Team 32

Engine Dyno

Purdue Polytechnic – South Bend

Engine Dyno

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Purdue Mentors / Customers: Dr. Megan Prygoski
Purdue Professors: Dr. Fred Berry & Dr. Sarah Leach

PURDUE POLYTECHNIC

Customer Background

Dr. Prygoski, a professor at Purdue Polytechnic's South Bend campus, teaches Mechanical Engineering Technology. With her M.S. and Ph.D in Mechanical Engineering from the University of Notre Dame she teaches Heat and Power and Applied Thermodynamics, two core MET courses which include lab exercises. The intention of the engine dyno is to be used in these labs. This dyno will enhance students' ability to conceptualize energy transfer and efficiency.

Problem Statement / Scope of Work

A previous capstone team collected components and designed a basic structure. The Dyno will be used in MET thermodynamics labs. Our customer asked for a reliable and long-lasting piece of equipment that will use an internal combustion engine to power alternators. The system load is created by supplying current to resistant heating elements. The measured rise in temperature is displayed in real time. Also, the client asked that all the temperature readings be within 10% of each other; to achieve this the water will be circulated using a water pump. The final objective was making the engine dyno a show piece to present to student interested in attending Purdue South Bend.

Requirements Matrix

Req. #	Requirement	Description	Test to Verify
1	Engine Dyno Test Run	Put Engine Dyno back together and make sure parts are tight before test run.	Put gasoline into system and start the engine.
2	Temperature of Water	Measure hest output from engine to water. Water temperature should be about the same.	The Arduino reads the data sent from the sensors.
3	Sync Temperature Sensor Readings	Each sensor reads within 10% of each other	Evenly distribute power and display data.
4	Display	Have LCD screen display four outputs for tempersture.	Arduino code interprets data and displays temperature on the LCD screen.
5	Fluid Flow Sensor	Have a fluid sensor to measure intake/amount of water going into the system. Find out how much fluid has flowed through the system.	The feedback from the flow sensor is sent to the Arduino and displayed on the LCD screen.
6	Safety Protocol	Place safety measures to ensure operator and bystanders can be safe when engine dyno is on.	The emergency stop ceases the system to come to complete stop.

Experimentation / Concepts Exploration

Pully System

Strengths:
- Powers heating elements
- Capable of powering additional parts

Weaknesses:
- If installed wrong, the belt could break or slide off

Battery Box

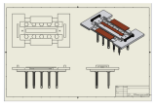
Strengths:
- Sturdy
- Easily removable
- Ledge to place and slide battery in.
- Bolts placed in groves used to stop battery from sliding

Control Panel strengths/ weakness)

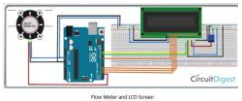
Strengths:
- Visible
- Components are in one spot
- Ease of use

Weaknesses:
- Slightly flexible

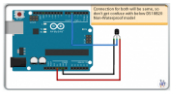
Final Design



Heating Element



Flow Meter and LCD Screen



Temperature Sensors

Engine / Chassis

Protective Equipment (Metal fence, Polycarbonate sheets, and an E-Stop

Water Pump / Flow Sensor

Failure Mode and Effect Analysis (FMEA)

FMEA – Failure Modes and Effective Analysis

Function	Potential failure mode	Potential failure effects	SEV	Potential Causes	OCC	Current controls	DET	RPN	Actions Takes
Mechanical Components									
Timing belt	Belt slips off	Critical failure and injuries	10	Improper alignment, bad belt, no belt guards	10	Realignment	1	2	Install pulley guards to prevent slippage
Alternator pulley	Loose pulley tension, slip	Loss of energy from belt to alternator	5	Incorrect installation of bully right now	1	install pulling up with torque wrench	2	4	Add an additional tensioner
Water pump	Pump burns put	Water won't circulate	1	Pump ran without water	2	Pump is placed below waterline	1	1	A switch to tun the pump on or off
Electrical Components									
Heating element	Heating elements become open	Data will be off compared to previous test	1	Corrosion, constant heating and cooling cycle, low water level	7	None	9	8	Bench and field test and water level line
Wiring	Overheat and melt	Fire, engine dyno destroyed, need new alternators	9	So why are not sized properly, load shorts out	2	calculate wire size	2	1	Install PVC conduit for wire
General									
Safety	Clothing getting caught in machinery	Loss of life or lens for operators	2	Loose clothing or jewelry and long hair	1	Shut down system nothing	2	4	Enclosed engine dyno with wired mesh

Testing

General Automation & Mechanical Test			
Step	Test	Details	Outcome
1	Cart Usability	Ensure the cart is lightweight, portable, and fits through the door	Cart fit through the door-way and was lightweight
2	Engine	Ensure the engine runs and fits through the door	The engine ran but the belt does vibrate
3	Heating System	Ensure the capability to heat the water	The heating elements do have the capacity to heat the water
4	Sensor/ Water Pump	Ensure the sensors and pump work as intended before installing	All parts worked as intented
Production Testing			
5	Starting the Motor	Make sure the engine can easily turn off and on	Test was a failure because e-stop has to be help in to start the engine
6	Water Temperature Increases	Ensure the engine provides wnough power to heat the water	The water temperature increased but very slowly
7	LCD	Ensure the temperature and flow rate are displayed on the LCD	Both the temperature and flow-rate were displayed on the LCD