Water Spray System

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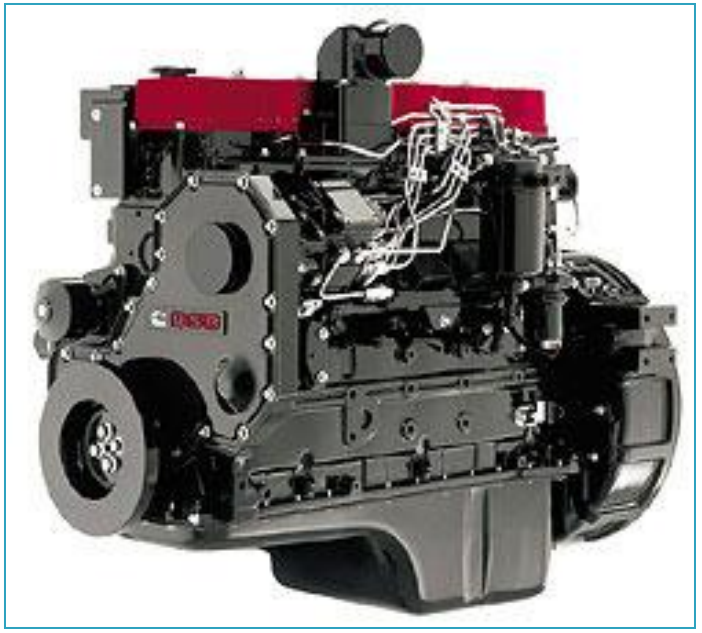
Overview

- Introduction
  - Product Specifications
  - Product Background
- Design Concept
- Calculations
- Cost Analysis
- Conclusions
- Future Work



A 215 hp Cummins diesel engine

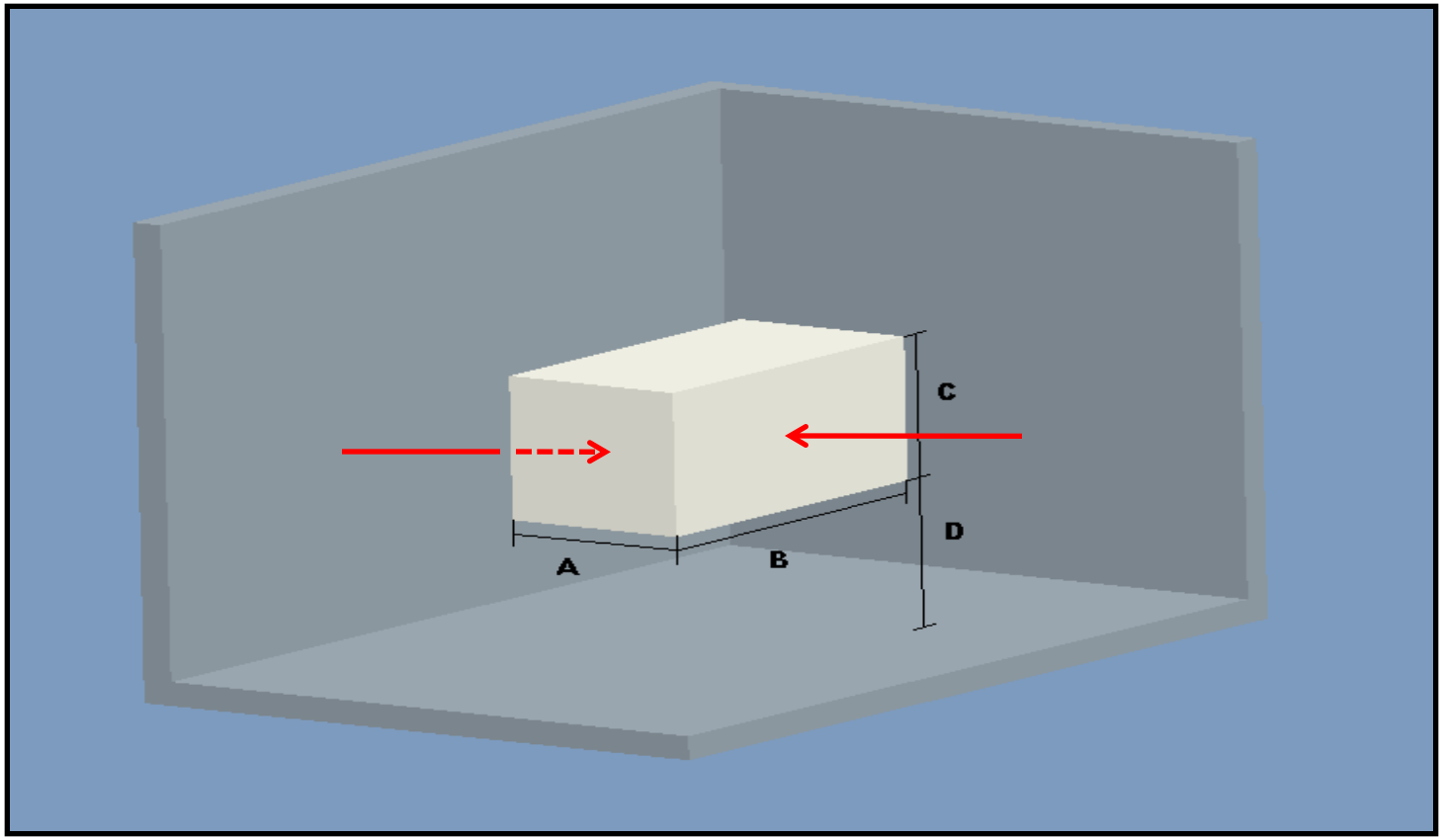
Project Background

- Cummins tests the effect of water on engines and their electrical components
- The test simulates the effect of driving over water puddles by spraying an engine undergoing an endurance test

Product Specifications

- Capable of spraying 3 ft x 6 ft area
- Stable structure
- Automated/Variable Spray Settings
  - Spray Duration
  - Spray Intervals
- Flow rate of 1 gpm per nozzle

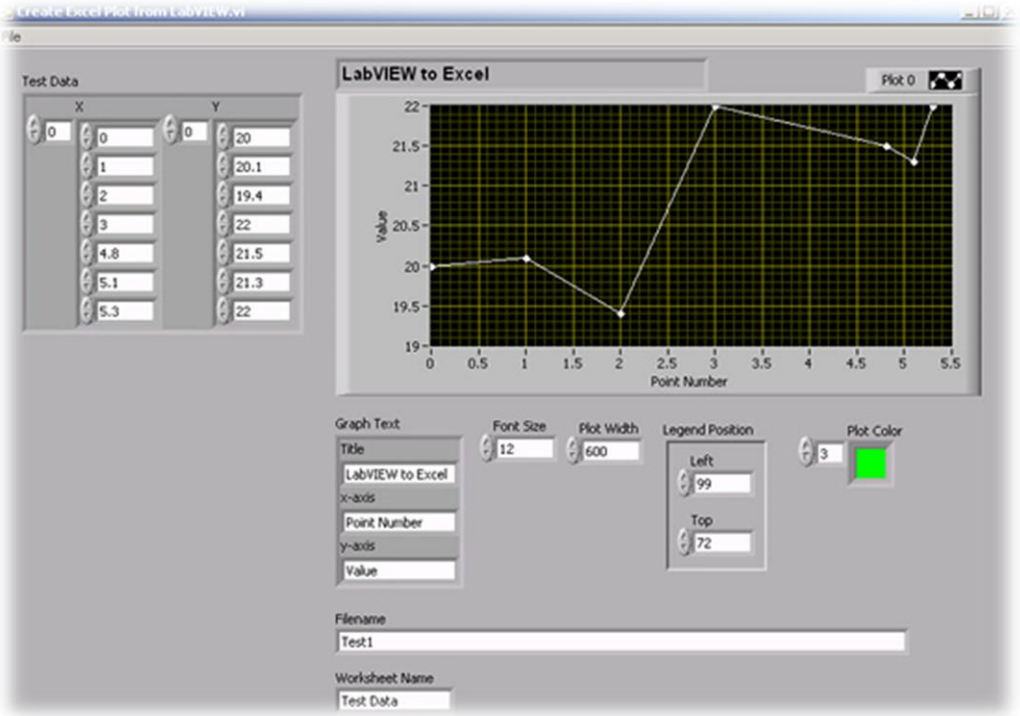
Product Specifications



Arrows indicate the planes of the engine that must be sprayed (A=B=C=3 ft; D=6 ft)

System Interface

- Graphical User Interface
  - Lab View
    - Universal program
    - Ease of Use
- Control Board
  - Simple
  - Inexpensive
  - Effective



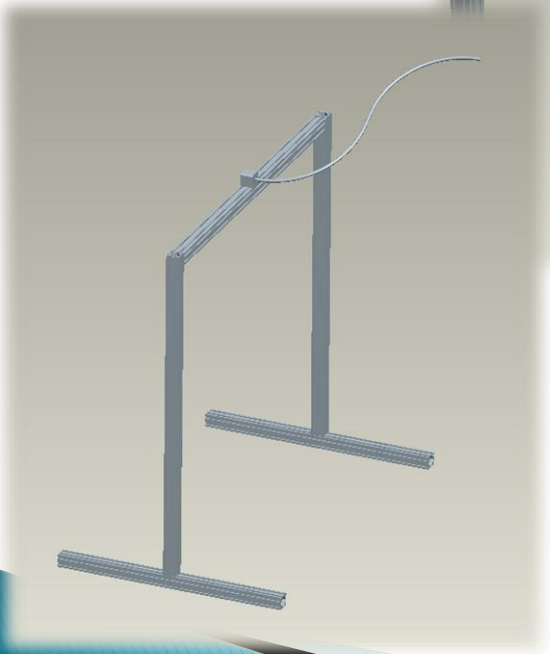
Example of Lab View front screen

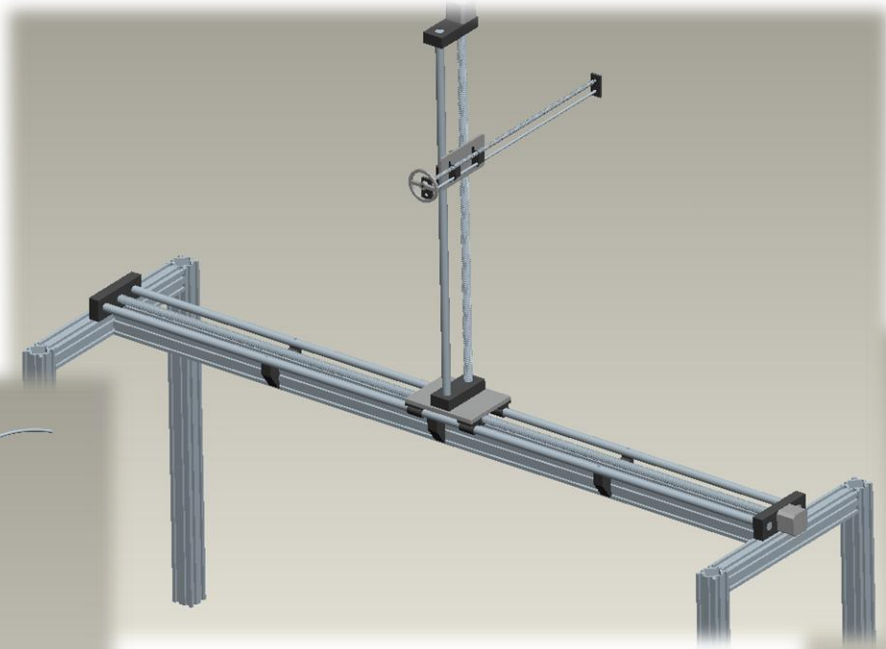
Initial Design Concepts

- Focused on automated motion
- Allowed for variable, automated spray settings
- One nozzle spraying one component at a time

Initial Design Concepts

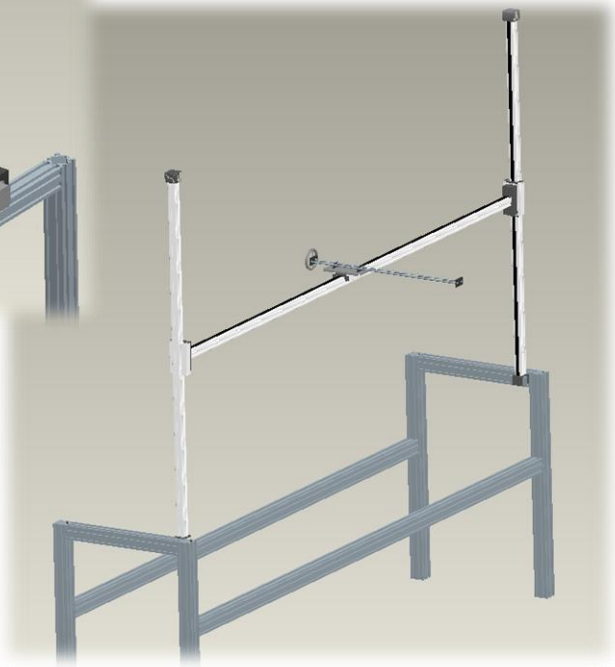
Flex Hose





X-Y Motion Table

Alternate X-Y Motion Table



Initial Design Concepts

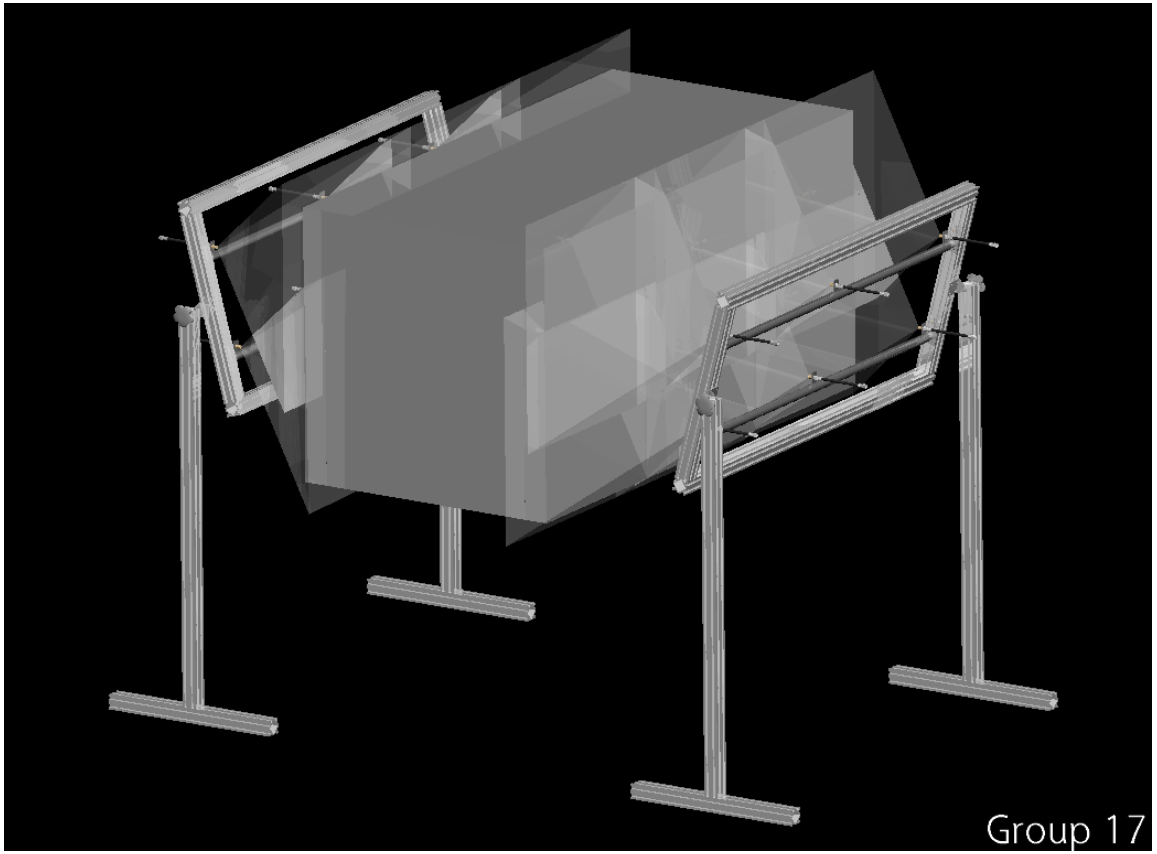
- Designs not approved by sponsor due to misunderstanding
- Designs did not account for fatigue due to long engine endurance testing
- Designs did not spray entire area simultaneously

Re-design Considerations

- New design must be capable of spraying *entire* 18 square foot area *simultaneously*
- Automated motion not necessary nor desired
- Automate spray settings *only*
- Must be stable structure

Revised Design Concept

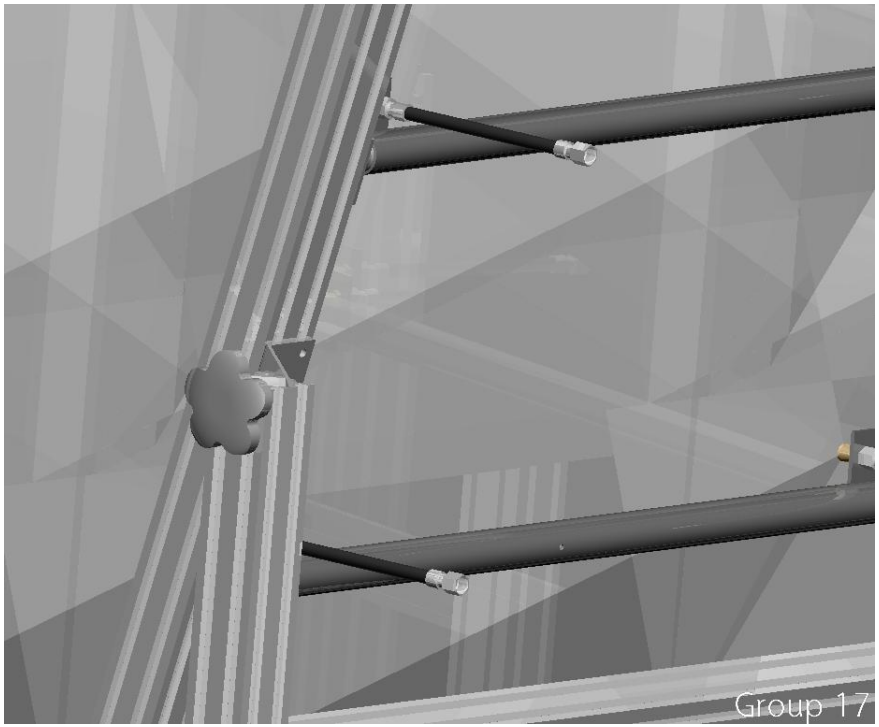
- General



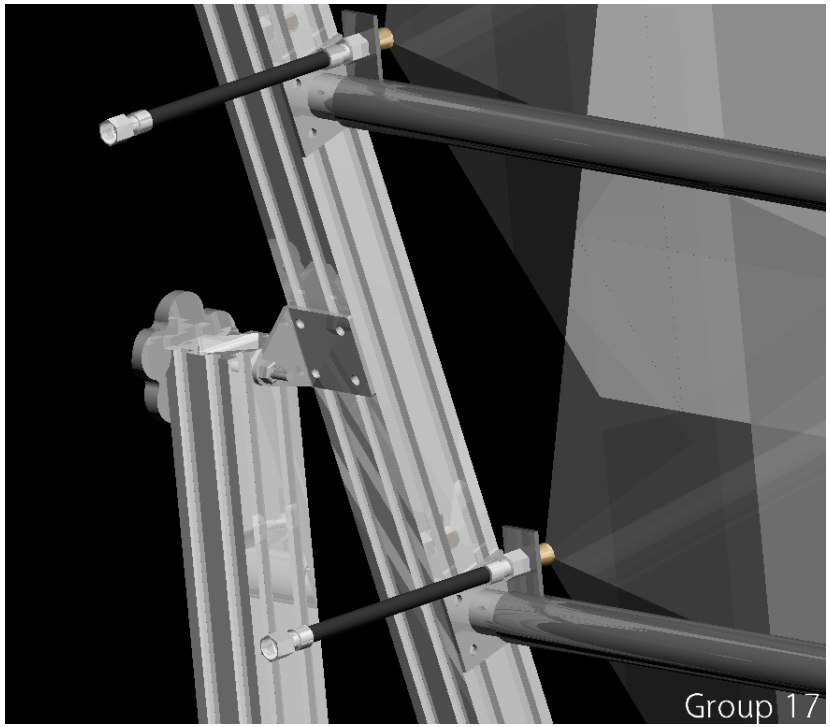
A general view of the system; the shadowed items represent the spray coverage of each individual nozzle

Revised Design Concept

- Position Adjustment



Anterior view of hinge mechanism

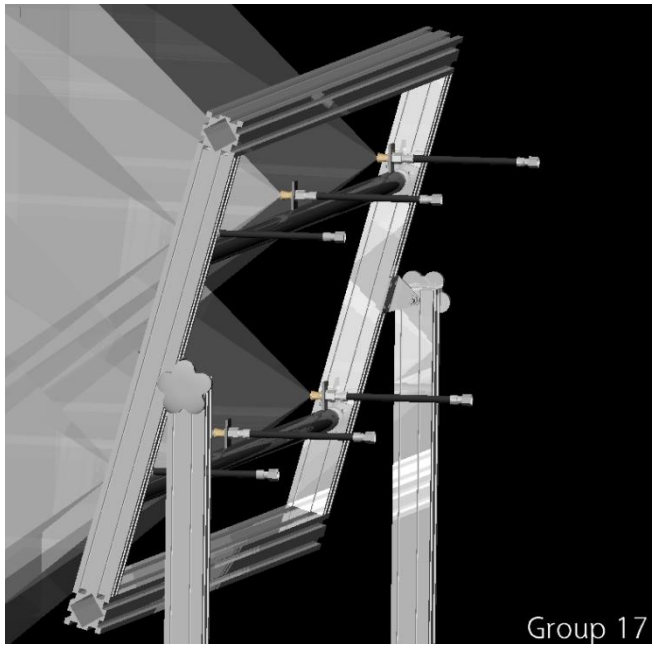


Interior view of hinge mechanism

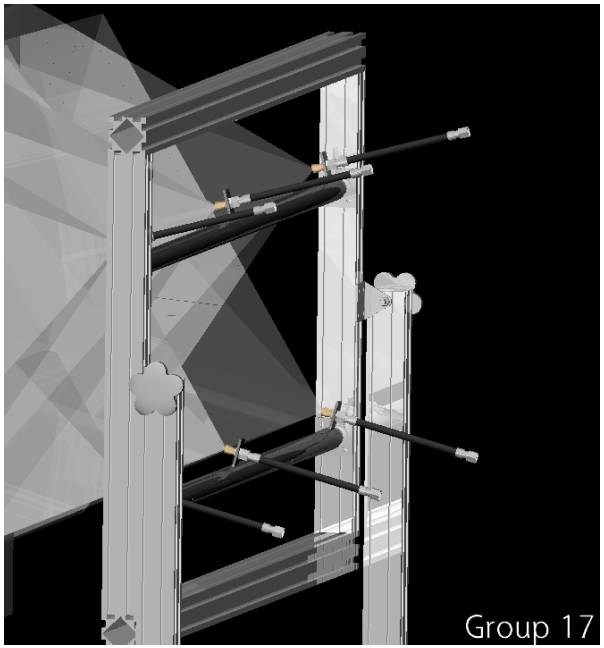
Hinge Mechanism allows for the spray structure to rotate. This is useful for different shaped engines such as V-configurations

Revised Design Concept

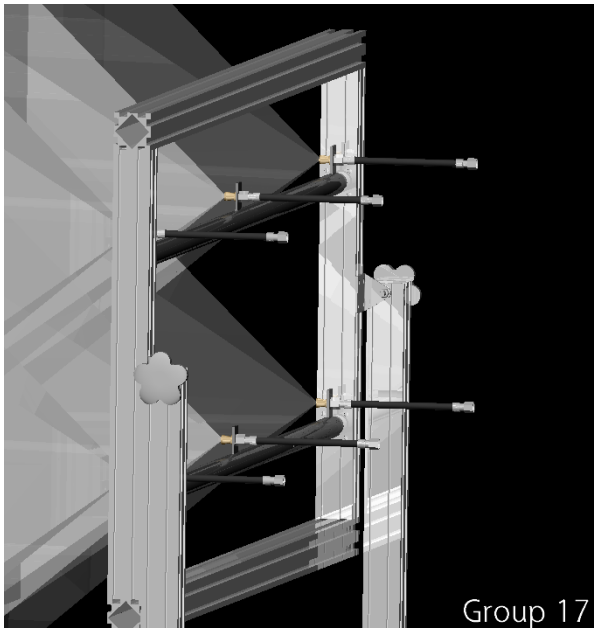
- Spray Adjustment



Frame Tilted
Nozzles remain Horizontal



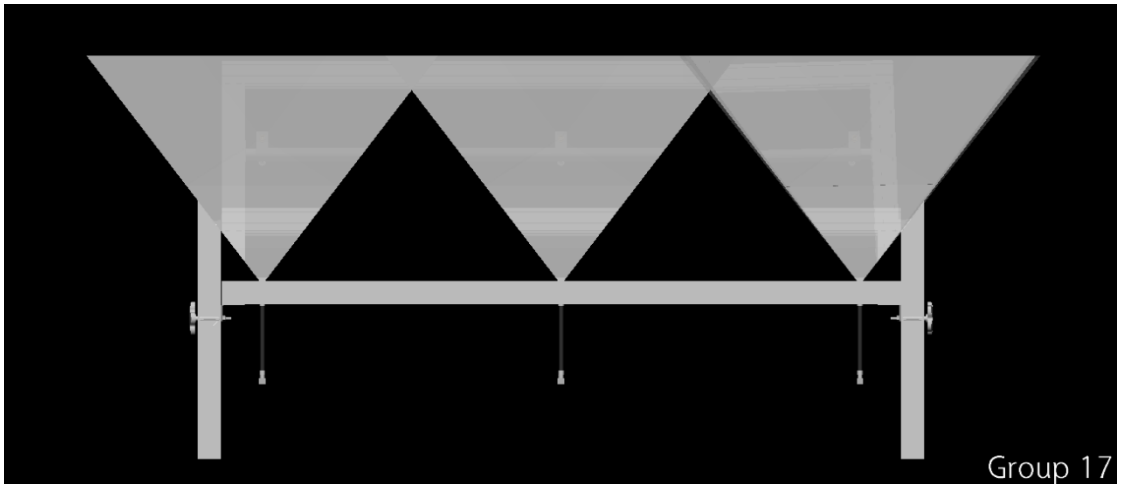
Frame Vertical
Nozzles Tilted inward



Frame Vertical
Nozzles Vertical

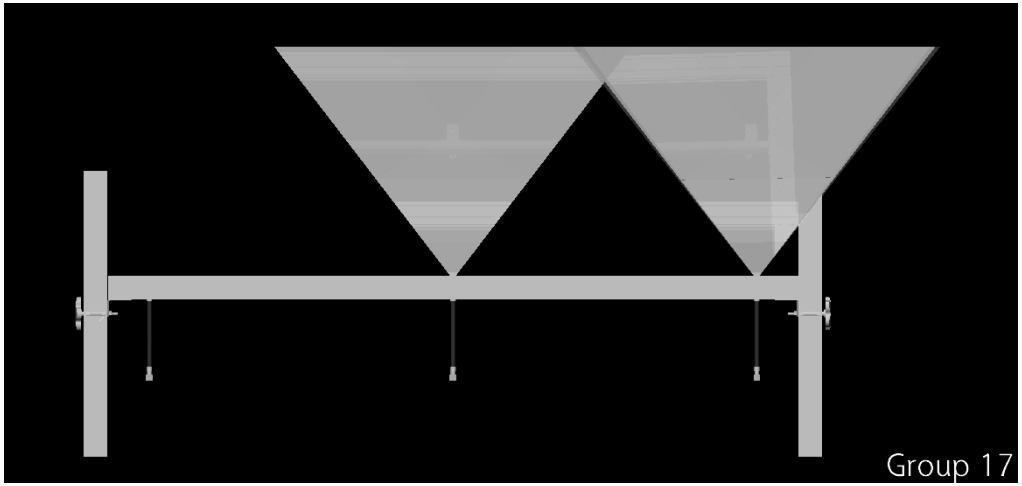
Revised Design Concept

- Spray Adjustment



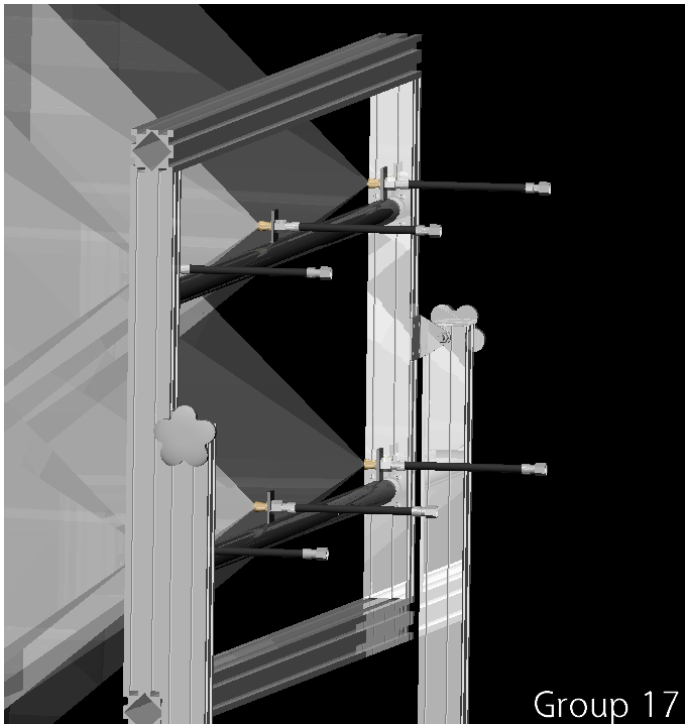
Left: Overhead view of all nozzle columns active

Right: Overhead view of one nozzle column shut off for more effective spraying

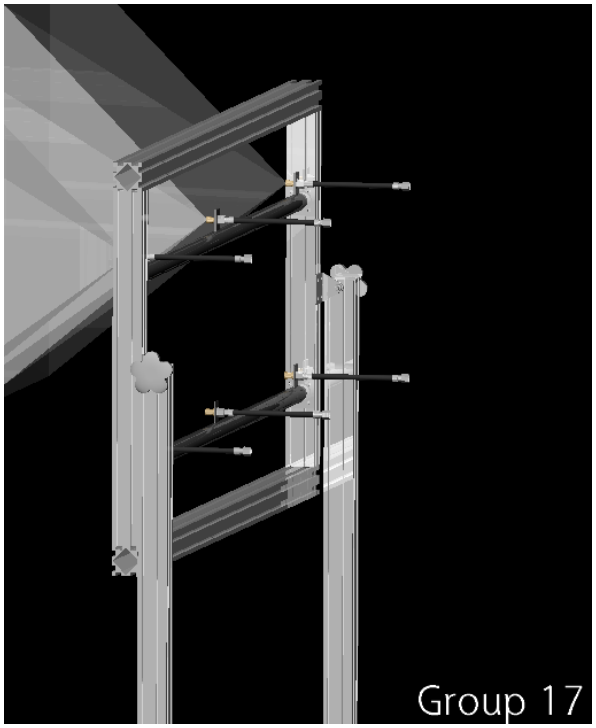


Revised Design Concept

- Spray Adjustment



Spray structure with all rows of nozzles active



One row of nozzles shut off for more efficient spraying

Bill of Materials

Part	Unit Price	Quantity	Part Total	Part Number
1/2" x 18" Brass Threaded Pipe	15.41	1	15.41	4512K18
1/2" x 24" Brass Threaded Pipe	20.60	4	82.40	4512K55
1/2" x 36" Brass Threaded Pipe	30.92	4	123.68	4512K31
1/2" x 48" Brass Threaded Pipe	41.14	2	82.28	4512K32
Extended-Life Centrifugal Pump	399.17	1	399.17	9929K55
5' Hose with Male-Female Fittings	26.66	12	319.92	5043T7
5' Hose with Male-Male Fittings	29.32	2	58.64	5043T6
Brass Plug Valve	18.68	12	224.16	5045K3
Brass Tee-Junction	6.05	3	18.15	4429K253
Brass Elbow Junction	5.16	4	20.64	4429K163
Brass Square Spray Pattern Nozzle	9.47	12	113.64	33925K54
Brass Pipe Cap	3.43	4	13.72	4429K143
48" Framing Extrusion	18.24	10	182.40	15EX1515UL-48
L-Bracket	4.00	16	64.00	15CB4804
		Total	**1718.21**	

Conclusion

- Re-design meets sponsor’s approval
- No automated motion
- Entire engine sprayed simultaneously

Future Work

- Use Pro Piping program to analyze system
- Finalize entire structure
- Purchase materials
- Assemble and test

A Special Thanks to…

- Mr. Alex Dugé
  - Cummins- Experimental Mechanics
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  - Faculty Advisor
- Dr. Rob Hovsapian
- Dr. Srinivas Kosaraju
- FAMU-FSU College of Engineering
  - Mechanical Engineering Department

Questions?

References

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- Janna, William S. *Design of Fluid Thermal Systems.* Stamford, CT: Cengage Learning, 2011. Print.
- McMaster-Carr. <http://www.mcmaster.com/#>
- Faztek T-Slotted Aluminum Solutions. <http://www.faztek.net>