# GENERANT COMPACTION STATION

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## Introduction

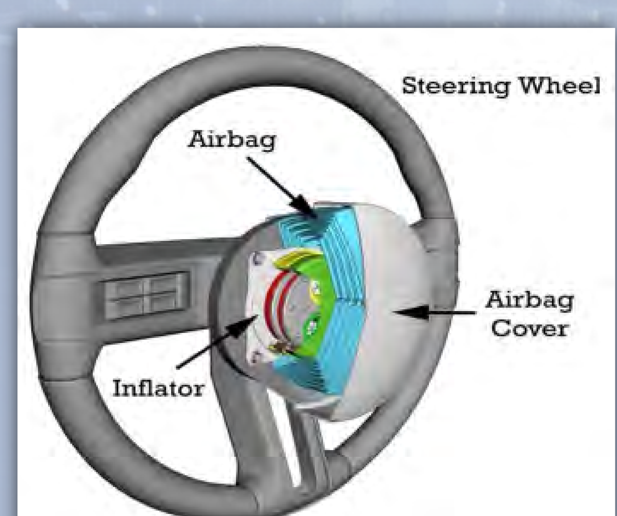
Autoliv produces 43% of the world's airbags. An inflator module in each airbag fills the bag with gas by igniting the enclosed generant tablets. It is critical to consistently package these tablets in order to ensure proper airbag function.

Generant tablets

Airbag inflator module

## Problem

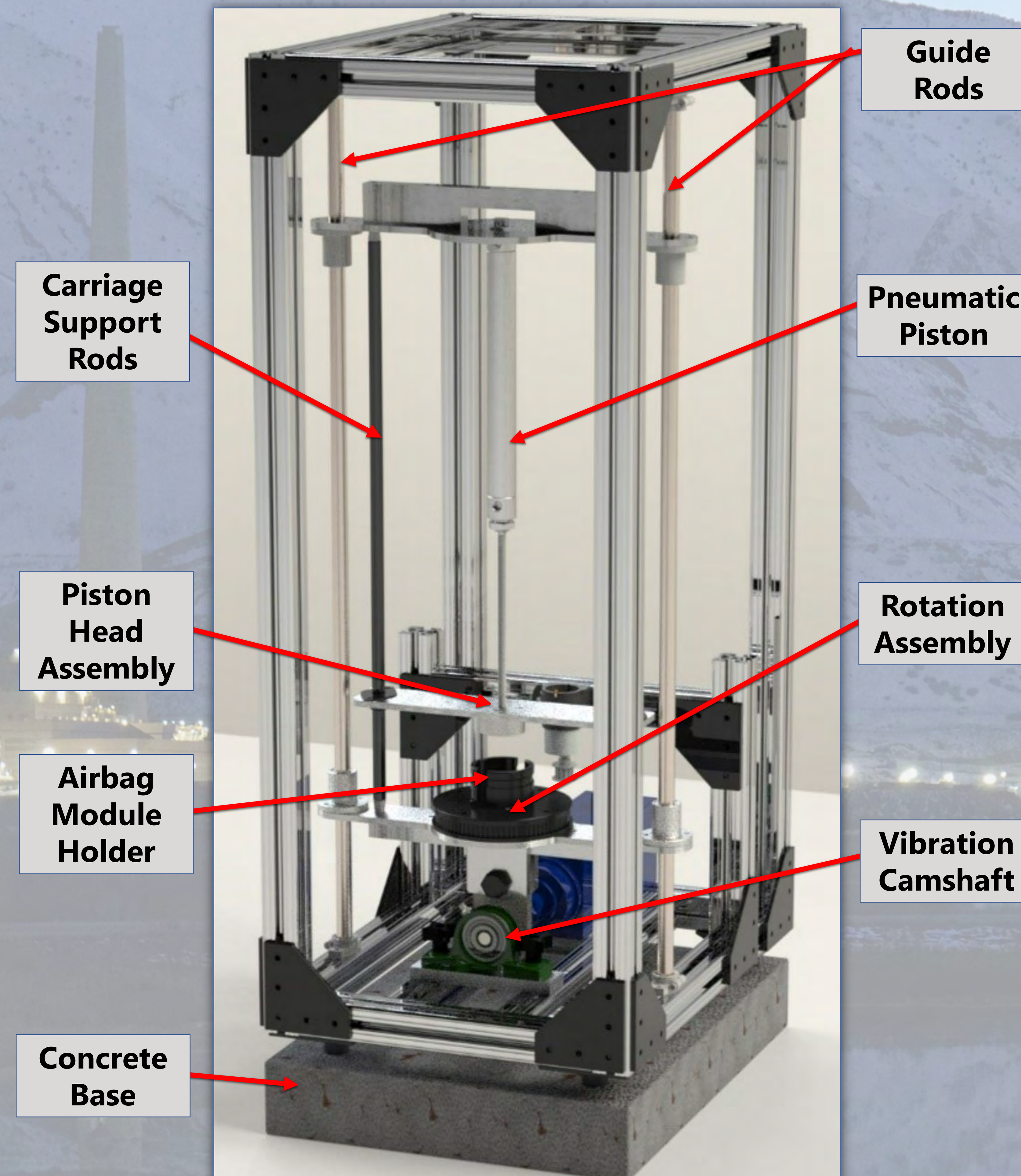
As new steering wheels trend smaller, the challenge becomes compacting the same mass of pellets into a smaller inflator module. Autoliv has tasked us with designing a machine capable of testing and recording the effects of different vibration and compaction parameters on generant packaging.



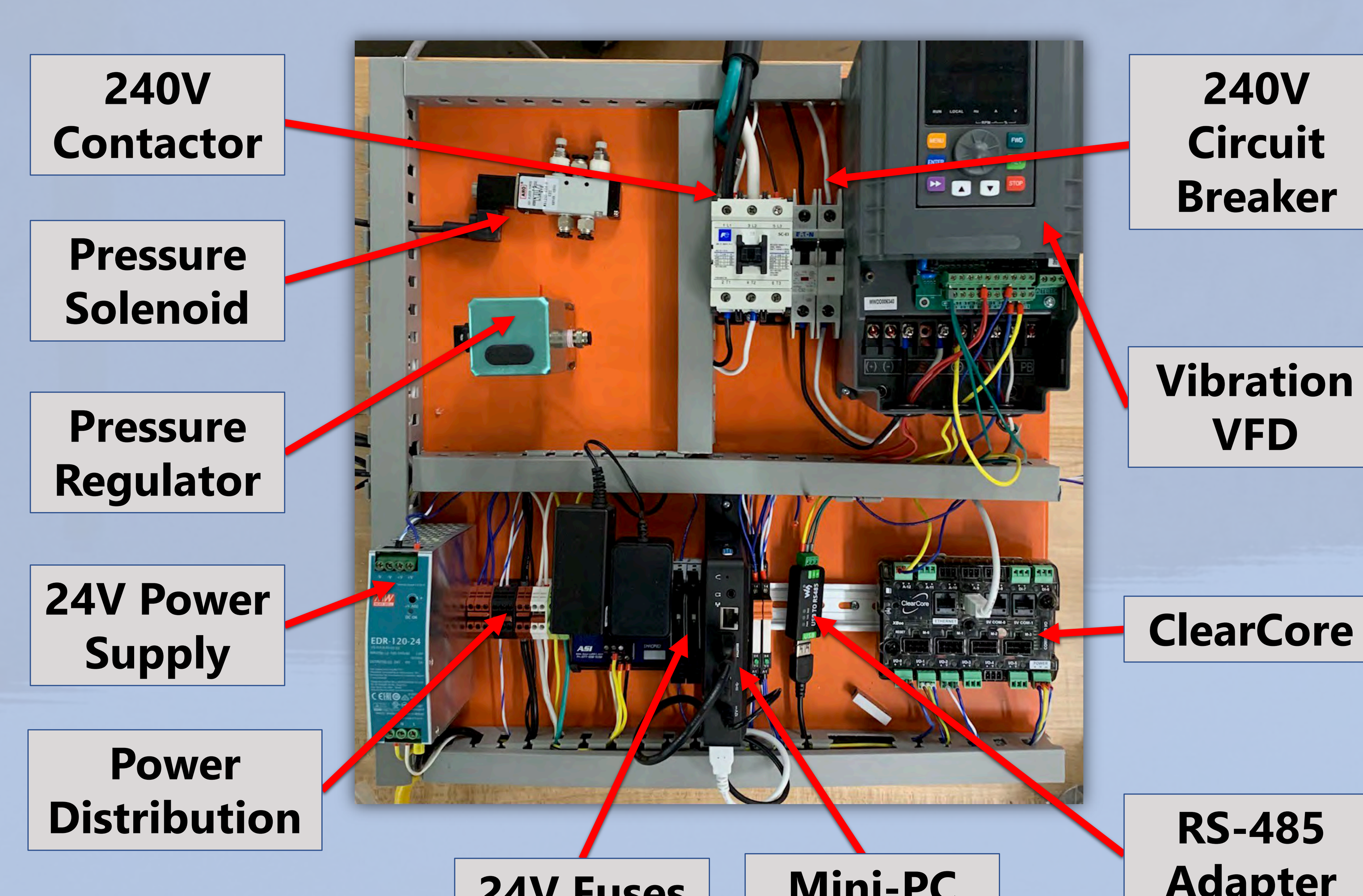

## Design Metrics

Our system will allow Autoliv to determine the ideal parameters for packaging airbag inflator modules. A table of design metrics which quantify the functional objectives is shown below.

| Metric | Target |
|---|---|
| Vibration direction | z |
| Variable vibration frequency | 50-150 Hz |
| Variable vibration amplitude | 0.2-1 mm |
| Compaction force | 0-500 N |
| Rotation under load | 0.15 Hz |
| Compaction time | 3-5 s |
| Piston diameter | 18-78 ±0.5 mm |
| Inflator cup holder inner diameter | 20-80 mm |

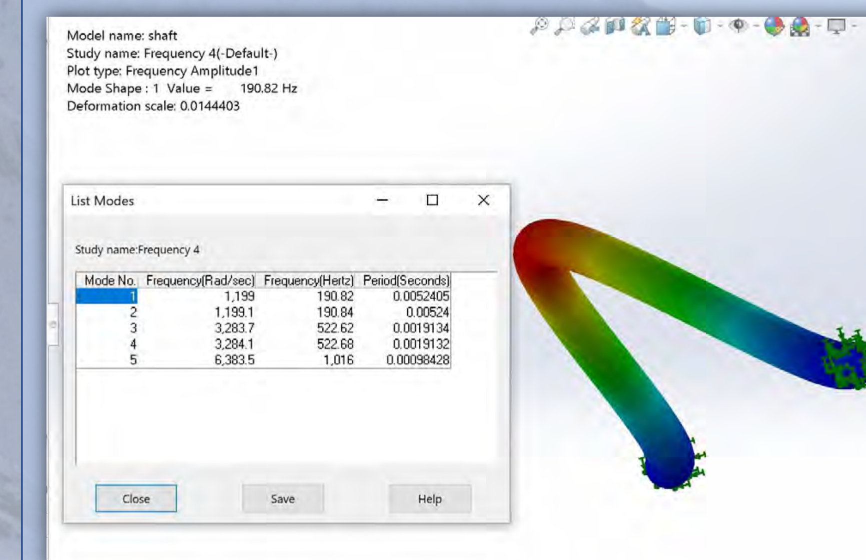



## Electrical Panel



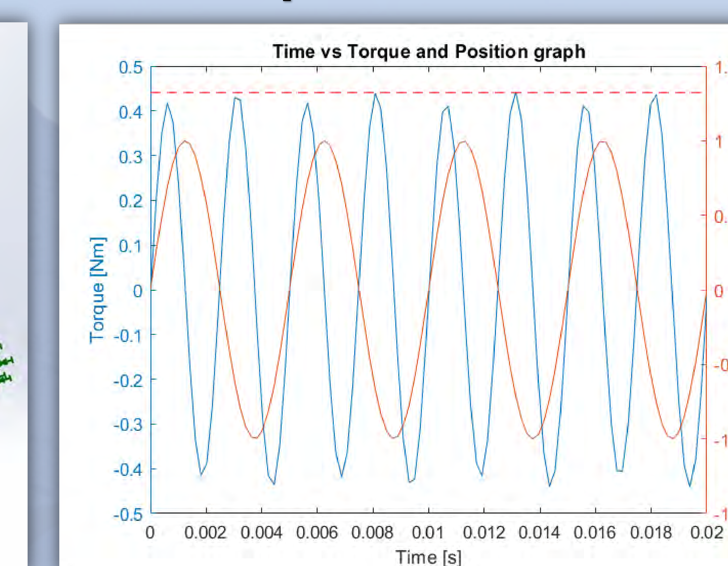

## Design Calculations and Simulation

### Carriage Support Rods Vibration Simulation



The carriage support rods experienced unwanted vibration during initial testing. We redesigned the rods and eliminated the vibration after conducting this simulation.

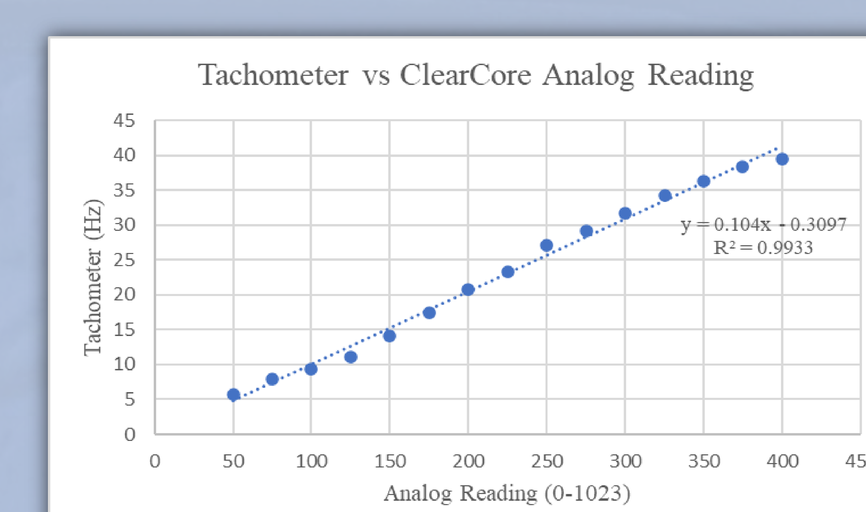
### Motor Selection Torque Calculation



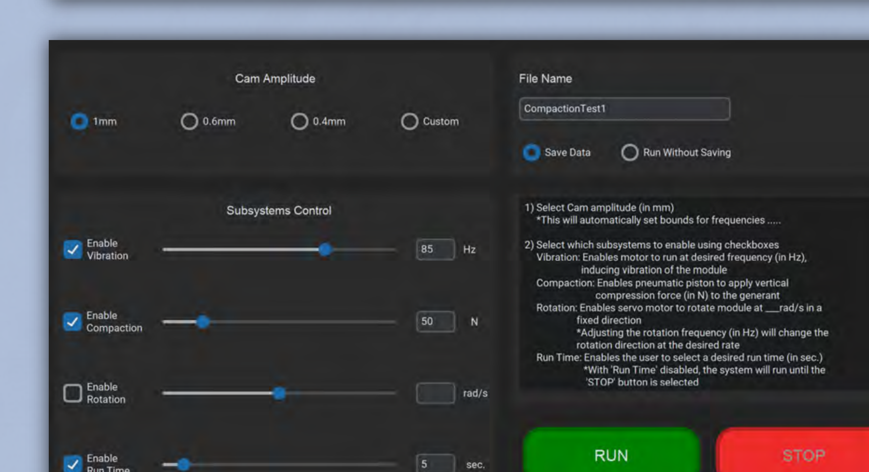

Toque, speed, frequency were taken into consideration to pick the appropriate motor power to handle our operation parameters.

## Testing and Results

We conducted tests on the vibration, compression, rotation, and HMI subsystems in order to verify that the machine would be meet the design metrics. After addressing issues noted in testing, such as the unwanted support rod vibrations, all subsystems achieved their respective design metrics.




**Vibration Testing Results**
Correlation between the microcontroller analog command and the resultant vibration frequency. The large $R^2$ value nullifies the need for a built-in frequency monitor.




**Human-Machine Interface**
This digital control panel allows for the activation of desired subsystems. The HMI displays and saves resulting data upon conclusion of each test.

## Conclusion

Our system achieved the design metrics through implementation of the vibration, compression, rotation subsystems and the human-machine interface. Through rigorous testing and analysis of these systems, we have shown that our prototype can vary and record a range of critical generant compaction parameters.