
Prototype II and Customer Feedback

Deliverable G

Client – Canadian Nuclear Laboratories

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GNG1103-F

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Introduction:

This report contains documentation on the prototyping plan of the design, as well as updated prototypes and Bill of Materials. It has been split into the Project Task Plan, Prototyping plan, followed by the feedback received in the meeting with PM's, and ending in the updated plans and designs for each subsection of the machine.

Project Task Plan:

Task Description	Estimated Duration (Days)	Owner
Gather materials	5	everyone
Construct extending pneumatic body	1	Dante, Connor
Test pneumatic body and record results	1	Fahad
Adapt body if failing tests	1	Fahad
Create prototype for drilling and collection	2	Fahad, Aymeric
Test drilling and collection, and record results	1	Dante
Adapt drilling and collection if failing tests	1	Dante
Update BOM and target specifications	1	Fahad, Dante
Create complete prototype (body and drilling) without complete feedback system	2	everyone
Test complete prototype and record results	1	Aymeric
Adapt complete prototype to pass tests	1	Aymeric
Fully implement feedback system	2	everyone
Test feedback system and record results	1	Connor
Adapt feedback System to record results	1	Connor
Update BOM and target specifications	1	Aymeric, Connor
Get feedback on final prototype	2	everyone
Create User manual and guide	1	everyone
Create final presentation and pitch	4	everyone

List Of Equipment Needed:

- 3D printer
- SolidWorks
- Onshape
- Laser Cutter
- Inkscape
- Hand Tools

Prototyping and Test Plans:

Test Number	Probable Critical Issue	Test Objective (why)	Test description (what)	Stop Criterion
1	Body can move up and down the tube	Testing for performance, Distance Travelled In how much time (feet/sec)	Extending the contraption to 15 feet and contracting it. Seeing how much weight it can push and pull	Body manages to push and pull the weight of the drilling mechanism
2	Controlled Drilling Mechanism	Performance, Management, Distance drilled (inches)	Drill into a material and test to see if device can make holes the same size consistently	Drilled hole sizes are consistent within the past 3 attempts
3	Collection Mechanism	Performance, Management, Amount of material collected (mg)	Drill a consistent hole into a material that will turn into powder, and measure how much the collection system collected in mg	The collected amount is consistent within 7 mg in the past 3 attempts
4	Test functionality of Fail Safe Mechanism	Risk Management	Removing the contraption from a tube utilizing the failsafe mechanism	Failsafe mechanism functions properly, used by multiple people

5	Testing if entire contraption works when assembled	Performance, Distance travelled (feet) Speed (feet/second) Hole size (inches) Material collected (mg)	Run through an entire material extraction process with the assembled complete prototype	When results equal results from tests 1,2 and 3
6	Feedback system test	Management, Risk management	Run through a material extraction process simulation	There is a clear feedback for when the prototype finishes extending, drilling and retracting

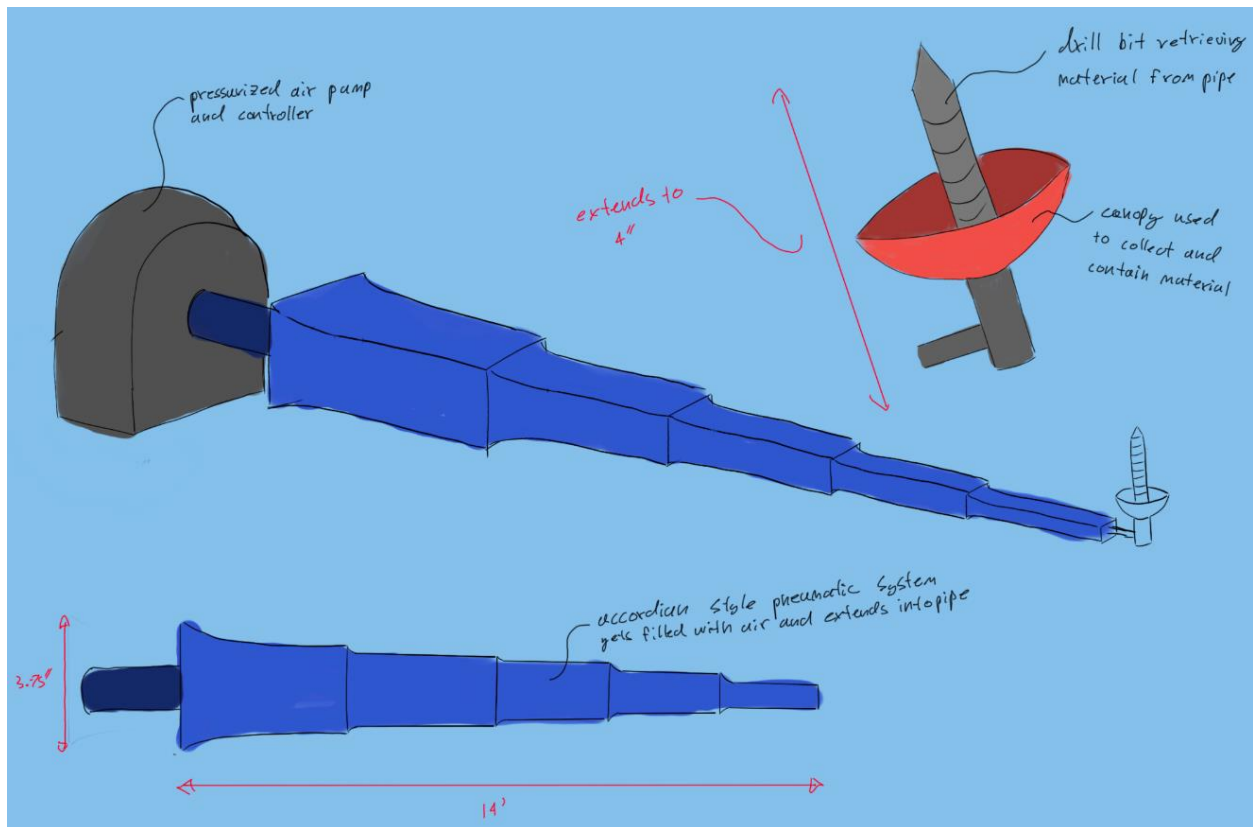
Project Risks:

Risks	Contingency plan
Prototype failing severely	<ul style="list-style-type: none"> - Change Implementation of the section - Or in extreme cases redesign the section entirely - Update Project Task Plan and timetable to account for added prototyping
Team Members not contributing	<ul style="list-style-type: none"> - Have a team reflection regarding the unfinished task - Align expectations with the group - Potentially meet with PM or TA - Provide support for teammate - Update Project Task Plan and timetable

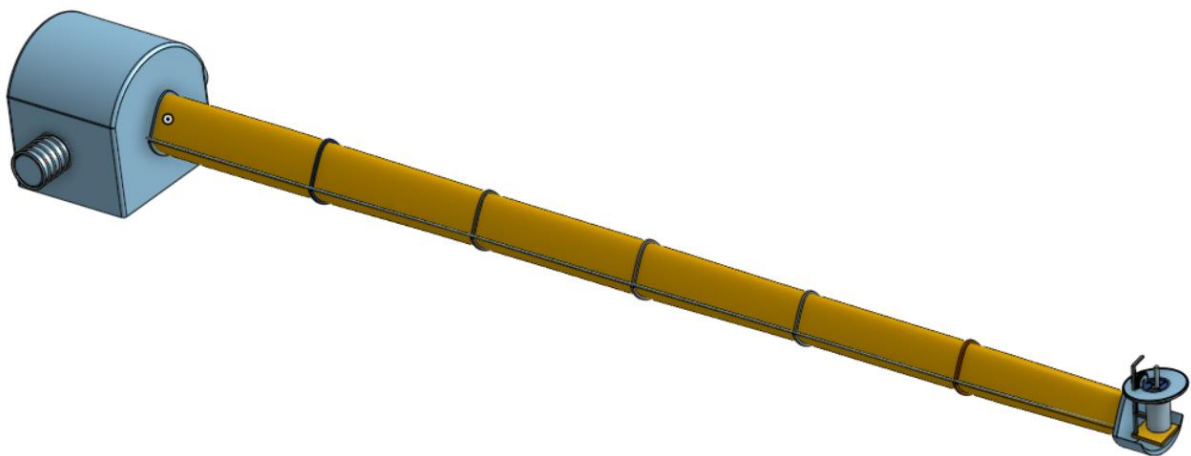
BOM excel sheet:

[BOM - group 15](#)

Prototype Sketch:



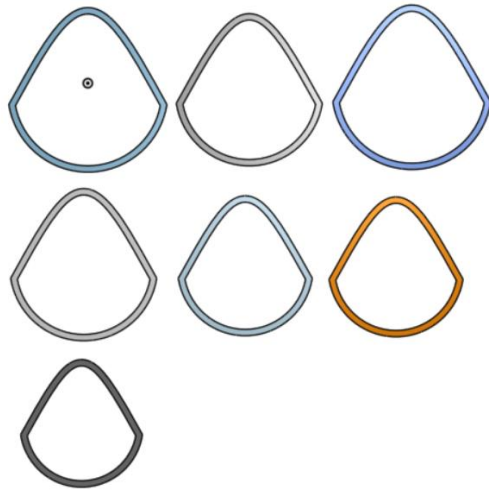
Design CAD:



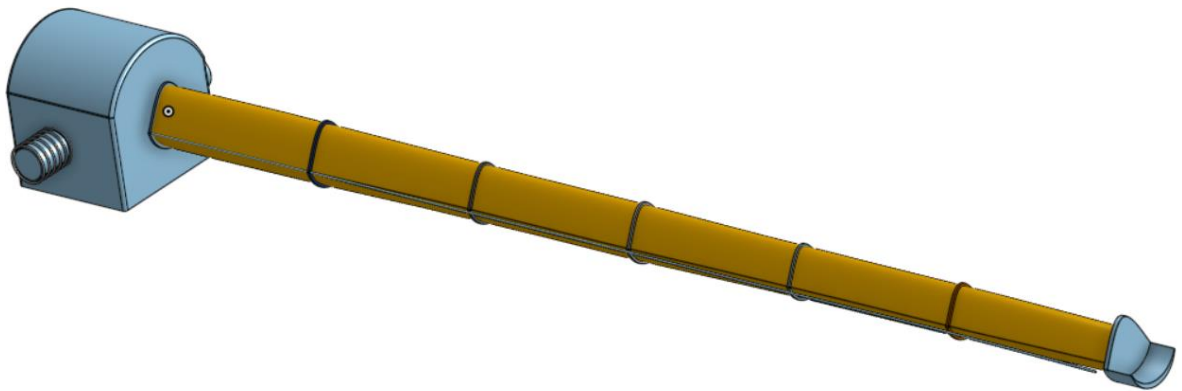
Link to [Onshape](#).

Pneumatic System:

-Frames



- Assembled concept:



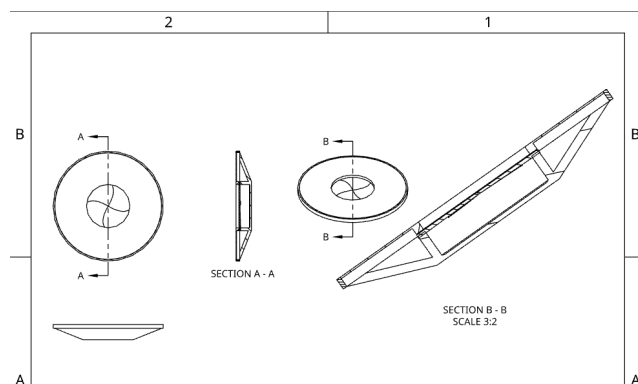
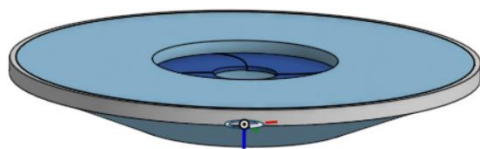
- Explanation:
 - The frames will be connected with PVC coated polyester and will act as support for the inflating and deflation of the Polyester. The polyester will be enclosed on itself by means of sewing it together. Then will be attached to the frames with glue.
- Changes From prototype 1: the frames have been changed from a square shape to a tear drop shape, that better fits into the inside of the pipe, to provide better stabilization and easier expansion.
- PLA required – 60 grams
- Link to [OnShape](#):

First Basic Prototype of expansion System:

- Purpose:
 - This prototype was made to test out basic expansion and retraction functionalities, and to visualize the changes that must occur.
- Materials:
 - Air pump
 - 3D printed supports
 - Garbage bag
 - Glue
- Results/Feedback:
 - The prototype was able to properly expand and push a load of up to 300 grams. But failed to properly retract using the deflation.
 - The supports also were not properly stable, and must be adapted to fully support the expansion and retraction
- Future steps:
 - Supports will be made with a wider base at the bottom in order to better stabilize the inflated contraption
 - The payload cart will be made and attached to the front of the expansion system in order to better test movement.
 - A longer expansion tube will be made to test the range of the idea.
 - A new retraction system will be made in order to properly retract the contraption



Collection System:



- Explanation:

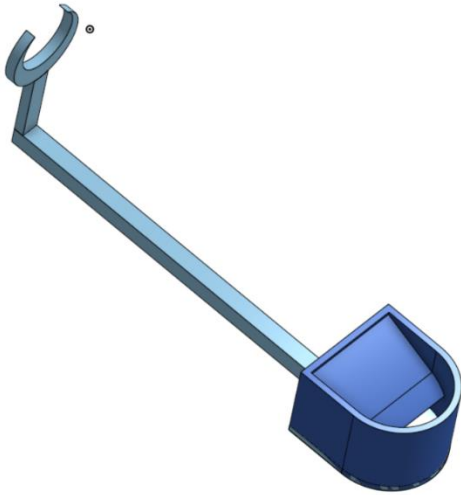
- A fully 3D printed container that attaches atop the motor and below the drill. It is constantly closed due to the lid being sloped inwards, and utilizes the centrifugal force generated by the spinning of the motor to open.
- Pla required: 30 grams
- Link to [OnShape](#)

First Basic Prototype of Collection System:



- Purpose:
 - To test the closing system utilizing centripetal force of the collection system
- Materials:
 - PLA
 - Paper
 - Pencil
- Results/Feedback:
 - The opening mechanism worked decently well, and would propagate open once the collector was spun.
 - The Closing mechanism once the collector stopped spinning, was not consistently working, and got the lid pieces stuck inside of the contraption (leading to the paper substitution).
- Future Steps:
 - Have a bigger opening in which the lid components can slide in and out.
 - Add a stopper to the lid components for them to not fall into or out of the contraption.
 - Scale the collection system to the proper measurements.
 - Create an adaptor to connect the collection system to a motor and a drill piece.
 - Test utilizing a motor.

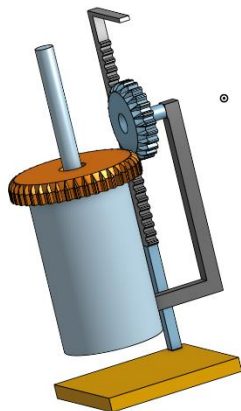
Add-on for Vertical Collection:



Explanation: This add-on works as a clip-on. It's placed under the motor and moves forward with the drill to the walls of the tube. The sample slips off the ramp and is then secured and can be retrieved safely.

Drill and motor component:

Full assembly



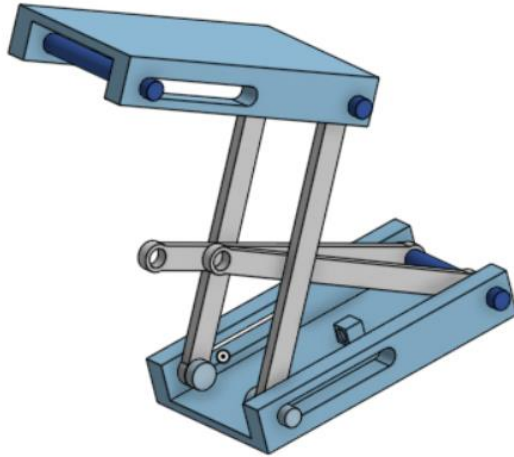
Explanation:

This Cad design represents the drill component that is attached to the end of our pneumatic system. This component oversees drilling to retrieve material.

To reach the walls of the drill we have included a gear system using bevel gears which aid with raising the drill motor with the drill but upwards. When the drill is spun gear two is also

spun simultaneously. Gear 2 is connected to gear one which is connected to a gear track. When gear one is spun due to gear two the contraption is raised, and the drill bit can reach the upper wall of the tube.

Alternative Motor Lifting Design:



Explanation: this design takes inspiration of a screw scissor lift, unfortunately from the picture it does not look like a screw scissor lift due to trouble of assembling parts in CAD. Besides that, this screw scissor lift consists of two platform, one on the bottom and one on the top that are lifted by two arms. The platform will be lifted upwards using a bolt and a nut that will spin. The spin will be powered by a motor. When the motor is turned on the the arms will slide down along with the pins to lift the platform upwards.

Client Feedback Received:

- The main feedback given from the Client to the pitch presentation involved the drilling mechanism. He stated that we would find much more success if the drilling and the actuation system for the drilling where controlled by separate motors. Allowing for better adjustment of speed and height sensibility.

Engineering Analysis:

- Physical low fidelity prototype test have been done on the expanding and collection system as stated throughout the report
- Current technical analysis is minimal, and tests have not occurred, but critical errors that might occur are:

- Tension in the expanding pneumatic mechanism causing mechanism to topple backwards.
- Friction in Polyester of expanding mechanism causing tears or ruptures.
- The drilling machine does not have enough power to drill through material.