Department of MECHANICAL ENGINEERING
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Airbag Inflator Filter Testing

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Autoliv

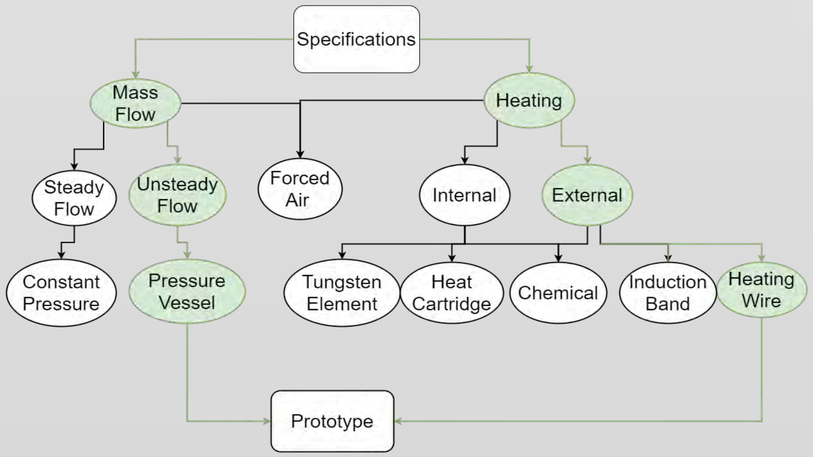
Background:

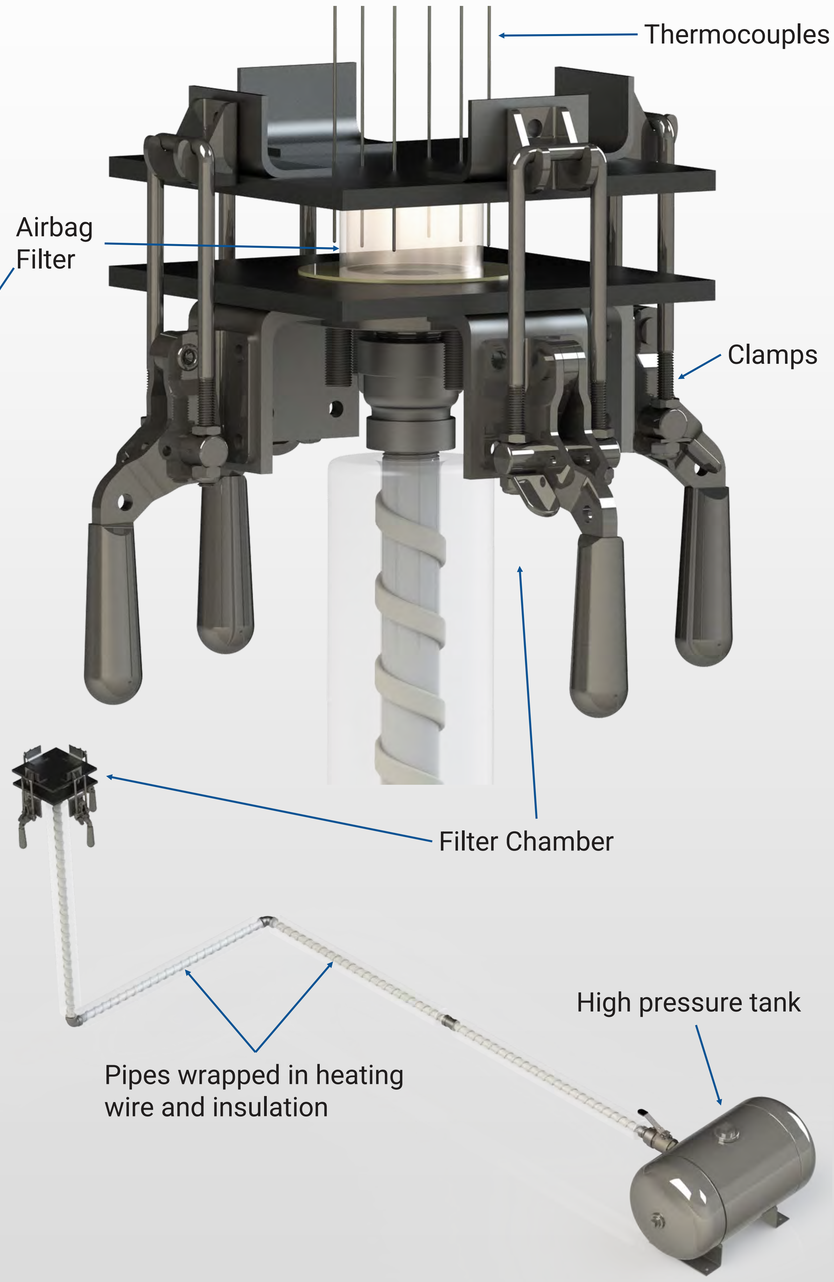
Airbag inflators are responsible for inflating airbags when a car accident occurs. They are capable of inflating an airbag in as little as 55 milliseconds. They accomplish this feat by igniting an explosive referred to as “generant”. The gases from the reaction are filtered before entering the airbag. Due to the extreme heat and pressure required to accurately simulate inflator ignition, current testing methods rely on building and testing a full inflator in order to test the performance of the filter. This testing process is expensive, time consuming, and does not allow for reuse of the filter.

Problem Statement:

The goal of this project is to design and prototype a device that is capable of testing airbag inflator filters. The test of the filter should recreate the extreme environment of the airbag inflation process by producing a temperature of 1000 K and a mass flow rate of 1.0 kg/s of hot air forced through the filter. The device will measure the temperature drop (ΔT) across the filter. This test will provide significant data to Autoliv to allow them to test different filter iterations and help determine what filter design is best for each of their inflators.

Design Methodology:





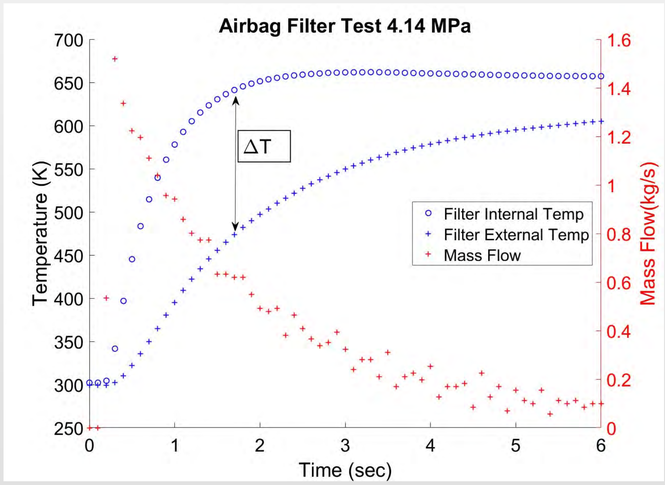
Testing:

1. Heat pipe and charge pressure vessel
2. Attach Filter Chamber and thermocouples
3. Open valve to release pressure

Experiments Results:

SUMMARY OF RESULTS				
Tank Pressure (MPa)	Max mass flow rate (kg/s)	Pipe Surface Temp (K)	Max internal air temp (K)	Max exit air temp (K)
0.69	0.267	898	592.3	318
2.07	0.731	923	652.4	570
3.105	1.11	938	588.8	475
4.14	1.519	946	661.6	628

- Mass flow rate exceeded requirement of 1.0 kg/s
- Temperature did not reach 1000 K
- Actual temperatures are not reflected in experimental results due to the inherent lag in thermocouples
- Models are used to validate experimental measurements



Conclusion:

The device is capable of meeting the mass flow rate requirement of 1.0 kg/s; however, the heating system is unable to heat the air to a temperature of 1000K before it reaches the filter. Although the temperature fell short, the device is still an improvement upon previous testing methods and is able to measure the temperature drop across the airbag inflator filter. With improvements to the heating system the device should be able to perform according to Autoliv’s specifications.

Acknowledgement:
Thanks to Insight Exhibits for providing a location for testing.