

Can Crush

What Is Pressure?



Introduction

Here's a pressure-packed demonstration that will convince students that air exerts significant pressure!

Concepts

- Pressure differential
- Atmospheric pressure

Materials

Can, metal with screw top lid

Hot plate

Tap water, 50 mL

Water bath

Zetex™ gloves, for high and low temperatures

Safety Precautions

Be careful of the hot can and the steam created by heating the water in the can. Wear goggles and protective gloves during the demonstration.

Procedure

1. Locate a metal can with an airtight screw top lid.
2. Remove the lid from the metal can. Be sure the can is clean and free of chemicals—a new, unused can is preferred.
3. Add approximately 50 mL of tap water to the metal can. This should be enough to cover the bottom of the can to a depth of approximately 1 cm.
4. Place the can on a hot plate and heat it until the water boils and steam flows out of the uncapped hole.
5. Using protective gloves, remove the steaming can from the hot plate. Place the can where it can be easily viewed.
6. Immediately place the cap on the can and close tightly.
7. The can will be dramatically crushed and it will likely do so in a loud fashion. For a quick crush, place the sealed can into an ice-water bath to cool the can rapidly.

Tips

- It is important that the cover on the can has an airtight seal. Be sure to get the lid placed tightly on the can before the cooling process begins.
- The collapsed can and an identical un-crushed can make a nice exhibit in a classroom display case.
- If a cap to the can is not available, try a rubber stopper. Be sure the rubber stopper fits snugly in the can opening.
- For a more impressive implosion, immerse the can into a sink of cold water.
- This demo can be downscaled or upscaled, depending on the size of the metal can and your ability to safely heat the water. A soda can heated, then immersed upside down in chilled water works nicely.
- For the largest demo, take a 55 gallon drum and put a dent in the side. Add about 1 gallon of water to it. Hot water will really speed up the process. Heat it on a camping stove until the water boils vigorously for at least ten minutes. If the can is painted, the paint may really stink if heated on an open flame, so have adequate ventilation. A cloud of condensed water vapor should escape from the mouth of the can for at least ten minutes. Coat the threads of the screw top with silicone sealing materials to ensure an airtight fit. Turn off the stove and, using gloves, put the top on the can as tight as you can with pliers or special tools for tightening drum tops. The can should collapse within

several minutes. Please view video and follow all safety precautions.

Discussion

The tremendous pressure required to “crush” the can comes from the differential in pressure that exists between the outside of the can (normal air pressure) and the partial vacuum created inside the can by the condensing steam. The pressure differential is caused by the condensation of the steam inside the closed system as the can cools. There is only a little air in the can to take the steam’s place. There is much less gas on the inside of the can so there is less pressure inside. The pressure on the outside of the can remains at atmospheric pressure (14.7 lb/in²) while the pressure inside the can is significantly reduced as the steam condenses. Remember that the can is not “sucked in”—it is the greater pressure on the outside of the can that pushes in on the can and “crushes” it. The total pressure exerted on the outside of the can may be calculated by determining the surface area of the outside of the can and multiplying this area by atmospheric pressure per unit area. The air is pushing on the outside with about 15 pounds per every square inch. With a 5 gallon can this is over 18,000 pounds. The cans are not designed to withstand such pressure differentials so the cans implode.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

Evidence, models, and explanation

Content Standards: Grades 5–8

Content Standard B: Physical Science, properties and changes of properties in matter, understanding of motions and forces

Content Standards: Grades 9–12

Content Standard B: Physical Science, structure and properties of matter, motions and forces

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Can Crush* activity, presented by Lee Marek, is available in *What Is Pressure?*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Can Crush* are available from Flinn Scientific, Inc.

Materials required to perform this activity are available in the *Collapsing Can Demonstration* available from Flinn Scientific. Materials may also be purchased separately.

Catalog No.	Description
AP4695	Collapsing Can Demonstration
AP3242	Gloves, Zetex™, 14" Length

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.