Target Summary

The top priority for this project is minimizing porosity (<1%). This target was stated by the Project Liaison, Dr. Phillip Flater. Porosity is the top priority due to the application of the products the device will create. The final device will use explosives in place of Sylgard and fill lattices to be placed inside of ammunitions. Having any voids inside the explosive structure can cause an uneven load distribution resulting in early structural failure and even premature explosions. Air voids will also cause the ammunition to experience hot spots once detonated. Hot spots can cause an improper explosion and potentially cause unintended damage.

To measure the porosity target, two methods will be used. The first method is via serial sectioning. This is a destructive process in which the filled lattice will be cut in small slices and the number of voids will be calculated from sight. The findings will be reported via a porosity density ratio. The ratio will be calculated by comparing the expected mass to the actual mass of the filled lattice. The expected mass will be calculated using the weight of the empty lattice, the volume of the empty lattice, and the density of the Sylgard. This method will allow for non-destructive porosity measurements which will be reported in the same manner as the serial sectioning.

Other targets that will need to be met will include keeping the working pressure and time within limits set by the material and equipment. The working pressure needs to be at least 28 mmHg (0.54 psi) to completely degas the silicone. While this is a relatively low pressure, it will need to be verified that a vacuum pump that can achieve this can be acquired and the pressure will not interfere with other sub-processes of the device. This pressure was determined from background research (Smooth-On, 2017). The number will be verified empirically using a vacuum with a pressure gage. The working time of silicone is limited by the pot time. Pot time is

defined as the amount time a material takes to double in viscosity (Dow Corning, 2004). After the pot time for Sylgard 184 (1.5 hours) (Dow Corning, 2004) is reached, the material will become harder to work with and may no longer be able to be manipulated for insertion or movement. Before the pot time expires, the device will need to degas the silicone and fill the lattice. The time for filling the lattice must be short enough to allow time for the other steps of the process (transportation of the silicone, degassing, etc.) and allow for extra time to rid the lattice of any extra voids that may have occurred during filling. However, the fill time must be long enough to ensure excessive bubbles are not introduced to the structure. Degassing of the silicone must also occur before the allotted pot time. The degassing time will need to be determined empirically to reach optimal air purged from the silicone which is determined by visual inspection.

The steps of the process should be as simple and as few as possible. This will ensure that the user of the device will be able to properly use it with no equipment or user failures. The number of goal steps will be limited by the complexity of the final chosen design.