

# EASY EMBER: ENGINEERING RELEASE REVIEW

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# PROJECT OBJECTIVE

- MIMIC THE PROPERTIES OF WILDFIRE FIREBRANDS FOR SAFE FIRE RESEARCH



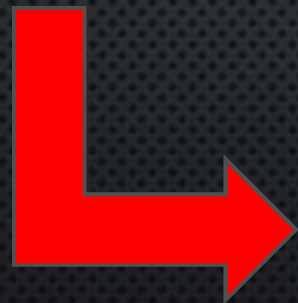
# VALUE PROPOSITION STATEMENT

- WILDFIRES COST \$\$\$\$
- WILDFIRES ARE DIFFICULT TO REPLICATE IN A LAB
- OUR EMBER GENERATOR WILL OUTPUT FIREBRANDS SIMILAR TO WILDFIRE SCENARIOS
- ENABLING RESEARCHERS TO TEST WILDFIRE IMPACT ON STRUCTURAL MATERIALS



# PRODUCT REQUIREMENTS

- KEY REQUIREMENTS FROM CLIENT:
  - EMBER OUTPUT SIMILAR TO WILDFIRES
    - ABLE TO CATCH MATERIALS ON FIRE
  - CAN FIT AND WORK IN FIRE LAB
  - FIRE SAFE



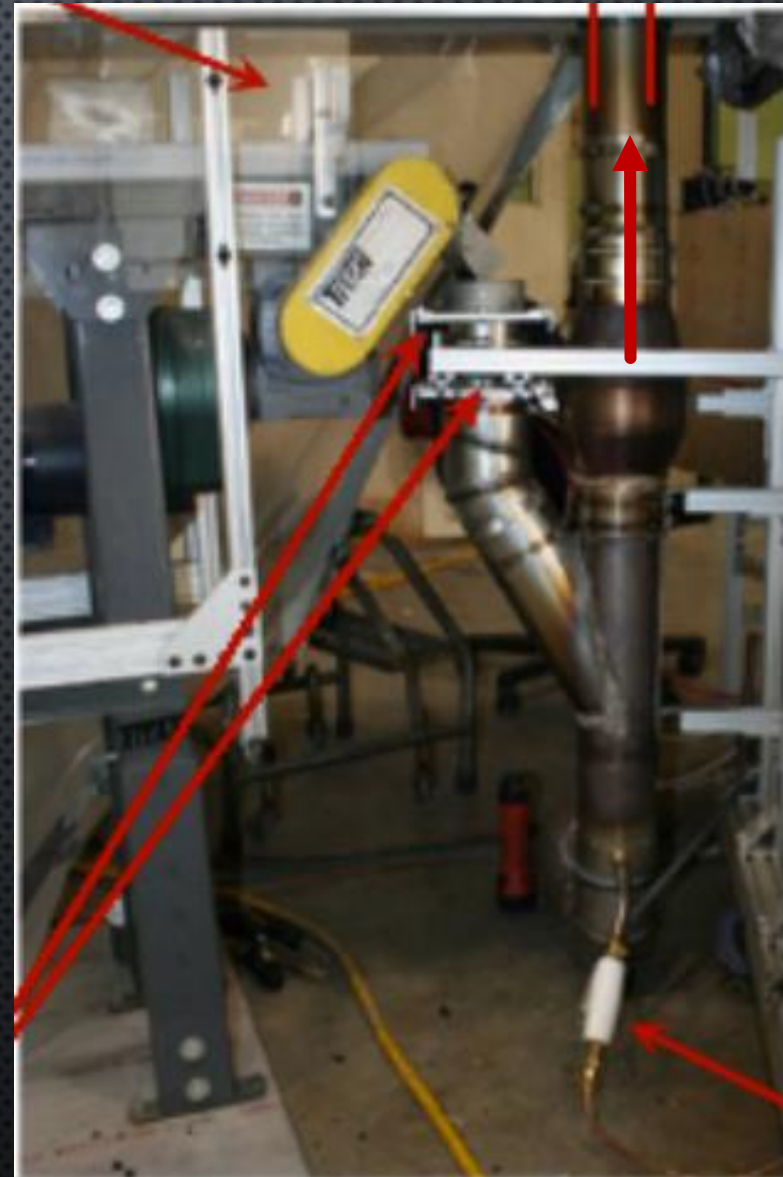
<b>Size</b>	<b>Able to transport on cart</b>
<b>Power &amp; Controls</b>	<b>120 VAC, 15amps, able to start/shutdown remotely</b>
<b>Ember Stream Duration</b>	<b>15 minutes without reloading fuel source</b>
<b>Airflow Output Speed</b>	<b>0-16ft/s, variable speed</b>
<b>Fuel Source</b>	<b>Variable (woodchips readily available)</b>
<b>Flame Source</b>	<b>Propane</b>
<b>Ember Flux</b>	<b>Open to design, enough to ignite common building materials</b>
<b>Frame Material Type</b>	<b>Heat resistant materials providing insulation for operator safety</b>
<b>Durability</b>	<b>Vibration resistance, able to transport in bed of truck, heat resistant up to 1400°F</b>
<b>Safety Features</b>	<b>Fuel line shut down, emergency shut down, fire suppression, chemical extinguish</b>
<b>Useful Life</b>	<b>5+ years</b>
<b>Budget</b>	<b>\$3,100</b>

# BACKGROUND

- NIST BABY DRAGON AS STARTING POINT
- KEY CHANGES:
  - MORE COMPACT DESIGN
  - EASIER TO TRANSPORT
  - REMOTE CONTROLS

CONVEYOR BELT

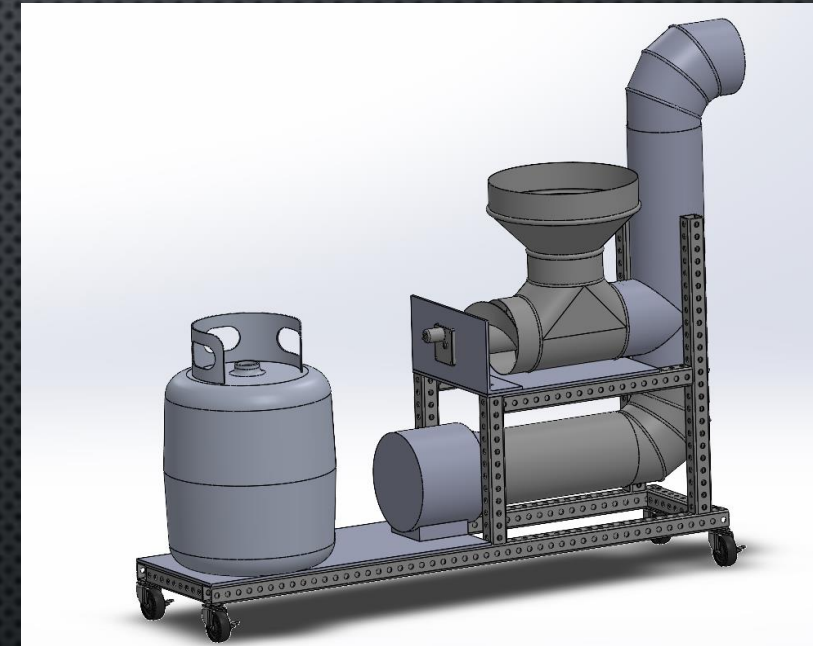
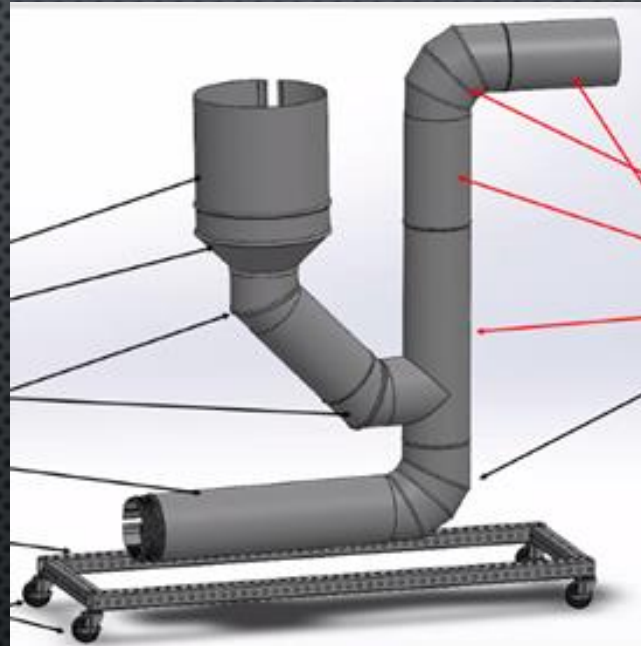
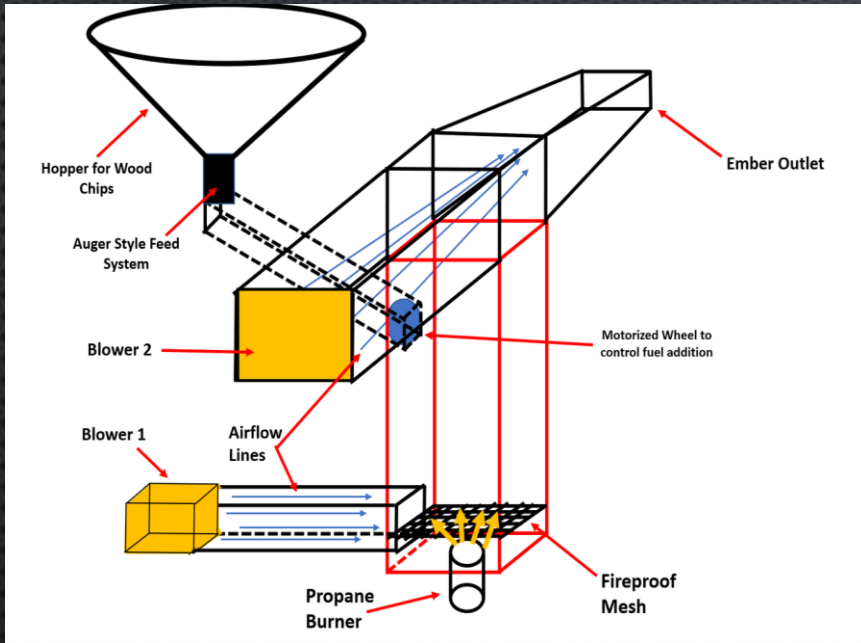
FIREBRANDS GO UP TO WIND TUNNEL



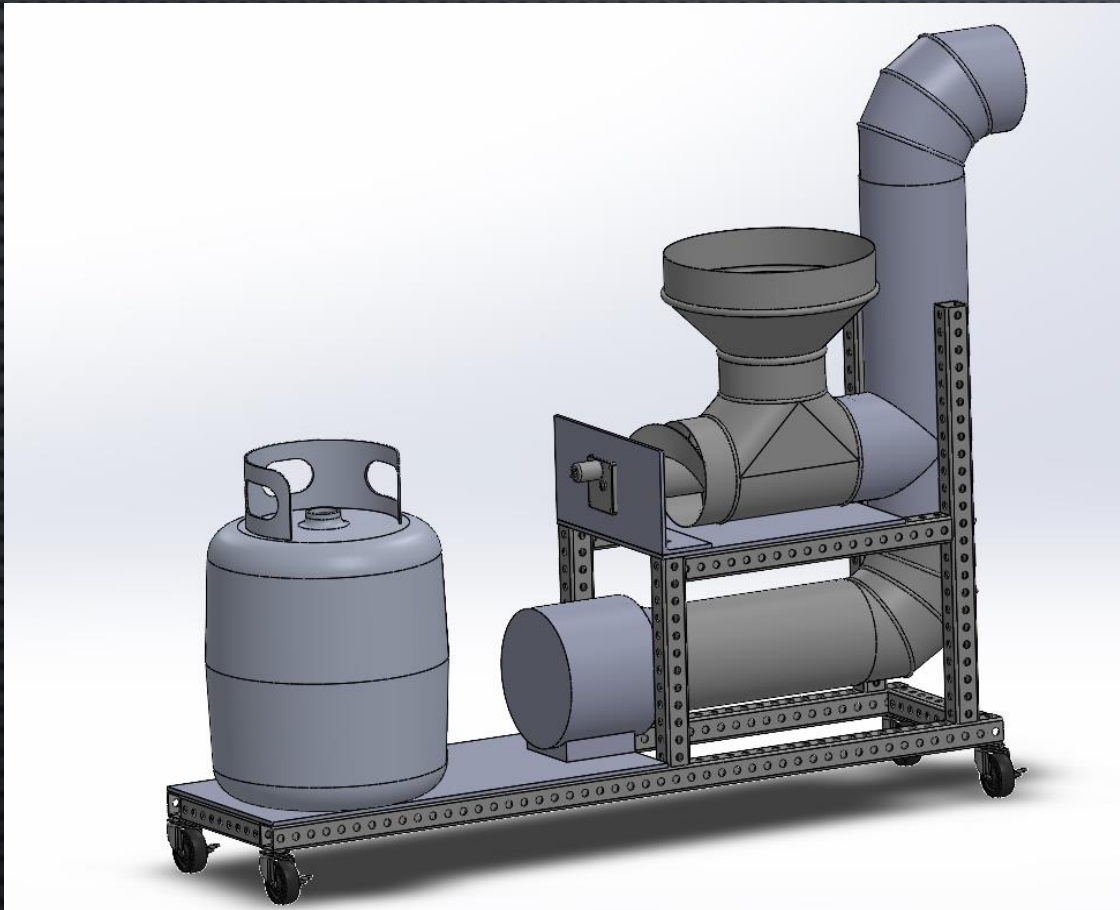
GATES

TORCH

# DESIGN EVOLUTION



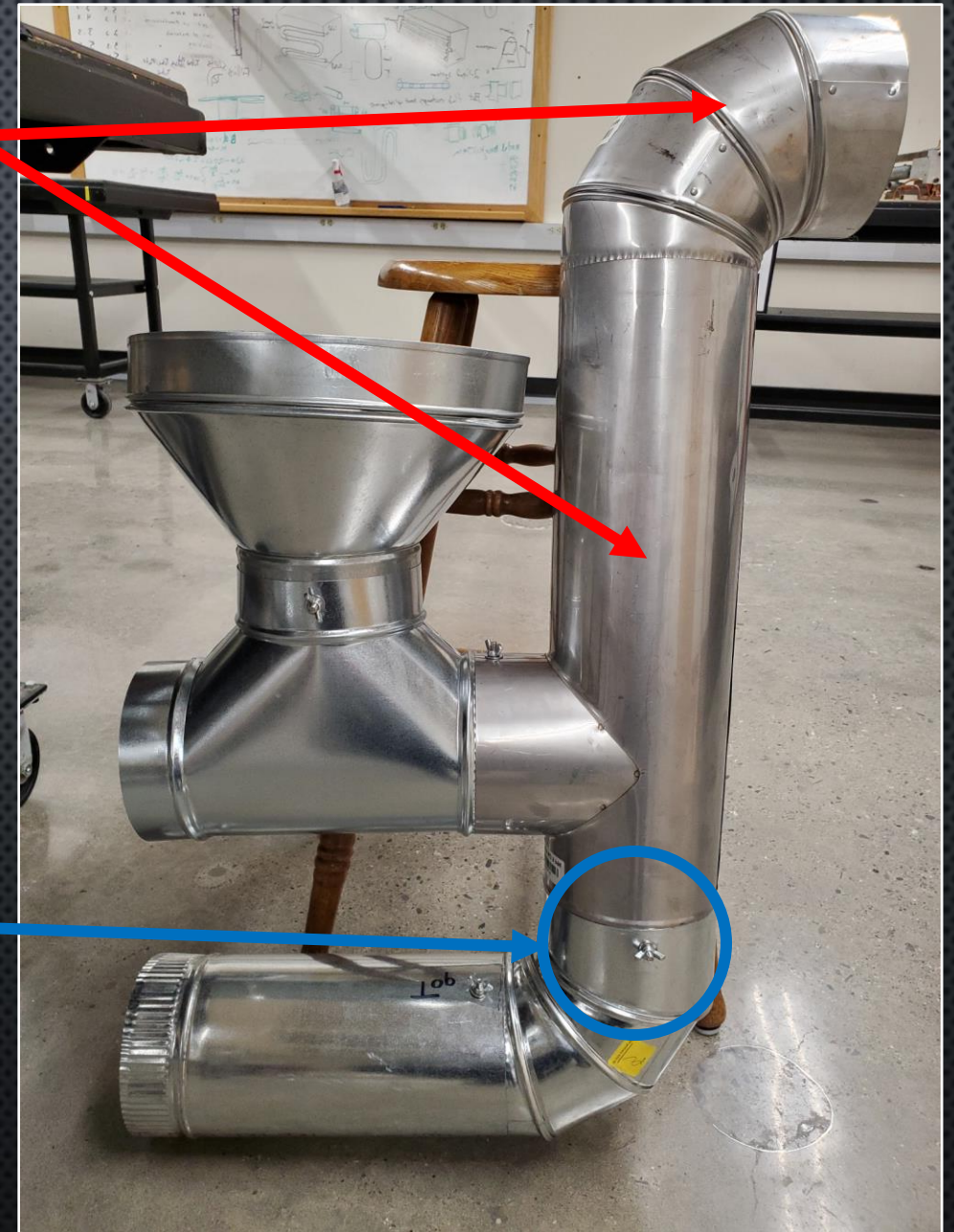
# BIG PICTURE



# STOVE PIPE DUCT

- 6" DIAMETER
- STAINLESS STEEL AND GALVANIZED
- L SHAPE FOR SIMPLICITY AND FUNCTIONALITY
- WING NUT BOLTS FOR EASY ASSEMBLY

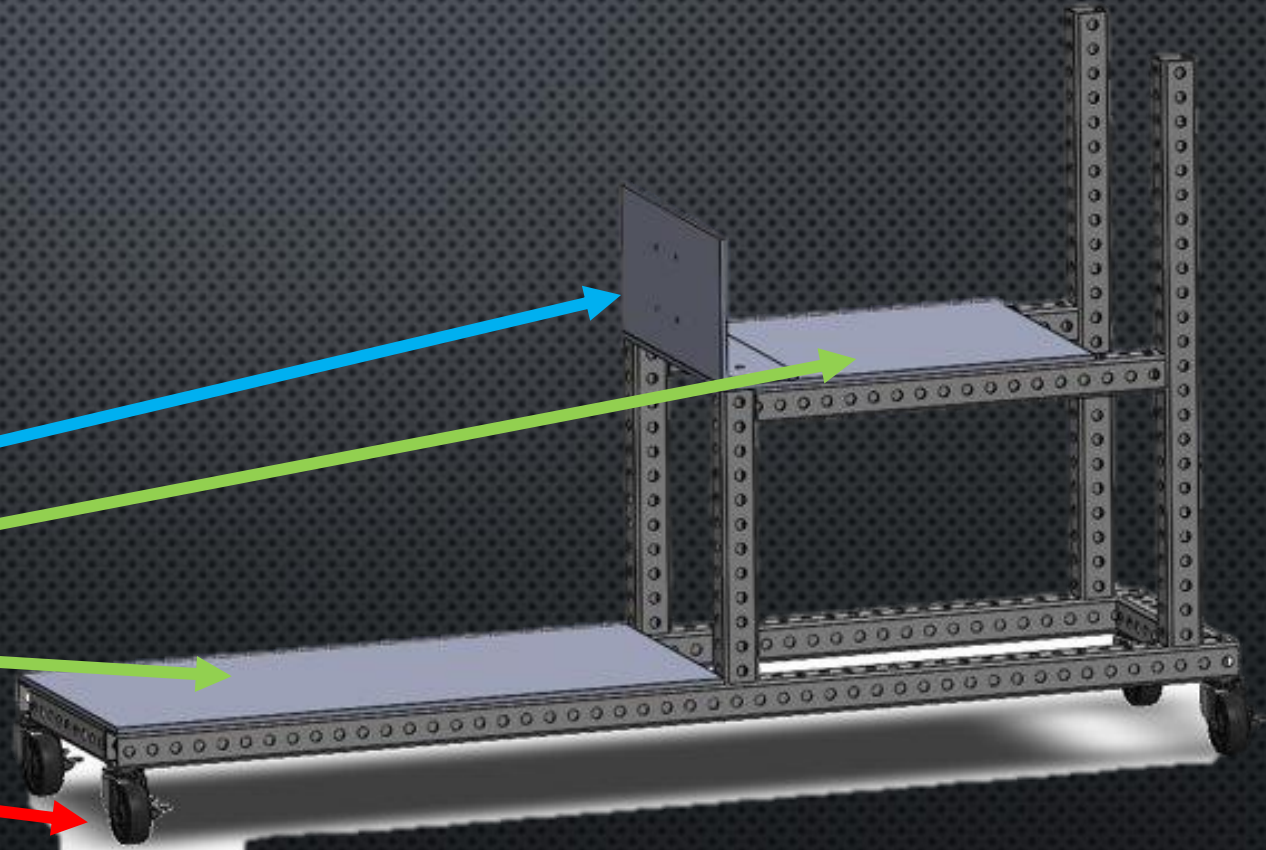
STAINLESS STEEL  
(HIGH HEAT)





# FRAME

- 1.5 x 1.5" PERF STEEL RAILING
  - BRACKETS AND FASTENERS
- VARIOUS CUT LENGTHS
- MOTOR BRACKET
- 2 BASE PLATES
- CASTERS

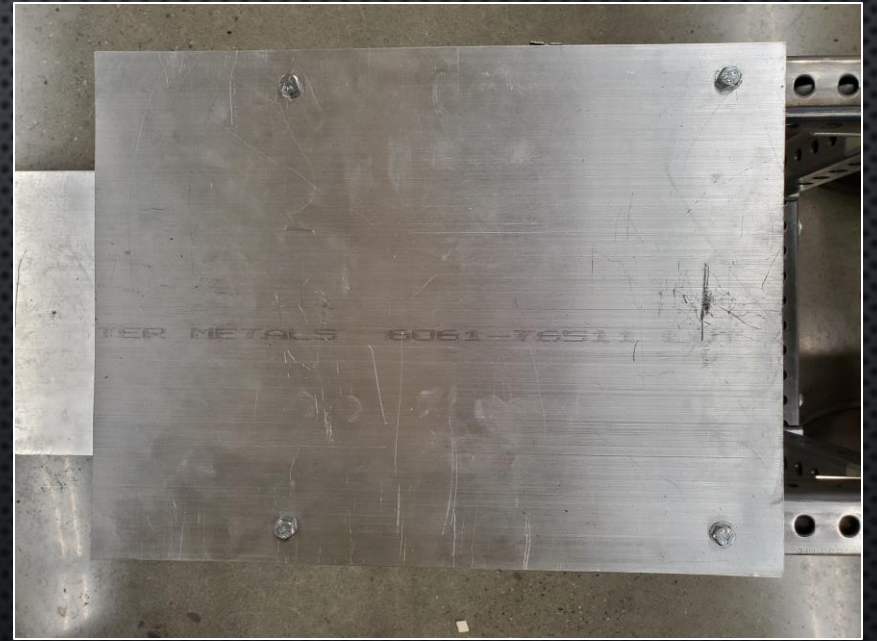


# BASE PLATES

PLATE 1  
26X12 IN

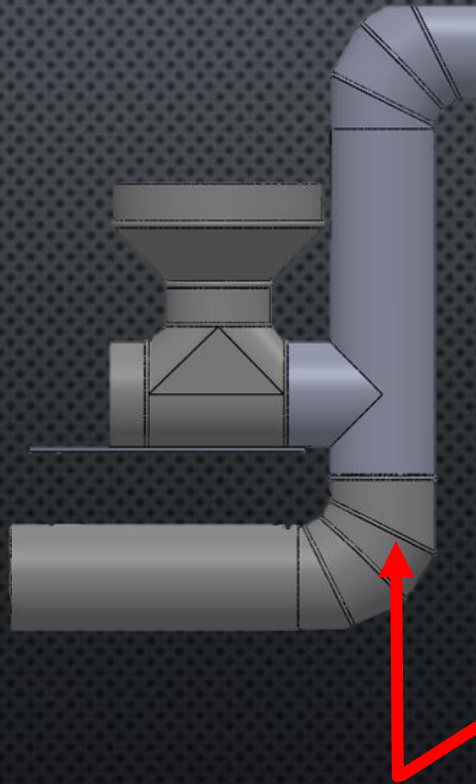


PLATE 2  
18X12 IN

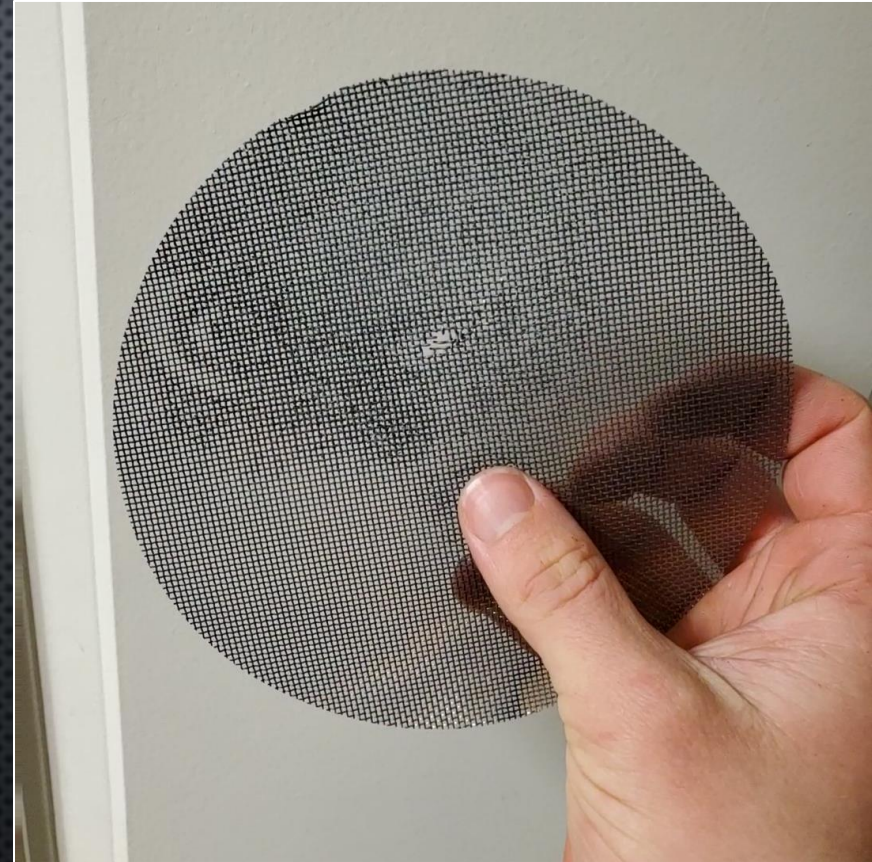


# PROPANE TANK/BURNER

- STANDARD 20#  
PROPANE GAS TANK
- MOUNTED TO BASE PLATE
- LARGE FLAME TORCH



# STAINLESS STEEL MESH



**304 Stainless Steel Wire Cloth Discs**  
5-1/2" Diameter, 20 x 20 Mesh Size

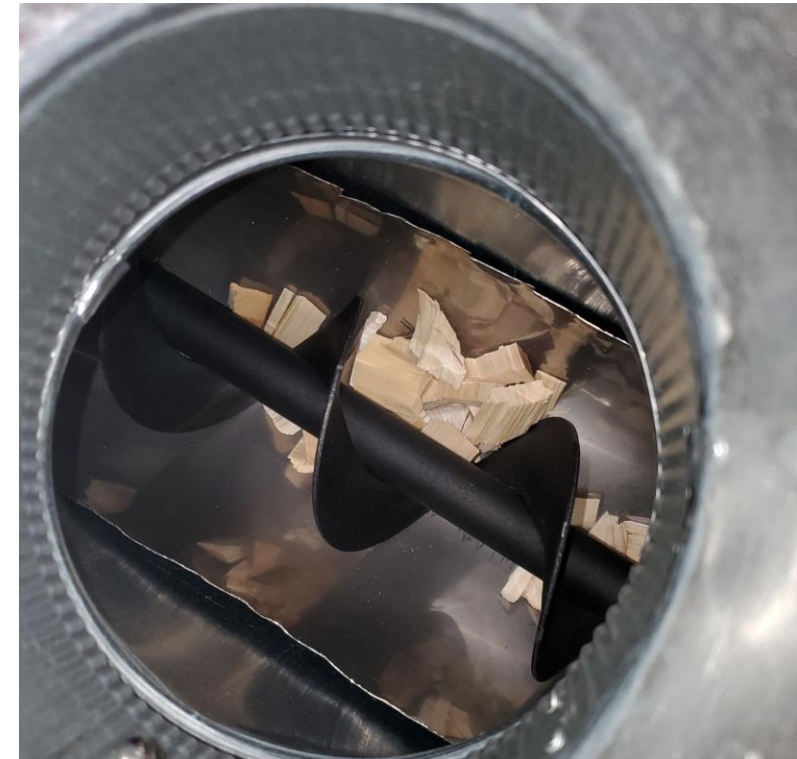
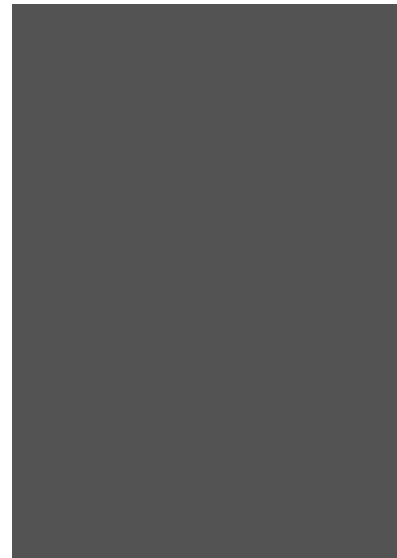
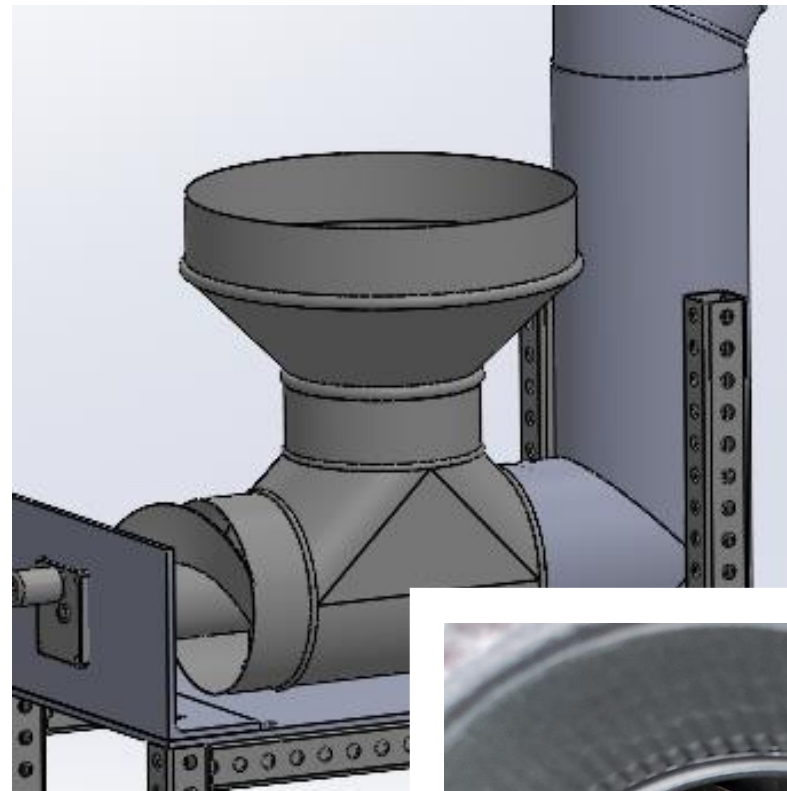
# BLOWER

- 6" DIAMETER
- 10-35 FT/S WIND SPEED RANGE
- INTEGRATES WITH 6" DIAMETER DUCT
- SPEED VARIABILITY
- AWAY FROM "HOT ZONE"



# HOPPER/HOLDING AREA

- 6" TO 12" EXPANSION
- FITS INTO HORIZONTAL TEE FITTING
- FUNNEL INSIDE OF HOPPER TO REDUCE DIAMETER TO 3"



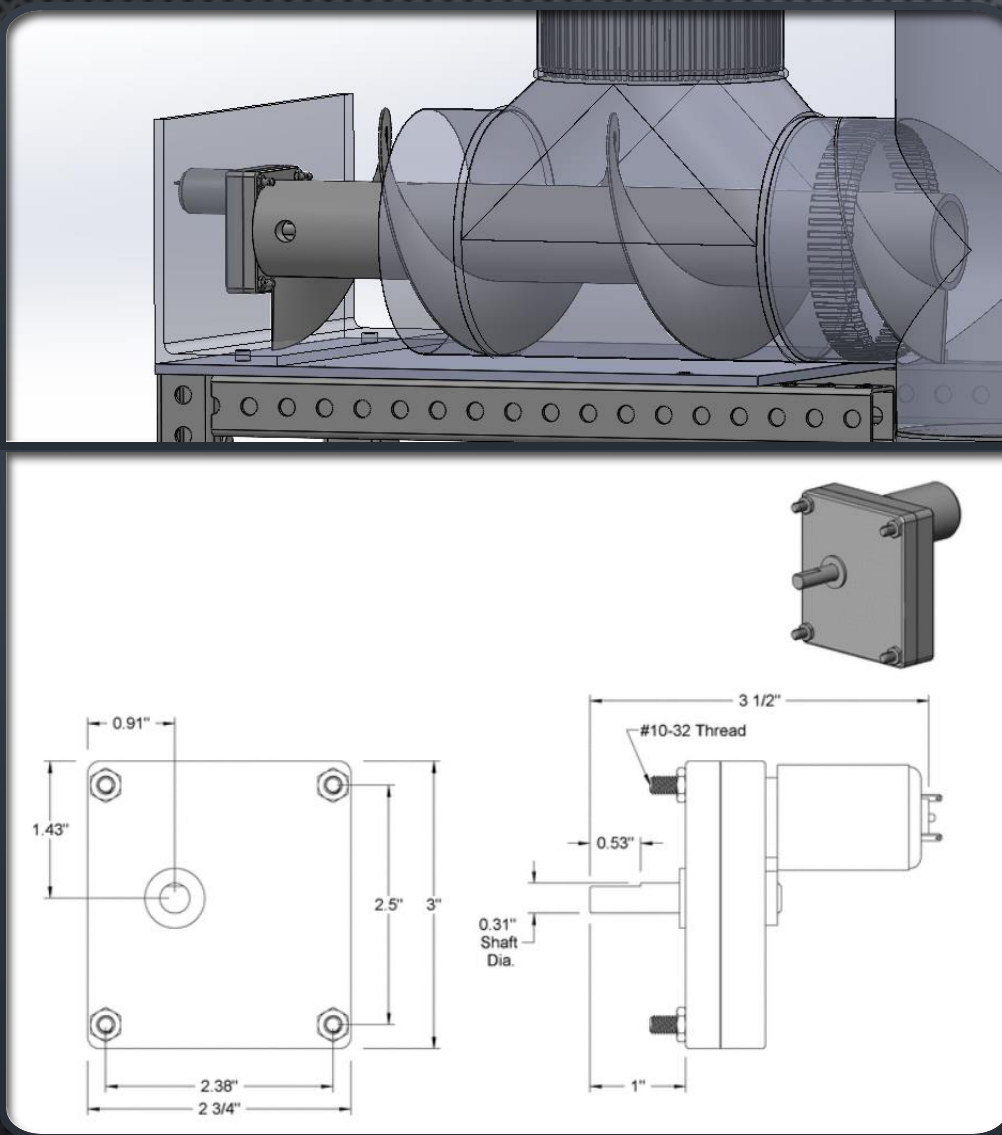
# MOTOR AND AUGER

- MOTOR SPECS

- 12 RPM
- 40 IN-LBS TORQUE
- 12 VDC

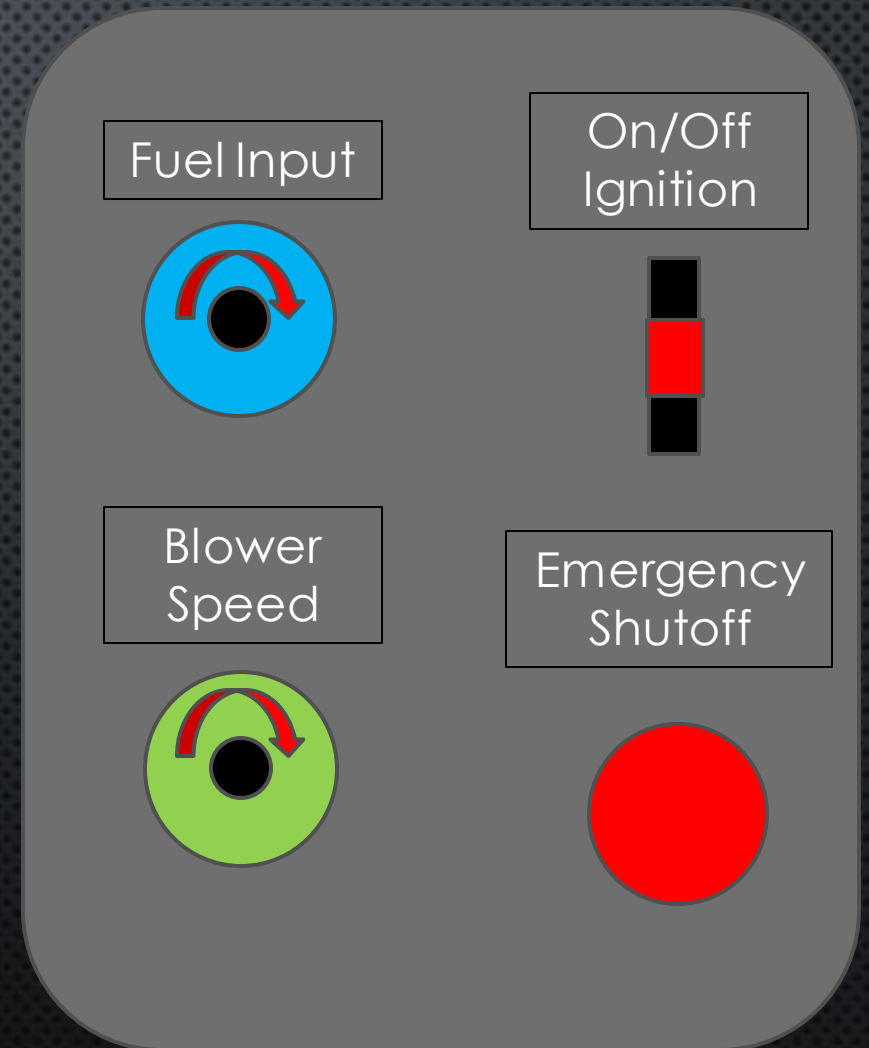
- AUGER SPECS

- 18" LENGTH
- 4" FIN DIAMETER



# SYSTEM CONTROL PANEL

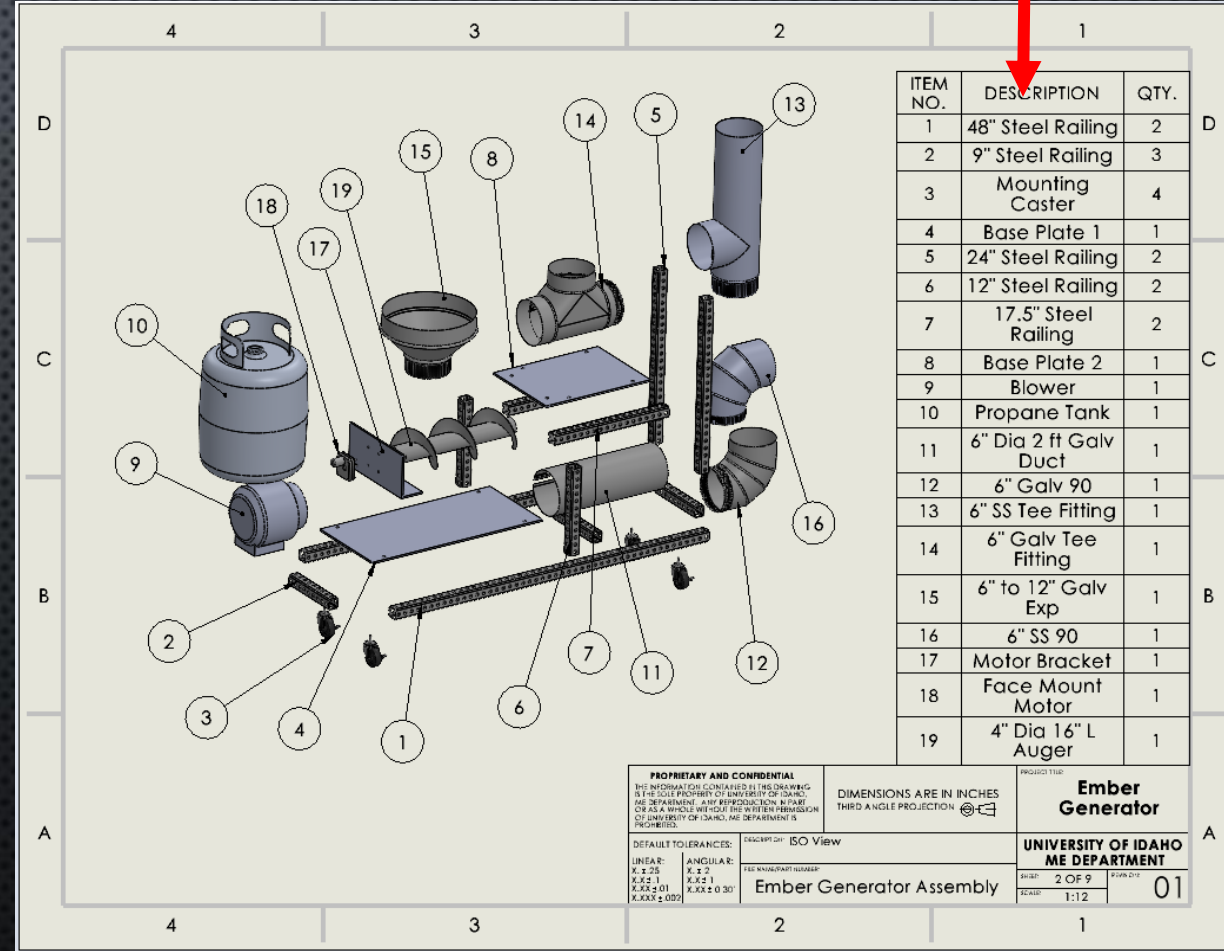
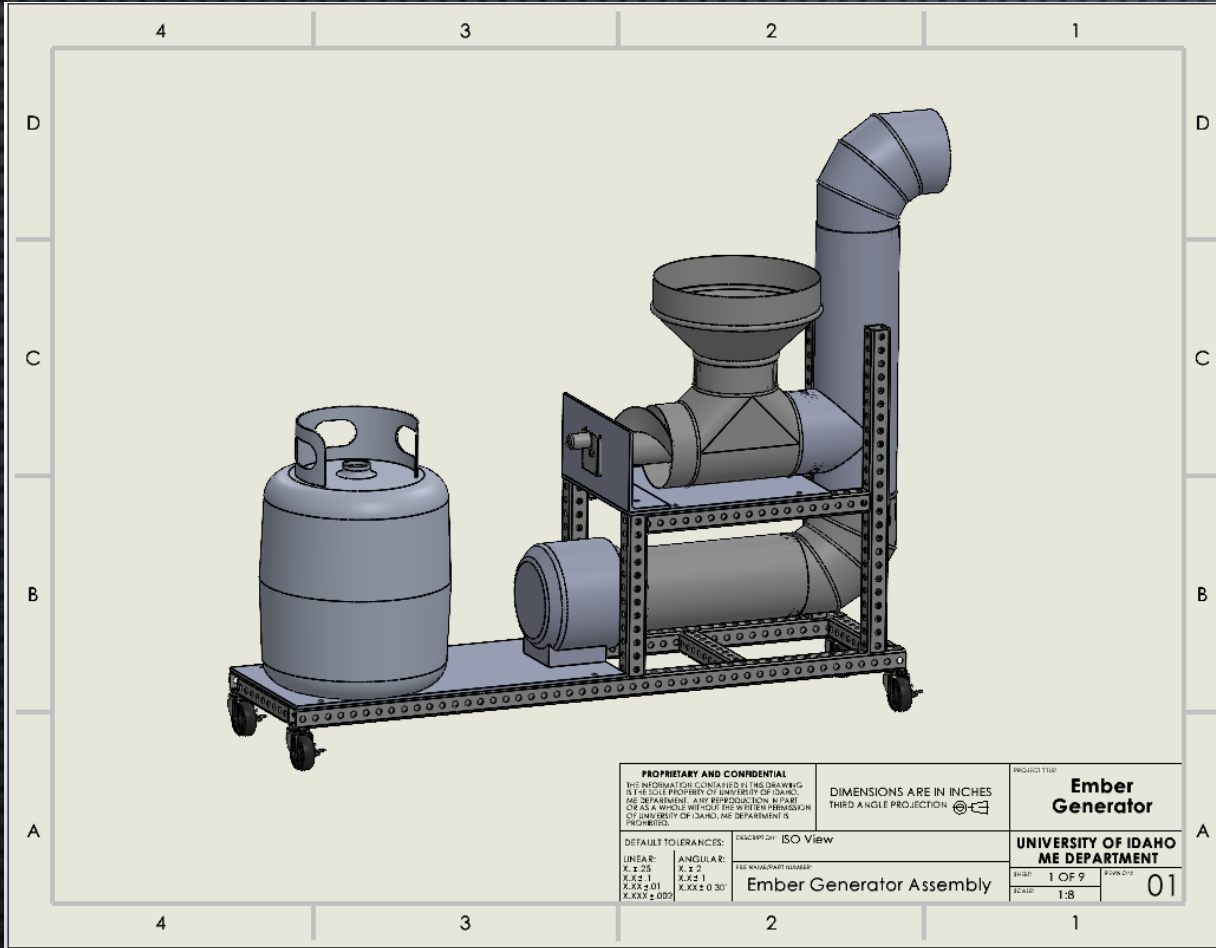
- AUGER MOTOR CONTROLLER CONNECTED TO FUEL INPUT DIAL
- BLOWER CONNECTED TO BLOWER SPEED DIAL
- SYSTEM IGNITION TO ON/OFF SWITCH
- ELECTRONIC VALVE TO EMERGENCY SHUTOFF
- LOCATED INSIDE FIRELAB CONTROL ROOM



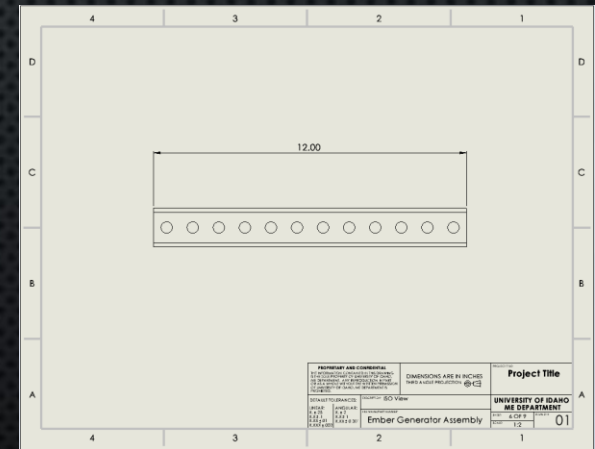
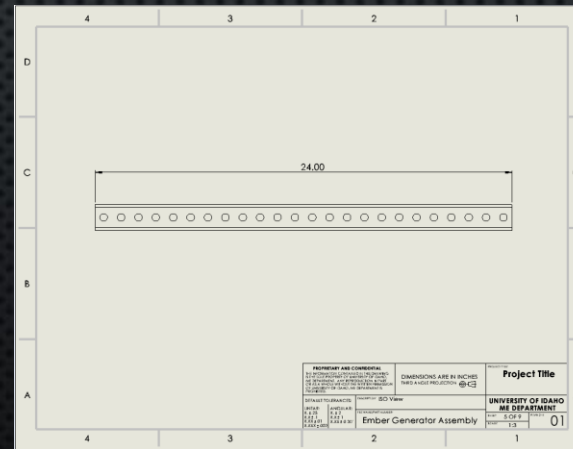
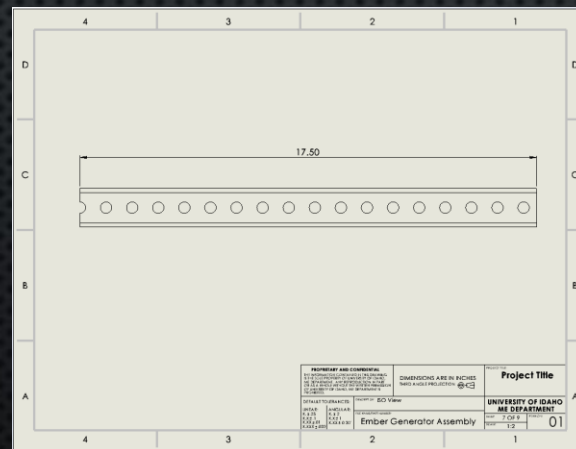
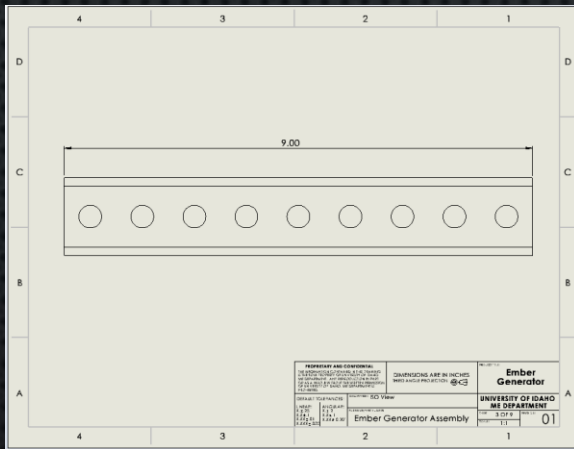
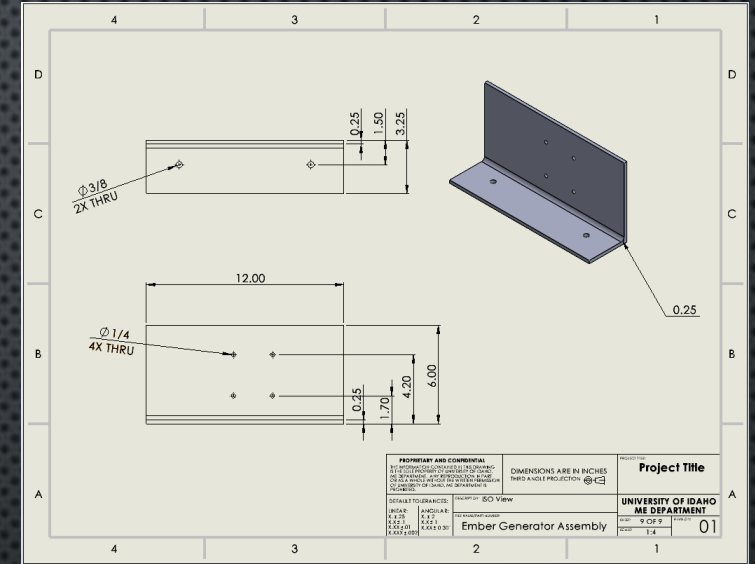
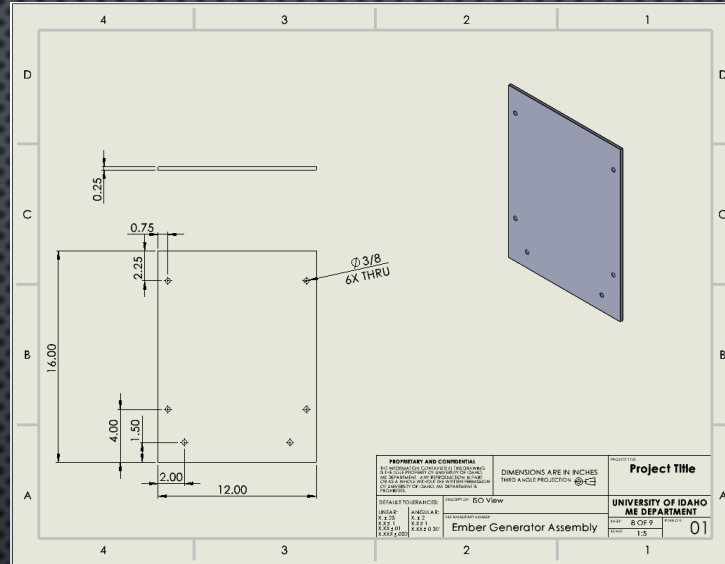
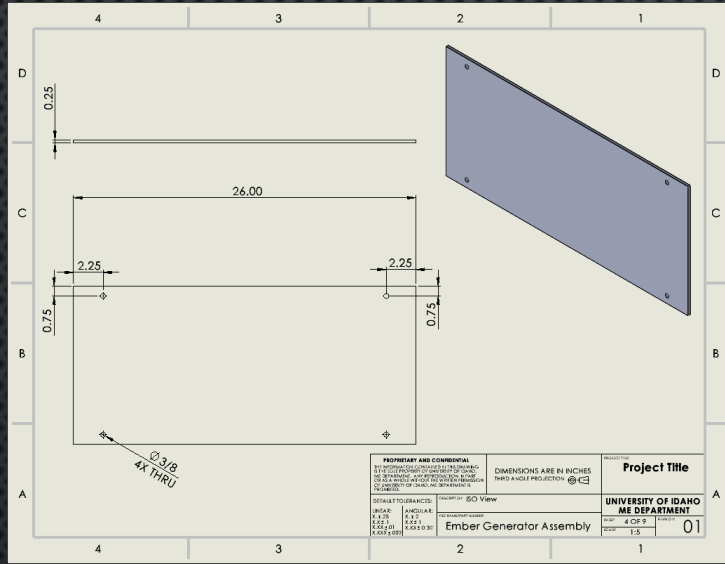


# SYSTEM DRAWINGS

BOM



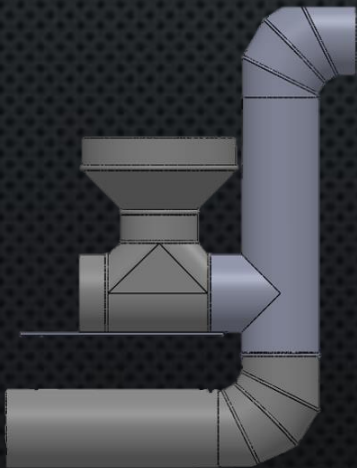
# CUSTOMIZED PARTS



# MANUFACTURING PLAN

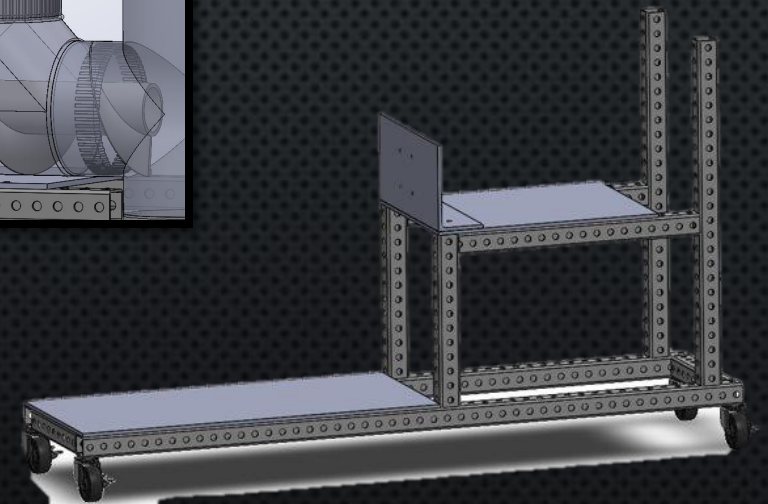
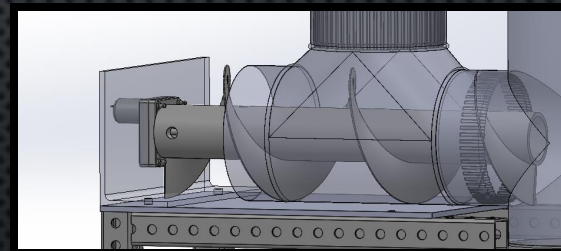
## Purchase

- Electrical Components
- Fasteners
- Piping
- Propane Burner



## Manufacture

- Frame
- Motor Mount
- Auger Feed System





# MANUFACTURING PROCESSES

# COST

Frame	Cost	Components	Cost
Railing	\$204.72	Propane and Accessories	\$136.70
Ducting	\$282.31	Auger System	\$270.00
Hardware	\$279.42	<b>TOTAL</b>	<b>\$1173.15</b>

## POTENTIAL RISKS

- INHALATION OF LARGE AMOUNTS OF SMOKE BY STUDENTS/RESEARCHERS PRODUCED BY EMBER GENERATOR
- EXCESSIVE AMOUNT OF EMBERS PRODUCED AND POTENTIALLY CAUSING A FIRE WITHIN FACILITY
- STOVEPIPE CAN BECOME EXTREMELY HOT TO TOUCH



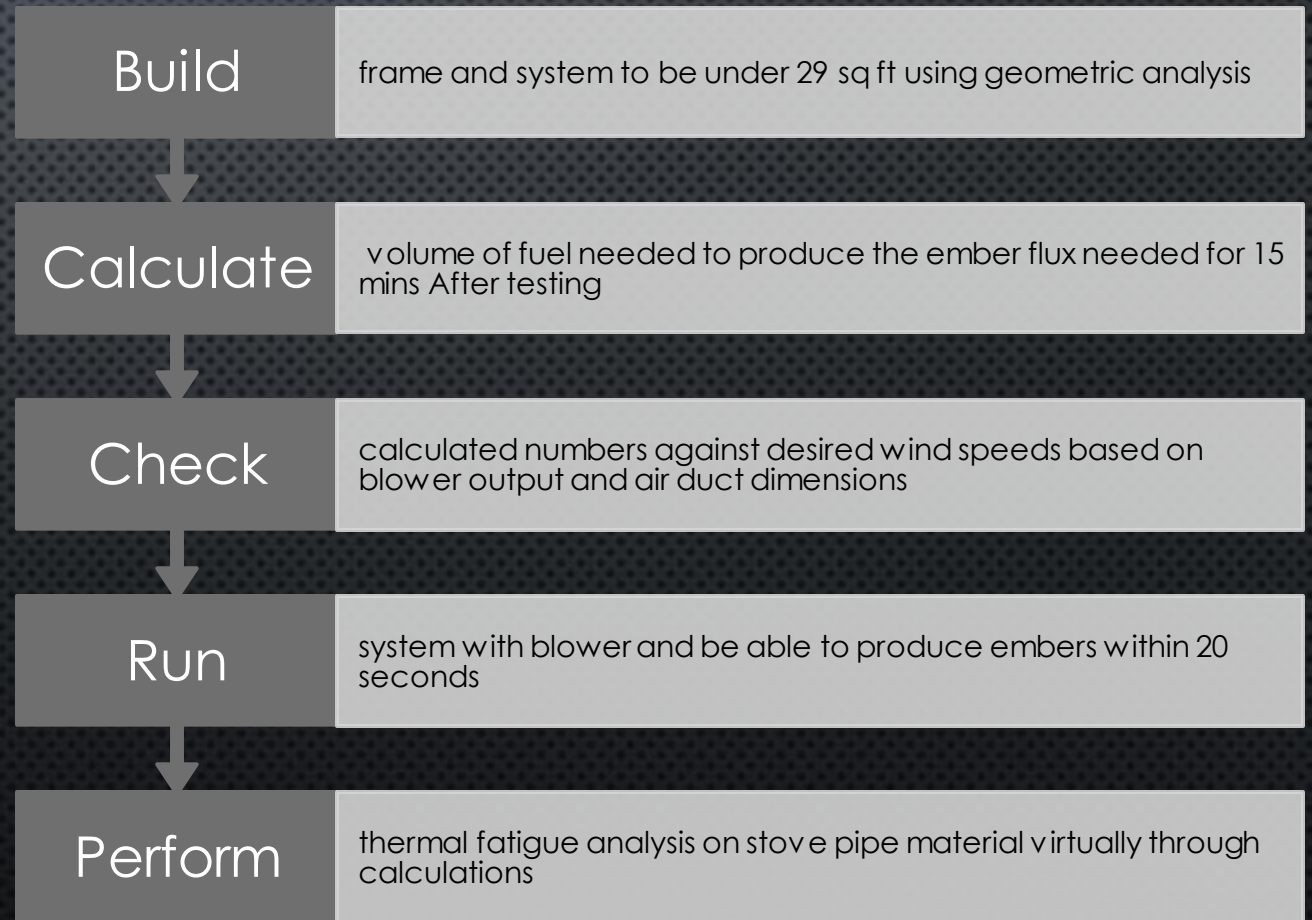
# RISK MITIGATION

- EMERGENCY SHUTOFF SYSTEM
  - ELECTRIC VALVE SHUTOFF
  - OPEN WINDOWS AND DOORS OF FACILITY WHEN SMOKE IS OVERWHELMING
  - OPERATORS WEAR GLOVES AND FIRE COATS



# DESIGN VALIDATION FOR PROTOTYPE REQUIREMENTS

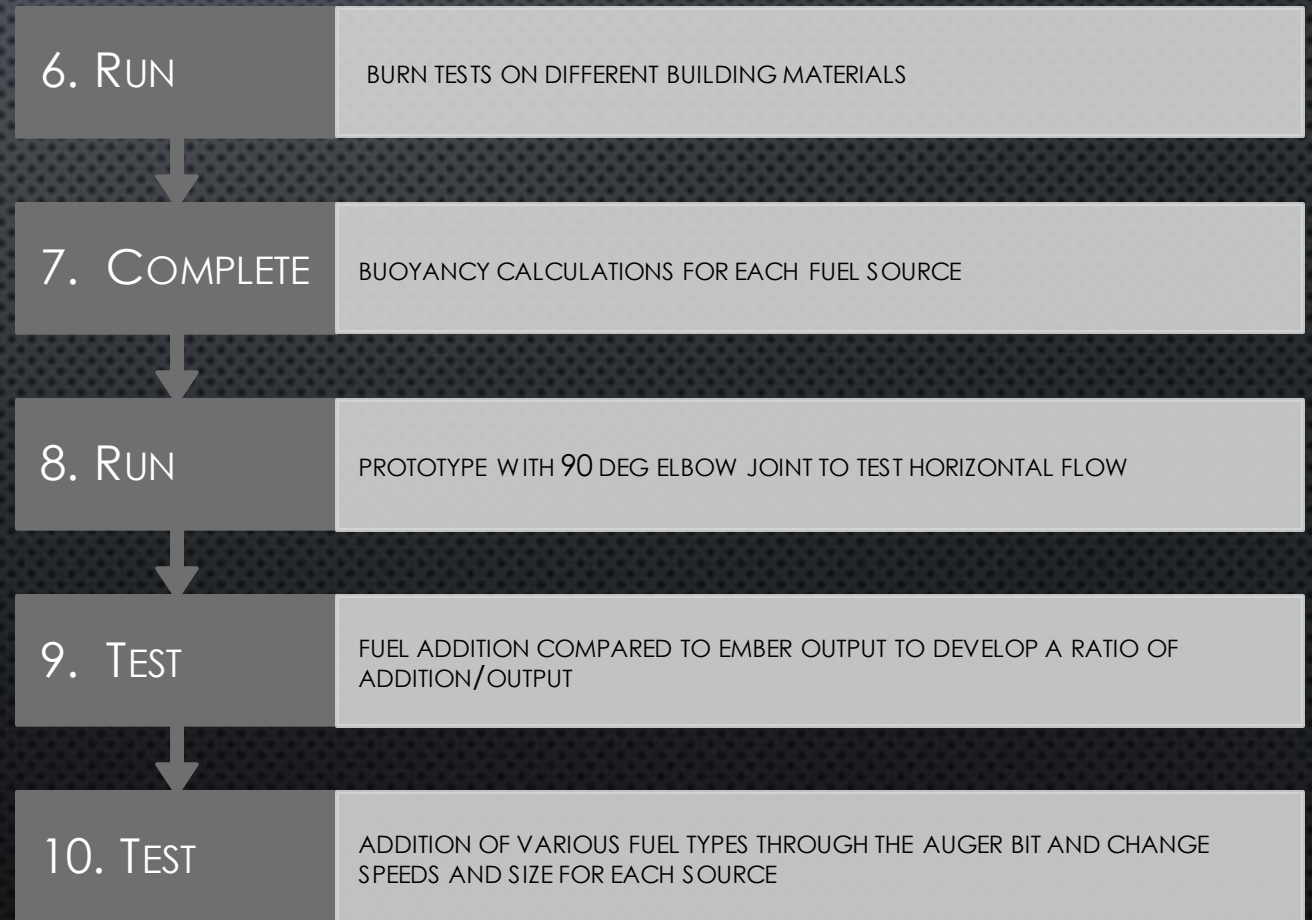
1. 6.5' x 4.5' SIZE TO FIT IN STANDARD TRUCK BED
2. RUN AUTONOMOUSLY FOR AT LEAST 15 MINS WITHOUT REFILLING SOURCE FUEL
3. DESIRED AIR SPEED: 10-30 FT/S
4. BURNER MUST QUICKLY IGNITE AND PRODUCE FIREBRANDS
5. MATERIALS MUST BE ABLE TO WITHSTAND HEAT FOR LONG PERIODS OF TIME





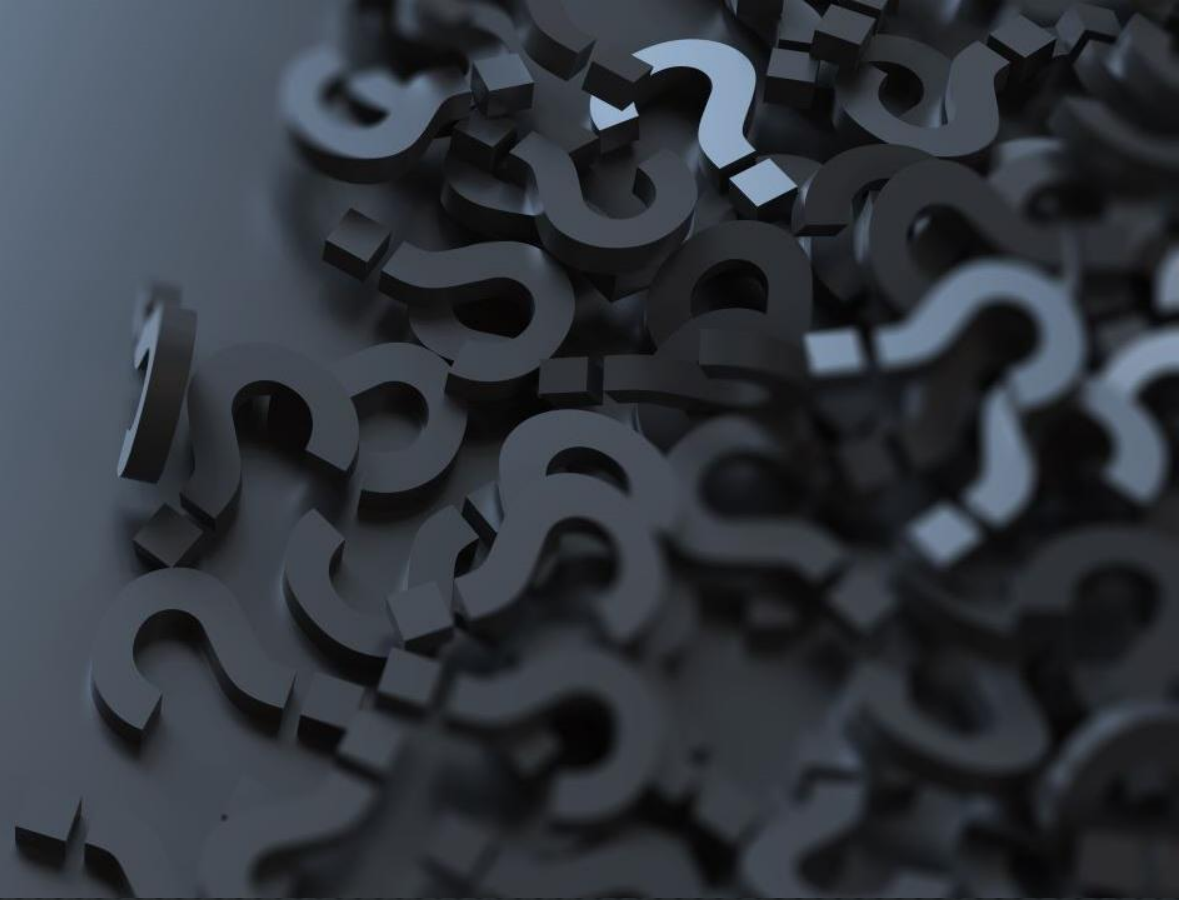
# DESIGN VALIDATION FOR PROTOTYPE REQUIREMENTS

- 6. EMBER PRODUCTION MUST BE ENOUGH TO CATCH BUILDING MATERIALS ON FIRE
- 7. FUEL SOURCE SHOULD BE BUOYANT AND FLOAT IN AIR
- 8. EMBERS EXIT SYSTEM HORIZONTALLY
- 9. FUEL ADDITION SPEED MUST GENERATE PROPER FIREBRAND FLUX
- 10. FEEDING SYSTEM MUST BE ADAPTABLE FOR DIFFERENT FUEL TYPES



# PROJECT SCHEDULE

- FEBRUARY: FABRICATE FINAL PRODUCT /FUNCTIONALITY TESTS
  - TEST AUGER DRILL WITH MOTOR
  - ADD EMERGENCY SHUTOFF SYSTEM
  - COMPLETE FUNCTIONALITY TESTS
- MARCH: COMPLETE FINAL PRODUCT BY SPRING BREAK
- APRIL: PRESENT RESULTS



QUESTIONS?