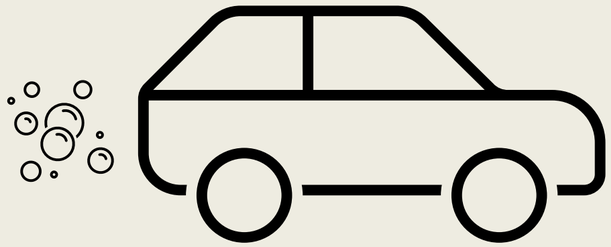
Modified Bumper Design

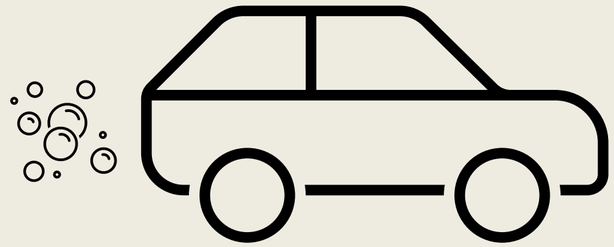
For Enhanced Vehicle Protection and Performance

Deja Hubbard
Matt Baker
Tj Allen
Yuwsef Alabdulhi
8 December 2023



AGENDA

- The Team
- Objective/requirements
- Our Client and their needs
- CAD Packet
- Manufacturing Process
- Testing Plan
- Final Production
- Our Budget



MEET THE TEAM

Finacial & Manufacture Manager

Deja Hubbard

Deja was born in Illinois and raised in Austin, Texas. Her Grandmother, Deborah Hubbard, has been the main influence leading her to pursue a major in engineer. Deja, who works in the AF Reserve specializing in aircraft metal technology, is a diligent and experienced worker with gained three years of machining and welding.

Logistics & Test Manager

Matt Baker

Matthew Baker was Born in Phoenix, Arizona and currently works within industry at W.L. Gore and associates. This Experience allows him ensure the manufacturing requirements are meet by validation the bumper would meet the requirements set. configure how the team will complete the task at hand. Matt enjoy grabbing a cold beer and Watching Football in his off time.

Project & Logistics Manager

Thomas Allen

Thomas (TJ) Allen is currently a process and manufacturing engineer at Elemental Motors. He was born and raised in Flagstaff and plans on living here for the next 5 years. He has a decade of experience in the automotive sector which makes him a good team leader for this project. He previously managed the NAPA in town and has a passion for cars and airplanes. TJ received his pilots license in 2016 and likes to travel and play video games in his down time.

CAD Engineer

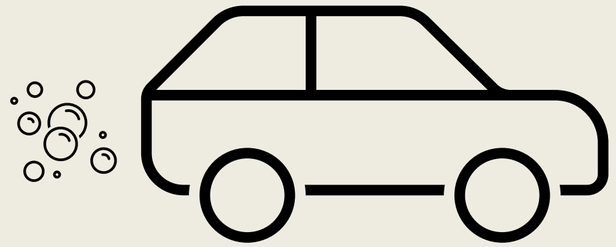
Yuwsef Alabdulhi

Yuwsef possesses a rare blend of persistence and sociability that is vital to excel in this field. He is highly skilled in collaborative work and is comfortable working with individuals from diverse backgrounds and skill sets, even in the presence of language barriers. Drawing from his five years of experience in the Air Force in his home country, he has developed a deep understanding of aircraft maintenance and engines. Furthermore, Yuwsef has a solid grasp of SolidWorks and is proficient in assembling and joining parts.

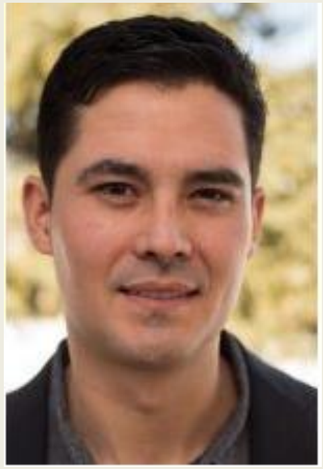
OBJECTIVE

Create an off-road bumper that can withstand extreme off-road conditions and have the towing capacity to remove the vehicle from tough situations.

Additionally, we made accommodations to maintain manufacturing design and sensors. As well as add auxiliary lighting, and personal engravement.



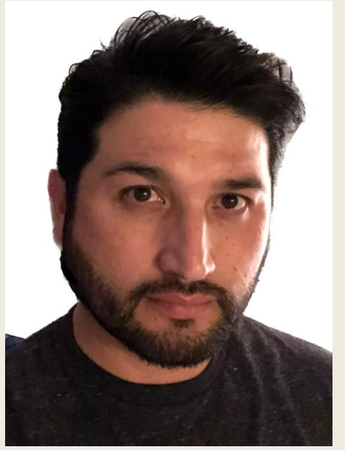
OUR CLIENTS



Professor as a Mechanical Engineering lecturer at Northern Arizona University, specializing in instructing topics such as engineering design, computer-aided design, and heat transfer. Drawing from extensive experience in both academic and industrial settings, Carson offers a well-rounded perspective in both his teaching and professional endeavors.

Carson Pete

Production Manager at Evan’s Alloys which manages and coordinates production processes, ensuring that projects are completed within designated timelines, budgetary limits, and stringent quality criteria. Cesar's wealth of experience encompasses working with diverse metals and executing projects with precision while adhering to stringent tolerances.

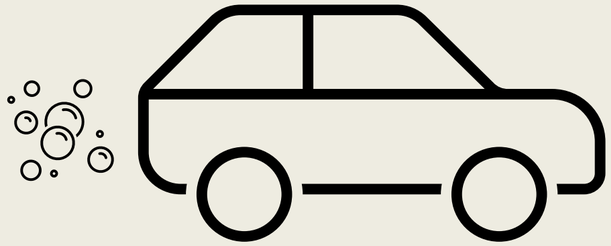


Cesar Blancarte

2008 Chevy Silverado

Designing Front and Rear Bumper

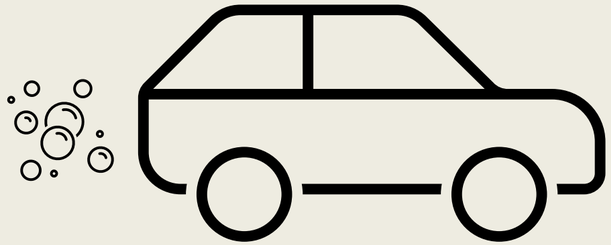
Carson Pete owns a 2008 Chevy Silverado 3500HD. Carson often uses this vehicle to travel down dirt roads daily and needs a versatile front bumper to withstand small impacts. This vehicle is used year-round and will need extra protection during the winter.



2018 Dodge 3500 Laramie

Designing Rear Bumper

Cesar Blancarte owns this 2018 Dodge ram 3500HD. Cesar lives off a dirt road that isn't maintained during the winter requiring an off-road bumper to protect his vehicle from being damaged during the hazardous road conditions. Cesar also requires the additional functionality of his bumper to have lights attached in the rear to load and unload his several trailers in the dark.

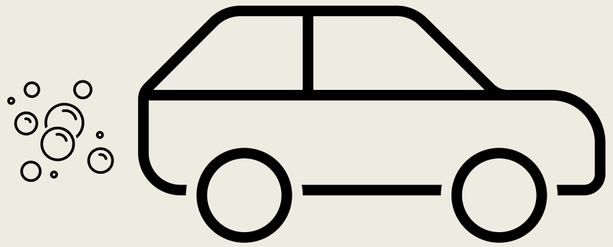


DESIGN REQUIREMENTS

- **Customer Requirements**
- CR1- Engravement of the front bumper
- CR2- Winch support
- CR3- Low cost
- CR4- Offroad lighting support
- CR5- Factory back up sensors
- CR6- Increased strength and durability
- CR7- Maintains legality and functionality
- CR8- Match factory lines
- CR9- Rust resistance

Engineering Requirements

•ER1- Yield strength (MPa)
•ER2- Pulling strength (lbs)
•ER3- Weight (kg)
•ER4- Ultimate Strength (MPa)
•ER5- Material deflection (mm)



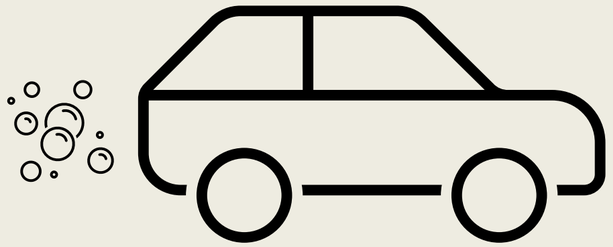
OUR BUDGET

Given Amount
$ 1,500

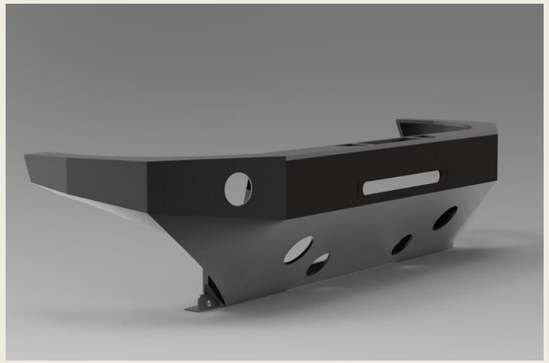
Spent Amount
$ 1,029.22

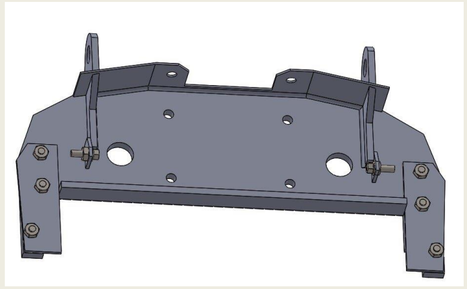
Left Over
$ 470.78

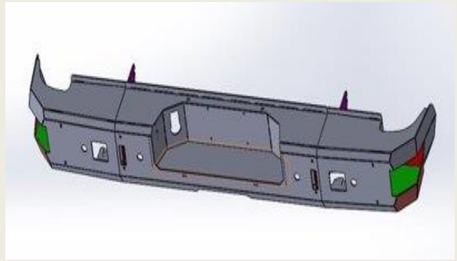
Material Cost
$ 722.02

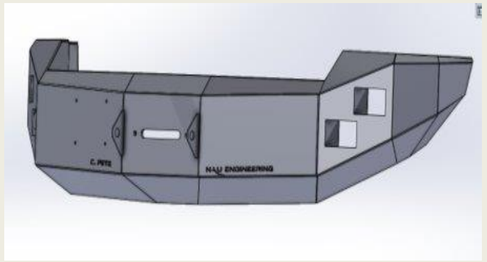


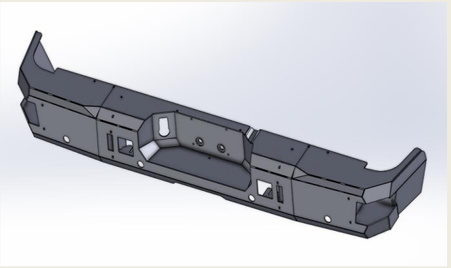
CAD DESIGN PROCESS











Original

DESIGN 1

The initial design consisted of one solid piece that met all the customer requirements. However, this is not practical to manufacture, and the team had to switch to a multipiece design.

Mounting

DAVID'S MOUNT

The original client's vehicle did not have any designs for a modified front bumper. So, the team made a winch plate to build off. This plate would mount to the frame and provide the best structural support we could offer.

Client Change

NEW DESIGN

The new client changed the design requirements to be a rear bumper for a Dodge Ram. This bumper would be made by modifying the current rear bumper design off the Chevy Silverado.

Alteration

CARSON'S

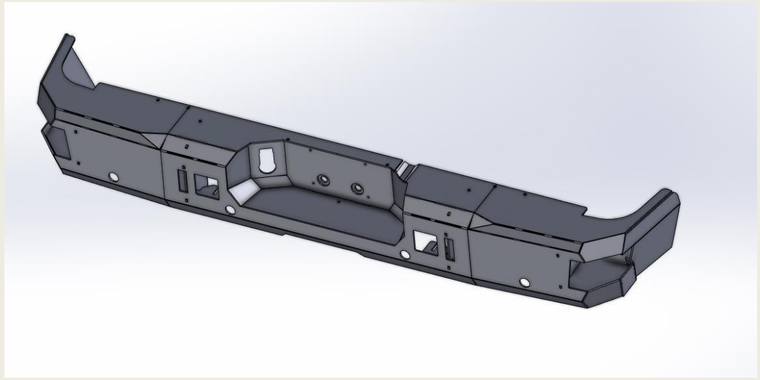
The front bumper was made into a multipiece design that the team can cut with a water jet. This new design includes a custom engraving and winch plate. This design meets all the requirements for the client and can be easily made.

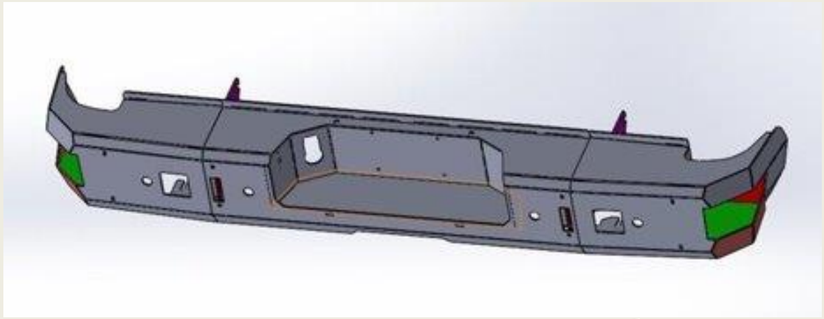
Alteration

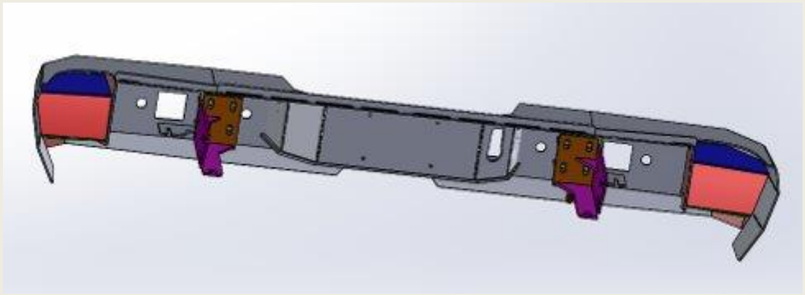
CESAR'S

The new client's bumper was made by modifying the other rear bumper and making a new look to meet the lines of the original bumper. This involved changing the main exterior of the bumper and the mounting points.

FINAL CAD DESIGN

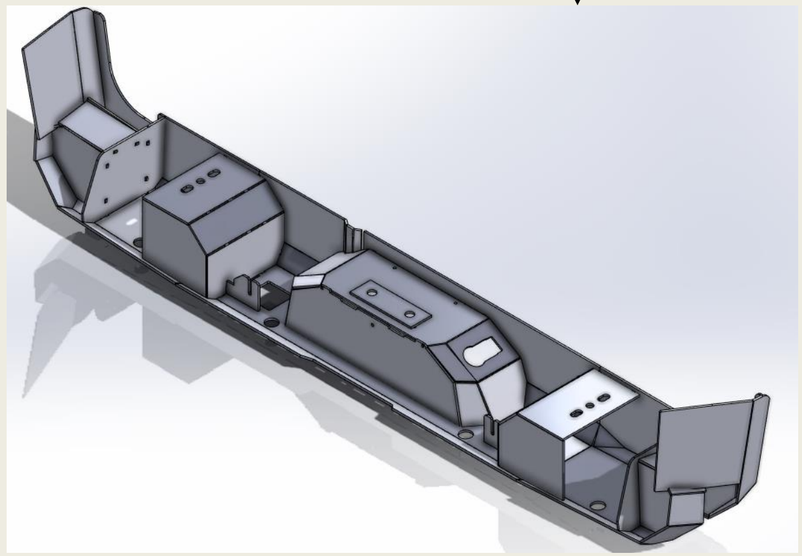




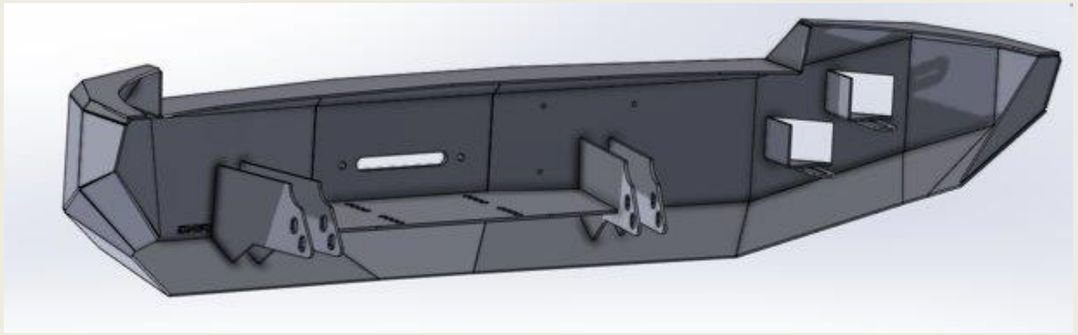


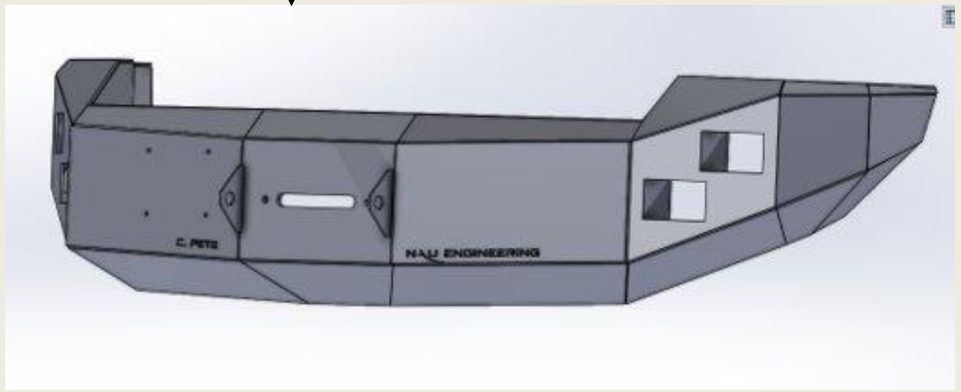
Rear Bumper: Chevy Silverado

Rear Bumpers: Dodge Ram



Front Bumpers: Chevy Silverado.

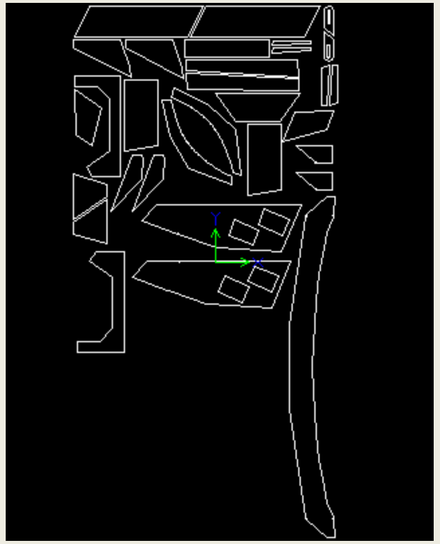




MANUFACTURING PROCESS

DXF FILES
Converting

DXF is a universal format that simplifies the design information, converting geometry designs into an accurately representation of a 2D dimensions. This conversion is crucial for a seamless transfer to the 3D assembly of the bumpers to 2D cuts for manufacturing.



WATER JET
Cutting

A water jet is a tool that utilizes a high-pressure stream of water, mixed with sand particles allowing for precise cuts on the materials. The waterjet is equipped with a small nozzle that allows the high pressure, creating a concentrated and powerful stream capable of cutting our sheet metals. This technology is accurate and efficient. This ensure that all the parts will fit together the first time.

BENDING
Fitting

The crucial process in our fabrication is bending the required metal pieces to ensure proper assembly fitting. By applying force on the specified location, the metal piece deforms allowing them to achieve the specified angle for proper fitment.

SPOT WELD
Adjustments

Spot welding involves applying a weld over a small area that will join two pieces together. The spot welds were done to start the shape of the bumper. After the fitment was check the spot welds could be broken and adjustments made.

FINAL MANUFACTURING STEPS

FULL WELDING

The team chose to TIG weld all the front bumpers. This type of welding adds material to the welds and increases the durability. The bumpers were all structurally and cosmetically welding using this method. Every gap and line was filled in and the bumpers were made structurally secure. This was the longest and most crucial part of the manufacturing process.

GRINDING

After the final welds were completed, the team had to clean up any sharp edges and welds. This involved using grinding and cutting wheel to smooth out the exterior surfaces. This process helped make the individual pieces look like one solid piece of metal. This also reduces any hazard being around this bumper by removing all sharp edges and imperfections.

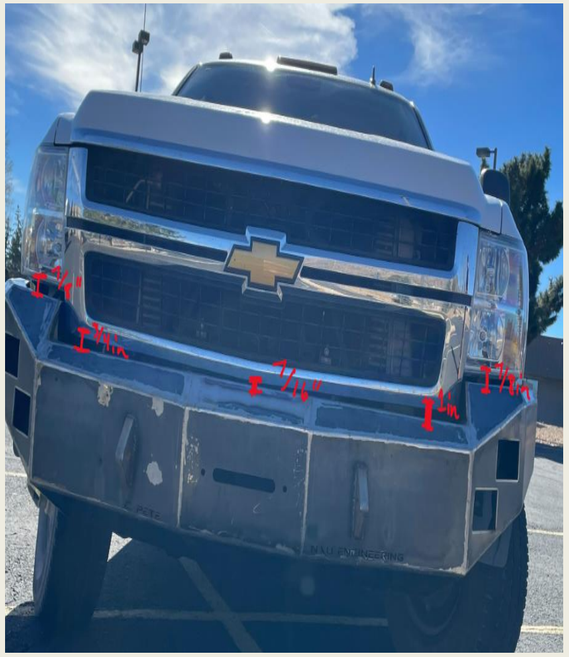
SPEC SHEET

Engineering Requirement	Target	Tolerance	Measured/ Calcated value	ER Met? Y/N	Client Acceptable Y/N
ER1- Yield strength (MPa)	250MPa	±25MPa	241MPa	Y	Y
ER2- Pulling strength (lbs)	13,000lbs	±130lbs	1300lbs	Y	Y
ER3- Weight (kg)	150 lbs	±50lbs	178 lbs	Y	Y
Rear Bumper (Carson's)	100 lbs	±25lbs	113lbs	Y	Y
Rear Bumper (Cesar's)	100 lbs	±25lbs	108lbs	Y	Y
ER4- Ultimate Strength (MPa)	400MPa	±40MPa	412MPa	Y	Y
ER5- Material deflection (mm)	0in	0.0625±in	0.0001924	Y	Y

TESTING PROCESS

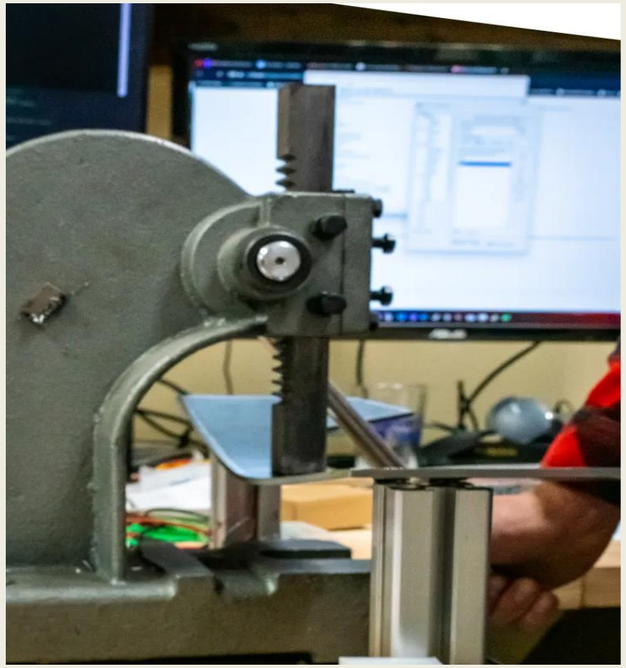
Fitment

This test is to ensure that the product fits on the vehicle and has a uniform gap to ensure the factory lines are meet



MATERIAL DEFORMATION

This test is to ensure that the materials that went into it are going to react as expected in the event that the bumper comes into contact with an object.

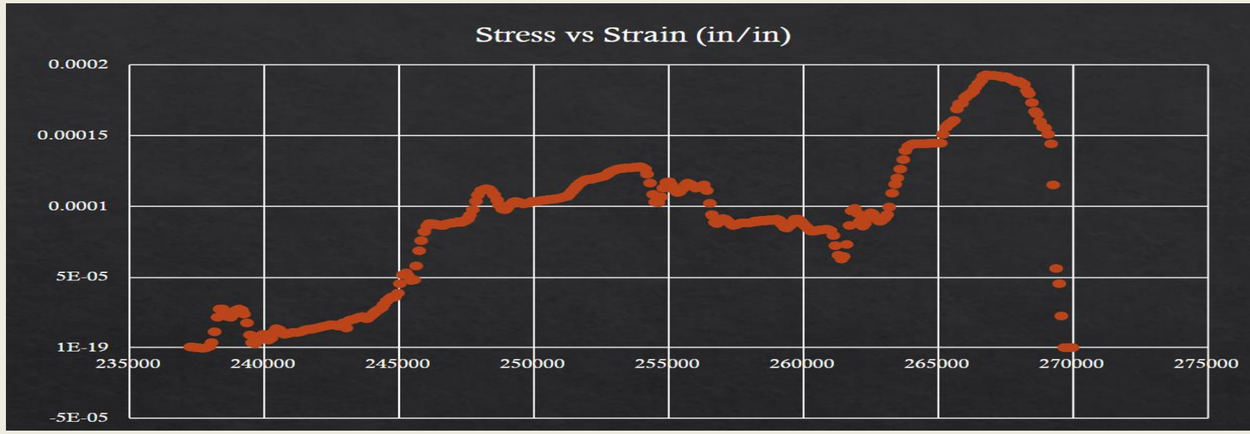


Bumper Pull

This Test is to ensure that the bumper as a whole is attached, and underload wouldn't deform under the significant load applied to the bumper.

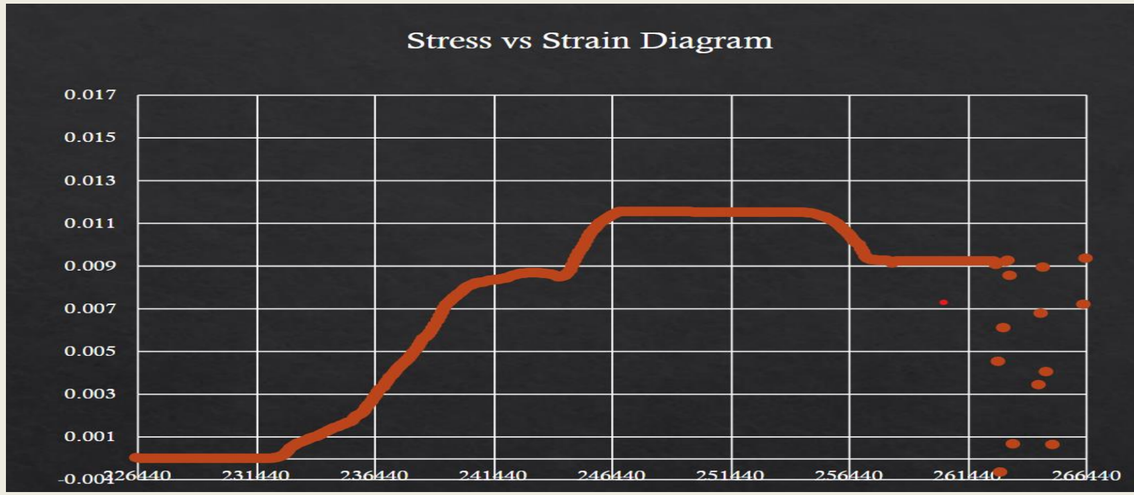
TESTING REULST

MATERIAL DEFORMATION Test



Max Force	6663.707955	lbf
Max Deformation	0.000056	in
Max Strain	0.000192369	in/in

Bumper Pull Test



Max Force	501711.824	psi
Max Deformation	0.004219618	in
Max Strain	0.014483534	in/in

FINAL PRODUCT

FINAL PRODUCT

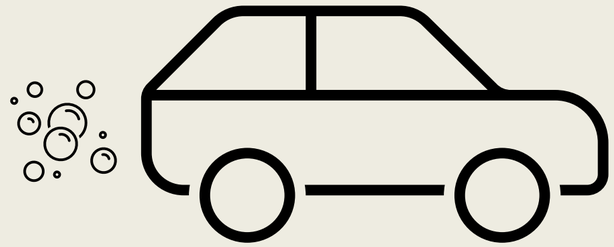
FINAL PRODUCT

FUTURE WORK

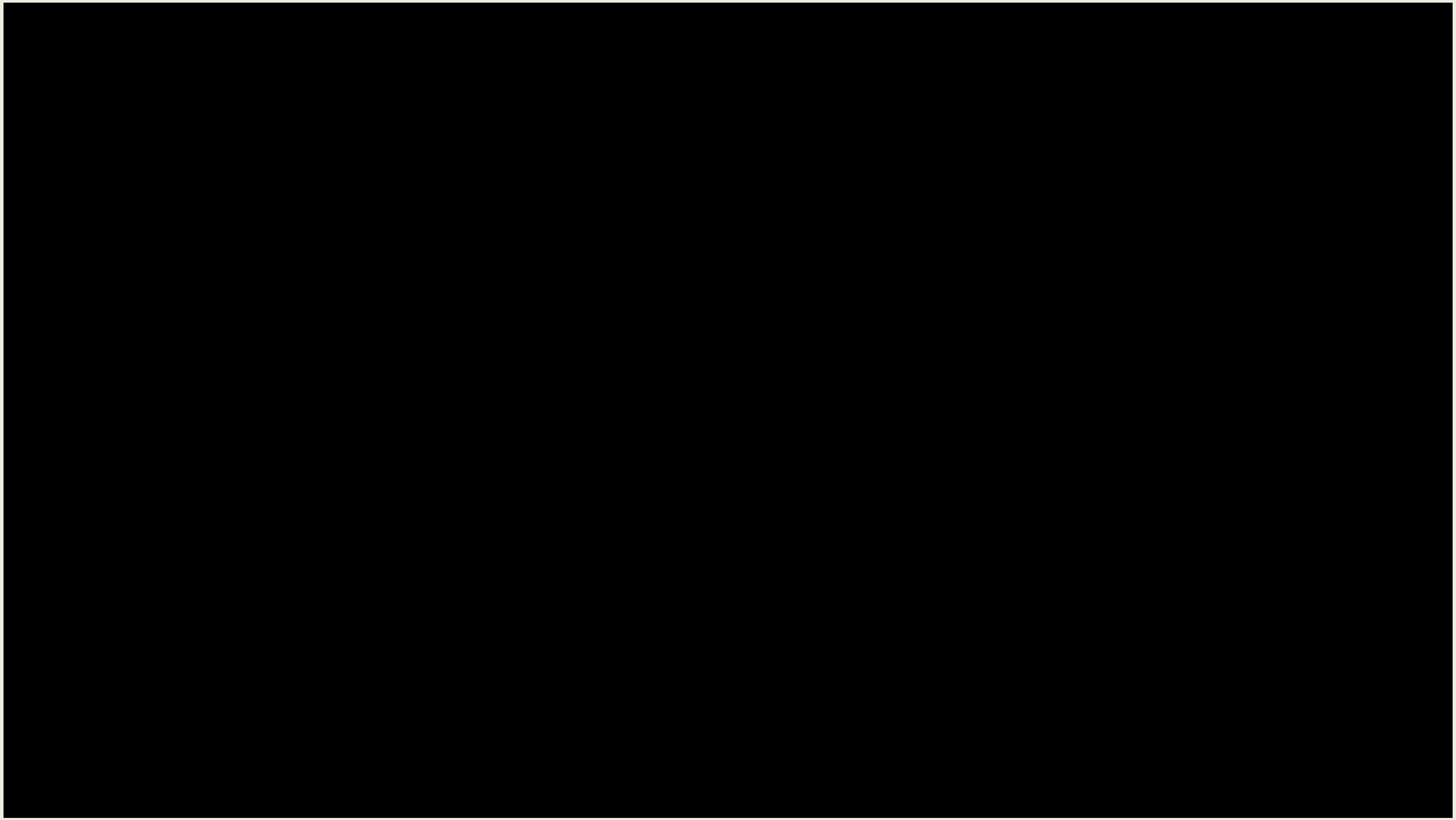
Powder coat

Install for client

Hook up all sensors and wiring



DEMONSTATION VIDEO



Thank you!

SCAN ME

Any Questions?