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Technical Article
Technical Article Content Pulled from the NIBA Belt Line Newsletter

Conveyor Transitions

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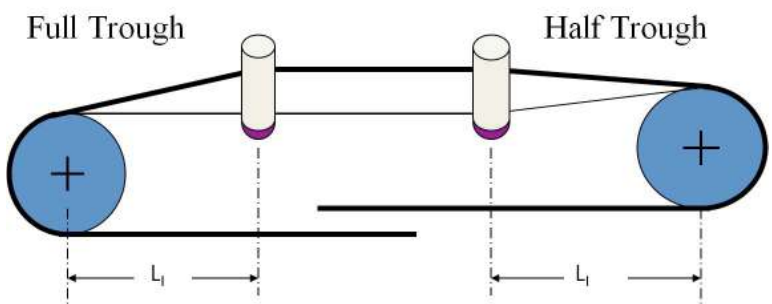
Bulk material conveyors with free flowing products commonly use troughed idlers sets along its length, increasing the belt load carrying capacity. Changing the cross belt profile to a wide "U" shaped high capacity configuration the belt must pass around flat faced terminal pulleys at each end of the system. Within these areas we find the conveyor transition.



As the conveyor belt changes from a flat profile to a troughed profile in its passage from the tail pulley and the troughed profile to the flat profile at the head pulley possible belt damaging tension and compressive forces can occur.

At the area of profile change, this transition must occur over sufficient conveyor length in order to avoid excessive tension in the belt edges (splice tearing) and avoid belt compression (center buckling). The conveyor system operating tension has a strong influence on the transition length as noted in the below tables.

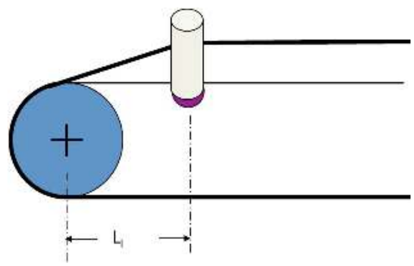
Transition distances are measurements from the centerline of a terminal pulley to the first full angle system idler (L_l). One or more belt supporting low angle transition idlers may be between the terminal pulley and the first full angle system idler and should not be included in this measurement.

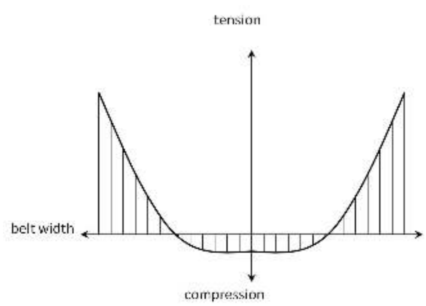
The two most common transition profile types are the full trough depth and ½ trough depth. The full trough is typically found at the tail, with the ½ trough typically found at the head. The full trough terminal pulley may be raised slightly to give a ½ trough configuration.

As you can see from the following full troughed profile drawings and charts, the belt is flat over a terminal pulley and has various lengths of transition distance. The below charts to the right of each transition drawing show how the cross belt tensions are affected by the change in transition length.

The following three drawings are typical of a fabric belt system. Full trough transition, operating at 70% rated belt tension, using 35° troughing idlers.

The first drawing shows a measured transition distance of 3/4 the belt width.



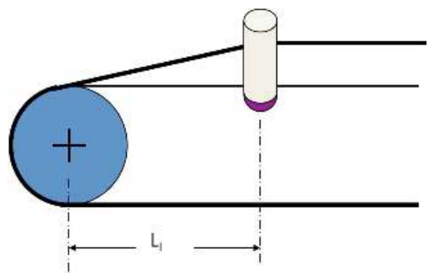


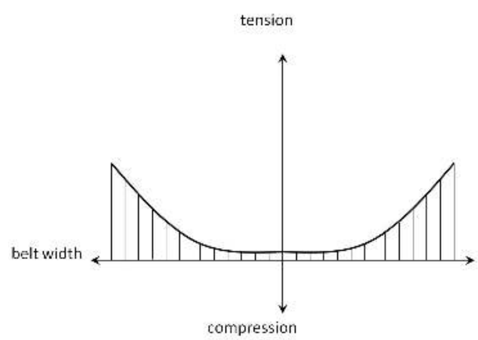
In Transition Drawing 1, the cross belt tension is far too great at the edges (more than 130%) and less than zero in the middle of the belt. Commonly resulting in splice edge failures and delaminating in the center of the belt.

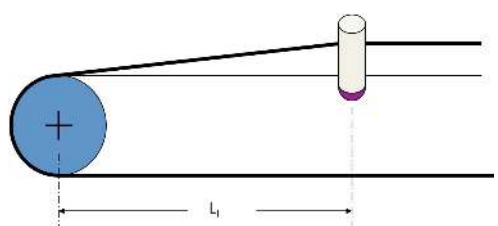
You can visually identify this in the field as the belt center will have a buckle (lifting off the center idler roll). Left unchecked an adhesion breakdown in the center of the belt will occur and thus propagate along the entire belt length.

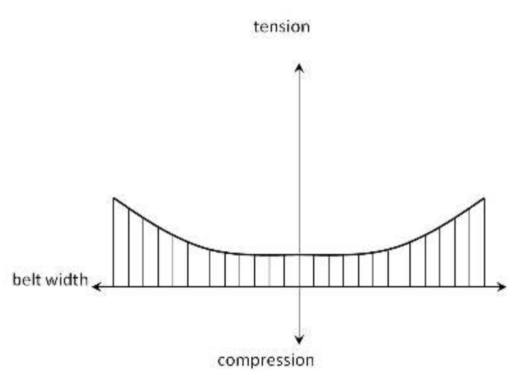
In Transition Drawing 2, the transition length is increased to 2 times the belt width. The edge tension is dropping to a workable limit. However without adequate transition distance, an insufficient amount of tension is present and is not great enough to keep the bottom of the belt in the trough and avoid some buckling. While this effect is not easily seen, long term subsequent problems with the belt and the splices will be encountered.

In Transition Drawing 3, the transition length is increased to 2.5 times the belt width. This is the proper length for this configuration (see table). Excessive edge tensions are eliminated by keeping the carcass within its elastic range. Center belt tensions are increased to spread the total cross belt tensions more evenly across the width.









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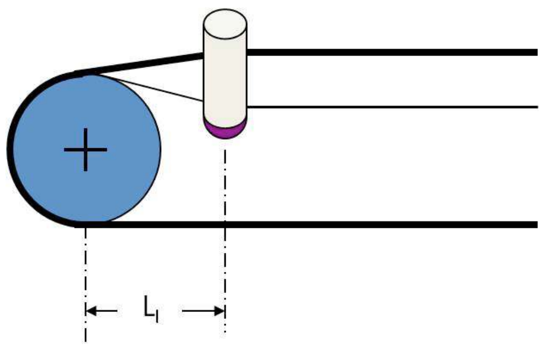
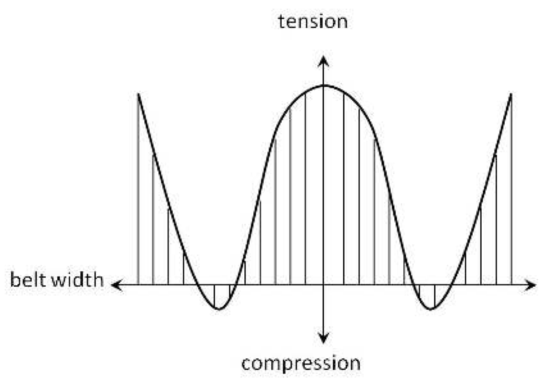
The next three following drawings are typical of a fabric belt system, with half trough transition, operating at 70% rated belt tension, using 35° troughing idlers.

A properly configured half troughed transition has a unique cross belt tension profile. Since this is commonly used at high tension terminal pulley locations (head pulley) cross belt tensions are averaged by setting the terminal pulley so a tangent line from the pulley top (rim) is above the idler center roll by an amount equal to half the height of the first full troughing idler.

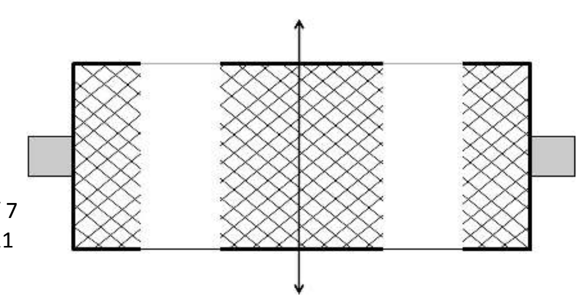
The first drawing shows a measured transition distance of 1/2 the belt width.





In Transition Drawing 4, the cross belt tension is poorly averaged and thus the belt edges and the belt center are more than 120% rated tension. The idler junction area of the belt is less than zero. As the belt moves onto the pulley the tensions must equalize quickly across the belt width and “belt creep” in the low tension areas can occur.

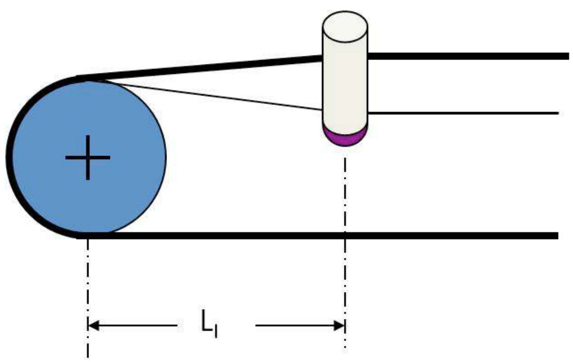
Adequate transition distances are extremely critical with the use of today’s high modulus, low stretch, conveyor belt carcasses. The stresses resulting from a short half trough transition distance at the high

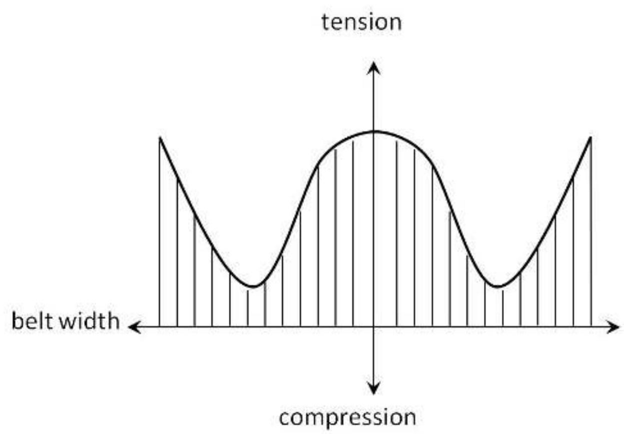


tension terminal pulley can be dramatically visible on the rubber pulley lagging wear pattern.

The belt creeps around the pulley face in the low tension areas near the idler junction resulting in skidding, wearing a corresponding channel into the rubber lagging.

Transition Drawing 5

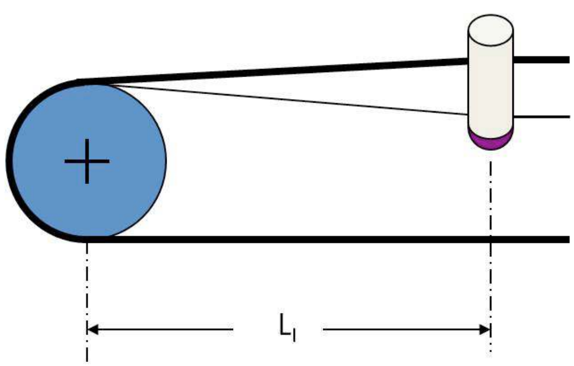


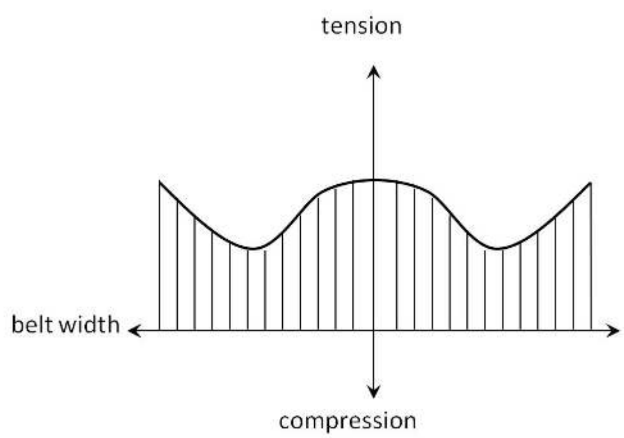


In Transition Drawing 5, the transition length is increased to the belt width. The cross belt tension at edge and center drop to workable limits. But without sufficient transition distance, too much shearing force across the splice width is encountered.

Left unchecked an adhesion breakdown in the idler junction areas of the splice will occur and thus propagate along the entire belt length.

Transition Drawing 6





In Transition Drawing 6, the transition length is increased to 1.5 times the belt width. This is more than the proper length for this configuration (see table). Excessive edge and center tensions are eliminated by keeping the carcass within its elastic range. Idler junction area tensions are increased thus allowing better tension distribution across the belt width.

The following tables provide a guide to the proper transition length based on system idler angle and percent of rated belt tension. Multiplying the belt width (inches) by the table transition distance factor will give the minimum recommended transition distance (inches).

Full Trough Transition Table

Idler Angle	% Rated Belt Tension	Belt Width x Factor = Transition Length (inch)	
		Fabric Belt	Steel Cord Belt
20°	Over 90		
	60 to 90	1.6	3.2
	Less than 90	1.2	2.8
35°	Over 90	3.2	6.8
	60 to 90	2.4	5.2
	Less than 90	1.8	3.6
45°	Over 90	4.0	8.0
	60 to 90	3.2	6.4
	Less than 90	2.4	4.4

½ Trough Transition Table

Idler Angle	% Rated Belt Tension	Belt Width x Factor = Transition Length (inch)	
		Fabric Belt	Steel Cord Belt
20°	Over 90	0.9	2.0
	60 to 90	0.8	1.6
	Less than 90	0.6	1.0
35°	Over 90	1.6	3.4
	60 to 90	1.3	2.6
	Less than 90	1.0	1.8
45°	Over 90	2.0	4.0
	60 to 90	1.6	3.2
	Less than 90	1.3	2.3

Remember, Transition distance, as defined by NIBA is the length from the center line of the first fully troughed idler roll to the center of the terminal pulley (either the head or tail pulley).

Since there are a variety of belt constructions with different properties, many conveyor systems with unique configurations, belt manufacturers should be consulted for their specific recommendation.

If you would like to learn more about this topic and other "mystery's of the conveyor", attend a NIBA Educational / Technical Committee training seminar. Click on www.NIBA.org to find upcoming class details or to order the 3-DVD set, "Track, Track & Troubleshoot", or to download video highlights.