INSIGHTS™
Belt Conveyor Maintenance
TECHNICAL SOLUTIONS FOR BELT CONVEYOR PRODUCTIVITY

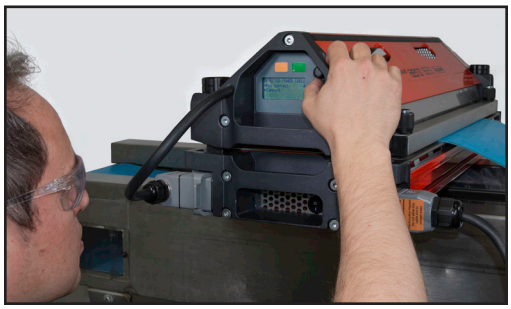
Splice Press Recipe Development

Developing a new splice recipe for an endless conveyor belt can be a challenging process – especially when there's insufficient technical information available. Experienced belt fabricators know that a recipe for a given belt will often work on one type of splice press, but not another. Fortunately, conveyor belt manufacturers provide their recipe recommendations for some splice press models; however, these guidelines often do not account for all splice presses used in the industry. In those situations, having a proven and methodic approach to developing a splice recipe can save a lot of time and money while optimizing the splice quality.

Splice Recipe Variables

The good news is that there is no one right answer when developing a splice press recipe for a new type of conveyor belt. Different combinations of temperature, pressure, and dwell time can be used to achieve similar splice quality levels. However, knowing where to start and how to troubleshoot the splice results will help you make the right adjustments to splice parameters to quickly find the optimal splice recipe.

For example, you notice the tips of the fingers in an endless splice aren't filled, yet there's bleed-through on the back of the belt. Should the splice temperature be increased, or pressure setting be decreased, or maybe both? What about dwell time, should it be increased or decreased? Maybe preheat should be used, or maybe the top half temperature should be increased and the bottom temperature decreased? These are the primary input variables that belt splice technicians consider when drawing on their experience to find that working splice recipe – but there are other factors that must be considered.



How PVC and TPU Process Differently

PVC transitions more gradually from a solid to a liquid state than TPU (Urethane). Often, technicians incorrectly use excessive splice pressure – rather than increasing splice temperature – which can lead to defects and also inconsistent splice quality with the same belt and recipe. In many cases, the ideal splice can be obtained by increasing splice temperature for PVC belts and decreasing splice pressure. This can significantly reduce this variation in splice quality caused by the excess pressure applied otherwise.

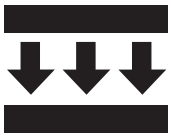
Another important difference is melt viscosity, which is the rate at which plastic flows at a given temperature. TPU has a lower viscosity than PVC, so it flows easier than PVC. One analogy of this is that liquid TPU flows like water, whereas PVC flows like molasses. As a result, less pressure is needed when splicing TPU belts. So, in general a TPU belt requires a lower splice temperature and lower pressure than PVC belt.

The following table is a summary of the above information:

CHARACTERISTIC	TPU	PVC
Transition from Solid State to Liquid State	Sharp; Immediate at Melt Temp	Slow; Gradually Changes as Temp Increases
Typical Splice Temperature	160 C	175 to 180 C
Melt Viscosity	Low (flows quickly)	High (flows slowly)
Typical Splice Pressure	0.8 Bar	1.3 Bar
Splice Dwell Time	Dependent on Belt Thickness	
Splice Pre-Heat Time	For thicker belts (belt including splice pads)	

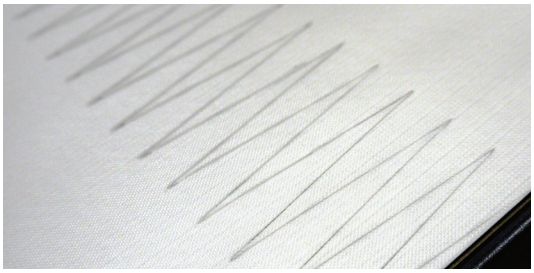
Fundamentals in Belt Splice Recipe Development

1. Temperature: Consider the ideal splicing temperature. It needs to be high enough for the plastic to flow, but be careful to not program temperatures too high, as this will degrade the polymer chains and significantly weaken the mechanical properties of the belt. Not only will the splice exhibit brown spots on the cover and/or bottom, but it can also lead to premature splice failure, belt downtime, and generally unhappy customers.

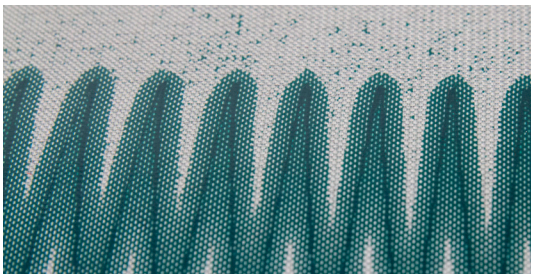


2. Pressure: Determine the right amount of pressure to move the plastic. There needs to be enough pressure to move the plastic to consistently fill the gap between the fingers, but not too much that will force the plastic to excessively flow through the fingers resulting in bleed through, or worse, fingers washing out. Ideal amount is a thin, solid line at the edges of the fingers. Excessive bleed through will change the coefficient of friction between the belt and conveyor components.

3. Time: This movement doesn't happen instantaneously, so a certain amount of time is needed for this material movement to occur.



Proper bleed through



Excessive bleed through

All of these things are interrelated, which complicates the splice recipe development process. For example, if there is not enough temperature, PVC will flow at a slower rate. In this case, increasing pressure and/or dwell time may result in an acceptable splice, but increases bleed through.

A preferred alternative might be to increase the temperature instead, allowing the plastic modules to flow easier.

Recommended Method for Splice Recipe Development

	TPU Belts	PVC Belts
Starting Splice Parameters:	Splice Temperature: 10 C lower than published melt temperature	Splice Temperature: 10 C lower than published melt temperature
	Dwell Time: 0.25 minutes per 1 mm belt thickness	Dwell Time: 0.25 minutes per 1 mm belt thickness
	Pressure: 0.8 bar	Pressure: 1.3 bar
First inspect If material does not flow:	Increase in 3C increments until material begins to flow	
Second inspect If material flows, but fingers and finger tips not filled: (time is what allows heat to fully penetrate the thickness of the belt)	Increase dwell time by 10 seconds	
Next inspect If insufficient bleed through is observed:	Increase pressure by 0.1 bar in lieu of adding dwell time	
Still having difficulties?	Read *Other Tools & Techniques* on next page	

Fundamentals in Belt Splice Recipe Development

Preheat: Due to the speed with quick cycle presses, there can be instances when it is necessary to slow the heat ramp up to allow heat to penetrate fully through the belt thickness to obtain a proper splice. If a belt is on the thicker side or is a profiled belt with a reverse patterned silicone pad, it may require the use of 'preheat' to properly soak heat throughout the entire belt thickness prior to splicing.

In a way it is similar to cooking frozen meat. Without allowing it to defrost prior to placing it in a hot oven, you will likely find the outside of your meat cooked properly but the inside still raw.

When splicing thick belts, or when thick profile pads are used, use a press that can be programmed for a lower temperature and held at this point for a number of minutes to allow the full belt thickness temperature to rise close to the final splice temperature, this is called the preheat cycle. Once the preheat cycle is complete, the press needs to be able to increase temperature to meet the splicing temperature and complete the cycle, resulting in proper and consistent bleed through for a strong finished splice.

Different Splice Temperatures for Top & Bottom:
Belts are typically not symmetrical in their composition and there are instances when it is desired to have different temperatures applied to the top and bottom platens. An example would be a belt where bleed through is evident on the bottom, but the fingers aren't filled. In this instance, consider decreasing the bottom splice temperature and increasing the top splice temperature.

Higher durometer PVC formulations (e.g. diamond profile at the bottom of the belt) do not flow as easily. They might need an extra 5-10°C. The reverse might be true for very soft formulations.

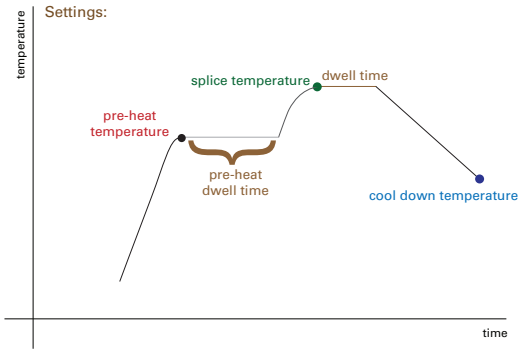
Choosing a press that allows users to program different temperatures for top and bottom platens is key.

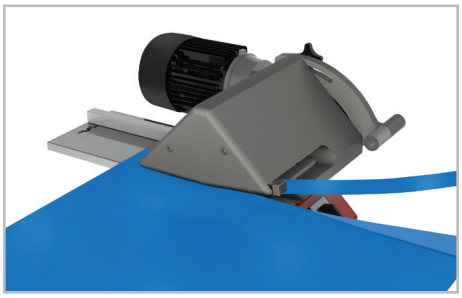
Foil: Typically, the use of foils is not necessary when finger splicing if proper time and attention are given to creating optimal splice parameters. Splicing without foils is preferred, as the foil adds thickness variation and does not provide additional strength. That being said, there are still instances when it is necessary to fill in pin holes at the finger tips or with belts with an extremely thin top cover. Most belt manufacturers sell foil in coils, but another option to consider is using a ply separator to make your own foil from the base belt material (a great use for remnants).

Conclusion

Although some scientific principles can be applied to setting splice parameters, remember that it is an art, not a science. It will take a bit of trial and error, but operators should be able to begin with a good starting point and then methodically work to produce the optimal splice. Remember temperature, time, and pressure can always be added, but never taken away. The good news is that once the splice parameters are created, you can document them for future use.

Example of heat not fully penetrating belt thickness





Solutions from Flexco

Novitool® Aero® Splice Press

The Aero® Press is ideal for splicing lightweight, thermoplastic belting. With cycle times as short as 8 minutes, the Aero allows your belt to be up and running fast, helping you minimize downtime and maximize productivity.

- The Aero Press allows users to program different temperatures for top and bottom platens with simple HMI controls.
- Press can be easily programmed for preheating thick belts or when a thick profile pad is used.
- The proprietary Flexco Aero Recipe Management Tool makes it easy to import, create, or modify recipes.
- 99 recipes can be created and stored directly on the press, while 990 additional recipes can be input through the Aero Recipe Management Tool on your computer and then transferred to the press via a USB flash drive.

Aero® Ordering Information

Belt Width		Ordering Number	Item Code
in	mm		
24	625	AERO-625	09000
36	925	AERO-925	09001
48	1225	AERO-1225	09002
60	1525	AERO-1525	09003
72	1835	AERO-1835	09004
84	2135	AERO-2135	09005

Other Solutions from Flexco

Novitool® Ply 130™ Ply Separator

The Ply 130™ is used to separate plies of a conveyor belt in preparation before splicing a belt with a splice press and allows you to make your own foil from the base belt material. The Ply 130 can precisely separate as deep as 5" (130 mm) in one action.

Novitool® Pun M™ Mobile Finger Punch

The Pun M™ is designed to effortlessly punch fingers into PU and PVC conveyor belts in preparation for installing vulcanized splices.

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Aero® Splice Press Patent number: US 9,090,022 B1 and other Patents Pending

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