



A NEW CUTTING TECHNOLOGY

ABSTRACT

Teel encountered a challenge with cut length tolerance in the extrusion process. Teel's customer required an extremely tight tolerance on the length of their part: a +/- 0.010" length tolerance with a 1.33 or better Cpk. **The solution was the implementation of a new cutting technology** with state-of-the-art controls and a new design which eliminated the second blade, leaving the machine with a single blade that would no longer create excess chips. The Cpk was better with the single blade cutter than the two blade system thanks to new controls technology and an improved ability to hold the tolerance, including on other parts that used two blades prior. Teel has seen numerous benefits, including reduced overall scrap, increased efficiency, and most importantly – **more consistent parts with higher tolerances thanks to a more precise cutting technology.**



THE PLAYERS

The partners involved in this solution were Teel Plastics, Conair, and the customer. Conair provided the machine technology required to hit the desired tight part length tolerance. As a truly customized solution, Conair made several on-site visits to Teel's headquarters in Baraboo, Wisconsin for trials and tests. Teel was able to successfully harness Conair's technology and incorporate it into their manufacturing process, achieving results that were consistent and reliable. Teel's customer was involved in the qualification process and driving the project from a quality standpoint in their process. The project was a joint-effort that spanned approximately nine months.

TEEL PLASTICS

Teel Plastics, Inc. is the premiere manufacturer of custom extruded plastic tubing and profiles, due to the expertise of their distinguished, skilled team – a group of problem solvers that pride themselves on being professional, progressive, and personable. For more than 60 years, Teel has demonstrated technical prowess paired with a can-do attitude and delivers with considerable knowledge of materials. Along with an ISO/IEC 17025:2005 accredited analytical laboratory on campus, Teel produces high quality custom tubing in a wide variety of sizes with tight tolerances and specializes in complex projects.

CONAIR

Conair manufactures and sells resin drying, blending, feeding, conveying/material handling equipment, heat-transfer systems and temperature-control equipment, granulators and downstream/upstream extrusion systems. Conair is committed to finding and delivering process solutions that make a real difference to their customers. They will work with customers to help transform their businesses with game-changing products and services that reduce costs, increase productive up-time and boost efficiency. A provider of new, used and refurbished equipment and parts to plastics processors worldwide, Conair also offers on-line ordering, 24-hour service/ parts assistance and preventative maintenance and training programs.

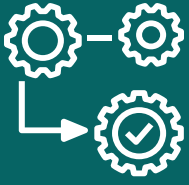


THE PROBLEM

Teel was dealing with a cut length tolerance concern in the extrusion process. This problem is likely to occur anywhere a narrow tolerance is needed for highly automated assembly equipment or finishing equipment. **Teel's customer required an extremely tight tolerance on the length of their part with very high consistency: a +/- 0.010" length tolerance with a 1.33 or better Cpk.** (The difference is about the thickness of a single sheet of paper.) As the market becomes more automated and efficient, this tight tolerance is becoming a more common request. Historically, Teel produced this healthcare product with a two blade process that creates a waste "chip." The excess material was cut off by the second blade. Although this chip was recycled, the excess plastic use was inefficient and made the cutting process inconsistent.



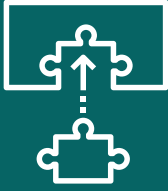
Teel developed this part in 2006 for the healthcare industry. They have been developing parts for this industry for more than 30 years. This specific part had been produced by Teel with equipment that uses two blades to achieve the tight length tolerance. Historically, people either need a wider tolerance or use old cutters with two blades (resulting in a chip), which was the standard for 20-30 years. Even with the old equipment, Teel observed differences in shrinkage from part to part. If Teel was holding +/- 0.002" online, after 24 hours that could grow to +/- 0.006". Understanding what causes that deviation in shrinkage was crucial to the success of the new machines.



THE PROCESS

The dimensions of the product made it crucial Teel maintain tight tolerances on all features of the part, or else meeting the required length tolerance would be nearly impossible. Plastic, much like other materials, grows when introduced to heat and shrinks when it is cooled. The heat that is lost from a finished part over a given time corresponds to a change in its overall length. This is not unique to this product, as Teel sees this in almost all parts they manufacture. But lost heat is only one of three variables effecting the shrinkage. The other two are stress relaxation and crystallization in semi-crystalline materials. Control of all three is vital to maintaining a tolerance within range after a part shrinks. Teel's online length tolerance is almost always offset longer than the customer's final spec to allow for the expected shrinkage. Running an extremely consistent speed and part temperature is what allows Teel to accurately predict shrinkage.



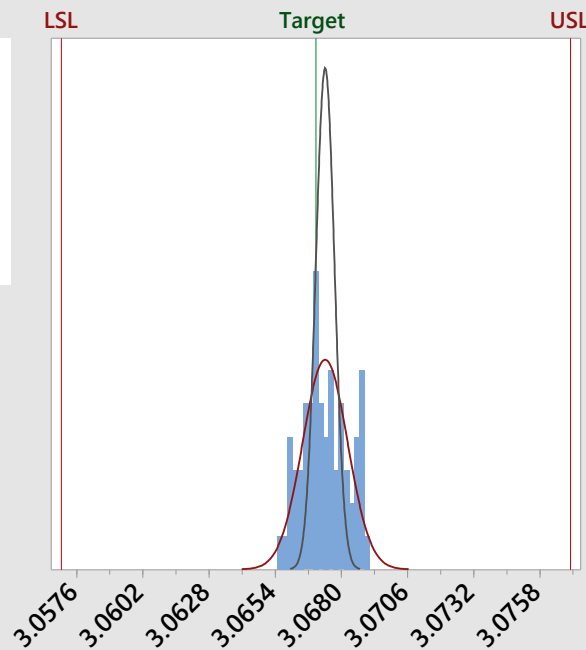


THE SOLUTION

The more repeatable a process the more repeatable the part it produces, and the easier it is to automate the assembly process and the fewer problems arise. **The solution to Teel's cut length tolerance concern was the implementation of a new cutting technology**, leaving the machine with a single blade and a significantly better control system resulting in better length tolerance on line and a better Cpk after part shrinkage. By using the new cutting system, Teel generated less waste while controlling the process more effectively, which has translated into **more consistent parts with tighter tolerances**.

New Cutter Length Capability

Process Data	
LSL	3.057
Target	3.067
USL	3.077
Sample Mean	3.06736
Sample N	280
StDev(Overall)	0.000882549
StDev(Within)	0.000369322

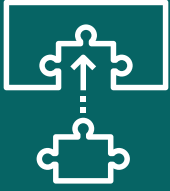


— Overall
— Within

Overall Capability	
Pp	3.78
PPL	3.91
PPU	3.64
Ppk	3.64
Cpm	3.49

Potential (Within) Capability	
Cp	9.03
CPL	9.35
CPU	8.70
Cpk	8.70

	Performance		
	Observed	Expected Overall	Expected Within
PPM < LSL	0.00	0.00	0.00
PPM > USL	0.00	0.00	0.00
PPM Total	0.00	0.00	0.00



THE SOLUTION (CONT.)

Other than the required tight tolerance on the length of their customer's part: a +/- 0.010" length tolerance with a 1.33 or better Cpk, Teel saw improved Cpk on other parts that used two blades prior. Teel also witnessed a major change in process repeatability due to the new design of the cutting system and its use of state-of-the-art servomotors and controls. The new one-blade process also can potentially increase performance speed, meaning more capacity to run additional parts using the new system. This can create additional savings by allowing Teel to continue to grow with their customers without investing in additional extruders.

Teel has already implemented similar cutting technology on another healthcare product that historically was created with a chip. Currently, Teel is in the middle of a project to order more of the high accuracy cutter pullers from Conair to update their fleet and increase their ability to handle high accuracy needs from customers.