

Appendix B: Lead Shot Alternatives

Another method of preventing lead contamination at pistol, rifle, trap, skeet, or sporting clays ranges is to use less toxic or non-lead ammunition.

Much progress has been made in the development of alternatives to lead shot for hunting uses. Information gathered since 1976 on lead poisoning of endangered and non-endangered migratory birds due to lead shot ingestion led the United States Fish and Wildlife Service (USFWS) to consider several alternatives to eliminate lead poisoning among migratory waterfowl birds. A ban on lead shot for water fowl hunting was phased in beginning in 1986 and finalized in 1991. Lead shot is also now banned for shotgun hunting occurring near wetlands in national wildlife refuges. Starting in the fall of 1998, the USFWS banned the use of lead shot in waterfowl production areas. Additionally, many state-managed hunting areas require non-toxic shot for upland/small game hunting.

There are several alternatives to lead shot on the market today and still more alternatives are being developed. Before being used for waterfowl hunting, these alternatives must be approved by the USFWS. Bismuth, steel, tungsten/iron, and tungsten/polymer shots have been approved by the USFWS and additional alternative shot materials are in the USFWS approval process. Most of the ammunition manufacturers in the United States, as well as the military, have developed non-toxic alternatives to lead. Research in Europe may also result in additional non-toxic shot alternatives from which U.S. shooters may choose in the future. The following pages compare lead shot to non-toxic, alternative shot.

Summary of Lead Shot Alternatives[†]

Shot Material	Approximate Cost per 25 Round Box ¹	Ballistic Performance	Availability	Comments
Lead	\$5.00/box \$3.00 - \$4.00/box of reloaded shells	Standard to which all alternatives are compared	Readily available	Lead is heavy and malleable
Bismuth* 97% Bismuth/ 3% tin	Bismuth shells are packed in 10 round boxes @ \$15.00 - \$25.00/ 10 round box	Similar to lead	Limited world supply of bismuth	Bismuth is a byproduct of lead and gold mining. There are currently many uses, including: medicine (Pepto-Bismol), cosmetics, pigments, and shotgun shot. The addition of tin makes bismuth more malleable and reduces frangibility. Bismuth shot is safe to use in older firearms.

[†] Product reference within this table is not an endorsement by EPA.

* Approved by USFWS for migratory waterfowl hunting.

¹ Costs will vary from store to store and were valid at the time of manual development.

Summary of Lead Shot Alternatives – Continued[†]

Shot Material	Approximate Cost per 25 Round Box ¹	Ballistic Performance	Availability	Comments
Steel [†]	<p>\$8.00 - \$12.95/box</p> <p>\$6.00/box of reloaded shells</p> <p>\$15.00/box (copper-plated)</p>	<p>In test performance by the Cooperative North American Shotgun Education Program (CONSEP) in hunting situations, no significant differences were found between lead and steel shot at reasonable distances. Lead is more effective at longer ranges.</p>	<p>Readily available from both domestic and imported sources.</p>	<p>Steel shot is about 33% lighter than lead. Therefore, the initial velocity must be increased so that downrange pellet energy remains similar. In hunting situations, larger, and therefore heavier, steel shot is used. Few shooting competitions allow steel shot at this point, but the number is increasing.</p> <p>While steel target loads are available, shooter perception that steel will adversely affect guns and scoring seems to be the limiting factor in acceptance of steel shot for target shooting.</p> <p>Steel shot will not damage newer guns, but may cause ring bulge in older guns if a very tight choke is used. This problem has been resolved in the newer guns with the use of screw-in chokes.</p>

[†] Product reference within this table is not an endorsement by EPA.

* Approved by USFWS for migratory waterfowl hunting.

¹ Costs will vary from store to store and were valid at the time of manual development.

Summary of Lead Shot Alternatives – Continued[†]

Shot Material	Approximate Cost per 25 Round Box ¹	Ballistic Performance	Availability	Comments
Steel [*] (cont.)				<p>Another concern with steel shot is safety. Because steel is much less malleable than lead, steel shot is likely to ricochet if it strikes something hard. Lead shot, on the other hand, will deform and flatten. In Europe, steel shot is banned for hunting because it can become embedded in trees. The steel shot in trees cut for lumber can cause damage to sawmill equipment and raise concerns about worker safety.</p> <p>Although steel shot can be reloaded, components are not readily available.</p>
Tungsten/iron [*] 40% tungsten/ 60% iron	\$62.50/box (tungsten/iron shots are packed in 10 round boxes @ \$25.00/10 round box)	Preliminary reports indicate that tungsten/iron shot is as effective as lead shot. However, the amount of shot in each cartridge is significantly less than in typical lead cartridges or even steel cartridges. The density of tungsten/iron is 94% that of lead.	Readily available	The tungsten/iron shot currently available is harder than steel. It would, therefore, cause similar damage to older guns.

[†] Product reference within this table is not an endorsement by EPA.

^{*} Approved by USFWS for migratory waterfowl hunting.

¹ Costs will vary from store to store and were valid at the time of manual development.

Summary of Lead Shot Alternatives – Continued[†]

Shot Material	Approximate Cost per 25 Round Box ¹	Ballistic Performance	Availability	Comments
<p>Tungsten/polymer[*] Various manufacturers have received final approval from the USFWS to market this type of shot.</p>	<p>Not available yet</p>	<p>Comparable to tungsten/iron</p>	<p>Currently not available</p>	<p>Two ammunition manufacturers are currently producing tungsten/polymer shot. This shot is more malleable than the tungsten/iron alloy and would, therefore, be less damaging to shotguns.</p> <p>A research and development company has developed a tungsten/polymer material as a substitute for lead in all its uses. According to this company, its tungsten/polymer can be formulated to be flexible or stiff, depending on the application. This material has been tested by the US Army in projectiles, but has not been used to manufacture shot. However, the company has initiated the process of applying to the USFWS for approval of this material as non-toxic shot.</p>

[†] Product reference within this table is not an endorsement by EPA.

¹ Costs will vary from store to store and were valid at the time of manual development.

Summary of Lead Shot Alternatives – Continued[†]

Shot Material	Approximate Cost per 25 Round Box ¹	Ballistic Performance	Availability	Comments
Tungsten/steel Same as tungsten/iron				
Tin USFWS granted temporary approval for 1999-2000 hunting season	Not available yet	Since tin is just being developed as an alternative to lead, performance information is not yet available. However, since the density of tin is less than steel, performance may be less effective than steel.	Currently not available	This material is just being developed as a lead shot alternative. However, it has similar problems as steel in that it is lighter than lead. The International Tin Research Institute in England is developing this product.

Other materials that are currently being experimented with as alternatives to lead are molybdenum and zinc. Not enough information is available to have included these alternatives in the above table.

[†] Product reference within this table is not an endorsement by EPA.

Summary of Lead Shot Alternatives - Conclusions

The table clearly illustrates that a number of non-toxic alternatives to lead shot exist such as steel and tungsten as well as alloys and synthetic polymers. As demand for shot from these metals increases from migratory waterfowl hunters, it is anticipated that the costs will come down. However, alternatives currently cost approximately two to twenty times more than lead shot.

The ban on lead shot in hunting situations impacts target shooting. The alternatives to lead shot that are now being developed for or are already approved by the USFWS for migratory bird hunting could be considered for use by target shooters.

Although alternatives to lead shot are now being used by hunters, it is rare that the alternatives are used by target shooters. The limiting factors appear to be the expense and performance. All the alternatives to lead are much more expensive, some prohibitively. Unfortunately, the least expensive alternative, steel, is also perceived to be less effective.

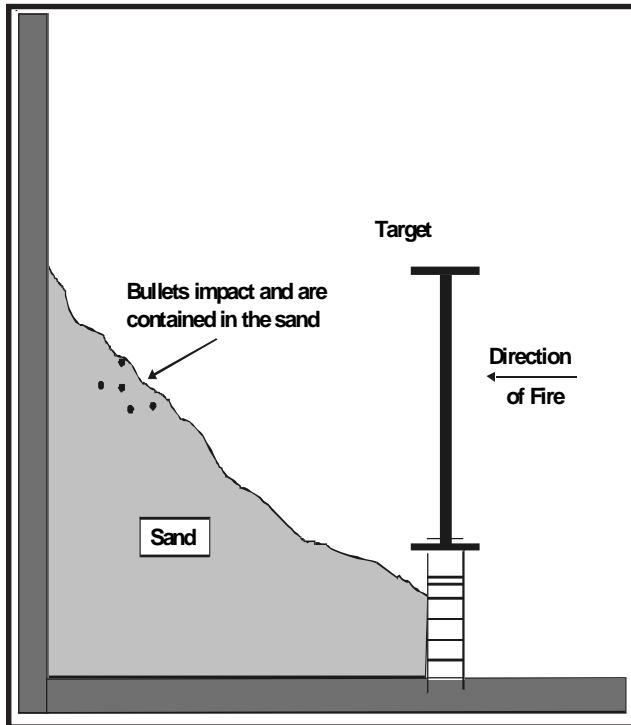
To encourage use of lead shot alternatives, some ranges sponsor shooting competitions using lead-free ammunition, but these are rare. The use of steel or other alternative shot is a recommended BMP in established sporting clays areas at which reclamation of lead shot is difficult to impossible.

Note: Switching to non-toxic shot may create additional issues. For instance, steel has an increased risk of ricochet. Switching to steel may require additional safety features and/or operating procedures.

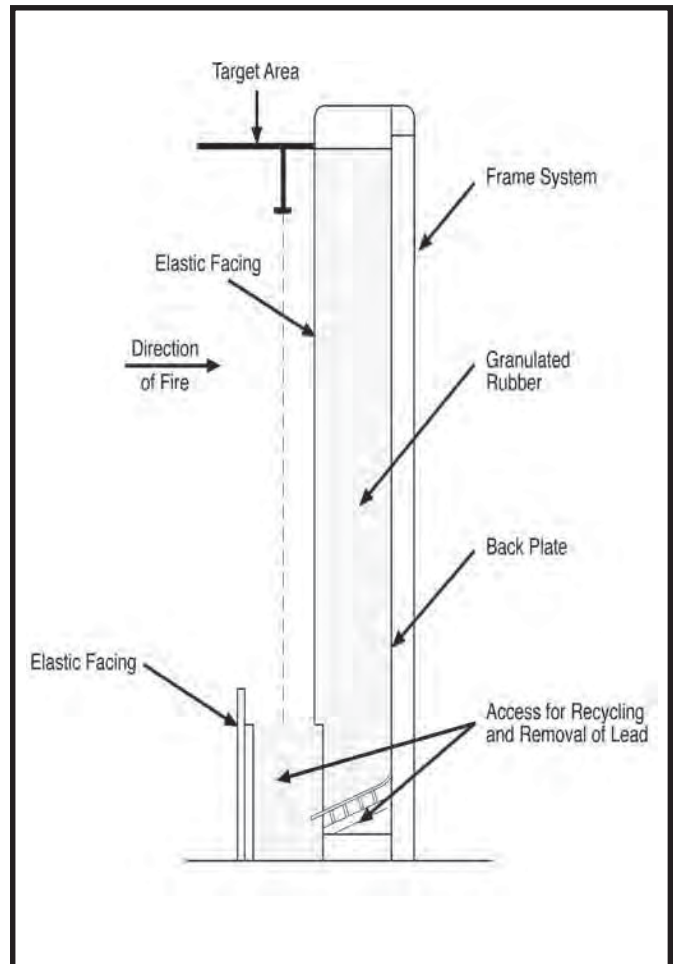
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Appendix C: Sample Bullet Containment Devices

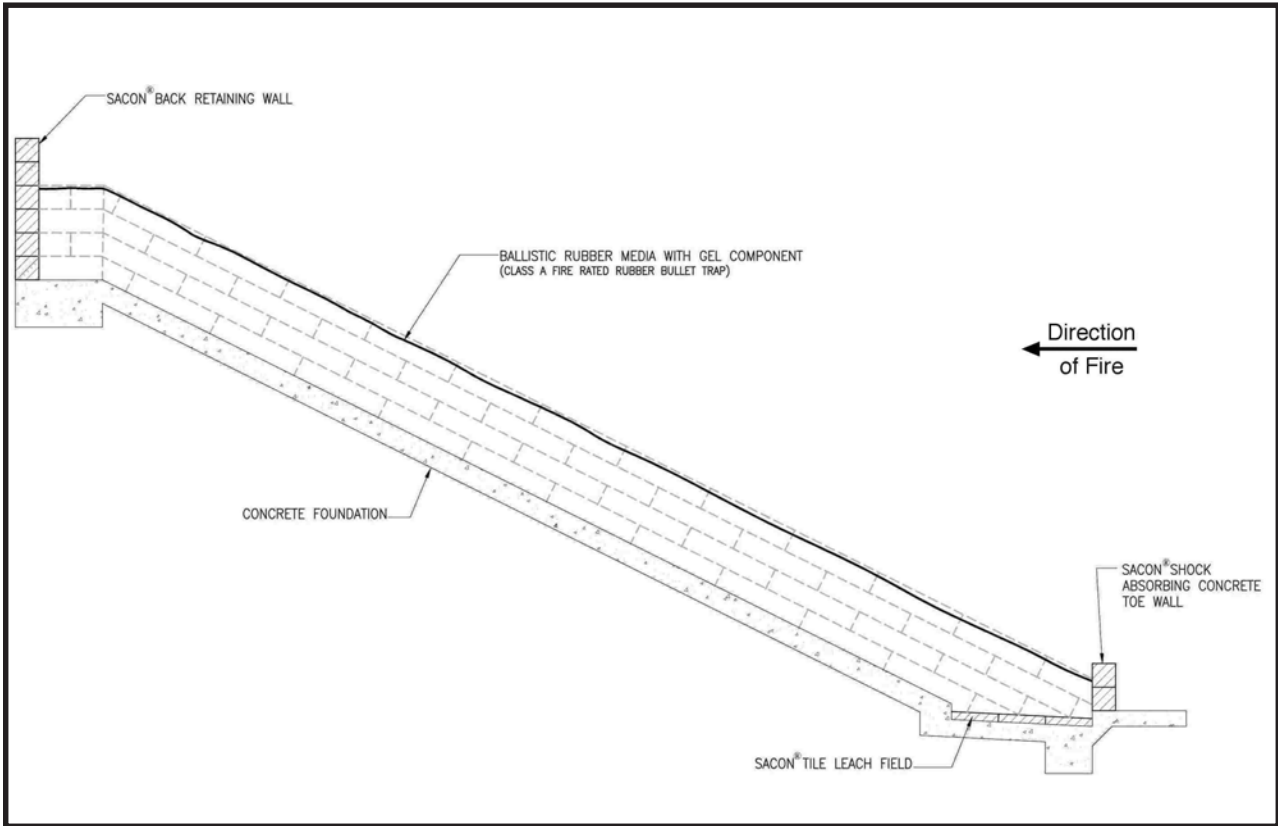
The bullet containment designs in this appendix are sample designs for the containment systems mentioned in this manual. Design systems may vary from different manufacturers. Reference to various individual bullet containment devices is included in this manual for informational purposes only. EPA does not endorse any particular bullet containment device, design, or product.



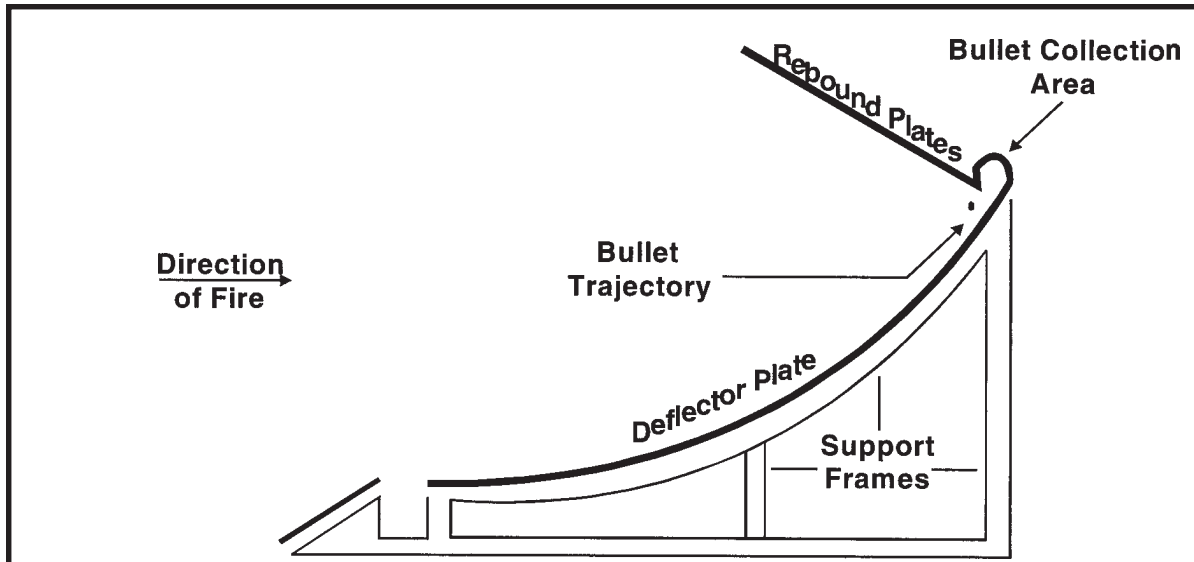
Sand Trap



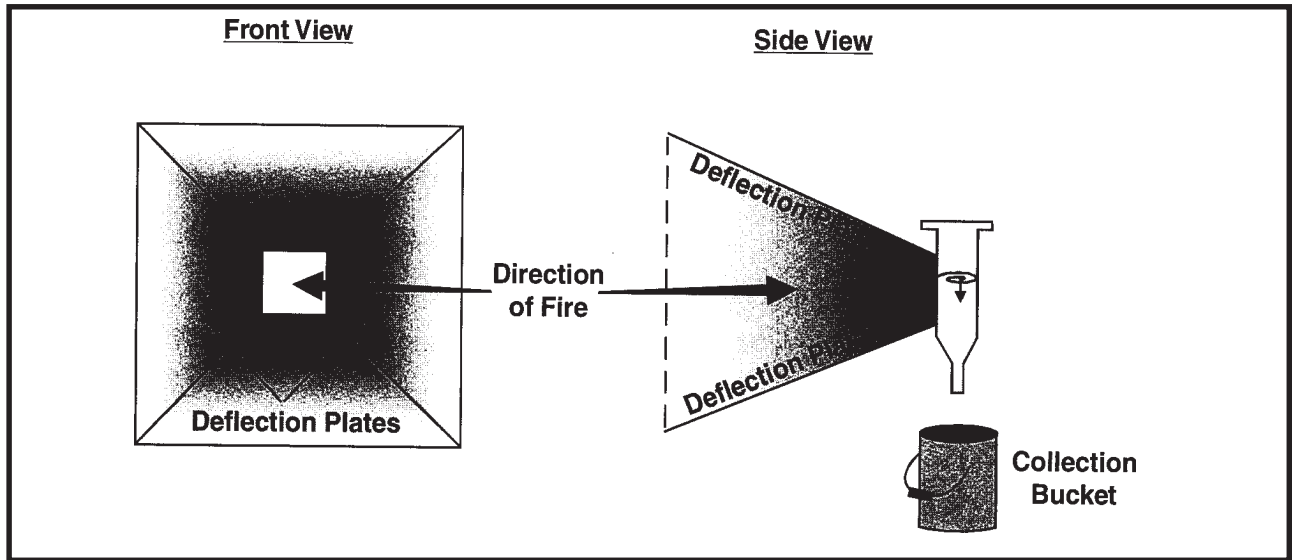
Rubber Granule Trap (Adapted from: *Bullet Trap Feasibility Assessment and Implementation Plan: Technology Identification Final Report*, U.S. Army Environmental Center, March 1996)



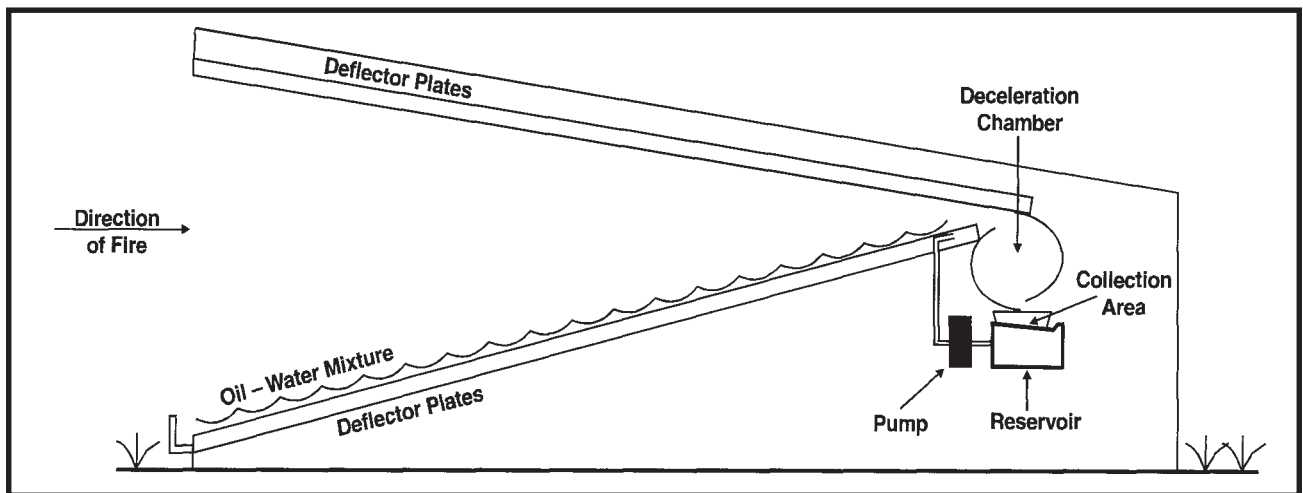
Gel-Cor Bullet Trap™ (Provided by Super Trap, Inc.)



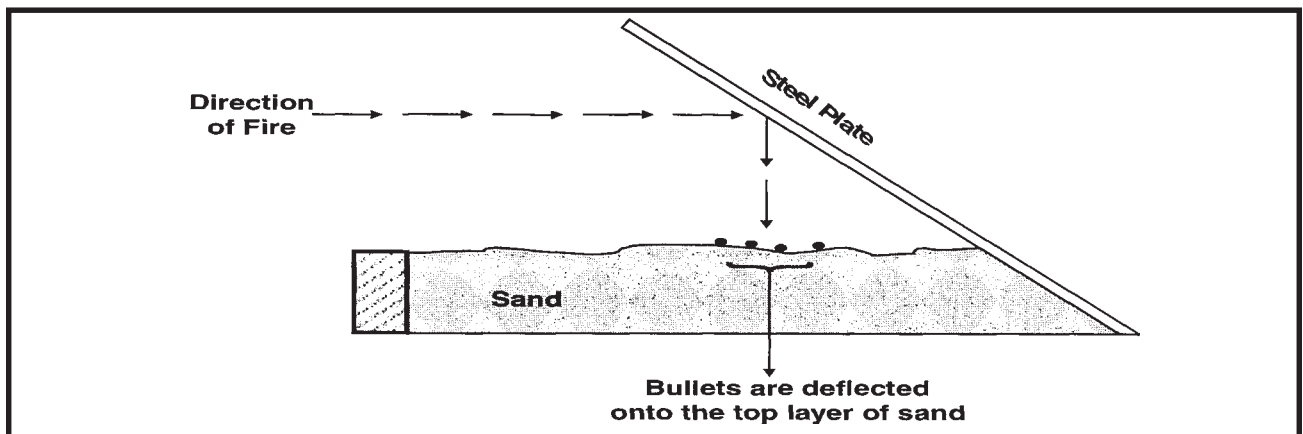
Escalator Trap (Adapted from: *Bullet Trap Technologies*, Action Target Educational Video Series)



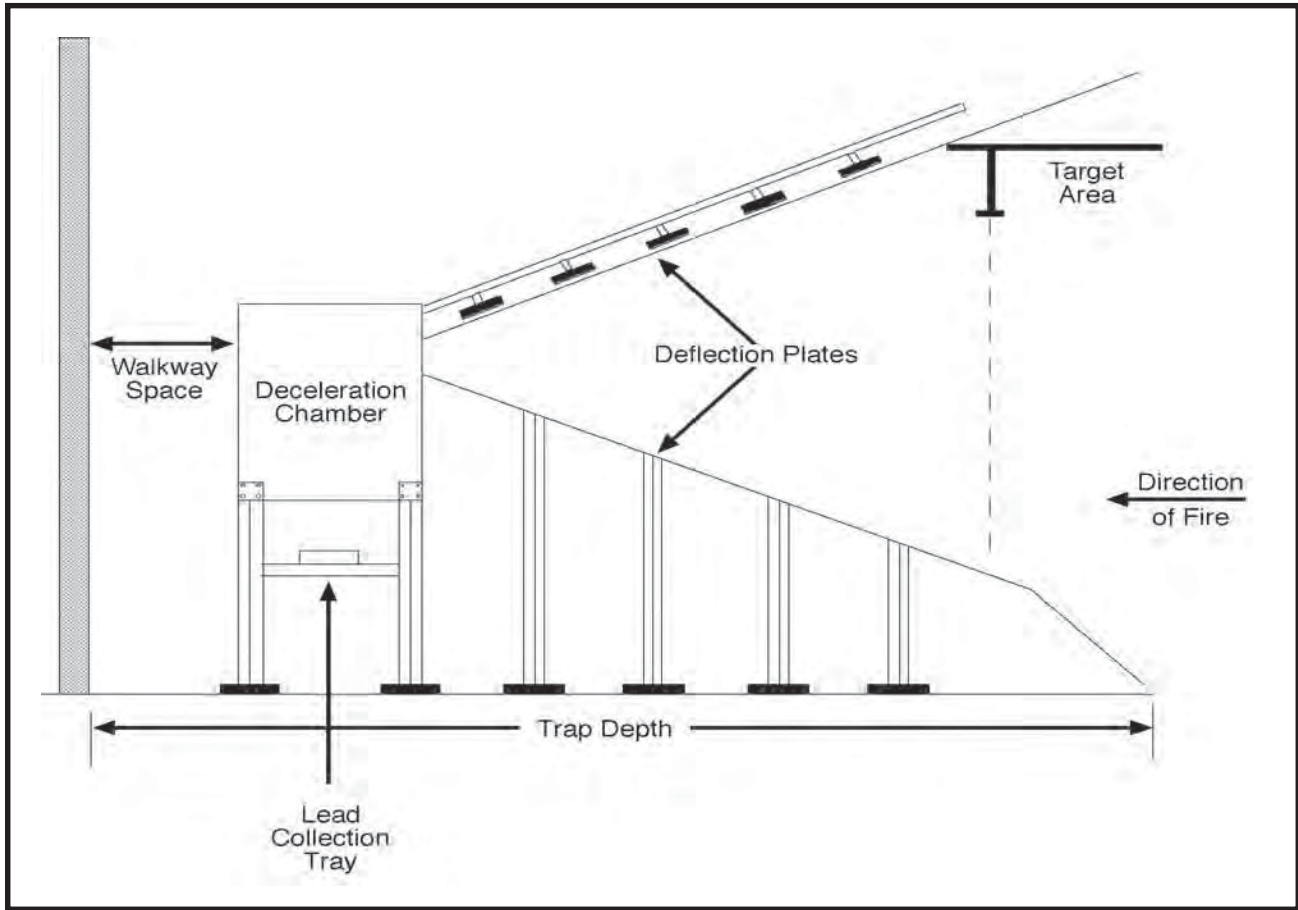
Vertical Swirl Trap (Adapted from: *Bullet Trap Feasibility Assessment and Implementation Plan: Technology Identification Final Report*, U.S. Army Environmental Center, March 1996)



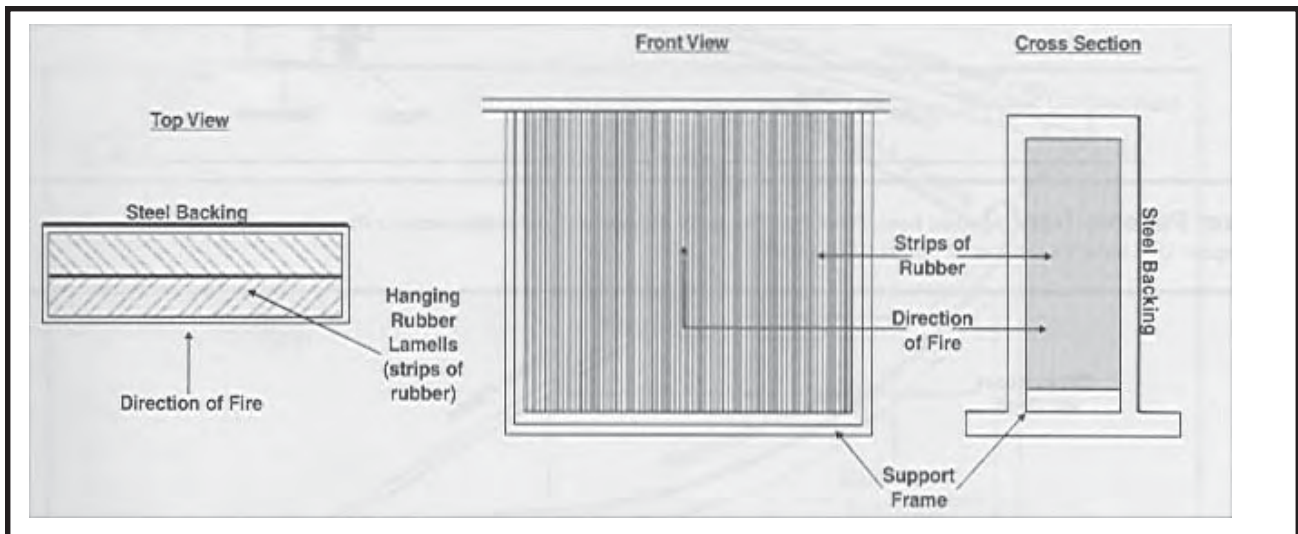
Wet Passive Trap (Adapted from: *Bullet Trap Feasibility Assessment and Implementation Plan: Technology Identification Final Report*, U.S. Army Environmental Center, March 1996)



Pitt and Plate (Adapted from: *Bullet Trap Feasibility Assessment and Implementation Plan: Technology Identification Final Report*, U.S. Army Environmental Center, March 1996)



Steel Bullet Trap (Adapted from: *Bullet Trap Technologies*, Action Target Educational Video Series)



Lamella Trap (Adapted from: *Bullet Trap Feasibility Assessment and Implementation Plan: Technology Identification Final Report*, U.S. Army Environmental Center, March 1996)

Appendix D: RCRA Regulatory Requirements and Interpretations

Timely separation of lead shot and bullets from soil at active ranges, recycling of the lead, and subsequent redeposition of the soil on the active range is exempt from RCRA regulation.

1. Reclaiming and Recycling Lead Shot

EPA's Office of Solid Waste issued guidance in 1997 indicating that lead shot, when recycled, is considered a scrap metal and is therefore exempt from RCRA regulation. A copy of the March 17, 1997 letter with this guidance is attached. Under the RCRA Subtitle C hazardous waste management regulations, lead shot would be considered scrap metal, which is exempt from hazardous waste regulations if it is recycled (see 40 CFR 261.6(a)(3)(ii)). Although storage of scrap metal being recycled is not affected by specific time limits such as the speculative accumulation provision (40 CFR 261.1(b)(8)), the scrap metal must legitimately be recycled to remain exempt under this provision. It should also be noted that lead shot may be subject to the authority of RCRA 7003, which addresses imminent hazards. However, use of best management practices is likely to prevent situations which would present an imminent hazard. Using such practices, together with following a clear, written policy governing the facility's recycling efforts, should also assist in assuring that the facility's practices can be demonstrated to be legitimate recycling.

2. Storage of Lead on Shooting Ranges Prior to Recycling

Some ranges have indicated that it may be desirable to store recovered lead shot and bullets on the range property for some periods of time prior to sale for recycling.

Provided that best management practices are followed in terms of storing and recycling the sorted lead, a range that follows such practices, and engages in legitimate recycling, should be able to store such material prior to recycling without RCRA regulatory controls (see discussion below). Best practices would suggest that the sorted lead, at a minimum, should not be exposed to the elements and should be managed so as to prevent releases to the environment. Best practices also indicate that the sorted lead should be stored in containers in good condition, regular inspections of the container condition should be conducted, and the records of inspections should be maintained and be readily available. Further, best practices also suggest that the sorted lead should be recycled in a timely manner and storage times should not exceed the time-frames or goals articulated in a clear, written policy.

3. Placement of Soil After Removal of Lead

For soil placed back on an active range after a BMP has been applied to remove the lead, the following regulatory approach has been followed. On February 12, 1997, EPA published the RCRA Subtitle C Military Munitions Rule in the Federal Register (62 Fed. Reg. 6621). The Military Munitions Rule considers range management to be a necessary part of the safe use of munitions for their intended purpose. Thus, the range clearance activity (recovery of lead shot and bullets) is an intrinsic part of the range operation. Therefore, the rule excludes range clearance activities (including the placement of soil back on the range) from RCRA Subtitle C regulation. Although the Military Munitions Rule did not apply to non-military ranges, EPA, in its response to comments on the proposed rule, clearly stated that “it felt that the ‘range clearance’ interpretation in the final Military Munitions Rule is consistent with the EPA’s interpretations for non-military ranges.” In addition, the EPA’s Director of the Office of Solid Waste sent the New York State Department of Environmental Conservation a letter dated April 29, 1997, confirming that the Military Munitions Rule range clearance principles apply equally to non-military ranges. A copy of the letter is attached.

4. Relocation of Backstop and Shotfall Zone Soil

Some ranges have indicated to the EPA that it may be desirable to transport and/or relocate a backstop in order to reorient or modify their range. This may occur when there is a need to reorient the range due to environmental concerns (e.g., shooting over water (wetland, stream, pond) or excessive runoff), alter the layout to improve shooter safety, or redesign to modify shooting conditions (e.g., adjusting number of shooting positions, increasing or decreasing target distance.) In some cases backstop material would not be moved off the range property, but to another area on the range property.

EPA’s position is that range backstop materials are part of the range and are not wastes when they are moved or relocated, as long as the range continues to be used as a range and the backstop materials continue to be used as backstop materials. Hence, backstop materials that are still in use are not subject to the RCRA hazardous waste management regulations and need not be tested for hazardous waste characteristics. However, removal of lead from backstop materials that are to be relocated or moved is a normal practice of good range management in that it extends the usable life of the materials and reduces the possibility of releases of lead into the environment. If lead removal does not occur before moving the backstop material, the lead will become more dispersed throughout the material during movement and will thus be more difficult to recover in future reclamation events.

As a range management practice, it is environmentally preferable to use soil that may already contain lead and is on an active portion of the range, which will therefore undergo regular lead reclamation in the future, than to leave such soil in place and construct a new backstop with lead-free soil. Records of all movements of berm and shotfall zone soils, along with corresponding site plans, should be maintained indefinitely, as they will be necessary in evaluating cleanup needs during subsequent construction or range closure.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460
March 17, 1997

Mr. Duncan Campbell
Environmental Protection Agency, Region V
RCRA Enforcement
77 West Jackson Boulevard
Chicago, Illinois 60604-3507

Dear Mr. Campbell:

Enclosed please find a memorandum on the regulatory status of lead shot, which includes a general discussion on the regulatory status of lead shot as scrap metal. I hope that this information is sufficient to address your specific concerns as they relate to the pile of lead shot at the Saxon Metals facility.

If you have any questions or would like to discuss this matter further, please contact me at (703) 308-8826.

Sincerely,
Jeffery S. Hannapel
Office of Solid Waste

Enclosure

To: Duncan Campbell, EPA Region V
From: Jeff Hannapel, EPA Office of Solid Waste
Date: March 13, 1997
Re: Regulatory Status of Lead Shot

Based on our conversations, it is my understanding that Saxon Metals received for recycling a shipment of approximately 30,000 pounds of lead shot from a commercial indoor shooting range. Smokeless gun powder is, presumably, commingled with the lead shot. The mixture appears to exhibit the ignitability characteristic of hazardous waste (as evidenced by the incident in which the material ignited when Saxon Metals was attempting to load it into the furnace with a front-end loader). You have asked our office to provide you with guidance on the regulatory status of the lead shot portion of the mixture, specifically whether it is considered a spent material or scrap metal.

The Agency has taken the position that the discharge of ammunition or lead shot does not constitute hazardous waste disposal because the Agency does not consider the rounds from the weapons to be "discarded." As you know, discard is a necessary criterion to be met

before a material can be considered a solid waste and subsequently a hazardous waste. (40 CFR §261.2(a).) The Agency's interpretation regarding discard is based on the fact that shooting is in the normal and expected use pattern of the manufactured product, i.e., the lead shot. Enclosed for your information is a September 6, 1988 letter from EPA to IDEM on this particular point.

In the federal regulations, the term, "scrap metal," is defined as "bits and pieces of metal parts (e.g., bars, turnings, rods, sheets, wire) or metal pieces that may be combined together with bolts or soldering (e.g., radiators, scrap automobiles, railroad box cars), which when worn or superfluous can be recycled." (40 C.F.R. §261.1.) In the Federal Register preamble for the final regulations on the definition of solid waste, EPA indicated that "scrap metal is defined as products made of metal that become worn out (or are off-specification) and are recycled to recover their metal content, or metal pieces that are generated from machine operations (i.e., turnings, stampings, etc.) which are recycled to recover metal." (50 Fed. Reg. 614, 624 (1985).) The lead shot portion of the Saxon Metals pile would be considered scrap metal pursuant to the regulatory definition of scrap metal.

EPA provided further clarification on the regulatory status of scrap metal in the Federal Register preamble to the definition of solid waste final regulations:

[a]t proposal, scrap metal that was generated as a result of use by consumers (copper wire scrap, for example) was defined as a spent material. (This type of scrap is usually referred to as "obsolete scrap.") Scrap from metal processing, on the other hand (such as turnings from machining operations) was defined as a by-product. (It is usually called "prompt scrap.") Yet the scrap metal in both cases is physically identical (i.e., the composition and hazard of both by-product and spent scrap is essentially the same) and, when recycled is recycled in the same way - by being utilized for metal recovery (generally in a secondary smelting operation). In light of the physical similarity and identical means of recycling of prompt scrap and obsolete scrap, the Agency has determined that all scrap metal should be classified the same way for regulatory purposes. Rather than squeeze scrap metal into either the spent material or by-product category, we have placed it in its own category.

(50 Fed. Reg. at p. 624) Based on these regulatory passages, the lead shot portion of the pile would be considered scrap metal, and not a spent material. The lead shot is a product that is made of metal that can be recycled to recover metal content. Furthermore, the lead shot has not been "discarded" by virtue of its discharge at the shooting range, because the discharge is within the normal and expected use pattern of the manufactured product. Accordingly, lead shot would be considered scrap metal for regulatory purposes. Scrap metal is a solid waste, but it is exempt from the regulatory requirements of Subtitle C when it is recycled. (40 C.F.R. §261.6(a)(3)(ii).) As part of the Phase IV land disposal restrictions supplemental rulemaking (which was proposed January 25, 1996 and is expected to be finalized in April 1997), processed scrap metal and two categories of unprocessed scrap metal that is being recycled would be excluded from RCRA jurisdiction.

Please note that this discussion of the regulatory status is limited to the lead shot portion of the pile as you requested. To the extent that the entire pile exhibits the ignitability or reactive characteristic of hazardous waste, the mixture of materials would be considered hazardous waste and not scrap metal. The scrap metal designation for the lead shot would be applicable only to the extent that the lead shot could be segregated from the other materials in the pile.

I hope that this guidance on the regulatory status of lead shot recovered from shooting ranges provides you with the clarification that you needed. If you have any questions or would like to discuss this matter further, please contact me.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460
APR 29 1997

Mr. John P. Cahill
Acting Commissioner
State of New York
Department of Environmental Conservation
Albany, New York 12233-1010

Dear Mr. Cahill:

Thank you for your letter of April 3, 1997 to Administrator Browner requesting a clarification of the Environmental Protection Agency (EPA) Final Military Munitions Rule regarding the extension of its range clearance principles to non-military ranges. Although the final rule addresses only military ranges, we agree with your view that the range clearance principles apply equally to non-military ranges [see comment no. 5 on page 36 of the enclosed excerpt from the Military Munitions Final Rule Response to Comments Background Document].

We are aware of the State of New York's active leadership role in the clean-up of private firing ranges. We appreciate your writing in support of the range clearance aspects of the final Military Munitions Rule and we will consider your suggestions that we issue broader guidance on the applicability of its principles to non-military ranges.

Sincerely yours,

Elizabeth Cotsworth, Acting Director
Office of Solid Waste

Enclosure

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