GREENHECK
Fan Application
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PRODUCT APPLICATION GUIDE
A technical bulletin for engineers, contractors and students in the air movement and control industry.

Measuring Belt Tension

This article discusses several methods for measuring the belt tension for V-belts commonly used in HVAC applications. Tensioning the belt is often done during initial startup and periodically throughout its life for preventative maintenance. Common belt tensioning methods are to measure belt tension by deflection, to measure belt tension by frequency, and to use a Tension Finder™. While there are other manufacturers of belt tensioning equipment, the following discussion and steps are based on Carlisle products.

Proper Belt Tension

The proper tension for operating a V-belt drive is the lowest tension at which the belts will not slip at peak load conditions. For applications without a variable frequency drive (VFD) or starter, and the motor is "ran across the line", the tension must be able to handle the increased motor torque during startup. For slow start VFD applications, the belt tension must handle the actual brake horsepower of the fan at the fan shaft.

For V-belts, after initial installation tensioning, a re-tensioning of the belt is recommended after a period of operation, usually one to two days. Belt tension should be checked periodically, about every three to six months. A more frequent inspection for noise or vibration is recommended.

Under-tensioned belts can slip, generating heat that often results in cracking and eventual belt failure. Over-tensioned belts will create excessive stretching in the belt and reduce both belt and bearing life as the bearing loads will increase. While checking the belt tension, the belts should also be inspected for any cracks or fraying as these indicate belt wear.

Measuring Belt Tension by Deflection

Measuring belt tension by deflection evaluates the force needed to achieve a given belt deflection. The recommended force can be referenced in the table at the end of the article. This article addresses using a single stem tensiometer. A tensiometer is a tool that measures the force required to move the tensiometer plunger a given distance. This force can be compared to a table of recommended tension forces to determine the status of the belt.

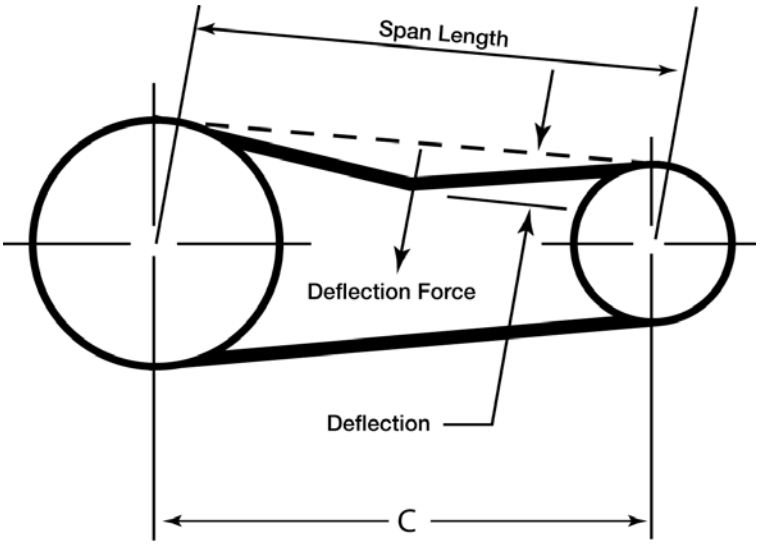

Figure 1. Belt Span Length

Required equipment: tensiometer, tape measure, straight edge (for single belt drives).

1. Turn off power to the motor and follow lock out, tag out procedures.

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2. Measure the span length of the belt. *See Figure 1.* Span length is the distance the belt spans between the sheaves. The desired belt deflection is 1/64 of an inch for every inch of belt span. For example, if the span length is 32 inches, the desired belt deflection is ½ inch.

3. Set the large "O" ring on the tensiometer to the desired deflection determined in Step 2. *See Figure 2.*

4. Set the small "O" ring on the tensiometer to the zero mark. *See Figure 2.*

5. Holding the tensiometer as indicated in *Figure 2*, press the opposing end of the tensiometer to the midpoint of the belt span as indicated in *Figure 1*. Press down on the tensiometer (deflecting the belt) until the large "O" ring is even with the original location of the belt. For a single belt drive, the tensiometer should be depressed until the large "O" ring is lined up with the bottom of the straight edge placed on the outside rims of the two sheaves. For a multiple belt drive, depress the tensiometer until the large "O" ring is even with the top of the next belt. Take a reading from each belt for an average.

6. The small "O" ring now indicates the force (lbs) required to get the desired belt deflection. Check this reading against the recommended minimum belt deflection force in the Recommended Minimum Belt Deflection Force table at the end of this document.

7. Tighten or loosen the belt accordingly to achieve the recommended minimum belt deflection force. Tightening the belt will increase the force; loosening the belt will decrease the belt deflection force.

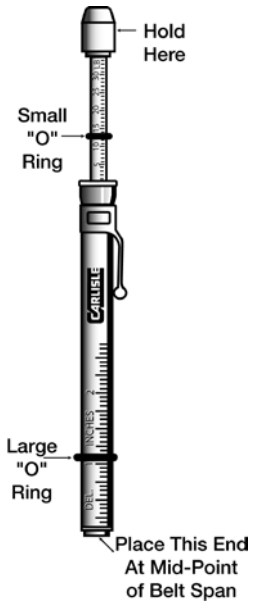

Figure 2. Carlisle Tensionmeter (Carlisle Part No. 102761)

Measuring Belt Tension by Frequency

By measuring the natural frequency of the tensioned belt, the tension of the belt can be calculated. This method is applicable for V and banded belts.

One way to measure the natural frequency of a belt is to use Carlisle's Frequency-Finder™. The Frequency-Finder uses a laser sensor to measure the frequency of a vibrating belt. This frequency can then be compared to the recommended frequency calculated with the software that accompanies the instrument.

Required equipment: Frequency-Finder, Carlisle's Drive Engineer software.

1. Turn off power to the motor and follow lock out, tag out procedures.

2. Use Carlisle's Drive Engineer software to calculate the desired minimum and maximum frequency for a given belt. The frequency directly correlates with the belt tension. A higher frequency relates to a higher belt tension.

3. Turn on the Frequency-Finder. The laser light will turn on. The Frequency-Finder is pictured in *Figure 3*.

Figure 3; Carlisle Frequency-Finder™ (Carlisle Part No. 109061)

4. Tap or pluck the free belt span to induce vibration in the belt.

5. Hold the laser probe within one inch above the free belt span with the laser facing the outside of the belt.

6. A successful measurement will be conveyed by an audible beep followed by the frequency being displayed (in Hz) on the LCD display of the Frequency-Finder.
7. Compare the reading from Step 6 to the desired range determined in Step 2. If the reading is below the desired frequency range, tighten the belt. If the reading is above the desired range, loosen the belt.

Using Tension-Finder™

A Tension-Finder™ can be used to set the tension for Carlisle belt lines listed in the Recommended Tensioning Slots table. A Tension-Finder should not be used with aramid or glass cord belts as it could result in damage to the equipment. The Tension-Finder is a gauge used to set the correct tension in the belt by measuring the amount of stretch in the belt while in tension.

Required equipment: Tension-Finder, pen or marker.

1. Turn off the power to the motor and follow lock out, tag out procedures.
2. Install the belts loosely on the aligned sheaves.
3. Increase the center distance of the sheaves to apply enough tension to the belts to remove the slack.

Recommended Tensioning Slots		
Belt Lines	Slot No.	
	New Belt	Used Belt
AP, BP, CP, DP, RBP, RCP, RDP A, B, C AX, BX, CX, DX, RBX, RCX, RDX	2	1
5V, 8V R3V, R5V, R8V 5VX, 8VX R3VX, R5VX, R8VX R5VL SPZX, SPAX, SPBX, SPCX	3	2

4. Scribe a line on the belt perpendicular to the direction of travel. The Tension-Finder can be used as a square.
5. Place the start slot of the Tension-Finder over the line scribed in Step 4.
6. Attach the spring to the belt with the scribed line still in the start slot of the Tension-Finder. For reference, if the spring slips scribe a line on the belt at the spring end of the Tension-Finder.
7. Using the *Recommended Tensioning Slots* table, determine the required tensioned slot for belt line and belt use.
8. Tension the belt until the scribe line from Step 4 is displayed in the designated slot of the Tension-Finder as determined in Step 7. *See Figure 4.*

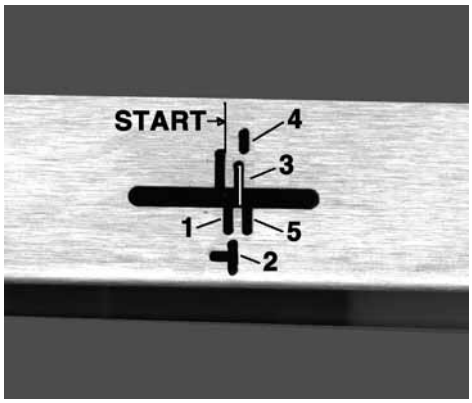

Figure 4; Carlisle Tension-Finder™ on a V-belt. (Carlisle Part No. 108039-A)

9. Remove the Tension-Finder from the belt before operation.

Recommended Minimum Belt Deflection Force on back page

Recommended Minimum Belt Deflection Force

Belt Section	Small Sheave		Drive Ratio			
	Speed Range	Diameter	1.0	1.5	2.0	4.0 & Over
3V	1200-3600 1200-3600 1200-3600 1200-3600 1200-3600	2.65 3.65 4.75 5.60 6.90	2.0 2.8 3.8 4.2 4.6	2.4 3.6 4.2 4.6 5.0	2.6 3.8 4.4 4.8 5.2	3.0 4.2 4.8 5.4 5.6
5V	900-1800 900-1800 900-1800 700-1200	7.1 9.0 14.0 21.2	8.5 10.0 12.0 14.0	9.5 11.0 13.0 15.0	10.0 12.0 14.0 16.0	11.0 13.0 15.0 17.0
8V	900-1800 900-1800 700-1500 700-1200 400-1000	12.5 14.0 17.0 21.2 24.8	18.0 21.0 24.0 28.0 31.0	21.0 23.0 26.0 30.0 32.0	23.0 24.0 28.0 32.0 34.0	25.0 28.0 30.0 34.0 36.0
3VX	1200-3600 1200-3600 1200-3600 1200-3600 1200-3600 1200-3600	2.20 2.50 3.00 4.12 5.30 6.90	2.2 2.6 3.1 3.9 4.6 5.0	2.5 2.9 3.5 4.3 4.9 5.4	2.7 3.1 3.7 4.5 5.1 5.6	3.0 3.6 4.2 5.1 5.7 6.2
5VX	1200-3600 1200-3600 1200-3600 1200-3600 900-1800 900-1800	4.4 5.2 6.3 7.1 9.0 14.0	6.5 8.0 9.5 10.0 12.0 14.0	7.5 9.0 10.0 11.0 13.0 15.0	8.0 9.5 11.0 12.0 14.0 16.0	9.0 10.0 12.0 13.0 15.0 17.0
8VX	900-1800 900-1800 700-1500 700-1200 400-1000	12.5 14.0 17.0 21.2 24.8	18.0 21.0 24.0 28.0 31.0	21.0 23.0 26.0 30.0 32.0	23.0 24.0 28.0 32.0 34.0	25.0 28.0 30.0 34.0 36.0
AP A	1800-3600 1800-3600 1800-3600 1800-3600	3.0 4.0 5.0 7.0	2.0 2.6 3.0 3.5	2.3 2.8 3.3 3.7	2.4 3.0 3.4 3.8	2.6 3.3 3.7 4.3
BP B	1200-1800 1200-1800 1200-1800 1200-1800	4.6 5.0 6.0 8.0	3.7 4.1 4.8 5.7	4.3 4.6 5.3 6.2	4.5 4.8 5.5 6.4	5.0 5.6 6.3 7.2
CP C	900-1800 900-1800 900-1800 700-1500	7.0 9.0 12.0 16.0	6.5 8.0 10.0 12.0	7.0 9.0 11.0 13.0	8.0 10.0 12.0 13.0	9.0 11.0 13.0 14.0
DP D	900-1500 900-1500 700-1200 700-1200	12.0 15.0 18.0 22.0	13.0 16.0 19.0 22.0	15.0 18.0 21.0 23.0	16.0 19.0 22.0 24.0	17.0 21.0 24.0 26.0
AX	1800-3600 1800-3600 1800-3600 1800-3600	3.0 4.0 5.0 7.0	2.5 3.3 3.7 4.3	2.8 3.6 4.1 4.6	3.0 3.8 4.3 4.8	3.3 4.2 4.6 5.3
BX	1200-1800 1200-1800 1200-1800 1200-1800	4.6 5.0 6.0 8.0	5.2 5.4 6.0 6.6	5.8 6.0 6.4 7.1	6.0 6.3 6.7 7.5	6.9 7.1 7.7 8.2
CX	900-1800 900-1800 900-1800 700-1500	7.0 9.0 12.0 16.0	10.0 11.0 12.0 13.0	11.0 12.0 13.0 14.0	12.0 13.0 13.0 14.0	13.0 14.0 14.0 15.0
DX	900-1500 900-1500 700-1200 700-1200	12.0 15.0 18.0 22.0	16.0 19.0 22.0 25.0	18.0 21.0 24.0 27.0	19.0 22.0 25.0 28.0	20.0 24.0 27.0 30.0