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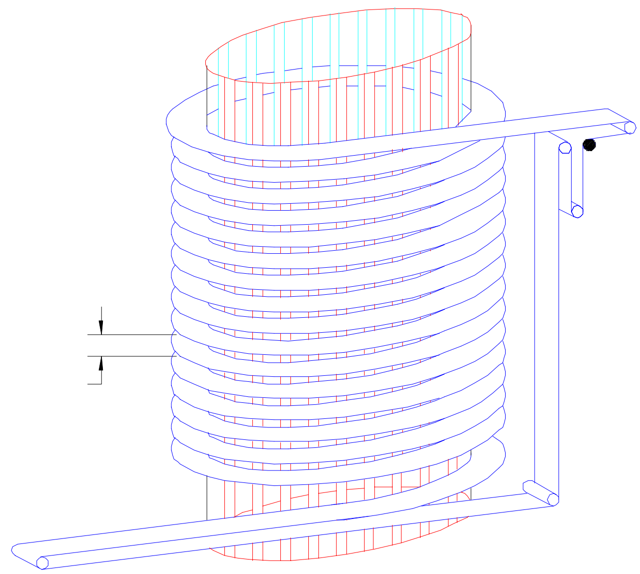
T E C H N I C A L   B U L L E T I N

LOTENSION THEORY OF OPERATION

PRINCIPLES OF OPERATION

Friction Drive By The Drum or Cage

At the heart of the Lotension Spiral System is the drum or cage. This is the largest single component of the system, and provides the main source of drive for the belt. By virtue of the large number of times that the belt wraps around the drum, it is extremely effective in providing a means for driving the belt. If it is properly constructed and operated the system can very well operate with a predictable tension.



Tier Pitch = Change in elevation over one revolution.

The Lotension system is often compared to a capstan such as is used to moor a large ship. A more familiar comparison might be made by referring to the practice of using a rope and the drive pulley to pull a new conveyor belt on to a conveyor. When we do this we string the rope through the conveyor path and wrap it around the drive pulley several times. We now apply power to the pulley to assist us in pulling the belt on to the system. If we wrap the rope around the pulley only once we can not move a heavy belt. If we wrap the rope around the pulley twice, we may be able to move the belt by pulling very hard. Once we wrap the rope three or four times around the pulley it takes very little force to move the belt. Five, six, or more wraps however do little to decrease how hard we have to pull on the rope to move the belt. In this case the conveyor system pulley is our CAGE or DRUM. Our hand that is pulling on the rope is the:

Auxiliary, Take-Up, or Tension Drive

Auxiliary, Take-Up, or Tension Drive is explained in this example:
We routed a rope through a conveyor system and wrapped it around the drum three or more times. As power is applied to the pulley nothing will happen until we pull on the rope, except that the pulley slips under the rope. As we start to pull on the rope the amount of slip decreases and the rope begins to move. The faster we pull on the rope the faster it moves and the less slip there is between the rope and the pulley. At some point however we are unable to pull any faster. We still have a small amount of slip and the rope is moving at this speed but we are not strong enough to pull the rope any faster. Our pulling on the rope is setting the speed at which the rope is moving through the system, and we can see a relationship between the amount of slip and how hard we have to pull in order to make the rope move faster. The Auxiliary Drive (also known as, take-up or tension drive) is our hand pulling on the rope. It sets the belt (rope) speed through the system and pulls the belt tight enough against the drum to drive. How tight and how fast this drive pulls the belt, determines how hard we are pulling, or how much tension is in the belt. As we noted there is an observable relationship between the slip and the tension. In a Lotension system we refer to this slip as Overdrive.

Overdrive

When we started the pulley, it just slipped under the rope until we pulled on the rope. This is because we have not pulled the rope tight enough against the drum to create enough friction to drive. Many systems have the cage or drum start before the tension drive in order to assure that the belt tension is as low as possible. [There is a bonus from this in that any eccentricity in the cage tends to

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force the belt to the side thus breaking any ice bond between the belt and supports.] As the tension drive starts to pull, the belt (rope) picks up speed and moves. There is still some slip, and the amount of pull is not too great. Once we speed up the pulling to where there is little to no slip the pull required becomes greater and greater because the pulley is not assisting us very much. At the point when we are pulling at the same speed as the pulley's surface, we are pulling the entire load. This is because the pulley's surface is only keeping up with our pulling, not assisting. If we pull even faster the amount of pull required actually increases due to the fact that not only are we pulling the entire load, but we are now pulling against the pulley trying to make it go faster. The pulley is becoming a brake instead of a drive. The relationship between the speed of the rope and the speed of the pulley surface can be measured in terms of the slip between the surfaces. As we have seen without slip, the amount of pull or tension increases dramatically.

In a Lotension Spiral System we attempt to quantify and adjust the amount of slip. Our aim is to set the amount of slip relative to our desired belt speed so as to obtain the least amount of pull needed to move the belt. It has been determined that the optimum value of slip usually lies within a range of three to eight percent. Since we are, in the case of a spiral system, not only pulling the belt around a pulley, but also moving it vertically at the same time we attempt to adjust out slip to the amount of required vertical movement. For this reason we measure the amount of slip in terms of vertical movement per revolution. Since there are limits on the amount of vertical movement, the optimum value of slip falls within our desired range.
To measure overdrive on a Lotension system see Technical Bulletin on "Measuring Overdrive".

Radius Weight

This is a simplified formula for estimating the belt tension while in contact with the drum. It is another term used to describe the system tension.

The Radius Weight or estimated system tension can be calculated by:

RW = $R \times W \times (f_r / f_c)$

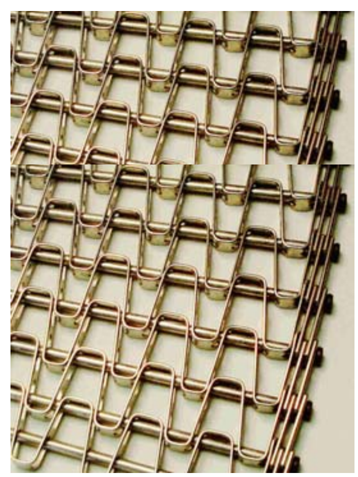
where
- R = the radius to the tension bearing link of the belt
- W = the weight of the belt plus the product load per unit length
- f_r = the coefficient of friction between the belt and support rails
- f_c = the coefficient of friction between the belt edge and the cage

Units:			
	R	in feet	[meters]
	W	in lbs/foot	[kg/meter]
	RW	in lbs-force	[Newtons; calculated value must be multiplied by 9.807 to convert from kg to Newtons]

When we can accurately assess the values of these factors we can accurately predict the amount of pull needed to move the belt at a determined speed.

Tension Limits

Omniflex®		
No Bar Links	100 pounds	[445 N]
Double HD Bar Links	300 pounds	[1334 N]
Small Radius Omniflex		
Heavy Duty Link at Center Position	300 pounds	[1334 N]
Hybri-Flex™ 150		
Triple Bar Links < 30 inches wide [762 mm]	300 pounds	[1334 N]
Double Bar Links < 30 inches wide [762 mm]	220 pounds	[997 N]
Triple Bar Links > 30 inches wide [762 mm]	250 pounds	[1112 N]
Double Bar Links > 30 inches wide [762 mm]	185 pounds	[823 N]
Fusion Grid™		
Heavy Duty Links	300 pounds	[1334 N]
Omni-Grid®		
All 3/4 and 1 Inch Pitch with Standard Links	100 pounds	[445 N]
All 3/4 and 1 Inch Pitch with Heavy Duty Links	150 pounds	[667 N]
Mega-Flex™ 125		
Heavy Duty Links	500 pounds	[2224 N]
Reduced Radius Omni-Grid		
Heavy Duty Link at Center Position	300 pounds	[1334 N]
Small Radius Omni-Grid		
Heavy Duty Link at Center Position	150 pounds	[667 N]
Super Small Radius Omni-Grid		
Heavy Duty Link at Center Position	150 pounds	[667 N]
Space Saver Omni-Grid		
Heavy Duty Links	150 pounds	[667 N]



AVAILABLE BELTS AND MINIMUM TURNING RADII

Omniflex

Belt Spec: Opening Size	Widths	Min. Turning Radius
E-1: 1 x 1 [*25.4 x 25.4*]	12-48 in. [305-1219mm]	2.0:1*
E-2: 1/2 x 1 [*12.7 x 25.4*]	12-48 in. [305-1219mm]	2.0:1*
E-3: 1/3 x 1 [*8.5 x 25.4*]	12-48 in. [305-1219mm]	2.0:1*
E-4: 1 x 1-1/4 [25 x 32]	12-54 in. [305-1372mm]	2.2:1

*With double bar links at inside edge, 1.8:1 without links.

Small Radius Omniflex

Belt Spec.	Width Range	Min. Turning Radius
G-1: 1 x 1, 1 x 1-1/2 [25.4 x 25.4], [25.4 x 38.1]	12-54 in. [305-1372mm]	1.0:1
G-3: 1/2 x 1, 1/2 x 1-1/2 [12.7 x 25.4], [12.7 x 38.1]	12-54 in. [305-1372mm]	1.0:1

Hybri-Flex 150

Belt Spec.	Width Range	Min. Turning Radius
1.46 inch pitch	12-48 in. [305-1219mm]	2.2:1

Fusion Grid

Belt Spec.	Width Range	Min. Turning Radius
1.2 inch pitch	16-54 in. [406-1372mm]	2.2:1

Omni-Grid

Belt Spec.	Width Range	Min. Turning Radius
¾ inch pitch	6-40 in. [152-1016 mm]	2.2:1
1 inch pitch	6-40 in. [152-1016 mm]	2.2:1

Reduced Radius Omni-Grid

Belt Spec.	Width Range	Min. Turning Radius
1 inch pitch	6-40 in. [152-1016 mm]	1.6:1

Small Radius Omni-Grid

Belt Spec.	Width Range	Min. Turning Radius
¾ inch pitch	12-48 in. [305-1219 mm]	1.0:1

Super Small Radius Omni-Grid

Belt Spec.	Width Range	Min. Turning Radius
1 inch pitch	12-48 in. [305-1219 mm]	0.8:1

Space Saver Omni-Grid

Belt Spec.	Width Range	Min. Turning Radius
¾ inch pitch	12-36 in. [305-914 mm]	2.2:1
1 inch pitch	12-36 in. [305-914 mm]	1.7:1