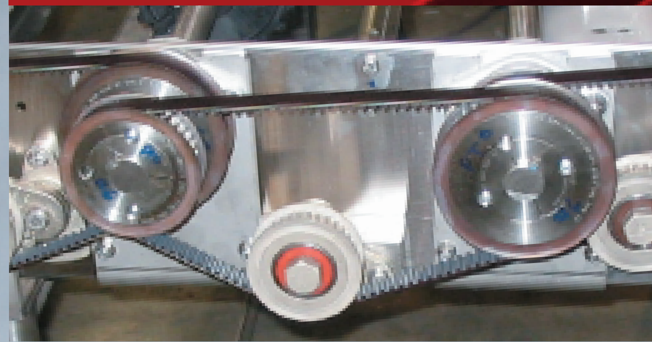
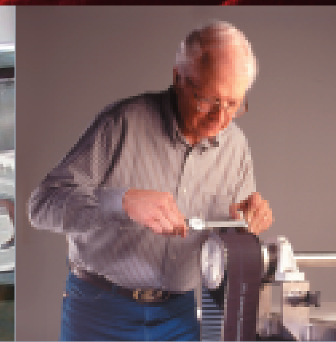


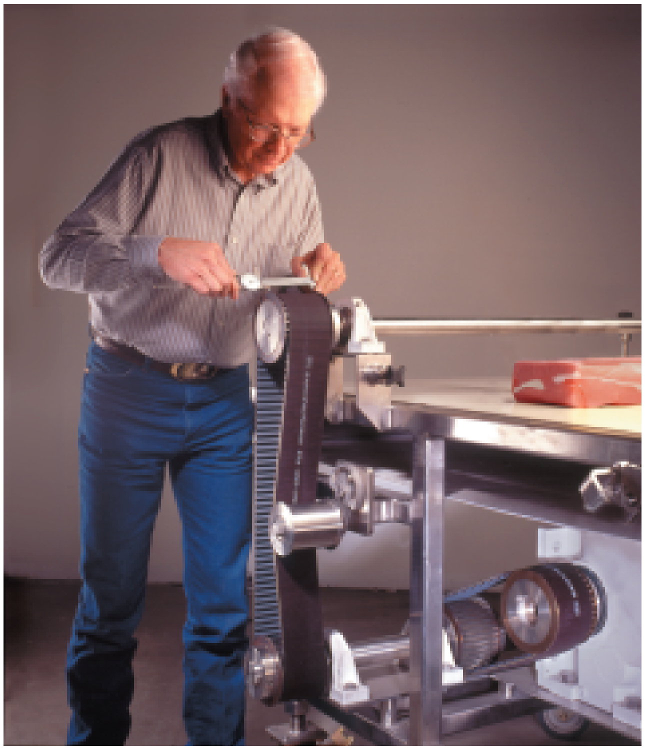


BELT PREVENTIVE MAINTENANCE FOR FOOD & BEVERAGE PROCESSING DRIVES

The Driving Force in Power Transmission®

Gates®

BELT PREVENTIVE MAINTENANCE FOR FOOD & BEVERAGE PROCESSING DRIVES



Gates engineers recommend Poly Chain® GT®2 drive systems with stainless steel sprockets because they are clean running and they resist caustic wash-down solutions.

Synchronous belt drive systems are an ideal replacement for chain, gear and V-belt drives in the food handling industry. Typical applications range from bucket elevators and belt conveyors, to pumps, dough mixers, bottling machines and meat grinders.

In general industrial applications, synchronous belt systems provide long, dependable life with reduced downtime and virtually no maintenance when installed according to the manufacturer's recommendations.

And, for food processors, synchronous belt drives are clean running systems that require no expensive oil baths or lubrication. When combined with stainless steel sprockets, the synchronous belt drive system has the added advantage of being able to resist chemicals, the build up of contaminants and caustic washdown solutions.

Most well designed systems should last on average two to three years. However, there are several factors that influence how often a belt drive should be replaced. These include drive-operating speed, drive-operating cycle, critical nature of the equipment, temperature extremes in the food processing area, environmental factors and accessibility of equipment. Since each drive system is unique, belt service life may be considered acceptable even if the belt only lasts a few weeks or months due to the harsh working environment.

Inspection Procedures

Unlike roller chain drives, if a synchronous belt system is installed properly, and retains its proper alignment when the system is loaded, there is no reason to check the drive until the belt fails.

Before installing a replacement belt, Gates Corporation Power Transmission Product Application engineers suggest that the drive be inspected to avoid future performance problems.

With the power shut off, locked and tagged, and the machine components in safe positions, remove the drive guard and inspect the belt for signs of unusual wear or damage. Symptoms such as excessive belt edge wear, tooth shear, belt cracking and tensile break are clues that may indicate the need to correct alignment, or to adjust tension to the correct values.

Synchronous belts are sensitive to misalignment and should not be used on drives where severe misalignment is inherent to the drive operation. Any improper tracking or severe sprocket misalignment will result in some reduction of belt life.

When a belt fails, the maintenance technician should inspect the sprockets to make sure they are not severely worn. If the sprockets have significant wear, the life of the next replacement belt will be significantly reduced. The sprockets need to be replaced at this time. In addition, they should be changed after every third replacement belt has reached its maximum service life.

Drive alignment

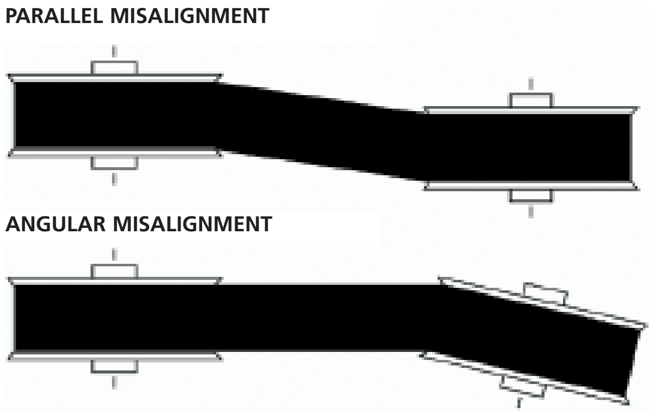
Misalignment is one of the most common causes of premature synchronous belt failure. Depending on its severity, misalignment can gradually reduce belt performance by increasing wear, fatigue and premature tensile failure due to unequal tensile member loading. Or, it can destroy a belt in a matter of hours or days.

While the forms of misalignment may be fairly well understood, accurate measurements and acceptable limits must be determined if maintenance technicians are to take corrective action.

Basically, any degree of misalignment, angular or parallel, will decrease the normal service life of a belt drive.

Angular misalignment

Angular misalignment has a severe effect on the performance of synchronous belt drives. Symptoms such as high belt tracking forces, uneven tooth/land wear, edge wear, high noise levels, and potential tensile failure due to uneven cord loading are possible. Also, wide belts are more sensitive to angular misalignment than narrow belts.



A synchronous drive system should be checked for parallel or angular misalignment before a new belt is installed.

Parallel misalignment

Parallel misalignment is generally not a critical concern with synchronous belt drives as long as the belt is not trapped or pinched between opposite flanges, and as long as the belt tracks completely on both sprockets.

Synchronous sprockets are designed with face widths greater than the belt widths to prevent problems associated with tolerance accumulation, and to allow for a small amount (fractions of an inch) of mounting offset.

As long as the width between opposite sprocket flanges exceeds the belt width, the belt will automatically align itself properly as it seeks a comfortable operating position on both sprockets. It is normal for a synchronous belt to lightly contact at least one of the sprocket flanges in the system while operating. Synchronous belts rarely run in the middle of the sprockets without contacting at least one flange.

Once it is aligned and tensioned correctly, a properly designed synchronous belt drive system will run maintenance free.

Checking alignment

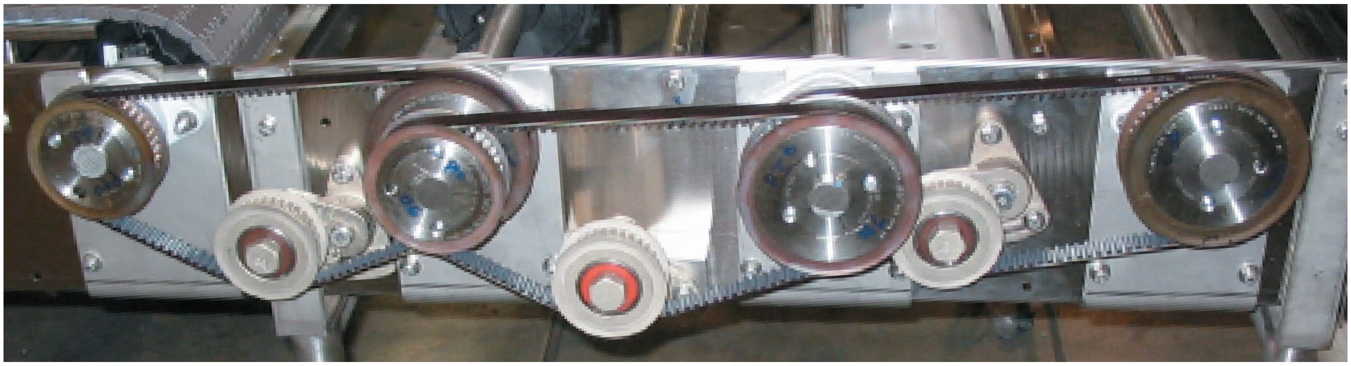
Misalignment of all synchronous belt drives should not exceed 1/4° or 1/16-inch per foot of center distance. Misalignment should be checked with a good straightedge tool. The tool should be applied from the driveR to driveN sprockets and from driveN to driveR sprockets, along the outside face of both sprockets. Misalignment will show up as a gap between the outside face of the sprocket and the straightedge.

A more precise method is to use the Gates EZ Align™ laser alignment device that uses a powerful reflected laser line to quickly identify the common types of sprocket misalignment.

Sprockets and shafts can be checked for tilting with a bubble level. Sprocket misalignment may result from the motor shaft and driveN machine shafts not being parallel, the sprockets not being properly located on the shafts, or the sprockets being tilted due to improper mounting.

Drive misalignment also can cause belt tracking problems. Although some belt tracking is normal and won't affect performance, optimum operation of the drive can only be achieved when the belt is contacting one flange in the drive system. When the belt contacts flanges on opposite sides of the sprockets in the system, the result can be undesirable parallel misalignment.

Improper installation of the bushing can result in the bushing/sprocket assembly being "cocked" on the shaft. This leads to angular misalignment and also increases the possibility of vibration. It is important to follow the instructions included with the bushing.



Some drive mounts may require extra plating or reinforcement to extend the service life of the synchronous belt system.

Checking bracketry
Maintenance technicians should also check related components, such as brackets and platforms, for proper design and placement. These parts must be strong enough to withstand the peak forces exerted by the drive without bending or flexing.

Synchronous belts are sensitive to fluctuations in the center distance that can be caused by inadequate bracketry. Because brackets and motor mounts used in food processing are often made of light-weight aluminum, rather than hardened steel, they can flex under load, causing misalignment and affecting components in the drive system. Center distance variation of as little as .004-inches resulting from flexing motor supports can negatively influence overall drive performance.

With the drive shut off and safely locked out, structural rigidity can be checked by pushing the two belt spans toward each other and looking for relative movement in the structure. If movement of the motor or center distance is noticed, the drive likely will have a structure that is insufficient for maintaining the expected service life of the belt. The structure should be reinforced to obtain the maximum performance from a synchronous belt drive. Whenever possible, a support should be fixed on both side frames of the motor, and be both horizontally and vertically adjustable.

The alignment of the drive should be checked both before and after belt tensioning since belt tensioning can possibly move some components.

Belt tensioning

Proper belt installation tension is important to the optimum performance and longevity of a synchronous drive system. Unfortunately, Gates engineers say a vast majority of synchronous drives are not tensioned properly.

A synchronous belt requires correct tensioning when installed, and should be retensioned after a 24-hour run in period. Subsequently, retensioning is not necessary unless drive conditions are altered.

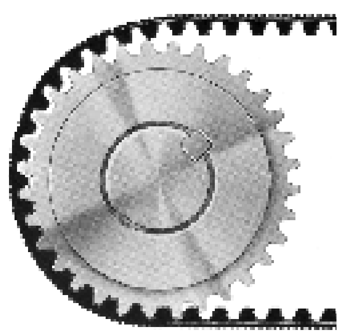
For synchronous drive systems, ideal tension is the lowest tension that properly seats the belt in the driveN sprocket on the slack side.

The calculated tension range at which belts should be installed depends on the drive components, and the load and speed of the drive. The belt manufacturer's recommendations should be followed to determine the calculated installation tension values. Due to system inefficiencies, belt drives are often carrying far less load than they were selected to carry.

The two extremes of improper tensioning are under- and over-tensioning.

Studies by Gates engineers show that most synchronous belt drive systems are drastically under-tensioned.

When a belt is under-tensioned, it will prematurely wear the belt teeth and possibly even ratchet (jump teeth) under heavy start up loads, shock loads, or structural flexing. Ratcheting increases stress on the belt teeth, accelerates tooth/groove wear and reduces belt life.



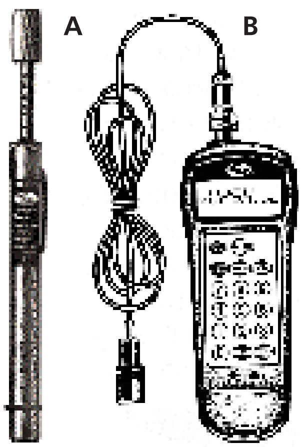
On an undertensioned drive, the belt teeth on the slack side of the drive will ride up on the sprocket teeth and cause premature belt wear.

Dynamic crimping – when the belt is not properly seating in the sprocket grooves – accounts for most under-tensioning failures. When this happens the tooth acts as a lever arm that pinches the tension cord at a sharp angle. This pinch point dramatically weakens the tension cord causing a failure point. The belt will then prematurely break.

This break will occur straight across the belt (parallel to the teeth), and usually takes place a few weeks or months after installation, depending on the severity of under-tensioning.

Ratcheting can also result in potential damage to bearings, shafts, and other drive components.

If a belt is over-tensioned, it will wear in the land area (area between the belt teeth). With the land areas gone, the teeth are very susceptible to falling off, but the belt may continue to run on the drive. Since the cord is directly exposed to the metal and the belt is able to slip, severe hardware damage can result. This can lead to premature belt failure. Over-tensioning also can damage bearings, shafts, and other drive components.



Tensioning tools

Gates engineers do not recommend using an "experienced thumb" for determining proper belt tension. Rather, they suggest that maintenance technicians use mechanical or electronic tools.

One inexpensive, easy-to-carry tool is a pencil-type spring force tension gauge (A) that measures static belt tension by indicating force at a specified deflection of the belt span.

For extremely accurate belt tension measuring, a sophisticated electronic sonic tension meter (B) works on the theory that a belt vibrates at a particular frequency based on the belt span length, belt width and belt type. To test the tension, simply strum the belt to set it vibrating, and the meter records the resulting oscillating sound wave as a tension value.

Approximately 24 hours after the drive has been aligned and tensioned, it should be rechecked for proper installation.

Sprocket maintenance

A common misperception about synchronous belt systems is that sprockets never wear out.

Gates application engineers report that a significant percentage of the belt drive problems they investigate can be traced to worn, nicked or cut sprockets.

A sure sign of sprocket wear is abnormal belt wear, and belt service life that progressively worsens with each belt that is installed. Most sprocket wear on an unprotected drive is due to abrasion caused by air-borne particulate matter, such as powdered foods like flour, salt and sugar, in the vicinity of the drive.

Nicks or cuts should be repaired immediately.

For applications requiring clean operating environments, such as food and beverage manufacturing, Gates recommends the use of stainless steel sprockets and bushings. Stainless steel is ideally suited for processes requiring optimal cleanliness and frequent high-pressure washdowns using caustic solutions and foam degreasers.

For food processing synchronous belt drives, Gates engineers recommend long-lasting, corrosion-resistant stainless steel sprockets.

Although a synchronous belt drive system using stainless steel sprockets is more costly than a metal sprocket system, the use of stainless steel roller chains and sprockets is four-to-five times more expensive than standard roller chain.

Conclusion

When installed properly with the correct alignment and tension, synchronous belt drives are virtually maintenance free. Synchronous belt drive systems require no lubrication. They do not give off the oil spray associated with roller chain drives. Clean operation makes them ideal for contamination-sensitive applications such as food handling and bottling. For drives requiring optimal clean operating conditions, synchronous belt and stainless steel sprocket drive systems are designed to carry extremely high power ratings, and they resist corrosion and caustic washdown solutions.

Additional resources

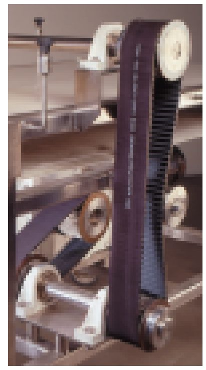
Gates Belt Preventive Maintenance and Safety program provides user tips ranging from inspection to installation of V-belts and synchronous belts. Also included is information on reducing downtime, controlling parts replacement costs and increasing energy savings. To schedule a free belt preventive maintenance seminar at your facility, download a copy of Gates 48-page "Belt Drive Preventive Maintenance & Safety Manual," or sign up for Gates free weekly "Belt Tips" email service, go to **www.gates.com/beltpm**.

For additional information on Gates clean running, maintenance free Poly Chain® GT®2 synchronous belt drive systems with stainless steel sprockets, go to **www.gates.com/stainless**.

To locate a Gates power transmission distributor in your area, go to **www.gates.com/distributors**.

To schedule a visit with a Gates Industrial sales representative, call 1-800-777-6363.

For technical assistance from Gates Power Transmission Product Application engineers, call 303-744-5800, or email **ptpasupport@gates.com.**

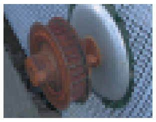
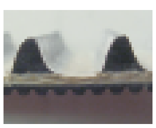
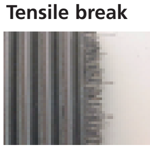


How to Install a Synchronous Belt

Follow these steps to install a synchronous drive belt: *(Warning: Do not crimp belts during handling or installation.)*

1. After power has been locked out and tagged, loosen the motor mounting bolts. Move the motor until the belt is slack and can be removed without prying it off the drive.
2. Remove the old belt and check it for unusual wear. Excessive wear may indicate problems with drive design or misalignment of the sprockets.
3. Clean sprockets by wiping with a rag slightly dampened with a light, non-volatile solvent. Scraping sprockets with a sharp object to remove grease or debris is not recommended.
4. Inspect sprockets for unusual or excessive wear.
5. Check alignment. Proper alignment is critical for maintaining the performance of synchronous belt drives.
6. Check other drive components such as bearings and shafts for alignment, lubrication, wear, etc.
7. Select correct replacement belt. (See Gates Belt/Sprocket Interchange Guide 12998-B)
8. Install the new belt over the sprockets. Do not pry the belt onto the drive.
9. Take up the center distance on the drive until proper tension is obtained using a tension tester. Rotate drive by hand for a few revolutions, and re-check the tension and alignment.
10. Secure the motor mounting bolts to the correct torque. Be sure all drive components are secure.
11. Start up the drive and observe its performance. Listen and look for unusual noise or vibration. Shut down the machine and check the bearings and the motor. If they feel hot, belt tension may be too tight or bearings may be misaligned or not lubricated correctly. The drive should be retensioned after a 24-hour run in period. If the tension has dropped significantly, the drive should be retensioned. The drive will not require any further tensioning.

Troubleshooting Synchronous Belt Drive Systems

Symptom	Diagnosis	Remedy
Rust contamination 	Rust caused by high moisture conditions in the production area or the use of water-based cleaning solvents	Replace cast iron sprockets and bushings with stainless steel components
		Replace cast iron sprockets with nickel plated sprockets and stainless steel bushings
Unusual noise 	Misaligned drive	Correct alignment
	Too low or high belt tension	Adjust tension to recommended value
	Backside idler	Use inside idler
	Worn sprocket	Replace sprocket
	Bent guide flange	Replace sprocket/flange
	Belt speed too high	Redesign drive
	Incorrect belt profile for the sprocket	Use similar belt/sprocket profile
	Subminimal diameter	Redesign drive using larger diameters
	Excess load	Redesign drive for increased capacity
Tension loss 	Weak support structure	Reinforce the structure
	Excessive sprocket wear	Replace sprocket or consider the use of an alternate sprocket material
	Fixed (nonadjustable) centers	Use inside idler for belt adjustment
	Excessive debris	Protect drive
	Excessive load	Redesign drive for increased capacity
	Subminimal diameter	Redesign drive using larger diameters
	Belt, sprockets or shafts running too hot	Check for conductive heat transfer from prime mover
	Unusual belt degradation, such as softening or melting	Reduce ambient drive temperature to 180°F maximum
Excessive belt edge wear 	Damage due to handling	Follow proper handling instructions
	Flange damage	Repair flange or replace sprocket
	Belt too wide	Use proper width sprocket
	Belt tension too low	Adjust tension to recommended value
	Rough flange surface finish	Replace or repair flange to eliminate abrasive surface
	Improper tracking	Correct alignment
	Belt hitting drive guard or bracketry	Remove obstruction or use inside idler
Premature tooth wear 	Too low or high belt tension	Adjust tension to recommended value
	Belt running partly off unflanged sprocket	Correct alignment
	Misaligned drive	Correct alignment
	Incorrect belt profile for the sprocket	Use similar belt/sprocket profile
	Worn sprocket	Replace sprocket
	Rough sprocket teeth	Replace sprocket
	Damaged sprocket	Replace sprocket
	Sprocket not to dimensional specification	Replace sprocket
	Belt hitting drive bracketry or other structure	Remove obstruction or use inside idler
	Excessive load	Redesign drive for increased capacity
	Insufficient hardness of sprocket material	Use a more wear resistant material
	Excessive debris	Protect belt
	Cocked bushing/sprocket assembly	Install bushing per instructions
Tooth shear 	Excessive shock loads	Redesign drive for increased capacity
	Less than 6 teeth-in-mesh	Redesign drive
	Extreme sprocket runout	Replace sprocket
	Worn sprocket	Replace sprocket
	Backside idler	Use inside idler
	Incorrect belt profile for the sprocket	Use similar belt/sprocket profile
	Misaligned drive	Correct alignment
	Belt undertensioned	Adjust tension to recommended value
Tensile break 	Excessive shock load	Redesign drive for increased capacity
	Subminimal diameter	Redesign drive using larger diameters
	Improper belt handling and storage prior to installation	Follow proper handling and storage procedures
	Debris or foreign object in drive	Protect drive
	Extreme sprocket runout	Replace sprocket
	Unusual sprocket wear	Use alternate sprocket material
	Dynamic crimp	Increase belt tension
Belt cracking 	Backside idler	Use inside idler
	Extreme low temperature startup	Preheat drive environment
	Extended exposure to harsh chemicals	Protect drive
	Extreme high temperatures	Try to remove heat; contact Gates for alternative belt constructions
	Cocked bushing/sprocket assembly	Install bushing per instructions
	Misaligned drive	Correct alignment
	Too low or too high belt tension	Adjust tension to recommended value

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