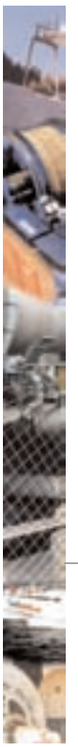
COOPER
SPLIT ROLLER BEARINGS



The World's Number One Split Roller Bearing

Application Identification Guide

Cooper Benefits

Reduce Down Time, (planned or unplanned).

Increase Maintenance Man Hour Productivity.

Keeps Contaminants Out.

Can Increase Application Life.

Promotes Workplace Safety.

Cooper Features

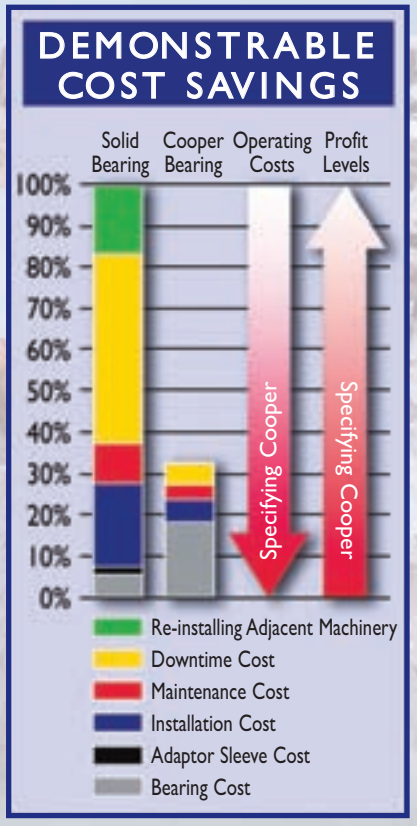
Split to the Shaft Bearing.

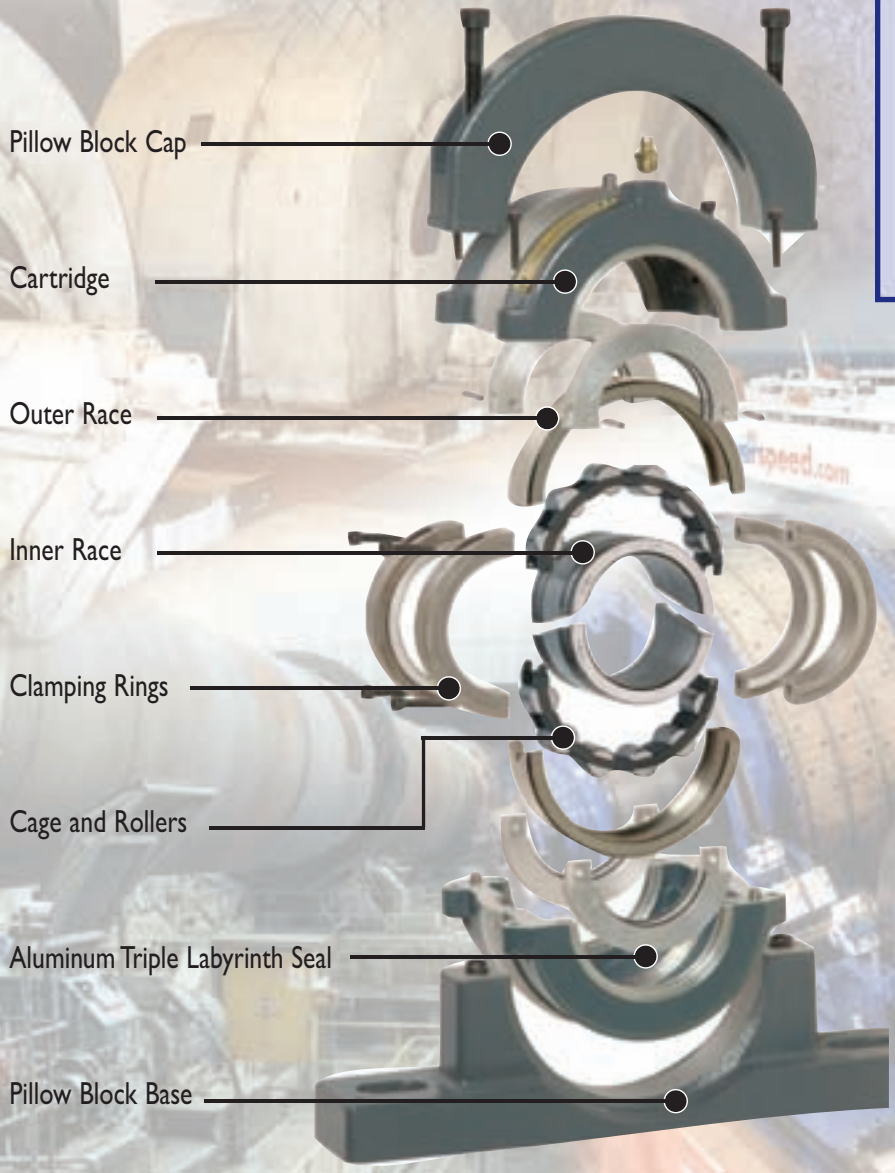
Superior Sealing.

Delivering result in...

Trapped Positions.

Hostile Environments.





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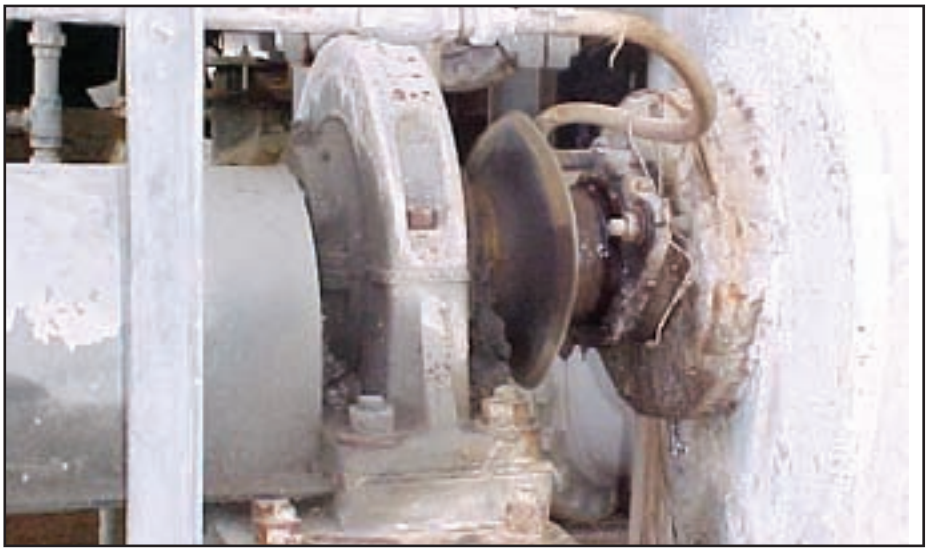


Fast Facts

Where To Find Agitators...

Most agitators can be found in paper mills. They can also be found in other plants where mixing is required. Geographically, they may be located anywhere in the country.

What To Look For...

An OEM's horizontal shaft agitator.

Application Description

Agitators are commonly used in the paper industry to mix pulp (stock) and water, or additives to the pulp, such as bleach. The primary concern is the axial (thrust) load produced by the blades. The shaft can be oriented vertically or horizontally, and are typically 2 - 6" in diameter. The speed is normally slow, usually 60 to 250 rpm, depending on the shaft size.

Advantages of Cooper

The main advantage of a Cooper bearing is the aluminum triple labyrinth (ATL) seal. Due to the bearing position on the stock tank, it is possible that the inboard bearing will get sprayed.

With the slow shaft speeds involved, the cartridge can be fully packed with water resistant grease and with the labyrinth design, prevents water from entering the cartridge housing. This is essential to the life of the inboard bearing.

Another advantage is the split design. This design allows for easy inspection and change out in trapped locations between the drive unit (usually a belt or gearbox) and the impeller.

Bearing Selection Data

Agitators are typically high thrust applications. In order to calculate the thrust load the motor horsepower and output rpm are required. If the agitator is belt driven, the diameter of the drive sheave and the diameter of the driven sheave are necessary.

The blade diameter and the number of blades must be known. The distances between the bearings and the blades are necessary. For a vertical shaft, the weight of the blade and shaft must be provided.

Additional Information

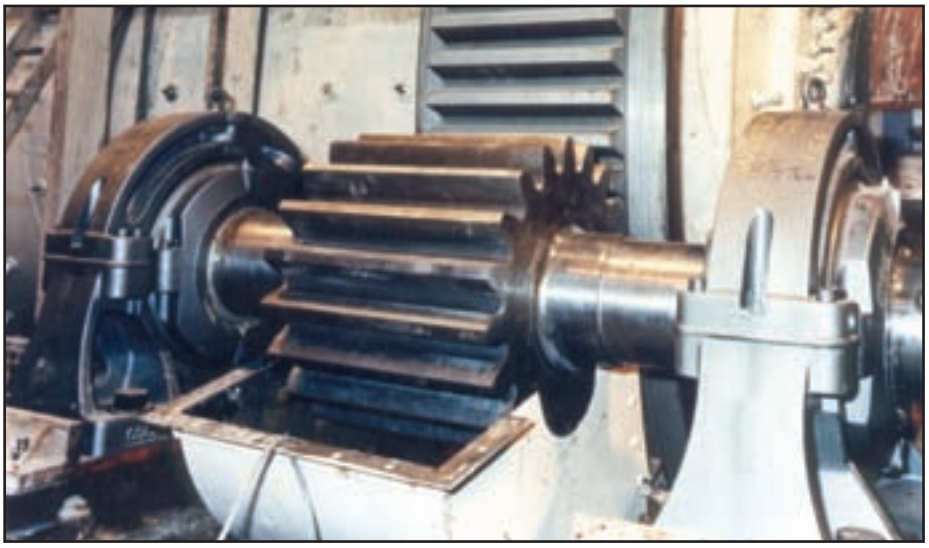
Clamping force (applies to fixed bearing only). In most agitator applications, thrust loads of 4,000 to 5,000 lbs and higher are often encountered. The slow speed maximizes Cooper's axial capacity, however; 02 Series are still required in most cases.

The thrust capacity at low speed is higher than the clamping force of the clamp rings. When the thrust capacity of the bearing is sufficient, but the clamping force is not sufficient to hold the axial force, the shaft will slip through the bore of the inner race.

This situation requires the inner race to be fixed to the shaft in such a way that the shaft cannot slip through. The inner race can be mounted in a recess, or between retaining rings.

Vertical Shaft

With a vertical shaft, the weight of the shafting, blade, and pulley or coupling weight must be considered in addition to the thrust load from the agitator blade. The dead weight of these components must be added to the calculated thrust, if the impeller is pulling upward, or subtracted if the impeller pushes downward. Since the shaft comes out of the tank vertically upward, the bearings will not usually be sprayed with liquid. While horizontal shafts typically use pillow block mounts, vertical shafts trend toward flange mounts.



Fast Facts

Where To Find Ball Mills...

Ball and hammer mills can be found in many industries. They include cement, iron ore and limestone industries.

What To Look For...

Belt and Gear Driven Ball Mills.

Application Description

A ball or hammer mill is a machine used to break up or pulverize large chunks of material for processing. A ball mill uses unconfined steel balls, tumbling in a large cylinder, to break up the raw material. Hammer mills replace the steel balls with rotating hammers, to break up the raw material. The initial chunks of material are placed in the cylinder at one end and exit out the other end through a screen. The screen determines the final size of the material suitable for processing.

During rotation, the material travels from one end of the cylinder to the other by means of spiral vanes or ribs called flights, located on the inside walls of the cylinder. The cylinder can also be slightly inclined to help transfer the material. When the material reaches the screen, it exits for processing. If the material is too large, it remains in the cylinder until the correct size is achieved.

Typical shaft speeds range anywhere from 20-60 rpm depending on the size and type of material being processed.

Advantages of Cooper

There are several advantages to choosing a Cooper bearing. One advantage is the split design. The split design allows for installation and inspection without removing sheaves, couplings, and other machine components. This can cut a machines down time from a day to only a few hours.

Another advantage is the design of the internal components of the bearing. A Cooper bearing has fewer, larger diameter rollers than most comparable bearings. This gives them a far greater tolerance to shock and vibration loads.

Bearing Selection Data

The motor horsepower and output rpm are required. If the mill is belt driven, the diameter of the drive sheave and the diameter of the driven sheave are necessary. In order to calculate the radial load, the weight of the cylinder, balls or hammers, and material must be known. In addition to these, the diameter of the hammers is also required for radial load calculations on a hammer mill. The axial (thrust) load can be determined by the angle of tilt and the total weight. It is also important to note the environment (temperature, contamination, etc.).

Additional Information - Shock Loads

There are heavy shock loads involved in this application. For this reason, a grease with extreme pressure (EP) additives is usually used.

Thermal Expansion/Contraction

Since the mills can be quite long, thermal expansion/contraction should be evaluated for the expansion bearing, even if there is only a moderate temperature rise during operation.

Application Description

As the name implies, a bucket elevator lifts loose or granular material in buckets. The elevator or "leg" is usually vertical but can be inclined. The buckets are rectangular and typically made of cast iron, welded steel, or plastic (fiberglass). The buckets are attached to a chain similar to a bicycle chain or bolted to a flat belt. The chain is a loop supported by sprockets at the top (head) and bottom (tail) of the leg. The drive is usually on top and consists of a motor and gearbox. Sprocket speed is slow, usually in the range 40 to 80 rpm.

From a drive standpoint, very little power is required. When empty the weight of the chain and buckets climbing the elevator are balanced by the chain and buckets descending. Net power consumption is limited to mechanical losses in the system. When loaded, the power consumption is still small since the weight of material being lifted is the only net load and speed is slow.

The head shaft bearings can carry substantial load regardless of the motor horsepower. The entire weight of chains and buckets must be supported as well as the shaft, sprocket, and coupling. If the gear reducer is a shaft mount type, the weight of the gearbox is added to the drive side bearing load. It is not unusual to use 02 Series bearings on an elevator with only a 20 Hp motor. The tail shaft is lightly loaded, serving primarily as a guide. These bearings are typically 01 Series.

Where To Find Them

Bucket elevators can be found in any industry where material handling of bulk solids is required. This can include agriculture (grain, fertilizer, etc.), power industry (coal, ash, etc.), rock quarries (rocks, minerals, etc.), and the marine industry (barge unloaders). These are just a few areas where bucket elevators can be found.

Advantages of Cooper

One of the main advantages of using Cooper bearings on bucket elevators is the split design. The head shaft bearings can be located over 100 feet in the air. If solid bearings were used, a crane would be necessary to remove the motor and other components in order to install the drive side bearing. The split feature of Cooper allows these bearings to be replaced without removing any of the components on the bucket elevator. A crane would not be necessary and down time would be minimal. The split feature also allows easy visual inspection of the bearings without disturbing the bucket elevator.

Another advantage of using Cooper bearings is our standard Aluminum Triple Labyrinth or ATL seal. The bearings on a bucket elevator are subject to a lot of dirt, dust, and the elements (rain).
The bore of the seals contains two rows of "O" ring material, which compress onto the shaft when mounted. This creates a 100% sealing capability between the shaft and the seal.

The only other entrance into the bearing is through the labyrinth of the seal, which is filled with grease during installation.
This sealing arrangement is excellent in keeping out contamination and moisture providing a longer bearing life.

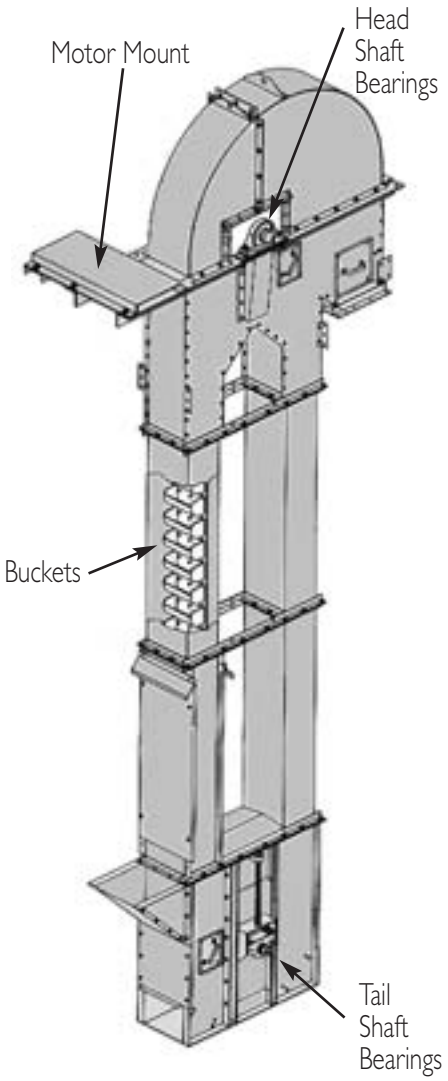
FastFacts

Where To Find Bucket Elevators...

Bucket elevators can be found in any industry where material handling of bulk solids is required. This can include agriculture (grain, fertilizer, etc.), power industry (coal, ash, etc.), rock quarries (rocks, minerals, etc.), and the marine industry (barge unloaders) are just a few areas where bucket elevators can be found.

What To Look For...

A schematic of a typical bucket elevator is shown below.



Bearing Selection Data

The primary concern on a bucket elevator is the amount of radial load supported by the bearings. This radial load is composed of the weight of the rotating components and shaft mount reducer (if present). To calculate the total radial load and make a bearing selection, the following information is required:

1. Shaft diameter
2. Shaft speed at bearings
3. Weight of each bucket
4. Number of buckets
5. Volume of buckets
6. Density of material in buckets
7. Weight of shaft mount reducer (if present)
8. Weight of chain and sprockets
9. Motor horsepower

Additional Information - Sample Bearing Selection

An elevator leg is described by its height; for example, a 60 foot leg has a height of 60 feet. The length of chain would therefore be double that or 120 feet. If the chain were known to be 18 lbs/ft, chain weight would be 120 x 18 or 2,160 lbs. If the pitch of the buckets was 12 inches, there would be 120 /1 or 120 buckets. A .75 cubic foot capacity steel bucket can weigh 60 lbs, 120 x 60 = 7,200 lbs. Half of those buckets can be full of a material weighing 85 lbs/ft3. The weight of material would be 1/2 x 120 x .75 x 85 = 3,825 lbs. Four feet of 3-7/16" shafting and two 50 lb sprockets would add 265 lbs to the total. The weight suspended on the head pulley bearings would be 13,450 lbs.

Half the total would be supported by each of the two bearings on the head shaft. Load per bearing would be 13/450, 2 or 6,725 lbs. Using a 1.5 service factor and 60 rpm, the required C rating for a 50,000 hour L_{10} life would be 47,903 lbs. The 01 BCP 307 would not be adequate with a rating of 40,300 lbs. The selection would go to the 02 Series.

Use of fiberglass buckets would change the loading significantly. The largest single component of the load is the weight of the buckets, usually more than half the total. In the previous example, a fiberglass bucket of similar capacity would weigh about 5 lbs. The weight savings would be 55 lbs per bucket or 6,600 lbs.

The load per bearing would drop by 3,300 lbs and the required C rating would fall to 24,397 lbs. This is well within the capacity of the 01 series. In general, if plastic buckets are employed, 01 Series will be adequate.

Lubrication

The head shaft of a bucket elevator is accessible by a long climb up a steep ladder. The same difficulty of access that makes split bearings desirable makes maintenance sporadic. The slow speed and self purging nature of the ATL seal allow the bearings to run fully packed with grease. This also helps keep contaminants out. The best benefit, however, is low frequency of re-lubrication. At 60 rpm it will take 6 months for the bearing to turn 16 million revolutions. This should be stressed in any presentation for an elevator application.

Application Description

Centrifugal fans discharge air or gases radially from a fan wheel. They are generally classified as single or double inlet. This is usually abbreviated as SWSI (single width, single inlet) or DWDI (double width, double inlet).

In general, fans can be categorized as center hung or overhung. Center hung fans have a bearing on either side of the fan wheel and can be classified as an arrangement 3 or 7. While arrangement 3 or 7 can be single or double inlet, typically these arrangements are used for double inlet fans. Overhung fans have both bearings on one side of the fan wheel. They are usually considered an arrangement 1 or 8, and are generally single inlet types. There are other arrangements (see Appendix 1), but these are the most common.

Single inlet fans usually have an overhung fan wheel. The majority of the wheel weight is carried by the bearing closest to the wheel. The bearing closest to the drive may be cap loaded, which holds the shaft down. To prevent excess shaft whip from the overhung load, the shaft must be larger in diameter than on a center hung fan with the same load.

Double inlet fans usually have a center hung fan wheel. When the wheel is centered on the bearings, the weight is shared by both bearings. Because the load is supported from both sides, the shaft can be relatively smaller in diameter than one that supports an overhung load.

Advantages of Cooper

The flange guided cylindrical roller bearing, used in Cooper bearings, has the lowest coefficient of friction of any rolling element bearing. Reduction of friction means less heat generation by the bearing. The low friction makes Cooper a very high speed bearing even though it is split. The use of a labyrinth seal rather than a contact seal further reduces the amount of heat generation. Consequently, Cooper bearings will run cooler than double row spherical roller bearings, double row tapered rollers, and even most ball bearings on a given application.

Coopers perform well in light load situations that frequently occur on fans. Single inlet fans with a direct drive motor often create situations where the bearings may be too lightly loaded. A too lightly loaded bearing may skid rather than roll, generating heat and leading to premature failure.

The split design also allows installation without removing sheaves, couplings, and other bearings. This can cut a machine's downtime from a day to only a couple of hours.

Bearing Selection Data

In order to make the proper selections, it must be determined if the fan is an SWSI or DWDI, and what type of arrangement it is. For both a SWSI and DWDI the motor horsepower and output rpm is required. If the fan is belt driven, the diameter of the motor sheave and the diameter of the fan sheave are necessary. For either arrangement the weight of the wheel is needed, and for an overhung fan wheel the distance between the bearings must be known.

For a SWSI fan the biggest concern is the axial load. In order to calculate the axial load it is important to know if thrust vanes are present or not.

Fast Facts

Where To Find Centrifugal Fans...

Centrifugal fans can be found in almost any type of manufacturing facility, office building, or plant across the entire country. Some applications for centrifugal fans include: cement, marine, paper, power, quarrying, steel, sugar, and water and sewage industries.

What To Look For...

Industries that require constant forced air ventiation. A typical Cooper fan application in a power plant is shown below.

In some applications manufacturers install thrust vanes on the back of the fan wheel. These vanes will generally reduce the axial thrust by half. The area of the inlet cone at its smallest diameter must also be known. The static pressure of the fan, in inches of water, is also needed. If the static pressure is not available, it can be determined using the drive power and gas flow rate (usually given in cubic feet per minute or cfm).

This method gives a -10 % to + 35% error for the static pressure. So to make an accurate selection we would prefer to know the static pressure of the fan.

For a DWDI fan the primary concern for making a selection is the radial load produced by the weight of the fan wheel and belt pull, if any. The fan wheels are essentially two single wheels positioned back to back. Nearly all the thrust load is eliminated because the axial load produced by one wheel is balanced by the other. The exception to this is when there are dampers on the inlets that are operated independently. Then the thrust would have to be calculated the same as a single inlet fan.

Additional Information - Clearance

To select the proper clearance in the bearing the shaft temperature and the ambient temperature is needed. If the shaft temperature is 70°F hotter than the ambient temperature, the shaft will cause the inner race to heat up and expand, while the outer race will be cooled by the air. This expansion will decrease the clearance, and if there is insufficient clearance the bearing will bind and seize up. In temperature differences between the shaft and bearing housing surface greater than 70°F, C3 clearance must be specified. If the temperature difference is greater than 130°F, C5 clearance must be specified.

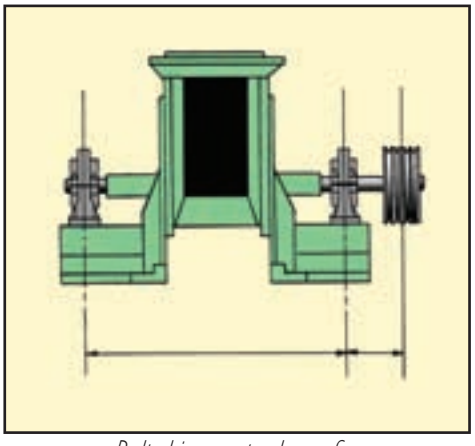
Spherical Fit

In high speed applications such as fans we recommend using an S1 spherical fit. The S1 fit is obtained by selective assembly.

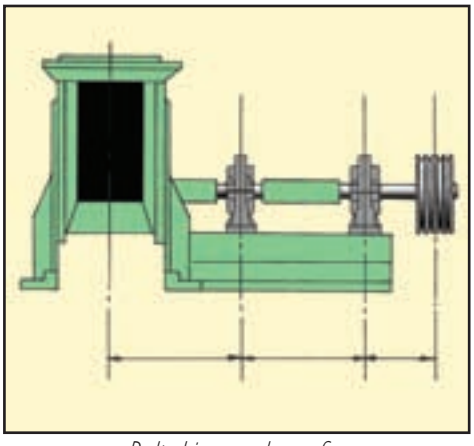
By taking cartridges at the high end of tolerance and pedestals at the low end of tolerance, a minimum clearance in the ball and socket joint is obtained. The S1 fit will dampen vibration and reduce any resulting damage to the bearing, cartridge, and pedestal.

Larger and multiple fans pose no problems for Cooper bearings

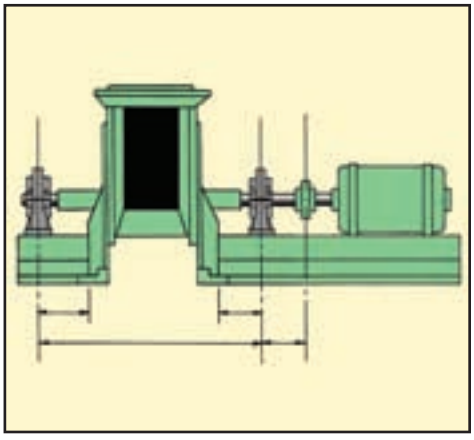
Basic Fan Arrangements



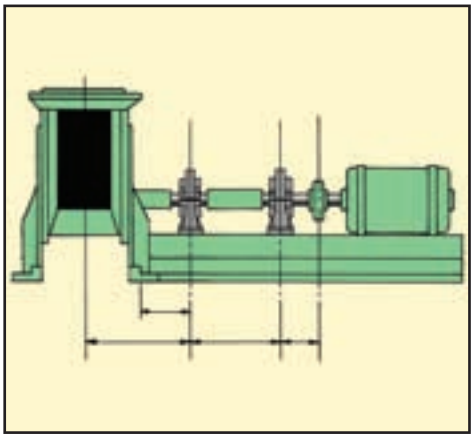
Belt drive center hung fan



Belt drive overhung fan



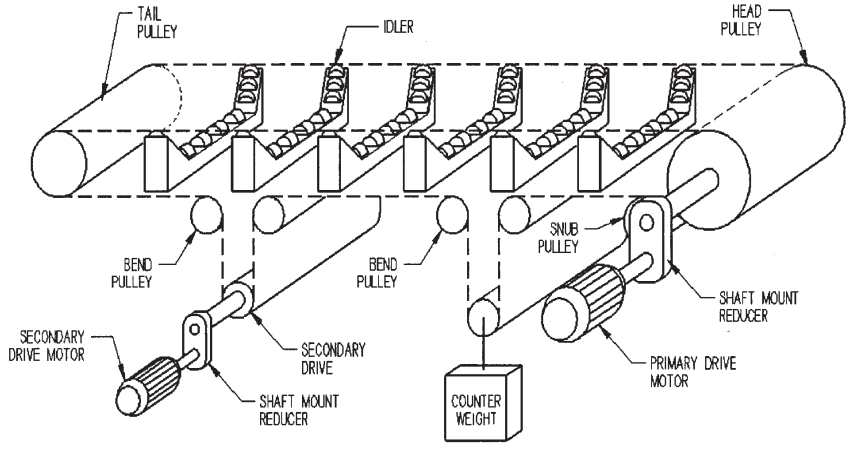
Direct drive center hung fan



Direct drive overhung fan

Application Description

Belt conveyors are used to transport dry materials up inclines or across relatively flat distances. A small conveyor system, generally driven by motors under 100 HP, may be as simple as a head pulley, tail pulley, and idlers. Large conveyor systems, up to 1000 HP, have head and tail pulleys, idlers, as well as bend, snub, and take-up pulleys. These large systems may also have a secondary drive.



Advantages of Cooper

There are several advantages to choosing a Cooper Split Roller Bearing for any belt conveyor system. The primary advantage is the Aluminum Triple Labyrinth or ATL seal. The ATL seal clamps to and spins with the shaft. Two "O" rings in the bore of each ATL grip the shaft to form a complete seal. The ATL seal is the best standard seal in the industry, and is good for even "Taconite" like applications when used under certain conditions. These applications involve very fine dust particles being conveyed and deposited near bearing locations.

The split design of Cooper bearings allows for installation and visual inspection in trapped locations between the drive and pulley. The design of Cooper's single row cylindrical roller can withstand the shock load placed on the bearings much better than other rolling element geometries. The bearings must withstand a considerable amount of shock load in conveyor applications, especially, if the belt is full during start up.

Bearing Selection Data

The drive horsepower or belt HP must be known. The belt speed in feet per minute (FPM), or the RPM, as well as the pulley diameter is needed. It is important to note the arc of contact, also known as the degree of wrap, between the pulley and the belt. The pulley surface, plain (smooth), or lagged (ridged) is also required. The belt tension on both sides of the drive pulley(s) would be extremely helpful if known.

In addition to the load due to the drive, the dead weight of the components are important in determining the bearing load. The weight of the pulleys, coupling(s), and also of the shaft mount speed reducer, if there is one, is needed. Also note if the belt is level or inclined. The length of the conveyor and the belt's weight in pounds per foot, along with the width of the belt and the tons per hour capacity of the belt are also helpful in the load calculations.

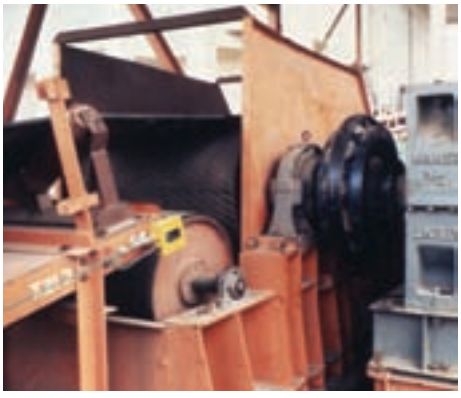
Fast Facts

Where To Find Conveyors...

Small conveyor systems can be found in cement ready-mix plants, load out facilities for trucks, railcars, and barges, or anywhere dry bulk materials must be handled. Large systems are commonly found in mines and coal fired power plants.

What To Look For...

A typical belt conveyor is shown left and below.



Cooper bearing used in steel mill in trapped position between the drive and head shaft.

Additional Information - Lubrication and Maintenance

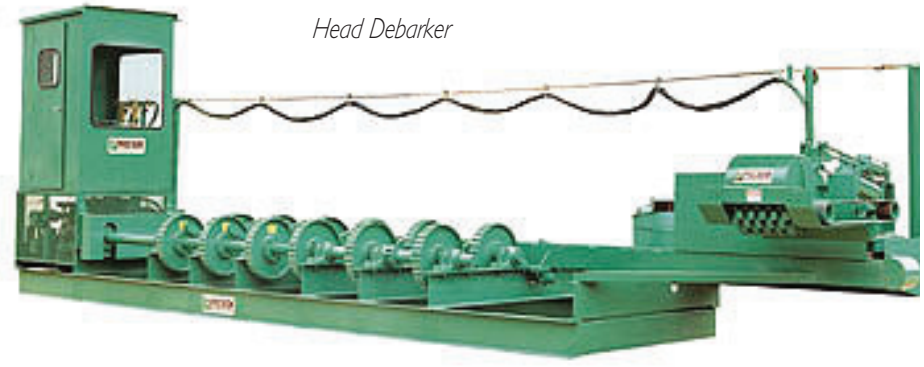
Most slow moving applications generally require a heavier lubrication than standard bearing grease. Generally, conveyor bearings demand a lubricant with EP additives and a VG grade 460 base oil. Examples of these include Mobil Mobiltemp 78, Texaco Starplex Premium, and Lubricating Engineers 1250 Almasol. Timely and frequent lubrication is a must to fulfil the expected life of a bearing.
Generally for conveyors, relubrication should occur every two to four weeks. Relubrication coats the contacting surfaces with fresh grease, and purges any fine particles out of the bearing that were attempting to move past the triple labyrinth.

Application Description

Debarkers are used to strip the bark from rough cut timber. There are two main types of debarkers. One of them is the head debarker which employs a floating cutter head that traverses over a rotating log and strips off the bark. Head debarkers can accommodate logs up to 54" in diameter and up to 24' in length. The second type is a drum debarker. A drum debarker consists of a large drum that accepts a number of logs from a conveyor and tumbles the logs against each other as it rotates to remove the bark.

Drum debarkers are driven by multiple underrollers. Drive motors range from 75 hp to about 125 hp, and there can be multiple drives depending on the size of the drum and number of underrollers. Many manufacturers use rubber tired drives to aid in shock absorption, improve speed control, and to "soft start" the equipment when ramping up. Radial loads come from the weight of the drum coupled with the size and number of logs. There are substantial forces during start-up and shock loads from the logs tumbling that need to be considered.

Head Debarker



The drum is supported and rotated on rubber tire drives similar to a rotary kiln. Drum debarkers rotate very slowly (as low as 9 rpm) and can accommodate much longer logs than a head debarker.

Head debarkers support one log at a time between two rows of steel-toothed bull wheels. The bull wheel shafts can be driven by 15 hp to 100 hp electric, hydraulic, or diesel motors. Shaft speed is generally less than 30 rpm but shock loads from logs being dumped onto and kicked off of the debarker are very high. Radial load depends on the size of the logs and the working pressure of the debarker head hold-down.

In addition, the friction forces generated between the rubber tires and drum add load to the system.

Advantages of Cooper

Debarkers provide classic trapped applications for Cooper bearings. The split design of Cooper bearings allows for installation and visual inspection in trapped locations between the bull wheels on a head debarker. In addition to the bull wheel shafts, most head debarkers have belt driven floating cutter heads.

Fast Facts

Where To Find Debarkers...

Debarkers, as their name would imply, are found in the lumber industry. Debarking is usually the first process raw timber goes through upon arrival at the sawmill. Logging trucks are off-loaded and the logs are conveyed directly to the debarker. Most debarkers see heavy abuse from shock loads as product is dumped into the machine, rotated or tumbled, and kicked out of the system.

What To Look For...

Lumber Mills and forestry operations.

If the bearing is trapped between the belt sheave and the drive, Cooper provides the advantage of being fully split for ease of replacement. This fully split-to-the-shaft design reduces downtime due to change out or maintenance to the time required disassembling and reassembling the pillow block. Motors, wheels, sheaves, and shafts all stay in place during replacement.

There are several other advantages to choosing a Cooper Split Roller Bearing for debarkers. The design of the Cooper single row cylindrical roller can withstand the shock load placed on the bearings much better than other rolling element bearing geometries. The bearings must withstand a considerable amount of shock load in debarker applications, especially during loading and start-up.

Continued on next page.

Large Drum Debarker

Detail of Drum Under-roller Drive

One of the most significant features of the Cooper bearing is the Aluminum Triple Labyrinth (ATL) seal. The ATL seal clamps to and spins with the shaft. Two "O" rings in the bore of each ATL grip the shaft to form a complete seal. The ATL seal is the best standard seal in the industry, and is especially good at keeping out fine sawdust and dirt particles found in the debarking process.

Bearing Selection Data

The load due to log weight and pressure exerted by the cutting head are the major factors to be considered in calculating radial load for a head debarker. To calculate total resultant load drive horsepower, drive type, shaft size and RPM, number of bull wheels, and distance between the bearings is needed. The weight of the floating head cutter and its designed working pressure is also needed.

If bearings are being selected for the drive head, other factors need to be considered. The drive horsepower, drive type, shaft size and RPM, and sheave diameters are needed to calculate tension from belt pull. The working pressure, weight of the floating head cutter, and the distance between bearings is needed to calculate resultant load from contact with the log.

Drum debarkers handle much heavier total loads, but are more basic machines than a head cutter. The most important factor in bearing selection for a drum debarker is determining the total weight of the drum vessel, the weight of its normal operating load of timber, and number of support wheels. The drive horsepower, drive type, drive wheel (rubber tire) diameter, shaft size and RPM are also needed. One very important factor to consider is whether the drum is on an incline. Most debarkers are not inclined, but if one is, we need to know the degree of the angle or its rise over run. Inclined rotating drums can exert very high axial loads and these need to be examined before selecting the bearing.

Additional Information - Common Features

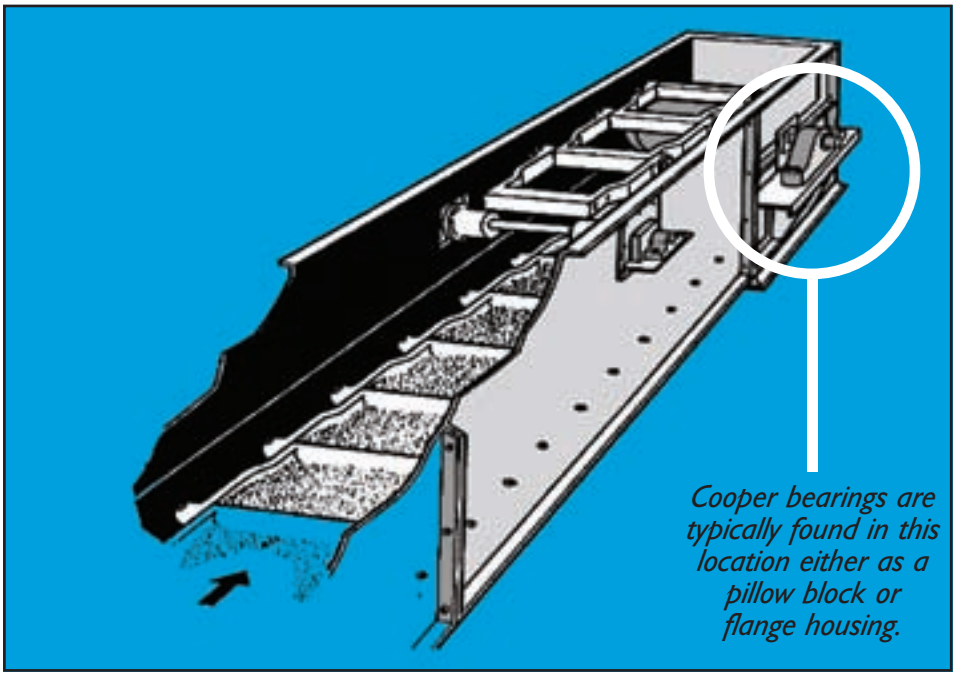
Because shock loads are troublesome to quantify, it is not uncommon to recommend that steel or ductile iron pedestals be used on debarker applications. The combination of heavy loads and slow speed make it difficult to achieve adequate lubrication flow to contact areas.

The addition of thin-dense chrome to the races improves lubrication and surface hardness, making it an attractive option on debarker bearings.

Lubrication and Maintenance

Most slow moving applications generally require a heavier lubrication than standard bearing grease. Generally, debarker bearings demand a lubricant with extreme pressure (EP) additives and a VG grade 460 base oil. Examples of these include Chevron UltraDuty #2, Texaco Starplex Premium, and Lubricating Engineers 1250 Almasol. The use of dry film additives (such as molybdeneum compounds) may aid in establishing and maintaining an adequate lubrication film on the running surfaces of the bearing.

Timely and frequent maintenance is necessary to maintain a fully packed bearing and fulfil the expected life of the bearing. Generally, regreasing should occur every two to four weeks. Relubrication coats the contacting surfaces with fresh grease, and purges any fine particles out of the bearing that were attempting to move past the triple labyrinth seal.



Application Description

Drag chain conveyors are generally used to transport materials, up inclines or across relatively flat surfaces, many times dumping product into hoppers or onto other conveyors. They drag material through a trough on chains instead of on a belt cupped by idlers.

Drag conveyors turn at relatively slow speeds, typically around 5 to 10 rpm, and are subject to heavy shock loads. In comparison to overland or belt conveyors, drag chain conveyors tend to be relatively short, most times less than 100 feet in length.

It is not uncommon for the headshaft to be fitted with steel hubs and a pipe sleeve on which the chain sprockets are mounted. Drive is usually through a gearbox reducer mounted to the motor and coupled to the headshaft.

Advantages of Cooper

Conveyors provide classic trapped applications for Cooper bearings. The split design of Cooper bearings allows for installation and visual inspection in trapped locations between the drive and chain sprocket drum. This fully split-to-the-shaft design reduces downtime due to change out or maintenance to the time required to disassemble and reassemble the pillow block. Motors, gearboxes, and shafts all stay in place during replacement.

There are several other advantages to choosing a Cooper Split Roller Bearing for a drag chain conveyor system. The design of the Cooper single row cylindrical roller can withstand the shock load placed on the bearings much better than other rolling element bearing geometries. The bearings must withstand a considerable amount of shock load in conveyor applications, especially if the trough is full during start up.

FastFacts

Where To Find Drag Chain Conveyors...

Drag chain conveyors are found in lumber, paper, scrap metal, and waste handling industries. In the movement of scrap metal, the metal is dropped onto the drag conveyors from an input chute and typically moves the scrap up a 10 to 12 ft. incline.

What To Look For...

Some of the longer drag chain conveyors are found in the pulp mills. These conveyors tend to be level and move pulp over 80 to 100 ft. distances. Flights or hooks can be found on lumber mill drag conveyor chains. The wood is dropped onto the conveyor and "grabbed" by the chain flights as the conveyor rotates. Most drag chain conveyors see heavy abuse from shock loads as product is dumped onto the chains!

One of the most significant features of the Cooper bearing is the Aluminum Triple Labyrinth (ATL) seal. The ATL seal clamps to and spins with the shaft. Two "O" rings in the bore of each ATL grip the shaft to form a complete seal. The ATL seal is the best standard seal in the industry, and is especially good at keeping dust and dirt particles being conveyed and deposited near bearing locations.

Bearing Selection Data

The load due to chain pull, material weight, and component weight are the major factors to be considered in calculating radial load.

Continued on next page...

To calculate total resultant load drive horsepower, chain speed in feet per minute (FPM), or the shaft RPM, as well as the sprocket diameter is needed. The number of chain strands and distance between bearings is also needed. The length of the conveyor and the tons-per-hour capacity of the belt are also helpful in the load calculations.

The tons-per-hour capacity is divided by chain speed to calculate the average weight of the material. This figure is multiplied times the length of the conveyor to approximate total material load. If the tons-per-hour capacity cannot be provided, the chart below gives the average weight of commonly conveyed material for your reference.

Material	Average Weight (per ft^3)
Cement	75 – 80 lb
Coal	50 – 55 lb.
Grains	38 – 45 lb.
Gravel	90 – 100 lb.
Sand (damp)	110 – 130 lb.
Sawdust	10 – 13 lb.
Stone	58 – 90 lb.
Wood Chips	12 – 20 lb.

In addition to the load due to chain pull, the dead weight of the components is important in determining the bearing load. The weight of the sprockets, coupling(s), shaft mounted drum (usually heavy pipe), and also the speed reducer if it is shaft mounted are all factored into the load calculations. Note if the conveyor is level or inclined.

Additional Information - Common Features

Because shock loads are troublesome to quantify, it is not uncommon to recommend that steel or ductile iron pedestals be used on drag chain applications. The combination of heavy loads and slow speed make it difficult to achieve adequate lubrication flow to contact areas. The addition of thin-dense chrome to the races improves lubrication and surface hardness, making it an attractive option on drag chain bearings.

Lubrication and Maintenance

Most slow moving applications generally require a heavier lubrication than standard bearing grease. Generally, conveyor bearings demand a lubricant with extreme pressure (EP) additives and a VG grade 460 base oil. Examples of these include Chevron UltraDuty #2, Texaco Starplex Premium, and Lubricating Engineers 1250 Almasol. Timely and frequent lubrication is a must to fulfil the expected life of a bearing. Generally, for conveyors regreasing should occur every two to four weeks. Relubrication coats the contacting surfaces with fresh grease, and purges any fine particles out of the bearing that were attempting to move past the triple labyrinth seal.

Application Description

Fin tube cooling fans are also known as fin fans. They have vertical shafts and large diameter blades, 8 to 12 feet typically. Fin tube cooling fans pull or push air through groups of tubes that are wrapped with fins. Fin fans are usually found in groups of 12 or more, positioned inside of a large box that is held around twenty feet in the air on stilts.

The shaft diameter usually ranges from 1-11/16" to 2-15/16". The standard shaft diameter utilized on new fans is 2-15/16". In most cases the vertical fin fan shaft is belt driven from the bottom of the shaft at speeds ranging from 200-500 RPM. The original equipment bearing is a ball or tapered roller bearing with a set screw attachment to the shaft. These bearings are mounted into a square flange which in turn is attached to an angle or channel frame. Cooper Bearing Company has designed a split square flange (DF line) to suit such applications.

Advantages of Cooper

There are several advantages to using Cooper Split Roller Bearings in fin fan applications. The solid bearings currently used on most fin fans are held in place with set screws. When that bearing fails, the set screws tear up the shaft requiring the whole fan to be removed and the shaft to be remachined. A Cooper bearing clamps to the shaft and the inner race protects the shaft when the bearing eventually fails. Without shaft damage, the fan does not have to be pulled. A crane is no longer needed to switch out the bearings.

This not only reduces downtime but it removes the risk of damaging the fin tubes upon extraction of the shaft.

Lubricant leakage is a problem on a vertical shaft. Most other bearings have contact seals where the shaft turns inside the seal. Eventually the seal wears and lubrication seeps through along the shaft. Cooper Bearing's Aluminum Triple Labyrinth Seal (ATL) is clamped to and spins with the shaft. Two "O" rings in the bore of each ATL grip the shaft and form a complete seal. This eliminates wear and does a much better job of keeping the lubrication in the bearing over long periods of time.

With the use of retaining rings and a Cooper Split Roller Bearing, a fin fan can be set up and properly aligned one time. From then on, all of the fin fan components can be referenced from the fixed bearing in position. There is no need to realign or reposition the fan after each bearing change out.

Bearing Selection Data

To calculate fan speed, the output rpm of the motor and both motor and fan sheave diameters are needed. The two sheaves are usually connected by V-belts under tension. Under running conditions the belt tension, causes a radial load on the bearing at the base of the shaft. This radial load is also known as belt pull. Belt pull can be calculated from motor hp, motor speed, and sheave diameters.

The axial load can be calculated from the weight of the blades and the shaft, plus the static pressure and blade diameter. Given the length and diameter of the shaft the weight can be calculated.

FastFacts

Where To Find Fin Fans...

Fin fans are commonly found in refineries and chemical plants. They lose far less water to evaporation than conventional cooling towers and are used where water availability is less.

The greatest concentrations are in southern California, Texas, and in the refineries around Philadelphia.

What To Look For...

Fin fans are found in groups, usually 12 or more. In a large refinery or chemical plant it is not unusual to find hundreds.

Usually the static pressure is only one to two inches of water gauge, so only the blade diameter is needed.

Additional Information - Vertical Shaft Applications

Bearing selection is based on holding up the shaft. For fin fan applications Cooper can handle up to 1380 lbs. of axial force at 500 RPM.

Continued on next page...

At slow speeds, a bearing has more thrust capacity than clamping capacity. It is general good practice for vertical shafts to add 20% to the normal clamp ring screw torque. This is 50 inch lbs. for 01 series bearings in the size range 1-11/16" to 3". A torque wrench is needed for consistent accuracy. Inaccurate torque may lead to shaft slippage and early failure. Retaining rings may also be used to prevent the shaft from slipping through the bore of the fixed bearing.

Lubrication and Shaft Tolerance

A high temperature grease should be used for applications above 180°F, typical for the top bearing on a fin fan. In general, a high temperature grease with a VG 460 base oil and an EP additive is recommended. Examples include Chevron Ultra Duty #2, Exxon Ronex Extra Duty Moly, Lubricating Engineers 1250 Almasol, Mobil Mobiltemp 78, and Texaco Starplex Premium.

The tolerance for most fin fans is +.000, -.003". Roundness and taper should be held to .001".

Most chemical plants and refineries provide huge opportunities for Cooper bearings on fin fan applications.

Application Description

Most drinking water is stored in surface reservoirs where the water picks up materials such as dirt and plant matter. To remove these materials a method called flocculation is used.

Water is pumped from the reservoir into a basin about 8' deep, 15' wide, and 80 to 100' long. Chemicals called flocculants are added that cause the dirt and plant matter to bind together into larger particles so they can be more easily filtered out. To thoroughly mix the flocculants with the water, a lineshaft in the bottom of the basin has a number of paddle wheels turning at a slow speed (usually 10-12 rpm)

The 2 to 5" diameter lineshaft runs the length of the basin and is supported by up to a dozen bearings. Typically there is a chain drive at one end, or in the middle of the shaft, supported by one fixed bearing, and the remaining bearings are all expansion bearings.

The three common arrangements are horizontal paddle wheels, walking beams, and vertical mixers. The horizontal paddle wheel is the most common arrangement.

Advantages of Cooper

There are several advantages to choosing a Cooper bearing for use on flocculators. The split design of the bearing allows for ease of inspection and the ability to change a bearing without removing other components from the shaft.

The aluminum triple labyrinth seal, along with a full pack of grease, will prevent any chemicals, sediment, crustacean from Zebra muscles, or other foreign materials from entering the bearing, while submerged in the flocculator basin.

Due to inadequate sealing, other bearings fail from these contaminants and destroy the shaft as they fail. This not only requires a lengthy down time to fix the problem but a costly maintenance item to replace the worn shafts. With a Cooper, the bearings and shaft can be inspected when the basin is drained once a year for routine maintenance.

Fast Facts

Where To Find Flocculators...

Flocculators can be found at water filtration plants in medium to larger size towns and cities where dirty water may be a problem. The smaller cities generally buy their water from adjacent larger cities, and do not require their own filtration plants.

Note: flocculators are not found in the waste water industry.

What To Look For...

Typical horizontal paddle wheel flocculator.

Bearing Selection Data

In most flocculators the radial load is minimal, so the 01 series bearing is used. It is still important to note the shaft speed and shaft size. The length of the lineshaft is necessary.

The drive arrangement, direct or chain driven, along with its location (at the end of the shaft or in the middle of the shaft) is required.

Continued on next page...

A water filtration plant where flocculators are found

The type of couplings used, rigid or flexible, must also be known. The maximum water temperature in the summer and the minimum water temperature in the winter would also be helpful.

A rough sketch of the arrangement (see lineshaft data sheet) is also needed.

Additional Information - Bearing Life

The biggest factors in bearing life are the condition and alignment of the shaft. An undersized or rusted shaft reduces the "grip" of the seal to the shaft. A poorly aligned shaft "cranks" at the bearing, opening and closing seal contacts.

In one city, where all the shafts were within tolerance and laser alignment was performed, they have experienced no Cooper failures in 15 years with 140 Cooper bearings in service.

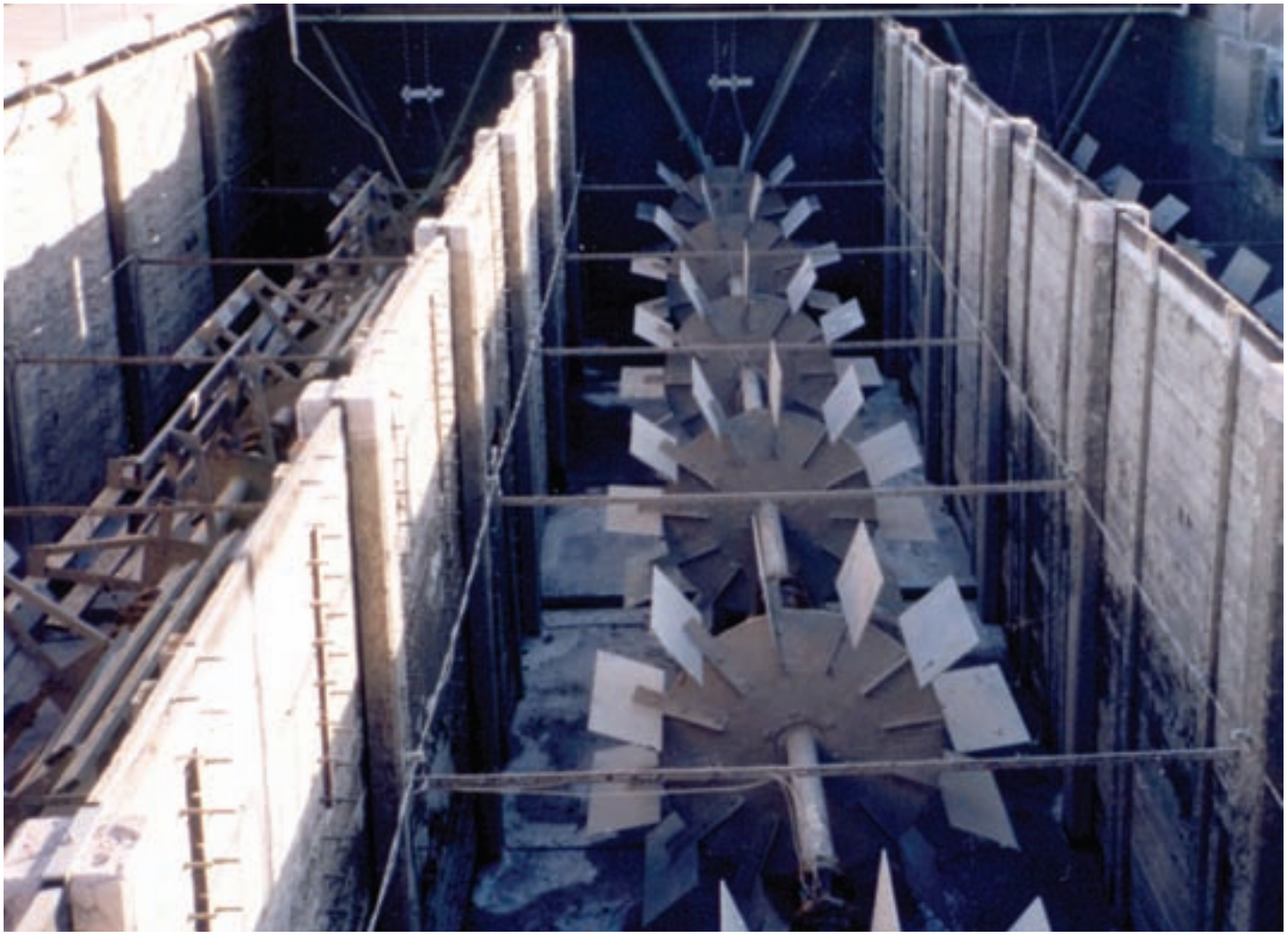
Lubrication

For flocculator applications we recommend using an aluminum complex food grade grease. While aluminum complex resists wash out, it is not compatible with many other types of grease. Prior to adding aluminum complex grease, the bearing should be solvent cleaned of other greases.

Due to the slow speeds and submerged location, a full pack of grease should be used.

For routine greasing, grease lines should be run from the surface down to the bearing.

A typical horizontal paddle wheel flocculator



Application Description

Gear drives are used to transmit motion from one shaft to another. They can be classified into three categories; spur gears, helical gears, and bevel gears.

Spur gears are used on machinery on low speed applications to transmit motion from one shaft to another parallel shaft.

Helical gears are used when high speeds are involved with large power transmission, or where noise dampening is important. Bevel gears are used to transmit power between intersecting shafts.

Advantages of Cooper

The primary advantage of a Cooper bearing is the split design. In some cases there may be several gears on a common shaft. The split design allows for installation and visual inspection of the bearing in trapped positions, without removing any other components from the shaft. This reduces down time from several days to hours.

Bearing Selection Data

In order to calculate the loads placed on the bearing, for any type of gear the motor horsepower and speed must be known.

Spur Gears

Spur gears can be identified from their teeth that are parallel to the axis of rotation. The smaller of the two mating gears is called the pinion. The larger is often called the gear, or bull gear. When in operation they do not exert an axial load on the shaft.
For this reason, the main concern for a spur gear is the radial load produced by the gear reaction. For each gear, the pitch diameter and number of teeth is required. The pressure angle of the mating gears should also be known. There are two common pressure angles for spur gears, 14° and 20°.

Helical Gears

Helical gear teeth are cut in the form of helices, making a constant angle with respect to the gear axis. When using helical gears, the helix angle results in a thrust load in addition to the resultant radial load. To calculate both loads, the pitch diameter and number of teeth are required. The pressure angle and helix angle must also be provided.

Bevel Gears

There are four types of bevel gears; straight, zerol, spiral, and hypoid. Straight bevel gears are used for slow speed (below 1000 ft/min). The other three types are used for higher speeds where vibration and noise reduction are important.

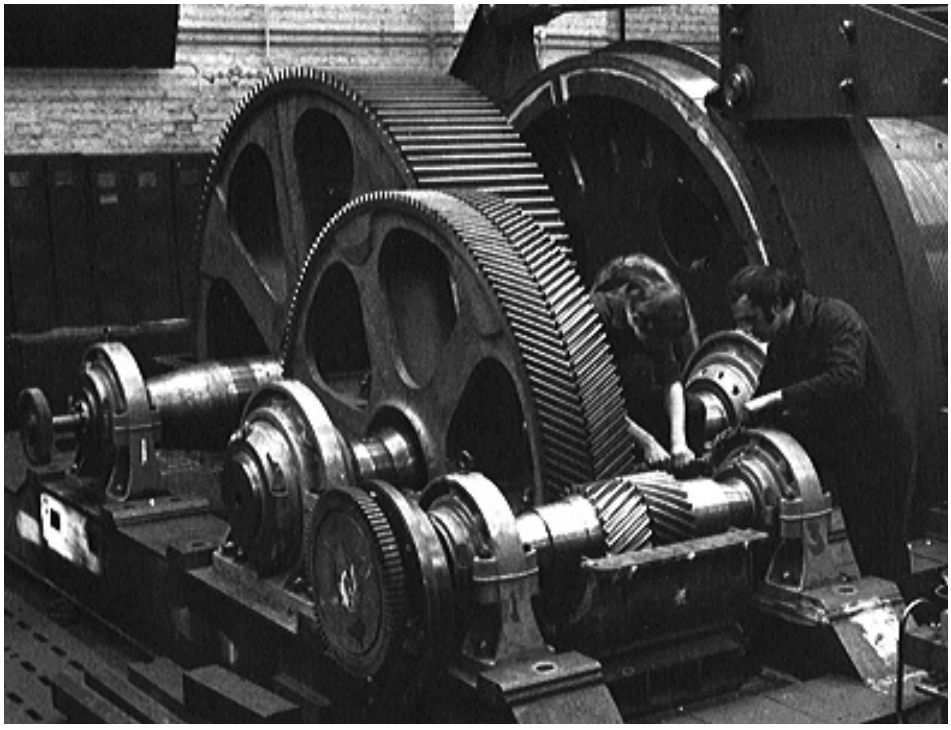
Fast Facts

Where To Find Gear Drives...

Gear drives can be located in plants where several machines next to each other are to be powered from the same drive unit. Typically, the shaft is perpendicular to the machinery, with bevel gears used to redirect the power. Gear drives are also used to reduce shaft speed from one shaft to another by varying the gear diameters.

What To Look For...

A large spur gear can be seen behind the two herringbone gears.



It is important to note if the bevel gear drive is a reversing type. If so, the shock loads typically exceed the thrust capacity of a Cooper bearing. Please consult the engineering team for further information.

Application Description

A lineshaft is a method of carrying power from a single source to one or more machines. This is done by joining sections of shaft together with couplings to achieve the desired length of shaft.

In order to power other pieces of equipment a power take off (sheave, pulley, sprocket, gear, etc.) is attached to the shaft. A belt or chain is then connected to the power take off and to the shaft of the machine.

Originally, a water wheel was used to provide the power to a shaft that ran the length of the mills. As steam turbines became available they replaced the water wheel, and with the advent of electricity, large motors took over. It wasn't until around 1950 that lineshafts were replaced with individual drives for each piece of machinery.

However, many old mills still use a lineshaft to transmit power to their machines. Mill lineshafts can have the power source at one end or somewhere near the center. They may be a few feet long or several hundred. A single shaft diameter may be maintained through the full length or several step downs may occur.

Marine lineshafts will probably be in use for quite some time. In order to balance a ship the heaviest components, such as the engine and reduction gear, must be near the center of the vessel (amidship).

The main propulsion is usually located at the back of the ship (stern) and maneuvering power (bow thruster) at the front. To transfer power from the engine to the propulsion units a line shaft is required. Since all marine shaft bearings are support bearings (no sheaves or sprockets to support), they are usually 01 series. A few high powered vessels use 02 series bearings, but the majority only require 01 series. Because the thrust loads are greater than what a Cooper or almost any other fixed type bearing can handle, a special flat thrust bearing is required. It is usually located in the reduction gear box between the engine and intermediate shafting. To calculate the radial and thrust loads applied by the bevel gears, the pitch radius of the gear and the pressure angle of the gear teeth must be provided. The cone angle made between the axis of the shaft and the gear teeth is also required.

Advantages of Cooper

The primary advantage of using Cooper bearings is the split design. In lineshaft applications it may be very difficult to install a solid replacement bearing due to the position of the power take offs, and any couplings.

Cooper also offers an SAF compatible line of pedestals, which are drop in replacements for many SAF style pillow blocks.

Bearing Selection Data

On a typical lineshaft the power take off may be a sheave, pulley, sprocket, or gear. Depending on what type there is, different information is required to make the proper bearing selection. For all arrangements, the drive horsepower, as well as the horsepower of the machine(s) being driven should be known. Also, the shaft speed and shaft diameter(s) is needed.

FastFacts

Where To Find Lineshafts...

Lineshafts are typically found in pre - World War II paper mills, flour mills, textile mills, etc. They are also widely used in marine vessels.

What To Look For...

A typical wall mounted mill lineshaft with belt driven power take-off shown in the bottom left.

Belt or Chain Drive

The type of drive (belt, rope, V-belt, or chain) must be noted. The driven sheave/sprocket diameter and the drive sheave/sprocket diameter is required.

Gear Drive

The pitch diameter of each gear is needed. Also, the number of teeth (or pitch) and pressure angle is necessary.

A rough sketch of the arrangement (see lineshaft data sheet) is also needed.

Additional Information - Intermediate Support

The distances between power take offs can be large. A shaft will sag under its own weight and will create a slope in the shaft. A slope greater than 1/2500 will cause a cylindrical roller bearing to edge load, and fail. A rule of thumb is to support the shaft at intervals of 20 times the shaft diameter.

The actual length at which the shaft sag will exceed the bearing's ability to align itself, can be computed based on the diameter of the shaft.

Non Essential Bearing Positions

In cases where independently powered equipment has replaced equipment driven by the line shaft, bearing positions may have been kept on the lineshaft that no longer serve any purpose. If there are bearings in a location that no longer has additional radial load on them from a power take off, there is a good possibility that the bearings are too lightly loaded and will fail due to skidding.

Bearing Location

The location of fixed (GR) bearings depends on the location of the power source and number and type of couplings. Exactly one fixed bearing is required for each solid section of shafting. A solid section can be created by joining separate sections of shafting with rigid couplings.

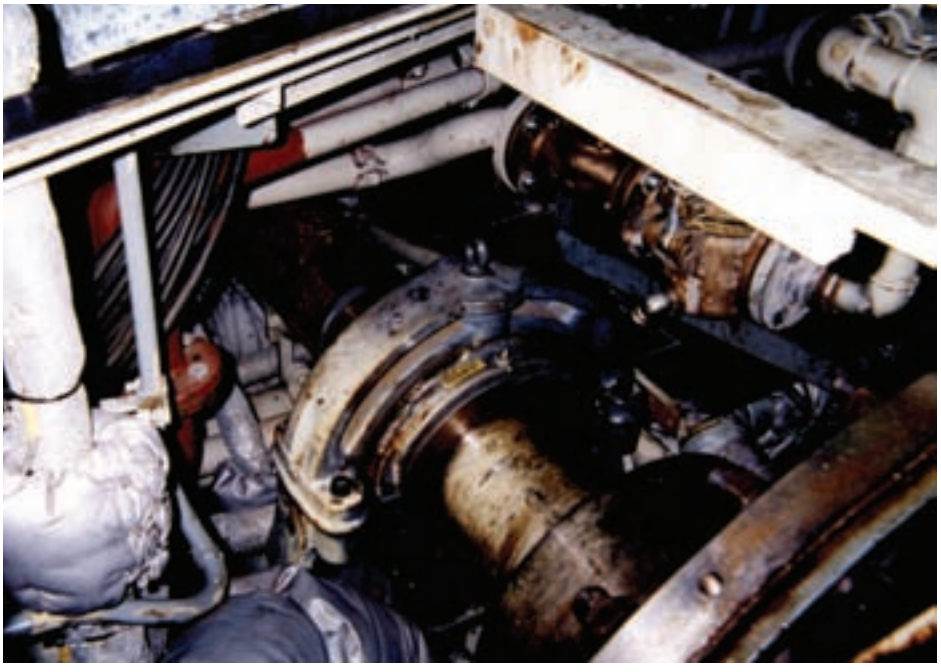
Separate sections can be achieved by joining pieces of shaft with flexible couplings or by separating them with the drive unit (locating the power source near the middle of the lineshaft). If the power source is located at one end and all couplings are rigid, a single fixed (GR) bearing would be used regardless of the shaft length.

In marine applications where the thrust loads are significant on ordinary propeller shafts, a special flat thrust bearing is used in the fixed position. This arrangement requires that all intermediate positions use expansion (EX) bearings.

A Schottel system, or Z drive uses a central engine to power remote gearboxes. The connecting shafts are joined by flexible couplings and universal joints. Each section can be treated as independent and is usually supported by two bearings, one fixed (GR) and one expansion (EX) bearing.

A typical propulsion shaft arrangement utilizing Cooper split bearings of various sizes.

The use of Cooper bearings in limited access positions is a distinct advantage.



Application Description

Lumber dry kilns are used to dry lumber before it is processed. The kilns reduce the time it takes for the raw lumber to properly dry before it can be cut into dimensional lumber. Generally, they are large metal buildings with access doors on the two long sides. They vary in size, but are commonly 60 - 100 feet wide by several hundred feet long.

In order to dry the lumber, steam is circulated through coils near the roof of the building. The hot air is circulated through the coils and building by use of a fan. The shaft runs the width of the building, and connects to a motor outside. The temperatures inside the kiln are generally between 250°F and 300°F.

Each shaft is driven by a separate motor, typically 5 or 10 hp, running at a speed of 600 to 1000 rpm. The shaft diameter in these applications is usually less than 3" in diameter.

Advantages of Cooper

The primary advantage of using Cooper bearings is the split design. The bearings are mounted near the roof, onto an I-beam that spans the width of the building. This mounting arrangement places them in a trapped position. The split design allows for installation and visual inspection in trapped locations on top of the I-beam.

Another advantage of Cooper is the Aluminum Triple Labyrinth or ATL seal. The ATL seal clamps to and spins with the shaft. In a high temperature application such as this, it is necessary to replace the standard Buna/Neoprene "O" rings in the seal, with Viton "O" rings. The Viton "O" rings are capable of operating at temperatures up to 350°F.

Bearing Selection Data

To calculate the fan speed, the output rpm of the motor is needed. Also, the fan sheave and motor sheave diameters are required. The two sheaves are usually connected by V-belts running under tension. Under running conditions the belt tension causes a radial load on the bearing. This radial load is known as the belt pull. The belt pull can be calculated from the motor horsepower, motor speed, and sheave diameters.

The axial load can be calculated from the diameter of the blades , and the static pressure. Given the length and diameter of the shaft, the weight of the shaft can be calculated. Usually the static pressure is only one inch of water gage, so only the blade diameter is needed.

To determine the proper lubrication and bearing selection, the temperature inside the kiln and the ambient temperature is necessary.

Additional Information - Bearing Location

In these applications, the fixed bearing can be mounted in two possible locations. One mounting arrangement can have the fixed bearing outside, next to the motor. An advantage of this placement is that the bearing will run cooler. The other bearing location is next to the fan. This is the preferred position if the fan is a reversing type. In other dry kiln applications, both mounting arrangements have been successful.

Lubrication

Due to the relatively slow speed and high temperature (above 180°F), a high temperature grease should be used.

Fast Facts

Where To Find Drying Kilns...

Dry kilns can be found wherever there are large lumber mills. This is typically in the Northeast, Northwest, and South, where the lumber industry is prevalent.

What To Look For...

A typical lumber mill drying kiln.

In general, a high temperature grease with a VG 460 base oil and an extreme pressure (EP) additive is recommended. Examples include Chevron Ultra Duty #2, Lubricating Engineers 1250 Almasol, and Texaco Starplex Premium.

Viton 'O' Rings

In a lumber dry kiln application, C3 clearance between the rollers and the outer race, is not necessary. Since the bearings are mounted inside the kiln, they are at the same temperature as the shaft, and will expand at the same rate. However, due to the high temperatures, it is necessary to specify that Viton "O" rings be used in the ATL seal to replace the standard Buna/Neoprene "O" rings.

Application Description

Motors are used to power equipment directly; while generators are used to produce electricity to power other equipment. The output of a motor or generator is measured in Watts (W) or thousands of Watts (kW), or horsepower (Hp). Cooper has provided bearings for units where the power output is a few hundred kW to several thousand kW. Shaft sizes can range from 3 –1/2" to 36".

Advantages of Cooper

The split design of the Cooper bearing allows for installation and inspection in trapped locations. The cylindrical rollers used in a Cooper bearing are excellent for high speed, high load applications. A Cooper bearing can operate at high speeds using grease lubrication, where a tapered or spherical roller can't operate at that high of speed or would require oil lubrication.

One of the more common bearings being replaced with a Cooper bearing is a RENK sleeve bearing. This bearing requires a pressurized oil lubrication system. With a Cooper running on grease lubrication, the expensive cost of an oil system is eliminated.

Bearing Selection Data

When making a bearing selection for motors or generators, the weight of the rotor and shaft is required. The operating speed is also necessary. It is also important to note if a variable speed motor is used. The type of coupling should also be identified. A sketch would also be helpful to determine the bearing location and the required mounting arrangement.

Additional Information - Mounting Arrangements

The most common mount is a flange. When using a pillow block, if a platform is not provided for mounting the pillow block, our special high rise pedestal can be used. Please consult the engineering department for additional details, if necessary.

Electrical Specification (EL)

The electrical specification is a company procedure involving re-inspection and selective assembly to ensure that the tolerances of the locating spigot, the bearing components, and the spherical seat between the cartridge and pedestal or flange, are in the mid to low range of their respective tolerances.

The units will then be marked indicating the EL specification has been met.

FastFacts

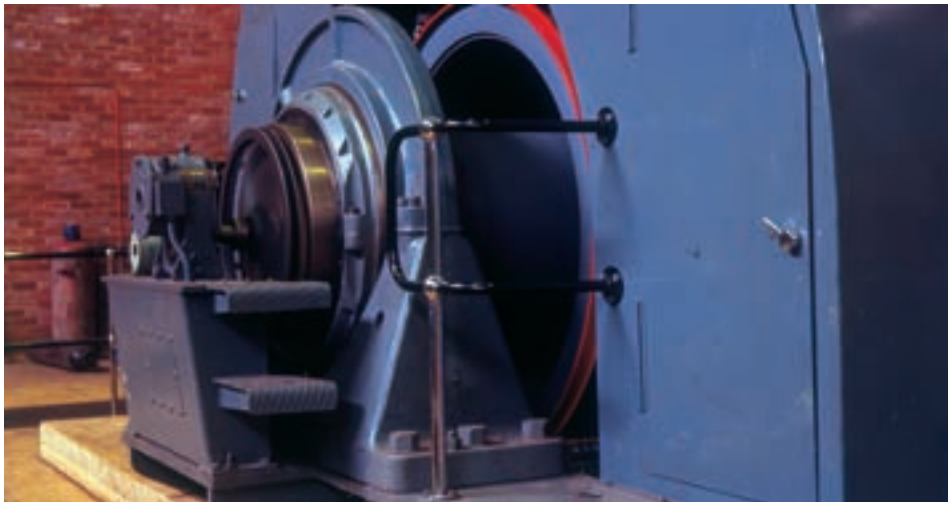
Where To Find Motors and Generators...

Motors can be found in any plant or manufacturing facility where large machinery is operated, such as steel mills. Generators are widely used in the power industry, such as hydro electric power plants.

What To Look For...

The most common arrangement has a center hung rotor supported at each end by a bearing. There are also single bearing arrangements as well. Pillow block and flange mounts are used.

Mill Motors using Cooper split roller bearings with high rise pedestals.



Lubrication

Extensive research was done in cooperation with a motor/generator OEM to find one grease that would meet a wide range of operating conditions (speed, loads, and shaft size). It was determined that a high temperature grease with a lithium complex thickener and extreme pressure additives should be used.

This grease should have a viscosity grade (VG) of 460. Some greases that meet this criteria are Lubricating Engineers 1250 Almasol and Texaco Starplex Premium.

Application Description

Pilger mills convert a round billet into seamless tubing. The billet may start out 12" (300mm) in diameter with a small hole through the center and end up 3/4" (19mm) in diameter. The billet is run through a die that reduces diameter while increasing length. The billet may start the pilgering process 20' (6 meters) long or less and end as several hundred feet (100 or more meters) of seamless tubing. The tubing can be copper or copper alloy, stainless steel or more exotic alloys.

The driving force is a large weight known as the mass compensator that moves vertically upward slowly under power and is then dropped suddenly to draw the billet through the die. The heart of the machine is a crankshaft with five split and two solid ring bearings on it. The solid ring bearings are conventional double row sphericals mounted in the machine box on either end of the crankshaft. They support half the load on the shaft.

Two bearings inboard of the pillow blocks are mounted in special connecting rods (con rods) that support the vertically moving large weight. Two bearings inboard of the weight bearings are also mounted in con rods that run horizontally to the die saddle. These are usually called the saddle bearings. The last bearing is mounted in a rigid housing, supports the center of the crankshaft and is called the center main.

The crankshaft rotates driving the weight up and moving the die back onto the billet. When the weight falls the die draws the billet forward squeezing it into a thinner and longer shape. While the crankshaft is rotating the con rods supporting the weight are moving up and down and the con rods pushing the die saddle are moving back and forth. This action is called reciprocating and causes significantly different loads on the bearings than simple rotation.

Pilger mill bearings are special in a number of ways. To reduce the shock load as the weight is dropped and the die moves forward the internal clearance is kept to a minimum. The minimum bearing clearance is called C2. The inner race of the bearing has a special chamfer

FastFacts

Where To Find Pilger Mills...

Seamless tubing is used in the chemical industry, some high pressure natural gas transmission lines and nuclear power plants. It is not surprising then that the builders of nuclear power plants, Westinghouse, General Electric and Combustion Engineering operate seamless tube mills. Tubing for the chemical industry tends to be exotic alloys made by specialty metal companies such as Sandvik Special Metals, Altech Specialty Metals and INCO Alloys.

What To Look For...

A removed crank shaft from a pilger mill.

on the inside diameter and grooves on the sides. These modifications enable it to fit tightly against the sides of the crank and allow lubrication to flow to the bearing. The cage has an extra strong joint that uses a steel ring with two screws securing each half. The sides of the cage have flanges projecting outward to contact the lips of the GR outer race. The outer race is a special "set out" design that enables it to grip the rod end more tightly than conventional bearings.

The clamp rings have a specially ground outside diameter so seal rings can ride there and have gaskets at the joints.

Advantages of Cooper

The nature of the crankshaft makes a split bearing the only alternative for the bearings in these locations.

Bearing Selection Data

Normally we want to know five things for a proper bearing selection. In the case of pilger mill bearings we need to concentrate on three.

Shaft size, as always, is a must. Speed, in this case expressed as cycles per minute, must also be known. The radial load is our primary concern and can be calculated from the amount of weight being dropped and how far it drops. Pilger mills have certain characteristics in common.
Because they are indoors and we know the life expectancy of the bearings, we do not need to know the environment or expected life.

Additional Information

The assembly of Cooper bearings on a pilger mill crankshaft is critical to bearing life. Because the load is reciprocating, the peak load of each cycle hits the inner race in the same place each revolution. It is essential to the life of the bearing to place the inner race joints 90 degrees away from the point of peak load. There should be a drawing showing where the inner race joints should be placed relative to top center on the crankshaft.

The seals are also critical to bearing life. In a survey done in 1997 indicated that the two biggest causes of bearing failure were the condition of aging machines and the wash out of bearing lubricant by the die lubricant. Careful assembly and greasing of the seals is required to hold bearing grease in the bearing while excluding die lubricant.

Lubrication is critical to the life of any bearing. The tremendous loads and relatively low speeds make lubrication difficult. In general an NLGI #2 grease with a minimum VG 460 base oil viscosity and an EP additive are required. Resistance to wash out is another important property. These properties are commonly found in high temperature greases. An alternative is to use synthetic grease with a minimum VG 460 base fluid viscosity.

NEVER MIX SYNTHETIC AND NON-SYNTHETIC GREASES IN A BEARING

Fast Facts

Where To Find Roll Tables...

Roll tables are found wherever metals are processed. This includes galvanizing lines, sheet metal coating facilities, rolling mills and casters. Both steel and aluminum are handled using roll tables. There are large numbers of bearings involved, two per roll on dozens or even hundreds of rolls. The best market for Cooper is where the environment is harsh, either from water spray or metal particles.

What To Look For...

Overhead view of roll table at the exit of a reheat furnace is shown on the left.

Application Description

Roll tables are used to transport sheet, plate or slabs of metal through a variety of processes that include rolling, coating and cooling. They consist of a number of rolls placed side by side to form a table between two process steps. There are usually guides of some type on either side of the rolls to keep the flat strip metal on the rollers. The steps can be between a reheat furnace and roll stand, unwinder and coating process (paint or galvanizing) or slab caster and cooling bed. The environment frequently includes heat, metal particles, water spray or a combination of the three.

A roll table consists of sections, typically of four rolls each, mounted on a steel frame. One or more of the rolls in each section are driven and the remainder are idlers. When a problem develops the entire "four-pack" can be removed for maintenance in a shop area.

Advantages of Cooper

Most of the original equipment solid ring bearings are either tapered bore with an adapter mount or straight bore that require a complex three step shaft arrangement with a threaded section. Installing adapter mount bearings requires proper tightening of the lock nut on the adapter. Too loose and the bearing slips, too tight and the clearance is removed from the bearing. Both problems lead to premature and frequent bearing failures. The clearance in a Cooper bearing is preset, just clamp it to the shaft with the recommended torque on the clamp ring screws.

When the straight bore bearings eventually fail, the shaft is damaged. The complex shaft arrangement with three steps and a threaded area make shaft repair a major job. Cooper bearings clamp to the shaft. When the bearing eventually fails it can be removed by cutting or burning the clamp ring screws.

In a hostile environment there is no better seal on the market than Cooper's aluminum triple labyrinth (ATL) seal. Depending on speed and temperature a full pack of grease may be used to further enhance the ATL seal capability. If conditions are not favorable for a full grease pack, grease ports can be added to the cartridge enabling grease to be pumped directly to the seal labyrinth.

Standard Cooper bearings are often not a direct match for the bearings already in place. Due to the large number of bearings involved in a roll table we have been willing to make special pedestals, seals and other components to fit the end user's needs. When shaft modifications have been necessary, as with three step shafts, Cooper has provided detailed drawings to the end user for their shaft modifications at no charge.

Bearing Selection Data

Like all other applications, we must know the shaft size. On rolls where there is a

Side view of a steel mill roll table

solid ring straight bore bearing and a three step shaft, we must also know the existing bearing and housing numbers and how long they are lasting.

Average life of the existing bearings can be determined most quickly from the total number of rolls (times two bearings per roll) divided by the number of bearings replaced in the past year.

Radial load will depend on the roll design and thickness, width and type of material being carried.

The best way to determine the roll weight and shaft arrangement at the bearings is to get a drawing of the roll.

The environment is a big factor. The two main components of the environment from a bearing standpoint are temperature and contaminants (water spray or metal particles).

Last but not least we will need the speed of the rolls in rpm.

Additional Information - Lubrication and Maintenance

Most relatively slow moving applications, especially with elevated temperatures, require a heavier lubrication than standard bearing grease.

Generally roll table bearings demand a lubricant with EP additives and a VG grade 460 base oil. Examples of these include Mobil Mobiltemp 78, Texaco Starplex Premium, and Lubricating Engineers 1250 Almasol.

Timely and frequent lubrication is a must to fulfil the expected life of a bearing. Generally, for roll tables, relubrication should occur every two to four weeks.

Relubrication coats the contacting surfaces with fresh grease, and purges any fine particles out of the bearing that were attempting to move past the triple labyrinth.

Application Description

Screw (or scroll) conveyors are used to convey many types of material, such as flour, lime phosphate, sugar beet pulp, cement, gypsum dust, and feathers.

The material is fed into a trough where it is then moved axially by the rotating screw, or flights until it reaches the discharge. The trough can be horizontal or inclined. The shaft diameter usually ranges from 3" to 6".

Typically the screw conveyor is direct driven through a gear reducer. The operating speeds range from 10 rpm to 120 rpm, usually with a 5 Hp to 100 Hp motor.

Advantages of Cooper

There are several advantages to choosing a Cooper bearing for use on screw conveyors. The split design of the bearing allows for ease of inspection and the ability to change a bearing without removing other components from the shaft.

If intermediate supports are used, the screw or flights usually can not be disassembled and a split bearing must be used.

Provided the operating speed is slow enough, less than 2000" dn (dn = shaft size x rpm), a full pack of grease could be maintained. The combination of our aluminum triple labyrinth (ATL) seal and a full pack of grease has proven to be a very effective method in keeping contamination from entering the bearing. Due to inadequate sealing, other bearings routinely fail from the contamination.

Bearing Selection Data

Screw conveyors are typically high thrust applications. The amount of thrust depends on many variables, such as the friction of the material being handled, its moisture content, the volume of material in the trough, the smoothness of the flights and the trough sides, etc.

Since there are so many factors in determining the thrust, it is nearly impossible to calculate. If the following information could be obtained, an approximation of the thrust load can be made.

The shaft size and shaft speed must be known. The horsepower must also be provided. The screw or flight diameter is necessary. The weight of the screw should also be known.

Also note if the trough is level or the angle of incline and the type of material being conveyed.

Additional Information - Clamping Force

The thrust capacity of the fixed bearing at low speed is higher than the clamping force of the clamp rings. When the thrust capacity of the bearing is sufficient, but the clamping force is not sufficient to hold the axial force, the shaft will slip through the bore of the inner race.

This situation requires the inner race to be fixed to the shaft in such a way that the shaft cannot slip through. The inner race can be mounted in a recess, or between retaining rings. If stainless steel shafting is used, the use of retaining rings or a recess is required.

Bearing Location

In these applications, the fixed bearing is usually located at the discharge end. This

FastFacts

Where To Find Screw Conveyors...

Screw conveyors can be found wherever there is a need to convey granular or powder like materials or where bulk materials must be conveyed. They can be found in the following industries, food processing, paper, sugar, and feed mills.

What To Look For...

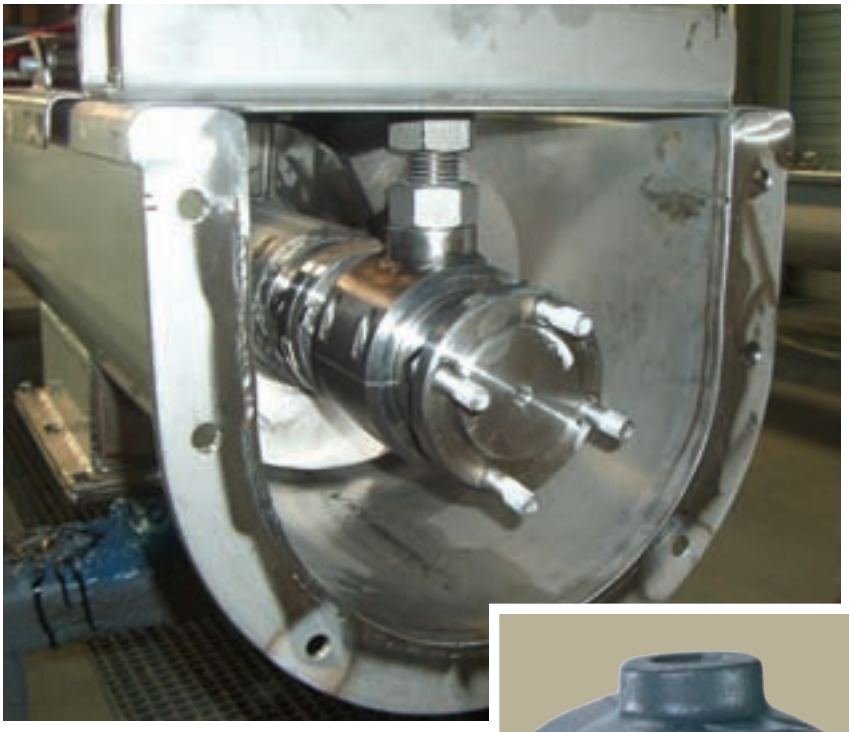
Image of a typical horizontal screw conveyor shown on the left.

will help keep the screw in tension and prevent it from buckling.

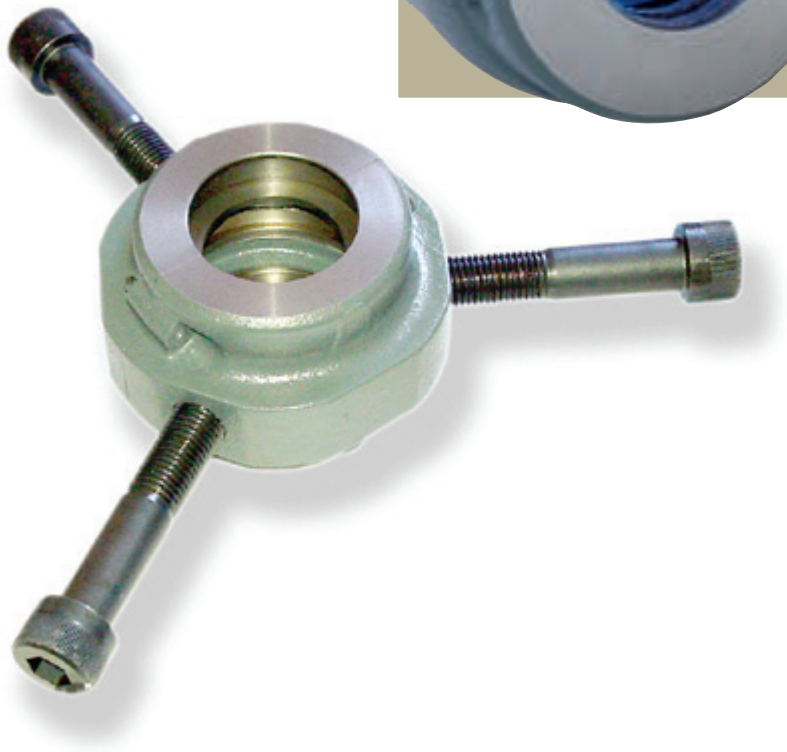
Mounting Arrangements

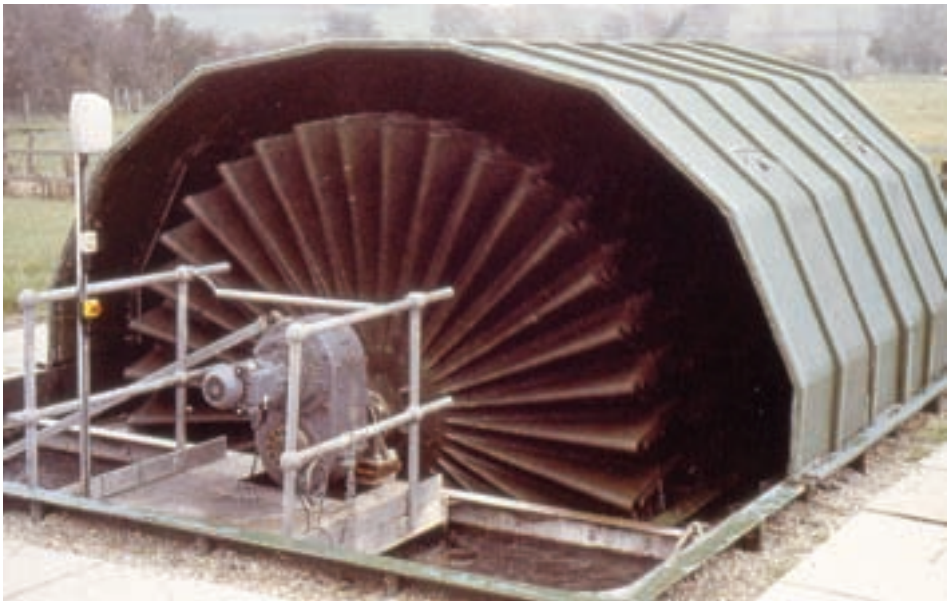
The screw is typically supported at each end of the trough. These bearing locations can be pillow block or flange mounts. The intermediate supports, if necessary, can either be hanger mounts (see picture below) or inverted pillow blocks. When inverted pillow blocks are used, the cartridge is usually rotated approximately 120° inside the pedestal.

This will keep the lube boss near top dead center so that the bearing can be lubricated manually or remotely without interfering with the operation of the screw.



As well as the standard hanger bearing, Cooper offer a triple mount hanger (shown below) and a stainless steel housing for use in the food industry (shown above).





Application Description

Our two biggest applications in sewage treatment have been Rotating Biological Contactors (RBC) and brush type aerators. Aerators and RBC's are used for a method called biological treatment. Bacteria, sometimes called "bugs", are introduced to waste stream to consume the sewage.

The bugs require a substantial amount of oxygen to grow and the BOD (biological oxygen demand) is supplied by pushing air into the water through aeration or exposing the biomass (bugs) to the air with an RBC.

A brush type aerator consists of a shaft spanning the waste stream or ditch. Attached to the shaft are galvanized steel or wooden paddles with something less than half their diameter submerged in the waste water. Air is pushed into the water by the paddles and some water is pushed into the air. Both functions serve to increase the level of dissolved oxygen in the water.

Shaft sizes vary with width of the ditch and diameter of the paddle wheel. The drive is usually a motor and gearbox of 25 to 50 hp (18 to 35 kW) with the aerator shaft speed under 60 rpm. Bearings will be 01 or 02 series according to load and L-10 life requirements. Pillow block mounts on either side of the ditch are the common support.

RBC's also consist of a shaft spanning the waste stream ditch. A large number of textured disks resembling oversized plastic waffles are placed on the shaft until it looks like a solid roll of the same diameter of the disks. The roll is submerged to varying extents in the waste stream. The biomass is introduced onto the large surface area created by the disks. As the shaft rotates the biomass on the disks is alternately exposed to the air and waste stream.

RBC's began to suffer shaft failures as the bugs grew and the weight of biomass clinging to the disks increased.

FastFacts

Where To Find Water Treatment...

In the late 1980's the United States government cracked down on municipalities that were not treating their waste water. This led to a change in the size and nature of treatment plants.

They are no longer confined only to large cities or even just to municipalities alone. Many smaller towns now require certain industries to pre-treat waste water before dumping it into the municipal system.

These industries include chemical, paper and meat packing.

What To Look For...

Rotating Biological Contactors.

The solution was to increase the portion of the disks that was submerged. This solution had the dual benefit of making the biomass "lighter" when submerged and increasing the contact time of the bacteria with the waste water. The unhealthy side effect was that the shaft and bearings became submerged. With the speeds low enough to allow for a full pack of water resistant grease, Cooper had a solution to offer.

Advantages of Cooper

There are several advantages to choosing a Cooper bearing for use on aerators and RBC's. The split design of the bearing allows for ease of inspection and the ability to change a bearing without removing other components from the shaft.

The aluminum triple labyrinth seal, along with a full pack of grease, will prevent any chemicals, sediment, or other foreign materials from entering the bearing, while submerged in operation. Due to inadequate sealing, other bearings fail from these contaminants and destroy the shaft as they fail. This not only requires a lengthy down time to fix the problem but a costly maintenance item to replace the worn shafts. With Cooper, the bearings and shaft can be inspected during routine maintenance.

Bearing Selection Data

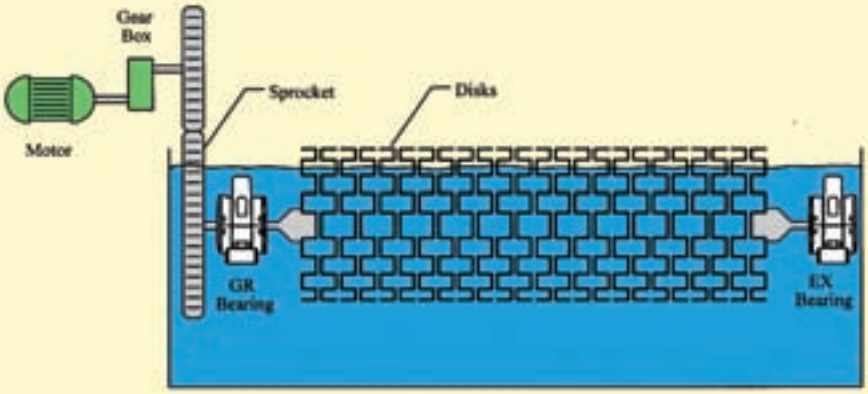
For bearing selection purposes the weight of the rotor assembly can be assumed to be equally divided between the two bearings. The load resulting from the drive torque will be applied to the drive side bearing only. The following information will be required:

1. Shaft diameter
2. Motor power and speed
3. Gearbox reduction ratio
4. Weight of the rotor
5. Diameter of paddles

Additional Information

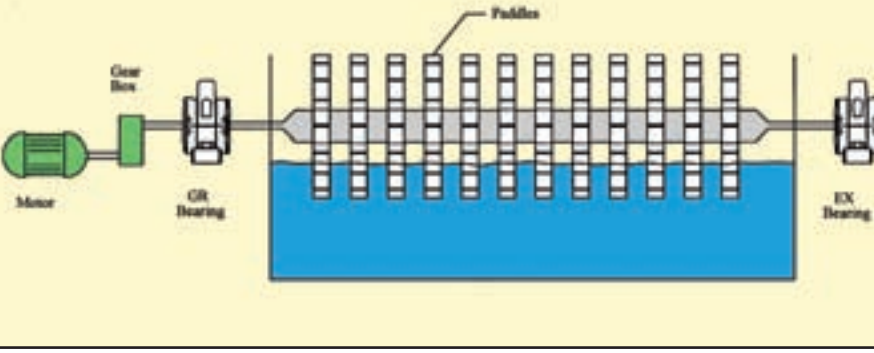
The bearing must be packed full of a water-resistant grease during assembly. The best way to keep a full pack in the bearing is with regular re-greasing. For submerged bearings, the best way to provide regular re-greasing is by running a length of tubing from each bearing to an accessible area. Remember to fill the tube with grease before connecting to the bearings.

A Typical Rotating Biological Contactor



A series a waffle textured disks placed side by side on a center shaft to create an apparently solid roll. This method creates a very large surface area for water to contact the biomass.

A Typical Disk Type Aerator



A series of radially oriented paddles along a common shaft create a "brush" type aerator. The rotating paddles push air into the water and kick up water into the air. Oxygen becomes dissolved in the water so the bacteria can breathe and grow.

END USER

Name: Company:

Address:

Telephone: Fax: Email:

DISTRIBUTOR

Name: Company:

Branch Address:

Telephone: Fax: Email:

EQUIPMENT

Equipment Name or Number:

Equipment Manufacturer:

SHAFT

Shaft Diameter:

Current Bearing:

LIFE

Current Bearing Life:

Expected Bearing Life:

SPEED

Bearing RPM:

or Motor Speed: and Sheave Diameter:

or Motor Speed: and Gearbox Ratio:

or Feet/Minutes: and Head Pulley Diameter:

OPERATING ENVIRONMENT

Wet Environment, Please Check:

Yes: ☐ No: ☐ Splashed or Sprayed: ☐ Submerged: ☐ Exposed to Elements: ☐

Temperature

Shaft Temperature: Ambient Temperature: Other Heat Sources:

Contamination

Material:

Extent of Contamination, Please Check: Light: ☐ Medium: ☐ Heavy: ☐

Do Bearings Fail Due to Contamination? Yes: ☐ No: ☐

LOAD

Type of Drive, Please Check:

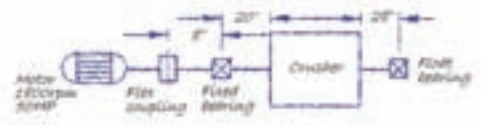
Direct Drive: ☐ Coupling Type: Flex Coupling: ☐ Rigid Coupling: ☐

Reduction Gear: ☐ with a Ratio of:

Belt Drive: ☐ with a Sheave Diameter of:

SKETCH OF APPLICATION AND COMMENTS

SAMPLE SKETCH



END USER

Name: Company:

Address:

Telephone: Fax: Email:

DISTRIBUTOR

Name: Company:

Branch Address:

Telephone: Fax: Email:

EQUIPMENT

Equipment Name or Number:

Equipment Manufacturer:

SHAFT

Shaft Diameter:

Current Bearing:

LIFE

Current Bearing Life:

Expected Bearing Life:

SPEED

Bearing RPM:

or Motor Speed: and Gear and Sprocket Ratio:

or Trunnion Diameter: and Trunnion Speed:

OPERATING ENVIRONMENT

Wet Environment, Please Check:

Yes: ☐ No: ☐ Splashed or Sprayed: ☐ Submerged: ☐ Exposed to Elements: ☐

Temperature

Shaft Temperature: Ambient Temperature: Other Heat Sources:

Contamination

Material:

Extent of Contamination, Please Check: Light: ☐ Medium: ☐ Heavy: ☐

Do Bearings Fail Due to Contamination? Yes: ☐ No: ☐

LOAD

Type of Drive, Please Check:

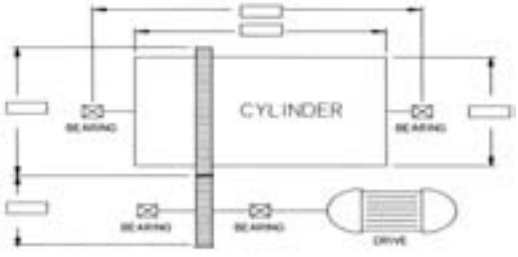
Pinion Drive: ☐ Chain Drive: ☐ Trunnion Drive: ☐

Drive Horsepower: Vessel Diameter: Angle of Incline:

Weight of Vessel, Balls or Hammer: Material:

SKETCH OF APPLICATION AND COMMENTS

SAMPLE SKETCH



END USER

Name: Company:

Address:

Telephone: Fax: Email:

DISTRIBUTOR

Name: Company:

Branch Address:

Telephone: Fax: Email:

EQUIPMENT

Equipment Name or Number:

Equipment Manufacturer:

SHAFT

Shaft Diameter:

Current Bearing:

LIFE

Current Bearing Life:

Expected Bearing Life:

SPEED

Bearing RPM:

or Motor Speed: and Gearbox Ratio:

or Motor Speed: and Head Pulley Diameter:

OPERATING ENVIRONMENT

Wet Environment, Please Check:

Yes: ☐ No: ☐ Splashed or Sprayed: ☐ Submerged: ☐ Exposed to Elements: ☐

Temperature

Shaft Temperature: Ambient Temperature: Other Heat Sources:

Contamination

Material:

Extent of Contamination, Please Check: Light: ☐ Medium: ☐ Heavy: ☐

Do Bearings Fail Due to Contamination? Yes: ☐ No: ☐

LOAD

Type of Drive, Please Check:

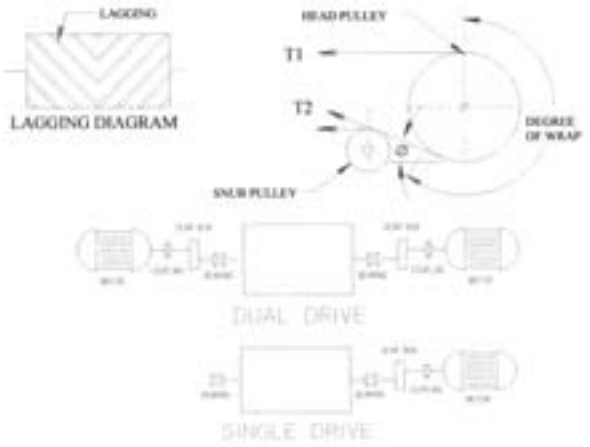
Direct Drive: ☐ Drive Horsepower:

Belt Drive ☐ → Flat Belt ☐
→ V-Belt ☐
→ Chain ☐

Shaft Mounted Speed Reducer: Yes ☐ No ☐ If Yes, Weight of Speed Reducer:

LOAD - Continued	PULLEY
Number of Motors:	Lagged ☐ or Plain ☐ Please Check
Angle of Incline:	Pulley Diameter
Total Drive HP:	Belt Weight: (lbs/ft).
FPM:	Degree of Wrap:
Belt Width:	
Overall Length:	

SKETCH OF APPLICATION AND COMMENTS



END USER

Name: Company:

Address:

Telephone: Fax: Email:

DISTRIBUTOR

Name: Company:

Branch Address:

Telephone: Fax: Email:

EQUIPMENT

Equipment Name or Number:

Equipment Manufacturer:

SHAFT

Shaft Diameter:

Current Bearing:

Vertical: ☐ or Horizontal: ☐

LIFE

Current Bearing Life:

Expected Bearing Life:

SPEED

Bearing RPM:

or Motor Speed: and Motor Sheave Diameter:

or Motor Speed: and Fan Sheave Diameter:

OPERATING ENVIRONMENT

Wet Environment, Please Check:

Yes: ☐ No: ☐ Splashed or Sprayed: ☐ Submerged: ☐ Exposed to Elements:

Temperature

Shaft Temperature: Ambient Temperature: Other Heat Sources:

Contamination

Material:

Extent of Contamination, Please Check: Light: ☐ Medium: ☐ Heavy: ☐

Do Bearings Fail Due to Contamination? Yes: ☐ No: ☐

LOAD

Type of Drive, Please Check:

Direct Drive: ☐ Belt Drive: ☐

Belt Drive ☐ → Flat Belt ☐
→ V-Belt ☐
→ Chain ☐

Drive Horsepower: Weight of Fan Wheel:

SINGLE INLET

Motor HP:

CFM:

Total Drive HP:

FPM:

Inlet Diameter:

Static Pressure:

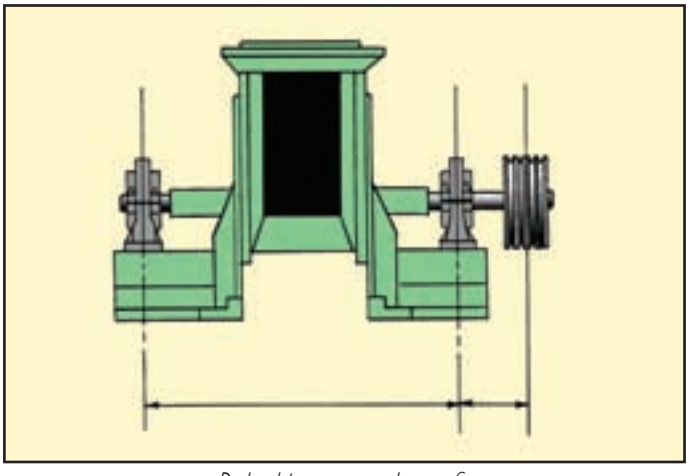
DOUBLE INLET

SW - Single Width DW - Double Width

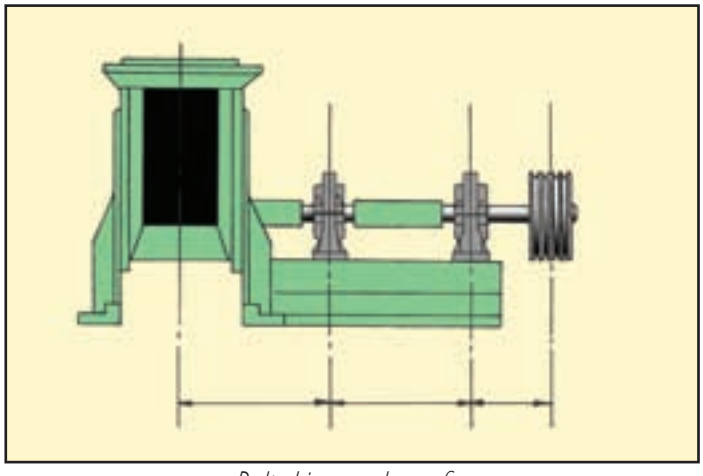
SI - Single Inlet DI - Double Inlet

SKETCH OF APPLICATION AND COMMENTS

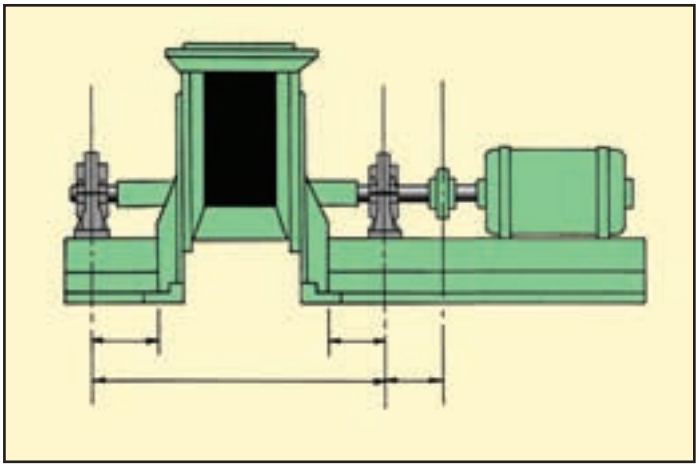
Please fill in dimensions ESPECIALLY for Overhung Arrangements



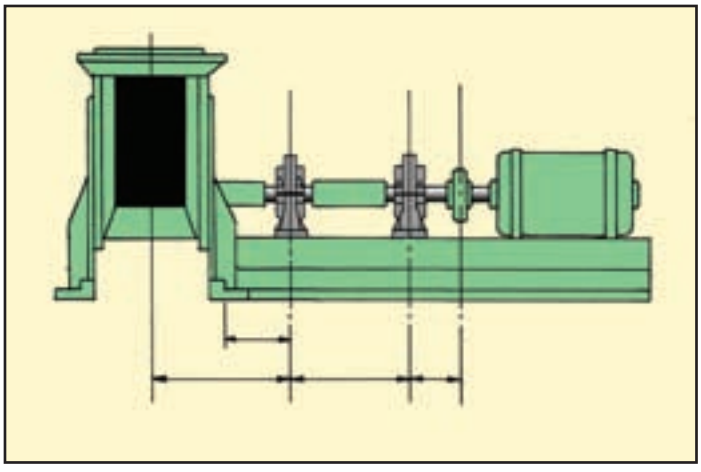
Belt drive center hung fan



Belt drive overhung fan



Direct drive center hung fan



Direct drive overhung fan

END USER

Name: Company:

Address:

Telephone: Fax: Email:

DISTRIBUTOR

Name: Company:

Branch Address:

Telephone: Fax: Email:

EQUIPMENT

Equipment Name or Number:

Equipment Manufacturer:

SHAFT

Shaft Diameter:

Current Bearing:

LIFE

Current Bearing Life:

Expected Bearing Life:

SPEED

Bearing RPM:

or Motor Speed: Gear and Sprocket Ratio:

or Motor Speed: and Speed Up: ☐ or Slow Down: ☐

OPERATING ENVIRONMENT

Wet Environment, Please Check:

Yes: ☐ No: ☐ Splashed or Sprayed: ☐ Submerged: ☐ Exposed to Elements:

Temperature

Shaft Temperature: Ambient Temperature: Other Heat Sources:

Contamination

Material:

Extent of Contamination, Please Check: Light: ☐ Medium: ☐ Heavy: ☐

Do Bearings Fail Due to Contamination? Yes: ☐ No: ☐

LOAD

Type of Drive, Please Check:

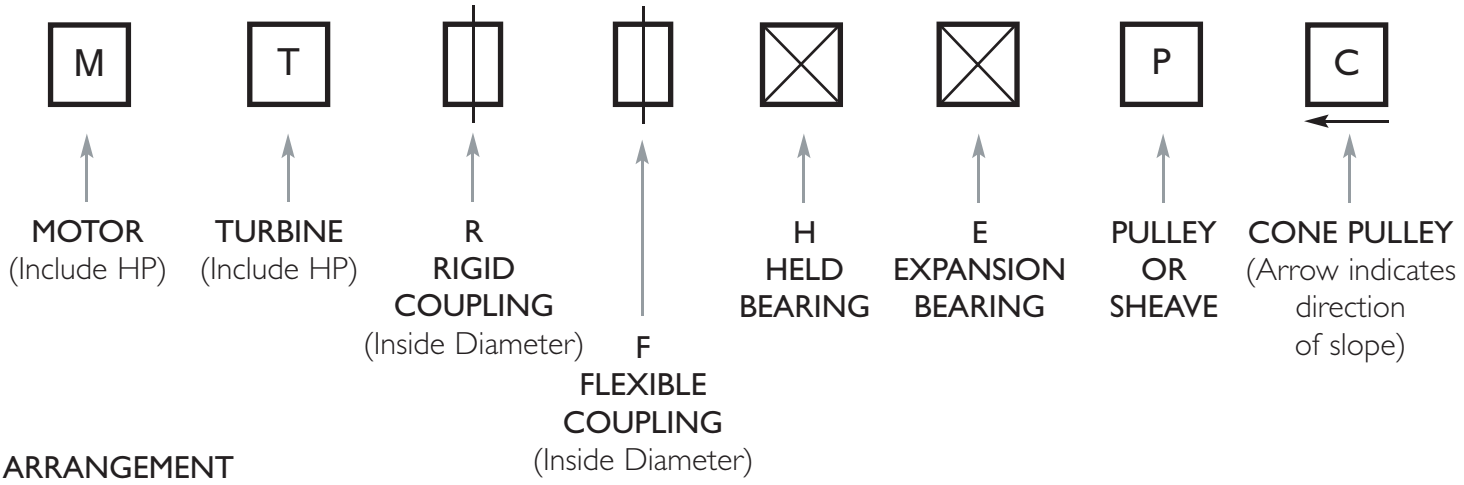
Direct Drive: ☐ Through Gearbox: ☐ Belt Drive: ☐ Drive Horsepower:

Are Power Take Offs (Sheaves/Pulleys) Drawing Equal Horsepower? Yes: ☐ No: ☐ Please Check

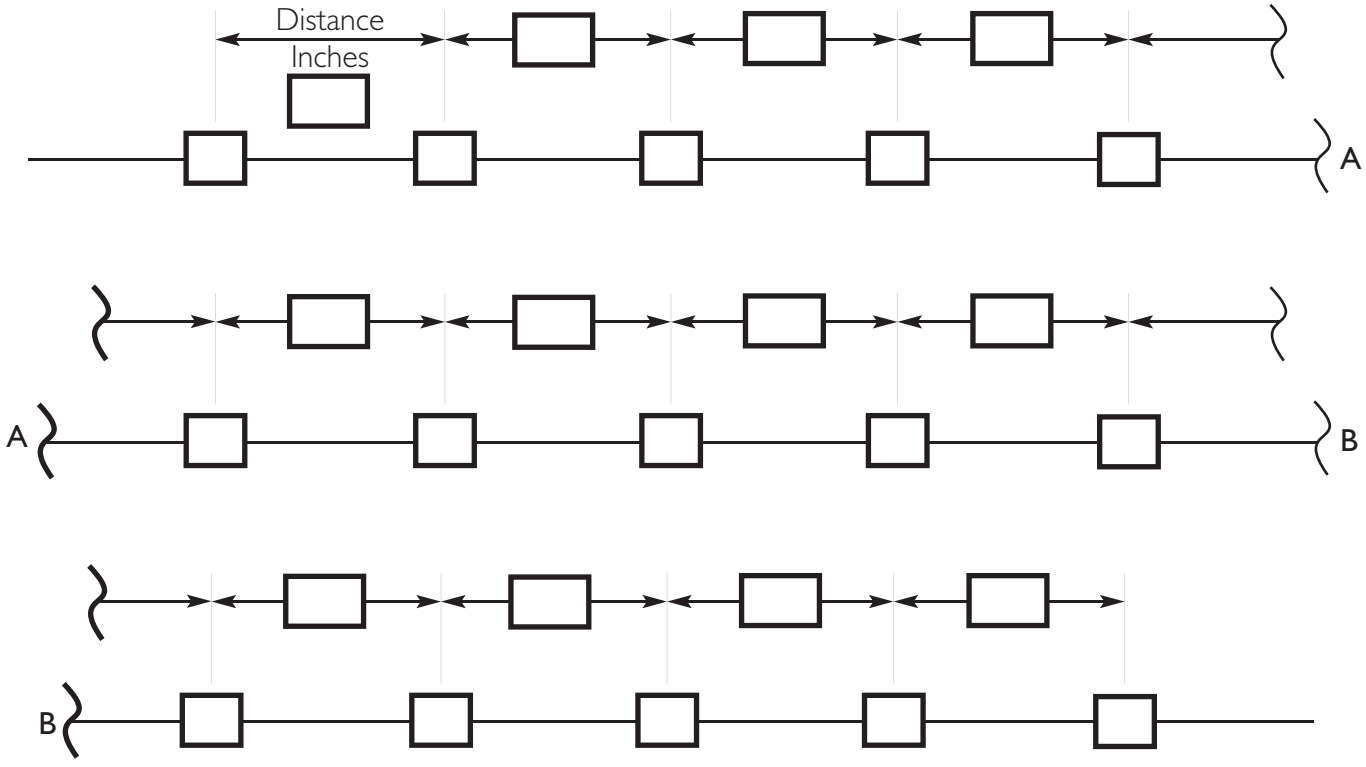
OR

If No, Which Draws the Majority Load?

PART LEGEND



ARRANGEMENT



END USER

Name: Company:

Address:

Telephone: Fax: Email:

DISTRIBUTOR

Name: Company:

Branch Address:

Telephone: Fax: Email:

EQUIPMENT

Equipment Name or Number:

Equipment Manufacturer:

SHAFT

Shaft Diameter:

Current Bearing:

LIFE

Current Bearing Life:

Expected Bearing Life:

SPEED

Bearing RPM:

or Motor Speed:

or Motor Speed: and Motor Sheave Diameter: and Mixer Sheave Diameter:

OPERATING ENVIRONMENT

Wet Environment, Please Check:

Yes: ☐ No: ☐ Splashed or Sprayed: ☐ Submerged: ☐ Exposed to Elements:

Temperature

Shaft Temperature: Surrounding Temperature: Other Heat Sources:

Contamination

Material:

Extent of Contamination, Please Check: Light: ☐ Medium: ☐ Heavy: ☐

Do Bearings Fail Due to Contamination? Yes: ☐ No: ☐

LOAD

Type of Drive, Please Check:

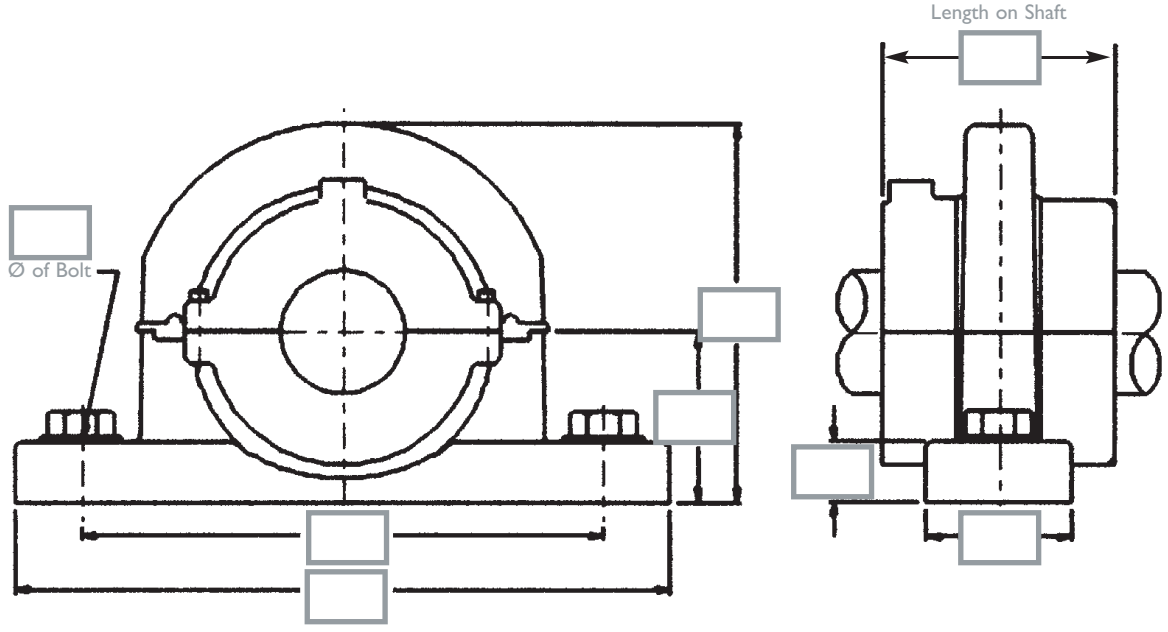
Direct Drive: ☐ or Belt Drive: ☐

Belt Drive ☐ → Flat Belt ☐
→ V-Belt ☐
→ Chain ☐

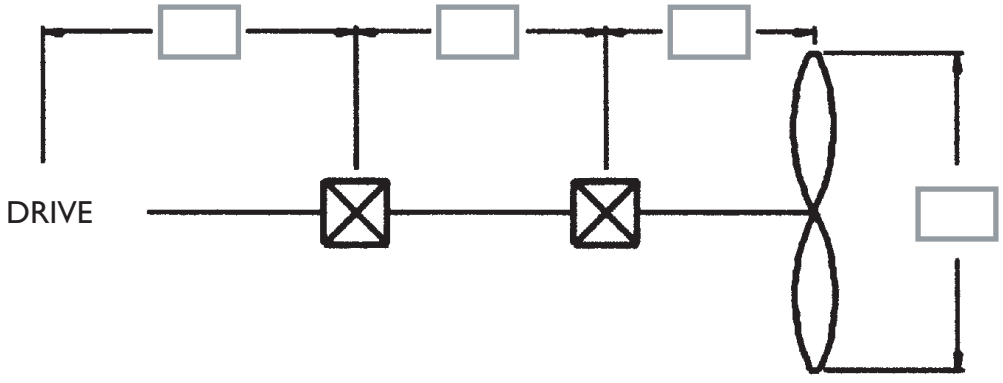
Drive Horsepower: Blade Diameter: Number of Blades:

For Vertical Shaft: Weight of Blade and Shaft:

DIMENSIONS OF EXISTING BEARING



ARRANGEMENT



COOPER
SPLIT ROLLER BEARINGS

Customer Service Centers

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PRC 100045
Tel: +86 (0) 10 68080803
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