Group M02 – Hot Stake Redesign

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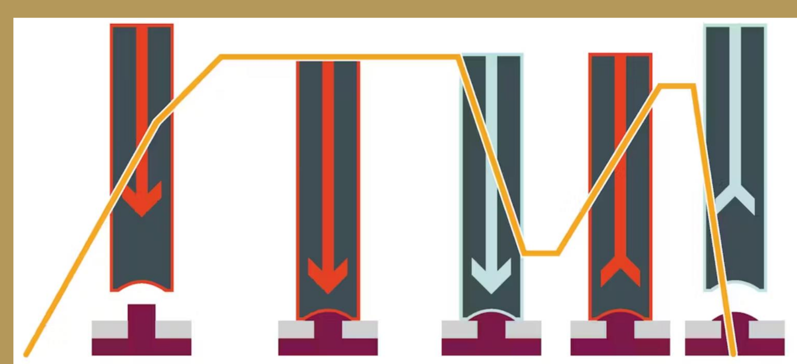
Understanding Hot Staking

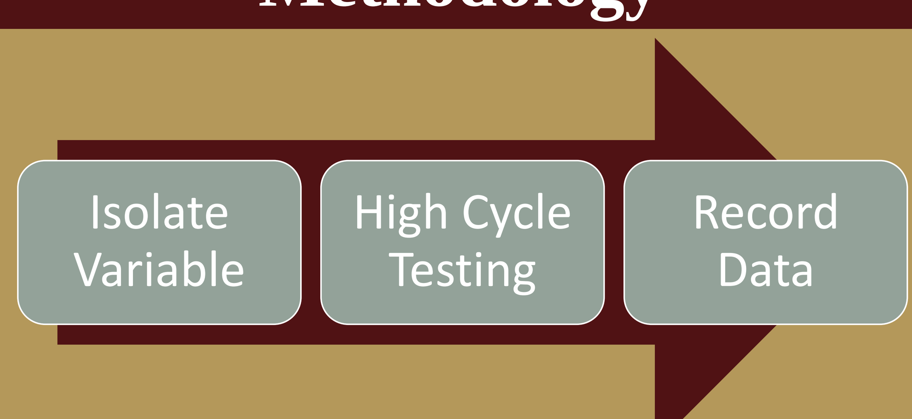


Hot staking is a method of fastening by deforming plastic using heat and pressure. As seen in the above picture, a plastic cylinder is pressed into a rivet shape to join two pieces together. The benefits of hot staking are its lower costs and ease of repeatability in high production operations.

Problem: Premature Breaking

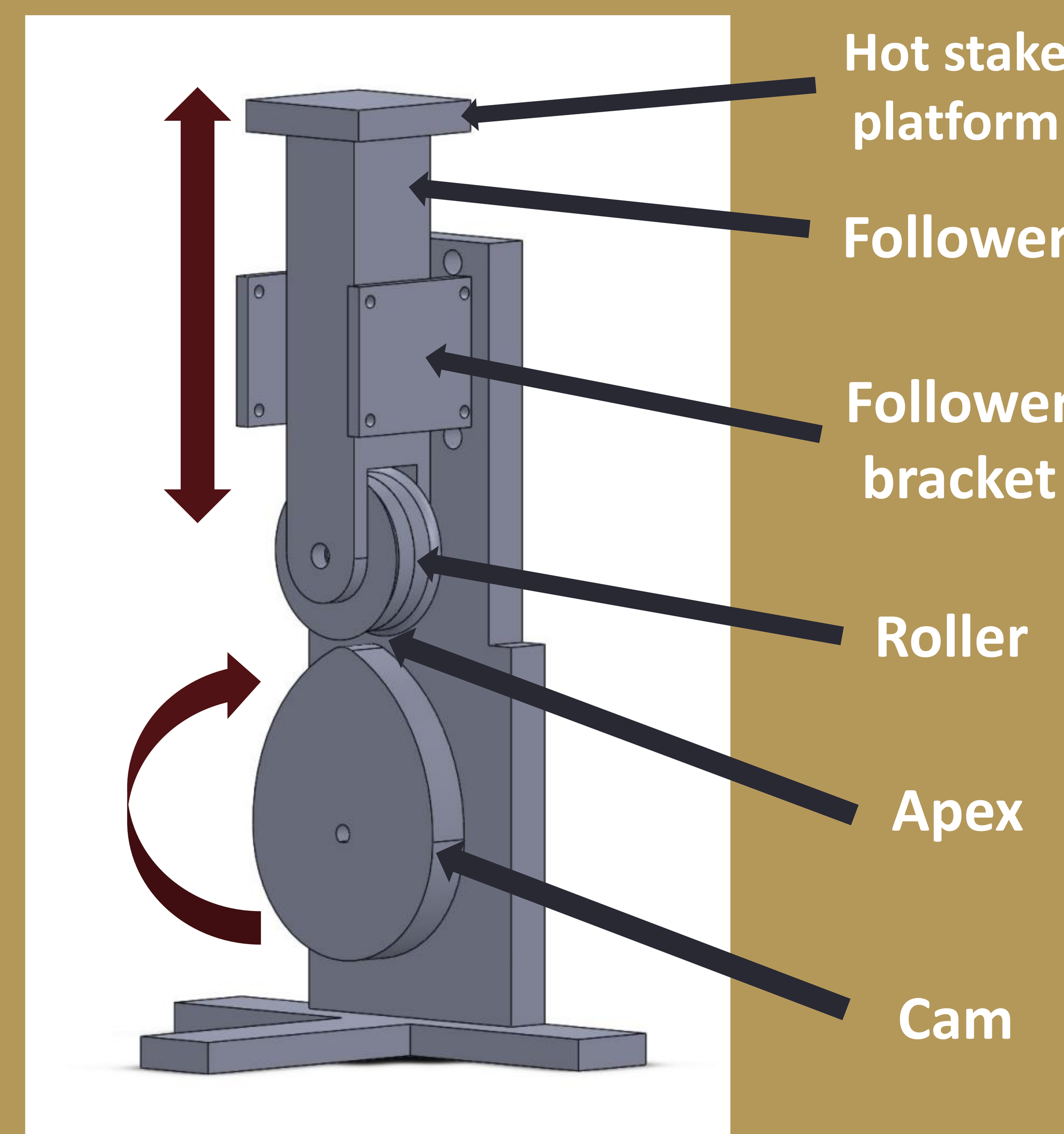
Even though the current hot stakes are rated for 100,000+ cycles, they are failing, breaking, and chipping in as little as 15,000 cycles. This is long before the usual monthly preventative maintenance, and with a large price tag it is very expensive and inefficient to keep using the hot stakes in their current form.

Methodology



1. Isolate Variable – The cause of the premature failure issue is likely a combination of several metrics. We will be isolating each of these metrics to test which levels are optimal.
2. High Cycle Testing – Once a metric is isolated and ready to be tested it will be subjected to a high number of cycles to test its effect on the durability of the hot stake.
3. Record Data – Data will be taken and added to a matrix to determine the ideal values of each metric to yield the longest duration.

Testing Prototype



To properly test our redesigned hot stakes, we need to use a method with repeatability and autonomy, something that we can let run for long periods of time with minimal human intervention. That is why we are using a cam and follower method to achieve stable and predictable results. As the cam rotates to its apex, it will push the follower up, thus pushing up the hot stake. As the apex rotates down, the follower will lower, thus lowering the hot stake.

Project Goals

We hope to develop a hot stake that will reliably function for 100,000 cycles or develop a more cost-effective hot stake if we cannot achieve our 100,000 cycles goal.

Chemical Method

One of the primary failure modes of the hot stakes is chipping: the non-stick coating flakes off far too early. We may be able to develop a similar, more cost-effective non-stick coating, or one that lasts longer for a similar price-point.

Interchangeable Method

While the hot stakes as a whole are an interchangeable part, failures most commonly occur in the heads. We hope to develop an interchangeable head design. Due to the reduced amount of material required to produce just the head, it would reduce the cost of replacement.

Operational Method

The possibility of user error cannot be ruled out. With our prototype, we hope to find out if the failures could be caused by improper use of the hot stakes: improper temperature, too much force applied, process speed, etc.

Milestones

- Designed and prototyped a fixture to test and simulate hot staking.
- Toured Continental's facility and observed defective hot stakes.
- Legal and NDA discussed and signed.
- Established list of potential solutions.

Plan for the Future

In the future, we aim to initiate trials for innovative approaches in utilizing the hot stake, including prototyping fresh designs and researching diverse coatings to increase its lifespan.

- Produce a safe method of replacing or servicing the hot stakes.
- Implement cost saving methods.
- Create a method compatible with existing machinery.
- Create a matrix of best result to be referenced and utilized in future applications.
- Create a modular testing method to account for variable force, material, and temperature testing.

Meet our Team!

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