

Impossible Industries

ENME 444: Mechanical Engineering Systems Design, Spring 2020

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Project Description

Background: In UMBC's materials and fluids laboratory, there is a fatigue testing machine that produces an excessive amount of noise. Exposure to the high noise level can be damaging to the ears of the students, teaching assistants, and professors in the lab. Additionally, communication is made extremely difficult when testing is in progress.

Objective: Design an insulated chamber to reduce the noise emitted by the fatigue testing machine

System Requirements

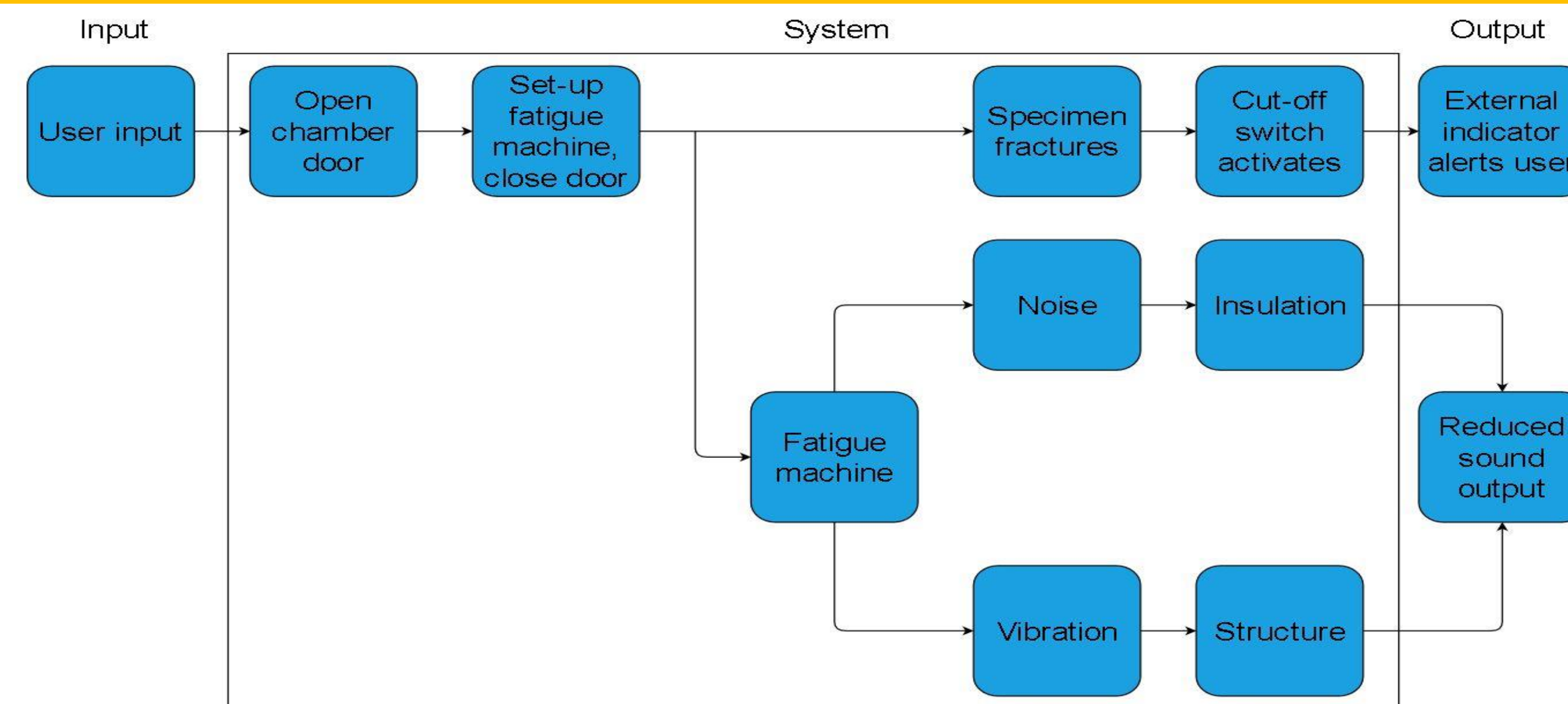


Figure 1: Functional Block Diagram

System requirements were determined based on the system functions as follows:

- Shall not hinder the users' to fully access and utilize all components of the fatigue testing machine
- Must have an indicator to alert the user when the test is over
- Must reduce the sound pressure level to 50 dB or less

Final CAD Model



Figure 5: Front view of insulated chamber partially opened

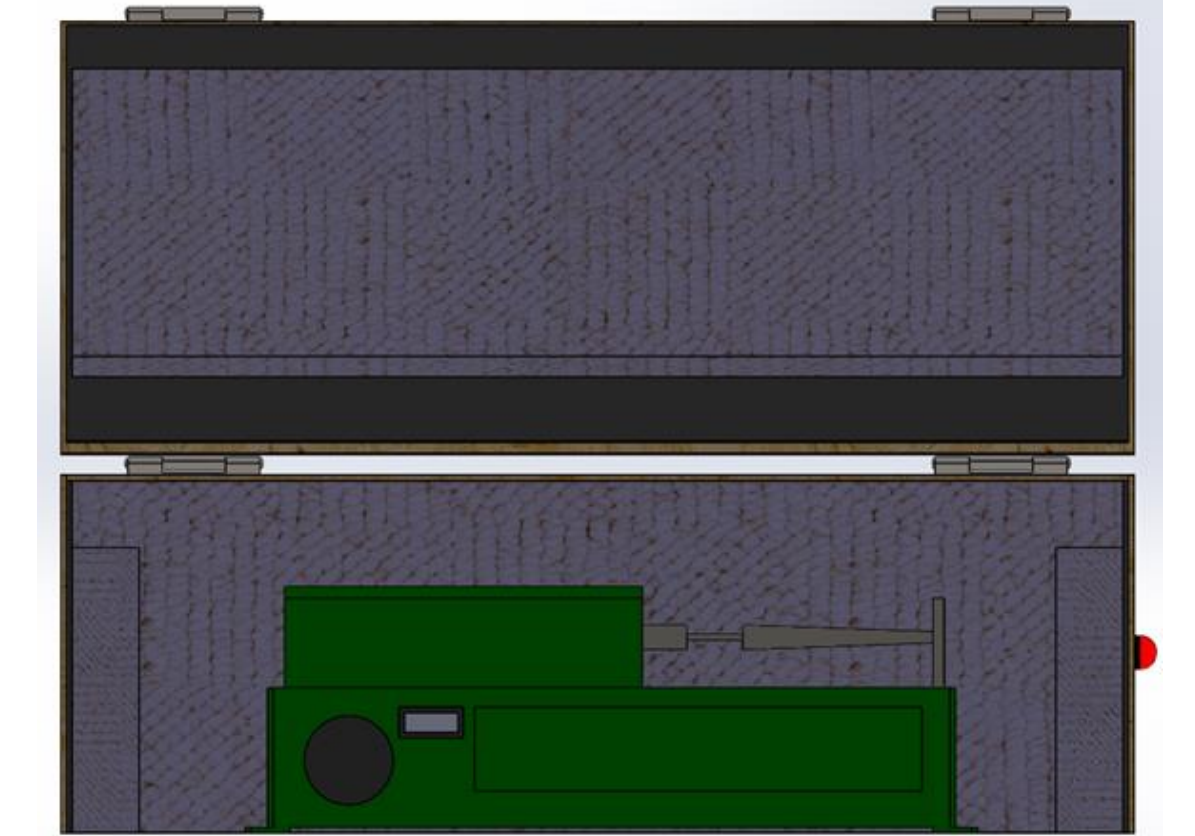
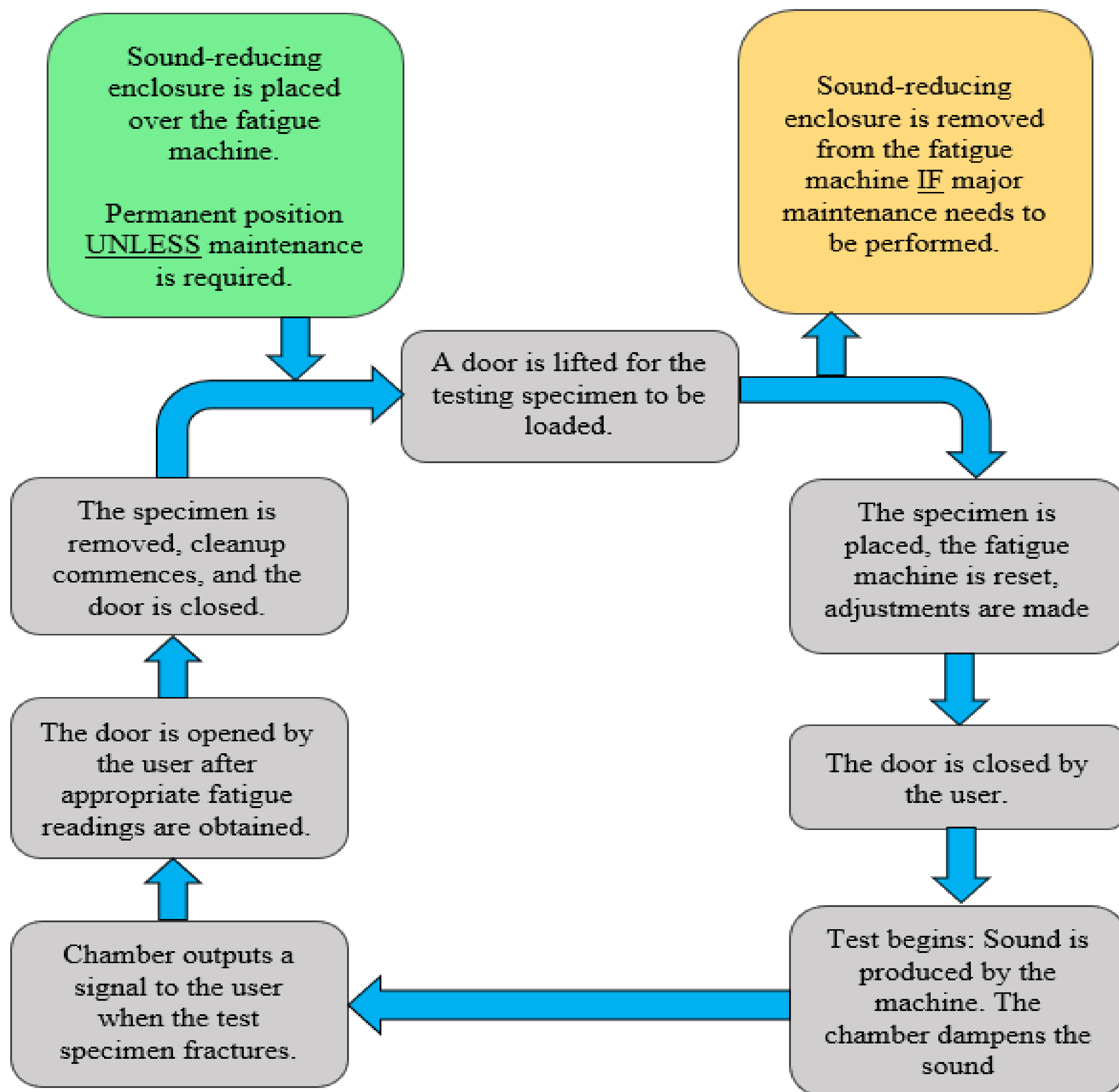


Figure 6: Front view of insulated chamber fully opened

Mission Scenario Diagram



Acoustic Analysis

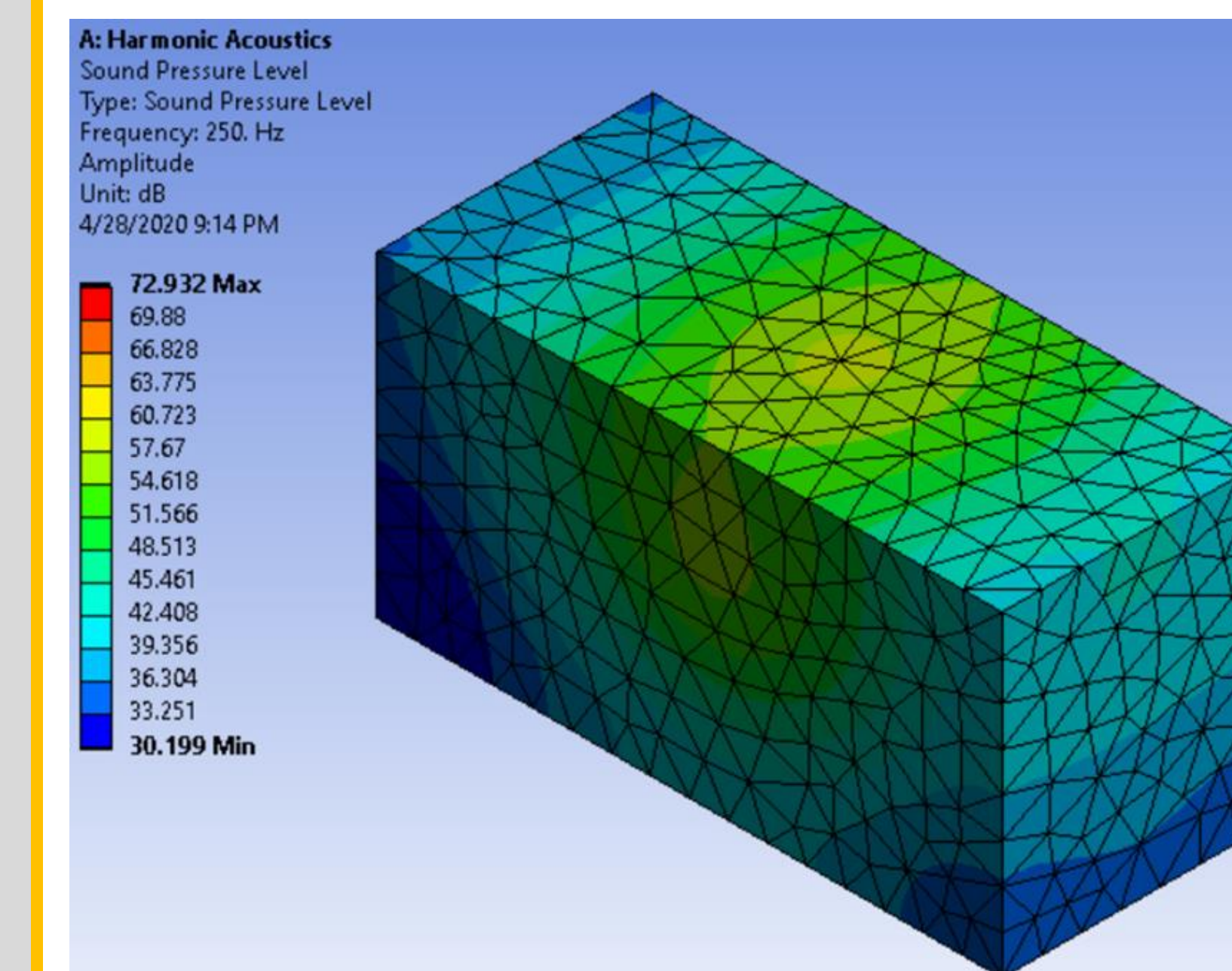
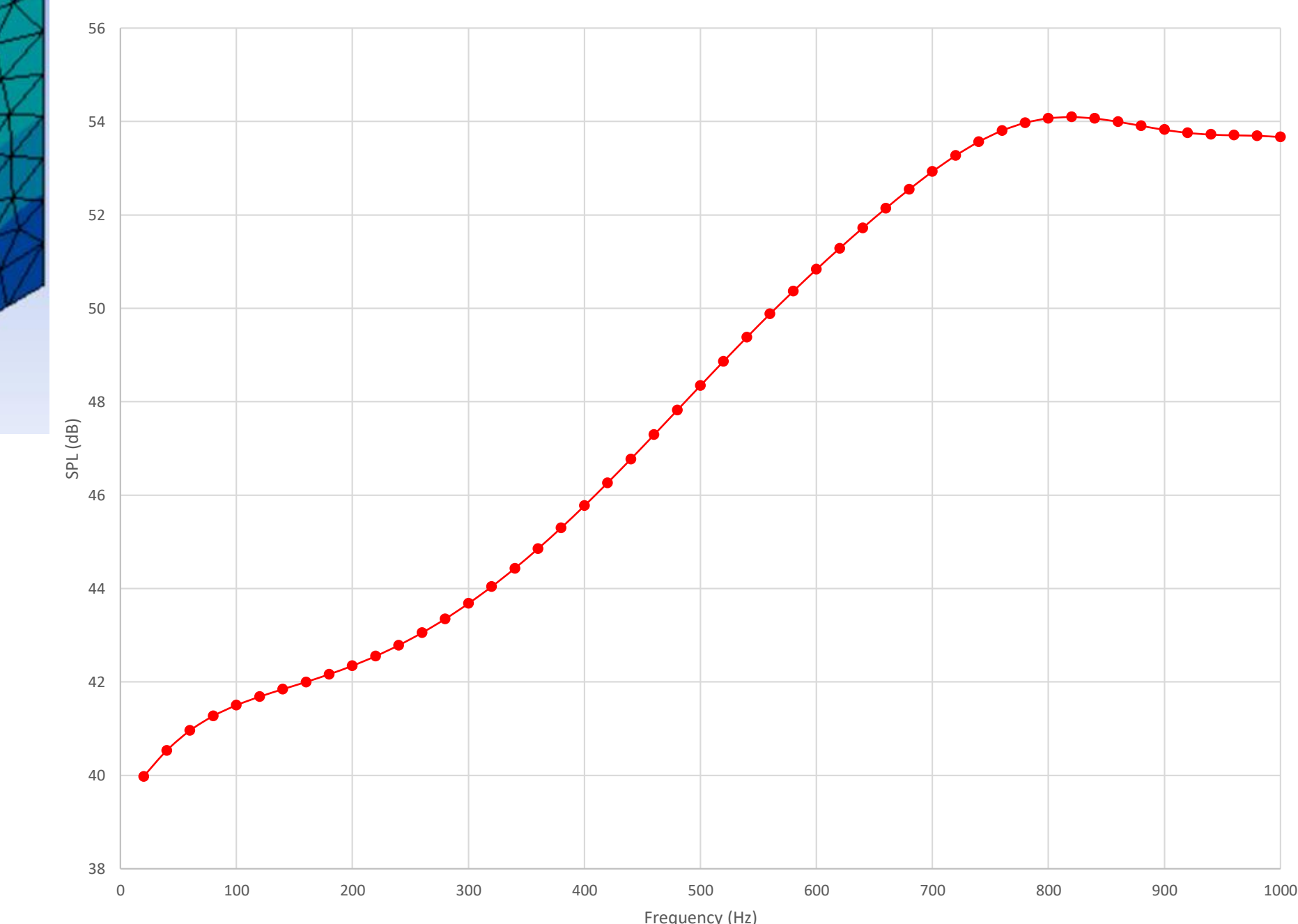


Figure 7: ANSYS finite element analysis of sound pressure level distribution. Average sound pressure level of 43 dB

Figure 8: Sound pressure level vs. frequency plot. Less than 50 dB at frequencies below 550 Hz



Design Evolution



Figure 2: First design with single set of hinges on front of chamber. Determined to limit accessibility to the top of the fatigue machine

Figure 3: Second design with single set of hinges on back of chamber. Difficulty opening due to door shape/size

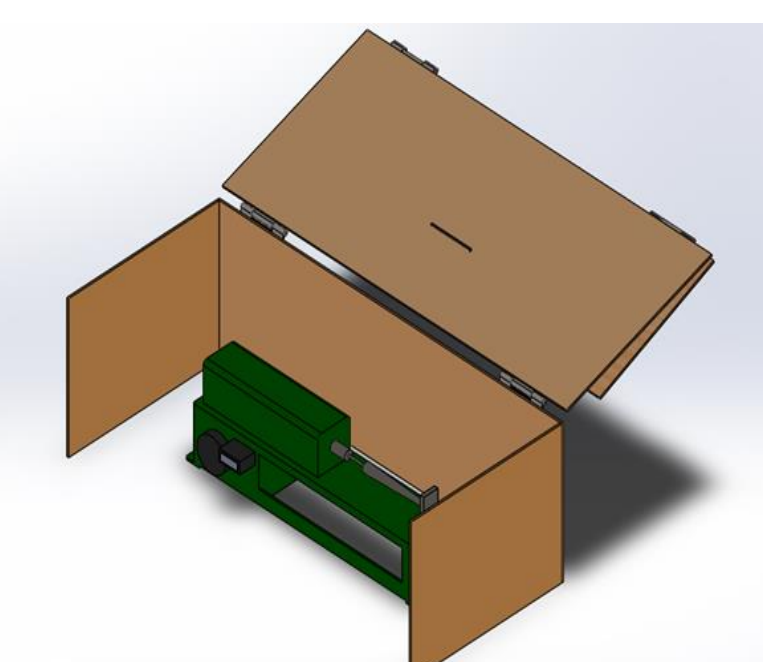
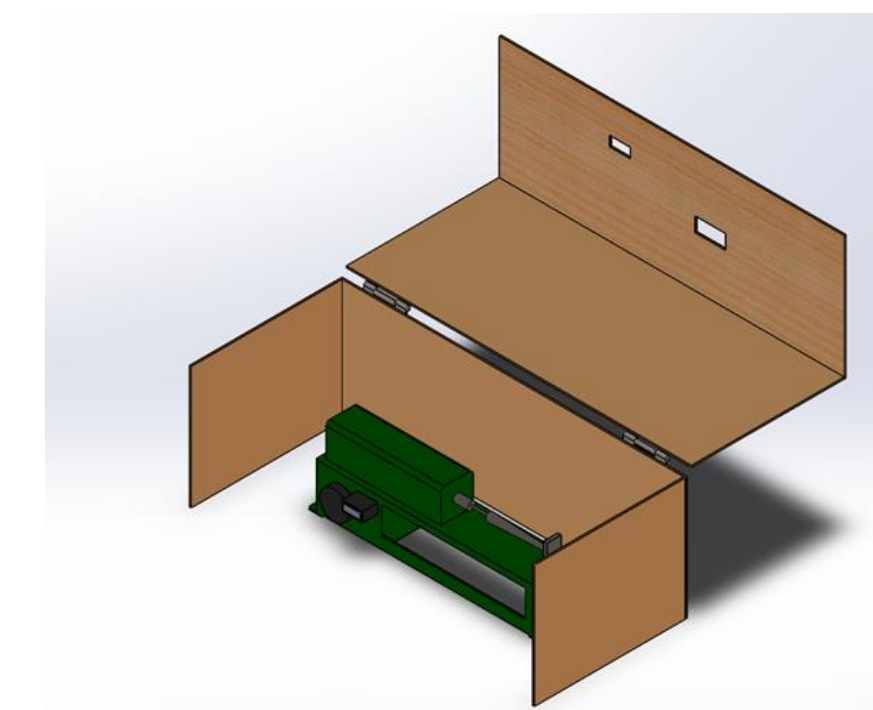


Figure 4: Final design with two sets of hinges (front and back of chamber) for full access to fatigue machine and ease of opening

Laser Sensor Circuit

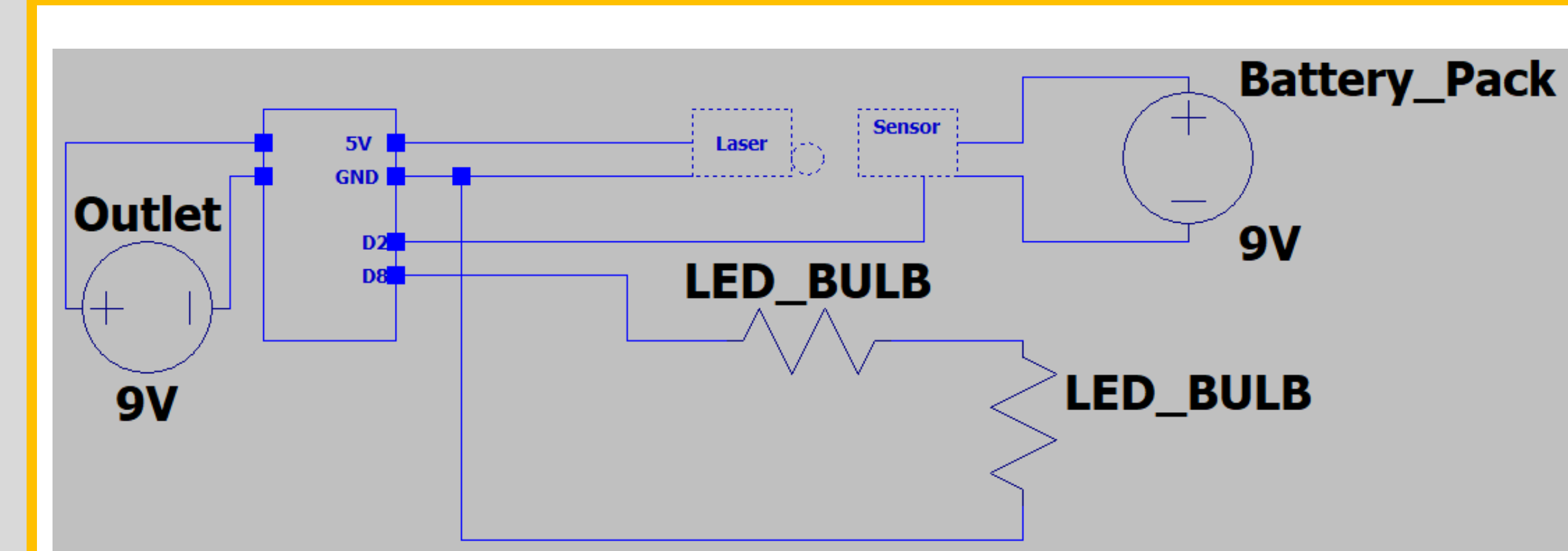


Figure 9: Circuit schematic. Fatigue machine will trip laser sensor and LED will indicate the test is over