

Closed System Greenhouse Effect Laboratory Experiment-Original Data

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Abstract

Conventional closed lab experiments using high-energy light sources and simple temperature sensors showed that CO₂-filled bottles often became hotter than bottles containing air. From this, they concluded that it proved the Greenhouse Effect. However, the thermometers and thermocouples used in those experiments did not measure absorption by Greenhouse Gases. In this study, a closed system laboratory experiment was designed and constructed to verify the accuracy of the aforesaid conclusion. In this experiment, both thermocouples and an infrared detector were used to collect the data. The results showed that the barrier holding the gas absorbed 98.3% of the infrared radiation. And the remaining 1.7% was not observed to be associated with absorption by the Greenhouse Gases. The experiment showed that Non-Greenhouse Gases performed as well as or better than the Greenhouse Gases relating to increased temperatures. Data from experiments using only scalar-measuring devices, like thermometers and thermocouples, proved inadequate. It further showed that infrared detectors can measure infrared absorption. However, the amount of absorption by the containment membrane was overwhelming and obscured any measurable observation of any Greenhouse Gas absorption. The conclusion was that the conventional Greenhouse Effect laboratory experiments using closed systems failed to prove the Greenhouse Effect theory.

Keywords

Climate Change, Greenhouse Effect, Laboratory Experiment, Greenhouse Gases, CO₂, Water Vapor, Infrared Detector

1. Introduction

The concept of the Greenhouse Effect is an issue where science and politics are intricately interwoven into its fabric. Briefly, the Sun emits high-energy sunlight

during the day, which heats up the Earth. To cool down, the Earth releases infrared radiation. Certain gases in the atmosphere, known as Greenhouse Gases, absorb some of this low-energy infrared radiation emitted by the Earth. This process is believed to warm the atmosphere by delaying the escape of this heat into space. The United Nations, through a co-owned subsidiary known as the Intergovernmental Panel on Climate Change (IPCC), has taken the lead in advancing this concept, which is built on the belief that man-made emissions of CO₂ are the cause. They list three reasons for its validity: 1) the Earth is warmer by 33 degrees based on a planetary blackbody analysis, 2) the composition of Venus and Mars support the Greenhouse Effect based on CO₂, and 3) ice cores going back 160,000 years show that the greenhouse CO₂ concentrations match global temperature variations. [1] There was not a single laboratory experiment cited in the IPCC assessment reports that proved or directly supported the Greenhouse Effect concept itself.

Despite the absence of lab experiments, many have used tests based on conventional greenhouses to prove their point. This is discussed in detail in an earlier publication. [2] In conventional greenhouses, sunlight passes through a transparent glass or plastic barrier and is absorbed by the ground, plants, and other solid objects within the structure. These objects warm the air inside through thermal conduction/convection. On the other hand, the Greenhouse Effect relates to a warming phenomenon caused by certain atmospheric gases absorbing a portion of the infrared radiation emitted by the Earth. Significant confusion stemmed from a lack of clarity on the difference between thermal heat transfer in conventional greenhouses and infrared radiation absorption by Greenhouse Gases. They are entirely different processes, even though they share a common name, *i.e.*, greenhouse.

In 1819-1888, Eunice Newton Foote performed a simple laboratory experiment. She used several 4-inch diameter glass cylinders thirty inches long, containing dry air, moist air, and carbon dioxide. She exposed the glass cylinders to high-energy sunlight and observed the temperatures inside. Unfortunately, she lacked the technical expertise regarding high-energy sunlight and low-energy infrared radiation emitted by the Earth. She was unaware that the glass in her cylinders blocked infrared radiation from entering or leaving the test chamber. Ms. Foote's experiment has been cited as proof of the Greenhouse Effect. [3] This type of laboratory test has been recommended by the US governmental entities. [4] Numerous K-12 and college educators have adopted it as well.

2. Thermal Heat Transfer

Understanding why thermometers show different temperatures for different gases requires some knowledge of basic thermodynamics. Temperature differences in the air and CO₂ bottle experiments could be solely due to thermal heat transfer, not radiation absorption by Greenhouse Gases. For example, a thermometer or a thermocouple **only measures the temperature**. It does not measure radiation.

Variations in the heat transfer characteristics of the gases surrounding the thermometers and thermocouples could account for the observed temperature differences. **Table 1** below lists a few heat transfer properties for various gases. Each one has an effect on the observed temperatures, independent of any absorption by Greenhouse Gases.

Table 1. Convection (h) depends on whether it is forced or natural. The values set forth in the table are for natural conditions. Air density varies significantly depending on the amount of water vapor. Increased humidity reduces the density because water vapor is less dense than air (up to 30+%).

Gas	Conductivity (k) (W/m K)	Convection (h) (W/m ² K)	Heat Capacity (c) (W/kg K)	Density (ρ) (kg/m ³)
Air	0.0257	2 - 10	1005	1.225
Nitrogen	0.0259	2 - 10	1040	1.165
Carbon Dioxide	0.0166	1 - 10	846	1.98
Argon	0.0177	2 - 5	520	1.78
Water Vapor	0.025	5 - 20	1870	0.804

An illustration of the importance of these heat transfer properties may be helpful. Assume there are two bottles, one containing dry air and one containing 100% CO₂. The bottles are set in the sun on a clear day. After several minutes to hours, the thermometers in each bottle will often show a slightly higher temperature in the bottle containing CO₂. Based on that factor alone, NASA and the media have concluded that the higher temperature was caused by the CO₂ absorbing infrared radiation. However, these entities failed to address the thermal conduction/convection properties as a cause of the temperature differences. All solid and liquid objects absorb radiation over a broad spectrum of wavelengths. Hence, the sunlight will be absorbed by the bottle itself and all the objects inside the bottle. If the thermometer/thermocouple bulb is exposed to the sunlight, it, too, will heat up by absorbing the sunlight. Absorption by solid and liquid objects differs from absorption by gases. Gases only absorb radiation over a narrow range of wavelengths that match their spectral characteristics. For example, CO₂ and water vapor only absorb about 2% - 3% of the infrared radiation being emitted by the Earth. This is addressed by Kirchoff's Laws on Spectral Absorption and Emission. [5] Graphs illustrating this absorbance are also shown in **Figure 4** and **Figure 5**.

Then why did the CO₂ bottle register a higher temperature? As shown in **Table 1**, air has a higher heat transfer rate, *i.e.*, air (0.0257 W/m K) versus CO₂ (0.0166 W/m K). Therefore, the thermometer in the air bottle will cool much faster than the CO₂ bottle. In fact, CO₂ is often used as an insulation gas in many commercial situations. Since the air cools the thermometer faster, it **creates the illusion** that CO₂ causes the bottle to appear warmer. But it could be that the air-containing bottle simply cooled faster. If the objects in the container are warmed by the absorbed radiation, then the air will transfer the heat away from the interior objects faster than inside the CO₂ bottle. Therefore, differences in the two bottles' internal

temperatures can be explained by thermal heat transfer characteristics rather than absorption by the Greenhouse Gases.

In the second column in **Table 1**, the conductivity (k) for each of the atmospheric gases is set forth. The higher the conductivity, the faster the heat can be transferred by the gas. For example, air, nitrogen, and water vapor have a heat transfer value about 50% higher than CO₂ or argon. As such, air, nitrogen, and water vapor would be expected to cool the contents of the test bottles faster than CO₂ or argon.

Column 3 shows the convection coefficient for various gases. Because there are numerous conditions affecting convective heat transfer, the standard reference tables usually provide ranges. Assuming all other factors are constant, CO₂ can transfer about the same amount of heat as dry air, but 2 to 5 times slower than air containing water vapor. Convection usually transfers the largest amount of energy in gas environments. While conduction is slow, convection is usually quite fast.

Column 3 provides the specific heat for the atmospheric gases. The specific heat is the energy needed to raise the temperature of each gas molecule by 1 degree. Higher specific heat means more energy is required. It acts like an insulator and resists temperature changes, usually hindering heat transfer.

Density is set forth in column 4. It operates with other heat transfer mechanisms. At a given temperature, heavier molecules typically move slower at the same temperature and transfer energy less efficiently. Consequently, the interplay of these heat transfer properties is sometimes cooperative and sometimes competitive.

It is surprising that the laboratory experiments suggested by NASA or by any of the greenhouse lesson plans used in high school and college labs fail to discuss the effects of these thermal heat transfer characteristics.

3. Purpose of this Study

This research will determine whether the Greenhouse Effect can be observed in the absence of thermal heat transfer. Besides pinpointing thermal heat transfer problems, the test should also use infrared radiation mirroring the Earth's temperatures (-13°F to 125°F) rather than sunlight. This is a condition of the definition of the Greenhouse Effect.

4. Experiment Design

In this experiment, an infrared heating source was used and capable of replicating the normal temperatures of the surface of the Earth (-13°F to 125°F). This avoids the problem associated with using exaggerated high-temperature radiation sources. The detailed layout of the test chamber with photos is set forth in **Appendix A**, along with a description of the equipment used. The general concept is illustrated in **Figure 1**. This figure shows a heat plate providing infrared radiation at controlled wavelengths (temperatures). It is separated from the insulated test chamber, which houses a bag containing one liter of the various test gases. The infrared

radiation enters the test chamber through a hole. The distance between the heat source and the hole was 48 cm (19 inches). This was sufficient to eliminate any thermal heat transfer between the heat source and the test chamber. A thermocouple was attached to the side of the bag to measure any temperature differences and was shielded from any direct infrared radiation. Another thermocouple measured the temperature of the air inside the test apparatus. An infrared detector was installed at the end of the test chamber and in a direct line of sight with the heater and through the test bag. It measured any reduction in infrared intensity and expressed the intensity as a temperature.

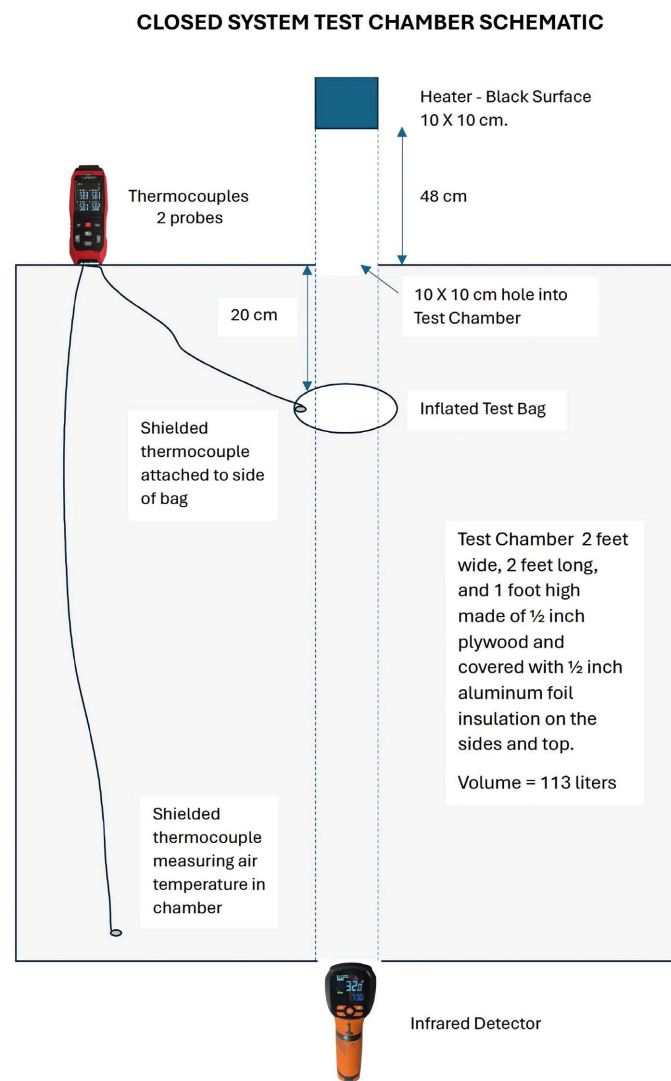


Figure 1. This is a schematic of the closed system test chamber. It shows the general layout of the test chamber.

The main purpose of this test, shown in **Figure 1**, was to eliminate as much of the influence from thermal heat transfers as possible, *i.e.*, sensible heat transfers. The heat source was set at 5 different temperature settings of 30°C, 60°C, 70°C,

100°C and 125°C. Although the 100°C and 125°C heater temperatures were higher than those normally emitted by the Earth's surface, they were selected to force a response. There was no physical connection between the heater and the test chamber. Any sensible heat from the heater would rise after leaving the heater and would not reach the open hole in the chamber located 48 cm (19 inches) away. The infrared detector is located at the back of the chamber and in direct line-of-sight with the heater and through the polyethylene bag containing the test gas. Except for the 100 cm² hole, the chamber was closed on all sides to prevent or reduce the effect of changes in ambient air temperatures and to exclude the effects from external visible and infrared light sources not originating from the heat source.

The first runs at each of the temperatures were done with no bag between the infrared detector and the heater. The goal was to measure absorption, loss, or wall effects within the dark chamber. The second test used an empty, gas-free flat bag across the five temperatures. We ran this test to measure how much infrared radiation was absorbed by the polyethylene bag. A test gas inflated the bag, and infrared radiation reduction was measured across the five temperatures. The test gases included dry air and non-greenhouse gases, such as nitrogen and argon. The remaining tests included air containing CO₂ at 800 ppmv, representing a doubling of the normal concentration (451 ppmv). The concentration was further increased to 1800 ppmv, constituting a fourfold increase. Finally, a concentration of 100% CO₂ was used, which constituted a 2439-fold increase over the existing ambient concentration. The Earth has never been at 100% CO₂, and this test was an extreme condition to force a response. Data showing a non-response under extreme conditions still provides useful information. A bag containing air with water vapor at 21,000 ppmv was also tested.

5. Test Results Using Infrared Detector Temperature Data

Figure 2 shows the data obtained. The infrared detector does not measure temperature directly. With respect to temperature, it acts like a proxy. It detects the intensity of the infrared radiation and converts that intensity into a temperature equivalent with various algorithms. The advantage of this detection method is that it reflects the amount of absorption (reduction) or emissions (additions) from other sources that may affect the intensity, *i.e.*, apparent temperature. If an object that absorbs 100% of the radiation, such as a person's hand, is placed between the heat source and the detector, then the detector will register zero intensity from the heater. However, it will register the emission intensity (temperature) from the hand. If an object allows some of the infrared radiation to pass through, then it will register as a reduction in the temperature from the heater. It will also detect emissions by the object, which can be converted into a temperature equivalent. This emission temperature will be canceled out if the object, such as a bag containing the test gases, has the same temperature between different bags. Ambient temperature, humidity, and CO₂ levels remained constant throughout the test.

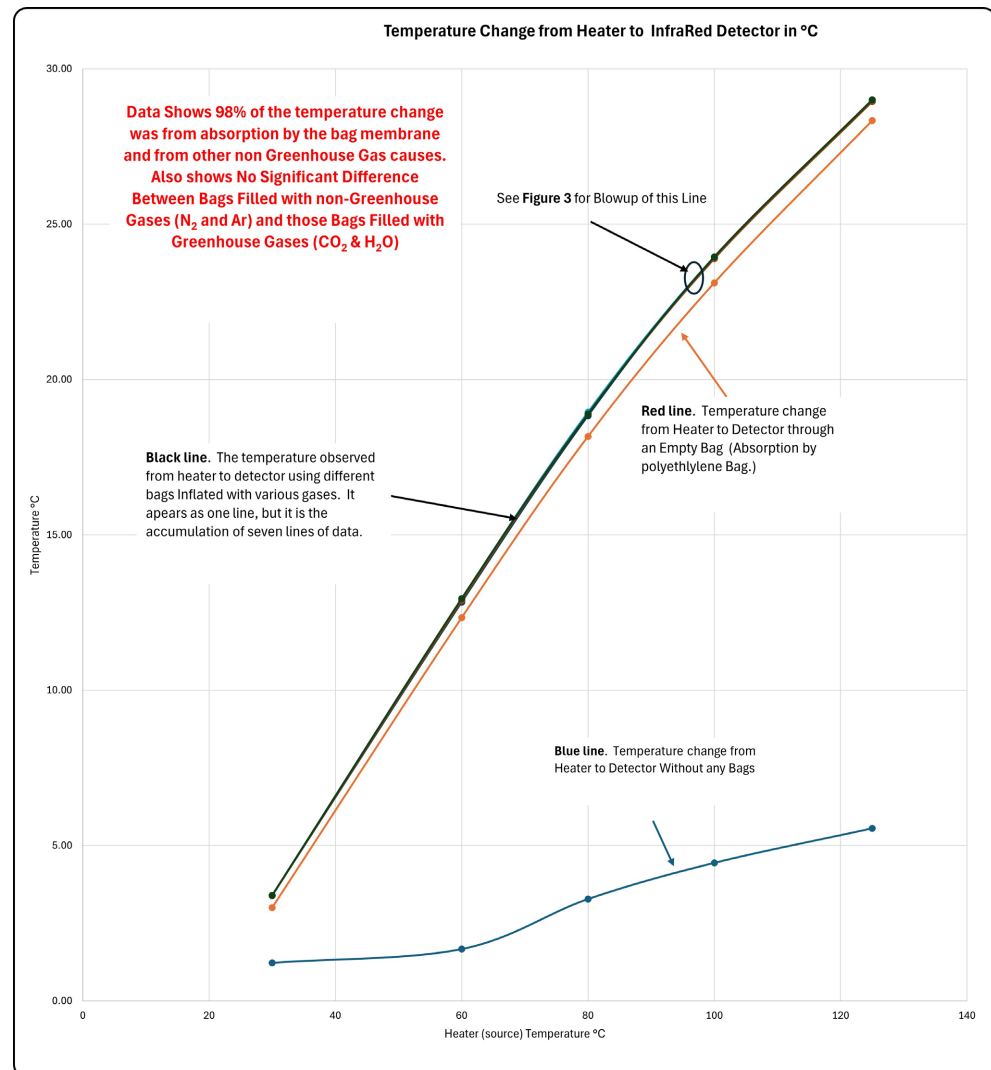


Figure 2. A chart showing the measured temperatures of the heater by the infrared detector in the closed system is shown in **Figure 1**. The Y-axis of the chart represents the temperature observed by the infrared detector. It shows the temperature change from heater to the detector using different bags inflated with various gases. The X-axis is the temperature of the heater.

The bottom blue line in **Figure 2** is the infrared measured temperature change without any object or bag between the heater and the infrared detector. This temperature should reflect any absorption by the air under ambient conditions, distance from the heater, and any infrared emissions from the interior of the test chamber. It indicates that out of 125°C emitted by the heater, there was a 5.5°C reduction relating to the air, distance, and other factors.

The red line reflects the absorption of infrared radiation by the empty bag. It illustrates that with respect to the 125°C heater temperature, there was a reduction of 22.5°C. This was higher than expected since polyethylene films are considered relatively transparent to infrared radiation of this wavelength. However, the bags were 2 mils in thickness, and the empty bag would include two layers for a total of 4 mils.

The top black line represents the absorption by various test gases in an inflated bag. An inflated bag changes the angles and increases the surface area of the bag membrane. Both of these factors will have an effect on the absorption or reflection of the infrared radiation by the bag, independent of the test gas inside. Hence, it is expected that inflated bags will have more absorption than empty bags. Tests conducted on bags filled with nitrogen at volumes of 300 to 800 ml showed a temperature reduction due to inflation of between 0.28°C and 0.35°C. However, the difference between the red line (empty bag) and the top black line (inflated bag) varied between 0°C and 0.84°C. A 0°C to 0.49°C temperature difference results from subtracting the inflation factor from the peak of the black line. The remaining disparity (0°C to 0.49°C) might be due to greenhouse gas absorption. However, 98.3% of the total temperature change resulted from factors other than greenhouse gas absorption. Plus, 0°C to 0.49°C is a small value and may be explained by measurement uncertainties or other contributing elements.

The top black line is the data from seven different test gases. It appears thicker because all seven lines are included in that same line. This included five lines from data with bags holding Greenhouse Gases. Of those five lines, one related to tests with dry air with a relative humidity of about 10% plus CO₂ at 451 ppmv. Another line related to moist air containing water vapor at 66% relative humidity (21,000 ppmv). Three more lines were from bags containing CO₂ at various concentrations, up to 100%. Finally, two lines were from bags containing non-Greenhouse Gases (nitrogen 100% and argon 100%). When non-greenhouse gases mimicked greenhouse gases, it provided exceptionally strong evidence against measuring Greenhouse Gas absorption using closed-system experiments.

Figure 2 is as near to conclusive evidence as one can get. It shows that thermal heat generated by absorption by the bag membrane was responsible for almost all of the temperature changes. All other sensible heat sources were substantially eliminated. It showed that none of the heat (temperature) changes constituted proof that it came from absorption by the Greenhouse Gases. For example, if the Greenhouse Gases were responsible for absorbing the infrared radiation, then there would be a difference in the lines where non-greenhouse gases were used, *i.e.*, nitrogen or argon. But that kind of proof was lacking. Therefore, closed systems cannot be used since there is **always a barrier** used to trap the gases. Since these barriers are made of a solid material, they will absorb infrared radiation and convert it to kinetic energy (temperature). Trapping the gases by a magnetic or electric field has not been developed. It may be possible to design a barrier that does not absorb infrared radiation, but so far, it has not been done. Sapphires (Al₂O₃) and CaF₂ are highly transparent to some IR wavelengths, and aerogels have very low absorption, but they are not used in conventional Greenhouse Effect experiments.

5.1. Anomaly (Magnification of Differences)

The black line in **Figure 2** is made up of seven different lines. If this line is mag-

nified hundreds of times, it will show small **differences** between the Greenhouse Gases and non-greenhouse gases.

Figure 3 illustrates the anomalies between the test gases based on a scale of 0.6°C . The average anomaly between gases is about 0.1°C . This is why the seven lines appear as a single line (approximately 0.1°C thick), as shown in **Figure 2**.

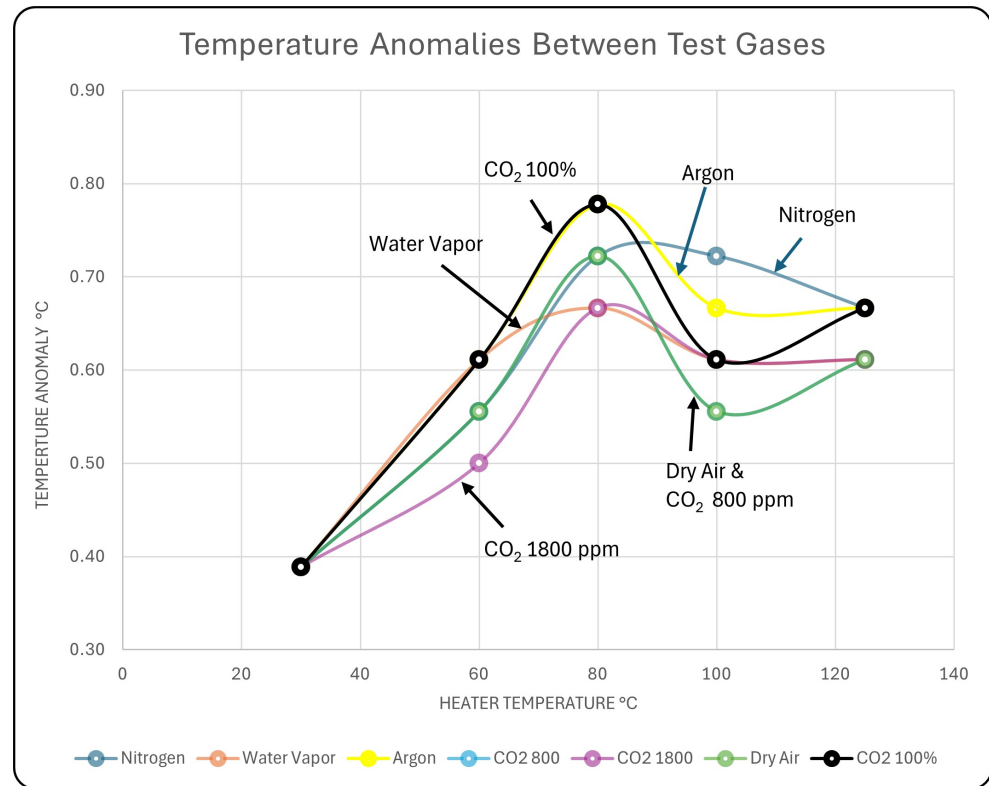


Figure 3. The chart shows the temperature anomalies between the test gases as measured by the infrared detector. The Y-axis of the chart represents the temperature anomaly between the test gases. The X-axis is the temperature of the source heater.

An anomaly is not an actual temperature, it is a difference in temperature. A difference in temperature does not exist in nature. It is a way for those in the scientific community to detect trends since it usually exaggerates the scales. But, using anomalies is a valuable diagnostic tool.

This figure displays slight differences between the seven gases. The Greenhouse Gases (water vapor, CO_2 at 800 ppmv, 1800 ppmv, and 100%) are above and below the non-greenhouse gases (nitrogen and argon). The lowest line is CO_2 at a concentration of 1800 ppmv. The highest peaks are for 100% CO_2 and argon. This occurred at a heater temperature of 80°C . The 100% CO_2 having the highest peak is consistent with the absorption of infrared radiation. But since argon (a Non-Greenhouse Gas) had the same peak, it suggests that thermal mechanisms were at play **and not** Greenhouse Gas absorption. Since these two gases have about the same densities and both have one of the lowest conduction/convection coefficients, it suggests that thermal heat transfer controlled the temperatures observed.

5.2. Reasons Why Greenhouse Gas Absorption Is Small

The test bag contents absorbed little, if any, of the infrared radiation from the heater, even when extreme concentrations were used. This is inconsistent with conventional Greenhouse Effect experiments. That's because, among other reasons, traditional experiments used high-energy sunlight or visible light as heat sources. This is discussed in more detail in paragraph 7.

The low absorption by the Greenhouse Gases was expected. This is because the wavelength of the infrared heat emitted by the Earth falls within the Infrared Window. The infrared window refers to a specific range of wavelengths in the infrared part of the electromagnetic spectrum—typically around 8 to 14 micrometers [89°C (192°F) to minus 66°C (-87°F)]. It is called a window because it is relatively transparent to absorption by the atmosphere. In this “window”, thermal radiation emitted by the Earth's surface can pass through the atmosphere with minimal absorption by gases like water vapor and carbon dioxide.

The absorbance spectra for these Greenhouse Gases as they relate to the wavelength of the infrared radiation actually emitted by the Earth are shown in **Figure 4** and **Figure 5**. The infrared wavelength is also related to the temperature of the source that produces that radiation. The figures show the wavelength of the infrared radiation emitted as well as the peak temperature of the Earth that emits that radiation.

Figure 4 and **Figure 5** show that little absorption by the Greenhouse Gases takes place with the temperature and wavelength of the infrared radiation emitted by the Earth.

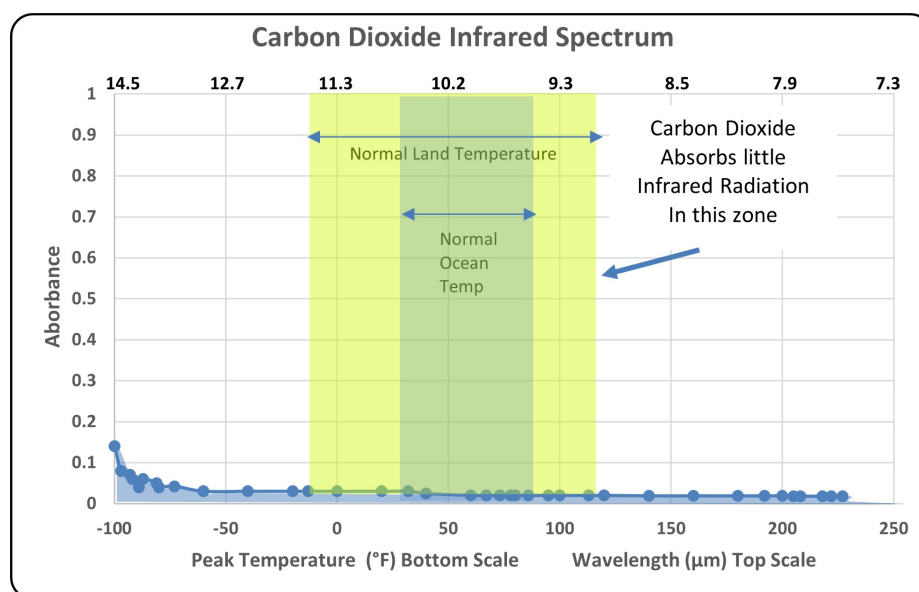


Figure 4. The absorbance spectra for carbon dioxide were extrapolated from information from the NIST Mass Spectrometer Data Center [7] and information from the Department of Astronomy, University of Washington [8]. This graph was set forth in Nelson & Nelson [6]. The absorbance is on the vertical scale, with zero representing no absorbance. The X-axis is the peak infrared temperature emitted from the Earth and its wavelength.

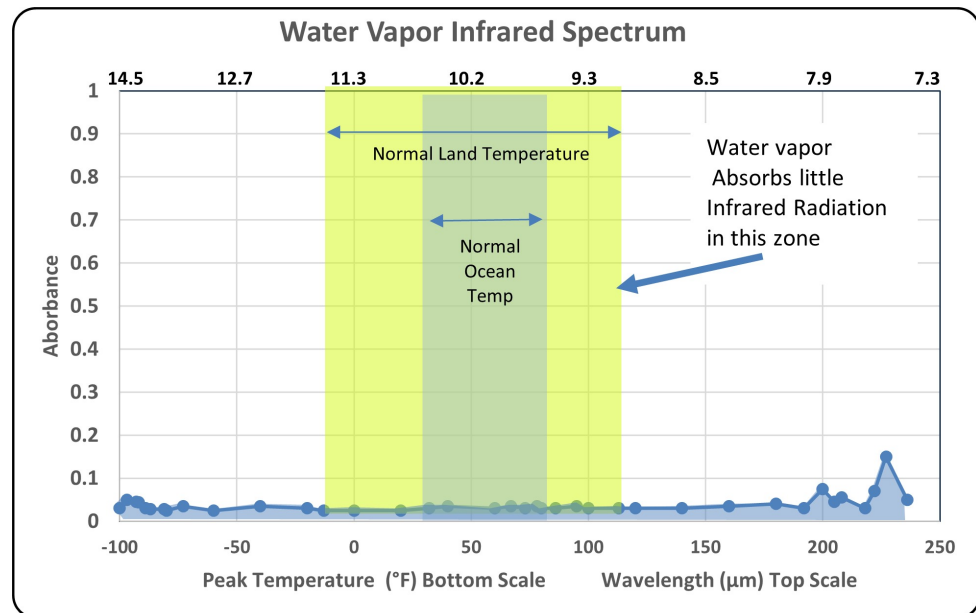


Figure 5. The absorbance spectra for water vapor were extrapolated from information from the NIST Mass Spectrometer Data Center [7] and information from the Department of Astronomy, University of Washington [8]. This graph was set forth in Nelson & Nelson [6].

As is shown in these figures, the absorbance was between about 2% - 4%. This means that on a cloudless day, 96% to 98% of the infrared radiation would be transmitted through the atmosphere unimpeded. Hence, the amount of absorbance by water vapor and CO₂ was expected to be small.

6. Test Results Using Thermocouple Temperature Data

Almost all laboratory experiments regarding the Greenhouse Effect are normally conducted with thermometers or thermocouples only. This includes those lab tests recommended by NASA. Thermometers and thermocouples measure only peak temperatures and do not measure the type or source of the energy. It does not measure any aspect of radiation, *i.e.*, intensity, wavelength, energy flux, direction, or angle. It is a scalar quantity, which means it only measures magnitude and no other characteristic or property. Radiation, on the other hand, is a vector quantity which has direction as well as magnitude. Consequently, using thermometers and thermocouples will not reveal anything about radiation except its final impact, which might or might not be related to infrared radiation.

On the other hand, infrared detectors are vector detectors. They measure direction as well as magnitude. That is why infrared detectors must be pointed at the source of the radiation. Specialized infrared detectors can be configured to measure wavelength by using special filters, diffraction gratings, or interferometers. On the other hand, infrared detectors do not measure the temperature directly. Plus, infrared detectors can be affected by many external factors (emissivity, distance-to-spot ratio, atmospheric conditions, ambient temperatures, etc.) Therefore, the most accurate test would include using both.

Test Procedure

In this test, each test gas was exposed to a specific source temperature for 180 minutes. Measurements were collected eight times; the first four were 15 minutes apart, and the rest were taken every 30 minutes. These measurements were taken using shielded thermocouples, as shown in **Figure 1**. The heating source was set to 30°C, 60°C, 80°C, 100°C, and 125°C. The seven test gases were 1) dry air (441 ppmv CO₂ & 10% humidity), 2) dry air containing 800 ppmv CO₂, 3) dry air containing 1800 ppmv CO₂, 4) 100% CO₂, 5) humid air containing 21,000 ppmv water vapor, 6) 100% nitrogen, and 7) 100% argon. The thermocouples were calibrated, and slight deviations identified in the calibration curve shown in **Appendix A** were applied.

Figure 6 is a bar graph comparing the temperature change rate (°C min) over the 180-minute test period with a heater source temperature of 60°C (140°F). This is slightly higher than the normal high average temperatures emitted by the Earth.

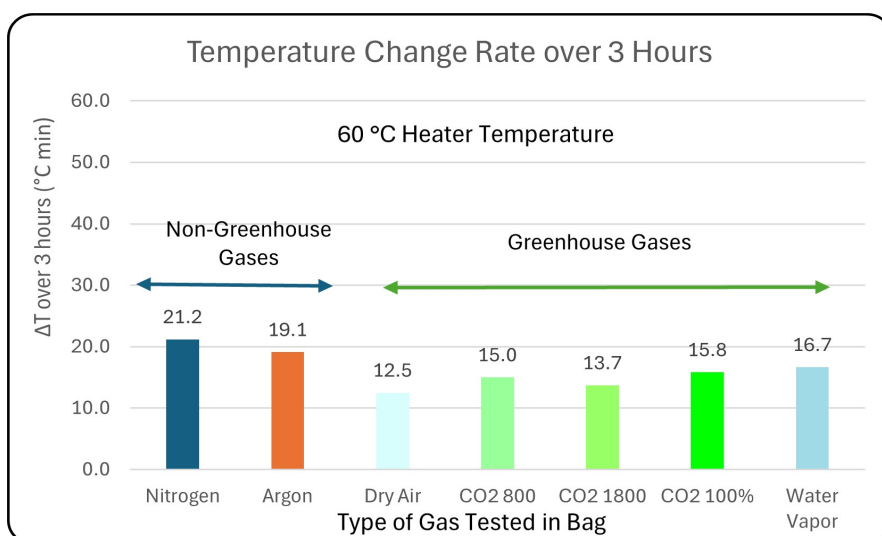


Figure 6. A bar chart showing the temperature change rate over 180 minutes with a heater temperature of 60°C. The Y-axis is the temperature change rate in °C min for each test gas. The X-axis is the name of the gas inside the test bag.

These higher temperatures were used to force a response. As can be seen, there does not appear to be any detectable feedback from the Greenhouse Gases. For example, nitrogen and argon both show a higher temperature change rate than all the Greenhouse Gases. If the Greenhouse Gases absorb infrared radiation from the heating source, they should show a higher temperature change rate. But the opposite was observed. Therefore, a mechanism other than gas absorption must be causing the bags to warm. Also, comparisons between the Greenhouse Gases show mixed results. For example, 100% CO₂ has the highest concentration of all other test bags containing Greenhouse Gases. That bar graph is shown as dark green with a value of 15.8°C min over 180 minutes. It is greater than dry air (light blue) with a value of 12.5°C min. That is consistent with gas absorption since dry

air contains less than 1% Greenhouse Gases. But it is less than air containing water vapor (darker blue and a value of 16.7°C min). The moist air contains 2.1% (21,000 ppmv) Greenhouse Gases and, therefore, should reflect a value 98% smaller than 100% CO₂. The bag containing 1800 ppmv CO₂ (13.7°C min) was less than the bag containing 800 ppmv CO₂. Both these observations are inconsistent with Greenhouse Gas absorption as a cause of the temperature differences. The most reasonable conclusion is shown in **Figure 2**, which shows that the bag membrane absorbing the infrared radiation was the most likely cause of the bag temperatures.

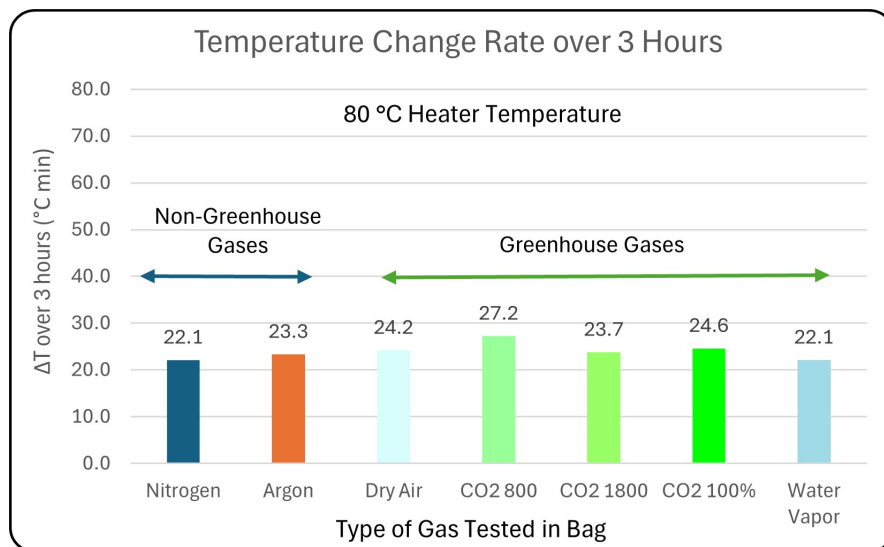


Figure 7. A bar chart showing the temperature change rate over 180 minutes with a heater temperature of 80°C. The Y-axis is the temperature change rate in °C min for each test gas. The X-axis is the name of the gas inside the test bag.

Figure 7 shows the temperature change rate (°C min) over the 180-minute test period with a heater source temperature of 80°C (176°F). There does not appear to be a connection to infrared absorption by the Greenhouse Gases. It shows that all the bags had very similar temperature change rates. This suggests that the temperature change rate was due to absorption by the bag membrane. Nitrogen, a non-Greenhouse Gas, had the same temperature rate change as water vapor, a Greenhouse Gas. CO₂ at a concentration of 0.08% (800 ppmv) had a slightly higher temperature than the bag containing 100% CO₂. These values are inconsistent with the Greenhouse Effect theory.

This raises another question. If the bags were the cause of the temperature change, then why didn't all the bags exhibit the exact same temperature? This question is partially answered by the variations in heat transfer factors listed in **Table 1** for each atmospheric gas. Another explanation is that the thermocouple temperatures have an accuracy of about 0.1°F. This could explain some of the inconsistencies. But it illustrates that just knowing the temperature magnitude (scalar) cannot answer questions regarding infrared radiation or its absorption by the Greenhouse

Gases.

7. Differences between Thermometers/Thermocouples (Scalar) and Infrared Detectors (Vector)

There are many differences in data measurements between infrared detectors and thermocouples/thermometers. First, infrared detectors measure direction as well as magnitude. Second, infrared detectors are faster. They are almost instantaneous, with response times measured in microseconds to milliseconds. This speed eliminates the effect of changes in ambient conditions, which may occur after many minutes and hours. Thermometers often require several minutes. Thermocouples can be measured in milliseconds to seconds. Third, thermometers and thermocouples require direct physical contact with the object. This contact adds an element of uncertainty, *i.e.*, errors. Infrared detectors do not require contact. Fourth, thermometers/thermocouples cannot measure heat transfer directly. This is achievable indirectly using several selectively placed sensors. Infrared detectors measure heat flux, *i.e.*, intensity.

In this experiment, it is readily apparent that infrared detectors provide far more useful information. This is shown by comparing **Figure 2** and **Figure 3** (infrared detectors) with **Figure 6** and **Figure 7** (thermometers/thermocouples). In **Figure 2**, the absorption by the test bag's membrane is shown. That information is very informative and useful. That data is not available or generated by the thermometer/thermocouple devices. Hence, Greenhouse Effect laboratory experiments conducted with only thermometers/thermocouples provide insufficient information to make a meaningful causation analysis.

Inconsistencies with Data from Conventional Greenhouse Effect Experiments

Why do conventional Greenhouse Effect experiments show results that appear to be inconsistent with these laboratory tests? That is easy to explain. First, the conventional Greenhouse Effect experiments used sunlight or high-temperature visible light heat lamps as their heat source. Individual photons from sunlight and visible light from high-intensity lamps have twenty-five times more energy than infrared photons emitted from the Earth. [2] This is because sunlight photons are emitted by a very high-temperature source and have a short wavelength. For example, sunlight from the Sun's surface is from a source that is 10,000°F. The filaments in light bulbs that create visible light are generated by extremely high temperatures. Photons generated by incandescent light bulbs are 5500°F, halogen light sources are 6000°F, metal halide bulbs are at 20,000°F, etc. These temperatures are not within the parameters of actual temperatures emitted by the surface of the Earth.

Low-energy infrared radiation is the fundamental criterion for the Greenhouse Effect. Twenty-five times more energy is not a small factor, it is a multiplier. In addition, there are many absorption bands for the various Greenhouse Gases

when high-energy visible light is used rather than the low-energy infrared radiation emitted by the Earth. This is illustrated by the Rhodes spectrographic Greenhouse Gas absorption graph. [9]

There are more reasons for the observed differences. The conventional Greenhouse Gas experiments only used thermometers or thermocouples. The scalar information from these experiments failed to reveal the vector information from the absorbed radiation. That point is apparent from this experiment. The conventional experiments failed to use a non-greenhouse gas, such as argon, as a control to see if the heat transfer properties were causing the temperature differences. Many of the conventional experiments pressurized the CO₂ bottle and not the air bottle. Simple thermodynamics, known as the Ideal Gas Laws [10], show that increased pressure will cause an increase in temperature. There were several obvious lamp misplacements in the conventional experiments. All these issues were discussed in detail in Nelson, M. (2024). [2]

8. Summary

Conventional closed lab experiments using high-energy light sources and simple temperature sensors showed that CO₂-filled bottles got hotter than ones containing air. From this, the sponsors of these experiments asserted that they proved the Greenhouse Effect. However, the thermometers and thermocouples used in those experiments did not measure absorption by Greenhouse Gases. Those conventional laboratory experiments did not measure any heat transfer associated with radiation.

A closed laboratory experiment was designed using a heat source that emitted infrared radiation at a temperature reflecting the Earth's surface. This experiment used thermocouples and infrared detectors. The results from this experiment showed that the membrane that contained the test gases absorbed 98.3% of the infrared radiation. And the remaining 1.7% were not observed to be associated with absorption by Greenhouse Gases. The non-Greenhouse Gases performed as well as or better than the Greenhouse Gases relating to the observed temperatures. This is illustrated in **Figure 3**, where nitrogen and argon exhibit higher temperature anomalies than CO₂ at 800 ppmv and 1800 ppmv. It is also shown in **Figure 6**, where nitrogen and argon had higher temperature change rates than the Greenhouse Gases. **Figure 7** shows argon had a higher temperature change rate than water vapor.

This experiment indicated that closed lab experiments could not be used to prove the Greenhouse Effect. Data from experiments using only scalar-measuring devices, like thermometers and thermocouples, proved wholly inadequate. It further showed that infrared detectors can measure infrared absorption. However, the amount of absorption by the containment membrane was overwhelming and obscured any measurable observation of Greenhouse Gas absorption.

Based on this study, it is recommended that anyone using conventional Greenhouse Effect lab experiments should understand thermodynamics. They should

also use instrumentation and analysis protocols capable of measuring and distinguishing thermal heat transfers from those associated with Greenhouse Gas absorption.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- [1] Houghton, J.T., Jenkins, G.T. and Ephraums, J.J. (1990) Climate Change. The Intergovernmental Panel on Climate Change, The IPCC Scientific Assessment. Cambridge University Press. <https://www.ipcc.ch/reports/>
- [2] Nelson, M.D. (2024) Laboratory Experiments Do Not Support the Greenhouse Effect as Applicable to CO₂. *International Journal of Geosciences*, **15**, 809-839. <https://doi.org/10.4236/ijg.2024.1510045>
- [3] Wikipedia.org (2025) Eunice Newton Foote 1819-1888. https://en.wikipedia.org/wiki/Eunice_Newton_Foote
- [4] NASA (2025) Climate Change Inquiry Labs: CO₂ and Air Temperature. Lab Instructions NASA, Global Precipitation Measurement Mission. https://gpm.nasa.gov/education/sites/default/files/lesson_plan_files/climate%20change%20inquiry/climate%20change%20inquiry%20carbon%20dioxide%20lab.pdf
- [5] Nelson, M., and Nelson, D.B. (2024) The Cloud Model for Climate Change. *International Journal of Geosciences*, **15**, 366-395. <https://doi.org/10.4236/ijg.2024.155020>
- [6] Nelson, M., and Nelson, D.B. (2024) Decoupling CO₂ from Climate Change. *International Journal of Geosciences*, **15**, 246-269. <https://doi.org/10.4236/ijg.2024.153015>
- [7] Wallace, W.E., Linstrom, P.J. and Mallard, W.G. (2024) NIST Mass Spectrometry Data Center, Infrared Spectra, NIST Chemistry WebBook, NIST Standard Reference Database Number 69. National Institute of Standards and Technology.
- [8] University of Washington (2024) VPL Molecular Spectroscopic Database. <https://vpl.astro.washington.edu/spectra/>
- [9] Rohde, Robert, Global Warming Art (2024) Wikimedia Commons, Atmospheric Transmission. https://commons.wikimedia.org/wiki/File:Atmospheric_Transmission.png
- [10] Wikipedia (2025) Ideal Gas Law. https://en.wikipedia.org/wiki/Ideal_gas_law

Appendix A

Test Equipment Photos & Information:

Figure A1 is a photograph of the test apparatus from the front. The back of the heater is shown in front of the test chamber and in line with the 10 cm by 10 cm hole. The various dimensions are set forth in **Figure 1**.

The thermocouple device is shown on the right side of the test chamber. It is an Environmental Test Danoplus 373 K/J Thermometer Data Logger Range of -50°C to 300°C —information at <http://www.cd50.net/37>.

A CO_2 /humidity detector is shown on the left-hand side and is a Gain Express Holding Company, Model AO17755a, with an accuracy of ± 50 ppm of CO_2 and $\pm 3\%$ Relative Humidity.

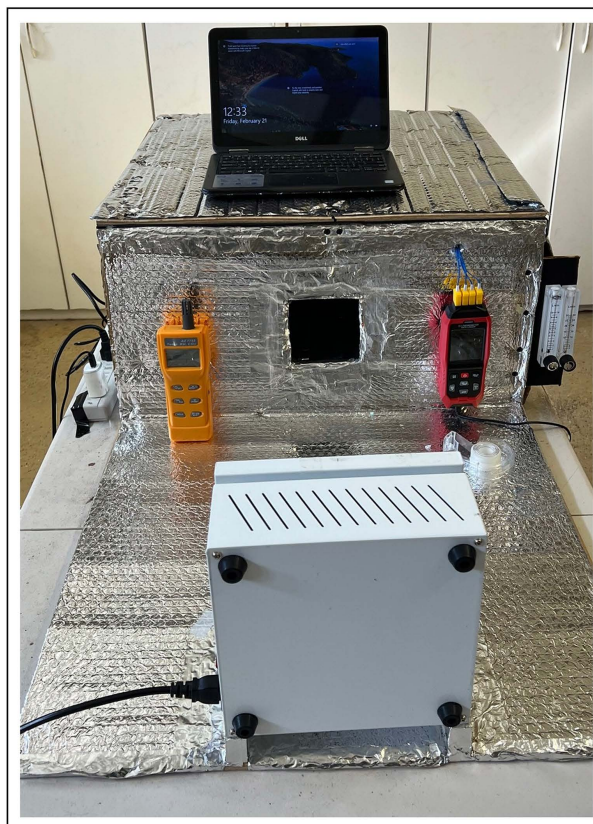


Figure A1. Front view of the test apparatus.

Figure A2 is a photograph of the heater. It is a high-performance Keenwise Electric Hot Plate, model number HP-E2020. It has precise control and a stable heat distribution. This heater has been modified for this experiment by covering the heating plate so that only a 10 cm by 10 cm area is exposed to the test apparatus. The remainder of the heat plate was covered by aluminum foil insulation to reduce the infrared radiation emitted from the heater outside the 100 cm^2 center portion. The center portion was painted with heat-resistant black paint to increase the emissivity of the surface in the center.



Figure A2. Front view heater facing the test apparatus.

Figure A3 is a photograph of the back of the apparatus showing the alignment of the infrared detector with the center of the heater. The infrared detector is a high-accuracy Mestek Infrared Detector model IRO5A-OR with a response time of 0.5 microseconds and a resolution of 0.1 degrees Fahrenheit.

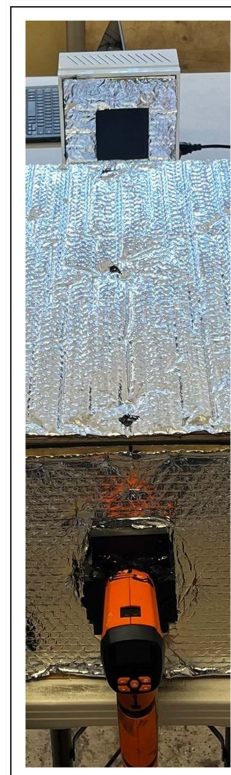


Figure A3. Back view of the apparatus.

Figure A4 is the calibration curve for the thermocouples.

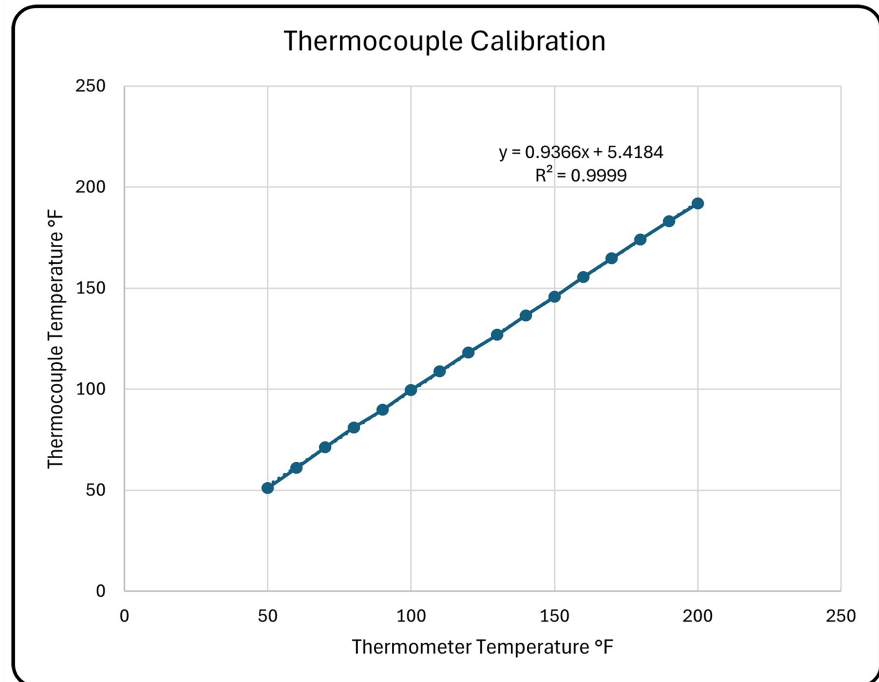


Figure A4. Calibration of the Danoplus thermocouples with a thermometer. The X-axis is the temperature of the thermometer, and the Y-axis is the temperature of the thermocouples.