7	4,8 + 0,2	2,3 + 0,3
65.1 – 75.0	20 ± 0,042	12	7,5 + 0,2	4,9 + 0,4	20 ± 0,042	8	5,4 + 0,2	2,7 + 0,3
75.1 – 85.0	22 ± 0,042	14	9 + 0,2	5,4 + 0,4	22 ± 0,042	9	6 + 0,2	3,1 + 0,4
85.1 – 95.0	25 ± 0,042	14	9 + 0,2	5,4 + 0,4	25 ± 0,042	9	6,2 + 0,2	2,9 + 0,4
95.1 – 110.0	28 ± 0,042	16	10 + 0,2	6,4 + 0,4	28 ± 0,042	10	6,9 + 0,2	3,2 + 0,4
110.1 – 130.0	32 ± 0,050	18	11 + 0,3	7,4 + 0,4	32 ± 0,050	11	7,6 + 0,2	3,5 + 0,4
130.1 – 150.0	36 ± 0,050	20	12 + 0,3	8,4 + 0,4	36 ± 0,050	12	8,3 + 0,2	3,8 + 0,4

Note:. For key assemblies on outer race (models GFRN, ALP, RIZN) the outer member bore should be to H7 tolerance.

ISO tolerance limits for shafts

Tolerance zone	Deviation	Nominal Shaft Dimension in mm						Tolerance Dimension in mm											
		1 incl. 3	over 3 incl. 6	over 6 incl. 10	over 10 incl. 18	over 18 incl. 30	over 30 incl. 40	40 incl. 50	over 50 incl. 65	65 incl. 80	over 80 incl. 100	100 incl. 120	120 incl. 140	140 incl. 160	160 incl. 180	180 incl. 200	200 incl. 225	225 incl. 250
h5	upper lower	0 -.004	0 -.005	0 -.006	0 -.008	0 -.009	0 -.011		0 -.013		0 -.015		0 -.018			0 -.020		
h6	upper lower	0 -.006	0 -.008	0 -.009	0 -.011	0 -.012	0 -.016		0 -.019		0 -.022		0 -.025			0 -.029		
h7	upper lower	0 -.007	0 -.012	0 -.015	0 -.018	0 -.021	0 -.025		0 -.030		0 -.035		0 -.040			0 -.045		
j6	upper lower	+.004 -.002	+.006 -.002	+.007 -.002	+.008 -.003	+.009 -.004	+.011 -.005		+.012 -.007		+.013 -.009		+.014 -.011			+.016 -.013		
k6	upper lower	-.006 0	+.009 +.001	+.010 +.001	+.012 +.001	+.015 +.002	+.018 +.002		+.021 +.002		+.025 +.003		+.028 +.003			+.033 +.004		
n6	upper lower	+.010 +.004	+.016 +.008	+.019 +.010	+.023 +.012	+.028 +.015	+.033 +.017		+.039 +.020		+.045 +.023		+.052 +.027			+.060 +.031		
p5	upper lower	+.010 +.006	+.017 +.012	+.021 +.015	+.026 +.018	+.031 +.022	+.037 +.026		+.045 +.032		+.052 +.037		+.061 +.043			+.070 +.050		
p6	upper lower	+.012 +.008	+.020 +.012	+.024 +.015	+.029 +.018	+.035 +.022	+.042 +.026		+.051 +.032		+.059 +.037		+.068 +.043			+.079 +.050		
p7	upper lower	+.018 +.008	+.024 +.012	+.030 +.015	+.036 +.018	+.043 +.022	+.051 +.026		+.062 +.032		+.072 +.037		+.083 +.043			+.096 +.050		
r6	upper lower	+.016 +.010	+.023 +.015	+.028 +.019	+.034 +.023	+.041 +.028	+.050 +.034		+.060 +.041	+.062 +.043	+.073 +.051	+.076 +.054	+.088 +.063	+.090 +.065	+.093 +.068	+.106 +.077	+.109 +.080	+.113 +.084

ISO tolerance limits for holes/ bores

Tolerance zone	Deviation	Nominal Hole/Bore Dimension in mm						Tolerance Dimension in mm													
		over 3 incl. 6	over 6 incl. 10	over 10 incl. 18	over 18 incl. 30	over 30 incl. 40	40 incl. 50	over 50 incl. 65	65 incl 80	over 80 .incl 100	100 .incl. 120	over 120 incl. 140	140 incl. 160	160 incl. 180	over 180 incl. 200	200 incl. 225	225 incl. 250	over 250 incl. 280	280 incl. 315
H6	upper lower	+.008 0	+.009 0	+.011 0	+.013 0	+.016 0		+.019 0		+.022 0		+.025 0			+.029 0			+.032 0	
H7	upper lower	+.012 .00	+.015 0	+.018 0	+.021 0	+.025 0		+.030 0		+.035 0		+.040 0			+.046 0			+.052 0	
H11	upper lower	+.075 .00	+.090 0	+.110 0	+.130 0	+.160 0		+.190 0		+.220 0		+.250 0			+.290 0			+.320 0	
K6	upper lower	+.002 -.006	+.002 -.007	+.002 -.009	+.002 -.011	+.003 -.013		+.004 -.015		+.004 -.018		+.004 -.021			+.005 -.024			+.005 -.027	
N6	upper lower	-.005 -.013	-.007 -.016	-.009 -.020	-.011 -.024	-.012 -.028		-.014 -.033		-.016 -.038		-.020 -.045			-.022 -.051			-.025 -.057	
P6	upper lower	-.009 -.017	-.012 -.021	-.015 -.026	-.016 -.031	-.021 -.037		-.026 -.045		-.030 -.052		-.036 -.061			-.041 -.070			-.047 -.079	
R6	upper lower	-.012 -.020	-.015 -.025	-.020 -.031	-.024 -.037	-.029 -.045		-.035 -.054	-.037 -.056	-.044 -.066	-.047 -.069	-.056 -.081	-.058 -.083	-.061 -.086	-.068 -.097	-.071 -.100	-.075 -.104	-.085 -.117	-.089 -.121
R7	upper lower	-.011 -.023	-.013 -.026	-.016 -.034	-.020 -.041	-.025 -.050		-.030 -.060	-.032 -.062	-.038 -.073	-.041 -.076	-.048 -.088	-.050 -.090	-.053 -.093	-.060 -.106	-.063 -.109	-.067 -.113	-.074 -.126	-.078 -.130

Mounting Requirements

Press fit assemblies

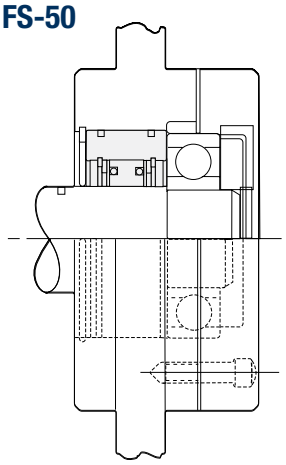
Shaft and bore tolerances are specified on the pages for each type where press fitting is appropriate.

As with standard bearings, suitable tooling must be used for press fitting such that no axial load is transmitted through the inner part of the clutch during assembly.

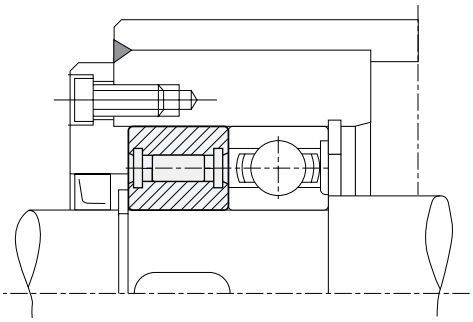
Mounting Examples

Non-supported models

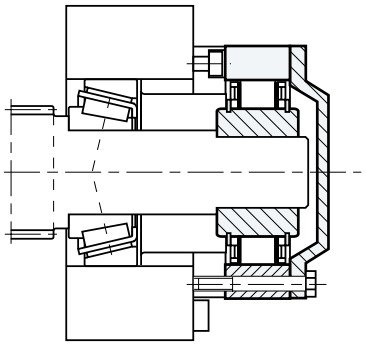
FS-50



AS

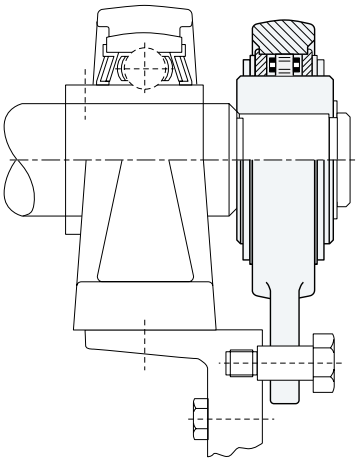


RSCI

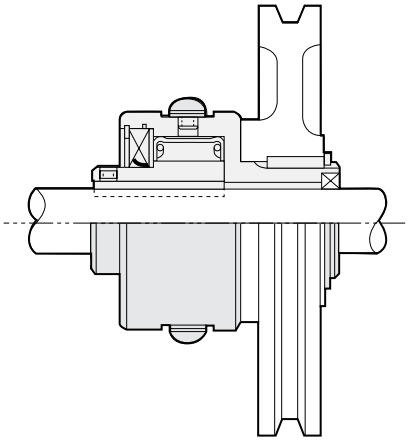


Bearing supported models

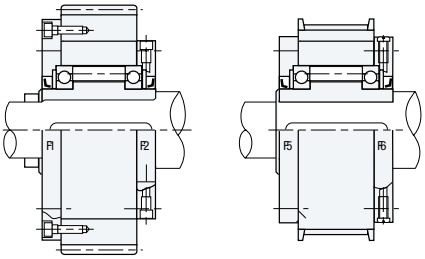
RSBW



FSR

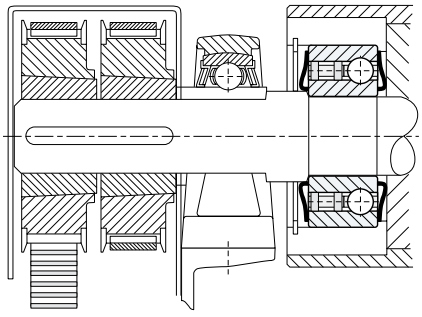


GFR

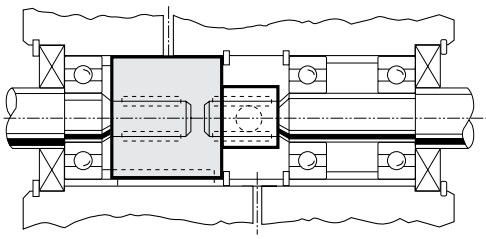


Combined bearing/clutch models

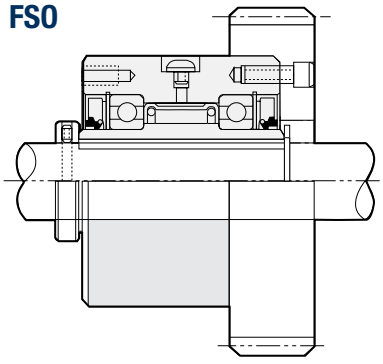
CSK



RL



FSO



Trouble Shooting

The list below of trouble shooting issues does not cover every scenario which might be experienced. It is only a quick guide. If the list does not cover your issue, always contact Formsprag Application Engineering for help.

Issue	Possible Correction
Model FSO	
Clutch has short operating life when used in backstopping applications.	Check torque arm to make sure it is not rigidly mounted, (Ref. Page 78).
Clutch slips and not holding the load.	Check lubricant type. Use only approved lubricants, many lubricants contain (EP) Extreme Pressure or anti-wear additives that reduce the coefficient of friction that the clutch design depends on for the transmission of torque (Ref. Page 132).
Clutch slips in cold weather.	Check lubricant operating range as the ambient temperature may be below the lower limit, (Ref. Page 132) contact Formsprag Engineering for low temperature approved lubricants.
Clutch slips after re-lubricating.	Check lubricant as not all lubricants are compatible, use only approved lubricants and flush completely when changing brands of lubricants (Ref. I & M Bulletins).
Clutch does not fit on the shaft with a slip fit.	Check shaft and bore size definitions (Ref. page 126) as shaft to bore fit must not be an interference fit.
Clutch is hard to install on Shaft.	Check key height to make sure it is not too tall. There must be clearance over the top of key. Normal design clearance is approximately 0.005 in. .
Clutch is running too hot	Oil clutches overrunning at maximum catalog speeds can reach 210° F at the outer race for the first 24 hours of operation before the lip seal wears in. The lip seal is the largest heat contributor to the clutch drag and internal heat generation. Maximum normal operating temperature at the outer race is 200°F.
Clutch leaks oil.	Determine location of oil leakage. If from around the lip seal area then the seal may need to be replaced. Check lip seal surface.
Model FSO C/T	
Clutch slips at high speeds.	Compare catalog maximum drive speed to application maximum drive speed. Designs with C/T Sprags can not drive beyond the Sprag lift-off speed.
Model FSR	
Clutch is leaking oil.	Oil can seep at the internal side of the inner race to the shaft area, check to see if a suitable sealant, such as RTV was applied around the bore and key seat at the end face of the inner race side, refer to service bulletin installation procedure.
Clutch is moving on shaft.	Set screws in the inner race are not tightened.
Model HPI	
Clutch is slipping.	Shaft and key tolerance should be a tight fit, at least line to line fits for indexing application. Alternately check for wrong type of lubricant containing EP additives, if any have been used contact Formsprag for rebuilding.
Model LLH	
Holdback operating life is short.	Check torque arm for loose mounting, or the wrong lubrication is being used with EP additives. Alternately check if clutch is not axially restrained, resulted in torque arm binding and reduced clutch bearing life, or oil sight gage not mounted correctly to show oil level.
Holdback is leaking oil.	Grease labyrinth seals require re-greasing quarterly or monthly under severe dusty conditions, if not job site contaminates can reach the internal oil lip seal area and compromise the lip seal or seal diameter, contact Formsprag for rebuilding.
Model RL	
Backstop does not operate smoothly. Experiences chatter.	Determine if there are over hauling torque load present, as RL clutches will not handle over hauling loads without special accommodation. If there are overhauling loads use the Model FL.

Bearing Loads

Formsprag ball bearing clutches are able to carry both radial and thrust loads. Often it is necessary to check the radial loading of the bearings for an application where the clutch is subjected to radial loads imposed by drive chains, gears, sprockets or V- belts. The radial loads imposed by high tension, multi-V belts are particularly high.

The load that can be applied to a ball bearing clutch is dependent upon the bearings used in the clutch and the recommended bearing load rating as specified by the bearing manufacturer. Table 1 gives the Maximum Permissible Load (lbs.) for radial and thrust conditions for Formsprag ball bearing clutches sizes 300 through 1027. These loads are based upon a calculated L-10 bearing life of 10,000 hours (50,000 hrs. avg. bearing life). Higher loads are possible at lower speeds.

Condition #1 (A) is the Maximum Permissible Load (lbs.) for radial loads centered between the bearings.

Condition #2 (B) is the Maximum Permissible Load (lbs.) radially applied above the end face of the clutch.

Condition #3 (C) is the Maximum Permissible Load (lbs.) radially applied which can be offset or overhung from the end of the clutch.

Example: Determine the Maximum permissible load (C) that can be radially applied to a stub shaft adapter 10 inches from the end of a FSO-700 clutch.

Using the formula:

$$\text{Load (C)} = \frac{(A)\ \ (L)}{2\ \ (d + D + L)}$$

$$\text{Load (C)} = \frac{2520\ \text{x}\ 3.060}{2\ \ (10 + .925 + 3.060)}$$

Load (C) = 276 lbs.

L-10 bearing lives for loads and speeds other than those listed in Table 1 for each clutch may be calculated by using the following formula:

$$(L\text{-}10)_0 = \left(\frac{A}{X_0}\right)^3 \text{x} \left(\frac{N}{N_0}\right) \text{x}\ 10{,}000$$

where: (L-10) is the new L-10 life in hrs.

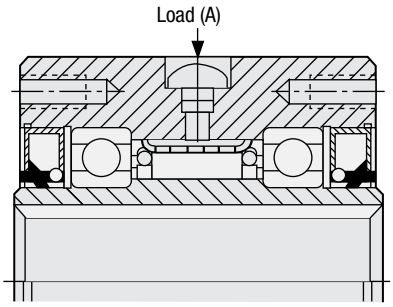
X_0 is new load in lbs.

A is load from Table 1 in lbs. (note: B and C can be used in place of A for Conditions #2 and #3 as required)

N is overrunning (O/R) speed from Table 1.

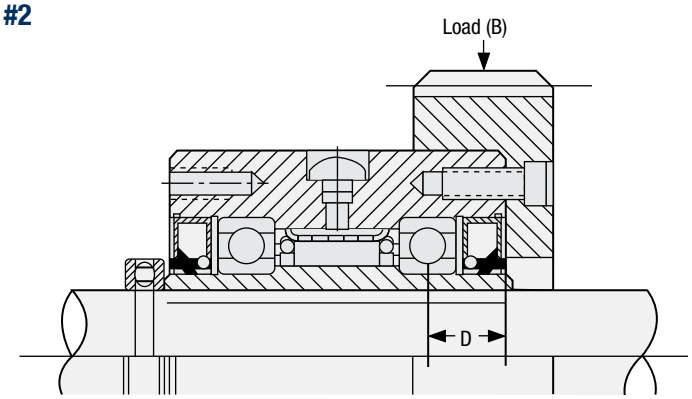
N_0 is new O/R speed.

Condition #1



Condition #1 has force or Load (A) in center of clutch between the two ball bearings. (See Table 1.)

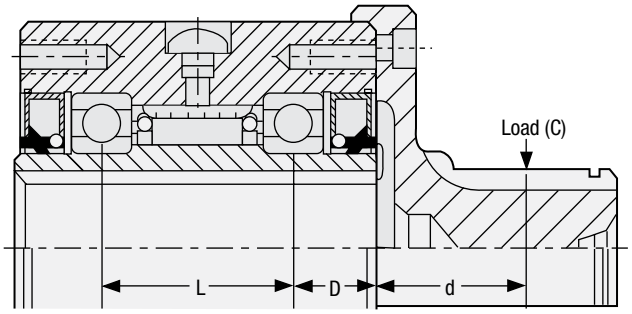
Condition #2



Condition #2 has force or Load (B) exerted on clutch bearings at end of clutch. Distance “D” is the distance from the centerline of the ball bearing nearest the load to end of clutch.

(See Table 1)

Condition #3



Condition #3 has force or load applied “d” distance from face of the clutch. (To be determined by individual application.) To calculate the Maximum Permissible Load (C) a distance “d” from the clutch face, use the following equation:

$$\text{Load (C)} = \frac{(A)(L)}{2\ \ (d + D + L)}$$

(Refer to Table 1 for values of A, D and L)

Table 1

Clutch No.	Maximum Permissible Load Cond. #1 (A) lb.	Maximum Permissible Load Cond. #2 (B) lb.	D in.	L in.	Thrust Cap. @ Max. O/R Speed lb.*	Max O/R Speed RPM
FSO-300	413	150	.516	1.381	413	3,600
FSO-400	480	160	.675	1.376	467	3,600
FSO-500	816	297	.745	1.990	820	3,000
FSO-600	879	304	.836	1.950	1,039	2,400
FSO-700	2,559	982	.925	3.060	2,810	2,000
FSO-750	1,656	612	1.247	3.550	2,158	1,800
FSO-800	2,412	891	1.251	3.542	3,237	1,500
FSO-900	3,183	1,191	1.257	3.740	4,046	1,350
FSO-1027	1,013	353	1.446	3.355	2,750	1,100
HPO-720	2,196	837	.925	2.96	1,098	3,000
HPO-750	1,795	663	1.247	3.53	897	2,600
HPO-800	2,273	840	1.251	3.55	1,136	2,100
HPO-900	2,712	1,014	1.257	3.73	1,356	1,850
HPO-1027	639	230	1.446	3.72	319	1,500

* Always contact Formsprag Engineering for approval when applying axial loads to the clutch.

Table 2

Clutch No.	Bore (Ref.)	Radial Load Capacity (lb.)	Max O/R Speed Inner Race RPM
FS-02	.250	12	3,450
FS-04	.375	15	2,800
FS-04	.500	15	2,800
FS-05	.625	30	1,800
FSR-3	.375	40	1,950
FSR-3	.500	40	1,950
FSR-5	.500	45	1,950
FSR-5	.625	45	1,950
FSR-6	.750	70	1,950
FSR-8	.875	110	1,650
FSR-8	1.000	110	1,650
FSR-10	1.125	130	1,250
FSR-10	1.250	130	1,250
FSR-12	1.375	190	1,150
FSR-12	1.500	190	1,150
FSR-14	1.625	250	950
FSR-14	1.750	250	950
FSR-16	1.875	260	950
FSR-16	2.000	260	950

Example: Determine the maximum permissible load that can be radially applied between the bearings of a FSO-750 with an overrunning speed of 600 RPM that will result in a L-10 bearing life of 10,000 hours.

Since the load is applied between the bearings the value (A) for Condition #1 is used for this calculation. Also, because the bearing life is 10,000 hours, the new L-10 remains at 10,000 hrs.

Using the bearing life formula:

$$(L\text{-}10)_0 = \left(\frac{A}{X_0}\right)^3 \times \left(\frac{N}{N_0}\right) \times 10{,}000$$

Substituting values into the equation:

$$10{,}000 = \left(\frac{2{,}040}{X_0}\right)^3 \times \left(\frac{1{,}800}{600}\right) \times 10{,}000$$

$$X_0^3 = 2{,}040^3 \times \frac{1{,}800}{600} \times \frac{10{,}000}{10{,}000}$$

$$X_0 = \sqrt[3]{2{,}040^3 \times 3 \times 1}$$

$$X_0 = 2{,}942 \text{ lbs}$$

Answer: The new maximum permissible radial load that can be applied is 2,942 lbs.

The clutch thrust capacity at Max. O/R speed given in Table 1 is the **Maximum permissible load** applied in an axial direction to the end of the clutch. The clutch thrust capacity listed in Table 1 is without any radial load applied to the clutch.
For applications that have both thrust and radial loads consult Formsprag engineering.

Sleeve bearing clutches, models FS-02 through FSR-16, are equipped with oil-impregnated bronze bearings (Figure 1). The bearings are designed to provide proper support for radial loads imposed on the clutch hubs, however, they are not designed to accept axial loads.

Table 2 gives the radial load capacity for each sleeve bearing model. The bearing capacity shown is rated at the maximum overrunning (O/R) speed of the inner race for each clutch model.

Higher radial loads are possible at lower speeds. In such cases please consult Formsprag engineering.

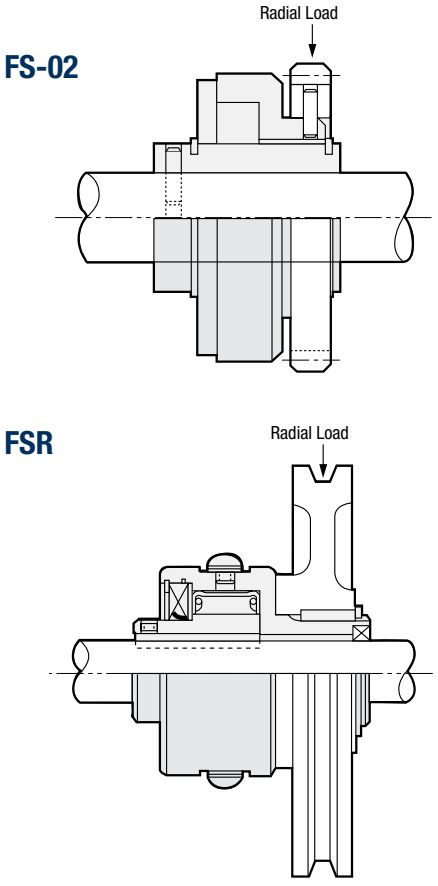


Figure 1

Lubrication

Proper lubrication and lubricant maintenance are the most important single maintenance factors for long, effective, trouble-free clutch operation.

Many models are shipped from the factory prelubricated and ready to install. Some models require lubrication to be added prior to being put into service, and other designs rely on lubrication integral to the application, see the model data pages for details.

Formsprag has evaluated and approved a wide selection of oil and grease lubricants necessary to meet a wide range of customer application needs. If no lubricant is specified on the order, the clutch will be supplied with the standard lubricant that is listed on the model data page. Not all lubricants are compatible, so before switching check with Formsprag Engineering. Grease lubrication is recommended for applications where: (1) conditions do not permit the type of maintenance required for oil lubricated clutches, (2) the clutch is exposed to severe dusty conditions, (3) the clutch is mounted on a vertical shaft.

The selection of the proper lubricant for each application should include the ambient temperature range; see the table below for a listing of approved lubricants. Contact Formsprag Engineering if you have any questions about lubrication.

Recommended Lubricants

Overrunning and Backstopping Applications			
Temperature Range			
+20°F to +150°F (–7°C to +65°C) Maximum permissible ambient temperature	–20°F to +20°F (–23°C to –7°C) Ambient temperature	–40°F to +150°F (–40°C to +65°C) Maximum permissible ambient temperature	+20°F to +150°F (-7°C to +65°C) If below +20°F (–7°C) Consult Formsprag
Oil Lubricants			**Grease Lubricants**
Chevron GST Oil 68 Mobil DTE Heavy Medium Automatic Transmission Fluid (ATF)** Texaco Regal Oil R&O 68 Shell Turbo Oil 68 Amoco Industrial Oil 68 Exxon Teresstic Oil 68 Sunoco Sunvis 931 Mobil SHC-626	Mobil Gargoyle Arctic C Heavy Texaco Regal Oil R&O 46 Automatic Transmission Fluid (ATF)** Amoco Oil Industrial 46 Sunoco Sunvis 921 Mobil SHC-624 Royal Purple Synfilm GT (equivalent to ISO #32)	Mobil Jet Oil 2 Shell Aeroshell Turbine Oil 555 (MIL-PRF-23699) Shell Aeroshell Turbine Oil 500 (MIL-PRF-23699) Exxon Turbo Oil 2380 Exxon Turbo Oil 2389 Military Oils MIL-PRF-7808 or MIL-PRF-23699 * Mobil HFA (MIL-PRF-5606)	Fiske Bros. Lubriplate Low-Temp Fiske Bros. Aero Lubriplate Shell Aeroshell No. 7 Shell Aeroshell No. 22 Beacon 325
Indexing Applications			
At 150 strokes per minutes or less	At 150 strokes per minutes or less	–10°F or below (–23°C)	Not Applicable Consult Formsprag
Oil Lubricants			
Mobil DTE Light Oil Automatic Transmission Fluid (ATF)** Texaco Regal Oil R&O 32 Shell Turbo Oil 32 Amoco Industrial Oil 32 Exxon Teresstic Oil 32	Sunoco Sunvis 916 Exxon Zerice 46 Automatic Transmission Fluid (ATF)**	Consult Formsprag	

* This lubricant is suitable for a low temperature and low speed application.
** Dexron III or Type F automatic transmission fluid (ATF) only

CAUTION: Do not use EP additives type lubricants (extreme pressure characteristics) or those containing slippery additives, such as molybdem disulfide graphite compounds.

Bolt assemblies

In clutch designs torque is often transmitted through bolts. Experience has shown that it is a practical and reliable way since clutches transmit torque in only one direction.

For the metric clutch designs the Bolt Strength Standards (8.8, 10.9 and 12.9) and torque tightening values (Nm) are listed in the adjacent table.

Metric Bolt Strength and Tightening Standards

Thread	8.8		10.9	
	Model	(Nm)	Model	(Nm)
M5	RSCI	(6)	GFR, AL, and RIZ	(8)
M6	RSCI	(10)	GFR, AL, and RIZ	(14)
M8	RSCI	(25)	GFR, AL, and RIZ	(34)
M10	RSCI	(48)	GFR, AL, and RIZ	(68)
M12	RSCI	(84)	GFR, AL, and RIZ	(118)
M16	RSCI	(206)	GFR, AL, and RIZ	(290)
M20	RSCI	(402)	GFR, AL, and RIZ	(550)
M24	RSCI	(696)	GFR, AL, and RIZ	(950)
M30	RSCI	(1420)	GFR, AL, and RIZ	(1900)