**Problem Statement**

- Aerodynamic properties must be equal to or greater than stock Ford grilles for HiViz to obtain the manufacturing warranty from Ford
- Simulations of airflow needed to be performed to obtain crucial data for comparisons
- Physical truck testing took place to obtain data from truck sensors, in order to do a comparison based on live OBD-II data

**Requirements**

<table>
<thead>
<tr>
<th>Number</th>
<th>Requirement</th>
<th>Description</th>
<th>Verification</th>
<th>Requirement Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simple OpenFOAM case</td>
<td>OpenFOAM case must be created and tested</td>
<td>Analysis</td>
<td>Qualification</td>
</tr>
<tr>
<td>2</td>
<td>Test the Ford stock grille</td>
<td>Use the Ford 3D model in the case to get airflow results</td>
<td>Test</td>
<td>Performance</td>
</tr>
<tr>
<td>3</td>
<td>Test the FireTech Grille</td>
<td>Use the FireTech Grille 3d model in the case to get airflow results</td>
<td>Test</td>
<td>Performance</td>
</tr>
<tr>
<td>4</td>
<td>Perform physical testing with both grilles and compare airflow results</td>
<td>Compare stock vs to FireTech airflow to compare the airflow and temperatures under similar operating conditions.</td>
<td>Inspection</td>
<td>Qualification</td>
</tr>
<tr>
<td>5</td>
<td>Complete report for HiViz clients</td>
<td>Compile all results from testing and give to HiViz for clients</td>
<td>Demonstration</td>
<td>Qualification</td>
</tr>
</tbody>
</table>

**Concepts**

- Initial testing locations included campus roads, parking lots, and a local dynamometer
- Physical testing and virtual simulations both needed to verify data
- Locations were selected based on convenience, accessibility, and feasibility
- Potential FireTech customers utilize their vehicles at either high speed or extended idle periods

**Final Design**

- Physical testing performed at Jackson County Airport
- New 2021 F-550s with Ford/HiViz grilles driven down runway at identical conditions
- Data recorded live using ForScan via OBD-II data
- Simulations were created to compare each grille’s air flow profile and pressure drop

- OpenFOAM used to simulate
- Single Ahmed-Body case used from wolf dynamics
- Utilized SimpleFOAM solver which is a Steady-State, Incompressible solver
- ParaView used as graphics interface of the simulations

**Results**

- Parallel truck performance through initial testing
- Firetech grille equipped truck outperforms stock Ford truck under long idle conditions and the latter half of runway testing.
- Simulations shows that magnitude of the airspeed of FireTech grille is greater.
- Recirculation behind the FireTech grille results in more efficient cooling of components in the engine bay
- The pressure profile between the FireTech and Ford stock grilles are practically identical

**Summary**

- Real world truck use of EMS, Fire, and first responder vehicles was recreated with meticulous variable control.
- This along with detailed flow simulations provides data proving the FireTech grille allows for more than adequate flow compared to the stock Ford grille when idling

**Team & Acknowledgements**

- Team (Left to right): Ty Dudley (BSET), Thomas Jones (BSE), Hank Seaman (BSE), James Smith (BSE)
- Project Sponsor: Sam Massa, HiViz
- Faculty Mentor: Hayri Sezer
- Others: Jim Rowell (Jackson County airport manager), Patrick Gardner