Gates®

Belt Drive Preventive Maintenance & Safety Manual

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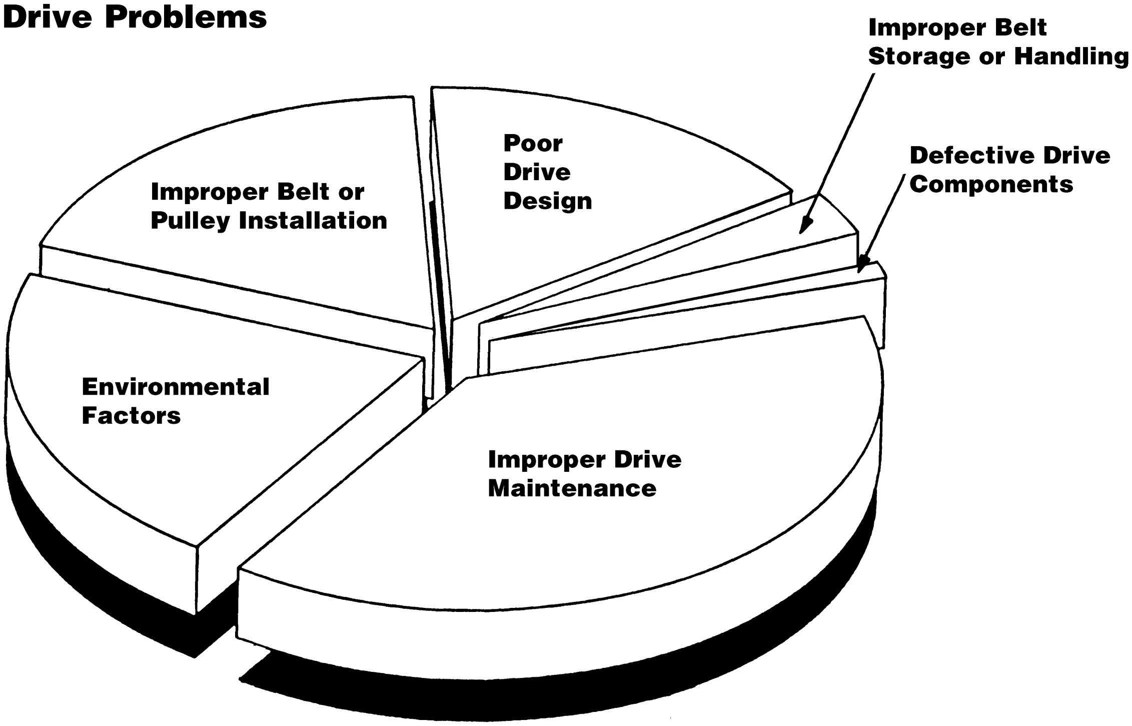
Sources of Drive Problems



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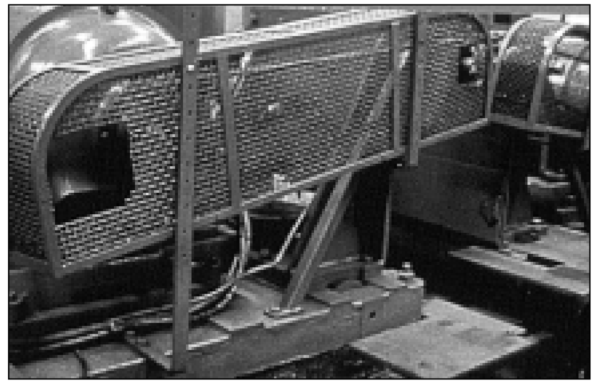
FOREWARD

Why Have A Preventive Maintenance Program?

When compared to the constant lubrication problems associated with chain drives, or the mechanical problems and high costs associated with gear drives, belts are the most cost-effective, reliable means of power transmission.

However, optimum belt drive performance requires proper maintenance. The potential for long service life is built into every Gates belt. When coupled with a regularly scheduled maintenance program, your belts and belt drives will run relatively trouble-free for a long time.

Power should be shut off and controls locked before inspecting



Belt drive should have adequate guard

*** Note** *Section cut-outs for demo*

Carefully inspect all belts

Important to your business

An effective preventive maintenance program saves your firm time and money. When you inspect and replace belts and faulty drive components before they fail, you reduce costly downtime and production delays.

What is a good belt maintenance program?

A comprehensive, effective program of preventive maintenance consists of several elements:

- Maintaining a safe working environment
- Belt product knowledge
- Regularly scheduled belt drive inspections
- Belt storage and handling
- Proper belt installation procedures
- Belt drive performance evaluations
- Troubleshooting

FOREWARD

Maintaining A Safe Working Environment

It is common sense to establish a safe working environment in and around your belt drives. The following precautions will make belt drive inspection and maintenance easier and safer.

Checklist

✔ Always shut off power, lock and tag control box.
✔ Place all machine components in safe position.
✔ Remove guard, inspect and clean.
✔ Inspect belt for wear, damage. Replace as needed.
✔ Inspect sheaves or sprockets for wear, alignment. Replace if worn.
✔ Inspect other drive components such as bearings, shafts, motor mounts and takeup rails.
✔ Inspect static conductive grounding system (if used) and replace components as needed.
✔ Check belt tension and adjust as needed.
✔ Recheck pulley alignment.
✔ Reinstall belt guard.
✔ Restart drive. Look and listen for anything unusual.

Wear Proper Clothing

Never wear loose or bulky clothes, such as neckties, exposed shirttails, loose sleeves or lab coats around belt drives. Wear gloves while inspecting sheaves or sprockets to avoid being cut by nicks, burrs or sharply worn pulley edges.

No loose or bulky clothing

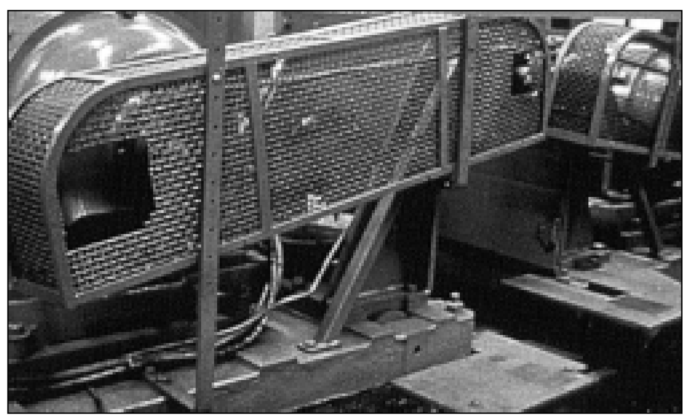
Maintain Safe Access to Drives

Always maintain a safe access to the belt drives. Keep area around drives free of clutter, debris and other obstructions. Floors should be clean and free of oil and debris to insure good footing and balance while working on machinery.

Don't clutter area around belt drive

Drive Guards

Always keep drives properly guarded. Every belt drive must be guarded when in operation. Guard must be designed and installed according to OSHA standards.



A properly guarded belt drive

A Properly Guarded Belt Drive

A properly designed guard has the following features:

- Completely encloses drive.
- Grills or vents for good ventilation.
- Accessible inspection door or panels.
- Can easily be removed and replaced if damaged
- Where necessary, should protect the drive from weather, debris and damage.

Follow these precautions to make your preventive maintenance easier.

Simple Drive Inspection

Begin preventive maintenance with a periodic drive inspection as a normal part of your maintenance rounds. 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 guard for looseness or damage. Keep it free of debris or dust and grime buildup on either the inside or the outside of the guard. Any accumulation of material on the guard acts as insulation, and could cause drives to run hotter.

The effect of temperature on belt life is important. For example, an internal temperature increase of 18°F (or approximately 36°F rise in ambient drive temperature) may cut belt life in half.

Also look for oil or grease dripping from guard. This may indicate over-lubricated bearings. If this material gets on rubber belts, they may swell and become distorted, leading to early belt failure.

It's a good idea to check motor mounts for proper tightness. Check take-up slots or rails to see that they are clean and lightly lubricated.

How Often To Inspect

The following factors influence how often you need to inspect a drive.

- Critical nature of equipment
- Drive operating cycle
- Accessibility of equipment
- Drive operating speed
- Environmental factors
- Temperature extremes in environment

Experience with your own equipment is your best guide to how often you need to inspect belt drives. Drives operating at high speeds, heavy loads, frequent stop/start conditions and at temperature extremes or operating on critical equipment require frequent inspection.

When To Perform Preventive Maintenance

To help establish a preventive maintenance schedule, keep the following in mind.

Critical Drives

A quick visual and hearing inspection may be needed every one to two weeks.

Normal Drives

With most drives, a quick visual and hearing inspection can be performed once a month.

Complete Inspection

A drive shutdown for a thorough inspection of belts, sheaves or sprockets and other drive components may be required every three to six months.

Remember, a well-designed industrial belt drive is capable of operating for several years when properly maintained and used under normal conditions.

Once the power is off, locked and tagged and the machine components are in safe positions, remove the guard and begin inspection.

DRIVE SHUTDOWN & THOROUGH INSPECTION

Preventive Maintenance Check List

By the following these steps, you can maintain a drive efficiently, safely and with very little effort.

1. Always turn off the power to the drive. Lock the control box and tag it with a warning sign "Down For Maintenance. Do Not Turn Power On."
   Make sure you have power turned off for the correct drive.
2. Test to make sure correct circuit has been turned off.
3. Place all machine components in a safe (neutral) position.
4. Remove guard and inspect for damage. Check for signs of wear or rubbing against drive components. Clean and realign guard to prevent rubbing if necessary.
5. Inspect belt for wear or damage. Replace as needed. (See page 7 and 8 for belt replacement procedure.) See page 11 for synchronous belt procedure.
6. Inspect sheaves or sprockets for wear and misalignment. Replace if worn. (See page 9 and 10 for pulley installation procedure.)

Turn off power, lock controls and tag

7. Inspect other drive components such as bearing, shafts, motor mounts and take-up rails.
8. Inspect static conductive grounding system (if used) and replace components as needed.
9. Check belt tension and adjust as needed.
10. Recheck sheave or sprocket alignment.
11. Reinstall belt guard.
12. Turn power back on and restart drive. Look and listen for anything unusual.

These steps are covered in detail in the following section.

Preventive Maintenance Procedure

Once the power is off, locked and tagged, and the machine components are in safe positions, remove the guard and begin inspection.

How to Inspect a Belt

Begin by inspecting the belt. Observing signs of unusual belt wear or damage can allow you to troubleshoot possible drive problems.

Mark or note a point on the belt, or one of the belts in a multiple V-belt drive. Work your way around the belt(s), checking for cracks, frayed spots, cuts or unusual wear patterns.

Begin by inspecting the belt

Check the belt for excessive heat. While belts do get hot during operations, if they are too hot to touch, then troubleshooting is in order. The maximum temperature at which a properly maintained V-belt should operate is 140° F (185° F for Gates synchronous belts).

Belts should be replaced if there are obvious signs of cracking, fraying, unusual wear or loss of teeth in a timing, or synchronous, belt.

How to Inspect a Sheave or Sprocket

It's always a good idea to check sheaves and sprockets for proper alignment and mounting. If belts have been removed from the drive, then the pulleys should be checked for wear or damage.

Use a straight edge to check pulley alignment

To check alignment, all you need is a straight edge or, for drives with long centers, a steel tape. If these are unavailable, heavy string will work.

Line the straight edge (tape or string) along the outside face of both pulleys as shown in the illustration. Misalignment will show up as a gap between the outside face and the straight edge, tape or string. Sheave or sprockets can be checked for tilting with a spirit level.

Three possible causes of sheave or sprocket misalignment are: (See Fig. 1, page 9)

1. Motor shafts and driven machine shafts are not parallel
2. Pulleys not properly located on the shafts
3. Pulleys are tilted due to improper mounting

Check Alignment Tolerances

As a general rule, sheave misaligment on V-belt drives should be less than 1/2˚ or 1/10" per foot of drive center distance. Misalignment for synchronous, Polyflex® and Micro-V® belts should be within 1/4° or 1/16" per foot of drive center distance.

The greater the misalignment, the greater the chance of belt instability, increased belt wear, noise, vibration and V-belt turnover.

Guard Inspection

Check guard for wear or possible damage. Don't overlook wear on the inside of guard. Clean the guard to prevent it from becoming insulated and closed to ventilation. Clean off any grease or oil that may have spilled onto the guard from over-lubricated bearings. Realign guard.

Check Other Drive Components

It's always a good idea to examine bearings for proper alignment and lubrication. Also check motor mounts for correct tightness. Be sure take-up rails are free of debris, obstructions, dirt or rust.

Check Belt Tension

Following the drive component inspection, the final step is to check belt tension and, if necessary, retension the belt. Then, make a final alignment check.

If too little tension is applied, the belts may slip. Too much tension can reduce belt and bearing life. Applying the proper tension is very important.

The correct tension is the lowest tension at which belts will run and not slip when the drive is under a full load. Experienced mechanics may claim to check belt tension with their thumb. But why take chances when there is a simple and more accurate method available?

Remember, belts with different construction will exhibit a different feel.

Following is an explanation on how to use the Gates Tension Tester.

How to Tension Belt Drives With Your Gates Tension Testers

(Up to 30 lbs.)

1. Measure span length **(t)**.

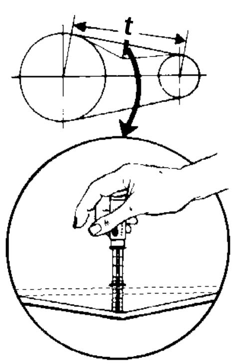
2. Position the lower of the two O-Rings using either of these methods:

a. On the scale reading “Deflection Inches”, set O-Ring to show a deflection equal to 1/64" per inch of span length **(t)**.

b. On the scale reading “Inches of Span Length”, set O-Ring to show a deflection equal to the inches of measured span length **(t)**.

3. At the center of span **(t)**, apply force with Gates Tension Tester perpendicular to the span, large enough to deflect one belt of a multiple belt set on drive until the bottom edge of the lower O-Ring is even with tops of remaining belts. For drives with only one belt, a straightedge across pulleys will assure accuracy of positioning.

4. Find the amount of deflection force on upper scale of Tension Tester. The Sliding Rubber O-Ring slides up the scale as tool compresses—and stays up for accurate reading of pounds force. Read at the bottom edge of ring (slide ring down before reusing).



5. Compare deflection force with range of forces recommended. If less than minimum recommended deflection force, belts should be tightened. If more than maximum recommended deflection force, drive is tighter than necessary.

NOTE: There normally will be a rapid drop in tension during the “run-in period” for V-belt drives. Check tension frequently during the first day of operation.

Read the scales at the bottom edge of the O-Ring. Leave the upper O-Ring in maximum “down” position.

Belts, like string, vibrate at a particular natural frequency based on mass and span length. Gates unique Sonic Tension Meter simply converts this frequency into a measurement of tension. Here’s how it works:

First, enter belt width, span length and unit weight into meter using built-in keypad. Next, hold meter sensor to belt span, then lightly strum belt to make it vibrate. Press "measure" button and that’s it. Meter instantly converts vibrations into belt tension. Readings are displayed on a liquid-crystal screen. (detailed instructions accompany tester)

Recommended Deflection Force Per Belt For Super HC® V-Belts, Super HC PowerBand® Belts, Super HC Molded Notch V-Belts or Super HC Molded Notch PowerBand Belts*

V-Belt Cross Section	Small Sheave Diameter Range (In.)	Small Sheave RPM Range	Speed Ratio Range	Recommended Deflection Force (Lbs.)	
				Minimum	Maximum
	2.65 - 2.80	1200-3600		3.0	4.3
	3.00 - 3.15	1200-3600	2.00	3.3	4.8
3V	3.35 - 3.65	1200-3600	to	3.7	5.4
	4.12 - 5.00	900-3600	4.00	4.4	6.4
	5.30 - 6.90	900-3600		4.8	7.1
	2.20	1200-3600		2.8	4.1
	2.35 - 2.50	1200-3600		3.2	4.7
	2.65 - 2.80	1200-3600	2.00	3.5	5.1
3VX	3.00 - 3.15	1200-3600	to	3.8	5.5
	3.35 - 3.65	1200-3600	4.00	4.1	6.0
	4.12 - 5.00	900-3600		4.8	7.1
	5.30 - 6.90	900-3600		5.8	8.6
	4.40 - 4.65	1200-3600		9.0	13.0
	4.90 - 5.50	1200-3600	2.00	10.0	15.0
5VX	5.90 - 6.70	1200-3600	to	11.0	17.0
	7.10 - 8.00	600-1800	4.00	13.0	19.0
	8.50 - 10.90	600-1800		14.0	20.0
	11.80 - 16.00	400-1200		15.0	23.0
	7.10 - 8.00	600-1800	2.00	11.0	16.0
5V	8.50 - 10.90	600-1800	to	13.0	18.0
	11.80 - 16.00	400-1200	4.00	14.0	21.0
8V	12.50 - 17.00	600-1200	2.00	28.0	41.0
			to		
	18.00 - 24.00	400- 900	4.00	32.0	48.0

Recommended Deflection Force Per Belt For Hi-Power II™ V-Belts, Hi Power II PowerBand Belts or Tri-Power® Molded Notch V-Belts*

V-Belt Cross Section	Small Sheave Diameter Range (In.)	Small Sheave RPM Range	Speed Ratio Range	Recommended Deflection Force (Lbs.)			
				Hi-Power II		Tri-Power Molded Notch	
				Minimum	Maximum	Minimum	Maximum
	3.0			2.7	3.8	3.8	5.4
	3.2	1750	2.00	2.9	4.2	3.9	5.6
A	3.4 - 3.6	to	to	3.3	4.8	4.1	5.9
AX	3.8 - 4.2	3600	4.00	3.8	5.5	4.3	6.3
	4.6 - 7.0			4.9	7.1	4.9	7.1
	4.6			5.1	7.4	7.1	10.0
	5.0 - 5.2	1160	2.00	5.8	8.5	7.3	11.0
B	5.4 - 5.6	to	to	6.2	9.1	7.4	11.0
BX	6.0 - 6.8	1800	4.00	7.1	10.0	7.7	11.0
	7.4 - 9.4			8.1	12.0	7.9	12.0
	7.0			9.1	13.0	12.0	18.0
	7.5	870	2.00	9.7	14.0	12.0	18.0
C	8.0 - 8.5	to	to	11.0	16.0	13.0	18.0
CX	9.0 - 10.5	1800	4.00	12.0	18.0	13.0	19.0
	11.0 - 16.0			14.0	21.0	13.0	19.0
	12.0 - 13.0	690	2.00	19.0	27.0	19.0	28.0
D	13.5 - 15.5	to	to	21.0	30.0	21.0	31.0
	16.0 - 22.0	1200	4.00	24.0	36.0	25.0	36.0

*Note: This information is for Horsepower Ratings which are mentioned in this manual only. Use with older drives could result in overtensioning.

How To Install V-Belts

When the decision is made to install a belt, either as a replacement or on a new drive, the following steps are recommended:

1. **After power has been turned off**, and guard removed, loosen motor mounting bolts.

2. Move motor until belt is slack and can be removed without prying. Never pry off a belt!

3. Remove old belts. It is a good idea to check them for unusual wear. Excessive wear may indicate problems with drive design or maintenance procedures.

4. Select correct replacement belt.
5. Belts and sheaves may be cleaned by wiping with a rag slightly dampened with a light, non-volatile substance. Soaking or brushing solvent on the belt is not advisable. Obviously, sanding or scraping the belt with a sharp object to remove grease or debris is not recommended. Belts must be dry before using on a drive.

NOTE:
Worn sheaves are a major cause of shortened belt life.

6. Inspect sheaves for wear and nicks. Gates Sheave Gauges make is easy to see if grooves are worn. If more than 1/32” of wear can be seen, the worn sheaves should be replaced.

7. Check alignment.

8. Inspect other drive components such as bearings and shafts for alignment, wear, lubrication, etc.

9. Install a new belt or belt set. Replace all belts on multiple belt drives. When a new belt replaces another belt in a multi-belt drive, the new one may be tensioned properly, but all of the old ones are undertensioned. The drive load may then be carried only by the new belt.

10. Take up the center distance on the drive, rotate the drive by hand for a few revolutions (this will help the belts seat properly) and check for proper tension, using a belt tension tester. Some long V80® belts may appear to hang unevenly when installed. It is normal for belts within RMA tolerances to create noticeable differences in deflection. This “catenary effect” is a curve made by a cord of uniform weight suspended between two points. This appearance will change with proper run-in and retensioning.

11. Secure motor mounting bolts to correct torque.

12. Replace guard.

13. A run-in procedure is recommended. This process consists of starting the drive, letting it run under full load and then stopping, checking and retensioning to recommended values. Running belts under full load allows them to seat themselves into the grooves.

If possible, let them run for about 24 hours. Even letting them run overnight, or over a lunch break, is better than nothing. This run-in procedure will reduce the future need for retensioning and extend belt life.

14. During startup, look and listen for unusual noise or vibration. It’s a good idea to shut down the machine and check bearings and motor. If they feel hot, the belt tension may be too tight or bearing may be misaligned or not lubricated properly.

How To Install and Align Pulleys

It is extremely important that new or replacement pulleys be installed and aligned properly. Any pulley types used in industry must be properly assembled, and bolts or setscrews tightened to the correct torque.

Most pulleys are attached to the shaft with a tapered bushing which fits a mating tapered bore in the pulley. This type of system consists of a bushing, a pulley, a key, and a setscrew, depending on bushing type. Bushings come in several bore size diameters. This allows for a reduction in the parts inventory required in your plant because one bushing can be used with a number of different size pulleys.

Type QD Pulleys

To install, slide the QD bushing on the shaft, flange end first. Assemble the key. Position the QD hub on the shaft. Tighten the setscrew over the key, hand-tight with a standard Allen wrench only. **Do not use excessive force.**

Slide the large end of the pulley taper bore into position over the cone, aligning pull-up bolt holes in the pulley and tapped holes in the flange of the bushing. Assemble pull-up bolts and lock washers. Align the pulleys.

Tighten pull-up bolts alternately and evenly. Do not use extensions on the wrench handle. There should be a gap between pulley hub face and bushing flange to assure a satisfactory cone grip and press fit. This gap must not be closed.

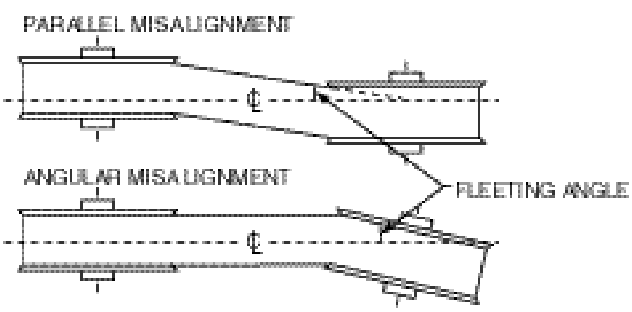
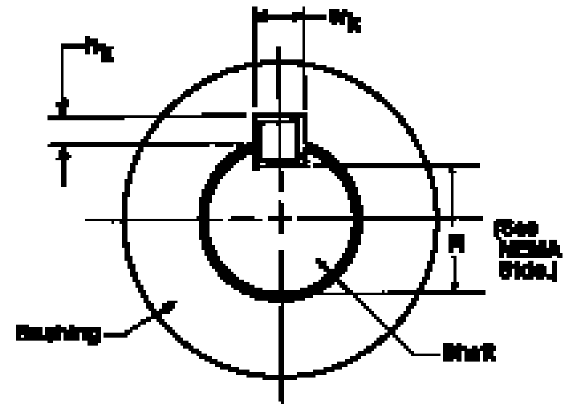


Fig. 1

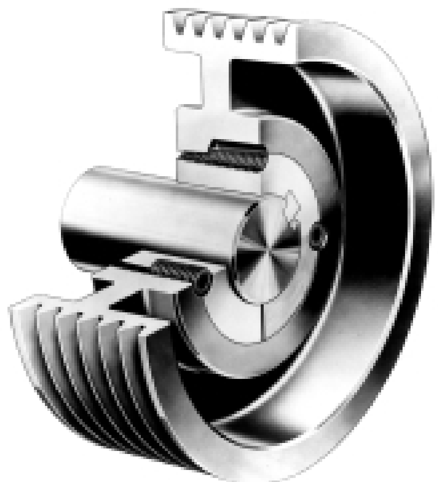


Shaft Diameter (Inches)			Width ^{w}k (inches)*	Depth ^{h}k +0.015-0.000 (Inches)
Up Through 7/16 (0.44)			3/32 (0.094)	3/64 (0.047)
Over 7/16	(0.44) To and Incl.	9/16 (0.56)	1/8 (0.125)	1/16 (0.062)
Over 9/16	(0.56) To and Incl.	7/8 (0.88)	3/16 (0.188)	3/32 (0.094)
Over 7/8	(0.88) To and Incl.	1 1/4 (1.25)	1/4 (0.250)	1/8 (0.125)
Over 1 1/4	(1.25) To and Incl.	1 3/8 (1.38)	5/16 (0.312)	5/32 (0.156)
Over 1 3/8	(1.38) To and Incl.	1 3/4 (1.75)	3/8 (0.375)	3/16 (0.188)
Over 1 3/4	(1.75) To and Incl.	2 1/4 (2.25)	1/2 (0.500)	1/4 (0.250)
Over 2 1/4	(2.25) To and Incl.	2 3/4 (2.75)	5/8 (0.625)	5/16 (0.312)
Over 2 3/4	(2.75) To and Incl.	3 1/4 (3.25)	3/4 (0.750)	3/8 (0.375)
Over 3 1/4	(3.25) To and Incl.	3 3/4 (3.75)	7/8 (0.875)	7/16 (0.438)
Over 3 3/4	(3.75) To and Incl.	4 1/2 (4.50)	1 (1.000)	1/2 (0.500)
Over 4 1/2	(4.50) To and Incl.	5 1/2 (5.50)	1 1/4 (1.250)	5/8 (0.625)
Over 5 1/2	(5.50) To and Incl.	6 1/2 (6.50)	1 1/2 (1.500)	3/4 (0.750)
Over 6 1/2	(6.50) To and Incl.	7 1/2 (7.50)	1 3/4 (1.750)	3/4 (0.750)
Over 7 1/2	(7.50) To and Incl.	9 (9.00)	2 (2.000)	3/4 (0.750)
Over 9	(9.00) To and Incl.	11 (11.00)	2 1/2 (2.500)	7/8 (0.875)
Over 11	(11.00) To and Incl.	13 (13.00)	3 (3.000)	1 (1.000)

*Tolerance on Width, ^{w}k for widths up through 1/2'' (0.500) . . . . +0.002-0.000
For widths over 1/2'' (0.500) through 1'' (1.000) . . . . +0.003-0.000
For widths over 1'' (1.000) . . . . +0.400-0.000

Taper Lock Sheaves

To install, insert bushing into sheaves. Match holes (not threads) and slip the entire unit onto shaft. Put screws into holes that are threaded into the sheave only. Align sheaves and tighten the screws. As the bushing is wedged inward, it contacts and grips the shaft.



Sprocket Installation

Bushing Style	Bolts		Torque Wrench	
	Qty.	Size	lb-ft	lb-in
H	2	1/4 x 3/4	7.9	95
JA	3	10-24 x 1	4.5	54
SH & SDS	3	1/4-20 x 1 3/8	9.0	108
SD	3	1/4-20 x 1 7/8	9.0	108
SK	3	5/16-18 x 2	15.0	180
SF	3	3/8-16 x 2	30.0	360
E	3	1/2-13 x 2 3/4	60.0	720
F	3	9/16-12 x 3 5/8	75.0	900
J	3	5/8-11 x 4 1/2	135.0	1620
M	4	3/4-10 x 6 3/4	225.0	2700
N	4	7/8-9 x 8	300.0	3600
P	4	1-8 x 9 1/2	450.0	5400
W	4	1 1/8-7 x 11 1/2	600.0	7200
S	5	1 1/4-7 x 15 1/2	750.0	9000

Caution: Excessive bolt torque can cause sprocket and/or bushing breakage.

Note: To insure proper bushing/sprocket performance, full bushing contact on the shaft is recommended.

Sprocket Installation

Bushing Style	Bolts		Torque Wrench	
	Qty.	Size	lb-ft	lb-in
1008	2	1/4-20 x 1/2	4.6	55
1108	2	1/4-20 x 1/2	4.6	55
1210	2	3/8-16 x 5/8	14.6	175
1610	2	3/8-16 x 5/8	14.6	175
2012	2	7/16-14 x 7/8	23.3	280
2517	2	1/2-13 x 1	35.8	430
3020	2	5/8-11 x 1 1/4	66.7	800
3525	3	1/2-13 x 1 1/2	83.3	1000
4030	3	5/8-11 x 1 3/4	141.7	1700
4535	3	3/4-10 x 2	204.2	2450
5040	3	7/8-9 x 2 1/4	258.3	3100
6050	3	1 1/4-7 x 3 1/2	651.7	7820
7060	4	1 1/4-7 x 3 1/2	651.7	7820

Caution: Excessive bolt torque can cause sprocket and/or bushing breakage.

Note: To insure proper bushing/sprocket performance, full bushing contact on the shaft is recommended.

HOW TO INSTALL SYNCHRONOUS BELTS

Follow these steps to install synchronous belt drive systems:

1. **After power has been locked out and tagged**, loosen motor mounting bolts. Move motor until belt is slack and can be removed without prying. Never pry off a belt!
2. Remove old belt and check it for unusual wear. Excessive wear may indicate problems with the drive design or maintenance program. Refer to pages 26-33 for visual aids.
3. Select correct replacement belt. **Do not crimp belts during handling or installation.**
4. Sprockets may be cleaned by wiping with a rag slightly dampened with a light, non-volatile solvent. Soaking or brushing the solvent on the belt is not advisable. Obviously, sanding or scraping the belt or sprocket with a sharp object to remove grease or debris is not recommended. Belts must be dry before using on a drive.
5. Inspect sprockets for unusual or excessive wear. Check alignment. Proper alignment is very critical with synchronous belt drives. Check other drive components such as bearings and shafts for alignment, lubrication, wear, etc.
6. Install new belt over sprockets. Do not pry or use force.
7. Take up center distance on drive until proper tension is obtained on the tension tester. Rotate drive by hand for a few revolutions and re-check tension and alignment.

9. Secure motor mounting bolts to correct torque. Be sure all drive components are secure since any change in drive centers during operation will result in poor belt performance.
10. Although belts will not require further tensioning, we recommend starting up the drive and observing performance. Look and listen for unusual noise or vibration. It's a good idea to shut down the machine and check bearings and motor. If they feel hot, belt tension may be too tight or bearings may be misaligned or not lubricated correctly.

BELT IDENTIFICATION

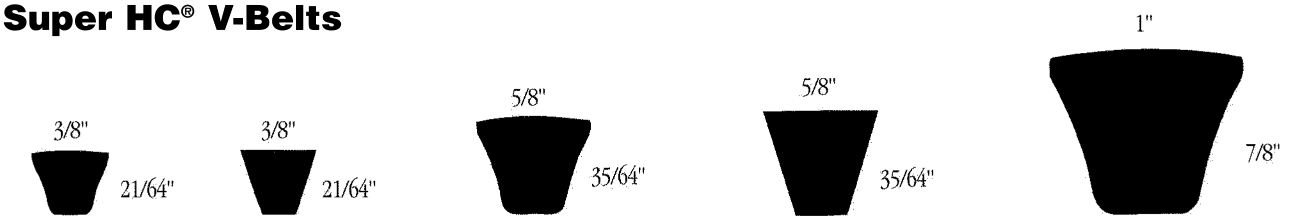
When preventive maintenance inspections indicate that belts need replacing, it's important that you install the correct belts.

Consequently, it is important that you be able to identify the various types and sizes of belts available, and then quickly be able to specify the correct replacement.

The information on the following pages will help you become familiar with the belt types used in the industry. You'll also discover that Gates makes a belt to fit nearly any application you can name.

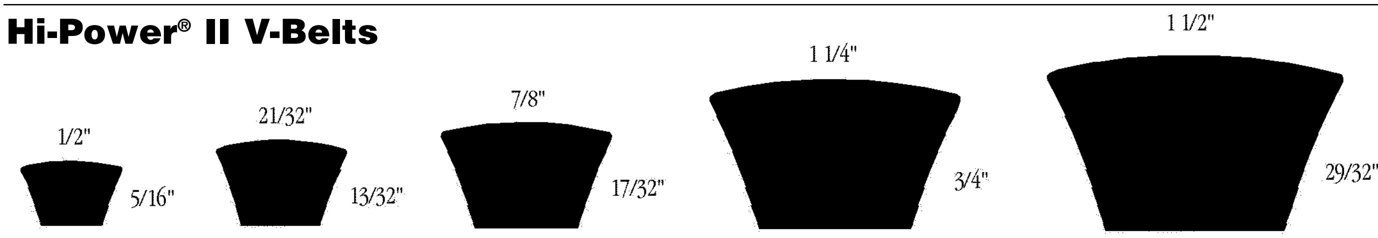
V-Belts

Super HC® V-Belts



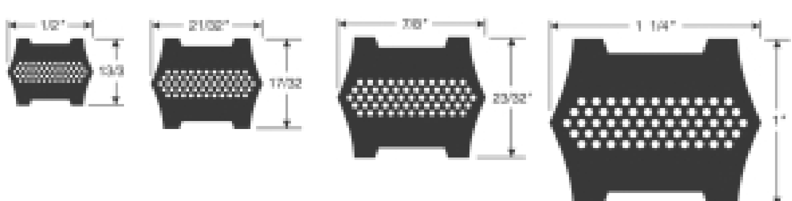
3V **3VX** **5V** **5VX** **8V**

Hi-Power® II V-Belts



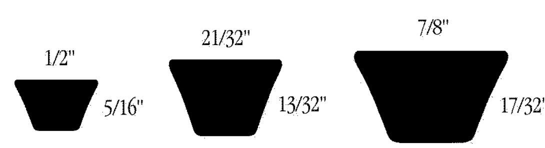
A **B** **C** **D** **E**

Dubl V-Belts



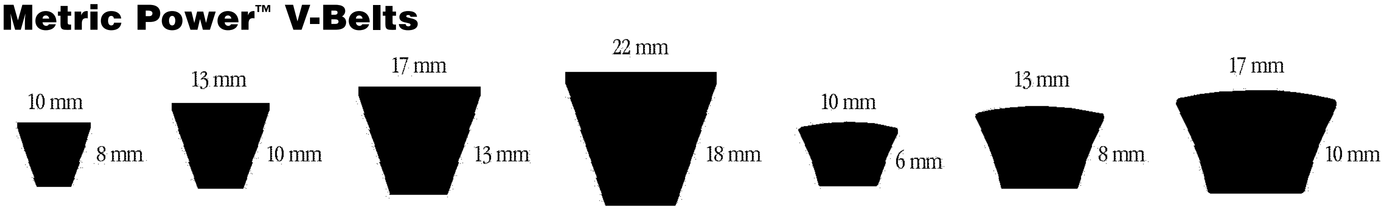
AA **BB** **CC** **DD**

Tri-Power® V-Belts



AX **BX** **CX**

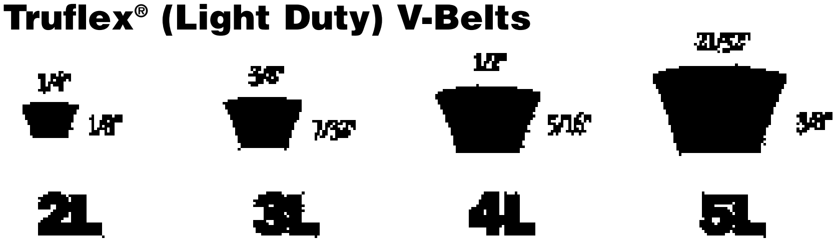
Metric Power™ V-Belts



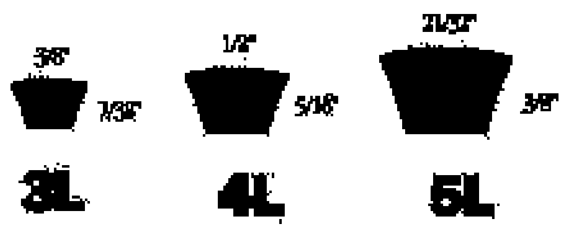
SPZ/XPZ **SPA/XPA** **SPB/XPB** **SPC/XPC** **10mm** **13mm** **17mm**

Multi-Speed Belts
Top Width-Sheave Angle

Truflex® (Light Duty) V-Belts

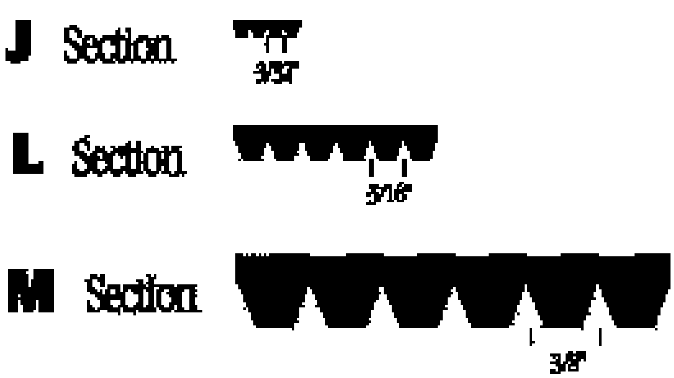


PoweRated® V-Belts



PowerBand® – Hi-Power II and Super HC®

Micro-V® Belts



Standard Polyflex®

Polyflex® JB®

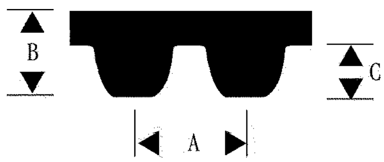
Synchronous Belts

All synchronous belts are identified in a similar manner, in either English or metric units. Belts are measured by:

1. **Pitch:** Distance in inches or millimeters between two adjacent tooth centers as measured on the belt pitch line.
2. **Pitch Length:** Total length (circumference) in inches or millimeters as measured along the pitch line. It is equal to the pitch multiplied by the number of teeth in the belt.
3. **Width:** Denoted in inches or millimeters.

Poly Chain® GT®2

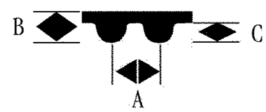
8mm Pitch



14mm Pitch

PowerGrip HTD®

3mm Pitch



5mm Pitch

PowerGrip GT2

2mm Pitch

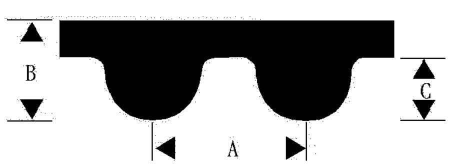
3mm Pitch

5mm Pitch

8mm Pitch

14mm Pitch

20mm Pitch



PowerGrip® Timing

MXL

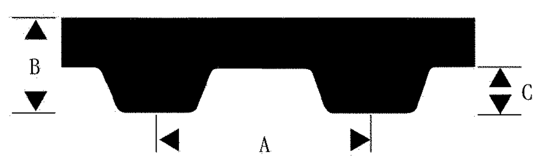
XL

L

H

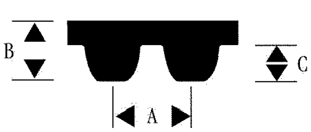
XH

XXH



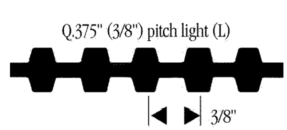
PowerGrip GT

8mm Pitch

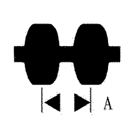


14mm Pitch

Twin Power® Timing
Twin Power® — PowerGrip GT & GT2



8mm Pitch



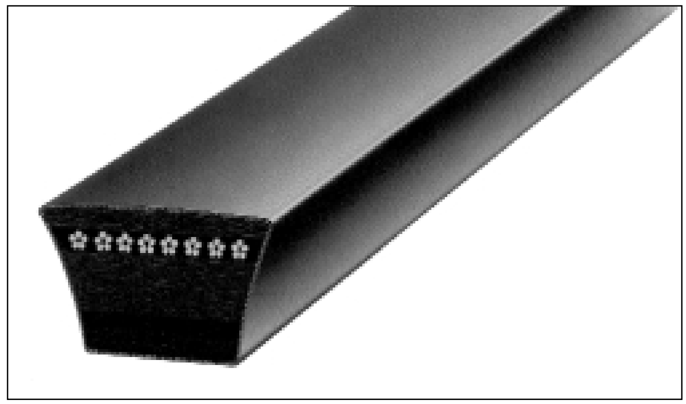
Narrow Section V-Belts

These high capacity belts are used to substantially reduce drive costs and decrease space requirements. This V-belt handles the complete range of drive horsepower recommended with three narrow cross sections instead of the five regular cross sections needed for classical heavy-duty belts. Specified by 3V, 5V or 8V cross sections. Specify Gates Super HC® V-Belts.

Classical Section V-Belts

These are the original belts used in heavy duty applications. They are specified by cross section and standard length. The size is designated as A, B, C, D or E. The easiest way to select a replacement is by finding the belt number on the worn belt. If not legible, measure the belts outside circumference with a flexible tape, preferably while it's still on the drive.

Then, order the Gates **Hi-Power II** V-Belt which has the next shorter standard length. For example: For an "A" section belt with a 28.0" O.C., order an A26 replacement belt.



Banded and Bandless Belts

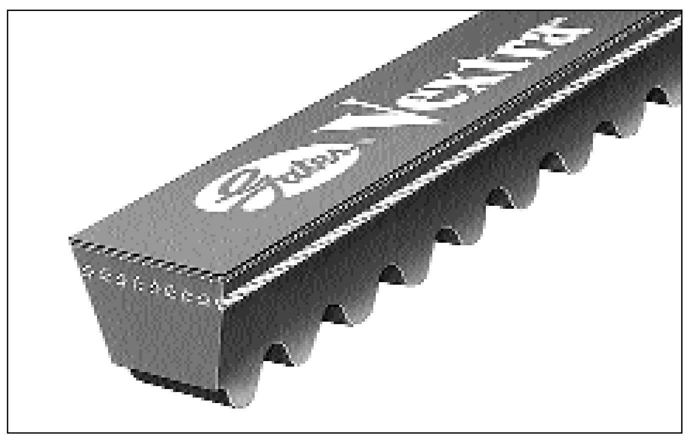
Banded belts, also called wrapped or covered belts, have a fabric cover. Un-notched and generally with concave sidewalls, they have rounded bottom corners and arched tops.

Bandless belts have no fabric cover They have straight, cut-edge sidewalls and special molded notches. These notches reduce bending stress during operation which allow them to run smaller diameter sheaves than can comparable non-notched banded belts.

Gates offers these two types in both the classical and narrow sections. In the classical section, Gates **Tri-Power**® molded notch is available in AX, BX and CX cross sections. Its length is specified by the same standard belt number as other classical section belts.

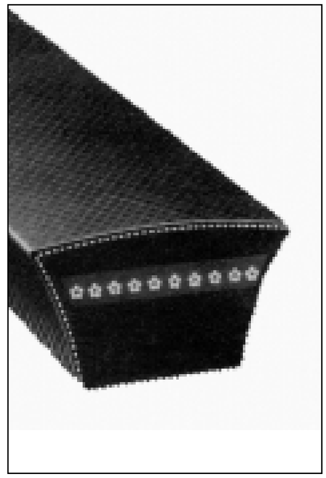
Gates also offers **Super HC Molded Notch** V-Belts in 3VX and 5VX sizes.

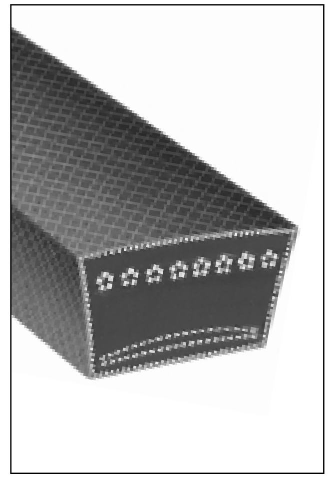
In both cases, an "X" is used in the belt number to designate a molded notch construction. For example: An AX26 is a bandless, molded notch classical section belt. A 5VX1400 is a narrow section, bandless, molded notch belt with a 140" O.C.



Note: The revolutionary Gates Vextra construction is used in the notched belts.

Light Duty Belts





These are used on light duty fractional horsepower drives and are designed for use with backside idlers. **Gates Truflex**® and **PoweRated**® V-Belts are offered in this category and are specified by cross section and outside circumference. **Truflex** is recommended for the lower lighter duty range. **PoweRated**®, a special belt designed for clutching, heavier shock-load and backside idler drives, is recognized by its green color. Reinforced with an aramid fiber tensile (pound for pound stronger than steel). **PoweRated** can interchange with **Truflex**, but **Truflex** cannot interchange with **PoweRated**.

Synchronous Belts

These belts are also known as timing or positive drive belts and are used where driveN shaft speeds must be synchronized to the rotation of the driveR shafts. They can also be used to eliminate noise and maintenance problems caused by chain drives.

Synchronous belts, such as **Gates Poly Chain**® **GT**®**2**, can be used in high horsepower drives... drives where space is severely limited... and where there is limited take up.

Synchronous drives are extremely efficient... as much as 98% with properly maintained **Poly Chain GT2** or **PowerGrip GT2** Systems. By contrast, chain drives are in the 91-98% efficiency range, while V-Belts average in the 93-98% range.

Distinctive tooth profiles (shapes) identify synchronous belts. Various sizes and constructions are available to meet a wide range of applications. The three important dimensions of a synchronous belt are pitch, width and pitch length. Tooth profiles must also be identified.

Belt Pitch - Distance (mm) between two adjacent tooth centers as measured on the belt's pitch line.

Belt Pitch Length - Circumference (mm) as measured along the pitch line.

Width - Top width (mm).

Tooth Profile - See page 14 for the easiest way to identify this.

Synchronous belts run on sprockets, which are specified by the following:

Pitch - Distance between groove centers, measured on the sprocket pitch circle. The pitch circle coincides with the pitch line of the mating belt.

Number of Sprocket Grooves

Width - Face width.

Note: The sprocket's pitch diameter is always greater than its outside diameter.

Note: PowerGrip GT2 belts must be used with PowerGrip GT2 sprockets for new designs

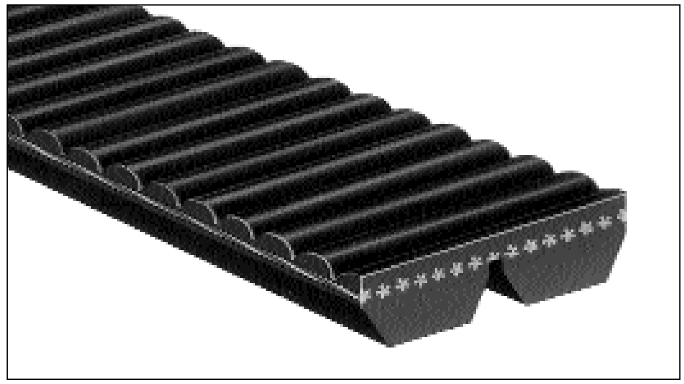
Note: 8 and 14 mm pitch PowerGrip GT2 belts can be used as replacement belts at the next smaller width for the following: HTD, Rpp, Rpp+Plus, HTB, HPT, HT100, HT150, ETH, HPR, HPPD, EHT or HTT.

Example: 14mm-170mm width – substitute a PowerGrip GT2-14mm-115 without any performance loss. Refer to page 22 for crossover information.

Note: The 8mm and 14mm PowerGrip GT belts can be used in the PowerGrip GT2, HTD, Rpp, Rpp+Plus, HPT, HPPD and HT sprockets. Refer to page 22 for crossover information.

Note: PowerGrip GT belts can be used as a substitute for HTD, Rpp, Rpp+Plus, HTB, HPT, HPPD, HT100, HT150, EHT or HPR without a performance loss. Refer to page 22 for crossover information.

Polyflex® JB® Belt



Here is a unique belt with a distinctive 60° belt angle and ribbed top specifically designed for long life in small diameter sheave drives. **Polyflex JB** is ideal for compact drives, drives with high speed ratios, and drives requiring especially smooth operation.

The "JB" refers to the belt's configuration. Two or three belts joined together to provide extra stability and improved performance. This joined belt style should be used instead of matched single belts whenever possible.

You'll find **Polyflex JB** Belts in these applications:

- Milling, grinding or drilling machines
- Lathes
- Machine spindle drives
- Centrifuges
- Blowers
- High speed compressors

Polyflex JB Belts are specified by
Top Width and Effective Length

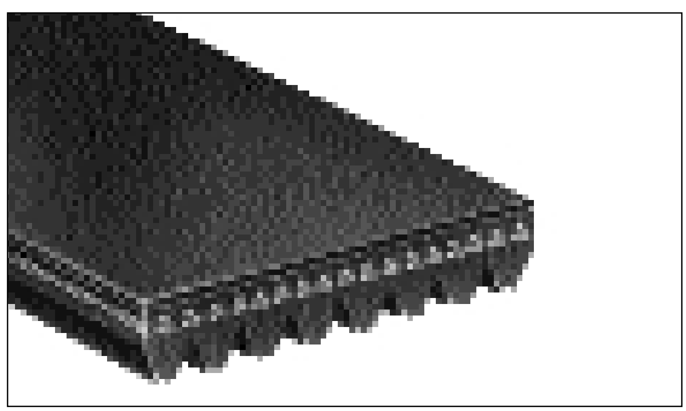
Multi-Speed Belts

(Variable Speed Drives)

Multi-Speed belts have a distinct shape. Multi-Speed belt top widths are usually greater than their thicknesses. This permits a greater range of speed ratios than standard belts. Usually cogged or notched on the underside, **Multi-Speed** belts are specified for equipment which require changes in driveN speed during operation.

Multi-Speed belts are specified by **Top Width**, **Outside Circumference**, and the required **Groove Angle**. The groove angle can be measured from the drive pulleys.

Micro-V® or V-Ribbed Belt



Gates Micro-V Belts outperform other V-ribbed belts because the are truncated (shorter). This shorter profile gives the new **Micro-V Belts** increased flexibility, reduced heat buildup and allows them to operate at extra high speeds on smaller diameter sheaves.

Two more advantages of the truncated are: (1) the belt does not bottom in the sheave, and (2) the belt can better tolerate debris in the sheave groove. They are extremely smooth running and highly resistant to oil, heat and other adverse conditions.

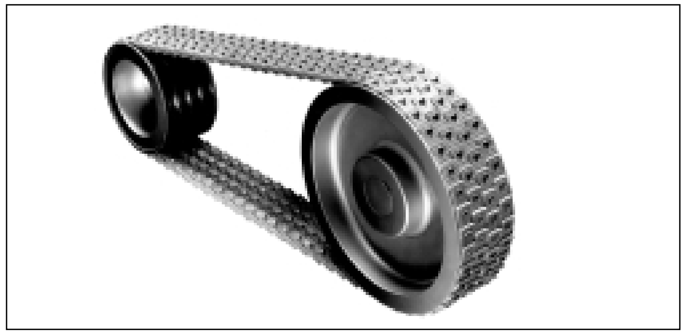
Three cross sections are available for industrial applications: J, L and M.

Spliced Belting

Used on drives with little or no take-up, or as an emergency belt replacement.

Belting is sold on reels in standard V-Belt cross sections. Ends are spliced with fasteners that require special assembly tools. Always use the correct fasteners with the correct belt type and cross section.

Nu-T-Link*, a new, high performance, spliced belt, is also available for use as emergency belting, and for drives where conditions are detrimental to rubber belts.



PowerBand® Belts

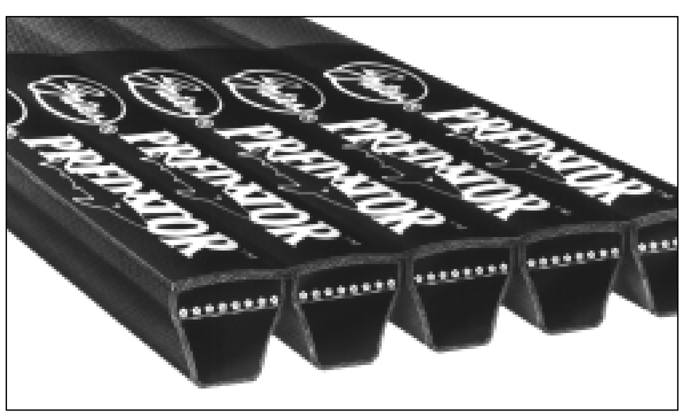
PowerBand belts were developed by Gates for drives subjected to pulsating loads, shock loads or extreme vibrations where single belts could flip over on the pulleys. A high-strength tie band permanently joins two or more belts to provide lateral rigidity. This keeps the belts running in a straight line in the pulley grooves. PowerBand construction is offered with **Gates Hi-Power® II**, **Super HC®** and **Super HC Molded Notch Belts**.

PREDATOR™

The Gates Predator™ V-Belt is a multi layered **PowerBand®** construction that adds strength, durability, shear and tear resistance and lateral rigidity to handle the toughest shock-loaded applications. It is available in **Super HC** and **Hi- Power II** profiles.

Predator V-Belts primary features:

- Aramid tensile cords for extraordinary strength, durability and virtually zero stretch.
- Chloroprene rubber compounds for superb oil and heat resistance.
- Specially-treated cover withstands slip and shear forces at peak loads without generating excessive heat. It also fends off penetration by foreign materials.
- Gates curves that compensate for effects that occur when belts bend around a sheave for uniform loading and maximum life.
- Precision-matched to maximize power absorption and belt life.



*Registered Trademark of Fenner-Manheim.

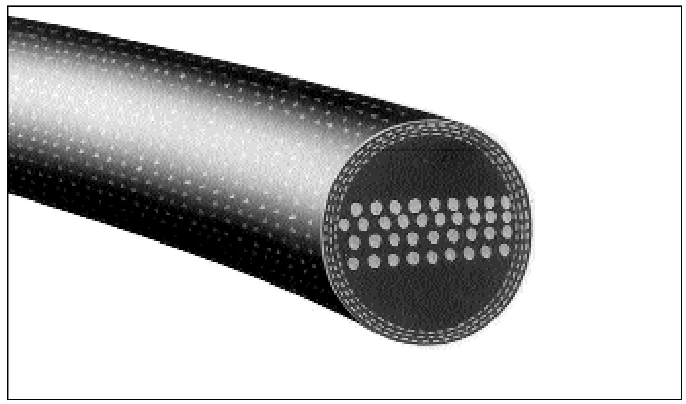
Dubl-V Belt

A special version of Gates Hi-Power® II for serpentine drives where power is transmitted by both the top and bottom of the belt. Dubl-V belts are specified by A, B, or C cross sections, and by Effective Length.

Round Endless Belts

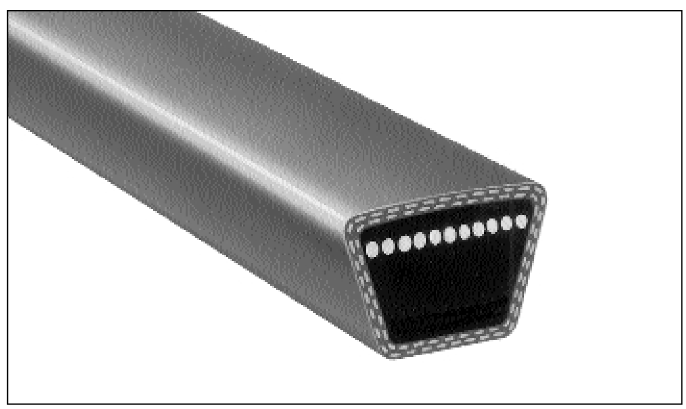
Recommended for replacing leather belting on serpentine or quarter-turn drives. They are specified by **Diameter** and **Inside Length**.

If your current drive has leather or round endless belting, you should consider a new drive design. V-belt drives offer many advantages in performance, even on serpentine or quarter-turn drives.



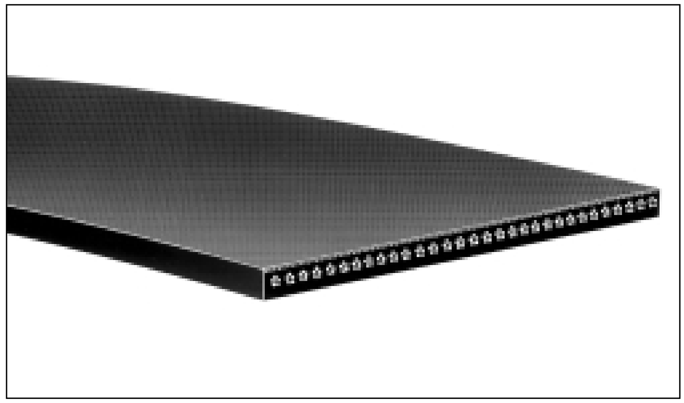
Power Cable®

Recommended for the toughest shock load applications, especially on drives that can't be shut down for retensioning after initial belt run-in. Reinforced with an aramid fiber tensile (pound for pound stronger than steel), Power Cable belts last longer and costs less than steel cable belts.



Flat Belts

Gates Speed- Flex® Belts, are designed for high speed applications such as drill presses, lathes, grinders and other woodworking equipment. Gates Powercord® Belts are designed for general purpose, lower speed applications. Flat belts are specified by belt **Width** and required **Inside Diameter**.



Static Conductive Belts

Rubber Manufacturers' Association (RMA) has published **Bulletin IP 3-3** for static conductivity. Static conductivity testing involves passing an electrical current of specified voltage through a section of belt and then measuring the belt's resistance to conduct the current. A resistance reading of six (6) megohms or more constitutes a test failure. Past testing has demonstrated that six (6) megohms or less is sufficient to prevent measurable static voltage buildup, thus preventing a static discharge.

A static discharge can interfere with radios and electronic instruments or controls used in your facility. It can also cause bearing pitting if the discharge occurs through the bearing. Static discharge can pose a hazard on drives that operate within potentially explosive environments.

V-belts are generally manufactured in accordance with the RMA bulletin, but you must check the static conductivity with the manufacturer.

PowerGrip® and Poly Chain® belts do not meet the static conductivity requirements specified in RMA Bulletin IP-3-3/1995.

The RMA bulletin applies to new, clean belts. Belts can collect debris or become worn and damaged and prevent a circuit, thus negating the static conductivity of the belt.

When a belt is used in a hazardous environment, we recommend that additional protection be taken to assure no accidental static spark discharges. The entire system must be properly grounded. A static-conductive brush or similar device is recommended to bleed off any static buildup on the belt that might occur.

To provide proper maintenance, you must understand the nature of the belt drives in your plant. You know the expected belt service life on each drive, and you are aware of the capabilities and limitations of this equipment.

On occasion, however, it is necessary to give some thought to belt service life, especially in these situations:

- When belt service life is meeting expectations, but you would like to reduce existing maintenance costs and down time.
- When belt service life is below the expected performance level and the situation must be improved.

Upgrade Drive Performance

A belt drive can sometimes be upgraded to improve performance. The first step is to see if simple improvements can be made at minimal costs. This involves checking the drive design for adequate capacity.

If further improvement is needed, the next step is to upgrade the drive to a higher performance belt system.

Here are examples of minor changes that could improve performance.

- Increase pulley diameters
- Increase the number of belts, or use wider belt
- Add vibration dampening to system
- Improve guard ventilation to reduce operating temperature
- Use at least the correct, minimum recommended pulley diameters on inside and backside idlers
- Use premium belts rather than general purpose types
- Replace pulleys when they are worn
- Keep pulleys properly aligned
- Place idler on span with lowest tension and as close to drives as possible
- Re-tension newly installed belts after a 4 - 24 hour run-in period
- Review proper belt installation and maintenance procedures

The Gates Rubber Company is the recognized industry leader in product innovation and belt drive technology. New products and applications are continually made available to Gates customers. Here are examples of advanced Gates belt innovations.

Advanced Gates Belt Innovations

- Poly Chain® GT®2 positive drive (synchronous) belts
- Power Grip® GT2
- Polyflex® JB® belts
- Power Cable® belts
- PoweRated® light-duty V-belts
- Nu-T-Link* spliced belting
- Super HC® Molded Notch V-belts
- Predator™ Powerband belts
- Vextra™ technology

*Registered Trademark of Fenner-Manheim.

Your local Gates distributor or representative can work with you to upgrade your existing drives and reduce your maintenance and down time costs.

Or, you may have a problem or excessive maintenance costs with a non-belt drive, such as gear or chain. Again, your local Gates distributor or representative can offer you excellent advice as to whether or not a belt drive could solve the problem and reduce your maintenance costs.

Improving Poor Drive Performance

If your belt drive system is properly designed, installed and maintained, it will need very little attention. Occasionally, however, a drive can be accidentally damaged or knocked out of adjustment.

Changing operating requirements or environmental conditions can also create problems.

Design Performance Grouping – PowerGrip GT

PowerGrip GT – 8 & 14mm Belts can be used to replace other non-Gates curvilinear belts in the same width

Company	Product Trade Name	Nomenclature	Belt-Pitch	Profile
Bando	Synchro-Link – HT	1600-8M-20-H	8 & 14mm	HTD
Dodge	HT100	1600-8M-20-HT100	8 & 14mm	HTD
Electron	EHT	1600-8M-20	8 & 14mm	HTD
Gates	HTD	1600-8M-20	8 & 14mm	HTD
Jason	HTB	1600-8M-20	8 & 14mm	HTD
MBL	HTT	1600-8M-20	8 & 14mm	HTD
Opti Belt	HTD	1600-8M-20	8 & 14mm	HTD
Browning	HPT	1610-14M-40	14mm	RPP
Dayco/Carlisle	RPP	1610-14M-40	14mm	RPP
Goodyear	HPPD	1610-14M-40	14mm	RPP
T.B. Woods	RPP	1610-14M-40	14mm	RPP
Thermoid	Syncho-Curve Timing	1610-14M-40	14mm	RPP

Design Performance Grouping – PowerGrip GT2

PowerGrip GT2 – 8 & 14mm Belts can be used to replace other non-Gates curvilinear belts in the next smallest width

Company	Product Trade Name	Nomenclature	Belt-Pitch	Profile
Bando	Synchro-Link – HT	1600-8M-20-H	8 & 14mm	HTD
Dodge	HT100	1600-8M-20-HT100	8 & 14mm	GT
Electron	EHT	1600-8M-20	8 & 14mm	HTD
Gates	HTD	1600-8M-20	8 & 14mm	HTD
Jason	HTB	1600-8M-20	8 & 14mm	HTD
MBL	HTT	1600-8M-20	8 & 14mm	HTD
Opti Belt	HTD	1600-8M-20	8 & 14mm	HTD
Browning	HPT	1610-14M-40	14mm	RPP
Dayco/Carlisle	RPP	1610-14M-40	14mm	RPP
Goodyear	HPPD	1610-14M-40	14mm	RPP
T.B. Woods	RPP	1610-14M-40	14mm	RPP
Thermoid	Synchro-Curve Timing	1610-14M-40	14mm	RPP
Dayco/Carlisle	RPP Plus	1610-14M-40	14mm	RPP
Dayco/Carlisle	HPR	1610-14M-40	14mm	RPP
Dodge	HT150	1610-14M-40-HT-150	8 & 14mm	GT
T.B. Woods	RPP Plus	1610-14M-40	14mm	RPP
T.B. Woods	HPR	1610-14M-40	14mm	RPP

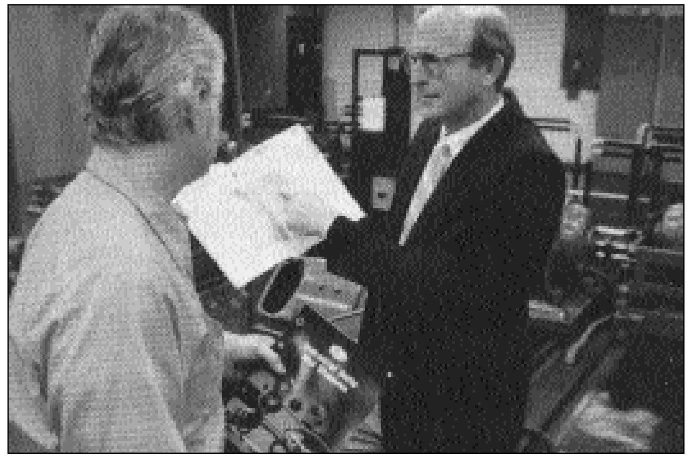
Competitors Width 8mm – Pitch	PowerGrip GT2 – Width 8mm – Pitch	Competitors Width 14mm - Pitch	PowerGrip GT2 – Width 14mm – Pitch
20	20	40	40
30	20	55	40
50	30	85	55
85	50	115	85

When troubleshooting a drive problem, your goal is to identify the cause(s), then take appropriate corrective action. We have developed a worksheet to help you with this process. Here is how to use it.

1. Describe your drive problem as accurately as possible. Use Step 1 as a guide. Use this step as a guide in the troubleshotting process.
2. Go through the list of “Drive Symptoms”. Check those symptoms you observe and record them, as well as your observations of anything unusual about the drive.
3. Go through the “Probable Cause and Action Summary Table”. List the probable cause(s) and corrective action. Also, review your list of observations.
4. Note your completed list of probable cause(s) and corrective action. Also, review your list of observations.
5. Determine if these two lists spotlight a particular problem source.

What to Do When All Else Fails

We’ve covered all of the most common belt drive problems you might encounter. However, if the problem still exists after all of your troubleshooting efforts have been exhausted, contact your Gates distributor. If he cannot solve the problem for you, he’ll put you in touch with a qualified Gates representative.



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

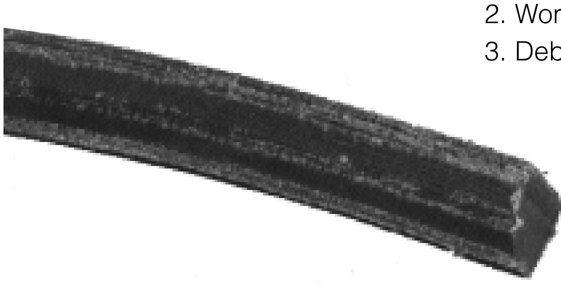
All Synchronous Belt Drives

- **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.

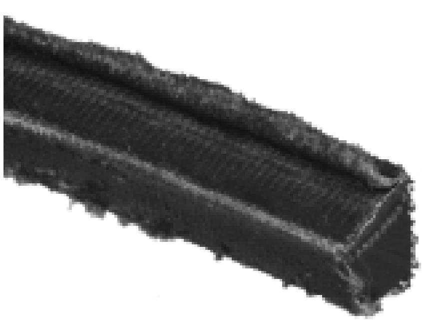
Severe or Abnormal V-Belt Wear–cont.

Symptoms	Probable Cause	Corrective Action
• Undercord or sidewall burn or hardening	1. Belt slipping 2. Worn sheaves 3. Underdesigned drive 4. Shaft movement	1. Retension until slipping stops. 2. Replace sheaves. 3. Refer to Gates drive manual. 4. Check for center distance changes.

Symptoms	Probable Cause	Corrective Action
• 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.



Belt Stretches Beyond Available Take-Up

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

Belt Noise

Symptoms	Probable Cause	Corrective Action
• Belt squeals or chirps	1. Belt slip 2. Contamination	1. Retension. 2. Clean belts and sheaves.
• Slapping Sound	1. Loose belts 2. Mismatched set 3. Misalignment	1. Retension. 2. Install matched belt set. 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 2. Incorrect Tension 3. Worn sheaves 4. Debris in sheaves	1. Use correct belt size. Use correct belt tooth profile for sprockets on synchronous drive. 2. Check tension and adjust 3. Replace 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) 2. Mismatched belts 3. Pulley misalignment	1. Retension. 2. Install new matched set. 3. Align pulley
• Unusual or excessive vibration	1. Incorrect belt 2. Poor machine or equipment design 3. Pulley out of round 4. Loose drive components	1. Use correct belt cross section in pulley. Use correct tooth profile and pitch in sprocket. 2. Check structure and brackets for adequate strength. 3. Replace with non-defective pulley. 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.

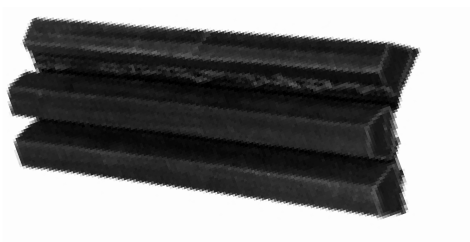
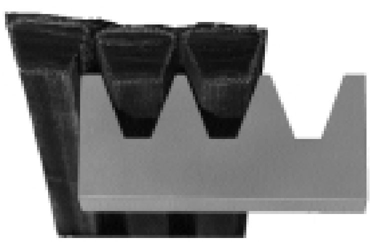
Performance Problems

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

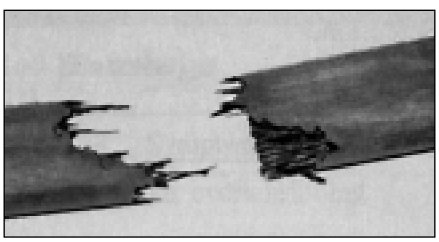
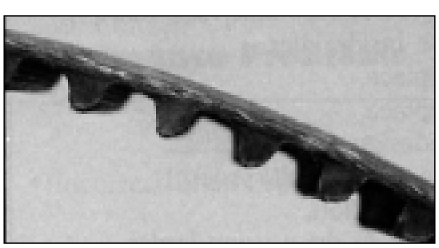
Problems With Banded (Joined) Belts

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.

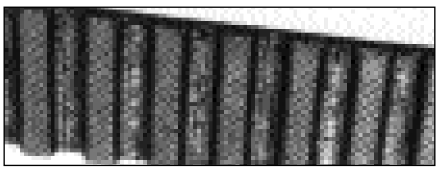
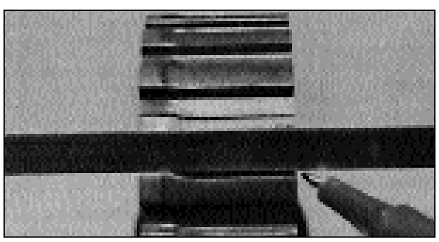
Problems With Synchronous Belts

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

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

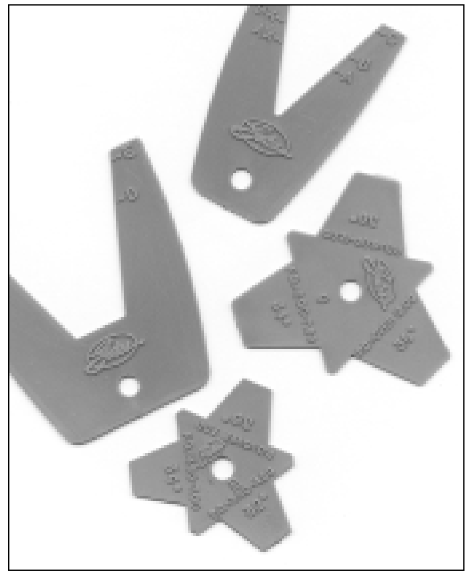
When a belt drive is excessively noisy, the belt is often incorrectly blamed. It is easy to eliminate the belt as the problem by spraying it with soapy water while it is running. If the noise goes away, or decreases, then the belt is part of the problem. If you still hear the same noise, the problem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

A

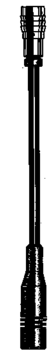
B

C

D

E

F



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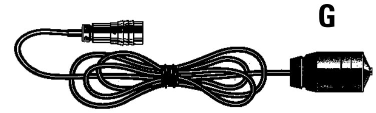


Belt Tension Testers

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:

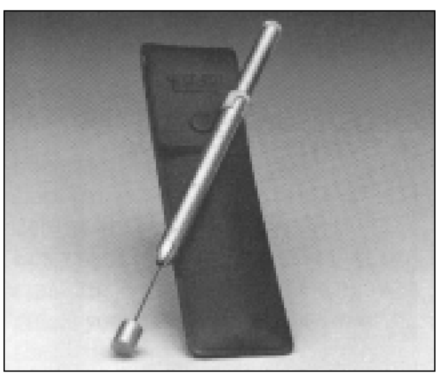
For use with these belts:
All synchronous belts
Micro-V® belts
Polyflex® belts

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

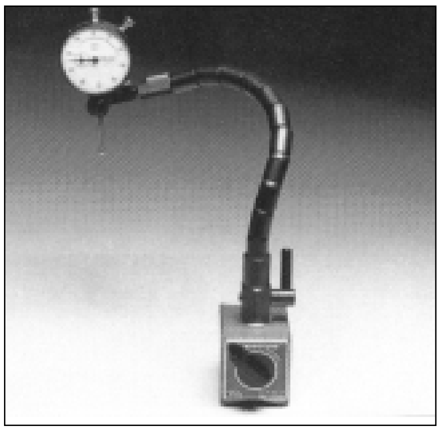
This tool can be used to isolate the forcing frequency behind vibration problems. It is a small, hand-held device which can be butted up against the vibrating equipment. A thin metal reed protrudes from the end, the length of which can be varied. As you vary the length, the reed will vibrate wildly at 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

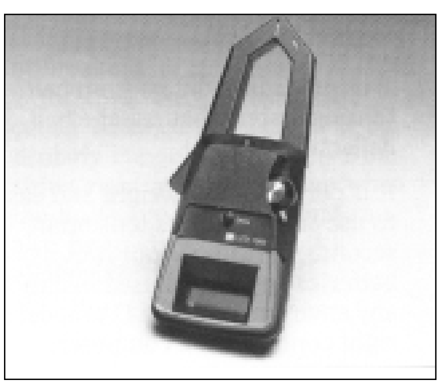
Improperly mounted sheaves or out-of-round pulleys are sometimes the root of vibration or more severe problems. This device can be used to measure side-to-side sheave wobble or diameter variation by holding it up to the sheave sidewall or top of the belt inside the pulley groove, respectively. IMPORTANT: 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.

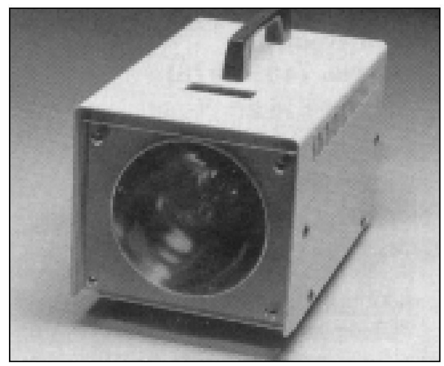


Needle Pyrometer

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

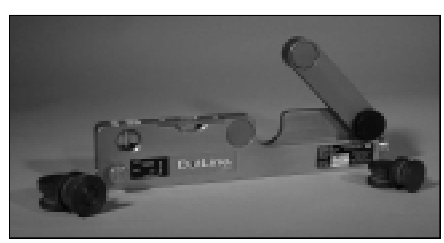


Table No. 1

Belt Section, Sheave Diameters and Standard Groove Angles*

Belt Section	Sheave Datum Diameter (D.D.) (in.)	Standard Groove Angle (± 0.33°)
A, AX	Up to 5.4	34
A, AX	Over 5.4	38
B, BX	Up to 7.0	34
B, BX	Over 7.0	38
C, CX	Up to 7.99	34
C, CX	8.0 to 12.0	36
C, CX	Over 12.0	38
D	Up to 12.99	34
D	13.0 to 17.0	36
D	Over 17.0	38
E	Up to 24.0	36
E	Over 24.0	38
Belt Section	**Sheave Outside Diameter (O.D.) (in.)**	**Standard Groove Angle (± 0.33°)**
3V, 3VX	Up to 3.49	36
3V, 3VX	3.50 to 6.00	38
3V, 3VX	6.01 to 12.00	40
3V, 3VX	Over 12.00	42
5V, 5VX	Up to 9.99	38
5V, 5VX	10.00 to 16.00	40
5V, 5VX	Over 16.00	42
8V	Up to 15.99	38
8V	16.00 to 22.4	40
8V	Over 22.4	42

*For these data on Micro-V® and Polyflex® JB™ belts, refer to Micro-V Drive Design Manual 15408 and Polyflex JB Drive Design Manual 15925.

Table No. 2

Maximum Allowable Outside Diameters For Cast Iron Pulleys

Maximum Shaft Speed (RPM)	Maximum Allowable Pulley Diameter (in.)
600	41.4
870	28.5
1,160	21.4
1,400	17.7
1,600	15.5
1,750	14.2
2,000	12.4
2,400	10.3
2,850	8.7
3,000	8.3
3,450	7.2
4,000	6.2
4,500	5.5
5,000	5.0
7,000	3.55
10,000	2.48

Electric Motor Frames Assignments and Minimum V-Belt Sheave Diameters

The National Electric Manufacturers Association (NEMA) publishes recommendations for the minimum diameter of sheaves to be used on General Purpose electric motors. Purpose of the recommendations is to prevent the use of too small sheaves, which can result in shaft or bearing damage because belt pull goes up as sheave diameter goes down.

The NEMA Standard MG-1-14.42, November 1978 shows minimum recommended sheave diameters as a function of frame number. The table below lists the NEMA frame assignments and minimum diameter recommendations according to the 1964 rerating program.

Table No. 3A

Frame No.	Shaft Dia. (In.)	Horsepower at Synchronous Speed, rpm				Super HC® V-Belts & PowerBand® Belts	Hi Power® II, PowerBand & Tri-Power® V-Belts
		3600 (3450)*	1800 (1750)*	1200 (1160)*	900 (870)*	Min. Outside Dia. (In.)	Min. Datum Dia. (In.)
143T	0.875	1-1/2	1	3/4	1/2	2.2	2.2
145T	0.875	2–3	1-1/2 – 2	1	3/4	2.4	2.4
182T	1.125	3	3	1-1/2	1	2.4	2.4
182T		5	—	—	—	2.4	2.6
184T		—	—	2	1-1/2	2.4	2.4
184T	1.125	5	—	—	—	2.4	2.6
184T		7-1/2	5	—	—	3.0	3.0
213T	1.375	7-1/2 –10	7-1/2	3	2	3.0	3.0
215T	1.375	10	—	5	3	3.0	3.0
215T		15	10	—	—	3.8	3.8
254T	1.625	15	—	7-1/2	5	3.8	3.8
254T		20	15	—	—	4.4	4.4
256T	1.625	20–25	—	10	7-1/2	4.4	4.4
256T		—	20	—	—	4.4	4.6
284T	1.875	—	—	15	10	4.4	4.6
284T		—	25	—	—	4.4	5.0
286T	1.875	—	30	20	15	5.2	5.4
324T	2.125	—	40	25	20	6.0	6.0
326T	2.125	—	50	30	25	6.8	6.8
364T	2.375	—	—	40	30	6.8	6.8
364T		—	60	—	—	7.4	7.4
365T	2.375	—	—	50	40	8.2	8.2
365T		—	75	—	—	8.6	9.0
404T		—	—	60	—	8.0	9.0
404T	2.875	—	—	—	50	8.4	9.0
404T		—	100	—	—	8.6	10.0
405T		—	—	75	60	10.0	10.0
405T	2.875	—	100	—	—	8.6	10.0
405T		—	125	—	—	10.5	11.5
444T		—	—	100	—	10.0	11.0
444T	3.375	—	—	—	75	9.5	10.5
444T		—	125	—	—	9.5	11.0
444T		—	150	—	—	10.5	—
445T		—	—	125	—	12.0	12.5
445T	3.375	—	—	—	100	12.0	12.5
445T		—	150	—	—	10.5	—
445T		—	200	—	—	13.2	—

*Approximate Full Load Speeds

For other than the General Purpose AC motors (for example, DC motors, Definite Purpose motors, motors with special bearings or motors that are larger than those covered by the NEMA standard), consult the motor manufacturer for minimum sheave diameter recommendations. It is helpful to the manufacturer to include details of the application with your inquiry.

Minimum Recommended Sprocket Outside Diameters for General Purpose Electric Motors Synchronous Belts

Data in the white area are from NEMA Standard MG-1-14-42, June 1972. Figures in black area are from MG-1-43, January 1968. The gray area is a composite of electric motor manufacturer data. They are generally conservative and specific motors and bearings may permit the use of a smaller motor sprocket. Consult the motor manufacturer.

NOTE: For a given horsepower and speed, the total belt pull is related to the motor sprocket size. As the size **decreases**, the total belt pull **increases**. Therefore, to limit the resultant load on motor and shaft bearings, NEMA lists minimum sprocket sizes for the various motors. The sprocket on the motor (DriveR sprocket) should be at least this large.

Table No. 3B

Motor Horsepower	Motor RPM (60 Cycle and 50 Cycle Electric Motors)						Motor Horsepower
	575 480*	690 575*	870 725*	1160 950*	1750 1425*	3450 2850*	
1/2	-	-	2.0	-	-	-	1/2
3/4	-	-	2.2	2.0	-	-	3/4
1	2.7	2.2	2.2	2.2	2.0	-	1
1-1/2	2.7	2.7	2.2	2.2	2.2	2.0	1-1/2
2	3.4	2.7	2.7	2.2	2.2	2.2	2
3	4.1	3.4	2.7	2.7	2.2	2.2	3
5	4.1	4.1	3.4	2.7	2.7	2.2	5
7-1/2	4.7	4.1	4.0	3.4	2.7	2.7	7-1/2
10	5.4	4.7	4.0	4.0	3.4	2.7	10
15	6.1	5.4	4.7	4.0	4.0	3.4	15
20	7.4	6.1	5.4	4.7	4.0	4.0	20
25	8.1	7.4	6.1	5.4	4.0	4.0	25
30	9.0	8.1	6.1	6.1	4.7	-	30
40	9.0	9.0	7.4	6.1	5.4	-	40
50	9.9	9.0	7.8	7.4	6.1	-	50
60	10.8	9.9	9.0	7.2	6.7	-	60
75	12.6	11.7	8.6	9.0	7.7	-	75
100	16.2	13.5	10.8	9.0	7.7	-	100
125	18.0	16.2	13.5	10.8	9.5#	-	125
150	19.8	18.0	16.2	11.7	9.5	-	150
200	19.8	19.8	19.8	-	11.9	-	200
250	19.8	19.8	-	-	-	-	250
300	24.3	24.3	-	-	-	-	300

*These RPM are for 50 cycle electric motors.

Use 8.6 for Frame Number 444 T only.

Minimum Recommended Sheave Diameter By Belt Cross Section

Belt Cross Section	Min. Recommended Datum Diameter (Standard Groove) (In.)
Classical V-Belts	
AX	2.20
A	3.00
BX	4.00
B	5.40
CX	6.80
C	9.00
D	13.00
E	21.00
Belt Cross Section	**Min. Recommended Outside Diameter (Standard Groove) (In.)**
Narrow V-Belts	
3VX	2.20
3V	2.65
5VX	4.40
5V	7.10
8V	12.50
Light Duty V-Belts	
2L	0.8
3L	1.5
4L	2.5
5L	3.5
Micro-V® Belts	
J	0.8
L	3.00
M	7.00
Polyflex® JB® Belts	
5M	1.04
7M	1.67
11M	2.64

Table No. 4A

Minimum Recommended Sprocket Sizes

Table No. 4B

Minimum Recommended Sprocket Sizes

Belt Pitch	Min. Recommended Sprocket Size (No. of Teeth)
PowerGrip® Timing	
MXL	12
XL	12
L	12
H	14
XH	18
XXH	18
PowerGrip HTD®*	
3M	12
5M	14
PowerGrip GT®	
8M	22
14M	28
PowerGrip GT®2/HTD	
20M	34
PowerGrip GT®2	
2M	12
3M	16
5M	18
8M	22
14M	28
Poly Chain® GT®2	
8M	22
14M	28

*Not a standard line item.

Minimum Recommended Idler Diameters

Table No. 5

Belt Cross Section	Min. O.D. Grooved Inside Idler (In.)	Min. O.D. Flat Inside Idler (In.)	Min. O.D. Outside Idler (In.)
A, AA, AX	2.75	2.25	4.25
B, BB, BX	4.00	3.75	6.00
C, CC, CX	6.75	5.75	8.50
D	9.00	7.50	13.50
3V, 3VX	2.65	**	4.25
5V, 5VX	7.10	**	10.00
8V	12.50	**	17.50

** Not recommended.

NOTE: See the "Idler Details" section in the Heavy-Duty Drive Design Manual #14995-A for Minimum Flat Idler Widths.

Minimum Center Distance Allowances for Belt Installation and Takeup

Table No. 6

V-Belt Number	Minimum Center Distance Allowance for Installation (Inches)						Minimum Center Distance Allowance for Initial Tensioning and Subsequent Takeup (Inches)
	3V/3VX		5V/5VX		8V		All Cross Sections
	Super HC* V-Belt	Super HC PowerBand* Belt*	Super HC V-Belt	Super HC PowerBand Belt*	Super HC V-Belt	Super HC PowerBand Belt*	All Types
Up to and Incl. 475	0.5	1.2					1.0
Over 475 to and Incl. 710	0.8	1.4	1.0	2.1			1.2
Over 710 to and Incl. 1060	0.8	1.4	1.0	2.1	1.5	3.4	1.5
Over 1060 to and Incl. 1250	0.8	1.4	1.0	2.1	1.5	3.4	1.8
Over 1250 to and Incl. 1700	0.8	1.4	1.0	2.1	1.5	3.4	2.2
Over 1700 to and Incl. 2000			1.0	2.1	1.8	3.6	2.5
Over 2000 to and Incl. 2360			1.2	2.4	1.8	3.6	3.0
Over 2360 to and Incl. 2650			1.2	2.4	1.8	3.6	3.2
Over 2650 to and Incl. 3000			1.2	2.4	1.8	3.6	3.5
Over 3000 to and Incl. 3550			1.2	2.4	2.0	4.0	4.0
Over 3550 to and Incl. 3750					2.0	4.0	4.5
Over 3750 to and Incl. 5000					2.0	4.0	5.5
Over 5000 to and Incl. 6000					2.0	4.0	6.0

*Also use these figures for individual Super HC V-Belts in deep groove sheaves.

Minimum Center Distance Allowances for Belt Installation and Takeup

Table No. 7

V-Belt Number	Minimum Center Distance Allowance For Installation (Inches)										Minimum Center Distance Allowance For Initial Tensioning and Subsequent Takeup (Inches)
	A		B		C		D		E		All Cross Sections
	Hi-Power II and Tri-Power® Molded Notch V-Belts	Hi-Power II PowerBand Belt*	Hi-Power II and Tri-Power Molded Notch V-Belts	Hi-Power II PowerBand Belt*	Hi-Power II and Tri-Power Molded Notch V-Belts	Hi-Power II PowerBand Belt*	Hi-Power II and Tri-Power Molded Notch V-Belts	Hi-Power II PowerBand Belt*	Hi-Power II V-Belts	Hi-Power II PowerBand Belt*	All Types
Up To and Incl. 35	0.75	1.20	1.00	1.50							1.00
Over 35 To and Incl. 55	0.75	1.20	1.00	1.50	1.50	2.00					1.50
Over 55 To and Incl. 85	0.75	1.30	1.25	1.60	1.50	2.00					2.00
Over 85 To and Incl. 112	1.00	1.30	1.25	1.60	1.50	2.00					2.50
Over 112 To and Incl. 144	1.00	1.50	1.25	1.80	1.50	2.10	2.00	2.90			3.00
Over 144 To and Incl. 180			1.25	1.80	2.00	2.20	2.00	3.00	2.50	3.40	3.50
Over 180 To and Incl. 210			1.50	1.90	2.00	2.30	2.00	3.20	2.50	3.50	4.00
Over 210 To and Incl. 240			1.50	2.00	2.00	2.50	2.50	3.20	2.50	3.60	4.50
Over 240 To and Incl. 300			1.50	2.20	2.00	2.50	2.50	3.50	3.00	3.90	5.00
Over 300 To and Incl. 390					2.00	2.70	2.50	3.60	3.00	4.00	6.00
Over 390					2.50	2.90	3.00	4.10	3.50	4.40	1.5% of belt length

*Also use these figures for individual Hi-Power II and Tri-Power Molded Notch V-Belts in deep groove sheaves.

Micro-V® Belts

V-Belt Number	Minimum Center Distance Allowance for Installation (Inches)			Minimum Center Distance Allowance For Initial Tensioning and Subsequent Takeup (Inches)
Standard Effective Length (In.)	J	L	M	All Cross Sections
Up through 20.0	0.4	—	—	0.3
20.1 through 40.0	0.5	—	—	0.5
40.1 through 60.0	0.6	0.9	—	0.7
60.1 through 80.0	0.7	1.0	—	0.9
80.1 through 100.0	0.8	1.2	1.5	1.1
100.1 through 120.0	—	1.2	1.6	1.3
120.1 through 160.0	—	1.4	1.7	1.7
160.1 through 200.0	—	—	1.8	2.2
200.1 through 240.0	—	—	1.9	2.6
240.1 through 300.0	—	—	2.2	3.3
300.1 through 360.0	—	—	2.5	3.9
60.1 through 370.0	—	—	2.7	4.6

Polyflex® JB® Belts

	5M	7M	11M	
280-300	0.4	—	—	0.2
307-710	0.6	0.6	1.0	0.6
730-1090	0.9	0.9	1.2	1.1
1120-1500	1.1	1.1	1.4	1.4
1550-1900	—	1.1	1.5	1.4
1950-2300	—	1.5	1.9	1.8

Poly Chain® GT2® Installation & Tensioning Allowances

Center Distance Allowance For Installation and Tensioning

Table No. 8

Belt Length	Standard Installation Allowance (Flanged Sprockets Removed For Installation)	Tensioning Allowance (Any Drive)
40" and under (1000mm and under)	0.07" 1.8mm	0.03" 0.8mm
Over 40" to 70" (Over 1000mm to 1780mm)	0.11" 2.8mm	0.03" 0.8mm
Over 70" to 100" (Over 1780mm to 2540mm)	0.13" 3.3mm	0.04" 1.0mm
Over 100" to 130" (Over 2540mm to 3300mm)	0.16" 4.1mm	0.04" 1.0mm
Over 130" to 180" (Over 3300mm to 4600mm)	0.21" 5.3mm	0.05" 1.3mm

Additional Center Distance Allowance For Installation Over Flanged Sprocket*

(Add to Installation Allowance in Above Table)

Belt Pitch	One Sprocket Flanged	Both Sprockets Flanged
8mm 8mm	0.85" 21.6mm	1.31" 33.3mm
14mm 14mm	1.23" 31.2mm	1.97" 50.0mm

* For drives that require installation of the belt over one sprocket at a time, use the value for both sprockets flanged, even if only one sprocket is flanged.

Table No. 9

Power Grip GT2® Center Distance Allowance For Installation and Tensioning

Length Belt (mm) (in)	Standard Installation Allowance (Flanged Sprockets Removed For Installation) (mm) (in)	Tensioning Allowance (All Drives) (mm) (in)
Up to 125 5	0.5 0.02	0.5 0.02
Over 125 to 250 5 to 10	0.8 0.03	0.8 0.03
Over 250 to 500 10 to 20	1.0 0.04	0.8 0.03
Over 500 to 1000 20 to 40	1.8 0.07	0.8 0.03
Over 1000 to 1780 40 to 70	2.8 0.10	0.8 0.04
Over 1780 to 2540 70 to 100	3.3 0.13	1.0 0.04
Over 2540 to 3300 100 to 130	4.1 0.16	1.3 0.05
Over 3300 to 4600 130 to 180	4.8 0.19	1.3 0.05
Over 4600 to 6900 180 to 270	5.6 0.22	1.3 0.05

Additional Center Distance allowance For Installation Over Flanged Sprockets*

(Add to Installation Allowance in Above Table)

Pitch	One Sprocket Flanged (mm) (in)	Both Sprockets Flanged (mm) (in)
5mm	13.5 0.53	19.1 0.75
8mm	21.8 0.86	33.3 1.31
14mm	31.2 1.23	50.0 1.97
20mm	47.0 1.85	77.5 3.05

* For drives that require installation of the belt over one sprocket at a time, use the value for "Both Sprockets Flanged"

Table No. 10

Power Grip® Timing Belts Center Distance Allowance for Installation and Tensioning

Belt Length (In.)	Standard Installation Allowance (Flanged Pulleys Removed For Installation)	Tensioning Allowance (Any Drive)
3.6 to 5.0	.02"	.02"
Over 5.0 to 10.0	.03"	.03"
Over 10.0 to 20.0	.04"	.03"
Over 20.0 to 40.0	.05"	.04"
Over 40.0 to 60.0	.07"	.05"
Over 60.0 to 150.0	.12"	.08"

Additional Center Distance Allowance for Installation Over Flanged Pulleys*

(Add to Installation Allowance in Above Table)

Belt Pitch	Small Pulley Flanged	Both Pulleys Flanged
0.080" (MXL)	.35"	.49"
0.200" (XL)	.46"	.71"
0.375" (L)	.64"	.85"
0.500" (H)	.64"	.96"
0.875" (XH)	1.14"	1.92"
1.250" (XXH)	1.53"	2.05"

*For drives that require installation of the belt over one pulley at a time, use the value for both pulleys flanged — even if only one pulley is flanged.

Table No. 11

Estimating Belt Length from Drive Dimensions

(2 Pulleys)

$$\text{Belt Length} = 2C + 1.57\,(D + d) + \frac{(D - d)^2}{4C}$$

Where: C = Shaft Center Distance

a.) For Super HC®: Belt Length = Belt Outside Diameter
D = O.D. of Larger Pulley
d = O.D. of Smaller Pulley

b.) For Hi-Power® II and Tri-Power® Molded Notch: Belt Length = Datum Length
D = Datum Diameter of Larger Pulley
d = Datum Diameter of Smaller Pulley

c.) For Synchronous Belts: Belt Length = Pitch Length
D = Pitch Diameter of Larger Sprocket
d = Pitch Diameter of Smaller Sprocket

Additional Gates Publications to Guide You in Design, Selection and Usage of Gates Belts and Pulleys

Gates produces many other publications — each designed to do a specific job.

Some provide you with the necessary information to design new belt drives — others provide you with product descriptions and specifications to guide in the selection of types and sizes of belts and pulleys — some contain application listings showing manufacturers' makes and models with the corresponding Gates Replacement Belt Numbers.

In all cases, the publications listed below have one thing in common — they will help you specify the most economical and proper Gates belt or pulleys best for your application.

Description	Form Number
V-Belt Technical Manuals	
Heavy-Duty V-Belt Drive Design Manual	14995-A
Synchronous Drive Manuals	
Poly Chain® GT® 2 Belt Drive Design Manual	17595
PowerGrip® GT® 2 Belt Drive Design Manual	17195
Light Power & Precision Drive Catalog	17183
Replacement Guides	
Belt Replacement Guide for Variable Speed Drives	12684
Metric V-Belt Interchange	19998-Y
Sheaves, Pulleys & Sprockets	19994-B

For additional information visit our web site at: www.gates.com

WORKSHEET

High Speed Drive Survey and Energy Savings Worksheet

CUSTOMER INFORMATION

Distributor ______________________

Customer ______________________

DRIVE INFORMATION

I.D. of Drive (location, number, etc.) ______________________

Description of DriveN Equipment ______________________

Manufacturer of DriveN Equipment ______________________

Horsepower Rating of Motor __________ DriveN HP Load (Peak) __________ (Normal) __________

Motor Frame Size __________ Motor Shaft Dia. __________ DriveN Shaft Dia. __________

Speed:

DriveR RPM __________ __________RPM Measured with Contact or Strobe Tachometer ☐ Yes ☐ No

DriveN RPM __________ __________RPM Measured with Contact or Strobe Tachometer ☐ Yes ☐ No

Speed Ratio __________ Speed Up __________ or Speed Down __________

Center Distance: Minimum __________ Nominal __________ Maximum __________

Existing Drive Components: DriveR __________ DriveN __________

Belts __________ Belt Manufacturer __________

Ambient Conditions:

Temperature __________ Moisture __________ Oil, etc. __________

Abrasives __________ Shock Load __________

Static Conductivity Required? ☐ Yes ☐ No

Maximum Sprocket Diameter (OD) and Width Limitations (for guard clearance):

DriveR: Max. OD __________ Max. Width __________ DriveN: Max. OD __________ Max. Width __________

Guard Description ______________________

Motor Mount:

Double Screw Base? ☐ Yes ☐ No Motor Mounted on Sheet Metal? ☐ Yes ☐ No

Adequate Structure? ☐ Yes ☐ No Floating/Pivot Motor Base? ☐ Yes ☐ No

Start Up Load:

%Motor Rating at Start Up __________ AC Inverter? ☐ Yes ☐ No Soft Start? ☐ Yes ☐ No

Duty Cycle:

Number of Starts/Stops __________ times per __________ (hour, day, week, etc.)

ENERGY SAVINGS INFORMATION

Energy Cost per KW-Hour ______________________

Hours of Operation: ______ Hours per Day ______ Days per Week ______ Weeks per Year

Low Speed Drive Design Information Sheet

For Drive Selections with Shaft Speeds Less Than 500 rpm

Distributor: ____

Customer: ____

Drive Identification (location, number, etc.) ____________________________

DriveR Information:

Motor Nameplate Data

Rated Horsepower__________ Rated RPM __________ Efficiency __________

Rated Voltage __________ Rated Amps __________ Rated Torque __________

Actual Motor Load _____________

Motor Type: AC Three-Phase ☐ AC Single-Phase ☐ DC (Direct Current) ☐
Output Speed: Constant ☐ Variable ☐

Measured Motor Data

Voltage: Phase 1__________ Phase 2__________ Phase 3__________

Amps: Phase 1__________ Phase 2__________ Phase 3__________

Reducer Information:

Reducer Type: Helical ☐ Planetary ☐ Cycloidal ☐ Worm ☐ Combination Type ☐ Other ☐

Reducer Efficiency ________ Output RPM________ Reducer Ration________

Rated **Input** HP/Torque ___________ Rated **Output** HP/Torque ___________

Existing Drive Information:

Drive Type: Chain ☐ V-Belt ☐ Synchronous Belt ☐

If chain, Type; 2/#60, #80, etc. _______________ Lubed ☐ Unlubed ☐

Current Drive Service Life _______________

DriveR Sprocket/Sheave ________(teeth/OD) DriveR Shaft Diameter________

DriveN Sprocket/Sheave ________(teeth/OD) DriveN Shaft Diameter________

Center Distance:

Minimum___________ Nominal___________ Maximum___________

Type of Center Distance Adjustment:________________________________

Idler used: Yes ☐ No ☐ Inside ☐ Backside ☐

DriveN Information:

Type of Equipment: ___________ Actual Horsepower Required ___________

Required Operating RPM ___________ Required Speed Ration ___________

Hours/Day __________ Days/Week __________ Weeks/Year __________

Shock Load: Light ☐ Moderate ☐ Severe ☐

Start Up Load: % Overload___________ Starting Torque ___________

Special Requirements:

Space Limitations:

Maximum DriveR Dia.______________ Maximum DriveN Dia._____________

Maximum DriveR Width ___________ Maximum DriveN Width ___________

Environmental Conditions:

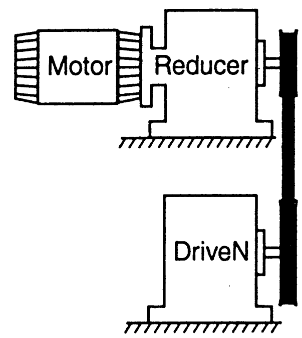
Temperature Range___________ Belt Conductivity Required ☐

Oil Mist ☐ Oil Splash ☐ Moisture ☐ Abrasives ☐

Drive Sketch:

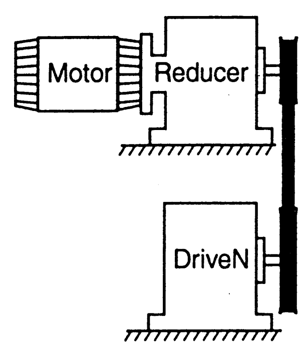
Drive Layout (check one)

☐ **Motor Reducer Belt Drive Dreven**



Belt Drive on Reducer Output Shaft

☐ **Motor Belt Drive Reducer Driven**



Belt Drive on Reducer Input Shaft

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