Modified Cylinder

Once our design was complete, it came to our attention by Dr. Cesar Luongo that there were some design flaws. Primarily, the spring will produce its maximum force when the least amount of force is needed and its minimum force when the most force is needed. The spring would rapidly swing the roof open at first, slow down to a halt, and then provide scarcely any support to the workers as they lift the roof the remaining distance. Since the object of this design is to assist the workers, forcing them to lift the entire roof at all, even a short distance, is not acceptable. Additional forms of power were discussed and researched and one of the constraints was lifted to help make a final decision.

It was decided that the design shown in Figure 6-6 is still adequate for what we need, however, it will be modified slightly. The spring will not be used because of the reasons stated above. Compressed air will be utilized to cause the motion of the piston, which will move the piston arm. Originally this approach was not considered because Lockheed Martin did not want to use compressed air, however, late in the design process they changed this constraint and this method became available. The air will come from an air container that can produce a maximum pressure of 160 psi. Figure 7-1 shows the new interior of the cylinder.

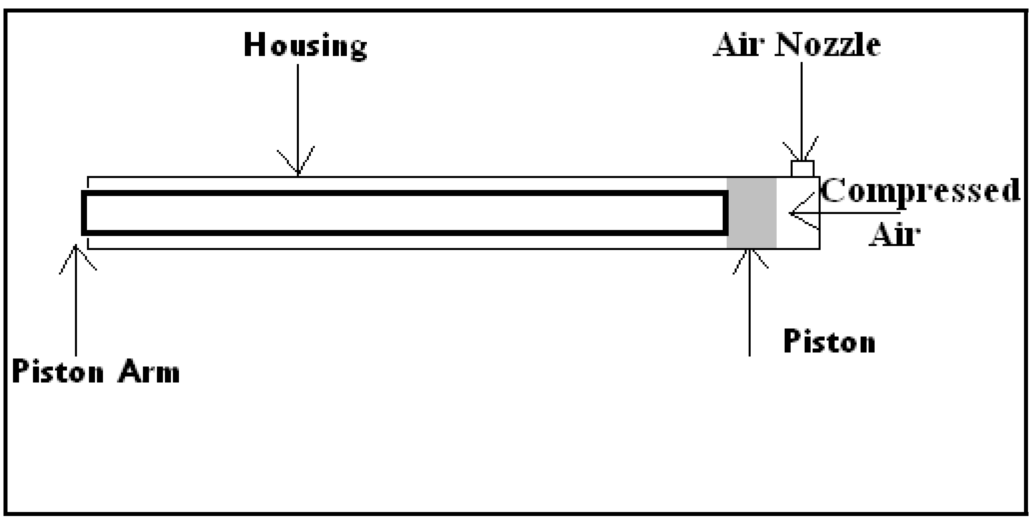

Figure 7-1: Schematic of Interior of Pneumatic Cylinder

A new calculation needed to be completed to determine how much pressure will be needed to open the roof. The forces needed to open the roof were calculated earlier, so to determine the pressure the force is divided by the area of the piston. Table 7-1 and Figure 7-2 show the pressure verses the angle of the roof.

Angle (deg)	Pressure (psi)
90	0
80	10.1
70	20.0
60	29.2
50	37.6
40	44.8
30	50.6
20	54.9
10	55.7
0	58.4

Table 7-1: Air Pressure Needed at Different Roof Angles

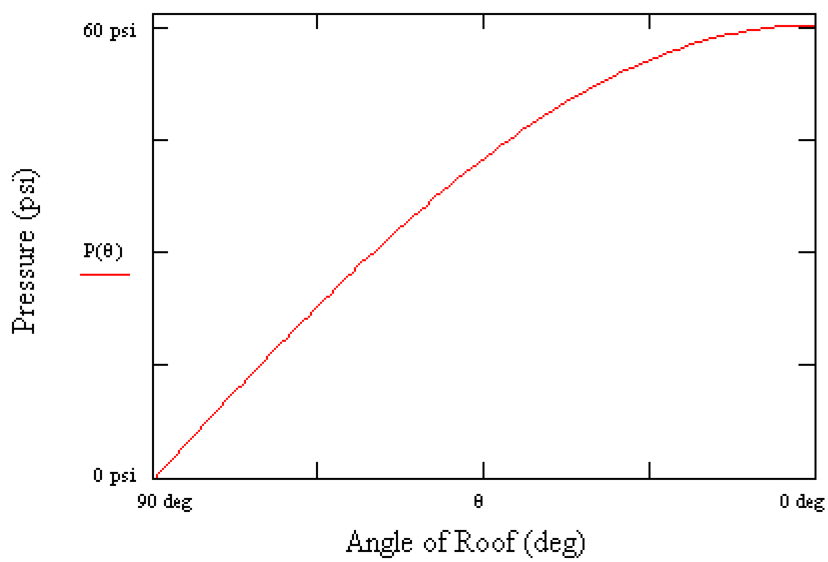

Figure 7-2: Angle of Roof vs. Pressure

Table 7-1 shows that the maximum pressure that will be needed to open the roof is 58.4 psi. The available air tank can exert a maximum pressure of 160 psi, so this tank can be used in our design. Figure 7-2 shows that as the angle of the roof increases, the pressure needed to open it also increases. Another reason why this approach is improved over the spring idea is that it can be controlled. Once the spring was unlocked, it could not be controlled. The air canister, however, has a valve that a worker can open and close and it has a pressure gauge, so the pressure can be monitored. The worker can start with a small pressure when the roof is closed and increase it as it is needed.

Once the pneumatic cylinder idea was reviewed and accepted by the team, the question of whether to build or buy one came up. Originally the idea was to build a pneumatic cylinder and test it within our design. We eventually decided against this because of the complexity of designing and building a pneumatic cylinder. We agreed that it would be very difficult to machine a perfect pneumatic cylinder that did not leak without the proper tools and machinery. Because of this, we decided to purchase one from McMaster Carr. Our main concern was that if we built a pneumatic cylinder and our design failed to work, there would be two possibly reasons. The device could have been poorly designed or the pneumatic cylinder could have been poorly constructed. Since our concern is to build a device that can lift the roof of the VCCT and not whether or not we can construct a pneumatic cylinder, we decided to purchase one that we could have confidence in. So if the device did not work, we would know that it was designed poorly. This will allow us to spend all of our time testing and improving our design.