BELT DRIVES

BELTS AND BELT DRIVES.

As a mechanism, rope drives were preceeded in history only by the lever. The ancient bore drill—Used for making fire—was the first practical application of the belt friction drive principal; by the 16th century endless belt drives were used for lathes, with animals as prime movers. However it was within an industrial context that belt drives became increasingly developed. Leather belting was the dominant power transmission medium of the early industrial revolution and from these leather belt drives arose a number of alternative solutions to the indirect drive problem. Developments led rapidly from alternative flat belt constructions to round driving ropes, the classical V-belt, the high performance flat belt, the narrow V-belt, ribbed belts and more recently toothed belts.
Of the five most important classes of non positive belt drive.

1. High performance flat belt.
2. Ribbed belt
3. Classical V-belts.
4. Narrow V-belts.
5. Toothed belts.

Our concern at Carrington is in the main with Nos. 3, 4, 5.

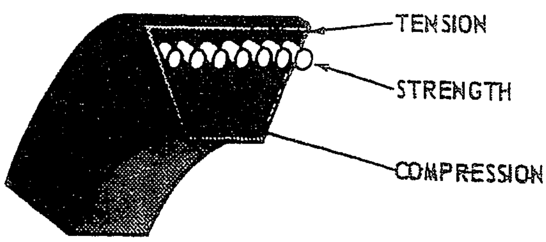
VEE BELT DRIVES
CONSTRUCTION

Belts of the Vee type, commonly manufactured of fabric, cord or a combination of these, treated with natural or synthetic rubbers compound and vulcanised together, provide a quiet, compact and resilient form of power transmission. They are used extensively in single and multiple form for automotive, home and commercial equipment and in industrial drives for a wide range of horsepowers extending upwards from fractional values.

The tapered cross sectional shape of a Vee belt causes it to wedge firmly into the pulley groove during operation so that the driving action takes place through the sides of the belt rather than the bottom, which normally is not in contact with the pulley at all.

Most standard industrial Vee belts satisfy B.S. 1440 but in addition have improved properties of resistance to abrasion, heat and oil derived from the use of neoprene compounds in their covers. Such properties were once only found in Premium belts. Now they are a standard feature.

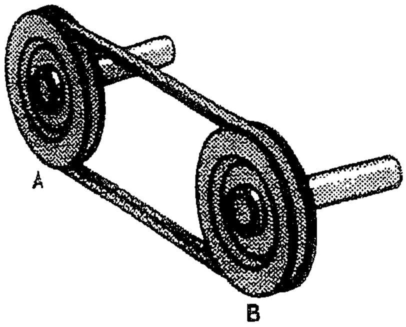
A Vee Belt must transmit power between two rotating sheaves (Pulleys) and must be both strong and flexible. The drawing below shows a cross section of a typical Vee Belt.

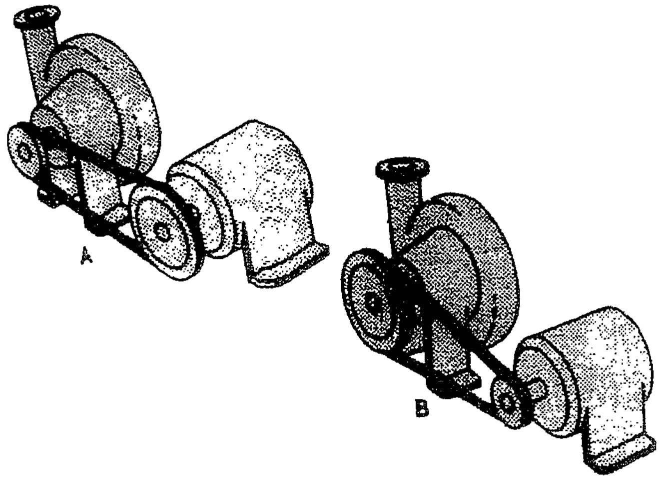


As can be seen, the belt is made up of three basic sections and each section has been designed to accomodate a different condition. The strength section of the belt is made of Terylene Tensile cables, these do not change their length at any time, therefore as the belt passes around the pulley the outside of the belt (tension) has to stretch, and is made out of a relatively soft elastic rubber. The inside of the belt (compression) contracts and is made out of a hard rubber for strength and resistance to wear. It is this section of the belt which give the strong friction grip for the drive. These three sections are encased in a strong cotton fabric, and impregnated with rubber.

V-Belt Drives Can Be Used As Speed Changers

Sheave A is the same size as sheave B.





When sheave "A" turns, sheave "B" turns at the same speed as A. Therefore, when both sheaves are the same size, the speed and torque of the driven shaft are the same as for the drive shaft.

The speed of motor "A" is the same as motor "B," and as the motor sheave in "A" is larger than the pump sheave, this pump turns faster than "B."

Speed Ratio's between two shafts depend on the sizes of the sheaves, and if one is replaced the ratio can be changed either up or down, depending on the size used. If both sheaves sizes are increased by 20% no speed change would occur, but more torque would be present.

Power is a combination of torque and speed, low torque at high speed can be changed to high torque at low speed, Vee Belts and sheaves can be used to change any of the above conditions but the amount of power transferred is the same.

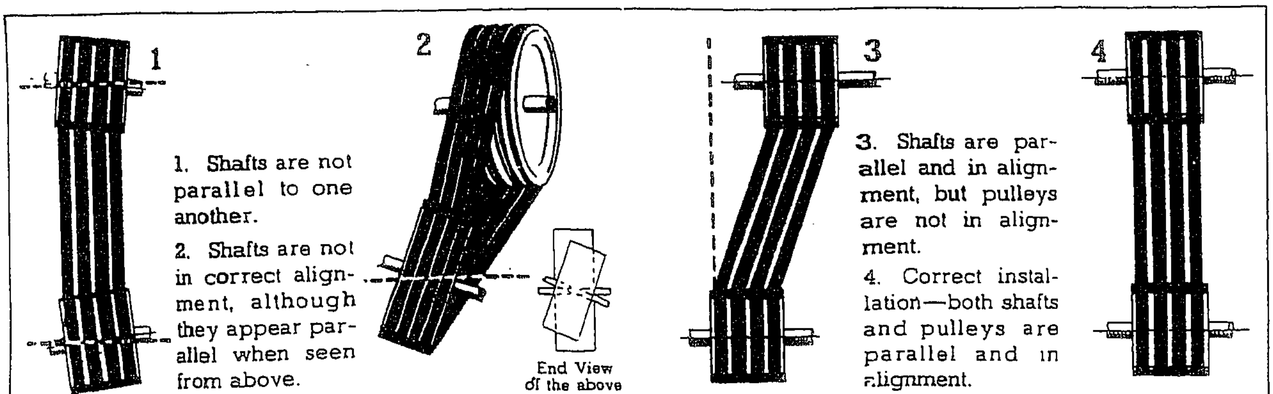
Note.
The information given in this section on belt installation take up allowance, and also tensioning, is only applicable to the Fenner range of V belts and timing belts.

ADJUSTMENT

Alignment

How Belts Are Adjusted

Careful adjustment of a V-belt drive minimizes wear.



1. Shafts are not parallel to one another.
2. Shafts are not in correct alignment, although they appear parallel when seen from above.
3. Shafts are parallel and in alignment, but pulleys are not in alignment.
4. Correct installation—both shafts and pulleys are parallel and in alignment.

The dotted lines emphasise the faults by indicating the correct position

Misalignment twists the belt.

Twisting the belt causes the grooves to wear down the sides of the belt.

The grooves of the drive sheave and the driven sheave should be lined up on the shafts so that the V-belt lies squarely in both grooves.

With the shafts parallel and the sheaves lined up exactly, the belt rests firmly in the groove without twisting.

Tension

The tightness of a belt is called its *tension*.

The belt must have enough tension so that it does not slip at full load.

A loose belt makes a squealing sound as it slips along the sides of the grooves.

Slippage creates heat that may damage the belt.

Slippage may cause two things:
loss of power transferred, and creation of heat which damages the belt.

You can adjust for slippage by increasing belt tension.

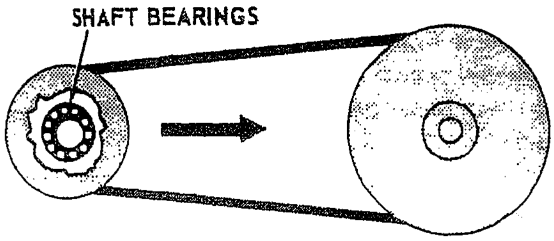
When a check of a slipping belt shows that it *is* properly adjusted, then the belt is probably slipping because it is overloaded.

One solution is to reduce the load.

Another solution is to use a multiple-belt drive.

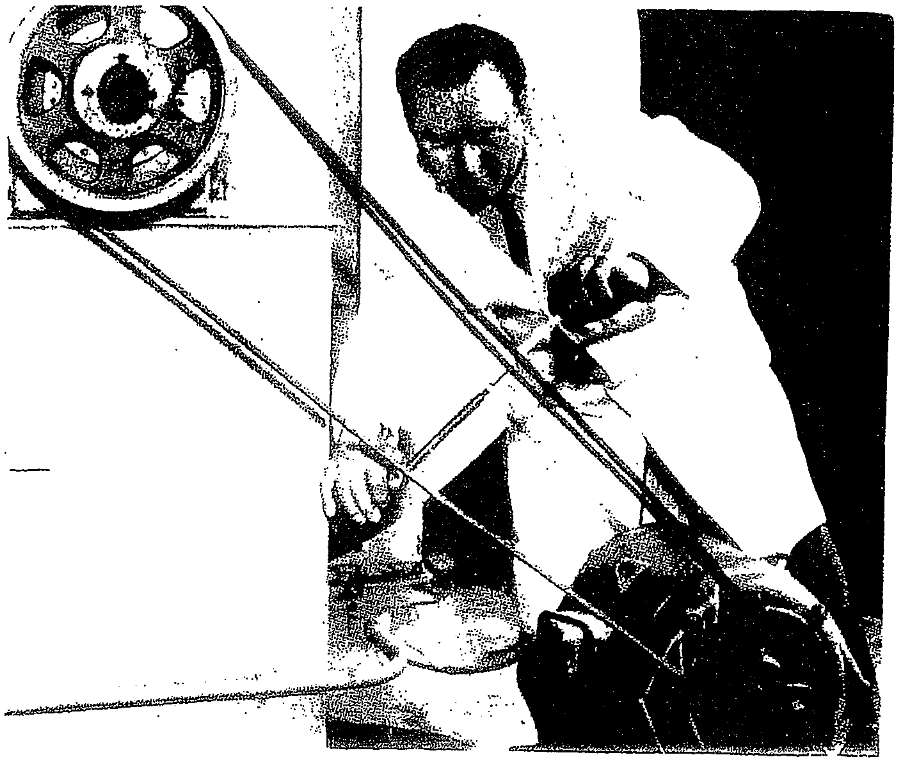
Each additional belt reduces the amount of load each belt has to carry, and thus reduces slippage

Sometimes a belt is too tight.



A tight belt pulls the shaft toward one side of its bearing and this causes increased wear on that side of the bearing.

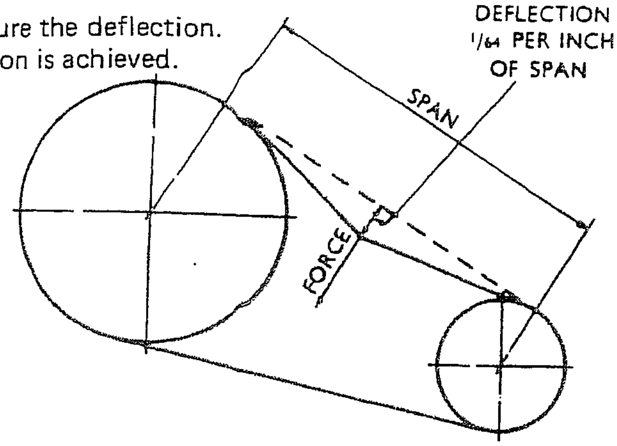
Also, if the belt is too tight, extra power is needed to move the belt drive, and a belt which is too-tight wastes power and may cause a belt to break in operation.



Tensioning a Vee Belt Drive

A drive should be tensioned until a slight bow appears on the slack side of the Vee belts when they are running under load.
To check for correct tension, proceed as follows.

1. Measure the Span length.
2. At the centre of the Span apply a force (with a Spring Balance or weight) equal to that recommended in the Value Table.
3. Lay straight edge along rim of pulleys and measure the deflection.
4. Tension or slacken until correct tension/deflection is achieved.



V-Belt Section	Force required to deflect V-Belt 1/64" per inch of span	
	Standard Industrial	Premium Industrial
A	1·5 to 2·2 lb.	2·1 to 3·1 lb.
B	3·5 to 5·2 lb.	4·9 to 7·3 lb.
C	7·0 to 10·5 lb.	8·0 to 14·7 lb.
D	12·8 to 19·2 lb.	17·9 to 24 lb.
E	22 to 33 lb.	31 to 46 lb.

If the measured force falls within the values given the drive tension should be satisfactory. A measured force below the lower value indicates undertensioning. If the force is higher than the upper value the drive is overtensioned; however, a new drive should be tensioned to near the higher value to allow for the normal drop in tension during the running-in period. After the drive has been running for a few days the V-Belts will have seated in the grooves and the drive tension should be re-checked.
Make adequate provision for tensioning the belts during their life.

Effect of under-belting a Multiple V-Belt Drive

Always select sufficient V-Belts to ensure enough power transmitting capacity for the maximum load; but the number cannot be based on power alone. In the case of speed increase drives this is particularly important, and it should always be borne in mind that pulley diameters, in addition to V-Belt velocity, have a distinct bearing on the basic H.P.

Apart from bad design due to under-belting, the appropriate service correction factor must be incorporated so that the drive has adequate capacity to give long and continuous service.

The following table emphasises the effect of under-belting. It is based on ten belts being the normal number required to drive the load. It will be seen that one V-Belt less decreases the life of the whole set by as much as 30%.

No. of V-Belts	Per cent. Life
10 (normal number of V-Belts) ...	100%
9	70%
8	45%
7	28%
6	17%

Installation

INSTALLATION AND TAKE-UP ALLOWANCE TABLE

V-Belt Inside Length in inches	Minimum Allowance below Standard Centre Distance for Application of V-Belts without injury					Minimum Allowance above Standard Centre Distance for stretch
	A	B	C	D	E	
15 to 25	3/4					1
26 to 37	3/4	1				1 1/2
38 to 59	3/4	1	1 1/2			2
60 to 89	3/4	1 1/4	1 1/2			2 1/2
90 to 119	1	1 1/4	1 1/2			3
120 to 157	1	1 1/4	1 1/2	2		3 1/2
158 to 194		1 1/4	2	2	2 1/2	4 1/2
195 to 237		1 1/2	2	2	2 1/2	5
238 to 267			2	2 1/2	2 1/2	5 1/2
268 to 327			2	2 1/2	3	6 1/2
328 to 417			2	2 1/2	3	7
418 and over				3	3 1/2	7 1/2

ALL DIMENSIONS GIVEN ARE IN INCHES

Installation

In assembling a drive, the motor or prime mover should be moved toward the driven unit so that the V-Belts may be placed in their respective grooves by hand. The above allowances should be available for adjustment of the centre distance.

Under no circumstances should V-Belts be forced on to pulleys with crowbars, wedges, screwdrivers, or any type of implement. Such procedure would tend to cause the outside jacket or inside cord, or both, to rupture. It is possible for the inside load-carrying cords to be broken by forcing over the grooves, without this being evident from the outside appearance of the V-Belt. Such V-Belts fail completely during the first few hours running.

When the V-Belts have been placed in the pulley grooves, the motor or prime mover should then be moved away from the driven unit to apply uniform tension to the V-Belts.

Ventilation

Where guards are necessary it is desirable to use the wire screen type rather than air-tight covers so as to permit free circulation of air and dissipation of any heat generated.

Jockey Pulley Tensioning

Where adjustment of centre distance cannot possibly be arranged, it is necessary to use a jockey pulley tensioning device. A grooved tensioning pulley may be used, and this should be placed on the inside of the V-Belts, mounted as near as possible to the larger pulley, and on the slack side of the drive for preference. Alternatively, a flat faced jockey pulley may be used on the outside of the belts (preferably on the slack side of the drive) and should be positioned within one-third of the centre distance from the driving pulley. Note that appropriate alteration to the Service Correction Factor should be made in the design of the drive Jockey pulley diameters should be at least equal to that of the smaller pulley of the drive, but larger if possible.

Jockey Pulley Movement

This can only be determined by laying out the drive to scale. It must allow for passing the belts over the outside diameter of one of the pulleys on installation, and should also allow for belt stretch during life of 3% for standard industrial V-Belts and 2% in the case of Premium V-Belts.

Replacement

Belts stretch somewhat from tension in normal use.

An old belt is a little longer than a new belt of the same specifications.

When one V-belt in a matching set becomes worn and stretched, the load on the other belt increases.

If the worn belt is replaced by a brand new one, the new belt is not stretched at all, and carries more than its share of the load.

One old belt among several new ones bears almost none of the load.

One new belt among several old ones bears almost all of the load.

Unless each belt carries an equal share of the load, one belt may break.

When any belt in a set becomes worn, or broken the whole set should be replaced. With a new matched set.

Fenner V-Belt Matching

In August 1952, Fenner introduced improved methods of identifying V-Belts for the purpose of making-up matched sets by means of a simple coding system. This system has proved so successful that it has been adopted in the British Standard Specification 1440. For your information, short V Belts are made in ring moulds—those in the long category, i.e. over 75 inches inside length, are made in press moulds. The resultant lengths of press moulded V-Belts are dependent upon the accurate weight of the covers, cords and rubber compound used in the construction of the belts. Actually, in practice there are slight variations in lengths when the belts are removed from the moulds. It is, therefore, essential to show by a coding number affixed to each belt just how it will match up with others from the press moulds. Ring moulded V-Belts do not show these length variations and consequently do not need special selection. They do not carry coding numbers.

When the code number 50 is shown on the cellulose tape attached to each V-Belt, this indicates that the actual length coincides with the nominal length printed on the belt. Each 1/10th of an inch variation from the nominal length is represented by one unit. For example, an A100 V-Belt coded 50 is 100 inches inside length. If the coding is 51, then it is 100·1 inches inside length, and if the coding is 49, it is 99·9 inches inside length.

In matching a set of V-Belts, do not include V-Belts which are outside four consecutive figures where the inside length exceeds 285 inches. For V-Belts between 151 and 285 inches inclusive do not go beyond three consecutive figures, and for V-Belts between 76 inches and 150 inches inclusive do not exceed two consecutive figures. For example, a suitably matched set of B173 V-Belts could be made from codes 48, 49, 50 or 52, 53, 54 and so on. For B85, however, only codes 49, 50 or 50, 51 and similar combinations should be selected.

Faults in V-Belt Drives and their Correction

Abrasion

Metal particles, sawdust and grit are the usual causes. Stop entry of these foreign materials by covering the top and/or one side of the drive. But where guards are necessary, it is desirable to use the wire screen type rather than air-tight covers, so as to permit free circulation of air.

Small Cracks on V-Belt Side and Base

Generally caused by heat and chemical fumes. Remedy by fitting Premium V-Belts.

Excessive Stretch

Usually due to overloading or internal breaks which are easily caused, but not noticed, if V-Belts are forced over tops of grooves. Check if extra duty may have been added subsequently to the drive design and installation.

Loss in Driven Speed

Often due to slippage resulting from insufficient tension. Check by tachometer readings against calculated speeds and remedy by adjusting tension. Slippage will result from the use of belt dressing which should never be employed on V-Belts. Any application is bound to be unevenly spread with the result that one or more V-Belts will tend to carry the full load.

V-Belt Swelling or Softening

Caused by oil, certain cutting fluids or rubber solvent. Remove cause, if possible, and use Premium V-Belts.

Mixing of V-Belts

V-Belts of different brands or types must not be mixed: the slightest difference in cross section and internal design will seriously affect running life. New and used V-Belts should not be run together in the same set for similar reasons. When making replacements, always fit all new or all used V-Belts in the same set.

Oil

Oil should not be allowed to come into contact with V-Belts if this can possibly be avoided. Where it is impracticable to cut out oily conditions, use Premium V-Belts.

Heat

Do not install a V-Belt Drive with standard quality V-Belts in a hot place, such as near a radiator or on drying machines and kilns, as excessive heat causes overcuring and early failure. Fenner Premium V-Belts should be employed wherever it is necessary for V-Belts to run in a temperature regularly exceeding 120 deg. F. (49 deg. C.).

Inability to Transmit Rated Load

This may be the result of the pulley grooves being cut unevenly, or of incorrect angle. Check each single groove with a template to ensure all V-Belts are running on the same pitch diameter. Have the drive design checked over to see that the drive has sufficient capacity for the load.

Whipping during Running

Usually caused by incorrect tensioning, principally on long centre drives. Try a slightly higher (or lower) tension.

Belt Dressing

Belt dressing should never be put on V-Belts to make them grip better.

This softens the belt materials and weakens or damages the belt.

INSTALLATION AND TAKE-UP ALLOWANCE TABLE

Wedge-Belt Cross Section	Wedge-Belt Symbol Number	Minimum Installation Allowance	Recommended Take-up Allowance
ALPHA	250— 450	1/2	1
	475— 750	3/4	1 1/4
	800—1060	3/4	1 1/2
	1120—1250	3/4	1 3/4
	1400	1	2 1/4
BETA	500— 710	1	1 1/4
	800—1060	1	1 1/2
	1120—1250	1	1 3/4
	1320—1600	1	2 1/4
	1700—2000	1	2 1/2
	2240	1 1/4	2 3/4
	2360—2500	1 1/4	3 1/4
	2800	1 1/4	3 1/2
	3150	1 1/4	4
DELTA	1000	1 1/2	1 1/2
	1120—1250	1 1/2	1 3/4
	1400—1600	1 1/2	2 1/4
	1800—2000	1 3/4	2 1/2
	2240	1 3/4	2 3/4
	2500	1 3/4	3 1/4
	2800	1 3/4	3 1/2
	3150	1 3/4	4
	3550	2	4
	4000—4500	2	5 1/2

These allowances are in inches

Jockey Pulleys

A grooved jockey pulley must be used when placed on the inside of the belts and it should be mounted as near as possible to the larger pulley and on the slack side.

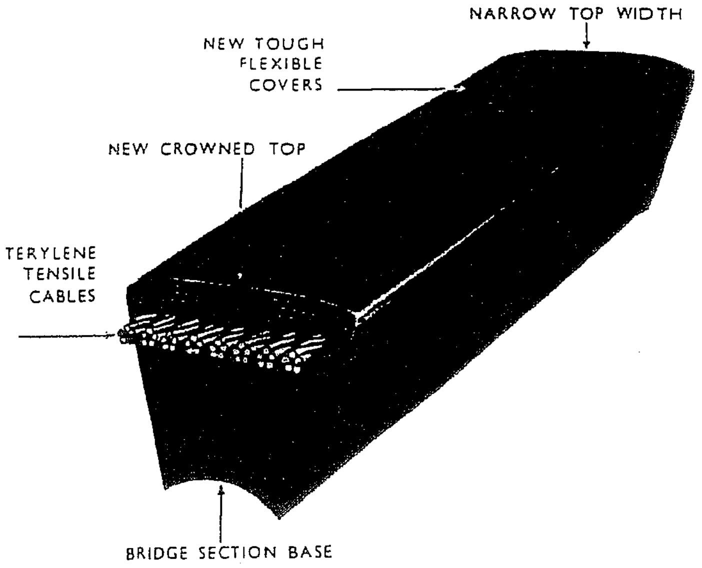
A flat jockey pulley may be used when placed on the outside of the belts, and should be positioned within one third of the span length from the driving pulley on the slack side of the belts.

Consult Fenner for recommendation of jockey pulley diameter and adjustment necessary to take up stretch during life of belts.

INSTALLATION AND OPERATION OF SPACESAVER DRIVES

WEDGE BELT SECTION	BELT DEFLECTION FORCE — LBF			
	SMALL PULLEY DIAMETER	BELT SPEED RANGE - FEET/MIN		
		0 to 2000	2000 to 4000	4000 to 6000
ALPHA	2.65 3.87	2·5 4·0	2·1 3·5	1·7 — 3·1
	4.5 and above	3·9 5·9	3·4 - 5·1	3.0 — 4·5
BETA	7·1 10·3	8·3 12·4	7·0 10·5	6·2 — 9·3
	11·8 and above	10·5 15·7	9·3 - 13·9	8·5 — 12·8
DELTA	13·2 and above	20·0 — 30·0	16·6 — 25·0	14·5 — 22·0

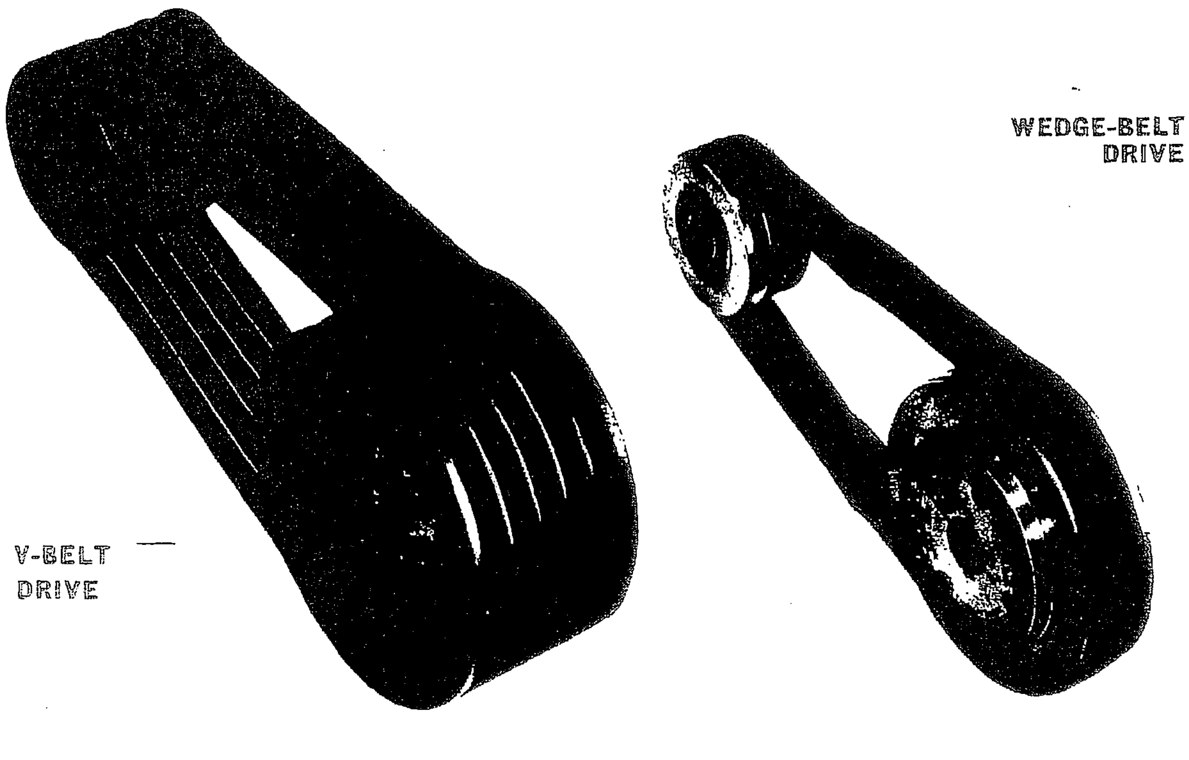
Narrow Vee Belts Spacesaver Wedge-Belts



Smaller Section – New Shape
How can smaller, and narrower, Wedge-Belts carry much *greater* loads than well-tried V-Belts? There are two good reasons. Firstly, new high performance materials are now available and, secondly, there has been new thinking on section shape and arrangement. In combination, they enable us to make important improvements to V-Belts. Two new cross-sections cater for all drives up to 200 H.P. They are named Alpha– $\frac{1}{2}$" wide, and Beta– $\frac{5}{8}$" wide.

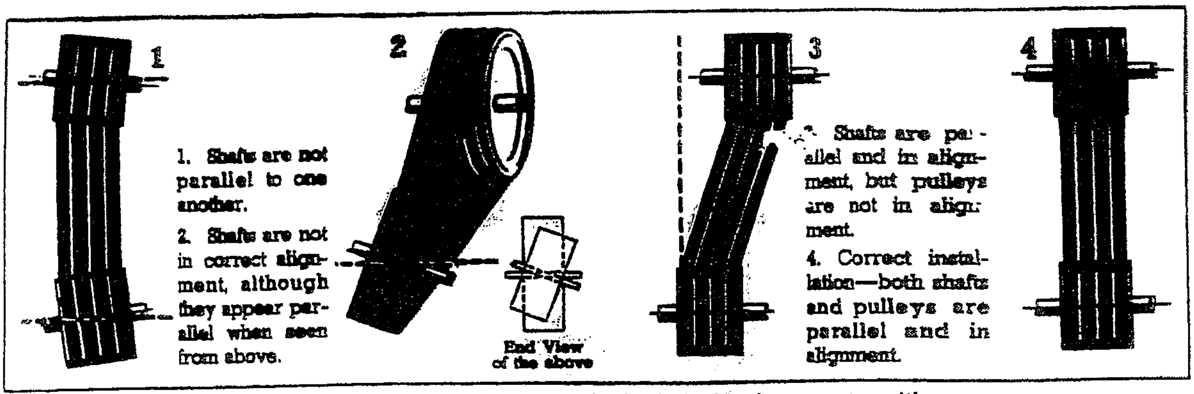
Bridge Section Base
Many V-Belts fail because the load-carrying cords cannot be kept in their designed and correct place under tension. Cord movement also sets up internal friction and generates heat—hitherto a sure belt destroyer. Narrower belts cannot buckle so easily, and in SpacesaVer Wedge-Belts the concave base is a further powerful stabiliser of the cords in their correct position.

Length and Section Stability
Modern materials and production methods used for SpacesaVer make matching a problem of the past. Not only can these smaller Wedge-Belts be measured precisely, but the determined length and coding number remains constant. A matched set stays matched.



COMPARE THIS V-BELT DRIVE WITH THE SPACESAVER WEDGE-BELT DRIVE
DESIGNED FOR THE SAME DUTIES
SPACESAVER IS SLIMMER, LIGHTER, SHORTER AND CHEAPER

ALIGNMENT - SPACESAVER



The dotted lines emphasise the faults by indicating the correct position

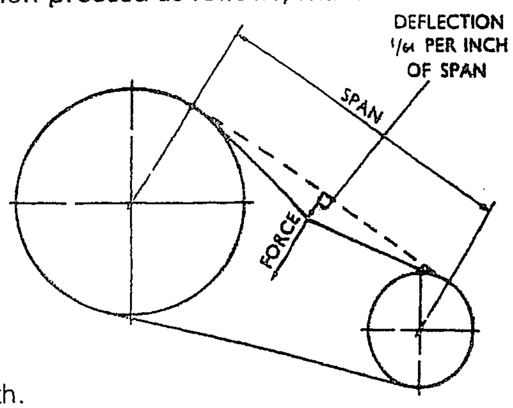
Guards
Where guards are necessary it is desirable to use the wire mesh type to permit adequate ventilation.

V-Flat Drives
Owing to the construction of the SpacesaVer Wedge-Belts they cannot be used on V-Flat Drives.

Installation
Always use a matched set of Wedge-Belts. Clean any oil and grease from the pulleys; remove any rust or burrs from the grooves.
Reduce the centre distance until the belts can be put into the pulley grooves without forcing; see table in next column. Make sure the pulleys are correctly aligned and that the shafts are parallel.
Place the belts into the pulley grooves and tension the drive.

Tensioning
Because of the high power ratings of SpacesaVer Wedge-Belts each belt will be required to operate at a higher tension than each belt in a V-Belt drive. This means that because of the flexibility of the smaller cross section the Wedge-Belts may not feel as tight as one would expect.

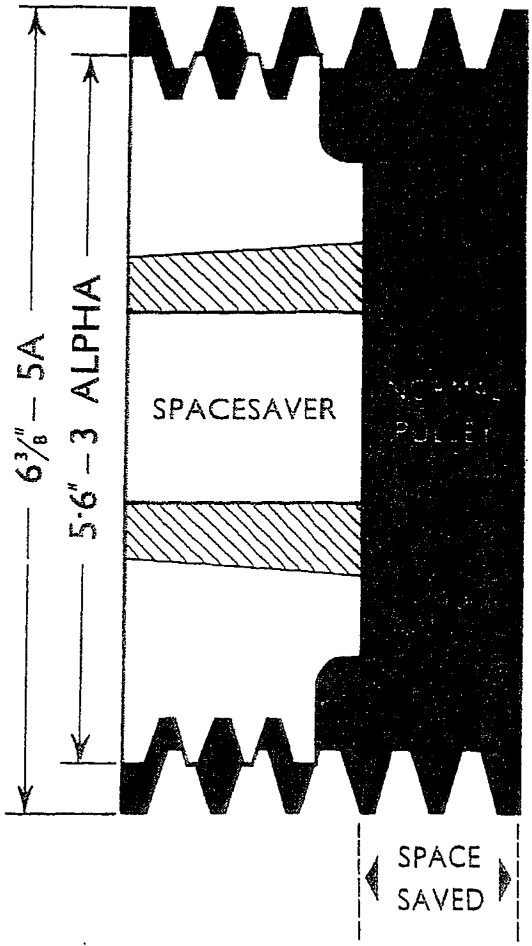
To check for correct tension proceed as follows; and see illustration of method on opposite page



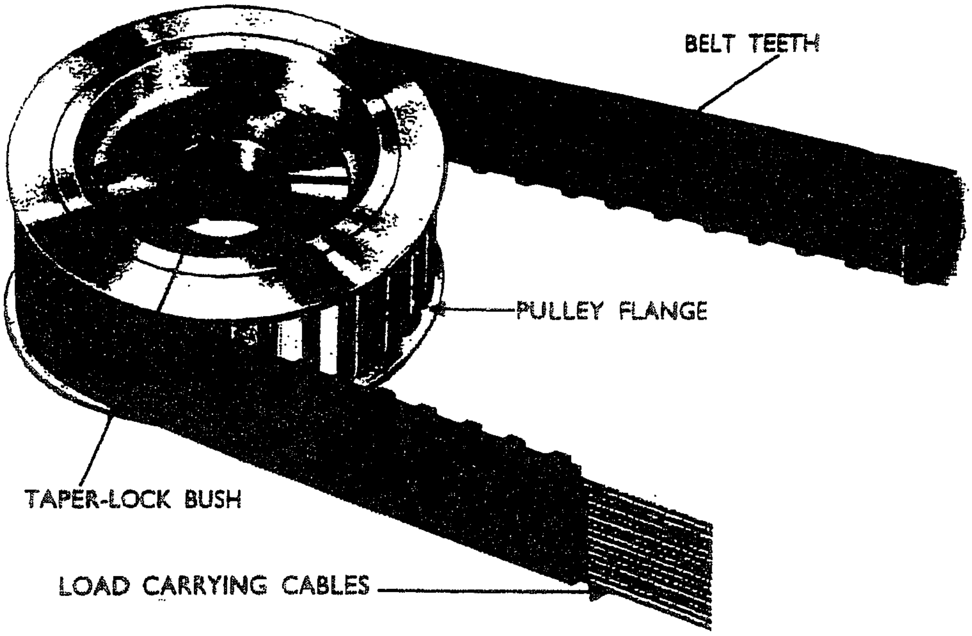
1. Measure the span length.
2. At the centre of the span apply a force at right angles to the belt to deflect one belt 1/64" for every inch of span length.
3. Compare this force with value in table on the next page.

If the measured force falls within the values given the drive tension should be satisfactory. A measured force below the lower value indicates undertensioning. If the force is higher than the upper value the drive is overtensioned; however, a new drive should be tensioned near the higher value to allow for the normal drop in tension during the running-in period. After the drive has been running a few days the Wedge-Belts will have seated in the grooves and the drive tension should be re-checked.
Make adequate provision for tensioning the belts during their life. The minimum take-up allowance is

Compare this 5·6″× 3 Alpha with the 6·375″×5A groove pulley — they are both for the same duty.



TIMING BELT DRIVES



The timing belt differs from Vee belting in that it is much thinner and carries teeth moulded into the inside face. These mesh with recesses generated onto a flat pulley, as shown, hence the drive is taken from these and not from friction at the sides of the sheaves as the V belt does, because of this they are used where a relationship between 2 shafts must be maintained and belt slip cannot be tolerated. These belts, because of their construction do not need the same tension as do V belts.

Positive Drive
Can be used for mechanisms where synchronisation is required. This is a feature not possessed by Wedge-Belt or V-Belt drives.

Fixed Centres
After correct initial tension has been obtained no re-tensioning whatever is required.

Economical
Particularly in greatly reduced time taken to fit, because Fenner Timing Belt pulleys are fitted with Taper-Lock bushes.

Wide Range
Ratios up to 8½ to 1 are available with standard pulleys, and load capacities vary from fractional to 500 h.p.

High Belt Speeds
On correctly designed drives belt speeds up to 16,000 feet/min. are permissable. Consult Fenner regarding all drives in this speed range.

Fenner Timing Belt Drives
The Fenner Timing Belt Drive takes its place in the range of power transmission media available with the quick and easy fixing Taper-Lock* bushes. It is not a friction drive—the grip required for driving is obtained by the moulded teeth in the belt meshing perfectly with the teeth in both driving and driven pulleys, with negligible backlash.

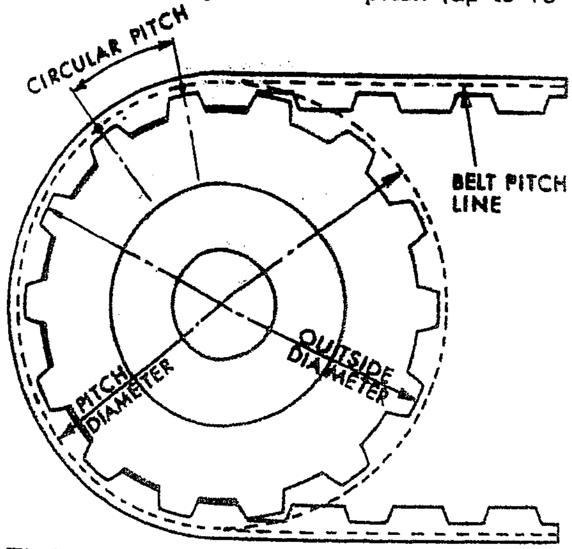
Cool Running
The very thin section ensures that the heat generated when the belt is flexed round the pulleys is kept to an absolute minimum; furthermore there is no creep or slip, the power losses in the drive are negligible and efficiency is high.

Lower Drive Tension
Because the drive does not rely on friction, the static and running tensions in the drive are low. This reduces shaft and bearing loads.

Belts of standard lengths are readily available in the following widths:

Pitch	Widths
$\frac{3}{8}$" Light	½", ¾" and 1"
½" Heavy	¾", 1", 1½", 2" and 3"
$\frac{7}{8}$" Extra Heavy	2", 3" and 4"

Widths not shown above in $\frac{3}{8}$", ½" and $\frac{7}{8}$" **pitch, and all widths in** $\frac{1}{5}$" **and 1¼" pitch** (up to 15" maximum) are available to special **order.**



The following nomenclature is used to identify a Fenner Timing Belt.

Length.
The first figures of the code number are obtained by taking the pitch length in inches and multiplying by 10.

Pitch of the Teeth.
The letters indicate the pitch as follows:

XL = Extra light $\frac{1}{5}$" pitch.
L = Light $\frac{3}{8}$" pitch.
H = Heavy ½" pitch.
XH = Extra Heavy $\frac{7}{8}$" pitch.
XXH = Double Extra Heavy 1¼" pitch.

Width of Belt.
The figures following the letters show the actual width in inches multiplied by 100.

Example
A 45" pitch length belt, ½" pitch (Heavy) and 1½" wide would be designated by the code number 450 H150.

Belts of Special Construction
Belts using high-tenacity-rayon load carrying cords or stainless steel cords, anti-static belts or belts manufactured to withstand temperatures outside the limits for standard timing belts are sometimes more suitable than belts of standard construction where unusual conditions of service appertain. For extreme temperatures they extend the range downwards to minus 50° Centigrade, and upwards to 115° Centigrade, from the normal limits of minus 35° to plus 85° Centigrade.

Standard Pulleys
These are made from Cast Iron Grade 17, except some of the smaller sizes which are of mild steel. The blanks are accurately machined and the teeth are generated to tolerances which ensure correct meshing with the belt.

In every timing belt drive at least one pulley requires to be flanged, and for reasons of economy, it is usual to have the smaller pulley flanged. Flanges are flared to ensure correct entry of the belt.

Both pulleys should be flanged if the drive centre distance is more than eight times the diameter of the smaller pulley, and certainly when the drive is to be used on vertical shafts.

In the stock range of pulleys all those with 48 teeth and less in $\frac{3}{8}$" and ½" pitches are flanged, and all pulleys with 40 teeth and less in $\frac{7}{8}$" pitch are flanged. Stock pulleys beyond this range are without flanges but can be supplied flanged to special order. The following nomenclature is used to identify Fenner Timing Belt pulleys

Number of Teeth
The first figures of the code number indicate the number of teeth in the pulley.

Pitch of the Teeth
The letters indicate the pitch in the same way as in the Belt coding, e.g. L = $\frac{3}{8}$" and XH = $\frac{7}{8}$".

Width of Belt
The figures following the letters are obtained by taking the belt width in inches and multiplying by 100.

example
A 48-tooth pulley $\frac{7}{8}$" pitch, for use with a 2" wide belt would be designated by the code number 48 XH 200.

Timing Belt Sizes and Installation Instructions

XL Extra Light 1/8" Pitch			L Light 3/8" Pitch			H Heavy 1/2" Pitch			XH Extra Heavy 7/8" Pitch	
60XL	180XL	Available in the following widths	150L	390L	Available in the following widths:	240H	600H	Available in the following widths:	507XH	Available in the following widths:
70XL	190XL	1/4" (025)	187L	420L	1/2" (050)	270H	630H	3/4" (075)	560XH	2" (200)
80XL	200XL	5/16" (031)	210L	450L	3/4" (075)	300H	660H	1" (100)	630XH	3" (300)
90XL	210XL	3/8" (037)	225L	480L	1" (100)	330H	700H	1 1/2" (150)	700KH	4" (400)
100XL	220XL		240L	510L		360H	750H	2" (200)	770XH	
110XL	230XL		255L	540L		390H	800H	3" (300)	840XH	
120XL	240XL		270L	600L		420H	850H		980XH	
130XL	250XL		285L			450H	900H		1120XH	
140XL	260XL		300L			480H	1000H		1260XH	
150XL			322L			510H	1100H		1400XH	
160XL			345L			540H	1250H		1540XH	
170XL			367L			570H	1400H		1750XH	

Widths not shown in the 3/8", 1/2" and 7/8" pitch and all widths in the 1/8" and 1 1/4" pitch (up to 15" max.) are available to special order, but in these cases the minimum quantity which can be supplied (or charged for) is determined by the standard mould width of 15".

Belt Tension
A Fenner Timing Belt should be a snug fit, neither too tight nor too loose. The belt's positive grip eliminates the need for high initial tension. Preloading, often the cause of premature failure, is not necessary. A belt in either the $\frac{7}{8}$- or 1¼-inch pitch can often be installed slightly slack (because of deeper tooth section) unless shock loads or reversals are normally high.

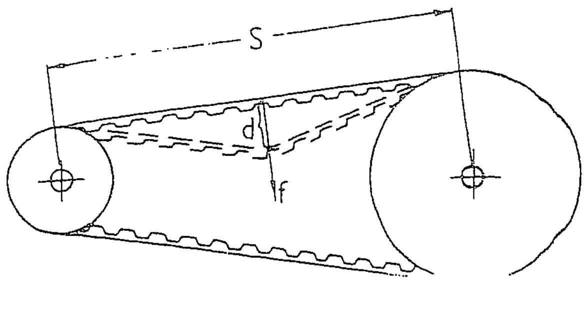
When torque is unusually high, a loose belt, on starting, may 'jump teeth'. In such case the tension should be increased gradually until satisfactory operation is attained.

Tensioning Method
1. Apply a force at the mid-point of the span between the two pulleys. Deflect the belt 1/64" for each inch of span length.
2. Installation tension should be regulated so that the value of this applied force equals the value of f given in the following formula:

$$f = \frac{T + s/LK}{16}$$

where s = the span distance in inches
T = the tension in lb. (Table below)
K = the constant from the Table
L = the length of the belt.

3. If the deflecting force is less than that given in the formula, the belt is too loose. If the deflecting force is greater than that given in the formula the belt is too tight.



Values for T & K		1/4	5/16	3/8	1/2	3/4	1	1 1/2	2	3	4
1/5" Pitch	T	6·7	8·3	10	15						
	K	0·85	1·2	1·7	2·7						
3/8" Pitch	T				17·1	27·9	39·3	61			
	K				9·9	17	24	37			
1/2" Pitch	T					66	93·3	145	200	313	444
	K					32	46	71	95	152	210
7/8" Pitch	T								227	356	504
	K								190	305	440

Belt Handling

On installation the belt should never be forced or prised over the pulley flange. Reduction of centre distance or idler tension usually permits the belt to slide on to the pulley easily. Otherwise one or both pulleys should be removed.

To ensure smooth operation and prevent premature failure, belts in storage should be *protected* against sharp bending or creasing. They should *not* be subjected to extreme heat, low temperature or high humidity.

Pulley Alignment

Misalignment of drive results in unequal tension and extreme edge wear. Consequently, pulley alignment should be proved with a straight-edge and shafts checked for parallelism. Only on a long-centre drive—because of the belt's tendency to run against one flange of the driveR pulley—it is sometimes advisable to offset the driveN pulley slightly to compensate.

It is important that the frame supporting the pulleys be rigid at all times. A non-rigid frame causes variation in centre distance and resulting belt slackness. This, in turn, can lead to jumping of teeth—especially under starting load with shaft misalignment.

Drive Idlers

Idlers, either inside or outside type, are never recommended and should not be used except for power take-off or functional use. When an idler is necessary, it should be on the slack side of the belt. Inside idlers must be grooved unless in excess of 40 grooves. Flat idlers must not be crowned (use edge flanges). Idler diameters must exceed the smallest diameter drive pulley. Idler arc of contact should be held to a minimum.

Timing Belt Drives

Causes of Premature Failure

The common causes of drive failure and their remedies are shown below. There are other less apparent causes of drive failure; excessive reverse load, sub-minimum diameter idler, variable centre distance (such as is caused by resiliently mounted motors) and so forth.

However, when a drive is correctly designed and correctly installed, AND PROPER CONSIDERATION HAS BEEN GIVEN TO THE LOAD COVERAGE, premature failure should not be encountered.

Belts in storage must be protected against sharp bending or creasing. They should not be subjected to extreme heat, low temperature or high humidity.

TYPE OF FAILURE	CAUSE OF FAILURE	CORRECTIVE ACTION
Excessive edge wear	Misalignment or non-rigid centres	Check alignment and/or reinforce mounting
	Bent flange	Straighten flange
Jacket wear on pressure-face side of belt tooth	Excessive overload and/or excessive belt tightness	Reduce installation tension and/or increase drive load-carrying capacity
Excessive jacket wear between belt teeth (exposed tension members)	Excessive installation tension	Reduce installation tension
Cracks in neoprene backing	Exposure to excessive low temperature (below —35° C.)	Eliminate low temperature condition or consult factory for proper belt construction
Softening of neoprene backing	Exposure to excessive heat (above 85° C.) and/or oil	Eliminate high temperature and oil condition or consult factory for proper belt construction
Tensile or tooth shear failure	Pulley below recommended diameter	Increase pulley diameter or use next smaller pitch
	Acid or caustic atmosphere	Refer to factory for belt construction
Excessive pulley tooth wear (on pressure-face and/or O.D.)	Excessive overload and/or excessive belt tightness	Reduce installation tension and/or increase drive load-carrying capacity
	Insufficient hardness of pulley material	Surface-harden pulley or use harder material
Loosening of flange	Incorrect flange installation	Reinstall flange correctly
	Misalignment	Correct alignment
Excessive drive noise	Misalignment	Correct alignment
	Excessive installation tension	Reduce tension
	Excessive load	Increase drive load-carrying capacity
	Pulley below recommended diameter	Increase pulley diameters
Tooth shear	Less than six teeth in mesh (TIM)	Increase TIM or use next smaller pitch
	Excessive load	Increase drive load-carrying capacity
Apparent belt stretch	Reduction of centre distance or non-rigid mounting	Retension drive and/or reinforce mounting
Cracks or premature wear at belt tooth root	Improper pulley groove top radius	Regroove or install new pulleys
Tensile break	Excessive load	Increase load-carrying capacity of drive
	Pulley below recommended diameter	Increase pulley diameters

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GOODYEAR Industrial V-Belt Tension Tester

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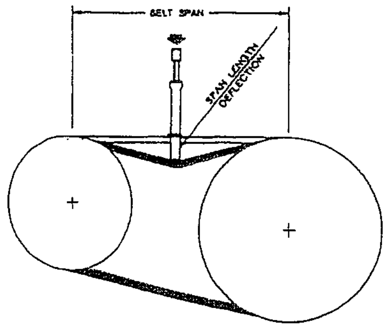
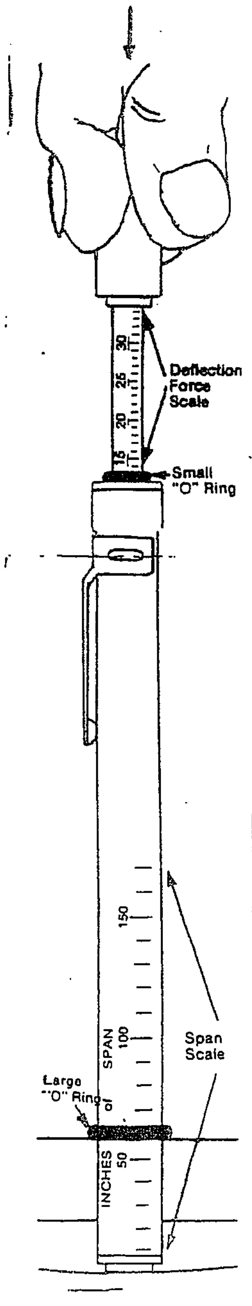


General rules of tensioning.

1. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions.
2. Check tension frequently during the first 24-48 hours of operation.
3. Over tensioning shortens belt and bearing life.
4. Keep belts free from foreign material which may cause slip.
5. Make V-drive inspection on a periodic basis. Tension when slipping. Never apply belt dressing as this will damage the belt and cause early failure.



TENSION MEASUREMENT PROCEDURE

1. Measure the belt span (see sketch).
2. Position bottom of the large "O" ring on the span scale at the measured belt span.
3. Set the small "O" ring on the deflection force scale to zero.
4. Place the tension tester squarely on one belt at the center of the belt span. Apply a force on the plunger and perpendicular to the belt span until the bottom of the large "O" ring is even with the top of the next belt or with the bottom of a straight edge laid across the sheaves.
5. Remove the tension tester and read the force applied from the bottom of the small "O" ring on the deflection force scale.
6. Compare the force you have applied with the values given in the tables on this sheet. The ~~forces should be between~~ the minimum and maximum shown. The maximum value is shown for "New Belt" and new belts should be tensioned at this value to allow for expected tension loss. Used belts should be maintained at the minimum value as indicated in the chart. IF THE BELT SPAN WAS MEASURED IN INCHES, THEN USE THE POUNDS OF FORCE VALUES FOR COMPARISON. IF THE BELT SPAN WAS MEASURED IN CENTIMETERS, THEN USE THE KILOGRAMS OF FORCE VALUES FOR COMPARISON.

NOTE: The ratio of deflection to belt span is 1:64 in either units of measurements.

SHEAVE DIAM - INCHES
DEFLECTION FORCE - LBS

Cross Section	Smallest Sheave Diameter Range	RPM Range	Belt Deflection Force: Uncogged Hy-T Belts and Uncogged Hy-T Torque Team — Used Belt	Uncogged — New Belt	Cogged Torque-Flex and Machined Edge Torque Team Belts — Used Belt	Cogged — New Belt
A, AX	3.0- 3.6	1000-2500 2501-4000	3 7 2 8	5.5 4 2	4.1 3.4	6 1 5.0
	3 8- 4.8	1000-2500 2501-4000	4.5 3 8	6.8 5 7	5.0 4.3	7 4 6 4
	5 0 7 0	1000-2500 2501-4000	5 4 4 7	8.0 7 0	5.7 5 1	9 4 7 6
B BX	3 4- 4 2	860-2500 2501-4000			4 9 4 2	7 2 6 2
	4 4- 5 6	860-2500 2501-4000	5 3 4 5	7 9 6 7	7 1 7 1	10 5 9 1
	5 8- 8 6	860-2500 2501-4000	6 3 6 0	9 4 8 9	8.5 7 3	12.6 10 9
C CX	7 0-.9 0	500-1740 1741-3000	11 5 9 4	17 0 13 8	14 7 11 9	21 8 17 5
	9 5-16 0	500-1740 1741-3000	14 1 12 5	21 0 18 5	15 9 14 6	23 5 21 6
D	12 0-16 0	200- 850 851-1500	24 9 21 2	37 0 31 3		
	18 0-20 0	200- 850 851-1500	30 4 25 6	45 2 38 0		
3V 3VX	2 2 2 4	1000-2500 2501-4000			3 3 2 9	4 9 4 3
	2 65-3 65	1000-2500 2501-4000	3 6 3 0	5 1 4 4	4 2 3 8	6 2 5 6
	4 12 6 90	1000-2500 2501-4000	4 9 4 4	7 3 6 6	5 3 4 9	7 9 7 3
5V 5VX	4 4- 6 7	500-1749 1750-3000 3001-4000			10 2 8 8 5 6	15 2 13 2 8 5
	7 1-10 9	500-1740 1741-3000	12 7 11 2	18 9 16 7	14 8 13 7	22 1 20 1
	11 8-16 0	500-1740 1741 3000	15 5 14 6	23 4 21 8	17 1 16 8	25 5 25 0
8V	12 5-17 0	200- 850 851-1500	33 0 26 8	49 3 39 9		
	18 0-22 4	200- 850 851-1500	39 6 35 3	59 2 52 7		

SHEAVE DIAM - MILLIMETERS
DEFLECTION FORCE - KG.

Cross Section	Smallest Sheave Diameter Range	RPM Range	Belt Deflection Force: Uncogged Hy-T Belts and Uncogged Hy-T Torque Team — Used Belt	Uncogged — New Belt	Cogged Torque-Flex and Machined Edge Torque Team Belts — Used Belt	Cogged — New Belt
A, AX	75- 90	1000-2500 2501-4000	1 7 1 3	2 5 1 9	1.9 1 5	2.8 2 3
	91-120	1000-2500 2501-4000	2.0 1.7	3.1 2.6	2.3 2.0	3 4 2 9
	121-175	1000-2500 2501-4000	2.4 2 1	3.6 3.2	2.6 2 3	4 3 3 4
B BX	85-105	860-2500 2501-4000			2 2 1 9	3 3 2 8
	105-140	860-2500 2501-4000	2 4 2 0	3 6 3 0	3 2 3 2	4 8 4 1
	141-220	860-2500 2501-4000	2.9 2 7	4 3 4 0	3 9 3 3	5 7 4 9
C CX	175-230	500-1740 1741-3000	5 2 4 3	7 7 6 3	6 7 5 4	9 9 7 9
	231-400	500-1740 1741-3000	6 4 5 7	9.5 8 4	7 2 6 6	10 7 9 8
D	305-400	200- 850 851-1500	11 3 9 6	16 8 14 2		
	401-510	200- 850 851-1500	13 8 11 6	20 5 17 2		
3V 3VX	55 60	1000-2500 2501-4000			1 5 1 3	2 2 2 0
	61 90	1000-2500 2501-4000	1 6 1 4	2 3 2 0	1 9 1 7	2 8 2 5
	91 175	1000-2500 2501-4000	2 2 2 0	3 3 3 0	2 4 2 2	3 6 3 3
5V 5VX	110-170	500-1749 1750-3000 3001-4000			4 6 4 0 2 5	6 9 6 0 3 9
	171-275	500-1740 1741 3000	5 8 5 1	8 6 7 6	6 7 6 2	10 0 9 1
	276-400	500-1740 1741 3000	7 0 6 6	10 6 9 9	7 8 7 6	11 6 11 3
8V	315-430	200- 850 851 1500	15 0 12 7	22 4 18 1		
	431-570	200- 850 851 1500	18 0 16 0	26 8 23 9		