

E80 Spring 2015 Final Report Rubric

1 Abstract

2 Introduction/background

3 Main body

3.A Scientific and/or Engineering Goals

Specific Topics: They should list the specific phenomena they want to measure, why these measurements are important, and what they expect to learn from the measurements.

For example, if they want to measure atmospheric temperature as a function of altitude, they should report that their rocket should remain in the troposphere, which extends to roughly a height of about 10 km (6 miles), and the standard model of the atmosphere uses a lapse rate of $-6.5\text{K}/\text{km}$. However, the profile can be affected by local solar heating of the ground, by thermals, and by unusual weather patterns. Therefore, if the local conditions follow the standard model they would expect to find a linear variation of temperature with height with a slope of -6.5K per 1000 m. But if the profile is steeper than expected close to the ground, there is local solar heating of the ground. If the profile is less steep than expected or shows an increase with elevation, it is possible that there is a temperature inversion, which has relevance to stagnant air or trapped air pollutants. If the profile is different during ascent than during descent, they may have encountered a thermal.

A similar explanation should accompany each goal.

3.B Sensor Selection

Specific topics: They should address what sensors they have chosen and how they relate to the scientific/engineering goals. They should address the sensor input/excitation range and how these compare with the expected excitation during flight. They should also address the output range and or form (voltage, AC voltage or pulse train, pulse width modulated, pulse height modulated, etc.), and impedance.

For example, if they chose a 40 AWG exterior thermocouple and their expected highest flight was on an H242T, they would expect a flight to about 1000 m AGL, and a temperature change of -6.5K from the atmospheric lapse rate, which corresponds to a voltage change of about -0.4 mV . The output is a low-impedance voltage roughly proportional to the difference in temperature between the thermocouple and the PC board. The thermocouple has a response time of $<1\text{ s}$ in still air and in the 10 ms region in moving air, so there will be a very slight lag in the temperature during ascent, but it should track the temperature very closely during descent.

A similar analysis should accompany each sensor.

3.C Circuit and Rocket Design

Specific topics: They should explain the circuits they designed and the values they chose or calculated to get the expected variations in output into the 0-to-3.3V @ 2k Ω input range of the data logger. They should explain how they chose their sample rate and how they avoided or used aliasing. They should also explain how they modified the rocket to have the sensor function properly.

For example, if they chose a 40 AWG thermocouple to measure the air temperature exterior to the rocket during flight, they would explain how they chose an instrumentation amp and a gain of 1000 to amplify the expected signal change of -0.4 mV to -0.4 V. They would also explain that if they wanted absolute temperature and not just temperature differences, that they chose a 100 k Ω thermistor (or other sensor) to measure the cold junction temperature, and put it in a voltage divider, where they conditioned the output with an op-amp buffer, and how they chose the voltage divider excitation voltage and op-amp gain to get the output into the 0-to-3.3 V range of the data logger.

They would explain how they modified the rocket to put the thermocouple on the outside of the rocket in good thermal contact with the air, and poor thermal contact with the rocket, and how they placed the thermistor in close proximity with relatively good thermal contact with the cold junction.

A similar explanation should accompany each sensor.

3.D Modeling

Specific Topics: They should explain how they used Rocksim or their own model to predict the rocket's performance versus time, and how this performance coupled with the model for the phenomenon the expected to measure, and how the model results informed the experimental protocol.

For example, if they chose a 40 AWG thermocouple measuring the air temperature outside the rocket on a flight with an H242T, they would use Rocksim to generate an altitude versus time plot, and then use the data for that plot and the lapse-rate model to generate an expected-temperature versus time plot. If they were concerned about the response time of their thermocouple, they would then use these data as the input to a first-order model and generate a plot of expected-voltage versus time, and see how well the thermocouple output tracked the expected temperature variations. They would then use either the temperature-versus-time or voltage-versus-time to choose a sample rate high enough to capture all of the transient information of interest and they would save the model for use in data analysis.

There should be a similar analysis for each sensor.

3.E Experimental Procedure

Specific Topics: There should be an explanation of their experimental protocol, e.g., The goals for each flight, prepping the rocket, configuring the data logger, starting the data logger, flight, recovery, retrieval of the data, and processing of the data.

3.F Comparison of Data to Model

Specific Topics: There should be a comparison of the modeled data from 3.D with the retrieved data from 3.E. Graphical comparison is preferred, but written comparison should be used as appropriate, especially to explain the graphical data. Error bars or estimates should be included in all experimental quantities. Whether each flight is compared individually or all flights compared together will depend on the data sets and the results. Descriptions of the degree of agreement should be made and possible explanations of the discrepancies should be present.

4 Conclusion

The conclusions should not be a summary, but should be a summation of lessons learned, both about the process and of the comparison of the data and models. It should answer the question, “What does it all mean?” It should include recommendations for future work and/or future versions of the class.

5 Acknowledgement

6 References

7 English usage

7.A Grammar/Usage/Mechanics

___ **Superior** – Free of spelling, capitalization, and usage errors. Few, if any, errors in punctuation. Sophisticated and consistent command of standard English.

___ **Good** – Number and type of errors does not interfere with meaning. Few, if any, spelling, capitalization, or usage errors.

___ **Marginal** – Number and type of errors may interfere with meaning at some points. Some spelling, capitalization, or usage errors. Some fragments and/or run-ons. Some errors in punctuation.

___ **Inadequate** – Number and type of errors obscure meaning. Frequent errors in spelling, capitalization, and usage. Many fragments and/or run-ons. Serious and frequent punctuation errors.

7.B Style/Organization

7.B.i Transitions

___ **Superior** – Ideas/paragraphs/sections are connected by effective transition words and phrases. Precise, interesting, and accurate word choice. Writing style enhances readability of writing.

___ **Good** – Transitions used. Word choice is adequate to convey meaning.

___ **Marginal** – Few or no transitions. Overall style choppy.

___ **Inadequate** – No transitions. Sentence style choppy. Vocabulary limited.

7.B.ii Focus

___ **Superior** – Language choices (degree of jargon) and use of background material reflect attention to audience. Writing has a clear, distinct focus.

___ **Good** – Most material is appropriate to audience. Focus may be unclear at points.

___ **Marginal** – Little evidence of attentiveness to audience. Focus on topic not consistently sustained.

___ **Inadequate** – No evidence of attentiveness to audience. Writing is unfocused.

7.B.iii Organization

___ **Superior** – Generally well-developed ideas have a logical flow. Introductory and closing material is used effectively. Piece has a sense of completeness.

___ **Good** – Ideas may not be in their most effective order. Some main points are underdeveloped. Some attempt is made at introductory and closing material; piece has a sense of completeness.

___ **Marginal** – Order of ideas not entirely effective. Lack of distinction between main and supporting statements. Piece seems incomplete.

___ **Inadequate** – Lack of cohesive plan for presentation of material. No opening or closing. Incomplete.

7.B.iv Elaboration / Support

___ **Superior** – Each main idea is supported by detailed data or reasoning. All details are related to topic. Complete, correct documentation of a wide variety of sources.

___ **Good** – Details and/or data in some paragraphs may be sketchy; details may be insufficient to reach conclusions. All details are related to topic. Complete documentation of a variety of sources.

___ **Marginal** – Details may appear to be listed rather than integrated into coherent flow; some details are irrelevant. Marginal documentation of sources; some key sources may be missing.

___ **Inadequate** – Half or more of conclusions/main ideas are not supported by details. Half or more details cited are irrelevant. Inadequate documentation of inadequate sources.