

Seed Storage Tube

Detailed Design Review

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Deliverables

- Drawing package
 - Visual instruction packet detailing the use and maintenance of the product without relying on knowledge of english language
- Prototype
 - Model of final product for purpose of testing viability of final product
- Functioning Final Product
 - Large air and watertight container designed to store seed while killing insects and keeping out moisture

Specifications

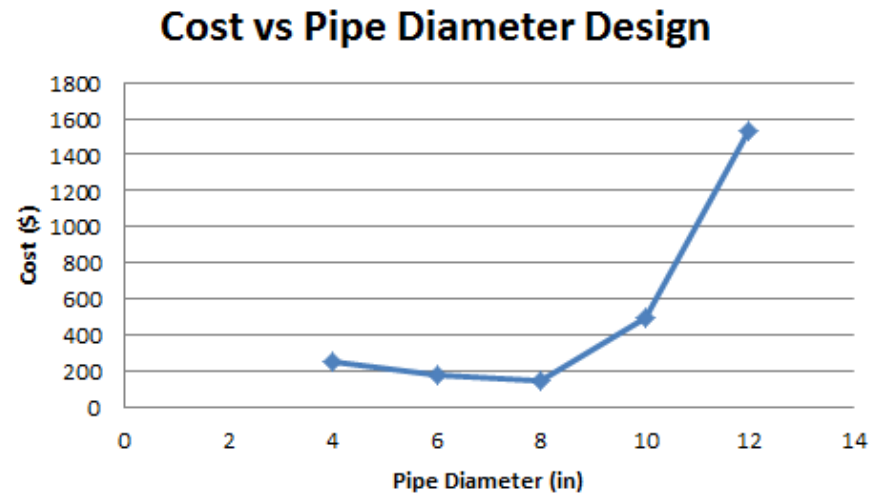
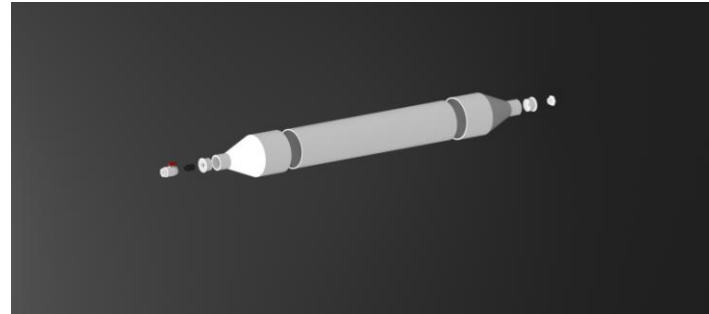
Criteria	Target
Keep seed dry	Less than 12% humidity
Store seed for long periods	Minimum of 2 years
Ease of assembly	Less than 1 hour to assemble
Ease of transportation	Less than 200 lbs, Portable by hand
Vacuum pressure	About 2inHg of absolute pressure
Fill time	Less than 10 minutes
Storage Volume	At least 4.7 cubic feet
Cost	Less than \$250 per unit

Project Learning

- Perdue University developed PICS Bags, which keep seeds dry and kill insects.
- A study conducted by Perdue University found that when stored in sealed containers like PICS bags, weevils can not access enough oxygen to metabolize water to survive. Placing seed, weevils and all, in a vacuum environment further reduces the available oxygen, killing insects faster.
- Our experiment showed that crickets became immediately lethargic at 20 inHg below atmospheric. They died within three days.
- Removing the air from a unit also removes the water vapor, further reducing insect's ability to metabolize water. Using our product to kill insects, then transferring the seed to a PICS bag would minimize insect damage and cost.
- Keeping a non-rigid container at high vacuum pressure is difficult. Even small gaps can prevent the unit from functioning.

PVC Design

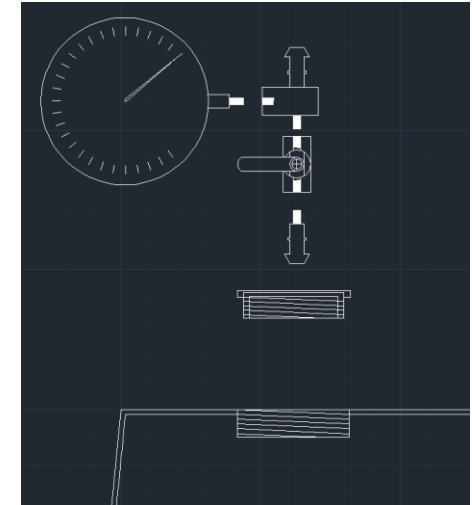
- Large sizes are expensive
 - Pipe thicknesses
 - Schedule 40,
schedule 80
 - Fittings
 - Reducers
 - Most expensive
 - Bushings



Based on storing at least 3 cubic feet

Plastic Drum Design

- Structural Integrity
 - Walls and lid
- Leak Rate
 - Through the lid
- Portability
 - Heavy
 - 55 gallons of seed when full



Total cost: ~\$120

PVC/Bag Design

- Leak Rate
 - Bag and PVC interface
 - 4 inHg/hr at best
- Sealing Methods
 - Heat sealing
 - Holes in bag
 - Gluing
 - Messy and long drying time
 - Hose clamps
 - Too much bag material

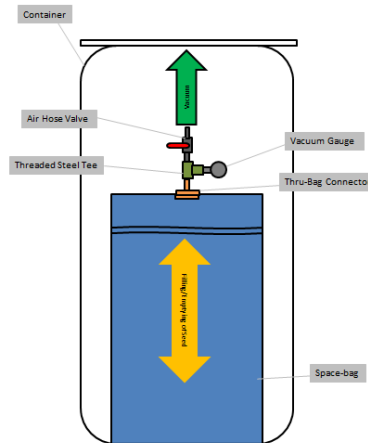
Total Price: ~\$140



Space Bag Design (Final)

Components

- Space bag
 - Size dependent on user
- Ball/check valve
- Vacuum gauge
- Tee
- Thru-bag connector
- Container
 - Size dependent on user
- 4-mil plastic bags
- Adhesive tape
 - If needed



Total Price: \$80 to \$90 depending on bag and container sizes

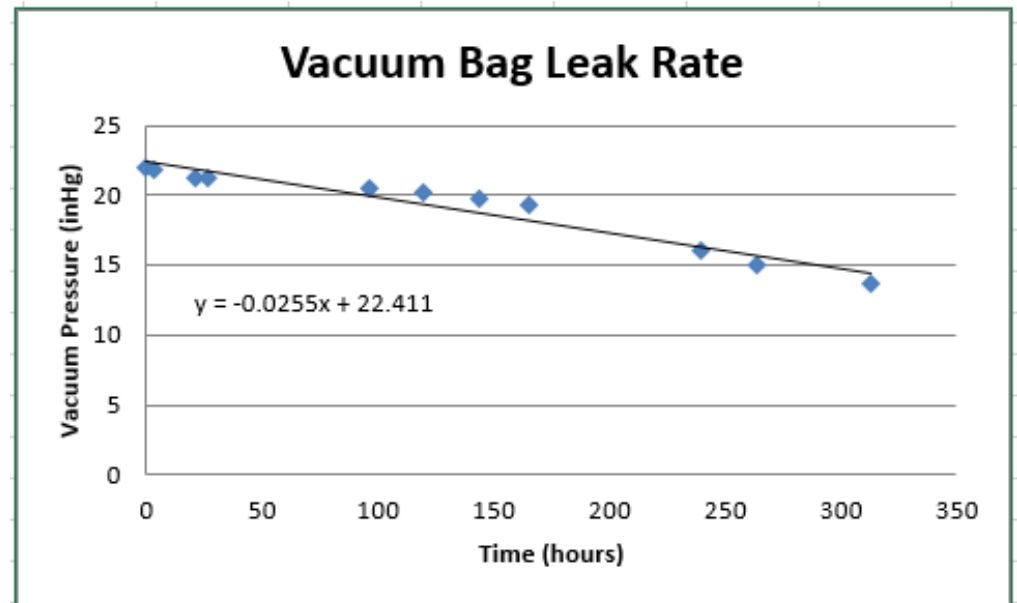
Manufacturing Process

- Avoid working on rough surfaces
 - Tear holes in bag
- Avoid wrinkles
 - Air leaks
- Pipe dope on all fittings
- Double bag
 - 4-mil bags



Results

- Best leak rate achieved
 - $-.026 \text{ inHg/hr}$
- Duration of testing
 - Approximately 13 days
- Starting vacuum pressure
 - -22 inHg/hr
- Ending vacuum pressure
 - -13.75 inHg/hr



Risks and Solutions

Risks	Solutions
Insufficient storage	<ul style="list-style-type: none">• The through-bag connector and bags can be sold separately. Many sizes of bags can be made available
Animals puncturing the bag	<ul style="list-style-type: none">• Bag is airtight. Animals can't smell seed• Rigid container (box or barrel) could further protect the bag.
Bag is not properly sealed	<ul style="list-style-type: none">• Multiple layers of bags and minimal openings reduce chance of leaking• When under a vacuum, the flexible bag presses most openings shut, further reducing leaking
Improper use of bag	<ul style="list-style-type: none">• If the bag is damaged due to improper use, the user would not need to purchase another whole unit. The bags and the through-bag connector(the most expensive part) can be sold separately.