# Portable Cleanroom for PIP II

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FERMILAB-POSTER-22-006-STUDENT

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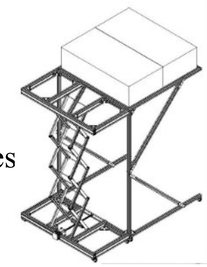
## Abstract

A cleanroom is an engineered space which maintains a very low concentration of airborne particles. The goal of the cleanroom is to ensure that outside particles do not interfere with any sensitive objects inside the cryomodules when making proper vacuum connections. The overall goal was to build and design functional cleanrooms that met the standards of ISO of 2 or better.
The cleanroom designs are unique. The team designed a safe and easy to set up and put away for travel in the Fermilab Facility testing center for retrieving data of the experiments performed.

## Introduction

When building the cleanrooms, the team had to ensure that the cleanroom was built to fulfill the tasks of supporting the weight of the HEPA filter units, easy assembly, the technicians being able to see when doing tasks, and being able to fit in allowed spaces. Also, just as important, we had to follow the guidelines for safety and regulation codes for building a cleanroom. For the cleanroom to work in the testing area to collect data from research, it had to be surrounded by the clear curtains that would avoid any air from the outside to disrupt any values. An example of the Stand-In cleanroom in figure 1.

Figure 1: Stand-In cleanroom with HEPA Filters and Scissor lift



## Methods and Materials

The team had to build and design a few things to help with the cryomodules. A Stand-In, and glove box cleanrooms and lastly a scissor lift. The Stand-In cleanroom had difficulties with the two HEPA filters on top. The glovebox was similarity the same design as the Stand-In, but it had a smaller frame and one HEPA filter. Both Cleanrooms will have LED lights for visibility due to the area. Lastly the Scissor lift was designed for the HEPA filters to be placed on top of the cleanroom for quick and easily removable for client to move and resemble in another area to work with for the cryomodules. The scissor lift needs motor to move up and down the cleanrooms. The team had an issue on where to put the motor, so the decision was to place the motor on bottom of the scissor lift.
The team chose to work with Aluminum because of the great strength to weight ratio it provided to us. Figure 2 displays The type of Aluminum used was perfect because it allows for better assembly because of its unique shape and overall appearance. Due to that reason, support structure was easily accessible without compromising the integrity of the cleanroom frame.
The aluminum used had an advantage of not rusting over time.

Figure 2: 80/20 Aluminum T-slots

## Results ( ANSYS results)

Figure 3 shows the deformation of the cleanroom. Blue being the lowest and red being the highest deformation. The max deformation is 13.967mm.

Figure 3: Deformation of Stand-In cleanroom

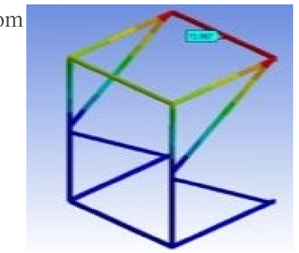
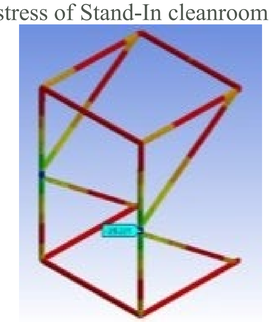


Figure 4 shows the bending stresses of the Stand-In. Red being the lowest and blue being the highest. The max bending stress is 29.221 Nm.

Figure 4: Bending stress of Stand-In cleanroom



## Results continued

Figure 5 shows the deformation of the cleanroom. Same as before with the colors The max deformation is 3.28mm.

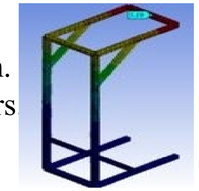


Figure 5: Deformation of Glovebox

Figure 6 (Picture to the right): shows the bending stress of the cleanroom. Same as before with the colors. The max bending stress is about 4.8 Nm

Figure 6: Bending stress of Glovebox

## Conclusions

After being approved, we were able to design the best possible cleanrooms and scissor lift that will assist in vacuum connections that worked well to perform a factor of safety of 1.95, which Fermilab National Lab suggested for the cleanrooms. The team enjoyed working alongside Fermilab and want to thank all of the Engineering staff.

## Acknowledgements

Work supported by the Fermi National Accelerator Laboratory, managed and operated by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the U.S. Department of Energy. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this manuscript, or allow others to do so, for U.S. Government purposes.