UNDERSTANDING LINER COMPRESSION

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The topic of Liner Compression always brings about good conversation. How much compression do we need? Can I just take my system vacuum and subtract the Touch Point of the liner to figure the liner compression? Which theory is correct – Over-pressure, or Residual Vacuum available for Massage? These are some of a long list of questions that you can guarantee will come up during a discussion on Liner Compression. While they are good questions, common mistakes people make when answering them can usually be traced back to a misunderstanding of definitions or preconceived ideas. **Liner compression in its simplest form is the force exerted on a teat by a liner through the pulsation cycle.**

Pulsation is defined as the cyclic opening and closing of the liner in ISO 3918-2007, or in other words - **pulsation is Liner Wall Movement (LWM)**. The liner walls move as a result of the pressure change in the pulsation chamber, and this movement is what applies the force on the teat during milking. Other dynamics that affect LWM are vacuum levels, liner barrel shape, wall thickness, and durometer. It is a combination of these factors that determine the liner compression on the teat.

Liner Compression begins when the liner comes into contact with the teat during liner closure. The pressure applied at the beginning of liner closure is normally minimal, but can be of concern if the liner is moving too fast. A liner moving within a pulsation cycle that has a c phase of 120 milliseconds or less can create a pressure spike within the teat causing discomfort to the cow (1). During the initial closing of the liner there is no contact between the teat end and the liner. Teat end contact is created when the liner has collapsed to the point where it starts to bend around the teat. This is the point where most people believe that the significant portion of Liner Compression begins.

Several key events happen when the teat end starts to absorb force. First, the Touch Point (TP) of the liner is reached. The TP is the point at which the opposing walls of the liner touch (3). TP is a useful measurement and is most accurate when comparing liners of the same barrel shape to each other. Comparing TP among similar shaped liners can give you an indication of how a liner may perform under certain machine settings. Liner properties that affect TP are the same as the factors that affect LWM. A common misconception is that the TP of a liner can be subtracted from the claw vacuum to figure the milk to rest ratio. This is commonly referred to as Residual Vacuum available for Massage (RVM). The fault in this theory is assuming that milk stops flowing when the TP is reached, which is not true for most liners. The second key event is when milk stops flowing. Many believe it is at this point that the pressure is sufficient enough to evaluate the compression of a liner. The term used to describe the load the liner applies to the teat from this point through the d phase of pulsation is Over-pressure (OP) (2). While OP and TP are different in practice, there is a correlation between them, at least for the current liner designs commercially available.

Recommendations have been published suggesting the amount of OP that is optimal. Liners operating in the 2.5-3.5 inHg range of OP have shown favorable results on teat end health prove to provide enough relief from milking vacuum to overcome teat congestion and edema (2). The Lauren Tri-Circle liner operates at a 3.5 inHg OP. The high TP (in comparison to other commercially available liners) enables the liner to perform at this level. Factors that affect this are barrel design and material selection. Other commonly used liners operate in the 5.5-7 inHg OP range. In order for these liners to decrease their OP values, they would need to increase wall thickness or durometer or decrease milking vacuum. The results of these actions could lead to operating parameters that would be unachievable or liner compression that never reaches the teat end.

Achieving the correct liner compression within a milking system is a balance between liner design characteristics and machine settings. Monitoring teat health, cow behavior, and milking performance are indicators that can be used to judge how effective a liner is operating. High rates of hyperkeratosis can mean that there is excessive liner compression, and slow milking can be an indicator of insufficient liner compression. If you have questions on liner compression, or would like to know what the Touch Point or Over-pressure values for the liner you are currently using, send your questions to research@lauren.com.

Figure 1. Relationship of Touch Point and Over-Pressure

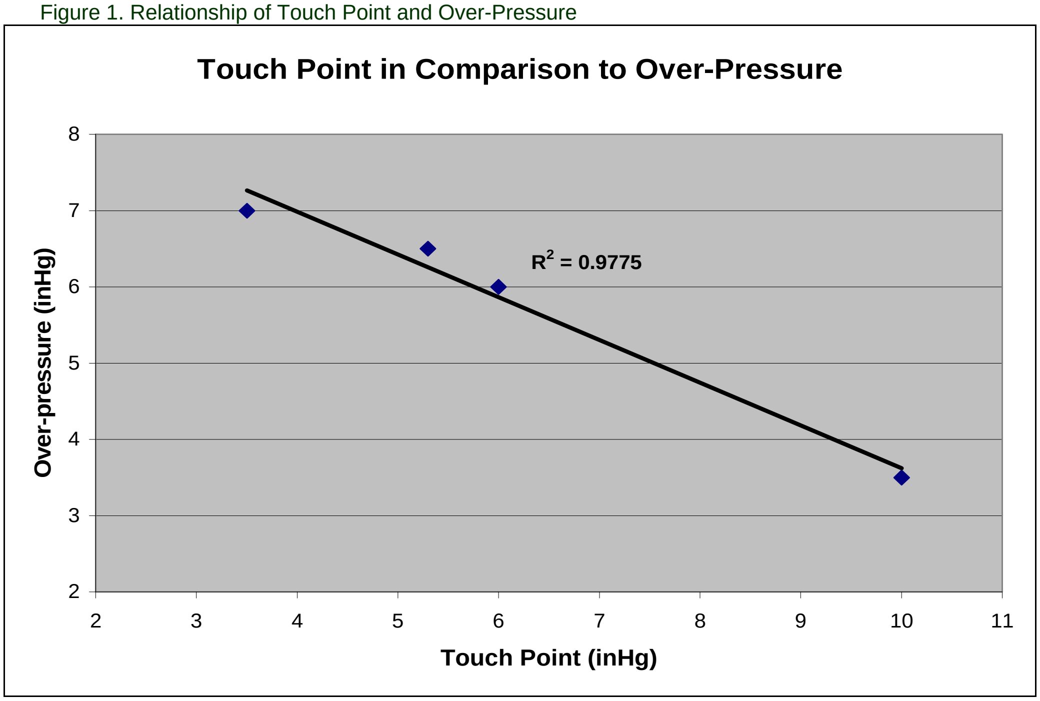
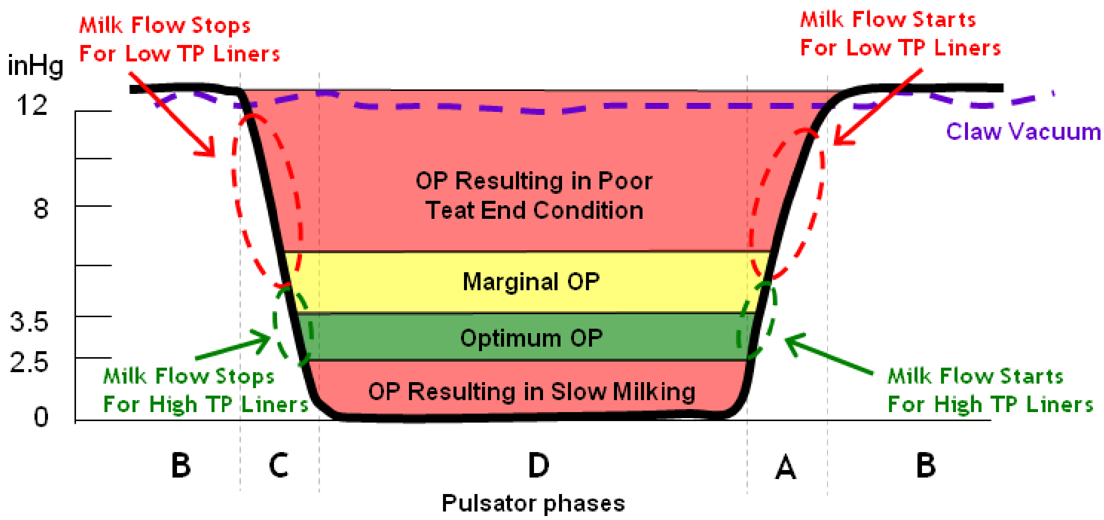


Figure 2. A representation of how Low and High Touch Point liners effect the Over-Pressure on the teat along with the results that can be associated with different levels of Over-Pressure.



Key Points:

- **A fast c phase may cause discomfort to cows during milking**
- **Pulsation is Liner Wall Movement**
- **Liner Compression starts when the liner contacts the teat during closure**
- **TP is a good tool to use when comparing similarly designed liners.**
- **The significant stage of liner compression starts when milk stops flowing and continues until milk starts flowing again**
- **OP starts in the c phase and reaches its maximum value during the d phase of pulsation**
- **TP and OP are correlated**

References

1. Kochman, A.K., F. Saho, B. Costello. 2008. Initial Pressure Application to the Teat by Various C Phases. NMC 47th Annual Meeting Proceedings, New Orleans, LA, pp 186-187.
2. Mein, G.A., D.M. Williams & D.J. Reinemann. 2003 Mechanical forces applied by the teatcup liner and responses of the teat. 42nd Annual Meeting Proceedings, Ft Worth, Texas, pp114-123.
3. Nordegren, S.A. 1980. Cyclic Vacuum Fluctuations in Milking Machines. (Doctoral Dissertation, University of Hohenheim, Germany). p144.