

Project Deliverable H Report

Prototype III and Customer Feedback

Course: GNG1103–Engineering Design

Team Name: Five Alive

Date: 2025.03.21

Team Members: Sam Stano, Owen Kaine, Aidin Moradi, Ziyi Wang

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1. Introduction

The purpose of this report is to document the development of Prototype III. Throughout this phase, our team has focused on addressing previous prototypes limitations, improving functionality, and ensuring compliance with customer requirements.

2. Prototype III development

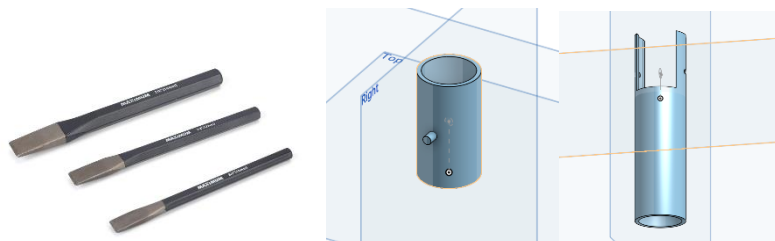
Our prototype III focuses on the collaboration between different systems, bringing them together to make the whole tool work perfectly. We plan to assemble the finished product this week and test it to verify that the tool we designed functions smoothly. We redesigned the collection system so that it now features a functional lid that operates via a sliding mechanism. Magnets provide a slight seal to prevent samples from being lost. For the scraping tool, we want our scraping tool to stay sharp and not be easily damaged. And we 3D printed a chisel holder to ensure that the chisel is securely installed. The final wheel mount was printed based on updated CAD with corrected measurements. It improved tool balance and allowed smoother movement through the testing pipe section.

3. Prototype III

In the pictures below, we have included images of the four main components that our team has built. The first component is the scraping tool, which will be used for our testing to ensure it efficiently removes debris from the pipe's interior surfaces. The second component is the collection system, designed to securely gather and store the debris scraped off during the testing process. The third component is the wheel mount and wheel design, which will be used to stabilize and facilitate the smooth movement of the prototype in various environments. The last component is the core Support Frame (Main Body), which is made of two durable 10-foot PVC pipes that are used to ensure mechanical support throughout the operation.

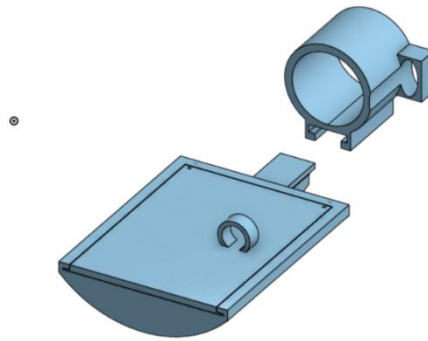
3.1 Scarping Tool

This is the chisel we finally chose. We want our scarping tool to stay sharp while being less prone to damage. We created a 3D-printed holder for the chisel so that it can rotate on the shaft, enabling it to scrape the pipe wall from different angles. This also ensures that the chisel will not fall due to other unexpected circumstances.

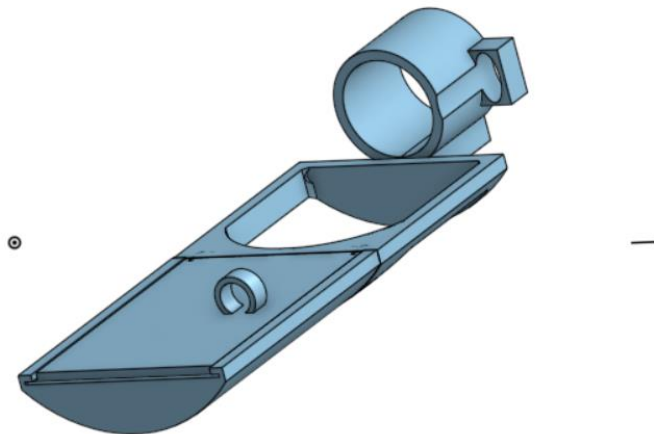


3.2 Collection System

The collection box now features a functional lid operated via a sliding mechanism. Magnets provide a light seal to prevent sample loss without obstructing debris flow. The container operates effectively in both vertical and horizontal orientations. In our previous prototypes our design did not include a way to attach to the main body of the PVC and in this prototype, we created a loop that is the diameter of the PVC. In addition, previous prototypes of the collection system had a funnel which was no longer seen as necessary considering that our precision of sample size will no longer depend on the box but rather on the scraping method.



3 iterations of the loop connector we printed to get the right width for being able to slide together with the box.

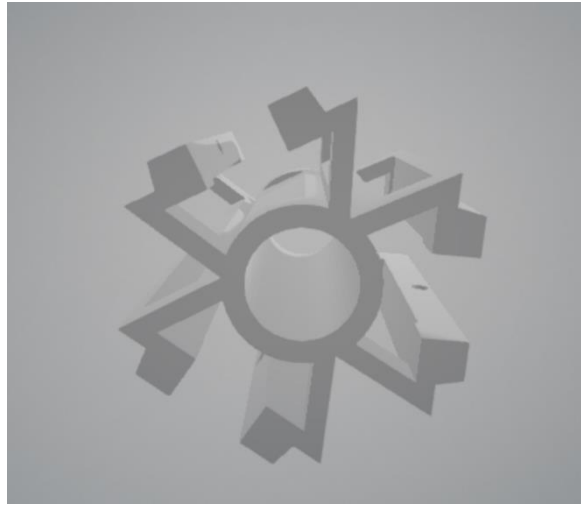
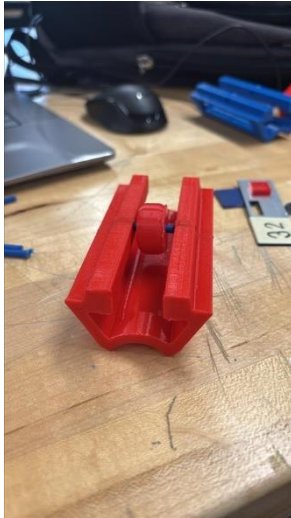


After the physical test we discovered a flaw in the previous box design because the chisel was not able to be placed in front of the loop entrance. To fix this, arms were added to the box and will be printed before design day.

3.3 Wheel Mount and Wheel Design

The final wheel mount was printed based on updated CAD with corrected measurements. It improved tool balance and allowed smoother movement through the testing pipe section. The Wheel Moun and Wheel is printed using the 3D printer in the lab. The new design proved to be more stable than earlier versions, reducing wobble and maintaining consistent contact with the

pipe walls during operation.



3.4 Core Support Frame (Main Body)

The core support frame (main body) is the backbone of the entire prototype. It is made of two durable 10-foot PVC pipes connected using male and female couplings that will be glued on with PVC glue. This body serves as the mounting base for the scraping tool, collection system, and wheel assemblies. The frame ensures mechanical support throughout the operation. The pipes were also joined using detachable couplers. The lightweight nature of the PVC also contributes to the prototype's portability.





At the end here is where the chisel holder will be attached along with the collection system after they are printed.

4. Analysis of Critical Components for Prototype III

Component/System	Function	Final Improvements	Risks
Core Support Frame	Connects and supports all subsystems; allows internal component movement.	Add more precise attachment points for stability and modular redesign	Low: PVC must hold structural integrity under slight pressure/weight.
Collection System	The collection device will be a CAD prototype this time with hopefully a more in-depth lid design.	Sliding lid design with magnetic seal to prevent sample loss	Still very little risk as it will be CAD and 3D printed
Wheel Mount and Wheels	The collection device will be a CAD prototype this time with hopefully a more in-depth lid design.	Improve the locking system and use CAD for better precision	Minimal risk, still CAD and 3D printable
Scraping Tool	Removes material from the inner wall of the pipe.	Sharper chisel, secured with a 3D-printed holder; aligned with a pivot mechanism.	Might wear down quickly or damage tubing; test for durability

Link to the (detailed) excel: [13_Prototype and Test Plan Template.xlsx](#)

6. Prototype III Analysis and Test results

Number	Test Description	Results
1	Attach a chisel to the end of the small diameter PVC to collect sample. Ensure that the chisel holder can accurately secure the chisel while scraping.	The chisel will scrape well against the inside of the tube, but we still need to test sample sizes a little more to ensure we get accurate numbers.
2	Measure our diameter with all the wheels attached and then send the product through the tubing to make sure it stays straight and stable.	The diameter is a little smaller which we made it to be so there is still room for it to work around a little bit. The wheels move smoothly within the tube.
3	Do some strength tests with the magnets and fit tests with the tubing. Attach the wire to the container and test that the lid can close smoothly.	We determined the magnets hold the lid together very well, as well as the lock-in mechanism for the container.
4	Test the optimal angle for chisel to scrape against pipe and how efficient it can be put into place.	We found the aircraft wire works very well by putting it into place and provides strong

		tension throughout the tubing.
5	Test the overall system integration by running the full product through a mock operation cycle, including scraping, collecting, and sealing the container.	The system performed smoothly, with the chisel scraping properly, wheels staying aligned, and the magnetic lid locking securely. Minor alignment adjustments may improve efficiency further.

7. Updated Bill of Materials

Material	Amount	Cost (CAD with tax included)	Source
Chisel	3	19.20	Canadian Tire
3d printing filament	Undetermined	Free	
3/4in diameter, 5ft PEX pipes	3	13.5	Home Depot
Metal Spacers	6	Already in Possession	N/A
10ft PVC pipes (1in diameter)	2	24.3	Home Depot
Female PVC couplings	2	4.23	Home Depot
Male PVC couplings	2	3.44	Home Depot

PEX pipe connectors	2	4.25	
Hot glue gun	NA	Already in possession	NA
PVC glue	NA	10.4	Home Depot
Magnets	60 pack	7.91	Amazon
50ft Metal Wire	1	18.1	Home Depot
Metal Wire Ferrules	10	7.1	Home Depot
Final Total		112.43	

8. Trello Task Board Update:

Team Member	Tasks Completed Last Week	Current Tasks (In Progress)	Tasks On Hold or Canceled	Estimated task duration
Aidin	Deliverable G and J	-Assisting in prototype	None	4 Days

		assembly and documentation. -Purchasing chisel		
Owen	Deliverable G and J	-Redo CAD collection system model -assembly and testing	None	4 Days
Ziyi	Deliverable G and J	-Assist with testing and document test results -create CAD model for chisel	None	4 Days
Sam	Deliverable G and J	-Assembling wheel mounts and assisting with testing and other assembling.	None	4 Days

9. Conclusion:

With Prototype III development, we now have a solid and comprehensive solution meeting all the functional specifications. In future, we will keep on optimizing performance based on test data that is collected. Task planning is updated on a regular basis to ensure coordination of the team and respect for the project schedule.