

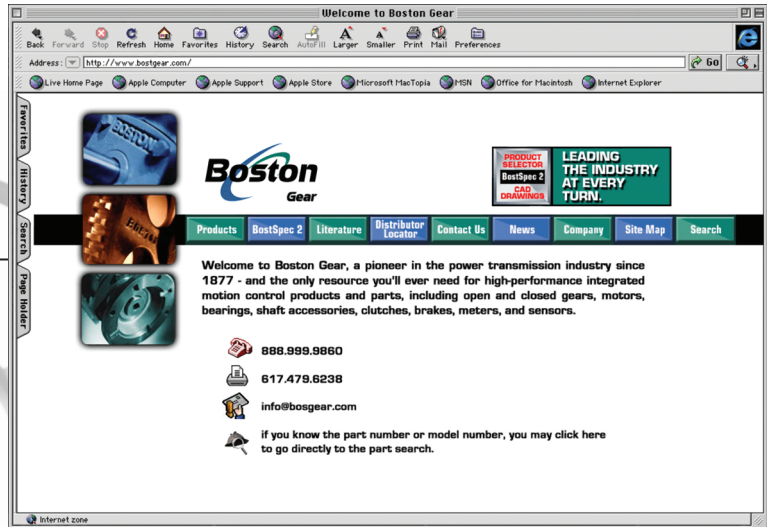
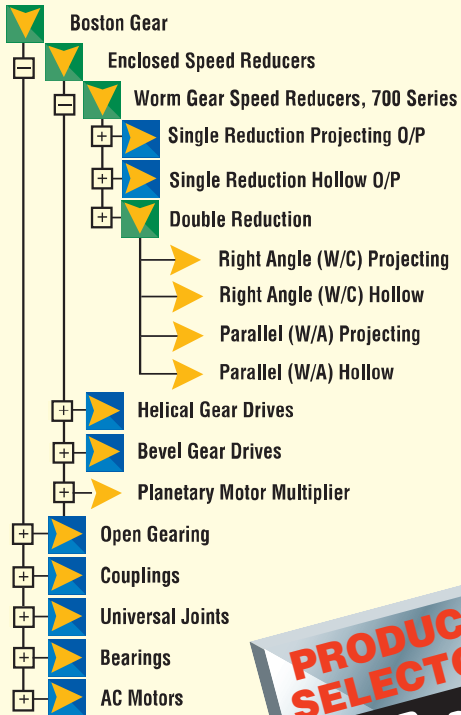
CENTRIC PRODUCTS



**Mechanical &
Pneumatic Overload
Centrifugal
Clutches**

Boston
Gear

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www.bostongear.com



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OUR QUALITY POLICY

THAT THE PEOPLE OF BOSTON GEAR
WILL PROVIDE
ALL PRODUCTS AND SERVICES
AT A QUALITY LEVEL
THAT MEETS OR EXCEEDS
THE EXPECTATIONS
AND THE REQUIREMENTS
OF OUR CUSTOMERS

www.bostongear.com

Boston Gear's new, easy to navigate web site offers a variety of tools designed to simplify the selection and ordering process. Powered by advanced internet XML technology, www.bostongear.com offers 24 hour access to the industry's premier source for power transmission information:

- **BostSpec2** – Boston Gear's award winning open and enclosed gearing configurator. Based upon your applications requirements, select from over 84,000 parts, view specifications, even download CAD drawings
- **Products** – get the most current product information, features, benefits, or application data
- **Literature** – all of Boston Gear's catalogs, brochures, specification sheets, and installation manuals are available for immediate downloading
- **Distributor Locator** – find your local stocking Boston Gear distributor

Whether you're looking to design a worm gear speed reducer to fit your application, get information on Boston Gear's newest products, or receive the latest news about the company, www.bostongear.com is your answer.



The Second Century of Service

Started in 1877 as a machine shop making gear cutting machines, Boston Gear has led the growth of the power transmission industry for more than a century. In its early years, Boston Gear introduced the concepts of gear standardization and stock gears – innovations of enormous benefit to power transmission system designers, specifiers and users.

Boston Gear was the early pioneer in enclosed drives, a category it still dominates with dependable, high-performance products like Worm, Helical and Bevel Gear Drives.

Today, Boston Gear provides the widest range of integrated power transmission products from one source. The convenience of this single-source capability is yours when you choose Boston Gear.

Engineering Services

The Boston Gear Engineering Group can satisfy your technical needs through skillful application of standard products or development of custom designs. Creating specials is an important aspect of customer service. It is supported by R & D personnel who use microprocessor-controlled equipment to collect and monitor data on materials and product performance.

Computer-Aided-Design (CAD) systems help Boston Gear engineers create new approaches to broad industrial challenges or specific customer needs. Computer simulation and testing at critical stages ensure that their designs are practical.

Manufacturing Excellence

Boston Gear manufactures more than 20,000 products in-house at operations in Florence, Kentucky, Louisburg and Charlotte, North Carolina and York, Pennsylvania. Production is efficiently organized into manufacturing cells under group technology. For example, turning and grinding are combined under the control of a single operator in each cell. This approach encourages a sense of responsibility and pride of workmanship, to gain consistently high-quality output.

Computerized production control provides close supervision over scheduling and resource planning, coupled with the flexibility to fit your requirements smoothly into the master schedule. Other dedicated computer controls within the production department govern the ordering and delivery functions to keep operations productive and efficient.

BOSTON GEAR CENTRIC CLUTCH PRODUCTS

Centric Clutch History

In 1998, Boston Gear acquired the Centric Clutch Company. Since 1948, Centric Clutch has been manufacturing Centrifugal Clutches for a wide range of industries. Designed as a means to connect power in a drive train with soft start or delay capabilities, Centric's centrifugal clutch was the industry's first overload protection device with repeatable performance.

Capitalizing on the need for a dependable and repeatable torque limiter, Centric produced the Trig-O-Matic Overload Release Clutch, the original single position, mechanical torque limiting device. Customer requests for a simple cost effective overload device led to the development of the Trig-O-Matic Lite which further solidified the company's position as an industry leader.

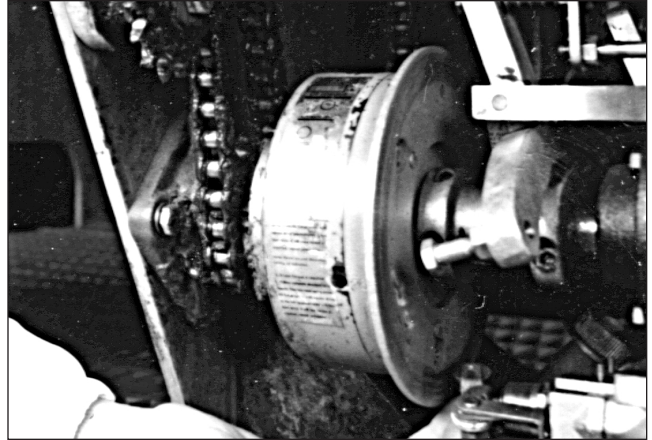
Centric revolutionized torque limiting technology with the VariTorque, the first single position pneumatic overload clutch. The VariTorque was designed to meet the specific needs of paper converting machinery where large starting inertias, high production speeds, and the possibility of equipment failure is great.

The addition of three Model H clutches have helped to position the Centric family of products as one of the industry's premier offerings of mechanical overload protection devices.

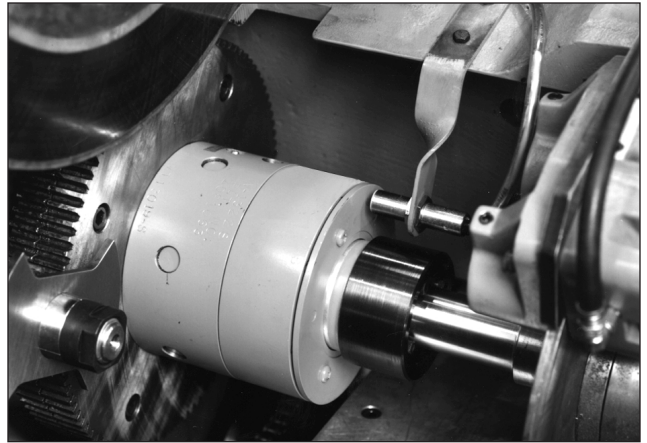
By combining Centric's industry expertise and engineering capabilities with Boston Gear's distributor network and responsiveness oriented culture, customer expectations will continue to be met and exceeded. In a world where down time is unacceptable, Boston Gear will continue the Centric tradition of producing high quality, durable clutches quickly and efficiently. Yesterday, today, and tomorrow, Boston Gear will provide you, our valued customers, with the answers to all of your torque overload needs.

Applications

Because we realize that no two torque overload applications are the same, Boston Gear is available to put over 120 years of mechanical power transmission expertise to work for you.



**TRIG-O-MATIC OVERLOAD CLUTCH
PACKAGING MACHINE CASE PALLETIZER**



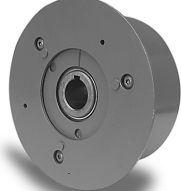






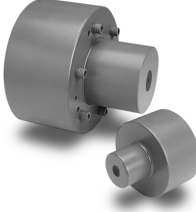


**VARITORQUE OVERLOAD CLUTCH
PAPER CONVERTING MACHINE**



**H1900 OVERLOAD CLUTCH
WATER TREATMENT PLANT**

BOSTON GEAR CENTRIC CLUTCH PRODUCTS

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<p>PNEUMATIC DISCONNECT CLUTCHES</p>	 <p>PDC SERIES Pages 61-66</p>		
<p>VARITORQUE™ OVERLOAD CLUTCHES</p>	 <p>VOR SERIES Pages 67-72</p>		
<p>CENTRIC CENTRIFUGAL CLUTCHES</p>	 <p>CCC SERIES Pages 73-78</p>		

BOSTON GEAR CENTRIC CLUTCH PRODUCTS

QUICK SELECTION GUIDE

BOSTON GEAR OVERLOAD CLUTCHES

Model	Trig-O-Matic Lite	Trig-O-Matic	H1600™	H1900™	H2000™	Disconnect	VariTorque
Series	LOR	ORC	HOR	WOR	POR	PDC	VOR
Number of Sizes	3	6	6	4	6	2	2
Actuation	Mechanical	Mechanical	Mechanical	Mechanical	Pneumatic	Pneumatic	Pneumatic
Engagement Style	Roller Detent	Pawl Notch	Ball Detent	Ball Detent	Ball Detent	Ball Detent	Pawl Notch
Reset Positions	Single	Single	Single	Four	Single	Single	Single
Reset Automatic	Auto or Manual	Automatic	Auto or Manual	Automatic	Automatic	Automatic	
Maximum RPM	1,000	1,800	500	50	3,600	1,800	1,000
Torque Range (Lb. In.)							
Minimum	200	35	25	850	120	300	250
Maximum	5,000	25,000	50,000	30,000	33,000	4,000	10,000
Torque Setting	Spring	Spring	Spring	Spring	Air	Air	Air
Torque Accuracy	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 10%	+/- 5%
Bore (In.)							
Minimum	3/4	1/2	7/16	3/4	7/16	5/8	5/8
Maximum	2-3/4	3-15/16	3-5/8	4-1/4	3-1/4	1-3/4	2-3/16
Bore Style	Bushing or Bored To Application	Bored To Application	Bored To Application	Bored To Application	Bored To Application	Bored To Application	Bored To Application
Mounting Type:							
Sprocket/Pulley	•	•	•	•	•	•	•
Flange	•	•	•	•	•	•	•
Flexible Coupling		•	•		•		
Indexing Coupling		•					
Rigid Coupling		•	•		•		
Page	7	13	33	43	51	61	67



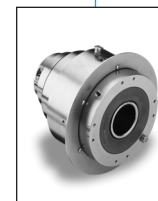
TRIG-O-MATIC LITE



TRIG-O-MATIC



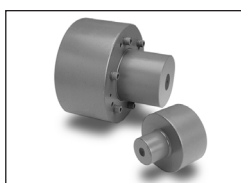
H1900



PDC



VARITORQUE



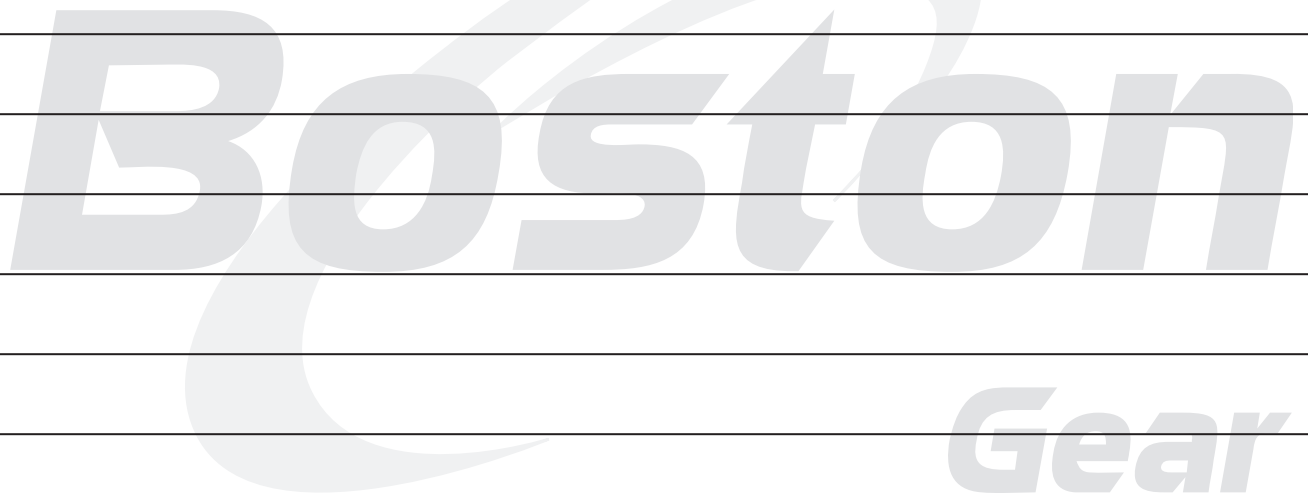
CENTRIFUGAL



H1600



H2000



Leading the Industry at Every Turn



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TRIG-O-MATIC LITE OVERLOAD CLUTCHES

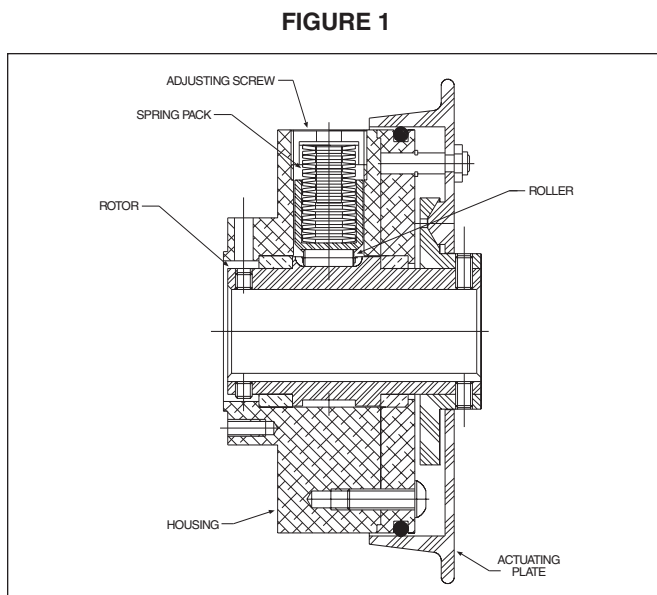
TRIG-O-MATIC LITE OVERLOAD CLUTCHES LOR SERIES

FEATURES

- Simple cost-effective design
- Bi-directional operation
- Single position reset
- Reliable limit switch actuating plate
- Easy torque adjustment
- Maximum torque limit stop
- Through shaft or end shaft mounting
- Straight bore bushings for easy mounting and stocking flexibility
- Large bore capacity
- Bored to size on request

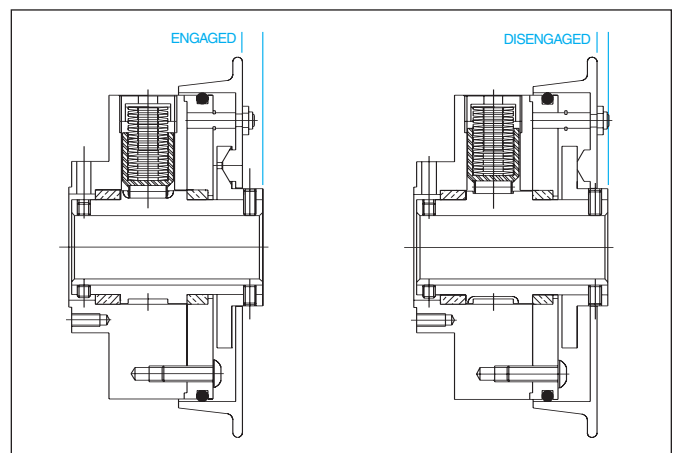
OPERATING PRINCIPLES

The LOR Series Trig-O-Matic Lite is an automatic reset, roller detent style clutch. It was designed to be cost-effective without sacrifice to accurate and dependable disconnect protection for mechanical equipment. Refer to Figure 1.



Torque transmission between the roller and the rotor is the key to the disengagement of the clutch. The roller is held in the detent of the rotor by the radial load generated by compressing the spring pack. This load determines the torque capacity of the clutch. Increasing or decreasing the spring compression provides an adjustment to the torque capacity. When a torque overload condition occurs, the roller moves out of the detent and free-wheels much like a needle bearing. This rolling action increases the efficiency in which the clutch operates and reduces any fluctuation of the torque setting caused by frictional changes. Refer to Figure 2.

FIGURE 2



The movement of the actuating plate during disengagement can be used to trip a limit switch or sensor and signal a torque overload condition. The drive should be shut down immediately and the source of the overload detected and cleared. The automatic reset feature of the clutch allows it to re-engage in its single position without manual assistance. Simply restart the drive and the clutch is again ready to provide accurate and dependable disconnect protection for your equipment.

TRIG-O-MATIC LITE OVERLOAD CLUTCHES

SELECTION

1. Determine overload release torque by one of these methods:

- Use the torque formula with horsepower and RPM specific to the selected clutch location. A service factor may be required for high inertia starts, reversing or peak load conditions, (refer to Page 80 for service factor information):

$$\text{Torque (Lb. In.)} = \frac{\text{HP} \times 63025}{\text{RPM}}$$

- Determine the "weak link" in the drive train, (i.e. chain, reducer, belt or shaft). Select an overload release torque that is below the "weak link's" maximum torque rating.
- Physically measure the drive torque with a torque wrench and size accordingly.

- Determine the bore size, keyway, and taper bore or straight bore bushing model.
- Refer to the Basic Selection Chart for the appropriate clutch size.
- Refer to Page 10 for ratings and dimensions.
- Refer to Page 81 for recommended mounting locations.

BASIC SELECTION CHART

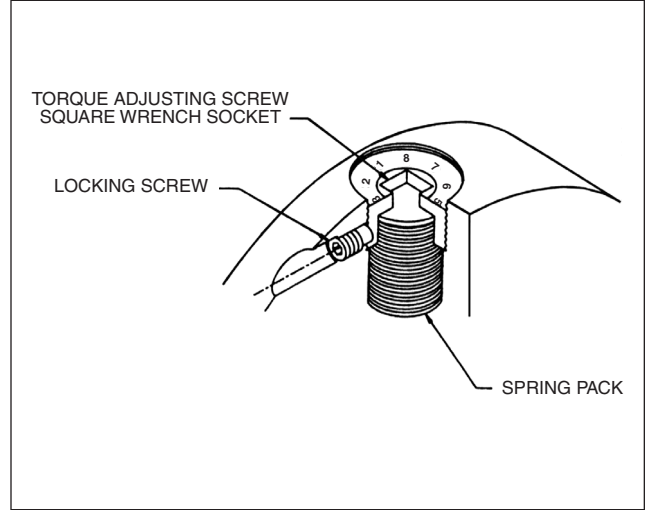
Clutch Size	Bore		Torque Range (Lb. In.)	Maximum RPM
	Stock	Max*		
060	1.2500	1.4375	200-700	1,000
200	1.9375	2.1250	600-2,000	1,000
400	2.4375	2.7500	2,000-5,000	600

*Larger bores may require flat keys (supplied with unit).

TORQUE ADJUSTMENT

Each clutch is tested throughout the torque range then set at the minimum torque range value at the factory. The torque dial label is indexed to a match mark on the clutch at the number "1" location. The torque dial label has eight hash marks evenly spaced at 45 degrees. To increase the torque, loosen the locking screw and turn the adjusting screw clockwise. When the desired torque value is achieved, secure the torque adjustment screw by tightening the locking screw.

TORQUE ADJUSTMENT



LOR SERIES PART NUMBERING SYSTEM

LOR
Series
Light Duty Overload Release Clutch

060
Size
060
200
400

S
Type
S = Standard Non-Metallic Flange
P = Flange with Proximity Plate (Pg. 11)

A
Torque Range
A = Adjustable

S16
Unit Bore
P = Bored to Size (in 1/16")
S = Straight Bushing Installed (in 1/16")
(S00 = Bored for Straight Bushing)
M = Metric Bored to Size (mm)
K = Metric Straight Bushing (mm)

HOW TO ORDER

When ordering a Trig-O-Matic Lite LOR Series Overload Clutch, please include code letters/numbers for series, size, type, torque range, and unit bore. Not all combinations are possible. Please refer to Page 10 for details.

Example:

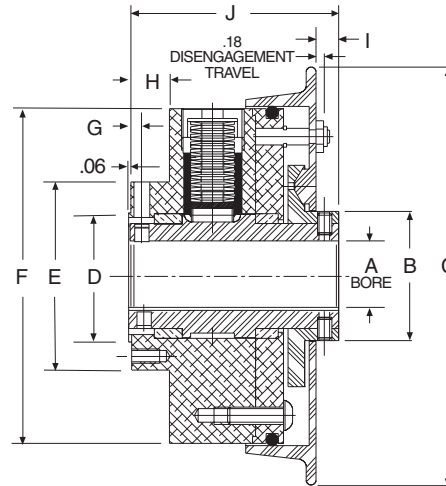
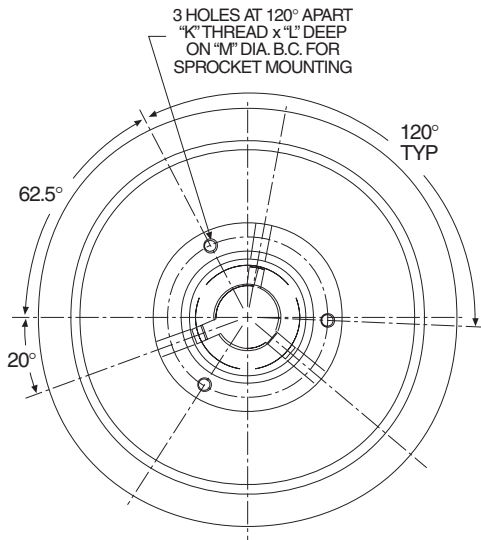
Required Size 060 Trig-O-Matic Lite Overload Clutch, standard flange, adjustable torque range, with a one inch bushing installed:

LOR 060 S — A S16

TRIG-O-MATIC LITE OVERLOAD CLUTCHES

TRIG-O-MATIC LITE OVERLOAD CLUTCHES LOR SERIES

STRAIGHT BORE OR BUSHING MODEL



ALL DIMENSIONS IN INCHES

Clutch Size	A* +.001/- .000	B	C	D +.002/- .004	E	F	G	H	I	J	K	L	M
060	1.2500	2.25	7.50	2.375	3.38	6.00	.24	.74	.40	3.77	1/4-20	0.56	2.875
200	1.9375	2.98	9.50	3.250	5.25	8.00	.22	.94	.59	4.91	3/8-16	0.75	4.500
400	2.4375	4.00	11.50	4.500	7.50	10.00	.38	1.31	.82	6.29	1/2-13	1.12	6.500

*Standard bore, refer to table below for available straight bore bushing kits.

RATINGS

Clutch Size	Bores (inch)			Torque Range (Lb.-In.)	Max. RPM*	WR ² (Lb.-In. ²)	Weight (Lbs.)
	Standard	Max. (1)	Max (2)				
060	1.2500	1.3750	1.4375	200-700	1,000	39	7.5
200	1.9375	2.0000	2.1250	600-2,000	1,000	181	19
400	2.4375	2.6250	2.7500	2,000-5,000	600	559	39

*Maximum RPM dependent on operation of clutch with limit switch and immediate shut down.

(1) Square Key

(2) Flat Key

INSTALLED STRAIGHT BORE BUSHING KITS

Clutch Size	3/4	15/16	1	1-1/16	1-1/8	1-3/16	1-1/4	1-5/16	1-3/8	1-7/16	1-1/2	1-5/8	1-11/16	1-3/4	1-7/8	1-15/16	2	2-1/8	2-3/16	2-1/4	2-7/16	
060	•	•	•		•		*															
200		•	•	•	•	•	•	•	•	•	•	•	•	•		*						
400									•	•	•	•	•	•	•	•	•	•	•	•	•	*
Bore Code	S12	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S26	S27	S28	S30	S31	S32	S34	S35	S36	S39	

*Standard bore, no bushing required

For bored to size models, refer to Page 80 for a complete list of bore codes.

Refer to Page 12 for straight bore bushing kits ordered separately.

Clutches are shipped set for the minimum torque value.

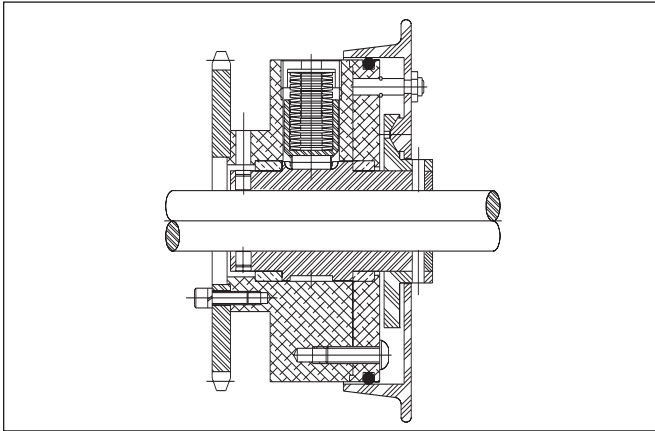
Refer to Page 9 for ordering information.

TRIG-O-MATIC LITE OVERLOAD CLUTCHES

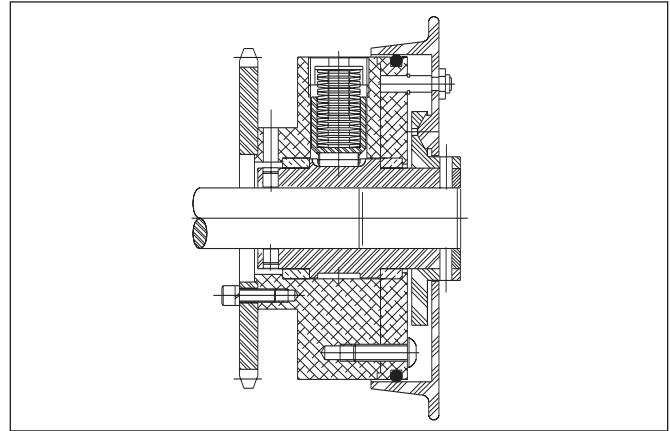
SUGGESTED MOUNTING ARRANGEMENTS

Boston Gear can provide assistance for virtually any drive layout. Plate sprockets, timing belt pulleys, gears, and couplings can be provided upon request.

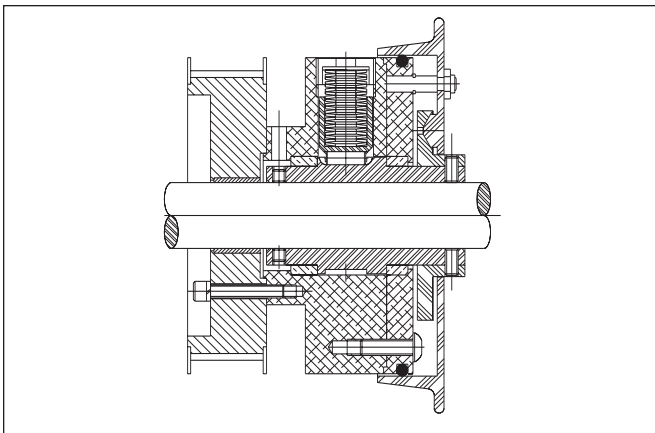
**PLATE SPROCKET MOUNT
WITH THROUGH SHAFT**



**PLATE SPROCKET MOUNT
WITH END SHAFT**



**TIMING BELT PULLEY MOUNT
WITH THROUGH SHAFT**



MINIMUM ACCEPTABLE PLATE SPROCKET MOUNTS*

Clutch Size	Minimum Number of Teeth per Pitch Size						
	#25 1/4 Pitch	#35 3/8 Pitch	#40 1/2 Pitch	#50 5/8 Pitch	#60 3/4 Pitch	#80 1 Pitch	#100 1-1/4 Pitch
060	47	32	25	21	18	—	—
200	—	48	37	30	26	20	—
400	—	—	51	42	35	27	23

*Order sprockets and gears separately. Please refer to Boston Gear's Bearing Products and Gearing Catalogs.

FLANGE WITH PROXIMITY PLATE

As the Trig-O-Matic Lite overload clutch is disengaged, the flange (Actuating Plate) moves 0.18 inches. This movement can be used to trip a mechanical limit switch and signal a torque overload condition. Many applications require that a proximity sensor be used in place of the mechanical limit switch which necessitates the addition of a metallic plate to the nonmetallic flange. This flange can be ordered on the Trig-O-Matic Lite overload clutch by indicating a letter P in the catalog number after the size (e.g., LOR-060P-AP16).

TRIG-O-MATIC LITE OVERLOAD CLUTCHES

BUSHING KITS

STRAIGHT BORE BUSHING KITS*
ORDER BY ITEM CODE

Clutch Size	Bore Size		Item Code
	Fraction	Decimal	
060	3/4	0.7500	77148
	15/16	0.9375	42656
	1	1.0000	77149
	1-1/8	1.1250	77150
200	15/16	0.9375	42661
	1	1.0000	42657
	1-1/16	1.0625	42658
	1-1/8	1.1250	42659
	1-3/16	1.1875	42660
	1-1/4	1.2500	77151
	1-5/16	1.3125	55679
	1-3/8	1.3750	42662
	1-7/16	1.4375	42663
	1-1/2	1.5000	42664
	1-5/8	1.6250	42665
	1-11/16	1.6875	42666
	1-3/4	1.7500	42667
400	1-3/8	1.3750	57819
	1-7/16	1.4375	59056
	1-1/2	1.5000	77152
	1-5/8	1.6250	84702
	1-11/16	1.6875	76497
	1-3/4	1.7500	76498
	1-7/8	1.8750	76499
	1-15/16	1.9375	76500
	2	2.0000	76501
	2-1/8	2.1250	76502
	2-3/16	2.1875	76503
	2-1/4	2.2500	76504



BORE TOLERANCES

Bores	Tolerance
0" to 1"	+0.0005/-0.0000
1" to 3"	+0.0010/-0.0000

STANDARD KEYWAYS

Bore Range	Square
Over – To	W x D
5/16 – 7/16	3/32 x 3/64
7/16 – 9/16	1/8 x 1/16
9/16 – 7/8	3/16 x 3/32
7/8 – 1-1/4	1/4 x 1/8
1-1/4 – 1-3/8	5/16 x 5/32
1-3/8 – 1-3/4	3/8 x 3/16
1-3/4 – 2-1/4	1/2 x 1/4
2-1/4 – 2-3/4	5/8 x 5/16

*Bushing kits include bushing and essential hardware



SECTION CONTENTS

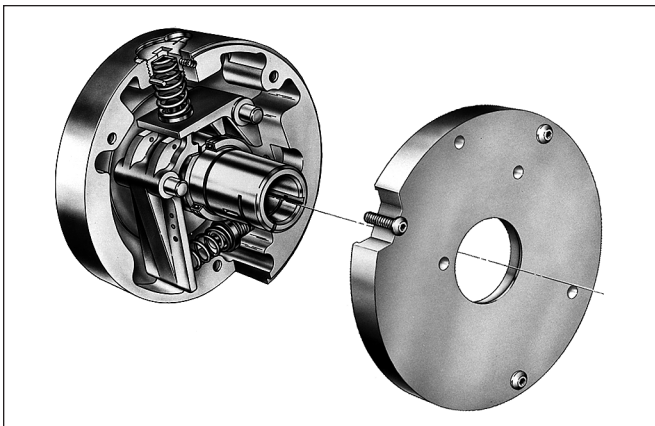
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TRIG-O-MATIC OVERLOAD CLUTCHES

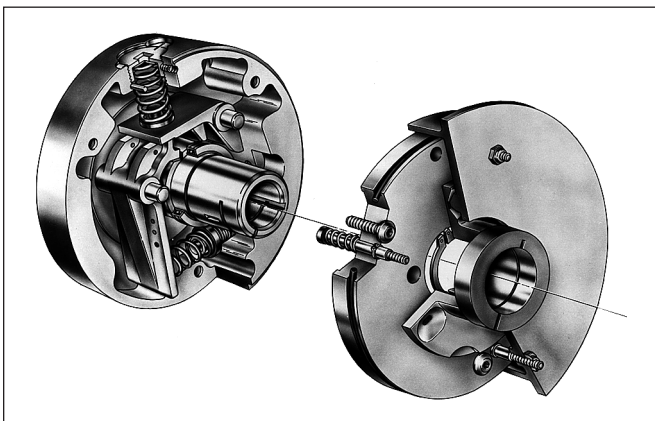
TRIG-O-MATIC OVERLOAD CLUTCHES ORC SERIES

FEATURES

- Bi-directional operation
- Single positioning for re-engagement at the exact cycle point at which it released
- Limit switch actuation for remote detection of overload condition
- Completely enclosed for dirty applications
- Automatic or manual reset
- Various configurations for direct and indirect drives
- Six sizes (Model F - five sizes) to accommodate various bore and torque ranges



STANDARD MODEL S



FULLY AUTOMATIC MODEL F



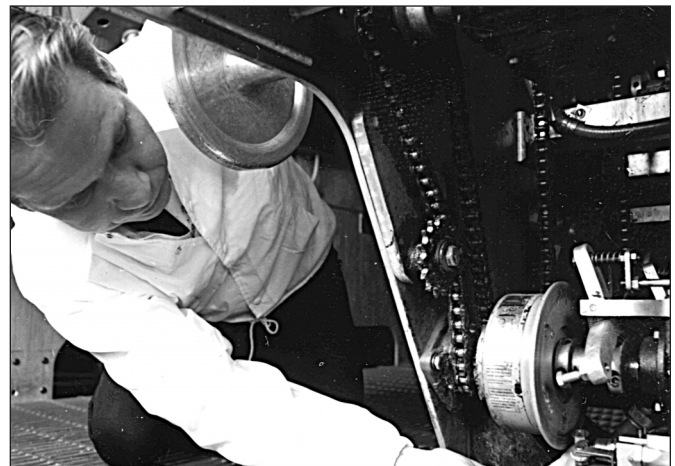
The Trig-O-Matic's unique "Trigger" action design disconnects the load at the instant an overload occurs and at the exact torque limit you set. When the overload condition is corrected, the clutch resets at the exact cycle point and torque at which it released.

The ORC Series Trig-O-Matic Overload Clutch is available in two models: the Standard Model S and the Fully Automatic Model F. Both provide single position engagement and a means to signal an overload condition. Each model is available in various sizes and types to adapt to your drive train. They incorporate reliability, repeatability and adjustability to protect your machinery from costly damage or downtime.

APPLICATIONS

The ORC Series Trig-O-Matic Overload Release Clutch can be applied on any drive train where the protection of reducers, indexers, chain, sprockets or product is required. It can replace less precise and less reliable devices such as shear pins and friction clutches.

Typical applications include: packaging machinery, paper converting machinery, baking equipment, bottling and capping machinery, indexing machinery, labeling machinery, conveyors, presses and water treatment equipment.



TRIG-O-MATIC OVERLOAD CLUTCHES

SELECTION

1. Determine the overload release torque by one of these methods:

a. Use the torque formula with horsepower and RPM specific to the selected clutch location. A service factor may be required for high inertia starts, reversing or peak load conditions, (refer to Page 80 for service factor information):

$$\text{Torque (Lb. In.)} = \frac{\text{HP} \times 63025}{\text{RPM}}$$

b. Determine the “weak link” in the drive train, (i.e. chain, reducer, belt or shaft). Select an overload release torque that is below the “weak link’s” maximum torque rating.

c. Physically measure the drive torque with a torque wrench and size accordingly.

2. Determine the bore size(s) and keyway(s):

a. Shaft size at the clutch location determines the clutch bore.

b. Shaft size at the coupling location determines the coupling bore, (if applicable).

3. Choose the appropriate Model (S or F), based upon the drive layout and the application’s requirements.

4. Refer to the Basic Selection Chart for the appropriate clutch size.

5. Refer to Pages 18-22 for ratings, dimensions, available styles, and types.

6. Refer to Page 81 for recommended mounting locations.

The **Standard Model S** is Boston Gear’s basic low-cost unit on which various optional features can be added. The clutch mechanism is available in automatic or manual reset. Typically, a manual reset clutch is used where it will run disengaged for extended periods of time. The automatic reset is generally used in conjunction with a limit switch to shut the drive down. The Standard Model is typically used to replace shear pins and where access to the clutch is available.

The **Fully Automatic Model F** includes all the features available in the Standard Model plus an automatic switch actuating mechanism, an automatic clutch mechanism and three mounting styles. The Model F is generally used where the unit is not easily accessible. This model is a complete overload clutch designed especially for production and packaging machinery.

TRIG-O-MATIC MODEL FEATURE COMPARISONS

ORC Series Model S	ORC Series Model F
Bi-directional	Bi-directional
Single Position	Single Position
Manual Clutch Reset	Automatic Clutch Reset
Automatic Clutch Reset	
Clutch Types B, C, N, R, T	Clutch Types B, C, N, R, T
One Mounting Style	Three Mounting Styles
Limit Switch Pin	Fully Automatic
Limit Switch Plate Actuator	Limit Switch Plate Actuator
Additional Features: Torque Selector Dial Max. Torque Limit Stop Grease Pack & Relief Fittings	Additional Features: Torque Selector Dial Max. Torque Limit Stop Grease Pack & Relief Fittings Locking Collar Mounting
Optional: Pressure Lube Bearings Balancing Locking Collar Mounting	Optional: Balancing One-Directional Feature

BASIC SELECTION CHART

Standard Model S					Fully Automatic Model F				
Clutch Size	Max. Bore (Inch)*	Torque Code	Torque Range (Lb. In.)		Clutch Size	Max. Bore (Inch)*	Torque Code	Torque Range (Lb. In.)	
			Min.	Max.				Min.	Max.
1	0.8750	L	35	100	1	0.7500	L	70	140
		M	75	275			M	110	275
		H	200	400			H	260	400
2	1.1875	L	50	200	2	1.1250	L	100	200
		M	200	600			M	200	600
		H	400	1,000			H	400	1,000
3	1.8120	L	200	850	3	1.7500	L	200	850
		M	800	2,200			M	800	2,200
		H	1,200	3,000			H	1,200	3,000
4	2.3120	L	600	1,400	4	2.1250	L	600	1,400
		M	1,200	3,000			M	1,200	3,000
		H	2,850	5,000			H	2,850	5,000
5	3.0000	L	1,600	3,000	5	2.7500	L	1,600	3,000
		M	2,500	6,000			M	2,500	6,000
		H	4,000	10,000			H	4,000	10,000
6	3.9375	L	4,000	8,000	—	—	—	—	—
		M	7,500	14,000			—	—	—
		H	12,500	25,000			—	—	—

*Larger bores may require flat keys (supplied with unit).

TRIG-O-MATIC OVERLOAD CLUTCHES

TRIG-O-MATIC ORC SERIES STANDARD MODEL S OPERATING PRINCIPLES

The Standard Model S ORC Series Trig-O-Matic Overload Release Clutch consists of two basic components: the rotor and the housing assembly. The clutch rotor is keyed and secured to the drive shaft with a setscrew.

The housing assembly includes a drive pawl and a reset pawl which are pivoted within the clutch housing. The drive pawl is held engaged in the rotor notch by the combined pressure of the drive and reset springs as shown in Figure 1. The combined pressure of these two springs determines the maximum torque which is transmitted without overload. With the clutch mechanism in the engaged position shown in Figure 1, the rotor and housing are held together and the entire unit rotates with the drive shaft at the same speed.

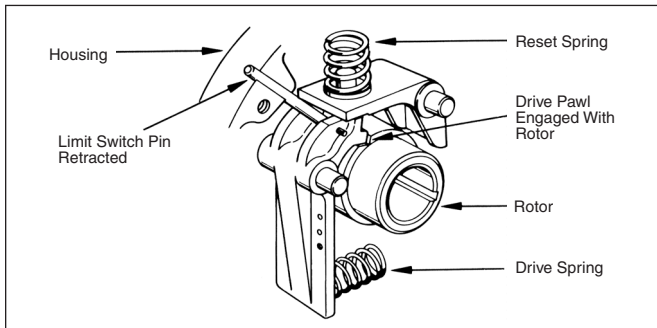


FIGURE 1 – ENGAGED

The Standard Model Trig-O-Matic is available in two clutch reset types: Manual and Automatic.

MANUAL RESET

The instant an overload occurs, the pressure of the drive and reset springs is overcome by the extra force applied to them. The drive pawl is forced out of its engaged position from the rotor and as it pivots up, the reset pawl lifts and locks it out of contact with the rotor as shown in Figure 2. The clutch then rotates freely.

When the overload condition has been corrected, the clutch is reset by inserting a hexagon wrench in the reset screw and turning the screw clockwise until the reset pawl releases the drive pawl. When the drive pawl re-engages with the rotor, the reset screw must be backed out to its original stop position. This is essential to restore the torque to its original setting.

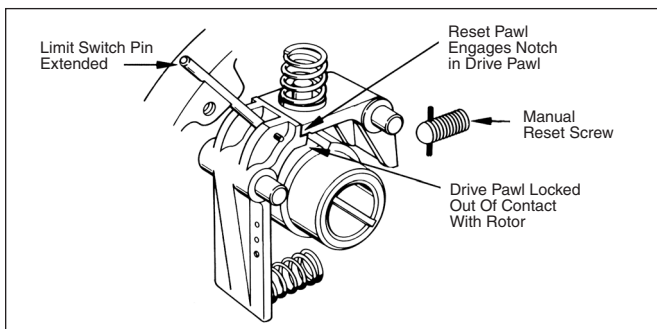


FIGURE 2
DISENGAGED - MANUAL

AUTOMATIC RESET

The instant an overload occurs, the pressure of the drive and reset springs is overcome by the extra force applied to them. The drive pawl is forced out of its engaged position from the rotor. The reset pawl applies pressure to the top of the drive pawl, holding it in contact with the rotor as shown in Figure 3. After one revolution the drive pawl will automatically return to its engaged position. If the overload is still present, it will not seat and will continue to rotate until overload has been removed.

The drive should be stopped as soon as possible. Mechanical means for actuating a limit switch is discussed below and on Page 23. After the overload condition has been corrected the

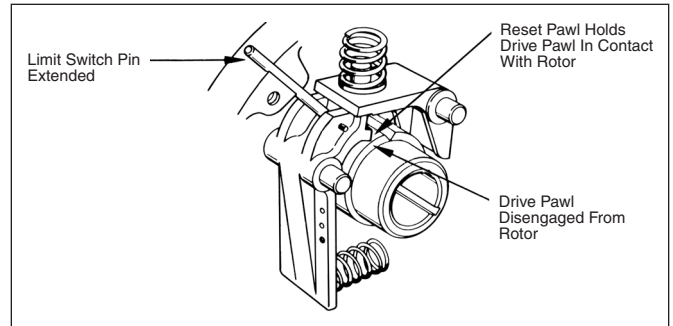


FIGURE 3
DISENGAGED - AUTOMATIC

drive must be “jogged” until the drive pawl engages with the rotor.

LIMIT SWITCH PIN

A Limit Switch Pin is furnished as a standard item to activate a limit switch that triggers the electrical controls. The travel of the Limit Switch Pin protruding radially from the clutch housing is controlled by the drive pawl motion upon disengagement. The Limit Switch Pin can be used if the housing **continues** to turn when an overload occurs and the rotor stops, (i.e., the housing is the driver and the rotor is the driven). The housing RPM must be considered to determine the time for the Limit Switch Pin to revolve around before contacting the limit switch.

The standard Limit Switch Pin extension is 1-inch, however, it can be made flush with the housing when engaged. If the Limit Switch Pin is not required, it can be omitted from the assembly.

If instantaneous operation of a limit switch is required or if the housing stops upon overload, see Page 23 for the Limit Switch Plate Actuator. Units which include this device do not have the Limit Switch Pin.

TRIG-O-MATIC OVERLOAD CLUTCHES

TORQUE SELECTOR DIAL

The torque selector dial shown in Figure 4 is a standard feature on all Standard Model S Trig-O Matic clutches. Each clutch is individually calibrated to specific torque values. The housing has two milled marks indicating minimum and maximum torque. In addition, these values are stamped on the housing adjacent to each mill mark. To adjust the torque, turn the selector screw until it is flush with the milled depth and the red scribed lines match the required output position. Additional marks can be indicated upon request.

MAXIMUM TORQUE LIMIT STOP

A maximum torque limit stop is supplied to prevent clutch lock-up. In conjunction with a torque selector dial, the maximum value indicated by the deepest milled mark can not be exceeded.

GREASE PACK FITTINGS

Grease pack and relief fittings are supplied countersunk into the clutch housing to pack the clutch cavity, preventing corrosion. This feature is especially suitable for outdoor or washdown service.

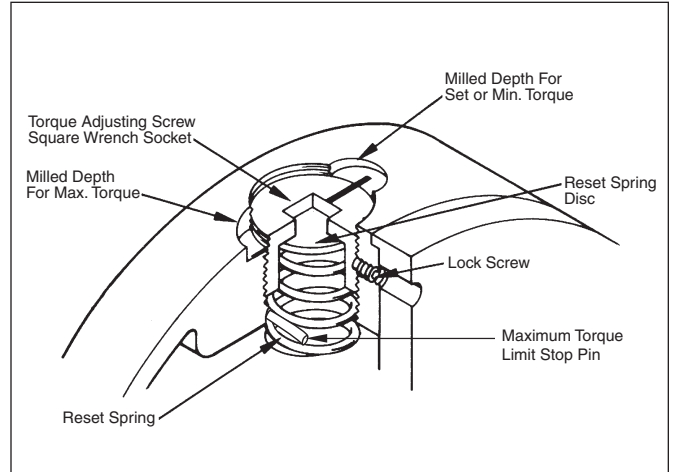


FIGURE 4

ORC MODEL S SERIES PART NUMBERING SYSTEM

ORC	2	SA	C	-	L	P16	-	P16
<u>Series</u>	<u>Size</u>	<u>Model</u>	<u>Type</u>		<u>Torque Range</u>			<u>Coupling Bore (Type C, N or R Only)</u>
Overload Release Clutch	1 2 3 4 5 6	SA = Standard Model, Automatic Reset with Pin Actuator SB* = Standard Model, Automatic Reset with Plate Actuator SC* = Standard Model, Automatic Reset with Reduced Plate Actuator SM = Standard Model, Manual Reset with Pin Actuator SP* = Standard Model, Manual Reset with Plate Actuator SS* = Standard Model, Manual Reset with Reduced Plate Actuator	B = Basic C = Flexible Coupling N = Indexing Coupling R = Rigid Coupling T = Sprocket Mount		L = Light M = Medium H = Heavy			P = Bored to Size (in 1/16") M = Metric Bored to Size (mm) (Leave Blank for Non-Coupled Units)
					<u>Unit Bore</u>			
					P = Bored to Size (in 1/16") M = Metric Bored to Size (mm)			

*Shown on page 23

HOW TO ORDER — STANDARD MODEL S

When ordering an ORC Series Trig-O-Matic Overload Clutch, please include code letters for series, size, model, type, torque range, unit bore and coupling bore (if applicable). Not all combinations are possible. Please refer to Pages 18-22 for details.

Example:

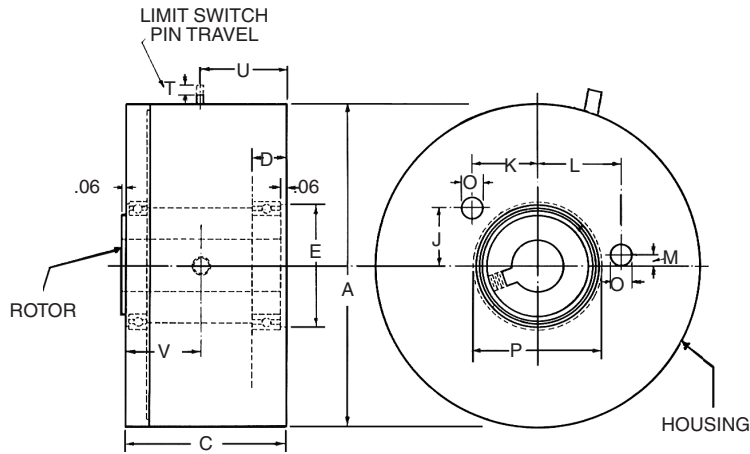
Required Size 2 Trig-O-Matic Overload Clutch, Standard Model S, automatic reset with pin actuator, flexible coupling, light torque range, with a one inch unit bore and a one inch coupling bore:

ORC 2 SA C — L P16 — P16

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL SA AND SM

TYPE B BASIC DESIGN



ALL DIMENSIONS IN INCHES

Clutch Size	A	C	D	E +.000/-0.002	J*	K*	L*	M*	O*	P	T	U	V	Weight (Lbs.)
1	4.50	2.31	0.69	1.500	0.81	0.81	1.06	.11	.31	1.62	.13	1.28	1.03	7
2	6.00	2.75	0.81	1.875	0.90	1.25	1.37	.18	.37	2.00	.13	1.53	1.22	14.5
3	8.00	3.50	0.94	2.750	1.25	1.62	1.94	.29	.50	2.87	.13	1.94	1.56	31
4	10.00	4.47	1.48	2.828	1.56	2.12	2.37	.43	.56	3.87	.13	2.66	1.81	64
5	12.00	5.12	1.62	4.000	1.94	2.62	3.00	.58	.69	4.26	.13	3.00	2.12	117
6	16.00	6.25	2.00	5.500	2.62	3.50	3.87	.90	.87	5.88	.25	3.68	2.56	253

*These dimensions refer to the pawl/trunnion holes. These holes are not through holes and should be avoided when mounting a coupling, sprocket, etc. to the clutch.

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM*	WR ² (Lb.-In. ²)
	L	M	H		
1	Min.	35	75	1,800	18
	Max.	100	275		
2	Min.	50	200	1,200	69
	Max.	200	600		
3	Min.	200	800	1,200	258
	Max.	850	2,200		
4	Min.	600	1,200	900	836
	Max.	1,400	3,000		
5	Min.	1,600	2,500	600	2,200
	Max.	3,000	6,000		
6	Min.	4,000	7,500	600	8,490
	Max.	8,000	14,000		

CLUTCH BORES

Clutch Size	Bores (inch)		
	Min.	Max. (1)	Max. (2)
1	0.5000	0.7500	0.8750
2	0.6250	1.1250	1.1875
3	0.7500	1.7500	1.8125
4	1.1250	2.2500	2.3125
5	1.5000	2.7500	3.0000
6	2.0000	3.7500	3.9375

Refer to Page 80 for a complete list of bore codes.
(1) Square Key
(2) Flat Key

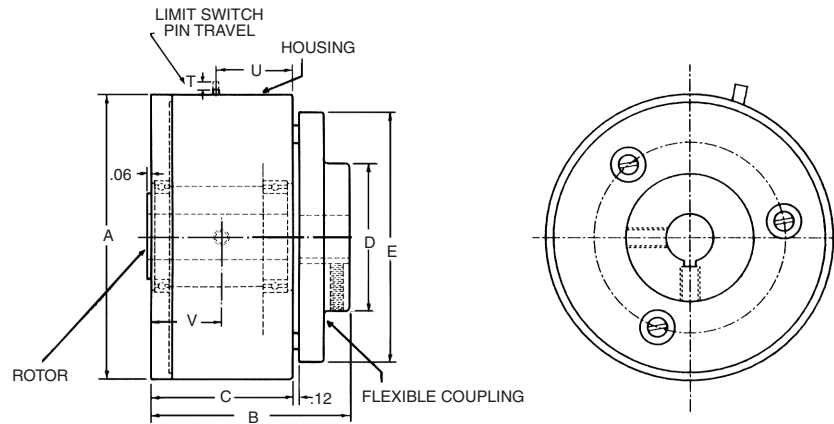
*Balancing and Manual Reset required for speeds exceeding 500 RPM.
For plate actuator Models SB, SC, SP and SS, refer to Page 23.
Clutches are shipped set for the minimum torque value of the selected range.

Refer to Page 17 for ordering information.

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL SA AND SM

TYPE C FLEXIBLE COUPLING



ALL DIMENSIONS IN INCHES

Clutch Size	A	B	C	D	E	U	T	V	Angular Misalignment*	Max. Parallel Offset*	Weight (Lbs.)
1	4.50	3.94	2.31	2.00	4.25	1.28	.13	1.03	< 1°	.012	10
2	6.00	4.62	2.75	2.56	5.25	1.53	.13	1.22	< 1°	.015	18
3	8.00	5.87	3.50	2.50	5.87	1.94	.13	1.56	< 1°	.016	39
4	10.00	7.71	4.47	4.87	9.12	2.66	.13	1.81	< 1°	.027	94
5	12.00	8.87	5.12	5.68	10.50	3.00	.13	2.12	< 1°	.031	163
6	16.00	11.12	6.25	8.18	13.25	3.68	.25	2.56	< 1°	.045	354

*Parallel offset and angular misalignment are proportionally reduced if both are present

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM*	WR ² (Lb.-In. ²)
	L	M	H		
1	Min. 35	75	200	1,800	25
	Max. 100	275	400		
2	Min. 50	200	400	1,200	80
	Max. 200	600	1,000		
3	Min. 200	800	1,200	1,200	300
	Max. 850	2,200	3,000		
4	Min. 600	1,200	2,850	900	1,190
	Max. 1,400	3,000	5,000		
5	Min. 1,600	2,500	4,000	600	2,850
	Max. 3,000	6,000	10,000		
6	Min. 4,000	7,500	12,500	600	10,900
	Max. 8,000	14,000	25,000		

*Balancing and Manual Reset required for speeds exceeding 500 RPM.
For plate actuator Models SB, SC, SP and SS, refer to Page 23.
Clutches are shipped set for the minimum torque value

CLUTCH AND COUPLING BORES

Clutch Size	Type	Bores (inch)		
		Min.	Max. (1)	Max. (2)
1	Clutch	0.5000	0.7500	0.8750
	Coupling	0.5000	1.5000	1.5625
2	Clutch	0.6250	1.1250	1.1875
	Coupling	0.6250	1.8125	1.9375
3	Clutch	0.7500	1.7500	1.8125
	Coupling	0.7500	1.7500	1.8125
4	Clutch	1.1250	2.2500	2.3125
	Coupling	1.1250	3.6875	3.8125
5	Clutch	1.5000	2.7500	3.0000
	Coupling	1.5000	4.2500	4.5000
6	Clutch	2.0000	3.7500	3.9375
	Coupling	2.0000	5.5000	5.7500

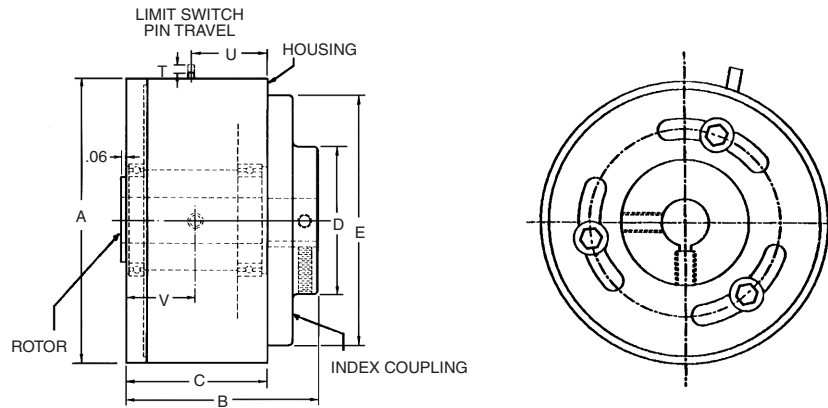
Refer to Page 80 for a complete list of bore codes.
(1) Square Key
(2) Flat Key

Refer to Page 17 for ordering information.

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL SA AND SM

TYPE N INDEXING COUPLING



ALL DIMENSIONS IN INCHES

Clutch Size	A	B	C	D	E	T	U	V	Weight (Lbs.)
1	4.50	3.81	2.31	2.00	4.25	.13	1.28	1.03	10
2	6.00	4.44	2.75	2.56	5.25	.13	1.53	1.22	18
3	8.00	5.75	3.50	3.00	7.00	.13	1.94	1.56	39
4	10.00	7.59	4.47	4.87	9.12	.13	2.66	1.81	94
5	12.00	8.68	5.12	5.68	10.50	.13	3.00	2.12	163
6	16.00	10.94	6.25	8.18	13.25	.25	3.68	2.56	354

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM*	WR ² (Lb.-In. ²)
	L	M	H		
1	Min. 35	75	200	1,800	25
	Max. 100	275	400		
2	Min. 50	200	400	1,200	80
	Max. 200	600	1,000		
3	Min. 200	800	1,200	1,200	300
	Max. 850	2,200	3,000		
4	Min. 600	1,200	2,850	900	1,190
	Max. 1,400	3,000	5,000		
5	Min. 1,600	2,500	4,000	600	2,850
	Max. 3,000	6,000	10,000		
6	Min. 4,000	7,500	12,500	600	10,900
	Max. 8,000	14,000	25,000		

*Balancing and Manual Reset required for speeds exceeding 500 RPM.
For plate actuator Models SB, SC, SP and SS, refer to Page 23.
Clutches are shipped set for the minimum torque value of the selected range.

CLUTCH AND COUPLING BORES

Clutch Size	Type	Bores (inch)		
		Min.	Max. (1)	Max. (2)
1	Clutch	0.5000	0.7500	0.8750
	Coupling	0.5000	1.5000	1.5625
2	Clutch	0.6250	1.1250	1.1875
	Coupling	0.6250	1.8125	1.9375
3	Clutch	0.7500	1.7500	1.8125
	Coupling	0.7500	1.7500	1.8125
4	Clutch	1.1250	2.2500	2.3125
	Coupling	1.1250	3.6875	3.8125
5	Clutch	1.5000	2.7500	3.0000
	Coupling	1.5000	4.2500	4.5000
6	Clutch	2.0000	3.7500	3.9375
	Coupling	2.0000	5.5000	5.7500

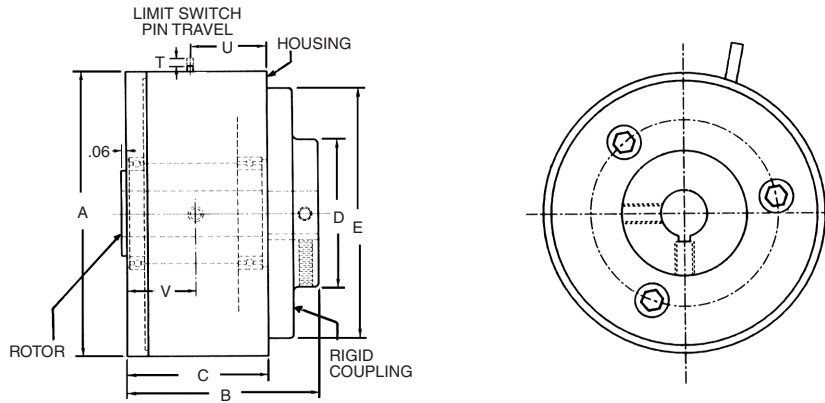
Refer to Page 80 for a complete list of bore codes.
(1) Square Key
(2) Flat Key

Refer to Page 17 for ordering information.

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL SA AND SM

TYPE R RIGID COUPLING



ALL DIMENSIONS IN INCHES

Clutch Size	A	B	C	D	E	T	U	V	Weight (Lbs.)
1	4.50	3.81	2.31	2.00	4.25	.13	1.28	1.03	10
2	6.00	4.44	2.75	2.56	5.25	.13	1.53	1.22	18
3	8.00	5.75	3.50	3.00	7.00	.13	1.94	1.56	39
4	10.00	7.59	4.47	4.87	9.12	.13	2.66	1.81	94
5	12.00	8.68	5.12	5.68	10.50	.13	3.00	2.12	163
6	16.00	10.94	6.25	8.18	13.25	.25	3.68	2.56	354

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM*	WR ² (Lb.-In. ²)
	L	M	H		
1	Min. 35	75	200	1,800	25
	Max. 100	275	400		
2	Min. 50	200	400	1,200	80
	Max. 200	600	1,000		
3	Min. 200	800	1,200	1,200	300
	Max. 850	2,200	3,000		
4	Min. 600	1,200	2,850	900	1,190
	Max. 1,400	3,000	5,000		
5	Min. 1,600	2,500	4,000	600	2,850
	Max. 3,000	6,000	10,000		
6	Min. 4,000	7,500	12,500	600	10,900
	Max. 8,000	14,000	25,000		

CLUTCH AND COUPLING BORES

Clutch Size	Type	Bores (inch)		
		Min.	Max. (1)	Max. (2)
1	Clutch	0.5000	0.7500	0.8750
	Coupling	0.5000	1.5000	1.5625
2	Clutch	0.6250	1.1250	1.1875
	Coupling	0.6250	1.8125	1.9375
3	Clutch	0.7500	1.7500	1.8125
	Coupling	0.7500	1.7500	1.8125
4	Clutch	1.1250	2.2500	2.3125
	Coupling	1.1250	3.6875	3.8125
5	Clutch	1.5000	2.7500	3.0000
	Coupling	1.5000	4.2500	4.5000
6	Clutch	2.0000	3.7500	3.9375
	Coupling	2.0000	5.5000	5.7500

*Balancing and Manual Reset required for speeds exceeding 500 RPM.
For plate actuator Models SB, SC, SP and SS, refer to Page 23.
Clutches are shipped set for the minimum torque value of the selected range.

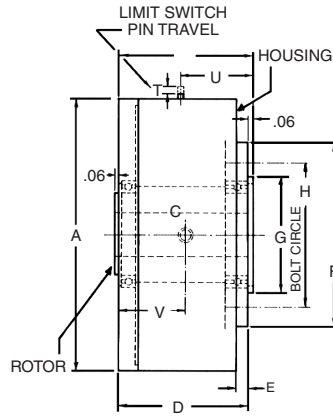
Refer to Page 80 for a complete list of bore codes.
(1) Square Key
(2) Flat Key

Refer to Page 17 for ordering information.

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL SA AND SM

TYPE T SPROCKET, SHEAVE, PULLEY



ALL DIMENSIONS IN INCHES

Clutch Size	A	C	D	E	F	G +.000/-0.002	H	T	U	V	Weight (Lbs.)
1	4.50	2.31	2.25	0.37	2.87	1.875	2.375	.13	1.28	1.03	6
2	6.00	2.75	2.69	0.43	3.68	2.250	3.000	.13	1.53	1.22	12
3	8.00	3.50	3.44	0.50	4.87	3.250	4.125	.13	1.94	1.56	26
4	10.00	4.47	4.41	0.68	6.12	3.203	5.000	.13	2.66	1.81	55
5	12.00	5.12	5.06	0.81	7.50	4.125	6.250	.13	3.00	2.12	100
6	16.00	6.25	6.19	1.06	10.00	6.000	8.750	.25	3.68	2.56	215

Refer to Page 32 for mounting hole patterns.

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM*	WR ² (Lb.-In. ²)
	L	M	H		
1	Min. 35	75	200	1,800	14
	Max. 100	275	400		
2	Min. 50	200	400	1,200	54
	Max. 200	600	1,000		
3	Min. 200	800	1,200	1,200	212
	Max. 850	2,200	3,000		
4	Min. 600	1,200	2,850	900	693
	Max. 1,400	3,000	5,000		
5	Min. 1,600	2,500	4,000	600	1,818
	Max. 3,000	6,000	10,000		
6	Min. 4,000	7,500	12,500	600	6,940
	Max. 8,000	14,000	25,000		

*Balancing and Manual Reset required for speeds exceeding 500 RPM.

For plate actuator Models SB, SC, SP and SS, refer to Page 23.

Clutches are shipped set for the minimum torque value of the selected range.

CLUTCH BORES

Clutch Size	Bores (inch)		
	Min.	Max. (1)	Max. (2)
1	0.5000	0.7500	0.8750
2	0.6250	1.1250	1.1875
3	0.7500	1.7500	1.8125
4	1.1250	2.2500	2.3125
5	1.5000	2.7500	3.0000
6	2.0000	3.7500	3.9375

Refer to Page 80 for a complete list of bore codes.

- (1) Square Key
- (2) Flat Key

Sprockets, gears, sheaves and pulleys can be mounted upon request. Refer to Page 32 for maximum sprocket sizes.

Refer to Page 17 for ordering information.

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES STANDARD MODEL S OPTIONS

LIMIT SWITCH PLATE ACTUATOR, MODELS SB/SC AND SP/SS

Available for all types, the Standard Model S Trig-O-Matic Limit Switch Plate Actuator provides instant operation of a limit switch to shut down the drive or to actuate an alarm should an overload occur.

The mechanism is entirely contained in the clutch cover and is actuated by the motion of the drive pawl. When an overload occurs, the drive pawl motion releases the actuating plate and it trips a limit switch. The total motion of the plate is .31 of an inch (See Figure 5).

After the overload has been cleared and the clutch is re-engaged, the actuating plate is manually returned to its normal operating position by applying equally spaced pressure to the surface of the plate.

A limit switch should be able to operate within the plate travel of .31 of an inch. Wire the switch in parallel with a jog circuit so that the drive can then be indexed to the start/run circuit.

LOCKING COLLAR SHAFT MOUNTING

In lieu of the standard setscrew mounting on the Standard Model S, a locking collar shaft mounting can be supplied.

BALANCING

Static balancing is available for applications that exceed 50% of the catalog maximum RPM. Always consult the factory with complete drive details and layout for these high speed applications.

CUSTOM VARIATIONS

Sprockets, sheaves, pulleys and gears can be supplied and mounted to the clutch.

Dimensional changes (i.e. overall length, limit switch actuating mechanism diameters, etc.)

Bores and keyways (i.e. metric, non-standard)

SPECIAL FINISHES

All clutches are supplied with a standard lacquer finish. Special coatings, finishes, or paints are also available upon request.

PRESSURE LUBE MODEL

Pressure lube bronze bearings are preferred instead of standard ball bearings for use in harsh environments such as wastewater treatment plants or installations requiring wash-down service. Grease fittings are furnished to permit periodic lubrication to the inside diameter of the sleeve bearings.

The Pressure Lube Model Trig-O-Matic is available with either the Limit Switch Pin or the Limit Switch Plate Actuator.

The Pressure Lube Model is equipped with all Standard Model S features and is available in either automatic or manual clutch reset types.

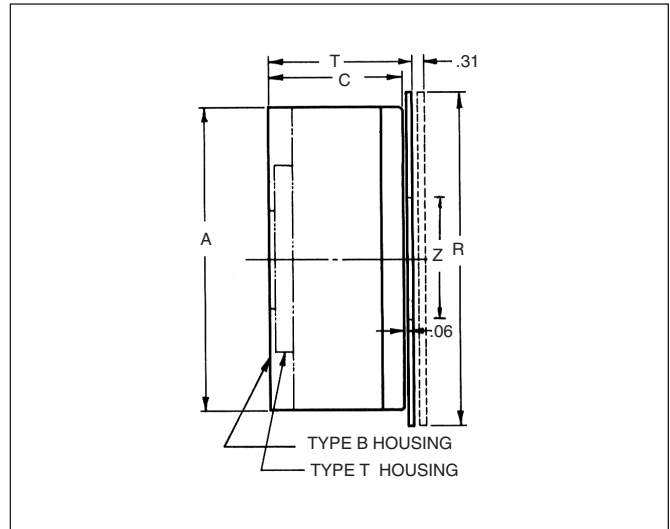


FIGURE 5

ALL DIMENSIONS IN INCHES

Clutch Size	A	C	R*	T	Z
1	4.50	2.31	5.50	2.53	2.00
2	6.00	2.75	7.00	2.97	3.25
3	8.00	3.50	9.50	3.72	4.50
4	10.00	4.47	11.50	4.69	5.75
5	12.00	5.12	13.50	5.34	5.50
6	16.00	6.25	17.50	6.50	7.25

*The R dimension may be reduced to the A dimension if required, specify SC/SS when ordering

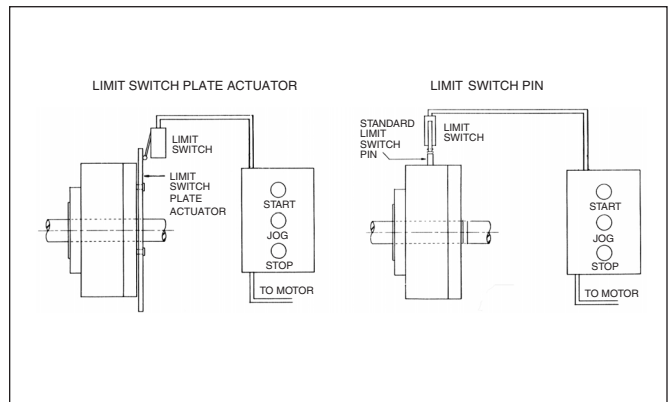


FIGURE 6

Figure 6 illustrates two methods of utilizing a single limit switch to detect an overload condition.

TRIG-O-MATIC OVERLOAD CLUTCHES

TRIG-O-MATIC ORC SERIES FULLY AUTOMATIC MODEL F OPERATING PRINCIPLES

The Fully Automatic Model F Trig-O-Matic Overload Release Clutch consists of three basic components: the rotor, the housing assembly and the automatic limit switch actuating plate assembly. The clutch rotor is keyed and secured with a locking collar (Models FJ and FG) or, with a setscrew (Model FR).

The housing assembly includes a drive pawl and a reset pawl which are pivoted within the clutch housing. The drive pawl is held in its engaged position by the combined pressure of the drive and reset springs as shown in Figure 7. The combined pressure of these two springs determines the maximum torque which is transmitted without overload. With the clutch mechanism in the engaged position, the rotor and housing are held together and the entire unit rotates with the drive shaft at the same speed.

When an overload occurs, the rotor rotates from its normal position within the housing. At this instant, the combined pressure of the drive and reset springs is overcome by the extra force applied to them and the drive pawl disengages from the rotor. The pressure applied by both springs holds the drive pawl in contact with the rotor, (See Figure 8). After one revolution, the drive pawl will automatically re-engage.

The automatic limit switch actuating plate assembly is incorporated to provide a means by which an external limit switch can be actuated to stop the drive.

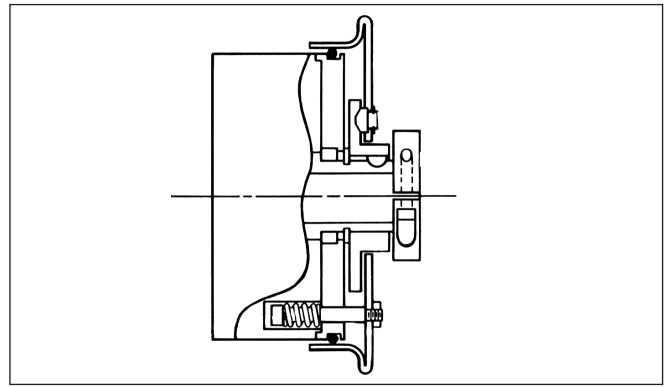


FIGURE 9 – SWITCH ACTUATING PLATE ASSEMBLY

After the overload condition has been corrected, the drive must be “jogged” until the drive pawl engages with the rotor. The clutch has now reindexed itself to its original position.

The fully automatic Model F includes, as standard, a limit switch actuating plate assembly. Upon overload, the rotor is released from its engaged position within the housing. The resulting rotation causes the cam plate, which is keyed to the rotor, to exert pressure on the lift-out buttons forcing them to move the actuating plate axially away from the clutch housing, (See Figure 9).

When the clutch re-engages, the actuating plate is automatically returned to its original position by the return spring's pressure on the return pins.

The actuating plate can only retract completely to its original position upon re-engagement of the drive pawl with the rotor.

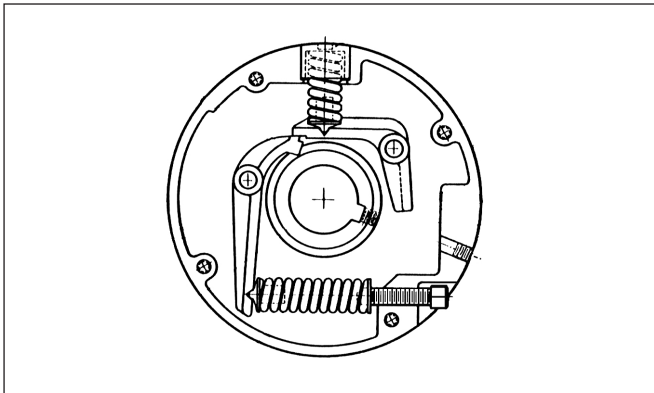


FIGURE 7 – ENGAGED

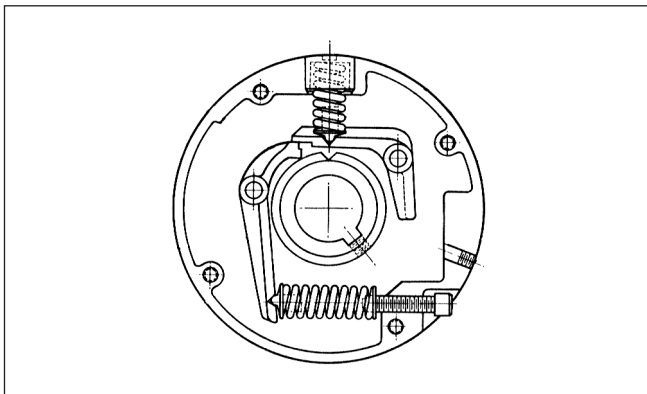


FIGURE 8 – DISENGAGED

LOCKING COLLAR MOUNTING

Three clutch models are available for mounting. Models FJ and FG incorporate a locking collar design which provides a positive clamp on the key and shaft. Model FR uses a standard setscrew mounting arrangement, (See Figure 10).

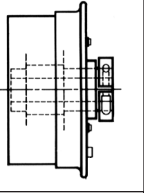
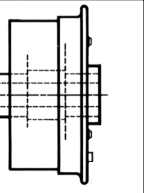
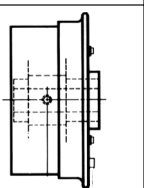
<p>Model FJ</p> 	<p>Model FJ is used where full shaft length is available.</p>
<p>Model FG</p> 	<p>Model FG is used where shaft length is limited.</p>
<p>Model FR</p> 	<p>Model FR is used where overall space is limited.</p>

FIGURE 10 – MODEL F STYLES

TRIG-O-MATIC OVERLOAD CLUTCHES

TORQUE SELECTOR DIAL

The torque selector dial shown in Figure 11 is a standard feature on all Fully Automatic Model F Trig-O-Matic clutches. Each clutch is individually calibrated to specific torque values. The housing has two milled marks indicating minimum and maximum torque. In addition, these values are stamped on the housing adjacent to each mill mark. To adjust the torque, turn the selector screw until it is flush with the milled depth and the red scribed lines match the required output position. Additional marks can be indicated upon request.

MAXIMUM TORQUE LIMIT STOP

A maximum torque limit stop is supplied to prevent clutch lock-up. In conjunction with a torque selector dial, the maximum value indicated by the deepest milled mark can not be exceeded.

GREASE PACK FITTINGS

Grease pack and relief fittings are supplied countersunk into the clutch housing to pack the clutch cavity, preventing corrosion. This feature is especially suitable for outdoor or washdown service.

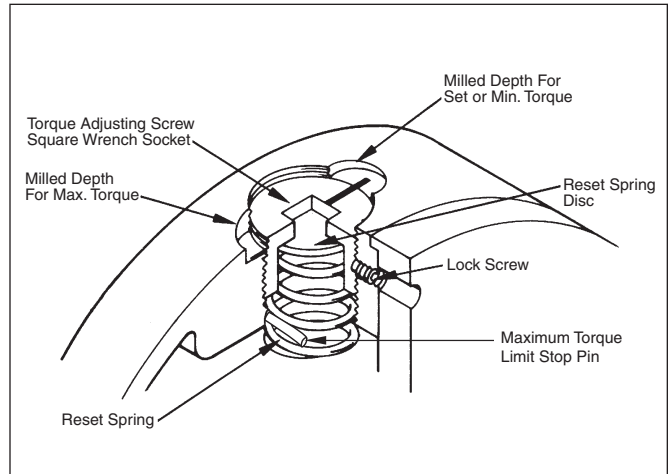


FIGURE 11

ORC MODEL F SERIES PART NUMBERING SYSTEM

ORC	2	FG	C	-	L	P16	-	P16
Series	Size	Model	Type		Torque Range	Coupling Bore (Type C, N or R Only)		
Overload Release Clutch	1 2 3 4 5	FJ = Model F, Full Available Shaft Length FG = Model F, Limited Available Shaft Length FR = Model F, Overall Limited Space	B = Basic C = Flexible Coupling N = Indexing Coupling R = Rigid Coupling T = Sprocket Mount		L = Light M = Medium H = Heavy	P = Bored to Size (in 1/16") M = Metric Bored to Size (mm) (Leave Blank for Non-Coupled Units)		
					Unit Bore			
					P = Bored to Size (in 1/16") M = Metric Bored to Size (mm)			

HOW TO ORDER — STANDARD MODEL F

When ordering an ORC Series Trig-O-Matic Overload Clutch, please include code letters for series, size, model, type, torque range, unit bore and coupling bore (if applicable). Not all combinations are possible. Please refer to Pages 26-30 for details.

Example:

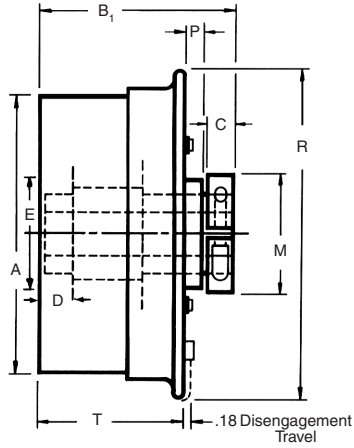
Required Size 2 Trig-O-Matic Overload Clutch, Model F automatic reset, limited available shaft length, flexible coupling, light torque range, with a one inch unit bore and a one inch coupling bore:

ORC 2 FG C — L P16 — P16

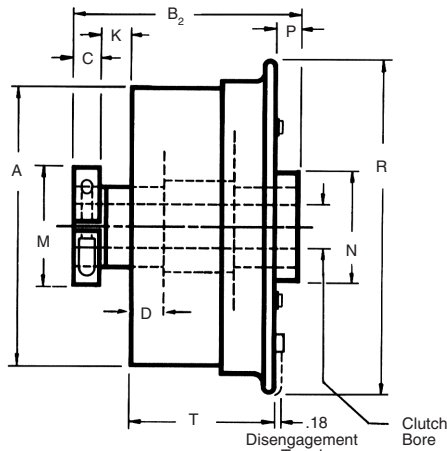
TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL FJ, FG, AND FR

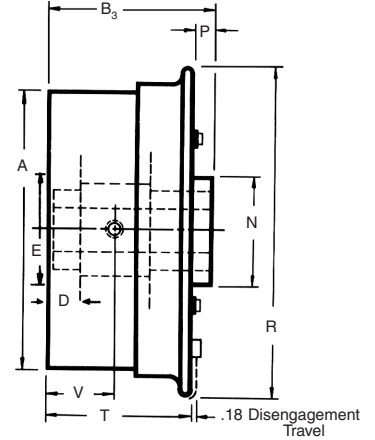
TYPE B BASIC DESIGN



MODEL FJ



MODEL FG



MODEL FR

ALL DIMENSIONS IN INCHES

Clutch Size	A	B ₁	B ₂	B ₃	C	D	E +0.000/-0.002	K	M	N	P	R	T	V	Weight (Lbs.)
1	4.50	3.78	4.49	3.26	.50	0.69	1.500	0.72	1.87	1.56	.38	5.50	2.89	1.28	8
2	6.00	4.28	4.96	3.72	.56	0.81	1.875	0.68	2.37	2.25	.38	7.50	3.34	1.53	16
3	8.00	5.52	6.38	4.72	.75	0.94	2.750	0.91	3.25	3.00	.59	9.50	4.14	1.93	34
4	10.00	6.85	7.50	6.00	.87	1.48	2.828	0.66	4.25	4.00	.82	11.50	5.18	2.66	75
5	12.00	7.82	9.32	6.76	.87	1.62	4.000	1.69	5.00	5.25	.86	14.00	5.91	3.00	140

Consult factory for special drilled and tapped mounting holes.

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM	WR ² (Lb.-In. ²)
	L	M	H		
1	Min.	70	110	500	22
	Max.	140	275		
2	Min.	100	200	500	77
	Max.	200	600		
3	Min.	200	800	500	280
	Max.	850	2,200		
4	Min.	600	1,200	500	950
	Max.	1,400	3,000		
5	Min.	1,600	2,500	500	2,545
	Max.	3,000	6,000		

Clutches are shipped set for the minimum torque value of the selected range.

CLUTCH BORES

Clutch Size	Bores (inch)		
	Min.	Max. (1)	Max. (2)
1	0.5000	0.7500	—
2	0.6250	1.0000	1.1250
3	0.7500	1.6250	1.7500
4	1.1250	2.0000	2.1250
5	1.5000	2.6250	2.7500

Refer to Page 80 for a complete list of bore codes.

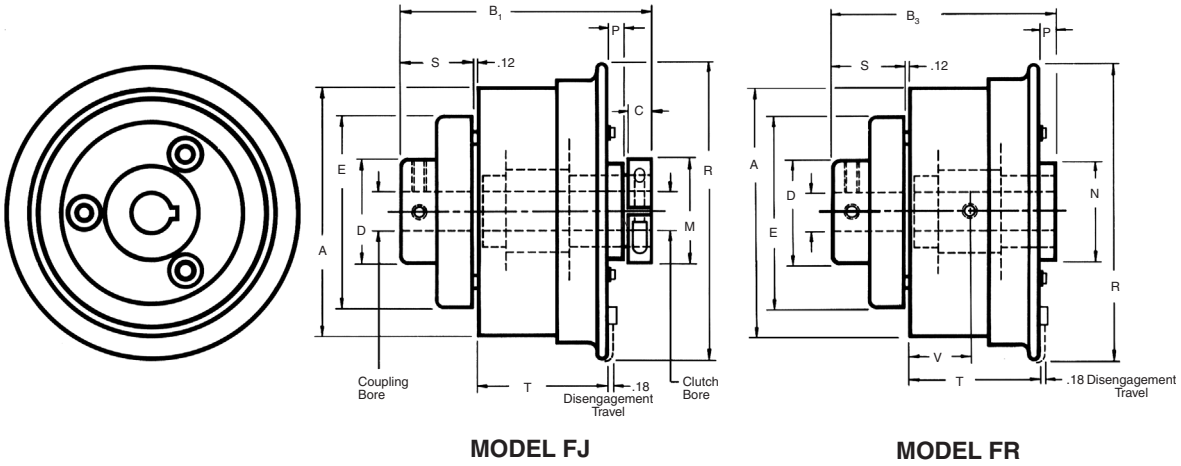
- (1) Square Key
- (2) Flat Key

Refer to Page 25 for ordering information.

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL FJ AND FR

TYPE C FLEXIBLE COUPLING



ALL DIMENSIONS IN INCHES

Clutch Size	A	B ₁	B ₃	C	D	E	M	N	P	R	S	T	V	Angular Misalignment*	Max. Parallel Offset*	Weight (Lbs.)
1	4.50	5.41	4.89	.50	2.00	4.25	1.87	1.56	.38	5.50	1.50	2.89	1.28	< 1°	.012	10
2	6.00	6.15	5.59	.56	2.56	5.25	2.37	2.25	.38	7.50	1.75	3.34	1.53	< 1°	.015	20
3	8.00	7.89	7.09	.75	2.50	5.87	3.25	3.00	.59	9.50	2.25	4.14	1.93	< 1°	.016	42
4	10.00	10.09	9.23	.87	4.87	9.12	4.25	4.00	.82	11.50	3.12	5.18	2.66	< 1°	.027	103
5	12.00	11.57	10.51	.87	5.68	10.50	5.00	5.25	.86	14.00	3.62	5.91	3.00	< 1°	.031	180

*Parallel offset and angular misalignment proportionately reduced if both are present.

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM	WR ² (Lb.-In. ²)
	L	M	H		
1	Min.	70	110	500	26
	Max.	140	275		
2	Min.	100	200	500	89
	Max.	200	600		
3	Min.	200	800	500	327
	Max.	850	2,200		
4	Min.	600	1,200	500	1,270
	Max.	1,400	3,000		
5	Min.	1,600	2,500	500	3,160
	Max.	3,000	6,000		

Clutches are shipped set for the minimum torque value of the selected range.

CLUTCH AND COUPLING BORES

Clutch Size	Type	Bores (inch)		
		Min.	Max. (1)	Max. (2)
1	Clutch	0.5000	0.7500	—
	Coupling	0.5000	1.5000	1.5625
2	Clutch	0.6250	1.0000	1.1250
	Coupling	0.6250	1.8125	1.9375
3	Clutch	0.7500	1.6250	1.7500
	Coupling	0.7500	1.7500	1.8125
4	Clutch	1.1250	2.0000	2.1250
	Coupling	1.1250	3.6875	3.8125
5	Clutch	1.5000	2.6250	2.7500
	Coupling	1.5000	4.2500	4.5000

Refer to Page 80 for a complete list of bore codes.

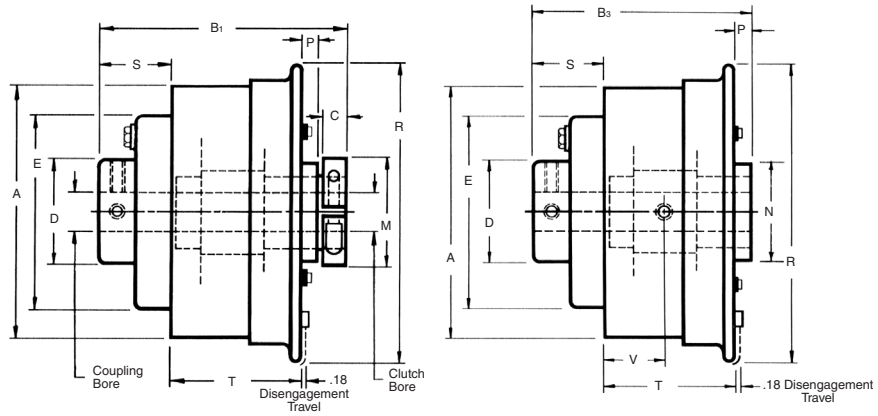
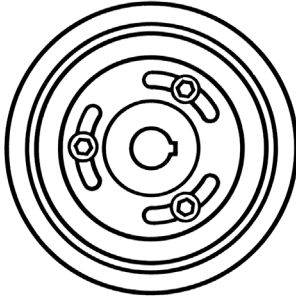
- (1) Square Key
- (2) Flat Key

Refer to Page 25 for ordering information.

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL FJ AND FR

TYPE N INDEXING COUPLING



MODEL FJ

MODEL FR

ALL DIMENSIONS IN INCHES

Clutch Size	A	B ₁	B ₃	C	D	E	M	N	P	R	S	T	V	Weight (Lbs.)
1	4.50	5.28	4.76	.50	2.00	4.25	1.87	1.56	.38	5.50	1.50	2.89	1.28	10
2	6.00	5.96	5.41	.56	2.56	5.25	2.37	2.25	.38	7.50	1.69	3.34	1.53	20
3	8.00	7.77	6.97	.75	3.00	7.00	3.25	3.00	.59	9.50	2.25	4.14	1.93	42
4	10.00	9.97	9.12	.87	4.87	9.12	4.25	4.00	.82	11.50	3.12	5.18	2.66	103
5	12.00	11.44	10.38	.87	5.68	10.50	5.00	5.25	.86	14.00	3.62	5.91	3.00	180

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM	WR ² (Lb.-In. ²)
	L	M	H		
1	Min.	70	110	500	26
	Max.	140	275		
2	Min.	100	200	500	89
	Max.	200	1,000		
3	Min.	200	800	500	327
	Max.	850	3,000		
4	Min.	600	1,200	500	1,270
	Max.	1,400	5,000		
5	Min.	1,600	2,500	500	3,160
	Max.	3,000	10,000		

Clutches are shipped set for the minimum torque value of the selected range.

CLUTCH AND COUPLING BORES

Clutch Size	Type	Bores (inch)		
		Min.	Max. (1)	Max. (2)
1	Clutch	0.5000	0.7500	—
	Coupling	0.5000	1.5000	1.5625
2	Clutch	0.6250	1.0000	1.1250
	Coupling	0.6250	1.8125	1.9375
3	Clutch	0.7500	1.6250	1.7500
	Coupling	0.7500	1.7500	1.8125
4	Clutch	1.1250	2.0000	2.1250
	Coupling	1.1250	3.6875	3.8125
5	Clutch	1.5000	2.6250	2.7500
	Coupling	1.5000	4.2500	4.5000

Refer to Page 80 for a complete list of bore codes.

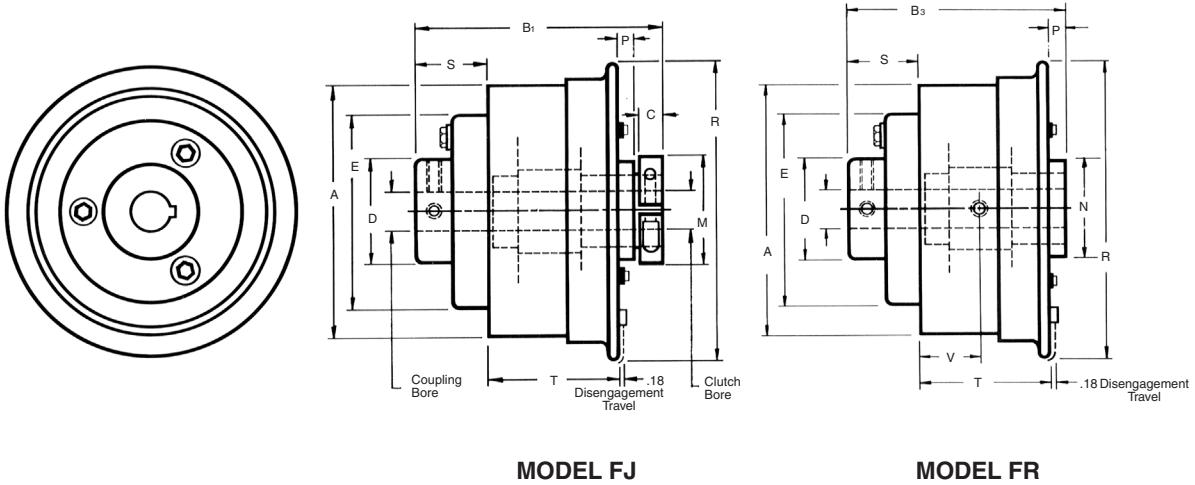
- (1) Square Key
- (2) Flat Key

Refer to Page 25 for ordering information.

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL FJ AND FR

TYPE R RIGID COUPLING



ALL DIMENSIONS IN INCHES

Clutch Size	A	B ₁	B ₃	C	D	E	M	N	P	R	S	T	V	Weight (Lbs.)
1	4.50	5.28	4.76	.50	2.00	4.25	1.87	1.56	.38	5.50	1.50	2.89	1.28	10
2	6.00	5.96	5.41	.56	2.56	5.25	2.37	2.25	.38	7.50	1.69	3.34	1.53	20
3	8.00	7.77	6.97	.75	3.00	7.00	3.25	3.00	.59	9.50	2.25	4.14	1.93	42
4	10.00	9.97	9.12	.87	4.87	9.12	4.25	4.00	.82	11.50	3.12	5.18	2.66	103
5	12.00	11.44	10.38	.87	5.68	10.50	5.00	5.25	.86	14.00	3.62	5.91	3.00	180

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM	WR ² (Lb.-In. ²)
	L	M	H		
1	Min.	70	110	500	26
	Max.	140	275		
2	Min.	100	200	500	89
	Max.	200	600		
3	Min.	200	800	500	327
	Max.	850	2,200		
4	Min.	600	1,200	500	1,270
	Max.	1,400	3,000		
5	Min.	1,600	2,500	500	3,160
	Max.	3,000	10,000		

Clutches are shipped set for the minimum torque value of the selected range.

CLUTCH AND COUPLING BORES

Clutch Size	Type	Bores (inch)		
		Min.	Max. (1)	Max. (2)
1	Clutch	0.5000	0.7500	—
	Coupling	0.5000	1.5000	1.5625
2	Clutch	0.6250	1.0000	1.1250
	Coupling	0.6250	1.8125	1.9375
3	Clutch	0.7500	1.6250	1.7500
	Coupling	0.7500	1.7500	1.8125
4	Clutch	1.1250	2.0000	2.1250
	Coupling	1.1250	3.6875	3.8125
5	Clutch	1.5000	2.6250	2.7500
	Coupling	1.5000	4.2500	4.5000

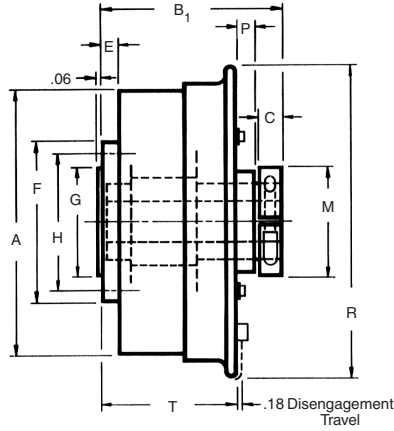
Refer to Page 80 for a complete list of bore codes.
(1) Square Key
(2) Flat Key

Refer to Page 25 for ordering information.

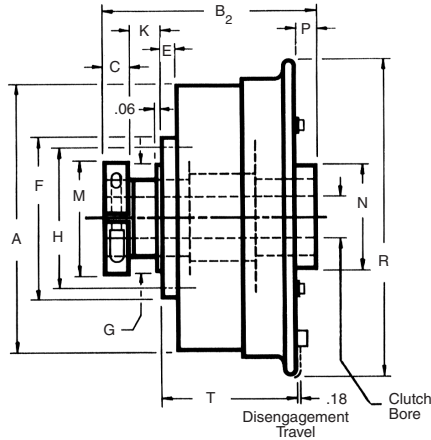
TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL FJ, FG, AND FR

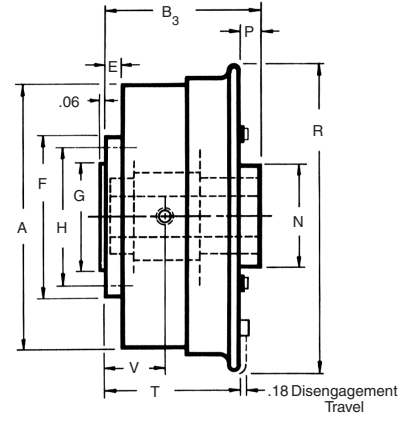
TYPE T SPROCKET, SHEAVE, PULLEY



MODEL FJ



MODEL FG



MODEL FR

ALL DIMENSIONS IN INCHES

Clutch Size	A	B ₁	B ₂	B ₃	C	E	F	G +.000/-002	H	K	M	N	P	R	T	V	Weight (Lbs.)
1	4.50	3.72	4.49	3.20	.50	.37	2.87	1.875	2.375	0.78	1.87	1.56	.38	5.50	2.83	1.22	7
2	6.00	4.22	4.96	3.66	.56	.43	3.68	2.250	3.000	0.74	2.37	2.25	.38	7.50	3.28	1.47	14
3	8.00	5.46	6.38	4.66	.75	.50	4.87	3.250	4.125	0.97	3.25	3.00	.59	9.50	4.08	1.88	30
4	10.00	6.79	7.50	5.94	.87	.68	6.12	3.203	5.000	0.72	4.25	4.00	.82	11.50	5.12	2.60	66
5	12.00	7.76	9.32	6.70	.87	.81	7.50	4.125	6.250	1.75	5.00	5.25	.86	14.00	5.85	2.93	123

Sprockets, sheaves, pulleys, and gears can be mounted upon request.
Refer to Page 32 for maximum sprocket sizes and mounting hole patterns.

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM	WR ² (Lb.-In. ²)
	L	M	H		
1	Min.	70	110	500	18
	Max.	140	275		
2	Min.	100	200	500	65
	Max.	200	1,000		
3	Min.	200	800	500	238
	Max.	850	2,200		
4	Min.	600	1,200	500	815
	Max.	1,400	3,000		
5	Min.	1,600	2,500	500	2,170
	Max.	3,000	10,000		

Clutches are shipped set for the minimum torque value of the selected range.

CLUTCH BORES

Clutch Size	Bores (inch)		
	Min.	Max. (1)	Max. (2)
1	0.5000	0.7500	—
2	0.6250	1.0000	1.1250
3	0.7500	1.6250	1.7500
4	1.1250	2.0000	2.1250
5	1.5000	2.6250	2.7500

Refer to Page 80 for a complete list of bore codes.
(1) Square Key
(2) Flat Key

Refer to Page 25 for ordering information.

TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES FULLY AUTOMATIC MODEL F OPTIONS

ONE-DIRECTION OPTION

For applications with oscillating torque loads, a one-directional clutch is available to prevent needless disengagement of the clutch due to back-loading conditions.

The unique rotor/drive pawl configuration permits the clutch to disengage in the normal running direction in the event of an overload. It back stops any load in the opposite direction and is virtually a solid connection when driven in the opposite direction (see Figure 12).

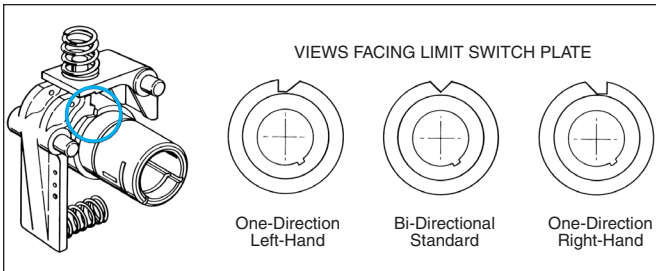


FIGURE 12

To select either the RIGHT-HAND or LEFT-HAND configuration:

1. Determine the normal direction of rotation facing either
 - a. the limit switch plate, or
 - b. the housing
2. Determine whether the input is driving through either
 - a. the rotor, or
 - b. the housing
3. With this information, select the correct configuration from the chart below.

Clockwise Running Rotation Facing Limit Switch Plate	
Rotor Driving (input) Right-Hand Clutch	Housing Driving (input) Left-Hand Clutch
Clockwise Running Rotation Facing Housing	
Rotor Driving (input) Left-Hand Clutch	Housing Driving (input) Right-Hand Clutch
Counter Clockwise Running Rotation Facing Limit Switch Plate	
Rotor Driving (input) Left-Hand Clutch	Housing Driving (input) Right-Hand Clutch
Counter Clockwise Running Rotation Facing Housing	
Rotor Driving (input) Right-Hand Clutch	Housing Driving (input) Left-Hand Clutch

CUSTOM VARIATIONS

Sprockets, sheaves, pulleys and gears can be supplied and mounted to the clutch.

Dimensional changes (i.e. overall length, limit switch actuating mechanism diameters, etc.).

Bores and keyways (i.e. metric, non-standard).

SPECIAL FINISHES

All clutches are supplied with a standard lacquer finish. Special coatings, finishes, or paints are also available upon request.

TYPICAL LIMIT SWITCH LAYOUT

The layout in Figure 13 uses a single limit switch to detect an overload condition. The switch should be able to operate within the travel of the limit switch plate. Upon overload the limit switch plate will move to actuate the limit switch and shut down the drive.

The switch should be wired in parallel with a jog circuit so that the drive can be indexed for re-engagement. After the clutch has been re-engaged, the limit switch will be reset and the drive can be restarted.

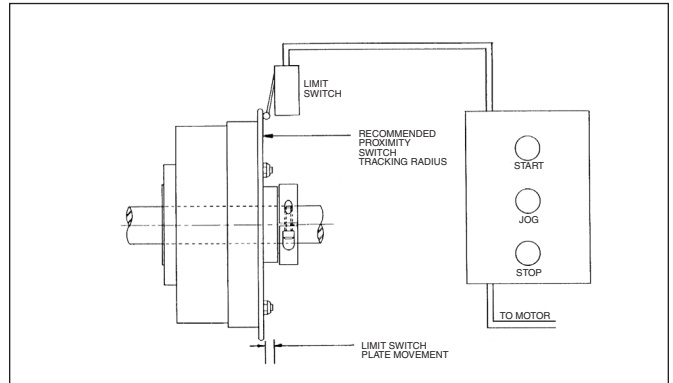


FIGURE 13

The limit switch actuating plate supplied with the Model F Trig-O-Matic Overload Clutch is furnished with a mild steel plate suitable for use with a proximity sensor.

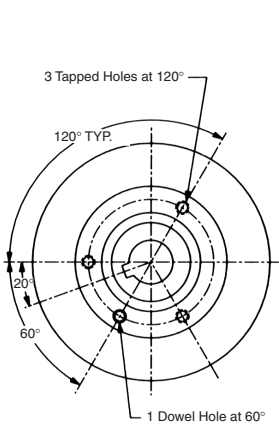
LIMIT SWITCH

Clutch Size	Movement (Inch)	Tracking Radius (Inch)
1	.18	2.38
2	.18	3.25
3	.18	4.18
4	.18	5.25
5	.18	6.25

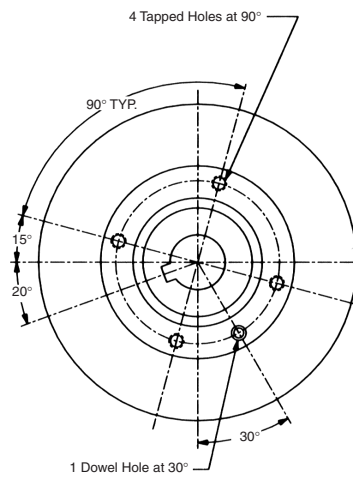
TRIG-O-MATIC OVERLOAD CLUTCHES

ORC SERIES MODEL S AND F

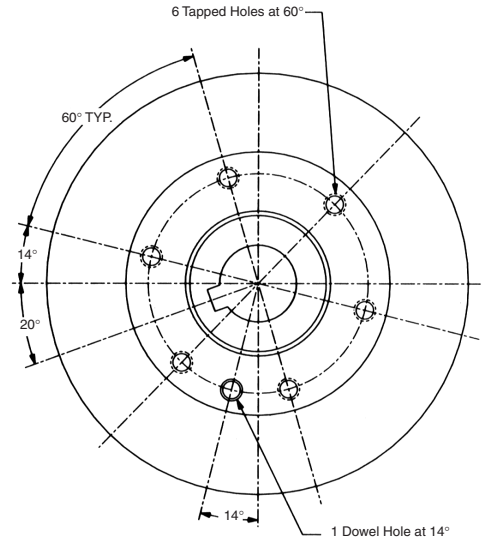
TYPE T MOUNTING HOLE PATTERNS



CLUTCH SIZES 1 AND 2



CLUTCH SIZES 3 AND 4



CLUTCH SIZES 5 AND 6

Clutch Size	Mounting Holes					
	Qty.	Thread Size	Tap Depth	Bolt Circle	Pilot Dia. +.000 -.002	Dowel Size
1	3	1/4-20	.50	2.375	1.875	.25
2	3	5/16-18	.50	3.000	2.250	.31
3	4	3/8-16	.62	4.125	3.250	.37
4	4	1/2-13	.87	5.000	3.203	.50
5	6	5/8-11	1.00	6.250	4.125	.62
6	6	5/8-11	1.00	8.750	6.000	.62

MINIMUM NUMBER OF TEETH OF STANDARD PLATE SPROCKETS ADAPTABLE TO TYPE T CLUTCHES

Clutch Size	Chain Size and Pitch											
	#25 1/4 Pitch	#35 3/8 Pitch	#40 1/2 Pitch	#41 1/2 Pitch	#50 5/8 Pitch	#60 3/4 Pitch	#80 1 Pitch	#100 1-1/4 Pitch	#120 1-1/2 Pitch	#140 1-3/4 Pitch	#160 2 Pitch	
1	40	28	22	22	18	Not Recommended						
2	54	36	28	28	22							19
3	Consult Factory		45	34	36	28	25	19	Not Recommended			
4	Consult Factory		42	45	36	30	23	19				
5	Consult Factory		Consult Factory		42	36	30	22	19	17	Not Recommended	
6	Consult Factory		Consult Factory		42	48	36	30	24	21		

For smaller sprockets consult factory.



SECTION CONTENTS

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MOUNTING HOLE PATTERNS.....	40
GENERAL INFORMATION.....	41

H1600 OVERLOAD CLUTCHES

H1600 OVERLOAD CLUTCHES HOR SERIES

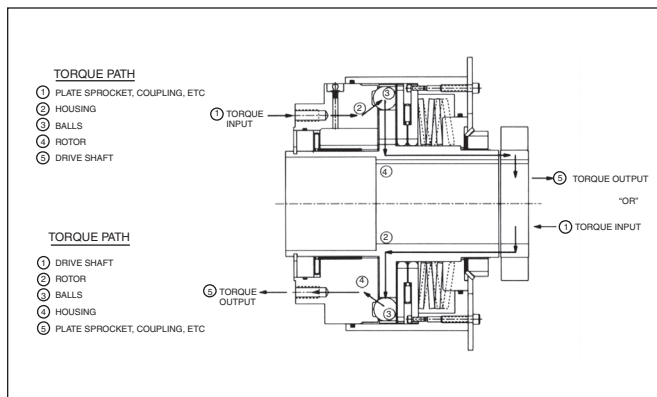
FEATURES

- Bi-directional operation
- Single position indexing
- Automatic reset
- Convenient torque adjustment
- Maximum torque limit stop
- Limit switch actuating mechanism
- Clamp collar for secure mounting
- Hardened components for long life
- Electroless nickel finish and stainless steel hardware for superior corrosion resistance
- Sealed from environmental contamination

OPERATING PRINCIPLES

The HOR Series H1600 is an automatic reset ball detent style overload release clutch. It has been designed to provide accurate and dependable torque disconnect protection for mechanical power transmission equipment. Torque is transmitted through the clutch in one of two paths. Refer to Figure 1.

FIGURE 1



Torque transmission between the balls and housing is the key to the disengagement of the clutch. The balls are forced into the pockets of the housing by an axial load generated by compressing a spring pack. This axial load determines the torque capacity of the clutch. Increasing or decreasing the spring compression or changing spring packs provides a means for multiple torque adjustments. When a torque overload condition occurs, the balls roll out of the pockets and freewheel similar to a ball thrust bearing. This rolling action



increases the efficiency in which the clutch operates and reduces any fluctuation of torque setting due to frictional changes. Refer to Figure 2.

The movement of the cover during disengagement can be used to trip a limit switch and signal a torque overload condition. The drive should be shut down immediately and the source of the overload determined and cleared. The drive can then be restarted. The automatic reset feature of the clutch will allow it to reengage without manual assistance and the clutch will once again be ready to provide accurate and dependable torque disconnect protection for your equipment.

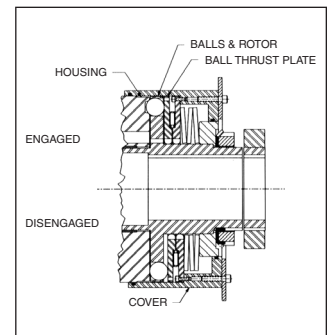


FIGURE 2

TORQUE ADJUSTMENT

The HOR Series H1600 Series Clutch can be factory set to your requirements. The torque setting of the clutch can easily be adjusted in the field to suit your needs. Two degrees of adjustment are available and described below.

Fine Adjustment: Lift the bearing lock washer tabs which secure the nut in position. Use a spanner wrench to adjust the bearing nut to your desired torque setting. Clockwise rotation will increase the torque and conversely, counterclockwise rotation will decrease the torque. Once the desired torque setting is made, fold the tab of the washer over the slot on the bearing nut to secure it in position at the new torque release level.

Coarse Adjustment: Large variations in torque setting can be accomplished by replacing the disc spring pack with that of a higher or lower spring rate. This change will effectively alter the load which can be applied to the balls.

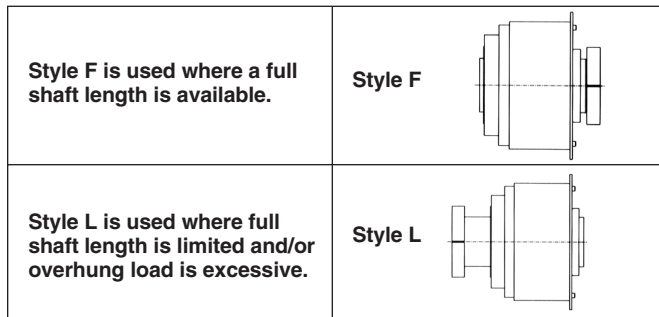
H1600 OVERLOAD CLUTCHES

SELECTION

- Determine the overload release torque by one of these methods:
 - Use the torque formula with horsepower and RPM specific to the selected clutch location. A service factor may be required for high inertia starts, reversing or peak load conditions, (refer to Page 80 for service factor information):

$$\text{Torque (Lb. In.)} = \frac{\text{HP} \times 63025}{\text{RPM}}$$
 - Determine the "weak link" in the drive train, (i.e., chain, reducer, belt or shaft). Select an overload release torque below the "weak link's" maximum torque rating.
 - Physically measure the drive torque with a torque wrench and size accordingly.
- Determine the bore size(s) and keyway(s):
 - Shaft size at the clutch location determines clutch bore.
 - Shaft size at the coupling location determines coupling bore (if applicable).
- Choose the appropriate Style based upon the drive layout and available space (See Figure 3).
- Refer to the Basic Selection Chart for the appropriate clutch size.
- Refer to Pages 36-39 for ratings, dimensions and types.
- Refer to Page 81 for recommended mounting locations.

FIGURE 3



BASIC SELECTION CHART

Clutch Size	Max. Bore* (In.)	Torque Code	Torque Range (Lb. In.)
02	0.6875	L	25-60
		M	50-125
		H	75-175
		W	100-250
04	1.1250	L	175-550
		M	250-850
		H	350-1,300
		W	600-2,000
05	1.7500	L	350-1,200
		M	500-1,800
		H	750-2,600
		W	1,000-4,000
		Y	1,650-6,000
06	2.1250	L	600-1,900
		M	750-2,700
		H	1,000-3,800
		W	1,500-5,600
09	3.1250	L	2,250-7,500
		M	3,000-10,500
		H	4,250-15,000
		W	6,250-22,500
11	3.6250	L	6,000-22,000
		M	9,000-32,000
		H	12,000-50,000

*Larger bores may require flat keys (supplied with unit).

HOW TO ORDER

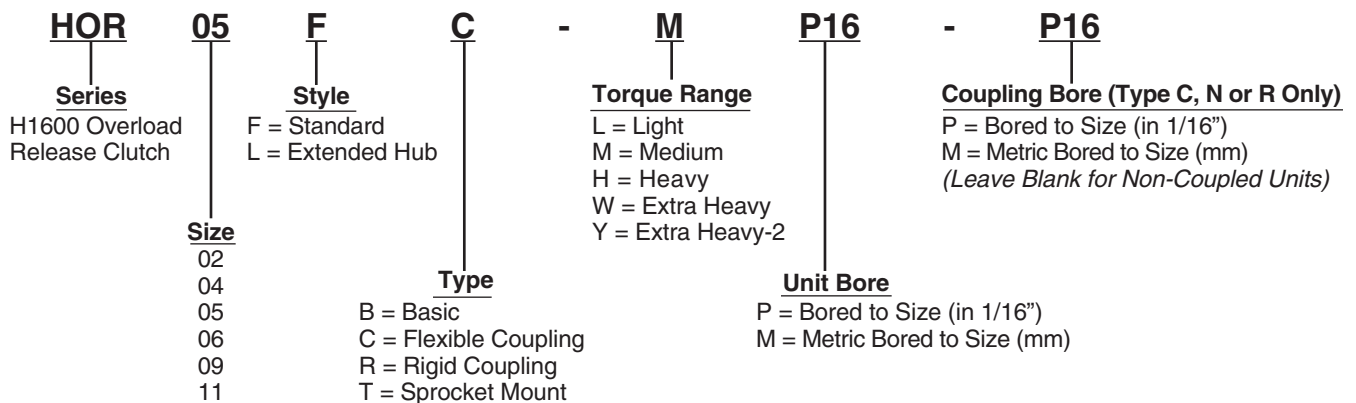
When ordering a HOR Series H1600 Overload Clutch, please include code letters/numbers for series, size, style, type, torque range, unit bore and coupling bore (if applicable).

Example:

Required size, 05 HOR Series H1600 Overload Clutch, standard style, flexible coupling, medium torque range, and a one inch bore on both the unit and coupling:

HOR **05** **F** **C** - **M** **P16** - **P16**

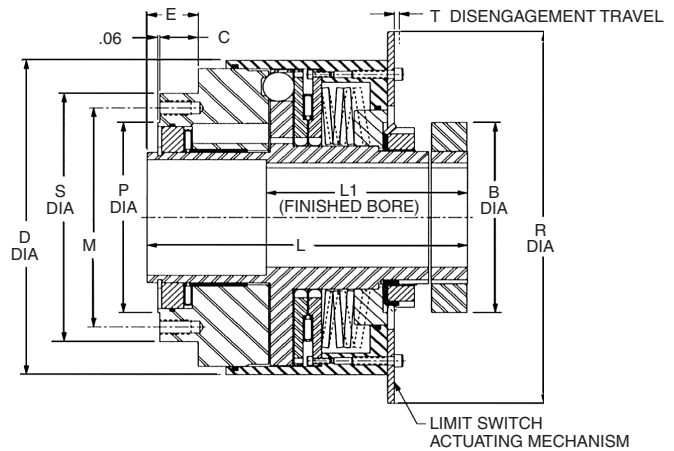
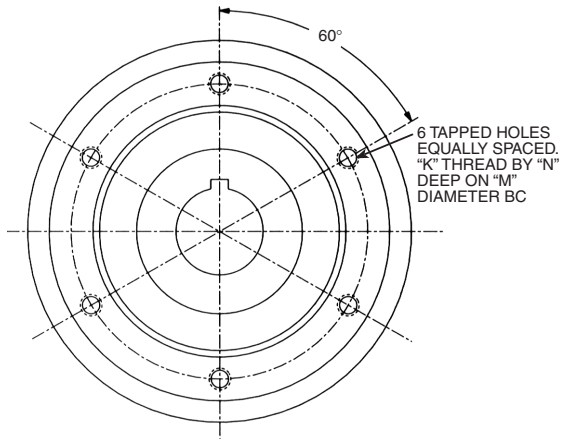
HOR SERIES PART NUMBERING SYSTEM



H1600 OVERLOAD CLUTCHES

HOR SERIES STYLE F

TYPE B BASIC MOUNTING



ALL DIMENSIONS IN INCHES

Clutch Size	B	C	D	E	L	L1	P +0.000/-0.002	R	S	T	Mounting Holes		
											N	K	M
02	1.75	0.29	2.81	0.45	3.52	2.00	1.781	5.81	2.63	.060	0.38	#8-32	2.125
04	2.38	0.35	4.25	0.56	4.79	3.00	2.688	7.25	3.63	.078	0.50	#10-24	3.062
05	3.50	0.43	5.88	0.70	6.20	3.88	3.625	8.88	5.00	.110	0.75	5/16-18	4.250
06	4.25	0.50	7.12	0.80	6.73	4.38	4.000	10.12	5.56	.128	0.81	3/8-16	4.750
09	5.75	1.03	9.50	1.40	9.00	5.50	5.750	12.50	7.56	.165	0.88	7/16-14	6.625
11	6.25	1.28	11.62	1.65	10.66	6.88	6.500	14.62	9.00	.183	1.00	5/8-11	7.750

Refer to Page 40 for minimum sprocket mounting table and mounting information

RATINGS

Clutch Size	Torque Range (Lb. In.)				Max. RPM	WR ^{2*} (Lb.-In. ²)	Weight* (Lbs.)
	Code	Min.	MRT	Max.			
02	L	25	45	60	500	3.4	3.9
	M	50	100	125			
	H	75	125	175			
	W	100	200	250			
04	L	175	400	550	500	22.3	11.0
	M	250	600	850			
	H	350	850	1,300			
	W	600	1,400	2,000			
05	L	350	900	1,200	500	129	30.2
	M	500	1,300	1,800			
	H	750	1,800	2,600			
	W	1,000	2,750	4,000			
06	L	1,650	4,000	6,000	500	266	43.3
	M	600	1,400	1,900			
	H	1,000	2,600	3,800			
	W	1,500	3,900	5,600			
09	L	2,800	7,000	10,000	500	1,155	104
	M	2,250	5,500	7,500			
	H	3,000	7,500	10,500			
	W	6,250	15,000	22,500			
11	L	6,000	15,000	22,000	500	2,995	171
	M	9,000	20,000	32,000			
	H	12,000	30,000	50,000			

CLUTCH BORES

Clutch Size	Bores (inch)	
	Max. (1)	Max. (2)
02	0.5000	—
04	1.0000	—
05	1.3750	1.5625
06	1.9375	2.1250
09	2.8750	3.1250
11	3.1875	3.5000

Refer to Page 80 for a complete list of bore codes.

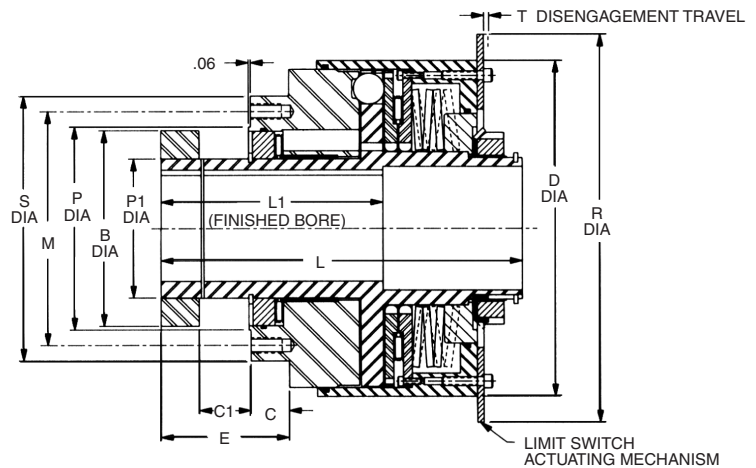
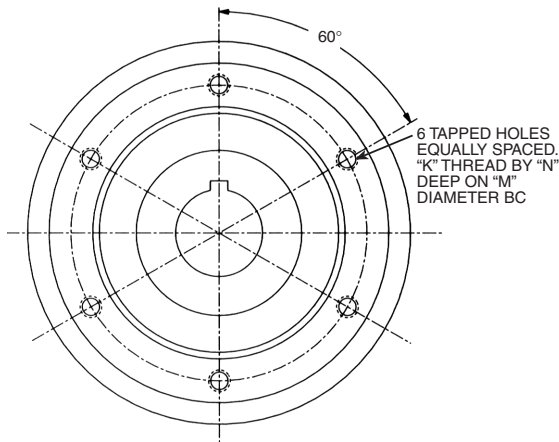
- (1) Square Key
- (2) Flat Key

*Weight and WR² estimated with maximum bores.
MRT is the Minimum Recommended Torque setting for those applications which require a minimal degree of backlash.
Clutches are shipped set for the minimum torque value of the selected range.
[Refer to Page 35 for ordering information.](#)

H1600 OVERLOAD CLUTCHES

HOR SERIES STYLE L EXTENDED HUB

TYPE B BASIC MOUNTING



ALL DIMENSIONS IN INCHES

Clutch Size	B	C	C1	D	E	L	L1	P +0.00/-0.002	P1		R	S	T	Mounting Holes		
									Min.	Max.				N	K	M
02	1.75	0.29	1.25	2.81	2.04	4.63	3.25	1.781	0.9843	0.9847	5.81	2.63	.060	0.38	#8-32	2.125
04	2.38	0.35	1.44	4.25	2.35	6.06	3.88	2.688	1.5728	1.5738	7.25	3.63	.078	0.50	#10-24	3.062
05	3.50	0.43	2.06	5.88	3.24	8.18	5.25	3.625	2.3623	2.3628	8.88	5.00	.110	0.75	5/16-18	4.250
06	4.25	0.50	3.62	7.12	4.87	10.25	6.88	4.000	2.7560	2.7566	10.12	5.56	.128	0.81	3/8-16	4.750
09	5.75	1.03	4.25	9.50	6.28	13.23	9.00	5.750	3.9350	3.9370	12.50	7.56	.165	0.88	7/16-14	6.625
11	6.50	1.28	4.50	11.62	7.16	15.01	10.00	6.500	4.7220	4.7240	14.62	9.00	.183	1.00	5/8-11	7.750

Refer to Page 40 for minimum sprocket mounting table and mounting information

RATINGS

Clutch Size	Torque Range (Lb. In.)				Max. RPM	WR ^{2*} (Lb.-In. ²)	Weight* (Lbs.)
	Code	Min.	MRT	Max.			
02	L	25	45	60	500	3.5	4.0
	M	50	100	125			
	H	75	125	175			
	W	100	200	250			
04	L	175	400	550	500	22.4	11.5
	M	250	600	850			
	H	350	850	1,300			
	W	600	1,400	2,000			
05	L	350	900	1,200	500	130	31.7
	M	500	1,300	1,800			
	H	750	1,800	2,600			
	W	1,000	2,750	4,000			
06	L	600	1,400	1,900	500	270	47.0
	M	750	1,900	2,700			
	H	1,000	2,600	3,800			
	W	1,500	3,900	5,600			
09	L	2,250	5,500	7,500	500	1,180	112
	M	3,000	7,500	10,500			
	H	4,250	10,000	15,000			
	W	6,250	15,000	22,500			
11	L	6,000	15,000	22,000	500	3,040	182
	M	9,000	20,000	32,000			
	H	12,000	30,000	50,000			

CLUTCH BORES

Clutch Size	Bores (inch)	
	Max. (1)	Max. (2)
02	0.6250	0.6875
04	1.1250	-
05	1.7500	-
06	1.9375	2.1250
09	2.8750	3.1250
11	3.2500	3.6250

Refer to Page 80 for a complete list of bore codes.

- (1) Square Key
- (2) Flat Key

*Weight and WR² estimated with maximum bores.

MRT is the Minimum Recommended Torque setting for those applications which require a minimal degree of backlash.

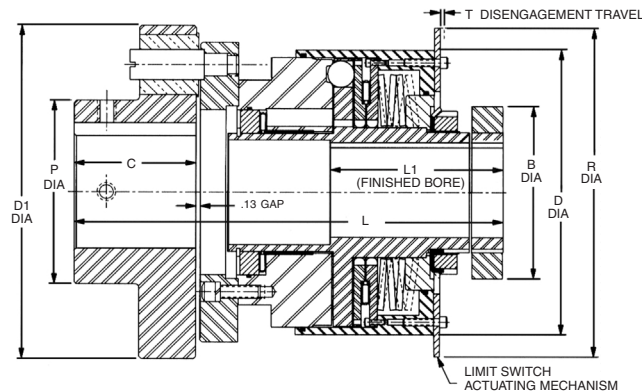
Clutches are shipped set for the minimum torque value of the selected range.

Refer to Page 35 for ordering information.

H1600 OVERLOAD CLUTCHES

**HOR SERIES
STYLE F**

**TYPE C
FLEXIBLE COUPLING**



ALL DIMENSIONS IN INCHES

Clutch Size	B	C	D	D1	L	L1	P	R	T	Max. Allowable Misalignment*	
										Parallel*	Angular*
02	1.75	1.25	2.81	3.94	5.50	2.00	2.50	5.81	.060	.012	1°
04	2.38	1.25	4.25	5.13	6.64	3.00	3.25	7.25	.078	.016	1°
05	3.50	2.38	5.88	6.88	9.94	3.88	3.88	8.88	.110	.027	1°
06	4.25	2.88	7.12	8.13	11.25	4.38	4.25	10.12	.128	.045	1°
09	5.75	4.00	9.50	11.13	14.52	5.50	6.12	12.50	.165	.045	1°
11	6.25	4.50	11.62	14.00	16.67	6.88	17.50	14.62	.183	.045	1°

*Parallel and Angular misalignment are proportionally reduced when both are present.

RATINGS

Clutch Size	Torque Range (Lb. In.)				Max. RPM	WR ² * (Lb.-In. ²)	Weight* (Lbs.)
	Code	Min.	MRT	Max.			
02	L	25	45	60	500	10.0	8.0
	M	50	100	125			
	H	75	125	175			
	W	100	200	250			
04	L	175	400	550	500	44.0	18.0
	M	250	600	850			
	H	350	850	1,300			
	W	600	1,400	2,000			
05	L	350	900	1,200	500	241	49.0
	M	500	1,300	1,800			
	H	750	1,800	2,600			
	W	1,000	2,750	4,000			
	Y	1,650	4,000	6,000			
06	L	600	1,400	1,900	500	550	82.0
	M	750	1,900	2,700			
	H	1,000	2,600	3,800			
	W	1,500	3,900	5,600			
	Y	2,800	7,000	10,000			
09	L	2,250	5,500	7,500	500	2,325	180
	M	3,000	7,500	10,500			
	H	4,250	10,000	15,000			
	W	6,250	15,000	22,500			
11	L	6,000	15,000	22,000	500	6,215	305
	M	9,000	20,000	32,000			
	H	12,000	30,000	50,000			

*Weight and WR² estimated with maximum bores.
MRT is the Minimum Recommended Torque setting for those applications which require a minimal degree of backlash.
Clutches are shipped set for the minimum torque value of the selected range.
[Refer to Page 35 for ordering information.](#)

CLUTCH AND COUPLING BORES

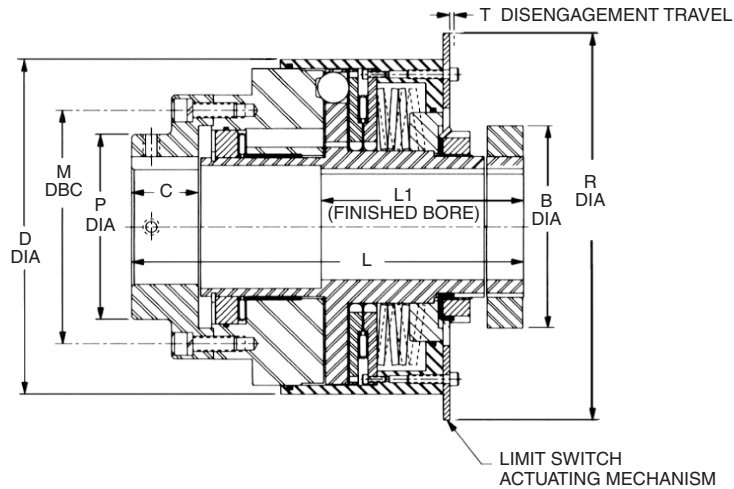
Clutch Size	Type	Bores	
		Max. (1)	Max. (2)
02	Clutch	0.5000	—
	Coupling	1.1875	—
04	Clutch	1.0000	—
	Coupling	1.8750	—
05	Clutch	1.3750	1.5625
	Coupling	2.3125	2.3750
06	Clutch	1.9375	2.1250
	Coupling	2.6250	2.7500
09	Clutch	2.8750	3.1250
	Coupling	4.0000	4.1250
11	Clutch	3.1875	3.5000
	Coupling	4.6250	5.0000

Refer to Page 80 for a complete list of bore codes.
(1) Square Key
(2) Flat Key

H1600 OVERLOAD CLUTCHES

**HOR SERIES
STYLE F**

**TYPE R
RIGID COUPLING**



ALL DIMENSIONS IN INCHES

Clutch Size	B	C	D	L	L1	M	P	R	T
02	1.75	0.75	2.81	4.36	2.00	2.125	1.38	5.81	.060
04	2.38	1.62	4.25	6.51	3.00	3.062	2.50	7.25	.078
05	3.50	2.13	5.88	8.43	3.88	4.250	3.31	8.88	.110
06	4.25	2.20	7.12	9.02	4.38	4.750	3.50	10.12	.128
09	5.75	3.34	9.50	12.43	5.50	6.625	5.25	12.50	.165
11	6.25	3.96	11.62	14.77	6.88	7.750	6.00	14.62	.183

RATINGS

Clutch Size	Torque Range (Lb. In.)			Max. RPM	WR ^{2*} (Lb.-In. ²)	Weight* (Lbs.)	
	Code	Min.	MRT				Max.
02	L	25	45	60	500	4.1	4.7
	M	50	100	125			
	H	75	125	175			
	W	100	200	250			
04	L	175	400	550	500	26.3	13.3
	M	250	600	850			
	H	350	850	1,300			
	W	600	1,400	2,000			
05	L	350	900	1,200	500	146	35.5
	M	500	1,300	1,800			
	H	750	1,800	2,600			
	W	1,000	2,750	4,000			
	Y	1,650	4,000	6,000			
06	L	600	1,400	1,900	500	296	50.9
	M	750	1,900	2,700			
	H	1,000	2,600	3,800			
	W	1,500	3,900	5,600			
	Y	2,800	7,000	10,000			
09	L	2,250	5,500	7,500	500	1,295	124
	M	3,000	7,500	10,500			
	H	4,250	10,000	15,000			
	W	6,250	15,000	22,500			
11	L	6,000	15,000	22,000	500	3,290	200
	M	9,000	20,000	32,000			
	H	12,000	30,000	50,000			

CLUTCH AND COUPLING BORES

Clutch Size	Type	Bores	
		Max. (1)	Max. (2)
02	Clutch	0.5000	—
	Coupling	0.7500	—
04	Clutch	1.0000	—
	Coupling	1.6250	1.6875
05	Clutch	1.3750	1.5625
	Coupling	2.1250	2.2500
06	Clutch	1.9375	2.1250
	Coupling	2.2500	2.3125
09	Clutch	2.8750	3.1250
	Coupling	3.3750	3.5000
11	Clutch	3.1875	3.5000
	Coupling	4.0000	4.1250

Refer to Page 80 for a complete list of bore codes.

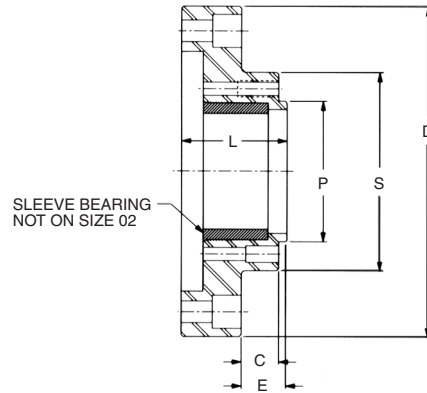
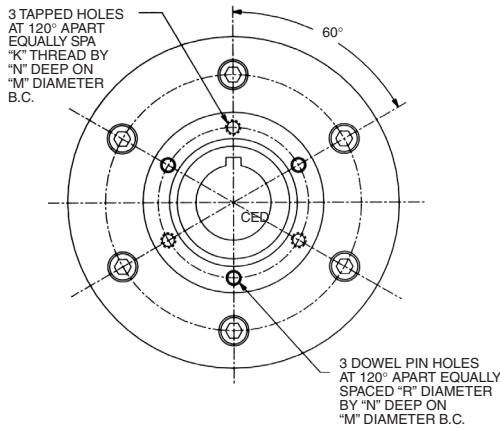
- (1) Square Key
- (2) Flat Key

*Weight and WR² estimated with maximum bores.
MRT is the Minimum Recommended Torque setting for those applications which require a minimal degree of backlash.
Clutches are shipped set for the minimum torque value of the selected range.
Refer to Page 35 for ordering information.

H1600 OVERLOAD CLUTCHES

HOR SERIES TYPE T ADAPTER

TYPE T SPROCKET, PULLEY, SHEAVE OR GEAR MOUNT



ALL DIMENSIONS IN INCHES

Clutch Size	C	D	E	K	L	M	N	P +.000/-0.002	R	S	WR ² (Lb.-In. ²)	Weight (Lbs.)
02	0.28	2.63	0.40	#8-32	0.71	1.422	.38	1.094	—	1.75	0.5	0.5
04	0.34	3.63	0.63	#8-32	1.02	2.250	.38	1.922	3/16	2.58	2.0	1.0
05	0.47	5.00	0.59	1/4-20	1.26	3.219	.50	2.750	1/4	3.66	12	3.0
06	0.69	5.56	0.81	1/4-20	1.55	3.406	.50	2.938	1/4	3.90	25	5.4
09	0.88	7.56	1.00	3/8-16	2.00	5.094	.75	4.344	3/8	5.84	93	11
11	1.02	9.00	1.14	3/8-16	2.32	5.938	.75	5.188	1/2	6.69	241	19

Mounting bolts must be minimum 160,000 PSI tensile, Rc 36-43
Dowel pins must be minimum 150,000 PSI shear, Rc 50-58 core hardness

MINIMUM NUMBER OF TEETH OF STANDARD PLATE SPROCKETS ADAPTABLE TO TYPES B AND T CLUTCHES

Clutch Size	Type	Chain Size and Pitch														
		#25 1/4 Pitch	#35 3/8 Pitch	#40 1/2 Pitch	#50 5/8 Pitch	#60 3/4 Pitch	#80 1 Pitch	#100 1-1/4 Pitch	Type	#25 1/4 Pitch	#35 3/8 Pitch	#40 1/2 Pitch	#50 5/8 Pitch	#60 3/4 Pitch	#80 1 Pitch	#100 1-1/4 Pitch
02	B	39	27	22	—	—	—	T	27	19	15	—	—	—	—	—
04	B	51	35	28	23	—	—	T	37	26	20	17	—	—	—	—
05	B	69	47	36	30	26	—	T	50	35	27	23	19	—	—	—
06	B	76	52	40	33	28	—	T	54	37	29	24	20	16	14	—
09	B	101	68	52	43	36	28	T	79	54	41	34	29	23	19	—
11	B	119	80	61	50	43	33	T	90	61	47	38	32	25	21	—

The Type T adapter may be ordered separately or factory mounted to the HOR Series Clutches shown on Pages 36 and 37, by specifying Type T.

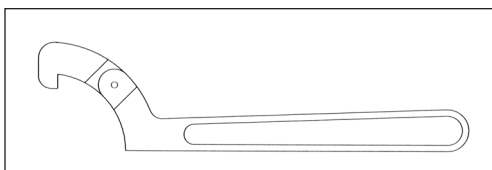
H1600 OVERLOAD CLUTCHES

GENERAL INFORMATION

TORQUE ADJUSTMENT WRENCH

Standard bearing nuts are used to adjust the spring load which controls the release torque of the clutch. These nuts are slotted and can easily be turned using a common, commercially available hook style spanner wrench. Refer to the table below for wrenches which are compatible with Boston Gear's torque overload release clutches.

TORQUE ADJUSTMENT WRENCH



Clutch Size	Wrench Part Number				Specifications (Inches)				
	Armstrong Tool Co.	McMaster-Carr Supply Co.	Williams Tool Co.	Snap-On Tool Co.	Diameter Range	Hook Thick.	Hook Depth	Length	
02	34-301	5471A11	471	AHS300	.75 to 2.00	.34	.13	6.38	
02, 04	34-304	5471A12	472	AHS301	1.25 to 3.00	.41	.16	8.13	
04, 05, 06	34-307	5471A13	474	AHS304	2.00 to 4.75	.47	.19	11.38	
09, 11	34-310	5471A14	474A	AHS307	4.50 to 6.25	.47	.25	12.13	
11	34-313	5471A23	474B	—	6.12 to 8.75	.47	.31	13.75	

TORQUE OVERLOAD DETECTION

The HOR Series H1600 Clutch is an automatic reset device designed for use when a fully disconnecting type is not desirable either because it is inaccessible and cannot be manually reset or because frequent resetting is not feasible. Because of this feature, it is important that the drive be shut down immediately upon a torque overload condition to prevent possible damage to the clutch caused by long-term reengaging and disengaging. Figure 4 utilizes a single limit switch to detect an overload condition. The switch should be able to operate within the disengagement travel of the clutch. Upon an overload, the cover of the clutch will move to actuate the limit switch and shut down the drive. The switch should be wired in parallel with a jog button so the drive can be indexed and permit the clutch to reengage at a safe speed. Once the clutch has been reengaged the limit switch will be reset and the drive can be restarted.

FIGURE 4
LIMIT SWITCH LAYOUT

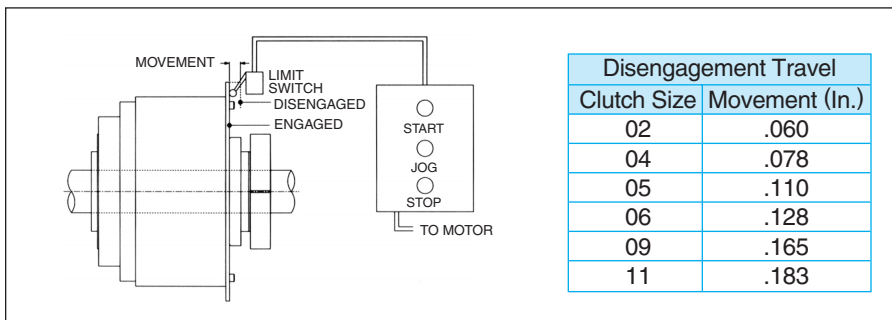
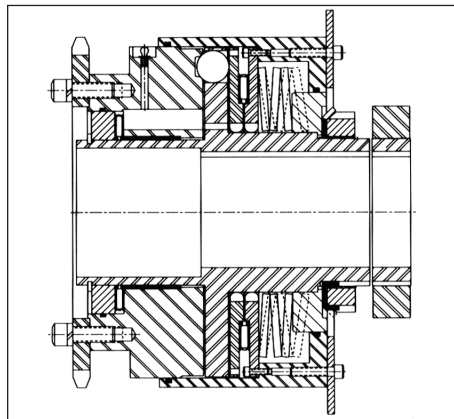
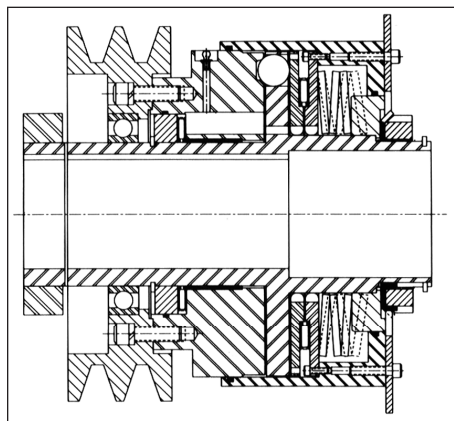


FIGURE 5
SUGGESTED MOUNTING ARRANGEMENTS



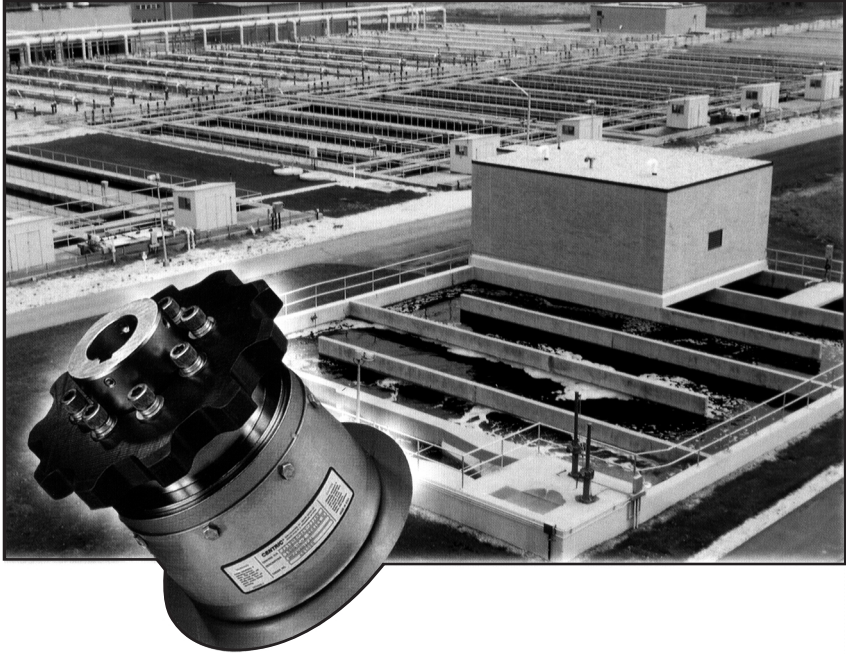
TYPE B, STYLE F
WITH SPROCKET MOUNTED



TYPE B, STYLE L
WITH SHEAVE MOUNTED



Leading the Industry at Every Turn



Designed for the water and wastewater industry.

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H1900 OVERLOAD CLUTCHES

H1900 OVERLOAD CLUTCHES WASTEWATER TREATMENT INDUSTRY WOR SERIES

FEATURES:

- Automatic or manual reset
- Large bore capacity
- Through shaft or end shaft mounting
- Accurate torque release
- Stainless steel enclosure
- Electroless nickel plated
- Adaptable for all drives
- Operating parts are hardened for long life

OPERATING PRINCIPLES

The WOR Series H1900 is a mechanical ball detent overload release clutch. It has been designed to provide accurate and dependable torque overload protection for mechanical water and wastewater treatment equipment.

Torque is transmitted between the balls and the detents of the rotor in the following manner:

The chrome alloy balls are forced into the detents of the 50 Rc hardened rotor by an axial load generated by compressing a spring pack. This axial load is what determines the torque capacity of the clutch. Increasing or decreasing the spring compression or changing spring packs provides a means for multiple torque adjustments. When a torque overload condition occurs, the balls roll out of the rotor detents. This rolling action reduces any fluctuation in torque due to frictional changes (See Figure 1).

The movement of the cover during disengagement of the balls can be used to trip a limit switch and signal an overload condition. The drive should be shut down immediately and the source of the overload determined and cleared. After the clutch has been reset the drive can then be restarted.

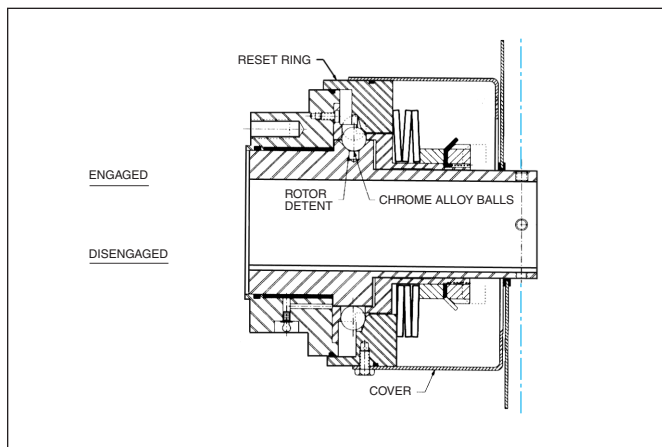


FIGURE 1



The **Manual Reset** (Style M or N) clutch can be reset in multiple positions. Rotate the drive until a lube fitting or a barring hole on the housing lines up with a tapped hole on the rotor. The rotor keyway should also be lined up with a lube fitting on the housing. After the proper position has been established, push evenly on both sides of the limit switch actuating plate. When the clutch is properly reset, the steel balls will move back into their detents and the actuating plate will return to its original position. An audible sound will be detected when the clutch re-engages, (See Figure 2).

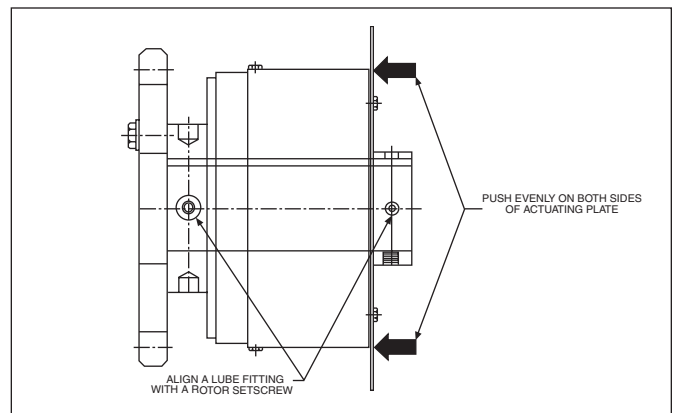


FIGURE 2

The **Automatic Reset** (Style A or B) version will re-engage without manual assistance. The steel balls will move back into their pockets every 1/4 of a revolution (1/8 of a revolution on the Size 11). After the overload condition has been cleared, jog the drive until the balls return to their detents and the actuating plate returns to its original position. An audible sound will be detected when the clutch re-engages.

H1900 OVERLOAD CLUTCHES

SELECTION

1. Determine the overload release torque by one of these methods:

- Use the torque formula with horsepower and RPM specific to selected clutch location. A service factor may be required for high inertia starts, reversing or peak load conditions, (refer to Page 80 for service factor information):

$$\text{Torque (Lb. In.)} = \frac{\text{HP} \times 63025}{\text{RPM}}$$

- Maximum drive torque of chain: If using non-metallic chain, contact the manufacturer of the chain and ask for its maximum drive torque.
- For shear pin replacement: Contact your local Boston Gear Area Sales Manager or the factory. They will gladly calculate the shear torque of your existing shear pins for you.

- Determine the bore size and keyway.
- Choose the proper style from Figures 3, 4, or 5 based upon the drive layout.
- Refer to the Basic Selection Chart for the appropriate clutch size.

BASIC SELECTION CHART

Size	Torque Code	Torque Range (Lb.-In.)		Maximum Bore (In.)*	
		Minimum	Maximum	Style A/M	Style B/N
05	L	850	1,700	1.7500	2.0000
	M	1,100	2,200		
	H	1,400	2,800		
	W	2,500	5,000		
06	L	1,250	2,500	2.2500	2.7500
	M	1,800	3,750		
	H	2,500	5,500		
	W	4,000	8,000		
09	L	2,250	5,750	3.0000	4.2500
	M	3,750	8,500		
	H	5,500	12,000		
	W	8,500	20,000		
11	L	5,000	12,000	4.0000	4.2500
	M	9,000	16,500		
	H	12,000	25,000		
	W	16,000	30,000		

*Larger bores may require flat keys (supplied with unit).

FIGURE 3

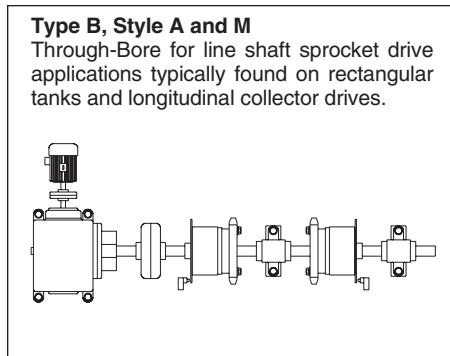


FIGURE 4

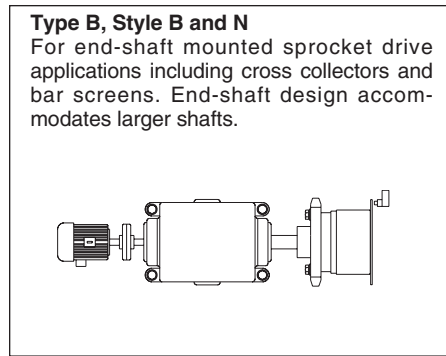
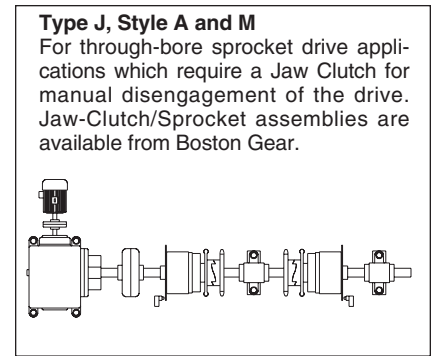
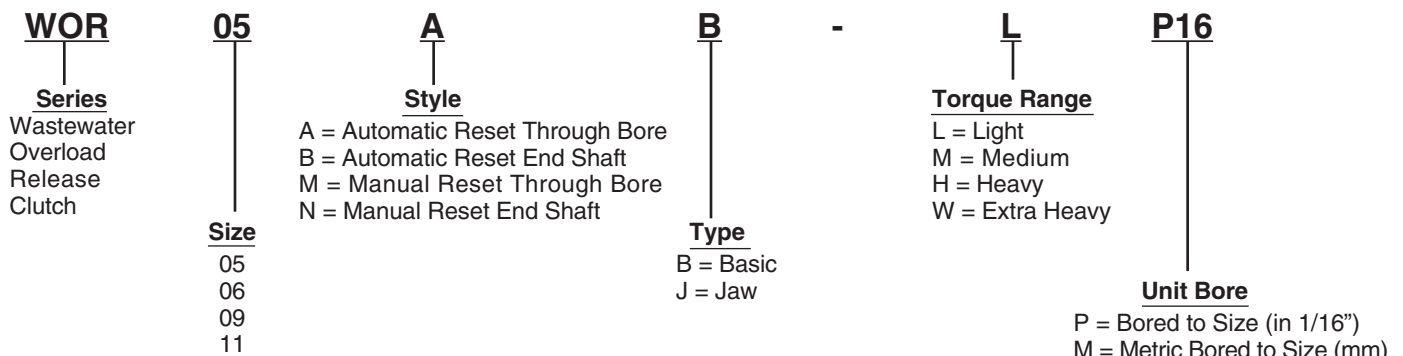


FIGURE 5



WOR SERIES PART NUMBERING SYSTEM



HOW TO ORDER

When ordering a WOR Series H1900 Overload Clutch for Wastewater Treatment applications, please include code letters/numbers for series, size, style, type, torque range, and bore size.

Example:

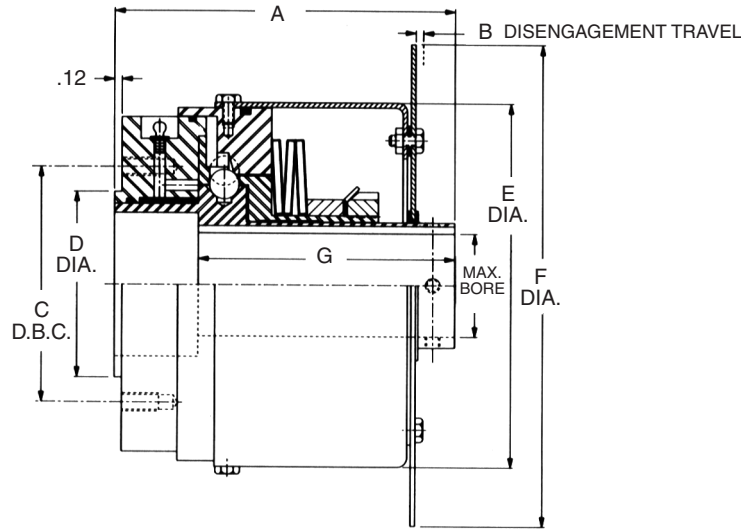
Required size, 05 WOR Series H1900 Overload Clutch, automatic reset, through-bore mounting, basic type, medium torque range, with a one inch bore:

WOR 05 A B — M P16

H1900 OVERLOAD CLUTCHES

**WOR SERIES
STYLE A AND M THROUGH-BORE**

**TYPE B
BASIC DESIGN**



ALL DIMENSIONS IN INCHES

Clutch Size	A	B	C	D +.000/-0.002	E	F	G	Mounting Holes			Min. H78 Sprocket
								No.	Thread	Depth	
05	5.76	.13	4.000	3.123	6.19	8.19	4.50	6	5/16-18	0.75	9 Tooth
06	7.45	.17	4.875	4.000	7.62	9.62	5.25	8	1/2-13	1.12	9 Tooth
09	9.14	.19	4.875	4.000	9.65	11.62	6.12	8	1/2-13	1.25	9 Tooth
11	10.00	.19	6.500	5.500	9.65	11.62	7.00	8	1/2-13	1.25	11 Tooth

RATINGS

Clutch Size	Torque Code	Torque Range (Lb. In.)		Max. RPM	Weight (Lbs.)
		Min.	Max.		
05	L	850	1,700	50	24
	M	1,100	2,200		
	H	1,400	2,800		
	W	2,500	5,000		
06	L	1,250	2,500	50	40
	M	1,800	3,750		
	H	2,500	5,500		
	W	4,000	8,000		
09	L	2,250	5,750	50	80
	M	3,750	8,500		
	H	5,500	12,000		
	W	8,500	20,000		
11	L	5,000	12,000	50	87
	M	9,000	16,500		
	H	12,000	25,000		
	W	16,000	30,000		

CLUTCH BORES

Clutch Size	Bores (inch)		
	Min.	Max. (1)	Max. (2)
05	0.6250	1.6250	1.7500
06	0.6250	2.1250	2.2500
09	1.0000	2.7500	3.0000
11	1.0000	3.7500	4.0000

Refer to Page 80 for a complete list of bore codes.

- (1) Square Key
- (2) Flat Key

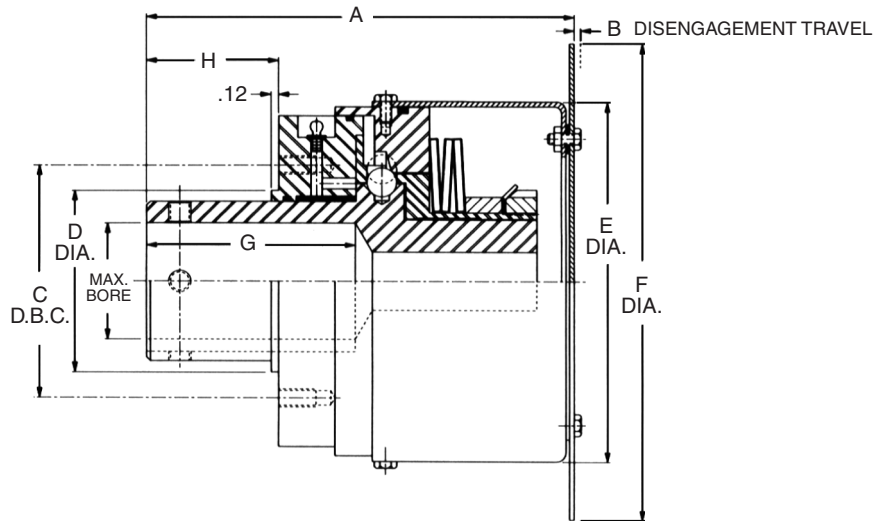
Clutches are shipped set for the minimum torque value of the specified range.

Refer to Page 45 for ordering information.

H1900 OVERLOAD CLUTCHES

WOR SERIES
STYLE B AND N END-SHAFT

TYPE B
BASIC DESIGN



ALL DIMENSIONS IN INCHES

Clutch Size	A	B	C	D +.000/-.002	E	F	G	M	Mounting Holes			Min. H78 Sprocket
									No.	Thread	Depth	
05	7.00	0.13	4.000	3.123	6.19	8.19	3.30	2.09	6	5/16-18	0.75	9 Tooth
06	9.04	0.17	4.875	4.000	7.62	9.62	4.69	2.56	8	1/2-13	1.12	9 Tooth
09	10.75	0.19	6.500	5.500	9.65	11.62	5.88	3.00	8	1/2-13	1.25	11 Tooth
11	11.44	0.19	6.500	5.500	9.65	11.62	5.88	3.00	8	1/2-13	1.25	11 Tooth

RATINGS

Clutch Size	Torque Code	Torque Range (Lb. In.)		Max. RPM	Weight (Lbs.)
		Min.	Max.		
05	L	850	1,700	50	25
	M	1,100	2,200		
	H	1,400	2,800		
	W	2,500	5,000		
06	L	1,250	2,500	50	42
	M	1,800	3,750		
	H	2,500	5,500		
	W	4,000	8,000		
09	L	2,250	5,750	50	83
	M	3,750	8,500		
	H	5,500	12,000		
	W	8,500	20,000		
11	L	5,000	12,000	50	87
	M	9,000	16,500		
	H	12,000	25,000		
	W	16,000	30,000		

CLUTCH BORES

Clutch Size	Bores (inch)	
	Min.	Max. (1)
05	0.6250	2.0000
06	0.6250	2.7500
09	1.0000	4.2500
11	1.0000	4.2500

Refer to Page 80 for a complete list of bore codes.
(1) Square Key

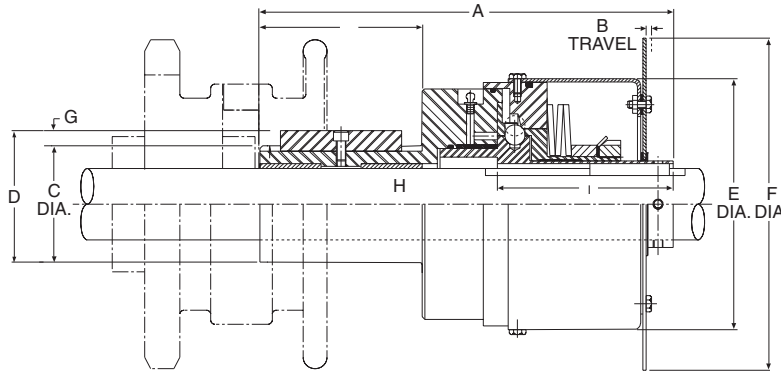
Clutches are shipped set for the minimum torque value of the specified range.

Refer to Page 45 for ordering information.

H1900 OVERLOAD CLUTCHES

WOR SERIES STYLE A AND M THROUGH-BORE

TYPE J JAW CLUTCH ADAPTER



ALL DIMENSIONS IN INCHES

Clutch Size	A	B	C	D +.000/-0.002	E	F	G	M	I
05	10.20	.13	2.875	3.250	6.19	8.19	.38	4.00	4.50
06	12.25	.17	3.500	3.875	7.62	9.62	.38	4.50	5.25
09	14.62	.19	4.000	4.500	9.65	11.62	.50	5.00	6.12
11	15.87	.19	5.000	5.500	9.65	11.62	.50	5.50	7.00

RATINGS

Clutch Size	Torque Code	Torque Range (Lb. In.)		Max. RPM	Weight (Lbs.)
		Min.	Max.		
05	L	850	1,700	50	31
	M	1,100	2,200		
	H	1,400	2,800		
	W	2,500	5,000		
06	L	1,250	2,500	50	50
	M	1,800	3,750		
	H	2,500	5,500		
	W	4,000	8,000		
09	L	2,250	5,750	50	96
	M	3,750	8,500		
	H	5,500	12,000		
	W	8,500	20,000		
11	L	5,000	12,000	50	119
	M	9,000	16,500		
	H	12,000	25,000		
	W	16,000	30,000		

CLUTCH BORES

Clutch Size	Bores (inch)		
	Min.	Max. (1)	Max. (2)
05	0.6250	1.6250	1.7500
06	0.6250	2.1250	2.2500
09	1.0000	2.7500	3.0000
11	1.0000	3.7500	4.0000

Refer to Page 80 for a complete list of bore codes.

- (1) Square Key
- (2) Flat Key

Clutches are shipped set for the minimum torque value of the specified range.

Refer to Page 45 for ordering information.

H1900 OVERLOAD CLUTCHES

GENERAL INFORMATION

LIMIT SWITCH LAYOUT

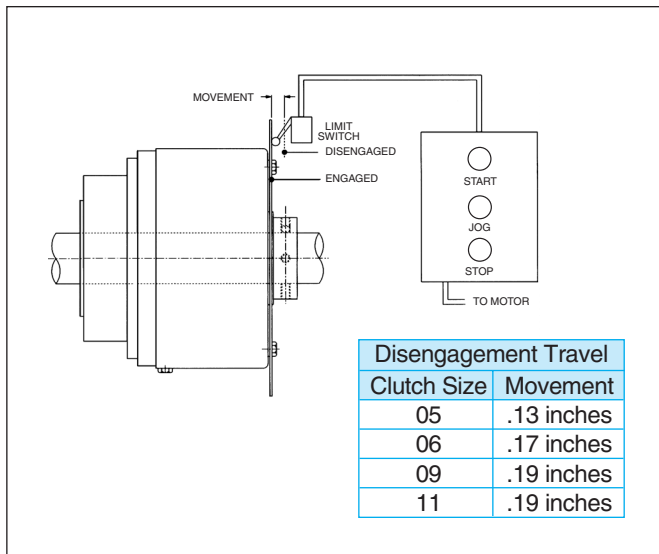


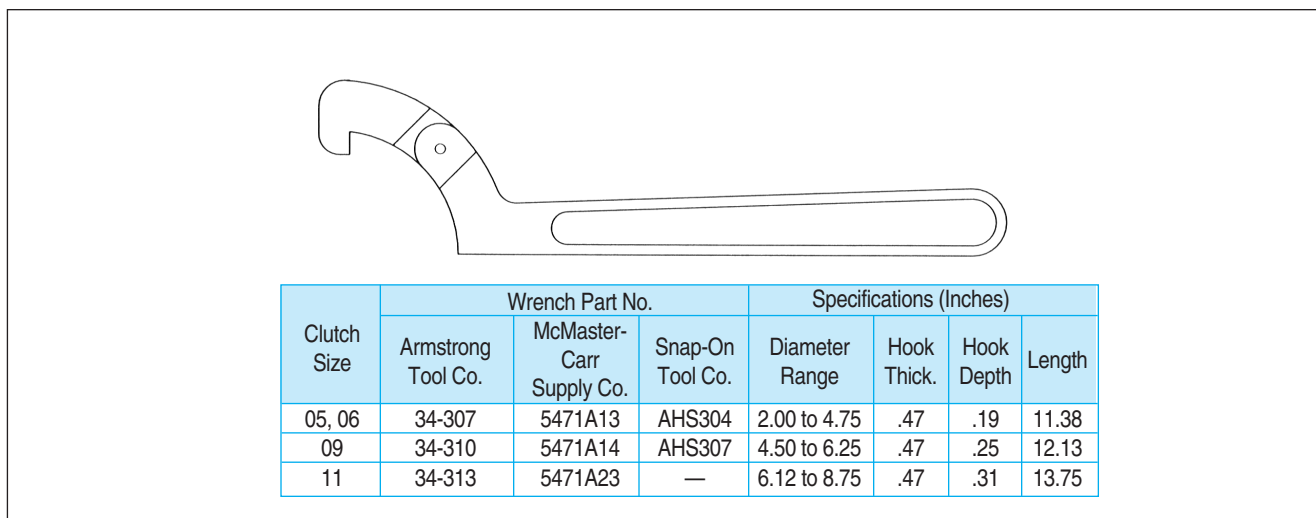
FIGURE 6
TORQUE OVERLOAD DETECTION

The WOR Series H1900 is offered with an automatic reset (Style A/B). Because of this feature, it is important that the drive be shut down immediately upon a torque overload condition. Figure 6 utilizes a single limit switch to detect an overload. The switch should be able to operate within the disengagement travel of the clutch. Upon an overload, an oversized stainless steel plate attached to the cover will move to actuate the limit switch and shut down the drive.

Torque Adjustment Wrench

Standard bearing nuts are used to adjust the spring load which controls the release torque of the clutch. These nuts are slotted and can easily be turned using a common, commercially available hook style spanner wrench. Refer to the table at bottom of this page for wrenches which are compatible with Boston Gear's torque overload release clutches.

TORQUE ADJUSTMENT WRENCH



SUGGESTED SPECIFICATIONS FOR WATER AND WASTEWATER TREATMENT APPLICATIONS

Overload release clutches shall be installed to provide positive protection against damaging jams to the drives. They are to be located on the output sides of speed reducers, or as near as possible to the potential source of the overload so that the drive components are adequately protected.

The clutches shall be a ball detent type which when an overload occurs, the detent balls will roll free from their seat against pre-set spring pressure, completely disengaging the drive. Springs are to be a precision Belleville design conforming to spec. DIN-2092 and DIN-2093.

Resetting shall be a simple manual push back re-engagement (or automatic reset) and torque values will remain constant within plus or minus 10% after each disengagement or re-engagement.

All clutches shall be fully adjustable through a wide torque range to meet varying conditions and include a maximum torque limit stop to prevent adjustment beyond designed torque values. A circular plate is to be incorporated in the cover as a means to operate a limit switch to annunciate and/or stop the drive.

The clutches shall be completely sealed suitable for outdoor installations, including a stainless steel cover, electroless nickel plated external parts, and an external grease fitting for packing the units.

Chrome alloy steel detent balls shall be hardened to 60 Rc and all major internal components hardened to 50 Rc minimum for long life.

The WOR Series H1900 Overload Release Clutches shall be manufactured by Boston Gear, Quincy, Massachusetts 02171.



Leading the Industry at Every Turn



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H2000 OVERLOAD CLUTCHES

H2000 PNEUMATIC OVERLOAD CLUTCHES POR SERIES

FEATURES:

- “In-Flight” torque control offers precise pneumatic torque control
- Remotely adjustable for starting and overrunning loads
- Bi-directional operation
- Single position indexing
- Automatic reset
- Through-shaft design
- Limit switch actuating mechanism
- Clamp collar for secure mounting
- Hardened parts for long clutch life
- Internal needle roller thrust bearings
- Lubrication fittings
- Sealed from environmental contamination
- Electroless nickel finish and stainless steel hardware for superior corrosion resistance

OPERATING PRINCIPLES

The POR Series H2000 is a pneumatic, ball detent style overload release clutch. It has been designed to provide accurate and dependable torque disconnect protection for mechanical power transmission equipment. Torque is transmitted through the clutch in one of two paths, (Refer to Figure 1).



Torque transmission between the balls and housing is the key to the disengagement of the clutch. The balls are forced into the pockets of the housing by an axial load generated by an air cylinder. This axial load determines the torque capacity of the clutch. Increasing or decreasing the air pressure provides a means for remotely controlled precise “in-flight” torque adjustment. When a torque overload condition occurs, the balls roll out of the pockets and free wheel much as a ball thrust bearing. This rolling action increases the efficiency in which the clutch operates and reduces any fluctuation of torque setting due to frictional changes, (Refer to Figure 2).

The clutch has been designed with an internal valving mechanism. During an overload condition, the air is purged instantaneously from the cylinder.

The movement of the air cylinder during disengagement can be used to trip a limit switch and signal a torque overload condition. The drive should be shut down immediately and the source of the overload determined and cleared. The drive can then be restarted.

To engage the clutch, reapply air pressure and jog the drive until the clutch engages. Adjust the release torque by increasing the air pressure supplied to the clutch to reach the desired torque value. The clutch is now ready for normal operation.

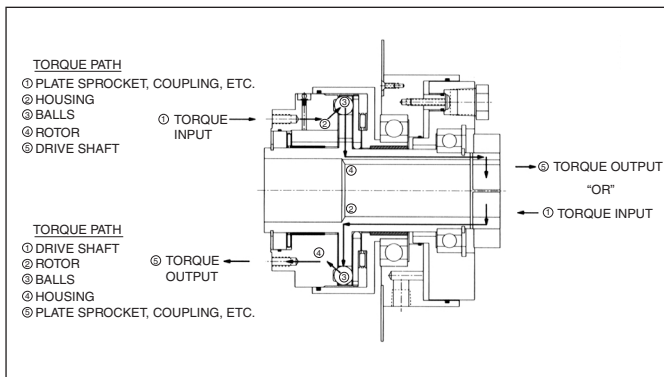


FIGURE 1

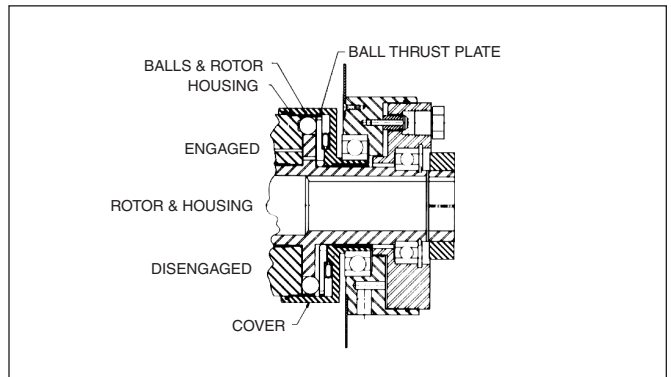


FIGURE 2

H2000 OVERLOAD CLUTCHES

SELECTION

- Determine the overload release torque by one of these methods:
 - Use the torque formula with horsepower and RPM specific to the selected clutch location. A service factor may be required for high inertia starts, reversing or peak load conditions, (refer to Page 80 for service factor information):

$$\text{Torque (Lb.-In.)} = \frac{\text{HP} \times 63025}{\text{RPM}}$$

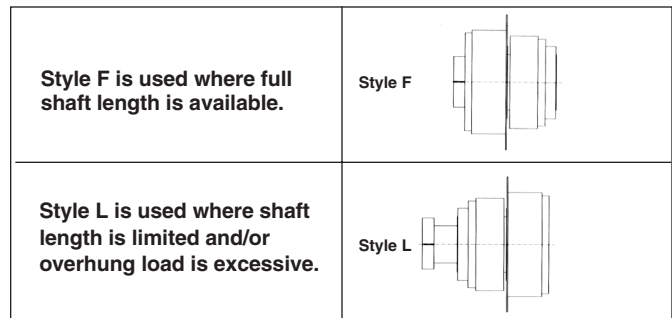
- Determine the “weak link” in the drive train, (i.e., chain, reducer, belt or shaft). Select an overload release torque below the “weak link’s” maximum torque rating.
 - Physically measure the drive torque with a torque wrench and size accordingly.
- Determine the bore size(s) and keyway(s):
 - Shaft size at the clutch location determines the clutch bore.
 - Shaft size at the coupling location determines the coupling bore, (if applicable).
 - Choose the appropriate Style (See Figure 3) based upon the drive layout and available space.
 - Refer to the Basic Selection Chart for the appropriate clutch size. Determine the approximate start-up and running air pressures for the application.
 - Refer to Pages 54-57 for ratings, dimensions, and types.
 - Refer to Page 81 for recommended mounting locations.

BASIC SELECTION CHART

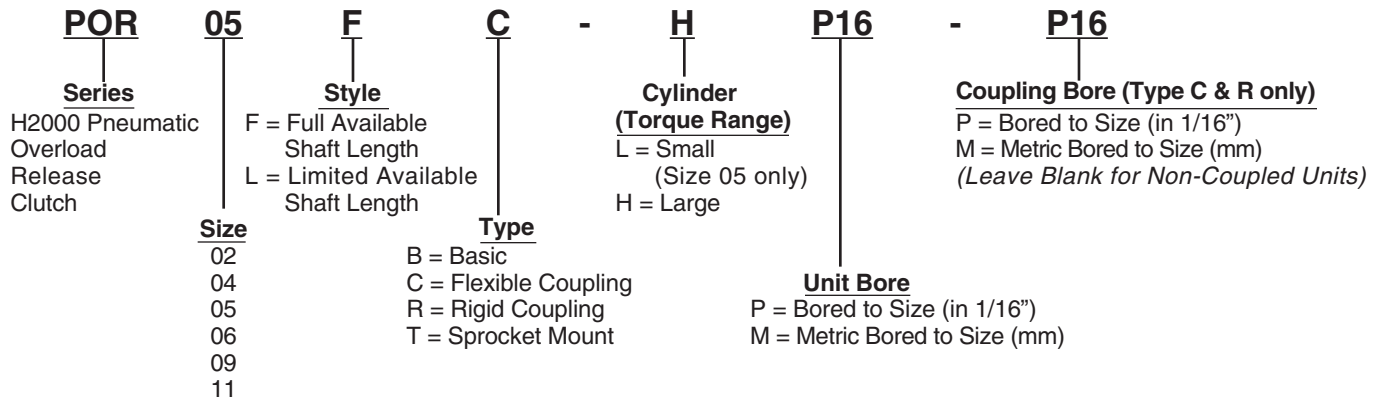
Clutch Size	Max.* Bore (In.)	Torque Code	Torque Range (Lb.-In.)	Max. RPM
02	0.750	H	120-470	3,600
04	1.187	H	400-1,400	1,800
05	1.750	L	850-2900	1,800
		H	1,350-4,700	
06	2.125	H	2,800-7,800	1,200
09	3.125	H	5,800-17,800	1,200
11	3.250	H	8,200-33,000	1,200

*Larger bores may require flat keys (supplied with unit).

FIGURE 3



POR SERIES PART NUMBERING SYSTEM



HOW TO ORDER

When ordering a POR Series H2000 Overload Clutch, please include code letters for series, size, style, type, torque range, unit bore and coupling bore (if applicable). Not all combinations are possible. Please refer to Pages 54-57 for details.

Example:

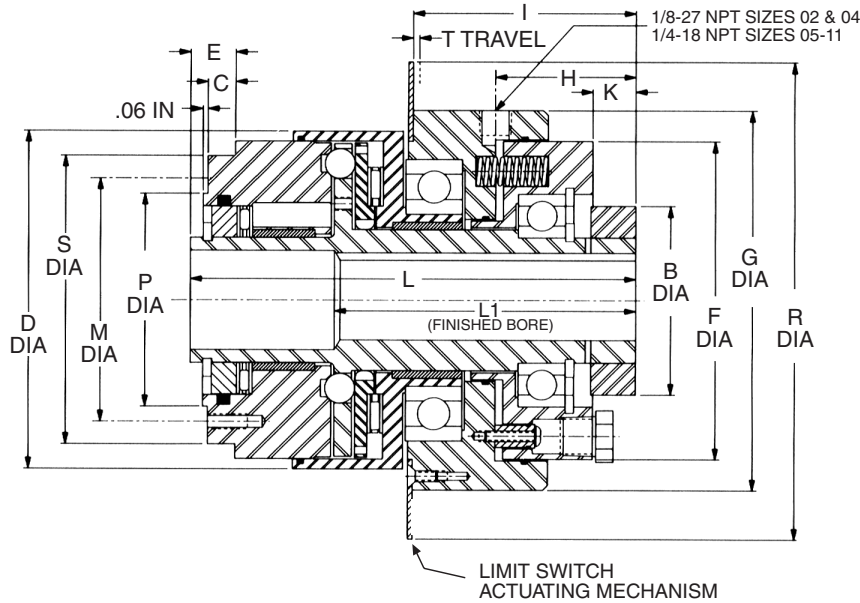
Required size, 05 POR Series H2000 Overload Clutch, full available shaft length, flexible coupling, large torque range, with a one inch unit bore and a one inch coupling bore:



H2000 OVERLOAD CLUTCHES

**POR SERIES
STYLE F**

**TYPE B
BASIC DESIGN**



ALL DIMENSIONS IN INCHES

Clutch Size	B	C	D	E	F	G	H	I	K	L	L1	M	P +.000/-002	R	S	T	Weight (Lbs.)
02	1.75	0.29	2.81	0.45	3.50	3.88	1.84	2.19	0.56	4.47	2.95	2.125	1.781	5.81	2.63	.060	5.0
04	2.38	0.35	4.25	0.56	4.00	4.75	1.76	2.79	0.54	5.57	3.77	3.062	2.688	7.25	3.63	.078	11.6
05	3.50	0.43	5.87	0.70	6.25	6.63	2.87	3.33	0.77	6.88	4.57	4.250	3.625	8.88	5.00	.110	28.3
06	4.25	0.50	7.13	0.80	7.25	7.75	3.00	3.54	0.72	7.42	5.00	4.750	4.000	10.12	5.56	.128	41.0
09	5.75	1.03	9.50	1.40	9.25	10.00	3.87	4.63	1.03	9.75	6.30	6.625	5.750	12.50	7.56	.165	98.5
11	6.00	1.28	11.62	1.65	11.50	12.25	4.50	5.20	1.25	11.25	7.44	7.750	6.500	14.62	9.00	.183	155

Refer to Page 58 for mounting information and minimum sprocket size.

RATINGS

Clutch Size	Torque Code	Torque Range (Lb. In.)	Max. RPM	WR ^{2*} (Lb-In ²)
02	H	120 - 470	3,600	3.3
04	H	400-1,400	1,800	18.6
05	L	850-2,900	1,800	80.0
	H	1,350-4,700		
06	H	2,800-7,800	1,200	175
09	H	5,800-17,800	1,200	805
11	H	8,200-33,000	1,200	1,863

*Estimated with maximum bores.

Clutches are shipped set for the minimum torque value for the selected range.

CLUTCH BORES

Clutch Size	Bores (inch)	
	Max. (1)	Max. (2)
02	0.6250	0.7500
04	1.1250	1.1875
05	1.5625	1.6250
06	2.0000	2.1250
09	2.8750	3.1250
11	3.1250	3.2500

Refer to Page 80 for a complete list of bore codes.

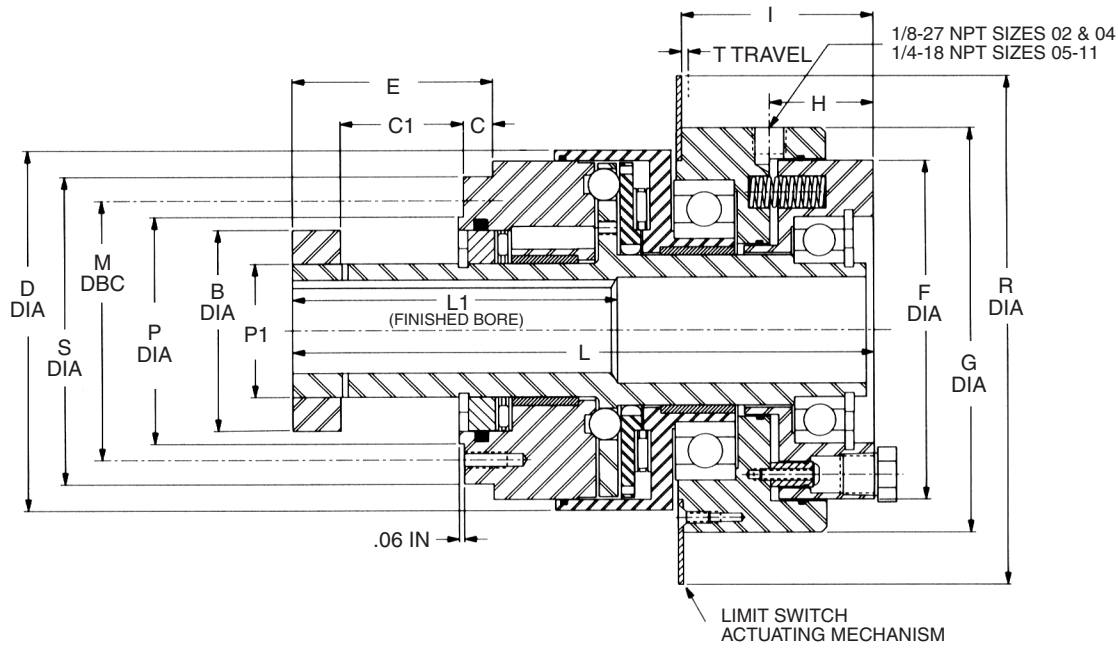
- (1) Square Key
- (2) Flat Key

Refer to Page 53 for ordering information.

H2000 OVERLOAD CLUTCHES

**POR SERIES
STYLE L**

**TYPE B
BASIC DESIGN**



ALL DIMENSIONS IN INCHES

Clutch Size	B	C	C1	D	E	F	G	H	I	L	L1	M	P +.000/-0.002	P1		R	S	T	Weight (Lbs.)
														Min.	Max.				
02	1.75	0.29	1.00	2.81	1.79	3.50	3.88	1.28	1.63	5.24	3.00	2.125	1.781	0.9843	0.9847	5.81	2.63	.060	5.2
04	2.38	0.35	1.44	4.25	2.35	4.00	4.75	1.22	2.25	6.83	3.81	3.062	2.688	1.5728	1.5738	7.25	3.63	.078	11.9
05	3.50	0.43	1.54	5.87	2.72	6.25	6.63	2.10	2.60	8.12	4.66	4.250	3.625	2.3623	2.3628	8.88	5.00	.110	28.9
06	4.25	0.50	2.25	7.13	3.50	7.25	7.75	2.28	2.82	9.40	5.46	4.750	4.000	2.7560	2.7566	10.12	5.56	.128	42.3
09	5.75	1.03	2.50	9.50	4.53	9.25	10.00	2.84	3.60	11.85	7.22	6.625	5.750	3.9350	3.9370	12.50	7.56	.165	103
11	6.50	1.28	2.63	11.62	5.28	11.50	12.25	3.25	3.95	13.63	8.16	7.750	6.500	4.7220	4.7240	14.62	9.00	.183	160

Refer to Page 58 for mounting information and minimum sprocket size.

RATINGS

Clutch Size	Torque Code	Torque Range (Lb. In.)	Max. RPM	WR ^{2*} (Lb-In ²)
02	H	120 - 470	3,600	3.4
04	H	400-1,400	1,800	18.9
05	L	850-2,900	1,800	81.7
	H	1,350-4,700		
06	H	2,800-7,800	1,200	178
09	H	5,800-17,800	1,200	820
11	H	8,200-33,000	1,200	1,889

*Estimated with maximum bores.

Clutches are shipped set for the minimum torque value for the selected range.

CLUTCH BORES

Clutch Size	Bores (inch)	
	Max. (1)	Max. (2)
02	0.6250	0.7500
04	1.1250	1.1875
05	1.7500	—
06	2.0000	2.1250
09	2.8750	3.1250
11	3.1250	3.2500

Refer to Page 80 for a complete list of bore codes.

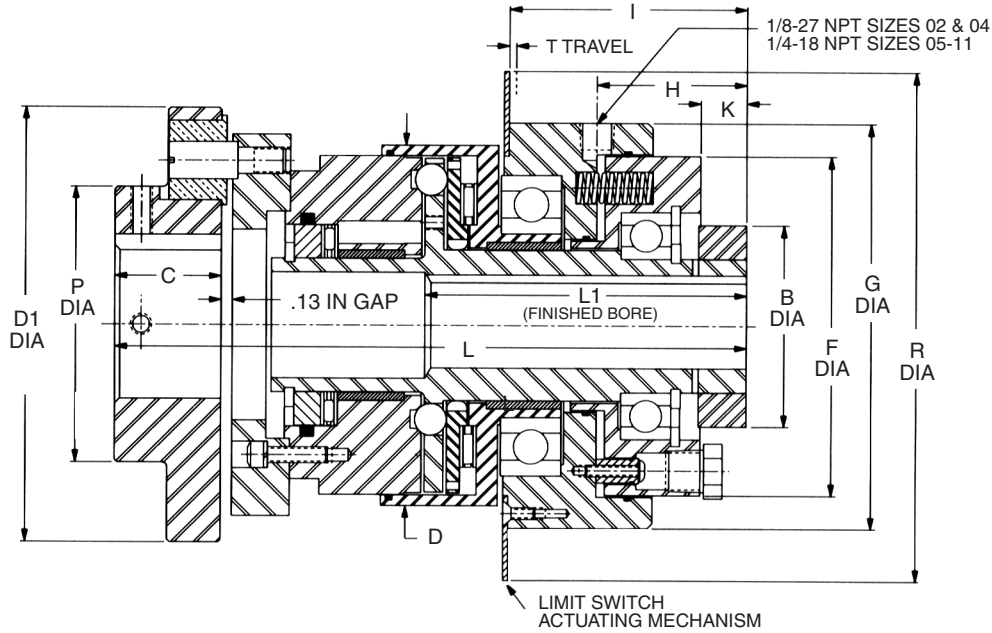
- (1) Square Key
- (2) Flat Key

Refer to Page 53 for ordering information.

H2000 OVERLOAD CLUTCHES

**POR SERIES
STYLE F**

**TYPE C
FLEXIBLE COUPLING**



ALL DIMENSIONS IN INCHES

Clutch Size	B	C	D	D1	F	G	H	I	K	L	L1	P	R	T	Parallel Offset	Angular Misalignment	Weight (Lbs.)
02	1.75	1.25	2.81	3.94	3.50	3.88	1.84	2.19	0.56	6.44	2.95	2.50	5.81	.060	.012	1°	8.6
04	2.38	1.25	4.25	5.13	4.00	4.75	1.76	2.79	0.54	7.42	3.77	3.25	7.25	.078	.016	1°	18.5
05	3.50	2.38	5.87	6.88	6.25	6.63	2.87	3.33	0.77	10.62	4.57	3.88	8.88	.110	.027	1°	47.2
06	4.25	2.88	7.13	8.13	7.25	7.75	3.00	3.54	0.72	11.94	5.00	4.25	10.12	.128	.045	1°	79.7
09	5.75	4.00	9.50	11.13	9.25	10.00	3.87	4.63	1.03	15.25	6.30	6.13	12.50	.165	.045	1°	174
11	6.00	4.50	11.62	14.00	11.50	12.25	4.50	5.20	1.25	17.26	7.44	7.50	14.62	.183	.045	1°	289

Parallel and angular misalignment are proportionally reduced when both are present.

TORQUE RANGE RATINGS

Clutch Size	Torque Code	Torque Range (Lb. In.)	Max. RPM	WR ² * (Lb-In ²)
02	H	120 - 470	3,600	9.6
04	H	400-1,400	1,800	39.5
05	L	850-2,900	1,800	192
	H	1,350-4,700		
06	H	2,800-7,800	1,200	458
09	H	5,800-17,800	1,200	1,975
11	H	8,200-33,000	1,200	5,083

*Estimated with maximum bores.

Clutches are shipped set for the minimum torque value for the selected range.

CLUTCH AND COUPLING BORES

Clutch Size	Type	Bores (inch)	
		Max. (1)	Max. (2)
02	Clutch	0.6250	0.7500
	Coupling	1.1875	—
04	Clutch	1.1250	1.1875
	Coupling	1.8750	—
05	Clutch	1.5625	1.6250
	Coupling	2.3125	2.3750
06	Clutch	2.0000	2.1250
	Coupling	2.6250	2.7500
09	Clutch	2.8750	3.1250
	Coupling	4.0000	4.1250
11	Clutch	3.1250	3.2500
	Coupling	4.6250	5.0000

Refer to Page 80 for a complete list of bore codes.

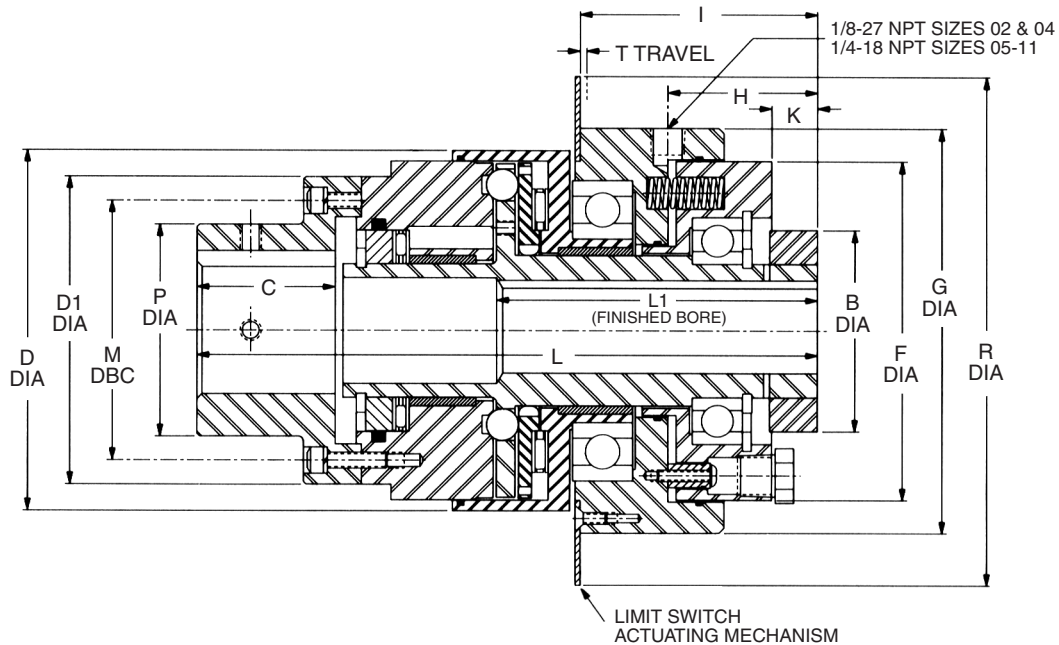
- (1) Square Key
- (2) Flat Key

Refer to Page 53 for ordering information.

H2000 OVERLOAD CLUTCHES

**POR SERIES
STYLE F**

**TYPE R
RIGID COUPLING**



ALL DIMENSIONS IN INCHES

Clutch Size	B	C	D	D1	F	G	H	I	K	L	L1	M	P	R	T	Weight (Lbs.)
02	1.75	0.75	2.81	2.63	3.50	3.88	1.84	2.19	0.56	5.31	2.95	2.125	1.38	5.81	.060	5.8
04	2.38	1.62	4.25	3.63	4.00	4.75	1.76	2.79	0.54	7.29	3.77	3.062	2.50	7.25	.078	13.9
05	3.50	2.13	5.87	5.00	6.25	6.63	2.87	3.33	0.77	9.11	4.57	4.250	3.31	8.88	.110	33.6
06	4.25	2.20	7.13	5.56	7.25	7.75	3.00	3.54	0.72	9.71	5.00	4.750	3.50	10.12	.128	48.6
09	5.75	3.34	9.50	7.56	9.25	10.00	3.87	4.63	1.03	13.18	6.30	6.625	5.25	12.50	.165	118
11	6.00	3.96	11.62	9.00	11.50	12.25	4.50	5.20	1.25	15.30	7.44	7.750	7.50	14.62	.183	184

RATINGS

Clutch Size	Torque Code	Torque Range (Lb. In.)	Max. RPM	WR ² * (Lb-In ²)
02	H	120 - 470	3,600	4.0
04	H	400-1,400	1,800	22.6
05	L	850-2,900	1,800	97.0
	H	1,350-4,700		
06	H	2,800-7,800	1,200	205
09	H	5,800-17,800	1,200	945
11	H	8,200-33,000	1,200	2,158

*Estimated with maximum bores.

Clutches are shipped set for the minimum torque value for the selected range.

CLUTCH AND COUPLING BORES

Clutch Size	Type	Bores	
		Max. (1)	Max. (2)
02	Clutch	0.6250	0.7500
	Coupling	0.7500	-
04	Clutch	1.1250	1.1875
	Coupling	1.6250	1.6875
05	Clutch	1.5625	1.6250
	Coupling	2.1250	2.2500
06	Clutch	2.0000	2.1250
	Coupling	2.2500	2.3125
09	Clutch	2.8750	3.1250
	Coupling	3.3750	3.5000
11	Clutch	3.1250	3.2500
	Coupling	4.0000	4.1250

Refer to Page 80 for a complete list of bore codes.

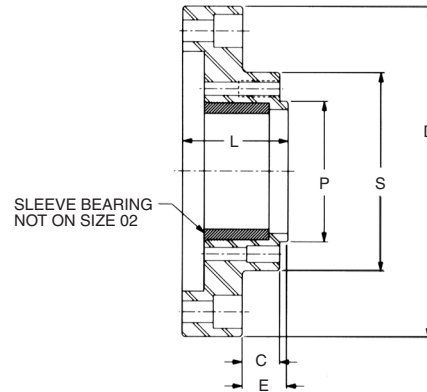
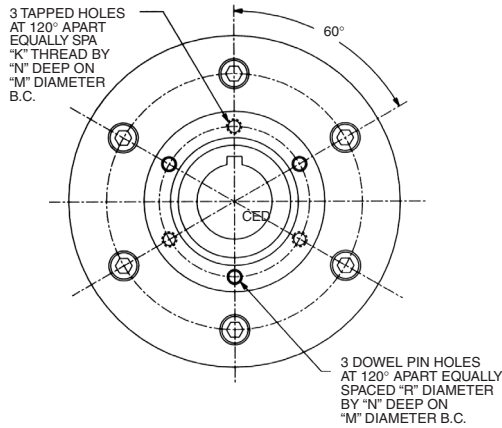
- (1) Square Key
- (2) Flat Key

Refer to Page 53 for ordering information.

H2000 OVERLOAD CLUTCHES

POR SERIES TYPE T ADAPTER

TYPE T SPROCKET, PULLEY, SHEAVE, OR GEAR MOUNT



ALL DIMENSIONS IN INCHES

Clutch Size	C	D	E	K	L	M	N	P +0.000/-0.002	R	S	WR ² (Lb.-In. ²)	Weight (Lbs.)
02	0.28	2.63	0.40	#8-32	0.71	1.422	.38	1.094	—	1.75	0.5	0.5
04	0.34	3.63	0.63	#8-32	1.02	2.250	.38	1.922	3/16	2.58	2.0	1.0
05	0.47	5.00	0.59	1/4-20	1.26	3.219	.50	2.750	1/4	3.66	12	3.0
06	0.69	5.56	0.81	1/4-20	1.55	3.406	.50	2.938	1/4	3.90	25	5.4
09	0.88	7.56	1.00	3/8-16	2.00	5.094	.75	4.344	3/8	5.84	93	11
11	1.02	9.00	1.14	3/8-16	2.32	5.938	.75	5.188	1/2	6.69	241	19

Mounting bolts must be minimum 160,000 PSI tensile, Rc 36-43.
Dowel pins must be minimum 150,000 PSI shear, Rc 50-58 core hardness.

MINIMUM NUMBER OF TEETH OF STANDARD PLATE SPROCKETS ADAPTABLE TO TYPES B AND T CLUTCHES

Clutch Size	Type	Chain Size and Pitch													
		#25 1/4 Pitch	#35 3/8 Pitch	#40 1/2 Pitch	#50 5/8 Pitch	#60 3/4 Pitch	#80 1 Pitch	#100 1-1/4 Pitch	Type	#25 1/4 Pitch	#35 3/8 Pitch	#40 1/2 Pitch	#50 5/8 Pitch	#60 3/4 Pitch	#80 1 Pitch
02	B	39	27	22	—	—	—	T	27	19	15	—	—	—	—
04	B	51	35	28	23	—	—	T	37	26	20	17	—	—	—
05	B	69	47	36	30	26	—	T	50	35	27	23	19	—	—
06	B	76	52	40	33	28	—	T	54	37	29	24	20	16	14
09	B	101	68	52	43	36	28	T	79	54	41	34	29	23	19
11	B	119	80	61	50	43	33	T	90	61	47	38	32	25	21

The Type T adapter may be ordered separately or factory mounted to the POR Series Clutches shown on Pages 54 and 55, by specifying Type T.

H2000 OVERLOAD CLUTCHES

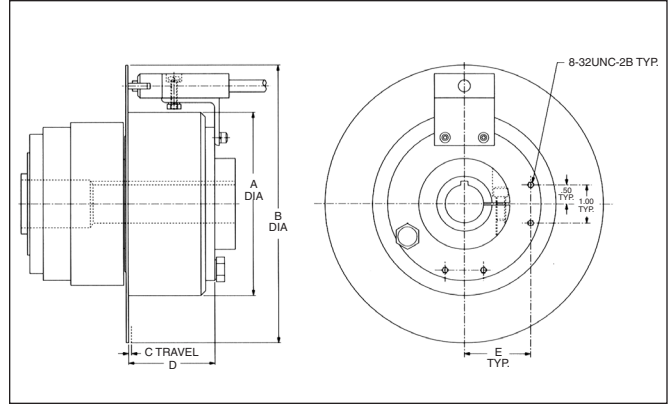
GENERAL INFORMATION

LIMIT SWITCHES

The POR Series H2000 clutch is an automatic reset device. It is important that the drive be shut down immediately upon a torque overload condition. The switch should be able to operate within the disengagement travel of the clutch. Upon an overload, the cylinder of the clutch will move to actuate the limit switch and shut down the drive. An oversized metallic plate provides a means for sensing movement from both ends and for utilizing a precision proximity switch.

As an option, Boston Gear offers a limit switch kit which mounts directly to the clutch. There are two sets of tapped holes on the face of the piston for mounting two limit switches. One switch may be used for your pneumatic control unit and the other switch may be used for the motor control. The motor control switch is used to open the circuit to the motor during a torque overload condition. The switch should be wired in its normally closed condition and in parallel with the JOG button of the motor control. This will permit the drive to be started in the event the clutch has stopped with the limit switch circuit in an open state.

The kit comes complete with a mechanical limit switch, mounting bracket and mounting hardware. Figure 4 shows the limit switch kits available for the POR Series H2000. Before using this switch in your circuit, verify that the electrical ratings meet your requirements.



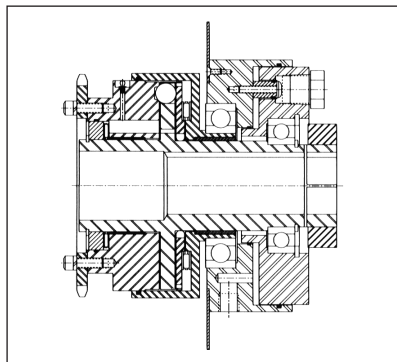
Clutch Size	A	B	C	D	E
02	3.88	5.81	.060	1.63	1.50
04	4.75	7.25	.078	2.25	1.73
05	6.63	8.88	.110	2.60	2.63
06	7.75	10.12	.128	2.82	3.06
09	10.00	12.50	.165	3.60	4.00
11	12.25	14.62	.183	3.95	5.00

Consult factory for ordering information.

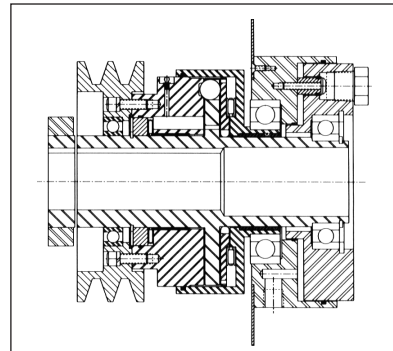
FIGURE 4
LIMIT SWITCH KIT

Clutch Size	Item Code
02 & 04	76493
05 & 06	76494
09 & 11	17571

FIGURE 5
SUGGESTED MOUNTING ARRANGEMENTS



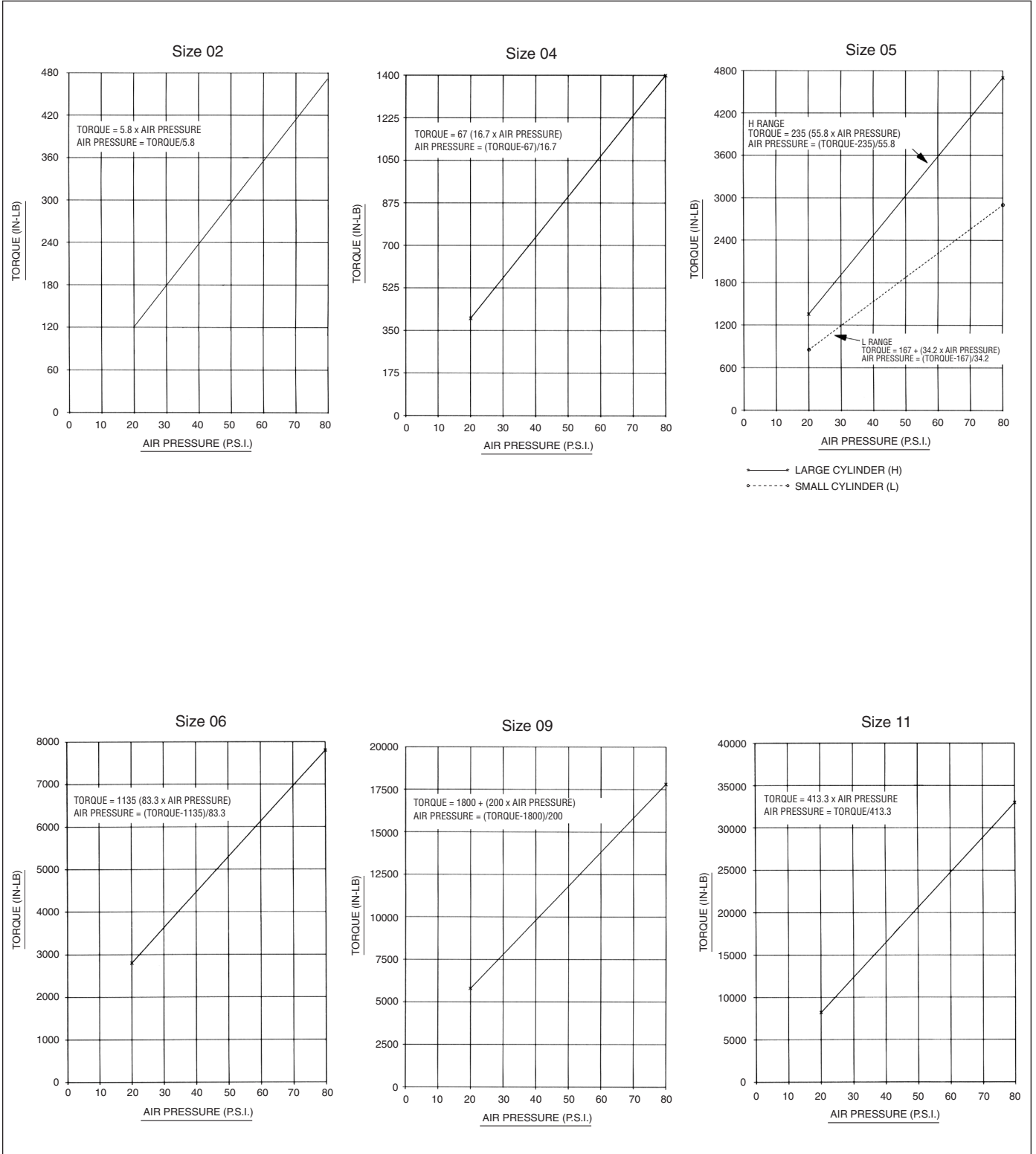
TYPE B, STYLE F
WITH SPROCKET MOUNTED



TYPE B, STYLE L
WITH SHEAVE MOUNTED

H2000 OVERLOAD CLUTCHES

TORQUE CURVES





SECTION CONTENTS

FEATURES	62
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SELECTION.....	63
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PNEUMATIC TORQUE LIMITING DISCONNECT CLUTCHES

PDC SERIES

FEATURES

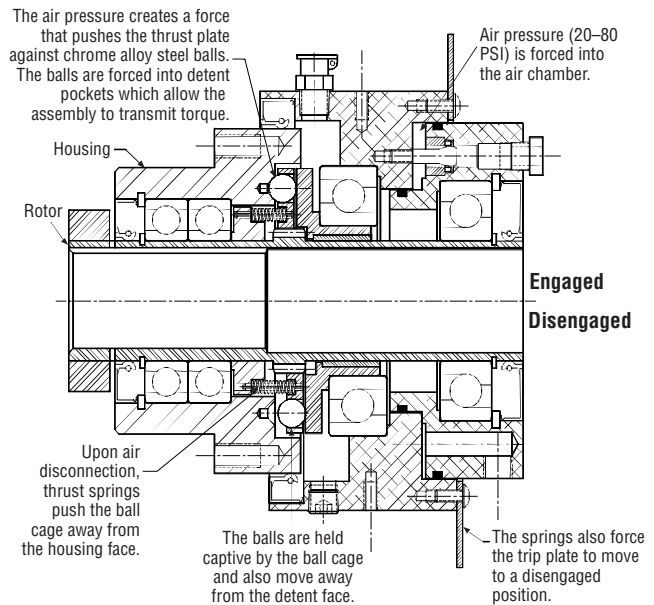
- "In-Flight" torque control offers precise pneumatic torque control
- Nickel plated and stainless steel exterior for superior corrosion resistance
- Completely sealed design
- Remotely adjustable for starting and overrunning loads
- Accurate and dependable disconnection, +/- 10% of torque setting
- Single position ball detent
- Instant disengagement
- Oil lubricated
- Dual radial ball bearings
- Internal valve
- Through shaft design
- Bi-directional operation
- Single position indexing
- Automatic reset
- Limit switch actuation mechanism
- Clamp collar for secure mounting
- Hardened parts for long clutch life
- Sealed from environmental contamination

The Boston Gear PDC Series Pneumatic Torque Limiting Disconnect Clutch is unique from other pneumatic clutches on the market today. Along with providing the expected protection from overloads in your equipment, it also allows the rotation of the two halves when the air is off and exhausted from the clutch.

The PDC clutches are completely sealed from the atmosphere and other harmful contaminants and all exterior surfaces are nickel plated for corrosion resistance and wash down service. Angular contact ball bearings are used in the units to provide added thrust capacity. Since many of these clutches are used with timing belt pulleys or sprockets, we have designed the unit with two radial ball bearings to provide support to the pulley or sprocket.

OPERATING PRINCIPLES

The Boston Gear PDC Series Pneumatic Disconnect Clutch is a ball detent air actuated device. It has been designed to provide accurate and dependable torque overload protection for mechanical power transmission equipment. It has also been designed to provide a remote disconnection of the drive when the air supply is removed. The following diagram demonstrates the engaged and disengaged functions.



The top half of the view shows the unit in an engaged condition. 20 to 80 psi of shop air is forced into the air chamber. That air pressure exerts a force on a hardened thrust plate that pushes against six chrome alloy steel balls. The balls are forced into detent pockets, which allow the assembly to transmit torque. Increasing or decreasing the air pressure remotely controls precision "in flight" torque adjustment. The machinery can still be in operation when the torque rating is being adjusted. When a torque overload occurs, the housing and rotor rotate independently of each other. The balls roll out of their detents and a limit switch actuating plate moves forward to trip a limit switch and signal a torque overload condition. The drive should be shut down immediately and the source of the overload determined and cleared. To re-engage the clutch, re-apply the air pressure and jog the drive until the clutch engages. The PDC Series is a single position device. The unit will re-engage every 360° in the same location every time.

The bottom half of the view shows the unit in a disengaged condition. When air is disconnected, internal springs push the ball cage away from detent face of the housing. The balls are held captive by the ball cage so they also move away from the detent face. At this point, the unit is free to rotate in a disengaged condition. The main components that transmit torque are not in contact with each other.

PNEUMATIC TORQUE LIMITING DISCONNECT CLUTCHES

SELECTION

1. Determine overload release torque by one of these methods:

- Use the torque formula with horsepower and RPM specific to the selected clutch location. A service factor may be required for high inertia starts, reversing or peak load conditions, (refer to Page 80 for service factor information):

$$\text{Torque (Lb. In.)} = \frac{\text{HP} \times 63025}{\text{RPM}}$$

- Determine the "weak link" in the drive train, (i.e. chain, reducer, belt or shaft). Select an overload release torque that is below the "weak link's" maximum torque rating.
- Physically measure the drive torque with a torque wrench and size accordingly.

2. Determine the bore size:

- Shaft size at the clutch location determines the clutch bore.

3. Refer to the Basic Selection Chart for the appropriate clutch size. Determine the approximate start-up and running air pressures for the application.

4. Refer to Pages 64 and 65 for ratings, dimensions and types.

5. Refer to Page 81 for recommended mounting locations.

*Larger bores may require reduced keys (supplied with unit)

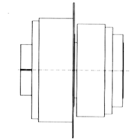
BASIC SELECTION CHART

Clutch Size	Max.* Bore (In.)	Torque Code	Torque Range (Lb.-In.)	Max. RPM
04	1.1875	H	300-1,700	1,800
05	1.7500	H	820-4,000	1,800

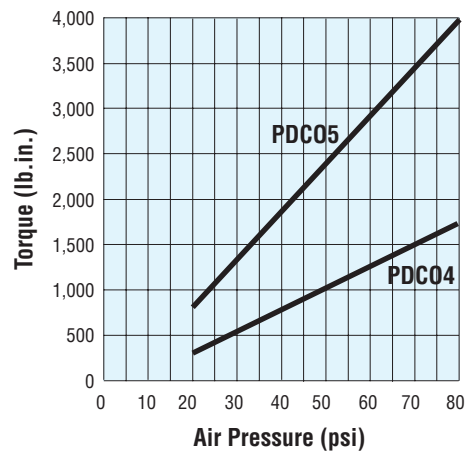
*Larger bores may require flat keys (supplied with unit)

Style F is used where full shaft length is available.

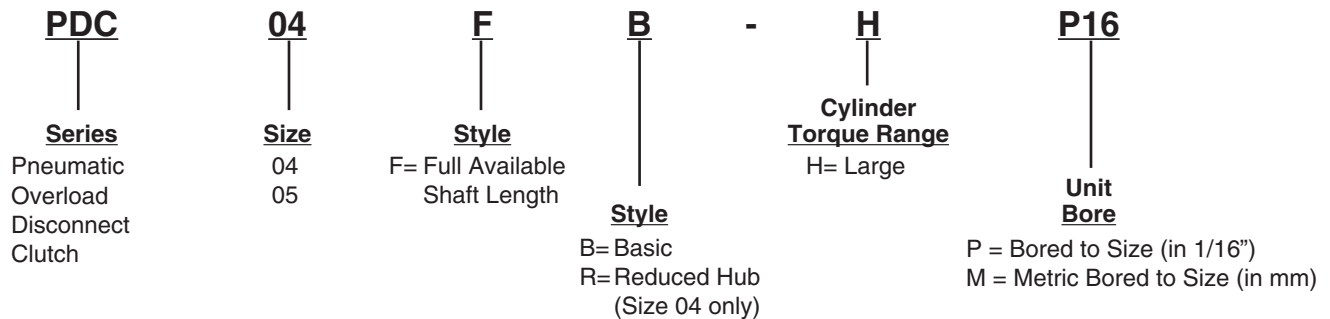
Style F



PDC Torque Curves



PDC SERIES PART NUMBERING SYSTEM



HOW TO ORDER

When ordering a PDC Series Overload Clutch, please include code letters/numbers for series, size, type, torque range, and unit bore.

Example:

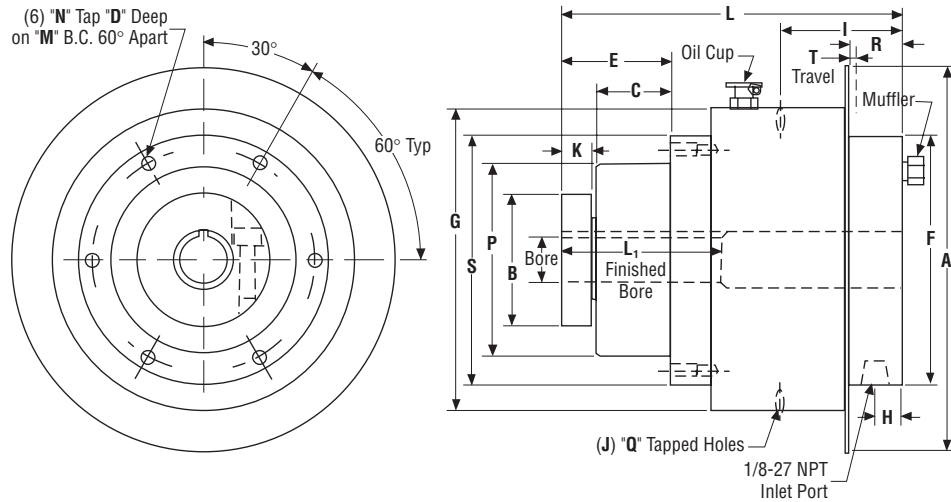
Required Size 04 PDC series Overload Clutch, full available shaft length, basic mount, large torque range with a one inch bore.

PDC 04 F B - H P16

PNEUMATIC TORQUE LIMITING DISCONNECT CLUTCHES

**PDC SERIES
STYLE F**

**TYPE B
BASIC DESIGN**



ALL DIMENSIONS IN INCHES

Clutch Size	A	B	C	D	E	F	G	H	I	J	K
04	7.00	2.38	1.36	.63	2.00	4.67	5.50	.34	2.20	3	.56
05	8.00	3.38	1.14	.94	1.98	5.92	6.58	.50	2.20	4	.75

CLUTCH BORES

Clutch Size	L	L1	M	N	P +.000/-002	Q	R	S	T
04	6.20	2.70	4.062	5/16-18	3.500	1/4-20	.95	4.53	.13
05	7.18	3.22	4.750	3/8-16	4.125	10-24	1.16	5.25	.15

Clutch Size	Bores (inch)	
	Max. (1)	Max. (2)
04	1.1250	1.1875
05	1.6250	1.7500

Refer to Page 80 for a complete list of bore codes.

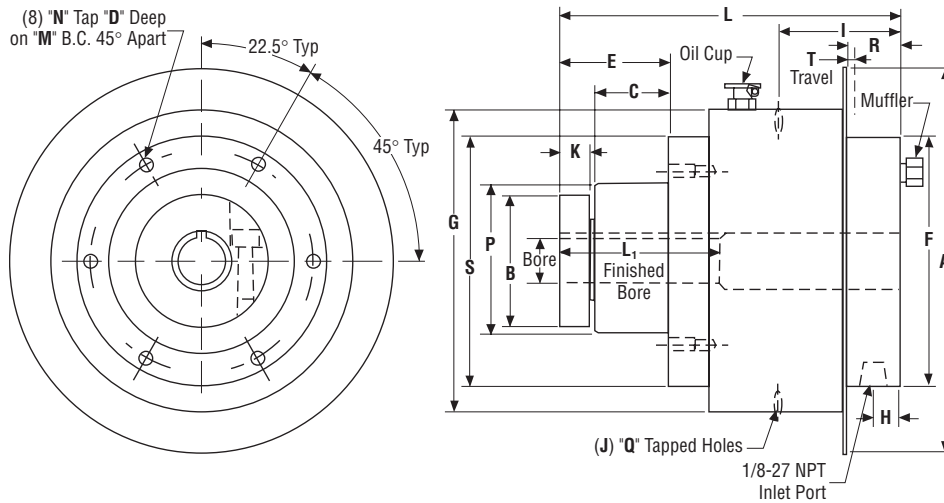
- (1) Square Key
- (2) Flat Key

Refer to Page 63 for ordering information

PNEUMATIC TORQUE LIMITING DISCONNECT CLUTCHES

**PDC SERIES
STYLE F**

**TYPE R
REDUCED HUB DESIGN**



ALL DIMENSIONS IN INCHES

Clutch Size	A	B	C	D	E	F	G	H	I	J	K
04	7.00	2.38	1.36	.56	2.00	4.67	5.50	.34	2.20	3	.56

CLUTCH BORES

Clutch Size	L	L1	M	N	P +.000/-0.002	Q	R	S	T
04	6.20	2.70	3.312	8-32	3.000	1/4-20	.95	4.53	.13

Clutch Size	Bores (inch)	
	Max. (1)	Max. (2)
04	1.1250	1.1875

Refer to Page 80 for a complete list of bore codes.

- (1) Square Key
- (2) Flat Key

Refer to Page 63 for ordering information



Leading the Industry at Every Turn



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VARITORQUE OVERLOAD CLUTCHES

VARITORQUE PNEUMATIC OVERLOAD CLUTCHES VOR SERIES

FEATURES

- “In Flight” torque control. Precise torque control adjustable for starting and overrunning loads
- Single positioning for re-engagement at the exact cycle point at which it released
- Torque accuracy within $\pm 5\%$
- Bi-directional operation
- Electroless nickel finish
- Six point drive engagement
- Automatic disconnect
- Deublin flange mounted air union
- Automatic switch actuating plate for instantaneous remote detection of overload condition
- Completely enclosed for “dirty” applications
- Pressure lubrication
- Positive split locking collar for secure shaft mounting
- Operates on static air pressure (20-80 psi), no elaborate air systems required

OPERATING PRINCIPLES

AIR UNION

The air pressure supplied to the clutch enters through the hex steel rotor of the Deublin air union. When the VOR Series VariTorque is engaged and operating, the union rotor is the only stationary part. The union housing rotates on a double row ball bearing protected by dirt-tight seals. A spring-loaded carbon micro-lapped seal prevents air leakage between the rotor and housing of the union. The air passes through the union housing into the cylinder assembly of the VariTorque.

CYLINDER ASSEMBLY

Air pressure acts against the surface area of the piston exerting a force to move the piston against the pressure pins. Resulting torque ranges (see Figure 1 on Page 67) are developed by different size piston surface areas of the two cylinder sizes, (L-small, H-large).



The switch actuating plate moves with the piston. It is directly connected to the piston through the cylinder housing via trip pins and trip plate bolts. The plate's lateral motion can be used to actuate a limit switch signaling an overload condition.

The valve assembly located through the piston serves two purposes. The first is to provide the single position engagement of the clutch. The piston will not be energized until the valve is seated in its cam seat located on the end of the rotor. This ensures that the rotor and cylinder-housing assembly always engage in the same relative position. The second purpose of the valve assembly is to relieve cylinder air pressure by allowing it to escape through the air exhaust muffler upon overload.

PISTON SPRINGS

Once the valve is seated in its single home position, the clutch can be engaged. Air pressure forces the piston against the three piston springs. These springs serve to move the piston and switch actuating plate out when the clutch overloads or the air pressure is shut off to the clutch.

HOUSING ASSEMBLY

The force from the piston is transmitted to six pressure pins. Six pawls equally spaced around the rotor are forced by the pressure pins to engage into six notches in the rotor barrel. The pressure pins, pawls and rotor are made of alloy steel and are electroless nickel plated for long life.

When the set torque limit in the VariTorque is exceeded, the pawls are forced out of the notches in the rotor barrel. They in turn push the pressure pins and piston. When the rotor turns in relation to the housing-cylinder assembly, the valve rides up the ramp of the cam seat and relieves the cylinder air pressure. The rotor now can rotate freely, independent of the housing assembly on two sealed ball bearings.

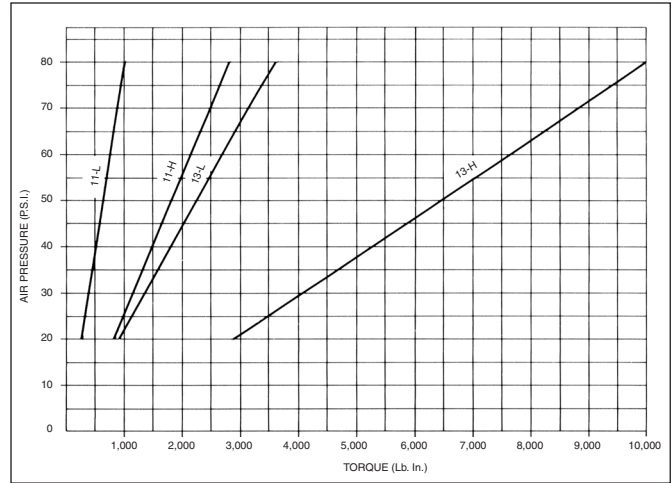
VARITORQUE OVERLOAD CLUTCHES

SELECTION

- Determine the overload release torque by one of these methods:
 - Use the torque formula with horsepower and RPM specific to the selected clutch location. A service factor may be required for high inertia starts, reversing or peak load conditions, (refer to Page 80 for service factor information):

$$\text{Torque (Lb. In.)} = \frac{\text{HP} \times 63025}{\text{RPM}}$$
 - Determine the “weak link” in the drive, (i.e. chain, reducer, belt or shaft). Select an overload release torque below the “weak link’s” maximum torque rating.
 - Physically measure the drive torque with a torque wrench and size accordingly.
- Determine the bore size and keyway.
- Determine the approximate start-up and running air pressures for the application.
- Refer to the Basic Selection Chart for the appropriate clutch size.
- Refer to Page 70 for ratings and dimensions.
- Refer to Page 81 for recommended mounting locations.

**FIGURE 1
AIR PRESSURE AND TORQUE CAPACITY**

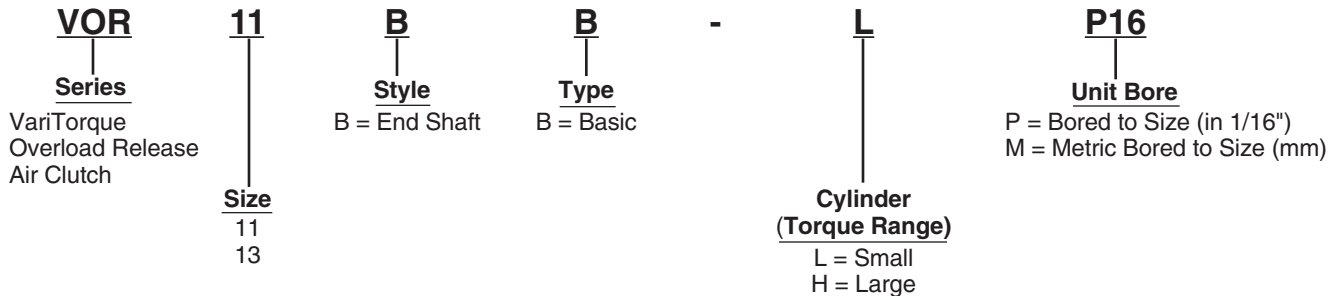


BASIC SELECTION CHART

Clutch Size	Maximum Bore (In.)*	Torque Code	Torque Range (Lb. In.)	Maximum RPM
11	1.3125	L	250-1,000	1,000
	1.2500	H	800-2,800	
13	2.1875	L	900-3,600	1,000
	1.9375	H	2,800-10,000	

*Larger bores may require flat keys (supplied with unit).

VOR SERIES PART NUMBERING SYSTEM



HOW TO ORDER

When ordering a VOR Series VariTorque Overload Clutch, please include code letters/numbers for series, size, style, type, torque range, and unit bore.

Example:

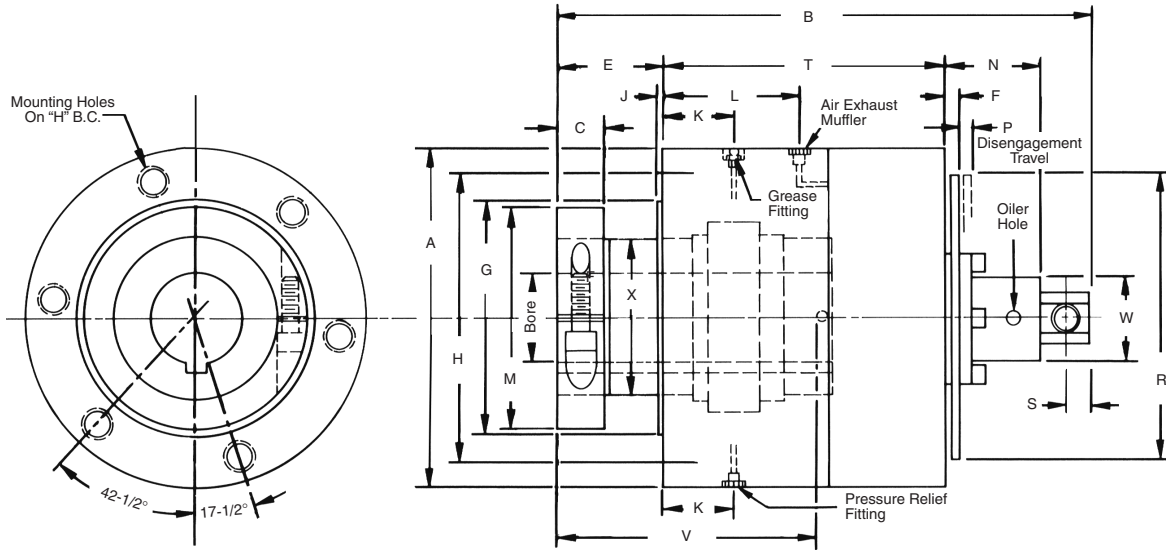
Required Size, 11 VOR Series Overload Clutch, end shaft mount, basic type, small torque range, with a one inch bore:

VOR 11 B B — L P16

VARITORQUE OVERLOAD CLUTCHES

VOR SERIES
STYLE A/B

TYPE B
BASIC DESIGN



ALL DIMENSIONS IN INCHES

Clutch Size	A	B	C	E	F	G ±.001	H	J	K	L	M	N	P	R	S	T	V	W	X +.0000 -.0005	Mounting Holes	
																				Qty.	Thread Size
11	4.75	9.03	.68	1.50	.21	2.748	3.500	.06	0.96	1.69	2.75	2.19	.13	4.75	.44	4.42	3.03	1.62	1.7722	6	5/16-18
13	6.50	10.19	.87	2.00	.21	4.498	5.500	.06	1.38	2.62	4.00	1.81	.16	6.50	.44	5.44	4.47	1.62	2.7565	6	5/8-11

RATINGS

Clutch Size	Torque Code	Torque Range (Lb.-In.)	Max. RPM	Air Inlet (NPT)	WR ² (Lb.-In. ²)	Weight (Lbs.)
11	L	250-1,000	1,000	1/4	45.7	17
	H	800-2,800			46.5	18
13	L	900-3,600	1,000	1/4	197	39
	H	2,800 - 10,000			212	41

Clutches are shipped set for the minimum torque value of the selected range.

CLUTCH BORES

Clutch Size	Torque Range	Bores (inch)	
		Max. (1)	Max. (2)
11	L	1.1875	1.3125
	H	1.1875	1.2500
13	L	1.7500	2.1875
	H	1.7500	1.9375

Refer to Page 80 for a complete list of bore codes.

- (1) Square Key
- (2) Flat Key

Refer to Page 69 for ordering information.

VARITORQUE OVERLOAD CLUTCHES

GENERAL INFORMATION

LIMIT SWITCH

In the layout in Figure 2 the limit switch should be wired in its normally closed condition. The switch is used to open the circuit to the motor during a torque overload condition. The switch should be wired in parallel with the JOG button so the drive may be started in the event the VariTorque clutch has stopped with the limit switch circuit in an open state.

AIR CONTROLS

The HIGH pressure regulator should be set at a pressure just HIGH enough to permit the VariTorque clutch to overcome any **momentary overload torques** caused during the machine's start-up and stopping period.

The LOW pressure regulator should be set at a pressure just LOW enough to permit the VariTorque clutch to overcome the **normal operating torques** caused during the machines running period and to permit a crisp and positive re-engagement of the VariTorque clutch should an overload occur.

INDIRECT DRIVES

The VariTorque overload release air clutch is utilized in conjunction with chain sprockets or belt driven sheaves. For chain and sprocket applications smaller than those shown in the table below or belt driven sheave applications, consult with the factory. In most cases, a minor modification of the VariTorque design or the sprocket/sheave will permit usage.

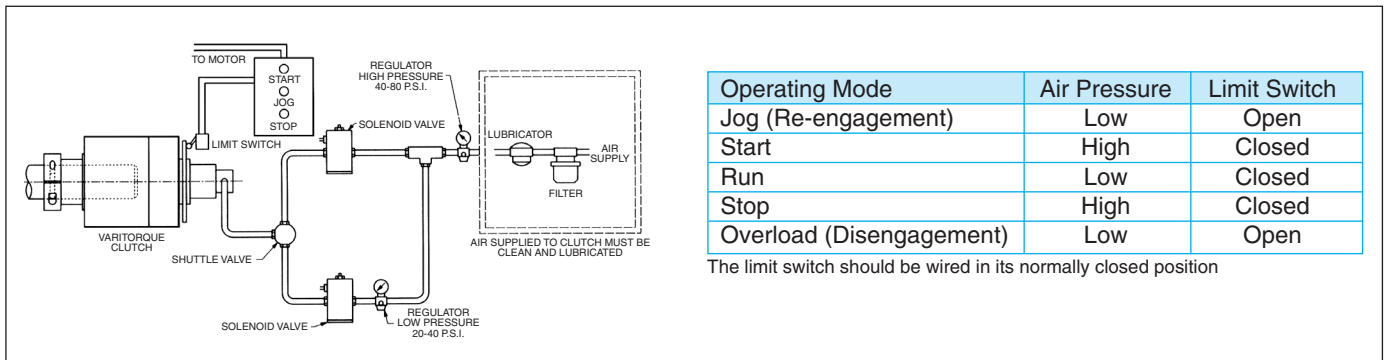
SPECIAL FINISHES

All VariTorque clutches are supplied with an electroless nickel finish. Special coatings, finishes or paints are also available.

CUSTOM VARIATIONS

- Sprockets or sheaves supplied and mounted
- Dimensional changes (i.e. overall length, actuating plate diameters)
- Bores and keyways (i.e. metric, non-standard)
- Special adaptations

FIGURE 2



Refer to Boston Gear's Fluid Power Products Catalog for air preparation and control products.

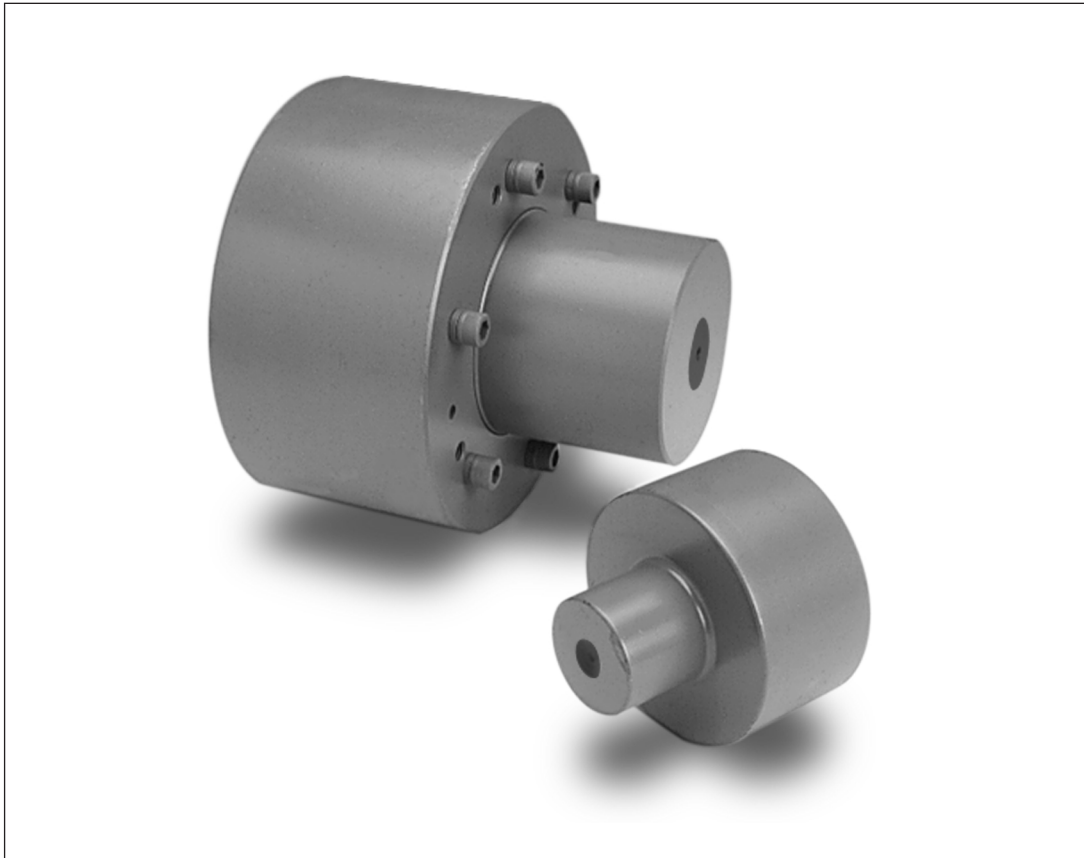
MINIMUM ACCEPTABLE PLATE SPROCKET MOUNTS

Clutch Size	Chain Size and Pitch									
	#35 3/8 Pitch	#40 1/2 Pitch	#41 1/2 Pitch	#50 5/8 Pitch	#60 3/4 Pitch	#80 1 Pitch	#100 1-1/4 Pitch	#120 1-1/2 Pitch	#140 1-3/4 Pitch	#160 2 Pitch
11	45	34	35	28	24	19	16	14	12	—
13	60	45	45	36	31	24	20	17	16	14

Boston Gear will also supply and mount sprockets or sheaves, as specified, for a complete package.



Leading the Industry at Every Turn



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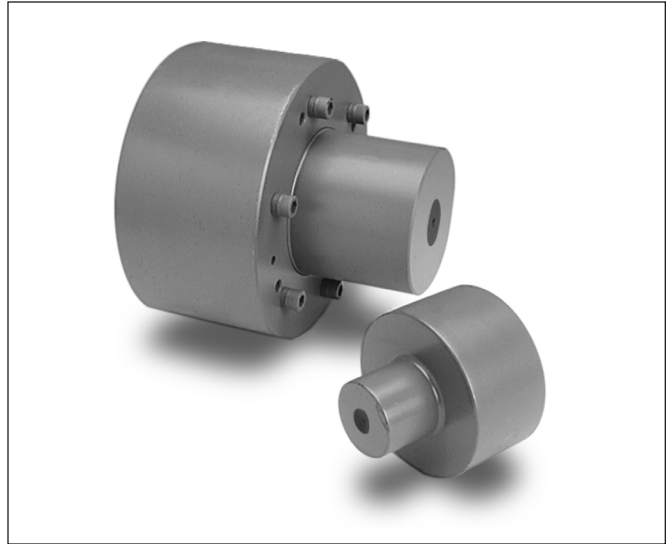
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CENTRIC CENTRIFUGAL CLUTCHES

CENTRIC CENTRIFUGAL CLUTCHES CCC SERIES

FEATURES

- Automatic engagement and disengagement
- Delayed engagement produces a “no load start”
- No slippage at full running speed
- Controlled soft-start acceleration
- 100% efficient at rated speed
- Standard, spring control, and deep pocket models
- Protection against shock loads during start-up



WHY ARE THEY USED?

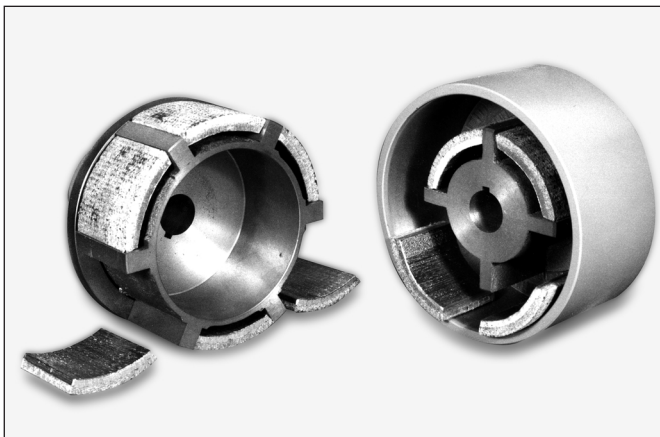
The Boston Gear Centric Centrifugal Clutch offers many advantages in motor and engine drive applications. Utilizing the centrifugal clutch enables the selection of normal torque motors for running loads rather than the selection of high torque motors for starting loads. The centrifugal clutch also sharply reduces the motor starting current requirements and heat losses inherent in the direct starting of a drive. This adds up to reduced power factors, greater efficiency and therefore, greater economy in motor drives.

When used with engine drives, the spring controlled centrifugal clutch allows the engine to warm up before starting the load or to stand by at an idling speed. Thus the spring controlled centrifugal clutch is used to great advantage in such applications as dual drives and engine driven pumping systems. This style clutch can also be used with turbines where a warm up period is necessary.

On any drive, the Boston Gear Centric Centrifugal Clutch provides protection against the shock loads which occur in the starting of a rigidly coupled drive. In many cases these loadings are capable of seriously damaging components of the drive and often expensive safety factors have to be designed into the machinery to protect against these loadings. The use of a centrifugal clutch eliminates these possibilities.

The use of a Boston Gear Centric Centrifugal Clutch allows the designer of a particular drive complete flexibility in clutch selection as each clutch is fabricated to order. Friction shoes of specific weights are custom designed therefore, any capacity within a particular clutch size can be obtained. The same holds true in the case of the spring controlled clutch. This style of clutch is designed to provide the specific engagement or disengagement speeds required by a specific application.

STANDARD STYLE



SPRING CONTROLLED STYLE



CENTRIC CENTRIFUGAL CLUTCHES

OPERATING PRINCIPLES

The Boston Gear Centric Centrifugal Clutch utilizes two basic force principles in its operation, centrifugal force and friction force. Centrifugal force is that force which tends to pull a rotating body away from its center of rotation. Friction force exists between any two bodies in contact where one of the bodies is trying to move relative to the other body.

Figure 1, a face view of a centrifugal clutch, shows the basic components of the device. The driver half or spider is mounted to the motor or engine shaft and the driven half is connected to the load either directly or by means of some indirect drive arrangement. The friction shoes are the connective element between the driver and driven.

When the drive is set in motion, the spider and the shoes start to rotate. The spider imposes a driving force (F_3) on the friction shoe as shown in Figure 2. The centrifugal force (F_1) developed by the rotary motion of the friction shoe impresses it against the drum creating a frictional force (F_2) between the shoe and the drum.

As the drive increases in speed, the centrifugal force increases and thereby frictional force increases. When the frictional force reaches sufficient magnitude, it overcomes the resistance of the load, and the clutch drives. At full load speed, the shoe is "locked" firmly against the drum and no slippage occurs.

In engine and turbine applications, where it is necessary to "warm up" before attempting to drive a load, a spring controlled clutch is utilized. Figure 3 shows a typical spring control shoe. Here, a flat spring is placed over pins which run through the base of the shoe. This spring is retained in slots which are milled in the legs of the spider creating additional forces (F_s) which are applied to the friction shoes. The thickness of the spring utilized determines at what speed the particular drive may idle while warming up. At this idling speed the centrifugal force (F_1) developed by the rotation is not of sufficient magnitude to overcome the total spring force ($2F_s$) acting in the opposite direction on the friction shoe. As the speed of the drive increases above the point at which the spring forces (F_s) and the centrifugal force (F_1) are balanced, the shoe is pressed against the drum creating a friction force. The operation from this point on is as described above.

SELECTION

There are an infinite number of combinations of Boston Gear Centric Centrifugal Clutches. While operating on the same basic principles, every clutch is designed to suit a specific customer application. To assure that the appropriate clutch is selected, please complete the Selection Guide on Page 78 and fax it to Boston Gear.

Upon receipt, our application engineering department will review your requirements and return the optimal Boston Gear Centric Centrifugal Clutch design along with its dimensional drawings.

FIGURE 1

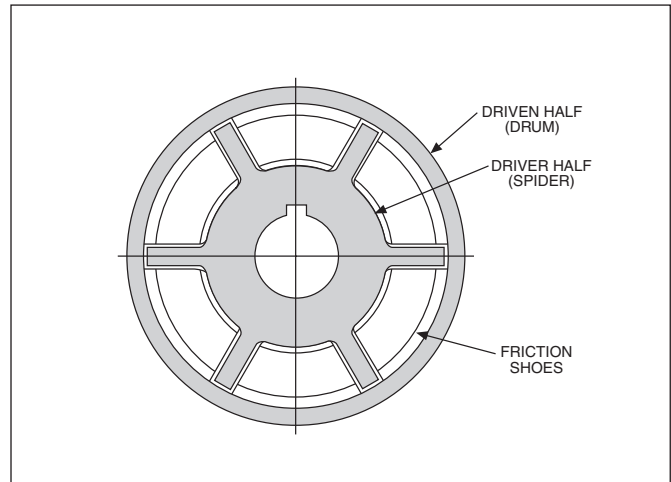


FIGURE 2

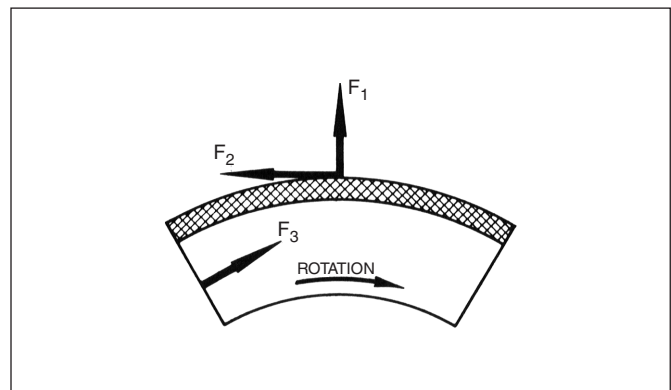
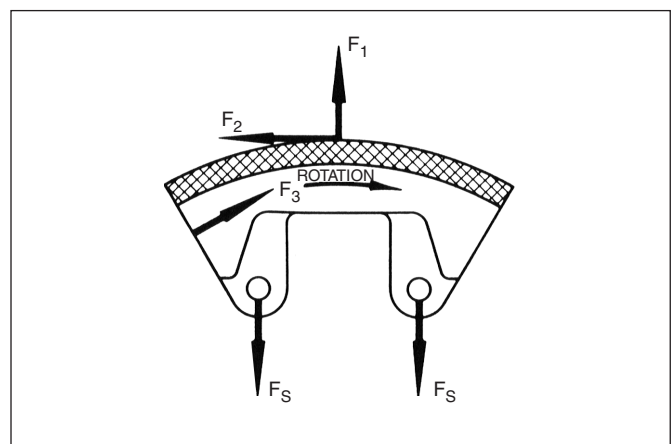


FIGURE 3



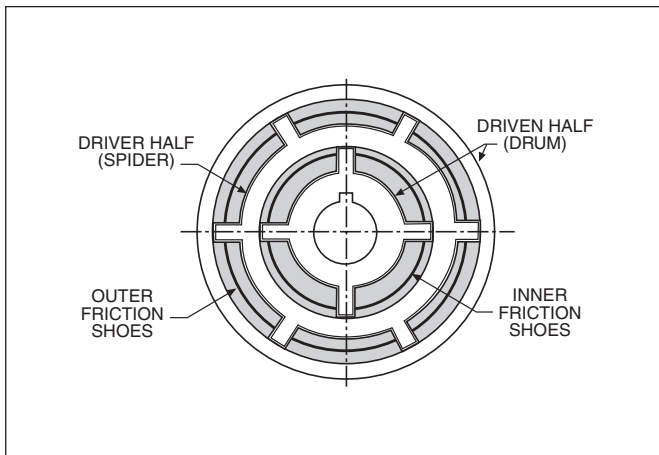
CENTRIC CENTRIFUGAL CLUTCHES

AVAILABLE STYLES

Boston Gear Centric Centrifugal Clutches are available for two basic applications: Styles F and J for electric motors and Style L for engines and turbines.

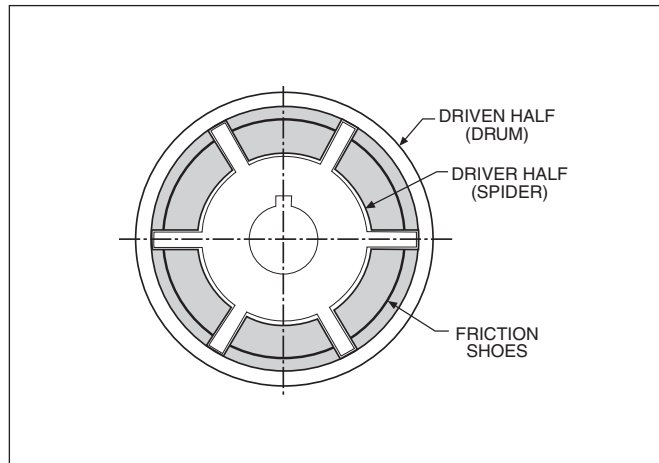
Standard Style F incorporates a shoe arrangement designed for electric motors, (Figure 4). As the motor comes up to speed, the outer friction shoes engage the driven half (the drum) and accelerate it. As it and the load come up to speed, the inner friction shoes engage the driver (the spider) locking up the drive.

**FIGURE 4
STANDARD STYLE F**



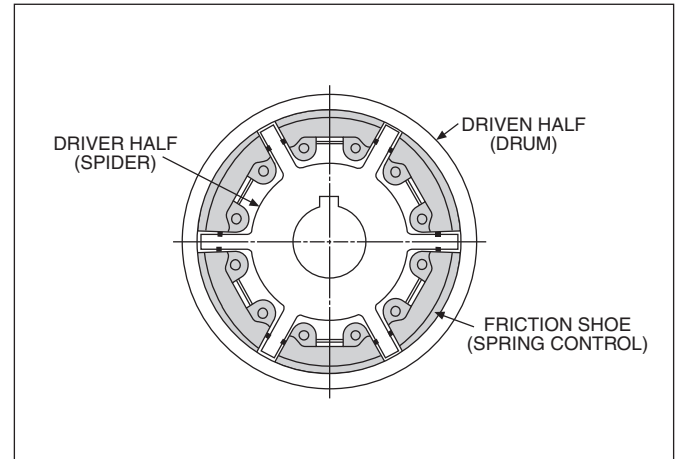
Where overload protection is required or greater capacity is needed in the drive, **Style J** containing deep pockets should be ordered, (Figure 5).

**FIGURE 5
DEEP POCKET STYLE J**



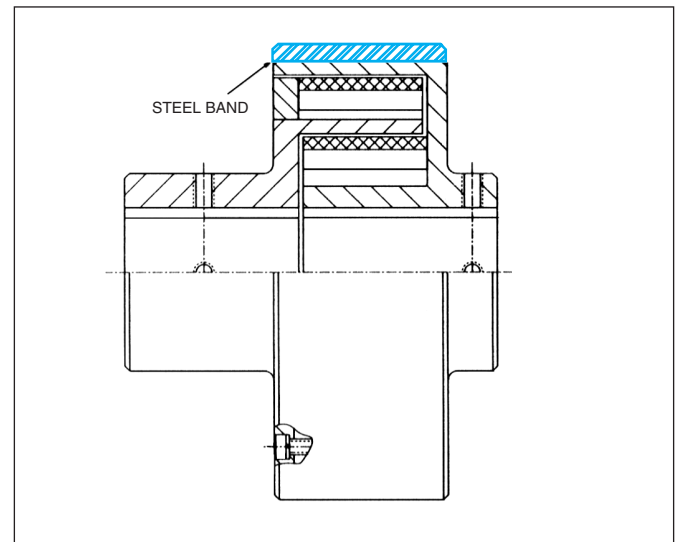
Style L incorporates a spring controlled shoe arrangement designed for engines, turbines, dual drives, or whenever a delayed engagement is desired, (Figure 6).

**FIGURE 6
SPRING CONTROLLED STYLE L**



For applications where either high speeds or large horsepower conditions exist, Styles G, K and M may be provided. These styles are identical to the models shown in Figures 4, 5 and 6, however they also incorporate steel bands wrapped around the housing helping to reduce stress, (Figure 7).

**FIGURE 7
STYLE F WITH STEEL BAND**



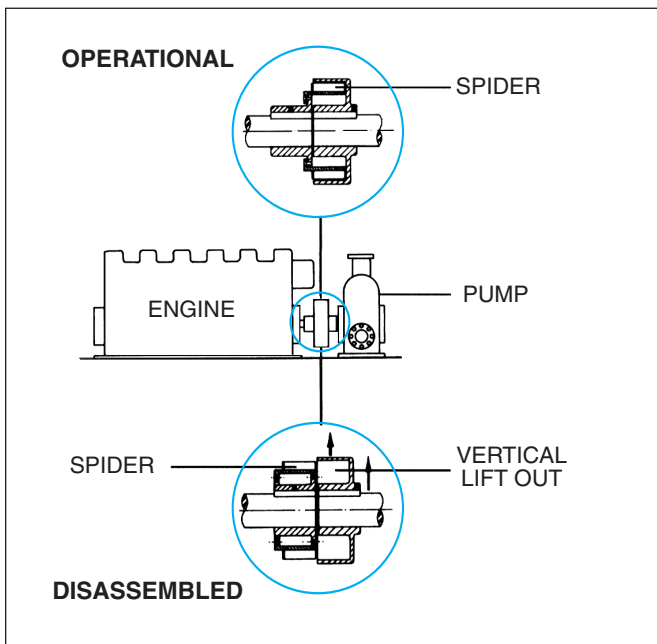
CENTRIC CENTRIFUGAL CLUTCHES

AVAILABLE TYPES

Type A Centric Centrifugal Clutches are similar to standard coupling/clutch designs in that the installation and removal of the clutch requires horizontal clearance. This type of design may necessitate the relocation of other drive train components to achieve this clearance.

The Type V clutch is a modification of the basic Type A unit. This construction is utilized to a great advantage in direct drive applications where the equipment used is too heavy to be conveniently telescoped at assembly or disassembly. Figure 8 shows how either piece of equipment can be vertically lifted out of its assembled position. The Type V clutch construction allows the clutch spider to be slipped back over its own hub, completely clearing the clutch drum. If a Type A construction had been used here, it would have been necessary to first move the pump horizontally in order to clear the drum and spider before a vertical lift could have been accomplished. This horizontal movement is often not convenient and sometimes impossible such as in certain dual drives and of course where space limitations exist.

**FIGURE 8
VERTICAL LIFTOUT**



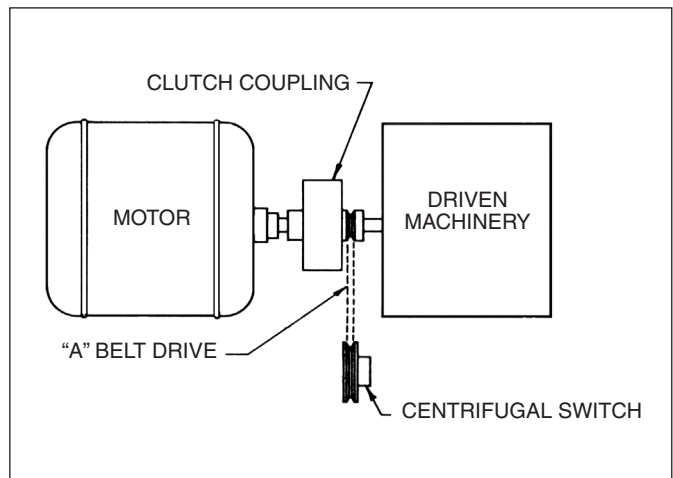
OVERLOAD DETECTION

In Figure 9 a safety device is incorporated to indicate an overload condition. In such applications a centrifugal switch is utilized. The switch is set to trip below a certain critical RPM determined by the application, and in so doing, actuate a signal or shut down the drive. The illustration shows the most common method of using a centrifugal switch in conjunction with a Boston Gear centrifugal clutch. "A" groove sheaves are mounted on the driven member of the clutch and the centrifugal switch. These sheaves are of such a ratio as to allow the centrifugal switch to operate within its limits.

For example, a drive arrangement is set to turn at 1750 RPM. It is determined that the desired cut out speed for the application is at 1500 RPM. The centrifugal switch is set to trip at speeds below 750 RPM and normally will run at 875 RPM which, through a 2:1 ratio corresponds to the drive RPM of 1750.

In actual operation the drive is turning at 1750 RPM. An overload occurs in the driven machinery and the capacity of the clutch is exceeded. While the driver half is still turning at the 1750 RPM, the driven half is dragging due to the increased capacity and drops below the 1500 RPM speed. The switch is actuated by this decrease in speed and an alarm is sounded or the drive is shut down.

FIGURE 9



CENTRIC CENTRIFUGAL CLUTCHES

SELECTION GUIDE

To select or order a Boston Gear Centric Centrifugal Clutch, please complete the following information and fax this form to Product Support at 1-800-752-4327.

GENERAL INFORMATION

Company		
Address	City	State
Contact Person	Tel. No.	Fax No.

APPLICATION DATA

1. Drive method: <input type="checkbox"/> Electric Motor <input type="checkbox"/> Engine/Turbine <input type="checkbox"/> Other
2. Method of drive: <input type="checkbox"/> Direct <input type="checkbox"/> Indirect (provide sketch)
3. Power transmission requirements at clutch location: Horsepower _____ RPM _____
4. Type: <input type="checkbox"/> Standard (A) <input type="checkbox"/> Vertical Lift-Out (V)
5. Speeds (required for engines, turbines, dual drives): Idling _____ RPM Engagement _____ RPM Disengagement _____ RPM
6. Bores: Driver (input) _____ inches Driver (output) _____ inches
7. Service Factor Required: _____

Use the space below to sketch any relevant application data:



ENGINEERING INFORMATION



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ENGINEERING INFORMATION

BORE CODES

Use the appropriate bore code shown below to designate the bore diameter (in inches) for the clutch's unit and coupling.

Bore Size (Fraction)	Bore Size (Decimal)	Bore Code
1/8	0.1250	P02
3/16	0.1875	P03
1/4	0.2500	P04
5/16	0.3125	P05
3/8	0.3750	P06
7/16	0.4375	P07
1/2	0.5000	P08
9/16	0.5625	P09
5/8	0.6250	P10
11/16	0.6875	P11
3/4	0.7500	P12
13/16	0.8125	P13
7/8	0.8750	P14
15/16	0.9375	P15
1	1.0000	P16
1-1/16	1.0625	P17
1-1/8	1.1250	P18
1-3/16	1.1875	P19
1-1/4	1.2500	P20
1-5/16	1.3125	P21
1-3/8	1.3750	P22
1-7/16	1.4375	P23
1-1/2	1.5000	P24
1-9/16	1.5625	P25
1-5/8	1.6250	P26
1-11/16	1.6875	P27
1-3/4	1.7500	P28
1-13/16	1.8125	P29
1-7/8	1.8750	P30
1-15/16	1.9375	P31
2	2.0000	P32
2-1/16	2.0625	P33
2-1/8	2.1250	P34
2-3/16	2.1875	P35
2-1/4	2.2500	P36
2-5/16	2.3125	P37
2-3/8	2.3750	P38
2-7/16	2.4375	P39
2-1/2	2.5000	P40
2-9/16	2.5625	P41
2-5/8	2.6250	P42
2-11/16	2.6875	P43
2-3/4	2.7500	P44
2-13/16	2.8125	P45
2-7/8	2.8750	P46
2-15/16	2.9375	P47
3	3.0000	P48
3-1/16	3.0625	P49
3-1/8	3.1250	P50
3-3/16	3.1875	P51
3-1/4	3.2500	P52
3-5/16	3.3125	P53
3-3/8	3.3750	P54
3-7/16	3.4375	P55
3-1/2	3.5000	P56

Bore Size (Fraction)	Bore Size (Decimal)	Bore Code
3-9/16	3.5625	P57
3-5/8	3.6250	P58
3-11/16	3.6875	P59
3-3/4	3.7500	P60
3-13/16	3.8125	P61
3-7/8	3.8750	P62
3-15/16	3.9375	P63
4	4.0000	P64
4-1/16	4.0625	P65
4-1/8	4.1250	P66
4-3/16	4.1875	P67
4-1/4	4.2500	P68
4-5/16	4.3125	P69
4-3/8	4.3750	P70
4-7/16	4.4375	P71
4-1/2	4.5000	P72
4-9/16	4.5625	P73
4-5/8	4.6250	P74
4-11/16	4.6875	P75
4-3/4	4.7500	P76
4-13/16	4.8125	P77
4-7/8	4.8750	P78
4-15/16	4.9375	P79
5	5.0000	P80
5-1/16	5.0625	P81
5-1/8	5.1250	P82
5-3/16	5.1875	P83
5-1/4	5.2500	P84
5-5/16	5.3125	P85
5-3/8	5.3750	P86
5-7/16	5.4375	P87
5-1/2	5.5000	P88
5-9/16	5.5625	P89
5-5/8	5.6250	P90
5-11/16	5.6875	P91
5-3/4	5.7500	P92
5-13/16	5.8125	P93
5-7/8	5.8750	P94
5-15/16	5.9375	P95
6	6.0000	P96
6-1/16	6.0625	P97
6-1/8	6.1250	P98
6-3/16	6.1875	P99
6-1/4	6.2500	P100
6-5/16	6.3125	P101
6-3/8	6.3750	P102
6-7/16	6.4375	P103
6-1/2	6.5000	P104
6-9/16	6.5625	P105
6-5/8	6.6250	P106
6-11/16	6.6875	P107
6-3/4	6.7500	P108
6-13/16	6.8125	P109
6-7/8	6.8750	P110
6-15/16	6.9375	P111
7	7.0000	P112

STANDARD KEYWAYS

Bore Range (Inch)	Square
Over - To	W x D
5/16 - 7/16	3/32 x 3/64
7/16 - 9/16	1/8 x 1/16
9/16 - 7/8	3/16 x 3/32
7/8 - 1-1/4	1/4 x 1/8
1-1/4 - 1-3/8	5/16 x 5/32
1-3/8 - 1-3/4	3/8 x 3/16
1-3/4 - 2-1/4	1/2 x 1/4
2-1/4 - 2-3/4	5/8 x 5/16
2-3/4 - 3-1/4	3/4 x 3/8
3-1/4 - 3-3/4	7/8 x 7/16
3-3/4 - 4-1/2	1 x 1/2
4-1/2 - 5-1/2	1-1/4 x 5/8
5-1/2 - 6-1/2	1-1/2 x 3/4
6-1/2 - 7-1/2	1-3/4 - 7/8

Square keyways will be furnished unless otherwise specified or noted in catalog.

Keys will be furnished with bores which require reduced keys.

BORE TOLERANCES (Inch)

Diameter	Tolerance
0 to 1	+0.0005/-0.0000
1 to 3	+0.0010/-0.0000
3 and up	+0.0020/-0.0000

CLUTCH LOCATION

LOCATION

The clutch should always be located as close as possible to the potential source of an overload condition. Figures 1 through 4 indicate both preferred and non-preferred locations for mounting an Overload Release clutch.

Note:

Clutch mounted sprockets, etc. and couplings should be positioned as close to a supporting bearing as possible to minimize overhung loads. A minimum shaft engagement of 1-1/2 times the shaft diameter is recommended for clutch and coupling flange installation.

DIRECT DRIVES

Figure 1 shows the **preferred** location for mounting in a direct drive application. The clutch is mounted on the low speed side of the reducer, and transmits power from its housing, through its rotor to the driven shaft.

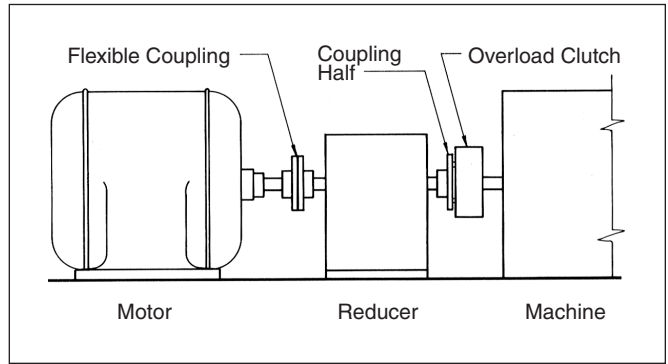
Locating the clutch as shown in Figure 2 is **not preferred**. Here the clutch is mounted on the high-speed side of the reducer. Generally, mounting in this manner requires the clutch to be hypersensitive to perform satisfactorily.

INDIRECT DRIVES

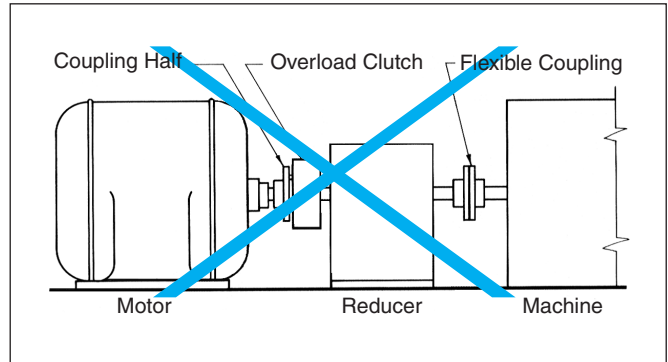
Either location of the clutch shown in Figure 3 is **preferred** in indirect drive applications, with the overload protection on the slow speed side of the reducer.

The mounting location in Figure 4 is **not preferred** for the same reasons as those for Figure 2. Always consult the factory when a mounting of this type is necessary.

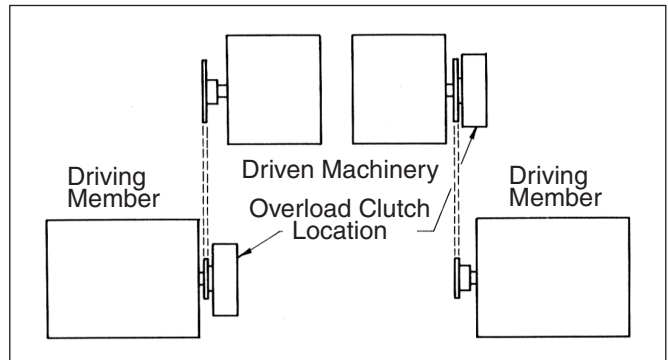
**FIGURE 1
DIRECT DRIVE PREFERRED**



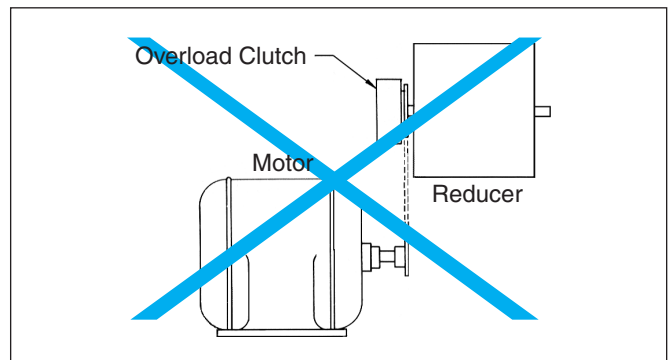
**FIGURE 2
DIRECT DRIVE NOT PREFERRED**



**FIGURE 3
INDIRECT DRIVE PREFERRED**



**FIGURE 4
INDIRECT DRIVE NOT PREFERRED**



ENGINEERING INFORMATION

APPLICATION CLASSIFICATION FOR VARIOUS LOADS

Type of Machine To Be Driven	Chart I For All Drives		
	Service Factor Loading		
	Not More Than 15 Mins. in 2 Hrs.	Not More Than 10 Hrs. per Day	More Than 10 Hrs. Per Day
AGITATORS			
Pure Liquid	0.80	1.00	1.25
Semi-Liquids, Variable Density	1.00	1.25	1.50
BLOWERS			
Centrifugal and Vane	0.80	1.00	1.25
Lobe	1.00	1.25	1.50
BREWING AND DISTILLING			
Bottling Machinery	0.80	1.00	1.25
Brew Kettles—Continuous Duty	—	—	1.25
Cookers – Continuous Duty	—	—	1.25
Mash Tubs – Continuous Duty	—	—	1.25
Scale Hopper – Frequent Starts	—	1.25	1.50
CAN FILLING MACHINES	—	1.00	—
CANE KNIVES	—	1.50	—
CAR DUMPERS	—	1.75	—
CAR PULLERS	—	1.25	—
CLARIFIERS	—	1.00	1.25
CLASSIFIERS	—	1.25	1.50
CLAY WORKING MACHINERY			
Brick Press & Briquette Machine	—	1.75	2.00
Extruders and Mixers	1.00	1.25	1.50
COMPRESSORS			
Centrifugal	—	1.00	1.25
Lobe – Reciprocating, Multi-Cycle	—	1.25	1.50
Reciprocating – Single Cycle	—	1.75	2.00
CONVEYORS— UNIFORMLY LOADED & FED			
Apron	—	1.00	1.25
Assembly-Belt – Bucket or Pan	—	1.00	1.25
Chain – Flight	—	1.00	1.25
Oven – Live Roll – Screw	—	1.00	1.25
CONVEYORS—HEAVY DUTY NOT UNIFORMLY FED			
Apron	—	1.25	1.50
Assembly-Belt – Bucket or Pan	—	1.25	1.50
Chain – Flight	—	1.25	1.50
Live Roll	—	—	—
Oven – Screw	—	1.25	1.50
Reciprocating – Shaker	—	1.75	2.00
CRANES AND HOISTS			
Main Hoists			
Bridge and Trolley Drive	*	1.00	1.25
CRUSHERS			
Ore, Stone	—	1.75	2.00
Sugar	—	1.50	1.50

Type of Machine To Be Driven	Chart I For All Drives		
	Service Factor Loading		
	Not More Than 15 Mins. in 2 Hrs.	Not More Than 10 Hrs. per Day	More Than 10 Hrs. Per Day
ELEVATORS			
Bucket – Uniform Load	—	1.00	1.25
Bucket – Heavy Load	—	1.25	1.50
Centrifugal Discharge	—	1.25	1.50
Freight	—	1.25	1.50
Gravity Discharge	—	1.00	1.25
FANS			
Centrifugal – Light (Small Diam.)	—	1.00	1.25
Large Industrial	—	1.25	1.50
FEEDERS			
Apron – Belt – Screw	—	1.25	1.50
Disc	—	1.00	1.25
Reciprocating	—	1.75	2.00
FOOD INDUSTRY			
Beet Slicer	—	1.25	1.50
Cereal Cooker	—	1.00	1.25
Dough Mixer – Meat Grinder	—	1.25	1.50
GENERATORS (NOT WELDING)	—	1.00	1.25
HAMMER MILLS	—	1.75	2.00
HOISTS			
Heavy Duty	—	1.75	2.00
Medium Duty and Skip Type	—	1.25	1.50
LAUNDRY TUMBLERS	—	1.25	1.50
LINE SHAFTS			
Uniform Load	—	1.00	1.25
Heavy Load	—	1.25	1.50
MACHINE TOOLS			
Auxiliary Drive	—	1.00	1.25
Main Drive – Uniform Load	—	1.25	1.50
Main Drive – Heavy Duty	—	1.75	2.00
METAL MILLS			
Draw Bench Carriers & Main Drive	—	1.25	1.50
SLITTERS	—	1.25	1.50
TABLE CONVEYORS — NON REVERSING			
Group Drives	—	1.25	1.50
Individual Drives	—	1.75	2.00
Wiring Drawing, Flattening or Winding	—	1.25	1.50
MILLS ROTARY TYPE BALL AND ROD			
Spur Ring Gear and Direct Connected	—	—	2.00
Cement Kilns, Pebble	—	—	1.50
Dryers and Coolers	—	—	1.50
Plain and Wedge Bar	—	—	1.50
Tumbling Barrels	—	—	2.00

ENGINEERING INFORMATION

APPLICATION CLASSIFICATION FOR VARIOUS LOADS (Continued)

Type of Machine To Be Driven	Chart I For All Drives		
	Service Factor Loading		
	Not More Than 15 Mins. in 2 Hrs.	Not More Than 10 Hrs. per Day	More Than 10 Hrs. Per Day
MIXERS			
Concrete – Continuous	—	1.25	1.50
Concrete – Intermittent	—	1.25	1.50
Constant Density	—	1.00	1.25
Semi-Liquid	—	1.25	1.50
OIL INDUSTRY			
Oil Well Pumping	—	—	*
Chillers, Paraffin Filter Press	—	1.25	1.50
Rotary Kilns	—	1.25	1.50
PAPER MILLS			
Agitator (Mixer)	—	1.25	1.50
Agitator – Pure Liquids	—	1.00	1.25
Barking Drums – Mechanical			
Barkers	—	1.75	2.00
Bleacher	—	1.00	1.25
Beater	—	1.25	1.50
Calender Heavy Duty	—	—	2.00
Calender Anti-Friction Brgs.	—	1.00	1.25
Cylinders	—	1.25	1.50
Chipper	—	—	2.00
Chip Feeder	—	1.25	1.50
Coating Rolls – Couch Rolls	—	1.00	1.25
Conveyors – Chips – Bark – Chemical	—	1.00	1.25
Conveyors – Log and Slab	—	—	2.00
Cutter	—	—	2.00
Cylinder Molds, Dryers (Anti-Friction Brg.)	—	—	1.25
Felt Stretcher	—	1.25	1.50
Screens – Chip and Rotary	—	1.25	1.50
Thickener (AC)	—	1.25	1.50
Washer (AC)	—	1.25	1.50
Winder – Surface Type	—	—	1.25
PLASTICS INDUSTRY			
Intensive Internal Mixers			
Batch Type	—	—	1.75
Continuous Type	—	—	1.50
Batch Drop Mill – 2 Rolls	—	—	1.25
Compounding Mills	—	—	1.25
Calenders	—	—	1.50
Extruder – Variable Speed	—	—	1.50
Extruder – Fixed Speed	—	—	1.75
PULLERS			
Barge Haul	—	—	2.00

Type of Machine To Be Driven	Chart I For All Drives		
	Service Factor Loading		
	Not More Than 15 Mins. in 2 Hrs.	Not More Than 10 Hrs. per Day	More Than 10 Hrs. Per Day
PUMPS			
Centrifugal	—	—	1.25
Proportioning	—	—	1.50
Reciprocating			
Single Acting, 3 or more Cycles	—	1.25	1.50
Double Acting, 2 or more Cycles	—	1.25	1.50
Rotary – Gear or Lube	—	1.00	1.25
RUBBER INDUSTRY			
Batch Mixers	—	—	1.75
Continuous Mixers	—	—	1.50
Calenders	—	—	1.50
Extruders – Continuous	—	—	1.50
Extruders – Intermittent	—	—	1.75
Tire Building Machines	—	—	—
Tire & Tube Press Openers	—	—	—
SEWAGE DISPOSAL EQUIPMENT			
Bar Screens	—	1.00	1.25
Chemical Feeders	—	1.00	1.25
Collectors	—	1.00	1.25
Dewatering Screws	—	1.25	1.50
Scum Breakers	—	1.25	1.50
Slow or Rapid Mixers	—	1.25	1.50
Thickeners	—	1.25	1.50
Vacuum Filters	—	1.25	1.50
SCREENS			
Air Washing	—	1.00	1.25
Rotary – Stone or Gravel	—	1.25	1.50
Traveling Water Intake	—	1.00	1.25
SKIP HOISTS	—	—	—
SLAB PUSHERS	—	1.25	1.50
STOKERS	—	—	1.25
TEXTILE INDUSTRY			
Batchers or Calenders	—	1.25	1.50
Cards	—	1.25	1.50
Card Machines	—	1.75	2.00
Dry Cans and Dryers	—	1.25	1.50
Dyeing Machines	—	1.25	1.50
Looms	—	1.25	1.50
Mangles, Nappers and Pads	—	1.25	1.50
Soapers, Tenner Frames	—	1.25	1.50
Spinners, Washers, Winders	—	1.25	1.50
TUMBLING BARRELS	1.50	1.75	2.00
WINDLASS	—	1.25	1.50

This list is not all-inclusive and each application should be checked to determine if any unusual operating conditions will be encountered.

APPLICATION FORMULAS

TO OBTAIN	HAVING	FORMULA
Velocity (V) Feet Per Minute	Pitch Diameter (D) of Gear or Sprocket - Inches and Revolutions Per Minute (RPM)	$V = .2618 \times D \times \text{RPM}$
Revolutions Per Minute (RPM)	Velocity (V) Feet Per Minute and Pitch Diameter (D) of Gear or Sprocket - Inches	$\text{RPM} = \frac{V}{.2618 \times D}$
Pitch Diameter (D) of Gear or Sprocket	Velocity (V) Feet Per Minute and Revolutions Per Minute (RPM)	$D = \frac{V}{.2618 \times \text{RPM}}$
Torque (T) In. Lbs.	Force (W) Lbs. and Radius (R) Inches	$T = W \times R$
Horsepower (HP)	Force (W) Lbs. and Velocity (V) Feet Per Minute	$\text{HP} = \frac{W \times V}{33000}$
Horsepower (HP)	Torque (T) In. Lbs. and Revolutions Per Minute (RPM)	$\text{HP} = \frac{T \times \text{RPM}}{63025}$
Torque (T)	Horsepower (HP) and Revolutions Per Minute (RPM)	$T = \frac{63025 \times \text{HP}}{\text{RPM}}$
Force (W) Lbs.	Horsepower (HP) and Velocity (V) Feet Per Minute	$W = \frac{33000 \times \text{HP}}{V}$
Revolutions Per Minute (RPM)	Horsepower (HP) and Torque (T) In. Lbs.	$\text{RPM} = \frac{63025 \times \text{HP}}{T}$

HORSEPOWER AND TORQUE

POWER is the rate of doing work.

WORK is the exerting of a **FORCE** through a **DISTANCE**. **ONE FOOT POUND** is a unit of **WORK**. It is the **WORK** done in exerting a **FORCE OF ONE POUND** through a **DISTANCE OF ONE FOOT**.

THE AMOUNT OF WORK done (Foot Pounds) is the **FORCE** (Pounds) exerted multiplied by the **DISTANCE** (Feet) through which the **FORCE** acts.

THE AMOUNT OF POWER used (Foot Pounds per Minute) is the **WORK** (Foot Pounds) done divided by the **TIME** (Minutes) required.

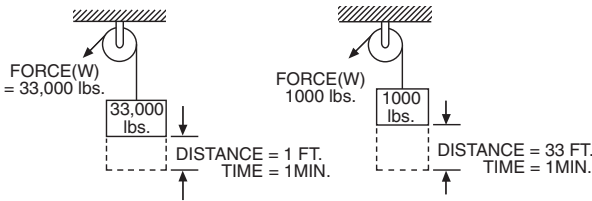
$$\text{POWER (Foot Pounds per Minute)} = \frac{\text{WORK (Ft. Lbs.)}}{\text{TIME (Minutes)}}$$

POWER is usually expressed in terms of **HORSEPOWER**.

HORSEPOWER is **POWER** (Foot Pounds per Minute) divided by 33,000.

$$\begin{aligned} \text{HORSEPOWER (HP)} &= \frac{\text{POWER (Ft. Lbs. per Minute)}}{33,000} \\ &= \frac{\text{WORK (Ft. Pounds)}}{33,000 \times \text{TIME (Min.)}} \\ &= \frac{\text{FORCE (Lbs.)} \times \text{DISTANCE (Feet)}}{33,000 \times \text{TIME (Min.)}} \end{aligned}$$

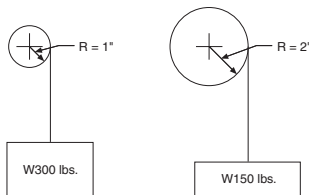
ILLUSTRATION OF HORSEPOWER



$$\text{HP} = \frac{33,000 \times 1}{33,000 \times 1} = 1 \text{ HP}$$

$$\text{HP} = \frac{1000 \times 33}{33,000 \times 1} = 1 \text{ HP}$$

TORQUE (T) is the product of a **FORCE (W)** in pounds, times a **RADIUS (R)** in inches from the center of shaft (Lever Arm) and is expressed in Inch Pounds.



$$\begin{aligned} T &= WR \\ &= 300 \times 1 = 300 \text{ In. Lbs.} \end{aligned}$$

$$\begin{aligned} T &= WR \\ &= 150 \times 2 = 300 \text{ In. Lbs.} \end{aligned}$$

If the shaft is revolved, the **FORCE (W)** is moved through a distance, and **WORK** is done.

$$\text{WORK (Ft. Lbs.)} = W \times \frac{2\pi R}{12} \times \text{No. of Rev. of shaft}$$

When **WORK** is done in a specified **TIME**, **POWER** is used.

$$\text{POWER (Ft. Pounds per Minute)} = W \times \frac{2\pi R}{12} \times \text{RPM}$$

Since (1) **HORSEPOWER** = 33,000 Ft. Pounds per Minute

$$\text{Horsepower (HP)} = W \times \frac{2\pi R}{12} \times \frac{\text{RPM}}{33,000} = \frac{W \times R \times \text{RPM}}{63,025}$$

but **TORQUE** (Inch Pounds) = **FORCE (W)** x **RADIUS (R)**

$$\text{Therefore HORSEPOWER (HP)} = \frac{\text{TORQUE (T)} \times \text{RPM}}{63,025}$$

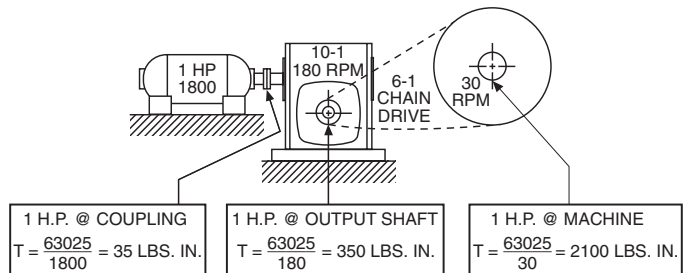
Where total reductions are small, 50 to 1 or less, HP figures are commonly used. Higher reductions require that **TORQUE** figures be used to select drive components, because with large reductions, a small motor can produce extremely high **TORQUE** at the final low speed. For example, 1/12 HP reduced to 1 RPM using the formula below and neglecting friction:

$$\text{HP} = \frac{\text{TORQUE} \times \text{RPM}}{63,025} \text{ or } \text{TORQUE} = \frac{63,025 \times \text{HP}}{\text{RPM}}$$

$$\text{TORQUE} = \frac{63,025 \times 1/12}{1} = 5,252 \text{ In. Lbs.}$$

Therefore, motors for use with large reductions should be carefully selected. Even a small motor, if stalled, can produce enough **Torque** to ruin the drive, unless it is protected by an overload clutch.

Neglecting frictional losses, this sketch illustrates the manner in which **Torque** increases as speed decreases.



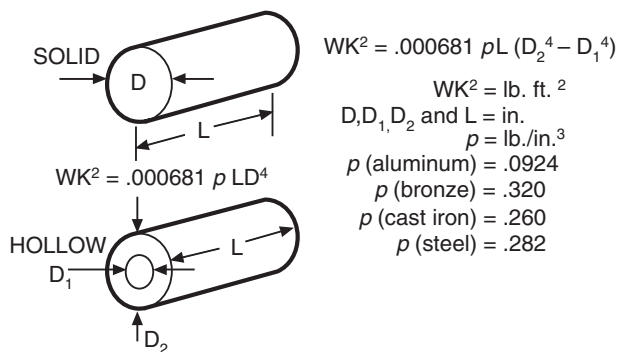
HORSEPOWER AND TORQUE (Continued)

INERTIA (WK²)

The factor WK² is the weight (lbs) of an object multiplied by the square of the radius of gyration (K). The unit measurement of the radius of gyration is expressed in feet.

For solid or hollow cylinders, inertia may be calculated by the equations shown below.

The inertia of solid steel shafting per inch of shaft length is given in the table. To calculate for hollow shafts, take the difference between the inertia values for the O.D. and I.D. as the value per inch. For shafts of materials other than steel, multiply the value for steel by the appropriate material factor.



WK² of Rotating Elements – In practical mechanical systems, all the rotating parts do not operate at the same speed. The WK² of all moving parts operating at each speed must be reduced to an equivalent WK² at the motor shaft, so that they can all be added together and treated as a unit, as follows:

$$\text{Equivalent } WK^2 = WK^2 \left[\frac{N}{N_M} \right]^2$$

Where,
 WK² = Inertia of the moving part
 N = Speed of the moving part (RPM)
 N_M = Speed of the driving motor (RPM)

When using speed reducers, and the machine inertia is reflected back to the motor shaft, the equivalent inertia is equal to the machine inertia divided by the square of the drive reduction ratio.

$$\text{Equivalent } WK^2 = \frac{WK^2}{(DR)^2}$$

Where, DR = drive reduction ratio = $\frac{N_M}{N}$

INERTIA OF STEEL SHAFTING (PER INCH OF LENGTH)

Diam. (In.)	WK ² (Lb. Ft. ²)	Diam. (In.)	WK ² (Lb. Ft. ²)
3/4	0.00006	10-1/2	2.35
1	0.0002	10-3/4	2.58
1-1/4	0.0005	11	2.83
1-1/2	0.001	11-1/4	3.09
1-3/4	0.002	11-1/2	3.38
2	0.003	11-3/4	3.68
2-1/4	0.005	12	4.00
2-1/2	0.008	12-1/4	4.35
2-3/4	0.011	12-1/2	4.72
3	0.016	12-3/4	5.11
3-1/2	0.029	13	5.58
3-3/4	0.038	13-1/4	5.96
4	0.049	13-1/2	6.42
4-1/4	0.063	13-3/4	6.91
4-1/2	0.079	14	7.42
5	0.120	14-1/4	7.97
5-1/2	0.177	14-1/2	8.54
6	0.250	14-3/4	9.15
6-1/4	0.296	15	9.75
6-1/2	0.345	16	12.59
6-3/4	0.402	17	16.04
7	0.464	18	20.16
7-1/4	0.535	19	25.03
7-1/2	0.611	20	30.72
7-3/4	0.699	21	37.35
8	0.791	22	44.99
8-1/4	0.895	23	53.74
8-1/2	1.000	24	63.71
8-3/4	1.130	25	75.02
9	1.270	26	87.76
9-1/4	1.410	27	102.06
9-1/2	1.550	28	118.04
9-3/4	1.750	29	135.83
10	1.930	30	155.55
10-1/4	2.130	—	—

MATERIAL FACTORS

Shaft Material	Factor
Rubber	.121
Nylon	.181
Aluminum	.348
Bronze	1.135
Cast Iron	.922

Formulas to Approximate WK²

For a solid cylinder or disc = $W \times \frac{r^2}{2}$
 where r = radius in feet and W is weight in pounds.

For a hollow cylinder: $WK^2 \times \frac{W r_1^2 + r_2^2}{2}$

where r₁ is $\frac{ID}{2}$ and r₂ is $\frac{OD}{2}$.

ENGINEERING INFORMATION

METRIC CONVERSION CHART

MULTIPLY	BY	TO OBTAIN	MULTIPLY	BY	TO OBTAIN
LENGTH			TORQUE		
Millimeter	.03937	Inch	Newton-meter	8.84	Lb. In.
Centimeter	.3937	Inch	Lb. In.	.113	Newton-Meter
Meter	39.37	Inch	Lb. Ft.	1.3558	Newton-Meter
Inch	2.54	Centimeter	Lb. Ft.	12	Lb. In.
Feet	30.48	Centimeter	MOMENT OF INERTIA		
Feet	.3048	Meter	Newton-Meters ²	2.42	Lb. Ft. ²
WEIGHT			Oz.-In. ²	.000434	Lb. Ft. ²
Gram	.03527	Ounce	Lb.-In. ²	.00694	Lb. Ft. ²
Kilogram	35.27	Ounce	Slug-Ft. ²	32.17	Lb. Ft. ²
Kilogram	2.205	Pounds	Oz.-In.-Sec. ²	.1675	Lb. Ft. ²
Ounce	28.35	Grams	Lb.-In.-Sec. ²	2.68	Lb. Ft. ²
Pound	453.6	Grams	POWER		
ROTATION			Joule/sec	.001341	Horsepower
RPM	.1047	Rad./Sec.	Kilocalorie/hour	3.967	BTW/Hour
RPM	6.00	Degrees/Sec.	Horsepower	.33000	Lb. Ft./Min.
Degrees/Sec.	.1667	RPM	Horsepower	746	Watts
Rad./Sec	9.549	RPM	BTU/hour	.2521	Kilocalorie/Hour
VELOCITY			Watts	.00134	Horsepower
Centimeter/second	.3937	Inches/Second	AREA		
Centimeter/second	1.969	Feet/Minute	Millimeters ²	.00155	Inches ²
Meter/second	3.281	Feet/Second	Centimeters ²	.155	Inches ²
Meter/second	196.9	Feet/Minute	Meters ²	10.76	Feet ²
Meter/second	2.237	Miles per hour	Inches ²	645.16	Millimeters ²
Inch/second	25.4	Millimeters/Second	Inches ²	6.452	Centimeters ²
Inch/second	2.54	Centimeters/Second	Feet ²	929.03	Centimeters ²
Foot/second	.3048	Meters/Second	Feet ²	.0929	Meters ²
Foot/minute	.00508	Meters/Second	DENSITY		
VOLUME			Ig/cm ³	.03613	Lb/In ³
Centimeter ³	.0610	Inches ³	Ig/cm ³	62.43	Lb/Ft ³
Centimeter ³	.034	Fluid Ounce	lb/in ³	27.68	Gr/Cm ³
Liter	61.02	Inches ³	lb/ft ³	.016	G/Cm ³
Liter	.0353	Feet ³	lb/ft ³	16.02	Kg/M ³
Liter	.264	U.S. Gallon			
Inch ³	16.39	Centimeter ³			
Feet ³	28.32	Liter			
Gallon	3.785	Liter			

TERMS AND CONDITIONS

ALL QUOTATIONS AND SALES BY BOSTON GEAR, THE CONTRACTING PARTY HERETO, HEREAFTER CALLED "COMPANY" ARE MADE ON THE FOLLOWING TERMS AND CONDITIONS.

1. QUOTATIONS and THEIR ACCEPTANCE

Unless otherwise specified, quotations on stock products are for immediate acceptance, subject to prior sales. Quotations on special products are made subject to acceptance within thirty (30) days from date thereof, but in making such quotations, the Company reserves the right to change or cancel them at any time prior to the receipt of the customers' written acceptance. All quotations for special products are based upon supplying up to plus or minus 5% of quantity ordered unless otherwise stated in the quotation. All quotations are made F.O.B. shipping point.

2. PRICES

Prices are in accordance with current Company price lists, are based on quantity specified and are subject to minimum order requirements of the Company. In the event the Company consents to the cancellation or suspension of orders, it shall be entitled to charge for work done and material ordered or used up to the time of giving its written consent to such cancellation or suspension. When work is to be done on material furnished by the customer, prices are based on the quantity specified being delivered by the customer at one time within a reasonable time after acceptance of order. Quotations will be made on special products of all types or on cutting only. Prices, specifications, and terms and conditions, as well as all statements appearing in the Company's catalogs and advertisements, and made elsewhere by the Company are subject to change without notice. Changes by the customer in specifications or delivery requirements will be subject to change in price. Whenever the net price of an order amounts to less than \$25.00, a minimum charge of \$25.00 will be made.

3. CREDIT TERMS

To those customer and prospective customers whose credit is satisfactory to the Company, terms are net thirty (30) days, from date of invoice, with the option of paying semi-monthly. The Company may at any time when, in its opinion, the financial condition of the customer or prospective customer warrants it, either alter or suspend credit, or discontinue deliveries, and render a charge covering the value of any partially finished special products which are then being manufactured for the customer. In those instances where credit is not established, and in cases where satisfactory references are not given, the terms are cash with order. For special products in those instances where credit is not established to the satisfaction of the Company, a deposit of at least 50% of total value of the order is required. Remittances should be made by check or money order, payable to the Boston Gear, Quincy, Massachusetts 02171, U.S.A. Delays in transportation shall not exceed the terms of payment.

4. MATERIAL FURNISHED by THE CUSTOMER

Unless otherwise specified, quotations are based on material furnished by the customer being of ordinary hardness, normal allowance for finish, uniform specification, and machine work being of ordinary commercial accuracy. If material furnished by the customer involves the Company in expense not contemplated by the contract, the customer will be charged for all such additional expense. If serious defects are found in the material furnished by the customer, the customer will be charged for the actual work done. The Company assumes no responsibility for, and will not be liable for loss of or damage to samples, blueprints, diagrams, and other material of any nature submitted or furnished by the customer or prospective

customer, provided the Company has exercised reasonable care in the handling of the same. The Company does not assume transportation and insurance costs on any of the foregoing items. In all cases where the customer or prospective customer makes no statement in writing, concerning the disposition of any of the foregoing material when submitted, the Company reserves the right to dispose of such material according to its best judgment.

5. DIMENSIONS

When dimensions of rims, bores, and hubs are not clearly specified, quotations are based on ordinary dimensions. Before the customer's blanks are accepted by the Company for cutting, the diameter, holes, rims, and ends of holes must be finished; for bevel gears, hubs, must be of uniform length. There should also be an allowance of extra blanks to cover possible spoilage. Unless otherwise specified, dimensions are in inches.

6. SAMPLES

In no case are samples furnished free. If agreed to by the Company, a few products in advance of a regular quantity order will be furnished but only at an agreed upon price over the regular quantity price.

7. TAXES

If any tax is at any time levied or imposed by the federal or any state or local government, or any other taxing authority, upon the products covered hereby, or in respect of the production, processing, manufacture, storage, sale, use, or consumption thereof, or, in the case of goods delivered at the Company's expense, upon the transportation thereof, including freight charges thereon, the amount of such tax shall be added to the purchase price above specified and shall be borne by the customer. The Company will accept a valid exemption certificate from the customer if applicable; however, if any exemption certificate previously accepted it not recognized by the taxing authority involved and the Company is required to pay the tax covered by such exemption certificate, the customer shall be required to promptly reimburse the Company for the taxes so paid.

8. SHIPMENTS

All shipments are made F.O.B. shipping point (subject to freight allowance under conditions stated in separate price schedules). When ordering, the customer's desired method of shipment must be clearly stated. Where instructions for shipping do not appear on the order, shipment will be made according to the Company's best judgment. Full risk of loss (including transportation delays and losses) shall pass the customer upon delivery of the products to F.O.B. point. Unless otherwise instructed, all Parcel Post shipments are insured at the customers' expense. Parcel Post shipments without insurance are at the customer's risk. Deliveries by Messenger Service to a terminal are made at the customer's risk and expense. Partial shipments shall be permitted and the Company may invoice each shipment separately.

9. REFUSAL of SHIPMENT

In case of the refusal or inability of the customer to accept any shipment in accordance with the terms of the order, the customer shall be liable for freight, express, storage, extra cost of handling and all other expenses incurred by the Company as a result of such refusal or inability.

TERMS AND CONDITIONS

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10. DELAY or NONPERFORMANCE

The Company shall not be liable for any delay or loss of any nature or failure in performance due to or caused by fire, flood, strike, or other differences with workmen, accidents, labor or material or transportation shortages, war (declared or undeclared), insurrection, riot, or by any governmental orders or regulations, legal interferences or prohibitions, defaults on the part of suppliers or other causes beyond the Company's reasonable control.

11. CLAIMS and REJECTED MATERIAL

Any products which have been altered or damaged are not returnable except with the Company's written consent. To reject products on inspection as defective, customer must notify the Company in writing within ten (10) days from receipt of the products. Before allowing or rejecting claim, the Company shall then have the option of reinspection at the customer's plant or its own. Defects that do not impair service shall not be a cause for rejection. The Company shall have the right to replace within a reasonable time any product or products which in its opinion do not conform to the order. No claim will be allowed for any products damaged by the customer or damaged in transit. Expenses incurred in connection with claims for which the Company is not liable, will be charged to the customer. The Company will not be responsible for any work done to correct errors unless such work is authorized by the written consent of the Company. The Company assumes no liability for any claim for infringement of any foreign or domestic patent.

12. LIMITED WARRANTY

The Company warrants that products manufactured or sold by it shall be free from defects in material and workmanship. Any products which shall within two (2) years of delivery, be proved to the Company's satisfaction to have been defective at the time of delivery in these respects will be replaced or repaired by the Company at its option. Freight is the responsibility of the customer. The Company's liability under this limited warranty is limited to such replacement or repair and it shall not be held liable in any form of action for direct or consequential damages to property or person. THE FOREGOING LIMITED WARRANTY IS EXPRESSLY MADE IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY AND INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS.

No employee, agent, distributor, or other person is authorized to give additional warranties on behalf of Boston Gear, nor to assume for Boston Gear any other liability in connection with any of its products, except an officer of Boston Gear by a signed writing.

13. WAIVER of BREACH

No waiver by the Company of any breach of these provisions shall constitute a waiver of any other breach.

14. CONSEQUENTIAL DAMAGES

The Company shall not be liable to the customer or others claiming through the customer for special or consequential charges for any reason whatsoever.

15. LAWS

To the best of the Company's knowledge and belief it is in compliance with all local, state and federal laws. All orders are subject to the condition that the Company's obligation under such local, state and federal laws and Executive Orders, Rules and Regulations issued thereunder, whether now in force or hereafter made effective, shall be no greater as a result of this agreement and no greater than required by such laws and the Company expressly disclaims assumptions of any of the customer's obligations under such laws.

16. GENERAL

Any terms and conditions of a customer's order which are inconsistent with or additional to the terms and conditions hereof shall not be binding on the Company and shall not be considered applicable to any sale or shipment of the Company's products. All such terms and conditions are hereby expressly rejected. No waiver, alteration or modification of any of the Company's terms and conditions shall be binding on the Company unless made in writing and agreed to by a duly authorized official of the Company.

17. PRINTERS, STENOGRAPHIC, and CLERICAL ERRORS

The Company is not responsible for printers' errors made in any of its publications and other forms of printed matter, or for any stenographic and clerical errors. All such errors are subject to correction.

18. REDUCER EXPRESS

- A) Quantities of reducers covered as part of this program are a maximum of:
 - 6 pieces for any 710-726 or 221-231 and 832-843
 - 2 pieces for any 730-760 or 239-247 and 862-873
- B) Bost-Kleen, Stainless Bost-Kleen, and modified reducers are not included as part of this program.
- C) Boston Gear will utilize any major courier to handle air shipments.
- D) Consult Boston Gear for details.

19. GUARANTEED SAME DAY SHIPMENT

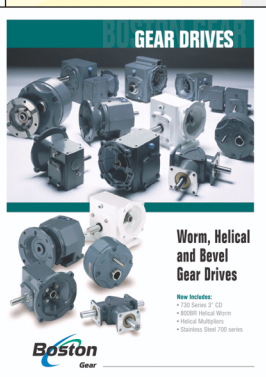
- Products must be available from stock.
- Does not apply to WOG or scheduled release shipments.
- Same day shipment available Monday through Friday excluding U.S. holidays. For emergency service, please call 859-525-8021.
- In the event your freight carrier is unable to meet your requirements, we reserve the right to substitute a carrier of equivalent quality.
- If a shipment is missed and Boston Gear pays the freight we'll pay for the freight charges as they were originally specified on the order.
- Brokerage and export fees still apply to shipments outside the U.S.
- For those distributors in Eastern or Central time zones, after 5 p.m. local time, please call 562-802-3834 or fax 562-802-0153 to place your order.
- Video Terminal Orders entered up until 8 p.m. ET will be shipped the same day.

Other products available from Boston Gear



Electrical Products

From fractional horsepower AC and DC motor controllers to a complete offering of complementary motors -including Ratiotrol®, the industry's first stock single phase DC drive, Boston Gear is prepared to meet the broad spectrum of your adjustable speed needs. And with a complete line of complementary clutches, brakes, and other accessories available from Boston Gear, we are prepared to serve your motion control product needs.



Enclosed Gear Drives

Boston Gear's comprehensive line of enclosed gear drives, including worm, in-line and parallel-shaft helical, miter, and bevel, provides you with the product variety you need to get the job done. Factor in our Guaranteed Same Day Shipment Program, which ensures rapid delivery, or our innovative Reducer Express™, which ensures overnight delivery, and you'll see why Boston Gear's speed reducers are preferred by manufacturers worldwide. In fact, every time you specify a Boston Gear product, you incorporate quality, responsiveness, and Boston Gear's 123-year reputation into your design.



Centric Clutches

Boston Gear offers the industry's most diversified line of clutches, with mechanical and pneumatic clutches to suit most any application. Our complete selection of torque overload devices, along with our Model H clutch and our entire line of centrifugal clutches, comes with Boston Gear's 120 years of mechanical power transmission expertise - so ask for Centric™ clutches by name. Because we apply the same quality standards to all of our products, you'll find our electrical and clutches offer exceptional performance, as well.



Bearing Products

When you want the freedom to select from the widest range of the highest quality bearings, come to the power transmission specialists at Boston Gear, because we offer the most comprehensive selection of bearing products from one single source in the power transmission industry. Everything from plain sleeve bearings, ball bearings, rod ends, and spherical bearings to linear bearings, pillow blocks and flanged units are in stock.



Fluid Power Products

Since many of today's factories require a combination of mechanical power transmission and compressed air systems for their manufacturing processes, Boston Gear offers a wide range of pneumatic products. From the simple blow gun or recoiling hose used to remove metal chips from a machining operation to the more complex cylinders, control valves, and FRL's used to move product through the assembly process automatically, Boston Gear has what you need.

COLFAX PT GROUP

Colfax Power Transmission Group

Colfax Power Transmission Group
Quincy, MA 02171
617-328-3300

Boston Gear

Boston Gear
*Enclosed Gear Drives,
Open Gearing, Overload
Clutches, AC and DC Motors
and Controls, Bearings,
Fluid Power Products*
Quincy, MA 02171
617-328-3300

For all Boston Gear product
lines, contact: 888-999-9860
for Customer Service

Warner Electric

Warner Electric
South Beloit, IL 61080
800-234-3369

Warner Electric
Clutches & Brakes
Roscoe, IL 61073

Warner Electric
Precision Electric Coils
Columbia City, IN 46725
260-244-6183

Formsprag Clutch

Formsprag Clutch
*Overrunning Clutches
and Holdbacks*
Warren, MI 48089
586-758-5000

Marland Clutch

Marland Clutch
*Roller Ramp and Sprag Type
Overrunning Clutches and Backstops*
LaGrange, IL 60525
708-352-3330

Wichita Clutch

Wichita Clutch
Pneumatic Clutches and Brakes
Wichita Falls, TX 76302
940-723-3400

For application assistance:
1-940-767-2000

Industrial Clutch

Industrial Clutch
*Dry and Oil Immersed Clutches
and Brakes; Hydraulic and
Pneumatic Controls*
Waukesha, WI 53187
262-547-3357

Ameridrives Couplings

Ameridrives Couplings
*Gear Couplings, Mill Spindles,
Universal Joints*
Erie, PA 16512
814-480-5000

Nuttall Gear and Delroyd Worm Gear

Nuttall Gear and
Delroyd Worm Gear
*Worm and Worm Gear Sets,
Parallel Shaft and In-Line
Helical Speed Reducers*
Niagara Falls, NY 14302
716-731-5180

Fincor Electronics

Fincor Electronics
*AC and DC Adjustable
Speed Drives, Motors,
Controls, and Accessories*
York, PA 17402
717-751-4200

Bay City Forge

Bay City Forge
*Carbon and Alloy Steel
Open-Die Forgings*
Erie, PA 16512
814-456-2088

www.bostongear.com

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Boston Gear

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