



BE BOLD. Shape the Future.
College of Engineering

Mission

Our goal was to redefine the dock diving experience by creating premium bumpers that combine exceptional performance and durability for both dogs and their owners.

- Engineered for Performance:** Our bumpers are thoughtfully designed to boost dogs' athletic abilities in water sports, featuring vibrant blue and yellow colors for visibility and ridges along the surface to maximize grip.
- Built for Durability:** Crafted to endure rigorous play, our bumpers are engineered to withstand an average bite force of 240 psi, ensuring they provide lasting enjoyment even during intense use.
- Committed to Safety:** We prioritize safety and quality, ensuring our bumpers are free from choking hazards and made exclusively with food-grade, pet-safe materials for worry-free fun.

Research

Issue	Percentage of Competitors Affected	Details
Water Exposure	90%	Bumpers degrade, in quality
Straps Unraveling	80%	Poses health risk for dogs
Time Consuming Reattachment	100%	Official report attaching bumpers is time consuming
Bumpers Detaching During Use	100%	Bumpers don’t detach when dogs hit or bite them
Interest In Magnetic Attachments	80%	Most competitors showed interest

Our research focused on creating a safe and easily detachable design. We identified that standard bumpers often posed challenges in attachment and detachment, especially when dogs bit or hit the bumper with force during dock dives. To address this, we explored designs that included structural modifications allowing for secure yet flexible connections and possible magnetic connections.



Dock Diving Bumper

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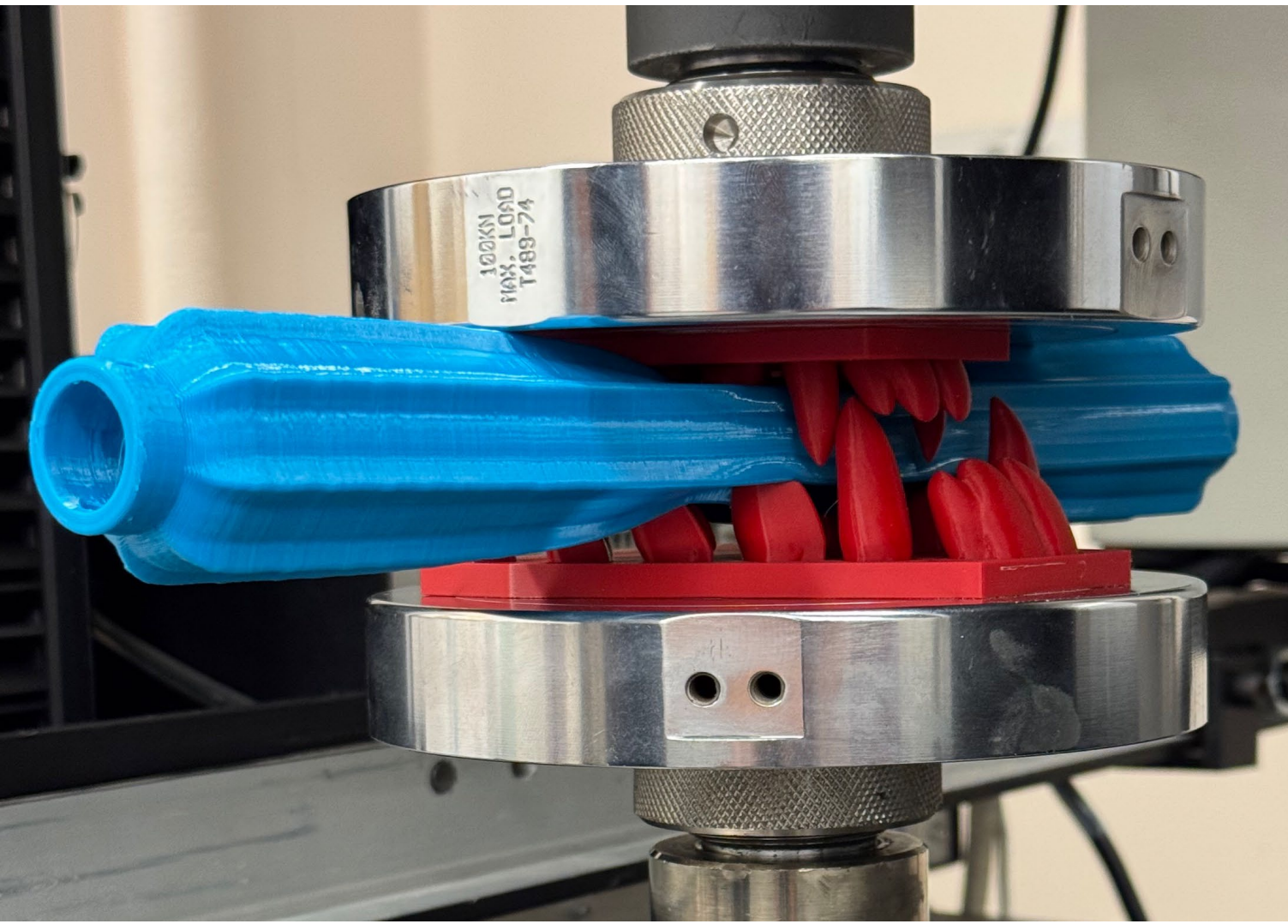
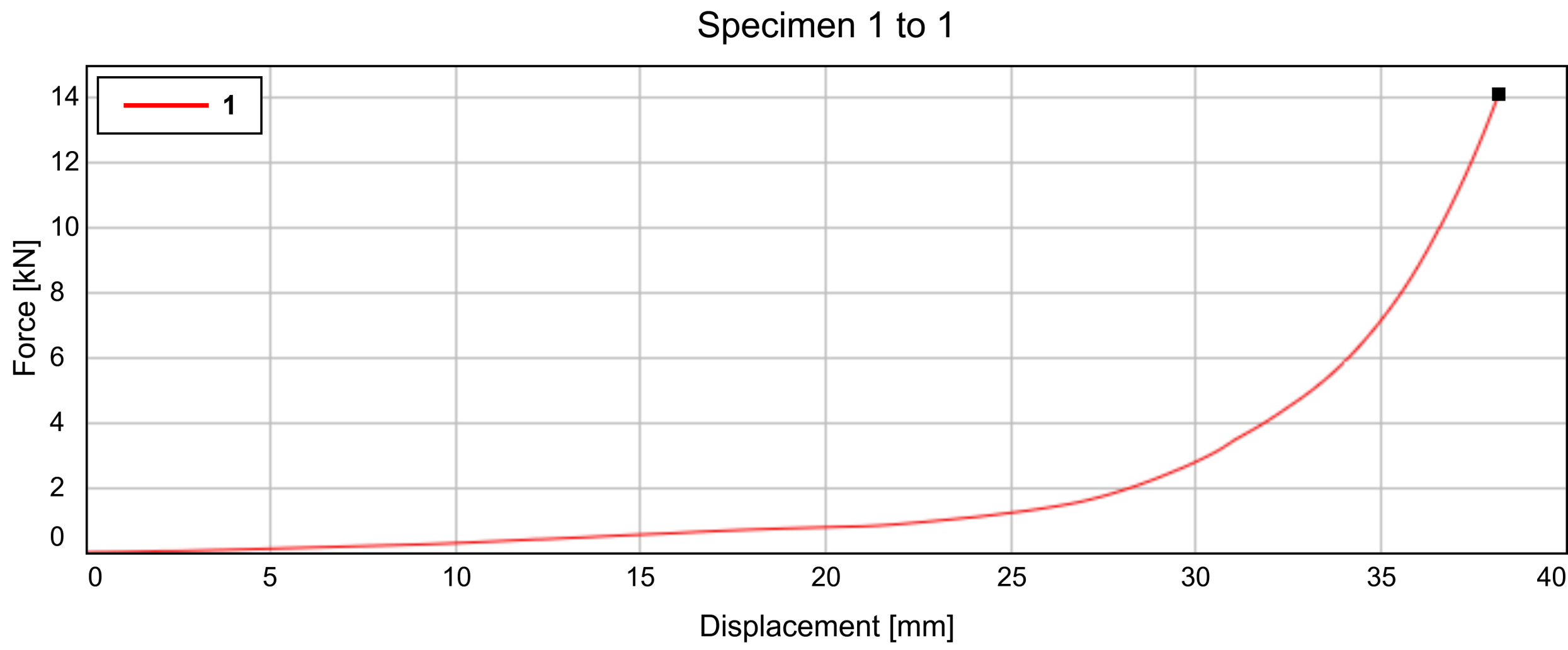
Steve Stochaj

Final Design



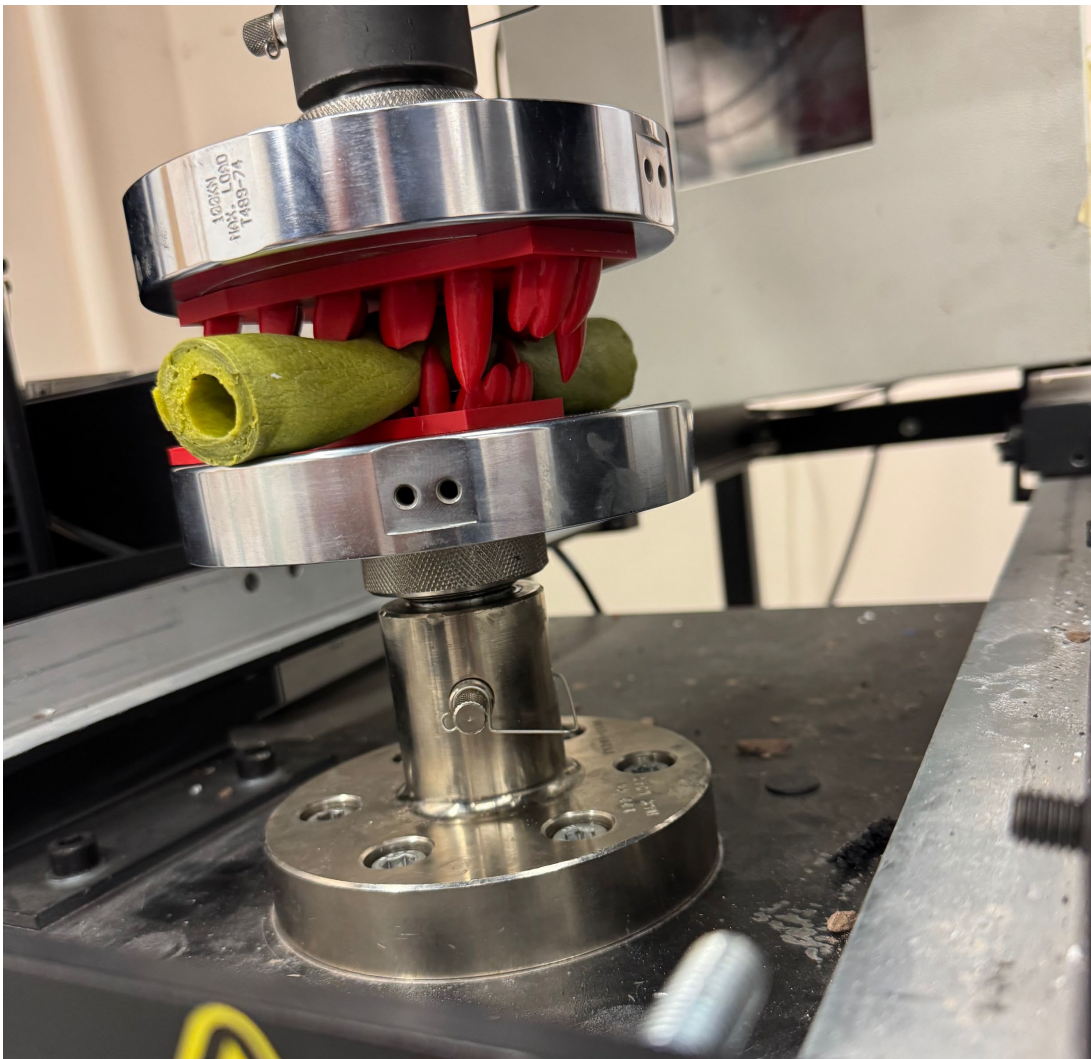
The dock diving bumper features a cylindrical design with a central opening and elongated ridges along its length for enhanced grip. At both extruded ends, a center circular hole has been cut out from the side profile to allow for attachment structure.

Final Results



- To assess the durability of the dock diving bumper prototype, an Instron machine equipped with a 3D-printed dog jaw was utilized. The bumper and material sample were subjected to a compressive load, requiring 14 kN to fully compress them until the top and bottom jaws made contact. Upon release, both the bumper and material sample showed no signs of punctures, demonstrating their strength under extreme force. Considering that the average dog bite force is approximately 235 psi, the test results revealed that the bumper could withstand a pressure of 4500 kN/m², equivalent to about 650 psi-comparable to the bite force of a Cane Corso.
- The bumper will be constructed from thermoplastic polyurethane (TPU), ensuring flexibility and resistance to wear, with AccuLite-260 as the internal foaming agent to provide lightweight buoyancy and impact absorption.
- The chart illustrates the outcomes of clip testing, detailing the force required to detach clips of different diameters (ranging from 4.5 mm to 5.4 mm) and square hole lengths (from 3 mm to 4.6 mm). The boxes highlighted in red represent the optimal weight range necessary for securing the bumper, which has a weight of approximately 10 oz. These values reflect the balance between ensuring the bumper remains secured during installation and ease of detachment, allowing it to be dislodged with the right amount of force while in use.

		Diameter of Clip (mm)									
Length of Square Hole (mm)	3	4.5	4.6	4.7	4.9	5	5.1	5.2	5.3	5.4	
	3.1	4 lb 9 oz	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.2	4 lb	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.3	3 lb 12oz	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.4	3 lb 6oz	3 lb 8oz	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.5	3 lb 4oz	3 lb 6oz	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.6	3 lb 2oz	3 lb 4oz	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.7	3 lb	3 lb 2oz	3 lb 2oz	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.8	2 lb 8 oz	2 lb 14oz	2 lb 10oz	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3.9	2 lb 2oz	2 lb 8oz	2 lb 7oz	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	4.1	1 lb 10oz	1 lb 15oz	2 lb	2 lb 7oz	2 lb 11oz	2 lb 14oz	N/A	N/A	N/A	N/A
	4.2	1 lb 7oz	1 lb 8oz	1 lb 14oz	2 lb 6oz	2 lb 8oz	2 lb 11oz	2 lb 15oz	N/A	N/A	N/A
	4.3	1 lb	1 lb 2oz	1 lb 10oz	1 lb 15oz	2 lb 2oz	2 lb 7oz	2 lb 13oz	3 lb	N/A	N/A
	4.4	7oz	1 lb	1 lb 7oz	1 lb 11oz	1 lb 14oz	2 lb 1oz	2 lb 11oz	2 lb 14oz	3 lb	N/A
	4.5	3oz	8oz	1 lb 1oz	1 lb 5oz	1 lb 7oz	1 lb 13oz	2 lb 6oz	2 lb 13oz	2 lb 15oz	N/A
	4.6	1oz	4oz	8oz	1 lb 1oz	1 lb 2oz	1 lb 8oz	2 lb 1oz	2 lb 7oz	2 lb 13oz	N/A



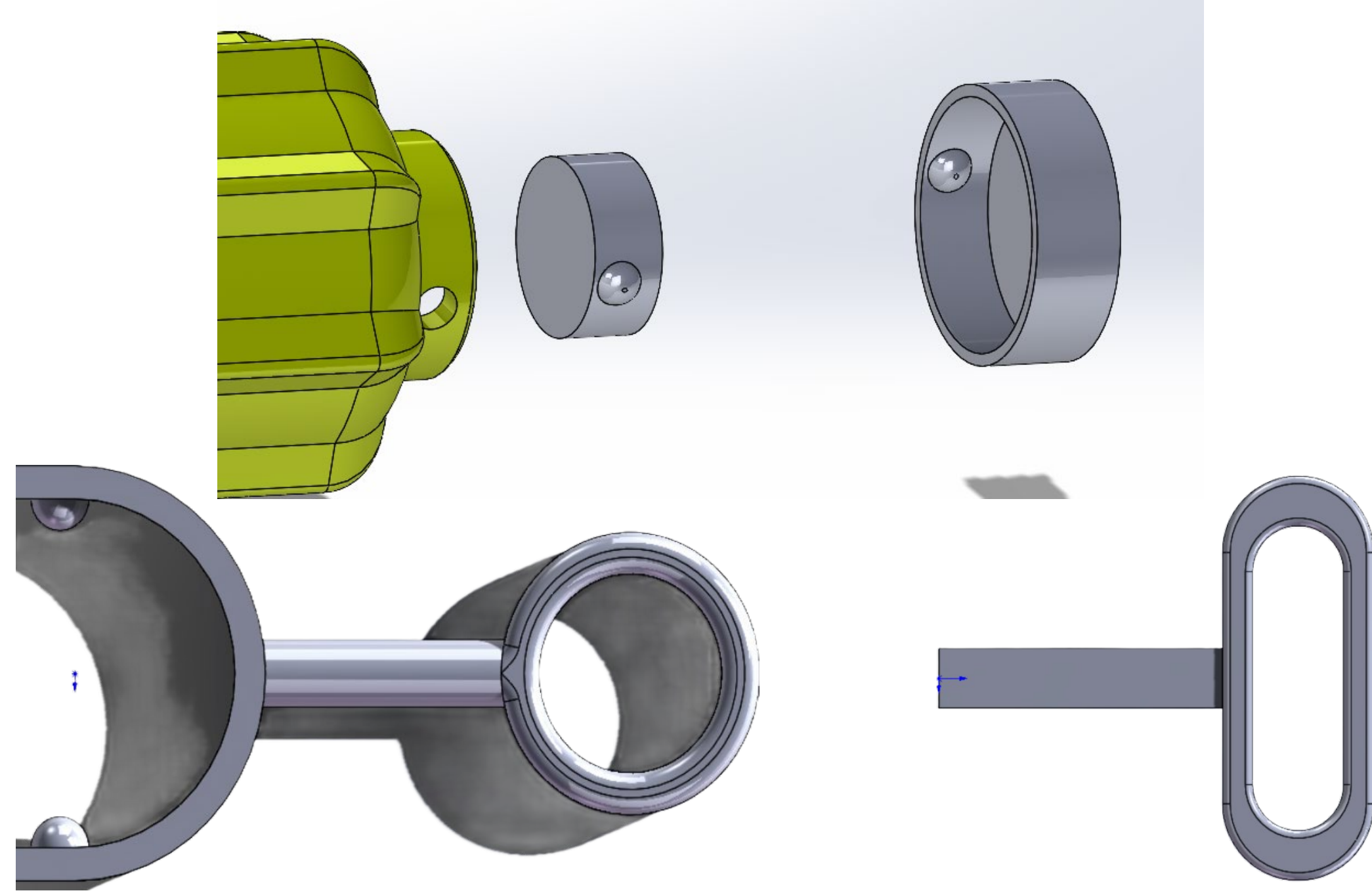
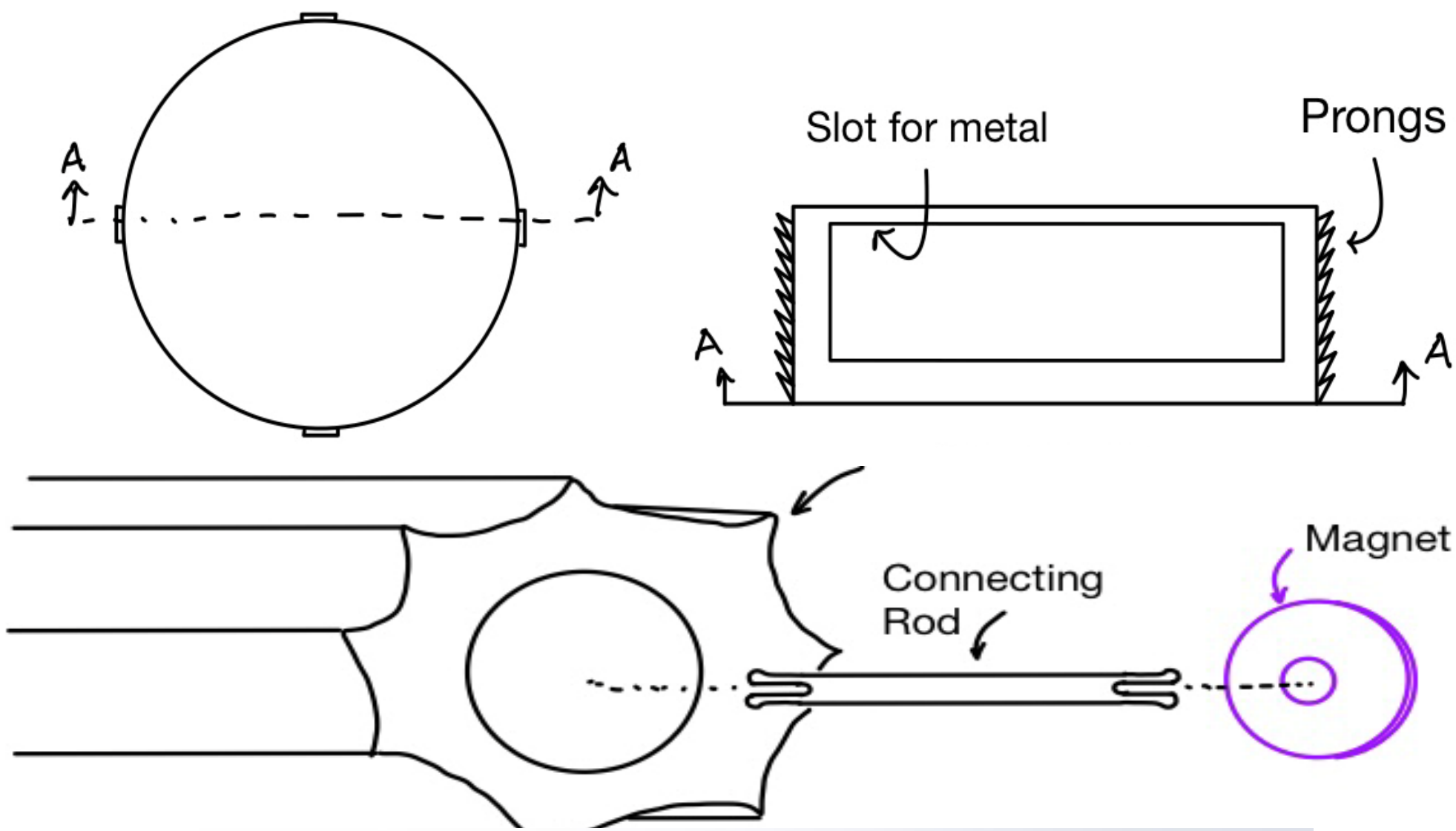
Concept Development

Design Phase

- Spoke with the company to determine product specifications
- Identified the required diameter and length for competition bumpers
- Analyzed competitor product dimensions
- Designed our product with similar dimensions to ensure compatibility with dogs already using competitor products

Design Concepts Considered

- Changing inner diameter of bumper
- Considered various ways to attach and detach the bumper, pictured below.
- Incorporating magnets as release mechanism.



References

[1] Magnetix, U. (2019, July 16). *Neodymium magnets - the most powerful magnets in the world*. Industrial and Promotional Magnets. <https://usmagnetix.com/products-resources/industrial-magnets/neodymium-magnets/>

[2] Usmagnetix. (2023, January 26). *Different types of magnets: Neodymium magnets: Ceramic magnets*. Industrial and Promotional Magnets. <https://usmagnetix.com/what-are-the-different-types-of-magnets/>

[3] Judkins, N. (2023, October 1). *The potential injuries associated with Dock Diving*. CANINE HEALTH & REHABILITATION. <https://www.caninehealthandrehabilitation.com/blog/the-potential-injuries-associated-with-dock-diving>