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Techniques

A device for refilling practice bear spray canisters

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Studies have shown bear spray to be effective for deterring aggressive and nuisance bears (Herrero and Higgins 1998, Smith et al. 2007). Consequently, bear safety books encourage people to carry it into bear country (Schneider 2004, Smith 2006, Gookin and Reed 2009). Those who carry bear spray are encouraged to practice the sequence of unholstering, removing the safety clip, and test-firing the canister before encountering a bear for the first time (Schneider 2004, Smith 2006, Gookin and Reed 2009). Using bear spray for practice, however, may result in undesirable side effects on the user, such as debilitating blowback (Smith et al. 2007), residues that are attractive to bears (Smith 1998), or injury to persons carrying partially filled canisters into bear country. To avoid these problems, several bear-spray vendors (e.g., Counter Assault®, UDAP®, and Frontiersman®) market practice bear-spray canisters that lack capsaicinoid compounds, the active ingredient that irritates sensory nerve endings, particularly in the eyes and respiratory tracts (Herrero and Higgins 1998). Such training canisters, also called inert spray, perform similarly to actual bear spray by using propellants that expel a rapidly expanding cloud of inert carrier at a distance of approximately 7 m. More important than simulating spray with inert ingredients, however, is the opportunity to practice the sequence of events that brings bear spray into action: unholstering, removing the safety clip, aiming, and pressing the trigger. Cans of inert spray range in cost from $15 to $25 each (2014 pricing) and provide approximately 7 1-second bursts of spray. Hence, organizations with large numbers of personnel working in bear country either spend thousands of dollars on inert spray or limit the practice needed to master spray deployment. Those who cannot afford these costs often forego practice (T. Smith personal observation). The purpose of this paper is to promote bear-spray training by providing a low-cost alternative to the purchase of inert spray cans. We hope this device will encourage more organizations to practice bear-spray deployment until their people master use of this deterrent (Figure 1).

Figure 1. Instructors for the National Outdoor Leadership School practice using inert bear spray. *(Photo by Brad Christensen)*.

This device for refilling inert bear-spray canisters can be readily built for >$40 with materials from a local hardware store. It will allow users to refill practice canisters hundreds of times, thus, saving money that can be used for other wildlife management needs. Using materials listed here, the device can be constructed in <1 hour. Refilling a spent canister can be done in <1 minute.

Assembling the device

Construction materials are listed in Table 1

Table 1. Materials list to build the practice bear spray refilling device.

Item	Quantity	Function
¾" by 3" PVC bushing	1	Water intake funnel
¾" PVC T-connector with ½" NPT adaptor	1	Air pressure input port assembly
Schrader valve (1/2" thread)	1	Air pressure input port
¾ " Schedule 40 PVC pipe	24"	Holds water for refilling canisters
¾" PVC valve	2	Seals system for pressurizations
¾" PVC end cap (threaded)	1	Used to make the filler nozzle assembly
¾" PVC nipple with ½" NPT threads	3"	Filler nozzle assembly threads onto here
Spray nozzle from inert canister	1	Used to create the filler nozzle assembly
PVC primer (8 ounce can with brush)	1	Prepares fittings for cement welding
PVC cement (8 ounce can with brush)	1	Welds PVC joints
Roll of Teflon tape	1	Seals end cap threads against pressure loss

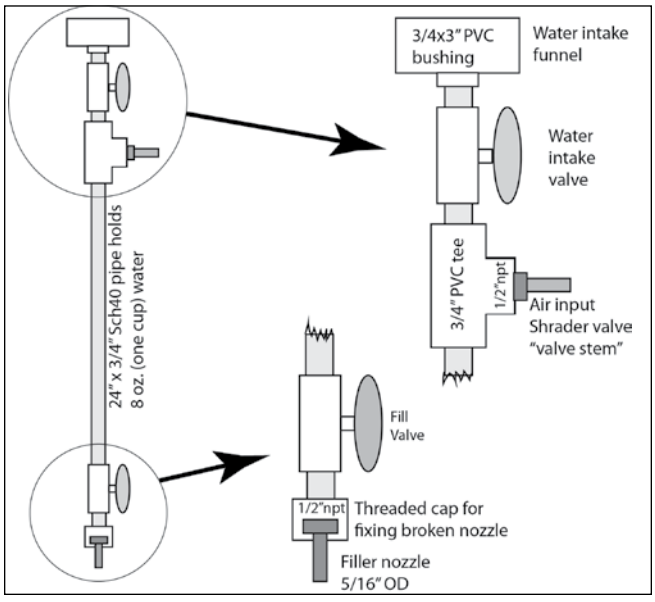

Figure 2. Schematic of practice bear-spray refilling device. *(Illustration by John Gookin)*

and Figure 2. To obtain a nozzle that will be used to make the filler nozzle assembly in the refill device, insert 2 small flat-blade screwdrivers (<3/8" [1.9 cm] in width) into the rectangular channels on both sides of the trigger on top of a spent canister. While≠ applying slight outward pressure to release the pins holding the trigger assembly, lift up on the trigger and remove it from the spray head. Remove the right-angled nozzle from the canister head. Next, drill a 5/16" (.79 cm) hole through the center of the threaded PVC end cap (Table 1; Figure 2). The horizontal portion of the nozzle (rectangular in cross-section) must be removed close to the 90° bend to fit inside the threaded PVC end cap. Mix a small amount (1 ounce [28 g]) of 2-part epoxy resin, glue the nozzle into place, and allow it to harden, being careful not to let epoxy enter the nozzle's opening. This filler nozzle assembly must be threaded onto the ¾" PVC tubing (Figure 2), rather than glued, because the nozzle can break during refilling, requiring replacement. We recommend construction of a second nozzle assembly as a backup.

The 24" (61 cm) piece of ¾" (1.9 cm) PVC pipe should have 2 short (2" [5 cm]) pieces cut from it to be used for connecting the bushing (funnel) to the water intake valve, and the valve to the ¾" (1.9 cm) tee (Figure 2). The lower fill valve is glued to a short ¾" PVC nipple (threaded on 1 end) to allow the replaceable nozzle filler assembly to be screwed in place, rather than glued. All joints in the refilling device should be cleaned and softened with PVC primer prior to gluing to insure maximum strength at glue-welded joints. During assembly, both valve handles should be aligned for convenience of operation. When threading the filler nozzle assembly and ½" (1.27 cm)

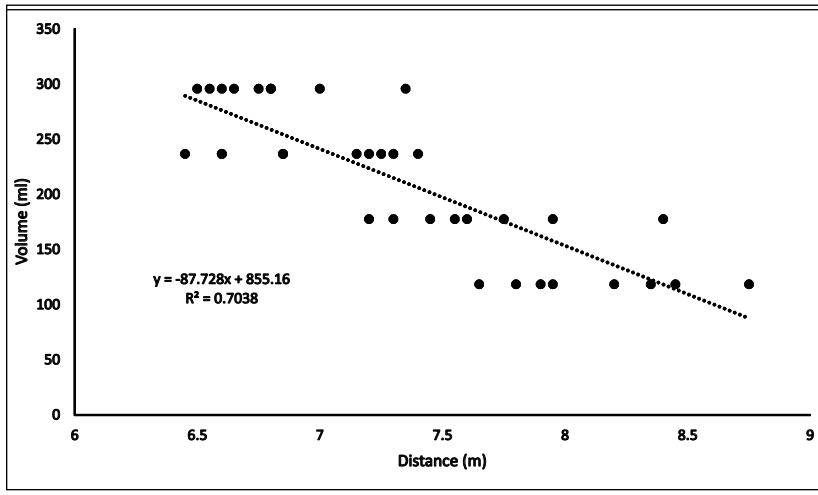

Figure 3. The influence of volume of water added to practice canister and distance expelled (*n* = 34).

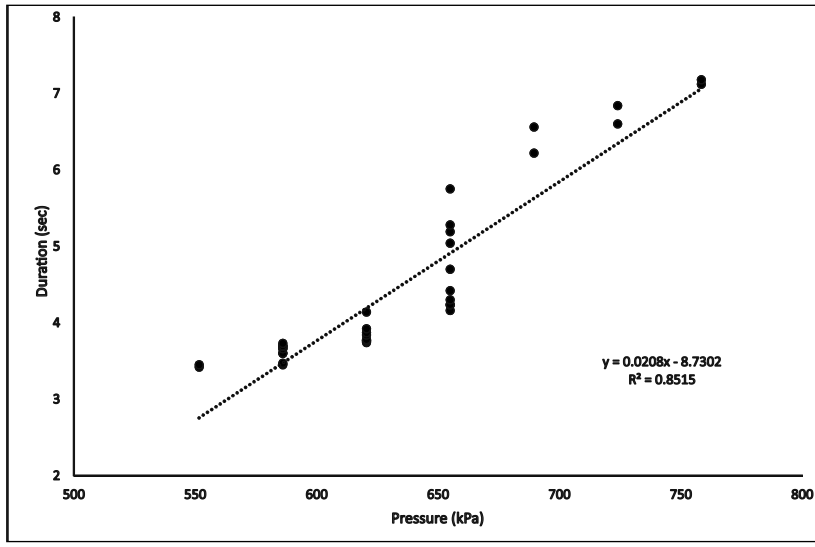

Figure 4. The influence air pressure in canister has on duration of spray (*n* = 38).

Schrader air valves into place, use Teflon® tape to seal against leaks. Allow newly glued joints to harden for at least 2 hours prior to use.

Canister refilling operation

To refill a spent bear-spray canister, the spray-head assembly must be removed from the empty can. This can be done with some canisters by holding the canister firmly while rotating the spray-head assembly counter-clockwise. If the spray head loosens, the head assembly will lift off after ½ to ¾ of a turn of the head. If the head assembly does not loosen after rotating, it will have to be dismantled for removal by first removing the trigger assembly and inserting the narrow blades of 2 small screwdrivers alongside the trigger (on top of the spray head). While applying slight outward pressure, lift our the trigger. This exposes the nozzle, which can be lifted out. Next, insert and rotate counter-clockwise an 8-mm Allen wrench to loosen the hexagonal nut that binds the head assembly to the canister. Remove the head assembly from the canister. By experimenting with varying tightnesses of this hex nut, find a tightness that allows the head to be removed easily as a single unit for refilling, yet, will not detach during practice sessions. The head will be a bit looser than on new cans, but will work fine, and finding this optimal tightness saves considerable time over reassembling the spray head each time a canister is refilled.

Given the high-pressure air used in refilling canisters, eye protection is recommended. Suspending the device (i.e., from an overhead beam or ceiling) frees one hand for operating valves and adding pressure, while the other holds the canister in place on the device. To refill a canister, close the fill valve and open the water intake valve (Figure 2). Add 1 cup of water to the water intake funnel; let the water trickle downward into the device, then close the water intake valve. With the air compressor

Table 2. Published MSDS information for 6 bear-spray products on the market.

Company or brand	Product name	Net contents (oz)	Pressure rating (psi)	Distance (ft)	Time (sec)
Counter Assault	Bear Deterrent	8.1	71 (70° F)	30	7
	Bear Deterrent	10.2	71 (70° F)	32	9
	Inert Training Spray	8.1	no data	10–12	7
UDAP	Pepper Power Bear Spray	7.9	96 (77° F)	30	4
	Magnum Bear Spray	9.2	96 (77° F)	30	5
	Inert Training Spray	7.9	96 (77° F)	30	4
Frontiersman	Bear Attack Deterrent	7.9	110	30	5
	Bear Attack Deterrent	9.2	110	35	5
	Inert Trainer	8.0	100	18	8
Guard Alaska	Bear Deterrent	9.0	55 (68° F)	15–20	9
Parkland Aero-Fillers	Bear Beware Bear Deterrent	7.9	96 (75° F)	22	no data
	Bear Beware Plus Bear Deterrent	11.5	96 (75° F)	25	no data
	Back-Off Bear Deterrent	no data	96 (75° F)	no data	no data
Mace Security International Inc.	Muzzle Bear Attack Defense Spray	9.2	96 (77° F)	35	6

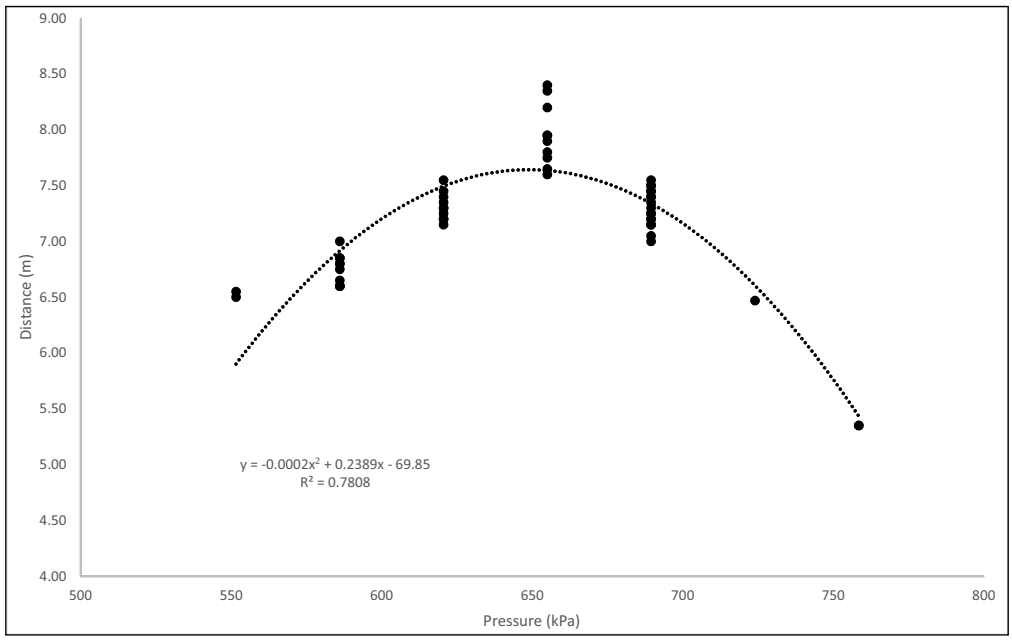

Figure 5. The influence air pressure in canister has on distance of spray (n = 52).

set to 95 pounds per square inch (PSI), attach a clamp-on tire inflator (i.e., does not require you to hold it in place) to the Schrader air valve. If using the refilling device suspended, raise a canister up onto the filler nozzle until firmly seated, and wrap 1 hand around both the top of the canister and bottom of the device to hold it in place. If not suspending the device, set the canister on a stable surface (i.e., table top), and lower the refilling nozzle into the canister until fully seated. Open the fill valve and add pressurized air until no more air is heard entering the refilling device, then close the fill valve. This not only forces the water down into the canister but also pressurizes the system to 95 PSI. Separate the canister and device, then open the water intake valve to release air pressure trapped between the 2 valves on the device. Reattach the head to the can by pressing until it snaps into place. Some canisters require the head assembly to be tightly attached for the trigger to work properly, while others work with loose heads. Some experimentation with spray assembly tightnesses will help determine what works best.

Additional notes

We obtained the material safety data sheets for several bear spray products to determine the range of pressures and fill volumes used by manufacturers (Table 2). Pressures ranged from 54.7 to 110.0 PSI in bear spray canisters. We experimented with a variety of air pressures and water volumes to see how these affected the distance and duration of practice canisters (Figures 3–5). Based on these data, we recommend the use of 1 cup of water and 95 PSI. Although spent cans of the actual bear spray product can be refilled, the refilling process routinely results in pressure and water escaping when the device is removed. Capsaicin residues in the canister can cause intense burning, so we recommend refilling only spent cans of inert product.

We believe that this low-cost alternative to disposing single-use inert training canisters will not only encourage more persons to practice bear spray deployment before entering the wilderness, but will also save money in wildlife management budgets that could otherwise be used for conservation. Ultimately, this project serves to increase the ability to defend oneself from aggressive bears, which in turn, helps conserve bears and protect people.

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