RIOT CONTROL WITHOUT BLOODSHED

THE SOFT/STING RING AIRFOIL GRENADE

A Feasibility Review of the U.S. Army's Experimental Civil Disturbance Control System

By Dennis T. Brennan

April, 1976

Preface

As early as 1971 Cleveland Mayor Ralph J. Perk actively promoted the development of less lethal or non-lethal weapons for possible use by the Cleveland Police Division and other civilian law enforcement agencies around the country. In 1975 Mayor Perk and Cleveland Law Director James B. Davis questioned whether recent advances in weapons engineering might soon provide a sub-lethal response option to policemen armed with lethal firearms but frequently encountering sub-lethal threats to life or public order.

In August, 1975, Director Davis suggested to Dr. Dennis T. Brennan, author of The Other Police report, that he pursue feasibility research into selected less lethal weapons intended for police use.

The following feasibility report on one non-lethal crowd control device was principally written under a generous AHS Foundation grant to the Governmental Research Institute. Only the perception by Mayor Perk, Law Director Davis, the Foundation and the Institute of the public interest in such an analysis made possible this report. Their assistance does not necessarily indicate concurrence in the conclusions and recommendations of this consultant's report.

All of the illustrations and figures concerning the Ring Airfoil Grenade which appear in the report's text have been reproduced with permission from various technical briefing materials and working memoranda of the Weapons Systems Concepts Office, Development and Engineering Directorate, Edgewood Arsenal, Maryland. While the Weapons Systems Concepts Office is in no way responsible for the facts and conclusions of this report, that Office's continuous generosity over many months in supplying information requested has been of invaluable assistance and is hereby gratefully acknowledged.

Research information or criticisms were also supplied by: the United States Law Enforcement Assistance Administration; the National Institute of Law Enforcement and Criminal Justice; the Human Engineering Laboratory and the Biophysics Division of Edgewood Arsenal, United States Army Development and Readiness Command; National Science Foundation; Batelle Memorial Institute; Gun Control Federation of Greater Cleveland; International Association of Chiefs of Police; Nassau County, New York Police Department; Baltimore City Police Department; many of the police officials attending the Cleveland Police Division's Midwest RAG Outdoor Demonstration, and most especially, Cleveland Police Chief Lloyd F. Garey.

--D.T.B.
April 3, 1976

PROLOGUE

It may have begun at an amusement park, a sporting event, a picket line or a political meeting. The crowd--several dozen to perhaps several thousand persons--may have felt provoked by some unpunished act into an outburst of righteous indignation. Or the disturbance may have grown from a demonstration organized to advance a political cause.

More often, some pretext like an exhausted beer supply, a closing time or a transportation delay sets boisterous young men and boys on a rampage of destroying for destroying's sake and fighting for fighting's sake. Such rampages or outbursts often encourage pillagers to smash store display windows and take whatever goods they can use or sell. Typically, men and women bystanders are watching the developing battle between the rioters and the newly-arrived police.

Here municipal police face an event more critical than thousands of routine patrol incidents. With the events possibly recorded by television cameramen and newspaper photographers, both politicians and the general public will decide whether the rioters or the police are more blameworthy for their conduct.

The rioters, grouped as far as ninety yards away, are usually blocking a public street or park. Sometimes they taunt the outnumbered police or approach to within ten to fifteen yards to throw rocks or bottles. The dangerousness of mob members and agitators can only be guessed; a wrong guess could prove fatal. While police officers may have to respond in kind to threats of potentially lethal force, even defensive firearms-use may ignite a violent rage among rioters or bystanders.

Rather than making many arrests and asserting personal authority, individual policemen must act together to disperse the crowd and prevent regrouping. Use of nightsticks would require close-range, unpredictable and perhaps bloody confrontations. To incapacitate leaders who are inciting others to riot and to motivate crowd members to themselves leave the scene, some longer-range and entirely non-lethal weapon is needed.

Such a device must be directable against individual crowd agitators; it must not inflict serious damage, immobilize or produce either bleeding or obviously excessive pain. While bystanders should neither be themselves physically affected by the weapon's effects, the weapon's incapacitating effects should convince both rioters and bystanders of the graduated yet effective deterrence intended by the policy.

Despite our best efforts, riots and the equipment needs they have uncovered will not go away in the next decade. What police need is a flexible crowd control system--the subject of this report.

CHAPTER ONE

A POLICE NEED: FLEXIBLE CROWD CONTROL

CRIME CONTROL BY WEAPONRY?: For many citizens determined to reduce crime, any analysis such as this raises a question of priorities. Rather than analyzing and field-testing new weapon systems for police use, should we not rather get at the root causes of crime--racial injustice and unemployment--or make the police behave better toward people? Questions from the other direction also arise: now that many citizens have forgotten the vital function played by police in meeting lawless force with lawful force, will not the introduction of less lethal weapons increase pressures to regulate police firearms use out of existence?

This first chapter briefly suggests: that policemen's duty to maintain order against both life-threatening and lesser crimes requires tactical flexibility and tangible deterrents; that the current police arsenal properly includes lethal firearms but yet remains too limited to permit graduated, effective deterrence to sub-lethal threats to public order; that riotous crowds present a frequently sub-lethal and recurrent threat to public order; and finally that in many situations crucial to police-community relations, the availability of non-lethal weapons would permit flexible crowd control and avoid both under-response and over-response. Chapter Two of this report will then assess how one crowd control device might meet this high-priority police need, and Chapter Three will offer some conclusions and recommendations.

FLEXIBLE POLICING: Citizens angered by real or apparent police misconduct often forget the legitimate discretion always exercised by American municipal police. The arrest of nineteenth-century lawbreakers was left to fee-charging constables with sworn warrants, while watchmen, the forerunners of our municipal police, managed street conflict less by enforcing vague laws than by personally "taking charge." Today's urban policeman remains neither a college-educated professional applying generalized knowledge nor a bureaucrat following detailed rules. As James Q. Wilson (Varieties of Police Behavior) explains, the policeman is a member of an order-maintaining craft who often works alone in exercising wide discretion over matters of assistance, arrest, life and death. He makes his crucial choices far from the rule-makers but near to persons fearful of or hostile to him. Instructed to "handle the situation," the urban policeman is forced to "play it by ear" in combining equity with leniency to suppress crime. Always he must be prepared to subdue dangerous persons with his physical force and weapons while accepting responsibility for using such force. However keen the hindsight vision of municipal administrators, they cannot formulate rules which eliminate discretion or abuse of discretion in police use of fatal force. To achieve flexible control of each particular lawbreaker, police must be properly recruited, trained and supervised--and then allowed to choose among weapons of varying force.

TANGIBLE DETERRENTS: Weapons are a reminder that crimes can often be prevented by increasing their physical risk. For example, when

an armed policeman approaches, the would-be mugger or rapist fears being captured and even shot during arrest for his projected crime. The general deterrence lesson should be obvious: the threatened or actual use of weapons controls crime when tangibly linked to the self-interest of potential criminals.

Many citizens might prefer governmental use of intangible deterrents, such as persuading the predatory criminal of the shamefulness of crime or changing the complex social process by which poverty, racial injustice and unemployment become "causes of crime." For the foreseeable future, unfortunately, only tangible crime deterrents--material power--will be at government's disposal. The threatened or actual use of weapons is but one among several tangible deterrents; prisons are another. American society could both prevent and deter a substantial fraction of serious crime by charging, sentencing, and imprisoning for determinate periods all serious or repeating offenders. This report, however, focuses only on the tangible crime-deterrence made possible by police weapons.

CURRENT POLICE ARSENAL: Municipal police are expected to use an appropriate degree of force where necessary to counter the many threats to human life, property and public order in our violence-prone society. To supplement their personal force, police may radio for assistance and/or resort to a very limited arsenal, usually consisting only of the nightstick, possibly a tear-gas aerosol and certainly a lethal revolver.

This lethal sidearm is the core of the police arsenal and the ultimate force within the officer's discretion. Although

seldom if ever used by most American policemen, this immediately available, instantly incapacitating, accurate, multi-shot sidearm is the only force respected by many armed criminals discovered near point-blank range. Officers are generally instructed that firearms are to be used only in the preservation of life or the apprehension of felons when all other means of capture have been exhausted.

SUB-LETHAL THREATS: Unfortunately, many situations in which an individual officer has the option of taking aggressive action appear unclear as to the facts and future intentions of the citizens involved. The officer must make rapid decisions affecting his life and safety as well as the citizens'. Especially in retrospect, most dangerous situations encountered by policemen involve a less-than-lethal threat and require only the use of variable-range, prompt stunning power rather than of fatal force. Although the pattern characterizing successful and unsuccessful firearms use has not been well researched, police firearms use too often kills the innocent--bystanders, hostages, and policemen themselves--or summarily overpunishes the criminal offender. Unnecessary firearms use raises serious community tensions, generating far more ill-will toward police than the good will accruing from hundreds of decent but routine police actions. Increasingly, any firearms use provokes civil or criminal charges against the officer using lethal force. As a long-term trend, Americans generally are growing increasingly intolerant of lethal violence--both against police and by police.

Routine street patrol and household disturbance calls bring police into many situations of moderate difficulty where force is needed. The person resisting arrest or questioning is likely to be an unarmed male, either adult or a physically mature teenager, who may push, shove or try to jerk away from the officer, or may even arm himself with a board, stick, knife or broken bottle. The offender is frequently intoxicated, "high" on drugs, or mentally excited. Although most such confrontations find the subject between arm's length and room's-length distance, some offenders or suspects are much further away from the officer--attempting to flee on foot or in a "borrowed" car, or barricaded inside a building. Crowds assembled for a parade, a demonstration or an entertainment may also become aggressive and destructive.

SUB-LETHAL RESPONSES: While police menaced by lethal force may have to respond in kind, in the situations described above the officer can usually protect himself from a sub-lethal threat and respond with sub-lethal force which incapacitates, immobilizes or subdues the offender so that he may be taken into custody. It should be noted that even the mildest force and most benign weapon involves some trauma and thus offers some remote chance of serious injury to an extremely frail, susceptible or unstable person. This injury applies to such weapons as the human fist, arm and leg as well as to the nightstick and aerosol lachrymators like "Chemical Mace." Conversely, too little weapons force can fail to stop the offender's attack or escape and exacerbate his aggression or excitement. Since there is no perfect weapon--i.e., totally effective, totally harmless--a sub-lethal response

to a sub-lethal threat must be selected for its minimal probability of an undesirable effect. "Undesirable effect" has therefore been defined by sub-lethal weapons researchers to be:

> . . . that anatomical and/or functional effect which persists longer than 24 hours and prevents an individual from performing routine daily tasks and/or produces permanent impairment as defined by the American Medical Association (AMA) ratings.

There are several now-traditional weapons which can be used so as to virtually eliminate the possibility of such an undesirable effect. The oldest such device is the nightstick, which can be used for offensive, defensive and control purposes. Although the average policeman is likely to use his nightstick hundreds of times for each use of his firearm, he receives very little if any retraining in the effective, graduated use of this all-purpose weapon. However, police often face situations where the number, strength or flight of their offenders warrants long-distance, multiple-target control devices. For such cases, chemical agents in liquid stream, powder or gaseous form have proved reasonably effective, despite the imperfect accuracy, reliability and safety of current launchers/dispensers. The recent introduction of the "super tear gas", CS, gives police an extremely safe, powerful and quick acting agent which does not require area decontamination (see Appendix, pp. 41-43). Another less hazardous device, the electric shock baton, became labelled as a "cattle prod" when introduced during civil rights demonstrations in the Sixties and now serves as a reminder that public acceptability is the first test any weapon must pass.

TASER PUBLIC DEFENDER: The considerable demand for a less-lethal weapon to defend against a "one-on-one" assault has generated considerable public exposure for an electrified dart gun known as the Taser TF-1. Beneath a nine-inch flashlight, the Taser's twin trigger ignites a gunpowder charge, firing two darts attached to two fine wires and carrying a 50,000-volt electrical charge. Whether the darts gently pierce the skin or merely stick into clothing, their electrical supercharge contracts the victim's muscles in very painful spasms, causing him to fall helpless within three seconds and yet to recover fully within a few minutes. Although some medical and police officials in the United States and Canada are seriously concerned about the Taser's physical shock hazard (especially to those with nerve disorders or heart disease), more than 2,000 of the $200-weapons have been purchased by the law-abiding and criminal publics in nine months. Because of increasing reports of its use in crime, the federal government ruled that Taser manufacturers and dealers must have a federal firearms license and maintain ownership transfer records. While somewhat inaccurate at its maximum range of 15 feet, the Taser's demonstrated potential for prompt incapacitation remains of interest to some police technology experts.

RIOTS--A PERMANENT THREAT: One important threat to life and property is rioting, which is legally defined as a lawless act engaged in by three or more persons and accompanied by violence or breach of the public peace. As the Prologue above suggests, rioting--the acts of an excited, disorderly, dangerous crowd--

often has little or nothing to do with political causes and much to do with the boisterous "fun" or the greediness of impulsive, improvident boys and young men who happen to be congregating on the streets or park when any incident triggers the "action." Cleveland, for example, has had its "Hough"'s and "Glenville"'s in the Sixties, but in the summer of 1975 it experienced an entirely non-political rampage at the All-Nations Festival. As Jules Archer's Riot! points out, the United States is well into its third century of almost continuous threats of bloody riots. Indeed, fear of riot or popular uprising was the usual nineteenth-century reason for arming municipal police. Today, we must face the fact that our society's efforts in the next decade to end racial injustice, poverty, slums, and unemployment are unlikely to be serious or successful, and further that an important fraction of our urban young men and boys are now unamenable to the disciplines of steady employment and prefer the "action" of the streets. However much we might wish for it, civil disturbances will not go away.

A UNIQUE PROBLEM: Further, riots present special problems for police organizations normally dispersed into small beats or patrols to maintain order and control ordinary crime. A riot makes quasi-military demands of mass deployment and concerted, disciplined action upon police organizations which at one time can field only a few men, most of whom have not received in-service training in working together in larger but outnumbered groups and under media scrutiny. Often the overall goal of dispersing the crowd and preventing its re-formation requires the unusual means

of not immobilizing or arresting violent lawbreakers; at other times speed and precision are necessary to isolate, arrest and remove riot agitators. Only practice and preparation can make chemical weapons or riot-batons (extended nightsticks) effective. While many other countries (e.g., France and Japan) garrison special riot police whose sole duty is to supplant the ordinary constabulary in riot situations, the United States expects its local police to handle this unique function, with occasional assists from a distinctly combat-oriented National Guard. Is it any wonder, then, that many riot and group disturbances in the last decade have been handled badly and have increased tensions among police and several community factions?

POLICE-COMMUNITY RELATIONS--AN OPPORTUNITY: Many police departments around the country now seem to have accepted the practical consequences of the radical difference between their normal crime/disorder control duties and civil disturbance control duties. They are reviewing their recruiting and supervisory procedures, analyzing newly developed weapons for possible addition to their arsenals, and seeking the time and money to accomplish regular in-service crowd control training programs. While society must insist that police experiment to identify an organizational role for police which maximizes police collaboration with those citizens who desire police presence, society's leaders must in turn learn from police which role expectations are reasonable. Some tension (but not widespread bitterness) between the police and crime-ridden communities is the inescapable by-product of close surveillance of plausible street-crime suspects. Police must be

asked to do much better at reducing street crime, but police efforts to this end will bear little fruit in the short term without equal improvement by our prosecutors, judges, wardens, and parole boards. To show their good faith with various community factions, police must look to what they can accomplish on their own in various "fishbowl" situations, including riot-control. Police are aware that, while group-target machine gun and rifle use were accepted riot control strategies in 1900, today's norms will frequently not permit most non-homicidal rioters even to be threatened with fatal force, much less arrested. If technology could provide a humanitarian technique for deterring and apprehending riot leaders, a step toward better community relations and respect could be taken. Could weapons technology develop a tangible yet safe deterrent to rioting?

STING RAG/SOFT RAG

FOR
NON-LETHAL
CIVIL DISTURBANCE CONTROL

STING RAG

SOFT RAG

CHAPTER TWO

THE ARMY RESEARCH ANSWER: RING AIRFOIL GRENADE

ARMY NEED PERCEIVED: The widespread mob violence of the Sixties and early Seventies also posed a serious challenge of non-lethal response capability for United States Army military police and Army-supplied National Guard. Like its civilian police counterparts, the Army inventory contained no items which permitted control forces to avoid close-range riot confrontations by selectively engaging individual rioters more than 15 meters away with accurate and non-hazardous devices of either the chemical-agent or kinetic-energy variety. Relatively safe group ("area") target weapons (such as the burning CS grenade) tended to engulf large areas, to affect innocent bystanders, and to require considerable clean-up. The effective range of numerous individual ("point") target riot control devices developed or tested for military police use (see Figure 1) was not great enough to keep rioters at a standoff distance where they could not hurl rocks and debris at control forces. Yet even the limited ranges of these riot-control projectiles necessitated a high risk of lethality at muzzle velocity and close to point-blank ranges. Here the weapon operator must balance the short-distance risk of serious injury against the intermediate-distance risk of inaccuracy and over-soft impact. Inaccurate range estimation under stress would lead to an accidental firing of one of the projectiles within their lethal range--as has happened with fatal results. Therefore, the Army identified a civil disturbance control need for a longer-range, accurate, effective projectile or projectiles which would provide the lowest probability

SUMMARY OF REPRESENTATIVE NON-LETHAL SYSTEMS FOR CIVIL DISTURBANCE CONTROL

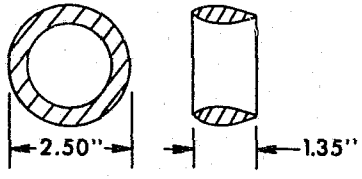
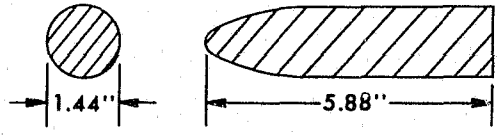
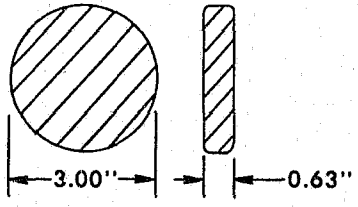
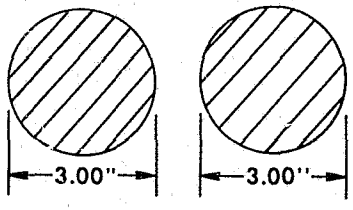
SYSTEM	PROJECTILE CONFIGURATION (FRONT VIEW / SIDE VIEW)	WEIGHT (LBS)	MUZZLE VELOCITY (FT/SEC)	MATERIAL
STING/SOFT RAG		0.075	200	SOFT RUBBER BODY WITH SOFT RUBBER INSERT FOR STING RAG AND CS POWDER INSERT FOR SOFT RAG
RUBBER BATON		0.33	200	SOLID HARD RUBBER BODY
STUN BAG		0.30	170	FABRIC BODY CONTAINING LEAD SHOT
WATER BALL		0.50	150	SOFT PLASTIC BODY CONTAINING WATER

FIGURE #1

of causing serious or lethal injury even at muzzle velocity and range.

LEAA EVALUATION PROGRAM: This Army research priority was chosen against a background of rapidly maturing physiological research on non-lethal weapon effects. In contrast to centuries of experience with bullets' penetrating trauma and a half century's experience with chemical agent weapons, very little precise information existed about blunt or non-penetrating trauma effects of kinetic-energy weapons. Following a November 1971 Research Needs for Law Enforcement Conference co-sponsored by the U.S. Justice Department and the National Science Foundation, the Justice Department's Law Enforcement Assistance Administration (LEAA) asked that responsibility for providing a technique for evaluating less-lethal weapons be given to the Military and Civilian Law Enforcement Technology Team, then a part of the Army Land Warfare Laboratory (LWL). Under grants from LEAA's Less-Lethal Weapons Evaluation Program, this technology research team conducted a long series of varied tests.

TRADEOFFS--STOPPING POWER VERSUS SAFETY: This LWL team soon discovered the difficulty in kinetic-energy weapons use of avoiding undesirable physiological effects. To study the tissue and systematic effects of seven less-lethal projectiles impacting on test animals with various levels of kinetic energy, LWL's Medical Group developed and applied two complex damage measurements to seven different body areas and organs. Heavier projectiles which overcame high air drag and provided effective stopping power (near-immediate functional disability) proved physiologically damaging

HAZARDOUS AND NON-HAZARDOUS PORTIONS OF OPERATIONAL VELOCITY RANGE OF VARIOUS NON-LETHAL CIVIL DISTURBANCE CONTROL SYSTEMS

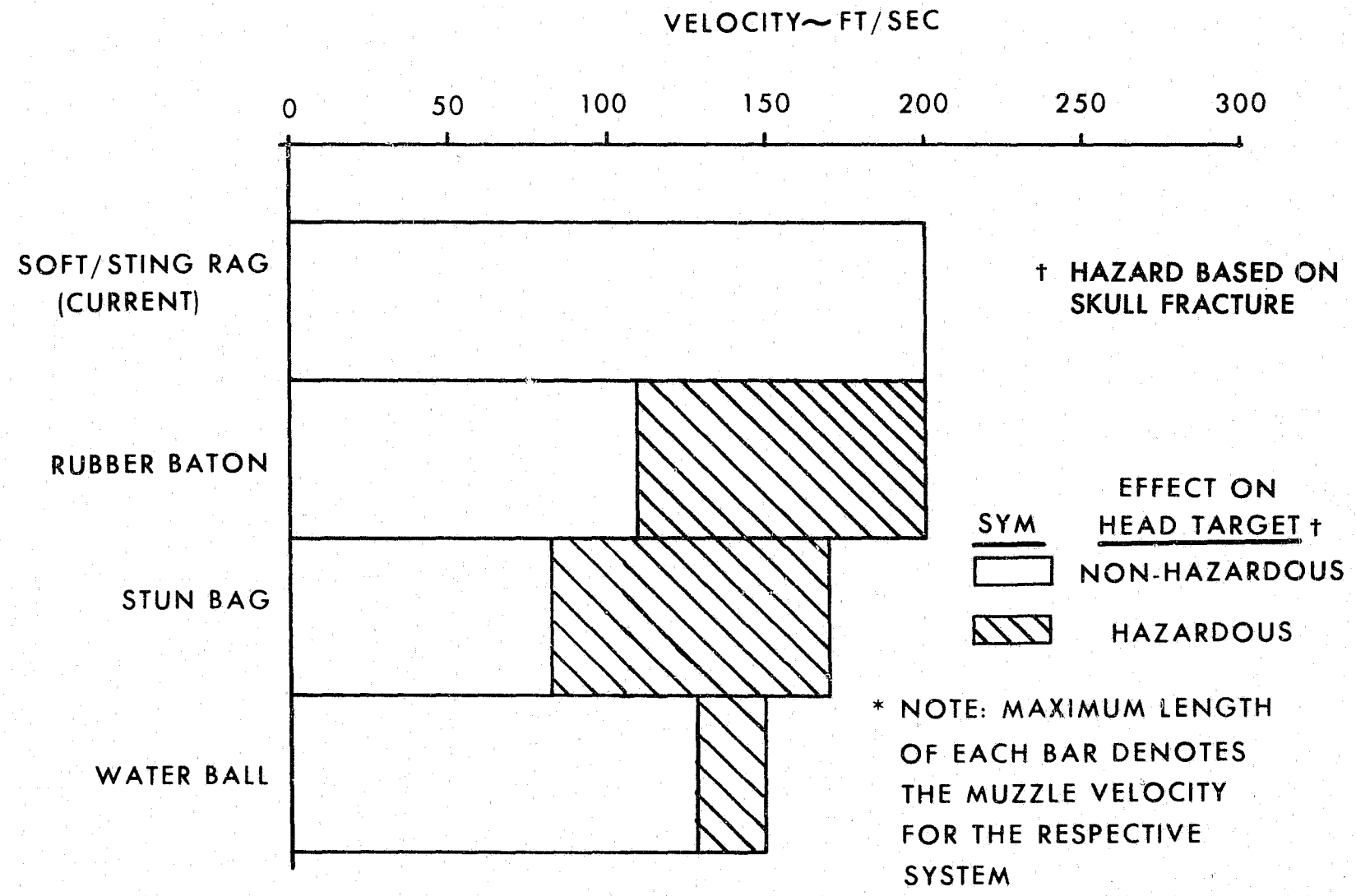


FIGURE #2

to the head, thorax (heart and lungs) and liver at near-muzzle range, unless launched at velocities so low as to limit sharply their range (for comparable data, see Figures 2, 3, and 13). On the other hand, smaller, lighter projectiles, while also subject to rapid velocity and height decay due to air drag and lack of aerodynamic left, proved generally more hazardous than larger projectiles for given kinetic-energy levels.

In its final report of June, 1974, the LWL research team concluded that "hazards must be accepted if a device is to be used to 'reliably' stop or immobilize an individual in open areas." As to the hazard-free potential of dispersing-by-show-of-force projectiles, the report states, "there is much evidence that a device/projectile can be made which will be muzzle-safe (cause no appreciable damage from [highest velocity] impacts at the muzzle of a launcher) and which will provide desired effects at ranges of interest." Although none of the LWL-tested projectiles has been approved for engineering development, the LWL's most favorable evaluation went to a frangible, soft-elastic projectile very similar to the projectile selected for Army engineering development.

GENERAL MEASUREMENTS STILL UNDISCOVERED: Some research goals were not met in this LWL/LEAA effort. The Law Enforcement Technology Team had been unable to show that its hazard test measure of foot-lbs. at impact represented a general comparative measure for the hazard performance of blunt projectiles. Analysis of impact test data by the Edgewood Arsenal Biophysics Division showed that differences in size, internal configuration, weight or velocity will tend to cause projectiles with the same kinetic energy to

VELOCITY AS A FUNCTION OF RANGE FOR VARIOUS NON-LETHAL CIVIL DISTURBANCE CONTROL SYSTEMS

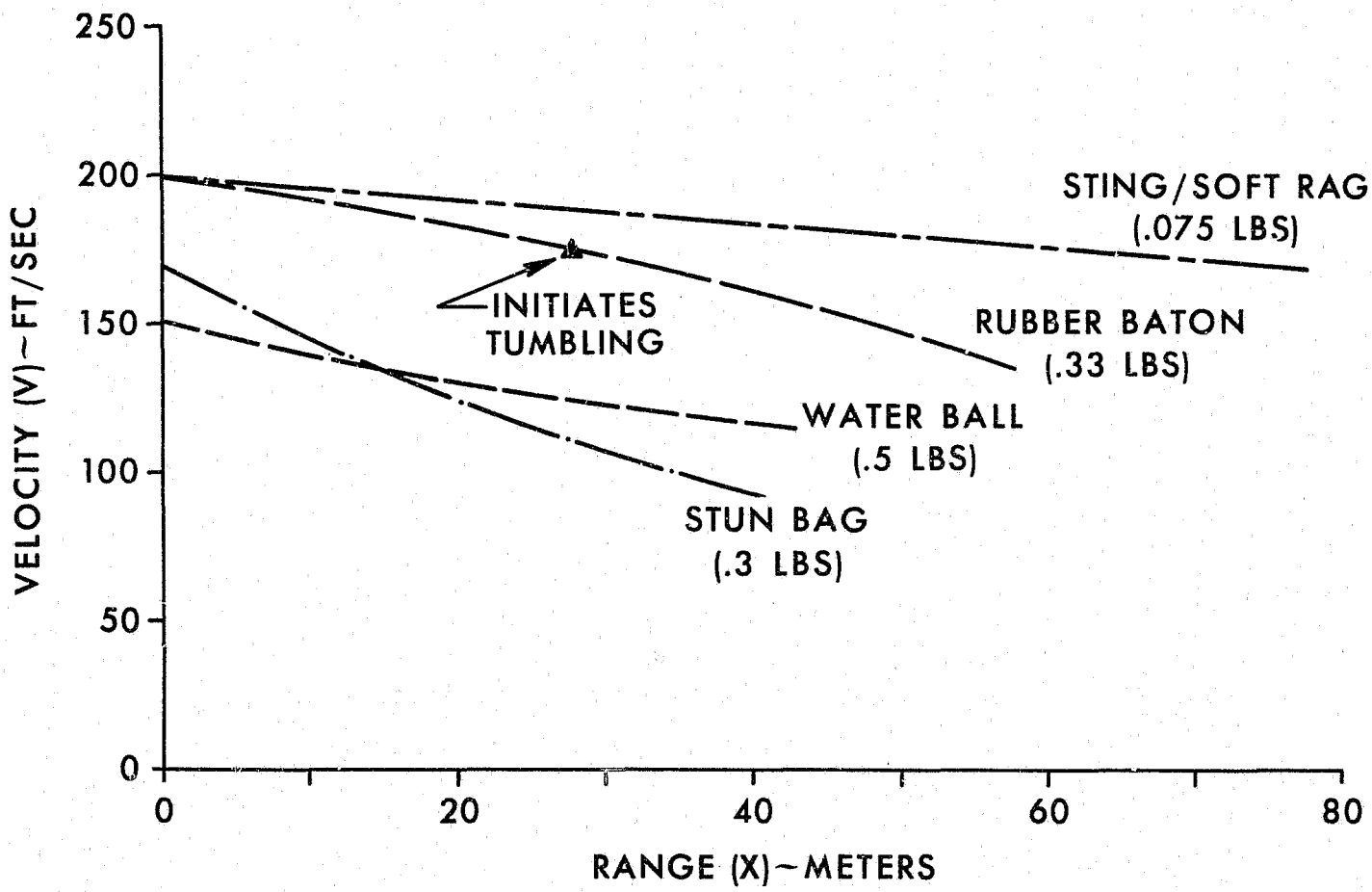
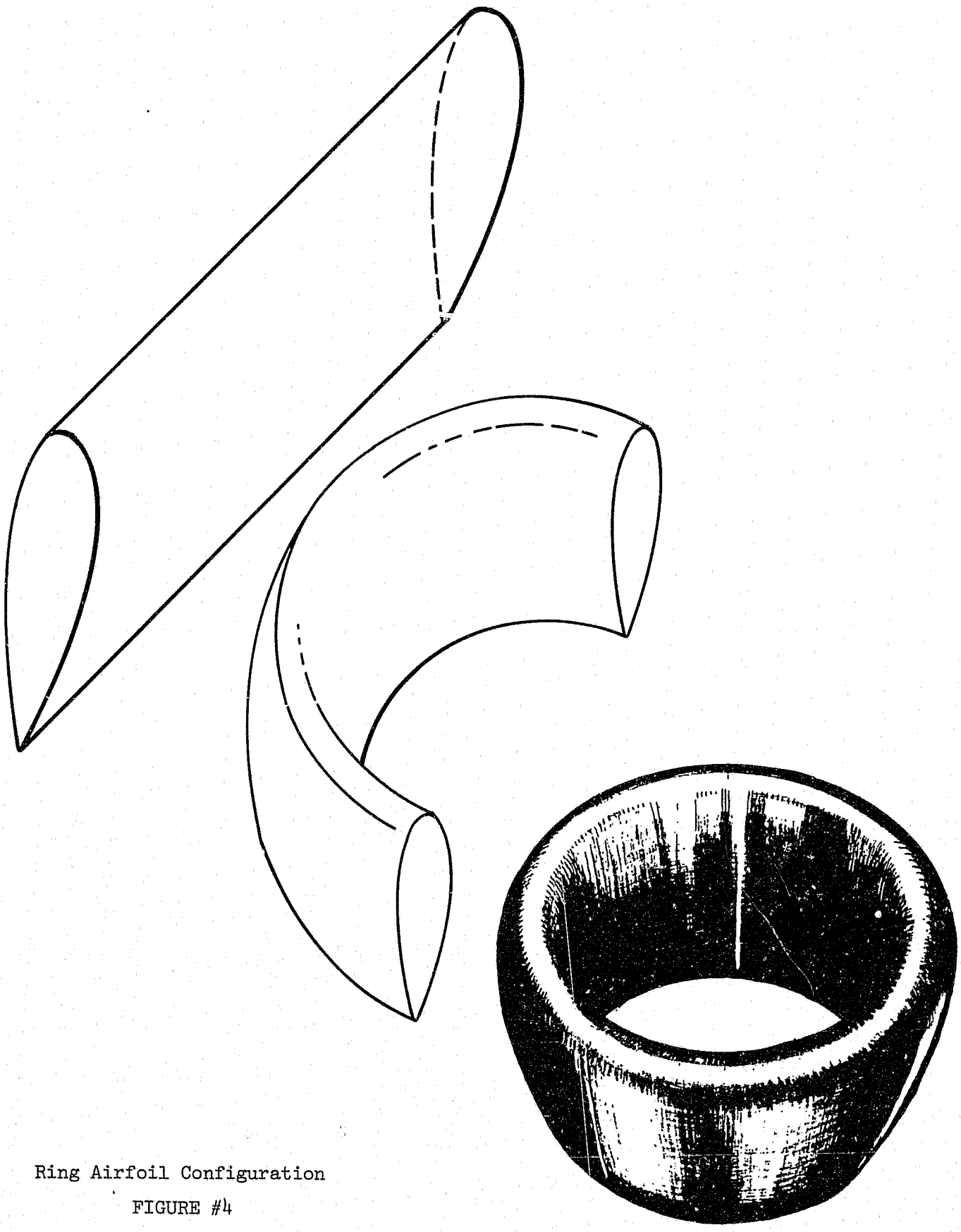


FIGURE #3

produce different damage levels. Not even the sparse data using eight distinct measurements of any given high-velocity/low-mass produced blunt trauma could completely assess such important variables as dose application time and total system compliance effects. Thus no general technique exists for evaluating less lethal weapons; even today each blunt trauma weapon must be exhaustively tested for its particular safety hazard effects.

SHOW-OF-FORCE BREAKTHROUGH: The search for a low-hazard projectile had been joined by the Weapons Systems Concepts Office, an Army aerodynamics research engineer group whose unconventional bullet and grenade development efforts had recently focused on the ring airfoil configuration. This configuration results when a thick "airplane-wing" shape is rolled into a ring (see Figure 4). When launched spinning about the axis running through its hole, a ring airfoil projectile develops lift which allows it to fly longer distances rather than merely hurtle along a shorter ballistic trajectory. This relatively flat or eye of sight flight path from launcher to target enables a shooter to aim directly at the target with an expectation of hitting where he aims (see Figures 3 and 5). This accuracy of ring airfoil projectiles is increased by a low spin decay which gives gyroscopic stability out to target.

Beginning in 1969, the Weapons Systems Concepts Office (a part of the Directorate of Development and Engineering at Edgewood Arsenal, Aberdeen Proving Ground, Maryland) initiated concept feasibility work on a deformable, small-mass ring airfoil projectile for crowd control. This was conceived to produce pain through high-speed, wide-area impacting of the many pain nerve endings massed in human skin and



Ring Airfoil Configuration

FIGURE #4

to deform and rebound quickly to minimize or eliminate organ damage. This Concepts Office also projected an incapacitating tear gas "grenade" version which would produce the same skin pain but would also utilize the high-spin, deformable ring to throw a swirling powder cloud on and around the rioter. In retrospect, this concept development settled for Army purposes the characteristics trade-off between safety and force: researchers were now designing kinetic energy weapons for mere display-of-force rather than stopping force. Although law-enforcement tactical considerations might suggest that powerful "known-down" less-lethal weapons be developed for military and municipal police use, such development seemed precluded in the early Seventies by strong social constraints against weapons causing intense pain or any permanent damage. Non-lethal weapons remain the order of the day.

ARMY SPECIFICATIONS: Encouraged by this feasibility work, the U.S. Army later approved a "required operational capability" for a "Soft RAG/Sting Ring Airfoil Munitions System" mandating the following characteristics. When filled with a chemical agent, the "Soft" Ring Airfoil Grenade (RAG) projectile must, on impact or grazing, immediately fail structurally and expel at least 80% of its incapacitating riot control agent in a 3-5 foot diameter cloud on the target. The "Sting" Ring Airfoil must deliver a sufficiently painful kinetic impulse to stop or deter most rioters. When used at a rate of fire up to 4-6 rounds per minute, both projectiles must possess at least a 95% probability of travelling to target and producing the desired effect. Launched from the standard M-16 rifle by an attached adapter, the projectiles must have sufficient

COMPARISON OF TRAJECTORY PROFILES FOR VARIOUS NON-LETHAL SYSTEMS FOR CIVIL DISTURBANCE CONTROL

CONF	LAUNCH VELOCITY (FT/SEC)	LAUNCH ANGLE (DEG)	PROJECTILE WEIGHT (LBS)
STING/SOFT RAG	200	2	.075
RUBBER BATON	200	2	.330
STUN BAG	170	2	.300
WATER BALL	150	2	.500

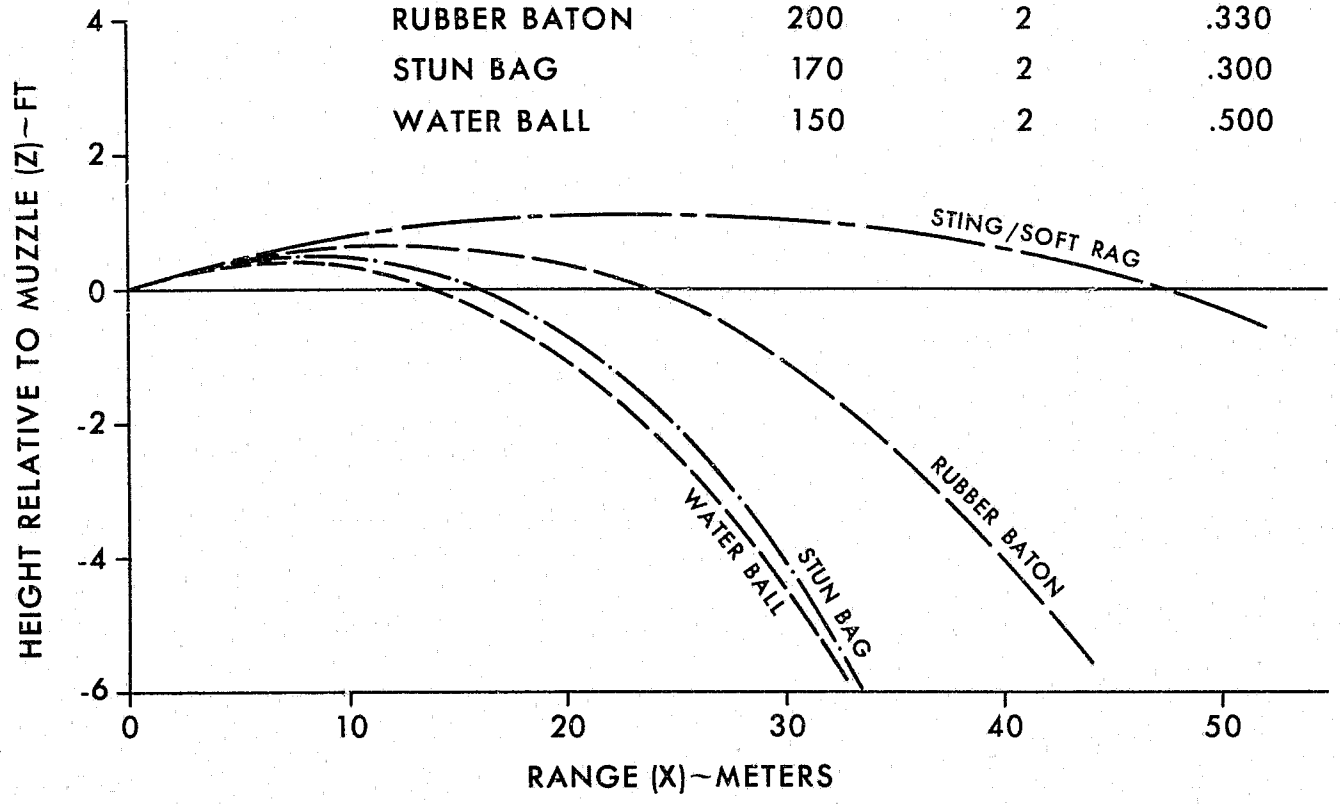
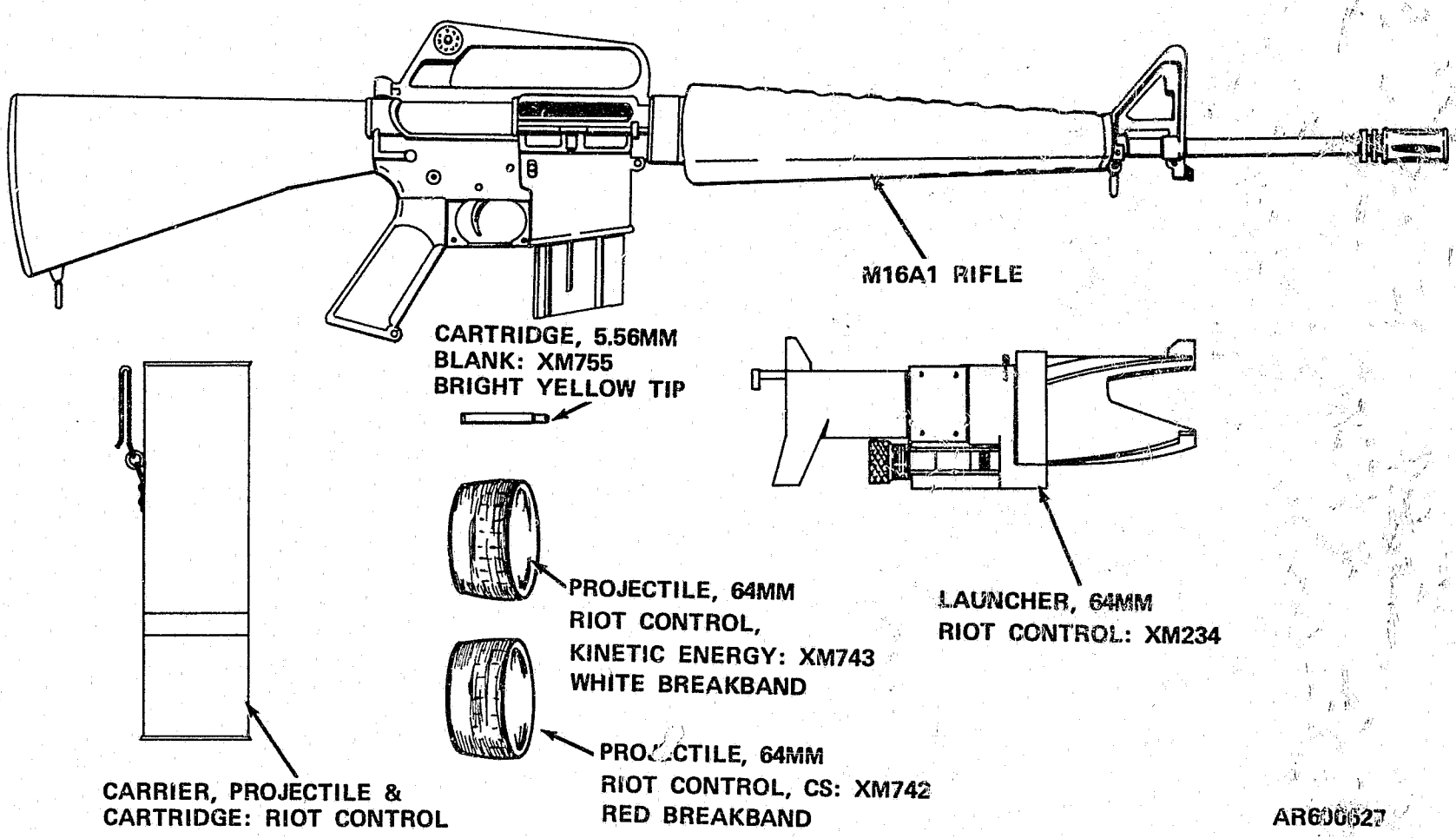


FIGURE #5

velocity to preclude rioters from evading or catching the "Sting" round or evading the "Soft" round to a range of 100 meters. The projectiles must reduce to an absolute minimum the possibility of causing irreversible physiologic damage to individuals. For each shot there must be an 80-90% probability of hitting an individual at 40 meters range and of hitting a small group (10-meter diameter target) at 60 meters. The projectiles must perform as specified in several climactic categories and must be stable in storage under humidity variations of from 5-90% and under temperature variations of from -30°F. to 130°F.

THE FINAL PRODUCTS: Following a four-year development effort, the Army has achieved the required capability through the RAG system components shown in Figure 6. The two-pound adapter/launcher (XM234) can be secured in a few seconds to the rifle sight, bayonet stud and flash suppressor of the M-16 rifle. The carrier is used for storing and dispensing six "Sting" or "Soft" RAG projectiles and blank or crimped cartridges, each containing 12 grains of a commercial shotgun propellent. Either projectile is inserted in the launcher cup by pushing the molded polyethylene holder and ejector (Figure 7) into the barrel of the launcher. When the holder-ejector unit is withdrawn, the projectile is firmly seated in the launcher cup. With a cartridge chambered into the rifle, the system is ready to be fired. The launcher firing cycle is shown in Figure 8. In its top picture, the launcher cup is held in the ready position by a spring detent which holds the shaft of the cup to the back end of the launcher. The middle picture shows how the propellent gases have travelled down the barrel of the

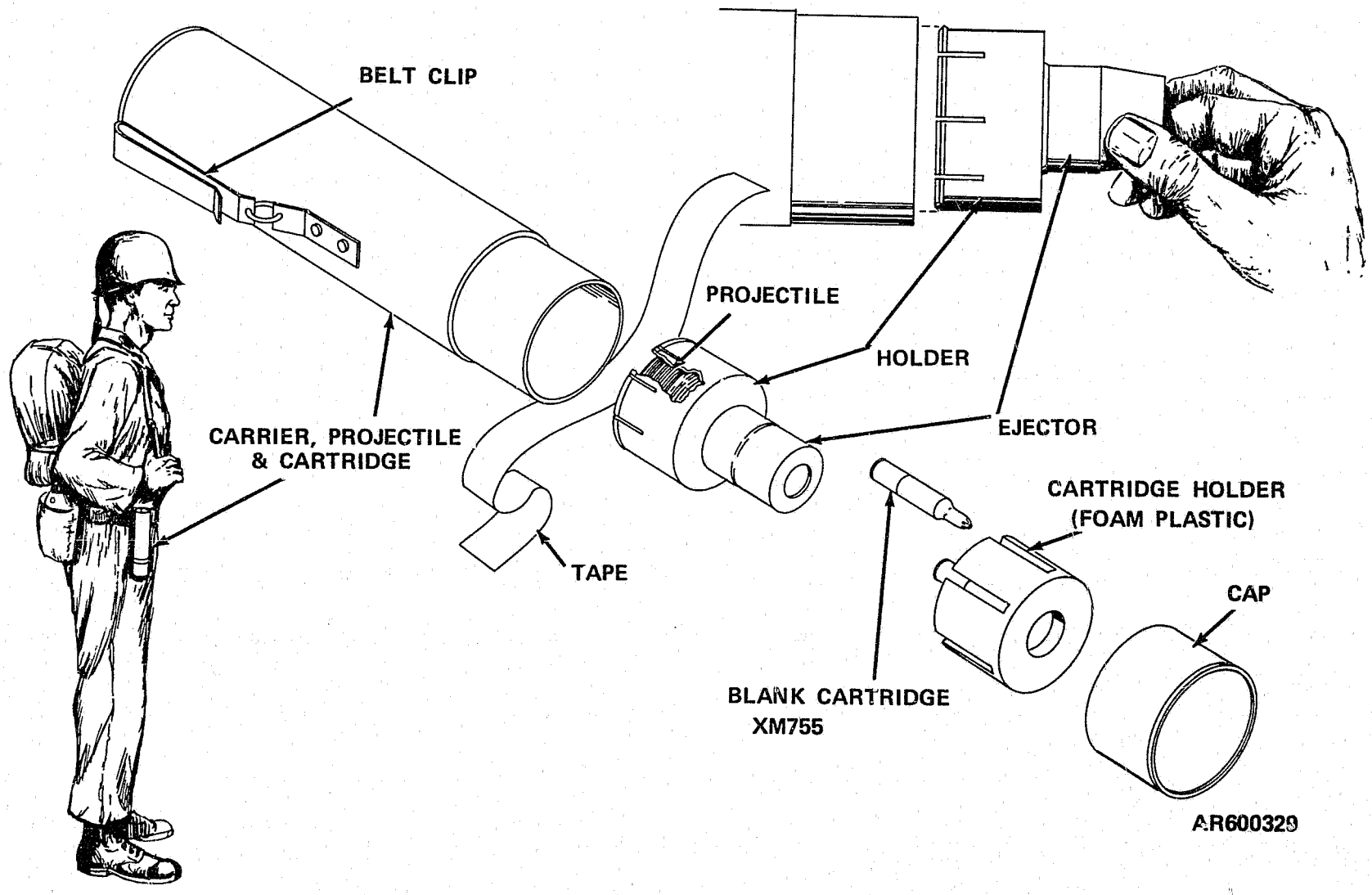


RAG System Components

FIGURE #6

launcher, impinging on the back of the cup, causing it to travel down the barrel of the launcher. Keys on the cup engage grooves in the launcher barrel to impart spin to the cup and projectile. After 1.5 milliseconds of acceleration and less than 1-1/2 inches of travel, the flat washer at the back end of the cup shaft engages the rubber buffer (bottom picture). The crushing action of the buffer decelerates the cup and shaft, allowing the projectile to exit at 200 ft./second and spinning at 5,000 R.P.M. As of 1974 this adapter/launcher was estimated to cost about $55 per unit in quantities of 10,000. Sting and Soft projectiles were expected to cost $2.00/$3.00 respectively per unit.

XM743: STING RAG: Despite the engineering success of this new launcher, it is the two new projectiles which distinguish this humanitarian weapon system. Both have the same external configuration (2.5" wide by 1.35" long) and weight (just over 1 ounce) and can be distinguished only by the color of the paper band surrounding the projectile. Both projectiles consist of a soft rubber-like ring with 18 compartments around their exterior circumference. While the Soft-RAG's compartments or cavities are filled with packets of non-combustible riot control agent, the Sting RAG's cavities are more shallow so that the projectiles will weigh the same. In both projectiles the presence of the cavities allows the "sting" impact energy to be released over a greater skin area and a longer time interval, thereby minimizing the likelihood of producing a serious injury. The paper breakband impregnated with a waterproof binder maintains the aerodynamic shape of the projectiles during their spinning flight and then breaks upon impact to assist



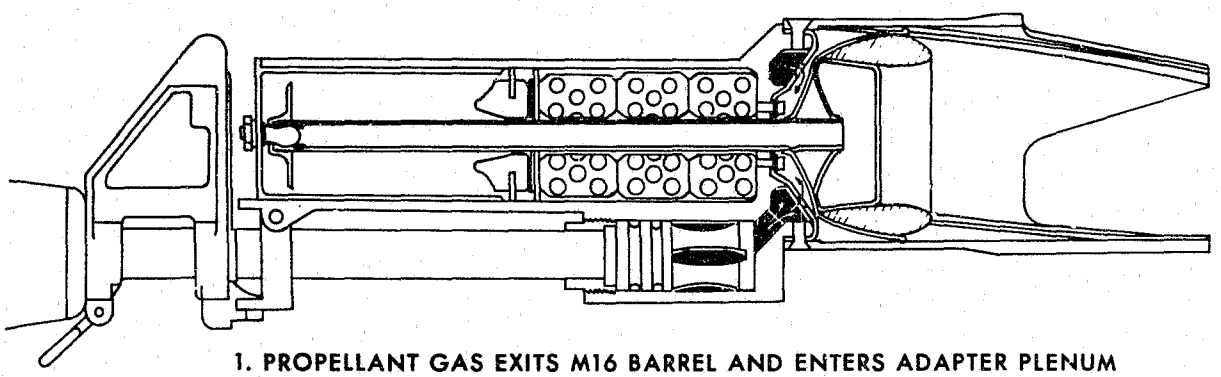
Storing And Loading RAG Projectiles

FIGURE #7

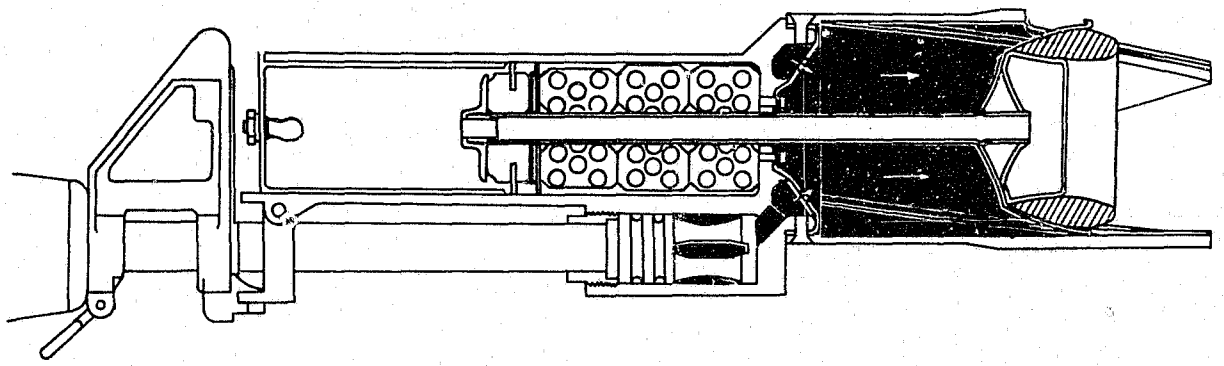
energy/energy-plus-powder diffusion. In the unanimous opinion of riot control experts observing Sting RAG impacts at 40 and 60 meters, the projectile's pain dose, somewhat comparable to a boxer's jab, should cause moderately motivated rioters to disperse.

XM742: SOFT RAG: Against highly-motivated rioters who ignore "Sting"'s pain and continue to threaten persons, damage property or incite others, the control personnel may interchangeably insert and fire the second or "Soft" RAG projectile, which exactly repeats the "Sting"'s pain dosage but also produces upon impact a 3-5 foot diameter cloud of powerful, CS-1, "tear gas" powder (Figure 9). The 18 recesses in "Soft"'s outside wall hold individual CS packets whose membrane-like cover ruptures easily under impact loads but is otherwise impermeable to the 2 grams of riot control agent. Figure 10 shows the XM742 in three stages of its semi-automated assembly. CS packet damage during handling and shipping is prevented both by the projectile's adhesive impregnated breakband and by its polyethylene holder/ejector which itself is stored with five other packaged projectiles in a sealed cannister. The key Soft RAG deterrent is its clinging CS particle cloud which immediately incapacitates the rioter for 10 minutes with its safe but demoralizing effects of headache, stinging skin, coughing and breathing difficulty, and several eye symptoms (burning sensation, heavy tearing, and involuntary closing). Even the most highly motivated rioter is entirely open to apprehension within 20-60 seconds after impact. If not apprehended, the targeted individual and possibly those immediately next to him would be eliminated from the riot, having to change clothes and shower to remove the persistent

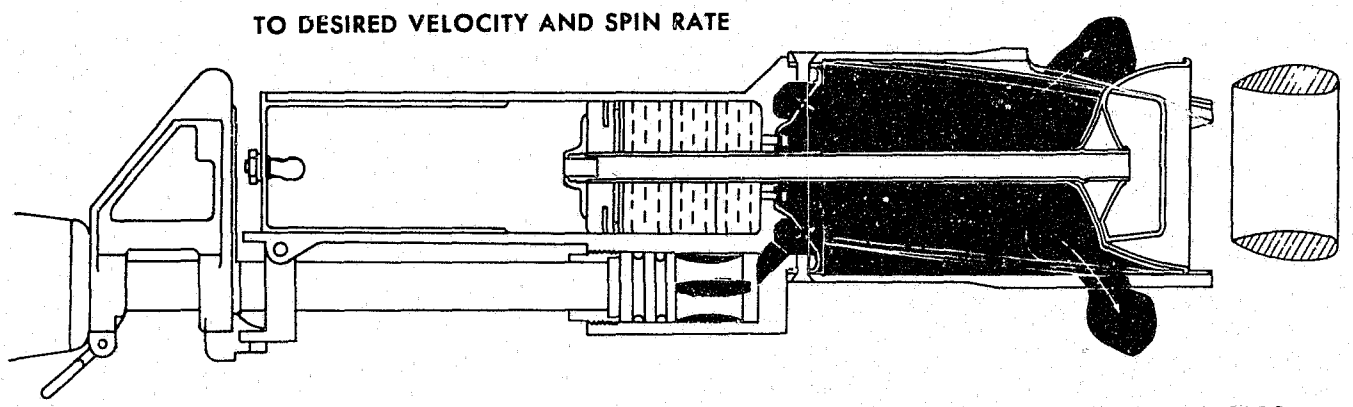
STING/SOFT RAG LAUNCHER ADAPTER FUNCTIONING SEQUENCE



1. PROPELLANT GAS EXITS M16 BARREL AND ENTERS ADAPTER PLENUM



2. GAS ENTERS ADAPTER CHAMBER ACCELERATING CUP/SHAFT/PROJECTILE TO DESIRED VELOCITY AND SPIN RATE

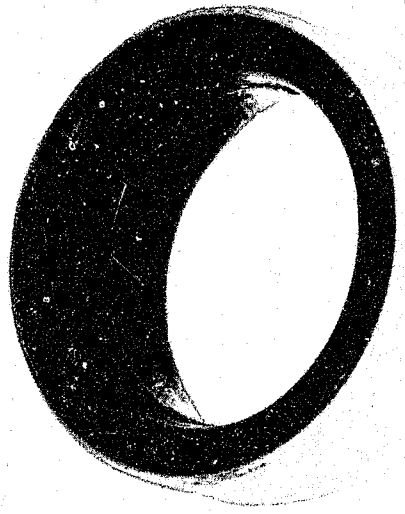


3. BUFFER ASSEMBLY ACTS TO RELEASE PROJECTILE AND BRINGS CUP/SHAFT TO STOP

FIGURE #8

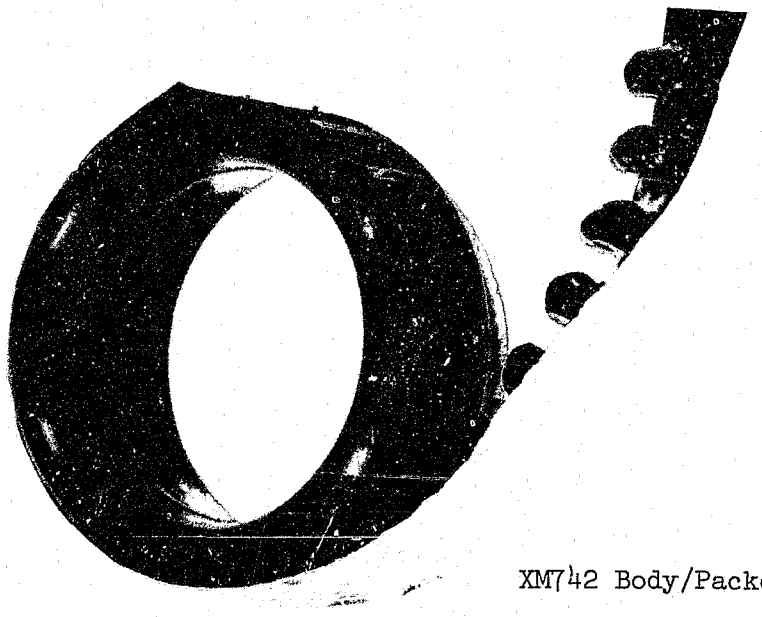
SOFT RAG PROJECTILE IMPACT

FIGURE #9

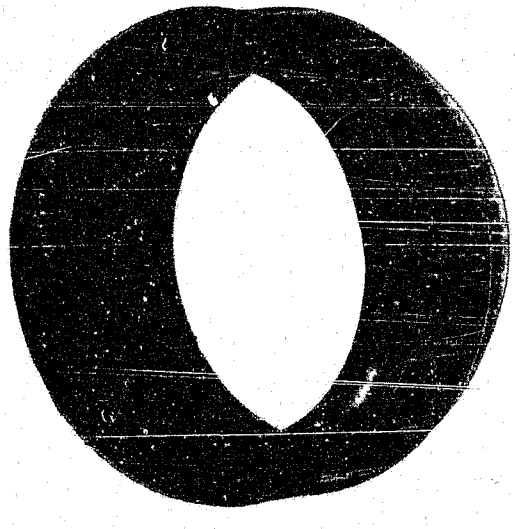


XM742 Completed:

Body/Packets/Breakband



XM742 Body/Packets



Assembly of XM742 Projectile

XM742 Body

FIGURE #10

CS powder. Additional information on the characteristics, tested effects, and extremely high safety factors of CS is presented in Appendix A, pp. 41 to 43.

POINT-TARGET ACCURACY: Both "Soft" and "Sting" projectiles have a low drag coefficient (0.11) and thus suffer little velocity decay, even out to a range of 60 meters. Their relatively flat trajectory (see Figure 5 above) enables the operator to aim at a target and expect to hit it anywhere within the 100 meter range. The ballistic trajectory of other projectiles forces their user to fire with exactly the correct gun elevation or miss the point target. Surpassing even the British "rubber bullet" (PVC) projectile, the RAG hits a 40-meter point target and a 60-meter group target better than 90% of the time with the first shot. Figure 11 shows RAG's superior accuracy, based on "Sting" firing data obtained in variable winds up to 8 m.p.h. at 60 meters and contrasted with the no-wind PVC firing data at only 50 meters. Even at a range of 100 meters under variable wind conditions, the RAG hits an 8' x 8' "group target" 60 percent of the time. These RAG firings were made by a number of individuals, none of whom were expert marksmen or riflemen and who typically required 6 or less practice rounds to achieve their normal accuracy.

MINIMAL SAFETY HAZARD: Because RAG's impact energy is nearly the same at point-blank and at useful ranges, its operator is released from the safe-range estimates required in all other projectile-launching riot control systems. Its "rubber doughnut" shape and high compliance (due to its 18 cavities and elastic material) deliver a kinetic-energy sting or noisy slap over a 5" diameter skin area.

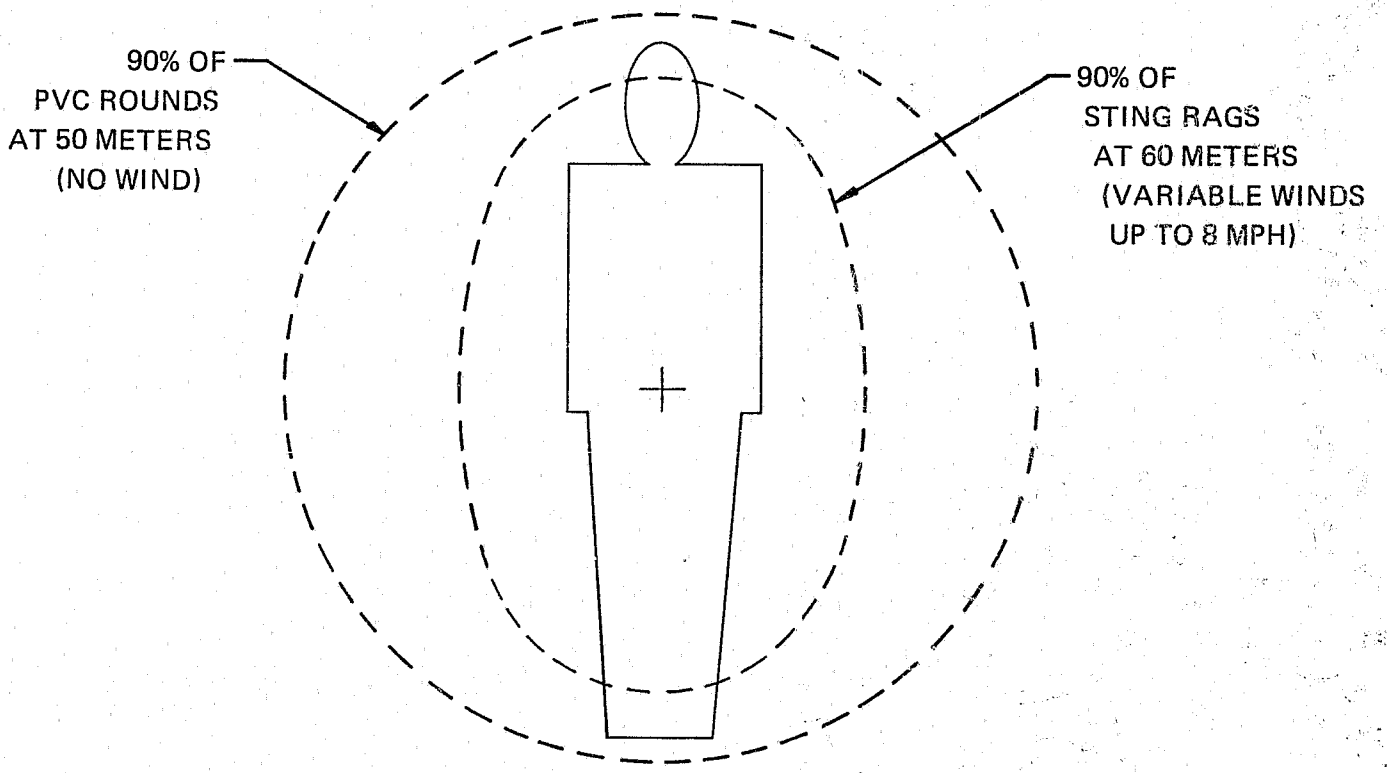


FIGURE #11

COMPARISON OF ACCURACY OF STING RAG AND BRITISH PVC ROUND – BASED ON FIRING TESTS

This splaying out over the target reduces its force per unit of skin area and per unit of time. Its initial 2.5" diameter prevents its fully entering the human eye socket and causing serious injury. If one ignores all other damage predictors besides kinetic energy, the 30 foot-pound kinetic energy of RAG is comparable to a baseball being lobbed from base to base. By contrast, the potentially fatal fast-pitched baseball can impact at roughly 100 foot-pounds. The lobbed-baseball comparison is imperfect because a baseball transfers a much higher fraction of its energy to its victim than would happen with the far more compliant RAG.

To establish empirically whether any portion of RAG's operational velocity and range is hazardous, the Army's Edgewood Arsenal Biophysics Division has tested several hundred RAG's in five distinct configurations at a wide range of controlled impact velocities against three types of targets representing the head, thorax (heart and lungs) and abdomen (principally the liver) of a human. By quantitative and photographic documentation of most-sensitive tissue response and lowest damage velocity, the Biophysics Division has established that RAG remains the only crowd control device empirically predicted to be non-hazardous to vital body organs at all operational ranges and velocities (see Figure 12). For example, the current RAG projectile has been fired against the consistently thin temporal bone area of the skull model as well as against thorax and abdomen targets. Latest information on these tests indicates that the non-damage threshhold in feet per second is rather uniform over all major body areas and always above actual RAG launch velocity. Although any blunt trauma projectile impacting on the human eye can cause permanent eye damage, the RAG's greater

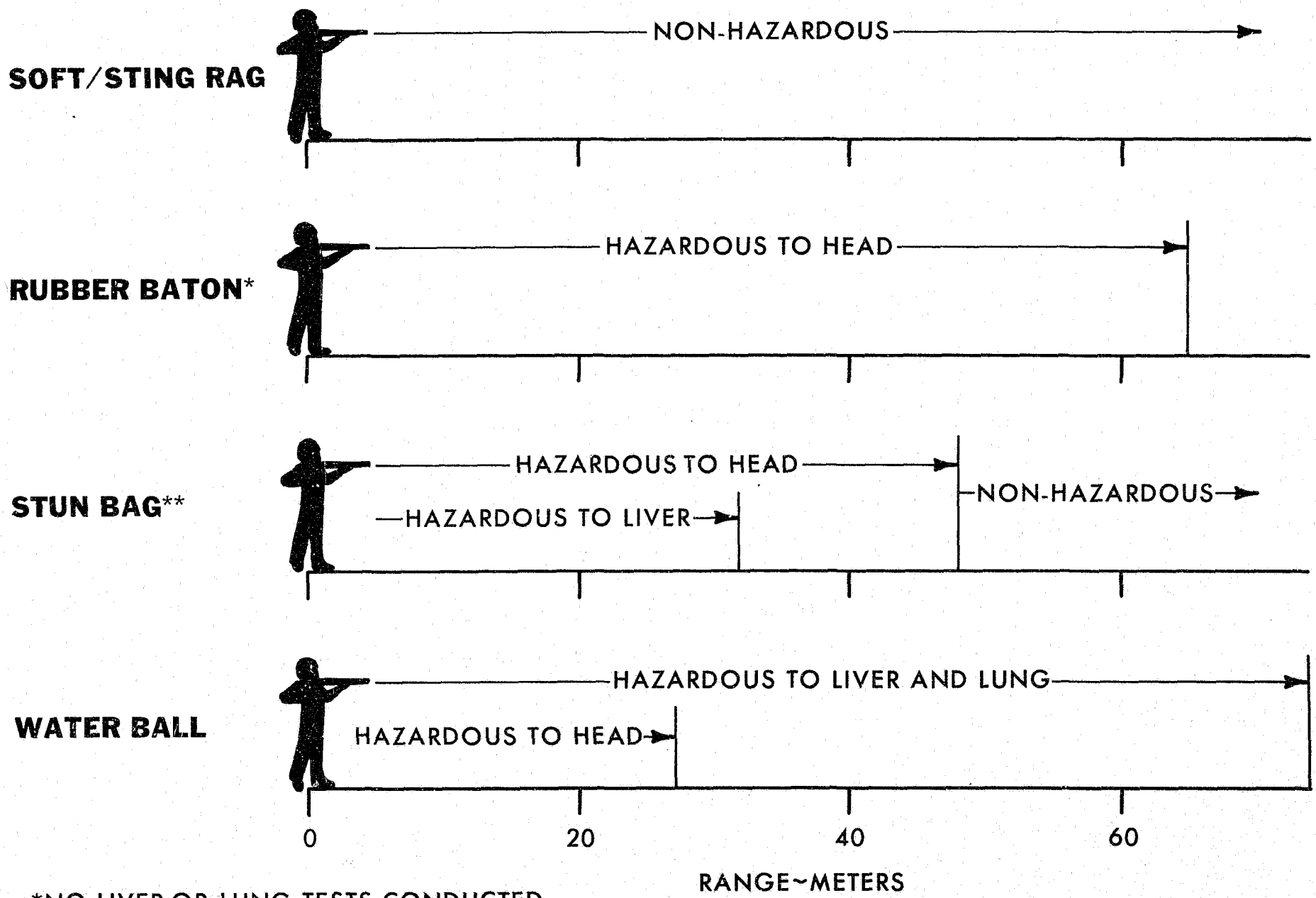


FIGURE #12

*NO LIVER OR LUNG TESTS CONDUCTED

**NO LUNG TESTS CONDUCTED

diameter, compliance and accuracy make it far less hazardous than any other projectile tested by this Army Biophysics Division. Army data published in August, 1975 on chemical agent incapacitation rates suggest that Soft RAG's CS concentration will be incapacitating in open-air confrontations without remotely approaching lethality levels in even the smallest of indoor rooms. Further tests are planned to detail the CS concentration level of Soft RAG's cloud.

RIOTER COUNTER-MEASURES: For a targeted rioter, the most obvious attempted counter-measure against a RAG firing would be to attempt to dodge the projectile. Fortunately for control forces, the RAG takes only 0.6 seconds to reach a target at 40 meters--a quicker time of flight than any other non-lethal crowd control projectile (see Figure 13). Experienced observers shielded from a 40-meter range impact judged that even a rioter attentive for the moment and direction of RAG launch could not evade its flight. The expended projectiles lack sufficient rigidity and mass to be thrown back with any accuracy and range. If a rioter were to attempt to throw an expended Soft RAG back at control forces, he would be doused with the remaining CS agent. The kinetic energy of Soft and Sting can be countered by heavy protective clothing or to a lesser extent by shields moved to the right place at the right time. Although protective masks and heavy clothing would neutralize even Soft's chemical agent effect, the foresight, skilled execution and inconvenience of all such countermeasures will probably continue to limit their use in the United States to the relatively rare case of a few individuals leading a well-organized, pre-planned riot.

TIME OF FLIGHT AS A FUNCTION OF RANGE FOR VARIOUS NON-LETHAL SYSTEMS FOR CIVIL DISTURBANCE CONTROL

CONF	WEIGHT (LBS)	LAUNCH VELOCITY (FT/SEC)
STING/SOFT RAG	.075	200
RUBBER BATON	.330	200
STUN BAG	.300	170
WATER BALL	.500	150

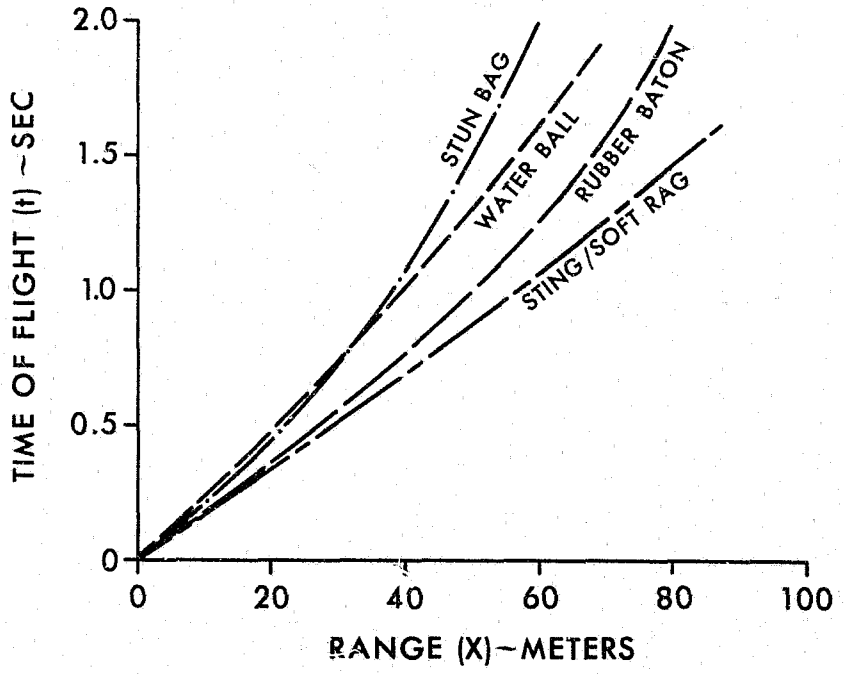


FIGURE #13

RAG SELECTED IN TWO ARMY/LEAA SCENARIOS: In August, 1975 the Law Enforcement Technology Team (now part of the Army Human Engineering Laboratory) and its Behavior Analysis Group published two reports of work done for the LEAA branch of the Department of Justice. One of these reports scrutinized five police tactical scenarios to provide detailed criteria for estimating the occurrence probabilities of "desirable" and "undesirable" effects of less-lethal weaponry. For two of the five scenarios the RAG was selected as the most effective device.

When applying its scenario in which police must produce high discomfort or loss of ambulatory function in moderately-to-highly motivated crowd agitators at ranges of 10 to 75 meters, this Technology Team singled out both Sting and Soft RAG as the best improvement over present devices because of increased accuracy. When considering its scenario in which police must suppress the manipulative function of an offender barricaded inside a building (possibly holding a hostage), the Team recommended Soft RAG use because of its advantage in immediate disorientation, eventual incapacitation and higher irritant with less fire and projectile hazard. This latter recommendation was corroborated by a recent filmed Army test showing a Soft RAG fired at a standard double-thickness glass windowpane at 40 meters' distance. The projectile broke the glass, penetrated inside the barracks room target, and deposited over 80% of its simulant powder inside the room.

FINAL DEVELOPMENT SCHEDULE: The XM234 launcher and XM743 Sting projectile have received Federal Stock numbers and have been scheduled for final Development and Acceptance Review by Army Military

Police in mid-September, 1976. This timetable is expected to permit full testing of a heavier launcher cup less subject to long-term fatigue. The September technical review is expected to produce immediate "type-classification" of the two devices--an acceptable for purchase-order status which should result in the delivery of up to 12,000 adapters and 180,000 Stings and cartridges beginning in late 1978. The National Guard representatives have closely followed RAG development and may well choose to supply its units with Ring Airfoil equipment.

The Soft RAG projectile has entered its Engineering Development stage with "type classification" expected late in 1978. The engineering challenge remaining in Soft RAG development is to identify a fully reliable breakband/packaging system which will tolerate both extended storage and launch forces without leaking CS agent and which will also expel at least 80% of its CS powder in a full 3 to 5-foot diameter cloud even when impacting on a soft or grazed target.

CIVILIAN POLICE GOAL: HAND-HELD LAUNCHER: Since RAG development is a non-classified military project open to civilian inquiry under the Freedom of Information Act, RAG briefings and demonstrations have been sought by many civilian law-enforcement or prison authorities. In April, 1975, a briefing/demonstration for several representatives each from Nassau County-New York, Baltimore City, Baltimore County, Philadelphia and New York City police departments produced agreement that RAG equipment could provide a uniquely non-lethal apprehension capability without curtailing necessary

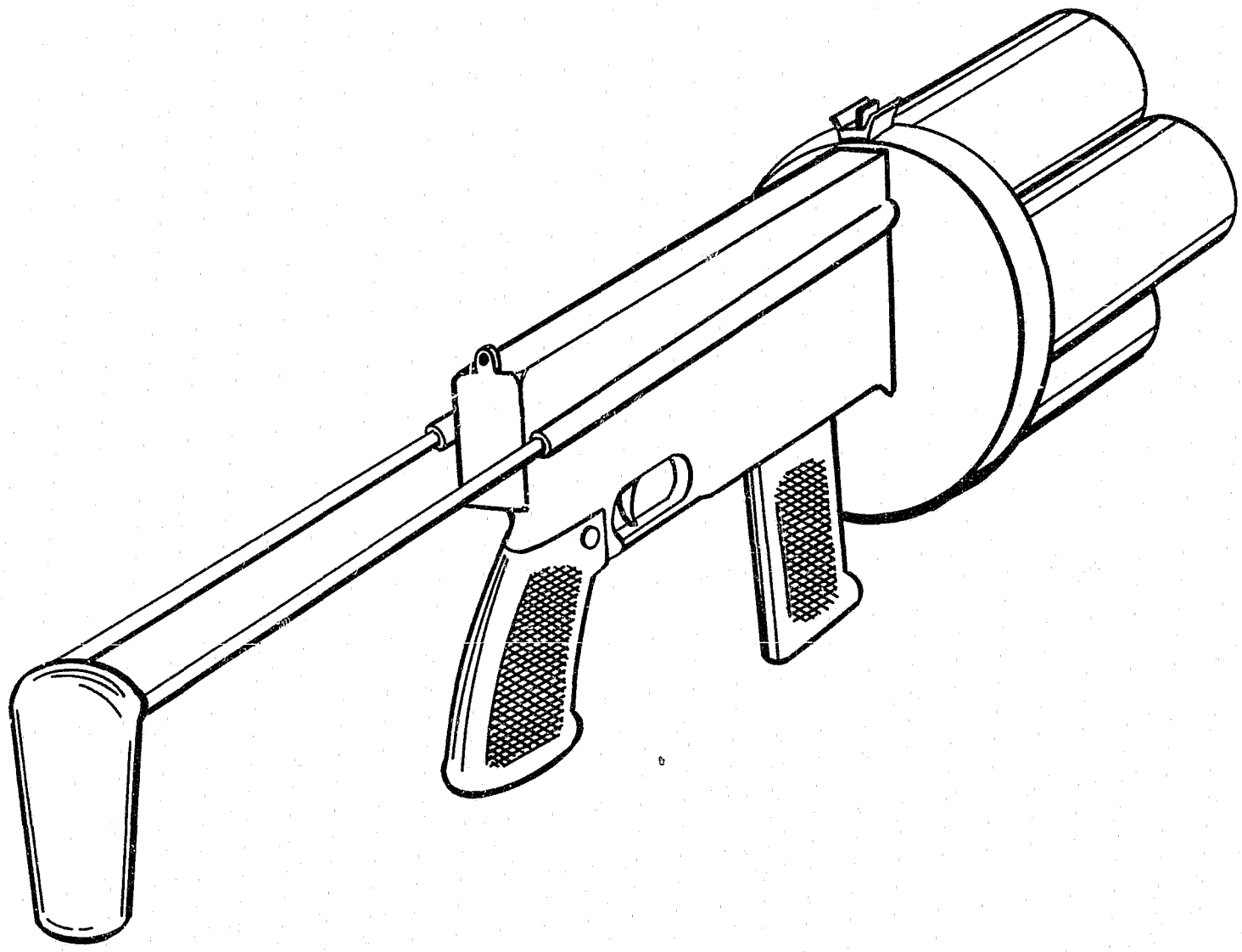
access to lethal force. However, this favorable estimate assumed that RAG projectiles would not be delivered by a military-style rifle but by a hand-held launcher tailored to police needs. Such a less threatening device would have multi-shot capacity with a pull-out stock for greater control (see Chapter III's divider page). Although a few hand-fabricated prototype police launchers might be available within four months of an engineering start-up, an estimated eighteen months and $350,000 of federal or private funds would be needed to complete production engineering, tool design and delivery, and mass production of units retailing at $175 apiece to law enforcement agencies only.

ARE BETTER WEAPONS NEEDED; LEAA'S HESITATION: Although the U. S. Army appears to recognize RAG's enormous potential for technology transfer from military police to civilian law-enforcement, its own funds must be spent on military defense-related goals. In view of LEAA's Less-Lethal Weapons Evaluation Program and its overall mandate to improve civilian law enforcement, LEAA funding of RAG launcher engineering would seem a relatively inexpensive and entirely appropriate way to capitalize on a four-year investment in humanitarian control devices. Nevertheless, when three of the above-mentioned police departments raised with LEAA the possibility of its financial support for a RAG launcher tailored to police needs, they were told that such support was impossible because LEAA was terminating its Less-Lethal Weapons Evaluation Program. A National Science Foundation interest in co-sponsorship with LEAA of RAG development met with LEAA disinterest. This LEAA hesitation after four years of involvement and after the favorable August, 1975

scenario report (mentioned above, p. 22) is difficult to explain. Telephone interviews with parties involved suggested that some LEAA research personnel resisted police and foundation interest in RAG out of a conviction that improved crime control has little or no relation to improved control devices. This report has taken an opposing and positive view of tangible crime deterrents.

UNDIMINISHED POLICE INTEREST: Despite LEAA's hesitation, the tactical and social benefits of RAG is a non-lethal control option have continued to deeply impress municipal and state police, law enforcement researchers and staff organizations, and various correctional authorities who have been able to observe RAG firings at the Army's Edgewood Arsenal in Maryland. At least two law enforcement agencies have expressed interest in purchasing part of the Army's first RAG procurement, and RAG equipment loan information has been requested by the Canadian Research Council and several NATO-ally countries.

Following a December RAG demonstration at the Cleveland police outdoor range for representatives of the Indiana State Police and ten Ohio police departments, Cleveland Mayor Ralph Perk has requested a temporary loan of RAG adapters and projectiles for crowd control training and possible use by the specially-trained Cleveland Police Tactical Unit. In return for this loan, Cleveland would submit a detailed user's report giving a full human factors evaluation of RAG's performance and suitability. Nationwide attention to Cleveland's flexible Crowd Control Pilot Program might widen police support for federal development funding for a hand-held launcher tailored to civilian-sector needs.



CONCEPTUAL DESIGN OF MULTISHOT SOFT/STING RAG LAUNCHER

CHAPTER THREE

CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

RAG FEASIBILITY: Some preliminary conclusions are possible about the feasibility of RAG for police crowd control use. As a practical matter, the policeman's most effective device for incapacitating/immobilizing a criminal or suspect is the firearm--a device engineered to kill and therefore subject to possible misuse by the arresting officer. For some years a rising tide of public opinion has favored humanitarian apprehension of every criminal and suspect. Despite the electric dart gun discussed in Chapter One, no one has yet engineered the "ray gun" of science fiction, the device that would immediately immobilize an armed attacker in the crucial zero-to-twenty feet range. While this highest-priority need remains unmet, Army RAG development presents to civilian police a different opportunity: to demonstrate more effective and flexible crowd control without bloodshed.

For, without doubt, the human potential for substantial urban rioting continues to exist. Young males--whose proportion of the total population will remain for thirty years at the high 1965 level--experience extremely high unemployment rates in our urban cores despite considerable governmental efforts at job-finding for youth. It therefore appears that our cities will continue to include concentrations of young men and boys with nothing constructive to do. Further, demonstrations and other public protest actions which risk violence seem to have become widely accepted as legitimate

means of pursuing group goals. The urban holocausts of the Sixties may be behind us, but small and medium-sized civil disorders continue to occur, provoked by various causes ranging from busing to beer.

When commanded to disperse an unarmed but dangerous crowd, police seeking to avoid the excessive force of the lethal revolver must choose between long-distance tear gassing of large groups or up-close aerosol spraying-plus-nightstick use on individuals. The too-frequent results of this limited option seem to be the undercontrol of delayed application of unpredictable area tear gas or the overcontrol of premature, indiscriminate nightstick use. In both cases the already-damaged relations between police and various community sectors are exacerbated. Because many individuals in a rioting crowd will allege (sometimes accurately) that they have committed no serious crime or even no crime at all, it is desirable from every perspective that dispersal devices not inflict serious damage, immobilize or produce either bleeding or obviously excessive pain. Although in many serious riots, some other control device than RAG is more appropriate in producing in rioters a perception of personal risk, RAG seems extremely likely to provide a frequently valuable option.

RAG provides two simple, graduated means of controlling many civil disturbances without requiring close-up confrontation or wide-area chemical weapons and with minimum probability of inflicting serious injury to participants or bystanders. Its two tactically distinct but interchangeable projectiles permit prompt warning/incapacitation of a few individual riot leaders or agitators in the

earlier stages of a riot, prior to the need for the less controllable force of nightsticks. Sting RAG's painful show-of-force will disperse most rioters as well as provide a reusable, inexpensive training round for both projectiles. Soft RAG's accurate delivery of a measured chemical dose on a discriminate target minimizes contamination of the surrounding area and persons. Indeed, since the visual signature of irritant gas has itself dispersed demonstrators in many actual demonstrations, both Soft RAG-targeted individuals and nearby persons may try to flee the scene after merely seeing and smelling a CS cloud produced by RAG.

In sum, careful Army development and testing of RAG is insuring that it meets most relevant performance criteria, including: public safety and medical side effects; vulnerability to countermeasures; environmental adaptability; cost effectiveness; and suitability in relation to risk involved. There is every probability that RAG can help deter riot escalation and perhaps save lives. It should facilitate arrest of riot agitators and minimize charges of police use of excessive force.

IMPEDIMENTS TO RAG USE: However, one cannot minimize the importance of the performance criteria still unmet: the overall police skills required for effective utilization and its corollary, public acceptability. For example, RAG unavoidably creates health hazards. This report (above, p. 20) has stated: "Although any blunt trauma projectile impacting on the human eye can cause permanent eye damage, the RAG's greater diameter, compliance and accuracy make it far less hazardous than any other projectile tested by this Army Biophysics Division." Yet despite RAG's <u>comparative</u> safety, it could easily

damage the eye if fired inaccurately.

Not every civilian law enforcement agency which might field-test RAG is both willing and able to provide sufficient riot-control and RAG-firing training to insure that only currently range-tested officers fire RAG rounds only after carefully aiming at the chest/stomach body area. Only well-disciplined departments could insure that on-site commanders prevent RAG field-testing use in long-range, high-wind, poor-visibility or fast-moving target conditions which increase the probability of inaccurate fire. Since any substantial upward variation in RAG velocity risks a lethal hazard, on-site commanders would have to assure that only the RAG blank cartridge (containing a close-tolerance amount of propellant) is chambered into the rifle launcher. Any decision to escalate crowd deterrence from Sting to Soft's tear gas component will require a commander's cool calculation of: the crowd's potential for retaliatory attack or panic behavior; wind conditions; control force protection; and the possibilities of arresting and decontaminating doused individuals.

Further, only a progressive police department could expect its community relations personnel to convey to the media and various community groups the RAG's positive role in overall crowd control strategy, its actual hazards (such as a broken nose or even blindness), and the temporary necessity to launch RAG projectiles from fearsome-looking rifles. Citizens and police alike must understand that any blunt-trauma projectile--even a glass of water unexpectedly thrown in the face--can be the indirect cause of death of an abnormally susceptible person and that therefore only obvious criminals (those violently agitating a mob after a full warning to

disperse) will be targeted with RAG's. In any particular disorder RAG use may or may not eliminate the necessity for the use of more lethal control force. Municipal or state officials directing such field-testing of RAG's must neither oversell its tactical value nor hide or understate its physical effects. The RAG is a powerful, painful control for rioting--that often nasty manifestation of human nature.

Thus, police testing of RAG must be viewed in the much larger context of the overriding public concern: did the police in this disorderly situation do a good, i.e., flexible, job of crowd control? Past public rejection of new specific non-lethal deterrents--such as the electrified baton used in southern civil rights protests--has been closely tied to public rejection of the social policies (e.g., racial segregation) defended by means of such force. Police entrusted with RAG field-testing should build field experience gradually and do everything reasonably possible to avoid introducing RAG for the first time in disturbances over bitterly divisive public issues. It should go without saying (but it does not) that any municipal testing of RAG should only follow a full review of riot control requirements, such as sufficient trained manpower, sufficient equipment (both lethal and non-lethal devices), realistic long-term intelligence gathering and a desire to communicate whenever possible with the human beings on the other side of the barricades. Any civilian law enforcement agency which has not faced up to these aspects of weapons acceptability by the public should not be permitted to field-test so promising a law-enforcement tool as the Ring Airfoil Grenade.

2. Recommendations

UNITED STATES ARMY: Despite these substantial extrinsic impediments to acceptable performance in the civilian sector, the Ring Airfoil Grenade has proven its worthiness for feasibility field tests in actual crowd control situations by selected civilian law enforcement agencies. Therefore, the United States Army should assist its civilian counterparts by loaning refurbished Ring Airfoil Grenade test equipment to one or more disciplined police agencies which can present an exhaustive users' report prior to Army distribution of mass-produced RAG's.

It appears that RAG production and distribution to Army Military Police (and possibly National Guard) units would begin to solve a substantial undercontrol/overcontrol perplexity which U.S. military forces will increasingly face at military bases around the world. One notes, for example, the current Israeli search for non-lethal weapons for use in Arab disturbances in the occupied Jordanian West Bank. Since the Ring Airfoil Grenade may mark only the beginning of a less-lethal point-target arsenal, the U.S. Army should exploit its unique biophysical test expertise to generate over the next two to three years a sufficient data base for high velocity/low mass induced blunt trauma to permit the establishment of generalized criteria and assessment models. Lacking such models, any non-lethal weapon developer must "reinvent the wheel" by conducting elaborate, expensive tests to predict the probability of serious injury associated with his particular control device.

LAW ENFORCEMENT ASSISTANCE ADMINISTRATION: The Justice Department's LEAA--whose federal mission is to bolster the anticrime capabilities of state and local criminal justice systems--must try to examine each request for police hardware development (tangible crime control) with the same enthusiasm it has reserved for "standards and goals" planning (intangible crime control). The National Institute of Law Enforcement and Criminal Justice (NILE), which is LEAA's research arm, should realize that its fears that the introduction of non-lethal weapons will simply pander to police aggression/mismanagement are no more grounded in reality that opposing police fears that non-lethal weapons will simply increase pressure to disarm police, i.e., take away their fatal force option. Both fears credit opposing interest groups with more influence in society than each group actually has. Both fears distract attention from the question whether non-lethal weapons can sometimes aid in deterring criminal activity and apprehending criminals. In our violent society, the struggle for domestic justice is made more difficult by the inflexible force options open to law enforcement agencies. Idealistic NILE planners may look upon weapons as necessary evils whose promotion furthers neither their organizational prestige nor justice, but realistic planning concedes that many of the continuing riots cannot be prevented and that therefore the planning question is whether RAG development for police use--the multi-shot concept pictured at the front of this chapter--can help minimize the possibility of bloodshed when police must use force to control the rioters.

Therefore, NILE and its LEAA parent should express to the U.S. Secretary of the Army their strong interest in prompt

transfer of Sting/Soft RAG technology to civilian law enforcement representatives as soon as the RAG system is no longer classed "experimental"--perhaps October, 1976. Although a major city like Cleveland (which has already publicly debated the merits of RAG use by its police) would offer much preparation and a wide range of field-test conditions, other technology transfer sites should not be neglected. For example, correctional institutions which can experience riots in limited access areas also appear well suited to Soft-RAG field testing.

Looking ahead, by December, 1976 LEAA should itself fund or otherwise secure $175,000 of funds for an engineering contractor to complete final design of the hand-held RAG launcher tailored to civilian police needs. Support for such a grant might come from such already-interested groups as the International Association of Chiefs of Police, the National Science Foundation, and the National Bureau of Standards. Commitment before 1977 to eight months of engineering design is necessary so that a subsequent nine-month production phase will be completed in time for police purchasers to take delivery of Police RAG's by June of 1978. It will be difficult to understand LEAA's four-year commitment to a Less-Lethal Weapons Evaluation Program without such an LEAA involvement in developing a RAG tailored to police use. The U. S. Army's exhaustive research and development program is providing an added non-lethal option for military law enforcement; only LEAA support for RAG development can rapidly interest many of the 40,000 civilian law enforcement agencies who have been subjected to solicitations by developers of less feasible crowd control devices.

MUNICIPAL AND STATE POLICE: Civilian police agencies wishing to field-test RAG must accept responsibility for devising and implementing detailed public information, testing and evaluation policies. This responsibility is a vital one, since any innovation in crowd control touches two of our most sacred rights; the right of peaceable assembly and the right to law and order in the streets. To help convince citizens that such a RAG pilot program will help handle unruly crowds in a calm, disciplined and graduated manner, test-firings against local volunteers are desirable. Just as police patrol dogs were initially shown in several cities at play with ghetto school children, so the exposure of partially shielded police officers, reporters and community group representatives to a Sting RAG impact under medically-monitored conditions would increase popular understanding of RAG impact effects. Such volunteer tests (forbidden to Army personnel) would almost certainly confirm the relatively non-hazardous character of RAG at any operational range and velocity. RAG projectiles should be explained as "life-saving weapons" which either "restrain" (Sting) or "incapacitate" (Soft) a riot agitator. Citizen concerns about effective controls on RAG use might be allayed by media reports on police in-service training of many kinds, including crowd control and RAG practice-firings. Although effective mob deterrence precludes detailed publicity on RAG tactics or countermeasures, police advance announcement of incremental crowd control policies would be most likely to maximize community support for whatever incremental force police must actually employ.

Realistically, police must expect some outcry from victims of the first few uses of the Ring Airfoil Grenade. A medical check-up with results available to the media should be given to every agitator who is apprehended after being hit with a RAG projectile. Despite RAG field-test use only following a police warning that the unlawful assembly must disperse, some targeted individuals who suffer skin lacerations and contusions (with subsequent welts) will probably file personal injury lawsuits alleging negligent targeting, testing or training in the use of a novel device. However, advice from the Cleveland Law Department suggests that, in Ohio and elsewhere, the legal privilege already granted to police offenders in the use of fists and other non-lethal force will apparently prevent recovery against all reasonable uses of the well-tested RAG. However, the introduction of the first long-distance, individual-target crowd control weapon places heavy responsibility on RAG-firing and commanding police officers to use great care in selecting targeted persons and estimating accurate-fire conditions. Further, the advertised availability of non-lethal crowd control options (in addition to wide-area tear gas grenades) may encourage media representatives to make extensive up-close filmings of any disorder and its control by police. To make an independent record of police activity and to study the little-understood behavioral cues which move a crowd from passivity to frenzy and back, police department researchers might film wherever possible the entire riot progress. To insure that this civilian police RAG testing and written evaluation is accessible and useful to the LEAA and other interested police agencies as well as to its Army originators, some standardized

accounting of the circumstances and results of each RAG fired must be made to the on-site police commander. Such an accounting might include: police tactical situation and other weapons used; crowd behavior variables before and after RAG firing; estimated range to targeted individual(s), with photograph of scene; accuracy attained in specified wind, light and terrain conditions, visible effects of RAG impact on rioter and any subsequent medical assessments; and marksmen's assessments of the ease or difficulty of RAG operation, maintenance and storage.

LEGAL FORCE IN OUR SOCIETY: The Ring Airfoil Grenade is obviously no substitute for the nightstick or the riot baton, much less for the lethal police revolver. However, police field-testing of RAG might be a stimulant toward adequate training and retraining in each of these basic weapons and in their utility or non-utility in riot control. The availability of RAG (especially of the projected hand-held launcher) must never be allowed to endanger policemen by forcing a delay for weapons choice when speedy response is essential. For the present the RAG is a crowd control weapon, not a weapon to be pressed into service in other situations. For the foreseeable future, purchase of the RAG should be restricted to law enforcement agencies, thus excluding both privately-employed guard/detective agencies and private citizens.

The RAG represents one engineering tradeoff, minimizing "knock-down force" so as to maximize continuous non-hazardness and immediate public acceptability. Research should continue on the development of other needed tradeoffs, such as a prompt-incapacitation weapon suitable for one-on-one or fleeing-suspect situations. RAG

engineering may not be adaptable to an ultimate one-on-one weapon, but perhaps a longer-range, harder-impact Soft RAG (possibly including marker dye) could be developed for use against a "fleeing felon." Most Americans appear to no longer accept the policing theory that any person who commits a crime, confronts authority or (as a suspect) tries to elude authority should thereafter run a risk of death equal to or surpassing the life-endangering risk he may present to police or the community. Police-sponsored research into variants on the present RAG may lessen this serious social problem. Unfortunately, progress is slow in such matters. Even the March, 1972 Security Planning Corporation report (Nonlethal Weapons for Law Enforcement: Research Needs and Priorities), with its generally excellent analyses and recommendations, remains on our agenda of unfinished business.

Yet we must not overlook the policy implications of the central fact: some police departments have recognized some advantage to a more graduated application of deterrent force. Given the widespread public concern with police performance, pragmatic police experiments with tested control devices like RAG deserve cautious support. Police initiatives are needed in other areas of law enforcement, but only the radical utopian opposes one immediate improvement on the ground that other improvements are also necessary. Not unreasonably, police interest in less-than-lethal force devices has thus far centered on the least ambiguous tactical situation: riot control. If introduced and utilized without planning and discipline, such experimentation could generate unwarranted police aggression, heighten community tensions and destroy the acceptability

of much-needed law enforcement hardware. On the other hand, present police interest in the Ring Airfoil Grenade could easily grow into a realistic attempt to plan for the eventual use of less-than-lethal force options in an expandable set of violence-control situations. The ethical, social, political and legal advantages of this experiment in the use of essentially defensive long-distance force are obvious.

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Appendix A

EDGEWOOD ARSENAL SPECIAL PUBLICATION
EASP 600-1
CHARACTERISTICS OF RIOT CONTROL AGENT CS
October 1967

This document has been approved for public release and sale; its distribution is unlimited.

DEPARTMENT OF THE ARMY
EDGEWOOD ARSENAL
EDGEWOOD ARSENAL, MARYLAND 21010

FOREWORD: This report was prepared for release to non-DOD requesters, including local and state law enforcement agencies and medical and safety personnel, in response to requests for information on the characteristics and effects of riot control agent CS.

The human subjects in the tests conducted by this installation are enlisted US Army volunteers. There is no coercion or enticement to volunteer. The most stringent medical safeguards surround every human test.

In conducting the research described in this report, the investigators adhered to the "Guide for Laboratory Animal Facilities and Care," as promulgated by the Committee on the Guide for Laboratory Animal Resources, National Academy of Sciences-National Research Council.

CHARACTERISTICS OF RIOT CONTROL AGENT CS

CS is the symbol identifying a riot control agent which has come into prominence in the last few years and is increasingly finding favor over the more familiar "tear gas" of the past. CS has sometimes been referred to as super-tear gas because of its more potent action. It is, however, an extremely safe material to use in spite of its potency. The Army made CS its standard riot control agent in 1959 and has practically replaced the previous CN tear gas in stockpiles. CS has been widely disseminated to Army and National Guard units and its ready availability through several commercial sources has placed it in the hands of many law enforcement agencies.

CS takes its name from the two scientists, B. B. Corson and R. W. Stoughton, who first prepared it in 1928. Its descriptive name in the language of the chemist is ortho-chlorobenzalmalononitrile which favors the use of the symbol. Contrary to its common name, it is not a gas but is a white, crystalline powder, similar in appearance to talcum powder. To get it to its intended target rapidly, it is dispersed as an aerosol cloud of finely divided particles. This dispersal is accomplished by blowers or bursting grenades or by burning a mixture of the powder and a fuel. Riot control hardware is designed to avoid mechanical or physical injury on the target, grenade and other dispersal devices being small and light (in one case made of rubber).

The effects of CS are impressive. CS produces immediate effects even in low concentrations. The irritating effects of the compound are felt immediately and the duration of effects is 5 to 10 minutes after the affected individual is removed to fresh air. During this time, affected persons are incapable of effective concerted action. The agent cloud causes severe burning sensation in the eyes with copious tears, coughing and difficulty in breathing with tightness of chest. The eyes close involuntarily, the nose runs, and moist skin stings.

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Area decontamination is not required as CS has a short duration of effectiveness in the concentrations used in riot control operations. Personnel exposed to CS may shower as necessary. When individuals are affected by CS, they should move to fresh air, face the wind and should not rub their eyes. If, in handling CS dissemination devices, a person received accidental gross contamination, he should remove clothing and flush his body with large amounts of water to remove most of the agent. If available, a 5% sodium bisulfite solution is helpful in removing the remainder of the agent.

To understand the small amount of agent required for effects, this can be related to quantities we are more familiar with. The effective concentration for the average person is 10 to 20 milligrams per cubic meter. Twenty milligrams is a quantity about one sixth the amount in an ordinary saccharin tablet. A cubic meter is about 35 cubic feet and it takes a man about 66 minutes to need that much air. This means that a man remaining in an effective cloud for 1 minute will breathe only one sixty-sixth of that one sixth of a saccharin tablet, or about one four-hundredth of the tablet.

Munitions when utilized efficiently produce concentrations which generally do not greatly exceed the effective dose. However, since unforeseen circumstances may occur in which higher concentrations are entered by individuals, it is necessary to know what the effect would be; i. e., what is the safety factor? First, it can be stated that CS has never been implicated in any death in man despite repeated use. Second, it was certified for use only after elaborate safety tests had been performed.

The physicians and toxicologists who were charged with this safety testing approached their tasks in a manner analagous to the testing of a new experimental drug. First resort was to extensive use of small rodents in carefully designed and humane experiments. Here the toxicologist determined the effect on the animal and, by gradually increasing dosages, determined the safety ration. The investigation then extended to a number of other larger animal species to give insight into the reaction of diverse types. Lastly, the higher animals, the primates, were tested to make closer analogy to man. In these experiments, animals of different sexes, ages, and weights were used to determine the effects of these differences. Animals were given brief exposures or repeated exposures to determine this effect. In addition to observing the apparent response of the animal, clinical and pathological measurements were made to determine if unseen changes were occurring. Lastly, after combining and reviewing all these results from lower animals experiments, since there were no contrary indications of toxic effects, volunteer men were tested to determine their response to the experimental chemical. It is obvious that volunteers were not given a dose much higher than an effective dose. The toxic dose level for the experimental animals can be used to estimate the safety factor for men.

The results of this extensive testing attest to the safety of CS. The combined data for mice, rats, guinea pigs, rabbits, dogs, and monkeys were used as the lethal estimate for men, despite the fact that this value ignores the more resistant swine, goats, sheep, and burros. On this basis, a 2600 safety factor is provided. This means at least 2600 times as much as is required to affect man would be required to be fatal. If the swine, goat, sheep, and burro data were included, the safety factor estimate would rise to 15,000. This indicates that it is extremely unlikely that in field use lethal concentrations could ever be present.

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Even more confidence in safety of CS has been developed from further toxicological studies. For example, monkeys and goats, ill with pneumonia, were not adversely affected by high concentrations of CS. Also, rats and dogs exposed for 5 weeks to repeated doses of CS showed no significant effects as shown by gross pathological examinations. Repeated exposures did not seem to make the animals more sensitive. To evaluate effects on the eye, CS was dropped in rabbits eyes. Only a temporary conjunctivitis resulted with no corneal damage. Finally, the response of men over 50 years of age or having medical histories of allergies, hypertension, jaundice, or hepatitis did not differ from that of young, healthy volunteers.

In summary, CS has been subjected to testing of a type typical for a new drug or medicine. These results coupled with extensive field use, show CS to be a highly effective riot control agent, fast acting, psychologically feared, but with a safety factor that makes the probability extremely low that lasting effects or death will come from its use in riot situations.

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