# Modular Acoustic Suppression System (MASS)

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## Background

Currently, the Environmental Control and Life Support Systems (ECLSS) in the human lander produces noise outside of the specified Noise Criterion levels affecting astronauts' sleep, concentration, and communication.

**Objective:** Design an innovative solution to reduce noise generated by ECLSS systems in long-duration space habitats.

## Design Specifications

**System Constraints:**

- Minimal barriers to NASA adoption (low mass, low power consumption)
- No additional risks to crew
- Mission operational life of 30-days for lunar missions, 1200-days for Mars missions

**Design Specifications (assuming use of 10 panels):**

| Specification | Required Value | Design Value |
|---|---|---|
| Acoustic | 63-200 Hz, 50-64 dB | 63-200 Hz, dB requires testing |
| Weight | <1000 lb | 83.5 lb |
| Power | <9.5 kW | 1.36 kW |
| Volume | <15 cubic feet | 1.13 cubic feet |

## Mechanical Design

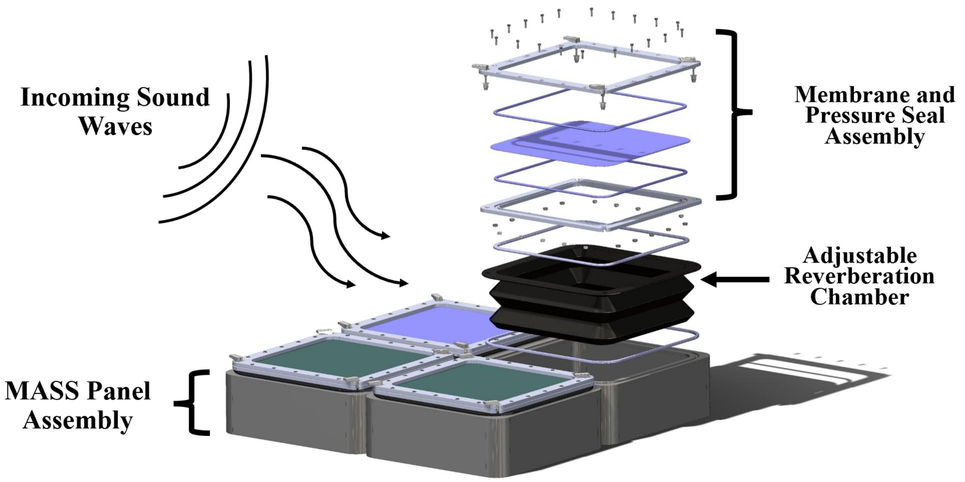
**Details and Innovations:**

- Tuned membrane absorber reduces frequencies ranging from 60-200 Hz
- Interchangeable flexible membranes of varying densities can be used to target different frequency ranges

**Key Features:**

- Noise Reduction – Flexible membrane reduces sound by achieving resonance with incoming sound waves.
- Adjustable – Chamber height is adjusted by linear actuators that respond to varying frequency inputs, changing membrane's resonant frequency.
- Compact and Modular – Components are contained in modular sections for ease of use.

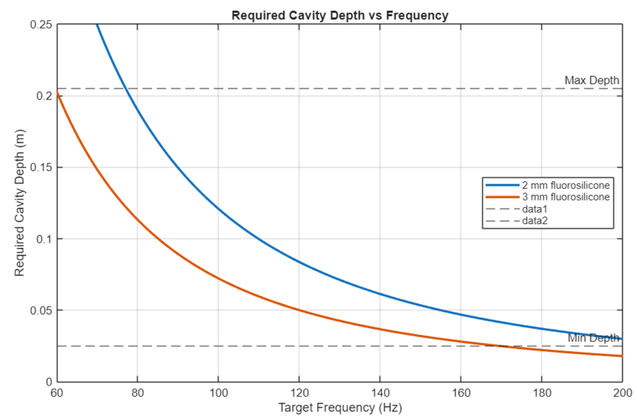
## Final Design




## Analysis

**Membrane Selection:**

- Analyzed as oscillating mass-acoustic spring-damper
- Required depth plotted from mathematical derivation and analyzed in MATLAB




***Plot of Required Depth for Target Frequencies***

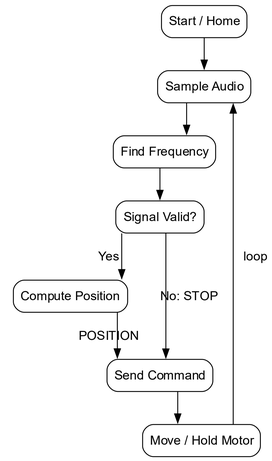

**Pressure Equalization:**

- Functions by equalizing to surrounding pressure during operation ($P_{inner} = P_{outer}$)
- Air released through bottom aperture allowing equalization while maintaining constant air volume during operation

## Control/Electrical Design

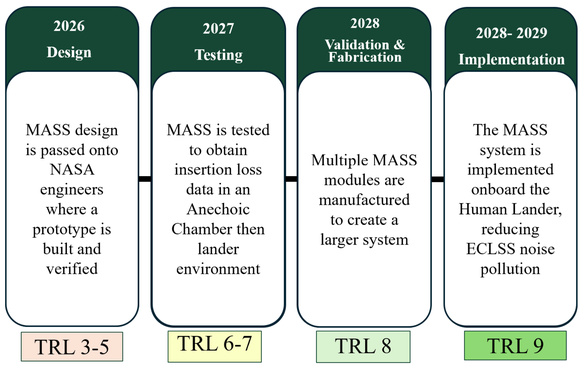
**Key Features:**

- Acoustic feedback – allows for active adjustment based on environmental input
- Control system – takes measured frequency as an input and outputs a positional height for linear actuation




***Control System Design***

## Path-to-Flight Project Timeline




## Budget

**Lifecycle Development Cost:** $5.6 M

## Future Steps

- Further testing required in anechoic chamber to verify noise suppression (TRL 6-7)
- Conduct durability testing representative of space environmental conditions
- Integrate and test the system within an ECLSS layout to determine feasibility and operational effectiveness
- Integrate MASS onboard the Human Lander (TRL 9)