No Contact Windshield Clearing

Alessandro Benites, Greyson Stratton, Jackson Wendel, Ryan Seamons

Project Coaches: Prof. Masood Amin, Prof. Abdennour Seibi

MOTIVATION

Windshield wipers have been around for over 100 years with little innovation. While mostly effective, they are not without their flaws.

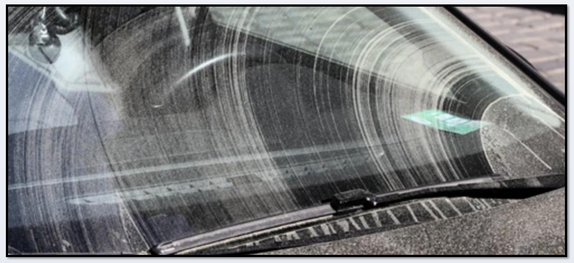


Image by *lesschwab.com* [1]

SCOPE

Develop and produce an effective alternative to clearing a windshield by evaluating and comparing the following criteria:

- Lifetime Cost
- Effective cleared area of the windshield
- Effective Visibility (Under heavy conditions)
- Effects on vehicle operation (aerodynamics, streaking, etc...)

CONCEPT GENERATION/SELECTION

Tools such a Morph Chart and Scoring Matrix were used to determine the most appropriate design to produce:

Cleaning methods	System Location	Activation Type	Power Source	Windshield material
• Compressed air • Repellent solution • Heat Roller	• Top • Bottom • Lateral(sides)	• Automatic • Manual • Sensors	• Mechanical • Electrical • Motor source	• Standard Glass • Ceramic Coated • Absorbent material

Activation type

Manual: The driver activates the system by pressing a button or lever.

Automatic: Programmed to activate automatically at set intervals.

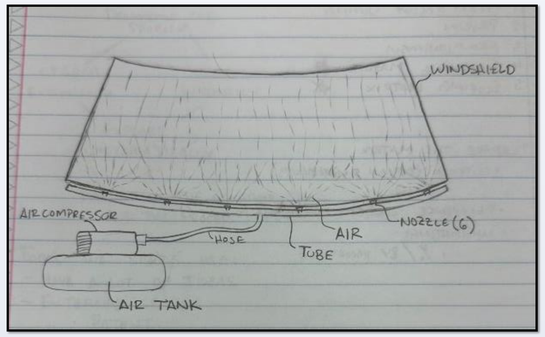
Sensors: Detect water presence or visibility changes, activating the system precisely.

Power Source

- **Mechanical**: Harnesses natural forces, e.g.(nozzles using outside air pressure.)
- **Electric**: Uses electrical power for pumps or compressors.
- **Motorized**: Draws power from the vehicle's engine, such as a motor-driven compressor.

		Heated Absorption Roller		Directional Compressed Air	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score
Area Coverage	0.2	5	1	4	0.8
Sound Disturbance	0.05	3	0.15	2	0.1
Volumetric Footprint	0.1	2	0.2	4	0.4
Cleaning Frequency	0.1	1	0.1	5	0.5
Lifespan/Durability	0.15	2	0.3	3	0.45
Energy Efficiency	0.08	2	0.16	3	0.24
Aerodynamic	0.07	3	0.21	4	0.28
Cost	0.1	2	0.2	3	0.3
Safety	0.05	2	0.1	4	0.2
Maintanance	0.1	1	0.1	3	0.3
Total Score		2.52		3.57	
Rank		5		1	
Decision		NO		YES	

COMPRESSED AIR CONCEPT



High-velocity air being directed across the windshield can push water off the glass without any physical contact unlike traditional wipers. The source of the compressed air and power supply are outside the scope of the project. This design is fully focused on the distribution of the high-velocity air.

TESTING & ANALYSIS

The following nozzles were tested for flow efficiency:

- 12" Air Blade
- 3" Air Blade
- Hi-Flow Nozzle
- Air Shield Nozzle
- Air Concentration
- Air Spread Nozzle

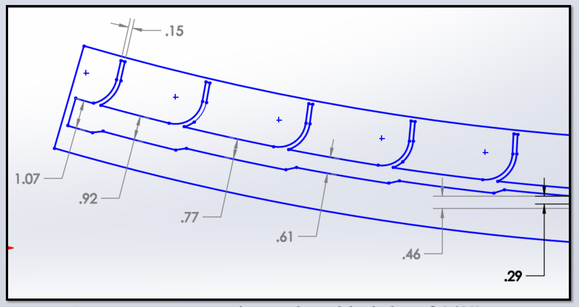
An anemometer was used to measure air velocity needed coming out of the nozzle.

2.2 CFM was estimated as the required 'Q' per nozzle.

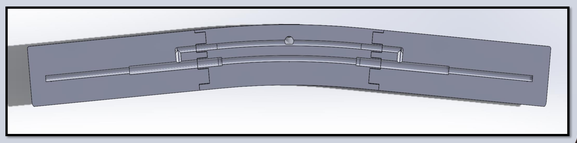
CHANNEL SIZING

Cross-sectional area:

$$A_{(m^2)} = Q_{(CFM)} / V_{(m/s)}$$



Assumes square channel and height of 3/8”

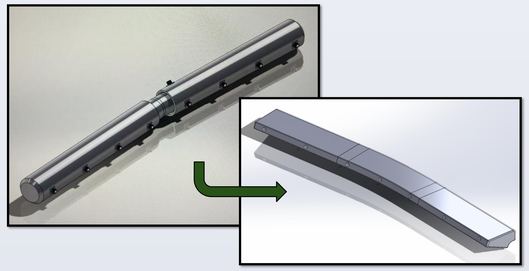


PROTYPING

- Acrylic Manifold



- Manifold body was improved to into the windshield pocket:



RESULTS

Original calculations of 2.2 CFM per nozzle adjusted to be 3 to 4 CFM after extensive testing. To maximize producibility and performance a 3D printed nozzle replicating the Hi-Flow Nozzle was produced.



A tapered 3D printed (seen above) manifold delivered the most consistent airflow across all nozzles, ensuring even performance throughout the system. Solenoids proved to be the most efficient method for reducing CFM usage without sacrificing coverage.



One nozzle was defective, and the manifold's orientation affected performance on the left side. Still, the photo shows the system works well with enough air. Simulated heavy rain was used, and airflow reached the top of the windshield, suggesting strong performance while driving.

TAKEAWAYS

- Compressed air presents a promising and efficient method for cleaning windshields by effectively removing water and debris without the need for traditional wipers.
- Current compressors are either to large and expensive or don't have the CFM to effectively clear an entire windshield.
- Implementation on commercial vehicles is not feasible with current compressor option.
- Semitrucks and other large vehicles have built in compression systems that could potentially accommodate a compressed air clearing system.

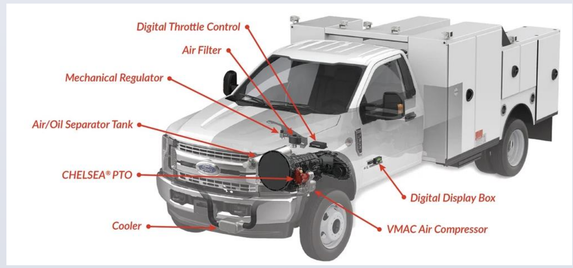


Image by *VMAC Air Innovated* [2]

REFERENCES

[1] “Easy fixes for common windshield wiper problems,” Les Schwab [Online]. Available: https://www.lesschwab.com/article/driving/how-to-fix-common-windshield-wiper-problems.html. [Accessed: 16-Apr-2025].

[2] “DTM70 direct-transmission mounted air compressor,” Up To 70 CFM [Online]. Available: https://www.vmacair.com/product/dtm/dtm70. [Accessed: 16-Apr-2025].

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ACKNOWLEDGEMENTS

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