DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

TEAM 27
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TRI-STAR INDUSTRIES

Department of Mechanical Engineering

AERODYNAMIC AMBULANCE BODY MOLDINGS

BACKGROUND

- [1] **Tri-Star** is Nova Scotia's leading emergency vehicle producers and is known internationally for their emergency vehicle solutions.
- An ambulance uses approximately [2] **$24 000/yr in fuel costs**, negatively impacting the global carbon footprint.
- Marginal gains in **drag-force reduction** contribute to larger **long-term efficiency savings**.
- New **aerodynamic body moldings** on an ambulance box's leading and trailing edges would reduce drag force, and thereby **saving on fuel consumption**.

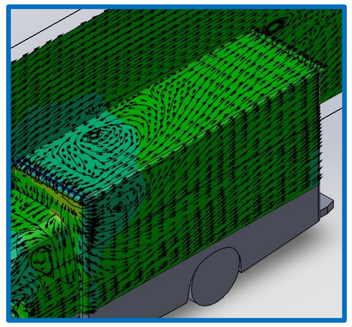
DESIGN DETAILS

- Final design determined by airflow characteristics around the trailing and leading edges.
- Down wash design on trailing edge reduces low pressure area (which generates lift force).
- Leading edge was less affected by airflow; rounded design matching the frame was used.

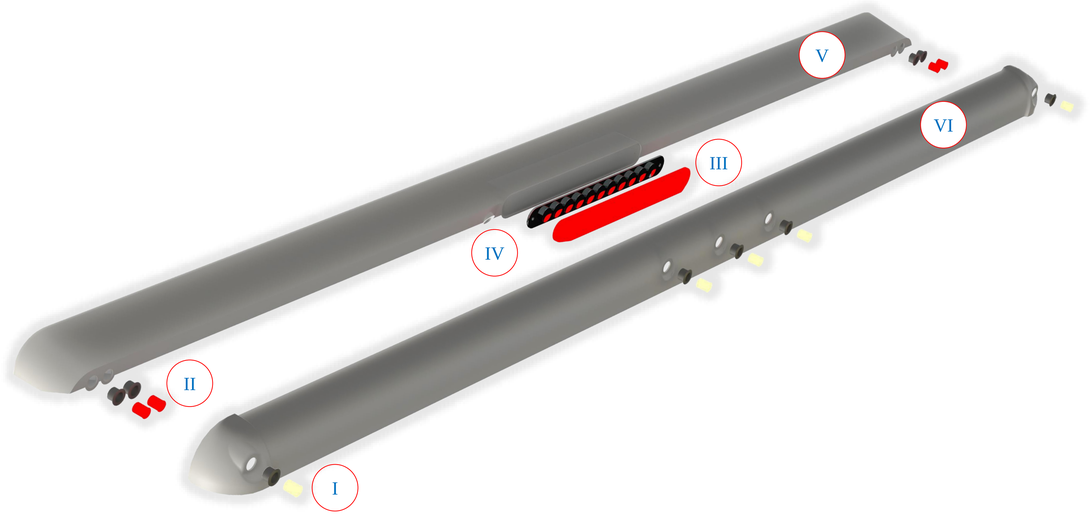
COMPLIANCE

- Devices improve the leading and trailing edges' aerodynamic characteristics of the ambulance's box.
- Devices are **2.3 m** internally in length with a curvature radius of **70 mm**.
- Devices compliant to **DOT** standards by containing all light fixtures in appropriate locations.
- Trailing edge device contains cut-out to house a rear camera.
- The devices are UV resistant, and have a temperature tolerance between –**40 °C** to **60 °C.**

DESIGN PROCESS



- **Research** conducted via meeting with:
  - Nova Scotia's Emergency Medical Care (**EMC**)
  - Emergency Health Services (**EHS**), Government
  - Former Master Engine Technician, **EMC**
- **Iterative design process** → Multiple designs generated by the team, screened until the final few candidates remained.
- **Solidworks 3D models reviewed** through a vigorous trial of Computational Fluid Dynamics (**CFD**) tests
  - Tests aid in facilitating an **optimized design**.
- **Solutions generated** to bring project closer to completion milestone:
  - Fabrication and adhesive methods
  - Material selection
  - Fitment tests
- Leading and trailing edge body molding prototypes were
  - 3D printed, fastened, sanded, primed, and painted.
- Prototypes completed an ambulance fitment test to prove compliant to requirements.



CONCLUSION

- The Team was able to reduce the overall drag force by **1.96%** and **1.44%** resulting in fuel savings of **$185/unit** and **$138/unit** in comparison to the unaltered ambulance body at speeds of **120 km/h** and **40 km/h**, respectively.
- Values presented above were adjusted with respect to downtime of an idling ambulance, and speed variations over time.

RECOMMENDATIONS

- Run real-world comparison tests to prove viability of project.
- Complete further CFD iterations of the profiles to achieve maximum reduction in drag force.
- Complete fabrication of prototypes via thermal forming methods.

REFERENCES

[1] "Who we are: Tri-Star industries limited: Yarmouth, NS," *Tri Star*. [Online]. Available: https://www.tri-star.ca/about. [Accessed: 27-Mar-2022].

[2] J. Goldstein, *[External] Dal Capstone Project Team 27*, 23-Dec-2021

LEGEND

I	Front Amber Clearance Lamps
II	Rear Red Clearance Lamps
III	Rear Identification Lamp
IV	Rear View Camera
V	Trailing Edge Profile
VI	Leading Edge Profile