Tablet Radial Force Measurement Device

Autoliv

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Project Description

- Tablets of explosive material are compacted for airbag deployment. The applied axial force is well known.
- The goal of our project is to measure the radial force acting from the tablet due to compaction forces. The requirement is to achieve repeatability in operation and reliability in data.
- The system is constrained to fit in an industrial environment and to be small enough for the compression apparatus to sit within a mechanical testing machine (270mm x 290mm).

Design Description

- The compression apparatus is a tablet compaction system which attaches to a mechanical testing machine. It applies force to a fine powder and forces it into a solid tablet.
- A load cell oriented along the radius of the tablet produces a voltage under load which is amplified, then read by the Programmable – Logic Controller (PLC).
- The information is processed into a graph using a python script. This information can then be compared to the axial force.

Design

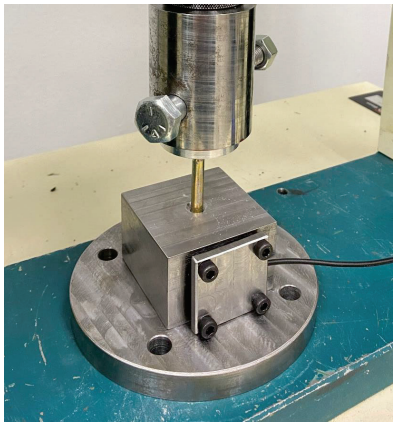

Figure 1. Assembled and installed compression apparatus

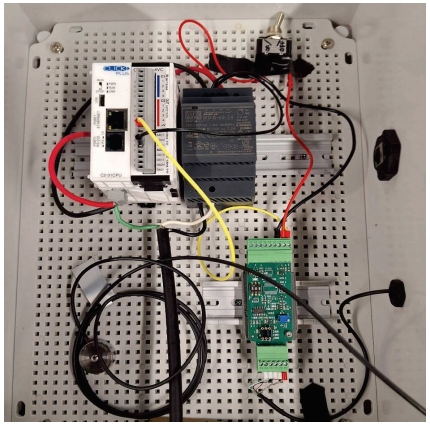

Figure 2. PLC, amplifier, and power source within IP67 rated junction box.

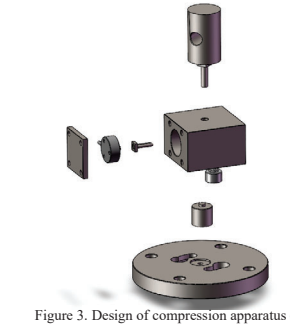

Figure 3. Design of compression apparatus (exploded view).

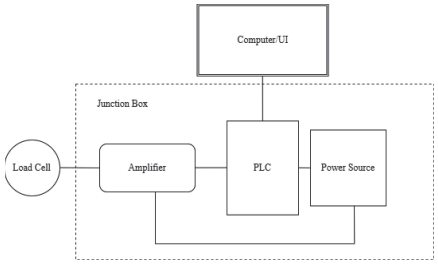

Figure 4. Flowchart describing data and power flow of the system.

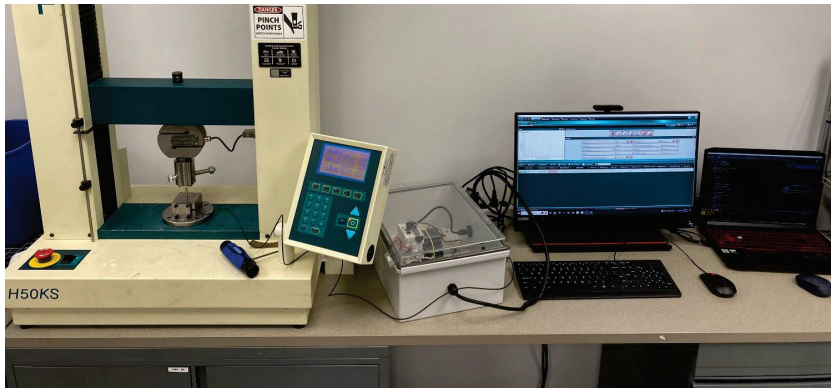

Figure 5. The entire system in operation using a Tinius Olsen H50KS mechanical testing machine.

Performance Review

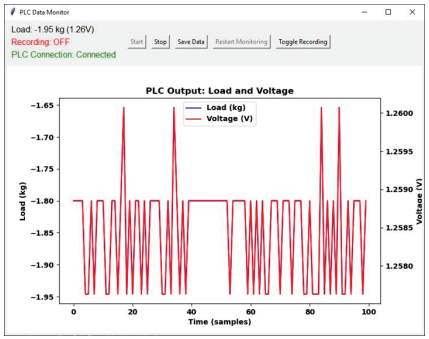

Figure 6. User interface of program during no loading.

- The code presents the user interface seen above. The current state is seen while under no load.

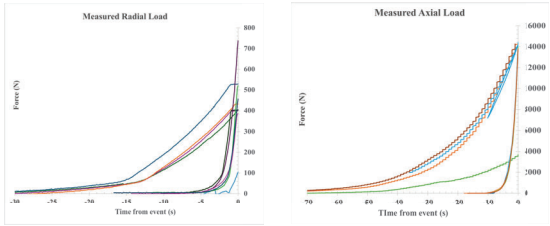

Figure 6 and 7. Axial and radial load measurements from tensile machine and PLC.

With an axial load of 14,250 N, the radial load was found to be 437.91 N ±3.372 N. This is lower than the 1,000 N to 4,000 N we expected.

Conclusion

- With optimal settings, the maximum radial load has an uncertainty of ±42.3 N. This project is repeatable in operation, and it fits within the described space.
- Electronics should be figured out as early as possible, since we struggled a lot with troubleshooting them. It would have also been useful to have a metal prototype early on to gauge fitment and strength.
- In the future, doing more research on amplifiers would be useful to ensure we purchase a more robust one.
- Thank you to Autoliv for this opportunity! Thanks to Michael Jordan and Joseph Newkirk for their invaluable help.