INSTALLATION AND TENSIONING GUIDE

Synchronous timing belt drives operate by positively engaging the teeth moulded to the timing belt with the corresponding teeth of a pulley. Synchronous timing belts do not rely on friction to transmit power (i.e. V Belts), and should not be confused with moulded-notch V Belts which transmit power by the wedging action of the V-shape. The positive engagement of the two sets of meshing teeth allows synchronous timing belts to transmit large torques and withstand large accelerations. Because of the positive engagement there is little relative motion and most importantly NO SLIP between the meshing teeth. Synchronous timing belts are extremely useful in applications where indexing, positioning or a constant speed ratio is required.

For correct installation of timing belt drives we recommend the following:

1. LOOSEN MOTOR

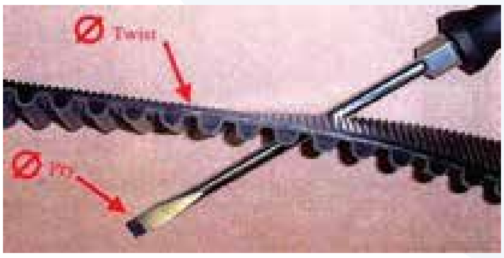
Check to make sure that the motor is OFF, a lock-out/ tag-out procedure should be in place to prevent accidentally motor start-ups. Loosen motor mounting bolts. Move motor until existing timing belt is slack and can be removed without prying.
NEVER PRY OFF A TIMING BELT, PRYING THE TIMING BELT WILL DAMAGE THE TIMING BELT PULLEYS TEETH AND/ OR FLANGE THAT YOU ARE LEVERAGING AGAINST.

2. REMOVE OLD TIMING BELT

Remove old timing belt and check the timing belt for unusual wear. Excessive wear may indicate problems with the drive design or preventive maintenance program.

3. SELECT CORRECT REPLACEMENT TIMING BELT

Selection of the correct timing belt replacement is critical.



Caution must be taken if any of the timing belt pulleys have been replaced with a timing belt pulley containing a different number of teeth. Besides the ratio being changed the center to center distance requirements will have changed for the timing belt also. Make sure that you are using the right length timing belt.
NEVER FORCE ON A TIMING BELT THAT WILL JUST FIT, PRYING THE TIMING BELT ON WILL CRACK THE TENSILE CORD MEMBERS INSIDE THE TIMING BELT LEADING TO PREMATURE BELT FAILURE.

4. CLEAN THE TIMING BELT PULLEYS

Timing belt pulleys may be cleaned by wiping with a rag slightly dampened with a light, non-volatile solvent. Soaking or brushing the solvent on the timing belt is not advisable. Obviously, sanding or scraping the timing belt or timing belt pulley with a sharp object to remove grease or debris is not recommended. Timing belts must be dry before using on a drive.

5. INSPECT THE TIMING BELT PULLEYS

Inspect the timing belt pulleys for unusual or excessive wear.

6. PROPER ALIGNMENT

The two main types of drive misalignment are ANGULAR and PARALLEL as illustrated in the below pictures.

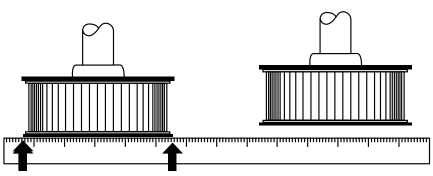


Fig. 26 Parallel Misalignnment

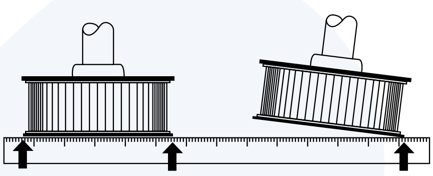
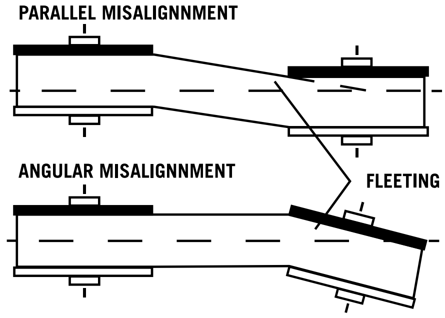


Fig. 25 Angular Misalignment



Timing belt drive alignment is one of the most common causes of drive performance problems. Misaligned drives can show symptoms such as:

- high timing belt tracking forces
- uneven timing belt tooth wear
- high noise levels
- uneven load distribution
- timing belt tensile cord failure

Angular Misalignment

- Angular misalignment is where the driver and driven shafts are not parallel, resulting in uneven loading of the timing belt tensile cords. The tensile cords on the high tension side are often overloaded which may cause edge cord failure which would be transmitted across the width of the timing belt. This misalignment also results in high timing belt tracking forces which causes excessive timing belt edge wear.

Parallel Misalignment

- Parallel misalignment is where the driver and driven shafts are parallel but the driver and driven timing belt pulleys on these shafts lie in different planes.

ANY DEGREE OF MISALIGNMENT WILL RESULT IN SOME REDUCTION OF BELT LIFE, WHICH IS NOT ACCOUNTED FOR IN THE NORMAL DRIVE DESIGN PROCEDURE. MISALIGNMENT OF TIMING BELT DRIVES SHOULD BE LESS THAN 1/4° DEGREE OR 1/16 PER FOOT OF LINEAR DISTANCE.

A simple procedure to check misalignment (both parallel and angular) is by using a straightedge (ruler) to check alignment as the previous illustration shows. The straightedge should be long enough to span the distance between the two outside edges of the timing belt pulley faces. Lay the ruler across the face of the two timing belt pulleys, if the two timing belt pulley faces are not even with the straightedge than you have parallel misalignment. Another possibility with using the straightedge method would be that one of the timing belt pulley faces would lay flush with the straightedge while the other timing belt pulley would have only one edge of the timing belt pulley face touching the straightedge. In this scenario an angular misalignment would be represented. This process should then be reversed using the opposite timing belt pulley as a starting point so that the total effect of the misalignment is taken into account. Remember to account for differences in the timing belt pulley edge thickness dimension and also the degree of bend on the timing belt pulley flanges.

Another procedure for checking for parallel misalignment would be to accurately measure the distance between the shafts at three (3) points along the shaft. The distance between the shafts should be the same at all three (3) points.

ALSO MAKE SURE THAT THE SHAFTS ARE RIGIDLY MOUNTED. SHAFTS SHOULD NOT DEFLECT WHEN THE TIMING BELT IS TENSIONED. A NON-RIGID MOUNT CAUSES VARIATION IN THE CENTER TO CENTER DISTANCES RESULTING IN TIMING BELT SLACK. THIS TIMING BELT SLACK COULD LEAD TO A RATCHETING OF TEETH ON THE TIMING BELT PULLEY - ESPECIALLY UNDER STARTING LOAD WITH SHAFT MISALIGNMENT.

7. INSTALL A NEW TIMING BELT

Install the new CMW timing belt over the timing belt pulleys. Do not pry or use force, loosen the motor mount and/or mounting brackets to loosely install the timing belt.

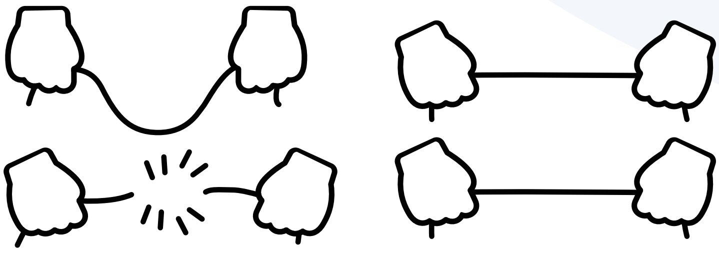
NEVER PRY ON A TIMING BELT, PRYING THE TIMING BELT WILL DAMAGE THE TIMING BELT PULLEYS TEETH AND/OR FLANGE THAT YOU ARE LEVERAGING AGAINST.

NEVER FORCE ON A TIMING BELT THAT WILL JUST FIT. PRYING THE TIMING BELT ON WILL CRACK THE TENSILE CORD MEMBERS INSIDE THE TIMING BELT.

8. PRE-TENSIONING/FINAL TENSIONING

Proper tensioning cannot be stressed enough, too loose of tensioning will cause the timing belt to ratchet (tooth jumping), while too tight of tensioning will possibly cause damage to the bearings, shafts and other drive components besides dramatically reducing timing belt life. The correct timing belt tension is the lowest tension at which timing belts will transmit the required mechanical power and not ratchet teeth when the drive is under a full load.

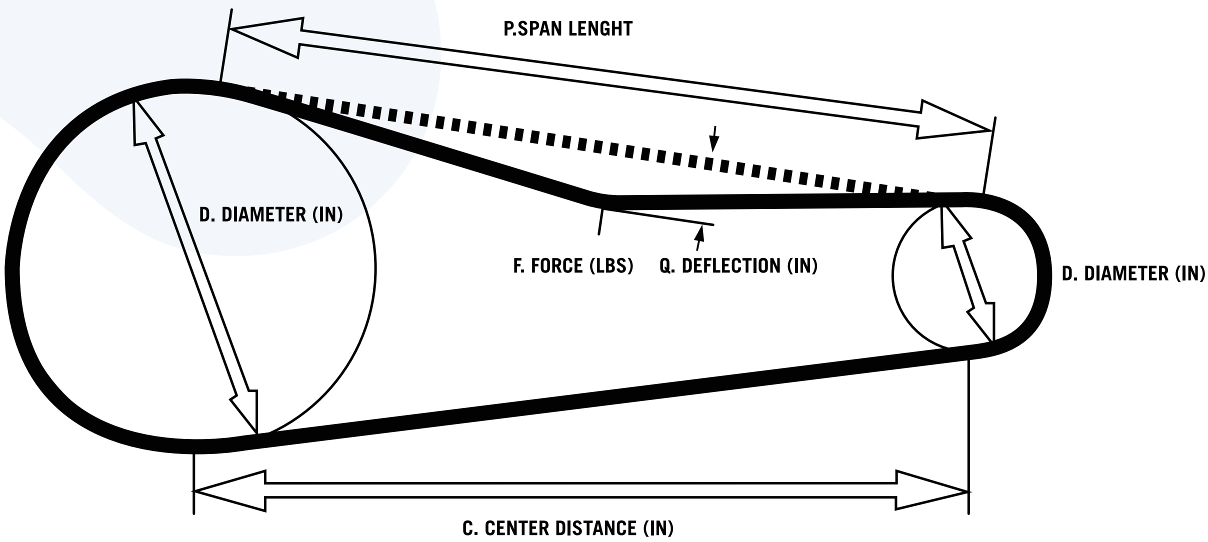
Loose timing belt tensioning acts like a loosely-held piece of string, with a snapping action as in a high torque situation the string or timing belt will break because the added stress is more than the timing belt was designed to take. While a taut string or timing belt can stand a strong pull.



Take up any loose slack in the timing belt by adjusting the centre to centre distance between the two timing belt pulleys. Before any final tensioning is to be applied make sure that the timing belt teeth are fully seated in the tooth grooves on both timing belt pulleys. Check to make sure that the timing belt teeth stay seated in the tooth grooves by rotating the drive system by hand. After the pre-tensioning steps are completed there are several methods for verifying proper final tensioning.

Numerical Method (Force/Deflection)

By measuring the deflection of the timing belt with a known force the required tension can be applied. While being a relatively quick method, this method is usually not very accurate. Primarily due to the difficulty in measuring small deflections and forces common in small timing belt drives. This method is better suited for larger drives with long belt spans.



F = Deflection Force
q = Deflection, 1/64" per inch of span length
c = Center Distance
D = Large Pulley Pitch Diameter
d = Small Pulley Pitch Diameter
P = Span Length

Before beginning, inspect the timing belt for damage and verify that the timing belt pulleys are properly aligned (parallel and angular).

1. Shorten the center distance or release the tensioning idler to install the timing belt. Do not pry the timing belt onto the timing belt pulleys.

2. Place the timing belt on each timing belt pulley and ensure proper engagement between the timing belt pulley and timing belt teeth.

3. Lengthen the center distance or adjust the tensioning idler to remove any timing belt slack.

4. Using a tape measure, measure the span length of the drive in inches. Refer to dimension “P” in the diagram above..

5. First determine the proper deflection force required to tension the timing belt. Place a straightedge across the top of the timing belt. At the center of the span length “P” apply force using a pencil style tension gauge perpendicular to the span length “P” (see below picture).

Polígono Industrial O Rebullón s/n. 36416 - Mos - España - rodavigo@rodavigo.com

• When using a pencil style tension gauge, the deflection scale is calibrated in inches of span length. Set the (large) O-ring on the body of the pencil style tension gauge at the dimension equal to 1/64” inch for every inch of span length.

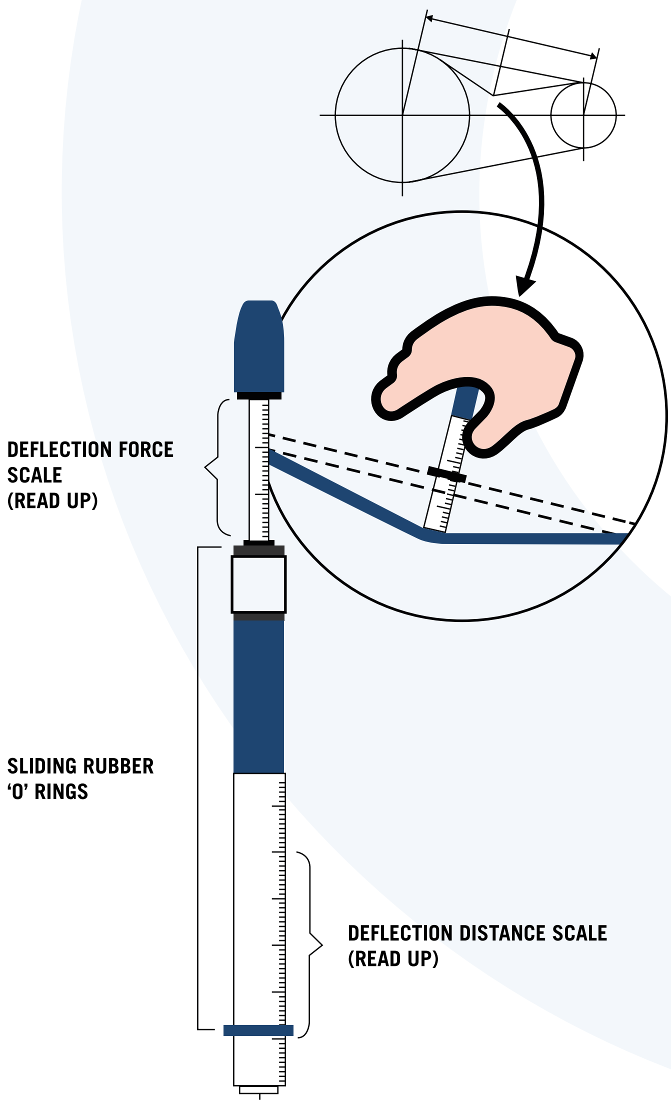
Example:
If the span length “P” is 16” inches, the deflection would be ¼” inch (1/64” multiplied by 16” equals ¼” inches)

Next set the (small) O-ring on the plunger at zero (0) this measures the deflection force in (lbs).

• The below illustration demonstrates how to use the pencil style tension gauge. Place the gauge perpendicular to the span length “P” with the rubber plunger against the palm of your hand. Deflect the timing belt until the bottom of the (large) O-ring is even with the bottom of the straight edge. Release the pressure on the gauge and read the measurement indicated by the (small) O-ring in pounds of force required to deflect the timing belt.

If the measured force is less than the required deflection force, lengthen the center distance.
If the measured force is greater than the required deflection force, shorten the center distance

SINGLE TENSION TESTER



READ JUST UNDERNEATH THE RING. BEFORE USING THE TENSION TESTER AGAIN, SLIDE THE RING DOWNWARDS AGAIN.

6. After the timing belt is properly tensioned, lock down the centre distance adjustments and recheck the sprocket alignment. Recheck the timing belt tension and alignment after eight hours of operation to ensure the drive has not shifted.

Sonic Tension Meter

The sonic tension meter provides the most accurate tension measuring available. Timing belts, like string, vibrate at a particular natural frequency based on mass and span length. By measuring this natural frequency of a free stationary timing belt span the sonic tension meter is able to instantly compute the static timing belt tension based upon the timing belt span length, timing belt width and timing belt type. The sonic tension meter provides accurate and repeatable tension measurements while using a nonintrusive procedure, the measurement process itself doesn't change the belt span tension. Measurement is made by strumming the timing belt like a guitar string to make it vibrate and then hold the meter close to the resonating timing belt to take a measurement.Both of the tensioning methods above require calculations to arrive at the proper tension value.

NOTE: DUE TO THE HIGH RESISTANCE TO ELONGATION (STRETCH), THERE IS NO NEED TO RE-TENSION A TIMING BELT AFTER THE INITIAL TENSIONING.

9. FINAL TIGHTENING OF MOUNTING BOLTS

Securely tighten all mounting bolts related to the drive components for timing belt tensioning. Loose mounting bolts will cause a change in the centre to centre distance resulting in performance problems.

10. START-UP

Start-up the drive and observe the mechanical power transmission system. Pay particular attention to any unusual noise or vibration. Shut down the system and check the bearings and motor related to the mechanical power transmission system for excessive heat. If the bearings or motor feel hot, belt tension may be too tight or bearings may be misaligned or not lubricated correctly.

MAINTENANCE AND TROUBLESHOOTING GUI

1. MAINTENANCE GUIDE

Belt drives are considered the most cost-effective and reliable means of power transmission when compared to chain drives (with constant lubrication problems), or gear drives (with mechanical problems and high costs). This reliability can however only be obtained when belts and drives are properly maintained. The potential for long service life is built into every Steighentech belt. When coupled to a regular maintenance programme, your belts and drives will run relatively trouble-free for a long period of time. To ensure reduced costly downtime and production delays always inspect belts and drives before they fail.

Your maintenance programme should consist of:

1) maintaining a safe working environment
2) proper belt installation procedures
3) regular belt drive inspections
4) belt drive performance inspections and evaluations
5) troubleshooting

1. SAFE WORKING:

• Only use rained personnel working on your belt drives.
• Always turn equipment off. Turn off the power to the drive before you start working.
• Lock the control box and tag it with a warning sign "Down for maintenance. Do not turn power on."
• Keep the key in your pocket.
• For added safety, and if possible, remove fuses.
• Check position of components Make sure all machine components are in a "safe" position. Place fly-wheels, counterweights, gears and clutches in a neutral position to avoid accidental movements. Always follow the manufacturer's recommendations for safe maintenance practices.
• All personnel should be supplied with and wear proper PPE.They should not wear loose or bulky clothes (e.g. ties, loose sleeves, lab coats) around belt drives. Wear gloves when inspecting pulleys to avoid being cut by nicks or sharply worn pulley edges.
• Maintain safe access to the drives Keep the areas around the drive free of clutter, debris and other obstructions. Floors should be clean and free of oil and debris to ensure good footing and balance of the operator whilst working on the machine.
• Ensure all drives are properly guarded. Every belt drive must be completely guarded while in operation.
• Before you put your drive back into normal operation, have a "test run" to check whether everything functions normally. Make any verifications necessary and take corrective action if needed.

2. SYNCHRONOUS BELT INSTALLATION

• After the power has been turned off, isolated (i.e. locked) and the guard removed, loosen the motor mounting bolts. Move the motor until the belt is slack and it can be removed without prising. Never prise off a belt!
• Remove old belt and check it for unusual wear. Excessive wear may indicate problems with drive design or maintenance procedures.
• Select correct replacement belt.

DE

• Pulleys can be cleaned with a rag slightly dampened with a light, non-volatile solvent. Do not sand or scrape the pulley with a sharp object to remove grease or debris. Pulleys must be dry before using on a drive.
• Inspect pulleys for unusual or excessive wear. Also check alignment. Correct alignment is more critical with synchronous belt drives.
• Check other drive components such as bearings and shafts for alignment, wear, and lubrication
• Install new belt over pulleys. Do not prise or use force.
• Take up centre distance on the drive until proper tension is obtained on the tension tester. Rotate the drives by hand for a few revolutions and recheck tension.
• Secure motor mounting bolts to correct torque. Be sure all drive components are secure since any change in drive centres during operation will result in poor belt performance.
• Although belts will not require further tensioning, we recommend starting up the drive and observing performance. Look and listen for any unusual noise or vibration. It is a good idea to shut down the machine and check the bearings and the motor. If they feel hot, the belt tension may be too high, or the bearings may be misaligned or improperly lubricated

3. SIMPLE DRIVE INSPECTION

• A good way to begin preventive maintenance is making periodic drive inspection a normal part of your maintenance rounds.
• Look and listen Look and listen for any unusual vibration or sound while observing the guarded drive in operation. A well-designed and maintained drive will operate smoothly and quietly.
• Inspect the guard for looseness or damage. Keep it free of debris and grime buildup. Any accumulation of material on the guard will act as insulation and could cause the drive to run hotter.
• Temperature is an important factor of belt performance and durability. For example, above 60°C an internal temperature increase of 10°C (50°F) – or approximately 20°C (68°F) rise in ambient temperature – may cut belt life in half.
• Look for oil or grease dripping from the guard. This may indicate over-lubricated bearings. Oil and grease attack rubber compounds, causing them to swell and distort. This will lead to early belt failure.
• Check motor mounts for proper tightness. Check take up slots or rails to see that they are clean and lightly lubricated.

4. BELT DRIVE PERFORMANCE INSPECTIONS AND EVALUATIONS

• The frequency of drive inspection will depend on various factors including the drive operating speed, the drive operating cycle, the critical nature of the equipment, the temperature extremes in the environment, environmental factors and the accessibility of the equipment.
• High speeds, heavy loads, frequent start/stop conditions, extreme temperatures and drives operating on critical equipment will mean more frequent inspections
• With critical drives, a quick visual and hearing inspection may be needed every one to two weeks.
• With normal drives, a quick visual and hearing inspection can be performed once a month.
• For a complete inspection, a drive shutdown and thorough inspection of belts or pulleys and other drive components may be required every three to six months.
• A belt drive can sometimes be upgraded to improve performance. Look at simple improvements that can be made at minimal costs. This involves checking the drive design for adequate capacity such as

1) increase pulley diameters;
2) increase the number of belts, or use wider belt;
3) add vibration dampening to the system;
4) improve guard ventilation to reduce operating temperature;
5) make sure pulley and back idler diameters are above the minimum recommended diameters;
6) use CMW POWERPLUS higher performance belts rather than standard belts;
7) replace worn pulleys;
8) keep pulleys properly aligned;
9) place idler on span with lowest tension and as close to driveR pulley as possible;
10) review proper belt installation and maintenance procedures.

5.TROUBLESHOOTING

Problems on synchronous timing belt drives can relate to:

1) Belt problems:
- Unusual noise
- Tension loss
- Excessive belt edge wear
- Tensile break
- Belt cracking
- Premature tooth wear
- Tooth shear

2) Pulley problems
- Flange failure
- Unusual pulley wear

3) Performance problems
- Belt tracking problems
- Excessive temperature: bearings, housings, shafts, etc.
- Shafts out of synchronisation
- Vibration
- Incorrect driveN speeds

2. TROUBLESHOOTING GUIDE

1. BEARING FAILURE

Proper tensioning cannot be stressed enough: too tight of tensioning will possibly cause damage to the bearings, shafts and other drive components besides dramatically reducing timing belt life. The correct timing belt tension is the lowest tension at which timing belts will transmit the required mechanical power and not ratchet teeth when the drive is under a full load.

To reduce the total tension on a drive for a given torque, the timing belt pulley diameter must be increased. Attempting to reduce tension by increasing timing belt width actually causes greater loads on bearings. Pull is concentrated farther away from the bearing and there is more timing belt pulley weight due to increased width of the drive.

Probable Cause:
- Too high of tension

Corrective Action:
- Adjust tension to recommended value

Probable Cause:
- Sub-minimal timing belt pulley diameters

Corrective Action:
- Use correct timing belt pulley diameter

Probable Cause:
- Misaligned drive

Corrective Action:
- Check parallel and angular alignment of the timing belt pulleys

2. EXCESSIVE TEMPERATURE OF BELT, BEARINGS, HOUSINGS, SHAFTS, ETC.

The timing belt material used in urethane timing belts is thermoplastic, meaning it has a melting point. When subjected to environmental temperatures in excess of 85°C/185°F, the timing belt teeth may begin to soften and deform. In addition, the tensile cord to urethane adhesion loses its integrity.
When rubber timing belts operate at elevated temperatures (greater than 85°C/ 185°F) for prolonged periods of time, the timing belt material gradually hardens resulting in back cracking due to bending. These cracks typically remain parallel to the timing belt teeth and usually occur over land areas (in between timing belt teeth). This typically results in timing belts failure due to tooth shear, which often leads to tensile cord fracture.

Probable Cause:
- Misaligned drive

Corrective Action:
- Check parallel and angular alignment of the timing belt pulleys

Probable Cause:
- Too low or high of tension

Corrective Action:
- Adjust tension to recommended value

Probable Cause:
- Incorrect timing belt tooth profile for the timing belt pulley

Corrective Action:
- Check timing belt / timing belt pulley compatibility

3. SHAFTS OUT OF SYNC (REGISTRATION ERROR)

Registration errors on precision timing belt drives can result from excessive backlash, or too much clearance between timing belt teeth and timing belt pulley grooves. The shape of the belt tooth and the fit of the tooth in the sprocket groove are important factors in determining positioning accuracy and drive performance. Clearance is needed between the timing belt tooth and timing belt pulley groove in each system to allow the timing belt tooth to enter and exit the groove smoothly with a minimum of interference. Too much clearance creates inaccuracy, while too little can generate excessive noise, vibration, and wear. An ideal timing belt tooth profile minimizes clearance without harming timing belt operations. Trapezoidal timing belt have relatively little backlash compared to curvilinear timing belts that provide improved torque carrying capability and resist ratcheting. Modified curvilinear timing belts offer both improved torque-carrying capability, and as little, or less backlash than trapezoidal timing belts.

Probable Cause:
- Drive design error

Corrective Action:
- Use correct timing belt pulley diameter
- Redesign drive

Probable Cause:

- Incorrect timing belt

Corrective Action:

- Check timing belt / timing belt pulley compatibility

4. TIMING BELT CRACKING

When rubber timing belts operate at elevated temperatures (greater than 85°C 185°F) for prolonged periods of time, the timing belt material gradually hardens resulting in back cracking due to bending. These cracks typically remain parallel to the timing belt teeth and usually occur over land areas (in between timing belt teeth). This typically results in timing belts failure due to tooth shear, which often leads to tensile cord fracture.

Probable Cause:

- Sub-minimal timing belt pulley diameter

Corrective Action:

- Use correct timing belt pulley diameter

Probable Cause:

- Backside idler

Corrective Action:

- Change timing belt pulley material
- Increase diameter of backside idler

Probable Cause:

- Extreme low temperature at start-up

Corrective Action:

- Pre-heat drive environment

Probable Cause:

- Exposure to oil, solvents, harsh chemicals

Corrective Action:

- Eliminate or control condition
- Clean and protect drive

Probable Cause:

- Cocked bushing / timing belt pulley assembly

Corrective Action:

- Remount bushing and timing belt pulley

5. TIMING BELT EXCESSIVE BELT EDGE WEAR

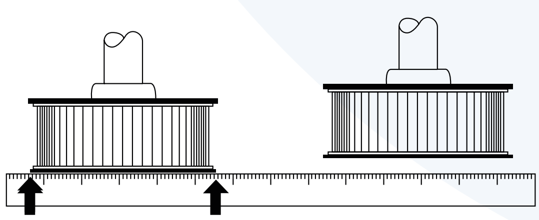


Fig. 26 Parallel Misalignnment

Timing belts running on flanged timing belt pulleys with parallel misalignment (offset sprockets) may exhibit excessive timing belt edge wear on both edges if the belt is pinched between opposite flanges. Timing belt failures may then occur by tooth root cracks or tears initiating from both edges of the timing belt. These tears may eventually extend across the entire width of the timing belt, resulting in tooth shear.

Probable Cause:
- Damage due to handling

Corrective Action:
- Follow proper handling and storage procedure

Probable Cause:
- Flange damage

Corrective Action:
- Reinstall, replace, repair flange

Probable Cause:
- Timing belt too wide

Corrective Action:
- Use proper width timing belt pulley

Probable Cause:
- Timing belt tension too low

Corrective Action:
- Adjust tension to recommended value

Probable Cause:
- Rough flange surface finish

Corrective Action:
- Reinstall, replace, repair flange

Probable Cause:
- Improper tracking

Corrective Action:
- Check parallel and angular alignment of the timing belt pulleys

Probable Cause:
- Timing belt hitting drive guard or brackets

Corrective Action:
- Eliminate or control condition

Probable Cause:
- Misalignment

Corrective Action:
- Check parallel and angular alignment of the timing belt pulleys

6. TIMING BELT PREMATURE TOOTH WEAR

Premature timing belt tooth wear is usually an indication of excessive wear of the timing belt pulley teeth. Timing belt shows signs of:
- High degree of tooth flank wear with the jacket flank exhibiting a fuzzy or flaking appearance
- Another indication is when replacement timing belt life is noticeably reduced from previous timing belts.

This excessive wear of the timing belt pulley teeth is often due to being used in an abrasive atmosphere. Indications of severely worn timing belt pulleys include:
- Groove wear
- Reduction in the outside finish diameter
- Polished land wear
- Teeth worn to the point of serious dimensional distortion. The teeth will become “razor” sharp to the touch..

Probable Cause:

- Too low or high tension

Corrective Action:

- Adjust tension to recommended value

Probable Cause:

- Belt running partly off unflanged pulley

Corrective Action:

- Check parallel and angular alignment of the timing belt pulleys

Probable Cause:

- Misaligned drive

Corrective Action:

- Check parallel and angular alignment of the timing belt pulleys

Probable Cause:

- Incorrect timing belt tooth profile for timing belt pulley

Corrective Action:

- Check timing belt / timing belt pulley compatibility

Probable Cause:

- Worn timing belt pulley

Corrective Action:

- Replace timing belt pulley

Probable Cause:

- Rough timing belt pulley teeth

Corrective Action:

- Replace timing belt pulley

Probable Cause:

- Damaged timing belt pulley

Corrective Action:

- Replace timing belt pulley

Probable Cause:

- Timing belt pulley not to dimensional specifications

Corrective Action:

- Replace timing belt pulley

Probable Cause:

- Timing belt hitting drive brackets or other part

Corrective Action:

- Eliminate or control condition
- Use inside idler

Probable Cause:

- Excessive load

Corrective Action:

- Check horsepower rating
- Redesign drive

Probable Cause:
• Insufficient hardness of timing belt pulley material
Corrective Action:
• Change timing belt pulley material

Probable Cause:
• Excessive debris
Corrective Action:
• Clean and protect drive

Probable Cause:
• Cocked bushing / timing belt pulley assembly
Corrective Action:
• Remount bushing and timing belt pulley

7. TIMING BELT PULLEY FLANGE FAILURE

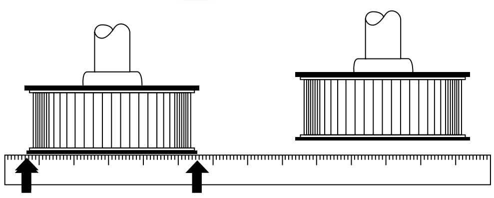


Fig. 26 Parallel Misalignnment

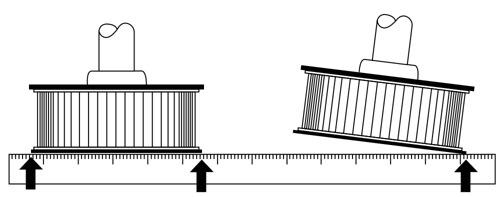


Fig. 25 Angular Misalignment

Timing belt pulley flange failure is often the direct result of misalignment. Misalignment can be observed as:
• Parallel Misalignment
• Angular Misalignment

Probable Cause:
• Timing belt forcing flange off
Corrective Action:
• Check parallel and angular alignment of the timing belt pulleys
• Reinstall, replace, repair flange

Probable Cause:
• Misaligned drive
Corrective Action:
• Check parallel and angular alignment of the timing belt pulleys

Probable Cause:
• Flange incorrectly mounted
Corrective Action:
• Reinstall, replace, repair flange

8. TIMING BELT PULLEY UNUSUAL WEAR
This excessive wear of the timing belt pulley teeth is often due to being used in an abrasive atmosphere. Indications of severely worn timing belt pulleys include:
• Groove wear
• Reduction in the outside finish diameter

Polígono Industrial O Rebullón s/n. 36416 - Mos - España - rodavigo@rodavigo.com

• Polished land wear
• Teeth worn to the point of serious dimensional distortion. The teeth will become "razor" sharp to the touch.

Probable Cause:
• Timing belt pulley has too little wear resistance
Corrective Action:
• Change timing belt pulley material

Probable Cause:
• Misaligned drive
Corrective Action:
• Check parallel and angular alignment of the timing belt pulleys

Probable Cause:
• Excessive debris
Corrective Action:
• Eliminate or control condition
• Clean and protect drive

Probable Cause:
• Excessive load
Corrective Action:
• Check horsepower rating
• Redesign drive

Probable Cause:
• Timing belt tension too low or high
Corrective Action:
• Adjust tension to recommended value

Probable Cause:
• Incorrect timing belt tooth profile for timing belt pulley
Corrective Action:
• Check timing belt / timing belt pulley compatibility

9. TIMING BELT TENSILE BREAK
The two (2) common forms of timing belt tensile break are:
• Crimp style
• Severe shock loads

Crimp Style – Timing Belt Tensile Break

A crimp style timing belt failure often resembles a "straight tear". A straight tear failure like this may occur when timing belt tensile cords are bent around an excessively small timing belt pulley diameter. A sharp bend may result in large compressive forces within the tensile cords causing individual fibers to buckle or crimp, reducing the overall ultimate tensile strength of the timing belt. Timing belt crimping damage is most commonly associated with:

• Timing belt mishandling
• Inadequate belt installation tension
• Sub-minimal sprocket diameters

• Entry of foreign objects within the timing belt drive

Severe Shock Load – Timing Belt Tensile Break

Severe shock loads can result in timing belt tensile breaks with a ragged and uneven appearance. Often this breakage is seen as a “angled tear”. The timing belt teeth engaged in the timing belt pulley at the instant of the shock load may also develop root cracks and/or exhibit tooth shear. If the shock load occurred only once, or was cyclical and repetitious at one specific location around the timing belt, the remaining belt teeth may appear normal. Cracks forming at the tooth roots sometimes move towards the tooth tips. Timing belt teeth containing multiple cracks may then shear, leaving only a portion of the tooth behind. The shock loads generated by the driven equipment may be an inherent part of system operation or may result from an occasional harsh condition such as jamming. If the drive shock loads cannot be eliminated, the timing belt tensile strength may need to be increased or the timing belt drive replaced with a more forgiving V-belt drive system capable of intermittent slip.

Probable Cause:

• Excessive shock load

Corrective Action:

• Check horsepower rating

• Eliminate or control condition

• Redesign drive

Probable Cause:

• Rolling or prying the timing belt over the flange when installing

Corrective Action:

• Follow proper installation procedure

Probable Cause:

• Sub-minimal timing belt pulley diameter

Corrective Action:

• Use correct timing belt pulley diameter

Probable Cause:

• Misalignment

Corrective Action:

• Check parallel and angular alignment of the timing belt pulleys

Probable Cause:

• Too low or high tension

Corrective Action:

• Adjust tension to recommended value

Probable Cause:

• Momentary peak load exceeded design load

Corrective Action:

• Check horsepower rating

• Redesign drive

Probable Cause:

• Wrong timing belt pitch used

Corrective Action:

• Check horsepower rating

• Redesign drive

Probable Cause:

- Improper timing belt handling and storage

Corrective Action:

- Follow proper installation procedure

Probable Cause:

- Weak support structure or mounts

Corrective Action:

- Reinforce structure

Probable Cause:

- To narrow timing belt width

Corrective Action:

- Check horsepower rating
- Replace timing belt pulley
- Redesign drive
- Replace timing belt

Probable Cause:

- Sharp teeth on the timing belt pulley

Corrective Action:

- Replace timing belt pulley

Probable Cause:

- Debris or foreign object in drive

Corrective Action:

- Follow proper installation procedure

Probable Cause:

- Extreme timing belt pulley run-out

Corrective Action:

- Replace timing belt pulley

10. TIMING BELT TENSION LOSS (RATCHETING)

Proper tensioning cannot be stressed enough: too loose of tensioning will cause the timing belt to ratchet (tooth jumping), while too tight of tensioning will possibly cause damage to the bearings, shafts and other drive components besides dramatically reducing timing belt life. The correct timing belt tension is the lowest tension at which timing belts will transmit the required mechanical power and not ratchet teeth when the drive is under a full load.

Probable Cause:

- Weak support structure or mounts

Corrective Action:

- Redesign drive
- Reinforce structure

Probable Cause:

- Center to center distance fluctuates

Corrective Action:

- Redesign drive

Probable Cause:

- Excessive timing belt pulley wear

Corrective Action:

- Replace timing belt pulley
- Change timing belt pulley material

Probable Cause:

- Fixed (non-adjustable) centers

Corrective Action:

- Use inside idler

Probable Cause:

- Excessive debris

Corrective Action:

- Eliminate or control condition
- Clean and protect drive

Probable Cause:

- Excessive load

Corrective Action:

- Check horsepower rating
- Redesign drive

Probable Cause:

- Sub-minimal timing belt pulley diameter

Corrective Action:

- Use correct timing belt pulley diameter

Probable Cause:

- Excessive low or high temperature (-34°C to 85°C / -30°F to 185°F)

Corrective Action:

- Eliminate or control condition
- Clean and protect drive
- Reduce ambient drive temperature to 85°C/ 185°F maximum

Probable Cause:

- Exposure to oil, solvents, harsh chemicals

Corrective Action:

- Eliminate or control condition
- Clean and protect drive

Probable Cause:

• Timing belt, timing belt pulley or shafts running to hot

Corrective Action:

• Check for conductive heat transfer from prime mover

Probable Cause:

• Unusual timing belt degradation

Corrective Action:

• Reduce ambient drive temperature to 85°C/ 185°F maximum

11. TIMING BELT TOOTH SHEAR

A common timing belt failure resulting from insufficient timing belt installation tension is referred to as tooth rotation. Timing belt tooth rotation can occur as timing belt teeth climb out of their respective timing belt pulley grooves (self tensioning) and drive loads are no longer applied at their roots. Drive loads applied further down the timing belt tooth flanks cause the timing belt teeth to bend (like a diving board) and "rotate." Timing belt tooth rotation can result in timing belt material tearing at the base of the timing belt teeth along the tensile member. As the tearing continues, timing belt teeth often begin to separate from the timing belt in strips. Failures due to excessive tooth rotation may resemble failures caused by insufficient rubber adhesion to the tensile cords. Unlike tooth rotation failures, failures from insufficient rubber adhesion leave the exposed tensile members clean where the timing belt teeth were once located.

Probable Cause:

• Excessive shock load

Corrective Action:

• Check horsepower rating

• Redesign drive

Probable Cause:

• Less than six (6) timing belt teeth in mesh

Corrective Action:

• Check horsepower rating

• Redesign drive

Probable Cause:

• Extreme timing belt pulley run-out

Corrective Action:

• Replace timing belt pulley

Probable Cause:

• Worn timing belt pulley

Corrective Action:

• Replace timing belt pulley

Probable Cause:

• Sub-minimal timing belt pulley diameter

Corrective Action:

• Use correct timing belt pulley diameter

Probable Cause:

• Backside idler

Corrective Action:

• Use inside idler

Probable Cause:

• Incorrect timing belt tooth profile for the timing belt pulley

Corrective Action:

• Check timing belt / timing belt pulley compatibility

Probable Cause:

• Misaligned drive

Corrective Action:

• Check parallel and angular alignment of the pulleys

Probable Cause:

• Timing belt tension too low

Corrective Action:

• Adjust tension to recommended value

12.TIMING BELT TRACKING

Timing belts operating on a combination of both flanged and non-flanged timing belt pulleys with parallel misalignment may walk or track partially off of the non-flanged timing belt pulleys. The portion of the timing belt remaining engaged with the non-flanged timing belt pulley will carry the full operating load and may develop a concentrated area of wear after running this way for a period of time. This may ultimately result in premature timing belt failure due to either tensile or tooth fatigue.

Probable Cause:

• Belt running partly off unflanged timing belt pulley

Corrective Action:

• Check parallel and angular alignment of the timing belt pulleys

Probable Cause:

• Misaligned drive

Corrective Action:

• Check parallel and angular alignment of the timing belt pulleys

Probable Cause:

• Weak support structure or mounts

Corrective Action:

• Reinforce structure

Probable Cause:

• Center to center distance exceeds eight (8) times smaller timing belt pulley diameter

Corrective Action:

• Check parallel and angular alignment of the timing belt pulleys
• Redesign drive

Probable Cause:

• Excessive timing belt edge wear

Corrective Action:

• Check parallel and angular alignment of the timing belt pulleys

13.TIMING BELT UNUSUAL NOISE (EXCESSIVE NOISE)

Timing belt noise is directly related to speed, width and pitch of the timing belt used.
Meshing frequency is assumed to be the primary frequency of noise generated by timing belt drives since the noise is generated from meshing interference and land impact during operation. Meshing frequency

is defined as the number of timing belt teeth that enter and exit the timing belt pulley grooves per unit of time. As the timing belt tooth enters and exits the timing belt pulleys tooth, air is compressed and forcibly evacuated, making a sound similar to air escaping from a balloon. Added to this is the impact between the timing belt teeth and timing belt pulley cause a slapping sound.
The most common unit of meshing frequency is # teeth/sec. This is equivalent to cycles/sec. Each timing belt pulley may have its own meshing frequency, but the major noise generator tends to be the Drive(R) with the timing belt entering at its highest tension. This high tension combined with a tight fit of the timing belt and timing belt pulley teeth causes the tensioned timing belt to resonate like a plucked guitar string.

Meshing frequency can be calculated as follows:

(# Sprocket Grooves x rpm) / 60 = cycles/sec

DEFINING THE NOISE AND HOW IT IS GENERATED:
• Impact generated by collision of the timing belt tooth against the bottom land of the timing belt pulley at the beginning of meshing
• Impact generated by collision of the timing belt pulley tooth tip against the bottom land of the timing belt at the beginning of engagement
• Collision between the flanks of the two teeth at the beginning of meshing
• Transverse and torsional vibrations of the timing belt
• Vibrations of the timing belt pulleys
• Airflow between timing belt and timing belt pulley
• Friction due to the contact between timing belt fabric and timing belt pulley material.

COMMON CAUSES:
• Drive misalignment

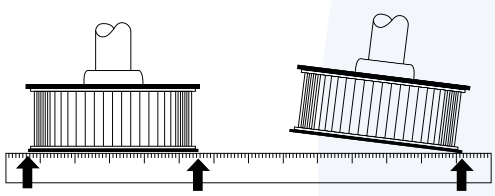


Fig. 25 Angular Misalignment

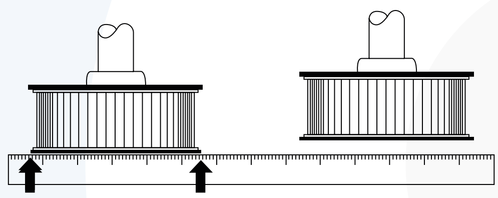


Fig. 26 Parallel Misalignnment

• Improper tensioning
The noise created by a drive increases with timing belt speed. Thus, the problem is generally associated with high speed applications. If proper tensioning and alignment do not reduce the noise level, the next possible cause is improper timing belt pulley dimensions. Verify that all timing pulley dimensions are according to RMA or manufacturer's specifications.

ADDITIONAL ISSUES TO CONSIDER INCLUDE:
• Use of polyurethane (plastic) timing belts cause a higher timing belt noise level than rubber timing belts.
• Acoustics of drive enclosure. Often times the guarding in place around a timing belt drive amplify the sound resonating from the timing belt drive.
• Improper mixing of timing belt and timing belt pulley tooth profiles.

DESIGNING DRIVES TO REDUCE NOISE
When designing synchronous drive systems, several general guidelines for noise reduction can be considered:
NOTE: However, larger timing belt pulleys result in faster timing belt speeds (see statement #1) so some optimization is required.

1. Minimize timing belt speeds. By slowing down the drive, the noise level is reduced and the frequency of any generated noise is lower. This often puts the frequency of the drive system into that unobjectionable area.
2. Minimize timing belt width. Using the narrowest timing belt that can handle the design loads at the design speed will help minimize noise levels.
3. Maximize small timing belt pulley diameter. By using the largest pitch diameter for the small timing belt pulley, noise levels will be reduced. This will also lead to improved timing belt life.
4. Minimize vibration of equipment. Vibration causes air displacement, which causes noise. Dampening vibration of the equipment will lower noise from the system in general.
5. Minimize air transmission paths. By considering drive location and/or using acoustical guards, the air displacement path is blocked and effectively reduces noise.
When checking the drive, evaluate carefully alignment and tension.

ALIGNMENT:
A drive with excessive misalignment, generally greater than 1/4 degree, will more likely generate noise than a properly aligned drive. Consider both parallel and angular misalignment. Also, properly aligned drives will yield improved timing belt life.

TENSION:
Improperly tensioned drives will more likely generate noise. Timing belt tension should not be too high or too low. Too low a tension can also lead to shortened timing belt life or ratcheting, while too high a tension will add undue stress to bearings, shafts and other related components.

14. VIBRATION

Timing belts produce low levels of vibration that may be objectionable in sensitive equipment. This vibration stems from the teeth as they mesh with timing belt pulleys and from the timing belt's high tensile modulus (stiffness), a characteristic that holds consistent belt pitch under load. To reduce such vibration, choose timing belt pulleys with diameters larger than the minimum size available because the timing belt teeth mesh more smoothly and also select a belt with a high stiffness characteristic.

Probable Cause:
- Incorrect timing belt tooth profile for the timing belt pulley

Corrective Action:
- Check timing belt / timing belt pulley compatibility

Probable Cause:
- Excessive load

Corrective Action:
- Check horsepower rating
- Redesign drive

Probable Cause:
- Centre to centre distance exceeds eight (8) times small timing belt pulley diameter

Corrective Action:
- Use inside idler
- Redesign drive

Probable Cause:
- Too low or high tension

Corrective Action:
- Adjust tension to recommended value

Probable Cause:
- Unbalanced timing belt pulleys

Corrective Action:
- Replace timing belt pulley(s)
- Remount bushing and timing belt pulley

Probable Cause:
- Weak support structures or mounts

Corrective Action:
- Reinforce structure

Probable Cause:
- Bushing or key loose

Corrective Action:
- Remount bushing and timing belt pulley