Regal Rexnord

Overrunning and Backstopping Clutches
For Mining Applications

FORMSPRAG CLUTCH™

A REGAL REXNORD BRAND

Formsprag Overrunning and Backstopping Clutches Are Hard at Work in Mines Around the World

For over 50 years, Formsprag Clutch has been a recognized leader in designing, manufacturing, and delivering dependable long-lived overrunning clutches for a wide spectrum of applications in the mining industry.

By offering the broadest range of both sprag and ramp & roller type overrunning clutches and backstops available globally, Formsprag Clutch, together with our sister company, Stieber in Germany, is the world's leading authority for solving mining application challenges requiring overrunning clutches.

BACKSTOPPING APPLICATIONS

LLH® (Long Life Holdbacks®)

LLH holdback clutches are mounted on the head shaft of the conveyor, typically on the side opposite the electric motor and gear reducer. The LLH clutch allows the headshaft to freely rotate in the driving direction while preventing any rotation in the opposite direction.

HSB (High Speed Backstops)

HSB units are intended for use as backstops on the high speed shaft or intermediate shaft of a reducer, and as holdbacks on the head shaft of conveyors. They use standard clutches with the addition of the oil reservoir. The oil reservoir is an aluminum casting with cooling fins. HSB models have a spacer replacing the seal at the reservoir end to permit free oil flow between clutch and reservoir. The reservoir has a flush oil sight gauge and a combination breather and oil filter.

FHB Backstopping Clutches

FHB is a high speed, centrifugal throw-out (C/T) Sprag type backstop with internal sealed ball bearings. It engages instantaneously and automatically to prevent any reverse shaft rotation. Operates at higher overrunning speeds and holds greater torque loads than competing backstops. A larger number of torque transmitting C/T Sprags reduce the hertzian contact stresses during backstopping leading to longer life than is possible with shoe designs.

CREEP/DUAL DRIVE APPLICATIONS

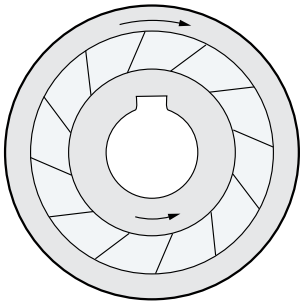
FSO Overrunning Clutches

In northern climates where there are outdoor conveyor belts that do not run continuously, they can experience the conveyor belt idlers freezing up. A solution is to operate the belt at a low and creep speed to prevent this. The FSO overrunning clutch is the safest and easiest type of clutch for this application.

Formsprag's Quality Management System is certified to ISO9001:2008 and AS9100 Rev.B.

Clutch Functions

Overrunning clutch



This class of applications is typified by standby and compound drives. For example, a steam turbine and a standby electric motor may be connected to a single driven shaft through overrunning clutches. The shaft can then be driven by either the turbine or the motor or both with no further modification of the installation. The turbine drive clutch automatically engages when the turbine starts to drive, but automatically overruns when the load is transferred to the electric motor.

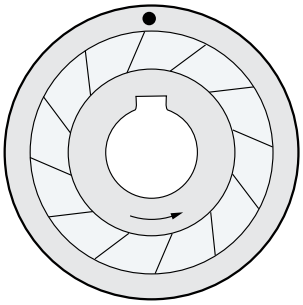
Considerations

- Type of motor
- Max starting torque
- Internal combustion engines, please consult Formsprag
- Nominal driving torque
- Range of driving speed
- Inertia (WR^2) of the driven masses
- Range of overrunning speed
- Number of starts during service life
- Shaft diameter

Applications

- Dual motor/engine drives
- Conveyor belts
- Creep and starter drives
- Disengagement of centrifugal masses

Backstopping clutch



In backstopping or holdback* applications, one race is always fixed to a stationary ground member. The function of the clutch is to permit rotation of the mechanism, connected to the other race, in one direction only, and to prevent any rotation in the reverse direction at all times. Although the clutch normally overruns most of the time, it is referred to as a holdback or backstop in conveyors, gear reducers and similar equipment because its function is to prevent reverse rotation.

**"Holdback" is a name given to a backstop clutch when mounted on an inclined conveyor head shaft.*

Considerations

- Motor breakdown torque
- Maximum dynamic reverse torque due to elasticity of the locked parts: elastic belts, shafts of more than 9 feet (3 meters) long
- Range of overrunning speed
- Number of torque applications during service life
- Shaft diameter

Applications

- Inclined conveyors
- Bucket elevators
- Pumps
- Gear drives
- Fans

Overrunning Clutch Designs

Ramp & Roller Overrunning Clutches

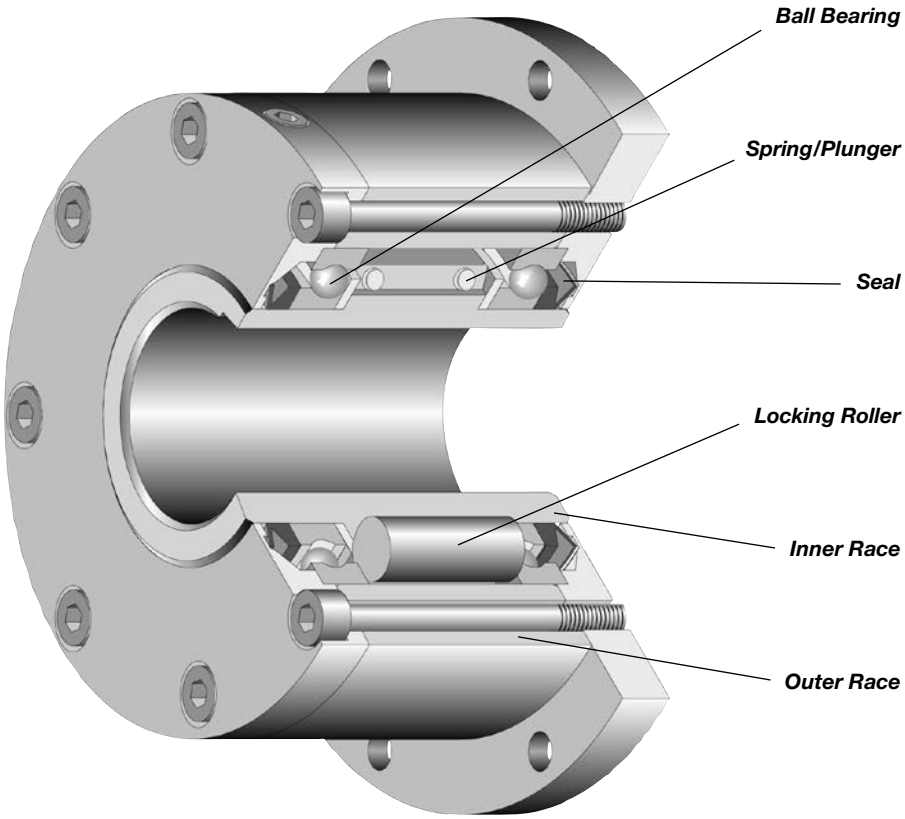
Two Design Styles

Stieber overrunning clutches are available in two basic designs:

- **Ramp & Roller**
- **Sprag**

Overrunning clutch speed is a major determining factor in selecting the design best suited for each application. Ramp & roller clutches are used for applications with low-to-medium overrunning speeds and for indexing. Sprag clutches are the choice for applications with high overrunning speeds and for backstopping.

With each basic design there are several variations to choose from to meet specific application requirements. These variations include clutches with or without internal bearings, as well as a range of mounting flanges, covers and couplings.

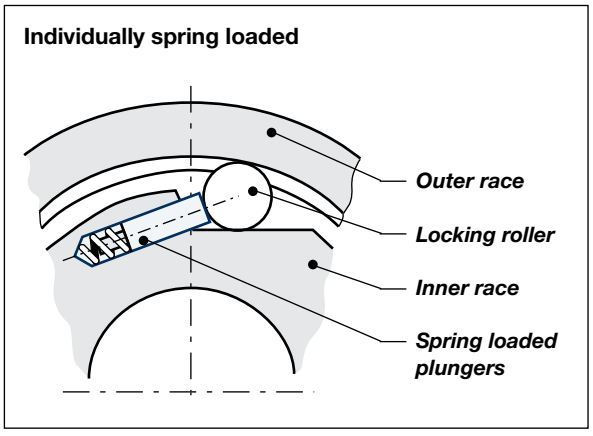


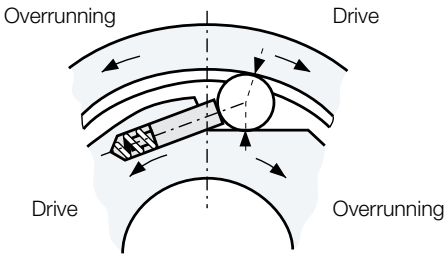
Ramp & Roller Design

These rugged, reliable clutches consist of a cylindrical outer race and an inner race incorporating the ramps on which the rollers ride. The rollers are individually spring loaded to provide constant force between the rollers and both races. This force ensures instantaneous lock-ups when switching from the overrunning mode to the driving mode.

This design is also quite versatile, as the clutch can be operated in all three modes: overrunning, indexing and backstopping. The outer race has greater overrunning speed capability than the inner race, making the unit ideal for use as an indexing clutch, with the outer race acting as the reciprocating member.

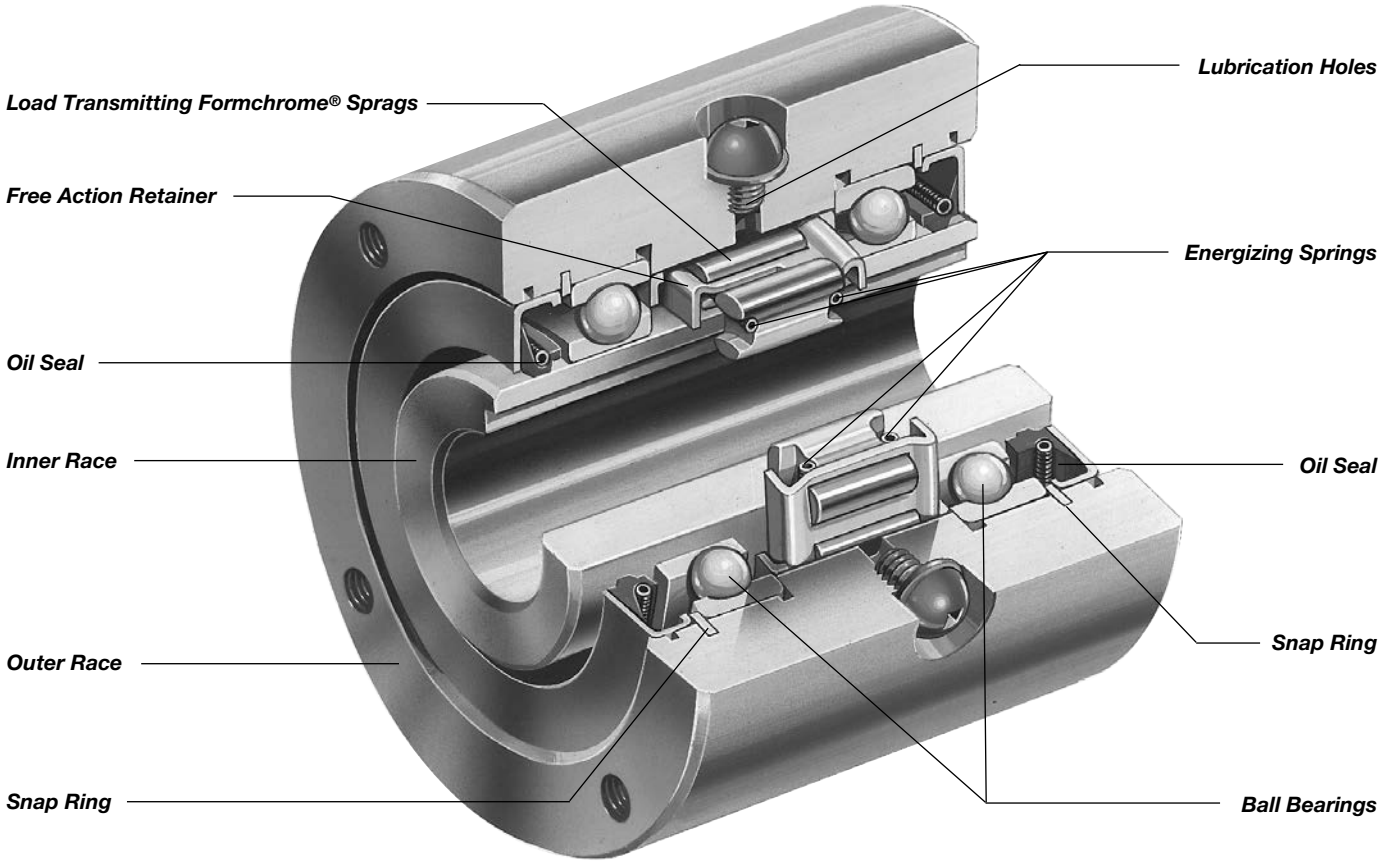
For increased accuracy in indexing applications, specify “V” type, with stronger energizing springs.





When the outer race is the driving member, this is the resultant race activity.

Sprag Overrunning Clutches



Sprag Design

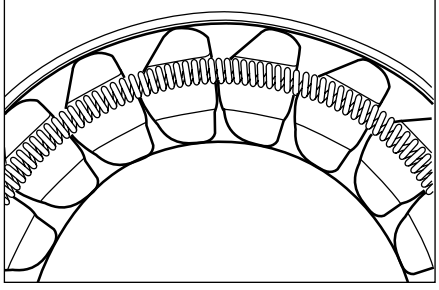
A sprag overrunning clutch consists of a cylindrical inner race and a cylindrical outer race surrounding it, with an annular space between the two races. A full complement of accurately formed sprags fills this annular space. Each sprag is essentially a strut placed between the races in such a way that it transmits power from one race to the other by a wedging action when either race is rotated in the driving direction. Rotation in the other direction disengages the sprags and the clutch is free, or overruns. Either race may be the driven member or driving member.

If one race of the overrunning clutch is securely fixed to a grounded member, so that it cannot rotate, and the other race is free to turn, the free race will turn freely in one direction of rotation, but will be locked to the ground in the opposite direction.

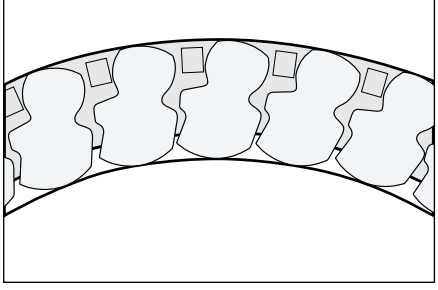
In an overrunning clutch, the specific sprag shapes have been developed to meet most conceivable types of clutch applications. Since different types of overrunning applications involve different loading characteristics, different sprag shapes are used to provide the greatest possible life, torque capacity, and functional characteristics for the three basic types of overrunning clutch applications: overrunning, indexing, and backstopping.

Various Sprag Designs

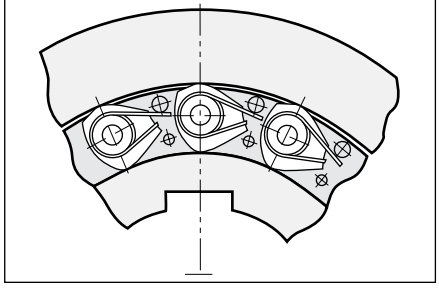
D shape sprag design



Free action PCE® design

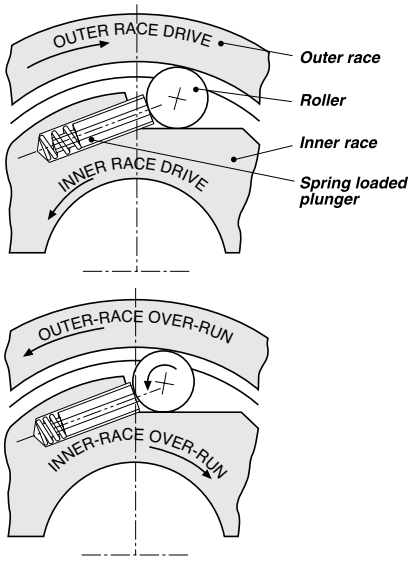


Inner race C/T design



Ramp & Roller Design

Ramp & roller clutches consist essentially of an outer race with a cylindrical inside diameter, an inner race with ramps, and a set of rollers which are individually spring loaded to provide constant contact between the rollers and both races. This arrangement assures instant action at all running speeds and guarantees immediate driving capability whenever one of the two races rotates with respect to the other in the drive direction.



Application

Clutches of this type can be used in all types of overrunning, backstopping and indexing applications.

When used as an overrunning clutch the ramp & roller clutch should be mounted in such a way that the outer race is the overrunning member. This is especially important with higher overrunning speeds. In applications where the inner race overruns, the centrifugal force on the rollers results in lower overrunning speed limits.

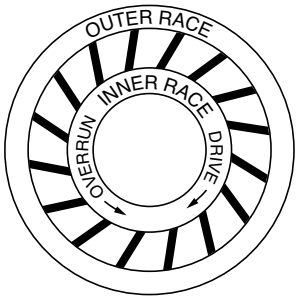
When used as a backstop a ramp & roller clutch with rotating inner race is especially suited at lower speeds. If the RPM is higher than the RPM recommended in the tables, we suggest using a sprag type clutch.

When used as an indexing clutch the outer race should always be the oscillating member and the inner race should be the driven member. Otherwise, the inertia of the rollers and springs will lead to inaccuracies, especially at high index frequencies. The use of thinner lubricating oil and stronger springs will provide higher indexing accuracy and can be supplied upon request.

Sprag Design

This sprag-type design overrunning clutch generally consists of an inner race, an outer race, a set of sprags, a sprag retainer, energizing springs, and bearings.

The wedging of the sprags between the races transmits power from one race to the other. The sprags have a greater diagonal dimension across one set of corners than across the other (see Figure 1). The wedging action occurs when the relative rotation of the inner and outer races tends to force the sprag to a more upright position where the cross-section is greater.



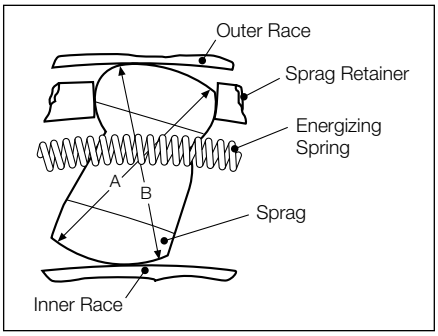


Figure 1
Detail of sprag. Dimension “A” is greater than dimension “B.”

Gripping Angle

Wedging action depends upon the wedging, or gripping angle of the sprags between the races. The fundamental concept of sprag clutches requires that the coefficient of friction of the sprag, with respect to the inner race at the instant torque is applied in the drive direction, must be greater than the tangent of the gripping angle, GA. If the condition is not satisfied, wedging will not occur.

The gripping angle is determined by the construction of Figure 2, where points A and B are the points of contact of the sprag with the inner and outer races, respectively.

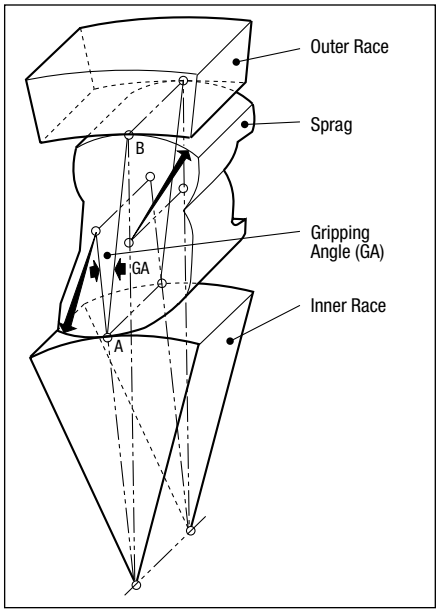


Figure 2
Geometry of sprag, showing gripping angle “GA.”

Sprags are designed to have a low initial gripping angle to insure positive initial engagement. As torque increases, the sprags produce radial forces which cause race deflections, which make the sprags roll to new positions. Sprags are usually designed to have an increasing gripping angle as they roll from overrunning position to maximum load-carrying position.

A higher gripping angle reduces the radial load imposed by the sprag, thus permitting higher torques to be transmitted within the limits of race stretch and brinelling.

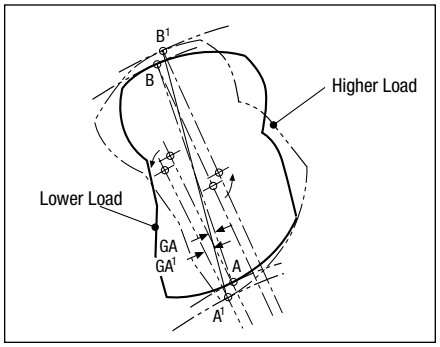
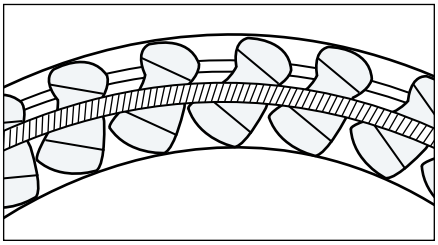


Figure 3
Gripping angle increases as load increases and annular space increases.

Formsprag and Stieber manufacture a wide variety of sprag sizes and shapes to meet the market requirements.

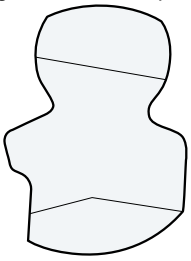
Free action



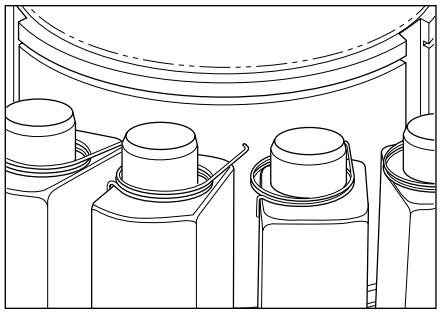
In the Formsprag “free action” retainer all sprags are permitted to have free and independent action. During overrunning this allows each sprag independently to adapt itself to any variations in annular space caused by runout or by foreign matter which may inadvertently get inside the clutch. Since each sprag operates independently, it cannot transfer the effects of variations from one sprag to the next. With all sprags in uniform engagement at all times, the load is evenly distributed. The free action principle also distributes wear evenly for a minimum of wear on all components.

PCE® sprag

PCE sprags are designed to overcome the effects of severe torsional and linear vibrations as well as high transient torque overloads. It is a Formsprag exclusive. This design, which provides built in protection from otherwise damaging overloads, is now standard in model sizes 300 through 700.



Sprag Energizing



The sprags are energized by springs that act upon each end of each sprag. Formsprag has developed several different types of energizing springs, such as contracting springs, expanding springs and a torsional type spring. In each overrunning clutch the type of energizing spring used will reflect Formsprag’s broad experience in the design and application of overrunning clutches in the choice of a method of energizing best suited for the particular design of clutch.

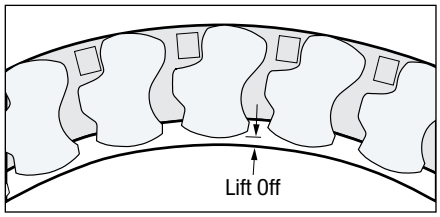
In all cases, whether the spring is an expanding spring, a contracting spring, or a torsional spring, the spring design energizes each sprag individually without transfer of motion or effect from one sprag to the next.

The C/T Sprag Principle

Centrifugal Throwout, or C/T, retainer assemblies are designed for high speed inner or outer race overrunning, and lower speed drive conditions. C/T sprags are available in a variety of models. Model FSO sizes 300 through 700 are available with PCE or C/T sprag option with outer race overrunning.

Outer Race C/T

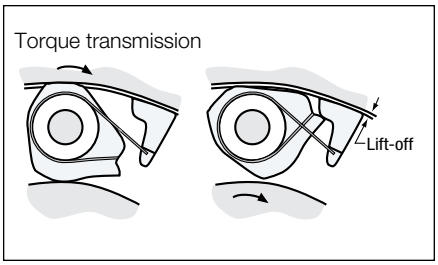
In the outer race centrifugally disengaging sprag design, the mass of the sprag is located so that when the outer race is overrunning, the centrifugal force of the sprags overcomes the force of the energizing spring causing the sprags to completely “lift off” of the inner race.



Inner Race C/T

Model RSBI & RIZ sizes 20 through 240 are available with the inner race C/T feature.

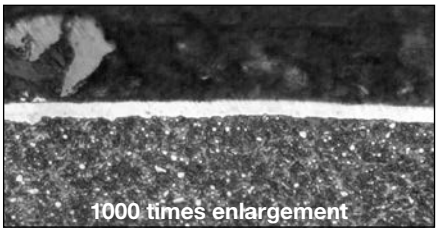
In the inner race centrifugally disengaging sprag design, the mass of the sprag is located so that when the inner race is overrunning the centrifugal force of the sprags overcomes the force of the energizing spring causing the sprags to completely “pull away” from the outer race.



The point at which the sprags lift off of the inner or outer race is listed as the “lift-off speed.” The maximum drive speed is always less than the lift-off speed to insure positive sprag energizing.

The primary advantage of the centrifugal throwout sprag retainer is that when the sprags lift off the inner or outer race there is no rubbing contact in the clutch. Therefore, the life of the clutch is determined by the life of the bearings.

Note: In centrifugal throwout designs, the sprags lift off the inner or outer race during overrunning. Therefore, for drive conditions, C/T designs require that the driving speed be lower than the lift-off speed.



Formchrome® extends sprag life

Ultra-hard Formchrome sprags provide extra-long life, maximum wear resistance and lower maintenance costs. Formchrome sprags — exclusive with Formsprag — are made by diffusing chromium into the surface of hardened high carbon alloy steel to form a chromium-carbide alloy.

Selection Procedure

When a clutch is to be selected on the basis of torque calculation, follow the eleven steps below:

1. Calculate **load torque** to be transmitted by the clutch.

$$\text{Torque (lb.ft.)} = \frac{5250 \times \text{HP}}{\text{RPM}}$$

or

$$\text{Torque (Nm)} = \text{lb.ft.} \times 1.356$$

2. Select the proper service factor from the appropriate table on page 9.
3. Determine the **design torque** by multiplying the load torque by the service factor.
4. Check the key and shaft stress before making a final clutch selection since this may determine the maximum allowable drive torque capacity.
5. Determine the overrunning and drive speed along with which race will overrun.
6. Select a clutch **MODEL** and **SIZE** from the catalog based on design torque, bore size, overrunning speed and dimensions for proper fit into the available space.
7. If the **outer race** is the overrunning member, then determine if the C/T option can be used for the clutch model selected.
   a. A Centrifugal Throwout (C/T) model clutch may be used if the drive speed is less than the maximum C/T drive speed and the overrunning speed is higher than the lift-off speed.
   b. A C/T model clutch may not be used when the drive speed is higher than the maximum C/T drive speed.
   c. For overrunning speeds other than listed, contact the factory.
8. When higher speeds are required select the LABYRINTH GREASE SEAL option listed in the Specification chart for each clutch model or contact Formsprag Application Engineering Department.
9. Determine the shaft size, bore and key size requirement of the clutch from the catalog. Refer to the **BORE SIZES/ SHAFT TOLERANCES** chart on pages 42 and 43 for the **ACTUAL BORE SIZE** that will be supplied with the clutch. If the actual bore size required is other than that listed, contact the factory.
10. Select the type of **LUBRICANT**, **oil** or **grease**, for the clutch model where appropriate. It should be noted that many of the clutch model are available in either oil or grease only. If the Labyrinth grease seal option is selected in step 8 above, the clutch must be **grease** lubricated.
11. Determine the **DIRECTION OF ROTATION** for the model selected where necessary. When viewing the clutch from the end as shown in the catalog, **if the inner race is to rotate freely in the CCW direction and drive in the CW direction it is a Right Hand (RH) rotation. Left Hand (LH) is opposite.** See clutch rotation on page 8.

The torque values listed in this catalog are based upon normal use with 1 million load cycles at full catalog torque and receiving proper care and maintenance. For Models FSO, HPI, FSA and SB the torque ratings are based upon using only one end face to transmit.

Caution: Consult factory for reciprocated type prime mover and any inclined or vertically mounted applications.

Special Designs

While the wide range of sizes and capacities covered by this catalog's line of clutches will cover substantially all industrial needs, it is sometimes necessary to design and build clutches to meet specialized requirements.

Special designs can also take advantage of a self-contained lubrication system or lubricant contained within the customer's machine. In such cases, lubrication could be introduced through the inner race or through clutches assembled without seals to permit a free flow of oil through the clutch. Since other factors may affect selection of clutches in both indexing and holdback cases, consult our Application Engineering Department for assistance.

How To Order

When placing an order always use the part number in addition to the model number if available.

The part number is marked on the clutch and listed in the price sheets. There is a unique part number for each design and bore combination and the format is as follows:

Format is CL XXXXX – XXX – XX

CL (clutch)

Base model no. (5 digits)

Clutch Bore (1, 2 or 3 digits)

Special Design of the same bore (1, 2 or 3 digits)

Example is CL42156-123-2

The model number is marked on the clutch and listed in the product catalog.

Example:

1. FSO 700 model clutch, optional C/T retainer, 2.2485/2.2500" bore, .625 x .32 keyseat, oil lubricated.
2. FSR - 16 model clutch, 1.000/1.001" bore, .50 x .25 keyseat, grease lubricated, right hand rotation.
3. HPI 900 model clutch, optional Labyrinth grease seals, 4.498/4.500" bore, 1.00 x .50 keyseat, grease lubricated.

Example:

1)	FSO – 700	C/T/	2.25	.625 x .32			
2)	FSR – 16		/ 1.00	.50 x .25	GR	RH	
3)	HPI – 900	L /	4.50	1.00 x .50	GR		

Model

Size

Options (Labyrinth Seal, C/T Sprag)

Nominal Bore

Keyseat Size*

Lubricant (Blank - Oil, GR - Grease)

Direction of Rotation

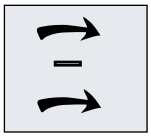
* If keyseat is not specified when ordering, the clutch will be supplied with the available standard keyseat.

Overrunning Clutches

Overrunning Speeds

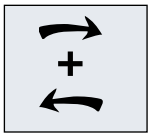
This is the maximum speed differential between the inner and outer races. When one race is stationary and the other overruns, clutch selection may be based on maximum overrunning speeds shown in the catalog.

Same direction of rotation



If both races rotate in the same direction at different speeds, the overrunning speed is the *difference* in their speeds.

Opposite direction of rotation

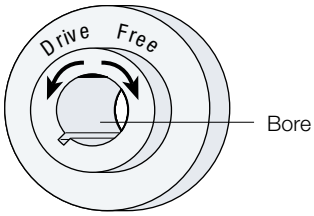


If the races rotate in opposite directions, the overrunning speed is the *sum* of their speeds.

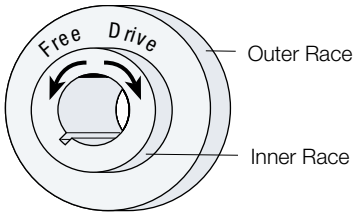
Drag Torque

In an overrunning clutch the drag or resistance to freely turn is a result of the additive values of seal drag, bearing drag and sprag energizing drag. This clutch drag torque is noted as “resistance after run-in” and is listed for each model on its data page. The drag (resistance after run-in) torque values for new clutches will be higher at first and after 12 to 24 hours of overrunning at standard motor speeds will reduce to catalog-listed values. When a clutch is overrunning, the drag torque is exerted upon the lower speed race and any attached drive components.

Clutch rotation



Left Hand Rotation Shown



Right Hand Rotation Shown

If the overrunning clutch design is not symmetrical, then the clutch rotation will need to be determined, and this information (RH or LH) must be provided at time of order placement.

To establish rotation of a clutch, look at the clutch from the end specified by the arrow for each clutch series. If the inner race drives the outer race in the clockwise direction it is a right hand rotation.

Service Factors

Formsprag and Stieber Overrunning Clutches

Clutches are suitable for many different power transmission applications. Please refer to this table for the proper service factor for your application.

Typical prime movers are listed at the left, types of loads across the top, and your service factor opposite the typical prime movers.

When torsional or linear vibration is present, use an FSO series clutch and increase the service factor at least 50%. For severe vibration, a greater service factor increase is necessary. To conform with couplings manufacturer's recommendations, use a minimum service factor of 1.5 on all Clutch Couplings.

Overrunning & Backstopping Applications Service Factors

		Driven Equipment Load Classifications			
		Light Steady Loads Starting torque is equal to or slightly greater than running torque.	**Moderate Loads** High starting torque or above average running torque.	**Medium Loads** Starting torque is approximately double running torque.	**Heavy-Duty Loads** High starting torque, shock loading, light torque reversals during drive.
					
		Centrifugal pumps, uniformly loaded conveyors, light-duty fans and blowers, liquid mixers and agitators, centrifugal compressors, lobe and vane type blowers, gear pumps, textile machinery, woodworking machinery.	Hot oil pumps, heavy-duty centrifugal pumps, cooling towers, slurry agitators, boiler feed pumps, hoists, conveyors.	Dredge pumps, dynamometer drives, light-duty hammermills, lineshafts, paper-converting machinery, rotary kilns, rotary or screw-type pumps for high viscosity fluids.	Mine ventilating fans, reciprocating pumps or compressors, papermaking machinery, heavy-duty hammermills, ore crushers, pulverizing mills.
Prime Mover	Steam, gas or air turbine	1.00	1.50	1.50	2.50
	AC electric motor	1.25	1.50	1.50	2.50
	DC electric motor with DOL start AC electric motor	1.25	1.50	1.75	3.00
	Gasoline, natural gas, propane or other spark ignition engine	3.0	3.0	Consult Formsprag	Consult Formsprag
	Diesel	Consult Formsprag	Consult Formsprag	Consult Formsprag	Consult Formsprag

DOL = Direct on Line

Indexing Applications Service Factors

Type of Load	FS-02, 04, 05 FSR-3 & 5	FSR 6 to 16 HPI	FSO	Roller Design
Less than 90° or less than 150 strokes/min.	3	2	2	2
Over 150 strokes/min.	4	2	N/A	3
When angle is greater than 90° and over 200 strokes/min.	4	2	N/A	2.5

* Recommended for maximum performance and maximum life.

Note: In all cases where considerable vibration is present, a higher service factor may be needed (possibly up to 6).

General Purpose Clutches

FSO/HPI

Overrunning, Indexing, Backstopping Ball Bearing Supported, Sprag Clutches

All models contain **PCE** sprags with Formchrome® and Formsprag "Free-action" retainers except models FSO 550 & FSO 650. Standard clutches and all C/T clutches are oil lubricated. Grease lubrication is available for applications where maintenance is inadequate, or where higher inner race overrunning speeds are required. These clutches mount on a through-shaft, with the inner race driven by a key. The ground O.D. of the outer race is designed as a pilot or mounting surface for attaching parts and is concentric with the bore. Tapped holes are provided in each end of the outer race for securing these parts to the clutches. Refer to Bore Sizes/Shaft Tolerances chart for mounting data, page 42.

For vertical mounting, contact Application Engineering.

Model FSO

General purpose, ball-bearing clutches suitable for overrunning, backstopping and light to medium-duty indexing applications. They are oil lubricated and equipped with lip type seals. Grease is available. Increased speeds are possible with steel labyrinth seals.

C/T Sprag Models (FSO Only)

C/T sprag clutches are ideal for applications with high speed outer race overrunning and low speed driving. Available with oil lubrication only.

Model HPI

Especially designed for ***medium to heavy-duty*** indexing applications, or applications in excess of 150 strokes/min. to provide the maximum in dependable, uniform, long life performance except models FSO 550 & FSO 650. They are oil lubricated and equipped with lip type seals. Grease is available.

Oil Lubricated Clutches

FSO-300 through 700 clutches are shipped from the factory with Mobil DTE Heavy Medium oil.

HPI-300 through 700 clutches are shipped from the factory with Mobil DTE Light oil.

Grease Lubricated Clutches

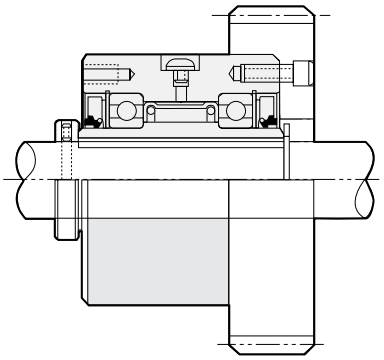
FSO-300 through 700 clutches are shipped from the factory packed with Fiske Brothers Lubriplate Low-Temp grease.

HPI-300 through 700 clutches are shipped from the factory with Mobil DTE Light.

OSHA cover kits are available for Models FSO & HPI-400 through 700, see page 39 for details.

For further information, write for Installation and Maintenance Bulletin No. 2219 for the FSO series and No. 2213 for the HPI series.

Typical Mounting Arrangement



The Model FSO clutches must be axially restrained, see accessories page 36 for set collars, restraint keys and OSHA covers, etc. All fasteners are recommended to be grade 8 bolts.

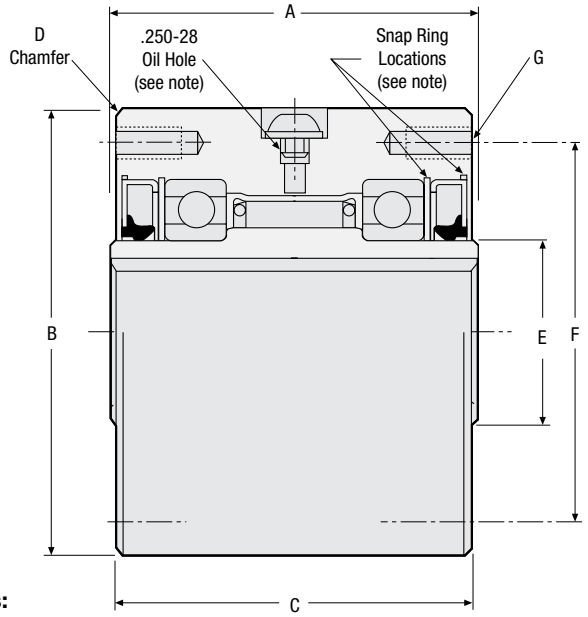
Specifications

Size	Torque Capacity lb.ft. (Nm)	Maximum RPM								Resistance after run-in lb.ft. (Nm)	Lubrication		Shipping Weight lb. (kg)
		Standard Models				C/T Sprag Models					Oil or Grease	Oil only	
		Overrunning Speed				Overrunning Speed							
		Oil and Grease Lip Seals		Labyrinth Grease Seals									
		Inner Race	Outer Race	Inner Race	Outer Race	Inner Race	Outer Race	Max. drive	Sprag lift-off		FSO oz (ml)	HPI oz (ml)	
300	275 (374)	3,000	900	3,600	900	3,000	6,000	1,100	1,300	.13 (.18)	.25 (7.0)	.50 (14.0)	3.5 (1.6)
400	300 (408)	2,800	850	3,600	850	2,800	5,000	1,100	1,300	.20 (.27)	.33 (9.9)	.67 (19.8)	6 (2.7)
500	1,175 (1598)	2,500	800	3,000	800	2,500	4,000	1,000	1,200	.23 (.31)	.75 (22.0)	1.25 (35.0)	10.5 (4.8)
550	1,885 (2564)	1,175	800	—	—	—	—	—	—	.35 (.47)	1.75 (52.0)	—	12 (5.4)
600	2,250 (3060)	2,200	750	2,400	750	2,200	3,600	1,000	1,200	.46 (.62)	1.75 (52.0)	3.00 (84.0)	19 (8.6)
650	2,375 (3230)	900	600	—	—	—	—	—	—	.80 (1.08)	6.00 (168.0)	—	24 (10.8)
700	5,000 (6800)	1,600	450	2,000	450	1,600	2,500	800	1,000	1.15 (1.56)	6.00 (168.0)	10.00 (280.0)	42 (19)

Note: Check key and shaft stress before making final clutch selection since this may determine the maximum allowable drive torque capacity. Shaft keys are not provided with the clutches on sizes 300 through 700.

FSO OSHA cover kits are designed for shaft end mounted FSO or HPI clutches and available from Formsprag from size 400 through 1027. These cover kits provide not only the stationary cover enclosure required by OSHA, but provide additional protection for the clutch from abrasive environments as well.

Note: OSHA requires that a stationary guard must enclose clutches with rotating projecting parts and operating seven (7) feet or less above the floor.



Notes:

Angle — oil hole to mounting bolt hole
Model 300, 400, 500= 45°
600 = 15°
700 = 0° or 30° (offset from center of outer race)

Snap ring is located on the outboard side of the oil seal on Models 400, 600 and 700. On Models 300 and 500, snap ring is inboard of the oil seal.

Dimensions inches (mm)

Size	A	B	C	D	E	F	G Number	G Thread	G Depth
300	2.50 (63.50)	3.000/2.998 (76.20/76.15)	2.38 (60.45)	.06 x 45° (1.58 x 45°)	1.12 (28.58)	2.625 (66.67)	4 @ 90°	.250-28	.50 (12.70)
400	2.75 (69.85)	3.500/3.498 (88.90/88.85)	2.69 (68.26)	.06 x 45° (1.58 x 45°)	1.19 (30.15)	2.875 (73.02)	4 @ 90°	.312-24	.63 (16.00)
500	3.50 (88.90)	4.250/4.248 (107.95/107.90)	3.38 (85.72)	06 x 45° (1.58 x 45°)	1.77 (45.0)	3.625 (92.07)	4 @ 90°	.312-24	.63 (15.87)
550	3.25 (82.55)	4.750/4.748 (120.65/120.60)	3.125 (79.38)	0.08	2.75 (69.85)	4.25 (107.95)	6 @ 60°	.312-24	.54 (13.72)
600	3.75 (95.25)	5.375/5.373 (136.53/136.47)	3.63 (92.07)	.06 x 45° (1.58 x 45°)	2.50 (63.50) 2.72 (69.09)	4.750 (120.65)	6 @ 60°	.312-24	.63 (15.87)
650	3.50 (88.90)	6.500/6.498 (165.1/165.05)	3.375 (85.72)	0.09	3.187 (80.94)	5.75 (146.05)	8	.375-24	.79 (20.06)
700	5.00 (127.00)	7.125/7.123 (180.97/180.92)	4.88 (123.82)	.06 x 45° (1.58 x 45°)	3.56 (90.42) 4.00 (101.60)	6.250 (158.75)	8†	.375-24	.75 (19.05)

Notes:

† Six holes equally spaced at 60° plus two extra holes at 180°. Six hardened mounting screws are adequate for torque loads up to 3000 lb.ft. (4068 Nm). Use eight hardened mounting screws for torque loads above these values.

‡ The "E" dimension is larger for this bore size.

Bore sizes and keyseats****

inches (mm)

Size	Bore Size	Keyseat	Bore Range Min.	Bore Range Max.
300	.500 (12.70) .625 (15.87) 15mm .750 (19.05)	1/8 x 1/16 (3.18 x 1.57) 3/16 x 3/32 (4.75 x 2.36) 5 x 2.3mm*** 3/16 x 3/32 (4.75 x 2.36)	.500 (12.70)	.750 (19.05)
400	.500 (12.70) .625 (15.87) 18 mm .750 (19.05) .875 (22.22)	1/8 x 1/16 (3.18 x 1.57) 3/16 x 3/32 (4.75 x 2.36) 6 x 2.8mm*** 3/16 x 3/32 (4.75 x 2.36) 3/16 x 1/16 (4.75 x 1.57)	.437 (11.10)	.875 (22.22)
500	.875 (22.22) 1.000 (25.40) 1.125 (28.57) 30mm 1.250 (31.75) 1.312 (33.32)	3/16 x 3/32 (4.75 x 2.36) 1/4 x 1/8 (6.35 x 3.18) 1/4 x 1/8 (6.35 x 3.18) 10 x 3.3mm*** 1/4 x 1/8 (6.35 x 3.18) 1/4 x 3/32 (6.35 x 2.29)	.750 (19.05)	1.312 (33.32)
550	1.250 (31.75) 1.312 (33.32) 1.5000 (38.10) 1.625 (41.27)	1/4 x 1/8 (6.35 x 3.18) 3/8 x 3/16 (9.52 x 4.75) 3/8 x 3/16 (9.52 x 4.75) 3/8 x 1/8 (9.52 x 3.18)	1.00 (25.40)	1.625 (41.27)
600	1.250 (31.75) 1.375 (34.92) 1.5000 (38.10) 40mm 1.625 (41.27) 1.750 (44.45) 45mm 50mm 2.000 (50.80)	1/4 x 1/8 (6.35 x 3.18) 3/8 x 3/16 (9.52 x 4.75) 3/8 x 3/16 (9.52 x 4.75) 12 x 3.3mm*** 3/8 x 3/16 (9.52 x 4.75) 3/8 x 3/16 (9.52 x 4.75) 14 x 3.8mm*** 14 x 3.8mm*** 3/8 x 1/8 (9.52 x 3.18)	.937 (23.80)	2.250*‡ (57.15)
650	1.937 (49.20) 2.000 (50.80) 2.250 (57.15) 2.437 (61.90) 2.500 (63.50)	1/2 x 1/4 (12.70 x 6.35) 1/2 x 1/4 (12.70 x 6.35) 1/2 x 1/4 (12.70 x 6.35) 5/8 x 1/8 (15.87 x 3.18) 5/8 x 1/8 (15.87 x 3.18)	1.69 (42.85)	2.500 (63.5)
700	1.937 (49.20) 50mm 2.000 (50.80) 2.250 (57.15) 60mm 2.437 (61.90) 2.500 (63.50) 65mm 2.750 (69.85) 70mm 2.937 (74.60) 75mm 80mm	1/2 x 1/4 (12.70 x 6.35) 14 x 3.8mm 1/2 x 1/4 (12.70 x 6.35) 1/2 x 1/4 (12.70 x 6.35) 18 x 4.4mm*** 5/8 x 5/16 (15.87 x 7.93) 5/8 x 5/16 (15.87 x 7.93) 18 x 4.4mm*** 5/8 x 7/32 (15.87 x 5.53) 20 x 4.9mm*** 5/8 x 1/8 (15.87 x 3.18) 20 x 4.9mm*** 22 x 5.4mm***	1.875 (47.62)	3.250**‡ (82.55)

* 1/2 x 1/8 keyway. ** 3/4 x 1/4 keyway.
*** Contact Formsprag for keyseat information.
**** For Bore Sizes/Shaft Tolerences, see page 42.
‡ The "E" dimension is larger for this bore size.

General Purpose Clutches

FS/FSO/HPI

Overrunning, Indexing, Backstopping Ball Bearing Supported, Sprag Clutches

All models contain Formchrome® sprags and Formsprag "Free-action" retainers. These clutches mount on a through-shaft, with the inner race driven by a key. *Standard keys are supplied by Formsprag at no additional charge.* The ground O.D. of the outer race is designed as a pilot or mounting surface for attaching parts and is concentric with the bore. Tapped holes are provided in each end of the outer race for securing these parts to the clutch. Refer to Bore Sizes/Shaft Tolerance chart for mounting data, page 42.

For vertical mounting, contact Application Engineering.

Model FSO

Allows higher inner race overrunning speeds than FS series. They are also suitable for general overrunning and light-to medium-duty indexing applications. They are grease lubricated and equipped with grease seals.

Model HPI

Are especially designed for medium to heavy-duty indexing applications, or applications in excess of 150 strokes/ min. to provide the maximum in dependable, uniform, long life performance. They are oil lubricated and equipped with lip type seals. Grease is available.

Model FS

Suitable for general overrunning, backstopping and light to medium-duty indexing applications. They are oil lubricated and equipped with lip-type seals.

C/T Sprag Models (FS Only)

Ideal for applications with high speed outer race overrunning and low speed driving. Available with oil lubrication only.

Oil Lubricated Clutch

FS-750 through 1027 clutches are shipped from the factory with Mobil DTE Heavy Medium oil.

HPI-750 through 1027 clutches are shipped from the factory with Mobil DTE Light oil.

Grease Lubricated Clutch

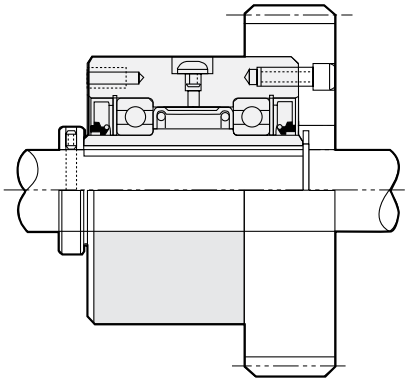
FSO-750 through 1027 clutches are shipped from the factory packed with Fiske Brothers Aero-Lubriplate grease.

HPI-750 through 1027 clutches are shipped from the factory with Mobil DTE Light.

OSHA cover kits are available for Models FS, FSO & HPI-750 through 1027, see page 39 for details.

For further information, write for Installation and Maintenance bulletin No. 2219 for FS and FSO series, and No. 2213 bulletin for the HPI series.

Typical Mounting Arrangement



The Model FSO clutches must be axially restrained, see accessories page 36 for set collars, restraint keys and OSHA covers, etc. All fasteners are recommended to be grade 8 bolts.

Specifications

Size	Torque Capacity lb.ft. (Nm)	Maximum RPM								Resistance after run-in lb.ft. (Nm)	Lubrication			Shipping Weight lb. (kg)
		Standard Models				C/T Sprag Models*					Grease		Oil	
		Overrunning Speed				Overrunning Speed								
		Lip Seal FS & FSO		Labyrinth FSO										
		Inner Race	Outer Race	Inner Race	Outer Race	Inner Race	Outer Race	Max. drive	Sprag lift-off		FSO oz (ml)	HPI oz (ml)	FS oz (ml)	
750	7,000 (9520)	1,000	650	1,800	650	1,000	1,800	650	800	3.75 (5.08)	7.5 (222)	13 (384)	7 (207)	83 (38)
800	13,000 (17,680)	850	525	1,500	525	850	1,500	525	675	5.25 (7.12)	7.5 (222)	15 (444)	8.5 (251)	102 (46)
900	18,000 (24,480)	700	500	1,350	500	700	1,350	500	650	6.25 (8.47)	18 (532)	16 (473)	11.5 (340)	156 (71)
1027	27,000 (36,720)	500	375	1,100	375	500	1,100	375	475	10.00 (13.56)	22 (651)	32 (946)	16 (473)	250 (113)

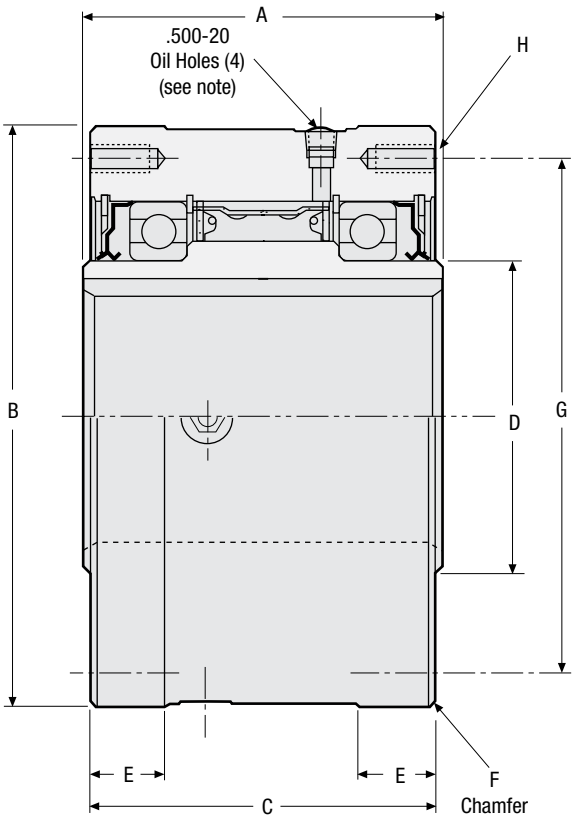
Notes:

* FSO-1027 C/T Sprags are not Formchromed.

Check key and shaft stress before making final clutch selection since this may determine the maximum allowable drive torque capacity.

FSO-750 only, shipped with labyrinth seals.

Shaft keys are provided with the clutches on sizes 750 and up.



Notes:

Angle — oil hole to mounting bolt hole

Model 750 = 0° or 30°
900 = 0° or 18°
800 = 0° or 45°
1027 = 15°

Dimensions inches (mm)

Size	A	B	C	D	E	F	G	H Number	H Thread	H Depth
750	6.00 (152.4)	8.750/8.748 (222.25/222.20)	5.88 (149.22)	4.25 (107.95)	1.25 (31.75)	.06 x 45° (1.58 x 45°)	7.00 (177.80)	8*	.500-20	1.00 (25.40)
800	6.00 (152.4)	10.000/9.998 (254.00/253.95)	5.88 (149.22)	5.50 (139.70)	1.25 (31.75)	.06 x 45° (1.58 x 45°)	8.94 (227.01)	8 @ 45°	.500-20	1.00 (25.40)
900	6.38 (161.9)	12.000/11.997 (304.80/304.72)	6.25 (158.75)	6.38 (161.92)	1.38 (34.92)	.06 x 45° (1.58 x 45°)	9.75 (247.65)	10 @ 36°	.625-18	1.25 (31.75)
1027	6.63 (168.3)	15.000/14.997 (381.00/380.92)	6.50 (165.10)	9.00 (228.60)	1.38 (34.92)	.13 x 45° (3.17 x 45°)	11.75 (298.45)	12 @ 30°	.625-18	1.00 (25.40)

* Six holes equally spaced at 60° plus two extra holes at 180°. Six hardened mounting screws are adequate for torque loads up to 5100 lb.ft. (6915 Nm). Use eight hardened mounting screws for torque loads above these values.

** For finished dimensions of keys supplied with the clutch, contact Formsprag.

Bore sizes and keyseats**†

inches (mm)

Size	Bore Size	Keyseat	Bore Range Min.	Bore Range Max..
750	2.437 (61.90)	5/8 x 5/16 (15.87 x 7.94)	2.250 (57.15)	3.437 (87.30)
	2.500 (63.50)	5/8 x 5/16 (15.87 x 7.94)		
	65mm	18 x 4.4mm***		
	2.750 (69.85)	5/8 x 5/16 (15.87 x 7.94)		
	70mm	20 x 4.9mm***		
	2.937 (74.60)	3/4 x 3/8 (19.05 x 9.52)		
	75mm	20 x 4.9mm***		
	3.000 (76.20)	3/4 x 3/8 (19.05 x 9.52)		
	80mm	22 x 5.4mm***		
	3.250 (82.55)	3/4 x 1/4 (19.05 x 6.35)		
	3.437 (87.30)	3/4 x 3/16 (19.05 x 4.75)		
800	3.000 (76.20)	3/4 x 3/8 (19.05 x 9.52)	2.625 (66.67)	4.437 (112.70)
	80mm	22 x 5.4mm***		
	3.250 (82.55)	3/4 x 3/8 (19.05 x 9.52)		
	85mm	22 x 5.4mmv***		
	3.437 (87.30)	7/8 x 7/16 (22.23 x 11.11)		
	3.500 (88.90)	7/8 x 7/16 (22.23 x 11.11)		
	90mm	25 x 5.4mm***		
	3.750 (95.25)	7/8 x 7/16 (22.23 x 11.11)		
	100mm	28 x 6.4mm***		
	3.937 (100.00)	1 x 1/2 (25.40 x 12.70)		
	4.000 (101.60)	1 x 1/2 (25.40 x 12.70)		
	4.250 (107.95)	1 x 3/8 (25.40 x 9.52)		
	110mm	28 x 6.4mm***		
	4.437 (112.70)	1 x 1/4 (25.40 x 6.35)		
900	100mm	28 x 6.4mm***	3.625 (92.07)	5.437 (138.10)
	4.000 (101.60)	1 x 1/2 (25.40 x 12.70)		
	4.250 (107.95)	1 x 1/2 (25.40 x 12.70)		
	110mm	28 x 6.4mm***		
	4.437 (112.70)	1 x 1/2 (25.40 x 12.70)		
	4.500 (114.30)	1 x 1/2 (25.40 x 12.70)		
	120mm	32 x 7.4mm***		
	4.750 (120.65)	1 x 1/2 (25.40 x 12.70)		
	4.937 (125.40)	1 x 3/8 (25.40 x 9.52)		
	5.000 (127.00)	1 x 3/8 (25.40 x 9.52)		
	130mm	32 x 7.4mm***		
	5.250 (133.35)	1 x 1/4 (25.40 x 6.35)		
	5.437 (138.10)	1 x 1/4 (25.40 x 6.35)		
1027	4.937 (125.40)	1 1/4 x 5/8 (31.75 x 15.87)	4.937 (125.40)	7.000 (177.80)
	130mm	36 x 8.4mm***		
	150mm	45 x 10.4mm***		
	6.000 (152.40)	1 1/4 x 5/8 (31.75 x 15.87)		
	6.250 (158.75)	1 1/2 x 1/2 (38.10 x 12.70)		
	6.625 (168.27)	1 1/2 x 1/2 (38.10 x 12.70)		
	6.750 (171.45)	1 1/2 x 1/2 (38.10 x 12.70)		
	6.875 (174.62)	1 1/2 x 1/2 (38.10 x 12.70)		
	175mm	45 x 10.4mm***		
	7.000 (177.80)	1 1/2 x 7/16 (38.10 x 11.10)		

*** Contact Formsprag for keyseat information.

† For Bore Sizes/Shaft Tolerences, see page 42.

FHB

Backstopping Ball Bearing Supported, Sprag Clutches

Model FHB is directly interchangeable with the older FALK® Model BIF external high-speed backstop.

Model FHB is a high speed, centrifugal throw-out (C/T) Sprag type backstop with internal sealed ball bearings. This self-contained design is completely maintenance free. It requires no re-lubrication, no external control, and no adjustment. It engages instantaneously and automatically to prevent any reverse shaft rotation. Model FHB operates at higher overrunning speeds and holds greater torque loads than competing backstops. A larger number of torque transmitting C/T Sprags reduce the hertzian contact stresses during backstopping leading to longer life than is possible with shoe designs.

The FHB backstop is mounted on a through-shaft with its inner race driven by a key, and its integral outer race torque arm prevented from rotating through a clearance fit interface with a fixed reaction pin. The reaction pin may also be used to provide axial restraint of the backstop on the rotating shaft.

Typical uses for the Model FHB backstop include inclined conveyors, bucket elevators, and other applications where a rotating shaft must be absolutely prevented from rotating in a reverse direction, as commonly found in mining, aggregates, material handling, and other industries. The high speed capability of the unit make this backstop ideal for mounting on double extended input shafts of gear reducers. The overrunning speed of the rotating shaft should be greater than 400 RPM to assure C/T Sprag “lift-off”.

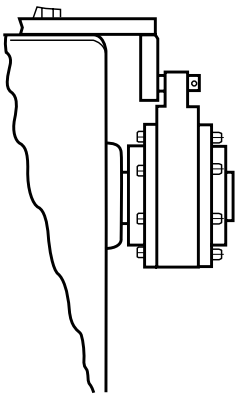
Grease Lubricated Backstops, the Model FHB is shipped from the factory lubricated for life and the ambient operating temperatures range is from -40°F (-40°C) to 150°F (65°C).

Optional OSHA cover kits are available for all three sizes. See page 39.

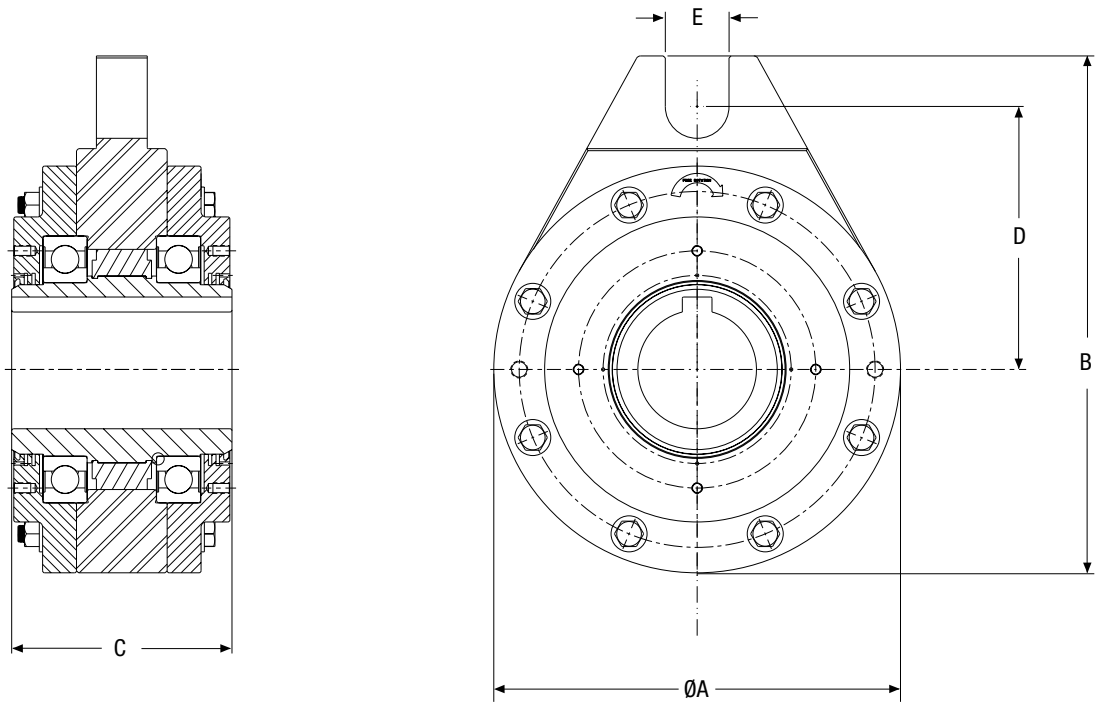
Specifications

Size	Torque Capacity lb.ft. (Nm)	Overrunning Speed Inner Race RPM Min	Overrunning Speed Inner Race RPM Max	Shipping Weight lb. (kg)
FHB-10	1,734 (2350)	400	2,400	31 (14)
FHB-20	1,734 (2350)	400	2,000	63 (29)
FHB-60	4,130 (5600)	400	1,800	158 (72)

Typical Mounting Arrangements



The Model FHB can be axially restrained by a cotter pin in the reaction pin



Dimensions – Formsprag FHB (mm)

Model No.	BORE Min	BORE Max	A	B	C	D	E
FHB-10	1.13 (28.70)	1.88 (47.75)	6.88 (174.75)	8.38 (212.85)	4.13 (104.90)	4.13 (104.90)	0.81 (20.5)
FHB-20	1.75 (44.45)	2.25 (57.15)	8.23 (209.04)	11.26 (286.00)	5.50 (139.70)	6.00 (152.40)	1.25 (31.75)
FHB-60	2.25 (57.15)	3.75 (95.25)	12 (304.80)	15.25 (387.35)	6.50 (165.10)	7.75 (196.85)	1.88 (47.75)

Dimensions – Falk® BIF (mm)

Model No.	BORE Min	BORE Max	A	B	C	D
10BIF	1.13 (28.70)	1.63 (41.40)	7.28 (184.91)	8.59 (218.19)	4.13 (104.90)	4.13 (104.90)
20BIF	1.75 (44.45)	2.25 (57.15)	10.28 (261.11)	12.27 (311.66)	5.50 (139.70)	6.00 (152.40)
60BIF	2.25 (57.15)	3.75 (95.25)	13.03 (330.96)	15.78 (400.81)	6.50 (165.10)	7.75 (196.85)

Bore sizes and keyseats inches (mm)

Size	Bore Size	Keyseat	Bore Range Min.	Bore Range Max.
10	1.13 (28.58) 1.25 (31.75) 1.50 (38.10) 1.56 (39.67) 1.63 (41.28)	1/4 x 1/8	1.13 (28.7)	1.88 (47.8)
20	1.75 (44.45) 1.79 (45.339) 2.00 (50.8) 2.13 (53.975) 2.25 (57.15)		1.75 (44.5)	2.25 (57.2)
60	2.25 (57.15) 2.38 (60.325) 2.50 (63.5) 2.75 (69.85) 2.94 (74.6) 3.00 (76.2) 3.25 (82.55) 3.50 (88.9) 3.75 (95.25)		2.25 (57.2)	3.75 (95.3)

HSB (High Speed Backstops)

Backstopping Ball Bearing Supported, Sprag Clutches

Combination sprag clutch and oil reservoir Holdback conveyors and reducers

HSB units are intended for use as backstops on the high speed shaft or intermediate shaft of a reducer, and as holdbacks on the head shaft of conveyors. They use standard clutches with the addition of the oil reservoir. The oil reservoir is an aluminum casting with cooling fins. HSB models have a spacer replacing the seal at the reservoir end to permit free oil flow between clutch and reservoir. The reservoir has a flush oil sight gauge and a combination breather and oil filter. Refer to Bore Sizes/Shaft Tolerance chart for mounting data. Standard keys supplied by Formsprag at no additional charge for models 750 through 1027.

A torque arm is required to prevent the outer race and reservoir from rotating, see page 40.

The FSO-400 through 700 and FS-750 through 1027 clutch assemblies that are used to make up the HSB series clutches are shipped from the factory with Mobil DTE Heavy Medium oil, but must be filled to the proper level before operation.

For further information, write for Installation and Maintenance Bulletin No. 2214.

Specifications

Size	Torque Capacity lb.ft. (Nm)	Overrunning Speed Max. RPM	Resistance after run-in lb.ft. (Nm)	Lubrication Oil oz (ml)	Shipping Weight lb. (kg)
400	300 (408)	2,900	.20 (.27)	2 (59.1)	7 (3.2)
500	1,175 (1598)	2,650	.45 (.61)	3.5 (103.5)	12.5 (5.7)
600	2,250 (3060)	2,300	.90 (1.22)	6 (177.4)	20 (9)
700	5,000 (6800)	2,000	2.13 (2.89)	10 (295.7)	47 (21)
750	7,000 (9520)	1,800	3.75 (5.08)	20 (591.4)	88 (40)
800	13,000 (17,680)	1,400	5.25 (7.12)	25 (739.3)	112 (51)
900	18,000 (24,480)	1,300	6.25 (8.47)	30 (887.1)	170 (77)
1027	27,000 (36,720)	1,050	10.00 (13.56)	40 (1183.4)	315 (143)

Notes:

Check key and shaft stress before making final clutch selection since this may determine the maximum allowable drive torque capacity. Specify direction of rotation when ordering.

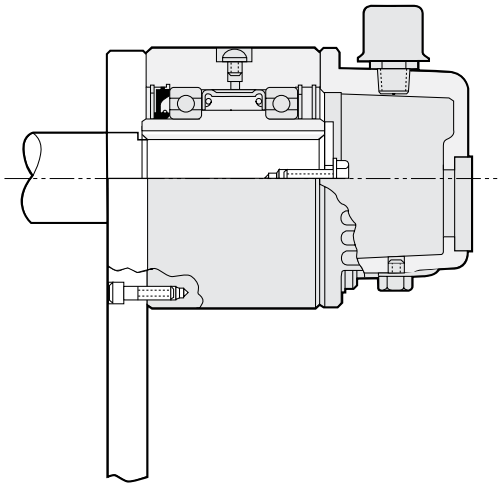
HSB-400 to 700 clutch assemblies are FSO clutches plus an HSB oil reservoir kit.

HSB-750 to 1027 clutch assemblies are FS clutches plus an HSB oil reservoir kit.

The reservoir kits are boxed separately.

Always consult the Installation and Maintenance Bulletin 2214 for the special seal modifications required to the FSO clutch when being used with the HSB oil reservoir kit, before attaching the reservoir.

Typical Mounting Arrangement



The Model HSB clutch with optional FSO Torque Arm, see Accessories, must be axially restrained on the shaft. The above typical drawing shows a customer supplied retaining plate and bolt and a stepped shaft, providing this restraint. All fasteners are recommended to be grade 8 bolts.

Bore sizes and keyseats

inches (mm)

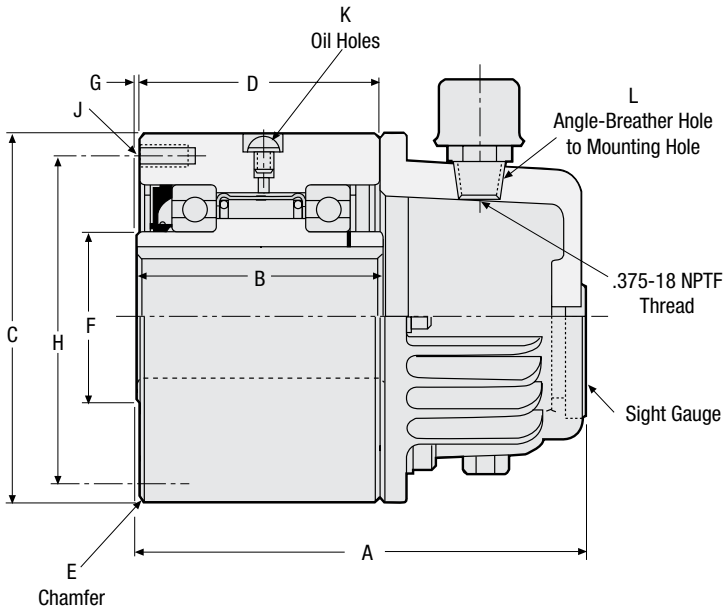
Size	d^{H7} Bore Size	Keyseat*
25	0.98 (25)	(8 X 3.3)
30	1.18 (30)	(8 X 3.3)
35	1.38 (35)	(10 X 3.3)
40	1.57 (40)	(12 X 3.3)
45	1.77 (45)	(14 X 3.8)
50	1.97 (50)	(16 X 4.3)
55	2.17 (55)	(16 X 4.3)
60	2.36 (60)	(18 X 4.4)
70	2.76 (70)	(20 X 4.9)
80	3.15 (80)	(22 X 5.4)
90	3.54 (90)	(25 X 5.4)

Metric Keyseat Dimensions*

Bore size (mm)	DIN 6885.1 (mm)			
	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
17.1 – 22.0	6 ± 0,024	6	3,5 + 0,1	2,8 + 0,3
22.1 – 30.0	8 ± 0,029	7	4 + 0,2	3,3 + 0,4
30.1 – 38.0	10 ± 0,029	8	5 + 0,2	3,3 + 0,4
38.1 – 44.0	12 ± 0,035	8	5 + 0,2	3,3 + 0,4
44.1 – 50.0	14 ± 0,035	9	5,5 + 0,2	3,8 + 0,4
50.1 – 58.0	16 ± 0,035	10	6 + 0,2	4,3 + 0,4
58.1 – 65.0	18 ± 0,035	11	7 + 0,2	4,4 + 0,4
65.1 – 75.0	20 ± 0,042	12	7,5 + 0,2	4,9 + 0,4
75.1 – 85.0	22 ± 0,042	14	9 + 0,2	5,4 + 0,4
85.1 – 95.0	25 ± 0,042	14	9 + 0,2	5,4 + 0,4
95.1 – 110.0	28 ± 0,042	16	10 + 0,2	6,4 + 0,4
110.1 – 130.0	32 ± 0,050	18	11 + 0,3	7,4 + 0,4
130.1 – 150.0	36 ± 0,050	20	12 + 0,3	8,4 + 0,4t

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

HSB (High Speed Backstops)



Dimensions inches (mm)

Size	A	B	C	D	E	F	G	H	J			K	L*
									Number	Thread	Depth		
400	4.78 (121.44)	2.75 (69.85)	3.500/3.498 (88.90/88.85)	2.69 (68.25)	.06 x 45° (1.57 x 45°)	1.19 (29.97)	.03 (.78)	2.88 (73.02)	4 @ 90°	.312-24	.50 (12.70)	.250-28	45°
500	6.50 (165.10)	3.50 (88.90)	4.250/4.248 (107.95/107.90)	3.38 (85.72)	.06 x 45° (1.57 x 45°)	1.19 (30.15)	.06 (1.57)	3.63 (92.07)	4 @ 90°	.312-24	.63 (15.87)	.250-28	45°
600	6.75 (171.45)	3.75 (95.25)	5.375/5.373 (136.52/136.47)	3.63 (92.07)	.06 x 45° (1.57 x 45°)	1.75 (44.45)	.06 (1.57)	4.75 (120.65)	6 @ 60°	.312-24	.63 (15.87)	.250-28	30°
700	9.00 (228.60)	5.00 (127.00)	7.125/7.123 (180.97/180.92)	4.88 (123.82)	.06 x 45° (1.57 x 45°)	3.56 (90.42)	.06 (1.57)	6.25 (158.75)	8**	.375-24	.75 (19.05)	.250-28	0° or 30°
750	11.00 (279.40)	6.00 (152.40)	8.750/8.748 (222.25/222.20)	5.88 (149.22)	.06 x 45° (1.57 x 45°)	4.25 (107.95)	.06 (1.57)	7.00 (177.80)	8**	.500-20	1.00 (25.40)	.500-20	0° or 30°
800	11.50 (292.10)	6.00 (152.40)	10.000/9.998 (254.00/253.95)	5.88 (149.22)	.06 x 45° (1.57 x 45°)	5.50 (139.70)	.06 (1.57)	8.94 (227.00)	8 @ 45°	.500-20	1.00 (25.40)	.500-20	0° or 45°
900	12.25 (311.15)	6.38 (161.92)	12.000/11.997 (304.80/304.72)	6.25 (158.75)	.06 x 45° (1.57 x 45°)	6.38 (161.92)	.06 (1.57)	9.75 (247.65)	10 @ 36°	.625-18	1.25 (31.75)	.500-20	0° or 18°
1027	12.68 (322.07)	6.63 (168.27)	15.000/14.997 (381.00/380.92)	6.50 (165.10)	.13 x 45° (3.17 x 45°)	9.00 (228.60)	.06 (1.57)	11.75 (298.45)	12 @ 30°	.625-18	1.00 (25.40)	.500-20	15°

* Angle-breather hole to mounting hole.

** Six holes equally spaced at 60° plus two extra holes at 180°. Six hardened mounting screws are adequate for torque loads up to 3,000 lb.ft. (4068 Nm) for model 700, or 5,100 lb.ft. (6916 Nm) for model 750; use eight hardened mounting screws for torque loads above these values.

Bore sizes and keyseats***† inches (mm)

Size	Bore Size	Keyseat	Bore Range Min.	Bore Range Max.
400	.500 (12.70)	1/8 x 1/16 (3.17 x 1.57)	.437 (11.10)	.875 (22.22)
	.625 (15.87)	3/16 x 3/32 (4.75 x 2.36)		
	.750 (19.05)			
	.875 (22.22)	3/16 x 1/16 (4.75 x 1.57)		
500	.875 (22.22)	3/16 x 3/32 (4.75 x 2.36)	.750 (19.05)	1.312 (33.32)
	1.000 (25.40)	1/4 x 1/8 (6.35 x 3.17)		
	1.125 (28.57)			
	1.250 (31.75)			
	1.312 (33.32)	1/4 x 3/32 (6.35 x 2.36)		
600	1.250 (31.75)	1/4 x 1/8 (6.35 x 3.17)	.937 (23.80)	2.250* (57.15)
	1.375 (34.92)	3/8 x 3/16 (9.52 x 4.75)		
	1.500 (38.10)			
	1.625 (41.27)			
	1.750 (44.45)			
	2.000 (50.80)	3/8 x 1/8 (9.52 x 3.17)		
700	1.937 (49.20)	1/2 x 1/4 (12.70 x 6.35)	1.875 (47.62)	3.250** (82.55)
	2.000 (50.80)			
	2.250 (57.15)			
	2.437 (61.90)	5/8 x 5/16 (15.87 x 7.92)		
	2.500 (63.50)			
	2.750 (69.85)	5/8 x 7/32 (15.87 x 5.59)		
	2.937 (74.60)	5/8 x 1/8 (15.87 x 3.17)		

* 1/2 x 1/8 keyway

** 3/4 x 1/4 keyway

*** For finished dimensions of keys supplied with the clutch, contact Formsprag.

† For Bore Sizes/Shaft Tolerances, see page 42.

Size	Bore Size	Keyseat	Bore Range Min.	Bore Range Max.
750	2.437 (61.90)	5/8 x 5/16 (15.87 x 7.92)	2.250 (57.15)	3.437 (87.30)
	2.500 (63.50)			
	2.750 (69.85)			
	2.937 (74.60)	3/4 x 3/8 (19.05 x 9.52)		
	3.000 (76.20)			
	3.250 (82.55)	3/4 x 3/16 (19.05 x .635)		
	3.437 (87.30)	3/4 x 3/16 (19.05 x 4.75)		
800	3.000 (76.20)	3/4 x 3/8 (19.05 x 9.52)	2.625 (66.67)	4.437 (112.70)
	3.250 (82.55)			
	3.437 (87.30)	7/8 x 7/16 (22.22 x 11.10)		
	3.500 (88.90)			
	3.750 (95.25)			
	3.937 (100.00)	1 x 1/2 (25.40 x 12.70)		
	4.000 (101.60)			
	4.250 (107.95)	1 x 3/8 (25.40 x 9.52)		
	4.437 (112.70)	1 x 1/4 (25.40 x 6.35)		
900	4.000 (101.60)	1 x 1/2 (25.40 x 12.70)	3.625 (92.07)	5.437 (138.10)
	4.250 (107.95)			
	4.437 (112.70)			
	4.500 (114.30)			
	4.750 (120.65)			
	4.937 (125.40)	1 x 3/8 (25.40 x 9.52)		
	5.000 (127.00)			
	5.250 (133.35)	1 x 1/4 (25.40 x 6.35)		
	5.437 (138.10)			
1027	4.937 to 6.000 (125.40 to 152.40)	1 1/4 x 5/8 (31.75 x 15.87)	4.937 (125.40)	7.000 (177.80)
	6.250 to .6.500 (158.75 to 165.10)	1 1/2 x 1/2 (38.10 x 12.70)		
	6.750 to 7.000 (171.45 to 177.80)	1 1/2 x 7/16 (38.10 x 11.10)		

LLH® (Long Life Holdbacks®)

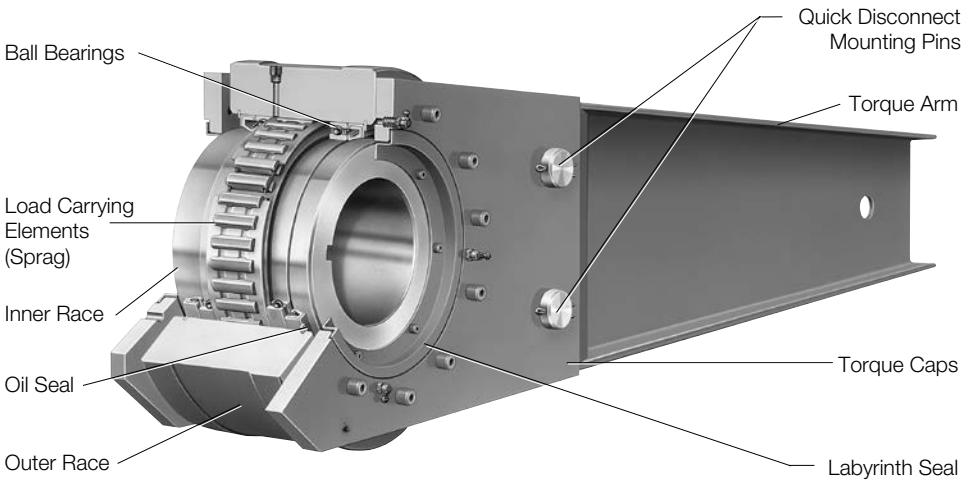
Backstopping Technology

Formsprag offers two technologies in backstopping designs, Sprag and Ramp & Roller. The sprag design is comprised of a full complement of accurately formed sprags filling the annular space. The ramp & roller design consists of precision-machined ramps on the inner race and bearing quality cylindrical rollers filling the annular space.

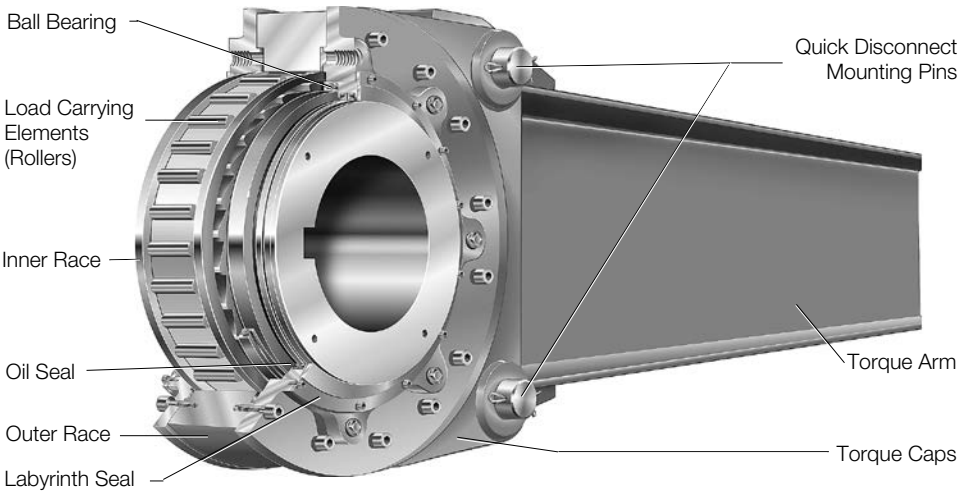
In backstopping or holdback applications, one race is always fixed to a stationary ground member. The function of the holdback clutch is to permit rotation of the mechanism connected to the inner race in one direction only, and to prevent rotation in the reverse direction at any time. Although the clutch normally overruns most of the time, it is referred to as a holdback or backstop in conveyors, gear reducers and similar equipment, because its function is to prevent reverse rotation.

LLH holdback clutches are ready to install. They are equipped with a one-piece, quickly detachable torque arm (simply remove two pins), and grease labyrinth protected oil seals that positively prevent airborne contaminants from reaching internal seals and parts. Oil lubricated, the clutch assembly also includes an oil sight gauge with filter breather, for ease in checking lubricant level. These clutches are designed to be mounted on a through shaft, with the inner race driven by a key. Standard keys are supplied by Formsprag with all holdbacks at no additional charge.

Sprag Design
(Models LLH-700S through LLH-5000S)



Ramp and Roller Design
(Models LLH-1250R through LLH-5500R)



Typical Holdback Specifications

1. Holdbacks installed on elevators and inclined conveyors must have adequate torque capacity to prevent runback, and must comply with the holdback manufacturer's recommended practice in the selection and application of a safe size.
2. The sprags within the holdback must be positioned and individually energized within a suitable retainer. Sprags must act independent of the retainer and independent of the action of any other sprag.
3. The sprags and the bearings within the holdback must be lubricated with lubricant suitable for the applicable extremes of ambient temperatures. The lubrication system must incorporate a transparent area suitable for visual checking of the oil level at approximately the level of the centerline of the shaft, suitable fitting for draining oil from the holdback, means for filling the holdback with oil, and a breather to relieve pressure within the holdback. The breather must be equipped with a renewable filter arranged to prevent entry of foreign matter into the lubrication system. The breather and filter may be incorporated into the oil filling fitting. An oil seal must be installed externally of each bearing.
4. For dusty or abrasive atmospheres the holdbacks must be equipped with a grease-filled labyrinth seal external to each oil seal. A sufficient number of grease fittings must be provided to insure complete filling and purging of the labyrinth.
5. The holdback must be symmetrical to permit field installation for either direction of rotation without disassembly of the sealed holdback assembly.

Specifications

Size	Torque Capacity lb.ft. (Nm)	Maximum Overrunning Speed RPM	Resistance after run-in lb.ft. (Nm)	Bore Range Available Min. in. (mm)	Bore Range Available Max. in. (mm)	Shipping Weight lb. (kg)
700	5,000 (6800)	400	2.63 (3.57)	1.875 (47.63)	2.937 (74.60)	160 (72)
750	7,000 (9520)	380	3.75 (5.09)	2.250 (57.15)	3.437 (87.30)	215 (97)
800	13,000 (17680)	300	5.25 (7.12)	2.625 (66.68)	4.437 (112.70)	325 (147)
900	18,000 (24480)	250	6.25 (8.48)	3.625 (92.08)	5.437 (138.10)	570 (258)
1027	27,000 (36720)	200	10 (13.56)	4.937 (125.40)	7.000 (177.80)	750 (340)
1051	45,000 (61200)	200	12 (16.27)	4.937 (125.40)	7.000 (177.80)	800 (363)
1250	65,000 (88400)	170	15 (20.34)	6.750 (171.45)	9.000 (228.60)	1,400 (633)
1300	90,000 (122400)	140	28 (37.97)	7.937 (201.60)	10.000 (254.00)	1,700 (770)
1375	135,000 (183600)	130	39 (52.87)	8.937 (227.00)	11.000 (279.40)	2,200 (995)
2000	200,000 (272000)	100	80 (108.48)	10.937 (277.80)	13.250 (336.55)	3,200 (1452)
2400	265,000 (360400)	85	100 (135.60)	13.000 (330.20)	15.500 (393.70)	4,200 (1905)
3500	375,000 (510000)	80	120 (162.72)	13.437 (341.30)	20.000 (508.00)	5,850 (2653)
5000	700,000 (952000)	75	125 (169.50)	13.437 (341.30)	20.000 (508.00)	5,930 (2690)

6. The holdback must be equipped with torque arm securely fastened to the outer race of the clutch. The outer end of the torque arm must be restrained by means that allow the arm to float while preventing rotation of the outer race.
7. The torque and speed capacity specified by the holdback manufacturer must be based upon adequate tests and engineering documentation. Since these units are used as safety devices, an adequate design safety factor must be used. The compressive stress used in the Hertz stress equations will not exceed 450,000 psi.
8. Load carrying elements in the holdbacks will preferably be manufactured from steel forgings, extrusions or bar stock.
9. To assure that proper heat treatment has been given to the holdback parts, relative to hardness, case depth and micro-structure, a certificate of quality attesting to proper metallurgical examination of the above mentioned items by the holdback manufacturer's laboratory will be provided to the purchaser.

LLH

Application Information

Formsprag Long Life Holdbacks are designed to “holdback” reverse torque. They are commonly used on inclined conveyors, bucket elevators, or pumps. Holdbacks have also been used on people moving systems, such as ski lifts and elevators. Specially designed nuclear holdbacks are currently installed on vertical shaft applications in several nuclear power plants with a required 40-year life.

Torque Arm Mounting Positions — With standard oil sight gauges, the preferred torque arm mounting position is approximately horizontal or slightly off of vertical. For installations requiring torque arms oriented in some other position, consult Formsprag.

Axial Retention Collars — Formsprag recommends that holdbacks be axially restrained on the shaft. The preferred method of accomplishing this is with set collars (see page 36). Any type of axial restraint applied to the torque arm reaction end will result in uneven bearing loads that will greatly reduce the bearing B-10 life. Restraint keys are also available. See page 37.

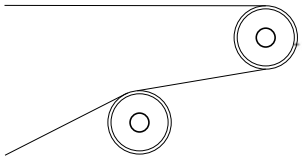
Typical Conveyor Holdback Arrangements

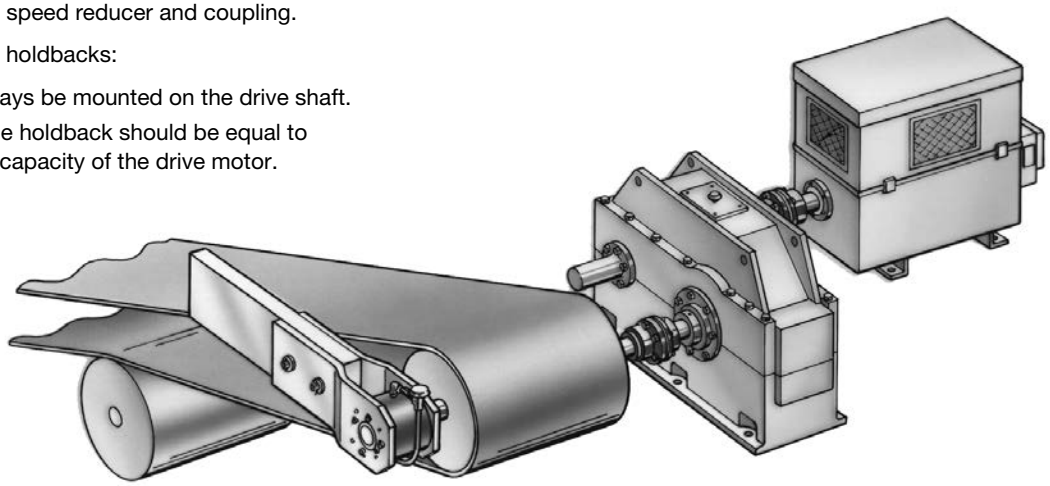
Single Head Pulley Drive

Locate the holdback on the opposite end of the head pulley drive shaft from the drive motor, speed reducer and coupling.

There are two rules for selecting holdbacks:

1. The holdback should always be mounted on the drive shaft.
2. The torque capacity of the holdback should be equal to or greater than the rated capacity of the drive motor.



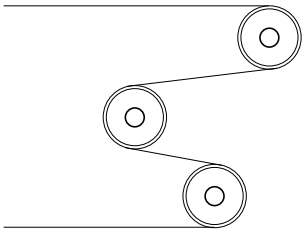


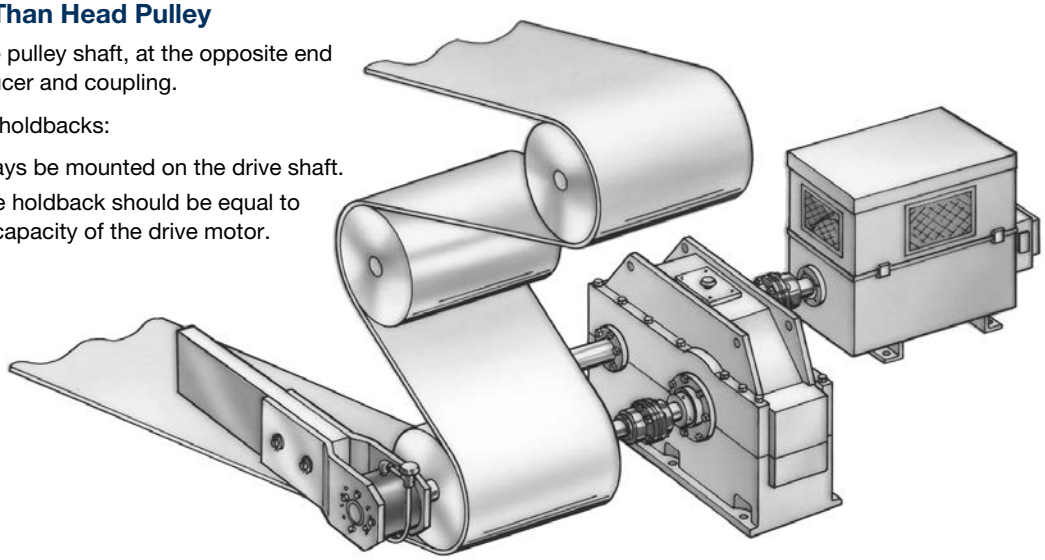
Single Drive Pulley Other Than Head Pulley

Locate the holdback on the drive pulley shaft, at the opposite end from the drive motor, speed reducer and coupling.

There are two rules for selecting holdbacks:

1. The holdback should always be mounted on the drive shaft.
2. The torque capacity of the holdback should be equal to or greater than the rated capacity of the drive motor.





Auxiliary Seals — All Formsprag holdbacks are furnished with two grease labyrinth-type seals. These seals, when purged with fresh grease periodically in accordance with our maintenance instructions, will protect the clutch against dusty or abrasive environments.

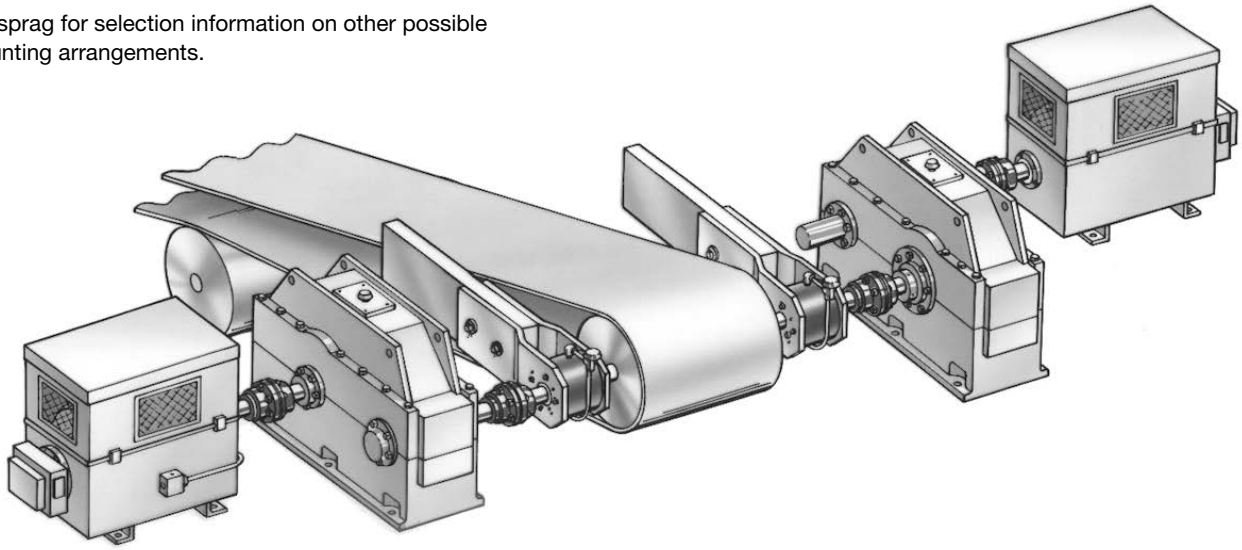
Operating Temperatures — For temperatures above 200°F consult Formsprag.

Standard Supplied Keys — All holdbacks are furnished with a hardened (25 – 40Rc) key. Customers should check key and shaft stress before making final clutch selection since this may determine the maximum allowable drive torque capacity. Do not drive or press-fit the key. It should be installed in the shaft keyway with a “push” fit.

Extended Storage — If holdbacks are kept out of operation for six months or more, they should be flushed out and relubricated prior to operation. If holdbacks are to be stored over an extended period of time, consult Formsprag for specific preservation and packaging instructions. See page 33 for extended storage.

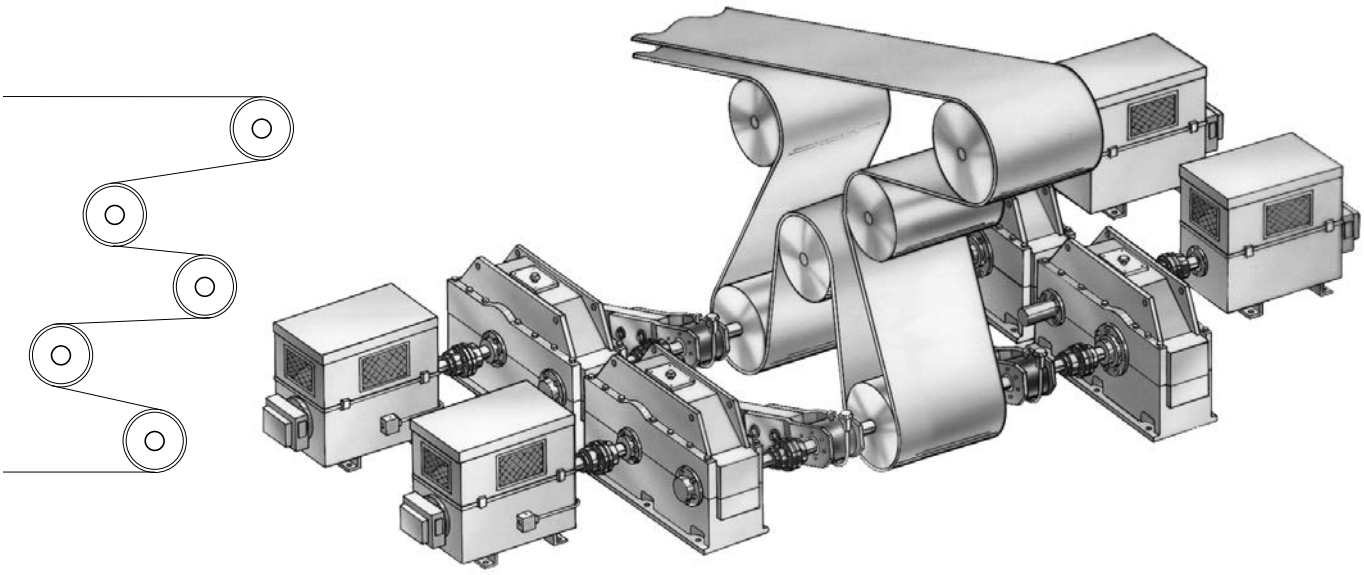
Single Pulley With Dual Drive

Contact Formsprag for selection information on other possible holdback mounting arrangements.



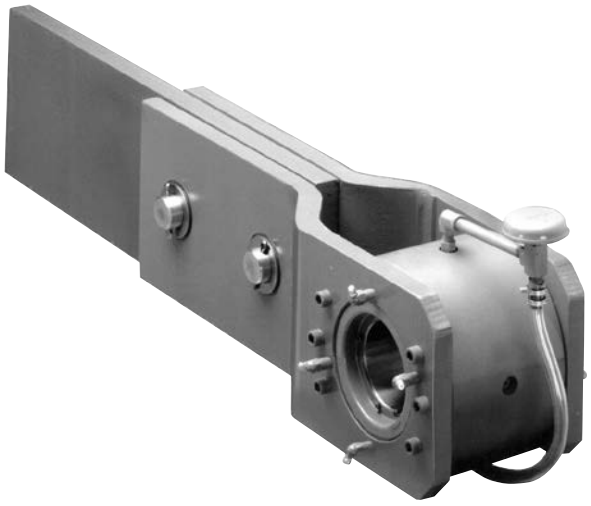
Tandem Drive Pulleys

Contact Formsprag for selection information on other possible holdback mounting arrangements.

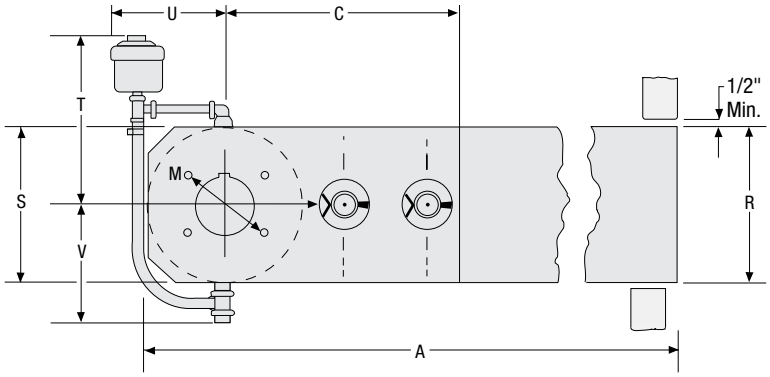


LLH

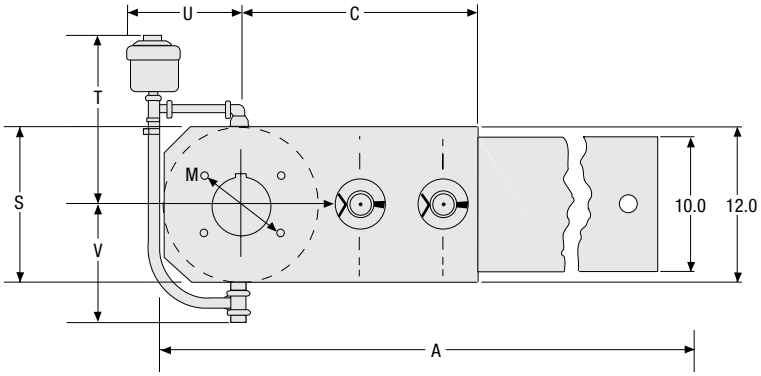
Model sizes 700 through 900



Horizontal Mounting



Sizes 700 through 800

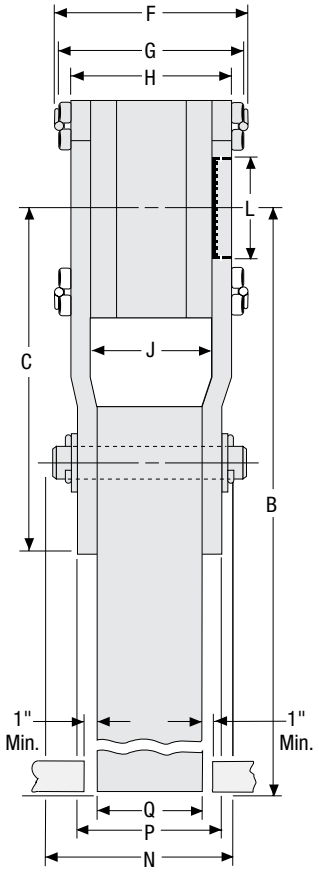


Size 900

Dimensions inches (mm)

Size	A	B	C	F	G	H	J	L	M	N	P
700	33.63 (854.07)	30.00 (762.00)	18.00 (457.20)	8.25 (209.55)	7.13 (180.97)	6.38 (161.92)	5.00 (127.00)	3.63 (92.07)	5.31 (134.92)	3.88 (98.42)	2.50 (63.50)
750	36.38 (923.92)	32.00 (812.80)	20.38 (517.52)	9.25 (234.95)	8.38 (212.72)	7.38 (187.32)	6.00 (152.40)	4.63 (117.47)	5.81 (147.62)	3.88 (98.42)	2.50 (63.50)
800	37.00 (939.80)	32.00 (812.80)	22.13 (561.97)	9.50 (241.30)	8.63 (219.07)	7.63 (193.67)	6.00 (152.40)	5.44 (138.10)	7.31 (185.72)	4.19 (106.35)	2.75 (69.85)
900	50.00 (1270.00)	44.00 (1117.60)	22.75 (577.85)	9.75 (247.65)	9.25 (234.95)	8.00 (203.20)	6.38 (161.92)	6.44 (163.50)	8.56 (217.47)	4.69 (119.05)	3.25 (82.55)

* Model 700 through 900, pins are on centerline of torque arm.



Sizes 700 through 900

Bore sizes and keyseats*† inches (mm)

Size	Bore Size	Keyseat	Bore Range Min.	Bore Range Max.
700	1.937 (49.20) 2.000 (50.80) 2.250 (57.15)	1/2 x 1/4 (12.70 x 6.35)	1.875 (47.62)	3.250 (74.60)
	2.437 (61.90) 2.500 (63.50)	5/8 x 5/16 (15.87 x 7.93)		
	2.750 (69.85)	5/8 x 7/32 (15.87 x 5.56)		
	2.937 (74.60)	5/8 x 1/8 (15.87 x 3.18)		
750	2.437 61.90) 2.500 (63.50) 2.750 (69.85)	5/8 x 5/16 (15.87 x 7.93)	2.250 (57.15)	3.437 (87.30)
	2.937 (74.60) 3.000 (76.20)	3/4 x 3/8 (19.05 x 9.52)		
	3.250 (82.55)	3/4 x 1/4 (19.05 x 6.35)		
	3.437 (87.30)	3/4 x 3/16 (19.05 x 4.75)		
800	2.937 (74.60) 3.000 (76.20) 3.250 (82.55)	3/4 x 3/8 (19.05 x 9.52)	2.625 (66.67)	4.437 (112.70)
	3.437 (87.30) 3.500 (88.90) 3.750 (95.25)	7/8 x 7/16 (22.22 x 11.10)		
	3.937 (100.00) 4.000 (101.60)	1 x 1/2 (25.40 x 12.70)		
	4.250 (107.95)	1 x 3/8 (25.40 x 9.52)		
	4.437 (112.70)	1 x 1/4 (25.40 x 6.35)		
900	3.937 (100.00) 4.000 (101.60) 4.250 (107.95) 4.437 (112.70) 4.500 (114.30) 4.750 (120.65)	1 x 1/2 (25.40 x 12.70)	3.625 (92.07)	5.437 (138.10)
	4.937 (125.40) 5.000 (127.00)	1 x 3/8 (25.40 x 9.52)		
	5.250 (133.35) 5.437 (138.10)	1 x 1/4 (25.40 x 6.35)		

* For finished dimensions of keys supplied with the clutch, contact Formsprag.

† For Bore Sizes/Shaft Tolerances, see page 34.

Dimensions inches (mm)

Size	Q	R	S	T	U	V
700	1.00 (25.40)	7.00 (177.80)	7.13 (180.97)	6.00 (152.40)	6.00 (152.40)	5.00 (127.00)
750	1.00 (25.40)	8.00 (203.20)	8.00 (203.20)	11.50 (292.10)	7.25 (184.15)	7.25 (184.15)
800	1.00 (25.40)	10.00 (254.00)	10.00 (254.00)	12.50 (317.50)	8.00 (203.20)	7.75 (196.85)
900	1.50 (38.10)	10.00 (254.00)	12.00 (304.80)	13.50 (342.90)	9.25 (234.95)	8.75 (222.25)

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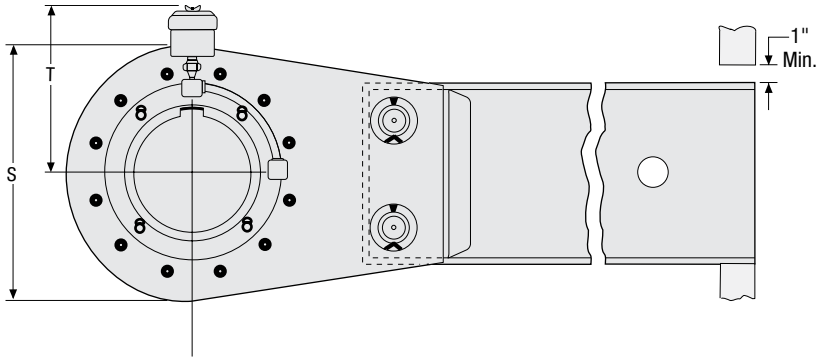
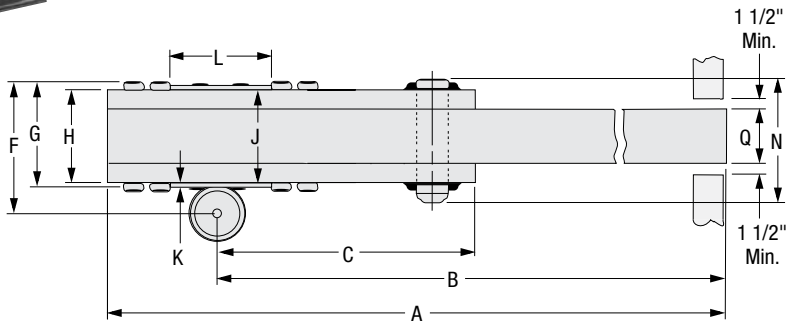
Model Sizes 1027 Through 5000

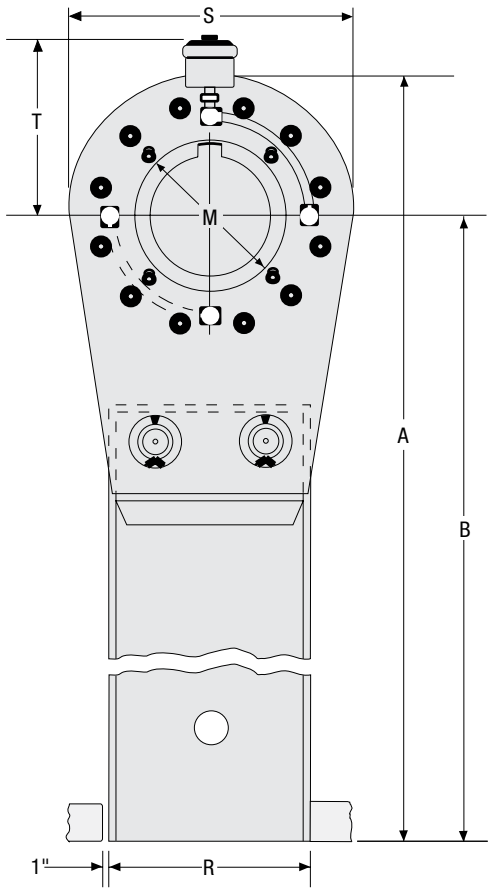


Horizontal Mounting



Dimensions inches (mm)

Size	A	B	C	F	G	H	J	K	L	M	N
1027	68.63 (1743.55)	61.88 (1571.62)	18.00 (457.20)	9.63 (244.47)	9.50 (241.30)	8.25 (209.55)	6.63 (168.27)	— —	8.88 (225.42)	10.75 (273.05)	10.00 (254.00)
1051	68.63 (1743.07)	61.13 (1552.57)	18.00 (457.20)	14.25 (361.95)	10.75 (273.05)	9.50 (241.30)	9.63 (244.47)	0.06 (1.57)	8.63 (219.07)	9.63 (244.47)	11.88 (301.62)
1250	76.00 (1930.40)	66.00 (1676.40)	20.25 (514.36)	14.97 (380.24)	11.57 (293.88)	9.80 (248.92)	10.25 (260.35)	.23 (5.84)	10.56 (268.22)	12.00 (304.80)	12.00 (304.80)
1300	77.75 (1974.85)	67.00 (1701.80)	21.81 (553.97)	15.10 (383.54)	11.87 (300.23)	9.80 (248.92)	10.25 (260.35)	.23 (5.84)	11.72 (297.69)	13.00 (330.20)	12.00 (304.80)
1375	82.25 (2089.15)	70.00 (1778.00)	24.50 (622.30)	15.22 (386.59)	12.07 (306.58)	9.80 (248.92)	11.00 (279.40)	.61 (15.494)	13.56 (344.42)	15.00 (381.00)	12.00 (304.80)
2000	97.00 (2463.80)	82.00 (2082.80)	29.44 (747.70)	15.38 (390.52)	12.38 (314.32)	10.38 (263.52)	10.62 (269.8)	0.13 (3.17)	17.56 (446.07)	19.25 (488.95)	13.00 (330.20)
2400	100.50 (2552.70)	82.50 (2095.50)	34.19 (868.35)	15.38 (390.52)	12.38 (314.32)	10.63 (269.87)	10.88 (276.22)	0.13 (3.17)	19.56 (496.87)	21.25 (539.75)	13.25 (336.55)
3500	101.50 (2578.10)	82.50 (2095.50)	34.12 (866.65)	20.16 (512.06)	17.00 (431.80)	14.75 (374.65)	18.00 (457.20)	1.03 (26.16)	22.46 (570.48)	26.00 (660.40)	16.75 (425.45)
5000	101.50 (2578.10)	82.50 (2095.50)	34.12 (866.65)	24.66 (626.36)	21.50 (546.10)	19.25 (488.95)	22.81 (579.37)	1.03 (26.16)	22.46 (570.48)	26.00 (660.40)	21.25 (539.75)



Vertical Mounting

(Must be mounted at least 10° off of vertical)

Dimensions inches (mm)

Size	P*	Q	R	S	T
1027	8.25 (209.55)	5.25 (133.35)	12.00 (304.80)	15.00 (381.00)	14.50 (368.30)
1051	9.50 (241.30)	5.25 (133.35)	12.00 (304.80)	15.00 (381.00)	12.00 (304.80)
1250	— —	5.50 (139.70)	15.00 (381.00)	20.00 (508.00)	13.17 (334.52)
1300	— —	6.25 (158.75)	18.00 (457.20)	21.50 (546.10)	13.42 (340.87)
1375	— —	6.25 (158.75)	18.00 (457.20)	24.50 (622.30)	14.55 (369.57)
2000	— —	7.13 (180.97)	24.00 (609.60)	30.00 (762.00)	17.25 (438.15)
2400	— —	7.88 (200.02)	24.00 (609.60)	36.00 (914.40)	18.75 (476.25)
3500	— —	8.00 (203.20)	24.00 (609.670)	38.00 (965.20)	20.17 (512.32)
5000	— —	8.00 (203.20)	24.00 (609.60)	38.00 (965.20)	20.17 (512.32)

* Width over torque cap, see page 25.

Bore sizes and keyseats**† inches (mm)

Size	Bore Size	Keyseat	Bore Range Min.	Bore Range Max.
1027	4.937 (125.40) to 6.000 (152.40)	1 1/4 x 5/8 (31.75 x 15.87)	4.937 (125.40)	7.000 (177.80)
	6.250 (158.75) to 6.500 (165.10)	1 1/2 x 1/2 (38.10 x 12.70)		
	6.750 (171.45) to 7.000 (177.80)	1 1/2 x 7/16 (38.10 x 11.10)		
1051	5.000 (127.00) to 6.000 (152.40)	1 1/4 x 5/8 (31.75 x 15.88)	4.937 (125.40)	7.000 (177.80)
	6.250 (158.75) to 6.625 (162.28)	1 1/2 x 5/8 (38.10 x 15.88)		
	6.750 (171.45) to 6.875 (174.63)	1 1/2 x 1/2 (38.10 x 12.70)		
	7.000 (177.80)	1 1/2 x 7/16 (38.10 x 11.11)		
1250	7.50 (190.50) to 7.937 (201.60)	1 3/4 x 7/8 (44.45 x 22.35)	6.750 (171.45)	9.000 (228.60)
	8.000 (203.20) to 8.250 (209.55)	1 3/4 x 5/8 (44.45 x 16.00)		
	8.312 (211.12) to 9.000 (228.60)	1 1/2 x 1/2 (38.10 x 12.70)		
1300	8.000 (203.20) to 9.000 (228.60)	1 3/4 x 7/8 (44.45 x 22.35)	7.937 (201.60)	10.000 (254.00)
	9.063 (230.20) to 10.000 (254.00)	1 1/2 x 1/2 (38.10 x 12.70)		
1375	9.000 (228.60) to 10.250 (260.35)	1 3/4 x 7/8 (44.45 x 22.35)	8.937 (227.00)	11.000 (279.40)
	10.312 (261.93) to 11.00 (279.40)	2 x 3/4 (50.80 x 19.05)		
2000	10.937 (277.80) to 12.000 (304.80)	2 1/2 x 1 1/4 (63.50 x 31.75)	10.937 (277.80)	13.250 (336.55)
	12.063 (306.40) to 13.250 (336.55)	2 1/2 x 1 (63.50 x 25.40)		
2400	13.000 (330.20) to 15.000 (381.00)	2 1/2 x 1 1/4 (63.50 x 31.75)	13.000 (330.20)	15.500 (393.70)
	15.063 (382.60) to 15.500 (393.70)	2 1/2 x 1 (63.50 x 25.40)		
3500	13.437 (341.30) to 13.750 (349.25)	2 1/2 x 1 1/4 (63.50 x 31.75)	13.437 (341.30)	20.00 (508.00)
	14.000 (355.60) to 18.000 (457.20)	3 x 1 1/2 (76.20 x 38.10)		
	20.000 (508.00)	3 x 1 1/4 (76.20 x 31.75)		
5000	13.437 (341.30) to 13.750 (349.25)	2 1/2 x 1 1/4 (63.50 x 31.75)	13.437 (341.30)	20.00 (508.00)
	14.000 (355.60) to 18.000 (457.20)	3 x 1 1/2 (76.20 x 38.10)		
	20.000 (508.00)	3 x 1 1/4 (76.20 x 31.75)		

** For finished dimensions of keys supplied with the clutch, contact Formsprag.

† For Bore Sizes/Shaft Tolerances, see page 34.

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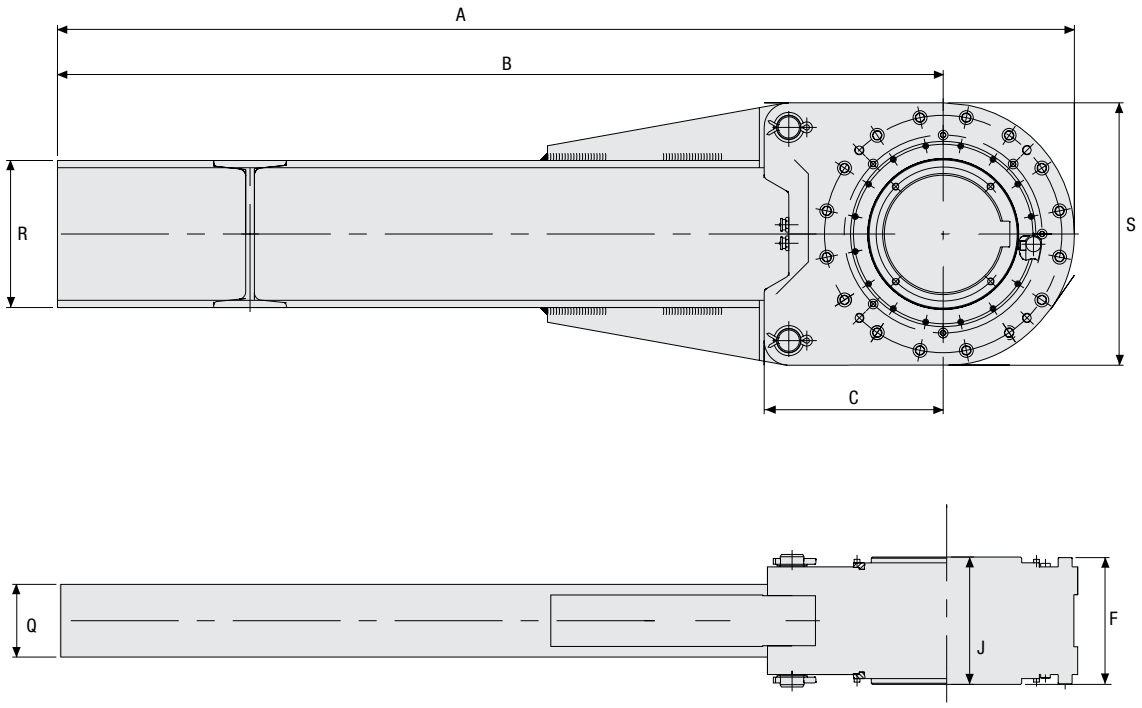
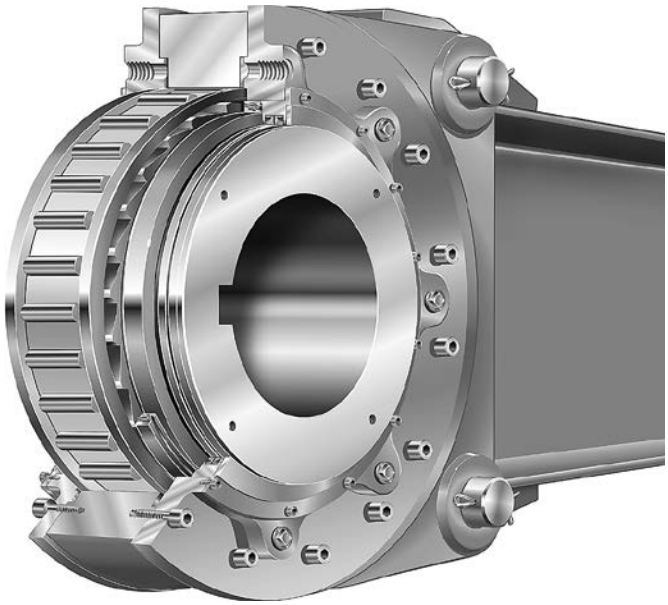
Model Sizes 1250R Through 5500R



Dimensions inches (mm)

Model No.	Torque Capacity	Maximum Overrunning Speed	A	B	C	F	J	Shipping Weight
1250R	63,000 (85909)	120	87.44 (2221)	77.95 (1980)	12.25 (311)	9.3 (236)	9.3 (236)	830 (381)
1300R	90,000 (122040)	105	91.89 (2334)	81.89 (2080)	14.25 (362)	10.5 (267)	10.5 (267)	1,130 (520)
1375R	135,000 (183060)	90	99.61 (2530)	87.99 (2235)	16.06 (408)	11.75 (298)	11.75 (298)	1,500 (690)
2000R	180,000 (244407)	80	107.72 (2736)	94.09 (2390)	16.54 (420)	12.6 (320)	12.6 (320)	2,100 (966)
2400R	240,000 (325,396)	70	115.16 (2925)	100.00 (2540)	18.0 (457)	16.0 (406)	16.0 (406)	2,700 (1242)
3500R	375,000 (508432)	60	138.89 (3528)	120.00 (3048)	23.0 (584)	18.75 (476)	18.7 (476)	6,000 (2760)
5000R	540,000 (732142)	60	166 (4216)	144 (3658)	26.50 (673)	22.5 (572)	22.5 (572)	9,000 (4140)
5500R	720,000 (976271)	60	166 (4216)	144 (3658)	26.50 (673)	23.5 (597)	23.5 (597)	10,000 (4545)

* Torque arm I-beam. S-type section dimensions may vary according to the American Iron and Steel Institute or DIN standards.



Dimensions inches (mm)

Model No.	Q*	R*	S
1250R	5.00 (127)	10.00 (254)	19.6 (489)
1300R	5.51 (140)	12.01 (305)	23.0 (584)
1375R	5.62 (143)	15.00 (381)	25.7 (653)
2000R	6.26 (159)	18.00 (457)	30.3 (770)
2400R	6.38 (162)	20.00 (508)	34.5 (876)
3500R	8.00 (203)	24.20 (615)	41.0 (1041)
5000R	10.12 (257)	27.20 (691)	47.0 (1194)
5500R	10.12 (257)	27.20 (691)	47.0 (1194)

Bore sizes and keyseats**† inches (mm)

Model No.	Bore Size	Keyseat	Bore Range Min.	Bore Range Max.
1250R	6.000 (152.00) to 6.500 (165.10)	1.500 x .75 (38.10 x 19.05)	5.25 (133.35)	8.000 (203.2)
	6.563 (166.70) to 7.500 (190.50)	1.750 x .75 (44.45 x 15.88)		
	7.563 (192.10) to 8.250 (209.55)	2.000 x .75 (50.80 x 19.05)		
1300R	6.500 (165.10)	1.500 x .75 (38.10 x 12.70)	5.75 (146.05)	9.000 (230.00)
	6.563 (166.70) to 7.500 (190.50)	1.750 x .75 (44.45 x 19.05)		
	7.563 (192.10) to 8.750 (222.25)	2.000 x .75 (50.80 x 19.05)		
1375R	7.750 (196.85) to 9.000 (228.60)	2.000 x .75 (50.80 x 19.05)	6.75 (171.45)	10.500 (270.00)
	9.063 (230.20) to 10.250 (260.35)	2.500 x .88 (63.50 x 22.23)		
2000R	9.000 (228.60)	2.000 x .75 (50.80 x 19.05)	7.25 (184.15)	11.75 (298.45)
	9.063 (230.20) to 11.000 (279.40)	2.500 x .88 (63.50 x 22.23)		
	11.063 (281.00) to 12.000 (304.80)	.000 x 1.00 (76.20 x 25.40)		
2400R	10.500 (266.70) to 11.000 (279.40)	2.500 x .88 (63.50 x 22.23)	8.25 (209.55)	14.000 (360.00)
	11.063 (281.00) to 13.000 (330.20)	3.000 x 1.00 (76.20 x 25.40)		
	13.063 (331.80) to 13.750 (249.25)	3.500 x 1.25 (88.90 x 31.75)		
3500R	13.000 (330.20)	3.000 x 1.00 (76.20 x 25.40)	10.25 (260.35)	18.00 (457.20)
	13.063 (331.80) to 15.000 (381.00)	3.500 x 1.25 (88.90 x 31.75)		
	15.063 (382.60) to 17.000 (431.80)	4.000 x 1.50 (101.60 x 38.10)		
5000R and 5500R	13.000 (330.20)	3.000 x 1.00 (76.20 x 25.40)	15.25 (387.35)	21.00 (533.40)
	13.063 (331.80) to 15.000 (381.00)	3.500 x 1.25 (88.90 x 31.75)		
	15.063 (382.60) to 18.000 (457.20)	4.000 x 1.50 (101.60 x 38.10)		
	18.063 (458.80) to 22.000 (558.80)	5.000 x 1.75 (127.00 x 44.45)		
	22.063 (560.40) to 21.000 (533.4)	6.000 x 4.00 (152.40 x 101.60)		

** For finished dimensions of keys supplied with the clutch, contact Formsprag.
† For Bore Sizes/Shaft Tolerances, see page 34.

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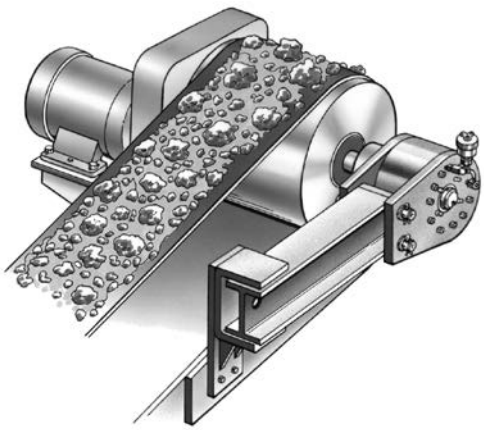
Selection Procedure

Conveyors

There are basically two ways to size conveyor backstops or holdbacks, either according to CEMA (Conveyor Equipment Manufacturers Association) standards or based on motor breakdown/stall torque values. Formsprag recommends that the selection be made on whichever value is greater.



CEMA Formula:

The CEMA formula allows the design engineer to consider friction as a partial aid in preventing reverse rotation, thus reducing the torque capacity required for the clutch. Selection by this method does require the use of a service factor (S.F.). The basic CEMA formula for design torque is:

$$T_{cema}\ (lb.ft.) = \frac{(S.F.)\ (Lift\ HP - 1/2\ Friction\ HP)\ (5{,}250)}{(Headshaft\ RPM)}$$

Formsprag recommends a minimum service factor of 1.5 when sizing with this formula. See worksheet, page 31.

Motor Breakdown or Stall Torque Formula:

Motor breakdown or stall torque could be imposed on the backstop if the conveyor is jammed or frozen, or when the conveyor is overloaded. In this condition the motor will produce stall torque which is significantly higher than the motor nameplate rating. This will cause the belt to stretch; and when the motor stalls, the stall torque produced by the motor will be imposed on the backstop. This torque will be increased if there is a load on the belt. Therefore, the maximum loading on a backstop occurs in the rare case of a moving belt being gradually overloaded until the motor reaches stall or breakdown torque. The torque on the backstop will be the motor torque from the stretched belt plus the torque from the load moving in the reverse direction due to the force of gravity.

To select a holdback based on motor breakdown torque, calculate motor torque using the following formula:

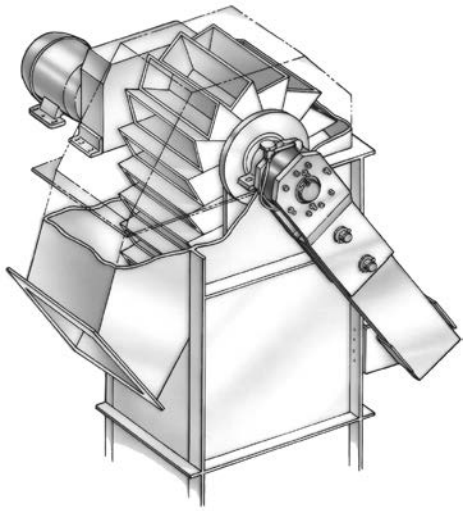
$$T_{motor}\ (lb.ft.) = \frac{(S.F.)\ (Motor\ Nameplate\ HP)\ (5{,}250)}{(Headshaft\ RPM)}$$

The clutch may be selected on the basis of installed nameplate horsepower without using a service factor (S.F.), provided the motor breakdown torque does not exceed 175 percent of the nameplate rating; a minimum service factor based upon the ratio of motor breakdown torque to 175 percent of nameplate torque is required in order to preclude serious damage to the installation or to the holdback.

Torque Limiting Device:

If a torque limiting device is used and is less than 175 percent of the motor nameplate torque, then the holdback selected should have a capacity not less than 1.5 times the CEMA runback torque.

Bucket Elevators



When selecting and sizing long life holdbacks application on bucket elevators, friction may or may not be considered because it is usually only a small fraction of the lift HP required. Similarly, motor breakdown HP is usually not considered if traction wheel drives are used because the elevator will usually slip before the breakdown HP is reached. For these reasons, the recommended design torque is based on lift HP alone.

$$T_B\ (lb.ft.) = \frac{(S.F.)\ (Lift\ HP)\ (5{,}250)}{(Headshaft\ RPM)}$$

A minimum service factor (S.F.) of 2.0 is recommended. If additional assistance is needed, consult Formsprag Application Engineering.

Speed and Idler Factors

Conveyors under 500' in length

Based on:

Material Weight (W)
Total Lift (H)
Conveyor Length (L)

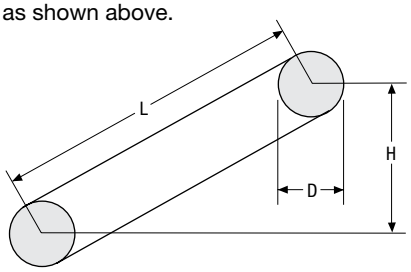
F = Speed factor for empty belt
C = Idler factor for loaded belt

Factor used depends on H/L Ratio
(Sine of Angle of Slope)

Belt Width	Material Weight (lb.ft.3) 30 lbs. F	30 lbs. C	50 lbs. F	50 lbs. C	75 lbs. F	75 lbs. C	100 lbs. F	100 lbs. C	130 lbs. F	130 lbs. C	200 lbs. F	200 lbs. C	H/L (Ratio)
18"	.017	.050	.017	.050	.018	.050	.018	.050	.018	.050	.020	.037	.0 - .105
	.015	.040	.015	.040	.016	.040	.016	.040	.018	.034	.020	.033	.105 - .310
24"	.021	.050	.020	.043	.020	.045	.020	.041	.020	.045	.022	.037	.0 - .105
	.020	.035	.019	.033	.019	.033	.020	.030	.020	.030	.020	.030	.105 - .310
30"	.025	.044	.025	.043	.022	.037	.022	.041	.025	.038	.022	.037	.0 - .105
	.024	.030	.025	.028	.022	.028	.023	.025	.025	.025	.025	.025	.105 - .310
36"	.030	.040	.030	.038	.030	.037	.030	.038	.032	.038	.030	.039	.0 - .105
	.027	.030	.027	.030	.027	.030	.027	.030	.032	.029	.030	.023	.105 - .310
42"	.030	.040	.036	.036	.030	.040	.030	.040	.036	.040	.038	.040	.0 - .105
	.031	.030	.031	.030	.035	.027	.036	.027	.036	.027	.038	.027	.105 - .310
48"	.038	.036	.038	.038	.038	.039	.043	.038	.045	.040	.052	.044	.0 - .105
	.038	.030	.038	.030	.040	.027	.043	.027	.043	.027	.052	.027.	.105 - .310
54"	.040	.037	.040	.040	.045	.042	.046	.042	.050	.047	—	—	.0 - .105
	.040	.030	.041	.028	.047	.028	.051	.028	.051	.030	—	—	.105 - .310
60"	.042	.037	.042	.040	.052	.045	.052	.049	—	—	—	—	.0 - .105
	.042	.030	.042	.028	.052	.029	.052	.030	—	—	—	—	.105 - .310

Worksheet—CEMA Formula

Holdback torque calculations are based on lift HP minus one-half friction HP. Equations are condensed and constants are tabulated as shown above.



Data

Conveyor Length	L	= _____	feet
Belt Speed	S	= _____	FPM
Short Tons Per Hour	W	= _____	TPH
Total Lift	H	= _____	feet
Headshaft Pulley Diameter	D	= _____	feet
Belt Width		= _____	inches
Material Weight		= _____	lb./ft.^{3}
Speed Factor	F	= _____	
Idler Factor	C	= _____	
Service Factor		= _____	
		(1.5 minimum)	

Calculations

Enter the data into these equations and perform the calculations following the sample worksheet.

(1) Power to lift load (P1):

$$P1 = \frac{WH}{990} = \frac{(\quad)\quad(\quad)}{990} = \_\_\_\_\_ \text{ HP}$$

(2) Power to move empty belt and idlers (P2):

$$P2 = \frac{.5LSF}{1{,}000} = \frac{.5\quad(\quad)\quad(\quad)\quad(\quad)}{1{,}000} = \_\_\_\_\_ \text{ HP}$$

(3) Power to move loaded belt (P3):

$$P3 = \frac{.5LWC}{990} = \frac{.5\quad(\quad)\quad(\quad)\quad(\quad)}{990} = \_\_\_\_\_ \text{ HP}$$

(4) Total Holdback Power (HBP) = P1 – P2 – P3 = _____ HBP

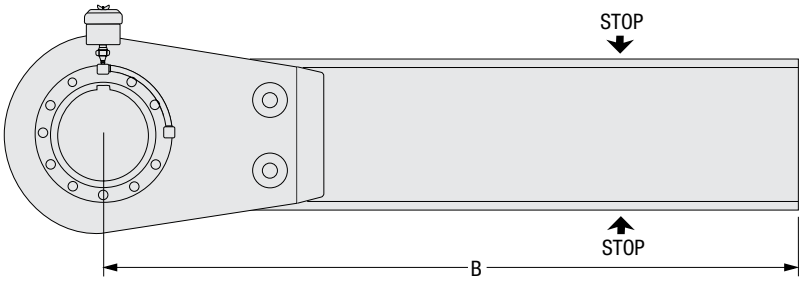
(5) Holdback Torque (T_{cema}) = $\frac{(HPB)\quad(\pi D)\quad 5{,}250\quad x\quad \text{Service Factor}}{S}$

$$T_{cema} = \frac{(\quad)\quad(\quad)\quad(\ 5{,}250\ )\quad(\quad)}{(\quad)} = \_\_\_\_\_ \text{ lb.ft.}$$

LLH

Torque Arm Installation

The torque arm reaction force is the force which the torque arm stops must resist. Formsprag recommends that the stops be at least 3/4 of the distance (B) away from the center line of the clutch.



The torque arm reaction force is calculated as follows:

$$\text{Torque Arm Reaction—lbs. (kg)} = \frac{\text{*Rated Backstopping Torque—lb.ft. (Nm)}}{\text{Distance (.75B) of stop from centerline—ft. (m)}}$$

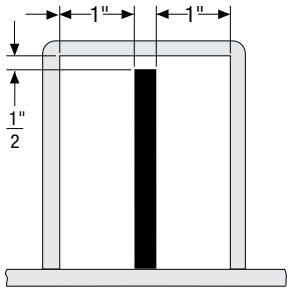
Note: Do not restrict torque arm movement in the axial direction.

*Ratings are shown on page 21 of catalog for applicable holdback.

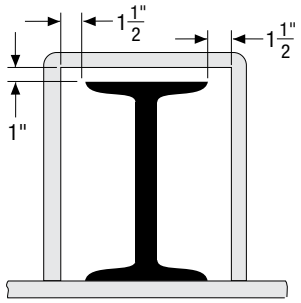
Torque Arm Clearance

Torque arm clearance is required on all sides of the torque arm to prevent binding which could cause uneven loading of the holdback bearings.

Note: The torque arm must not be rigidly fastened at reaction point.



Models 700 thru 900



Models 1027 thru 5000

Specifications

Size	B ft. (m)	.75B ft. (m)	Catalog Torque Values lb.ft. (Nm)	Torque Arm Reaction lb. (kg)
700S	2.5 (.76)	1.88 (.57)	4,000 (5424)	2,150 (975)
750S	2.67 (.81)	2.00 (.61)	6,800 (9221)	3,400 (1542)
800S	2.67 (.81)	2.00 (.61)	11,500 (15594)	5,750 (2608)
900S	3.67 (1.12)	2.75 (.84)	18,000 (24408)	6,550 (2970)
1027S	5.16 (1.57)	3.87 (1.18)	27,000 (36612)	7,000 (3175)
1051S	5.09 (1.55)	3.82 (1.16)	45,000 (61020)	12,000 (5443)
1250S	5.50 (1.68)	4.13 (1.26)	65,000 (88140)	15,750 (7145)
1250R	6.5 (1.98)	4.87 (1.48)	63,000 (85417)	12,936 (7145)
1300S	5.58 (1.71)	4.19 (1.28)	90,000 (122040)	21,500 (9750)
1300R	6.8 (2.0)	5.1 (1.5)	90,000 (122040)	17,647 (9750)
1375S	5.83 (1.78)	4.38 (1.34)	135,000 (183060)	31,000 (14060)
1375R	7.3 (2.2)	5.4 (1.65)	135,000 (183060)	25,000 (14060)
2000S	6.83 (2.08)	5.12 (1.56)	200,000 (271200)	39,500 (17917)
2000R	7.5 (2.3)	5.85 (1.72)	180,000 (244047)	30,770 (17917)
2400S	6.88 (2.10)	5.16 (1.57)	265,000 (359340)	51,500 (23360)
2400R	8.3 (2.5)	6.2 (1.87)	240,000 (325396)	38,700 (23360)
3500S	6.88 (2.10)	5.16 (1.57)	375,000 (508500)	68,000 (30844)
3500R	10 (3.0)	7.5 (2.25)	375,000 (508500)	50,000 (30844)
5000S	6.88 (2.10)	5.16 (1.57)	700,000 (949200)	136,250 (61800)
5000R	12 (3.6)	9 (2.7)	540,000 (732146)	60,000 (27272)
5500R	12 (3.6)	9 (2.7)	720,000 (976271)	80,000 (36363)

OSHA Cover Kit

End cover kits for shaft end mounted LLH units are available from Formsprag. These cover kits provide not only the stationary cover enclosure required by OSHA, but additional protection for the LLH from abrasive environments as well.

Note: OSHA requires that clutches with projecting parts (and operating seven (7) feet or less above the floor) must be enclosed by a stationary guard (see below). Also, shaft couplings with bolts, nuts and set screws must be covered with safety sleeves unless they are counter sunk or do not extend beyond the flange of the coupling (see below).

(k) *Guarding of clutches, cutoff couplings, and clutch pulleys*—(1) Guards. Clutch cutoff couplings, or clutch pulleys having projecting parts, where such clutches are located seven (7) feet or less above the floor or less above the floor or working platform, shall be enclosed by a stationary guard constructed in accordance with this section. A "U" type guard is permissible.

Size	End Cover Part No.	Dimension "A" Inches
LLH-700	CL-7891	2.00
LLH-750	CL-7892	2.00
LLH-800	CL-7893	2.00
LLH-900	CL-7894	2.00
LLH-1027	CL-7895	2.50
LLH-1051	CL-7896	2.50
LLH-1250	CL-7897	2.50
LLH-1300	CL-7898	2.50
LLH-1375	CL-7899	3.00
LLH-2000	CL-7900	3.00
LLH-2400	CL-7901	Consult
LLH-3500	CL-7902	Formsprag
LLH-5000	CL-7902	

(i)(2) *Couplings.* Shaft coupling shall be so constructed as to present no hazard from bolts, nuts, setscrews, or revolving surfaces. Bolts, nuts, and set screws will, however, be permitted where they are covered with safety sleeves or where they are used parallel with the shafting and are countersunk or else do not extend beyond the flange of the coupling.

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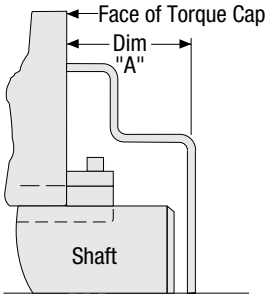
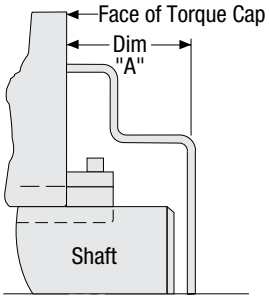
SATURDAY, MAY 29, 1971



Sizes 700 through 1027



Sizes 1051 through 5000

Lubrication

LLH Clutches are normally oil lubricated, see the Installation and Maintenance Bulletin No. 2224 for Models 700 thru 1027 or Bulletin No. 2211 for Models 1051 thru 5000 for the list of approved lubricants.

Grease Recommended for Long Life Holdbacks

Grease is recommended for vertical shaft applications, but it is not to be used where ambient temperatures are below +20°F. Below +20°F, consult Formsprag.

Storage

Formsprag LLH's are shipped 3/4 full of oil and ready for operation. If the clutch is to be stored for a long period of time (6 months to 2 years), it must be completely filled with oil (Mobil Artic "C") and stored under a roof at above freezing temperatures. At the customer's request, Formsprag will prepare the clutch for storage in accordance with our Spec SP-2700.

Oil Lubrication

The oil level should be checked weekly. To add oil, remove breather cover (entire breather on Model LLH-700), and pour oil into holdback.

Use a recommended oil for the permissible ambient temperature range as specified in the Installation and Maintenance Bulletin No. 2224 for Models 700 through 1027 or Bulletin No. 2211 for Models 1051 through 5000. Formsprag holdbacks are shipped three-fourths full of Mobil DTE Heavy Medium oil.

Holdbacks should be flushed every six months. If holdbacks operate under severe dust conditions, or 24 hours a day, flush every three months.

Auxiliary Seal Lubrication

Auxiliary seals should be lubricated every three months/monthly if clutch operates under extremely dusty conditions. To relubricate auxiliary seals, pump seals full, through all fittings on both sides, until old grease is purged and clean grease runs out around the entire circumference of seal.

Use a grease selected from the Installation and Maintenance Bulletin No. 2224 for Models 700 through 1027 or Bulletin No. 2211 for Models 1051 through 5000. Auxiliary seals are packed with Mobil Oil SHC 32 grease prior to shipment.

For additional information, request Lubrication & Maintenance Brochure A-4032 and Installation & Maintenance Bulletin No. 2224 for Models 700 through 1027. For Models 1051 through 5000, request Installation & Maintenance Bulletin No. 2211.

LLH

Bore sizes and shaft tolerances

English (inches)

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

Nominal Bore	Bore Diameter	Shaft Diameter
1.937	1.9385/1.9395	1.9375/1.9360
2.000	2.0010/2.0020	2.0000/1.9985
2.125	2.1260/2.1270	2.1250/2.1235
2.250	2.2510/2.2525	2.2500/2.2485
2.375	2.3760/2.3770	2.3750/2.3740
2.437	2.4385/2.4400	2.4375/2.4360
2.500	2.5010/2.5025	2.5000/2.4980
2.625	2.6260/2.6275	2.6250/2.6230
2.750	2.7510/2.7525	2.7500/2.7480
2.937	2.9385/2.9400	2.9375/2.9355
3.000	3.0010/3.0025	3.0000/2.9980
3.250	3.2510/3.2525	3.2500/3.2470
3.437	3.4385/3.4400	3.4375/3.4345
3.500	3.5010/3.5025	3.5000/3.4970
3.750	3.7510/3.7525	3.7500/3.7470
3.937	3.9385/3.9400	3.9375/3.9345
4.000	4.0010/4.0025	4.0000/3.9970
4.250	4.2510/4.2530	4.2500/4.2460
4.437	4.4385/4.4405	4.4375/4.4335
4.500	4.5010/4.5030	4.5000/4.4960
4.750	4.7510/4.7530	4.7500/4.7460
4.937	4.9385/4.9405	4.9375/4.9335
5.000	5.0010/5.0030	5.0000/4.9960
5.250	5.2510/5.2530	5.2500/5.2460
5.437	5.4385/5.4405	5.4375/5.4335
5.500	5.5010/5.5030	5.5000/5.4960
5.750	5.7510/5.7530	5.7500/5.7460
5.937	5.9385/5.9405	5.9375/5.9335
6.000	6.0020/6.0040	6.0000/5.9960
6.250	6.2520/6.2540	6.2500/6.2460
6.437	6.4390/6.4410	6.4375/6.4335
6.500	6.5020/6.5040	6.5000/6.4960
6.750	6.7520/6.7540	6.7500/6.7460
6.937	6.9400/6.9420	6.9375/6.9335

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

For bore sizes and recommended shaft tolerances for all other clutch series see page 42.

Nominal Bore	Bore Diameter	Shaft Diameter
7.000	7.003/7.005	7.001/7.000
7.500	7.504/7.506	7.502/7.501
7.750	7.754/7.756	7.752/7.751
8.000	8.004/8.006	8.002/8.001
8.250	8.254/8.256	8.252/8.251
8.500	8.504/8.506	8.502/8.501
8.750	8.754/8.756	8.752/8.751
9.000	9.004/9.006	9.002/9.000
9.250	9.254/9.256	9.252/.9.250
9.500	9.504/9.506	9.502/9.500
9.750	9.754/9.756	9.752/9.750
10.000	10.004/10.006	10.002/10.000
10.500	10.504/10.506	10.502/10.500
11.000	11.004/11.006	11.002/11.000
11.500	11.504/11.506	11.502/11.500
12.000	12.004/12.006	12.002/11.999
12.250	12.254/12.256	12.252/12.249
12.500	12.504/12.506	12.502/12.499
13.000	13.004/13.006	13.002/12.999
13.250	13.254/13.256	13.252/13.249
13.500	13.504/13.506	13.502/13.499
13.750	13.754/13.756	13.752/13.749
14.000	14.004/14.006	14.002/13.999
14.250	14.254/14.256	14.252/14.249
14.500	14.504/14.506	14.502/14.499
14.750	14.754/14.756	14.752/14.749
15.000	15.004/15.006	15.002/14.999
15.250	15.254/15.256	15.252/15.249
15.500	15.504/15.506	15.502/15.499
15.750	15.754/15.756	15.752/15.749
16.000	16.004/16.007	16.002/16.000
16.250	16.254/16.257	16.252/16.250
16.500	16.504/16.507	16.502/16.500
16.750	16.754/16.757	16.752/16.750
17.000	17.004/17.007	17.002/17.000
17.250	17.254/17.257	17.252/17.250
17.500	17.504/17.507	17.502/17.500
17.750	17.754/17.757	17.752/17.750
18.000	18.004/18.007	18.002/18.000
18.250	18.254/18.257	18.252/18.250
18.500	18.504/18.507	18.502/18.500
18.750	18.754/18.757	18.752/18.750
19.000	19.004/19.007	19.002/19.000
20.000	20.004/20.007	20.002/20.000

Metric (millimeters)

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

For metric bores the recommended bore tolerances are F7.

Nominal Bore	Bore Diameter	Shaft Diameter
49.20	49.24/49.26	49.21/49.17
50.80	50.83/50.85	50.80/50/76
53.98	54.00/54.03	53.97/53.94
57.15	57.18/57.21	57.15/57.11
61.90	61.94/61.98	61.91/61.87
63.50	63.53/63.56	63.50/63.45
66.68	66.70/66.74	66.68/66.62
69.85	69.88/69.91	69.85/69.80
74.60	74.64/74.68	74.61/74.56
76.20	76.23/76.26	76.20/76.15
82.55	82.58/82.61	82.55/82.47
87.30	87.34/87.38	87.31/87.24
88.90	88.92/88.96	88.90/88.82
95.25	95.28/95.31	95.25/95.17
100.00	100.04/100.08	100.01/99.94
101.60	101.63/101.66	101.60/101.52
107.95	107.98/108.03	107.95/107.88
112.70	112.74/112.79	112.71/112.61
114.30	114.33/114.38	114.30/114.20
120.65	120.68/120.73	120.65/120.55
125.40	124.44/125.49	125.43/125.31
127.00	127.03/127.08	127.00/126.90
133.35	133.38/133.43	133.35/133.25
138.10	138.14/138.19	138.11/138.01
139.70	139.72/139.78	139.70/139.60
146.05	146.08/146.13	146.05/145.95
150.80	150.84/150.89	150.81/150.71
152.40	152.45/152.50	152.40/152.30
158.75	158.80/158.85	158.75/158.65
163.50	163.55/163.60	163.51/163.41
165.10	165.15/165.20	165.10/164.10
171.45	171.50/171.55	171.45/171.35
176.20	176.28/176.33	176.21/176.11

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.

For bore sizes and recommended shaft tolerances for all other clutch series see page 43.

Nominal Bore	Bore Diameter	Shaft Diameter
177.80	177.88/177.93	177.83/177.80
190.50	190.60/190.66	190.55/190.53
196.85	196.95/197.00	196.90/196.88
203.20	203.30/203.35	203.25/203.23
209.55	209.65/209.70	209.60/209.58
215.90	216.00/216.05	215.95/215.93
222.25	222.35/222.40	222.30/222.28
228.60	228.70/228.75	228.65/228.60
234.95	235.05/235.10	235.00/234.95
241.30	241.40/241.45	241.35/241.30
247.65	247.75/247.80	247.70/247.65
254.00	254.10/254.15	254.05/254.00
266.80	266.80/266.85	266.75/266.70
279.40	279.50/279.55	279.45/279.40
292.10	292.20/292.25	292.15/292.10
304.80	304.90/304.95	304.85/304.77
311.15	311.25/311.30	311.20/311.12
317.50	317.60/317.65	317.55/317.47
330.20	330.30/330.35	330.25/330.17
336.55	336.65/336.70	336.60/336.52
342.90	343.00/343.05	342.95/342.87
349.25	349.35/349.40	349.30/349.22
355.60	355.70/355.75	355.65/355.57
361.95	362.05/362.10	362.00/361.92
368.30	368.40/368.45	368.35/368.27
374.65	374.75/373.80	374.70/374.62
381.00	381.10/381.15	381.05/380.97
387.35	387.45/387.50	387.40/387.32
393.70	393.80/393.85	393.75/393.67
400.05	400.15/400.20	400.10/400.02
406.40	406.50/406.58	406.45/406.40
412.75	412.85/412.93	412.80/412.75
419.10	419.20/419.28	419.15/419.10
425.25	425.55/425.63	425.50/425.45
431.80	431.90/431.98	431.85/431.80
438.15	438.25/438.33	438.20/438.15
444.50	444.60/444.68	444.55/444.50
450.85	450.95/451.01	450.90/450.85
457.20	457.30/457.38	457.25/457.20
463.55	463.65/463.73	463.60/463.55
469.90	470.00/470.08	469.95/469.90
476.25	476.35/476.43	476.30/476.25
482.60	482.70/482.78	482.65/482.60
508.00	508.10/508.18	508.05/508.00

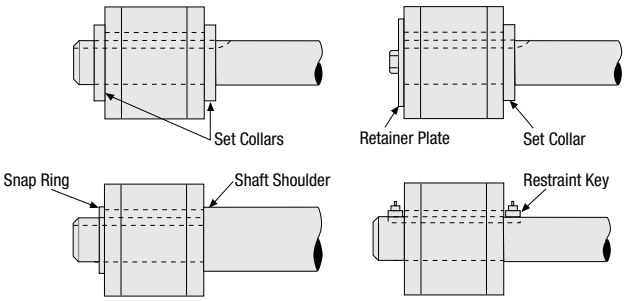
Axial Restraint Set Collars

Axial Restraint

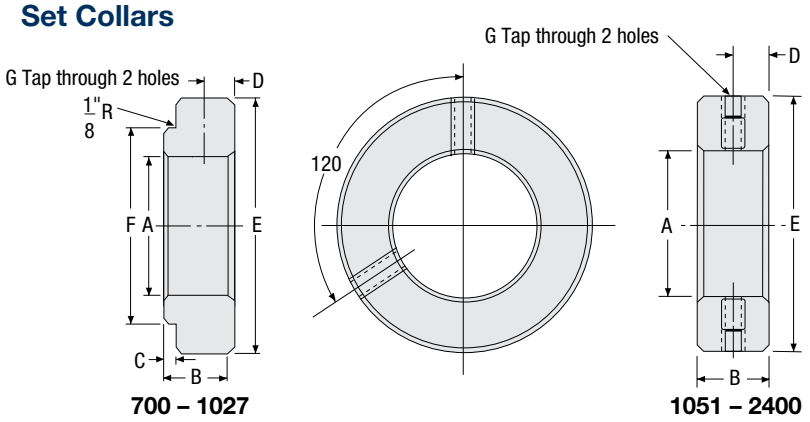
Formsprag requires that all clutches and holdbacks be axially restrained when mounted. Our recommended bore to shaft fits are loose to facilitate installation and removal, therefore, axial restraint must be provided by set collars, shoulders, restraining keys, retaining snap rings, retainer plates, or some other axial restraint device approved by Formsprag.

Holdback axial restraint is required to prevent the reaction end of the torque arm from imposing biasing loads on the bearings. Holdbacks installed without axial restraint can shift on the shaft, causing bearing loads which can significantly reduce bearing B-10 life.

For customers wishing to have a tolerance gap between the axial restraining device and the holdback inner race, a maximum gap of 1/8" per side is recommended.



Set Collars



700 – 1027 1051 – 2400

Shaft Length Required to Mount LLH with Two Set Collars

Model	Required Shaft Length in.	mm
700	8.67	220.22
750	9.64	244.86
800	9.91	251.49
900	10.28	261.11
1027	11.03	280.16
1051	12.13	308.10
1250	13.25	336.55
1300	13.25	336.55
1375	14.50	368.30
2000	14.13	358.90
2400	14.88	377.95
3500	22.00	558.80
5000	22.00	558.80

Dimensions inches (mm)

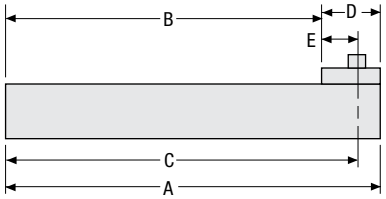
Size	Part No.	A Bore	B	C	D	E	F	G Bore	Screw
700	CL32136-1	1.938 to 2.938 (49.23 to 74.63)	1.625 (41.28)	.625 (15.88)	.500 (12.70)	4.000 (101.60)	3.500 (88.90)	.500-20	SC2206-N
750	CL32136-2	2.438 to 3.438 (61.93 to 87.33)	1.565 (39.70)	.563 (14.30)	.500 (12.70)	4.500 (114.30)	4.000 (101.60)	.500-20	SC2206-N
800	CL32136-3	2.938 to 4.438 (74.63 to 112.73)	1.688 (42.88)	.688 (17.48)	.500 (12.70)	5.500 (139.70)	5.000 (127.00)	.500-20	SC2206-N
900	CL32136-4	3.938 to 5.438 (100.03 to 138.13)	1.688 (42.88)	.688 (17.48)	.500 (12.70)	6.500 (165.10)	6.000 (152.40)	.500-20	SC2206-N
1027	CL32136-5	4.938 to 7.000 (125.43 to 177.80)	1.938 (49.23)	.688 (17.48)	.625 (15.88)	8.000 (203.20)	7.625 (193.68)	.500-20	SC2206-N
1051	CL32136-6	4.938 to 7.000 (125.43 to 177.80)	1.250 (31.75)	— —	.625 (15.88)	8.000 (203.20)	— —	.500-20	SC2206-N
1250	CL32136-8	6.750 to 9.000 (171.45 to 228.60)	1.500 (38.10)	— —	.750 (19.05)	10.000 (254.00)	— —	.625-18	SC2608-N
1300	CL32136-9	7.938 to 10.000 (201.64 to 254.00)	1.500 (38.10)	— —	.750 (19.05)	11.250 (285.75)	— —	.625-18	SC2608-N
1375	CL32136-15	8.938 to 11.000 (227.03 to 279.40)	1.750 (44.45)	— —	.875 (22.23)	13.000 (330.20)	— —	.750-10	SC2711-N
2000	CL32136-12	11.000 to 13.250 (279.40 to 336.55)	1.750 (44.45)	— —	.875 (22.23)	15.500 (393.70)	— —	.750-10	SC2711-N
2400	CL32136-13	13.250 to 15.500 (336.55 to 393.70)	2.000 (50.80)	— —	1.000 (25.40)	19.563 (496.90)	— —	.750-10	SC2711-N
3500	Built-in Set Collar								
5000	Built-in Set Collar								

Axial Restraint Keys Introduction

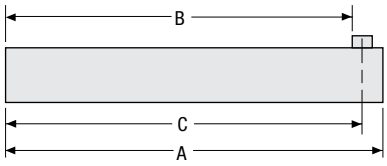
Restraint keys are a cost effective method of providing axial restraint for clutches and holdbacks. The restraint key is longer than the clutch through bore length or clutch width. The single block key will prevent axial movement in only one direction and must be used with some other means to prevent movement in the other direction such as a set collar or a step in the shaft.

The double block key will prevent axial movement of the clutch in either direction. All restraint keys must be secured in the shaft key seat. This can usually be accomplished by cutting the keyseat with an end mill without breaking out at the end of the shaft.

Single Block

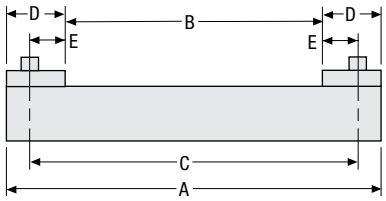


LLH-700 thru LLH-1027

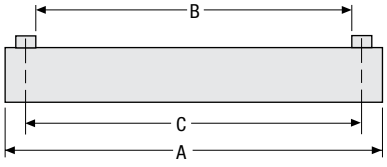


LLH-1051 thru LLH-5000

Double Block



LLH-700 thru LLH-1027



LLH-1051 thru LLH-5000

Single Block Style inches (mm)

Size	A	B	C	D	E	Screw Series
700	6.312 (160.32)	5.062 (128.57)	6.000 (152.40)	1.250 (31.75)	.937 (23.80)	SC1000
750	7.500 (190.50)	6.062 (153.97)	7.062 (179.37)	1.437 (36.50)	1.000 (25.40)	SC1000
800	7.625 (193.68)	6.062 (153.97)	7.187 (182.44)	1.562 (39.67)	1.125 (28.58)	SC1300
900	8.062 (204.77)	6.437 (163.50)	7.625 (193.68)	1.625 (41.28)	1.187 (30.15)	SC1500
1027	8.312 (211.12)	6.687 (169.85)	7.875 (200.03)	1.625 (41.28)	1.187 (30.15)	SC1500
1051	10.625 (269.88)	9.687 (246.05)	9.968 (253.19)	—	—	SC1700
1250	11.187 (284.15)	10.312 (261.92)	10.593 (269.06)	—	—	SC1700
1300	11.187 (284.15)	10.312 (261.92)	10.593 (269.06)	—	—	SC1700
1375	12.187 (309.55)	11.062 (280.97)	11.437 (290.50)	—	—	SC2100
2000	11.625 (295.28)	10.687 (271.45)	11.062 (280.97)	—	—	SC2100
2400	11.875 (301.63)	10.937 (277.80)	11.687 (296.85)	—	—	SC2100

Double Block Style inches (mm)

Size	A	B	C	D	E	Screw Series
700	7.625 (193.68)	5.125 (130.18)	7.000 (177.80)	1.250 (31.75)	.938 (23.83)	SC1000
750	9.000 (228.60)	6.125 (155.58)	8.125 (206.38)	1.438 (36.53)	1.000 (25.40)	SC1000
800	9.250 (234.95)	6.125 (155.58)	8.375 (212.73)	1.563 (39.70)	1.125 (28.58)	SC1300
900	9.750 (247.65)	6.500 (165.10)	8.875 (225.43)	1.625 (41.28)	1.188 (30.18)	SC1500
1027	10.000 (254.00)	6.750 (171.45)	9.125 (231.78)	1.625 (41.28)	1.188 (30.18)	SC1500
1051	11.625 (295.28)	9.750 (247.65)	10.313 (261.95)	—	—	SC1700
1250	12.062 (306.37)	10.375 (263.53)	10.938 (277.83)	—	—	SC1700
1300	12.062 (306.37)	10.375 (263.53)	10.938 (277.83)	—	—	SC1700
1375	13.375 (339.73)	11.125 (282.58)	11.875 (301.63)	—	—	SC2100
2000	12.625 (320.68)	10.750 (273.05)	11.500 (292.10)	—	—	SC2100
2400	13.000 (330.20)	11.000 (279.40)	11.750 (298.45)	—	—	SC2100

3500 to 5000 as required

Note: Restraint keys must be secured in shaft keyseat.

Stub Shaft Adapters

For Clutch Sizes 400 through 1027 Mount Gears, Pulleys, and Similar Attachments

Stub shaft adapters are available to fit clutches from size 400 through 1027. They are secured to the clutch by fastening to the tapped holes at the end face of the outer race. The stub shaft adapters may be used to mount gears, pulleys or similar attachments when the item to be mounted is too small to mount on the O.D. of the clutch, and to mount couplings when the customer desires to use a coupling other than the Formsprag-Formflex clutch coupling assembly.

Hardened bolts are supplied by Formsprag at no additional charge with purchased adapters.

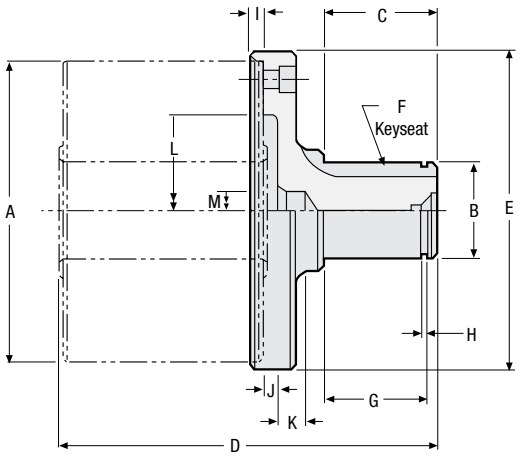
Selection

Size	Adapter No.	Kit No.
400	A-4	AC30156
500	A-5	AC30157
600	A-6	AC30158
700	A-7	AC30159-4
750	A-7.5	AC30161-5
800	A-8	AC30160-6
900	A-9	AC30162-4
1027	A-10	AC30163-A

Consult Formsprag for other stub shaft adapter sizes.

Dimensions inches (mm)

Model No.	A	B	C	D
400	3.500/3.501 (88.90/88.85)	.751/.750 (19.07/19.05)	1.50 (38.10)	5.09 (129.36)
500	4.250/4.251 (107.95/107.90)	1.251/1.250 (31.77/31.75)	1.75 (44.45)	6.19 (157.15)
600	5.375/5.376 (136.52/136.47)	1.751/1.750 (44.47/44.45)	2.00 (50.80)	6.75 (171.45)
700	7.125/7.126 (180.97/180.92)	2.752/2.750 (69.90/69.85)	2.50 (63.50)	8.44 (214.30)
750	8.750/8.751 (222.25/222.20)	3.252/3.250 (82.60/82.55)	3.00 (76.20)	10.50 (266.70)
800	10.000/10.001 (254.00/253.95)	4.252/4.250 (108.00/107.95)	3.75 (95.25)	11.13 (282.57)
900	12.000/12.001 (304.80/304.72)	5.252/5.250 (133.40/133.35)	4.50 (114.30)	12.25 (311.15)
1027	15.000/15.002 (381.00/380.92)	6.252/6.250 (158.80/158.75)	5.50 (139.70)	13.56 (344.42)

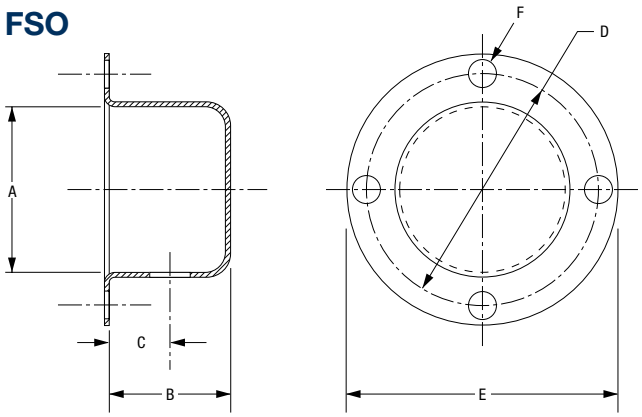


Detail drawings sufficient to manufacture stub shaft adapters are available on request for those who would prefer to manufacture their own.

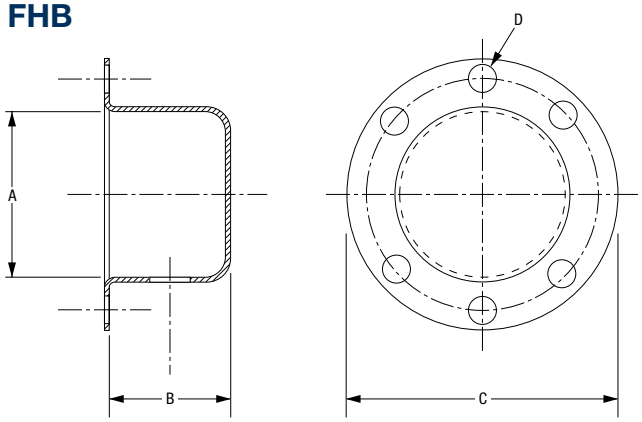
Size	E	F	G	H	I	J	K	L	M	Weight lb. (kg)
400	3.88 (98.42)	.250 x .13 (6.35 x 3.18)	1.347/1.351 (34.21/34.31)	.033/.043 (.84/1.09)	0.250 (6.35)	0.188 (4.76)	0.438 (11.11)	1.875 (47.63)	0.563 (14.29)	1.6 (.73)
500	4.63 (117.47)	.312 x .16 (7.92 x 3.96)	1.579/1.584 (40.11/40.23)	.045/.055 (1.14/1.40)	0.250 (6.35)	0.250 (6.35)	0.500 (12.70)	2.625 (66.68)	0.625 (15.88)	3.2 (1.45)
600	5.75 (146.05)	.375 x .19 (9.52 x 4.75)	1.835/1.840 (46.61/46.99)	.055/.065 (1.40/1.65)	0.250 (6.35)	0.250 (6.35)	0.500 (12.70)	3.500 (88.90)	0.625 (15.88)	5.8 (2.63)
700	7.63 (193.67)	.625 x .31 (15.87 x 7.92)	2.335/2.340 (59.31/59.44)	.103/.113 (2.62/2.87)	0.250 (6.35)	0.250 (6.35)	0.500 (12.70)	5.000 (127.00)	0.625 (15.88)	12.6 (5.72)
750	9.50 (241.30)	.750 x .38 (19.05 x 9.52)	2.804/2.809 (71.22/71.35)	.103/.113 (2.62/2.87)	0.375 (9.53)	0.250 (6.35)	0.625 (15.88)	5.500 (139.70)	1.000 (25.40)	23.8 (10.79)
800	10.75 (273.05)	1.000 x .50 (25.40 x 12.70)	3.566/3.571 (90.57/90.70)	.120/.130 (3.05/3.30)	0.320 (8.13)	0.375 (9.53)	0.750 (19.05)	7.500 (190.50)	1.500 (38.10)	40.5 (18.37)
900	12.75 (323.85)	1.250 x .63 (31.75 x 15.87)	4.316/4.321 (109.63/109.75)	.139/.149 (3.53/3.78)	0.375 (9.53)	0.313 (7.94)	0.870 (22.10)	7.750 (196.85)	1.250 (31.75)	62.8 (28.49)
1027	15.75 (400.05)	1.250 x .63 (31.75 x 15.87)	5.140/5.145 (130.56/130.68)	.094/.104 (2.34/2.64)	0.375 (9.53)	0.310 (7.87)	0.875 (22.23)	10.000 (254.00)	1.250 (31.75)	103.4 (46.90)

FSO, FHB OSHA Cover Kits

FSO



FHB



FSO OSHA cover kits are designed for shaft end mounted FSO or FHB clutches and available from Formsprag from size 400 through 1027. These cover kits provide not only the stationary cover enclosure required by OSHA, but provide additional protection for the clutch from abrasive environments as well.

The OSHA cover kit includes the cover and required fasteners.

Note: OSHA requires that a stationary guard must enclose clutches with rotating projecting parts and operating seven (7) feet or less above the floor.

FSO Cover & Dimensions inches (mm)

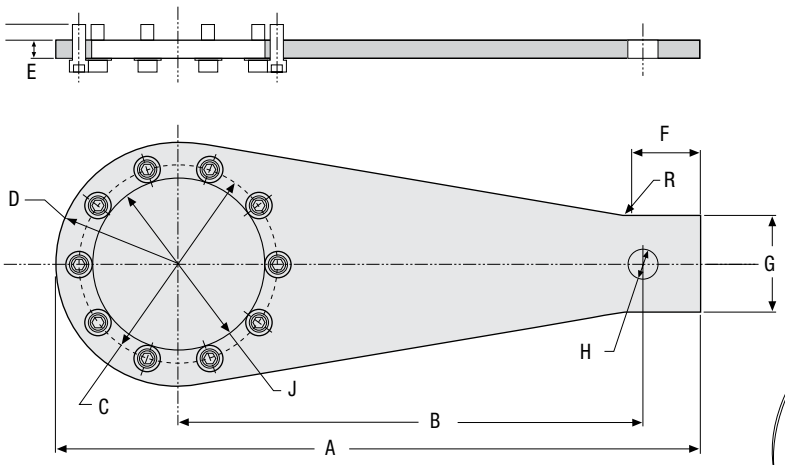
Size	Kit No.	A	B	C	D	E	F	F dia.
400	AC33594	2.06 (58.32)	1.50 (38.1)	0.75 (19.05)	2.88 (73.15)	3.38 (85.85)	4 @ 90°	0.34 (8.64)
500	AC33595	2.75 (69.85)	1.50 (38.1)	0.75 (19.05)	3.63 (92.20)	4.13 (104.90)	4 @ 90°	0.34 (8.64)
550	AC33713-1	2.25 (57.1)	1.50 (38.1)	0.75 (19.05)	4.25 (107.9)	4.75 (120.6)	6 @ 60°	0.34 (8.64)
600	AC33596	3.88 (98.55)	1.50 (38.1)	0.75 (19.05)	4.75 (120.65)	5.25 (133.35)	6 @ 60°	0.34 (8.64)
650	AC33714-1	3.25 (82.5)	1.50 (38.1)	1.00 (25.4)	5.75 (146)	6.50 (165.1)	8 @ 45°	0.40 (10.2)
700	AC33597	5.25 (133.35)	1.50 (38.1)	0.75 (19.05)	6.25 (158.75)	7.00 (177.80)	4 @ 90°	0.44 (11.18)
750	AC33600	5.88 (149)	2.00 (50.8)	1.00 (25.4)	7.00 (177.80)	8.00 (203.20)	4 @ 90°	0.56 (14.22)
800	AC33598	7.50 (190.5)	2.00 (50.8)	1.00 (25.4)	8.94 (277.08)	9.88 (250.95)	4 @ 90°	0.56 (14.22)
900	AC33599	8.56 (217.4)	2.00 (50.8)	1.00 (25.4)	9.75 (247.65)	11.00 (279.40)	6 @ 60°	0.69 (17.53)
1027	AC33601	10.23 (259.84)	3.00 (76.2)	1.50 (38.1)	11.75 (298.45)	13.50 (342.90)	4 @ 90°	0.75 (19.05)

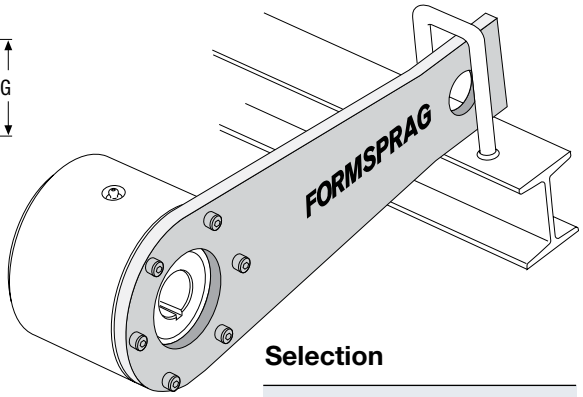
FHB Cover & Dimensions inches (mm)

Size	Kit No.	A	B	C	D*	
					No. of Holes	Dia.
10	CL70139	2.8 (69.9)	1.5 (38.1)	4.8 (120.7)	6 @ 60°	4.3 (109.2)
20	CL70140	3.9 (98.6)	1.5 (38.1)	5.3 (133.4)	6 @ 60°	4.8 (120.7)
60	CL70141	5.9 (149.4)	2.0 (50.8)	8.0 (203.2)	4 @ 90°	7.0 (177.8)

* These covers can be used on other Formsprag clutches so there may be additional mounting holes, not required for the FHB Backstops.

FSO Torque Arm





FSO Torque Arms are used to help facilitate the installation of the clutch when used as a backstop. The FSO Torque Arms are available to fit clutches from size 300 through 1027. These arms are designed to work with Clutch Models FSO, HPI, and HSB.

The torque arm must be secured to the clutch and must not be rigidly fastened at the reaction point. Rotation of the clutch must be restricted at the reaction point by either a pin or angle iron. Torque arm reaction point clearance is required on all sides of the arm to prevent binding, which could cause uneven loading of the clutch bearing, resulting in reduced clutch life.

Selection

Size	Kit No.
300	TA300
400	TA400
500	TA500
550	TA550
600	TA600
650	TA650
700	TA700
750	TA750
800	TA800
900	TA900
1027	TA1027

Size	A	B	C	D	E	F	G	H	J	No. of Bolts
300	9.63 (244.6)	7.13 (181.1)	2.62 (66.5)	1.50 (38.1)	0.38 (9.6)	1.50 (38.1)	1.50 (38.1)	0.75 (19)	1.25 (31.8)	4
400	9.63 (244.6)	7.13 (181.1)	2.87 (72.8)	1.75 (44.4)	0.38 (9.6)	1.50 (38.1)	1.50 (38.1)	0.75 (19)	1.25 (31.8)	4
500	13.00 (330.2)	9.63 (244.6)	3.62 (91.9)	2.13 (54.1)	0.38 (9.6)	2.25 (57.1)	2.25 (57.1)	1.00 (25.4)	1.80 (45.7)	4
550	10.13 (257.3)	7 (177.8)	4.25 (107.9)	2.5 (63.5)	0.38 (9.6)	1.37 (34.9)	2.25 (57.1)	0.78 (19.8)	2.43 (61.7)	12
600	16.00 (406.4)	11.88 (301.7)	4.75 (120.6)	2.68 (68)	0.38 (9.6)	2.50 (36.5)	2.50 (36.5)	1.00 (25.4)	2.81 (71.1)	6
650	13.63 (346)	9.5 (241)	5.75 (146)	3.25 (82.5)	0.38 (9.6)	1.75 (44.4)	3.0 (76.2)	0.78 (19.8)	3.4 (87.3)	16
700	21.00 (533.4)	15.75 (400)	6.25 (158.7)	3.56 (90.4)	0.50 (12.7)	3.00 (76.2)	3.00 (76.2)	1.25 (31.8)	4.25 (107.9)	8
750	22.31 (566.6)	15.25 (387.4)	7.00 (177.8)	4.38 (111.2)	0.50 (12.7)	2.91 (73.9)	4.38 (111.2)	1.25 (31.8)	5.50 (139.7)	8
800	26.41 (670.8)	18.63 (473.2)	8.94 (227)	5.00 (127)	0.50 (12.7)	3.56 (90.4)	4.75 (120.7)	1.25 (31.8)	6.75 (171.5)	8
900	31.72 (805.6)	22.88 (581.1)	9.75 (247.6)	6.00 (152.4)	0.88 (22.3)	3.38 (85.9)	4.75 (120.7)	1.50 (38.1)	8.50 (215.9)	10
1027	33.50 (850.9)	23.00 (584.2)	11.75 (298.5)	7.50 (190.5)	0.88 (22.3)	3.38 (85.9)	5.25 (133.3)	1.75 (44.5)	10.50 (266.7)	10

Stieber has two manufacturing facilities: one in Munich and a second in Heidelberg. These plants have produced identical clutches marketed under different part numbers as listed in the chart below. The models listed in bold are in current production and supersede the other model.

Stieber Interchange Chart

Munich	Heidelberg	Munich	Heidelberg	Munich	Heidelberg
AS	**NSS**			**CAB**	RS/BI, RBI
ASNU	**NFS**			CA	—
AN	NF	—	ETK	**CLA**	RIW, RIZ
ANG/ANR	NFR	—	**ETKG**	**CLAP**	RIWN, RINZ
AG	GFR			**F…**	RS/BF
AL(P)				CR	—
AGP	GFRN			CSK	**KK**
AL..G	EOC			CSK..P	—
ALB..M	**RS/RW**			CSK..RS	—
ALB..M	**UGF/UGR**			**CLV(P)**	RAZ, RANZ
AV..04	RS/BW			—	GFK
AV	—				
AK	—				
AA	—				
AR	—				
ALZ	—				
AVZ	—				
ASK	—				
AE	—				
—	KI				

Cross-Reference Part Numbers

Formsprag	Morse	Renald	Marland
FS-02	—	SA-02	—
FS-04	—	SA-04	—
FS-05	—	SA-05	—
FSR-3	PB-3A	SB-3	—
FSR-5	PB-5A	SB-5	—
FSR-6	PB-6A	SB-6	—
FSR-8	PB-8A	SB-8	—
FSR-10	PB-10A	SB-10	—
FSR-12	PB-12A	SB-12	—
FSR-14	PB-14A	SB-14	—
FSR-16	PB-16A	SB-16	—
FSO-300	MG-300A	—	—
FSO-400	MG-400A	*SO-400	RMS-14
FSO-500	MG-500A	*SO-500	RMS-21
FSO-550	—	—	RMS-26
FSO-600	MG-600A	*SO-600	RMS-32
FSO-650	—	—	RMS-40
FSO-700	MG-700A	*SO-700	RMS-47
FS-750	MG-750A	*SO-750	RMS-55
FS-800	MG-800A	*SO-800	RMS-72
FS-900	MG-900A	*SO-900	—
FS-1027	MG-1000A	*SO-1000	—
HPI-300	MI-300A	—	—
HPI-400	MI-400A	SX-400	RMS-14
HPI-500	MI-500A	SX-500	RMS-21
—	—	—	RMS-26
HPI-600	MI-600A	SX-600	RMS-32
—	—	—	RMS-40
HPI-700	MI-700A	SX-700	RMS-47
HPI-750	MI-750A	SX-750	RMS-55
HPI-800	MI-800A	SX-800	RMS-72
HPI-900	MI-900A	SX-900	—
HPI-1027	MI-1000A	SX-1000	—
FS-100	HT-10	—	—
FS-200	HT-20	—	—
FS-300	HT-30	—	—
FSO-300L†	MO-300A	—	—
FSO-400L†	MO-400A	—	—
FSO-500L†	MO-500A	—	—
FSO-600L†	MO-600A	—	—
FSO-700L†	MO-700A	—	—
FSO-750L†	MO-750A	—	—
FSO-800L†	MO-800A	—	—
FSO-900L†	MO-900A	—	—
FSO-1027L†	MO-1000A	—	—

* Also available for end face GR lubrication

† FSO Series with labyrinth seal option

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.

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 34.

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
	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
	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
	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
	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

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.

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 (millimeters)

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.

For Metric bores the recommended bore tolerances are H7.

Sleeve Bearing Clutches

Series	Nominal Bore	Bore Diameter	Shaft Diameter
FS	6.35	6.35/6.401	6.35/6.325
	9.525	9.525/9.576	9.512/9.500
	12.70	12.70/12.751	12.687/12.675
	15.875	15.875/15.900	15.862/15.850
FSR	9.525	9.525/9.550	9.512/9.500
	12.70	12.70/12.725	12.687/12.675
	15.875	15.875/15.900	15.862/15.850
	17.450	17.450/17.475	17.437/17.424
	19.05	19.05/19.075	19.037/19.025
	22.225	22.225/22.250	22.212/22.200
	25.400	25.400/25.425	25.387/25.375
	28.575	28.575/28.600	28.562/28.537
	31.75	31.75/31.775	31.737/31.712
	34.925	34.925/34.950	34.912/34.887
	38.1	38.1/38.125	38.087/38.062
	41.275	41.275/41.300	41.262/41.237
	44.45	44.45/44.475	44.437/44.412
	47.625	47.625/47.650	47.612/47.587
	50.8	50.8/50.825	50.787/50.762
	55.550	55.550/55.575	55.537/55.512

* For LLH series, see page 35.

	Nominal Bore	Bore Diameter	Shaft Diameter
	12.700	12.675/12.700	12.675/12.649
	15.875	15.850/15.875	15.850/15.824
	19.050	19.025/19.050	19.025/18.999
	22.225	22.200/22.225	22.200/22.174
	25.400	25.375/25.400	25.375/25.349
	28.575	28.550/28.575	28.550/28.524
	31.750	31.725/31.750	31.725/31.699
	33.325	33.299/33.325	33.299/33.274
	34.925	34.900/34.925	34.900/34.874
	38.100	38.075/38.100	38.075/38.049
	41.275	41.250/41.275	41.250/41.224
	44.450	44.425/44.45	44.425/44.399
	49.200	49.187/49.213	49.187/49.162
5	50.800	50.775/50.800	50.775/50.749
	53.975	53.950/53.975	53.950/53.924
	57.150	57.112/57.150	57.112/57.087
1	61.900	61.874/61.913	61.874/61.849
	61.900	61.887/61.913	61.887/61.862
	63.500	63.462/63.500	63.462/63.437
	66.675	66.650/66.675	66.650/66.624
	69.850	69.812/69.850	69.812/69.787
	74.600	74.574/74.613	74.574/74.549
	76.200	76.162/76.200	76.162/76.137
	82.550	82.512/82.550	82.512/82.487
	87.300	87.274/87.313	87.274/87.249
	88.900	88.862/88.900	88.862/88.837
	95.250	95.212/95.250	95.212/95.187
6	100.000	99.974/100.013	99.974/99.949
	100.000	99.962/100.000	99.962/99.936
2, 6	101.600	101.562/101.600	101.562/101.537
	101.600	101.549/101.600	101.549/101.524
	107.950	107.899/107.950	107.899/107.874
2	107.950	107.912/107.950	107.912/107.874
	112.700	112.662/112.713	112.662/112.636
2	112.700	112.674/112.713	112.674/112.649
	114.300	114.249/114.300	114.249/114.224
	120.650	120.599/120.650	120.599/120.574
	125.400	125.362/125.413	125.362/125.336
2	125.400	125.374/125.413	125.374/125.336
	127.000	126.949/127.000	126.949/126.924
4	127.000	127.051/127.102	127.025/127.000
	133.350	133.299/133.350	133.299/133.274
3	138.100	138.062/138.113	138.062/138.036
	138.100	138.049/138.100	138.049/138.024
	139.700	139.649/139.700	139.649/139.624
	146.050	145.999/146.050	145.999/145.974
	150.800	150.762/150.813	150.762/150.736
	150.800	150.774/150.813	150.774/150.749
3	152.400	152.349/152.400	152.349/152.324
	158.750	158.699/158.750	158.699/158.674
	163.500	163.462/163.513	163.462/163.436
3	163.500	163.474/163.525	163.474/163.449
	165.100	165.049/165.100	165.049/165.024
	171.450	171.399/171.450	171.399/171.374
	176.200	176.162/176.213	176.162/176.136

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
177.800	177.800/177.749	177.724/177.749
190.500	190.602/190.652	190.576/190.551
196.850	196.952/197.002	196.926/196.901
203.200	203.302/203.352	203.276/203.251
209.550	209.652/209.702	209.626/209.601
215.900	216.002/216.052	215.976/215.951
222.250	222.352/222.402	222.326/222.301
228.600	228.702/228.752	228.676/228.651
234.950	235.052/235.102	235.026/235.001
241.300	241.402/241.452	241.376/241.351
247.650	247.752/247.802	247.726/247.701
254.000	254.102/254.152	254.076/254.051
266.700	266.802/266.852	266.776/266.751
279.400	279.502/279.552	279.476/279.451
292.100	292.202/292.252	292.176/292.151
304.800	304.902/304.952	304.876/304.825
311.150	311.252/311.302	311.226/311.175
317.500	317.602/317.652	317.576/317.525
330.200	330.302/330.352	330.276/330.225
336.550	336.652/336.702	336.626/336.575
342.900	343.002/343.052	342.976/342.925
349.250	349.352/349.402	349.326/349.275
355.600	355.702/355.752	355.676/355.625
361.950	362.052/362.102	362.026/361.975
368.300	393.802/368.452	368.376/368.325
374.650	374.752/374.802	374.726/374.675
381.000	381.102/381.152	381.076/381.025
387.350	387.452/387.502	387.426/387.375
393.700	393.802/393.852	393.776/393.725
400.050	400.152/400.202	400.126/400.075
406.400	406.502/406.578	406.476/406.425
412.750	412.852/412.928	412.826/412.775
419.100	419.202/419.278	419.176/419.125
425.450	425.552/425.628	425.526/425.475
431.800	431.902/431.978	431.876/431.825
438.150	438.252/438.328	438.226/438.175
444.500	444.602/444.678	444.576/444.525
450.850	450.952/451.028	450.926/450.875
457.200	457.302/457.378	457.276/457.225
463.550	463.652/463.728	463.626/463.575
469.900	470.002/470.078	469.976/469.925
476.250	476.352/476.428	476.326/476.275
482.600	482.702/482.778	482.676/482.625
508.000	508.102/508.178	508.076/508.025

1 Model 750 only

2 Model 900 only

3 Model 1027 only

4 Model 1051 only

5 FSO 600/50.8 tolerance 50.800/50.825

6 Model 800 only

Mounting Requirements

Press fit assemblies

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

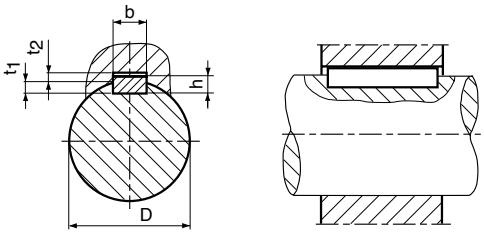
As with standard bearings, suitable tooling must be used for press fitting such that no axial load is transmitted through the inner part of the clutch during assembly.

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.

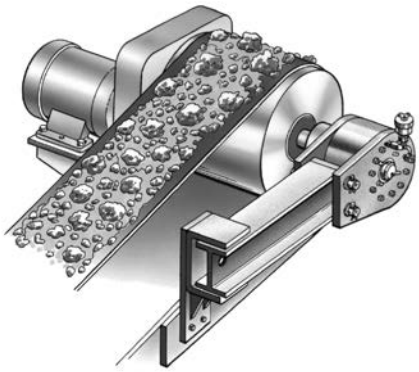
(Metric keyseat dimensions listed on page 45.)



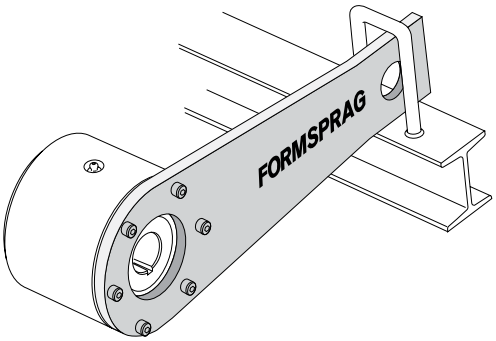
Mounting Examples

Listed below are a number of clutch models that are used in backstopping applications. In each case the clutch must be axially restrained on the shaft and the torque arm must be restrained from rotating, but free to float in the axial and radial planes to avoid pre-loading the internal bearings of the clutch.

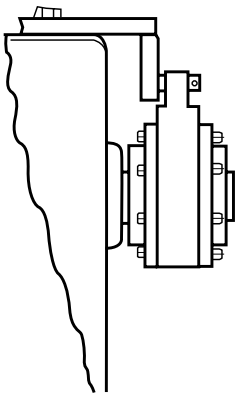
LLH



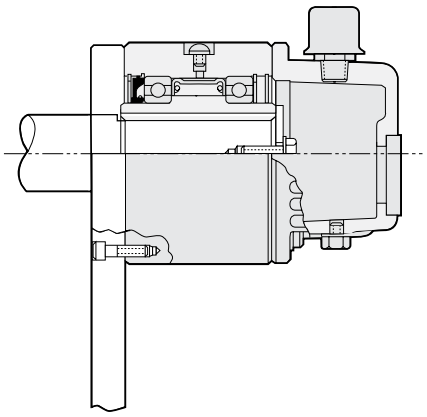
FSO



FHB



HSB



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

ISO tolerance limits for holes/bores

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

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:

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

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

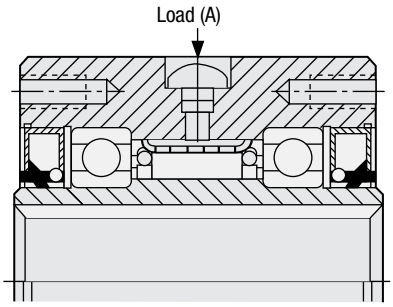
X_0 is new load in lbs.

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.

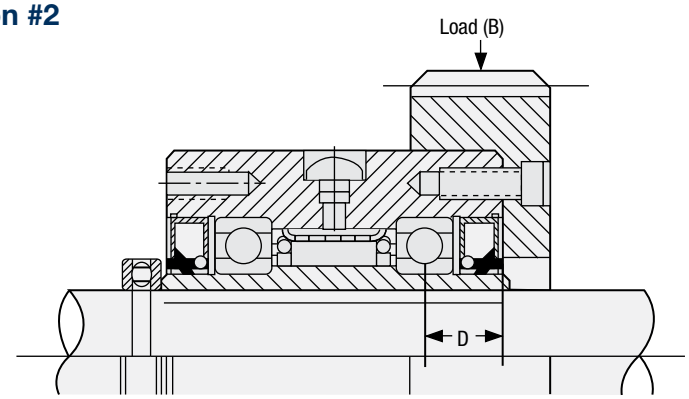
N_0 is new O/R speed.

Condition #1



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

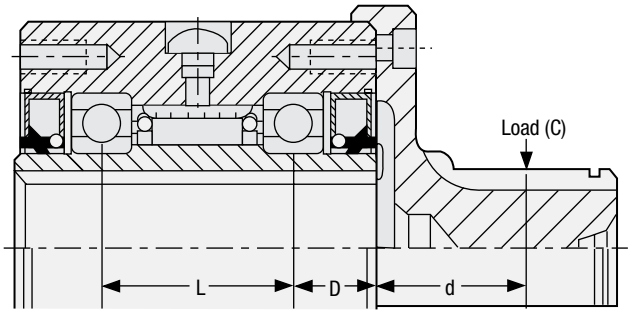
Condition #2



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

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

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.

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.
** Any automatic transmission fluid (ATF) without friction reducing agents or high friction modifier, synthetic preferred.

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

Overrunning Clutches Application Data Form

For Application Assistance call 1-800-927-3262 or Fax (586) 758-5204

Date _____

_____
Company name

_____
Address

_____
City State Zip

_____
Name of contact Title

_____
Phone Fax

Type of equipment

_____

_____

Type of application

___Overrunning ___Indexing
___Backstop ___Clutch Coupling

Maximum torque at clutch

_____ pound-feet, or

_____ HP at _____ RPM

Power Source

___Electric motor ___Diesel engine
___Turbine ___Air cylinder
___Gasoline engine

Load Application

___Smooth ___Moderate ___Shock

Lubrication

___Runs in oil ___Not accessible
___Accessible for lubricating

Type or specification of lubricant

_____

For overrunning or backstop applications

Inner race speed during overrunning_____ RPM max.

Outer race speed during overrunning_____ RPM max.

If both members are rotating during overrunning, are they rotating in the

___Same direction ___Opposite directions

Time cycle of Formsprag clutch

Drive_____minutes Rest_____minutes

Over-run_____minutes

For indexing applications

Indexes per minute_____max.

Degrees per index_____max.

Clutch operating time

_____ hours per day

Shaft diameter (give limits)

_____

_____

Size of keyseat in shaft

_____

Environment

Temperature range _____ °F to _____°F

Exposed location?_____

Radiation?_____

For non-symmetrical clutches and clutch-couplings

a. Identify the end from which the clutch is viewed

_____

b. The (inner, outer) member (drives, over-runs) in the (clockwise, counter-clockwise) direction

Anticipated quantity required

a. For this application

_____

b. Annually

_____

Supply a sketch of your installation.

Note: A clutch is not a coupling. When necessary to couple two shafts, a coupling must be used with the clutch. Ambient temperature should not exceed approximately 150°F. It is requested that prints of installation be supplied if available.

_____
Completed by

Conversion Factors

Length

			1μm	=	.00004 in.
1 in.	=	25.4 mm = 0.0254 m	1 m	=	39.37 in.
1 ft.	=	304.8 mm = 0.3048 m	1 m	=	3.28 ft.

Area

1 in.^{2}	=	6.4516x10^{-4} m^2	1 m^2	=	1550 in.^{2}
1 ft.^{2}	=	9.29x10^{-2} m^2	1 m^2	=	10.764 ft.^{2}

Volume

1 in.^{3}	=	1.639x10^{-5} m^3	1 m^3	=	61023 in.^{3}
1 ft.^{3}	=	2.832x10^{-2} m^3	1 m^3	=	35.315 ft.^{3}
1 gal (US)	=	3.7854 l	1 l	=	0.2642 gal (US)

Mass

1 lb. s^2 ft.$^{-1}$	=	14.6 kg	1 kg	=	6.85x10^{-2} lb. s^2 ft.^{1}

Force

1 lb.	=	445 g	1 kg	=	2.2 lb.

Pressure

1 lb.in.$^{-2}$	=	6.895x10^{-3} Nmm^{-2}	1 Nmm^{-2}	=	145 lb.in.$^{-2}$
(pai)	=	6.895x10^3 Nm^{-2}	1 bar	=	14.2 lb.in.$^{-2}$

Torque

1 lb.in.	=	0.113 Nm	1 Nm	=	8.85 lb.in.
1 lb.ft.	=	1.36 Nm	1 Nm	=	0.738 lb.ft.

Work

1 Btu	=	778 lb.ft.			
1 Btu	=	1055 J = 1.055 kJ	1 kJ	=	0.948 Btu
1 Btu	=	2.93x10^{-4} kWh	1 kWh	=	3410 Btu

Power

1 HP	=	746 W = 0.746 kW	1 kW	=	1.34 HP
1 HP	=	1.014 CV	1 CV	=	0.986 HP

Moment of Inertia

1 lb.ft.^{2}	=	0.04214 kgm^2	1 kgm^2	=	23.73 lb.ft.^{2}
1 lb.in.^{2}	=	2.93x10^{-4} kgm^2	1 kgm^2	=	3417.17 lb.in.^{2}
1 lb.ft. s^2	=	1.3847 kgm^2	1 kgm^2	=	0.738 lb.ft. s^2
1 lb.in. s^2	=	0.1129 kgm^2	1 kgm^2	=	8.8507 lb. in. s^2

Mass/Volume

1 lb.ft.$^{-3}$	=	16.018 kgm^{-3}	1 kgm^{-3}	=	6.24x10^{-2} lb.ft.$^{-3}$

Temperature

°F	=	(1.8x°C) + 32	°C	=	5/9x(°F–32)
°F	=	1.8x(K–273) + 32			
K	=	5/9x (°F–32) + 273			

Warranty

Formsprag LLC warrants that it will repair or replace (whichever in its sole discretion it deems advisable) any product it manufactured and sold which proves to be defective in material or workmanship within a period of one (1) year from date of original purchase for consumer, commercial or industrial use. This warranty extends only to the original purchaser and is not transferable or assignable without Formsprag LLC's prior consent.

This warranty covers normal use and does not cover damage or defect which results from alterations, accident, neglect, disassembly, or improper installation, operation, or maintenance.

Formsprag LLC's obligation under this warranty is limited to the repair or replacement of the defective product. In no event shall Formsprag LLC be liable for consequential, indirect or incidental damages of any kind incurred by reason of manufacture, sale or use of any defective product. Formsprag LLC neither assumes nor authorizes any other person to give any other warranty or to assume any other obligation or liability on its behalf.

Performance Assurance

Rated torque and speeds of Formsprag Clutch products are provided in current catalogs to assist the buyer in selecting the proper Formsprag Clutch product. In addition, application assistance is offered by Formsprag Clutch for guidance to the buyer in selection of a catalog product and application of custom designed products. Since the actual performance characteristics of all Formsprag Clutch products in the buyer's application is the responsibility of the buyer, performance assurance is usually accomplished through manufacture of a prototype by Formsprag Clutch, and a test or qualification program on the part of the buyer.

Rotating Equipment

Rotating equipment is potentially dangerous and should be properly guarded. The user should check for all applicable safety codes (in local area) and provide a suitable guard. Formsprag clutches and backstops have surfaces which wear with use over time and as a result will need to be replaced. The decision for time of replacement must be made by the operator of the equipment based upon the specific application and performance of the clutch or backstop.

Catalog Changes

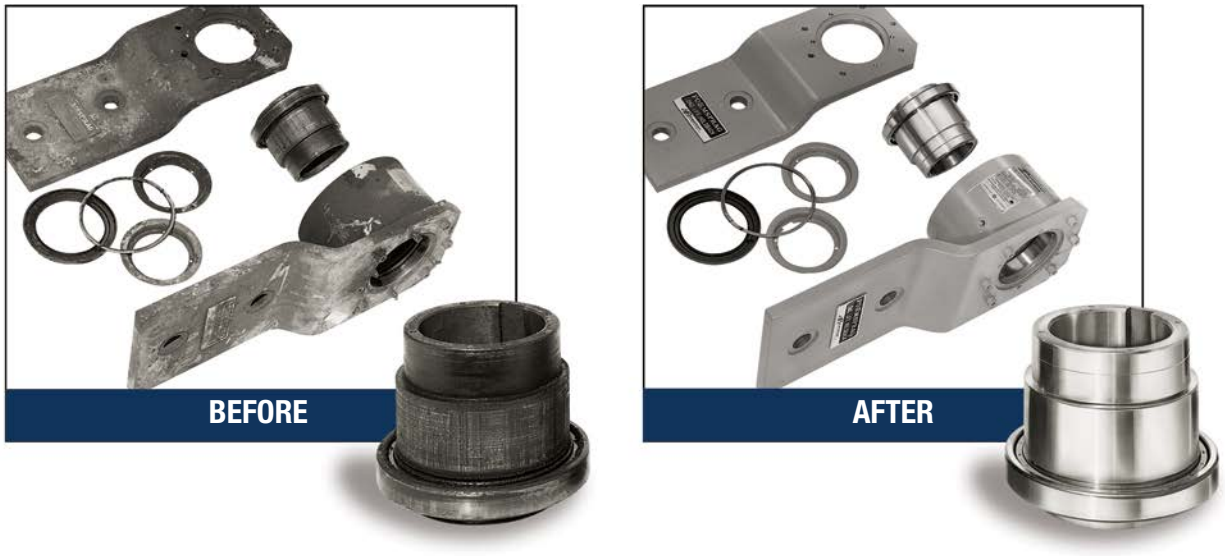
The contents of this catalog are subject to change without notice or obligation.

Remanufactured Clutches...
Look like New, Warranteed like New.

Formsprag Rebuild Service Department can refurbish your overrunning clutches. We take your worn, scaled, seized, scored, or rough running clutches and make them like new…for substantially less than the replacement cost.

As a major manufacturer of overrunning clutches, we have the people, facilities, and experience to rebuild and replace all components as needed. The same standards of excellence that exist in the manufacture of original equipment clutches are closely adhered to in the overhaul procedure of every rebuilt clutch.

The difference is not just cosmetic.



The Rebuild Service Department will perform the following procedures to restore your overrunning clutches to original specifications with a new warranty:

All internal components– sprags, energized springs, retainer, bearings, seal and hardware are refurbished or replaced to new performance standards. The inner and outer races are ground to specifications noted below so that no wear patterns remain.

- Sprag Surface is hardened to 58-62 Rc
- Sprag Surface finish is 15-25 microinches
- Sprag Surface taper limit is 0.0002 inch per inch

Consider these advantages:

Price – A guaranteed savings of 30% (compared to list price for a new unit).
Speed – Clutches are received, inspected and rebuilt in the shortest possible time frame.
Warranty – The Model LLH has a 3 year warranty, all other models are 1 year on labor and materials, same as new clutches.
Emergency Breakdown Program – All products that are air freighted into the Formsprag Clutch plant are processed immediately and, in most cases, are able to be rebuilt within a 24-hour period. However, for applications that can't afford 'downtime', a spare clutch is recommended.

We're also interested in helping you prevent problems and failures. We can recommend a preventive maintenance schedule for all your clutches.

Formsprag's Quality Management System is certified to ISO 9001: 2008 and AS 9100 Rev. D

For more information call 1-800-927-3262

Notes

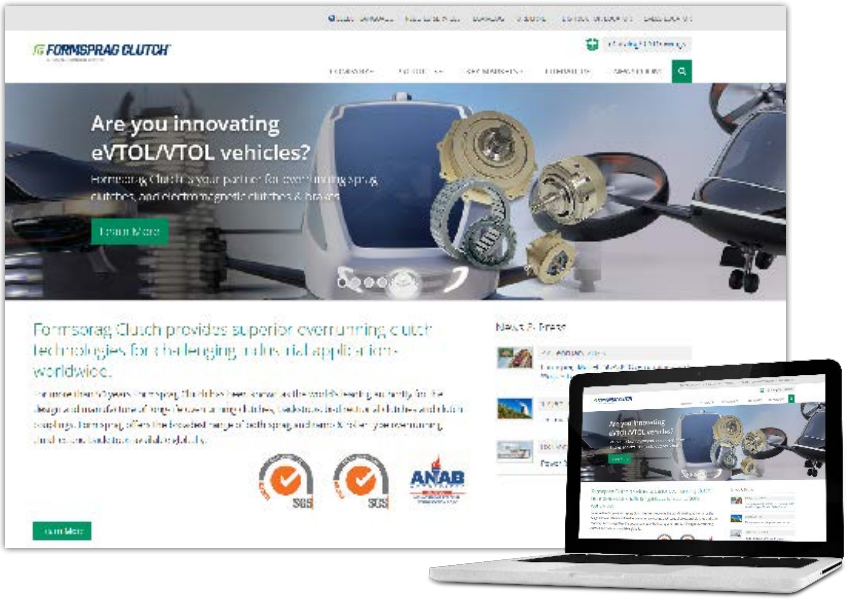
Formsprag Clutch Online Resources

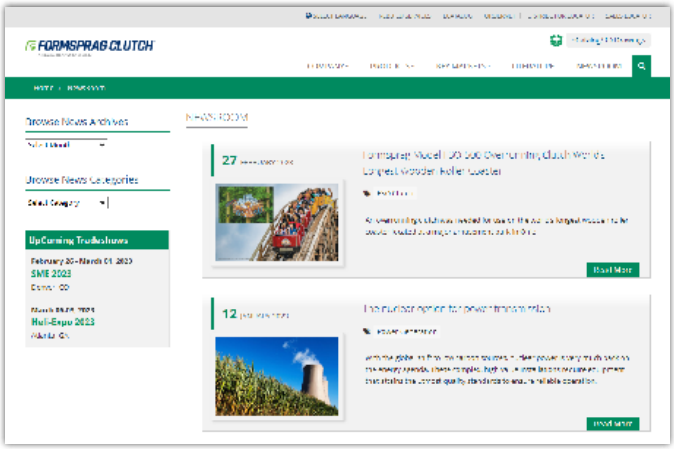
VISIT US ON THE WEB AT
WWW.FORMSPRAG.COM

Everything Formsprag Clutch

From the Formsprag Clutch homepage you can explore all of our resources and visit our key market portals to find solutions for your specific needs.

WWW.FORMSPRAG.COM





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WWW.FORMSPRAG.COM/NEWSROOM

Formsprag Clutch eCatalog

The eCatalog offers product selections and comparisons to meet your specific needs. Submit an online RFQ to the local distributor of your choice.

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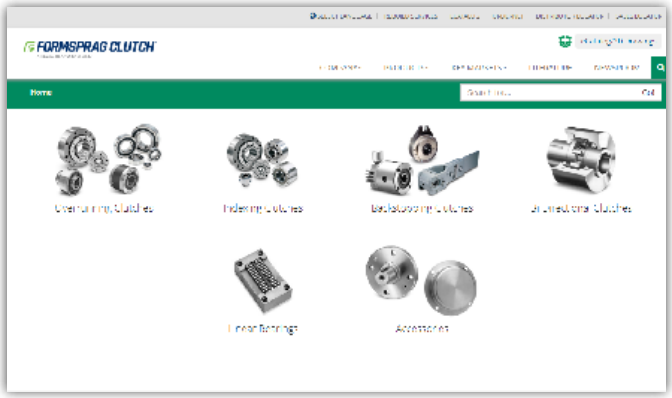

Formsprag Clutch Facilities

North America

USA
23601 Hoover Road
Warren, MI 48089 - USA
586-758-5000
Overrunning Clutches and Holdbacks

Customer Service
1-800-927-3262

Application Support
1-800-927-3262

South America

Brazil
Avenida João Paulo Ablas, 2970
Jardim da Glória, Cotia - SP,
06711-250 - Brasil
+55 (11) 4615-6300
Overrunning Clutches and Holdbacks

Europe

Germany
Hatschekstraße 36
69126 Heidelberg - Germany
+49 (0) 6221-30470
Overrunning Clutches and Holdbacks

Asia Pacific

Australia
+61 2 9894 0133

China
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