**Nicolet FEAR Chain Tensioning Method**

Problem: Our team has had trouble tensioning chain in the past on our robot so that the chain does not skip/break.

This is a method we developed November & December 2016.

Working Criteria for System:

* Works for multiple chain sizes & lengths
  + 25 & 35 chain
  + Lengths that would be on robot
* Ease of use
  + Under 15 min. of training
* Low cost
  + Less than $30
* 2 part system
  + Off-robot measuring technique
  + On-robot device

Research

|  |  |  |
| --- | --- | --- |
| Reason for Research | Source | Information |
| Products we could buy | <https://www.mcmaster.com/#chain-tensioners/=15etjis> | Bought idlers are VERY expensive |
| Techniques that exist | <http://www.hardcoresledder.com/forums/350-mini-sled-forum/424039-chain-tensioner.html> | Drive-ChainAdjuster1.JPG |
| <https://www.chiefdelphi.com/media/photos/26057> | 52232599a8bb9337cb672bd4ff906aab_l.jpg |
| <https://www.chiefdelphi.com/forums/showthread.php?t=61099> | Off-center hole in HDPE idler, rotate to tension |
| <https://www.chiefdelphi.com/forums/showthread.php?t=102013> | PVC idler or sprocket idler |
| Shared PDF (“Chain Manufacturer's’ Manual”) in Chain Tensioning folder | Where idlers can be added |
| Companies that make idlers | <http://www.botlanta.org/converters/dale-calc/sprocket.html> |  |
| <http://www.brewertensioner.com/products.html> |  |
| General knowledge about robotics | <http://hcwilson.weebly.com/uploads/3/8/4/6/38463501/frc_guide_-_arpan_rao.pdf> | See link for information & tips on everything robotics from another FRC team |
| Chain length calculators | <http://www.botlanta.org/converters/dale-calc/sprocket.html> |  |
| <http://www.islandpondrailroad.com/chain.htm> |  |
| Plastic for idler | <http://www.vanderveerplastics.com/compare-materials.html?sel1=abs-machined-parts&sel2=hdpe> | ABS v. HDPE |
| <https://en.wikipedia.org/wiki/Acrylonitrile_butadiene_styrene> | ABS |
| <http://www.makerfarm.com/index.php/hardware/delrin-wheels-idlers.html> | Delrin |
| <http://www.rccrawler.com/forum/tools-procedures/128834-cutting-delrin.html> | How to cut delrin |
| <https://www.mcmaster.com/#standard-acetal-homopolymer-rods/=15bavkq> | McMaster - Carr: Delrin |
| <https://www.mcmaster.com/#hdpe/=15bavur> | McMaster - Carr: HDPE |
| <https://www.mcmaster.com/#polyamide/=15bau0f> | McMaster - Carr: Polyamide |
| How to break & add chain | <http://www.hardcoresledder.com/forums/350-mini-sled-forum/424039-chain-tensioner.html> | Video tutorial |

Adding Chain:

Use math equation

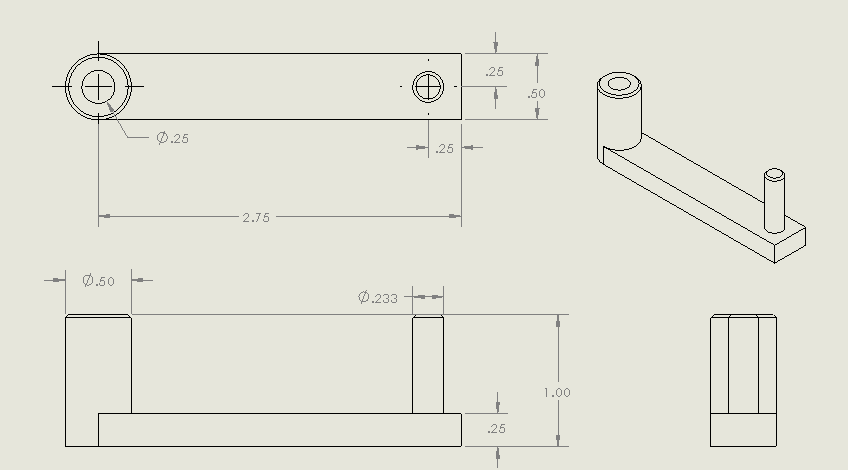
* <http://www.botlanta.org/converters/dale-calc/sprocket.html>
* <http://www.islandpondrailroad.com/chain.htm>

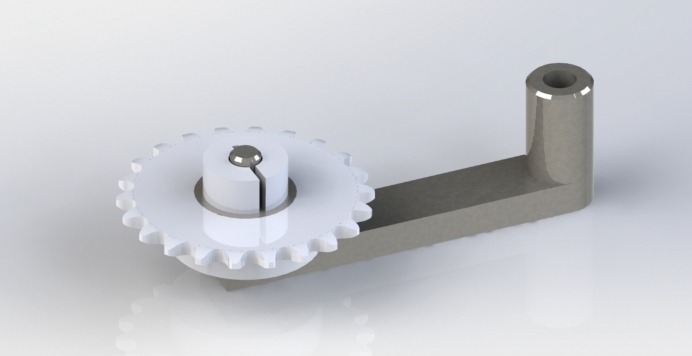
We used these equations to find the number of chain links for axles that are 10.5 in. apart. The length was 1-2 links off. Use the math equation as an approximation and add/subtract links as necessary.

Tensioning Chain:

Idea 1: Spring Loaded Idler

CAD & Drawing:





Pictures of Manufactured Part:



Materials:

From McMaster Carr:

* $5.48 / ½ ft. Low-carbon steel bar, 2.5in. / arm = $2.25 each
* $3.80 ea. ¼ in. 303 Stainless Steel Shaft Collar
* Spring still requires further research, but is estimated around $5 (Spring in prototype was taken from an old motor)

From Amazon:

* $4.76 / 5 pc Miniature ball bearing = $1 each

From Andymark:

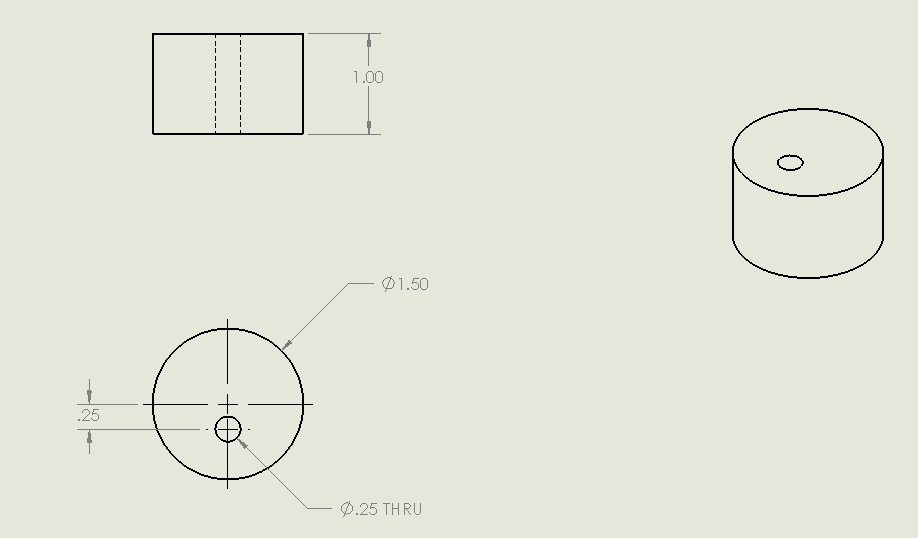
* $16.00 ea. 22 tooth hubbed 25 sprocket

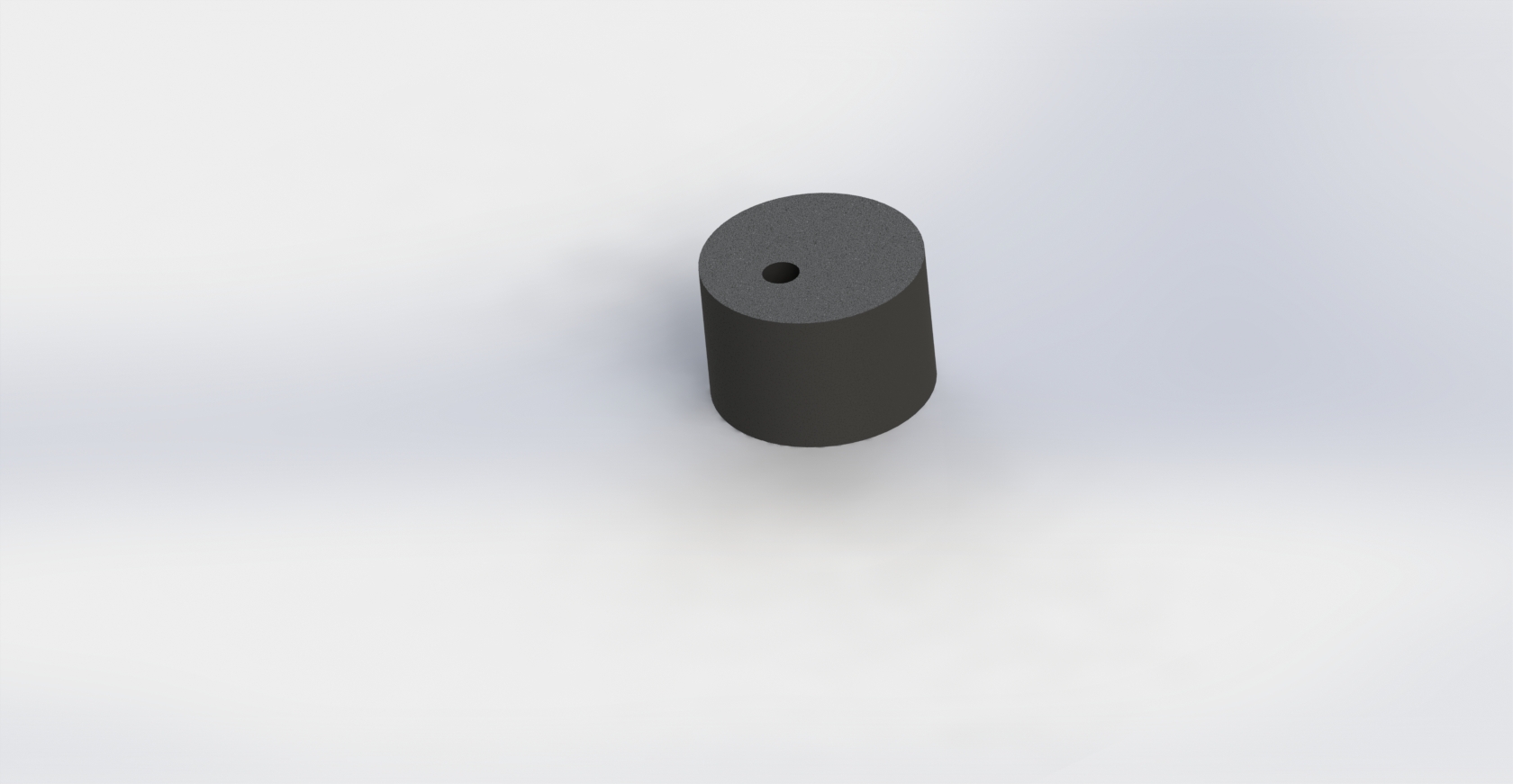
Process:

1. Manufacture steel part with CNC or mill
2. Boar out hole in sprocket with CNC or mill so that bearing can be press fit into it
3. Press fit bearing into sprocket
4. Put sprocket on arm of steel part and lock with shaft collar
5. Put spring on and attach to frame

Idea 2: Plastic Delrin Idler

CAD & Drawing:





Pictures of Manufactured Part:



Materials:

From McMaster Carr:

* $10.37 Wear- and Water-Resistant Delrin® Acetal Resin (1.5 in. diameter, black), 1 in. per device
* ¼ 20 bolt and nut

Process:

* Cut delrin to 1 in. long with vertical band saw
* Drill hole with mill

Decision Matrix

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Criteria | Works for 25 & 35 chain | Would work for lengths that would be on robot | Ease of use (amount of time to train to use) | Cost per 1 device | Time to make | Time to install | [Certifications](https://docs.google.com/spreadsheets/d/1aD5dubkxEOG1YgeMhfvaGtIYh42YQjSmQi3X6bjomYA/edit#gid=0) required to make | Quality of tensioning | Totals |
| How to measure | Prototype | Prototype | Talk to someone not on chain tensioning team and see if they understand, time how long to explain  1 = more than 10 min.  2 = 3 - 10 min.  3 = up to 3 min. | Add costs of parts  1 = more than $10  2 = up to $10  3 = Materials we have | Time how long to make  1 = 20 min. Or more  2 = 10 - 20 min.  3 = 10 min. Or less | Time how long to install  1 = 20 min. Or more  2 = 10 - 20 min.  3 = 10 min. Or less | 1 = Advanced zip ties  2 = Intermediate zip ties  3 = Basic zip ties | Not able to test - would need prototype able to move (not enough time to test) |  |
| Weights: | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 |  |
| Spring Loaded Idler | 3 (9) | 3 (9) | 3 (9) | 2 (6) | 1 (1) | 2 (4) | 1 (2) |  | 40 |
| Plastic Delrin Idler | 3 (9) | 3 (9) | 3 (9) | 2 (6) | 3 (3) | 3 (6) | 1 (2) |  | 44 |

1=bad 3=good

Conclusion:

* These designs have not been tested on a moving prototype, so more testing would need to be done before using them on a robot
* We can combine the designs into a delrin idler on the spring system