

Absolute Zero Sphere

TD-8595

Introduction

The Absolute Zero Sphere consists of a Fast Response Temperature Probe and plastic tubing (with pressure connector) mounted into a hollow copper sphere. When the sphere is submerged in a water bath and connected to a temperature sensor, pressure sensor, and computer interface, you can use PASCO data collection software to record and display the temperature and pressure. The Fast Response Temperature Probe plugs into any PASCO temperature sensor capable of accepting a 3.5 mm connector.

The Absolute Zero Sphere is used to experimentally determine the temperature of absolute zero in degrees Celsius. Absolute zero is, by definition, the point at which a gas exerts zero pressure. When used with the software, the device allows students to observe the relationship between temperature and pressure, and to mathematically extrapolate to find the value of absolute zero.

Equipment

Included equipment:

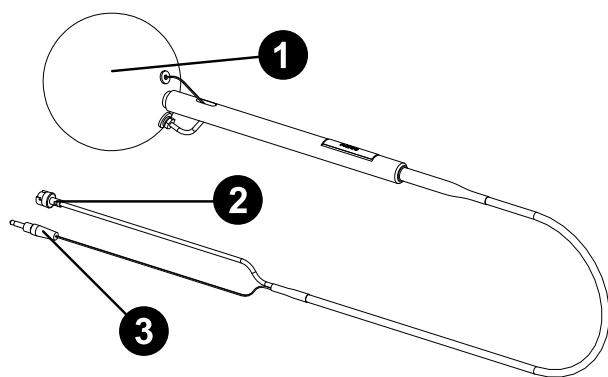
- Absolute Zero Sphere
- Non-valved coupling for 1/8-inch tubing

Required equipment:

Any combination of a PASCO temperature and pressure sensor, such as the following:

- Wireless Absolute Pressure-Temperature Sensor (PS-4257)
- Wireless Temperature Link (PS-3222) and Wireless Pressure Sensor (PS-3203)
- PASPORT Temperature Sensor (PS-2125) and PASPORT Absolute Pressure Sensor (PS-2107)

Features



- ❶ Sphere
- ❷ Pressure connector
- ❸ Temperature probe connector

Theory

For an ideal gas in a fixed volume, the absolute pressure of the gas is directly proportional to the absolute temperature of the gas. This relationship is given by the equation:

$$T = \left(\frac{V}{nR} \right) P$$

Therefore, a plot of temperature versus pressure for an ideal gas will result in a straight line. The slope of this line depends on the amount of gas present, but regardless of the amount of gas, the intercept of the line with the temperature axis will be at absolute zero. If temperature is measured in Kelvin, this means that the line will pass through the graph's origin. If we instead plot the temperature in degrees Celsius ($^{\circ}\text{C}$), the line will instead pass through the temperature axis at the temperature of absolute zero in $^{\circ}\text{C}$.

Equipment setup

1. Plug the Fast Response Temperature Probe plug into a temperature sensor.
2. Connect the sphere's pressure connector to the quick-release port on a pressure sensor. (If you are using a wireless sensor, see **Connect to a wireless pressure sensor** for special instructions.)
3. Connect the sensors to PASCO Capstone, SPARKvue, or Chemvue. If either sensor is a PASPORT sensor, this will require a PASPORT interface. For more detailed instructions, see the manual for your chosen sensors and the SPARKvue, Capstone, or Chemvue online help.
4. Set up a graph display in the software, measuring temperature on the y-axis and pressure on the x-axis. Enable Manual Sampling mode.
5. Submerge the sphere into a bucket of ice water.
6. Begin data collection.

Connect to a Wireless Pressure Sensor

The Wireless Pressure Sensor (PS-3203) and Wireless Absolute Pressure-Temperature Sensor (PS-4257) require a special procedure to connect to the Absolute Zero Sphere's pressure connector. You can use the included non-valved coupling to make an adapter that connects this sensor to the sphere. The sensor includes a length of plastic tubing and a male luer connector, which are needed to complete the adapter. To connect the Absolute Zero Sphere to the wireless sensor:

1. Cut a short piece of plastic tubing, about 2-3 cm in length.
2. Use a very small amount of glycerin to lubricate the barb end of the male luer connector and the barb end of the coupling included with the Absolute Zero Sphere.
3. Push the barb ends of the male luer connector and coupling into opposite ends of the plastic tubing, as shown in Figure 1.
4. Connect the adapter's male luer connector end to the Wireless Pressure Sensor, as shown in Figure 1.

5. Connect the adapter's coupling end to the sphere's pressure connector. Slightly twist the pressure connector clockwise to lock it in place. (You can unlock the pressure connector later by twisting it counterclockwise.)

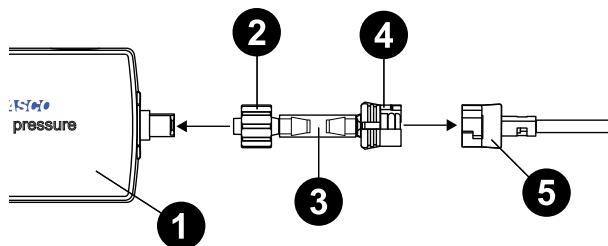


Figure 1: Connect the Wireless Pressure Sensor to the Absolute Zero Sphere. 1: Sensor. 2: Male Luer connector. 3: Plastic tubing. 4: Non-valved coupling. 5: Pressure connector.

Specifications and accessories

Visit the product page at [pasco.com/product/TD-8595](https://www.pasco.com/product/TD-8595) to view the specifications and explore accessories. You can also download experiment files and support documents from the product page.

Experiment files

Download one of several student-ready activities from the PASCO Experiment Library. Experiments include student handouts and teacher notes. Visit [pasco.com/freelabs/TD-8595](https://www.pasco.com/freelabs/TD-8595).

Technical support

Need more help? Our knowledgeable and friendly Technical Support staff is ready to answer your questions or walk you through any issues.

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Limited warranty

For a description of the product warranty, see the Warranty and Returns page at www.pasco.com/legal.

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