



# Lunar Washer/Dryer The Astropanthers

Ford Blunt IV, Percy Grady, Noah Crew, Kristopher Moore, Adrian Aker



## Introduction

The primary goal of this project is to design a compact and efficient washer-dryer unit capable of functioning within the unique constraints of lunar gravity (1/6g) and limited cabin space, enabling astronauts to wash and dry their garments during missions. This solution must meet NASA's strict specifications, including minimal impact on cabin conditions by conserving water and power and controlling humidity and temperature to avoid the release of hot or humid air. Additionally, the washer-dryer should integrate seamlessly with the existing spacecraft infrastructure.

## Project Goals

NASA is exploring innovative solutions to improve the quality of life for astronauts on extended missions. During these missions, astronauts must have access to clean clothing without the need to bring excessive amounts of spare garments. To address this, NASA has called for the development of an advanced washer-dryer combo that can function efficiently in a lunar habitat. This unit must adapt to the unique environmental conditions of space, such as reduced gravity and limited resources, and be compatible with existing space infrastructure.

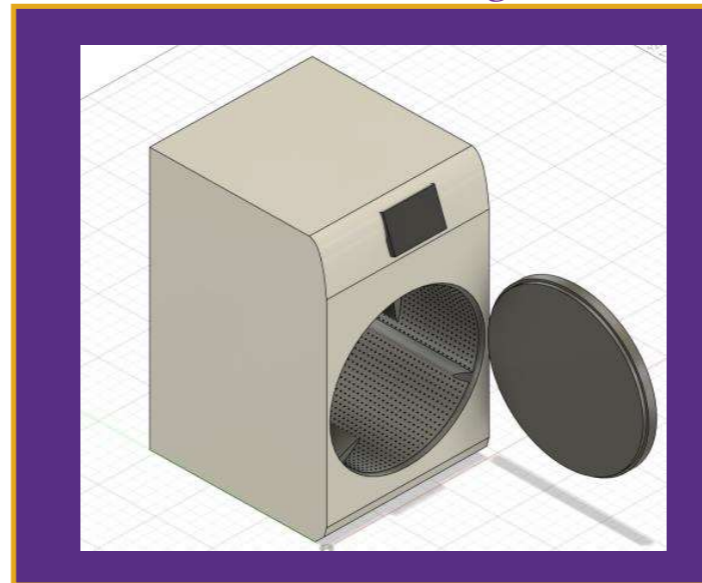
## Design Constraints

- Must be derived from existing washer/dryer all-in-one technology and be optimized for lunar gravity (1/6g)
- Must function reliably and not exhaust heat or humidity
- Must be operational at an atmospheric pressure of 70kPa
- Minimize the use of energy, time to launder, and water usage
- Minimize size and volume of machine
- Clothes must not come out damp

## Washer Functionality

- Similar to terrestrial model in parts
- Longer soak period
- Slower spin speed for washing time
- No rinse cycle
- Higher spin speed for spin cycle

## CAD Rendering



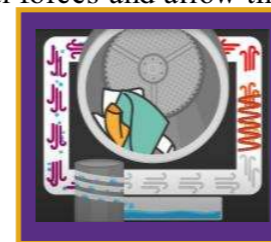
## Description of CAD

The CAD model is based on the GE Profile Front Load Washer and Heat Pump Dryer. It is a horizontal-axis washer and drying machine

## Dryer Functionality

- Air is heated via a heating element and pulled into the drum
- The hot air evaporates and removes moisture from clothes
- The moist, cooler air is sent to a condenser to remove moisture
- The cool air is then sent back through the heating element

The tumbling of clothes is vital when it comes to drying clothes. However, the force of lunar gravity will be unable to overcome the centrifugal force on the clothes. The rpm of the drying cycle will be reduced to decrease centrifugal forces and allow the clothes to tumble.



## Requirements

- Employ pumps, seals, and valves rated for vacuum. Use sealed pressurized compartments.
- Develop a horizontal, or other, tumbler system that could be optimized for lunar gravity conditions, possibly with variable motor speeds.
- The internal components can be installed in dust-proof enclosures. Filtration systems and airlocks could be fitted on entry points.
- Integrate an energy recovery system to recycle waste heat from drying. Plan operations according to peak power availability of solar or any other energy source.
- Utilize pressure-rated seals, designing with fail-safe systems. Provide safety valves that will automatically regulate the pressure in the event of failure.

## Summary

The Lunar Washer-Dryer combo machine is based on a current terrestrial washer-dryer combo machine and optimized to work in a lunar environment. During the washer cycle, it utilizes less water by soaking the clothes for a longer time as well as eliminating the rinse cycle by increasing the spin speed during the spin cycle. During the drying cycle it uses a heat pump to operate as a heat pump dryer, using less energy overall to clean the clothes and preventing hot, humid air from leaking out into the atmosphere.

## Acknowledgments

We would like to acknowledge our advisor Dr. Quincy Moore. We would also like to acknowledge our NASA advisors Michael Ewert and Andrew Arends.

## Future Plans

- Wiring plans and logistics
- Code for different cycles
- Physical model
- Water recycling system

