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Demonstration of the "Trampoline Effect" in aluminum bats

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Fans of the National Pastime know that aluminum bats hit baseballs harder than wooden bats. This partly explains why aluminum bats are banned in the highest levels of competition such as Major League Baseball. The effectiveness of the aluminum bat is partially attributed to the "trampoline effect."[1-2]

The trampoline effect can easily be demonstrated with an unhappy ball[3] and an empty 12-ounce aluminum soda can. Drop the unhappy ball on just about any surface and it doesn't rebound any appreciable amount. The energy of the collision is lost mainly to internal vibrations in the ball. Now, drop the unhappy ball onto the rounded surface of the empty soda can. It bounces off and often rises to nearly the height from which it was dropped! Much of the energy of the collision goes into a surface vibration of the can called a "hoop mode." Amazingly, this energy is returned to the ball during the collision.

When a solid bat, such as a wooden bat, collides with a ball, some of the energy goes into the transverse vibrations of the bat.[4] For a hollow bat, such as an aluminum bat, energy goes into surface vibrations (such as hoop modes) as well as, to a lesser extent, the transverse vibrations. In a well-designed aluminum bat, the energy in the surface vibrations can be almost completely returned to the ball.

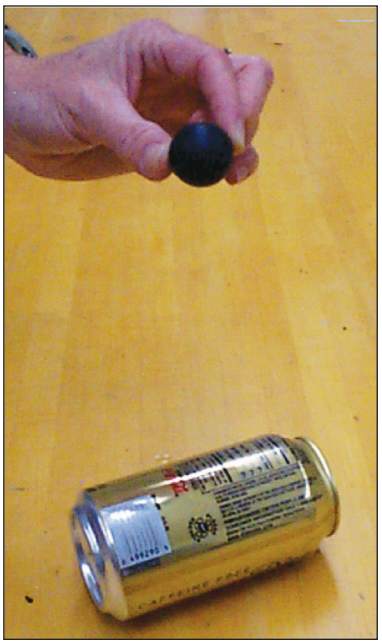

Fig. 1. Dropping the unhappy ball onto the empty soda can.

References

1. See the website by Dan Russell at paws.kettering.edu/~drussell/bats-new/alumwood.html.
2. Alan M. Nathan, Daniel A. Russell, and Lloyd V. Smith, "The physics of the trampoline effect in baseball and softball bats," presented at the 2004 meeting of the International Sports Engineering Association in Davis, CA. Available at webusers.npl.illinois.edu/~a-nathan/pob/index.html.
3. Sargent-Welch item WL0709 at www.sargentwelch.com.
4. L. L. Van Zandt, "The dynamical theory of the baseball bat," *Am. J. Phys.* **60**, 172–181 (Feb. 1992).