Type of Bearings

Bearings can be divided into 4 groups: non-precision, semi-precision, precision and journal bearings.

Non-Precision Bearings
These bearings have hardened steel balls and raceways. They are often referred to as “full complement” meaning they do not have a ball retainer. The outer race is either stamped or machined. Non-precision bearings are used where speeds and loads are moderate.

Semi-Precision Bearings
These bearings have hardened steel balls and raceways along with a ball retainer, or “cage”, to separate the balls. These bearings are suitable for speeds up to 400 RPM.

Precision Bearings
These bearings have hardened and ground balls, raceways and ball retainers. They are normally shielded and sealed. Precision bearings are suitable for speeds above 400 RPM and for heavier loads.

Journal Bearings
These bearings consist of a housing and a bushing. They have no balls or seals. The housing is generally plastic or wood. Journal bearings are used in wash-down or similar conditions.

Bearing Components

Races
Races are the inner and outer surfaces that are in contact with the balls. Non-precision and semi-precision bearings have a machined inner race and a machined or stamped outer race. Both races are hardened steel. Precision bearings have inner and outer races made of higher quality steel which are machined, hardened and ground to a fine finish.

Balls
Balls are the medium between the inner and outer race which allows the outer race to rotate while the inner race is held stationary. Balls in non-precision and semi-precision bearings are hardened steel. Balls in precision bearings are hardened chrome alloy steel.

Ball Retainer
A ball retainer, or “cage”, separates the balls from each other, minimizing noise and contact friction between balls. This enables higher operating speeds.

Shields and Seals
Shields and seals help keep contaminants out of the bearing. A shield is generally made of steel. It “shields” contaminants from falling directly onto the balls. A shield can be used by itself or in conjunction with a seal, in which case, the shield will also protect the seal from damage. Seals are available in teflon, felt, rubber, nylon and mylar. Seals affixed to the outer race also contact the inner race. They create a slight frictional drag, but seal out contaminants while helping to retain grease within the bearing. Standard seals are suitable for temperatures up to 225° F.

Lubrication

Non-precision and semi-precision bearings are available with three lubrication options: oiled, grease-packed or regreasable. Precision bearings are standard with grease.

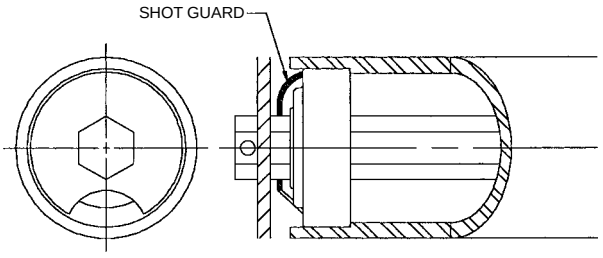
Oiled
These bearings are generally used in gravity applications requiring a low coefficient of friction. The temperature range of standard oil is 0° to 200° F.

Grease Packed
These bearings are generally used in powered applications. The temperature range of standard grease is -10° to +225° F. They are also suitable for higher humidity applications.

Regreasable
These bearings share the same features as grease packed bearings and, in addition, are designed to accept more grease through a grease fitting located on the end of the axle. Regreasable bearings have either a drilled inner race or an extended back closure.

Shot Guards

When excessive dirt and grit exist, such as in a foundry, shot guards may be used to help keep out contaminants. Shot guards slide over the shaft and fit up against the bearing. They are used only on bearings without flanges and where the tube is counter bored so the bearing and shot guard can be recessed slightly inside the tube. Shot guards are made of steel.



Tolerance on Bearing Body Diameter

The tolerance on body diameter dimensions listed in this catalog is generally +/- .006. This is only a guideline. Bearing dimensions should be verified with a micrometer.

Bearing Load Rating and Life

Non-precision, semi-precision and precision bearings are compared on the basis of a given load rating over a specified period of time or number of revolutions. Material type of the races and balls, ground or unground races, RPM, load type and duration, lubrication, temperature and humidity all play a role in the life of a bearing. Non-precision bearings are rated differently

than semi-precision and precision bearings. Journal bearings are rated based on a PV factor which is a rated pressure times velocity, dependent upon material type.

Non-Precision Bearings
Load ratings of non-precision bearings are difficult to predict because of the nature of their design (stamped outer races, carbon steel balls, unground raceways, etc.). They have, however, proven to be successful for use in conveyors where loads and speeds are moderate. They are also an economical alternative to a precision bearing. Most bearing manufacturers use the following CEMA equation to determine a load rating based on a minimum life of 1 million revolutions (Basic Dynamic Load Rating).

$$C = f Z^{2/3} D^{1.8}$$

where:
- C = Basic Dynamic Load Rating
- f = A factor which depends on the geometry of the bearing components, the accuracy to which the bearing parts are made and the material
- Z = The number of balls
- D = The ball diameter in inches

Minimum life refers to the number of hours or revolutions that 90 percent of bearings under the rated load will survive. Load ratings for non-precision bearings listed in this catalog are based on the manufacturer's ratings.

Semi-Precision and Precision Bearings
Load ratings for precision bearings are easier to predict because the bearings are constructed with closer tolerance control, ground races, uniform ball loading and quality bearing steel. Semi-precision bearings do not have ground races or bearing type steel, but do have a ball retainer and are rated like precision bearings. Load ratings for semi-precision and precision bearings listed in this catalog are based on a minimum life of 3 million revolutions. To calculate the minimum life for loads other than the rated load, use the following equation:

$$L_{10} = \left(\frac{C}{P_e} \right)^3 \text{ x 3 million revolutions}$$

where:
- L_{10} = Minimum Life
- C = Rated Capacity
- P_e = Applied Radial Load

Journal Bearings
These bearings are rated on a PV factor where "P" represents the total load over the projected area of the bearing I.D. and "V" represents the surface velocity of the shaft in FPM. This PV factor is a "rule-of-thumb" for limiting the amount of heat that is generated at the bearing surface. It is not an exact value because of variations in the coefficient of friction and the heat dissipation rate. PV factors for several materials and a formula to predict bearing load ratings are as follows:

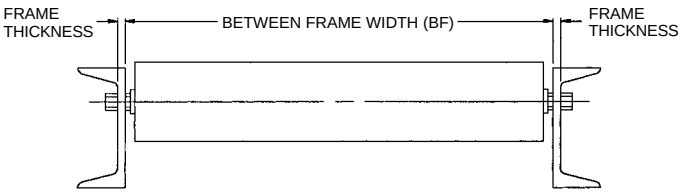
	PV Factor
Delrin ® or Celcon ®	3000
Nylatron ® GS	4000
Teflon filled Acetal	8000
Teflon filled Nylon	10000
Wood (Hardwood)	12000

$$PV = \left(\frac{W}{L \times D} \right) \times V$$

where:
- D = Shaft Diameter
- L = Bearing Length
- V = Shaft Velocity
- W = Applied Radial Load
- PV = PV Factor from above

Roller Description

A roller is an assembly of three major components: axle, tube and bearings. The length of a roller is defined in terms of the "between frame width" or "BF". This BF dimension allows 1/16 in. clearance between the extension on the bearing and the side frame at each end. Frame thickness is also important information to insure proper assembly.



Roller Components

Axle
Most conveyor rollers have hexagonal axles to avoid rotation of the axles in the frames and to prevent the inner race from rotating on the axle. Round axles are also available. Larger sizes are kept from rotating by use of a keeper bar. Bearings used on these larger axles usually have set screws or eccentric locking collars to prevent inner races from rotating on the axle. Hex axles from 1/4 in. through 1 5/8 in. and round axles from 1/4 in. through 3 7/16 in. diameter are available.

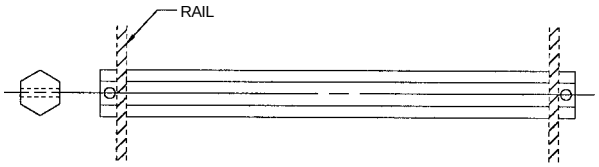
Tube
Tubes are specified by outside diameter (O.D.) and wall thickness. Diameters from 1 in. through 8 in. are available. Wall thicknesses are expressed as either a fractional gage or a decimal dimension.

Bearings
In most cases, each roller illustrated in this catalog will list various bearing options. The selection may include bearings that are plain, sealed or shielded. There may also be non-precision, precision or journal bearings from which to select. Select the bearing best suited for your needs.

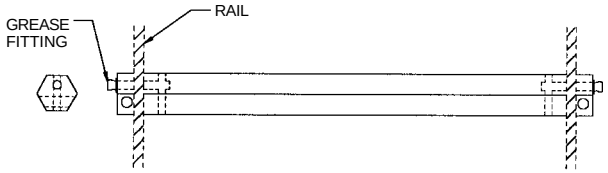
Axle Construction

Pin or Ring Retained Axle

This axle has a hole drilled through each end of the axle to accommodate cotter pins or hog rings. Axles can also be drilled for pressure lubrication of bearings. Pin retained axles are offered in hex sizes of 1/4 in. through 1 1/2 in. and in round sizes of 5/16 in. through 3 7/16 in.



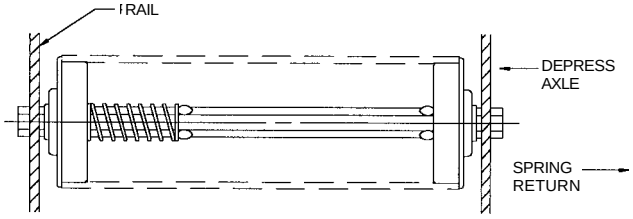
Non-Lubricated



Axle Drilled for Lubrication

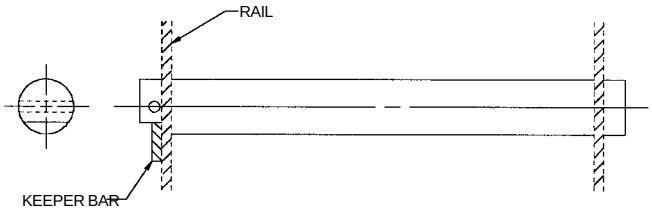
Spring Retained Axle

This axle has “dimples” at both ends. When assembled into a roller, the axle is held in place by dimples between bearings. A spring retained roller is assembled into a frame by first inserting one end of the axle into the frame. The free end of the axle is then depressed and dropped into the other side frame. Removing the roller is equally as simple. Spring retained axles are available in hex sizes of 5/16 in. through 11/16 in. and a round axle size of 1/4 in.



Keeper Bar Retained Axle

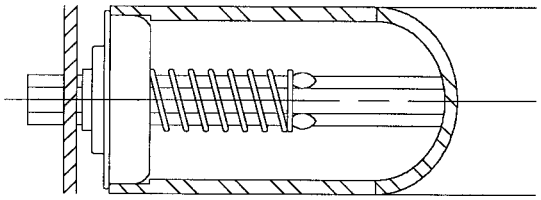
This axle has a hole and machined flat on one end. The keeper bar is welded to the frame and rests against the flat surface of the axle, preventing it from rotating. The hole is for a cotter pin which holds the axle in the frame. Keeper bar retained axles are used only on round shafts 1 in. in diameter and larger.



Roller Construction

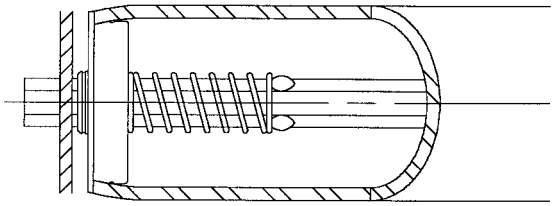
Counter Bored

This type of roller has a tube which is counter bored to the correct inside diameter for the bearing to be press fit into place, or slip fit for large diameter rollers.



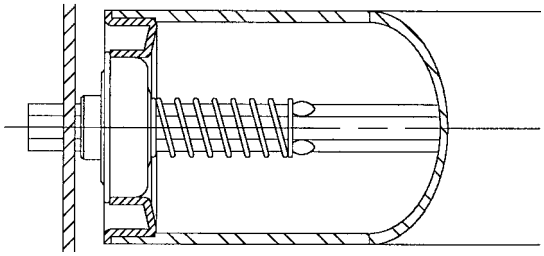
Crimped

This type of roller has a tube which is crimped down over the bearing to hold it in place. Bearings installed in this manner are non-replaceable.



With Adapter

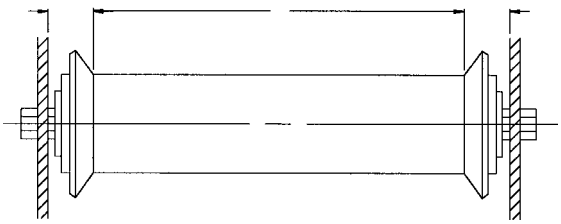
This type of roller uses a combination of a bearing and an adapter. The bearing is first press fit into the adapter and the adapter is then press fit into the tube.



Other Options

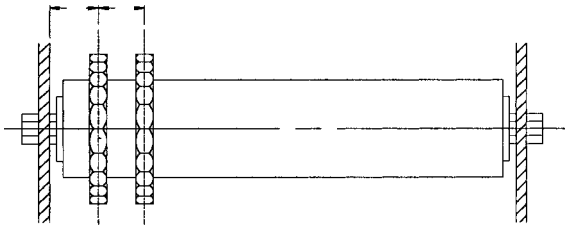
Rollers with Flanges

Flanges can be welded to the tube to guide the product. Flange location and quantity per tube must be specified. For flange selection, see pages 69 - 70.



Rollers with Sprockets

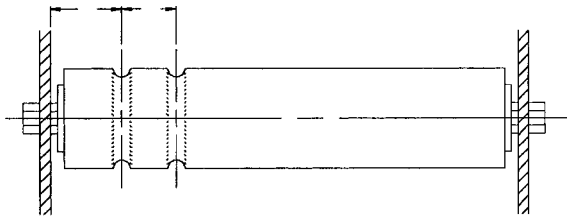
Type A plate sprockets are welded to rollers for use in Chain Driven Live Roller Conveyors. Single or multiple sprockets per roller are available. Location of sprockets, chain size and number of teeth must be specified. Hardened tooth sprockets are also available. Below are the standard sprockets for specified roller diameters. These sprockets may also be purchased individually.



STANDARD SPROCKETS					
Roller Dia.	Sprocket Size	Roller Dia.	Sprocket Size	Roller Dia.	Sprocket Size
1.9 in.	40A18 50A15 60A13	2 9/16 in.	40A22 50A18 60A15 80A13	4"	60A22 80A17 100A14
2 1/2 in.	40A22 50A17 60A15	3 1/2 in.	60A20 80A16 100A13	5"	80A20 100A17

Rollers with Grooves

Grooves can be rolled into the tube to accommodate 3/16 in. dia. urethane drive belts such as those used on Line Shaft Conveyors. Location of grooves must be specified. Standard roller diameters include 1 3/8 in., 1.9 in. and 2 1/2 in. Other sizes are available.



GROOVED ROLLERS		
Roller Size	Hex Size	Page No.
1 3/8 in. O.D. x 18 Ga.	5/16 in. Hex	75
1 3/8 in. O.D. x 16 Ga.	5/16 in. Hex	77
1.9 in. O.D. x 16 Ga.	7/16 in. Hex	85
1.9 in. O.D. x .145 in. Wall	7/16 in. Hex	89
2 1/2 in. O.D. x 11 Ga.	11/16 in. Hex	100

Tapered Rollers

Tapered rollers are available in several sizes. For details, see page 121 - 122.

Rollers with Shot Guards

Shot guards are available on select rollers and help protect the bearing against contamination. For shot guard selection, see page 60.

Rollers that are Hardened

All heavy-walled rollers are available with a hardened tube surface. Case hardened depth and Rockwell hardness must be specified.

Rollers with Special Coverings

Rollers are available with molded-on urethane or with slide-on sleeves. PVC covers are also available. Material type, durometer and thickness must be specified.

Rollers with Lagging

Rollers are available with lagging. Types of lagging available for rollers include:

- Resilient rubber with adhesive back - 2 in. wide available in a 60 ft. roll
- Sand paper with adhesive back - 2 in. wide available in a 60 ft. roll
- Rough top belting (to be glued and riveted) - 1 in. wide or 2 in. wide available in a 50 ft. roll

Roller Capacities

Roller capacity refers to the maximum load a single roller can support. Key factors in establishing a roller's capacity are as follows:

- Bearing capacity
- Bearing offset (dimension from side frame to centerline of balls)
- Axle deflection
- Tube deflection

Capacities in this catalog are based on tube deflection of no more than .21% of BF and axle angular deflection of no more than 1 degree at the bearings. Angular deflection of axle at the bearings is limited to .75 degrees for cylindrical semi-precision and precision bearings.

Roller Selection for a Given Load

Because the conveying surface of products is not perfectly flat, use only 2/3 of the rollers under the product when calculating the required roll capacity.

Common sense tells us that it is not practical to use a 1 3/8 in. diameter roll on 1 1/2 in. centers for a 6000 lb. product (12 in. wide x 120 in. long), so in addition to the rule above, use the following guide lines:

Roll Diameter & Axle	Max. Product Weight
1 in. O.D. - 5/16 in. hex	300 lbs.
1 3/8 in. O.D. - 5/16 in. hex	600 lbs.
1.9 in. O.D. - 7/16 in. hex	1500 lbs.
2 1/2 in. O.D. - 11/16 in. hex	3500 lbs.
3 1/2 in. O.D. - 1 1/16 in. hex	6000 lbs.
3 1/2 in. O.D. - 1 7/16 in. O.D.	10,000 lbs.
4 in. O.D. - 1 7/16 in. O.D.	15,000 lbs.
5 in. O.D. - 1 11/16 in. O.D.	25,000 lbs.

The above guidelines assume "0" shock load and are not applicable for 3 or more lanes.