Step 1

Describe the problem

- *What is wrong?*
- *When did it happen?*
- *How often does it happen?*
- *What is the drive application?*
- *Have the machine operations or output changed?*
- *What kind of belt(s) are you using?*
- *What are your expectations for belt performance in this application?*

Step 2

Identify symptoms and record observations of anything unusual.

Drive Symptoms Check List
(Check those you observe)

- **Premature Belt Failure**
  - ☐ Broken belt(s)
  - ☐ Belt(s) fail to carry load (slip). No visible reason
  - ☐ Edge cord failure
  - ☐ Belt delamination or undercord separation

- **Severe or Abnormal Belt Wear**
  - ☐ Wear on belt top surface
  - ☐ Wear on top corners of belt
  - ☐ Wear on belt sidewall
  - ☐ Wear on belt bottom corners
  - ☐ Wear on bottom surface of belt
  - ☐ Undercord cracking
  - ☐ Burn or hardening on bottom or sidewall
  - ☐ Belt surface flaking, sticky or swollen
  - ☐ Belt stretch
  - ☐ Extensive hardening of belt exterior

- **Banded (Joined) Belt Problems**
  - ☐ Tie-band separation
  - ☐ Top of tie-band frayed, worn or damaged
  - ☐ Band comes off drive
  - ☐ One or more ribs run outside of pulley

- **V-belt Turns Over or Jumps off Sheave**
  - ☐ Single belt
  - ☐ One or more belts in a set
  - ☐ Joined or banded belts

- **Belt Stretches Beyond Take-Up**
  - ☐ Single belt
  - ☐ Multiple belts stretch unequally
  - ☐ All belts stretch equally

TROUBLESHOOTING GUIDE

All V-Belt Drives

- **Belt Noise**
  - ☐ Squeal or “chirp”
  - ☐ Slapping noise
  - ☐ Rubbing sound
  - ☐ Grinding
  - ☐ Unusually loud drive
- **Unusual Vibration**
  - ☐ Belts flopping
  - ☐ Excessive vibration in drive system
- **Problem With Pulleys**
  - ☐ Broken or damaged
  - ☐ Severe, rapid groove wear
- **Problems With Drive Components**
  - ☐ Bent or broken shafts
  - ☐ Damaged guard
- **Problems With Take Up**
  - ☐ Make sure you are using Gates belts
  - ☐ Not all belts are same

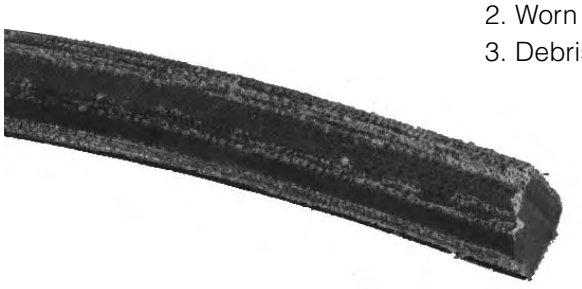
All Synchronous Belt Drives

- **Belt Problems**
  - ☐ Unusual noise
  - ☐ Tension loss
  - ☐ Excessive belt edge wear
  - ☐ Tensile break
  - ☐ Cracking
  - ☐ Premature tooth wear
  - ☐ Tooth shear
  - ☐ Belt ratcheting
  - ☐ Land area worn
- **Hot Bearings**
- **Performance Problems**
  - ☐ Incorrect driveN speeds
- **Sprocket Problems**
  - ☐ Flange failure
  - ☐ Unusual wear
- **Performance Problems**
  - ☐ Belt tracking problems
  - ☐ Excessive temperature: bearings, housings, shafts, etc.
  - ☐ Shafts out of sync
  - ☐ Vibration

Premature Belt Failure

Symptoms	Probable Cause	Corrective Action
• Broken belt(s) 	1. Under-designed drive 2. Belt rolled or pried onto sheave 3. Object falling into drive 4. Severe shock load	1. Redesign, using Gates manual. 2. Use drive take-up when installing. 3. Provide adequate guard or drive protection. 4. Redesign to accommodate shock load.
• Belts fail to carry load, no visible reason	1. Underdesigned drive 2. Damaged tensile member 3. Worn sheave grooves 4. Center distance movement	1. Redesign, using Gates manual. 2. Follow correct installation procedure. 3. Check for groove wear; replace as needed. 4. Check drive for center distance movement during operation.
• Edge cord failure	1. Pulley misalignment 2. Damaged tensile member	1. Check alignment and correct. 2. Follow correct installation procedure.
• Belt de-lamination or undercord separation	1. Too small sheaves 2. Use of too small backside idler	1. Check drive design, replace with larger sheaves. 2. Increase backside idler to acceptable diameter.

Severe or Abnormal V-Belt Wear

Symptoms	Probable Cause	Corrective Action
• Wear on top surface of belt	1. Rubbing against guard 2. Idler malfunction	1. Replace or repair guard. 2. Replace idler.
• Wear on top corner of belt 	1. Belt-to-sheave fit incorrect (belt too small for groove)	1. Use correct belt-to-sheave combination.
• Wear on belt sidewalls	1. Belt slip 2. Misalignment 3. Worn sheaves 4. Incorrect belt	1. Retention until slipping stops. 2. Realign sheaves. 3. Replace sheaves. 4. Replace with correct belt size.
• Wear on bottom corner of belt	1. Belt-to-sheave fit incorrect 2. Worn sheaves	1. Use correct belt-to-sheave combination. 2. Replace sheaves.
• Wear on bottom surface of belt 	1. Belt bottoming on sheave groove 2. Worn sheaves 3. Debris in sheaves	1. Use correct belt/sheave match. 2. Replace sheaves. 3. Clean sheaves.
• Undercord cracking	1. Sheave diameter too small 2. Belt slip 3. Backside idler too small 4. Improper storage	1. Use larger diameter sheaves. 2. Retention. 3. Use larger diameter backside idler. 4. Don't coil belt too tightly, kink or bend.Avoid heat and direct sunlight.

Severe or Abnormal V-Belt Wear–cont.

Symptoms	Probable Cause	Corrective Action
• Undercord or sidewall burn or hardening	1. Belt slipping	1. Retension until slipping stops.
	2. Worn sheaves	2. Replace sheaves.
	3. Underdesigned drive	3. Refer to Gates drive manual.
	4. Shaft movement	4. Check for center distance changes.
		
• Belt surface hard or stiff	1. Hot drive environment	1. Improve ventilation to drive.
• Belt surface flaking, sticky or swollen	1. Oil or chemical contamination	1. Do not use belt dressing. Eliminate sources of oil, grease or chemical contamination.
		

V-Belts Turn Over or Come Off Drive

Symptoms	Probable Cause	Corrective Action
• Involves single or multiple belts	1. Shock loading or vibration	1. Check drive design. Use Gates PowerBand® belts or Power Cable® belts.
	2. Foreign material in grooves	2. Shield grooves and drive.
	3. Misaligned sheaves	3. Realign the sheaves.
	4. Worn sheave grooves	4. Replace sheaves.
	5. Damaged tensile member	5. Use correct installation and belt storage procedure.
	6. Incorrectly placed flat idler	6. Carefully align flat idler on slack side of drive as close as possible to driveR sheaves.
	7. Mismatched belt set	7. Replace with new set of matched belts.Do not mix old and new belts.
	8. Poor drive design	8. Check for center distance stability and vibration dampening.

PROBLEM/SOLUTION SUMMARY TABLE

Belt Stretches Beyond Available Take-Up

Symptoms	Probable Cause	Corrective Action
• Multiple belts stretch unequally	1. Misaligned drive	1. Realign and retension drive.
	2. Debris in sheaves	2. Clean sheaves.
	3. Broken tensile member or cord damaged	3. Replace all belts, install properly.
	4. Mismatched belt set	4. Install matched belt set.
• Single belt, or where all belts stretch evenly	1. Insufficient take-up allowance	1. Check take-up. Use allowance specified in Gates design manuals.
	2. Grossly overloaded or under designed drive	2. Redesign drive.
	3. Broken tensile members	3. Replace belt, install properly.

Belt Noise

Symptoms	Probable Cause	Corrective Action
• Belt squeals or chirps	1. Belt slip	1. Retension.
	2. Contamination	2. Clean belts and sheaves.
• Slapping Sound	1. Loose belts	1. Retension.
	2. Mismatched set	2. Install matched belt set.
	3. Misalignment	3. Realign pulleys so all belts share load equally.
• Rubbing sound	1. Guard interference	1. Repair, replace or redesign guard.
• Grinding sound	1. Damaged bearings	1. Replace, align & lubricate.
• Unusually loud drive	1. Incorrect belt	1. Use correct belt size. Use correct belt tooth profile for sprockets on synchronous drive.
	2. Incorrect Tension	2. Check tension and adjust
	3. Worn sheaves	3. Replace sheaves
	4. Debris in sheaves	4. Clean sheaves, improve shielding, remove rust, paint, or remove dirt from grooves.

Unusual Vibration

Symptoms	Probable Cause	Corrective Action
• Belts flopping	1. Loose belts (under tensioned)	1. Retension.
	2. Mismatched belts	2. Install new matched set.
	3. Pulley misalignment	3. Align pulley
• Unusual or excessive vibration	1. Incorrect belt	1. Use correct belt cross section in pulley. Use correct tooth profile and pitch in sprocket.
	2. Poor machine or equipment design	2. Check structure and brackets for adequate strength.
	3. Pulley out of round	3. Replace with non-defective pulley.
	4. Loose drive components	4. Check machine components and guards, motor mounts, motor pads, bushings, brackets and framework for stability adequate design strength, proper maintenance and proper installation.

PROBLEM/SOLUTION SUMMARY TABLE

Problems With Sheaves

Symptoms	Probable Cause	Corrective Action
• Broken or damaged sheave	1. Incorrect sheave installation	1. Do not tighten bushing bolts beyond recommended torque values.
	2. Foreign objects falling into drive	2. Use adequate drive guard.
	3. Excessive rim speeds	3. Keep pulley rim speeds below maximum recommended value.
	4. Incorrect belt installation	4. Do not pry belts onto pulleys.
• Severe Groove Wear	1. Excessive belt tension	1. Retension, check drive design.
	2. Sand, debris or contamination	2. Clean and shield drive as well as possible.
	3. Wrong belt	3. Make sure belt and sheave combination is correct.

Problem With Other Drive Components

Symptoms	Probable Cause	Corrective Action
• Bent or broken shaft	1. Extreme belt overtension	1. Retension
	2. Overdesigned drive*	2. Check drive design, may need to use smaller or fewer belts.
	3. Accidental damage	3. Redesign drive guard.
	4. Machine design error	4. Check machine design.
	5. Accidental damage to guard or poor guard design	5. Repair, redesign for durability.
	6. Pulley mounted too far away from outboard bearing	6. Move pulley closer to bearing.

Hot Bearings

Symptoms	Probable Cause	Corrective Action
• Drive needs overtensioning	1. Worn grooves - belts bottoming and won't transmit power until overtensioned*	1. Replace sheaves. Tension drive properly.
	2. Improper tension	2. Retension.
• Sheaves too small	1. Motor manufacturer's sheave diameter recommendation not followed	1. Redesign using drive manual.
• Poor bearing condition	1. Bearing underdesigned	1. Check bearing design.
	2. Bearing not properly maintained	2. Align and lubricate bearing.
• Sheaves too far out on shaft	1. Error or obstruction problem	1. Place sheaves as close as possible to bearings. Remove obstructions
• Belt slippage	1. Drive undertensioned	1. Retension.

Performance Problems

Symptoms	Probable Cause	Corrective Action
• Incorrect driveN speed	1. Design error	1. Use correct driveR/driveN sheave size for desired speed ratio.
	2. Belt slip	2. Retension driveR. Use synchronous belt.

* Using too many belts, or belts that are too large, can severely stress motor or driveN shafts. This can happen when load requirements are reduced on a drive, but the belts are not redesigned accordingly. This can also happen when a drive is greatly overdesigned. Forces created from belt tensioning are too great for the shafts.

PROBLEM/SOLUTION SUMMARY TABLE

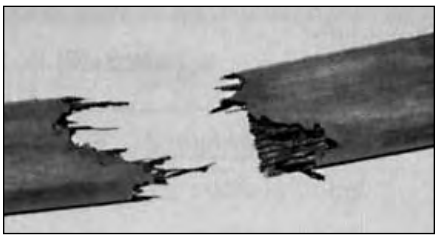
Problems With Banded (Joined) Belts

Symptoms	Probable Cause	Corrective Action
• Tie band separation 	1. Worn sheaves 2. Improper groove spacing	1. Replace sheaves. 2. Use standard groove sheaves.
• Top of tie band frayed or worn 	1. Interference with guard 2. Backside idler malfunction or damaged	1. Check guard. 2. Replace or repair backside idler
• PowerBand® belt comes off drive repeatedly	1. Debris in sheaves 2. Misalignment	1. Clean grooves. Use single belts to prevent debris from being trapped in grooves. 2. Realign drive.
• One or more “ribs” runs out of pulley 	1. Misalignment 2. Undertensioned	1. Realign drive. 2. Retension.

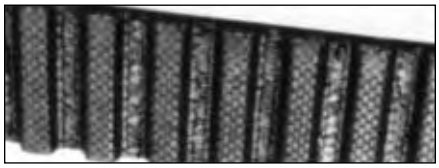
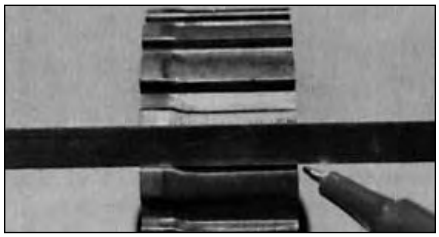
Problems With Synchronous Belts

Symptoms	Probable Cause	Corrective Action
• Unusual noise	1. Misaligned drive	1. Correct alignment.
	2. Too low or high tension	2. Adjust to recommended value
	3. Backside idler	3. Use inside idler.
	4. Worn sprocket	4. Replace.
	5. Bent guide flange	5. Replace.
	6. Belt speed too high	6. Redesign drive.
	7. Incorrect belt profile for sprocket (i.e. HTD, GT®, etc.)	7. Use proper belt/sprocket combination.
	8. Subminimal diameter	8. Redesign drive using larger diameters.
	9. Excess load	9. Redesign drive for increased capacity.

PROBLEM/SOLUTION SUMMARY TABLE

Tension Loss	1. Weak support structure	1. Reinforce structure.
	2. Excessive sprocket wear	2. Use alternate sprocket material.
	3. Fixed (non-adjustable) centers	3. Use inside idler for belt adjustment.
	4. Excessive debris	4. Remove debris, check guard.
	5. Excessive load	5. Redesign drive for increased capacity.
	6. Subminimal diameter	6. Redesign drive using larger diameters.
	7. Belt, sprocket or shafts running too hot	7. Check for conductive heat transfer from prime mover.
	8. Unusual belt degradation	8. Reduce ambient drive temperature to 185°F maximum.
Excessive Belt Edge Wear	1. Damage due to handling	1. Follow proper handling instructions.
	2. Flange damage	2. Repair flange or replace sprocket.
	3. Belt too wide	3. Use proper width sprocket.
	4. Belt tension too low	4. Adjust tension to recommended value.
	5. Rough flange surface finish	5. Replace or repair flange (to eliminate abrasive surface).
	6. Improper tracking	6. Correct alignment.
	7. Belt hitting drive guard or bracketry	7. Remove obstruction or use inside idler.
	8. Misalignment	8. Realign drive
Tensile Break 	1. Excessive shock load	1. Redesign drive for increased capacity.
	2. Subminimal diameter	2. Redesign drive using larger diameters.
	3. Improper belt handling and storage prior to installation (crimping)	3. Follow proper storage and handling procedures.
	4. Debris or foreign object in drive	4. Remove objects and check guard.
	5. Extreme sprocket run-out	5. Replace sprocket.
Belt Cracking	1. Subminimal diameter	1. Redesign drive using larger diameter.
	2. Backside idler	2. Use inside idler or increase diameter of backside idler.
	3. Extreme low temperature at start-up.	3. Pre-heat drive environment.
	4. Extended exposure to harsh chemicals	4. Protect drive.
	5. Cocked bushing/sprocket assembly	5. Install bushing per instructions.
Premature Tooth Wear 	1. Too low or high belt tension	1. Adjust to recommended value.
	2. Belt running partly off unflanged sprocket	2. Correct alignment.
	3. Misaligned drive	3. Correct alignment.
	4. Incorrect belt profile for sprocket (i.e. HTD, GT®, etc)	4. Use proper belt/sprocket combination.
	5. Worn sprocket	5. Replace.
	6. Rough sprocket teeth	6. Replace sprocket

PROBLEM/SOLUTION SUMMARY TABLE

Premature Tooth Wear–cont.	7. Damaged sprocket	7. Replace.
	8. Sprocket not to dimensional specification	8. Replace.
	9. Belt hitting drive bracketry or other structure	9. Remove obstruction or use idler
	10. Excessive load	10. Redesign drive for increased capacity
	11. Insufficient hardness of sprocket material	11. Use a more wear-resistant sprocket
	12. Excessive debris	12. Remove debris, check guard.
	13. Cocked bushing/sprocket assembly	13. Install bushing per instructions.
Tooth Shear 	1. Excessive shock loads	1. Redesign drive for increased capacity.
	2. Less than 6 teeth-in-mesh	2. Redesign drive.
	3. Extreme sprocket run-out	3. Replace sprocket.
	4. Worn sprocket	4. Replace.
	5. Backside idler	5. Use inside idler
	6. Incorrect belt profile for the sprocket (i.e. HTD, GT®, etc.)	6. Use proper belt/sprocket combination.
	7. Misaligned drive	7. Realign.
	8. Belt undertensioned	8. Adjust tension to recommended value.
Flange Failure	1. Belt forcing flange off	1. Correct alignment or properly secure flange to sprocket.
Unusual Sprocket Wear 	1. Sprocket has too little wear resistance (i.e. plastic, aluminum, soft metals)	1. Use alternate sprocket material.
	2. Misaligned drive	2. Correct alignment.
	3. Excessive debris	3. Remove debris, check guard.
	4. Excessive load	4. Redesign drive for increased capacity.
	5. belt tension too low or high	5. Adjust tension to recommended value.
	6. Incorrect belt profile (i.e. HTD, GT, etc.)	6. Use proper belt/sprocket combination.
Belt Tracking	1. Belt running partly off unflanged sprocket	1. Correct alignment.
	2. Centers exceed 8 times small sprocket diameter and both sprockets are flanged.	2. Correct parallel alignment to set belt to track on both sprockets.
	3. Excessive belt edge wear	3. Correct alignment.
Excessive Temperature (Belt, Bearing, Housing, Shafts, etc.)	1. Misaligned drive	1. Correct alignment.
	2. Too low or high belt tension	2. Adjust tension to recommended value.
	3. Incorrect belt profile (i.e. HTD, GT, etc.)	3. Use proper belt/sprocket combination.
Shafts Out of Sync	1. Design error	1. Use correct sprocket sizes.
	2. Incorrect belt	2. Use correct belt with correct tooth profile for grooves.
Vibration	1. Incorrect belt profile for the sprocket (i.e. HTD, GT, etc.)	1. Use proper belt/sprocket combination.
	2. Too low or high belt tension	2. Adjust tension to recommended value.
	3. Bushing or key loose	3. Check and reinstall per instructions.

TROUBLESHOOTING TOOLS

You are faced with a problem drive and must determine the cause. The tools available to help you troubleshoot range from the surprisingly simple to complicated. Following is a list of tools you can use to effectively diagnose a problem. While Gates does not sell most of the items discussed in this section, unless noted, the items are readily available from industrial instrumentation outlets throughout the United States.

Eyes, Ears, Nose & Hands

When troubleshooting a belt drive problem, stand back and observe the drive while it is in operation and at rest. Do you smell warm rubber? Can you see anything unusual about the way the belt travels around the drive? Is the drive frame flexing under load? Do you hear chirping, squealing or grinding noises? Is there an accumulation of fabric dust beneath the drive which might interfere with the belts?

Squirt Bottle With Soapy Water

When a belt drive is excessively noisy, the belt is often incorrectly blamed. It is easy to eliminate the belt as the problem by spraying it with soapy water while it is running. If the noise goes away, or decreases, then the belt is part of the problem. If you still hear the same noise, the problem is likely due to other drive components.

Ball Of String

Variation in drive center distance, often caused by weak supporting structure, can cause problems from vibration to short belt life. To determine if center distance variation exists, turn off the drive and tightly tie a piece of string from the driveR to the driveN shaft.Start up the drive and note if the string stretches almost to the point of breaking, or goes slack. If either is the case, the problem could be center distance variation. It is particularly important to observe the string right at drive start up when the loads are highest. String can also be used to check pulley alignment.

Belt & Sheave Groove Gauges

If you suspect a belt-to-sheave groove mismatch, English and metric belt and sheave groove gauges can be used to check dimensions. These also are handy for identifying a belt cross section for replacements and for checking sheave grooves for wear.

These gauges are available from your belt supplier For price information, contact your Gates distributor.

English Gauge: Form #13998
Metric Gauge: Form #13998-M

Long Straight Edge

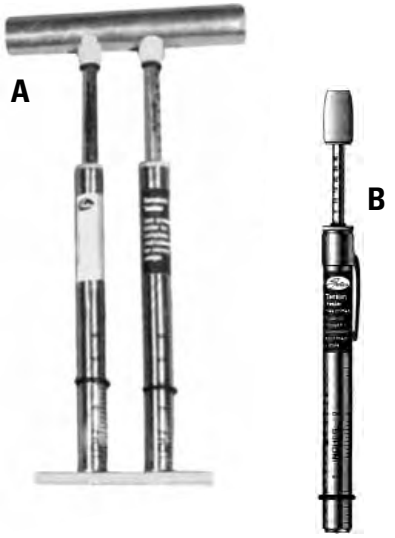
While V-Belts can be somewhat forgiving of misalignment, this condition can still affect V-Belt performance. Even slight misalignment can cause major problems on a synchronous drive.Use a long straight edge, made of wood, metal or any rigid material, to quickly check drive alignment. Simply lay the straight edge across the pulley faces and note the points of contact (or lack of contact).

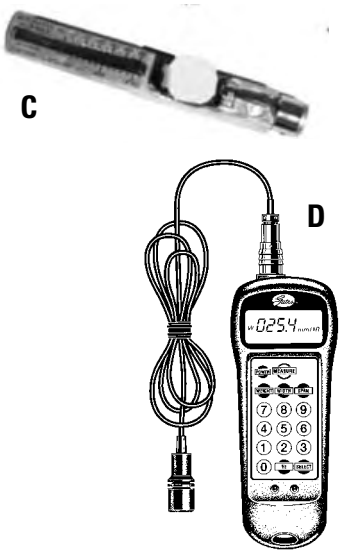
Design Flex® and Design View®

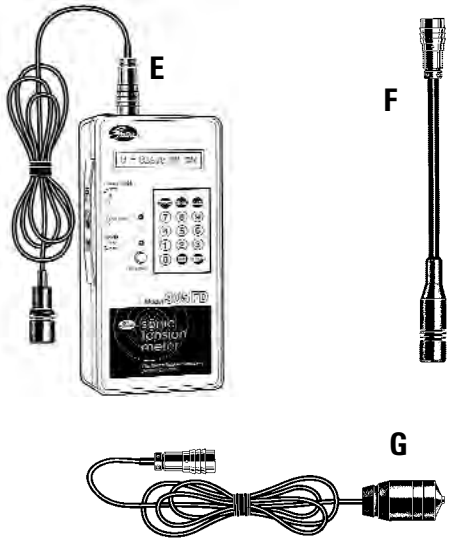
Gates design suite of engineering programs include interactive support software and a user friendly interface for rapid data retrieval and smooth design work.

NOTE: In some cases redesign of the drive is necessary. Gates Drive Design software provides a quick, accurate and flexible method of correctly redesigning problem drives.

TROUBLESHOOTING TOOLS







Belt Tension Testers

Improper belt tension, either too high or too low, can cause belt drive problems. An "experienced" thumb may be okay for ordinary drives, but for critical drives, Gates recommends using at ension gauge. Proper tension and installation can extend belt life and reduce costly downtime.

Several types of tension gauges are available.

A. "Double Barrel" Tension Tester (Product No. 7401-0075)
Maximum deflection force: 66 lbs. For use with all multiple V-Belt and large synchronous drives, including PowerBand® and Poly Chain® GT® belt drives.

*A 5-Barrel Tension Tester is also available. Contact your Gates representative for details.

B. Tension Tester (Pencil Type) (Product No. 7401-0076)
Maximum deflection force: 30 lbs. For use with all small V-Belt and synchronous drives, including PowerBand and Poly Chain GT belt drives.

The pencil type tension testers are recommended for use with:
- Super HC V-Belts
- Hi Power II V-Belts
- PowerBand Belts
- Poly Chain GT2 Belts
- PowerGrip GT2 Belts

C. Krikit Gauge (Product No. 7401-0071)
For use with:
- Automotive V-Belts

D. Sonic Tension Meter

Now!- More compact and easy to use.

For extremely accurate belt tension measuring, the Gates Sonic Tension Meter is an electronic device that measures the natural frequency of a free stationary belt span and instantly computes the static belt tension based upon the belt span length, belt width and belt type.

Features:

- Uses sound waves instead of force/deflection.
- Results are repeatable with any operator.
- Portable, lightweight and easy to use.
- Fast. Calculates tension in seconds.
- Can be used in almost any environment.
- Model 505C runs on two AAA batteries.
- Model 305FD runs on four AAA batteries.
- Model 305FD connects to a computer for data downloading.

D. Model 505C - Product No. 7420-0201

E. Model 305FD - Product No. 7420-0203

Accessories:

F. Flexible Sensor - Product No. 7420-0204 (Optional with 505C)

G. Optional Inductive Sensor - Product No. 7420-0212

Both Models:

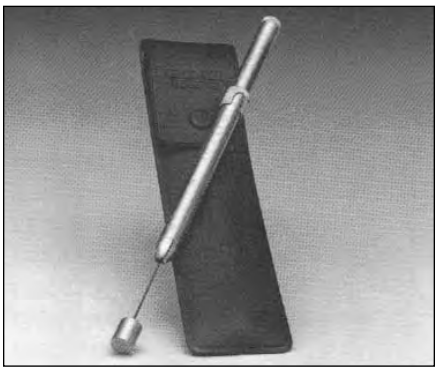
For use with these belts:
All synchronous belts
Micro-V® belts
Polyflex® belts

Tension Gauge

Improper belt tension, either too high or too low, can cause belt drive problems. Several types of tension gauges are available; see page 35. An inexpensive pencil type is adequate for most situations. See your local Gates distributor for price and availability.

Vibrotach Tachometer

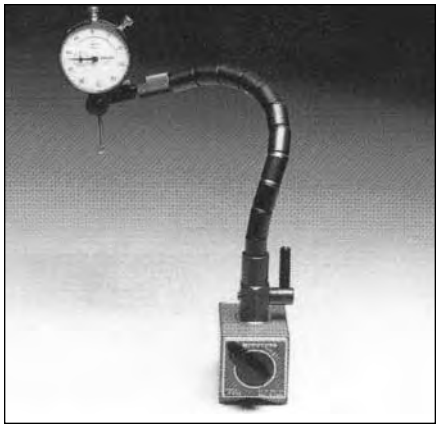
This tool can be used to isolate the forcing frequency behind vibration problems. It is a small, hand-held device which can be butted up against the vibrating equipment. A thin metal reed protrudes from the end, the length of which can be varied. As you vary the length, the reed will vibrate wildly at some point. The tachometer scale then gives you the forcing rpm or frequency. Once the system frequencies are identified, it is easy to trace and correct the source of the problem.



Available from:
Martin Engineering Co.
U.S. route 34
Neponset, IL 61345
1-800-544-2947

Dial Indicator

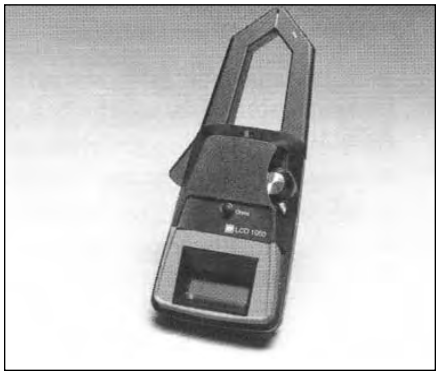
Improperly mounted sheaves or out-of-round pulleys are sometimes the root of vibration or more severe problems. This device can be used to measure side-to-side sheave wobble or diameter variation by holding it up to the sheave sidewall or top of the belt inside the pulley groove, respectively. IMPORTANT: Always turn off the machine before using the dial indicator. Rotate the drive by hand to make your measurements.



Clamp-On Ammeter

If belts are failing prematurely, it's possible the driveN load was underestimated when the drive was designed. Use the ammeter to check the actual load being delivered by an electric motor. The clamp-on style allows you to do this safely, without baring wires or worrying about electrical connections.

This tool also can be used to troubleshoot vibration problems if they are caused by electrical sources such as arcing switches, power surges or electrical connections.

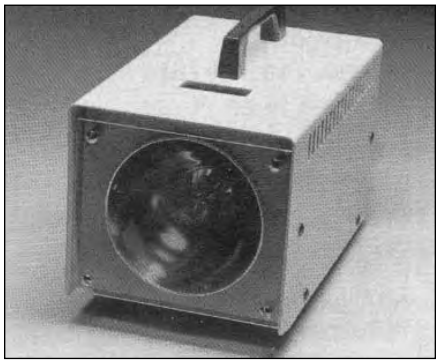


Needle Pyrometer

The pyrometer allows you to accurately measure internal and external belt temperatures.

Strobe Tachometer

You cannot always see what is happening to a drive while it is in operation. This instrument allows you to stop the action to get a better idea of the dynamic forces affecting the drive. The strobe tachometer is best used after initial diagnosis of the problem because it helps pinpoint the cause. It will help you identify such things as single or dual mode belt span vibration and frame flexure.



DotLine Laser Tool

- Compact design
- Includes an adjustable pivoting mounting arm
- Laser projects either a dot or a line
- Laser line is very easy to read on targets
- Adjustable targets for custom sheave/sprocket edge thickness available
- Includes a hard foam filled plastic carrying case