

ARTICLE 1. INTRODUCTION

1.01 The Range

- 1.01.1 Shooting ranges are places where people may participate in recreation, competition, skill development and training with either firearms, archery equipment or air guns.

1.02 Purpose of Source Book

- 1.02.1 This source book provides both basic and advanced guidance to assist in the planning, design, construction and maintenance of shooting range facilities. This source book discusses methods and technologies which, if applied conscientiously, can result in a fuller and more rational use of land areas for range operations.
- 1.02.2 The purpose of a shooting range is to provide a location where people can enjoy various shooting sports. A shooting range should satisfy a number of goals, including the following: recreational shooting sports enjoyment; reasonable cost of construction and operation of the range facilities; and reasonable accommodations for the safety of both those utilizing the range and the general public. A reasonable satisfaction of these needs can only be achieved when one considers the entire context in which a particular facility will be operating, the type of shooting sports that will be conducted, the rules and controls that will be employed, the overall physical design of the range, and last, but not least, all aspects of the surrounding environment (terrain, population density, etc.).
- 1.02.3 Besides meeting the objective of allowing the range to function for particular shooting purposes and other functional considerations, an important concern is that the range satisfy reasonable expectations of safety for range participants and the public at large. A determination that a range satisfies such reasonable expectations can only be made by a thorough professional evaluation of the range.
- 1.02.4 The purpose of this source book is not, under any circumstances, to act as a substitute for such a thorough professional evaluation of a range. Such an evaluation should take into account all of the aforementioned considerations. This source book may not be used in lieu of the evaluation of engineers and architects that are required to design a range. The application of specific design features set forth in this source book requires an assessment of the functional utility of any such features for the range subject to evaluation by architects and/or engineers. This Source Book is merely provided for the purpose of furnishing certain general engineering, design and other strategies, information and ideas that may be employed, based upon the particular circumstances of a particular range, where there is a demonstrated need for such applications.
- 1.02.5 This source book will provide certain information and strategies and specifications that may or may not be useful or applicable, depending upon the particular circumstances and objectives of a particular range. The various designs, strategies, specifications, suggestions and information contained in this source book are not, merely by reason of their inclusion in the source book, intended to imply that all of them, or in fact any of them, are necessary or even applicable, to the design of every range or any particular range. For these reasons, this source book may not be utilized to establish design standards or criteria for ranges.

ARTICLE 3. SOURCE BOOK ORGANIZATION

3.01 Source Book Design

- 3.01.1 This Source Book is designed to provide technical guidance and typical examples of physical layout and equipment used on firing ranges for various firearms, ammunition types and shooting activities. Further, many of these facilities may be provided in various indoor and outdoor configurations.

3.02 Range Categories

- 3.02.1 Ranges are categorized by the type of construction, shooting activity, target, firearms and ammunition to be used on them. These categories introduce factors which will influence the design, dimensions and/or layout of the facility.

3.03 Source Book Organization

- 3.03.1 The Source Book is divided into two types of chapters: general and technical. General chapters deal with information necessary for any shooting facility, while the technical chapters concern specific shooting activities. By combining general chapters with those dealing with specifics, individual packets can be arranged to plan, design and construct a specific range type. Divided into three sections, the Source Book first presents introductory information, then planning and general guidance, followed by technical suggestions on how to design and construct both indoor and outdoor facilities.

3.04 Source Book Overview

- 3.04.1 This source book provides basic drawings of range layout and equipment. It is not practical to discuss local ordinances or zoning/building codes or specific topographic and geological conditions. The technical information along with information gathered from on-site visits and from studying local ordinances provides the basis for planning and design of a range facility. Simply to impose a "standard" plan onto a parcel of land or in an existing building, without considering the site's individual conditions, is to invite improper planning with unsatisfactory results.
- 3.04.2 Proper design work requires a practical understanding and knowledge of local ordinances, codes and engineering principles. Therefore it is recommended that an engineer, architect or consultant experienced in range planning and design be consulted from the outset of the project. Those involved must know why certain policies and procedures must be followed and the consequences should they not be.
- 3.04.3 Locating the best people from the local area is of primary importance. Gun club member surveys often reveal experienced individuals such as architects, engineers, attorneys and real estate personnel. Of all the professionals a club or association or private business can locate, one of the most important is an experienced land development attorney. This person can save countless hours by completing the necessary sequences of transactions when a site must be purchased or leased.
- 3.04.4 During the planning and design phases of the project, safety must be paramount. Remember that health and safety considerations are twofold: (1) ensuring the health and safety of participants, staff and spectators, and (2) ensuring the health and safety of surrounding inhabitants. Unless both of these aspects are incorporated into design criteria, the range will soon experience problems.
- 3.04.5 The Range Source Book is a technical publication for shooting range builders and operators. All information contained herein is in the form of suggested practices only, and no standards are stated or implied. Failure to follow each, every, or any of the suggestions in no way implies that the range is being operated negligently. Nothing contained herein shall be construed as a standard for the evaluation of any specific shooting facility.

ARTICLE 4. TERMINOLOGY

4.01 Clarification of Terms

4.01.1 Certain words, terms and phrases have meanings beyond those found in dictionaries, especially when used technically to refer to a specific activity or business. The shooting sports are no exception. The following definitions clarify the use of these terms throughout this Source Book. Please note that these definitions are not 'legal' or 'statutory' definitions; i.e., they should not be used in order to determine compliance with the law. You must look to the specific applicable federal, state or local law, statute, ordinance and/or regulation in order to determine the legal definition of a term in order to determine compliance with the law.

4.02 Definitions

Action: The "working mechanism" of a firearm that loads, fires, extracts and ejects a spent cartridge, and in some instances, reloads a new cartridge.

Archery: The shooting of arrows or bolts from a bow. See Bowhunting.

Backstop: A device constructed to stop or redirect bullets fired on a range.

Baffles: Barriers to contain bullets and to reduce, redirect or suppress sound waves. Baffles are placed either overhead, alongside or at ground level to restrict or interrupt errant or off-the-target shots.

Ballistics: The study of what happens to moving projectiles in the barrel and in flight--their trajectory, force, impact and penetration. The study is divided into three sections: internal, external and terminal. "Internal" refers to what happens inside the barrel before the bullet or shot leaves the muzzle. "External" is what happens after the bullet or shot leaves the barrel and travels to its final point of impact. "Terminal" is what happens to the bullet or shot at the final point of impact.

Ballistic Coefficient: A number which indicates how a bullet's shape, length, weight, diameter and nose design affect its stability, velocity and range against air resistance.

Barrel: The metal tube of a gun made from iron or steel, through which the bullet or shot charge passes when the gun is fired.

Berm: An embankment used for restricting bullets to a given area, or as a protective or dividing wall between ranges.

Blackpowder: A finely ground mixture of three basic ingredients sulfur, charcoal (carbon), and saltpeter (potassium nitrate). Often used to refer to blackpowder substitutes, such as Pyrodex.®

Bowhunting: A term used to describe the act of hunting game with bow and arrows/bolts.

Breech: The rear end of the barrel. In modern arms, the portion of the barrel into which the cartridge is inserted. See Chamber.

Breechloader: A firearm loaded through the breech.

Bullet: A single projectile fired from a firearm.

Bullet Trap: A device designed to trap or capture the entire bullet and fragments as opposed to redirecting the projectile into a water or sand pit.

Cartridge: A self-contained unitized round of ammunition that is made up of a case, a primer, powder and a bullet. The case is usually made from brass but may be steel, metal alloy or plastic.

Chamber: The enlarged portion of the barrel at the breech in which the cartridge is placed ready for firing.

Direct Fire Zone: The area on a shooting range established according to the relationship of the shooting position and target position. Typically set up on a one-to-one basis (one target to each firing point).

Discipline: A means of enforcing rules, including procedure, penalties and administrative processes. Also, a field of study or a type of shooting practice or competition.

Escalator Trap: A steel plate structure used as a bullet trap on indoor and outdoor ranges, designed to slope away from the bullet impact so that the bullet upon striking the plate will be directed upward along the surface into a swirl chamber where remaining bullet energy is expended.

Firearm: A term used to describe any gun, usually small, from which a bullet is propelled by means of hot gasses generated by burning powder (usually smokeless or blackpowder).

Firing Distance: The distance between the firing line and the target line.

Firing Line: A line parallel to the targets from where firearms are discharged.

Firing Position (Point): An area directly behind the firing line having a specified width and depth that is occupied by a shooter, his equipment and, if appropriate, an instructor or coach.

Firing Range: (1) A facility designed for the purpose of providing a place on which to discharge firearms, shoot air guns and/or archery equipment; (2) May refer to several ranges constructed in a complex.

Firing Range Complex: A grouping of two or more ranges of differing types, purposes or firing distances located at a single site location or property. It may include club houses, parking facilities and other related structures.

Flying M: NRA-sanctioned action pistol shooting event Timed-Man-Against-Man.

Handgun: A term used to describe pistols, either auto-loading, single shot or cylinder types held in one or two hands with no other support, such as a shoulder stock, etc.

Horizontal Bullet Catcher (Eyebrow Catcher): A device installed along a backstop, a berm, or on the range floor, and designed to capture ricocheting projectiles. More frequently used on backstop areas where the slope does not positively contain bullets.

Impact Area: That area in a backstop or bullet trap directly behind the target where bullets are expected to impact. The term may also refer to an area down range of an outdoor range where bullets will impact if not captured in a backstop.

Line of Sight: An imaginary straight line from the eye through the sights of a firearm to the target.

Magazine: The part of a repeating firearm which holds the cartridges in position ready to be loaded one at a time into the chamber. The magazine may be an integral part of a firearm or a separate device attached to the action.

Misfire: Failure of a cartridge to discharge after the firearm's firing pin has struck the primer. Also referred to as a hangfire.

Muzzle: The forward end of a barrel.

Muzzleloader: Any of a number of firearms (pistols, rifles and shotguns) designed to be loaded from the muzzle end of the firearm or barrel. The term is often used loosely to refer to firearms loaded from the forward end of a swing out breech.

Muzzle Velocity: The velocity of a projectile as it exits the muzzle of a firearm.

Noise: The sensation perceived by the sense of hearing. Unwanted sound is referred to as noise.

Pistol: A firearm capable of being held, aimed and fired with one hand. Also known as a revolver or a handgun.

Plinking: Informal shooting at any of a variety of inanimate targets.

Range: The distance traveled by a projectile from the firearm to a final impact point. Three terms apply to range: "pointblank," "effective" and "maximum". For the purposes of shooting range design, pointblank range refers to distances less than five yards; effective range means the greatest distance a projectile will travel with accuracy; maximum range means the maximum distance a projectile will travel.

Rifle: (1) A modern firearm designed to be fired from the shoulder generally having a barrel more than 16 inches long. Its main characteristic is a rifled (grooved) barrel that imparts a spin to a single projectile as it travels through the bore. (2) Some rifles designed for military or law enforcement use may have a pistol grip stock in lieu of a shoulder stock.

Rimfire: A cartridge ignited by priming compound distributed around the inside of its rim.

Rules and Regulations: Standards used in the operation of a shooting range. Rules and regulations are set up to govern the method of range operation to include health and safety. The violation of range rules and regulations generally carries penalties enforced by operations personnel.

Safety Baffles: Vertical or sloping barriers designed to prevent a projectile from traveling into an undesired area or direction. Most often used to prevent bullets from leaving a confined area (the range proper).

Shotgun: (1) A firearm designed to be fired from the shoulder with a smoothbore barrel that fires shotshells possessing a varying number of round pellets. (2) Some barrels are designed to be used with rifled slugs, most generally having smoothbores, but in rare cases may be rifled. (3) Law enforcement and military shotguns may have a pistol grip stock in lieu of a shoulder stock.

Shotshell: A cartridge, designed to be used in shotguns. A unitized round of ammunition is comprised of a hull or shell, a primer, powder, shot cup or wad and shot. Shells are normally constructed from plastic or paper.

Small Arms: Firearms that may be both carried and discharged by one person, as opposed to artillery pieces. Small arms are not subject to precise definitions, but the term usually includes rifles, handguns (pistols), shotguns, submachine guns and machine guns.

Smallbore: NRA-sanctioned shooting event using .22 rimfire rifles on bullseye targets.

Target Line: A line parallel to the firing line along which targets are placed.

Trajectory: The path a projectile travels from the muzzle to the point of impact.

Velocity: The speed at which a projectile travels. (Usually measured in feet per second or meters per second.)

Venetian Blind Trap: A steel trap that has a series of angled plates, 45 degrees or less, sloping to the rear and toward the bullet impact area and installed in a vertical fashion as to resemble a Venetian Blind. The bullets are directed upon impact into a chamber located at the bottom of the device, where remaining velocity and energy are expended. The chamber provides easy access for lead removal.

ARTICLE 1. INTRODUCTION

1.01 Purpose

- 1.01.1 This chapter discusses the general requirements for the design of a range. It provides the range builder with a quick reference of sizes and types of facilities needed on a particular type range. Note at the outset that physical design alone cannot always account for the unpredictable. The safety plan must include consideration of design and construction as it relates to an intended use. For example, a range designed only for .22 caliber rimfire rifles should never be used for high power rifles. Therefore, safety must include certain control measures to ensure the facility is used within its design. Range development planning and design involve the blending of what is needed with an assessment of risks associated with its use. Safeguards must be incorporated in each phase to minimize risks, and are applied throughout the process of planning, design, site selection, construction-right through the final day of operation. Further, they apply during the construction of target frames, the enforcement of rules and regulations, and training of members, users and supervisors.
- 1.01.2 This chapter also includes an overview of the decision making process.

1.02 Cross References

- 1.02.1 Additional information relating to range development is available:
- a. Introduction
 - b. Safety Plan - Section I Chapter 2
 - c. Planning and Design - Section I Chapter 3
 - d. Organization and Management - Section I, Chapter 4
 - e. Operations & Maintenance - Section II Chapter 3
 - f. See NRA Rules
- 1.02.2 The following information is contained in this chapter.
- a. Planning Overview
 - b. General Design Guidelines

ARTICLE 1. GENERAL

1.01 Purpose

- 1.01.1 The primary purpose of this chapter is to address those issues pertinent to the development of a safety plan for a proposed range project. It also points out that safety is a function of management and shooters together, involving a series of decisions to develop a workable safety plan. The plan must be clear and concise so that it is understood by all users. It must continue throughout the life of the project. A properly designed and constructed physical plant does not guarantee a risk free operation, nor does a well-written document spelling out safety rules and regulations create a safe environment. The human element must be controlled through a positive action plan that combines both physical and psychological aspects into a cohesive, manageable operation. It is incumbent upon range managers to understand the design principles involved in range development so that a safety plan befitting the operation can be developed and used effectively. What follows are the basic elements of such a plan.

1.02 Assumptions

- 1.02.1 The term "safe range" is based on the assumption that all shooting takes place in the direction of the targets, that users always keep their firearms unloaded and actions open when arriving or departing a range; that firearms are always unloaded except when the shooter is in position on the firing line; that users will use only firearms with which they are familiar and will always use the proper ammunition. There are more, but these assumptions are the basis of a good safety plan. Safety cannot be left to chance! The final step is to add enforcement. Enforcement ties the separate parts into a cohesive and workable safety plan. Remember, a range is only as safe as the manner in which it is used.

1.03 Control

- 1.03.1 Positive control assures that range facilities are used properly. Users must obey posted rules and regulations and conduct themselves in a responsible manner. Control of a facility implies that appropriate authority is bestowed upon range officers appointed to enforce the rules and regulations. Further, disciplinary action, such as reprimands, suspension or revocation of range privileges, may be necessary to correct errant behavior. Remember that if you do promulgate range rules and regulations, you must be sure to enforce them. You may be held responsible for the damage or injury caused by your failure to enforce your range rules and regulations.

1.04 Cross Reference

- 1.04.1 A general discussion of what constitutes a quality range facility can be found in Section I, Chapter 1 - General Information. Specific rules related to outdoor and indoor facilities and including specific shooting activities may be found in the corresponding chapters in Sections II and III.

ARTICLE 2. SAFETY PLANNING

2.01 Introduction

- 2.01.1 The expression "safety is no accident" implies the necessity of planning. This plan is both a formal process by which safety is enhanced and a written document with a heading, date, preamble and terms. This document must be approved, signed, published, reviewed at specific intervals and distributed to all range users to study and use.

2.02 Planning for Safety

- 2.02.1 All elements of the plan must fit into an integrated, package, best described as "the Four E's": EVALUATE, ENGINEER, EDUCATE and ENFORCE.
- 2.02.2 The first step is to EVALUATE the needs of the user and identify what specific shooting activity will be conducted on the facility. Since there are many shooting activities, evaluate each one as it relates to the proposed range site. Each shooting activity requires different design considerations, making it even more important to select the best site and configuration for a particular activity.
Note: During these initial phases of the project evaluate several sites to ensure that the site chosen is the best.
- 2.02.3 Whatever the choice, it is necessary to ENGINEER the range specifically to accommodate the chosen shooting activity. The use of the range facility outside its design limits violates accepted engineering practices and breeches the basic concept of a safety plan. Using a range for purposes beyond its design is similar to using a chain saw to cut steel pipe. For example, using a smallbore range for highpower rifle. Those who control the range must understand this important concept, and must provide procedures for using the facility correctly.
- 2.02.4 Once the engineering phase is complete and the range is open for live firing activities, it becomes necessary to EDUCATE those who use the facility. "Few shooters know how to use a range properly" is the premise on which a user education program, including evening and weekend classes, is based. The users must know the whys and wherefores if they are to perform as expected. One class certain to raise a few eyebrows is "How to use a Benchrest." Few shooters know how to use a benchrest properly or effectively. Hence, training programs aimed at teaching supervisors and users how to use a range properly is an important part of the overall safety plan.
- 2.02.5 A strong relationship exists among the Evaluation, Engineering and Education processes. However, the final process, ENFORCEMENT, must be added to solidify the safety plan. A quality set of rules and regulations may be almost worthless without a means of assuring compliance by all users. This mechanism provides two types of control: Passive meaning single shooter no supervision; or Active meaning either a range officer is in charge or any number of instructors are on hand to maintain close control. Passive control is practiced more frequently on ranges where individual users are allowed access. On training ranges, active control is the rule. Passive control implies that a more thorough indoctrination of users be undertaken along with instructions on the consequences of any violations. Whatever type is utilized, formulate a comprehensive set of rules and regulations and support them with adequate enforcement procedures. Again, remember that you may be held responsible for the damage or injury caused by your failure to enforce your range rules and regulations.

2.03 The Safety Plan

- 2.03.1 The safety plan stipulates how, when, why and by whom the facility will be used. It is a document used during the planning, design, construction and the use of the facility.
- 2.03.1.1 The document should be written on the sponsoring organization's letterhead or official stationary.
- 2.03.1.2 The document should indicate the date of adoption and bear the signatures of the current officers. Highlight subsequent revisions and include a record of when and by whom modifications were made and approved.
- 2.03.1.3 Any revisions should specifically state (1) that they supersede and replace any previously adopted safety plan segments and (2) that previously distributed copies be destroyed. Also establish a review date, perhaps once a year, to assure the safety plan is working and remains relevant.

- 2.03.1.4 The document should include a preamble stating a specific purpose. For example: "This safety plan has been established to ensure the health and safety of those individuals who use or frequent this facility and the community at large. It is a plan developed to assure the continuity of a facility through a concerted public relations effort."
- 2.03.1.5 There should be a terminology section to define clearly terms often loosely interpreted. (See Section I, Chapter 1 for terminologies.) An example might be "rifle" which could be interpreted as highpower or blackpowder when it is intended to be smallbore (.22 caliber rimfire) and for a specific range.
- 2.03.1.6 The safety plan should divide rules and regulations into categories, i.e., Section I, Gun Handling Rules; Section II, General Range Rules; and Section III, Specific Range Rules (according to the type range); Section IV, Administrative Rules and Regulations (refer to Article 3).
- 2.03.1.7 Any exceptions to the rules or regulations should be carefully defined to avoid confusion. Exceptions may be printed in a combined separate section, i.e., Section V, or directly after each rule to which a specific exception applies. A prime example is alcoholic beverages. Alcoholic beverages should never be allowed when live firing is in progress. However, when picnics or special outings are held on the facility, alcoholic drinks may be allowed but ONLY in moderation, in designated areas and only after shooting activities have ended for the day. There may be federal, state or local statutes, ordinances and/or regulations prohibiting, or making criminal, the sale and/or serving of alcohol without having obtained a license to do so. Besides these regulatory requirements and/or penal prohibitions, such activities may, pursuant to state or local law, give a party cause of action to sue the server/seller in civil court for injuries or damages caused by a party that became intoxicated. You are strongly advised to engage a local attorney licensed to practice law in your state to advise you in regard to these matters.
- 2.03.1.8 The conclusion of a quality safety plan is found in Section VI, which spells out the consequences or action that will accompany any violation of the safety rules and regulations. Any disciplinary action taken should fit the offense with varying degrees of severity. Disciplinary action may range from a friendly warning to being ejected from the facility. Remember, without enforcement, the safety plan is worthless. Do not use physical force to eject an individual. The use of physical force may subject you to criminal charges and/or civil liability. You are strongly advised to engage a local attorney licensed to practice law in your state to advise you in regard to your right of 'self help' in these matters.
- 2.03.1.9 Post the projected review date on bulletin boards and send notices to users so that everyone will know when to check for revisions or submit recommendations for changes.
- 2.03.1.10 Identify specific categories of rules and regulations and publish them in order of their importance to the safety plan.
- 2.03.2 Gun Handling Rules
- 2.03.2.1 Gun handling rules are of primary importance. They should always appear first in the safety plan and be prominently displayed on the range. Several versions exist, but as a minimum, the following rules are suggested:
- a. ALWAYS KEEP THE GUN POINTED IN A SAFE DIRECTION.
 - b. ALWAYS KEEP YOUR FINGER OFF THE TRIGGER UNTIL READY TO SHOOT, and outside the trigger guard, until ready to fire or until the command "Commence Firing" has been given.
 - c. ALWAYS KEEP THE ACTION OPEN AND FIREARM UNLOADED UNTIL READY TO USE. On a firing range this means the shooters are in position on the firing line and the range has been cleared for live firing.

- d. KNOW YOUR TARGET AND WHAT IS BEYOND. When on shooting ranges, be mindful also of adjacent areas and act accordingly.
- e. BE SURE THE GUN IS SAFE TO OPERATE.
- f. KNOW HOW TO USE THE GUN SAFELY.
- g. USE ONLY THE CORRECT AMMUNITION FOR YOUR GUN. When at a shooting range with more than one firearm, use one at a time and when finished, store that firearm and its ammunition before using the next one.
- h. WEAR EAR AND EYE PROTECTION.
- i. NEVER USE ALCOHOL OR DRUGS BEFORE OR WHILE SHOOTING.
- j. STORE GUNS SO THEY ARE NOT ACCESSIBLE TO UNAUTHORIZED PERSONS. There may be federal, state or local statutes, ordinances and/or regulations regulating the manner of firearms storage, including some that may make the failure to properly store firearms a criminal offense. Besides these regulatory requirements and/or penal prohibitions, such activities may, pursuant to state or local law, give a party a cause of action to sue you for injuries or damages caused by a third party that obtained access to one of your firearms. you are strongly advised to engage a local attorney licensed to practice law in your state to advise you in regard to these matters.
- k. Be aware that certain types of guns and many shooting activities require additional safety precautions.

2.03.3 General Range Rules

2.03.3.1 All general range rules, whether on indoor or outdoor ranges, should incorporate at a minimum the following:

- a. Know and obey all range commands.
- b. Know where others are at all times.
- c. Shoot only at authorized targets.
- d. Ground level targets are not authorized without a proper backstop. See exceptions for Smallbore Rifle, Highpower and Smallbore Silhouette. Maintain the proper target height to ensure that the fired projectile, after passing through the target, hits the desired portion of the backstop. This will reduce the possibility of ricochets and projectiles escaping the property.
- e. Designate a range officer when none is present or assigned.
- f. Unload, open the action, remove the magazine and ground and/or bench all firearms during a cease-fire.
- g. Do NOT handle any firearm or stand at the firing line where firearms are present while others are down range.
- h. Always keep the muzzle pointed at the backstop or bullet trap. Never allow the muzzle to point in any direction whereby an inadvertent discharge would allow the escape of a projectile into an outer area.

2.03.4 Specific Range Rules and Regulations

2.03.4.1 Specific range rules and regulations must be developed for each range facility and shooting activity.

At a minimum they should include:

- a. Gun Handling Rules.
- b. General Range Rules.
- c. Regulations on the type of firearm, shooting activity, caliber, shot size or type of target to ensure range user safety.
- d. Establish administrative regulations regarding target supplies, target frame materials, security and equipment usage, along with buildings and grounds maintenance as necessary for safe and efficient range operations.

2.03.5 Administrative Rules and Regulations

2.03.5.1 Section IV of the Safety Plan contains the administrative rules and regulations that normally govern range schedules, parking, guest policies, member/user responsibilities, hours of operation, security, program development, range supervision and other items such as sign-in procedures.

2.03.6 Guarantees of Notification

2.03.6.1 Few actions arouse anger quicker than the adoption of rules without proper notification, especially in member controlled clubs. The prominent posting of rules and regulations and the mailing of copies to each member or user are but two approaches. The best method is to hold a series of meetings at which each user is given a copy and is requested to read it and sign, stating that it has been read, it is understood, and will be followed. As each individual is contacted, check his/her name off a sheet. This guarantees that users cannot use the excuse that they weren't told. Another approach is to print the rules in each copy of the newsletter or to read them at each meeting. Regardless of the method, be certain no one uses the facility unless he/she knows, understands and will comply with the rules.

2.03.7 Summary

2.03.7.1 A safety plan links each aspect of the process - planning, design, construction and use - into an integrated program. This program is designed to reduce risks associated with the use of firearms either on or off the range. Further, the plan protects the safety and health of those who live nearby.

ARTICLE 3. GENERAL ADMINISTRATIVE REGULATIONS

3.01 Introduction

3.01.1 Administrative regulations aid in defining who does what, when, why and for what reason. This portion of the range safety document covers the organization and operation of the facility and is a supplement to the regular safety rules and regulations.

3.02 General Categories

3.02.1 Forming a club, an organization or chartering an agency requires certain documentation, including the following: a charter, by-laws, safety plan and other legal documents as required by national, state and local laws, regulations and guidelines. These documents must establish:

1. Who is authorized to use the facility, e.g., members, the public, employees, special groups, law enforcement, etc.?
2. What method will be used to identify authorized personnel?
3. The authority of range officials to carry out the rules and regulations and to enforce penalties.
4. General use procedures of the facility. Where are targets stored? What targets can be used and for what purpose? How are targets to be used?
5. Hours of operation. This is often a critical aspect of public relations.
6. What shooting activities are allowed, and specifically which ones are NOT allowed? What restrictions are placed on how a firearm is to be used, such as from a benchrest, prone and using a sling or offhand, etc.?
7. The scheduled use of the facility. Can it be reserved? By whom and for what purposes? Can alcoholic beverages be consumed on the property when firearms are not present? Can other organizations use the facility? Training activities are an important part of the scheduled use, e.g., hunter education.
8. Pet control
9. The transportation of firearms into and from the facility. How are they to be transported?
10. Buildings and grounds maintenance.
11. Food service on the grounds.
12. Parking

- 3.02.2 There are serious legal, accounting, monetary and tax consequences that will result depending upon which type of organizational structure your club chooses. Seek the advise of an accountant and an attorney to determine whether you should incorporate and what type of tax status to apply for. Use the services of a local attorney licensed to practice law in your state to advise you and to prepare the organizational documents and to file them with the appropriate state agencies. Use the attorney or accountant to file the proper tax documents with the Internal Revenue Service and with your state's taxing agency.

ARTICLE 4. GENERAL RANGE COMMANDS

4.01 Purpose

- 4.01.1 The purpose of range commands is to provide concise, clear and standard methods of range operation. This provides the shooters or participants with easy to understand guidelines and enhances safety.

4.02 Superseding Commands

- 4.02.1 All sanctioned competitions and many organizations have standardized range commands which may supersede the commands contained herein. The following are offered only as a guide in developing a range safety plan document.
- 4.03 Suggested Basic Range Commands
- 4.03.1 Any range or shooting organization that does not have prescribed range commands or does not desire to develop their own should use the commands given in the applicable rulebook as published by the NRA or other shooting sports governing body. The following commands are a guide from which to develop commands for a particular use.
- 4.03.2 The following commands are provided along with their purpose and a description of the action that should result. All commands are given by a designated range or safety official, except for cease-fire or misfire. A cease-fire may be called by anyone detecting an unsafe situation. In the event of a misfire, the shooter experiencing the difficulty should alert the range officer immediately. If a range officer is not formally assigned, then participants should mutually designate a person to perform the function.

4.04 Commands and Actions

- 4.04.1 To indicate EMERGENCY OR HAZARDOUS CONDITIONS
- a. Command: CEASE FIRE!
Purpose: To stop all shooting routinely or, in case of emergency, immediately
Action: Participants immediately stop shooting, continue to keep the muzzle pointed down range, remove finger from within the trigger guard, unload and clear the firearm and await further instructions from the range officer.
 - b. Command: MISFIRE!
Purpose: To notify the range officer and other participants that a round did not fire when the trigger was pulled and to alert other shooters along the line that a hazardous condition may exist.

Action: (1) The shooter experiencing the misfire continues to keep the firearm pointed down range, removes the finger from within the triggerguard and awaits further instructions. (2) The range officer may or may not call a general cease-fire depending upon the situation. (3) Shooters immediately adjacent to the misfire should cease fire, unload, open and either ground or bench their firearms and step back from the line. (4) The remaining shooters may continue to fire as directed by a range officer or may cease fire at their option and await further instructions.

4.04.2 Preparing the range for live firing

a. Command: "LOAD!" (optional for training)

Purpose: To notify participants that they can load the prescribed number of rounds. For muzzleloaders, the commands are somewhat different. The command "Commence Firing" is given after which the participants will snap a minimum of three caps prior to loading the firearm. The command "load" is not for muzzleloading shooters.

Action: Participants will load the prescribed number of rounds and stand ready for the next command.

b. Command: "IS THE LINE READY?"

Purpose: To determine if all shooters along the line are ready.

Action: All shooters not ready should indicate their status to the range officer. Sufficient time will be allowed for the shooter to complete his preparation.

c. Command: "READY ON THE RIGHT!"

Purpose: To declare that the shooters have indicated they are ready.

Action: Any shooter not ready at this command may choose to either alert the line officer that he is not ready or to complete the process of getting ready before the final command has been given.

d. Command: "READY ON THE LEFT!"

Purpose: To continue the command prior to giving the commence firing command.

Action: Same as subparagraph 4.04.2.c

e. Command: "READY ON THE FIRING LINE!"

Purpose: To notify all participants that the range is about to be under live fire and that if anyone is not ready at this point, he should call a range officer; otherwise, await the next command.

Action: Participants simply await the next command.

f. Command: "COMMENCE FIRING!"

Purpose: To declare the range formally open for live fire.

Action: The participants may commence the prescribed course of fire. Muzzleloaders may snap caps prior to loading. No muzzleloader may be loaded before the command to fire has been given.

4.04.3 Firing Period

Firing shall continue until a predetermined time period has lapsed or until all participants have completed the prescribed course of fire. During informal shooting events, participants when finished firing should simply open the action, clear the firearm, bench or ground the firearm and step back behind the line and wait until all shooters have completed the event. After this, a mutually agreed upon cease-fire is called.

4.04.4 To stop firing and declare the range safe

a. Command: "SHOOTERS YOU HAVE (X) NUMBER OF MINUTES LEFT TO COMPLETE THE COURSE OF FIRE or SHOOTERS FIRE YOUR REMAINING ROUNDS."

Purpose: To alert all shooters that a general cease-fire is about to be called and to allow the slower shooters to complete the course of fire. Those that have completed the day's activities may put away their equipment. In the event there are rounds remaining that have not been fired, the shooter, upon the command "Cease Fire" simply unloads, clears and grounds or benches his firearm.

b. Command: "CEASE FIRE!"

Purpose: To stop all firing.

Action: All participants shall unload, open, remove magazines and bench or ground all firearms. And if activities are complete for the day, step back from the line or clear the area by packing away firearms, ammunition, other gear and cleaning up the area.

c. Command: "SNAP CAPS!" (Muzzleloading only)

Purpose: To assure that the flash hole is open and the barrel is free of any material (oil) capable of causing a hangfire. In some events, this command is also used to determine if all firearms are unloaded. In others, safety precautions require the guns to be uncapped, unprimed with hammers down prior to leaving the line.

Action: All participants using percussion type muzzleloaders shall step up to the firing line, affix a primer cap, point the firearm down range and "snap" the cap.

d. Command: "RANGE IS CLEAR!"

Purpose: To alert all shooters along the line that travel beyond the firing line for purposes of target change or retrieval, the removal of brass and trash is approved.

Action: Participants may move down range as directed or desired to change, remove targets or to clean up. The next relay shall not take up positions on the firing line until told to do so. Participants not going down range are to stand back from the firing line and away from firearms. NO firearm will be handled while others are down range.

ARTICLE 1. GENERAL

Portions reprinted from *Sound Abatement Techniques and Defending Yourself Against Noise Complaints* by Scott Hansen, Consultant.

1.01 Purpose

- 1.01.1 The purpose of this chapter is to provide a better understanding of the environmental issue of sound or "noise" pollution. Sound will be discussed as it relates to small arms shooting ranges, using a minimum of technical language and complex mathematical formulae.

1.02 Introduction

- 1.02.1 In the past few years, public recognition of sound and how it affects the public has prompted noise abatement programs for all sources of sound. Noise from a variety of sources has been found to reduce the quality of one's life. Prolonged exposure to high levels of sound without hearing protection can result in permanent hearing loss. OSHA -- the Occupational Safety and Health Administration -- has determined that a sound level of 90 dBA is the threshold for hearing conservation programs. Because firearms easily exceed this level of sound, users must wear hearing protection.
- 1.02.2 Today, regulations control sound emissions of most outdoor activities. When examining recreational activities, many of the regulations from federal agencies are not actively enforced. Therefore, state and local laws have been enacted which place great emphasis on community noise from industrial and recreational activities.
- 1.02.3 Shooting ranges reproduce high levels of sound. Sound waves often travel beyond the boundaries of the range property. Escaping sound waves may be perceived as unwanted community noise by neighboring property owners. Remote areas, away from housing developments, etc., no longer exist the way they did 40 years ago. In those rare situations where they do exist, time and distance often detract shooters from using these facilities. It is important for range owners and operators to work with the local zoning board. Shooting ranges should be highlighted as *noise parks*. This designation should make the ranges visible to zoning planners and developers prior to developing neighboring properties. Range owners/operators should implement sound abatement programs into their yearly planning. These noise plans must actively pursue the goal of a sound abatement plan: preventing conflict before it occurs. These plans may entail contacting an acoustical consultant, not three days before a board of zoning hearing, but before a problem develops. This consultation may be prior to the opening of a new range, or at the beginning of the shooting season. Sound levels should be taken at the property lines during normal operation of the range, such as during competitions of day-to-day activity. These documented evaluations will be compared to future levels as changes are made to and around the range. The evaluations will also determine if the range satisfies local sound laws.

- 1.02.4 Sound abatement planning also allows range layouts to change and gives the range design team the flexibility to change locations, directions, and entire sites if necessary.
- 1.02.4.1 Developing good public relations with the range neighbors and community at large is essential. Show the community that you are bringing in money when people visit your facility and subsequently patronize sporting goods shops, hotels, and restaurants. Some ranges have made deals with these types of businesses during weekend shooting events. There are many other examples of good public relations which will be discussed by others. If you show that you are a valuable community asset, the community is more likely to support you.

ARTICLE 2. DEFINITIONS

- 2.00 The following definitions will help the layman understand some of the technical terms used by engineers and others who practice in the field of acoustics, and are not an attempt to teach the reader to be an acoustical expert. It provides only the essential elements of sound and a general description of when sound becomes "noise".

2.01 Sound

- 2.01.1 To develop a complete description of the sound generated by gunfire, consultants measure and describe its frequency spectrum, its overall sound pressure level (SPL), and the variation of both of these quantities with time. Michael Rettinger, consultant on acoustics, in his book Acoustic Design and Noise Control, Volume II, describes sound, "Like a wafted kiss, sound is both a physical phenomenon and a subjective sensation." In the former sense, either a form of mechanical energy or a variation in pressure or stress, it will be called a "sound wave" for ready identification. Sound is the stimulus for hearing, even though not all sounds are audible to the human ear. Sound waves behave like ripples on a pond after someone throws a rock into it. The object thrown becomes the sound source, the ripples the sound pressure waves. In the pond we see a two-dimensional pattern of circular waves, but in the atmosphere sound waves are three-dimensional, spherical and far more complex.

2.02 Noise

- 2.02.1 Wyle Laboratories defines noise, in a publication produced for the EPA as: "Whenever unwanted sounds intrude into our environment, noise exists." An example is when someone is resting or asleep and has sleep interrupted by a neighbor mowing a lawn. To the person mowing the lawn, the sound generated by the mower is necessary and therefore unobtrusive. To the one trying to sleep, it's noise.

2.03 Terms

Absorption Coefficient: The fraction of incident sound not reflected by a surface. Values range from 0.01 for marble slate, to 1.0 for absorbent wedges used in anechoic rooms.

Acoustics: 1. The study of sound, including its generation, transmission, and effect. 2. The properties of such areas as rooms and theaters, which have to do with how clearly sounds are transmitted and heard in it.

Ambient Noise: The totality of noise in a given place and time. It is usually a composite of sounds from varying sources at varying distances. Also see residual noise.

A-Weighted Sound Level (La): Sound pressure level, filtered or weighted to reduce the influences of the low and high frequency noise. It was designed to approximate the response of the human ear. Noise is measured on a dBA scale. Small arms fire is generally measured on the A weighted scale and impulse response mode.

Background Noise: The total noise in a situation or system except the sound that is desired or needed.

Baffle: A shielding structure or series of partitions which reduces noise by lengthening the path of sound transmission between source and receiver.

Daytime: The hours between 7am and 7pm.

Decibel (dB): In layman's terms, the unit used to measure the relative loudness or level of a sound. The range of human hearing is from about 0 decibels to about 140 decibels.

Evening: The hours between 7pm and 10pm.

Impulsive Sound: Noise with an abrupt onset, high intensity, short duration typically less than one second and often rapid changing spectral composition.

Inverse Square Law: The law describing the situation in which the mean square sound pressure changes in inverse proportion to the square of the distance from the source. Under this condition the sound pressure level decreases six decibels for each doubling of the distance from the source.

L(eq) energy equivalent sound level (Leq): Is a measure which describes with a single number the sound level of a fluctuating noise environment over a time period. It is a sound level based on the arithmetic average energy content of the sound.

L(dn): is the Leq (energy averaged sound level) over a 24-hour period. It is adjusted to include a 10 dB penalty for noise occurring during the nighttime hours (10 pm to 7 am). Weight is given to nighttime noise in this way to account for the lower tolerance of people to noise at night.

Microphone: An electroacoustical transducer that responds to sound waves and delivers essentially equivalent electric waves.

Nighttime: The hours between 10pm and 7am.

Noise: Any unwanted sound, and by extension, any unwanted disturbance within the frequency band.

Noise Contour: A continuous line on a map of the area around the noise source connecting all points of the same noise exposure level.

Noise Level Reduction: The amount of noise level reduction achieved through the incorporation of noise attenuation in the design and construction of the structure.

Peak Sound Pressure: The maximum instantaneous sound pressure (a) for a transient or impulsive sound of short duration, or (b) in a specific time interval for a sound of long duration.

Reflection: The throwing back of an image, of the original sound, by a surface.

Refraction: The bending of a sound wave from its original path, either because of passing from one medium to another or because (in air) of a temperature or wind gradient.

Residual Noise Level (ambient): The residual noise level is the level of the unidentifiable noise which remain after eliminating all identifiable noises. For this chapter, L90 has been used as an estimate of the residual (ambient) noise level when no steady state identifiable noises are known to be present.

Shielding: Attenuating the sound by placing walls, buildings or other barriers between the sound source and the receiver.

Sound Level: The weighted sound pressure level obtained by use of a sound level meter having standard frequency-filter for attenuating part of the sound spectrum.

Sound Level Meter: An instrument, comprising of a microphone, an amplifier, an output meter, and frequency-weighting networks. Sound level meters are used for the measurement of noise and sound levels in a specific manner.

Sound Pressure: (1) The minute fluctuations in the atmospheric pressure which accompany the passage of a sound wave. The pressure fluctuations on the tympanic membrane are transmitted to the inner ear and give rise to the sensation of audible sound. (2) For steady sound, the value of the sound pressure averaged over a period time.

Sound Pressure Level (SPL): In dB, is 20 times the logarithm to the base 10 of the ratio of the pressure of this sound to the reference pressure. The reference pressure shall be explicitly stated. The following reference pressures commonly used are:

- (1) 20 micropascals (2x.0001 microbar)[20 micronewton/meter squared]
- (2) 1 microbar
- (3) 1 pascal

Sound Transmission Coefficient: The ratio of transmitted to incident energy flux at a discontinuity in a transmission medium.

Sound Transmission Loss (TL): A measure of sound insulation provided by a structural configuration. Expressed in decibels, it is ten times the logarithm to the base ten of the reciprocal of the sound transmission coefficient of the configuration.

Yearly Day-Night Average Sound Levels (DNL): The 24-hour average sound level, in decibels, for the period from midnight to midnight. Day night averages are obtained after the addition of ten decibels to sound levels for the periods between midnight and 7 am and between 10 pm and midnight, local time, as averaged over a span of one year. It is the standard metric of the Federal Aviation Administration for determining the cumulative exposure of individuals to noise.

ARTICLE 3. CONCEPTS AND METHODOLOGY

3.01 Concepts

- 3.01.1 The National Rifle Association has developed the information in this chapter to provide a general discussion on sound, its potential effects and sound abatement technologies suited for use on ranges. This will be helpful to ranges which may be required to install sound abatement materials or where future land use criteria deems it necessary. The information pertains to outdoor ranges more than indoor ranges.
- 3.01.1.1 Any observer may or may not consider "sound" generated by a given source to be "noise". Therefore, in most recreational activities, especially with small arms, planners of ranges must consider what effect sounds generated will have on the nearby environment.
- 3.01.1.2 "Noise" exposure is the integrated effect, over a given period of a number of different sound levels and durations. The integration also includes specific weighting factors for the events during certain time periods in which sound affects the environment more severely, such as when people are trying to sleep. The national quiet time is considered to be between 10pm and 7am. The various scales for "noise" exposure in use throughout the country differ by the methods of integration or summation, time period weighting factors and frequency weightings.
- 3.01.1.3 That certain types of noise can affect human health and safety is well documented. Adverse effects depend on their loudness and frequency spectrum. Generally, sounds generated on ranges will have little, if any, effect on the physical or psychological health of inhabitants of the surrounding area. Where they do, it is noted for inclusion in a "noise" plan.

- 3.01.1.4 From the first planning meeting to the last nail driven during construction, it is important that the master plan include a sound mitigation program. Failure to adopt such a plan can result in financial losses for the range owners or operators, or the termination of an otherwise quality range operation. Where once there was nothing for miles, clubs are waking up and finding that housing developments are moving in with little if any response time. Therefore for existing ranges it is wise to develop a noise mitigation program within its long range plan.
- (1) Develop concepts and methods to abate sound for eventual use on planned ranges. Although the physics of sound is the same everywhere, each range will be different from others. Methods that will work for one may not be suitable for another.
 - (2) Conduct research on materials that may be suitable for use on a particular type range such as benchrest, pistol, smallbore or highpower. Specific applications can then be determined.
 - (3) Develop specifics on:
 - a. Terrain features
 - b. Soil and surface geology characteristics
 - c. Hydrology and vegetation
 - d. Existing land uses and utilities
 - e. Population densities
 - f. Other environmental considerations, such as air quality, prevailing wind conditions, temperature changes, and humidity fluctuations

3.02 Land Use Determinants

3.02.1 Master Plan

3.02.1.1 Developing a master plan for a specific site may seem to be a lot of unnecessary work in some cases, but it's smart planning. The master plan outlines sound abatement technology and involves a study of the following:

- (1) Any sound abatement program must meet the standards of existing regulations, ordinances or laws. In most instances existing laws will specify a sound level for a particular land use. To determine if the facility will meet the standards, measurements must be taken to determine what if anything must be done to mitigate any problem. Sound level measurements for small arms will use the fast or impulse detector response mode as identified on a Precision Integrating Sound Level Meter and Analyzer. Sound measuring devices must meet ANSI standards and have a factory calibration date within one year of the date when testing is to be conducted. All meters used for testing must be designed to allow for field calibration with field calibrators having a factory calibration certificate validated each year.
- (2) A complete description of the proposed site and surrounding areas including site maps to aid in determining if the land use is compatible with current and projected land uses around the proposed site. In addition, it is advisable to conduct an environmental analysis, a part of which would be the development of a "noise" profile as discussed in this chapter. (See Section I, Chapter 3, Paragraph 2.14 for guidance and procedures for conducting an environmental analysis.)
- (3) A study of the economic impact the proposed range will have on the area surrounding or in close proximity to the proposed site.
- (4) A complete description of the range facility including detailed drawings. Have a consultant draw a "noise" profile overlay and include it in the sound abatement program. Include in this portion of the document solutions to the identified existing or potential problems. How much will they cost? How effective will they be? Are they politically and socially possible?
- (5) A complete description of the community and neighboring properties. Include: existing use, planned use, safety, and other environmental considerations.

- (6) A sound survey of the area. This will provide information on which future plans will hinge. It will also provide a vehicle whereby public input can be obtained towards the construction of a project. It will also provide time to educate the community on the benefits of the project. Where results of these surveys show significant public opposition may exist, the master plan must include sound abatement strategies that will answer opposing arguments.

3.03 Land Use Compatibility

3.03.1 Area

3.03.1.1 Land use as it relates to existing conditions is but one facet of the study and is directly linked to what future conditions may exist at a site. Regulation of land use in some areas is so stringent that any other than what already exists may be rejected. When a range locates in an area the one factor seldom considered, is the community and its role as a regulatory body. Should a noise complaint arise as a result of range operations and the proper approvals have been received, the noise problem is no longer a problem the range facility must face alone. The community must also become involved and assist in resolving the conflict. In other instances, even with full knowledge of the presence of a range, adjoining parcels have been rezoned for new housing developments, giving little, if any, forethought to future consequences.

3.03.1.2 One of the primary yet often overlooked considerations in developing a range project is the economic impact the facility will have on the community. How it effects the community should it locate nearby, or if it is forced to move to another site are critical issues. Local economies are important. Even though shooting is a recreational activity, the range becomes part of the local business community. Outside activities, such as tournaments, bring outside money into the economy thereby playing an important political role in the local community. Most range operators do not give the economic impact a range can have on a local area sufficient consideration. Major tournaments, will not only draw hundreds of individuals into an area, but will also attract new revenues.

3.03.2 Existing Conditions

3.03.2.1 What are the existing conditions at the proposed or existing site? Study the environment to determine what impact is occurring. This is the reason an environmental analysis (EA) is necessary. Conducting an EA requires a thorough review to determine if there is any reason to implement a major and costly sound abatement program. It requires a complete description of what may or may not occur if the range is built. (See Section I, Chap. 3, paragraph 2.14 for guidance and procedures for conducting an environmental analysis.)

3.03.3 Future Conditions

3.03.3.1 As a general guide, the following categories were developed by the NRA based on field and text book work:

- (1) Unacceptable: If the sound level exceeds 90 dB(A) for 1 hour out of 24 or exceeds 85 dB(A) for 8 hours out of 24 and the receiver is less than 1/4 mile from the sound source.
- (2) Discretionary: Normally Acceptable, if the level exceeds 80 dB(A) for 8 hours out of 24 or if there are "loud" impulsive sounds (referring to sonic booms, artillery, etc.) on site and the distance from the property boundary and the receiver is one mile or more.
- (3) Discretionary: Normally acceptable if the level does not exceed 75 dB(A) at the property boundary more than 6 hours out of 24 hours and distance from the boundary line and the receiver is over 1/2 mile.
- (4) Acceptable: If the sound levels at the receiver do not exceed 65 dB(A) more than 8 hours out of 24 or activities do not extend into the nighttime hours of 10pm through 7am.

Active shooting is to take place during the daytime hours of 7am - 10pm, with curtailed, but not necessarily discontinued activities during evening hours of 7pm - 10 pm. Shooting activities should not continue into nighttime hours, 10pm - 7am.

3.03.4 Regulatory Controls

3.03.4.1 Governmental planning organizations offer services to local agencies to assist them in developing goals and policies for community "noise" control. They also provide general land use, environmental protection and open space recommendations. In July 1981, the U.S. Environmental Protection Agency developed a Community Noise Assessment Program designed to assist communities to assess, control and improve their noise environment. Even though this document focuses on larger more densely populated areas, it does provide some valuable tips for the range planner. For example, they define assessment tools to be similar to those provided in this chapter for site evaluation purposes for both existing and proposed range facilities.

3.03.4.2 A number of states have laws relating to noise. Most of these noise laws are concerned with motor vehicle, snowmobile, or boating sounds. A few, such as New Jersey, Illinois, and Connecticut, have very clear noise laws relating to impulse sounds. Some laws include definitive methods for measuring the sound, and clearly defined acceptable levels. Others are very vague.

Connecticut, for example, states that "no one shall cause or allow the emission of impulse noise in excess of 80 dB peak sound pressure levels during the nighttime to any Class A Noise Zone." Peak sound pressure level, L_{peak} , means the absolute maximum value of the instantaneous sound pressure level occurring in a specified period of time. The noise laws of Illinois, on the other hand, use maximum levels. Maximum sound pressure level, L_{max} , is defined as the maximum root mean square value of the instantaneous sound pressure level 61 dBA, depending on time of day and the class of neighboring property. These different state laws, like local laws, vary greatly. It is important for range developers/operators to be familiar with the requirements and restrictions of laws applicable to their facilities.

3.03.5 The Community and its Role

- a. Develop a noise control program and goals.
- b. Develop details of an acoustical survey, before, during and after.
- c. Develop details for an attitudinal survey.
- d. Gather existing complaint data.
- e. Present the program design, and its implementation costs.
- f. Make noise measurements. The standard criteria to be used when taking noise measurements are:
 - (1) At the property line, and in direct line with the receiver.
 - (2) Select measuring points that are clear of interfering objects (other than naturally occurring ones such as trees) or terrain.
 - (3) Describe the surface area over which the sound travels. Certain surface area configurations, such as a good grass cover affects the rate of decay for sound. The intervening distance between a point source and a receiver is also an attenuating factor. As a rule, each time the distance is doubled the sound pressure level is reduced by one-half, or reduced by about 6 dB. Take note of any walls, buildings, signs, people or other barriers normally between the point source and the measuring point. These obstacles serve also to attenuate the sound pressure levels. A hard surface does not add much to attenuation but distance, thick grass and heavy shrubbery do. Significant terrain features are also important, for example a noise source in a depression is provided barriers that will redirect sound and is not as serious as one at a higher elevation. Therefore, a range located in a valley presents less of a problem than one at the same general elevation as the surrounding area. Ranges elevated above a receiver will have the advantage of atmospheric attenuation, with additional components attenuated via wind. Atmospheric and wind attenuation is a function of temperature, wind speed, humidity and frequency. Atmospheric attenuation has a greater effect on high frequencies such as the supersonic crack of a bullet. Wind and temperature together affect propagation of sound in a variety of ways, but one of the more important is called a temperature inversion, but are normally directional. A wind gradient tends to cause a sound wave traveling with the wind to

slope or bend toward the ground and appear to be louder. A sound wave traveling against the wind will bend upward and away from the earth, hence developing a sound shadow very near the source. This is one reason it is difficult to hear upwind from a source. Another reason is the masking effect of wind noise around the ears.

- (4) Note noise reflecting off surface areas, such as trees, bodies of water, overhead firing line covers, hillsides, hard surfaces such as pavement can have a marked affect as well.

Information needed on the field data sheet should include:

- a. The time the receiving property is occupied.
- b. What are the characteristics of the home?
 1. Is it air conditioned?
 2. Do they have a stereo?
 3. Is the room most used in the house closest to the range?
 4. Are there large pane windows facing the range?
 5. How thick are the walls?
 6. Is the house insulated?
 7. The elevation of the house in relation to the range?
- c. Conduct attitudinal survey
- d. Review complaint data
- e. Review noise survey results. A review of the survey results will now permit a fuller understanding of the situation. Once the data collection is complete, break it down into categories for analysis.

There are three sources for solutions to a noise problem. (1)What the range can do to abate sound levels over what existing laws allow, (2) measures available to the complainant, and (3) the role of the community in the matter.

- f. Apply strategy analysis for development of "noise" abatement alternatives.
- g. Compile alternatives and recommendations for "noise" abatement.

3.03.6 Government

3.03.6.1 County: In many jurisdictions, the county will be the governing agency. County planning boards assist in planning general land use and often develop long range plans. These plans are helpful in determining how future development will impact a planned range.

3.03.6.1.2 State: In most instances, states rely on the county and local agencies. However, in some instances, state agencies will have jurisdiction.

3.03.7 Populations

3.03.7.1 Information on population characteristics such as density, growth rates for previous periods and projected future growth rates also provide valuable information. A range builder can use this data to determine how growth rates will add or detract from the proposed facility. Population growth provides additional resources for the properly sited facility, and potential problems of encroachment for an improperly sited one.

3.03.8 Noise profiles

3.03.8.1 During the site selection process, have a consultant develop a sound "noise" profile for each proposed site to determine what abatement procedures, if any, will be needed on each. Remoteness has, in the past, been the accepted norm used to select a site. By using modern technological advances in acoustical materials, outdoor ranges can be sited near population centers. Developing a noise profile requires the services of an engineer practicing in the field of acoustics or someone thoroughly familiar with sound testing equipment and sound abatement methodologies.

3.03.9 General considerations

3.03.9.1 Cooperation with other range operations, community groups, educational institutions, recreational related organizations and others can gain needed support when justification is being put together. Early cooperation will show other groups how the facility will benefit the local community. In many instances, this aspect is omitted. How a particular operation will affect the local economy is important and necessary to counter any negative input. This balanced with how the facility will impact the local environment is also important.

3.03.10 Noise Abatement Programs

3.03.10.1 Noise abatement programs are necessary on all ranges from the standpoint of the user. Hearing protection should be a requirement for all users who are within 50 feet of the firing line.

3.03.10.2 Sound abatement shields or barriers should be installed on ranges where neighbors are within 1/4 mile of the facility unless significant natural barriers exist. Any fixtures or terrain features must serve either to redirect or capture sound. Exact configurations depend upon site characteristics.

3.03.11 Noise Measurement Standards

3.03.11.1 Select equipment based on the following:

- (1) Must meet all ANSI specifications.
- (2) Select multi-directional microphones.
- (3) Position microphones 4-5 feet above the ground on a tripod.
- (4) Select test sites at property boundaries or according to existing statutes.
- (5) Use a wind screen in all outdoor conditions.
- (6) Average wind speeds must be less than 12 mph. (Wind noise at higher speeds will invalidate data.)
- (7) Set sound level meter on tripod or stand and use a 5 foot extension for the microphone. (Use an extension on the microphone when necessary.)
- (8) Calibrate sound level meter and other recording devices before, during (every hour) and after sampling.
- (9) Have equipment factory calibrated once each year.

3.04 Selection of Sound Abatement Applications

3.04.1 The only way to prevent all sound from escaping the range property is to encapsulate it in an airtight enclosure. Sound levels can, however, be significantly reduced through good design. Sound usually travels from the source to the receiver via multiple paths, e.g., direct and reflected paths. By blocking line of sight, propagation paths, or the direct path from the firearms to the receiver, the major component of the sound is minimized. However, diffraction, refraction, the bending of sound waves, and reflection of sound waves will still allow sound to propagate to the receiver.

3.04.2 What are some practical examples of noise control on outdoor ranges? The most common type of sound abatement used on shooting ranges is barriers. Since a firing line cover provides shelter for the shooters, it is a common starting point in noise control. Across the country, cover designs vary greatly. They range in height from 7 to 15 feet. Some have flat roofs, some slanted, others gabled. Many are made with 4x4 posts, while others use metal poles or I-beams. Roofing materials range from corrugated metal to a full wooden-shingle construction. Corrugated metal roofs have a limited number of attachment points and are very resonant. This means that the material is likely to ring when excited, either by a stone hitting it or a pressure pulse from discharging firearms. A more damped firing line cover made from typical roof material, e.g., wood and shingles, is desirable.

3.04.3 To eliminate the direct source-to-receiver path of noise, construct a barrier, berm, or wall. To eliminate the direct path to this side of the range, another barrier should be constructed extending from the back wall forward 10 - 20 feet beyond the firing line, or long enough to block the line of

sight from the other end of the firing line to the concerned receiver. These walls should be physically coupled to the firing line cover, if possible. If cracks exist between these two structures, sound will be able to propagate away from the range in those directions. The mass of the barrier is also critical. The more massive the wall, the better the transmission loss will be, i.e., more sound reduction. There are many references which provide acoustic properties of materials. One example is a book by Beranek (Acoustics, Am. Inst. Phys., New York, 1988). Figure 10.27 of this book shows pictorially the average transmission losses of different wall construction. For example, the average transmission loss of a ½ inch fiberboard on 2x4 studs is about 31dB. A single sheet of ½ inch plywood yields an average transmission loss of about 22dB. These are excellent references one can use when constructing wall-type barriers.

- 3.04.4 The effect of enclosing a range with barriers is to direct all of the sound from the firearms in the forward direction and away from the noise-sensitive area. Sound will still propagate to the neighboring community due to diffraction and reflections from downrange obstacles, e.g., the hillside, berms, and trees. Insulation added to the walls and ceiling of the firing line cover will reduce the impact of the sound reflected onto the shooter or range user. Insulation will also help reduce the sound pressure levels being projected forward of the firing line area by absorbing the sound energy instead of reflecting it. Insulation can be added to the firing line cover in many forms. Attaching batting to the underside of the firing line cover, using blown-in insulation, or installing a drop ceiling with attaching insulation board have all been used successfully on shooting ranges.
- 3.04.5 Another solution to fixed point firing ranges is the tube range. This design consists of one or two sections of 36 inch or greater class III drain pipe. The pipe should be concrete -- not metal. Metal pipes tend to ring loudly even when partially buried in the ground. The ends of the tube are capped; these caps are typically made of plywood with holes cut into each cap just large enough to handle the firearm and have an unobstructed view of the targets. In this manner, the tube acts like a large silencer. Some tube designs include internal baffles to break-up the sound waves as they propagate down the tube. This design is generally used for benchrest shooting only. Three-position shooting is possible on this type range if trenches are dug at the front of the tube and adjustable platforms constructed for other positions.
- 3.04.6 The Discussion so far has concentrated on fixed position shooting. What about shotgun ranges where the targets can vary 180° horizontally and vertically? Barriers can be utilized in some situations with limited success. Because of the movement of the firearm, enclosing the range is difficult. For example, an enclosed trap or skeet range is not commonplace but could be done in a dome-like structure. For these situations, landscaping appears to be the only solution. Sound control by landscaping employs three processes: ground impedance, natural barriers, and to a lesser extent, increasing the noise of the environment.
- 3.04.7 Cook and Haverbeke (*Tree and Shrubs for Noise Abatement*, Nebraska Agricultural Experimental Station Research Bulletin #246, July 1971, CN: DNAL 100-N27-(3)) studied the effect trees and other forms of vegetation had on transmission of sound. They planted trees and shrubs in the form of shelter belts and wind-breaks, and measured sound levels of traffic noise and pure tones. They found that 65-100 foot wide stands of dense trees and shrubs are needed to reduce noise. For optimum results, the trees should be close to the source as opposed to close to the receiver. Trees, with uniform vertical foliage, should be planted as close as possible to form a continuous, dense barrier. Sparsely-planted trees offer little resistance to propagating sound. Where year-round screen is desired, evergreens or deciduous varieties which maintain their leaves are recommended.