Element E – Score 0
Bicycle Tire Pressure Project

Element E: Application of STEM principles and practices

This entry would be likely to receive a score of 0, based on the EDPPSR.

The entry consists primarily of a brief explanation of different ways that air pressure can be measured and asserts the use of mathematics to solve the problem ("Indeed, mathematics was necessary to discover and explain the relationship between the voltage given off by the sensor and the pressure in the bicycle wheel"). Nowhere does the entry mention the solution or explain the application of STEM principles or practices to substantiate the solution. Furthermore, there is no evidence of any involvement whatsoever by experts (qualified consultants and/or project mentors).

This entry includes graphics for which source documentation is necessary. That feature is not included among the criteria for Element E but is assessed when assigning a score for Element N: Writing Like an Engineer. In some instances (e.g., the plot illustrating measured tire pressure versus measured output voltage), a brief lead-in in the text would be helpful. Informative chart, graph, or figure should ever be expected to "do the talking" for the text. It is always advisable to tell the reader/reviewer what to look for in that display and discuss the highlights.

Engineering Design Process Portfolio Scoring Rubric
Component and Element Titles

Component I: Presenting and Justifying a Problem and Solution Requirements
- Element A: Presentation and justification of the problem
- Element B. Documentation and analysis of prior solution attempts
- Element C. Presentation and justification of solution design requirements

Component II: Generating and Defending an Original Solution
- Element D: Design concept generation, analysis, and selection
- **Element E: Application of STEM principles and practices**
- Element F: Consideration of design viability

Component III: Constructing and Testing a Prototype
- *Element G: Construction of a testable prototype*
- Element H: Prototype testing and data collection plan
- Element I: Testing, data collection and analysis

Component IV: Evaluation, Reflection, and Recommendations
- Element J: Documentation of external evaluation
- *Element K: Reflection on the design project*
- Element L: Presentation of designer's recommendations

Component V: Documenting and Presenting the Project
- Element M: Presentation of the project portfolio
- Element N: Writing like an Engineer

Please Note: Elements M and N require no submission from the portfolio author(s) and are intended to be scored based on the portfolio work as a whole from what has been submitted from Elements A through L

Element E: Application of STEM principles and practices

5 The proposed solution is well-substantiated with STEM principles and practices applicable to all or nearly all design requirements and functional claims; there is substantial evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by two or more experts (qualified consultants and/or project mentors) and that those reviews provide confirmation (verification) or detail necessary to inform a corrective response.

4 The proposed solution is generally substantiated with STEM principles and practices applicable to some design requirements and functional claims; there is some evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by at least two experts (qualified consultants and/or project mentors) and that those reviews provide confirmation (verification) or some detail necessary to inform a corrective response.

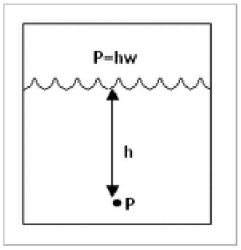
3 The proposed solution is partially substantiated with STEM principles and practices applicable to at least a few design requirements and functional claims; there is some evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by at least one expert (qualified consultant or project mentor) but this review may not provide clear confirmation (verification) or at least some detail to inform a corrective response.

2 The proposed solution is minimally substantiated with STEM principles and practices applicable to at least a few design requirements and functional claims; there is minimal evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by at least one expert (qualified consultant or project mentor) but there is no evidence of confirmation (verification) or any detail to inform a corrective response.

1 The proposed solution is minimally substantiated with STEM principles or practices applicable to at least a few design requirements and functional claims; however, there is no evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by an expert (qualified consultant or project mentor).

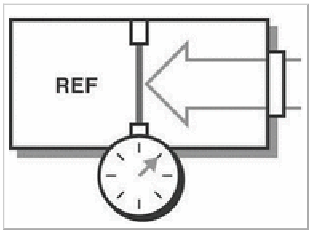
0 The proposed solution is not substantiated with STEM principles or practices applicable to any design requirements and/or functional claims.

The Use of Math and Science Through Studying Pressure Measurements and Voltage



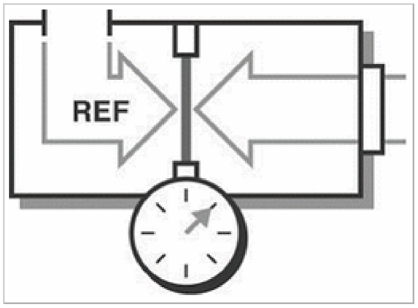
A significant scientific concept necessary to understand and consider before our creating the prototype was the different ways pressure can be measured. There exist three manners in which air pressure can be measured, these include absolute, gauge, and differential.

Absolute Pressure



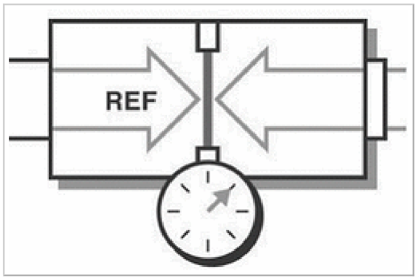
Absolute pressure measurement is measured relative to a vacuum (see left). Often times, the abbreviations PAA (Pascals Absolute) or PSIA (Pounds per Square Inch Absolute) are used to describe absolute pressure.

Gauge Pressure



Gauge pressure is measured relative to ambient atmospheric pressure (see picture). Similar to absolute pressure, the abbreviations PAG (Pascals Gauge) or PSIG (Pounds per Square Inch Gauge) are used to describe gauge pressure.

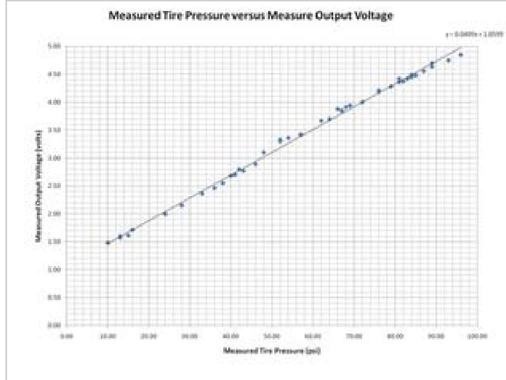
Differential Pressure



Differential pressure is similar to gauge pressure, but instead of measuring relative to ambient atmospheric pressure, differential measurements are taken with respect to a specific reference pressure (see left). Also, the abbreviations PAD (Pascals Differential) or PSID (Pounds per Square Inch Differential) are used to describe differential pressure.

Relationship between Voltage and Pressure

Indeed, mathematics was necessary to discover and explain the relationship between the voltage given off by the sensor and the pressure in the bicycle wheel.

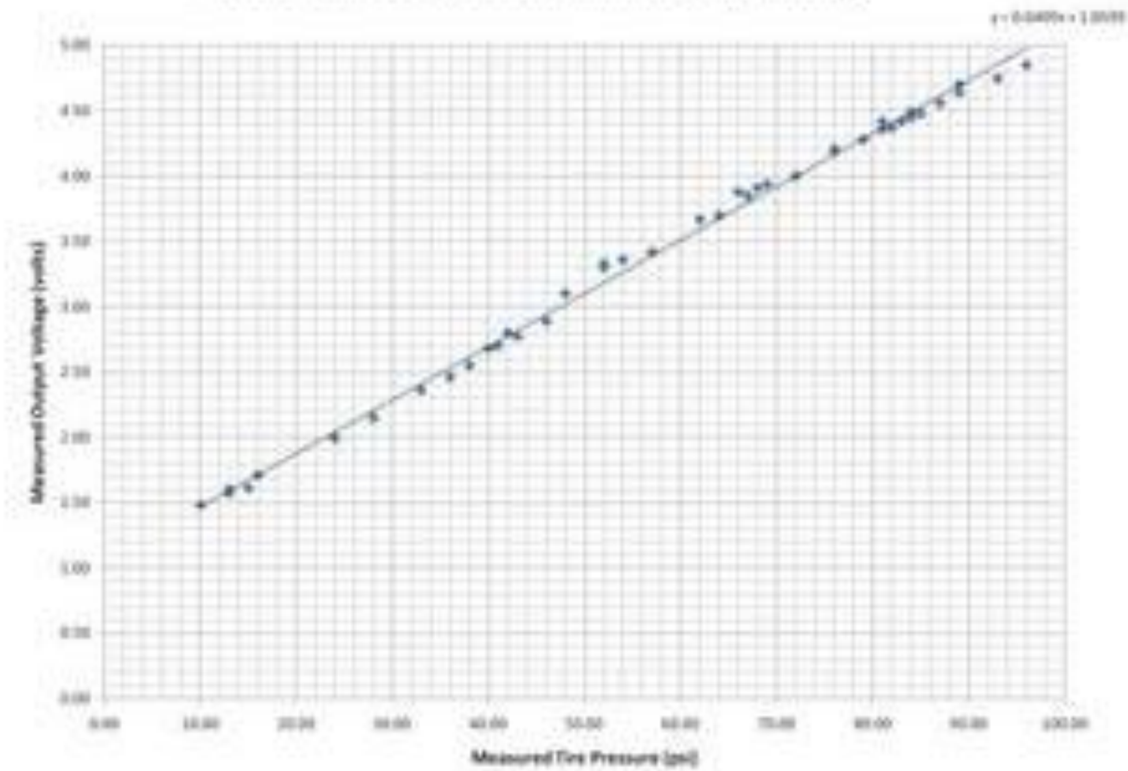


The Search for a Sensor

Datasheets	P51 Family
Product Photos	P51-100-A-A-I36-4.5V-R
Product Training Modules	**P51 Pressure Sensors** **P51 Pressure Measurement Overview**
Catalog Drawings	P51 Series Side P51 Series Bottom
Standard Package	1
Category	Sensors, Transducers
Family	Pressure
Series	MediaSensor™
Pressure Type	Absolute
Operating Pressure	100 PSI
Port Size	Male, 1/4" (6.35mm) NPT
Output	0.5 ~ 4.5V
Accuracy	±0.5%
Voltage - Supply	5V
Termination Style	Cable 3'
Operating Temperature	-40°C ~ 105°C
Package / Case	Stainless Steel
Factory Setting	-
Catalog Page	2744 (US2011 Interactive) 2744 (US2011 PDF)
Other Names	734-1042 P51-100-A-A-I36-4.5V-000-000

Among the most important criteria was an appropriate output voltage range. The larger the range, the less sensitive the output end of our prototype would have to be. As can be seen on the left here, the output we choose went from .5 voltage at 0 PSIA (Pounds per square inch absolute) to 4.5 volts at 100 PSIA. Therefore, the relationship between one PSIA lost is .04 volts, as 4/100 = .04 volts.

Measured Tire Pressure versus Measure Output Voltage



Datasheets	P51 Family
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