SmERT

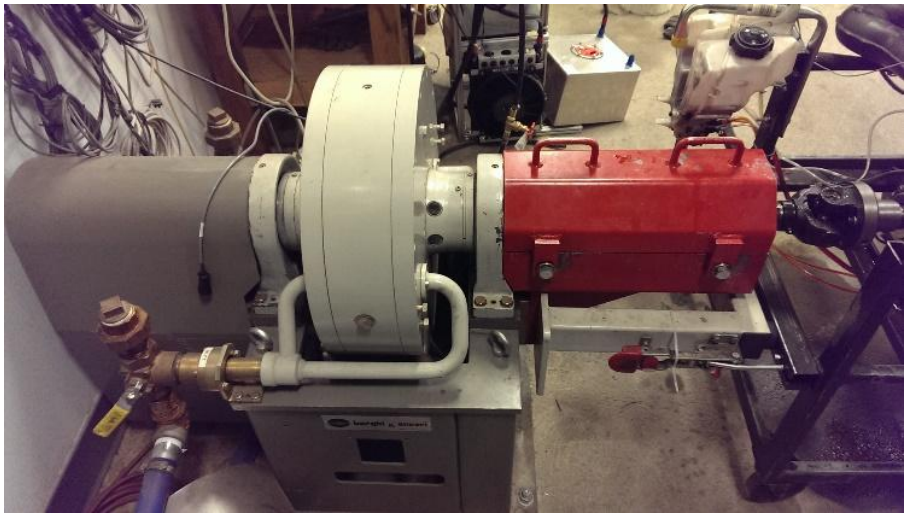
(Small Engines Research Team)

Joseph Gillilan
Jacob Johnson
Kyle Polito

Client: University Of Idaho
Lead instructor: Dr. Daniel Cordon

Small Engines Research Facility

University operated internal combustion engine lab funded by NIATT, College of Engineering, and the Department of Mechanical Engineering



Current Capabilities

- Dynamometer
- Paint booth
- Fuel consumption & flow measurement
- Lacks research grade emissions analyzing equipment…

Design Task

Improve University infrastructure by providing professional vehicle emissions testing capability to:

- Graduate Students
- Formula Hybrid Team
- Clean Snowmobile Team
- Other Research Teams

Project Needs

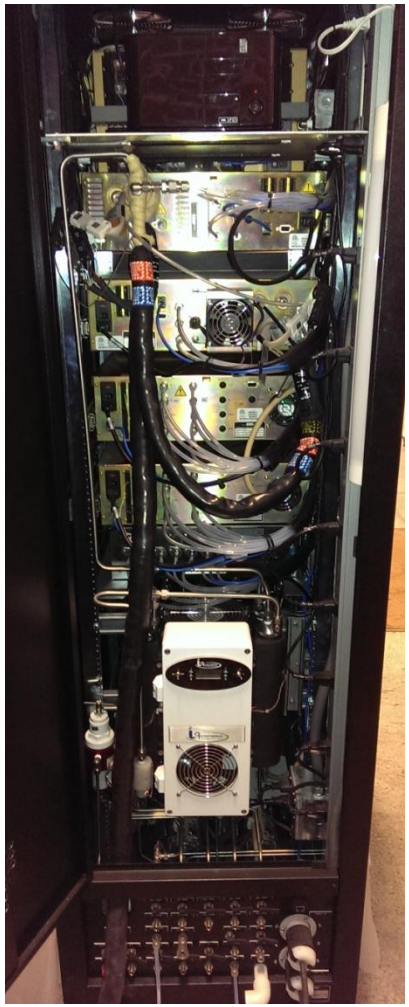
Setup & verify the functionality of the new emissions analyzer in the SmERF:

- Single-bay Emissions System purchased from California Analytical Instruments (CAI)
- Machine needed correct calibration gasses, regulators, zero-air generator, instructions, etc.

CAI Emissions System

Features

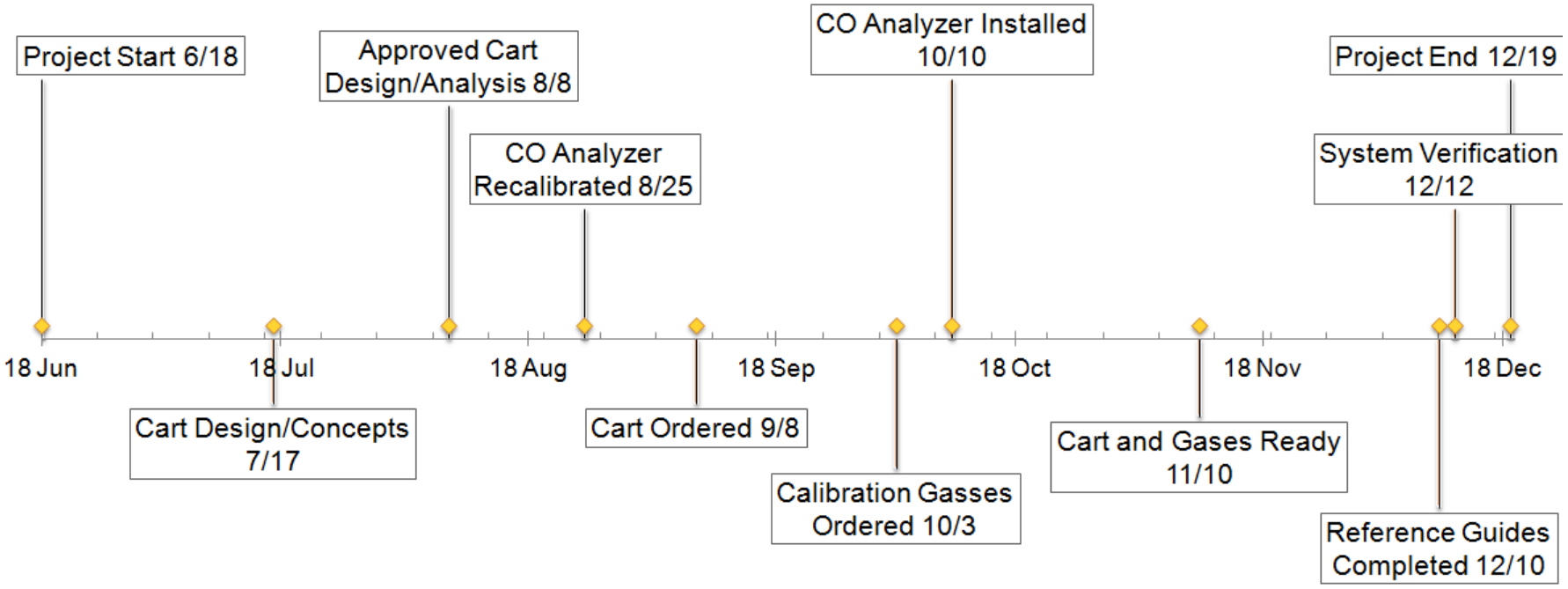
- Single-bay mobile rack mount system
- Analyzer modules for CO, CO2 & O2, NOx, THC
- Gas divider for calibrating analyzers
- Onboard computer for real time data logging



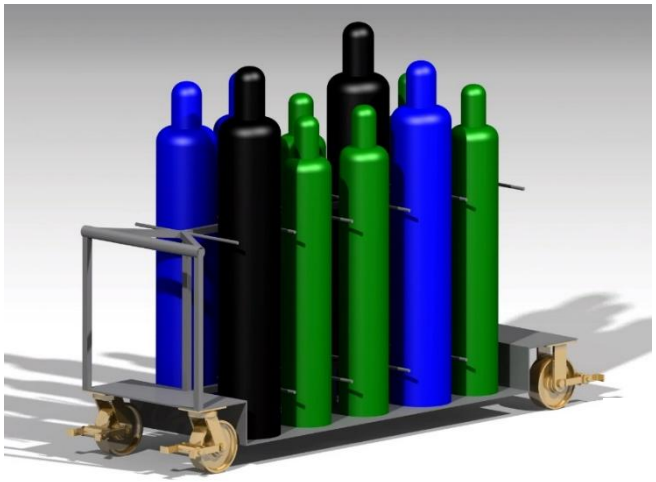
Key Tasks

- Mobile storage solution for calibration gasses
- Recalibrate CO Analyzer
- Zero Air Generator
- Identify & install necessary hardware
- Create documentation for future students
- Verify system functionality

Project Timeline



Decision…Build or Buy?

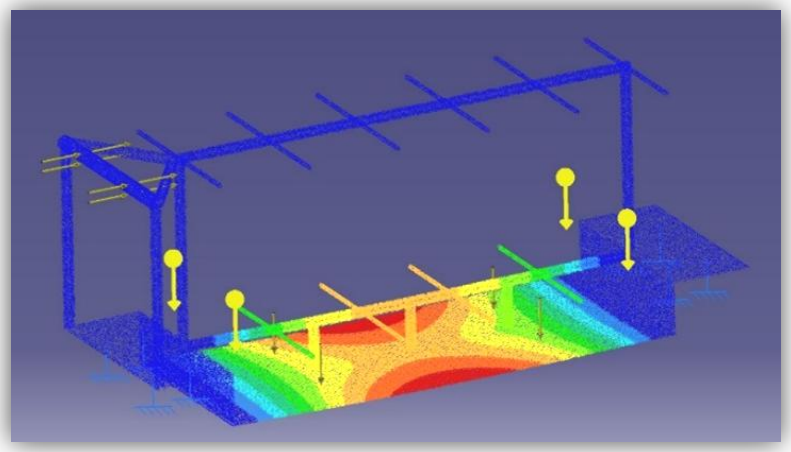


So many options...

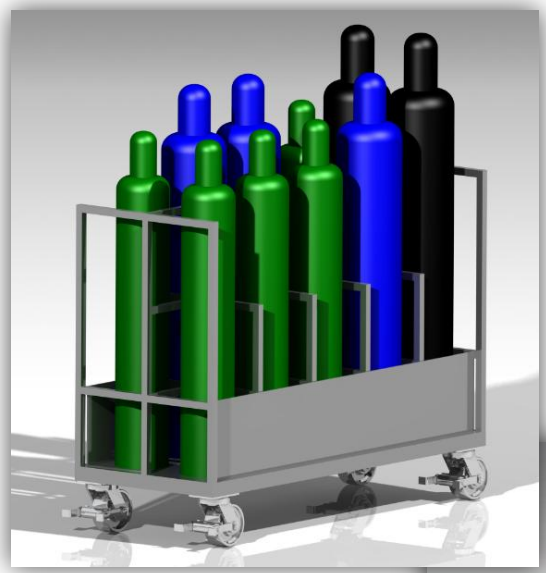
Gas Cylinder Cart

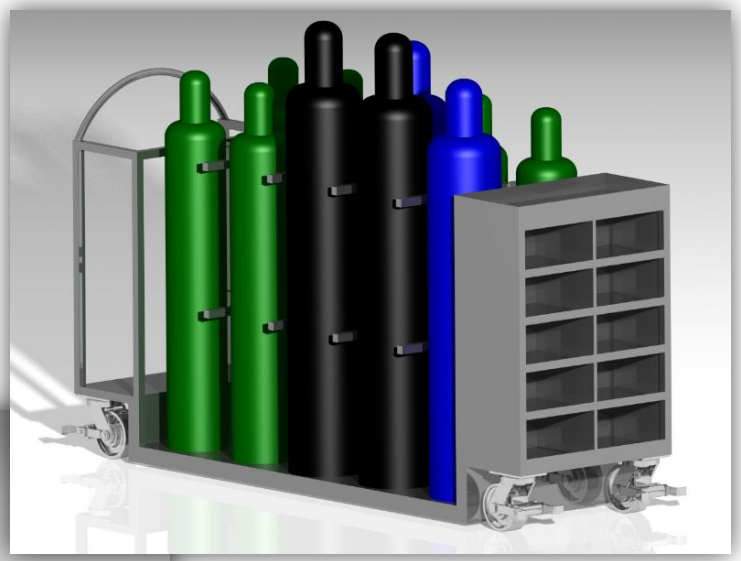
Specifications

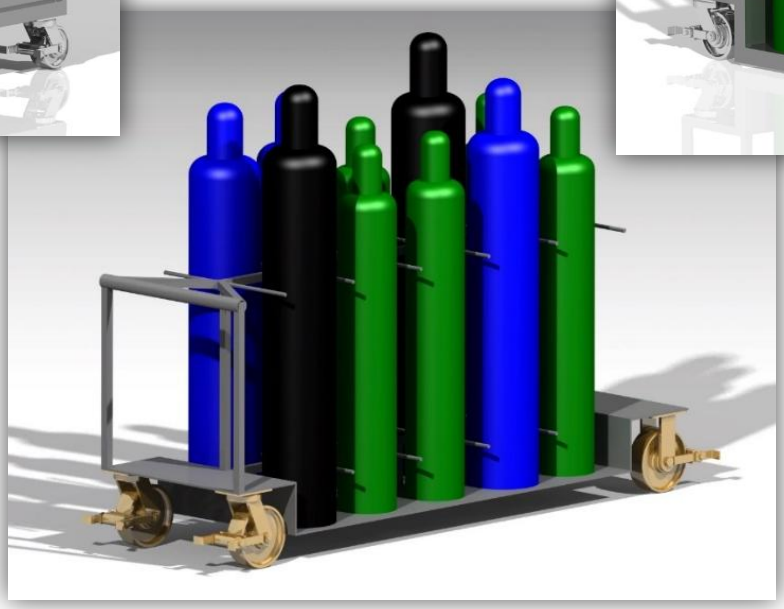
- Secure cylinders valve end up
- Cylinders can be removed individually
- Accepts cylinders up to 9.25” in diameter
- Can be moved by one person
- Locking casters
- Holds 8 to 10 cylinders
- 1000 lb. capacity



In-house Design Concepts







Renders created using CATIA v5

Final Cart Decision

MECO 8 Cylinder Truck

CO Analyzer

Purpose

Uses NDIR (non-dispersive infrared) technology to measure dual low and high level CO

Problem

Does not measure a high enough concentration of CO for our current needs

Solution

Sent to CAI for recalibration
CO Low: 0 - 100, 0 - 1000 PPM
CO High: 0 - 0.5%, 0 - 5.0%

Zero Air Generator

Purpose

Used to purge gasses from the analyzers after testing

Zero air – Ambient air purified to contain less than 0.1 ppm total hydrocarbons

Requirements

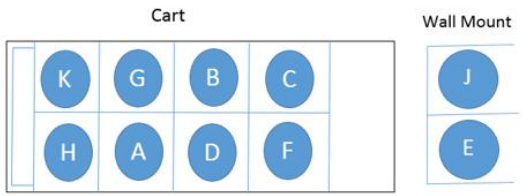
- Must be mounted vertically
- Compressed air free of particles larger than .01 micron

Hardware

- Regulators
- Gas Cylinders
- Hoses
- Fittings
- Valves
- Filters
- Gauges
- System Cover

Documentation

System Diagram

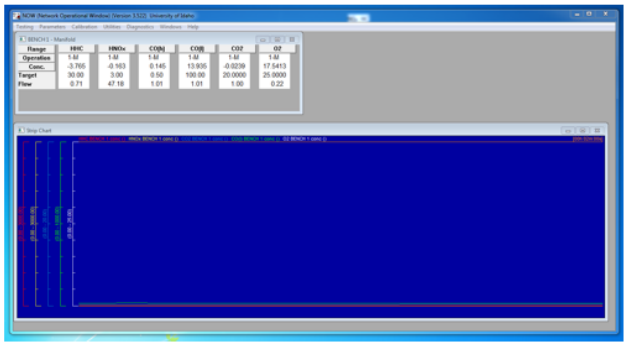


Cyl./Input	Analyzer	Gas Cylinder	Regulator Type
A	THC Span	90 ppm Propane bal Air	CGA 590
B	O2 Span	21% Oxygen bal Nitrogen	CGA 590
C	COH Span	4.5% Co bal Nitrogen	CGA 350
D	COL Span	90 ppm CO bal Nitrogen	CGA 350
E	Nox Span	Empty	N/A
F	CO2 Span	17.7% CO2 bal Nitrogen	CGA 580
G	NO Span	2682 ppm Nitric Oxide bal Nitrogen	CGA 660
H	N2	Nitrogen	CGA 580
I	Zero Air	Zero Air Generator	N/A
J	Fuel	40% Hydrogen bal Helium	CGA 350
K	O2	Compressed Oxygen	CGA 540

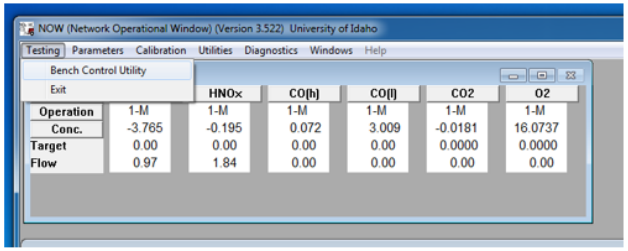
Quick Reference Guides

How to take a measurement:

1. Open the NOW program



2. Go to testing and select "bench control utility"



Results & Conclusion

SmERF infrastructure improved

- On track to meet design tasks
- Client expectations met
- Research abilities of the University increased
- Attractive to potential students
- Analyzer system ready to use today!

Moving Forward…

- Verify complete system functionality
- Refine reference guides

Questions?