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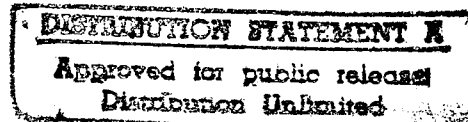


**U.S. Army
Environmental
Center**

Bullet Trap Feasibility Assessment and Implementation Plan

Technology Identification Final Report

Report No. SFIM-AEC-ET-96005
Contract No. DW398AW9S
Task Order No. 04-24



March 1996

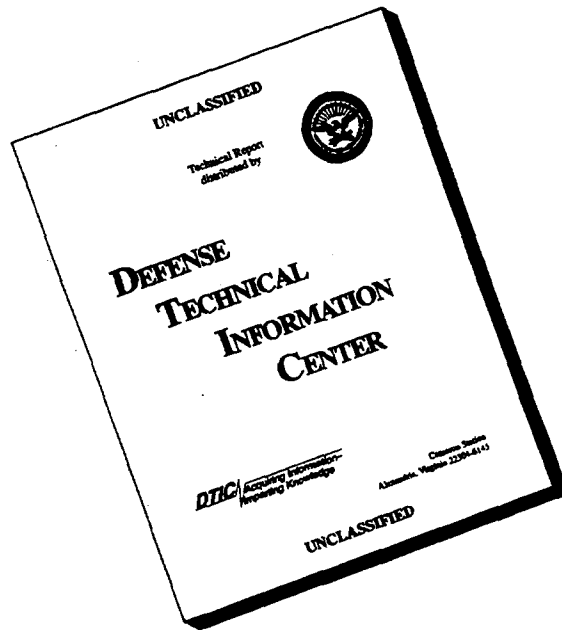
Prepared for:
U. S. Army Environmental Center
SFIM-AEC-ETD
Aberdeen Proving Ground, MD 21010-5401

Prepared by:
TRW
Systems Integration Group
One Federal Systems Park Drive
Fairfax, Virginia 22033

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**BULLET TRAP FEASIBILITY ASSESSMENT
AND IMPLEMENTATION PLAN**

TECHNOLOGY IDENTIFICATION

FINAL REPORT

March 1996

Contract No. MDA970-89-C-0019

Task Order No. 04-24/00

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U. S. ARMY ENVIRONMENTAL CENTER

SFIM-AEC-ETD

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One Federal Systems Park Drive
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| 13. ABSTRACT The U.S. Army Environmental Center (USAEC) is evaluating the feasibility of using bullet traps on standard Army small arms ranges. Currently on outdoor ranges, shooters fire small arms into earthen berms or far down range into the soil. This deposits lead and other heavy metals in the soil and may lead to regulatory restrictions on ranges that might include closing the ranges. Bullet traps generally operate through either deceleration, impact or friction to slow and stop the bullet. This Technology Identification Report (TIR) reviews and provides illustrative figures for eleven friction, five impact, and three deceleration type traps. In addition to an extensive literature review, numerous site visits were made to discuss bullet traps with range management professionals, commercial manufacturers and subject matter experts. This TIR identifies all known small arms traps that may be applicable to Army small arms ranges based on available manufacturers' performance data. Bullet traps may be a feasible solution to heavy metals build-up in soils currently experienced on Army ranges, if applied within the limits of the design parameters of each trap and the required Army training environment. |
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DISCLAIMER

This Technology Identification Report represents our best effort to identify all commercially available bullet traps, and traps capable of being manufactured locally, that can reasonably be used on outdoor small arms ranges. Additionally, these traps must be able to handle US military ammunition up to .50 caliber.

Inclusion of a bullet trap in this report does not constitute an endorsement or approval of use of that trap. Because live fire testing is not a part of this evaluation, performance data is that supplied by the manufacturers. The views, opinions, and/or findings contained in this report should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation. This report may not be cited for purposes of advertisement.

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EXECUTIVE SUMMARY
TECHNOLOGY IDENTIFICATION REPORT
BULLET TRAP FEASIBILITY ASSESSMENT AND IMPLEMENTATION PLAN

Numerous Department of Defense small arms ranges have the potential to build up lead and other metals in soils. In some cases, those inorganic constituents may become mobile and migrate to surface or groundwater. The U.S. Army Environmental Center (USAEC) is seeking ways to reduce the potential of off-site migration of lead and other heavy metals thus reducing the potential impact on the environment at these ranges.

Bullet traps may provide a means to recycle the projectile material and prevent the contamination of the range and the environment. The bullet traps would also mitigate the excessive soil erosion experienced on outdoor ranges caused by the impact of the projectiles. In addition, bullet traps reduce or eliminate safety problems caused by ricochets off natural or other materials on current ranges. Bullet traps, which are designed to capture bullets fired into limited cross-sectional areas, are currently being developed and marketed by independent commercial vendors and may represent a feasible solution for some types of firing ranges. This Technology Identification Report (TIR) reviews the bullet trap technologies that are currently available.

A computerized literature search was conducted to identify potentially applicable bullet trap technologies for use on outdoor ranges. Also, military installations were visited and nationally recognized experts were contacted to identify sources and types of bullet traps. Table ES-1 presents a summarized description of the identified bullet trap technologies.

Although most existing bullet trap designs are created for indoor applications, environmental concerns and demands of the marketplace have encouraged several major manufacturers to modify their traps for outdoor use. Bullet traps can be grouped into three broad categories, deceleration, impact, and friction, though there is some blurring of the dividing line. Deceleration traps use a circular or helical chamber to allow the bullet to spin inside until it has shed sufficient velocity to drop through a recovery port in the bottom.

Impact traps include those such as the traditional steel or armor plate, concrete backstops, or other materials whose function is to cause the bullet to fragment or to be directed into a catchment area. Their advantages are that they are generally inexpensive to construct, low technology, reasonably durable, and require little maintenance. The disadvantages are that they cause bullet fragmentation, with the consequent lead recovery and disposal problems, are essentially immobile, and can contribute to ricochets.

Friction traps include a variety of traps from the earthen berm, to some very esoteric designs. These traps cause friction on the surface of the bullet, slowing its flight and bringing it to a stop within a defined distance. Their methods and materials vary widely, as is shown in the following descriptions. The advantages of friction traps are that they generally capture the bullet intact, though with varying degrees of deformation and can be more easily tailored to the mission. Disadvantages are that they generally require more maintenance, and are more expensive to construct, though some types are promoted as being the lowest cost of all categories.

A number of indoor designs, such as the Passive Bullet Trap at the new National Rifle Association indoor range in their headquarters in Virginia, are quite innovative, but also quite expensive. Most companies who list themselves in trade publications or compendia such as the Thomas Register, are really assemblers of other companies' materials or are target not bullet trap manufacturers. Those who are true bullet trap manufacturers are few and do not advertise widely. Consequently, they are hard to discover. To date the market had been rather limited and not able to support large numbers of manufacturers. In the past, the dominant designs were of the deflection type and therefore easy to manufacture locally. Due to an abundance of land, most shooters could travel a short distance from home to fire on an outdoor facility backed by a earthen berm; therefore, demand was limited. A worldwide search was conducted to include Canada, Scandinavia, western and eastern Europe, Japan, Korea, Australia and New Zealand. Of the foreign countries investigated, only Germany, Italy and Switzerland had manufacturers. Some of the traps that have been investigated appear to be viable candidates for some applications on Army outdoor small arms ranges. However, manufacturer's performance claims should be verified by demonstration under operational conditions to provide objective data on the traps ability to contain or prevent the spread of heavy metals on the range as well as the durability, maintenance requirements, effects on training, life-cycle cost, and utility of these traps.

Table ES-1. BULLET TRAP DESIGNS

| Trap | Manufacturer | Type | Design | Ballistics |
|-----------------------------|-------------------------------|--------------|--------------------------------|-----------------------|
| GranTrap | Caswell | Friction | Recycled tire granules | .50 cal. and smaller |
| TEC | Range Masters | Friction | Shredded tire bonded in blocks | 7.62 NATO and smaller |
| Thunder Ranch | Action Target | Impact | Armor back with Linatex front | Handgun |
| Lamella | Caswell | Friction | Conveyor belt strips | .50 cal. and smaller |
| Passive Bullet Trap - OP96 | Savage Range Systems | Deceleration | Helical chamber | .50 cal. and smaller |
| TCT | Action Target | Deceleration | Helical chamber | 7.62 NATO and smaller |
| Granular Trap | Capito & Assenmacher | Friction | Rubber granules | .50 cal. and smaller |
| Logs or Railroad Ties | None | Friction | Piles of ties or logs | .50 cal. and smaller |
| Sand Trap | Various | Impact | Angled plate w/ sand box | 7.62 NATO and smaller |
| Water Trap | Various | Impact | Angled plate w/ water trough | 7.62 NATO and smaller |
| Rubber Blocks | Various | Friction | Solid rubber blocks | 7.62 NATO and smaller |
| Wax/Plastic Blocks | Various | Friction | Wax or polyurethane blocks | 7.62 NATO and smaller |
| Escalator | Various | Impact | Multiple angled plates | 7.62 NATO and smaller |
| Steel Louver | Various | Impact | Steel louvers and sand box | 7.62 NATO and smaller |
| Tires | None | Friction | Stacked tires | 7.62 NATO and smaller |
| SACON | Waterways Experiment Station | Friction | Shock attenuating concrete | 7.62 NATO and smaller |
| REGUPOL | Berleburger Schaumstoffwerk | Friction | Polymer elastic | Handgun |
| R493 | Shooting Ranges International | Deceleration | Helical chamber | 7.62 NATO and smaller |
| Elastomeric Granular Screen | Societa FRA.SA | Friction | Stable granular mound | 7.62 NATO and smaller |

SECTION 1 INTRODUCTION

1.1 Background

Numerous Department of Defense (DOD) small arms ranges have the potential to build up lead and other metals in soils. In some cases, those inorganics may become mobile and migrate to surface or ground water. The Army currently operates approximately 1400 outdoor small arms ranges in the Continental United States (CONUS). The Navy operates approximately 270 outdoor small arms ranges (including Marine Corps ranges) and the Air Force operates approximately 200 outdoor small arms ranges. The U.S. Army Environmental Center (USAEC) is seeking ways to reduce the potential for off-site migration of lead and other heavy metals thus reducing the potential impacts on the environment at these ranges.

An effective technology for destroying lead and other heavy metals deposited in soil does not exist. Techniques that limit the volume of heavy metals deposited in the soil will provide significant cost avoidance if these sites require some type of response action. The implementation of bullet traps will limit or prevent the build-up of heavy metals in soils.

This report identifies and describes commercially available outdoor bullet traps that capture and contain small arms projectiles. . These devices may provide a means to recycle the projectile material and prevent the build-up of heavy metals in the soil on the range. Bullet traps may also mitigate the excessive soil erosion experienced on outdoor ranges caused by the impact of the rounds. Erosion control and soil stabilization on the ranges may help prevent the migration of existing heavy metals off range and may help alleviate the recurring costs of land rehabilitation on the ranges. In addition, bullet traps may reduce or eliminate safety problems caused by ricochets on existing ranges. Bullet traps may represent a feasible solution for some types of firing ranges.

1.2 Objectives

The overall objectives of this project are to assess the feasibility of using bullet traps on Army outdoor small arms ranges and to develop an implementation guidance document for the use of bullet traps on various types of outdoor training ranges.

To meet this objective the following principal technical tasks were performed:

- Identify and describe existing, commercially available bullet trap designs.
- Study the various types of training missions and their associated range designs and develop functional and mission specific operational evaluation criteria for various range designs.
- Assess the feasibility of using each of the bullet trap designs previously identified. The bullet trap designs will be evaluated using the functional and mission specific operational criteria. Once the bullet trap designs have been evaluated, those that are considered to be the most applicable for use on outdoor ranges will be identified. Only the bullet traps that can be used on a range without compromising the conditions necessary for effective training will be recommended for use. Possible modifications to existing bullet trap designs will be identified which will permit the bullet traps to be used on outdoor ranges without impacting training objectives. The specific range types for which there are no feasible commercial bullet traps available will be identified. Possible methods of capturing the rounds for recycling in these cases will be identified and discussed for possible future study.
- Develop an implementation guidance document that integrates feasible bullet trap technology with training doctrine.

This report identifies and describes existing, commercially available bullet trap designs for outdoor small arms range use. This report will serve as a compendium of currently available bullet trap technologies for evaluation for use on Army outdoor small arms ranges. Section 2 of this report describes the investigation process used by TRW, Inc. to identify available bullet trap technologies. Section 3 describes and discusses the identified bullet trap technologies. Conclusions and recommendations are presented in Section 4.

SECTION 2

LITERATURE SEARCH

Section 2 contains a listing of databases and keywords used to conduct the literature search for available bullet trap technologies. Preliminary screening criteria and the identified technologies are included. The results of site visits to Army installations are included. These visits yielded insights into factors to be considered in bullet trap use on Army ranges.

2.1 Methodology

In order to identify the available technologies for capturing bullets, a search of the research and technical literature was conducted through the following electronic databases:

TRW's Electronic Collateral Support System (ELCSS)

DataTimes

Knight-Ridder

Defense Technical Information Center

Computer Select

National Technical Information Service (NTIS)

Thomas Register

Dun's Identifier

Trade and Industry Index

Dialog

These sources also included foreign publications. Some of the services, such as DataTimes, Dialog, and ELCSS were a compendium of numerous publication databases. ELCSS, for example, searches more than 300 databases and Dialog more than 450. Numerous searches of the Internet were made and the National Rifle Association Range Technical Operations Team was contacted for information. Several Jane's volumes were referenced also. Boolean logic was used in the searches so that hits would be obtained even if only a part of a key word or term was found. For example, if bullet and trap were used, hits would be generated if bullet, bullets, trap, traps, or bullet trap were found. It was felt this provided greater coverage even though manual review of each citation was needed. Key words used in the electronic searches were:

- bullet trap
- small arms range
- firing range
- shooting range
- training range
- rifle range
- berm
- outdoor range
- "small arms" plus environment cleanup
- stopping bullets
- lead trap

The results of each set of searches were compared with previous ones to eliminate duplicates. Little was found on the subject of bullet traps or bullet trap design even though numerous "hits" were obtained in the searches. For example, a search on "bullet trap" yielded 85 hits, but with the exception of several articles on the purchase of Passive Bullet Trap by Challenger International, the articles dealt with an Israeli-developed rifle grenade called the bullet trap rifle grenade. This is illustrative of the problems encountered with the literature search. The hits had to be manually reviewed and most contained little useful information. Almost all information was obtained via personal connections or referrals. There is very little in the published literature on bullet traps, either indoor or outdoor, and virtually nothing on bullet traps for military applications.

A number of Training and Doctrine Command (TRADOC) and Forces Command (FORSCOM) installations were visited to understand the types of ranges used, the training requirements, range operation, and maintenance approaches. These visits were performed to develop evaluation criteria for the second principal task outlined in Section 1.2. However, two of the installations, Fort Drum and Fort Knox, were experimenting with bullet traps and were able to provide valuable leads for identifying bullet trap technologies. Fort Drum has installed a Caswell lamella trap on a 25 meter range (Fig. 3.2.4) primarily to prevent rounds from leaving the range and to prevent erosion. Fort Knox installed a series of log walls on a field fire range that had no berm to prevent rounds from escaping the range (Fig. 3.2.8). Thunder Ranch, a commercial firearms training school, was also visited to look at their innovative bullet trap design and to discuss the problems of using bullet traps without impacting training effectiveness or realism. Thunder Ranch needed a target/trap combination that was portable, but needed only to stop handgun calibers (Fig. 3.2.3).

Every source found to offer information on bullet traps was further pursued. The rather limited results of the literature search were digested and any leads followed. All personal or professional referrals were followed up with phone calls to potential manufacturers and designers. Contacts were made with the Marine Corps, FBI, and local law enforcement for names of known manufacturers. Several nationally recognized experts, such as Russell Friedline of the National Rifle Association Range Technical Team were consulted. Additionally, Loren Kramer, Larry Tilton, and Craig Copious donated their time to answer questions, offer suggestions, and point to yet more sources. The military attaches at U.S. embassies in the United Kingdom, Italy, France, Germany, Switzerland, Sweden, Canada, and Israel were contacted for assistance in identifying foreign manufacturers of bullet traps. These efforts were combined with the results of literature searches and personal and phone interviews to produce the list of traps contained in this document.

2.2 Preliminary Screening Criteria

General Army requirements were discussed in general terms with the bullet trap manufacturers to aid in identifying prospective bullet traps for use on outdoor military ranges. The requirements were used for bullet trap identification and data collection only. Bullet traps were not eliminated from further consideration in this report based on the preliminary screening. Evaluation criteria for the bullet traps will be fully developed and discussed in a separate report.

Preliminary screening criteria were driven by the Army's requirements and other factors, such as installation and life cycle cost, maintenance requirements, effectiveness in both trapping bullets and preventing lead migration into the environment, and impact on training effectiveness and realism. The bullet traps must be useable outdoors under inclement weather conditions. A number of innovative bullet traps are currently available for indoor range use. The manufacturers of these traps have developed modified versions of their indoor traps for outdoor use. However,, performance data from outdoor use of these traps is limited in most cases. In these cases, available data from the bullet traps indoor use will be used to help evaluate the traps.

2.3 Identification of Technologies

Based upon the literature and technology searches described in Section 2.1, the bullet traps identified were:

- * GranTrap
- * Total Entrapment Composite (TEC)
- * Thunder Ranch
- * Lamella
- * Passive Bullet Trap - OP96
- * Total Containment Trap (TCT)
- * Granular Trap
- * Railroad Ties or Log Piles
- * Sand Trap
- * Water Trap
- * Rubber Blocks
- * Wax/ Plastic Blocks
- * Escalator Trap
- * Steel Louvers with Sand Bed
- * Tires
- * Shock Attenuating Concrete
- * REGUPOL
- * SRI R493
- * Elastomeric Granular Trap

USAEC wanted no traps eliminated from consideration based on this report. All of the traps will be evaluated after evaluation criteria have been developed. A description of each of the traps is included in Section 3.

SECTION 3 BULLET TRAP DESCRIPTIONS

Bullet traps are intended to perform one major function, stop bullets from traveling any further downrange. They do this by a variety of methods and designs, most of which will be described in categorical terms in the balance of this section. In the past, the only consideration was to find the lowest cost solution that would stop the bullet. For this reason, most were earthen berms. With the advent of specialized training, indoor ranges, and environmental awareness, the quest for other methods gathered momentum. Factors in choosing bullet traps include its utility for restricted space, safety, environmental impact, and disposal requirements. This document does not provide an analysis of the various bullet trap designs, but it does provide a technical description and manufacturer's data to permit the reader to make a choice based upon their unique requirements. Costs are not included at the request of the manufacturers. A number of bullet traps and bullet trap manufacturers were identified. Many of the bullet trap designs were very similar. For example, one rubber composite block bullet trap offered by a British firm appears to be basically the same as that of a US manufacturer, Range Masters, with the exception of the presence of recovery channels in the Range Masters trap

Bullet traps can be grouped into three broad categories, deceleration, impact, and friction, though there is some blurring of the dividing line. Deceleration traps use a circular or helical chamber to allow the bullet to spin inside until it has shed sufficient velocity to drop through a recovery port in the bottom.

Impact traps include those such as the traditional steel or armor plate, concrete backstops, or other materials whose function is to cause the bullet to fragment or to be directed into a catchment area. Their advantages are that they are generally inexpensive to construct, low technology, reasonably durable, and require little maintenance. The disadvantages are they cause bullet fragmentation, with the consequent lead recovery and disposal problems, are essentially immobile, and can contribute to ricochets.

Friction traps include a variety of traps from the lowest, yet probably the most effective, technology, the earthen berm, to some very esoteric designs. These traps cause friction on the surface of the bullet, slowing its flight and bringing it to a stop within a defined distance. Their methods and materials vary widely, as is shown in the following descriptions. The advantages of friction traps are that they generally capture the bullet intact, though with varying degrees of deformation and can be more easily tailored to the mission. Disadvantages are that they generally require more maintenance, and are more expensive to construct, though some types are promoted as being the lowest cost of all categories.

3.1 Bullet Trap Technology Descriptions

| | |
|----------------------|--|
| Bullet Trap: | GranTrap |
| Manufacturer: | Caswell International Corp. 1221 Marshall St. NE Minneapolis, MN 55413 |
| Method: | Friction |
| Ballistics: | .50 cal. and smaller |
| Construction: | The GranTrap is a large vertical box comprised of a steel frame with a steel backplate and steel or plywood sides. The front is a sheet of material that is identical to the large conveyor belts used in mines. The interior of the trap is filled with a clean, granulated, recycled tire material. There is a containment tray at the bottom front of the trap to collect bullets. |
| Capacity: | Manufacturer claims 50,000+ rounds |
| Installation: | 2 days, exclusive of site preparation. A level concrete pad is typically required for installation of the trap. |
| Maintenance: | Monthly is recommended. Caswell uses a two stage vacuum/blower to separate the GranTex from the bullets in the collection trough at the front of the trap, recycling the GranTex material back in the top of the trap. Bullets are generally intact. Frequent patching of the rubber facing material with sheets of rubber is required. The sheet rubber patch is installed with small screws. |
| Description: | The bullet penetrates the front sheet and is halted, generally within the first 12 inches, by the granulated material. As succeeding bullets impact the trap, the preceding bullets are shaken down the column of granulated rubber and gather at the bottom in a trough where they can be collected and recycled. There is leakage of GranTex from several locations on the trap, but it is most noticeable at the point where bullet impact has chewed through the front strap. Even though a patch is placed over the hole, leakage still occurs. This is a licensed technology from Germany. |

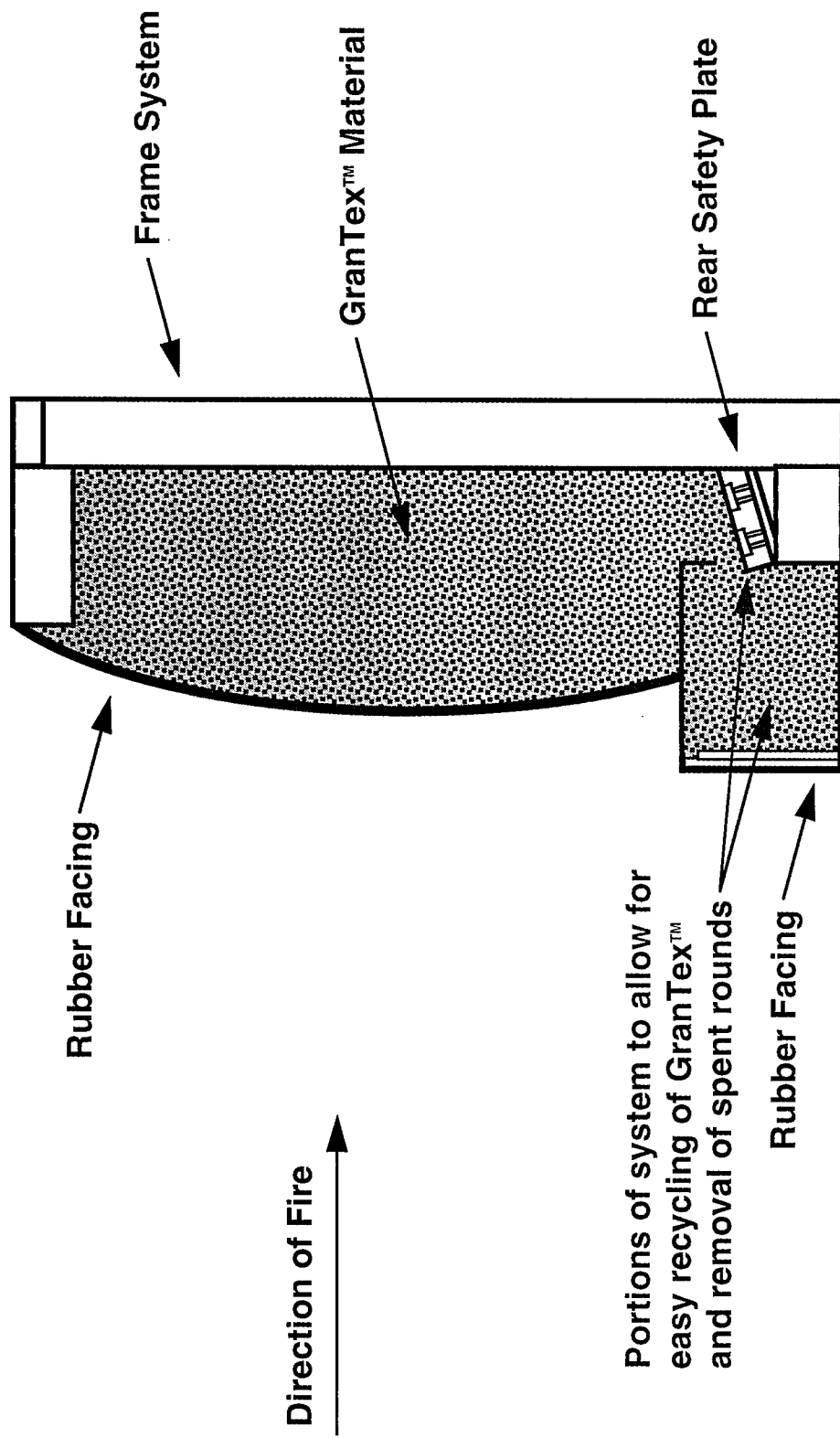


Figure 3.2.1 Caswell International - Gran Trap

Bullet Trap: Total Entrapment Composite (TEC)

Manufacturer: Range Masters, Inc.
199 Coon Rapids Blvd.
Suite 304
Coon Rapids, MN 55433

Method: Friction

Ballistics: 7.62 NATO and smaller

Construction: The TEC system consists of a set of large blocks molded from shredded, recycled tires in a matrix of Kevlar® reinforced bonding mixture. The blocks weigh approximately 60 pounds each and measure about 30 x 12 x 9 inches. The trap consists of a block matrix held in place by use of jacking straps tightened to prevent any movement under impact. The blocks are elevated on a platform which has an inclined plane underneath to cause trapped bullets to roll into a collection tray. The platform is protected from stray rounds by ground baffles made of the same blocks as the bullet trap. The appearance of the block is similar to an oversized cinder block. Because of its modular construction, this trap is flexible in design, and can be arranged in various height, width, and depth combinations to provide a larger backstop if desired.

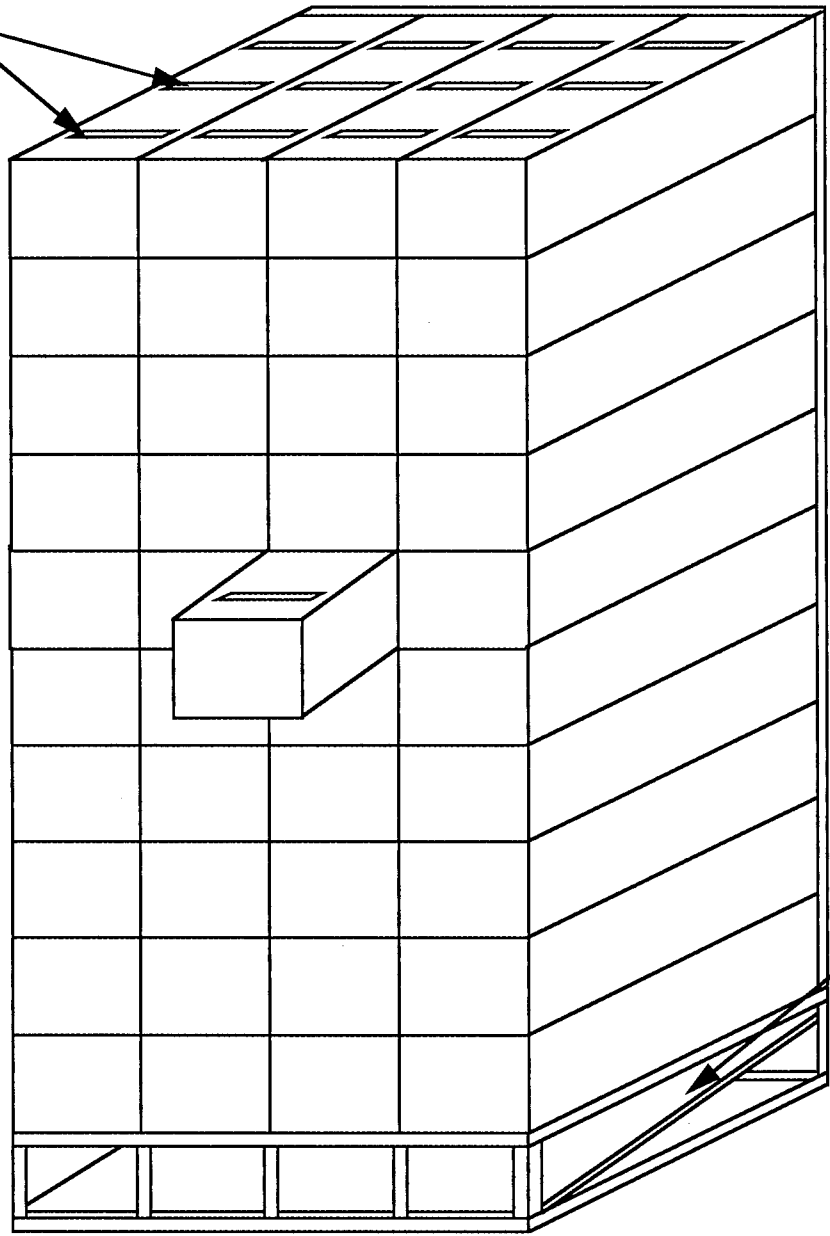
Capacity: The manufacturer claims 10,000 to 20,000 round before the block needs to be rotated, depending upon the type of ammunition used.

Installation: 4 hours, exclusive of site preparation. A level concrete pad is typically required for installation of the trap.

Maintenance: Inspect weekly and recover bullet from recovery tray. Rotate block positions within the trap as wear becomes evident, probably monthly, to maximize life of the trap.

Description: The interior of each block has recovery channels molded into it, allowing spent bullets to drop to the recovery area. The positioning of the recovery channels can be customized for the type of ammunition used. Plastic channel strips are inserted between blocks to more effectively channel spent rounds into the collection tray. The fired round penetrates the front of the block, shedding velocity until it hits one of the recovery channels, where it falls into the collection tray. Particulates of the rubber compound also fall out the recovery channels, but not in great quantities. Recovery and recycle of the bullets is a matter of emptying the recovery tray. Bullets are generally intact.

Recovery Channels



Steel Backer Plate

Recovery System

Ground Baffles

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Figure 3.2.2 Range Masters, Inc. Total Entrapment Composite

Bullet Trap: Thunder Ranch portable trap

Manufacturer: Action Target (assembled on-site)
P.O. Box 636
Provo, UT 84603

Method: Impact

Ballistics: Handgun ammunition

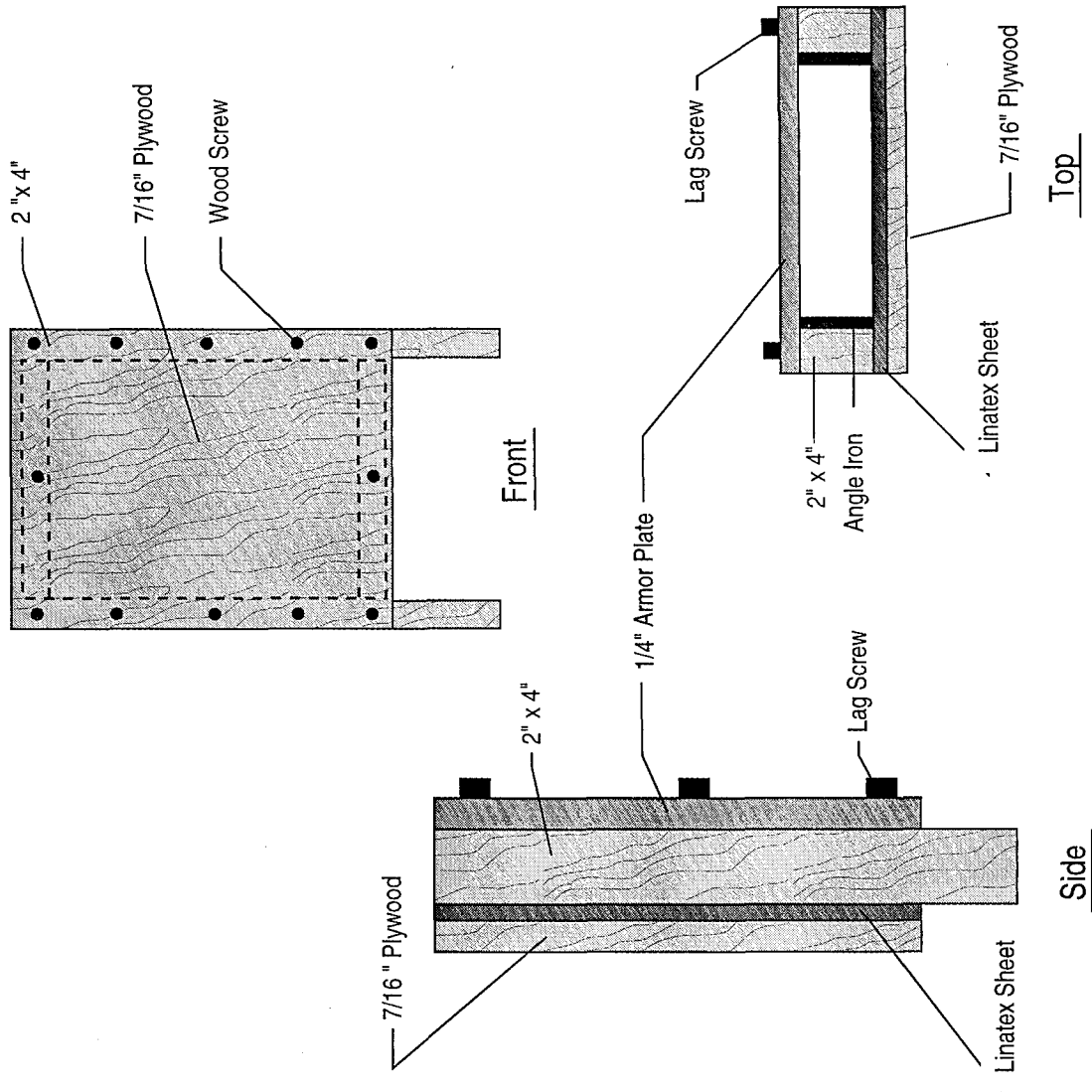
Construction: The Thunder Ranch trap is an evolution of a design that, in one form or another, has been at a variety of training sites. The trap consists of 2 x 4 lumber legs, approximately 6 ft. in height. The back is a ¼ inch armor plate, 30 in. wide by 48 in. high, held in place by lag screws. On the front of the trap is a sheet of Linatex, a self sealing material similar to that in military fuel tanks. On top of the Linatex is a plywood sheet on which the target is mounted. A piece of cardboard could also be used, as the plywood is primarily for cosmetics and insurance against fragments penetrating the Linatex near the end of its useful life. Around the interior perimeter is angle iron to deflect bullet fragments.

Capacity: Approximately 3,000 rounds before recommended emptying of bullet fragments. Life of the Linatex barrier will depend on the type of ammunition used, but is expected to be at least 10,000 rounds.

Installation: Minutes, exclusive of trap construction. The trap can be moved by two people.

Maintenance: Thunder Ranch inspects all traps weekly, cleaning as needed, generally monthly.

Description: The bullet pierces the target and trap facing and hits the Linatex. The Linatex stretches but is not penetrated until the bullet contacts the armor plate and fragments. The Linatex snaps back and seals, forming a barrier to the bullet fragments. The fragments fall to the bottom of the trap for collection. It is believed that by replacing the 2 x 4 legs with 2 x 6's, the life of the Linatex barrier could be extended by up to 50 percent. Ammunition other than standard ball ammunition, such as hollowpoint, wadcutter, or frangible rounds, tends to cause accelerated wear of the Linatex.



088-01070

Figure 3.2.3 Thunder Ranch - Portable Trap

Bullet Trap: Lamella

Manufacturer: Caswell International Corp.
1221 Marshall St. NE
Minneapolis, MN 55413

Method: Friction

Ballistics: .50 cal. and smaller

Construction: The lamella trap consists of a series of strips of recycled industrial conveyor belts, about 10 feet long, hung in a herringbone pattern with the side to the shooter. The length of the conveyor belts can be varied to suit the intended use of the trap. In addition, a smaller version of the trap, approximately 3 feet square is placed immediately behind the target and in front of the main trap to slow the rounds and reduce wear on the main trap.

Capacity: Manufacturer claims at least 50,000 round before replacement of the lamella strips.

Installation: Depends upon the size desired. A 110 foot wide trap took 15 man days to install at one range. A level concrete pad is typically recommended by the manufacturer for installation of the trap.

Maintenance: The lamella strips are replaced individually as necessary, and the 3-foot mini-traps are placed to concentrate wear onto an easy to repair module. The trap should be inspected monthly during moderate use and bi-weekly under heavy use.

Description: The bullet penetrates successive layers of the strips until it sheds its velocity and falls to the bottom of the trap. The bullets sometimes imbed themselves in the strips or, more often, fragment. As the individual lamella strips wear, they can be quickly rotated to other locations within the trap that receive less fire and the strips from those locations moved to the high volume areas. The trap was effective in tests against all types of small arms up to .50 caliber. This is a licensed technology from Germany.

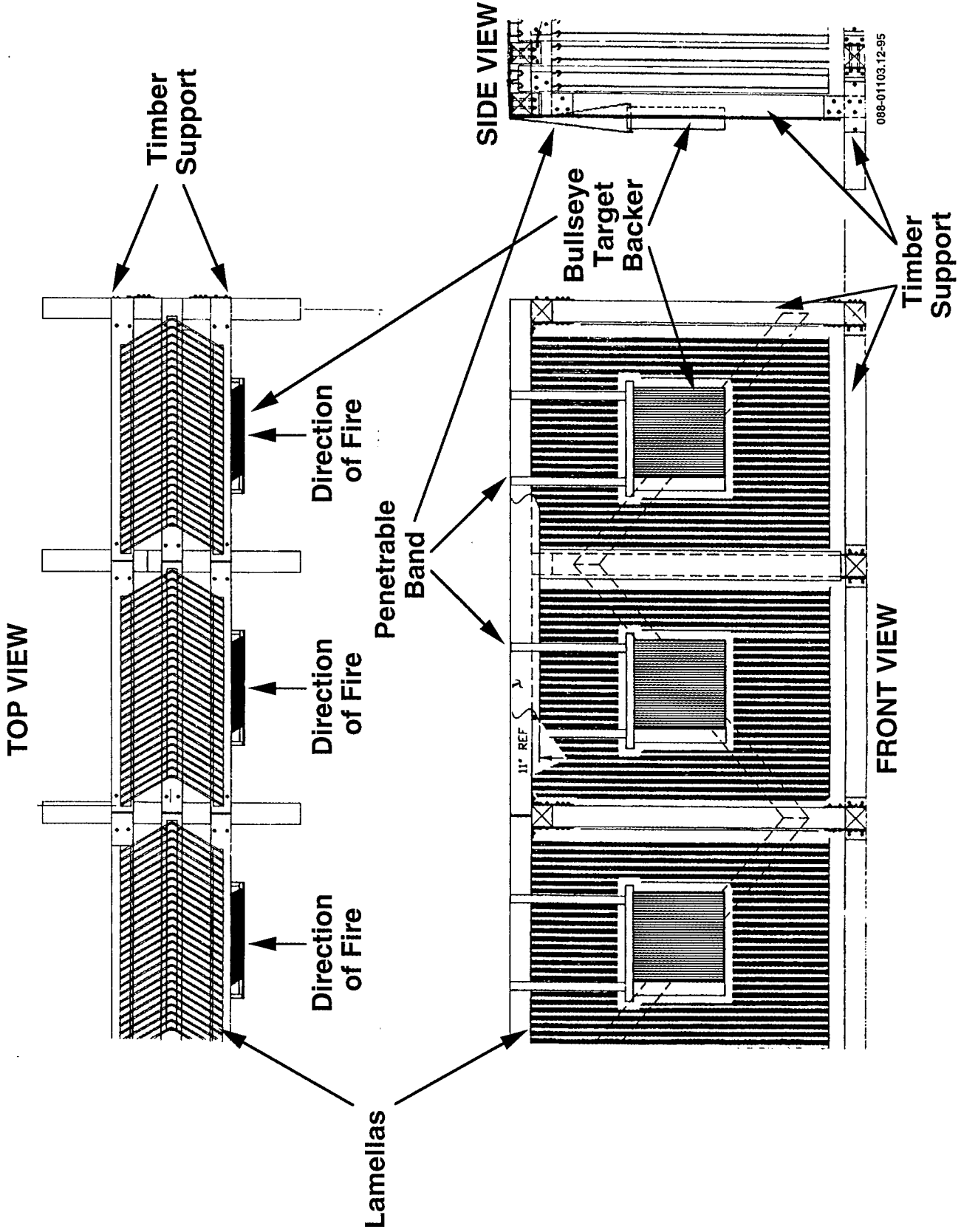


Figure 3.2.4 Caswell International - Lamella Trap

Bullet Trap: Passive Bullet Trap - OP96

Manufacturer: Savage Range Systems, Inc.
100 Springdale Rd.
Westfield, MA 01085

Method: Deceleration

Ballistics: .50 cal. and smaller

Construction: The OP96 is a three piece, helical deceleration chamber with steel plates top and bottom in front set at an angle of 12 degrees from horizontal to deflect the bullet into the trap. An injector introduces a fine spray of water and water-soluble oil at the point of entry into the deceleration chamber to coat the bullet. The bullet spins around the chamber until it runs out of velocity and it slides backward to drop through a slot in the bottom of the trap into a collection tray. The unused spray is recycled back into a reservoir which feeds the injector. The initial contact portion of the trap itself is bolted on to allow for easy removal and replacement as it wears or as different ammunition types are captured.

Capacity: Depends upon the type of ammunition being fired and the capacity of the collection tray. Up to 25,000 rounds between emptyings of the collection tray can be handled before there is the beginning of a danger of backing up into the trap.

Installation: Installed in modular units by the manufacturer. A level concrete pad is typically required for installation of the trap.

Maintenance: Collection tray and spray reservoir should be checked weekly and maintained as needed. The initial contact portion of the trap is anticipated to last for at least 250,000 rounds.

Description: The OP96 is based on a centrifugal deceleration principle. The fired round is directed into the mouth of the trap by two angled collection plates positioned at an angle of 12 degrees from the horizontal. The round then spins around in a circular path inside the trap until it loses velocity. It then drops down into a collection container. The trap comes in both indoor and outdoor designs. In the indoor version, the contact surface of the collection plate is washed with a fluid consisting of water, mineral oil, and ethylene glycol. This serves the purpose of a lubricant and suppresses lead dust thereby reducing the respiratory hazard to shooters and range maintenance personnel. The wash fluid is filtered and recycled back over the collection plate. In the outdoor version, the collection plates are not washed with a fluid. Instead, a fine spray of water and soluble oil is

directed at the entrance of the OP96. As the bullet enters the trap, it receives a coating of lubricant which prevents lead dust from forming and reduces wear on the trap. Other than that differentiation, the designs are essentially identical. Both traps can be manufactured to the users desired width.

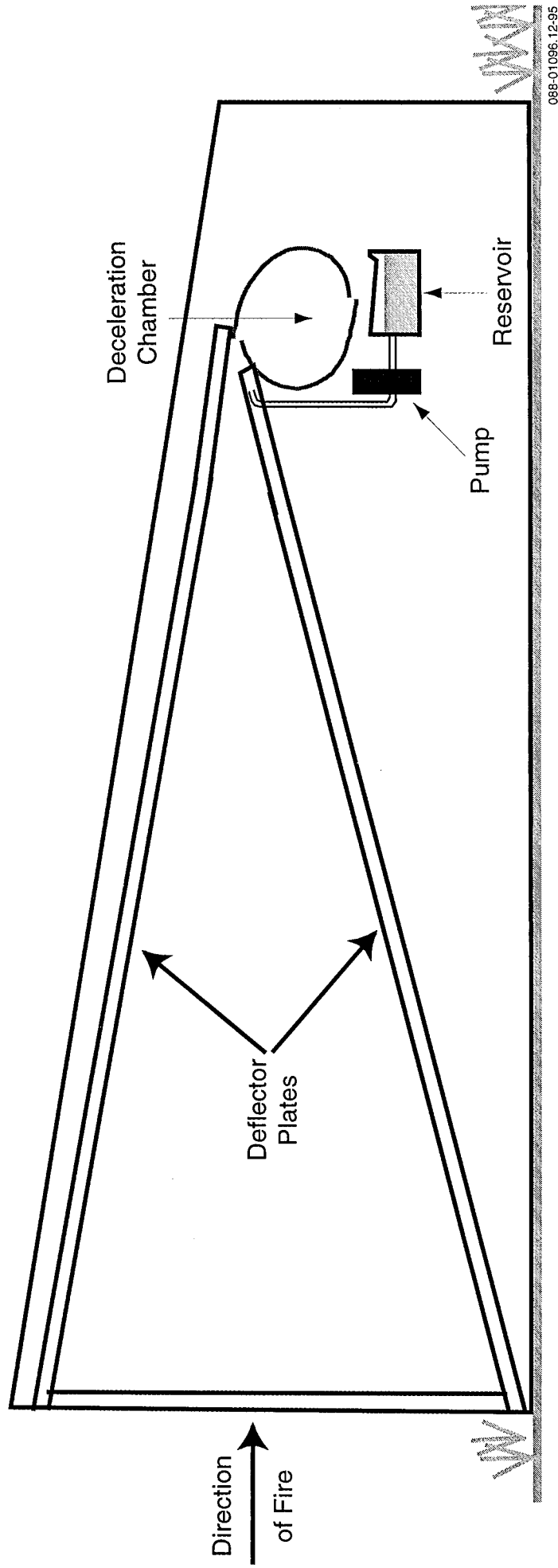


Figure 3.2.5 Passive Bullet Trap - OP96

Bullet Trap: Total Containment Trap (TCT)

Manufacturer: Action Target, Inc.
P.O. Box 636
Provo, UT 84603

Method: Deceleration

Ballistics: 7.62 NATO and smaller

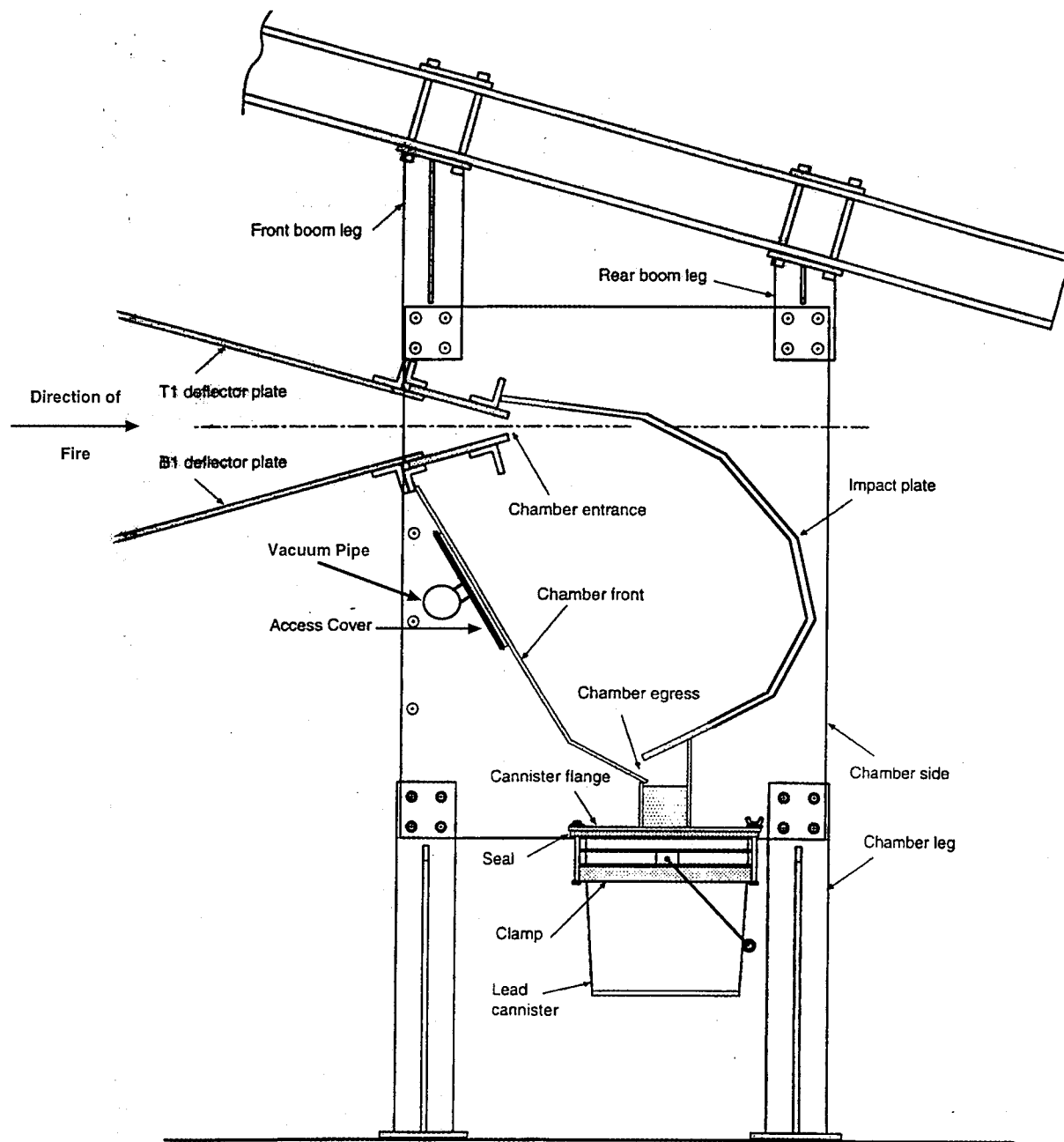
Construction: The TCT is a helical chamber with steel plates top and bottom in front set at an angle of 12 degrees from horizontal to deflect the bullet into the trap. The initial contact portion of the trap itself is bolted on to allow for easy removal and replacement as it wears or as different ammunition types are captured.

Capacity: Depends upon the type of ammunition being fired and the capacity of the collection container.

Installation: Installed by the manufacturer or customer.

Maintenance: Collection containers should be checked weekly and emptied or replaced as needed. The initial contact portion of the trap is anticipated to last for at least 250,000 rounds.

Description: The TCT is based on a centrifugal deceleration and impact principle. The fired round is directed into the mouth of the trap by two angled collection plates positioned at an angle of 12 degrees from the horizontal. The bullet enters the trap, sliding along the angled plate which directs it into an armor plate where it impacts and drops into a sealed collection container. The trap comes in both indoor and outdoor designs.



088-01095.02-96

Figure 3.2.6 Action Target - Total Containment Trap - 2

Bullet Trap: Granular Trap

Manufacturer: Capito and Assenmacher
44319 Dortmund Wichkede
44311 Dortmund
Germany

Method: Friction

Ballistics: .50 cal. and smaller

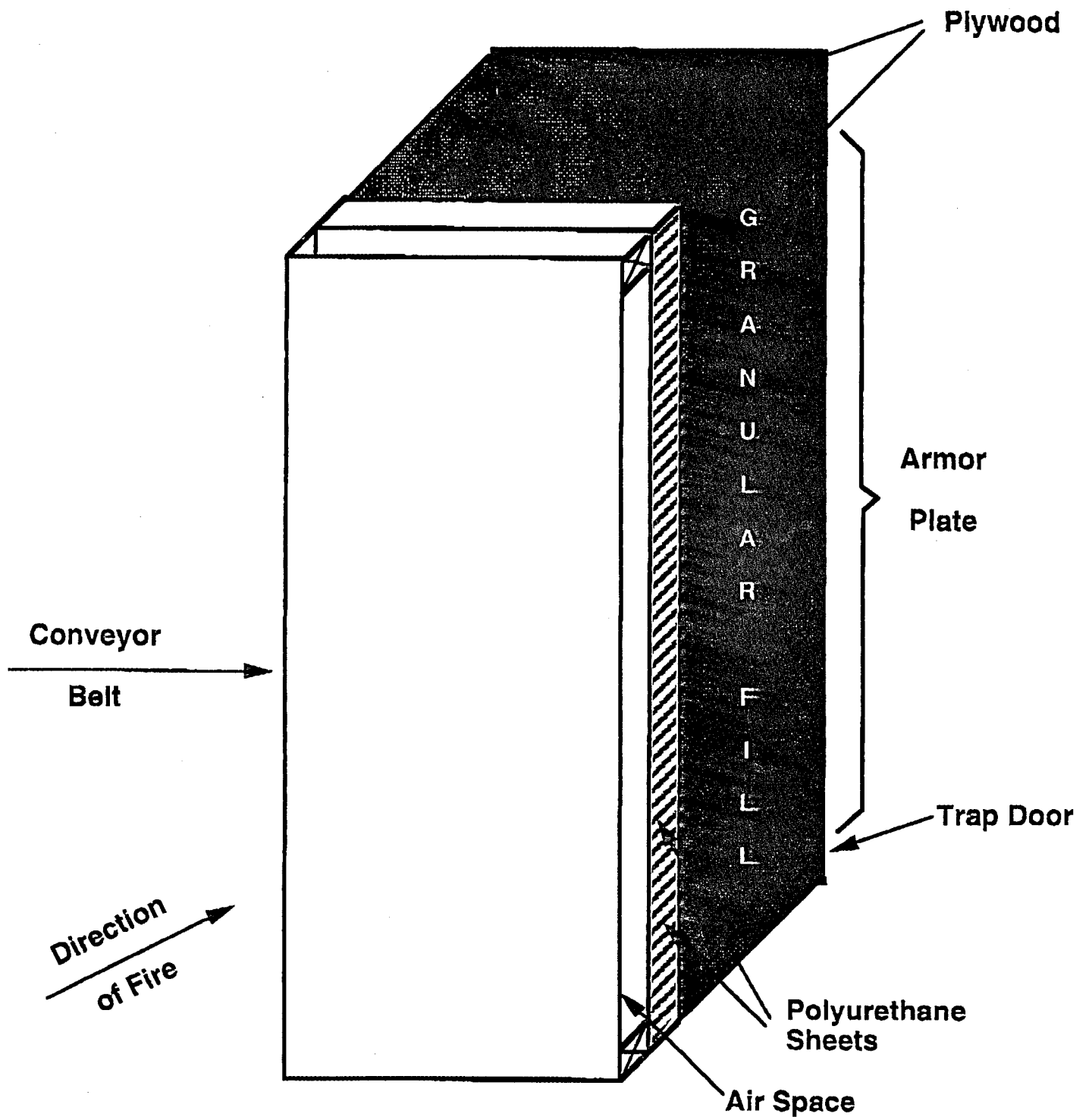
Construction: The trap is a large vertical box comprised of a rubber curtain made of a conveyor belt material in front, an air space, and 2 inch thick polyurethane sheets, one meter square, as the front panel. The sides are plywood and the back is armor plate. The interior is filled with a soft rubber granulated material which is coated with something resembling baby powder. The trap is one sheet (1 m) wide, four sheets (4 m) tall, and one meter in depth. There is an access door at the rear of the trap to allow removal of the granular material and bullets by means of a truck-mounted vacuum and sifting system. Following separation of the bullets, up to 80 percent of the granular material is recovered and recycled back into the trap.

Capacity: Manufacturer claims 25,000+ rounds

Installation: 4 hours, exclusive of site preparation, which requires a level concrete pad

Maintenance: Monthly is recommended. Bullets are generally recovered intact. Polyurethane sheets are replaced infrequently and require removal of the granular material. The rubber facing is repaired by rubber patches are screwed to the front of the worn-out facing.

Description: The bullet penetrates the front curtain and polyurethane sheet and is halted, generally within the first 12 inches, by the granulated material. Pistol rounds penetrate somewhat less, rifle rounds, somewhat more. For 9mm pistol rounds fired from 25 meters or farther, the bullet will penetrate the front curtain, but will not penetrate the polyurethane sheet. Instead, it bounces off, rebounds to the front curtain, and falls to the bottom. In tests conducted so far, tracer rounds have had no noticeable effect.



088-01104.12-95

Figure 3.2.7 Caplto & Assenmacher - Granular Trap

Bullet Trap: Railroad Ties or Log Piles

Manufacturer: None

Method: Friction

Ballistics: .50 cal and smaller

Construction: This is a simple outdoor trap in which railroad ties or logs are stacked perpendicular to the axis of firing. They can be stacked several deep and as high as the desired target height. In certain cases these can be made into a crib and filled with dirt.

Capacity: Depends upon the types of ties or logs being used and the types of ammunition fired into them. Several thousand rounds should be able to be fired before noticeable degradation occurs,

Installation: Varies from a few hours to several days depending upon how large and elaborate the stack is made and whether it has filler added.

Maintenance: Repair usually requires disassembly of the backstop to remove disintegrated ties and insert new ones. Disposal of the shot-up tie may fall under RCRA controls.

Description: Rounds passing through the target impact the railroad ties or logs and are stopped. The advantages to this design are that is easy to construct with troop labor and it reuses material that is available in large quantities. The disadvantage is that the rounds are embedded in the ties and are difficult to recover. Additionally, after a lengthy period of firing, the ties disintegrate and could allow the lead to end up in the ground. This method is being used currently to protect the front of cement target boxes, or coffins, at several outdoor ranges and as a backstop in a few applications .

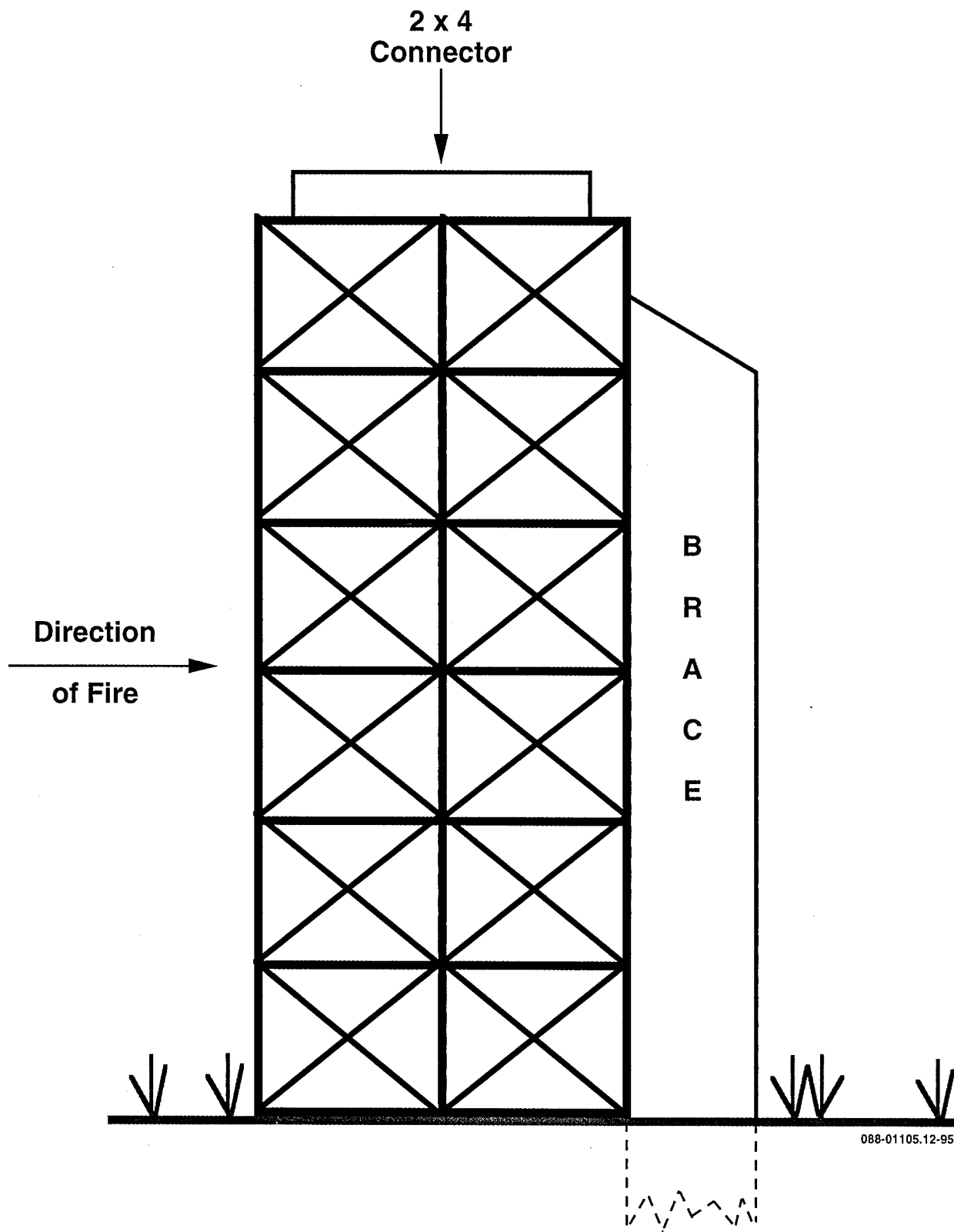


Figure 3.2.8 Railroad Ties

Bullet Trap: Sand Trap

Manufacturer: Various

Method: Impact

Ballistics: 7.62 NATO and smaller

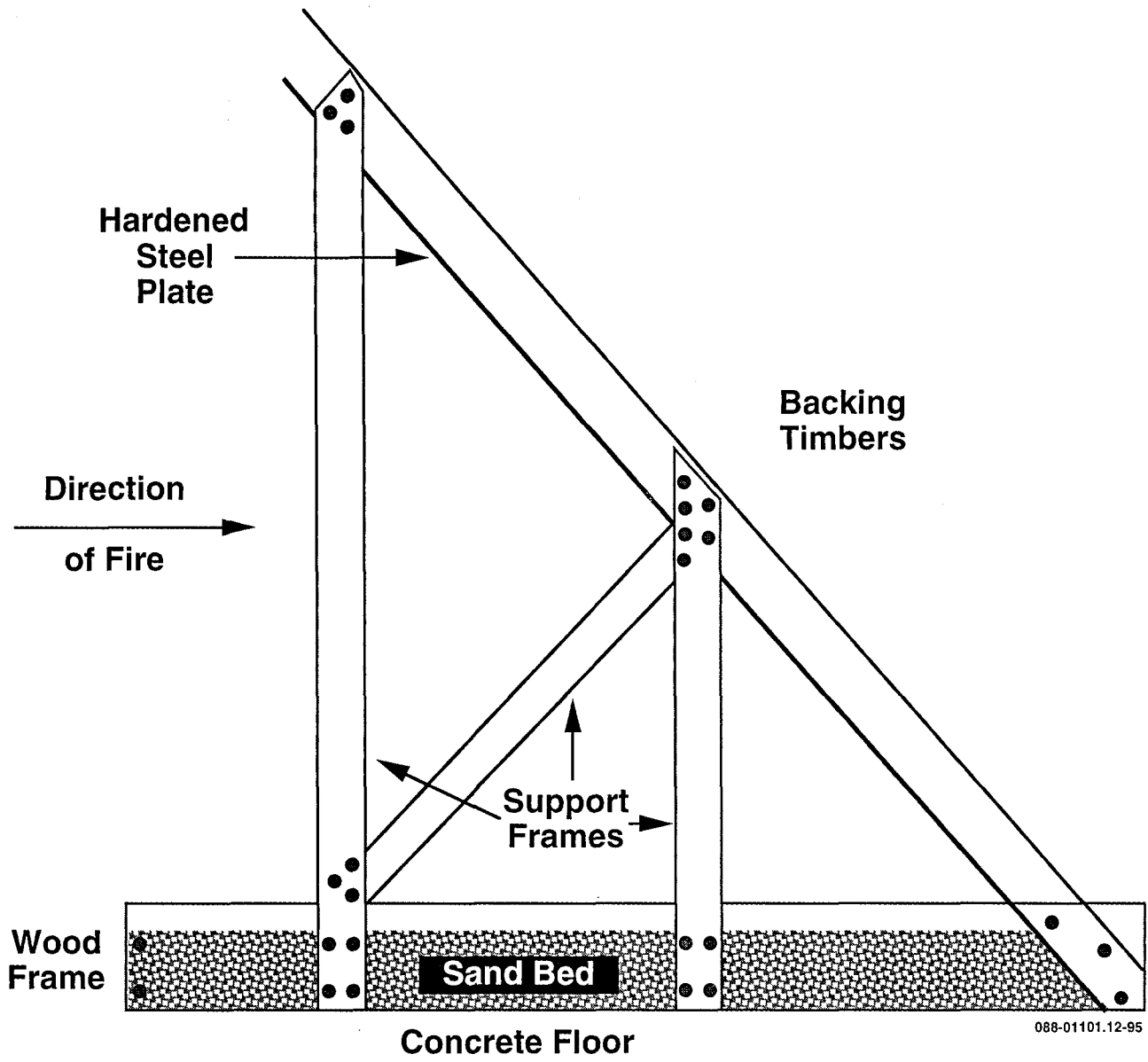
Construction: This is one of the most widely used design in bullet traps because of the simplicity of design, and ease of construction. A large steel plate the width of the lane behind the targets is mounted at an angle, tilted forward so that bullets are deflected downward into a bed of sand or dirt.

Capacity: Varies depending upon the size of the trap and the types of ammunition fired.

Installation: Generally needs a construction or engineer company to install because of the weight of the steel plates. Construction/installation may take several days.

Maintenance: Maintenance requirements are low. Bullet fragments are collected and the sand sifted on an as needed basis, probably no more frequently than monthly, and perhaps less.

Description: Bullets impact the steel plate and fragment. The fragments are directed downwards into the sand trap to be recovered later. On occasion, bullet fragments will escape the trap. The advantages of this system are its simplicity of design, relatively low cost to construct, and ease of operation and maintenance. Disadvantages of the steel plate are primarily environmental; airborne lead dust is created when the bullet strikes the plate, and at the same time it smears lead on the plate. When another bullet strikes the same place the lead residue on the plate contributes to the airborne pollution. Fragments sometimes fall outside the containment area. Cleaning the lead out of the sand bed requires personnel protection measures.



088-01101.12-95

Figure 3.2.9 Sand Trap

Bullet Trap: Water Trap

Manufacturer: Local

Method: Impact

Ballistics: 7.62 NATO and smaller

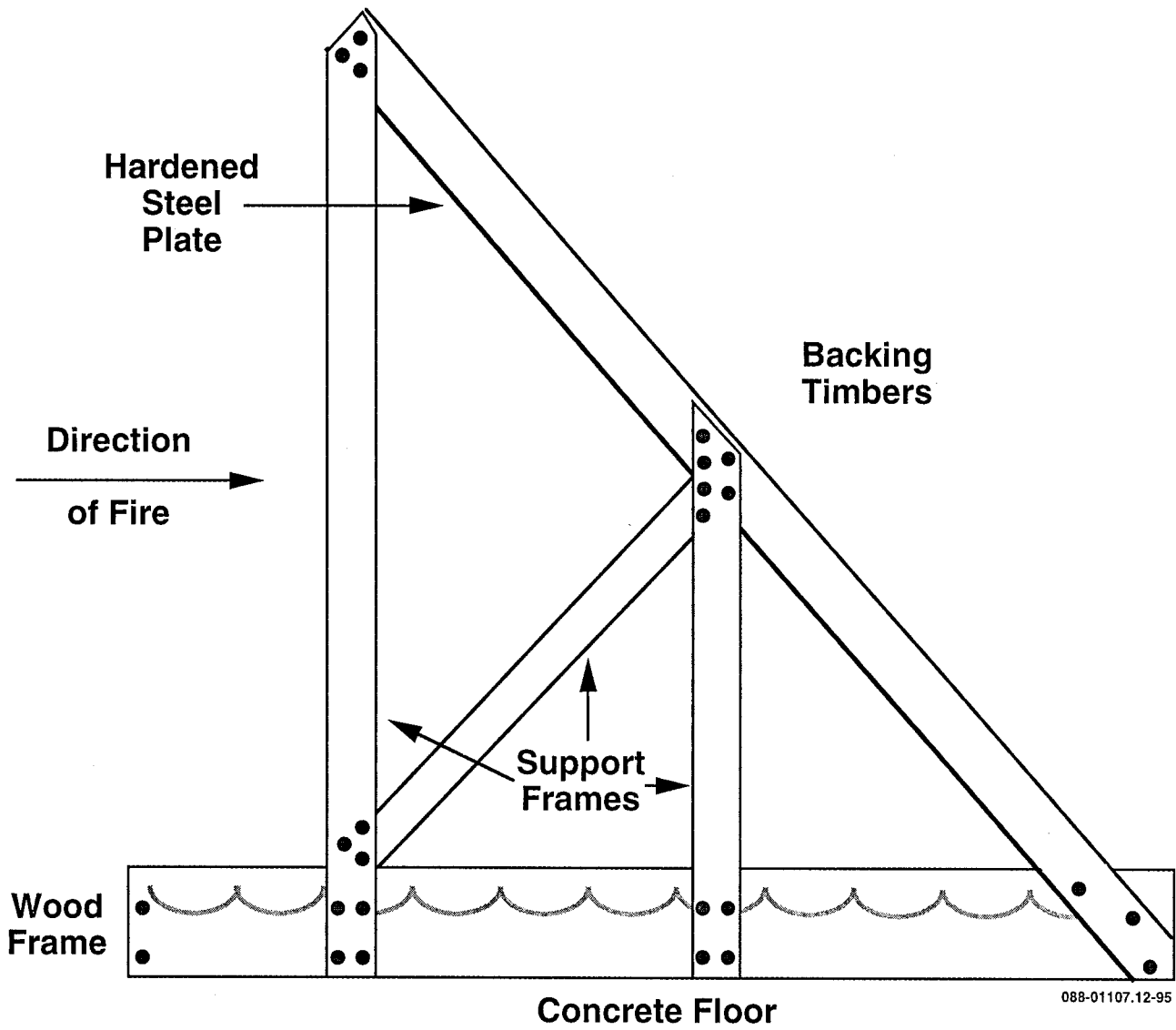
Construction: A large steel plate the width of the lane behind the targets is mounted at an angle, tilted forward so that bullets are deflected downward into a water trough.

Capacity: Varies depending upon the size of the trap and the types of ammunition fired.

Installation: Generally needs a construction or engineer company to install because of the weight of the steel plates. Construction/installation may take several days.

Maintenance: Maintenance requirements are low. Bullet fragments are collected from the water trough on an as needed basis, probably no more frequently than monthly, and perhaps less. There is a potential for generation of soluble lead. This may create a hazardous waste disposal problem.

Description: Bullets impact the steel plate and fragment. The fragments are directed downwards into the water trap to be recovered later. The advantage over the sand trap is its ease of cleaning. The disadvantages are that it requires a larger trough and more maintenance, especially in colder climates.



088-01107.12-95

Figure 3.2.10 Water Trap

Bullet Trap: Rubber Blocks

Manufacturer: Various, U.S. and International

Method: Friction

Ballistics: 7.62 NATO and smaller

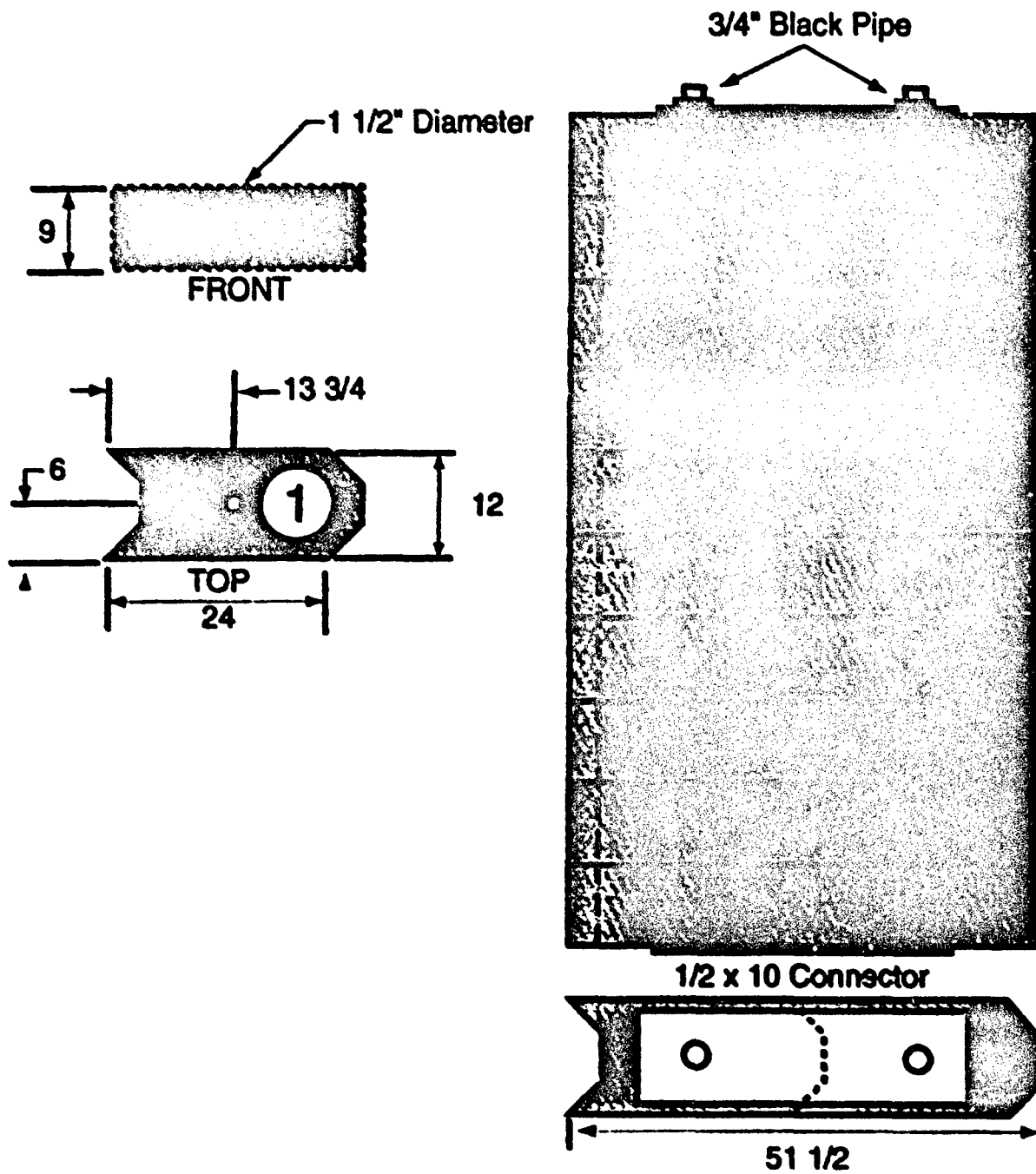
Construction: These traps consist of blocks of various rubber compounds or recycled materials stacked to form a barrier. These are used to line shooting houses for special operations personnel to train in, as baffles on walls and ceilings on indoor ranges, and as ballistic protection for damage-prone items such as fuel pipes at aircraft arming areas. The blocks vary in size, but are generally around 60 to 80 pounds and measure 30 x 12 x 12.

Capacity: Depends upon the type of ammunition fired.

Installation: Half day, exclusive of site preparation.

Maintenance: Depends upon the type of ammunition used, but claims of 10,000 rounds are common.

Description: When the bullet strikes the block, the friction of the rubber on the bullet surface causes the bullet to stop in a short distance, usually less than 2 feet. Their advantages are they are modular, so only the worn block needs to be replaced, compact, and reasonably easy to move with hand labor. Disadvantages are that there have been reports of fires from tracer rounds, disposal of the used blocks presents a problem, and there are unresolved questions about durability and cost.



88-01108.12-85

Figure 3.2.11 - Rubber Blocks

Bullet Trap: Wax/Plastic Blocks

Manufacturer: Various, U.S. and International

Method: Friction

Ballistics: 7.62 NATO and smaller

Construction: These traps consist of blocks of various wax and plastic compounds or recycled materials stacked to form a barrier. At the date of this report, there are no manufacturers of these bullet traps still in business. The wax and plastic blocks operate on the same principles as the rubber blocks and the Range Masters TEC blocks, being stacked or banded into the size backstop desired.

Capacity: Depends upon the type of ammunition fired.

Installation: Half day, exclusive of site preparation.

Maintenance: Depends upon the type of ammunition used, but claims of 10,000 rounds are common.

Description: As in the rubber blocks, friction between the bullet surface and the block material stops the bullet, generally retaining it intact unless struck by another bullet. The advantages are that these blocks are modular, compact, and easier to move with hand labor and tend to capture the bullets intact. The disadvantages are they cannot operate over the same climatic ranges as other traps, tend to melt somewhat under prolonged and closely spaced firing, and provide a disposal/recycle problem.

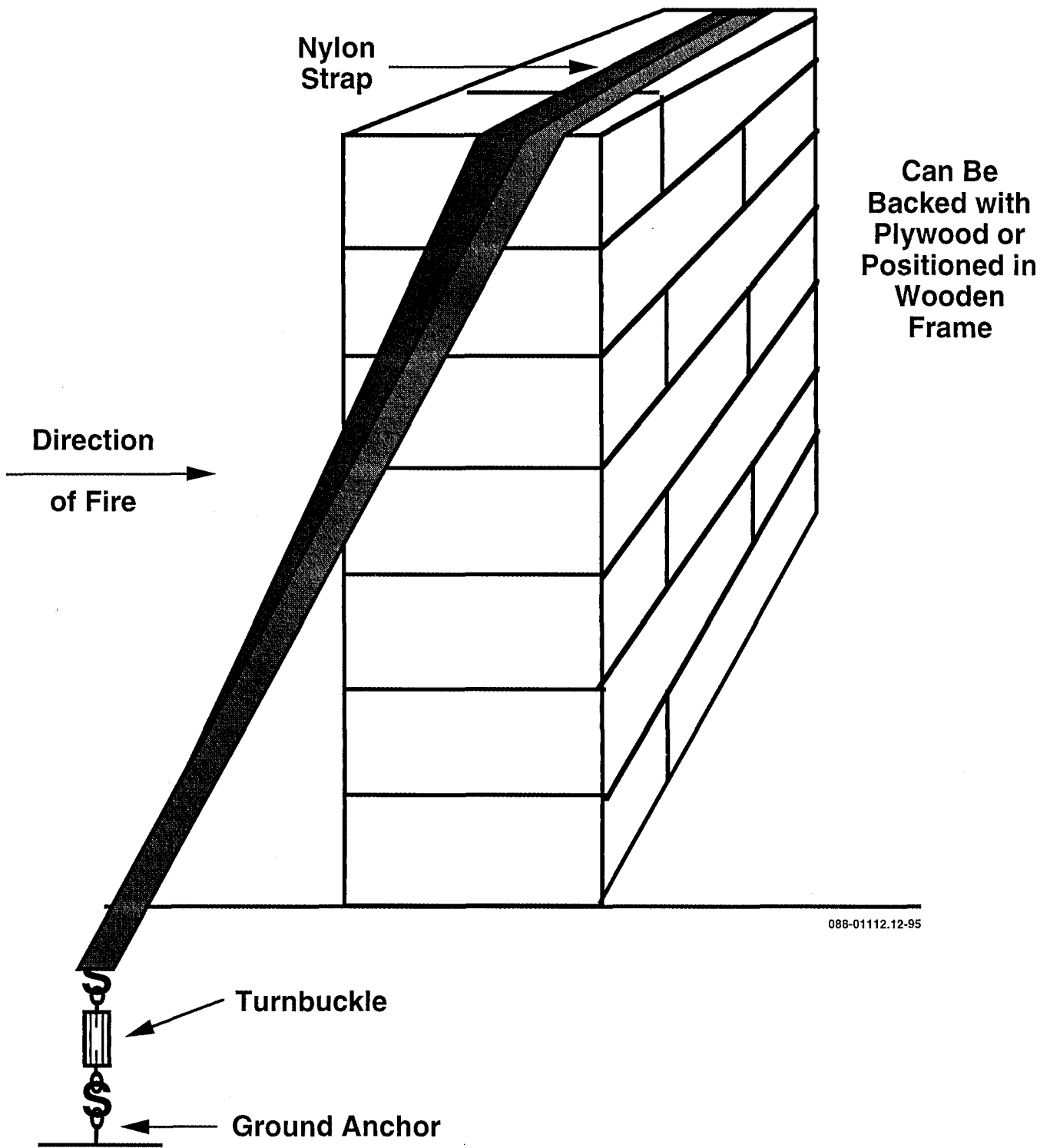


Figure 3.2.12 Wax / Plastic Blocks

Bullet Trap: Escalator Trap

Manufacturer: Various

Method: Impact

Ballistics: 7.62 NATO and smaller

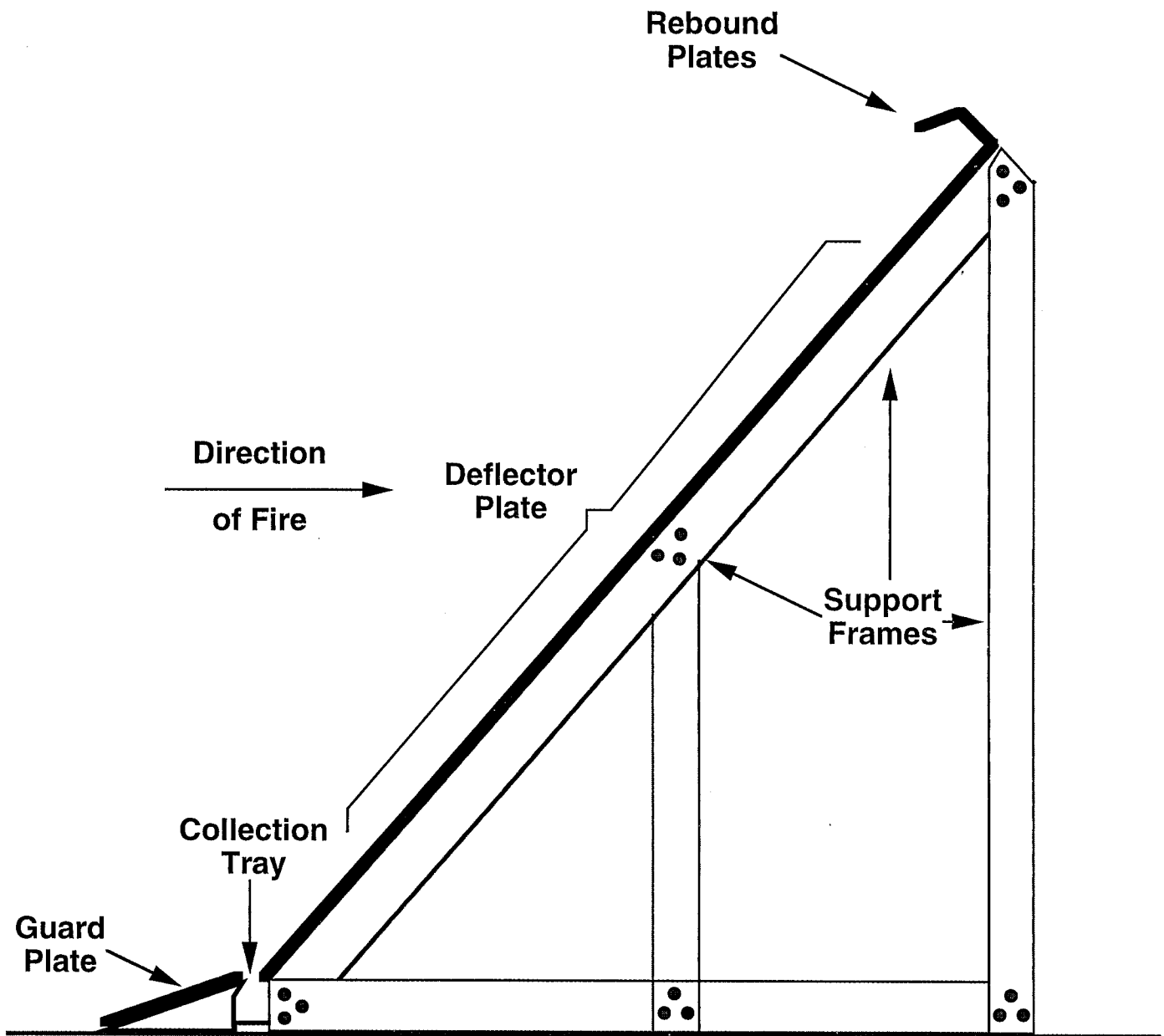
Construction: This is a widely used design in bullet traps because of the simplicity of design. In this design a steel plate is angled away from the firing line to direct the bullet upward into another steel plate. The bullet fragments are collected in a tray at the foot of the trap.

Capacity: Varies depending upon the size of the trap and the types of ammunition fired.

Installation: Generally needs a construction or engineer company to install because of the weight of the steel plates. Construction/installation may take several days.

Maintenance: Maintenance requirements are low. Bullet fragments are collected, probably no more frequently than monthly, and perhaps less.

Description: The bullet strikes the plate and is deflected upward along or near the plate surface where it strikes another steel plate. At this plate the bullet spends most of its energy, and rebounds or fragments. It then slides down the face of the larger plate and into a collection tray on the floor of the range. The advantage of this design is its ease of collection of spent bullets. Disadvantages include fragmentation of the bullet, the possibility of rebounding, and the cost of manufacturing and installation. In addition, collection and disposal of the lead require proper personnel protective equipment and adequate containers for the lead.



088-01108.12-95

Figure 3.2.13 Escalator Trap

Bullet Trap: Steel Louvers with Sand Bed

Manufacturer: Various

Method: Impact

Ballistics: 7.62 NATO and smaller

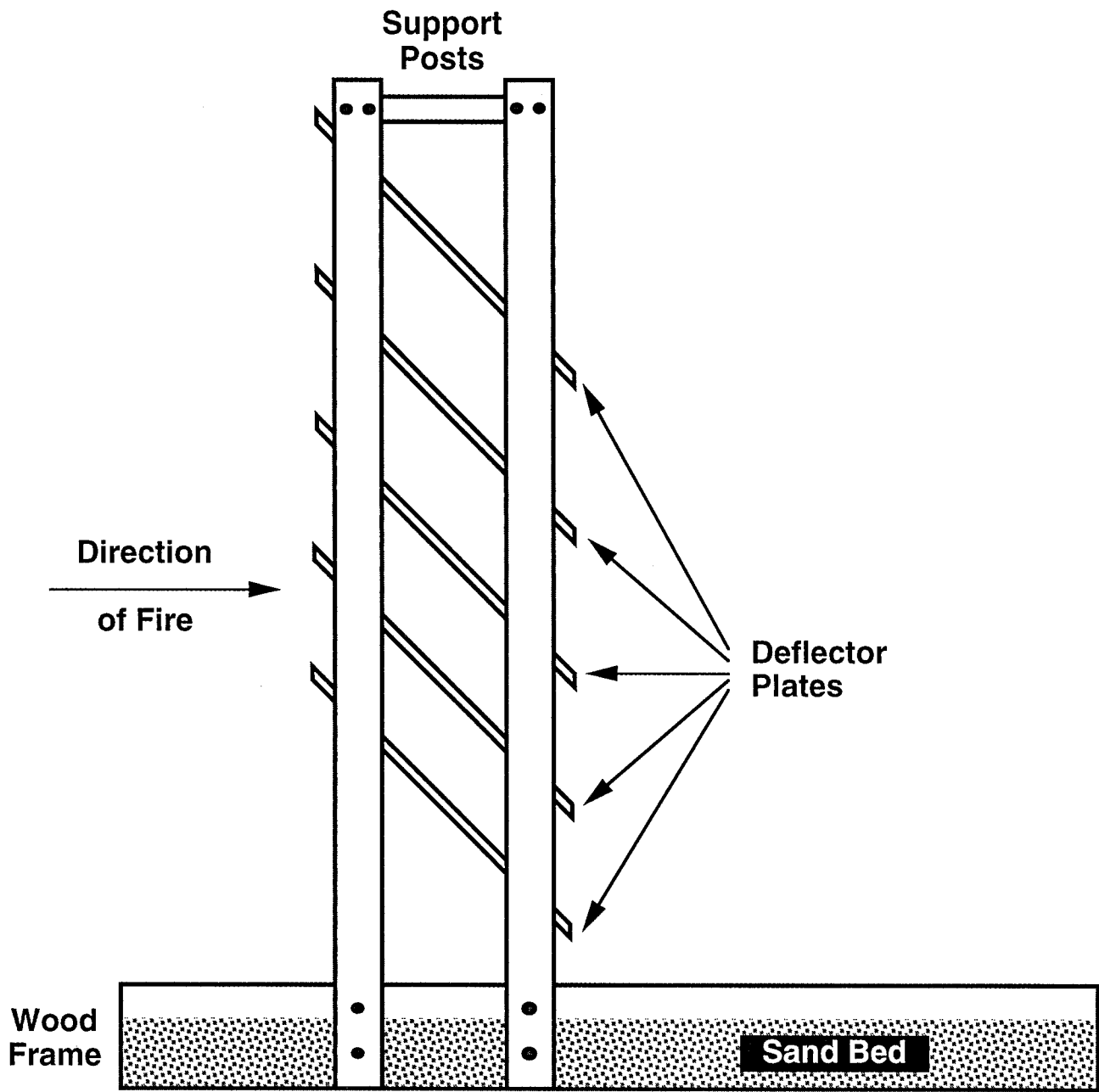
Construction: Like the larger downward angled deflection designs, this design arranges a series of steel louvers in a vertical rack with each louver angled toward the firing line. The steel louvers are approximately 12" to 18" in width and are arranged to provide some overlap between plates when rounds are fired at angles that are approximately parallel to the floor of the range. The spent rounds fall into a bed of sand beneath the louvers

Capacity: Varies depending upon the size of the trap and the types of ammunition fired.

Installation: Generally needs a construction or engineer company to install because of the weight of the steel plates. Construction/installation may take several days.

Maintenance: Maintenance requirements are low. Bullet fragments are collected and the sand sifted on an as needed basis, probably no more frequently than monthly, and perhaps less.

Description: The primary advantage of this design is a saving of horizontal space behind the targets, and is usually only used on ranges where space is at a premium in an existing facility. The disadvantages of the regular steel plate and sand bed carry over to this design with the additional potential hazard posed by bullets striking the leading edge of the louvers. The chance of a bullet ricocheting directly back to the firing line is remote, but this does increase the amount of bullet fragments and airborne lead dust. Lead smearing on the deflector surfaces increases the potential for airborne pollution when struck by a succeeding round. Cleaning lead out of the sand bed requires personnel protection measures.



088-01111.12-95

Figure 3.2.14 Louver Trap

Bullet Trap: Tires

Manufacturer: Local recycle

Method: Friction

Ballistics: 7.62 NATO and smaller

Construction: Soft containers such as old vehicle tires or large plastic barrels are filled with sand or dirt and placed directly behind the targets.

Capacity: Varies depending upon the size of the trap and the types of ammunition fired.

Installation: Can probably be done with troop labor under range management personnel guidance. Time depends upon the size and complexity of the trap.

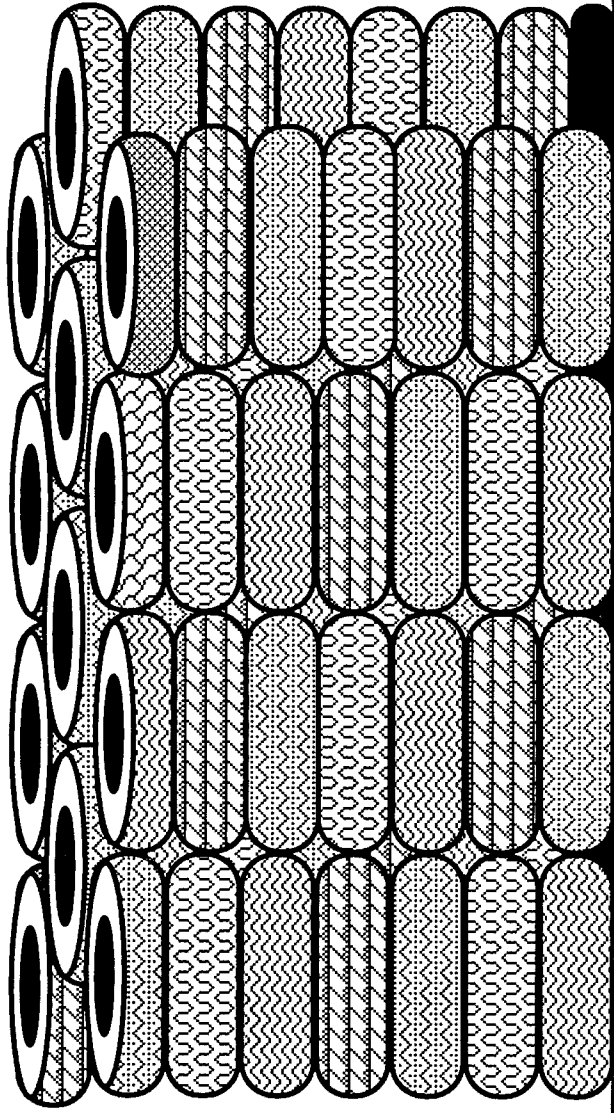
Maintenance: Maintenance requirements are low. Bullet fragments are collected and the sand sifted on an as needed basis, probably no more frequently than monthly, and perhaps less. Tires are replaced on an as needed basis. Used tires may need to be handled under RCRA controls.

Description: The advantage of this design is the ease of set up, and that it can be customized to specific shooting range requirements. A variant of the vehicle tire trap involves nesting or layering the tires several thicknesses deep and using no sand. Tire traps have been used for anti-terrorist training in shooting houses for many years. When so many rounds have been fired into the face of the container that it ruptures enough to leak sand and lead onto the ground, the container can be rotated 90 degrees or more to present a different face to the firing line, thereby extending the life of the container. Use of the tires provides a form of recycling. Disadvantages include the difficulty of recovering spent bullets, disposal of the used tires, and the need to completely disassemble the trap to repair it. In addition, there have been reported instances of ricochets of pistol bullets from the tire backstops.

Filled with
Dirt or Sand

Tires Banded
Together
or Stacked
Inside Column

Stacked
Three
Deep



Direction
of Fire

088-01109.12-95

Figure 3.2.15 Rubber Tires

Bullet Trap: Shock Attenuating Concrete (SACON)

Manufacturer: U. S. Army Corps of Engineers
Waterways Experiment Station
Structures Laboratory, Attn: CEWES-SC-EM
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Method: Friction

Ballistics: 7.62 NATO and smaller

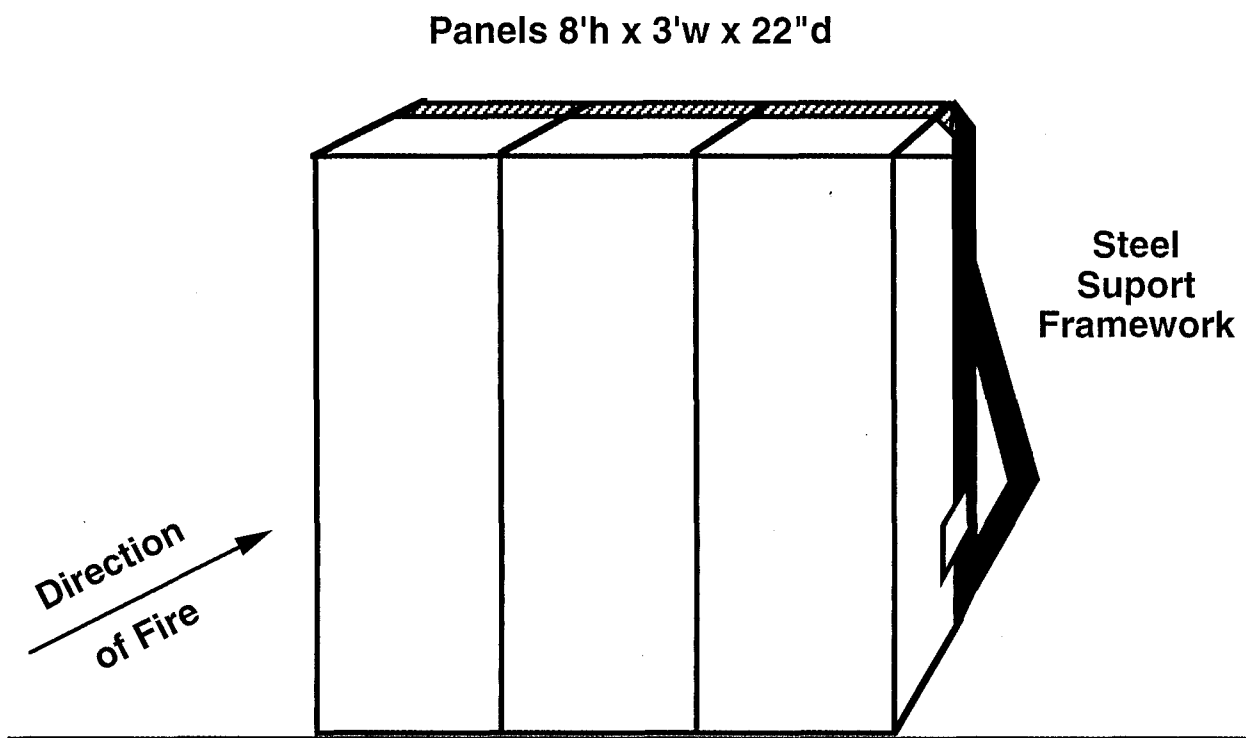
Construction: SACON is cast into large panels 8' high, 3' wide and 22" thick. These panels are fitted into steel I-beam brackets and grouped into walls. The primary application to date has been in shooting houses. With the ability to pour and cure like regular concrete, however, SACON can be formed into a wide variety of shapes and dimensions.

Capacity: 1,000 rounds before patching is needed.

Installation: Similar to other concrete construction: 1 day to pour , and 28 days to cure.

Maintenance: After 1,000 rounds, the SACON is eroded about 2/3 of the way through a 22" panel. At this time, it is recommended that the void be patched with fresh SACON. This patch will also require a 28 day curing time. The alternative is to replace the panel from a stockpile of precast panels.

Description: SACON is a generic term for a combined low density, fiber reinforced concrete. SACON involves the substitution of a light-weight material such as expanded polystyrene beads or preformed foamed air voids for the gravel aggregate. This is done to achieve densities of 30 to 90 pounds per cubic inch compared to conventional concrete at 150 pounds per cubic inch. This composition allows SACON to not only absorb bullets, but also shock waves that would be generated on light demolition ranges.



088-01110.12-95

Figure 3.2.16 Shock Attenuating Concrete (SACON)

Bullet Trap: REGUPOL

Manufacturer: Berleburger Schaumstoffwerk GMBH
P.O. Box 1180
5920 Bad Berleberg, Germany

US Distributor: Tennek, Inc.
311 Albans Court
Malvern, PA 19355

Method: Friction

Ballistics: Military handgun ammunition

Construction: Blocks of REGUPOL used as bullet traps are 500mm x 500mm x 200mm thick and stacked two blocks deep. Then, REGUPOL roll material is 1250 mm wide by 10 to 20 mm thick and is suspended in front of the blocks to guard against fragments.

Capacity: Manufacturer claims 10,000 rounds

Installation: Two days by a team of four factory technicians

Maintenance: Blocks of REGUPOL are replaced when they reach load-up.

Description: REGUPOL elastic tiles are pre-formed sheets and blocks of recycled polyurethane/rubber granules. A flexible material, REGUPOL can be used in a variety of thicknesses and configurations to absorb bullets and clad overhead baffles and floors of ranges to prevent ricochets. The manufacturer claims REGUPOL is heat and weather resistant and is suitable for outdoor range applications.

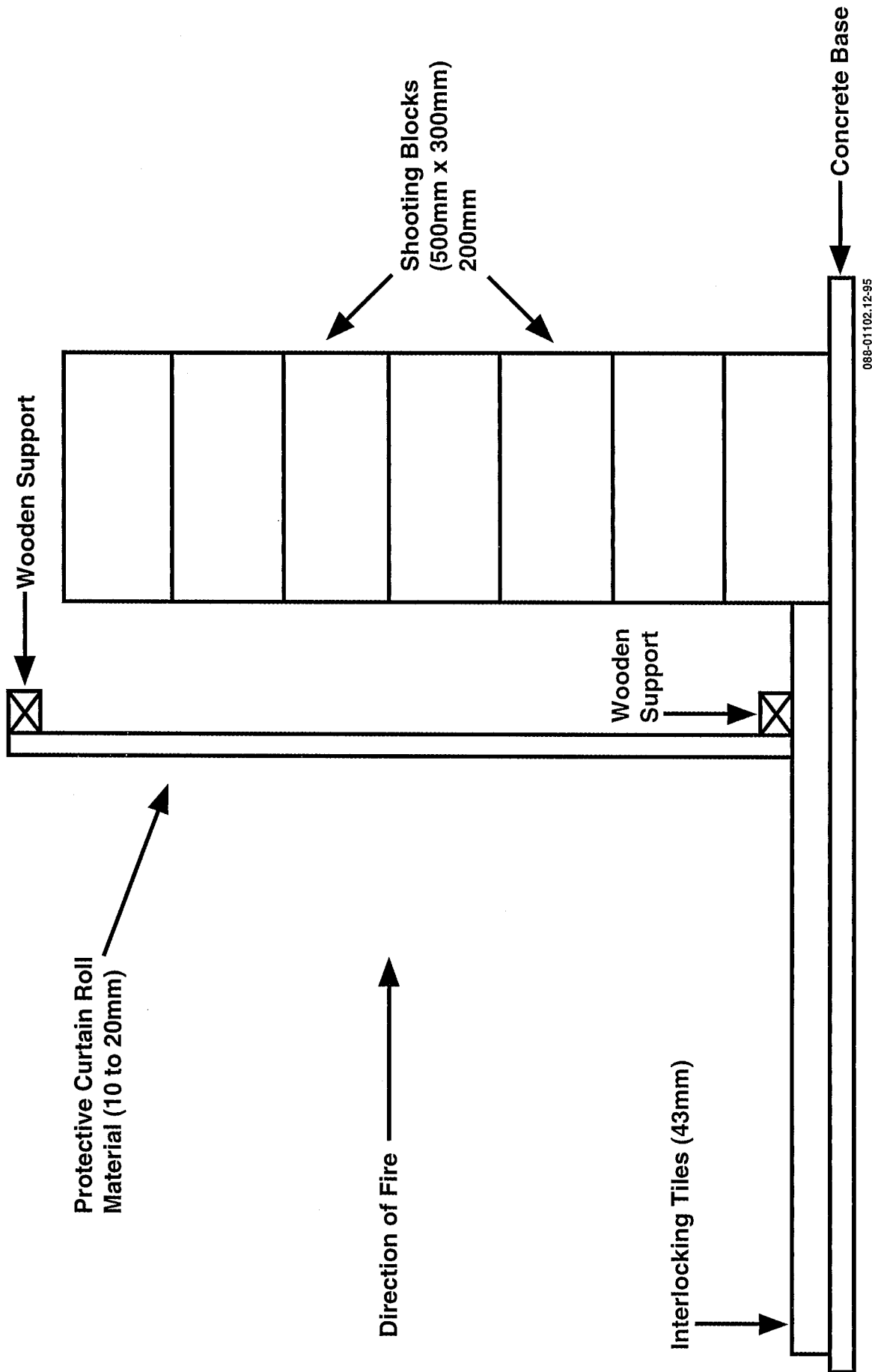


Figure 3.2.17 REGUPOL

Bullet Trap: R493

Manufacturer: Shooting Ranges International, Inc.
3030 S. Valley View Road
Las Vegas, NV 89102

Method: Deceleration

Ballistics: 7.62 NATO and smaller

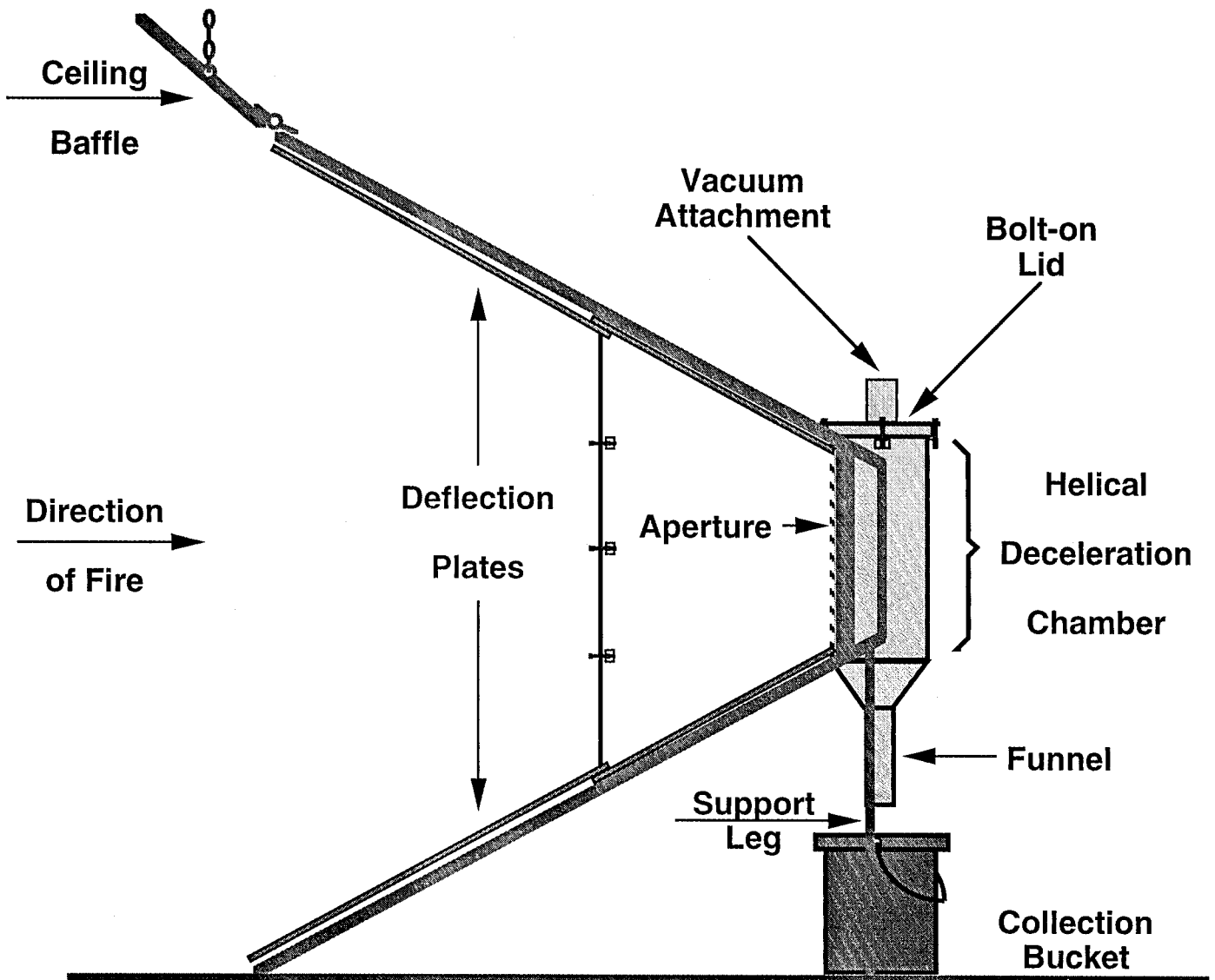
Construction: This is a modular, free standing trap with four angled hardened steel plates per firing position funneling in to a vertical aperture that traps the bullet.

Capacity: Manufacturer claims 500,000 rounds before plate replacement.

Installation: Four man crew needs one day to install 10 traps.

Maintenance: Periodic emptying of bullets and fragments from trap containers.

Description: This is a dry plate system using four steeply angled plates to deflect the shots inward to an aperture. After passing through the aperture the bullet enters a helical chamber which causes the bullet to spin and decelerate. The bullet then falls through an opening in the bottom of the trap into the bullet collection container.



088-01113.12-95

Figure 3.2.18 Shooting Ranges International - SRI R493

Bullet Trap: Elastomeric Granular Screen

Manufacturer: Societa FRA.SA.
44 Via del Giordano
Rome, Italy
11-49-06-5924175

Method: Friction

Ballistics: 7.62 NATO and smaller

Construction: This unique design is in the shape of a trapezoid of loose rubber granules canted back at a natural angle of repose. Underneath this large pile of rubber granules is a conveyor belt and support structure. Behind and below the conveyor is a sifting box and a vacuum system. The vacuum is connected by piping that reaches up over the top of the trapezoid slope.

Capacity: Estimated to surpass 100,000 rounds before a substantial amount of elastomeric granules need to be replenished.

Installation: Several weeks with the work being done by the vendor. Societa FRA.SA specializes in modular indoor ranges that can be installed in two days with a trained crew and a cargo crane.

Maintenance: Daily operation of the conveyor/ sifter unit, requiring less than one hour of down time.

Description: When a round is fired at the sloping trap surface, the bullet penetrates the rubber granules, loses velocity, and angles downward. The conveyor moves the very bottom layer of granules and projectiles rearward to a sifter. Once the heavier projectiles have been removed the lighter granules are vacuumed up to the top and dumped onto the face of the slope. The manufacturer claims that the bullets are not deformed, and that a large number of them can be reloaded, resulting in substantial savings.

Removable Cover

Ballistic Deflector

Bed of Absorbent Elastomeric Granular Material

Direction of Fire

Ejected Material

Air Exhaust

Electrical Utility Cabinet

Pneumatic Tube

Collected Projectiles

Blade Transport

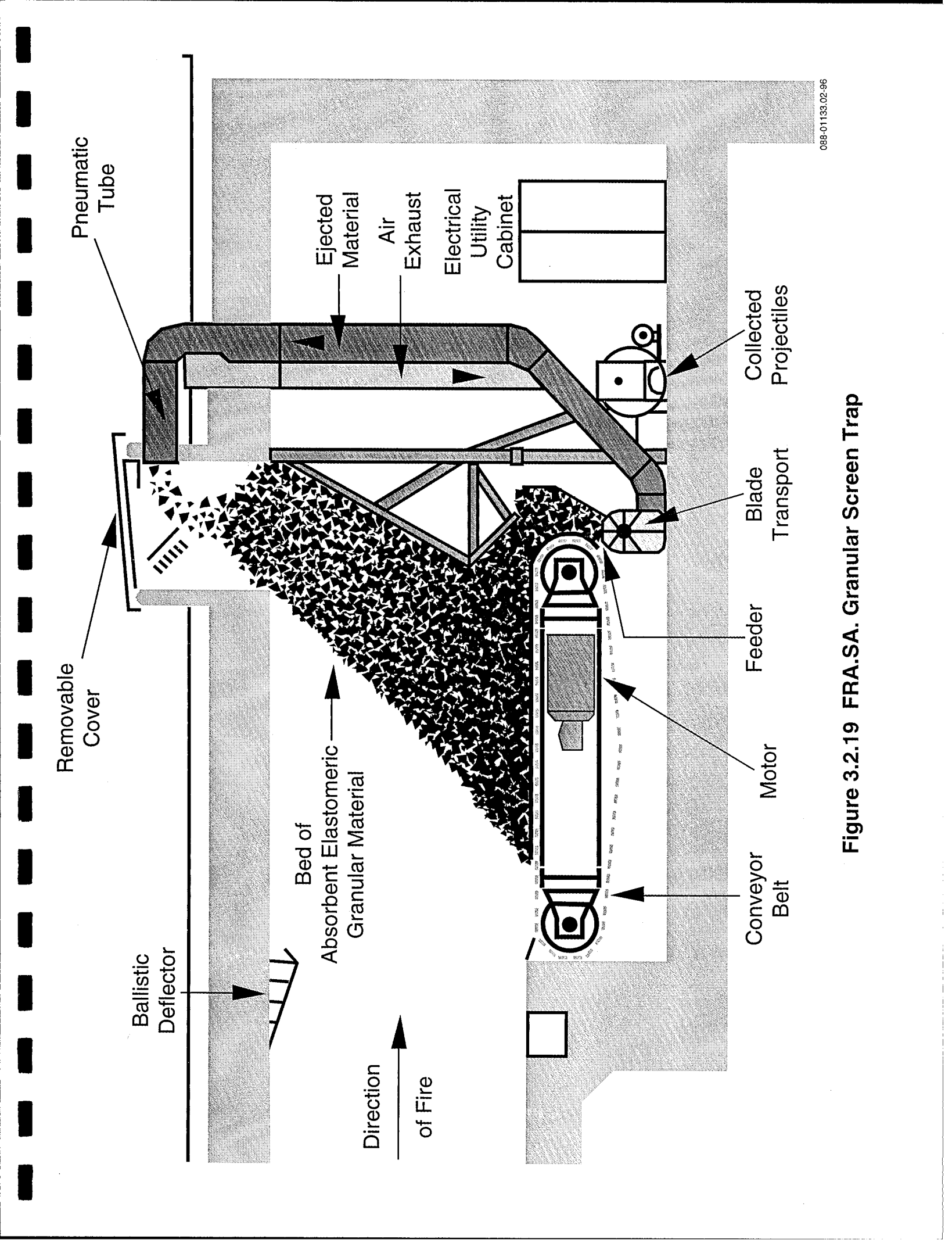
Feeder

Motor

Conveyor Belt

088-01133.02-96

Figure 3.2.19 FRA.SA. Granular Screen Trap



SECTION 4 CONCLUSIONS

There are few unique bullet trap designs currently produced for outdoor ranges. A number of indoor designs, such as the Passive Bullet Trap at the new NRA indoor range in their headquarters in Virginia, are quite innovative, but also quite expensive. Several major manufacturers are modifying their most successful designs to operate in an outdoor setting. Most companies who list themselves in trade publications or compendia, such as the Thomas Register, are really assemblers of other companies' materials or are target, not bullet trap, manufacturers. Those who are true bullet trap manufacturers are few and do not advertise widely. Consequently, they are hard to discover. To date the market had been rather limited and not able to support large numbers of manufacturers. Until recently, neither environmental concerns nor urban sprawl made it necessary to consider use of bullet traps. Most shooters could easily travel to an outdoor range and fire into a berm or simply into the woods without much concern for the consequences. Urban sprawl and heightened environmental awareness have now made the use of bullet traps either desirable or necessary, thus attracting manufacturers into a previously small market. In addition to domestic manufacturers, Canada, western Europe, eastern Europe, Scandinavia, Asia, Australia, and New Zealand were investigated as potential suppliers. Of the foreign countries investigated, only Germany, Italy and Switzerland had manufacturers. Some of the traps that have been investigated appear to be viable candidates for some applications on Army outdoor small arms ranges. However, manufacturers performance claims should be verified by demonstration under operational conditions to provide objective data on the traps ability to contain or prevent the spread of heavy metals on the range as well as the durability, maintenance requirements, effects on training, life-cycle cost, and utility of these traps.

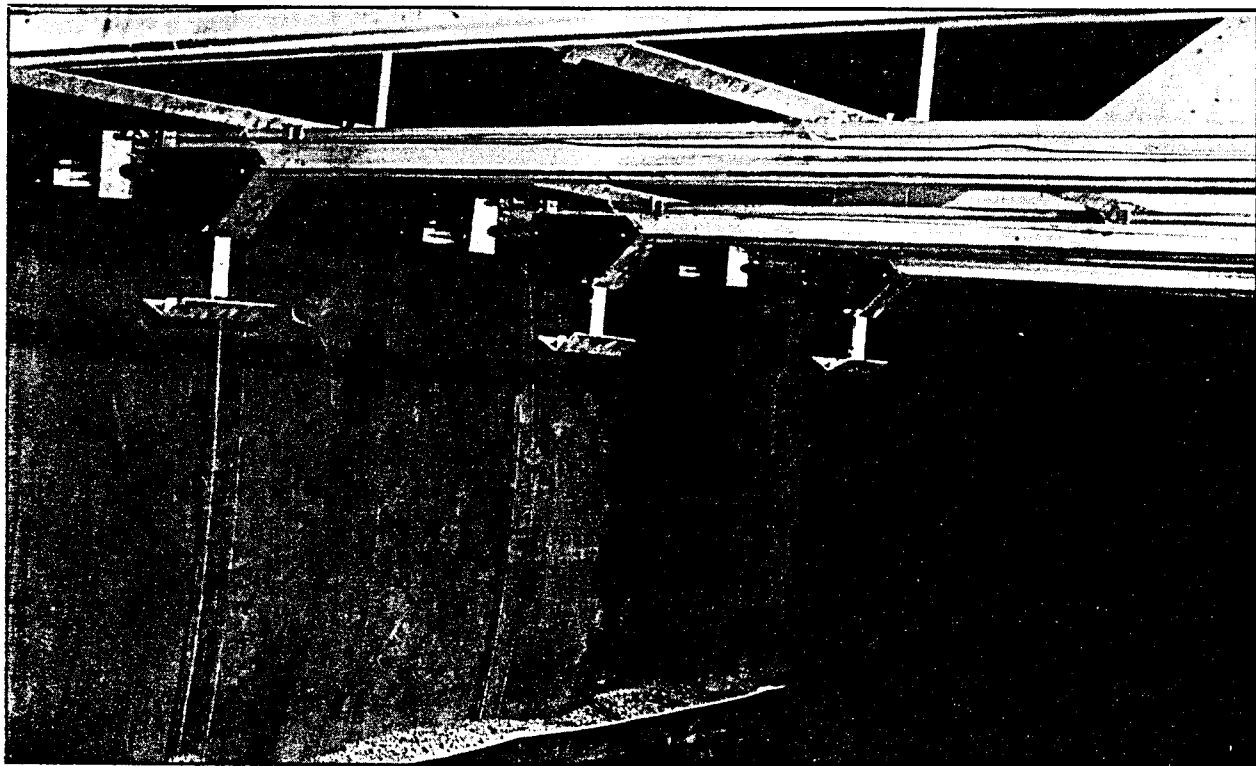
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SECTION 6
MANUFACTURER'S LITERATURE

GranTrap™

The Innovator
Caswell
International Corporation

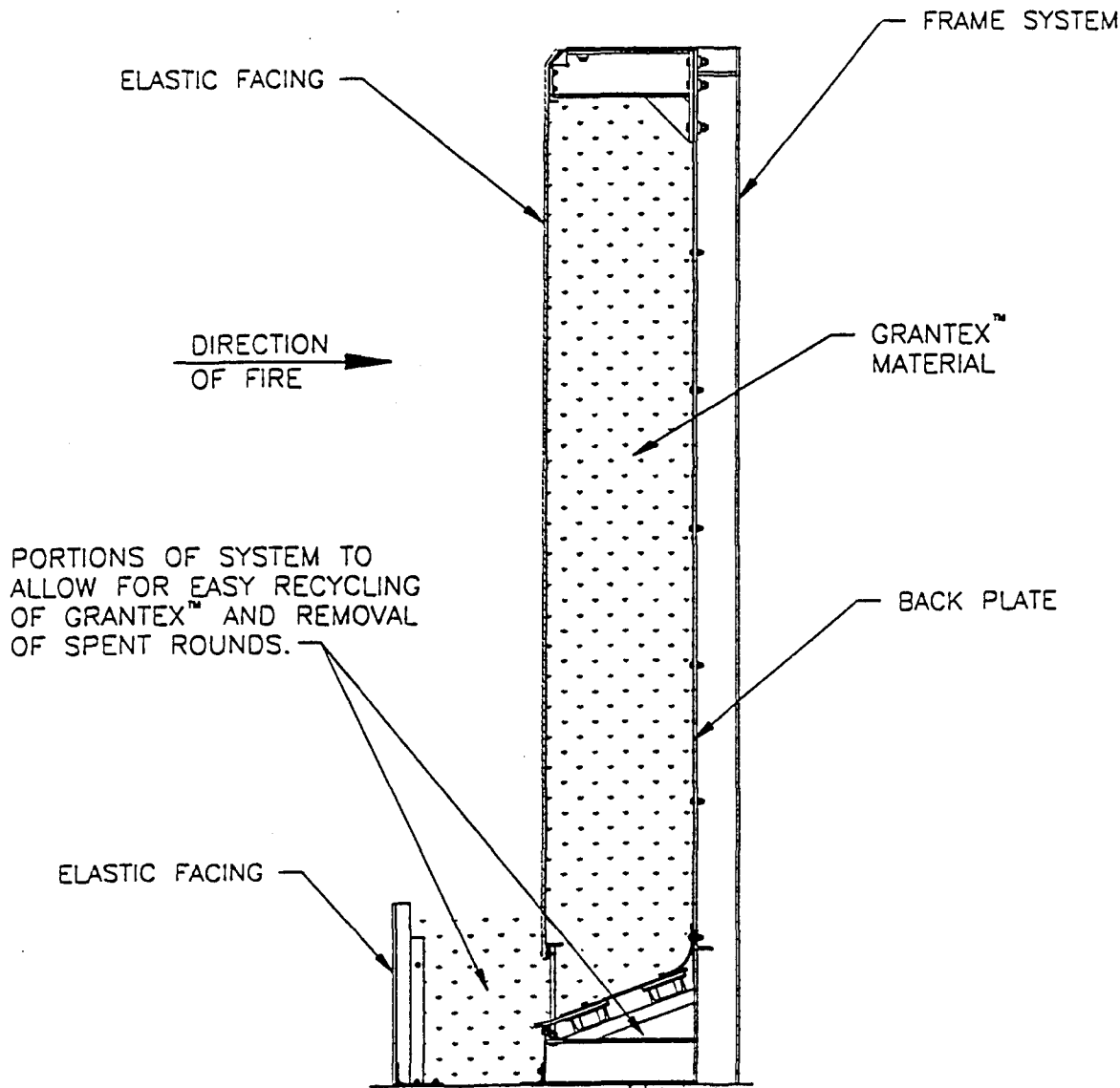


GranTrap™ Granular Rubber Bullet Trap

The patented GranTrap granular rubber bullet trap was developed to meet the need for a cleaner and safer environment in indoor and outdoor shooting ranges. The GranTrap allows bullets to pass through the rubber front panel and be captured intact in a chamber filled with GranTex™, a specially treated rubber granulate material manufactured from recycled materials. The bullets remain intact, eliminating air borne lead dust and preventing lead and jacket backsplatter.

The GranTrap is available in pistol and rifle versions and can be used in indoor or outdoor ranges.

The GranTrap Granular Rubber Bullet Trap is licensed and manufactured under U. S. Patent numbers 5,171,020, 5,340,117 and other patents pending. GranTrap and GranTex are trademarks of Caswell International Corporation



GranTrap Cross-Sectional View @ Mid-Point

ADVANTAGES OF THE GRANTRAP

- Competitively priced compared to steel bullet traps.
- Smaller "footprint" than steel traps.
- Safer to use due to the soft rubber front which allows the bullets to pass through without breakup.
- NO lead or jacket backscatter. Bullets are captured intact.
- Easier to clean the range. No lead or jacket particles to pick up.
No need for protective clothing or air respirators
- Less equipment maintenance than steel traps.
 - No loose bolts or shifting plates
 - No wear on steel plates and other impacted surfaces
 - Patching of front panel takes less than five minutes
- Lead removal in the GranTrap is easier and safer.
- Exhaust air filters last several times longer.

The Innovator
Caswell

International Corporation

1221 Marshall St. N.E.
Minneapolis, MN 55413
Telephone: (612) 379-2000
Fax: 379-2367



Range Masters, Inc.

**PRODUCTS
&
SERVICES**

PO Box 164
Le Center, MN 56052
612/357-4104
FAX 612/357-4105

Range Masters, Inc. is dedicated to the design and construction of durable, cost effective products to meet the needs of today's range owner. The need is now greater than ever for safe, environmentally sound ranges. Tighter governmental regulations on firearm generated lead will soon end the practice of firing into outdoor earth berms. Indoor ranges with steel trap ranges, with their incredible amounts of generated lead waste, will not escape the closer scrutiny. To combat these range threatening problems, Range Masters, Inc. has developed a new system.

At Range Masters, Inc. our ballistic team has developed a revolutionary new family of products called the TEC System. The TEC System, or Total Entrapment Composite, utilizes particles of rubber recycled from tires bonded together with a synthetic agent, additionally reinforced with Kevlar®. Using this composite and our various product designs, we are able to provide an unmatched range of use.

To achieve a ballistically safe range, only two things need to happen. The projectile must be controlled and then contained. Regardless of the angle of fire, nothing can return toward the shooter or firing line. In all TEC System products, angle of fire has no effect. Additionally, no portion of the projectile escapes containment to return toward the firing line.

Beyond ballistic safety, there is the risk of long term lead exposure in firing ranges. When projectiles strike traditional steel traps, they shatter, causing dramatic increases in airborne lead. With any TEC System product, any lead is contained, blocking re-entry to the range. Indoors, an 80% to 90% reduction of airborne lead can be achieved with TEC Systems. (Varies by style of ammunition vs. steel traps.)

Besides safety aspects, there are additional benefits to using TEC System products. High among these is reduced costs, both in clean up expenses and replacement of lead contaminated equipment.

Since the composite absorbs and contains the lead, it does not create hazardous waste. This greatly reduces the exorbitant expenses involved with clean up of hazardous or toxic materials.

Additionally, since concentrations of airborne lead are reduced, mechanical range equipment is less likely to become lead damaged. Greater mean time between replacement results in less funding spent on replacement or maintenance.

While TEC System products reduce costs, perhaps one of their premier assets is income generation. Projectiles fired into and recovered from TEC System products can be resold to local primary smelting operations. Again, there is none of the regulatory problems of hazardous waste.

Bullet Trap

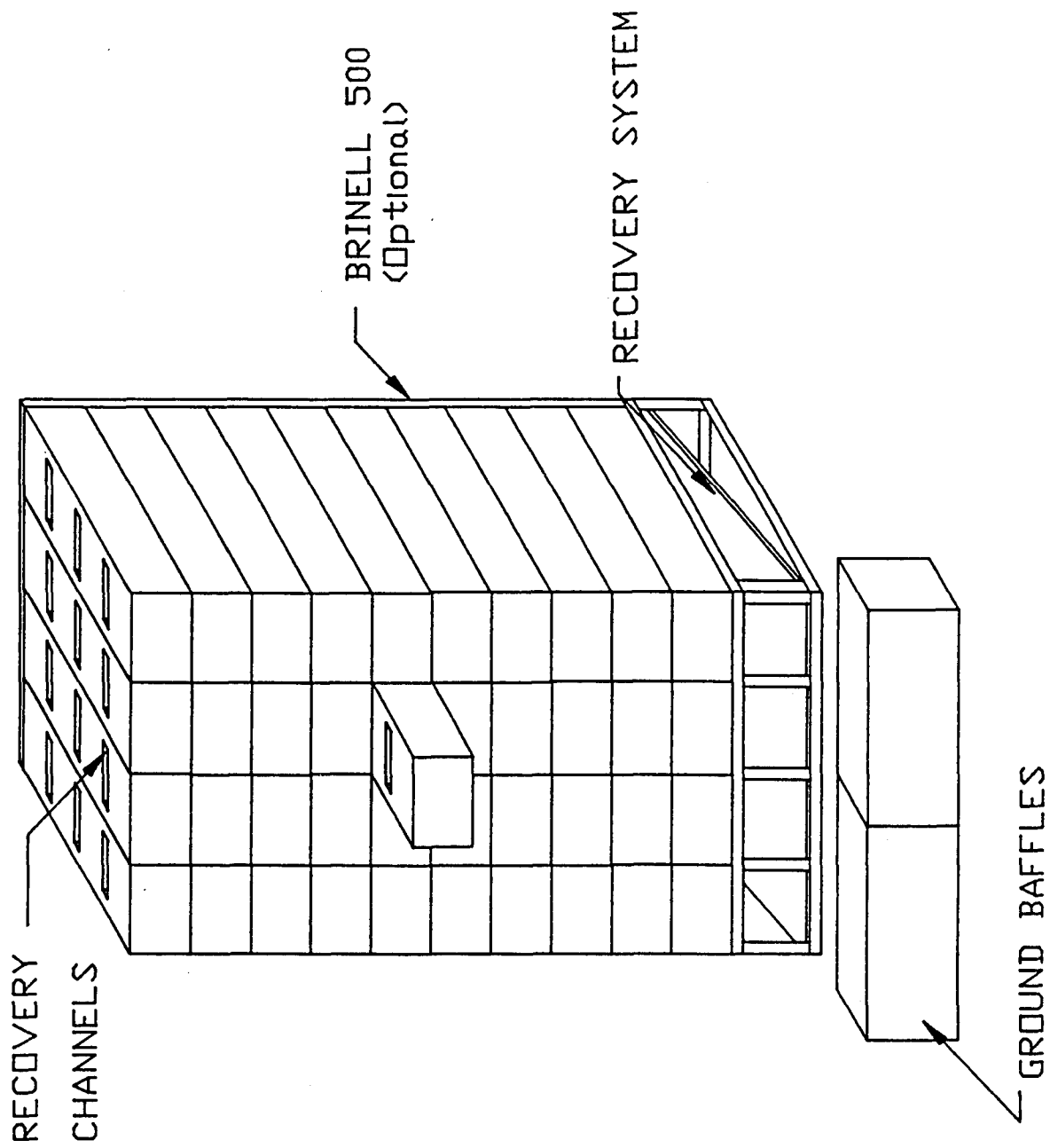
RMI bullet traps offer the dependability and versatility demanded by modern shooting conditions.

The TEC System bullet trap is truly a bullet trap. The bullet is absorbed, unlike traditional steel traps which merely create a ricochet. This absorption of the bullet is an important feature. It permits the bullet to be decelerated with a considerable reduction in bullet fragmentation. The extraordinary design of the RMI bullet trap offers a solution to several problems a range owner faces daily. Some of these problems are mechanical fail, lead build up, hollow point and steel core ammunition usage, depth of trap, large components and complex equipment.

The RMI bullet trap uses no moving parts to trap or recover the bullets. An infallible system is utilized to recover bullets . . . gravity. The bullets pass through the outer surface of the trap where deceleration takes place. Without sufficient energy to re-enter the composite, the projectile then falls through the channels inserted through the TEC System blocks to a recovery area. Unlike solid rubber composites, these channels allow for expansion, due to the introduction of more projectiles. Without room for expansion, projectiles will continue to mass bullets without relief. In short order, a dangerous situation can be reached, potentially causing fragmentation to return into the fire lanes.

Due to the great variety of ammunition available to today's shooter, full control of what is fired may not be achieved. Bullet traps must be able to provide safe containment no matter what type ammunition is used. RMI bullet traps accept hollow point and steel core bullets, without undue wear, unlike steel traps that are rendered unsafe after limited uses of steel core bullets. Many composite bullet traps use either hard rubber or plastic surfaces. These types are subject to rapid deterioration when hollow point ammunition is used. Hollow point bullets are widely used in both law enforcement and recreational shooting which account for a large portion of shooting in today's ranges.

Bullet trap depth is an important consideration when choosing range equipment. The RMI trap requires approximately 30 inches of depth. This means a reduction in building construction and



Shoot House & Ballistic Panels

A split second is all you have to hit a moving target and a miss could cost you your life. This is a real situation that law enforcement and military personnel face across the nation daily. The only way to train for this type of shooting situation is realistic training. With this increasing need for realistic live fire training, safety is paramount. Traditionally, live fire urban training was conducted in tire houses, wooden structures, and large outdoor ranges. These shooting environments all have one thing in common - secondary missiles or ricochets!

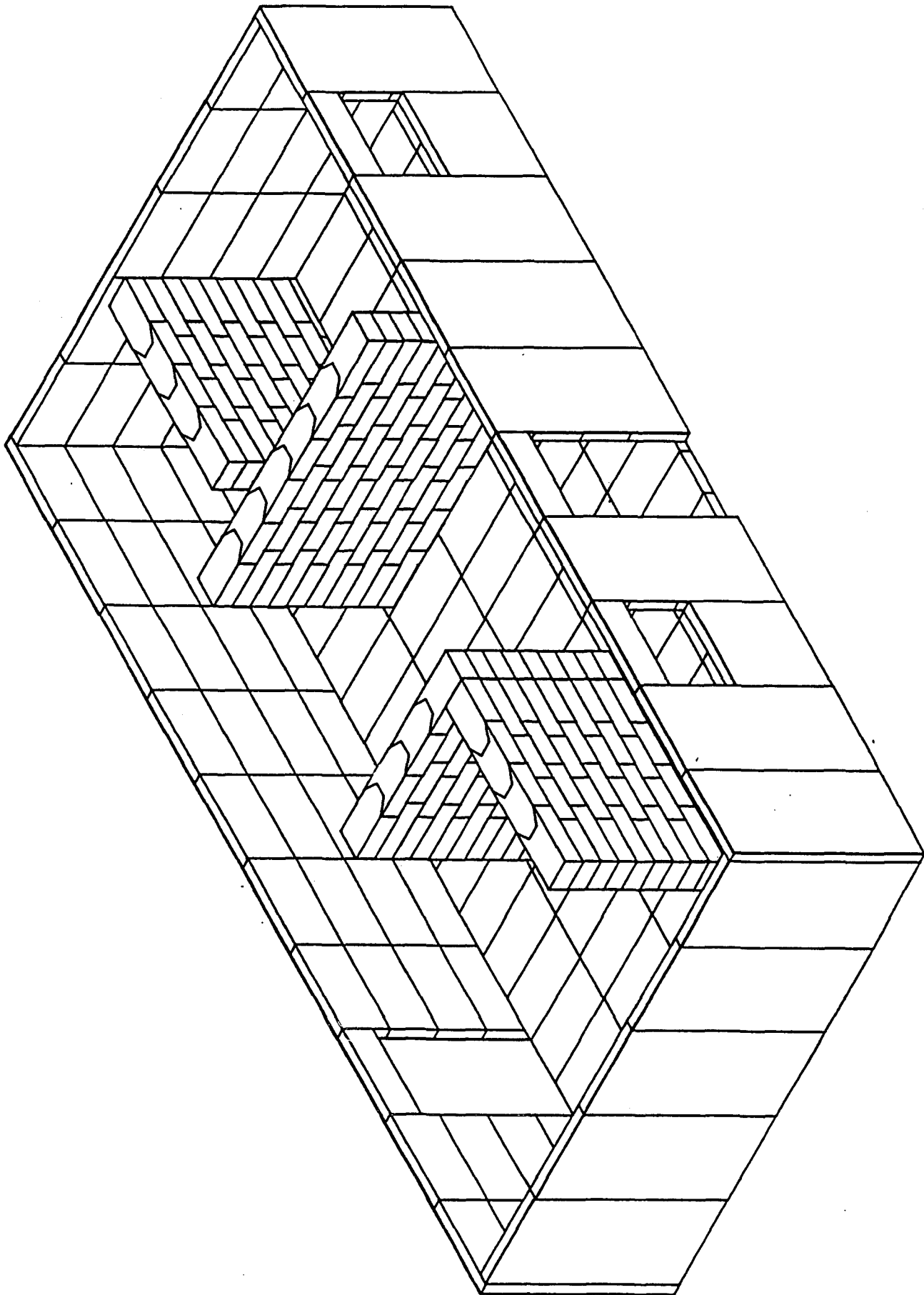
Today, there is a solution to this serious and often life threatening condition. Range Masters, Inc. offers several products to increase the safety of live fire training. The backbone of our product line is the TEC System. The TEC System uses rubber particles from recycled tires bonded with a synthetic agent and reinforced with Kevlar®. This product is not only cost effective, but also lessens the ecological burden on the planet.

By utilizing the TEC System, the shooting environment can be customized to meet tactical training requirements. One of the optional systems is sheet steel (ranging based on consumer specs from mild to Brinell 500) faced with replaceable TEC System panels. This provides positive containment and increased safety.

The second option is our interlocking block system. This system employs a manageable solid block that is simple to install. This is an important consideration when manpower is limited. With numerous configurations and the ability to create free standing walls, various training environments can be used. Additionally, rubber composites, unlike wood, absorb great amounts of sound and does not splinter. These are important factors when training requires a safe, durable product for close orders training.

The TEC System panels have been designed to meet several shooting requirements. The panels are produced under strict quality control. This allows for diverse product usage. The side wall panels can be used for ground/floor covering. This will greatly increase the overall safety of the tactical shooting site.

For conventional shooting situations, the panels are used to face baffles, safety ceilings, concrete walls, and floors.



Outdoor Ranges

From the time firearms were first used, outdoor ranges have been operated. Other than improvements in the areas of safety and back stops, most outdoor ranges have not changed.

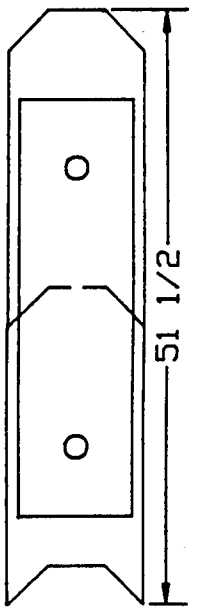
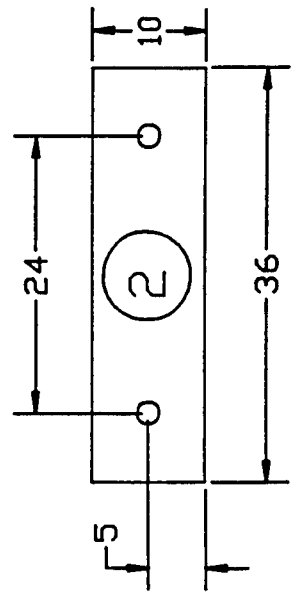
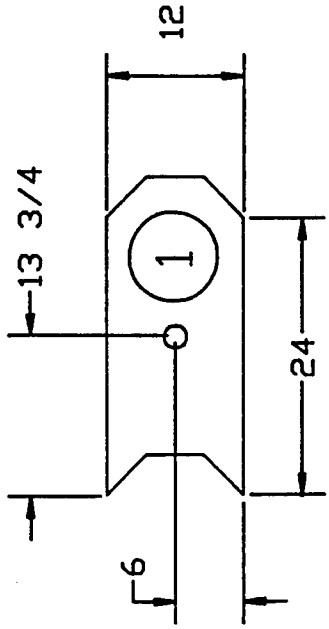
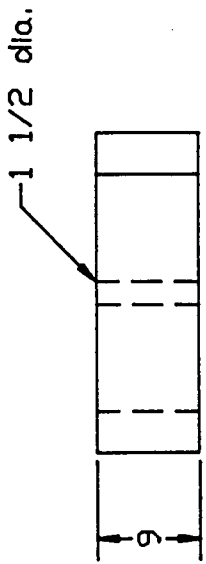
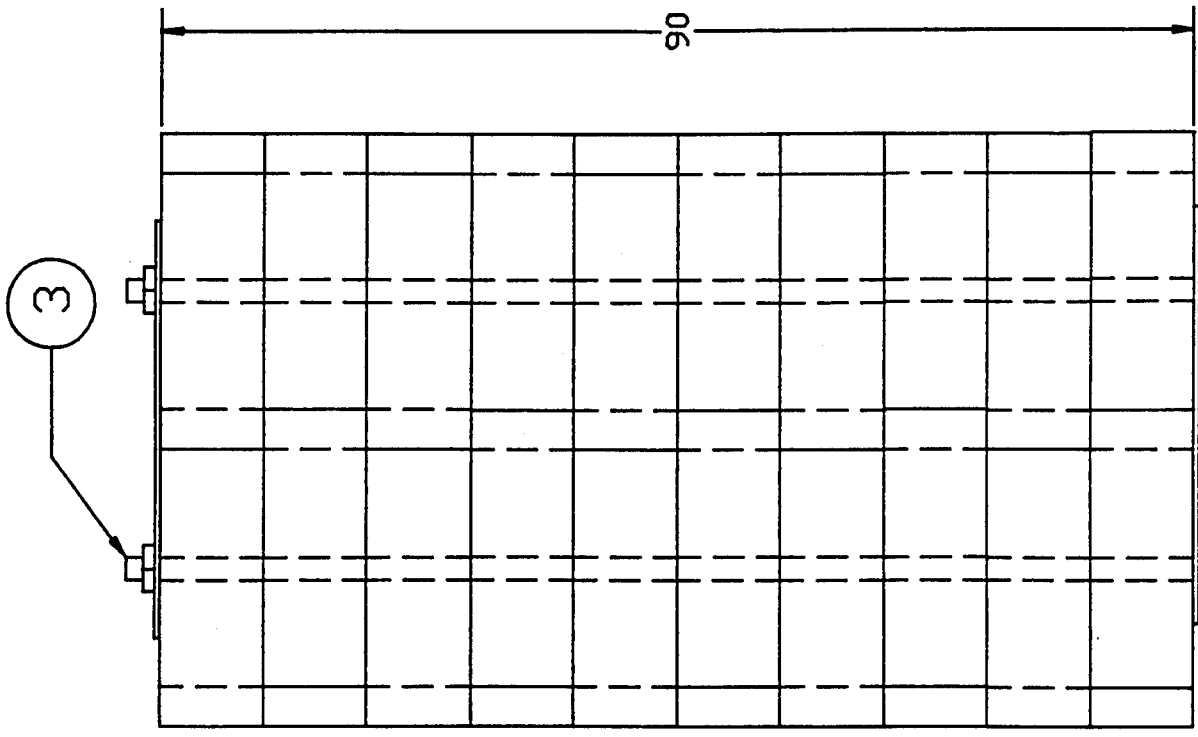
In most of today's outdoor ranges, the majority of back stops are still earth berms. Earth berms must be periodically mined to recover lead. Earth backstops, though inexpensive to construct, become costly over time. With the new increasing environmental pressures added to the rising cost of professional recovery, earth back stops will soon be a thing of the past.

One of the major draw backs to the use of earth back stops is safety. Bullets will either ricochet off or "roll over" the top of the back stop. There have been several attempts to curb these incidents over the years. The only viable solution has been a shot fall zone! The large amount of land required for even 22 rimfire ammunition can easily exceed most project budgets.

In the construction of range amenities wood, concrete and steel are used. These elements have been for the most part used due to cost and availability. Today, range owners have a solution to problems like wooden structures being decimated or law suits deriving from secondary missiles. The TEC system products can be used to replace berms and earth back stops, RMI interlocking blocks can be placed in a frame to fabricate free standing TEC walls. Interlocking blocks can be used to retard erosion if your range currently contains a earth back stop. The TEC panels can be adhered to concrete or steel surfaces, allowing for the retro-fitting of most ranges.

One of the most bothersome by products of firearm usage is sound. We offer various products and techniques to conform to required sound levels. With the use of TEC system products, sound can be channeled and absorbed. One of the techniques of sound abatement available are ribbed TEC panels that can be adhered to the sides of wood or steel range dividers. Further, free standing walls can be cost effectively erected in problem areas to greatly reduce and channel sound down range. If bench rests are used, we offer a portable sound suppression system that adjusts to standard bench rest height. This system will notably reduce the amount of sound exiting the range. The suppression system is designed to absorb part of the sound and channel the remaining sound waves down range. These inexpensive systems can increase shooting comfort while decreasing the amount of sound exiting your range.

| # | Description | Length | Qty. |
|---|---------------------|--------|------|
| 1 | RMI angle block | | 18 |
| 2 | 1/2x10 | 36 | 2 |
| 3 | sch-40 3/4 blk pipe | 96 | 2 |



| | |
|--------------------|-------------------|
| RANGE MASTERS Inc. | |
| 11/1/94 | Ang. Blk. Wall |
| DATE | |
| REV. DATE | SCALE: 1/16" = 1' |
| SHT 1 OF 1 | DWG BY CDH |
| | REV. |

Military Ranges

Range safety is one of a commander's most critical task in conducting any live fire exercise. RMI clearly leads the industry in this area. All members of our research and design team have served in the military and conducted range training for several years. With a vast amount of hands-on experience we were able to develop products to meet the specific needs of military ranges.

M-16A2 ZERO Range

One of the most important elements in qualification is a properly zeroed weapon. With the addition of RMI products your current zero range will become safer and have needed amenities.

With safety being the primary concern, we have developed a new baffle system which allows the individual zeroing to acquire his/her target while restricting the elevation of their weapon. The baffles are faced with TEC panels that, in the event of a misplaced shot, will absorb the projectile.

By replacing the front of existing earth back stops with a RMI modular bullet trap, there will be no imbedded rounds or rock to create an unsafe training environment. By using baffles with the bullet trap, elevation can be controlled to keep rounds from being fired over the bullet trap.

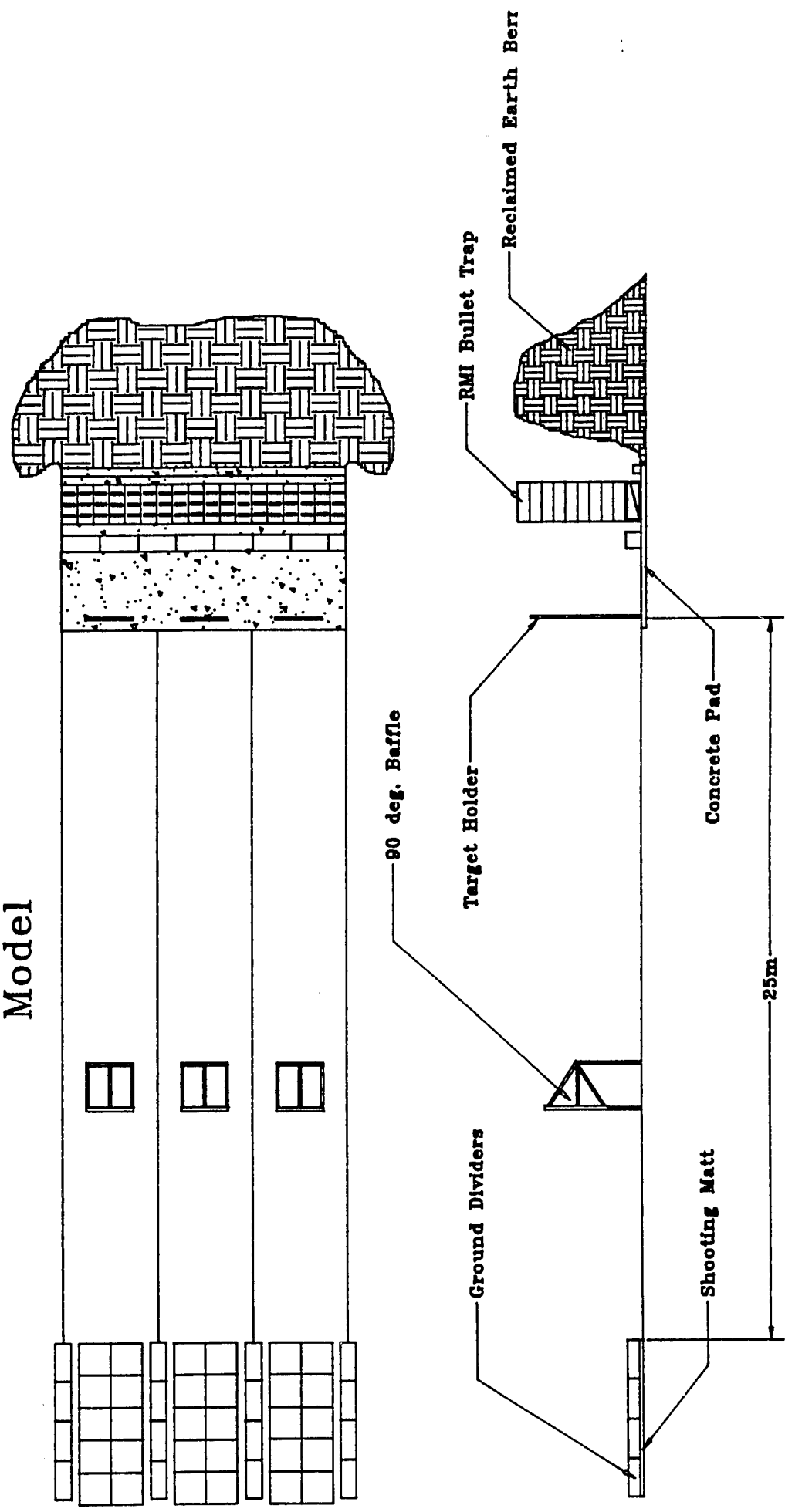
Lane separators can be added at the firing line. The separators are designed to protect personnel from being struck by either brass or ground ricochet from a misguided round. An optional mat may be placed between the lane separators. These mats will provide a non-slip surface and when placed on a slight grade permit water to drain away from the firing position.

To augment the RMI M-16A2 zero range we offer a revolutionary target holder. Our holders are constructed with a solid sheet of TEC system. The targets are simply stapled to the face of the sheet. The holders reduce the projectiles velocity and thus, increase the durability of the bullet trap. The TEC system sheets are far more durable than wood or other similar materials. With increased durability the overall cost of range operation is reduced.

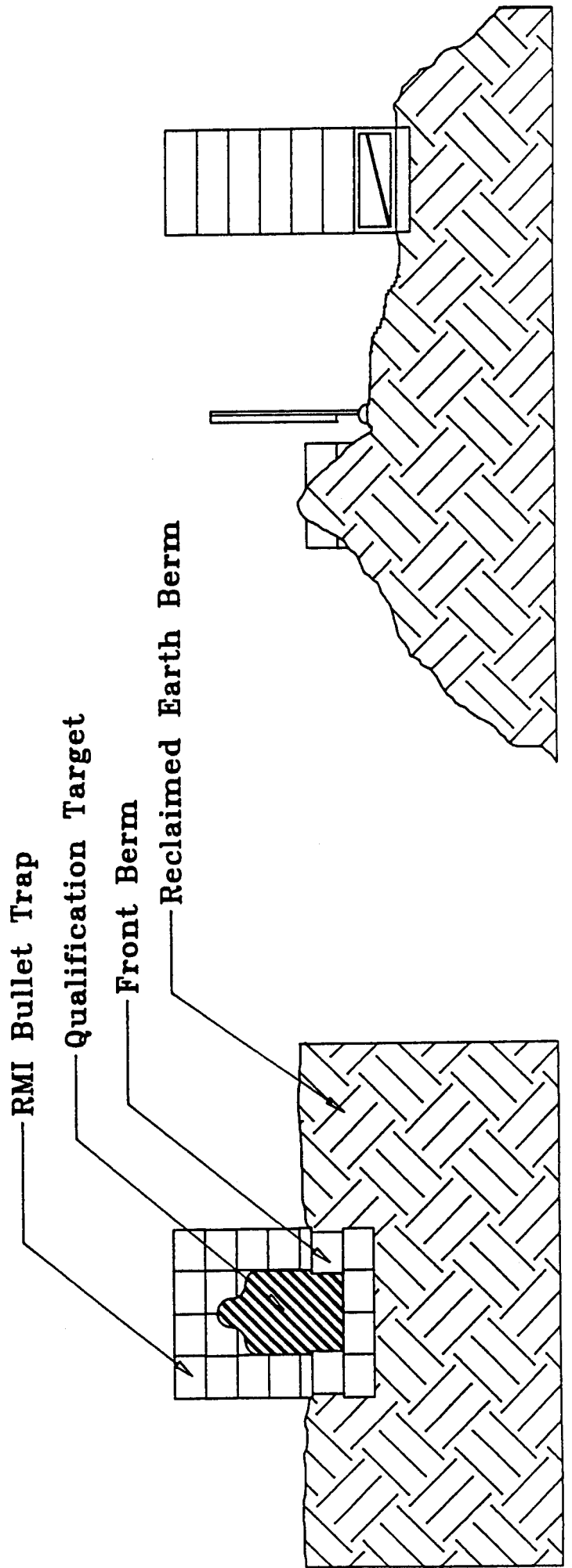
RMI

25m Zero Range

Model



RMI Qualification Range Model



LINATEX®

TARGET BACKING CURTAINS

IT'S CURTAINS FOR BACKSPLATTER AND LEAD CONTAMINATION

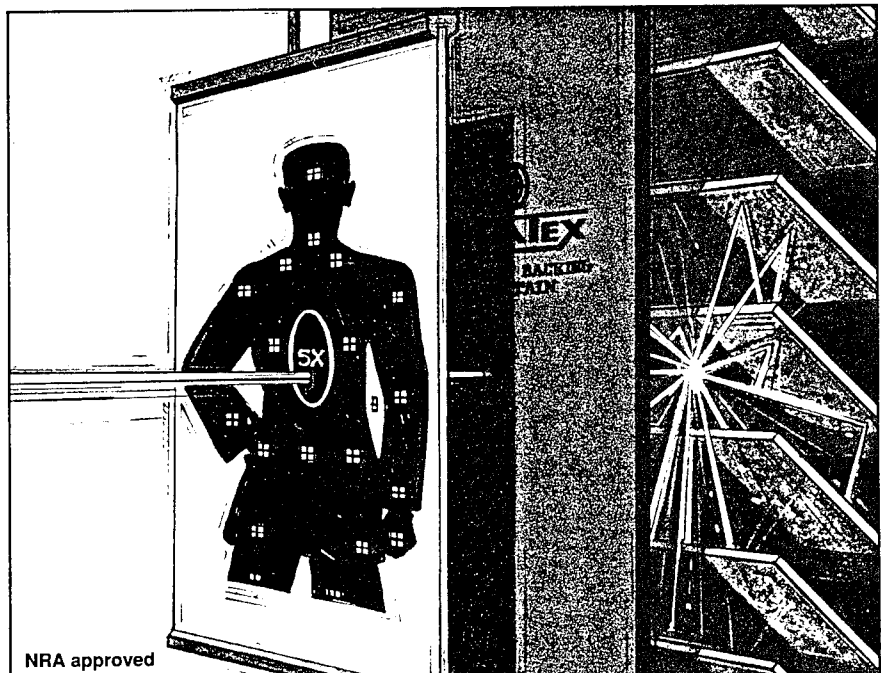
Two of the biggest dangers you face at indoor shooting ranges are about to bite the dust thanks to LINATEX TARGET BACKING CURTAINS.

Made from LINATEX, the curtains self-seal instantly when pierced by ammunition, leaving only a pin-prick sized hole. Ricocheting backsplatter and lead particulates are effectively contained, even at close range, avoiding contamination of the firing area.

PROTECT THE SHOOTER WITH LINATEX . . . THE SAFEST, MOST ECONOMICAL TARGET BACKING AVAILABLE.

LINATEX curtains last thousands of rounds and have been used successfully with .22 calibre, 38 wad cutter, 44 magnum, 6.5mm, .303 calibre, .357 magnum, 45 auto and 9mm ammunition. In addition to lasting thousands of rounds, LINATEX TARGET BACKING CURTAINS can be easily repaired with a simple patch kit.

This unique material is used by hundreds of military, police, government and private indoor ranges throughout the United States. Ask for our user list.



*Cut-away view of a LINATEX TARGET BACKING CURTAIN in action.
See reverse side for typical range layout.*

FEATURES & BENEFITS

- Prevents dangerous backsplatter and ricochets.
- The screening effect provided by the LINATEX curtain substantially reduces airborne lead fumes and makes it much easier to extract fumes from the range.
- LINATEX is self sealing. Under tests, a small LINATEX curtain, 1/4" thick x 2' x 2' had only a small hole after some 25,000 rounds of .303 calibre had been fired through the curtain.
- Noise reduction. Reflected noise off the backstop is confined.
- Unlike other target backings such as canvas, paper, plywood or particle board, LINATEX does not fragment or disintegrate into small particles which could cause fouling of air purification units on indoor facilities. See illustrations on reverse side.

Continued on back.

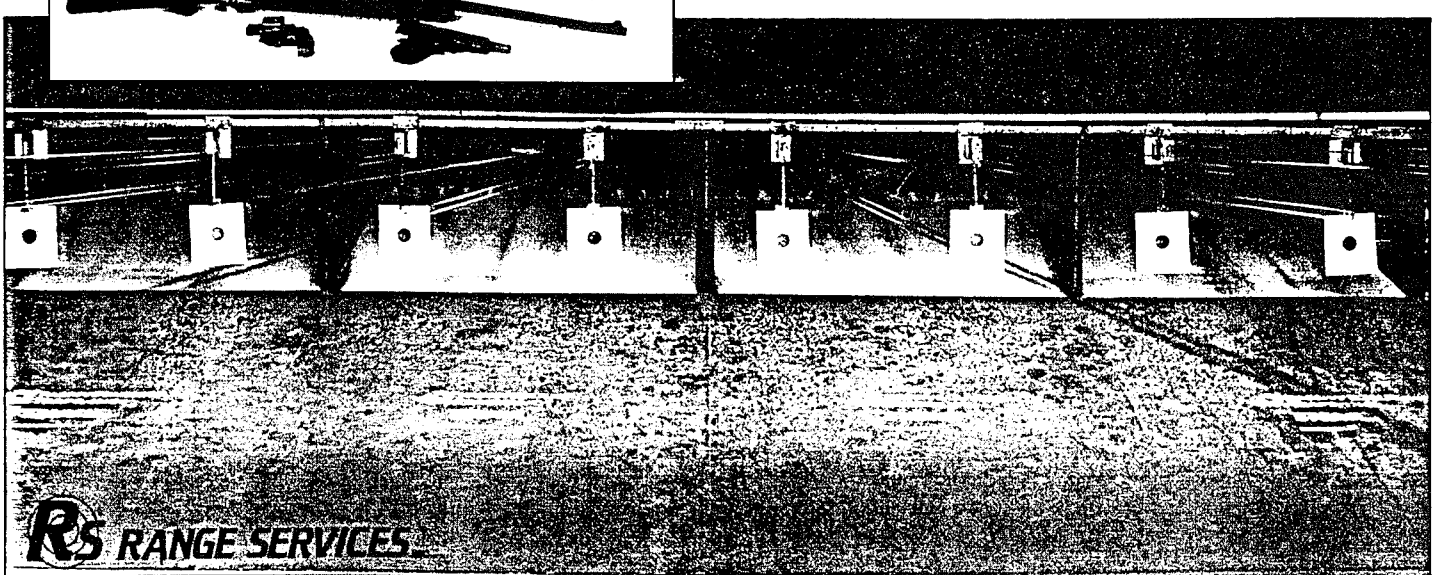
SAVAGE RANGE SYSTEMS INC.



PASSIVE BULLET TRAPS INC.
"Wet" Range & Trap Systems



Providing a 'One Stop' full service to the Firearms Industry and all indoor/outside shooting ranges.



SAVAGE RANGE SYSTEMS INC. PRESENTS...



Manufacturers of a complete line of patented "wet" traps and ranges that provide superior lead dust control, shooter protection from particle "spit back" and complete bullet recovery. Using the laws of nature to capture a bullet, the Snail™ system deflects, hydroplanes and decelerates by lubricated centrifugal friction. In less than two seconds and 50 revolutions, a bullet will generally stay intact and fall into a collection tray for ease of recycle or disposal. Designed for firearm, ammo and accessory manufacturers, gunsmiths, armorers, ballistic labs, range facilities and government firearm training and qualifying establishments.

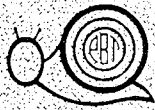
DUELATRON TARGET SYSTEMS

Offers more than 20 years experience in the design, manufacturing and service support of quality portable and permanently mounted electronic, pneumatic (air driven) and wireless target systems. Choose from handheld portable pop-up targets, portable cable and track mounted Running Man target systems to permanently installed computer controlled target ranges to fit nearly every budget and firearms training requirement.



Provides engineering, planning, equipment selection, budgeting and installation support for indoor and outdoor ranges. Will provide air quality monitoring, range retrofit and regular maintenance programs.

| PRODUCT DESCRIPTION & INDEX | CATALOG PAGE |
|---|--------------|
| <u>CHECK IT™</u> firearms clearing and precaution trap. | Page 3 |
| <u>IM FIRE TRAP</u> operation and targeting of all rim-fire firearms. | Page 3 |
| <u>GUNSMITH SERIES</u> designed for function firing of handguns, shotgun and rifles up to .50 cal. | Page 4 |
| <u>POP UP TRAP SERIES</u> used by firearm, ammo and accessory manufacturers, for testing, proofing, functioning, and ranging handguns, shotguns and rifles up to .600 Nitro Express. | Page 5 |
| <u>INDOOR and OUTDOOR RANGES</u> engineered to fit all existing and proposed range facilities. | Page 6 |
| <u>DUELATRON PORTABLE AT-37 WIRELESS</u> for combat shooting scenarios with up to 15 individual targets as far away as 300 yards. | Page 7 |
| <u>PNEUMATIC TARGET SYSTEMS</u> highly reliable, portable and permanent, low cost & minimum maintenance target systems. | Page 8 |
| <u>RUNNING MAN TARGET SYSTEMS</u> designed for combat training, portable or permanent, and adapts to numerous field conditions. | Page 9 |
| <u>CIRCULAR BALLISTIC PANELS</u> creates combat villages that are infinitely adjustable and interlocking. May be used for ballistic wall coverings and baffle systems. | Page 10 |
| <u>WIRELESS TARGET CONTROL SYSTEMS and ACCESSORIES</u> wireless, pneumatic and electronic controllers. | Page 10/11 |
| <u>RANGE SERVICES INC.</u> provides full engineering support services and maintenance programs. | Page 12 |



BOX TRAP SERIES

BOX TRAP SERIES

General Description

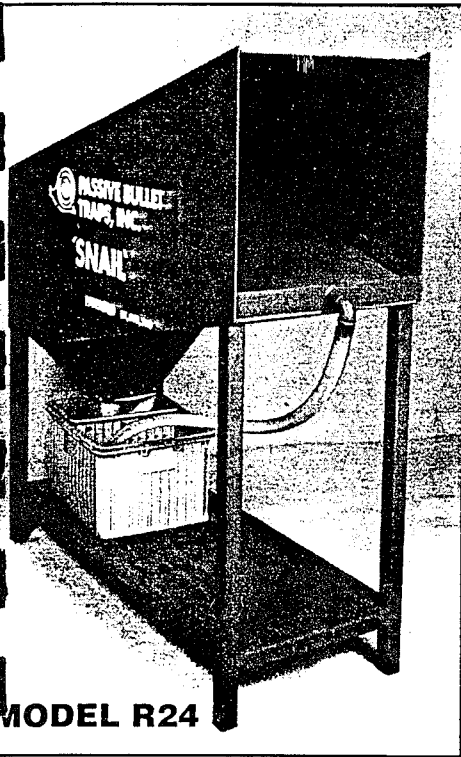
One-piece box trap. Designed for function, targeting and velocity testing. Includes one-piece welded construction, impeller pump, collection tray and tank to contain and recycle liquid. Ideal for firearms and ammo manufacturers. Center line of hit area to floor is 53" standard. Non-standard applications can be accommodated upon request.

MODEL R24 24" x 24" target area, and rated for .600 nitro express (no steel core).

MODEL RA24 Same as above with optional replaceable ramps designed to withstand armor piercing (non-Sabot).

MODEL R36 36" x 36" target area, and rated for .600 nitro express (no steel core).

MODEL RA36 Same as above and designed with replaceable ramps to withstand armor piercing bullets (non-Sabot).

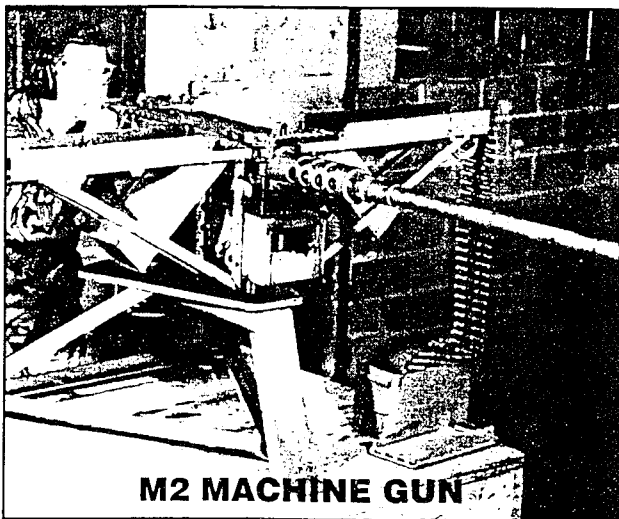


MODEL R24

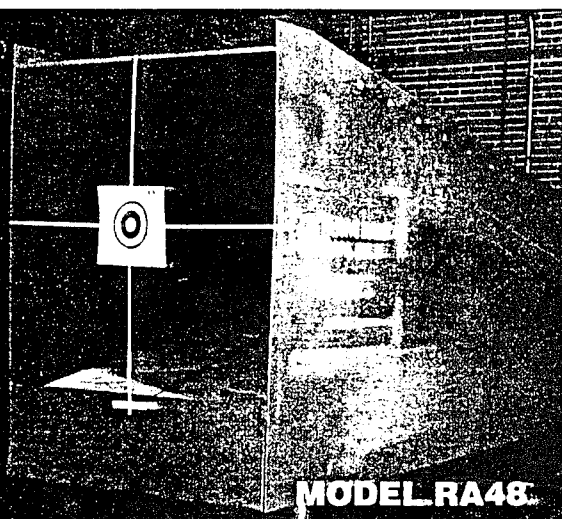
MODEL R48 48" x 48" target area, and rated for .600 nitro express (no steel core).

MODEL RA48 Same as above, and designed with replacement ramps for armor piercing bullets (non-Sabot).

HEAVY DUTY BOX TRAP



M2 MACHINE GUN



MODEL RA48

General Description

Designed for military and firearm/ammo manufacturers, this trap is mobile, sectional and perfect for testing large caliber machine guns, up to .50 cal. in steel core. Can be fabricated to suit application and building restraints. Bullets are collected in a basket above the recycling tank.

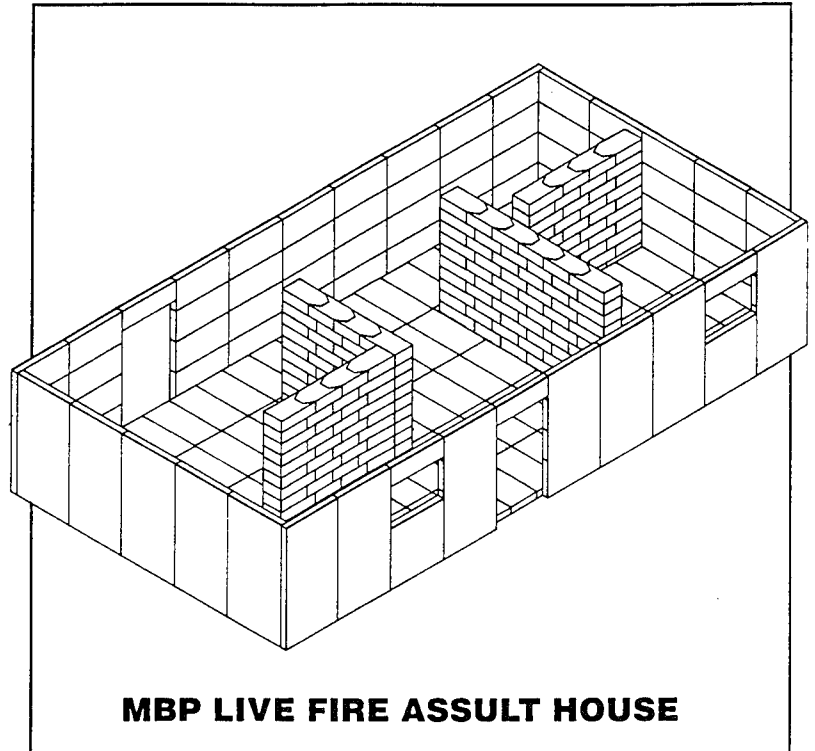
For armor piercing applications, ramps can be bolted together for ease of removal and replacement. Designed to withstand a M2 machine gun in full auto belt-fed mode at a typical distance of 30 meters, indoor or outside.

DUELATRON TARGET SYSTEMS

MODULAR BALLISTIC PANELS (MBPs)

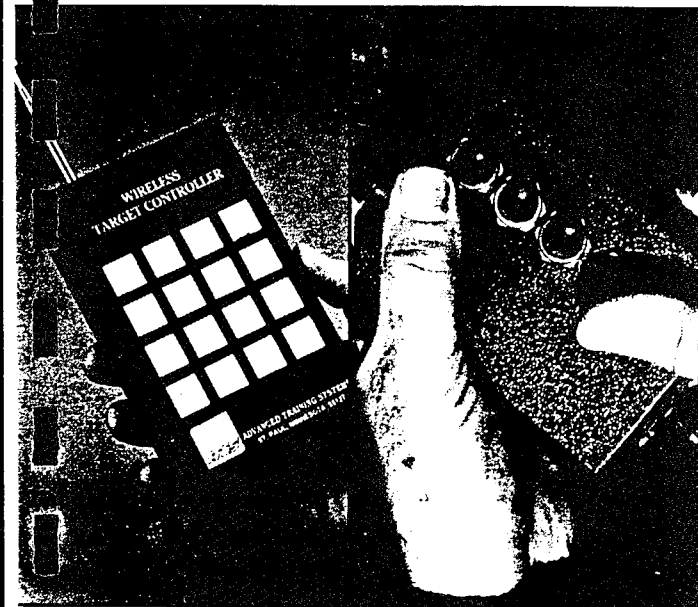
Working with recycled rubber tire products, DUELATRON has created the proprietary MBP System for use in the construction of live fire Combat Villages and protective ballistic coverings for indoor ranges. DUELATRON MBPs are bonded with special compounds and reinforced with Kevlar synthetic materials to create ballistic walls, ceilings, baffles, floors and modular (moveable) panels which will stop live fire pistol rounds and shotgun slugs for a truly safe 360° shooting environment.

Unlike traditional ballistic wall coverings and baffles made from plywood bases, DUELATRON MBPs are rubber based, sound absorbent, have non-splatter/ricochet qualities and are designed for long life in indoor and outdoor environments. Available in a variety of colors and textures (including smooth and ribbed surfaces, as well as interlocking freestanding components) these moveable walls and ballistic wall coverings can be easily attached to wood, steel, concrete or painted surfaces.



MBP LIVE FIRE ASSULT HOUSE

TARGET CONTROL SYSTEMS AND ACCESSORIES



RADIO TRANSMITTER MANUAL CONTROLLER

DUELATRON offers a wide variety of target control systems for operating wireless, pneumatic and electronic target systems. For example....

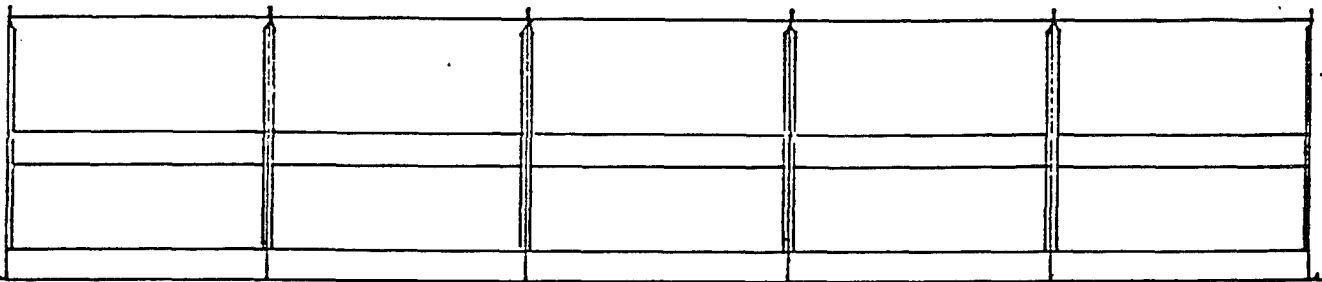
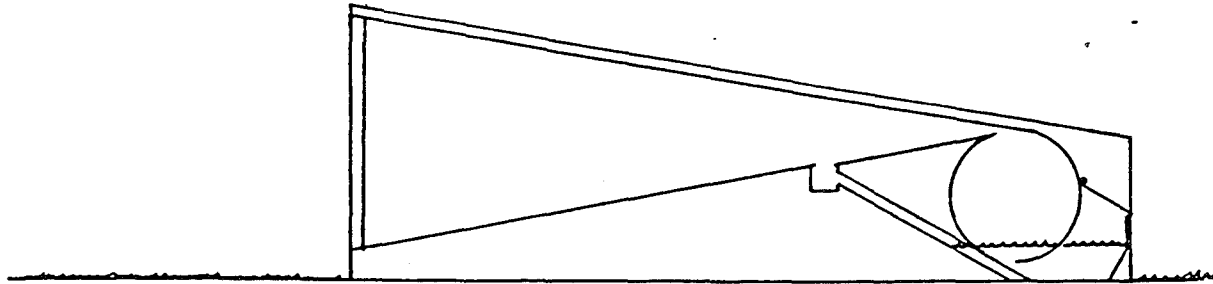
- A handheld wireless target transmitter, capable of controlling up to 15 targets individually (or 15 clusters of targets) or all targets simultaneously, as far away as 300 yards in all directions.
- Manual (switch operated) target controllers for 5, 10 and 15 pneumatic targets, allowing both individual and in unison control of all targets.
- Programmable solid-state Timers with variable delay times (from 0-99 seconds) and variable target exposure times (from 0-999 seconds) in one second increments.
- Portable PC Range Computers capable of controlling 100 targets individually or in various combinations. With the exclusive DUELATRON RCS (Range Control System) software package, virtually any basic qualification through advanced firearms training course can be imagined via manual, variable timed courses or user written programs.



PASSIVE BULLET TRAPS INC.

"Wet" Range & Trap Systems

Model OP96



OUTDOOR AREA RANGE SERIES

General Description

Designed for outdoor use, this pumpless wet range system will protect the environment from lead contamination. Liquid is contained in the lower part of the deceleration chamber, so that bullets wipe through and automatically wet the inside of the chamber. Individual sections are joined together to create desired width, according to the number of shooter stations required.

Collection takes place at the rear of the system, and bullet material can be removed (a) manually, (b) bucket and hoist or (c) conveyor.

Model OP96 — Outdoor area range, sections 8' x 8' average width and height. Rated for all handguns up to .50 AE. Each unit weights 5,200 lbs.

Model OR96 — Outdoor area range, 8' x 8' average width and height. Rated for all rifles up to .50 caliber, no steel core or AP rounds.

Model ORA96 — Rated for armor piercing and steel cored bullets. (Designed for specific user applications.)



*The Leader in
Tractor
Fine
Equipment*

52.00

Products & Pricing 1995



**ACTION
TARGET**

Building A Firing Range

From the ground up, Action Target is the leader in firing range development and range equipment. Whether you are beginning a completely new project, expanding your existing facility, or looking for a single target to sharpen your skills, Action Target can help you. Action Target is unsurpassed in all facets of range development, and is uniquely qualified to help you meet your individual needs.

Our primary concern is not just selling range equipment, but making sure you get the right equipment for your firearms training needs. The right equipment must not only meet your varied training requirements, but must also be installed properly and function dependably in all conditions. We are constantly improving the quality and design of our products to meet your training needs. With Action Target you can be sure that you are getting the best equipment value for your training dollar.

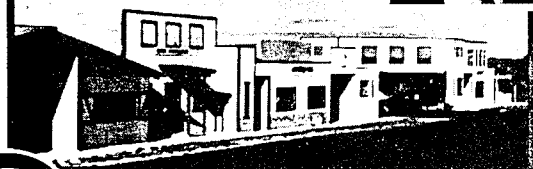
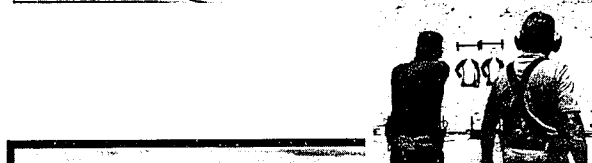
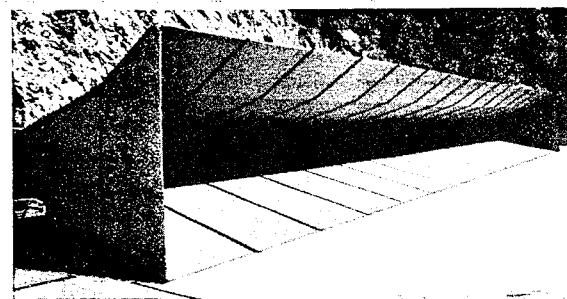
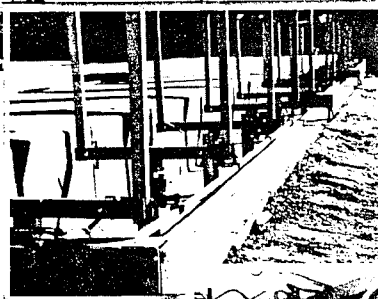
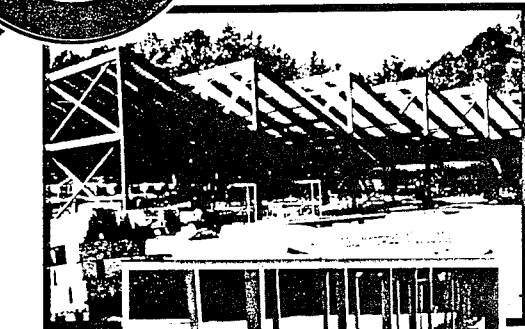
Because getting the proper equipment is just one part of the total range design process, Action Target is ready to help you address all major design issues. We install more ranges each year than anyone else in the industry, and we understand the complexities of range design, construction, and maintenance. Our services can help you select an appropriate site, make cost and budget projections, conform to local and federal government regulations, and meet safety requirements.

Every project, from the largest government or municipal training facility to the smallest local range, benefits from the expertise of the engineers and installers at Action Target. However, there are some cases when your range needs may require more specialized assistance. Even in these circumstances, Action Target can help. Because of our reputation, we have developed contacts with top professionals in many related industries. We can refer you to those people, some of whom provide services at little or no cost, who will most effectively address your specialized range needs.

Action Target's goal is to make your training practical, safe, dependable, and cost effective. We have the benefit of seeing more ranges, installing more systems, and working with more professional trainers and departments than anyone else in the industry. No one is more qualified to help you meet your training goals or specific range requirements than Action Target. Please call me to discuss your range training needs, concerns, and questions.



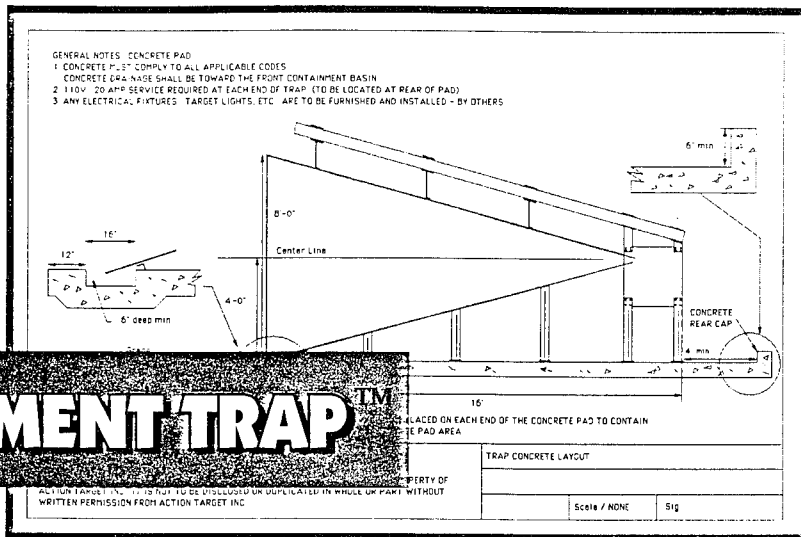
M. Scott Roberts



ACTION TARGET

TOTAL CONTAINMENT TRAP™

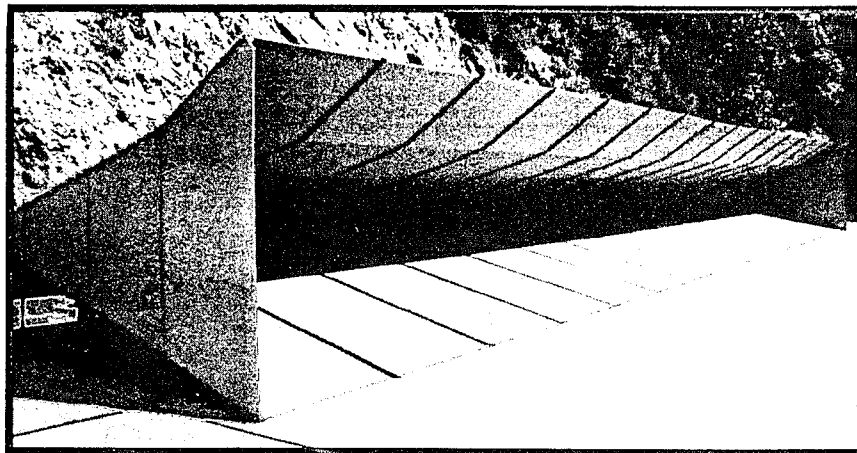
U.S. Patent Pending



The TOTAL CONTAINMENT TRAP (TCT) is simply the best overall solution for ranges where safety, reliability, low maintenance, and ease of use are top priorities. Action Target's TOTAL CONTAINMENT TRAP has overcome the problems of other inferior designs which do not provide for close-distance shooting or for shooting with high power rounds. The advanced design of the TCT uses a gracefully sloping funnel to safely direct rounds into a large chamber where they can be stopped with complete safety. The TCT can be safely used for handgun, shotgun, and most high power rounds, and is ideal on both indoor and outdoor ranges. The TCT is an independent, free-standing structure, so it can be installed with minimal preparation on nearly any range site.

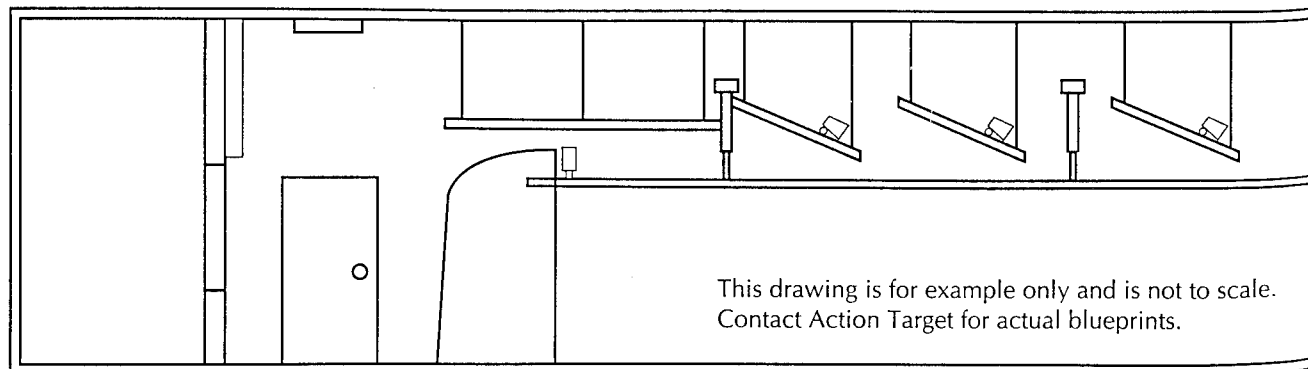
The TCT's all-steel construction and funnelling action provide the only bullet containment and splatter protection your range will need. There are no costly, high-maintenance shields or curtains of any kind required. Remember, the "Total Containment" concept means containment of bullets, containment of ricochet and splatter, and containment of ongoing range maintenance expenses.

Once the bullets have been collected in the main chamber, a number of debris removal systems may be used to extract the spent rounds. Such systems range from simple pull-out trays to fully automated conveyor belt drives. Call Action Target for assistance in deciding which configurations are best suited to your specific needs.

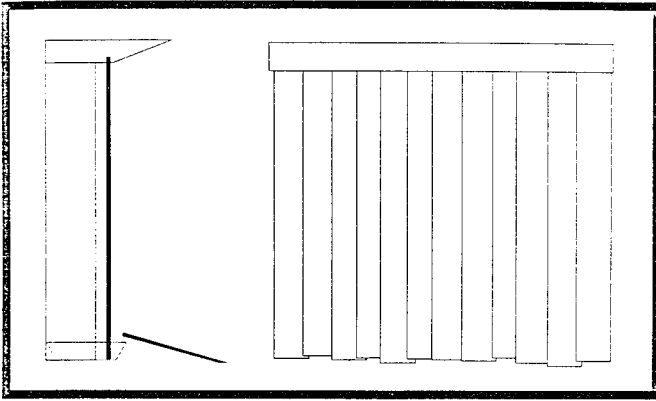


TCT Description

- Deflection Plate: 1/4" to 3/8"
- Hardness BHN: 300 to 350
- Trap Opening: 8 feet (full size trap)



This drawing is for example only and is not to scale. Contact Action Target for actual blueprints.



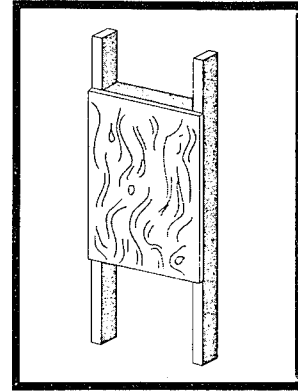
LOW PROFILE TRAP

U.S. Patent Pending

Ranges with space limitations can be served well by the Action Target Low Profile Trap (LPT). The LPT breaks the bullet into small pieces, directing them into the collection bins at the base of the trap. This makes it a simple process to recover the lead and clean the trap. The LPT uses a very small amount of floor space, and allows the target to come within inches of the trap.

PORTABLE TRAP

Action Target offers a portable bullet trap for use in conjunction with the MATCH systems, or for use in other tactical applications. Contact our sales staff for more information.



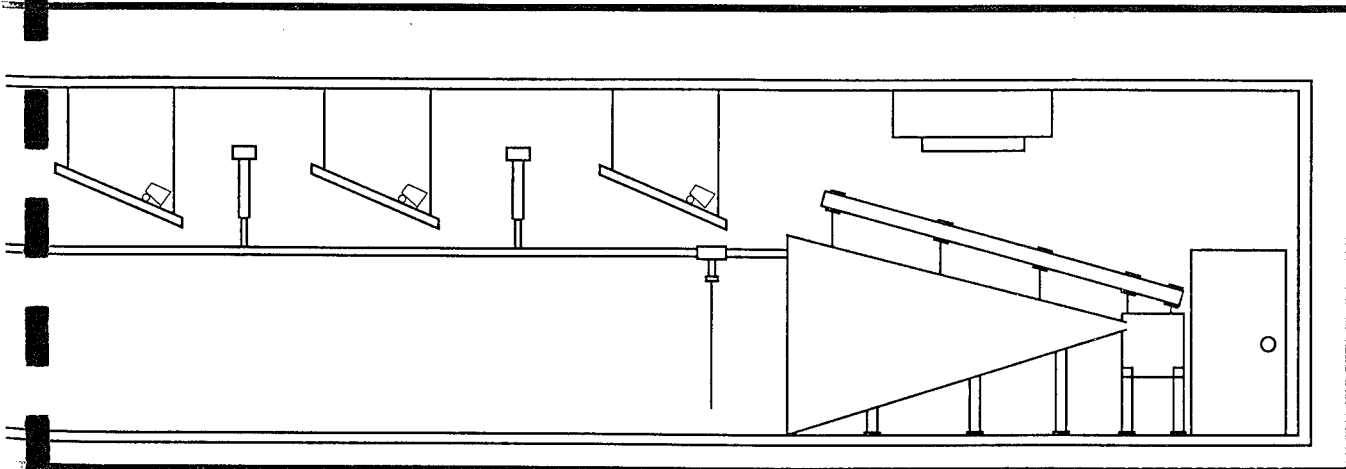
Technical Range Assistance

Technical assistance is available from Action Target for your range design. You can save a lot of time and headache if you let our engineers and sales staff work with you to determine what equipment fits your specific needs and budget. Action Target supports three bullet traps as stock products. Additionally, we can assist you with everything from a simple sand berm designs to high-power water traps. Action Target can help you avoid many expensive pitfalls by providing you with information on environmental concerns, legal issues, and new technology.

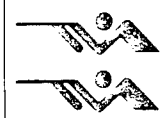
Questions & Answers

- Q:** Why would a bullet trap be needed on an outdoor range?
- A:** With the lead containment and environmental issues so prevalent today, it is becoming more evident that capturing and safely disposing of our lead projectiles makes a lot of sense.
- Q:** Can both handguns and rifles be fired on any type of bullet trap?
- A:** Of the traps made by Action Target Inc., The Total Containment Trap may be used to contain both handgun and rifle ammunition. The Low Profile Trap should only be used with lower velocity rounds.
- Q:** What kind of service and maintenance is required for a bullet trap?
- A:** The amount of maintenance depends on the type of trap you choose. Contact Action Target for a free video describing the different kinds of bullet traps available.

BULLET TRAPS



Indoor shooting ranges



Safety is the main requirement in shooting ranges. The use of REGUPOL is imperative.

REGUPOL products are used as the floor covering, wall- and ceiling padding as the REGUPOL safety features ensure the best possible protection against ricochets.

Floor Recommendations

REGUPOL special floor, consisting of:

REGUPOL-elastic tiles

Size: 500 x 500 x 43 mm
Colour: black
Surface: covered with a 2 mm thick, seamless polyurethane coating.

A test certificate issued by the Shooting Institute Ulm, is applicable to this floor surface (test no. 1211.1/M 89024).

Important: the seamless PU-coating makes wet cleaning possible, resulting in the complete removal of unburned powder deposits.

Alternative:

REGUPOL-elastic tiles

Size: 500 x 500 x 43 mm
Colours: black, red-brown, green
loose laid.

Walls and ceilings

REGUPOL-elastic tiles — size and colour as indicated above — screwed on wooden battens reduce the incidence of ricochets in the range.

Butt

Special construction with REGUPOL-elastic tiles — as described above —

REGUPOL shooting blocks

Size: 500 x 300 x 200 mm
Colour: red-brown.

in addition

REGUPOL roll material

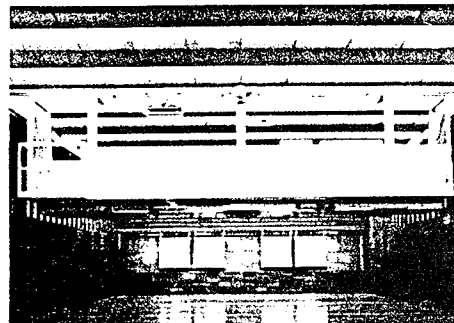
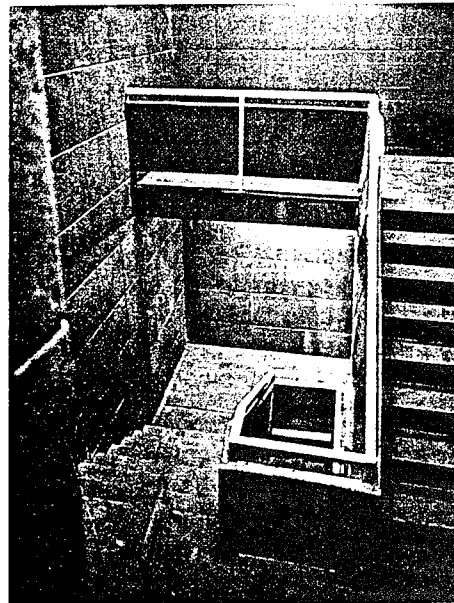
width: 1.250 mm
thickness: 10 to 20 mm
colour: black

as a protective curtain against shrapnel in the butt.

Safety by experience

Construction and performance of shooting ranges require a high degree of responsibility. REGUPOL guarantees safety through many years of experience. This is why the GSG 9 recommend the full facility be fitted with REGUPOL-elastic tiles to ensure complete safety.

Please contact us and we will show you shooting ranges, where the full requirements of safety and security have been achieved with REGUPOL products.



REGUPOL products are also used in outdoor shooting ranges.

Cladding of concrete walls and shields with REGUPOL-elastic tiles
Size: 500 x 500 x 43 mm.

REGUPOL is also recommended to cover steel shields using a sandwich type construction.

REGUPOL-elastic tiles

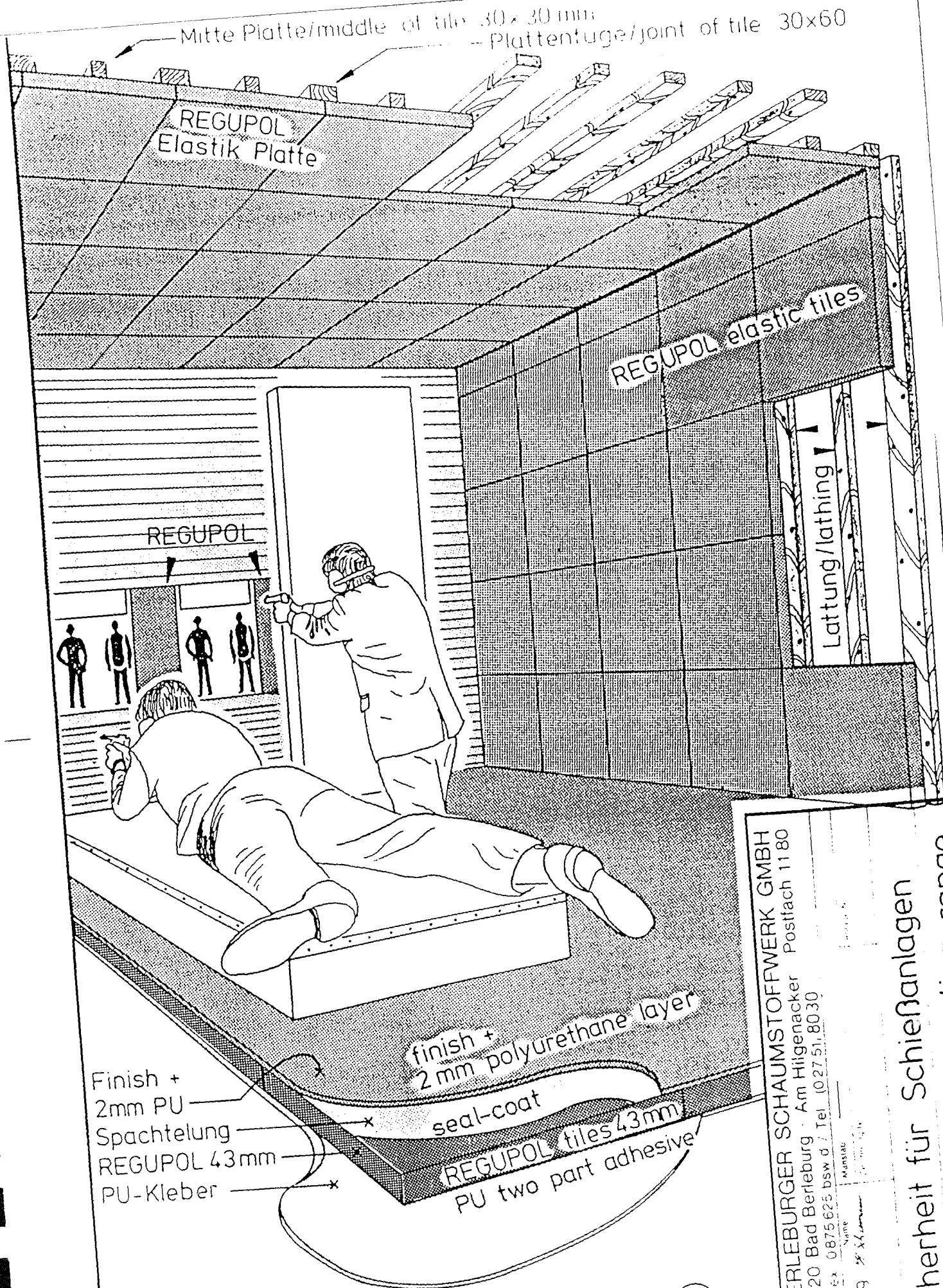
type: profiled
size: 500 x 500 x 50 mm
structure: + 4 mm aluminium backing

For floor surfacing in outdoor areas — access roads, firing positions etc. — we recommend

REGUPOL-interlocking pavement tiles

type: Behaton-form
thickness: 43 mm
colour: red-brown

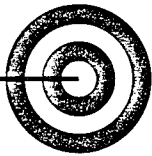




Übersichtszeichnung Nr. 17
example drawing nr.

BERLEBURGER SCHAUMSTOFFWERK GMBH
5920 Bad Berleburg · Am Hiltgenacker Postfach 1180
Telefax 0875 625 bsw d / Tel. 027 51 8030
Münster
Name
Aug 89

Sicherheit für Schießanlagen
safety outfit for shooting-range



SHOOTING RANGES INTERNATIONAL

MAILING ADDRESS: 3030 S. Valley View Blvd.
Las Vegas, Nevada 89102 • (702) 876-5444
SHIPPING ADDRESS: 3240 #D Sirius
Las Vegas, Nevada 89102

SHOOTING RANGES INTERNATIONAL, INC., (SRI) recognizes the growing demand for professional designed and operated indoor shooting ranges. The need for quality, functional, and safe shooting range equipment has come to the fore-front of today's shooting industry. Indoor shooting ranges offer the following objectives in gun use and ownership:

- Firearm education
- Safety
- Training
- Year-round operation
- Controlled shooting environment
- Positive firearm profile
- Environmentally safe for noise and contaminates

SRI BACKGROUND

The principals at SRI have an extensive background in the following four major areas that will benefit you as a potential range owner:

RANGE OPERATIONS

With over ten years experience in operating the largest indoor shooting range in Nevada, SRI can assist you in all areas of range ownership and daily operations. With this working knowledge comes the experience of range materials and equipment.

METAL FABRICATION

Metal fabrication and materials is of major importance to the success of your range equipment. Our metal fabrication facility has been involved in all aspects of metal work and forming. All of our metal fabrication is done in-house. Range components are designed and engineered with specified metals and fabrication requirements.

CONSTRUCTION

With the working knowledge of general construction we can assist you in most areas of planning and building your own facilities. This assistance will save valuable time and money in expediting your construction process.

HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

Indoor shooting ranges have specified requirements for air filtration of smoke, lead and air-borne particles. HVAC for indoor ranges is a major concern. With over 35 years experience in the HVAC industry, at a commercial level, SRI is your complete in-house service for HVAC design and engineering.

ADDITIONAL OPTIONS OFFERED BY SRI INCLUDE:

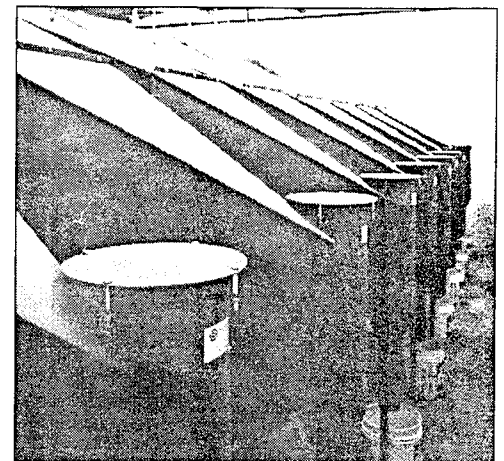
- Full HVAC design
- Complete range starter packages
- On-the-job training
- Technical assistance
- Various range releases

SRI's P393 Pistol & R493 Rifle Bullet Traps

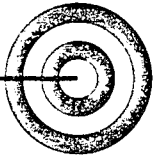
Our patented vertical chamber completely traps the bullet when entering the helical which forces bullet velocity reduction causing the bullet and fragments to fall harmlessly through the funnel into the bullet storage container, located below. Lead collection for recycling is as easy as changing collection containers.

EPA regulations for air filtration and lead clean-up are addressed with this system. Offered with each trap is a direct air exhaust hook-up. Thus all free airborne particles in the trap are exhausted to and collected in the air filtration system. Because of these features, employee's exposure to lead contamination is kept to a minimum. SRI bullet traps offer the following:

- Free standing — self supporting.
- All materials are angle designed for minimum wear.
- Modular design conforms to buildings' various dimensions.
- Superior bullet containment.
- Direct air filtration trap exhaust hook-up.
- Low cost to install and maintain.



Behind the P393 Bullet Trap System, bolt on lids can be removed for inspection. An optional exhaust lid may be used to vent and filter traps directly. Containers are in place to collect the trapped lead bullets.



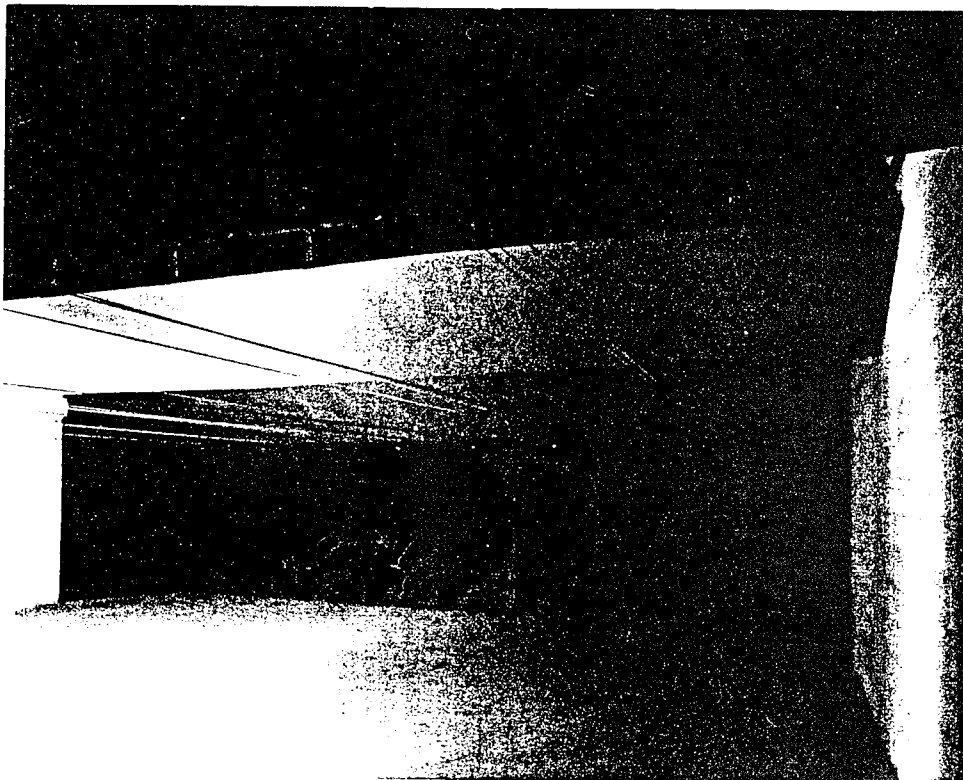
SHOOTING RANGES **INTERNATIONAL**

SRI'S P293 PISTOL & R493 RIFLE BULLET TRAPS

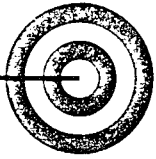
The SRI bullet trap actually traps the bullet when it enters the helical which forces bullet velocity reduction until the bullet and fragments fall harmlessly through the funnel into the bullet storage container. Lead collection for recycling is as easy as changing collection containers.

EPA regulations for air filtration and lead clean up are addressed with this system. Each trap comes with a direct air exhaust hook up. Thus, all free airborne particles in the trap are exhausted to and collected in the air filtration system. Because of these features, employee exposure to lead contamination is kept to a minimum. SRI bullet traps offer the following:

- * Free standing-requires no building support.
- * All materials are angle designed for minimum wear.
- * Modular design conforms to buildings various dimension.
- * Superior bullet containment.
- * Direct air filtration trap exhaust hook up.
- * Low cost to install & maintain.

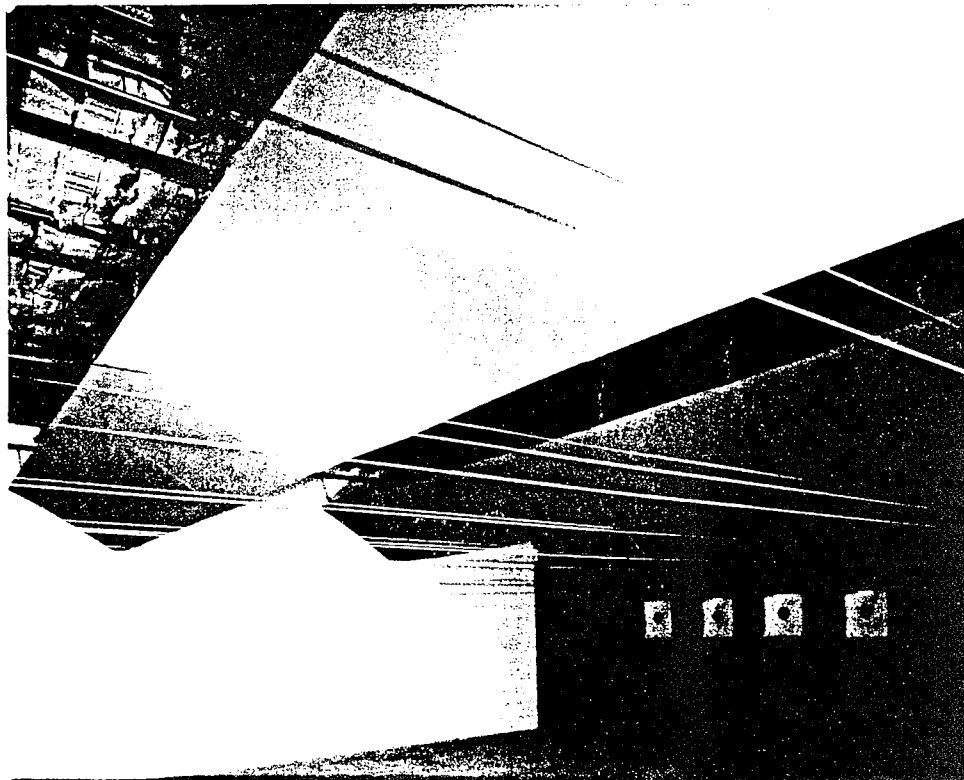
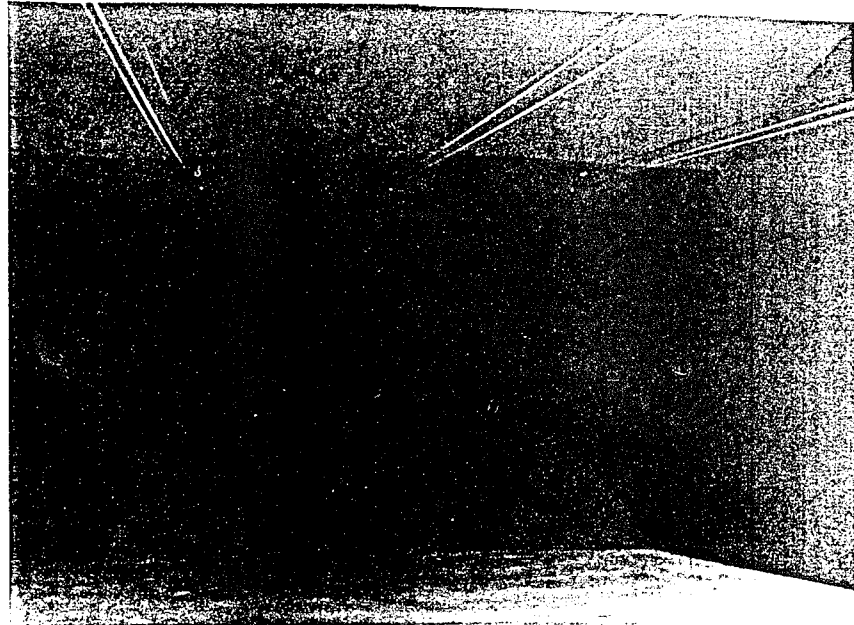


COMPLETED EIGHT LANE BULLET TRAP SYSTEM. ALL STEEL COMPONENTS ARE RECESSED INTO WALLS AND FLOOR TO ELIMINATE EXPOSED EDGES.



SHOOTING RANGES
INTERNATIONAL

**P393 PISTOL TRAPS
WITH TARGET
RETRIEVAL ENDS.**



**CEILING GUARD
DEFLECTION PLATES
HANGING FROM A
STANDARD ROOF
TRUSS SYSTEM.**

FRA.SA.

Study and Research Divisions

Mechanic

Operative



Lead and lead-poisoning dangers

Lead is a metal which comes in natural state in the form of "galena" (or lead-sulphide).

Lead is highly poisonous to human organism when assimilated pure or as alloys or compounds.

The most common occasions of lead assumption are represented by industrial processes concerning lead: mining of raw mineral, high temperature processing involving fumes or dusts output, manufacturing or use of lead objects or its compounds (parasiticides, dyes, mordants, polyvinyl-resins stabilizers, alloys for printing types or parts of internal combustion engines), manufacturing of battery plates or of special glasses. In addition to the above mentioned causes, affecting mostly people directly concerned with special manufacturing, others, represented by lead contained in food and by hydrocarbon polluting the air of our towns, affect the population in general.

Assimilated through breathing or food, lead deposits in red blood cells and thereat in liver, kidneys and ultimately

in bones. From such organs lead is eliminated slowly through faeces or saliva, or more rapidly, in case of intoxication of chronic or saturated subjects. The pathologic syndrome of lead intoxication is called SATURNISM or LEAD-POISONING. It affects digestion and circulation, kidneys, nervous and bone systems. Symptoms are characterized by anemia, stomach and gastroduodenal diseases, hyperazotemia, high-blood pressure, brain pathologies with paralysis of peripheral nerves and, in some cases, death.

To a correct diagnosis it is important to demonstrate the direct exposure of victims to lead fumes, dust or smoke in such a quantity as to cause intoxication. Therapy provides for immediate removal of intoxicated subjects from the dangerous activity.

Prevention operates reducing polluting activities and controlling production and use of lead substances or alloys. In high risks subjects (such as firing ground instructors), the action of lead on blood can dangerously be coupled with that of carbon-oxide forming carboshaemoglobin.

The problem of lead oxide in indoor firing grounds

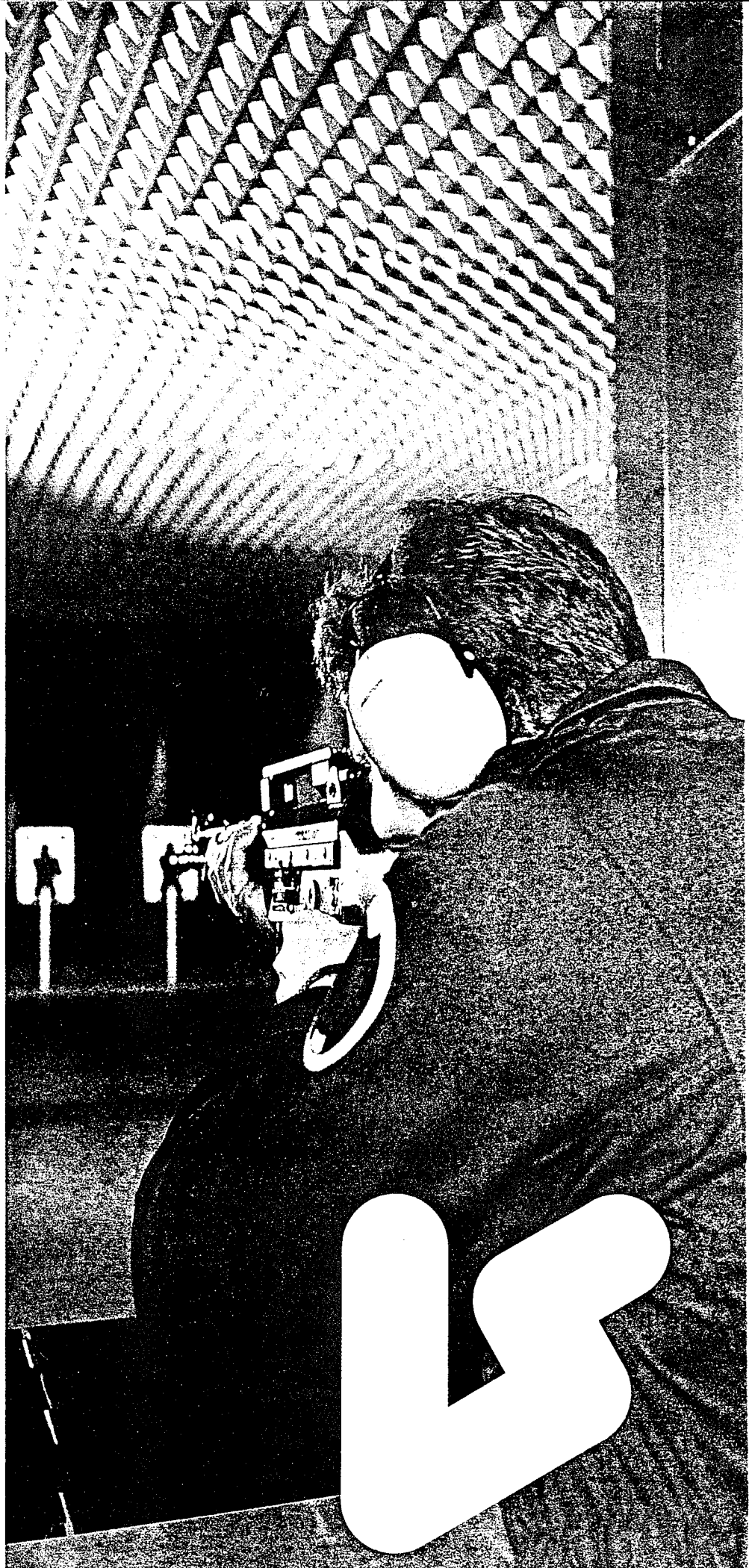
In western Europe countries, progressive urbanization, high density of population and road networks make more and more difficult the survival of outdoor firing grounds. Today, the trend is toward hypogean or indoor firing grounds.

In these structures, though, the problems of lead oxide and the need to expel it by previous filtrage of fumes and dusts remain unsolved.

The impact of a military-type bullet against a buffer screen generates a very high temperature which vaporizes the lead part of the ogive and pulverizes the coat, producing fumes made of lead oxide and microscopic metal particles.

In average size firing grounds 8000 shots are fired each day; consequently, the above-mentioned process involves 73 kg of lead, nickel and copper each day (23 tons a year) which are transformed in highly toxic fumes. To eliminate dust and smoke without danger for man and environment, a filtering device capable of treating 6 million cubic meters of air per hour, would be needed. Such structure is practically impossible to realize.

The lack of a solution to the problem of eliminating lead oxide from firing grounds has represented so far a great obstacle to the training of military detachments not provided with outdoor firing grounds, while indoor training has requested more than a risk in terms of physical health.





The FRA.SA., in two years' highly costly experimentations and studies, has tested all already-known solutions, their effectiveness and possible improvements.

Among more usual, gas filtering and digestion, which is however too complex and expensive. Moreover, its purification effectiveness is no more than 60% and involves the doublefold problem of 1) releasing into the atmosphere fumes not completely purified and 2) finding a place to discharge polluted filters which no local administration would allow.

Equally unfitting were the "Energy-lowering shields" because of high costs, short duration of diaphragms and complexity of

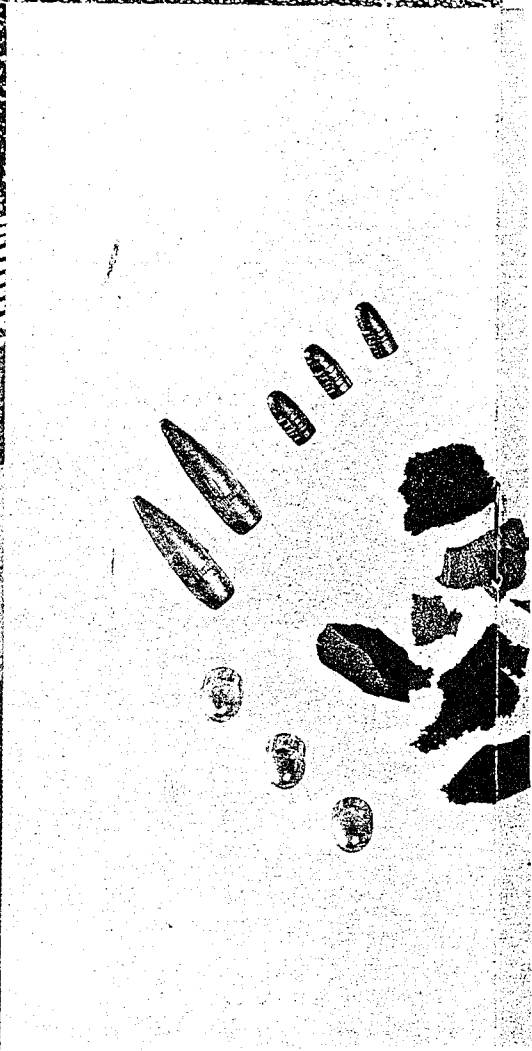
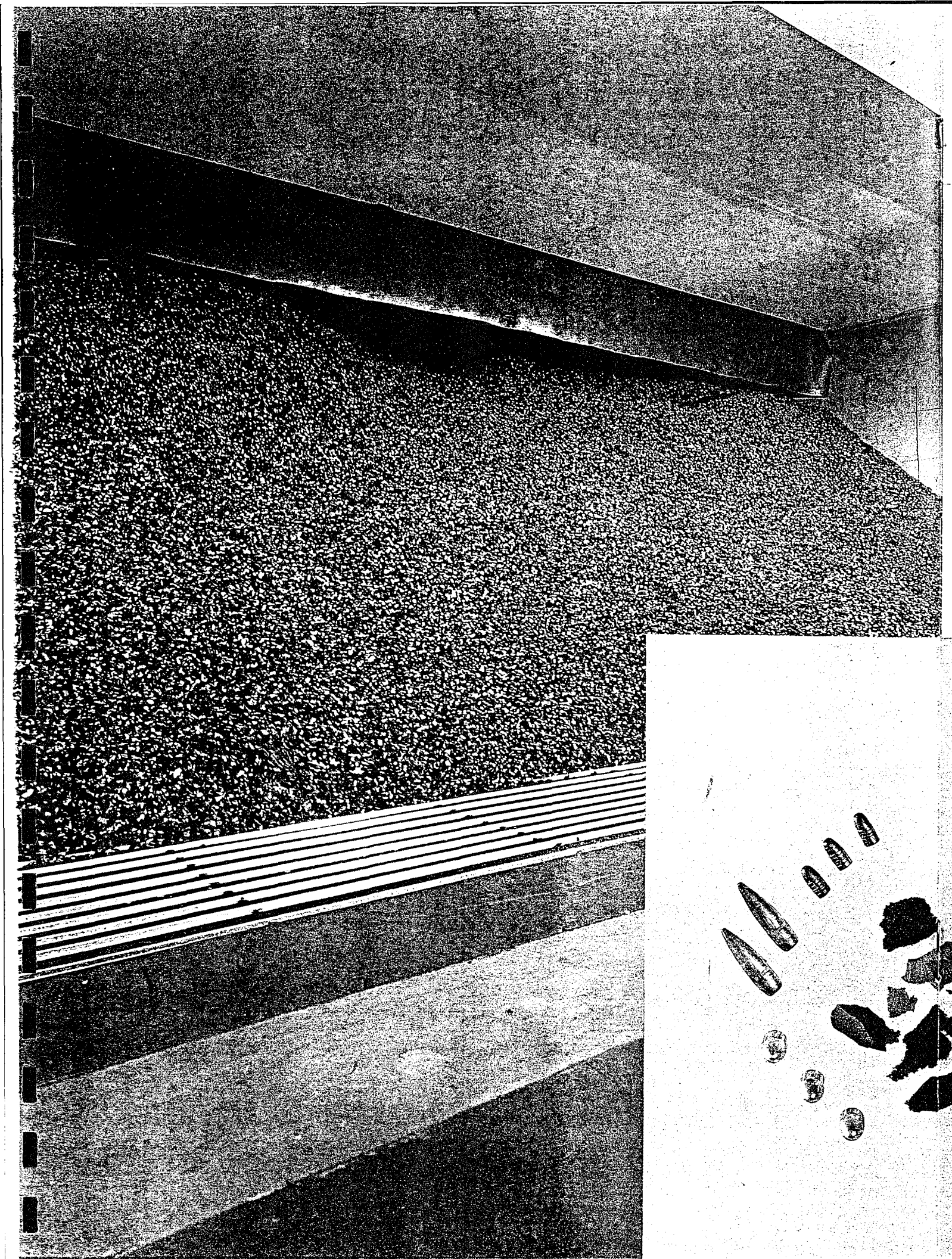
maintenance. The solution came when, leaving apart traditional systems, a completely innovative structure was devised.

The innovation started a new era in indoor firing grounds, eradicating from the source the causes of lead oxide fumes inside the firing ground.

With this new system, Italy places itself in the van in the field of indoor firing grounds building for war weapons and great volumes of firing activities.

The innovation consists in a bullet buffer made of elastomeric granules kept together only by their very same weight, in which noses plunge slowing down their kinetic energy gradually





so as not to suffer alterations of any kind except that of rifling.

The elastomeric granules screen looks like a trapezoid bulwark running along the whole length of the terminal wall of the shooting lines. The screen is equipped with mechanisms which reshape, automatically and continuously, its geometry which the impact of bullets tends to modify. The reshaping is so rapid that the "hole" of the ogiva is sutured before the following bullet reaches the screen, even in the case, almost impossible to happen, that the following ogiva, shot from an automatic gun, had the very same trajectory.

As to the material of the elastomeric granules, it is an insulating sponge deriving from a polymer made of nitrilic rubber and PVC treated with puffing agents.

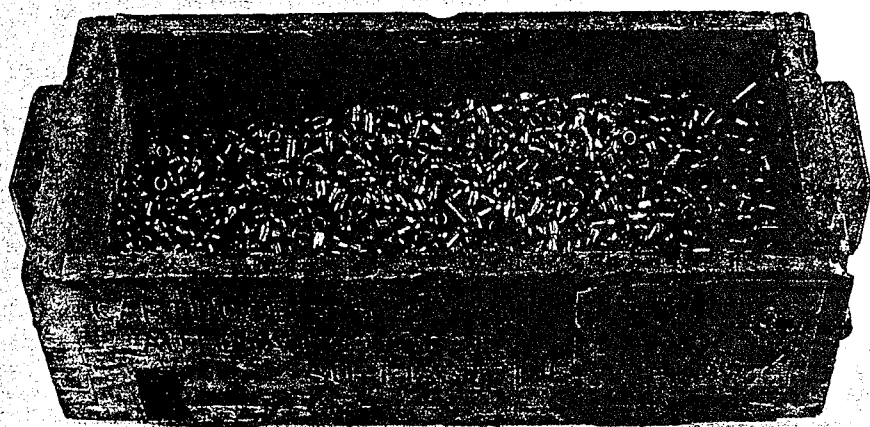
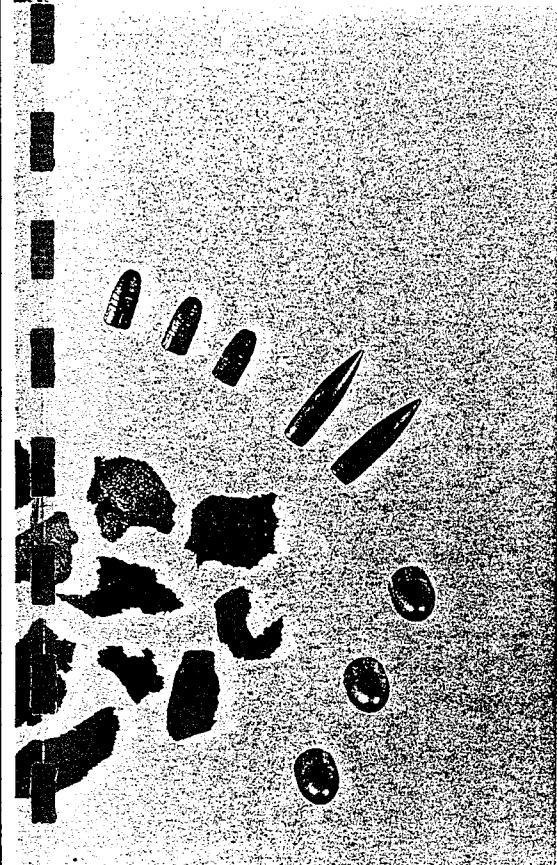
The very nature of the polymer assures high resistance to ageing and self-extinguishment, which is increased by the addition of special substances. In addition, the mineral charges contained in the spongy mass grant thermoacoustic insulation and hydrorepellence.

Advantages and new possibilities offered by FRA.SA. 1°

The value of an innovative technical solution lies in the advantages and in the additional possibilities it offers as regards to traditional solutions. Some of the advantages of FRA.SA. 1° are evident, others came out by experience: it's usual with easy, but revolutionary solutions. Hereunder are

some of the advantages and new applications the innovation offers to firing grounds.

The main advantage that the ELASTOMERIC GRANULAR SCREEN offers is the solution to the problem of lead oxide, because the screen eliminates from the origin the cause which generates it: in fact, firing grounds which shall adopt the new structure will not have at all to deal with this problem, nor they shall have to worry about violation of anti-pollution regulations. In addition, an indoor firing ground free from lead fumes offers more security, internal and external, in comparison to outdoor ones. The absence of lead oxide filtering devices shall not create problems of impeachments or complaints in case of malfunctioning. Rebounding of bullets from the Elastomeric Granular



Screen is practically impossible.

Test shots fired against the area immediately around the screen always hit the screen itself without lead losses or damage of the ogive coating. The overall weight of the screen and of its equipment is inferior to that of conventional hard buffers.

The mechanical part of FRA.SA. 1° is much simpler and less expensive than a lead oxide purifier. Running costs of such mechanical part are much less expensive than any purifying device. Energy consumption of FRA.SA. 1° is only 10-20% of the total energy consumption of an indoor firing ground.

Control and maintenance of FRA.SA. 1° can be made occasionally by non specialized staff.

The elastomeric granules do not lose their characteristics because of oxidation or absorption of bullets kinetic energy. The duration of the elastomeric screen is at least equal to that of conventional buffers. In case of decrease of the granules volume (signalled by sensors or found out directly), all losses can be "topped up" in the mass movement circuit or directly in the elastomeric screen.

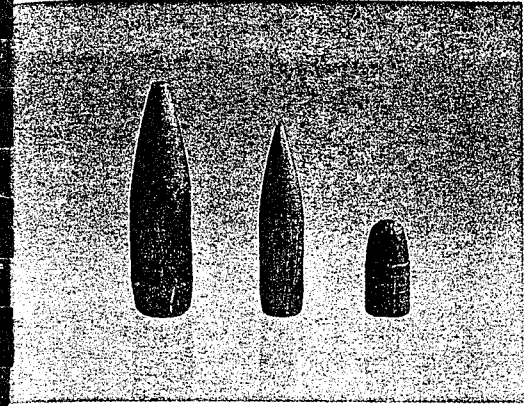
FRA.SA. 1° does not have delicate or complex devices difficult to replace: both static and dynamic parts are simple and resistant. The material of granules is absolutely fire-repellent and does not take fire

spontaneously; in case of need it can be destroyed by incinerator or it can be re-used in housing thanks to its high sound absorption quality as filling of anti-acoustic hollow spaces. The impact of tracer bullets makes on the screen the same almost undetectable effects of normal ogives. In normal hard bullet buffer screens, the noise of the impact of the ogive sums up its decibels to that of the shot. In firing grounds equipped with electronic score indicators, such echoes may distort scoring. Anomalous shots can rebound ogives on indicators located at targets feet and damage them. This will not happen with FRA.SA. 1°.

But the far most impressive and almost unexpected result of the research is that elastomeric granular screens leave ogives practically intact. Just grazed by the rifling, the could be salvaged by re-gauging, or the metal might be retrieved by fusion. In addition, the rifling trace could tell of the state of wear of weapons, and the identical weight of the retrieved ogives could allow easy calculation of the bullets used (by means of a piece-counting balance) especially in Police firing grounds where Parabellum cal. 9 bullets are almost exclusively used.

In addition to the above mentioned advantages, the FRA.SA. ABSORBING ELASTOMERIC GRANULAR SCREEN offers other advantages that hard traditional screens cannot give: the absence of lead

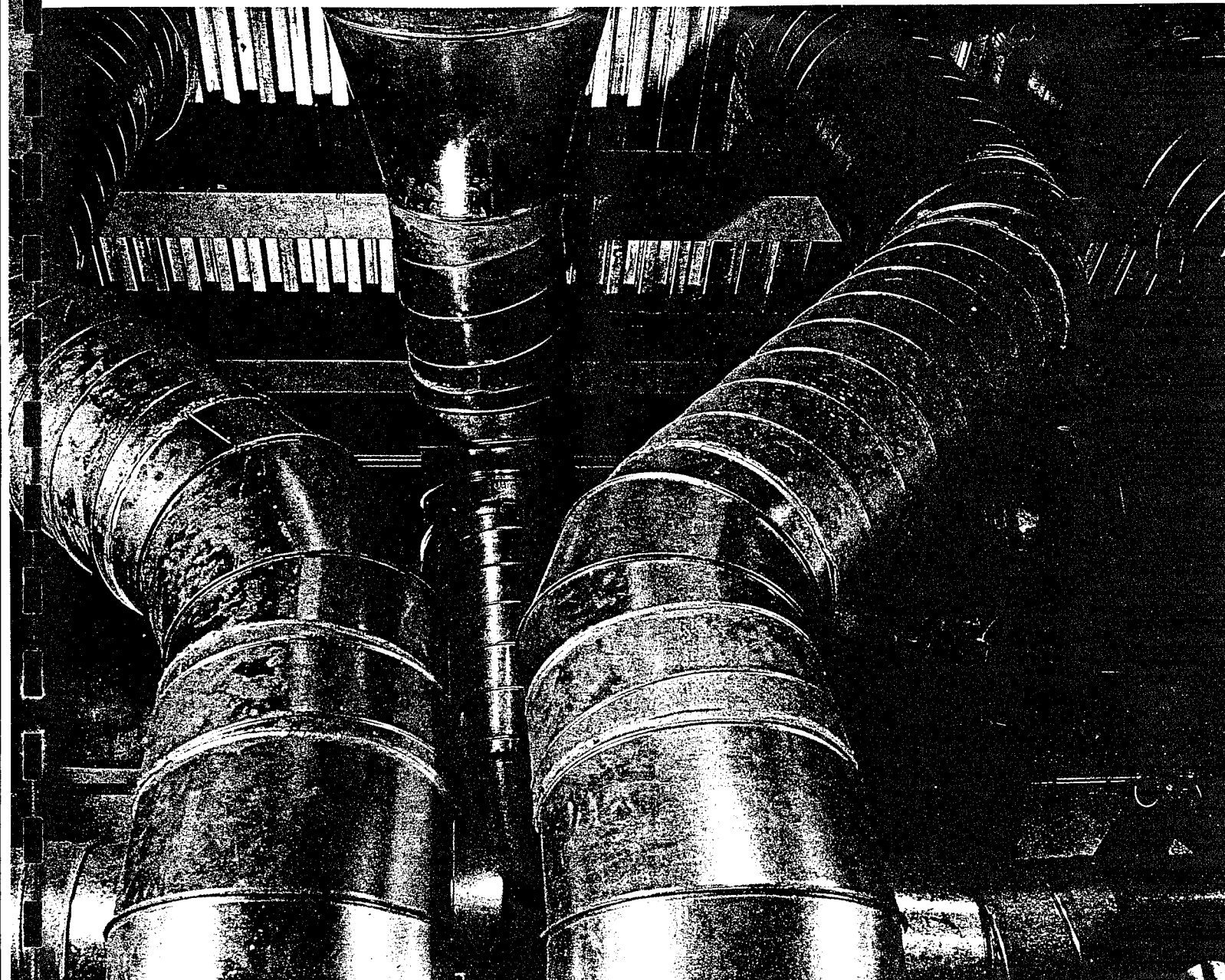


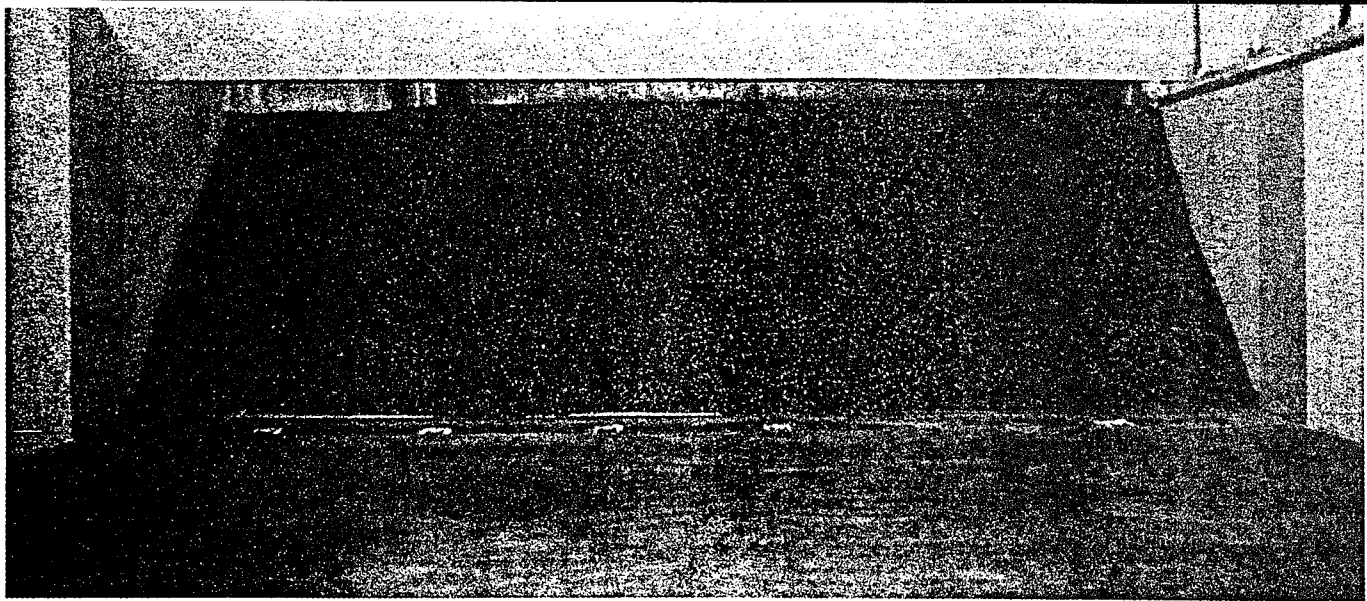


fumes allows the presence of both indoor and outdoor firing grounds within the range of inhabited settlements. In high cost urban areas, it might be convenient to install civilian firing grounds in basements or depots, etc..

An Elastomeric Screen would also be very useful in civilian firing grounds where short defence weapons or hunting rifles are used, because of the same lead oxide problem. The adoption of FRA.SA. 1° in outdoor firing grounds would eliminate the continuous and expensive

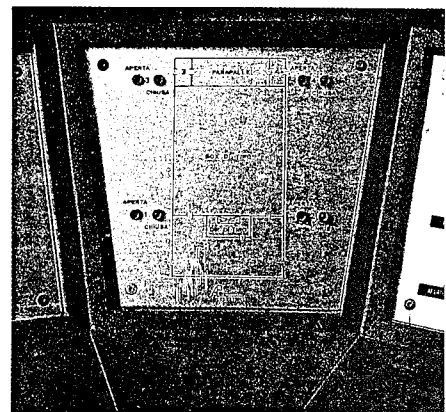
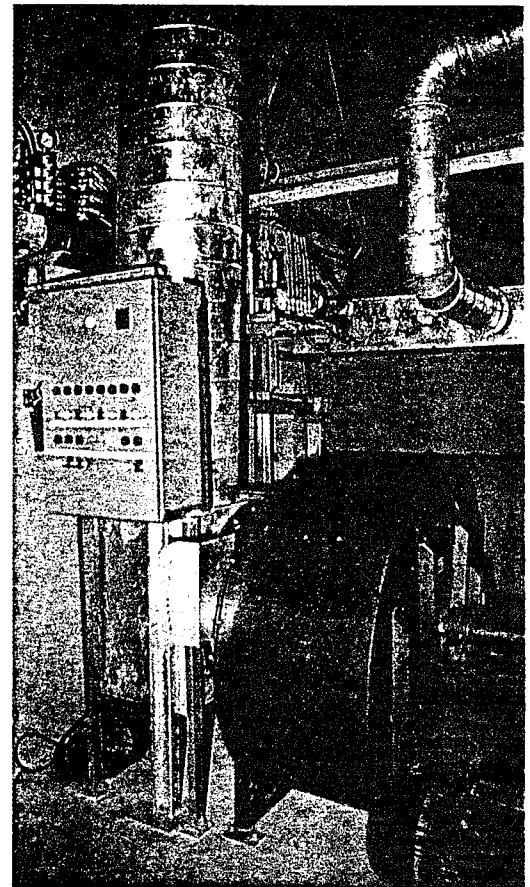
substitution of wood bullet buffers still used. In many firing grounds built by FRA.SA. the overhanging area may be used for other purposes, even in case of a water-bearing stratum just two meters from the surface. The dimensions of the FRA.SA. Elastomeric Granular Screen can be adapted to civilian long or short weapons, even automatic, and to military automatic weapons. The screen can even absorb the impact of non-explosive machine-gun bullets. The absence of lead oxide allows continuous and





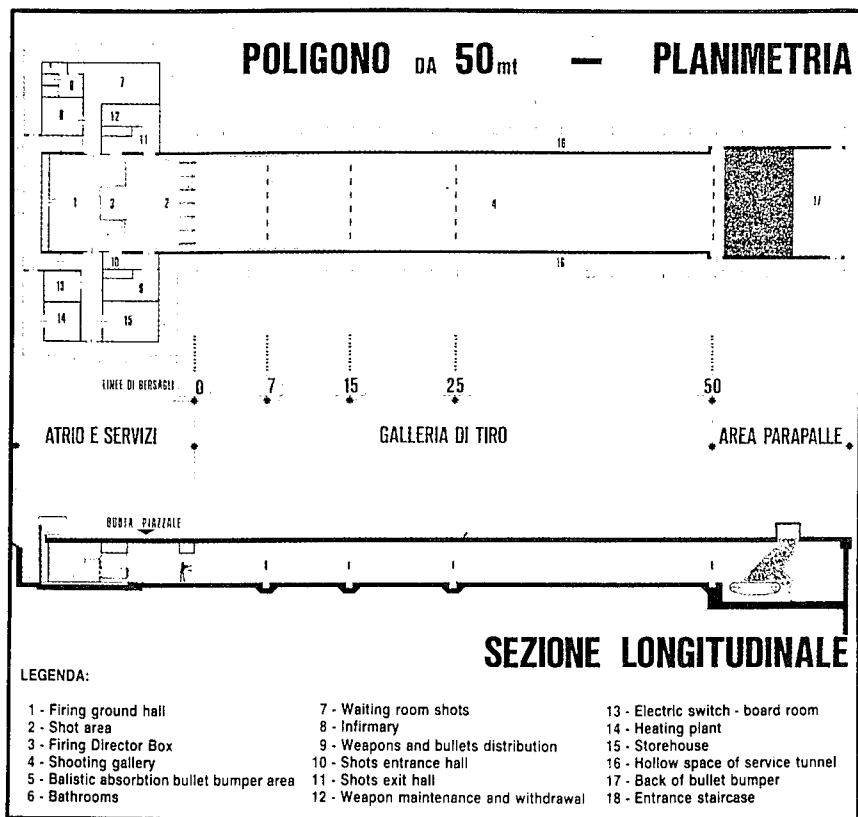
simultaneous use of a great number of guns, which firing volume would create problems to any depuration system. If the ongoing research for new and improved solutions would identify a material more suitable or more convenient to the functions carried on by the elastomeric granules of FRA.SA. I°, they may be easily replaced. In fact, FRA.SA. I° is equipped with an automatic cleaning out device. The back of the Elastomeric Screen rests on a vertical ballistic steel wall which serves as ultimate impassable obstacle. This characteristic allows the fitting of FRA.SA. I° structures to hard buffer screens with relatively low costs. These, in brief, the advantages and the new possibilities of the FRA.SA. I° tested by research and by experience deriving from our installation at the Caserma Italia at Ostia Lido. Its realization was made possible thanks, in particular, to the receptivity of our military H.Q.. As to the above mentioned training structure, it is the first firing ground equipped with the FRA.SA. I°

Elastomeric Granular Screen. The Caserma Italia is equipped with the most advanced and sophisticated security systems, as the pamphlet shows. It can be considered the most advanced structure of its kind. The screen, which is an integral part of the whole structure, has been tested, under our request, by the National Test Stand of Portable Firing Weapons at Gardone V.T. and was declared absolutely and completely qualified for its functions. Each part of the FRA.SA. I° is worldwide trade marked. The FRA.SA. I° Company has been collaborating with the Italian Armed Forces for more than a decade realizing numerous traditional firing grounds all over the country. At present, it is building three more grounds all equipped with FRA.SA. I°: one in Turin, for the Customs Corps and two others at Albenza and Montorio Veronese for the Army. The FRA.SA. is a national enterprise, totally financed by Italian capitals. Its administrative seat is in Rome, Via del Giordano n° 44.



The technical and legislative aspects of the problem

The presence of lead in air, water and in the food chain is one of the reasons of the actual environment degradation. The motivation of the numerous EEC laws illustrates the seriousness of the problem which shows an alarmingly growing trend. The activities of an indoor firing ground, which creates lead compounds, fall within the EEC rules enacted by the Council Directive of July 28, 1982 (Art. 2 - par. 1 - comma 2° - an. I, N°10, 19 and 24 and art. 11, 12 and 13) EEC Official Journal n° L 247/12 of August 23, 1982. The Directive provides for periodical control of indoor environment (art. 4 - par. 5 - an. 4) and on physical conditions of staff, with immediate intervention (art. 8 and 9) if lead concentration in the air exceeds 150 mg/m³. Such value corresponds to the set of rules of the American Conference of Government Industrial Hygienists (ACGIH), universally accepted. In the same environmental responsibility framework, recycling or elimination of lead, zinc and copper dusts accumulated near ballistic bullet buffers are still unsolved: dusts are taken occasionally and with inadequate techniques, while recycling does not have guarantees or controls of any kind. In indoor firing grounds gas or fumes problems can be partially solved at atmospheric level, but certainly not at water or land level.



Control of the air inside an indoor firing ground made 4' after a 250 shots salvo of 7.62 NATO gave, for the sole particles with diameter inferior to 0.3 Mm, a concentration of 6.22 mg/m³ within the range of 25 m from the ballistic bullet buffer.

Such concentration spread in the whole gallery in 10' with a dilution not exceeding 1.900 mg/m³. For particles larger than 0.3 Mm, maximum concentration reached 90.100 Mgr/m³ with a polluting cloud extended up to 56 m from the screen.

Minimum concentration that can be obtained by a filtering device intervening on the above mentioned conditions is 480 mg/m³. Regulations prescribe maximum tolerance of 2 mg/m³.

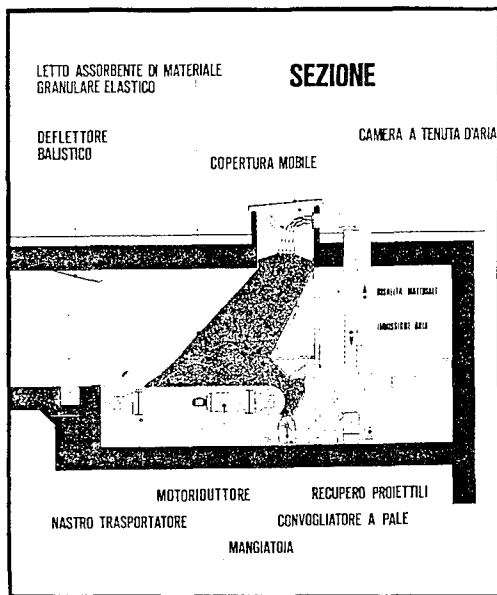
Such situation derives partially from the fact that the

filtering device cannot keep particles with a diameter smaller than 0.3 Mm, to capture which a chemical process not yet available would be needed.

Therefore, at present, in indoor firing grounds equipped with ballistic bullet buffers, internal and external conditions cannot be modified without a radical transformation of the bullet stopping system.

National and local authorities are trying to find reasonable compromises between environment safeguard and continuation of necessary activities.

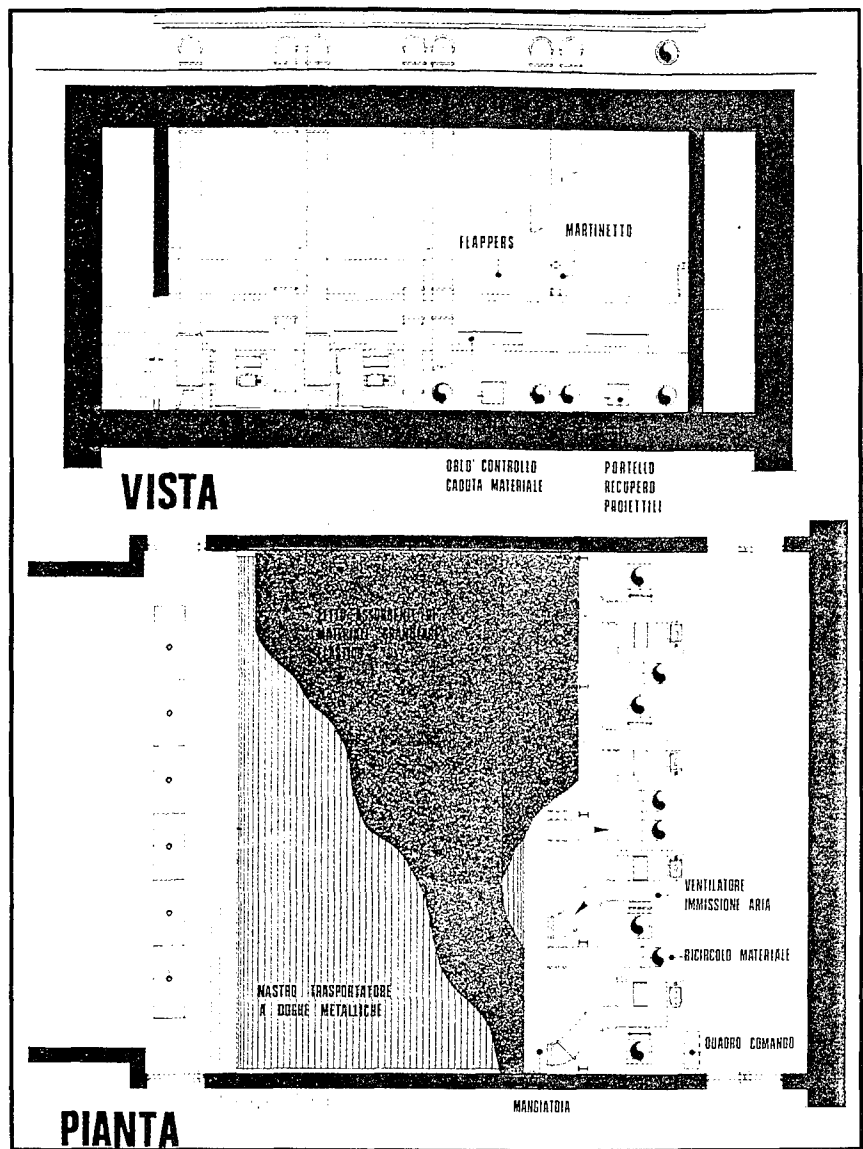
The solution offered by FRA.SA. I° eliminates at the root the problem of lead fumes inside and outside firing grounds. Our solution also offers the legislator all elements for its adoption as a mean of progressively improve the



quality of atmosphere. FRA.SA. 1° should be included, for its characteristics, among those devices admitted to benefit from subsidies provided for environmental protection in all EEC state members.

Costs collation

A mere mathematic collation between a buffer originating lead fumes and dust and one which does not, is totally useless. To evaluate the difference between a "clean" activity and one producing polluting substances, it would be necessary to analyze elements pertaining more to civilization than to a given technique. In addition, the collation would be between an obsolete structure (which might even be out of rules and that would only partially fulfill its function), and another which is innovative, modern and totally meeting its function, offering in addition a number of advantages that might be considered a sort of "innovation revenues". FRA.SA. 1°, in fact, besides being self-paying and having installation and management costs by far more inferior to obsolete structures, is also superior as for mechanical and technical



| TYPE OF BULLET BUMPER | TOTAL COST BASE 100 | PARTIAL COST | | MAINTENANCE COSTS |
|-----------------------------------|---------------------|---------------|-----------------|---|
| | | BULLET BUMPER | FILTERING PLANT | |
| Metallic | 100% | 51.6% | 48.4% | + 5.9% |
| Elastomeric absorption FRA.SA. 1° | 55.3% | 55.3% | ∅ | Totally offset by market value of unspoiled retrieved bullets metal |

wear. Therefore, it is clear that the cost of the elastomeric buffer completely equipped is nearly the half (55.3%) of a ballistic bullet buffer equipped with indispensable filtering devices.

The above table was elaborated on the basis of 1986 costs revalorized at 1987 (ISTAT

basis). Recent experiences show that the elastomeric mass composing FRA.SA. 1° needs movement and filtering only for one hour out eight of training, with enormous energy and mechanical wear saving, and an overall duration up to 10 times longer.